CRF24060

60 W, SiC RF Power MESFET

Cree's CRF24060 is an unmatched silicon carbide (SiC) RF power Metal-Semiconductor Field-Effect Transistor (MESFET). SiC has superior properties compared to silicon or gallium arsenide, including higher breakdown voltage, higher saturated electron drift velocity, and higher thermal conductivity. SiC MESFETs offer greater efficiency, greater power density, and wider bandwidths compared to Si and GaAs transistors.

Package Type: 440193
PN: CRF24060F

FEATURES

- 13 dB Small Signal Gain
- High Efficiency
- 50 W minimum P_{1dB}
- Up to 2400 MHz Operation
- 48 V Operation
- High Breakdown Voltage
- High Temperature Operation

APPLICATIONS

- Wideband Military Communications
- Secure Comms for Homeland Defense
- Class A, A/B Amplifiers
- TDMA, EDGE, CDMA, W-CDMA
- Broadband Amplifiers
- MMDS

Typical Performance

RoHS COMPLIANT

- Drain Efficiency of 45% at 1500 MHz at 60 W P_{OUT}
- IMD -31 dBc at 1000 MHz at 50 W PEP
- 13 dB Small Signal Gain at 1500 MHz
- 60 W @ P_{1dB} at 1500 MHz
- 80 W P_{3dB} at 1500 MHz

Note: Measured in amplifier circuit CRF24060-TB at V_{DS} = 48 V, I_{DQ} = 2000 mA.

Rev 2.0 – April 2010

Absolute Maximum Ratings (not simultaneous) at 25˚C Case Temperature

Parameter	Symbol	Rating	Units
Drain-source Voltage	V_{DSS}	120	Volts
Gate to source Voltage	V_{GS}	-20, +3	Volts
Storage Temperature	T_{STG}	-55, +150	˚C
Operating Junction Temperature	T_J	255	˚C
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.4	˚C/W
Screw Torque	T	80	in-oz
Soldering Temperature	T_S	225	˚C

Electrical Characteristics (T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[3]						
Gate Threshold Voltage	$V_{GS(th)}$	-13	-10	–	VDC	V_{DS} = 10 V, I_D = 2.5 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-7	–	VDC	V_{DS} = 48 V, I_D = 2000 mA
Zero Gate Voltage Drain Current	I_{DSS}	6.0	7.5	9.0	A	V_{DS} = 10 V, V_{GS} = 0 V
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	100	–	–	VDC	V_{GS} = -18, I_D = 50 mA
Forward Transconductance	g_m	700	800	–	mS	V_{DS} = 48 V, I_D = 2000 mA
Case Operating Temperature	T_C	-30	–	125	˚C	
RF Characteristics						
Gain	G_{SS}	10	13	–	dB	V_{DD} = 48 V, I_{DQ} = 2000 mA, f = 1100 MHz
Power Output at 1 dB Compression	P_{1dB}	50	60	–	W	V_{DD} = 48 V, I_{DQ} = 2000 mA, f = 1100 MHz
Power Output at 3 dB Compression	P_{3dB}	-	80	–	W	V_{DD} = 48 V, I_{DQ} = 2000 mA, f = 1100 MHz
Drain Efficiency[1,2]	η	40	45	–	%	V_{DD} = 48 V, I_{DQ} = 2000 mA, f = 1100 MHz P_{OUT} = P_{1dB}
Intermodulation Distortion	IMD_3	–	-31	–	dBc	V_{DD} = 48 V, I_{DQ} = 2000 mA, f_1 = 1000 MHz, f_2 = 1000.1 MHz, P_{OUT} = 50W PEP
Output Mismatch Stress	VSWR	10 : 1	–	–	Ψ	No damage at all phase angles, V_{DD} = 48 V, I_{DQ} = 2000 mA, f = 1000 MHz, P_{OUT} = 50W CW
Dynamic Characteristics						
Input Capacitance	C_{DS}	–	5.0	–	pF	V_{DS} = 48 V, V_{gs} = -16 V, f = 1 MHz
Output Capacitance	C_{GS}	–	15	–	pF	V_{DS} = 48 V, V_{gs} = -16 V, f = 1 MHz
Reverse Transfer Capacitance	C_{GD}	–	2.8	–	pF	V_{DS} = 48 V, V_{gs} = -16 V, f = 1 MHz

Notes:
[1] Drain Efficiency = P_{OUT} / P_{DC}
[2] Power Added Efficiency (PAE) = (P_{OUT} - P_{IN}) / P_{DC}
[3] Measured on wafer prior to packaging.

