



TEST DATA

ON

1.0 TO 2.0 GHz

(Other Frequencies Available from 100 MHz to 18.0 GHz
in Octave and Sub-Octave Bands)

8 Bit, DIGITALLY CONTROLLED

360°, ANALOG PHASE SHIFTER

PMI MODEL No:

PS-12-360-QQ1470

Serial Numbers: PM310103 & PM310104

DESIGNED & TESTED BY
STEPHEN KUHN

REPORTED BY
P. WOOD

OCTOBER 15, 2003

PLANAR MONOLITHICS INDUSTRIES, INC., 7311-G GROVE ROAD, FREDERICK, MD 21704

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TABLE OF CONTENTS

| DESCRIPTION | PAGE |
|---|------------|
| ● SPECIFICATIONS | 3 |
| ● PHOTOGRAPH | 3 |
| ● ENVIRONMENTAL RATINGS | 4 |
| ● CONTROL CONNECTOR PIN OUT | 4 |
| ● PRODUCT FEATURE | 5 |
| ● MECHANICAL OUTLINE | 6 |
| ● FUNCTIONAL BLOCK DIAGRAM | 7 |
| ● PERFORMANCE OVER FREQUENCY AND TEMPERATURE | 8 THRU 24 |
| ● PHASE SHIFTER RESPONSE TIME (SWITCHING SPEED) | 25 THRU 29 |
| ● TEST DATA AS PRESENTED TO CUSTOMER | 30 THRU 32 |

This Test Report is on only one example of the Phase Shifter products produced by Planar Monolithics Industries, Inc. Various models are available including Octave and Sub-octave frequency ranges from 0.1 to 18.0 GHz as well as Analog and Digital variants including I & Q Vector Modulators. The sizes of the units vary widely according to frequency of operation and model type. Please contact the factory with your requirements and speak with one of PMI's Applications Engineers.

1.0 TO 2.0 GHz, 360 DEGREE, ANALOG PHASE SHIFTER WITH DIGITAL CONTROL, PMI MODEL No: PS-12-360-QQ1470

KEY FEATURES:

- **1.0 TO 2.0 GHz**
(Other Frequencies to 18 GHz Available)
- **0° TO 360° PHASE SHIFT**
- **200nS HIGH SPEED**
- **TTL LOGIC**
- **LOW LOSS**



SPECIFICATIONS:

- **FREQUENCY RANGE** : **1.0 TO 2.0 GHz**
(Other Frequencies to 18 GHz Available)
- **INSERTION LOSS** : **5.5 dB Max. @ 25°C**
6.0 dB Max. @ 85°C
- **VSWR** : **2.0:1 Max. Input and Output**
- **RF INPUT POWER OPERATING** : **10 mW Peak or CW**
- **PHASE SHIFT** : **360° Minimum**
- **PHASE SHIFT FLATNESS** : **±15% Over Frequency**
- **LOGIC INPUT** : **TTL Control**
- **TEMPERATURE COMPENSATION** : **Maximum Phase Drift shall be no more than ±5° or ±5%, whichever is greater, over the specified temperature range.**
- **STEP SIZE** : **1.41° (LSB)**
- **AMPLITUDE RIPPLE** : **±1.5 dB Max.**
- **SWITCHING SPEED** : **200 nS**
- **DC POWER SUPPLY** : **+15 vdc @ 90 mA with 8 bit Control set High**
-15 vdc @ 60 mA with 8 bit Control set High
- **CONNECTORS** : **RF In/Out SMA Female**
DC & Control 15 Pin "D" Subminiature
- **SIZE** : **7.75" X 2.50" X 1.00"**

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ENVIRONMENTAL RATINGS

- TEMPERATURE : -40°C TO +85°C (Operating)
: -40°C TO +100°C (Storage)
- HUMIDITY : MIL-STD-202F, METHOD 103B, CONDITION B
- SHOCK : MIL-STD-202F, METHOD 213B, CONDITION B
- VIBRATION : MIL-STD-202F, METHOD 204D, CONDITION B
- ALTITUDE : MIL-STD-202F, METHOD 105C, CONDITION B
- TEMPERATURE CYCLE : MIL-STD-202F, METHOD 107D, CONDITION A

MIL-STD-883 ENVIRONMENTAL RATINGS ALSO AVAILABLE CONTACT FACTORY FOR INFORMATION

| PIN OUT | |
|---------|--------------|
| PIN ID | FUNCTION |
| 1 | 1.41° (LSB) |
| 2 | 2.8° |
| 3 | 5.6° |
| 4 | 11.2° |
| 5 | 22.5° |
| 6 | 45.0° |
| 7 | 90.0° |
| 8 | 180.0° (MSB) |
| 9 | N/C |
| 10 | N/C |
| 11 | N/C |
| 12 | N/C |
| 13 | + 15 VDC |
| 14 | - 15 VDC |
| 15 | GROUND |

| THE EIGHT CONTROL BITS ARE REPRESENTED AS HEXADECIMAL NUMBERS. | | |
|--|------------------|------------------|
| APPROXIMATE PHASE VALUE | TTL CONTROL BITS | HEXADECIMAL CODE |
| 0 | 0000 0000 | 00H |
| 45 | 0000 0010 | 20H |
| 90 | 0000 0100 | 40H |
| 135 | 0000 0110 | 60H |
| 180 | 0000 1000 | 80H |
| 225 | 0000 1010 | A0H |
| 270 | 0000 1100 | C0H |
| 315 | 0000 1110 | E0H |
| 360 | 1111 1111 | FFH |



PRODUCT FEATURE

| REVISIONS | | DATE | APPROVED |
|-----------|--------------|----------|----------|
| ZONE | DESCRIPTION | 08-16-03 | |
| | JOB# P21234E | | |

DESCRIPTION

PMI MODEL NUMBER PS-12-360 IS A 1 TO 2GHZ DIGITALLY CONTROLLED ANALOG PHASE SHIFTER WITH CAPABILITY FOR PHASE SHIFTING FROM 0 TO 360°. THE UNIT CONSISTS OF AN ANALOG PHASE SHIFTER AND A DIGITAL-TO-ANALOG CONVERTER. EIGHT LOGIC INPUT LINES ALLOW 256 DISCRETE VALUES OF PHASE.

SPECIFICATIONS

- FREQUENCY RANGE..... 1 TO 2 GHz (AVAILABLE UP TO 18 GHz)
- RF IMPEDANCE -(NOMINAL)..... 50 OHMS
- VOLTAGE..... +15V @ 90 mA
- LOGIC INPUT..... TTL CONTROL
- PHASE SHIFT (MIN)..... 360°
- STEP SIZE (LSB)..... 1.41° LSB
- INSERTION LOSS (MAX)..... 5.5 dB MAX @ 25°C
- AMPLITUDE RIPPLE MAX..... 6.0 dB MAX @ 85°C
- VSWR MAX..... ±1.50 DB
- SWITCHING SPEED..... 2.0 TO 1 MAX INPUT AND OUTPUT
- TEMPERATURE COMPENSATION..... 200 NS
- MONOTONICITY..... GUARANTEED
- RF POWER (OPERATING)..... PEAK OR CONTINUOUS WAVE10 mW

CONNECTORS

- RF INPUT/OUTPUT..... SMA FEMALE
- POWER AND CONTROLS..... MALE 15 PIN SUBMINIATURE "D" CONNECTOR
- SIZE..... 7.75 x 2.50 x 1.00

ENVIRONMENTAL RATINGS

- TEMPERATURE..... -40° C TO +85° C (OPERATING)
-40° C TO +100° C (STORAGE)
- HUMIDITY..... MIL-STD-202F, METHOD 103B COND. B
- SHOCK..... MIL-STD-202F, METHOD 213B COND. B
- VIBRATION..... MIL-STD-202F, METHOD 204D COND. B
- ALTITUDE..... MIL-STD-202F, METHOD 105C COND. B
- TEMPERATURE CYCLE..... MIL-STD-202F, METHOD 107D COND. A

NOTE: THE ABOVE SPECIFICATIONS ARE SUBJECT TO CHANGE OR REVISION

ELECTRICAL CONNECTOR PIN ASSIGNMENTS

| PIN LETTER | FUNCTION |
|------------|--------------------|
| 1 | LOGIC INPUTS (LSB) |
| 2 | LOGIC INPUTS |
| 3 | LOGIC INPUTS |
| 4 | LOGIC INPUTS |
| 5 | LOGIC INPUTS |
| 6 | LOGIC INPUTS |
| 7 | LOGIC INPUTS |
| 8 | LOGIC INPUTS (MSB) |
| 9 | NC |
| 10 | NC |
| 11 | NC |
| 12 | NC |
| 13 | + 15 VDC |
| 14 | - 15 VDC |
| 15 | GROUND |

CONFIDENTIAL AND PROPRIETARY

| | | | | | |
|-----------|----------|---------|---|---------------|----------|
| PART NO. | DATE | DATE | TITLE | SCALE | SHEET |
| | 08/12/03 | 11/3/03 | PRODUCT FEATURE PS-12-360-QQ1470 1-2GHZ, 0-360° PHASE SHIFTER | A 0ZXZ8 | 100-6671 |
| APPROVALS | DESIGNED | CHECKED | ISSUED | SIZE FROM NO. | ENG NO. |
| | | | | A | 100-6671 |
| | | | | | 5 |
| | | | | | 1 of 3 |



PT49-PS-PW-1003

MECHANICAL OUTLINE

| | | | |
|-------------|--------------------|-------------|-----------------|
| ZONE | REVISIONS | DATE | APPROVED |
| | DESCRIPTION | | |
| | JOB# P21234E | 08-16-03 | |

DESCRIPTION

PMI MODEL NUMBER PS-12-360 IS A 1 TO 2GHZ DIGITALLY CONTROLLED ANALOG PHASE SHIFTER WITH CAPABILITY FOR PHASE SHIFTING FROM 0 TO 360°. THE UNIT CONSISTS OF AN ANALOG PHASE SHIFTER AND A DIGITAL-TO-ANALOG CONVERTER. EIGHT LOGIC INPUT LINES ALLOW 256 DISCRETE VALUES OF PHASE.

MECHANICAL OUTLINE

CONFIDENTIAL AND PROPRIETARY

| | | | |
|-----------------|------------------|---------------|--------------------------------------|
| PART NO. | APPROVALS | DATE | PLANAR MONOLITHICS INDUSTRIES |
| | | 08/12/03 | FREDERICK, MARYLAND |
| EXAMIN | CHECKED | ISSUED | PRODUCT FEATURE |
| | | | PS-12-360-QQ1470 |
| | | | 1-2GHZ, 0-360° PHASE SHIFTER |
| | | | SIZE: FPCW NO. A 0ZXZ8 |
| | | | REV. 5 |
| | | | SCALE: N:S 100-6671 |
| | | | SHEET 2 of 3 |

NOTES:
 1) DIMENSIONS ARE IN INCHES
 2) TOLERANCES: X.XX ±0.020
 X.XXX ±0.010



FUNCTIONAL SCHEMATIC

| REVISIONS | | DATE | APPROVED |
|-----------|--------------------------------------|----------|----------|
| ZONE | DESCRIPTION | DATE | APPROVED |
| | JOB # P21234E LOCKHEED MARTIN, FL | 08-16-03 | |

DESCRIPTION

PMI MODEL NUMBER PS-12-360 IS A 1 TO 2GHZ DIGITALLY CONTROLLED ANALOG PHASE SHIFTER WITH CAPABILITY FOR PHASE SHIFTING FROM 0 TO 360°. THE UNIT CONSISTS OF AN ANALOG PHASE SHIFTER AND A DIGITAL-TO-ANALOG CONVERTER. EIGHT LOGIC INPUT LINES ALLOW 256 DISCRETE VALUES OF PHASE.

FUNCTIONAL BLOCK DIAGRAM

| PIN LETTER | FUNCTION |
|------------|--------------------|
| 1 | LOGIC INPUTS (LSB) |
| 2 | LOGIC INPUTS |
| 3 | LOGIC INPUTS |
| 4 | LOGIC INPUTS |
| 5 | LOGIC INPUTS |
| 6 | LOGIC INPUTS |
| 7 | LOGIC INPUTS |
| 8 | LOGIC INPUTS (MSB) |
| 9 | NC |
| 10 | NC |
| 11 | NC |
| 12 | NC |
| 13 | + 15 VDC |
| 14 | - 15 VDC |
| 15 | GROUND |

