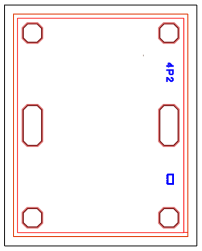
*MMIC*

# Power Splitter/Combiner Die WP4P1-D+

4 Way-0° 50Ω 1525 to 2375 MHz



## The Big Deal

- Wide Bandwidth, 1525 to 2375 MHz
- Excellent Amplitude Unbalance, 0.15 dB typ.

## Product Overview

Mini-Circuits' WP4P1-D+ is a MMIC 4-way 0˚ splitter/combiner Die designed for wideband operation from 1525 to 2375 MHz. Manufactured using Si IPD technology, its compact size saves valuable space in hybrids.

## Key Features

| Feature | Advantages |
|---|---|
| Bandwidth, 1525 to 2375 MHz | One power splitter can be used in many applications, saving component count. |
| Excellent Amplitude Unbalance, 0.15 dB typ. and Good Phase Unbalance, 1 deg. typ. | Excellent Amplitude and phase unbalance helps to accurately divide the input signals which is essential in test and measurement circuits. |
| Unpackaged Die, 0.855 x 1.069 mm | Enables user to integrate it directly into hybrids. Small die size saves space in customer hybrids. |

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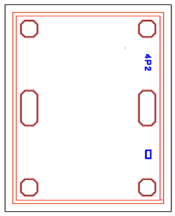


### Product Features

- Wide bandwidth, 1525 to 2375 MHz
- Excellent amplitude unbalance, 0.15 dB typ.

### Applications

- PCS/DCS
- WCDMA
- GPS

***+RoHS Compliant***

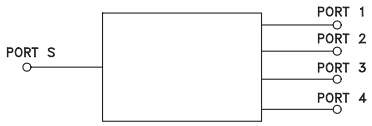
*The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications*

***Ordering Information: Refer to Last Page***

## General Description

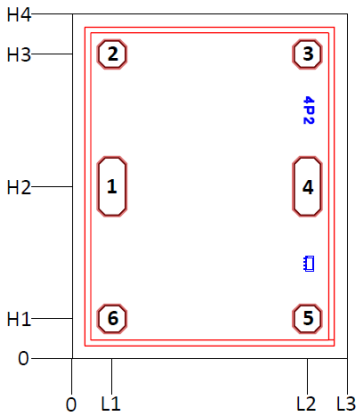
Mini-Circuits' WP4P1-D+ is a MMIC 4-way 0˚ splitter/combiner Die designed for wideband operation from 1525 to 2375 MHz. Manufactured using Si IPD technology, its compact size saves valuable space in hybrids.

## Simplified Schematic and Pad Description




| Pad# | Function |
|---|---|
| 1 | RF IN |
| 2 | RF OUT 1 |
| 3 | RF OUT 2 |
| 5 | RF OUT 3 |
| 6 | RF OUT 4 |
| 4 | Ground |

## Bonding Pad Position




Dimensions in µm, Typical

| L1 | L2 | L3 | H1 | H2 | H3 | H4 | Thickness | Die Size | Pad Size 1 & 4 | Pad Size 2,3,5 & 6 |
|---|---|---|---|---|---|---|---|---|---|---|
| 124 | 731 | 855 | 124 | 534 | 945 | 1069 | 254 | 855x1069 | 82 x 177 | 82 x 82 |

## Electrical Specifications at 25°C[1]

| Parameter | Frequency (MHz) | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Frequency Range | | 1525 | | 2375 | MHz |
| Insertion Loss above 3.0 dB | 1525 - 2375 | | 0.9 | | dB |
| Isolation | 1525 - 2375 | | 26 | | dB |
| Phase Unbalance | 1525 - 2375 | | 2.0 | | Degree |
| Amplitude Unbalance | 1525 - 2375 | | 0.2 | | dB |
| VSWR (Port S) | 1525 - 2375 | | 1.5 | | :1 |
| VSWR (Port 1,2,3,4) | 1525 - 2375 | | 1.4 | | :1 |

