

DOCSIS[®] 3.1

PRODUCT GUIDE

*The Next Generation Technology
for CATV and Broadband*



finding new ways...
setting higher standards

 **Mini-Circuits[®]**
www.minicircuits.com

INTRODUCTION

The Industry's Widest Variety of RF/IF and Microwave Products for the Next Generation of Broadband Applications

As consumer demand for higher data capacity continues to intensify, network operators deploying optical and hybrid fiber-coaxial (HFC) infrastructure continue to push the limits of their equipment to operate under the new, DOCSIS® 3.1 standard. Competition at the operator level is driving rapid qualification and development of new equipment, with testing and certification for deployment expected to expand in the very near term. To meet the new standard and accelerate time to market, program managers, system designers and purchasing managers in the broadband space need components with tightly specified performance and high reliability with value pricing and fast delivery.

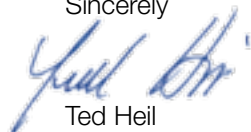
Mini-Circuits is deeply committed to supporting equipment manufacturers and operators in the broadband market as this transition occurs. Many of our components are already being successfully designed into DOCSIS 3.1 applications from head-end infrastructure to customer-premises equipment. In support of this transition to DOCSIS 3.1, Mini-Circuits has expanded our product portfolio to include a variety of new models developed especially to meet the unique requirements of this standard.

We're very pleased to present our product offering for the next generation of CATV and Broadband applications in our new DOCSIS® 3.1 Product Guide. Inside you'll find detailed information on a wide range of RF components from passive devices including transformers, couplers, and splitter/combiners to active elements including amplifiers, equalizers and more – all designed and carefully specified to meet DOCSIS 3.1 standards. We hope this material gives you a convenient reference to make an informed decision as you evaluate parts for your design.

With the industry's broadest variety of off-the-shelf RF/IF and microwave products, chances are, we have you covered, but even if you don't see what you need here, we're always here to support you. We invite you to get in touch with our applications team (apps@minicircuits.com) to discuss any questions or special requirements you may have. Our engineers can design custom components to meet your exact requirements for low cost and with exceptionally fast turnaround times.

Thank you for your interest in Mini-Circuits and our extensive offering of RF products for the most advanced implementation of cable network technology to date. We hope this information gives you a valuable tool in your search for the right components to make your project a success.

Sincerely



Ted Heil
President
Mini-Circuits

PERFORMANCE YOU CAN COUNT ON:

Precision Test and Measurement of 75Ω Products

Meeting the new standard for data over cable systems demands components that perform reliably to meet the precise requirements of your design. Mini-Circuits has long been highly regarded in the industry for the sophistication of our test and measurement techniques, and our expertise in this area enables us to qualify the performance of our products for broadband and cable network applications to a superior level of accuracy. Characterizing RF products for use in cable and broadband networks poses the unique problem of how to perform test and measurement of 75Ω components using the industry-standard 50Ω vector network analyzer equipment. The accuracy and precision of this testing depends entirely on the measurement method employed.

Two traditional methods for performing these measurements are building matching circuits for each DUT into test fixtures and back-to-back transformer measurement. Building matching circuits to compensate for impedance mismatch could require dozens of different matching circuits to test different components, which makes it both costly and impractical. Furthermore, compensating for the losses of matching circuits undermines measurement accuracy. At the same time, back-to-back transformer measurement is dependent on the matching and losses of the transformers used and therefore only provides an approximation of the real performance of the DUT.

Fortunately, in recent years, the RF industry introduced vector network analyzers capable of performing virtual impedance conversion or "Z-conversion." Measurement with virtual impedance conversion avoids the need for test fixtures with matching circuits, eliminating the problem of compensating for loss. The fixture is used with 50Ω at all ports, calibration is performed using a 50Ω calibration kit, and then auto port extension and Z-conversion are applied. This method allows precision measurement of components with 75Ω impedance and is especially effective with passive components such as splitters, couplers and transformers.

By using virtual impedance conversion to characterize the performance of our 75Ω product portfolio, Mini-Circuits is able to provide our customers with tight performance specifications for every product we produce. In the broadband cable market where high demand and competition are driving requirements for high system performance and speed to market, designers need parts they can rely on to meet those requirements. As you evaluate parts for your design, it's important to consider how suppliers are qualifying performance given the special challenges of test and measurement for 75Ω products. With Mini-Circuits, you can know we're using the most advanced tools and the most accurate measurement methods available, so you can have confidence in the performance of our products.

For more information about test and measurement at Mini-Circuits, we invite you to reach out to us. Our engineers are ready to discuss any questions or special requirements you may have. We're here to support you!

Contact:
Mini-Circuits Applications
apps@minicircuits.com

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PHA-11+	16	18.8	50	3000	12-13
PHA-22+	16	17	50	1500	14-15
MGVA-62+	15.7	12.2	40	3000	16-17
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TCD-6-122-75X+	6.7	5	1250	28-29
TCD-13-122-75X+	12.7	5	1250	30
TCD-18-122-75X+	17.5	5	1250	30
TCD-20-4-75+	20	40	1200	31
TCD-20-4-75X+	20	40	1200	31
DBTC-6-4-75+	6	5	1250	32-33
DBTC-9-4-75L+	9.3	5	1200	34
DBTC-12-4-75+	12	5	1200	34
DBTC-16-5-75L+	16	5	1500	35
DBTC-20-4-75L+	20.5	5	1250	35
ADC-8-4-75+	7.9	5	1250	36
ADC-10-4-75+	10.5	5	1250	36
ADC-12-4-75+	12.5	5	1250	37
ADC-16-4-75+	16.3	5	1250	37
ADC-20-4-75+	19.7	5	1250	38
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ADP-2-10-75M+	2-Way 0°	5	1200	54
ADP-2-20-75+	2-Way 0°	5	2000	54
CDP-2-122-75+	2-Way 0°	5	1200	55
SYPS-2-282-75+	2-Way 0°	5	2750	55
CDP-2-122W-75X+	2-Way 0°	1	1250	56-57
TCP-2-122-75X+	2-Way 0°	5	1250	58-59
SBTCJ-122-75+	2-Way 180°	5	1250	60
SYPS-3-12W-75+	3-Way 0°	5	1200	60
SCA-4-15-75+	4-Way 0°	10	1500	61
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TC1-1T-75X+	1	5	120	90-91
TC4-6T-75X+	4	1	300	92-93
TRS1-182-75+	1	10	1800	94-95
ADTL1-15-75+	1	10	1500	96
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Model Number	Impedance Ω	Min Freq. MHz	Max Freq. MHz	
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BMP-5075R+	50/75	DC	2000	100
UNMP-5075+	50/75	DC	3000	101
UNMP-5075-33+	50/75	DC	3000	101

Test Cables

Model Number	Connector Type	Min Freq. MHz	Max Freq. MHz	
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CBL-3 FM-75+	F	DC	3000	102
CBL-6FM-75+	F	DC	3000	103
CBL-1MFM-75+	F	DC	3000	103

USB Power Sensors

Model Number	Dynamic Range dB	Min Freq. MHz	Max Freq. MHz	
PWR-2.5GHS-75	-30 to +20 dBm	0.1	2500	104-105

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Model Number	Max Attenuation dB	Min Freq. MHz	Max Freq. MHz	
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EVA-2-75+	40	50	2000	110-111

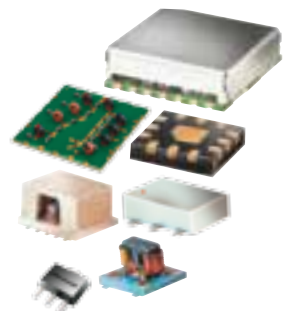
Voltage Variable Equalizers

Model Number	Max Attenuation dB	Min Freq. MHz	Max Freq. MHz	
VAEQ-1220-75+	11	50	1220	112-113

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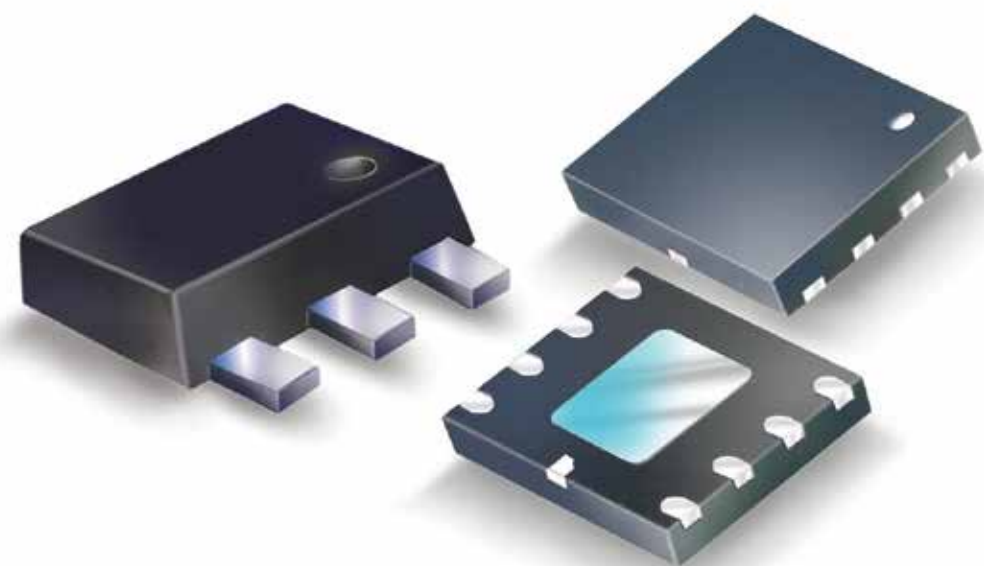
All Products are **RoHS Compliant**

The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications.



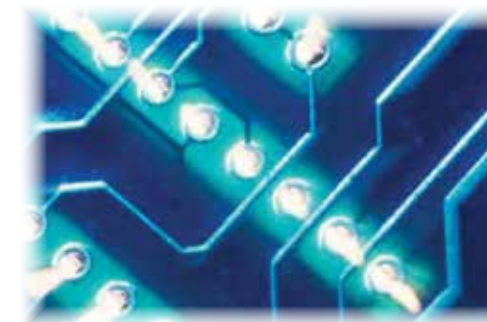
MMIC AMPLIFIERS

Our selection of amplifiers for CATV and broadband systems provides frequency ranges supporting both upstream and downstream bandwidth requirements for the DOCSIS 3.1 standard. These amplifiers provide outstanding dynamic range and gain flatness, enabling excellent system performance across broad bandwidths. Manufactured using E-PHEMT and InGap HBT technology on GaAs, they come in packages as small as SOT-89 with designed-in ESD protection and excellent unit-to-unit repeatability.



FEATURES

- ▶ Flat Gain
- ▶ High Dynamic Range
- ▶ Low Noise
- ▶ Discrete and Dual-Matched Models
- ▶ Upstream and Downstream Bands
- ▶ Tiny Size



75Ω Flat Gain, High Dynamic Range
Monolithic Amplifier

0.05-1.5 GHz

Monolithic E-PHEMT MMIC Amplifier

PGA-106-75+

Product Features

- High IP3, 37 dBm typ. at 0.5 GHz
- Gain, 17.4 dB typ. at 0.5 GHz
- High Pout, P1dB 19.8 dBm typ. at 0.5 GHz
- Low Noise Figure, 3.1 dB at 0.5 GHz



CASE STYLE: DF782

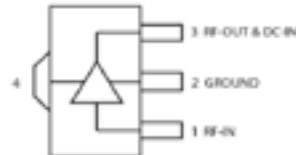
Typical Applications

- CATV
- GPON
- MOCA
- DBS

General Description

PGA-106-75+ (RoHS compliant) is an advanced wideband amplifier fabricated using E-PHEMT* technology and offers extremely high dynamic range over a broad frequency range and with low noise figure and flat gain. In addition, the PGA-106-75+ has excellent input and output return loss over a broad frequency range. Lead finish is SnAgNi. It has repeatable performance from lot to lot and is enclosed in a SOT-89 package for very good thermal performance.

simplified schematic and pin description



Function	Pin Number	Description
RF IN	1	RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation.
RF-OUT and DC-IN	3	RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig. 2
GND	2,4	Connections to ground. Use via holes as shown in "Suggested Layout for PCB Design" to reduce ground path inductance for best performance.

*Enhanced mode pseudomorphic High Electron Mobility Transistor.

Electrical Specifications at 25°C, 75Ω and 5.0V⁽¹⁾, unless noted

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units
Frequency Range		0.05		1.5	GHz
Gain	0.05	—	17.8	—	dB
	0.5	—	17.4	—	
	1.0	15.5	16.9	19.5	
	1.2	—	16.7	—	
	1.5	—	16.1	—	
Input Return Loss	0.05		14.9		dB
	0.5		14.5		
	1.0		21.0		
	1.2		25.3		
	1.5		18.4		
Output Return Loss	0.05		21.2		dB
	0.5		16.0		
	1.0		15.5		
	1.2		14.6		
	1.5		12.5		
Reverse Isolation	1.0		24.4		dB
Output Power @ 1 dB compression	0.05		19.2		dBm
	0.5		19.8		
	1.0		20.1		
	1.2		19.8		
	1.5		19.3		
Output IP3	0.05		37.5		dBm
	0.5		37.3		
	1.0		36.2		
	1.2		36.0		
	1.5		35.0		
Output IP2 ⁽²⁾	0.05		61.0		dBm
	0.5		59.8		
	1.0		58.4		
	1.2		52.2		
	1.5		59.8		
Noise Figure	0.05		3.3		dB
	0.5		3.1		
	1.0		3.3		
	1.2		3.3		
	1.5		3.7		
Device Operating Voltage (Vd)		4.8	5.0	5.2	V
Device Operating Current			116	132	mA
Device Current Variation vs. Temperature ⁽⁴⁾			97		µA/°C
Device Current Variation vs Voltage			0.05		mA/mV
Thermal Resistance ⁽³⁾			76		°C/W

⁽¹⁾ Measured on Mini-Circuits Characterization Eval board TB-670+. See Characterization Test Circuit (Fig. 1)

⁽²⁾ Output IP2 measured at sum frequency of the two tones (f meas=f1+f2).

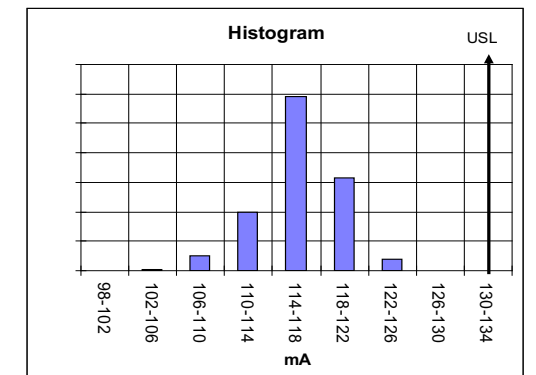
⁽³⁾ Junction to ground lead.

⁽⁴⁾ (Current at 85°C - Current at -45°C)/130

Absolute Maximum Ratings

Parameter	Ratings
Operating Temperature (ground lead)	-40°C to 85°C
Storage Temperature	-65°C to 150°C
Operating Current at 5.0V	170 mA
Power Dissipation	0.85 W
Input Power (CW)	+26 dBm (5 minutes) +14 dBm (continuous)
DC Voltage on Pin 3	6 V

Permanent damage may occur if any of these limits are exceeded. Electrical maximum ratings are not intended for continuous normal operation.



75Ω Flat Gain, High Dynamic Range
Monolithic Amplifier

5-250 MHz

Monolithic E-PHEMT MMIC Amplifier

PGA-106R-75+

Product Features

- High IP3, 34 dBm typ.
- Gain, 17.9 dB typ.
- High Pout, P1dB 19.5 dBm typ.
- Excellent gain flatness, ± 0.1 dB typ.



CASE STYLE: DF782

Typical Applications

- CATV Return path

General Description

PGA-106R-75+ (RoHS compliant) is an advanced wideband amplifier fabricated using E-PHEMT* technology and offers extremely high dynamic range over a broad frequency range and with low noise figure and flat gain. In addition, the PGA-106R-75+ has excellent input and output return loss over a broad frequency range. Lead finish is SnAgNi. It has repeatable performance from lot to lot and is enclosed in a SOT-89 package for very good thermal performance.

simplified schematic and pin description



Function	Pin Number	Description
RF IN	1	RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation.
RF-OUT and DC-IN	3	RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig. 2
GND	2,4	Connections to ground. Use via holes as shown in "Suggested Layout for PCB Design" to reduce ground path inductance for best performance.

*Enhanced mode pseudomorphic High Electron Mobility Transistor.

Parameter	Condition (MHz)	Min.	Typ.	Max.	Units
Frequency Range		5		250	MHz
Gain	5 - 250	16.3	17.9	19.9	dB
Gain Flatness (±)	5 - 250		0.1		dB
Input Return Loss	5 - 250		15.3		dB
Output Return Loss	5 - 250		19.0		dB
Reverse Isolation	5 - 250		23.4		dB
Output Power @ 1dB compression	5 - 250		19.5		dBm
Output IP3	5 - 250		34.4		dBm
Output IP2 ⁽²⁾	5 - 250		62.0		dBm
Noise Figure	10	—	6.0	—	dB
	50	—	3.3	—	
	250	—	3.1	—	
Device Operating Voltage (Vd)		4.8	5.0	5.2	V
Device Operating Current		—	116	132	mA
Device Current Variation vs. Temperature ⁽⁴⁾			97		µA/°C
Device Current Variation vs Voltage			0.05		mA/mV
Thermal Resistance ⁽³⁾			76		°C/W

⁽¹⁾ Measured on Mini-Circuits Characterization Test board TB-587+. See Characterization Test Circuit (Fig. 1)

⁽²⁾ Output IP2 measured at sum frequency of the two tones (f meas= f1+f2).

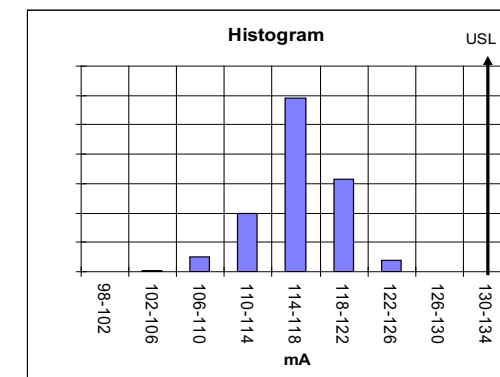
⁽³⁾ Junction to ground lead.

⁽⁴⁾ (Current at 85°C - Current at -45°C)/130

Absolute Maximum Ratings

Parameter	Ratings
Operating Temperature (ground lead)	-40°C to 85°C
Storage Temperature	-65°C to 150°C
Operating Current at 5.0V	170 mA
Power Dissipation	0.85 W
Input Power (CW)	+23 dBm (5 minutes) +14 dBm (continuous)
DC Voltage on Pin 3	6 V

Permanent damage may occur if any of these limits are exceeded. Electrical maximum ratings are not intended for continuous normal operation.



Product Features

- Two matched amplifiers in one package
- High IP3, +44 dBm at 0.8 GHz in push-pull configuration
- High IP2, +78 dBm at 0.8 GHz in push-pull configuration
- Gain, 16 dB typ. at 0.8 GHz
- P1dB, +22 dBm typ. at 0.8 GHz
- Low noise figure, 1.8 dB typ. at 0.8 GHz
- May be used as replacement for WJ AH11a,b

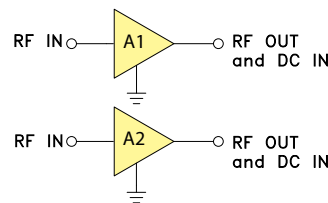
Typical Applications

- CATV
- FTTH
- Optical networks
- Base station infrastructure
- Balanced amplifiers
- 75 Ohm push-pull and balanced amplifiers

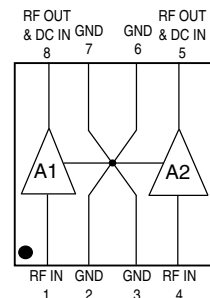
General Description

PHA-11+ is a dual matched wideband high dynamic range amplifier. Enclosed in a 6.0 x 4.9 mm MCLP plastic package. PHA-11+ is fabricated using E-PHEMT* technology and is ideal for use in balanced and push-pull amplifiers.

simplified schematic (each of A1, A2) and pin description



CASE STYLE: DL1020



Function	Pin Number	Description
RF IN, A1	1	RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. (see Application circuit, Fig 2.)
RF-OUT and DC-IN, A1	8	RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig 2
RF IN, A2	4	RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. (see Application circuit, Fig 2.)
RF-OUT and DC-IN, A2	5	RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig 2
GND	2,3,6,7 & paddle	Connections to ground. Use via holes as shown in "Suggested Layout for PCB Design" to reduce ground path inductance for best performance.

* Enhancement mode pseudomorphic High Electron Mobility Transistor.
 a. Suitability for model replacement within a particular system must be determined by and is solely the responsibility of the customer based on, among other things, electrical performance criteria, stimulus conditions, application, compatibility with other components and environmental conditions and stresses.
 b. The WJ part number is used for identification and comparison purposes only.

Electrical Specifications¹ at 25°C, Zo=50Ω and Device Voltage 5V, unless noted
 (Specifications (other than Matching or where defined as push-pull) are for each of the two matched amplifiers in the package)

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units	
Frequency Range		0.05		3.0	GHz	
Gain	0.05	—	17.7	—	dB	
	0.25	—	16.4	—		
	0.45	—	16.3	—		
	0.8	14.5	16.1	17.7		
	2.0	—	14.5	—		
Input Return Loss	0.05	—	11.3	—	dB	
	0.25	—	19.5	—		
	0.45	—	19.4	—		
	0.8	—	17.0	—		
	2.0	—	8.4	—		
Output Return Loss	0.05	—	14.1	—	dB	
	0.25	—	22.1	—		
	0.45	—	21.7	—		
	0.8	—	18.8	—		
	2.0	—	10.0	—		
Output Power @ 1 dB compression ⁽²⁾	0.05	—	22.4	—	dBm	
	0.25	—	22.7	—		
	0.45	—	22.7	—		
	0.8	—	22.5	—		
	2.0	—	21.5	—		
Output IP3 ⁽⁶⁾	0.05	—	41.4	—	dBm	
	0.25	—	41.4	—		
	0.45	—	41.6	—		
	0.8	37.0	41.5	—		
	2.0	—	42.9	—		
Noise Figure	0.05	—	1.8	—	dB	
	0.25	—	1.8	—		
	0.45	—	1.8	—		
	0.8	—	1.8	—		
	2.0	—	2.2	—		
Matching between A1, A2	Amplitude Unbalance	0.05	—	0.11	—	dB
		0.25	—	0.12	—	
		0.45	—	0.12	—	
		0.8	—	0.12	0.6	
		2.0	—	0.22	—	
	Phase Unbalance	0.05	—	0.25	—	deg.
		0.25	—	0.3	—	
		0.45	—	0.31	—	
		0.8	—	0.51	—	
		2.0	—	1.0	5.0	
3.0	—	1.6	—			
3.0	—	2.0	—			
Device Operating Voltage		4.8	5.0	5.2	V	
Device Operating Current (each amplifier)		110	146	180	mA	
Device Current Variation vs. Temperature			23		µA/°C	
Device Current Variation vs Voltage			0.053		mA/mV	
Thermal Resistance, junction-to-ground lead ⁽⁷⁾			34		°C/W	

Absolute Maximum Ratings ⁽⁴⁾

Parameter	Ratings
Operating Temperature ⁽⁵⁾	-40°C to 85°C
Storage Temperature	-55°C to 150°C
Operating Current at 5V ⁽⁶⁾	200 mA
Power Dissipation ⁽⁶⁾	1000 mW
Input Power (CW)	+24
DC Voltage (pads 5,8)	6V

Notes:
 (1) Measured on Mini-Circuits Test Board TB-561-11+ (characterization test circuit, Fig 1a).
 (2) Current increases at P1dB
 (3) Measured on evaluation boards (push-pull amplifiers) TB-566-50-11+, TB-666-50-11+ (50Ω) and TB-566-75-11+ (75Ω). See Characterization Test Circuit (Fig. 1b)
 (4) Permanent damage may occur if any of these limits are exceeded.
 (5) These ratings are not intended for continuous normal operation.
 (6) Defined with reference to ground pad temperature.
 (7) Per single ended amplifier
 (8) Jc= Junction Temperature-85°C
 (9) Voltage X sum of current in A1 & A2

Push-Pull Amplifier Typical Performance ⁽³⁾

Freq. GHz	TB-566-75-11+ (75Ω)			TB-566-50-11+ (50Ω)			TB-666-50-11+ (50Ω)		
	Gain (dB)	Output IP3 (dBm)	Output IP2 (dBm)	Gain (dB)	Output IP3 (dBm)	Output IP2 (dBm)	Gain (dB)	Output IP3 (dBm)	Output IP2 (dBm)
0.05	14.2	45.0	79.0	15.2	45.0	82.0	14.1	40.1	71.4
0.25	13.7	43.0	79.0	13.8	45.0	84.0	13.8	40.7	70.5
0.45	14.0	42.0	81.0	13.8	44.0	81.0	14.1	42.2	75.6
0.85	14.1	43.0	72.0	13.0	44.0	76.0	13.1	40.4	71.5
1.20	13.8	40.6	78.0	12.0	43.0	72.0	12.9	39.4	62.1
1.30	13.5	40.3	78.0	--	--	--	12.8	40.0	56.8
1.50	--	--	--	--	--	--	12.2	39.7	60.8
2.00	--	--	--	--	--	--	11.8	41.0	65.2
3.00	--	--	--	--	--	--	8.6	36.2	70.8

Product Features

- Two matched amplifiers in one package
- High IP3, +44 dBm at 0.8 GHz in push-pull configuration
- High IP2, +78 dBm at 0.8 GHz in push-pull configuration
- Gain, 16 dB typ. at 0.8 GHz
- P1dB, +22 dBm typ. at 0.8 GHz
- Low noise figure, 1.8 dB typ. at 0.8 GHz
- May be used as replacement for WJ AH22^{a,b}



CASE STYLE: DL1020

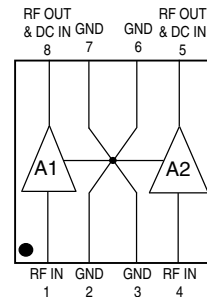
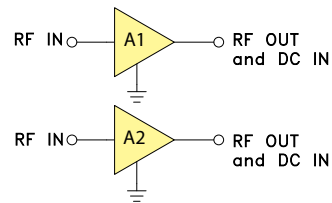
Typical Applications

- CATV
- FTTH
- Optical networks
- Base station infrastructure
- Balanced amplifiers
- 75 Ohm push-pull and balanced amplifiers

General Description

PHA-22+ is a dual matched wideband high dynamic range amplifier. Enclosed in a 6.0 x 4.9 mm MCLP plastic package. PHA-22+ is fabricated using E-PHEMT* technology and is ideal for use in balanced and push-pull amplifiers.

simplified schematic (each of A1, A2) and pin description



Function	Pin Number	Description
RF IN, A1	1	RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. (see Application Circuit, Fig 2.)
RF-OUT and DC-IN, A1	8	RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig 2
RF IN, A2	4	RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. (see Application Circuit, Fig 2.)
RF-OUT and DC-IN, A2	5	RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig 2
GND	2,3,6,7 & paddle	Connections to ground. Use via holes as shown in "Suggested Layout for PCB Design" to reduce ground path inductance for best performance.

* Enhancement mode pseudomorphic High Electron Mobility Transistor.

a. Suitability for model replacement within a particular system must be determined by and is solely the responsibility of the customer based on, among other things, electrical performance criteria, stimulus conditions, application, compatibility with other components and environmental conditions and stresses.

b. The WJ part number is used for identification and comparison purposes only.

Electrical Specifications¹ at 25°C, Zo=50Ω and Device Voltage 5V, unless noted

(Specifications (other than Matching or where defined as push-pull) are for each of the two matched amplifiers in the package)

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units
Frequency Range		0.05		1.5	GHz
Gain	0.05	—	17.7	—	
	0.8	14.5	16.1	17.7	dB
	1.5	—	15.4	—	
Input Return Loss	0.05		11.3		
	0.8		17.0		dB
	1.5		11.7		
Output Return Loss	0.05		14.1		
	0.8		18.8		dB
	1.5		13.1		
Output Power @ 1 dB compression ⁽²⁾	0.05		22.4		
	0.8		22.5		dBm
	1.5		22.5		
Output IP3 ⁽⁶⁾	0.05	—	41.4		
	0.8	37.0	41.5		dBm
	1.5	—	42.9		
Noise Figure	0.05		1.8		
	0.8		1.8		dB
	1.5		2.0		
Matching between A1, A2	Amplitude Unbalance	0.05	0.11	—	
		0.8	0.12	0.6	dB
		1.5	0.22	—	
	Phase Unbalance	0.05	0.3	—	
		0.8	1.0	5.0	deg.
		1.5	1.6	—	
Device Operating Voltage		4.8	5.0	5.2	V
Device Operating Current (each amplifier)		110	146	180	mA
Device Current Variation vs. Temperature			23		μA/°C
Device Current Variation vs Voltage			0.053		mA/mV

Push-Pull Amplifier Typical Performance ⁽³⁾

Frequency (GHz)	TB-566-75+ (75Ω)			TB-566-50+ (50Ω)		
	Gain (dB)	Output IP3 (dBm)	Output IP2 (dBm)	Gain (dB)	Output IP3 (dBm)	Output IP2 (dBm)
0.05	14.2	45.0	79.0	15.2	45.0	82.0
0.25	13.7	43.0	79.0	13.8	45.0	84.0
0.45	14.0	42.0	81.0	13.8	44.0	81.0
0.85	14.1	43.0	72.0	13.0	44.0	76.0
1.20	13.8	40.6	78.0	12.0	43.0	72.0
1.30	13.5	40.3	78.0	--	--	--

Absolute Maximum Ratings ⁽⁴⁾

Parameter	Ratings
Operating Temperature ⁽⁵⁾	-40°C to 85°C
Storage Temperature	-55°C to 150°C
Operating Current at 5V ⁽⁶⁾	200 mA
Power Dissipation ⁽⁶⁾	1000 mW
Input Power (CW)	+24 dBm
DC Voltage (pads 5,8)	6V

Notes:

(1) Measured on Mini-Circuits Test Board TB-561-22+ (characterization test circuit, Fig 1a).

(2) Current increases at P1dB

(3) Measured on evaluation boards (push-pull amplifiers) TB-566-50+ (50Ω) and TB-566-75+ (75Ω). See Characterization Test Circuit (Fig. 1b)

(4) Permanent damage may occur if any of these limits are exceeded.

These ratings are not intended for continuous normal operation.

(5) Defined with reference to ground pad temperature.

(6) Per single ended amplifier

(7) Θjc= Junction Temperature-85°C

Voltage X sum of current in A1 & A2

Product Features

- Two matched amplifiers in one package
- High IP3, +37.9 dBm at 0.9 GHz
- High IP2, +70 dBm at 0.9 GHz in push-pull configuration
- Gain, 15.7 dB typ at 0.9 GHz
- Excellent Gain flatness, ±0.5 dB (0.05-3 GHz)
- P1dB, +19.6 dBm typ at 0.9 GHz

Typical Applications

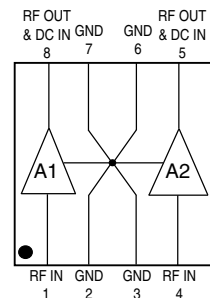
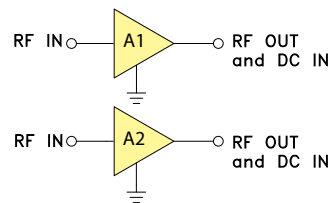
- SATCOM
- CATV
- FTTH
- Optical networks
- Base station infrastructure
- Balanced amplifiers
- 75 Ohm push-pull and balanced amplifiers

General Description

MGVA-62+ (RoHS compliant) is an advanced ultra-flat gain amplifier fabricated using InGaP HBT technology and offers high dynamic range over a broad frequency range. In addition, the MGVA-62+ has good input and output return loss over a broad frequency range without the need for external matching components. Lead finish is SnAgNi and is enclosed in a 4.9 x 6 mm MCLP package for good thermal performance.



simplified schematic (each of A1, A2) and pad description



Function	Pad Number	Description
RF IN, A1	1	RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. (see Application circuit, Fig 2.)
RF-OUT and DC-IN, A1	8	RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig 2
RF IN, A2	4	RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. (see Application circuit, Fig 2.)
RF-OUT and DC-IN, A2	5	RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig 2
GND	2,3,6,7 & paddle	Connections to ground. Use via holes as shown in "Suggested Layout for PCB Design" to reduce ground path inductance for best performance.

Electrical Specifications¹ at 25°C, Zo=50Ω and Device Voltage 5V, unless noted

(Specifications (other than Matching or where defined as push-pull) are for each of the two matched amplifiers in the package)

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units	
Frequency Range		0.04		3.0	GHz	
Gain	0.04	—	16.7	—	dB	
	0.5	—	15.7	—		
	0.9	14.1	15.7	17.3		
	2.0	—	15.8	—		
	2.6	—	15.8	—		
Gain Flatness	0.05-3.0		±0.5		dB	
	0.04		16.7			
	0.5		13.3			
	0.9		12.2			
	2.0		9.3			
Input Return Loss	2.6		8.0		dB	
	3.0		7.1			
	0.04		12.5			
	0.5		18.1			
	0.9		19.4			
Output Return Loss	2.0		18.2		dB	
	2.6		12.9			
	3.0		10.2			
	0.04		19.8			
	0.5		19.8			
Output Power @ 1 dB compression ^(2,3)	0.9		19.6		dBm	
	2.0		19.4			
	2.6		18.4			
	3.0		17.4			
	0.04		36.3			
Output IP3 ⁽³⁾	0.5		37.9		dBm	
	0.9	34.8	37.9			
	2.0		34.3			
	2.6		31.7			
	3.0		29.9			
Noise Figure	0.04		4.7		dB	
	0.5		4.8			
	0.9		4.8			
	2.0		5.1			
	2.6		5.4			
Matching between A1, A2	Amplitude Unbalance	0.04	—	0.0	—	dB
		0.5	—	0.1	—	
		0.9	—	0.1	0.5	
		2.0	—	0.1	—	
		2.6	—	0.1	—	
	3.0	—	0.2	—		
	Phase Unbalance	0.04	—	0.0	—	deg.
		0.5	—	0.1	—	
		0.9	—	0.3	5.0	
		2.0	—	0.7	—	
2.6		—	0.7	—		
3.0	—	0.6	—			
Device Operating Voltage		4.8	5.0	5.2	V	
Device Operating Current (each amplifier)			82	92	mA	
Device Current Variation vs. Temperature			61		µA/°C	
Device Current Variation vs Voltage			0.036		mA/mV	
Thermal Resistance, junction-to-ground lead ⁽⁴⁾			39		°C/W	

⁽¹⁾ Measured on Mini-Circuits Test Board TB-561-62+, see characterization circuit, Fig 1.
⁽²⁾ Current increases at P1dB

⁽³⁾ Per single ended amplifier
⁽⁴⁾ θjc= (Junction Temperature - 85°C) / (Voltage X sum of current in A1 & A2)

Absolute Maximum Ratings⁽⁶⁾

Parameter	Ratings
Operating Temperature ⁷	-40°C to 85°C
Storage Temperature	-55°C to 150°C
Operating Current at 5V	120 mA
Power Dissipation	0.725 W
Input Power (CW)	24 dBm
DC Voltage (pads 5, 8)	6.0

⁽⁶⁾ Permanent damage may occur if any of these limits are exceeded. These ratings are not intended for continuous normal operation.
⁽⁷⁾ Defined with reference to ground pad temperature.

