| REVISIONS | | | | |
|---|---|---|---|---|
| ZONE | REV | DESCRIPTION | DATE | APPROVED |
| | A1 | ORIGINAL RELEASE | 05/05/17 | S. PALACIO |
| | A2 | MISCELLANEOUS UPDATES | 09/25/17 | S. PALACIO |
| | | | | |



***Planar Monolithics Industries, Inc.***
**7311-F GROVE ROAD**
**FREDERICK, MD 21704**

| | NAME: | DATE: |
|---|---|---|
| CONTRACT NO: | | |
| DRAWN: | M. Berry | 09/25/17 |
| CHECKED: | | |
| PROJ ENGR: | S. Palacio | 09/25/17 |
| PROG MGR: | | |
| MFG.ENGR: | | |
| QA ENGR: | J. Peacher | 09/25/17 |
| RELIABILITY: | | |

# ACCEPTANCE TEST PROCEDURE

MODEL: PMTO-8R8G9R56G-CD-1
PMI PART NO: 27331550

| | | | | |
|---|---|---|---|---|
| PMI | SIZE **A** | CAGE CODE **05XQ0** | DWG. NO. **28031550** | REVISION A2 |
| | SCALE | N/A | | SHEET 1 OF 16 |

# TABLE OF REVISIONS

| DESCRIPTION | DATE | PMI |
|---|---|---|
| ORIGINAL RELEASE | 05/05/17 | M. BERRY |
| MISCELLANEOUS UPDATES | 09/25/17 | M. BERRY |
| | | |
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| | | |
| | | |
| | | |

# TABLE OF CONTENTS

# TABLE OF TESTS

The following tests ***shall*** be performed and recorded on the 27631550 Test Data Sheet in the order below.

| TEST SEQUENCE | PARAMETER | VERIFICATION METHOD | | | % INSPECTED | SECTION |
|---|---|---|---|---|---|---|
| | | ALL | SAMPLE | BY DESIGN | | |
| 1 | RF Connectors | X | X | X | 100% | 4.9.1 |
| 2 | DC Connectors | X | X | X | | 4.9.2 |
| 3 | Dimensions & Mounting | X | X | X | | 4.9.5 |
| 4 | Finish | X | X | X | | 4.9.6 |
| 5 | Marking | X | X | X | | 4.9.7 |
| 6 | Power Supply Requirements | X | X | X | | 4.8 |
| 7 | Tuning Element/Mechanism | | | X | | 4.3 |
| | Run In | X | | | | 4.0 |
| 8 | Output Characteristics | X | X | X | | |
| 9 | Frequency Range | X | X | X | | |
| 10 | Power Output (Any Frequency) | X | X | X | | 4.2 |
| 11 | Tuning Capability | X | X | X | | 4.1 |
| 12 | FM Noise | X | | X | | 4.5 |
| 13 | Spurious & Harmonic Signals | X | X | X | | 4.4 |
| ANY | Long Term Frequency Drift | | X | X | SAMPLE | 4.6 |
| ANY | AM Noise | | X | X | | 4.5 |
| ANY | Pulling Factor | | X | X | | 4.7 |
| | Temperature Coefficient | | | X | | 4.6 |
| | Cooling | | | X | | 4.9.3 |
| | Weight | | | X | | 4.9.4 |
| | Environmental | | | X | | Appendix A |

## 1.0 SCOPE

This procedure defines the tests required for the acceptance of a PMI Model PMTO-8R8G9R56G-CD-1.

## 2.0 TEST EQUIPMENT

Test equipment ***shall*** be inspected for current calibration and serviceability. Test connectors ***shall*** be cleaned and inspected prior to test set connection. Coaxial test cables ***shall*** be inspected for proper impedance (i.e. 50 Ω coax for RF). **Test Equipment with equivalent or better specifications than the equipment defined in the table below may be substituted.** RF cables and adapters to be used as needed and proper calibration of test setup is required.

# TABLE OF EQUIPMENT

| ITEM NO | ITEM | MANUFACTURER | MODEL NUMBER |
|---|---|---|---|
| 1 | PNA NETWORK ANALYZER | AGILENT | N5230A |
| 2 | E-CAL MODULE | AGILENT | N4692A |
| 3 | DC POWER SUPPLY (TRIPLE OUTPUT) | AGILENT | E3631A |
| 4 | SIGNAL GENERATOR | KEYSIGHT | E8257D |
| 5 | POWER METER | GIGATRONICS | 8541C |
| 6 | POWER SENSOR (CW) | GIGATRONICS | 80325A |
| 7 | POWER SENSOR (PEAK) | GIGATRONICS | 80355A |
| 8 | POWER SENSOR (MODULATED) | GIGATRONICS | 80425A |
| 9 | TWT AMPLIFIER | CPI | VZM6993J5 (Base 250W Model) |
| 10 | CIRCULATOR | PMI | RMCI.12-18Sf |
| 11 | 50 Ω HIGH POWER LOAD | PMI | 1431-2 |
| 12 | WAVEFORM GENERATOR | AGILENT | 33522A |
| 13 | OSCILLOSCOPE | AGILENT | MSOX3034A |
| 14 | DETECTOR (CRYSTAL OR DIODE) | PMI | DD-20-218-5PF-3-P-M-OPT0518 |
| 15 | PERSONAL COMPUTER (PC) | | |
| 16 | DIGITAL MULTIMETER (DMM) | AGILENT | 34401A |
| 17 | HIGH PASS FILTER | PMI | HP2G-1780-CD-SS |
| 18 | THERMAL PLATFORM (HOT/COLD PLATE) | ESS | T650 |
| 19 | 20 dB FIXED ATTN (200 W CW, 1 kW PEAK) | PMI | WA95-20-43 |
| 20 | 30 dB FIXED ATTN (200 W CW, 1 kW PEAK) | PMI | WA95-30-43 |
| 21 | 3 Hz – 50 GHz PXA SPECTRUM ANALYZER | KEYSIGHT | N9030A |

## 3.0 GENERAL REQUIREMENTS

Evidence supporting successful completion of in-process testing (ESS Testing) ***shall*** be verified prior to formal acceptance testing. The Device Under Test, or DUT, ***shall*** be closed prior to formal acceptance test to provide a tamper proof seal. At any point during testing a unit does not meet the required specifications, testing ***shall*** be manually or automatically (dependent on availability of automated setup) stopped.

