TIMES MICROWAVE SYSTEMS
An Amphenol Company

17th Edition

LMR®

FLEXIBLE COMMUNICATIONS COAX

NEW in this catalog!

More -X Series
No Braid Trim
Connectors

CST All-In-One Prep Tools
for LMR-195/200, 300 & 500

Times Protect®

Protector Connector Series

Weatherized Series

Broadband Series

World Class Products for Wireless Applications

The History of TMS

Times Microwave Systems (TMS) was founded in 1948 as the Times Wire and Cable Company. TMS is an engineering oriented organization specializing in the design and manufacture of high performance flexible and semi-rigid coaxial cable, connectors, and cable assemblies for RF transmission from HF through Microwave frequencies. TMS is committed to continuous improvement with respect to ISO-9001 Quality Standards and ISO-14001 Environmental Management Systems.

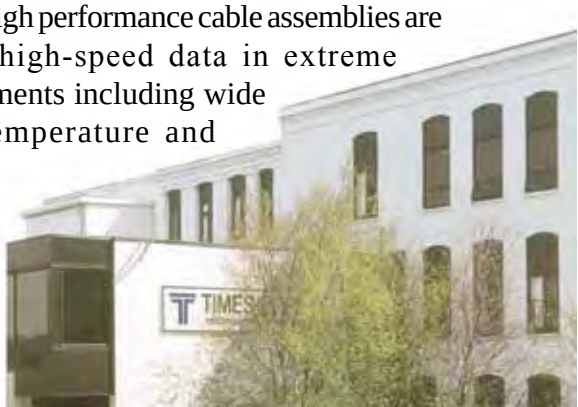
The expertise that provided cable solutions for the demanding requirements of airborne electronic warfare systems and led the way in the development of low smoke cables for shipboard applications is now yielding high performance cables to meet the needs of the wireless communications market. The innovative product line provides a better alternative to corrugated copper cables for antenna feeders and system interconnects. Compared to corrugated copper cables, LMR cables offer better flexibility, resistance to linking, comparable attenuation, and easier connector attachment at a lower cost.

The work performed at TMS in the 60's, 70's, and 80's forms the basis for today's high performance coaxial cables. TMS pioneered the development of closed cell low loss polyethylene foam dielectric and low loss taped PTFE dielectric coaxial cables. Through a thorough understanding of transmission line theory and manufacturing processes, TMS was the first to produce cables with reduced periodicity and impedance matched interfaces, resulting in the first transmission lines with low VSWR over broadband frequency ranges up to 40 GHz. The development of connector design and manufacturing expertise allowed TMS to take full performance responsibility for the entire cable assembly, which was unprecedented at the time.

TMS has been instrumental in the development of military specifications, including MIL-C-17 for coaxial cables. Times is the leading source of MIL-C-17 qualified products, holding far more QPL's (Qualified Product Listings) than any other manufacturer in the world. Times also helped the US Navy write the MIL-T-81490 Transmission Line Specification, and is qualified to supply microwave transmission lines that meet MIL-T-81490 and MIL-C-87104 (US Air Force) requirements. These are the specifications that define harsh military airborne environments that Electronic Warfare transmission lines must perform in, year after year.

TMS applies its expertise to customer requirements through a staff of Field Application Engineers. Unlike other cable manufacturers with limited product lines, who try to fit customer applications to their existing products, the philosophy of TMS is to select or design the right product for the application. This results in an optimal and cost effective solution.

TMS is the leader in the design, qualification, manufacture, and on-time delivery of high performance cable and cable assembly products to the commercial wireless and military marketplace. In 2003, TMS was selected by Lockheed Martin Aeronautics to supply the Broadband Airborne Cable Assemblies on the F-35 Joint Strike Fighter (JSF). TMS was chosen to supply this solution since its high performance cable assemblies are able to handle high-speed data in extreme avionics environments including wide variations in temperature and pressure.



TIMES MICROWAVE SYSTEMS

Contents

LMR® discussion

What is LMR® cable?

Times LMR cables are high performance broadband, flexible, low loss 50 Ohm coaxial communication cables designed for use in wireless applications such as:

- Private land mobile/2-way land mobile
- WiFi/WiMax
- Cellular
- Paging
- Satellite
- Cellular
- Paging
- GPS
- RFID
- In-Building Communications
- Oil & Gas
- Utilities
- Positive Train Control (PTC)
- Distributed Antenna Systems (DAS)
- Public Safety
- Wireless Internet (WISP)
- SCADA/Telemetry
- Broadband
- Wireless Machine-to-Machine (Wireless M2M)
- Military/Defense

Where can LMR® cables be used?

Times LMR cables can be used virtually anywhere high performance coaxial cables are used, including:

- Internal component and equipment wiring
- Inter/intra cabinet jumpers
- Base station and antenna jumpers
- Tower and pole feeder runs
- In-building runs, including riser runs and air-handling plenums
- Rooftop installations

What sizes of LMR® cable are available?

A full range of LMR cables are available from LMR-100 (0.100") all the way up to LMR-1700-DB (1 1/4"). Because LMR cables are so flexible, it's possible to eliminate jumpers entirely in many feeder cable applications. The elimination of jumper cables provides reduced cost, better reliability and lower cost- or may even allow the use of a smaller size feeder cable, while achieving the same loss as for a larger corrugated feeder.

What are the advantages of LMR®?

Times LMR cables have RF performance comparable to traditional corrugated copper cables, but unlike corrugated cables they are highly flexible, non-kinking, and offer unsurpassed ease and speed of connector installation. Compared to RG type braided cables, LMR cables offer far lower loss and better RF shielding. These features make LMR cables the best choice for *any* wireless application.

What makes LMR® cable different than corrugated cables?

Design features of Times LMR cable include:

1) Polyethylene Foam Dielectric

- Closed cell
- Dry nitrogen gas injected- no moisture to degrade performance
- High velocity
- Low loss

2) High Performance Flexible Shielding System

- Multi-laminar aluminum composite tape bonded to the dielectric
  - Provides >90dB isolation shielding (180dB cross talk)
  - Bonded construction ensures 100% effective shielding
  - Acts as a second moisture barrier
- Outer Braid of tinned copper:
  - Provides positive means for grounding and connector attachment

3) Polyethylene Outer Jacket

- Heavy duty UV, sunlight and weather resistant, 20 to 40 year life

How does LMR® cable compare to RG type braided cable or 9913?

LMR cables have lower loss and far better shielding than comparably sized braided cables. Polyethylene jacket, closed cell foam poly dielectric and bonded tape conductor all contribute to the superior weather resistance of LMR cables compared to braided cables and 9913.

Is there only one type of LMR® cable, or are there options?

Included in this catalog are the many different types of LMR cables which are available, so you can always be certain that there is an LMR cable just right for your particular application. Besides standard LMR cable, Times offers:

LMR-FR: Fire retardant cable for installation in building vertical risers or where fire retardancy is critical, both UL and CSA listed (CMR/CATVR).

LMR-LLPL: Low loss plenum rated cables for use in virtually any in-building application, including air handling plenums and spaces where maximum fire retardancy and low smoke generation are required. LMR-LLPL cables are the most rugged and easiest to install plenum rated cables available, especially for difficult installs in older buildings. Cables are both UL and CSA listed (CMP/CATVP).

LMR-DB: Watertight cables with an inert flooding compound injected in the braid to completely eliminate the possibility of any water migration- *with a 10 year warranty!* The DB feature is optional on sizes 600 and smaller, and standard on sizes 900 and larger.

LMR Ultraflex: Stranded center conductor and thermoplastic rubber jacket for maximum flexibility.

LMR-MA: Unbonded tape conductor for ease of removal for special applications.

LMR-PVC: Polyvinylchloride outer jacket for enhanced flexibility.

LMR-lite: Lightweight version of the standard LMR cable. Aluminum braid is used instead of tinned copper braid to offer a lighter weight cable.

FBT: Similar to LMR-LLPL, but with a fluoropolymer (FEP) outer jacket for high temperature performance up to 150°C (302°F).

T-COM: The ultimate in low loss, high performance coax with a triple shielding system pioneered by Times to achieve enhanced shielding and low passive intermod (-155dB).

LMR-75: These are 75 Ohm versions of the standard LMR cable for unsurpassed performance in broadband video and specialized RF applications.

T-RAD: 50 Ohm leaky feeder cable for RF coverage up to 2.5GHz. For use in buildings, mines, tunnels or any enclosed area. Flexible, non-kinking low cost design.

TIMES MICROWAVE SYSTEMS

LMR® discussion

What about connectors and installation tools?

Times offers a complete line of connectors for all its cables. A wide variety of connector interfaces is offered for almost every application:

- N
- BNC
- TNC
- UHF
- Reverse polarity
- MUHF
- 716DIN
- SMA
- QDS (quick disconnect)
- F
- LC
- HN
- QMA

Special connectors are available, and Times is always adding new ones. Times also offers a complete line of cable prep and connector installation tools, so you never will be frustrated by not having the right tools- Times is your one-stop source.

Do all Times connectors require soldering?

An extensive line of solder-pin type connectors is offered. However, Times has become the recognized industry leader in developing simplified connectors especially suited for field applications offering more nonsolder type connectors than any other cable manufacturers. The Times well-known line of Advantage™ -X series EZ nonsolder connectors which also do not require braid trimming has become renowned in the industry. With center pin contacts made from silver or gold plated beryllium-copper, EZ connectors are the preferred choice for quick and reliable field installations.

How can I get cable and tower installation accessories that work with LMR® cable?

Easy- Times furnishes a complete line of site installation hardware and accessories- everything you need to get you from the antenna to the equipment:

- **Ground kits:** Perfectly sized to each LMR cable, with never a chance of the ground strap being too tight (crushed cable), or too loose (poor grounding).
- **Hangers**: Snap-in, butterfly
- **Hoisting grips**
- **Weatherproofing kits:** Tape and cold shrink
- **Tie wraps**
- **Mounting hardware**
- **Entry ports and hardware**

Does anyone else make a cable like LMR®?

Some have tried, but no one can match Times LMR when it comes to what's important to the customer. Some don't even offer anything but cable, while Times offers:

- The most complete line of cable, connectors (including ***EZ***), tools and accessories
- The biggest range of sizes
- The most cable type options
- The most extensive distribution network
- Unsurpassed technical support
- The assurance that comes from knowing you are dealing with the industry leader, and
- ***The only company with its phone number printed on every foot of cable we make.*** You never have to guess who to call if you have a question or need help solving a problem, because everything is supplied by Times.

What about price?

In most cases Times LMR cables and connectors will save you money compared to corrugated cable. By combining the lower purchase cost with the ease and speed of installation, excellent savings are achieved. LMR cables also offer significant performance advantages compared to RG type cables at comparable prices.

How about jumpers and cable assemblies?

Times manufactures high quality LMR cable assemblies and Flextech jumpers- 100% factory tested before shipment for insertion loss and VSWR. Many of Times' LMR distributors also supply LMR cable assemblies and provide excellent service, especially for quick delivery requirements.

Where are LMR® cables made?

Times LMR cables are manufactured in our ISO certified Wallingford, Connecticut plant, where we have been making high quality coaxial cable for over 60 years.

What about availability?

Times LMR cables, connectors and accessories are stocked by our vast network of national, regional and international distributors worldwide, so you are never far from a convenient source.

How can I get started using LMR® cables?

Easy- just call our friendly Sales Department at either 1-800-TMS-COAX (1-800-867-2629) or 203-949-8400 and you can also visit our comprehensive web site at www.timesmicrowave.com for product and technical information or to request other Times literature.

I'm new at this and might need help with the connectors or accessories

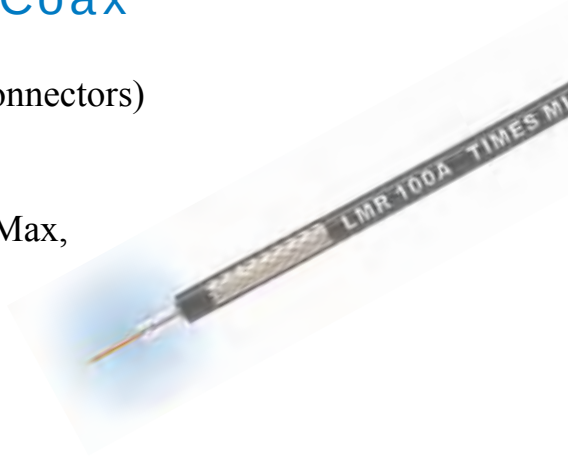
Times has put together a full complement of "how-to" videos of many of the most popular Advantage™ -X Series EZ connectors as well as ground kits and other accessories. These videos are available both on the Times Microwave Website and YouTube. And if you ever need help on a job, just call us- our phone number is right on the cable.

TIMES MICROWAVE SYSTEMS

LMR®-100A
Flexible Low Loss Communications Coax

Ideal for...

- Drop-in Replacement for RG-316/RG-174 (uses standard connectors)
- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable



• **LMR®-PVC** is designed for low loss general-purpose indoor/outdoor applications and is somewhat more flexible than the standard polyethylene jacketed LMR.

• **LMR®-PVC-W** is a white-jacketed version of LMR-PVC for marine and other indoor/outdoor applications where color compatibility is desired.

• **Flexibility** and bendability are hallmarks of the LMR-100A cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-100A. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-100A cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** A wide variety of connectors are available for LMR-100A cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-100A cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BCCS	0.018	(0.46)
Dielectric	Solid PE	0.060	(1.52)
Outer Conductor	Aluminum Tape	0.065	(1.65)
Overall Braid	Tinned Copper	0.083	(2.11)
Jacket	(see table above)	0.110	(2.79)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.25	(6.4)
Bend Radius: repeated	in. (mm)	1	(25.4)
Bending Moment	ft-lb (N-m)	0.1	(0.014)
Weight	lb/ft (kg/m)	0.0092	(.014)
Tensile Strength	lb (kg)	15	(6.8)
Flat Plate Crush	lb/in. (kg/mm)	10	(0.18)

Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

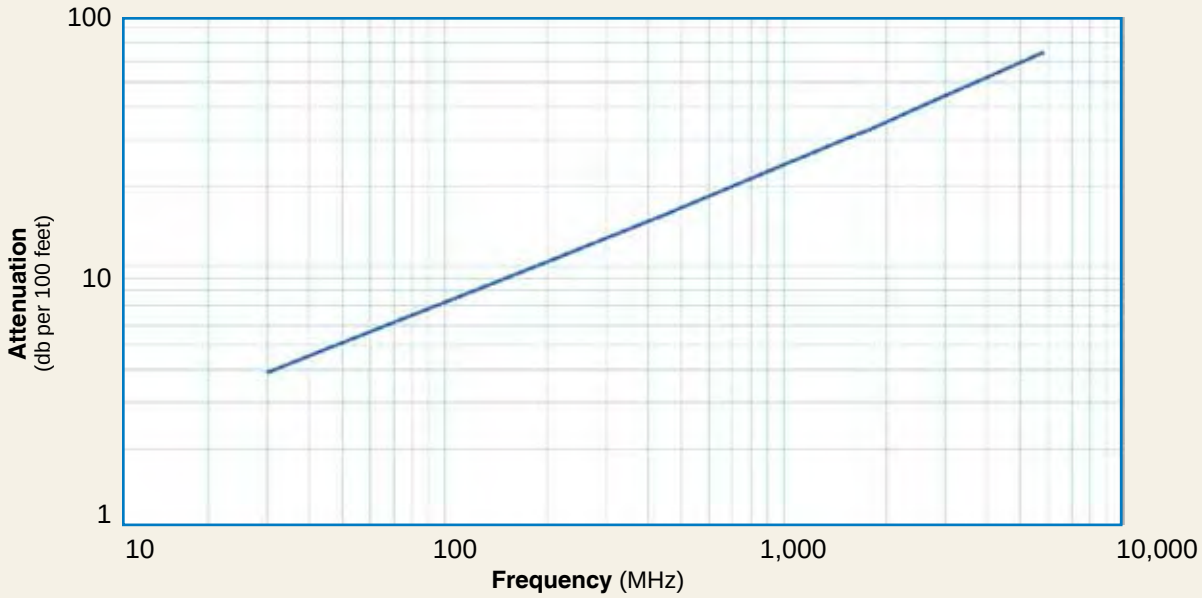
Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	66	
Dielectric Constant	NA	2.30	
Time Delay	nS/ft (nS/m)	1.54	(5.05)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	30.8	(101.1)
Inductance	uH/ft (uH/m)	0.077	(0.25)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	81.0	(266)
Outer Conductor	ohms/1000ft (/km)	9.5	(31.2)
Voltage Withstand	Volts DC	500	
Jacket Spark	Volts RMS	2000	
Peak Power	kW	0.6	

Part Description				Stock
Part Number	Application	Jacket	Color	Code
LMR-100A-FR	Indoor/Outdoor Riser CMR	FRPE	Black	54037
LMR-100A-PVC	Indoor/Outdoor	PVC	Black	54119
LMR-100A-PVC-W	Indoor/Outdoor	PVC	White	54200

PVC = Poly Vinyl Chloride; MTO = Made to Order

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	3.9	5.1	8.9	10.9	15.8	22.8	30.1	33.2	35.2	39.8	64.1
Attenuation dB/100 m	12.9	16.7	29.4	35.8	51.9	74.9	98.7	109.0	115.5	130.6	210.3
Avg. Power kW	0.230	0.180	0.100	0.083	0.057	0.039	0.029	0.027	0.025	0.022	0.013

Calculate Attenuation = (0.709140) • $\sqrt{\text{FMHz}}$ + (0.001740) • FMHz (interactive calculator available at http://www.timesmicrowave/telecom)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR ** Freq.	(GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)lb	Weight (g)	
1. SMA male	Straight Plug	TC-100-SM	3190-1551	<1.25:1	(<3)	Hex	Solder	Crimp	SS/G	1.0 (25.4)	0.32 (8.1)	0.015	(6.8)
2. TNC male	Straight Plug	TC-100-TM	3190-1552	<1.25:1	(<3)	Knurl	Solder	Crimp	S/G	1.4(35.6)	0.59 (15.0)	0.045	(20.4)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Install Tools

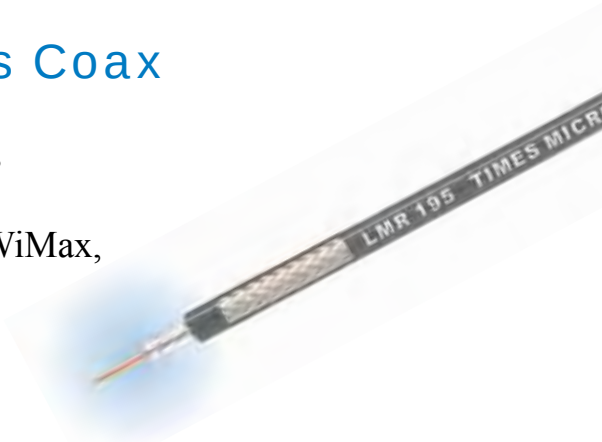
Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100, 195, 200 and 240 connectors
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

TIMES MICROWAVE SYSTEMS

LMR®-195
Flexible Low Loss Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable
- Drop-in replacement for RG-58 and RG-142



• **LMR®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

• **LMR®- DB** is identical to standard LMR plus has the advantage of being watertight. The addition of waterproofing compound in and around the foil/braid insures continuous reliable service should the jacket be inadvertently damaged during installation or in the future.

• **LMR®- FR** is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. LMR-FR is UL/NEC & CSA rated'CMR' and 'FT4' respectively, meets FAA FAR25 requirements and is MSHA-P for mining applications.

• **LMR®- FR-PVC** is a general-purpose indoor cable and has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively. It is less expensive than LMR-FR, however it emits toxic fumes (HCL) and greater smoke density when burned.

• **LMR®- PVC** is designed for low loss general-purpose applications and is somewhat more flexible than the standard polyethylene jacketed LMR.

• **LMR®- PVC-W** is a white-jacketed version of LMR-PVC for marine and other applications where color compatibility is desired.

• **LMR®- MA** is a flexible cable designed specifically for mobile antenna applications. It has a PVC jacket and un-bonded aluminum tape to facilitate end stripping with automated equipment.

• **Flexibility** and bendability are hallmarks of the LMR-195 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-195. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-195 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** A wide variety of connectors are available for LMR-195 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-195 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	**Application**	**Jacket**	**Color**	**Code**
LMR-195	Outdoor	PE	Black	54110
LMR-195-DB	Outdoor/Watertight	PE	Black	54113
LMR-195-FR	Indoor/Outdoor Riser CMR	FRPE	Black	54111
LMR-195-FR-W	Indoor/Outdoor Riser CMR	FRPE	White	54158
LMR-195-FR-PVC	Indoor/Outdoor Riser CMR	FRPVC	Black	54105
LMR-195-MA	Mobile Antennas	PVC	Black	54210
LMR-195-PVC	General Purpose	PVC	Black	54215
LMR-195-PVC-W	General Purpose	PVC	White	54199

Construction Specifications			
Description	**Material**	**In.**	**(mm)**
Inner Conductor	Solid BC	0.037	(0.94)
Dielectric	Foam PE	0.110	(2.79)
Outer Conductor	Aluminum Tape	0.116	(2.95)
Overall Braid	Tinned Copper	0.139	(3.53)
Jacket	(see table above)	0.195	(4.95)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.5	(12.7)
Bend Radius: repeated	in. (mm)	2.0	(50.8)
Bending Moment	ft-lb (N-m)	0.2	(0.27)
Weight	lb/ft (kg/m)	0.021	(0.03)
Tensile Strength	lb (kg)	40	(18.2)
Flat Plate Crush	lb/in. (kg/mm)	15	(0.27)

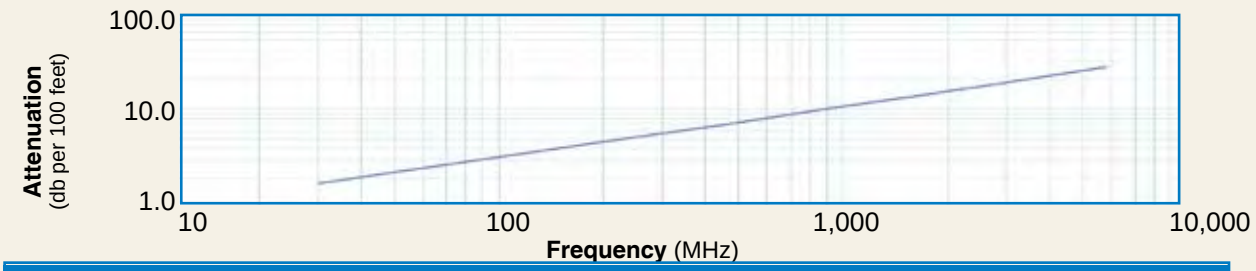
Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.56	
Time Delay	nS/ft (nS/m)	1.27	(4.17)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	25.4	(83.3)
Inductance	uH/ft (uH/m)	0.064	(0.21)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	7.6	(24.9)
Outer Conductor	ohms/1000ft (/km)	4.9	(16.1)
Voltage Withstand	Volts DC	1000	
Jacket Spark	Volts RMS	3000	
Peak Power	kW	2.5	

Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	2.0	2.5	4.4	5.4	7.8	11.1	14.5	16.0	16.9	19.0	29.9
Attenuation dB/100 m	6.5	8.4	14.6	17.7	25.5	36.5	47.7	52.5	55.4	62.4	98.1
Avg. Power kW	0.89	0.68	0.39	0.32	0.22	0.16	0.12	0.11	0.10	0.09	0.06

Calculate Attenuation = (0.356859) • $\sqrt{\text{FMHz}}$ + (0.000470) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. N male	Straight Plug	TC-195-NM	3190-1555	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.5 (38.1)	0.75 (19.1)	0.073 (33.1)
2. N male	Right Angle	TC-195-NMH-RA-D	3190-2425	<1.35:1 (6)	Hex/Knurl	Solder	Crimp	A/G	1.3 (32.1)	1.19 (30.1)	0.083 (37.5)
3. SMA male	Straight Plug	TC-195-SM	3190-1553	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0 (25.4)	0.32 (8.1)	0.015 (6.8)
4. TNC male	Straight Plug	TC-195-TM	3190-1554	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.4 (35.6)	0.59 (15.0)	0.045 (20.4)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100,195, 200 and 240 connectors
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Strip Tool	CST-195/200	3192-102	Prep tool for LMR-195/200
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST cutting tools

TIMES MICROWAVE SYSTEMS

LMR®-200
Flexible Low Loss Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable

• **LMR®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

• **LMR®- DB** is identical to standard LMR plus has the advantage of being watertight. The addition of waterproofing compound in and around the foil/braid insures continuous reliable service should the jacket be inadvertently damaged during installation or in the future.

• **LMR®- FR** is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. LMR-FR is UL/NEC & CSA rated'CMR' and 'FT4' respectively, meets FAA FAR25 requirements and is MSHA-P for mining applications.

• **LMR®- FR-PVC** is a general-purpose indoor cable and has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively. It is less expensive than LMR-FR, however it emits toxic fumes (HCL) and greater smoke density when burned.

• **LMR®- PVC** is designed for low loss general-purpose applications and is somewhat more flexible than the standard polyethylene jacketed LMR.

• **LMR®- PVC-W** is a white-jacketed version of LMR-PVC for marine and other applications where color compatibility is desired.

• **LMR®- MA** is a flexible cable designed specifically for mobile antenna applications. It has a PVC jacket and un-bonded aluminum tape to facilitate end stripping with automated equipment.

• **Flexibility** and bendability are hallmarks of the LMR-200 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-200. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-200 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** A wide variety of connectors are available for LMR-200 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-200 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
LMR-200	Outdoor	PE	Black	54022
LMR-200-DB	Outdoor/Watertight	PE	Black	54089
LMR-200-FR	Indoor/Outdoor Riser CMR	FRPE	Black	54028
LMR-200-FR-PVC	Indoor/OutdoorRiser CMR	FRPVC	Black	54125
LMR-200-PVC	General Purpose	PVC	Black	54216
LMR-200-PVC-W	General Purpose	PVC	White	54201
LMR-200-MA	Mobile Antennas	PVC	Black	54045

Construction Specifications			
Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.044	(1.12)
Dielectric	Foam PE	0.116	(2.95)
Outer Conductor	Aluminum Tape	0.121	(3.07)
Overall Braid	Tinned Copper	0.144	(3.66)
Jacket	(see table above)	0.195	(4.95)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.5	(12.7)
Bend Radius: repeated	in. (mm)	2	(50.8)
Bending Moment	ft-lb (N-m)	0.2	(0.27)
Weight	lb/ft (kg/m)	0.022	(0.03)
Tensile Strength	lb (kg)	40	(48)
Flat Plate Crush	lb/in. (kg/mm)	15	(0.27)

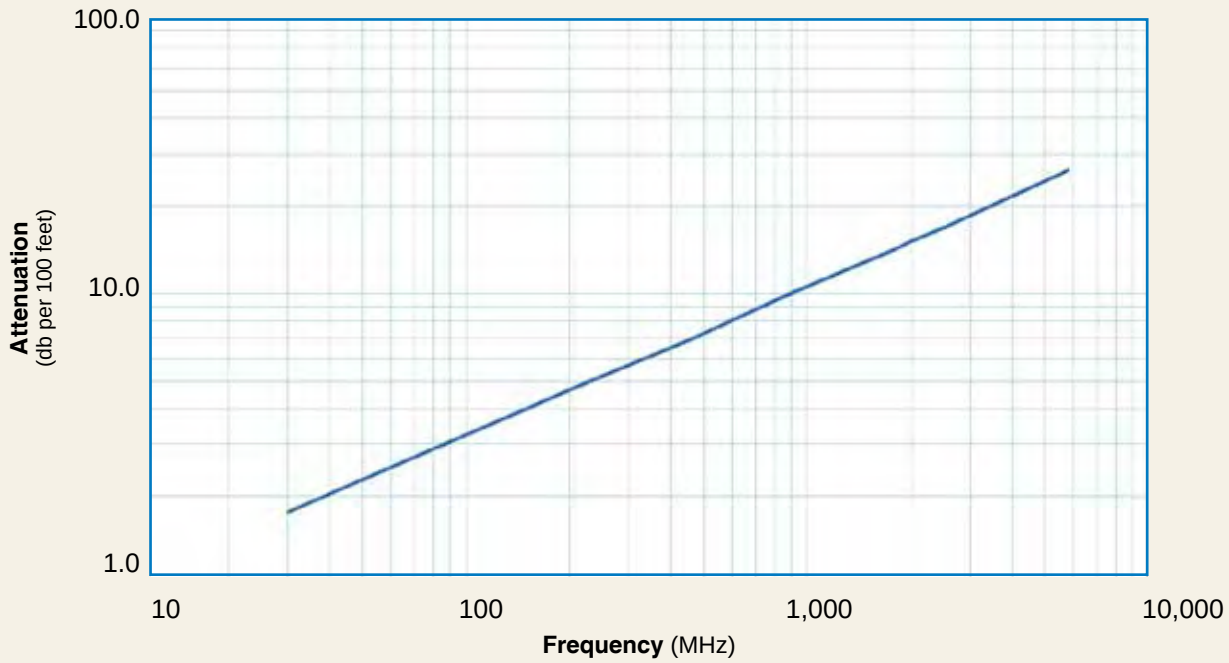
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	83	
Dielectric Constant	NA	1.45	
Time Delay	nS/ft (nS/m)	1.22	(4.02)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	24.5	(80.3)
Inductance	uH/ft (uH/m)	0.061	(0.20)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	5.36	(17.6)
Outer Conductor	ohms/1000ft (/km)	4.9	(16.1)
Voltage Withstand	Volts DC	1000	
Jacket Spark	Volts RMS	3000	
Peak Power	kW	2.5	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	1.8	2.3	4.0	4.8	7.0	9.9	12.9	14.2	15.0	16.9	26.4
Attenuation dB/100 m	5.8	7.5	13.1	15.9	22.8	32.6	42.4	46.6	49.3	55.4	86.5
Avg. Power kW	1.02	0.79	0.45	0.37	0.26	0.18	0.14	0.13	0.12	0.11	0.07

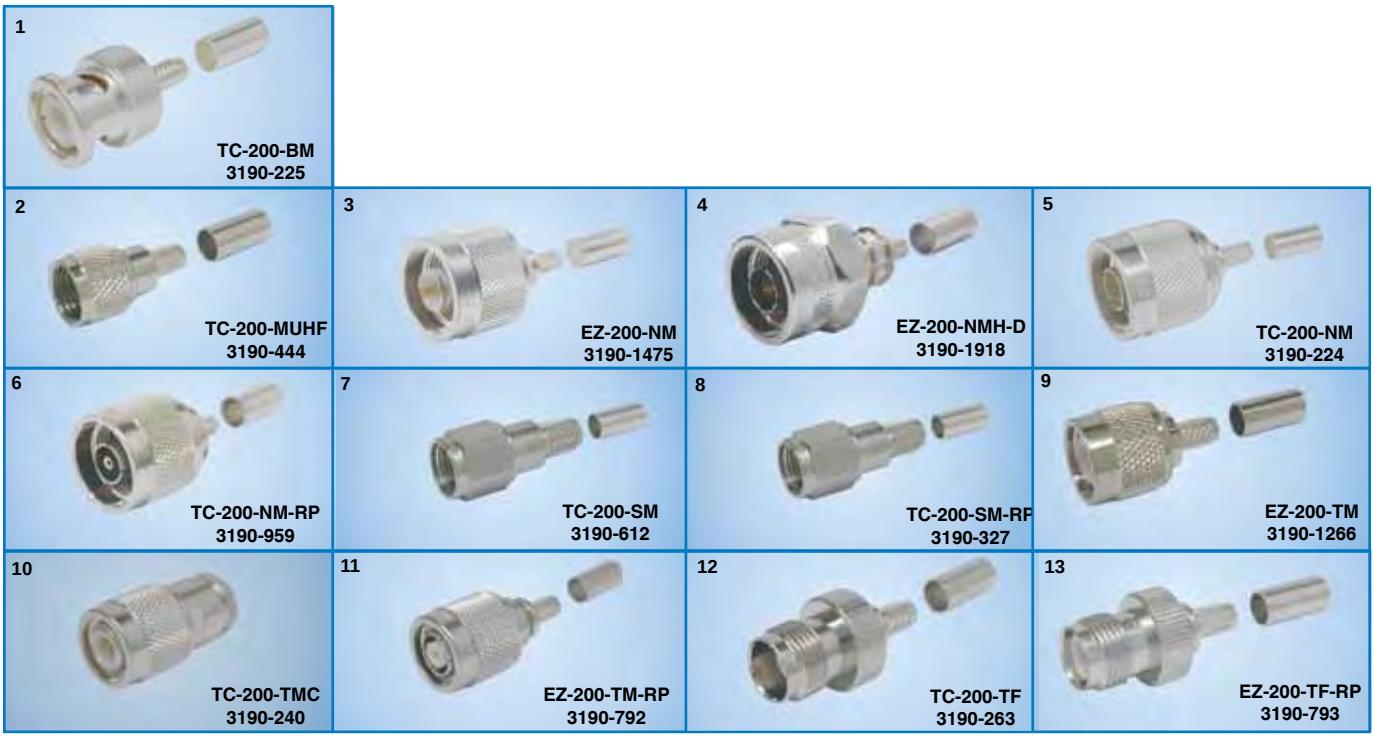
Calculate Attenuation =
$(0.320900) \cdot \sqrt{FMHz} + (0.000330) \cdot FMHz$ (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:
VSWR=1.0; Ambient = +25°C (77°F)

Power:
VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR®-200
Flexible Low Loss Communications Coax



Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
1. BNC male	Straight Plug	TC-200-BM	3190-225	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.7	(43.2)	0.56	(14.2)	0.045	(20.4)
2. Mini-UHF	Straight Plug	TC-200-MUHF	3190-444	<1.25:1 (2.5)	Knurl	Solder	Crimp	NG	1.1	(27.9)	0.45	(11.4)	0.015	(6.8)
3. N male	Straight Plug	EZ-200-NM	3190-1475	<1.25:1 (8)	Knurl	Spring Fit	Crimp	S/G	1.5	(38.1)	0.75	(19.1)	0.073	(33.1)
4. N male	Straight Plug	EZ-200-NMH-D	3190-1918	<1.25:1 (8)	Hex/Knurl	Spring Fit	Crimp	A/G	1.5	(38.1)	0.75	(19.1)	0.073	(33.1)
5. N male	Straight Plug	TC-200-NM	3190-224	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.5	(38.1)	0.75	(19.1)	0.073	(33.1)
6. N male	Reverse Polarity	TC-200-NM-RP	3190-959	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/G	1.5	(38.1)	0.75	(19.1)	0.073	(33.1)
7. SMA male	Straight Plug	TC-200-SM	3190-612	<1.25:1 (8)	Hex	Solder	Crimp	SS/G	1.0	(25.4)	0.32	(8.1)	0.015	(6.8)
8. SMA male	Reverse Polarity	TC-200-SM-RP	3190-327	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0	(25.4)	0.32	(8.1)	0.015	(6.8)
9. TNC male	Straight Plug	EZ-200-TM	3190-1266	<1.25:1 (2.5)	Knurl	Spring Fit	Crimp	S/G	1.4	(35.6)	0.59	(15.0)	0.045	(20.4)
10. TNC male	Straight Plug	TC-200-TMC	3190-240	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G	1.7	(43.2)	0.59	(15.0)	0.045	(20.4)
11. TNC male	Reverse Polarity	EZ-200-TM-RP	3190-792	<1.25:1 (2.5)	Knurl	Spring Fit	Crimp	A/G	1.4	(35.6)	0.32	(8.1)	0.045	(20.4)
12. TNC female	Straight Jack	TC-200-TF	3190-263	<1.25:1 (2.5)	NA	Solder	Crimp	N/G	1.3	(33.0)	0.57	(14.5)	0.033	(15.0)
13. TNC female	Reverse Polarity	EZ-200-TF-RP	3190-793	<1.25:1 (2.5)	NA	Spring Fit	Crimp	A/G	1.3	(33.0)	0.57	(14.5)	0.033	(15.0)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

GK-S200TT

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S200TT	GK-S200TT	Standard Ground Kit (each)

CT-240/200/195/100
3190-667

RB-CST
3192-086

CST-195/200
3192-102

DBT-U
3192-001

CCT-01
3190-1544

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100, 195, 200 and 240 connectors
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Strip Tool	CST-195/200	3192-102	Combination prep tool for LMR-195 and LMR-200
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all strip tools

TIMES MICROWAVE SYSTEMS

LMR®-240
Flexible Low Loss Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs (e.g. WLL, GPS, LMR, Mobile Antennas)
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable

• **LMR®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

• **LMR®- DB** is identical to standard LMR plus has the advantage of being watertight. The addition of waterproofing compound in and around the foil/braid insures continuous reliable service should the jacket be inadvertently damaged during installation or in the future.

• **LMR®- FR** is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. LMR-FR is UL/NEC & CSA rated'CMR' and 'FT4' respectively, meets FAA FAR25 requirements and is MSHA-P for mining applications.

• **LMR®- FR-PVC** is a general-purpose indoor cable and has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively. It is less expensive than LMR-FR, however it emits toxic fumes (HCL) and greater smoke density when burned.

• **LMR®- PVC** is designed for low loss general-purpose applications and is somewhat more flexible than the standard polyethylene jacketed LMR.

• **LMR®- PVC-W** is a white-jacketed version of LMR-PVC for marine and other applications where color compatibility is desired.

• **LMR®- MA** is a flexible cable designed specifically for mobile antenna applications. It has a PVC jacket and un-bonded aluminum tape to facilitate end stripping with automated equipment.

• **Flexibility** and bendability are hallmarks of the LMR-240 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-240. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-240 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** A wide variety of connectors are available for LMR-240 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-240 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
LMR-240	Outdoor	PE	Black	54021
LMR-240-DB	Outdoor/Watertight	PE	Black	54090
LMR-240-FR	Indoor/Outdoor Riser CMR	FRPE	Black	54029
LMR-240-FR-PVC	Indoor/Outdoor Riser CMR	FRPVC	Black	54214
LMR-240-PVC	General Purpose	PVC	Black	54140
LMR-240-PVC-W	General Purpose	PVC	White	54202
LMR-240-MA	Indoor & Mobile Antenna	PVC	Black	54046

Construction Specifications			
Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.056	(1.42)
Dielectric	Foam PE	0.150	(3.81)
Outer Conductor	Aluminum Tape	0.155	(3.94)
Overall Braid	Tinned Copper	0.178	(4.52)
Jacket	(see table above)	0.240	(6.10)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.75	(19.1)
Bend Radius: repeated	in. (mm)	2.5	(63.5)
Bending Moment	ft-lb (N-m)	0.25	(0.34)
Weight	lb/ft (kg/m)	0.034	(0.05)
Tensile Strength	lb (kg)	80	(36.3)
Flat Plate Crush	lb/in. (kg/mm)	20	(0.36)

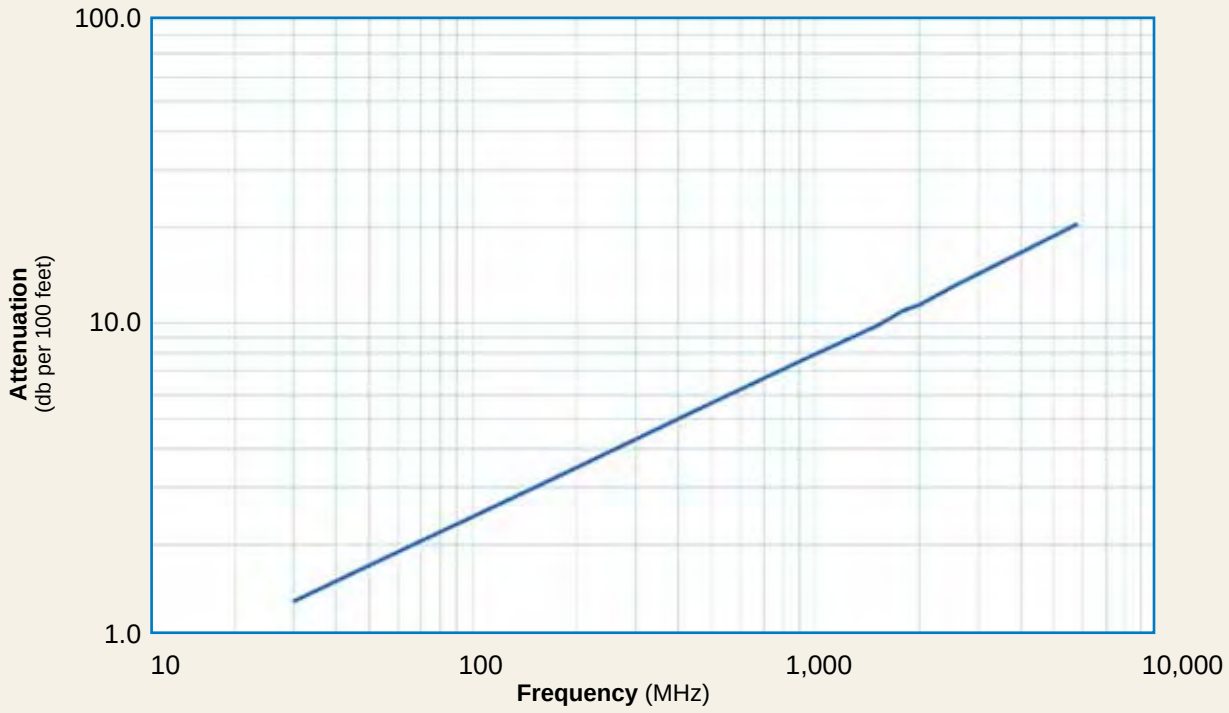
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	84	
Dielectric Constant	NA	1.42	
Time Delay	nS/ft (nS/m)	1.21	(3.97)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	24.2	(79.4)
Inductance	uH/ft (uH/m)	0.060	(0.20)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	3.2	(10.5)
Outer Conductor	ohms/1000ft (/km)	3.89	(12.8)
Voltage Withstand	Volts DC	1500	
Jacket Spark	Volts RMS	5000	
Peak Power	kW	5.6	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	1.3	1.7	3.0	3.7	5.3	7.6	9.9	10.9	11.5	12.9	20.4
Attenuation dB/100 m	4.4	5.7	9.9	12.0	17.3	24.8	32.4	35.6	37.7	42.4	66.8
Avg. Power kW	1.49	1.15	0.66	0.54	0.38	0.26	0.20	0.18	0.17	0.15	0.10

Calculate Attenuation =
$(0.242080) \cdot \sqrt{FMHz} + (0.000330) \cdot FMHz$ (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:
VSWR=1.0 ; Ambient = +25°C (77°F)

Power: VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR®-240
Flexible Low Loss Communications Coax

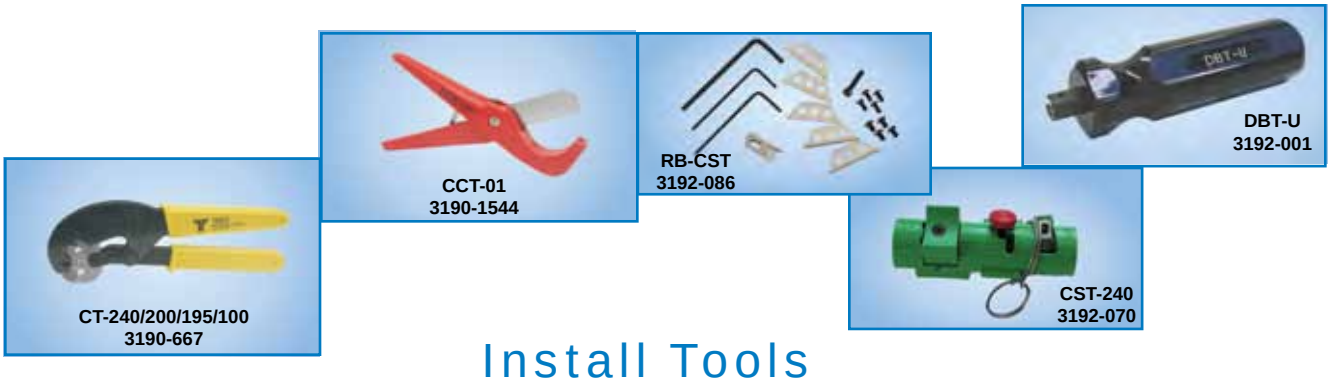
Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Contact Attach	Inner Contact Attach	Outer Body /Pin	Finish*	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
1. F Male	Straight Plug	TC-240-FM	3190-924	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/G	1.1	(28)	0.45	(11.4)	0.014	(6.4)
2. N Male	Straight Plug	EZ-240-NMH-D	3190-1127	<1.25:1	(2.5)	Hex/Knurl	Spring Finger	Crimp	A/G	1.5	(38.1)	0.78	(19.8)	0.086	(39.0)
3. N Male	Right Angle	TC-240-NMH-RA-D	3190-2426	<1.35:1	(6)	Hex/Knurl	Solder	Crimp	A/G	1.2	(32.4)	1.22	(31.0)	0.091	(41.7)
4. N Male	Straight Plug	TC-240-NMH-D	3190-382#	<1.25:1	(2.5)	Hex/Knurl	Solder	Crimp	N/S	1.5	(38)	0.75	(19.1)	0.086	(39.0)
5. N Male	Straight Plug	TC-240-NMC	3190-244	<1.25:1	(2.5)	Knurl	Solder	Clamp	S/G	1.5	(38)	0.75	(19.1)	0.082	(37.2)
6. 1.0/2.3 DIN	Straight Plug	EZ-240-1023M	3190-2512	<1.35:1	(2.5)	knurl	Spring Finger	Crimp	N/G	1.1	(228.5)	0.33	(8.5)	0.014	(6.63)
7. N Female	Bulkhead Jack	TC-240-NF-BH	3190-419	<1.25:1	(2.5)	NA	Solder	Crimp	A/G	1.7	(44)	0.88	(22.2)	0.115	(52.2)
8. N Female	Panel Mount	TC-240-NF-BHF(A)	3190-866#	<1.25:1	(2.5)	NA	Solder	Crimp	A/G	1.7	(44)	0.88	(22.2)	0.115	(52.2)
9. BNC Male	Straight Plug	TC-240-BMC	3190-242	<1.25:1	(2.5)	Knurl	Solder	Clamp	S/G	1.7	(43)	0.56	(14.2)	0.040	(18.1)
10. BNC Male	Straight Plug	TC-240-BM(A)	3190-867	<1.25:1	(2.5)	Knurl	Solder	Crimp	A/G	1.7	(43)	0.5 6	(14.2)	0.043	(19.5)
11. TNC Male	Straight Plug	EZ-240-TM	3190-1128	<1.25:1	(2.5)	Knurl	Spring Finger	Crimp	N/G	1.4	(34.3)	0.59	(15.0)	0.043	(19.5)
12. TNC Male	Straight Plug	TC-240-TM	3190-275	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/G	1.7	(43)	0.59	(15.0)	0.043	(19.5)
13. TNC Male	Reverse Polarity	EZ-240-TM-RP	3190-970	<1.25:1	(2.5)	Knurl	Spring Finger	Crimp	A/G	1.4	(36)	0.59	(15.0)	0.043	(19.5)
14. QMA Male	Straight Plug	EZ-240-QM	3190-1533	<1.25:	(6)	Knurl	Spring Finger	Crimp	N/G	1.2	(30.0)	0.41	(10.5)	0.014	(6.35)
15. QMA Male	Right Angle	EZ-240-QM-RA	3190-1539	<1.25:	(<6)	Knurl	Spring Finger	Crimp	N/G	0.8	(20.3)	0.65	(16.5)	0.019	(8.62)
16. SMA Male	Straight Plug	EZ-240-SM	3190-1530	<1:25:	(6)	Hex	Spring Finger	Crimp	N/G	1.0	(25.4)	0.32	(8.1)	0.016	(7.26)
17. SMA Male	Straight Plug	TC-240-SM	3190-380#	<1.25:1	(10)	Hex	Solder	Crimp	SS/G	1.0	(25)	0.32	(8.1)	0.016	(7.3)
18. SMA Male	Right Angle	TC-240-SM-RA	3190-381#	<1.35:1	(6)	Hex	Solder	Crimp	SS/G	0.8	(20)	0.65	(16.5)	0.019	(8.6)
19. SMA Male	Reverse Polarity	TC-240-SM-RP	3190-326	<1.25:1	(2.5)	Hex	Solder	Crimp	SS/G	1.0	(25)	0.32	(8.1)	0.016	(7.3)
20. SMA Female	Bulkhead Jack	TC-240-SF-BH	3190-824#	<1.25:1	(2.5)	NA	Solder	Crimp	SS/G	1.1	(29)	0.31	(7.9)	0.019	(8.6)
21. Mini-UHF	Straight Plug	TC-240-MUHF	3190-445	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/G	1.1	(28)	0.45	(11.4)	0.014	(6.4)
22. 7/16 Din Male	Straight Plug	TC-240-716M	3190-2580	<1.35:1	(3)	Hex	Spring Finger	Crimp	A/S	2.0	(50.5)	1.26	(32.0)	0.186	(84.4)
23. 7/16 Din Male	Right Angle	TC-240-716M-RA	3190-2589	<1.35:1	(3)	Hex	Solder	Crimp	A/S	1.4	(34.3)	1.60	(40.6)	0.239	(108.5)
24. TNC Female	Straight Jack	EZ-240-TF	3190-2552	<1.35:1	(6)	NA	Spring Finger	Crimp	N/G	1.1	(27.0)	0.45	(11.4)	0.035	(15.9)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair #Available in bulk pack

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S240TT	GK-S240TT	Standard Ground Kit (each)



Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100, 195, 200 and 240 connectors
Strip Tool	CST-240	3192-070	Prep tool for LMR-240 connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST strip tools

TIMES MICROWAVE SYSTEMS

LMR®-300
Flexible Low Loss Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable

• **LMR®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

• **LMR®- DB** is identical to standard LMR plus has the advantage of being watertight. The addition of waterproofing compound in and around the foil/braid insures continuous reliable service should the jacket be inadvertently damaged during installation or in the future.

• **LMR®- FR** is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. LMR-FR is UL/NEC & CSA rated'CMR' and 'FT4' respectively, meets FAA FAR25 requirements and is MSHA-P for mining applications.

• **LMR®- FR-PVC** is a general-purpose indoor cable and has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively. It is less expensive than LMR-FR, however it emits toxic fumes (HCL) and greater smoke density when burned.

• **LMR®- PVC** is designed for low loss general-purpose applications and is somewhat more flexible than the standard polyethylene jacketed LMR.

• **LMR®- PVC-W** is a white-jacketed version of LMR-PVC for marine and other applications where color compatibility is desired.

• **Flexibility** and bendability are hallmarks of the LMR-300 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-300. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-300 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** A wide variety of connectors are available for LMR-300 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-300 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	**Application**	**Jacket**	**Color**	**Code**
LMR-300	Outdoor	PE	Black	54086
LMR-300-DB	Outdoor/Watertight	PE	Black	54114
LMR-300-FR	Indoor/Outdoor Riser CMR	FRPE	Black	54087
LMR-300-FR-PVC	Indoor/Outdoor Riser CMR	FRPVC	Black	54108
LMR-300-PVC	General Purpose	PVC	Black	54217
LMR-300-PVC-W	General Purpose	PVC	White	54203

Construction Specifications			
Description	**Material**	**In.**	**(mm)**
Inner Conductor	Solid BC	0.070	(1.78)
Dielectric	Foam PE	0.190	(4.83)
Outer Conductor	Aluminum Tape	0.196	(4.98)
Overall Braid	Tinned Copper	0.225	(5.72)
Jacket	(see table above)	0.300	(7.62)

Environmental Specifications		
Performance Property	**°F**	**°C**
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

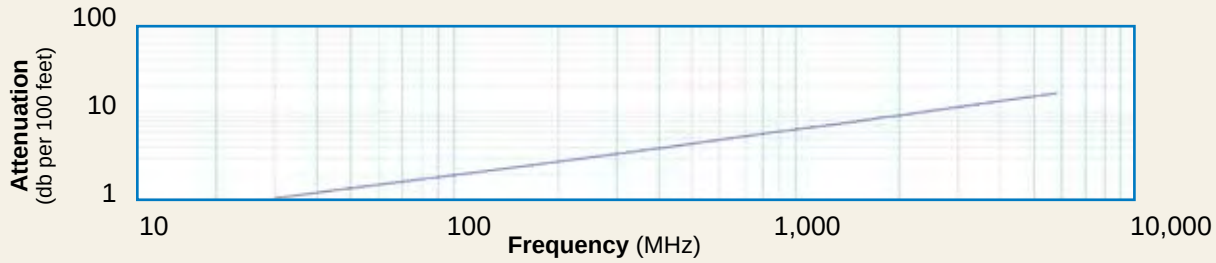
Electrical Specifications			
Performance Property	**Units**	**US**	**(metric)**
Velocity of Propagation	%	85	
Dielectric Constant	NA	1.38	
Time Delay	nS/ft (nS/m)	1.20	(3.92)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.9	(78.4)
Inductance	uH/ft (uH/m)	0.060	(0.20)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	2.12	(7.0)
Outer Conductor	ohms/1000ft (/km)	2.21	(7.3)
Voltage Withstand	Volts DC	2000	
Jacket Spark	Volts RMS	5000	
Peak Power	kW	10	

TIMES MICROWAVE SYSTEMS

Mechanical Specifications

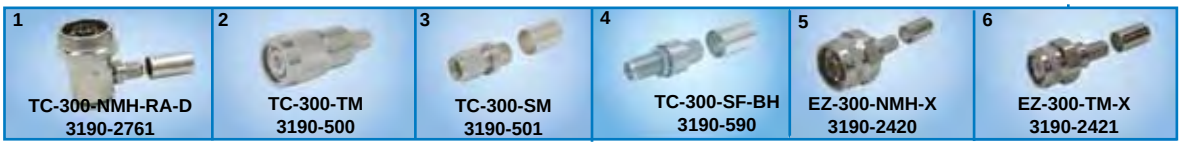
Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.88	(22.2)
Bend Radius: repeated	in. (mm)	3.0	(76.2)
Bending Moment	ft-lb (N-m)	0.38	(0.52)
Weight	lb/ft (kg/m)	0.055	(0.08)
Tensile Strength	lb (kg)	120	(54.5)
Flat Plate Crush	lb/in. (kg/mm)	30	(0.54)

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuaton dB/100 ft	1.1	1.4	2.4	2.9	4.2	6.1	7.9	8.7	9.2	10.4	16.5
Attenuaton dB/100 m	3.5	4.5	7.9	9.6	13.8	19.9	26.0	28.7	30.3	34.2	54.2
Avg. Power kW	2.09	1.62	0.92	0.76	0.52	0.36	0.28	0.25	0.24	0.21	0.13

Calculate Attenuation = (0.191930) • $\sqrt{FMHz}$ + (0.000330) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading



Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. N Male	Right Angle	TC-300-NMH-RA-D	3190-2761	<1.30:1 (2.5)	Hex/Knurl	Solder	Crimp	N/S	1.4 (35)	1.41 (35.8)	0.130 (59.0)
2. TNC Male	Straight Plug	TC-300-TM	3190-500	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/G	1.7 (43)	0.59(15.0)	0.050 (22.7)
3. SMA Male	Straight Plug	TC-300-SM	3190-501	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0 (25)	0.35 (8.9)	0.018 (8.2)
4. SMA Female	Bulkhead Jack	TC-300-SF-BH	3190-590	<1.25:1 (2.5)	NA	Solder	Crimp	SS/G	1.1 (28)	0.31 (7.9)	0.022 (10.0)
5. N male	Straight Plug	EZ-300-NMH-X	3190-2420	<1.25:1 (6)	Hex	Spring finger	Crimp	A/G	1.3 (34)	0.87 (22.0)	0.077 (34.95)
6. TNC Male	Straight Plug	EZ-300-TM-X	3190-2421	<1.25:1 (6)	Hex	Spring finger	Crimp	A/G	1.3 (32)	0.66 (16.8)	0.058 (26.2)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair


GK-S300TT

Hardware Accessories

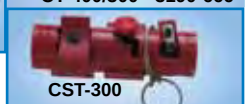
Type	Part Number	Stock Code	Description
Ground Kit	GK-S300TT	GK-S300TT	Standard Ground Kit (each)

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-400/300	3190-666	Crimp tool for LMR-300 connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Prep Tool	CST-300	3192-084	Prep tool for LMR-300 Connectors
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST strip tools
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool


RB-CST
3192-086


CT-400/300 - 3190-666


CST-300
3192-084


DBT-U
3192-001


CCT-01
3190-1544

TIMES MICROWAVE SYSTEMS

LMR®-400
Flexible Low Loss Communications Coax

Ideal for...

- Drop-in replacement for RG-8/9913 Air-Dielectric type Cable
- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable
- **NEW!** Times Protect® LP-18-400 protector-series

• **LMR®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

• **LMR®- DB** is identical to standard LMR plus has the advantage of being watertight. The addition of waterproofing compound in and around the foil/braid insures continuous reliable service should the jacket be inadvertently damaged during installation or in the future.

• **LMR®- FR** is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. LMR-FR is UL/NEC & CSA rated'CMR' and 'FT4' respectively, meets FAA FAR25 requirements and is MSHA-P for mining applications.

• **LMR®- FR-PVC** is a general-purpose indoor cable and has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively. It is less expensive than LMR-FR, however it emits toxic fumes (HCL) and greater smoke density when burned.

• **LMR®- PVC** is designed for low loss general-purpose applications and is somewhat more flexible than the standard polyethylene jacketed LMR.

• **LMR®- PVC-W** is a white-jacketed version of LMR-PVC for marine and other applications where color compatibility is desired.

• **Flexibility** and bendability are hallmarks of the LMR-400 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-400. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-400 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** A wide variety of connectors are available for LMR-400 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-400 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
LMR-400	Outdoor	PE	Black	54001
LMR-400-DB	Outdoor/Watertight	PE	Black	54091
LMR-400-FR	Indoor/Outdoor Riser CMR	FRPE	Black	54030
LMR-400-FR-PVC	Indoor/Outdoor Riser CMR	FRPVC	Black	54073
LMR-400-PVC	General Purpose	PVC	Black	54218
LMR-400-PVC-W	General Purpose	PVC	White	54204

Construction Specifications			
Description	Material	In.	(mm)
Inner Conductor	Solid BCCAI	0.108	(2.74)
Dielectric	Foam PE	0.285	(7.24)
Outer Conductor	Aluminum Tape	0.291	(7.39)
Overall Braid	Tinned Copper	0.320	(8.13)
Jacket	(see table above)	0.405	(10.29)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.00	(25.4)
Bend Radius: repeated	in. (mm)	4.0	(101.6)
Bending Moment	ft-lb (N-m)	0.5	(0.68)
Weight	lb/ft (kg/m)	0.068	(0.10)
Tensile Strength	lb (kg)	160	(72.6)
Flat Plate Crush	lb/in. (kg/mm)	40	(0.71)

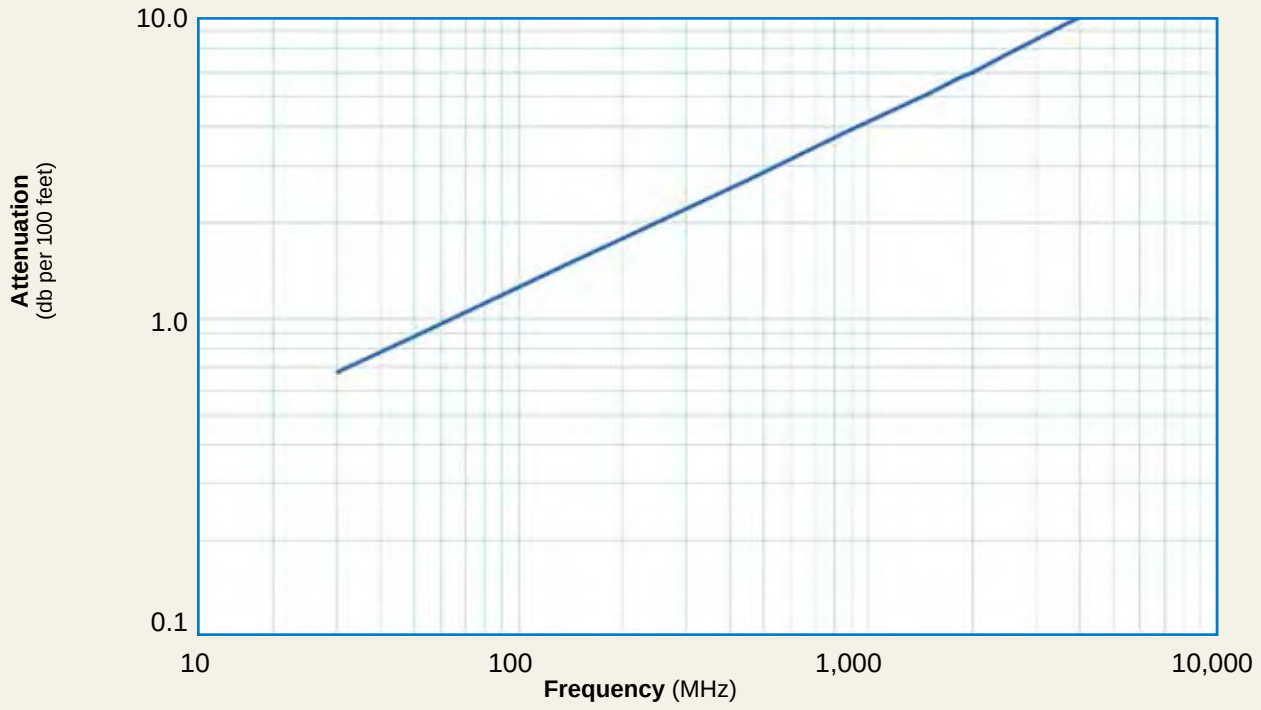
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	85	
Dielectric Constant	NA	1.38	
Time Delay	nS/ft (nS/m)	1.20	(3.92)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.9	(78.4)
Inductance	uH/ft (uH/m)	0.060	(0.20)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	1.39	(4.6)
Outer Conductor	ohms/1000ft (/km)	1.65	(5.4)
Voltage Withstand	Volts DC	2500	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	16	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	0.7	0.9	1.5	1.9	2.7	3.9	5.1	5.7	6.0	6.8	10.8
Attenuation dB/100 m	2.2	2.9	5.0	6.1	8.9	12.8	16.8	18.6	19.6	22.2	35.5
Avg. Power kW	3.33	2.57	1.47	1.20	0.83	0.58	0.44	0.40	0.37	0.33	0.21

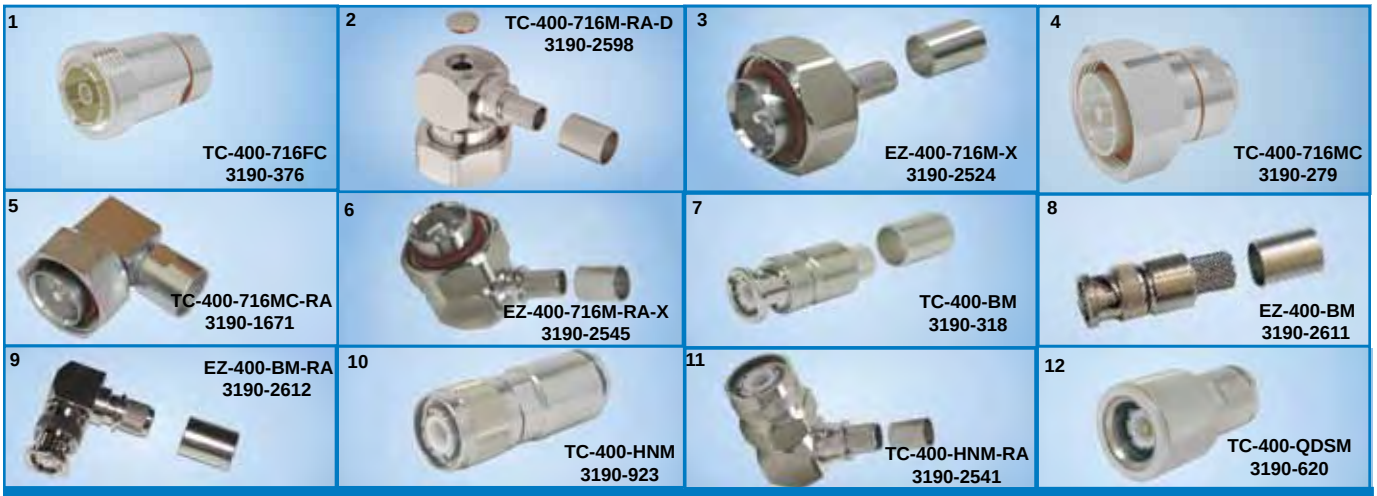
Calculate Attenuation =
$(0.122290) \cdot \sqrt{FMHz} + (0.000260) \cdot FMHz$ (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:
VSWR=1.0 ; Ambient = +25°C (77°F)

Power:
VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

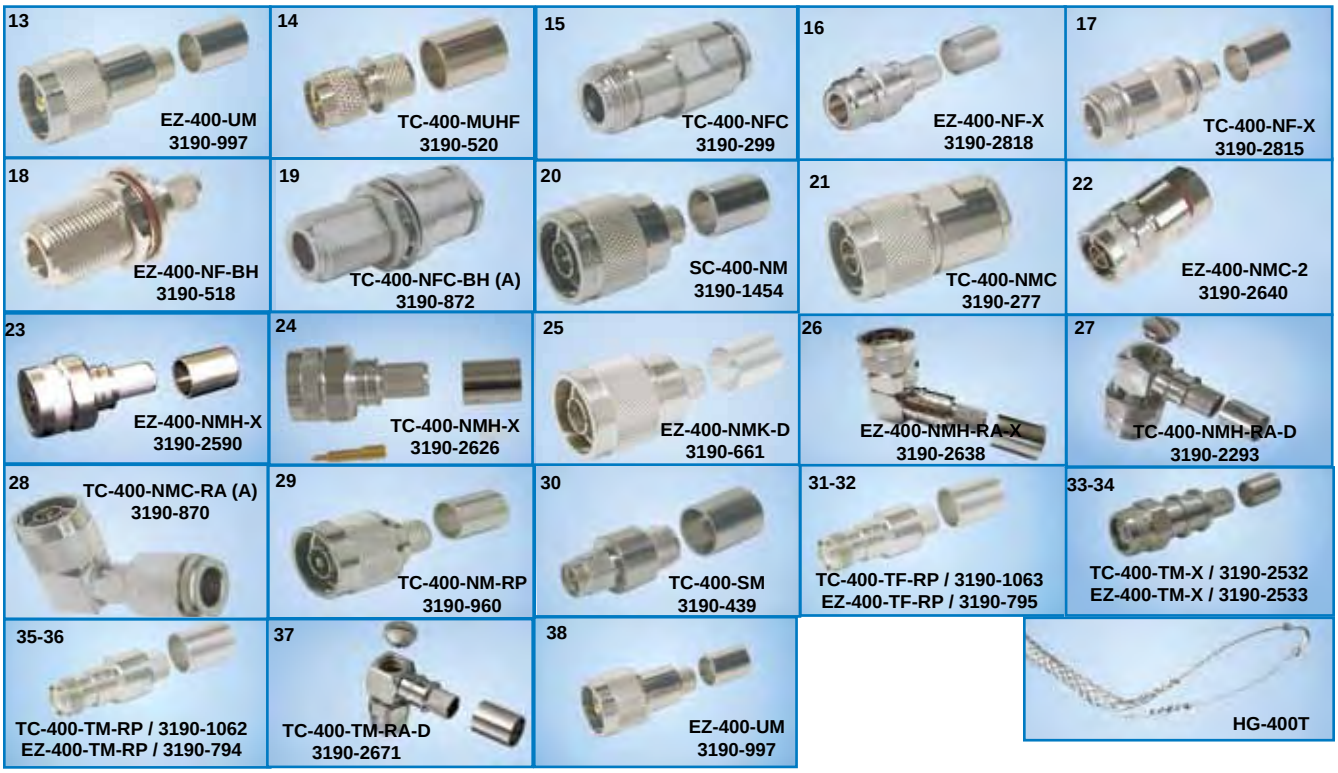
LMR®-400
Flexible Low Loss Communications



Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
1. 7-16 DIN Female	Straight Jack	TC-400-716-FC	3190-376	<1.25:1 (2.5)	NA	Solder	Clamp	S/S	1.6	(41)	1.13	(28.7)	0.281	(127.5)
2. 7-16 DIN	Right Angle	TC-400-716M-RA-D	3190-2598	<1.35:1 (6)	Hex	Solder	Crimp	A/S	1.7	(43..20	1.98	(50.3)	0.374	(169.5)
3. 7-16 DIN Male	Straight Plug	EZ-400-716M-X	3190-2524	<1.25:1 (6)	Hex	Spring Finger	Crimp	A/G	1.6	(39.5)	1.38	(35)	0.277	(126.0)
4. 7-16 DIN Male	Straight Plug	TC-400-716-MC	3190-279	<1.25:1 (2.5)	Hex	Solder	Clamp	S/S	1.4	(36)	1.40	(35.6)	0.268	(121.6)
5. 7-16 DIN Male	Right Angle	TC-400-716MC-RA	3190-1671	<1.25:1 (<3)	Hex	Solder	Clamp	A/S	2.4	(61.5)	1.88	(47.8)	0.35	(159)
6. 7-16DIN Male	Right Angle	EZ-400-716M-RA-X	3190-2545	<1.35:1 (6)	Hex	Spring Finger	Crimp	A/G	1.6	(41.7)	1.75	(44.3)	0.374	(0.17)
7. BNC Male	Straight Plug	TC-400-BM	3190-318	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/S	1.7	(43)	0.56	(14.2)	0.063	(28.6)
8. BNC Male	Straight Plug	EZ-400-BM	3190-2611	<1.35:1 (2)	Knurl	Spring Finger	Crimp	A/G	1.7	(42.7)	0.56	(14.2)	0.066	(29.9)
9. BNC Male	Right Angle	EZ-400-BM-RA	3190-2612	<1.35:1 (2)	Knurl	Spring Finger	Crimp	A/G	1.9	(48.0)	1.32	(33.5)	0.097	(44.0)
10. HN Male	Straight Plug	TC-400-HNM	3190-923	<1.25: (<1)	Knurl	Solder	Clamp	S/G	2.3	(59.2)	0.88	(22.4)	0.25	(113.4)
11. HN Male	Right Angle	TC-400-HNM-RA	3190-2541	<1.25:1 (2.5)	Hex	Solder	Crimp	A/G	1.6	(41.4)	1.56	(39.6)	0.198	(90.0)
12. QDS Male	Straight Plug	TC-400-QDSM	3190-620	<1.25: (<3)	Knurl	Solder	Clamp	A/G	1.8	(46.6)	1.00	(25.4)	0.25	(113.4)
13. UHF Male	Straight Plug	EZ-400-UM	3190-997	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	N/G	1.8	(48)	0.80	(20.3)	0.076	(34.4)
14. Mini-UHF	Straight Plug	TC-400-MUHF	3190-520	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/G	1.1	(28)	0.50	(12.7)	0.020	(9.1)
15. N Female	Straight Jack	TC-400-NFC	3190-299	<1.25:1 (2.5)	NA	Solder	Clamp	N/S	1.6	(41)	0.75	(19.1)	0.119	(54.0)
16.	Straight Jack	EZ-400-NF-X	3190-2818	<1.25:1 (2.5)	NA	Spring Finger	Crimp	N/G	1.8	(45)	0.66	(16.8)	0.105	(47.6)
17.	Straight Jack	TC-400-NF-X	3190-2815	<1.25:1 (2.5)	NA	Solder	Crimp	N/G	1.8	(45)	0.66	(16.8)	0.105	(47.6)
18.	Bulkhead Jack	EZ-400-NF-BH	3190-518#	<1.25:1 (2.5)	NA	Spring Finger	Crimp	N/G	1.8	(46)	0.88	(22.4)	0.102	(46.3)
19.	Bulkhead Jack	TC-400-NFC-BH (A)	3190-872	<1.25:1 (2.5)	NA	Solder	Clamp	A/G	1.8	(46)	0.88	(22.4)	0.145	(65.8)
20. N Male	Straight Plug	SC-400-NM	3190-1454	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/G	1.5	(38)	0.75	(19.1)	0.090	(40.8)
21.	Straight Plug	TC-400-NMC	3190-277	<1.25:1 (2.5)	Knurl	Solder	Clamp	N/G	1.5	(38)	0.70	(17.8)	0.121	(54.9)
22.	Straight Plug	EZ-400-NMC-2	3190-2640	<1.25:1 (2.5)	Hex/Knurl	Spring Finger	Clamp	N/G	1.5	(38)	0.75	(19.1)	0.121	(54.9)
23.	Straight Plug	EZ-400-NMH-X	3190-2590	<1.25:1 (10)	Hex/Knurl	Spring Finger	Crimp	A/G	1.5	(38)	0.89	(22.6)	0.103	(46.8)
24.	Straight Plug	TC-400-NMH-X	3190-2626	<1.25:1 (10)	Hex/Knurl	Solder	Crimp	A/G	1.5	(38)	0.89	(22.6)	0.113	(51.3)
25.	Straight Plug	EZ-400-NMK-D	3190-661	<1.25:1 (10)	Knurl	Spring Finger	Crimp	S/G	1.5	(38)	0.75	(22.6)	0.113	(51.3)
26.	Right Angle	EZ-400-NMH-RA-X	3190-2638	<1.35:1 (6)	Hex/Knurl	Spring Finger	Crimp	A/G	1.87	(47)	1.42	(36.0)	0.177	(80.2)
27.	Right Angle	TC-400-NMH-RA-D	3190-2293#	<1.35:1 (6)	Hex/Knurl	Solder	Crimp	A/G	1.8	(46)	1.25	(31.8)	0.130	(59.0)
28.	Right Angle	TC-400-NMC-RA (A)	3190-870	<1.35:1 (2.5)	Hex	Solder	Clamp	A/G	1.8	(46)	1.25	(31.8)	0.150	(68.0)
29.	Reverse Polarity	TC-400-NM-RP	3190-960	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/G	1.5	(38)	0.75	(19.1)	0.090	(40.8)
30. SMA Male	Straight Plug	TC-400-SM	3190-439	<1.25:1 (8)	Hex	Solder	Crimp	N/G	1.2	(29)	0.50	(12.7)	0.032	(14.5)
31. TNC Female	Reverse Polarity	TC-400-TF-RP	3190-1063	<1.25:1 (2.5)	NA	Solder	Crimp	N/G	1.8	(46)	0.55	(14.0)	0.074	(33.6)
32.	Reverse Polarity	EZ-400-TF-RP	3190-795	<1.25:1 (2.5)	NA	Spring Finger	Crimp	A/G	1.8	(46)	0.55	(14.0)	0.074	(33.6)
33. TNC Male	Straight Plug	TC-400-TM-X	3190-2532	<1.25:1 (6)	Hex/Knurl	Solder	Crimp	A/G	1.9	(48)	0.67	(17.5)	0.075	(34.3)
34.	Straight Plug	EZ-400-TM-X	3190-2533	<1.25:1 (6)	Hex/Knurl	Spring Finger	Crimp	A/G	1.9	(48)	0.67	(17.5)	0.075	(34.3)
35.	Reverse Polarity	TC-400-TM-RP	3190-1062	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/G	1.7	(43)	0.59	(15.0)	0.074	(33.6)
36.	Reverse Polarity	EZ-400-TM-RP	3190-794	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	A/G	1.7	(43)	0.59	(15.0)	0.074	(33.6)
37.	Right Angle	TC-400-TM-RA-D	3190-2671	<1.35:1 (6)	Hex/Knurl	Solder	Crimp	A/G	1.4	(35)	1.41	(35.8)	0.130	(59.0)
38. UHF Male	Straight Plug	EZ-400-UM	3190-997	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	N/G	1.9	(48)	0.80	(20.3)	0.090	(40.8)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector *Available in bulk pack



Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S400TT	GK-S400TT	Standard Grounding Kit (each)
Hoisting Grip	HG-400T	HG-400T	Laced Type (each)

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1719	3190-202	.429" Hex Dies
Crimp Tool	CT-400/300	3190-666	Crimp tool for LMR 400 connectors
Crimp Rings	CR-400	3190-830	Crimp rings for TC/EZ-400 connectors (package of 10)
Strip Tool	ST-400C-2	3190-1972	Prep tool for EZ-400-NMC-2 two piece clamp style connector
Strip Tool	CST-400	3192-004	Combination prep tool for LMR-400 crimp and clamp style connectors
Mid-Span Strip Tool	GST-400	3190-2174	For ground strap attachment
Replacement Blades	RB-456	3190-421	Replacement blades for Strip Tool
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Tool Kit	TK-400EZ	3190-1601	Tool kit for LMR-400 Crimp Connectors (includes CCT-01, CST-400, CT-400/300, Tool Pouch)
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST strip tools

TIMES MICROWAVE SYSTEMS

LMR®-500
Flexible Low Loss Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable

• **LMR®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

• **LMR®- DB** is identical to standard LMR plus has the advantage of being watertight. The addition of waterproofing compound in and around the foil/braid insures continuous reliable service should the jacket be inadvertently damaged during installation or in the future.

• **LMR®- FR** is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. LMR-FR is UL/NEC & CSA rated'CMR' and 'FT4' respectively, meets FAA FAR25 requirements and is MSHA-P for mining applications.

• **Flexibility** and bendability are hallmarks of the LMR-500 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-500. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-500 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** A wide variety of connectors are available for LMR-500 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-500 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	**Application**	**Jacket**	**Color**	**Code**
LMR-500	Outdoor	PE	Black	54002
LMR-500-DB	Outdoor/Watertight	PE	Black	54092
LMR-500-FR	Indoor/Outdoor Riser CMR	FRPE	Black	54031

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.142	(3.61)
Dielectric	Foam PE	0.370	(9.40)
Outer Conductor	Aluminum Tape	0.376	(9.55)
Overall Braid	Tinned Copper	0.405	(10.29)
Jacket	(see table above)	0.500	(12.70)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.25	(31.8)
Bend Radius: repeated	in. (mm)	5.0	(127.0)
Bending Moment	ft-lb (N-m)	1.75	(2.37)
Weight	lb/ft (kg/m)	0.097	(0.14)
Tensile Strength	lb (kg)	260	(118.0)
Flat Plate Crush	lb/in. (kg/mm)	50	(0.89)

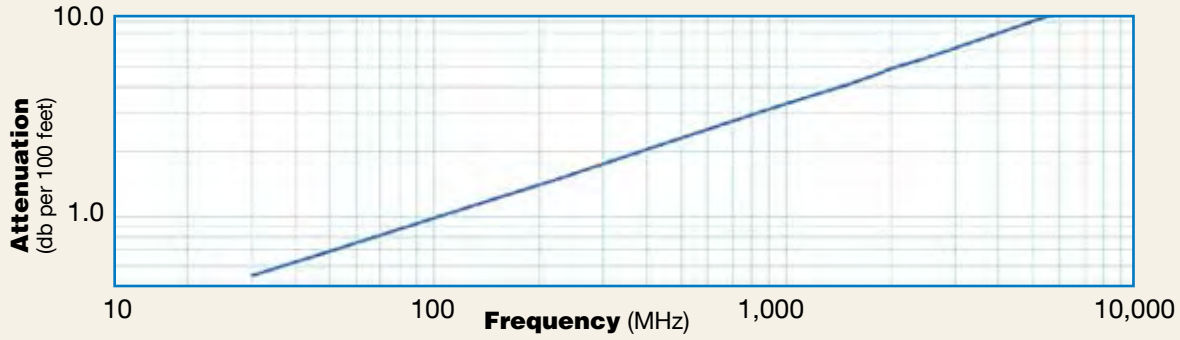
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+85	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	86	
Dielectric Constant	NA	1.35	
Time Delay	nS/ft (nS/m)	1.18	(3.88)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.6	(77.5)
Inductance	uH/ft (uH/m)	0.059	(0.19)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.82	(2.7)
Outer Conductor	ohms/1000ft (/km)	1.27	(4.2)
Voltage Withstand	Volts DC	3000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	22	

Attenuation vs. Frequency **(typical)**

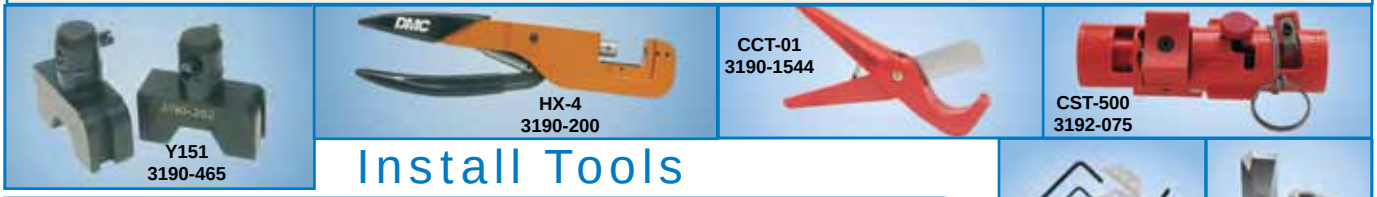


Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	0.5	0.7	1.2	1.5	2.2	3.1	4.1	4.6	4.8	5.5	8.9
Attenuation dB/100 m	1.8	2.3	4.0	4.9	7.1	10.3	13.6	15.0	15.9	18.0	29.1
Avg. Power kW	4.400	3.393	1.931	1.583	1.088	0.752	0.569	0.515	0.485	0.428	0.264

Calculate Attenuation = (0.096590) • $\sqrt{FMHz}$ + (0.000260) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR Freq. (GHz)		Nut	Inner Coupling Attach	Outer Contact Attach	Finish* Contact /Pin	Body in	Body (mm)	Length in	Length (mm)	Width lb	Weight (g)
1.	Straight Plug	TC-500-NMH-X	3190-2514	<1.35:5	(6)	Hex/Knurl	Solder	Crimp	A/G	1.8	(45)	0.87	(22.0)	0.099	(45.0)
2.	Right Angle	TC-500-NMH-RA-D	3190-2513	<1.25:1	(6)	Hex/Knurl	Solder	Crimp	A/G	1.5	(39)	1.6	(42.0)	0.279	(127.0)
3. N Female	Straight Jack	TC-500-NFC	3190-215	<1.25:1	(2.5)	NA	Solder	Clamp	S/G	2.2	(56)	0.94	(23.9)	0.215	(97.5)
4.	Bulkhead Kit	BHA-KIT	3190-223	<1.25:1	(2.5)	NA	NA	NA	NA	NA	NA	NA	NA	0.014	(6.4)
5. N Male	Straight Plug	TC-500-NMC	3190-377#	<1.25:1	(2.5)	Hex	Solder	Clamp	S/G	2.1	(53)	0.92	(23.4)	0.228	(103.4)
6.	Right Angle	TC-500-NMC-RA	3190-227#	<1.25:1	(2.5)	Hex	Solder	Clamp	S/G	2.4	(61)	1.5	(38.1)	0.275	(124.7)
7. TNC Male	Straight Plug	TC-500-TM	3190-464	<1.25:1	(2.5)	Hex	Solder	Crimp	N/G	1.5	(38)	1.62	(15.7)	0.082	(28.1)
8. UHF Male	Straight Plug	TC-500-UMC	3190-354	<1.25:1	(2.5)	Knurl	Solder	Clamp	S/G	2.1	(53)	0.88	(22.4)	0.215	(97.5)
9. N Male	Straight Plug	EZ-500-NMH-D	3190-2596	<.35:1	(6)	Hex/Knurl	Spring Finger	Crimp	A/G	1.7	(44)	0.83	(21.0)	0.111	(50.5)



Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y151	3190-465	.532" Hex Dies
Strip Tool	CST-500	3192-075	For Crimp & Clamp Style Connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable End Flush Cut Tool
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for strip tools
Replacement Blade	RB-01	3190-1609	Replacement Blade for Cutting Tool
Replacement Blades	RB-456	3190-421	Replacement Blade kit for Strip Tools

TIMES MICROWAVE SYSTEMS

LMR®-600
Flexible Low Loss Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable

• **LMR®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

• **LMR®- DB** is identical to standard LMR plus has the advantage of being watertight. The addition of waterproofing compound in and around the foil/braid insures continuous reliable service should the jacket be inadvertently damaged during installation or in the future.