Push-Pull Amplifier Typical Performance⁽⁵⁾

Freq. GHz	TB-666-50-62+ (50Ω)		
	Gain (dB)	Output IP3 (dBm)	Output IP2 (dBm)
0.04	13.3	36.4	68.7
0.5	13.1	37.0	69.5
0.9	12.9	39.5	70.0
2.0	12.7	35.6	50.6
2.6	12.4	32.3	72.6
3.0	11.2	31.4	68.0

⁽⁵⁾ Measured on evaluation boards TB-666-50-62+ (push-pull amplifier)

Dual Matched MMIC Amplifier

0.04-3 GHz

Monolithic InGaP HBT MMIC Amplifier

MGVA-63+

Product Features

- Two matched amplifiers in one package
- High IP3, +34.3 dBm at 0.9 GHz
- High IP2, +70 dBm at 0.9 GHz in push-pull configuration
- Gain, 21.4 dB typ at 0.9 GHz
- P1dB, +19.4 dBm typ at 0.9 GHz



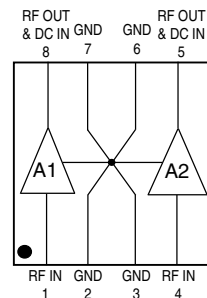
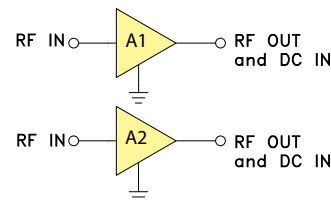
Typical Applications

- SATCOM
- CATV
- FTTH
- Optical networks
- Base station infrastructure
- Balanced amplifiers
- 75 Ohm push-pull and balanced amplifiers

General Description

MGVA-63+ (RoHS compliant) is a high gain amplifier fabricated using InGaP HBT technology and offers high dynamic range over a broad frequency range. Lead finish is SnAgNi and is enclosed in a 4.9 x 6 mm MCLP package for good thermal performance.

simplified schematic (each of A1, A2) and pad description



Function	Pad Number	Description
RF IN, A1	1	RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. (see Application circuit, Fig 2.)
RF-OUT and DC-IN, A1	8	RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig 2
RF IN, A2	4	RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. (see Application circuit, Fig 2.)
RF-OUT and DC-IN, A2	5	RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig 2
GND	2,3,6,7 & paddle	Connections to ground. Use via holes as shown in "Suggested Layout for PCB Design" to reduce ground path inductance for best performance.

* Enhancement mode pseudomorphic High Electron Mobility Transistor.

Electrical Specifications¹ at 25°C, Zo=50Ω and Device Voltage 5V, unless noted

(Specifications (other than Matching or where defined as push-pull) are for each of the two matched amplifiers in the package)

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units	
Frequency Range		0.04		3.0	GHz	
Gain	0.04	—	22.2	—	dB	
	0.5	—	21.4	—		
	0.9	19.2	21.4	23.5		
	2.0	—	20.8	—		
	2.6	—	19.8	—		
	3.0	—	18.9	—		
Gain Flatness	0.05-3.0		±1.5		dB	
Input Return Loss	0.04		16.3		dB	
	0.5		18.1			
	0.9		16.6			
	2.0		11.8			
	2.6		9.2			
	3.0		7.7			
Output Return Loss	0.04		13.5		dB	
	0.5		20.5			
	0.9		17.2			
	2.0		8.5			
	2.6		6.3			
	3.0		5.2			
Output Power @ 1 dB compression ^(2,3)	0.04		19.3		dBm	
	0.5		19.0			
	0.9		19.4			
	2.0		19.0			
	2.6		18.0			
	3.0		17.4			
Output IP3 ⁽³⁾	0.04	—	33.6	—	dBm	
	0.5	—	34.3	—		
	0.9	31.0	34.3	—		
	2.0	—	32.2	—		
	2.6	—	30.7	—		
	3.0	—	29.6	—		
Noise Figure	0.04		3.6		dB	
	0.5		3.6			
	0.9		3.6			
	2.0		3.6			
	2.6		3.8			
	3.0		3.7			
Matching between A1, A2	Amplitude Unbalance	0.04	—	0.1	—	dB
		0.5	—	0.1	—	
		0.9	—	0.1	0.5	
		2.0	—	0.2	—	
		2.6	—	0.2	—	
		3.0	—	0.1	—	
	Phase Unbalance	0.04	—	0.0	—	deg.
		0.5	—	0.6	—	
		0.9	—	0.9	5.0	
		2.0	—	1.5	—	
		2.6	—	1.5	—	
		3.0	—	0.6	—	
Device Operating Voltage		4.8	5.0	5.2	V	
Device Operating Current (each amplifier)			69	78	mA	
Device Current Variation vs. Temperature			69		μA/°C	
Device Current Variation vs Voltage			0.043		mA/mV	
Thermal Resistance, junction-to-ground lead ⁽⁴⁾			58.4		°C/W	

⁽¹⁾ Measured on Mini-Circuits Test Board TB-561-63+, see characterization circuit, Fig 1.
⁽²⁾ Current increases at P1dB

⁽³⁾ Per single ended amplifier
⁽⁴⁾ θ_{JC} = (Junction Temperature - 85°C) / (Voltage X sum of current in A1 & A2)

Absolute Maximum Ratings⁽⁶⁾

Parameter	Ratings
Operating Temperature ⁷	-40°C to 85°C
Storage Temperature	-55°C to 150°C
Operating Current at 5V	100 mA
Power Dissipation	0.5 W
Input Power (CW)	13 dBm
DC Voltage (pads 5, 8)	5.7

⁽⁶⁾ Permanent damage may occur if any of these limits are exceeded. These ratings are not intended for continuous normal operation.
⁽⁷⁾ Defined with reference to ground pad temperature.

Push-Pull Amplifier Typical Performance⁽⁵⁾

Freq. (GHz)	TB-666-50-63+ (50Ω)		
	Gain (dB)	Output IP3 (dBm)	Output IP2 (dBm)
0.04	18.5	32.2	58.1
0.5	19.1	32.1	64.1
0.9	18.9	35.9	68.4
2.0	18.2	32.7	49.5
2.6	17.1	30.7	67.9
3.0	16.4	30.2	67.6

⁽⁵⁾ Measured on evaluation boards TB-666-50-63+ (push-pull amplifier)

Product Features

- Two matched amplifiers in one package
- High IP3, +37.5 dBm at 0.9 GHz
- High IP2, +59 dBm at 0.9 GHz in push-pull configuration
- Gain, 14.4 dB typ. at 0.9 GHz
- Excellent Gain Flatness, ±0.5 dB (0.1-2 GHz)
- P1dB, +21 dBm typ. at 0.9 GHz
- Low noise figure, 1.9 dB typ. at 0.9 GHz

Typical Applications

- SATCOM
- CATV
- FTTH
- Optical networks
- Base station infrastructure
- Balanced amplifiers
- 75 Ohm push-pull and balanced amplifiers

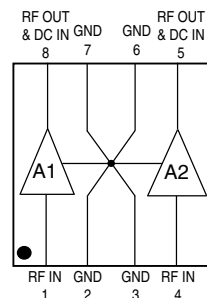
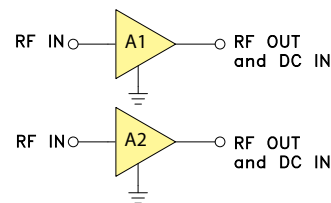
General Description

MPGA-105+ (RoHS compliant) is an advanced ultra-flat gain amplifier fabricated using E-PHEMT technology and offers extremely high dynamic range over a broad frequency range and with low noise figure. In addition, the MPGA-105+ has good input and output return loss over a broad frequency range without the need for external matching components. Lead finish is SnAgNi and is enclosed in a 4.9 x 6 mm MCLP package for good thermal performance.



CASE STYLE: DL1020

simplified schematic (each of A1, A2) and pad description



Function	Pad Number	Description
RF IN, A1	1	RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. (see Application circuit, Fig 2.)
RF-OUT and DC-IN, A1	8	RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig 2
RF IN, A2	4	RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. (see Application circuit, Fig 2.)
RF-OUT and DC-IN, A2	5	RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig 2
GND	2,3,6,7 & paddle	Connections to ground. Use via holes as shown in "Suggested Layout for PCB Design" to reduce ground path inductance for best performance.

* Enhancement mode pseudomorphic High Electron Mobility Transistor.

Electrical Specifications¹ at 25°C, Zo=50Ω and Device Voltage 5V, unless noted
(Specifications other than Matching or where defined as push-pull are for each of the two matched amplifiers in the package)

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units	
Frequency Range		0.04		3.0	GHz	
Gain	0.04	13.0	16.0	15.9	dB	
	0.5		14.6			
	0.9		14.4			
	2.0		14.1			
	2.6		14.3			
3.0	14.0					
Gain Flatness	0.1-2.0		±0.5		dB	
Input Return Loss	0.04	15.0	11.3		dB	
	0.5		24.3			
	0.9		20.6			
	2.0		19.0			
	2.6		11.6			
3.0	10.5					
Output Return Loss	0.04		12.6		dB	
	0.5		20.5			
	0.9		15.1			
	2.0		8.2			
	2.6		7.4			
3.0	7.9					
Output Power @ 1 dB compression ^(2,6)	0.04		21.0		dBm	
	0.5		20.5			
	0.9		21.0			
	2.0		19.8			
	2.6		19.8			
3.0	20.1					
Output IP3 ⁽⁶⁾	0.04	35.5	35.9		dBm	
	0.5		37.6			
	0.9		37.8			
	2.0		34.1			
	2.6		32.5			
3.0	32.1					
Noise Figure	0.04		1.7		dB	
	0.5		1.9			
	0.9		1.9			
	2.0		1.8			
	2.6		1.7			
3.0	1.8					
Matching between A1, A2	Amplitude Unbalance		0.0		dB	
			0.1			
			0.1			
			0.2			
			0.3			
	0.2					
	Phase Unbalance			0.7		deg.
				0.4		
				0.8		
				1.6		
1.4						
0.8						
Device Operating Voltage		4.8	5.0	5.2	V	
Device Operating Current (each amplifier)			63	77	mA	
Device Current Variation vs. Temperature			80		µA/°C	
Device Current Variation vs Voltage			0.014		mA/mV	
Thermal Resistance, junction-to-ground lead ⁽⁷⁾			47		°C/W	

Absolute Maximum Ratings⁽⁴⁾

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-65°C to 150°C
Operating Current at 5V ⁽⁶⁾	94 mA
Power Dissipation ⁽⁶⁾	0.47 W
Input Power (CW) ⁽⁶⁾	23 dBm (5 minutes max, 17 dBm (continuous))
DC Voltage (pads 5, 8)	5.5V

Push-Pull Amplifier Typical Performance⁽³⁾

Frequency (GHz)	Gain (dB)	Output IP3 (dBm)	Output IP2 (dBm)
0.04	12.2	34.4	66.6
0.5	12.3	35.8	58.7
0.9	11.4	43.3	59.4
2.0	10.4	35.1	55.3
2.6	8.7	35.0	66.9
3.0	8.1	34.9	67.8

⁽¹⁾ Measured on Mini-Circuits Test Board TB-561-105+, see characterization circuit, Fig 1.
⁽²⁾ Current increases at P1dB
⁽³⁾ Measured on evaluation boards (push-pull amplifiers) TB-666-50-11+.
 See characterization Test Circuit (Fig 1b)
⁽⁴⁾ Permanent damage may occur if any of these limits are exceeded.
⁽⁵⁾ Defined with reference to ground pad temperature.
⁽⁶⁾ Per single ended amplifier.
⁽⁷⁾ $\theta_{jc} = (\text{Junction Temperature} - 85^\circ\text{C}) / (\text{Voltage} \times \text{sum of current in A1 \& A2})$

DIRECTIONAL COUPLERS

With 20 standard catalog models specified for DOCSIS 3.1 requirements, Mini-Circuits' wide selection of directional couplers spans coupling values from 6 to 25 dB. Core and wire models feature Mini-Circuits unique Top Hat® feature to improve speed and accuracy of pick and place assembly. All models offer flat coupling across frequency, low mainline loss, and good directivity.

FEATURES

- ▶ Coupling from 6 to 25 dB
- ▶ Excellent Coupling Flatness
- ▶ Low Mainline Loss
- ▶ High Directivity
- ▶ Power Handling up to 1W
- ▶ Top Hat® Feature on Core and Wire Models



Surface Mount ^{tophat®} Directional Coupler

75Ω 10 dB 5 to 1250 MHz

TCD-10-122-75X+

Features

- wideband, 5 to 1250 MHz
- low mainline loss, 1.7 dB typ.
- aqueous washable
- leads for excellent solderability
- protected by US Patent 6,140,887

Applications

- DOCSIS® 3.1 Systems
- VHF/UHF
- CATV
- cellular



CASE STYLE: AT1521

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Specifications at 25°C

Parameter	Condition (MHz)	Min.	Typ.	Max.	Unit
Frequency Range		5		1250	MHz
Mainline Loss¹ (above theoretical 0.1 dB)	5-50	—	1.1	1.5	dB
	50-1000	—	1.5	1.9	
	1000-1250	—	1.7	2.0	
Nominal Coupling	5-1250	—	10.0±0.5	—	dB
Coupling Flatness(±)	5-1250	—	0.3	0.6	dB
Directivity	5-250	16	21	—	dB
	250-1000	10	15	—	
	1000-1250	8	12	—	
Return Loss (Input)	5-50	17	20	—	dB
	50-1000	16	22	—	
	1000-1250	16	20	—	
Return Loss (Output)	5-50	20	25	—	dB
	50-1000	18	22	—	
	1000-1250	18	20	—	
Return Loss (Coupling)	5-50	17	18	—	dB
	50-1000	16	22	—	
	1000-1250	16	20	—	
Input Power	5-200	—	—	0.5	W
	200-1250	—	—	1.0	

1. Mainline loss includes theoretical power loss at coupled port.

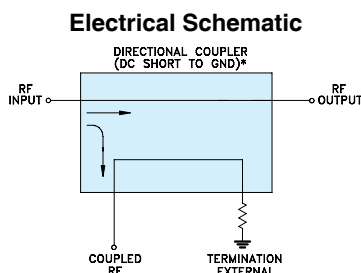
Maximum Ratings

Parameter	Ratings
Operating Temperature	-40°C to 85°C*
Storage Temperature	-55°C to 100°C

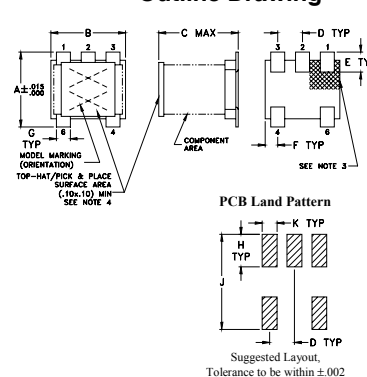
Permanent damage may occur if any of these limits are exceeded.
* Case temperature is defined as temperature on ground leads.

Pin Connections

Function	Pin Number
INPUT	3
OUTPUT	4
COUPLED	1
GROUND	2
75Ω TERM EXTERNAL	6



Outline Drawing

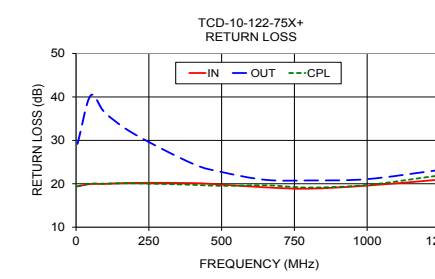
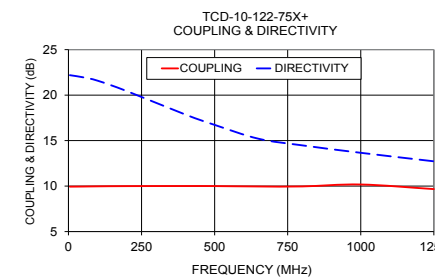
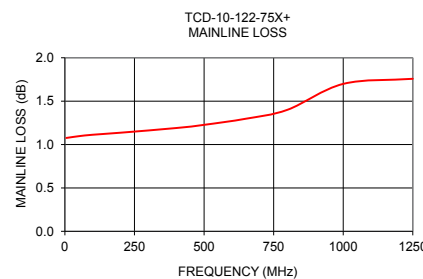


Outline Dimensions (Inch/mm)

A	B	C	D	E	F
.150	.150	.160	.050	.040	.025
3.81	3.81	4.06	1.27	1.02	0.64
G	H	J	K	wt	
.028	.065	.190	.030	grams	
0.71	1.65	4.83	0.76	0.15	

Typical Performance Data

Frequency (MHz)	Mainline Loss (dB) In-Out	Coupling (dB) In-Cpl	Directivity (dB)	Return Loss (dB)		
				In	Out	Cpl
5	1.08	9.94	22.19	19.41	29.19	19.41
50	1.10	9.95	21.96	19.96	40.31	20.02
100	1.11	9.97	21.58	19.99	36.32	20.02
200	1.14	10.00	20.43	20.21	31.46	20.13
400	1.19	10.01	17.86	20.16	24.64	19.76
500	1.23	10.00	16.73	19.82	22.71	19.53
650	1.30	9.96	15.21	19.18	20.91	19.66
800	1.40	9.97	14.48	18.87	20.77	19.14
1000	1.70	10.18	13.66	19.58	21.07	19.72
1250	1.76	9.67	12.72	20.97	23.18	21.94



Additional Notes

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Surface Mount ^{top hat®} Directional Coupler

75Ω 16.5 dB 5 to 1250 MHz

TCD-16-122-75X+

Features

- wideband, 5 to 1250 MHz
- low mainline loss, 1.5 dB typ.
- aqueous washable
- leads for excellent solderability
- protected by US Patent 6,140,887

Applications

- DOCSIS® 3.1 Systems
- VHF/UHF
- CATV
- cellular



CASE STYLE: DB1627

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Specifications at 25°C

Parameter	Condition (MHz)	Min.	Typ.	Max.	Unit
Frequency Range		5		1250	MHz
Mainline Loss¹ (above theoretical 0.1 dB)	5 - 50	—	1.5	2.0	dB
	50 - 1000	—	1.4	1.8	
	1000 - 1250	—	1.5	1.9	
Nominal Coupling	5 - 1250	—	16.5±0.5	—	dB
Coupling Flatness(±)	5 - 1250	—	0.3	0.6	dB
Directivity	5 - 50	15	20	—	dB
	50 - 1000	18	22	—	
	1000 - 1250	15	23	—	
Return Loss (Input)	5 - 50	13	15	—	dB
	50 - 1000	17	25	—	
	1000 - 1250	17	20	—	
Return Loss (Output)	5 - 50	14	16	—	dB
	50 - 1000	18	23	—	
	1000 - 1250	17	20	—	
Return Loss (Coupling)	5 - 50	10	12	—	dB
	50 - 1000	14	17	—	
	1000 - 1250	17	20	—	
Input Power	5 - 100	—	—	0.5	W
	100 - 1250	—	—	1.0	

1. Mainline loss includes theoretical power loss at coupled port.

Maximum Ratings

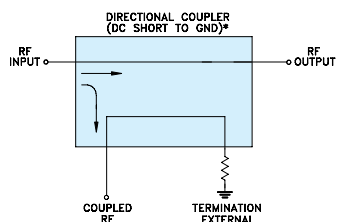
Parameter	Ratings
Operating Temperature	-40°C to 85°C*
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.
* Case temperature is defined as temperature on ground leads.

Pin Connections

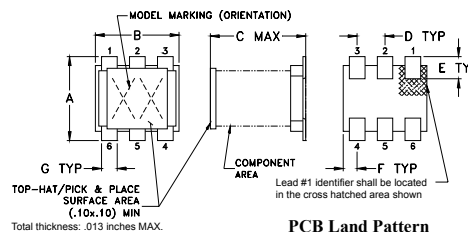
Function	Pin Number
INPUT	3
OUTPUT	4
COUPLED	1
GROUND	2
75Ω TERM EXTERNAL	6
NOT USED	5

Electrical Schematic

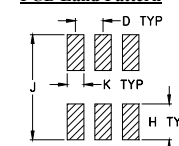


* ELECTRICAL SCHEMATIC IS FOR DIRECTIONAL COUPLER WITH INTERNAL TRANSFORMER(S) AND EXTERNAL TERMINATION.

Outline Drawing



PCB Land Pattern

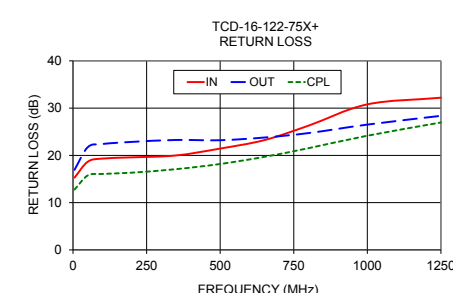
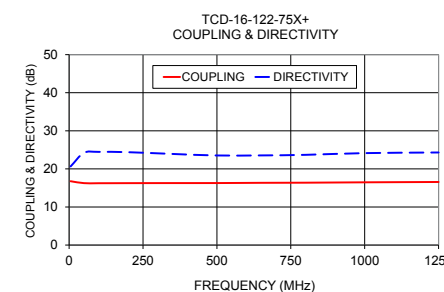
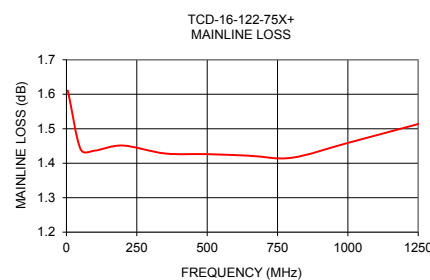


Outline Dimensions (inch/mm)

A	B	C	D	E	F
.160	.150	.160	.050	.040	.025
4.06	3.81	4.06	1.27	1.02	0.64
G	H	J	K		wt
.028	.065	.190	.030		grams
0.71	1.65	4.83	0.76		0.15

Typical Performance Data

Frequency (MHz)	Mainline Loss (dB) In-Out	Coupling (dB) In-Cpl	Directivity (dB)	Return Loss (dB)		
				In	Out	Cpl
5	1.61	16.76	20.64	15.28	16.94	12.76
50	1.44	16.26	24.21	18.65	21.72	15.75
100	1.44	16.24	24.47	19.33	22.41	16.07
200	1.45	16.26	24.38	19.58	22.85	16.34
350	1.43	16.28	23.92	19.98	23.26	17.08
500	1.43	16.28	23.52	21.44	23.20	18.18
650	1.42	16.34	23.54	23.23	23.78	19.68
800	1.42	16.38	23.69	26.28	24.72	21.52
1000	1.46	16.48	24.14	30.79	26.51	24.16
1250	1.51	16.56	24.31	32.20	28.37	26.96



Additional Notes

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Surface Mount ^{top hat®} Directional Coupler

75Ω 6.7 dB 5 to 1250 MHz

TCD-6-122-75X+

Features

- wideband, 5 to 1250 MHz
- low mainline loss, 2.5 dB typ.
- aqueous washable
- leads for excellent solderability
- protected by US Patent 6,140,887

Applications

- DOCSIS® 3.1 Systems
- VHF/UHF
- CATV
- cellular

Electrical Specifications at 25°C

Parameter	Condition (MHz)	Min.	Typ.	Max.	Unit
Frequency Range		5		1250	MHz
Mainline Loss ¹ (above theoretical 0.1 dB)	5-100	—	2.2	2.8	dB
	100-1000	—	2.3	2.9	
	1000-1250	—	2.8	3.5	
Nominal Coupling	5-1250	—	6.7±0.3	—	dB
Coupling Flatness(±)	5-1250	—	±0.2	±0.5	dB
Directivity	5-100	13	15	—	dB
	100-1000	10	13	—	
	1000-1250	8	12	—	
Return Loss (Input)	5-100	10	15	—	dB
	100-1000	14	16	—	
	1000-1250	13	15	—	
Return Loss (Output)	5-100	15	20	—	dB
	100-1000	15	18	—	
	1000-1250	13	18	—	
Return Loss (Coupling)	5-100	10	14	—	dB
	100-1000	13	15	—	
	1000-1250	13	16	—	
Input Power	5-500	—	—	0.3	W
	500-1250	—	—	0.5	

1. Mainline loss includes theoretical power loss 1.1dB at coupled port.

Maximum Ratings

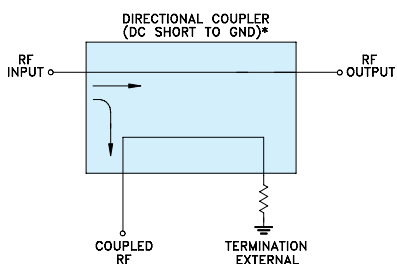
Parameter	Ratings
Operating Temperature	-40°C to 85°C*
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.
* Case temperature is defined as temperature on ground leads.

Pin Connections

Function	Pin Number
INPUT	3
OUTPUT	4
COUPLED	1
GROUND	2
75Ω TERM EXTERNAL	6

Electrical Schematic



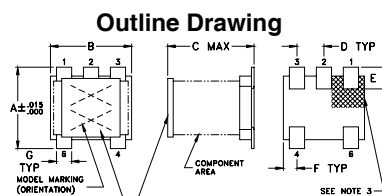
* ELECTRICAL SCHEMATIC IS FOR DIRECTIONAL COUPLER WITH INTERNAL TRANSFORMER(S) AND EXTERNAL TERMINATION.



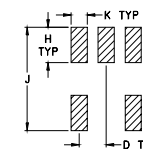
CASE STYLE: AT1521

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000



PCB Land Pattern



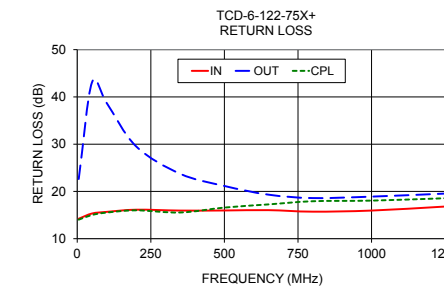
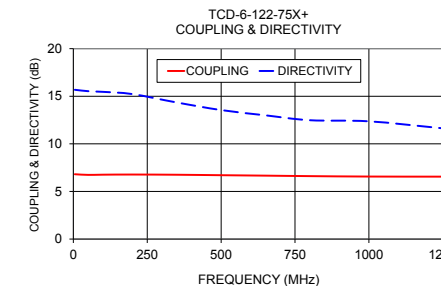
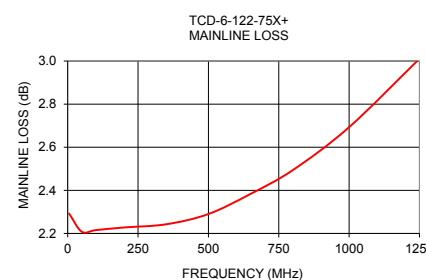
- Notes:
1. Case Material: Plastic
 2. Termination Finish: Tin plate over Nickel plate.
 3. Lead#1 Identifier shall be located in the cross-hatched area shown, on bottom view. Identifier may be either a molded or marked feature.
 4. Top-Hat total thickness: .013 inches max.

Outline Dimensions (inch/mm)

A	B	C	D	E	F
.150	.150	.160	.050	.040	.025
3.81	3.81	4.06	1.27	1.02	0.64
G	H	J	K	wt	
.028	.065	.190	.030	grams	
0.71	1.65	4.83	0.76	0.15	

Typical Performance Data

Frequency (MHz)	Mainline Loss (dB) In-Out	Coupling (dB) In-Cpl	Directivity (dB)	Return Loss (dB)		
				In	Out	Cpl
5	2.29	6.81	15.68	14.24	22.63	14.03
50	2.21	6.74	15.53	15.33	43.05	15.02
100	2.22	6.76	15.46	15.68	38.71	15.53
200	2.23	6.78	15.23	16.14	29.54	16.00
350	2.24	6.76	14.34	15.95	23.73	15.55
500	2.29	6.71	13.55	15.97	21.16	16.59
650	2.38	6.66	13.00	16.04	19.32	17.26
800	2.49	6.61	12.48	15.72	18.60	17.93
1000	2.69	6.57	12.37	15.96	18.91	18.06
1250	3.01	6.56	11.63	16.81	19.55	18.56



Additional Notes

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- The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

TCD-13-122-75X+

75Ω 12.7 dB 5 to 1250 MHz

Features

- wideband 5 to 1250 MHz
- low mainline loss, 1.2 dB typ.
- aqueous washable
- leads for excellent solderability
- protected by US Patent 6,140,887

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB)			Input Power (W) Max.
					Input Typ.	Output Typ.	Coupling Typ.	
	5 - 500	0.9	12.7±0.5	20	19	22	20	0.5
NEW! TCD-13-122-75X+	500 - 1000	1.0	12.7±0.5	15	22	24	23	1.0
	1000 - 1250	1.2	12.7±0.5	11	20	20	20	1.0

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	3
Output	4
Coupled	1
Ground	2
75Ω Term External*	6
Not used	5

*Case temperature is defined as temperature on ground leads

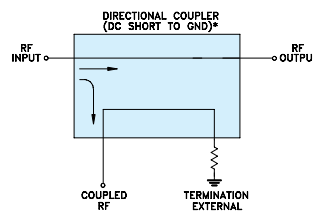


CASE STYLE: DB1627

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Schematic



* ELECTRICAL SCHEMATIC IS FOR DIRECTIONAL COUPLER WITH INTERNAL TRANSFORMER(S) AND EXTERNAL TERMINATION.

TCD-18-122-75X+

75Ω 17.5 dB 5 to 1250 MHz

Features

- wideband 5 to 1250 MHz
- low mainline loss, 1.0 dB typ.
- aqueous washable
- leads for excellent solderability
- protected by US Patent 6,140,887

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB)			Input Power (W) Max.
					Input Typ.	Output Typ.	Coupling Typ.	
	5 - 50	1.2	17.5±0.8	18	17	18	17	0.5
NEW! TCD-18-122-75X+	50 - 1000	1.0	17.5±0.8	22	22	23	23	1.0
	1000 - 1250	1.1	17.5±0.8	18	24	18	25	1.0

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	3
Output	4
Coupled	1
Ground	2
75Ω Term External*	6
Not used	5

*Case temperature is defined as temperature on ground leads

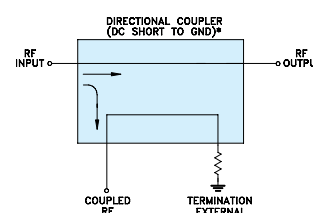


CASE STYLE: DB1627

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Schematic



* ELECTRICAL SCHEMATIC IS FOR DIRECTIONAL COUPLER WITH INTERNAL TRANSFORMER(S) AND EXTERNAL TERMINATION.

TCD-20-4-75+

75Ω 20 dB 40 to 1200 MHz

Features

- wideband 40 to 1200 MHz
- excellent flatness, ±0.5 dB typ. each band
- better performance than MA-COM EMDC-20-2-75
- footprint compatible to EMDC-10-1-75
- aqueous washable

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB) Typ.	Input Power (W) Max.
TCD-20-4-75+	500 - 870	0.6	20±0.6	23	10.4	1.0
	870 - 1200	0.6	19.5±0.7	20	10.4	1.0

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	3
Output	4
Coupled	1
Ground	2
75Ω Term External	6
Not used	5

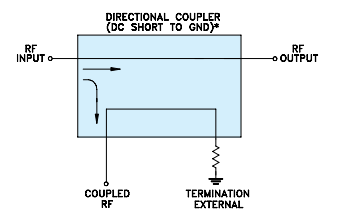


CASE STYLE: DB714

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Schematic



* ELECTRICAL SCHEMATIC IS FOR DIRECTIONAL COUPLER WITH INTERNAL TRANSFORMER(S) AND EXTERNAL TERMINATION.

TCD-20-4-75X+

75Ω 20 dB 40 to 1200 MHz

Features

- wideband 40 to 1200 MHz
- excellent flatness, ±0.5 dB typ. each band
- better performance than MA-COM EMDC-20-2-75
- footprint compatible to EMDC-10-1-75
- aqueous washable

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB) Typ.	Input Power (W) Max.
TCD-20-4-75X+	500 - 870	0.6	20±0.6	23	10.4	1.0
	870 - 1200	0.6	19.5±0.7	20	10.4	1.0

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	3
Output	4
Coupled	1
Ground	2
75Ω Term External	6
Not used	5

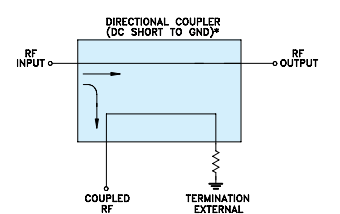


CASE STYLE: DB1627

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Schematic



* ELECTRICAL SCHEMATIC IS FOR DIRECTIONAL COUPLER WITH INTERNAL TRANSFORMER(S) AND EXTERNAL TERMINATION.