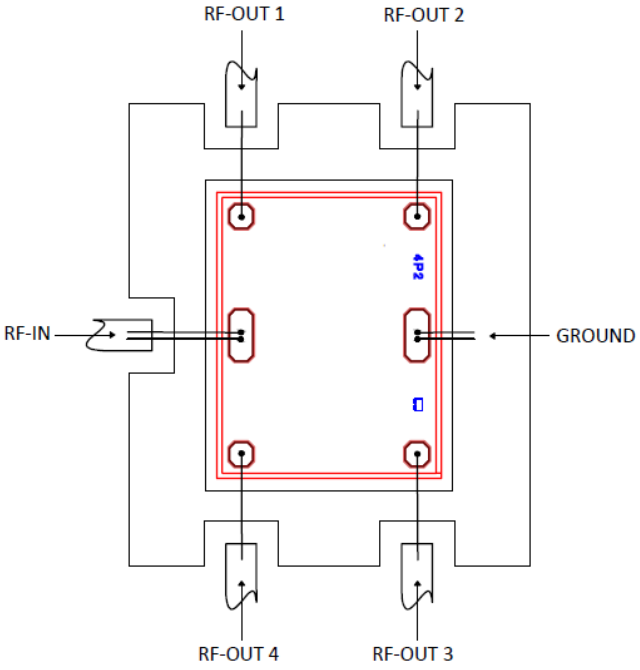
1. Tested in 3x3mm, Mini-Circuits 12-lead MCLP package.

## Maximum Ratings[1,2]

| Parameter | Ratings |
|---|---|
| Operating Temperature | -40°C to 85°C |
| Power Input (as a splitter) | 1.5W |
| Internal Dissipation | 0.375W |

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

## Assembly Diagram




## Assembly and Handling Procedure

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC dice are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be opened in clean room conditions at an appropriately grounded anti-static workstation. Devices need careful handling using correctly designed collets, vacuum pickup tips or sharp antistatic tweezers to deter
   ESD damage to dice.
3. Die Attach
   The Die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are DieMat DM6030HK-PT/H579 or Ablestik 84-1LMISR4. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total Die periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition. It is recommended to use antistatic Die pick up tools only.
4. Wire Bonding
   Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the dice gold bond pads. Thermosonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1 mil diameter. Bonds must be made from the bond pads on the Die to the package or substrate. All bond wires should be kept as short as low as reasonable to minimize performance degradation due to undesirable series inductance.

## Additional Detailed Technical Information

*additional information is available on our dash board.*

| | | |
|---|---|---|
| **Performance Data** | Data Table | |
| | Swept Graphs | |
| | S-Parameter (S5P Files) Data Set with and without port extension(.zip file) | |
| **Case Style** | Die | |
| **Die Ordering and packaging information (Note 5)** | Quantity, Package | Model No. |
| | Small, Gel - Pak: 5,10,50,100 KGD* | WP4P1-DG+ |
| | Medium†, Partial wafer: KGD*<1554 | WP4P1-DP+ |
| | †**Available upon request contact sales representative** | |
| | Refer to AN-60-067 | |
| **Environmental Ratings** | ENV-80 | |

*Known Good Dice ("KGD") means that the dice are taken from PCM good wafer and visually inspected in question have been subjected to Mini-Circuits while this is not definitive, it does help to provide a higher degree of confidence that dice are capable of meeting typical RF electrical parameters specified by Mini-Circuits.

## ESD Rating**

Human Body Model (HBM): Class 1A (Pass 250V) in accordance with ANSI/ESD STM 5.1 - 2001

** Tested in 3x3mm, Mini-Circuits 12-lead MCLP package.

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.

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# 4 Way-0° Power Splitter/Combiner Die WP4P1-D+