• **LMR®- FR** is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. LMR-FR is UL/NEC & CSA rated'CMR' and 'FT4' respectively, meets FAA FAR25 requirements and is MSHA-P for mining applications.

• **LMR®- FR-PVC** is a general-purpose indoor cable and has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively. It is less expensive than LMR-FR, however it emits toxic fumes (HCL) and greater smoke density when burned.

• **LMR®- PVC** is designed for low loss general-purpose applications and is somewhat more flexible than the standard polyethylene jacketed LMR.

• **LMR®- PVC-W** is a white-jacketed version of LMR-PVC for marine and other applications where color compatibility is desired.

• **Flexibility** and bendability are hallmarks of the LMR-600 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-600. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-600 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** A wide variety of connectors are available for LMR-600 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-600 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	**Application**	**Jacket**	**Color**	**Code**
LMR-600	Outdoor	PE	Black	54003
LMR-600-DB	Outdoor/Watertight	PE	Black	54093
LMR-600-FR	Indoor/Outdoor Riser CMR	FRPE	Black	54032
LMR-600-FR-PVC	Indoor/Outdoor Riser CMR	FRPVC	Black	54074
LMR-600-PVC	General Purpose	PVC	Black	54219
LMR-600-PVC-W	General Purpose	PVC	White	54206

Construction Specifications			
Description	**Material**	**In.**	**(mm)**
Inner Conductor	Solid BCCAl	0.176	(4.47)
Dielectric	Foam PE	0.455	(11.56)
Outer Conductor	Aluminum Tape	0.461	(11.71)
Overall Braid	Tinned Copper	0.490	(12.45)
Jacket	(see table above)	0.590	(14.99)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.50	(38.1)
Bend Radius: repeated	in. (mm)	6.0	(152.4)
Bending Moment	ft-lb (N-m)	2.75	(3.73)
Weight	lb/ft (kg/m)	0.131	(0.20)
Tensile Strength	lb (kg)	350	(158.9)
Flat Plate Crush	lb/in. (kg/mm)	60	(1.07)

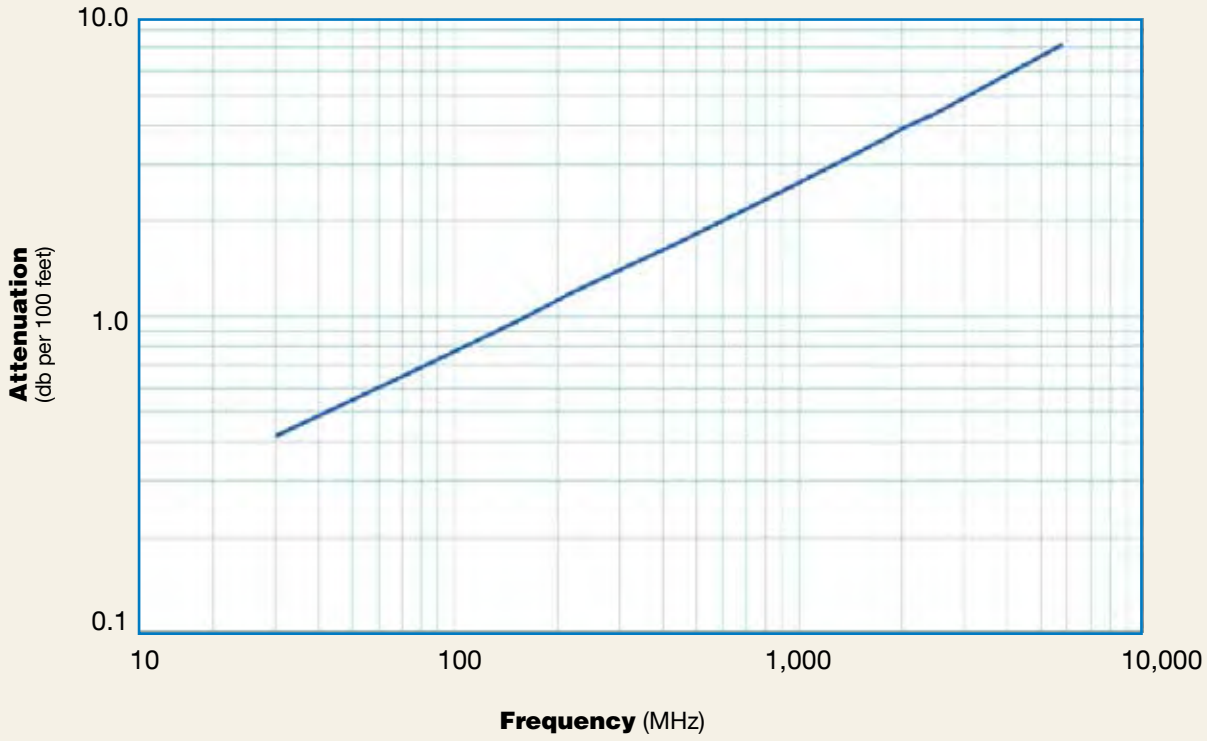
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	87	
Dielectric Constant	NA	1.32	
Time Delay	nS/ft (nS/m)	1.17	(3.83)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.4	(76.6)
Inductance	uH/ft (uH/m)	0.058	(0.19)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.53	(1.7)
Outer Conductor	ohms/1000ft (/km)	1.2	(3.9)
Voltage Withstand	Volts DC	4000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	40	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	0.4	0.5	1.0	1.2	1.7	2.5	3.3	3.7	3.9	4.4	7.3
Attenuation dB/100 m	1.4	1.8	3.2	3.9	5.6	8.2	10.9	12.1	12.8	14.5	23.8
Avg. Power kW	5.51	4.24	2.41	1.97	1.35	0.93	0.70	0.63	0.59	0.52	0.32

Calculate Attenuation =
(0.075550) • $\sqrt{FMHz}$ + (0.000260) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:
VSWR=1.0; Ambient = +25°C (77°F)

Power:
VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

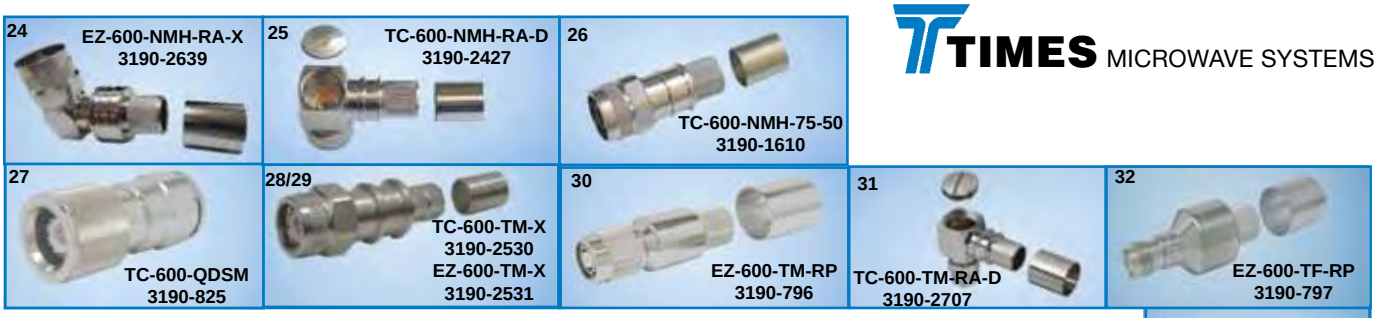
TIMES MICROWAVE SYSTEMS

LMR®-600
Flexible Low Loss Communications Coax

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)		Inner Coupling Nut	Outer Contact Attach	Finish* Contact Attach	Body /Pin	Length in	(mm)	Width in	(mm)	Weight lb	(g)
1. 7/8 EIA	Flange	EZ-600-78EIA	3190-1373	<1.25:1	(2.5)	NA	Spring Finger	Clamp	S/S	2.3	(58)	2.60	(66.0)	0.873	(396.0)
2. 7-16 DIN Female	Straight Jack	TC-600-716FC	3190-375	<1.25:1	(2.5)	NA	Solder	Clamp	S/S	1.1	(28)	1.00	(25.4)	0.249	(112.9)
3. 7-16 DIN	Straight Plug	EZ-600-716M-X	3190-2643	<1.30:1	(6)	Hex	Spring Finger	Crimp	A/S	1.6	(42)	1.38	(35.0)	0.209	(94.80
4. 7-16 DIN	Straight Plug	TC-600-716M-X	3190-2642	<1.30:1	(6)	Hex	Solder	Crimp	A/S	1.6	(40)	1.38	(35.0)	0.191	(86.6
5. 7-16 DIN Male	Straight Plug	EZ-600-716MH	3190-503	<1.25:1	(2.5)	Hex	Spring Finger	Crimp	S/S	2.0	(51)	1.30	(33.0)	0.254	(115.2)
6.	Straight Plug	TC-600-716MC	3190-502	<1.25:1	(2.5)	Hex	Solder	Clamp	S/S	2.0	(51)	1.30	(33.0)	0.347	(157.4)
7.	Right Angle	TC-600-716M-RA	3190-395	<1.35:1	(2.5)	Hex	Solder	Crimp	S/S	1.4	(36)	1.40	(35.6)	0.354	(160.8)
8. 7/16 Male	Right Angle	EZ-600-716M-RA-X	3190-2546	<1.35:1	(6)	Hex	Spring Finger	Crimp	A/G	1.6	(40)	1.38	(35.0)	0.462	(210.0)
9. 7-16 DIN	Right Angle	TC-600-716M-RA-D	3190-2599	<1.35:1	(6)	Hex	Solder	Crimp	A/S	1.7	(44)	2.00	(50.9)	0.362	(164.2)
10.	Straight Jack	EZ-600-716F	3190-2447	<1.25:1	(6)	Hex	Spring Finger	Crimp	A/G	1.8	(45)	1.32	(33.6)	0.158	(71.7)
11. HN Male	Straight Plug	TC-600-HNM	3190-1429	<1.25:1	(<1)	Knurl	Solder	Clamp	S/g	2.3	(59.2)	0.88	(22.4)	0.25	(113)
12. LC Male	Straight Plug	TC-600-LCM	3190-1406	<1.25:1	(<1)	Hex	Solder	Clamp	N/S	3.1	(78.0)	1.62	(41.1)	1.20	(544)
13. N Female	Straight Jack	TC-600-NF-X	3190-2816	<1.30:1	(6)	NA	Solder	Crimp	A/G	1.7	(43)	0.69	(17.6)	0.076	(34.6)
14.	Straight Jack	EZ-600-NF-X	3190-2817	<1.30:1	(6)	NA	Spring Finger	Crimp	A/G	1.7	(43)	0.69	(17.6)	0.090	(40.6)
15.	Bulkhead Jack	EZ-600-NF-BH	3190-616	<1.25:1	(2.5)	NA	Spring Finger	Crimp	S/G	2.4	(61)	0.88	(22.4)	0.195	(88.5)
16.	Bulkhead Jack	TC-600-NF-BH	3190-589	<1.25:1	(2.5)	NA	Solder	Crimp	S/G	2.4	(61)	0.88	(22.4)	0.195	(88.5)
17.	Bulkhead Jack	TC-600-NFC-BH	3190-466	<1.25:1	(2.5)	NA	Solder	Clamp	S/G	2.2	(56)	0.94	(23.9)	0.214	(97.1)
18. N Male	Straight Plug	EZ-600-NMK	3190-669	<1.25:1	(2.5)	Knurl	Spring Finger	Crimp	S/G	2.1	(53)	0.92	(23.4)	0.164	(74.4)
19.	Straight Plug	EZ-600-NMC-2-D	3190-2641	<1.25:1	(6)	Hex/Knurl	Spring Finger	Clamp	A/G	2.1	(53)	0.92	(23.4)	0.202	(91.6)
20.	Straight Plug	TC-600-NMC	3190-357	<1.25:1	(2.5)	Hex	Solder	Clamp	S/G	2.1	(53)	0.92	(23.4)	0.208	(93.4)
21.	Right Angle	TC-600-NMC-RA	3190-233	<1.35:1	(2)	Hex	Solder	Clamp	S?G	2.2	(56.6)	1.29	(32.8)	0.270	(122.6)
22.	Straight Plug	EZ-600-NMH-X	3190-2627	<1.25:1	(8)	Hex/Knurl	Spring Finger	Crimp	A/G	2.1	(53)	0.92	(23.4)	0.164	(74.4)
23.	Straight Plug	TC-600-NMH-X	3190-2628	<1.25:1	(8)	Hex/Knurl	Spring Finger	Crimp	A/G	2.1	(53)	0.92	(23.4)	0.166	(75.3)
24.	Right Angle	EZ-600-NMH-RA-X	3190-2639	<1.35:1	(6)	Hex	Spring Finger	Crimp	A/G	2.0	(50)	1.42	(36.0)	0.224	(101.7)
25.	Right Angle	TC-600-NMH-RA-D	3190-2427	<1.35:1	(6)	Hex	Solder	Crimp	A/G	1.8	(46.5)	1.62	(41.2)	0.185	(84.3)
26.	Straight Plug	TC-600-NMH-75-50	3190-1610	<1.35:1	(6)	Hex	Solder	Crimp	N/G	2.1	(52.8)	0.91	(23.1)	0.130	(59.0)
27. QDS Male	Straight Plug	TC-600-QDSM	3190-825	<1.25:1	(<1)	Knurl	Solder	Clamp	A/G	2.2	(55.6)	1.00	(25.4)	0.25	(113)
28. TNC Male	Straight Plug	TC-600-TM-X	3190-2530	<1.25:1	(6)	Hex/Knurl	Solder	Crimp	A/G	2.3	(57.6)	0.75	(19.0)	0.100	(45.6)
29.	Straight Plug	EZ-600-TM-X	3190-2531	<1.25:1	(6)	Hex/Knurl	Spring Finger	Crimp	A/G	2.3	(57.6	0.75	(19.0)	0.100	(45.6)
30.	Reverse Polarity	EZ-600-TM-RP	3190-796	<1.25:1	(2.5)	Knurl	Spring Finger	Crimp	A/G	2.2	(56)	0.87	(22.0)	0.112	(50.8)
31.	Right Angle	TC-600-TM-RA-D	3190-2707	<1.35:1	(6)	Hex/Knurl	Solder	Crimp	A/G	1.6	(41)	1.75	(44.5)	0.164	(74.3)
32. TNC Female	Reverse Polarity	EZ-600-TF-RP	3190-797	<1.25:1	(2.5)	NA	Spring Finger	Crimp	A/G	2.3	(58)	0.87	(22.0)	0.100	(45.4)
33. UHF Male	Straight Plug	EZ-600-UM	3190-615	<1.25:1	(2.5)	Knurl	Spring Finger	Crimp	S/G	1.7	(43)	0.88	(22.4)	0.164	(74.4)
34.	Straight Plug	TC-600-UMC	3190-213	<1.25:1	(2.5)	Knurl	Solder	Clamp	S/G	1.7	(43)	0.88	(22.4)	0.198	(89.8)

Finsh metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair *Available in bulk pack



Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1720	3190-203	.610" Hex Dies
Crimp Rings	CR-600	3190-831	Crimp Rings for TC/EZ-600 connectors (pkg of 10)
Strip Tool	CST-600	3192-052	Combination prep tool for LMR-600 crimp and clamp style connectors
Replacement Blades	RB-456	3190-421	Replacement Blades for Strip Tools
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Midspan Strip Tool	GST-600A	3190-1051	For ground strap attachment
Wrench	WR-600	3190-1435	15/16" Box Wrench (2 required for EZ-600-NMC-2)
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST strip tools
Tool Kit	TK-600EZ	3190-1602	Tool kit for LMR crimp/clamp connectors (includes CCT-01, CST-600, HX-4, Y1720, Tool Pouch)

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S600TT	GK-S600TT	Standard Grounding Kit (each)
Hoisting Grip	HG-600T	HG-600T	Split/Laced Type (each)
Cold Shrink	CS-A600T	CS-A600T	Cable to Antenna Junction (each)
Cold Shrink	CS-60120T	CS-60120T	LMR-600 to -1200 Junction (each)
Cold Shrink	CS-60170T	CS-60170T	LMR-600 to -1700 Junction (each)
Hanger Blocks	CB-600T	CB-600T	Dual Cable Support Block (kit of 10)
Standard Entry Port Cushion	SC-600T-3	SC-600T-3	Three cables (each)
Snap-In Hangers	SH-U600T	SH-U600T	Snap-In Hangers (Kit of 10)
Hanger Block Supporting Hardware			Complete Range of Supporting Hardware & Adapters Available

TIMES MICROWAVE SYSTEMS

LMR®-900
Flexible Low Loss Communications Coax

Ideal for...

- Medium Antenna Feeder runs (no jumpers required)
- Jumper Assemblies for 1-5/8" & 2-1/4" Feeders
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable

• **LMR®- DB** is identical to standard LMR plus has the advantage of being watertight. The addition of waterproofing compound in and around the foil/braid insures continuous reliable service should the jacket be inadvertently damaged during installation or in the future.

• **LMR®- FR** is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. LMR-FR is UL/NEC & CSA rated'CMR' and 'FT4' respectively, meets FAA FAR25 requirements and is MSHA-P for mining applications.

• **Flexibility** and bendability are hallmarks of the LMR-900 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-900. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability**: LMR-900 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors**: A selection of connectors including type-N, 7/16 DIN, and 7/8 EIA flanges are available for LMR-900. Other interfaces are available on request. Transition to interfaces smaller than type-N is best accomplished with a short jumper cable.

• **Cable Assemblies**: All LMR-900 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	**Application**	**Jacket**	**Color**	**Code**
LMR-900-DB	Outdoor/Watertight	PE	Black	54094
LMR-900-FR	Indoor/Outdoor Riser CMR	FRPE	Black	54033

PVC: Poly Vinyl Chloride

Construction Specifications			
Description	**Material**	**In.**	**(mm)**
Inner Conductor	BC Tube (.222" ID)	0.262	(6.65)
Dielectric	Foam PE	0.680	(17.27)
Outer Conductor	Aluminum Tape	0.686	(17.42)
Overall Braid	Tinned Copper	0.732	(18.59)
Jacket	(see table above)	0.870	(22.10)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	3.00	(76.2)
Bend Radius: repeated	in. (mm)	9.0	(228.6)
Bending Moment	ft-lb (N-m)	9.0	(12.20)
Weight	lb/ft (kg/m)	0.266	(0.40)
Tensile Strength	lb (kg)	750	(340.5)
Flat Plate Crush	lb/in. (kg/mm)	100	(1.79)

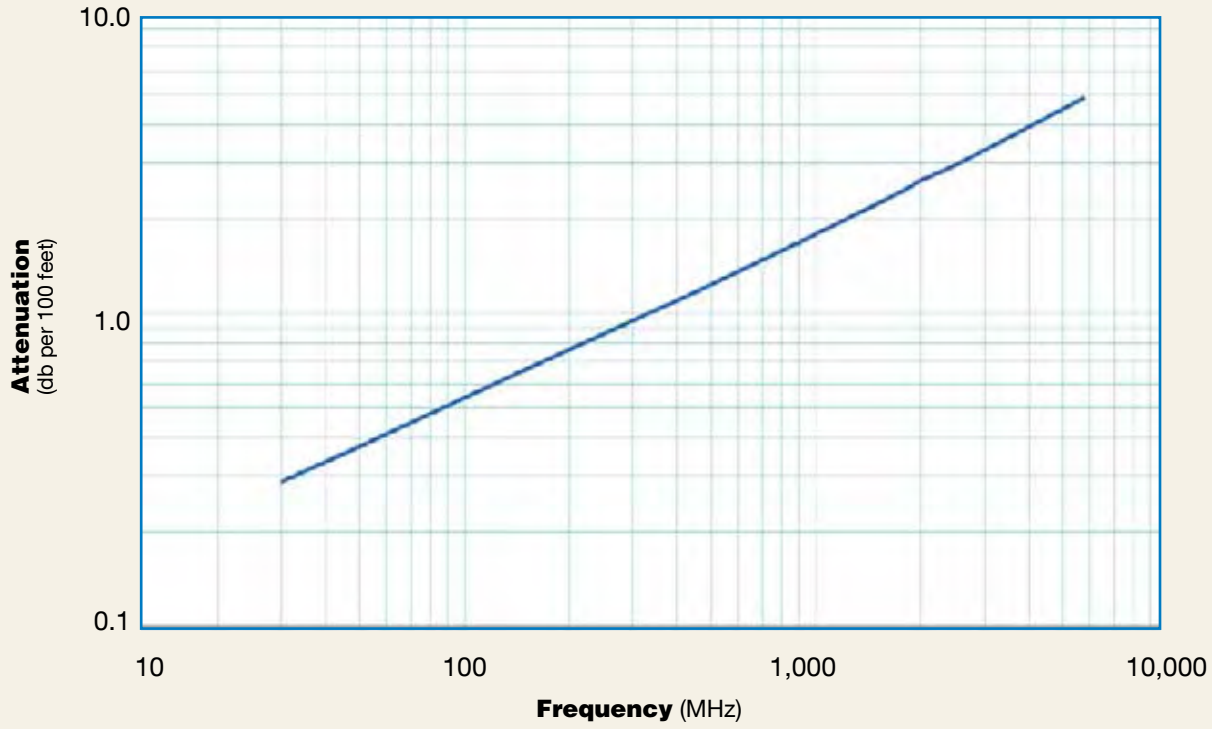
Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	87	
Dielectric Constant	NA	1.32	
Time Delay	nS/ft (nS/m)	1.17	(3.83)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.4	(76.6)
Inductance	uH/ft (uH/m)	0.058	(0.19)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.54	(1.77)
Outer Conductor	ohms/1000ft (/km)	0.55	(1.8)
Voltage Withstand	Volts DC	5000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	62	

Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	0.3	0.4	0.7	0.8	1.2	1.7	2.2	2.5	2.6	3.0	4.9
Attenuation dB/100 m	0.9	1.2	2.2	2.6	3.8	5.6	7.4	8.2	8.6	9.8	16.0
Avg. Power kW	8.89	6.85	3.89	3.19	2.19	1.51	1.14	1.03	0.97	0.86	0.52

Calculate Attenuation =
(0.051770) • $\sqrt{\text{FMHz}}$ + (0.000160) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:
VSWR=1.0 ; Ambient = +25°C (77°F)

Power:
VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR®-900
Flexible Low Loss Communications Coax

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)		Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
1. 7-16 DIN Female	Straight Jack	EZ-900-716FC-2	3190-1550	<1.25:1	(2.5)	NA	Press Fit	Clamp	S/S	2.0	(51)	1.38	(35.1)	0.379	(171.9)
2. 7-16 DIN Male	Straight Plug	EZ-900-716MC-2	3190-1641	<1.25:1	(2.5)	Hex	Press Fit	Clamp	S/S	2.0	(51)	1.44	(36.6)	0.485	(220.0)
3. 7-16 DIN Male	Right Angle	EZ-900-716-MC-RA	3190-614	<1.35:1	(2.5)	Hex	Press Fit	Clamp	S/S	2.7	(69)	2.15	(55.0)	1.150	(521.6)
4. 7/8 EIA Male	Straight Plug	EZ-900-78EIA-2	3190-1282	<1.25:1	(2.5)	NA	Press Fit	Clamp	S/S	3.0	(76)	2.24	(56.9)	1.013	(459.5)
5. 7/8 EIA Male	Right Angle	EZ-900-78EIA-RA	3190-1450	<1.25:1	(1)	Flange	Press Fit	Clamp	S/S	2.95	(75.0)	2.60	(66.0)	1.50	(680.4)
6. N Female	Straight Jack	EZ-900-NFC-2	3190-1263	<1.25:1	(6)	NA	Press Fit	Clamp	S/S	2.0	(51)	1.38	(35.1)	0.443	(200.9)
7. N Male	Straight Plug	EZ-900-NMC-2	3190-1262	<1.25:1	(6)	Hex/Knurl	Press Fit	Clamp	S/S	2.0	(51)	1.38	(35.1)	0.463	(210.0)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Install Tools

Type	Part Number	Stock Code	Description
Strip Tool	ST-900C	3190-1310	For LMR 900 Clamp Style Connectors
Midspan Strip Tool	GST-900A	3190-435	For Ground Strap Attachment
Wrenches	WR-900	3190-509	1-1/4" Box Wrench (2 required)
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool


GK-S900TT

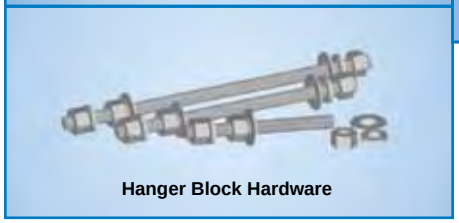

HG-900T


CS-A900T, CS-90120T, CS-90170T


SC-900T


Standard Entry Panels


CB-900T


Hanger Block Hardware


SH-U900T

Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S900TT	GK-S900TT	Standard Grounding Kit (each)
Hoisting Grip	HG-900T	HG-900T	Split/Laced Type (each)
Cold Shrink	CS-A900T	CS-A900T	Cable to Antenna Junction (each)
Cold Shrink	CS-90120T	CS-90120T	LMR-900 to -1200 Junction (each)
Cold Shrink	CS-90170T	CS-90170T	LMR-900 to -1700 Junction (each)
Stand. Entry Port Cushion	SC-900T-3	SC-900T-3	Three Cables (each)
Standard Entry Panels			Full Range of Port Styles/Combinations Available
Hanger Blocks	CB-900T	CB-900T	Dual Cable Support Block (kit of 10)
Hanger Block Supporting Hardware			Complete Range of Supporting Hardware & Adapters Available
Snap-in Hangers	SH-U900T	SH-U900T	Snap-in Hanger (Kit of 10)

TIMES MICROWAVE SYSTEMS

LMR®-1200
Flexible Low Loss Communications Coax

Ideal for...

- Medium Antenna Feeder runs
- Jumper Assemblies for 1-5/8" & 2-1/4" Feeders
- Building-Top Sites
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable

• **LMR®- DB** is identical to standard LMR plus has the advantage of being watertight. The addition of waterproofing compound in and around the foil/braid insures continuous reliable service should the jacket be inadvertently damaged during installation or in the future.

• **LMR®- FR** is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. LMR-FR is UL/NEC & CSA rated'CMR' and 'FT4' respectively, meets FAA FAR25 requirements and is MSHA-P for mining applications.

• **Flexibility** and bendability are hallmarks of the LMR-1200 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-1200. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-1200 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** A selection of connectors including type-N, 7/16 DIN, and 7/8 EIA flanges are available for LMR-1200. Other interfaces are available on request. Transition to interfaces smaller than type-N is best accomplished with a short jumper cable.

• **Cable Assemblies:** All LMR-1200 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description

Part Number	Application	Jacket Color		Stock Code
LMR-1200-DB	Outdoor/Watertight	PE	Black	54095
LMR-1200-FR	Indoor/Outdoor Riser CMR	FRPE	Black	54034

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	BC Tube (.309" ID)	0.349	(8.86)
Dielectric	Foam PE	0.920	(23.37)
Outer Conductor	Aluminum Tape	0.926	(23.52)
Overall Braid	Tinned Copper	0.972	(24.69)
Jacket	(see table above)	1.200	(30.48)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	6.50	(165.1)
Bend Radius: repeated	in. (mm)	12.0	(304.8)
Bending Moment	ft-lb (N-m)	15	(20.34)
Weight	lb/ft (kg/m)	0.448	(0.67)
Tensile Strength	lb (kg)	1300	(590.2)
Flat Plate Crush	lb/in. (kg/mm)	250	(4.47)

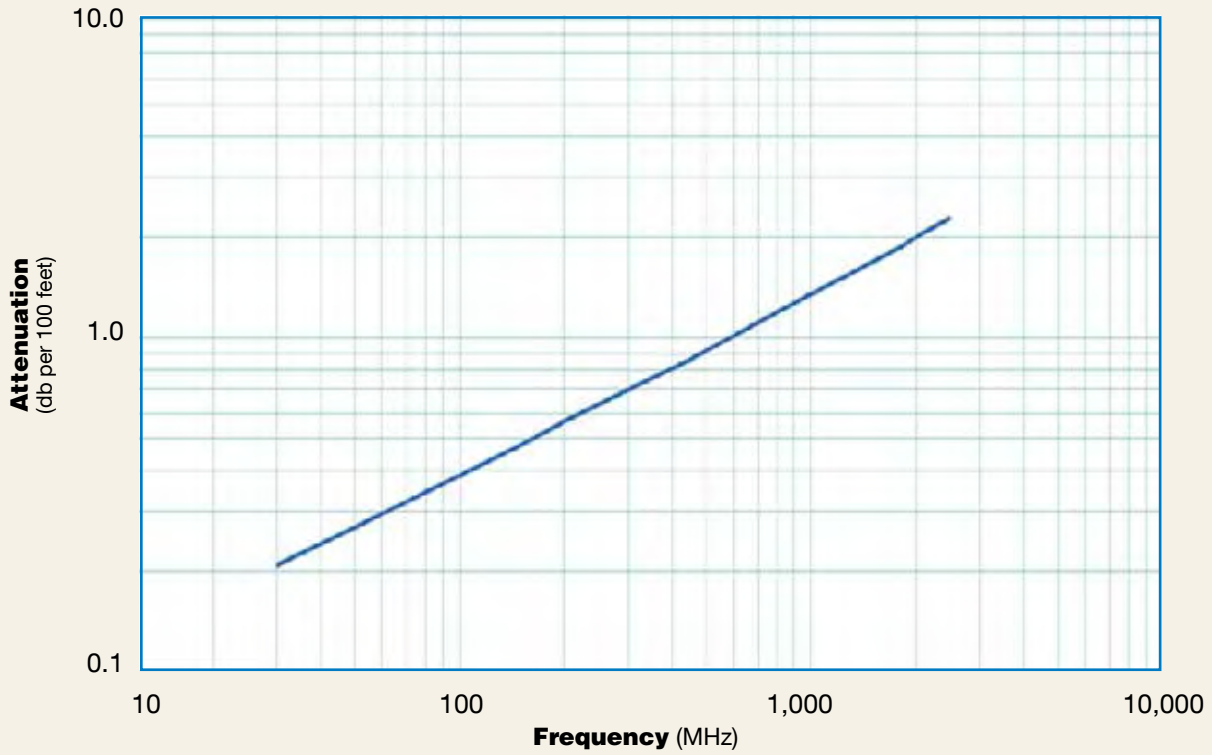
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	88	
Dielectric Constant	NA	1.29	
Time Delay	nS/ft (nS/m)	1.15	(3.79)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.1	(75.8)
Inductance	uH/ft (uH/m)	0.058	(0.19)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.32	(1.0)
Outer Conductor	ohms/1000ft (/km)	0.37	(1.2)
Voltage Withstand	Volts DC	6000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	90	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500
Attenuation dB/100 ft	0.2	0.3	0.5	0.6	0.9	1.3	1.7	1.9	2.0	2.3
Attenuation dB/100 m	0.7	0.9	1.6	1.9	2.8	4.2	5.5	6.1	6.5	7.4
Avg. Power kW	12.63	9.72	5.54	4.49	3.06	2.09	1.57	1.41	1.33	1.16

Calculate Attenuation =
$(0.037370) \bullet \sqrt{FMHz} + (0.000160) \bullet FMHz$ (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:
VSWR=1.0 ; Ambient = +25°C (77°F)

Power:
VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR®-1200
Flexible Low Loss Communications Coax

1.

EZ-1200-716-FC-2
3190-2784

2.

EZ-1200-716MC-2
3190-2781

5.

EZ-1200-NFC-2
3190-2785

6.

EZ-1200-NMC-2
3190-2783

3.

EZ-1200-78EIA-2
3190-2780

4.

EZ-1200-78EIA-RA-2
3190-2782

Connectors

	Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Body /Pin	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)	Finish*
1.	7-16 DIN Female	Straight Jack	EZ-1200-716FC-2	3190-2784	<1.20:1 (2.5)	NA	Spring Finger	Clamp	A/S	2.3	(58)	1.73	(44.0)	0.586	(265.8)	
2.	7-16 DIN Male	Straight Plug	EZ-1200-716MC-2	3190-2781	<1.20:1 (2.5)	Hex	Spring Finger	Clamp	A/S	2.3	(58)	1.73	(44.0)	0.848	(384.6)	
3.	7/8 EIA	Straight Plug	EZ-1200-78EIA-2	3190-2780	<1.15:1 (0.5)	NA	Spring Finger	Clamp	A/S	3.8	(96)	2.22	(56.5)	1.206	(547.0)	
4.	7/8 EIA	Right Angle	EZ-1200-78EIA-RA-2	3190-2782	<1.15:1 (0.5)	NA	Spring Finger	Clamp	A/S	3.1	(80)	3.07	(78.1)	1.800	(816.5)	
5.	N Female	Straight Jack	EZ-1200-NFC-2	3190-2785	<1.20:1 (2.5)	NA	Spring Finger	Clamp	A/S	2.2	(51)	1.73	(44.0)	0.630	(285.9)	
6.	N Male	Straight Plug	EZ-1200-NMC-2	3190-2783	<1.20:1 (2.5)	Hex/Knurl	Spring Finger	Clamp	A/S	2.4	(61)	1.73	(44.0)	0.651	(295.3)	

* Finishes: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair


WR-1200A - 3190-512
WR-1200B - 3190-511


3192-124
ST-1200-CH


CCT-01
3190-1544


GST-1200A
3190-436

Install Tools

Type	Part Number	Stock Code	Description
Midspan Strip Tool	GST-1200A	3190-436	For Ground Strap Attachment
Wrench	WR-1200A	3190-512	1-9/16" Box Wrench (1 required)
Wrench	WR-1200B	3190-511	1-7/16" Box Wrench (1 required)
Strip Tool	ST-1200-CH	3192-124	For LMR-1200 clamp style connectors
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool


GK-S1200TT

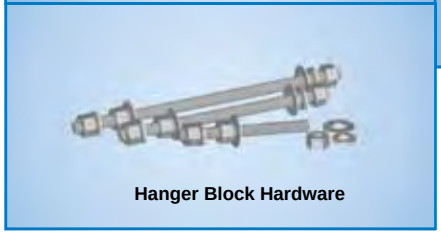

HG-1200T


CS-60120T, CS-90120T


SC-1200T


Standard
Entry Panels


CB-1200T


Hanger Block Hardware


SH-U1200T

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S1200TT	GK-S1200TT	Standard Grounding Kit (each)
Hoisting Grip	HG-1200T	HG-1200T	Split/Laced Type (each)
Cold Shrink	CS-90120T	CS-90120T	LMR-900 to -1200 Junction (each)
Cold Shrink	CS-60120T	CS-60120T	LMR-600 to -1200 Junction (each)
Standard Entry Port Cushion	SC-1200T	SC-1200T	Three Cables (each)
Standard Entry Panels	Full Range of Port Styles/Combinations Available		
Hanger Blocks	CB-1200T	CB-1200T	Dual Cable Support Block (kit of 10)
Hanger Block Supporting Hardware	Complete Range of Supporting Hardware & Adapters Available		
Snap-In Hangers	SH-U1200T	SH-U1200T	Snap-In Hangers (Kit of 10)

TIMES MICROWAVE SYSTEMS

LMR®-1700
Flexible Low Loss Communications Coax

Ideal for...

- Long Antenna Feeder runs
- Building-Top Sites
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable

• **LMR®- DB** is identical to standard LMR plus has the advantage of being watertight. The addition of waterproofing compound in and around the foil/braid insures continuous reliable service should the jacket be inadvertently damaged during installation or in the future.
• **LMR®- FR** is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. LMR-FR is UL/NEC & CSA rated'CMR' and 'FT4' respectively, meets FAA FAR25 requirements and is MSHA-P for mining applications.

• **Flexibility** and bendability are hallmarks of the LMR-1700 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.
• **Low Loss** is another hallmark feature of LMR-1700. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.
• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-1700 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.
• **Connectors:** A selection of connectors including type-N, 7/16 DIN, and 7/8 EIA flanges are available for LMR-1700. Other interfaces are available on request. Transition to interfaces smaller than type-N is best accomplished with a short jumper cable.
• **Cable Assemblies:** All LMR-1700 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description

Part Number	Application	Jacket Color	Stock Code
LMR-1700-DB	Outdoor/Watertight	PE Black	54096
LMR-1700-FR	Indoor/Outdoor Riser CMR	FRPE Black	54035

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	BC Tube (.477" ID)	0.527	(13.39)
Dielectric	Foam PE	1.350	(34.29)
Outer Conductor	Aluminum Tape	1.356	(34.44)
Overall Braid	Tinned Copper	1.402	(35.61)
Jacket	(see table above)	1.670	(42.42)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	13.50	(342.9)
Bend Radius: repeated	in. (mm)	17.0	(431.8)
Bending Moment	ft-lb (N-m)	40	(54.23)
Weight	lb/ft (kg/m)	0.736	(1.10)
Tensile Strength	lb (kg)	1500	(681.0)
Flat Plate Crush	lb/in. (kg/mm)	300	(5.36)

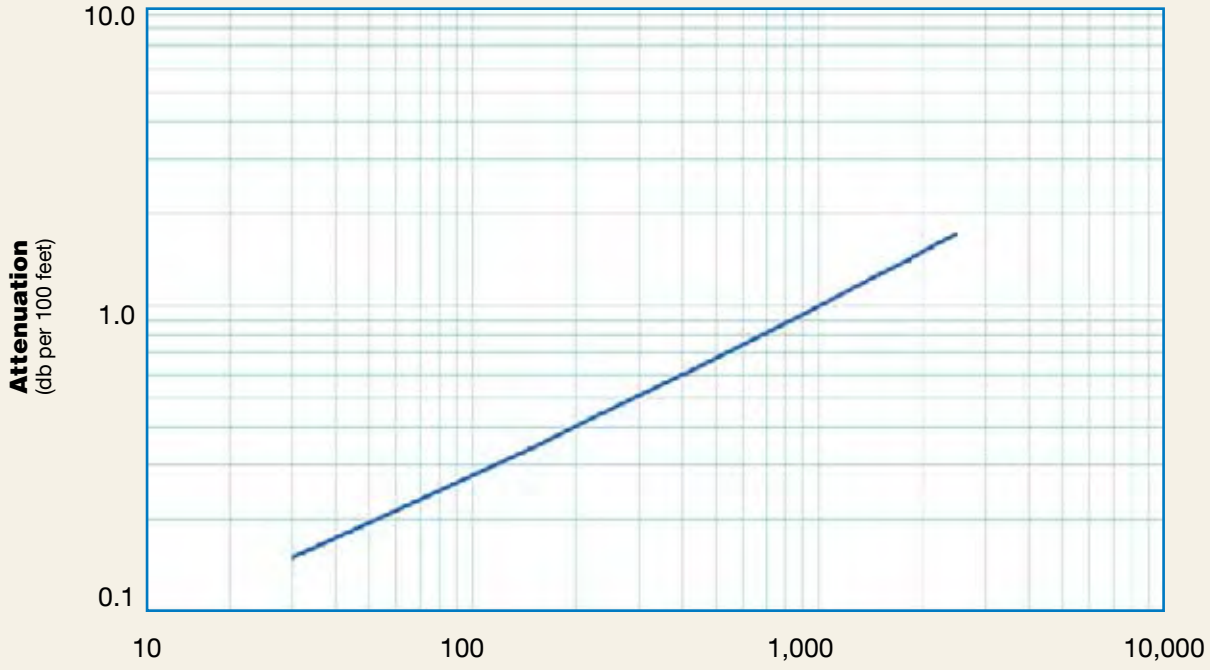
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	89	
Dielectric Constant	NA	1.26	
Time Delay	nS/ft (nS/m)	1.14	(3.75)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	22.8	(74.9)
Inductance	uH/ft (uH/m)	0.057	(0.19)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.21	(0.7)
Outer Conductor	ohms/1000ft (/km)	0.27	(0.9)
Voltage Withstand	Volts DC	9000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	202	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500
Attenuation dB/100 ft	0.1	0.2	0.3	0.4	0.6	0.9	1.3	1.4	1.5	1.7
Attenuation dB/100 m	0.5	0.6	1.1	1.4	2.1	3.1	4.1	4.6	4.9	5.7
Avg. Power kW	20.27	15.55	8.72	7.09	4.79	3.23	2.40	2.15	2.02	1.76

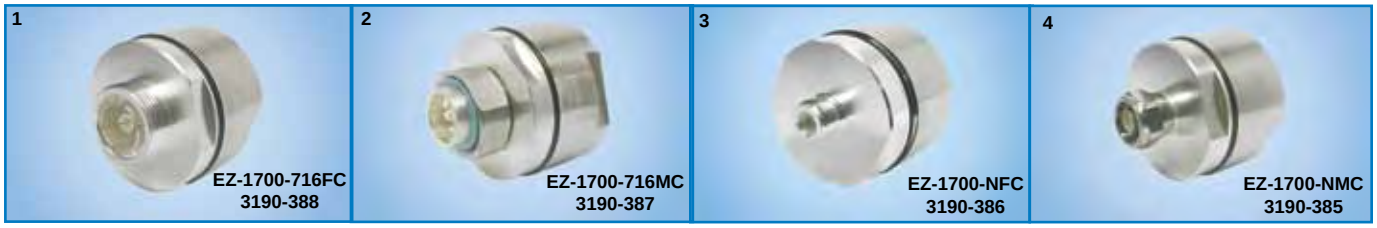
Calculate Attenuation =
$(0.026460) \bullet \sqrt{FMHz} + (0.000160) \bullet FMHz$ (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:
VSWR=1.0; Ambient = +25°C (77°F)

Power:
VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR®-1700 Flexible Low Loss Communications Coax



Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Contact Attach	Inner Contact Attach	Outer Body /Pin	Finish*	Length in (mm)	Width in (mm)	Weight lb (g)
1. 7-16 DIN Female	Straight Jack	EZ-1700-716FC	3190-388	<1.25:1 (2.5)	NA	Press Fit	Clamp	S/S		2.17 (55)	2.2 (55.9)	1.005(455.9)
2. 7-16 DIN Male	Straight Plug	EZ-1700-716MC	3190-387	<1.25:1 (2.5)	Hex	Press Fit	Clamp	S/S		2.17 (55)	2.2 (55.9)	1.055(478.5)
3. N Female	Straight Jack	EZ-1700-NFC	3190-386	<1.25:1 (2.5)	NA	Press Fit	Clamp	S/S		2.17 (55)	2.2 (55.9)	1.087(493.1)
4. N Male	Straight Plug	EZ-1700-NMC	3190-385	<1.25:1 (2.5)	Hex	Press Fit	Clamp	S/S		2.17 (55)	2.2 (55.9)	1.058(479.9)

* Finishes: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Install Tools

Type	Part Number	Stock Code	Description
Strip Tool	ST-1700C	3190-312	For Clamp Style Connectors
Midspan Strip Tool	GST-1700A	3190-437	For Ground Strap Attachment
Wrenches	WR-1700	3190-514	2" Box Wrench (2 required)
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool


GK-S1700TT

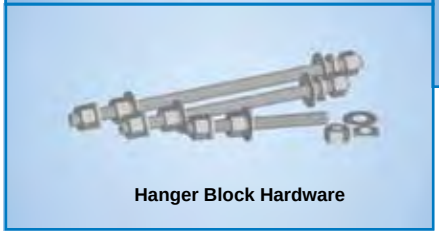

HG-1700T


CS-90170T, CS-60170T


SC-1700T


Standard Entry Panels


CB-1700T


Hanger Block Hardware


SH-U1700T

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S1700TT	GK-S1700TT	Standard Grounding Kit (each)
Hoisting Grip	HG-1700T	HG-1700T	Split/Laced Type (each)
Cold Shrink	CS-90170T	CS-90170T	LMR-900 to -1700 Junction (each)
Cold Shrink	CS-60170T	CS-60170T	LMR-600 to -1700 Junction (each)
Standard Entry Port Cushion	SC-1700T	SC-1700T	One Cable (each)
Standard Entry Panels	Full Range of Port Styles/Combinations Available		
Hanger Blocks	CB-1700T	CB-1700T	Dual Cable Support Block (kit of 10)
Hanger Block Supporting Hardware	Complete Range of Supporting Hardware & Adapters Available		
Snap-In Hangers	SH-U1700T	SH-U1700T	Snap-In Hangers (Kit of 10)

TIMES MICROWAVE SYSTEMS

LMR® lite-195
Flexible Low Loss Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable
- Drop-in replacement for RG-58 and RG-142

• **LMR-LW195** is a lightweight low loss coaxial cable that employs an aluminum braid shield instead of the traditional tinned copper shield. LMR-LW195 has been designed and engineered with a combination of electrical, physical and mechanical properties that reduce weight and cost.

• **Flexibility** and bendability that are hallmarks of LMR-195 are also the same for LMR-LW195. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.
•**Low Loss** is another hallmark feature of LMR-LW195. Size for size LMR® has the lowest loss of any flexible cable and comparable loss to semi rigid hard-line cables.
• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).
• **Weatherability:** LMR-LW195 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.
• **Connectors:** LMR-LW195 uses the same connectors, tools and installation accessories as standard LMR®. A wide variety of connectors are available for LMR-LW195 including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.
• **Cable Assemblies**: All LMR-LW195 cable types are available as pre-terminated cable assemblies.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
LMR-LW195	Outdoor	PE	Black	45110

PE = Polyethylene

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.037	(0.94)
Dielectric	Foam PE	0.110	(2.79)
Outer Conductor	Aluminum Tape	0.116	(2.95)
Overall Braid	Aluminum	0.139	(3.53)
Jacket	(See table above)	0.195	(4.95)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.5	(12.7)
Bend Radius: repeated	in. (mm)	2	(50.8)
Bending Moment	ft-lb (N-m)	0.2	(0.27)
Weight	lb/ft (kg/m)	.015	(0.022)
Tensile Strength	lb (kg)	40	(18.2)
Flat Plate Crush	lb/in. (kg/mm)	15	(0.27)

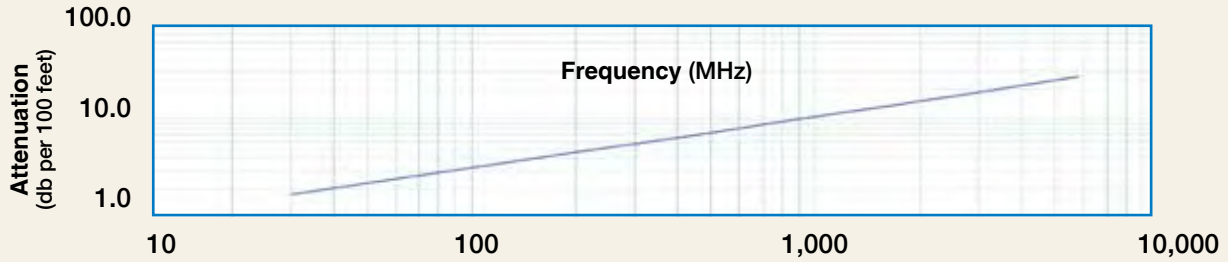
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	80	
Dielectric Constant	NA	1.56	
Time Delay	nS/ft (nS/m)	1.27	(4.17)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	25.4	(83.3)
Inductance	uH/ft (uH/m)	0.064	(0.21)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	7.6	(24.9)
Outer Conductor	ohms/1000ft (/km)	18.1	(59.4)
Voltage Withstand	Volts DC	1000	
Jacket Spark	Volts RMS	3000	
Peak Power	kW	2.5	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	2.0	2.5	4.4	5.4	7.8	11.1	14.5	16.0	16.9	19.0	29.9
Attenuation dB/100 m	6.5	8.4	14.6	17.7	25.5	36.5	47.7	52.5	55.4	62.4	98.1
Avg. Power kW	0.89	0.68	0.39	0.32	0.22	0.16	0.12	0.11	0.10	0.09	0.06

Calculate Attenuation = (0.356859) • $\sqrt{FMHz}$ + (0.000470) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR® lite-200
Flexible Low Loss Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable

• **LMR-LW200** is a lightweight low loss coaxial cable that employs an aluminum braid shield instead of the traditional tinned copper shield. LMR-LW200 has been designed and engineered with a combination of electrical, physical and mechanical properties that reduce weight and cost.

• **Flexibility** and bendability that are hallmarks of LMR-200 are also the same for LMR-LW200. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

•**Low Loss** is another hallmark feature of LMR-LW200. Size for size LMR® has the lowest loss of any flexible cable and comparable loss to semi rigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-LW200 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** LMR-LW200 uses the same connectors, tools and installation accessories as standard LMR®. A wide variety of connectors are available for LMR-LW200 including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies**: All LMR-LW200 cable types are available as pre-terminated cable assemblies.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
LMR-LW200	Outdoor	PE	Black	45022

PE = Polyethylene

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.044	(1.12)
Dielectric	Foam PE	0.116	(2.95)
Outer Conductor	Aluminum Tape	0.121	(3.07)
Overall Braid	Aluminum	0.144	(3.66)
Jacket	(See table above)	0.195	(4.95)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.5	(12.7)
Bend Radius: repeated	in. (mm)	2	(50.8)
Bending Moment	ft-lb (N-m)	0.2	(0.27)
Weight	lb/ft (kg/m)	.015	(.022)
Tensile Strength	lb (kg)	40	(48)
Flat Plate Crush	lb/in. (kg/mm)	15	(0.27)

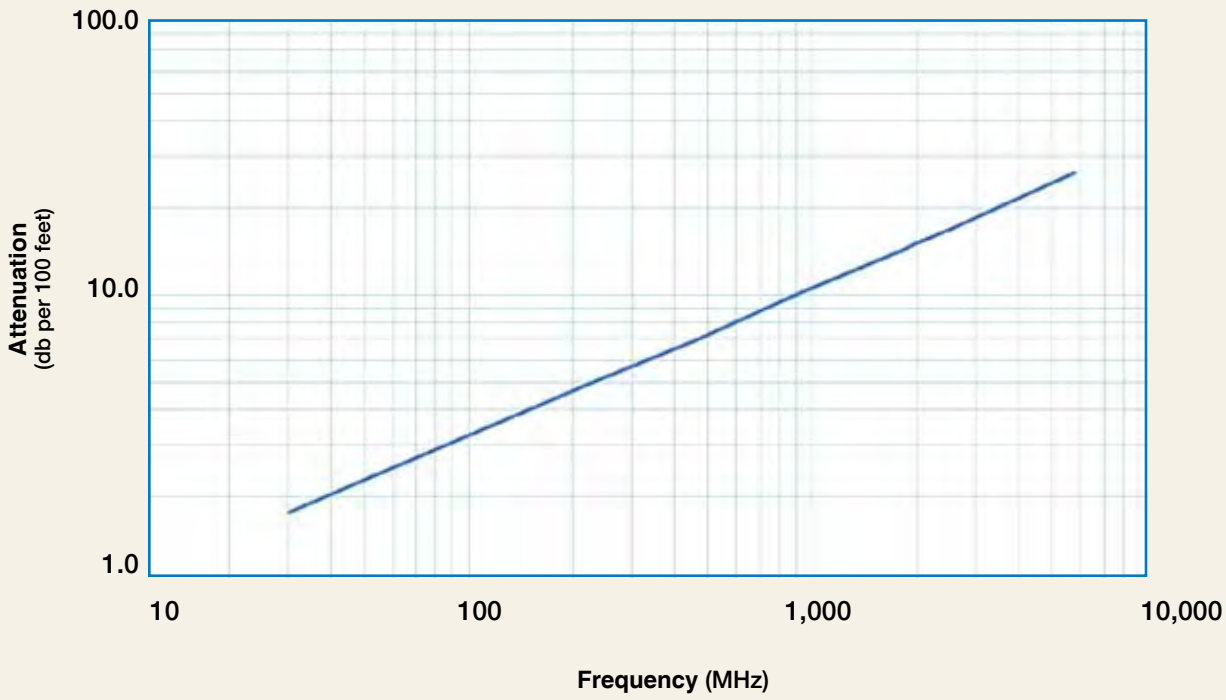
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	83	
Dielectric Constant	NA	1.45	
Time Delay	nS/ft (nS/m)	1.22	(4.02)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	24.5	(80.3)
Inductance	uH/ft (uH/m)	0.061	(0.20)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	5.36	(17.6)
Outer Conductor	ohms/1000ft (/km)	18.1	(59.4)
Voltage Withstand	Volts DC	1000	
Jacket Spark	Volts RMS	3000	
Peak Power	kW	2.5	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	1.8	2.3	4.0	4.8	7.0	9.9	12.9	14.2	15.0	16.9	26.4
Attenuation dB/100 m	5.8	7.5	13.1	15.9	22.8	32.6	42.4	46.6	49.3	55.4	86.5
Avg. Power kW	1.02	0.79	0.45	0.37	0.26	0.18	0.14	0.13	0.12	0.11	0.07

Calculate Attenuation =

$(0.320900) \bullet \sqrt{FMHz} + (0.000330) \bullet FMHz$ (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:

VSWR=1.0; Ambient = +25°C (77°F)

Power:

VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR® lite-240
Flexible Low Loss Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs (e.g. WLL, GPS, LMR, Mobile Antennas)
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable

• **LMR-LW240** is a lightweight low loss coaxial cable that employs an aluminum braid shield instead of the traditional tinned copper shield. LMR-LW240 has been designed and engineered with a combination of electrical, physical and mechanical properties that reduce weight and cost.

• **Flexibility** and bendability that are hallmarks of LMR-240 are also the same for LMR-LW240. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

•**Low Loss** is another hallmark feature of LMR-LW240. Size for size LMR® has the lowest loss of any flexible cable and comparable loss to semi rigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-LW240 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** LMR-LW240 uses the same connectors, tools and installation accessories as standard LMR®. A wide variety of connectors are available for LMR-LW240 including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-LW240 cable types are available as pre-terminated cable assemblies.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
LMR-LW240	Outdoor	PE	Black	45021

PE = Polyethylene

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.056	(1.42)
Dielectric	Foam PE	0.150	(3.81)
Outer Conductor	Aluminum Tape	0.155	(3.94)
Overall Braid	Aluminum	0.178	(4.52)
Jacket	(See table above)	0.240	(6.10)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.75	(19.1)
Bend Radius: repeated	in. (mm)	2.5	(63.5)
Bending Moment	ft-lb (N-m)	0.25	(0.39)
Weight	lb/ft (kg/m)	.026	(0.039)
Tensile Strength	lb (kg)	80	(36.3)
Flat Plate Crush	lb/in. (kg/mm)	20	(0.36)

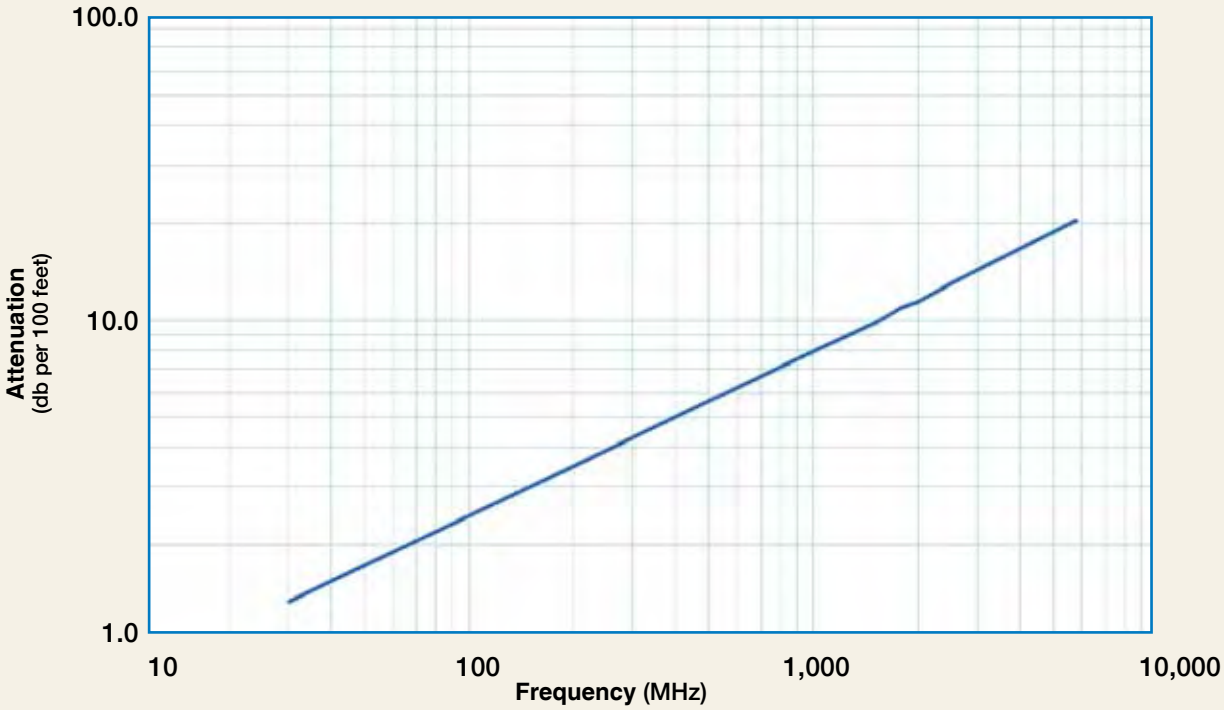
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	84	
Dielectric Constant	NA	1.42	
Time Delay	nS/ft (nS/m)	1.21	(3.97)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	24.2	(79.4)
Inductance	uH/ft (uH/m)	0.060	(0.20)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	3.2	(10.5)
Outer Conductor	ohms/1000ft (/km)	14.4	(47.2)
Voltage Withstand	Volts DC	1500	
Jacket Spark	Volts RMS	5000	
Peak Power	kW	5.6	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	1.3	1.7	3.0	3.7	5.3	7.6	9.9	10.9	11.5	12.9	20.4
Attenuation dB/100 m	4.4	5.7	9.9	12.0	17.3	24.8	32.4	35.6	37.7	42.4	66.8
Avg. Power kW	1.49	1.15	0.66	0.54	0.38	0.26	0.20	0.18	0.17	0.15	0.10

Calculate Attenuation =
(0.242080) • $\sqrt{FMHz}$ + (0.000330) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation:
VSWR=1.0 ; Ambient = +25°C (77°F)
Power: VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR lite®-400
Flexible Low Loss Communications Coax

Ideal for...

- Drop-in replacement for RG-8/9913 Air-Dielectric type Cable
- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable

• **LMR-LW400** is a lightweight low loss coaxial cable that employs an aluminum braid shield instead of the traditional tinned copper shield. LMR-LW400 has been designed and engineered with a combination of electrical, physical and mechanical properties that reduce weight and cost.

• **Flexibility** and bendability that are hallmarks of LMR-400 are also the same for LMR-LW400. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

•**Low Loss** is another hallmark feature of LMR-LW400. Size for size LMR® has the lowest loss of any flexible cable and comparable loss to semi rigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-LW400 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** LMR-LW400 uses the same connectors, tools and installation accessories as standard LMR®. A wide variety of connectors are available for LMR-LW400 including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-LW400 cable types are available as pre-terminated cable assemblies.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
LMR-LW400	Outdoor	PE	Black	45001
LMR-LW400-DB	Outdoor	PE	Black	45091

PE = Polyethylene

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.108	(2.74)
Dielectric	Foam PE	0.285	(7.24)
Outer Conductor	Aluminum Tape	0.291	(7.39)
Overall Braid	Aluminum	0.320	(8.13)
Jacket	(See table above)	0.405	(10.29)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.00	(25.4)
Bend Radius: repeated	in. (mm)	4.0	(101.6)
Bending Moment	ft-lb (N-m)	0.5	(0.50)
Weight	lb/ft (kg/m)	.050	(0.075)
Tensile Strength	lb (kg)	160	(72.6)
Flat Plate Crush	lb/in. (kg/mm)	40	(0.71)

Environmental Specifications

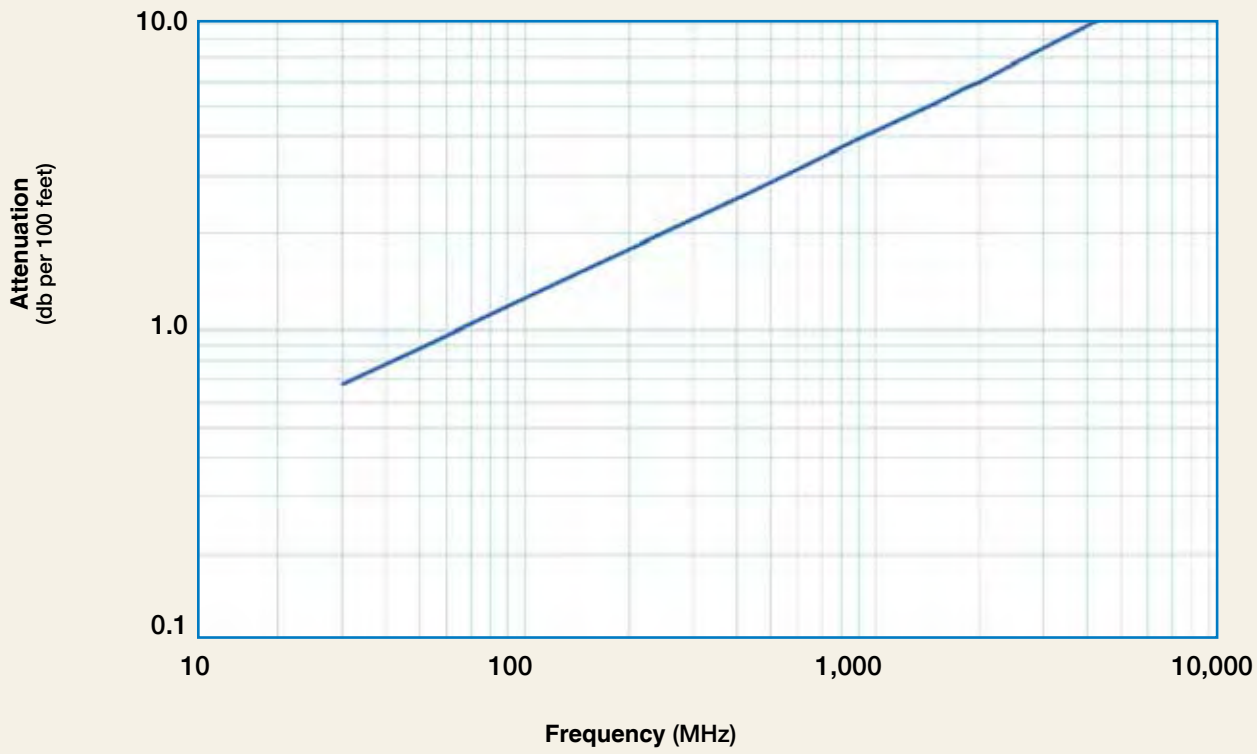
Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

TIMES MICROWAVE SYSTEMS

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	85	
Dielectric Constant	NA	1.38	
Time Delay	nS/ft (nS/m)	1.20	(3.92)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.9	(78.4)
Inductance	uH/ft (uH/m)	0.060	(0.20)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	1.39	(4.6)
Outer Conductor	ohms/1000ft (/km)	6.1	(20.0)
Voltage Withstand	Volts DC	2500	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	16	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	0.7	0.9	1.5	1.9	2.7	3.9	5.1	5.7	6.0	6.8	10.8
Attenuation dB/100 m	2.2	2.9	5.0	6.1	8.9	12.8	16.8	18.6	19.6	22.2	35.5
Avg. Power kW	3.33	2.57	1.47	1.20	0.83	0.58	0.44	0.40	0.37	0.33	0.21

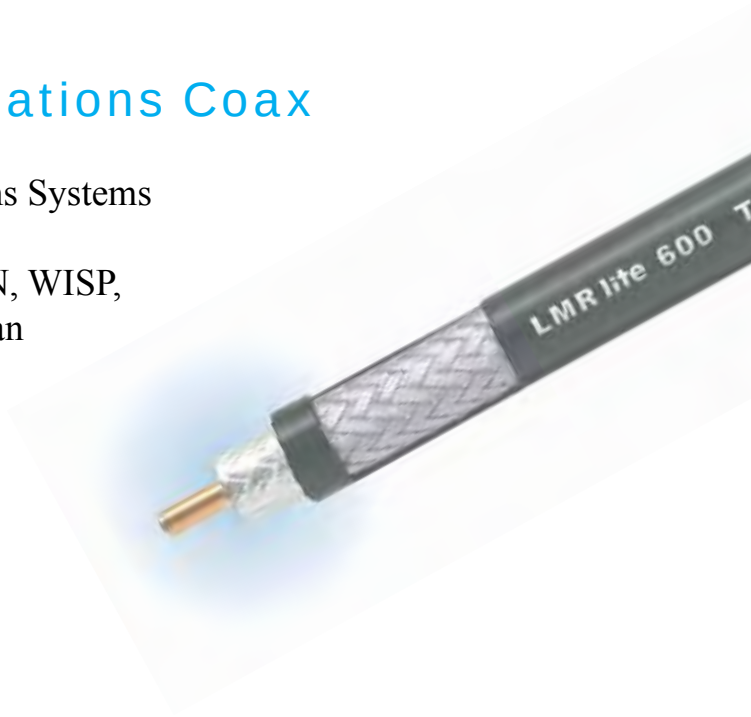
Calculate Attenuation =
(0.122290) • $\sqrt{\text{FMHz}}$ + (0.000260) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation:
VSWR=1.0 ; Ambient = +25°C (77°F)
Power:
VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR® lite-600
Flexible Low Loss Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable



• **LMR-LW600** is a lightweight low loss coaxial cable that employs an aluminum braid shield instead of the traditional tinned copper shield. LMR-LW600 has been designed and engineered with a combination of electrical, physical and mechanical properties that reduce weight and cost.

• **Flexibility** and bendability that are hallmarks of LMR-600 are also the same for LMR-LW600. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

•**Low Loss** is another hallmark feature of LMR-LW600. Size for size LMR® has the lowest loss of any flexible cable and comparable loss to semi rigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-LW600 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** LMR-LW600 uses the same connectors, tools and installation accessories as standard LMR®. A wide variety of connectors are available for LMR-LW600 including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-LW600 cable types are available as pre-terminated cable assemblies.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
LMR-LW600	Outdoor	PE	Black	45003

PE = Polyethylene

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.176	(4.47)
Dielectric	Foam PE	0.455	(11.56)
Outer Conductor	Aluminum Tape	0.461	(11.71)
Overall Braid	Aluminum	0.490	(12.45)
Jacket	(see table above)	0.590	(14.99)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.50	(38.1)
Bend Radius: repeated	in. (mm)	6.0	(152.4)
Bending Moment	ft-lb (N-m)	2.75	(3.73)
Weight	lb/ft (kg/m)	.099	(.147)
Tensile Strength	lb (kg)	260	(118.0)
Flat Plate Crush	lb/in. (kg/mm)	60	(1.07)

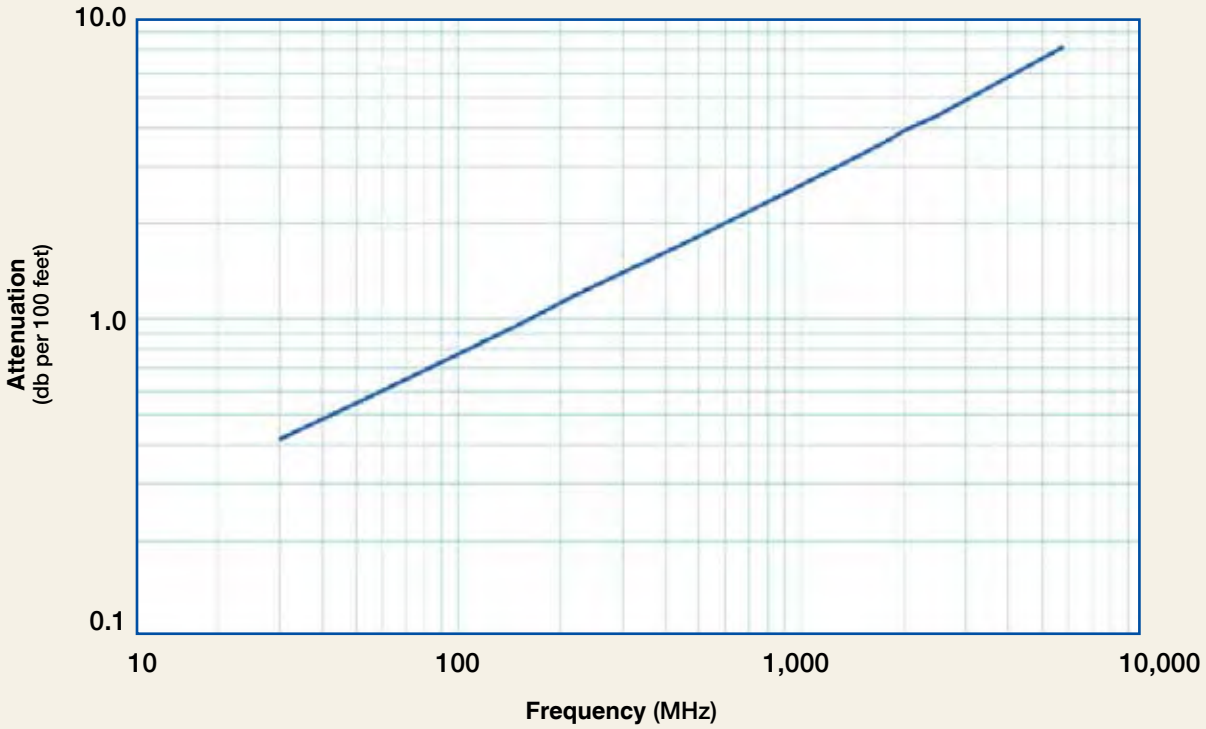
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	87	
Dielectric Constant	NA	1.32	
Time Delay	nS/ft (nS/m)	1.17	(3.83)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.4	(76.6)
Inductance	uH/ft (uH/m)	0.058	(0.19)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.53	(1.7)
Outer Conductor	ohms/1000ft (/km)	4.4	(14.8)
Voltage Withstand	Volts DC	4000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	40	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	0.4	0.5	1.0	1.2	1.7	2.5	3.3	3.7	3.9	4.4	7.3
Attenuation dB/100 m	1.4	1.8	3.2	3.9	5.6	8.2	10.9	12.1	12.8	14.5	23.8
Avg. Power kW	5.51	4.24	2.41	1.97	1.35	0.93	0.70	0.63	0.59	0.52	0.32

Calculate Attenuation =
(0.075550) • $\sqrt{\text{FMHz}}$ + (0.000260) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation:
VSWR=1.0; Ambient = +25°C (77°F)
Power:
VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR®-195-UF
UltraFlex Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application that requires periodic/repeated flexing

• **LMR®- UltraFlex** has a stranded center conductor and rubber outer jacket designed for multiple bending/flexing cycles. It is used for both indoor and outdoor applications.

• **Flexibility** and bendability are hallmarks of the LMR-195-UF cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-195-UF. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-195-UF cables are designed for outdoor exposure and have a life expectancy in excess of 10 years.

• **Connectors:** A wide variety of connectors are available for LMR cable, including all common interface types, reverse polarity, and solder-on center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-195-UF cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Stranded BC	0.038	(0.97)
Dielectric	Foam Polyethylene	0.110	(2.79)
Outer Conductor	Aluminum Tape	0.116	(2.95)
Overall Braid	Tinned Copper	0.139	(3.53)
Jacket	Black Thermoplastic Elastomer	0.195	(4.95)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.5	(12.7)
Bend Radius: repeated	in. (mm)	2	(50.8)
Bending Moment	ft-lb (N-m)	0.1	(0.14)
Weight	lb/ft (kg/m)	0.021	(0.03)
Tensile Strength	lb (kg)	40	(18.2)
Flat Plate Crush	lb/in. (kg/mm)	10	(0.18)

Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

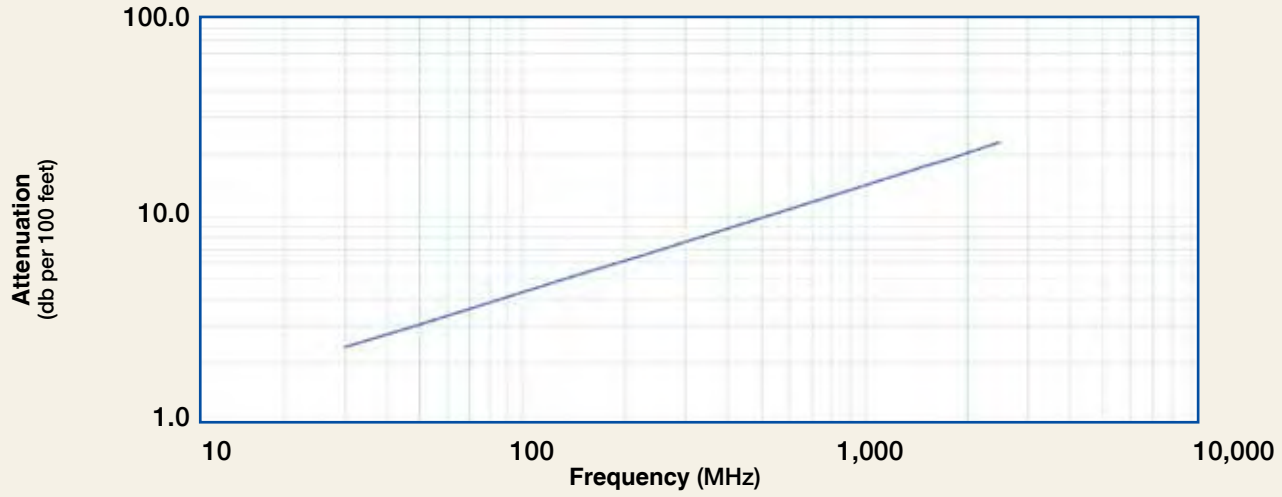
Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.56	
Time Delay	nS/ft (nS/m)	1.27	(4.17)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	25.4	(83.3)
Inductance	uH/ft (uH/m)	0.064	(0.21)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	9.5	(31.2)
Outer Conductor	ohms/1000ft (/km)	4.9	(16.1)
Voltage Withstand	Volts DC	1000	
Jacket Spark	Volts RMS	3000	
Peak Power	kW	2.5	

Part Description

Part Number	Application	Jacket	Color	Stock Code
LMR-195-UF	Indoor/Outdoor	TPE	Black	54212

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	2.3	3.0	5.3	6.4	9.3	13.2	17.3	19.0	20.1	22.6	35.6
Attenuation dB/100 m	7.7	9.9	17.3	21.1	30.4	43.4	56.77	62.4	65.9	74.2	116.7
Avg. Power kW	0.78	0.61	0.35	0.28	0.20	0.14	0.10	0.09	0.09	0.08	0.05

Calculate Attenuation = (0.424232) • $\sqrt{FMHz}$ + (0.000563) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lbs (g)
1. N male	Straight Plug	TC-195-NM	3190-1555	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.5 (38.1)	0.75 (19.1)	0.073 (33.1)
2. SMA male	Straight Plug	TC-195-SM	3190-1553	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0 (25.4)	0.32 (8.1)	0.015 (6.8)
3. TNC male	Straight Plug	TC-195-TM	3190-1554	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.4 (35.6)	0.59 (15.0)	0.045 (20.4)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100, 195, 200 and 240 connectors
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

TIMES MICROWAVE SYSTEMS

LMR®-200-UF
UltraFlex Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application that requires periodic/repeated flexing

• **LMR®- UltraFlex** has a stranded center conductor and rubber outer jacket designed for multiple bending/flexing cycles. It is used for both indoor and outdoor applications.

• **Flexibility** and bendability are hallmarks of the LMR-200-UF cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-200-UF. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-200-UF cables are designed for outdoor exposure and have a life expectancy in excess of 10 years.

• **Connectors:** A wide variety of connectors are available for LMR-200-UF cable, including all common interface types, reverse polarity, and solder-on center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-200-UF cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Stranded BC	0.044	(1.12)
Dielectric	Foam Polyethylene	0.116	(2.95)
Outer Conductor	Aluminum Tape	0.121	(3.07)
Overall Braid	Tinned Copper	0.144	(3.66)
Jacket	Black Thermoplastic Elastomer	0.195	(4.95)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.5	(12.7)
Bend Radius: repeated	in. (mm)	2	(50.8)
Bending Moment	ft-lb (N-m)	0.1	(0.14)
Weight	lb/ft (kg/m)	0.022	(0.03)
Tensile Strength	lb (kg)	40	(18.2)
Flat Plate Crush	lb/in. (kg/mm)	10	(0.18)

Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

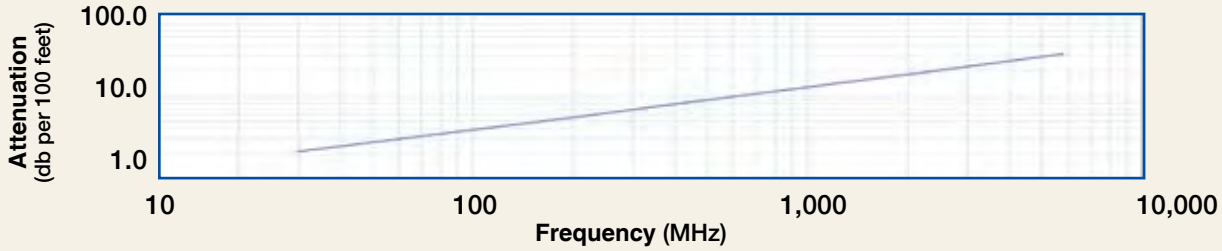
Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	83	
Dielectric Constant	NA	1.45	
Time Delay	nS/ft (nS/m)	1.22	(4.02)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	24.5	(80.3)
Inductance	uH/ft (uH/m)	0.061	(0.20)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	7.5	(24.6)
Outer Conductor	ohms/1000ft (/km)	4.9	(16.1)
Voltage Withstand	Volts DC	1000	
Jacket Spark	Volts RMS	3000	
Peak Power	kW	2.5	

Part Description

Part Number	Application	Jacket	Color	Stock Code
LMR-200-UF	Indoor/Outdoor	TPE	Black	54042

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	2.1	2.7	4.8	5.8	8.3	11.9	15.5	17.1	18.0	20.2	31.6
Attenuation dB/100 m	7.0	9.0	15.7	19.0	27.4	39.1	50.9	55.9	59.1	66.4	103.8
Avg. Power kW	0.95	0.73	0.42	0.35	0.24	0.17	0.13	0.12	0.11	0.10	0.06

Calculate Attenuation = (0.385082) • $\sqrt{\text{FMHz}}$ + (0.000396) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. BNC male	Straight Plug	TC-200-BM	3190-225	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.7 (43.2)	0.56(14.2)	0.045 (20.4)
2. Mini-UHF	Straight Plug	TC-200-MUHF	3190-444	<1.25:1 (2.5)	Knurl	Solder	Crimp	NG	1.1 (27.9)	0.45(11.4)	0.015 (6.8)
3. N male	Straight Plug	TC-200-NM	3190-224	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.5 (38.1)	0.75(19.1)	0.073 (33.1)
4. SMA male	Straight Plug	TC-200-SM	3190-612	<1.25:1 (8)	Hex	Solder	Crimp	SS/G	1.0 (25.4)	0.32(8.1)	0.015(6.8)
5. SMA male	Reverse Polarity	TC-200-SM-RP	3190-327	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0 (25.4)	0.32(8.1)	0.015(6.8)
6. TNC male	Straight Plug	TC-200-TMC	3190-240	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G	1.7 (43.2)	0.59(15.0)	0.045 (20.4)
7. TNC female	Straight Jack	TC-200-TF	3190-263	<1.25:1 (2.5)	NA	Solder	Crimp	N/G	1.3 (33.0)	0.57(14.5)	0.033 (15.0)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S200TT	GK-S200TT	Standard Ground Kit (each)

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100, 195, 200 and 240 connectors
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

TIMES MICROWAVE SYSTEMS

LMR®-240-UF
UltraFlex Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs (e.g. WLL, GPS, LMR, Mobile Antennas)
- Any application that requires periodic/repeated flexing

• **LMR®- UltraFlex** has a stranded center conductor and rubber outer jacket designed for multiple bending/flexing cycles. It is used for both indoor and outdoor applications.

