GaN Amplifier 40 V, 180 W
4.4 - 5.0 GHz

MACOM PURE CARBIDE™

CGHV50200F
Rev. V1

Features

- Saturated Power: 180 W
- Large Signal Gain: 11.5 dB
- Drain Efficiency: 48%
- Internally Matched: 50 Ω
- High Temperature Operation
- RoHS* Compliant

Applications

- Troposcatter Communications
- Beyond Line of Sight—BLOS
- Satellite Communications

Description

The CGHV50200F is a gallium nitride (GaN) amplifier designed specifically with high efficiency, high gain and wide bandwidth capabilities, which makes the CGHV50200F ideal for troposcatter communications, 4.4 - 5.0 GHz C-Band SatCom applications and Beyond Line of Sight.

The GaN HEMT is matched to 50 ohm, for ease of use. It is designed for CW, pulse, and linear mode of power amplifier operation. The amplifier is supplied in a ceramic/metal flange package, type 440217.

Typical RF Performance:

Measured in Evaluation Test Fixture[1] at 30 dBc, 1.6 MHz from carrier under OQPSK modulation, 1.6 Msps, PN23, Alpha Filter = 0.2

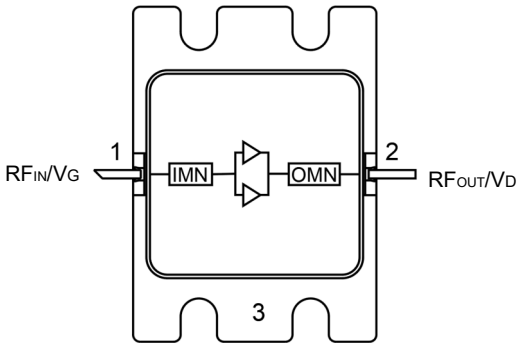
- V_{DS} = 40 V, I_{DQ} = 1 A, T_C = 25°C

Frequency (GHz)	Output[1] Power (W)	Power[1] Gain (dB)	η_D[1] (%)
4.4	100	11.4	49
4.6	100	11.6	47
4.8	126	11.0	48
5.0	101	11.8	48

1. Performance values and curves in this data sheet were measured in this fixture.

440217

Functional Schematic



Pin Configuration

Pin #	Pin Name	Function
1	RF_{IN} / V_G	RF Input / Gate
2	RF_{OUT} / V_D	RF Output / Drain
3	Flange[2]	Ground / Source

2. The flange on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information

Part Number	MOQ Increment
CGHV50200F	Bulk
CGHV50200F-AMP	Sample Board

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

RF Electrical Specifications: T_A = +25°C, V_{DS} = 40 V, I_{DQ} = 1 A

Parameter	Units	Min.	Typ.	Max.	Conditions
Small Signal Gain at f = 4.4 GHz	dB	14	15.4	—	V_{dd}=40V, I_{dq}= 1 A, P_{in} = 10 dBm
Small Signal Gain at f = 4.8 GHz	dB	14	15.3	—	
Small Signal Gain at f = 5.0 GHz	dB	14.25	15.2	—	
Power Gain at f = 4.4 GHz	dB	10.5	12.1	—	V_{dd}=40V, I_{dq}= 1 A, P_{out} = 48 dBm 1.6 Msps OQPSK Modulation, PN23, Alpha Filter = 0.2
Power Gain at f = 4.8 GHz	dB	10.5	12.4	—	
Power Gain at f = 5.0 GHz	dB	10.5	12.2	—	
Power Added Efficiency at f = 4.4 GHz	%	30	42	—	
Power Added Efficiency at f = 4.8 GHz	%	30	37	—	
Power Added Efficiency at f = 5.0 GHz	%	30	40	—	
OQPSK Linearity at 4.4 GHz	dBc	—	-29	-25	
OQPSK Linearity at 4.8 GHz	dBc	—	-34	-28	
OQPSK Linearity at 5.0 GHz	dBc	—	-34	-26	
Ruggedness: Output Mismatch	Ψ	—	—	3:1	No damage at all phase angles, V_{dd}=40V, I_{dq}= 1 A, CW P_{OUT} = 180 W

