

# MACOM PURE CARBIDE

#### Features

- Full S-Band Radar Coverage
- Saturated Power: 450 W
- Large Signal Gain: >10 dB
- Drain Efficiency: 55%
- Internally Matched: 50 Ω
- Pulsed and CW Operation

## Applications

• Civil & Military, Pulsed and CW S-Band Radar

## Description

The CGHV38375F is a packaged, 450 W HPA matched to 50 ohms at both input and output ports. The CGHV38375F operates from 2.75 - 3.75 GHz providing coverage over the entire S-Band radar band. This high-power amplifier provides >10 dB of large signal gain and 40% power-added efficiency and is ideally suited as a high-power building block supporting both pulsed and CW radar applications.

## **Typical RF Performance:**

Measured at fixed input power of +46 dBm, 100  $\mu$ s pulse width, 10% duty cycle.

• V<sub>DS</sub> = 50 V, I<sub>DQ</sub> = 500 mA, T<sub>C</sub> = 25°C

Frequency (GHz)	Output Power (dBm)	Gain (dB)	η₀ (%)
2.75	55.9	9.9	50
2.9	57.4	11.4	67
3.3	57.5	11.5	62
3.5	57.7	11.7	60
3.75	56.8	10.8	60

## **Ordering Information**

Part Number	Package
CGHV38375F	bulk
CGHV38375F-AMP	Sample Board



## **Functional Schematic**



## **Pin Configuration**

Pin #	Description
1	Gate / RF Input
2 Drain / RF Output	
3 Source / Flange	

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

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Parameter	Test Conditions	Units	Min.	Тур.	Max.
Output Power	$\begin{array}{l} {\sf P}_{\sf IN} = 46 \; {\sf dBm}, \\ {\sf Pulse Width} = 100 \; \mu {\sf s}, \; {\sf Duty Cycle} = 10\% \\ 2.75 \; {\sf GHz} \\ 2.9 \; {\sf GHz} \\ 3.3 \; {\sf GHz} \\ 3.5 \; {\sf GHz} \\ 3.75 \; {\sf GHz} \end{array}$	dBm	54.0 56.5 56.5 56.0 55.75	55.8 57.5 57.8 57.5 56.9	_
Drain Efficiency	$\begin{array}{l} {\sf P}_{\sf IN} = 46 \; dBm, \\ {\sf Pulse Width} = 100 \; \mu {\sf s}, \; {\sf Duty Cycle} = 10\% \\ 2.75 \; {\sf GHz} \\ 2.9 \; {\sf GHz} \\ 3.3 \; {\sf GHz} \\ 3.5 \; {\sf GHz} \\ 3.75 \; {\sf GHz} \end{array}$	%	31.0 53.5 52.0 47.0 52.0	42.8 60.5 63.2 58.6 61.9	_
Small Signal Gain	P <sub>IN</sub> = -10 dBm 2.75 GHz 2.9 GHz 3.3 GHz 3.5 GHz 3.75 GHz	dB	6.5 10.0 9.0 9.0 9.5	9.4 12.9 13.5 13.3 13.1	_
Input Return Loss	P <sub>IN</sub> = -10 dBm	dB	—	6	—
Output Return Loss	P <sub>IN</sub> = -10 dBm	dB		6	_
Output Mismatch Stress (VSWR)	No damage at all phase angles	Ψ	_	5:1	_

## RF Electrical Specifications: Freq. = 2.75 - 3.75 GHz, $T_A$ = +25C, $V_{DD}$ = 50 V, $I_{DQ}$ = 500 mA

Note: Final testing and screening for all amplifier sales is performed using the CGHV38375F-AMP at 2.75-3.75 GHz.

