

### Features

- 28 dB Gain
- 25 dB Attenuation Range
- -62 dBc ACPR @ 67 dBmV Output  
-1 channel 256 QAM
- -60 dBc ACPR @ 59 dBmV/channel  
-4 channel 256 QAM
- 6 V, 900 mA
- Differential Input and Output
- Low Harmonics
- Single Control Voltage
- Lead-Free 5x7 mm PQFN-40LD
- Halogen-Free "Green" Mold Compound
- RoHS\* Compliant and 260°C Reflow Compatible

### Description

The MAAM-010399 is an integrated 3 stage differential amplifier with embedded voltage variable attenuator. This part is intended as the output amplifier in a downstream Edge QAM RF modulator. The module provides excellent linearity and ACPR at output levels greater than 7 dB above Cable Labs DRFI requirements. The voltage variable attenuator (VVA) is implemented with PIN diodes to provide continuous power level control with high linearity and is controlled with a single voltage. The part is packaged in a 5x7 mm PQFN package.

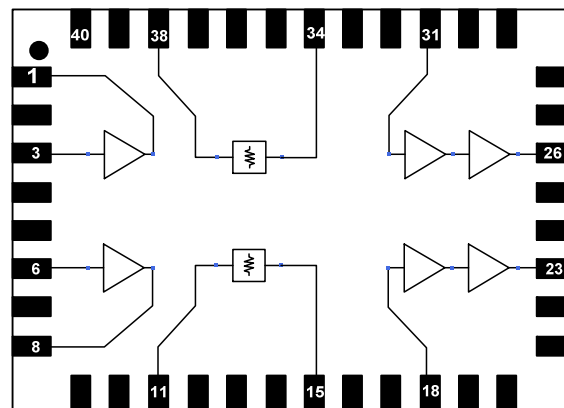
### Ordering Information <sup>1,2</sup>

Part Number	Package
MAAM-010399-TR1000	1000 piece reel
MAAM-010399-TR3000	3000 piece reel
MAAM-010399-001SMB	Sample Test Board

1. Reference Application Note M513 for reel size information.
2. All sample boards include 5 loose parts.

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

### Functional Schematic



### Pin Configuration <sup>3,4</sup>

Pin No.	Pin Name	Description
1	RF <sub>OUT</sub> 1+	Stage 1 Output (+)
2	FB1+	Stage 1 Feedback (+)
3	RF <sub>IN</sub> +	Stage 1 Input (+)
5	IADJ1	Stage 1 Current Adjust
6	RF <sub>IN</sub> 1-	Stage 1 Input (-)
7	FB1-	Stage 1 Feedback (-)
8	RF <sub>OUT</sub> 1-	Stage 1 Output (-)
9,17,32,40	VREF	VVA reference voltage
11	VVA <sub>IN</sub> -	VVA Input (-)
13,36	V <sub>CONTROL</sub>	VVA Control Voltage
15	VVA <sub>OUT</sub> -	VVA Output (-)
18	RF <sub>IN</sub> 2-	Stage 2 Input (-)
19	FB2-	Stage 2 Feedback (-)
20	V <sub>DD</sub> 2-	Stage 2 Drain Bias (-)
23	RF <sub>OUT</sub> -	Output of VGA (-)
24	IADJ2	Stage 2 Current Adjust
25	IADJ3	Stage 3 Current Adjust
26	RF <sub>OUT</sub> +	Output of VGA (+)
29	V <sub>DD</sub> 2+	Stage 2 Drain Bias (+)
30	FB2+	Stage 2 Feedback (+)
31	RF <sub>IN</sub> 2+	Stage 2 Input (+)
34	VVA <sub>OUT</sub> +	VVA Output (+)
38	VVA <sub>IN</sub> +	VVA Input (+)
41	Paddle	RF & DC Ground

3. Do not ground pins 10,12,14,16,33,35,37 and 39 (all are "No Connection").
4. Pins 4, 21, 22, 27 and 28 may or may not be grounded (all are "No Connection").

