

PHASEMASTER®

PHASE STABLE CABLE ASSEMBLIES



UNMATCHED COMBINATION OF PHASE STABILITY, LOW LOSS, AND VALUE



Take a look at our **Phase Master®** cables.

Superior phase stability vs. temperature makes this cable the ideal choice for phase-sensitive applications—particularly those **with wide operating temperature ranges**.

Phase Master's enhanced phase stability—a result of a proprietary combination of high performance, tape wrapped PTFE dielectric and helically wrapped SPC shield—offers:

- Improved system performance
- Less frequent calibration
- More precise measurements

From environmental stress screening to electronically scanned radar systems, count on Phase Master® assemblies to provide **unparalleled value and performance**.

PhaseMaster® 096

1.513 dB/ft nom @ 50 GHz

PhaseMaster® 110

1.282 dB/ft nom @ 50 GHz

PhaseMaster® 130

0.959 dB/ft nom @ 50 GHz

PhaseMaster® 160

0.678 dB/ft nom @ 40 GHz

PhaseMaster® 190

0.496 dB/ft nom @ 32 GHz

PhaseMaster® 210

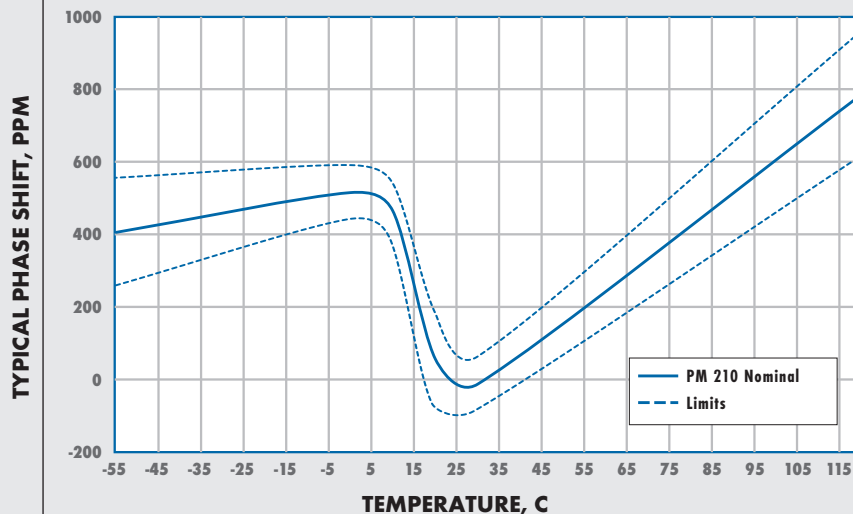
0.367 dB/ft nom @ 26.5 GHz

PhaseMaster® 300

0.205 dB/ft nom @ 18 GHz

Please consult Teledyne Storm Microwave for other available connector styles.

PHASE vs. TEMPERATURE – PHASE MASTER® 210 CABLE



**TELEDYNE
STORM MICROWAVE**
Everywhereyoulook™

High value microwave and
electronic interconnect solutions

www.teledynestorm.com

SPECIFICATIONS	PHASEMASTER®		
	190	210	300
Cable Designator	63	62	61
Diameter (in/mm)	0.187/4.75	0.210/5.33	0.299 / 7.59
Operating Frequency (Max, GHz)	32	26.5	18
Attenuation–Nom @ 2 GHz (dB/ft)	0.112	0.092	0.062
Attenuation–Nom @ 10 GHz (dB/ft)	0.261	0.215	0.147
Attenuation–Nom @ 18 GHz (dB/ft)	0.359	0.296	0.205
Attenuation–Nom @ 26.5 GHz (dB/ft)	0.446	0.367	–
Attenuation–Nom @ 32 GHz (dB/ft)	0.496	--	--
Attenuation–Nom @ 40 GHz (dB/ft)	--	–	–
Attenuation–Nom @ 50 GHz (dB/ft)	--	–	–
Power Handling -- Avg Power in Watts @ 1 GHz	750	878	1615
Phase Stability vs. Temp -- ppm (nom/tolerance)	–55°C	445/150	410/150
	+20°C	35/100	60/125
	+120°C	800/125	790/175
Phase Stability vs. Flexure† (@ 18 GHz, nom)	±4°	±4.5°	±8°
Shielding Effectiveness–Min‡ (dB @ 1 GHz)	> 90	> 90	> 90
Typical VSWR (2 straight connectors)	1.25 to 32 GHz	1.22 to 26.5 GHz	1.22 to 18 GHz
Min Bend Radius (in/mm)	Static	0.95/24.1	1.0/25.4
	Dynamic	2.0 / 50.8	2.0/50.8
Connector Retention, Straight pull (lbs/kg max)	40/18.14	50/22.68	75/34.02
Velocity of Propagation (%)	82.75	84.0	85.0
Weight (grams/ft & /m)	15.9 / 52.15	19.40/63.65	39.2 / 128.58
Operating Temperature Range (°C)	–55 to +125 (FEP jacket) –55 to +100 (LSZH jacket)		