### 3.1 TEST CONDITIONS

Unless specified otherwise, testing ***shall*** be performed at an ambient temperature of 25 °C ± 3°C. The DUT ***shall*** be conductively cooled in a manner that maintains the DUT case temperature within the specified ambient temperature window. PMI will test the DUT on a thermal platform (Item #18) to ensure temperature is regulated. Initial characterization to include all Section 4.0 test parameters listed below; the measured values may vary but will meet specifications over the operating temperature range.

### 3.2 TEST FAILURE

If test failure is indicated, the test program for the DUT ***shall*** be stopped by the technician. The cognizant engineering and quality representatives ***shall*** be notified. The engineering and quality representatives ***shall*** assess the failure to assign cause. A written course of action ***shall*** be developed by engineering and quality to determine the root cause of the failure.

## 4.0 TEST PROCEDURE

In order to verify that the design of the DUT achieves the desired specification requirements the device must be tested and the results recorded. The following procedures and techniques will be followed using the various layout diagrams illustrated below. All tests to be performed over the 8.8 to 9.56 GHz frequency range unless otherwise noted.

*Prior to test, the tuner element **shall** be exercised in a smooth, continuous manner from low band edge to upper band edge ten times as an initial "break-in". Measurements are to be taken after 15-min warm up.*

### 4.1 TUNING SENSITIVITY & SENSITIVITY DEVIATION

a) Clear the Spectrum Analyzer (Item #21) of all preexisting settings.
b) Set the Spectrum Analyzer from 8.8 to 9.6 GHz.
c) Connect cables to the DUT as seen in Figure 1 and display Frequency vs Power.
d) Turn the Tuning Mechanism clockwise/down until the RF Output Frequency reads 8.9 GHz. (the starting torque for the mechanical tuning element ***shall not*** exceed 25 in. oz. maximum)
e) Note the Tuning Mechanism position using the graduations on the label.
f) Rotate the Tuning Mechanism counterclockwise/up and record the RF Output Frequency at each 180° interval until reaching the upper limit of 9.46 GHz.
g) Repeat for second RF output.

Tuning Sensitivity ***shall*** be defined as the slope of the trendline of the data – the limits of which can be seen in Figure 2. The unit's Sensitivity Deviation ***shall*** be defined as the maximum difference in MHz from the trendline – the limits of which can be seen in Figures 3 and 4.

## 4.2 POWER OUTPUT

a) Clear the Spectrum Analyzer (Item #21) of all preexisting settings.
b) Set the Spectrum Analyzer from 8.8 to 9.6 GHz.
c) Connect cables to the DUT as seen in Figure 1 and display Frequency vs Power.
d) Hold maximum point on spectrum analyzer and starting from 8.8 GHz, rotate the Tuning Mechanism to the upper limit. Record for both RF outputs.

## 4.3 TUNING ELEMENT

a) Rotate the tuning mechanism clockwise until stop.
b) Using a torque sensor or gauge, apply 100 in-oz (0.52 ft-lbs) to the tuning mechanism.
c) Rotate the tuning mechanism counterclockwise until stop, and repeat. Record pass/fail criteria.

## 4.4 SPURIOUS HARMONIC SIGNALS

a) Clear the Spectrum Analyzer (Item #21) of all preexisting settings.
b) Set the Spectrum Analyzer from 8.0 to 20.0 GHz.
c) Connect cables to the DUT as seen in Figure 1 and display Frequency vs Power.
d) Measure the Spurs & Harmonic dBc values of other peak frequencies.
e) Perform measurements at the lower limit, midband, and upper limit of both RF outputs.

## 4.5 NOISE (AM/FM) – PASS BY DESIGN

The Noise ***shall*** be less than the limits shown in on Page 12.

## 4.6 TEMPERATURE COEFFICIENT & LONG TERM FREQUENCY DRIFT

a) Clear the Spectrum Analyzer (Item #21) of all preexisting settings.
b) Set the Spectrum Analyzer from 8.8 to 9.6 GHz.
c) Connect cables to the DUT as seen in Figure 1 and display Frequency vs Power.
d) Set the DUT to midband (~9.1 GHz). After 1 hour, record Long Term Frequency Drift.
e) Repeat for second RF output.
f) Using the Thermal Platform (Item #18), cool the DUT to 0°C, then heat to 50°C.
g) Record the Temperature Coefficient at each 5°C interval. Repeat for second RF output.

## 4.7 PULLING FACTOR – PASS BY DESIGN

For load VSWR of 1.5:1 for all phases at both outputs, the Pulling Factor ***shall*** be less than 50 kHz.

## 4.8 POWER SUPPLY (CURRENT DRAW)

a) Set the Power Supply (Item #3) current limits to 1.5 Amps.
b) Connect DC cables to DUT as labeled on the unit and record Current Drawn.

