# MAAM-010333

## Optical Node RF Amplifier
## 50 - 1000 MHz

Rev. V3

### Features

- -8 dBm to +2 dBm Optical Input Range
- Low Equivalent Input Noise (EIN): 3.2 pA/rtHz
- Single +5 V Bias
- 29 dB Gain at 55 MHz; 34 dB Gain at 1000 MHz
- 27 dB Gain Control Range
- +24 dBmV/ch Output at 550 MHz
- Lead-Free 4 mm PQFN-24LD Plastic Package
- Halogen-Free "Green" Mold Compound
- RoHS* Compliant and 260°C Reflow Compatible

### Description

The MAAM-010333 provides high gain, low noise and low distortion amplification for optical node applications.

The MAAM-010333 is fabricated using M/A-COM Technology Solutions' low noise GaAs pHEMT technology in a lead-free 4 mm 24-lead package. The amplifier requires a minimal number of off-chip components resulting in a highly integrated low cost solution.

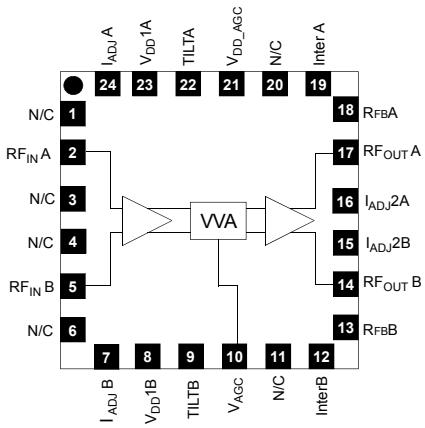
### Ordering Information [1,2]

| Part Number | Package |
|---|---|
| MAAM-010333-TR1000 | 1000 Piece Reel |
| MAAM-010333-TR3000 | 3000 Piece Reel |
| MAAM-010333-001SMB | Sample Test Board |

1. Reference Application Note M513 for reel size information.
2. All sample boards include 5 loose parts. Sample board is supplied with mounted photodiode.

* Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

### Functional Schematic




### Pin Configuration [3]

| Pin No. | Pin Name | Description |
|---|---|---|
| 1 | N/C | No Connection |
| 2 | $RF_{IN}A$ | RF Input A |
| 3 | N/C | No Connection |
| 4 | N/C | No Connection |
| 5 | $RF_{IN}B$ | RF Input B |
| 6 | N/C | No Connection |
| 7 | $I_{ADJ}B$ | Current Adjust |
| 8 | $V_{DD}1B$ | + 5V Bias Voltage |
| 9 | TiltB | Tilt Connection |
| 10 | $V_{AGC}$ | AGC Control Voltage: 0V to 3V |
| 11 | N/C | No Connection |
| 12 | InterB | Interstage Pin |
| 13 | $R_{FB}B$ | Feedback Resistor |
| 14 | $RF_{OUT}$ B | RF Output B |
| 15 | $I_{ADJ}2B$ | Current Adjust |
| 16 | $I_{ADJ}2A$ | Current Adjust |
| 17 | $RF_{OUT}$ A | RF Output A |
| 18 | $R_{FB}A$ | Feedback Resistor |
| 19 | InterA | Interstage Pin |
| 20 | N/C | No Connection |
| 21 | $V_{DD\_AGC}$ | + 5V AGC Bias Voltage |
| 22 | TiltA | Tilt Connection |
| 23 | $V_{DD}1A$ | + 5V Bias Voltage |
| 24 | $I_{ADJ}A$ | Current Adjust |
| 25 | Paddle | RF & DC Ground |

3. The exposed pad centered on the package bottom must be connected to RF and DC ground.



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## Electrical Specifications[4]: $V_{DD}$ = +5 Volts, $T_A$ = 25°C, $Z_0$ = 75 Ω

