

**DC Pass, High Power**

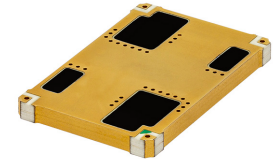
# Dual-Directional Coupler

**DDCH-50-521+**

**50Ω 50dB Coupling 300W 20 to 520 MHz**

## The Big Deal

- High power handling, up to 300W
- Low insertion loss, 0.10 dB Typ
- Good coupling flatness,  $\pm 0.25$  dB Typ
- High directivity, 25 dB Typ



*Generic photo used for illustration purposes only*  
CASE STYLE: PQ2100

## Product Overview

Mini-Circuits DDCH-50-521+ high-power dual-directional coupler provides high power handling up to 300W and insertion loss of 0.10 dB Typ with 50 dB coupling. Covering frequencies from 20 to 520 MHz, it supports a wide variety of applications from military to commercial, including GSM transmitters and more.

High directivity of 25 dB provides accurate sampling from the coupled port, and typical input/output return loss of 30 dB provides excellent matching over full frequency range. The coupler is designed into an open printed laminate (1.0 x 1.5 x 0.128") with wrap-around terminations for good solderability and easy visual inspection.

## Key Features

| Feature                               | Advantages                                                                                                                                            |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| High power handling, up to 300W       | Usable in many systems with high-power requirements such as antenna feeds, power amplifiers, and others that require sampling a high power RF signal. |
| Low mainline loss, 0.10 dB Typ.       | Used primarily in high power transmission applications, the excellent through-path signal loss maximizes the power transmitted to the antenna.        |
| Good coupling flatness, $\pm 0.25$ dB | Flat coupling values across the frequency range allows accurate signal sampling through the coupled port with minimal measurement error.              |
| High directivity, 25 dB Typ.          | High directivity with 50 dB coupling allows accurate signal sampling through the coupled port with minimal measurement error.                         |
| DC current passing up to 4 A          | Suitable for use in systems requiring DC voltage on the RF line, such as supplying bias to antenna circuitry via the antenna cable.                   |



## Dual-Directional Coupler

DDCH-50-521+

50Ω 50dB Coupling 300W 20 to 520 MHz

## Maximum Ratings

|                               |                    |
|-------------------------------|--------------------|
| Operating Temperature, case** | -55°C to 105°C     |
| Storage Temperature           | -55°C to 105°C     |
| DC Current                    | 4A                 |
| RF power *                    | 300W @ +85°C, case |

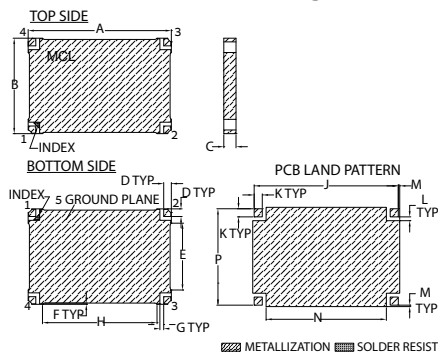
\*Derates to 240W at 95°C and 200W @ 105°C case temperature  
 \*\*Case temperature is defined as temperature on base plate.  
 Permanent damage may occur if any of these limits are exceeded.

## Pad Connections\*\*

|                 |   |
|-----------------|---|
| INPUT           | 4 |
| OUTPUT          | 2 |
| COUPLED FORWARD | 1 |
| COUPLED REVERSE | 3 |
| GROUND          | 5 |

\*\*Model is Dual-directional input and output are interchangeable.

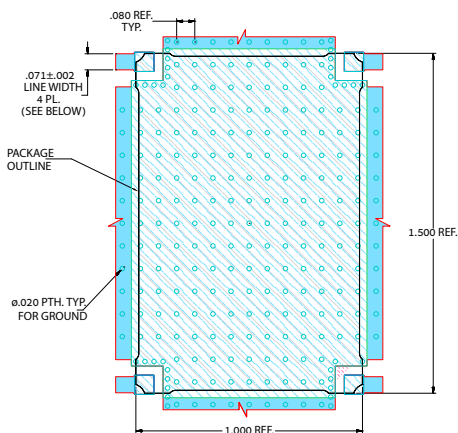
## Outline Drawing



Base material: Printed wiring laminate.  
 Termination Finish: 2-5 μinch (0.05-0.13 microns) immersion Gold.

## Outline Dimensions (inch/mm)

| A     | B     | C    | D    | E     | F     | G    | H     |       |
|-------|-------|------|------|-------|-------|------|-------|-------|
| 1.500 | 1.000 | .128 | .080 | .700  | .013  | .040 | 1.200 |       |
| 38.10 | 25.40 | 3.25 | 2.03 | 17.78 | 0.33  | 1.02 | 30.48 |       |
| J     | K     | L    | M    | N     | P     |      |       | wt.   |
| 1.510 | .085  | .040 | .015 | 1.260 | 1.010 |      |       | grams |
| 38.35 | 2.16  | 1.02 | 0.38 | 32.00 | 25.65 |      |       | 12.0  |

Demo Board MCL P/N: TB-865+  
Suggested PCB Layout (PL-471)

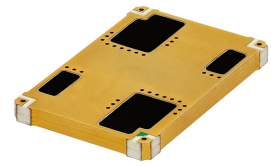
- NOTES:
1. TRACE WIDTH IS SHOWN FOR ROGERS RO4003C WITH DIELECTRIC THICKNESS. 0.032"±.0015". COPPER: 1 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
  2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
- DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
- DENOTES COPPER LAND PATTERN FREE OF SOLDERMASK

## Features

- high power, up to 300W
- low insertion loss, 0.10 dB Typ.
- good coupling flatness, ±0.25 dB Typ.
- high directivity, 25 dB Typ.
- DC current pass through input to output

## Applications

- GSM
- Research and Development Labs
- Defense and Military



Generic photo used for illustration purposes only

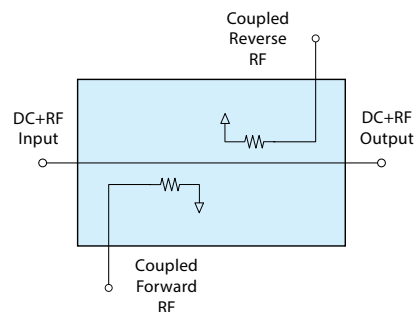
CASE STYLE: PQ2100

## +RoHS Compliant

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

## Electrical Specifications @ +25°C

| Parameter              | Condition (MHz) | Min.     | Typ.    | Max. | Units |
|------------------------|-----------------|----------|---------|------|-------|
| Frequency Range        |                 | 20       |         | 520  | MHz   |
| Insertion Loss         | 20 - 150        | —        | 0.05    | 0.10 | dB    |
|                        | 150 - 520       | —        | 0.10    | 0.20 |       |
| Coupling               | 20 - 520        | —        | 50±0.35 | —    | dB    |
| Coupling Flatness      | 20 - 520        | —        | ±0.65   | —    | dB    |
|                        | 30 - 520        | —        | ±0.25   | —    |       |
| Directivity            | 20 - 520        | 20       | 25      | —    | dB    |
| Return Loss (Input)    | 20 - 150        | 30       | 35      | —    | dB    |
|                        | 150 - 520       | 21       | 30      | —    |       |
| Return Loss (Output)   | 20 - 150        | 30       | 35      | —    | dB    |
|                        | 150 - 520       | 21       | 30      | —    |       |
| Return Loss (Coupling) | 20 - 150        | —        | 9       | —    | dB    |
|                        | 150 - 520       | 10       | 13      | —    |       |
| Input RF Power         | @+85°C, case    | 20 - 520 | —       | 300  | W     |
|                        | @+95°C, case    | 20 - 520 | —       | 240  |       |
|                        | @+105°C, case   | 20 - 520 | —       | 200  |       |
| Thermal Resistance     | 20 - 520        | —        | 0.2     | —    | °C/W  |