CONFIDENTIAL AND PROPRIETARY

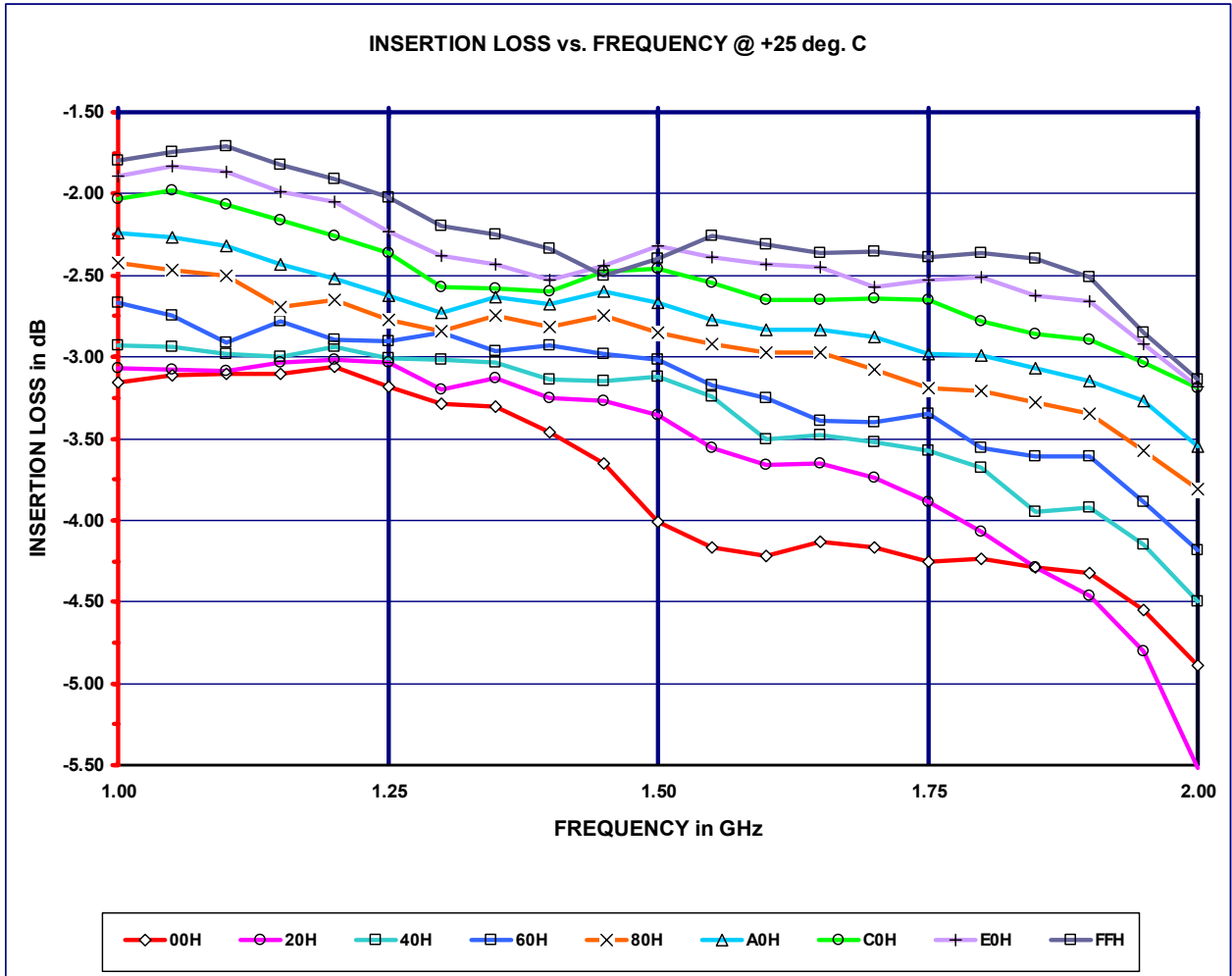
| | | | | | |
|-----------|----------|--|---------|----------|--------|
| PART NO. | DATE | TITLE | SCALE | SHEET | 3 of 3 |
| | 08/12/03 | PLANAR MONOLITHICS INDUSTRIES FREDERICK, MARYLAND | N: S | | |
| APPROVALS | | PRODUCT FEATURE | | | |
| DRAWN | 08/12/03 | PS-12-360-QQ1470 | | | |
| CHECKED | 11/3/03 | 1-2GHZ, 0-360° PHASE SHIFTER | | | |
| ISSUED | | | | | |
| | | SIZE | DWG NO. | REV. | |
| | | A | 0ZXZ8 | 100-6671 | 5 |

NOTES:
 1) DIMENSIONS ARE IN INCHES
 X.XX ±0.020
 X.XXX ±0.010

PHASE SHIFTER
PERFORMANCE OVER FREQUENCY
AND
TEMPERATURE

INSERTION LOSS, INPUT RETURN LOSS
AND OUTPUT RETURN LOSS DATA IN dB
AND PHASE DATA IN DEGREES
AS MEASURED OVER TEMPERATURE
AT +25°C, -40°C & +85°C

PLOT OF INSERTION LOSS IN dB AS MEASURED AT +25°C



THE EIGHT CONTROL BITS ARE REPRESENTED AS HEXADECIMAL NUMBERS.

| APPROXIMATE PHASE VALUE | TTL CONTROL BITS | HEXADECIMAL CODE |
|-------------------------|------------------|------------------|
| 0 | 0000 0000 | 00H |
| 45 | 0000 0100 | 20H |
| 90 | 0000 0010 | 40H |
| 135 | 0000 0110 | 60H |
| 180 | 0000 0001 | 80H |
| 225 | 0000 0101 | A0H |
| 270 | 0000 0011 | C0H |
| 315 | 0000 0111 | E0H |
| 360 | 1111 1111 | FFH |

INSERTION LOSS IN dB AS MEASURED AT +25°C

| FREQUENCY | HEXADECIMAL CONTROL CODES | | | | | | | | |
|-----------|---------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| | 00H | 20H | 40H | 60H | 80H | A0H | C0H | E0H | FFH |
| 1.0000 | -3.16 | -3.07 | -2.93 | -2.67 | -2.42 | -2.24 | -2.03 | -1.89 | -1.80 |
| 1.0500 | -3.11 | -3.08 | -2.94 | -2.75 | -2.47 | -2.27 | -1.98 | -1.83 | -1.74 |
| 1.1000 | -3.10 | -3.09 | -2.98 | -2.91 | -2.50 | -2.32 | -2.07 | -1.87 | -1.71 |
| 1.1500 | -3.10 | -3.03 | -3.00 | -2.78 | -2.69 | -2.43 | -2.16 | -1.99 | -1.82 |
| 1.2000 | -3.06 | -3.02 | -2.94 | -2.89 | -2.65 | -2.52 | -2.26 | -2.05 | -1.91 |
| 1.2500 | -3.18 | -3.03 | -3.01 | -2.90 | -2.77 | -2.62 | -2.36 | -2.23 | -2.02 |
| 1.3000 | -3.29 | -3.20 | -3.02 | -2.85 | -2.84 | -2.73 | -2.57 | -2.38 | -2.20 |
| 1.3500 | -3.30 | -3.13 | -3.03 | -2.96 | -2.75 | -2.63 | -2.58 | -2.43 | -2.25 |
| 1.4000 | -3.46 | -3.25 | -3.14 | -2.93 | -2.82 | -2.68 | -2.60 | -2.53 | -2.34 |
| 1.4500 | -3.65 | -3.27 | -3.15 | -2.98 | -2.75 | -2.60 | -2.48 | -2.44 | -2.50 |
| 1.5000 | -4.01 | -3.36 | -3.12 | -3.02 | -2.85 | -2.67 | -2.46 | -2.32 | -2.40 |
| 1.5500 | -4.17 | -3.56 | -3.24 | -3.17 | -2.92 | -2.77 | -2.55 | -2.39 | -2.26 |
| 1.6000 | -4.22 | -3.66 | -3.50 | -3.25 | -2.97 | -2.83 | -2.65 | -2.43 | -2.31 |
| 1.6500 | -4.13 | -3.65 | -3.48 | -3.39 | -2.97 | -2.83 | -2.65 | -2.45 | -2.36 |
| 1.7000 | -4.17 | -3.74 | -3.52 | -3.40 | -3.08 | -2.88 | -2.64 | -2.57 | -2.35 |
| 1.7500 | -4.25 | -3.89 | -3.57 | -3.35 | -3.19 | -2.98 | -2.65 | -2.53 | -2.39 |
| 1.8000 | -4.24 | -4.07 | -3.68 | -3.56 | -3.21 | -2.99 | -2.78 | -2.51 | -2.36 |
| 1.8500 | -4.29 | -4.29 | -3.95 | -3.61 | -3.28 | -3.07 | -2.86 | -2.62 | -2.40 |
| 1.9000 | -4.32 | -4.46 | -3.92 | -3.61 | -3.35 | -3.15 | -2.89 | -2.66 | -2.51 |
| 1.9500 | -4.55 | -4.80 | -4.15 | -3.89 | -3.57 | -3.27 | -3.03 | -2.92 | -2.85 |
| 2.0000 | -4.89 | -5.52 | -4.50 | -4.18 | -3.81 | -3.55 | -3.19 | -3.18 | -3.14 |

THE EIGHT CONTROL BITS ARE REPRESENTED AS HEXADECIMAL NUMBERS.

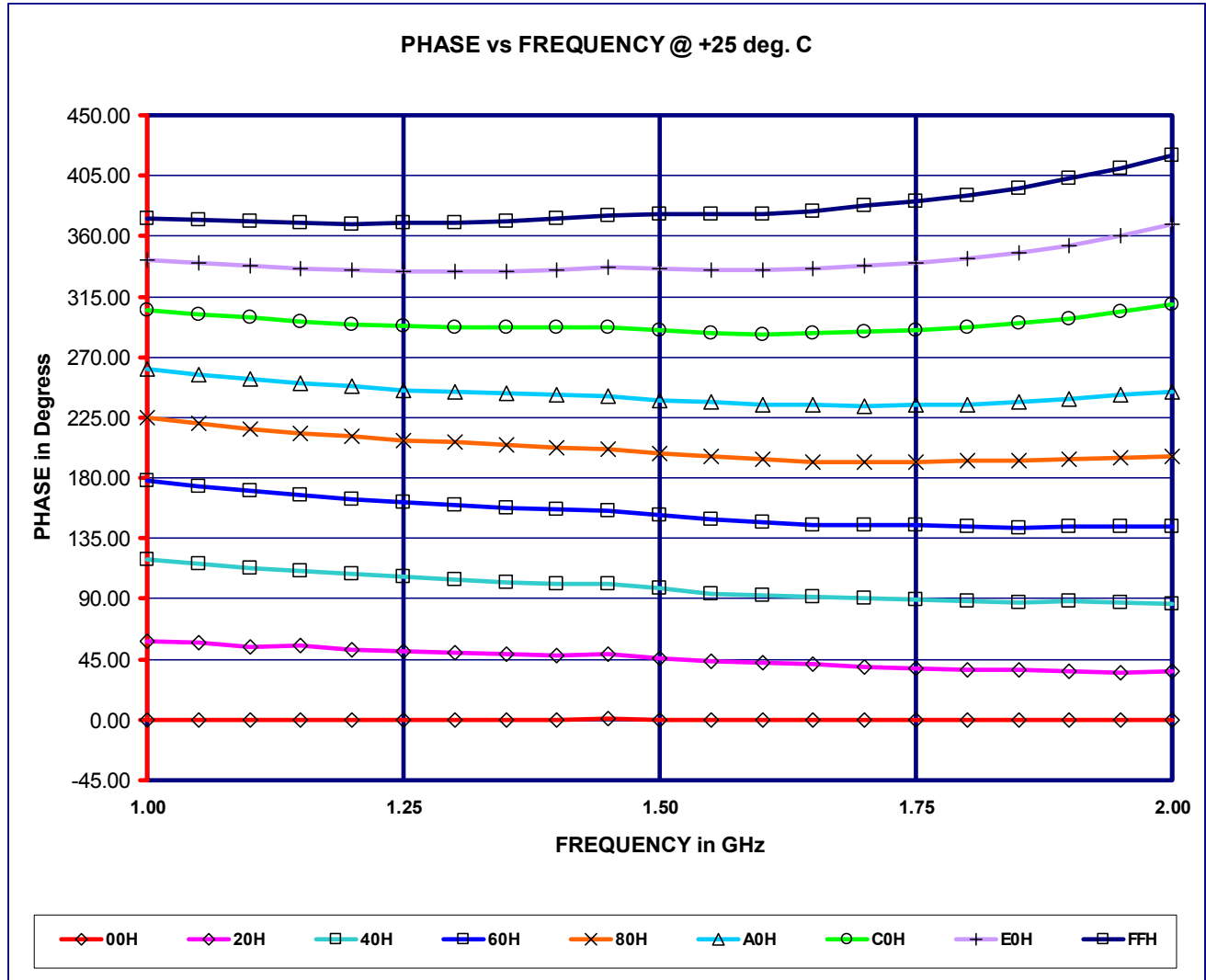
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|-------------------------|------------------|------------------|
| 0 | 0000 0000 | 00H |
| 45 | 0000 0100 | 20H |
| 90 | 0000 0010 | 40H |
| 135 | 0000 0110 | 60H |
| 180 | 0000 0001 | 80H |
| 225 | 0000 0101 | A0H |
| 270 | 0000 0011 | C0H |
| 315 | 0000 0111 | E0H |
| 360 | 1111 1111 | FFH |

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PLOT OF PHASE DATA IN DEGREES AS MEASURED AT 25°C



THE EIGHT CONTROL BITS ARE REPRESENTED AS HEXADECIMAL NUMBERS.

| APPROXIMATE PHASE VALUE | TTL CONTROL BITS | HEXADECIMAL CODE |
|-------------------------|------------------|------------------|
| 0 | 0000 0000 | 00H |
| 45 | 0000 0100 | 20H |
| 90 | 0000 0010 | 40H |
| 135 | 0000 0110 | 60H |
| 180 | 0000 0001 | 80H |
| 225 | 0000 0101 | A0H |
| 270 | 0000 0011 | C0H |
| 315 | 0000 0111 | E0H |
| 360 | 1111 1111 | FFH |

PHASE DATA IN DEGREES AS MEASURED AT 25°C

| FREQUENCY | HEXADECIMAL CONTROL CODES | | | | | | | | |
|-----------|---------------------------|-------|--------|--------|--------|--------|--------|--------|--------|
| | 00H | 20H | 40H | 60H | 80H | A0H | C0H | E0H | FFH |
| 1.0000 | -0.30 | 58.50 | 119.40 | 178.00 | 224.80 | 261.40 | 305.10 | 341.90 | 373.00 |
| 1.0500 | 0.10 | 57.00 | 116.10 | 174.00 | 220.60 | 257.10 | 302.00 | 339.80 | 372.00 |
| 1.1000 | 0.10 | 53.70 | 113.00 | 170.30 | 216.80 | 253.40 | 299.10 | 337.70 | 370.90 |
| 1.1500 | 0.10 | 55.50 | 110.50 | 167.10 | 213.00 | 250.40 | 296.40 | 335.80 | 369.70 |
| 1.2000 | -0.10 | 52.60 | 108.10 | 164.60 | 210.80 | 248.40 | 294.50 | 334.70 | 369.10 |
| 1.2500 | -0.40 | 51.10 | 106.10 | 162.30 | 208.00 | 245.60 | 292.80 | 334.20 | 370.20 |
| 1.3000 | -0.40 | 50.10 | 104.20 | 160.20 | 206.80 | 244.20 | 292.10 | 333.50 | 370.40 |
| 1.3500 | -0.20 | 48.90 | 102.10 | 157.70 | 204.40 | 243.20 | 291.80 | 333.80 | 370.90 |
| 1.4000 | -0.30 | 48.30 | 101.40 | 156.30 | 202.80 | 242.20 | 291.80 | 334.30 | 373.00 |
| 1.4500 | 0.50 | 48.80 | 100.90 | 155.20 | 201.70 | 241.30 | 292.40 | 336.80 | 375.40 |
| 1.5000 | -0.50 | 46.00 | 98.00 | 152.10 | 198.60 | 238.10 | 289.60 | 335.40 | 376.00 |
| 1.5500 | -0.10 | 43.90 | 94.20 | 149.40 | 196.30 | 236.20 | 287.80 | 334.90 | 376.30 |
| 1.6000 | 0.10 | 42.30 | 92.10 | 146.50 | 194.00 | 234.40 | 287.10 | 334.30 | 376.70 |
| 1.6500 | -0.20 | 41.20 | 91.30 | 144.90 | 192.20 | 234.10 | 287.70 | 335.90 | 378.90 |
| 1.7000 | 0.10 | 39.60 | 90.50 | 145.00 | 192.10 | 233.40 | 288.70 | 338.20 | 382.30 |
| 1.7500 | 0.20 | 38.60 | 89.40 | 144.40 | 192.20 | 234.40 | 290.20 | 340.60 | 386.20 |
| 1.8000 | -0.40 | 37.60 | 88.20 | 143.30 | 192.50 | 234.80 | 291.70 | 343.70 | 390.30 |
| 1.8500 | -0.20 | 36.80 | 87.70 | 143.20 | 193.00 | 237.00 | 294.90 | 347.80 | 395.70 |
| 1.9000 | 0.10 | 36.00 | 87.90 | 143.70 | 194.10 | 239.10 | 299.00 | 352.90 | 402.80 |
| 1.9500 | 0.30 | 35.50 | 87.40 | 143.80 | 195.50 | 241.70 | 304.20 | 360.70 | 410.00 |
| 2.0000 | 0.10 | 35.70 | 86.20 | 143.50 | 196.10 | 244.00 | 309.00 | 368.70 | 420.00 |