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| Trans-Impedance Gain [5,6] | 50 MHz<br>870 MHZ<br>1 GHz | dB | 26.5<br>31.0<br>31.5 | 29.0<br>33.0<br>34.0 | 30.5<br>35.0<br>35.5 |
| Gain Tilt [7] | $V_{AGC}$ = +3 V<br>$V_{AGC}$ = 0 V | dB | - | 5<br>7 | - |
| Gain Flatness [8] | $V_{AGC}$: 0 to 3 V | dB | | 0.7 | |
| Gain Control Range | 50 MHz<br>870 MHZ<br>1 GHz | dB | 25.5<br>23.0<br>24.0 | 29.0<br>26.0<br>27.0 | 32.0<br>29.0<br>30.0 |
| AGC Control Voltage Range | 50 MHz - 1 GHz | V | 0 | - | +3 |
| EIN [6] | 50 MHz - 1 GHz | pA/rtHz | - | 3.2 | - |
| Output Return Loss | 50 MHz - 1 GHz | dB | - | 18 | - |
| CTB [9] | 79 channels | dBc | - | -68 | - |
| CSO [9] | 79 channels | dBc | - | -65 | - |
| Current | $V_{DD}$ = +5 V | mA | 225 | 260 | 295 |

4. Performance is specified using JDSU Photodiode EPM-745 or equivalent (EPM705) and output balun # MABA-009210-CT1760.
5. Gain = 20*log($Z_T$/75), where $Z_T$ = Transconductance (Ω)
6. Specified at maximum gain ($V_{AGC}$ = +3.0 V)
7. Positive gain slope from 50 MHz to 1 GHz (tilt of best fit straight line from 50 MHz to 1 GHz)
8. Flatness defined as peak-peak deviation from best fit straight line.
9. Optical Input Power Range: -8 dBm to +2 dBm; 79 channels
   OMI = 3.5%; Pout = +24 dBmV/ch at 550 MHz
   $P_{OUT}$ = +22.5 dBmV/ch at 55 MHz; +24 dBmV/ch at 550 MHz

## Absolute Maximum Ratings [10,11,12]

| Parameter | Absolute Maximum |
|---|---|
| Input Power | +3 dBm Optical |
| Operating Voltage | +15 volts |
| AGC Voltage | +5 volts |
| Operating Temperature | -40°C to +85°C |
| Junction Temperature[13] | +150°C |
| Storage Temperature | -65°C to +150°C |

10. Exceeding any one or combination of these limits may cause permanent damage to this device.
11. M/A-COM Technology Solutions does not recommend sustained operation near these survivability limits.
12. Operating at nominal conditions with $T_J \leq$ +150°C will ensure MTTF > 1 x $10^6$ hours.
13. Junction Temperature ($T_J$) = $T_C$ + Θjc * ((V * I) - ($P_{OUT}$ - $P_{IN}$))
    Typical thermal resistance (Θjc) = 19° C/W.
    a) For $T_C$ = 25°C,
    $T_J$ = 53 °C @ 5 V, 295 mA
    b) For $T_C$ = 85°C,
    $T_J$ = 112 °C @ 5 V, 295 mA

## Handling Procedures

Please observe the following precautions to avoid damage:

## Static Sensitivity

Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.