## *Typical Performance Data*

TEST CONDITIONS: INPUT POWER = -10dBm @ Temperature = +25°C

| FREQ. (MHz) | TOTAL LOSS[1] (dB) | | | | AMP. UNBAL. (dB) | ISOLATION (dB) | | | PHASE UNBAL. (deg.) |
|---|---|---|---|---|---|---|---|---|---|
| | S-1 | S-2 | S-3 | S-4 | | 1-2 | 2-3 | 3-4 | |
| 1200 | 9.98 | 10.24 | 10.15 | 9.95 | 0.29 | 17.01 | 15.25 | 16.97 | 3.76 |
| 1300 | 8.85 | 9.09 | 9.00 | 8.82 | 0.27 | 18.94 | 16.81 | 18.87 | 3.22 |
| 1400 | 7.99 | 8.21 | 8.12 | 7.97 | 0.25 | 21.67 | 18.89 | 21.52 | 2.75 |
| 1500 | 7.38 | 7.58 | 7.49 | 7.35 | 0.23 | 25.63 | 21.61 | 25.36 | 2.30 |
| 1525 | 7.26 | 7.46 | 7.37 | 7.23 | 0.22 | 26.91 | 22.40 | 26.61 | 2.19 |
| 1575 | 7.07 | 7.25 | 7.16 | 7.04 | 0.21 | 29.98 | 24.11 | 29.61 | 1.98 |
| 1600 | 6.98 | 7.16 | 7.08 | 6.95 | 0.21 | 31.75 | 25.01 | 31.40 | 1.88 |
| 1650 | 6.85 | 7.01 | 6.93 | 6.82 | 0.20 | 34.91 | 26.76 | 35.09 | 1.69 |
| 1675 | 6.80 | 6.95 | 6.87 | 6.76 | 0.19 | 35.19 | 27.49 | 35.99 | 1.60 |
| 1710 | 6.73 | 6.89 | 6.80 | 6.70 | 0.19 | 33.76 | 28.19 | 34.96 | 1.49 |
| 1720 | 6.72 | 6.87 | 6.79 | 6.68 | 0.18 | 33.16 | 28.30 | 34.34 | 1.46 |
| 1740 | 6.69 | 6.84 | 6.76 | 6.66 | 0.18 | 31.91 | 28.38 | 33.00 | 1.39 |
| 1760 | 6.67 | 6.81 | 6.73 | 6.63 | 0.18 | 30.71 | 28.28 | 31.68 | 1.33 |
| 1780 | 6.65 | 6.79 | 6.71 | 6.62 | 0.17 | 29.60 | 28.02 | 30.45 | 1.27 |
| 1800 | 6.64 | 6.77 | 6.69 | 6.60 | 0.17 | 28.61 | 27.64 | 29.36 | 1.21 |
| 1820 | 6.62 | 6.75 | 6.67 | 6.59 | 0.16 | 27.72 | 27.17 | 28.38 | 1.15 |
| 1840 | 6.62 | 6.74 | 6.66 | 6.58 | 0.16 | 26.92 | 26.66 | 27.50 | 1.09 |
| 1860 | 6.61 | 6.73 | 6.65 | 6.58 | 0.16 | 26.20 | 26.13 | 26.72 | 1.03 |
| 1880 | 6.61 | 6.73 | 6.65 | 6.57 | 0.15 | 25.54 | 25.59 | 26.01 | 0.97 |
| 1900 | 6.61 | 6.72 | 6.64 | 6.57 | 0.15 | 24.95 | 25.06 | 25.36 | 0.91 |
| 1920 | 6.61 | 6.72 | 6.64 | 6.58 | 0.15 | 24.40 | 24.55 | 24.78 | 0.86 |
| 1940 | 6.61 | 6.72 | 6.64 | 6.58 | 0.14 | 23.91 | 24.08 | 24.25 | 0.80 |
| 1960 | 6.62 | 6.72 | 6.64 | 6.58 | 0.14 | 23.45 | 23.62 | 23.76 | 0.75 |
| 1980 | 6.63 | 6.73 | 6.64 | 6.59 | 0.13 | 23.03 | 23.19 | 23.31 | 0.69 |
| 2000 | 6.63 | 6.73 | 6.65 | 6.60 | 0.13 | 22.64 | 22.77 | 22.89 | 0.64 |
