

# Thermally Enhanced GaN Amplifier

## 630 W, 48 V, 2110 - 2200 MHz



**MACOM PURE CARBIDE™**

**WGC22630**

Rev. V1

### Features

- GaN on SiC HEMT Technology
- Pulsed CW Performance: 2155 MHz, 48 V, 40  $\mu$ s Pulse Width, 10% Duty Cycle, Combined Outputs
- Output Power @ P4dB = 630 W
- Efficiency @ P4dB = 68%
- RoHS\* Compliant

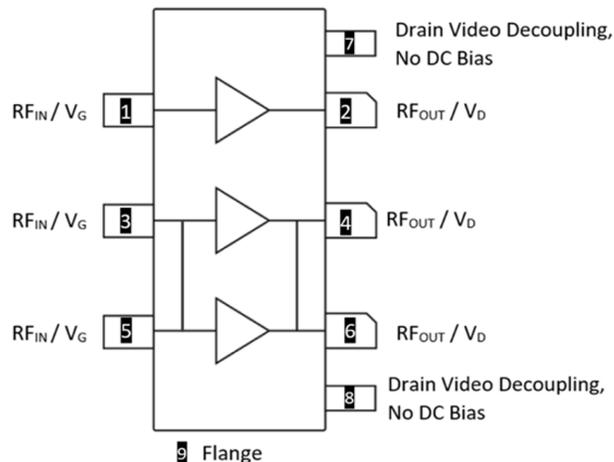
### Applications

- Cellular Power

### Description

The WGC22630 is a 630 W (P4dB) GaN on Silicon Carbide HEMT amplifier designed for use in multi-standard cellular power amplifier applications. It features optimized operation from 2110 - 2200 MHz and a thermally-enhanced over-molded plastic package.

### Functional Schematic



### Typical RF Performance<sup>1</sup>

WCDMA 3GPP TM1 64 DPCH 10dB PAR @ 0.01% CCDF,  $V_{DS} = 48$  V,  $I_{DQCAR} = 360$  mA,  $V_{GSPK} = -4.7$  V,  $P_{OUT} = 49.3$  dBm (85 W),  $T_A = +25^\circ$ C.

Frequency (MHz)	Gain (dB)	Efficiency (%)	OPAR (dB)	ACPR (dBc)
2110	16.5	58.0	8.5	-29.6
2155	16.5	57.2	8.3	-29.7
2200	16.1	55.6	8.1	-30.3

1. Measurements taken in MACOM Doherty Evaluation Test Fixture with device soldered to the heatsink, 50  $\Omega$  system.

### Pin Configuration<sup>2</sup>

Pin #	Function
1	Carrier RF <sub>IN</sub> / V <sub>G</sub>
3, 5	Peak RF <sub>IN</sub> / V <sub>G</sub>
2	Carrier RF <sub>OUT</sub> / V <sub>D</sub>
4, 6	Peak RF <sub>OUT</sub> / V <sub>D</sub>
7, 8	Drain Video Decoupling. No DC Bias
9	Flange

2. Exposed metallization on the back side of the package.

### Ordering Information

Part Number	Package
WGC22630-V1A-R2	250 piece reel
LTAWGC22630-E1	Sample Board

<sup>1</sup> \* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

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### RF Electrical Specifications:

$V_{DS} = 48\text{ V}$ ,  $I_{DQCAR} = 360\text{ mA}$ ,  $V_{GSPK} = -4.7\text{ V}$ ,  $T_A = +25^\circ\text{C}$ .

Note: Performance in MACOM Doherty Evaluation Test Fixture with device soldered to the heatsink, 50  $\Omega$  system.