Dual-Directional Coupler  
(DC THRU)\*

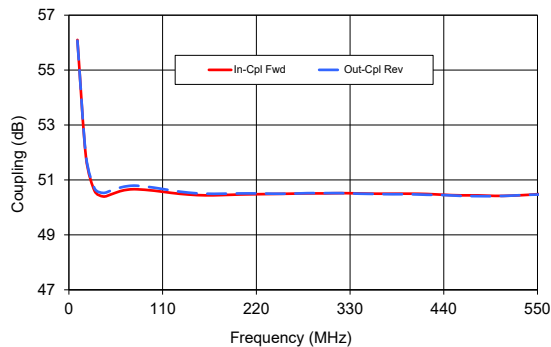
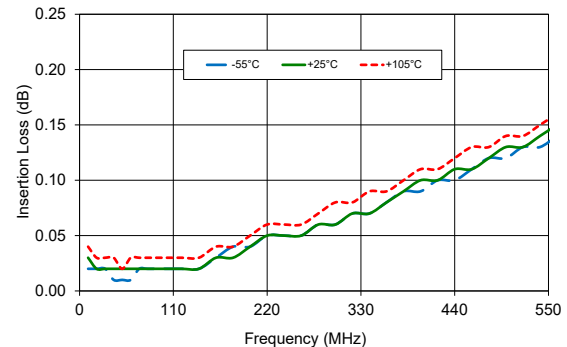
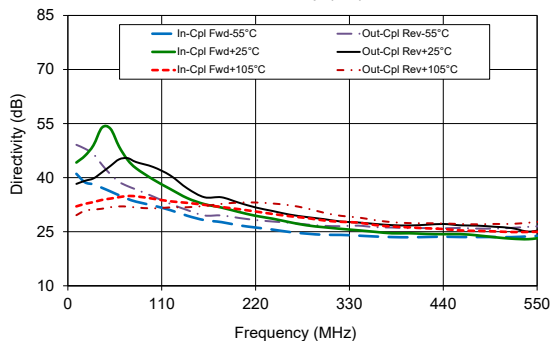
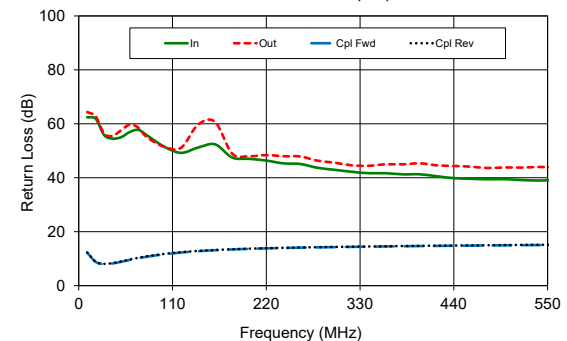
\*Mainline is DC coupled.

\*Coupling ports are DC coupled to internal terminations.

Typical Performance Data \*

| FREQUENCY<br>(MHz) | Insertion Loss<br>(dB) |       |        | Coupling<br>(dB) |                  | Directivity<br>(dB) |       |        |               |       |        | Return Loss<br>(dB) |       |            |            |
|--------------------|------------------------|-------|--------|------------------|------------------|---------------------|-------|--------|---------------|-------|--------|---------------------|-------|------------|------------|
|                    | In - Out               |       |        | In -<br>Cpl Fwd  | Out -<br>Cpl Rev | In - Cpl Rev        |       |        | Out - Cpl Fwd |       |        | In                  | Out   | Cpl<br>Fwd | Cpl<br>Rev |
|                    | -55°C                  | +25°C | +105°C |                  |                  | -55°C               | +25°C | +105°C | -55°C         | +25°C | +105°C |                     |       |            |            |
| 20                 | 0.02                   | 0.02  | 0.03   | 51.84            | 51.89            | 38.72               | 46.06 | 32.73  | 48.04         | 39.13 | 30.86  | 61.82               | 62.73 | 8.78       | 8.85       |
| 30                 | 0.02                   | 0.02  | 0.03   | 50.61            | 50.70            | 38.14               | 48.99 | 33.22  | 46.53         | 39.79 | 31.14  | 55.77               | 56.28 | 7.98       | 8.08       |
| 40                 | 0.01                   | 0.02  | 0.03   | 50.40            | 50.53            | 37.18               | 53.89 | 33.83  | 43.58         | 41.47 | 31.38  | 54.52               | 55.58 | 8.25       | 8.39       |
| 50                 | 0.01                   | 0.02  | 0.02   | 50.48            | 50.62            | 36.17               | 53.55 | 34.20  | 40.90         | 43.27 | 31.81  | 55.08               | 57.66 | 8.87       | 9.02       |
| 60                 | 0.01                   | 0.02  | 0.03   | 50.59            | 50.72            | 35.11               | 48.63 | 34.59  | 38.84         | 45.08 | 32.02  | 56.99               | 59.75 | 9.55       | 9.71       |
| 80                 | 0.02                   | 0.02  | 0.03   | 50.66            | 50.79            | 33.34               | 42.60 | 34.82  | 36.72         | 44.33 | 31.73  | 55.74               | 55.04 | 10.74      | 10.89      |
| 100                | 0.02                   | 0.02  | 0.03   | 50.61            | 50.72            | 32.26               | 39.49 | 34.15  | 34.77         | 42.96 | 31.47  | 51.58               | 51.50 | 11.62      | 11.76      |
| 140                | 0.02                   | 0.02  | 0.03   | 50.47            | 50.54            | 29.43               | 34.32 | 33.01  | 31.00         | 37.02 | 31.79  | 51.20               | 59.72 | 12.77      | 12.88      |
| 160                | 0.03                   | 0.03  | 0.04   | 50.44            | 50.50            | 28.22               | 32.66 | 32.46  | 29.51         | 34.57 | 32.16  | 52.39               | 60.67 | 13.14      | 13.23      |
| 200                | 0.04                   | 0.04  | 0.05   | 50.47            | 50.51            | 26.79               | 30.51 | 31.27  | 28.84         | 33.09 | 33.08  | 47.02               | 47.99 | 13.64      | 13.72      |
| 220                | 0.05                   | 0.05  | 0.06   | 50.48            | 50.51            | 26.17               | 29.42 | 30.61  | 28.25         | 31.74 | 33.11  | 46.38               | 48.42 | 13.82      | 13.89      |
| 260                | 0.05                   | 0.05  | 0.06   | 50.50            | 50.50            | 24.92               | 27.64 | 29.31  | 27.48         | 29.75 | 32.34  | 45.10               | 47.89 | 14.09      | 14.16      |
| 280                | 0.06                   | 0.06  | 0.07   | 50.51            | 50.52            | 24.47               | 26.77 | 28.80  | 27.02         | 29.07 | 31.47  | 43.71               | 46.34 | 14.20      | 14.26      |
| 320                | 0.07                   | 0.07  | 0.08   | 50.52            | 50.52            | 24.12               | 25.80 | 27.75  | 26.54         | 27.83 | 29.41  | 42.23               | 44.62 | 14.38      | 14.44      |
| 340                | 0.07                   | 0.07  | 0.09   | 50.51            | 50.50            | 23.92               | 25.40 | 27.55  | 26.69         | 27.57 | 28.97  | 41.70               | 44.43 | 14.45      | 14.52      |
| 380                | 0.09                   | 0.09  | 0.10   | 50.50            | 50.48            | 23.52               | 24.56 | 26.44  | 26.17         | 26.83 | 27.65  | 41.27               | 44.97 | 14.61      | 14.69      |
| 400                | 0.09                   | 0.10  | 0.11   | 50.50            | 50.48            | 23.46               | 24.58 | 26.22  | 25.99         | 26.73 | 27.40  | 41.29               | 45.35 | 14.68      | 14.76      |
| 440                | 0.10                   | 0.11  | 0.12   | 50.46            | 50.45            | 23.61               | 24.32 | 25.76  | 25.95         | 27.15 | 27.30  | 39.86               | 44.37 | 14.79      | 14.88      |
| 460                | 0.11                   | 0.11  | 0.13   | 50.44            | 50.42            | 23.53               | 24.34 | 25.36  | 26.05         | 26.78 | 27.13  | 39.63               | 44.11 | 14.84      | 14.93      |
| 500                | 0.12                   | 0.13  | 0.14   | 50.42            | 50.41            | 23.54               | 23.48 | 25.10  | 25.88         | 26.38 | 27.16  | 39.48               | 43.84 | 14.95      | 15.05      |
| 520                | 0.13                   | 0.13  | 0.14   | 50.43            | 50.43            | 23.50               | 23.08 | 24.92  | 26.07         | 26.02 | 27.17  | 39.16               | 43.77 | 15.01      | 15.11      |

\* Data at +25°C unless specified otherwise.

