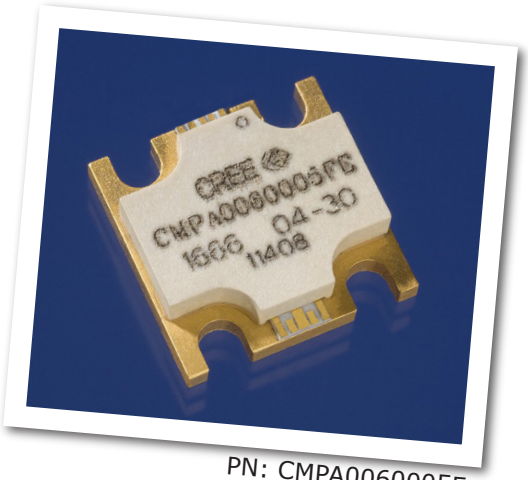
PRELIMINARY

CMPA0060005F

5 W, 20 MHz - 6000 MHz, GaN MMIC Power Amplifier

Cree's CMPA0060005F is a gallium nitride (GaN) High Electron Mobility Transistor (HEMT) based monolithic microwave integrated circuit (MMIC). GaN has superior properties compared to silicon or gallium arsenide, including higher breakdown voltage, higher saturated electron drift velocity and higher thermal conductivity. GaN HEMTs also offer greater power density and wider bandwidths compared to Si and GaAs transistors. This MMIC employs a distributed (traveling-wave) amplifier design approach, enabling extremely wide bandwidths to be achieved in a small footprint screw-down package featuring a copper-tungsten heat sink.



PN: CMPA0060005F
Package Type: 780019

Typical Performance Over 20 MHz - 6.0 GHz (T_c = 25°C)

Parameter	20 MHz	0.5 GHz	1.0 GHz	2.0 GHz	3.0 GHz	4.0 GHz	5.0 GHz	6.0 GHz	Units
Gain	19.8	18.5	17.8	16.7	16.5	18.1	17.0	18.9	dB
Saturated Output Power, P_{SAT}[1]	8.1	7.3	7.7	7.9	5.1	5.9	6.9	5.7	W
Power Gain @ P_{OUT} 37 dBm	17.8	16.4	15.6	14.7	13.5	14.3	13.5	13.6	dB
PAE @ P_{OUT} 37 dBm	23	20	20	20	17	20	19	24	%

Note[1]: P_{SAT} is defined as the RF output power where the device starts to draw positive gate current in the range of 2-4 mA.
Note[2]: V_{DD} = 48 V, I_D = 100 mA

Features

- 17 dB Small Signal Gain
- 5 W Typical P_{SAT}
- Operation up to 48 V
- High Breakdown Voltage
- High Temperature Operation
- ~0.5" x 0.5" total product size

Applications

- Ultra Broadband Amplifiers
- Fiber Drivers
- Test Instrumentation
- EMC Amplifier Drivers

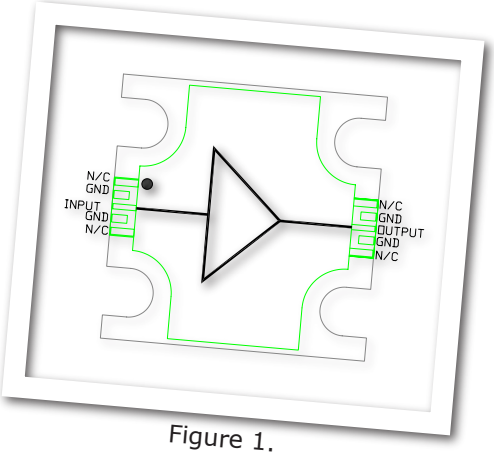


Figure 1.