† ± 360 degree bends around a 20 x cable OD mandrel. ‡ Subject to connector choice.

Specifications subject to change without notice.

PHASEMASTER® FEATURES & BENEFITS

FEATURES

- ~ Low density, low loss ePTFE dielectric
- ~ Helically wrapped SPC primary shield
- ~ Fully captivated connectors
- ~ Combination hex/knurl coupling nuts
- ~ Diameters of 0.096", 0.110", 0.127", 0.159", 0.187", 0.210" and 0.299"

ADVANTAGES

- ~ Reduced cable loss
- ~ Increased thermal stability
- ~ Reduced cable loss
- ~ Reduced leakage
- ~ Increased connector retention
- ~ Easier to tighten, while still able to torque
- ~ Sizes and frequencies to fit a wide range of applications

BENEFITS

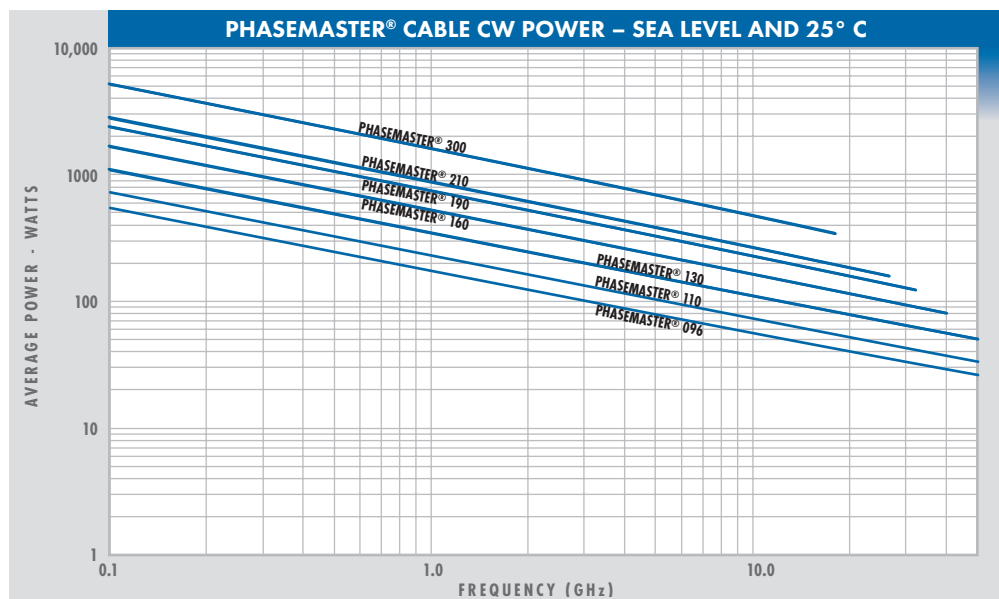
- ~ Meet challenging system gain or signal-to-noise requirements
- ~ Meet challenging system power or Mean Time Between Failures (MTBF) requirements
- ~ Meet challenging system gain or signal-to-noise requirements
- ~ Improved system performance
- ~ Reduced chance of degradation after install or use
- ~ Reduced fatigue, increased repeatability
- ~ Enhanced design-in options