DDCH-50-521+  
Coupling (dB)DDCH-50-521+  
Insertion Loss (dB)DDCH-50-521+  
Directivity (dB)DDCH-50-521+  
Return Loss (dB)

## 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.
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# Dual-Directional Coupler

# DDCH-50-521+

## Typical Performance Data

TEST CONDITIONS: INPUT POWER =+5 dBm @Temperature = -55°C

| FREQ.<br>(MHz) | INSERTION<br>LOSS <sup>1</sup><br>(dB)<br>In - Out | COUPLING<br>(dB) |           | DIRECTIVITY<br>(dB) |           | RETURN LOSS<br>(dB) |       |       |       |
|----------------|----------------------------------------------------|------------------|-----------|---------------------|-----------|---------------------|-------|-------|-------|
|                |                                                    | In - Fwd         | Out - Rev | In - Fwd            | Out - Rev | In                  | Out   | Fwd   | Rev   |
| 10             | 0.02                                               | 56.12            | 56.11     | 41.06               | 49.11     | 52.07               | 54.99 | 12.32 | 12.41 |
| 20             | 0.02                                               | 51.90            | 51.96     | 38.72               | 48.04     | 47.80               | 49.64 | 8.73  | 8.79  |
| 30             | 0.02                                               | 50.72            | 50.82     | 38.14               | 46.53     | 45.30               | 46.37 | 7.91  | 8.00  |
| 40             | 0.01                                               | 50.54            | 50.66     | 37.18               | 43.58     | 43.89               | 44.58 | 8.18  | 8.30  |
| 50             | 0.01                                               | 50.63            | 50.76     | 36.17               | 40.90     | 43.60               | 44.10 | 8.80  | 8.93  |
| 60             | 0.01                                               | 50.73            | 50.87     | 35.11               | 38.84     | 43.91               | 44.53 | 9.48  | 9.62  |
| 70             | 0.02                                               | 50.79            | 50.92     | 34.12               | 37.65     | 44.75               | 45.62 | 10.12 | 10.28 |
| 80             | 0.02                                               | 50.80            | 50.92     | 33.34               | 36.72     | 45.93               | 47.50 | 10.70 | 10.88 |
| 100            | 0.02                                               | 50.74            | 50.84     | 32.26               | 34.77     | 48.52               | 53.88 | 11.63 | 11.86 |
| 120            | 0.02                                               | 50.66            | 50.73     | 31.00               | 32.76     | 49.71               | 55.91 | 12.36 | 12.64 |
| 140            | 0.02                                               | 50.59            | 50.65     | 29.43               | 31.00     | 44.61               | 42.56 | 12.94 | 13.24 |
| 160            | 0.03                                               | 50.57            | 50.62     | 28.22               | 29.51     | 40.41               | 38.28 | 13.42 | 13.69 |
| 180            | 0.04                                               | 50.58            | 50.62     | 27.67               | 29.53     | 38.75               | 37.87 | 13.79 | 13.99 |
| 200            | 0.04                                               | 50.60            | 50.63     | 26.79               | 28.84     | 37.49               | 36.58 | 14.05 | 14.17 |
| 220            | 0.05                                               | 50.63            | 50.64     | 26.17               | 28.25     | 37.26               | 36.20 | 14.24 | 14.26 |
| 240            | 0.05                                               | 50.64            | 50.65     | 25.59               | 27.83     | 37.78               | 36.60 | 14.37 | 14.31 |
| 260            | 0.05                                               | 50.65            | 50.65     | 24.92               | 27.48     | 38.43               | 37.41 | 14.47 | 14.35 |
| 280            | 0.06                                               | 50.67            | 50.67     | 24.47               | 27.02     | 39.57               | 38.35 | 14.54 | 14.36 |
| 300            | 0.06                                               | 50.68            | 50.67     | 24.15               | 26.64     | 40.69               | 39.50 | 14.57 | 14.36 |
| 320            | 0.07                                               | 50.70            | 50.68     | 24.12               | 26.54     | 42.39               | 41.78 | 14.58 | 14.37 |
| 340            | 0.07                                               | 50.68            | 50.65     | 23.92               | 26.69     | 43.13               | 44.26 | 14.58 | 14.40 |
| 360            | 0.08                                               | 50.68            | 50.64     | 23.68               | 26.27     | 42.85               | 47.81 | 14.60 | 14.46 |
| 380            | 0.09                                               | 50.67            | 50.63     | 23.52               | 26.17     | 41.43               | 51.41 | 14.63 | 14.54 |
| 400            | 0.09                                               | 50.66            | 50.62     | 23.46               | 25.99     | 40.66               | 56.07 | 14.65 | 14.61 |
| 420            | 0.10                                               | 50.65            | 50.61     | 23.54               | 26.02     | 40.25               | 55.66 | 14.65 | 14.68 |
| 440            | 0.10                                               | 50.64            | 50.59     | 23.61               | 25.95     | 39.61               | 49.79 | 14.64 | 14.74 |
| 460            | 0.11                                               | 50.63            | 50.59     | 23.53               | 26.05     | 39.18               | 45.82 | 14.65 | 14.80 |
| 480            | 0.12                                               | 50.65            | 50.59     | 23.52               | 25.87     | 38.69               | 43.53 | 14.68 | 14.89 |
| 500            | 0.12                                               | 50.64            | 50.58     | 23.54               | 25.88     | 38.62               | 42.98 | 14.72 | 14.96 |
| 520            | 0.13                                               | 50.63            | 50.59     | 23.50               | 26.07     | 38.35               | 42.22 | 14.76 | 15.03 |
| 540            | 0.13                                               | 50.63            | 50.58     | 23.72               | 26.36     | 38.18               | 41.41 | 14.78 | 15.09 |
| 560            | 0.14                                               | 50.62            | 50.57     | 23.94               | 26.60     | 38.14               | 40.16 | 14.81 | 15.14 |
| 580            | 0.15                                               | 50.63            | 50.56     | 24.06               | 26.67     | 37.85               | 39.10 | 14.88 | 15.20 |
| 600            | 0.16                                               | 50.63            | 50.57     | 24.30               | 26.60     | 37.84               | 38.84 | 14.97 | 15.25 |
| 620            | 0.16                                               | 50.62            | 50.58     | 24.50               | 26.54     | 37.67               | 38.86 | 15.07 | 15.30 |
| 640            | 0.17                                               | 50.63            | 50.63     | 23.77               | 26.74     | 37.66               | 39.09 | 15.17 | 15.35 |
| 660            | 0.18                                               | 50.64            | 50.62     | 23.87               | 26.58     | 37.89               | 39.33 | 15.27 | 15.41 |
| 680            | 0.19                                               | 50.66            | 50.63     | 24.03               | 26.44     | 38.16               | 39.87 | 15.38 | 15.48 |
| 700            | 0.19                                               | 50.68            | 50.67     | 23.41               | 25.86     | 39.02               | 41.99 | 15.49 | 15.58 |
| 720            | 0.20                                               | 50.72            | 50.71     | 22.70               | 25.59     | 40.07               | 45.13 | 15.59 | 15.67 |
| 740            | 0.20                                               | 50.77            | 50.73     | 22.67               | 25.34     | 41.14               | 49.69 | 15.66 | 15.76 |
| 760            | 0.21                                               | 50.82            | 50.80     | 22.49               | 25.15     | 41.47               | 49.20 | 15.72 | 15.84 |
| 780            | 0.22                                               | 50.83            | 50.81     | 22.75               | 25.32     | 41.14               | 45.10 | 15.77 | 15.92 |
| 800            | 0.23                                               | 50.79            | 50.75     | 22.98               | 24.65     | 39.98               | 41.54 | 15.82 | 15.98 |
| 820            | 0.24                                               | 50.75            | 50.71     | 22.19               | 23.31     | 38.65               | 39.23 | 15.86 | 16.02 |
| 840            | 0.24                                               | 50.76            | 50.72     | 21.13               | 22.39     | 37.80               | 38.01 | 15.89 | 16.04 |
| 860            | 0.25                                               | 50.80            | 50.74     | 20.39               | 21.65     | 37.41               | 37.37 | 15.91 | 16.05 |
| 880            | 0.26                                               | 50.84            | 50.75     | 19.97               | 21.12     | 37.46               | 37.18 | 15.93 | 16.06 |
| 900            | 0.26                                               | 50.85            | 50.76     | 19.61               | 20.75     | 37.23               | 36.75 | 15.95 | 16.07 |
| 920            | 0.27                                               | 50.82            | 50.75     | 19.03               | 20.09     | 36.85               | 36.30 | 15.96 | 16.09 |
| 940            | 0.28                                               | 50.80            | 50.76     | 18.35               | 19.34     | 36.63               | 36.03 | 15.98 | 16.11 |
| 960            | 0.28                                               | 50.82            | 50.76     | 17.84               | 18.70     | 36.21               | 35.52 | 15.98 | 16.12 |
| 980            | 0.29                                               | 50.87            | 50.77     | 17.47               | 18.18     | 35.78               | 34.94 | 15.99 | 16.13 |
| 1000           | 0.30                                               | 50.89            | 50.76     | 17.44               | 17.58     | 35.08               | 34.11 | 16.00 | 16.13 |