Surface Mount Directional Coupler

75Ω 6dB 5 to 1250 MHz

DBTC-6-4-75+

Features

- very flat coupling
- very broadband, multi octave
- temperature stable, LTCC base
- all welded construction
- leads attached for better solderability
- micro miniature coupler
- aqueous washable
- protected by US Patents 6,140,887 & 6,784,521



CASE STYLE: AT790-1

Electrical Specifications at 25°C

Parameter	Condition (MHz)	Min.	Typ.	Max.	Unit
Frequency Range		5		1250	MHz
Mainline Loss	5-50	—	2.2	3.1	dB
	50-500	—	2.2	2.6	
	500-1000	—	2.3	2.8	
	1000-1250	—	2.3	2.9	
Nominal Coupling	5-1250	—	6.8 ±0.3	—	dB
Coupling Flatness(±)	5-1250	—	—	±0.8	dB
Directivity	5-50	13	15	—	dB
	50-500	13	17	—	
	500-1000	10	16	—	
	1000-1250	7	12	—	
Return Loss (Input)	5-1250	—	15.56	—	dB
Return Loss (Output)	5-1250	—	15.56	—	dB
Return Loss (Coupling)	5-1250	—	15.56	—	dB
Input Power	5-500	—	—	0.5	W
	50-500	—	—	1.0	
	500-1000	—	—	1.0	
	1000-1250	—	—	1.0	

Maximum Ratings

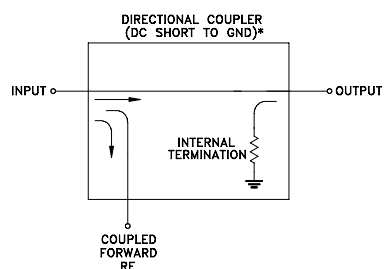
Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

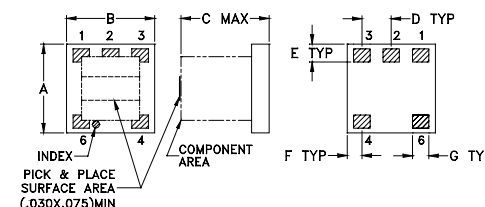
Function	Pin Number
INPUT	3
OUTPUT	4
COUPLED	1
GROUND	2
NOT USED	6

Electrical Schematic

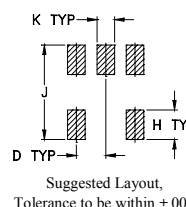


* ELECTRICAL SCHEMATIC IS FOR DIRECTIONAL COUPLER WITH INTERNAL TRANSFORMER(S) THAT ROUTES DC FROM RF PORTS TO GROUND.

Outline Drawing



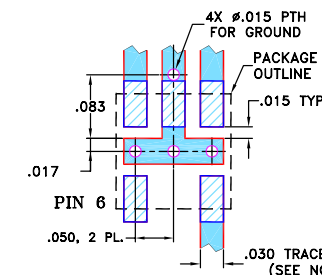
PCB Land Pattern



Outline Dimensions (inch/mm)

A	B	C	D	E	F	G	H	J	K	wt
.150	.150	.150	.050	.030	.025	.028	.050	.160	.030	grams
3.81	3.81	3.81	1.27	0.76	0.64	0.71	1.27	4.06	0.76	0.10

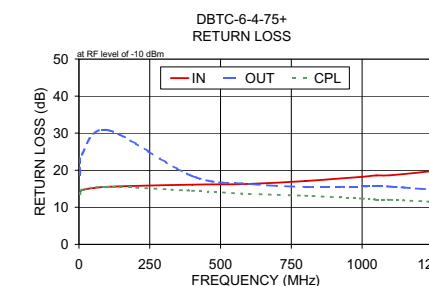
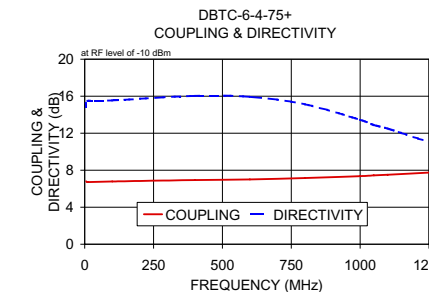
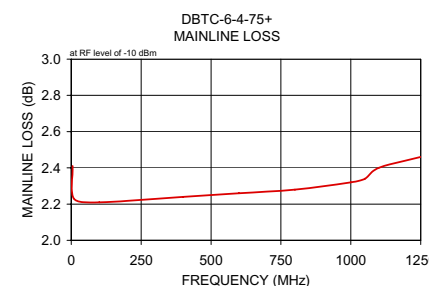
Demo Board MCL P/N: TB-279 Suggested PCB Layout (PL-151)



- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS 0.030" ± 0.002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
- DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
 - DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Typical Performance Data

Frequency (MHz)	Mainline Loss (dB) In-Out	Coupling (dB) In-Cpl	Directivity (dB)	Return Loss (dB)		
				In	Out	Cpl
5.00	2.41	6.80	14.87	13.53	18.73	13.56
10.00	2.23	6.72	15.49	14.64	24.15	14.72
100.00	2.21	6.78	15.54	15.55	30.88	15.56
400.00	2.24	6.94	16.04	16.09	18.42	14.47
600.00	2.26	7.01	15.94	16.32	16.33	13.60
800.00	2.28	7.16	15.12	17.08	15.48	13.11
1000.00	2.32	7.36	13.45	18.22	15.61	12.36
1050.00	2.34	7.44	12.88	18.62	15.75	12.10
1100.00	2.40	7.51	12.50	18.66	15.58	12.04
1250.00	2.46	7.75	11.03	19.78	14.75	11.49



Additional Notes

- A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

DBTC-9-4-75L+

75Ω 9.3 dB 5 to 1200 MHz

Features

- wideband 5 to 1200 MHz
- temperature stable, LTCC base
- aqueous washable
- leads for excellent solderability
- protected by US Patent 6,140,887 & 6,784,521

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB) Typ.	Input Power (W) Max.
DBTC-9-4-75L+	5 - 50	1.3	9.3±0.5	20	10.4	0.5
	50 - 500	1.4	9.3±0.5	19	9.8	0.5
	500 - 1000	1.5	9.3±0.5	18	9.8	0.5
	1000 - 1200	1.8	9.3±0.5	17	9.8	0.5

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	3
Output	4
Coupled	1
Ground	2
Not used	6

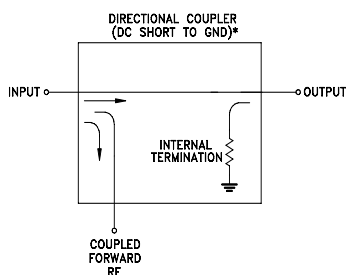


CASE STYLE: AT1030

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Schematic



* ELECTRICAL SCHEMATIC IS FOR DIRECTIONAL COUPLER WITH INTERNAL TRANSFORMER(S) THAT ROUTES DC FROM RF PORTS TO GROUND.

DBTC-16-5-75L+

75Ω 16 dB 5 to 1500 MHz

Features

- wideband 5 to 1500 MHz
- temperature stable, LTCC base
- aqueous washable
- leads for excellent solderability
- protected by US Patent 6,140,887 & 6,784,521

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB) Typ.	Input Power (W) Max.
DBTC-16-5-75L+	5 - 1000	1.0	16.3±0.5	21	17.7	1.0
	1000 - 1500	1.3	16.8±0.7	19	17.7	1.0

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	3
Output	4
Coupled	1
Ground	2
Not used	6

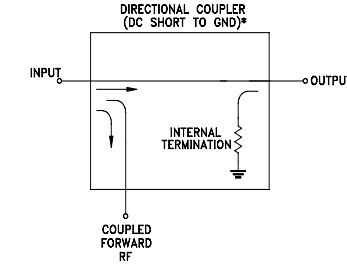


CASE STYLE: AT1030

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Schematic



* ELECTRICAL SCHEMATIC IS FOR DIRECTIONAL COUPLER WITH INTERNAL TRANSFORMER(S) THAT ROUTES DC FROM RF PORTS TO GROUND.

DBTC-12-4-75L+

75Ω 12 dB 5 to 1200 MHz

Features

- wideband 5 to 1200 MHz
- temperature stable, LTCC base
- aqueous washable
- protected by US Patent 6,140,887 & 6,784,521

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB) Typ.	Input Power (W) Max.
DBTC-12-4-75L+	5 - 50	1.1	12±0.5	19	17.7	0.5
	50 - 500	1.1	12±0.5	18	17.7	1.0
	500 - 1000	1.2	12±0.5	17	17.7	1.0
	1000 - 1200	1.3	12±0.5	13	17.7	1.0

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	3
Output	4
Coupled	1
Ground	2
Not used	6

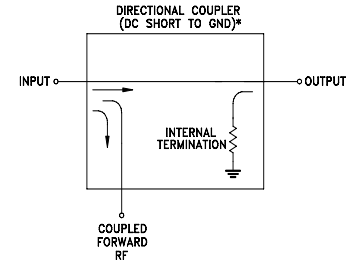


CASE STYLE: AT790-1

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Schematic



* ELECTRICAL SCHEMATIC IS FOR DIRECTIONAL COUPLER WITH INTERNAL TRANSFORMER(S) THAT ROUTES DC FROM RF PORTS TO GROUND.

DBTC-20-4-75L+

75Ω 20.5 dB 5 to 1250 MHz

Features

- wideband 5 to 1250 MHz
- temperature stable, LTCC base
- aqueous washable
- protected by US Patent 6,140,887 & 6,784,521

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB) Typ.	Input Power (W) Max.
DBTC-20-4-75L+	5 - 1250	0.6	20.5±0.5	19	17.7	1.0

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	3
Output	4
Coupled	1
Ground	2
Not used	6

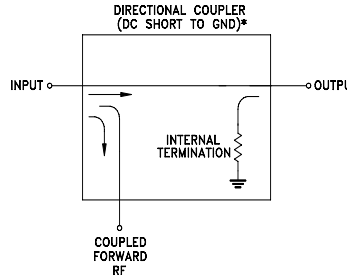


CASE STYLE: AT790-1

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Schematic



* ELECTRICAL SCHEMATIC IS FOR DIRECTIONAL COUPLER WITH INTERNAL TRANSFORMER(S) THAT ROUTES DC FROM RF PORTS TO GROUND.

ADC-8-4-75+

75Ω 7.9 dB 5 to 1250 MHz

Features

- wideband, 5-1250 MHz
- excellent coupling flatness, ±0.15 typ.
- aqueous washable
- protected by U.S Patents 6,133,525 & 6,140,887

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB)			Input Power (W) Max.
					Input Typ.	Output Typ.	Coupling Typ.	
ADC-8-4-75+	5 - 870	1.8	7.9±0.5	16	16	22	16	1.0
	870 - 1250	2.0	7.9±0.5	13	18	20	19	1.0

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	1
Output	6
Coupled	3
Ground	2
75Ω Term External	4
Isolate (Do not use)	5

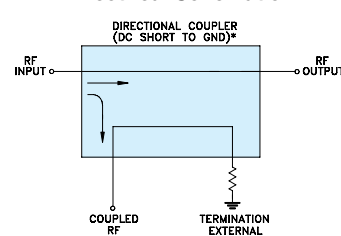


CASE STYLE: CD542

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	500, 1000

Electrical Schematic



ADC-12-4-75+

75Ω 12.5 dB 5 to 1250 MHz

Features

- low mainline loss, 0.9 dB typ.
- good directivity, 18 dB typ.
- good VSWR, 1.25:1 typ.
- excellent coupling flatness, ±0.15 dB typ.
- aqueous washable
- protected by U.S Patents 6,133,525 & 6,140,887

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB)			Input Power* (W) Max.
					Input Typ.	Output Typ.	Coupling Typ.	
ADC-12-4-75+	5 - 870	0.85	12.5±0.5	18	19	22	19	0.5
	870 - 1250	1.0	12.5±0.5	12	18	18	16	1.0

* 5-20 MHz, 0.5W Max.; 20-1250 MHz, 1.0W Max.

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	1
Output	6
Coupled	3
Ground	2
75Ω Term External	4
Isolate (Do not use)	5

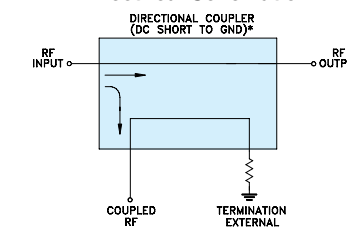


CASE STYLE: CD542

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	500, 1000

Electrical Schematic



ADC-10-4-75+

75Ω 10.5 dB 5 to 1250 MHz

Features

- wideband, 5-1250 MHz
- low mainline loss, 1.0 dB typ.
- excellent coupling flatness, ±0.3 typ.
- aqueous washable
- protected by U.S Patents 6,133,525 & 6,140,887

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB)			Input Power (W) Max.
					Input Typ.	Output Typ.	Coupling Typ.	
ADC-10-4-75+	5 - 500	0.9	10.5±0.5	20	23	27	19	1.0
	500 - 1250	1.1	10.5±0.5	15	22	25	18	1.0

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	1
Output	6
Coupled	3
Ground	2
75Ω Term External	4
Isolate (Do not use)	5

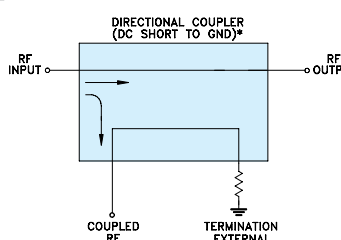


CASE STYLE: CD542

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	500, 1000

Electrical Schematic



ADC-16-4-75+

75Ω 16.3 dB 5 to 1250 MHz

Features

- low mainline loss, 0.7 dB typ.
- high directivity, 20 dB typ.
- good VSWR, 1.15:1 typ.
- excellent coupling flatness, ±0.1 dB typ.
- aqueous washable
- protected by U.S Patents 6,133,525 & 6,140,887

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB)			Input Power* (W) Max.
					Input Typ.	Output Typ.	Coupling Typ.	
ADC-16-4-75+	5 - 500	0.7	16.3±0.5	25	23	25	22	0.5
	500 - 1250	0.9	16.3±0.5	15	25	26	26	1.0

* 5-50 MHz, 0.5W Max.; 50-1250 MHz, 1.0W Max.

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	1
Output	6
Coupled	3
Ground	2
75Ω Term External	4
Isolate (Do not use)	5

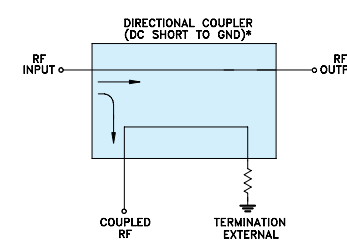


CASE STYLE: CD542

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	500, 1000

Electrical Schematic



Visit www.minicircuits.com for pricing, availability, and complete model information.

ADC-20-4-75+

75Ω 19.7 dB 5 to 1250 MHz

Features

- low mainline loss, 0.5 dB typ.
- high directivity, 23 dB typ.
- excellent coupling flatness, ±0.15 dB typ.
- aqueous washable
- protected by U.S. Patents 6,133,525 & 6,140,887

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB)			Input Power (W) Max.
					Input Typ.	Output Typ.	Coupling Typ.	
ADC-20-4-75+	5 - 870	0.5	19.7±0.5	25	25	25	20	1.0
	870 - 1250	0.7	19.7±0.5	17	22	22	15	1.0

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	1
Output	6
Coupled	3
Ground	2
75Ω Term External	4
Isolate (Do not use)	5

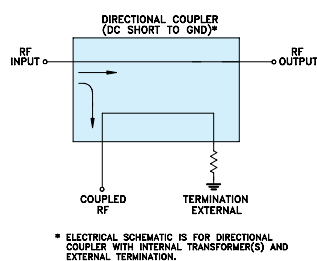


CASE STYLE: CD542

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	500, 1000

Electrical Schematic



TCD-9-1W-75X+

75Ω 8.9 dB 5 to 2000 MHz

Features

- low mainline loss, 1.3 dB typ. (5-1000 MHz)
- aqueous washable
- leads for excellent solderability
- protected by U.S. Patent 6,140,887

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB) Typ.	Input Power (W) Max.
	1000 - 2000	2.5	8.5±0.5	10	17.7	1.0

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	3
Output	4
Coupled	1
Ground	2
75Ω Term External	6
Not used	5

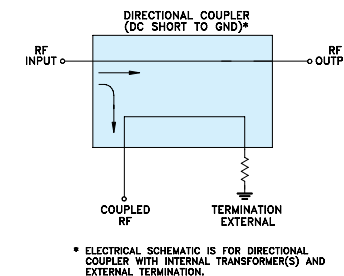


CASE STYLE: DB1627

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Schematic



ADC-25-4-75+

75Ω 25 dB 5 to 1250 MHz

Features

- low mainline loss, 0.3 dB typ.
- high coupling, 25 dB typ.
- excellent VSWR, 1.2:1 typ.
- aqueous washable
- protected by U.S. Patents 6,133,525 & 6,140,887

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB)			Input Power (W) Max.
					Input Typ.	Output Typ.	Coupling Typ.	
ADC-25-4-75+	5 - 500	0.3	25±1.0	20	26	26	25	0.5
	500 - 1250	0.5	25±1.0	16	20	21	20	0.5

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Input	1
Output	6
Coupled	3
Ground	2
75Ω Term External	4
Isolate (Do not use)	5

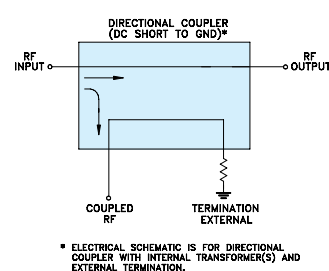


CASE STYLE: CD636

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Schematic



LRDC-10-2W-75+

75Ω 10 dB 10 to 1200 MHz

Features

- low mainline loss, 1.1 dB typ.
- high directivity, 22 dB typ.

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Mainline Loss (dB) Typ.	Coupling (dB) Typ.	Directivity (dB) Typ.	Return Loss (dB) Typ.	Input Power (W) Max.

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

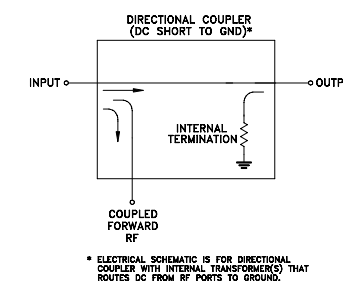
Pin Connections

Input	6
Output	1
Coupled	4
Ground	2,5
Isolate (Do not use)	3



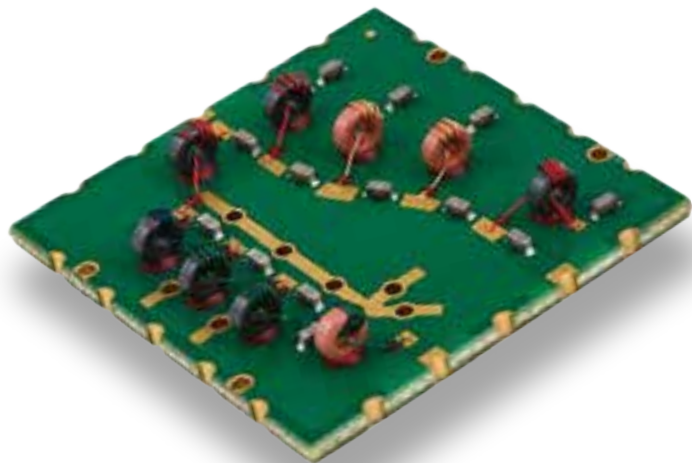
CASE STYLE: QQQ130

Electrical Schematic



HIGH PERFORMANCE DIPLEXERS

Designed specifically for CATV and broadband systems and equipment, Mini-Circuits' DPB-family of 75Ω diplexers are ideal for diplexing multiband signals into two channels. Excellent return loss and low insertion loss minimize signal loss through both channels, while high out-of-channel rejection with very steep transitions eliminates unwanted spurious signals in the pass bands. 4 models in the DPB-family offer 4 different channel splits within the DC to 1220 band to meet various system requirements.



FEATURES

- ▶ Insertion Loss as low as 0.8 dB
- ▶ Excellent Return Loss, 22 dB
- ▶ High Out-of-Channel Rejection, 50 dB
- ▶ Power Handling up to +30 dBm
- ▶ Various Channel Splits



Surface Mount
Diplexer

75Ω DC to 1220 MHz (DC-42, 54-1220 MHz)

Performance Charts

DPB4254-75+

Maximum Ratings

Operating Temperature	-40° to 85°C
Storage Temperature	-55°C to 100°C
RF Power Input	27dBm Max.

Permanent damage may occur if any of these limits are exceeded. These ratings are not intended for continuous normal operation.

Pin Connections

HIGH PASS PORT	7
LOW PASS PORT	9
COMMON PORT	18
GROUND	1-6,8,10-17,19,20

Features

- Low insertion loss
- 75Ω Impedance
- Excellent return loss
- High rejection

Applications

- Cable TV systems (DOCSIS 3.1 standard)
- Multiband radio systems



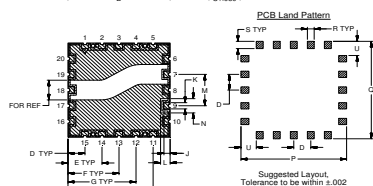
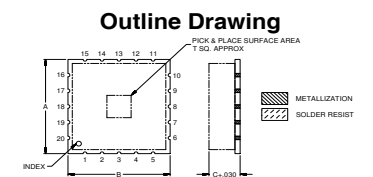
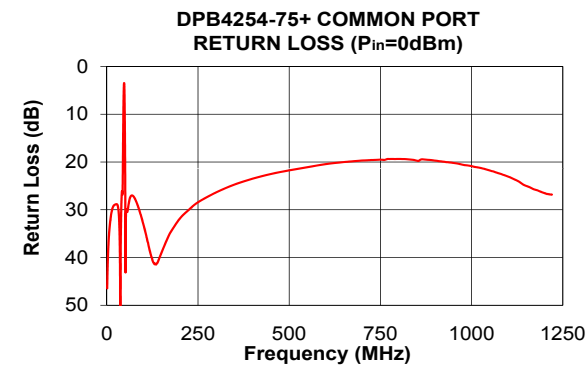
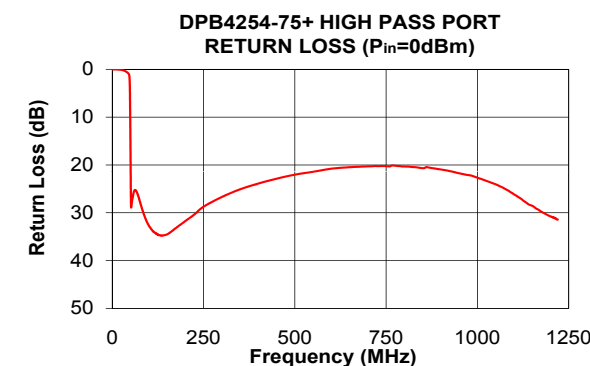
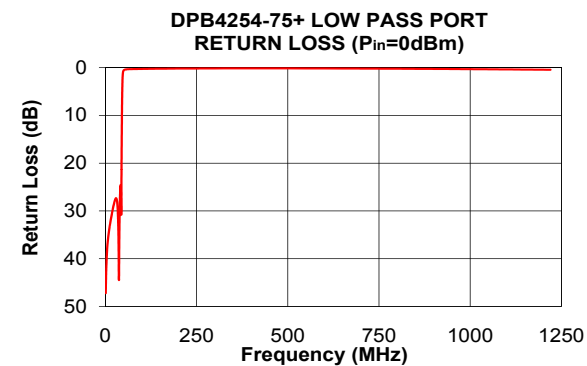
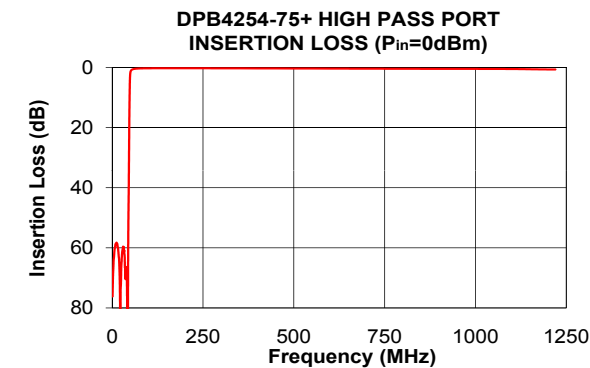
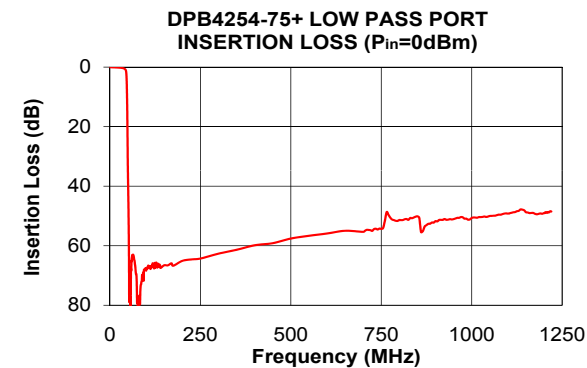
CASE STYLE: PA2002

Electrical Specifications at 25°C

Parameter	Port	Frequency (MHz)	Min.	Typ.	Max.	Unit	
Pass Band	Insertion Loss	Low Pass	DC-42	-	0.8	1.5	dB
		High Pass	54-1220	-	0.8	1.5	
	Return Loss	Low Pass	DC-42	18	22	-	dB
		High Pass	54-1220	17	22	-	
Common		DC-42	18	22	-		
Stop Band Isolation	Low Pass	54-700	45	50	-	dB	
	High Pass	700-1220	43	45	-		

Typical Performance Data at 25°C

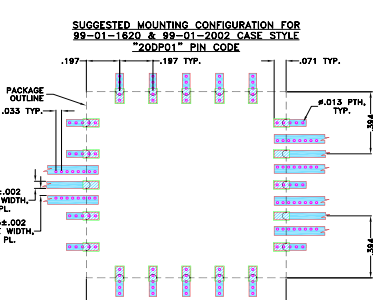
FREQUENCY (MHz)	INSERTION LOSS (dB)			RETURN LOSS (dB)	
	Low Pass Port	High Pass Port	Common Port	Low Pass Port	High Pass Port
1.0	0.04	76.19	46.46	47.21	0.02
10.0	0.10	58.76	31.99	34.11	0.03
40.0	0.55	68.16	28.57	26.99	0.58
42.0	0.73	77.07	26.13	24.80	0.70
44.5	1.37	51.98	16.71	17.61	0.89
45.5	2.57	40.72	9.25	8.78	1.01
46.0	3.86	33.91	6.59	5.82	1.09
47.0	8.60	19.25	3.73	2.37	1.45
47.5	12.18	13.40	3.49	1.57	1.93
48.0	16.74	8.74	4.15	1.12	2.96
49.5	34.02	2.28	13.39	0.65	12.04
50.0	37.91	1.73	18.70	0.59	16.67
54.0	70.61	0.78	30.05	0.40	27.62
55.0	72.01	0.71	30.35	0.38	27.25
60.0	64.95	0.51	28.76	0.34	25.46
100.0	68.36	0.29	32.99	0.27	32.67
250.0	64.30	0.28	28.44	0.17	28.74
300.0	62.66	0.29	26.35	0.16	26.71
500.0	57.58	0.35	21.76	0.15	22.03
700.0	55.33	0.42	19.69	0.19	20.30
1000.0	50.67	0.49	20.87	0.32	22.66
1220.0	48.51	0.67	26.83	0.44	31.42



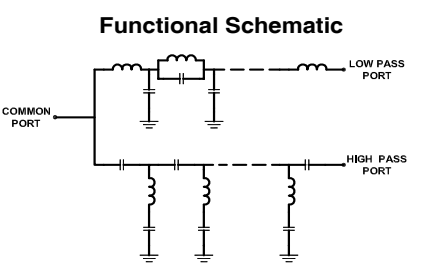
Outline Dimensions (inch/mm)

	A	B	C	D	E	F	G	H	J	K
	1.181	1.181	.300	.197	.394	.591	.787	.984	.071	.079
	30.00	30.00	7.62	5.00	10.00	15.00	20.00	25.00	1.80	2.00
	L	M	N	P	Q	R	S	T	U	Wt.
	.111	.394	.179	1.221	1.221	.079	.091	.280	.178	grams
	2.82	10.00	4.54	31.01	31.01	2.01	2.31	7.11	4.52	3.8

Demo Board MCL P/N: TB-786+
Suggested PCB Layout (PL-435)



- NOTES:
1. TRACE WIDTH IS SHOWN FOR OAK-602 WITH DIELECTRIC THICKNESS .031±.002". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
 2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
- DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
 - DENOTES COPPER LAND PATTERN FREE OF SOLDERMASK



Surface Mount Duplexer

75Ω DC to 1220 MHz (DC-65, 88-1220 MHz)

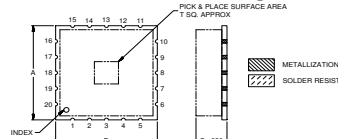
Maximum Ratings

Operating Temperature	-40° to 85°C
Storage Temperature	-55°C to 100°C
RF Power Input	27dBm Max.
Permanent damage may occur if any of these limits are exceeded. These ratings are not intended for continuous normal operation	

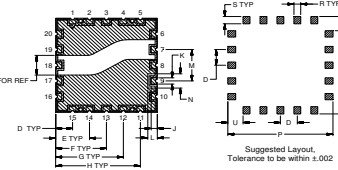
Pin Connections

HIGH PASS PORT	7
LOW PASS PORT	9
COMMON PORT	18
GROUND	1-6,8,10-17,19,20

Outline Drawing



PCB Land Pattern

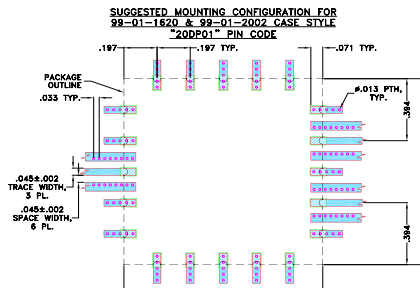


Outline Dimensions (inch/mm)

A	B	C	D	E	F	G	H	J	K
1.181	1.181	.300	.197	.394	.591	.787	.984	.071	.079
30.00	30.00	7.62	5.00	10.00	15.00	20.00	25.00	1.80	2.00

L	M	N	P	Q	R	S	T	U	Wt.
.111	.394	.179	1.221	1.221	.079	.091	.280	.178	grams
2.82	10.00	4.54	31.01	31.01	2.01	2.31	7.11	4.52	3.8

Demo Board MCL P/N: TB-786+
Suggested PCB Layout (PL-435)



- NOTES:
- TRACE WIDTH IS SHOWN FOR OAK-802 WITH DIELECTRIC THICKNESS .031±.002". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
 - BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
- DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
 - DENOTES COPPER LAND PATTERN FREE OF SOLDERMASK

Features

- Low insertion loss
- 75Ω Impedance
- Excellent return loss
- High rejection

Applications

- Cable TV systems (DOCSIS 3.1 stanard)
- Multiband radio systems

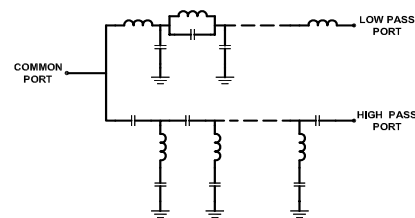
Electrical Specifications at 25°C

Parameter	Port	Frequency (MHz)	Min.	Typ.	Max.	Unit	
Pass Band	Insertion Loss	Low Pass	DC-65	-	0.9	1.5	dB
		High Pass	88-1220	-	1.2	1.6	
	Return Loss	Low Pass	DC-65	18	22	-	
		High Pass	88-1220	17	22	-	
Stop Band Isolation	Low Pass	88-900	45	50	-	dB	
	High Pass	900-1220	43	45	-		

Typical Performance Data at 25°C

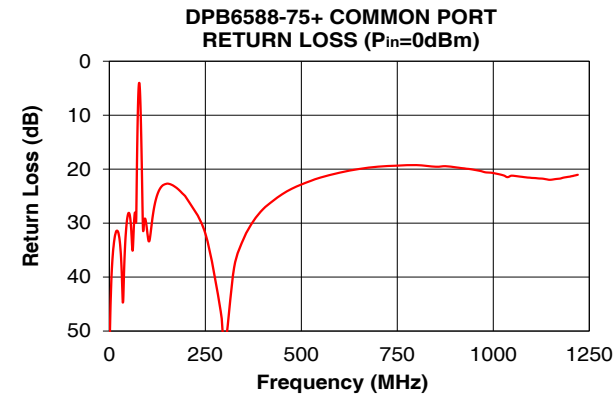
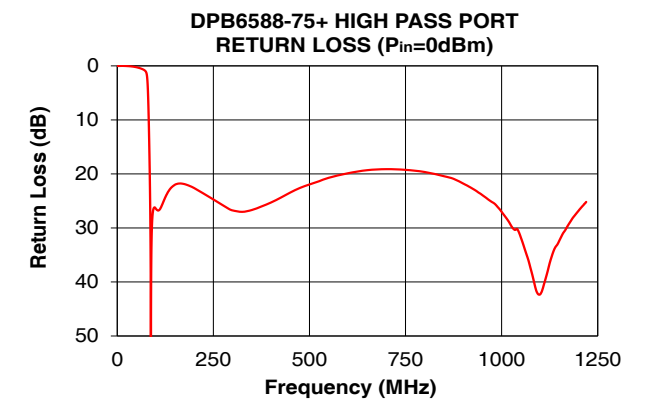
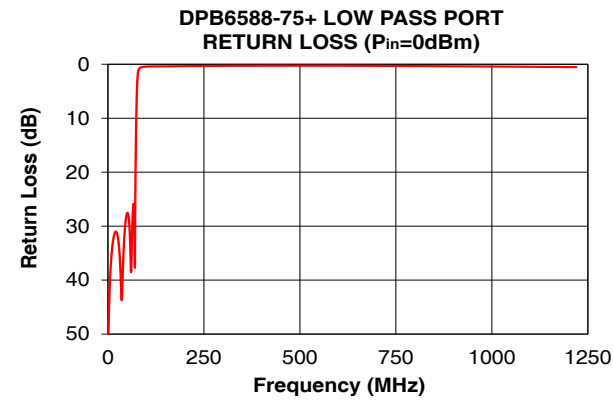
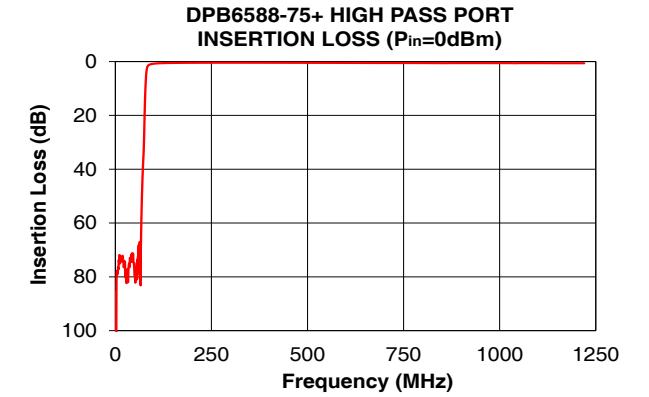
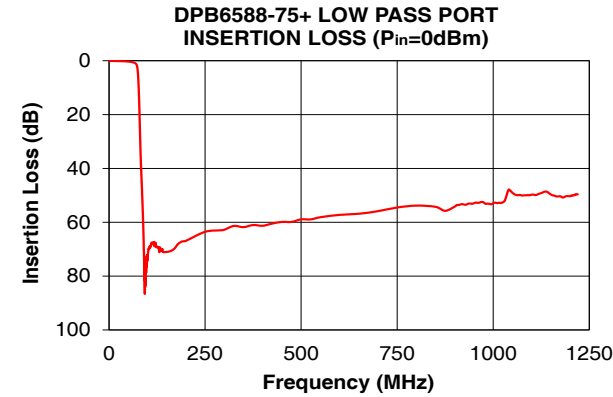
FREQUENCY (MHz)	INSERTION LOSS (dB)			RETURN LOSS (dB)	
	Low Pass Port	High Pass Port	Common Port	Low Pass Port	High Pass Port
1.0	0.04	85.70	51.54	51.03	0.03
10.0	0.08	75.18	34.87	34.81	0.01
50.0	0.30	79.72	28.11	27.57	0.25
60.0	0.50	71.47	35.00	38.45	0.45
65.0	0.71	72.36	29.02	27.15	0.59
70.0	1.13	46.18	28.91	37.15	0.77
74.0	2.87	32.11	9.96	9.24	1.03
75.0	4.28	26.87	7.10	6.07	1.16
76.0	6.45	20.73	5.18	3.87	1.36
78.0	13.24	10.96	4.02	1.70	2.37
79.5	20.35	6.32	5.25	1.12	4.27
80.0	23.05	5.24	6.05	1.01	5.22
81.5	31.33	3.12	9.48	0.81	8.99
85.0	45.19	1.54	21.56	0.61	22.52
88.0	56.57	1.20	31.45	0.53	40.52
100.0	73.85	0.78	32.40	0.42	26.41
250.0	63.55	0.43	31.93	0.32	24.72
300.0	62.79	0.43	53.49	0.30	26.76
500.0	58.93	0.46	22.84	0.26	21.95
900.0	54.17	0.56	19.64	0.37	21.78
1000.0	52.95	0.56	20.72	0.41	27.02
1220.0	49.63	0.61	21.03	0.53	25.18

Functional Schematic



Performance Charts

DPB6588-75+



Surface Mount Diplexer

75Ω DC to 1220 MHz (DC-85, 102-1220 MHz)

Performance Charts

DPB85102-75+

Maximum Ratings

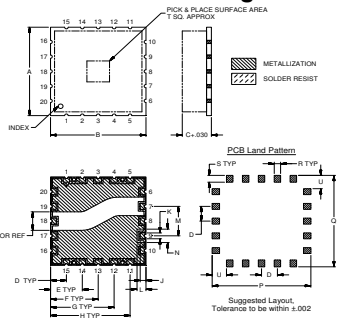
Operating Temperature	-40° to 85°C
Storage Temperature	-55°C to 100°C
RF Power Input	29dBm Max.