• **North America** Tel: 800.366.2266 • **Europe** Tel: +353.21.244.6400  
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# Differential CATV Variable Gain Amplifier

## 50 - 1100 MHz

Rev. V1

**Electrical Specifications<sup>5</sup>:** Freq. = 981 MHz,  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = +6$  Volts,  $V_{ref} = 1.3$  Volts,  $Z_0 = 75 \Omega$ , (Performance specified with input/output Balun MABA-010321-CT1A42)

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	VVA Control = 5.5 V	dB	26	28	—
Gain Flatness		dB	—	0.25	—
Gain Slope		dB	—	0.5	—
Noise Figure <sup>6</sup>	200 - 1000 MHz, VVA Control = 5.5 V 50 - 200 MHz, VVA Control = 5.5 V	dB	—	5.0 6.5	—
Input Return Loss		dB	—	20	—
Output Return Loss		dB	—	20	—
Reverse Isolation		dB	—	60	—
Attenuation Range			—	25	—
Maximum Output	Level N=1 Level N=2 Level N=4	dBmV	— — 57	67 63 59	— — —
ACPR <sup>7</sup>	@ max output N=1 @ max output N=2 @ max output N=4	dBc	— — —	— — —	-62 -60 -60
P1dB		dBm	—	28	—
OIP2	2-tone, 5 dBm/tone, 6 MHz spacing, 500 MHz	dBm	—	80	—
OIP3	2-tone, 5 dBm/tone, 6 MHz spacing, 500 MHz	dBm	—	48	—
CTB	77 Channels, 39 dBmV/ch.	dBc	—	-78	—
CSOL	77 Channels, 39 dBmV/ch.	dBc	—	-78	—
CSOH	77 Channels, 39 dBmV/ch.	dBc	—	-81	—
2 <sup>nd</sup> Harmonic	Single Channel, $P_{OUT} = 67$ dBmV	dBc	—	-65	—
3 <sup>rd</sup> Harmonic	Single Channel, $P_{OUT} = 67$ dBmV	dBc	—	-65	—
$I_{DD}$		mA	—	900	1050
$I_{DD3}$		mA	—	520	600
$I_{CONTROL}$	VVA Control = 5.5 V	mA	—	35	—

5. N = number of channels

6. Includes Balun Loss.

7. Adjacent Channel (750 kHz from channel block edge to 6 MHz from channel block edge)

## 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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### Absolute Maximum Ratings<sup>8,9,10</sup>

Parameter	Absolute Maximum
RF Input Power	-2 dBm
Voltage	9 volts
Operating Temperature	-40°C to +100°C
Junction Temperature <sup>11</sup>	+155°C
Storage Temperature	-65°C to +150°C

8. Exceeding any one or combination of these limits may cause permanent damage to this device.

9. M/A-COM Technology Solutions does not recommend sustained operation near these survivability limits.

10. Operating at nominal conditions with  $T_J < 155^\circ\text{C}$  will ensure  $\text{MTTF} > 1 \times 10^6$  hours.

11. Junction Temperature ( $T_J$ ) =  $T_C + \Theta_{jc} * (V * I)$

Typical thermal resistance ( $\Theta_{jc}$ ) = 14.9°C/W.

a) For  $T_C = 25^\circ\text{C}$ ,

$T_J = 63^\circ\text{C}$  @ 6 V, 420 mA (output stage)

b) For  $T_C = 100^\circ\text{C}$ ,

$T_J = 138^\circ\text{C}$  @ 6 V, 420 mA (output stage)