| 2025 | 6.65 | 6.74 | 6.66 | 6.61 | 0.12 | 22.19 | 22.29 | 22.40 | 0.63 |
| 2050 | 6.66 | 6.75 | 6.67 | 6.63 | 0.12 | 21.79 | 21.84 | 21.97 | 0.64 |
| 2100 | 6.70 | 6.77 | 6.69 | 6.66 | 0.11 | 21.07 | 21.03 | 21.19 | 0.65 |
| 2150 | 6.74 | 6.80 | 6.72 | 6.71 | 0.10 | 20.47 | 20.32 | 20.53 | 0.72 |
| 2200 | 6.78 | 6.84 | 6.75 | 6.75 | 0.09 | 19.94 | 19.70 | 19.97 | 0.85 |
| 2250 | 6.83 | 6.88 | 6.79 | 6.80 | 0.09 | 19.50 | 19.15 | 19.48 | 0.98 |
| 2300 | 6.88 | 6.92 | 6.83 | 6.85 | 0.09 | 19.12 | 18.67 | 19.06 | 1.10 |
| 2350 | 6.93 | 6.96 | 6.87 | 6.90 | 0.09 | 18.78 | 18.23 | 18.69 | 1.24 |
| 2375 | 6.96 | 6.98 | 6.89 | 6.93 | 0.10 | 18.63 | 18.02 | 18.52 | 1.32 |
| 2400 | 6.99 | 7.01 | 6.91 | 6.95 | 0.10 | 18.50 | 17.83 | 18.36 | 1.40 |
| 2500 | 7.09 | 7.10 | 6.99 | 7.06 | 0.11 | 18.01 | 17.15 | 17.82 | 1.72 |
| 2600 | 7.20 | 7.19 | 7.08 | 7.17 | 0.13 | 17.63 | 16.56 | 17.39 | 2.03 |
| 2700 | 7.32 | 7.29 | 7.17 | 7.27 | 0.15 | 17.32 | 16.05 | 17.07 | 2.34 |
| 2800 | 7.42 | 7.37 | 7.25 | 7.37 | 0.18 | 17.06 | 15.60 | 16.81 | 2.65 |
| 3000 | 7.64 | 7.54 | 7.41 | 7.56 | 0.22 | 16.63 | 14.79 | 16.42 | 3.24 |
| 3200 | 7.83 | 7.69 | 7.56 | 7.73 | 0.27 | 16.28 | 14.07 | 16.14 | 3.75 |
| 3400 | 8.00 | 7.82 | 7.70 | 7.88 | 0.30 | 15.95 | 13.39 | 15.89 | 4.25 |
| 3600 | 8.17 | 7.96 | 7.84 | 8.03 | 0.34 | 15.59 | 12.75 | 15.61 | 4.65 |
| 3800 | 8.34 | 8.10 | 7.97 | 8.17 | 0.37 | 15.21 | 12.15 | 15.26 | 5.11 |
| 4000 | 8.50 | 8.27 | 8.12 | 8.32 | 0.39 | 14.78 | 11.60 | 14.81 | 5.63 |
| 4200 | 8.65 | 8.42 | 8.24 | 8.45 | 0.41 | 14.27 | 11.12 | 14.26 | 6.27 |
| 4400 | 8.76 | 8.55 | 8.36 | 8.59 | 0.41 | 13.65 | 10.71 | 13.57 | 7.00 |
| 4600 | 8.86 | 8.67 | 8.47 | 8.66 | 0.39 | 12.90 | 10.36 | 12.82 | 7.74 |
| 4800 | 8.92 | 8.77 | 8.56 | 8.73 | 0.36 | 12.12 | 10.11 | 12.04 | 8.40 |
| 5000 | 8.94 | 8.82 | 8.64 | 8.73 | 0.30 | 11.33 | 9.98 | 11.27 | 8.96 |
| 5200 | 8.91 | 8.86 | 8.70 | 8.73 | 0.21 | 10.61 | 9.97 | 10.55 | 9.35 |
| 5400 | 8.89 | 8.94 | 8.78 | 8.74 | 0.20 | 9.97 | 10.05 | 9.90 | 9.55 |
| 5600 | 8.88 | 9.02 | 8.85 | 8.73 | 0.29 | 9.41 | 10.16 | 9.32 | 9.81 |
| 5800 | 8.86 | 9.13 | 8.93 | 8.77 | 0.37 | 8.93 | 10.25 | 8.82 | 10.22 |