Permanent damage may occur if any of these limits are exceeded. These ratings are not intended for continuous normal operation.

Pin Connections

HIGH PASS PORT	7
LOW PASS PORT	9
COMMON PORT	18
GROUND	1-6,8,10-17,19,20

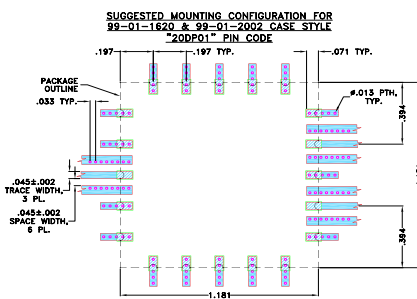
Outline Drawing



Outline Dimensions (inch/mm)

A	B	C	D	E	F	G	H	J	K
1.181	1.181	.300	.197	.394	.591	.787	.984	.071	.079
30.00	30.00	7.62	5.00	10.00	15.00	20.00	25.00	1.80	2.00
L	M	N	P	Q	R	S	T	U	Wt.
.111	.394	.179	1.221	1.221	.079	.091	.280	.178	grams
2.82	10.00	4.54	31.01	31.01	2.01	2.31	7.11	4.52	3.8

Demo Board MCL P/N: TB-786+
Suggested PCB Layout (PL-435)



- NOTES:
- TRACE WIDTH IS SHOWN FOR OAK-802 WITH DIELECTRIC THICKNESS .031"±.002". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
 - BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
 - INDICATES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
 - INDICATES COPPER LAND PATTERN FREE OF SOLDERMASK

Features

- Low insertion loss
- 75Ω Impedance
- Excellent return loss
- High rejection

Applications

- Cable TV systems (DOCSIS 3.1 standard)
- Multiband radio systems

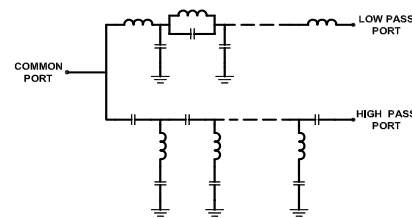
Electrical Specifications at 25°C

Parameter	Port	Frequency (MHz)	Min.	Typ.	Max.	Unit	
Pass Band	Insertion Loss	Low Pass	DC-85	-	1.2	1.7	dB
		High Pass	102-1220	-	1.3	1.8	
	Return Loss	Low Pass	DC-85	18	22	-	
	High Pass	102-1220	16	22	-		
	Common	102-1220	16	22	-		
Stop Band Isolation	Low Pass	102-1220	45	50	-	dB	
	High Pass	DC-85	45	50	-		

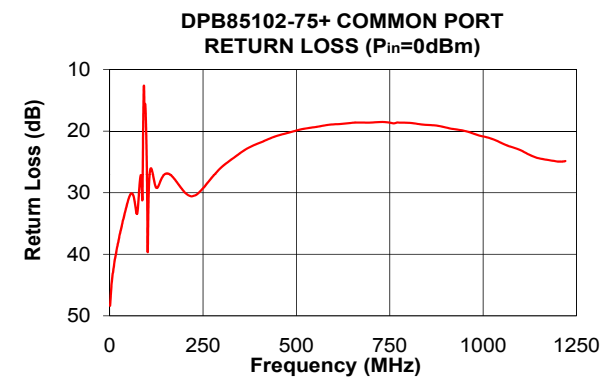
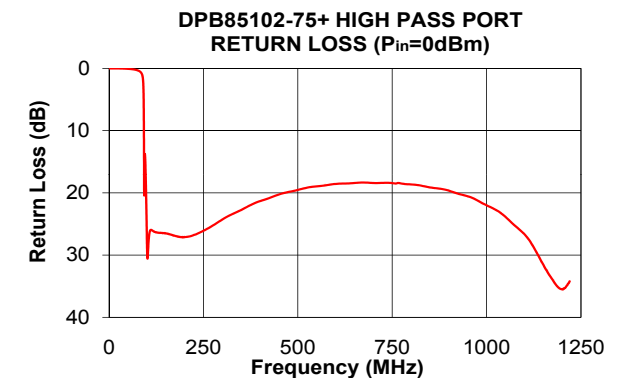
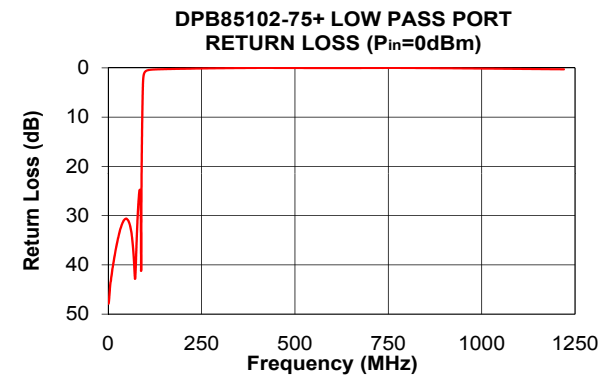
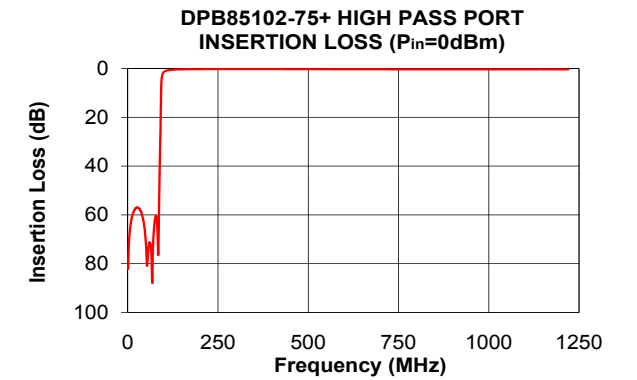
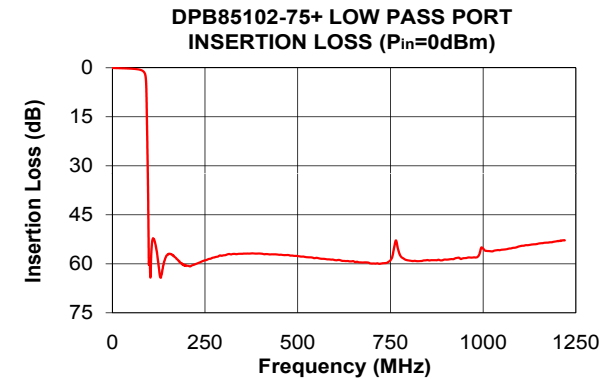
Typical Performance Data at 25°C

FREQUENCY (MHz)	INSERTION LOSS (dB)			RETURN LOSS (dB)	
	Low Pass Port	High Pass Port	Common Port	Low Pass Port	High Pass Port
1.00	0.05	82.15	48.38	47.86	0.01
5.00	0.08	67.67	44.83	44.43	0.01
40.00	0.21	60.39	33.40	31.22	0.04
85.00	1.24	72.24	27.77	24.80	0.68
89.00	2.20	36.13	23.42	25.52	1.32
89.50	2.49	32.61	20.47	20.48	1.52
91.00	4.26	21.51	13.82	10.74	2.86
92.00	7.42	12.06	12.82	6.27	6.51
93.00	13.76	5.92	16.55	3.25	19.52
95.00	26.94	3.01	15.60	1.46	13.76
96.00	34.49	2.45	16.53	1.16	14.84
96.50	38.73	2.24	17.34	1.06	15.77
97.75	51.51	1.83	20.16	0.88	18.87
98.00	54.54	1.77	20.83	0.85	19.61
100.00	58.26	1.39	28.35	0.69	26.39
102.00	62.58	1.16	39.66	0.59	30.56
120.00	56.29	0.53	28.34	0.34	26.26
150.00	57.08	0.33	26.90	0.26	26.50
250.00	58.93	0.22	29.28	0.12	26.09
500.00	57.61	0.25	19.89	0.02	19.52
1000.00	55.35	0.32	20.86	0.13	21.99
1220.00	52.81	0.31	24.85	0.29	34.21

Functional Schematic



CASE STYLE: PA2002



Surface Mount Diplexer

75Ω DC to 1220 MHz (DC-204, 258-1220 MHz)

Performance Charts

DPB204258-75+

Maximum Ratings

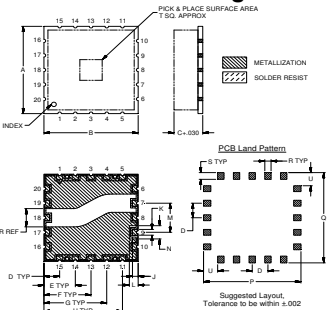
Operating Temperature	-40° to 85°C
Storage Temperature	-55°C to 100°C
RF Power Input	30dBm Max.

Permanent damage may occur if any of these limits are exceeded. These ratings are not intended for continuous normal operation.

Pin Connections

HIGH PASS PORT	7
LOW PASS PORT	9
COMMON PORT	18
GROUND	1-6,8,10-17,19,20

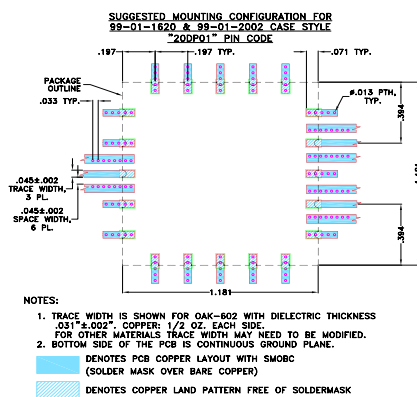
Outline Drawing



Outline Dimensions (inch/mm)

A	B	C	D	E	F	G	H	J	K
1.181	1.181	.300	.197	.384	.591	.787	.984	.071	.079
30.00	30.00	7.62	5.00	10.00	15.00	20.00	25.00	1.80	2.00
L	M	N	P	Q	R	S	T	U	Wt.
.111	.394	.179	1.221	1.221	.079	.091	.280	.178	grams
2.82	10.00	4.54	31.01	31.01	2.01	2.31	7.11	4.52	3.8

Demo Board MCL P/N: TB-786+ Suggested PCB Layout (PL-435)



Features

- Low insertion loss
- 75Ω Impedance
- Excellent return loss
- High rejection

Applications

- Cable TV systems (DOCSIS 3.1 standard)
- Multiband radio systems

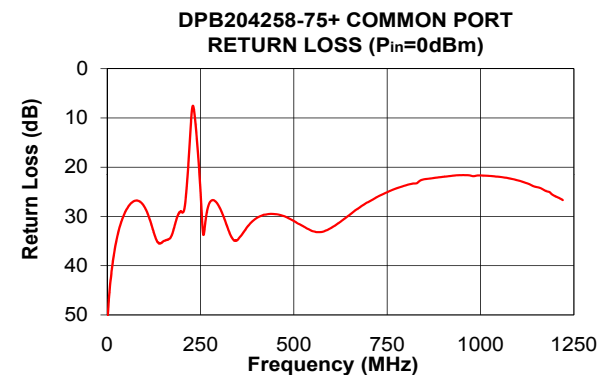
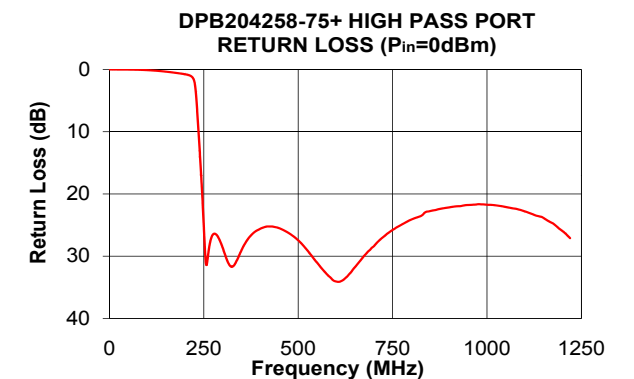
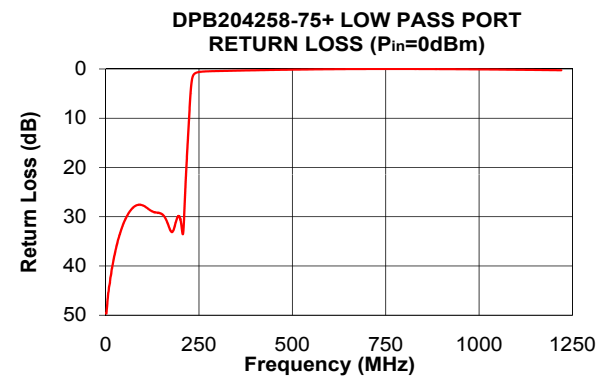
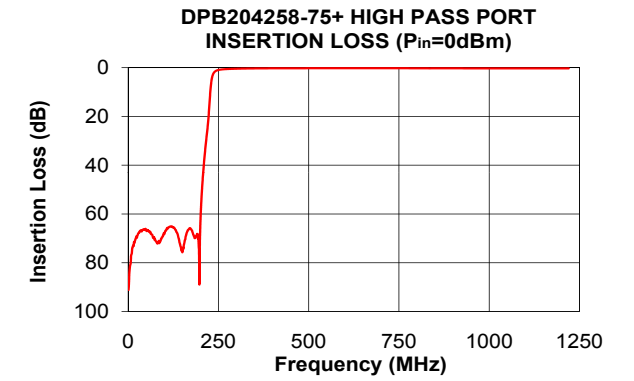
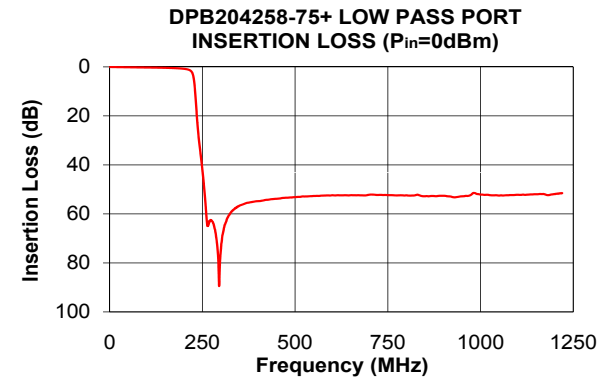
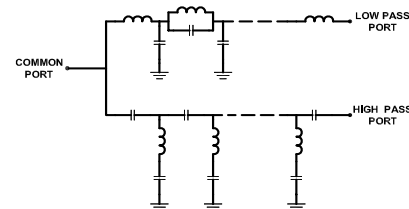
Electrical Specifications at 25°C

Parameter	Port	Frequency (MHz)	Min.	Typ.	Max.	Unit	
Pass Band	Insertion Loss	Low Pass	DC-204	-	0.9	1.5	dB
		High Pass	258-1220	-	0.8	1.5	
	Return Loss	Low Pass	DC-204	18	22	-	dB
		High Pass	258-1220	17	22	-	
Common		DC-204	18	22	-		
Stop Band Isolation	Low Pass	258-1220	45	50	-	dB	
	High Pass	DC-204	45	50	-		

Typical Performance Data at 25°C

FREQUENCY (MHz)	INSERTION LOSS (dB)			RETURN LOSS (dB)	
	Low Pass Port	High Pass Port	Common Port	Low Pass Port	High Pass Port
1	0.05	91.13	50.42	49.61	0.01
5	0.07	81.39	46.61	47.07	0.01
100	0.27	68.22	28.06	27.70	0.12
204	0.87	51.03	29.08	32.38	0.82
215	1.30	31.20	22.25	21.83	1.04
220	1.84	24.43	16.62	14.67	1.28
221	2.03	22.93	15.37	13.31	1.36
225	3.51	15.09	10.47	7.87	1.95
228	6.31	8.98	7.98	4.34	3.14
230	9.46	6.10	7.53	2.78	4.52
234	17.85	3.13	9.11	1.39	8.11
236	22.07	2.44	10.55	1.12	10.01
240	28.90	1.66	13.95	0.85	13.92
242	31.62	1.44	15.82	0.78	15.96
250	42.10	0.97	24.68	0.62	25.25
258	55.20	0.77	33.72	0.54	31.25
260	59.43	0.74	33.18	0.53	30.46
300	74.38	0.45	27.98	0.42	28.66
500	53.15	0.26	30.92	0.14	27.45
700	52.18	0.25	27.06	0.01	28.43
1000	52.11	0.31	21.69	0.09	21.74
1220	51.52	0.31	26.68	0.26	27.11

Functional Schematic



POWER SPLITTERS/ COMBINERS

Mini-Circuits offers a diverse range of RF splitter/combiners for DOCSIS 3.1 applications. Our selection includes models from 2 to 8 ways in-phase, as well as 2-way 180° hybrids. They come in a variety of case styles including core and wire and printed laminate, and all models provide low insertion loss, high isolation and minimal phase and amplitude unbalance.



FEATURES

- ▶ 2, 3, 4 and 8-Way
- ▶ Insertion Loss as low as 0.7 dB
- ▶ High Isolation, up to 30 dB
- ▶ Low Phase and Amplitude Unbalance (as low as 1°/0.1 dB)
- ▶ Power Handling up to 1W
- ▶ Top Hat® Feature on Core and Wire Models



Surface Mount Power Splitter/Combiner

2-Way 0° 75Ω 5 to 1250 MHz

ADP-2-122-75+

Features

- wideband, 5 to 1250 MHz
- low insertion loss, 0.9 dB typ.
- aqueous washable
- protected under U.S. Patent 6,133,525

Applications

- DOCSIS® 3.1 Systems
- cellular
- VHF/UHF
- communication systems
- CATV

Electrical Specifications at 25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Frequency Range		5		1250	MHz
Insertion Loss, above 3.0 dB	5-50	—	0.25	0.5	dB
	50-1000	—	0.75	1.2	
Isolation	5-50	17	20	—	dB
	50-1000	18	22	—	
Phase Unbalance	5-50	—	0.5	1.0	Degree
	50-1000	—	1.5	3.5	
Amplitude Unbalance	5-50	—	0.1	0.2	dB
	50-1000	—	0.15	0.3	
VSWR (Port S)	5-1000	—	1.15	1.30	:1
	1000-1250	—	1.25	1.35	
VSWR (Port 1 and Port 2)	5-1000	—	1.25	1.4	:1
	1000-1250	—	1.2	1.4	

Maximum Ratings

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Power Input (as a splitter)	0.5W max.
Internal Dissipation	0.125 W max.

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Function	Pin Number
SUM PORT	1
PORT 1	3
PORT 2	4
GROUND	6
NOT USED	2,5

Electrical Schematic

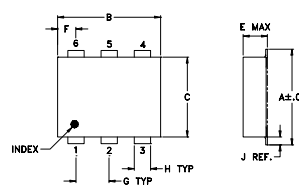


CASE STYLE: CD636

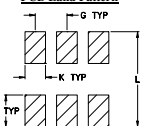
Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	500, 1000

Outline Drawing



PCB Land Pattern

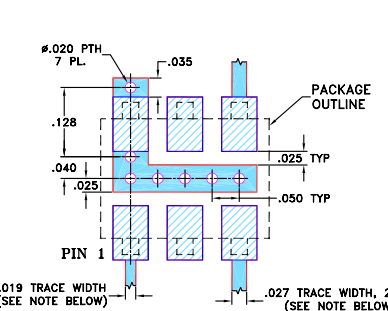


Suggested Layout, Tolerance to be within ±.002

Outline Dimensions (inch/mm)

A	B	C	D	E	F	G
272	.310	.220	.100	.162	.055	.100
3.91	7.87	5.59	2.54	4.11	1.40	2.54
H	J	K	L	wt		
.030	.026	.065	.300	grams		
1.76	0.66	1.65	7.62	0.25		

Demo Board MCL P/N: TB-243 Suggested PCB Layout (PL-141)

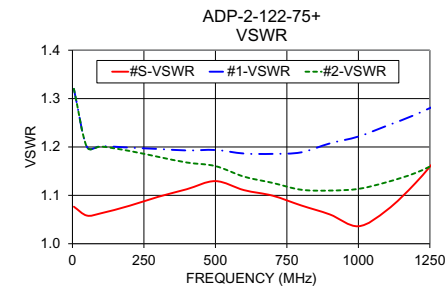
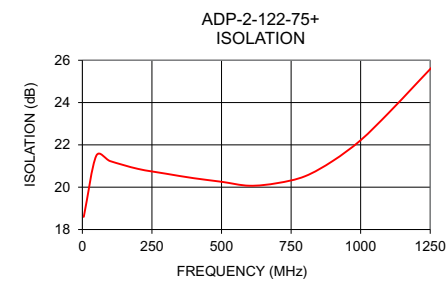
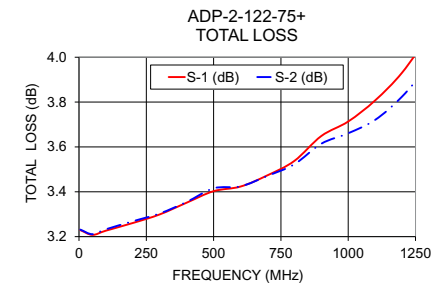


- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .030" ± .002". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED. 2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
- DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
 - DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Typical Performance Data

Frequency (MHz)	Total Loss ¹ (dB)		Amplitude Unbalance (dB)	Isolation (dB)	Phase Unbalance (deg.)	VSWR S	VSWR 1	VSWR 2
	S-1	S-2						
5	3.23	3.23	0.00	18.60	0.03	1.08	1.32	1.32
50	3.21	3.21	0.00	21.49	0.17	1.06	1.20	1.20
100	3.23	3.23	0.01	21.23	0.33	1.06	1.20	1.20
200	3.26	3.27	0.01	20.87	0.66	1.08	1.20	1.19
300	3.30	3.30	0.00	20.64	0.93	1.10	1.20	1.18
400	3.35	3.35	0.00	20.43	1.21	1.11	1.19	1.17
500	3.40	3.42	0.01	20.26	1.43	1.13	1.19	1.16
600	3.42	3.42	0.00	20.07	1.56	1.11	1.19	1.14
700	3.47	3.47	0.00	20.19	1.68	1.10	1.19	1.13
800	3.54	3.52	0.01	20.52	1.80	1.08	1.19	1.11
900	3.65	3.61	0.03	21.24	1.76	1.06	1.21	1.11
1000	3.71	3.66	0.05	22.22	1.84	1.04	1.22	1.11
1100	3.81	3.72	0.09	23.50	1.90	1.07	1.24	1.13
1200	3.93	3.82	0.11	24.89	1.96	1.13	1.27	1.15
1300	4.10	3.97	0.13	26.28	1.92	1.19	1.29	1.17

1. Total Loss = Insertion Loss + 3dB splitter loss.



Additional Notes

- Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

ADP-2-10-75M+

75Ω 5 to 1200 MHz

Features

- wideband, 5 to 1200 MHz
- high isolation, 27 dB typ.
- aqueous washable
- protected under U.S. Patent 6,133,525



CASE STYLE: CD636

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	500, 1000

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Insertion Loss Above 3 dB (dB) Typ.	Isolation (dB) Typ.	Phase Unbalance (Deg.) Max.	Amplitude Unbalance (dB) Max.
ADP-2-10-75M+	5 - 50	0.2	26	1.0	0.1
	50 - 500	0.4	27	2.0	0.2
	500 - 1000	0.7	29	4.0	0.3
	1000 - 1200	1.0	27	5.0	0.4

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Power Input (as a splitter)	1W
Internal Dissipation	0.125 W

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

SUM Port	1
Port 1	3
Port 2	4
Ground	6
Externally connect together & isolate	2,5

Electrical Schematic



ADP-2-20-75M+

75Ω 5 to 2000 MHz

Features

- wideband, 5 to 2000 MHz
- low insertion loss, 0.5 dB typ.
- aqueous washable
- protected under U.S. Patent 6,133,525



CASE STYLE: CD542

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	500, 1000

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Insertion Loss Above 3 dB (dB) Typ.	Isolation (dB) Typ.	Phase Unbalance (Deg.) Max.	Amplitude Unbalance (dB) Max.
ADP-2-20-75+	5 - 50	0.4	16	1.0	0.15
	50 - 1000	0.5	16	4.0	0.3
	1000 - 2000	0.6	28	5.0	0.6

Maximum Ratings

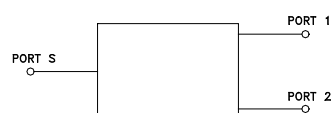
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Power Input (as a splitter)	0.5W
Internal Dissipation	0.25 W

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

SUM Port	1
Port 1	3
Port 2	4
Ground	6
Not used	2,5

Electrical Schematic



CDP-2-122-75+

75Ω 5 to 1200 MHz

Features

- wideband, 5 to 1200 MHz
- low insertion loss, 0.8 dB typ.
- excellent matching return loss, 20 dB typ.
- aqueous washable



CASE STYLE: TT1491-2

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Insertion Loss Above 3 dB (dB) Typ.	Isolation (dB) Typ.	Phase Unbalance (Deg.) Max.	Amplitude Unbalance (dB) Max.	VSWR (:1) Port-S Typ.	Port 1 & 2 Typ.
NEW! CDP-2-122-75+	5 - 50	0.4	24	3.0	0.5	1.05	1.20
	50 - 600	0.6	25	3.0	0.4	1.10	1.15
	600 - 1200	1.0	20	5.0	0.6	1.25	1.10

Maximum Ratings

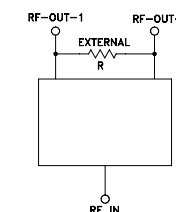
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Power Input (as a splitter)	1W
Internal Dissipation	0.125 W

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

SUM Port	6
Port 1	3
Port 2	4
Ground	1
Not used	2,5
Ext. resistor 165Ω	3,4

Electrical Schematic



SYPS-2-282-75+

75Ω 5 to 2750 MHz

Features

- wideband, 5 to 2750 MHz
- low insertion loss, 0.8 dB typ.
- high isolation, 25 dB typ.



CASE STYLE: AH202-2

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Insertion Loss Above 3 dB (dB) Typ.	Isolation (dB) Typ.	Phase Unbalance (Deg.) Max.	Amplitude Unbalance (dB) Max.
SYPS-2-282-75+	5 - 50	0.5	20	2.0	0.2
	50 - 1375	0.8	25	4.0	0.4
	1375 - 2700	1.5	22	6.0	1.0

Maximum Ratings

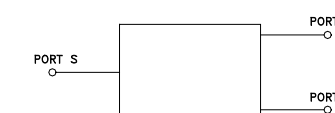
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Power Input (as a splitter)	0.5 W
Internal Dissipation	0.05 W

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

SUM Port	8
Port 1	4
Port 2	5
Ground	1,2,3,6,7

Electrical Schematic



Surface Mount ^{top hat®} Power Splitter/Combiner

2-Way 0° 75Ω 1 to 1250 MHz

CDP-2-122W-75+



CASE STYLE: TT1491-1

Features

- wideband, 1 to 1250 MHz
- low insertion loss, 0.8 dB typ.
- good isolation, 21 dB typ.
- aqueous washable

Applications

- DOCSIS® 3.1 Systems
- cellular
- VHF/UHF
- communication systems

Electrical Specifications at 25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Frequency Range		1		1250	MHz
Insertion Loss Above 3.0 dB	1-10	—	0.4	0.9	dB
	10-870	—	0.8	1.3	
	870-1000	—	1.1	1.5	
	1000-1250	—	1.5	1.9	
Isolation	1-10	17	23.0	—	dB
	10-870	16	21.0	—	
	870-1000	16	19.0	—	
	1000-1250	15	19.0	—	
Phase Unbalance	1-10	—	2.0	5.0	Degree
	10-870	—	1.5	4.0	
	870-1000	—	1.5	4.0	
	1000-1250	—	1.0	4.0	
Amplitude Unbalance	1-10	—	0.25	0.6	dB
	10-870	—	0.20	0.6	
	870-1000	—	0.25	0.6	
	1000-1250	—	0.30	0.7	
VSWR (Port S)	1-10	—	1.16	1.35	:1
	10-870	—	1.15	1.25	
	870-1000	—	1.20	1.35	
	1000-1250	—	1.20	1.40	
VSWR (Port 1-2)	1-10	—	1.25	1.50	:1
	10-870	—	1.15	1.30	
	870-1000	—	1.25	1.40	
	1000-1250	—	1.30	1.60	

1. Mainline loss includes theoretical power loss at coupled port.

Maximum Ratings

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Power Input (as a splitter)	1W max.
Internal Dissipation	0.125W max.

Permanent damage may occur if any of these limits are exceeded.