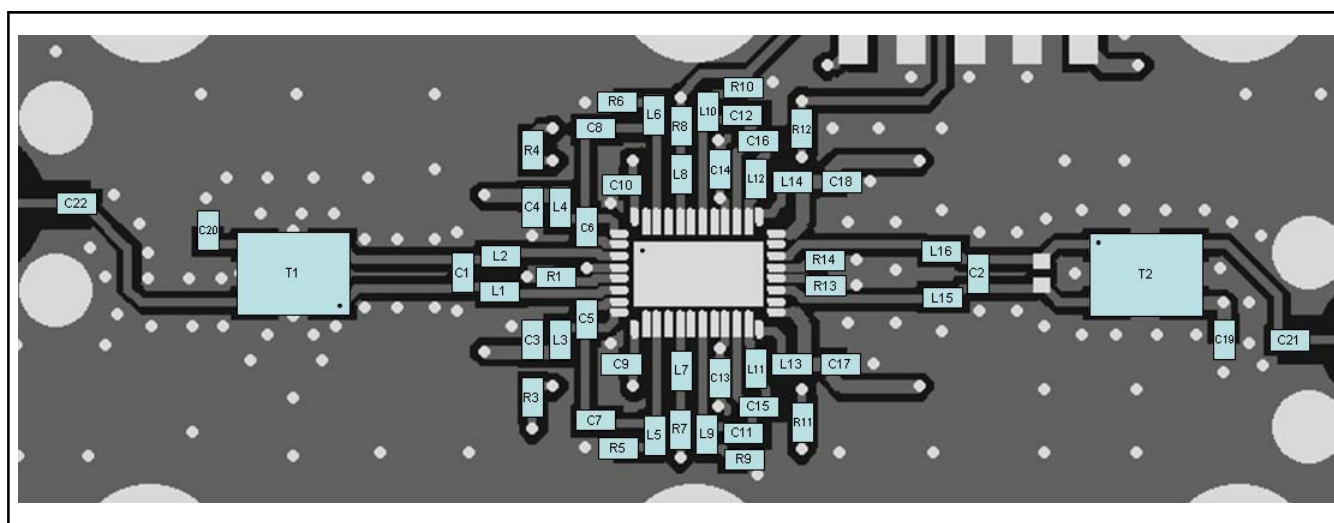
### Parts List<sup>12</sup>

Component	Value	Package
C1	0.5 pF	0402
C2	1.8 pF	0402
C3, C4, C9, C10, C13, C14, C17 - C22	0.01 $\mu\text{F}$	0402
C5 - C8, C11, C12, C15, C16	1000 pF	0402
L1, L2, L15, L16	0 $\Omega$	0402
L3 - L8, L13 - L14 <sup>13</sup>	1 k $\Omega$	0402
L9, L10	68 nH	0402
L11, L12	12 nH	0402
R1	50 $\Omega$	0402
R2	330 $\Omega$	0402
R3 - R6, R9 - R12	200 $\Omega$	0402
R7, R8, R13	150 $\Omega$	0402
R14	82 $\Omega$	0402
R15	1 k $\Omega$	0402
T1, T2	1:1 Baluns	