Note: Final testing and screening for all amplifier sales is performed using the CGHV50200F-AMP

DC Electrical Characteristics T_A = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Drain-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 150 V	I_{DLK}	-	-	16.6	mA
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 10 V	I_{GLK}	-5.8	-	-	mA
Gate Threshold Voltage	V_{DS} = 10 V, I_D = 41.6 mA	V_T	-3.8	-3.0	-2.3	V
Gate Quiescent Voltage	V_{DS} = 40 V, I_D = 1 A	V_{GSQ}	-	-2.7	-	V

Absolute Maximum Ratings[1,2]

Parameter	Absolute Maximum
Drain-Source Voltage	150 V
Gate Voltage	-10, +2 V
DC Drain Current	14 A
Gate Current	41.6 mA
Storage Temperature	-65°C to +150°C
Mounting Temperature[3]	+245°C
Junction Temperature[4,5]	+225°C
Operating Temperature	-40°C to +125°C

1. Exceeding any one or combination of these limits may cause permanent damage to this device.
2. MACOM does not recommend sustained operation near these survivability limits.
3. Mounting temperature for 30 seconds.
4. Operating at nominal conditions with $T_J \leq +225$ C will ensure MTTF > 1 x 10^6 hours.
5. Junction Temperature (T_J) = T_C + Θjc * (V * I)
   Typical thermal resistance (Θjc) = 0.81 °C/W for CW.
   a) For T_C = +85°C,
   T_J = 220 °C @ P_{diss}=166.4 W

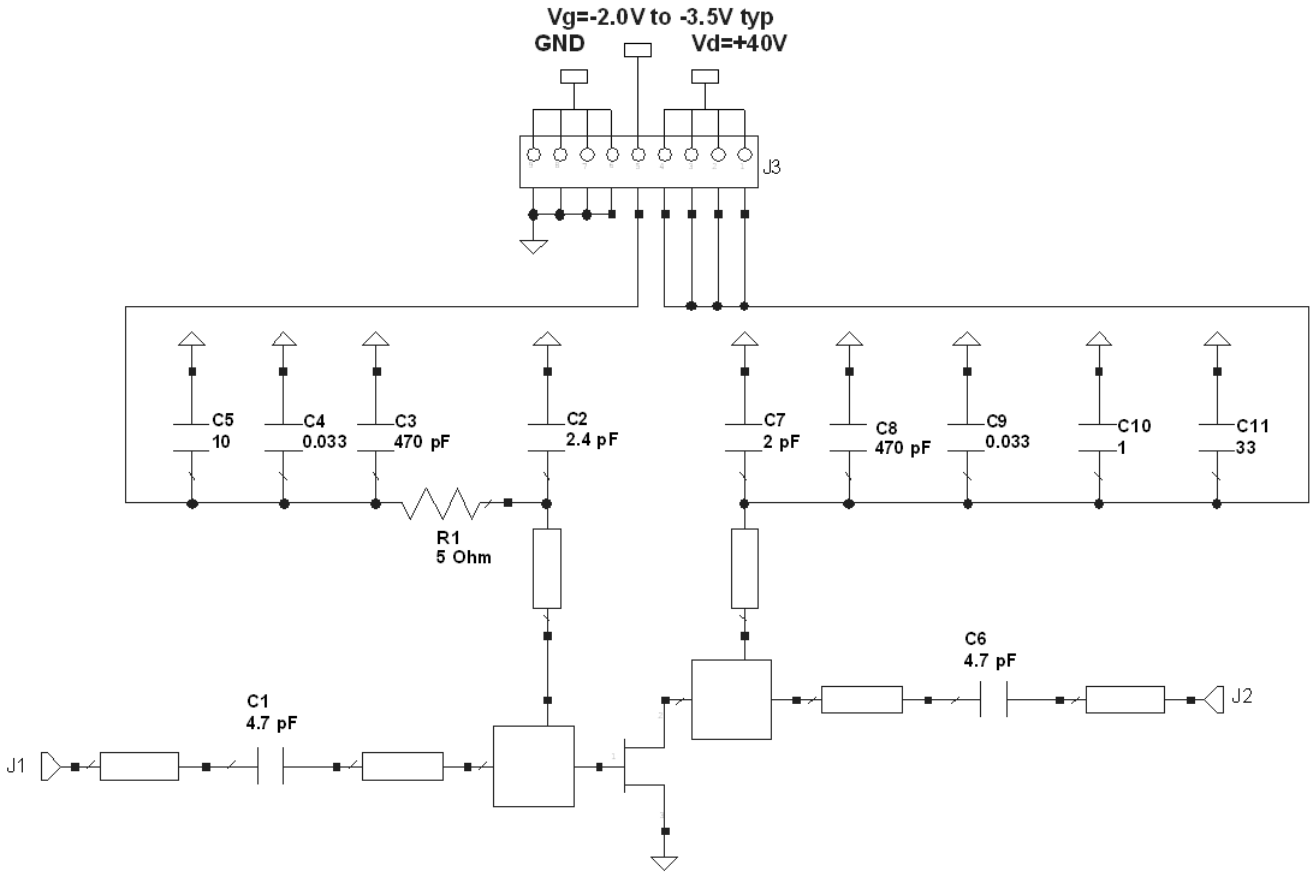
Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