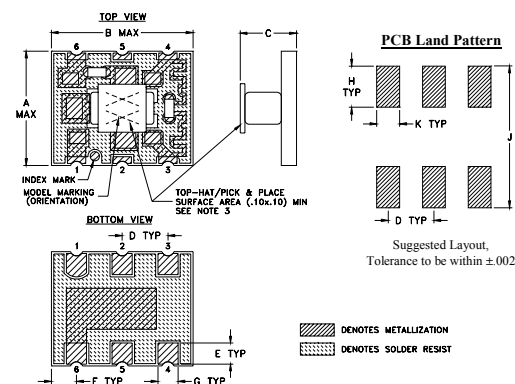
Pin Connections

Function	Pin Number
SUM PORT	1
PORT 1	3
PORT 2	4
GROUND	6
NOT USED	2,5

Electrical Schematic



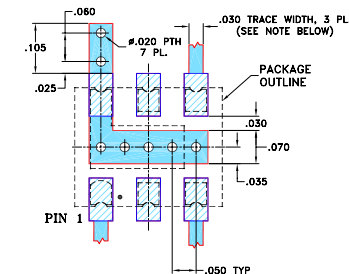
Outline Drawing



Outline Dimensions (inch/mm)

A	B	C	D	E	F	G	H	J	K	wt.
.255	.310	.133	.100	.050	.055	.044	.090	.310	.050	grams
6.48	7.87	3.38	2.54	1.27	1.40	1.12	2.29	7.87	1.27	0.35

Demo Board MCL P/N: TB-565+ Suggested PCB Layout (PL-327)

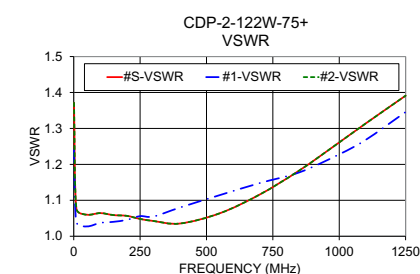
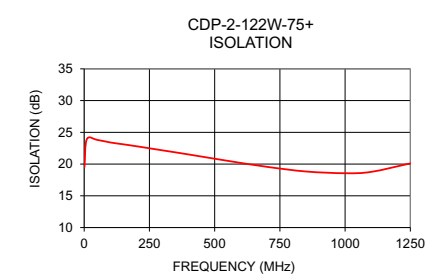
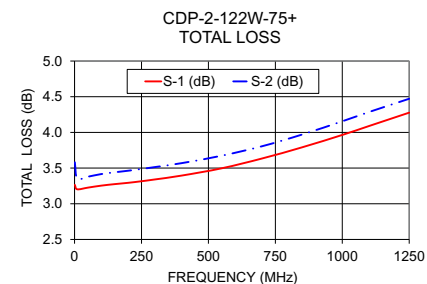


- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .030" ± .002". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Typical Performance Data

Frequency (MHz)	Total Loss ¹ (dB)		Amplitude Unbalance (dB)	Isolation (dB)	Phase Unbalance (deg.)	VSWR S	VSWR 1	VSWR 2
	S-1	S-2						
1	3.26	3.58	0.32	19.50	2.05	1.23	1.24	1.37
10	3.20	3.35	0.15	23.90	0.41	1.16	1.04	1.08
50	3.23	3.38	0.15	23.81	0.10	1.15	1.03	1.06
100	3.25	3.42	0.16	23.40	0.23	1.15	1.04	1.06
150	3.28	3.44	0.17	23.11	0.33	1.15	1.04	1.06
200	3.29	3.46	0.17	22.81	0.41	1.15	1.05	1.06
250	3.32	3.49	0.17	22.49	0.49	1.14	1.06	1.05
300	3.34	3.51	0.17	22.16	0.56	1.14	1.05	1.04
400	3.40	3.57	0.17	21.52	0.68	1.13	1.08	1.04
550	3.50	3.67	0.18	20.51	0.81	1.13	1.11	1.06
700	3.63	3.81	0.17	19.57	0.99	1.12	1.15	1.12
850	3.79	3.97	0.18	18.83	0.90	1.14	1.18	1.18
1000	3.96	4.16	0.19	18.56	0.52	1.16	1.23	1.26
1100	4.09	4.29	0.20	18.77	0.15	1.17	1.27	1.31
1250	4.28	4.47	0.19	20.11	0.66	1.14	1.35	1.39

1. Total Loss = Insertion Loss + 3dB splitter loss.



Additional Notes

- A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

Surface Mount Power Splitter/Combiner

2-Way 0° 75Ω 5 to 1250 MHz

TCP-2-122-75X+

Features

- low insertion, 0.8 dB typ.
- excellent amplitude unbalance, 0.3 dB typ.
- very good phase unbalance, 1.0 deg. typ.
- external resistor & capacitor required
- aqueous washable
- leads for excellent solderability
- low cost

Applications

- DOCSIS® 3.1 Systems
- VHF/UHF
- CATV
- cellular

Electrical Specifications at 25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Frequency Range		5		1250	MHz
Insertion Loss Above 3.0 dB	5-50	—	0.5	0.7	dB
	1000-1250	—	1.0	1.9	
Isolation	5-1000	19	25	—	dB
	1000-1250	17	23	—	
Phase Unbalance	5-1000	—	1.0	3	Degree
	1000-1250	—	2.0	5	
Amplitude Unbalance	5-1000	—	0.3	0.6	dB
	1000-1250	—	0.5	0.8	
VSWR (Port S)	5-1000	—	1.3	1.6	:1
	1000-1250	—	1.6	1.9	
VSWR (Port 1-2)	5-1000	—	1.3	1.8	:1
	1000-1250	—	1.6	1.9	

1. Mainline loss includes theoretical power loss at coupled port.

Maximum Ratings

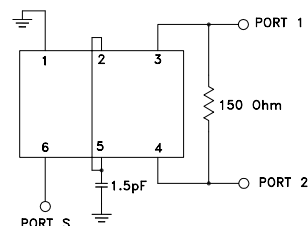
Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Power Input (as a splitter)	0.5W max.

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Function	Pin Number
SUM PORT	6
PORT 1	3
PORT 2	4
GROUND	1
CONNECT	2,5
EXT. RESISTOR 150Ω	3,4
EXT. CAPACITOR 1.5pF	2 OR 5 TO GND

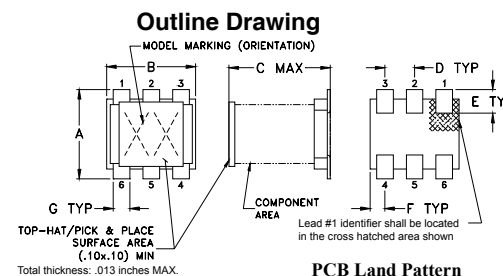
Electrical Schematic



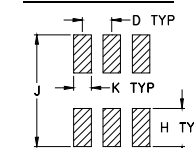
CASE STYLE: DB1627

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000



PCB Land Pattern

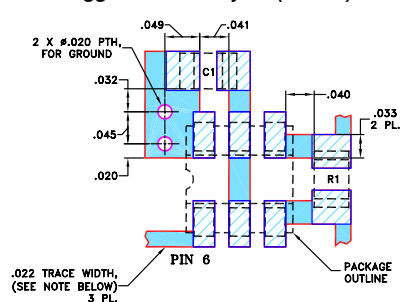


Suggested Layout, Tolerance to be within ±.002

Outline Dimensions (inch/mm)

A	B	C	D	E	F
.160	.150	.160	.050	.040	.025
4.06	3.81	4.06	1.27	1.02	0.64
G	H	J	K	wt	
.028	.065	.190	.030	grams	
0.71	1.65	4.83	0.76	0.15	

Demo Board MCL P/N: TB-124 Suggested PCB Layout (PL-002)



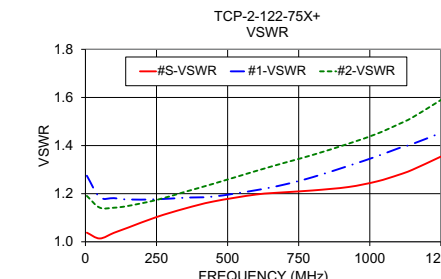
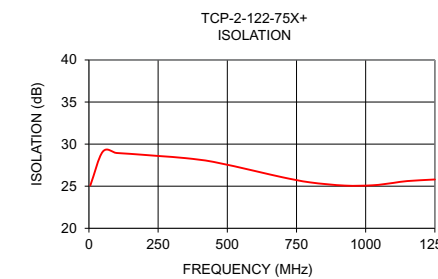
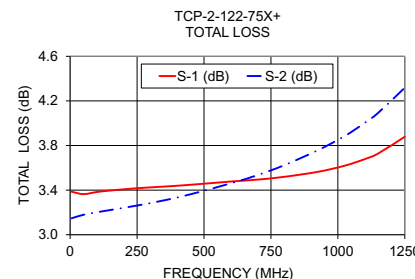
RESISTOR R1: 150 Ohm, 0805 SIZE
CAPACITOR C1: 1.5 pF, 0805 SIZE

- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS 0.030" ± 0.002"; COPPER: 1 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE. DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER) DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Typical Performance Data

Frequency (MHz)	Total Loss ¹ (dB)		Amplitude Unbalance (dB)	Isolation (dB)	Phase Unbalance (deg.)	VSWR S	VSWR 1	VSWR 2
	S-1	S-2						
5	3.39	3.15	0.24	25.09	1.29	1.04	1.27	1.19
50	3.36	3.18	0.19	29.10	0.06	1.01	1.19	1.14
100	3.38	3.20	0.18	28.95	0.10	1.04	1.18	1.14
150	3.40	3.22	0.17	28.84	0.21	1.06	1.18	1.15
250	3.42	3.26	0.16	28.59	0.39	1.10	1.18	1.17
350	3.43	3.31	0.12	28.33	0.53	1.14	1.18	1.21
450	3.45	3.36	0.09	27.89	0.64	1.17	1.19	1.24
600	3.48	3.46	0.02	26.81	0.72	1.20	1.21	1.29
700	3.49	3.53	0.04	26.06	0.67	1.21	1.24	1.33
800	3.52	3.62	0.10	25.45	0.51	1.21	1.27	1.36
925	3.56	3.76	0.19	25.07	0.09	1.23	1.32	1.41
1025	3.62	3.88	0.27	25.11	0.42	1.25	1.36	1.45
1100	3.68	4.00	0.32	25.39	0.90	1.28	1.39	1.49
1150	3.73	4.09	0.36	25.61	1.30	1.30	1.41	1.52
1250	3.88	4.32	0.44	25.80	1.99	1.35	1.45	1.59

1. Total Loss = Insertion Loss + 3dB splitter loss.



Additional Notes

- A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

2-Way 180°

75Ω 5 to 1250 MHz

SBTCJ-122-75X+

Features

- wideband, 5 to 1250 MHz
- low insertion loss, 1.5 dB typ.
- leads for excellent solderability
- low cost



CASE STYLE: DB1627

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Insertion Loss Above 3 dB (dB) Typ.	Isolation (dB) Typ.	Phase Unbalance (Deg.) Max.	Amplitude Unbalance (dB) Max.	VSWR (:1)	
						Port-S Typ.	Port 1 & 2 Typ.
	5 - 50	1.1	29	3.0	0.6	1.27	1.23
NEW! SBTCJ-122-75+	50 - 1000	1.5	28	9.0	0.9	1.25	1.28
	1000 - 1250	2.1	20	12.0	1.7	1.25	1.68

Maximum Ratings

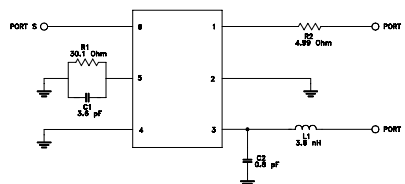
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Power Input (as a splitter)	1.0 W

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Sum port	6
Port 1 (180°)	1
Port 2 (0°)	3
Ground	4
Ext. inductor series 3-6hH	3
Ext. capacitor 0.8pF	3 to gnd
Ext. capacitor 3.6pF	5 to gnd
Ext. resistor 30.1Ω	5 to gnd
Ext. resistor series 4.99Ω	1
Ground or not used	2

Electrical Schematic



3-Way 0°

75Ω 5 to 1200 MHz

SYPS-3-12W-75+

Features

- wideband, 5 to 1200 MHz
- low insertion loss, 0.7 dB typ.
- good isolation, 25 dB typ.
- wide frequency band, 5 to 1200 MHz, useable 5 to 1300 MHz
- low amplitude unbalance, 0.2 dB typ.
- low phase unbalance, 2.0 deg. typ.



CASE STYLE: AH202

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Insertion Loss Above 4.8 dB (dB) Typ.	Isolation (dB) Typ.	Phase Unbalance (Deg.) Max.	Amplitude Unbalance (dB) Max.	VSWR (:1)	
						Port-S Typ.	Port 1 & 2 Typ.
	5 - 20	0.6	26	—	—	1.0	1.3
NEW! SYPS-3-12W-75+	20 - 860	0.7	25	3.0	0.1	1.2	1.2
	860 - 1200	1.2	20	5.0	0.8	1.25	1.25

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Power Input (as a splitter)	1W
Internal Dissipation	0.15 W

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

SUM Port	8
Port 1	1
Port 2	4
Port 3	5
Ground	2,3,6,7

Electrical Schematic



4-Way 0°

75Ω 10 to 1500 MHz

SCA-4-15-75+

Features

- wideband, 10 to 1500 MHz
- high isolation, 25 dB typ.
- excellent amplitude unbalance, 0.3 dB typ.



CASE STYLE: DZ943

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Insertion Loss Above 6 dB (dB) Typ.	Isolation (dB) Typ.	Phase Unbalance (Deg.) Max.	Amplitude Unbalance (dB) Max.	VSWR (:1)	
						Port-S Typ.	Port 1 & 2 Typ.
	10 - 40	0.5	19	8	0.8		
NEW! SCA-4-15-75+	40 - 900	1.2	25	9	0.9		
	900 - 1200	1.4	19	12	1.0		
	1200 - 1500	2.0	18	16	1.1		

Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Power Input (as a splitter)	0.5W
Internal Dissipation	0.375 W

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

SUM Port	3
Port 1	6
Port 2	7
Port 3	9
Port 4	10
Ground	1,2,4,5,8

Electrical Schematic



Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	500, 1000

8-Way 0°

75Ω 5 to 1250 MHz

SCPA-8-122-75+

Features

- wideband, 5 to 1250 MHz
- good isolation, 25 dB typ.
- aqueous washable
- shielded metal case



CASE STYLE: HU1371

Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Insertion Loss Above 9 dB (dB) Typ.	Isolation (dB) Typ.	Phase Unbalance (Deg.) Max.	Amplitude Unbalance (dB) Max.	VSWR (:1)	
						Port-S Typ.	Port 1 - 8 Typ.
	5 - 50	0.9	30	8.0	0.3	1.4	1.3
NEW! SCPA-8-122-75+	50 - 500	1.6	20	9.0	0.8	1.3	1.2
	500 - 1000	2.6	20	10.0	2.0	1.5	1.4
	1000 - 1250	4.0	18	18.0	2.8	1.9	1.6

Maximum Ratings

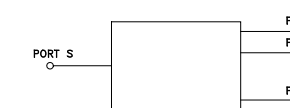
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Power Input (as a splitter)	1W
Internal Dissipation	0.875 W

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

SUM Port	1
Port 1	3
Port 2	4
Port 3	5
Port 4	6
Port 5	9
Port 6	10
Port 7	11
Port 8	12
Ground	2,7,8,13,14

Electrical Schematic



Surface Mount Power Splitter/Combiner

4-Way 0° 75Ω 5 to 1250 MHz

SCP-4-122-75+



CASE STYLE: YY161

Features

- wideband, 5 to 1250 MHz
- high isolation, 25 dB typ
- excellent amplitude unbalance, 0.4 dB typ.

Applications

- DOCSIS® 3.1 Systems
- cellular
- CATV
- receivers/transmitters

Electrical Specifications at 25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Frequency Range		5		1250	MHz
Insertion Loss, above 6.0 dB	5-100	—	0.6	1.0	dB
	100-1000	—	1.1	1.9	
Isolation	5-1000	16	25	—	dB
	1000-1250	14	18	—	
Phase Unbalance	5-100	—	1.0	3.0	Degree
	100-1000	—	6.0	12.0	
Amplitude Unbalance	5-1000	—	0.5	0.9	dB
	1000-1250	—	0.9	1.5	
VSWR (Port S)	5-1000	1.32	1.22	—	:1
	1000-1250	1.49	1.28	—	
VSWR (Port 1 - 4)	5-1000	1.57	1.28	—	:1
	1000-1250	2.32	1.57	—	

Maximum Ratings

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Power Input (as a splitter)	1W max.
Internal Dissipation	0.375W max.

Permanent damage may occur if any of these limits are exceeded.

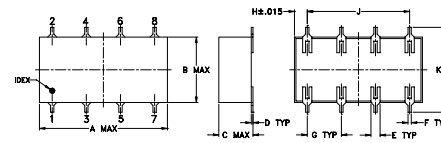
Pin Connections

Function	Pin Number
SUM PORT	3
PORT 1	2
PORT 2	4
PORT 3	6
PORT 4	8
GND	1,5,7

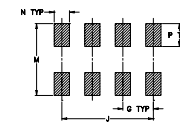
Electrical Schematic



Outline Drawing



PCB Land Pattern

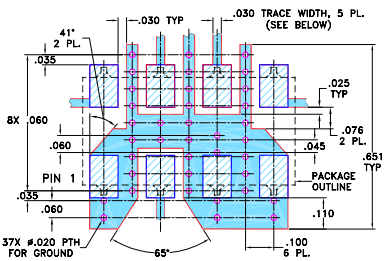


Suggested Layout,
Tolerance to be within ±0.02

Outline Dimensions (inch/mm)

A	B	C	D	E	F	G
0.75	0.38	0.28	0.01	0.05	0.02	0.2
19.05	9.65	7.11	0.25	1.27	0.51	5.08
H	J	K	M	N	P	wt
0.075	0.6	0.45	0.47	0.1	0.15	grams
1.91	15.24	11.43	11.94	2.54	3.81	1.60

Demo Board MCL P/N: TB-184 Suggested PCB Layout (PL-175)



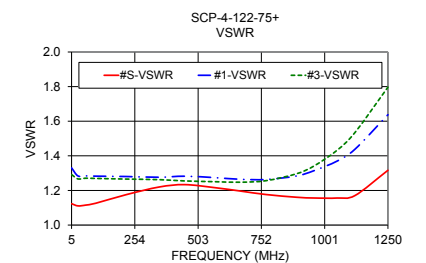
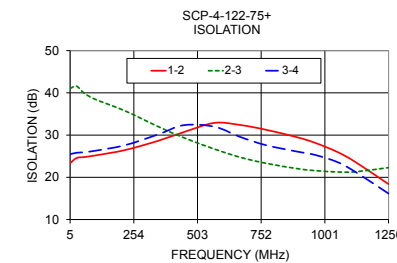
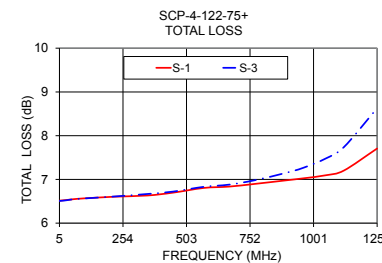
NOTE: 1. TRACE WIDTH IS SHOWN FOR FR4 WITH DIELECTRIC THICKNESS: .030 ± .002; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

- DENOTES PCB COPPER LAYOUT
- DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Typical Performance Data

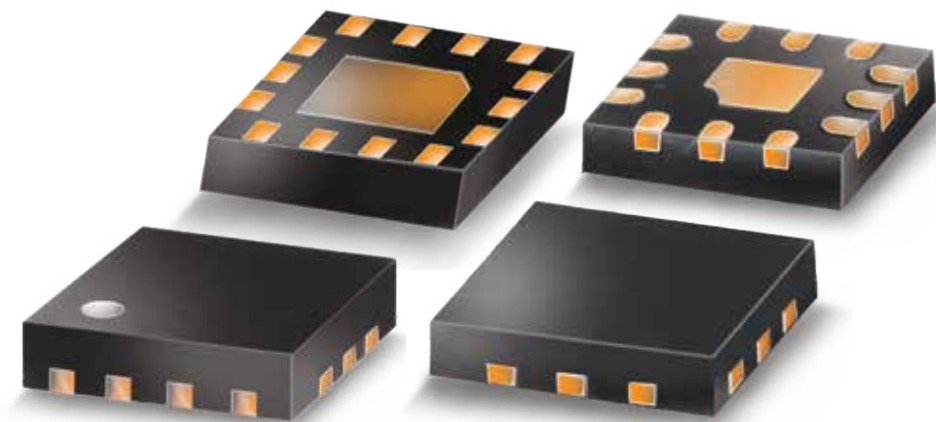
Freq. (MHz)	Total Loss ¹ (dB)				Amp. Unbal. (dB)	Isolation (dB)			Phase Unbal. (deg.)	VSWR S	VSWR 1	VSWR 2	VSWR 3	VSWR 4
	S-1	S-2	S-3	S-4		1-2	2-3	3-4						
5	6.51	6.52	6.51	6.51	0.01	23.35	41.04	25.49	0.04	1.12	1.33	1.33	1.29	1.29
30	6.53	6.52	6.52	6.52	0.01	24.56	41.58	25.80	0.21	1.11	1.28	1.28	1.27	1.26
60	6.55	6.55	6.55	6.55	0.00	24.80	39.92	25.94	0.43	1.12	1.28	1.29	1.27	1.27
100	6.57	6.57	6.56	6.57	0.01	25.14	38.55	26.26	0.69	1.13	1.28	1.29	1.27	1.27
220	6.60	6.62	6.61	6.61	0.02	26.46	35.72	27.61	1.54	1.18	1.28	1.29	1.27	1.27
350	6.63	6.69	6.67	6.67	0.06	28.67	31.99	30.18	2.29	1.22	1.28	1.29	1.26	1.28
450	6.70	6.77	6.72	6.72	0.07	30.72	29.37	32.35	2.87	1.23	1.28	1.29	1.25	1.28
570	6.80	6.90	6.83	6.83	0.10	32.89	26.67	31.97	3.65	1.22	1.27	1.28	1.25	1.29
670	6.84	6.97	6.88	6.86	0.13	32.39	24.74	29.56	4.45	1.20	1.26	1.28	1.25	1.29
770	6.90	7.08	6.98	6.95	0.19	31.27	23.33	27.62	5.21	1.18	1.26	1.30	1.26	1.30
890	6.98	7.24	7.15	7.09	0.26	29.53	22.08	26.12	6.22	1.16	1.28	1.33	1.30	1.34
960	7.02	7.34	7.26	7.19	0.31	28.23	21.60	25.34	6.90	1.16	1.31	1.36	1.34	1.39
1050	7.10	7.49	7.48	7.37	0.40	26.00	21.27	23.61	7.81	1.16	1.37	1.42	1.43	1.48
1120	7.20	7.66	7.74	7.59	0.54	23.64	21.31	21.29	8.47	1.17	1.44	1.50	1.53	1.59
1250	7.71	8.31	8.63	8.39	0.92	18.38	22.30	16.15	9.57	1.32	1.64	1.68	1.80	1.85

1. Total Loss = Insertion Loss + 6dB splitter loss.



HIGH-POWER REFLECTIVE MMIC SWITCHES

For highly reliable signal routing in CATV and broadband systems, Mini-Circuits offers a series of 75Ω MMIC switches made using Silicon-on-Insulator process technology with built-in CMOS drivers. Available in SPDT, SP3T, SP4T, SP5T and SP6T designs, they provide extremely fast switching, low insertion loss, high isolation, and high IP3 in tiny packages with very low current consumption.



FEATURES

- ▶ Fast switching, 1.9 μs
- ▶ Insertion Loss as low as 0.38 dB
- ▶ High Isolation, up to 42 dB
- ▶ High IP3, up to +56 dBm
- ▶ High Power Handling, up to 3W
- ▶ Low Current Consumption, as low as 37 μA
- ▶ Tiny Size, 2x2mm



SPDT RF Switch

75Ω 5-3000 MHz

SPDT RF Switch

JSW2-33DR-75+

Reflective RF Switch with internal driver.
Single Supply Voltage, +2.3V to +4.8V, High Power 3W

Product Features

- High Isolation, 42 dB typ. at 1 GHz
- Low insertion loss, 0.38 dB typ. at 1 GHz
- High IP3, 56 dBm typ. at 1 GHz
- Low current consumption, 37 μA typ.
- High Power, P0.1dB 3W

Typical Applications

- CATV systems
- SATCOM system
- Automated Test Stations

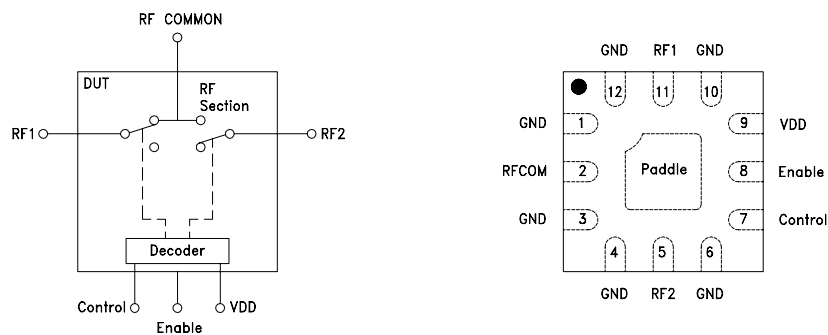
General Description

JSW2-33DR-75+ is a high power (35 dBm) reflective SPDT switch with integral CMOS driver, operates with single positive supply voltage while consuming, 37μA typical. JSW is a reflective short on output port in OFF state. It has been designed for very wideband operation of 5-3000 MHz. It is packaged in a tiny 2mm x 2mm x 0.55mm package and is rated MSL1 and class 1B for ESD (HBM)



CASE STYLE: MT1818

Simplified Schematic and Pad Description



Function	Pad Number	Description
RF COM	2	RF Common/ SUM Port, (see Fig. 2)
RF1	11	RF Out #1/In Port #1, (see Fig. 2)
RF2	5	RF Out #1/In Port #2, (see Fig. 2)
Control	7	CMOS Control IN
VDD	9	Supply Voltage
Enable	8	Shutdown mode enabled by connecting to logic low
GND	1,3,4,6,10,12	Ground

RF Electrical Specifications⁽¹⁾, 5 - 3000 MHz, T_{AMB}=25°C, V_{DD}= +2.3 to 4.8V

Parameter	Condition (MHz)	Min.	Typ.	Max.	Units
Frequency Range		5		3000	MHz
Insertion Loss ⁽²⁾ (ON STATE)	5 to 1000		0.38	0.48	dB
	1000 to 1500		0.48	0.58	
	1500 to 2000		0.54	0.64	
	2000 to 3000		0.53	0.64	
Isolation between Common port and RF1/RF2 Ports	5 to 1000	40	42		dB
	1000 to 1500	35	38		
	1500 to 2000	32	35		
	2000 to 3000	28	31		
Isolation between RF1 and RF2 ports ⁽³⁾	5 to 1000	40	45		dB
	1000 to 1500	35	41		
	1500 to 2000	32	37		
	2000 to 3000	28	32		
Return Loss (ON STATE), all ports	5 to 1000		19		dB
	1000 to 1500		16		
	1500 to 2000		16		
	2000 to 3000		17		
Input IP3 (V _{DD} =3V)	5 to 1000		56		dBm
	1000 to 1500		62		
	1500 to 2000		63		
	2000 to 3000		63		
0.1dB Input Compression ⁽⁴⁾	5 to 3000		35.0		dBm

DC Operating Electrical Specifications

Parameter	Min.	Typ.	Max.	Units
VDD, Supply Voltage	2.3		4.8	V
Supply Current		37		μA
Control Enable Voltage Low	0		0.4	V
Control Enable Voltage High	1.65		VDD	V
Control Current		1		μA
Shutdown mode - Supply Current		7		μA

Notes:

1. Tested on Mini-Circuit's test board TB-723-N+ (see Characterization Test Circuit, Fig.1).
2. Insertion loss values include test board loss.
3. Enable voltage "HI", either RF1 or RF2 are ON.
4. Do not exceed RF input power as shown in Absolute Maximum Rating table.

Switching Specifications

Parameter	Min.	Typ.	Max.	Units
Rise/Fall Time (10 to 90% or 90 to 10% RF)	—	0.5 (Rise Time) 0.7 (Fall Time)	—	μSec
Switching Time, 50% CTRL to 90/10% RF	—	1.9 (ON Time) 1.1 (OFF Time)	—	μSec
Video Feedthrough, (control 0 to 1.65V, freq.=10 KHz)	—	3.0	—	mV _{p,p}

SPDT RF Switch

75Ω 5-3000 MHz

SPDT RF Switch

JSW2-33HDR-75+

Reflective RF Switch with internal driver.
Single Supply Voltage, +2.3V to +4.8V, High Power 3W

Product Features

- High IP3, +70 dBm typ. at 150 MHz
- High Power, P0.1dB 3W
- High Isolation, 42 dB typ. at 1 GHz
- Low insertion loss, 0.38 dB typ. at 1 GHz
- Low current consumption, 37 μA typ.

Typical Applications

- CATV systems
- SATCOM system
- Automated Test Stations

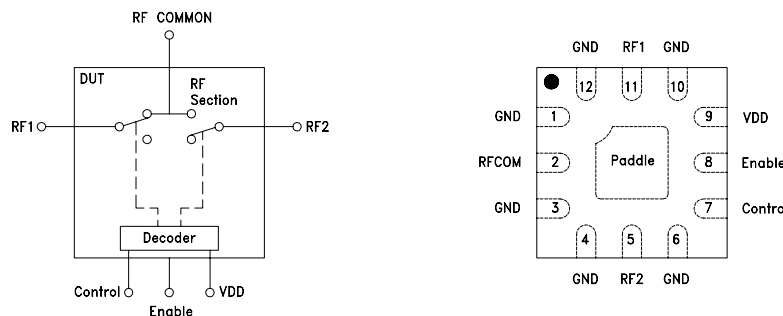
General Description

JSW2-33HDR-75+ is a high power (35 dBm) reflective SPDT switch with integral CMOS driver, operates with single positive supply voltage while consuming, 37μA typical. JSW is a reflective short on output port in OFF state. It has been designed for very wideband operation of 5-3000 MHz. It is packaged in a tiny 2mm x 2mm x 0.55mm package and is rated MSL1 and class 1B for ESD (HBM)



CASE STYLE: MT1818

Simplified Schematic and Pad Description



Function	Pad Number	Description
RF COM	2	RF Common/ SUM Port, (see Fig. 2)
RF1	11	RF Out #1/In Port #1, (see Fig. 2)
RF2	5	RF Out #1/In Port #2, (see Fig. 2)
Control	7	CMOS Control IN
VDD	9	Supply Voltage
Enable	8	Shutdown mode enabled by connecting to logic low
GND	1,3,4,6,10,12	Ground

RF Electrical Specifications⁽¹⁾, 5 - 3000 MHz, T_{AMB}=25°C, V_{DD}= +2.3 to 4.8V

Parameter	Condition (MHz)	Min.	Typ.	Max.	Units
Frequency Range		5		3000	MHz
Insertion Loss ⁽²⁾ (ON STATE)	5 to 1000		0.38	0.48	dB
	1000 to 1500		0.48	0.58	
	1500 to 2000		0.54	0.64	
	2000 to 3000		0.53	0.64	
Input IP3 (V _{DD} =3V)	150		+70		dBm
	1800		+70		
0.1dB Input Compression ⁽⁴⁾	20 to 3000		35.0		dBm
Isolation between Common port and RF1/RF2 Ports	5 to 1000	40	42		dB
	1000 to 1500	35	38		
	1500 to 2000	32	35		
	2000 to 3000	28	31		
Isolation between RF1 and RF2 ports ⁽³⁾	5 to 1000	40	45		dB
	1000 to 1500	35	41		
	1500 to 2000	32	37		
	2000 to 3000	28	32		
Return Loss (ON STATE), all ports	5 to 1000		19		dB
	1000 to 1500		16		
	1500 to 2000		16		
	2000 to 3000		17		

DC Operating Electrical Specifications

Parameter	Min.	Typ.	Max.	Units
VDD, Supply Voltage	2.3		4.8	V
Supply Current		37		μA
Control Enable Voltage Low	0		0.4	V
Control Enable Voltage High	1.65		VDD	V
Control Current		1		μA
Shutdown mode - Supply Current		7		μA

- Notes:
1. Tested on Mini-Circuit's test board TB-723-N+ (see Characterization Test Circuit, Fig.1).
 2. Insertion loss values include test board loss.
 3. Enable voltage "HI", either RF1 or RF2 are ON.
 4. Do not exceed RF input power as shown in Absolute Maximum Rating table.

Switching Specifications

Parameter	Min.	Typ.	Max.	Units
Rise/Fall Time (10 to 90% or 90 to 10% RF)	—	0.5 (Rise Time) 0.7 (Fall Time)	—	μSec
Switching Time, 50% CTRL to 90/10% RF	—	1.9 (ON Time) 1.1 (OFF Time)	—	μSec
Video Feedthrough, (control 0 to 1.65V, freq.=10 KHz)	—	3.0	—	mV _{P-P}

SP3T RF Switch

75Ω 5-2000 MHz

Reflective RF Switch with internal driver.
Single Supply Voltage, +2.5V to +4.8V

Product Features

- High Isolation, 38 dB typ. at 1 GHz
- Low insertion loss, 0.7 dB typ. at 1 GHz
- High IP3, 59 dBm typ. at 1 GHz
- Low current consumption, 40 μA typ.

Typical Applications

- CATV systems
- SATCOM system
- Automated Test Stations
- Telecom systems

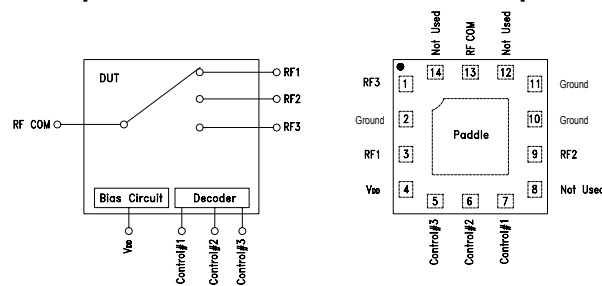
General Description

JSW3-23DR-75+ is a reflective SPDT switch with integral driver, operates with single positive supply voltage while consuming, 40 μA typical. It has been designed for very wideband operation of 5-2000 MHz. It is packaged in a tiny 14-lead 2mm x 2mm x 0.55mm package and is rated MSL1 and class 1B ESD.



CASE STYLE: MT1817

Simplified Schematic and Pad Description



Function	Pad Number	Description	Function	Pad Number	Description
RF COM	13	RF Common/ SUM Port	Control #1	7	Control IN #1
RF1	3	RF Out #1/In Port #1	Control #2	6	Control IN #2
RF2	9	RF Out #2/In Port #2	Control #3	5	Control IN #3
GND	2	Ground	VDD	4	Supply Voltage
GND	10	Ground	GND	Paddle	Ground
RF3	1	RF Out #5/In Port #5	Not Used	8,12,14	No Connection
GND	11	Ground			

SP3T RF Switch

JSW3-23DR-75+

RF Electrical Specifications⁽¹⁾, 5 - 2000 MHz, T_{AMB}=25°C, V_{DD}= +2.5 to 4.8V

Parameter	Condition (MHz)	Min.	Typ.	Max.	Units
Frequency Range		5		2000	MHz
Insertion Loss ⁽²⁾ (ON STATE)	5 to 1000	—	0.7	0.9	dB
	1000 to 1500	—	0.8	1.0	
	1500 to 2000	—	1.1	1.3	
Isolation between Common Port and RF1 to RF3 Ports ⁽³⁾	5 to 1000	35	38	—	dB
	1000 to 1500	29	32	—	
	1500 to 2000	22	25	—	
Return Loss (ON STATE) RF-COM, RF1 to RF3 Ports	5 to 1000	—	15	—	dB
	1000 to 1500	—	14	—	
	1500 to 2000	—	10	—	
Input IP3	V _{DD} =2.5 to 4.8V	5 to 500	—	55	dBm
	V _{DD} =3.0V	1000 to 2000	—	59	
0.1dB Input Compression ⁽⁴⁾	5 to 2000	—	35	—	dBm

DC Electrical Specifications

Parameter	Min.	Typ.	Max.	Units
VDD, Supply Voltage	2.5	3.0	4.8	V
Supply Current (V _{DD} = 3V)		40		μA
Control Voltage Low	0		0.4	V
Control Voltage High	1.35	1.8	2.7/V _{DD}	V
Control Current		0.5	1.0	μA
Shutdown Current at V _{DD} = 3V		5		μA

Notes:

1. As measured in Mini-Circuit's test board TB-722-3-F+ (see Characterization Test Circuit, Fig.1).
2. Insertion loss values are de-embedded from test board loss.
3. Isolations for other port combinations, see Tables 1 & 2
4. Do not exceed RF input power as shown in Absolute Maximum Rating table.