### 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/MCStore/terms.jsp](http://www.minicircuits.com/MCStore/terms.jsp)



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201104  
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# Dual-Directional Coupler

# DDCH-50-521+

## Typical Performance Data

TEST CONDITIONS: INPUT POWER =+5 dBm @Temperature = +25°C

| FREQ.<br>(MHz) | INSERTION<br>LOSS <sup>1</sup><br>(dB)<br>In - Out | COUPLING<br>(dB) |           | DIRECTIVITY<br>(dB) |           | RETURN LOSS<br>(dB) |       |       |       |
|----------------|----------------------------------------------------|------------------|-----------|---------------------|-----------|---------------------|-------|-------|-------|
|                |                                                    | In - Fwd         | Out - Rev | In - Fwd            | Out - Rev | In                  | Out   | Fwd   | Rev   |
| 10             | 0.03                                               | 56.10            | 56.07     | 44.20               | 38.27     | 62.44               | 64.36 | 12.22 | 12.29 |
| 20             | 0.02                                               | 51.84            | 51.89     | 46.06               | 39.13     | 61.82               | 62.73 | 8.78  | 8.85  |
| 30             | 0.02                                               | 50.61            | 50.70     | 48.99               | 39.79     | 55.77               | 56.28 | 7.98  | 8.08  |
| 40             | 0.02                                               | 50.40            | 50.53     | 53.89               | 41.47     | 54.52               | 55.58 | 8.25  | 8.39  |
| 50             | 0.02                                               | 50.48            | 50.62     | 53.55               | 43.27     | 55.08               | 57.66 | 8.87  | 9.02  |
| 60             | 0.02                                               | 50.59            | 50.72     | 48.63               | 45.08     | 56.99               | 59.75 | 9.55  | 9.71  |
| 70             | 0.02                                               | 50.65            | 50.78     | 44.95               | 45.42     | 57.75               | 58.55 | 10.18 | 10.34 |
| 80             | 0.02                                               | 50.66            | 50.79     | 42.60               | 44.33     | 55.74               | 55.04 | 10.74 | 10.89 |
| 100            | 0.02                                               | 50.61            | 50.72     | 39.49               | 42.96     | 51.58               | 51.50 | 11.62 | 11.76 |
| 120            | 0.02                                               | 50.53            | 50.62     | 36.85               | 40.62     | 49.24               | 51.10 | 12.28 | 12.41 |
| 140            | 0.02                                               | 50.47            | 50.54     | 34.32               | 37.02     | 51.20               | 59.72 | 12.77 | 12.88 |
| 160            | 0.03                                               | 50.44            | 50.50     | 32.66               | 34.57     | 52.39               | 60.67 | 13.14 | 13.23 |
| 180            | 0.03                                               | 50.45            | 50.50     | 31.71               | 34.56     | 47.49               | 48.96 | 13.43 | 13.51 |
| 200            | 0.04                                               | 50.47            | 50.51     | 30.51               | 33.09     | 47.02               | 47.99 | 13.64 | 13.72 |
| 220            | 0.05                                               | 50.48            | 50.51     | 29.42               | 31.74     | 46.38               | 48.42 | 13.82 | 13.89 |
| 240            | 0.05                                               | 50.49            | 50.50     | 28.62               | 30.75     | 45.35               | 47.98 | 13.96 | 14.03 |
| 260            | 0.05                                               | 50.50            | 50.50     | 27.64               | 29.75     | 45.10               | 47.89 | 14.09 | 14.16 |
| 280            | 0.06                                               | 50.51            | 50.52     | 26.77               | 29.07     | 43.71               | 46.34 | 14.20 | 14.26 |
| 300            | 0.06                                               | 50.51            | 50.52     | 26.25               | 28.50     | 42.96               | 45.61 | 14.29 | 14.35 |
| 320            | 0.07                                               | 50.52            | 50.52     | 25.80               | 27.83     | 42.23               | 44.62 | 14.38 | 14.44 |
| 340            | 0.07                                               | 50.51            | 50.50     | 25.40               | 27.57     | 41.70               | 44.43 | 14.45 | 14.52 |
| 360            | 0.08                                               | 50.50            | 50.49     | 24.97               | 27.16     | 41.70               | 44.99 | 14.53 | 14.60 |
| 380            | 0.09                                               | 50.50            | 50.48     | 24.56               | 26.83     | 41.27               | 44.97 | 14.61 | 14.69 |
| 400            | 0.10                                               | 50.50            | 50.48     | 24.58               | 26.73     | 41.29               | 45.35 | 14.68 | 14.76 |
| 420            | 0.10                                               | 50.49            | 50.46     | 24.40               | 26.93     | 40.56               | 44.61 | 14.74 | 14.83 |
| 440            | 0.11                                               | 50.46            | 50.45     | 24.32               | 27.15     | 39.86               | 44.37 | 14.79 | 14.88 |
| 460            | 0.11                                               | 50.44            | 50.42     | 24.34               | 26.78     | 39.63               | 44.11 | 14.84 | 14.93 |
| 480            | 0.12                                               | 50.44            | 50.41     | 23.99               | 26.69     | 39.43               | 43.61 | 14.90 | 14.99 |
| 500            | 0.13                                               | 50.42            | 50.41     | 23.48               | 26.38     | 39.48               | 43.84 | 14.95 | 15.05 |
| 520            | 0.13                                               | 50.43            | 50.43     | 23.08               | 26.02     | 39.16               | 43.77 | 15.01 | 15.11 |
| 540            | 0.14                                               | 50.46            | 50.46     | 22.94               | 25.04     | 38.98               | 44.01 | 15.05 | 15.15 |
| 560            | 0.15                                               | 50.50            | 50.47     | 23.48               | 25.74     | 39.15               | 43.78 | 15.09 | 15.19 |
| 580            | 0.16                                               | 50.50            | 50.46     | 23.66               | 26.07     | 39.09               | 43.53 | 15.14 | 15.24 |
| 600            | 0.16                                               | 50.52            | 50.48     | 23.67               | 26.44     | 39.11               | 43.98 | 15.19 | 15.29 |
| 620            | 0.17                                               | 50.51            | 50.53     | 23.96               | 26.48     | 38.77               | 44.60 | 15.25 | 15.35 |
| 640            | 0.18                                               | 50.51            | 50.53     | 24.69               | 26.79     | 38.68               | 45.36 | 15.30 | 15.40 |
| 660            | 0.19                                               | 50.51            | 50.53     | 24.87               | 26.68     | 38.95               | 45.70 | 15.34 | 15.45 |
| 680            | 0.19                                               | 50.53            | 50.51     | 25.15               | 26.67     | 39.17               | 45.48 | 15.39 | 15.51 |
| 700            | 0.20                                               | 50.55            | 50.52     | 25.14               | 26.22     | 39.42               | 46.32 | 15.44 | 15.56 |
| 720            | 0.21                                               | 50.56            | 50.54     | 24.98               | 25.98     | 39.69               | 47.16 | 15.49 | 15.60 |
| 740            | 0.21                                               | 50.58            | 50.54     | 24.90               | 25.64     | 40.37               | 48.35 | 15.53 | 15.64 |
| 760            | 0.22                                               | 50.58            | 50.54     | 24.97               | 25.07     | 41.31               | 49.64 | 15.55 | 15.67 |
| 780            | 0.23                                               | 50.61            | 50.58     | 23.78               | 24.49     | 42.24               | 50.98 | 15.58 | 15.72 |
| 800            | 0.24                                               | 50.62            | 50.60     | 23.05               | 24.00     | 42.97               | 54.25 | 15.62 | 15.75 |
| 820            | 0.25                                               | 50.61            | 50.60     | 22.91               | 23.32     | 43.84               | 58.32 | 15.65 | 15.79 |
| 840            | 0.25                                               | 50.62            | 50.61     | 22.58               | 22.69     | 45.01               | 57.74 | 15.68 | 15.82 |
| 860            | 0.26                                               | 50.66            | 50.64     | 21.76               | 22.09     | 46.03               | 55.85 | 15.72 | 15.84 |
| 880            | 0.27                                               | 50.71            | 50.65     | 21.07               | 21.15     | 46.94               | 53.84 | 15.75 | 15.88 |
| 900            | 0.28                                               | 50.71            | 50.65     | 20.50               | 20.24     | 47.17               | 50.66 | 15.78 | 15.93 |
| 920            | 0.28                                               | 50.71            | 50.68     | 19.66               | 19.38     | 47.33               | 47.75 | 15.81 | 15.96 |
| 940            | 0.29                                               | 50.70            | 50.68     | 19.10               | 18.73     | 47.84               | 46.19 | 15.84 | 15.99 |
| 960            | 0.30                                               | 50.70            | 50.68     | 18.43               | 18.15     | 46.68               | 44.44 | 15.86 | 16.00 |
| 980            | 0.31                                               | 50.73            | 50.69     | 17.77               | 17.73     | 44.94               | 42.94 | 15.89 | 16.03 |
| 1000           | 0.31                                               | 50.76            | 50.69     | 17.15               | 17.25     | 42.79               | 41.29 | 15.92 | 16.05 |

