MAAM-010333

Optical Node RF Amplifier
50 - 1000 MHz

Rev. V1

Features

- -6 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.

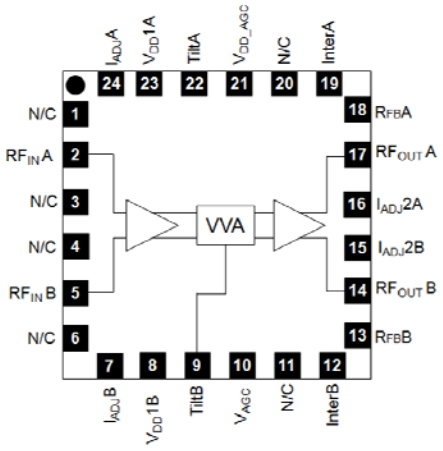
Ordering Information [1,2]

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	$R_{FB}B$	Feedback Resistor
19	InterA	Interstage Pin
20	N/C	No Connection
21	V_{DD_AGC}	+ 5V AGC Bias Voltage
22	TiltA	Tilt Connection
23	$V_{DD1}A$	+ 5V Bias Voltage
24	$I_{ADJ}1$	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 870 MHZ 1 GHz	dB	26.5 31.0 31.5	29.0 33.0 34.0	30.5 35.0 35.5
Gain Tilt [7]	V_{AGC} = +3 V V_{AGC} = 0 V	dB	-	5 7	-
Gain Flatness [8]	V_{AGC}: 0 to 3 V	dB		0.7	
Gain Control Range	50 MHz 870 MHZ 1 GHz	dB	25.5 23.0 24.0	29.0 26.0 27.0	32.0 29.0 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: -6 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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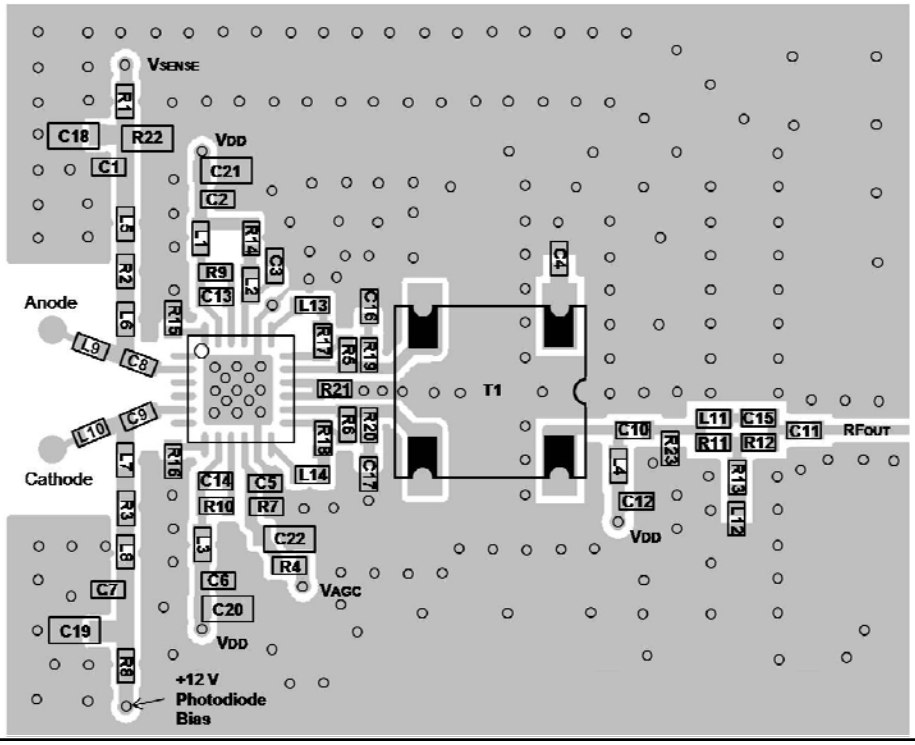
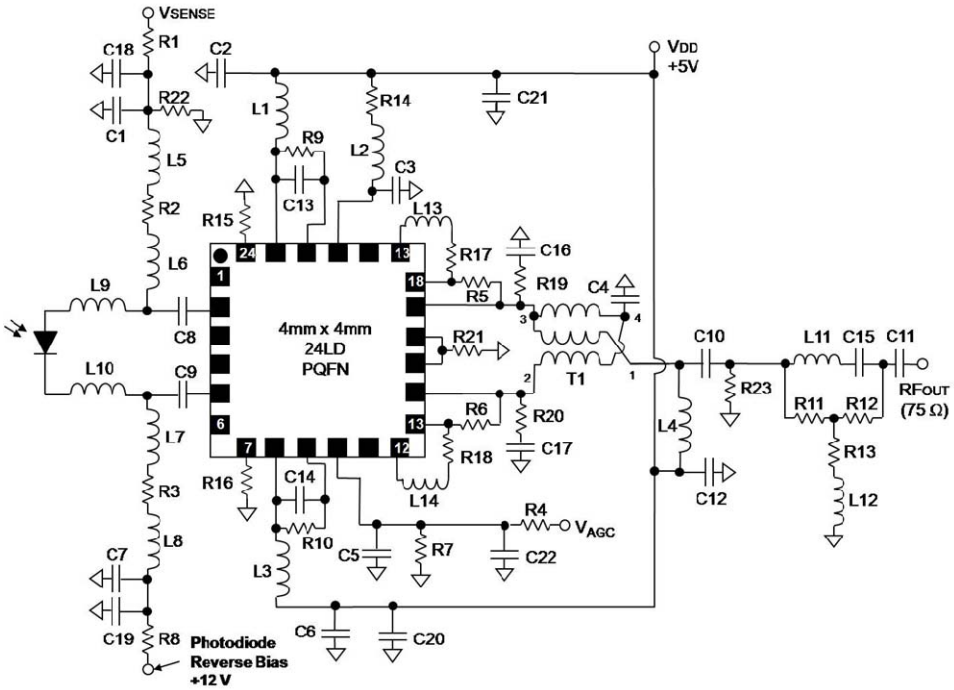
Recommended PCB