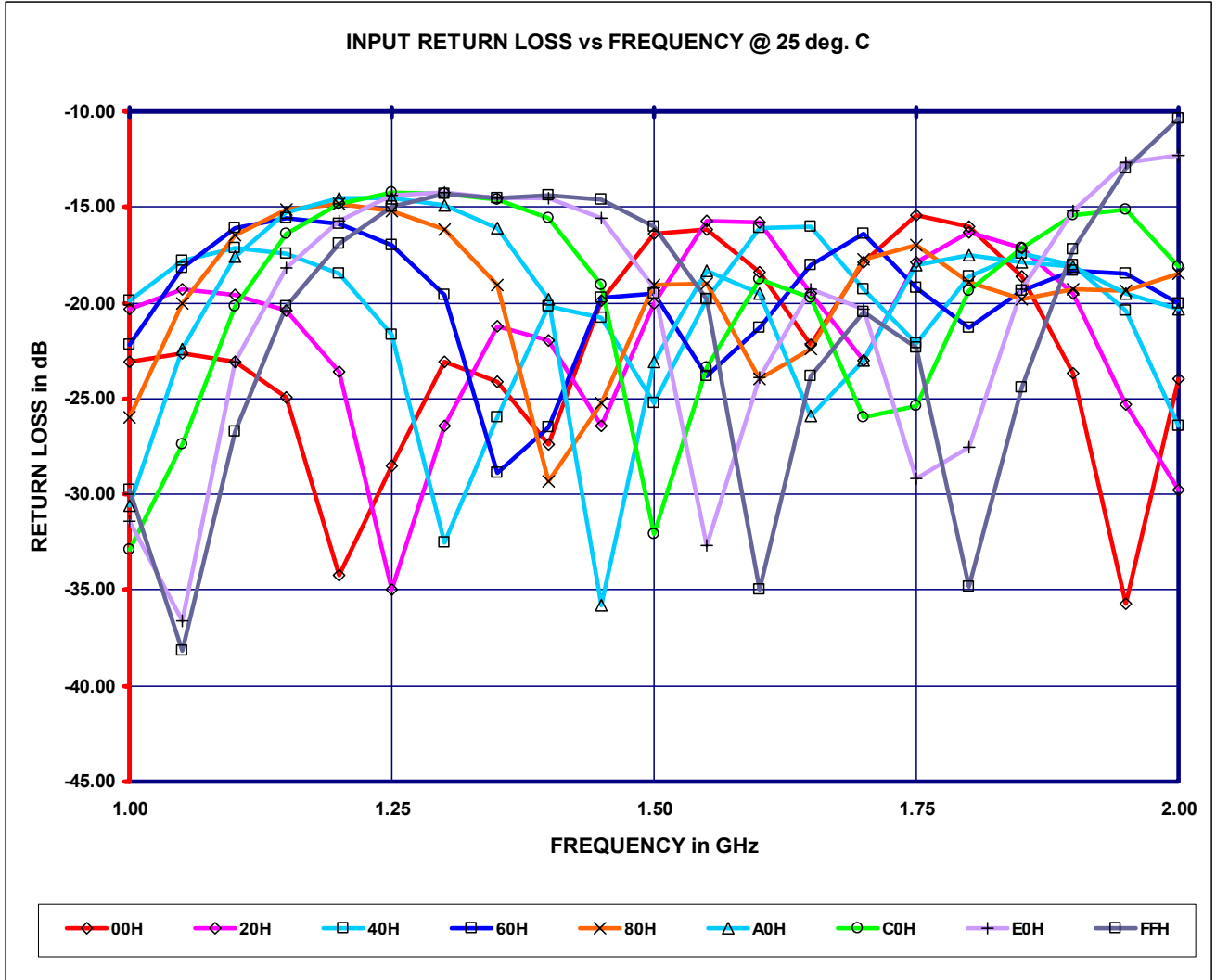
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|--|------------------|------------------|
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| 45 | 0000 0100 | 20H |
| 90 | 0000 0010 | 40H |
| 135 | 0000 0110 | 60H |
| 180 | 0000 0001 | 80H |
| 225 | 0000 0101 | A0H |
| 270 | 0000 0011 | C0H |
| 315 | 0000 0111 | E0H |
| 360 | 1111 1111 | FFH |

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PLOT OF INPUT RETURN LOSS IN dB AS MEASURED AT 25°C



THE EIGHT CONTROL BITS ARE REPRESENTED AS HEXADECIMAL NUMBERS.

| APPROXIMATE PHASE VALUE | TTL CONTROL BITS | HEXADECIMAL CODE |
|-------------------------|------------------|------------------|
| 0 | 0000 0000 | 00H |
| 45 | 0000 0100 | 20H |
| 90 | 0000 0010 | 40H |
| 135 | 0000 0110 | 60H |
| 180 | 0000 0001 | 80H |
| 225 | 0000 0101 | A0H |
| 270 | 0000 0011 | C0H |
| 315 | 0000 0111 | E0H |
| 360 | 1111 1111 | FFH |

INPUT RETURN LOSS IN dB AS MEASURED AT 25°C

| FREQUENCY | HEXADECIMAL CONTROL CODES | | | | | | | | |
|-----------|---------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| | 00H | 20H | 40H | 60H | 80H | A0H | C0H | E0H | FFH |
| 1.0000 | -23.10 | -20.30 | -19.90 | -22.20 | -26.00 | -30.60 | -32.90 | -31.40 | -29.80 |
| 1.0500 | -22.60 | -19.30 | -17.80 | -18.20 | -20.00 | -22.40 | -27.40 | -36.60 | -38.20 |
| 1.1000 | -23.10 | -19.60 | -17.10 | -16.10 | -16.50 | -17.60 | -20.20 | -23.10 | -26.70 |
| 1.1500 | -24.90 | -20.40 | -17.40 | -15.60 | -15.10 | -15.30 | -16.40 | -18.20 | -20.20 |
| 1.2000 | -34.20 | -23.60 | -18.50 | -15.90 | -14.80 | -14.50 | -14.80 | -15.70 | -16.90 |
| 1.2500 | -28.50 | -35.00 | -21.70 | -17.00 | -15.20 | -14.50 | -14.20 | -14.40 | -15.00 |
| 1.3000 | -23.10 | -26.40 | -32.50 | -19.60 | -16.20 | -14.90 | -14.30 | -14.20 | -14.30 |
| 1.3500 | -24.10 | -21.20 | -26.00 | -28.90 | -19.10 | -16.10 | -14.60 | -14.50 | -14.50 |
| 1.4000 | -27.40 | -22.00 | -20.20 | -26.50 | -29.30 | -19.80 | -15.60 | -14.50 | -14.40 |
| 1.4500 | -19.90 | -26.40 | -20.80 | -19.70 | -25.20 | -35.80 | -19.10 | -15.60 | -14.60 |
| 1.5000 | -16.40 | -20.00 | -25.20 | -19.50 | -19.10 | -23.10 | -32.10 | -19.20 | -16.00 |
| 1.5500 | -16.20 | -15.70 | -19.80 | -23.80 | -19.00 | -18.30 | -23.40 | -32.70 | -19.80 |
| 1.6000 | -18.40 | -15.80 | -16.10 | -21.30 | -24.00 | -19.50 | -18.80 | -23.90 | -35.00 |
| 1.6500 | -22.20 | -19.50 | -16.00 | -18.00 | -22.40 | -25.90 | -19.70 | -19.30 | -23.80 |
| 1.7000 | -17.90 | -23.00 | -19.30 | -16.40 | -17.70 | -23.00 | -26.00 | -20.30 | -20.50 |
| 1.7500 | -15.40 | -17.90 | -22.10 | -19.20 | -17.00 | -18.00 | -25.40 | -29.20 | -22.30 |
| 1.8000 | -16.00 | -16.30 | -18.60 | -21.30 | -18.90 | -17.50 | -19.40 | -27.50 | -34.80 |
| 1.8500 | -18.60 | -17.10 | -17.40 | -19.40 | -19.80 | -17.90 | -17.10 | -19.30 | -24.40 |
| 1.9000 | -23.70 | -19.50 | -18.00 | -18.30 | -19.30 | -18.10 | -15.40 | -15.20 | -17.20 |
| 1.9500 | -35.70 | -25.30 | -20.40 | -18.50 | -19.40 | -19.50 | -15.10 | -12.70 | -13.00 |
| 2.0000 | -24.00 | -29.80 | -26.40 | -20.00 | -18.50 | -20.30 | -18.10 | -12.30 | -10.40 |

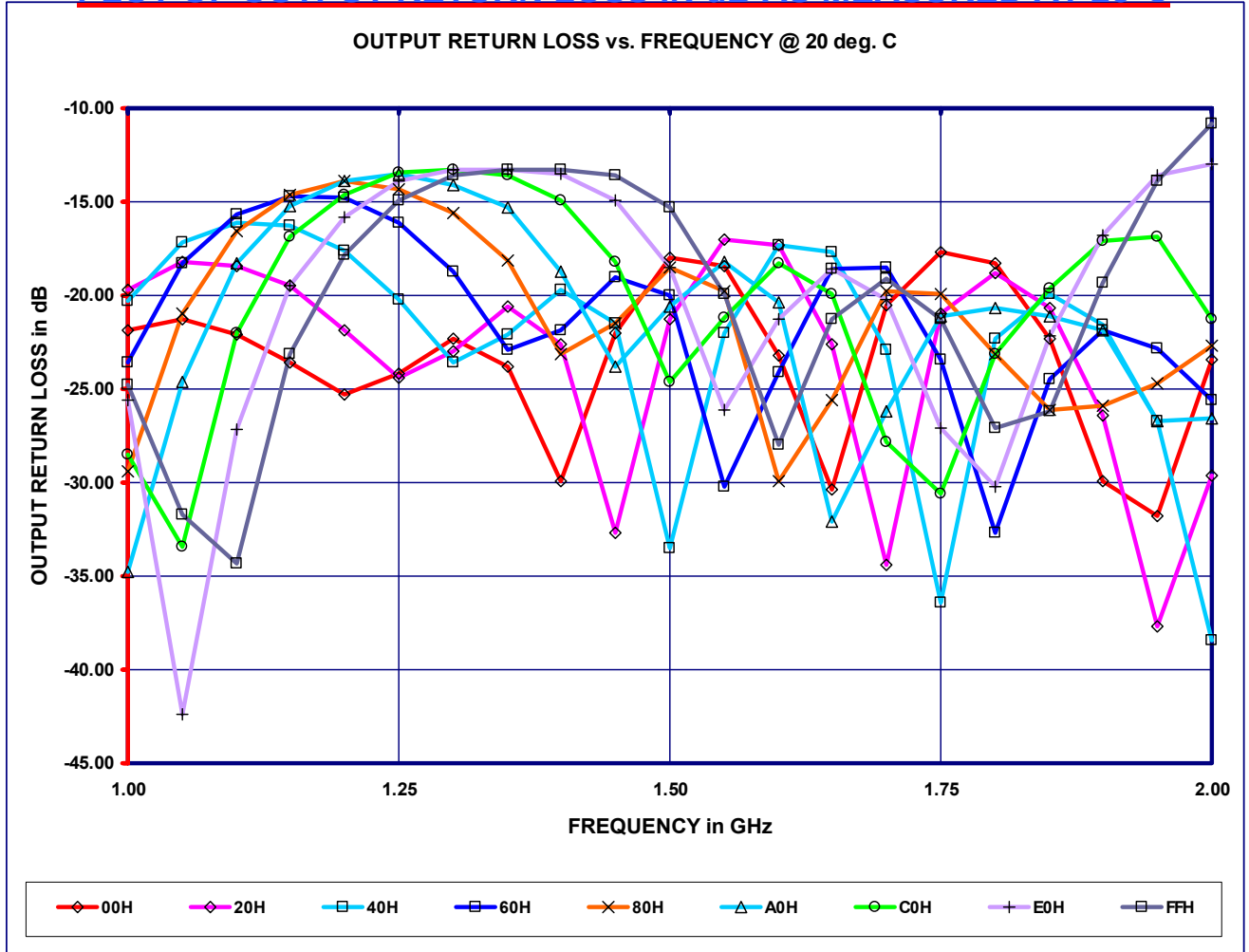
| THE EIGHT CONTROL BITS ARE REPRESENTED AS HEXADECIMAL NUMBERS. | | |
|--|------------------|------------------|
| APPROXIMATE PHASE VALUE | TTL CONTROL BITS | HEXADECIMAL CODE |
| 0 | 0000 0000 | 00H |
| 45 | 0000 0100 | 20H |
| 90 | 0000 0010 | 40H |
| 135 | 0000 0110 | 60H |
| 180 | 0000 0001 | 80H |
| 225 | 0000 0101 | A0H |
| 270 | 0000 0011 | C0H |
| 315 | 0000 0111 | E0H |
| 360 | 1111 1111 | FFH |

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PLOT OF OUTPUT RETURN LOSS IN dB AS MEASURED AT 25°C



| THE EIGHT CONTROL BITS ARE REPRESENTED AS HEXADECIMAL NUMBERS. | | |
|--|------------------|------------------|
| APPROXIMATE PHASE VALUE | TTL CONTROL BITS | HEXADECIMAL CODE |
| 0 | 0000 0000 | 00H |
| 45 | 0000 0100 | 20H |
| 90 | 0000 0010 | 40H |
| 135 | 0000 0110 | 60H |
| 180 | 0000 0001 | 80H |
| 225 | 0000 0101 | A0H |
| 270 | 0000 0011 | C0H |
| 315 | 0000 0111 | E0H |
| 360 | 1111 1111 | FFH |