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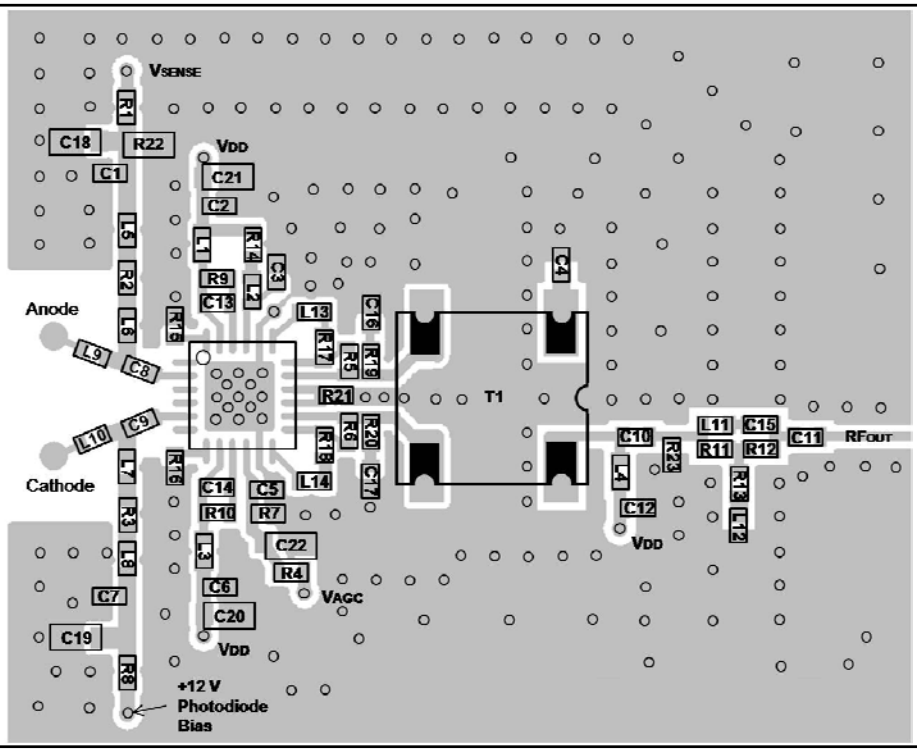
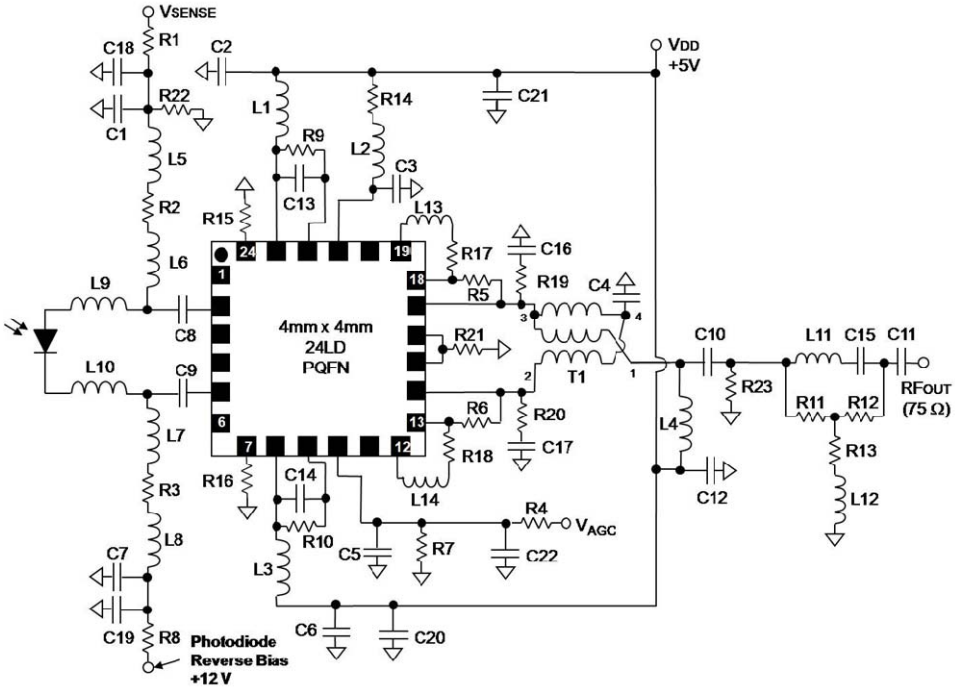
## Recommended PCB




## Schematic Including Off-Chip Components









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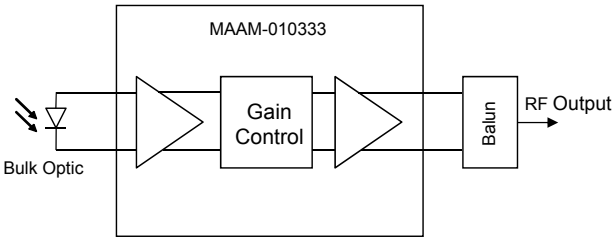
## Parts List