## 4.9 MECHANICAL, MARKING, & WORKMANSHIP

### 4.9.1 RF CONNECTORS
RF connectors ***shall*** be type SMA female meeting the requirements of MIL-C-39012.

### 4.9.2 DC POWER CONNECTORS
DC power connectors ***shall*** be EMI solder terminals.

### 4.9.3 COOLING
The unit ***shall*** require no means of cooling other than conduction cooling by mounting on customer's heat sink which will maintain 0°C to 65°C.

### 4.9.4 WEIGHT
2.4 pounds maximum.

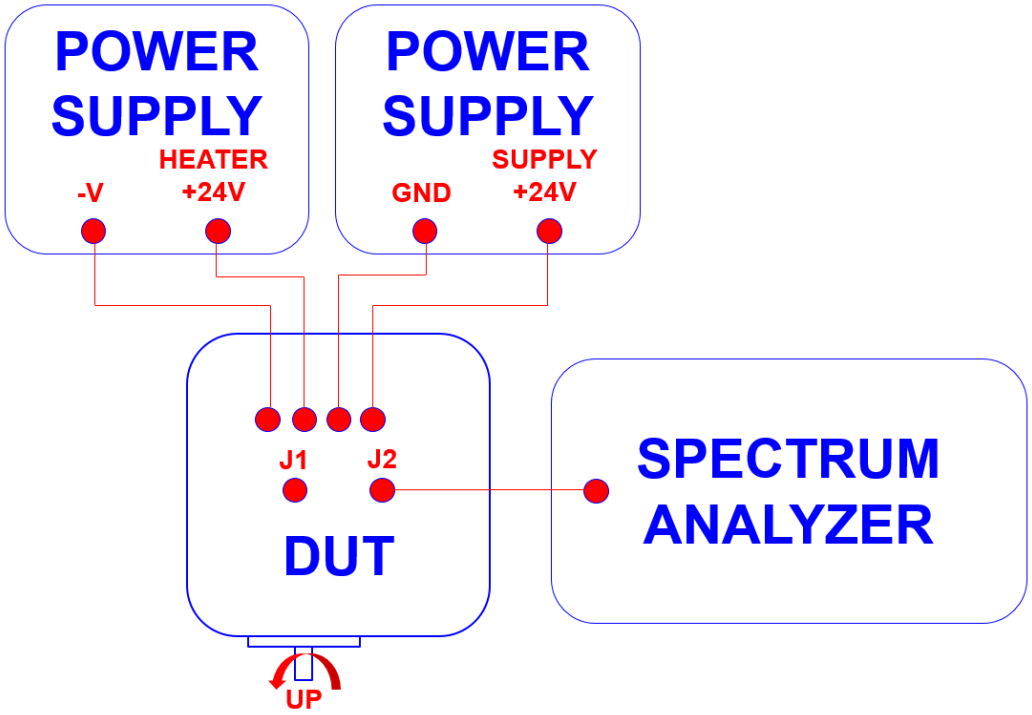
### 4.9.5 DIMENSIONS AND MOUNTING
Per Figure 1 of SCD #5399619.

### 4.9.6 FINISH
Chemical film per MIL-C-5541 Class 1A.

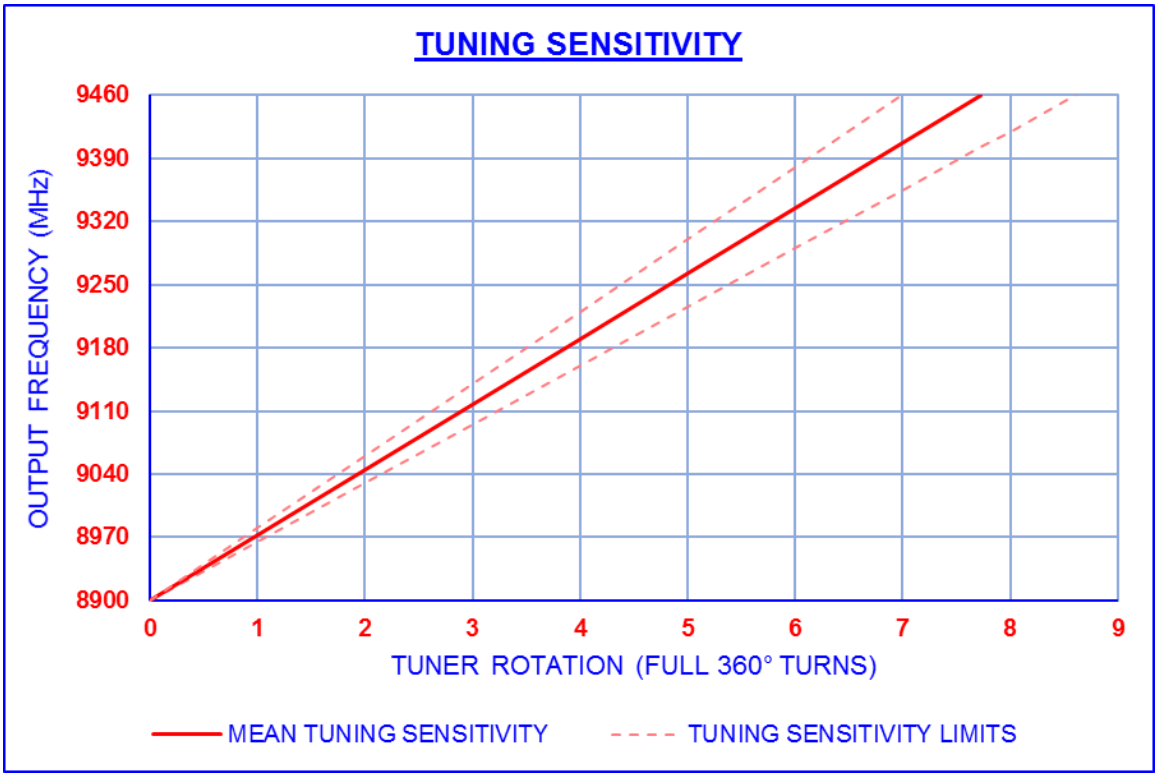
### 4.9.7 MARKING
Each oscillator ***shall*** be marked with the manufacturer's code identification number, name or registered trademark, and part number in accordance with MIL-STD-130.