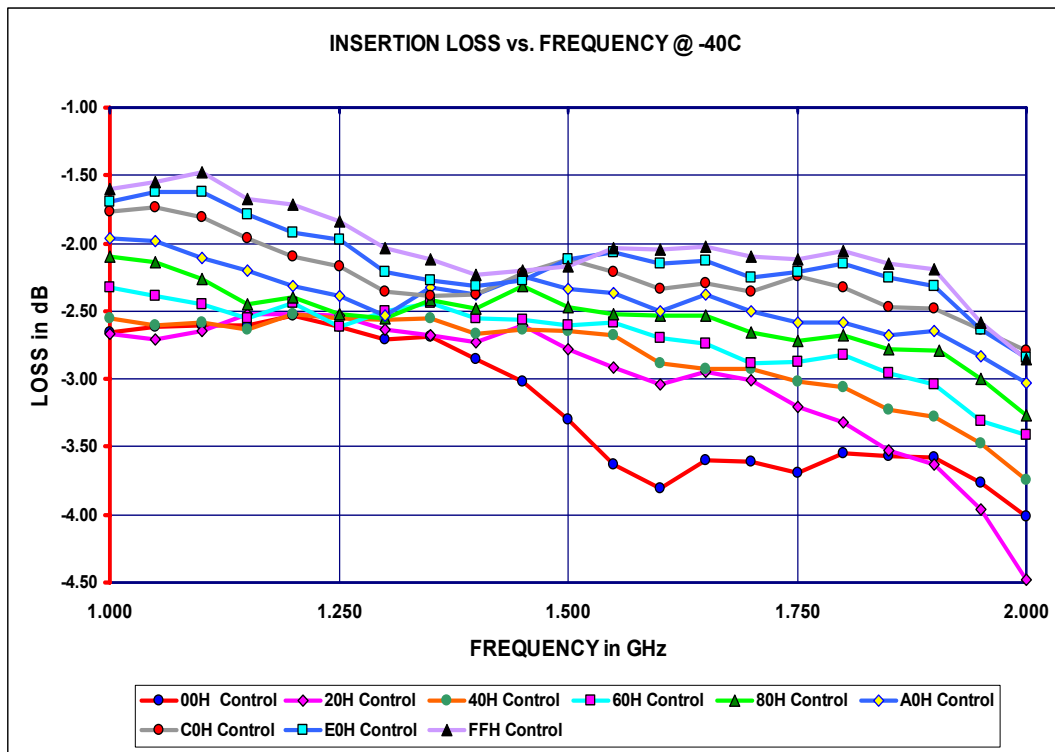
OUTPUT RETURN LOSS IN dB AS MEASURED AT 25°C

| FREQUENCY | HEXADECIMAL CONTROL CODES | | | | | | | | |
|-----------|---------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| | 00H | 20H | 40H | 60H | 80H | A0H | C0H | E0H | FFH |
| 1.0000 | -21.90 | -19.70 | -20.30 | -23.60 | -29.40 | -34.80 | -28.50 | -25.60 | -24.80 |
| 1.0500 | -21.30 | -18.20 | -17.20 | -18.30 | -21.00 | -24.60 | -33.40 | -42.40 | -31.70 |
| 1.1000 | -22.10 | -18.40 | -16.10 | -15.70 | -16.60 | -18.30 | -22.00 | -27.20 | -34.30 |
| 1.1500 | -23.60 | -19.50 | -16.30 | -14.70 | -14.60 | -15.20 | -16.90 | -19.50 | -23.10 |
| 1.2000 | -25.30 | -21.90 | -17.60 | -14.80 | -13.90 | -13.90 | -14.60 | -15.80 | -17.80 |
| 1.2500 | -24.20 | -24.40 | -20.20 | -16.10 | -14.30 | -13.50 | -13.40 | -13.90 | -14.90 |
| 1.3000 | -22.30 | -23.00 | -23.60 | -18.70 | -15.60 | -14.10 | -13.30 | -13.30 | -13.60 |
| 1.3500 | -23.80 | -20.60 | -22.10 | -22.90 | -18.10 | -15.30 | -13.60 | -13.30 | -13.30 |
| 1.4000 | -29.90 | -22.60 | -19.70 | -21.90 | -23.10 | -18.70 | -14.90 | -13.50 | -13.30 |
| 1.4500 | -22.00 | -32.70 | -21.50 | -19.00 | -21.50 | -23.80 | -18.20 | -14.90 | -13.60 |
| 1.5000 | -18.00 | -21.30 | -33.50 | -20.00 | -18.50 | -20.60 | -24.60 | -18.50 | -15.30 |
| 1.5500 | -18.40 | -17.00 | -22.00 | -30.20 | -19.80 | -18.20 | -21.20 | -26.10 | -19.90 |
| 1.6000 | -23.20 | -17.30 | -17.30 | -24.10 | -29.90 | -20.40 | -18.30 | -21.30 | -28.00 |
| 1.6500 | -30.40 | -22.60 | -17.70 | -18.60 | -25.60 | -32.10 | -19.90 | -18.60 | -21.30 |
| 1.7000 | -20.50 | -34.40 | -22.90 | -18.50 | -19.80 | -26.20 | -27.80 | -20.20 | -19.10 |
| 1.7500 | -17.70 | -21.00 | -36.40 | -23.40 | -19.90 | -21.10 | -30.60 | -27.10 | -21.30 |
| 1.8000 | -18.30 | -18.80 | -22.30 | -32.70 | -23.10 | -20.70 | -23.10 | -30.20 | -27.10 |
| 1.8500 | -22.30 | -20.70 | -19.90 | -24.50 | -26.10 | -21.10 | -19.60 | -22.20 | -26.20 |
| 1.9000 | -29.90 | -26.40 | -21.60 | -21.90 | -25.90 | -21.90 | -17.10 | -16.80 | -19.30 |
| 1.9500 | -31.80 | -37.70 | -26.70 | -22.80 | -24.70 | -26.70 | -16.90 | -13.60 | -13.90 |
| 2.0000 | -23.40 | -29.60 | -38.40 | -25.60 | -22.70 | -26.60 | -21.30 | -13.00 | -10.80 |

| THE EIGHT CONTROL BITS ARE REPRESENTED AS HEXADECIMAL NUMBERS. | | |
|--|------------------|------------------|
| APPROXIMATE PHASE VALUE | TTL CONTROL BITS | HEXADECIMAL CODE |
| 0 | 0000 0000 | 00H |
| 45 | 0000 0100 | 20H |
| 90 | 0000 0010 | 40H |
| 135 | 0000 0110 | 60H |
| 180 | 0000 0001 | 80H |
| 225 | 0000 0101 | A0H |
| 270 | 0000 0011 | C0H |
| 315 | 0000 0111 | E0H |
| 360 | 1111 1111 | FFH |



INSERTION LOSS IN dB AS MEASURED AT -40°C



| Frequency | HEXADECIMAL CONTROL CODES | | | | | | | | |
|-----------|---------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| | 00H | 20H | 40H | 60H | 80H | A0H | C0H | E0H | FFH |
| 1.000 | -2.66 | -2.67 | -2.55 | -2.33 | -2.10 | -1.96 | -1.77 | -1.69 | -1.60 |
| 1.050 | -2.62 | -2.71 | -2.61 | -2.39 | -2.14 | -1.98 | -1.74 | -1.62 | -1.55 |
| 1.100 | -2.60 | -2.65 | -2.58 | -2.45 | -2.26 | -2.11 | -1.81 | -1.62 | -1.48 |
| 1.150 | -2.60 | -2.52 | -2.64 | -2.55 | -2.45 | -2.20 | -1.96 | -1.79 | -1.67 |
| 1.200 | -2.53 | -2.52 | -2.52 | -2.44 | -2.40 | -2.32 | -2.10 | -1.92 | -1.71 |
| 1.250 | -2.62 | -2.53 | -2.55 | -2.62 | -2.52 | -2.39 | -2.17 | -1.97 | -1.84 |
| 1.300 | -2.71 | -2.64 | -2.56 | -2.50 | -2.55 | -2.53 | -2.36 | -2.21 | -2.04 |
| 1.350 | -2.69 | -2.68 | -2.55 | -2.44 | -2.42 | -2.33 | -2.39 | -2.27 | -2.12 |
| 1.400 | -2.85 | -2.73 | -2.67 | -2.55 | -2.48 | -2.38 | -2.38 | -2.32 | -2.23 |
| 1.450 | -3.02 | -2.60 | -2.64 | -2.56 | -2.32 | -2.24 | -2.22 | -2.27 | -2.20 |
| 1.500 | -3.30 | -2.78 | -2.65 | -2.60 | -2.47 | -2.34 | -2.12 | -2.12 | -2.17 |
| 1.550 | -3.63 | -2.92 | -2.68 | -2.58 | -2.52 | -2.37 | -2.21 | -2.07 | -2.04 |
| 1.600 | -3.81 | -3.04 | -2.88 | -2.70 | -2.53 | -2.50 | -2.34 | -2.15 | -2.05 |
| 1.650 | -3.60 | -2.95 | -2.93 | -2.74 | -2.53 | -2.38 | -2.29 | -2.13 | -2.02 |
| 1.700 | -3.61 | -3.01 | -2.93 | -2.88 | -2.66 | -2.50 | -2.36 | -2.25 | -2.10 |
| 1.750 | -3.69 | -3.21 | -3.02 | -2.87 | -2.72 | -2.58 | -2.24 | -2.21 | -2.12 |
| 1.800 | -3.55 | -3.32 | -3.06 | -2.82 | -2.68 | -2.58 | -2.33 | -2.15 | -2.06 |
| 1.850 | -3.57 | -3.53 | -3.23 | -2.96 | -2.78 | -2.68 | -2.47 | -2.25 | -2.15 |
| 1.900 | -3.58 | -3.63 | -3.28 | -3.04 | -2.79 | -2.65 | -2.48 | -2.32 | -2.19 |
| 1.950 | -3.76 | -3.96 | -3.48 | -3.31 | -3.00 | -2.83 | -2.64 | -2.64 | -2.58 |
| 2.000 | -4.01 | -4.48 | -3.74 | -3.41 | -3.27 | -3.03 | -2.79 | -2.84 | -2.85 |

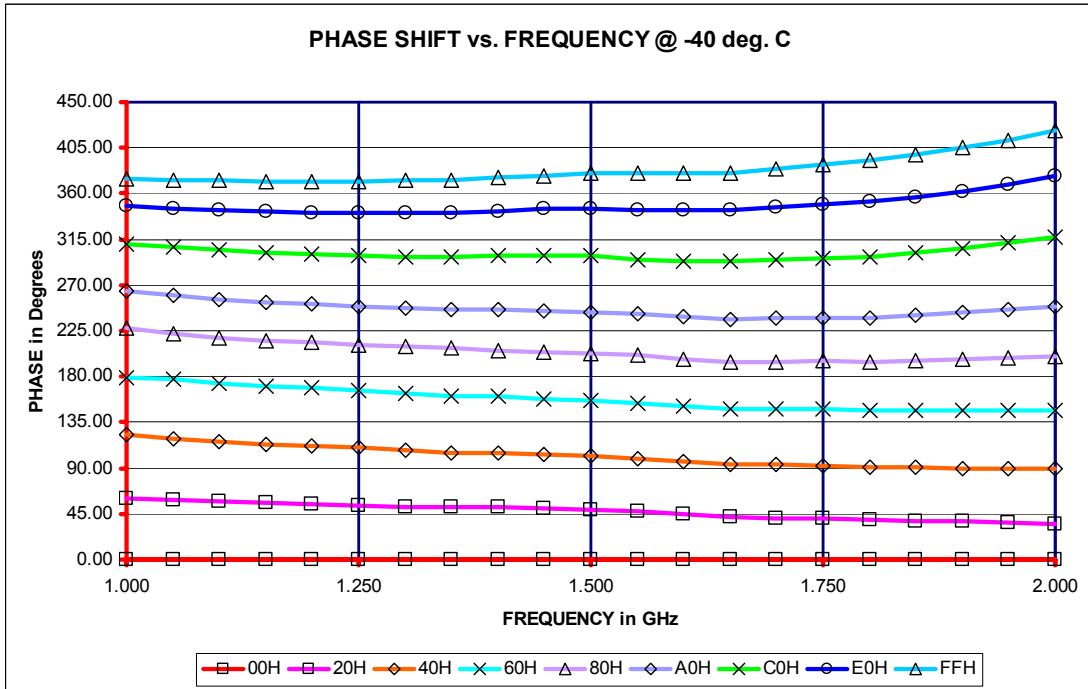
PLANAR MONOLITHICS INDUSTRIES, INC., 7311-G GROVE ROAD, FREDERICK, MD 21704

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PHASE DATA IN DEGREES AS MEASURED AT -40°C



| Frequency | HEXADECIMAL CONTROL CODES | | | | | | | | |
|-----------|---------------------------|-------|--------|--------|--------|--------|--------|--------|--------|
| | 00H | 20H | 40H | 60H | 80H | A0H | C0H | E0H | FFH |
| 1.000 | -0.20 | 60.60 | 122.30 | 178.70 | 227.20 | 263.60 | 310.40 | 348.10 | 374.80 |
| 1.050 | -0.20 | 58.60 | 118.60 | 177.00 | 222.90 | 259.70 | 306.80 | 345.60 | 373.50 |
| 1.100 | 0.00 | 56.80 | 116.20 | 173.10 | 218.30 | 256.20 | 304.00 | 343.90 | 372.60 |
| 1.150 | 0.10 | 55.50 | 113.80 | 170.90 | 215.40 | 253.00 | 301.60 | 342.40 | 371.60 |
| 1.200 | -0.10 | 54.60 | 112.00 | 168.50 | 213.80 | 251.50 | 299.90 | 340.80 | 371.60 |
| 1.250 | -0.10 | 53.20 | 110.00 | 165.70 | 211.10 | 249.00 | 298.60 | 340.60 | 372.10 |
| 1.300 | -0.10 | 52.00 | 107.30 | 164.00 | 210.10 | 248.00 | 298.30 | 340.90 | 372.50 |
| 1.350 | -0.20 | 51.10 | 105.20 | 161.40 | 207.60 | 246.60 | 298.10 | 341.10 | 373.80 |
| 1.400 | 0.10 | 51.10 | 104.60 | 160.20 | 206.00 | 246.30 | 298.60 | 343.00 | 375.70 |
| 1.450 | -0.30 | 50.10 | 103.30 | 158.40 | 204.10 | 244.60 | 298.50 | 344.60 | 377.70 |
| 1.500 | 0.20 | 49.00 | 102.00 | 157.00 | 202.90 | 243.20 | 298.40 | 345.80 | 380.40 |
| 1.550 | 0.10 | 47.30 | 98.80 | 153.90 | 200.70 | 241.30 | 295.30 | 344.20 | 380.40 |
| 1.600 | 0.10 | 44.10 | 95.80 | 150.50 | 197.40 | 238.30 | 294.10 | 343.20 | 380.20 |
| 1.650 | -0.20 | 42.10 | 93.70 | 147.70 | 194.70 | 236.70 | 293.50 | 343.30 | 380.60 |
| 1.700 | 0.10 | 41.20 | 93.10 | 148.00 | 194.70 | 236.90 | 295.00 | 346.50 | 384.40 |
| 1.750 | 0.20 | 40.00 | 92.20 | 147.70 | 195.10 | 237.50 | 296.80 | 349.00 | 388.90 |
| 1.800 | -0.10 | 38.90 | 90.40 | 146.70 | 194.90 | 238.20 | 298.30 | 352.40 | 392.80 |
| 1.850 | -0.10 | 38.30 | 90.20 | 146.30 | 195.70 | 240.60 | 301.30 | 356.60 | 398.30 |
| 1.900 | -0.10 | 37.80 | 90.10 | 146.60 | 196.90 | 243.00 | 305.90 | 362.30 | 404.90 |
| 1.950 | -0.20 | 36.70 | 90.10 | 147.10 | 198.80 | 245.50 | 311.80 | 369.30 | 412.50 |
| 2.000 | 0.50 | 35.30 | 89.30 | 147.40 | 199.40 | 248.10 | 317.30 | 377.50 | 422.60 |

