## The Big Deal

- Low insertion loss, 2.2 dB typ.
- Wide phase shift, $360^{\circ}$


CASE STYLE: HU1371

- Low frequency and small size


## Product Overview

Mini-Circuits' SCPHS-180+ is a voltage variable phase shifter providing $360^{\circ}$ phase control from 90 to 180 MHz in a miniature surface mount package. This model has a control bandwidth of DC to 30 kHz and a control voltage range from 0 to +10 V . Housed in a shielded, 12-lead package with wrap-around terminations, the unit measures only $0.87 \times 0.80 \times 0.25^{\prime \prime}$, offering a space-efficient, low-cost alternative to larger, expensive connectorized phase shifters typical for low frequency operation.

| Feature |  |
| :--- | :--- |
| Low insertion loss, 2.2 dB typ. | Enables good transmission of signal power from input to output and minimizes effect on system noise <br> figure. |
| Wide phase shift, $360^{\circ}$ | In test environments, $360^{\circ}$ phase control allows the user to experiment with various incident phases. This <br> can be used to test residual phase noise of amplifiers and to determine the influence of phase between <br> two mismatched components in a system. |
| Low frequency operation and tiny size, <br> $0.87 \times 0.80 \times 0.25 "$ | Typically, lower frequency phase shifters are large, connectorized designs. SCPHS-180+ provides low <br> frequency phase shift capability in a tiny surface mount package, saving space and reducing system cost. |

## Phase Shifter

## $50 \Omega \quad 360^{\circ}$ Voltage Variable $\quad 90$ to 180 MHz

Maximum Ratings

| Operating Temperature | $-40^{\circ} \mathrm{C}$ to $85^{\circ} \mathrm{C}$ |
| :--- | ---: |
| Storage Temperature | $-55^{\circ} \mathrm{C}$ to $100^{\circ} \mathrm{C}$ |
| RF Input Power | $24 \mathrm{dBm} \mathrm{max}$. |
| Control Voltage | 15 V |
| Permanent damage may occur if any of these limits are exceeded. |  |

Pin Connections

| IN | 1 |
| :--- | ---: |
| OUT | 6 |
| BIAS | $10,11 \wedge$ |
| GROUND | $2,3,4,5,7,8,9,12,13,14$ |
| A proper operation is achieved with pins 10 or 11 or |  |

$\wedge$ proper operation is achieved with pins 10 or 11 or both connected to BIAS.


Outline Dimensions ( $\left.\begin{array}{c}\text { inch } \\ \mathrm{mm}\end{array}\right)$

| A | B | C | D | E | F | G | H |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| .870 | .800 | .250 | .100 | .097 | - | .060 | .040 |
| 22.10 | 20.32 | 6.35 | 2.54 | 2.46 | - | 1.52 | 1.02 |
| J | K | L | M | N | P |  | wt |
| .105 | .910 | - | .060 | .060 | - |  | grams |
| 2.67 | 23.11 | - | 1.52 | 1.52 | - |  | 2.85 |

Demo Board MCL P/N: TB-1141+ Suggested PCB Layout (PL-690)

ackage

OTES:
TRACE WIDTH IS SHOWN FOR ROGERS ROA350B WITH DIELECTRIC THICKNESS
.O30土.002"; COPPER: 1/2 OZ. EACH SIDE
FOR OTHER MATERALS TRACE WITH MAY NEED TO BE MODIFIED.
BOTTOM SIDE OF THE PCB IS CONTNUOUS GROUND
$\square$ denotes pce copper layout with smobc (solder mask over bare copper).
denotes copper land patiern free of solder mask.