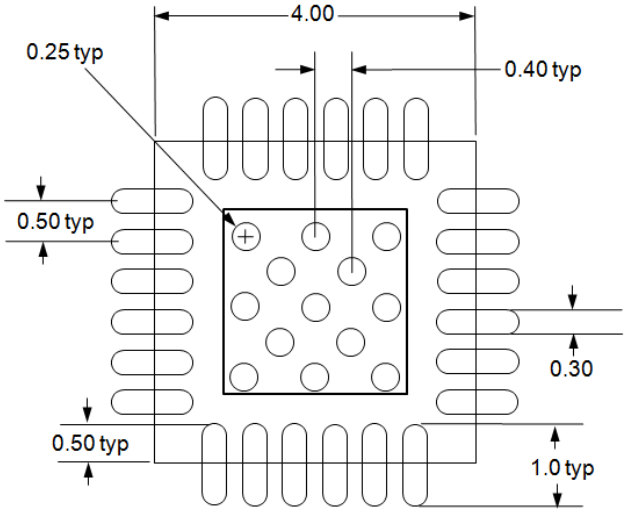
| Component | Value | Case Style |
|---|---|---|
| L1 - L8[14] | Ferrite Bead | 0402 |
| L9 - L10 | 12 nH w/w | 0402 |
| L11 | 8.2 nH | 0402 |
| L12 | 33 nH | 0402 |
| L13 - L14 | 10 nH | 0402 |
| C1 - C12 | 10 nF | 0402 |
| C13 - C14 | 2.7 pF | 0402 |
| C15 | 3.0 pF | 0402 |
| C16 - C17 | 2.0 pF | 0402 |
| C18 - C22 | 1.0 µF | 0603 |
| R1 - R4 | 1 kΩ | 0402 |
| R5 - R7 | 680 Ω | 0402 |
| R8 | 200 Ω | 0402 |
| R9 - R10 | 120 Ω | 0402 |
| R11 - R12 | 39 Ω | 0402 |
| R13 | 82 Ω | 0402 |
| R14 | 180 Ω | 0402 |
| R15 - R16 | 12 Ω | 0402 |
| R17 - R18 | 47 Ω | 0402 |
| R19 - R20 | 62 Ω | 0402 |
| R21 | 6.2 Ω | 0402 |
| R22 | 1 kΩ | 0603 |
| R23 | 470 Ω | 0402 |
| T1[15] | 1:1 Balun | SM-118A |

14. Ferrite Bead from Murata, part number BLM15HD182SN
15. M/A-COM Technology Solutions MABA-009210-CT1760
    1:1 $T_X$ Line Balun

## Application Schematic




## PCB Land Pattern




All dimension are in mm





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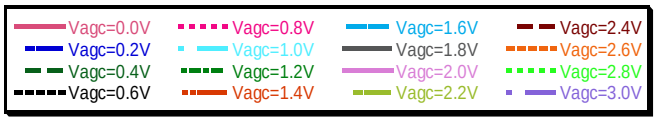
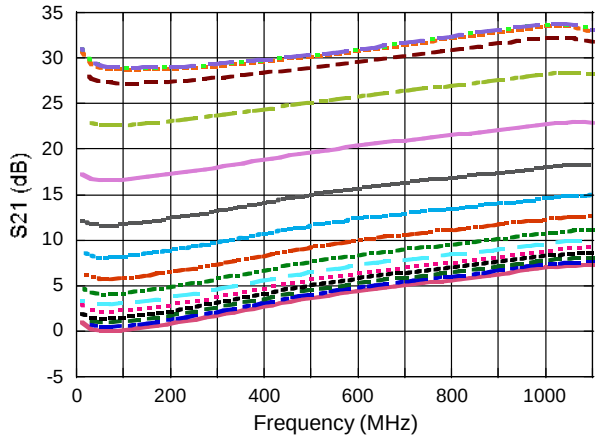
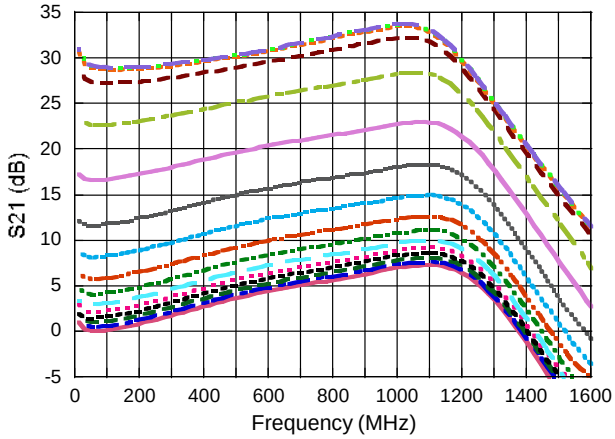
## Typical Performance Curves:
## +25°C, VAGC = 0V to 3V in 0.2 V Steps