12. The 1:1 baluns, T1 & T2, are M/A-COM Technology Solutions part number MABA-010321-CT1A42.

13. The 1 k $\Omega$  ferrite bead, part number BLM15HD102SN, is from Murata.

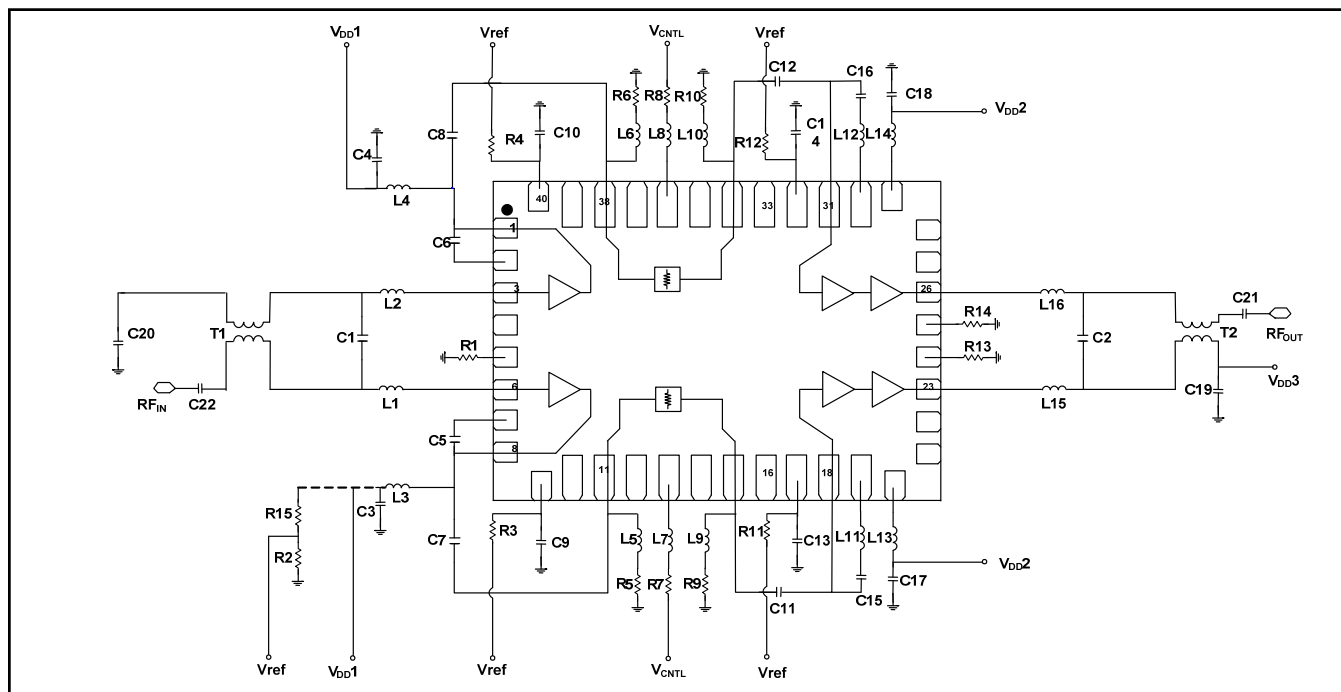
### Recommended PCB



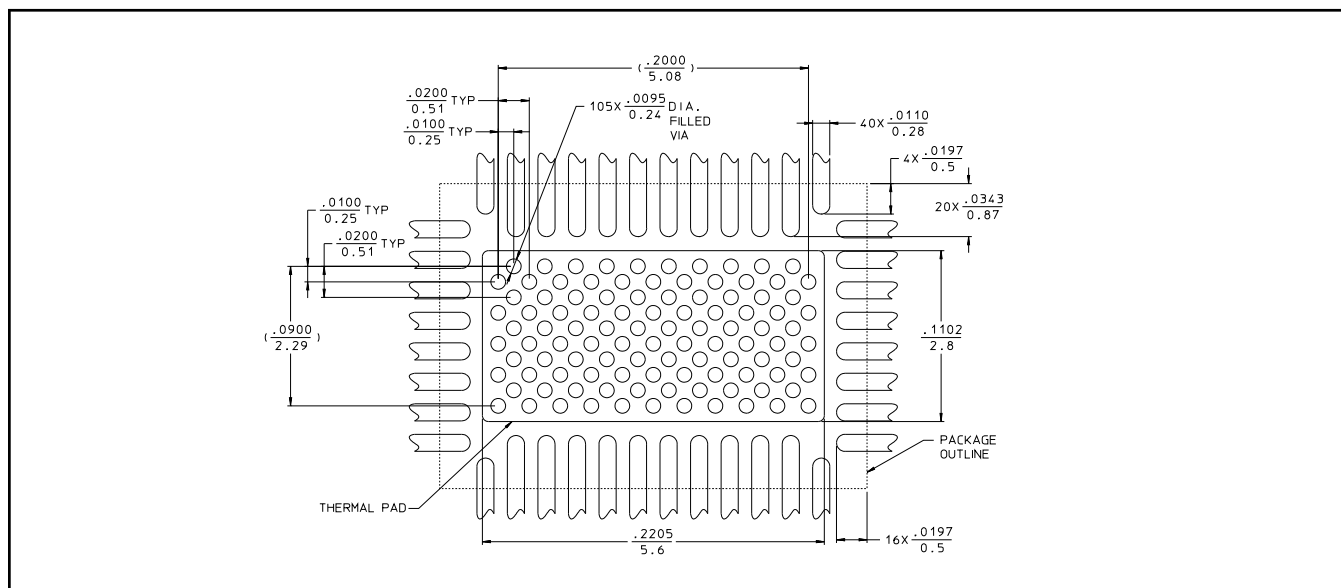
## Differential CATV Variable Gain Amplifier 50 - 1100 MHz