SPECIFICATIONS		PHASEMASTER®			
		096	110	130	160
Cable Designator		66	65	68	64
Diameter (in/mm)		0.096/2.44	0.110/2.79	0.127/3.23	0.159/4.04
Operating Frequency (Max, GHz)		50	50	50	40
Attenuation–Nom @ 2 GHz (dB/ft)		0.280	0.234	0.181	0.139
Attenuation–Nom @ 10 GHz (dB/ft)		0.642	0.538	0.412	0.321
Attenuation–Nom @ 18 GHz (dB/ft)		0.874	0.735	0.559	0.439
Attenuation–Nom @ 26.5 GHz (dB/ft)		1.074	0.905	0.684	0.541
Attenuation–Nom @ 32 GHz (dB/ft)		1.188	1.003	0.756	0.600
Attenuation–Nom @ 40 GHz (dB/ft)		1.340	1.133	0.851	0.678
Attenuation–Nom @ 50 GHz (dB/ft)		1.513	1.282	0.959	–
Power Handling -- Avg Power in Watts @ 1 GHz		176	232	348	528
Phase Stability vs. Temp -- ppm (nom/tolerance)	–55°C	758/100	607/100	213/200	365/125
	+20°C	55/100	-27/100	-3/100	70/100
	+120°C	950/100	808/100	990/100*	865/150
Phase Stability vs. Flexure† (@ 18 GHz, nom)		±6.5°	±4°	±2.7°	±3.5°
Shielding Effectiveness–Min‡ (dB @ 1 GHz)		> 95	> 95	> – 90	> – 90
Typical VSWR (2 straight connectors)		1.30 to 50 GHz	1.33 to 50 GHz	1.35 to 50 GHz	1.28 to 40 GHz
Min Bend Radius (in/mm)	Static	0.50/12.7	0.50/12.7	0.625/15.9	0.75/19.05
	Dynamic	1.00/25.4	1.00/25.4	1.25/31.8	1.53/38.1
Connector Retention, Straight pull (lbs/kg max)		15/6.80	25/11.34	25/11.34	20/9.07
Velocity of Propagation (%)		81.0	81.0	84.0	87.0
Weight (grams/ft & /m)		4.83/15.85	6.77/22.21	9.24/30.31	12.12/39.76
Operating Temperature Range (°C)		–55 to +125 (FEP jacket) –55 to +100 (LSZH jacket)			

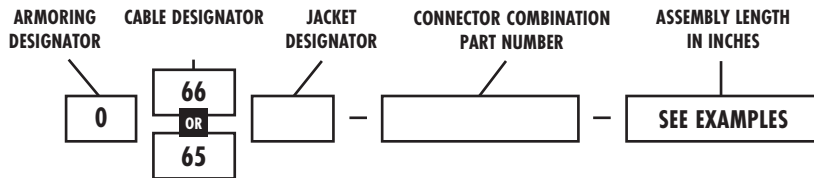
† ± 360 degree bends around a 20 x cable OD mandrel. ‡ Subject to connector choice.

Specifications subject to change without notice.

* PM 130 upper temp. shift @ +125°C



PHASEMASTER® ORDERING INFORMATION: Part Number Designation



Armoring Designator: 0 - Unarmored

Jacket Designator: Blank - Standard FEP **Z** - Low Smoke Zero Halogen (LSZH)

PHASEMASTER® 096

CONNECTOR OPERATING FREQUENCY

	18 GHz	26.5 GHz	40 GHz	50 GHz	
18 GHz	SMA RAP	SMA SP	SMK (2.92 mm) SP	SMK RAP	2.4 mm SP
26.5 GHz	SMA RAP	SMA SP	SMK (2.92 mm) SP	SMK RAP	2.4 mm SP
40 GHz	SMA RAP	SMA SP	SMK (2.92 mm) SP	SMK RAP	2.4 mm SP
50 GHz	SMA RAP	SMA SP	SMK (2.92 mm) SP	SMK RAP	2.4 mm SP

