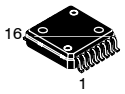
Document Number: MMG1001NT1
Rev. 8, 3/2007

RoHS

Gallium Arsenide CATV Integrated Amplifier Module

MMG1001NT1

**870 MHz
19 dB GAIN
132-CHANNEL
CATV INTEGRATED AMPLIFIER
MODULE**



**CASE 978-03
PFP-16**

Features

- Specified for 79-, 112- and 132-Channel Loading
- Excellent Distortion Performance
- Built-in Input Diode Protection
- GaAs FET Transistor Technology
- Unconditionally Stable Under All Load Conditions
- RoHS Compliant
- In Tape and Reel. T1 Suffix = 1000 Units per 16 mm, 13 inch Reel.

Applications

- CATV Systems Operating in the 40 to 870 MHz Frequency Range
- Input Stage Amplifier in Optical Nodes, Line Extenders and Trunk Distribution Amplifiers for CATV Systems
- Output Stage Amplifier on Applications Requiring Low Power Dissipation and High Output Performance
- Driver Amplifier in Linear General Purpose Applications

Description

- 24 Vdc Supply or 12 Vdc Supply with Bias Change, 40 to 870 MHz, CATV Integrated Forward Amplifier Module

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
RF Voltage Input (Single Tone)	V_{in}	+65	dBmV
DC Supply Voltage 24 V Application 12 V Application	V_{CC}	 +26 +14	Vdc
Operating Case Temperature Range	T_C	-20 to +100	°C
Storage Temperature Range	T_{stg}	-40 to +100	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	6.6	°C/W

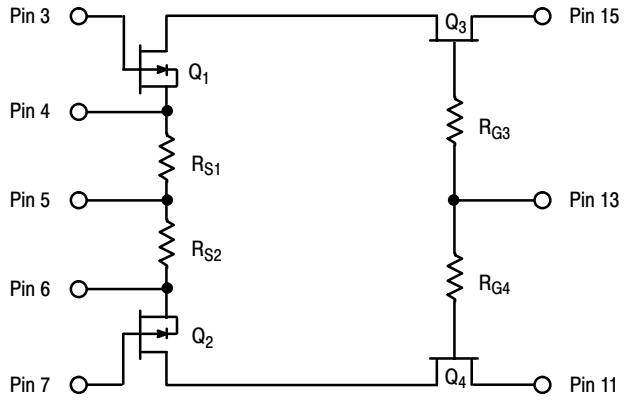
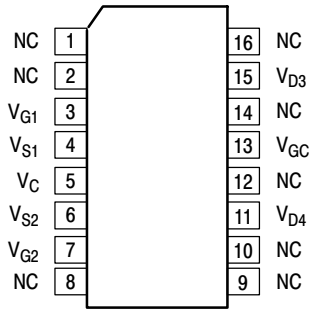


Figure 1. Functional Diagram



(Top View)

Note: Exposed backside flag is source terminal for transistors.

Figure 2. Pin Connections

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Table 3. ESD Protection Characteristics

Test Conditions	Class
Human Body Model	1 (minimum)
Machine Model	M1 (minimum)
Charge Device Model	C5 (minimum)

Table 4. Moisture Sensitivity Level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD 22-A113, IPC/JEDEC J-STD-020	3	260	°C

