DO-IT-YOURSELF

POWER SPLITTERS

Mini-Circuits®

Typical Performance Data For TCP-2-10

Frequency (MHz)	Insertion Loss (dB) S-1	Insertion Loss (dB) S-2	Amplitude Unbalance (dB)	Isolation (dB)	Phase Unbalance (dB)	VSWR S	VSWR 1	VSWR 2
5.00	3.10	3.33	0.23	30.15	0.98	1.05	1.28	1.17
7.00	3.10	3.30	0.20	31.40	0.82	1.04	1.23	1.15
10.00	3.10	3.29	0.19	32.26	0.60	1.04	1.20	1.14
100.00	3.16	3.30	0.14	30.00	0.15	1.06	1.10	1.12
190.00	3.20	3.34	0.14	27.03	0.45	1.09	1.09	1.12
370.00	3.26	3.40	0.13	23.32	0.88	1.14	1.06	1.10
550.00	3.36	3.46	0.10	21.68	1.23	1.15	1.05	1.06
730.00	3.43	3.49	0.06	21.37	1.41	1.11	1.04	1.02
910.00	3.54	3.55	0.01	23.06	1.63	1.05	1.11	1.08
1000.00	3.66	3.65	0.01	25.28	1.74	1.07	1.17	1.14

Typical Performance Data For TCP-2-10-75

Frequency (MHz)	Insertion Loss (dB) S-1	Insertion Loss (dB) S-2	Amplitude Unbalance (dB)	Isolation (dB)	Phase Unbalance (deg.)	VSWR S	VSWR 1	VSWR 2
5.00	3.13	3.50	0.37	24.98	0.43	1.04	1.17	1.38
10.00	3.12	3.38	0.26	27.65	0.22	1.02	1.15	1.26
100.00	3.16	3.38	0.22	28.67	0.07	1.04	1.14	1.20
300.00	3.25	3.38	0.14	27.92	0.24	1.14	1.20	1.18
500.00	3.32	3.27	0.04	29.42	0.56	1.20	1.20	1.16
700.00	3.41	3.27	0.14	29.83	0.68	1.22	1.30	1.19
800.00	3.46	3.32	0.15	27.04	0.70	1.22	1.31	1.22
900.00	3.54	3.40	0.14	24.10	0.66	1.21	1.30	1.23
950.00	3.63	3.46	0.16	22.90	0.63	1.21	1.32	1.23
1000.00	3.64	3.52	0.11	21.81	0.56	1.20	1.35	1.23

Typical Performance Data For TCP-2-25

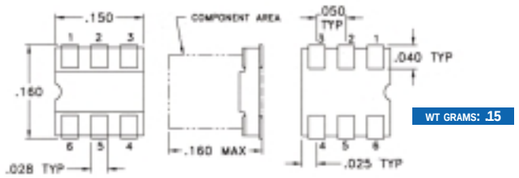
Frequency (MHz)	Insertion Loss (dB) S-1	Insertion Loss (dB) S-2	Amplitude Unbalance (dB)	Isolation (dB)	Phase Unbalance (deg.)	VSWR S	VSWR 1	VSWR 2
200.00	3.56	3.54	0.01	16.61	0.32	1.96	1.54	1.53
346.67	3.59	3.56	0.03	17.48	0.54	1.94	1.55	1.54
640.00	3.70	3.61	0.08	18.59	0.87	1.90	1.62	1.68
1080.00	3.73	3.54	0.19	20.91	1.22	1.85	1.68	1.60
1373.33	3.78	3.52	0.26	22.17	1.46	1.77	1.73	1.62
1520.00	3.74	3.45	0.29	22.38	1.52	1.73	1.73	1.63
1813.33	3.75	3.39	0.35	21.59	1.72	1.57	1.77	1.63
2106.67	3.78	3.39	0.39	19.71	1.96	1.44	1.81	1.67
2400.00	3.78	3.38	0.40	17.51	2.42	1.23	1.90	1.75
2523.08	3.83	3.44	0.39	16.64	2.60	1.19	1.88	1.74

PIN CONFIGURATIONS	TCP-2-10	TCP-2-10-75	TCP-2-25
SUM PORT	6	6	6,5,2
PORT 1	3	3	3
PORT 2	4	4	4
GROUND	1	1	1
SHORT	2,5	2,5	-
RESISTOR:	100Ω 3,4	150Ω 3,4	475Ω 3,4
CAPACITOR 1.5pF	2 To GND / 5 To GND	5 To GND	-