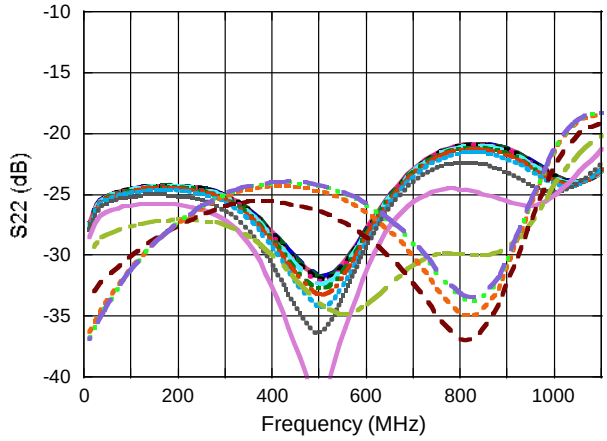

### *Receiver Gain vs. Frequency to 1.1 GHz*




### *Receiver Gain vs. Frequency to 1.6 GHz*




### *Output Return Loss vs. Frequency*









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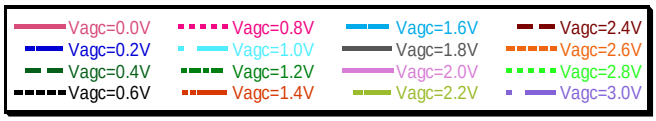
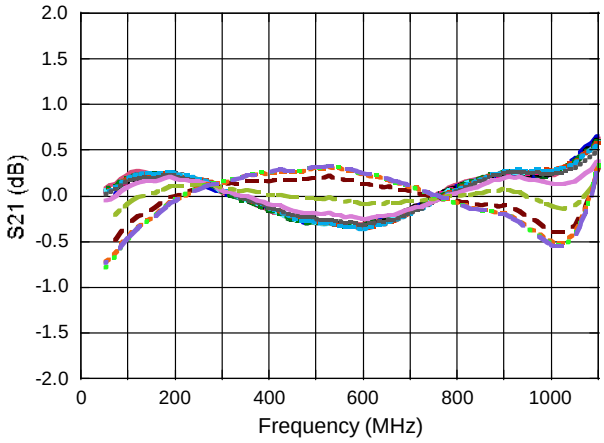
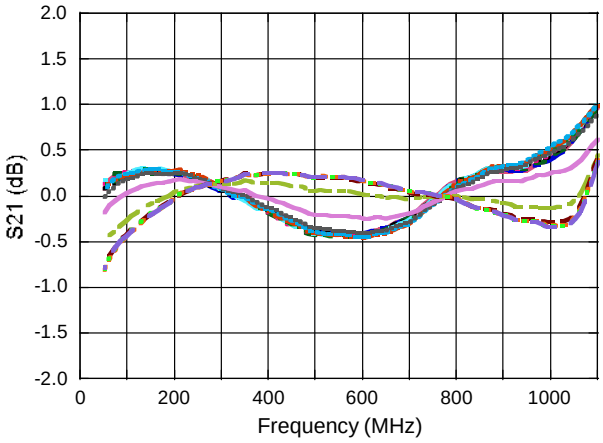
## Typical Performance Curves:
## VAGC = 0V to 3V in 0.2 V Steps