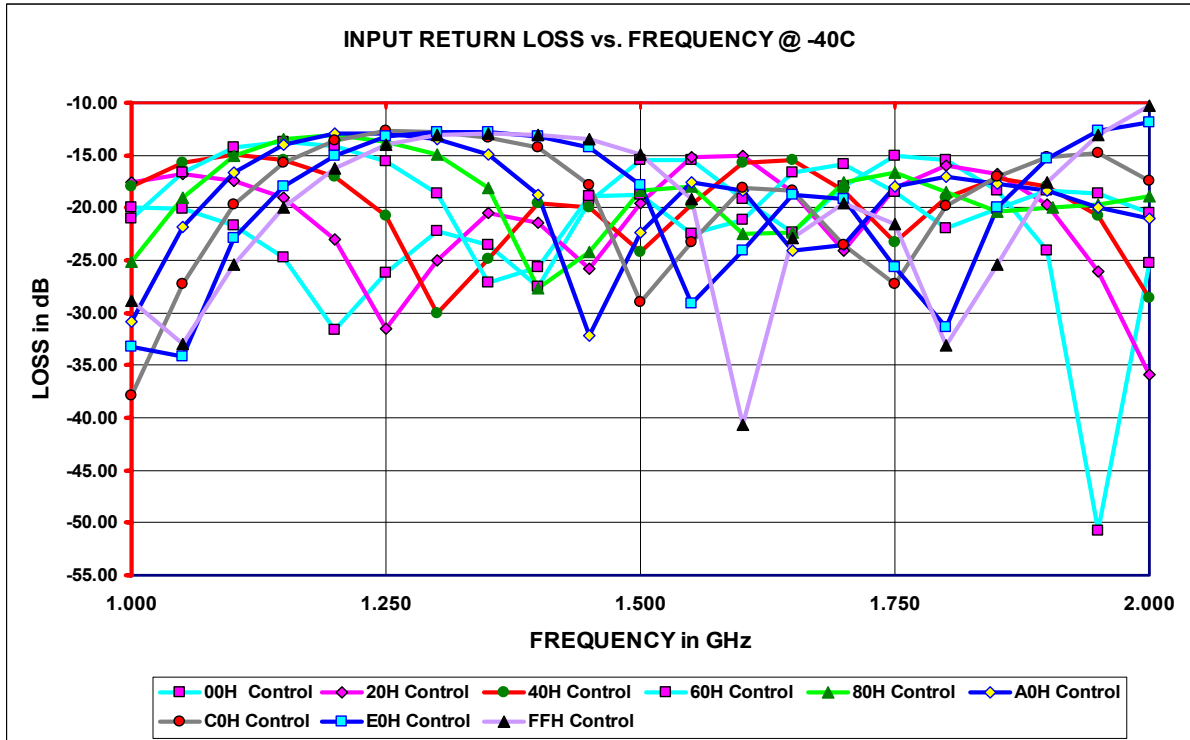
PLANAR MONOLITHICS INDUSTRIES, INC., 7311-G GROVE ROAD, FREDERICK, MD 21704

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INPUT RETURN LOSS IN dB AS MEASURED AT -40°C



| Frequency | 00H | 20H | 40H | 60H | 80H | A0H | C0H | E0H | FFH |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 1.000 | -19.90 | -17.60 | -18.00 | -21.00 | -25.10 | -30.80 | -37.90 | -33.20 | -28.90 |
| 1.050 | -20.10 | -16.80 | -15.70 | -16.70 | -19.00 | -21.80 | -27.20 | -34.10 | -33.00 |
| 1.100 | -21.70 | -17.40 | -14.90 | -14.30 | -15.10 | -16.70 | -19.70 | -22.90 | -25.40 |
| 1.150 | -24.70 | -19.00 | -15.50 | -13.70 | -13.50 | -14.00 | -15.70 | -18.00 | -19.90 |
| 1.200 | -31.60 | -23.00 | -17.10 | -14.10 | -13.00 | -12.90 | -13.60 | -15.00 | -16.30 |
| 1.250 | -26.20 | -31.50 | -20.70 | -15.60 | -13.70 | -12.90 | -12.70 | -13.20 | -14.00 |
| 1.300 | -22.20 | -25.00 | -30.10 | -18.60 | -14.90 | -13.50 | -12.80 | -12.80 | -13.00 |
| 1.350 | -23.60 | -20.50 | -24.90 | -27.10 | -18.10 | -14.90 | -13.30 | -12.80 | -12.90 |
| 1.400 | -27.50 | -21.40 | -19.50 | -25.70 | -27.60 | -18.70 | -14.30 | -13.20 | -13.00 |
| 1.450 | -19.40 | -25.80 | -19.90 | -18.90 | -24.20 | -32.20 | -17.80 | -14.30 | -13.40 |
| 1.500 | -15.50 | -19.60 | -24.20 | -18.70 | -18.30 | -22.30 | -29.00 | -17.80 | -14.90 |
| 1.550 | -15.50 | -15.20 | -19.70 | -22.50 | -18.00 | -17.50 | -23.30 | -29.10 | -19.20 |
| 1.600 | -19.10 | -15.00 | -15.70 | -21.20 | -22.50 | -18.40 | -18.10 | -24.10 | -40.60 |
| 1.650 | -22.30 | -18.50 | -15.40 | -16.70 | -22.30 | -24.10 | -18.40 | -18.80 | -22.90 |
| 1.700 | -18.00 | -24.10 | -18.40 | -15.80 | -17.60 | -23.50 | -23.60 | -19.20 | -19.60 |
| 1.750 | -15.10 | -18.10 | -23.30 | -18.50 | -16.60 | -18.00 | -27.20 | -25.60 | -21.50 |
| 1.800 | -15.50 | -16.00 | -19.00 | -22.00 | -18.50 | -17.10 | -19.80 | -31.40 | -33.10 |
| 1.850 | -18.30 | -16.80 | -17.20 | -20.10 | -20.30 | -17.70 | -17.00 | -20.00 | -25.40 |
| 1.900 | -24.10 | -19.70 | -17.90 | -18.30 | -19.90 | -18.30 | -15.20 | -15.30 | -17.50 |
| 1.950 | -50.80 | -26.10 | -20.70 | -18.60 | -19.70 | -19.90 | -14.80 | -12.60 | -13.00 |
| 2.000 | -25.30 | -35.90 | -28.60 | -20.50 | -18.90 | -21.00 | -17.40 | -11.80 | -10.30 |

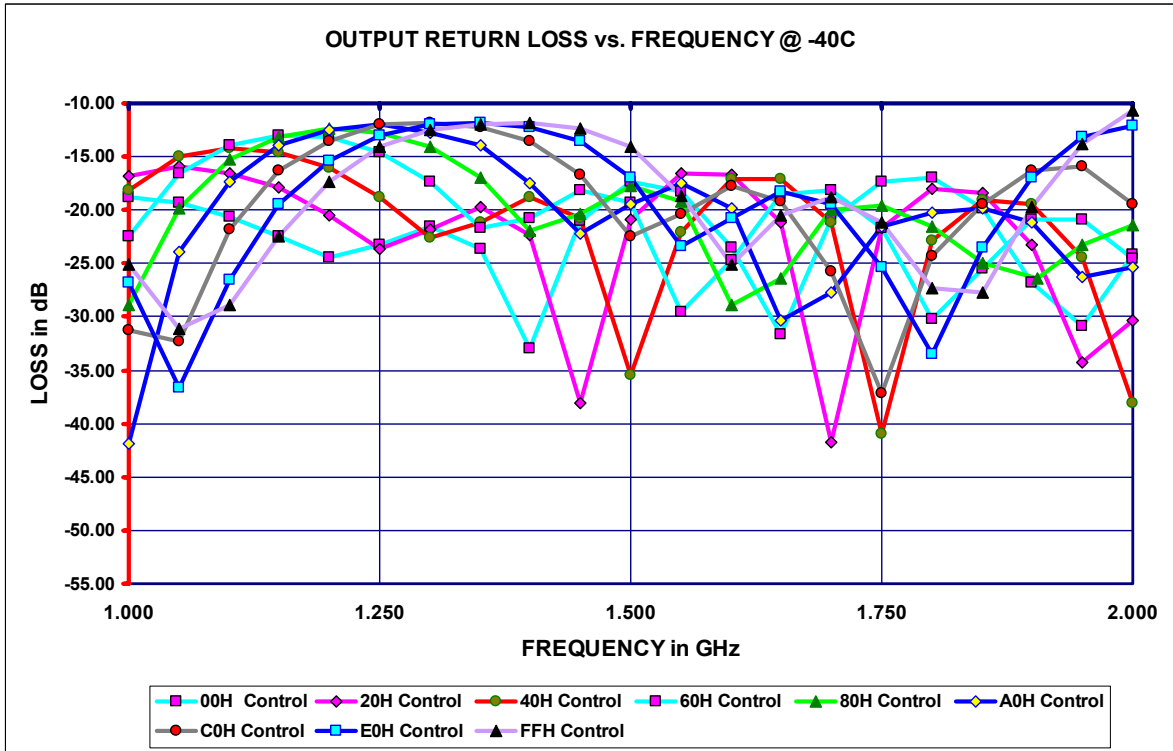
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OUTPUT RETURN LOSS IN dB AS MEASURED AT -40°C



| Frequency | 00H | 20H | 40H | 60H | 80H | A0H | C0H | E0H | FFH |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 1.000 | -18.80 | -16.80 | -18.10 | -22.50 | -28.90 | -41.90 | -31.30 | -26.80 | -25.10 |
| 1.050 | -19.30 | -15.90 | -15.00 | -16.60 | -19.90 | -23.90 | -32.30 | -36.60 | -31.10 |
| 1.100 | -20.60 | -16.50 | -14.20 | -14.00 | -15.20 | -17.40 | -21.80 | -26.50 | -28.90 |
| 1.150 | -22.40 | -17.90 | -14.60 | -13.00 | -13.10 | -14.00 | -16.30 | -19.50 | -22.50 |
| 1.200 | -24.40 | -20.50 | -16.10 | -13.20 | -12.40 | -12.50 | -13.50 | -15.40 | -17.30 |
| 1.250 | -23.20 | -23.60 | -18.80 | -14.60 | -12.70 | -12.00 | -12.00 | -13.00 | -14.10 |
| 1.300 | -21.50 | -21.80 | -22.60 | -17.30 | -14.10 | -12.70 | -11.80 | -12.00 | -12.50 |
| 1.350 | -23.70 | -19.70 | -21.10 | -21.70 | -16.90 | -13.90 | -12.20 | -11.90 | -12.00 |
| 1.400 | -32.90 | -22.30 | -18.80 | -20.70 | -21.90 | -17.50 | -13.50 | -12.20 | -11.80 |
| 1.450 | -21.00 | -38.10 | -20.70 | -18.10 | -20.30 | -22.20 | -16.70 | -13.50 | -12.30 |
| 1.500 | -17.30 | -20.90 | -35.50 | -19.30 | -17.70 | -19.50 | -22.40 | -16.90 | -14.10 |
| 1.550 | -18.30 | -16.60 | -22.10 | -29.50 | -19.20 | -17.50 | -20.30 | -23.40 | -18.70 |
| 1.600 | -23.50 | -16.70 | -17.10 | -24.70 | -28.90 | -19.80 | -17.70 | -20.80 | -25.10 |
| 1.650 | -31.70 | -21.20 | -17.10 | -18.50 | -26.40 | -30.30 | -19.20 | -18.30 | -20.50 |
| 1.700 | -20.90 | -41.80 | -21.20 | -18.10 | -20.00 | -27.70 | -25.80 | -19.50 | -18.80 |
| 1.750 | -17.40 | -21.70 | -40.90 | -21.70 | -19.60 | -21.60 | -37.10 | -25.40 | -21.20 |
| 1.800 | -16.90 | -18.00 | -22.90 | -30.20 | -21.50 | -20.20 | -24.30 | -33.50 | -27.30 |
| 1.850 | -19.90 | -18.40 | -19.00 | -25.50 | -25.00 | -19.80 | -19.40 | -23.50 | -27.70 |
| 1.900 | -26.80 | -23.20 | -19.40 | -20.90 | -26.40 | -21.10 | -16.30 | -16.90 | -19.70 |
| 1.950 | -30.80 | -34.30 | -24.40 | -20.90 | -23.30 | -26.30 | -15.90 | -13.20 | -13.80 |
| 2.000 | -24.20 | -30.40 | -38.10 | -24.50 | -21.40 | -25.40 | -19.40 | -12.10 | -10.70 |