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Absolute Maximum Ratings (not simultaneous) at 25˚C

Parameter	Symbol	Rating	Units
Drain-source Voltage	V_{DSS}	84	VDC
Gate-source Voltage	V_{GS}	-10, +2	VDC
Storage Temperature	T_{STG}	-55, +150	˚C
Operating Junction Temperature	T_J	175	˚C
Forward Gate Current	I_G	4	mA
Screw Torque	T	40	in-oz
Thermal Resistance, Junction to Case	$R_{\theta JC}$	4.3	˚C/W

Electrical Characteristics (Frequency = 20 MHz to 6.0 GHz unless otherwise stated; T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold Voltage[2]	V_P	–	–2.5	–	V	V_{DS} = 10 V, I_D = 20 mA
Gate Quiescent Voltage	V	–	-2.0	–	V	V_{DS} = 28 V, I_D = 100 mA
Saturated Drain Current	I_{DC}	–	1.4	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
RF Characteristics						
Small Signal Gain	S21	–	17	–	dB	V_{DD} = 28 V, I_{DQ} = 100 mA
Input Return Loss	S11	–	12	–	dB	V_{DD} = 28 V, I_{DQ} = 100 mA
Output Return Loss	S22	–	18	–	dB	V_{DD} = 28 V, I_{DQ} = 100 mA
Power Output at P_{SAT}	P_{SAT}	5	6	–	W	V_{DD} = 28 V, I_{DQ} = 100 mA
Power Added Efficiency @ 33 dBm P_{OUT}	PAE	–	20	–	%	V_{DD} = 28 V, I_{DQ} = 100 mA
Power Gain @ 33 dBm P_{OUT}	G_P	–	14	–	dB	V_{DD} = 28 V, I_{DQ} = 100 mA
Output Mismatch Stress	VSWR	–	5 : 1	–	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 100 mA, P_{IN} = 23 dBm

Notes:

[1] P_{SAT} is defined as the RF output power where the device starts to draw positive gate current in the range of 2-4 mA.

[2] The device will draw approximately 20-25 mA at pinch off due to the internal circuit structure.

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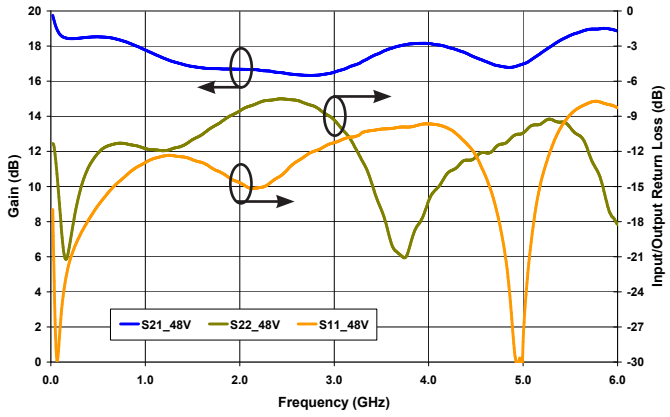
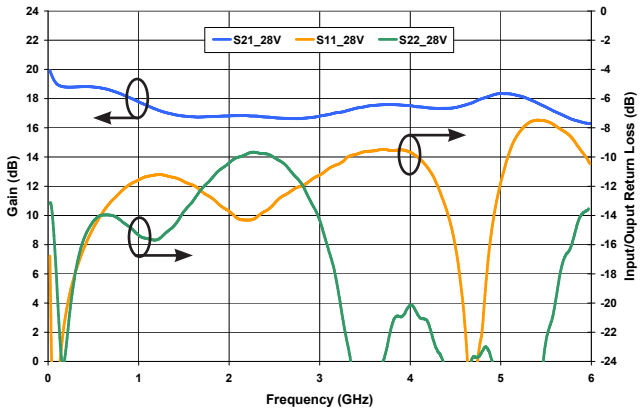
Typical Performance

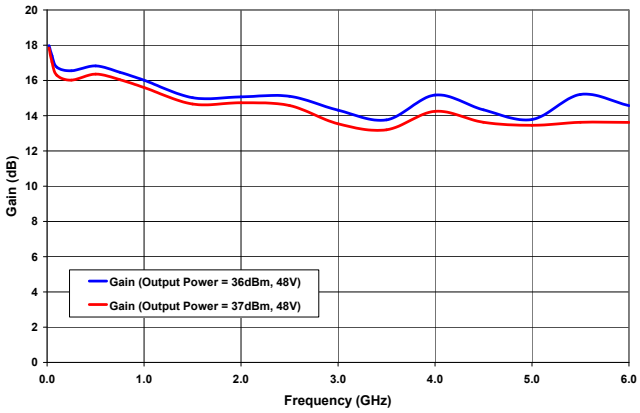
Small Signal Gain and Return Losses vs Frequency at 48 V