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	WCDMA <sup>3</sup> , 2155 MHz, $P_{OUT} = 49.3\text{ dBm}$	Gp	—	16.5	—	dB
Drain Efficiency	WCDMA <sup>3</sup> , 2155 MHz, $P_{OUT} = 49.3\text{ dBm}$	$\eta$	—	57.2	—	%
Output CCDF @ 0.01%	WCDMA <sup>3</sup> , 2155 MHz, $P_{OUT} = 49.3\text{ dBm}$	PAR	—	8.3	—	dB
Adjacent Channel Power	WCDMA <sup>3</sup> , 2155 MHz, $P_{OUT} = 49.3\text{ dBm}$	ACP	—	-29.7	—	dBc
Input Return Loss	WCDMA <sup>3</sup> , 2155 MHz, $P_{OUT} = 49.3\text{ dBm}$	IRL	—	-19	—	dB
Ruggedness: Output Mismatch	All phase angles	$\psi$	VSWR = 10:1, No Device Damage			

### RF Electrical Specifications:

$V_{DS} = 48\text{ V}$ ,  $I_{DQCAR} = 360\text{ mA}$ ,  $V_{GSPK} = V_{GS}$  at  $I_{DQPK} = 720\text{ mA} - 1.6\text{ V}$ ,  $T_A = +25^\circ\text{C}$

Note: Performance in MACOM Doherty Production Test Fixture, 50  $\Omega$  system.

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	WCDMA <sup>3</sup> , 2200 MHz, $P_{OUT} = 49.3\text{ dBm}$	Gp	13.5	16	—	dB
Drain Efficiency	WCDMA <sup>3</sup> , 2200 MHz, $P_{OUT} = 49.3\text{ dBm}$	$\eta$	47	55	—	%
Output CCDF @ 0.01%	WCDMA <sup>3</sup> , 2200 MHz, $P_{OUT} = 49.3\text{ dBm}$	PAR	6.7	7.7	—	dB
Adjacent Channel Power	WCDMA <sup>3</sup> , 2200 MHz, $P_{OUT} = 49.3\text{ dBm}$	ACP	—	-28.5	-23	dBc

3. WCDMA 3GPP TM1 64 DPCH 10dB PAR @ 0.01% CCDF.

**DC Electrical Characteristics:  $T_A = 25^\circ\text{C}$**

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
<b>Carrier Amplifier</b>						
Drain-Source Leakage Current	$V_{GS} = -8\text{ V}, V_{DS} = 10\text{ V}$	$I_{DLK}$	—	—	5.7	mA
Gate-Source Leakage Current - Mid Voltage	$V_{GS} = -8\text{ V}, V_{DS} = 50\text{ V}$	$I_{GLKM}$	-8.5	—	—	mA
Gate-Source Leakage Current - High Voltage	$V_{GS} = -8\text{ V}, V_{DS} = 150\text{ V}$	$I_{GLKH}$	-11.2	—	—	mA
Gate Threshold Voltage	$V_{DS} = 10\text{ V}, I_D = 36\text{ mA}$	$V_T$	-3.8	-3.1	-2.3	V
<b>Peaking Amplifier</b>						
Drain-Source Leakage Current	$V_{GS} = -8\text{ V}, V_{DS} = 10\text{ V}$	$I_{DLK}$	—	—	11.4	mA
Gate-Source Leakage Current - Mid Voltage	$V_{GS} = -8\text{ V}, V_{DS} = 50\text{ V}$	$I_{GLKM}$	-16.9	—	—	mA
Gate-Source Leakage Current - High Voltage	$V_{GS} = -8\text{ V}, V_{DS} = 150\text{ V}$	$I_{GLKH}$	-22.3	—	—	mA
Gate Threshold Voltage	$V_{DS} = 10\text{ V}, I_D = 72\text{ mA}$	$V_T$	-3.8	-3.1	-2.3	V

**Recommended Operating Voltages**

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Drain Operating Voltage	—	V	—	—	50
Gate Quiescent Voltage	$V_{DS} = 48\text{ V}, I_D = 360\text{ mA}$	V	-3.6	-2.9	-2.1

### Absolute Maximum Ratings<sup>4,5,6</sup>

Parameter	Absolute Maximum
Drain Source Voltage, $V_{DS}$	125 V
Gate Source Voltage, $V_{GS}$	-10 V to +2 V
Operating Voltage, $V_{DS}$	55 V
Gate Current (Carrier), $I_G$	36 mA
Gate Current (Peaking), $I_G$	72 mA
Drain Current (Carrier), $I_D$	12.2 A
Drain Current (Peaking), $I_D$	24.4 A
Junction Temperature	+225°C
Storage Temperature	-65°C to +150°C

4. Exceeding any one or combination of these limits may cause permanent damage to this device.
5. MACOM does not recommend sustained operation near these survivability limits.
6. Product's qualification were performed @ +225°C. Operation @  $T_J$  (+275°C) reduces median time to failure.