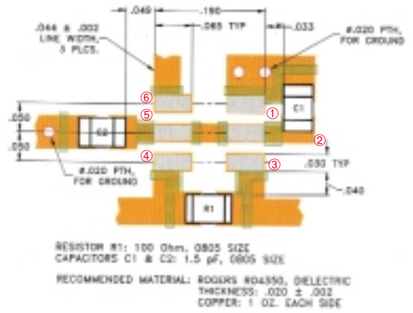
Operating Temperature: -20°C to 85°C, Storage Temperature: -55°C to 100°C

CASE STYLE DRAWINGS & DIMENSIONS (INCH)

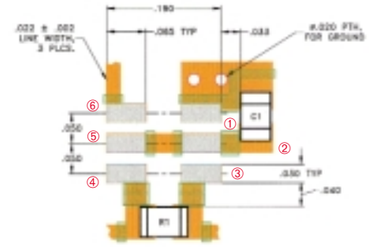
CASE STYLE DB714



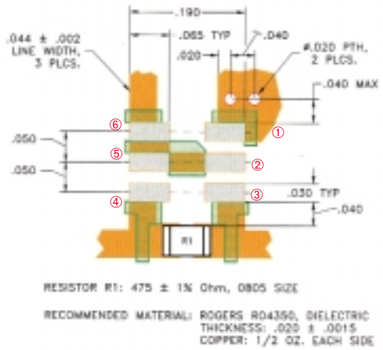
SUGGESTED PCB LAYOUT FOR TCP-2-10



SUGGESTED PCB LAYOUT FOR TCP-2-10-75

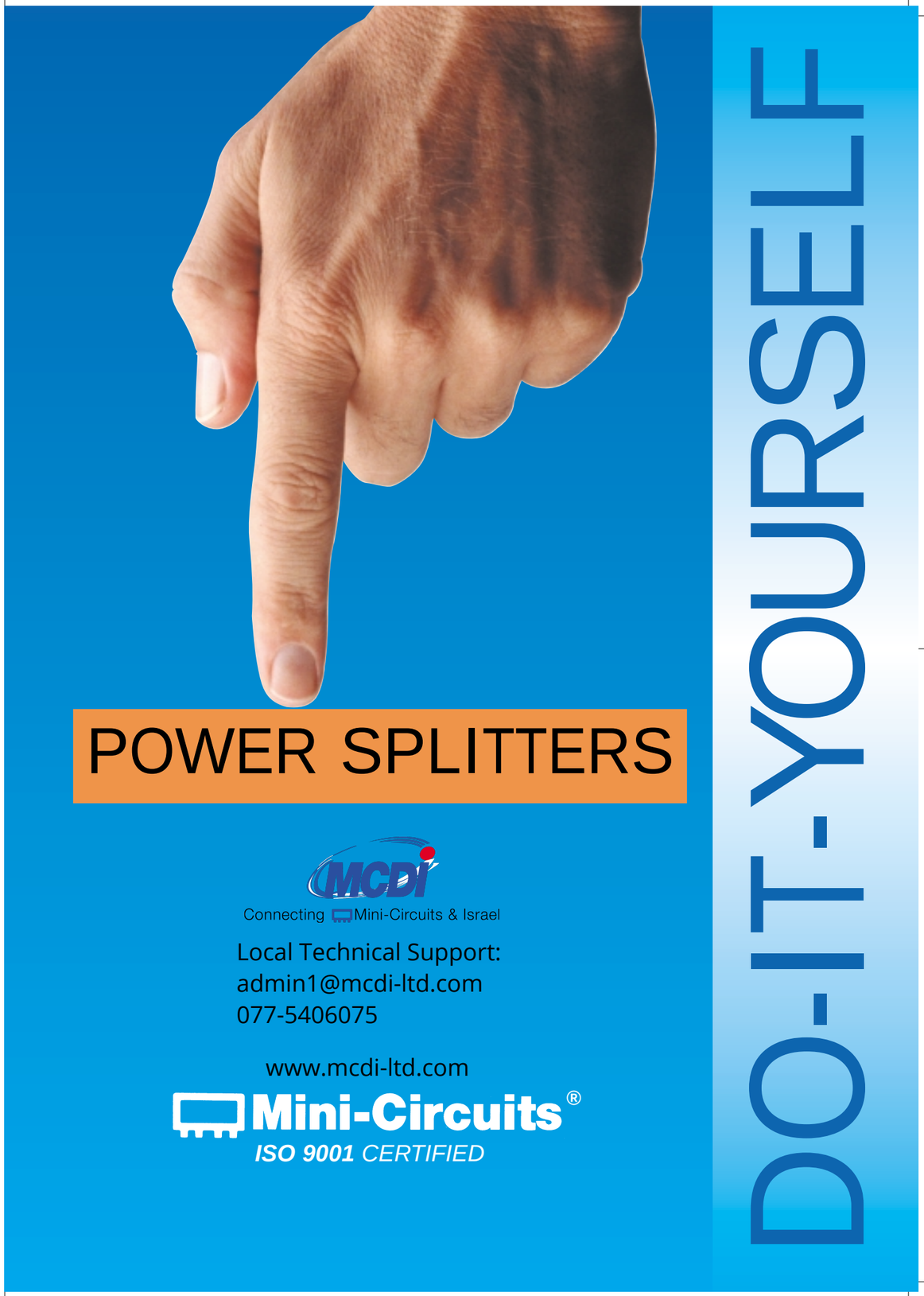


SUGGESTED PCB LAYOUT FOR TCP-2-25



DENOTES METALLIZATION
DENOTES SOLDER MASK
DENOTES METALLIZATION FOR DEVICE SOLDERING

Fig. 6



DO-IT-YOURSELF

LOW COST POWER SPLITTERS

Introduction

Ever expanding applications of RF and Microwaves for Wireless and Cable applications have revived the development efforts of components at these frequencies. There is a continuing demand to reduce the cost and increase the performance and quality at the same time. Mini-Circuits is working to satisfy these goals and has introduced a new splitter series to satisfy the demands of the market. These splitters are designed to need only commercially available low-cost off-the-shelf chip resistors and capacitors as external components, and are designed for automated manufacturing to achieve low overall cost.

What Constitutes a Power Splitter

Fig 1 is the block schematic of a two-way power splitter. It consists of a divider section, a matching section, a resistor R1 and a capacitor C1. The function of the divider section is, as the name implies, to divide the input signal into two parts. The matching section together with capacitor C1 performs wide-band matching at all ports. Resistor R1 helps provide wide-band isolation between the two RF output ports. The matching and divider sections form the heart of the splitter. They are realized using magnetic cores. The matching and divider sections are integrated into a single unit, and are herein afterwards called the splitter. The next section describes the splitter.