• **Flexibility** and bendability are hallmarks of the LMR-240-UF cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-240-UF. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-240-UF cables are designed for outdoor exposure and have a life expectancy in excess of 10 years.

• **Connectors:** A wide variety of connectors are available for LMR-240-UF cable, including all common interface types, reverse polarity, and solder-on center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-240-UF cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Stranded BC	0.056	(1.42)
Dielectric	Foam Polyethylene	0.150	(3.81)
Outer Conductor	Aluminum Tape	0.155	(3.94)
Overall Braid	Tinned Copper	0.178	(4.52)
Jacket	Black Thermoplastic Elastomer	0.240	(6.10)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.75	(19.1)
Bend Radius: repeated	in. (mm)	2.5	(63.5)
Bending Moment	ft-lb (N-m)	0.125	(0.17)
Weight	lb/ft (kg/m)	0.034	(0.05)
Tensile Strength	lb (kg)	80	(36.3)
Flat Plate Crush	lb/in. (kg/mm)	13	(0.23)

Environmental Specifications

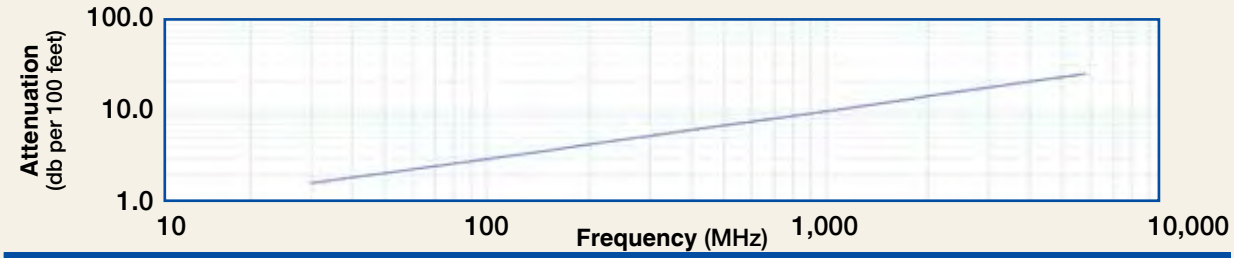
Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	84	
Dielectric Constant	NA	1.42	
Time Delay	nS/ft (nS/m)	1.21	(3.97)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	24.2	(79.4)
Inductance	uH/ft (uH/m)	0.060	(0.20)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	4.28	(14.1)
Outer Conductor	ohms/1000ft (/km)	3.89	(12.8)
Voltage Withstand	Volts DC	1500	
Jacket Spark	Volts RMS	5000	
Peak Power	kW	5.6	

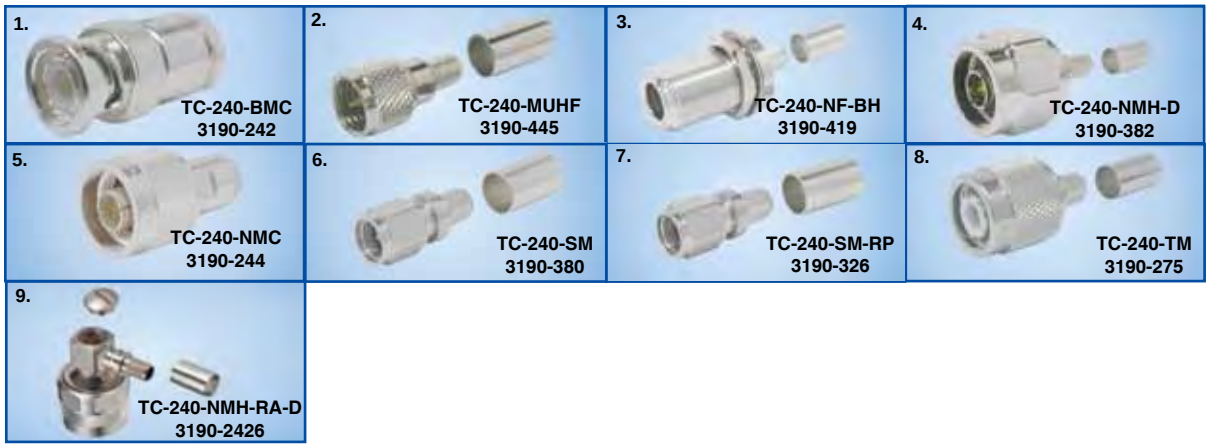
Part Description				
Part Number	Application	Jacket	Color	Stock Code
LMR-240-UF	Indoor/Outdoor	TPE	Black	54041

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	1.6	2.1	3.6	4.4	6.3	9.1	11.8	13.0	13.8	15.5	24.4
Attenuation dB/100 m	5.3	6.8	11.9	14.4	20.8	29.8	38.9	42.8	45.2	50.9	80.1
Avg. Power kW	1.24	0.96	0.55	0.45	0.31	0.22	0.17	0.15	0.14	0.13	0.08

Calculate Attenuation = (0.290501) • $\sqrt{\text{FMHz}}$ + (0.000396) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading



Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
1. BNC Male	Straight Plug	TC-240-BMC	3190-242	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G	1.7	(43)	0.56	(14.2)	0.040	(18.1)
2. Mini-UHF	Straight Plug	TC-240-MUHF	3190-445	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/G	1.1	(28)	0.45	(11.4)	0.014	(6.4)
3. N Female	Bulkhead Jack	TC-240-NF-BH	3190-419	<1.25:1 (2.5)	NA	Solder	Crimp	A/G	1.7	(44)	0.88	(22.2)	0.115	(52.2)
4. N Male	Straight Plug	TC-240-NMH-D	3190-382	<1.25:1 (2.5)	Hex	Solder	Crimp	N/S	1.5	(38)	0.75	(19.1)	0.086	(39.0)
5. N Male	Straight Plug	TC-240-NMC	3190-244	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G	1.5	(38)	0.75	(19.1)	0.082	(37.2)
6. SMA Male	Straight Plug	TC-240-SM	3190-380	<1.25:1 (10)	Hex	Solder	Crimp	SS/G	1.0	(25)	0.32	(8.1)	0.016	(7.3)
7. SMA Male	Reverse Polarity	TC-240-SM-RP	3190-326	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0	(25)	0.32	(8.1)	0.016	(7.3)
8. TNC Male	Straight Plug	TC-240-TM	3190-275	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/S	1.7	(43)	0.59	(15.0)	0.043	(19.5)
9. N Male	Right Angle	TC-240-NMH-RA-D	3190-2426	<1.35:1 (6)	Hex/Knurl	Solder	Crimp	A/G	1.2	(32.4)	1.22	(31.0)	0.091	(41.7)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S240TT	GK-S240TT	Standard Ground Kit (each)

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100, 195, 200 and 240 connectors
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

TIMES MICROWAVE SYSTEMS

LMR®-300-UF
UltraFlex Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application that requires periodic/repeated flexing

• **LMR®- UltraFlex** has a stranded center conductor and rubber outer jacket designed for multiple bending/flexing cycles. It is used for both indoor and outdoor applications.

• **Flexibility** and bendability are hallmarks of the LMR-300-UF cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-300-UF. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-300-UF cables are designed for outdoor exposure and have a life expectancy in excess of 10 years.

• **Connectors:** A wide variety of connectors are available for LMR-300-UF cable, including all common interface types, reverse polarity, and solder-on center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-300-UF cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				
Part Number	Application	Jacket	Color	Stock Code
LMR-300-UF	Indoor/Outdoor	TPE	Black	54088

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Stranded BC	0.070	(1.78)
Dielectric	Foam Polyethylene	0.190	(4.83)
Outer Conductor	Aluminum Tape	0.196	(4.98)
Overall Braid	Tinned Copper	0.225	(5.72)
Jacket	Black Thermoplastic Elastomer	0.300	(7.62)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.88	(22.2)
Bend Radius: repeated	in. (mm)	3.0	(76.2)
Bending Moment	ft-lb (N-m)	0.2	(0.27)
Weight	lb/ft (kg/m)	0.055	(0.08)
Tensile Strength	lb (kg)	120	(54.5)
Flat Plate Crush	lb/in. (kg/mm)	20	(0.36)

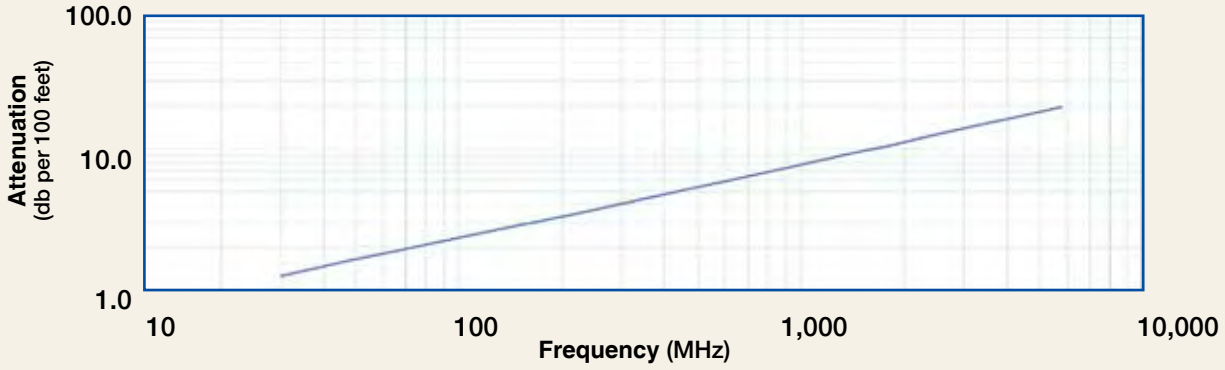
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	85	
Dielectric Constant	NA	1.38	
Time Delay	nS/ft (nS/m)	1.20	(3.92)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.9	(78.4)
Inductance	uH/ft (uH/m)	0.060	(0.20)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	2.96	(9.7)
Outer Conductor	ohms/1000ft (/km)	2.21	(7.3)
Voltage Withstand	Volts DC	2000	
Jacket Spark	Volts RMS	5000	
Peak Power	kW	10	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	1.3	1.6	2.9	3.5	5.1	7.3	9.5	10.5	11.1	12.5	19.8
Attenuation dB/100 m	4.2	5.4	9.4	11.5	16.6	23.8	31.2	34.4	36.4	41.0	65.0
Avg. Power kW	1.74	1.35	0.77	0.63	0.44	0.30	0.23	0.21	0.20	0.18	0.11

Calculate Attenuation = (0.230316) • $\sqrt{\text{FMHz}}$ + (0.000392) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. SMA Male	Straight Plug	TC-300-SM	3190-501	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0 (25)	0.35 (8.9)	0.018 (8.2)
2. SMA Female	Bulkhead Jack	TC-300-SF-BH	3190-590	<1.25:1 (2.5)	NA	Solder	Crimp	SS/G	1.1 (28)	0.31 (7.9)	0.022 (10.0)
3. TNC Male	Straight Plug	TC-300-TM	3190-500	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/S	1.7 (43)	0.59 (15.0)	0.050 (22.7)
4. N Male	Right Angle	TC-300-NMH-RA-D	3190-2761	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/G	1.7 (43)	0.59 (15.0)	0.050 (22.7)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S300T	GK-S300T	Standard Ground Kit (each)

Install Tools

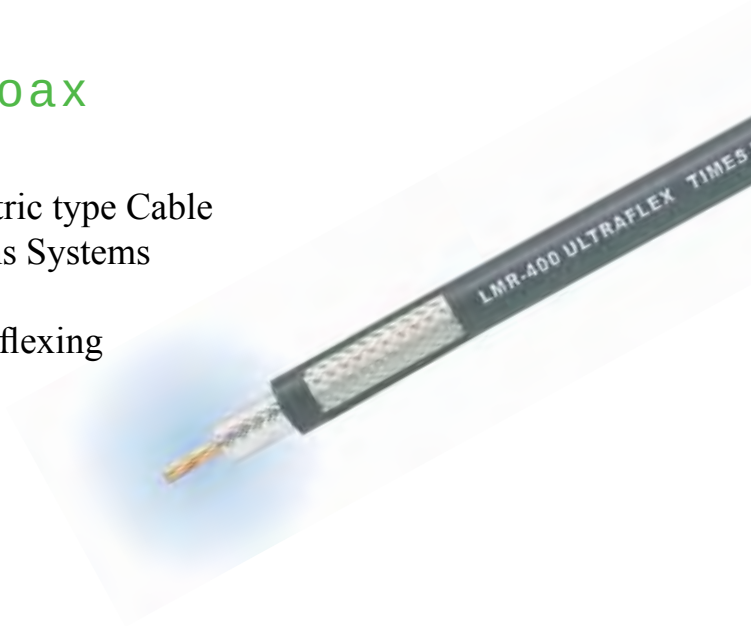
Type	Part Number	Stock Code	Description
Crimp Tool	CT-400/300	3190-666	Crimp tool for LMR-300 UF connectors
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

TIMES MICROWAVE SYSTEMS

LMR-®400-UF
UltraFlex Communications Coax

Ideal for...

- Drop-in replacement for RG-8/9913 Air-Dielectric type Cable
- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application that requires periodic/repeated flexing



• **LMR®- UltraFlex** has a stranded center conductor and rubber outer jacket designed for multiple bending/flexing cycles. It is used for both indoor and outdoor applications.

• **Flexibility** and bendability are hallmarks of the LMR-400-UF cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-400-UF. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-400-UF cables are designed for outdoor exposure and have a life expectancy in excess of 10 years.

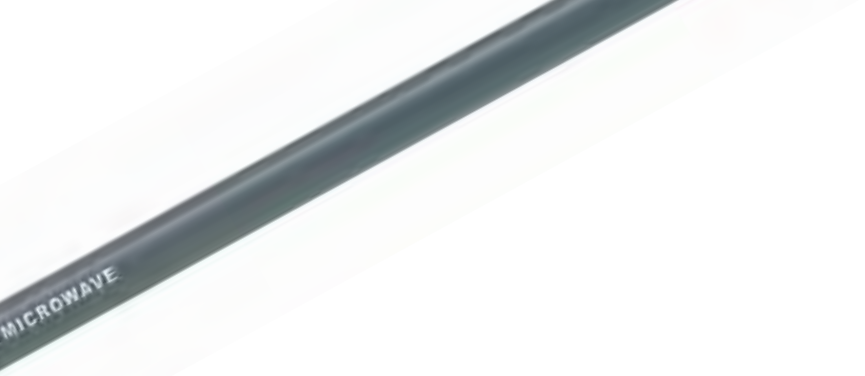
• **Connectors:** A wide variety of connectors are available for LMR-400-UF cable, including all common interface types, reverse polarity, and solder-on center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-400-UF cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				
Part Number	Application	Jacket	Color	Stock Code
LMR-400-UF	Indoor/Outdoor	TPE	Black	54040

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Stranded BC	0.108	(2.74)
Dielectric	Foam Polyethylene	0.285	(7.24)
Outer Conductor	Aluminum Tape	0.291	(7.39)
Overall Braid	Tinned Copper	0.320	(8.13)
Jacket	Black Thermoplastic Elastomer	0.405	(10.29)



Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.0	(25.4)
Bend Radius: repeated	in. (mm)	4.0	(101.6)
Bending Moment	ft-lb (N-m)	0.375	(0.51)
Weight	lb/ft (kg/m)	.088	(0.131)
Tensile Strength	lb (kg)	160	(72.6)
Flat Plate Crush	lb/in. (kg/mm)	20	(0.36)

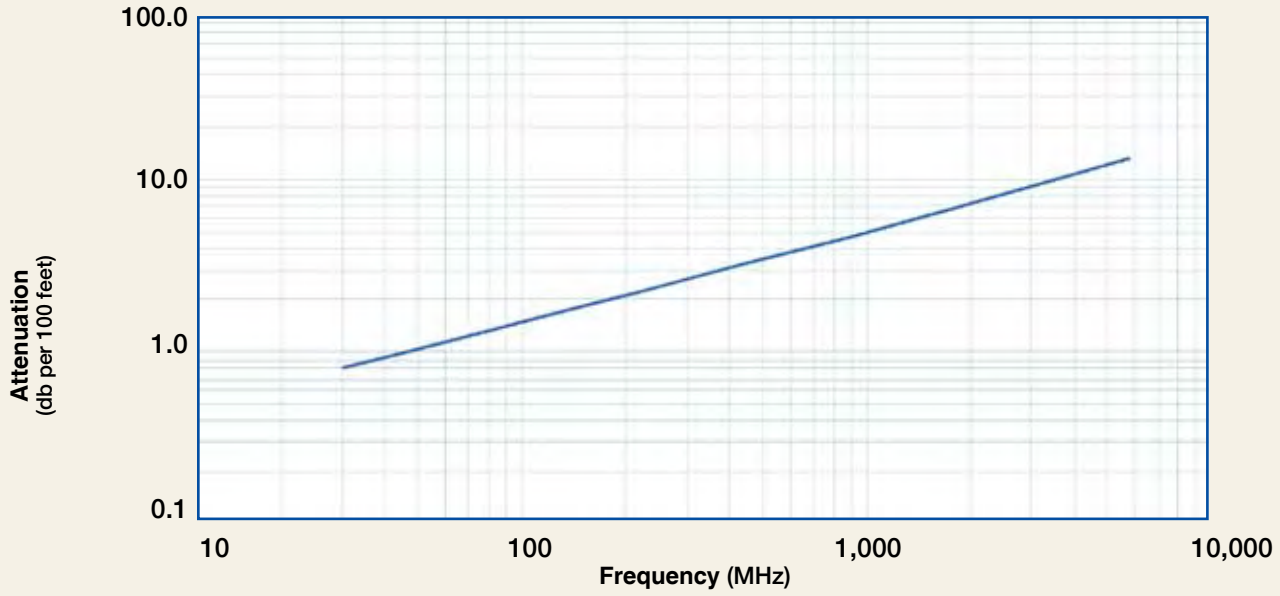
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	85	
Dielectric Constant	NA	1.38	
Time Delay	nS/ft (nS/m)	1.20	(3.92)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.9	(78.40)
Inductance	uH/ft (uH/m)	0.060	(0.21)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	1.07	(3.51)
Outer Conductor	ohms/1000ft (/km)	1.65	(5.4)
Voltage Withstand	Volts DC	2500	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	16	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	0.8	1.1	1.8	2.2	3.3	4.7	6.2	6.8	7.2	8.1	13.0
Attenuation dB/100 m	2.7	3.5	6.1	7.4	10.7	15.4	20.2	22.3	23.6	26.6	42.6
Avg. Power kW	2.77	2.14	1.22	1.00	0.69	0.48	0.36	0.33	0.31	0.28	0.17

Calculate Attenuation = (0.146748) • $\sqrt{\text{FMHz}}$ + (0.000312) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR®-400-UF
UltraFlex Communications Coax

Connectors Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)		Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	(mm)	Width in	(mm)	Weight lb	(g)
1. 7-16 DIN Female	Straight Jack	TC-400-716-FC	3190-376	<1.25:1	(2.5)	NA	Solder	Clamp	S/S	1.6	(41)	1.13	(28.7)	0.281	(127.5)
2. 7-16 DIN Male	Straight Plug	TC-400-716-MC	3190-279	<1.25:1	(2.5)	Hex	Solder	Clamp	S/S	1.4	(36)	1.40	(35.6)	0.268	(121.6)
3. BNC Male	Straight Plug	TC-400-BM	3190-318	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/S	1.7	(43)	0.56	(14.2)	0.063	(28.6)
4. Mini-UHF	Straight Plug	TC-400-MUHF	3190-520	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/G	1.1	(28)	0.50	(12.7)	0.020	(9.1)
5. N Female	Straight Jack	TC-400-NFC	3190-299	<1.25:1	(2.5)	NA	Solder	Clamp	N/S	1.6	(41)	0.75	(19.1)	0.119	(54.0)
6. N Male	Straight Plug	SC-400-NM	3190-1454	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/G	1.5	(38)	0.75	(19.1)	0.090	(40.8)
7.	Straight Plug	TC-400-NM	3190-188	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/G	1.5	(38)	0.75	(19.1)	0.090	(40.8)
8.	Straight Plug	TC-400-NMH-X	3190-2626	<1.25:1	(10)	Hex/Knurl	Solder	Crimp	A/G	1.5	(38)	0.89	(22.6)	0.113	(51.3)
9.	Straight Plug	TC-400-NMC	3190-277	<1.25:1	(2.5)	Knurl	Solder	Clamp	N/G	1.5	(38)	0.75	(19.1)	0.121	(54.9)
10.	Right Angle	TC-400-NMH-RA-D	3190-2293#	<1.35:1	(6)	Hex/Knurl	Solder	Crimp	A/G	1.8	(46)	1.25	(31.8)	0.130	(59.0)
11. SMA Male	Straight Plug	TC-400-SM	3190-439	<1.25:1	(8)	Hex	Solder	Crimp	N/G	1.2	(29)	0.50	(12.7)	0.032	(14.5)
12. TNC Male	Straight Plug	TC-400-TM	3190-260	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/S	1.7	(43)	0.59	(15.0)	0.074	(33.6)
13.	Right Angle	TC-400-TM-RA-D	3190-2671	<1.35:1	(6)	Hex/Knurl	Solder	Crimp	A/G	1.4	(35)	1.41	(35.8)	0.130	(59.0)
14. TNC Male	Straight Plug	TC-400-TM-X	3190-2532	<1.25:1	(6)	Hex/Knurl	Solder	Crimp	A/G	1.9	(48)	0.67	(17.5)	0.075	(34.3)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

GK-S400TT

HG-400T

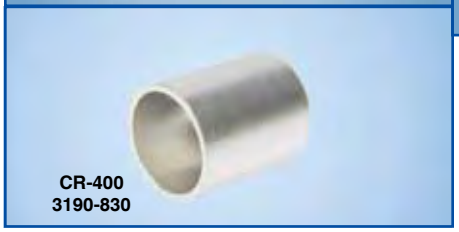
Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S400TT	GK-S400TT	Standard Grounding Kit (each)
Hoisting Grip	HG-400T	HG-400T	Laced Type (each)

HX-4
3190-200

Y1719
3190-202

CT-400/300
3190-666



CR-400
3190-830

CCT-01
3190-1544

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1719	3190-202	.429" Hex Dies
Crimp Tool	CT-400/300	3190-666	Crimp tool for LMR 400 connectors
Crimp Rings	CR-400	3190-830	Crimp rings for TC/EZ-400 connectors (package of 10)
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

TIMES MICROWAVE SYSTEMS

LMR®-500-UF UltraFlex Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application that requires periodic/repeated flexing

• **LMR®- UltraFlex** has a stranded center conductor and rubber outer jacket designed for multiple bending/flexing cycles. It is used for both indoor and outdoor applications.

• **Flexibility** and bendability are hallmarks of the LMR-500-UF cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-500-UF. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-500-UF cables are designed for outdoor exposure and have a life expectancy in excess of 10 years.

• **Connectors:** A wide variety of connectors are available for LMR-500-UF cable, including all common interface types, reverse polarity, and solder-on center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-500-UF cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Stranded BC	0.142	(3.61)
Dielectric	Foam Polyethylene	0.370	(9.40)
Outer Conductor	Aluminum Tape	0.376	(9.55)
Overall Braid	Tinned Copper	0.405	(10.29)
Jacket	Black Thermoplastic Elastomer	0.500	(12.70)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.25	(31.8)
Bend Radius: repeated	in. (mm)	5.0	(127.0)
Bending Moment	ft-lb (N-m)	1.25	(1.69)
Weight	lb/ft (kg/m)	0.1	(0.15)
Tensile Strength	lb (kg)	260	(118.0)
Flat Plate Crush	lb/in. (kg/mm)	35	(0.63)

Environmental Specifications

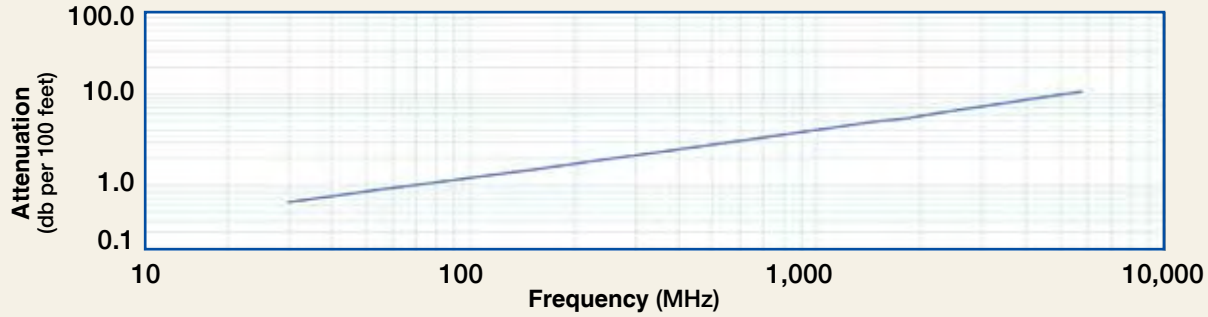
Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	85	
Dielectric Constant	NA	1.38	
Time Delay	nS/ft (nS/m)	1.20	(3.92)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.9	(78.4)
Inductance	uH/ft (uH/m)	0.060	(0.20)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.68	(2.21)
Outer Conductor	ohms/1000ft (/km)	1.27	(4.2)
Voltage Withstand	Volts DC	2500	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	22	

Part Description				
Part Number	Application	Jacket	Color	Stock Code
LMR-500-UF	Indoor/Outdoor	TPE	Black	54043

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	0.6	0.8	1.5	1.8	2.6	3.8	5.0	5.5	5.8	6.6	10.6
Attenuation dB/100 m	2.1	2.7	4.8	5.9	8.5	12.3	16.3	18.0	19.1	21.6	34.9
Avg. Power kW	3.68	2.84	1.61	1.32	0.91	0.63	0.48	0.43	0.41	0.36	0.22

Calculate Attenuation = (0.115908) • $\sqrt{\text{FMHz}}$ + (0.000312) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading


1 TC-500-NMH-X 3190-2514


2 TC-500-NMH-RA-D 3190-2513


3 TC-500-NMC 3190-377


4 TC-500-NMC-RA 3190-227


5 TC-500-NFC 3190-215


6 TC-500-TM 3190-464


7 TC-500-UMC 3190-354


8 BHA-KIT 3190-223

Connectors

Interface	Description	Part Number	Stock Code	VSWR Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. N Male	Straight Plug	TC-500-NMH-X	3190-2514	<1.35:5 (6)	Hex/Knurl	Solder	Crimp	A/G	1.8 (45)	0.87 (22.0)	0.099 (45.0)
2.	Right Angle	TC-500-NMH-RA-D	3190-2513	<1.25:1 (6)	Hex/Knurl	Solder	Crimp	A/G	1.5 (39)	1.6 (42.0)	0.279 (127.0)
3.	Straight Plug	TC-500-NMC	3190-377#	<1.25:1 (2.5)	Hex	Solder	Clamp	S/G	2.1 (53)	0.92 (23.4)	0.228 (103.4)
4.	Right Angle	TC-500-NMC-RA	3190-227#	<1.35:1 (2.5)	Hex	Solder	Clamp	S/G	2.4 (61)	1.5 (38.1)	0.275 (124.7)
5. N Female	Straight Jack	TC-500-NFC	3190-215	<1.25:1 (2.5)	NA	Solder	Clamp	S/G	2.2 (56)	0.94 (23.9)	0.215 (97.5)
6. TNC Male	Straight Plug	TC-500-TM	3190-464	<1.25:1 (2.5)	Hex	Solder	Crimp	N/G	1.5 (38)	0.62 (15.7)	0.082 (28.1)
7. UHF Male	Straight Plug	TC-500-UMC	3190-354	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G	2.1 (53)	0.88 (22.4)	0.215 (97.5)
8.	Bulkhead Kit	BHA-KIT	3190-223	<1.25:1 (2.5)	NA	NA	NA	NA	NA NA	NA NA	0.014 (6.4)

*Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair #Available in bulk pack


Y151 3190-465


HX-4 3190-200


CCT-01 3190-1544

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y151	3190-465	.532" Hex Dies
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool


GK-S500TT

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S500TT	GK-S500TT	Standard Ground Kit (each)

TIMES MICROWAVE SYSTEMS

LMR®-600-UF
UltraFlex Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application that requires periodic/repeated flexing

• **LMR®- UltraFlex** has a stranded center conductor and rubber outer jacket designed for multiple bending/flexing cycles. It is used for both indoor and outdoor applications.

• **Flexibility** and bendability are hallmarks of the LMR-600-UF cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-600-UF. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-600-UF cables are designed for outdoor exposure and have a life expectancy in excess of 10 years.

• **Connectors:** A wide variety of connectors are available for LMR-600-UF cable, including all common interface types, reverse polarity, and solder-on center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-600-UF cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				
Part Number	Application	Jacket	Color	Stock Code
LMR-600-UF	Indoor/Outdoor	TPE	Black	54044

Construction Specifications			
Description	Material	In.	(mm)
Inner Conductor	Stranded BC	0.176	(4.47)
Dielectric	Foam Polyethylene	0.455	(11.56)
Outer Conductor	Aluminum Tape	0.461	(11.71)
Overall Braid	Tinned Copper	0.490	(12.45)
Jacket	Black Thermoplastic Elastomer	0.590	(14.99)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.5	(38.1)
Bend Radius: repeated	in. (mm)	6.0	(152.4)
Bending Moment	ft-lb (N-m)	1.75	(2.37)
Weight	lb/ft (kg/m)	0.165	(0.25)
Tensile Strength	lb (kg)	350	(158.9)
Flat Plate Crush	lb/in. (kg/mm)	40	(0.71)

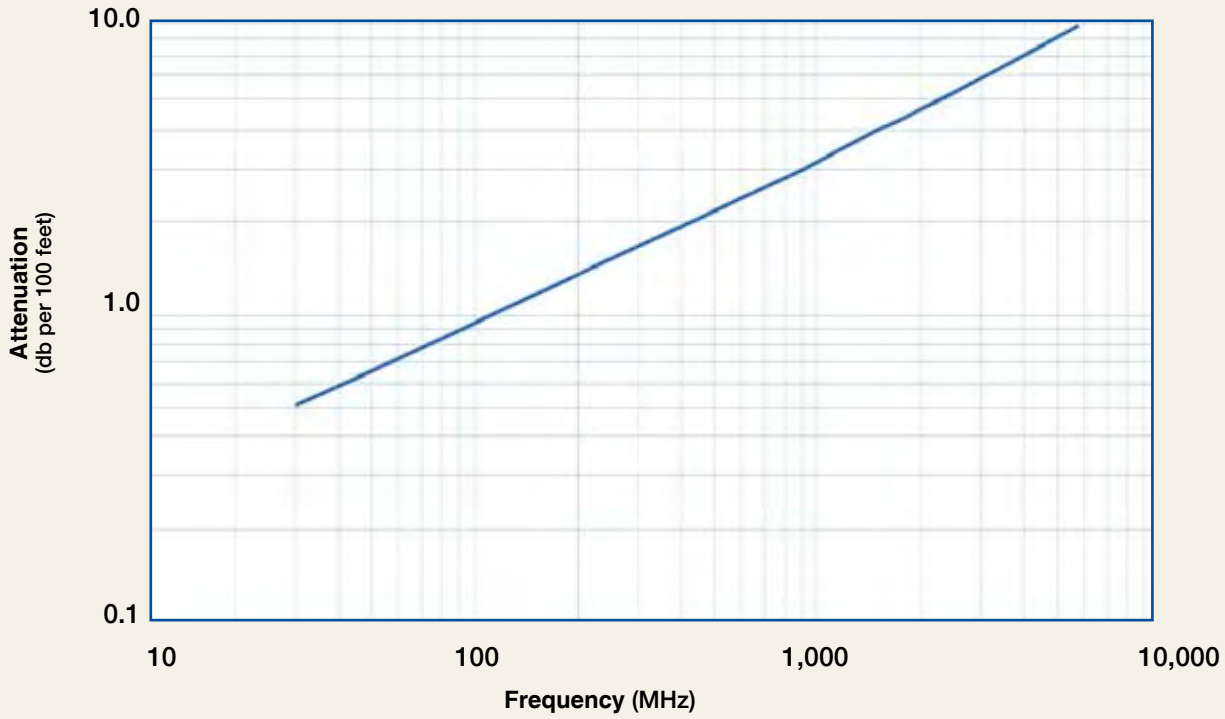
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	87	
Dielectric Constant	NA	1.32	
Time Delay	nS/ft (nS/m)	1.17	(3.83)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.4	(76.6)
Inductance	uH/ft (uH/m)	0.058	(0.19)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.43	(1.42)
Outer Conductor	ohms/1000ft (/km)	1.2	(3.9)
Voltage Withstand	Volts DC	4000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	40	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	0.5	0.7	1.2	1.4	2.1	3.0	4.0	4.4	4.7	5.3	8.7
Attenuation dB/100 m	1.7	2.2	3.8	4.6	6.8	9.8	13.1	14.5	15.3	17.4	28.6
Avg. Power kW	4.59	3.53	2.00	1.64	1.12	0.77	0.58	0.52	0.49	0.43	0.26

Calculate Attenuation =
(0.090660) • $\sqrt{FMHz}$ + (0.000312) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation:
VSWR=1.0; Ambient = +25°C (77°F)
Power:
VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR®-600-UF
UltraFlex Communications Coax

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
1. 7-16 DIN Female	Straight Jack	TC-600-716-FC	3190-375	<1.25:1 (2.5)	NA	Solder	Clamp	S/S	1.1	(28)	1.00	(25.4)	0.249	(112.9)
2. 7-16 DIN Male	Straight Plug	TC-600-716-MC	3190-502	<1.25:1 (2.5)	Hex	Solder	Clamp	S/S	2.0	(51)	1.30	(33.0)	0.347	(157.4)
3.	Right Angle	TC-600-716M-RA	3190-395	<1.35:1 (2.5)	Hex	Solder	Crimp	S/S	1.4	(36)	1.40	(35.6)	0.354	(160.8)
4. N Male	Straight Plug	TC-600-NMC	3190-357*	<1.25:1 (2.5)	Hex	Solder	Clamp	S/G	2.1	(53)	0.92	(23.4)	0.208	(93.4)
5.	Right Angle	TC-600-NMC-RA	3190-233	<1.35:1 (2.5)	Hex	Solder	Clamp	S/G	2.1	(53)	0.92	(23.4)	0.280	(117.9)
6.	Right Angle	TC-600-NMH-RA-D	3190-2427	<1.35:1(6)	Hex	Solder	Crimp	A/G	1.8	(46.5)	1.62	(41.2)	0.185	(84.3)
7.	Straight Plug	TC-600-NMH-75/50	3190-1610	<1.35:1 (6)	Hex	Solder	Crimp	N/G	2.1	(52.8)	0.91	(23.1)	0.130	(59.0)
8. TNC	Straight Plug	TC-600-TM-RP	3190-1064	<<1.35:1 (6)	Knurl	Solder	Crimp	N/G	1.6	(40.2)	0.68	(17.0)	0.090	(40.8)
9.	Straight Plug	TC-600-TM-X	3190-2530	<1.25:1 (6)	Hex/Knurl	Solder	Crimp	A/G	2.3	(57.6)	0.75	(19.0)	0.100	(45.6)
10. N Female	Bulkhead Jack	TC-600-NF-BH	3190-589*	<1.25:1 (2.5)	NA	Solder	Crimp	S/G	2.4	(61)	0.88	(22.4)	0.195	(88.5)
11.	Bulkhead Jack	TC-600-NFC-BH	3190-466	<1.25:1 (2.5)	NA	Solder	Clamp	S/G	2.2	(56)	0.94	(23.9)	0.214	(97.1)
12. UHF Male	Straight Plug	TC-600-UMC	3190-213	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G	1.7	(43)	0.88	(22.4)	0.198	(89.8)
13. N Male	Straight Plug	TC-600-NMH-X	3190-2628	<1.25:1 (8)	Hex/Knurl	Solder	Crimp	A/G	2.1	(53)	0.92	(23.4)	0.166	(75.3)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Y1720
3190-203

HX-4
3190-200

CCT-01
3190-1544

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1720	3190-203	.610" Hex Dies
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

GK-S600TT

CS-A600T,
CS-60120T, CS-60170T

Hanger Block Supporting Hardware

SC-600T

Standard Entry Panels

HG-600T

CB-600T

Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S600TT	GK-S600TT	Standard Grounding Kit (each)
Hoisting Grip	HG-600T	HG-600T	Split/Laced Type (each)
Cold Shrink	CS-A600T	CS-A600T	Cable to Antenna Junction (each)
Cold Shrink	CS-60120T	CS-60120T	LMR-600 to -1200 Junction (each)
Cold Shrink	CS-60170T	CS-60170T	LMR-600 to -1700 Junction (each)
Standard Entry Port Cushion	SC-600T-3	SC-600T-3	Three Cables (each)
Standard Entry Panels	Full Range of Port Styles/Combinations Available		
Hanger Blocks	CB-600T	CB-600T	Dual Cable Support Block (kit of 10)
Hanger Block Supporting Hardware	Complete Range of Supporting Hardware & Adapters Available		

TIMES MICROWAVE SYSTEMS

LMR®-195-LLPL
Flexible Low Loss Plenum Coax

Ideal for...

- Indoor Plenum Feeder runs
- Drop in replacement for RG-142
- UL/NEC/CSA rated CMP/FT6
- Any wireless application (e.g. LMDS, MMDS, WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Cellular, PCS, Paging) requiring an easily routed, low loss RF cable for in-building systems

- **LMR®- LLPL** is an indoor highly fire retarded cable intended specifically for runs within return air handling plenums (e.g. dropped ceilings, raised floors). It has a UL/NEC & CSA rating of 'CMP' and 'FT6' respectively.
- **Flexibility** and bendability are hallmarks of the LMR-195-LLPL cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.
- **Low Loss** is another hallmark feature of LMR-195-LLPL. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.
- **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).
- **Weatherability:** LMR-195-LLPL cables are designed for indoor Plenum applications. Black jacketed LMR-LLPL versions can be supplied for applications that originate outdoors (e.g., rooftop) and subsequently enter the building.
- **Connectors:** A variety of connectors are available for LMR-195-LLPL cable, including the most common interface types. Most employ crimp outer attachment using standard hex crimp sizes.
- **Cable Assemblies:** All LMR-195-LLPL cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				
Part No.	Application	Jacket	Color	Stock Code
LMRR-195-LLPL	Indoor/Outdoor Plenum CMP/FT-6	FRPVC	Orange	54211

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.037	(0.94)
Dielectric	Low density PTFE	0.113	(2.87)
Outer Conductor	Aluminum Tape	0.119	(3.02)
Overall Braid	Tinned Copper	0.142	(3.61)
Jacket	Orange FRPVC	0.195	(4.95)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.5	(12.7)
Bend Radius: repeated	in. (mm)	2.0	(50.8)
Bending Moment	ft-lb (N-m)	0.1	(0.14)
Weight	lb/ft (kg/m)	0.021	(0.03)
Tensile Strength	lb (kg)	40	(18.2)
Flat Plate Crush	lb/in. (kg/mm)	10	(0.18)

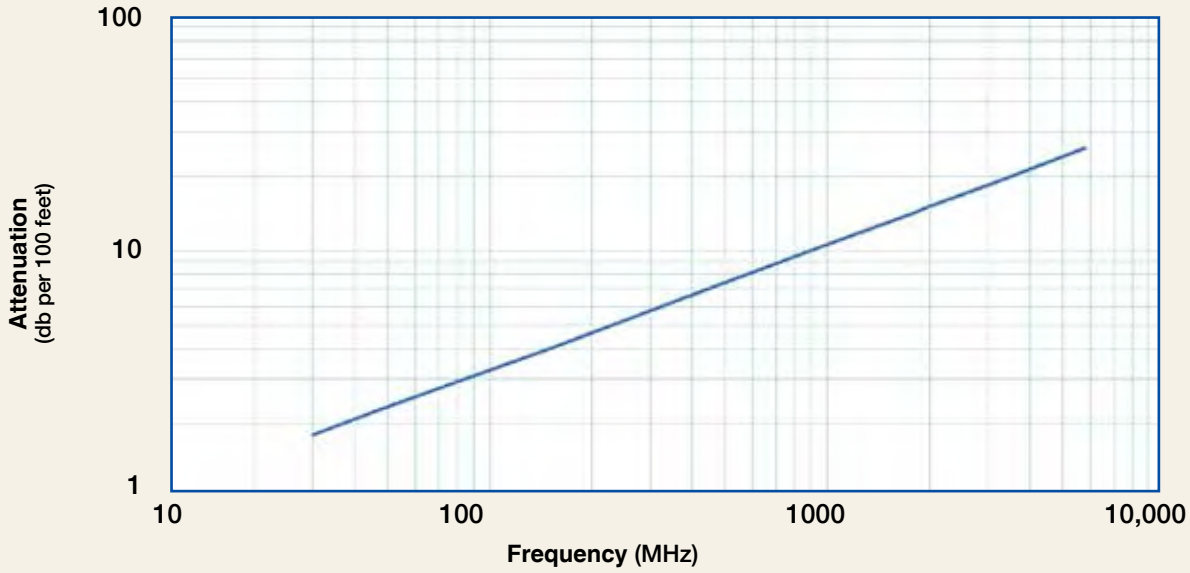
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	+23/+167	-5/+75
Storage Temperature Range	+23/+167	-5/+75
Operating Temperature Range	+23/+167	-5/+75

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	7.6	(24.9)
Outer Conductor	ohms/1000ft (/km)	4.9	(16.1)
Voltage Withstand	Volts DC	1000	
Jacket Spark	Volts RMS	3000	
Peak Power	kW	2.5	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	2.0	2.5	4.4	5.3	7.8	10.9	14.1	15.4	16.3	18.3	21.4	28.2
Attenuation dB/100 m	6.4	8.3	14.4	17.5	25.1	35.6	46.2	50.7	53.5	60.0	70.2	92.5
Avg. Power kW	0.70	0.54	0.31	0.26	0.18	0.12	0.10	0.09	0.08	0.07	0.06	0.05

Calculate Attenuation =
(0.356297) •$\sqrt{\text{FMHz}}$ + (0.000183) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation:
VSWR=1.0 ; Ambient = +25°C (77°F)
Power:
VSWR=1.0; Ambient = +40°C; Jacket = +75°C (167°F); Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. N male	Straight Plug	TC-195-NM	3190-1555	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.5 (38.1)	0.75 (19.1)	0.073 (33.1)
2. SMA male	Straight Plug	TC-195-SM	3190-1553	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0 (25.4)	0.32 (8.1)	0.015 (6.8)
3. TNC male	Straight Plug	TC-195-TM	3190-1554	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.4 (35.6)	0.59 (15.0)	0.045 (20.4)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100, 195, 200 and 240 connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Strip Tool	CST-195/200	3192-102	Combination prep tool for LMR-195 & 200
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all strip tools

TIMES MICROWAVE SYSTEMS

LMR®-200-LLPL
Flexible Low Loss Plenum Coax

Ideal for...

- Indoor Plenum Feeder runs
- UL/NEC/CSA rated CMP/FT6
- Any wireless application (e.g. LMDS, MMDS, WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Cellular, PCS, Paging) requiring an easily routed, low loss RF cable for in-building systems

• **LMR®- LLPL** is an indoor highly fire retarded cable intended specifically for runs within return air handling plenums (e.g. dropped ceilings, raised floors). It has a UL/NEC & CSA rating of 'CMP' and 'FT6' respectively.

• **Flexibility** and bendability are hallmarks of the LMR-200-LLPL cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-200-LLPL. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-200-LLPL cables are designed for indoor Plenum applications. Black jacketed LMR-LLPL versions can be supplied for applications that originate outdoors (e.g., rooftop) and subsequently enter the building.

• **Connectors:** A variety of connectors are available for LMR-200-LLPL cable, including the most common interface types. Most employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-200-LLPL cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				
Part No.	Application	Jacket Color		Stock Code
LMR-200-LLPL	Indoor/Outdoor Plenum CMP/FT6	FRPVC	Orange	54058

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid Bare Copper	0.040	(1.02)
Dielectric	Low density PTFE	0.118	(3.00)
Outer Conductor	Aluminum Tape	0.123	(3.12)
Overall Braid	Tinned Copper	0.146	(3.71)
Jacket	Orange FRPVC	0.195	(4.95)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.5	(12.7)
Bend Radius: repeated	in. (mm)	2.0	(50.8)
Bending Moment	ft-lb (N-m)	0.2	(0.27)
Weight	lb/ft (kg/m)	0.032	(0.05)
Tensile Strength	lb (kg)	30	(13.6)
Flat Plate Crush	lb/in. (kg/mm)	65	(1.16)

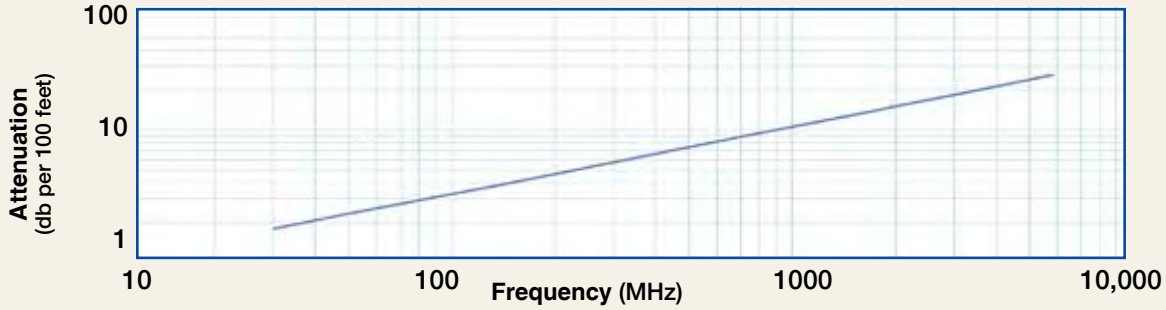
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	+23/+167	-5/+75
Storage Temperature Range	+23/+167	-5/+75
Operating Temperature Range	+23/+167	-5/+75

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	6.5	(21.3)
Outer Conductor	ohms/1000ft (/km)	4.9	(16.1)
Voltage Withstand	Volts DC	1000	
Jacket Spark	Volts RMS	3000	
Peak Power	kW	2.5	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	1.8	2.3	4.1	4.9	7.1	10.0	13.0	14.3	15.1	16.0	19.8	26.1
Attenuation dB/100 m	5.9	7.7	13.3	16.1	23.2	32.9	42.7	48.9	49.5	55.5	65.0	85.7
Avg. Power kW	0.77	0.59	0.34	0.28	0.19	0.14	0.11	0.10	0.09	0.08	0.07	0.05

Calculate Attenuation = (0.329080) • $\sqrt{\text{FMHz}}$ + (0.00018) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
VSWR = 1.0, Ambient = +40C; Jacket = +75C (167F); Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
1. BNC Male	Straight Plug	TC-200-BM	3190-225	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.7	(43.2)	0.56	(14.2)	0.045	(20.4)
2. Mini-UHF	Straight Plug	TC-200-MUHF	3190-444	<1.25:1 (2.5)	Knurl	Solder	Crimp	NG	1.1	(27.9)	0.45	(11.4)	0.015	(6.8)
3. N Male	Straight Plug	TC-200-NM	3190-224	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.5	(38.1)	0.75	(19.1)	0.073	(33.1)
4.	Reverse Polarity	TC-200-NM-RP	3190-959	<1:25:1 (2.5)	Knurl	Solder	Crimp	N/G	1.5	(38.0)	0.75	(19.1)	0.073	(33.1)
5. TNC Male	Straight Plug	TC-200-TMC	3190-240	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G	1.7	(43.2)	0.59	(15.0)	0.045	(20.4)
6. TNC Female	Straight Jack	TC-200-TF	3190-263	<1.25:1 (2.5)	NA	Solder	Crimp	N/G	1.3	(33.0)	0.57	(14.5)	0.033	(15.0)
7. SMA-Male	Straight plug	TC-200-SM	3190-612	<1.25:1 (8)	Hex	Solder	Crimp	SS/G	1.0	(25.4)	0.32	(8.1)	0.015	(6.8)
8. SMA-Rev.Polarity	Straight Plug	TC-200-SM-RP	3190-327	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0	(25.4)	0.32	(8.1)	0.015	(6.8)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S200TT	GK-S200TT	Standard Ground Kit (each)

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100, 195, 200 and 240 connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Strip Tool	CST-195/200	3192-102	Combination prep tool for LMR-195/200
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Replacement Blade Kit	RB-CST	3192-086	Replacement Kit for all CST strip tools

TIMES MICROWAVE SYSTEMS

LMR®-240-LLPL
Flexible Low Loss Plenum Coax

Ideal for...

- Indoor Plenum Feeder runs
- UL/NEC/CSA rated CMP/FT6
- Any wireless application (e.g. LMDS, MMDS, WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Cellular, PCS, Paging) requiring an easily routed, low loss RF cable for in-building systems

• **LMR®- LLPL** is an indoor highly fire retarded cable intended specifically for runs within return air handling plenums (e.g. dropped ceilings, raised floors). It has a UL/NEC & CSA rating of 'CMP' and 'FT6' respectively.

• **Flexibility** and bendability are hallmarks of the LMR-240-LLPL cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-240-LLPL. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-240-LLPL cables are designed for indoor Plenum applications. Black jacketed LMR-LLPL versions can be supplied for applications that originate outdoors (e.g., rooftop) and subsequently enter the building.

• **Connectors:** A variety of connectors are available for LMR-240-LLPL cable, including the most common interface types. Most employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies:** All LMR-240-LLPL cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				
Part No.	Application	Jacket	Color	Stock Code
LMR-240-LLPL	Indoor/Outdoor Plenum CMP/FT6	FRPVC	Orange	54059

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid Bare Copper	0.051	(1.30)
Dielectric	Low density PTFE	0.150	(3.81)
Outer Conductor	Aluminum Tape	0.155	(3.94)
Overall Braid	Tinned Copper	0.178	(4.52)
Jacket	Orange FRPVC	0.240	(6.10)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.75	(19.1)
Bend Radius: repeated	in. (mm)	2.5	(63.5)
Bending Moment	ft-lb (N-m)	0.25	(0.34)
Weight	lb/ft (kg/m)	0.047	(0.07)
Tensile Strength	lb (kg)	60	(27.22)
Flat Plate Crush	lb/in. (kg/mm)	85	(1.52)

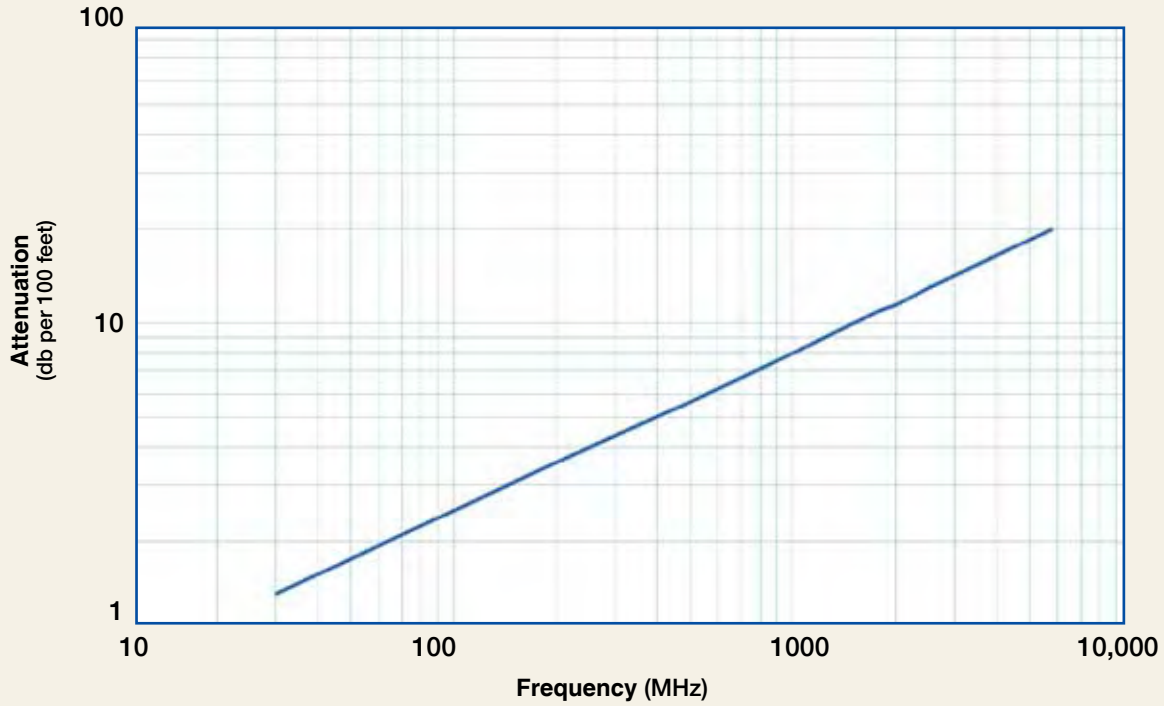
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	+23/+167	-5/+75
Storage Temperature Range	+23/+167	-5/+75
Operating Temperature Range	+23/+167	-5/+75

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	4.0	(13.1)
Outer Conductor	ohms/1000ft (/km)	3.9	(12.8)
Voltage Withstand	Volts DC	1500	
Jacket Spark	Volts RMS	5000	
Peak Power	kW	5.6	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	1.4	1.8	3.1	3.7	5.4	7.6	9,9	10.9	11.5	12.9	15.1	20.0
Attenuation dB/100 m	4.5	5,8	10.1	12.2	17.6	25.0	32.5	35.7	37.7	42.3	49.6	65.6
Avg. Power kW	1.18	0.91	0.52	0.43	0.30	0.21	0.16	0.15	0.14	0.12	0.10	0.08

Calculate Attenuation =
(0.248520) • $\sqrt{FMHz}$ + (0.000183) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation:
VSWR=1.0; Ambient = +25°C (77°F)
Power:
VSWR=1.0; Ambient = +40°C; Jacket = +75°C (167°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR®-240-LLPL
Flexible Low Loss Plenum Coax

Connectors Interface	Description	Part Number	Stock Code	VSWR** Freq.	(GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	(mm)	Width in	(mm)	Weight lb	(g)
1. BNC Male	Straight Plug	TC-240-BMC	3190-242	<1.25:1	(2.5)	Knurl	Solder	Clamp	S/G	1.7	(43)	0.56	(14.2)	0.040	(18.1)
2. Mini-UHF	Straight Plug	TC-240-MUHF	3190-445	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/G	1.1	(28)	0.45	(11.4)	0.014	(6.4))
3. N Female	Bulkhead Jack	TC-240-NF-BH	3190-419	<1.25	(2.5)	NA	Solder	Crimp	A/G	1.7	(44)	0.88	(22.2)	0.115	(52.2)
4. N Male	Straight Plug	TC-240-NM	3190-382	<1.25:1	(2.5)	Hex	Solder	Crimp	N/S	1.5	(38)	0.75	(19.1)	0.086	(39.0)
5.	Straight Plug	TC-240-NMC	3190-244	<1.25:1	(2.5)	Knurl	Solder	Clamp	S/G	1.5	(38)	0.75	(19.1)	0.082	(37.2)
6. SMA Female	Bulkhead Jack	TC-240-SF-BH	3190-824	<1.25:1	(2.5)	NA	Solder	Crimp	SS/G	1.1	(29)	0.31	(7.9)	0.019	(8.6)
7. SMA Male	Straight Plug	TC-240-SM	3190-380	<1.25:1	(10)	Hex	Solder	Crimp	SS/G	1.0	(25)	0.32	(8.1)	0.016	(7.3)
8.	Right Angle	TC-240-SM-RA	3190-381	<1.35:1	(6)	Hex	Solder	Crimp	SS/G	0.8	(20)	0.65	(16.5)	0.019	(8.6)
9.	Rev. Polarity	TC-240-SM-RP	3190-326	<1.25:1	(2.5)	Hex	Solder	Crimp	SS/G	1.0	(25)	0.32	(8.1)	0.016	(7.3)
10. TNC Male	Straight Plug	TC-240-TM	3190-275	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/S	1.7	(43)	0.59	(15.0)	0.043	(19.5)
11. N Male	Right Angle	TC-240-NMH-RA-D	3190-2426	<1.35:1	(6)	Hex/Knurl	Solder	Crimp	A/G	1.2	(32.4)	1.22	(31.0)	0.091	(41.7)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

GK-S240TT

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S240TT	GK-S240TT	Standard Ground Kit (each)

CT-240/200/195/100 - 3190-667

DBT-U
3192-001

CCT-01
3190-1544

CST-240
3192-070

RB-CST
3192-086

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100, 195, 200 and 240 connectors
Strip Tool	CST-240	3192-070	Prep tool for LMR-240 connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Replacement Blade Kit	RB-CST	3192-086	Replacement kit for all CST strip tools

TIMES MICROWAVE SYSTEMS

LMR®-300-LLPL
Flexible Low Loss Plenum Coax

Ideal for...

- Indoor Plenum Feeder runs
- UL/NEC/CSA rated CMP/FT6
- Any wireless application (e.g. LMDS, MMDS, WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Cellular, PCS, Paging) requiring an easily routed, low loss RF cable for in-building systems

- **LMR®- LLPL** is an indoor highly fire retarded cable intended specifically for runs within return air handling plenums (e.g. dropped ceilings, raised floors). It has a UL/NEC & CSA rating of 'CMP' and 'FT6' respectively.
- **Flexibility** and bendability are hallmarks of the LMR-300-LLPL cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.
- **Low Loss** is another hallmark feature of LMR-300-LLPL. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.
- **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).
- **Weatherability:** LMR-300-LLPL cables are designed for indoor Plenum applications. Black jacketed LMR-LLPL versions can be supplied for applications that originate outdoors (e.g., rooftop) and subsequently enter the building.
- **Connectors:** A variety of connectors are available for LMR-300-LLPL cable, including the most common interface types. Most employ crimp outer attachment using standard hex crimp sizes.
- **Cable Assemblies:** All LMR-300-LLPL cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				
Part Number	Application	Jacket Color		Stock Code
LMR-300-LLPL	Indoor/Outdoor Plenum CMP/FT6	FRPVC	Orange	54175

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid Bare Copper	0.063	(1.60)
Dielectric	Low density PTFE	0.190	(4.83)
Outer Conductor	Aluminum Tape	0.196	(4.98)
Overall Braid	Tinned Copper	0.225	(5.72)
Jacket	Orange FRPVC	0.300	(7.62)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.88	(22.2)
Bend Radius: repeated	in. (mm)	3.0	(76.2)
Bending Moment	ft-lb (N-m)	0.38	(0.52)
Weight	lb/ft (kg/m)	0.055	(0.08)
Tensile Strength	lb (kg)	120	(54.5)
Flat Plate Crush	lb/in. (kg/mm)	30	(0.54)

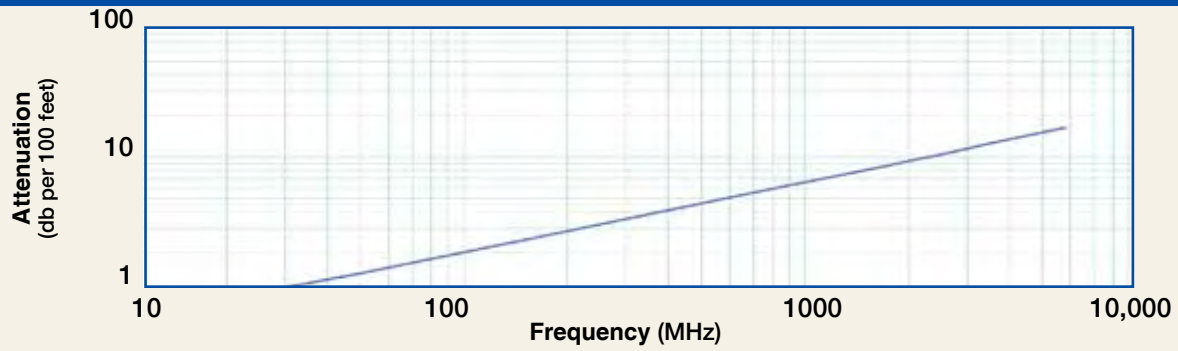
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	+23/+167	-5/+75
Storage Temperature Range	+23/+167	-5/+75
Operating Temperature Range	+23/+167	-5/+75

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	2.61	(8.6)
Outer Conductor	ohms/1000ft (/km)	2.21	(7.3)
Voltage Withstand	Volts DC	2000	
Jacket Spark	Volts RMS	5000	
Peak Power	kW	10	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	1.1	1.4	2.5	3.0	4.3	6.2	8.1	8.9	9.4	10.5	12.3	16.4
Attenuation dB/100 m	3.6	4.7	8.2	9.9	14.3	20.3	26.4	29.1	30.7	34.5	40.5	53.7
Avg. Power kW	1.72	1.33	0.77	0.63	0.44	0.31	0.24	0.21	0.20	0.18	0.15	0.11

Calculate Attenuation = (0.200950) • $\sqrt{\text{FMHz}}$ + (0.000183) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Jacket = +75°C (167°F);
Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR Freq.	(GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	(mm)	Width in	(mm)	Weight lb	(g)
1. SMA Male	Straight Plug	TC-300-SM	3190-501	<1.25:1	(2.5)	Hex	Solder	Crimp	SS/G	1.0	(25)	0.35	(8.9)	0.018	(8.2)
2. SMA Female	Bulkhead Jack	TC-300-SF-BH	3190-590	<1.25:1	(2.5)	NA	Solder	Crimp	SS/G	1.1	(28)	0.31	(7.9)	0.022	(10.0)
3. TNC Male	Straight Plug	TC-300-TM	3190-500	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/S	1.7	(43)	0.59	(15.0)	0.050	(22.7)
4. N Male	Right Angle	TC-300-NMH-RA-D	3190-2761	<1.30:1	(2.5)	Hex/Knurl	Solder	Crimp	N/S	1.4	(35)	1.41	(35.8)	0.130	(59.0)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S300TT	GK-S300TT	Standard Ground Kit (each)

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-400/300	3190-666	Crimp tool for LMR 300 connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Cutting Tool	CST-300	3192-084	Combination prep tool for LMR-300
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all strip tools

TIMES MICROWAVE SYSTEMS

LMR®-400-LLPL
Flexible Low Loss Plenum Coax

Ideal for...

- Indoor Plenum Feeder runs
- UL/NEC/CSA rated CMP/FT6
- Any wireless application (e.g. LMDS, MMDS, WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Cellular, PCS, Paging) requiring an easily routed, low loss RF cable for in-building systems

- **LMR®- LLPL** is an indoor highly fire retarded cable intended specifically for runs within return air handling plenums (e.g. dropped ceilings, raised floors). It has a UL/NEC & CSA rating of 'CMP' and 'FT6' respectively.
- **Flexibility** and bendability are hallmarks of the LMR-400-LLPL cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.
- **Low Loss** is another hallmark feature of LMR-400-LLPL. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.
- **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).
- **Weatherability:** LMR-400-LLPL cables are designed for indoor Plenum applications. Black jacketed LMR-LLPL versions can be supplied for applications that originate outdoors (e.g., rooftop) and subsequently enter the building.
- **Connectors:** A variety of connectors are available for LMR-400-LLPL cable, including the most common interface types. Most employ crimp outer attachment using standard hex crimp sizes.
- **Cable Assemblies:** All LMR-400-LLPL cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description

Part Number	Application	Jacket	Color	Stock Code
LMR-400-LLPL	Indoor/Outdoor Plenum CMP/FT6	FRPVC	Orange	54070

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.095	(2.41)
Dielectric	Low density PTFE	0.285	(7.24)
Outer Conductor	Aluminum Tape	0.291	(7.39)
Overall Braid	Tinned Copper	0.320	(8.13)
Jacket	Orange FRPVC	0.405	(10.29)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.00	(25.4)
Bend Radius: repeated	in. (mm)	4.0	(101.6)
Bending Moment	ft-lb (N-m)	0.5	(0.68)
Weight	lb/ft (kg/m)	0.114	(0.17)
Tensile Strength	lb (kg)	120	(54.5)
Flat Plate Crush	lb/in. (kg/mm)	185	(3.31)

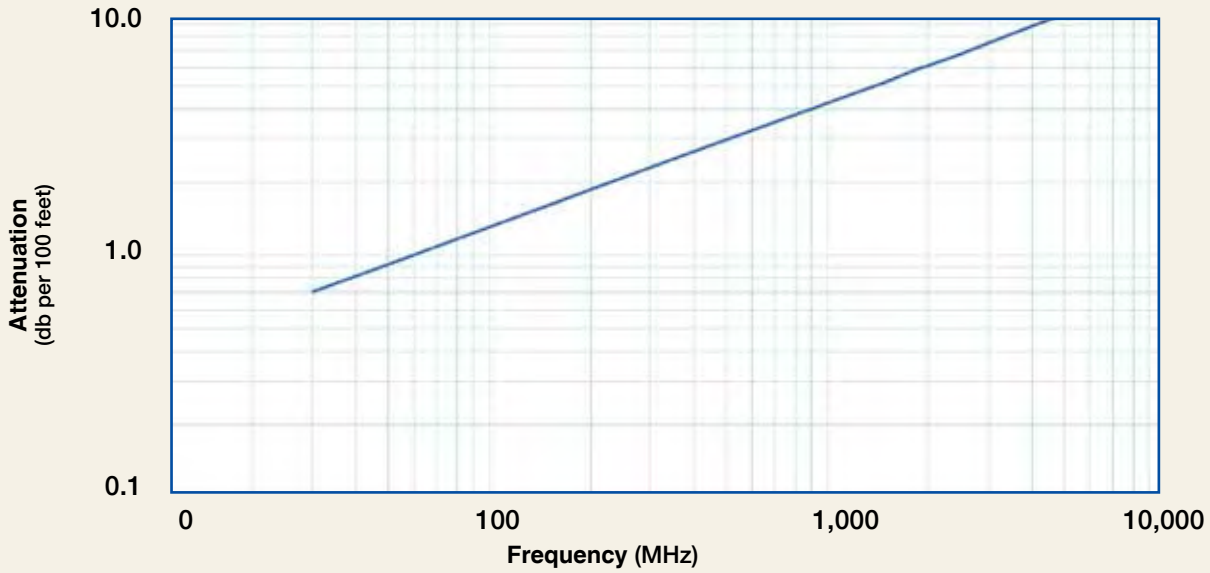
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	+23/+167	-5/+75
Storage Temperature Range	+23/+167	-5/+75
Operating Temperature Range	+23/+167	-5/+75

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	1.8	(5.9)
Outer Conductor	ohms/1000ft (/km)	1.65	(5.4)
Voltage Withstand	Volts DC	2500	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	16	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	0.7	0.9	1.6	1.9	2.8	4.0	5.2	5.7	6.1	6.8	8.0	10.7
Attenuation dB/100 m	2.3	3.0	5.3	6.4	9.2	13.2	17.1	18.9	19.9	22.4	26.4	35.1
Avg. Power kW	3.33	2.57	1.48	1.22	0.84	0.59	0.45	0.41	0.39	0.34	0.29	0.22

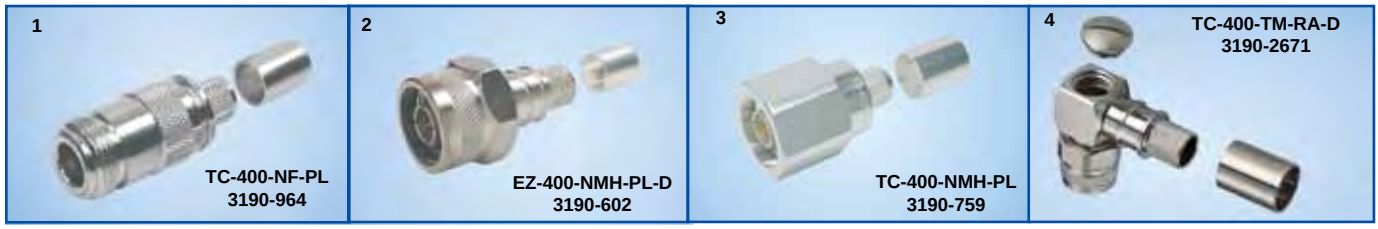
Calculate Attenuation =
$(0.129140) \bullet \sqrt{FMHz} + (0.000150) \bullet FMHz$ (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:
VSWR=1.0 ; Ambient = +25°C (77°F)

Power:
VSWR=1.0; Ambient = +40°C; Jacket = +75°C (167°F); Sea Level; dry air; atmospheric pressure; no solar loading

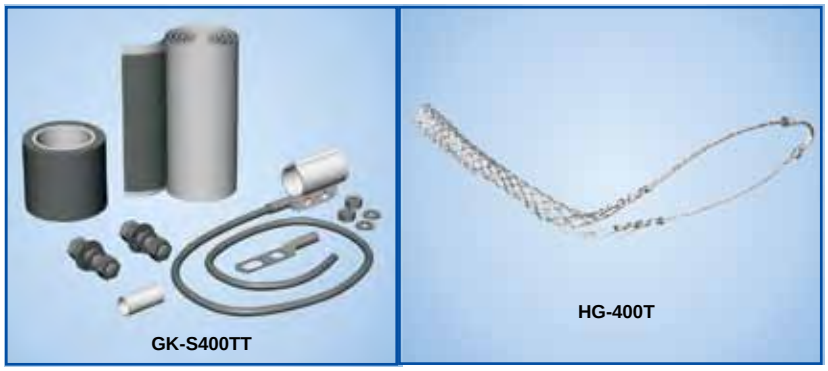
TIMES MICROWAVE SYSTEMS

LMR®-400-LLPL
Flexible Low Loss Plenum Coax



Connectors Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. N Female	Straight Jack	TC-400-NF-PL	3190-964	<1.25:1 (2.5)	NA	Solder	Crimp	N/G	1.8 (45)	0.66 (16.8)	0.105 (47.6)
2. N Male	Straight Plug	EZ-400-NMH-PL-D	3190-602	<1.25:1 (2.5)	Hex/Knurl	Spring Finger	Crimp	A/G	1.5 (38)	0.89 (22.6)	0.113 (51.3)
3.	Straight Plug	TC-400-NMH-PL	3190-759	<1.25:1 (2.5)	Hex	Solder	Crimp	S/G	1.5 (38)	0.89 (22.6)	0.113 (51.3)
4. TNC	Right Angle	TC-400-TM-RA-D	3190-2671	<1.35:1 (6)	Hex/Knurl	Solder	Crimp	A/G	1.2 (30)	1.48 (37.6)	0.110 (50.0)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair



Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S400TT	GK-S400TT	Standard Grounding Kit (each)
Hoisting Grip	HG-400T	HG-400T	Laced Type (each)

HX-4
3190-200


Y1719
3190-202


CT-400/300
3190-666


CST-400
3192-004

DBT-U
3192-001


CCT-01
3190-1544


TK-400EZ
3190-1602


GST-400
3190-2174


RB-CST
3192-086

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1719	3190-202	.429" Hex Dies
Crimp Tool	CT-400/300	3190-666	Crimp tool for LMR 400 connectors
Crimp Rings	CR-400	3190-830	Crimp rings for TC/EZ-400 connectors (package of 10)
Strip Tool	CST-400	3192-004	Combination prep tool for LMR-400 crimp and clamp connectors
Mid-Span Strip Tool	GST-400	3190-2174	For ground strap attachment
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Replacement Blade Kit	RB-CST	3192-086	Replacement kit for all CST strip tools
Tool Kit	TK-400EZ	3190-1602	Tool kit for LMR-400 crimp/clamp connectors (includes CCT-01, CST-400, CT-400/300, Tool Pouch)

TIMES MICROWAVE SYSTEMS

LMR®-500-LLPL
Flexible Low Loss Plenum Coax

Ideal for...

- Indoor Plenum Feeder runs
- UL/NEC/CSA rated CMP/FT6
- Any wireless application (e.g. LMDS, MMDS, WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Cellular, PCS, Paging) requiring an easily routed, low loss RF cable for in-building systems

- **LMR®- LLPL** is an indoor highly fire retarded cable intended specifically for runs within return air handling plenums (e.g. dropped ceilings, raised floors). It has a UL/NEC & CSA rating of 'CMP' and 'FT6' respectively.
- **Flexibility** and bendability are hallmarks of the LMR-500-LLPL cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.
- **Low Loss** is another hallmark feature of LMR-500-LLPL. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.
- **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).
- **Weatherability:** LMR-500-LLPL cables are designed for indoor Plenum applications. Black jacketed LMR-LLPL versions can be supplied for applications that originate outdoors (e.g., rooftop) and subsequently enter the building.
- **Connectors:** A variety of connectors are available for LMR-500-LLPL cable, including the most common interface types. Most employ crimp outer attachment using standard hex crimp sizes.
- **Cable Assemblies:** All LMR-500-LLPL cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.121	(3.07)
Dielectric	Low density PTFE	0.370	(9.40)
Outer Conductor	Aluminum Tape	0.376	(9.55)
Overall Braid	Tinned Copper	0.405	(10.29)
Jacket	Orange FRPVC	0.500	(12.70)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.25	(31.8)
Bend Radius: repeated	in. (mm)	5.0	(127.0)
Bending Moment	ft-lb (N-m)	1.75	(2.37)
Weight	lb/ft (kg/m)	0.174	(0.26)
Tensile Strength	lb (kg)	195	(88.5)
Flat Plate Crush	lb/in. (kg/mm)	200	(3.57)

Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	+23/+167	-5/+75
Storage Temperature Range	+23/+167	-5/+75
Operating Temperature Range	+23/+167	-5/+75

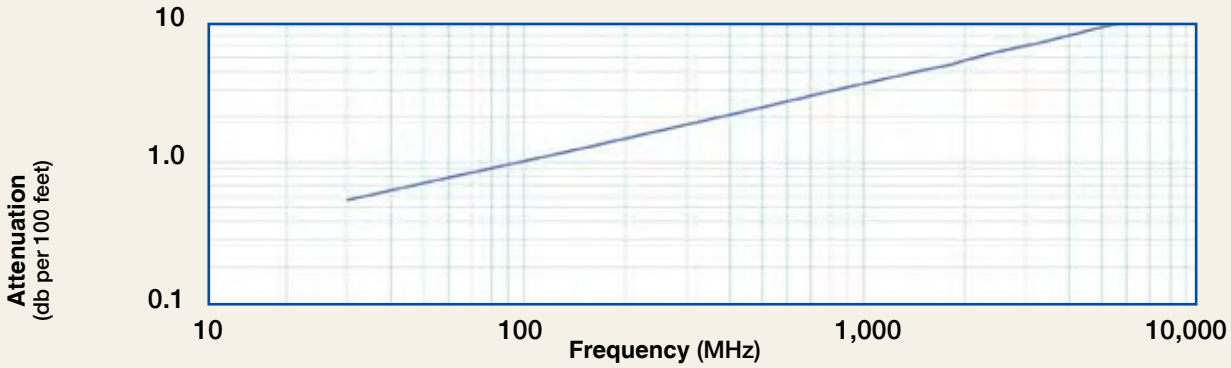
Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	1.09	(3.6)
Outer Conductor	ohms/1000ft (/km)	1.27	(4.2)
Voltage Withstand	Volts DC	3000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	11.6	

Part Description

Part Number	Application	Jacket	Color	Stock Code
LMR-500-LLPL	Indoor/Outdoor Plenum CMP/FT6	FRPVC	Orange	54060

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	0.6	0.7	1.3	1.5	2.2	3.1	4.1	4.5	4.8	5.4	6.4	8.5
Attenuaiton dB/100 m	1.8	2.4	4.1	5.0	7.2	10.3	13.5	14.8	15.7	17.7	20.9	27.9
Avg. Power kW	4.99	3.86	2.21	1.82	1.26	0.88	0.67	0.61	0.58	0.51	0.43	0.32

Calculate Attenuation = (0.100260) • $\sqrt{FMHz}$ + (0.000150) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Jacket = +75°C (167°F);
Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Number	Part Code	Stock	VSWR** Freq. (GHz)		Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	(mm)	Width in	(mm)	Weight lb	(g)
1. N Male	Straight Plug	TC-500-NMH-X	3190-2514		<1.35:5	(6)	Hex/Knurl	Solder	Crimp	A/G	1.8	(45)	0.87	(22.0)	0.099	(45.0)
2.	Right Angle	TC-500-NMH-RA-D	3190-2513		<1.25:1	(6)	Hex/Knurl	Solder	Crimp	A/G	1.5	(39)	1.6	(42.0)	0.279	(127.0)
3.	Straight Plug	TC-500-NMC-PL	3190-900		<1.25:1	(2.5)	Hex	Solder	Clamp	S/G	2.1	(53)	0.92	(23.4)	0.228	(103.4)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y151	3190-465	.532" Hex Dies
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Strip Tool	CST-500	3192-075	Combination prep tool for LMR-500
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST strip tools
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

TIMES MICROWAVE SYSTEMS

LMR®-600-LLPL
Flexible Low Loss Plenum Coax

Ideal for...