Rev. V1

### Application Schematic



### Land Pattern<sup>14</sup>



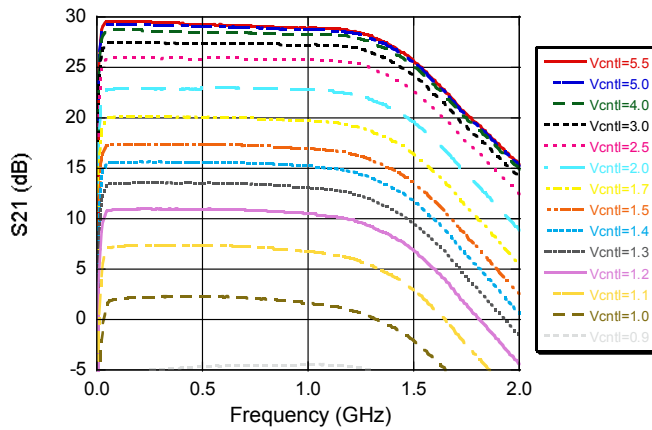
14. Vias to be plated solid copper.

## Differential CATV Variable Gain Amplifier 50 - 1100 MHz

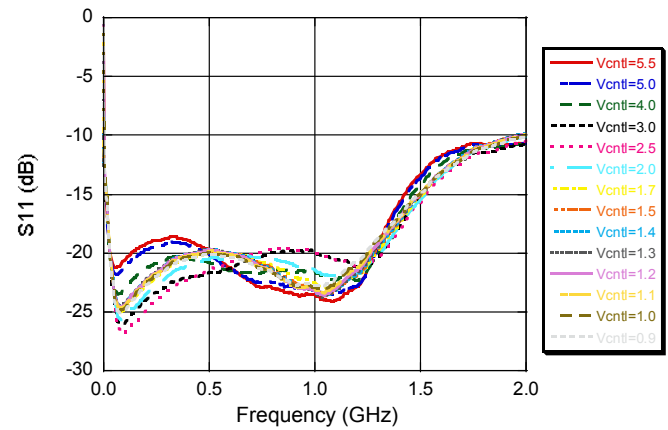
Rev. V1

### Typical Performance Curves: $V_{DD} = +6$ Volts, $V_{REF} = 1.3$ Volts

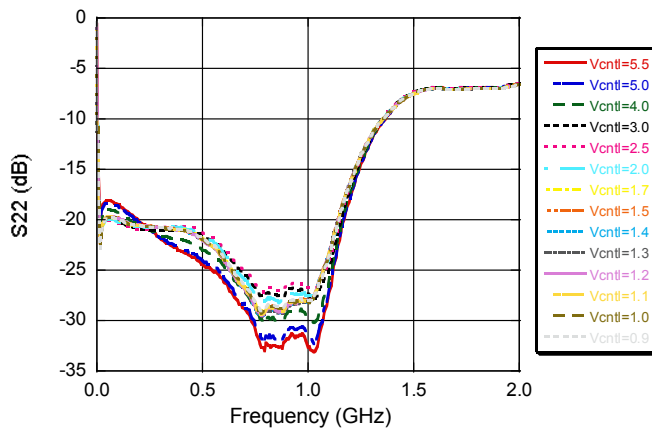
**Gain vs. Frequency & VGA Control**



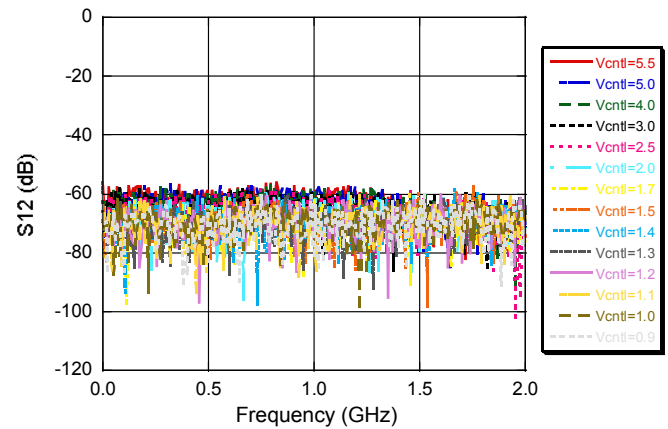
**Input Return Loss vs. Frequency & VGA Control**



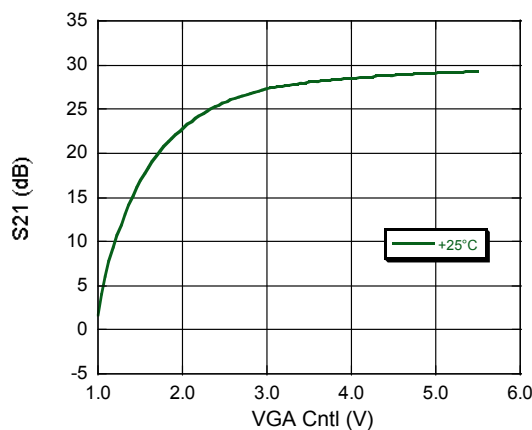
**Output Return Loss vs. Frequency & VGA Control**