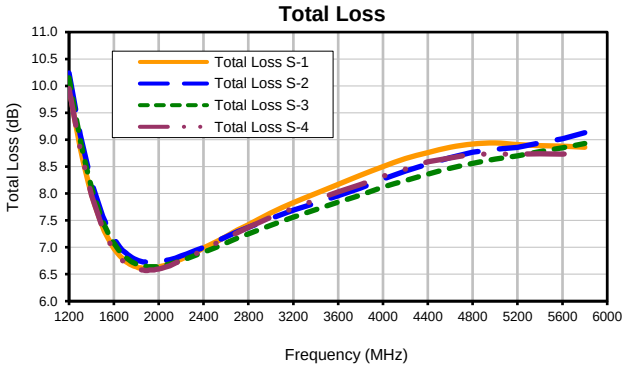
| FREQ. (MHz) | VSWR (:1) | | | | |
|---|---|---|---|---|---|
| | S | 1 | 2 | 3 | 4 |
| 1200 | 4.82 | 1.76 | 1.69 | 1.70 | 1.68 |
| 1300 | 3.51 | 1.70 | 1.64 | 1.65 | 1.63 |
| 1400 | 2.61 | 1.63 | 1.59 | 1.60 | 1.57 |
| 1500 | 2.00 | 1.56 | 1.53 | 1.53 | 1.52 |
| 1525 | 1.88 | 1.55 | 1.51 | 1.52 | 1.50 |
| 1575 | 1.68 | 1.52 | 1.48 | 1.49 | 1.48 |
| 1600 | 1.58 | 1.50 | 1.47 | 1.48 | 1.47 |
| 1650 | 1.42 | 1.48 | 1.44 | 1.45 | 1.44 |
| 1675 | 1.36 | 1.47 | 1.43 | 1.44 | 1.43 |
| 1710 | 1.27 | 1.45 | 1.41 | 1.42 | 1.41 |
| 1720 | 1.25 | 1.45 | 1.41 | 1.42 | 1.41 |
| 1740 | 1.22 | 1.44 | 1.40 | 1.41 | 1.40 |
| 1760 | 1.18 | 1.43 | 1.39 | 1.40 | 1.39 |
| 1780 | 1.16 | 1.43 | 1.38 | 1.39 | 1.39 |
| 1800 | 1.14 | 1.42 | 1.38 | 1.38 | 1.38 |
| 1820 | 1.13 | 1.42 | 1.37 | 1.38 | 1.37 |
| 1840 | 1.13 | 1.41 | 1.36 | 1.37 | 1.37 |
| 1860 | 1.14 | 1.41 | 1.36 | 1.36 | 1.36 |
| 1880 | 1.16 | 1.40 | 1.35 | 1.36 | 1.35 |
| 1900 | 1.18 | 1.40 | 1.34 | 1.35 | 1.35 |
| 1920 | 1.21 | 1.40 | 1.34 | 1.35 | 1.34 |
| 1940 | 1.24 | 1.40 | 1.34 | 1.34 | 1.34 |
| 1960 | 1.27 | 1.39 | 1.33 | 1.34 | 1.33 |
| 1980 | 1.30 | 1.39 | 1.33 | 1.33 | 1.33 |
| 2000 | 1.33 | 1.39 | 1.32 | 1.33 | 1.32 |
| 2025 | 1.37 | 1.39 | 1.32 | 1.32 | 1.32 |
| 2050 | 1.41 | 1.39 | 1.31 | 1.32 | 1.32 |
| 2100 | 1.49 | 1.39 | 1.31 | 1.31 | 1.31 |
| 2150 | 1.57 | 1.39 | 1.30 | 1.31 | 1.30 |
| 2200 | 1.65 | 1.39 | 1.30 | 1.30 | 1.30 |
| 2250 | 1.73 | 1.39 | 1.30 | 1.30 | 1.30 |
| 2300 | 1.80 | 1.39 | 1.30 | 1.30 | 1.30 |
| 2350 | 1.88 | 1.40 | 1.30 | 1.30 | 1.29 |
| 2375 | 1.92 | 1.40 | 1.29 | 1.30 | 1.29 |
| 2400 | 1.95 | 1.40 | 1.29 | 1.30 | 1.29 |
| 2500 | 2.09 | 1.41 | 1.30 | 1.29 | 1.29 |
| 2600 | 2.24 | 1.41 | 1.30 | 1.29 | 1.29 |
| 2700 | 2.37 | 1.41 | 1.29 | 1.29 | 1.29 |
| 2800 | 2.48 | 1.42 | 1.29 | 1.28 | 1.29 |
| 3000 | 2.71 | 1.41 | 1.28 | 1.27 | 1.28 |
| 3200 | 2.91 | 1.39 | 1.26 | 1.25 | 1.26 |
| 3400 | 3.07 | 1.37 | 1.24 | 1.23 | 1.24 |
| 3600 | 3.24 | 1.35 | 1.22 | 1.21 | 1.23 |
| 3800 | 3.42 | 1.33 | 1.21 | 1.21 | 1.23 |
| 4000 | 3.62 | 1.32 | 1.22 | 1.22 | 1.25 |
| 4200 | 3.80 | 1.32 | 1.26 | 1.25 | 1.28 |
| 4400 | 3.94 | 1.33 | 1.32 | 1.30 | 1.33 |
| 4600 | 4.10 | 1.37 | 1.42 | 1.38 | 1.42 |
| 4800 | 4.22 | 1.42 | 1.54 | 1.47 | 1.52 |
| 5000 | 4.28 | 1.49 | 1.67 | 1.60 | 1.65 |
| 5200 | 4.29 | 1.58 | 1.82 | 1.75 | 1.82 |
| 5400 | 4.34 | 1.68 | 1.99 | 1.92 | 1.99 |
| 5600 | 4.39 | 1.79 | 2.15 | 2.09 | 2.17 |
| 5800 | 4.45 | 1.88 | 2.29 | 2.24 | 2.34 |