- Indoor Plenum Feeder runs
- UL/NEC/CSA rated CMP/FT6
- Any wireless application (e.g. LMDS, MMDS, WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Cellular, PCS, Paging) requiring an easily routed, low loss RF cable for in-building systems

- **LMR®- LLPL** is an indoor highly fire retarded cable intended specifically for runs within return air handling plenums (e.g. dropped ceilings, raised floors). It has a UL/NEC & CSA rating of 'CMP' and 'FT6' respectively.
- **Flexibility** and bendability are hallmarks of the LMR-600-LLPL cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.
- **Low Loss** is another hallmark feature of LMR-600-LLPL. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.
- **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).
- **Weatherability:** LMR-600-LLPL cables are designed for indoor Plenum applications. Black jacketed LMR-LLPL versions can be supplied for applications that originate outdoors (e.g., rooftop) and subsequently enter the building.
- **Connectors:** A variety of connectors are available for LMR-600-LLPL cable, including the most common interface types. Most employ crimp outer attachment using standard hex crimp sizes.
- **Cable Assemblies:** All LMR-600-LLPL cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description

Part Number	Application	Jacket	Color	Stock Code
LMR-600-LLPL	Indoor/Outdoor CMP/FT6	Plenum FRPVC	Orange	54061

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.150	(3.81)
Dielectric	Low density PTFE	0.455	(11.56)
Outer Conductor	Aluminum Tape	0.461	(11.71)
Overall Braid	Tinned Copper	0.490	(12.45)
Jacket	Orange FRPVC	0.590	(14.99)

Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	+23/+167	-5/+75
Storage Temperature Range	+23/+167	-5/+75
Operating Temperature Range	+23/+167	-5/+75

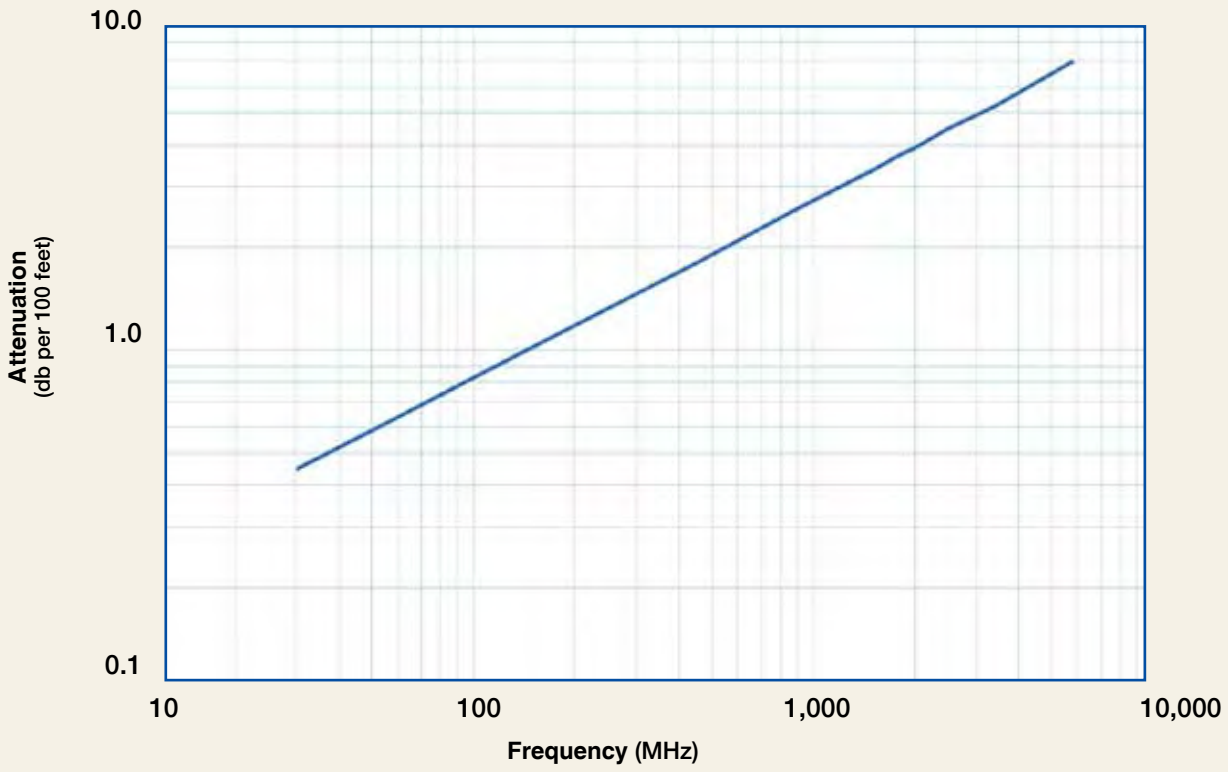
Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.73	(2.40)
Outer Conductor	ohms/1000ft (/km)	1.20	(3.9)
Voltage Withstand	Volts DC	4000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	40	

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.5	(38.1)
Bend Radius: repeated	in (mm)	6.0	(152.4)
Bending Moment	ft-lb (N-m)	2.75	(3.73)
Weight	lb/ft (kg/m)	0.24	(0.36)
Tensile Strength	lb (kg)	265	(120.3)
Flat Plate Crush	lb/in. (kg/mm)	210	(3.75)

Attenuation vs. Frequency **(typical)**

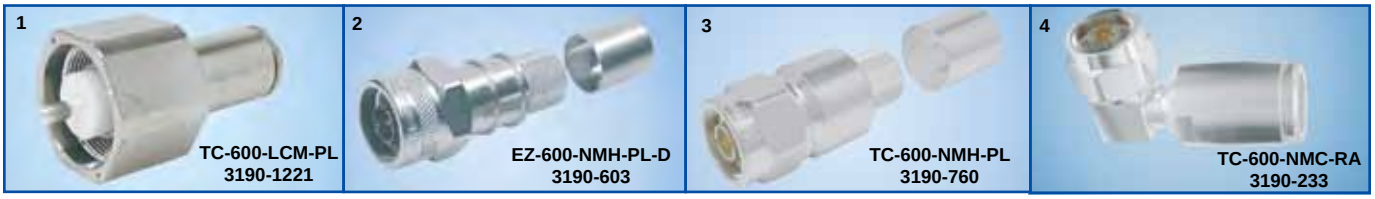


Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	0.5	0.6	1.0	1.2	1.8	2.6	3.4	3.7	3.9	4.4	5.3	7.1
Attenuation dB/100 m	1.5	1.9	3.3	4.1	5.9	8.5	11.1	12.2	12.9	14.5	17.2	23.2
Avg. Power kW	6.97	5.39	3.08	2.53	1.75	1.22	0.93	0.84	0.79	0.70	0.59	0.44

Calculate Attenuation =
(0.081390) • $\sqrt{FMHz}$ + (0.000150) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation:
VSWR=1.0 ; Ambient = +25°C (77°F)
Power:
VSWR=1.0; Ambient = +40°C; Jacket = +75°C (167°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

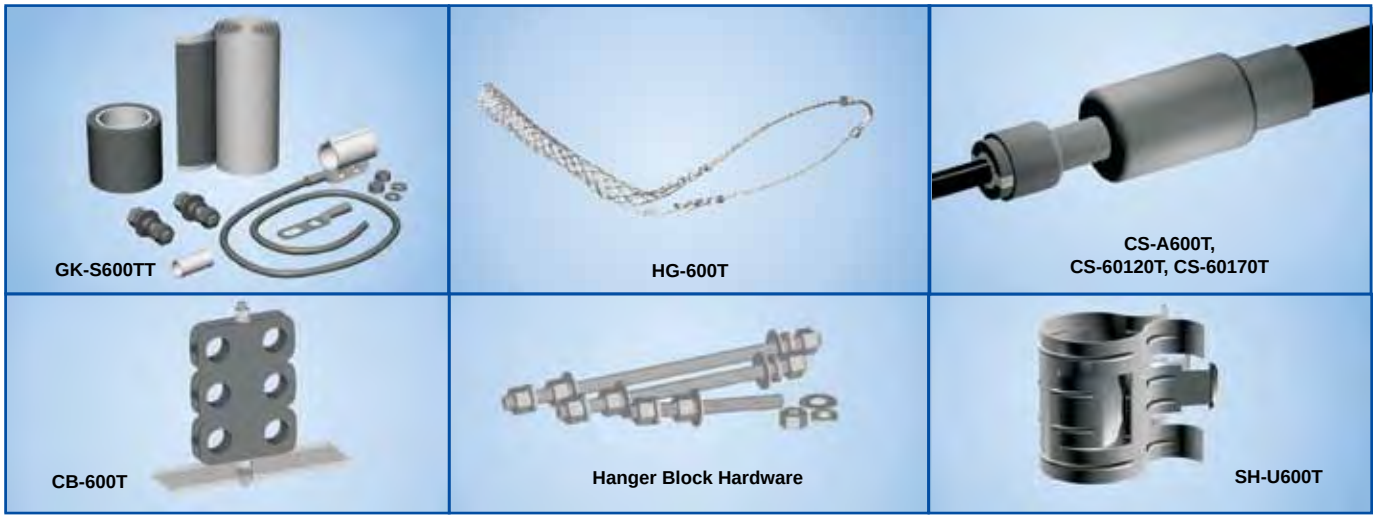
LMR®-600-LLPL
Flexible Low Loss Plenum Coax



Connectors

Interface	Part Description	Stock Number	Code	VSWR** Freq.	Coupling (GHz)	Contact Nut	Contact Attach	Inner Body Attach	Outer /Pin	Finish* Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
1. LC Male	Straight plug	TC-600-LCM-PL	3190-1221	<1.25:1	(1)	Hex	Solder	Clamp	N/S	3.1	(78.7)	1.62	(41.1)	1.20	(544)
2. N Male	Straight Plug	EZ-600-NMH-PL-D	3190-603	<1.25:1	(2.5)	Hex/Knurl	Spring Finger	Crimp	A/G	2.1	(53)	0.92	(23.4)	0.166	(75.3)
3.	Straight Plug	TC-600-NMH-PL	3190-760	<1.25:1	(2.5)	Hex	Solder	Crimp	S/G	2.1	(53)	0.92	(23.4)	0.208	(93.4)
4.	Right Angle	TC-600-NMC-RA	3190-233	<1.35:1	(2.5)	Hex	Solder	Clamp	S/G	2.1	(53)	0.92	(23.4)	0.280	(17.9)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair



Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S600TT	GK-S600TT	Standard Grounding Kit (each)
Hoisting Grip	HG-600T	HG-600T	Split/Laced Type (each)
Cold Shrink	CS-A600T	CS-A600T	Cable to Antenna Junction (each)
Cold Shrink	CS-60120T	CS-60120T	LMR-600 to -1200 Junction (each)
Cold Shrink	CS-60170T	CS-60170T	LMR-600 to -1700 Junction (each)
Hanger Blocks	CB-600T	CB-600T	Dual Cable Support Block (kit of 10)
Hanger Block Supporting Hardware			Complete Range of Supporting Hardware & Adapters Available
Snap-In Hangers	SH-U600T	SH-U600T	Snap-In Hangers (Kit of 10)

HX-4
3190-200

Y1720
3190-203

CR-600
3190-831

TK-600EZ
3190-1602

RB-CST
3192-086

DBT-U
3192-001

CST-600
3192-052

GST-600A
3190-1051

CCT-01
3190-1544

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1720	3190-203	.610" Hex Dies
Crimp Rings	CR-600	3190-831	Crimp Rings for TC/EZ-600 connectors (pkg of 10)
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Midspan Strip Tool	GST-600A	3190-1051	For ground strap attachment
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Replacemnt Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST strip tools
Replacement Blades	RB-456	3190-421	Replacement blades for CST-600C and ST-600EZ
Prep Tool	CST-600	3192-052	Prep tool for LMR-600 crimp/clamp style connectors
Tool Kit	TK-600EZ	3190-1602	Tool kit for LMR-600 crimp/clamp connectors (includes CCT-01, CST-600, HX-4, Y1720, Tool Pouch)

TIMES MICROWAVE SYSTEMS

LMR®-900-LLPL
Flexible Low Loss Plenum Coax

Ideal for...

- Indoor Plenum Feeder runs
- UL/NEC/CSA rated CMP/FT6
- Any wireless application (e.g. LMDS, MMDS, WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Cellular, PCS, Paging) requiring an easily routed, low loss RF cable for in-building systems

• **LMR®- LLPL** is an indoor highly fire retarded cable intended specifically for runs within return air handling plenums (e.g. dropped ceilings, raised floors). It has a UL/NEC & CSA rating of 'CMP' and 'FT6' respectively.

• **Flexibility** and bendability are hallmarks of the LMR-900-LLPL cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-900-LLPL. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-900-LLPL cables are designed for indoor Plenum applications. Black jacketed LMR-LLPL versions can be supplied for applications that originate outdoors (e.g., rooftop) and subsequently enter the building.

• **Connectors:** Type-N and 7-16 male and female connectors are available for LMR-900-LLPL cable. Other interface types can be provided by using a short jumper cable assembly.

• **Cable Assemblies:** All LMR-900-LLPL cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description

Part Number	Application	Jacket	Color	Stock Code
LMR-900-LLPL	Indoor/Outdoor Plenum CMP/FT6	FRPVC	Orange	54062

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	BC Tube	0.227	(5.77)
Dielectric	Low density PTFE	0.680	(17.27)
Outer Conductor	Aluminum Tape	0.686	(17.42)
Overall Braid	Tinned Copper	0.732	(18.59)
Jacket	Orange FRPVC	0.870	(22.10)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	3.00	(76.2)
Bend Radius: repeated	in. (mm)	9.0	(228.6)
Bending Moment	ft-lbs (N-m)	9.0	(12.20)
Weight	lbs/ft (kg/m)	0.542	(0.81)
Tensile Strength	lbs (kg)	660	(299.6)
Flat Plate Crush	lbs/in. (kg/mm)	300	(5.36)

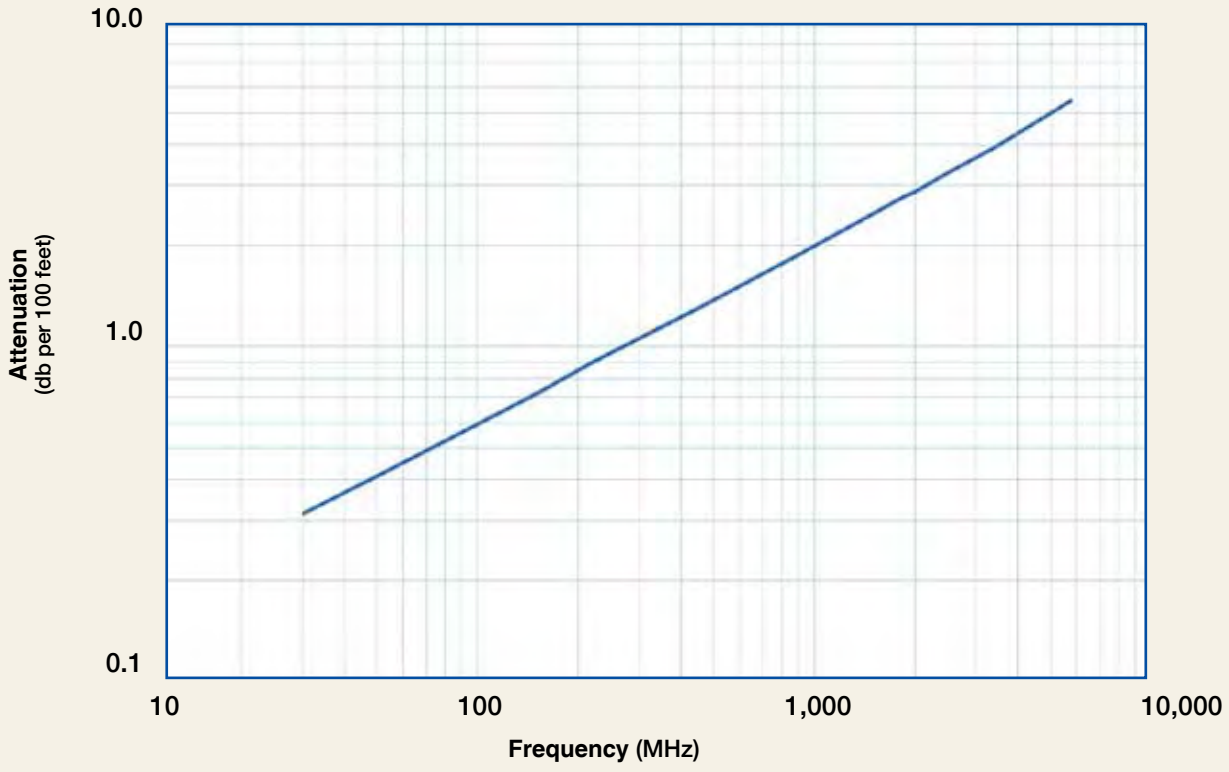
Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.63	(2.07)
Outer Conductor	ohms/1000ft (/km)	0.55	(1.8)
Voltage Withstand	Volts DC	5000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	62	

Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	+23/+167	-5/+75
Storage Temperature Range	+23/+167	-5/+75
Operating Temperature Range	+23/+167	-5/+75

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	0.3	0.4	0.7	0.9	1.3	1.9	2.5	2.8	2.9	3.3	4.0	5.4
Attenuation dB/100 m	1.0	1.4	2.4	2.9	4.3	6.2	8.2	9.0	9.6	10.9	13.0	17.8
Avg. Power kW	13.21	10.18	5.77	4.74	3.25	2.24	1.69	1.52	1.44	1.26	1.06	0.77

Calculate Attenuation =
(0.057220) • $\sqrt{FMHz}$ + (0.000183) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation:
VSWR=1.0 ; Ambient = +25°C (77°F)
Power:
VSWR=1.0; Ambient = +40°C; Jacket = +75°C (167°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR®-900-LLPL
Flexible Low Loss Plenum Coax


1
EZ-900-716MC-PL-2
3190-1549


2
EZ-900-NFC-PL-2
3190-1586


3
EZ-900-NMC-PL-2
3190-1585

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq.	(GHz)	Coupling Nut	Contact Attach	Inner Contact Attach	Outer Finish* Body /Pin	Length in	(mm)	Width in	(mm)	Weight lb	(g)
1. 716 Male	Straight Plug	EZ-900-716-MC-PL-2	3190-1549	<1.25:1	(2.5)	Hex	Press Fit	Clamp	S/S	2.0	(51)	1.44	(36.6)	0.485	(220.0)
2. N Female	Straight Jack	EZ-900-NFC-PL-2	3190-1586	<1.25:1	(2.5)	NA	Press Fit	Clamp	S/G	2.0	(51)	1.38	(35.1)	0.443	(200.9)
3. N Male	Straight Plug	EZ-900-NMC-PL-2	3190-1585	<1.25:1	(2.5)	Hex/Knurl	Press Fit	Clamp	S/S	2.0	(51)	1.38	(35.1)	0.463	(210.0)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair


ST900C
3190-1310


GST-900A
3190-435


CCT-01
3190-1544


WR-900
3190-510

Install Tools

Type	Part Number	Stock Code	Description
Strip Tool	ST-900C	3190-1310	For LMR 900 Clamp Style Connectors
Midspan Strip Tool	GST-900A	3190-435	For Ground Strap Attachment
Wrenches	WR-900	3190-510	1-1/4" Box Wrench (2 required)
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool


GK-S900TT


HG-900T


CS-A900T, CS-90120T, CS-90170T


Standard Entry Port Cushion


Standard Entry Panels


CB-900T


Hanger Block Supporting Hardware


SH-U900T

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S900TT	GK-S900TT	Standard Grounding Kit (each)
Hoisting Grip	HG-900T	HG-900T	Split/Laced Type (each)
Cold Shrink	CS-A900T	CS-A900T	Cable to Antenna Junction (each)
Cold Shrink	CS-90120T	CS-90120T	LMR-900 to -1200 Junction (each)
Cold Shrink	CS-90170T	CS-90170T	LMR-900 to -1700 Junction (each)
Port Cushion	SC-900T-3	SC-900T-3	Three Cables (each)
Standard Entry Panels			Full Range of Port Styles/Combinations Available
Hanger Blocks	CB-900T	CB-900T	Dual Cable Support Block (kit of 10)
Hanger Block Supporting Hardware			Complete Range of Supporting Hardware and Adapters Available
Snap-in Hangers	SH-U900T	SH-U900T	Snap-in Hanger (Kit of 10)

TIMES MICROWAVE SYSTEMS

LMR®-1200-LLPL
Flexible Low Loss Plenum Coax

Ideal for...

- Indoor Plenum Feeder runs
- UL/NEC/CSA rated CMP/FT6
- Any wireless application (e.g. LMDS, MMDS, WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Cellular, PCS, Paging) requiring an easily routed, low loss RF cable for in-building systems

• **LMR®- LLPL** is an indoor highly fire retarded cable intended specifically for runs within return air handling plenums (e.g. dropped ceilings, raised floors). It has a UL/NEC & CSA rating of 'CMP' and 'FT6' respectively.

• **Flexibility** and bendability are hallmarks of the LMR-1200-LLPL cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-1200-LLPL. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-1200-LLPL cables are designed for indoor Plenum applications. Black jacketed LMR-LLPL versions can be supplied for applications that originate outdoors (e.g., rooftop) and subsequently enter the building.

• **Connectors:** Type-N male and female connectors are available for LMR-1200-LLPL cable. Other interface types can be provided by using a short jumper cable assembly.

• **Cable Assemblies:** All LMR-1200-LLPL cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description

Part Number	Application	Jacket	Color	Stock Code
LMR-1200-LLPL	Indoor/Outdoor Plenum CMP/FT6	FRPVC	Orange	54063

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	BC Tube	0.310	(7.87)
Dielectric	Low density PTFE	0.920	(23.37)
Outer Conductor	Aluminum Tape	0.926	(23.52)
Overall Braid	Tinned Copper	0.972	(24.69)
Jacket	Orange FRPVC	1.200	(30.48)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	6.50	(165.1)
Bend Radius: repeated	in.s (mm)	12.0	(304.8)
Bending Moment	ft-lbs (N-m)	15.0	(20.34)
Weight	lbs/ft (kg/m)	0.7	(1.04)
Tensile Strength	lbs (kg)	975	(442.7)
Flat Plate Crush	lbs/in. (kg/mm)	375	(6.70)

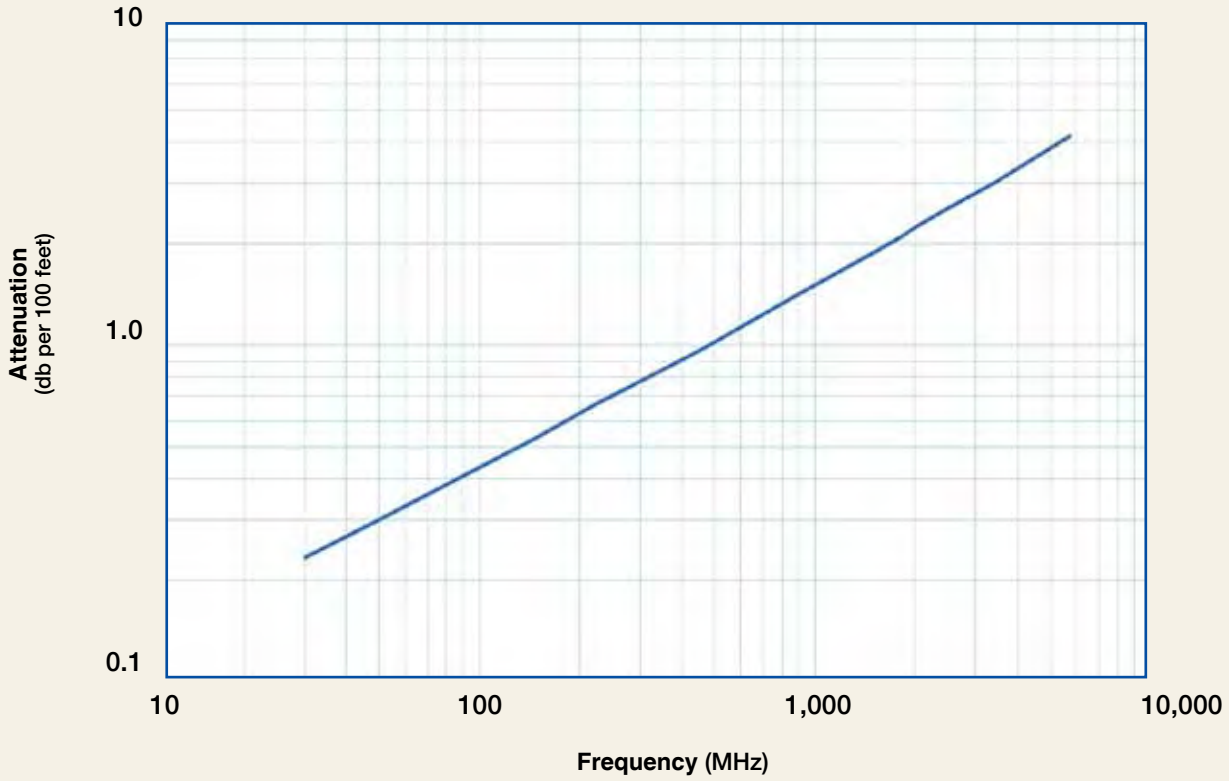
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	+23/+167	-5/+75
Storage Temperature Range	+23/+167	-5/+75
Operating Temperature Range	+23/+167	-5/+75

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.37	(1.21)
Outer Conductor	ohms/1000ft (/km)	0.37	(1.2)
Voltage Withstand	Volts DC	6000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	90	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400
Attenuation dB/100 ft	0.2	0.3	0.5	0.7	1.0	1.4	1.9	2.1	2.2	2.5	3.1
Attenuation dB/100 m	0.8	1.0	1.8	2.2	3.2	4.6	6.2	6.9	7.3	8.3	10.0
Avg. Power kW	23.42	18.01	10.17	8.31	5.66	3.86	2.90	2.60	2.45	2.15	1.79

Calculate Attenuation =
(0.041720) • $\sqrt{FMHz}$ + (0.000183) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation:
VSWR=1.0 ; Ambient = +25°C (77°F)
Power:
VSWR=1.0; Ambient = +40°C; Jacketr = +75°C (167°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR®-1200-LLPL
Flexible Low Loss Plenum Coax

Connectors Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Contact Attach	Inner Contact Attach	Outer Body /Pin	Finish*	Length in (mm)	Width in (mm)	Weight lb (g)
1. N Female	Straight Jack	EZ-1200-NFC-PL	3190-912	<1.25:1 (2.5)	NA	Press Fit	Clamp	S/S		2.0 (51)	1.65(41.9)	0.650(294.8)
2. N Male	Straight Plug	EZ-1200-NMC-PL	3190-911	<1.25:1 (2.5)	Hex	Press Fit	Clamp	S/S		2.0 (51)	1.65(41.9)	0.659(298.9)

* Finishes: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Install Tools

Type	Part Number	Stock Code	Description
Midspan Strip Tool	GST-1200A	3190-436	For Ground Strap Attachment
Wrench	WR-1200A	3190-512	1-9/16" Box Wrench (1 required)
Wrench	WR-1200B	3190-511	1-7/16" Box Wrench (1 required)
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Strip Tool	ST-1200-CH	3192-124	For LMR-1200 clamp style connectors
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool


GK-S1200TT


HG-1200T


CS-90120T, CS-60120T


SC-1200T


Standard Entry Panels


CB-1200T


Hanger Block Supporting Hardware


SH-U1200T

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S1200TT	GK-S1200TT	Standard Grounding Kit (each)
Hoisting Grip	HG-1200T	HG-1200T	Split/Laced Type (each)
Cold Shrink	CS-90120T	CS-90120T	LMR-900 to -1200 Junction (each)
Cold Shrink	CS-60120T	CS-60120T	LMR-600 to -1200 Junction (each)
Standard Entry Port Cushion	SC-1200T-3	SC-1200T-3	Three Cables (each)
Standard Entry Panels	Full Range of Port Styles/Combinations Available		
Hanger Blocks	CB-1200T	CB-1200T	Dual Cable Support Block (kit of 10)
Hanger Block Supporting Hardware	Complete Range of Supporting Hardware & Adapters Available		
Snap-In Hangers	SH-U1200T	SH-U1200T	Snap-In Hangers (Kit of 10)

TIMES MICROWAVE SYSTEMS

LMR®-200-75 Ohm
Flexible Low Loss Coaxial Cable

Ideal for...

- Satellite Applications
- Video Applications-CCTV, CATV, baseband or broadband
- In-Building Feeder Runs
- Any 75 ohm Wireless Application requiring an easily routed,

• **LMR®-75** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than any smooth wall or corrugated hard-line cables.

• **Flexibility** and bendability are hallmarks of the LMR-200-75 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-200-75. Size for size LMR-75 has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-200-75 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** Standard available connectors include type-N and type-F male plug with 75 ohm interface. Most LMR-75 connectors are the EZ install type with crimp outer and non-solder center contact attachment.

• **Cable Assemblies:** All LMR-200-75 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description

Part Number	Application	Jacket	Color	Stock Code
LMR-200-75	Indoor/Outdoor	PE	Black	54213
LMR-200-75-DB	Outdoor	PE	Black	54242

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.025	(0.64)
Dielectric	Foam PE	0.116	(2.95)
Outer Conductor	Aluminum Tape	0.121	(3.07)
Overall Braid	Tinned Copper	0.144	(3.66)
Jacket	Black PE	0.195	(4.95)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.5	(12.7)
Bend Radius: repeated	in. (mm)	2	(50.8)
Bending Moment	ft-lb (N-m)	0.2	(0.27)
Weight	lb/ft (kg/m)	0.022	(0.03)
Tensile Strength	lb (kg)	40	(18.2)
Flat Plate Crush	lb/in. (kg/mm)	15	(0.27)

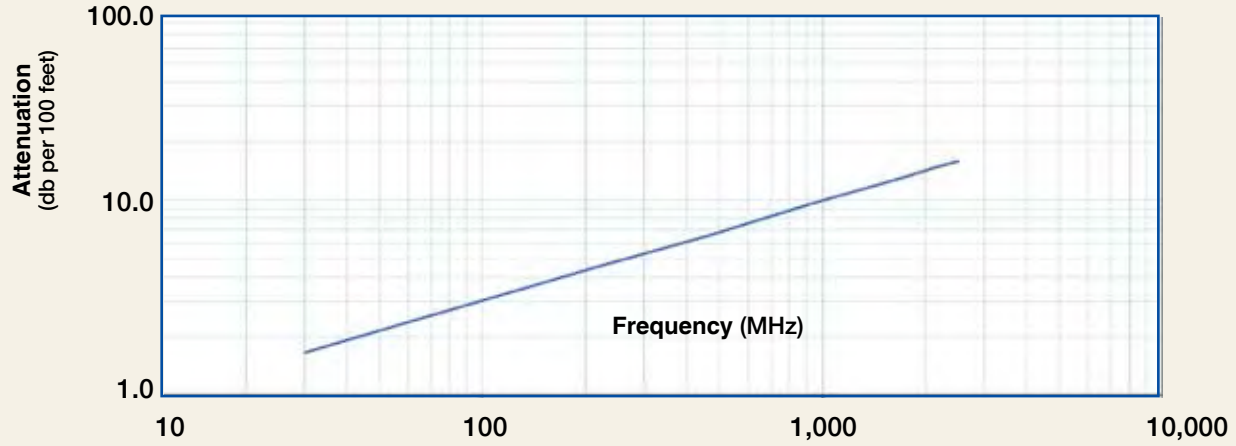
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Max Operating Frequency	GHz	2.5	
Velocity of Propagation	%	83	
Dielectric Constant	NA	1.45	
Time Delay	nS/ft (nS/m)	1.22	(4.02)
Impedance	ohms	75	
Capacitance	pF/ft (pF/m)	16.3	(53.6)
Inductance	uH/ft (uH/m)	0.092	(0.30)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	16.8	(55.1)
Outer Conductor	ohms/1000ft (/km)	4.9	(16.1)
Voltage Withstand	Volts DC	1000	
Jacket Spark	Volts RMS	3000	
Peak Power	kW	2.5	

Attenuation vs. Frequency (typical)



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500
Attenuation dB/100 ft	1.7	2.1	3.7	4.5	6.5	9.3	12.1	13.4	14.1	15.9
Attenuation dB/100 m	5.4	7.0	12.2	14.9	21.4	30.6	39.8	43.8	46.3	52.0
Avg. Power kW	0.98	0.76	0.43	0.36	0.25	0.17	0.13	0.12	0.11	0.10

Calculate Attenuation = (0.300717) • FMHz + (0.000335) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F)

Power: VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Contact Attach	Inner Contact Attach	Outer Body /Pin	Finish*	Length in (mm)	Width in (mm)	Weight lb (g)
1. F male	Straight Plug	EZ-200-FMH-75	3190-1611	<1.35:1 (2.5)	Hex	Spring Finger	Crimp	N/G		1.1 (27.0)	0.50 (12.7)	0.015 (6.8)
2. N male	Straight Plug	EZ-200-NM-75	3190-1612	<1.35:1 (2.5)	Knurl	Spring Finger	Crimp	N/G		1.5 (38.1)	0.83 (21.1)	0.073 (33.1)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195	3190-667	Crimp tool for LMR 240, 200 and 195
Strip Tool	CST-195/200	3192-102	Combination prep tool for LMR-195/200 crimp and clamp connectors
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST tools
Debur Tool	DBT-U	3192-001	Removes center conductor rough edges

Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S200TT	GK-S200TT	Standard Grounding Kit

TIMES MICROWAVE SYSTEMS

LMR®-240-75 Ohm
Flexible Low Loss Coaxial Cable

Ideal for...

- Satellite Applications
- Video Applications-CCTV, CATV, baseband or broadband
- In-Building Feeder Runs
- Any 75 ohm Wireless Application requiring an easily routed,

• **LMR®-75** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than any smooth wall or corrugated hard-line cables.

• **Flexibility** and bendability are hallmarks of the LMR-240-75 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-240-75. Size for size LMR-75 has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-240-75 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** Standard available connectors include type-N and type-F male plug with 75 ohm interface. Most LMR-75 connectors are the EZ install type with crimp outer and non-solder center contact attachment.

• **Cable Assemblies:** All LMR-240-75 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description

Part Number	Application	Jacket	Color	Stock Code
LMR-240-75	Indoor/Outdoor	PE	Black	54150
LMR-240-75-DB	Outdoor	PE	Black	54226

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.032	(0.82)
Dielectric	Foam PE	0.150	(3.81)
Outer Conductor	Aluminum Tape	0.155	(3.94)
Overall Braid	Tinned Copper	0.178	(4.52)
Jacket	Black PE	0.240	(6.10)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.75	(19.1)
Bend Radius: repeated	in. (mm)	2.5	(63.5)
Bending Moment	ft-lb (N-m)	0.25	(0.34)
Weight	lb/ft (kg/m)	0.034	(0.05)
Tensile Strength	lb (kg)	80	(38.3)
Flat Plate Crush	lb/in. (kg/mm)	20	(0.36)

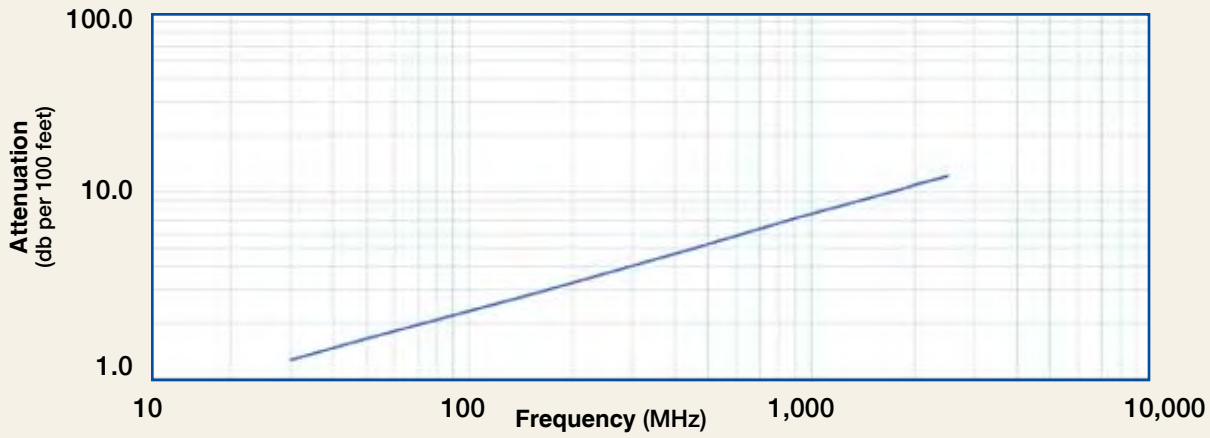
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Max Operating Frequency	GHz	2.5	
Velocity of Propagation	%	84	
Dielectric Constant	NA	1.42	
Time Delay	nS/ft (nS/m)	1.21	(3.97)
Impedance	ohms	75	
Capacitance	pF/ft (pF/m)	16.1	(52.9)
Inductance	uH/ft (uH/m)	0.091	(0.30)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	10.1	(33.1)
Outer Conductor	ohms/1000ft (/km)	3.89	(12.8)
Voltage Withstand	Volts DC	1500	
Jacket Spark	Volts RMS	5000	
Peak Power	kW	5.6	

Attenuation vs. Frequency (typical)



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500
Attenuation dB/100 ft	1.3	1.6	2.9	3.5	5.0	7.2	9.4	10.3	10.9	12.3
Attenuation dB/100 m	4.1	5.4	9.4	11.4	16.4	23.5	30.7	33.8	35.8	40.3
Avg. Power kW	1.41	1.09	0.62	0.51	0.35	0.25	0.19	10.17	0.16	0.14

Calculate Attenuation =

(0.229100) • $\sqrt{FMHz}$ + (0.000330) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:

VSWR=1.0 ; Ambient = +25°C (77°F)

Power:

VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
BNC Male	Straight Plug	TC-240-BM-75	3190-1814	<1.1:1 (2.0)	Knurl	Solder-on	Crimp	N/G	1.37 (34.8)	0.56 (14.2)	0.043 (19.5)
F Male	Straight Plug	EZ-240-FMH-75	3190-1613	<1.25:1 (2.0)	Hex	Spring Finger	Crimp	N/G	1.7 (43.4)	0.56 (14.2)	0.016 (7.3)
	Straight Plug	TC-240-FMH-75	3190-1483	<1.25:1 (2.5)	Hex	Solder-on	Crimp	N/G	1.7 (43.2)	0.56 (14.2)	0.016 (7.3)
N Male	Straight Plug	EZ-240-NM-75	3190-1614	<1.25:1 (2.0)	Knurl	Spring Finger	Crimp	N/G	1.5 (38.1)	0.83 (21.1)	0.086 (39.0)
	Straight Plug	TC-240-NM-75	3190-477	<1.25:1 (2.5)	Knurl	Solder-on	Crimp	N/G	1.5 (38.1)	0.83 (21.1)	0.086 (39.0)

Accessories & Install Tools

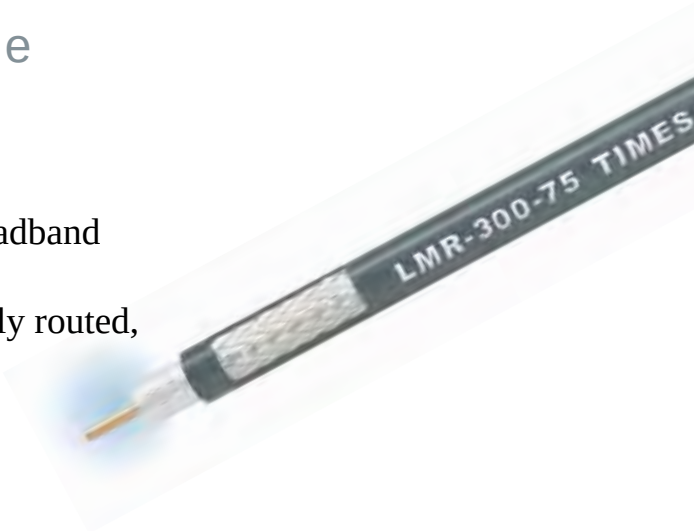
Type	Part Number	Stock Code	Description
Ground Kit	GK-S240TT	GK-S240TT	Standard Grounding Kit
Strip Tool	CST-240	3192-070	Prep tool for LMR-240 connectors
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST strip tools
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges

TIMES MICROWAVE SYSTEMS

LMR®-300-75 Ohm
Flexible Low Loss Coaxial Cable

Ideal for...

- Satellite Applications
- Video Applications-CCTV, CATV, baseband or broadband
- In-Building Feeder Runs
- Any 75 ohm Wireless Application requiring an easily routed,



• **LMR®-75** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than any smooth wall or corrugated hard-line cables.

• **Flexibility** and bendability are hallmarks of the LMR-300-75 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-300-75. Size for size LMR-75 has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-300-75 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** Standard available connectors include type-N and type-F male plug with 75 ohm interface. Most LMR-75 connectors are the EZ install type with crimp outer and non-solder center contact attachment.

• **Cable Assemblies:** All LMR-300-75 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description

Part Number	Application	Jacket	Color	Stock Code
LMR-300-75	Indoor/Outdoor	PE	Black	54146
LMR-300-75-DB	Outdoor	PE	Black	54241

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.044	(1.12)
Dielectric	Foam PE	0.190	(4.83)
Outer Conductor	Aluminum Tape	0.196	(4.98)
Overall Braid	Tinned Copper	0.225	(5.72)
Jacket	Black PE	0.300	(7.62)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.875	(22.2)
Bend Radius: repeated	in. (mm)	3.0	(76.2)
Bending Moment	ft-lb (N-m)	0.38	(0.52)
Weight	lb/ft (kg/m)	0.055	(0.08)
Tensile Strength	lb (kg)	120	(54.5)
Flat Plate Crush	lb/in. (kg/mm)	30	(0.54)

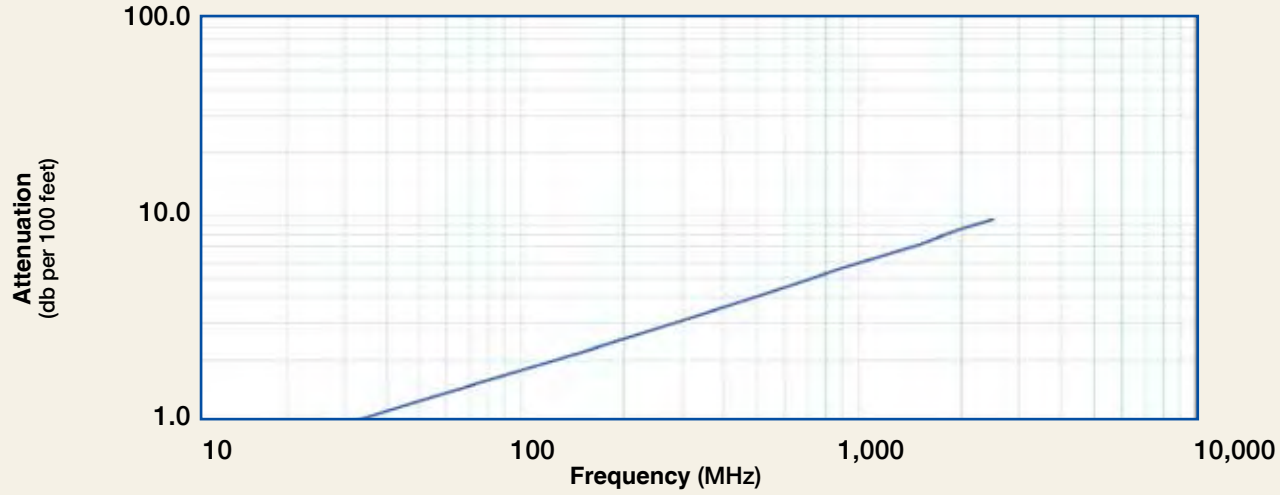
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Max Operating Frequency	GHz	2.5	
Velocity of Propagation	%	85	
Dielectric Constant	NA	1.38	
Time Delay	nS/ft (nS/m)	1.20	(3.92)
Impedance	ohms	75	
Capacitance	pF/ft (pF/m)	15.9	(52.3)
Inductance	uH/ft (uH/m)	0.090	(0.29)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	5.36	(17.6)
Outer Conductor	ohms/1000ft (/km)	2.21	(7.3)
Voltage Withstand	Volts DC	2000	
Jacket Spark	Volts RMS	5000	
Peak Power	kW	10	

Attenuation vs. Frequency (typical)



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500
Attenuation dB/100 ft	1.0	1.3	2.2	2.7	3.9	5.6	7.3	8.0	8.5	9.6
Attenuation dB/100 m	3.2	4.1	7.2	8.8	12.7	18.2	23.9	26.4	27.9	31.5
Avg. Power kW	2.06	1.59	0.91	0.74	0.51	0.36	0.27	0.25	0.23	0.21

Calculate Attenuation = (0.175490) • $\sqrt{FMHz}$ + (0.000330) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Inner Coupling Nut	Outer Contact Attach	Finish* Contact Attach	Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. BNC Male	Straight Plug	TC-300-BM-75	3190-1841	<1.1:1 (2.0)	Knurl	Solder-on	Crimp	N/G	1.37 (34.8)	0.56(14.2)	0.043 (19.5)
2. F Male	Straight Plug	EZ-300-FMH-75	3190-1615	<1.25:1 (2.5)	Hex	Spring Finger	Crimp	N/G	1.7 (43.2)	0.56(14.2)	0.018 (8.2)
3. N Male	Straight Plug	EZ-300-NM-75	3190-1616	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	N/G	1.5 (38.1)	0.83(21.1)	0.074 (33.6)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-300/400	3190-666	Crimp tool for LMR 300 and 400
Strip Tool	CST-300	3192-084	Combination prep tool for LMR-300 crimp and clamp connectors
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST tools
Debur Tool	DBT-U	3192-001	Removes center conductor rough edges

Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S300TT	GK-S300TT	Standard Grounding Kit

TIMES MICROWAVE SYSTEMS

LMR®-400-75 Ohm
Flexible Low Loss Coaxial Cable

Ideal for...

- Satellite Applications
- Video Applications-CCTV, CATV, baseband or broadband
- In-Building Feeder Runs
- Any 75 ohm Wireless Application requiring an easily routed,

• **LMR®-75** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than any smooth wall or corrugated hard-line cables.

• **Flexibility** and bendability are hallmarks of the LMR-400-75 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-400-75. Size for size LMR-75 has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability**: LMR-400-75 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors**: Standard available connectors include type-N and type-F male plug with 75 ohm interface. Most LMR-75 connectors are the EZ install type with crimp outer and non-solder center contact attachment.

• **Cable Assemblies**: All LMR-400-75 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description

Part Number	Application	Jacket	Color	Stock Code
LMR-400-75	Indoor/Outdoor	PE	Black	54147
LMR-400-75-DB	Outdoor	PE	Black	54228

Construction Specifications

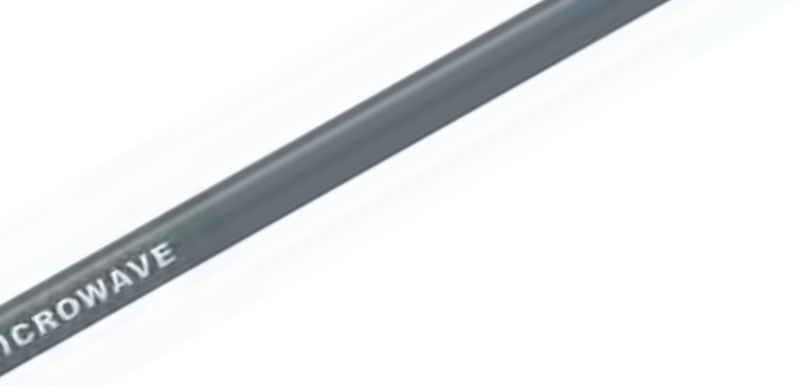
Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.065	(1.65)
Dielectric	Foam PE	0.285	(7.24)
Outer Conductor	Aluminum Tape	0.291	(7.39)
Overall Braid	Tinned Copper	0.320	(8.13)
Jacket	Black PE	0.405	(10.29)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.0	(25.4)
Bend Radius: repeated	in. (mm)	4.0	(101.6)
Bending Moment	ft-lb (N-m)	0.5	(0.68)
Weight	lb/ft (kg/m)	0.068	(0.10)
Tensile Strength	lb (kg)	160	(72.6)
Flat Plate Crush	lb/in. (kg/mm)	40	(0.71)

Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

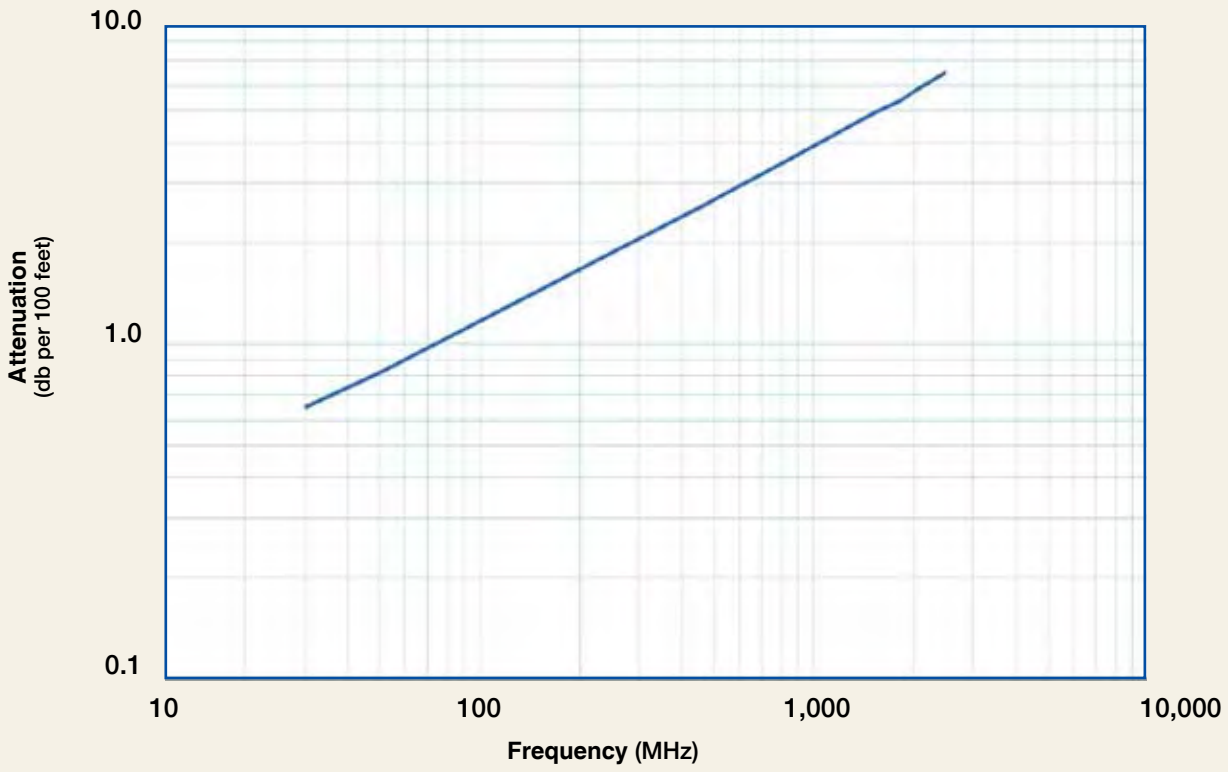


TIMES MICROWAVE SYSTEMS

Electrical Specifications

Performance Property	Units	US	(metric)
Max Operating Frequency	GHz	2.5	
Velocity of Propagation	%	85	
Dielectric Constant	NA	1.38	
Time Delay	nS/ft (nS/m)	1.20	(3.92)
Impedance	ohms	75	
Capacitance	pF/ft (pF/m)	15.9	(52.3)
Inductance	uH/ft (uH/m)	0.090	(0.29)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	2.50	(8.20)
Outer Conductor	ohms/1000ft (/km)	1.65	(5.4)
Voltage Withstand	Volts DC	2000	
Jacket Spark	Volts RMS	5000	
Peak Power	kW	10	

Attenuation vs. Frequency (typical)



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	**2500**
Attenuation dB/100 ft	0.6	0.8	1.5	1.8	2.6	3.7	4.9	5.4	5.7	6.4
Attenuation dB/100 m	2.1	2.7	4.8	5.8	8.4	12.1	16.0	17.6	18.7	21.1
Avg. Power kW	2.99	2.31	1.32	1.08	0.74	0.52	0.39	0.35	0.33	0.30

Calculate Attenuation =

$(0.115570) \bullet \sqrt{FMHz} + (0.000260) \bullet FMHz$ (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:

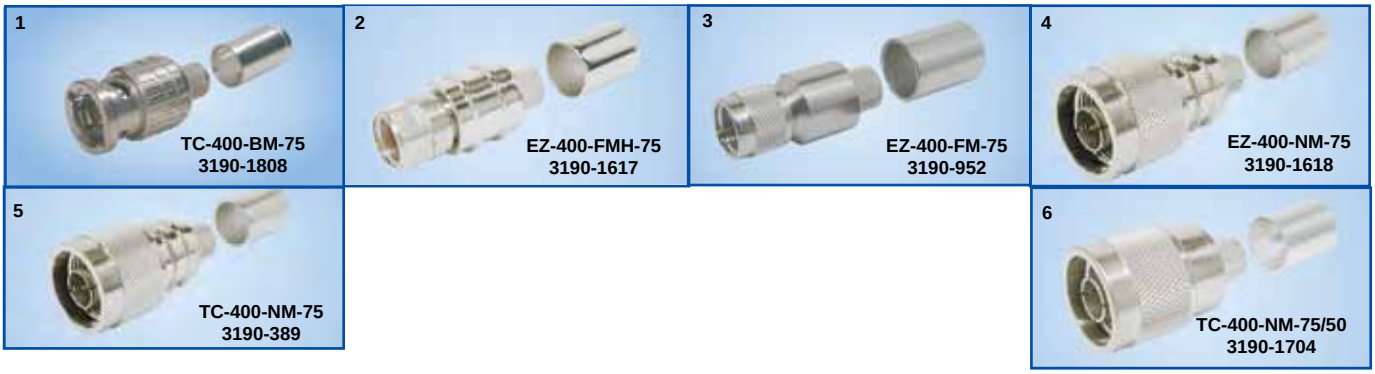
VSWR=1.0 ; Ambient = +25°C (77°F)

Power:

VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR®-400-75 Ohm
Flexible Low Loss Coaxial Cable



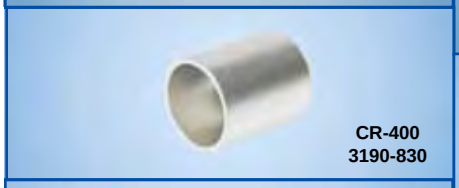
Connectors Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
1. BNC Male	Straight Plug	TC-400-BM-75	3190-1808	<1.1:1 (2.0)	Knurl	Solder-on	Crimp	N/G	1.37	(34.8)	0.56	(14.2)	0.043	(19.5)
2. F Male	Straight Plug	EZ-400-FMH-75	3190-1617	<1.25:1 (2.0)	Hex	Spring Finger	Crimp	N/G	1.7	(42.9)	0.49	(12.4)	0.02	(9.07)
3.	Straight Plug	EZ-400-FM-75	3190-952	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	N/G	1.7	(43.2)	0.56	(14.2)	0.002	(9.1)
4. N Male	Straight Plug	EZ-400-NM-75	3190-1618	<1.25:1 (2.0)	Knurl	Spring Finger	Crimp	N/G	2.0	(50.5)	0.81	(20.6)	0.10	(45.36)
5.	Straight Plug	TC-400-NM-75	3190-389	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/G	1.5	(38.1)	0.83	(21.1)	0.90	(40.8)
6.	Straight Plug	TC-400-NM-75/50***	3190-1704	<1.25:1 (2.0)	Knurl	Solder	Crimp	N/G	1.5	(38.1)	0.83	(21.1)	0.09	(39.01)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair
***NOTE: 75/50 suffix indicates the connector is for installation on 75 ohm LMR cable and mates with 50 ohm type-N connectors


HX-4
3190-200


Y1719
3190-202


CT-400/300
3190-666


CR-400
3190-830


CST-400-75
3192-089


DBT-U
3192-001


CCT-01
3190-1544


GST-400
3190-2174


TK-400EZ-75
660-0084


RB-CST
3192-086

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1719	3190-202	.429" Hex Dies
Crimp Tool	CT-400/300	3190-666	Crimp tool for LMR 400 connectors
Crimp Rings	CR-400	3190-830	Crimp rings for TC/EZ-400 connectors (package of 10)
Strip Tool	CST-400-75	3192-089	Combination prep tool for LMR-400-75 crimp and clamp connectors
Mid-Span Strip Tool	GST-400	3190-2174	For ground strap attachment
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST tools
Tool Kit	TK-400EZ-75	660-0084	Tool kit for LMR-400-75 crimp/clamp connectors includes, CCT-01,CST-400-75, CT-400/300, Tool Pouch)


GK-S400TT


HG-400T

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S400TT	GK-S400TT	Standard Grounding Kit (each)
Hoisting Grip	HG-400T	HG-400T	Laced Type (each)

TIMES MICROWAVE SYSTEMS

LMR®-600-75 Ohm
Flexible Low Loss Coaxial Cable

Ideal for...

- Satellite Applications
- Video Applications-CCTV, CATV, baseband or broadband
- In-Building Feeder Runs
- Any 75 ohm Wireless Application requiring an easily routed,

• **LMR®-75** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than any smooth wall or corrugated hard-line cables.

• **Flexibility** and bendability are hallmarks of the LMR-600-75 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-600-75. Size for size LMR-75 has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** LMR-600-75 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** Standard available connectors include type-N and type-F male plug with 75 ohm interface. Most LMR-75 connectors are the EZ install type with crimp outer and non-solder center contact attachment.

• **Cable Assemblies:** All LMR-600-75 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description

Part Number	Application	Jacket	Color	Stock Code
LMR-600-75	Indoor/Outdoor	PE	Black	54148
LMR-600-75-DB	Outdoor	PE	Black	54220

Construction Specifications

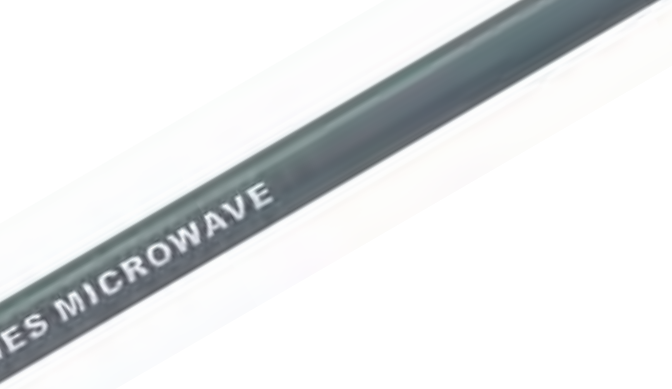
Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.108	(2.74)
Dielectric	Foam PE	0.455	(11.56)
Outer Conductor	Aluminum Tape	0.461	(11.71)
Overall Braid	Tinned Copper	0.490	(12.45)
Jacket	Black PE	0.590	(14.99)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.5	(38.1)
Bend Radius: repeated	in. (mm)	6.0	(152.4)
Bending Moment	ft-lb (N-m)	2.75	(3.73)
Weight	lb/ft (kg/m)	0.131	(0.20)
Tensile Strength	lb (kg)	350	(158.9)
Flat Plate Crush	lb/in. (kg/mm)	60	(1.07)

Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

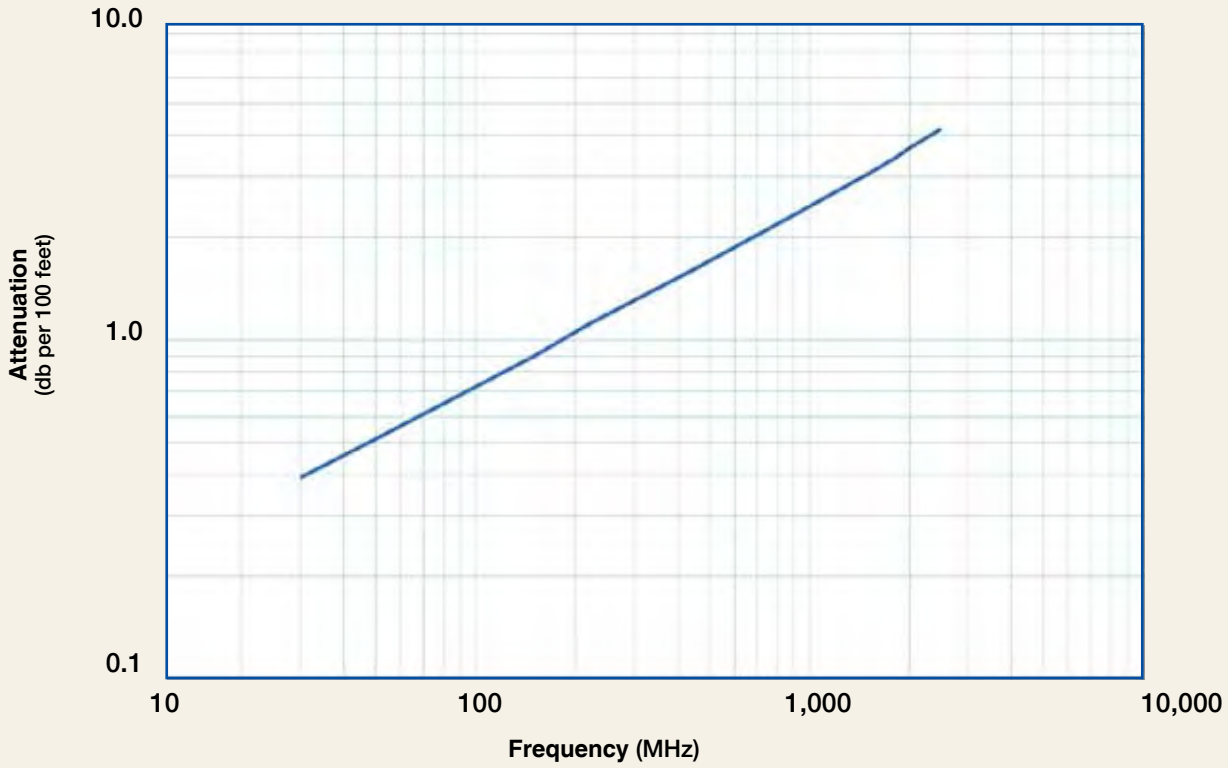


TIMES MICROWAVE SYSTEMS

Electrical Specifications

Performance Property	Units	US	(metric)
Max Operating Frequency	GHz	2.5	
Velocity of Propagation	%	87	
Dielectric Constant	NA	1.32	
Time Delay	nS/ft (nS/m)	1.17	(3.83)
Impedance	ohms	75	
Capacitance	pF/ft (pF/m)	15.6	(51.1)
Inductance	uH/ft (uH/m)	0.088	(0.29)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	1.39	(4.56)
Outer Conductor	ohms/1000ft (/km)	1.2	(3.9)
Voltage Withstand	Volts DC	4000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	40	

Attenuation vs. Frequency (typical)



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500
Attenuation dB/100 ft	0.4	0.5	0.9	1.1	1.6	2.3	3.1	3.5	3.7	4.2
Attenuation dB/100 m	1.3	1.7	3.0	3.6	5.3	7.7	10.2	11.4	12.1	13.7
Avg. Power kW	4.77	3.67	2.08	1.70	1.16	0.80	0.60	0.54	0.51	0.45

Calculate Attenuation =
(0.070590) • $\sqrt{FMHz}$ + (0.000260) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation:
VSWR=1.0 ; Ambient = +25°C (77°F)
Power:
VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR-600-75 Ohm
Flexible Low Loss Coaxial Cable


1
EZ-600-FMH-75
3190-1619


2
EZ-600-NM-75
3190-1620


3
TC-600-NMH-75/50
3190-1610

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Contact Attach	Inner Contact Attach	Outer Body /Pin	Finish*	Length in (mm)	Width in (mm)	Weight lb (g)
F Male	Straight Plug	EZ-600-FMH-75	3190-1619	<1.25:1 (2.5)	Hex	Spring Finger	Crimp	N/G		1.7 (43.2)	0.56(14.2)	0.112 (50.8)
N Male	Straight Plug	EZ-600-NM-75	3190-1620	<1.25:1 (2.0)	Knurl	Spring Finger	Crimp	N/G		2.1 (53.1)	0.87(22.1)	0.166 (75)
	Straight Plug	TC-600-NMH-75/50***	3190-1610	<1.25:1 (2.0)	Hex	Solder	Crimp	N/G		2.1 (53.1)	0.83(21.1)	0.166 (75)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair
***NOTE: 75/50 suffix indicates the connector is for installation on 75 ohm LMR cable and mates with 50 ohm type-N connectors

HX-4
3190-200


RB-CST
3192-086


Y1720
3190-203


CR-600
3190-831


ST-600-75
3192-090

DBT-U
3192-001


GST-600A
3190-1051


CCT-01
3190-1544

Install Tools


TK-600EZ-75
660-0085

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1720	3190-203	.610" Hex Dies
Crimp Rings	CR-600	3190-831	Crimp Rings for TC/EZ-600 connectors (pkg of 10)
Strip Tool	ST-600-75	3192-090	Strip tool for LMR-600-75 crimp and clamp style
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Midspan Strip Tool	GST-600A	3190-1051	For ground strap attachment
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Replacement Blade Kit	RB-CST	3192-086	Replacement blade for all CST strip tools
Tool Kit	TK-600EZ-75	660-0085	Tool kit for LMR-600 Crimp Connectors (includes CCT-01, ST-600-75, HX-4, Y1720, Tool Pouch)


GK-S600TT


HG-600T


CS-A600T, CS-60120T, CS-60170T


SC-600T


Standard Entry Panels


CB-600T


Hanger Block Hardware


SH-U600T

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S600TT	GK-S600TT	Standard Grounding Kit (each)
Hoisting Grip	HG-600T	HG-600T	Split/Laced Type (each)
Cold Shrink	CS-A600T	CS-A600T	Cable to Antenna Junction (each)
Cold Shrink	CS-60120T	CS-60120T	LMR-600 to -1200 Junction (each)
Cold Shrink	CS-60170T	CS-60170T	LMR-600 to -1700 Junction (each)
Stand. Entry Port Cushion	SC-600T-3	SC-600T-3	Three Cables (each)
Standard Entry Panels			Full Range of Port Styles/Combinations Available
Hanger Blocks	CB-600T	CB-600T	Dual Cable Support Block (kit of 10)
Hanger Block Supporting Hardware			Complete Range of Supporting Hardware & Adapters Available
Snap-In Hangers	SH-U600T	SH-U600T	Snap-In Hangers (Kit of 10)

TIMES MICROWAVE SYSTEMS

TCOM®-195
Low Loss Low Passive Intermod Coax

Ideal for...

- -155 dBc Intermodulation Distortion
- Low Loss UHF/Microwave Interconnect
- Wireless Base Station Interconnect
- Flexible for Easy Routing

Part Description				Stock
Part Number	Application	Jacket	Color	Code
TCOM-195	Outdoor	PE	Black	55021
TCOM-195-FR	Indoor-Riser CMR	FRPE	Black	55012

•TCOM® standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than any air-dielectric and corrugated hard-line cables.

TCOM®- FR is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. TCOM-FR has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively.

Flexibility and bendability are hallmarks of the TCOM-195 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

Low Loss is another hallmark feature of TCOM-195. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

Passive Intermod is lower than –155 dBc exceed the performance levels for most wireless applications.

RF Shielding is 60 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 100 dB (i.e. >200 dB between two adjacent cables).

Weatherability: TCOM-195 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

Connectors: A wide variety of connectors are available for TCOM-195 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

Cable Assemblies: All TCOM-195 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

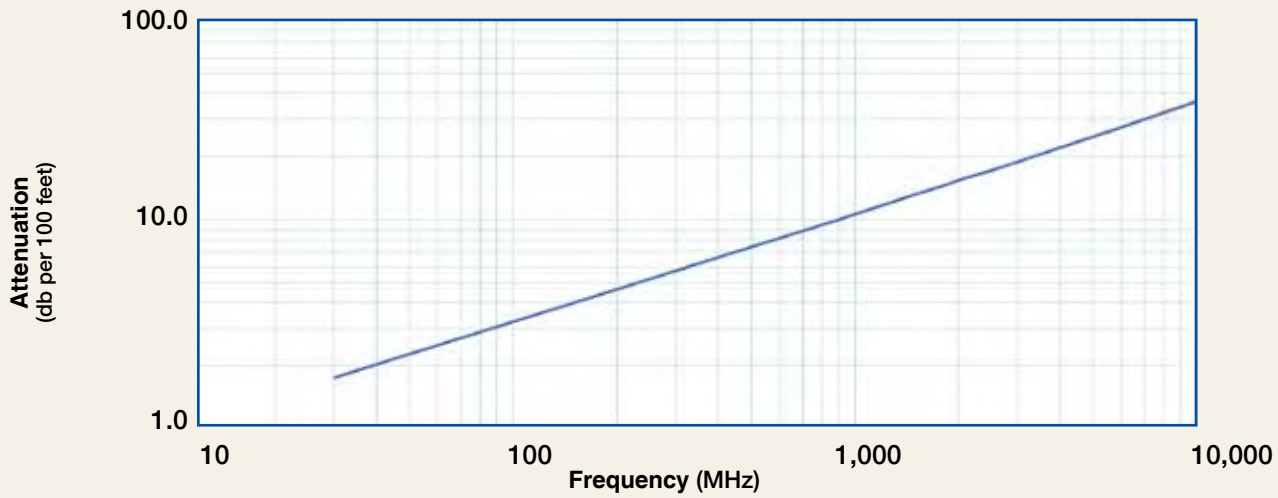
Construction Specifications			
Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.037	(0.94)
Dielectric	Foam PE	0.110	(2.79)
Outer Conductor	SPC Strip Braid	0.120	(3.05)
Overall Braid	TC Braid over Al tape	0.148	(3.76)
Jacket	(see table above)	0.195	(4.95)

Mechanical Specifications			
Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.5	(12.7)
Bend Radius: repeated	in. (mm)	2	(50.8)
Bending Moment	ft-lb (N-m)	0.2	(0.27)
Weight	lb/ft (kg/m)	0.035	(0.05)
Tensile Strength	lb (kg)	40	(18.2)
Flat Plate Crush	lb/in. (kg/mm)	15	(0.27)

Environmental Specifications		
Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications			
Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.56	
Time Delay	nS/ft (nS/m)	1.27	(4.17)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	25.4	(83.3)
Inductance	uH/ft (uH/m)	0.064	(0.21)
Shielding Effectiveness	dB	>100	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	7.6	(24.9)
Outer Conductor	ohms/1000ft (/km)	3.42	(11.2)
Voltage Withstand	Volts DC	1000	
Jacket Spark	Volts RMS	3000	
Peak Power	kW	2.5	
Passive Intermod	dBc	-155	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800	10,000
Attenuation dB/100 ft	1.8	2.3	4.0	4.9	7.0	10.1	13.1	14.5	15.3	17.2	27.2	36.8
Attenuation dB/100 m	5.8	7.5	13.1	16.0	23.0	33.0	43.1	47.5	50.2	56.5	89.1	120.7
Avg. Power kW	0.91	0.71	0.40	0.33	0.23	0.16	0.12	0.11	0.10	0.09	0.06	0.04

Calculate Attenuation = (0.321011) • $\sqrt{\text{FMHz}}$ + (0.000469) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Contact Attach	Inner Contact Attach	Outer Body /Pin	Finish*	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
1. N male	Straight Plug	TC-195-NM	3190-1555	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G		1.5	(38.1)	0.75	(19.1)	0.073	(33.1)
2. SMA male	Straight Plug	TC-195-SM	3190-1553	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G		1.0	(25.4)	0.32	(8.1)	0.015	(6.8)
3. TNC male	Straight Plug	TC-195-TM	3190-1554	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G		1.4	(35.6)	0.59	(15.0)	0.045	(20.4)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100, 195, 200and 240 connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Strip Tool	CST-195/200	3192-102	Combination prep tool for LMR-195 and LMR-200
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all strip tools

TIMES MICROWAVE SYSTEMS

TCOM®-200
Low Loss Low Passive Intermod Coax

Ideal for...

- -155 dBc Intermodulation Distortion
- Low Loss UHF/Microwave Interconnect
- Wireless Base Station Interconnect
- Flexible for Easy Routing

• **TCOM®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

TCOM®- FR is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. TCOM-FR has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively.

Flexibility and bendability are hallmarks of the TCOM-200 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

Low Loss is another hallmark feature of TCOM-200. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

Passive Intermod is lower than –155 dBc exceed the performance levels for most wireless applications.

RF Shielding is 60 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 100 dB (i.e. >200 dB between two adjacent cables).

Weatherability: TCOM-200 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

Connectors: A wide variety of connectors are available for TCOM-200 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

Cable Assemblies: All TCOM-200 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
TCOM-200	Outdoor	PE	Black	55001
TCOM-200-FR	Indoor-Riser CMR	FRPE	Black	55022
TCOM-200-PUR-DB	Outdoor/ Watertight	PUR	Black	55042

Construction Specifications			
Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.044	(1.12)
Dielectric	Foam PE	0.116	(2.95)
Outer Conductor	SPC Strip Braid	0.126	(3.20)
Overall Braid	TC Braid over Al tape	0.154	(3.91)
Jacket	(see table above)	0.195	(4.95)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.5	(12.7)
Bend Radius: repeated	in. (mm)	2	(50.8)
Bending Moment	ft-lb (N-m)	0.2	(0.27)
Weight	lb/ft (kg/m)	0.040	(0.06)
Tensile Strength	lb (kg)	40	(18.2)
Flat Plate Crush	lb/in. (kg/mm)	15	(0.27)

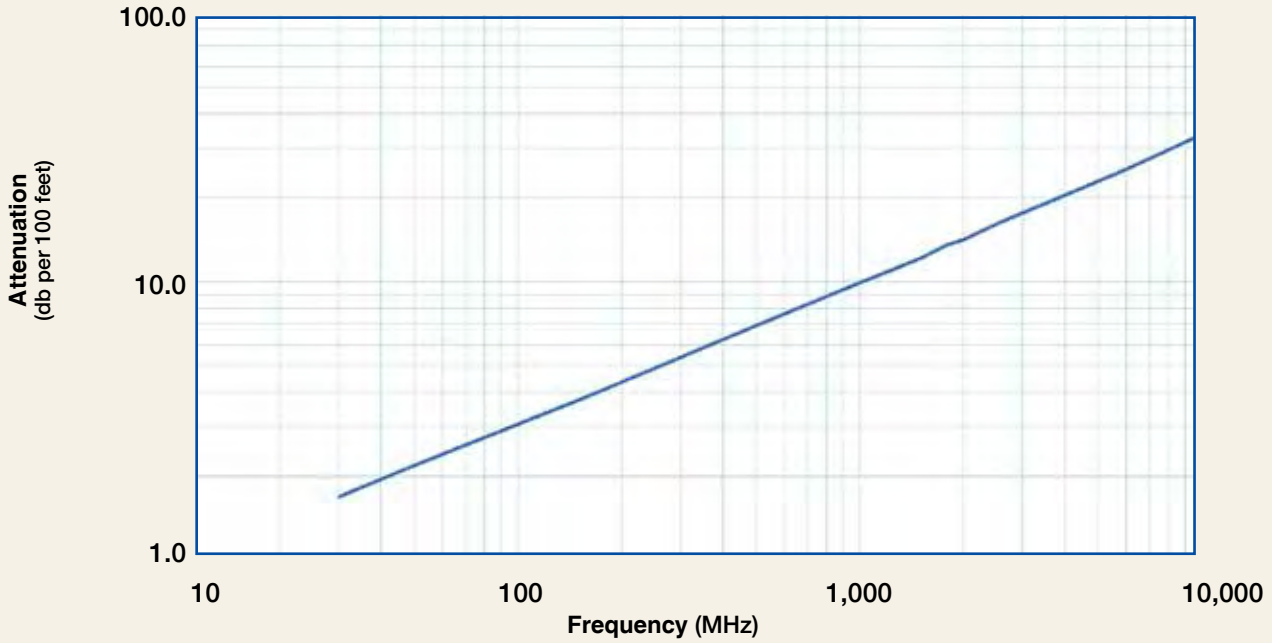
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	83	
Dielectric Constant	NA	1.45	
Time Delay	nS/ft (nS/m)	1.22	(4.02)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	24.5	(80.3)
Inductance	uH/ft (uH/m)	0.061	(0.20)
Shielding Effectiveness	dB	>100	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	5.36	(17.6)
Outer Conductor	ohms/1000ft (/km)	3.84	(12.6)
Voltage Withstand	Volts DC	1000	
Jacket Spark	Volts RMS	3000	
Peak Power	kW	2.5	
Passive Intermod	dBc	-155	

Attenuation vs. Frequency **(typical)**

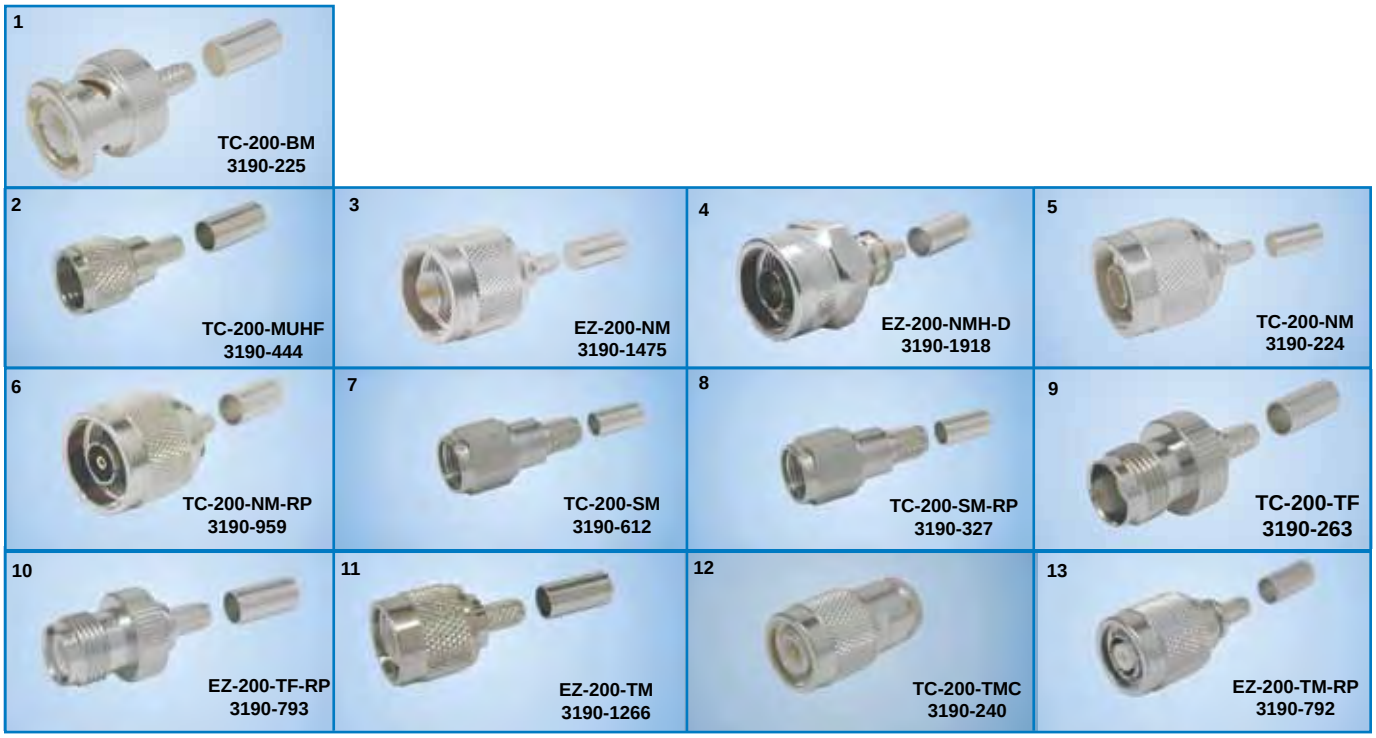


Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800	10,000
Attenuation dB/100 ft	1.7	2.2	3.8	4.6	6.6	9.4	12.3	13.5	14.2	16.0	25.0	33.7
Attenuation dB/100 m	5.5	7.1	12.4	15.0	21.6	30.9	40.2	44.2	46.7	52.5	82.2	110.5
Avg. Power kW	1.08	0.84	0.48	0.39	0.27	0.19	0.15	0.13	0.13	0.11	0.07	0.05

Calculate Attenuation = (0.303670) • $\sqrt{\text{FMHz}}$ + (0.000331) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

TCOM-200
Low Loss Low Passive Intermod Coax



Connectors Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. BNC male	Straight Plug	TC-200-BM	3190-225	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.7 (43.2)	0.56 (14.2)	0.045 (20.4)
2. Mini-UHF	Straight Plug	TC-200-MUHF	3190-444	<1.25:1 (2.5)	Knurl	Solder	Crimp	NG	1.1 (27.9)	0.45 (11.4)	0.015 (6.8)
3. N male	Straight Plug	EZ-200-NM	3190-1475	<1.25:1 (8)	Knurl	Spring Fit	Crimp	S/G	1.5 (38.1)	0.75 (19.1)	0.073 (33.1)
4. N male	Straight Plug	EZ-200-NMH-D	3190-1918	<1.25:1 (8)	Hex/Knurl	Spring Fit	Crimp	A/G	1.5 (38.1)	0.75 (19.1)	0.073 (33.1)
5. N male	Straight Plug	TC-200-NM	3190-224	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.5 (38.1)	0.75 (19.1)	0.073 (33.1)
6. N male	Reverse Polarity	TC-200-NM-RP	3190-959	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/G	1.5 (38.1)	0.75 (19.1)	0.073 (33.1)
7. SMA male	Straight Plug	TC-200-SM	3190-612	<1.25:1 (8)	Hex	Solder	Crimp	SS/G	1.0 (25.4)	0.32 (8.1)	0.015 (6.8)
8. SMA male	Reverse Polarity	TC-200-SM-RP	3190-327	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0 (25.4)	0.32 (8.1)	0.015 (6.8)
9. TNC female	Straight Jack	TC-200-TF	3190-263	<1.25:1 (2.5)	NA	Solder	Crimp	N/G	1.3 (33.0)	0.57 (14.5)	0.033 (15.0)
10. TNC female	Reverse Polarity	EZ-200-TF-RP	3190-793	<1.25:1 (2.5)	NA	Spring Fit	Crimp	A/G	1.3 (33.0)	0.57 (14.5)	0.033 (15.0)
11. TNC male	Straight Plug	EZ-200-TM	3190-1266	<1.25:1 (2.5)	Knurl	Spring Fit	Crimp	S/G	1.4 (35.6)	0.59 (15.0)	0.045 (20.4)
12. TNC male	Straight Plug	TC-200-TMC	3190-240	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G	1.7 (43.2)	0.59 (15.0)	0.045 (20.4)
13. TNC male	Reverse Polarity	EZ-200-TM-RP	3190-792	<1.25:1 (2.5)	Knurl	Spring Fit	Crimp	A/G	1.4 (35.6)	0.32 (8.1)	0.045 (20.4)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair


GK-S200TT

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S200TT	GK-S200TT	Standard Ground Kit (each)


CT240/200/195/100
3190-667


DBT-U
3192-001


CCT-01
3190-1544


CST-195/200
3192-102


RB-CST
3192-086

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100, 195, 200 and 240 connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Strip Tool	CST-195/200	3192-102	Combination prep tool for LMR-195 and LMR-200
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all strip tools

TIMES MICROWAVE SYSTEMS

TCOM®-240
Low Loss Low Passive Intermod Coax

Ideal for...

- -155 dBc Intermodulation Distortion
- Low Loss UHF/Microwave Interconnect
- Wireless Base Station Interconnect
- Flexible for Easy Routing

• **TCOM®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

TCOM®- FR is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. TCOM-FR has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively.

TCOM®- PUR has a polyurethane outer jacket designed for multiple bending/flexing cycles in rugged tactical applications.

Flexibility and bendability are hallmarks of the TCOM-240 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

Low Loss is another hallmark feature of TCOM-240. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

Passive Intermod is lower than –155 dBc exceed the performance levels for most wireless applications.

RF Shielding is 60 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 100 dB (i.e. >200 dB between two adjacent cables).