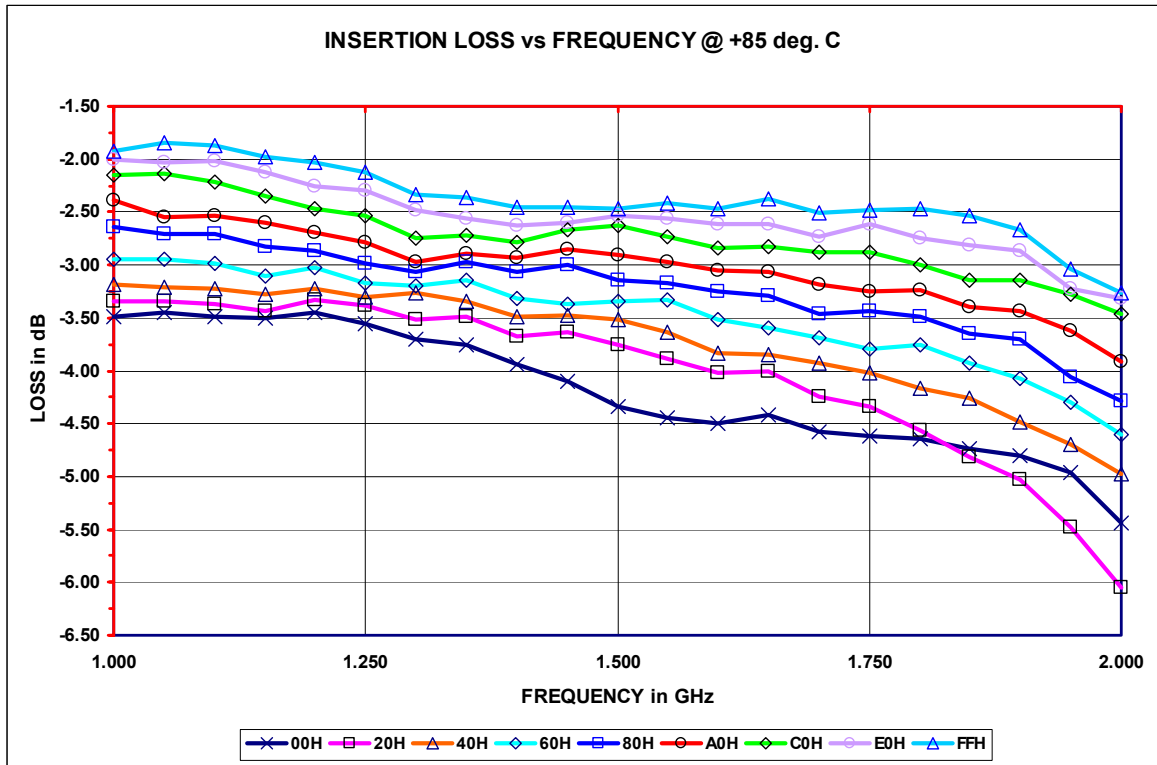
PLANAR MONOLITHICS INDUSTRIES, INC., 7311-G GROVE ROAD, FREDERICK, MD 21704

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INSERTION LOSS DATA IN dB AS MEASURED AT +85°C



| FREQUENCY | 00H | 20H | 40H | 60H | 80H | A0H | C0H | E0H | FFH |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 1.000 | -3.49 | -3.35 | -3.18 | -2.95 | -2.64 | -2.39 | -2.15 | -2.00 | -1.92 |
| 1.050 | -3.45 | -3.35 | -3.21 | -2.94 | -2.71 | -2.55 | -2.13 | -2.03 | -1.85 |
| 1.100 | -3.49 | -3.37 | -3.23 | -2.99 | -2.71 | -2.54 | -2.22 | -2.02 | -1.87 |
| 1.150 | -3.50 | -3.43 | -3.28 | -3.11 | -2.82 | -2.6 | -2.35 | -2.12 | -1.98 |
| 1.200 | -3.45 | -3.33 | -3.22 | -3.03 | -2.86 | -2.7 | -2.47 | -2.25 | -2.03 |
| 1.250 | -3.56 | -3.38 | -3.31 | -3.17 | -2.99 | -2.78 | -2.54 | -2.29 | -2.12 |
| 1.300 | -3.70 | -3.52 | -3.26 | -3.20 | -3.06 | -2.97 | -2.75 | -2.48 | -2.33 |
| 1.350 | -3.75 | -3.49 | -3.34 | -3.15 | -2.97 | -2.89 | -2.72 | -2.56 | -2.36 |
| 1.400 | -3.94 | -3.67 | -3.49 | -3.32 | -3.07 | -2.93 | -2.79 | -2.63 | -2.46 |
| 1.450 | -4.10 | -3.64 | -3.48 | -3.37 | -3 | -2.85 | -2.67 | -2.60 | -2.46 |
| 1.500 | -4.34 | -3.75 | -3.51 | -3.35 | -3.15 | -2.91 | -2.63 | -2.53 | -2.47 |
| 1.550 | -4.44 | -3.89 | -3.64 | -3.33 | -3.17 | -2.97 | -2.74 | -2.56 | -2.41 |
| 1.600 | -4.50 | -4.02 | -3.84 | -3.52 | -3.25 | -3.05 | -2.84 | -2.61 | -2.47 |
| 1.650 | -4.42 | -4.00 | -3.85 | -3.59 | -3.29 | -3.06 | -2.83 | -2.62 | -2.38 |
| 1.700 | -4.58 | -4.24 | -3.93 | -3.69 | -3.46 | -3.19 | -2.88 | -2.73 | -2.51 |
| 1.750 | -4.62 | -4.34 | -4.02 | -3.79 | -3.44 | -3.25 | -2.88 | -2.62 | -2.48 |
| 1.800 | -4.64 | -4.57 | -4.17 | -3.76 | -3.49 | -3.24 | -3 | -2.75 | -2.47 |
| 1.850 | -4.73 | -4.81 | -4.26 | -3.93 | -3.65 | -3.39 | -3.14 | -2.81 | -2.540 |
| 1.900 | -4.80 | -5.03 | -4.48 | -4.07 | -3.7 | -3.43 | -3.14 | -2.87 | -2.670 |
| 1.950 | -4.96 | -5.48 | -4.69 | -4.30 | -4.06 | -3.62 | -3.28 | -3.22 | -3.040 |
| 2.000 | -5.44 | -6.05 | -4.98 | -4.60 | -4.28 | -3.91 | -3.46 | -3.32 | -3.270 |

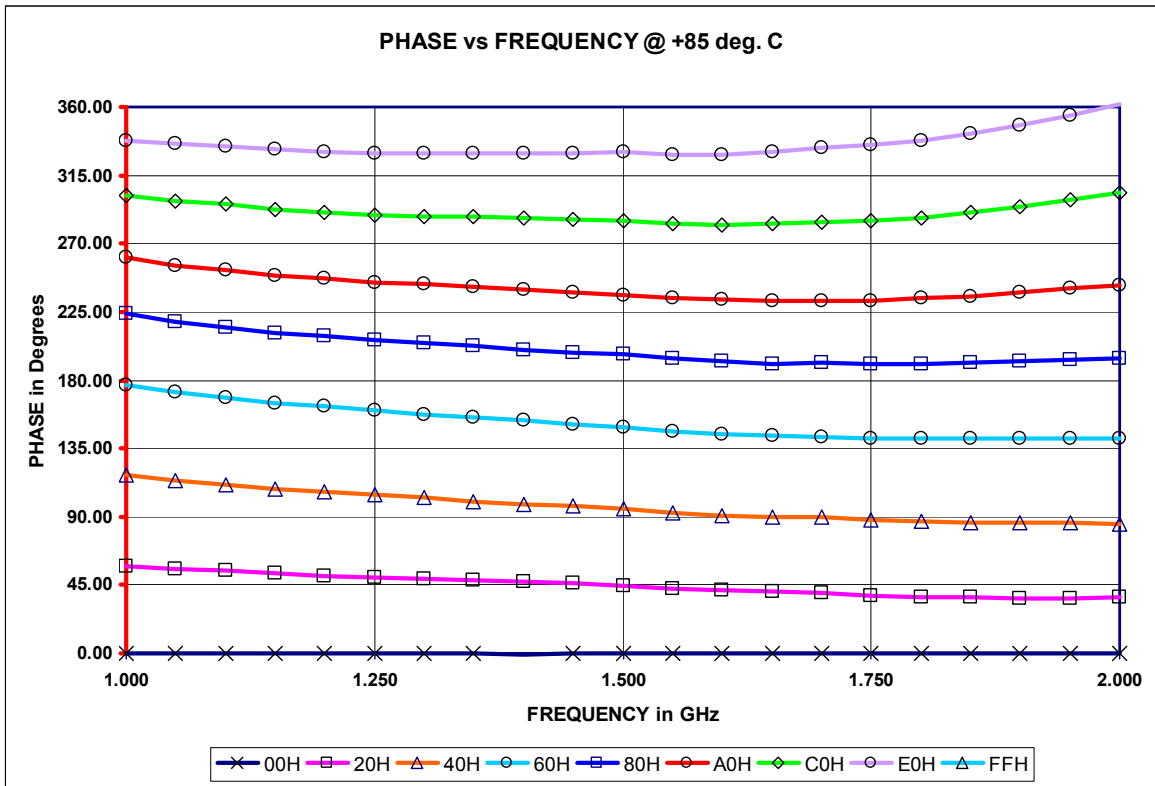
PLANAR MONOLITHICS INDUSTRIES, INC., 7311-G GROVE ROAD, FREDERICK, MD 21704

Tel: 301-631-1579 • Fax: 301-662-2029

Email: sales@planarmonolithics.com • Website: www.planarmonolithics.com



PHASE DATA IN DEGREES AS MEASURED AT +85°C



| FREQUENCY | 00H | 20H | 40H | 60H | 80H | A0H | C0H | E0H | FFH |
|-----------|-------|-------|--------|--------|-------|-------|-------|--------|---------|
| 1.000 | 0.20 | 57.70 | 117.20 | 176.50 | 223.5 | 260.6 | 301.9 | 338.20 | 370.90 |
| 1.050 | 0.10 | 55.70 | 113.90 | 171.80 | 218.8 | 255.8 | 298.4 | 335.90 | 369.30 |
| 1.100 | 0.40 | 54.50 | 111.00 | 168.50 | 215 | 253 | 295.7 | 333.80 | 368.70 |
| 1.150 | 0.40 | 52.40 | 108.50 | 165.10 | 211.1 | 248.8 | 292.7 | 331.90 | 366.90 |
| 1.200 | 0.10 | 51.20 | 106.50 | 162.50 | 208.9 | 246.9 | 290.8 | 330.30 | 367.20 |
| 1.250 | 0.10 | 50.10 | 104.50 | 159.90 | 206.4 | 244.2 | 288.9 | 329.60 | 367.00 |
| 1.300 | 0.10 | 49.10 | 102.50 | 157.70 | 204.8 | 243 | 287.9 | 329.20 | 367.30 |
| 1.350 | 0.30 | 48.20 | 100.10 | 155.40 | 202.7 | 241.4 | 287.4 | 329.20 | 367.70 |
| 1.400 | -0.60 | 47.10 | 98.50 | 153.30 | 200 | 239.5 | 286.5 | 329.00 | 368.50 |
| 1.450 | -0.20 | 46.00 | 97.20 | 150.80 | 198.5 | 237.7 | 285.9 | 329.80 | 369.90 |
| 1.500 | 0.40 | 44.80 | 95.40 | 149.30 | 196.8 | 236.2 | 284.7 | 330.00 | 371.60 |
| 1.550 | 0.00 | 42.60 | 92.40 | 146.30 | 194.1 | 233.8 | 282.9 | 328.70 | 371.80 |
| 1.600 | -0.10 | 41.20 | 90.80 | 144.50 | 192.2 | 232.8 | 282.5 | 328.90 | 373.10 |
| 1.650 | 0.10 | 40.50 | 89.80 | 143.30 | 191 | 232.5 | 283.1 | 330.30 | 375.10 |
| 1.700 | 0.30 | 39.70 | 89.60 | 142.90 | 191.3 | 232.4 | 284.3 | 333.00 | 379.00 |
| 1.750 | 0.00 | 37.80 | 87.70 | 142.00 | 190.5 | 232.5 | 285.2 | 335.10 | 381.90 |
| 1.800 | 0.10 | 37.20 | 86.90 | 141.50 | 190.9 | 233.8 | 286.9 | 337.70 | 386.20 |
| 1.850 | 0.20 | 36.90 | 86.30 | 141.60 | 191.5 | 235.5 | 290.7 | 342.10 | 392.300 |
| 1.900 | 0.30 | 36.40 | 86.10 | 141.70 | 192.9 | 237.8 | 294 | 347.70 | 398.300 |
| 1.950 | 0.30 | 36.50 | 85.90 | 142.00 | 193.1 | 240.2 | 299 | 354.50 | 406.000 |
| 2.000 | 0.40 | 37.10 | 84.70 | 141.50 | 194.8 | 242.5 | 303.6 | 361.80 | 415.800 |