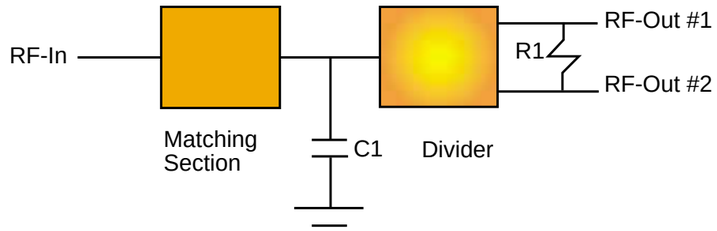


Fig.1 Block Schematic of a Power Splitter

Construction of the "TCP" device

TCP-series splitters use one magnetic core transmission line transformer for power division and another similar transformer for matching. The transformers share a common structure, for compactness. The base of the device is plastic with embedded leads, which makes the construction very rugged. The leads are solder plated for excellent solderability. All connections from the transformers to the header are made by welding. This helps to ensure preciseness of the assembly, with resulting high performance repeatability, as well as preventing any disconnection during reflow.

Performance of the Splitter

Mini-Circuits has introduced three splitters covering the frequency range of 5 to 2500 MHz. TCP-2-10 and TCP-2-25 are designed for 50 ohm, and TCP-2-10-75 is for 75 ohm characteristic impedance. *Fig 2* is a typical photo of the splitters and *Table1* gives the specifications. *Fig 3* shows the insertion loss of TCP-2-10. The insertion loss of the splitter is typically 0.5 dB above the 3 dB split over the band. *Fig 4* shows the isolation vs. frequency, which is typically 25dB over the band. *Fig 5* shows VSWR vs. frequency at all three ports, which is typically 1.1:1. Circuit board layout plays an important part in the performance of the splitter. In order to minimize parasitic effects, suggested layouts as shown in *Fig 6* should be used.