Weatherability: TCOM-240 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

Connectors: A wide variety of connectors are available for TCOM-240 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

Cable Assemblies: All TCOM-240 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
TCOM-240	Outdoor	PE	Black	55017
TCOM-240-FR	Indoor-Riser CMR	FRPE	Black	55023

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.056	(1.42)
Dielectric	Foam PE	0.150	(3.81)
Outer Conductor	SPC Strip Braid	0.160	(4.06)
Overall Braid	TC Braid over Al tape	0.188	(4.78)
Jacket	(see table above)	0.240	(6.10)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.75	(19.1)
Bend Radius: repeated	in. (mm)	2.5	(63.5)
Bending Moment	ft-lb (N-m)	0.25	(0.34)
Weight	lb/ft (kg/m)	0.045	(0.07)
Tensile Strength	lb (kg)	80	(36.3)
Flat Plate Crush	lb/in. (kg/mm)	20	(0.36)

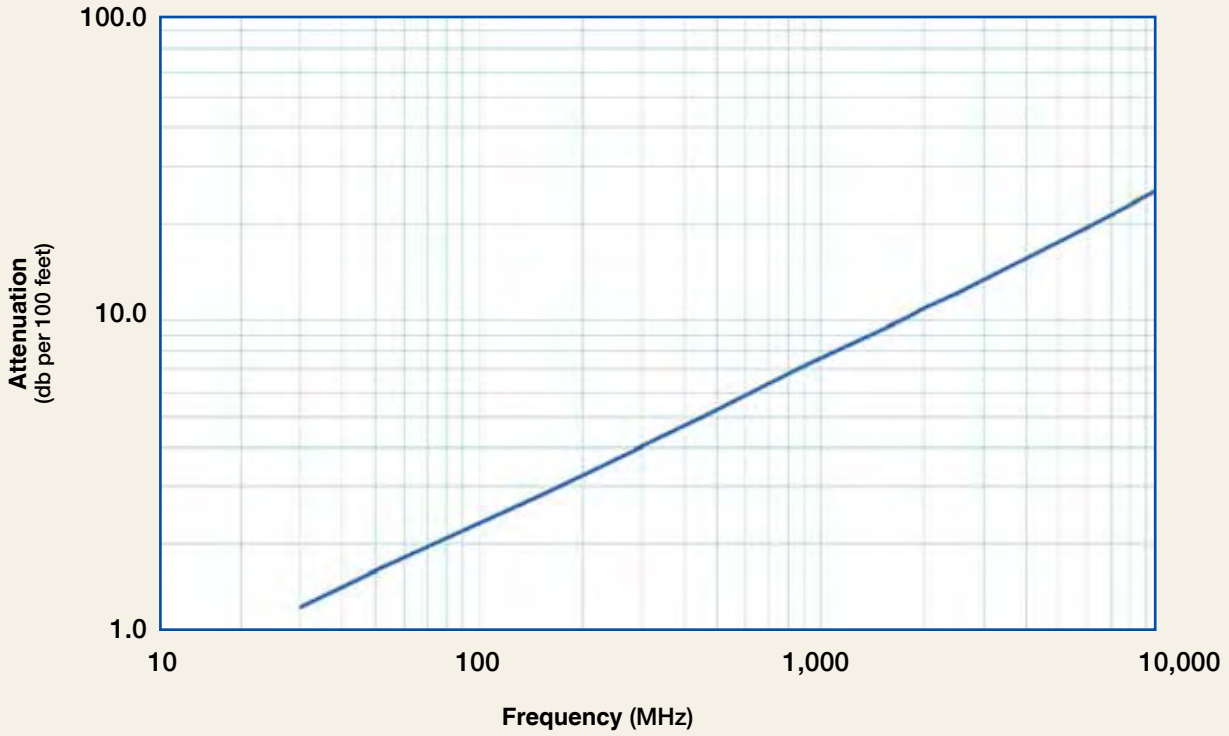
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	84	
Dielectric Constant	NA	1.42	
Time Delay	nS/ft (nS/m)	1.21	(3.97)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	24.2	(79.4)
Inductance	uH/ft (uH/m)	0.060	(0.20)
Shielding Effectiveness	dB	>100	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	3.2	(10.5)
Outer Conductor	ohms/1000ft (/km)	2.06	(6.8)
Voltage Withstand	Volts DC	1500	
Jacket Spark	Volts RMS	5000	
Peak Power	kW	5.6	
Passive Intermod	dBc	-155	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800	10,000
Attenuation dB/100 ft	1.3	1.6	2.9	3.5	5.0	7.2	9.4	10.3	10.9	12.3	19.4	26.2
Attenuation dB/100 m	4.2	5.4	9.4	11.4	16.4	23.5	30.7	33.9	35.8	40.3	63.6	86.0
Avg. Power kW	1.58	1.22	0.70	0.57	0.40	0.28	0.21	0.19	0.18	0.16	0.10	0.07

Calculate Attenuation =

$(0.229148) \bullet \sqrt{FMHz} + (0.000331) \bullet FMHz$ (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:

VSWR=1.0 ; Ambient = +25°C (77°F)

Power:

VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

TCOM-240
Low Loss Low Passive Intermod Coax

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
1. BNC Male	Straight Plug	TC-240-BMC	3190-242	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G	1.7	(43)	0.56	(14.2)	0.040	(18.1)
2. BNC Male	Straight Plug	TC-240-BM(A)	3190-867	<1.25:1 (2.5)	Knurl	Solder	Crimp	A/G	1.7	(43)	0.56	(14.2)	0.043	(19.5)
3. Mini-UHF	Straight Plug	TC-240-MUHF	3190-445	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/G	1.1	(28)	0.45	(11.4)	0.014	(6.4)
4. N Male	Straight Plug	EZ-240-NMH-D	3190-1127	<1.25:1 (2.5)	Hex/Knurl	Spring Finger	Crimp	A/G	1.5	(38.1)	0.78	(19.8)	0.086	(39.0)
5. N Male	Straight Plug	TC-240-NMH	3190-382	<1.25:1 (2.5)	Hex	Solder	Crimp	N/S	1.5	(38)	0.75	(19.1)	0.086	(39.0)
6. N Male	Straight Plug	TC-240-NMC	3190-244	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G	1.5	(38)	0.75	(19.1)	0.082	(37.2)
7. N Male	Right Angle	TC-240-NMH-RA-D	3190-2426	<1.35:1 (6)	Hex/Knurl	Solder	Crimp	A/G	1.2	(32.4)	1.22	(31.0)	0.091	(41.7)
8. N Female	Panel Jack	TC-240-NF-BHF(A)	3190-866	<1.25:1 (2.5)	NA	Solder	Crimp	A/G	1.7	(44)	1.00	(25.4)	0.115	(52.2)
9. N Female	Bulkhead Jack	TC-240-NF-BH	3190-419	<1.25:1 (2.5)	NA	Solder	Clamp	A/G	1.8	(46)	0.88	(22.4)	0.145	(65.8)
10. SMA Female	Bulkhead Jack	TC-240-SF-BH	3190-824	<1.25:1 (2.5)	NA	Solder	Crimp	SS/G	1.1	(29)	0.31	(7.9)	0.019	(8.6)
11. SMA Male	Straight Plug	TC-240-SM	3190-380	<1.25:1 (10)	Hex	Solder	Crimp	SS/G	1.0	(25)	0.32	(8.1)	0.016	(7.3)
12. SMA Male	Right Angle	TC-240-SM-RA	3190-381	<1.35:1 (6)	Hex	Solder	Crimp	SS/G	0.8	(20)	0.65	(16.5)	0.019	(8.6)
13. SMA Male	Reverse Polarity	TC-240-SM-RP	3190-326	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0	(25)	0.32	(8.1)	0.016	(7.3)
14. TNC Male	Straight Plug	EZ-240-TM	3190-1128	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	N/G	1.4	(34.3)	0.59	(15.0)	0.043	(19.5)
15. TNC Male	Straight Plug	TC-240-TM	3190-275	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/S	1.7	(43)	0.59	(15.0)	0.043	(19.5)
16. TNC Male	Reverse Polarity	EZ-240-TM-RP	3190-970	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	A/G	1.4	(36)	0.59	(15.0)	0.043	(19.5)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair


GK-S240TT

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S240TT	GK-S240TT	Standard Ground Kit (each)


RB-CST
3192-086


CT-240/200/195/100
3190-667


CST-240
3192-070


DBT-U
3192-001


CCT-01
3190-1609

Installation Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100, 195, 200 and 240 connectors
Strip Tool	CST-240	3192-070	Prep tool for LMR-240 connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST strip tools

TIMES MICROWAVE SYSTEMS

TCOM®-300
Low Loss Low Passive Intermod Coax

Ideal for...

- -155 dBc Intermodulation Distortion
- Low Loss UHF/Microwave Interconnect
- Wireless Base Station Interconnect
- Flexible for Easy Routing

• **TCOM®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

TCOM®- FR is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. TCOM-FR has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively.

TCOM®- PUR has a polyurethane outer jacket designed for multiple bending/flexing cycles in rugged tactical applications.

Flexibility and bendability are hallmarks of the TCOM-300 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

Low Loss is another hallmark feature of TCOM-300. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

Passive Intermod is lower than –155 dBc exceed the performance levels for most wireless applications.

RF Shielding is 60 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 100 dB (i.e. >200 dB between two adjacent cables).

Weatherability: TCOM-300 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

Connectors: A wide variety of connectors are available for TCOM-300 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

Cable Assemblies: All TCOM-300 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
TCOM-300	Outdoor	PE	Black	55011
TCOM-300-FR	Indoor-Riser CMR	FRPE	Black	55013
TCOM-300-PUR-DB	Outdoor/ Watertight	PUR	Black	55038

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.070	(1.78)
Dielectric	Foam PE	0.190	(4.83)
Outer Conductor	SPC Strip Braid	0.200	(5.08)
Overall Braid	TC Braid over Al tape	0.234	(5.94)
Jacket	(see table above)	0.300	(7.62)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.88	(22.2)
Bend Radius: repeated	in. (mm)	3.0	(76.2)
Bending Moment	ft-lb (N-m)	0.38	(0.52)
Weight	lb/ft (kg/m)	0.055	(0.08)
Tensile Strength	lb (kg)	120	(54.5)
Flat Plate Crush	lb/in. (kg/mm)	30	(0.54)

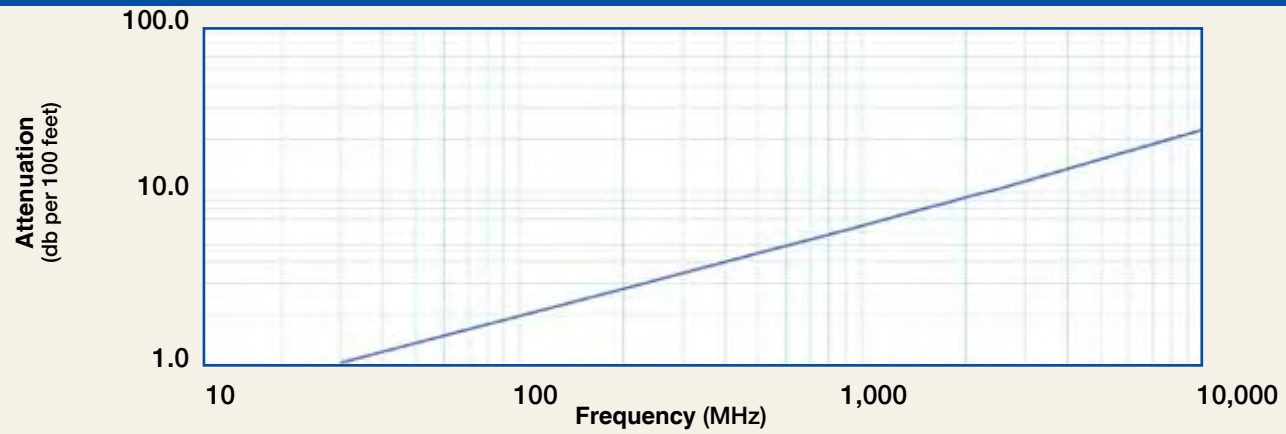
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	85	
Dielectric Constant	NA	1.38	
Time Delay	nS/ft (nS/m)	1.20	(3.92)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.9	(78.4)
Inductance	uH/ft (uH/m)	0.060	(0.20)
Shielding Effectiveness	dB	>100	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	2.12	(7.0)
Outer Conductor	ohms/1000ft (/km)	2.10	(6.9)
Voltage Withstand	Volts DC	2000	
Jacket Spark	Volts RMS	5000	
Peak Power	kW	10	
Passive Intermod	dBc	-155	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800	10,000
Attenuation dB/100 ft	1.1	1.4	2.4	3.0	4.3	6.1	8.0	8.8	9.3	10.5	16.7	22.7
Attenuation dB/100 m	3.5	4.6	8.0	9.7	14.0	20.1	26.3	29.0	30.7	34.6	54.8	74.5
Avg. Power kW	2.07	1.60	0.91	0.75	0.52	0.36	0.28	0.25	0.24	0.21	0.13	0.10

Calculate Attenuation = (0.194337) • $\sqrt{\text{FMHz}}$ + (0.000327) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. TNC Male	Straight Plug	TC-300-TM	3190-500	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/S	1.7 (43)	0.59 (15.0)	0.050 (22.7)
2. SMA Male	Straight Plug	TC-300-SM	3190-501	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0 (25)	0.35 (8.9)	0.018 (8.2)
3. SMA Female	Bulkhead Jack	TC-300-SF-BH	3190-590	<1.25:1 (2.5)	NA	Solder	Crimp	SS/G	1.1 (28)	0.31 (7.9)	0.022 (10.0)
4. N Male	Right Angle	TC-300-NMH-RA-D	3190-2761	<1.30:1 (2.5)	Hex/Knurl	Solder	Crimp	N/S	1.4 (35)	1.41 (35.8)	0.130 (59.0)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S300TT	GK-S300TT	Standard Ground Kit (each)

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-400/300	3190-666	Crimp tool for LMR 300 connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Prep Tool	CST-300	3192-084	Prep tool for LMR-300 connectors
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all strip tools

TIMES MICROWAVE SYSTEMS

TCOM®-400
Low Loss Low Passive Intermod Coax

Ideal for...

- -155 dBc Intermodulation Distortion
- Low Loss UHF/Microwave Interconnect
- Wireless Base Station Interconnect
- Flexible for Easy Routing

• **TCOM®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

TCOM®- FR is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. TCOM-FR has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively.

TCOM®- PUR has a polyurethane outer jacket designed for multiple bending/flexing cycles in rugged tactical applications.

Flexibility and bendability are hallmarks of the TCOM-400 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

Low Loss is another hallmark feature of TCOM-400. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

Passive Intermod is lower than –155 dBc exceed the performance levels for most wireless applications.

RF Shielding is 60 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 100 dB (i.e. >200 dB between two adjacent cables).

Weatherability: TCOM-400 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

Connectors: A wide variety of connectors are available for TCOM-400 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

Cable Assemblies: All TCOM-400 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
TCOM-400	Outdoor	PE	Black	55003
TCOM-400-FR	Indoor-Riser CMR	FRPE	Black	55016
TCOM-400-PUR	Indoor/Outdoor	PUR	Black	55015
TCOM-400-PUR-DB	Outdoor/ Watertight	PUR	Black	55031

Construction Specifications			
Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.108	(2.74)
Dielectric	Foam PE	0.285	(7.24)
Outer Conductor	SPC Strip Braid	0.295	(7.49)
Overall Braid	TC Braid over Al tape	0.330	(8.38)
Jacket	(see table above)	0.405	(10.29)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.00	(25.4)
Bend Radius: repeated	in. (mm)	4.0	(101.6)
Bending Moment	ft-lb (N-m)	0.5	(0.68)
Weight	lb/ft (kg/m)	0.080	(0.12)
Tensile Strength	lb (kg)	160	(72.6)
Flat Plate Crush	lb/in. (kg/mm)	40	(0.71)

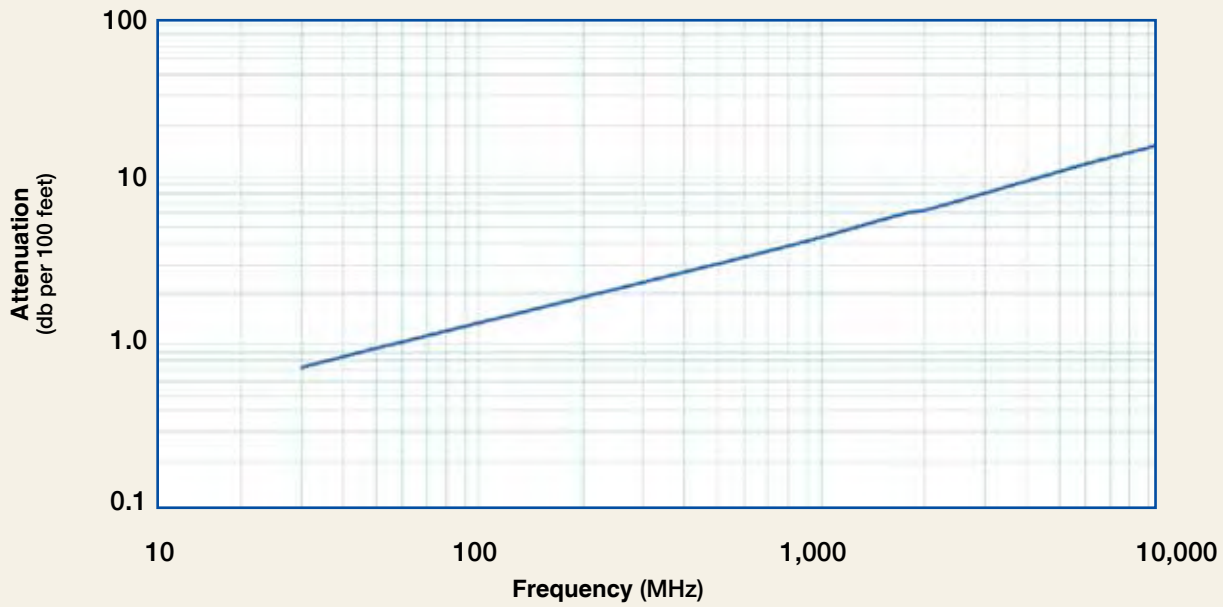
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	85	
Dielectric Constant	NA	1.38	
Time Delay	nS/ft (nS/m)	1.20	(3.92)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.9	(78.4)
Inductance	uH/ft (uH/m)	0.060	(0.20)
Shielding Effectiveness	dB	>100	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	1.39	(4.6)
Outer Conductor	ohms/1000ft (/km)	1.47	(4.8)
Voltage Withstand	Volts DC	2500	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	16	
Passive Intermod	dBc	-155	

Attenuation vs. Frequency (typical)



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800	10,000
Attenuation dB/100 ft	0.7	0.9	1.6	2.0	2.9	4.2	5.4	6.0	6.4	7.2	11.5	15.7
Attenuation dB/100 m	2.4	3.1	5.4	6.5	9.5	13.6	17.9	19.7	20.9	23.6	37.6	51.4
Avg. Power kW	3.12	2.41	1.38	1.13	0.78	0.54	0.41	0.37	0.35	0.31	0.19	0.14

Calculate Attenuation =

(0.130555) • $\sqrt{FMHz}$ + (0.000262) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:

VSWR=1.0 ; Ambient = +25°C (77°F)

Power:

VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

TCOM-400
Low Loss Low Passive Intermod Coax

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)		Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
1. 7-16 DIN Female	Straight Jack	TC-400-716-FC	3190-376	<1.25:1	(2.5)	NA	Solder	Clamp	S/S	1.6	(41)	1.13	(28.7)	0.281	(127.5)
2. 7-16 DIN Male	Straight Plug	TC-400-716-MC	3190-279	<1.25:1	(2.5)	Hex	Solder	Clamp	S/S	1.4	(36)	1.40	(35.6)	0.268	(121.6)
3. BNC Male	Straight Plug	TC-400-BM	3190-318	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/S	1.7	(43)	0.56	(14.2)	0.063	(28.6)
4. Mini-UHF	Straight Plug	TC-400-MUHF	3190-520	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/G	1.1	(28)	0.50	(12.7)	0.020	(9.1)
5. N Female	Straight Jack	TC-400-NFC	3190-299	<1.25:1	(2.5)	NA	Solder	Clamp	N/S	1.6	(41)	0.75	(19.1)	0.119	(54.0)
6.	Straight Jack	EZ-400-NF-X	3190-2818	<1.25:1	(2.5)	NA	Spring Finger	Crimp	N/G	1.8	(45)	0.66	(16.8)	0.105	(47.6)
7.	Bulkhead Jack	EZ-400-NF-BH	3190-518	<1.25:1	(2.5)	NA	Spring Finger	Crimp	N/G	1.8	(46)	0.88	(22.4)	0.102	(46.3)
8.	Bulkhead Jack	TC-400-NFC-BH (A)	3190-872	<1.25:1	(2.5)	NA	Solder	Clamp	A/G	1.8	(46)	0.88	(22.4)	0.145	(65.8)
9. N Male	Straight Plug	SC-400-NM	3190-1454	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/G	1.5	(38)	0.75	(19.1)	0.090	(40.8)
10.	Straight Plug	TC-400-NMC	3190-277	<1.25:1	(2.5)	Knurl	Solder	Clamp	N/G	1.5	(38)	0.75	(19.1)	0.121	(54.9)
11.	Straight Plug	EZ-400-NMH-X	3190-2590	<1.25:1	(10)	Hex/Knurl	Spring Finger	Crimp	A/G	1.5	(38)	0.89	(22.6)	0.103	(46.8)
12.	Straight Plug	TC-400-NMH-X	3190-2626	<1.25:1	(10)	Hex/Knurl	Solder	Crimp	A/G	1.5	(38)	0.89	(22.6)	0.113	(51.3)
13.	Straight Plug	EZ-400-NMK	3190-661	<1.25:1	(10)	Knurl	Spring Finger	Crimp	S/G	1.5	(38)	0.89	(22.6)	0.113	(51.3)
14.	Right Angle	EZ-400-NMH-RA-X	3190-2638	<1.35:1	(6)	Hex/Knurl	Spring Finger	Crimp	A/G	1.87	(47)	1.42	(36.0)	0.177	(80.2)
15.	Right Angle	TC-400-NMC-RA (A)	3190-870	<1.35:1	(2.5)	Hex	Solder	Clamp	A/G	1.8	(46)	1.25	(31.8)	0.150	(68.0)
16.	Reverse Polarity	TC-400-NM-RP	3190-960	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/G	1.5	(38)	0.75	(19.1)	0.090	(40.8)
17. SMA Male	Straight Plug	TC-400-SM	3190-439	<1.25:1	(8)	Hex	Solder	Crimp	N/G	1.2	(29)	0.50	(12.7)	0.032	(14.5)
18. TNC Female	Reverse Polarity	EZ-400-TF-RP	3190-795	<1.25:1	(2.5)	NA	Spring Finger	Crimp	A/G	1.8	(46)	0.55	(14.0)	0.074	(33.6)
19. TNC Male	Reverse Polarity	EZ-400-TM-RP	3190-794	<1.25:1	(2.5)	Knurl	Spring Finger	Crimp	A/G	1.7	(43)	0.59	(15.0)	0.074	(33.6)
20.	Straight Plug	TC-400-TM-X	3190-2532	<1.25:1	(6)	Hex/Knurl	Solder	Crimp	A/G	1.9	(48)	0.67	(17.5)	0.075	(34.3)
21.	Straight Plug	EZ-400-TM-X	3190-2533	<1.25:1	(6)	Hex/Knurl	Spring Finger	Crimp	A/G	1.9	(48)	0.67	(17.5)	0.075	(34.3)
22.	Right Angle	TC-400-TM-RA-D	3190-2671	<1.35:1	(6)	Hex/Knurl	Solder	Crimp	A/G	1.4	(35)	1.41	(35.8)	0.130	(59.0)
23. UHF Male	Straight Plug	EZ-400-UM	3190-997	<1.25:1	(2.5)	Knurl	Spring Finger	Crimp	N/G	1.9	(48)	0.80	(20.3)	0.090	(40.8)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S400TT	GK-S400TT	Standard Grounding Kit (each)
Hoisting Grip	HG-400T	HG-400T	Laced Type (each)

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1719	3190-202	.429" Hex Dies
Crimp Tool	CT-400/300	3190-666	Crimp tool for LMR 400 connectors
Crimp Rings	CR-400	3190-830	Crimp rings for TC/EZ-400 connectors (package of 10)
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Strip Tool	CST-400	3192-004	Combination prep tool for TCOM-400 crimp and clamp style connectors
Replacement Blades	RB-01	3190-1609	Replacement blades for cutting tool
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST strip tools
Tool Kit	TK-400EZ	3190-1602	Tool kit for LMR-400 crimp and clamp style connectors (includes CCT-01, CST-400, CT-400/300, Tool Pouch)

TIMES MICROWAVE SYSTEMS

TCOM®-500
Low Loss Low Passive Intermod Coax

Ideal for...

- -155 dBc Intermodulation Distortion
- Low Loss UHF/Microwave Interconnect
- Wireless Base Station Interconnect
- Flexible for Easy Routing

• **TCOM®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

TCOM®-FR is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. TCOM-FR has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively.

TCOM®-PUR has a polyurethane outer jacket designed for multiple bending/flexing cycles in rugged tactical applications.

Flexibility and bendability are hallmarks of the TCOM-500 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

Low Loss is another hallmark feature of TCOM-500. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

Passive Intermod is lower than –155 dBc exceed the performance levels for most wireless applications.

RF Shielding is 60 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 100 dB (i.e. >200 dB between two adjacent cables).

Weatherability: TCOM-500 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

Connectors: A wide variety of connectors are available for TCOM-500 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

Cable Assemblies: All TCOM-500 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description

Part Number	Application	Jacket	Color	Stock Code
TCOM-500	Outdoor	PE	Black	55004
TCOM-500-FR	Indoor-Riser CMR	FRPE	Black	55025

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.142	(3.61)
Dielectric	Foam PE	0.370	(9.40)
Outer Conductor	SPC Strip Braid	0.380	(9.65)
Overall Braid	TC Braid over Al tape	0.415	(10.54)
Jacket	(see table above)	0.500	(12.70)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.25	(31.8)
Bend Radius: repeated	in. (mm)	5.0	(127.0)
Bending Moment	ft-lb (N-m)	1.75	(2.37)
Weight	lb/ft (kg/m)	0.120	(0.179)
Tensile Strength	lb (kg)	260	(118.0)
Flat Plate Crush	lb/in. (kg/mm)	50	(0.89)

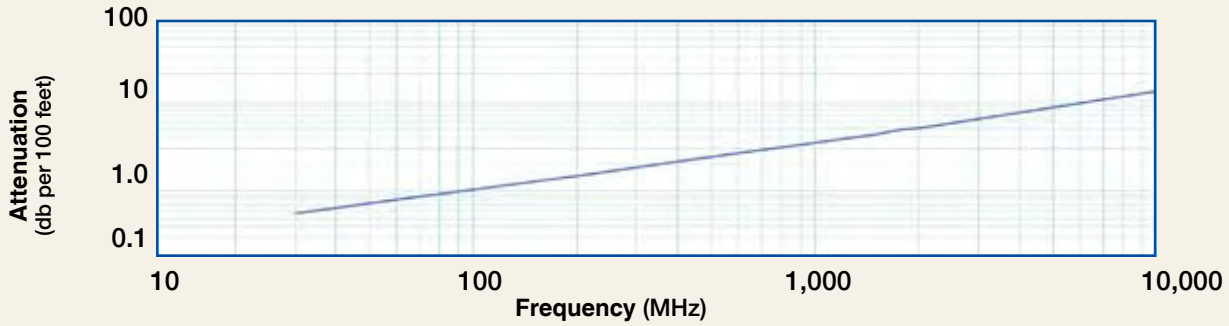
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	86	
Dielectric Constant	NA	1.35	
Time Delay	nS/ft (nS/m)	1.18	(3.88)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.6	(77.5)
Inductance	uH/ft (uH/m)	0.059	(0.19)
Shielding Effectiveness	dB	>100	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.82	(2.7)
Outer Conductor	ohms/1000ft (/km)	1.32	(4.3)
Voltage Withstand	Volts DC	3000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	22	
Passive Intermod	dBc	-155	

Attenuation vs. Frequency (typical)



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800	10,000
Attenuation dB/100 ft	0.6	0.7	1.3	1.6	2.3	3.3	4.3	4.8	5.0	5.7	9.2	12.7
Attenuation dB/100 m	1.8	2.4	4.2	5.1	7.4	10.7	14.1	15.6	16.5	18.7	30.2	41.7
Avg. Power kW	4.21	3.25	1.85	1.52	1.04	0.72	0.55	0.49	0.47	0.41	0.25	0.18

Calculate Attenuation = (0.100972) • $\sqrt{\text{FMHz}}$ + (0.000262) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. N Male	Straight Plug	TC-500-NMH-X	3190-2514	<1.35:5 (6)	Hex/Knurl	Solder	Crimp	A/G	1.8(45)0.87	(22.0)0.099	(45.0)
2.	Right Angle	TC-500-NMH-RA-D	3190-2513	<1.25:1 (6)	Hex/Knurl	Solder	Crimp	A/G	1.5(39)1.6	(42.0) 0.279	(127.0)
3.	Straight Plug	TC-500-NMC	3190-377	<1.25:1 (2.5)	Hex	Solder	Clamp	S/G	2.1 (53)	0.92 (23.4)	0.228 (103.4)
4.	Right Angle	TC-500-NMC-RA	3190-227	<1.35:1 (2.5)	Hex	Solder	Clamp	S/G	2.4 (61)	1.5 (38.1)	0.275 (124.7)
5. N Female	Straight Jack	TC-500-NFC	3190-215	<1.25:1 (2.5)	NA	Solder	Clamp	S/G	2.2 (56)	0.94 (23.9)	0.215 (97.5)
6.	Bulkhead Kit	BHA-KIT	3190-223	<1.25:1 (2.5)	NA	NA	NA	NA	NA NA	NA NA	0.014 (6.4)
7. TNC Male	Straight Plug	TC-500-TM	3190-464	<1.25:1 (2.5)	Hex	Solder	Crimp	N/G	1.5 (38)	0.62 (15.7)	0.082 (28.1)
8. UHF Male	Straight Plug	TC-500-UMC	3190-354	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G	2.1 (53)	0.88 (22.4)	0.215 (97.5)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector **pair**

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y151	3190-465	.532" Hex Dies
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Prep Tool	CST-500	3192-075	Prep tool for LMR-500 crimp/clamp connectors
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST tools

TIMES MICROWAVE SYSTEMS

TCOM®-600
Low Loss Low Passive Intermod Coax

Ideal for...

- -155 dBc Intermodulation Distortion
- Low Loss UHF/Microwave Interconnect
- Wireless Base Station Interconnect
- Flexible for Easy Routing

• **TCOM®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

TCOM®- FR is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. TCOM-FR has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively.

TCOM®- PUR has a polyurethane outer jacket designed for multiple bending/flexing cycles in rugged tactical applications.

Flexibility and bendability are hallmarks of the TCOM-600 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

Low Loss is another hallmark feature of TCOM-600. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

Passive Intermod is lower than –155 dBc exceed the performance levels for most wireless applications.

RF Shielding is 60 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 100 dB (i.e. >200 dB between two adjacent cables).

Weatherability: TCOM-600 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

Connectors: A wide variety of connectors are available for TCOM-600 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

Cable Assemblies: All TCOM-600 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description

Part Number	Application	Jacket	Color	Stock Code
TCOM-600	Outdoor	PE	Black	55005
TCOM-600-FR	Indoor-Riser CMR	FRPE	Black	55018
TCOM-600-PUR	Indoor/Outdoor	PUR	Black	55006
TCOM-600-PUR-DB	Outdoor/ Watertight	PUR	Black	55041

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.176	(4.47)
Dielectric	Foam PE	0.455	(11.56)
Outer Conductor	SPC Strip Braid	0.465	(11.81)
Overall Braid	TC Braid over Al tape	0.500	(12.70)
Jacket	(see table above)	0.590	(14.99)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.50	(38.1)
Bend Radius: repeated	in. (mm)	6.0	(152.4)
Bending Moment	ft-lb (N-m)	2.75	(3.73)
Weight	lb/ft (kg/m)	0.160	(0.24)
Tensile Strength	lb (kg)	350	(158.9)
Flat Plate Crush	lb/in. (kg/mm)	60	(1.07)

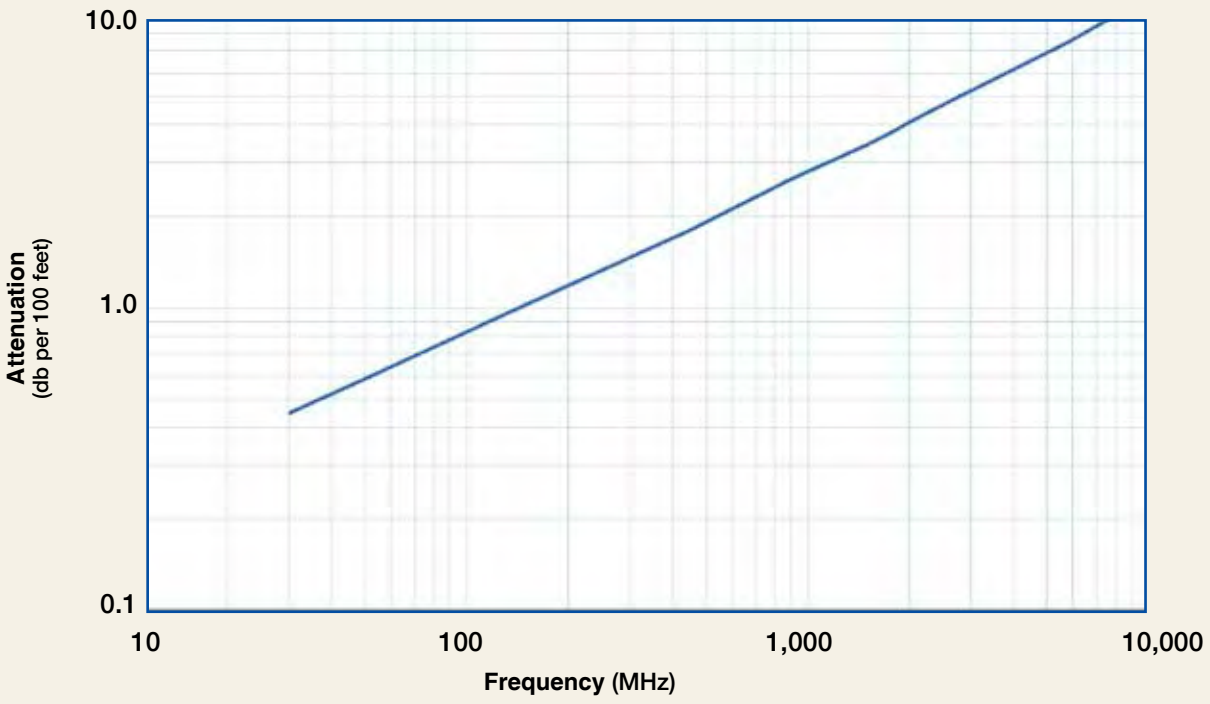
Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	87	
Dielectric Constant	NA	1.32	
Time Delay	nS/ft (nS/m)	1.17	(3.83)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.4	(76.6)
Inductance	uH/ft (uH/m)	0.058	(0.19)
Shielding Effectiveness	dB	>100	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.53	(1.74)
Outer Conductor	ohms/1000ft (/km)	1.52	(5.0)
Voltage Withstand	Volts DC	4000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	40	
Passive Intermod	dBc	-155	

Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Attenuation vs. Frequency (typical)



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800	10,00
Attenuation dB/100 ft	0.4	0.6	1.0	1.2	1.8	2.6	3.5	3.9	4.1	4.6	7.6	10.6
Attenuation dB/100 m	1.5	1.9	3.3	4.1	6.0	8.6	11.4	12.7	13.4	15.2	24.9	34.7
Avg. Power kW	5.20	4.01	2.28	1.86	1.28	0.88	0.66	0.60	0.56	0.50	0.30	0.22

Calculate Attenuation =

(0.080075) • $\sqrt{FMHz}$ + (0.000256) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:

VSWR=1.0 ; Ambient = +25°C (77°F)

Power:

VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

TCOM-600
Low Loss Low Passive Intermod Coax

Connectors

	Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)		Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	(mm)	Width in	(mm)	Weight lb	(g)
1.	7-16 DIN Female	Straight Jack	TC-600-716-FC	3190-375	<1.25:1	(2.5)	NA	Solder	Clamp	S/S	1.1	(28)	1.00	(25.4)	0.249	(112.9)
2.	7-16 DIN Male	Straight Plug	EZ-600-716-MH	3190-503	<1.25:1	(2.5)	Hex	Spring Finger	Crimp	S/S	2.0	(51)	1.30	(33.0)	0.254	(115.2)
3.		Straight Plug	TC-600-716-MC	3190-502	<1.25:1	(2.5)	Hex	Solder	Clamp	S/S	2.0	(51)	1.30	(33.0)	0.347	(157.4)
4.		Right Angle	TC-600-716M-RA	3190-395	<1.35:1	(2.5)	Hex	Solder	Crimp	S/S	1.4	(36)	1.40	(35.6)	0.354	(160.8)
5.	N Female	Bulkhead Jack	EZ-600-NF-BH	3190-616	<1.25:1	(2.5)	NA	Spring Finger	Crimp	S/G	2.4	(61)	0.88	(22.4)	0.195	(88.5)
6.		Bulkhead Jack	TC-600-NF-BH	3190-589	<1.25:1	(2.5)	NA	Solder	Crimp	S/G	2.4	(61)	0.88	(22.4)	0.195	(88.5)
7.		Bulkhead Jack	TC-600-NFC-BH	3190-466	<1.25:1	(2.5)	NA	Solder	Clamp	S/G	2.2	(56)	0.94	(23.9)	0.214	(97.1)
8.	N Male	Straight Plug	EZ-600-NMH-X	3190-2627	<1.25:1	(8.0)	Hex/Knurl	Spring Finger	Crimp	A/G	2.1	(53)	0.92	(23.4)	0.164	(74.4)
9.		Straight Plug	EZ-600-NMC-2-D	3190-2641	<1.25:1	(6)	Hex/Knurl	Spring Finger	Clamp	A/G	2.1	(53)	0.92	(23.4)	0.202	(91.6)
10.		Straight Plug	TC-600-NMC	3190-357	<1.25:1	(2.5)	Hex	Solder	Clamp	S/G	2.1	(53)	0.92	(23.4)	0.208	(93.4)
11.		Right Angle	TC-600-NMC-RA	3190-233	<1.35:1	(2.5)	Hex	Solder	Clamp	S/G	2.1	(53)	0.92	(23.4)	0.280	(17.9)
12.	TNC Male	Straight Plug	EZ-600-TM	3190-418	<1.25:1	(2.5)	Knurl	Spring Finger	Crimp	S/G	1.7	(43)	0.59	(15.0)	0.112	(50.8)
13.		Straight Plug	TC-600-TM-X	3190-2530	<1.25:1	(6)	Hex/Knurl	Solder	Crimp	A/G	2.3	(57.6)	0.75	(19.0)	0.100	(45.6)
14.		Straight Plug	EZ-600-TM-X	3190-2531	<1.25:1	(6)	Hex/Knurl	Spring Finger	Crimp	A/G	2.3	(57.6	0.75	(19.0)	0.100	(45.6)
15.	UHF Male	Straight Plug	EZ-600-UM	3190-615	<1.25:1	(2.5)	Knurl	Spring Finger	Crimp	S/G	1.7	(43)	0.88	(22.4)	0.164	(74.4)
16.		Straight Plug	TC-600-UMC	3190-213	<1.25:1	(2.5)	Knurl	Solder	Clamp	S/G	1.7	(43)	0.88	(22.4)	0.198	(89.8)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

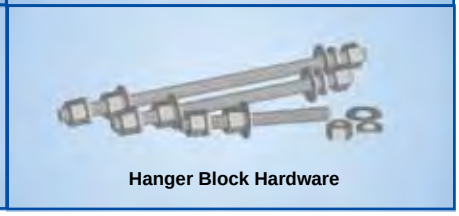

GK-S600TT


HG-600T


CS-A600T, CS-60120T, CS-60170T


SC-600T


CB-600T


Hanger Block Hardware

Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S600TT	GK-S600TT	Standard Grounding Kit (each)
Hoisting Grip	HG-600T	HG-600T	Split/Laced Type (each)
Cold Shrink	CS-A600T	CS-A600T	Cable to Antenna Junction (each)
Cold Shrink	CS-60120T	CS-60120T	LMR-600 to -1200 Junction (each)
Cold Shrink	CS-60170T	CS-60170T	LMR-600 to -1700 Junction (each)
Standard Entry Port Cushion	SC-600T-3	SC-600T-3	Three Cables (each)
Standard Entry Panels			Full Range of Port Styles/Combinations Available
Hanger Blocks	CB-600T	CB-600T	Dual Cable Support Block (kit of 10)
Hanger Block Supporting Hardware			Complete Range of Supporting Hardware & Adapters Available


HX-4
3192-200


Y1720
3190-203


DBT-U
3192-001


WR600
3190-1435


CCT-01
3190-1544


CST-600
3192-052


RB-CST
3192-086


TK-600-EZ
3190-1602

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1720	3190-203	Standard .610" Hex
Cutting Tool	CCT-01	3190-1544	Cable and flush cut tool
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST strip tools
Wrench	WR600	3190-1435	15/16" Box Wrench (2 required for EZ-600-NMC-2)
Strip Tool	CST-600	3192-052	Combination prep tool for T-COM 600 crimp/clamp connectors
Tool Kit	TK-600EZ	3190-1602	Tool kit for LMR crimp/clamp connectors (includes CCT-01, CST-600, HX-4, Y1720, Tool Pouch)

TIMES MICROWAVE SYSTEMS

Installation Tools

Crimp Tools


HX-4


Y1719


CT-400/300

Midspan Strip Tools


GST-400A

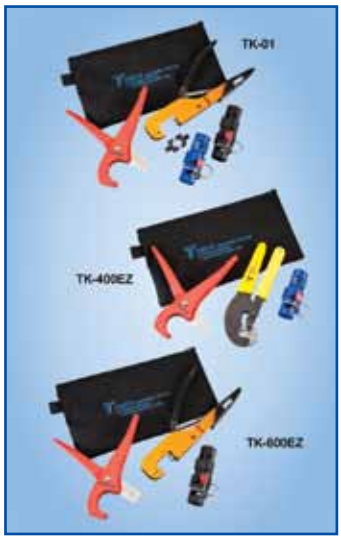

GST-600A

Part Number	Stock Code	Description	Qty
HX-4	3190-200	Crimp Tool (handle only)	each
Y197	3190-610	.213" hex dies fo TC/EZ-195/200 crimp connectors	each
Y375	3190-608	.255" hex dies for TC/EZ-240 crimp connectors	each
Y102	3190-611	.324" hex dies for TC/EZ-300 crimp connectors	each
Y1719	3190-202	.429" hex dies for TC/EZ-400 crimp connectors	each
Y151	3190-465	.532" hex dies for TC/EZ-500 crimp connectors	each
Y1720	3190-203	.610" hex dies for TC/EZ-600 crimp connectors	each
CT-400/300	3190-666	Crimp tool for LMR-400 & LMR-300 connectors	each
CT-240/200/100	3190-667	Crimp tool for LMR-240, LMR-200, LMR195 & LMR-100 connectors	each
GST-400A	3190-2174	Midspan strip tool for LMR-400 grounding kit	each
GST-600A	3190-1051	Midspan strip tool for LMR-600 grounding kit	each
GST-900A	3190-435	Midspan strip tool for LMR-900 grounding kit	each
GST-1200A	3190-436	Midspan strip tool for LMR-1200 grounding kit	each
GST-1700A	3190-437	Midspan strip tool for LMR-1700 grounding kit	each

Deburring

Wrenches

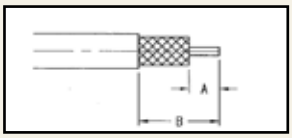
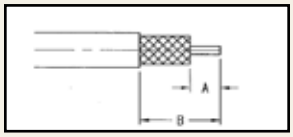
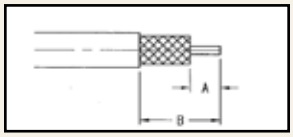
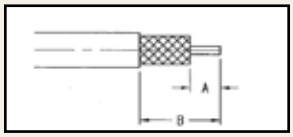
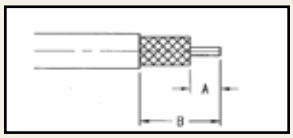
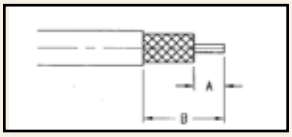
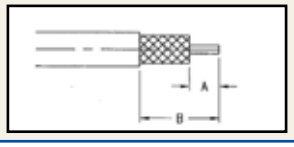
Tool Kits

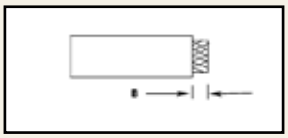
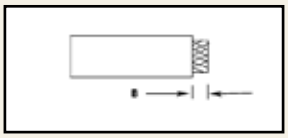
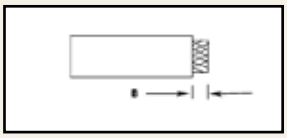
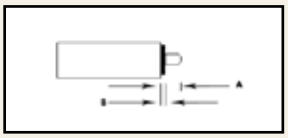
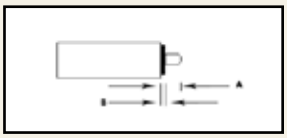
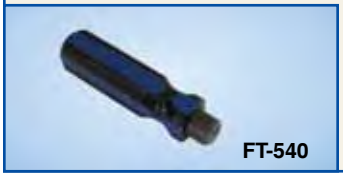


Cable End Cutting Tools

Part Number	Stock Code	Description	Qty
DBT-U	3192-001	Deburring tool for LMR-195 through LMR-600 center conductors	each
WR-600	3190-1435	15/16" box wrench (two required for EZ-600-NMC-2)	each
WR-900	3190-509	1-1/4" box wrench (two required for EZ-900 connectors)	each
WR-1200A	3190-512	1-9/16" box wrench (one required for EZ-1200 connectors)	each
WR-1200B	3190-511	1-7/16" box wrench (one required for EZ-1200 connectors)	each
WR-1700	3190-514	2" box wrench (two required for EZ-1700 connectors)	each
TK-01	3190-731	Install tool kit for LMR-400/600 connectors (includes CCT-01, CST-400, CST-600, HX-4, .429 and .610 hex dies, tool pouch)	each
TK-400EZ	3190-1601	Tool kit for LMR-400 crimp connectors (includes CCT-01, CST-400, CT-400/300, tool pouch)	each
TK-600EZ	3190-1602	Tool kit for LMR-600 crimp connectors (includes CCT-01,CST-600, HX-4, .610 hex dies, tool pouch)	each
CCT-01	3190-1544	Cable end flush cut tool (pkg of 1)	each
RB-01	3190-1609	Replacement blade for CCT-01	each

TIMES MICROWAVE SYSTEMS

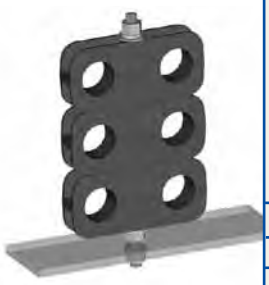
	Stock Code	Description	Diagram	A	B1	B2
 CST-195/200	3192-102	Prep tool for LMR-195/200 connectors		0.150"	0.550"	0.800"
 CST-240	3192-070	Prep tool for LMR-240 connectors		0.200"	0.600"	0.800
 CST-300	3192-084	Prep tool for LMR-300 connectors		0.250"	0.750"	1.000"
 CST-400	3192-004	Prep tool for LMR-400 crimp/clamp style connectors		0.210"	0.600"	0.800"
 ST-400C-2	3192-1972	Prep tool for EZ-400-NMC-2 & EZ-400-NFC-2 two piece clamp style conectors		0.250"	0.500"	N/A
 CST-500	3192-075	Prep tool for LMR-500 crimp/clamp style connectors		0.250"	0.580"	0.825
 CST-600	3192-052	Prep tool for LMR-600 crimp/clamp style connectors		0.250"	0.625"	1.000"

	Stock Code	Description	Diagram	A	B1	B2
 ST-900C	3190-1310	Prep tool for LMR-900 connectors		N/A	0.400"	N/A
 ST-1200-CH	3192-124	Prep tool for LMR-1200 connectors		N/A	0.400"	N/A
 ST-1700C	3190-312	Prep tool for LMR-1700 connectors		N/A	0.400"	N/A
 ST-396-J	3192-092	Prep tool for LMR-SW-396 connectors		8.5mm	2mm	N/A
 FT-396	3192-088	Flaring tool for LMR-SW-396 connectors				
 ST-540-J	3192-091	Prep tool for LMR-SW-540 connectors		8.5mm	2mm	N/A
 FT-540	3192-074	Flaring tool for LMR-SW-540 connectors				

TIMES MICROWAVE SYSTEMS

Hardware Accessories

Mini Coax Support Blocks



Neatly stack coax into space saving bundles. Lower material cost by reducing hardware requirements.

Application:	Coax Support
Size:	1/2" to 1-1/4" coax
Design:	Two-run block hangers
Feature:	Compact coax bundles
Mounts to:	3/8" or 10mm threaded rod
Material:	Long glass polypropylene
Includes:	Blocks only
Order Sep.:	3/8" or 10mm mounting hardware kits

	TMS part no.	Quant/pkg.	Weight lb (kg)
Mini coax support block for LMR-600	CB-600T	10	1.2 (0.5)
Mini coax support block for LMR-900	CB-900T	10	1.2 (0.5)
Mini coax support block for LMR-1200	CB-1200T	10	1.2 (0.5)
Mini coax support block for LMR-1700 coax	CB-1700T	10	1.7 (0.8)

Mounting Hardware Kits for Coax Support Blocks and Hanger Clamps

Pre-cut galvanized threaded rod hardware kits for stacking and installing mini coax support blocks.

Application:	Coax Support
Size:	3/8"
Design:	1, 2, and 3-stack threaded rod kits
Feature:	Stacks coax blocks
Mounts to:	—
Material:	Galv. (3/8") or stainless steel (10mm)
Includes:	Threaded rod and hardware
Order Sep.:	Additional accessories

	TMS part no.	Quant/pkg.	Weight lb (kg)
Hardware kit for LMR-600, 900, 1200 support blocks	HK-SSCB	10	1.8 (0.8)
Hardware kit for LMR-1700 support blocks	HK-SSCB-158	10	1.9 (0.9)
Hardware kit for mounting (2) mini coax support blocks for LMR-600, 900, 1200	HK-DSCB	10	2.3 (1.0)
Hardware kit for mounting (2) mini coax support blocks for LMR-1700	HK-DSCB-158	10	2.5 (1.1)
Hardware kit for mounting (3) mini coax support blocks for LMR-600, 900, 1200	HK-TSCB	10	2.8 (1.3)
Hardware kit for mounting (3) mini coax support blocks for LMR-1700	HK-TSCB-158	10	3.2 (1.5)

Adapter Bracket

Support coax blocks in wall mount applications.

Application:	Coax Support
Size:	7/16" (11.1mm) holes
Design:	Adapts hangers to flat surfaces
Feature:	Compact design
Mounts to:	—
Material:	Stainless steel
Includes:	Bracket
Order Sep.:	Additional accessories

	TMS part no.	Quant/pkg.	Weight lb (kg)
Adaptor bracket	AB-CB	10	4.6 (2.1)

Stainless Steel Adapter Bracket

Adapt angled members for securing coax cables. Unique design easily converts to accommodate snap-in hangers.

Application:	Coax Support
Size:	7/16" (11.1mm) holes
Design:	Adapts hangers to flat surfaces
Feature:	Fits any bolt-on hanger style
Mounts to:	—
Material:	Hot dip galv. steel,
Includes:	Bracket
Order Sep.:	Additional accessories

	TMS part no.	Quant/pkg.	Weight lb (kg)
Universal SST angle adapter	AB-CBH	1	2.3 (1.0)

Butterfly Hangers

Butterfly hangers for standard non-snap-in installations.

Application: Coax Support
Size: see chart
Design: Bolt-on single run hanger
Feature: Traditional hanger solution
Mounts to: 7/16" (11.1mm) prepunched hole
Material: Stainless steel
Includes: Hangers and set bolts
Order Sep.: Hanger hardware kits & additional accessories
Note: Hanger hardware kit not included; order separately

	TMS part no.	Quant/pkg.	Weight lb	(kg)
Butterfly hanger for LMR-400	BH-S38 NH	10	1.0	(0.5)
Butterfly hanger for LMR-600	BH-12 NH	10	1.0	(0.5)
Butterfly hanger for LMR-900	BH-58 NH	10	1.1	(0.5)
Butterfly hanger for LMR-1200	BH-78 NH	10	1.1	(0.5)
Butterfly hanger for LMR-1700	BH-114 NH	10	1.4	(0.6)

Standard Hangers

Standard hanger for reduced installation time

App.: Coax Support
Size: See chart
Design: Pre-formed bolt-on single run hanger
Feature: Reduced installation time
Mounts to: 7/16" (11.1mm) prepunched hole
Material: Stainless steel
Includes: Hangers and set bolts
Order Sep.: Hanger hardware kits & additional accessories
Note: Hanger hardware kit not included; order separately

	TMS part no.	Quant/pkg.	Weight lb	(kg)
Standard hanger for LMR-400	BH-S38 NH	10	0.8	(0.4)
Standard hanger for LMR-600	BH-S12 NH	10	0.8	(0.4)
Standard hanger for LMR-1200	BH-S78 NH	10	1.8	(0.8)
Standard hanger for LMR-1700	BH-S114 NH	10	1.1	(0.5)

Clip Hangers

Easy install solution

Application: Coax Support
Size: See chart
Design: Clip-on single run hanger
Feature: Easy-to-install solution
Mounts to: 7/16" (11.1mm) prepunched hole
Material: Stainless steel
Includes: Hangers and set bolts
Order Sep.: Hanger hardware kits and additional accessories
Note: Hanger hardware kit not included; order separately

	TMS part no.	Quant/pkg.	Weight lb	(kg)
Clip hanger kit for LMR-600	CH-12 NH	10	0.8	(0.4)
Clip hanger kit for LMR-1200	CH-78 NH	10	0.8	(0.4)
Clip hanger kit for LMR-1700	CH-114 NH	10	1.1	(0.5)

Universal Snap-in Hangers

Snap-in hangers simplify coax installation by eliminating the need for mounting hardware and installation tools.

Application: Coax Support
Size: See chart
Design: One-piece hanger solution
Feature: Simplifies coax installation
Mounts to: 3/4" (19.1mm) holes
Material: Stainless steel
Includes: Hangers
Order Sep.: Additional mounting accessories

	TMS part no.	Quant/pkg.	Weight lb	(kg)
Universal snap-in hanger for LMR-600	SH-U600T	10	0.7	(0.3)
Universal snap-in hanger for LMR-900	SH-U900T	10	1.0	(0.5)
Universal snap-in hanger for LMR-1200	SH-U1200T	10	1.2	(0.5)
Universal snap-in hanger for LMR-1700	SH-U1700T	10	1.3	(0.6)

TIMES MICROWAVE SYSTEMS

Hardware Accessories

Hanger Hardware Kits

Standard, clip and butterfly for flange attachment.

Application: Coax Support
Size: 3/8" or 10mm
Design: Hardware kit for hanger attachment to member
Feature: —
Mounts to: —
Material: Stainless steel
Includes: Bolts, nuts, lockwashers
Order Sep.: Hangers

	TMS part no.	Quant/pkg.	Weight lb	(kg)
Hanger hardware kit, 3/8" x 3/4" slotted hex head bolts, lock washers and hex nuts	HK-34-10	10	0.5	(0.2)
Hanger hardware kit, 3/8" x 1" slotted head bolts lock washers and hex nuts	HK-100-10	10	0.6	(0.3)
Hanger hardware kit, 10mm x 20mm slotted head bolts lock washers and hex nuts	HK-M1020-10	10	0.5	(0.2)

Universal Angle Adapters

Adapt angled members for securing coax hangers.

Application: Coax Support
Size: 3/4" (19.1mm) holes w/ 3/8" tapped insert
Design: Adapts hangers to angle members
Feature: Accepts snap-ins or 3/8" hardware
Mounts to: Up to 7/8" (22mm) angle members
Material: Stainless steel
Includes: Adapters, set bolt, hanger hardware kit, avail. w/ or wo insert
Order Sep.: Hangers

	TMS part no.	Quant/pkg.	Weight lb	(kg)
Universal angle adapter for snap-ins or 3/8" tapped holes	AA-U	10	4.9	(2.2)
Angle adapter, large version, with 3/8" threaded hardware	AA-US	10	4.7	(2.1)

Angle Adapters

Adapt angled members for securing coax hangers using 3/8" threaded hardware.

Application: Coax Support
Size: 3/8" tapped holes
Design: Adapts hangers to angle members
Feature: High strength solution
Mounts to: Up to 7/8" (22mm) angle members
Material: Stainless steel
Includes: Adapters, set bolt, hanger hardware kit
Order Sep.: Hangers

	TMS part no.	Quant/pkg.	Weight lb	(kg)
Angle adapter with 3/8" tapped holes	AA-SL	10	5.4	(2.5)
Angle adapter with 10 mm tapped holes	AA-SL-M10	10	5.4	(2.5)

Stand-Off Adapters

Adapt and stand coax off 2" from round members. Unique design easily converts to accommodate snap-in hangers. Round member adapters included unless noted.

Application: Coax Support
Size: 3/8" or 10mm tapped hole
Design: Adapts hangers to round members
Feature: Provides 2" (50.8mm) stand-off
Mounts to: Versions for 1" to 6" (25.4mm to 152.4mm) OD
Material: Stainless steel
Includes: Stand-offs, avail. w. or w.o. hose clamps
Order Sep.: Hangers

	TMS part no.	Quant/pkg.	Weight lb	(kg)
Universal SST stand-off adapter *	SA-38S	10	3.8	(1.7)
Universal SST stand-off adapter for 1"-2" OD members**	SA-38S100	10	3.8	(1.7)
Universal SST stand-off adapter for 2"-3" OD members**	SA-38S200	10	3.8	(1.7)
Universal SST stand-off adapter for 3"-4" OD members**	SA-38S300	10	4.0	(1.8)
Universal SST stand-off adapter for 4"-5" OD members**	SA-38S400	10	4.1	(1.9)
Universal SST stand-off adapter for 5"-6" OD members**	SA-38S500	10	4.4	(2.0)

* Round member adapters not included **Round adapter included

Snap-In Stand-Off Adapters

Adapt and stand coax off 2" from round members to avoid obstructions such as tower leg flanges and cross members

Application:	Coax Support
Size:	3/4" (19.1mm) hole
Design:	Adapts hangers to round members
Feature:	Accepts snap-ins
Mounts to:	Versions for 1" to 6" (25.4mm to 152.4mm) OD
Material:	Stainless steel
Includes:	Stand-offs, avail. with or without hose clamps
Order Sep.:	Snap-ins

	TMS part no.	Quant/pkg.	Weight lb (kg)
Snap-In Stand-Off Adapter *	SA-SS	10	2.9 (1.3)
Snap-In Stand-Off Adapter for 1-2" (25.4mm-50.8mm) OD members**	SA-SS100	10	3.8 (1.7)
Snap-In Stand-Off Adapter for 2-3" (50.8mm-76.2mm) OD members**	SA-SS200	10	3.9 (1.8)
Snap-In Stand-Off Adapter for 3-4" (76.2mm-101.6mm) OD members**	SA-SS300	10	4.0 (1.8)
Snap-In Stand-Off Adapter for 4-5" (101.6mm-127.0mm) OD members**	SA-SS400	10	4.1 (1.9)
Snap-In Stand-Off Adapter for 5-6" (127.0mm-152.4mm) OD members**	SA-SS500	10	4.1 (1.9)

* Round member adapters must be purchased separately **Round member adapter included

Mini Cluster Support Bracket

Mini Cluster bracket provides compact mounting support for a variety of different hanger types

Application:	Coax Support
Size:	3/4" (19.1mm) and 7/16" (11.1mm) holes
Design:	Three-run cluster bracket
Feature:	Compact mounting solution
Mounts to:	—
Material:	Hot dip galv. steel
Includes:	Bracket
Order Sep.:	Hangers, mounting hardware

	TMS part no.	Quant/pkg.	Weight lb (kg)
Mini Cluster Support Bracket	CS-BS	10	4.4 (2.0)

Round Member Adapters

Adapt round members when securing most hanger styles.

Application:	Coax Support
Size:	3/4" (19.1mm) and 7/16" (11.1mm) holes
Design:	Three-run cluster bracket
Feature:	Compact mounting solution
Mounts to:	—
Material:	Hot dip galvanized steel
Includes:	Bracket
Order Sep.:	Hangers, mounting hardware

	TMS part no.	Quant/pkg.	Weight lb (kg)
Round member adapter, 1"-2" OD	RMA-100	10	0.8 (0.4)
Round member adapter, 2"-3" OD	RMA-200	10	1.0 (0.5)
Round member adapter, 3"-4" OD	RMA-300	10	1.2 (0.5)
Round member adapter, 4"-5" OD	RMA-400	10	1.3 (0.6)
Round member adapter, 5"-6" OD	RMA-500	10	1.3 (0.6)
Round member adapter, 6"-8" OD	RMA-600	10	1.3 (0.6)

TIMES MICROWAVE SYSTEMS

Hardware Accessories

Lace-up Hoisting Grips

Hoisting Grips provide an effective method for lifting coax cables to the top of a tower where it is tied off to support the cable weight

*LMR-400 Grip is non-lace-up

Application: Coax Support
Size: Versions for coax and elliptical waveguide
Design: Mesh grip with single eye support
Feature: Lace-up installation at any point on coax
Mounts to: —
Material: Tinned bronze
Includes: Grip
Order Sep.: —

	TMS part no.	Quant/pkg.	Weight lb	(kg)
Hoisting Grip for LMR-400 Coaxial Cable*	HG-400T	1	0.3	(1.0)
Lace-up Hoisting Grip for LMR-600 Coaxial Cable	HG-600T	1	0.3	(1.0)
Lace-up Hoisting Grip for LMR-900 Coaxial Cable	HG-900T	1	0.4	(0.2)
Lace-up Hoisting Grip for LMR-1200 Coaxial Cable	HG-1200T	1	0.6	(0.3)
Lace-up Hoisting Grip for LMR-1700 Coaxial Cable	HG-1700T	1	0.6	(0.3)

Universal Weatherproofing Kits

Mastic and electrical tape kit facilitates easy installation and provides a long-term environmental seal for connections.

Application: Coax Protection
Size: —
Design: Tape kit for multi-layer wrap
Feature: Multi-connection protection
Mounts to: —
Material: Butyl and vinyl
WK-U
Includes: Six (6) rolls mastic, 2-1/2" x 24" (64mm x 610mm)
Two (2) rolls electrical tape, 3/4" x 66' (19mm x 20m)
One (1) roll electrical tape, 2" x 20' (51mm x 6m)
Order Sep.: —

	TMS part no.	Quant/pkg.	Weight lb	(kg)
Universal Kit (does 6 connections)	WK-U	1	3.4	(1.5)
Vinyl-mastic Kit (does 2 connections)	WK-2	1	0.6	(0.3)

3M™ Cold Shrink™ Weatherproofing Kits

Avoid tapes and mastics with Cold Shrink™. This unique weatherproofing solution installs in less than three minutes, and eliminates the taping processes.

	TMS part no.	Quant/pkg	Weight lb	(kg)
LMR-400 & LMR-600 (antenna interface)	CS-4060T	1	0.4	(0.2)
LMR-600 (antenna interface)	CS-A-600T	1	0.8	(0.4)
LMR-900 (antenna interface)	CS-A900T	1	0.8	(0.4)
LMR-1200 to LMR-400	CS-40120T	1	0.8	(0.4)
LMR-1200 to LMR-500	CS-50120T	1	0.8	(0.4)
LMR-1200 to LMR-600	CS-60120T	1	0.8	(0.4)
LMR-1200 to LMR-900	CS-90120T	1	0.8	(0.4)
LMR-1700 to LMR-400	CS-40170T	1	1.0	(0.5)
LMR-1700 to LMR-500	CS-50170T	1	1.0	(0.5)
LMR-1700 to LMR-600	CS-60170T	1	0.9	(0.4)
LMR-1700 to LMR-900	CS-90170T	1	0.9	(0.4)

Rapid-Tite Self Bonding Silicone Tape

Self-bonding silicone tape is a cost effective, labor saving alternative to traditional vinyl mastic and butyl rubber sealing kits.

	TMS part no.	Quant/pkg	No. Connections
1.5" wide x 15' length x 30 mil. silicone tape	WK-S-1	1	6
	WK-S-2	2	12

Standard Ground Kits

Pre-formed copper strap facilitates easy installation and protects coax from lightening strikes in excess of 200 kA

Application: Grounding
Size: Versions for coax and elliptical waveguide
Design: Bolt-on style with 3' (0.9m) lead / crimp lug
Feature: RoHS compliant
Mounts to: Coax outer conductor
Material: Tin plated copper strap
Includes: Ground kit, lug, weatherproofing kit
Order Sep.: —

	TMS part no.	Quant/pkg.	Weight lb	(kg)
Standard Ground Kit for LMR-195 Coaxial Cable	GK-S195TT	1	1.4	(0.6)
Standard Ground Kit for LMR-200 Coaxial Cable	GK-S200TT	1	1.4	(0.6)
Standard Ground Kit for LMR-240 Coaxial Cable	GK-S240TT	1	1.4	(0.6)
Standard Ground Kit for LMR-300 Coaxial Cable	GK-S300TT	1	1.4	(0.6)
Standard Ground Kit for LMR-400 Coaxial Cable	GK-S400TT	1	1.4	(0.6)
Standard Ground Kit for LMR-500 Coaxial Cable	GK-S500TT	1	1.4	(0.6)
Standard Ground Kit for LMR-600 Coaxial Cable	GK-S600TT	1	1.4	(0.6)
Standard Ground Kit for LMR-900 Coaxial Cable	GK-S900TT	1	1.4	(0.6)
Standard Ground Kit for LMR-1200 Coaxial Cable	GK-S1200TT	1	1.4	(0.6)
Standard Ground Kit for LMR-1700 Coaxial Cable	GK-S1700TT	1	1.4	(0.6)

4" Feed-thru Entry Panels

Traditional panel for weather-tight building penetration

Application: Entry Port Solutions
Size: 20 configurations
Design: Entry plates with round ports
Feature: Easy to install solution
Mounts to: Walls
Material: Aluminum
Includes: Port, caps, mounting hardware
Order Sep.: 4" (101.6mm) Boot Assemblies

	TMS part no.	Quant/pkg.	Weight lb	(kg)
Entry Panel, 1 port, 1 x 1, standard	EP-220	1	1.0	(0.5)
Entry Panel, 1 port, 1 x 1, compact	EP-574	1	0.6	(0.3)
Entry Panel, 2 port, 1 x 2	EP-1448	1	2.3	(1.0)
Entry Panel, 3 port, 1 x 3	EP-1635	1	2.9	(1.3)
Entry Panel, 4 port, 1 x 4	EP-575	1	3.5	(1.6)
Entry Panel, 4 port, 2 x 2, standard	EP-1199	1	4.2	(1.9)
Entry Panel, 4 port, 2 x 2, compact	EP-1650	1	4.0	(1.8)
Entry Panel, 6 port, 2 x 3	EP-1449	1	6.1	(2.8)
Entry Panel, 6 port, 1 x 6	EP-1477	1	6.0	(2.7)
Entry Panel, 8 port, 2 x 4, standard	EP-576	1	6.1	(2.8)
Entry Panel, 8 port, 2 x 4, large	EP-1338	1	6.0	(2.7)
Entry Panel, 9 port, 3 x 3	EP-1033	1	7.1	(3.2)
Entry Panel, 10 port, 2 x 5	EP-1297	1	7.4	(3.4)
Entry Panel, 12 port, 3 x 4, standard	EP-1118	1	8.5	(3.9)
Entry Panel, 12 port, 3 x 4, large	EP-1334	1	7.0	(3.2)
Entry Panel, 12 port, 2 x 6	EP-1336	1	9.2	(4.2)
Entry Panel, 16 port, 4 x 4	EP-1447	1	9.1	(4.1)
Entry Panel, 18 port, 3 x 6	EP-1333	1	13.0	(5.9)
Entry Panel, 20 port, 4 x 5	EP-1861	1	11.0	(5.0)
Entry Panel, 24 port, 4 x 6	EP-1340	1	15.8	(7.2)

Note: Custom configurations available. Contact your sales administrator for details

TIMES MICROWAVE SYSTEMS

Hardware Accessories

Feed-Thru Boot Assemblies

Innovative one-piece design simplifies installation. For use with EP-series feed-thru entry panels. Order cushion insert separately.

Application:	Entry Port Solutions
Size:	4" (101.6mm)
Design:	Compression boot for aluminum entry panels
Feature:	One-piece design simplifies installation
Mounts to:	Entry panels
Material:	EPDM rubber
Includes:	Boot, two hose clamps
Order Sep.:	Cushion Inserts, Entry Panel

	TMS part no.	Quant/pkg.	Weight lb	(kg)
4" Boot assembly, cushion not included	BA-400	1	1.3	(0.6)

Cushion Inserts

Standard port cushions are used with BA-400 boot assembly.

Application:	Entry Port Solutions
Size:	Versions for coax and elliptical waveguide
Design:	Compression fit round cushions
Feature:	Dependable seal
Mounts to:	Feed-Thru Boot Assembly
Material:	EPDM rubber
Includes:	Cushion
Order Sep.:	Boot Assembly, Entry Panel

	TMS part no.	Quant/pkg.	Weight lb	(kg)
Standard port cushion, blank (no holes)	SC-B	1	0.4	(0.2)
Standard port cushion with 6 holes for LMR-400 coax	SC-400T-6	1	0.4	(0.2)
Standard port cushion with 1 hole for LMR-600 coax	SC-600T-1	1	0.4	(0.2)
Standard port cushion with 2 holes for LMR-600 coax	SC-600T-2	1	0.4	(0.2)
Standard port cushion with 3 holes for LMR-600 coax	SC-600T-3	1	0.4	(0.2)
Standard port cushion with 4 holes for LMR-600 coax	SC-600T-4	1	0.4	(0.2)
Standard port cushion with 1 hole for LMR-900 coax	SC-900-1	1	0.4	(0.2)
Standard port cushion with 2 holes for LMR-900 coax	SC-900-2	1	0.4	(0.2)
Standard port cushion with 3 holes for LMR-900 coax	SC-900-3	1	0.4	(0.2)
Standard port cushion with 4 holes for LMR-900 coax	SC-900-4	1	0.4	(0.2)
Standard port cushion with 1 hole for LMR-1200 coax	SC-1200T-1	1	0.4	(0.2)
Standard port cushion with 2 holes for LMR-1200 coax	SC-1200T-2	1	0.4	(0.2)
Standard port cushion with 3 holes for LMR-1200 coax	SC-1200T-3	1	0.3	(0.1)
Standard port cushion with 1 hole for LMR-1700 coax	SC-1700T-1	1	0.3	(0.1)

Cushion Plugs

Cushion plugs are used to fill unoccupied holes.

Application:	Entry Port Solutions
Size:	1/2" to 1-5/8" coax
Design:	Plugs for unused cushion holes
Feature:	Allows for future expansion
Mounts to:	Cushion Inserts
Material:	EPDM rubber
Includes:	Plugs
Order Sep.:	Cushion Inserts or Boot Assemblies

	TMS part no.	Quant/pkg.	Weight lb	(kg)
Cushion plug for LMR-400 coax	CP-400T	5	0.2	(0.1)
Cushion plug for LMR-600 coax	CP-600T	5	0.2	(0.1)
Cushion plug for LMR-900 coax	CP-900T	5	0.3	(0.1)
Cushion plug for LMR-1200 coax	CP-1200T	5	0.3	(0.1)
Cushion plug for LMR-1700 coax	CP-1700T	5	0.5	(0.2)

Engineered Products

FBT® Flexible Low Loss High Power Cable: FBT® is a flexible low loss indoor/outdoor highly fire retardant cable suitable for use up to 150°C. Intended specifically for runs within and between base station cabinets, it can also be used in return air handling plenums or outdoors.

FlexTech™ Commercial Cable Assemblies: The use of higher frequencies for telecommunications applications has placed increasingly rigorous demands on cable assembly performance. Our 50 year plus background in military microwave assemblies has provided us the expertise to address these performance requirements, while our commercial expertise allows us to provide economical solutions. FlexTech™ jumper assemblies furnished standard with LMR-DB cable provide rugged dependability for any application.

T-RAD™ 50 Ohm Leaky Feeder Cable: T-RAD™ leaky feeder cables offer a cost effective solution to providing RF coverage in enclosed areas. The flexibility of the cable combined with quick attachment connectors, allows the cable to be easily installed, which is ideal for in-building applications.

SilverLine™: SilverLine™ Test Cables are cost effective, durable, high-performance cable assemblies designed for use in a broad range of test and interconnect applications. Fabricated from rugged, solid PTFE dielectric cable with stainless steel connectors and a proven strain relief system, these cables provide long life and excellent stability in applications where they are repeatedly flexed and mated/unmated. They are ideal for use in production, field and laboratory test environments. They are also economical enough to be used as interconnects in test systems.

LMR Bundled Cable: By bundling LMR® cables together under a common polyethylene outer jacket, this innovative design is the perfect solution for Smart Antenna and other sector applications. LMR® Bundled Cable greatly reduces the cost of installation by slashing the cost of labor and accessories compared to an installation using individual runs. LMR® Bundled Cable is supplied as a complete system, including weather seal breakout boots and ground kits with full technical support and custom tools, pictorial instructions and installation videos.

Certified Installer Training Program

The LMR® Certified Installer Training Program covers all installation aspects of LMR coaxial transmission line cables, connectors and components, including grounding. Topics covered include:

- Coaxial cable fundamentals: characteristics, attenuation, return loss
- LMR coaxial cable designs, features and benefits
- Connectors
  - Various interfaces
  - EZ (non-solder) vs. TC (solder style) of center conductor attachment
  - Clamp vs. crimp style connector attachments
  - Impedance uniformity
  - Other characteristics
- Connector termination demonstrations (EZ andTC), using prep and installation tools on LMR-240, 400, 600 and 900 connectors and cables
- Attendee connector terminations
  - EZ-400-NMH-X (3190-2590)
  - EZ-400-NMH-RA-X (3190-2638)
  - EZ-600-NMC-2 (3190-2641)
  - EZ-900-NMC-2 (3190-1262)
  - Attendees work with a full set of LMR tools and test assemblies they build for attenuation and return loss, using a hand held field analyzer
- Ground kit and weather sealing demonstrations
- SilverLine, QMA and TuffGrip demonstrations
- Radiating cable demonstrations
- LMR bundled cable with end cap and ground kit demonstrations

This one day program is available to groups of 10 or more and can be arranged through any Times distributor. It can be held at a location convenient to the group, at the Times Microwave location in Wallingford, Connecticut or at a participating Times distribution partner location. Attendees receive a certificate as a trained LMR installer. Contact your local Times representative for details.

Part #	Description
CITP	Certified Installer Training Program

TIMES MICROWAVE SYSTEMS

Engineered Products:

FBT™-195
Flexible Low Loss High Power Communications Coax

Ideal for...

- High Power Base Station Jumper Assemblies
- In-Building Plenum Feeder Runs
- Any High Power Low Loss RF cable application

• **FBT™** is an indoor/outdoor highly fire retardant cable intended specifically for runs within and between base station cabinets. It is also applicable for return air handling plenums (e.g., dropped ceilings, raised floors). It has a UL/NEC rating of 'CL2P' for plenum applications.

• **Flexibility** and bendability are hallmarks of the FBT-195 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of FBT-195. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** FBT-195 cables designed for outdoor exposure incorporate FEP jackets for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** A wide variety of connectors are available for FBT-195 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies** – All FBT-195 cable types are available as pre-terminated cable assemblies. Refer the section on FlexTech for further details.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
FBT-195	Indoor/Outdoor	FEP	Brown	54165

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.037	(0.94)
Dielectric	Low Density PTFE	0.113	(2.87)
Outer Conductor	Aluminum Tape	0.119	(3.02)
Overall Braid	Tinned Copper	0.142	(3.61)
Jacket	Brown FEP	0.175	(4.45)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.5	(12.7)
Bend Radius: repeated	in. (mm)	2	(50.8)
Bending Moment	ft-lb (N-m)	0.1	(0.14)
Weight	lb/ft (kg/m)	0.020	(0.03)
Tensile Strength	lb (kg)	40	(18.2)
Flat Plate Crush	lb/in. (kg/mm)	10	(0.19)

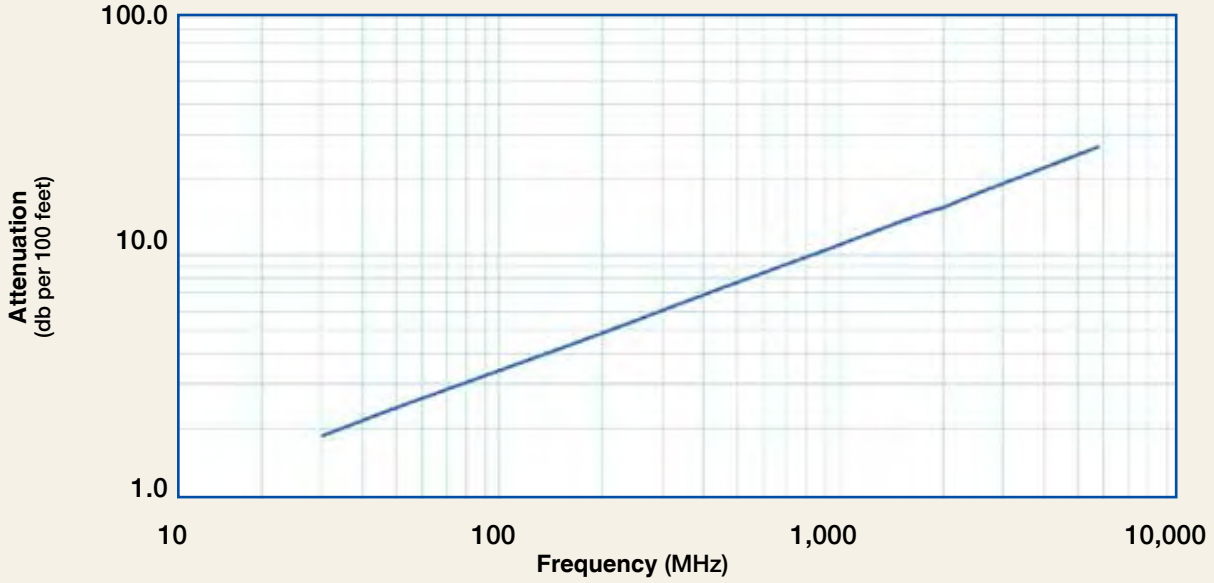
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-67/+302	-55/+150
Storage Temperature Range	-67/+302	-55/+150
Operating Temperature Range	-67/+302	-55/+150

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	7.6	(24.9)
Outer Conductor	ohms/1000ft (/km)	4.90	(16.1)
Voltage Withstand	Volts DC	1000	
Jacket Spark	Volts RMS	3000	
Peak Power	kW	2.5	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	2.0	2.5	4.4	5.3	7.8	10.9	14.1	15.4	16.3	18.3	21.4	28.2
Attenuation dB/100 m	6.4	8.3	14.4	17.5	25.1	35.6	46.2	50.7	53.5	60.0	70.2	92.5
Avg. Power kW	1.62	1.25	0.72	0.59	0.41	0.29	0.22	0.20	0.19	0.17	0.14	0.11

Calculate Attenuation = (0.340820) • $\sqrt{\text{FMHz}}$ + (0.000183) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. N male	Straight Plug	TC-195-NM	3190-1555	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.5 (38.1)	0.75 (19.1)	0.073 (33.1)
2. SMA male	Straight Plug	TC-195-SM	3190-1553	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0 (25.4)	0.32 (8.1)	0.015 (6.8)
3. TNC male	Straight Plug	TC-195-TM	3190-1554	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.4 (35.6)	0.59 (15.0)	0.045 (20.4)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100,195, 200 and 240 connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable and flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

TIMES MICROWAVE SYSTEMS

Engineered Products:

FBT™-200
Flexible Low Loss High Power Communications Coax

Ideal for...

- High Power Base Station Jumper Assemblies
- In-Building Plenum Feeder Runs
- Any High Power Low Loss RF cable application

- **FBT™** is an indoor/outdoor highly fire retardant cable intended specifically for runs within and between base station cabinets. It is also applicable for return air handling plenums (e.g., dropped ceilings, raised floors). It has a UL/NEC rating of 'CL2P' for plenum applications.
- **Flexibility** and bendability are hallmarks of the FBT-200 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.
- **Low Loss** is another hallmark feature of FBT-200. Size for size FBT has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.
- **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).
- **Weatherability:** FBT-200 cables designed for outdoor exposure incorporate FEP jackets for UV resistance and have life expectancy in excess of 20 years.
- **Connectors:** A wide variety of connectors are available for FBT-200 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most FBT connectors employ crimp outer attachment using standard hex crimp sizes.
- **Cable Assemblies** – All FBT-200 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.040	(1.02)
Dielectric	Low Density PTFE	0.118	(3.00)
Outer Conductor	Aluminum Tape	0.123	(3.12)
Overall Braid	Tinned Copper	0.146	(3.71)
Jacket	Brown FEP	0.175	(4.45)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	0.5	(12.7)
Bend Radius: repeated	in. (mm)	2	(50.8)
Bending Moment	ft-lb (N-m)	0.2	(0.27)
Weight	lb/ft (kg/m)	0.032	(0.05)
Tensile Strength	lb (kg)	30	(13.6)
Flat Plate Crush	lb/in. (kg/mm)	65	(1.169)

Environmental Specifications

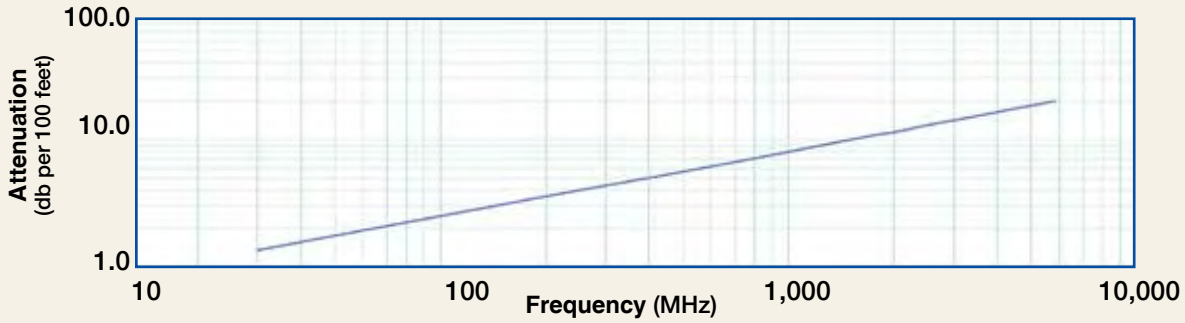
Performance Property	°F	°C
Installation Temperature Range	-67/+302	-55/+150
Storage Temperature Range	-67/+302	-55/+150
Operating Temperature Range	-67/+302	-55/+150

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	6.50	(21.3)
Outer Conductor	ohms/1000ft (/km)	4.90	(16.1)
Voltage Withstand	Volts DC	1000	
Jacket Spark	Volts RMS	3000	
Peak Power	kW	2.5	

Part Description				Stock
Part Number	Application	Jacket	Color	Code
FBT-200	Indoor/Outdoor	FEP	Brown	54166

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	1.8	2.3	4.1	4.9	7.1	10.0	13.0	14.3	15.1	16.9	19.8	26.1
Attenuation dB/100 m	5.9	7.7	13.3	16.1	23.2	32.9	42.7	46.9	49.5	55.5	65.0	85.7
Avg. Power kW	1.71	1.32	0.76	0.62	0.43	0.30	0.23	0.21	0.20	0.18	0.15	0.11

Calculate Attenuation = (0.329075) • $\sqrt{\text{FMHz}}$ + (0.000183) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
1. BNC Male	Straight Plug	TC-200-BM	3190-225	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.7	(43.2)	0.56	(14.2)	0.045	(20.4)
2. Mini-UHF	Straight Plug	TC-200-MUHF	3190-444	<1.25:1 (2.5)	Knurl	Solder	Crimp	NG	1.1	(27.9)	0.45	(11.4)	0.015	(6.8)
3. N Male	Straight Plug	TC-200-NM	3190-224	<1.25:1 (2.5)	Knurl	Solder	Crimp	S/G	1.5	(38.1)	0.75	(19.1)	0.073	(33.1)
4.	Reverse Polarity	TC-200-NM-RP	3190-959	<1:25:1 (2.5)	Knurl	Solder	Crimp	N/G	1.5	(38.0)	0.75	(19.1)	0.073	(33.1)
5. SMA Male	Straight plug	TC-200-SM	3190-612	<1.25:1 (8)	Hex	Solder	Crimp	SS/G	1.0	(25.4)	0.32	(8.1)	0.015	(6.8)
6. SMA Male	Reverse Polarity	TC-200-SM-RP	3190-327	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0	(25.4)	0.32	(8.1)	0.015	(6.8)
7. TNC Male	Straight Plug	TC-200-TMC	3190-240	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G	1.7	(43.2)	0.59	(15.0)	0.045	(20.4)
8. TNC Female	Straight Jack	TC-200-TF	3190-263	<1.25:1 (2.5)	NA	Solder	Crimp	N/G	1.3	(33.0)	0.57	(14.5)	0.033	(15.0)

*Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S200TT	GK-S200TT	Standard Ground Kit (each)

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100, 195, 200 and 240 connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

TIMES MICROWAVE SYSTEMS

Engineered Products:

FBT™-240
Flexible Low Loss High Power Communications Coax

Ideal for...