### Thermal Characteristics

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Thermal Resistance ( $R_{\theta JC}$ ) Carrier Peak	$T_C = +85^\circ\text{C}$ 123 W DC 157 W DC	°C/W	—	1.1 0.6	—

### Bias Sequencing

#### 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 to the gate
3. Turn-off drain voltage
4. Turn-off gate voltage

### 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 HBM Class 1B and CDM Class C3 devices.

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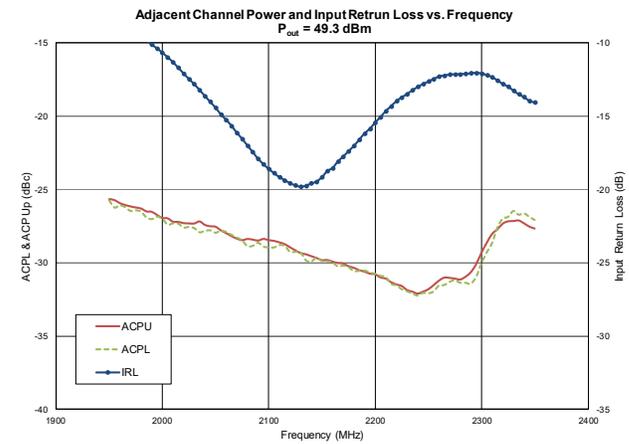
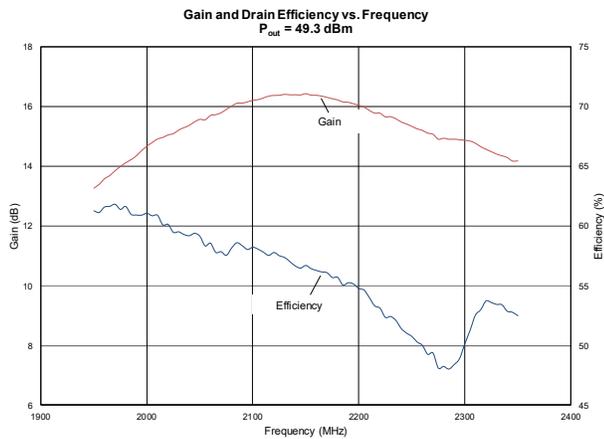
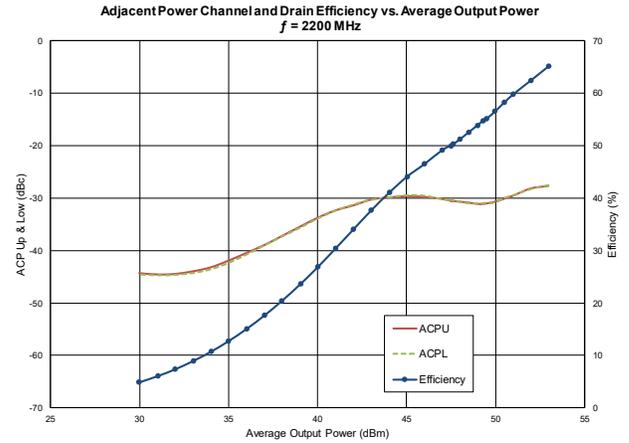
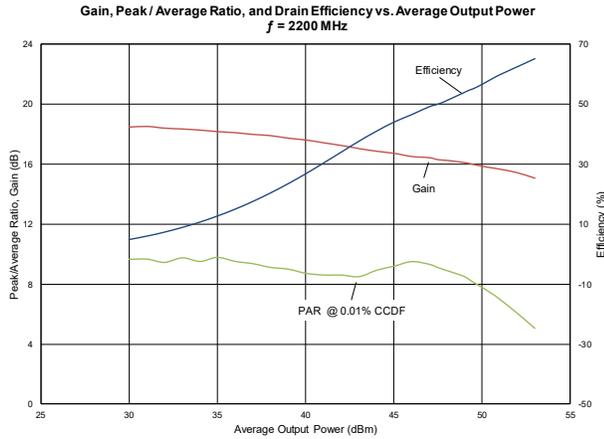
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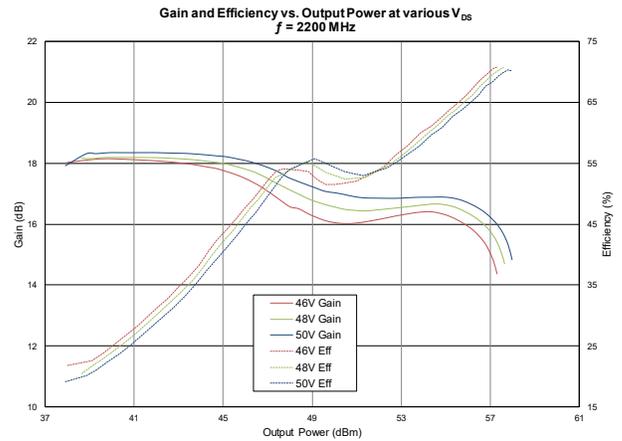
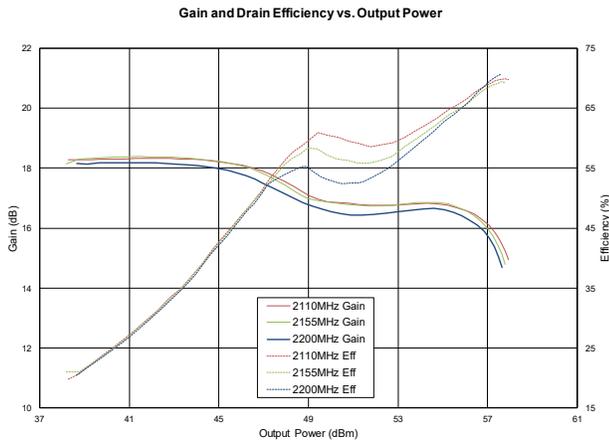
### Typical Performance Curves as measured in Doherty evaluation test fixture:

WCDMA 3GPP TM1 64 DPCH 10dB PAR @ 0.01% CCDF,  $V_{DS} = 48\text{ V}$ ,  $I_{DQCAR} = 360\text{ mA}$ ,  $V_{GSPK} = -4.7\text{ V}$ ,  $T_A = +25^\circ\text{C}$ .



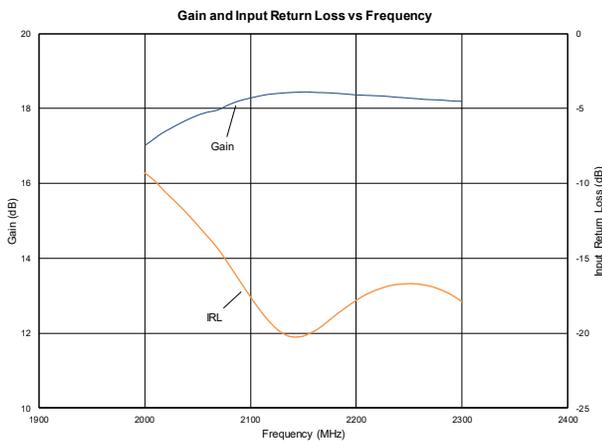
**Typical Performance Curves as measured in Doherty evaluation test fixture:**

Pulsed CW, 40 μsec pulse width, 10% Duty Cycle,  $V_{DS} = 48\text{ V}$ ,  $I_{DQCAR} = 360\text{ mA}$ ,  $V_{GSPK} = -4.7\text{ V}$ ,  $T_A = +25^\circ\text{C}$ .



**Typical Performance Curves as measured in Doherty evaluation test fixture:**

CW Small Signal,  $V_{DS} = 48\text{ V}$ ,  $I_{DQCAR} = 360\text{ mA}$ ,  $V_{GSPK} = -4.7\text{ V}$ ,  $T_A = +25^\circ\text{C}$ .