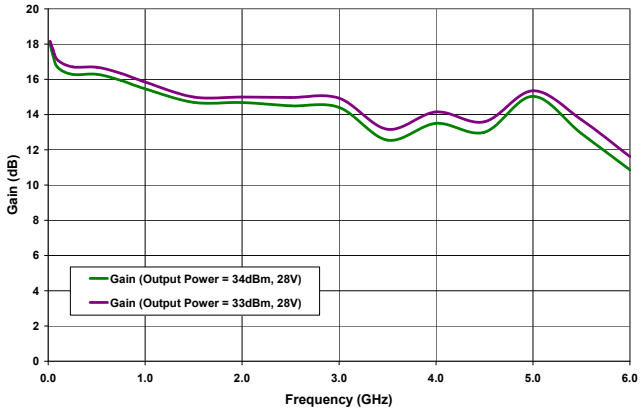
Small Signal Gain and Return Losses vs Frequency at 28 V



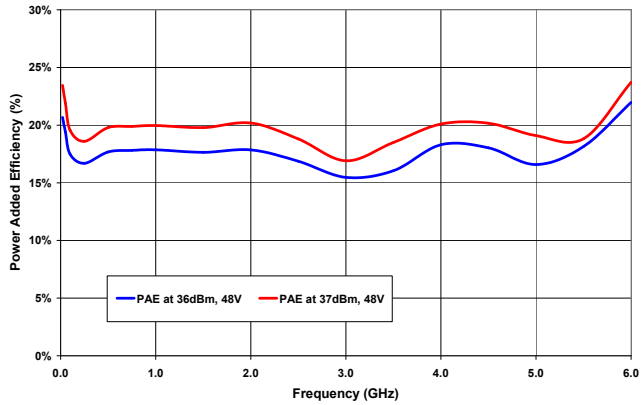
Power Gain vs Frequency at 48V



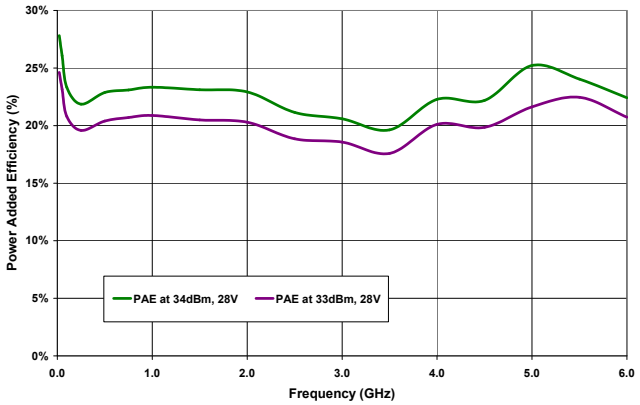
Power Gain vs Frequency at 28V



PAE at 36 & 37 dBm Output Power vs Frequency at 48 V



PAE at 33 & 34 dBm Output Power vs Frequency at 28 V



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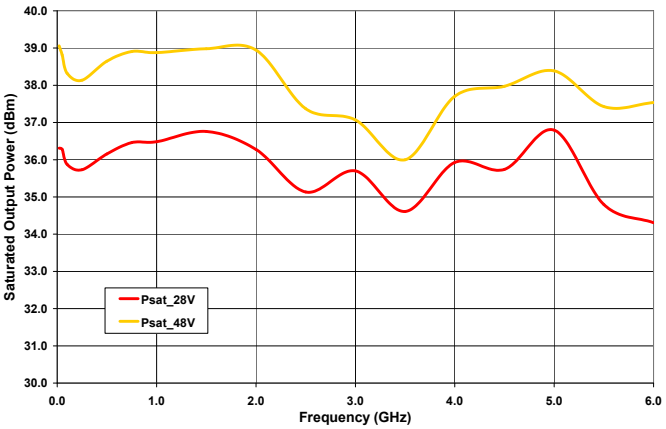
Typical Performance