## 5.0 FIGURES/TEST DIAGRAMS

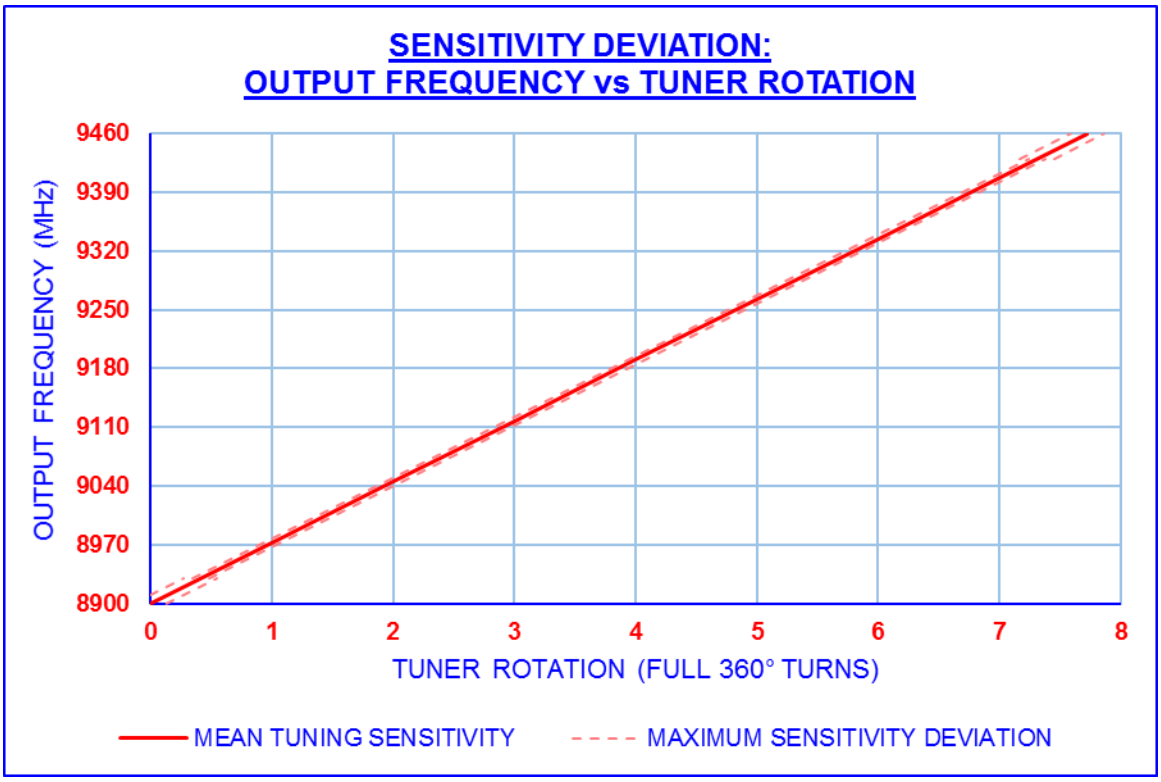
### FIGURE 1 – TEST CONFIGURATION FOR TESTS 4.1 – 4.9