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

Evaluation Test Fixture and Recommended Tuning Solution, 4.4—5.0 GHz



Description

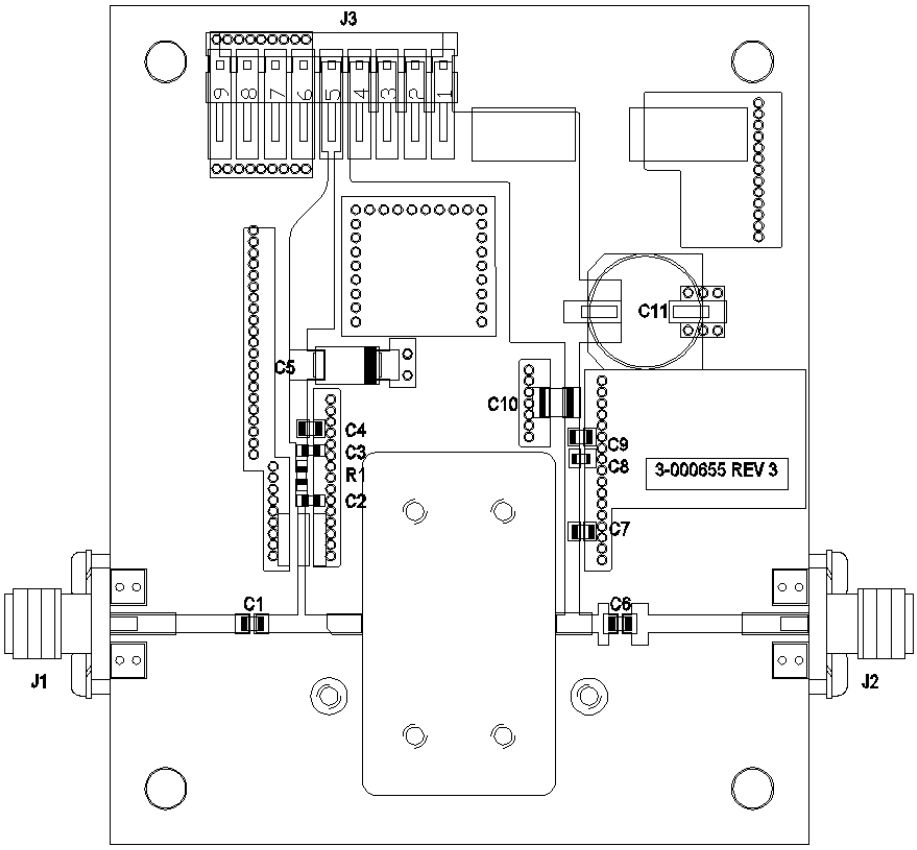
Parts measured on evaluation board (30-mil thick RF35). Matching is provided using a combination of lumped elements and transmission lines as shown in the simplified schematic above. Recommended tuning solution component placement, transmission lines, and details are shown on the next page.