Features

- low insertion loss, 2.2 dB typ.
- wide phase shift, $360^{\circ}$
- aqueous washable


## Applications

- FM Broadcast
- Aircraft Communication
- VHF


Generic photo used for illustration purposes only
CASE STYLE: HU1371
+RoHS Compliant
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Electrical Specifications at $25^{\circ} \mathrm{C}$

| Parameter | Condition (MHz) | Min. | Typ. | Max. | Unit |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Frequency Range |  | 90 |  | 180 | MHz |
| Phase Range | $90-180$ | 360 | - | - | Degrees |
| Insertion Loss | $90-180$ | - | 2.2 | 5 | dB |
| Control Voltage | $90-180$ | - | $0-10$ | - | V |
| Control Bandwidth | $90-180$ | - | $\mathrm{DC}-30$ | - | kHz |
| VSWR | $90-180$ | - | 1.7 | - | $: 1$ |

DC input resistance at Control port: 1460 ohms typ.
Typical Performance Data

| Control Voltage (V) | Phase Shift* (Degrees) |  |  | VSWR <br> (:1) |  |  | Insertion Loss (dB) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} 90 \\ \text { MHz } \end{gathered}$ | $135$ | $180$ | $\begin{gathered} 90 \\ \text { MHz } \end{gathered}$ | $\begin{aligned} & 135 \\ & \mathrm{MHz} \end{aligned}$ | $\begin{aligned} & 180 \\ & \mathrm{MHz} \end{aligned}$ | $\begin{gathered} 90 \\ \mathrm{MHz} \end{gathered}$ | $\begin{aligned} & 135 \\ & \mathrm{MHz} \end{aligned}$ | $\begin{aligned} & 180 \\ & \mathrm{MHz} \end{aligned}$ |
| 0 | 0.0 | 0.0 | 0.0 | 1.4 | 1.8 | 2.1 | 1.9 | 2.1 | 2.9 |
| 1 | 37.5 | 12.4 | 4.9 | 1.9 | 1.7 | 2.2 | 2.4 | 2.1 | 3.0 |
| 2 | 94.8 | 32.8 | 12.3 | 2.1 | 1.6 | 2.3 | 2.8 | 2.1 | 3.2 |
| 3 | 195.8 | 80.3 | 27.1 | 1.5 | 1.2 | 2.5 | 2.5 | 2.1 | 3.5 |
| 4 | 326.1 | 212.1 | 69.0 | 1.2 | 1.2 | 2.6 | 1.8 | 2.6 | 4.1 |
| 5 | 395.9 | 374.3 | 182.8 | 1.6 | 1.6 | 1.2 | 2.2 | 2.5 | 3.6 |
| 6 | 419.0 | 442.1 | 325.7 | 1.8 | 1.3 | 1.0 | 2.0 | 1.9 | 3.2 |
| 7 | 428.9 | 467.8 | 407.7 | 2.0 | 1.2 | 2.0 | 2.0 | 1.7 | 3.2 |
| 8 | 434.1 | 480.6 | 444.4 | 2.1 | 1.1 | 2.2 | 2.1 | 1.6 | 3.0 |
| 9 | 437.2 | 488.2 | 464.7 | 2.1 | 1.1 | 2.1 | 2.1 | 1.6 | 2.8 |
| 10 | 439.2 | 493.1 | 477.3 | 2.2 | 1.1 | 2.0 | 2.1 | 1.6 | 2.7 |