Table 5. Electrical Characteristics for 24 V Application (V_{CC} = 24 Vdc, T_C = +30°C, 75 Ω system unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
Frequency Range		BW	40	—	870	MHz
Power Gain	50 MHz 870 MHz	G_p	— —	18 19	— —	dB
Slope	40 - 870 MHz	S	—	0.6	—	dB
Gain Flatness (40 - 870 MHz, Peak to Valley)		G_F	—	0.5	—	dB
Input Return Loss (Z_o = 75 Ohms) f = 40-160 MHz f = 161-450 MHz f = 451-870 MHz		IRL	 — —	 21 19 22	 — — —	dB
Output Return Loss (Z_o = 75 Ohms) f = 40-400 MHz f = 401-870 MHz		ORL	 — —	 22 17	 — —	dB
Composite Second Order (V_{out} = +44 dBmV/ch., Worst Case) (V_{out} = +46 dBmV/ch., Worst Case) (V_{out} = +48 dBmV/ch., Worst Case)	 132-Channel FLAT 112-Channel FLAT 79-Channel FLAT	 CSO_{132} CSO_{112} CSO_{79}	 — — —	 -65 -65 -71	 -58 -59 -62	dBc
Cross Modulation Distortion @ Ch 2 (V_{out} = +44 dBmV/ch., FM = 55 MHz) (V_{out} = +46 dBmV/ch., FM = 55 MHz) (V_{out} = +48 dBmV/ch., FM = 55 MHz)	 132-Channel FLAT 112-Channel FLAT 79-Channel FLAT	 XMD_{132} XMD_{112} XMD_{79}	 — — —	 -64 -63 -62	 -52 -52 -52	dBc
Composite Triple Beat (V_{out} = +44 dBmV/ch., Worst Case) (V_{out} = +46 dBmV/ch., Worst Case) (V_{out} = +48 dBmV/ch., Worst Case)	 132-Channel FLAT 112-Channel FLAT 79-Channel FLAT	 CTB_{132} CTB_{112} CTB_{79}	 — — —	 -63 -64 -65	 -56 -56 -58	dBc
Noise Figure	50 MHz 870 MHz	NF	— —	4 4	5.0 5.0	dB
DC Current (V_{DC} = 24 V, T_C = -20° to +100°C)		I_{DC}	230	250	265	mA

(continued)

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Table 5. Electrical Characteristics for 12 V Application (V_{CC} = 12 Vdc, T_C = +30°C, 75 Ω system unless otherwise noted) **(continued)**

Characteristic		Symbol	Min	Typ	Max	Unit
Frequency Range		BW	40	—	870	MHz
Power Gain	50 MHz 870 MHz	G_p	— —	18 19	— —	dB
Slope	40 - 870 MHz	S	—	0.6	—	dB
Gain Flatness (40 - 870 MHz, Peak to Valley)		G_F	—	0.5	—	dB
Input Return Loss (Z_o = 75 Ohms) f = 40 - 160 MHz f = 161 - 450 MHz f = 451 - 870 MHz		IRL	 — —	 21 19 19	 — — —	dB
Output Return Loss (Z_o = 75 Ohms) f = 40 - 400 MHz f = 401 - 750 MHz f = 751 - 870 MHz		ORL	 — — —	 19 17 15	 — — —	dB
Composite Second Order (V_{out} = +42 dBmV/ch., Worst Case) (V_{out} = +42 dBmV/ch., Worst Case)	 112 - Channel FLAT 79 - Channel FLAT	 CSO_{112} CSO_{79}	 — —	 -65 -71	 — —	dBc
Cross Modulation Distortion @ Ch 2 (V_{out} = +42 dBmV/ch., FM = 55 MHz) (V_{out} = +42 dBmV/ch., FM = 55 MHz)	 112 - Channel FLAT 79 - Channel FLAT	 XMD_{112} XMD_{79}	 — —	 -63 -62	 — —	dBc
Composite Triple Beat (V_{out} = +42 dBmV/ch., Worst Case) (V_{out} = +42 dBmV/ch., Worst Case)	 112 - Channel FLAT 79 - Channel FLAT	 CTB_{112} CTB_{79}	 — —	 -64 -65	 — —	dBc
Noise Figure	50 MHz 870 MHz	NF	— —	4 4	5.0 5.0	dB
DC Current (V_{DC} = 12 V, T_C = -20° to +100°C)		I_{DC}	190	210	225	mA