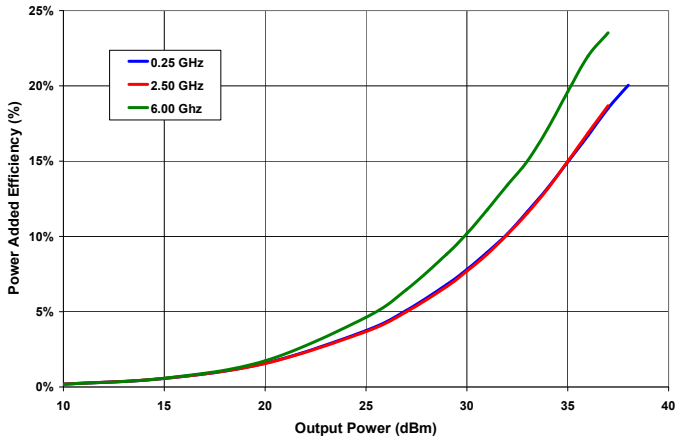
Saturated Output Power Performance (P_{SAT}) vs Frequency



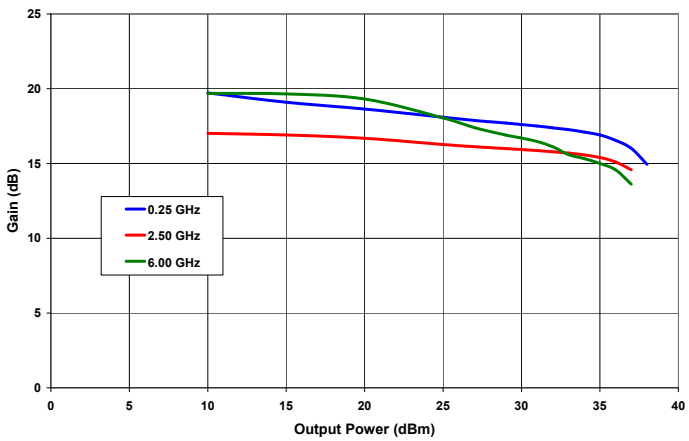
Frequency (GHz)	P_{SAT} at 28V (dBm)	P_{SAT} at 48V (dBm)	P_{SAT} at 28V (W)	P_{SAT} at 48V (W)
0.02	36.6	39.1	4.3	8.1
0.5	36.2	38.7	4.1	7.3
1.0	36.5	38.9	4.5	7.7
1.5	36.8	39.0	4.7	7.9
2.0	36.3	39.0	4.2	7.9
2.5	35.1	37.4	3.3	5.5
3.0	35.7	37.1	3.7	5.1
3.5	34.6	36.0	2.9	3.8
4.0	35.9	37.7	3.9	5.9
4.5	35.7	38.0	3.8	6.3
5.0	36.8	38.4	4.8	6.9
5.5	34.8	37.4	3.0	5.5
6.0	34.3	37.5	2.7	5.7

Note: P_{SAT} is defined as the RF output power where the device starts to draw positive gate current in the range of 2-4 mA.

Power Added Efficiency vs Output Power as a Function of Frequency at 48V



Gain vs Output Power at 48 V



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General Device Information

The CMPA0060005F is a GaN HEMT MMIC Distributed Driver Amplifier, which operates between 20 MHz - 6.0 GHz. The amplifier typically provides 17 dB of small signal gain and 5 W saturated output power with an associated power added efficiency of better than 20 %. The wideband amplifier's input and output are internally matched to 50 Ohm. The amplifier requires bias from appropriate Bias-T's, through the RF input and output ports.

The CMPA0060005F is provided in a flange package format. The input and output connections are gold plated to enable gold bond wire attach at the next level assembly.

The measurements in this data sheet were taken on devices wire-bonded to the test fixture with 2 mil gold bond wires. The CMPA0060005F-TB and the device were then measured using external Bias-T's, (Tecdia: TBT-03M1), as shown in Figure 2. The Bias-T's were included in the calibration of the test system. All other losses associated with the test fixture are included in the measurements.