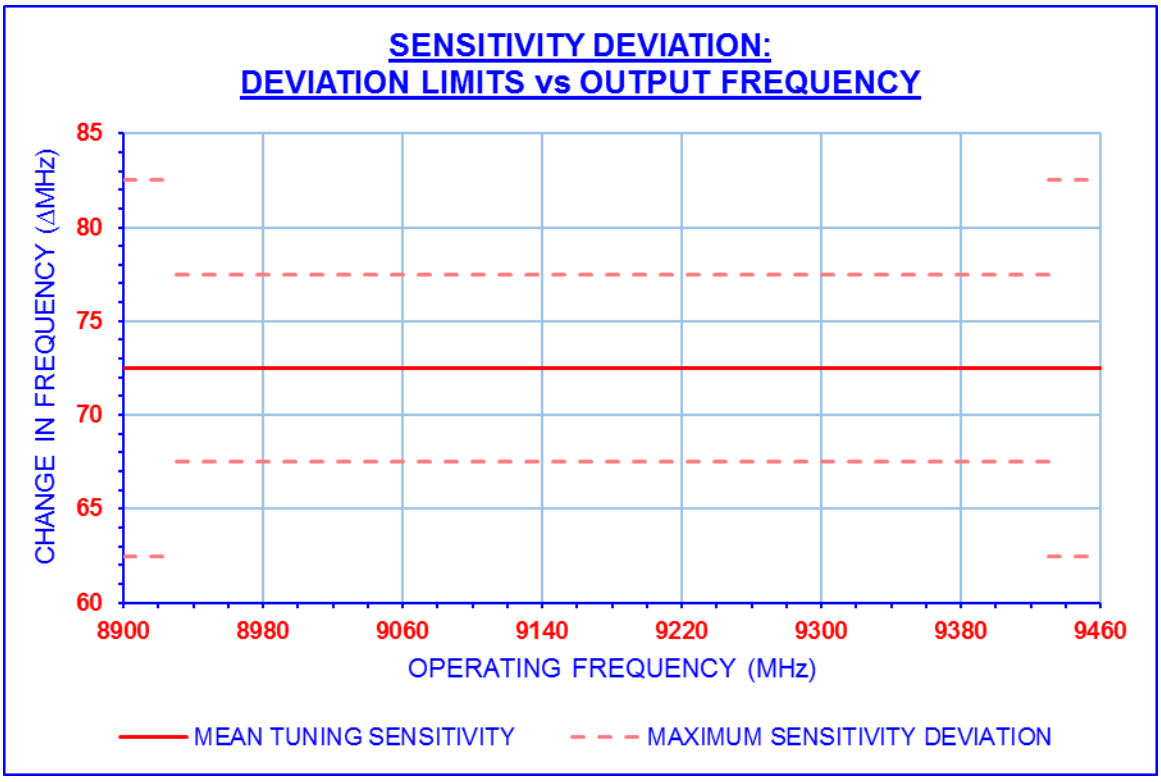

### FIGURE 2 – TEST PROCEDURE 4.1, TUNING SENSITIVITY



## FIGURE 3 – TEST PROCEDURE 4.1, TUNING SENSITIVITY DEVIATION




## FIGURE 4 – TEST PROCEDURE 4.1, TUNING SENSITIVITY DEVIATION



## 6.0 TEST DATA SHEET

**SUMMARY TEST DATA**
**ON**
**PMTO-8R8G9R56G-CD-1**

| | | | | | |
|---|---|---|---|---|---|
| **Customer:** | | **Tested By:** | XXXXXXXX | | |
| **SO No:** | | **Temperature:** | +25°C | | |
| **Model No:** | PMTO-8R8G9R56G-CD-1 | **Date:** | MM/DD/YYYY | | |
| **Serial No:** | PLXXXXX/YYWW | **Drawing No:** | 27631550 | **Rev:** | A2 |

| TEST ITEM | PARAMETERS | SPECIFIED VALUE | TEST RESULTS | QA QC |
|---|---|---|---|---|
| 1 | Frequency Range | 8.8 to 9.56 GHz (Tuning)<br>8.9 to 9.46 GHz (Specifications) | **GHz** | |
| 2 | Tuning Sensitivity | 65 MHz/360° MIN<br>80 MHz/360° MAX | **MHz/360°**<br>**MHz/360°** | |
| 3 | Output Frequency vs Tuner Rotation | ±10 MHz (8.90 to 8.93 GHz)<br>±5 MHz (8.93 to 9.43 GHz)<br>±10 MHz (9.43 to 9.46 GHz) | **MHz**<br>**MHz**<br>**MHz** | |
| 4 | Power Output (Any Frequency) | J1: +10 (+3, -0) dBm<br>J2: 0 (+3, -0) dBm | **dBm**<br>**dBm** | |
| 5 | Tuning Element | Starting Torque: 25 inch-oz MAX<br>Withstanding Torque: 100 inch-oz MIN | **inch-oz**<br>**inch-oz** | |
| 6 | Spurious Harmonic Signals | 60 dBc MIN (IN BAND)<br>45 dBc MIN (OUT OF BAND)<br>30 dBc MIN (HARMONICS) | **dBc**<br>**dBc**<br>**dBc** | |
| 7 | Noise | See Plots Below | | |
| 8 | Temperature Coefficient | 15 kHz/°C MAX from 0°C to +50°C | **kHz/°C** | |
| 9 | Long Term Frequency Drift | 50 kHz/hr MAX @ any constant temperature from 0°C to +50°C | **kHz/hr** | |
| 10 | Pulling Factor | <50 kHz | **kHz** | |
| 11 | Regulator/Oscillator Power Supply | +24±1 VDC @ 1.5 A MAX<br>2% Regulation, Ripple = 2 mVrms | **+24±1 @ ____ A** | |
| 12 | Heater Power Supply | +24±1 VDC @ 1.5 A MAX<br>2% Regulation, Ripple = 50 mVrms | **+24±1 @ ____ A** | |
| 13 | Weight | 2.4 lbs MAX | **lbs** | |