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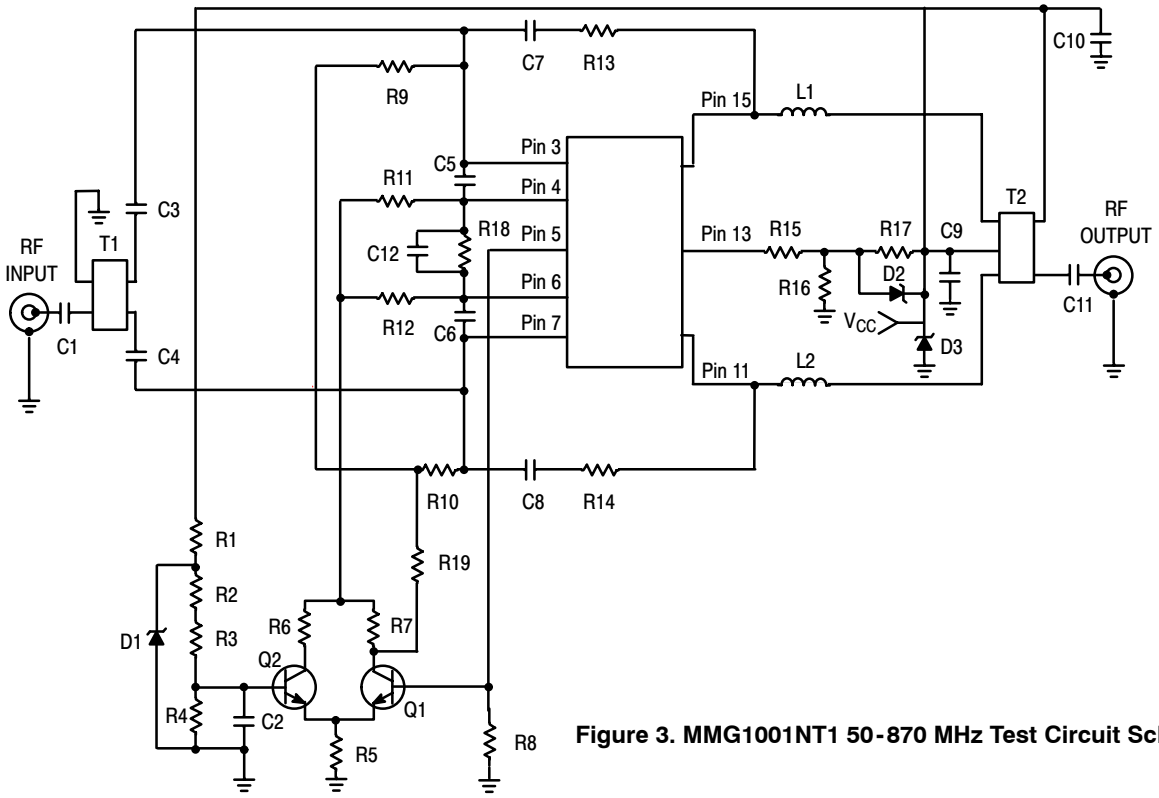