* Normalized at control voltage $=0 \mathrm{~V}$


SCPHS-180+ INSERTION LOSS


SCPHS-180+


Electrical Schematic


| CONTROL <br> VOLTAGE <br> (V) | PHASE SHIFT* <br> (Deg.) |  |  | VSWR <br> (:1) |  |  |  | INSERTION LOSS |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\mathbf{9 0} \mathbf{~ M H z}$ | $\mathbf{1 3 5} \mathbf{~ M H z}$ | $\mathbf{1 8 0} \mathbf{~ M H z}$ | $\mathbf{9 0 ~ M H z}$ | $\mathbf{1 3 5} \mathbf{~ M H z}$ | $\mathbf{1 8 0} \mathbf{~ M H z}$ | $\mathbf{9 0} \mathbf{~ M H z}$ | $\mathbf{1 3 5} \mathbf{~ M H z}$ | $\mathbf{1 8 0} \mathbf{~ M H z}$ |  |
| 0 | 0.00 | 0.00 | 0.00 | 1.41 | 1.79 | 2.11 | 1.93 | 2.09 | 2.91 |  |
| 1 | 37.50 | 12.41 | 4.89 | 1.87 | 1.71 | 2.18 | 2.38 | 2.10 | 3.01 |  |
| 2 | 94.76 | 32.84 | 12.26 | 2.12 | 1.56 | 2.29 | 2.79 | 2.09 | 3.16 |  |
| 3 | 195.76 | 80.28 | 27.10 | 1.46 | 1.16 | 2.48 | 2.51 | 2.11 | 3.47 |  |
| 4 | 326.11 | 212.07 | 68.99 | 1.24 | 1.17 | 2.62 | 1.82 | 2.57 | 4.07 |  |
| 5 | 395.90 | 374.31 | 182.81 | 1.56 | 1.64 | 1.15 | 2.17 | 2.46 | 3.60 |  |
| 6 | 419.04 | 442.14 | 325.70 | 1.85 | 1.30 | 1.04 | 1.99 | 1.85 | 3.19 |  |
| 7 | 428.93 | 467.80 | 407.67 | 2.01 | 1.16 | 2.01 | 2.01 | 1.68 | 3.24 |  |
| 8 | 434.06 | 480.58 | 444.42 | 2.09 | 1.11 | 2.17 | 2.06 | 1.61 | 3.05 |  |
| 9 | 437.19 | 488.17 | 464.75 | 2.15 | 1.08 | 2.08 | 2.10 | 1.58 | 2.83 |  |
| 10 | 439.25 | 493.08 | 477.35 | 2.18 | 1.07 | 1.97 | 2.12 | 1.56 | 2.66 |  |

*Normalized at control voltage $=0 \mathrm{~V}$




## Case Style

## Outline Dimensions



## PCB Land Pattern



Suggested Layout, Tolerance to be within $\pm .002$

| CASE\# | A | B | C | D | E | F | G | H | J | K | L | M | N | P | WT, <br> GRAM |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| HU1371 | .870 <br> $(22.10)$ | .800 <br> $(20.32)$ | (6.35) | .100 <br> $(2.54)$ | .097 <br> $(2.46)$ | - | - | .060 | .040 | .105 | .910 | - | .060 | .060 | - |
| $(1.52)$ | $(1.02)$ | $(2.67)$ | $(23.11)$ | - | $(1.52)$ | $(1.52)$ | - | 2.85 |  |  |  |  |  |  |  |

Dimensions are in inches (mm). Tolerances: 2PL. +/- .03; 3PL. +/- . 015
Notes:

1. Case material: Nickel-Silver alloy.
2. Base: Printed wiring laminate.
3. Termination finish:

For RoHS Case Styles: 2-5 $\mu$ inch (.05-. 13 microns) Gold over .120-. $240 \mu$ inch (3.05-6.10 microns) Nickel plate. All models (+) suffix.
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs \& shopping online see Mini-Circuits web site

The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com RFIIF MICROWAVE COMPONENTS

## Tape \& Reel Packaging TR-F21

DEVICE ORIENTATION IN T\&R


DIRECTION OF FEED

| Tape Width, <br> $\mathbf{m m}$ | Device Cavity <br> Pitch, $\mathbf{m m}$ | Reel Size, <br> inches | Devices per Reel |
| :---: | :---: | :---: | :---: |
| 32 | 32 | 13 | 200 |

Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

Go to: www.minicircuits.com/pages/pdfs/tape.pdf

THIRD ANGLE PROJECTION

| REVISIONS |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| REV | ECN No. | DESCRIPTION | DATE | DR | AUTH |
| OR | ECO-003790 | NEW RELEASE | $08 / 24 / 20$ | ITG | IL |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

## SUGGESTED MOUNTING CONFIGURATION FOR

HU1371 CASE STYLE


## NOTES:

1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .030土.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.