Biasing Sequence

Bias ON
1. Ensure RF is turned off
2. Apply pinch-off voltage of -5 V to the gate
3. Apply nominal drain voltage
4. Bias gate to desired quiescent drain current
5. Apply RF

Bias OFF
1. Turn RF off
2. Apply pinch-off voltage of -5 V to the gate
3. Turn-off drain voltage
4. Turn-off gate voltage

Evaluation Test Fixture and Recommended Tuning Solution, 4.4-5.0 GHz



Assembly Parts List

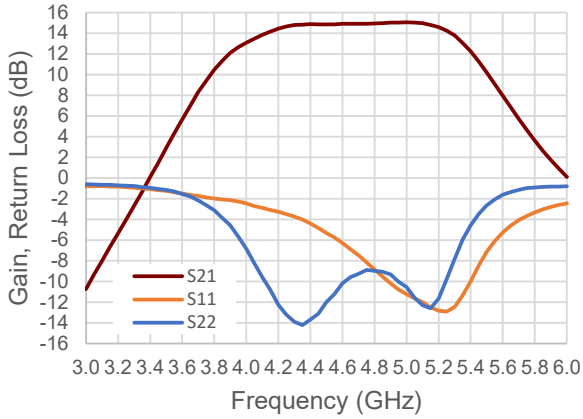
Reference Designator	Description	Qty
R1	RES, 5.1, OHM, +/- 1%, 1/16W, 0603	1
C1, C6	CAP, 4.7pF, +/-1%, 250V, 0805	2
C2	CAP, 2.4pF, +/- 0.25pF, 250V, 0603	1
C3, C8	CAP, 470pF, 5%, 100V, 0603, X	2
C4, C9	CAP, 33000pF, 0805, 100V, X7R	2
C5	CAP 10µF 16V TANTALUM	1
C7	CAP, 2.0pF, +/-1%, 250V, 0805	1
C10	CAP, 1.0µF, 100V, 10%, X7R, 1210	1
C11	CAP, 33µF, 20%, G CASE	1
J1, J2	J1,J2 CONN, SMA, PANEL MOUNT JACK	2
J3	J3 HEADER RT>PLZ .1CEN LK 9POS	1
—	PCB, RF35, 2.5 X 3.0 X 0.030	1
—	2-56 SOC HD SCREW 1/4 SS	4
—	#2 SPLIT LOCKWASHER SS	4
Q1	CGHV50200F	1

Typical Performance Curves as Measured in the 4.4 – 5.0 GHz Evaluation Test Fixture

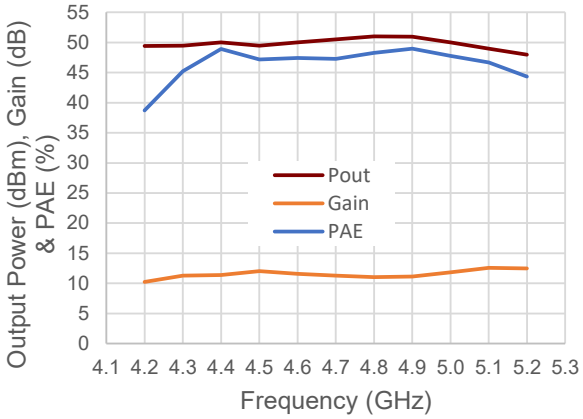
OQPSK modulation, 1.6 Msps, PN23, Alpha Filter = 0.2 , V_{DS} = 40V, I_{DQ} = 1 A **(Unless otherwise noted)**