Figure 3. MMG1001NT1 50-870 MHz Test Circuit Schematic

Table 6. MMG1001NT1 50-870 MHz Test Circuit Component Designations and Values

Designation	24 V Application		12 V Application		Manufacturer
	Description	Part Number	Description	Part Number	
C1, C7, C8, C11	220 pF Chip Capacitors	C0603C221J5RAC	220 pF Chip Capacitors	C0603C221J5RAC	Kemet
C2, C3, C4, C9, C10	0.01 μF Chip Capacitors	C0603C103J5RAC	0.01 μF Chip Capacitors	C0603C103J5RAC	Kemet
C5, C6	1.8 pF Chip Capacitors	06035J1R8BS	1.8 pF Chip Capacitors	06035J1R8BS	AVX
C12	5.6 pF Chip Capacitor	06035J5R6BS	5.6 pF Chip Capacitor	06035J5R6BS	AVX
D1	5.1 V Zener Diode	MM3Z5V1T1G	5.1 V Zener Diode	MM3Z5V1T1G	ON Semi
D2	27 V Zener Diode	MM3Z27VT1G	27 V Zener Diode	MM3Z27VT1G	ON Semi
D3	Transient Voltage Suppressor	1.5SMC27AT3G	Transient Voltage Suppressor	1.5SMC27AT3G	ON Semi
L1, L2	22 nH Chip Inductors	HK160822NJ-T	22 nH Chip Inductors	HK160822NJ-T	Taiyo Yuden
Q1, Q2	Dual Transistors Package	MBT3904DW1T1G	Dual Transistors Package	MBT3904DW1T1G	ON Semi
R1	2.2 kΩ, 1/4 W Chip Resistor	CRCW12062201FKTA	820 Ω, 1/4 W Chip Resistor	CRCW12068200FKTA	Vishay
R2	560 Ω, 1/10 W Chip Resistor	CRCW06035600FKTA	560 Ω, 1/10 W Chip Resistor	CRCW06035600FKTA	Vishay
R3	82 Ω, 1/10 W Chip Resistor	CRCW06030820FKTA	40 Ω, 1/10 W Chip Resistor	CRCW06030400FKTA	Vishay
R4	820 Ω, 1/10 W Chip Resistor	CRCW06038200FKTA	150 Ω, 1/10 W Chip Resistor	CRCW06031500FKTA	Vishay