Schematic Including Off-Chip Components



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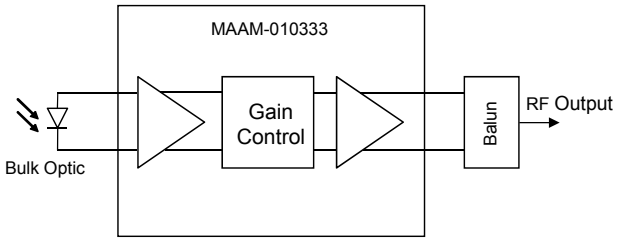
Parts List

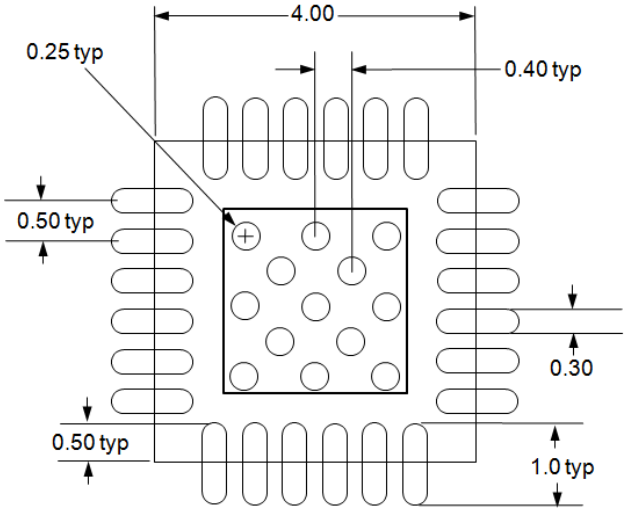
Component	Value	Case Style
L1 - L8[14]	Ferrite Bead	0402
L9 - L10	12 nH w/w	0402
L11	8.2 nH	0402
L12	33 nH	0402
L13 - L14	10 nH	0402
C1 - C12	10 nF	0402
C13 - C14	2.7 pF	0402
C15	3.0 pF	0402
C16 - C17	2.0 pF	0402
C18 - C22	1.0 µF	0603
R1 - R4	1 kΩ	0402
R5 - R7	680 Ω	0402
R8	200 Ω	0402
R9 - R10	120 Ω	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