## DC Electrical Specifications: Freq. = 2.75 - 3.75 GHz, T<sub>A</sub> = +25C

Parameter	Test Conditions	Units	Min.	Тур.	Max.
Gate Threshold Voltage	$V_{DS}$ = 10 V, $I_{D}$ = 83.6 mA	V	-3.8	-3.0	-2.3
Gate Quiescent Voltage	V <sub>DD</sub> = 28 V, I <sub>DQ</sub> = 500 mA	VDC	—	-2.7	
Saturated Drain Current	$V_{DS}$ = 6.0 V, $V_{GS}$ = 2.0 V	А	54.4	77.7	
Drain Source Breakdown Voltage	V <sub>GS</sub> = -8 V, I <sub>D</sub> = 83.6 mA	V	125		

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## Absolute Maximum Ratings<sup>1,2</sup>

Parameter	Absolute Maximum
Drain-Source Voltage	150 V
Gate Voltage	-10, +2 V
Drain Current	24 A
Gate Current	102 mA
Input Power	48 dBm
Storage Temperature	-55C to +150°C
Mounting Temperature	+320°C
Junction Temperature <sup>3,4,5</sup>	+225°C
Operating Temperature	-40°C to +85°C

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

- MACOM does not recommend sustained operation near these survivability limits.
- 3. Operating at nominal conditions with  $T_J \le +275$  C will ensure MTTF > 1 x 10<sup>6</sup> hours.
- Junction Temperature (T<sub>J</sub>) = T<sub>C</sub> + Θjc \* (V \* I) Typical thermal resistance (Θjc) = 0.22 °C/W for 100 µs/10%.
  - a) For  $T_C = +25^{\circ}C$ ,

T<sub>J</sub> = 121C @ P<sub>DISS</sub> = 437 W

b) For  $T_C$  = +85°C,

 $T_J$  = 179 °C @ P<sub>DISS</sub> = 427 W

- 5. Junction Temperature  $(T_J) = T_C + \Theta jc^* (V^* I)$ Typical thermal resistance  $(\Theta jc) = 0.5$  °C/W for CW.
  - a) For  $T_c = +85^{\circ}C$ ,

T<sub>J</sub> = 185 °C @ P<sub>DISS</sub> = 200 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.

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## **Thermal Characteristics**

Parameter	Operating Conditions	Value
Operating Junction Temperature $(T_J)$	Freq = 3.5 GHz, $V_D$ = 50 V, $I_{DQ}$ = 500 mA,	179°C
Thermal Resistance, Junction to Case ( $R_{\mbox{\tiny \thetaJC}}$ )	$P_{DISS} = 426.5 \text{ W}, T_c = 85^{\circ}\text{C}, PW = 100 \ \mu\text{s}, DC = 10\%$	0.22°C/W



Frequency (GHz)

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## MACOM PURE CARBIDE

### **Typical Performance Curves:**

 $V_D$  = 50 V,  $I_{DQ}$  = 500 mA, Pulse Width = 100 µs, Duty Cycle = 10%, P<sub>IN</sub> = 46 dBm, T<sub>B</sub> = +25°C. For Engineering Evaluation Only – This data does not Modify MACOM's Datasheet Limits.

70

60

50

40

2.7



Drain Current vs. Frequency vs. Temperature

Gate Current vs. Frequency vs. Temperature

3.1

3.3

Frequency (GHz)

3.5

3.7

3.9

85 °C

25 °C

2.9







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Drain Efficiency (%)





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### Drain Efficiency vs. Frequency vs. V<sub>Ds</sub>



#### Drain Current vs. Frequency vs. V<sub>DS</sub>

Gate Current vs. Frequency vs. V<sub>ps</sub>







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# Drain Efficiency vs. Frequency vs. I<sub>DQ</sub>



#### Drain Current vs. Frequency vs. I<sub>DQ</sub>

Gate Current vs. Frequency vs. I<sub>DQ</sub>







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70

60

50

40

30 20

10 0

18



#### Drain Current vs. Input Power vs. Frequency

Gate Current vs. Input Power vs. Frequency

28

33

Input Power (dBm)