R5	820 Ω, 1/10 W Chip Resistor	CRCW06038200FKTA	100 Ω, 1/10 W Chip Resistor	CRCW06031000FKTA	Vishay
R6	120 Ω, 1/10 W Chip Resistor	CRCW06031200FKTA	120 Ω, 1/10 W Chip Resistor	CRCW06031200FKTA	Vishay
R7	1.5 kΩ, 1/10 W Chip Resistor	CRCW06031501FKTA	1.5 kΩ, 1/10 W Chip Resistor	CRCW06031501FKTA	Vishay
R8	12 Ω, 1 W Chip Resistor	CRCW25120120FKTA	4.8 Ω, 1 W Chip Resistor	CRCW251204R8FKTA	Vishay
R9, R10, R15	470 Ω, 1/10 W Chip Resistors	CRCW06034700FKTA	470 Ω, 1/10 W Chip Resistors	CRCW06034700FKTA	Vishay
R11, R12	18 Ω, 1/10 W Chip Resistors	CRCW06030180FKTA	18 Ω, 1/10 W Chip Resistors	CRCW06030180FKTA	Vishay
R13, R14	910 Ω, 1/10 W Chip Resistors	CRCW06039100FKTA	910 Ω, 1/10 W Chip Resistors	CRCW06039100FKTA	Vishay
R16	2 kΩ, 1/10 W Chip Resistor	CRCW06032001FKTA	2.7 kΩ, 1/10 W Chip Resistor	CRCW06032701FKTA	Vishay
R17	6.2 kΩ, 1/10 W Chip Resistor	CRCW06036201FKTA	6.2 kΩ, 1/10 W Chip Resistor	CRCW06036201FKTA	Vishay
R18	15 Ω, 1/10 W Chip Resistor	CRCW06030150FKTA	15 Ω, 1/10 W Chip Resistor	CRCW06030150FKTA	Vishay
R19	0 Ω, 1/10 W Chip Resistor	CRCW06030000FKTA	0 Ω, 1/10 W Chip Resistor	CRCW06030000FKTA	Vishay
T1	Input Transformer	None	Input Transformer	None	None
T2	Output Transformer	None	Output Transformer	None	None
PCB	FR4, 62 mil, ε_r = 4.81	None	FR4, 62 mil, ε_r = 4.81	None	None

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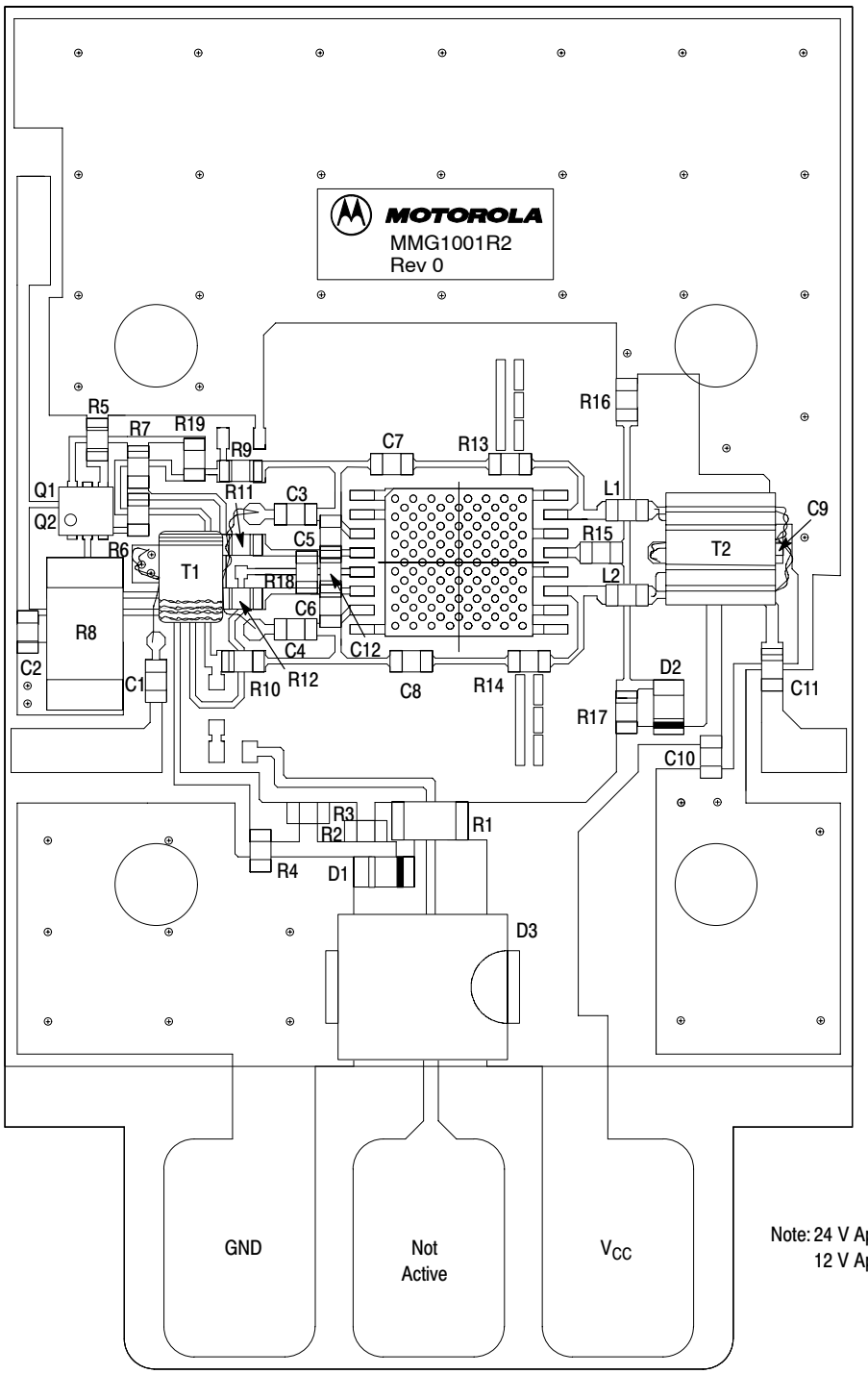