Switching Specifications

Parameter	Min.	Typ.	Max.	Units
Rise/Fall Time (10 to 90% or 90 to 10% RF)	—	0.42 (Rise Time) 0.84 (Fall Time)	—	μSec
Switching Time, 50% CTRL to 90/10% RF (ON/OFF)	—	1.9 (ON Time) 1.4 (OFF Time)	—	μSec
Video Feedthrough, (control 0 to 1.8V, freq.=10 KHz, V _{DD} =3V)	—	4.0	—	mV _{P-P}

SP4T RF Switch

75Ω 5-2000 MHz

SP4T RF Switch

JSW4-23DR-75+

Reflective RF Switch with internal driver.
Single Supply Voltage, +2.5V to +4.8V, High Power 3W

Product Features

- High Isolation, 38 dB typ. at 1 GHz
- Low insertion loss, 0.7 dB typ. at 1 GHz
- High IP3, 59 dBm typ. at 1 GHz
- Low current consumption, 40 μA typ.
- High Power, P0.1dB 3W

Typical Applications

- CATV systems
- SATCOM system
- Automated Test Stations
- Telecom systems

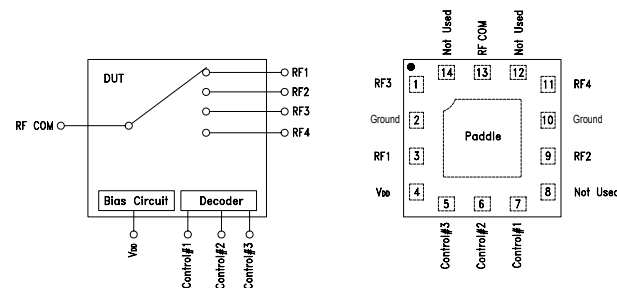
General Description

JSW4-23DR-75+ is a high power 3W reflective SP4T switch with integral driver, operates with single positive supply voltage while consuming, 40 μA typical. It has been designed for very wideband operation of 5-2000 MHz. It is packaged in a tiny 14-lead 2mm x 2mm x 0.55mm package and is rated MSL1 and class 1B ESD.



CASE STYLE: MT1817

Simplified Schematic and Pad Description



Function	Pad Number	Description	Function	Pad Number	Description
RF COM	13	RF Common/ SUM Port	Control #1	7	Control IN #1
RF1	3	RF Out #1/In Port #1	Control #2	6	Control IN #2
RF2	9	RF Out #2/In Port #2	Control #3	5	Control IN #3
GND	2	Ground	VDD	4	Supply Voltage
GND	10	Ground	GND	Paddle	Ground
RF3	1	RF Out #5/In Port #5	Not Used	8,12,14	No Connection
RF4	11	RF Out #6/In Port #6			

RF Electrical Specifications⁽¹⁾, 5 - 2000 MHz, T_{AMB}=25°C, V_{DD}= +2.5 to 4.8V

Parameter	Condition (MHz)	Min.	Typ.	Max.	Units
Frequency Range		5		2000	MHz
Insertion Loss ⁽²⁾ (ON STATE)	5 to 1000	—	0.7	0.9	dB
	1000 to 1500	—	0.8	1.0	
	1500 to 2000	—	1.1	1.3	
Isolation between Common Port and RF1 to RF4 Ports ⁽³⁾	5 to 1000	35	38	—	dB
	1000 to 1500	29	32	—	
	1500 to 2000	22	25	—	
Return Loss (ON STATE) RF-COM, RF1 to RF4 Ports	5 to 1000	—	15	—	dB
	1000 to 1500	—	14	—	
	1500 to 2000	—	10	—	
Input IP3	V _{DD} =2.5 to 4.8V	5 to 500	—	55	dBm
	V _{DD} =3.0V	1000 to 2000	—	59	
0.1dB Input Compression ⁽⁴⁾	5 to 2000	—	35	—	dBm

DC Electrical Specifications

Parameter	Min.	Typ.	Max.	Units
VDD, Supply Voltage	2.5	3.0	4.8	V
Supply Current (V _{DD} = 3V)		40		μA
Control Voltage Low	0		0.4	V
Control Voltage High	1.35	1.8	2.7/V _{DD}	V
Control Current		0.5	1.0	μA
Shutdown Current at V _{DD} = 3V		5		μA

Notes:

1. As measured in Mini-Circuit's test board TB-722-4-F+ (see Characterization Test Circuit, Fig.1).
2. Insertion loss values are de-embedded from test board loss.
3. Isolations for other port combinations, see Tables 1 & 2
4. Do not exceed RF input power as shown in Absolute Maximum Rating table.

Switching Specifications

Parameter	Min.	Typ.	Max.	Units
Rise/Fall Time (10 to 90% or 90 to 10% RF)	—	0.42 (Rise Time) 0.84 (Fall Time)	—	μSec
Switching Time, 50% CTRL to 90/10% RF (ON/OFF)	—	1.9 (ON Time) 1.4 (OFF Time)	—	μSec
Video Feedthrough, (control 0 to 1.8V, freq.=10 KHz, V _{DD} =3V)	—	4.0	—	mV _{P-P}

SP5T RF Switch

75Ω 5-2000 MHz

SP5T RF Switch

JSW5-23DR-75+

Reflective RF Switch with internal driver.
Single Supply Voltage, +2.5V to +4.8V, High Power 3W

Product Features

- High Isolation, 38 dB typ. at 1 GHz
- Low insertion loss, 0.7 dB typ. at 1 GHz
- High IP3, 59 dBm typ. at 1 GHz
- Low current consumption, 40 μA typ.
- High Power, P0.1dB 3W

Typical Applications

- CATV systems
- SATCOM system
- Automated Test Stations
- Telecom systems

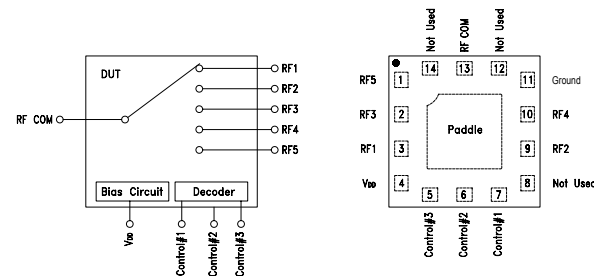
General Description

JSW5-23DR-75+ is a high power 3W reflective SP5T switch with integral driver, operates with single positive supply voltage while consuming, 40 μA typical. It has been designed for very wideband operation of 5-2000 MHz. It is packaged in a tiny 14-lead 2mm x 2mm x 0.55mm package and is rated MSL1 and class 1B ESD.



CASE STYLE: MT1817

Simplified Schematic and Pad Description



Function	Pad Number	Description	Function	Pad Number	Description
RF COM	13	RF Common/ SUM Port	Control #1	7	Control IN #1
RF1	3	RF Out #1/In Port #1	Control #2	6	Control IN #2
RF2	9	RF Out #2/In Port #2	Control #3	5	Control IN #3
RF3	2	RF Out #3/In Port #3	VDD	4	Supply Voltage
RF4	10	RF Out #4/In Port #4	GND	Paddle	Ground
RF5	1	RF Out #5/In Port #5	Not Used	8,12,14	No Connection
GND	11	Ground			

RF Electrical Specifications⁽¹⁾, 5 - 2000 MHz, T_{AMB}=25°C, V_{DD}= +2.5 to 4.8V

Parameter	Condition (MHz)	Min.	Typ.	Max.	Units
Frequency Range		5		2000	MHz
Insertion Loss ⁽²⁾ (ON STATE)	5 to 1000	—	0.7	0.9	dB
	1000 to 1500	—	0.8	1.0	
	1500 to 2000	—	1.1	1.3	
Isolation between Common Port and RF1 to RF5 Ports ⁽³⁾	5 to 1000	35	38	—	dB
	1000 to 1500	29	32	—	
	1500 to 2000	22	25	—	
Return Loss (ON STATE) RF-COM, RF1 to RF5 Ports	5 to 1000	—	15	—	dB
	1000 to 1500	—	14	—	
	1500 to 2000	—	10	—	
Input IP3	V _{DD} =2.5 to 4.8V	5 to 500	—	55	dBm
	V _{DD} =3.0V	1000 to 2000	—	59	
0.1dB Input Compression ⁽⁴⁾	5 to 2000	—	35	—	dBm

DC Electrical Specifications

Parameter	Min.	Typ.	Max.	Units
VDD, Supply Voltage	2.5	3.0	4.8	V
Supply Current (V _{DD} = 3V)		40		μA
Control Voltage Low	0		0.4	V
Control Voltage High	1.35	1.8	2.7/V _{DD}	V
Control Current		0.5	1.0	μA
Shutdown Current at V _{DD} = 3V		5		μA

Notes:

1. As measured in Mini-Circuit's test board TB-722-5-F+ (see Characterization Test Circuit, Fig.1).
2. Insertion loss values are de-embedded from test board loss.
3. Isolations for other port combinations, see Tables 1 & 2
4. Do not exceed RF input power as shown in Absolute Maximum Rating table.

Switching Specifications

Parameter	Min.	Typ.	Max.	Units
Rise/Fall Time (10 to 90% or 90 to 10% RF)	—	0.42 (Rise Time) 0.84 (Fall Time)	—	μSec
Switching Time, 50% CTRL to 90%/10% RF (ON/OFF)	—	1.9 (ON Time) 1.4 (OFF Time)	—	μSec
Video Feedthrough, (control 0 to 1.8V, freq.=10 KHz, V _{DD} =3V)	—	4.0	—	mV _{p-p}

SP6T RF Switch

75Ω 5-2000 MHz

SP6T RF Switch

JSW6-23DR-75+

Reflective RF Switch with internal driver.
Single Supply Voltage, +2.5V to +4.8V, High Power 3W

Product Features

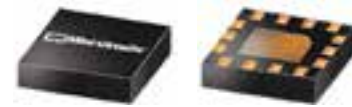
- High Isolation, 38 dB typ. at 1 GHz
- Low insertion loss, 0.7 dB typ. at 1 GHz
- High IP3, 59 dBm typ. at 1 GHz
- Low current consumption, 40 μA typ.
- High Power, P0.1dB 3W

Typical Applications

- CATV systems
- SATCOM system
- Automated Test Stations
- Telecom systems

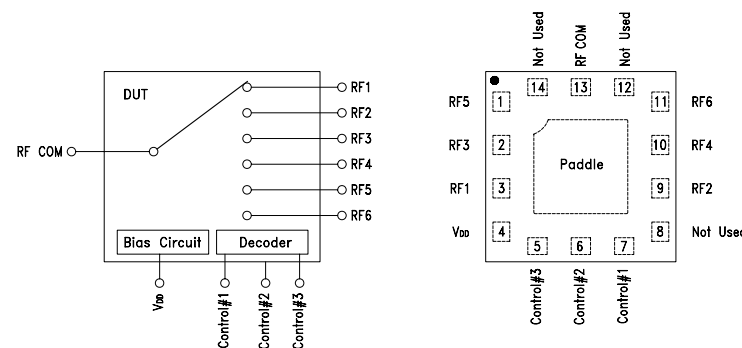
General Description

JSW6-23DR-75+ is a high power 3W reflective SPDT switch with integral driver, operates with single positive supply voltage while consuming, 40 μA typical. It has been designed for very wideband operation of 5 - 2000 MHz. It is packaged in a tiny 14-lead 2mm x 2mm x 0.55mm package and is rated MSL1 and class 1B ESD.



CASE STYLE: MT1817

Simplified Schematic and Pad Description



Function	Pad Number	Description	Function	Pad Number	Description
RF COM	13	RF Common/ SUM Port	Control #1	7	Control IN #1
RF1	3	RF Out #1/In Port #1	Control #2	6	Control IN #2
RF2	9	RF Out #2/In Port #2	Control #3	5	Control IN #3
RF3	2	RF Out #3/In Port #3	VDD	4	Supply Voltage
RF4	10	RF Out #4/In Port #4	GND	Paddle	Ground
RF5	1	RF Out #5/In Port #5	Not Used	8,12,14	No Connection
RF6	11	RF Out #6/In Port #6			

RF Electrical Specifications⁽¹⁾, 5 - 2000 MHz, T_{AMB}=25°C, V_{DD}= +2.5 to 4.8V

Parameter	Condition (MHz)	Min.	Typ.	Max.	Units
Frequency Range		5		2000	MHz
Insertion Loss ⁽²⁾ (ON STATE)	5 to 1000	—	0.7	0.9	dB
	1000 to 1500	—	0.8	1.0	
	1500 to 2000	—	1.1	1.3	
Isolation between Common Port and RF1 to RF6 Ports ⁽³⁾	5 to 1000	35	38	—	dB
	1000 to 1500	29	32	—	
	1500 to 2000	22	25	—	
Return Loss (ON STATE) RF-COM, RF1 to RF6 Ports	5 to 1000	—	15	—	dB
	1000 to 1500	—	14	—	
	1500 to 2000	—	10	—	
Input IP3	V _{DD} =2.5 to 4.8V	5 to 500	—	55	dBm
	V _{DD} =3.0V	1000 to 2000	—	59	
0.1dB Input Compression ⁽⁴⁾	5 to 2000	—	35	—	dBm

DC Electrical Specifications

Parameter	Min.	Typ.	Max.	Units
VDD, Supply Voltage	2.5	3.0	4.8	V
Supply Current (V _{DD} = 3V)		40		μA
Control Voltage Low	0		0.4	V
Control Voltage High	1.35	1.8	2.7/V _{DD}	V
Control Current		0.5	1.0	μA
Shutdown Current at V _{DD} = 3V		5		μA

Notes:

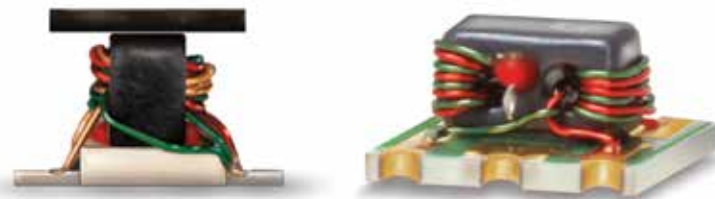
1. As measured in Mini-Circuit's test board TB-722-N+ (see Characterization Test Circuit, Fig.1).
2. Insertion loss values are deembedded from test board loss.
3. Isolations for other port combinations, see Tables 1 & 2
4. Do not exceed RF input power as shown in Absolute Maximum Rating table.

Switching Specifications

Parameter	Min.	Typ.	Max.	Units
Rise/Fall Time (10 to 90% or 90 to 10% RF)	—	0.42 (Rise Time) 0.84 (Fall Time)	—	μSec
Switching Time, 50% CTRL to 90/10% RF (ON/OFF)	—	1.9 (ON Time) 1.4 (OFF Time)	—	μSec
Video Feedthrough, (control 0 to 1.8V, freq.=10 KHz, V _{DD} =3V)	—	4.0	—	mV _{p-p}

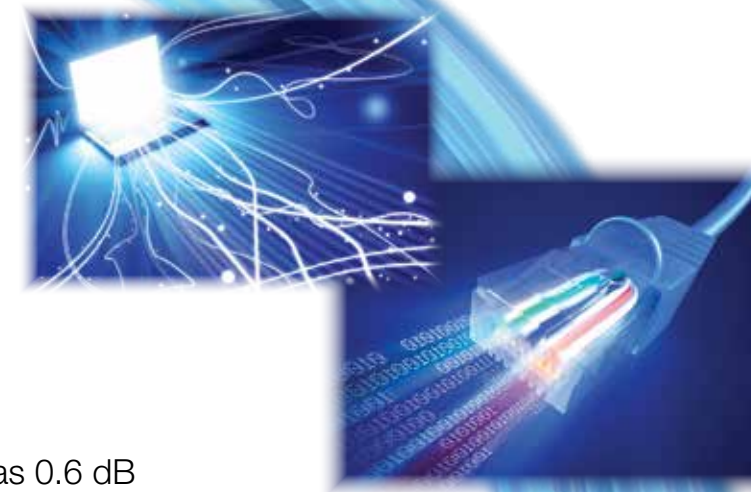
RF TRANSFORMERS

Mini-Circuits offers an industry-leading selection of RF transformers for DOCSIS 3.1 compliant systems and equipment. Our line includes a variety of configurations including balanced-to-balanced, balanced-to-unbalanced, and unbalanced-to-balanced designs with impedance ratios ranging from 1:1 to 4:1. Featuring both core and wire and printed laminate case styles, all models offer excellent return loss, low insertion loss and low unbalance.



FEATURES

- ▶ Insertion Loss as low as 0.6 dB
- ▶ Impedance Ratios from 1:1 to 4:1
- ▶ Various Configurations with and without Center Taps
- ▶ Low Phase and Amplitude Unbalance (as low as 1°/0.1 dB)
- ▶ Power Handling up to 1W
- ▶ Top Hat® Feature on Core and Wire Models



Surface Mount RF Transformer

75Ω 0.5 to 1000 MHz

ADTL1-4-75+

Features

- wideband, 0.5 to 1000 MHz
- balanced transmission line
- excellent amplitude unbalance, 0.3 dB typ. and phase unbalance, 1 deg. typ. in 1 dB bandwidth
- aqueous washable
- protected under US patent 6,133,525



CASE STYLE: CD542

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	500, 1000

Electrical Specifications at 25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Impedance Ratio			1		Ohm
Frequency Range		0.5		1000	MHz
Insertion Loss*	0.5 - 1000		3.0		dB
	1 - 600		2.0		
Amplitude Unbalance	5 - 400		1.0		dB
	1 - 600		0.3		
Phase Unbalance	5 - 400		0.3		dB
	1 - 600		2.0		
Phase Unbalance	5 - 400		1.0		Degree
	1 - 600		2.0		

* Insertion Loss is referenced to mid-band loss, 0.2 dB typ.

Maximum Ratings

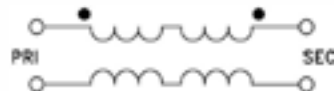
Parameter	Ratings
Operating Temperature	-20°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power	1W
DC Current	30mA

Permanent damage may occur if any of these limits are exceeded.

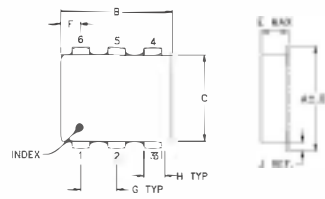
Pin Connections

Function	Pin Number
PRIMARY DOT	1
PRIMARY	3
SECONDARY DOT	6
SECONDARY	4
NOT USED	2,5

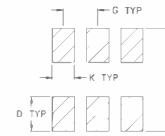
Config. G



Outline Drawing



PCB Land Pattern



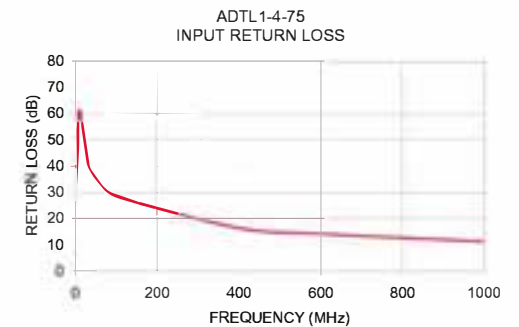
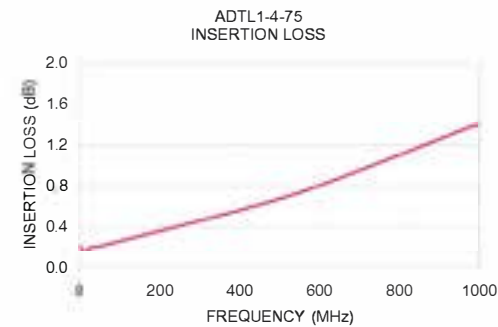
Suggested Layout.
Tolerance to be within ±0.02

Outline Dimensions (inch/mm)

A	B	C	D	E	F	G
.272	.310	.220	.100	.112	.055	.100
6.91	7.87	5.59	2.54	2.84	1.40	2.54
H	K			wt		
.030	.026	.065	.300	grams		
0.76	0.66	1.65	7.62	0.20		

Typical Performance Data

FREQUENCY (MHz)	INSERTION LOSS (dB)	INPUT R. LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE (Deg.)
0.50	0.23	32.81	0.57	4.57
1.00	0.21	36.36	0.48	2.95
5.00	0.17	47.97	0.29	0.91
10.00	0.17	61.49	0.27	0.37
30.00	0.21	40.69	0.27	0.13
50.00	0.22	35.25	0.28	0.27
100.00	0.27	28.41	0.27	0.57
400.00	0.57	16.57	0.02	1.33
600.00	0.81	14.32	0.24	0.63
1000.00	1.41	11.48	0.35	4.51



Additional Notes

- Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

Surface Mount RF Transformer

75Ω 5 to 1800 MHz

ADTL1-18-75+

Features

- wideband, 5 to 1800 MHz
- balanced transmission line
- aqueous washable
- protected under US patent 6,133,525



CASE STYLE: CD542

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	500, 1000

Electrical Specifications at 25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Impedance Ratio			1		Ohm
Frequency Range		5		1800	MHz
Insertion Loss*	5 - 1800		2.0		dB
	25 - 1200		1.0		
Amplitude Unbalance	5 - 1800		0.4		dB
	25 - 1200		0.4		
Phase Unbalance	5 - 1800		4.0		Degree
	25 - 1200		3.0		

* Insertion Loss is referenced to mid-band loss, 0.4 dB typ.

Maximum Ratings

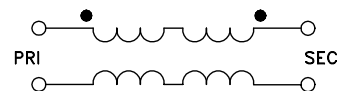
Parameter	Ratings
Operating Temperature	-20°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power	1W
DC Current	30mA

Permanent damage may occur if any of these limits are exceeded.

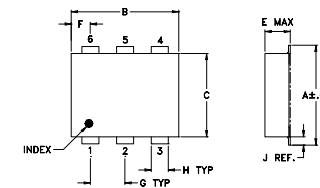
Pin Connections

Function	Pin Number
PRIMARY DOT	1
PRIMARY	3
SECONDARY DOT	6
SECONDARY	4
NOT USED	2,5

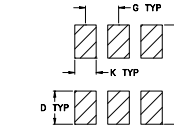
Config. G



Outline Drawing



PCB Land Pattern



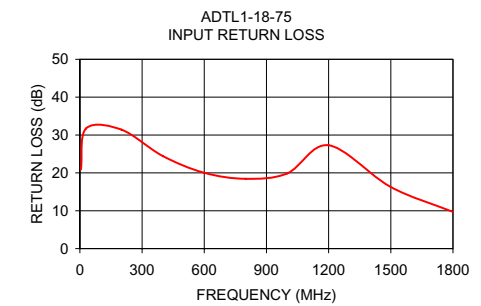
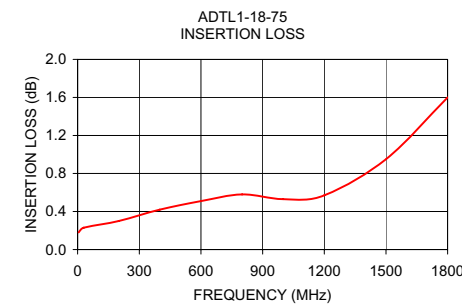
Suggested Layout,
Tolerance to be within ±.002

Outline Dimensions (inch/mm)

A	B	C	D	E	F	G
.272	.310	.220	.100	.112	.055	.100
6.91	7.87	5.59	2.54	2.84	1.40	2.54
H	J	K	L			wt
.030	.026	.065	.300			grams
0.76	0.66	1.65	7.62			0.20

Typical Performance Data

FREQUENCY (MHz)	INSERTION LOSS (dB)	INPUT R. LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE (Deg.)
5.00	0.18	20.90	1.01	20.51
30.00	0.23	31.73	0.72	4.08
200.00	0.30	31.44	0.54	0.47
400.00	0.42	24.44	0.42	2.05
600.00	0.51	20.03	0.28	3.18
800.00	0.58	18.44	0.11	3.74
1000.00	0.53	19.85	0.07	3.93
1200.00	0.57	27.29	0.27	3.67
1500.00	0.95	16.27	0.46	3.10
1800.00	1.60	9.71	0.44	2.21



Additional Notes

- Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

Surface Mount ^{top hat} RF Transformer

75Ω 4.5 to 3000 MHz

TC1-1-13M-75X+

Features

- wideband, 4.5 to 3000 MHz
- balanced transmission line
- good return loss
- excellent amplitude unbalance, 0.7 dB typ. and phase unbalance, 2 deg typ. in 1 dB bandwidth
- plastic base with leads
- aqueous washable



CASE STYLE: AT1521

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Specifications at 25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Impedance Ratio			1		Ohm
Frequency Range		4.5		3000	MHz
Insertion Loss*	2000 - 3000		3.0		dB
	1000 - 2000		2.0		
Amplitude Unbalance	4.5 - 1000		1.0		dB
	1000 - 2000		0.5		
Phase Unbalance	4.5 - 1000		0.7		Degree
	1000 - 2000		3.0		
Phase Unbalance	4.5 - 1000		2.0		Degree
	1000 - 2000		3.0		

* Insertion Loss is referenced to mid-band loss, 0.5 dB typ.

Maximum Ratings

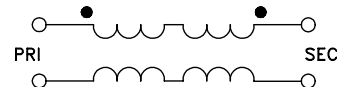
Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power	0.25W
DC Current	30mA

Permanent damage may occur if any of these limits are exceeded.

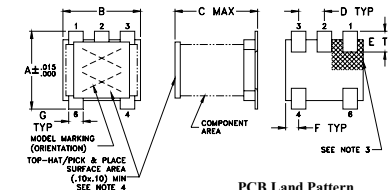
Pin Connections

Function	Pin Number
PRIMARY DOT	6
PRIMARY	4
SECONDARY DOT	1
SECONDARY	3
NOT USED	2

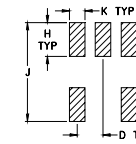
Config. G



Outline Drawing



PCB Land Pattern



Suggested Layout, Tolerance to be within ±.002

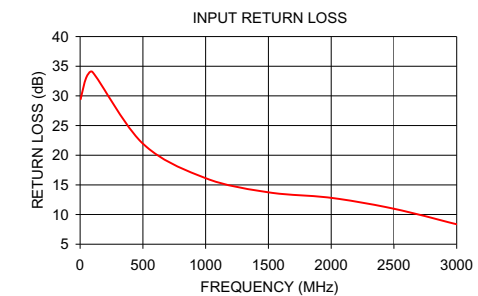
- Notes:
1. Case Material: Plastic
 2. Termination Finish: Tin plate over Nickel plate.
 3. Lead#1 identifier shall be located in the cross-hatched area shown, on bottom view. Identifier may be either a molded or marked feature.
 4. Top-Hat total thickness: .013 inches max.

Outline Dimensions (inch/mm)

A	B	C	D	E	F
.150	.150	.160	.050	.040	.025
3.81	3.81	4.06	1.27	1.02	0.64
G	H	J	K	wt	
.028	.065	.190	.030	grams	
0.71	1.65	4.83	0.76	0.15	

Typical Performance Data

FREQUENCY (MHz)	INSERTION LOSS (dB)	INPUT R. LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE (Deg.)
4.50	0.31	29.45	1.10	5.08
10.00	0.29	29.98	0.90	2.60
50.00	0.30	33.14	0.88	0.06
100.00	0.33	34.00	0.91	0.32
500.00	0.55	21.95	0.65	0.81
1000.00	0.71	16.13	0.61	2.12
1500.00	0.96	13.75	0.21	1.23
2000.00	1.19	12.82	0.30	0.38
2500.00	1.63	10.98	0.47	4.03
3000.00	2.39	8.36	0.49	8.50



Additional Notes

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- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

Surface Mount RF Transformer

75Ω 5 to 3000 MHz

TC1-33-75G2A+

Features

- suitable for tin/lead and RoHS solder systems
- wideband, 5 to 3000 MHz
- balanced transmission line
- good return loss, 20 dB typ. at 1 dB band
- excellent amplitude unbalance, 0.3 dB typ. and phase unbalance, 3 deg typ. in 1 dB bandwidth
- aqueous washable



CASE STYLE: AT224-3

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Specifications at 25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Impedance Ratio			1		Ohm
Frequency Range		5		3000	MHz
Insertion Loss*	2000 - 3000		3.0		dB
	1200 - 2000		2.0		
Amplitude Unbalance	5 - 1200		1.0		dB
	1200 - 2000		1.0		
Phase Unbalance	5 - 1200		0.3		Degree
	1200 - 2000		4.0		
	5 - 1200		3.0		

* Insertion Loss is referenced to mid-band loss, 1.0 dB typ.

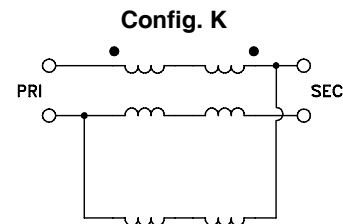
Maximum Ratings

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power	0.25W
DC Current	30mA

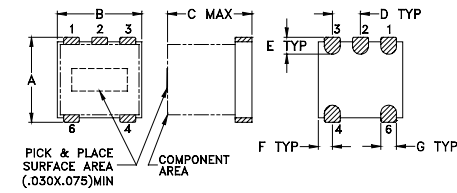
Permanent damage may occur if any of these limits are exceeded.

Pin Connections

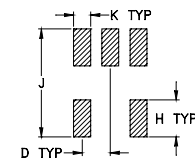
Function	Pin Number
PRIMARY DOT	6
PRIMARY	4
SECONDARY DOT	1
SECONDARY	3
NOT USED	2



Outline Drawing



PCB Land Pattern

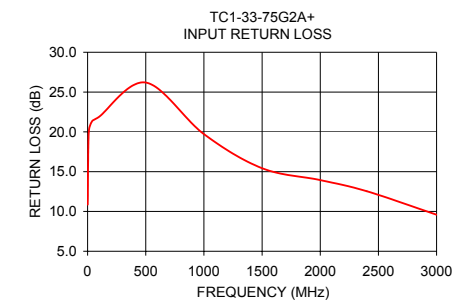
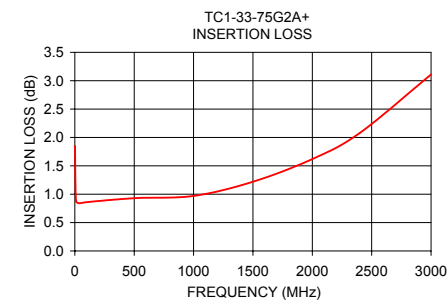


Outline Dimensions (inch/mm)

A	B	C	D	E	F
.150	.150	.150	.050	.030	.025
3.81	3.81	3.81	1.27	0.76	0.64
G	H	J	K	wt	
.028	.065	.190	.030	grams	
0.71	1.65	4.83	0.76	0.10	

Typical Performance Data

FREQUENCY (MHz)	INSERTION LOSS (dB)	INPUT R. LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE (Deg.)
1.00	1.85	10.86	0.38	2.91
10.00	0.88	20.01	0.04	0.84
40.00	0.84	21.37	0.00	0.58
100.00	0.86	21.90	0.01	0.92
500.00	0.93	26.20	0.10	3.63
1000.00	0.97	19.72	0.18	4.76
1500.00	1.22	15.43	0.77	3.62
2000.00	1.62	13.94	1.40	0.56
2400.00	2.08	12.54	1.84	4.10
3000.00	3.11	9.59	2.06	12.70



Additional Notes

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- B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuits' applicable established test performance criteria and measurement instructions.
- C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

Balanced to Unbalanced RF Transformer



100 to 75Ω 5 to 2800 MHz

TC1.33-282X+

Features

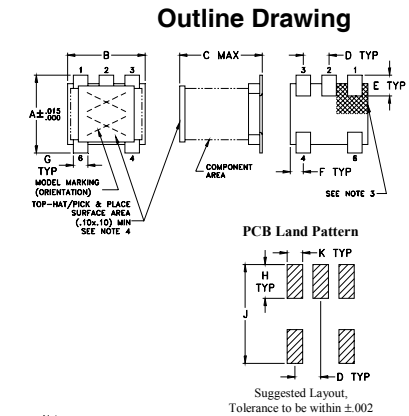
- suitable for tin/lead and RoHS solder systems
- wideband, 5 to 2800 MHz
- balanced transmission line
- good return loss, 20 dB typ. at 1 dB band
- excellent amplitude unbalance, 0.3 dB typ.
- aqueous washable



CASE STYLE: AT1521

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000



- Notes:
1. Case Material: Plastic
 2. Termination Finish: Tin plate over Nickel plate.
 3. Lead#1 Identifier shall be located in the cross-hatched area shown, on bottom view. Identifier may be either a molded or marked feature.
 4. Top-Hat total thickness: .013 inches max.

Outline Dimensions (inch/mm)

A	B	C	D	E	F
.150	.150	.160	.050	.040	.025
3.81	3.81	4.06	1.27	1.02	0.64
G	H	J	K	wt	
.028	.065	.190	.030	grams	
0.71	1.65	4.83	0.76	0.15	

Electrical Specifications at 25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Impedance Ratio (secondary/primary)			1.33		Ohm
Frequency Range		5		2800	MHz
Insertion Loss*	5 - 2800		3.0		dB
	30 - 2000		2.0		
Amplitude Unbalance	50 - 1500		1.0		dB
	30 - 2000		0.3		
Phase Unbalance	50 - 1500		6.0		Degree
	30 - 2000		6.0		

* Insertion Loss is referenced to mid-band loss, 1.0 dB typ. Measured in 75Ω system.