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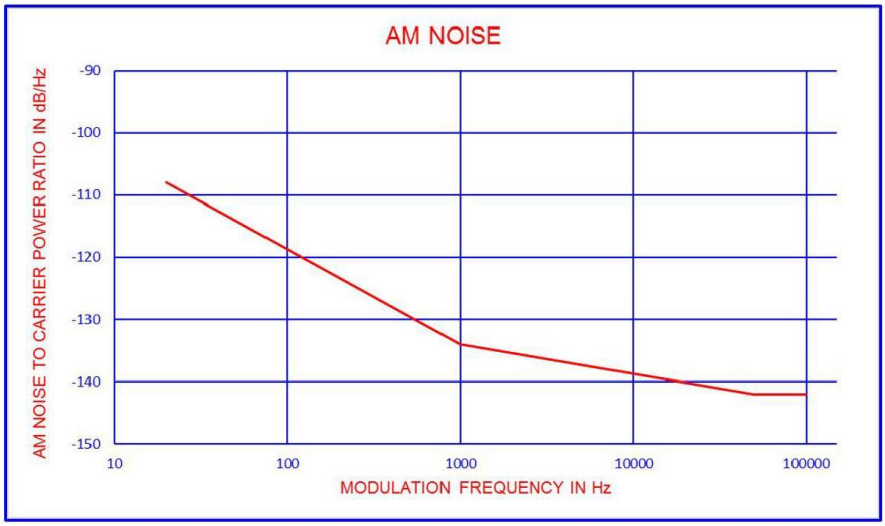
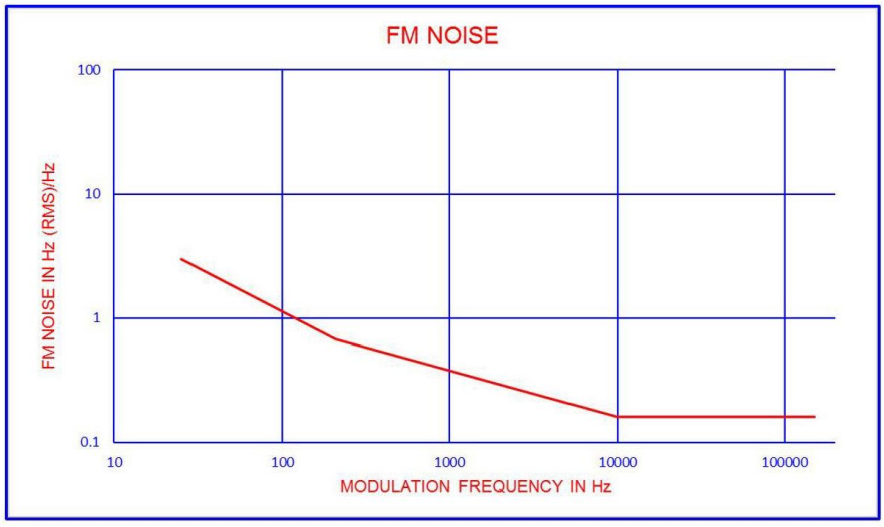
Email: sales@pmi-rf.com

**SUMMARY TEST DATA**
**ON**
**PMTO-8R8G9R56G-CD-1**




**QA/QC Approval:** _____ **Date:** _____

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Email: sales@pmi-rf.com

# 7.0 OUTLINE DRAWING

## DESCRIPTION

PMI MODEL: PMTO-8R8G9R56G-CD-1 IS A TEMPERATURE STABILIZED OUTPUT MEDIUM POWER X-BAND GUNN-EFFECT OSCILLATOR FOR USE AS AN RF SIMULATOR SIGNAL GENERATOR. THIS UNIT CONTAINS A PRECISION VOLTAGE REGULATOR, A LOW-NOISE GUNN-EFFECT OSCILLATOR MOUNTED ON A THERMAL PLATFORM WITH INTEGRAL LOAD ISOLATORS FOR EACH OF THE RF OUTPUTS AND A SOLID STATE PROPORTIONAL TEMPERATURE CONTROLLER ALONG WITH ASSOCIATED HEATERS AND TEMPERATURE SENSOR. THIS UNIT SHALL ME ALL REQUIREMENTS LISTED BELOW AFTER A 15 MINUTE WARMUP WITH ALL OUTPUTS TERMINATED IN A 50 Ω LOAD WITH A VSWR OF 1.5:1 FOR ALL PHASES OVER THE OPERATING RANGE. THE UNIT SHALL BE CAPABLE OF WITHSTANDING, WITHOUT DAMAGE OR PERMANENT DEGRADATION OF PERFORMANCE, ANY TEMPORARY EXTREME LOAD CONDITION; I.E., SHORT OR OPEN CIRCUIT.

## SPECIFICATIONS

- FREQUENCY RANGE: ---------- 8.8 TO 9.56 GHz (TUNING)
  8.9 TO 9.46 GHz (TO MEET SPECIFICATION)
- TUNING SENSITIVITY: ---------- 65 MHz/360° ROTATION MIN
  80 MHz/360° ROTATION MAX
- OUTPUT FREQ. VS TUNER ROTATION: -- ±10 MHz, 8.90 TO 8.93 GHz
  ±5 MHz, 8.93 TO 9.43 GHz
  ±10 MHz, 9.43 TO 9.46 GHz
- POWER OUTPUT (ANY FREQUENCY): ---- J1: +10 (+3, -0) dBm
  J2: 0 (+3, -0) dBm
- TUNING ELEMENT: ---------- STARTING TORQUE: 25 INCH-OZ MAX
  WITHSTANDING TORQUE: 100 INCH-OZ MIN @ STOPS
- SPURIOUS HARMONIC SIGNALS: --------- 60 dBc MINIMUM (IN BAND)
  45 dBc MINIMUM (OUT OF BAND)
  30 dBc MINIMUM (HARMONICS)
- NOISE: ---------- SEE PLOTS
- TEMPERATURE COEFFICIENT: ---------- 15 kHz/°C MAX FROM 0°C TO +50°C
- LONG TERM FREQUENCY DRIFT: --------- 50 kHz/hr MAX @ ANY CONSTANT TEMP FROM 0°C TO +50°C
- PULLING FACTOR: ---------- LESS THAN 50 kHz
- REG/OSC POWER SUPPLY: ---------- +24±1 VDC @ 1.5 A MAX, 2% REGULATION, RIPPLE = 2 mVrms
- HEATER POWER SUPPLY (ISOLATED): -- +24±1 VDC @ 1.5 A MAX, 2% REGULATION, RIPPLE = 50 mVrms
- CONNECTORS: ---------- SMA FEMALE 2 PLACES
- SIZE (EXCLUDING CONNECTORS): ------- 3.50" x 3.50" x 3.00"
  88.9 mm x 88.9 mm x 76.2 mm
- WEIGHT: ---------- 2.4 lbs [1088.7 g] MAX
- FINISH: ---------- CHEMICAL FILM PER MIL-C-5541 CLASS 1A