Note: 24 V Application, V_{CC} = 24 V
12 V Application, V_{CC} = 12 V

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Figure 4. MMG1001NT1 50-870 MHz Test Circuit Component Layout

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TYPICAL CHARACTERISTICS FOR 24 V APPLICATION

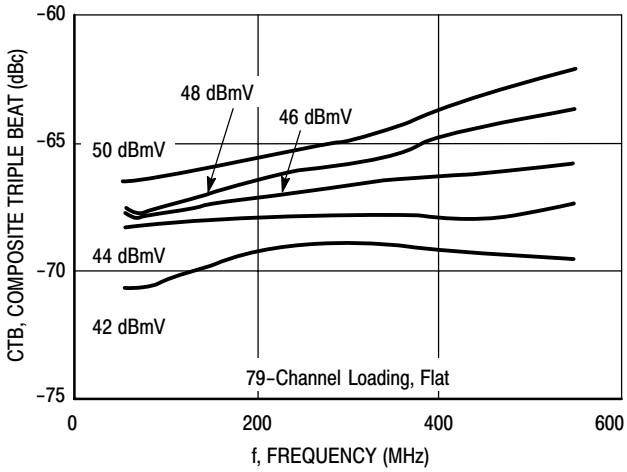

Figure 5. Composite Triple Beat versus Frequency

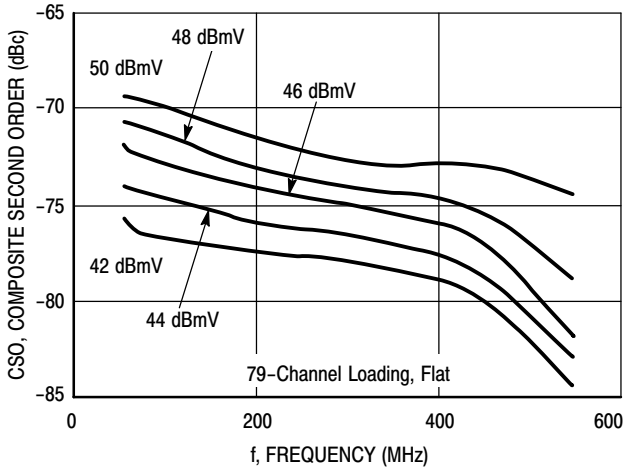

Figure 6. Composite Second Order versus Frequency

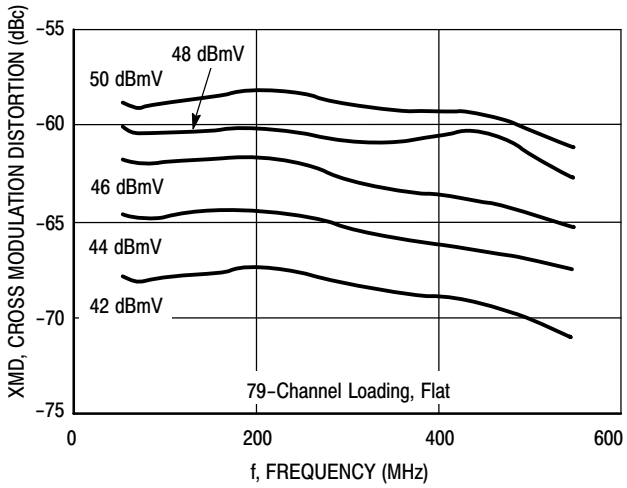

Figure 7. Cross Modulation Distortion versus Frequency

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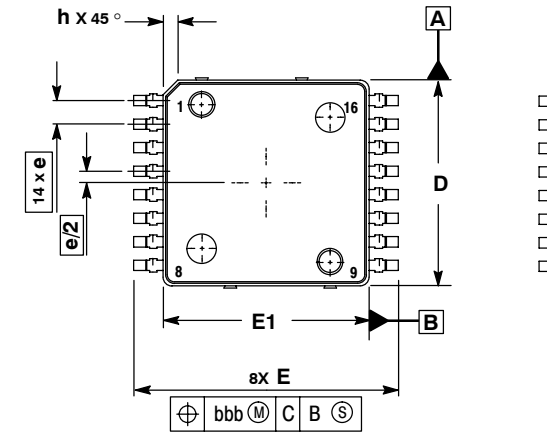
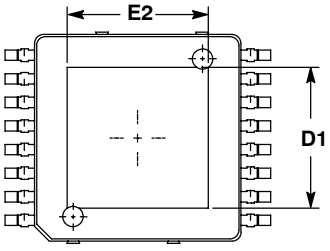
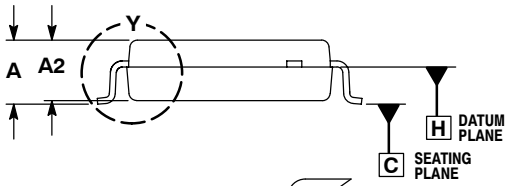
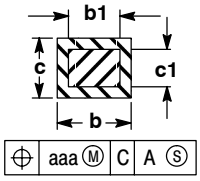
PACKAGE DIMENSIONS



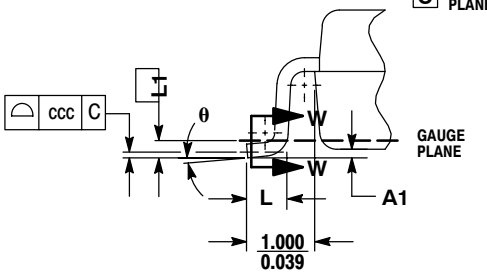


BOTTOM VIEW





SECT W-W



DETAIL Y

NOTES:
1. CONTROLLING DIMENSION: MILLIMETER.
2. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DATUM PLANE -H- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.250 PER SIDE. DIMENSIONS D AND E1 DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -H-.
5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION IS 0.127 TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-.

	MILLIMETERS	
DIM	MIN	MAX
A	2.000	2.300
A1	0.025	0.100
A2	1.950	2.100
D	6.950	7.100
D1	4.372	5.180
E	8.850	9.150
E1	6.950	7.100
E2	4.372	5.180
L	0.466	0.720
L1	0.250 BSC	
b	0.300	0.432
b1	0.300	0.375
c	0.180	0.279
c1	0.180	0.230
e	0.800 BSC	
h	---	0.600
θ	0°	7°
aaa	0.200	
bbb	0.200	
ccc	0.100	

CASE 978-03
ISSUE C
PFP-16

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REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
7	Oct. 2006	• Replaced “N suffix indicates 260°C reflow capable” bullet with RoHS Compliant, p. 1
8	Mar. 2007	• Updated Part Numbers in Table 6, Component Designations and Values, to RoHS compliant part numbers and added Manufacturer column, p. 4

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