Typical Performance Data

FREQUENCY (MHz)	INSERTION LOSS (dB)	INPUT R. LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE (Deg.)
5.00	1.48	17.72	0.38	3.28
10.00	1.20	21.95	0.21	2.17
30.00	1.08	27.05	0.11	0.55
50.00	1.08	28.04	0.09	0.06
100.00	1.09	28.09	0.08	1.09
500.00	0.99	24.29	0.21	5.00
1000.00	0.97	22.66	0.07	6.34
1500.00	1.20	22.41	0.71	5.18
2000.00	1.64	21.22	1.49	1.64
2400.00	2.13	17.79	2.00	3.40
2800.00	2.76	13.83	2.31	10.70

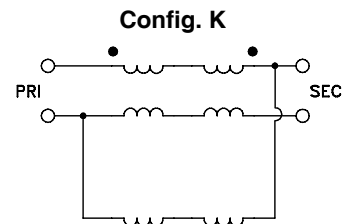
Maximum Ratings

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power	0.25W
DC Current	30mA

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Function	Pin Number
PRIMARY DOT	6
PRIMARY	4
SECONDARY DOT	1
SECONDARY	3
NOT USED	2



Additional Notes

- Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

Surface Mount ^{top.hat®} RF Transformer

75Ω 5 to 120 MHz

TC1-1T-75X+

Features

- DOCSIS 3.1 suitable
- plastic base with leads
- aqueous washable

Applications

- impedance matching
- unbalance to balance transformation
- cable/CATV and broadband fiber networks



CASE STYLE: AT1521

Electrical Specifications at 25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Impedance Ratio			1		Ohm
Frequency Range		5	—	120	MHz
Insertion Loss*	5 - 75	—	0.1	0.4	dB
	75 - 120	—	0.3	0.6	
Amplitude Unbalance	5 - 75	—	0.1	0.2	dB
	75 - 120	—	0.2	0.3	
Phase Unbalance	5 - 75	—	1	4	Degree
	75 - 120	—	3	6	
Return Loss	5 - 20	25	30	—	dB
	20-75	23	28	—	
	75-120	20	25	—	

*Insertion Loss is referenced to mid-band loss, 0.25 dB typ.

Maximum Ratings

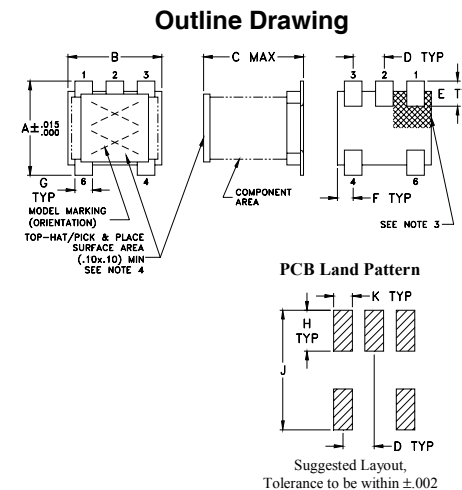
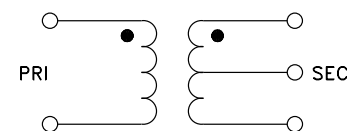
Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power	0.25W
DC Current	30mA

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Function	Pin Number
PRIMARY DOT	6
PRIMARY	4
SECONDARY DOT	1
SECONDARY	3
SECONDARY CT	2

Config. A

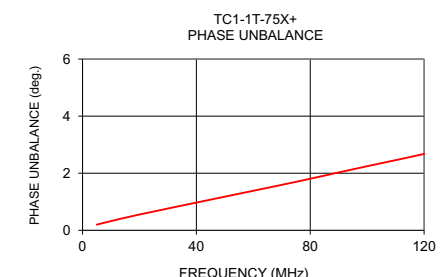
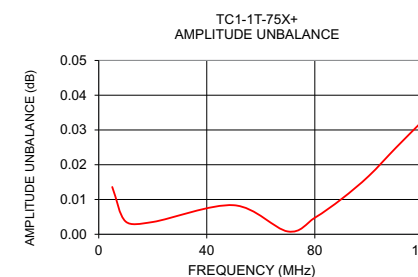
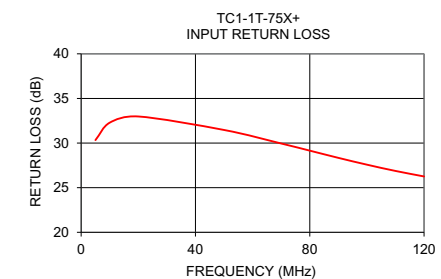
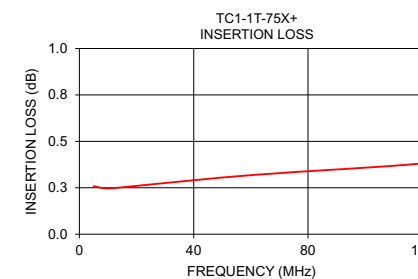


Outline Dimensions (inch/mm)

A	B	C	D	E	F
.150	.150	.160	.050	.040	.025
3.81	3.81	4.06	1.27	1.02	0.64
G	H	J	K		wt
.028	.065	.190	.030		grams
0.71	1.65	4.83	0.76		0.15

Typical Performance Data

FREQUENCY (MHz)	INSERTION LOSS (dB)	INPUT R. LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE (Deg.)
5.00	0.26	30.33	0.01	0.20
10.00	0.25	32.29	0.00	0.32
20.00	0.26	32.98	0.00	0.55
50.00	0.31	31.47	0.01	1.18
70.00	0.33	29.95	0.00	1.59
80.00	0.34	29.15	0.00	1.81
90.00	0.35	28.34	0.01	2.03
100.00	0.36	27.58	0.02	2.25
110.00	0.37	26.88	0.02	2.46
120.00	0.38	26.26	0.03	2.68



Surface Mount ^{top hat} RF Transformer

75Ω 1 to 300 MHz

TC4-6T-75X+

Features

- DOCSIS 3.1 suitable
- plastic base with leads
- aqueous washable

Applications

- impedance matching
- unbalance to balance transformation
- cable/CATV and broadband fiber networks



CASE STYLE: AT1521

Electrical Specifications at 25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Impedance Ratio (secondary/primary)			4		Ohm
Frequency Range		1	—	300	MHz
Insertion Loss*	1- 300	—	—	0.8	dB
Amplitude Unbalance	1- 300	—	0.1	0.5	dB
Phase Unbalance	1- 300	—	0.2	2	Degree
Return Loss	1- 300	13	20	—	dB

*Insertion Loss is referenced to mid-band loss, 0.7 dB typ.

Maximum Ratings

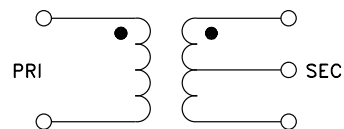
Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power	0.25W
DC Current	30mA

Permanent damage may occur if any of these limits are exceeded.

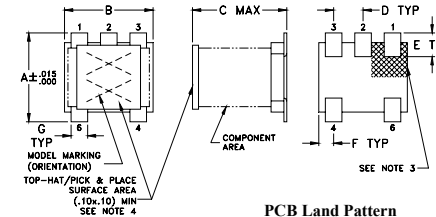
Pin Connections

Function	Pin Number
PRIMARY DOT	6
PRIMARY	4
SECONDARY DOT	1
SECONDARY	3
SECONDARY CT	2

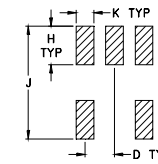
Config. A



Outline Drawing



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.002

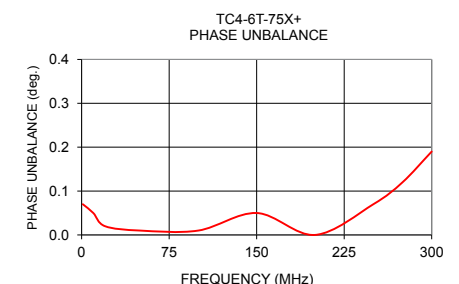
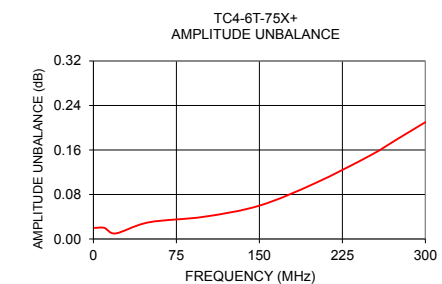
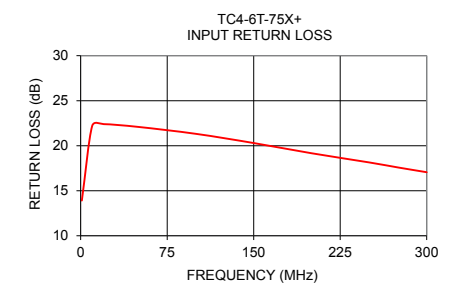
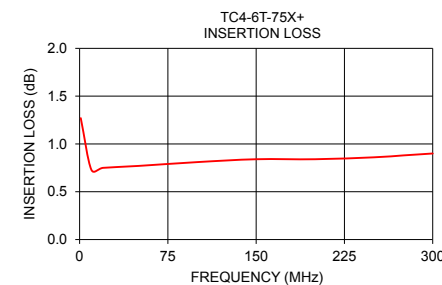
- Notes:
1. Case Material: Plastic
 2. Termination Finish: Tin plate over Nickel plate.
 3. Lead#1 Identifier shall be located in the cross-hatched area shown, on bottom view. Identifier may be either a molded or marked feature.
 4. Top-Hat total thickness: .013 inches max.

Outline Dimensions (inch mm)

A	B	C	D	E	F
.150	.150	.160	.050	.040	.025
3.81	3.81	4.06	1.27	1.02	0.64
G	H	J	K	wt	
.028	.065	.190	.030	grams	
0.71	1.65	4.83	0.76	0.15	

Typical Performance Data

FREQUENCY (MHz)	INSERTION LOSS (dB)	INPUT R. LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE (Deg.)
1.00	1.27	13.91	0.02	0.07
10.00	0.73	22.21	0.02	0.05
20.00	0.75	22.40	0.01	0.02
50.00	0.77	22.09	0.03	0.01
100.00	0.81	21.32	0.04	0.01
150.00	0.84	20.30	0.06	0.05
200.00	0.84	19.17	0.10	0.00
250.00	0.86	18.15	0.15	0.07
275.00	0.88	17.59	0.18	0.12
300.00	0.90	17.06	0.21	0.19



Balanced ^{top hat®} RF Transformer

75Ω 10 to 1800 MHz

TRS1-182-75+

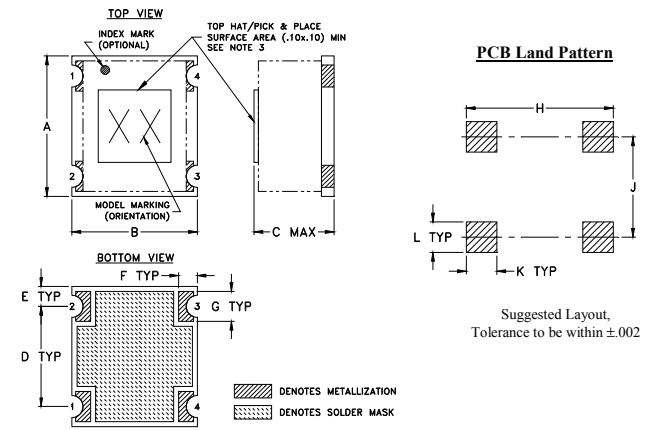
Features

- suitable for tin/lead and RoHS solder systems
- wideband, 10 to 1800 MHz
- balanced transmission line
- good return loss, 20 dB typ. at 1 dB band
- excellent amplitude unbalance, 0.3 dB typ.
- aqueous washable
- excellent intermod suppression



CASE STYLE: TT1618-1

Outline Drawing



Electrical Specifications at 25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Impedance Ratio			1		Ohm
Frequency Range		10		1800	MHz
Insertion Loss*	50-1200	—	0.6	1.0	dB
	10-1800	—	0.9	2.0	
Amplitude Unbalance	50-1000	—	0.3	0.7	dB
	1000-1200 10-1800	—	0.5 0.7	0.7 1.4	
Phase Unbalance	50-1000	—	2	4	Degree
	1000-1200	—	3	8	
	10-1800	—	7.5	15	
Primary Return Loss (Input)	50-500	16	22	—	dB
	500-1000	13	20	—	
	1000-1200 10-1800	13 8	20 12.5	—	

*Insertion Loss is referenced to mid-band loss, 0.25 dB typ.

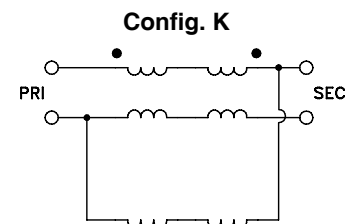
Maximum Ratings

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power	1W
DC Current	30mA

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Function	Pin Number
PRIMARY DOT	4
PRIMARY	1
SECONDARY DOT	2
SECONDARY	3

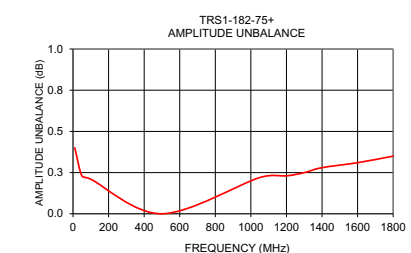
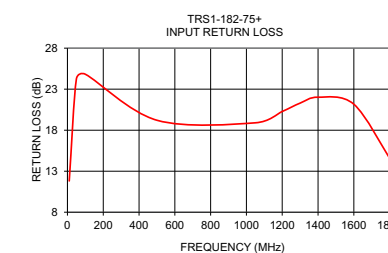
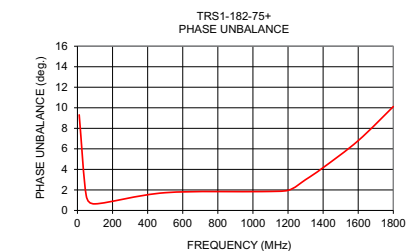
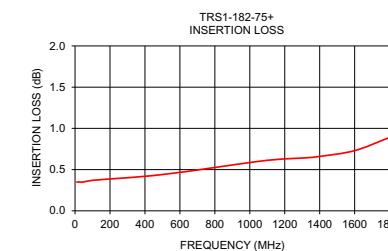


Outline Dimensions (inch/mm)

A	B	C	D	E	F
.280	.250	.16	.200	.040	.037
7.11	6.35	4.06	5.08	1.02	0.94
G	H	J	K	L	wt.
.060	.293	.200	.061	.061	grams
1.52	7.44	5.08	1.55	1.55	3

Typical Performance Data

FREQUENCY (MHz)	INSERTION LOSS (dB)	INPUT R. LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE (Deg.)
10.0	0.35	11.81	0.40	9.31
50.0	0.35	24.24	0.23	1.45
100.0	0.37	24.82	0.21	0.64
500.0	0.44	19.21	0.00	1.73
1000.0	0.60	18.90	0.22	1.84
1200.0	0.63	20.28	0.23	1.96
1300.0	0.64	21.30	0.25	3.00
1400.0	0.66	22.02	0.28	4.17
1600.0	0.73	21.17	0.31	6.80
1800.0	0.89	14.58	0.35	10.12



ADTL1-15-75+

75Ω 10 to 1500 MHz

Features

- wideband, 10 to 1500 MHz
- balanced transmission line
- excellent amplitude & phase unbalance
- aqueous washable
- protected by US Patent 6,133,525



CASE STYLE: CD542

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	500, 1000

Electrical Specifications at 25°C

Model No.	Ω Ratio	Frequency Range (MHz)	Insertion Loss over frequency range (MHz)			Typ. Phase Unbalance (Deg)		Typ. Amplitude Unbalance (dB)	
			3 dB	2dB	1dB	1dB	2dB	1dB	2dB
ADTL1-15-75+	1	10 - 1500	—	10 -1500	30 - 1000	3	3	0.15	0.3

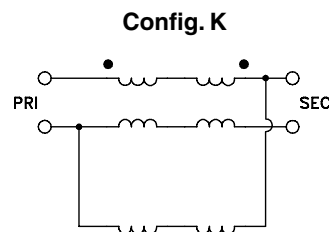
Maximum Ratings

Operating Temperature	-20°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power	0.5W
DC Current	30mA

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Primary Dot	1
Primary	3
Secondary Dot	6
Secondary	4
Not used	2,5



TC1-33-75G2+

75Ω 5 to 3000 MHz

Features

- wideband, 5 to 3000 MHz
- balanced transmission line
- excellent amplitude & phase unbalance
- aqueous washable



CASE STYLE: AT224-3

Available Tape and Reel at no extra cost

Reel Size	Devices/Reel
7"	20, 50, 100, 200, 500
13"	1000, 2000

Electrical Specifications at 25°C

Model No.	Ω Ratio	Frequency Range (MHz)	Insertion Loss over frequency range (MHz)			Typ. Phase Unbalance (Deg)		Typ. Amplitude Unbalance (dB)	
			3 dB	2dB	1dB	1dB	2dB	1dB	2dB
TC1-33-75G2+	1	5 -3000	2000 - 3000	1200 - 2000	5 -1200	3	4	0.3	1.0

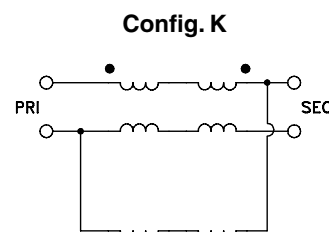
Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power	0.25W
DC Current	30mA

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Primary Dot	6
Primary	4
Secondary Dot	1
Secondary	3
Not used	2



TRS1-23-75+

75Ω 10 to 2200 MHz

Features

- wideband, 10 to 2200 MHz
- balanced transmission line
- excellent amplitude unbalance
- aqueous washable



CASE STYLE: AT577-1

Electrical Specifications at 25°C

Model No.	Ω Ratio	Frequency Range (MHz)	Insertion Loss over frequency range (MHz)			Typ. Phase Unbalance (Deg)		Typ. Amplitude Unbalance (dB)	
			3 dB	2dB	1dB	1dB	2dB	1dB	2dB
TRS1-23-75+	1	10 - 2200	10 - 2200	30 -1500	50 - 1000	3	5	0.4	0.6

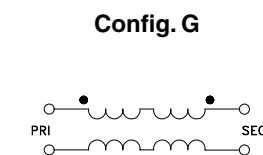
Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power	0.5W
DC Current	300mA

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Primary Dot	1
Primary	3
Secondary Dot	6
Secondary	4
Not used	2,5



TX-2-5-1+

75Ω 20 to 1250 MHz

Features

- wideband, 20 to 1250 MHz
- excellent return loss, 25 dB in 1 bandwidth
- excellent amplitude balance, 0.4 dB typ. and phase unbalance, 3 deg typ.
- R class transformer



CASE STYLE: TT240

Electrical Specifications at 25°C

Model No.	Ω Ratio	Frequency Range (MHz)	Insertion Loss over frequency range (MHz)			Typ. Phase Unbalance (Deg)		Typ. Amplitude Unbalance (dB)	
			3 dB	2dB	1dB	1dB	2dB	1dB	2dB
TX-2-5-1+	2	20 - 1250	—	20 - 1250	100 - 800	3	—	0.4	—

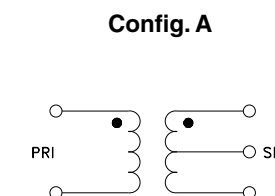
Maximum Ratings

Operating Temperature	-20°C to 85°C
Storage Temperature	-55°C to 100°C
RF Power	0.25W
DC Current	30mA

Permanent damage may occur if any of these limits are exceeded.

Pin Connections

Primary Dot	6
Primary	4
Secondary Dot	3
Secondary	1
Secondary CT	2
Not used	5



TEST ACCESSORIES

To support your testing needs from R&D to production test, Mini-Circuits provides a vast array of products for lab environments. We've highlighted a few of these products here, which we believe are uniquely applicable to testing in CATV systems, but we encourage you to visit our website to explore our full offering of test solutions and accessories, which includes everything from adapters to integrated rack-mounted test systems.



Matching Pads

Features

- ▶ 50/75Ω Impedance Conversion
- ▶ Excellent VSWR, 1.15 typ.
- ▶ Power Handling up to 0.5W
- ▶ BNC and N-Type Connectors

75Ω USB Smart Power Sensor

Features

- ▶ CW Power Measurements
- ▶ Wide Dynamic Range, -30 to +20 dBm
- ▶ Fast Measurement Speed, 30ms
- ▶ Good VSWR, 1:03:1
- ▶ User-Friendly GUI Software Included
- ▶ Built-in Measurement Applications
- ▶ Complete DLLs for 32/64-bit Windows® Systems Included
- ▶ Complete Programming Instructions for Windows & Linux® environments



75Ω Test Cables

Features

- ▶ Performance Qualified to 20,000 flexures
- ▶ Return Loss up to 38 dB
- ▶ Low insertion loss
- ▶ Power Handling up to 338W
- ▶ Stainless Steel F-Type Connectors
- ▶ Available in Wide Variety of Lengths

BMP-5075+

50/75Ω DC to 2000 MHz

Features

- wideband DC to 2000 MHz
- excellent VSWR, 1.15 typ.
- excellent flatness



CASE STYLE: FF747
Connectors
75ΩM-BNC
50ΩF-BNC

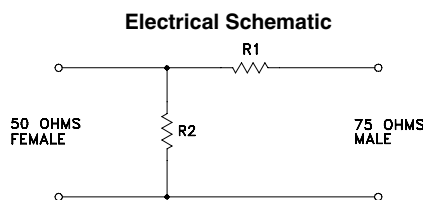
Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Attenuation (dB)		VSWR (:1) Max.	Power (W)
		Nom.	Flatness Max.		
BMP-5075+	DC - 100	5.7±0.1	0.2	1.06	0.25
	100 - 1000	5.7±0.1	0.3	1.22	0.25
	1000 - 2000	5.7±0.1	0.4	1.4	0.25

Maximum Ratings

Operating Temperature	-55°C to 100°C
Storage Temperature	-55°C to 100°C
RF Input Power	0.25W

Permanent damage may occur if any of these limits are exceeded.



BMP-5075R+

50/75Ω DC to 2000 MHz

Features

- wideband DC to 2000 MHz
- excellent VSWR, 1.15 typ.
- excellent flatness



CASE STYLE: FF747
Connectors
75ΩM-BNC
50ΩF-BNC

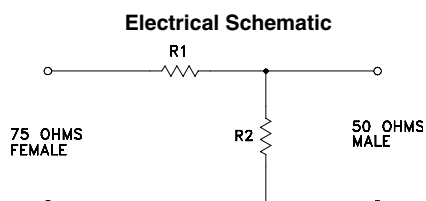
Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Attenuation (dB)		VSWR (:1) Max.	Power (W)
		Nom.	Flatness Max.		
BMP-5075R+	DC - 100	5.7±0.1	0.2	1.06	0.25
	100 - 1000	5.7±0.1	0.3	1.22	0.25
	1000 - 2000	5.7±0.1	0.4	1.4	0.25

Maximum Ratings

Operating Temperature	-55°C to 100°C
Storage Temperature	-55°C to 100°C
RF Input Power	0.25W

Permanent damage may occur if any of these limits are exceeded.



UNMP-5075+

50/75Ω DC to 3000 MHz

Features

- wideband, DC to 3000 MHz
- 0.5 watt rating
- rugged unibody construction
- off-the-shelf availability
- very low cost



CASE STYLE: FF779
Connectors
75ΩM-N
50ΩF-N

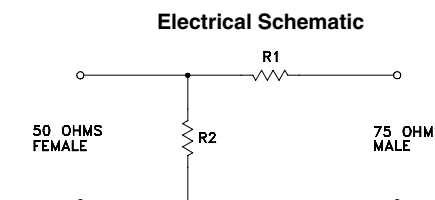
Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Attenuation (dB)		VSWR (:1) Max.	Power (W)
		Nom.	Flatness Max.		
UNMP-5075+	DC - 100	5.7±0.1	0.2	1.10	0.5
	100 - 1000	5.7±0.1	0.3	1.30	0.5
	1000 - 3000	5.7±0.1	0.4	1.50	0.5

Maximum Ratings

Operating Temperature	-45°C to 100°C
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.



UNMP-5075-33+

50/75Ω DC to 3000 MHz

Features

- wideband, DC to 3000 MHz
- excellent VSWR
- rugged unibody construction
- off-the-shelf availability
- very low cost



CASE STYLE: FF779
Connectors
75ΩM-N
50ΩF-N

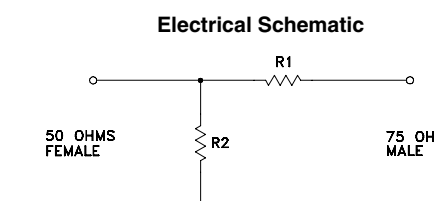
Electrical Specifications at 25°C

Model No.	Frequency Range (MHz)	Attenuation (dB)		VSWR (:1) Max.	Power (W)
		Nom.	Flatness Max.		
UNMP-5075-33+	DC - 100	5.7±0.15	0.2	1.10	0.35
	100 - 1000	5.7±0.15	0.3	1.10	0.35
	1000 - 3000	5.7±0.15	0.4	1.20	0.35

Maximum Ratings

Operating Temperature	-45°C to 100°C
Storage Temperature	-55°C to 100°C
RF Input Power	0.5W

Permanent damage may occur if any of these limits are exceeded.



CBL-2FM-75+

75Ω DC to 3000 MHz

Features

- wideband coverage, DC to 3000 MHz
- extra rugged construction with strain relief for longer life
- stainless steel F-Male connectors for long mating-cycle life
- useful over temperature range, -55°C to 105°C
- triple shield cable for excellent shielding effectiveness
- flexible for easy connection & bend radius

Electrical Specifications at 25°C

Model No.	Length (FT)	Frequency Range (MHz)	Insertion Loss (dB) Typ.	Return Loss (dB) Typ.
CBL-2FM-75+	2	DC - 500	0.22	38
		500 - 1000	0.32	38
		1000 - 2000	0.45	34
		2000 - 3000	0.61	25

Maximum Ratings

Operating Temperature	-55°C to 105°C
Storage Temperature	-55°C to 105°C
Power Handling at 25°C, Sea Level	338W at 0.5 GHz 210W at 1 GHz 143W at 2 GHz 98W at 3 GHz

Permanent damage may occur if any of these limits are exceeded.

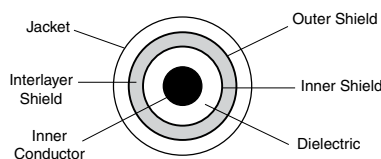
Cable Construction	
Inner Conductor	Solid Silver Plated Copper Clad Steel
Dielectric	Solid PTFE
Shield	Silver-Plated Copper Flat Ribbon Braid Aluminum-Polyimide Tape Interlayer Silver-Plated Copper Braid (90%k)
Jacket	Blue FEP
Connectors	
<ul style="list-style-type: none"> • passivated stainless steel • gold plated beryllium copper center contacts • PTFE dielectric 	



CASE STYLE: ND1919-2

Connectors	Model
Conn1 F-MALE Conn2 F-MALE	CBL-2FM-75+

Cable Cross Section



CBL-6FM-75+

75Ω DC to 3000 MHz

Features

- wideband coverage, DC to 3000 MHz
- extra rugged construction with strain relief for longer life
- stainless steel F-Male connectors for long mating-cycle life
- useful over temperature range, -55°C to 105°C
- triple shield cable for excellent shielding effectiveness
- flexible for easy connection & bend radius

Electrical Specifications at 25°C

Model No.	Length (FT)	Frequency Range (MHz)	Insertion Loss (dB) Typ.	Return Loss (dB) Typ.
CBL-6FM-75+	6	DC - 500	0.53	33.9
		500 - 1000	0.77	32.4
		1000 - 2000	1.12	29.5
		2000 - 3000	1.43	28.3

Maximum Ratings

Operating Temperature	-55°C to 105°C
Storage Temperature	-55°C to 105°C
Power Handling at 25°C, Sea Level	338W at 0.5 GHz 210W at 1 GHz 143W at 2 GHz 98W at 3 GHz

Permanent damage may occur if any of these limits are exceeded.

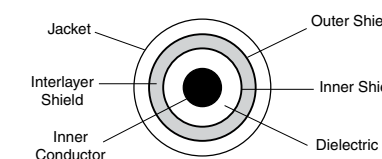
Cable Construction	
Inner Conductor	Solid Silver Plated Copper Clad Steel
Dielectric	Solid PTFE
Shield	Silver-Plated Copper Flat Ribbon Braid Aluminum-Polyimide Tape Interlayer Silver-Plated Copper Braid (90%k)
Jacket	Blue FEP
Connectors	
<ul style="list-style-type: none"> • passivated stainless steel • gold plated beryllium copper center contacts • PTFE dielectric 	



CASE STYLE: ND1919-6

Connectors	Model
Conn1 F-MALE Conn2 F-MALE	CBL-6FM-75+

Cable Cross Section



CBL-3FM-75+

75Ω DC to 3000 MHz

Features

- wideband coverage, DC to 3000 MHz
- extra rugged construction with strain relief for longer life
- stainless steel F-Male connectors for long mating-cycle life
- useful over temperature range, -55°C to 105°C
- triple shield cable for excellent shielding effectiveness
- flexible for easy connection & bend radius

Electrical Specifications at 25°C

Model No.	Length (FT)	Frequency Range (MHz)	Insertion Loss (dB) Typ.	Return Loss (dB) Typ.
CBL-3FM-75+	3	DC - 500	0.28	35.2
		500 - 1000	0.41	30.4
		1000 - 2000	0.60	29.3
		2000 - 3000	0.77	26.8

Maximum Ratings

Operating Temperature	-55°C to 105°C
Storage Temperature	-55°C to 105°C
Power Handling at 25°C, Sea Level	338W at 0.5 GHz 210W at 1 GHz 143W at 2 GHz 98W at 3 GHz

Permanent damage may occur if any of these limits are exceeded.

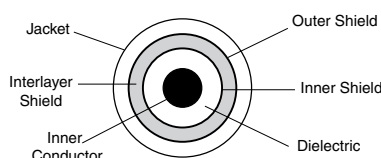
Cable Construction	
Inner Conductor	Solid Silver Plated Copper Clad Steel
Dielectric	Solid PTFE
Shield	Silver-Plated Copper Flat Ribbon Braid Aluminum-Polyimide Tape Interlayer Silver-Plated Copper Braid (90%k)
Jacket	Blue FEP
Connectors	
<ul style="list-style-type: none"> • passivated stainless steel • gold plated beryllium copper center contacts • PTFE dielectric 	



CASE STYLE: ND1919-3

Connectors	Model
Conn1 F-MALE Conn2 F-MALE	CBL-3FM-75+

Cable Cross Section



CBL-1MFM-75+

75Ω DC to 3000 MHz

Features

- wideband coverage, DC to 3000 MHz
- extra rugged construction with strain relief for longer life
- stainless steel F-Male connectors for long mating-cycle life
- useful over temperature range, -55°C to 105°C
- triple shield cable for excellent shielding effectiveness
- flexible for easy connection & bend radius

Electrical Specifications at 25°C

Model No.	Length (M)	Frequency Range (MHz)	Insertion Loss (dB) Typ.	Return Loss (dB) Typ.
CBL-1MFM-75+	1	DC - 500	0.32	37
		500 - 1000	0.49	32
		1000 - 2000	0.78	32
		2000 - 3000	0.89	24.3

Maximum Ratings

Operating Temperature	-55°C to 105°C
Storage Temperature	-55°C to 105°C
Power Handling at 25°C, Sea Level	338W at 0.5 GHz 210W at 1 GHz 143W at 2 GHz 98W at 3 GHz

Permanent damage may occur if any of these limits are exceeded.

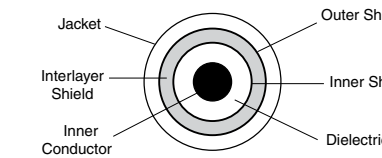
Cable Construction	
Inner Conductor	Solid Silver Plated Copper Clad Steel
Dielectric	Solid PTFE
Shield	Silver-Plated Copper Flat Ribbon Braid Aluminum-Polyimide Tape Interlayer Silver-Plated Copper Braid (90%k)
Jacket	Blue FEP
Connectors	
<ul style="list-style-type: none"> • passivated stainless steel • gold plated beryllium copper center contacts • PTFE dielectric 	



CASE STYLE: ND1919-3.28

Connectors	Model
Conn1 F-MALE Conn2 F-MALE	CBL-1MFM-75+

Cable Cross Section



Visit www.minicircuits.com for pricing,

availability, and complete model information.

Wide Dynamic Range

USB Smart Power Sensor

75Ω 100 kHz to 2500 MHz

Product Features

- Wide bandwidth, 100 kHz to 2500 MHz
- 50 dB Dynamic Range, -30 to +20 dBm
- Good VSWR, 1.03:1 typ.
- Fast measurement speed, 30 msec typ.
- Automatic frequency calibration & temperature compensation
- Multi-sensor capability (up to 24)
- Built in Application Measurement Software
- Remote operation via internet
- Effective, easy-to-use Windows® GUI
- Linux® support
- Compatible with 32/64-bit Windows® or Linux® operating systems
- Supports a wide range of programming environments (See application note [AN-49-001](#) for details)



Model No.	Description
PWR-2.5GHS-75	USB smart Power Sensor
Included Accessories	
PWRSN-2.5GHS-75	Power Sensor Head
USB-CBL+	6 ft data cable (USB Type-A Plug)
PWR-SEN-CD	Installation CD

Typical Applications

- Turn almost any Windows or Linux PC into a Power Meter
- Pocket-sized portability for benchtop testing anywhere
- Remote location monitoring
- Automatic, scheduled data collection
- Evaluate high-power, multi-port devices with built-in virtual couplers/attenuators & other software tools

Mini-Circuits Power Meter Program for Smart USB Power Sensor



USB Smart Power Sensor

PWR-2.5GHS-75

Electrical Specifications (CW)², -30 dBm to +20 dBm, 100 kHz to 2500 MHz

Parameter	Freq. Range (MHz)	Min.	Typ.	Max.	Units	
Dynamic Range ³	0.1 - 2500	-30	-	+20	dBm	
VSWR	0.1 - 2500	-	1.03	1.20	:1	
Uncertainty of Power Measurement @ 25°C	@ -30 to +5 dBm	0.1 - 1000	-	± 0.10	± 0.30	dB
		1000 - 2500	-	± 0.05	± 0.30	dB
	@ +5 to +12 dBm	0.1 - 1000	-	± 0.05	± 0.25	dB
		1000 - 2500	-	± 0.05	± 0.20	dB
	@ +12 to +20 dBm	0.1 - 1000	-	± 0.10	± 0.30	dB
		1000 - 2500	-	± 0.15	± 0.40	dB
Uncertainty of Power Measurement @ 0°C to 50°C	@ -30 to +5 dBm	0.1 - 1000	-	± 0.10	-	dB
		1000 - 2500	-	± 0.10	-	dB
	@ +5 to +12 dBm	0.1 - 1000	-	± 0.10	-	dB
		1000 - 2500	-	± 0.10	-	dB
	@ +12 to +20 dBm	0.1 - 1000	-	± 0.10	-	dB
		1000 - 2500	-	± 0.15	-	dB
Linearity @ 25°C	0.1 - 2500	-	± 2.3	-	%	
Measurement Resolution	0.1 - 2500	0.01	-	-	dB	
Averaging Range	0.1 - 2500	1	-	999	-	
Measurement Speed	@ Low Noise Mode	0.1 - 2500	-	100	-	mSec
	@ Faster Mode	-	-	30	-	
Current (via host USB)	0.1 - 2500	-	40	70	mA	

Minimum System Requirements

Parameter	Requirements
Interface	USB HID
Host operating system	32 Bit operating system: Windows 98®, Windows XP®, Windows Vista®, Windows 7®, Windows 8® 64 Bit operating system: Windows Vista®, Windows 7®, Windows 8® Linux® support: 32/64 Bit operating system
Hardware	Pentium® II or higher, RAM 256 Mb, USB port
USB cable (supplied)	Power sensor to be used with the supplied USB cable only

Absolute Maximum Ratings

Parameter	Ratings
Operating Temperature	0°C to 50°C
Storage Temperature	-30°C to 70°C
DC Voltage at RF port	4V
CW Power	+25dBm

Permanent damage may occur if any of these limits are exceeded. Operating in the range between operating power limits and absolute maximum ratings for extended periods of time may result in reduced life and reliability.