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# Dual-Directional Coupler

# DDCH-50-521+

## Typical Performance Data

TEST CONDITIONS: INPUT POWER =+5 dBm @Temperature = +105°C

| FREQ.<br>(MHz) | INSERTION<br>LOSS <sup>1</sup><br>(dB)<br>In - Out | COUPLING<br>(dB) |           | DIRECTIVITY<br>(dB) |           | RETURN LOSS<br>(dB) |       |       |       |
|----------------|----------------------------------------------------|------------------|-----------|---------------------|-----------|---------------------|-------|-------|-------|
|                |                                                    | In - Fwd         | Out - Rev | In - Fwd            | Out - Rev | In                  | Out   | Fwd   | Rev   |
| 10             | 0.04                                               | 56.04            | 56.03     | 32.03               | 29.59     | 58.12               | 54.32 | 12.11 | 12.18 |
| 20             | 0.03                                               | 51.76            | 51.79     | 32.73               | 30.86     | 51.76               | 49.51 | 8.82  | 8.90  |
| 30             | 0.03                                               | 50.50            | 50.57     | 33.22               | 31.14     | 47.90               | 46.55 | 8.04  | 8.17  |
| 40             | 0.03                                               | 50.28            | 50.37     | 33.83               | 31.38     | 46.24               | 45.29 | 8.33  | 8.50  |
| 50             | 0.02                                               | 50.35            | 50.45     | 34.20               | 31.81     | 45.07               | 44.58 | 8.96  | 9.17  |
| 60             | 0.03                                               | 50.45            | 50.56     | 34.59               | 32.02     | 44.51               | 44.01 | 9.65  | 9.87  |
| 70             | 0.03                                               | 50.52            | 50.62     | 34.90               | 31.97     | 44.38               | 43.63 | 10.29 | 10.50 |
| 80             | 0.03                                               | 50.53            | 50.63     | 34.82               | 31.73     | 44.86               | 43.30 | 10.85 | 11.04 |
| 100            | 0.03                                               | 50.49            | 50.58     | 34.15               | 31.47     | 48.53               | 43.68 | 11.71 | 11.82 |
| 120            | 0.03                                               | 50.42            | 50.50     | 33.44               | 31.76     | 54.09               | 45.47 | 12.32 | 12.34 |
| 140            | 0.03                                               | 50.37            | 50.43     | 33.01               | 31.79     | 47.64               | 46.19 | 12.72 | 12.67 |
| 160            | 0.04                                               | 50.35            | 50.41     | 32.46               | 32.16     | 41.89               | 44.02 | 12.99 | 12.91 |
| 180            | 0.04                                               | 50.36            | 50.41     | 31.86               | 32.72     | 37.70               | 37.53 | 13.20 | 13.11 |
| 200            | 0.05                                               | 50.39            | 50.43     | 31.27               | 33.08     | 35.49               | 35.49 | 13.36 | 13.29 |
| 220            | 0.06                                               | 50.41            | 50.43     | 30.61               | 33.11     | 33.98               | 34.23 | 13.50 | 13.48 |
| 240            | 0.06                                               | 50.42            | 50.43     | 29.93               | 32.83     | 32.86               | 33.18 | 13.61 | 13.65 |
| 260            | 0.06                                               | 50.43            | 50.43     | 29.31               | 32.34     | 32.20               | 32.47 | 13.73 | 13.84 |
| 280            | 0.07                                               | 50.44            | 50.44     | 28.80               | 31.47     | 31.69               | 31.98 | 13.84 | 14.02 |
| 300            | 0.08                                               | 50.45            | 50.44     | 28.14               | 30.28     | 31.59               | 31.89 | 13.96 | 14.18 |
| 320            | 0.08                                               | 50.46            | 50.44     | 27.75               | 29.41     | 31.66               | 31.93 | 14.09 | 14.34 |
| 340            | 0.09                                               | 50.44            | 50.41     | 27.55               | 28.97     | 32.03               | 32.25 | 14.20 | 14.47 |
| 360            | 0.09                                               | 50.43            | 50.40     | 26.86               | 28.22     | 32.55               | 32.67 | 14.32 | 14.59 |
| 380            | 0.10                                               | 50.42            | 50.40     | 26.44               | 27.65     | 32.98               | 32.94 | 14.44 | 14.69 |
| 400            | 0.11                                               | 50.41            | 50.39     | 26.22               | 27.40     | 33.41               | 33.21 | 14.56 | 14.76 |
| 420            | 0.11                                               | 50.40            | 50.37     | 25.95               | 27.36     | 33.39               | 33.22 | 14.68 | 14.83 |
| 440            | 0.12                                               | 50.39            | 50.36     | 25.76               | 27.30     | 33.41               | 33.40 | 14.78 | 14.89 |
| 460            | 0.13                                               | 50.38            | 50.35     | 25.36               | 27.13     | 33.60               | 33.57 | 14.87 | 14.95 |
| 480            | 0.13                                               | 50.39            | 50.35     | 25.23               | 27.06     | 33.86               | 33.65 | 14.96 | 15.00 |
| 500            | 0.14                                               | 50.39            | 50.35     | 25.10               | 27.16     | 34.23               | 33.87 | 15.04 | 15.06 |
| 520            | 0.14                                               | 50.38            | 50.35     | 24.92               | 27.17     | 34.30               | 34.01 | 15.13 | 15.12 |
| 540            | 0.15                                               | 50.39            | 50.35     | 24.94               | 27.51     | 34.58               | 34.40 | 15.20 | 15.18 |
| 560            | 0.16                                               | 50.38            | 50.34     | 25.04               | 27.88     | 34.98               | 34.85 | 15.26 | 15.24 |
| 580            | 0.17                                               | 50.38            | 50.34     | 25.02               | 27.91     | 35.33               | 35.32 | 15.33 | 15.32 |
| 600            | 0.18                                               | 50.39            | 50.35     | 25.04               | 27.99     | 35.77               | 35.96 | 15.39 | 15.39 |
| 620            | 0.18                                               | 50.40            | 50.35     | 25.11               | 27.81     | 35.96               | 36.56 | 15.46 | 15.48 |
| 640            | 0.19                                               | 50.41            | 50.38     | 24.78               | 27.98     | 36.30               | 37.31 | 15.52 | 15.57 |
| 660            | 0.20                                               | 50.42            | 50.37     | 24.79               | 27.84     | 36.84               | 38.13 | 15.58 | 15.67 |
| 680            | 0.21                                               | 50.44            | 50.39     | 24.65               | 27.80     | 37.32               | 38.92 | 15.65 | 15.77 |
| 700            | 0.22                                               | 50.46            | 50.41     | 24.50               | 27.68     | 37.97               | 40.20 | 15.70 | 15.85 |
| 720            | 0.22                                               | 50.49            | 50.44     | 24.08               | 27.35     | 38.68               | 41.15 | 15.75 | 15.91 |
| 740            | 0.23                                               | 50.53            | 50.46     | 23.95               | 26.92     | 39.75               | 42.20 | 15.80 | 15.96 |
| 760            | 0.24                                               | 50.59            | 50.51     | 23.77               | 27.17     | 41.02               | 43.58 | 15.84 | 16.01 |
| 780            | 0.25                                               | 50.63            | 50.52     | 23.64               | 27.24     | 42.23               | 45.62 | 15.89 | 16.08 |
| 800            | 0.26                                               | 50.59            | 50.49     | 23.78               | 25.93     | 43.43               | 49.70 | 15.94 | 16.13 |
| 820            | 0.26                                               | 50.57            | 50.47     | 23.24               | 24.50     | 44.72               | 56.96 | 15.99 | 16.17 |
| 840            | 0.27                                               | 50.58            | 50.48     | 22.28               | 23.31     | 46.18               | 68.68 | 16.03 | 16.20 |
| 860            | 0.28                                               | 50.60            | 50.49     | 21.48               | 22.43     | 46.89               | 55.60 | 16.07 | 16.23 |
| 880            | 0.29                                               | 50.64            | 50.50     | 20.96               | 21.79     | 46.27               | 49.61 | 16.13 | 16.28 |
| 900            | 0.29                                               | 50.67            | 50.51     | 20.42               | 21.04     | 43.92               | 44.91 | 16.19 | 16.33 |
| 920            | 0.30                                               | 50.67            | 50.52     | 19.70               | 20.22     | 41.90               | 41.91 | 16.24 | 16.37 |
| 940            | 0.31                                               | 50.68            | 50.52     | 19.05               | 19.47     | 40.71               | 40.26 | 16.28 | 16.40 |
| 960            | 0.32                                               | 50.70            | 50.53     | 18.43               | 18.72     | 39.36               | 38.73 | 16.31 | 16.42 |
| 980            | 0.33                                               | 50.73            | 50.56     | 17.98               | 18.14     | 38.05               | 37.46 | 16.35 | 16.44 |
| 1000           | 0.33                                               | 50.72            | 50.55     | 17.73               | 17.53     | 36.62               | 36.04 | 16.39 | 16.48 |