For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

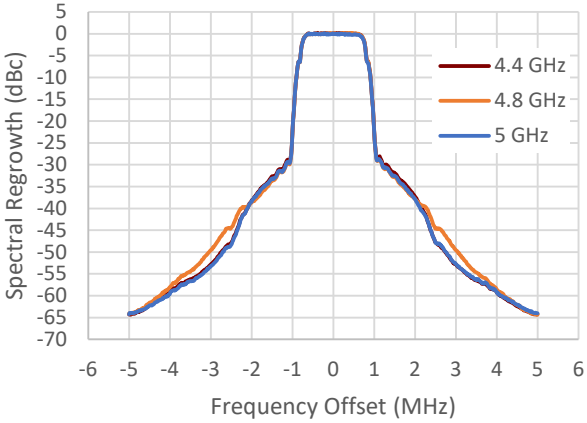
S11, S21, & S22 vs. Frequency



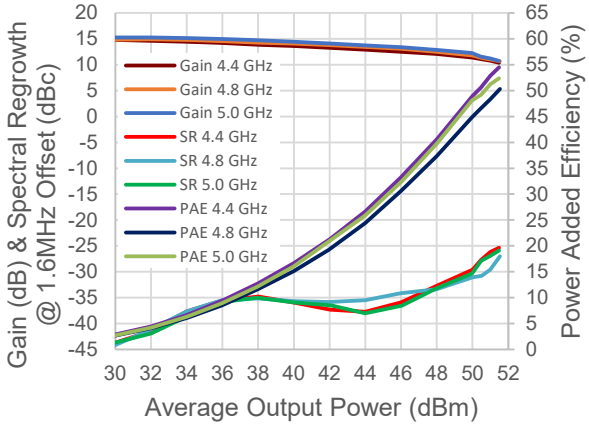
Output Power, Gain, Drain Efficiency vs. Frequency With Spectral Regrowth = -30 dBc



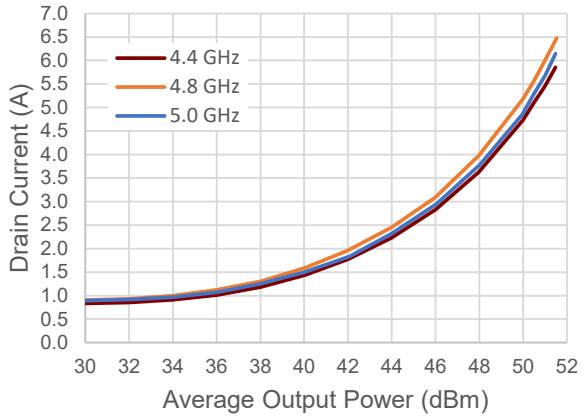
Spectral Mask with P_{AVE} = 48 dBm



Gain, Spectral Regrowth and PAE vs. P_{AVE}



Drain Current vs. Average Output Power

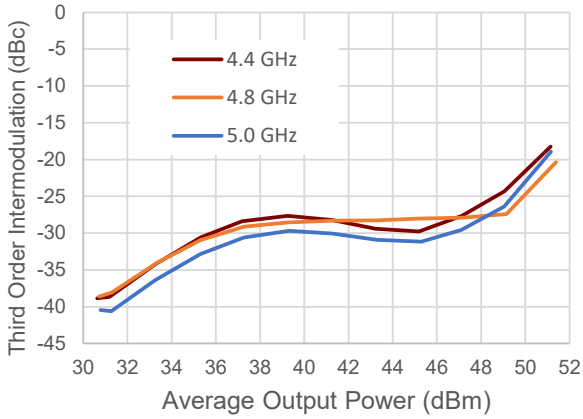


Typical Performance Curves as Measured in the 4.4 – 5.0 GHz Evaluation Test Fixture

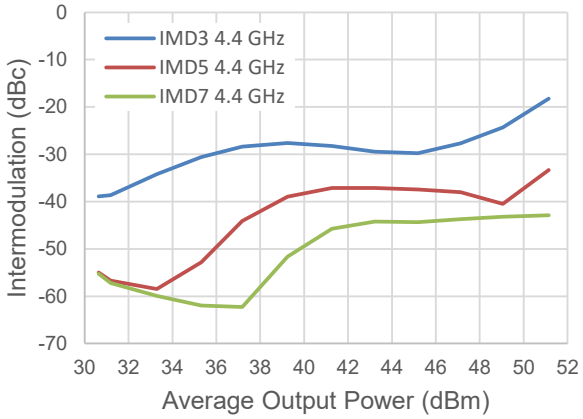
V_{DS} = 40V, I_{DQ} = 1 A **(Unless otherwise noted)**