# Thermally Enhanced GaN Amplifier

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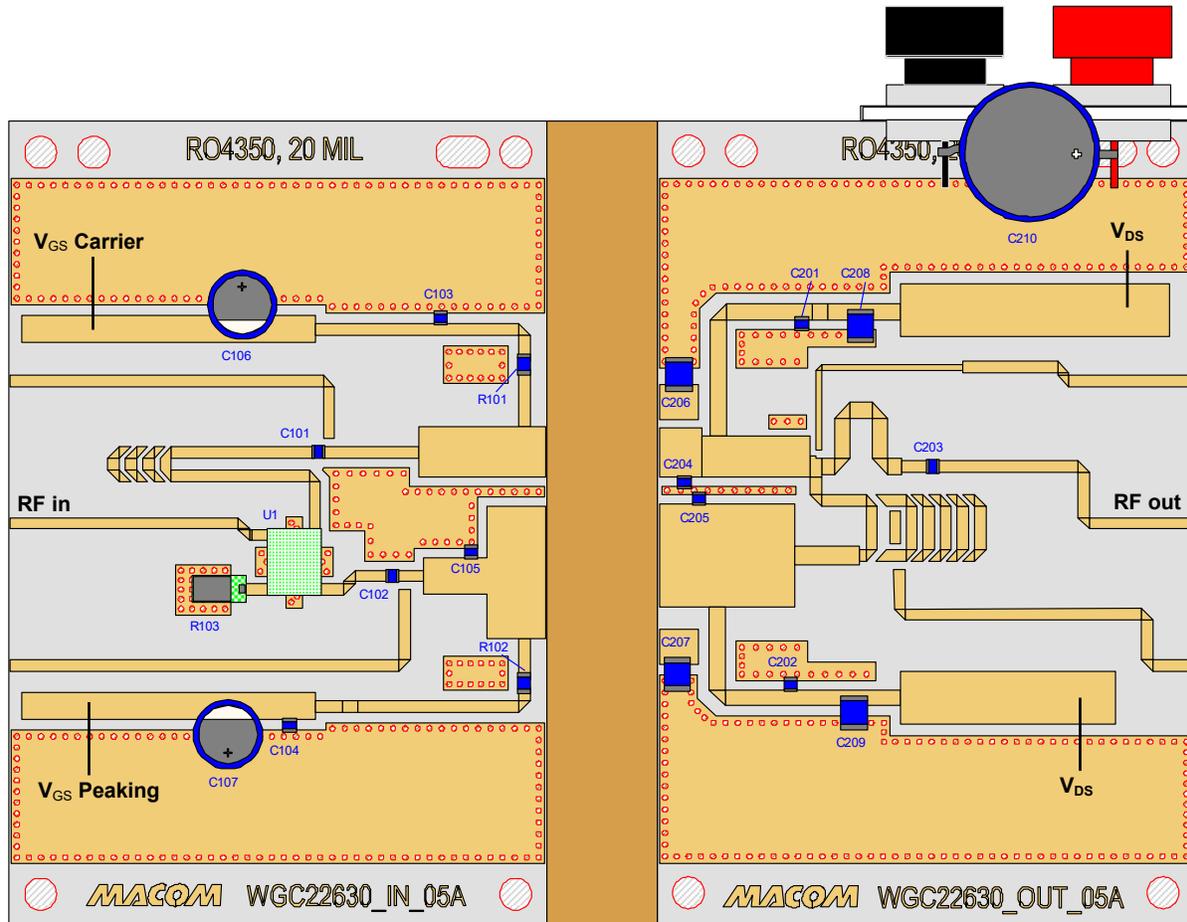


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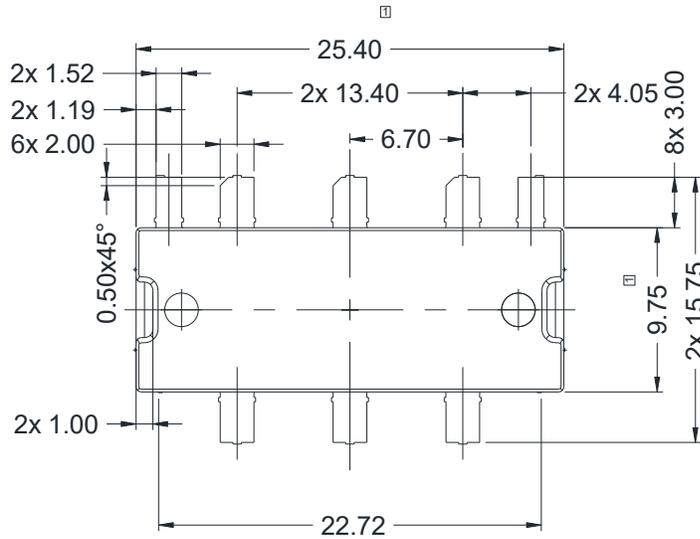
### Evaluation Board: 2110 - 2200 MHz