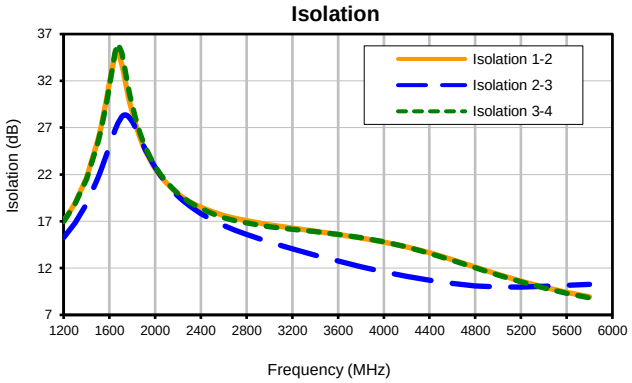
[1]Total Loss = Insertion Loss + 6dB Splitter Loss

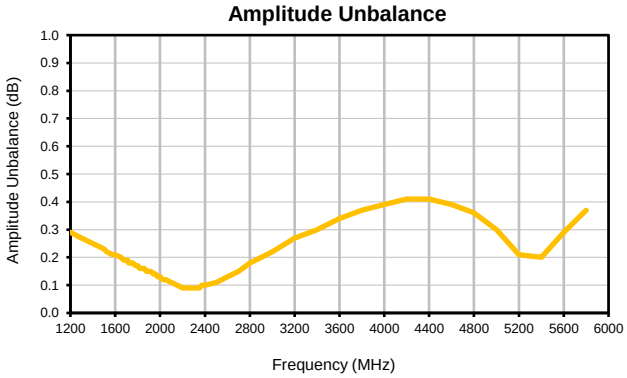
Note: Test data of Die packaged in industry standard, 3x3 mm, 12-lead MCLP package

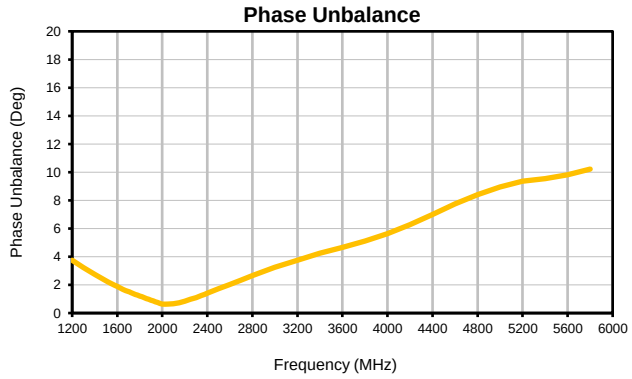
# 4 Way-0° Power Splitter/Combiner Die WP4P1-D+

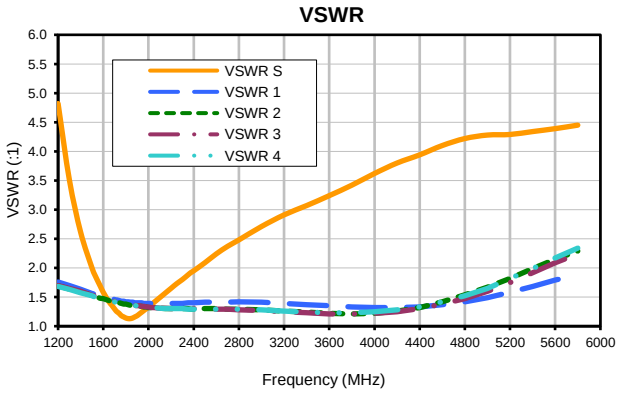
*Typical Performance Curves*




Note: Test data of Die packaged in industry standard, 3x3 mm, 12-lead MCLP package

Mini-Circuits

# Environmental Specifications ENV80

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 | -40° to 85° C or -40° to 105° C or -55° to 105° C or -45° to 105° C<br>Ambient Environment | Refer to Individual Model Data Sheet |
| Storage Environment (Die) | -65° to 150°C | Individual Model Data Sheet |
| Storage Environment(Packaging) | -40° to 70°C and 40 to 60% humidity (In Factory Shipped Package) | |