CONNECTOR COMBINATION PART NUMBERS *

Frequency	SMA RAP	SMA SP	SMK (2.92 mm) SP	SMK RAP	2.4 mm SP	
18 GHz	2121	0121	0121	0521	2125	0621
26.5 GHz	0121	0101	0101	0105	0125	0106
40 GHz	0521	0105	0105	0505	0525	0506
50 GHz	2125	0125	0525	2525	0625	0625

CONNECTOR CODES	
SP	Straight Plug
RAP	Right-Angle Plug

EXAMPLES:

066-0505-048 = Unarmored PhaseMaster® 096 with standard FEP jacket, SMK (2.92 mm) SP to SMK (2.92 mm) SP (assembly operates to 40 GHz), 48 inches

066Z-0101-012 = Unarmored PhaseMaster® 096 with LSZH jacket, SMA SP to SMA SP (assembly operates to 26.5 GHz), 12 inches

PHASEMASTER® 110

CONNECTOR OPERATING FREQUENCY

	18 GHz	26.5 GHz	40 GHz	50 GHz	
18 GHz	SMA RAP	SMA SP	SMK (2.92 mm) SP	SMK RAP	2.4 mm SP
26.5 GHz	SMA RAP	SMA SP	SMK (2.92 mm) SP	SMK RAP	2.4 mm SP
40 GHz	SMA RAP	SMA SP	SMK (2.92 mm) SP	SMK RAP	2.4 mm SP
50 GHz	SMA RAP	SMA SP	SMK (2.92 mm) SP	SMK RAP	2.4 mm SP

CONNECTOR COMBINATION PART NUMBERS *

Frequency	SMA RAP	SMA SP	SMK (2.92 mm) SP	SMK RAP	2.4 mm SP	
18 GHz	2121	0121	0121	0521	2125	0621
26.5 GHz	0121	0101	0101	0105	0125	0106
40 GHz	0521	0105	0105	0505	0525	0506
50 GHz	2125	0125	0525	2525	0625	0625

CONNECTOR CODES	
SP	Straight Plug
RAP	Right-Angle Plug

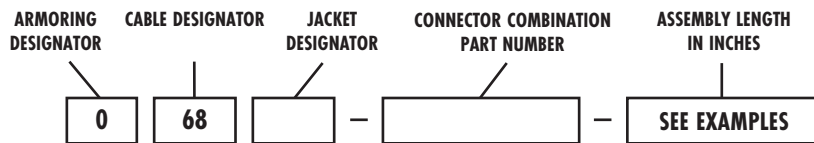
EXAMPLES:

065-0606-180 = Unarmored PhaseMaster® 110 with standard FEP jacket, 2.4 mm SP to 2.4 mm SP (assembly operates to 50 GHz), 180 inches

065Z-0525-036 = Unarmored PhaseMaster™ 110 with LSZH jacket, SMK (2.92 mm) SP to SMK RAP (assembly operates to 40 GHz), 36 inches

* Other connector styles available; consult Storm | Connector requirements in accordance with MIL-PRF-39012, MIL-STD-348, and IEEE-287 as appropriate.

PHASEMASTER® ORDERING INFORMATION: Part Number Designation



Armoring Designator: **0** - Unarmored **A** - Armored

Jacket Designator: **Blank** - Standard FEP **Z** - Low Smoke Zero Halogen (LSZH)

PHASEMASTER® 130

CONNECTOR COMBINATION PART NUMBERS*

	CONNECTOR OPERATING FREQUENCY				
	26.5 GHz	40 GHz	50 GHz	50 GHz	50 GHz
26.5 GHz	SMA SP	SMK (2.92 mm) SP	SMK (2.92 mm) SJ	2.4 mm SP	2.4 mm SJ
40 GHz	SMK (2.92 mm) SP	SMK (2.92 mm) SJ	2.4 mm SP	2.4 mm SJ	
50 GHz	2.4 mm SP	2.4 mm SJ			