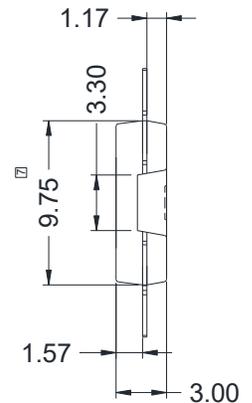
### Parts List for Evaluation Board: 2110 - 2200 MHz

Component	Description	Manufacturer	Manufacturer P/N
<b>Input</b>			
C101, C102, C103, C104	Capacitor, 22 pF	ATC	ATC800A220JT250X
C105	Capacitor, 0.7 pF	ATC	ATC800A0R7CT250X
C106, C107	Capacitor, 10 $\mu$ F, 100 V	Panasonic	EEV-HD2A100P
R101, R102	Resistor, 10 $\Omega$	Panasonic	ERJ-8GEYJ100V
R103	Resistor, 50 $\Omega$	TTM Technologies	C16A50Z4
U1	Hybrid Coupler	Anaren	X3C21P1-03S
<b>Output</b>			
C201, C202, C203	Capacitor, 22 pF	ATC	ATC800A220JT250X
C204	Capacitor, 0.8 pF	ATC	ATC800A0R8CT250X
C205	Capacitor, 0.5 pF	ATC	ATC800A0R5CT250X
C206, C207, C208, C209	Capacitor, 10 $\mu$ F, 100 V	Murata	GRM32EC72A106KE05L
C210	Capacitor, 100 $\mu$ F, 100 V	Cornell Dubilier Electronics (CDE)	SK101M100ST

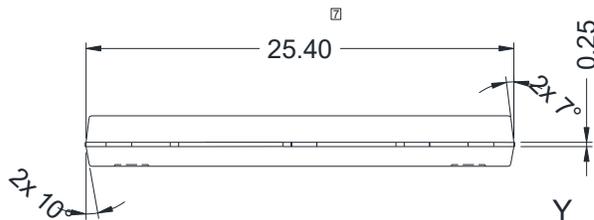
Package Outline Drawing PG-HBSOF-8-1



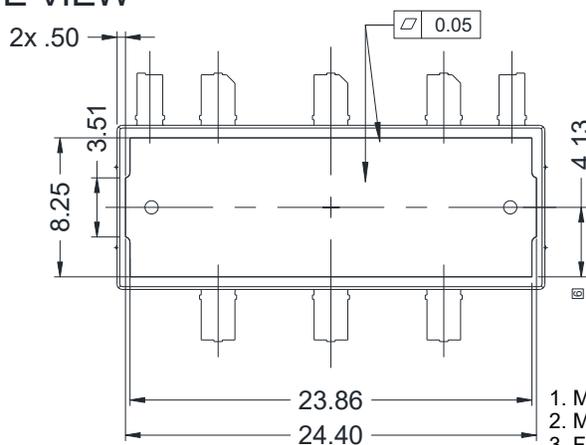
TOP VIEW



END VIEW



SIDE VIEW



BOTTOM VIEW

1. Mold/dam bar/metal protrusion of 0.30 mm max per side not included.
2. Metal protrusions connected to source and shall not exceed 0.10 mm max.
3. Fillets and radii: Unless otherwise noted all radii are 0.3 mm max.
4. Molded package Ra 1.2-1.6  $\mu$ m.
5. All metal surfaces tin pre-plated, except area of cut.
6. Exposed metal surface tin plated, may not be covered by mold compound.
7. Does not include mold/dam bar/metal protrusion.
8. Interpret dimensions and tolerances per ISO 8015.
9. Dimensions are in mm.
10. All tolerances are  $\pm 0.1$  mm unless specified otherwise.

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