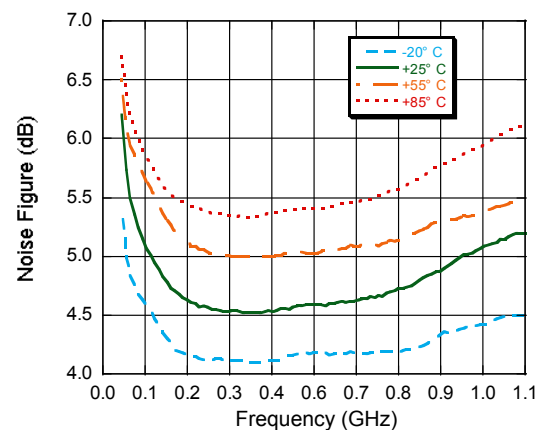
**Reverse Isolation**



**Gain vs. VVA Control @ 500 MHz**



**Noise Figure**

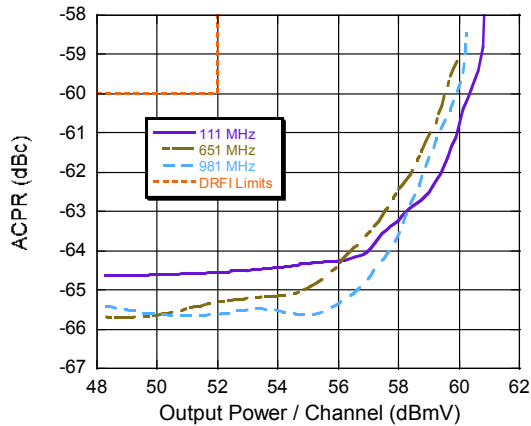


## Differential CATV Variable Gain Amplifier 50 - 1100 MHz

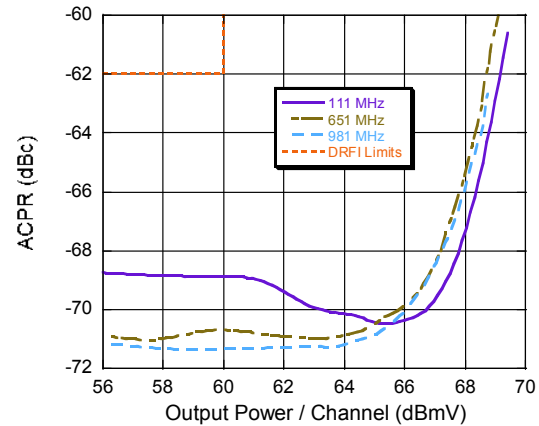
Rev. V1

### Typical Performance Curves: $V_{DD} = +6$ Volts, $V_{REF} = 1.3$ Volts

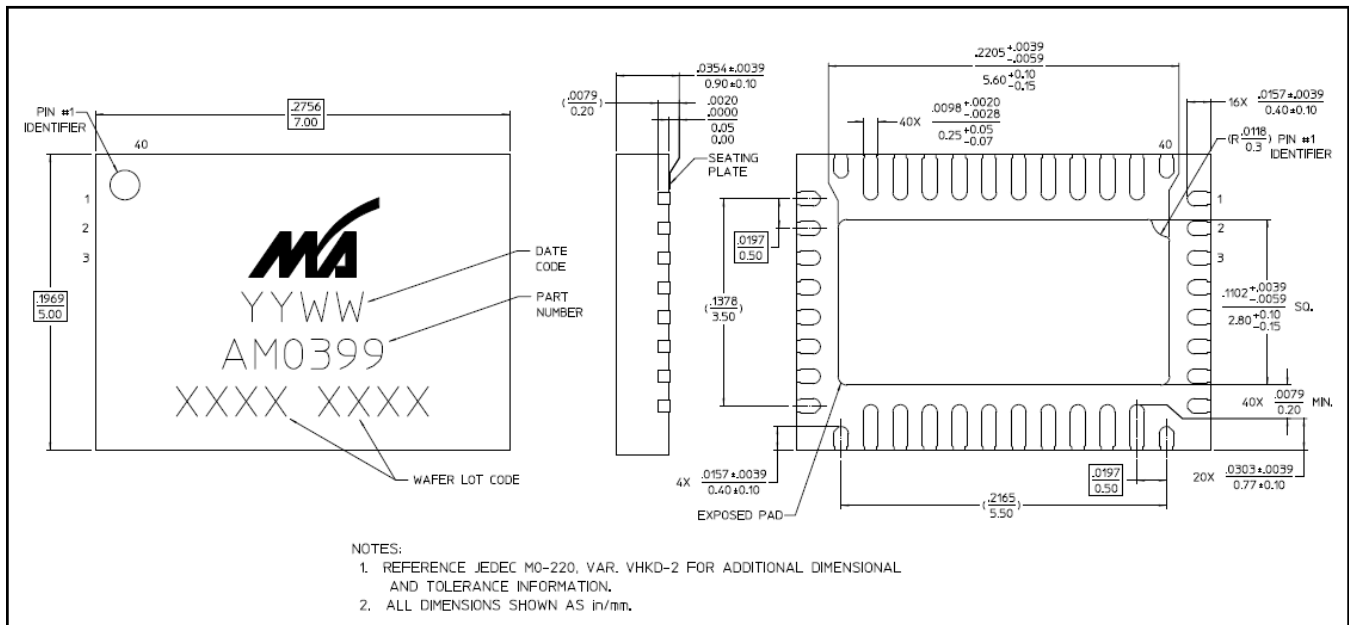
ACPR vs.  $P_{OUT}$ , 4 Channels



ACPR vs.  $P_{OUT}$ , Single Channel



### Lead-Free 5x7 mm 40-Lead PQFN<sup>†</sup>



<sup>†</sup> Reference Application Note S2083 for lead-free solder reflow recommendations.  
Meets JEDEC moisture sensitivity level 1 requirements.  
Plating is NiPdAuAg.