| UNLESS OTHERWISE SPECIFIED | DRAWN |  | date |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| DIMENSIONS ARE IN INCHES <br> TOLERANCES ON: <br> 2 PL DECIMALS $\pm$ <br> 3 PL DECIMALS $\pm .005$ <br> ANGLES $\pm$ <br> FRACTIONS $\pm$ |  |  | $\begin{aligned} & \hline 08 / 24 / 20 \\ & \hline 08 / 24 / 20 \\ & \hline \end{aligned}$ |  |  |  |  |  |  |  |  |
|  | $\begin{array}{\|l\|} \hline \text { CHECKED } \\ \hline \text { APPROVED } \\ \hline \end{array}$ | GF |  |  |  |  |  |  |  |  |  |
|  |  |  | 08/24/20 | PL, HU1371, TB-1141+ |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| $\square$ Mini-Circuits ${ }^{\circledR}$ <br> THIS DOCUMENT AND ITS CONTENTS ARE THE PROPERTY OF MINI-CIRCUITS. <br> EXCEPT FOR USE EXPRESSLY GRANTED, IN WRITING, TO ITS VENDORS, VENDEE <br> AND THE UNITED STATES GOVERNMENT, MINI-CIRCUITS RESERVES ALL PROPRIETARY DESIGN, USE, MANUFACTURING AND REPRODUCTION RIGHTS THEREEO. THESE CONTENTS SHALL NOT BE USED, DUPLICATED OR DISCLOSED TO ANY OUTSIDE THEEE CONTENTS SHAL NO BE USED, DUPLCATED OR DISCLOSED TO ANY OUTS PARTY, IN WHOLE OR IN PART, WITHOUT WRITTEN PERMISSION OF MIN-CIRCUITS. |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  | SIZE A | $\begin{aligned} & \hline \text { CODE IDENT } \\ & 15542 \end{aligned}$ | DRAWI | $\stackrel{N}{N} \mathbf{9} \text { : } 8-\mathrm{P}]$ | $-690$ |  |  | OR |
|  |  |  |  | FILE: | 98PL690 | SCALE: | 2.5:1 | SHEET: | 1 | OF | 1 |

## Evaluation Board and Circuit



TB-1141 +


Schematic Diagram

## Notes:

1. 50 Ohm SMA Female connectors.
2. PCB Material: RO4350 or equivalent.

Dielectric Constant=3.5, Thickness=.030 inch. $\quad \square$ Mini-Circuits ${ }^{\circledR}$

## WMini-Circuits

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 | $-40^{\circ} \text { to } 85^{\circ} \mathrm{C}$ <br> Ambient Environment | Individual Model Data Sheet |
| Storage Temperature | $-55^{\circ} \text { to } 100^{\circ} \mathrm{C}$ <br> Ambient Environment | Individual Model Data Sheet |
| Humidity | 90 to $95 \%$ RH, 240 hours, $50^{\circ} \mathrm{C}$ | MIL-STD-202, Method 103, Condition A, Except $50^{\circ} \mathrm{C}$ and end-point electrical test done within 12 hours |
| Thermal Shock | $-55^{\circ}$ to $100^{\circ} \mathrm{C}, 100$ cycles | MIL-STD-202, Method 107, Condition A-3, except $+100^{\circ} \mathrm{C}$ |
| Solder Reflow Heat | Sn-Pb Eutetic Process: $225^{\circ} \mathrm{C}$ peak Pb -Free Process $245^{\circ}-250^{\circ} \mathrm{C}$ peak | J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1 |
| Solderability | 10X Magnification | J-STD-002, 95\% Coverage |
| Vibration (High Frequency) | 20 g peak, $10-2000 \mathrm{~Hz}$, 12 times in each of three perpendicular directions (total 36) | MIL-STD-202, Method 204, Condition D |
| Mechanical Shock | $50 \mathrm{~g}, 11 \mathrm{~ms}, 1 / 2$-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 $25^{\circ} \mathrm{C}$; terpene defluxer at $25^{\circ} \mathrm{C}$; <br> distilled water + proylene glycol monomethyl ether + monoethanolamine at $63^{\circ} \mathrm{C}$ to $70^{\circ} \mathrm{C}$ | MIL-STD-202, Method 215 |
| ENV02T1 Rev: B 02/25/11 M130240 File: ENV02T1.pdf This document and its contents are the property of Mini-Circuits. |  | Page: 1 |
|  |  |  |