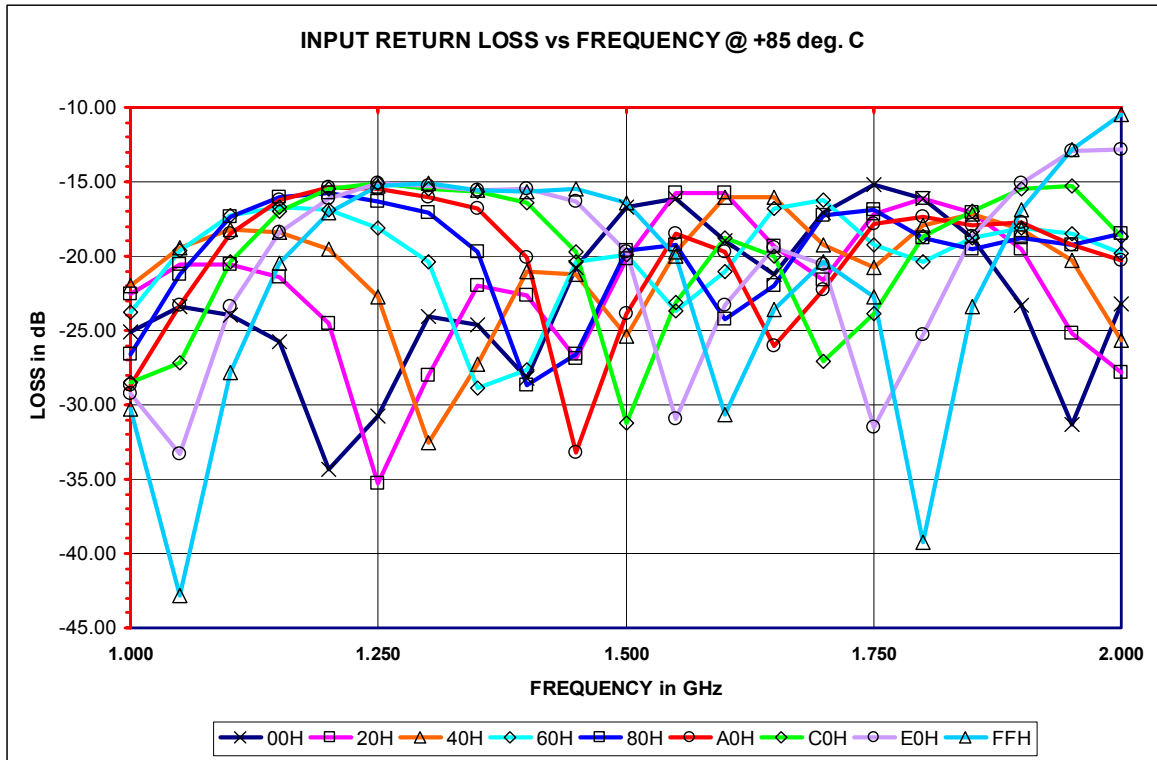
PLANAR MONOLITHICS INDUSTRIES, INC., 7311-G GROVE ROAD, FREDERICK, MD 21704

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INPUT RETURN LOSS IN dB AS MEASURED AT +85°C



| FREQUENCY | 00H | 20H | 40H | 60H | 80H | A0H | C0H | E0H | FFH |
|-----------|--------|--------|--------|--------|-------|-------|-------|--------|---------|
| 1.000 | -25.10 | -22.50 | -22.00 | -23.80 | -26.6 | -28.7 | -28.5 | -29.20 | -30.30 |
| 1.050 | -23.40 | -20.60 | -19.40 | -19.60 | -21.2 | -23.3 | -27.2 | -33.30 | -42.80 |
| 1.100 | -24.00 | -20.60 | -18.20 | -17.30 | -17.4 | -18.5 | -20.4 | -23.40 | -27.80 |
| 1.150 | -25.80 | -21.40 | -18.40 | -16.70 | -16 | -16.2 | -17 | -18.40 | -20.50 |
| 1.200 | -34.30 | -24.50 | -19.50 | -16.90 | -15.8 | -15.4 | -15.5 | -16.10 | -17.10 |
| 1.250 | -30.80 | -35.30 | -22.70 | -18.10 | -16.3 | -15.5 | -15.1 | -15.10 | -15.30 |
| 1.300 | -24.10 | -28.00 | -32.50 | -20.40 | -17.1 | -16 | -15.5 | -15.30 | -15.10 |
| 1.350 | -24.60 | -22.00 | -27.30 | -28.90 | -19.7 | -16.8 | -15.7 | -15.60 | -15.60 |
| 1.400 | -28.20 | -22.60 | -21.00 | -27.60 | -28.7 | -20.1 | -16.4 | -15.50 | -15.70 |
| 1.450 | -20.80 | -26.90 | -21.20 | -20.40 | -26.6 | -33.2 | -19.7 | -16.30 | -15.50 |
| 1.500 | -16.70 | -20.20 | -25.40 | -19.90 | -19.6 | -23.9 | -31.2 | -19.70 | -16.40 |
| 1.550 | -16.10 | -15.80 | -19.70 | -23.70 | -19.2 | -18.5 | -23.1 | -30.90 | -20.00 |
| 1.600 | -19.00 | -15.80 | -16.00 | -21.00 | -24.2 | -19.7 | -18.8 | -23.30 | -30.70 |
| 1.650 | -21.20 | -19.30 | -16.00 | -16.80 | -22 | -26 | -20 | -19.40 | -23.60 |
| 1.700 | -17.10 | -21.60 | -19.20 | -16.20 | -17.3 | -22.3 | -27.1 | -20.60 | -20.40 |
| 1.750 | -15.20 | -17.20 | -20.80 | -19.20 | -16.9 | -17.8 | -23.9 | -31.50 | -22.70 |
| 1.800 | -16.10 | -16.10 | -17.90 | -20.40 | -18.8 | -17.4 | -18.7 | -25.30 | -39.20 |
| 1.850 | -18.80 | -17.10 | -17.20 | -18.80 | -19.5 | -17.9 | -17 | -18.70 | -23.400 |
| 1.900 | -23.30 | -19.50 | -18.20 | -18.10 | -18.8 | -17.7 | -15.5 | -15.10 | -16.900 |
| 1.950 | -31.30 | -25.20 | -20.30 | -18.50 | -19.2 | -19.2 | -15.3 | -12.90 | -12.800 |
| 2.000 | -23.20 | -27.80 | -25.70 | -19.80 | -18.5 | -20.3 | -18.7 | -12.80 | -10.500 |

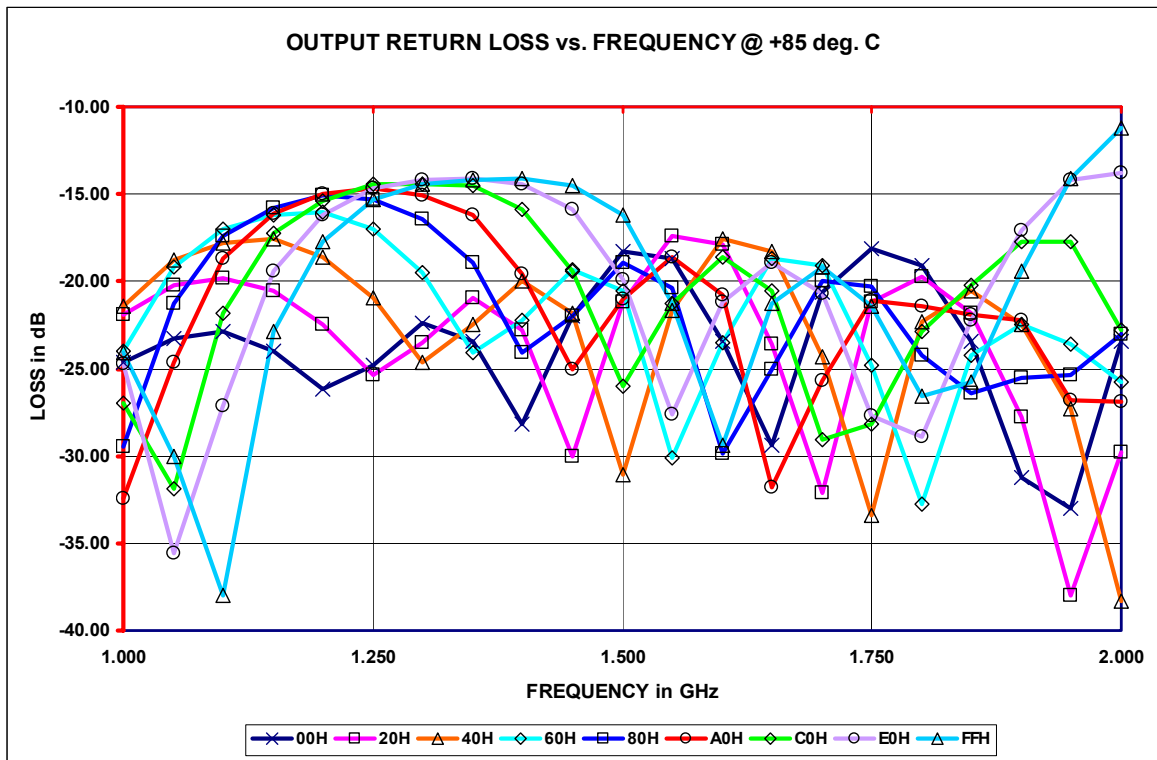
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OUTPUT RETURN LOSS IN dB AS MEASURED AT +85°C



| FREQUENCY | 00H | 20H | 40H | 60H | 80H | A0H | C0H | E0H | FFH |
|-----------|--------|--------|--------|--------|-------|-------|-------|--------|--------|
| 1.000 | -24.60 | -21.90 | -21.40 | -24.00 | -29.5 | -32.4 | -27 | -24.70 | -24.10 |
| 1.050 | -23.30 | -20.20 | -18.80 | -19.20 | -21.3 | -24.6 | -31.9 | -35.60 | -30.00 |
| 1.100 | -22.90 | -19.80 | -17.80 | -17.00 | -17.4 | -18.7 | -21.8 | -27.10 | -38.00 |
| 1.150 | -24.00 | -20.50 | -17.60 | -16.20 | -15.8 | -16.1 | -17.2 | -19.40 | -22.90 |
| 1.200 | -26.20 | -22.50 | -18.60 | -16.00 | -15.1 | -15 | -15.4 | -16.20 | -17.70 |
| 1.250 | -24.80 | -25.40 | -20.90 | -17.00 | -15.3 | -14.7 | -14.4 | -14.70 | -15.30 |
| 1.300 | -22.40 | -23.50 | -24.60 | -19.50 | -16.4 | -15.1 | -14.4 | -14.20 | -14.40 |
| 1.350 | -23.40 | -20.90 | -22.50 | -24.10 | -18.9 | -16.2 | -14.5 | -14.10 | -14.20 |
| 1.400 | -28.20 | -22.80 | -20.00 | -22.20 | -24.1 | -19.6 | -15.9 | -14.40 | -14.10 |
| 1.450 | -22.00 | -30.00 | -21.80 | -19.30 | -22 | -25 | -19.4 | -15.90 | -14.50 |
| 1.500 | -18.30 | -21.20 | -31.10 | -20.50 | -18.9 | -21 | -26 | -19.90 | -16.20 |
| 1.550 | -18.70 | -17.40 | -21.70 | -30.10 | -20.4 | -18.6 | -21.3 | -27.60 | -21.30 |
| 1.600 | -23.40 | -17.90 | -17.60 | -23.50 | -29.9 | -20.8 | -18.6 | -21.20 | -29.40 |
| 1.650 | -29.40 | -23.60 | -18.30 | -18.70 | -25 | -31.8 | -20.5 | -18.90 | -21.30 |
| 1.700 | -20.60 | -32.10 | -24.30 | -19.10 | -20 | -25.7 | -29.1 | -20.70 | -19.20 |
| 1.750 | -18.10 | -21.20 | -33.40 | -24.80 | -20.3 | -21.1 | -28.2 | -27.70 | -21.40 |
| 1.800 | -19.10 | -19.70 | -22.30 | -32.80 | -24.2 | -21.4 | -22.9 | -28.90 | -26.60 |
| 1.850 | -23.40 | -21.80 | -20.50 | -24.20 | -26.4 | -21.9 | -20.2 | -22.20 | -25.80 |
| 1.900 | -31.20 | -27.80 | -22.50 | -22.50 | -25.5 | -22.2 | -17.7 | -17.10 | -19.40 |
| 1.950 | -33.00 | -38.00 | -27.30 | -23.60 | -25.4 | -26.8 | -17.7 | -14.20 | -14.10 |
| 2.000 | -23.40 | -29.80 | -38.30 | -25.80 | -23 | -26.9 | -22.8 | -13.80 | -11.20 |

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PHASE SHIFTER RESPONSE TIME (SWITCHING SPEED)

SWITCHING SPEED — 0° TO 360°

Phase Shifter Switching response time.

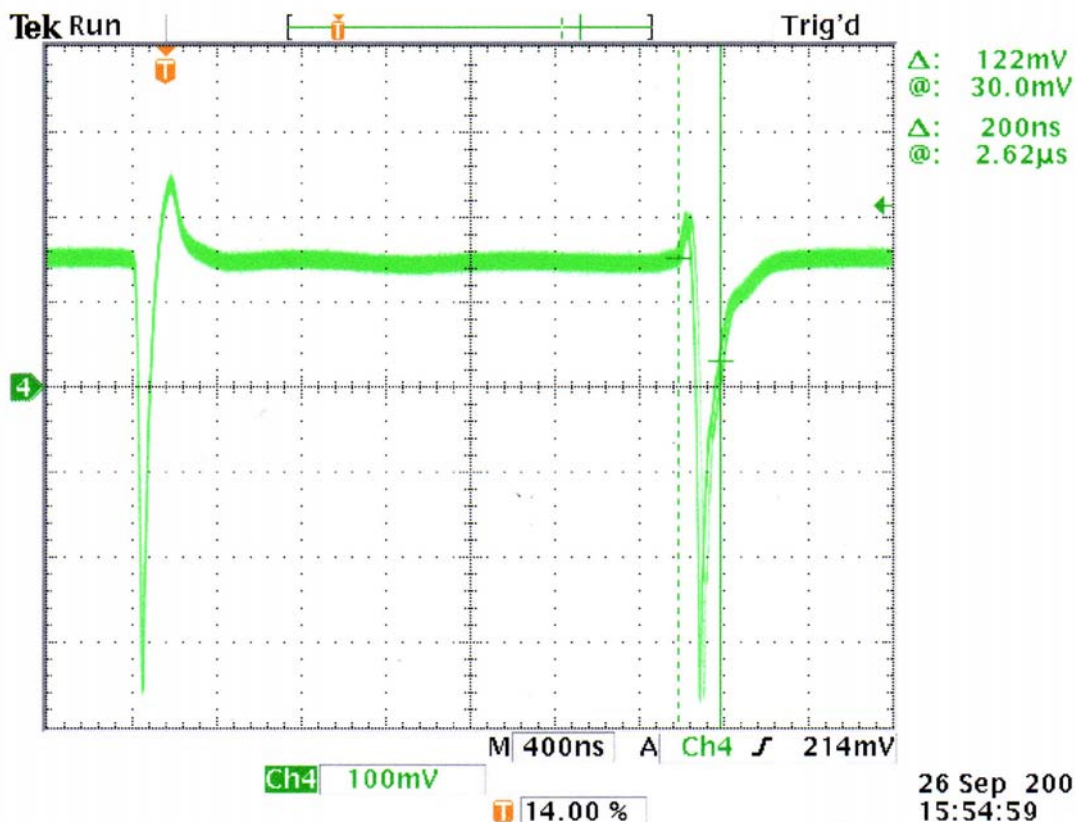
A mixer is used to produce an indicator of relative phase between two microwave signals. This test is carried out by dividing an input signal at 1.5GHz with a power divider. One signal is passed through the Phase Shifter then into the mixer. The other signal is connected as the LO of the mixer.

The output of the mixer is un-calibrated but is related to the relative phase of the two signals.

This shows the switching time of switching between different phase settings.

DIGITAL CODES 00H to FFH (Hexadecimal numbers = 8 bits)

APPROXIMATELY 0 to 360 degrees



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SWITCHING SPEED — 45° TO 315°

Phase Shifter Switching response time.