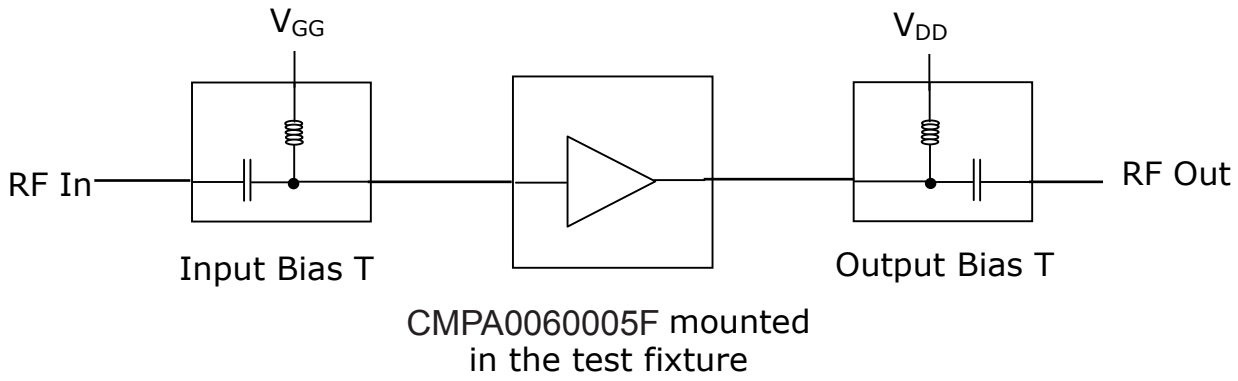

Figure 2. Typical test system setup required for measuring CMPA0060005F-TB

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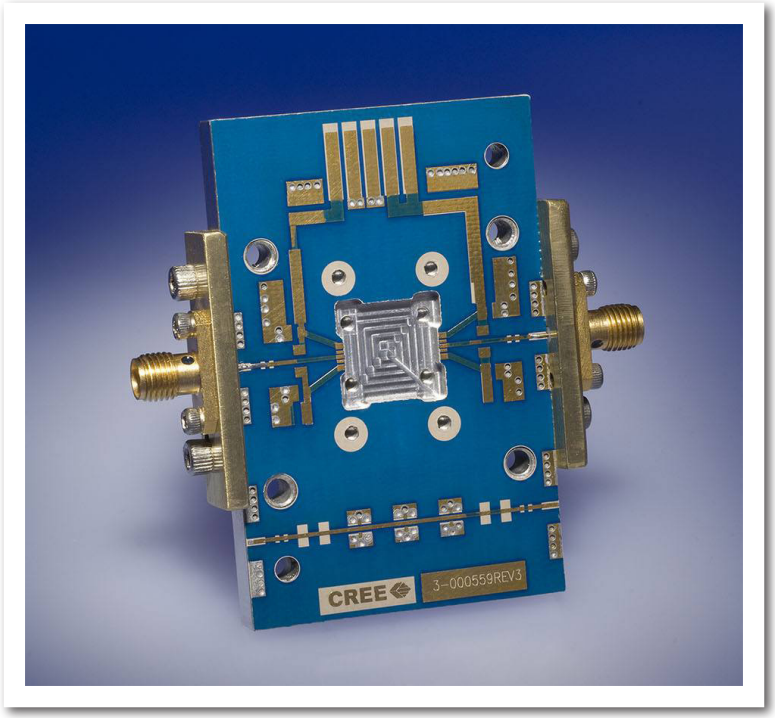
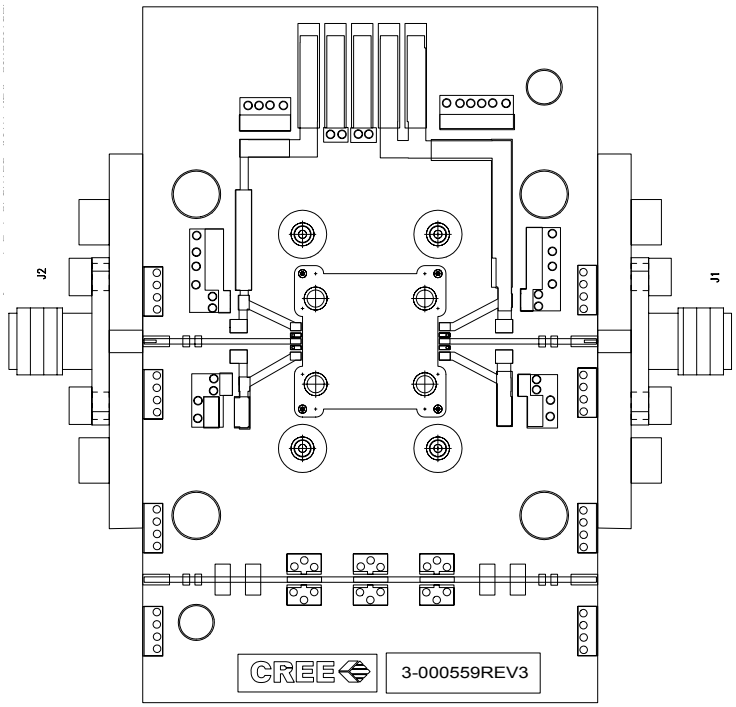
CMPA0060005F-TB Demonstration Amplifier Circuit