- High Power Base Station Jumper Assemblies
- In-Building Plenum Feeder Runs
- Any High Power Low Loss RF cable application

• **FBT™** is an indoor/outdoor highly fire retardant cable intended specifically for runs within and between base station cabinets. It is also applicable for return air handling plenums (e.g., dropped ceilings, raised floors). It has a UL/NEC rating of 'CL2P' for plenum applications.

• **Flexibility** and bendability are hallmarks of the FBT-240 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of FBT-240. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** FBT-240 cables designed for outdoor exposure incorporate FEP jackets for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** A wide variety of connectors are available for FBT-240 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies –** All FBT-240 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
FBT-240	Indoor/Outdoor	FEP	Brown	54167

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.051	(1.30)
Dielectric	Low Density PTFE	0.150	(3.81)
Outer Conductor	Aluminum Tape	0.155	(3.94)
Overall Braid	Tinned Copper	0.178	(4.52)
Jacket	Brown FEP	0.205	(5.21)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.0	(25.4)
Bend Radius: repeated	in. (mm)	2	(50.8)
Bending Moment	ft-lb (N-m)	0.25	(0.34)
Weight	lb/ft (kg/m)	0.040	(0.06)
Tensile Strength	lb (kg)	60	(27.2)
Flat Plate Crush	lb/in. (kg/mm)	85	(1.52)

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	4.00	(13.1)
Outer Conductor	ohms/1000ft (/km)	3.90	(12.8)
Voltage Withstand	Volts DC	1500	
Jacket Spark	Volts RMS	5000	
Peak Power	kW	5.6	

Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-67/+302	-55/+150
Storage Temperature Range	-67/+302	-55/+150
Operating Temperature Range	-67/+302	-55/+150

Attenuation vs. Frequency **(typical)**

Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	1.4	1.8	3.1	3.7	5.4	7.6	9.9	10.9	11.5	12.9	15.1	20.0
Attenuation dB/100 m	4.5	5.8	10.1	12.2	17.6	25.0	33.2	35.7	37.7	42.3	49.6	65.6
Avg. Power kW	2.48	1.92	1.10	0.91	0.63	0.44	0.34	0.31	0.29	0.26	0.22	0.17

Calculate Attenuation =

(0.248515) • $\sqrt{FMHz}$ + (0.000183) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:

VSWR=1.0 ; Ambient = +25°C (77°F)

Power:

VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

Engineered Products:

FBT-240
Flexible Low Loss High Power Communications Coax

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Contact Attach	Inner Contact Attach	Outer Body /Pin	Finish*	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
1. BNC Male	Straight Plug	TC-240-BMC	3190-242	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G		1.7	(43)	0.56	(14.2)	0.040	(18.1)
2. Mini-UHF	Straight Plug	TC-240-MUHF	3190-445	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/G		1.1	(28)	0.45	(11.4)	0.014	(6.4)
3. N Female	Bulkhead Jack	TC-240-NF-BH	3190-419	<1.25 (2.5)	NA	Solder	Crimp	A/G		1.7	(44)	0.88	(22.2)	0.115	(52.2)
4. N Male	Straight Plug	TC-240-NMH	3190-382	<1.25:1 (2.5)	Hex	Solder	Crimp	N/S		1.5	(38)	0.75	(19.1)	0.086	(39.0)
5. N Male	Straight Plug	TC-240-NMC	3190-244	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G		1.5	(38)	0.75	(19.1)	0.082	(37.2)
6. SMA Female	Bulkhead Jack	TC-240-SF-BH	3190-824	<1.25:1 (2.5)	NA	Solder	Crimp	SS/G		1.1	(29)	0.31	(7.9)	0.019	(8.6)
7. SMA Male	Straight Plug	TC-240-SM	3190-380	<1.25:1 (10)	Hex	Solder	Crimp	SS/G		1.0	(25)	0.32	(8.1)	0.016	(7.3)
8. SMA Male	Right Angle	TC-240-SM-RA	3190-381	<1.35:1 (6)	Hex	Solder	Crimp	SS/G		0.8	(20)	0.65	(16.5)	0.019	(8.6)
9. SMA Male	Reverse Polarity	TC-240-SM-RP	3190-326	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G		1.0	(25)	0.32	(8.1)	0.016	(7.3)
10. TNC Male	Straight Plug	TC-240-TM	3190-275	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/S		1.7	(43)	0.59	(15.0)	0.043	(19.5)
11. TNC Male	Right Angle	TC-240-TM-RA	3190-604	<1.35:1 (2.5)	Knurl	Solder	Crimp	N/G		1.3	(33)	0.57	(14.5)	0.055	(24.9)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

GK-S240TT

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S240TT	GK-S240TT	Standard Ground Kit (each)

CCT-01
3190-1544

DBT-U
3190-001

CT-240/200/195/100
3190-667

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-240/200/195/100	3190-667	Crimp tool for LMR-100, 195, 200 and 240 connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable and flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

TIMES MICROWAVE SYSTEMS

Engineered Products:

FBT-300
Flexible Low Loss High Power Communications Coax

Ideal for...

- High Power Base Station Jumper Assemblies
- In-Building Plenum Feeder Runs
- Any High Power Low Loss RF cable application

- **FBT™** is an indoor/outdoor highly fire retardant cable intended specifically for runs within and between base station cabinets. It is also applicable for return air handling plenums (e.g., dropped ceilings, raised floors). It has a UL/NEC rating of 'CL2P' for plenum applications.
- **Flexibility** and bendability are hallmarks of the FBT-300 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.
- **Low Loss** is another hallmark feature of FBT-300. Size for size FBT has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.
- **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).
- **Weatherability:** FBT-300 cables designed for outdoor exposure incorporate FEP jackets for UV resistance and have life expectancy in excess of 20 years.
- **Connectors:** A wide variety of connectors are available for FBT-300 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most FBT connectors employ crimp outer attachment using standard hex crimp sizes.
- **Cable Assemblies** – All FBT-300 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BC	0.063	(1.60)
Dielectric	Low Density PTFE	0.190	(4.83)
Outer Conductor	Aluminum Tape	0.196	(4.98)
Overall Braid	Tinned Copper	0.225	(5.72)
Jacket	Brown FEP	0.260	(6.60)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.3	(31.8)
Bend Radius: repeated	in. (mm)	3	(76.2)
Bending Moment	ft-lb (N-m)	0.38	(0.52)
Weight	lb/ft (kg/m)	0.065	(0.10)
Tensile Strength	lb (kg)	120	(54.52)
Flat Plate Crush	lb/in. (kg/mm)	30	(0.54)

Environmental Specifications

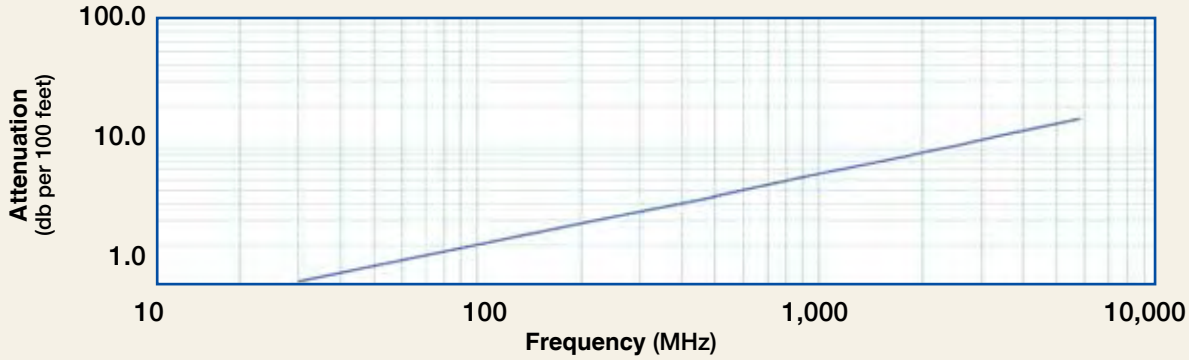
Performance Property	°F	°C
Installation Temperature Range	-67/+302	-55/+150
Storage Temperature Range	-67/+302	-55/+150
Operating Temperature Range	-67/+302	-55/+150

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	2.61	(8.6)
Outer Conductor	ohms/1000ft (/km)	2.21	(7.3)
Voltage Withstand	Volts DC	2000	
Jacket Spark	Volts RMS	5000	
Peak Power	kW	10	

Part Description				Stock
Part Number	Application	Jacket	Color	Code
FBT-300	Indoor/Outdoor	FEP	Brown	54168

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	1.1	1.4	2.5	3.0	4.3	6.2	8.0	8.8	9.3	10.5	12.3	16.3
Attenuation dB/100 m	3.6	4.7	8.1	9.9	14.2	20.2	26.3	28.9	30.6	34.3	40.3	53.5
Avg. Power kW	3.44	2.67	1.53	1.26	0.87	0.61	0.47	0.43	0.40	0.36	0.30	0.23

Calculate Attenuation = (0.200179) • $\sqrt{\text{FMHz}}$ + (0.000183) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. SMA Male	Straight Plug	TC-300-SM	3190-501	<1.25:1 (2.5)	Hex	Solder	Crimp	SS/G	1.0 (25)	0.35 (8.9)	0.018 (8.2)
2. SMA Female	Bulkhead Jack	TC-300-SF-BH	3190-590	<1.25:1 (2.5)	NA	Solder	Crimp	SS/G	1.1 (28)	0.31 (7.9)	0.022 (10.0)
3. TNC Male	Straight Plug	TC-300-TM	3190-500	<1.25:1 (2.5)	Knurl	Solder	Crimp	N/S	1.7 (43)	0.59 (15.0)	0.050 (22.7)

*Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S300TT	GK-S300TT	Standard Ground Kit (each)

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	CT-400/300	3190-666	Crimp tool for LMR 300 connectors
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

TIMES MICROWAVE SYSTEMS

Engineered Products:

FBT™-400
Flexible Low Loss High Power Communications Coax

Ideal for...

- High Power Base Station Jumper Assemblies
- In-Building Plenum Feeder Runs
- Any High Power Low Loss RF cable application

- **FBT™** is an indoor/outdoor highly fire retardant cable intended specifically for runs within and between base station cabinets. It is also applicable for return air handling plenums (e.g., dropped ceilings, raised floors). It has a UL/NEC rating of 'CL2P' for plenum applications.
- **Flexibility** and bendability are hallmarks of the FBT-400 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.
- **Low Loss** is another hallmark feature of FBT-400. Size for size FBT has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.
- **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).
- **Weatherability:** FBT-400 cables designed for outdoor exposure incorporate FEP jackets for UV resistance and have life expectancy in excess of 20 years.
- **Connectors:** A wide variety of connectors are available for FBT-400 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most FBT connectors employ crimp outer attachment using standard hex crimp sizes.
- **Cable Assemblies –** All FBT-400 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
FBT-400	Indoor/Outdoor	FEP	Brown	54171

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.095	(2.41)
Dielectric	Low Density PTFE	0.285	(7.24)
Outer Conductor	Aluminum Tape	0.291	(7.39)
Overall Braid	Tinned Copper	0.320	(8.13)
Jacket	Brown FEP	0.370	(9.40)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.8	(44.5)
Bend Radius: repeated	in. (mm)	4	(101.6)
Bending Moment	ft-lb (N-m)	1	(1.36)
Weight	lb/ft (kg/m)	0.104	(0.15)
Tensile Strength	lb (kg)	120	(54.5)
Flat Plate Crush	lb/in. (kg/mm)	185	(3.31)

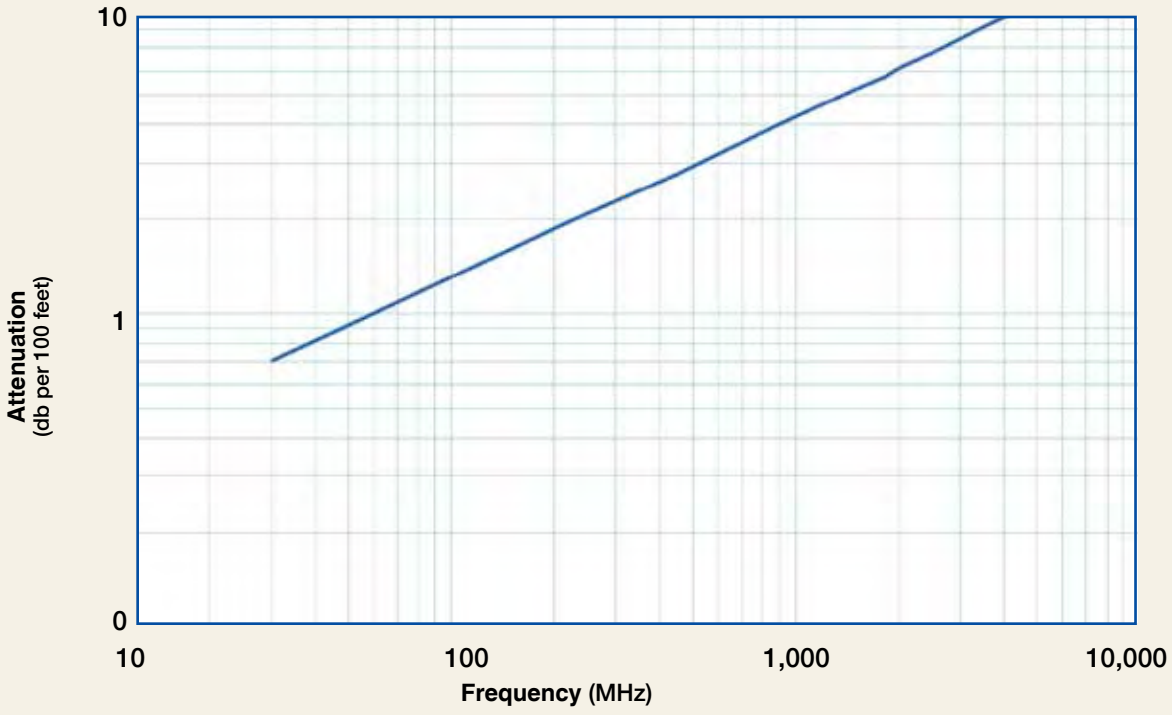
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-67/+302	-55/+150
Storage Temperature Range	-67/+302	-55/+150
Operating Temperature Range	-67/+302	-55/+150

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	1.80	(5.9)
Outer Conductor	ohms/1000ft (/km)	1.65	(5.4)
Voltage Withstand	Volts DC	2500	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	16	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	0.7	0.9	1.6	1.9	2.8	4.0	5.2	5.7	6.1	6.8	8.0	10.7
Attenuation dB/100 m	2.3	3.0	5.3	6.4	9.2	13.1	17.1	18.8	19.9	22.4	26.3	35.0
Avg. Power kW	6.23	4.82	2.76	2.27	1.58	1.10	0.84	0.77	0.73	0.65	0.55	0.41

Calculate Attenuation =

$(0.129138) \bullet \sqrt{FMHz} + (0.000146) \bullet FMHz$ (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:

VSWR=1.0 ; Ambient = +25°C (77°F)

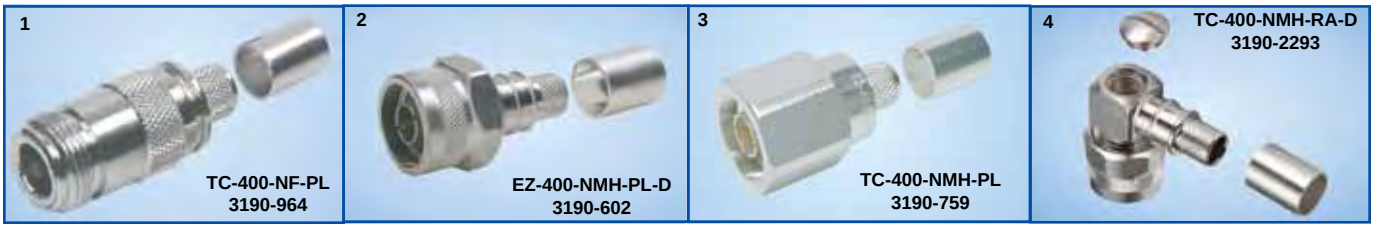
Power:

VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

Engineered Products:

FBT-400
Flexible Low Loss High Power Communications Coax



Connectors Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. N Female	Straight Jack	TC-400-NF-PL	3190-964	<1.25:1 (2.5)	NA	Solder	Crimp	N/G	1.8 (45)	0.66(16.8)	0.105 (47.6)
2. N Male	Straight Plug	EZ-400-NMH-PL-D	3190-602	<1.25:1 (2.5)	Hex/Knurl	Spring Finger	Crimp	A/G	1.5 (38)	0.89(22.6)	0.113 (51.3)
3.	Straight Plug	TC-400-NMH-PL	3190-759	<1.25:1 (2.5)	Hex	Solder	Crimp	S/G	1.5 (38)	0.89(22.6)	0.113 (51.3)
4.	Right Angle	TC-400-NMH-RA-D	3190-2293	<1.35:1 (6)	Hex/Knurl	Solder	Crimp	A/G	1.8 (46)	1.25(31.8)	0.130 (59.0)

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S400T	GK-S400T	Standard Grounding Kit (each)

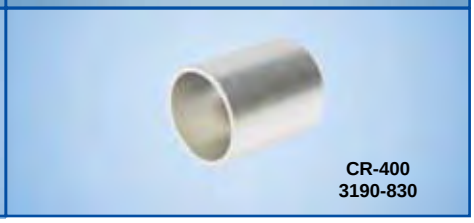
HX-4
3190-200

DBT-U
3192-001

Y1719
3190-202

CCT-01
3190-1544

CT-400/300
3190-666



CR-400
3190-830

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1719	3190-202	.429" Hex Dies
Crimp Tool	CT-400/300	3190-666	Crimp tool for LMR 400 connectors
Crimp Rings	CR-400	3190-830	Crimp rings for TC/EZ-400 connectors (package of 10)
Deburr Tool	DBT-U	3192-001	For 'EZ' Style Connectors
Cutting Tool	CCT-01	3190-1544	Cable and flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

TIMES MICROWAVE SYSTEMS

Engineered Products:

FBT™-500
Flexible Low Loss High Power Communications Coax

Ideal for...

- High Power Base Station Jumper Assemblies
- In-Building Plenum Feeder Runs
- Any High Power Low Loss RF cable application

• **FBT™** is an indoor/outdoor highly fire retardant cable intended specifically for runs within and between base station cabinets. It is also applicable for return air handling plenums (e.g., dropped ceilings, raised floors). It has a UL/NEC & CSA rating of 'CL2P' and 'FT6' respectively.

• **Flexibility** and bendability are hallmarks of the FBT-500 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of FBT-500. Size for size FBT has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability:** FBT-500 cables designed for outdoor exposure incorporate FEP jackets for UV resistance and have life expectancy in excess of 20 years.

• **Connectors:** A wide variety of connectors are available for FBT-500 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most FBT connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies** – All FBT-500 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.123	(3.12)
Dielectric	Low Density PTFE	0.370	(9.40)
Outer Conductor	Aluminum Tape	0.376	(9.55)
Overall Braid	Tinned Copper	0.405	(10.29)
Jacket	Brown FEP	0.465	(11.81)

Mechanical Specifications

Performance Property	Units	US	metric
Bend Radius: installation	in. (mm)	2.3	(57.2)
Bend Radius: repeated	in. (mm)	5	(127.0)
Bending Moment	ft-lb (N-m)	1.75	(2.37)
Weight	lb/ft (kg/m)	0.168	(0.25)
Tensile Strength	lb (kg)	120	(54.5)
Flat Plate Crush	lb/in. (kg/mm)	185	(3.31)

Environmental Specifications

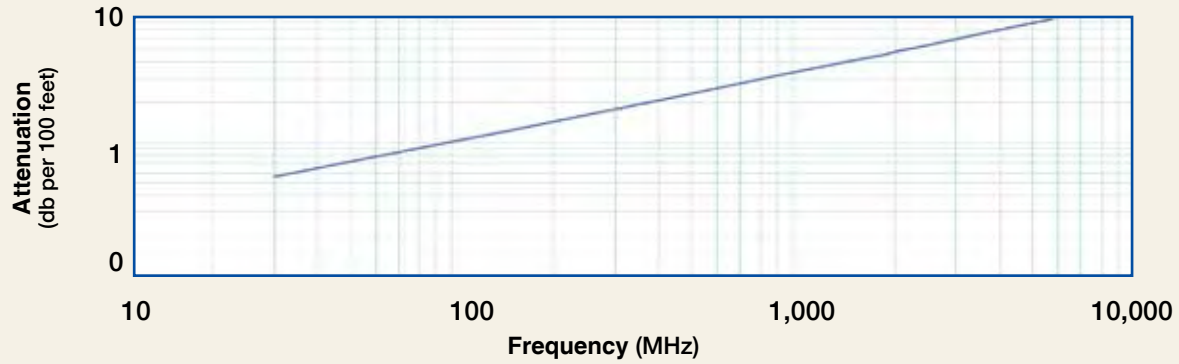
Performance Property	°F	°C
Installation Temperature Range	-67/+302	-55/+150
Storage Temperature Range	-67/+302	-55/+150
Operating Temperature Range	-67/+302	-55/+150

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	1.09	(3.6)
Outer Conductor	ohms/1000ft (/km)	1.27	(4.2)
Voltage Withstand	Volts DC	3000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	11.6	

Part Description				Stock
Part Number	Application	Jacket	Color	Code
FBT-500	Indoor/Outdoor	FEP	Brown	54172

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	0.6	0.7	1.3	1.5	2.2	3.1	4.1	4.5	4.8	5.4	6.4	8.5
Attenuation dB/100 m	1.8	2.3	4.1	5.0	7.2	10.3	13.5	14.8	15.7	17.6	20.9	27.9
Avg. Power kW	8.90	6.88	3.94	3.24	2.24	1.56	1.20	1.08	1.03	0.91	0.77	0.57

Calculate Attenuation = (0.100255) • $\sqrt{\text{FMHz}}$ + (0.000146) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)
Attenuation: VSWR=1.0 ; Ambient = +25°C (77°F) **Power:** VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F);
Sea Level; dry air; atmospheric pressure; no solar loading

TC-500-NMC-PL
3190-900

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
N Male	Straight Plug	TC-500-NMC-PL	3190-900	<1.25:1 (2.5)	Hex	Solder	Clamp	S/G	2.1 (53)	0.92 (23.4)	0.228 (103.4)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair

HX-4
3190-200

Y151
3190-465

DBT-U
3192-001

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y151	3190-465	.532" Hex Dies
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

CCT-01
3190-1544

TIMES MICROWAVE SYSTEMS

Engineered Products:

FBT™-600
Flexible Low Loss High Power Communications Coax

Ideal for...

- High Power Base Station Jumper Assemblies
- In-Building Plenum Feeder Runs
- Any High Power Low Loss RF cable application

- **FBT™** is an indoor/outdoor highly fire retardant cable intended specifically for runs within and between base station cabinets. It is also applicable for return air handling plenums (e.g., dropped ceilings, raised floors). It has a UL/NEC & CSA rating of 'CL2P' and 'FT6' respectively.
- **Flexibility** and bendability are hallmarks of the FBT-600 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.
- **Low Loss** is another hallmark feature of FBT-600. Size for size FBT has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.
- **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).
- **Weatherability:** FBT-600 cables designed for outdoor exposure incorporate FEP jackets for UV resistance and have life expectancy in excess of 20 years.
- **Connectors:** A wide variety of connectors are available for FBT-600 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most FBT connectors employ crimp outer attachment using standard hex crimp sizes.
- **Cable Assemblies** – All FBT-600 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
FBT-600	Indoor/Outdoor	FEP	Brown	54173

Construction Specifications			
Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.150	(3.81)
Dielectric	Low Density PTFE	0.455	(11.56)
Outer Conductor	Aluminum Tape	0.461	(11.71)
Overall Braid	Tinned Copper	0.490	(12.45)
Jacket	Brown FEP	0.565	(14.38)

Mechanical Specifications			
Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	2.8	(69.9)
Bend Radius: repeated	in. (mm)	6	(152.4)
Bending Moment	ft-lb (N-m)	2.75	(3.73)
Weight	lb/ft (kg/m)	0.210	(0.31)
Tensile Strength	lb (kg)	265	(120.3)
Flat Plate Crush	lb/in. (kg/mm)	210	(3.75)

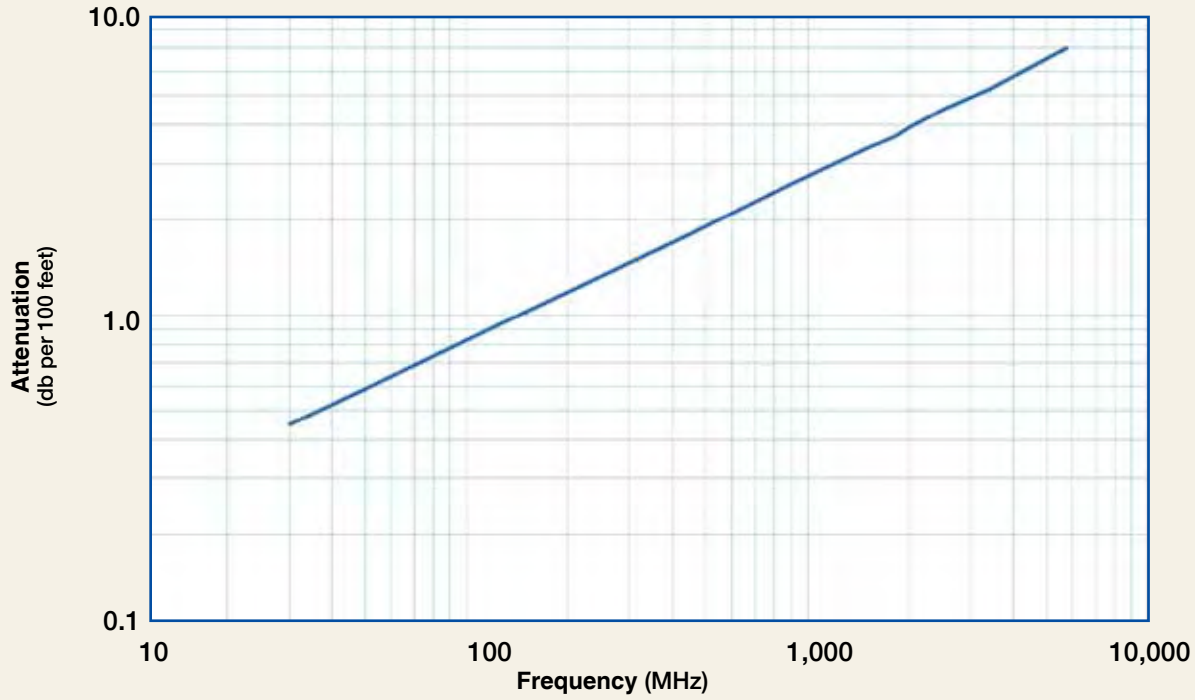
Environmental Specifications		
Performance Property	°F	°C
Installation Temperature Range	-67/+302	-55/+150
Storage Temperature Range	-67/+302	-55/+150
Operating Temperature Range	-67/+302	-55/+150

TIMES MICROWAVE SYSTEMS

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	76	
Dielectric Constant	NA	1.73	
Time Delay	nS/ft (nS/m)	1.34	(4.40)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	26.7	(87.6)
Inductance	uH/ft (uH/m)	0.067	(0.22)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.73	(2.4)
Outer Conductor	ohms/1000ft (/km)	1.20	(3.9)
Voltage Withstand	Volts DC	4000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	40	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	3400	5800
Attenuation dB/100 ft	0.5	0.6	1.0	1.2	1.8	2.6	3.4	3.7	3.9	4.4	5.3	7.1
Attenuation dB/100 m	1.5	1.9	3.3	4.1	5.9	8.4	11.1	12.2	12.9	14.5	17.2	23.2
Avg. Power kW	11.84	9.14	5.23	4.30	2.97	2.07	1.57	1.43	1.35	1.20	1.01	0.75

Calculate Attenuation =
(0.081389) • $\sqrt{\text{FMHz}}$ + (0.000146) • FMHz (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:
VSWR=1.0 ; Ambient = +25°C (77°F)

Power:
VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

Engineered Products:

FBT-600
Flexible Low Loss High Power Communications Coax

Connectors Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Contact Attach	Inner Contact Attach	Outer Body /Pin	Finish*	Length in (mm)	Width in (mm)	Weight lb (g)
1. LC Male	Straight plug	TC-600-LCM-PL	3190-1221	<1.25:1 (1)	Hex	Solder	Clamp	N/S		3.1 (78.7)	1.62 (41.1)	1.20 (544)
2. N Male	Straight Plug	EZ-600-NMH-PL-D	3190-603	<1.25:1 (2.5)	Hex/Knurl	Spring Finger	Crimp	A/G		2.1 (53)	0.92 (23.4)	0.166 (75.3)
3.	Straight Plug	TC-600-NMH-PL	3190-760	<1.25:1 (2.5)	Hex	Solder	Crimp	S/G		2.1 (53)	0.92 (23.4)	0.208 (93.4)
4.	Right Angle	TC-600-NMC-RA	3190-233	<1.35:1 (2.5)	Hex	Solder	Clamp	S/G		2.1 (53)	0.92 (23.4)	0.280 (17.9)
5.	Right Angle	TC-600-NMH-RA-D	3190-2427	<1.35:1 (6)	Hex	Solder	Crimp	A/G		1.8 (46.5)	1.62 (41.2)	0.185 (84.3)

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S600TT	GK-S600TT	Standard Grounding Kit (each)

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1720	3190-203	.610" Hex Dies
Crimp Rings	CR-600	3190-831	Crimp Rings for TC/EZ-600 connectors (pkg of 10)
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Midspan Strip Tool	GST-600A	3190-1051	For ground strap attachment
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool

TIMES MICROWAVE SYSTEMS

Engineered Products:

FlexTech™ Commercial Cable Assemblies

Performance:

The use of higher frequencies for telecommunications applications has placed increasingly rigerous demands on cable assembly performance. Our 50 year plus background in military microwave assemblies has provided us the expertise to address these performance requirements, while our commercial expertise allows us to provide economical solutions.

Testing:

- VSWR or Return Loss
- Insertion Loss
- Time Delay
- Absolute or Relative Phase Matching
- Phase Trimming

Value Added

- Variety of Strain Relief Boots
- Multitude of Labeling Possibilities
- Bar Coding
- Customized Packaging

Connector Specifications: *FlexTech*™ cable assemblies can be furnished with virtually any connector interface.

Cable Specifications: *FlexTech*™ jumper assemblies are furnished standard with LMR-DB cable unless otherwise requested. Cable performance characteristics are listed in the section for each individual cable size. The following table summarizes the characteristics of general interest.

Cable Type	LMR-400	LMR-600	LMR-900
Diameter	.405"	.590"	.870"
Impedance		50 Ohms	
Bend Radius	1"	1-1/2"	3"
Weight(lbs/ft)	.068	.131	.266
Temperature		-40°C to +85°C	

Assembly Part Numbers Definition

Cable Type — Cable Length

LMR-400-DB/3ft/Nm/Nm

Connector 1 Connector 2

Cable Type	Length	Connectors 1&2
LMR-xxx LMR-xxx-FR LMR-xxx-LLPL LMR-xxx-UF LMR-xxx-W LMR-xxx-DB	ft in m cm	See available connectors for the particular cable

TIMES MICROWAVE SYSTEMS

Specialized WLAN Assemblies

Competitively Priced

The cable assembly list below has been developed to provide a quick cross reference to a Times Microwave Systems part number for some of the more common configurations being used for WLAN applications. Any of these assemblies ordered by the TMS part number in the right hand column will be 100% tested for IL and VSWR in the relevant brand.

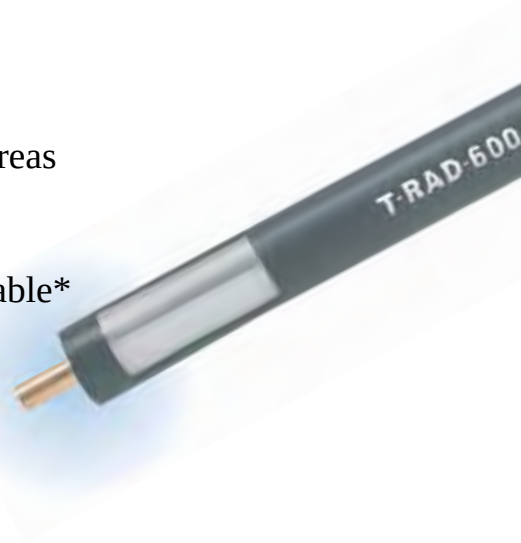
Equipment OEM	OEM part # or model	Cable	Length	Connector 1	Connector 2	TMS part #
Agere		LMR-400-DB	50'	Nm	Nm	AE14563
Agere		LMR-400-DB	75'	Nm	Nm	AE14564
Alvarion/Breezecom		LMR-195-DB	3'	Nt	Sm RA cust.	AE14565
Alvarion/Breezecom		LMR-195-DB	20'	Nt	SM RA cust.	AE14566
Alvarion/Breezecom		LMR-195-DB	50'	Nt	Sm. RA cust.	AE14567
Alvarion/Breezecom		LMR-195-DB	75'	Nt	Sm. RA cust.	AE14568
Alvarion/Breezecom		LMR-195-DB	100'	Nt	Sm. RA cust.	AE14569
Alvarion/Breezecom		LMR-195-DB	3'	Nm	Sm. RA cust.	AE14570
Alvarion/Breezecom		LMR-195-DB	20'	Nm	Sm. RA cust.	AE14571
Alvarion/Breezecom		LMR-195-DB	50'	Nm	Sm. RA cust.	AE14572
Alvarion/Breezecom		LMR-195-DB	75'	Nm	Sm. RA cust.	AE14573
Alvarion/Breezecom		LMR-195-DB	100'	Nm	Sm. RA cust.	AE14574
Cisco/Aironet		LMR-200-DB	5'	TNCm RP	TNCf RP	AE14575
Cisco/Aironet		LMR-200-DB	10'	TNCm RP	TNCf RP	AE14576
Cisco/Aironet	72-2760-02	LMR-400-DB	20'	TNCm RP	TNCf RP	AE14577
Cisco/Aironet	72-2760-02	LMR-400-DB	50'	TNCm RP	TNCf RP	AE14578
Cisco/Aironet		LMR-600-DB	20'	TNCm RP	TNCf RP	AE14579
Cisco/Aironet		LMR-600-DB	50'	TNCm RP	TNCf RP	AE14580
Cisco/Aironet	72-2766-02	LMR-600-DB	100'	TNCm RP	TNCf RP	AE14581
Cisco/Aironet	72-2787-02	LMR-600-DB	150'	TNCm RP	TNCf RP	AE14582
Enterasy/Cabletron	CSIES-AB-C20	LMR-200-DB	20'	Nm	Nm	AE14583
Enterasy/Cabletron	CSIES-AA-C20	LMR-200-DB	20'	Nm RP	Nm RP	AE14584
Enterasy/Cabletron	CSIES-AB-C50	LMR-400-DB	50'	Nm	Nm	AE14563
Enterasy/Cabletron	CSIES-AA-C50	LMR-400-DB	50'	Nm RP	Nm RP	AE14585
Enterasy/Cabletron	CSIES-AB-C50	LMR-400-DB	75'	Nm	Nm	AE14564
Enterasy/Cabletron	CSIES-AA-C50	LMR-400-DB	75'	Nm RP	Nm RP	AE14586
Orinoco		LMR-100	2'	WaveLANm RA	Nt	AE14587
Orinoco		LMR-100	2'	WaveLANm RA	Nm	AE14588
Proxim		LMR-195-DB	3'	Sm RP	Nf	AE14589
Proxim		LMR-195-DB	3'	Sm RP	Nm	AE14590
Proxim		LMR-100	2'	mmcx RA m	Nf	AE14591
Symbol		LMR-195-DB	3'	BNCm RA	Nf	AE14592
Symbol		LMR-195-DB	3'	BNCm RA	Nm	AE14593

TIMES MICROWAVE SYSTEMS

Engineered Products:

T-RAD-600
50 Ohm Leaky Feeder Coaxial Cable

- Provides RF coverage in buildings, mines and other enclosed areas
- Offers broadband performance up to 2.5 GHz
- Flexible, non-kinking design provides easier installation
- Accepts standard "EZ" crimp connectors used for LMR-600 cable*
- FR series is MSHA approved for mining applications



Part Number	Part Description: Application	Jacket	Color	Stock Code
AA 9096	T-RAD-600-PVC	PVC	Black	44030
AA-9097	T-RAD-600-FR	FRPE	Black	44031

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.176	(4.47)
Dielectric	Gas-Injected Foam Polyethylene	0.455	(11.56)
Inner Shield	Bonded Aluminum Tape	0.458	(11.63)
Jacket	See table above	0.530	(13.46)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.5	(38)
Bend Radius: repeated	in. (mm)	6.0	(152.4)
Weight	lb/ft (kg/m)	0.09	(0.137)

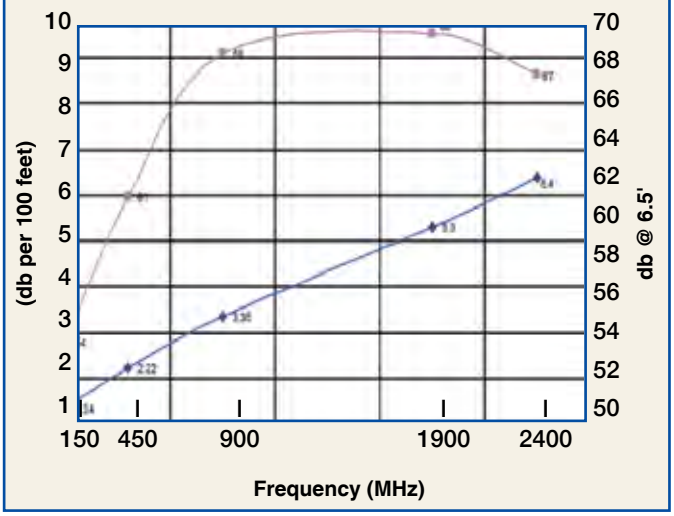
Environmental Specifications

Performance Property	°F	°C
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	86	
Dielectric Constant	NA	1.35	
Time Delay	nS/ft (nS/m)	1.18	(3.87)
Impedance	ohms	50	
Voltage Withstand	Volts DC	4000	
Jacket Spark	Volts RMS	6000	

Loss & Coupling vs. Frequency (typical)



Frequency (MHz)	150	450	900	1900	2400
Attenuation dB/100 ft	1.34	2.22	3.35	5.30	6.40
Attenuation dB/100 m	4.39	7.28	10.98	17.38	20.99
Coupling Loss dB**	54	61	68	69	67

* Request T-RAD-600 connector data sheet and attachment instructions
** Coupling loss measured at 6.5 feet (2 meters) *** Patent applied for

Special Crimp Ring part number 3192-038 (TR-600) must be used on all EZ style connectors

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach***	Finish* Body /Pin	Length in	Length (mm)	Width in	Width (mm)	lb	Weight (g)
1. 7-16 DIN Male	Straight Plug	EZ-600-716-MH	3190-503	<1.25:1 (2.5)	Hex	Spring Finger	Crimp	S/S	2.0	(51)	1.30	(33.0)	0.254	(115.2)
2. N Male	Straight Plug	EZ-600-NMH-D	3190-1268	<1.25:1 (2.5)	Hex/Knurl	Spring Finger	Crimp	A/G	2.1	(53)	0.92	(23.4)	1.164	(74.4)
3.	Right Angle	EZ-600-NMH-RA	3190-762	<1.35:1 (6)	Hex	Spring Finger	Crimp	S/G	2.1	(53)	0.92	(23.4)	0.185	(83.9)
4. N Female	Straight Jack	EZ-600-NF	3190-955	<1.25:1 (2.5)	NA	Spring Finger	Crimp	S/G	2.3	(59)	0.87	(22.1)	0.150	(68.0)
5.	Bulkhead Jack	EZ-600-NF-BH	3190-616	<1.25:1 (2.5)	NA	Spring Finger	Crimp	S/G	2.4	(61)	0.88	(22.4)	0.195	(88.5)
6. TNC Male	Straight Plug	EZ-600-TM	3190-418	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	S/G	1.7	(43)	0.59	(15.0)	0.112	(50.8)
7.	Reverse Polarity	EZ-600-TM-RP	3190-796	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	A/G	2.2	(56)	0.87	(22.0)	0.112	(50.8)
8. TNC Female	Reverse Polarity	EZ-600-TF-RP	3190-797	<1.25:1 (2.5)	NA	Spring Finger	Crimp	A/G	2.3	(58)	0.87	(22.0)	0.100	(45.4)
9. UHF Male	Straight Plug	EZ-600-UM	3190-615	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	S/G	1.7	(43)	0.88	(22.4)	0.164	(74.4)
10. Crimp Ring	Crimping	TR-600	3192-038	Package of 50 pieces										

*Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair
*** Requires separate crimp ring; contact TMS engineering

TIMES MICROWAVE SYSTEMS

Engineered Products:

T-RAD-600-DB
50 Ohm Leaky Feeder Coaxial Cable

- Provides RF coverage in buildings, mines and other enclosed areas
- Watertight design for direct bury applications
- Offers broadband performance up to 2.5 GHz
- Flexible, non-kinking design provides easier installation
- Accepts standard "EZ" crimp connectors used for LMR-600 cable*

Part Description				Stock
Part No.	Application	Jacket	Color	Code
AA-9299	T-RAD-600-DB	PVC/PE	Black	44038

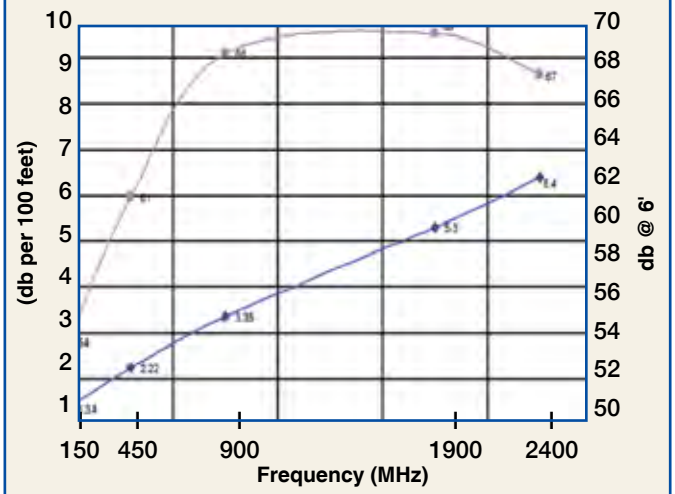
Construction Specifications			
Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.176	(4.47)
Dielectric	Gas-Injected Foam Polyethylene	0.455	(11.56)
Inner Shield	Bonded Aluminum Tape	0.458	(11.63)
Jacket	Extruded PVC/PE	0.590	(14.98)

Mechanical Specifications			
Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.5	(38)
Bend Radius: repeated	in. (mm)	0.12	(.178)
Weight	lb/ft (kg/m)	0.09	(0.137)

Environmental Specifications		
Performance Property	°F	°C
Operating Temperature Range	+23/+167	-5/+75

Electrical Specifications			
Performance Property	Units	US	(metric)
Velocity of Propagation	%	86	
Dielectric Constant	NA	1.35	
Time Delay	nS/ft (nS/m)	1.18	(3.87)
Impedance	ohms	50	
Voltage Withstand	Volts DC	4000	
Jacket Spark	Volts RMS	6000	

Loss & Coupling vs. Frequency (typical)



Frequency (MHz)	150	450	900	1900	2400
Attenuation dB/100 ft	1.34	2.22	3.35	5.30	6.40
Attenuation dB/100 m	4.39	7.28	10.98	17.38	20.99
Coupling Loss dB**	54	61	68	69	67

* Request T-RAD-600 connector data sheet and attachment instructions
** Coupling loss measured at 6.5 feet (2 meters) *** Patent applied for

Connectors

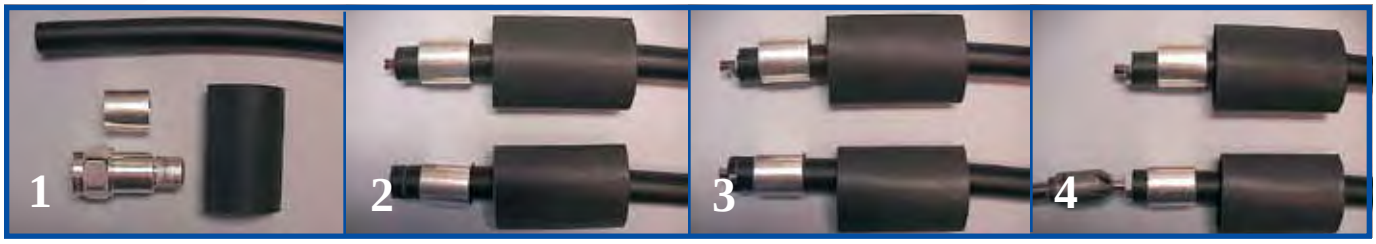
Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach***	Finish* Body /Pin	Length in	Length (mm)	Width in	Width (mm)	lb	Weight (g)
1. 7-16 DIN Male	Straight Plug	EZ-600-716-MH	3190-503	<1.25:1 (2.5)	Hex	Spring Finger	Crimp	S/S	2.0	(51)	1.30	(33.0)	0.254	(115.2)
2. N Male	Straight Plug	EZ-600-NMH-D	3190-2627	<1.25:1 (2.5)	Hex/Knurl	Spring Finger	Crimp	A/G	2.1	(53)	0.92	(23.4)	1.164	(74.4)
3.	Right Angle	EZ-600-NMH-RA	3190-762	<1.35:1 (6)	Hex	Spring Finger	Crimp	S/G	2.1	(53)	0.92	(23.4)	0.185	(83.9)
4. N Female	Straight Jack	EZ-600-NF	3190-955	<1.25:1 (2.5)	NA	Spring Finger	Crimp	S/G	2.3	(59)	0.87	(22.1)	0.150	(68.0)
5.	Bulkhead Jack	EZ-600-NF-BH	3190-616	<1.25:1 (2.5)	NA	Spring Finger	Crimp	S/G	2.4	(61)	0.88	(22.4)	0.195	(88.5)
6. TNC Male	Straight Plug	EZ-600-TM	3190-418	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	S/G	1.7	(43)	0.59	(15.0)	0.112	(50.8)
7.	Reverse Polarity	EZ-600-TM-RP	3190-796	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	A/G	2.2	(56)	0.87	(22.0)	0.112	(50.8)
8. TNC Female	Reverse Polarity	EZ-600-TF-RP	3190-797	<1.25:1 (2.5)	NA	Spring Finger	Crimp	A/G	2.3	(58)	0.87	(22.0)	0.100	(45.4)
9. UHF Male	Straight Plug	EZ-600-UM	3190-615	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	S/G	1.7	(43)	0.88	(22.4)	0.164	(74.4)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair
*** Requires separate crimp ring; contact TMS engineering

TIMES MICROWAVE SYSTEMS

T-RAD Connector installation procedure

LMR-600 crimp connectors can be used on T-RAD-600 cables with special TR-600 crimp rings (stock code 3192-038).
NOTE: TR-600 crimp rings must be purchased separately



Step 1: Flush cut the cable squarely

Step2: Slide the heat shrink and TR-600 crimp ring over the cable. Use a knife or razor to cut a 0.250" long ring from the end of the cable. Make sure that the cut is square.

Step 3: Lightly score the circumference of the cable 0.20" back from the end of the core. Make one long longitudinal cut. Pry up a piece of the jacket and gently peel the ring of the jacket off the core.

Step 4: Debur the center conductor using the DBT 01 deburring tool

Step 5: Slide the connector over the end of the core and push it up to the end of the jacket. Rotate the connection back and forth in a clockwise-counter clockwise motion in reference to the axis of the cable until the back of the connector works its way under the end of the jacket. Now push the connector onto the cable with some back and forth motion until it stops.
NOTE: A small longitudinal cut of 1/4" may be made to the outer jacket to assist with the connector body sliding under the outer jacket.

Step 6: Position the heavy duty HX-4 crimp tool, with the appropriate dies (stock code 3190-203), directly behind and adjacent to the connector body, and crimp the connector. The crimp tool automatically releases when the crimp is complete

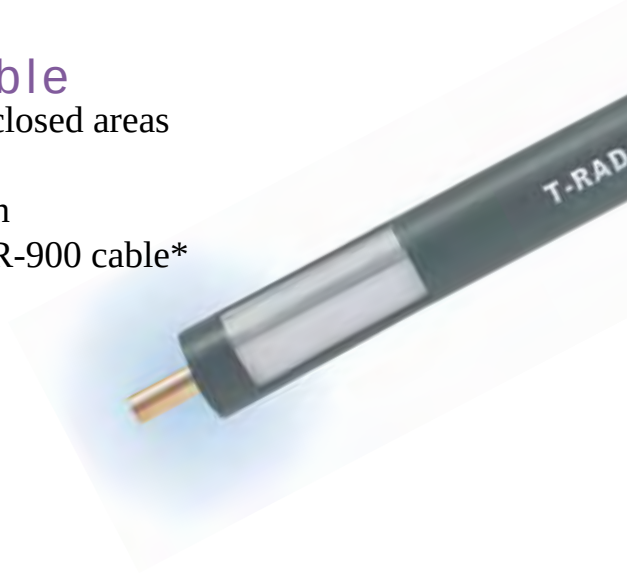
Step 7: Position the heat shrink boot as far forward on the connector body as possible without interfering with the coupling nut; use a heat gun to form a weather-tight seal.

Special Crimp Ring part number 3192-038 (TR-600) must be used on all EZ style connectors

TIMES MICROWAVE SYSTEMS

T-RAD-900
50 Ohm Leaky Feeder Coaxial Cable

- Provides RF coverage in buildings, mines and other enclosed areas
- Offers broadband performance up to 2.5 GHz
- Flexible, non-kinking design provides easier installation
- Accepts standard "EZ" clamp connectors used for LMR-900 cable*
- FR series is MSHA approved for mining applications



Part Description

Part No.	Application	Jacket	Color	Stock Code
AA-9298	T-RAD-900-PVC	PVC	Black	44042
AA-9630	T-RAD-900-FR	FRPE	Black	44046

Construction Specifications

Description	Material	In.	(mm)
Inner Conductor	BC Tube	0.262	(6.65)
Dielectric	Gas-Injected Foam Polyethylene	0.680	(17.27)
Inner Shield	Bonded Aluminum Tape	0.686	(17.42)
Jacket	see table above	0.870	(22.10)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	3.00	(76.2)
Bend Radius: repeated	in. (mm)	9.0	(228.6)
Weight	lb/ft (kg/m)	0.266	(0.40)

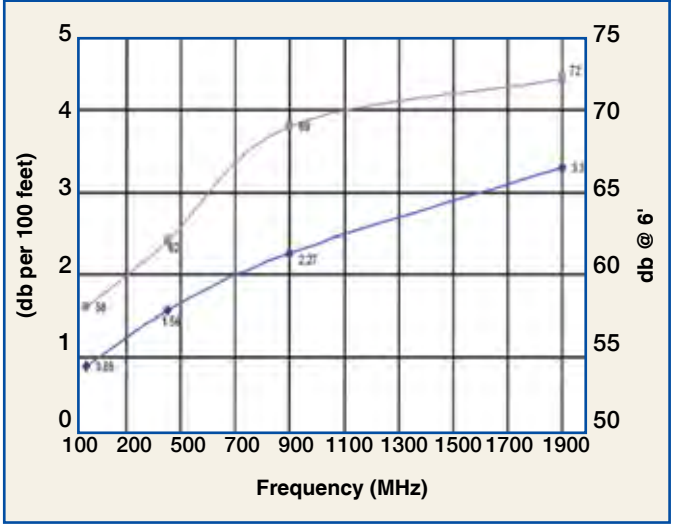
Environmental Specifications

Performance Property	°F	°C
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	87	
Dielectric Constant	NA	1.32	
Time Delay	nS/ft (nS/m)	1.17	(3.83)
Impedance	ohms	50	
Voltage Withstand	Volts DC	5000	
Jacket Spark	Volts RMS	8000	

Loss & Coupling vs. Frequency (typical)



Frequency (MHz)	150	450	900	1900
Attenuation dB/100 ft	0.88	1.56	2.27	3.3
Attenuation dB/100 m	2.89	5.12	7.44	10.8
Coupling Loss dB**	58	62	69	72

* Request T-RAD-900 connector data sheet and attachment instructions
** Coupling loss measured at 6.5 feet (2 meters) *** Patent applied for

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	lb	Weight (g)
1. 7-16 DIN Female	Straight Jack	EZ-900-716FC	3190-334	<1.25:1 (2.5)	NA	Press Fit	Clamp	S/S	2.0 (51)	1.38 (35.1)	0.379	(171.9)
2. 7-16 DIN Male	Straight Plug	EZ-900-716MC-2	3190-1641	<1.25:1 (2.5)	Hex	Press Fit	Clamp	S/S	2.0 (51)	1.44 (36.6)	0.485	(220.0)
3. 7-16 DIN Male	Right Angle	EZ-900-716-MC-RA	3190-614	<1.35:1 (2.5)	Hex	Press Fit	Clamp	S/S	2.7 (69)	2.15 (55.0)	1.150	(521.6)
4. 7/8 EIA	Straight Plug	EZ-900-78EIA-2	3190-1282	<1.25:1 (2.5)	NA	Press Fit	Clamp	S/S	3.0 (76)	2.24 (56.9)	1.013	(459.5)
5. N Male	Straight Plug	EZ-900-NMC-2	3190-1262	<1.25:1 (6)	Hex	Press Fit	Clamp	S/S	2.0 (51)	1.38 (35.1)	0.463	(210.0)
6. N Female	Straight Jack	EZ-900-NFC-2	3190-1263	<1.25:1 (6)	NA	Press Fit	Clamp	S/S	2.0 (51)	1.38 (35.1)	0.443	(200.9)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair
NOTE: Clamp drain wire for connector attachment. A heavy duty adhesive lined shrink boot is recommended to attach over the connector body and cable jacket

TIMES MICROWAVE SYSTEMS

Engineered Products:

SilverLine™

Test Cables

ISO 9001 Certified

Coax Test Cables for:

- *High Volume Production Test Stations*
- *Research & Development Labs*
- *Environmental & Temperature Test Chambers*
- *Replacement for OEM Test Port Cables*
- *Field RF Testing*
- *Cellular Infrastructure Site Testing*

SilverLine™ Test Cables are cost effective, durable, high-performance cable assemblies designed for use in a broad range of test and interconnect applications. Fabricated from rugged, solid PTFE dielectric cable with stainless steel connectors and a proven strain relief system, these cables provide long life and excellent stability in applications where they are repeatedly flexed and mated/unmated. SilverLine™ test cables are ideal for use in production, field and laboratory test environments. They are also economical enough to be used as interconnects in test systems.

Features & Benefits:

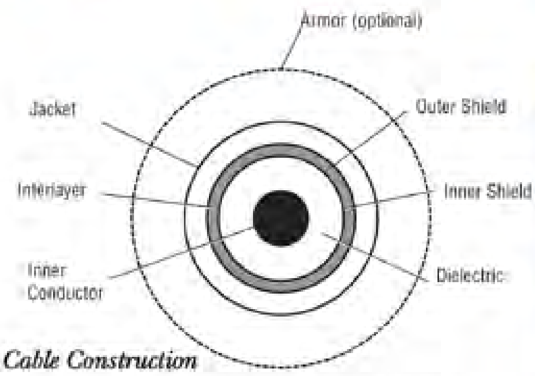
- Phase & Loss Stable
- Long Flex Life
- Triple Shielded Cable
- High Mating Cycle, Stainless Steel Connectors
- Rugged, Solder-Clamp Attachment
- Redundant, Long Life Strain Relief System
- ROHS Compliant

Time's *Silverline*™ Product Guarantee

Times will repair or replace your SilverLine test cable at its option if the connector attachment fails within four months of shipment. This guarantee excludes cable or connector interface damage from misuse or abuse.

Engineered Products:

SilverLine™



Cable Construction

Inner Conductor: Solid Silver Plated Copper Clad Steel

Dielectric: Solid PTFE

Shield: Silver-Plated Copper Flat Ribbon Braid
Aluminum-Polyimide Tape Interlayer
36 GA Silver-Plated Copper Braid (90%k)

Jacket: Clear FEP

Armor (Optional):

PVC Style: Steel wire reinforced, thick wall, high flex life clear PVC
Steel Style: 100% coverage, square locked, galvanized steel hose, high angle steel braid and TPR jacket.

Connectors

- Passivated stainless steel finish (QMA right angle and QMA straight coupling nut only are nickel plated brass)
- QMA SureGrip™ coupling nut design
- Captive contact
- Thick wall interface (SMA)
- Gold plated beryllium copper center contacts
- PTFE dielectric
- Type N & SMA OneTurn™ (1 full rotation to mate)
- High temperature 7mm
- Knurl/hex coupling nut (Type N and TNC)
- Precision grade 7-16

Connector Attachment/Strain Relief

- Rugged, solder-clamp to braid, 175-300 lb pull force. Additional crimp system on armored version.
- Redundant triple layer strain relief system (Dual layer on armored version)

Physical & Mechanical Specifications

Dimensions	in	mm
Inner Conductor	0.037	0.94
Dielectric	0.116	2.95
Inner Shield	0.126	3.20
Interlayer	0.132	3.35
Outer Shield	0.154	3.91
Jacket	0.195	4.95
Armor (optional)	0.450	11.50
Weight lbs./ft (kg/m)	Cable: 0.043 (0.064)	Armor: 0.066 (0.098)
Armor Crush Resistance	PVC:1200 lbs. per linear inch - Steel: 1500 lbs. per linear inch	
Bend Radius: minimum	1	25
Connector Retention	Unarmored & Armored PVC > 175 lbs - Steel Armored > 300 lbs	
Mating Life Cycle	QMA SMA, Type N > 5000*	
Length Tolerances	≤ 2 ft. or 0.75m, -0, +0.50" (12.7mm) > 2 ft. or 0.75m, -0, +2% of length	
Temperature Range	-67°/+221°F	-55°/+105°C

Electrical Specifications

		4 GHz	6 GHz	18 GHz	26.5 GHz
VSWR Max	BNC	1.20:1			
	7-16 DIN, QMA		1.25:1		
	SMA, QMA 2.4mm, 3.5mm, Type N, TNC		1.20:1	1.30:1 1.35:1 (R/A's)	1.35:1 (SMA 2.4mm 3.5mm)
	7mm		1.25:1	1.35:1	

Impedance	50 ohms
Velocity of Propagation	70 %
Shielding Effectiveness	>100 dB
Capacitance	29.4 pf/ft = 96.4 pf/meter
Phase Stability (ten, 4" radius, 180° reverse bends)	DC to 10 GHz: +/- 1.1° 10 to 18 GHz: +/- 2.0°

Attenuation Max @ +77°F (+25°C)

Attenuation (GHz)	dB/100 ft	dB/100 m
1	12.2	40.0
2	18.0	59.0
6	34.2	112
12	52.5	172
18	68.4	224
26.5	88.7	290

Attenuation at Frequency	(A=K1 √FMHz + K2 FMHz)
K1	0.348
K2	0.0012

Power Handling @ +77°F (+25°C) (Sea Level) (Cable Only)**

Power Handling (GHz)	Watts (max.)
0.4	891
1	539
2	363
6	180
12	117
18	88
26.5	65

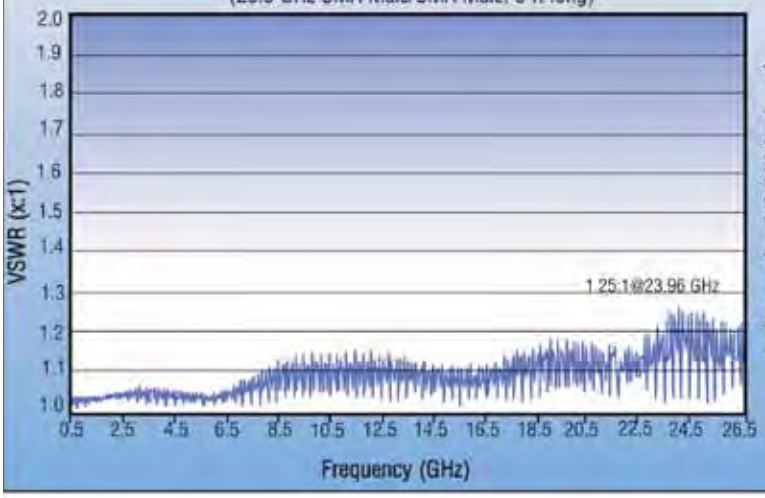
* SMA Male & Type N: Assumes use of calibrated torque wrench, [illegible] connector is within mechanical spec limits. QMA: Assumes proper use, care and cleaning.
** Connector configuration may limit cable assembly maximum power handling capability.

Specifications subject to change without notice.

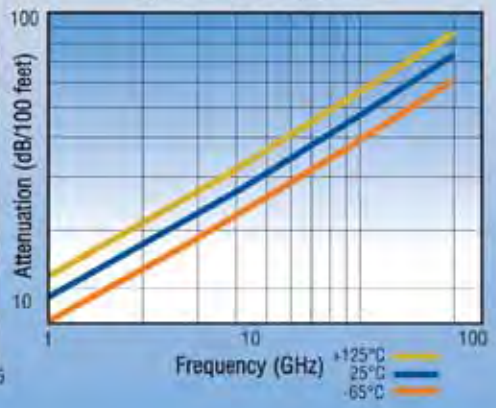
TIMES MICROWAVE SYSTEMS

Silverline Test Cables

(26.5 GHz SMA Male/SMA Male, 3 ft long)



Attenuation vs. Temperature



Ordering Information

U = Unarmored (1ft (0.25m) Minimum Assembly Length
A = Armored (2 ft (0.5m) Minimum Assembly Length
S = Steel, torque and crush resistant armor 3ft (1.0m)

Feet: 0.50 ft Increments
Example: -04.50F = 4.50 ft

Meters: 0.25 m increments
Example: -00.75M = 0.75 m

SLXXX-XXXXXX-XX.XXX

F= Feet M = Meters

Maximum Frequency

04 = 4.0 GHz (BNC equipped only)
06 = 6.0 GHz
18 = 18.0 GHz
26 = 26.5 GHz (SMA, 2.4mm, 3.5mm only)

Connector Codes (2 or 3 Characters)

First Connector

BM	=	BNC Male
SM	=	SMA Male
S1T	=	SMA Male OneTurn™
SF	=	SMA Female
SMR	=	SMA Right Angle
35M	=	3.5mm Male
35F	=	3.5mm Female
3RF	=	3.5mm Ruggedized Female
NM	=	Type N Male
N1T	=	Type N Male OneTurn™
NF	=	Type N Female
NMR	=	Type N Right Angle
70M	=	7mm
76F	=	7-16 Male
TM	=	ETNC Male (Extended range)
TF	=	ETNC Female (Extended range)
QMM	=	QMA Male (changeable interface see pg. 4)
QMR	=	QMA Right Angle (changeable interface see pg. 4)

Second Connector

3.5mm Female (L), Ruggedized 3.5mm Female (R)

Labels on unarmored assemblies under 1.5 feet (0.5m) long remain loose to increase flexibility.

Some connector combinations and/or lengths may be unavailable. Please contact Times or your Times authorized representative.

SilverLine™

SilverLine™-QMA Performance Characteristics

QMA Plug Permanently Installed

NEW! 18GHz QMA r/a with Quick Release

Specifications:
- Frequency Response: DC-18.0 GHz
- VSWR: 1:35:1 Maximum, 1:25:1 Typical

Features & Benefits:
- High Frequency Operation
- 5000 Mate Life
- SureGrip™ Coupling Nut
- Smooth, Fast Retraction for Quick Changes

Notes:

TIMES MICROWAVE SYSTEMS

ISO 9001 Certified

SilverLine-LP™ (Low-PIM)

Passive Intermodulation Testing

- *Cellular Site Certification*
- *Troubleshooting*
- *Performance Analysis*
- *Antenna or Radio Component Production Test*

Features and Benefits

- Much easier to handle than raw corrugated cable
- Better than -117dbm (-160dbc) Performance*
- Includes a set of low PIM adaptors
- Low attenuation
- Rugged, durable, steel armored design
- Retractable, OneTurn™ connector for fast-on fast-off mating
- European and US Hex sizes all in one
- Water resistant
- RoHS compliant

SilverLine™-LP is another first from Times Microwave. There now exists a cable assembly specifically designed for low passive intermodulation performance and to withstand the physical abuse of field testing.

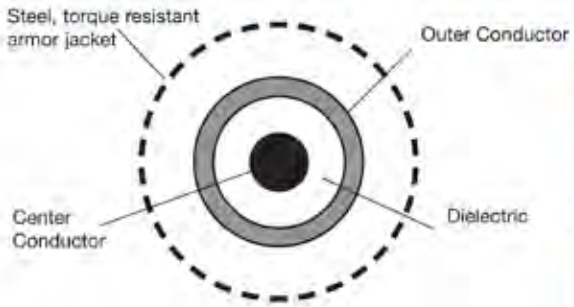
SilverLine™-LP works well with both the latest generation of portable field PIM analyzers and traditional bench top models. A field or production test technician need no longer struggle with bare corrugated cable as a temporary test lead only to have it kink, crack and fail repeatedly, requiring a steady supply of replacements.

SilverLine™-LP incorporates the very best of Times' field proven cable assembly technology, TuffGrip™ armor design and a revolutionary new concept in connector attachment that makes connector/cable junction failures a thing of the past.

The SilverLine™-LP manufacturing process has been tailored to achieve low, consistent PIM performance and user friendliness! As an added value every low PIM assembly comes complete with a set of three Times low pim adaptors to suit all installation test needs.

*Cable at rest

SilverLine-LP Specifications:



Cable Construction

Inner Conductor: Copper clad aluminum

Dielectric: Foam PE

Shield: Copper

Armor: Full, 100% non-interleaved spiral steel sheath overlaid with steel, opposing force structure for torque resistance. Waterproof, UV and abrasion resistant, black TPE outer jacket.

Connectors

- Body: Tri-metal plated brass
- Shell: Aluminum
- Waterproof
- Accommodates US and European hex sizes
- OneTurn™ feature for fast-on fast-off mating

Connector Attachment

Fully soldered center contact and shield. Attachment includes a three inch long, ribbed, wedge clamp-to-armor for the strongest most robust retention system in the industry.

*Achieving mating life with brass requires interfaces to be clean at all times. Remove dust, dirt and especially any metal particles after every mate cycle using a lint free cotton swab and/or dry compressed air. Damage to connector interface voids the warrantee. Protect connector interface at all times by replacing protective caps when not in use.

**Proper torque (21 ft/lbs) and cleanliness are mandatory (see note above for cleaning). PIM value will vary within approx -117 dbm to 125 dbm even with cable at rest. Loosen then re-torque coupling nuts if -120 dbm is not achieved when connectors are first torqued.

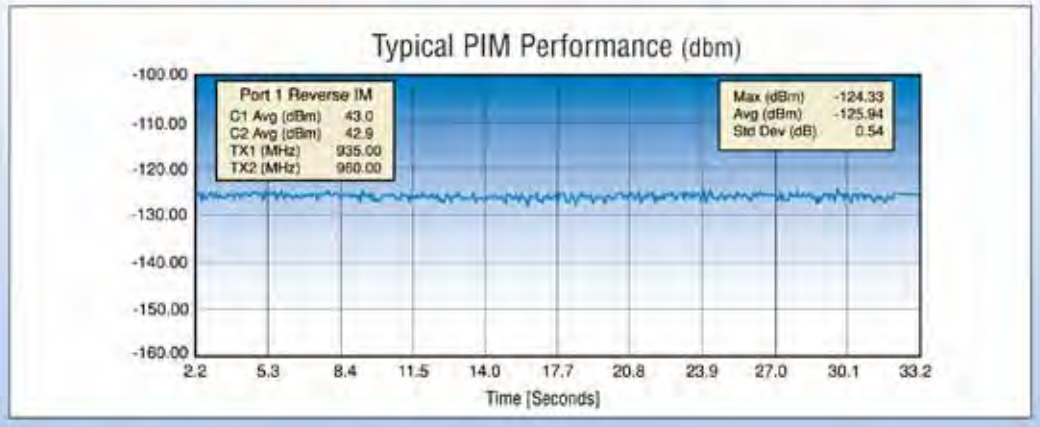
Physical & Mechanical Specifications		
Dimensions	In	mm
Center Conductor	0.11	2.80
Dielectric	0.25	6.35
Outer shield	0.37	9.50
Armor	0.59	14.99
Weight: lbs/ft (kg/m)	Cable & Armor Combined: 0.258 (0.383)	
Armor Crush Resistance	>1200 lbs per linear inch	
Bend Radius (min)	18	457.2
Connector Retention	>500 lbs	
Mating Life Cycle	1000*	
Length Tolerances	+/-2% of Length	
Storage Temperature	-40°/+185°F	-40°/+85°C
Electrical Specifications		
Passive Intermodulation	-117 dbm (-160 dbc) min. at rest**	
VSWR (ret. loss) DC - 3 Ghz	1.25:1 (19db) typ.	1.35:1 (16.54db) max
Impedance	50 Ohms	
Velocity of Propagation	83%	
Shielding Effectiveness	> -100db	
Capacitance	24.3 pf/ft	79.7 pf/meter
Attenuation Max	@ 77°F (+25°C)	
MHz	d/b100 ft	db/100m
800	3.6	11.8
900	3.9	13.0
1800	5.6	18.7
1900	5.8	19.0
2100	6.2	20.1
3000	7.5	24.7
Power handling @77°F (+25°C) (Watts, Avg.) (Sea Level) (Cable Only)		
MHz	Watts (average)	
800	946	
900	729	
1800	460	
1900	445	
2100	430	
3000	340	

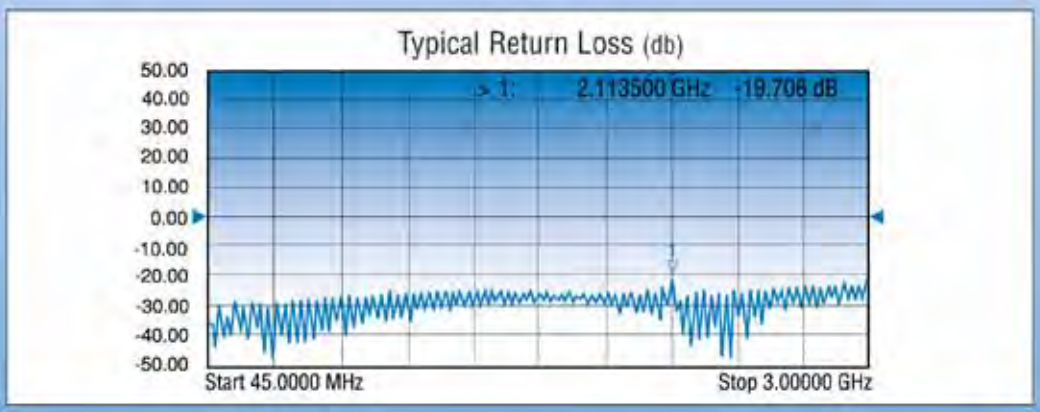
Specifications subject to change without notice.

For longest life, flex the cable as little as possible and maintain at an 18 in (45.72mm) bend diameter ***minimum.***

TIMES MICROWAVE SYSTEMS

PIM Performance and Return Loss vs. Frequency





Ordering Information

SLLP03-76M76M-XX.XXMK

3 Ghz

K = Includes set of three low PIM adaptors.
Omit for cable assembly only

Every 0.25 meter length from 1.5 to 2.75m
Example: - 02.75M = 2.75m

Low PIM adaptor kit PN: 660-0007EA

Kit contents:

Female bullet, M-F r/a
and M-F connector saver

Heavy duty nylon case with sturdy velcro closure,
individual compartments, belt clip and metal lanyard

Low PIM Accessories

Bench PIM Load - pn 67020

Frequency:	800MHz - 3000MHz
Size: in (mm)	7.1h x 2.8w x 5.04d (180 x 68 x 128)
Approx Weight:	6.8 lbs. (3.08kg)
Impedance:	50 Ohms
Return Loss:	16 db min
Intermodulation:	-165 dbc (2 x 43 dbm carriers)
Power Handling:	75 watts average
Coupling Torque:	21 ft-lbs (29 N*m) min 36 ft-lbs (49 N*m) max
Operating Temp:	32-95°F (0-32°C)
Connector Type:	7-16 Female

Includes folding handle, wrench flats to aid torquing to proper values and protective interface cap.

Frequency:	800MHz - 2500MHz
Size: in (mm)	10.4L x 3w (263 x 76)
Approx Weight:	3.4 lbs. (1.54kg)
Impedance:	50 Ohms
Return Loss:	16 db min
Intermodulation:	-165 dbc (2 x 43 dbm carriers)
Power Handling:	40 watts average
Coupling Torque:	21 ft-lbs (29 N*m) min 36 ft-lbs (49 N*m) max
Operating Temp:	32-95°F (0-32°C)
Connector Type:	7-16 male, 7-16 female

Includes wrench flats to aid torquing to proper values, interface caps, and lanyard loop.

Portable PIM Load - pn 67019*

** Caution: Always cap unmated end during use.*

3/8" Corrugated Low Pim Test Lead
pn SLCORO3-76M76M-03.00M
(101-4372PC)

Cable Type:	3/8" Super Flexible Corrugated Cable
Connectors:	7-16 male both ends
Length:	3 meters
Impedance:	50 Ohms
Return Loss:	< 26db 1800-2100MHz
Intermodulation:	< -165 dbc (2 x 43 dbm carriers)

TIMES MICROWAVE SYSTEMS

Engineered Products:

SilverLine-TG™

Coax Test Cables

TuffGrip®

ISO 9001 Certified

For Wireless System Testing:

- *Cell Site Antenna & Cable Sweep Test*
- *Troubleshooting*
- *RF Maintenance*
- *Field RF Test*

Anritsu SiteMaster™ courtesy of Anritsu Co.

SilverLine-TG™ (*TuffGrip*®) test cables are designed for sweep testing cellular infrastructure site cables and antennas. Its unique features were designed by field technicians *for* field technicians.

TuffGrip® employs a hefty handgrip at the system end to better withstand the rigors of field work. It meets the demands of repeated mating and unmating to cell tower cables with connectors that may have degraded from exposure.

The robust hand grip allows the user to apply as much resistance as necessary to properly torque the system cable connector, while preventing excess torque from being applied to the high performance test cable. A proper connection may now be made quickly with a single wrench.

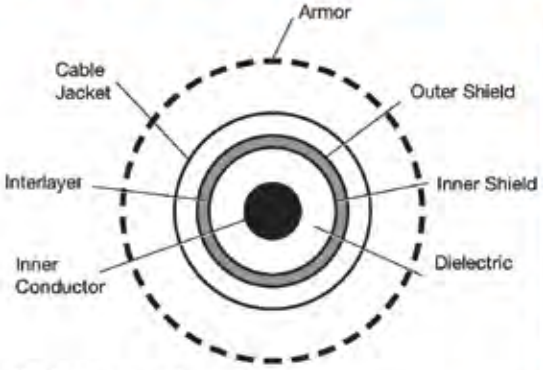
TuffGrip® test cables are double steel armored and anti-torqueing, yet they are completely flexible. All connectors are stainless steel for thousands of mating cycles.

Features & Benefits:

- RF stable with flexure for accurate measurements
- Rugged Construction for long life in field use
- > 50,000 flex life cable for added assurance
- High Frequency Operation to meet future needs
- Permanently attached heavy duty protective caps

Engineered Products:

SilverLine-TG™ Specifications:



Cable Construction

Inner Conductor: Solid Silver Plated Copper Clad Steel

Dielectric: Solid PTFE

Shield: Silver-Plated Copper Flat Ribbon Braid
Aluminum-Polyimide Tape Interlayer
36 GA Silver-Plated Copper Round Braid 90%k)

Jacket: Clear FEP

Armor: Full, 100% non-interleaved spiral steel sheath overlaid with captured, opposing-force structure for anti-torque resistance. Waterpfoof, UV resistant, black TPE outer jacket.

Connectors

- Passivated stainless steel finish
- Captive contact
- Precision grade connectors
- 7-16 male includes retractable coupling nut with **Times** exclusive OneTurn™ fast mating feature
- Knurl/hex Type N coupling nut

Connector Attachment

- System side: TuffGrip® (patented)
- Analyzer side: solder/clamp/crimp

Ordering Information

SLSXX-NMXXX-XX.XXM

06 = 6 GHz
18 = 18 GHz (NMNFG only)

NM = Type N male
NFG = N female TuffGrip®
7MG = 7-16 male TuffGrip® with OneTurn™ retractable coupling nut
7FG = 7-16 female TuffGrip®

01.50 = 1.5 m
03.00 = 3.0 m
05.00 = 5.0 m

Meters

Times' SilverLine-TG™ Replacement Guarantee

Times will repair or replace your SilverLine-TG test cable at its option if the connector attachment fails within one year of shipment. Excludes cable or connector interface damage from misuse or abuse.

TuffGrip®			
Mechanical Specifications			
Dimensions	in		mm
Armored O.D.	0.430		10.92
Minimum Bend Radius	2.50		63.5
Connector Retention	> 290 lbs.		
Armor Crush Resistance	> 1200 lbs. per linear inch		
Mating Life Cycle	> 5,000*		
Flex Life	> 50,000**		
Temperature Range	-67°/+221°F		-55°/+105°C
Electrical Specifications			
Impedance	50 ohms		
Velocity of Propagation	70 %		
Shielding Effectiveness	>100 dB		
Capacitance	29.4 pf/ft = 96.4 pf/m		
Phase Stability (ten, 4" radius, 180° reverse bends)	DC to 10 GHz: +/- 1.1° 10 to 18 GHz: +/- 2.0°		
VSWR Max		6 GHz	18 GHz
	Type N	1.20:1	1.35:1
	7-16	1.25:1	
Attenuation Max @ +77°F (+25°C)			
Frequency (GHz)	dB/100 ft		dB/100 m
1.0	12.2		40.0
2.0	18.0		59.0
6.0	34.2		112.0
18.0	68.4		224.0
Power Handling @ +77°F (+25°C) (Sea Level) (Cable Only***)			
Frequency (GHz)	Watts (max.)		
1	539		
2	363		
6	180		
18	88		
3191-291 Adaptor Specifications:			
Max VSWR:	DC-800 MHz		1.03:1
	800-1.90 GHz		1.05:1
	1.9 - 2.6 GHz		1.05:1
	2.6 - 5.9 GHz		1.15:1

Specifications subject to change without notice.
Assumes the use of a calibrated torque wrench, proper care and cleaning of interface, and mated connector is within mil spec limits.
** *Minimum bend radius not to be exceeded.*
*** *Connector configuration may limit cable assembly maximum power handling capability.*

TIMES MICROWAVE SYSTEMS

Engineered Products:

Intra-Flex™

ISO 9001 Certified

High Performance, Low Loss
In-The-Box RF Interconnects

Features & Benefits:

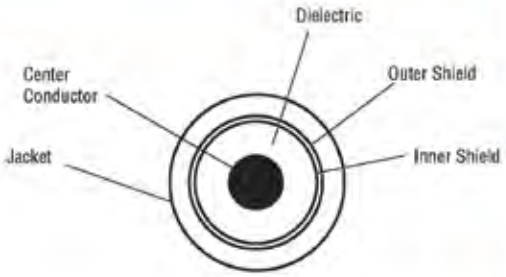
- Low loss improves performance
- Braid design maintains shielding when flexed and bent
- True flexible cable simplifies and eases installation
- Eliminates solder joint failures
- Buy as Assemblies or Cable and Connectors
- Short Lead Time

Intra-Flex™ is an in-the-box interconnect solution. A true, flexible coax it can be used as an alternative to 0.141" diameter copper semi-rigid, tin-soaked braid cable or other similar sized solid PTFE dielectric cables. Intra-Flex™ exhibits approximately 12% lower attenuation compared to 0.141" sized coax. Used as a substitute for semi-rigid coax, Intra-Flex™ eliminates the need for custom-formed configurations dedicated to a specific location within the system. It also eliminates the time and cost to develop drawings depicting the shape. Used as a substitute for tin-soaked braid cable, Intra-Flex™ assemblies eliminate failures from cracked solder joints.

Intra-Flex™ may also be substituted where RG 58, RG142, RG223 and RG400 are used. It exhibits 36% to 51% improvement in maximum attenuation, and achieves 25dB to 50dB better shielding than these RG cables. Intra-Flex™ may be repeatedly flexed without return loss performance degradation or shortening the products life cycle due to mechanical failure.