## ENVIRONMENTAL RATINGS

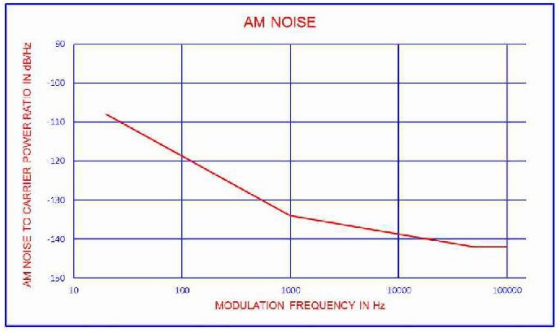
- TEMPERATURE: ---------- MIL-F-18870 (OS) CLASS 4 EQUIPMENT
  -0 °C TO +50 °C (OPERATING)
  -62 °C TO +75 °C (NON-OPERATING)
- HUMIDITY: ---------- MIL-F-18870 (OS) CLASS 4 EQUIPMENT
- SHOCK: ---------- 30G, 11ms, 3 HALF-SINE SHOCKS, 3-AXIS
  (±1 MHz FREQUENCY SHIFT MAXIMUM)
- VIBRATION: ---------- MIL-STD-167 TYPE I

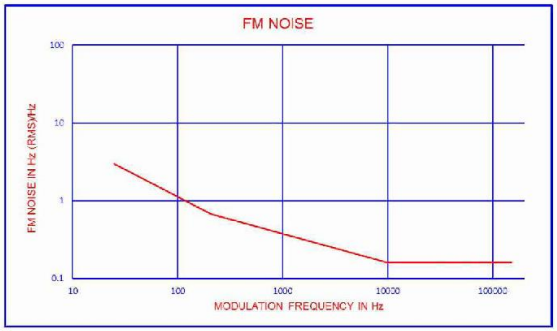
NOTE: SPECIFICATIONS WILL VARY OVER OPERATING TEMPERATURE

NOTE: THE ABOVE SPECIFICATIONS ARE SUBJECT TO CHANGE OR REVISION



| REVISIONS | | | | |
|---|---|---|---|---|
| ZONE | REV. | DESCRIPTION | DATE | APPROVED |
| | 1 | ORIGINAL RELEASE | 05/08/17 | |
| | 2 | MISCELLANEOUS UPDATES | 09/26/17 | |
| | | | | |

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ISO 9001 CERTIFIED

| APPROVALS | DATE |
|---|---|
| DRAWN M. Berry | 05/08/17 |
| CHECKED | |
| ISSUED | |

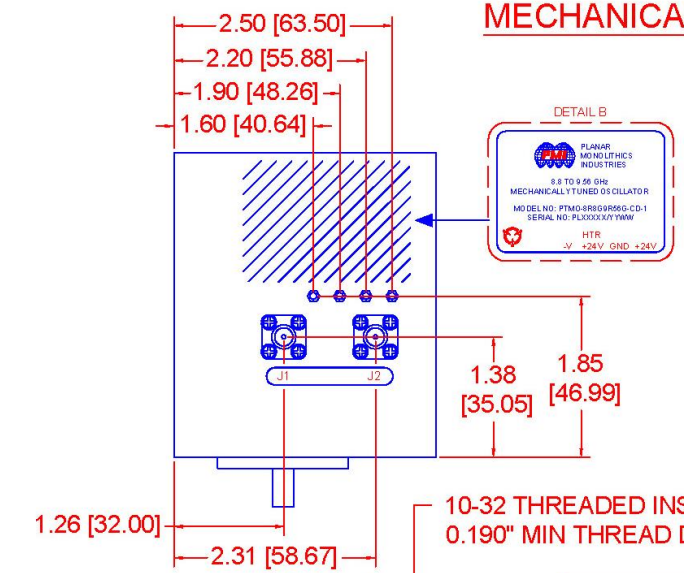
TITLE: PRODUCT FEATURE
PMTO-8R8G9R56G-CD-1
8.8 to 9.56 GHz Mechanically Tuned Oscillator

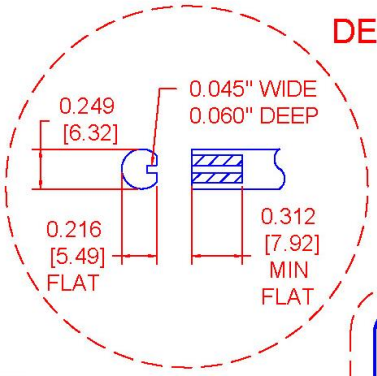
| SIZE | FSCM NO. | DWG NO. | REV. |
|---|---|---|---|
| A | 05XQ0 | 27031550 | 2 |