38

43

48

48

2.75 GHz

3.5 GHz

3.75 GHz

23







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70

60

50

40

30 20

10 0

18

Drain Efficiency (%)

Output Power vs. Input Power vs. Temperature



Drain Current vs. Input Power vs. Temperature

Gate Current vs. Input Power vs. Temperature

28

33

Input Power (dBm)

38

43

48

Drain Efficiency vs. Input Power vs. Temperature

85 °C

25 °C

23







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#### Drain Efficiency vs. Input Power vs. V<sub>Ds</sub>



Drain Current vs. Input Power vs. V<sub>Ds</sub>

Gate Current vs. Input Power vs. V<sub>DS</sub>







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#### Output Power vs. Input Power vs. I<sub>DQ</sub> 65 1000 mA Output Power (dBm) 55 500 mA 250 mA 45 35 25 18 23 28 33 38 43 48 Input Power (dBm)

#### Drain Efficiency vs. Input Power vs. Input





Gate Current vs. Input Power vs. Inc







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### **Typical Performance Curves:**

 $V_D = 50 \text{ V}, \text{ I}_{DQ} = 500 \text{ mA}, \text{ CW}, \text{ P}_{IN} = 43 \text{ dBm}, \text{ T}_B = +25^{\circ}\text{C}.$ 

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60

50

40

30

20

2.7

Drain Efficiency (%)

**Output Power vs. Frequency vs. Temperature** 



#### Drain Current vs. Frequency vs. Temperature

Gate Current vs. Frequency vs. Temperature

3.1

3.3

Frequency (GHz)

3.5

3.7

3.9

Drain Efficiency vs. Frequency vs. Temperature

85 °C

25 °C

2.9







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#### **Output Power vs. Frequency vs. V**<sub>DS</sub>



#### Drain Current vs. Frequency vs. V<sub>Ds</sub>

## Drain Efficiency vs. Frequency vs. V<sub>DS</sub>

Gate Current vs. Frequency vs. V<sub>DS</sub>









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#### Drain Current vs. Frequency vs. I<sub>DQ</sub>

Drain Efficiency vs. Frequency vs. I<sub>PQ</sub>

Gate Current vs. Frequency vs. I<sub>DO</sub>









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## **Typical Performance Curves:**

 $V_D$  = 50 V,  $I_{DQ}$  = 500 mA, CW,  $T_B$  = +25°C.

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50

40

30

20

10

0

13

2.75 GHz

3.5 GHz

3.75 GHz

18

Output Power vs. Input Power vs. Frequency



Drain Current vs. Input Power vs. Frequency

Gate Current vs. Input Power vs. Frequency

28

Input Power (dBm)

33

38

43

23

Drain Efficiency vs. Input Power vs. Frequency







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### **Typical Performance Curves:**

 $V_D$  = 50 V,  $I_{DQ}$  = 500 mA, CW,  $T_B$  = +25°C.

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50

40

30

20

10

0

13

Drain Efficiency (%)

**Output Power vs. Input Power vs. Temperature** 



Drain Current vs. Input Power vs. Temperature

Gate Current vs. Input Power vs. Temperature

23

28

Input Power (dBm)

33

38

Drain Efficiency vs. Input Power vs. Temperature

85 °C

25 °C

18







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#### **Output Power vs. Input Power vs. V**<sub>DS</sub>



#### Drain Efficiency vs. Input Power vs. V<sub>Ds</sub>



#### Drain Current vs. Input Power vs. V<sub>Ds</sub>

Gate Current vs. Input Power vs. V<sub>Ds</sub>







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#### Output Power vs. Input Power vs. IDQ



#### Drain Efficiency vs. Input Power vs. I<sub>DQ</sub>



#### Drain Current vs. Input Power vs. IDQ

Gate Current vs. Input Power vs. IDQ







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## CGHV38375F Rev. V1

## **Typical Performance Curves:**

 $V_D$  = 50 V,  $I_{DQ}$  = 500 mA,  $P_{IN}$  = -20 dBm,  $T_B$  = +25°C.