Engineered Products:

Intra-Flex™ Specifications:



Cable Construction

Center Conductor: Bare Copper, 0.044" (1.12 mm)

Dielectric: Foam PE

Inner Shield: Silver Plated Copper Flat Ribbon Braid 0.126" (3.20 mm)

Outer Shield: 36GA Tinned Copper Round Wire Braid, 90%k 0.148" (3.76 mm)

Jacket: Black PVC 0.195" (4.95 mm)

Connector Construction

- Body: Nickel Plated Brass
- Center Pin: Gold Plated
- Dielectric: PTFE

Physical & Mechanical Specifications		
Dimensions	in	mm
Outside Diameter	0.195	4.95
Weight per 1kft (305m)	40 lbs	18 kg
Minimum Bend Radius	0.2	5
Preferred Bend Radius	0.5	13
Number of Bends*	min radius: < 10	preferred radius: < 25
Operating Temperature	-40°C to + 85°C	
Connector Retention	> 15 lbs	> 6.8 kg
Termination Method	Solder center, crimp braid	
Length Tolerances (< 2.0', 0.6m)	-0,+0.4	-0,+10

Electrical Specifications		
VSWR (max through 3 Ghz)	1.25:1	
Impedance	50 Ohms	
Velocity of Propagation	83 %	
Shielding Effectiveness	>80 dB	
Capacitance	24.3 pF/ft = 79.70 pF/meter	
Attenuation max @ +77°F (+25°C)		
(MHz)	dB/100 ft	dB/100 m
150	4.2	13.8
450	7.3	23.9
900	10.3	33.8
2000	15.6	51.2
2400	17.3	56.1
3000	19.4	63.6
Max attenuation, any frequency:	(0.33404 x √ Fghz) + (0.000364 x Fghz)	
Connector Attenuation, max	Straight	Right Angle
(Includes attachment mismatch)	(0.1 x √ Fghz)	(0.15 x √ Fghz)
Power Handling**		
(Mhz)	77°F (25°C)	104°F (40°C)
150	590	480
450	340	270
900	240	190
2000	160	130
2400	140	110
3000	126	105

**Assumes a single location on the cable is repeatedly flexed, and 3 Ghz operation.*
*** Sea level*
Specifications subject to change without notice.

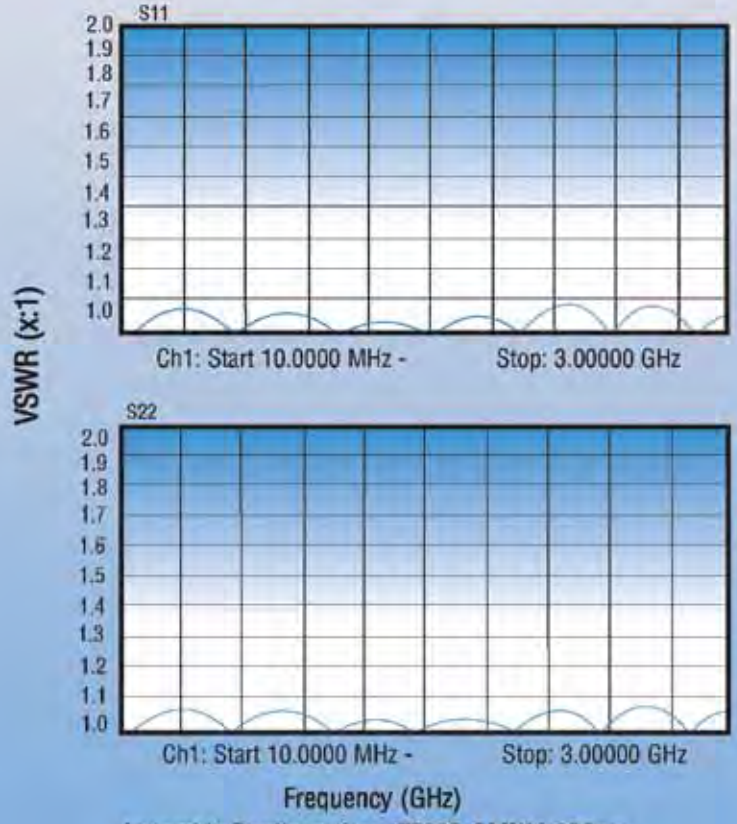
*All **Intra-Flex™** cable assemblies are 100% RF tested for VSWR and insertion loss.*

TIMES MICROWAVE SYSTEMS

Engineered Products:

Intra-Flex™ Test Cable

Typical VSWR vs Frequency



Assembly Configuration: ITF200-SMNM-030cm
SMA male to Type N male, 30 centimeters long

Cable Assembly Ordering Information

Cable Diameter

Length (cm)**
Example: 030 = 30cm

ITF200-XXXX-XXXX-XXXcm

Connector Codes (2 or 3 Characters)
BM = BNC Male (3 Ghz only)
SM = SMA Male
SMR = SMA Right Angle
SFB = SMA Female Bulkhead
NM = Type N Male*
NFB = Type N Female Bulkhead
NMR = Type N Right Angle*
NF4F = Type N Female 4-Hole Flange

Conn. 1
Conn. 2

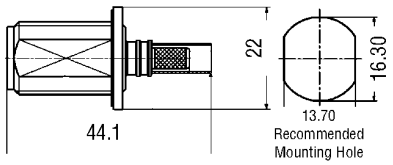
*Type N has Hex/Knurl Coupling Nut

**Length tolerances: ≤ 50cm: -0, +5mm
50cm-100cm: -0, +10mm

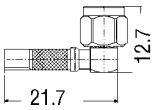
See Page 4 to Order Cable and Connectors Separately

Engineered Products:

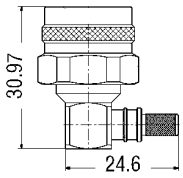
Connector Ordering Information:



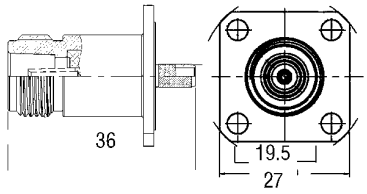
Type N Female Bulkhead
3190-2430



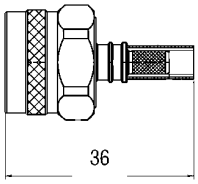
SMA Right Angle
3190-2112



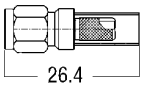
Type N Right Angle
3190-2425



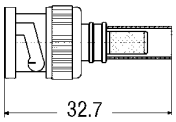
Type N Female 4-Hole Flange
3190-2213



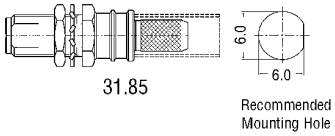
Type N Male
3190-2349



SMA Male
3190-2214



BNC Male
3190-2429



SMA Female Bulkhead
3190-2428

*Dimensions in millimeters

Cable Ordering Information:

Number: MI 55026

TIMES MICROWAVE SYSTEMS

LMR-SW™

ISO 9001 Certified

New 50 Ohm Low Loss, Low PIM Coaxial Cables

- *Seamless Thin Wall Aluminum Outer Conductor*
  - *Pinhole-free*
  - *Eliminates Risk of Seam Failure*
  - *100% RF Shielded*
- *Easy to Attach Connectors*
- *Excellent PIM Performance Typically < -170 dBc*
- *Low VSWR and Attenuation*
- *Tools and Accessories Available*

LMR-SW396
LMR-SW540

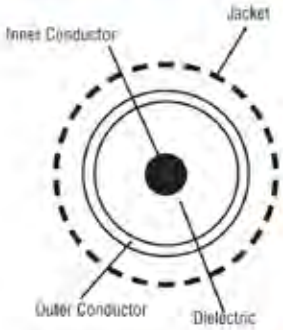
LMR-SW 50 Ohm low loss coaxial cables employ a thin wall, seamless aluminum outer conductor which results in an exceptional combination of low loss, light weight and flexibility. Superior in electrical performance to corrugated copper cables with easily field installed connectors and lighter weight, LMR-SW cable also provides significant cost savings.

LMR-SW cables are the perfect solution for PIM-sensitive installations such as full duplex transmission lines and co-located sites. They are suitable for short to medium height tower runs and flexible enough to be used as jumper cables for both indoor and outdoor applications up to 5.8 GHz.

The high quality connectors are user-friendly and provide excellent and reliable performance when installed with the easy-to-use cable prep tools. Typical PIM performance better than -170 dBc can be achieved consistently. Grounding kits, hangers and other installation accessories are also available.

Features:
- Low Loss
- Low PIM
- Outstanding Connector Retention Strength
- Type N and 716 DIN Connectors Available
- Easy Handling
- 10 Year Warranty

LMR-SW™



Cable Construction

Inner Conductor: Copper Clad Aluminum

Dielectric: Foamed Polyethylene

Outer Conductor: Seamless Aluminum Tube

Jacket: Polyethylene, Outdoor, Black

Physical Specifications	LMR-SW396	LMR-SW540
Overall Diameter:in (mm)	0.450 (11.4)	0.610 (15.5)
Bend Radius: in (mm)	2.00 (51)	3.00 (76)
Bending Moment: ft-lbs (N-m)	2.0 (2.71)	6.3 (8.80)
Tensile Strength lb (Kg)	220 (99.8)	375 (170)
Flat Plate Crush Strength: lbf (kgf)	95 (43)	90 (40)
Weight: lbs/1000 ft (lb/km)	70 (104)	138 (205)
Environmental Specifications		
Installation Temperature Range °F/°C	-40 / +185	(-40 / +85)
Storage Temperature Range °F/°C	-40 / +185	(-40 / +85)
Operating Temperature Range °F/°C	-40 / +185	(-40 / +85)
Electrical Specifications		
Velocity of Propagation: %	87	88
Impedance: Ohms	50 +/- 1	50 +/- 1
Capacitance: pF/ft (pF/m)	24.2 pF/ft (78.2 pF/m)	23.1pF/ft (75.8pF/m)
Inductance: µH/ft (uH/m)	0.058 µH/ft (0.19 µH/m)	0.058 µH/ft (0.19 µH/m)
Shielding Effectiveness: dB	>100	>100
Passive Intermodulation (PIM): dBc	< -170	< -170
Center Conductor DC Resistance: Ohms/1000 ft/(km)	0.82 (2.69)	0.42 (1.38)
Shield DC Resistance: Ohms/1000 ft (km)	0.85 (2.79)	0.63 (2.07)

Attenuation & Average Power @ MHz	LMR-SW396 (dB/100 ft)	(dB/100 m)	(kW)	LMR-SW540 (dB/100 ft)	(dB/100 m)	(kW)
30	0.51	1.7	5.76	0.36	1.2	8.35
50	0.66	2.2	4.44	0.47	1.5	6.44
150	1.16	3.8	2.52	0.83	2.7	3.67
200	1.34	4.4	2.16	0.96	3.1	3.16
300	1.66	5.5	1.75	1.18	3.9	2.56
400	1.94	6.4	1.50	1.37	4.5	2.21
450	2.06	6.8	1.41	1.46	4.8	2.07
900	3.00	9.8	0.97	2.11	6.9	1.44
1800	4.41	14.5	0.66	3.06	10.0	0.99
1900	4.55	14.9	0.64	3.15	10.3	0.96
2500	5.32	17.5	0.54	3.67	12.0	0.82
3500	6.47	21.2	0.45	4.43	14.5	0.68
4900	7.90	25.9	0.36	5.36	17.6	0.56
5800	8.74	28.7	0.33	5.90	19.4	0.51

Connectors		
N Male	EZ-SW396-NMC	EZ-SW540-NMC
N Female	EZ-SW396-NFC	EZ-SW540-NFC
716 Din Male	EZ-SW396-716MC	EZ-SW540-716MC
716 Din Female	EZ-SW396-716FC	EZ-SW540-716FC
Connector Installation Tools		
Complete Tool Kits	TK-SW396EZ	TK-SW540EZ
Ground Kits		
Exact Fit Ground Kits	GK-S396TT	GK-S540TT

TIMES MICROWAVE SYSTEMS

Engineered Products:

Bundled Cables

High quality LMR® Low Loss flexible 50 Ohm coax feeder cable, bundled under a common outer jacket for multiple run applications

- Smart antenna feeders
- IF & RF runs to tower mounted amplifiers for cellular, point to point, broadcast wireless or WiMax systems

- **LMR® Bundled Cable** is a spiral configuration of multiple LMR-400 or smaller LMR cables under a common polyethylene outer jacket. This innovative design acts as the perfect feeder cable for applications requiring multiple runs, such as on towers or building top sites. A unique, patented grounding fixture grounds the outer shields of each cable and a rugged end cap seals the bundle to prevent moisture ingress at the break-out point.
- **LMR Bundled Cable** can be supplied as a complete assembly with break outs and connectors on both ends, as a single ended assembly with pull hoist (base can be trimmed and terminated after installation on tower), or as raw cable and accessories along with easy to use tools. Pictorial instructions and videos are available to assist in the installation of the accessories.

Attenuation dB/100 ft

Frequency (MHz)	150	450	900	2000	2500
LMR-BC240-4	3	5.4	7.7	11.7	13.1
LMR-BC240-9	3	5.4	7.7	11.7	13.1
LMR-BC240-9-LW-75	3	5.4	7.7	11.7	13.1
LMR-BC240-12	3	5.4	7.7	11.7	13.1
LMR-BC300-12	2.4	4.3	6.2	9.4	10.6
LMR-BC400-7	1.5	2.8	4	6.2	7
LMR-BC400-9	1.5	2.8	4	6.2	7
LMR-BC400-9-DB	1.5	2.8	4	6.2	7

- **Features and Benefits:**
  - Less cable runs
  - Fewer ground kits
  - Significantly less cable clamps to install
  - Reduced labor and material costs
  - Rip cord for easy removal of outer jacket
  - Inner cables labeled with an identifier every six inches
  - Less wind load
  - Greater system reliability
  - Professional appearance
  - Standard cables include:
    - LMR-BC240-4
    - LMR-BC240-9
    - LMR-BC240-9-LW-75
    - LMR-BC240-12
    - LMR-BC300-12
    - LMR-BC400-7
    - LMR-BC400-9
    - LMR-BC400-9-DB

Consult factory for other or custom configurations.

Part Number (Stock Code)	LMR-BC240-4 (31845)	LMR-BC240-9 (31844)
Components	LMR-240	LMR-240
Bundle Configuration	F-4	1-8
Outer Protection	PE Jacket	PE Jacket
Overall Diameter (in)	0.688	1.06
Weight (lbs/ft)	0.195	0.375
Bend Radius (in)	7	11
Temperature Range		
Impedance		

Install Tools

The LMR bundled cable tool package contains a number of unique products designed for easy use and long life. The ST-BC-1 and ST-BC-2 make up a universal outer sheath removal tool set that can be used with any of our bundled cables. Custom sheath removal tools are available for the LMR-BC240-12, LMR-BC300-12 and the LMR-BC400-9. (See table on page 191)

The GST-240A, 300A and 400A inner cable jacket removal tools can easily accomplish the otherwise challenging task of removing the outer jacket from the internal LMR-240, 300 and 400 cables.

GST-BC Series:
Custom designed to quickly remove the outer sheath of the LMR bundled cable.

ST-BC-2:
Can be used in combination with the ST-BC-1 to remove the outer sheath of a bundled cable for grounding or fan out.

ST-BC-1:
Can be used in combination with the ST-BC-2 to remove the outer sheath of a bundled cable for grounding or fan out.

GST-240A, GST-300A, GST-400A:
Custom designed to quickly remove the outer jacket of the individual internal cables of LMR-240, 300 and 400 based cables.

Bundled Cable Specifications

LMR-BC240-9-LW-75 (31846)	LMR-BC240-12 (31842)	LMR-BC300-12 (31843)	LMR-BC400-7 (31836)	LMR-BC400-9 (31831)	LMR-BC400-9-DB (31838)
LMR-LW-240-75	LMR-240	LMR-300	LMR-400	LMR-400	LMR-400-DB
1-8	4-8	4-8	1-6	1-8	1-8
PE Jacket	PE Jacket	PE Jacket	PE Jacket	PE Jacket	PE Jacket
1.06	1.2	1.475	1.35	1.6	1.6
0.295	0.58	0.89	0.63	0.75	0.75
11	13	15	14	16	16
-40ºF to + 185ºF (-40º C to + 85º C)					
50 Ohms					

TIMES MICROWAVE SYSTEMS

Engineered Products:

Bundled Cables

Grounding Kit


GK-BC-400-9

All outdoor antenna feeder runs should be grounded at their lowest point just prior to entering the base station or radio enclosure. Depending on the height of the tower run, additional ground points may be required (see table below)

Tower Height (TH)	Location of Additional Grounds*	Comments
<30 meters	No additional GKs required	
30-59 meters	TH/2	1 additional GK
60-69 meters	TH/3 and (TH/3)(2)	2 additional GKs

* These locations are referenced from the base of the tower

Times Microwave Systems has developed a unique, patented grounding fixture that is both economical and easy to install. This ground fixture effectively grounds all the individual cables in the bundle, while requiring only one bonding cable per fixture to be fastened to the tower.

Grounding

1) The outer conductors of individual cables must be grounded/bonded to an adequate ground.

2) All installations regardless of tower height (TH) should be grounded just prior to entering the equipment building or shelter. The cable should also be grounded at the tower base. The ground at the tower base and just prior to building entry should be as close to the ground plane as possible.

3) For towers greater than 30 meters high, additional grounding is required.

End Cap Kit

Times Microwave Systems offers weather seal break out End Caps for a number of the LMR bundled cables. These kits consist of a hard ABS plastic split shell with stainless steel screws, a silicone rubber split cushion and a silicone rubber gasket. The split cushion is formed over the inner cables and the shell is then positioned over the transition so that the end of the outer jacket of the cable is roughly in the middle of the shell. (see the bundled cable End Cap pictorial instructions at www.timesmicrowave.com)

TIMES MICROWAVE SYSTEMS

Weather Seal Kit

It is important that the ground kit be properly weather sealed. This bundled cable process provides labor savings and increased reliability. Composed of six rolls of Butyl Rubber tape and three rolls of black polyvinyl tape, the WK-U Weather Seal Kit provides everything necessary to properly seal one installed ground fixture.

Tools and Install Accessories

Type	Part Number	Description
Bundle Jacket Strip Tool	ST-BC-1 & ST-BC-2	Bundled jacket strip tool for cables not having a custom jacket removal tool
	GST-BC240-12	Bundled jacket strip tool for LMR-BC240-12
	GST-BC300-12	Bundled jacket strip tool for LMR-BC300-12
	GST-1700	Bundled jacket strip tool for LMR-BC400-9
Individual Coax Strip Tool	GST-240A	Individual coax strip tool for LMR-240 based cables
	GST-300A	Individual coax strip tool for LMR-300 based cables
	GST-400A	Individual coax strip tool for LMR-400 based cables
Hangers	1/2" cable hanger	Hangers for LMR-BC240-4
	7/8" cable hanger	Hangers for LMR-BC240-9
	7/8" cable hanger	Hangers for LMR-BC240-9 LW-75
	SH-U1200T	Hangers for LMR-BC240-12
	1 1/4" cable hanger	Hangers for LMR-BC300-12
	1 1/4" cable hanger	Hangers for LMR-BC400-7
	SH-U1700T	Hangers for LMR-BC400-9
	SH-U1700T	Hangers for LMR-BC400-9-DB
Hoisting Grips	1/2" cable hoist	Hoisting grips for LMR-BC240-4
	7/8" cable hoist	Hoisting grips for LMR-BC240-9
	7/8" cable hoist	Hoisting grips for LMR-BC240-9-LW-75
	HG-1200T	Hoisting grips for LMR-BC240-12
	1 1/4" cable hoist	Hoisting grips for LMR-BC300-12
	1 1/4" cable hoist	Hoisting grips for LMR-BC400-7
	HG-1700T	Hoisting grips for LMR-BC400-9
	HG-1700T	Hoisting grips for LMR-BC400-9-DB

TIMES MICROWAVE SYSTEMS

ISO 9001 Certified

Times Protect®

LP-BTR Series

- *DC Blocked for Maximum Surge Protection*
- *Multi-Strike Capability*
- *Broadband Performance from 20MHz up to 1000MHz*
- *Exceptional RF Characteristics*
- *Solid Brass Construction for Durability and Long Life*
- *Universal Grounding Bracket for Flange or Bulkhead Installations*

Lightning and Surge Protection for The 21st Century™

The **Times Protect®** LP-BTR high performance surge arrestor series addresses applications in the 20MHz-1000MHz spectrum. Our unique DC blocking technology employed in this design provides optimum isolation of the antenna port from the protected equipment port for maximum surge protection. LP-BTR surge protectors have exceptional RF performance and are constructed from the highest quality materials for unsurpassed durability and longevity. These units meet and surpass all applicable industry standards.

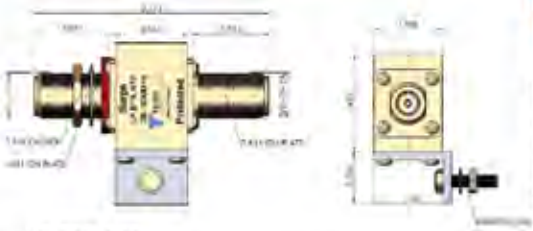
The LP-BTR product family is available with N connector configurations to satisfy various installation requirements.

LP-BTR Series:

- LP-BTR-NFF
  N Female connectors on surge and protected sides
- LP-BTR-NMP
  N Male connector on protected side with N Female connector on surge side
- LP-BTR-NMS
  N Male connector on surge side with N Female connector on protected side

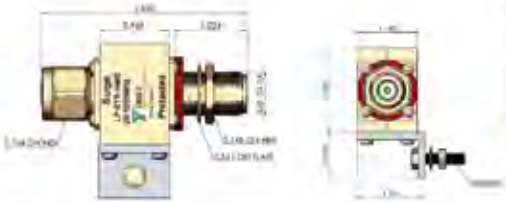
TIMES MICROWAVE SYSTEMS
An Amphenol Company

Times-Protect®



• LP-BTR-NFF
20-1000MHz DC Blocked N Type F/F

• LP-BTR-NMP
20-1000MHz DC Blocked N Type M on Protected

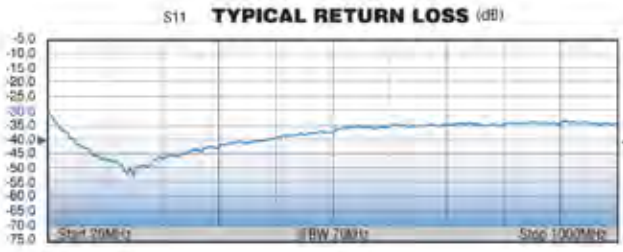


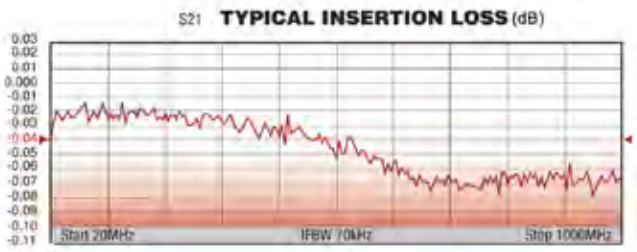
• LP-BTR-NMS
20-1000MHz DC Blocked N Type M on Surge

*All dimensions shown in inches

Electrical Specifications	
Impedance	50 Ω
Frequency Range	20-1000 MHz
VSWR/Return Loss	<1.1:1 / <-26dB
Insertion Loss	< 0.1dB
Impulse Discharge Current	10KA multiple (8x20µs wave-form)
Turn-on Voltage	600V ± 20%
Turn-on Time	2.5ns for 2kV/ns
Energy Throughput Rating	<200µJ (4kV/2kA 1.2x50/8x20µs wave-form)
Power Handling at Frequency	375W (20-220MHz) 125W (220-700MHz) 50W (700-1000MHz)
Protection Circuit	DC Blocked
Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C / -40°C - +50°C
Weatherization	Required for external use
Thermal Shock	US MIL-STD 202, Meth.107,Cond.B
Vibration	US MIL-STD 202, Meth.204,Cond.B
Shock	US MIL-STD 202, Meth.213,Cond.I
RoHS Compliant	Yes
Mating Life Cycle	> 500
Recommended Coupling Nut Torque	7 to 10 lb-in
Unit Weight	0.25kg/pc / 0.55lb

Material Specifications		
Component	Material	Plating
Body	Brass	White Bronze
Inner Conductor Male	Brass	Silver
Inner Conductor Female	Phosphor Bronze	Silver
Outer Conductor	Brass	White Bronze
Coupling Nut	Brass	White Bronze
Insulator	PTFE	--





TIMES MICROWAVE SYSTEMS

ISO 9001 Certified

Times Protect®

IP67 Weatherized!

LP-BTRW Series

- *IP67 Weatherized for Outdoor Use*
- *DC Blocked for Maximum Surge Protection*
- *Multi-Strike Capability*
- *Broadband Performance From 20MHz up to 1000MHz*
- *Exceptional RF Characteristics*
- *Solid Brass White Bronze Plated Construction for Durability and Long Life*
- *Universal Grounding Bracket Supplied*

Lightning and Surge Protection for The 21st Century™

The **Times Protect™** LP-BTRW high performance surge arrestor series addresses applications in the 20MHz-1000MHz spectrum. Our unique DC blocking technology employed in this design provides optimum isolation of the antenna port from the protected equipment port for maximum surge protection.

LP-BTRW surge protectors have exceptional RF performance and are constructed from the highest quality materials for unsurpassed durability and longevity. These units meet and surpass all applicable industry standards.

The LP-BTRW product family is available with N connector configurations and fully weatherized to the IP67 standard for outdoor use.

LP-BTRW Series:

- LP-BTRW-NFF
  N Female connectors on surge and protected sides
- LP-BTRW-NMP
  N Male connector on protected side with N Female connector on surge side
- LP-BTRW-NMS
  N Male connector on surge side with N Female connector on protected side

Times-Protect™

• LP-BTRW-NFF
20-1000MHz DC Blocked N Type F/F

• LP-BTRW-NMP
20-1000MHz DC Blocked N Type M on Protected

• LP-BTRW-NMS
20-1000MHz DC Blocked N Type M on Surge

*All dimensions shown in inches

Electrical Specifications	
Impedance	50 Ω
Frequency Range	20-1000 MHz
VSWR/Return Loss	<1.1:1 / <-26dB
Insertion Loss	< 0.1dB
Impulse Discharge Current	10KA multiple (8x20µs wave-form)
Turn-on Voltage	600V ± 20%
Turn-on Time	2.5ns for 2kV/ns
Energy Throughput Rating	<200µJ (6kV/3kA 1.2x50/8x20µs wave-form)
Power Handling at Frequency	375W (20-220MHz) 125W (220-700MHz) 50W (700-1000MHz)
Protection Circuit	DC Blocked
Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C / -40°C - +50°C
Weatherization	IEC 60068 55/155/56 & IP67
Thermal Shock	US MIL-STD 202, Meth.107,Cond.B
Vibration	US MIL-STD 202, Meth.204,Cond.B
Shock	US MIL-STD 202, Meth.213,Cond.I
RoHS Compliant	Yes
Mating Life Cycle	> 500
Recommended Coupling Nut Torque	7 to 10 in-lb
Unit Weight	0.25kg/pc / 0.55lb

Material Specifications		
Component	Material	Plating
Body	Brass	White Bronze
Inner Conductor Male	Brass	Silver
Inner Conductor Female	Phosphor Bronze	Silver
Outer Conductor	Brass	White Bronze
Coupling Nut	Brass	White Bronze
Insulator	PTFE	--

TIMES MICROWAVE SYSTEMS

Times Protect®

LP-GTR-D Series

- *DC Pass Multi-Strike Design*
- *Replaceable Gas Tube*
- *Broadband Bidirectional Design*
- *Excellent IL/RL Performance Over the Entire Operating Frequency Band*
- *Fully Weatherized Housing*
- *Solid Brass Construction for Durability and Long Life*
- *Includes Universal Right Angle Bracket Adaptor*

TIMES MICROWAVE SYSTEMS
An Amphenol Company

ISO 9001 Certified

Lightning and Surge Protection for The 21st Century™

The **Times -Protect**® LP-GTR-D series is an exceptional broadband DC pass design for lightning protection applications requiring DC power to be supplied to the electronics. Offering outstanding surge performance the LP-GTR-D series is the perfect protection solution for distributed antenna systems, tower mounted amplifiers, GPS systems and other applications requiring DC pass circuitry. These devices exhibit outstanding RF performance with high surge current handling characteristics and cover a broad range of power handling requirements from 50 to 550 watts. Its fully weatherized housing meeting IP67 standard allows for outdoor as well as indoor installation. The 716 DIN connector types can be used from DC through 2500MHz.

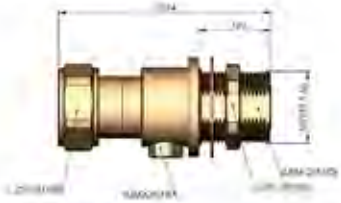
LP-GTR-D Series:

- LP-GTR-DFF (90Vdc/50W)
- LP-GTR-DFF-23 (230Vdc/210W)
- LP-GTR-DFF-35 (350Vdc/550W)
  716 DIN Female connectors on both sides - bidirectional
- LP-GTR-DFM (90Vdc/50W)
- LP-GTR-DFM-23 (230Vdc/210W)
- LP-GTR-DFM-35 (350Vdc/550W)
  716 DIN Male connector on one side & 716 DIN Female connector on the other side - bidirectional

Times-Protect®

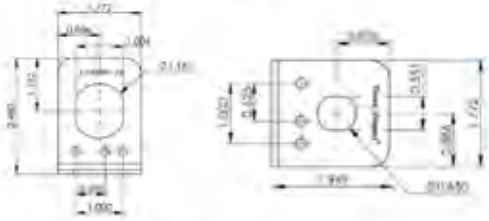
- LP-GTR-DFF
- LP-GTR-DFF-23
- LP-GTR-DFF-35

DC Pass DIN Type F/F



- LP-GTR-DFM
- LP-GTR-DFM-23
- LP-GTR-DFM-35

DC Pass DIN Type F/M



- Universal Right Angle Bracket Adaptor

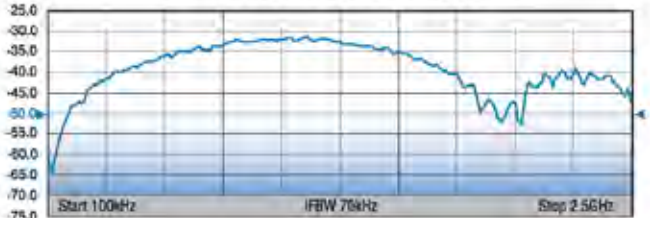
*All dimensions shown in inches

Electrical Specifications			
Impedance	50 Ω		
Frequency Range	DC-2500 MHz		
VSWR/Return Loss	< 1.08:1 / <-28dB (DC to 1000MHz) < 1.1:1 / <-26dB (1000 to 2500MHz)		
Insertion Loss	< 0.1dB (DC-1000MHz) < 0.2dB (1000-2500MHz)		
Maximum Surge Current	20kA multiple (8x20µs wave-form)		
Part Number: LP-GTR-	DFF/DFM	DFF-23/DFM-23	DFF-35/DFM-35
Impulse Sparkover	500V (1kV/µs)	700V (1kV/µs)	800(1kV/µs)
Turn-on	90Vdc	230Vdc	350Vdc
Average Power	50 Watts	210 Watts	550 Watts
Protection Circuit	DC Pass		

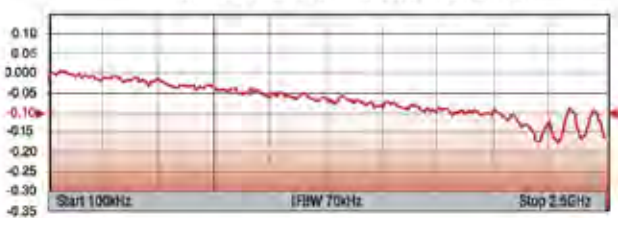
Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C
Weatherization	IEC 60068 40/085/21 & IP 67
Thermal Shock	US MIL-STD 202, Meth.107,Cond.B
Vibration	US MIL-STD 202, Meth.204,Cond.B
Shock	US MIL-STD 202, Meth.213,Cond.I
RoHS Compliant	Yes
Wear/Mating Cycles	500 minimum
Recommended Coupling Nut Torque	220 to 300 lb-in
Unit Weight	0.4kg/pc \ 0.88lb

Material Specifications		
Component	Material	Plating
Body	Brass	White Bronze
Inner Conductor Male	Brass	Silver
Inner Conductor Female	Phosphor Bronze	Silver
Washer	Brass	White Bronze
Coupling Nut	Brass	White Bronze
Insulator	TPX	---
O-Ring	Silicone Rubber	---

S11 **TYPICAL RETURN LOSS**(dB)



S21 **TYPICAL INSERTION LOSS**(dB)



TIMES MICROWAVE SYSTEMS

Times Protect®

ISO 9001 Certified

LP-GTR-N Series

- *DC Pass Multi-Strike Design*
- *Replaceable Gas Tube*
- *Broadband Bidirectional Design*
- *Excellent IL/RL Performance Over the Entire Operating Frequency Band*
- *Fully Weatherized Housing*
- *Solid Brass Constuction for Durability and Long Life*
- *Includes Universal Right Angle Bracket Adaptor*

TIMES MICROWAVE SYSTEMS
An Amphenol Company

Lightning and Surge Protection for The 21st Century™

The Times-Protect® LP-GTR-N series is an exceptional broadband DC pass design for lightning protection applications requiring DC power to be supplied to the electronics. Offering outstanding surge performance, the LP-GTR-N series is the perfect protection solution for distributed antenna systems, tower mounted amplifiers, GPS systems and other applications requiring DC pass circuitry. These devices exhibit outstanding RF performance with high surge current handling characteristics and cover a broad range of power handling requirements from 50 to 550 watts. Its fully weatherized housing meeting IP67 standard allows for outdoor as well as indoor installation. The N connector designs cover the entire frequency spectrum from DC through 3000MHz.

LP-GTR-N Series:

- LP-GTR-NFF (90Vdc/50W)
- LP-GTR-NFF-23 (230Vdc/210W)
- LP-GTR-NFF-35 (350Vdc/550W)

  N Female connectors on both sides - bidirectional
- LP-GTR-NFM (90Vdc/50W)
- LP-GTR-NFM-23 (230Vdc/210W)
- LP-GTR-NFM-35 (350Vdc/550W)

  N Male connector on one side & N Female connector on the other side - bidirectional

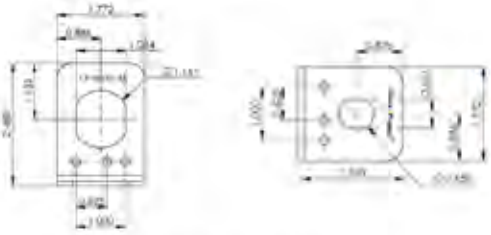
Times-Protect®

- LP-GTR-NFF
- LP-GTR-NFF-23
- LP-GTR-NFF-35

DC Pass N Type F/F

- LP-GTR-NFM
- LP-GTR-NFM-23
- LP-GTR-NFM-35

DC Pass N Type F/M



- Universal Right Angle Bracket Adaptor

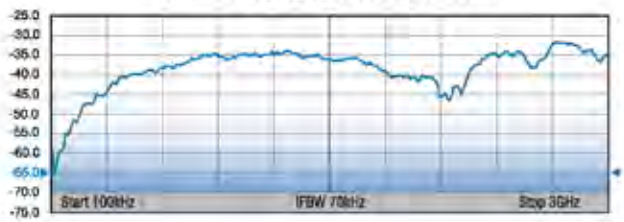
*All Dimensions shown in inches

Electrical Specifications			
Impedance	50 Ω		
Frequency Range	DC-3000 MHz		
VSWR/Return Loss	< 1.1:1 / <-26dB (DC-2800MHz) < 1.13:1 / <-24dB (2800-3000MHz)		
Insertion Loss	< 0.1dB (DC-1000MHz) < 0.2dB (1000-3000Mhz)		
Maximum Surge Current	20kA multiple (8x20µs wave-form)		
Part Number: LP-GTR	NFF/NFM	NFF-23/NFM-23	NFF-35/NFM-35
Impulse Sparkover	500V (1kV/µs)	700V (1kV/µs)	800V (1kV/µs)
Turn on	90Vdc	230Vdc	350Vdc
Average Power	50 Watts	210 Watts	550 Watts
Protection Circuit	DC Pass		

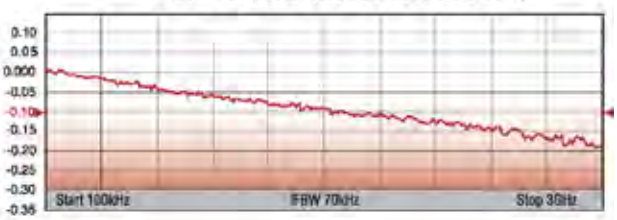
Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C
Weatherization	IEC 60068 40/085/21 & IP67
Thermal Shock	US MIL-STD 202, Meth.107,Cond.B
Vibration	US MIL-STD 202, Meth.204,Cond.B
Shock	US MIL-STD 202, Meth.213,Cond.I
RoHS Compliant	Yes
Wear/Mating Cycles	500 minimum
Recommended Coupling Nut Torque	7 to 10 lb-in
Unit Weight	0.2kg/pc \ 0.44lb

Material Specifications		
Component	Material	Plating
Body	Brass	White Bronze
Inner Conductor Male	Brass	Silver
Inner Conductor	Phosphor Bronze	Silver
Washer	Brass	White Bronze
Coupling Nut	Brass	White Bronze
Insulator	TPX	--
O-Ring	Silicone Rubber	--

S11 **TYPICAL RETURN LOSS** (dB)



S21 **TYPICAL INSERTION LOSS** (dB)



TIMES MICROWAVE SYSTEMS

ISO 9001 Certified

Times Protect®

LP-STR-D Series

- *DC Blocked for Superior Surge Protection*
- *Multi-Strike Capability*
- *High Power Rated*
- *High Surge Current Rating*
- *Outstanding IL/RL Characteristics*
- *Excellent PIM Performance*
- *Fully Weatherized Housing*
- *Solid Brass Construction for Durability and Long Life*

Lightning and Surge Protection for The 21st Century™

The **Times Protect®** LP-STR-D high performance series is an exceptional DC blocked design for outstanding surge performance. The operating bandwidth of 800MHz-2500MHz makes the LP-STR-D series suitable for a broad range of applications. With its excellent passive intermodulation performance, outstanding RF performance over the entire operating band and superior power handling capability, the LP-STR-D product family is unequaled. Its fully weatherized housing meeting IP67 standard allows for outdoor as well as indoor installation.

LP-STR-D Series:

- LP-STR-DFF
  716 DIN Female connectors on surge and protected side
- LP-STR-DMP
  716 DIN Male connector on protected side with 716 DIN Female connector on surge side
- LP-STR-DMS
  716 DIN Male connector on surge side with 716 DIN Female connector on protected side

TIMES MICROWAVE SYSTEMS
An Amphenol Company

Times-Protect®

- LP-STR-DFF
  800-2500MHz DC Blocked DIN Type F/F

- LP-STR-DMP
  800-2500MHz DC Blocked DIN Type M on Protected

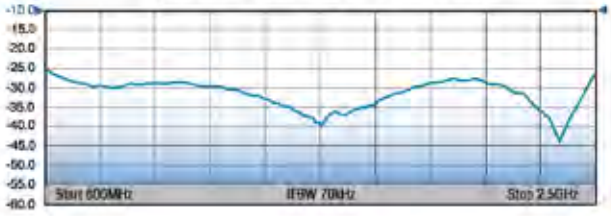
- LP-STR-DMS
  800-2500MHz DC Blocked DIN Type M on Surge

*All dimensions shown in inches

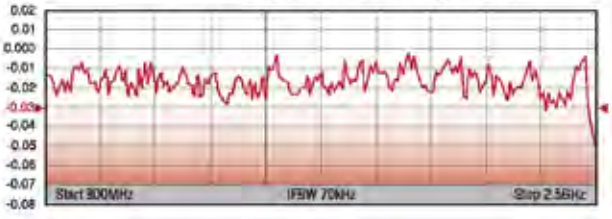
Electrical Specifications	
Impedance	50 Ω
Frequency Range	800-2500 MHz
VSWR / Return Loss	<1.13:1 / <-24dB (800-840MHz) <1.1:1 / <-26dB (840-2500MHz)
Insertion Loss	< 0.1dB
Average Power	700 Watts
PIM	<-160 dBc
Maximum Surge Current	50kA (8/20µs wave-form)
Residual Pulse Voltage	< 100V (50kA 8/20µs wave-form)
Residual Pulse Voltage	< 1V (4kV/2kA 1.2x50/8x20µs wave-form)
Energy Throughput Rating	< 1nJ (4kV/2kA 1.2x50/8x20µs wave-form)
Protection Circuit	DC Blocked
Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C
Weatherization	IEC 60068 55/155/56 & IP67
Thermal Shock	US MIL-STD 202, Meth.107,Cond.B
Vibration	US MIL-STD 202, Meth.204,Cond.B
Shock	US MIL-STD 202, Meth.213,Cond.I
RoHS Compliant	Yes
Mating Life Cycle	> 500
Recommended Coupling Nut Torque	220 to 300 lb-in
Unit Weight	0.6kg/pc 1.32lb

Material Specifications		
Component	Material	Plating
Body	Brass	White Bronze
Inner Conductor Male	Brass	Silver
Inner Conductor Female	Phosphor Bronze	Silver
Coupling Nut	Brass	White Bronze
Insulator	PTFE	--
O-Ring	Silicone Rubber	--

S11 **TYPICAL RETURN LOSS** (dB)



S21 **TYPICAL INSERTION LOSS** (dB)



TIMES MICROWAVE SYSTEMS

ISO 9001 Certified

Times Protect®

LP-STR-N Series

- *Excellent PIM Performance*
- *Outstanding IL/RL Characteristics*
- *DC Blocked for Superior Surge Performance*
- *High Surge Current Rating*
- *Broadband Multi-Strike Design*
- *High Power Rated*
- *Fully Weatherized Housing*
- *Solid Brass Construction for Durability and Long Life*

Lightning and Surge Protection for The 21st Century™

The **Times Protect®** LP-STR-N high performance series is an exceptional DC blocked design for superior surge performance, capable of withstanding multiple lightning strikes. The operating band width of 800MHz-2500MHz makes the LP-STR-N series suitable for a broad range of applications. With its excellent passive intermodulation performance, outstanding RF performance over the entire operating band and excellent power handling capability, the LP-STR-N product family is unequaled. Its fully weatherized housing meeting IP67 standard allows for outdoor as well as indoor installation.

LP-STR-N Series:

- LP-STR-NFF
  N Female connectors on surge and protected sides
- LP-STR-NMP
  N Male connector on protected side with N Female connector on surge side
- LP-STR-NMS
  N Male connector on surge side with N Female connector on protected side

TIMES MICROWAVE SYSTEMS
An Amphenol Company

Times-Protect®

- LP-STR-NFF
  800-2500MHz DC Blocked N Type F/F

- LP-STR-NMP
  800-2500MHz DC Blocked N Type M on Protected

- LP-STR-NMS
  800-2500MHz DC Blocked N Type M on Surge

*All dimensions shown in inches

Electrical Specifications	
Impedance	50 Ω
Frequency Range	800-2500 MHz
VSWR/Return Loss	< 1.13:1 / <-24dB (800-840MHz) < 1.1:1 / <-26dB (840-2500MHz)
Insertion Loss	< 0.1dB
Average Power	500 Watts
PIM	<-160 dBc
Maximum Surge Current	50kA (8x20µs wave-form)
Residual Pulse Voltage	< 100V (50kA 8x20µs wave-form)
Residual Pulse Voltage	< 1V (4kV/2kA 1.2x50/8x20µs wave-form)
Energy Throughput Rating	< 1nJ (4kV/2kA 1.2x50/8x20µs wave-form)
Protection Circuit	DC Blocked
Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C
Weatherization	IEC 60068 55/155/56 & IP67
Thermal Shock	US MIL-STD 202, Meth.107,Cond.B
Vibration	US MIL-STD 202, Meth.204,Cond.B
Shock	US MIL-STD 202, Meth.213,Cond.I
RoHS Compliant	Yes
Wear/Mating Cycles	500 minimum
Recommended Coupling Nut Torque	7 to 10 in-lb
Unit Weight	0.53kg/pc 1.17lb

Material Specifications

Component	Material	Plating
Body	Brass	White Bronze
Inner Conductor Male	Brass	Silver
Inner Conductor Female	Phosphor Bronze	Silver
Coupling Nut	Brass	White Bronze
Insulator	PTFE	--
O-Ring	Silicone Rubber	--

S11 **TYPICAL RETURN LOSS**(dB)

S21 **TYPICAL INSERTION LOSS**(dB)

TIMES MICROWAVE SYSTEMS

Times Protect®

LP-STRL-D Series

- *Long Term Evolution (LTE) and 700 MHz Public Safety Applications*
- *Excellent PIM Performance*
- *Outstanding IL/RL Characteristics*
- *DC Blocked for Superior Surge Performance*
- *High Surge Current/Power Rated*
- *Broadband Multi-Strike Design*
- *Fully Weatherized Housing*
- *Solid Brass Construction for Durability and Long Life*

ISO 9001 Certified

100% PIM Tested

Lightning and Surge Protection for The 21st Century™

The **Times Protect®** high performance series is an exceptional DC blocked design for outstanding surge performance, capable of withstanding multiple lightning strikes. The operating band width of 680MHz-2200MHz makes the LP-STRL-D series suitable for a broad range of applications. This design covers the 700MHz Band for Public Safety Services as well as LTE (Long Term Evolution) applications. With it's excellent passive intermodulation performance, outstanding RF performance over the entire operating band and superior power handling capability, the LP-STRL-D product family in unequaled. Its fully weatherized housing meeting IP67 standard allows for outdoor as well as indoor installation.

- LP-STRL-DFF
  716 DIN Female connectors on surge and protected side
- LP-STRL-DMP
  716 DIN Male connector on protected side with 716 DIN Female connector on surge side
- LP-STRL-DMS
  716 DIN Male connector on surge side with 716 DIN Female connector on protected side

TIMES MICROWAVE SYSTEMS
An Amphenol Company

Times-Protect®

- LP-STR-DFF
  800-2500MHz DC Blocked DIN Type F/F

- LP-STR-DMP
  800-2500MHz DC Blocked DIN Type M on Protected

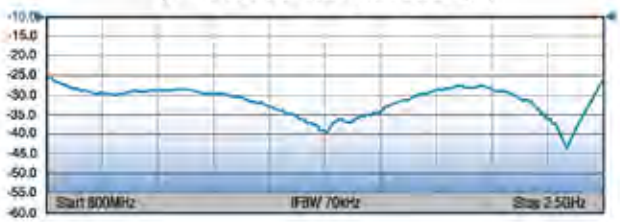
- LP-STR-DMS
  800-2500MHz DC Blocked DIN Type M on Surge

All dimensions shown in inches

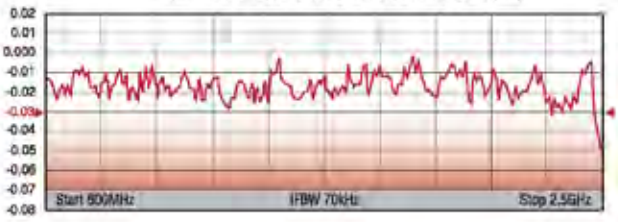
Electrical Specifications	
Impedance	50 Ω
Frequency Range	800-2500 MHz
VSWR / Return Loss	<1.13:1 / <-24dB (800-840MHz) <1.1:1 / <-26dB (840-2500MHz)
Insertion Loss	< 0.1dB
Average Power	700 Watts
PIM	<-160 dBc
Maximum Surge Current	50kA (8/20µs wave-form)
Residual Pulse Voltage	< 100V (50kA 8/20µs wave-form)
Residual Pulse Voltage	< 1V (4kV/2kA 1.2x50/8x20µs wave-form)
Energy Throughput Rating	< 1nJ (4kV/2kA 1.2x50/8x20µs wave-form)
Protection Circuit	DC Blocked
Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C
Weatherization	IEC 60068 55/155/56 & IP67
Thermal Shock	US MIL-STD 202, Meth.107,Cond.B
Vibration	US MIL-STD 202, Meth.204,Cond.B
Shock	US MIL-STD 202, Meth.213,Cond.I
RoHS Compliant	Yes
Mating Life Cycle	> 500
Recommended Coupling Nut Torque	220 to 300 lb-in
Unit Weight	0.6kg/pc 1.32lb

Material Specifications		
Component	Material	Plating
Body	Brass	White Bronze
Inner Conductor Male	Brass	Silver
Inner Conductor Female	Phosphor Bronze	Silver
Coupling Nut	Brass	White Bronze
Insulator	PTFE	--
O-Ring	Silicone Rubber	--

S11 **TYPICAL RETURN LOSS** (dB)



S21 **TYPICAL INSERTION LOSS** (dB)



TIMES MICROWAVE SYSTEMS

Times Protect®

LP-STRL-N Series

- *Long Term Evolution (LTE) and 700 MHz Public Safety Applications*
- *Excellent PIM Performance*
- *Outstanding IL/RL Characteristics*
- *DC Blocked for Superior Surge Performance*
- *High Surge Current/Power Rated*
- *Broadband Multi-Strike Design*
- *Fully Weatherized Housing*
- *Solid Brass Construction for Durability and Long Life*

TIMES MICROWAVE SYSTEMS
An Amphenol Company

ISO 9001 Certified

Lightning and Surge Protection for The 21st Century™

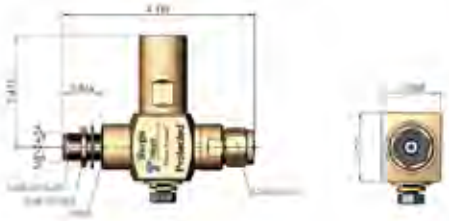
The **Times Protect®** LP-STRL-N high performance series is an exceptional DC blocked design for outstanding surge performance, capable of withstanding multiple lightning strikes. The operating band width of 680MHz - 2200MHz makes the LP-STRL-N series suitable for a broad range of applications. This design covers the 700MHz Band for Public Safety Services as well as LTE (Long Term Evolution) applications. With its excellent passive intermodulation performance, outstanding RF performance over the entire operating band and superior power handling capability, the LP-STRL-N product family is unequaled. Its fully weatherized housing meeting IP67 standard allows for outdoor as well as indoor installation.

LP-STRL-N Series:

- LP-STRL-NFF
  N Female connectors on surge and protected sides
- LP-STRL-NMP
  N Male connector on protected side with N Female connector on surge side
- LP-STRL-NMS
  N Male connector on surge side with N Female connector on protected side

Times-Protect®

• LP-STRL-NFF
680-2200MHz DC Blocked N Type F/F



• LP-STRL-NMP
680-2200MHz DC Blocked N Type M on Protected

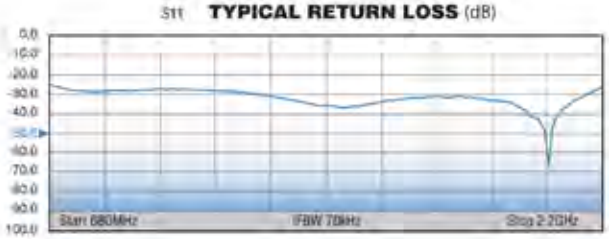
• LP-STRL-NMS
680-2200MHz DC Blocked N Type M on Surge

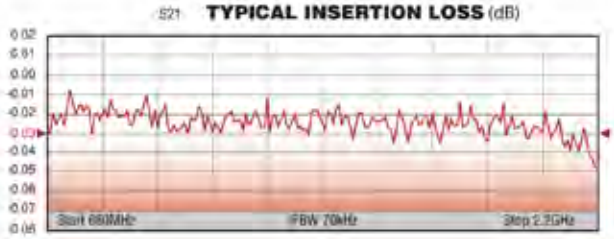
*All dimensions shown in inches

Electrical Specifications	
Impedance	50 Ω
Frequency Range	680-2200 MHz
VSWR/Return Loss	< 1.13:1 / <-24dB (680-700MHz) < 1.1:1 / <-26dB (700-2200MHz)
Insertion Loss	< 0.1dB
Average Power	500 Watts
PIM	<-160dBc
Maximum Surge Current	50kA (8x20µs wave-form)
Residual Pulse Voltage	< 100V (50kA 8x20µs wave-form)
Residual Pulse Voltage	< 1V (4kV/2kA 1.2x50/8x20µs wave-form)
Energy Throughput Rating	< 1nJ (4kV/2kA 1.2x50/8x20µs wave-form)
Protection Circuit	DC Blocked

Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C
Weatherization	IEC 60068 55/155/56 & IP67
Thermal Shock	US MIL-STD 202, Meth.107,Cond.B
Vibration	US MIL-STD 202, Meth.204,Cond.B
Shock	US MIL-STD 202, Meth.213,Cond.I
RoHS Compliant	Yes
Wear/Mating Cycles	500 minimum
Recommended Coupling Nut Torque	7 to 10 in-lb
Unit Weight	0.53kg/pc / 1.17lb

Material Specifications		
Component	**Material**	**Plating**
Body	Brass	White Bronze
Inner Conductor Male	Brass	Silver
Inner Conductor Female	Phosphor Bronze	Silver
Coupling Nut	Brass	White Bronze
Insulator	PTFE	--
O-Ring	Silicone Rubber	--





TIMES MICROWAVE SYSTEMS

ISO 9001 Certified

Times Protect®

LP-GPX-05-N Series
L1, L2 & L3 GPS Protector

- Bidirectional Filter Based Design
  - Outstanding IL/RL Characteristics
  - DC Blocked RF path for Superior Performance
- Solid State DC Path Protection Circuit
- Fully Weatherized Housing

Lightning and Surge Protection for The 21st Century™

The LP-GPX-05-N high performance series is an exceptional DC pass design for protection of GPS receivers requiring up to 5Vdc power to be supplied on the center pin.

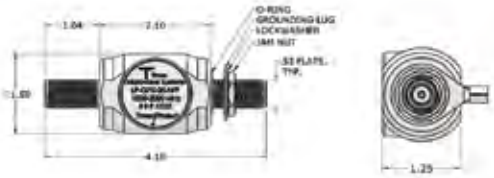
While the RF path is DC blocked, the biased DC voltage protection circuit uses Solid State protection technology to provide unsurpassed surge performance. The LP-GPX-05-N series offers outstanding Insertion Loss and Return Loss characteristics over the 1000-2000MHz band, making it suitable for protection of commercial and military GPS, as well as other applications in this band.

Unlike competitive protectors, the white bronze plated construction of the LP-GPX-05-N series eliminates potential galvanic corrosion issues and provides long life in hostile environments. The fully weatherized housing is sealed to IP65 allowing for outdoor as well as indoor installation.

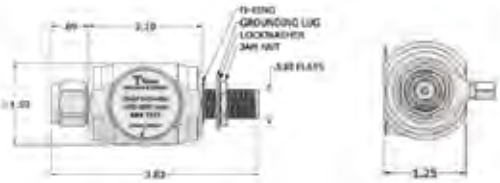
LP-GPX-05-N Series:

- LP-GPX-05-NFF
  N Female connectors on surge and protected sides - bidirectional
- LP-GPX-05-NFM
  N Male connector on one side & N Female connector on the other side - bidirectional

Times-Protect®



- LP-GPX-05-NFF
  1000 - 2000MHz N Type F/F



- LP-GPX-05-NFM
  1000 - 2000MHz N Type F/M

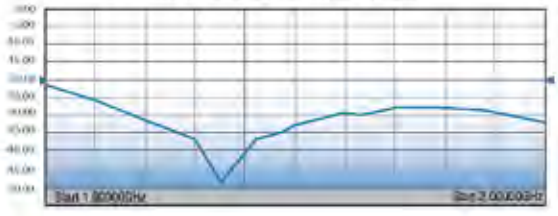
*All dimensions shown in inches

Electrical Specifications	
Impedance	50 Ω
Frequency Range	1000 - 2000 MHz
VSWR/ Return Loss	1.2:1 / <-20dB
Insertion Loss	< 0.1dB
Average Power	50W
Maximum Surge Current	10kA multiple (1.2x50/8x20µs wave-form)
Turn on-Voltage	6Vdc
Residual Pulse Voltage	< 12V (6kV/3kA 1.2x50/8x20µs wave-form)
Energy Throughput	< 110µJ
Protection Circuit	DC Blocked RF Path/Solid State DC Pass

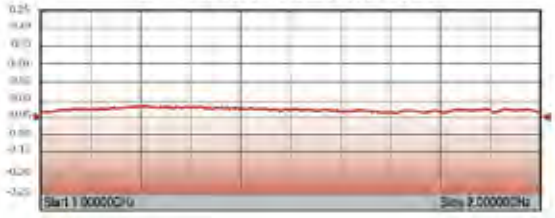
Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C
Weatherization	IEC 60529 IP65
Thermal Shock	US MIL-STD 202, Meth.107,Cond.B
Vibration	US MIL-STD 202, Meth.204,Cond.B
Shock	US MIL-STD 202, Meth.213,Cond.I
RoHS Compliant	Yes
Mating Life Cycle	> 500
Recommended Coupling Nut Torque	7 - 10 in-lb

Material Specifications		
Component	Material	Plating
Body	Aluminum	White Bronze
Connector Housing	Brass	White Bronze
Inner Conductor Male	Brass	Silver
Inner Conductor Female	Phosphor Bronze	Silver
Coupling Nut	Brass	White Bronze
Insulator	PTFE	--
O-Ring	Silicone Rubber	--

S11/S22 **TYPICAL RETURN LOSS**



S21 **TYPICAL INSERTION LOSS**



TIMES MICROWAVE SYSTEMS

ISO 9001 Certified

Times Protect®

LP-GPX-05-S Series
L1, L2 & L3 GPS Protector

- Bidirectional Filter Based Design
  - Outstanding IL/RL Characteristics
  - DC Blocked RF path for Superior Performance
- Solid State DC Path Protection Circuit
- Fully Weatherized Housing

Lightning and Surge Protection for The 21st Century™

The LP-GPX-05-S high performance series is an exceptional DC pass design for protection of GPS receivers requiring up to 5Vdc power to be supplied on the center pin.

While the RF path is DC blocked, the biased DC voltage protection circuit uses Solid State protection technology to provide unsurpassed surge performance. The LP-GPX-05-S series offers outstanding Insertion Loss and Return Loss characteristics over the 1000-2000MHz band, making it suitable for protection of commercial and military GPS, as well as other applications in this band.

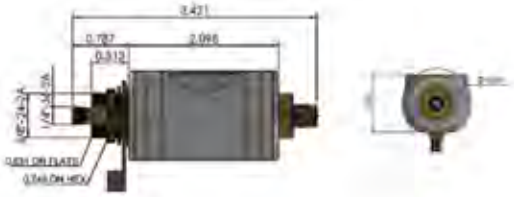
Unlike competitive protectors, the white bronze plated construction of the LP-GPX-05-S series eliminates potential galvanic corrosion issues and provides long life in hostile environments. The fully weatherized housing is sealed to IP65 allowing for outdoor as well as indoor installation.

LP-GPX-05-S Series:

- LP-GPX-05-SFF
  SMA Female connectors on surge and protected sides - bidirectional
- LP-GPX-05-SFM
  SMA Male connector on one side & SMA Female connector on the other side - bidirectional

Times-Protect®

- LP-GPX-05-SFF
  1000 - 2000MHz SMA Type F/F



- LP-GPX-05-SFM
  1000 - 2000MHz SMA Type F/M

*All dimensions shown in inches

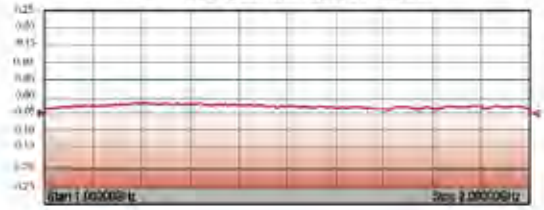
Electrical Specifications	
Impedance	50 Ω
Frequency Range	1000 - 2000 MHz
VSWR/ Return Loss	1.2:1 / <-20dB
Insertion Loss	< 0.1dB
Average Power	50W
Maximum Surge Current	10kA multiple (1.2x50/8x20µs wave-form)
Turn on-Voltage	6Vdc
Residual Pulse Voltage	< 12V (6kV/3kA 1.2x50/8x20µs wave-form)
Energy Throughput	< 110µJ
Protection Circuit	DC Blocked RF Path/Solid State DC Pass

Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C
Weatherization	IEC 60529 IP65
Thermal Shock	US MIL-STD 202, Meth.107,Cond.B
Vibration	US MIL-STD 202, Meth.204,Cond.B
Shock	US MIL-STD 202, Meth.213,Cond.I
RoHS Compliant	Yes
Mating Life Cycle	> 500
Recommended Coupling Nut Torque	3 - 5 in-lb

Material Specifications		
Component	Material	Plating
Body	Aluminum	White Bronze
Connector Housing	Brass	White Bronze
Inner Conductor Male	Brass	Silver
Inner Conductor Female	Phosphor Bronze	Silver
Coupling Nut	Brass	White Bronze
Insulator	PTFE	--
O-Ring	Silicone Rubber	--

S11/S22 **TYPICAL RETURN LOSS**

S21 **TYPICAL INSERTION LOSS**



TIMES MICROWAVE SYSTEMS

ISO 9001 Certified

Times Protect®

LP-GPX-05-T Series
L1, L2 & L3 GPS Protector

- Bidirectional Filter Based Design
  - Outstanding IL/RL Characteristics
  - DC Blocked RF path for Superior Performance
- Solid State DC Path Protection Circuit
- Fully Weatherized Housing

Lightning and Surge Protection for The 21st Century™

The LP-GPX-05-T high performance series is an exceptional DC pass design for protection of GPS receivers requiring up to 5Vdc power to be supplied on the center pin.

While the RF path is DC blocked, the biased DC voltage protection circuit uses Solid State protection technology to provide unsurpassed surge performance. The LP-GPX-05-T series offers outstanding Insertion Loss and Return Loss characteristics over the 1000-2000MHz band, making it suitable for protection of commercial and military GPS, as well as other applications in this band.

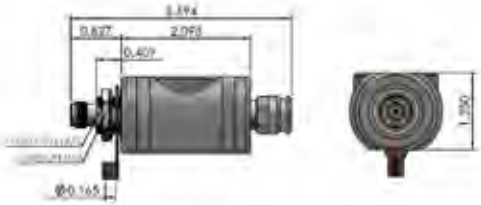
Unlike competitive protectors, the white bronze plated construction of the LP-GPX-05-T series eliminates potential galvanic corrosion issues and provides long life in hostile environments. The fully weatherized housing is sealed to IP65 allowing for outdoor as well as indoor installation.

LP-GPX-05-T Series:

- LP-GPX-05-TFF
  TNC Female connectors on surge and protected sides - bidirectional
- LP-GPX-05-TFM
  TNC Male connector on one side & TNC Female connector on the other side - bidirectional

Times-Protect®

- LP-GPX-05-TFF
  1000 - 2000MHz TNC Type F/F



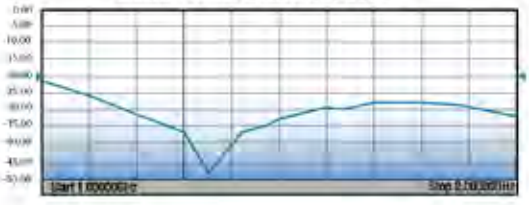
- LP-GPX-05-TFM
  1000 - 2000MHz TNC Type F/M

*All dimensions shown in inches

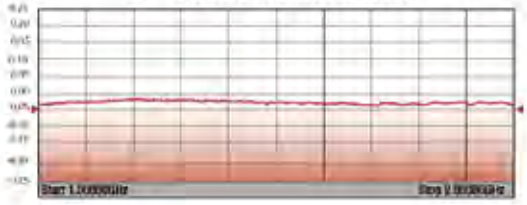
Electrical Specifications	
Impedance	50 Ω
Frequency Range	1000 - 2000 MHz
VSWR/ Return Loss	1.2:1 / <-20dB
Insertion Loss	< 0.1dB
Average Power	50W
Maximum Surge Current	10kA multiple (1.2x50/8x20µs wave-form)
Turn on-Voltage	6Vdc
Residual Pulse Voltage	< 12V (6kV/3kA 1.2x50/8x20µs wave-form)
Energy Throughput	< 110µJ
Protection Circuit	DC Blocked RF Path/Solid State DC Pass
Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C
Weatherization	IEC 60529 IP65
Thermal Shock	US MIL-STD 202, Meth.107,Cond.B
Vibration	US MIL-STD 202, Meth.204,Cond.B
Shock	US MIL-STD 202, Meth.213,Cond.I
RoHS Compliant	Yes
Mating Life Cycle	> 500
Recommended Coupling Nut Torque	4 - 6 in-lb

Material Specifications		
Component	Material	Plating
Body	Aluminum	White Bronze
Connector Housing	Brass	White Bronze
Inner Conductor Male	Brass	Silver
Inner Conductor Female	Phosphor Bronze	Silver
Coupling Nut	Brass	White Bronze
Insulator	PTFE	--
O-Ring	Silicone Rubber	--

S11/S22 **TYPICAL RETURN LOSS**



S21 **TYPICAL INSERTION LOSS**



TIMES MICROWAVE SYSTEMS

ISO 9001 Certified

Times Protect®

LP-GTV-N Series

- *DC Pass Multi-Strike Design*
- *Broadband Bidirectional Design*
- *Excellent IL/RL Performance Over the Entire Operating Frequency Band*
- *Fully Weatherized Housing*
- *White Bronze Plated for Durability and Long Life*

Lightning and Surge Protection for The 21st Century™

The **Times-Protect®** LP-GTV-N series is an exceptional broadband DC pass design for lightning protection applications requiring DC power to be supplied to the electronics. These devices exhibit outstanding RF performance with high surge current handling characteristics and cover a broad range of applications requiring up to 150W of RF power handling. Its fully weatherized housing meeting IP67 standard allows for outdoor as well as indoor installation. The N connector designs cover the entire frequency spectrum from DC through 7000MHz.

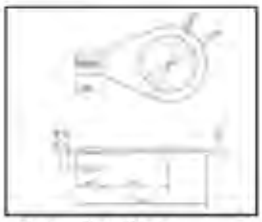
LP-GTV-N Series:

- LP-GTV-NFF (150W)
  N Female connectors on both sides - bidirectional
- LP-GTV-NFM (150W)
  N Male connector on one side & N Female connector on the other side - bidirectional

Times-Protect®

• LP-GTV-NFF
DC Pass N Type F/F

• LP-GTV-NFM
DC Pass N Type F/M



• Grounding Ring

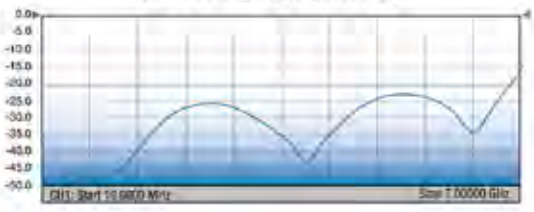
*All Dimensions shown in inches

Electrical Specifications	
Impedance	50 Ω
Frequency Range	DC-7000 MHz
VSWR/Return Loss	< 1.2:1 / <-20dB (DC-6700MHz) < 1.3:1 / <-17dB (6700-7000MHz)
Insertion Loss	< 0.2dB (DC-6700MHz) < 0.3dB (6700-7000Mhz)
Maximum Surge Current	10kA multiple (8x20µs wave-form
Impulse Sparkover	700V (1kV/µs)
Turn on	180Vdc
Average Power	150 Watts
Protection Circuit	DC Pass

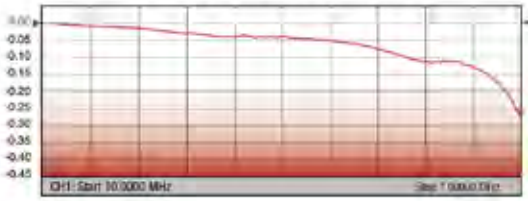
Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C
Weatherization	IEC 60068 40/085/21 & IP67
Thermal Shock	US MIL-STD 202, Meth.107,Cor
Vibration	US MIL-STD 202, Meth.204,Cor
Shock	US MIL-STD 202, Meth.213,Cor
RoHS Compliant	Yes
Wear/Mating Cycles	500 minimum
Recommended Coupling Nut Torque	7 to 10 lb-in
Unit Weight	1.41 oz / 40 grams

Material Specifications		
Component	Material	Plating
Body	Aluminum	White Bronze
Inner Conductor Male	Brass	Silver
Inner Conductor	Phosphor Bronze	Silver
Washer	Brass	White Bronze
Coupling Nut	Brass	White Bronze
Insulator	PTFE	--
O-Ring	Silicone Rubber	--

S11 **TYPICAL RETURN LOSS**



S21 **TYPICAL INSERTION LOSS**



TIMES MICROWAVE SYSTEMS

Times Protect®

LP-18-400-N Connector Protector

- *Eliminates the Need for Separate Cable Connector*
- *Attaches Directly to LMR®-400 Cable*
- *Uses EZ-400-X (No Braid Trim) Connector Interface*
- *DC Pass Multi-Strike Broadband Bidirectional Design*
- *Fully Weatherized Housing*
- *Solid Brass Construction*
- *White Bronze Plated for Durability and Long Life*

ISO 9001 Certified

Cable Connector and Lightning Protector in One!

The Times Protect® LP-18-400-N series is an exceptional in-line broadband DC pass surge protection design incorporating lightning protection circuitry and the EZ-400-X series crimp style connector interface unit. This combination allowing the in-line surge protector to be attached directly to the LMR®-400 cable eliminates the cable connector needed when using conventional lightning protectors. The LP-18-400-N series protectors exhibit outstanding RF performance over the entire frequency spectrum from DC through 6000MHz and the elimination of the extra connector further reduces return loss, insertion loss and lowers cost. In addition, its fully weatherized housing meets the IP-67 standard for outdoor as well as indoor installation.

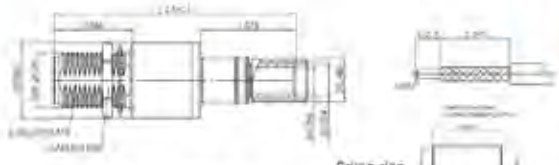
LP-18-400-N Series:

- LP-18-400-NF-X (150W)
  N Female connector on one side and EZ-400-X crimp style interface on the other side - bidirectional

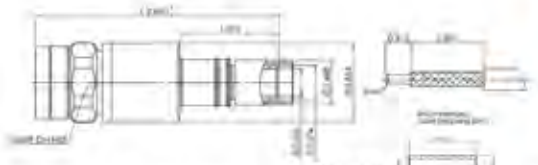
- LP-18-400-NMH-X (150W)
  N Male connector on one side and EZ-400-X crimp style interface on the other side - bidirectional

The LP-18-400-N series protectors install easily onto LMR®-400 cable using the standard CST-400 prep tool and either the CT-400/300 crimp tool or the HX-4 crimp handle with the Y1719 (0.429") hex dies.

Times-Protect®



• LP-18-400-NF-X
DC Pass N Type Female



• LP-18-400-NMH-X
DC Pass N Type Male

*All Dimensions shown in inches

Installation Tools:

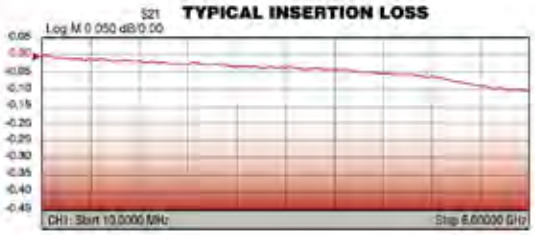
CST-400 Prep Tool
CT-400/300 Crimp Tool or HX-4 Crimp Tool with Y1719 (0.429") hex dies

CST-400

Electrical Specifications	
Impedance	50 Ω
Frequency Range	DC-6000 MHz
VSWR/Return Loss	< 1.15:1 / <23dB (DC-6000MHz)
Insertion Loss	<0.15dB (DC-6000MHz)
Maximum Surge Current	10kA multiple (8x20µs wave-form)
Impulse Sparkover	700V (1kV/µs)
Turn on	180Vdc
Average Power	150 Watts
Protection Circuit	DC Pass

Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C
Weatherization	IEC 60068 40/085/21 & IP67
Thermal Shock	US MIL-STD 202, Meth.107,Cond.B
Vibration	US MIL-STD 202, Meth.204,Cond.B
Shock	US MIL-STD 202, Meth.213,Cond.I
RoHS Compliant	Yes
Wear/Mating Cycles	500 minimum
Recommended Coupling Nut Torque	7 to 10 lb-in
Unit Weight	3.4 oz / 95 grams

Material Specifications		
Component	Material	Plating
Body	Brass	White Bronze
Inner Conductor Male	Brass	Silver
Inner Conductor Female	Phosphor Bronze	Silver
Washer	Brass	White Bronze
Coupling Nut	Brass	White Bronze
Insulator	PTFE	--
O-Ring	Silicone Rubber	--



Note: IL and RL data without LMR®-400 cable

TIMES MICROWAVE SYSTEMS

ISO 9001 Certified

Times Protect®

LP-WBX Series

- Filter based Protection Circuit
  - Broadband Outstanding IL/RL
  - DC Blocked for Superior Surge Performance
  - Ultra Broadband Multi-Strike Design
- Fully Weatherized Housing

Lightning and Surge Protection for The 21st Century™

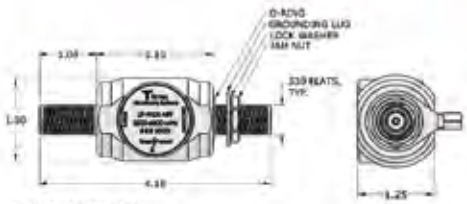
The LP-WBX-N high performance series uses a filter circuit to provide exceptional lightning protection over the 2000-6000MHz frequency band, covering both the unlicensed WiFi bands and several licensed operating bands.

Unlike competitive protectors, the white bronze plated construction of the LP-WBX-N series eliminates potential galvanic corrosion issues and provides long life in hostile environments. The fully weatherized housing is sealed to IP65 allowing for outdoor as well as indoor installation.

LP-WBX-N Series:

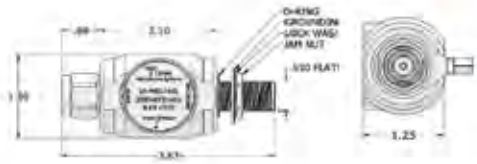
- LP-WBX-NFF
  N Female connectors on surge and protected sides
- LP-WBX-NMP
  N Male connector on protected side with N Female connector on surge side
- LP-WBX-NMS
  N Male connector on surge side with N Female connector on protected side

Times-Protect®



• LP-WBX-NFF
2000 - 6000MHz N Type F/F

• LP-WBX-NMP
2000 - 6000MHz N Type M on Protected



• LP-WBX-NMS
2000 - 6000MHz N Type M on Surge

*All dimensions shown in inches

Electrical Specifications	
Impedance	50 Ω
Frequency Range	2000 - 6000 MHz
VSWR/Return Loss	<1.2:1 / <-20dB
Insertion Loss	< 0.2dB
Average Power	50W
Maximum Surge Current	20kA max / 10kA multiple (8x20µs wave-form)
Residual Pulse Voltage	< 3V (6kV/3kA 1.2x50/8x20µs wave-form)
Energy Throughput	<150nJ
Protection Circuit	DC Blocked
Mechanical / Environmental Specifications	
Temp Range Storage/Operating	-40°C - +85°C
Weatherization	IEC 60529 & IP65
Thermal Shock	US MIL-STD 202, Meth.107,Cond.B
Vibration	US MIL-STD 202, Meth.204,Cond.B
Shock	US MIL-STD 202, Meth.213,Cond.I
RoHS Compliant	Yes
Mating Life Cycle	> 500
Recommended Coupling Nut Torque	7-10 in-lb

Material Specifications

Component	Material	Plating
Body	Aluminum	White Bronze
Connector Housing	Brass	White Bronze
Inner Conductor Male	Brass	Silver
Inner Conductor Female	Phosphor Bronze	Silver
Coupling Nut	Brass	White Bronze
Insulator	PTFE	--
O-Ring	Silicone Rubber	--

TIMES MICROWAVE SYSTEMS

Times Protect

Smart Panel®

ISO 9001 Certified

Superior Surge Protection Performance:

- Bulkhead-Mounted RF Protectors
- True Single Point Ground by Design
- Low Inductance Ground Plate For Control of Ground Potential Rise

Designed for Easy Installation:

- Eliminates External Coaxial Grounding Kits
- Eliminates Internal Lightning Protector Trapeze
- Can Accommodate EWG-Data-DC-Fiber Entry Ports
- Works With 4 - 8 Inch Wall Thickness
- Most Prep Work Can Be Performed Off Site
- Minimal On-Site Labor Costs

No Outside Exposed Copper - Addresses Theft Issues

Intelligently designed to effectively conduct lightning current to ground while balancing the need for security and economy

TIMES MICROWAVE SYSTEMS
An Amphenol Company

Lightning and Surge Protection for The 21st Century™

Times Microwave Systems introduces a revolutionary concept in shelter and base station entrance panels. Designed to eliminate traditional entrance panel shortcomings and improve surge protection of expensive base station equipment, the Times-Protect® Smart-Panel® offers major advantages compared to traditional installation methods.

The Times-Protect® Smart-Panel® provides for single point grounding and eliminates costly and time consuming cable ground kits. The external copper master ground bar is also eliminated so there are no copper parts to steal outside the shelter. Inside the shelter the installation is simplified and cost reduced by the elimination of the lightning protector trapeze. Bulkhead mounted lighting protectors eliminate added trapeze ground lead inductance, creating a perfect return path for surge currents during a lightning event.

The completely weatherized Times-Protect® Smart-Panel® adjusts to the shelter wall thickness and is supplied with all the necessary installation hardware as well as a heavy duty copper internal master ground bar and a low inductance ground plate.

Constructed of powder-coated heavy duty aluminum the Smart-Panel® is available in both 12 and 24 port designs and either type N or 716 DIN bulkhead mount configurations. A copper version is also available. All designs can also accommodate EWG, Cat 5 data, DC or Fiber entry ports.