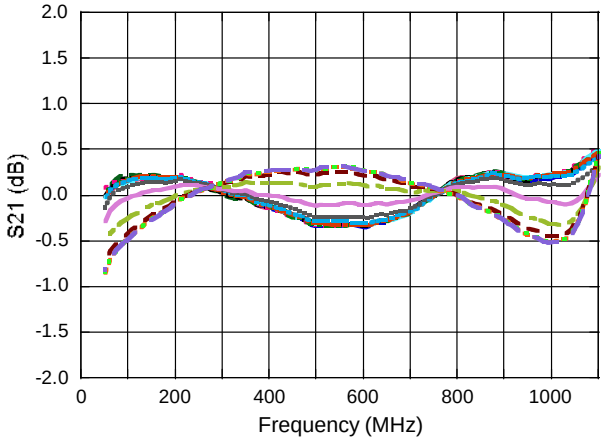

***Gain Flatness Deviation From Best Fit Line***
***@ +25°C***




***Gain Flatness Deviation From Best Fit Line***
***@ -40°C***




***Gain Flatness Deviation From Best Fit Line***
***@ +85°C***





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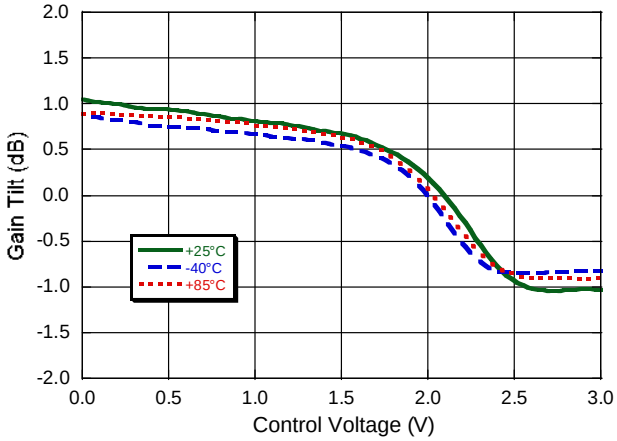
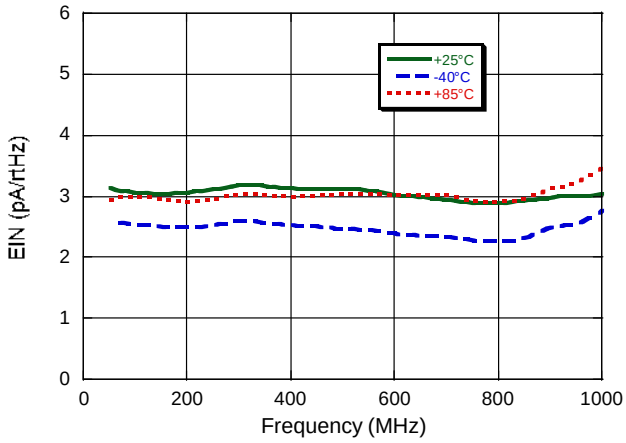
## Typical Performance Curves

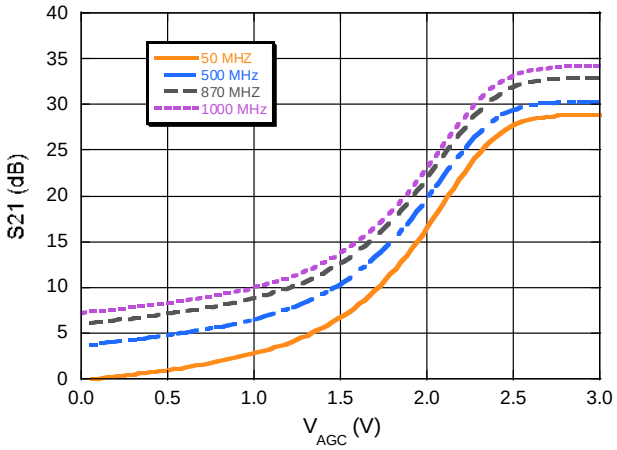
***Gain Tilt Deviation from Average Tilt***
***VAGC: 0V to 3V in 0.2 V Steps***




***Equivalent Input Noise @ Max Gain***
***VAGC = 3V***




***Receiver Gain vs. VAGC***
***VAGC = 0V to 3V in 0.2V Steps***





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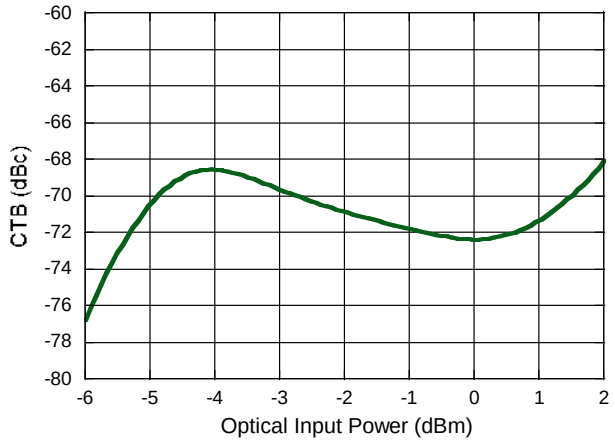
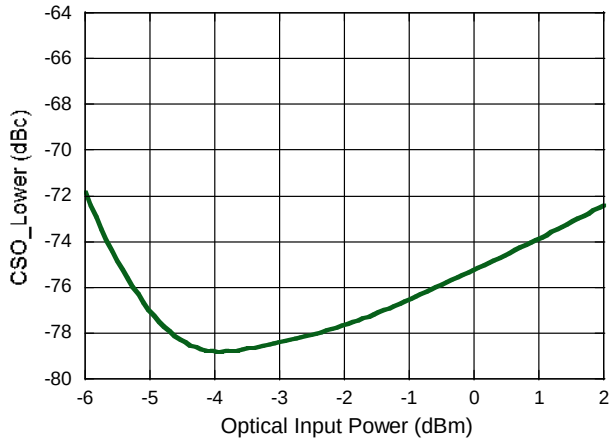
## Typical Performance Curves:

**79 Channels; NTSC Frequency Plan Pout = +22.5 dBmV/ch @ 55 MHz; +24 dBmV @ 550 MHz**

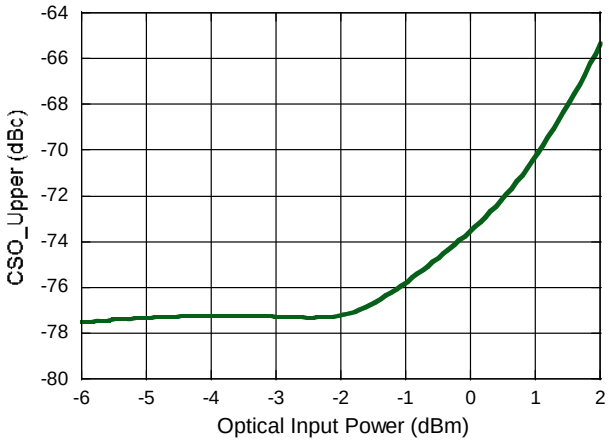
***CTB vs. Optical Input Power***




***CSO_Lower vs. Optical Input Power***




***CSO_Upper vs. Optical Input Power***





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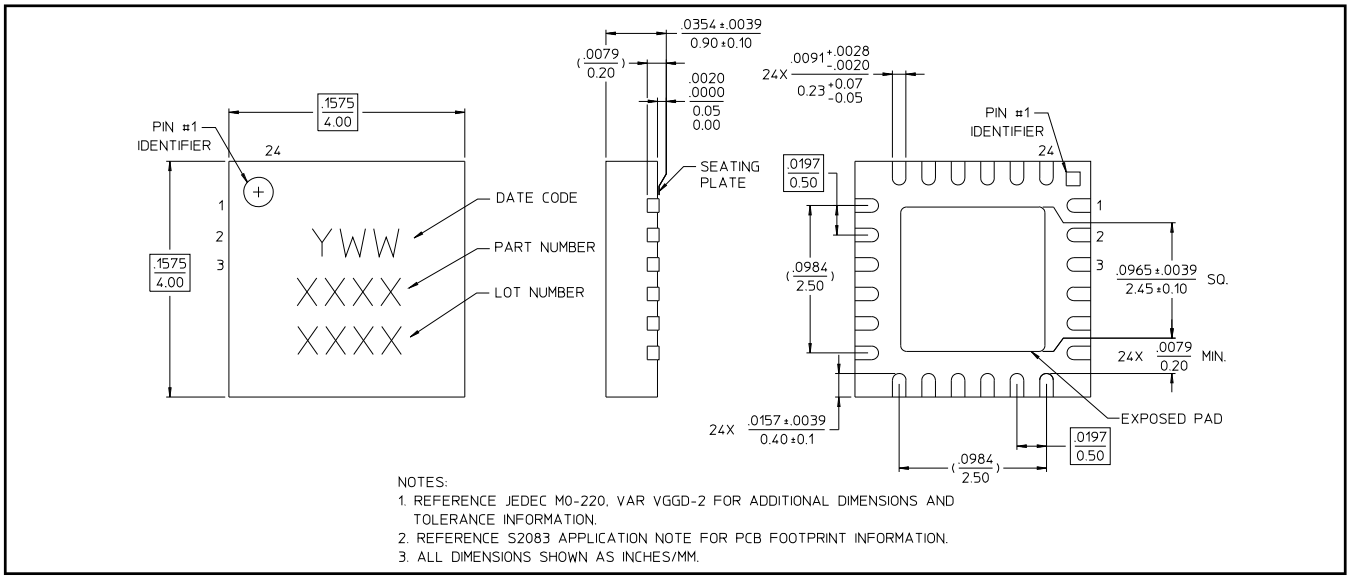
## *Lead Free* 4 mm 24-lead PQFN†




† Reference Application Note 2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is 100% matte tin over copper.