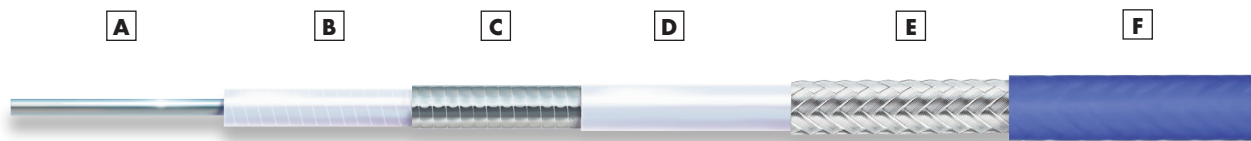
CONNECTOR CODES	
SP	Straight Plug
SJ	Straight Jack

EXAMPLES:

068-0606-048 = Unarmored PhaseMaster®130 with standard FEP jacket, 2.4 mm SP to 2.4 mm SP (assembly operates to 50 GHz), 48 inches

068Z-0115-150 = Unarmored PhaseMaster®130 with LSZH jacket, SMA SP to SMK (2.92 mm) SJ (assembly operates to 26.5 GHz), 150 inches

PHASEMASTER® 130 CABLE CONSTRUCTION



A Silver-plated copper center conductor

B Expanded PTFE dielectric

C Helically wrapped SPC flat wire shield

D PTFE

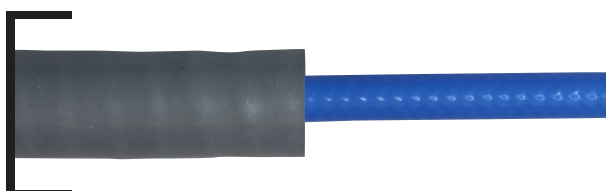
E Silver-plated copper braid

F Extruded blue FEP jacket standard; blue LSZH (low smoke zero halogen) jacket on request

ARMORING OPTION FOR PHASEMASTER® 130

ARMORED

Armoring Designator: **A**



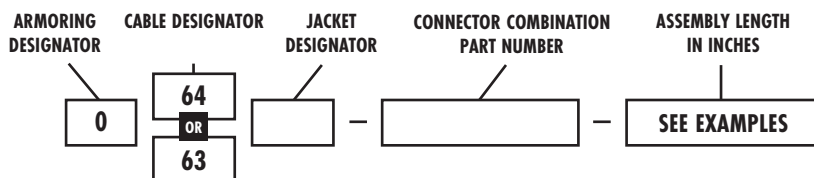
Design for both inside and outside environments where the application requires more cut and crush resistance. This armor option is extremely flexible and light while still providing protection. The cable is covered with a stainless steel flat wire spiral, fiberglass braid, and silicone jacket.

Temperature: -55° C thru +125° C

Diameter: 0.276"/7.00 mm

* Other connector styles available; consult Storm | Connector requirements in accordance with MIL-PRF-39012, MIL-STD-348, and IEEE-287 as appropriate.

PhaseMaster® ORDERING INFORMATION: Part Number Designation



Armoring Designator[†]: **0** - Unarmored **A** - Hard Armored (polyolefin jacket)
AN - Hard Armored (no polyolefin jacket)

[†] Hard armoring with FFRA connectors is a custom part number; call Storm.

Jacket Designator: **Blank** - Standard FEP **Z** - Low Smoke Zero Halogen (LSZH)

PHASEMASTER® 160

		CONNECTOR OPERATING FREQUENCY							
		26.5 GHz				40 GHz			
CONNECTOR COMBINATION PART NUMBERS*		3.5 mm SP	SMA SP	SMA RAP	SMA FFRAP	SMK (2.92 mm) SP	SMK (2.92 mm) FFRAP	2.4 mm SP	2.4 mm FFRAP
		26.5 GHz	3.5 mm SP	0404	0104	0421	0451	0405	0455
SMA SP	0104		0101	0121	0151	0105	0155	0106	0156
SMA RAP	0421		0121	2121	2151	0521	2155	0621	2156
SMA FFRAP	0451		0151	2151	5151	0551	5155	0651	5156
40 GHz	SMK (2.92 mm) SP	0405	0105	0521	0551	0505	0555	0506	0556
	SMK (2.92 mm) FFRAP	0455	0155	2155	5155	0555	5555	0655	5556
	2.4 mm SP	0406	0106	0621	0651	0506	0655	0606	0656
	2.4 mm FFRAP	0456	0156	2156	5156	0556	5556	0656	5656

Other connector styles include: SMA SJ, SMK(2.92 mm) SJ, SMK(2.92 mm) BFJ and SMK(2.92 mm) RAP.