Times-Protect® Smart-Panel® Series:

Part Number	Configuration
LP-SP-12N	12 port N hole
LP-SP-12D	12 port 716 DIN hole
LP-SP-24N	24 port N hole
LP-SP-24D	24 port 716 DIN hole

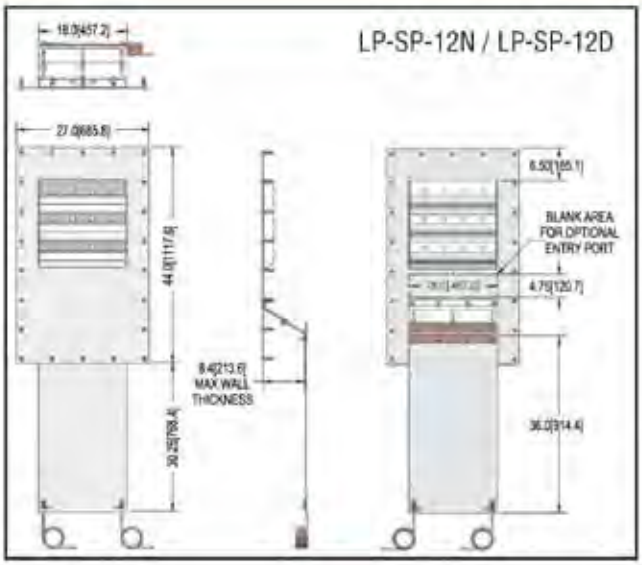
Smart-Panel®

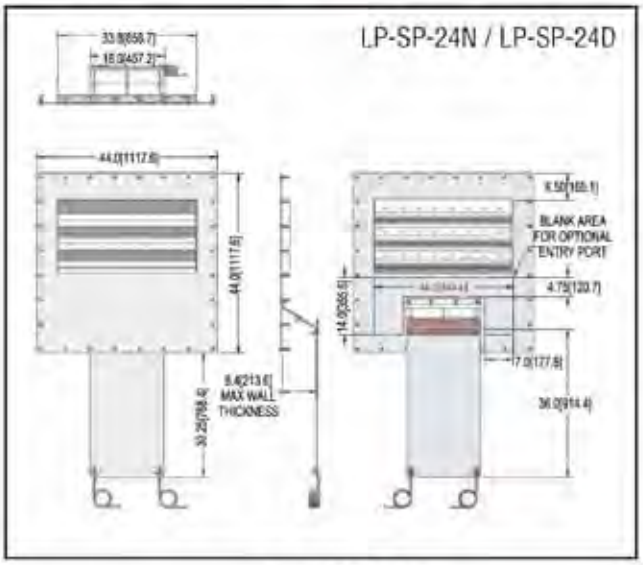
Included Installation Hardware

- 3/8" x 2" tamper Resistant Galv Lag Screw
- 3/8" Short Galv Lag Shield
- 3/8" x 1-3/4" Tamper Resistant Bolt
- 3/8" SS Flat Washer
- 3/8" Lock Washer
- 3/8" SS Hex Nut
- Ground Lug 2/0 AWG
- Tamper Resistant Wrench
- Hole Cutout Template

Available Accessories

- Lightning Protectors
  Based on Network Requirements
- Feed Through Connectors:
  LP-FT-DFDF (DIN Feed-Through)
  LP-FT-NFNF (N Feed-Through)
- Blank Hole Plugs:
  LP-DP (DIN Hole Plug)
  LP-NP (N Hole Plug)





Specifications

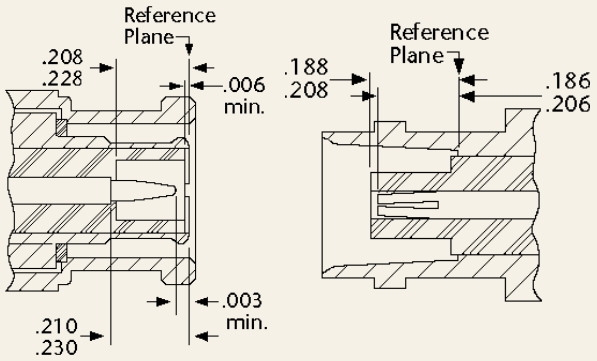
Material:	6061-T6	
Master Ground Bar	C110 Copper	
Finish	Powder Coat	
Weight (lbs):	50 (12 Port)	58 (24 Port)

TIMES MICROWAVE SYSTEMS

Connector Interface Guide

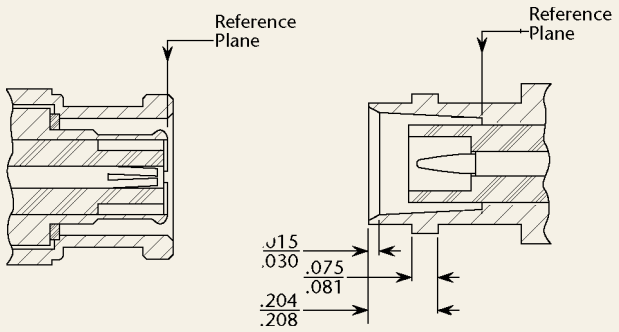
BNC Connectors

Plug (male) **Jack** (female)



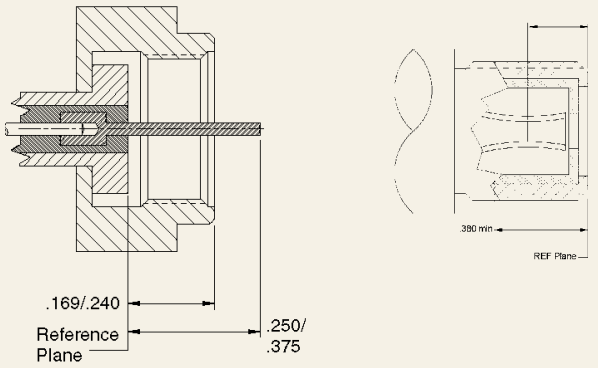
BNC-RP (Reverse Polarity) Connectors

Plug (male) **Jack** (female)



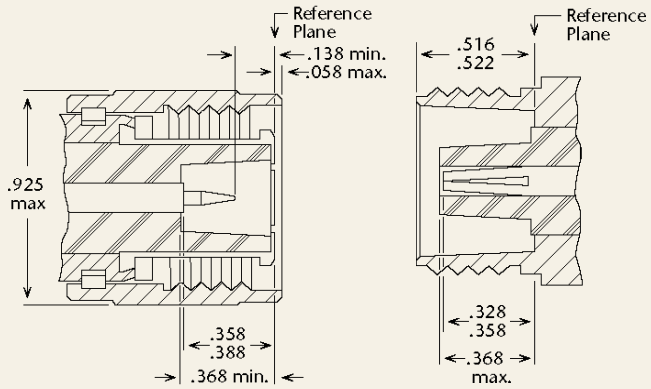
F Connectors

Plug (male) **Jack** (female)



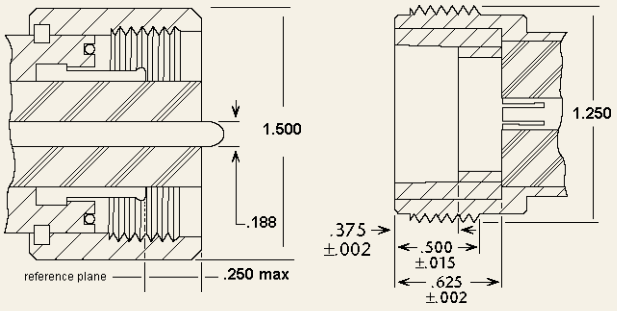
HN Connectors

Plug (male) **Jack** (female)



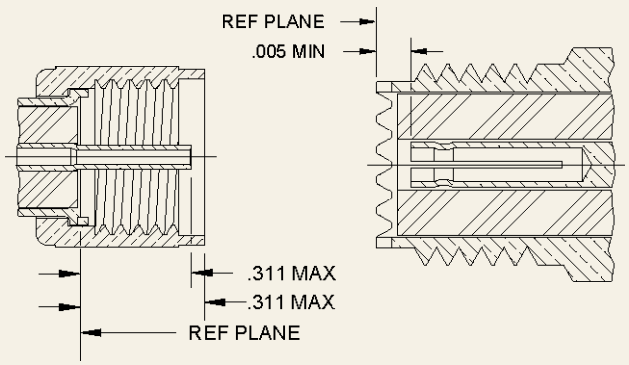
LC Connectors

Plug (male) **Jack** (female)



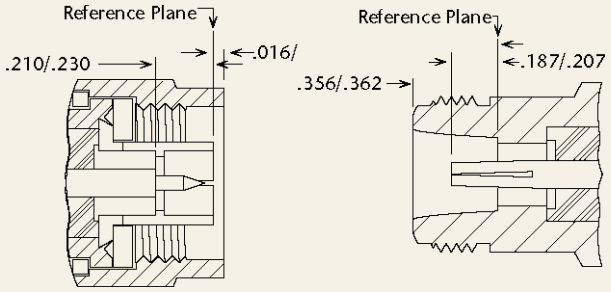
MUHF Connectors

Plug (male) **Jack** (female)



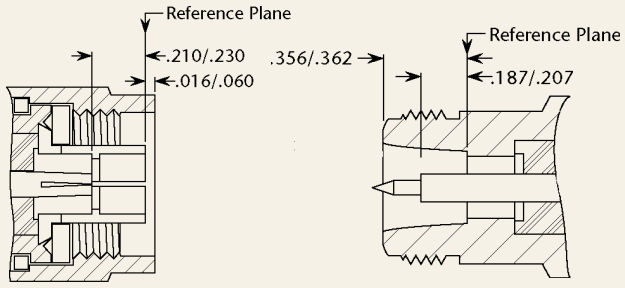
N Connectors

Plug (male) **Jack** (female)



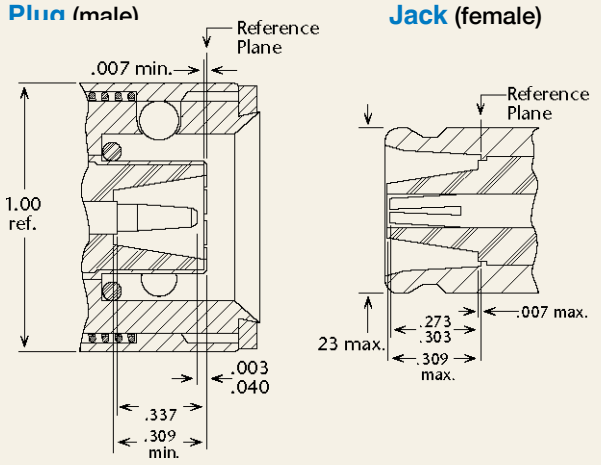
N-RP (Reverse Polarity) Connectors

Plug (male) **Jack** (female)



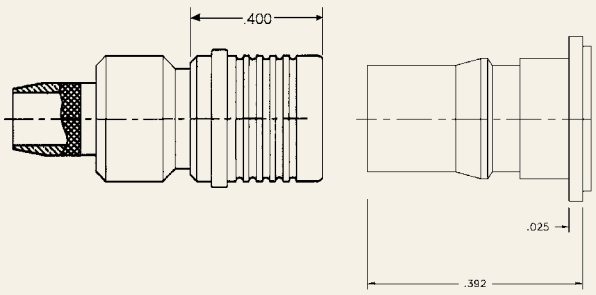
QDS Connectors

Plug (male) **Jack** (female)



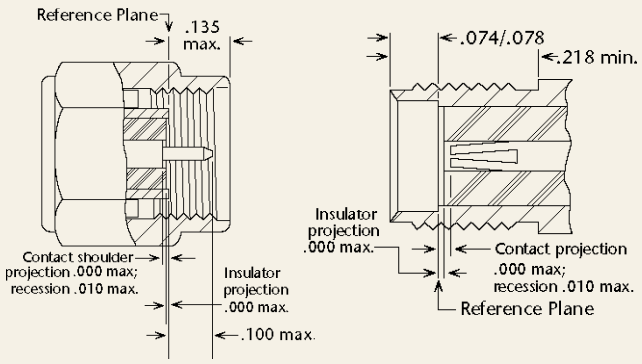
QMA Connectors

Plug (male) **Jack** (female)



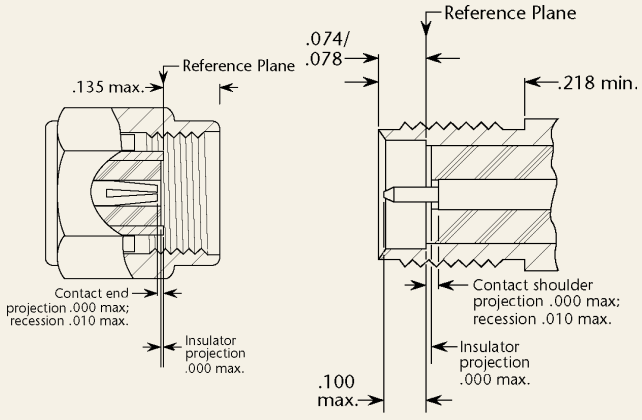
SMA Connectors

Plug (male) **Jack** (female)



SMA-RP (Reverse Polarity) Connectors

Plug (male) **Jack** (female)

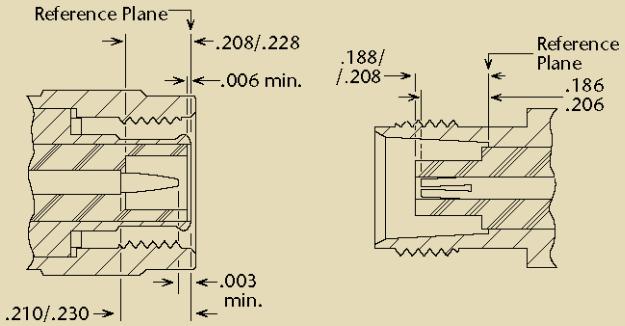


TIMES MICROWAVE SYSTEMS

Connector Interface Guide

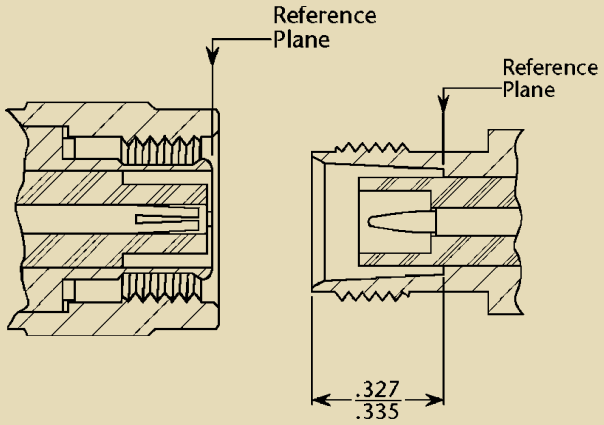
TNC Connectors

Plug (male) **Jack** (female)



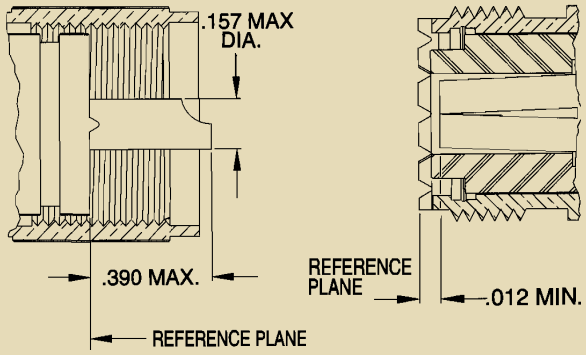
TNC-RP (Reverse Polarity) Connectors

Plug (male) **Jack** (female)

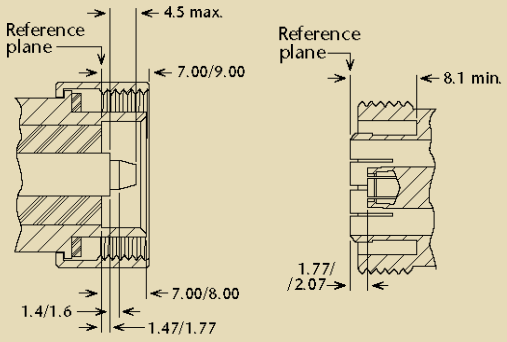


UHF Connectors

Plug (male) **Jack** (female)

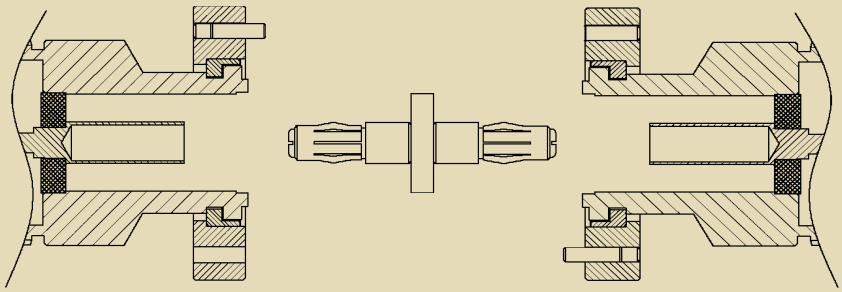


7/16 DIN Connectors



7/8 EIA Connectors

Jack (female) **Male - Male Bullet** **Jack** (female)



Materials Abbreviations Legend

CONDUCTORS & BRAID MATERIALS

AL .....Aluminum
BC .....Bare Copper
BeCu .....Beryllium-Copper Alloy 172
BCCAI .....Bare Copper Clad Aluminum
CCS .....Bare Copper Clad Steel
GS .....Galvanized Steel
HR .....High Resistance Wire
MW .....Magnet Wire
NC .....Nickel Covered Copper
SA.....Silver Covered Alloy
SC.....Silver Covered Copper
SCBeCu.....Silver Covered Beryllium Copper
SCCadBr .....Silver Covered Cadmium Bronze
SCCAl .....Silver Covered Copper Clad Aluminum
SCCS.....Silver Covered Copper Clad Steel
SNCCS.....Silver Covered Nickel Covered Copper Clad Steel
SCS .....Silver Covered Copper Strip
TC .....Tinned Copper
TCCS.....Tinned Copper Clad Steel

DIELECTRIC MATERIALS

PE.....Solid Low Density Polyethylene
PTFE .....Solid Polytetrafluoroethylene
LDTFE .....Low Density PTFE
Foam PE .....Gas Injected Foam PE
FEP.....Solid Fluorinated Ethylene Propylene
CPT .....Conductive PTFE
CPE .....Conductive Polyethylene (Type A-5 per MIL-C-17)
Rubber.....per MIL-C-17 (obsolete)
MGO .....Magnesium Oxide (MgO)

INTERLAYER MATERIALS

PE.....Solid Polyethylene
PTFE .....Solid Polytetrafluoroethylene
MY .....Polyester
KP.....Polyimide
ALMY.....Aluminum-Polyester Laminate
ALKP .....Aluminum-Polyimide Laminate
CPC.....Copper-Polyester-Copper Laminate

JACKET MATERIALS

E-CTFE.....Ethylene Chlorotrifluoroethylene
Type XI per MIL-C-17
ETFE.....Ethylene Tetrafluoroethylene Copolymer
Type X per MIL-C-17
FEP.....Fluorinated Ethylene Propylene
Type IX per MIN-C-17
FG Braid.....Fiberglass; Impregnated
Type V per MIL-C-17
PE.....Clear Polyethylene
Type III per MIL-C-17
LS/LT .....Low Smoke/Low Toxicity
(XLPE)
PE.....Polyethylene, black HMW
Type IIIA per MIL-C-17
PFA.....Perfluoroalkoxy
Type XIII per MIL-C-17
PTFE .....Polytetrafluoroethylene
Type VIIA per MIL-C-17
PUR.....Polyurethane, black
Type XII per MIL-C-17
PVC-I .....Polyvinyl Chloride, black (contaminating)
Type 1 per MIL-C-17
PVC-II.....Polyvinyl Chloride, grey (non-contaminating)
Type II per MIL-C-17
PVC-IIA.....Polyvinyl Chloride, black (non-contaminating)
Type IIA per MIL-C-17
Rubber Per MIL-C-17 (obsolete)
SIL/DAC.....Dacron Braid over Silicone Rubber
Type VI per MIL-C-17
TPE .....Thermo Plastic Elastomer
XLPE.....Crosslinked Polyolefin
Type XIV per MIL-C-17

Coaxial Cable Equations Legend

Symbol	Definition	Units	Symbol	Definition	Units
α	= Attenuation in dB/100 feet	dB/100 feet	**Fco**	= Cutoff frequency	**GHz**
ε	= Dielectric constant		**C**	= Braid carriers	
Γ	= Reflection coefficient		**N**	= Braid ends per carrier	
ϕ	= Electrical length	degrees	**t**	= Flat strip thickness	**inches**
C	= capacitance	pF/foot	**w**	= Flat strip width	**inches**
L	= Inductance	uH/foot	**SRL**	= Return loss	**dB**
Zo	= Impedance	ohms	**VSWR**	= Voltage standing wave ratio	
Vp	= Velocity of propagation	%	**FWD**	= Forward power	**dB**
df	= Dissipation factor		**RFL**	= Reflected power	**dB**
Td	= Time delay	nS/foot	**MML**	= Mismatch loss	**dB**
F	= Frequency	MHz	**ME**	= Match efficiency	**%**
PTC	= Phase temperature coefficient	ppm/C	$\mathbf{k_s}$	= 1.0 for solid center conductor	
Δ**T**	= Change in temperature (t2 t0 t1)	C		= 0.939 for 7 strand center conductor	
LTH	= Length	feet		= 0.97 for 19 strand center conductor	
$\Delta\phi$	= Change in electrical length (t1 to t2)	degrees	**log**	= logarithm to base 10	
D	= dielectric diameter	inches	**ln**	= logarithm to base e	
d	= center conductor diameter	inches	$\mathbf{k_1}$	= resistive loss constant	
ds	= Braid wire size	inches	$\mathbf{k_2}$	= dielectric loss constant	
Fbd	= Braid factor				

TIMES MICROWAVE SYSTEMS

Coax Cable Design Equations

Impedance (ohms)

$$Z_0 = 138\ V_p \log\left(\frac{D}{d \bullet ks}\right) = 60\ V_p \ln\left(\frac{D}{d \bullet ks}\right)$$

$$Z_0 = \frac{138}{\sqrt{\varepsilon}} \log\left(\frac{D}{d \bullet k_s}\right) = \frac{60}{\sqrt{\varepsilon}} \ln\left(\frac{D}{d \bullet k_s}\right)$$

$$Z_0 = \sqrt{L/C}$$

Velocity of Propagation and Dielectric Constant

$$V_P = \frac{1}{\sqrt{\varepsilon}} = \frac{1}{V_P^2}$$

Time Delay (nS/foot)

$$Td = \frac{1.016}{V_P} = 1.016\sqrt{\varepsilon}$$

Capacitance (pF/foot)

$$C = \frac{7.36\varepsilon}{\log\left(\frac{D}{d \bullet k_s}\right)} = \frac{16.95\varepsilon}{\ln\left(\frac{D}{d \bullet k_s}\right)}$$

$$C = \frac{7.36}{V_P^2 \log\left(\frac{D}{d \bullet k_s}\right)} = \frac{16.95}{V_P^2 \text{ in } \left(\frac{D}{d \bullet k_s}\right)}$$

$$C = \frac{1016}{Z_0 \bullet V_P}$$

Inductance (uH/foot)

$$L = .140 \log\left(\frac{D}{d \bullet ks}\right) = .0606 \ln\left(\frac{D}{d \bullet ks}\right)$$

$$L = \frac{Z_o^2 \bullet C}{1 \times 10^6}$$

Attenuation (dB/foot)

$$\alpha = \frac{.4343}{Z_o \bullet D}\left[\frac{D}{d \bullet ks} + Fbd\right]\sqrt{F} + \frac{2.78 \bullet df \bullet F}{V_P}$$

$$\alpha = k_1\sqrt{F} + k_2 F$$

Braid Factor

Round Wire Braid: $Fbd = \frac{8D + 16\ ds}{C \bullet N \bullet ds}$

Flat Strip Braid: $Fbd = \frac{2\pi\ (D + 2t)}{C \bullet W}$

Solid Tube: $Fbd = 1.0$

Cutoff Frequency (GHz)

$$Fco = \frac{7.5 \bullet Vp}{(D + (d \bullet ks)}$$

$$Fco = \frac{7.5}{\sqrt{\varepsilon}\ (D + (d \bullet ks)}$$

Electrical Length (degrees)

$$\Phi = \frac{360 \bullet F \bullet L_{TH}}{984 \bullet V_p}$$

$$\Phi = \frac{360 \bullet F \bullet L_{TH} \bullet \sqrt{\varepsilon}}{984}$$

Phase Temperature Coefficient (ppm/C°)

$$PTC = \frac{\Delta\Phi \bullet 1 \times 10^6}{\Phi \bullet \Delta T}$$

Phase Stability (degrees)

$$\Delta\Phi = \frac{PTC \bullet \Phi \bullet \Delta T}{1 \times 10^6}$$

Return Loss (dB)

$$RL = -20 \log \Gamma$$

$$RL = -20 \log \frac{VSWR-1}{VSWR+1}$$

$$RL = -10 \log \frac{RFL}{FWD}$$

VSWR

$$VSWR = \frac{1 + \Gamma}{1 - \Gamma}$$

$$VSWR = \frac{1 + 10^{RL/20}}{1 - 10^{RL/20}}$$

$$VSWR = \frac{1 + \sqrt{RFL/FWD}}{1 - \sqrt{RFL/FWD}}$$

Reflection Coefficient

$$\Gamma = 10^{-RL/20}$$

$$\Gamma = \frac{VSWR - 1}{VSWR + 1}$$

$$\Gamma = \sqrt{RFL/FWD}$$

Match Efficiency (%)

$$ME = (1 - \Gamma^2) \bullet 100$$

$$ME = \left[1 - \left(\frac{VSWR - 1}{VSWR + 1}\right)^2\right] \bullet 100$$

$$ME = \left(\frac{FWD-REL}{FWD}\right) \bullet 100$$

Match Efficiency (%)

$$MML = -10 \log (1 - \Gamma^2)$$

$$MML = -10 \log \left[1 - \left(\frac{VSWR-1}{VSWR+1}\right)^2\right]$$

$$MML = -10 \log \left(1 - \frac{RFL}{FWD}\right)$$

General Electrical Properties

	Cable Type	Impedance (ohms)	Capacitane (p/F/foot)	Velocity (%)	Dielecrtic Constant	Time Delay (nS/foot)
50 OHM	Solid Polyethylene	50	30.8	65.9	2.30	1.54
	Foam PE	50	24.5	83.0	1.45	1.22
	Foam PE	50	24.2	84.0	1.42	1.21
	Foam PE	50	23.9	85.0	1.38	1.20
	Foam PE	50	23.6	86.0	1.35	1.18
	Foam PE	50	23.3	87.0	1.32	1.17
	Foam PE	50	23.1	88.0	1.29	1.16
	Solid PTFE	50	29.2	69.5	2.07	1.46
	Tape PTFE	50	28.6	71.0	1.98	1.43
	Low Density PTFE	50	26.7	76.0	1.73	1.34
	Low Density PTFE	50	25.4	80.0	1.56	1.27
75 OHM	Solid Polyethylene	75	20.6	65.9	2.30	1.54
	Foam PE	75	16.3	83.0	1.45	1.22
	Foam PE	75	16.1	84.0	1.42	1.21
	Foam PE	75	15.9	85.0	1.38	1.20
	Foam PE	75	15.8	86.0	1.35	1.18
	Foam PE	75	15.6	87.0	1.32	1.17
	Foam PE	75	15.4	88.0	1.29	1.16
	Solid PTFE	75	19.5	69.5	2.07	1.46
	Low Density PTFE	75	17.8	76.0	1.73	1.34
	Low Density PTFE	75	16.9	80.0	1.56	1.27
MISC	Solid Polyethylene	95	16.2	65.9	2.30	1.54
	Foam PE	95	12.6	85.0	1.38	1.20
	Air Spaced PE	95	12.6	85.0	1.38	1.20
	Solid PTFE	95	15.4	69.5	2.07	1.46
	Air Spaced PE	125	09.6	85.0	1.38	1.20
	Air Spaced PE	185	06.5	85.0	1.38	1.20

Properties of Wire and Cable Insulating Materials

Material	Dielectric Constant	Dissipation Factor	Volume-Resistivity (ohm-cm)	Operating Temperature (Range ^{o}C)
PTFE	2.07	0.0003	10^{19th}	-75 to +250
Polyethylene	2.3	0.0003	10^{16th}	-65 to +80
Foam Polyethylene	1.29 - 1.64	0.0001	10^{12th}	-65 to +100
Polyvinylchloride	3.0 - 8.0	0.07 - 0.16	2×10^{12th}	-50 to +105
Polyamide	3.5 - 4.6	0.03 - 0.4	4×10^{14th}	-60 to +120
Silicone Rubber	2.1 - 3.5	0.007 - 0.016	10^{13th}	-70 to +250
Ethylene Propylene	2.24	0.00046	10^{17th}	-40 to +105
FEP	2.1	0.0007	10^{18th}	-70 to +200
Low Density PTFE	1.38 - 1.73	0.00005	10^{19th}	-75 to +250
Foam FEP	1.45	0.0007	10^{18th}	-75 to +200
Polyimide	3.0 - 3.5	0.002 - 0.003	10^{13th}	-75 to +300
PFA	2.1	0.001	10^{16th}	-75 to +260
ETFE	2.6	0.005	10^{16th}	-75 to +150
ECTFE	2.5	0.0015	10^{16th}	-65 to +150
PVDF	7.8	0.02	10^{14th}	-75 to +125

TIMES MICROWAVE SYSTEMS

A guide to the selection of RF coaxial cable

Choosing the best coaxial cable for a new application requires an understanding of the application and of the range of cables to choose from. The best choice can only be arrived at by a careful evaluation of the performance and cost trade-offs. Our in-depth expertise in all aspects of coaxial cable technology can help you to arrive at the best choice for your application.

Times Microwave Systems offers the broadest range of coaxial cables of any manufacturer. We also have the expertise to design and produce custom cables if there is no design available for your application.

In choosing the best coaxial cable for an application, the cable characteristics listed below should be considered. The following sections provide detailed discussions of each characteristic.

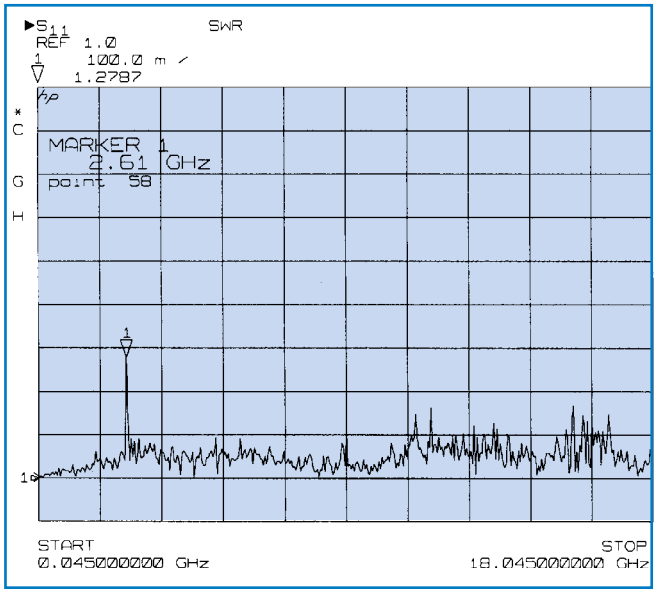
A: Characteristic Impedance
B: VSWR & Impedance Uniformity
C: Attenuation
· Attenuation Uniformity
· Attenuation Stability
D: Power Rating
E: Operating Voltage
F: Shielding
G: Capacitance
H: Velocity of Propagation
I: Electrical Length Stability
J: Cut-Off Frequency
K: Pulse Response
L: Self-Generated Cable Noise
M: Operating Temperature Range
N: Flexibility
O: Environmental Resistance
P: Cable Strength
Q: Qualification & U L Approval

Table 1 provides various formulae describing cable characteristics.

A. CHARACTERISTIC IMPEDANCE

The characteristic impedance of a coaxial cable is determined by the ratio of the diameter of the outer conductor to the inner conductor and the dielectric constant of the insulating material between the conductors. Because the RF energy in the cable travels on the surface of the conductors, the important diameters are the outside diameter of the center conductor and the inside diameter of the outer conductor. Impedance is selected to match the system requirements.

Fig. 1
VSWR vs. Frequency



The most common coaxial cables impedances are 50, 75, and 95 ohm. Other impedances from 35 to 185 ohms are sometimes used. Fifty ohm cables are used in microwave and wireless communications applications. Seventy-five ohm cables are typically used in cable television applications and video applications. Ninety-five ohm cables are typically used for data transmission applications.

For best system performance, the cable must be selected to match the impedance of the other components in the system. Of the most commonly used coaxial cables, 75 ohms impedance provides the lowest attenuation and 35 ohms impedance provides the best power handling. For practical cables with non-ideal dielectrics and conductors, these differences are small. The availability of required

components and cables with the appropriate characteristic impedance is usually the prime factor in selecting a given system impedance.

B. SIGNAL REFLECTION: VSWR, RETURN LOSS, REFLECTION FACTOR & IMPEDANCE UNIFORMITY

There are three things that happen to RF energy input into a coaxial cable assembly:

1. It is transmitted to the other end of the cable, as is usually desired.
2. It is lost along the length of the cable either by being transformed into heat or by leaking out of the cable.
3. It is reflected back towards the input end of the cable.

Reflections back towards the input end of the cable are caused by variations in impedance along the length of the cable assembly. This includes differences in impedance between the cable and the devices to which it is attached. Typically the connectors and the interface between the connectors and the cable will be major contributors to the reflection. The cable itself can also contribute to the reflections. One source of cable reflections is periodic variations in impedance which result from the manufacturing process and add up at a specific frequency. When viewed in a sweep over a range of frequencies this will show up as a spike. An example of a spike is shown in Figure 1.

The magnitude of a reflection can be expressed in several ways. Perhaps the most familiar is VSWR or Voltage Standing Wave Ratio. A value of 1.0:1 or just 1.0 indicates no reflected power or a perfect cable. Alternatively, the reflection can be expressed as return loss—the ratio of the reflected power to the input power usually expressed in decibels. Table 1 gives the formulas to convert between VSWR, return loss and reflection coefficient. A tabulation of the equivalent values of all three measures is also provided in Table 2.

The lack of reflected power (or low VSWR) is often used as a figure of merit for coaxial components, including cables, connectors and cable assemblies. It is indicative of how well the uniformity of the cable is

Table 2
VSWR Conversions

VSWR (:1)	Return Loss (dB)	Reflection Coefficient	Mismatch Loss (dB)	Match Efficiency (%)
1.011	45	0.006	0.000	100.00
1.020	40	0.010	0.000	99.99
1.036	35	0.018	0.001	99.97
1.065	30	0.032	0.004	99.90
1.074	29	0.035	0.005	99.87
1.08	28	0.400	0.007	99.84
1.09	27	0.045	0.009	99.80
1.11	26	0.050	0.011	99.75
1.12	25	0.056	0.014	99.68
1.13	24	0.063	0.017	99.60
1.15	23	0.071	0.022	99.50
1.17	22	0.079	0.027	99.37
1.20	21	0.089	0.035	99.21
1.22	20	0.100	0.044	99.00
1.25	19	0.112	0.055	98.74
1.29	18	0.126	0.069	98.42
1.33	17	0.141	0.088	98.00
1.38	16	0.158	0.110	97.49
1.43	15	0.178	0.140	96.84
1.50	14	0.200	0.176	96.02
1.58	13	0.224	0.223	94.99
1.67	12	0.251	0.283	93.69
1.78	11	0.282	0.359	92.06
1.92	10	0.316	0.458	90.00
2.10	9	0.355	0.584	87.41
2.32	8	0.398	0.749	84.15
2.61	7	0.447	0.967	80.05
3.01	6	0.501	1.256	74.88
3.57	5	0.562	1.651	68.38
4.42	4	0.631	2.205	60.19
5.85	3	0.708	3.021	49.88

Match efficiency - e.g. 100 Watts Forward Power at 1.33:1 VSWR yields 98 Watts Output (i.e. 2 Watts Reflected)

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maintained along its length, whether the connectors are properly designed and attached and how well the transitions between line sizes are compensated for in the connectors. It is generally a function of frequency, with reflections generally getting higher as the frequency increases.

In many applications, low reflected power is critical for proper system performance. In these cases, it is essential that this be considered in the selection of the cable and connectors. In addition, care must be taken to properly attach the connectors to the cable in order to achieve the proper results. Purchase of completed, factory assembled and tested cable assemblies should be considered for VSWR critical applications.

Note that actual input impedance at a particular frequency may be quite different from the characteristic impedance of the cable due to reflections in the line. The Voltage Standing Wave Ratio (or VSWR) of a particular length of cable is an indicator of the difference between the actual input impedance of the cable and its average characteristic impedance.

Fig. 2
Attenuation Temperature Correction Factor

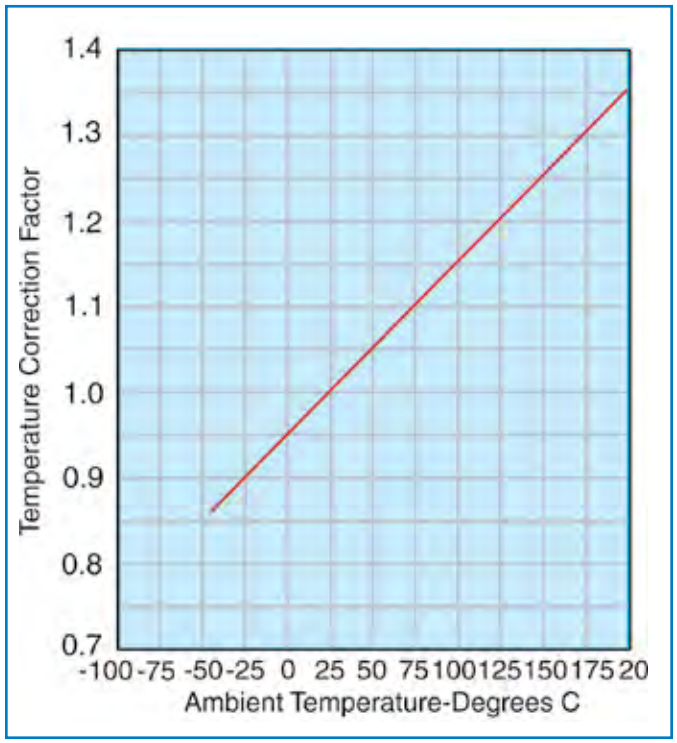
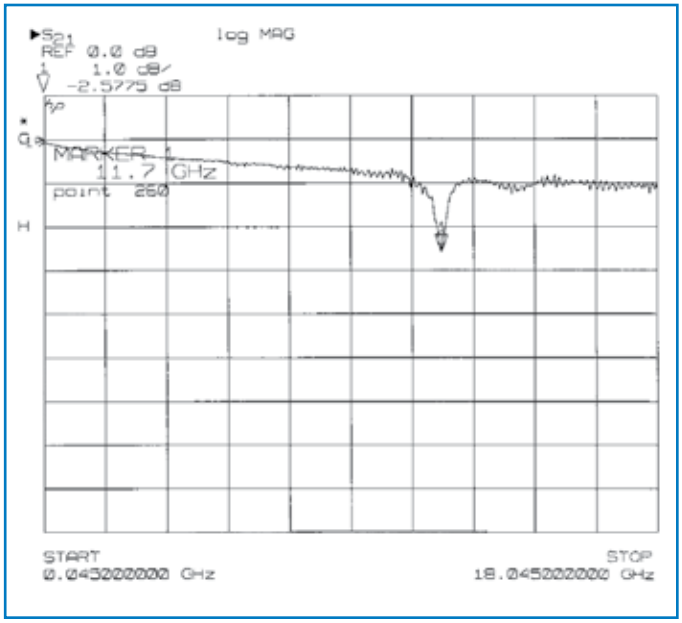


Fig. 3
Attenuation vs. Frequency



The impedance of long lengths of cable will exhibit very little change over their operating temperature ranges - less than 2%.

It is possible to fabricate cables having a characteristic impedance that varies through the length of the cable for matching purposes. Thus a coaxial cable can be used as a broadband impedance transformer to match differing source and load impedances. The transforming action is related to cable length and the minimum operating frequency, and the cable must be designed for the specific application.

C. ATTENUATION

Attenuation is the loss of signal along the length of a cable. As the RF signal passes through the cable, a portion of the signal is converted to heat and a portion of the signal leaks out of the cable through the outer conductor. This loss of signal is usually expressed in decibels per unit of length at a specific frequency, since attenuation increases with frequency.

For most applications, the objective is to minimize the losses in the cable runs or to stay within a loss budget. Minimum loss corresponds to an attenuation of 0 dB or a ratio of 1 to 1 between input and output power. Because cable losses decrease with increasing

cable diameter for the same type of construction, minimizing cable loss means maximizing cable size.

Attenuation is determined by the conductive and dielectric losses of the cable. Larger cables have lower conductor losses, reducing attenuation. Dielectric loss is independent of size. Dielectric losses increase linearly with frequency, while conductor losses increase with the square root of frequency. Therefore, dielectric losses become a larger proportion of the total cable loss as frequency increases.

Attenuation must be modified by a correction factor for the ambient temperature (see Figure 2). Elevated temperature increases cable attenuation by increasing the resistance of the conductors and by increasing the power factor of the dielectric (see Figure 6 for correction factors).

To select a cable construction for a particular application, determine the desired attenuation at the highest frequency from system requirements. Determine the corrected attenuation by dividing the desired attenuation by the temperature correction factor. Choose the smallest cable meeting the corrected attenuation value from the tables.

For cables with low attenuation for their size,see the LMR, StripFlex, SFT, and CLL families of cables.

Fig. 4
Attenuation vs. Flexure

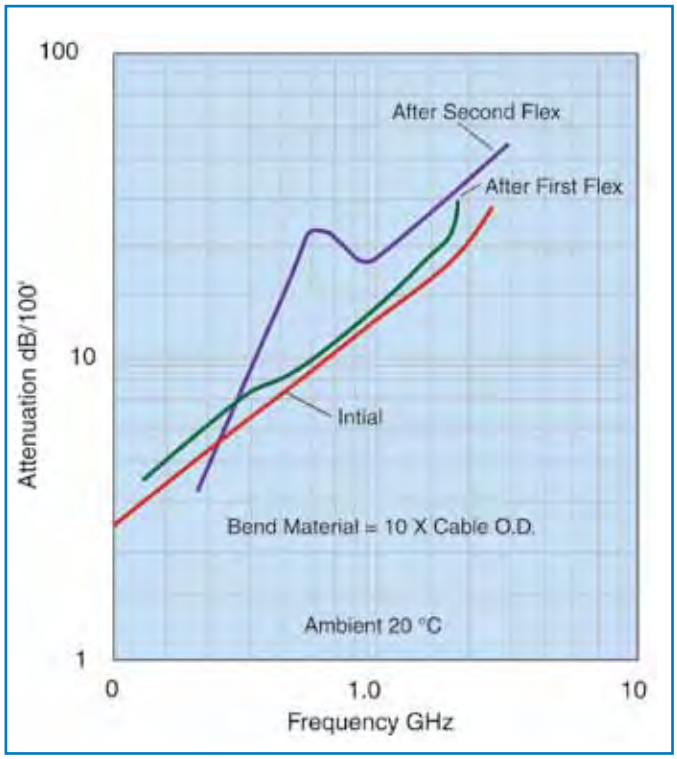
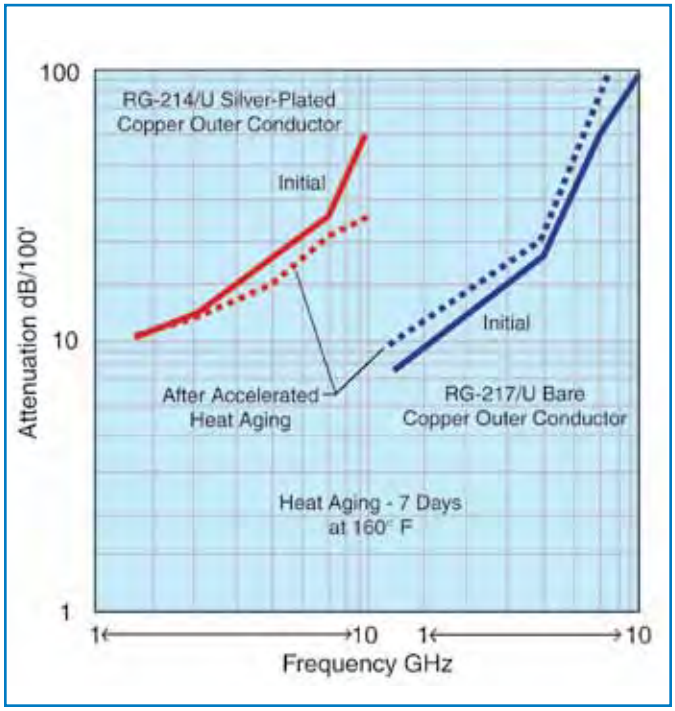


Fig. 5
Attenuation Stability



Attenuation Uniformity

The attenuation of any cable may not change uniformly as the frequency changes. Random and periodic impedance variations give rise to random and periodic attenuation responses. Narrow-band attenuation "spikes" such as that shown in Figure 3 can occur. If required, cables can be procured in various lengths where a maximum attenuation variation from nominal is specified over a customer defined frequency range.

Attenuation Stability

The attenuation of braided cables can increase with time and flexure. The change with time can be caused by corrosion of the braided shield, by contamination of the primary insulation due to jacket plasticizers, and by moisture penetration through the jacket. These

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effects can be essentially eliminated by encapsulating the braid with an appropriate flooding compound, as is done in the DB versions of the LMR cables. (Vapor penetration occurs at differing rates through all plastic and elastomeric materials.) Attenuation degradation is more pronounced at frequencies above 1 GHz. Cables having bare copper and tinned copper braids exhibit far greater attenuation degradation than cables with silver plated braids. These effects are illustrated in Figure 5.

The following guidelines apply:

a. Tin plated braids: Below 1 GHz, cables manufactured with tin plated braids have 15-20% more attenuation than bare copper braids in the "as manufactured" condition, but are more stable than bare copper braided cables.

b. Foam polyethylene: Flexible braided cables with foam polyethylene dielectrics have approximately 15 to 40% lower attenuation than solid polyethylene cables

Fig. 6
Power Temperature Correction Factor

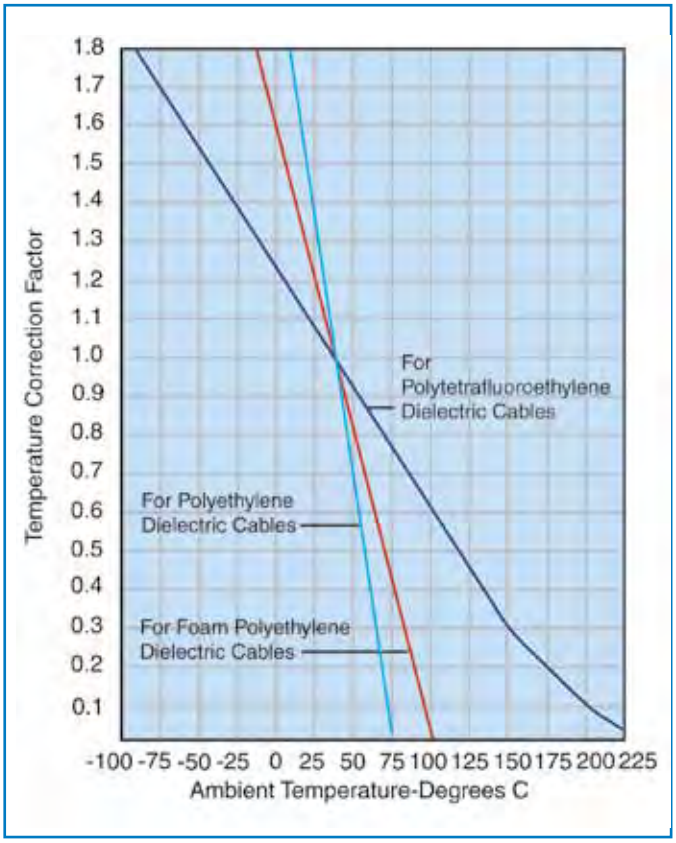
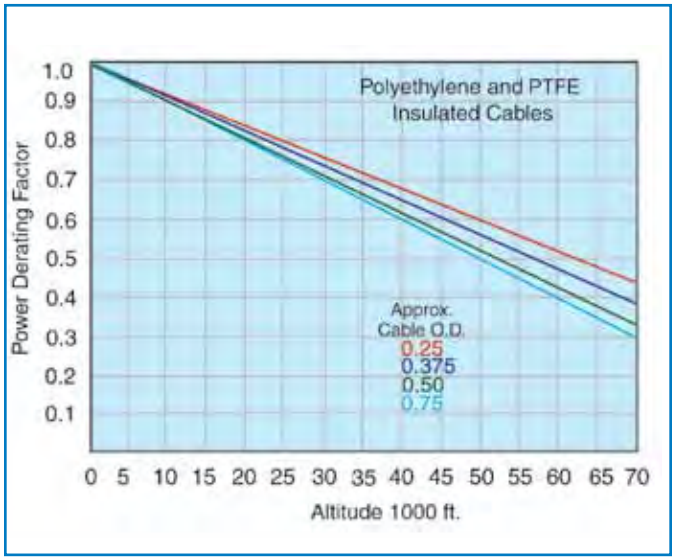


Fig. 7
Power Altitude Correction Factor



of the same core size and impedance. However, some polyethylene foams can absorb moisture causing attenuation increases. LMR cables utilize a closed cell, non-hydroscopic foam composition and are not subject to this problem.
See LMR cables.

c. If PVC jackets are used, a Type IIA, non-contaminating PVC should be specified for applications where attenuation uniformity over time is important. Type I PVC's contain plasticizers which can leach into the dielectric over time causing an increase in attenuation.

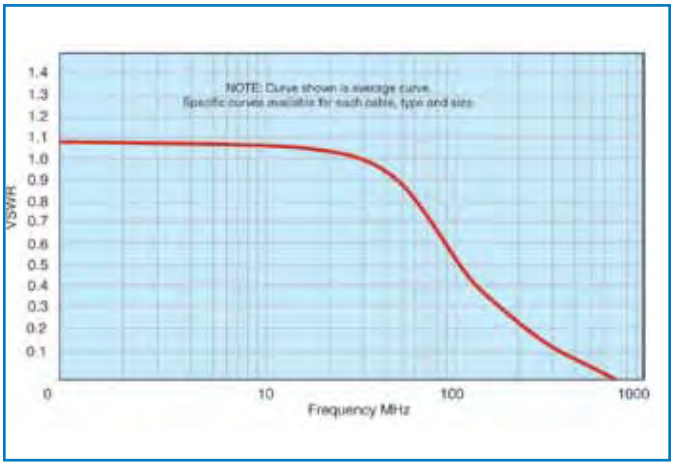
d. The ultimate in attenuation stability can be achieved by specifying hermetically-sealed cable assemblies. These will preclude the ingress of contaminants of any sort into the cable and result in the best stability, such as MilTech assemblies. Contact Times Microwave for more information on this type of assembly.

For flexible cables in extreme environmental conditions, a protected braid (e.g. LMR-DB) is recommended.

D. AVERAGE POWER RATING

Electrical losses in a coaxial cable result in the generation of heat in the center and outer conductors, as well as in the dielectric core. The power handling

Fig. 8
Second VSWR
Correction Factor Multiplier K



capability of a cable is related to the ability of the cable to dissipate this heat. The ultimate limiting factor in power handling is the maximum allowable operating temperature of the materials used in the cable, especially the dielectric. This is because most of the heat is generated at the center conductor of the cable. In general, the power handling capability of a given cable is inversely proportional to its attenuation, and directly related to its size. The other factor is the heat transfer properties of the cable, especially the dielectric.

Cable power ratings must be derated by correction factors for the ambient temperature, altitude and VSWR encountered in a particular application. High ambient temperature and high altitude reduce the power rating of a cable by impeding heat transfer out of the cable. VSWR reduces power rating by causing localized hot spots in the cable.

To select the cable construction for a particular requirement, determine the average input power at the highest frequency from system requirements. Then determine the effective average input power as follows:

$$\textbf{Effective Power} = \frac{\textbf{Average Power x (VSWR correction)}}{\textbf{(Temp. correction) x (Alt. correction)}}$$

Temperature and altitude corrections are shown on Figures 6 and 7.

VSWR correction factor =

$$\frac{1}{1/2\,(VSWR + \overline{VSWR}) + 1/2\,k1\,(VSWR - \overline{VSWR})}$$

Where k, is shown in Figure 8. Select a cable from the Attenuation and Power charts rated at this effective power level.

Note that the peak power handling capability of a cable is related to the maximum operating voltage rating. See Section E, below.

E. MAXIMUM OPERATING VOLTAGE

Care must be taken to ensure that the continuous voltage (and the peak voltage related to pulsed power conditions) applied to a cable is held below its maximum voltage rating. Note that there are two separate voltage ratings for a cable: Corona Voltage and Dielectric Withstanding Voltage:

1. Corona is a voltage related ionization phenomenon which causes noise generation, long term dielectric damage, and eventual breakdown of the cable. Thus, a cable cannot operate continuously with corona, and the maximum operating voltage must be less than the corona extinction level (extinction voltage) of the cable. The determination of corona voltages requires sensitive instrumentation capable of detecting the voltage induced ionization noise generation.

2. The Dielectric Withstanding Voltage, or dielectric strength of the cable, is a measure of the voltage level required to abruptly break down the dielectric employed in a cable. DWV testing requires less sensitive instrumentation, and is a test measurement where a voltage is applied to the cable for a limited time only, and monitored for current flow.

Maximum operating A.C. (RMS) voltage levels or peak voltage are given for each construction in the Cable Data Section of this catalog. The maximum permissible D.C. voltage level is conservatively 3 times the A.C. level.

To select a cable for a particular application, determine the actual RMS (peak /l.4) ,

$$\textbf{RMS voltage} = \frac{\textbf{(peak voltage value)}}{\textbf{1.4}}$$

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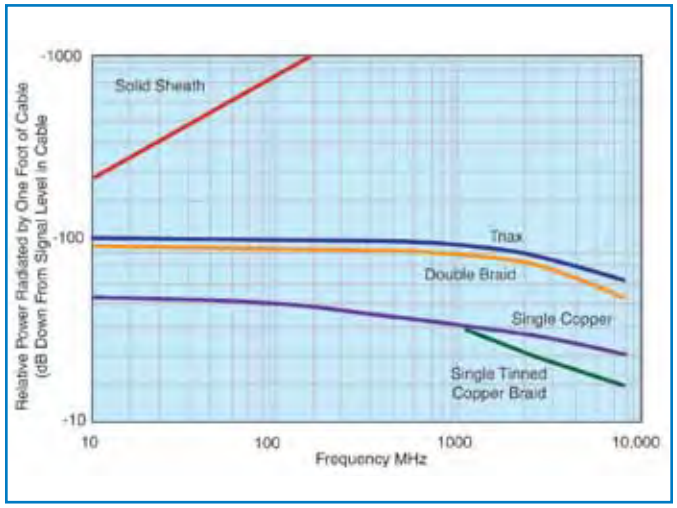
Fig. 9
Shielding Effectiveness



or actual peak voltage = (RMS x value 1.4)
from system requirements. Then determine the effective input voltage by multiplying the actual input voltage by the square root of the VSWR:

Effective voltage = Actual voltage x $(VSWR)^{1/2}$

Then select a cable with a maximum operating voltage greater than the effective RMS voltage. Maximum operating voltages are listed in the cable data section.

As the altitude where a cable is being used increases, the maximum operating voltage of a completed cable assembly is reduced due to the reduction in dielectric strength of the lower pressure air in the termination area.

F. SHIELDING AND CROSS-TALK (OR ISOLATION)

1. The shielding efficiency of a coaxial cable depends on the construction of its outer conductor. The most common constructions available are:

Single Braid: Consisting of bare, tinned, or silver plated round copper wires (70 to 95% coverage).

Double Braid: Consisting of two single braids as described above with no insulation between them.

Triaxial: Consisting of two single braids as described above with a layer of insulation between them.

Strip Braids: Consists of flat strips of copper rather than round wires (90% coverage).

Strip Outer Conductors/Spiral Flat Strips: Exhibiting @ 100% coverage.

Solid Sheath: Consisting of aluminum or copper tubing (100% coverage).

2. The relative shielding effectiveness of these constructions are illustrated in Figure 9 over the frequency range from 10 MHz to 8 GHz. This graph shows the level of signal which leaks through the outer shield of a one foot sample of each construction. The curves describing the performance of the flexible cables, i.e., the triax braid, double braid, and single braid construction are based on measured data.

To estimate the total leakage in cables under 1100 ft. long, add 20 log L to the figure read from the graph (where L is the cable length in feet). The curve showing the typical performance of the semi-flexible (or solid sheath) cables is based on theory. In practice the shielding efficiency of interconnections made using semi-flexible (solid sheath) cables is limited by the leakage at the connectors.

3. The isolation (or cross talk) between two coax cable runs is the sum of the isolation factors of the two cables and the isolation due to the "coupling factor" between the runs. This coupling factor will depend on the relative spacing, positioning and environment of the cable runs and on the grounding practices employed. The coupling factor will substantially affect the isolation between the cable runs.

4. Measurements show that the RF(1 -30 MHz) cross

Fig. 10
Phase Stability

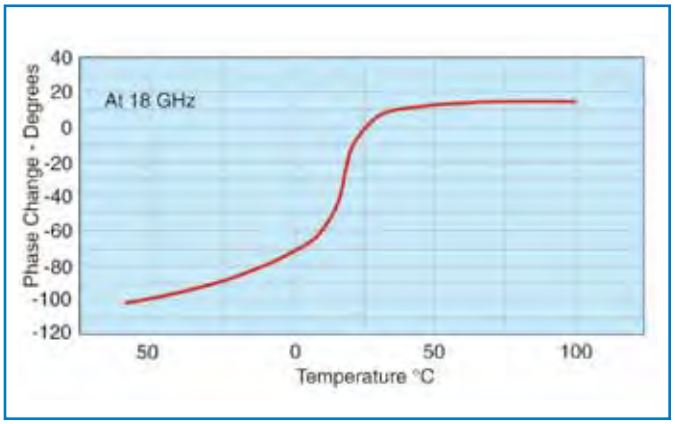
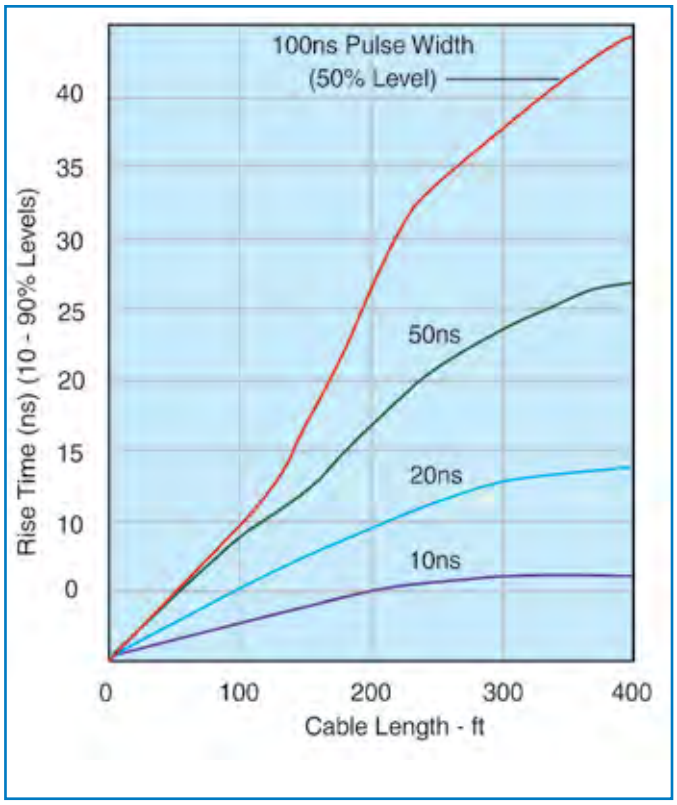


Fig. 11
Pulse Distortion



talk between two single braided coaxes over a 20 foot run length is approximately 80 db down from the signal level inside the cables. The coaxes were laid side-by-side over the 20 foot test length. (This test data illustrates the affect of the "coupling factor" noted above.)

5. Special Constructions that provide enhanced shielding characteristics are available. These cables include the LMR, RD, and RDT families of cables, and the StripFlex, SFT, and TFlex cables.

G. CAPACITANCE

Capacitance in a cable is related to the dielectric material and the characteristic impedance. Typical capacitance values are shown in the General Electrical Properties on page 187 for some common coaxial lines.

As seen in the table, the higher impedance cables provide lower "capacitance per foot" values, resulting in reduced loading for data communications applications.

H. VELOCITY OF PROPAGATION

The velocity of propagation in a coaxial cable is determined primarily by the dielectric constant of the insulating material between the inner and outer conductors. This property is usually expressed as a percentage of the velocity of light in free space, and is typically noted as Vg or Vp.

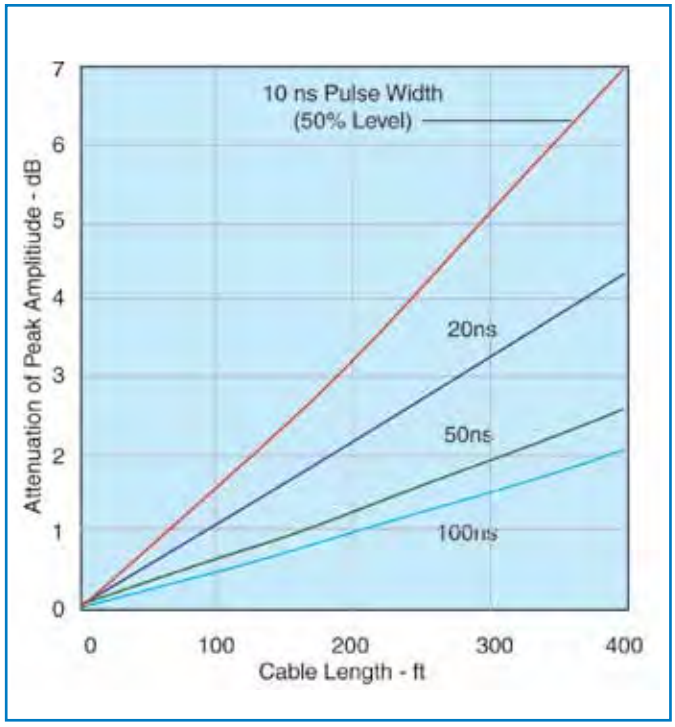
The General Electrical Properties on page 182 shows the velocity of propagation and time delay of cables insulated with commonly used dielectrics.

Delay lines made from coaxial cable can sometimes benefit from using lower velocity cables, thus providing maximum delay in the shortest length. But, the difference in loss between the lower and higher velocity cables must also be taken into account.

I. ELECTRICAL LENGTH STABILITY

Applications such as antenna feed systems may require many cable assemblies that are trimmed to a specific electrical length. In these applications, the change of the electrical length of the cable with temperature, flexure, tension and other environmental factors is critical. The variation of electrical length with

Fig. 12
Pulse Amplitude vs. Length



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temperature for standard flexible cables is shown in Figure 10.

For polyethylene insulated cables:-100 to -250 parts per million/^{o}C.

For TFE insulated cables:-50 to -100 parts/million/^{o}C.

The variation of electrical length with temperature for the standard foam dielectric semiflexible cables is -20 to -30 parts/million/^{o}C.

Times has special flexible and semiflexible cable designs with improved electrical length versus temperature characteristics. Semiflexible cables having an electrical length change with temperature as low as five parts/million per degree centigrade are available. See SFT and Coppersol Low Loss CLL cables.

J. CUT-OFF FREQUENCY

The cut-off frequency of a coaxial cable is that frequency at which modes of energy transmission other than the Tranverse Electro-Magnetic (TEM) mode can be generated. It does not mean that the TEM mode becomes highly attenuated. This frequency is a function of the mean diameter of the conductors and the velocity of propagation of the cable. The higher modes are only generated at impedance discontinuities and in many situations the cable can be operated above the cut-off frequency without substantial VSWR or insertion loss increase. However, it is recommended that cables not be operated above their cut-off frequency.

K. PULSE RESPONSE OF COAXIAL CABLES

1. The following characteristics must be considered when analyzing the Time Domain response of cable to pulses or step functions:

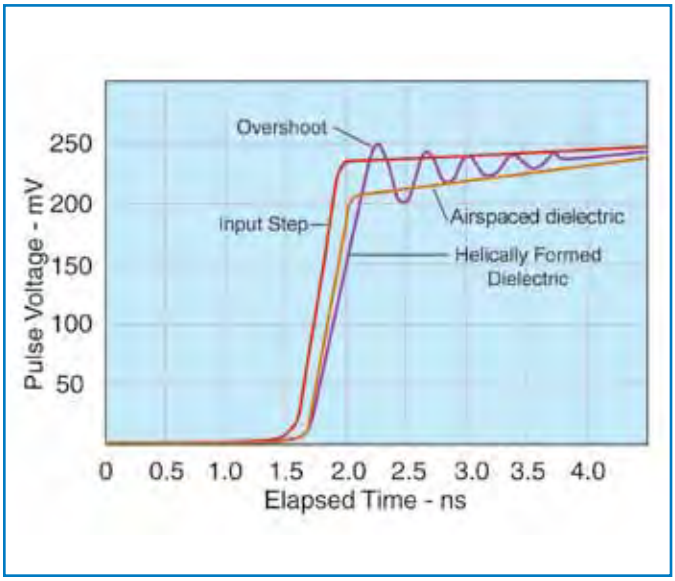
a: Impedance and Reflection;
b: Rise Time;
c: Amplitude;
d: Overshoot or Preshoot;
e: Pulse Echoes.

a: **Impedance and Reflection**

1. Select impedance to match system requirements.

2. The impedance will vary along the length of cable. Variations of +5% are not uncommon. Cables can be produced to tolerances of 2%. Tighter tolerances are not recommended.

Fig. 13
Step Response
(Output Amplitude vs. Time)



b: & c: Rise Time and Amplitude

1. The output rise time is a function of input rise time, pulse width and cable attenuation. A typical pulse response is shown in Figures 11 and 12, while a typical step response is shown in Figure 13. Increased cable temperature causes an increase in rise time and decrease in amplitude.

d: Overshoot or Preshoot

1. Figure 13 shows the overshoot which can be encountered with a 0.1 ns input pulse rise time in cables due to finite reflections. Such overshoot is not common in cables with longitudinally extruded dielectrics.

2. Preshoot is encountered in some balanced delay lines and can be minimized by cable design.

e: Pulse Echoes

When a narrow pulse is placed on a cable, the distortions noted above will occur. In addition, a small pulse of energy may emerge after the initial pulse has arrived. This pulse echo is caused by finite periodic reflections within the cable. Normally the echo level can be neglected.

L. SELF-GENERATED CABLE NOISE

A noted cable phenomenon, is the generation of accoustical and electrical noise when flexed. The acoustical noise is a function of mechanical motion within the cable. Such noise (and the associated mechanical and frictional force) is minimized by proper cable design. Electrical noise generation is attributed to an electrostatic effect, which in testing has exhibited more than 500 millivolts in RG cable. This noise voltage can be minimized by preventing motion between dielectrics and conductors or dissipating electrostatic charges between conductors and dielectrics with semiconducting layers. Low noise constructions must take into account the life expectancy and environmental conditions to which they are subjected. Times manufactures low noise cables for special applications.

M. OPERATING TEMPERATURE RANGE

1. The operating temperature range of flexible coaxial cable is determined primarily by the operating temperature range of the dielectric and jacketing materials. Note that only silver plated conductors are suitable for long term use at temperatures over 80 degrees C.

2. Operating temperature limits of the most commonly used dielectrics and jacket types are given in the following table:

Material	Temperature Range
Polytetrafluoroethylene (PTFE)	-75°C to + 250°C
Polyethylene	-40°C to + 85°C
Foamed Polyethylene	- 40°C to + 100°C
Foamed or Solid Ethylene Propylene Jackets	- 40°C to + l05°C
Fluorinated Ethylene Propylene (FEP)	-70°C to +200°C
Polyvinylchloride (PVC)	- 40°C to + 85°C
Ethylene Chloro Trifluoroethylene (ECTFE)	- 65°C to + l50°C
Polyurethane	-100°C to + 125°C
Perfluoroalkoxy (PFA)	-65°C to + 260°C
Nylon	-60°C to + 120°C
Ethylene Propylene	- 40°C to + l05°C
High Molecular Weight Polyethylene	- 55°C to + 85°C
Crosslinked Polyolefin	- 30°C to + 85°C
Silicone Rubber	-70° to + 200°C
Silicone Impregnated Fiberglass	- 70°C to + 250°C
High Temperature Nylon Fiber	- 100°C to + 250°C

N. FLEXIBILITY

Coaxial cables with stranded center conductor and braided outer conductors are intended for use in those applications where the cable must flex repeatedly while in service. Cables with stranded center conductors will exhibit higher attenuation compared to cables with solid center conductors. In general, the higher the number of strands, the better the flexibility and the greater the increase in attenuation.

Standard braided outer conductor constructions will withstand over 1000 flexes through 180° if bent over a radius 20 times the diameter of the cable. Flexible cables may be stored, and are normally shipped, on reels with a hub radius greater than 10 times the diameter of the cable. If a flexible cable is to be installed in a fixed, bent configuration, the minimum bend radius recommended is 5 times the cable diameter. Tighter bends can be made. Special braid designs are available for improved flex-life.

Coaxial cables with a tubular aluminum or copper outer conductors, commonly referred to as semi-flexible or semi-rigid cables, will not withstand more than ten 180- bends over a bend radius equal to 20 times the diameter of the cable. Semi-flex cables are normally shipped on reels having a hub radius of 20 times the O.D. of the cable. Semi-flex cables may be field bent for installation. The minimum recommended bend radius is equal to 10 times the O.D. of the cable. Cables bent on a bend radius of 5 times the O.D. of the cable may exhibit mechanical and electrical degradation.

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O. ENVIRONMENTAL RESISTANCE

The life of a coaxial cable depends on many factors. The effects of ultra-violet exposure, high humidity, galvanic action, salt-water and corrosive vapors on the materials used are prime causes of cable failure. Resistance to flame must also be considered. The following guidelines apply:

a. Sunlight: For low temperature cables exposed to sunlight (ultra-violet), the use of high molecular weight polyethylene, with a specific carbon black particle size, % by weight and particle distribution, is recommended for maximum life expectancy. Polyvinylchloride jackets exhibit a life expectancy of less than 1/2 that of properly compounded polyethylene.

b. Humidity or water vapor can enter flexible cables through pin-holes in the jacket, at the connector, or by vapor transmission through the jacket. All materials exhibit a finite vapor transmission rate. For example, a ten foot length of cable with a polymer outer jacket exhibits a helium leak rate of approximately 10^{-4} cc/sec/ft. Even the least porous thermoplastics, such as FEP, do not offer a significant improvement. In airborne applications, the combination of finite vapor transmission rates and large temperature extremes cause condensation in cables. The moisture can collect in low areas causing corrosion or shorting of a connector. One method of preventing moisture accumulation in cables is to fill all voids with a moisture-proofing compound which will not harden with age. See LMR-DB and Imperveon Cables for additional data. Times also supplies hermetically sealed cable assemblies with leak rates of less than 10^{-5} cc/sec/ft.

c. Salt-water Immersion-The electrical characteristics of cable will be rapidly affected if the conductors are exposed to salt-water. Unless an immersion test is performed on the jacket, there is a good possibility of one pinhole per 1000 feet. Even if sufficient tests could be performed, damage during installation or damage from rodents normally will cause leakage. Pressure-tight, non-hosing cables capable of withstanding the pressure at the required cable depth can be recommended.

d. Corrosive Vapors: The use of tin and silver coatings does afford some protection against corrosive vapors. However, such protection is short-lived. For installation near salt-water or chemical plants, a filled cable such as LMR-DB or Imperveon is recommended.

e. Underground Burial & Galvanic Action: Underground moisture which comes in contact with any cable metals, will cause rapid corrosion. Tubular aluminum outer conductors have been almost destroyed in 90 days. Therefore, any cables installed underground should have pinhole-free jackets. Since jacket damage due to installation techniques and rodents can occur, cables filled with a flooding compound should be used. For maximum reliability against rodents, a steel tape armor with over-jacketing is recommended.

f. Flame Resistance: Cables have different degrees of flame resistance depending on the jacket and dielectric material. "Flame retardant" cables are cables having limited flame spread (propagation). PVC jackets offer some flame retardance, depending on the compound selected.

Flame retardant jackets, which are actually within the flame, will burn. If the flame is removed, they will self-extinguish. PVC jackets will not drip burning material. However, if the dielectric is polyethylene, the dielectric may drip ignited materials. PTFE and FEP will not support combustion, drip or burn. TMS has a series of Low Smoke / Low Toxicity cables to provide the utmost in protection. These cables utilize a proprietary TMS compound which is non-halogenated and produces combustion products that are low smoke and low toxicity. See the LSSB/LLSB, LMR-FR and M17 qualified cable lines.

P. CABLE STRENGTH

The break strength of the cable depends primarily on the strength of the outer conductor. The cables will normally achieve at least 70% of the break strength of the outer conductor, if the center conductor will stretch up to 10% before breakage. Caution must be taken with cables with copper-covered steel or alloy center conductors where breakage would occur with only 1% to 10% elongation. Conductor sizes less than 26 AWG can easily be broken during assembly operations.

Special alloy conductors are available which can achieve a tensile strength of 110,000 psi and 10% elongation.

Q. QUALIFICATION APPROVAL

Often, cables must be qualified to certain standards to allow usage in particular applications. Typical examples of necessary qualifications are:

Military: Most military applications require that cable conform to particular specifications. Many of these specifications require the manufacturer to qualify product by conducting a series of tests on a length of cable with a military representative present as a witness. MIL-C-17, the basic specification for most coaxial cables, requires a Qualified Products List (QPL). TMS maintains numerous MIL-C-17 qualifications.

Commercial (UL) Approval: The building codes of many cities require that cables installed in their buildings be approved by the Underwriters Laboratories (UL). With UL service, the cable is subjected to a clearly defined series of tests and examinations, and has met the quality and safety standards imposed by Underwriters Laboratories. Approval of new designs meeting UL standards normally can be made in a relatively short period of time. A large variety of TMS products are UL approved.

New York State Requirements: Article 15, Part 1120 of the New York State Uniform Fire Prevention and Building Code requires that materials used in some buildings and transit systems be tested and registered with The New York Department of State. For the TMS products tested, the fire/gas/toxicity data is found in: DOS file number 16120-931203-4001.

London Underground Limited: TMS has gained LUL approval on a series of low-smoke cable constructions. These cables were tested for smoke emission, toxic fume emission, and flammability assessment against the requirements of the London Underground Code of Practice for fire safety.

Contact your TMS representative for more information regarding TMS product qualifications.

MSHA Approvals: TMS has qualified the complete range of LMR-FR coaxial cables (file number 07-KA070010-MSHA-P) and T-RAD-FR leaky feeder cables (file number 07-KA07009-MSHA-P) to the MSHA flame requirements. Contact your TMS representative for further information.

TIMES MICROWAVE SYSTEMS

Attenuation (dB per 100 feet ; +25C)

	2¼" LDF	1⅝" LDF	1¼" LDF	LMR-1700	⅞" LDF	LMR-1200	LMR-900	½" LDF	LMR-600	LMR-500	½" SuperFlex	⅜" LDF
Frequency / Size	2.350"	1.980"	1.550"	1.670"	1.090"	1.200"	0.870"	0.630"	0.590"	0.500"	0.520"	0.440"
30 MHz	0.096"	0.120	0.147	0.149	0.197	0.209	0.288	0.369	0.421	0.54	0.561	0.567
50 MHz	0.125"	0.156	0.191	0.195	0.257	0.272	0.374	0.479	0.547	0.70	0.730	0.736
150 MHz	0.227"	0.280	0.340	0.347	0.458	0.481	0.658	0.845	0.964	1.22	1.29	1.30
220 MHz	0.281"	0.345"	0.416"	0.427	0.560"	0.589	0.803	1.05"	1.18	1.49	1.58"	1.59"
450 MHz	0.422	0.515	0.617	0.632	0.834	0.864	1.17	1.51	1.72	2.17	2.32	2.30
700 MHz	-.-	-.-	-.-	0.809	-.-	1.10	1.48	-.-	2.18	2.77	-.-	-.-
900 MHz	0.641"	0.767"	0.912"	0.936	1.23"	1.27	1.70	2.21"	2.50	3.13	3.41"	3.36"
1,500 MHz	0.879"	1.050	1.22	1.26	1.66	1.69	2.24	2.93	3.31	4.13	4.57	4.43
2,000 MHz	1.058"	1.250	1.45	1.50	1.97	1.99	2.63	3.45	3.90	4.84	5.41	5.21
2,500 MHz	-.-	1.440	1.68"	1.71	2.27"	2.26	2.98	3.91"	4.42	5.48	6.17"	5.91"
Attenuation at Any Frequency = [k1 x SqRt (Fmhz)] + [k2 x Fmhz] or use Performance Calculator at www.timesmicrowave.com												
k1				0.02646		0.03737	0.05177		0.07555	0.09659		
k2				0.00016		0.00016	0.00016		0.00026	0.00026		

Power Handling (kW ; +40C ; Sea Level)

	2¼" LDF	1⅝" LDF	1¼" LDF	LMR-1700	⅞" LDF	LMR-1200	LMR-900	½" LDF	LMR-600	LMR-500	½" SuperFlex	⅜" LDF
Frequency / Size	2.350"	1.980"	1.550"	1.670"	1.090"	1.200"	0.870"	0.630"	0.590"	0.500"	0.520"	0.440"
30 MHz	39.5"	28.9	21.1	20.3	14.0	12.6	8.9	6.31	5.5	4.4	5.75	4.14
50 MHz	30.2"	22.1	16.2	15.6	10.7	9.7	6.8	4.85	4.3	3.4	4.42	3.19
150 MHz	16.7"	12.3	9.09	8.7	6.04	5.5	3.9	2.75	2.4	1.9	2.49	1.81
220 MHz	13.5"	13.5"	7.45"	7.1	4.94"	4.5	3.2	2.23"	1.9	1.6	2.04"	1.49"
450 MHz	8.91	6.71	5.01	4.8	3.32	3.1	2.2	1.53	1.3	1.1	1.38	1.02
700 MHz	-.-	-.-	-.-	3.8	-.-	2.4	1.7	-.-	1.1	0.85	-.-	-.-
900 MHz	5.90"	4.49"	3.39"	3.3	2.24	2.1	1.5	1.05"	0.93	0.75	0.944"	0.703"
1,500 MHz	4.29"	3.30	2.52	2.4	1.66	1.6	1.1	0.793	0.70	0.57	0.705	0.530
2,000 MHz	3.57"	2.76	2.13	2.0	1.40	1.3	1.0	0.673	0.59	0.49	0.597	0.451
2,500 MHz	-.-	2.40	1.84"	1.8	1.21"	1.2	0.9	0.594"	0.52	0.43	0.547"	0.398"

General Performance Properties

	LMR-1700	LMR-1200	LMR-900	LMR-600	LMR-500	LMR-400	LMR-300	LMR-240	LMR-200
Conductor: (note 1)	0.527"	0.349"	0.262"	0.176"	0.142"	0.108"	0.070"	0.056"	0.044"
Dielectric: Cellular PE (note 2)	1.350"	0.920"	0.680"	0.455"	0.370"	0.285"	0.190"	0.150"	0.116"
Shield: Aluminum Tape (note 3)	1.356"	0.926"	0.686"	0.461"	0.376"	0.291"	0.196"	0.155"	0.121"
Tinned Copper Braid	1.402"	0.972"	0.732"	0.490"	0.405"	0.320"	0.225"	0.178"	0.144"
Jacket: Black PE (note 4)	1.670"	1.200"	0.870"	0.590"	0.500"	0.405"	0.300"	0.240"	0.195"
Bend Radius (note 5)	13.5"	6.5"	3"	1.5"	1.25"	1"	.875"	0.75"	0.50"
Weight(lbs/foot)	0.736	0.448	0.266	0.131	0.097	0.068	0.055	0.034	0.022
Temperature Range	-40°C to +85°C								
Impedance	50 Ohms								
Velocity (%)	89	88	87	87	86	85	85	84	83
Capacitance (pF per Foot)	22.8	23.1	23.4	23.4	23.6	23.9	23.9	24.2	24.5
DC Resistance: center conductor	0.21	0.32	0.54	0.53	0.82	1.39	2.12	3.20	5.36
(ohms/1000') : shield	0.27	0.37	0.55	1.20	1.27	1.65	2.21	3.89	4.90
Shielding	> 90 db								
Phase Stability	+/- 10 ppm/degC								

Selection Guide

TIMES MICROWAVE SYSTEMS

LMR-400	3/8" SuperFlex	Belden 9913	ULTRA-LINK™	RG213/ RG214	1/4" SuperFlex	LMR-300	LMR-240	Belden RG8X	LMR-200	ULTRA-LINK	LMR-195	RG-58	LMR-100A
0.405"	0.415"	0.405"	0.405"	0.405"	0.300"	0.300"	0.240"	0.242"	0.195"	0.195"	0.195"	0.195"	0.110"
0.7	0.654	0.8	0.7	1.2	0.98	1.1	1.3	2.0	1.8	2.5	2.0	2.5	3.9
0.9	0.848	0.9	-.-	1.6	1.27	1.4	1.7	2.5	2.3	-.-	2.6	3.1	5.1
1.5	1.49	1.6	1.5	2.8	2.23	2.4	3.0	4.7	4.0	5.1	4.4	6.2	8.9
1.8	1.82*	-.-	-.-	3.5	2.72	2.9	3.7	6.0	4.8	-.-	5.4	7.4	10.9
2.7	2.66	2.8	2.7	5.2	3.93	4.2	5.3	8.6	7.0	9.5	7.8	10.6	15.8
3.42	-.-	-.-	-.-	-.-	-.-	5.1	6.6	-.-	8.7	-.-	9.8	-.-	20.0
3.9	3.86*	4.2	4.19	8.0	5.67*	6.1	7.6	12.8	9.9	14.0	11.1	16.5	22.8
5.1	5.12	5.6	-.-	-.-	7.47	7.9	9.9	-.-	12.9	-.-	14.5	-.-	30.0
6.0	6.01	6.7	-.-	-.-	8.73	9.2	11.5	-.-	15.0	-.-	16.9	-.-	35.0
6.8	6.84*	-.-	6.8*	-.-	9.85*	10.4	12.9	-.-	16.9	37*	19.0	-.-	40.0
0.12229						0.19193	0.24208		0.32090		0.35686		0.70914
0.00026						0.00033	0.00033		0.00033		0.00047		0.00174

LMR-400	3/8" SuperFlex	Belden 9913	ULTRA-LINK	RG213/ RG214	1/4" SuperFlex	LMR-300	LMR-240	Belden RG8X	LMR-200	ULTRA-LINK	LMR-195	RG-58	LMR-100A
0.405"	0.415"	0.405"	0.405"	0.405"	0.300"	0.300"	0.240"	0.242"	0.195"	0.195"	0.195"	0.195"	0.110"
3.3	3.97	2.2	-.-	1.8	2.28	2.1	1.49	0.35	1.02	4.0	0.89	0.40	0.23
2.6	3.06	1.7	-.-	1.2	1.76	1.6	1.15	0.28	0.79	-.-	0.68	0.30	0.18
1.5	1.74	0.90	-.-	0.62	1.00	0.93	0.66	0.15	0.45	2.0	0.39	0.16	0.10
1.2	1.44*	-.-	-.-	-.-	0.825*	0.76	0.54	-.-	0.37	-.-	0.32	-.-	0.08
0.83	0.975	0.45	-.-	0.30	0.567	0.52	0.38	0.08	0.26	1.0	0.22	0.08	0.06
0.66	-.-	-.-	-.-	-.-	-.-	0.43	0.30	-.-	0.21	-.-	0.18	-.-	0.05
0.58	0.674*	0.28	-.-	0.18	0.393*	0.36	0.26	0.05	0.18	0.65	0.15	0.05	0.040
0.44	0.507	0.20	-.-	-.-	0.299	0.28	0.20	-.-	0.14	-.-	0.12	-.-	0.030
0.37	0.431	0.16	-.-	-.-	0.256	0.24	0.17	-.-	0.12	-.-	0.10	-.-	0.025
0.33	0.379*	-.-	-.-	-.-	0.225*	0.21	0.15	-.-	0.11	-.-	0.09	-.-	0.020

Competitor's Data As Published
*=estimated from published data.

LMR-195	LMR-100A
0.037"	0.018"
0.110"	0.060"
0.116"	0.065"
0.139"	0.083"
0.195"	0.110"
0.50"	0.25"
0.021	0.009
80	66
25.4	30.8
7.58	81.0
4.90	9.5

NOTES:

(1) Center Conductor in LMR-900, LMR-1200 & LMR-1700 is Copper Tube
Center Conductor in LMR-400, LMR-500 & LMR-600 is Copper Clad Aluminum
Center Conductor in LMR-195, LMR-200, LMR-240 and LMR-300 is Bare Copper
LMR-100A is BCCS

(2) Low loss closed cell polyethylene foam (LMR-100A solid polyethylene)

(3) Aluminum laminated tape bonded (LMR-100A unbonded) to the Dielectric with a Tinned Copper Overbraid

(4) Black UV protected polyethylene (LMR-100A black PVC)

(5) Less than 1 ohm impedance change at bend

TIMES MICROWAVE SYSTEMS

Part Reference Guide

MISSION

TIMES MICROWAVE SYSTEMS designs and manufactures high performance RF transmission line for the telecommunications industry.

These products consist of flexible coaxial cable, connectors, accessories and cable assemblies

We are committed to understanding the needs and requirements of our customers and providing highly engineered, cost effective products.

TIMES MICROWAVE SYSTEMS is dedicated to *total* customer satisfaction and superior results for our shareholders in all we do.

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