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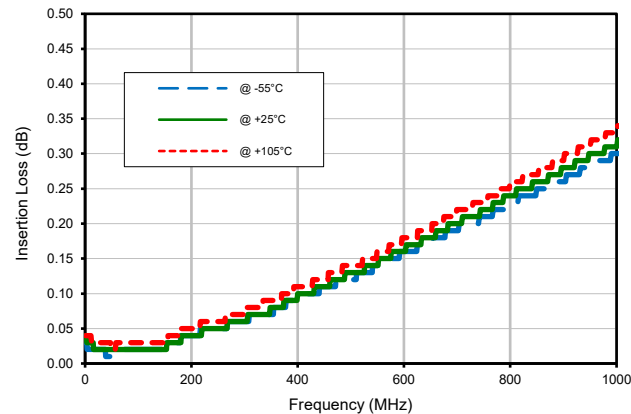
Rev. OR  
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 201104  
 Page 3 of 3

# Dual-Directional Coupler

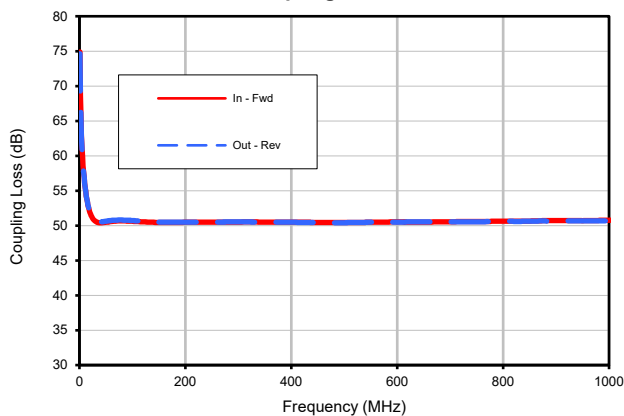
## Typical Performance Curves

DDCH-50-521+

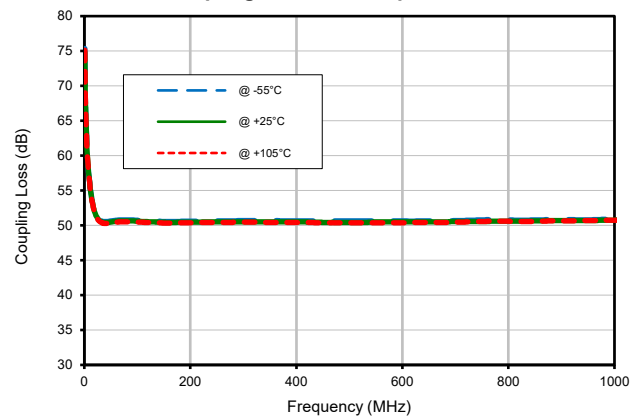
Insertion Loss vs. Temperature



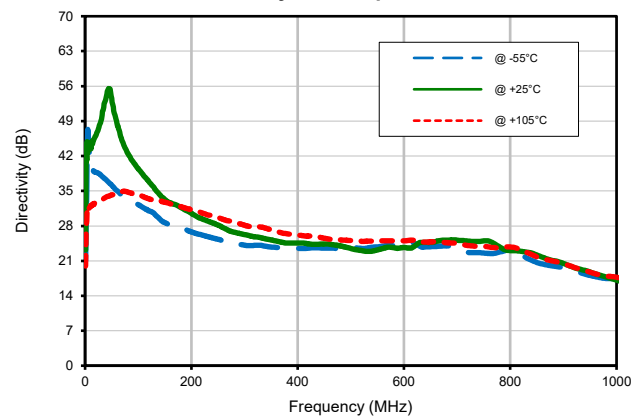
Coupling Loss



Coupling Loss vs. Temperature



Directivity vs. Temperature



### Notes

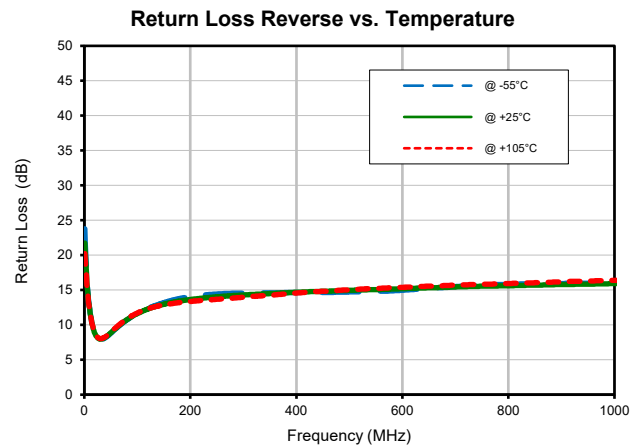
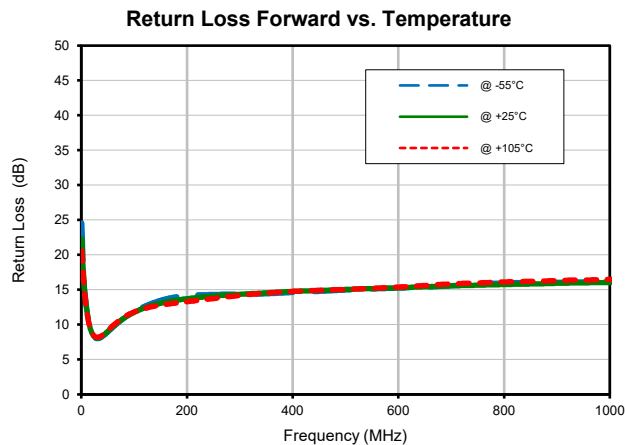
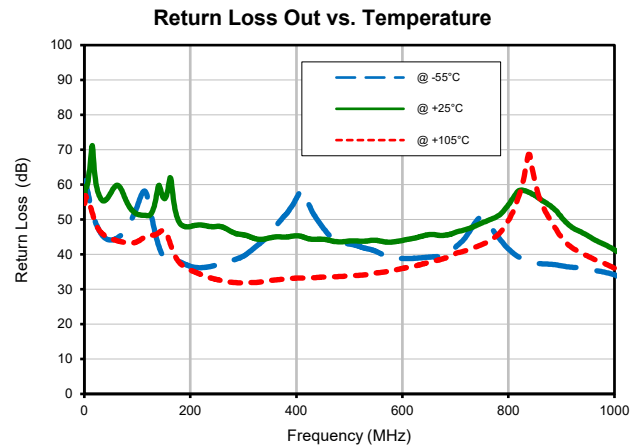
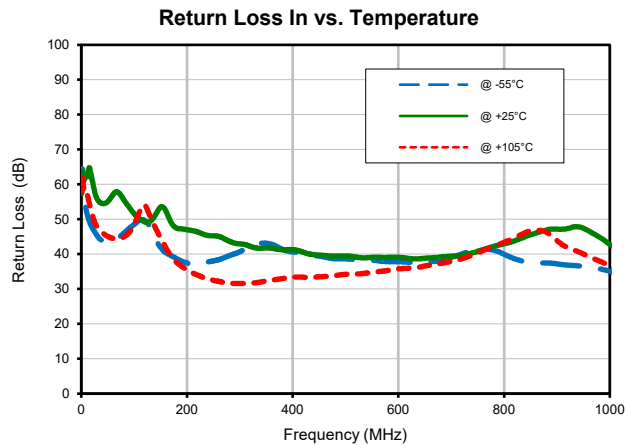
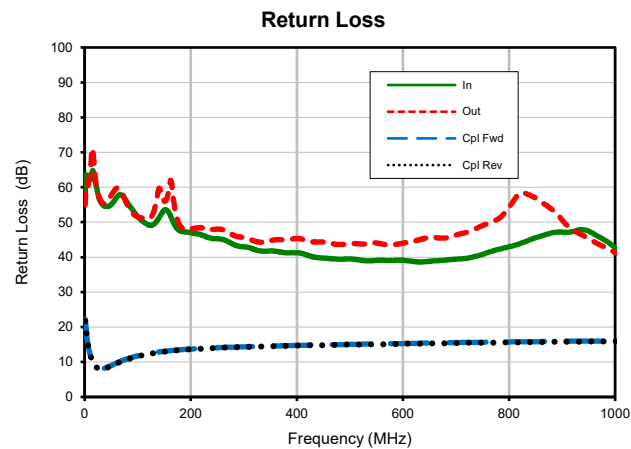
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# Dual-Directional Coupler