For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

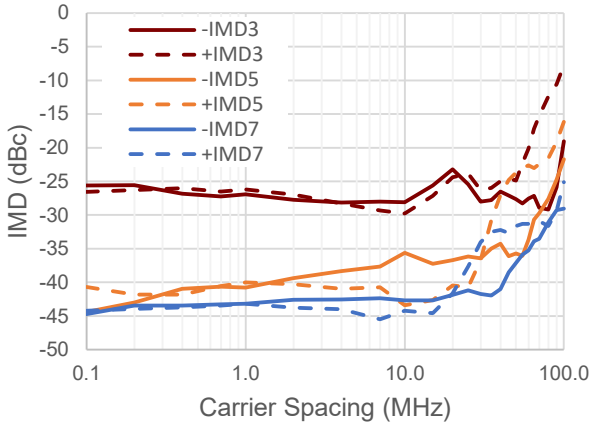
IMD3 vs. Average Output Power



IMD vs. Average Output Power



Two Tone Carrier Spacing Sweep at P_{AVE} = 48 dBm

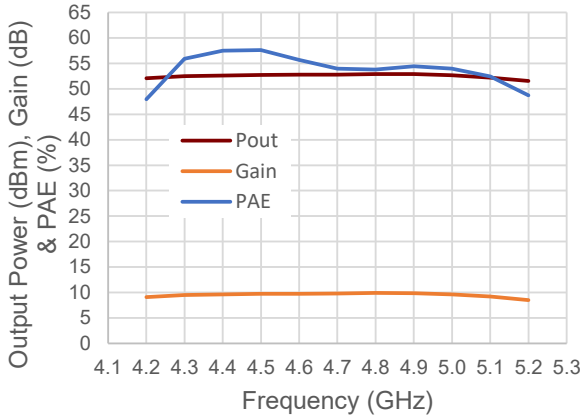


Typical Performance Curves as Measured in the 4.4 – 5.0 GHz Evaluation Test Fixture

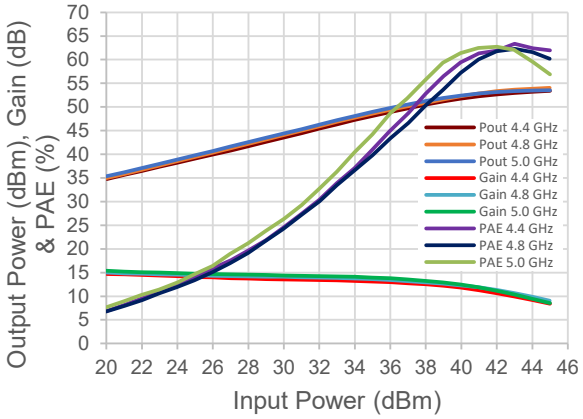
Pulse width = 100 µs, Duty Cycle = 10%, P_{IN} = 43 dBm, V_{DS} = 40V, I_{DQ} = 1 A **(Unless otherwise noted)**

For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

Output Power, Gain and PAE vs. Frequency



IMD3 vs. Average Output Power

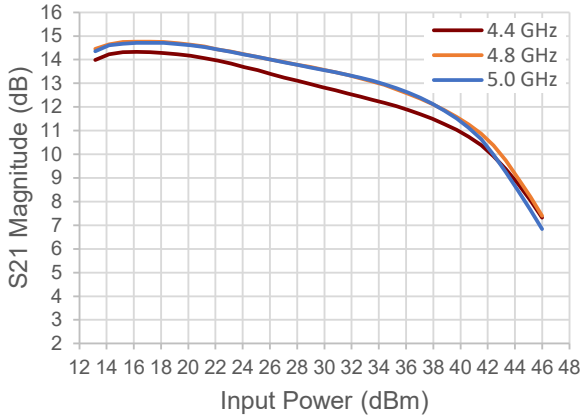


Typical Performance Curves as Measured in the 4.4 – 5.0 GHz Evaluation Test Fixture