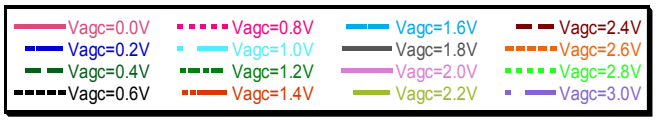


PCB Land Pattern

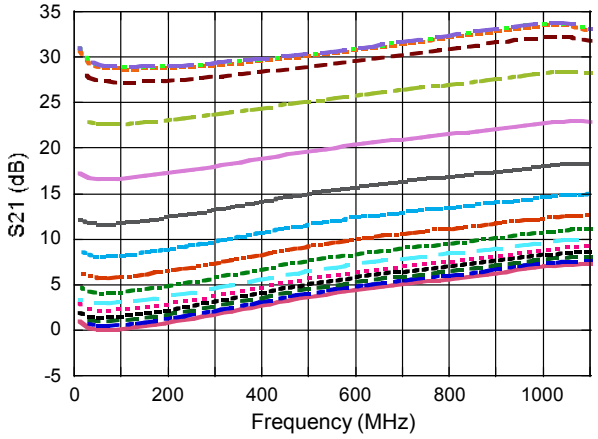


All dimension are in mm

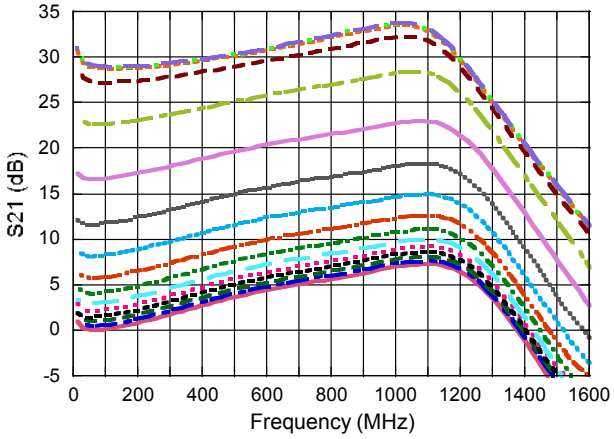
Typical Performance Curves:
+25°C, VAGC = 0V to 3V in 0.2 V Steps