# DDCH-50-521+

## Typical Performance Curves (Return Loss)

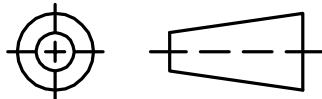


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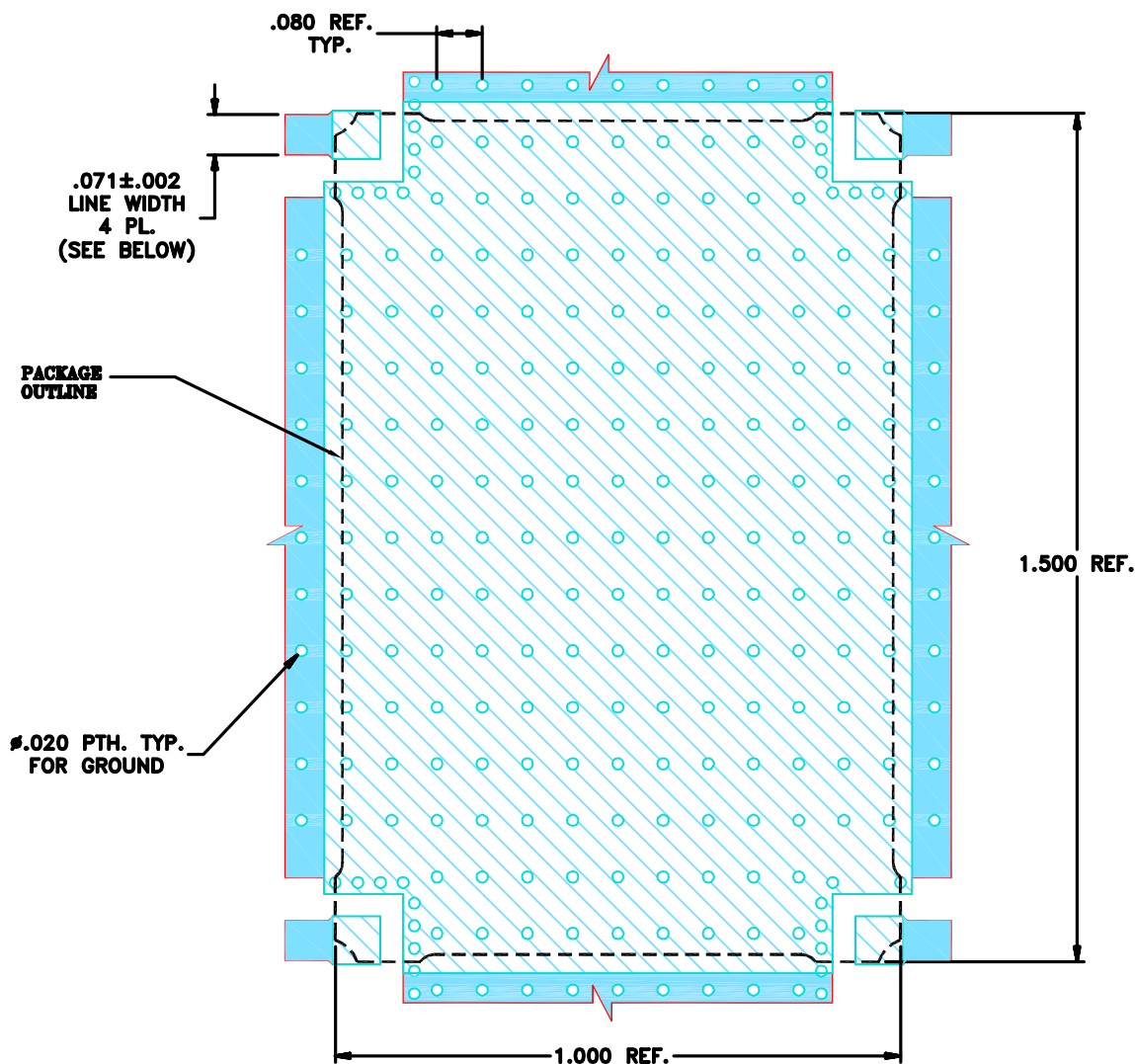
## THIRD ANGLE PROJECTION



## REVISIONS

| REV | ECN No. | DESCRIPTION                           | DATE  | DR | AUTH |
|-----|---------|---------------------------------------|-------|----|------|
| OR  | M153642 | NEW RELEASE                           | 01/16 | DK | YB   |
| A   | M156950 | CHANGE PIN CONNECTION CODE            | 06/16 | DK | YB   |
| B   | M159071 | CH. MATERIAL, DIELECT.THK&COP. WEIGHT | 12/16 | DK | YB   |
| B   | R91223  | CH. MATERIAL, DIELECT.THK&COP. WEIGHT | 12/16 | DK | YB   |

**SUGGESTED MOUNTING CONFIGURATION  
FOR PQ2100 CASE STYLE 04DC01 PIN CONNECTION, 50 OHM**



## NOTES:

- TRACE WIDTH IS SHOWN FOR ROGERS R04003C WITH DIELECTRIC THICKNESS.  $.032 \pm .0015$ ". COPPER: 1 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

## UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

TOLERANCES ON:

2 PL DECIMALS  $\pm$ 3 PL DECIMALS  $\pm .005$ ANGLES  $\pm$ FRACTIONS  $\pm$ 

## INITIALS

## DATE

DRAWN

DK (RAVON)

11 JAN 16

CHECKED

HH (RAVON)

11 JAN 16

APPROVED

YB (RAVON)

11 JAN 16



Mini-Circuits®

13 Neptune Avenue  
Brooklyn NY 11235

**PL, 08DC07, 50, PQ2100, MBD,  
TB-865 (50  $\Omega$ )**

SIZE

A

CODE IDENT

15542

DRAWING NO:

98-PL-471

REV:

B

FILE: 98PL471(B)

SCALE:

3:1

SHEET:

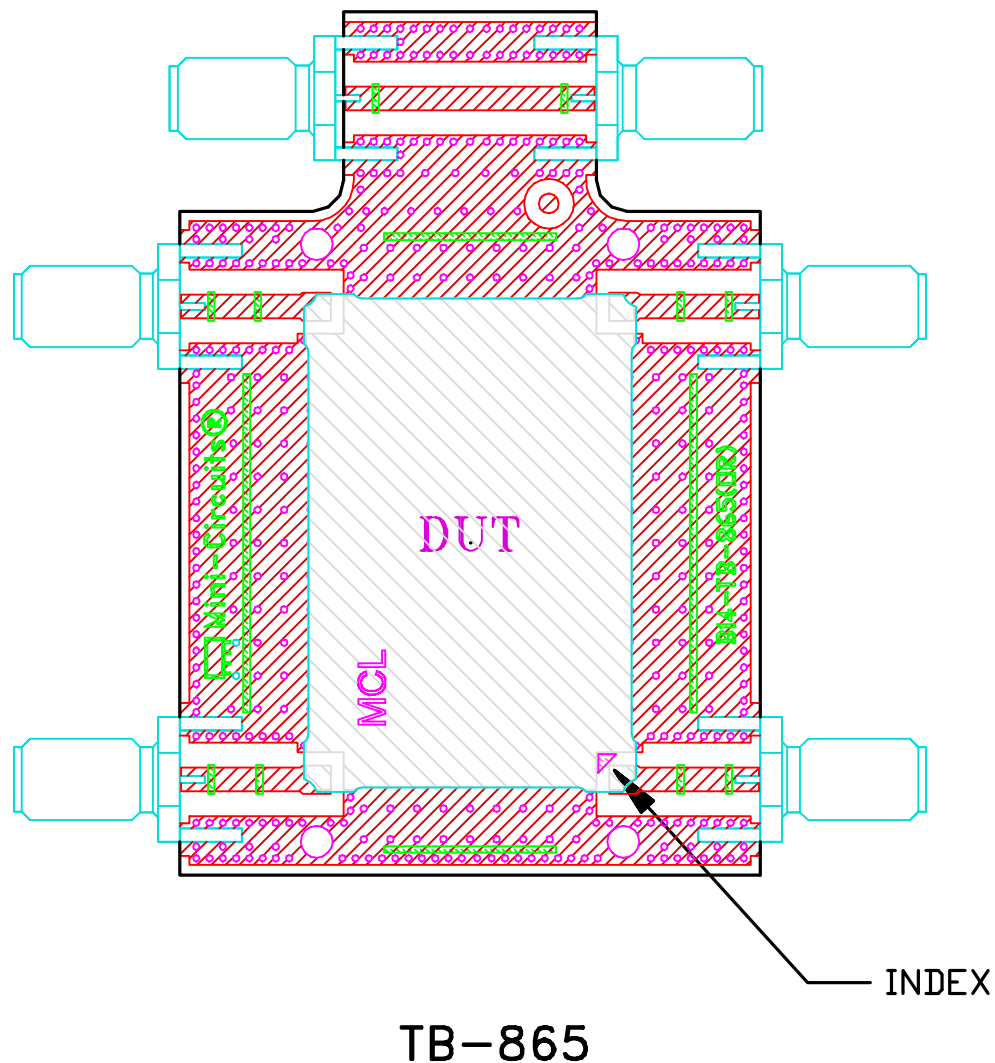
1 OF 1



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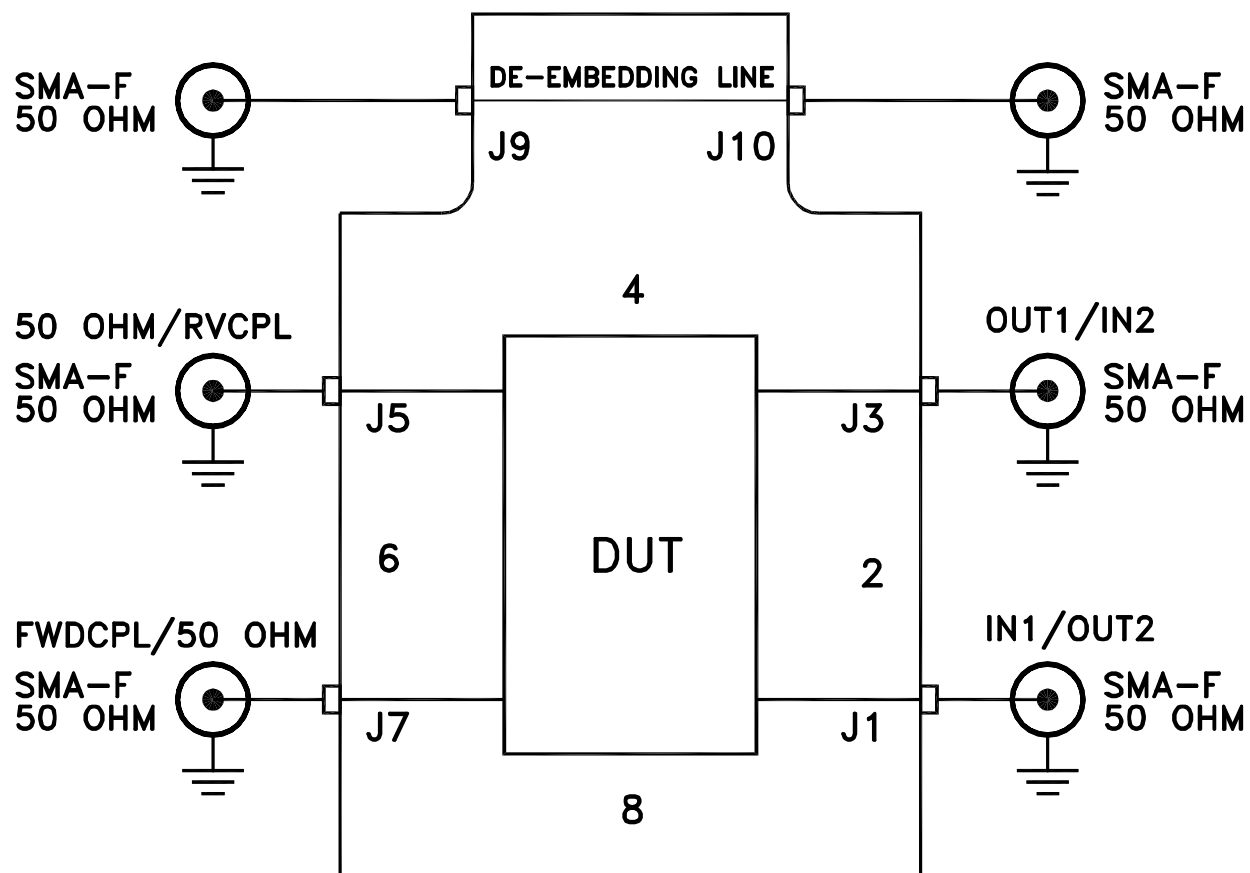
ASHEETA1.DWG REV:A DATE:01/12/95

# Evaluation Board and Circuit



## NOTES:

1. SMA FEMALE CONNECTORS.
2. PCB MATERIAL: ROGERS RO4003C OR EQUIVALENT, DIELECTRIC CONSTANT=3.5, DIELECTRIC THICKNESS=.032 INCH.



TB-865  
Schematic Diagram



All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

| Specification                  | Test/Inspection Condition                                                                                                                                       | Reference/Spec                                                                                       |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| Operating Temperature          | -55° to 105° C<br>Case Environment                                                                                                                              | Individual Model Data Sheet                                                                          |
| Storage Temperature            | -55° to 105°C<br>Ambient Environment                                                                                                                            | Individual Model Data Sheet                                                                          |
| Humidity                       | 90 to 95% RH, 240 hours, 50°C                                                                                                                                   | MIL-STD-202, Method 103, Condition A, Except 50°C and end-point electrical test done within 12 hours |
| Thermal Shock                  | -55° to 100°C, 100 cycles                                                                                                                                       | MIL-STD-202, Method 107, Condition A-3, except +100°C                                                |
| Solder Reflow Heat             | Sn-Pb Eutectic Process 225°C peak<br>Pb-Free Process 245° - 250°C peak                                                                                          | J-STD-020C, Table 4-1, 4-2 and 5-2, Figure 5-1                                                       |
| Solderability                  | 10X Magnification                                                                                                                                               | J-STD-002, Para 4.2.5, Test S, 95% Coverage                                                          |
| Vibration (high Frequency)     | 20g peak, 10-2000 Hz, 12 times in each of three perpendicular directions (total 36)                                                                             | MIL-STD-883, Method 2007.3, Condition A                                                              |
| Mechanical Shock               | 50g, 11 ms, 1/2-sine, 18 shocks: 3 each direction, each of 3 axes                                                                                               | MIL-STD-202, Method 213, Condition A                                                                 |
| Marking Resistance to Solvents | Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C;<br>distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C | MIL-STD-202, Method 215                                                                              |