CMPA0060005F-TB Demonstration Amplifier Circuit Outline



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CMPA0060005F-TB Demonstration Amplifier Circuit Bill of Materials

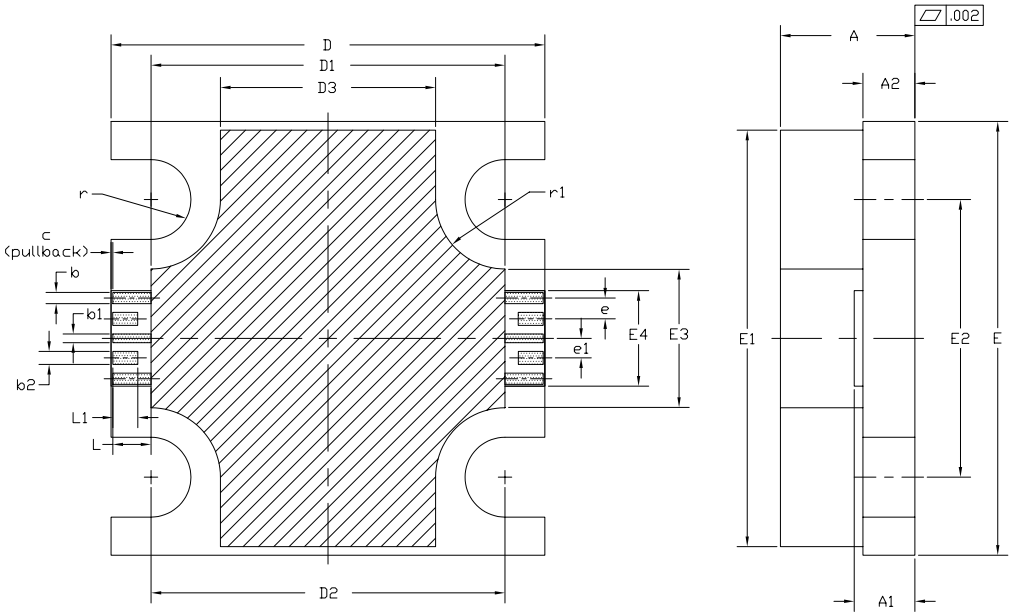
Designator	Description	Qty
J1,J2	CONNECTOR, SMA, AMP1052901-1	2
-	PCB, TACONIC, RF-35-0100-CH/CH	1
Q1	CMPA0060005F	1

Notes

[1] The CMPA0060005F is connected to the PCB with 2.0 mil Au bond wires.

[2] An external bias T is required.

Product Dimensions CMPA0060005F (Package Type — 780019)



NOTES:

1. DIMENSIONING AND TOLERANICING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
5. ALL PLATED SURFACES ARE NI/AU

DIM	INCHES		MILLIMETERS		NOTE
	MIN	MAX	MIN	MAX	
A	0.148	0.162	3.76	4.12	–
A1	0.066	0.076	1.67	1.93	–
A2	0.056	0.064	1.42	1.63	–
b	0.013		0.33		x4
b1	0.010		0.25		x2
b2	0.015		0.38		x4
c	0.002		0.05		x2
D	0.495	0.505	12.57	12.83	–
D1	0.403	0.413	10.23	10.49	–
D2	0.408		10.36		–
D3	0.243	0.253	6.17	6.43	–
E	0.495	0.505	12.57	12.83	–
E1	0.475	0.485	12.06	12.32	–
E2	0.320		8.13		–
E3	0.155	0.165	3.93	4.19	–
E4	0.105	0.115	2.66	2.92	–
e	0.024		0.61		x4
e1	0.023		0.57		x4
L	0.044		1.12		x6
L1	0.029		0.74		x4
r	R0.046		R1.17		x4
r1	R0.080		R2.03		x4

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