CONNECTOR CODES	
SJ	Straight Jack
BFJ	Bulkhead Feedthru Jack
SP	Straight Plug
RAP	Right-Angle Plug
FFRAP	Factory Formed Right-Angle Plug

EXAMPLES:

064-0505-048 = Unarmored PhaseMaster® 160 with standard FEP jacket, SMK (2.92 mm) SP to SMK (2.92 mm) SP (assembly operates to 40 GHz), 48 inches

AN64Z-0606-180 = Hard Armored (no polyolefin jacket) PhaseMaster® 160 with LSZH jacket, 2.4 mm SP to 2.4 mm SP (assembly operates to 40 GHz), 180 inches

PHASEMASTER® 190

		CONNECTOR OPERATING FREQUENCY						
		18 GHz	26.5 GHz		32 GHz			
CONNECTOR COMBINATION PART NUMBERS*		SMA SP	SMA SJ	3.5 mm SP	3.5 mm SJ	SMK (2.92 mm) SP	SMK (2.92 mm) SJ	SMK (2.92 mm) FFRAP
		18 GHz	SMA SP	0101	0111	0104	0114	0105
SMA SJ	0111		1111	0411	1115	0511	1115	1155
26.5 GHz	3.5 mm SP	0104	0411	0404	0414	0405	0415	0455
	3.5 mm SJ	0114	1115	0414	1414	0514	1415	1455
32 GHz	SMK (2.92 mm) SP	0105	0511	0405	0514	0505	0515	0555
	SMK (2.92 mm) SJ	0115	1115	0415	1415	0515	1515	1555
	SMK (2.92 mm) FFRAP	0155	1155	0455	1455	0555	1555	5555

CONNECTOR CODES	
SP	Straight Plug
SJ	Straight Jack
FFRAP	Factory Formed Right-Angle Plug

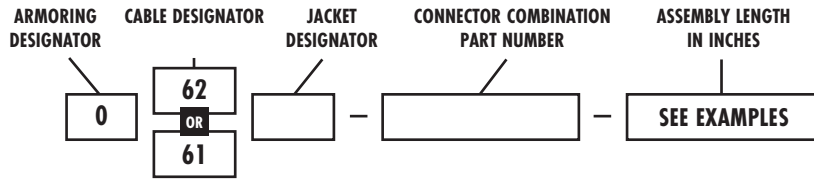
EXAMPLES:

063-5555-048 = Unarmored PhaseMaster® 190 with standard FEP jacket, 2.92 mm FFRAP to 2.92 mm FFRAP (assembly operates to 32 GHz), 48 inches

A63Z-0505-180 = Hard Armored (polyolefin jacket) PhaseMaster® 190 with LSZH jacket, 2.92 mm SP to 2.92 mm SP (assembly operates to 32 GHz), 180 inches

* Other connector styles available; consult Storm | Connector requirements in accordance with MIL-PRF-39012, MIL-STD-348, and IEEE-287 as appropriate.

PhaseMaster® ORDERING INFORMATION: Part Number Designation



Armoring Designator†: **O** - Unarmored **R** - Ruggedized (polyurethane jacket)
A - Hard Armored (polyolefin jacket) **AN** - Hard Armored (no polyolefin jacket)
 † Hard armoring with FFRA connectors is a custom part number; call Storm.
 Ruggedizing not available with FFRA connectors.