² All specifications apply to continuous wave (CW) signals.
³ Maximum continuous safe operational power limit: +23 dBm. Performance is guaranteed up to +20 dBm.

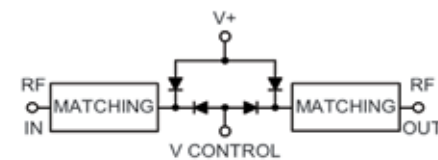
CONTROL PRODUCTS

Mini-Circuits voltage variable attenuators and equalizers are perfect for systems where precise control over signal strength is needed. Our VVAs are ideal for adjusting the amplitude of input/output signals in Automatic Level Control (ALC) circuits, and our Voltage Variable Equalizers allow operators to compensate for cable losses without having to measure the length of each cable, saving significant cost and resources deployed in the field. All models are designed for 75Ω networks and characterized to meet DOCSIS 3.1 bandwidth requirements!



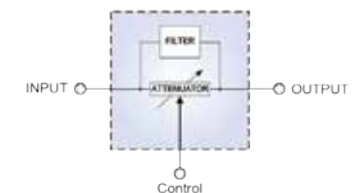
Voltage Variable Attenuator Features

- ▶ Attenuation from 18 to 40 dB
- ▶ High linearity, +50 dBm IP3
- ▶ No external bias or matching required
- ▶ Low power consumption
- ▶ Ideal for adjusting input/output signals in ALC circuits



Voltage Variable Equalizer Features

- ▶ Adjustable attenuation slope
- ▶ High linearity, +50 dBm IP3
- ▶ Low deviation from linear loss, ±0.5 dB
- ▶ Low power consumption
- ▶ Enables easy compensation for cable loss



Surface Mount

Voltage Variable Attenuator

75Ω 10 to 2000 MHz

Performance Charts

EVA-23-75+

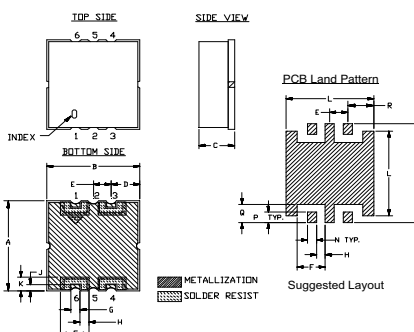
Maximum Ratings

Operating Temperature	-45°C to 85°C
Storage Temperature	-55°C to 100°C
Absolute Max. Supply Voltage(V+)	6V
Absolute Max. Control Voltage(Vctrl)	10V
Absolute Max. RF Input Level	+22dBm
Permanent damage may occur if any of these limits are exceeded.	

Pin Connections

RF IN	1
RF OUT	6
V CONTROL	3
V+	4
GROUND	2,5

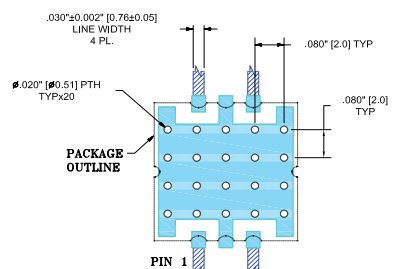
Outline Drawing



Outline Dimensions (inch/mm)

	A	B	C	D	E	F	G	H	
	.394	.394	.150	.122	.075	.120	.038	.037	
	10.01	10.01	3.81	3.10	1.90	3.05	0.97	0.94	
	J	K	L	M	N	P	Q	R	wt.
	.026	.061	.370	.434	.038	.046	.081	.110	grams
	0.66	1.55	9.40	11.02	0.97	1.17	2.06	2.79	0.7

Demo Board MCL P/N: TB-381
Suggested PCB Layout (PL-238)



NOTE:
1. TRACE WIDTH IS SHOWN FOR RO4350 WITH DIELECTRIC THICKNESS .030"±.002". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
DENOTES COPPER LAND PATTERN FREE OF SOLDERMASK

Features

- Frequency range, 10-2000 MHz
- High IP3, 50 dBm typ.
- Maximum attenuation at minimum current
- No external bias and RF matching network required
- Small size, shielded case
- Aqueous washable



CASE STYLE: HE1135

Applications

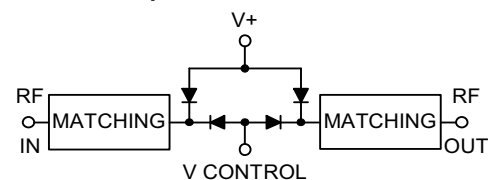
- CATV
- Variable gain amplifiers
- Feed forward amplifiers
- ALC circuits

Electrical Specifications (T_{AMB} = 25°C)

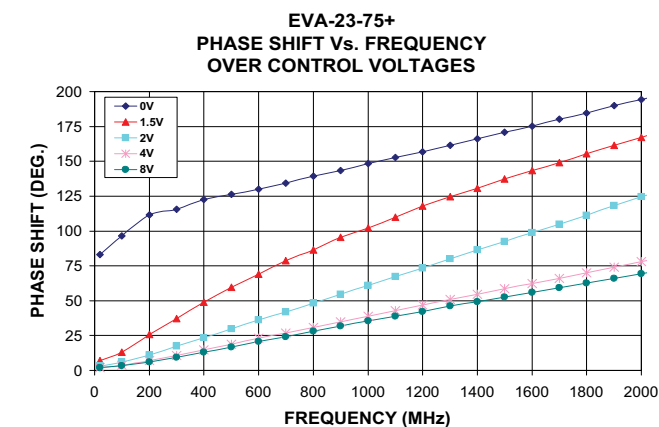
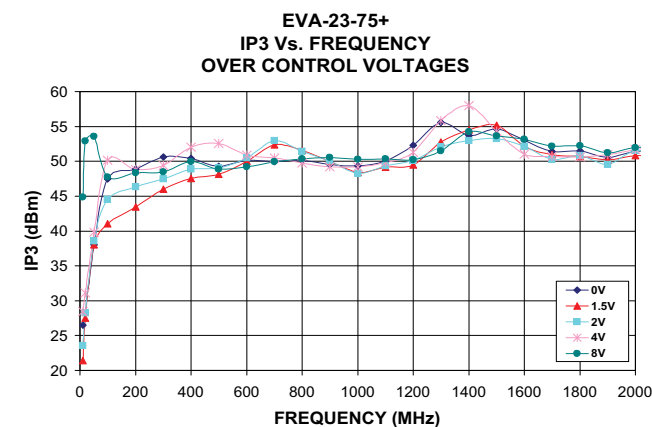
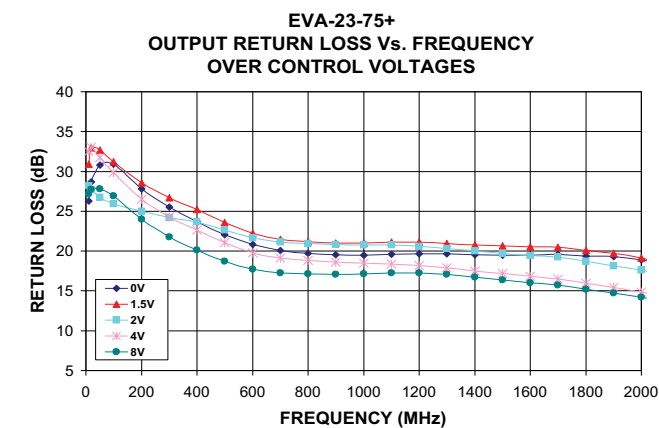
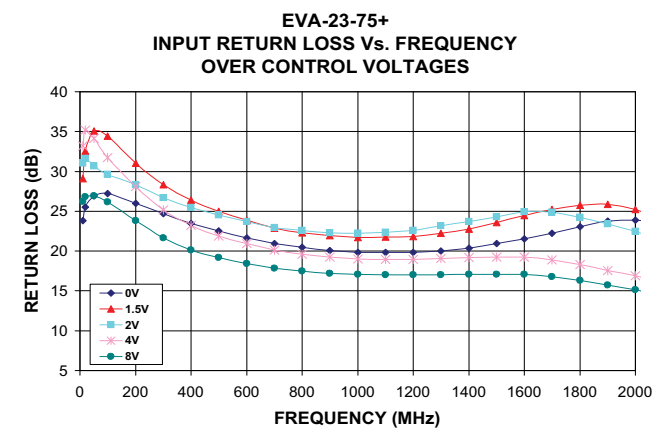
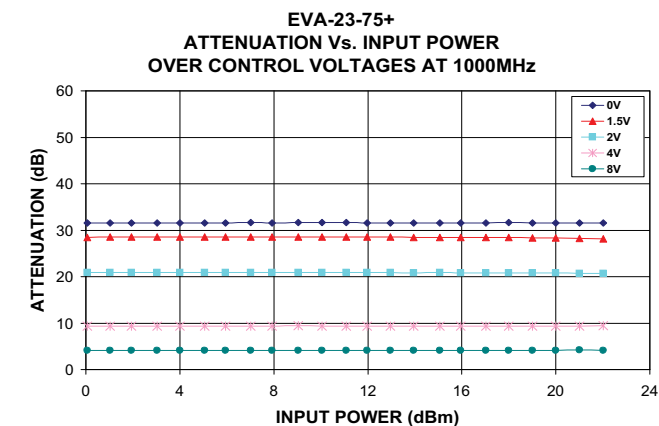
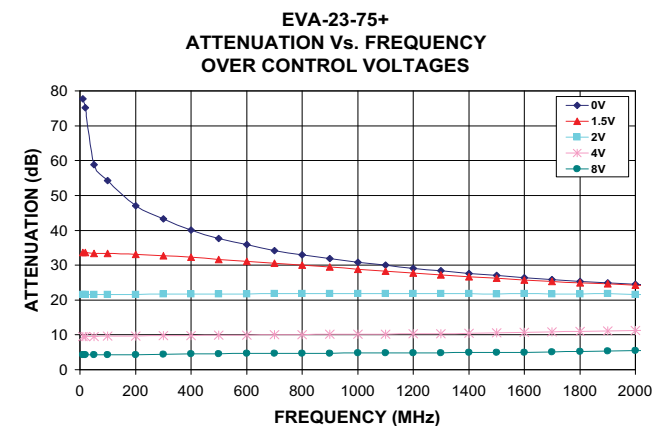
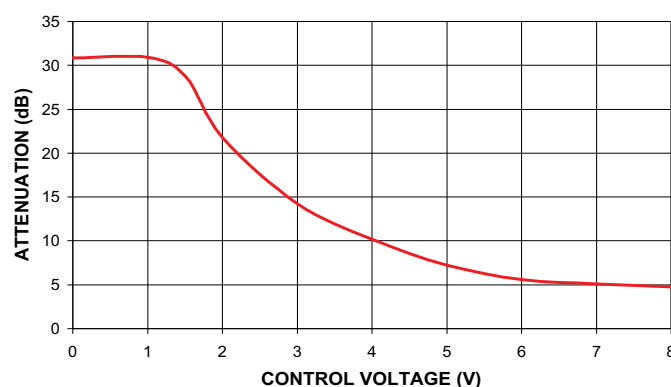
FREQ. (MHz)	MIN. INSERTION LOSS, dB (+8V)		MAX. ATTENUATION dB (0V)		INPUT POWER (dBm)	CONTROL Voltage Current (V) (mA)		IP3 (dBm)	RETURN LOSS (dB)		POWER SUPPLY Voltage Current (V) (mA)	
	Min.	Max.	Typ.	Min.		Max.	Typ.		Max.	Typ.	Typ.	Max.
10 - 1000	4.5	5.5	40	25	+22	0 - 8	15	48	19	+3	4	
1000 - 2000	5.0	6.0	27	18	+22	0 - 8	15	52	14	+3	4	

Notes:
Rise/Fall time: 15µSec Typ.
Switching Time, turn on/off: 20µSec. Typ.

Equivalent Schematic



EVA-23-75+ TYPICAL ATTENUATION AT 1000 MHz



Surface Mount Voltage Variable Attenuator

75Ω 50 to 2000 MHz

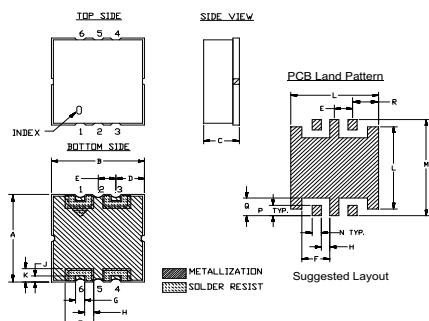
Maximum Ratings

Operating Temperature	-45°C to 85°C
Storage Temperature	-55°C to 100°C
Absolute Max. Supply Voltage(V+)	7V
Absolute Max. Control Voltage(Vctrl)	9V
Absolute Max. RF Input Level	+22 dBm
Permanent damage may occur if any of these limits are exceeded.	

Pin Connections

RF IN	1
RF OUT	6
V CONTROL	3
V+	4
GROUND	2,5

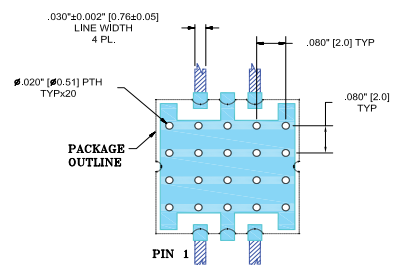
Outline Drawing



Outline Dimensions (inch/mm)

	A	B	C	D	E	F	G	H	
	.394	.394	.150	.122	.075	.120	.038	.037	
	10.01	10.01	3.81	3.10	1.90	3.05	0.97	0.94	
	J	K	L	M	N	P	Q	R	wt.
	.026	.061	.370	.434	.038	.046	.081	.110	grams
	0.66	1.55	9.40	11.02	0.97	1.17	2.06	2.79	0.7

Demo Board MCL P/N: TB-381
Suggested PCB Layout (PL-238)



NOTE:
1. TRACE WIDTH IS SHOWN FOR RO4360 WITH DIELECTRIC THICKNESS .030"±.002". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
■ DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
■ DENOTES COPPER LAND PATTERN FREE OF SOLDERMASK

Features

- Frequency range, 50-2000 MHz
- IP3, 50 dBm typ.
- Maximum attenuation at minimum current
- No external bias and RF matching network required
- Small size, shielded case
- Aqueous washable

Applications

- CATV
- Variable gain amplifiers
- Feed forward amplifiers
- ALC circuits



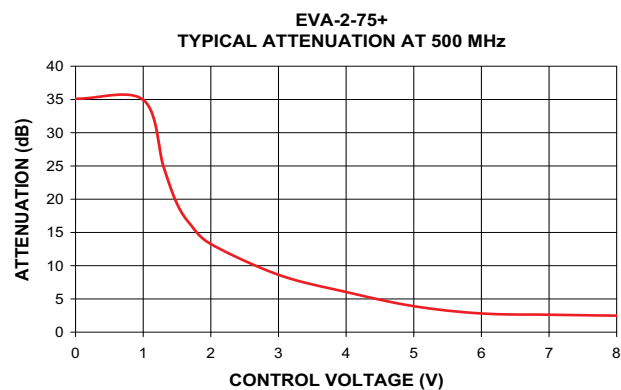
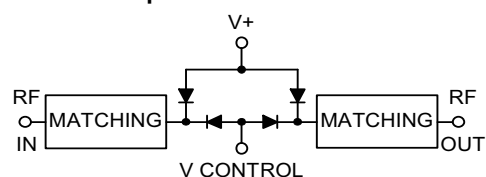
CASE STYLE: HE1135

Electrical Specifications (T_{AMB} = 25°C)

FREQ. (MHz)	MIN. INSERTION LOSS, dB (+8V)		MAX. ATTENUATION dB (0V)		INPUT POWER (dBm)	CONTROL Voltage Current (V) (mA)		IP3 (dBm)	RETURN LOSS (dB)		POWER SUPPLY Voltage Current (V) (mA)	
	Min.	Max.	Typ.	Max.		Min.	Max.		Typ.	Typ.	Min.	Max.
50 - 1000	2.5	3.5	40	25	+22	0 - 8	40	48	27	+5	3	
1000 - 2000	3.0	4.7	24	20	+22	0 - 8	40	51	20	+5	3	

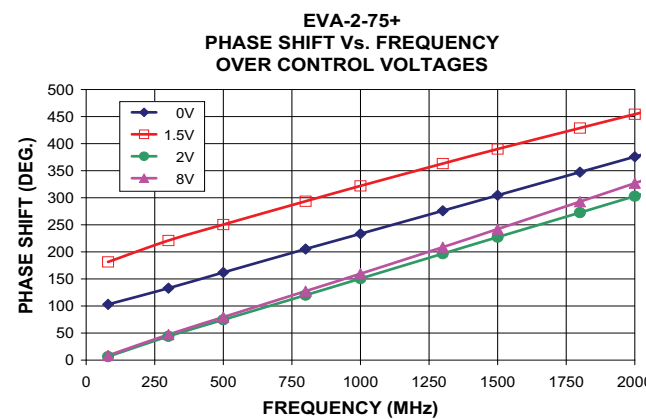
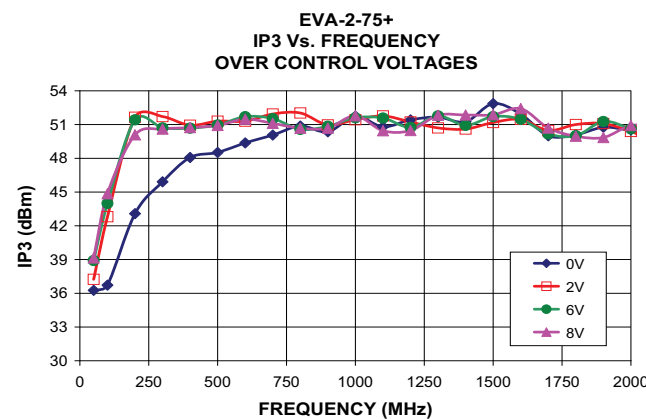
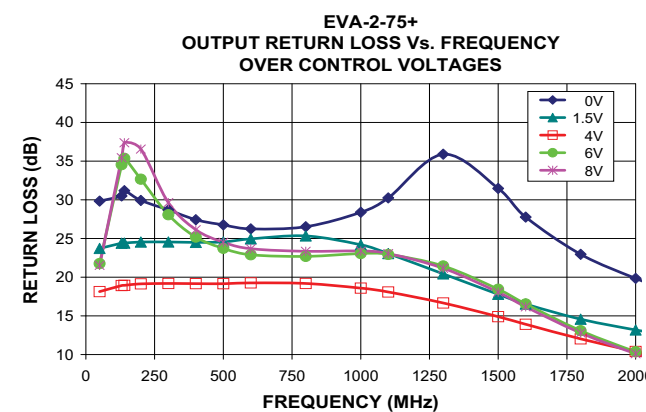
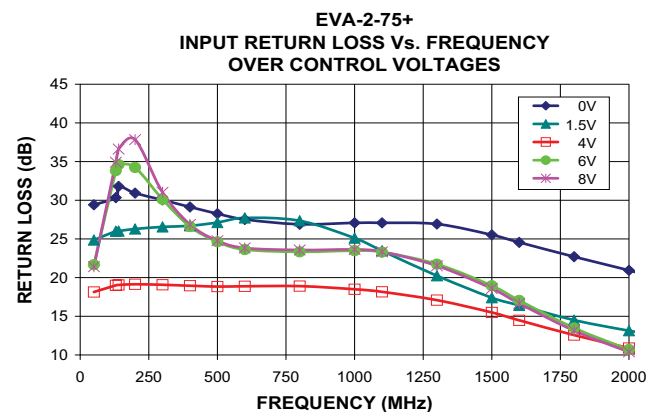
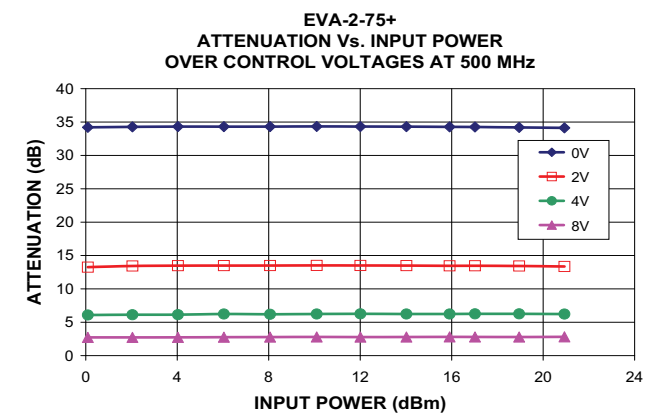
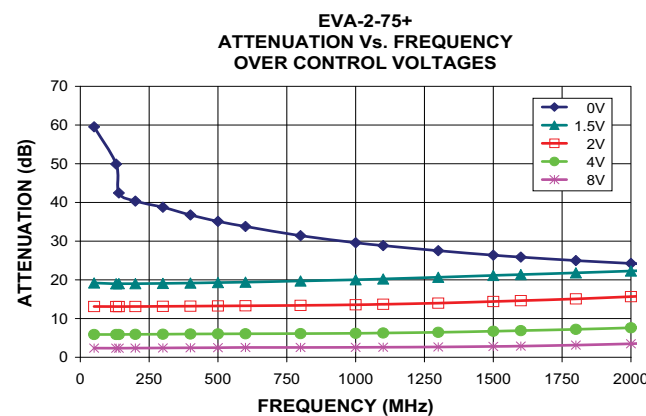
Notes:
Rise/Fall time: 15μSec/36μSec Typ.
Switching Time, turn on/off: 40μSec. Typ.

Equivalent Schematic



Performance Charts

EVA-2-75+



Surface Mount Voltage Variable Equalizer

75Ω 50 to 1220 MHz

Features

- Wide bandwidth
- Low insertion loss
- Low deviation from linear loss, ± 0.5 dB typ.
- High IP3 +50 dBm typ.
- Shielded case
- Aqueous washable

Applications

- Cable loss compensation
- Instrumentation



Electrical Specifications at 25°C, V+=5V_{DC} unless otherwise noted

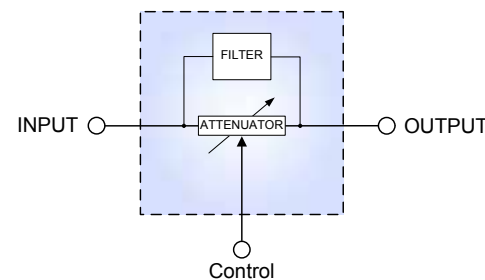
Parameter	Condition	Min.	Typ.	Max.	Units
Frequency Range		50		1220	MHz
Insertion Loss	50 MHz, Control Voltage, 0 - 7V		15 - 1.7		dB
	1220 MHz, Control Voltage, 0 - 7V		3.1 - 1.6		
Deviation from Linear Loss	Control Voltage 0 - 7V		± 0.5		dB
IP3	Control Voltage, 2.5 - 7V	+42	+50		dBm
1 dB Compression	Control Voltage, 0 - 7V		+30		dBm
Input Return Loss	Control Voltage, 0 - 7V		15		dB
Output Return Loss	Control Voltage, 0 - 7V		13		dB
Supply Voltage (V+)	Control Voltage, 0 - 7V	3.5	5	5.5	V
Supply Current	Control Voltage 7V,		0		mA
	Control Voltage 0V,		10	16	
Control Current	Control Voltage 7V		12	20	mA
	Control Voltage 2.5V		0		

Maximum Ratings

Parameter	Ratings
Operating Temperature	0°C to 85°C
Storage Temperature	-55°C to 100°C
Input Power	+23 dBm
Control voltage	11 V
Supply Voltage (V+)	7 V

Permanent damage may occur if any of these limits are exceeded.

Simplified Functional Diagram



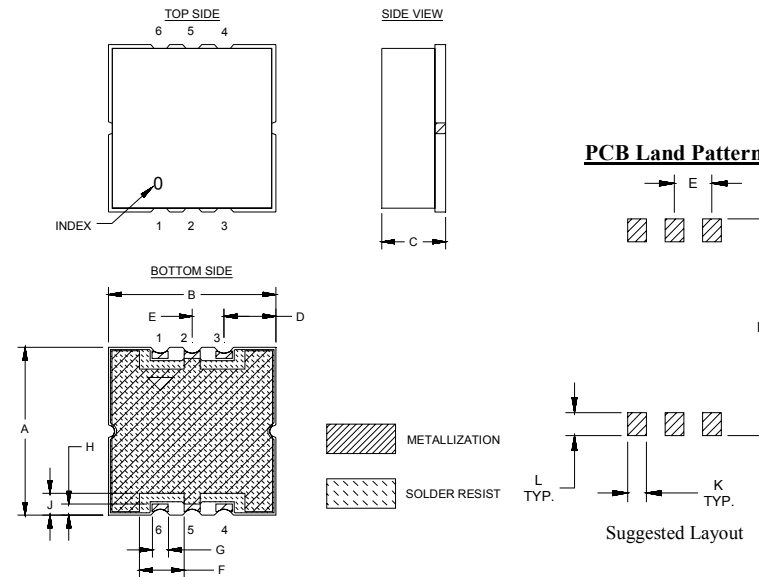
Pin Connections

Function	Pin Number
RF IN	1
RF OUT	6
V CONTROL	3
V+	4
GROUND	2,5

Voltage Variable Equalizer

VAEQ-1220-75+

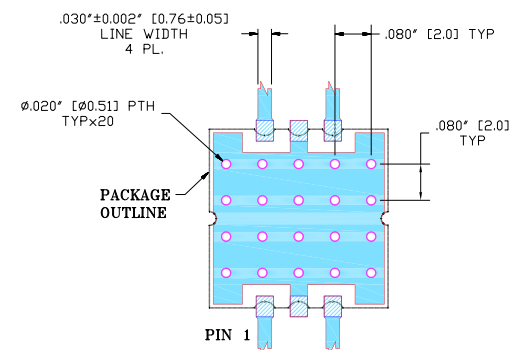
Outline Drawing



Outline Dimensions (inch/mm)

A	B	C	D	E	F	G	H	J	K	L	M	wt. grams
.394	.394	.150	.122	.075	.098	.038	.026	.051	.038	.046	.434	0.7
10.01	10.01	3.81	3.10	1.90	2.49	0.97	0.66	1.29	0.97	1.17	11.02	

Demo Board MCL P/N: TB-549+ Suggested PCB Layout (PL-315)



NOTE:

1. TRACE WIDTH IS SHOWN FOR R04350 WITH DIELECTRIC THICKNESS. .030"±.002". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

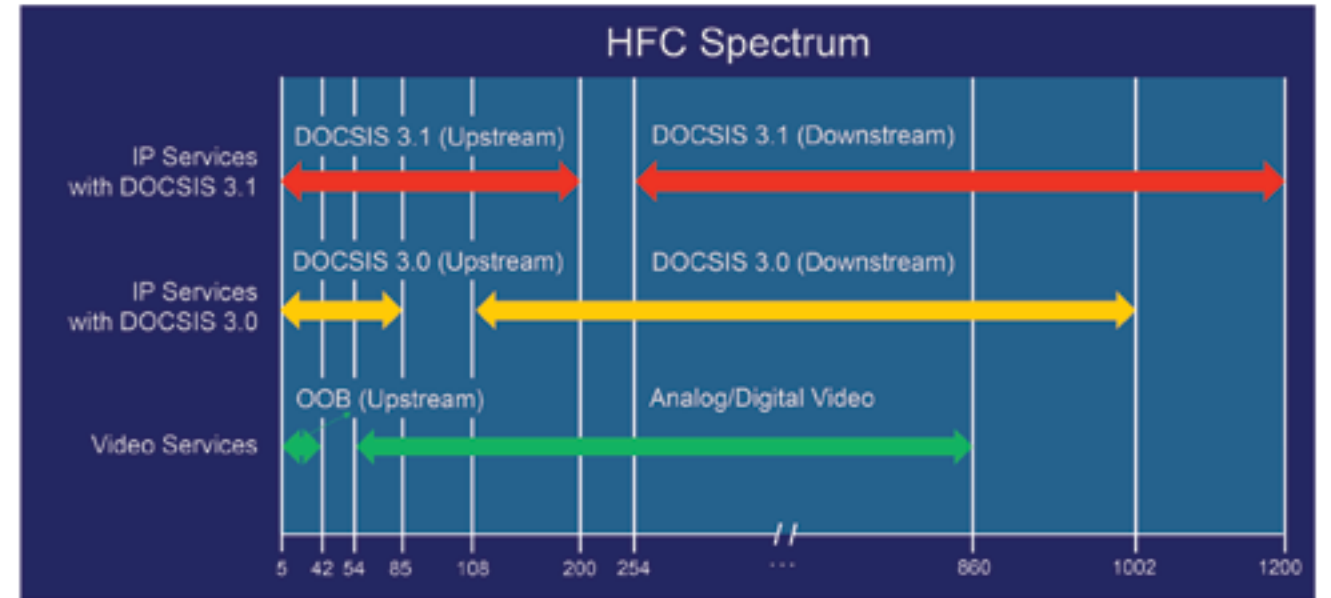
- DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
- DENOTES COPPER LAND PATTERN FREE OF SOLDERMASK

Pin Connections

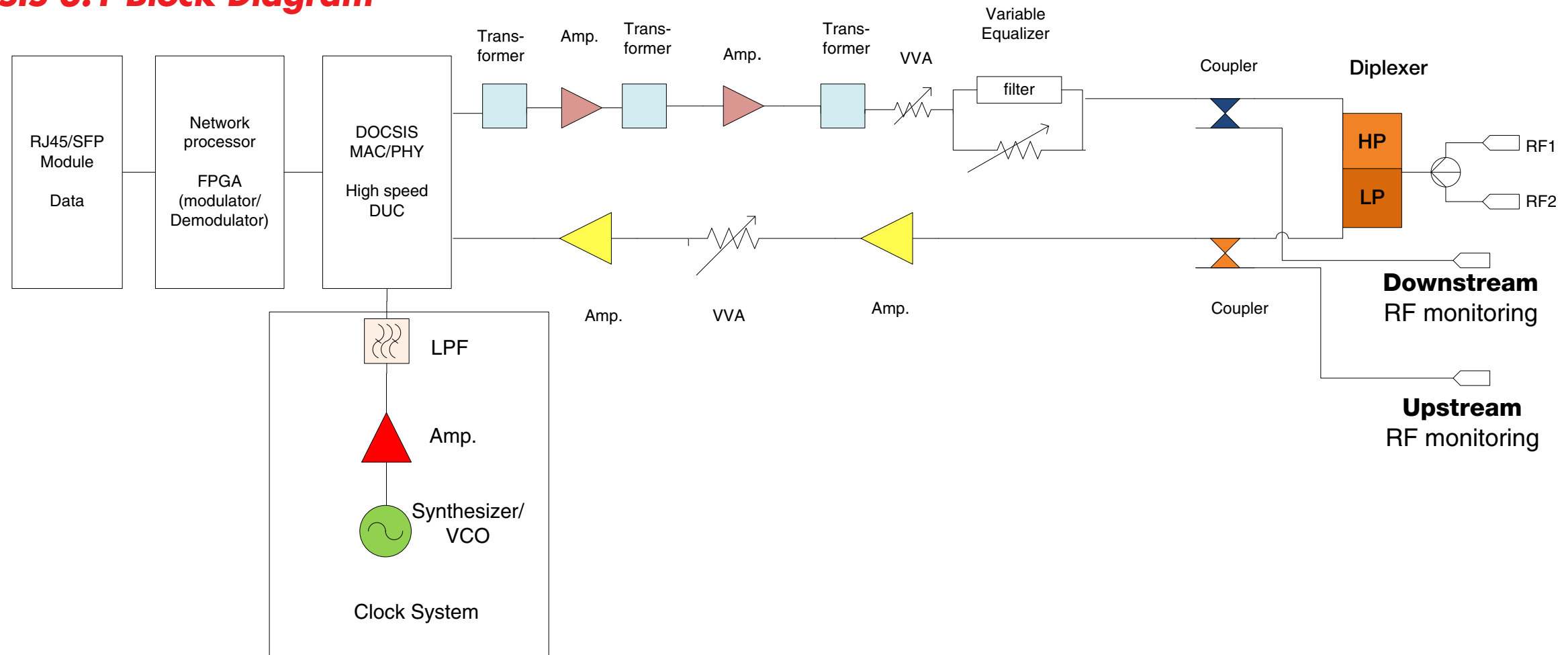
Function	Pin Number
RF IN	1
RF OUT	6
V CONTROL	3
V+	4
GROUND	2,5

DOCSIS 3.1 Features

- **Speed:** 10 Gbps downstream, 1 Gbps upstream
- **Capacity:** 50% more data over the same spectrum on existing HFC networks
- **Efficiency:** Increase cable modem energy efficiency.
- **Quality:** Reduce network delay, improving responsiveness for applications
- **Migration:** DOCSIS 3.1 modems are designed to co-exist with older versions, enabling incremental deployment based on market demand



DOCSIS 3.1 Block Diagram



DOCSIS® 3.1

The Next Generation Technology for CATV and Broadband



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