The external components, resistor and capacitor should be of 0805 size. The capacitor should be of NPO type with a nominal value of 1.5pF. The chip resistor should have a nominal value of 100, 150, and 475 ohms for TCP-2-10, TCP-2-10-75, and TCP-2-25 respectively.

Conclusion

Three power splitters have been introduced to operate over 5-2500 MHz. Due to all-welded connections the splitters are very rugged. The product has been designed to be fabricated in automated set-ups which helps lower the cost. Further cost reduction is obtained by designing the unit to work with a low-cost off-the-shelf chip resistor and capacitor used as external components.

ELECTRICAL SPECIFICATIONS Table 1

MODEL NO.	FREQ. RANGE (MHz)	ISOLATION (dB) L Typ.	ISOLATION (dB) L Min.	ISOLATION (dB) M❖ Typ.	ISOLATION (dB) M❖ Min.	ISOLATION (dB) U Typ.	ISOLATION (dB) U Min.	INSERTION LOSS (dB) ABOVE 3.0 (dB) L Typ.	INSERTION LOSS (dB) ABOVE 3.0 (dB) L Max.	INSERTION LOSS (dB) ABOVE 3.0 (dB) M❖ Typ.	INSERTION LOSS (dB) ABOVE 3.0 (dB) M❖ Max.	INSERTION LOSS (dB) ABOVE 3.0 (dB) U Typ.	INSERTION LOSS (dB) ABOVE 3.0 (dB) U Max.	PHASE UNBALANCE (Deg.) L Max.	PHASE UNBALANCE (Deg.) M❖ Max.	PHASE UNBALANCE (Deg.) U Max.	AMPLITUDE UNBALANCE (dB) L Max.	AMPLITUDE UNBALANCE (dB) M❖ Max.	AMPLITUDE UNBALANCE (dB) U Max.	Price $ ea. Qty. (10-49)
TCP-2-10	5-1000	25	17	25	16	21	16	0.3	0.9	0.5	0.9	0.5	1.4	4	4	6	0.6	0.6	0.3	3.95
■TCP-2-10-75	5-1000	24	14	29	19	30	16	0.3	1.4	0.3	0.9	0.6	1.3	6	4	3	1.2	0.6	0.5	4.95
TCP-2-25	200-2500			18	10					0.6	1.3				6			0.8		4.95

❖ When only specification for M range given, specification applies to entire frequency range.

■ Denotes 75 ohm model **L**=low range [f_L to 10 f_L] **M**=mid range [10f_L to f_U/2] **U**=upper range [f_U/2 to f_U]

Fig. 2

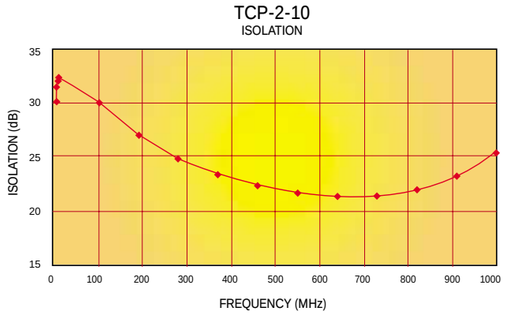


Fig. 4

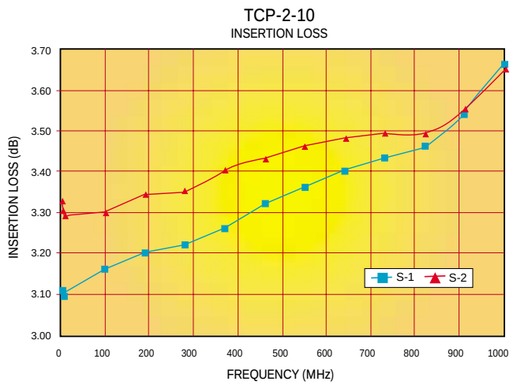


Fig. 3

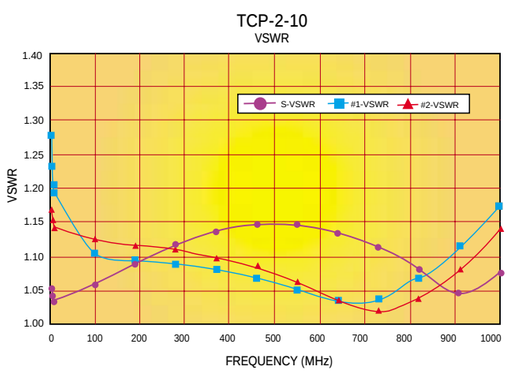


Fig. 5