Jacket Designator: **Blank** - Standard FEP **Z** - Low Smoke Zero Halogen (LSZH)

PHASEMASTER® 210

CONNECTOR COMBINATION PART NUMBERS*

	26.5 GHz		18 GHz								
	3.5 mm SP	3.5 mm FFRAP	SMA SP	SMA SP	SMA RAP	SMA FFRAP	TNC SP	TNC FFRAP	N SP	N FFRAP	
26.5 GHz	3.5 mm SP	0404	0454	0441	0104	0421	0451	0204	0452	0304	0453
	3.5 mm FFRAP	0454	5454	4154	0154	2154	5154	0254	5254	0354	5354
	SMA SP	0441	4154	4141	0141	2141	4151	0241	4152	0341	4153
18 GHz	SMA SP	0104	0154	0141	0101	0121	0151	0102	0152	0103	0153
	SMA RAP	0421	2154	2141	0121	2121	2151	0221	2152	0321	2153
	SMA FFRAP	0451	5154	4151	0151	2151	5151	0251	5152	0351	5153
	TNC SP	0204	0254	0241	0102	0221	0251	0202	0252	0203	0253
	TNC FFRAP	0452	5254	4152	0152	2152	5152	0252	5252	0352	5253
	N SP	0304	0354	0341	0103	0321	0351	0203	0352	0303	0353
	N FFRAP	0453	5354	4153	0153	2153	5153	0253	5253	0353	5353

Other connector styles include: SMA SJ, 3.5mm SJ, N BFJ and N 4HFMJ.

CONNECTOR CODES	
4HFMJ	4-Hole Flange Mount Jack
SJ	Straight Jack
BFJ	Bulkhead Feedthru Jack
SP	Straight Plug
RAP	Right-Angle Plug
FFRAP	Factory Formed Right-Angle Plug

EXAMPLES:

062-0404-048 = Unarmored PhaseMaster® 210 with standard FEP jacket, 3.5 mm SP to 3.5 mm SP (assembly operates to 26.5 GHz), 48 inches

R62Z-4141-120 = Ruggedized PhaseMaster® 210 with LSZH jacket, SMA SP to SMA SP (assembly operates to 26.5 GHz), 120 inches

PHASEMASTER® 300

CONNECTOR COMBINATION PART NUMBERS*

	18 GHz						
	SMA SP	SMA FFRAP	TNC SP	TNC FFRAP	N SP	N FFRAP	
18 GHz	SMA SP	0101	0151	0102	0152	0103	0153
	SMA FFRAP	0151	5151	0251	5152	0351	5153
	TNC SP	0102	0251	0202	0252	0203	0253
	TNC FFRAP	0152	5152	0252	5252	0352	5253
	N SP	0103	0351	0203	0352	0303	0353
	N FFRAP	0153	5153	0253	5253	0353	5353

Other connector styles include: SMA RAP, SMA SJ and N BFJ.

CONNECTOR CODES	
RAP	Right-Angle Plug
SJ	Straight Jack
BFJ	Bulkhead Feedthru Jack
SP	Straight Plug
FFRAP	Factory Formed Right-Angle Plug

EXAMPLES:

061-0303-036 = Unarmored PhaseMaster® 300 with standard FEP jacket, N SP to N SP (assembly operates to 18 GHz), 36 inches

AN61Z-0101-108 = Hard Armored (no polyolefin jacket) PhaseMaster® 300 with LSZH jacket, SMA SP to SMA SP (assembly operates to 18 GHz), 108 inches

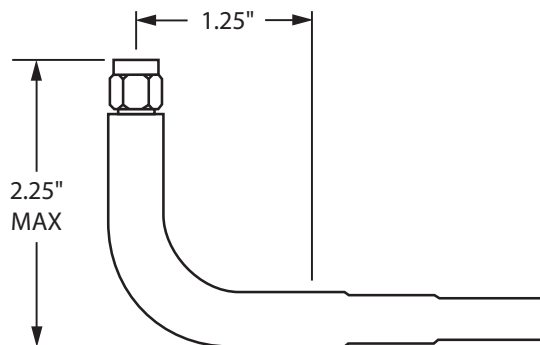
* Other connector styles available; consult Storm | Connector requirements in accordance with MIL-PRF-39012, MIL-STD-348, and IEEE-287 as appropriate.