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### S21 vs. Frequency vs. Temperature



# **S21** vs. Frequency vs. $V_{DS}$



#### S11 vs. Frequency vs. Temperature



S11 vs. Frequency vs. V<sub>DS</sub>



S22 vs. Frequency vs. Temperature



#### S22 vs. Frequency vs. V<sub>Ds</sub>



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# MACOM PURE CARBIDE

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## Typical Performance Curves:

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S11 vs. Frequency vs. IDQ



S22 vs. Frequency vs. IDQ



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#### 2<sup>nd</sup> Harmonic vs. Output Power vs. Temperature



2<sup>nd</sup> Harmonic vs. Output Power vs. Temperature



<sup>2&</sup>lt;sup>nd</sup> Harmonic vs. Output Power vs. V<sub>Ds</sub>



2<sup>nd</sup> Harmonic vs. Output Power vs. V<sub>Ds</sub>

2<sup>nd</sup> Harmonic vs. Output Power vs. V<sub>ps</sub>



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## MACOM PURE CARBIDE

Evaluation Test Fixture 2.75 - 3.75 GHz



### **Bias Sequencing** Turning the device ON

- 1. Set  $V_{GS}$  to pinch-off ( $V_P$ ).
- 2. Turn on V<sub>DS</sub> to nominal voltage (50 V).
- 3. Increase  $V_{GS}$  until  $I_{DS}$  current is reached.
- 4. Apply RF power to desired level.

#### Turning the device OFF

- 1. Turn the RF power OFF.
- 2. Decrease  $V_{GS}$  down to  $V_P$  pinch-off. 3. Decrease  $V_{DS}$  down to 0 V. 4. Turn off  $V_{GS}$ .

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# MACOM PURE CARBIDE.

### Evaluation Test Fixture 2.75 - 3.75 GHz



### **Parts List**

Reference Designator	Description	Qty
R1	RES, 511 OHM, +/- 1%, 1/16W,0603	1
R2, R4	RES, 5.1 OHM, +/- 1%, 1/16W,0603	2
R3	RES, 4.7 OHM, 1%, 1/4W, 1206	1
C1	CAP, 6.8 pF, +/- 0.25pF, 250V, 0603	1
C2,C7,C8	CAP, 10 pF, +/- 1%, 250V, 0805	3
C3	CAP, 10 pF, +/-5%,250V, 0603,	1
C4,C9	CAP, 470 pF, 5%, 100V, 0603, X	2
C5	CAP, 33000 pF, 0805, 100V, X7R	1
C6	CAP, 10 µF, 16V, TANTALUM	1
C10	CAP, 1 µF, 100V, 10%, X7R, 1210	1
C11	CAP, 33 µF, 20%, G CASE	1
C12	CAP, 3300 µF, +/-20%, 100V, ELECTROLYTIC	1
C13	CAP, 1 µF, 0805, 100V, X7S	1
J1,J2	CONN, SMA, PANEL MOUNT JACK, FL	2
J3	HEADER RT>PLZ .1CEN LK 9POS	1
J4	CONNECTOR ; SMB, Straight, JACK, SMD	1
W1	CABLE, 18 AWG, 4.2	1
Q1	Transistor CGHV38375F	1
PCB	PCB, RF35-TC, 2.5 X 4.0 X 0.030	1

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## Product Dimensions (Package Type 440226)

- NOTES: (UNLESS OTHERWISE SPECIFIED) 1. INTERPRET DRAWING IN ACCORDANCE WITH ANSI Y14.5M-2009
- 2. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF .020 BEYOND EDGE OF LID
- 3. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF .008 IN ANY DIRECTION
- 4. ALL PLATED SURFACES ARE GOLD OVER NICKEL



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