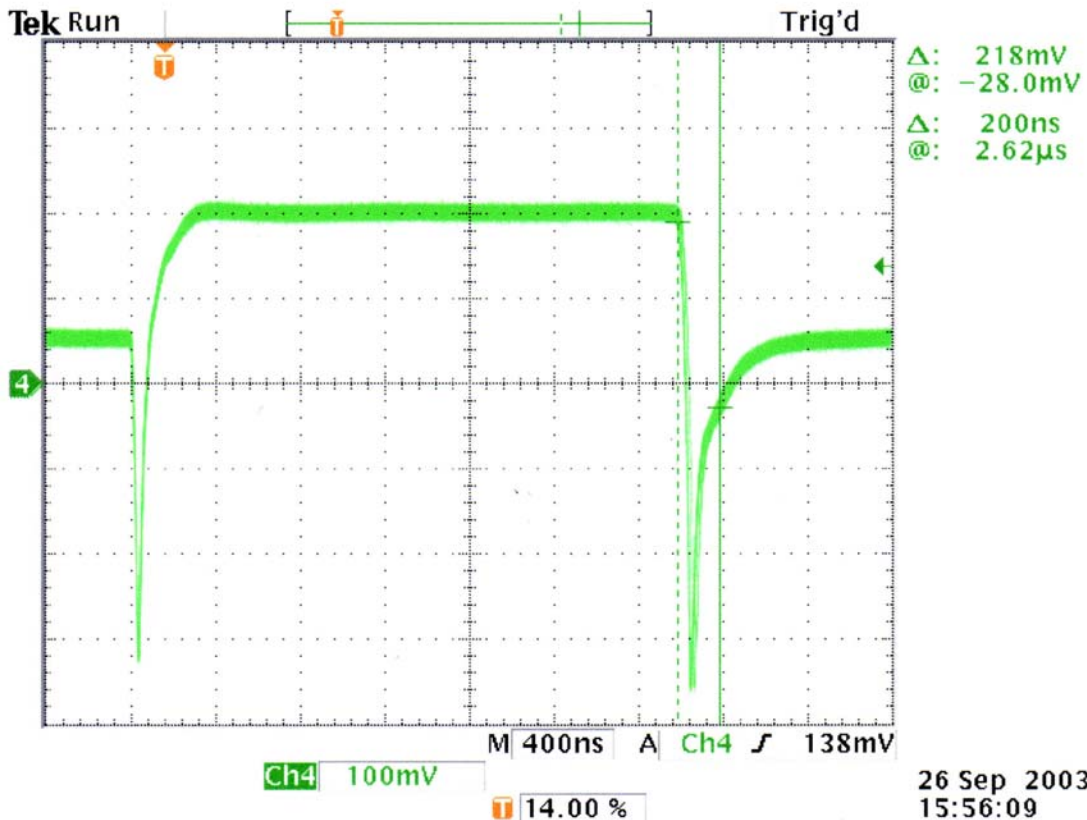
A mixer is used to produce an indicator of relative phase between two microwave signals. This test is carried out by dividing an input signal at 1.5GHz with a power divider. One signal is passed through the Phase Shifter then into the mixer. The other signal is connected as the LO of the mixer.

The output of the mixer is un-calibrated but is related to the relative phase of the two signals.

This shows the switching time of switching between different phase settings.

DIGITAL CODES 20H to E0H (Hexadecimal numbers = 8 bits)

APPROXIMATELY 45 to 315 degrees



SWITCHING SPEED — 90° TO 270°

Phase Shifter Switching response time.

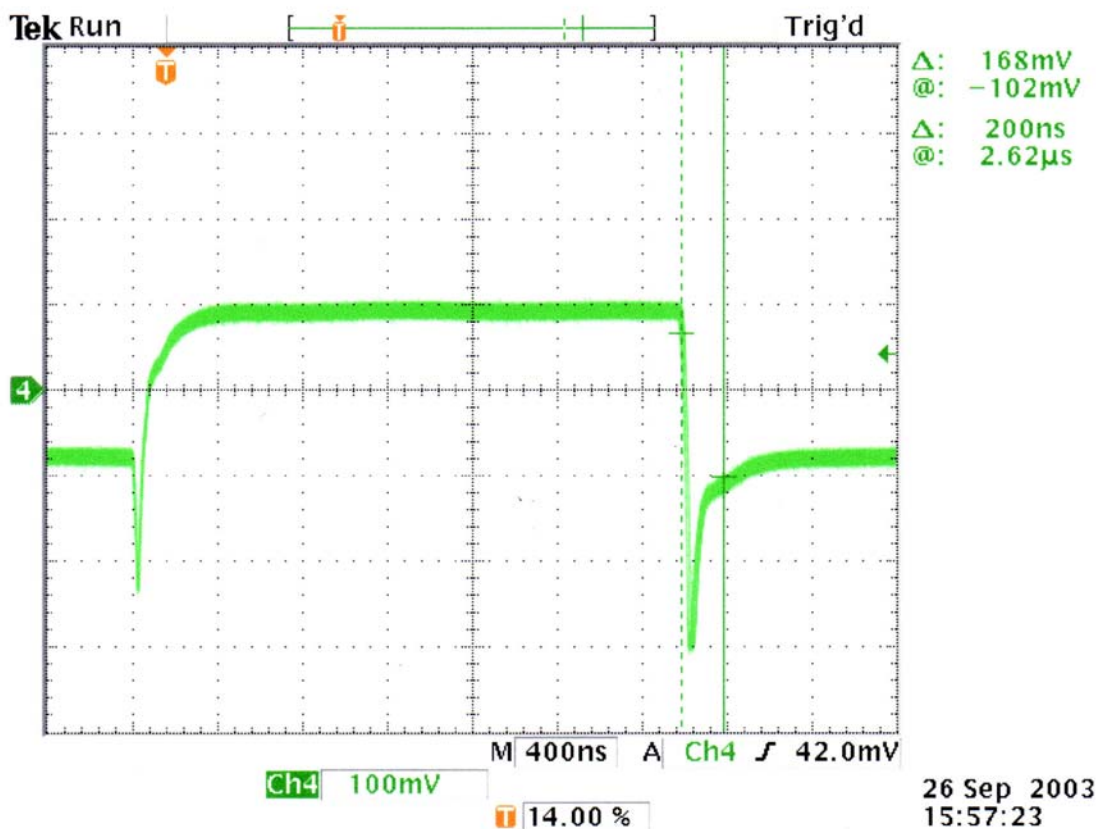
A mixer is used to produce an indicator of relative phase between two microwave signals. This test is carried out by dividing an input signal at 1.5GHz with a power divider. One signal is passed through the Phase Shifter then into the mixer. The other signal is connected as the LO of the mixer.

The output of the mixer is un-calibrated but is related to the relative phase of the two signals.

This shows the switching time of switching between different phase settings.

DIGITAL CODES 40H to C0H (Hexadecimal numbers = 8 bits)

APPROXIMATELY 90 to 270 degrees



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SWITCHING SPEED — 135° TO 225°

Phase Shifter Switching response time.

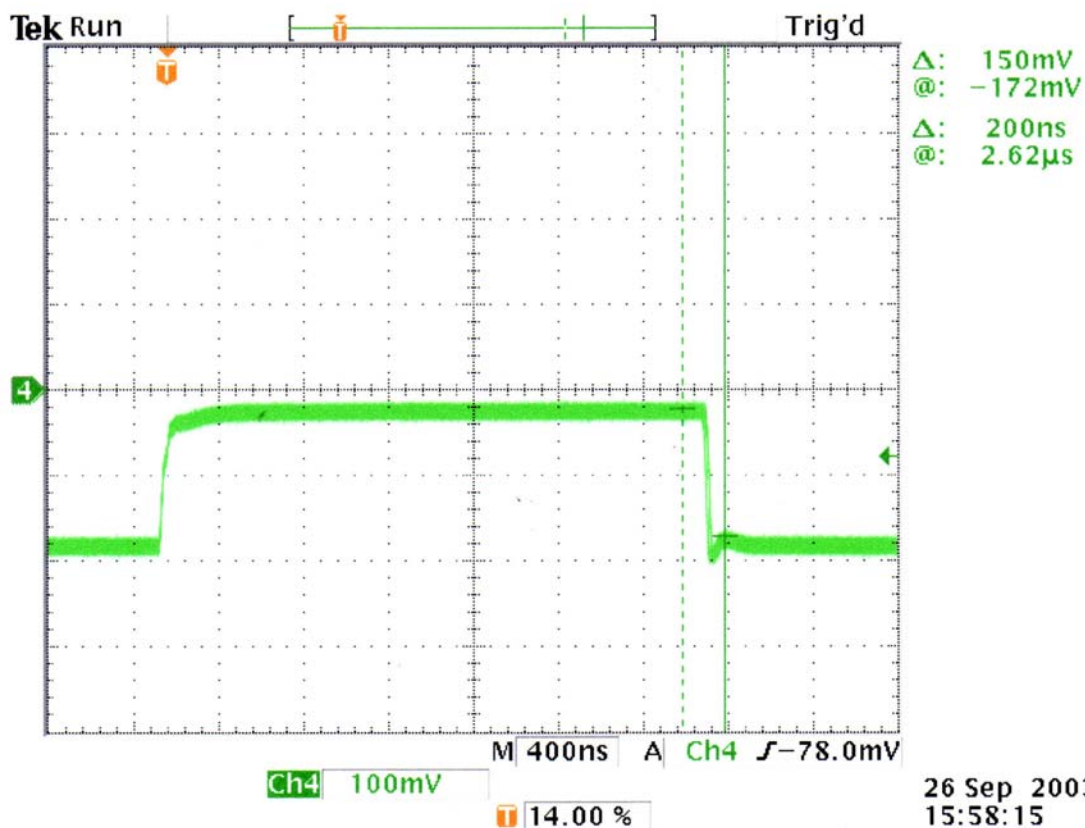
A mixer is used to produce an indicator of relative phase between two microwave signals. This test is carried out by dividing an input signal at 1.5GHz with a power divider. One signal is passed through the Phase Shifter then into the mixer. The other signal is connected as the LO of the mixer.

The output of the mixer is un-calibrated but is related to the relative phase of the two signals.

This shows the switching time of switching between different phase settings.

DIGITAL CODES 60H to A0H (Hexadecimal numbers = 8 bits)

APPROXIMATELY 135 to 225 degrees



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TEST DATA AS PRESENTED
TO THE CUSTOMER

FORM: 389-PHA1P2 10/03/03



PLANAR MONOLITHICS INDUSTRIES
 7311G GROVE ROAD, FREDERICK, MD 21704
 TEL: 301-631-1579 FAX: 301-662-4938
 http://www.planarmonolithics.com/pmi/

**SUMMARY TEST DATA
 ON
 8 BIT PHASE SHIFTER**

CUSTOMER: LOCKHEED MARTIN JOB NO: P21234E
 MODEL NO: PS-12-360 TESTED BY: STEVEN KUHN
 OPTION NO: QQ1470 TEMPERATURE: -40°C TO 85°C
 SERIAL NO: PM310104 DATE: 30 Sept 2003

| TEST ITEM NO: | PARAMETERS | MEASURED VALUE | REMARKS QA/QC |
|---------------|-----------------------------------|----------------------------|--|
| 1 | FREQUENCY RANGE: | 1.0 GHz TO 2.0 GHz | Q2 |
| 2 | RF IMPEDANCE (NOMINAL): | 50 | Q2 |
| 3 | VOLTAGE: | +15V @ 82mA -15V @ 58mA | Q2 |
| 4 | PHASE SHIFT (MIN): | 374° | Q2 |
| 5 | STEP SIZE (LSB): | 1.4° TYP. | Q2 |
| 6 | INSERTION LOSS (MAX): | 5.7 dB | Q2 |
| 7 | AMPLITUDE RIPPLE (MAX): | ±1.2 dB | Q2 |
| 8 | SWITCHING SPEED: | 200 nS TYP. | (10% TO 90% OF PHASE SHIFT) |
| 9 | TEMPERATURE DRIFT: (-40°C - 85°C) | 1% MAX | 1.00% @ CODE 80H, 1.5 GHz 0.26% @ CODE FFH, 1.5 GHz |
| 10 | MONOTONICITY | GUARANTEED | Q2 |
| 11 | RF POWER (OPERATING): | 10 mW | Q2 |

NOTE: Any additional test data on back

TESTED ON: HP0720C, TD93054, HPE3631A, Gigatronics 12000A
 QA/QC APPROVAL: [Signature] DATED: 10/03/03



PT49-PS-PW-1003



FORM: 389-PHA1P1 10/03/03

PLANAR MONOLITHICS INDUSTRIES
 7311G GROVE ROAD, FREDERICK, MD21704
 TEL: 301-631-1579 FAX: 301-662-4938
<http://www.planarmonolithics.com/pmi/>

**SUMMARY TEST DATA
 ON
 8 BIT PHASE SHIFTER**

CUSTOMER: LOCKHEED MARTIN JOB NO: P21234E
 MODEL NO: PS-12-360 TESTED BY: STEVEN KUHN
 OPTION NO: QQ1470 TEMPERATURE: -40°C TO 85°C
 SERIAL NO: PM310103 DATE: 25 Sept 2003

| TEST ITEM NO: | PARAMETERS | MEASURED VALUE | REMARKS QA/QC |
|---------------|-----------------------------------|----------------------------|--|
| 1 | FREQUENCY RANGE: | 1.0 GHz TO 2.0 GHz | Q2 |
| 2 | RF IMPEDANCE (NOMINAL): | 50 | Q2 |
| 3 | VOLTAGE: | +15V @ 87mA -15V @ 57mA | Q2 |
| 4 | PHASE SHIFT (MIN): | 369° | Q2 |
| 5 | STEP SIZE (LSB): | 1.4° TYP. | Q2 |
| 6 | INSERTION LOSS (MAX): | 5.9 dB | Q2 |
| 7 | AMPLITUDE RIPPLE (MAX): | ±1.4 dB | Q2 |
| 8 | SWITCHING SPEED: | 200 nS TYP. | (10% TO 90% OF PHASE SHIFT) |
| 9 | TEMPERATURE DRIFT: (-40°C - 85°C) | 3% MAX | 3.00% @ CODE 80H, 1.5 GHz 2.40% @ CODE FFH, 1.5 GHz |
| 10 | MONOTONICITY | GUARANTEED | Q2 |
| 11 | RF POWER (OPERATING): | 10 mW | Q2 |

NOTE: Any additional test data on back

TESTED ON: HP 8720C, TDS 3054, HP E3631A, 12000A *Gigatroni.*
 QA/QC APPROVAL: David V. Smith Q2 DATED: 10/03/03