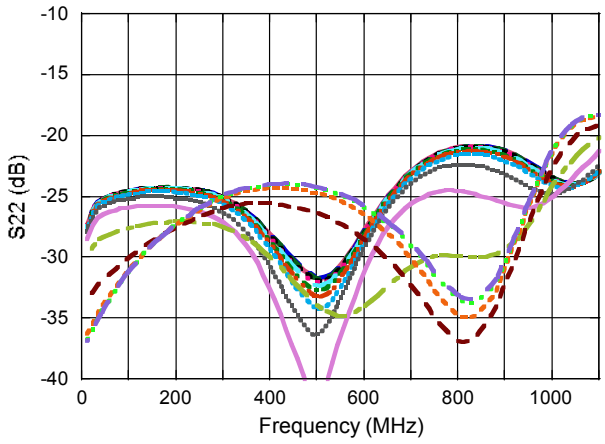
Receiver Gain vs. Frequency to 1.1 GHz



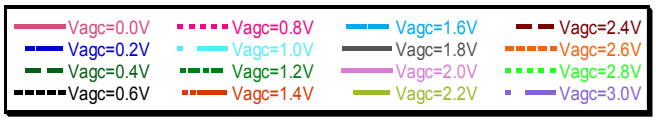
Receiver Gain vs. Frequency to 1.6 GHz



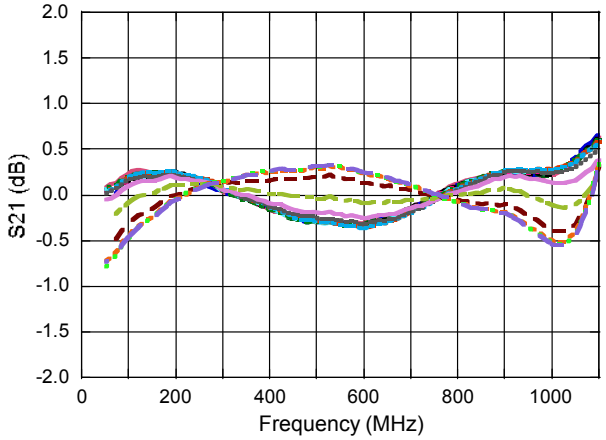
Output Return Loss vs. Frequency



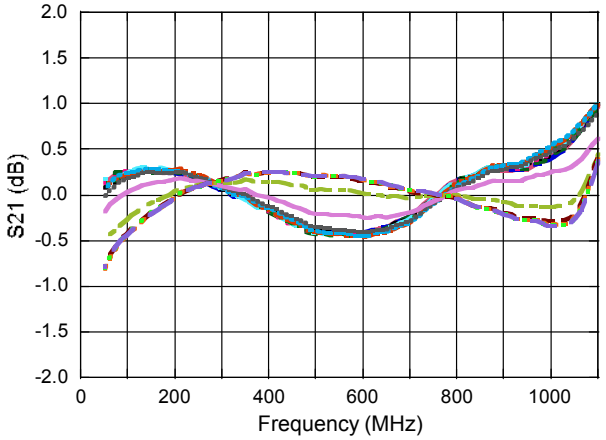
Typical Performance Curves:
VAGC = 0V to 3V in 0.2 V Steps



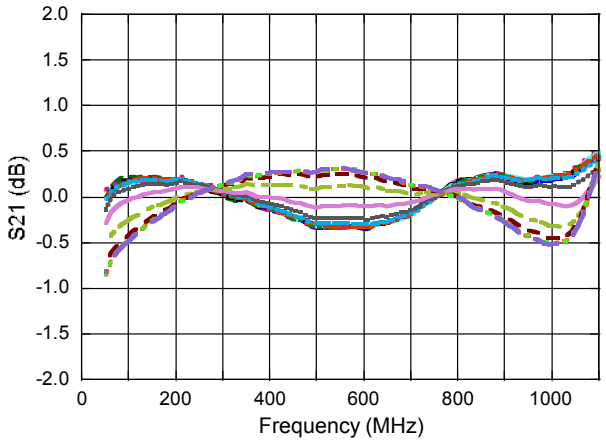
Gain Flatness Deviation From Best Fit Line @ +25°C