FACTORY FORMED RIGHT-ANGLE (FFRA) CONNECTORS

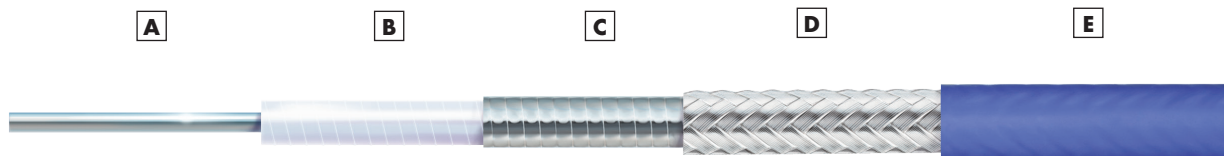
Designed using straight connectors and a shrink tubing–strain relief combination, FFRA connectors offer a moderate right-angle space advantage at a significant cost savings over traditional right-angle connectors.

FFRA connectors are available for most PhaseMaster® cable sizes. See the Connector tables for specific connectors available as FFRA's.

Note: The dimensions given here are for PM160 with an SMK connector. Larger cables will have proportionally larger dimensions. Contact Storm for specifics.



PhaseMaster® CABLE CONSTRUCTION



- A** Silver-plated copper center conductor
- B** Expanded PTFE dielectric
- C** Helically wrapped SPC flat wire shield
- D** Silver-plated copper braid
- E** Extruded blue FEP jacket standard; blue LSZH (low smoke zero halogen) jacket on request

ARMORING & RUGGEDIZING OPTIONS

The Hard Armored option (with and without polyolefin jacket) is available for PhaseMaster® 160, 190, 210, and 300 cables. And, when specifying FFRAP connectors, custom part numbering must be used. Call Storm for details.

The Ruggedized option (with polyurethane jacket) is available for PhaseMaster® 210 and 300 cables, but not with FFRAP connectors.

HARD ARMORED – Polyolefin jacket

Armoring Designator: **A**



Designed for both inside and outside environments where flexibility and weight are not as critical, but where the application requires the ultimate in cut and crush resistance (500 lbs/in). The cable is covered with a stainless steel interlocked armor and a cross-linked polyolefin jacket.

Temperature: -55° C thru +125° C

Diameter: PhaseMaster® 160 – 0.300"/7.62 mm
PhaseMaster® 190 – 0.430"/10.92 mm
PhaseMaster® 210 – 0.430"/10.92 mm
PhaseMaster® 300 – 0.525"/13.34 mm

HARD ARMORED – No polyolefin jacket

Armoring Designator: **AN**



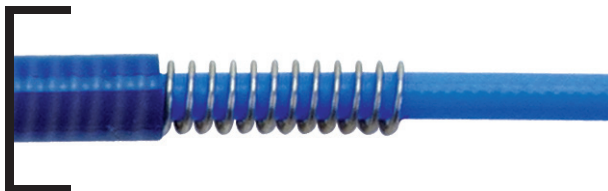
Designed for both inside and outside environments where flexibility and weight are not as critical, but where the application requires the ultimate in cut and crush resistance (500 lbs/in). The cable is covered with a stainless steel interlocked armor.

Temperature: -55° C thru +125° C

Diameter: PhaseMaster® 160 – 0.265"/6.73 mm
PhaseMaster® 190 – 0.395"/10.03 mm
PhaseMaster® 210 – 0.395"/10.03 mm
PhaseMaster® 300 – 0.475"/12.07 mm

RUGGEDIZED – Polyurethane jacket

Armoring Designator: **R**



For applications similar to the above, where weight, flexibility, and moderate compression resistance (300 lbs/in) are important, but where abrasion resistance is also critical. The cable is covered with a flexible wound helix of passivated stainless steel wire and an extruded polyurethane jacket.

Temperature: -55° C thru +100° C

Diameter: PhaseMaster® 210 – 0.348"/8.84 mm
PhaseMaster® 300 – 0.454"/11.53 mm