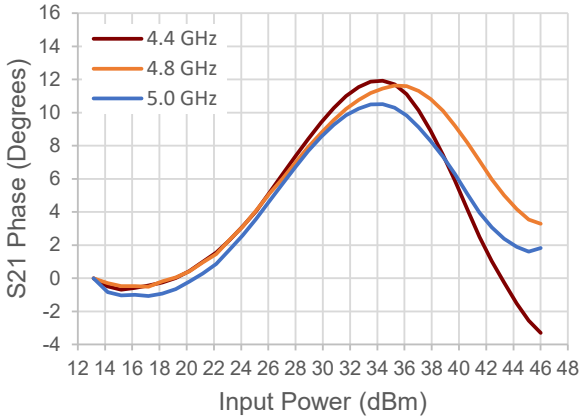
V_{DS} = 40V, I_{DQ} = 1 A **(Unless otherwise noted)**

For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

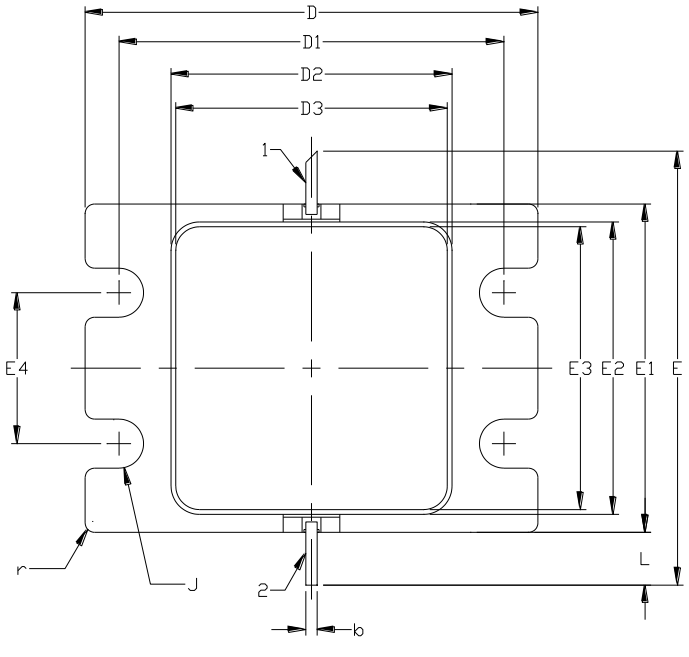
AM-AM

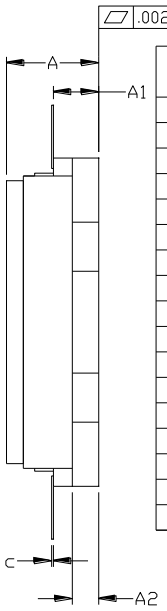


AM-PM



Lead-free 440217 Package Dimensions





1. GATE
2. DRAIN

DIM	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.185	0.201	4.70	5.11	
A1	0.088	0.100	2.24	2.54	2x
A2	0.049	0.061	1.24	1.55	
b	0.022	0.026	0.56	0.66	2x
c	0.003	0.006	0.08	0.15	
D	0.935	0.955	23.75	24.26	
D1	0.797	0.809	20.24	20.55	2x
D2	0.581	0.593	14.76	15.06	
D3	0.565	0.571	14.35	14.50	
E	0.906		23.01		REF
E1	0.679	0.691	17.25	17.55	
E2	0.604	0.616	15.34	15.65	
E3	0.588	0.594	14.93	15.09	
E4	0.309	0.321	7.85	8.15	2x
J	ø0.097	ø0.107	ø2.46	ø2.72	4x
L	0.090	0.130	2.29	3.30	2x
r	0.02 TYP		0.51 TYP		12x