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

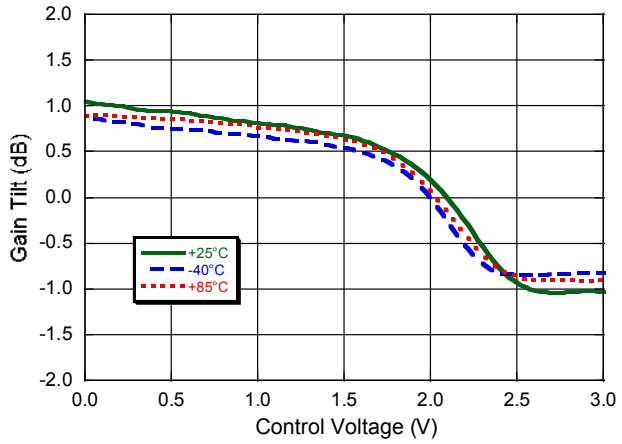


Gain Flatness Deviation From Best Fit Line @ +85°C

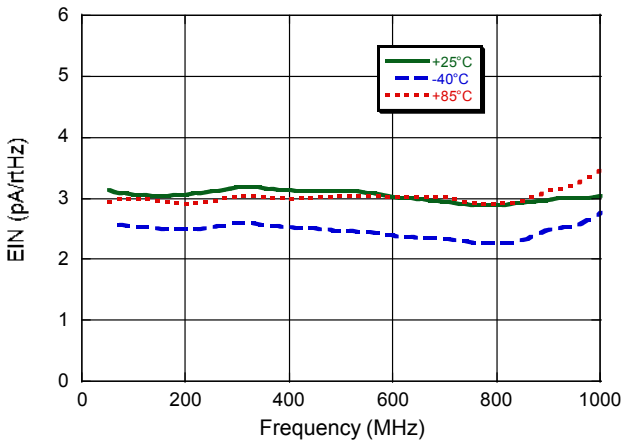


Typical Performance Curves

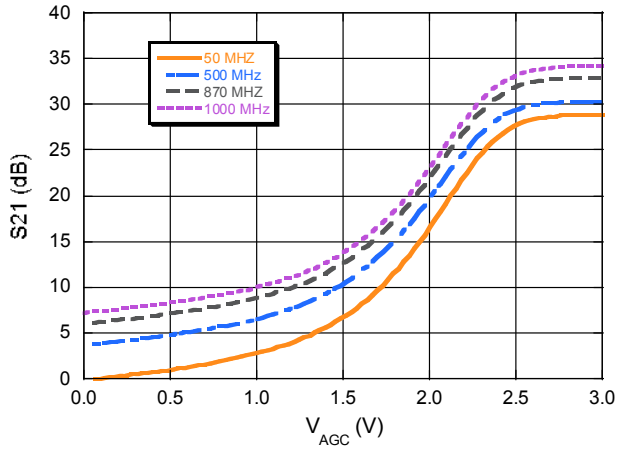
Gain Tilt Deviation from Average Tilt
VAGC: 0V to 3V in 0.2 V Steps



Equivalent Input Noise @ Max Gain
VAGC = 3V



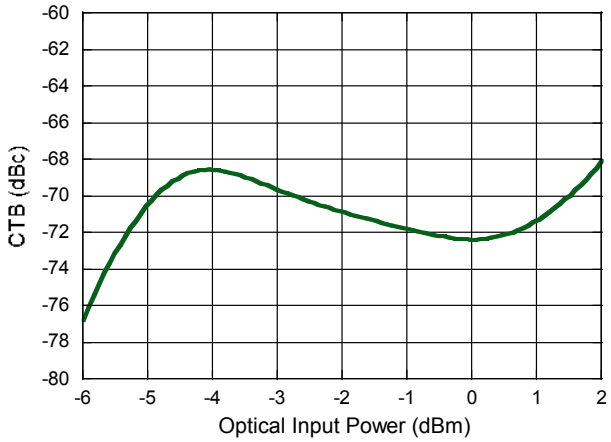
Receiver Gain vs. VAGC
VAGC = 0V to 3V in 0.2V Steps



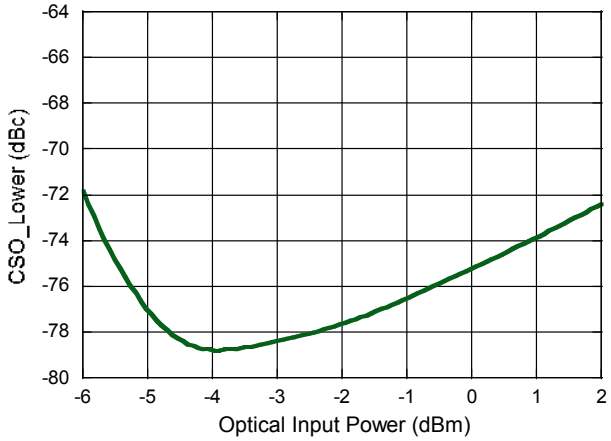
Typical Performance Curves:

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

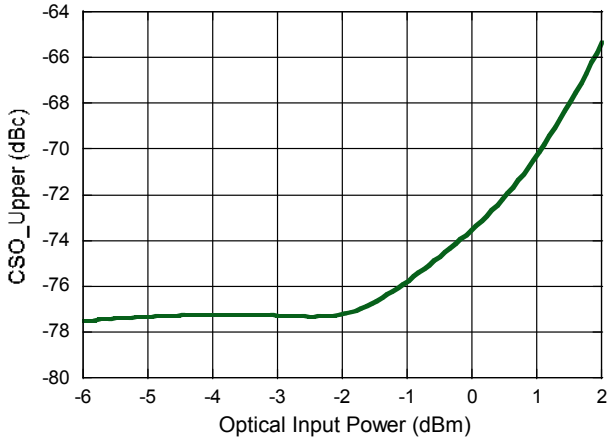
CTB vs. Optical Input Power



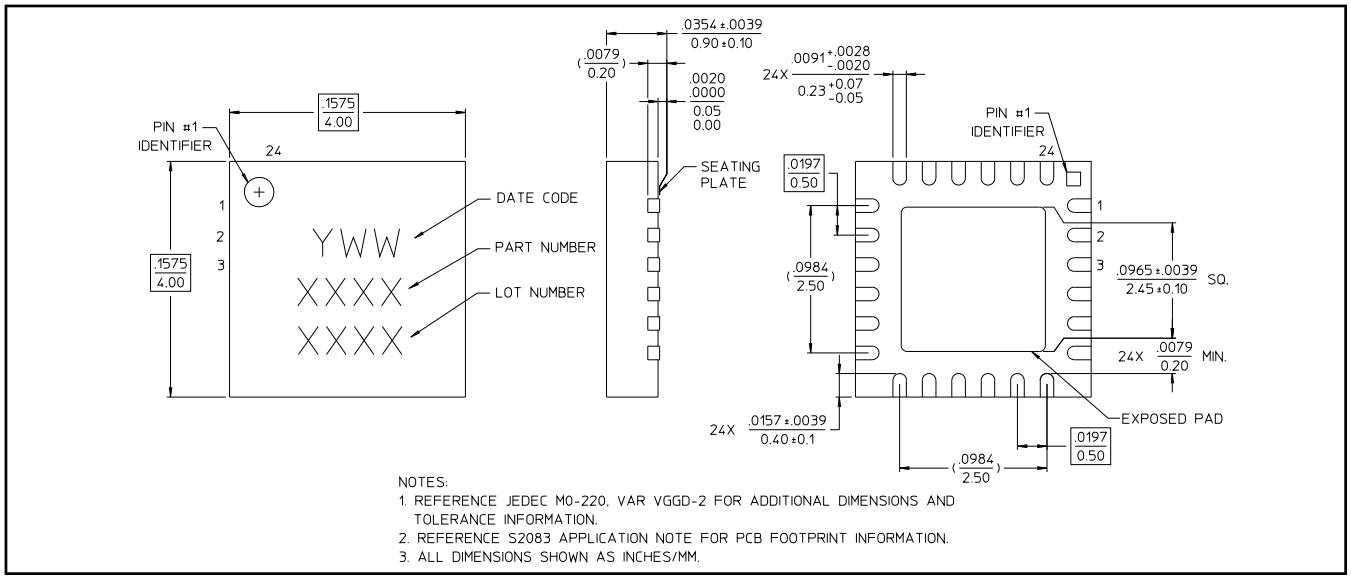
CSO_Lower vs. Optical Input Power



CSO_Upper vs. Optical Input Power



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.

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