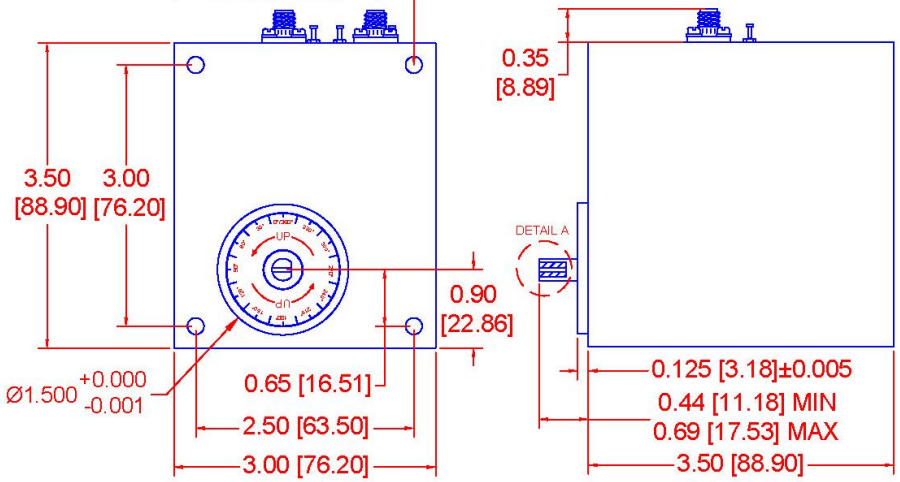
SCALE N:S SHEET 1 OF 2

# MECHANICAL OUTLINE

| REVISIONS | | | | |
|---|---|---|---|---|
| ZONE | REV. | DESCRIPTION | DATE | APPROVED |
| | 1 | ORIGINAL RELEASE | 05/08/17 | |
| | 2 | MISCELLANEOUS UPDATES | 09/26/17 | |
| | | | | |




## DETAIL B

PLANAR MONOLITHICS INDUSTRIES

8.8 TO 9.56 GHz
MECHANICALLY TUNED OSCILLATOR

MODEL NO: PTMO-8R8G9R56G-CD-1
SERIAL NO: PLXXXXX/YYWW

HTR
-V +24V GND +24V

ALL DIMENSIONS ARE IN INCH [mm]
TOLERANCES:
X.XX ±0.020 [0.508]
X.XXX ±0.010 [0.254]

PMI CONFIDENTIAL AND PROPRIETARY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ISO 9001 CERTIFIED


| APPROVALS | DATE |
|---|---|
| DRAWN M. Berry | 05/08/17 |
| CHECKED | |
| ISSUED | |

TITLE: PRODUCT FEATURE
PMTO-8R8G9R56G-CD-1
8.8 to 9.56 GHz Mechanically Tuned Oscillator

| SIZE | FSCM NO. | DWG NO. | REV. |
|---|---|---|---|
| A | 05XQ0 | 27031550 | 2 |

SCALE N:S SHEET 2 OF 2

| SIZE | CAGE CODE | DWG. NO. | REVISION |
|---|---|---|---|
| A | 05XQ0 | 28031550 | A2 |
| SCALE | N/A | | SHEET 14 OF 16 |

## APPENDIX A

## ENVIRONMENTAL STRESS SCREENING DETAILS OF PMTO-8R8G9R56G-CD-1

# SCREENING TESTS

| REQUIREMENT | TEST DETAILS | RESULTS |
|---|---|---|
| Temperature Cycling | Each unit ***shall*** be subjected to ten (10) cycles of the temperature curve seen in Figure A below, with no voltages applied. The steps are as follows:<br>(A) +25°C → 15 Minutes → +75±3°C<br>(B) 90 Minutes @ +75±3°C<br>(C) +75±3°C → 15 Minutes → +25°C<br>(D) +25°C → 15 Minutes → -62(+0, -5)°C<br>(E) 90 Minutes @ -62(+0, -5)°C<br>(F) -62(+0, -5)°C → 15 Minutes → +25°C | Attachment A |
| Burn-In | Each unit ***shall*** be operated at 50 °C ambient for 10 cycles under the following conditions:<br>(A) 3.5 hours with all voltages applied.<br>(B) 0.5 hours minimum with no applied voltages. | Attachment B |

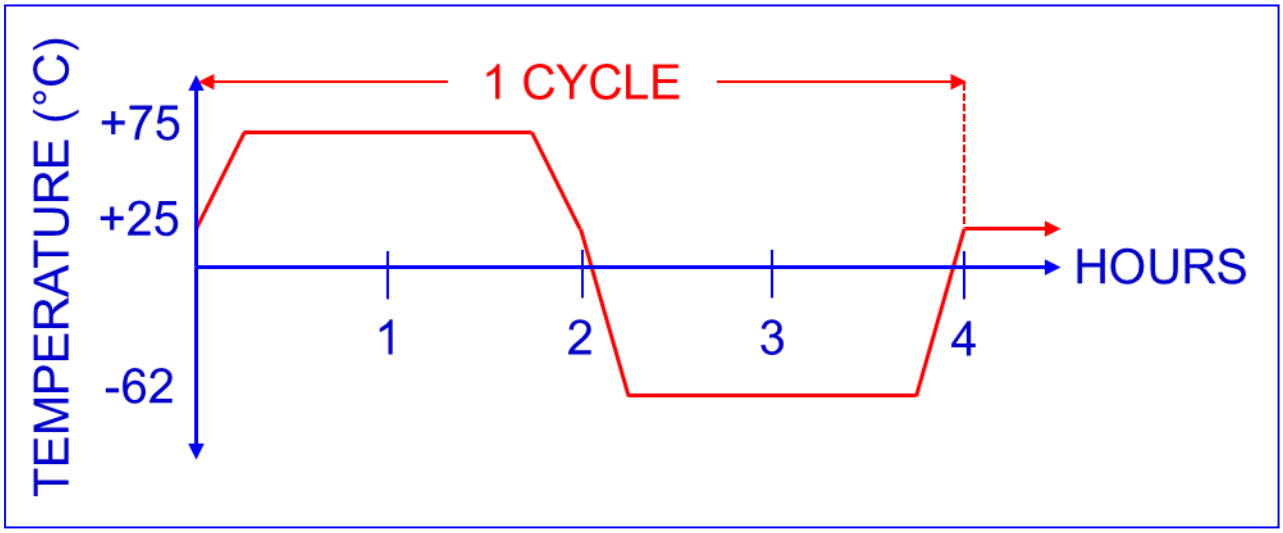


**FIGURE A – TEMPERATURE CYCLING PROFILE**