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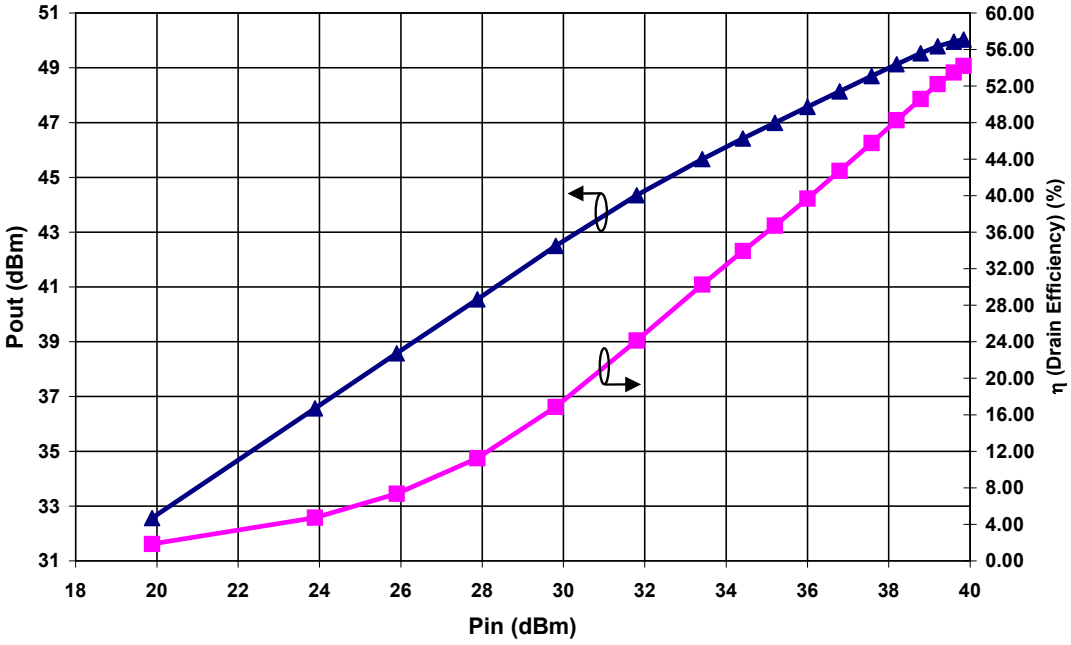
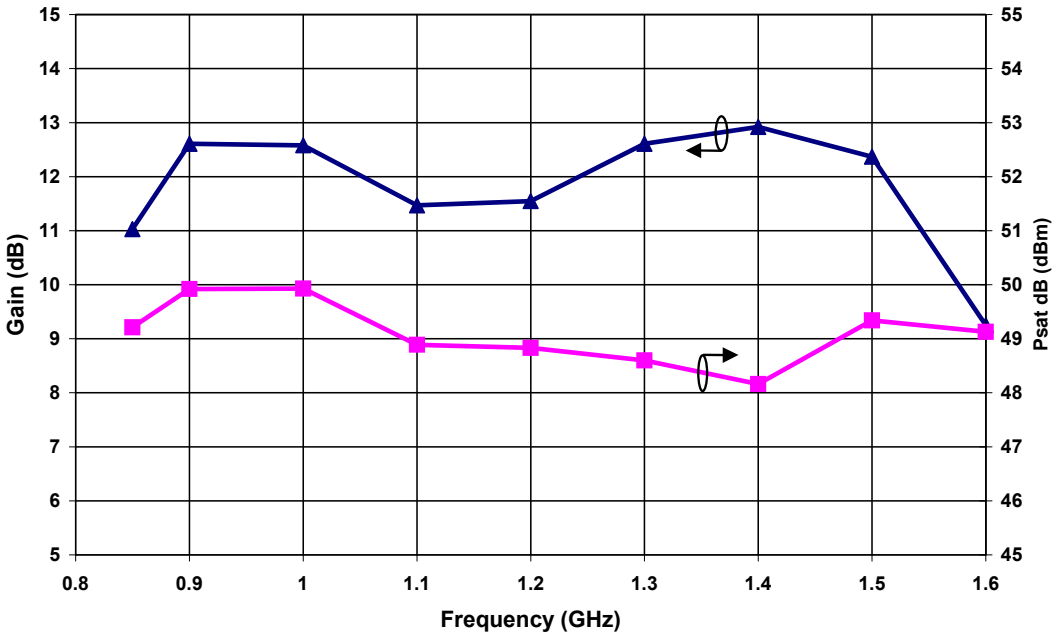
Typical Performance (T_C = 25°C, V_{DS} = 48 V, I_{DQ} = 2000 mA in Flange Package)

Typical Power Performance
Swept CW Data vs Power at 1000 MHz



Typical Wideband Performance
Swept CW Data vs Frequency



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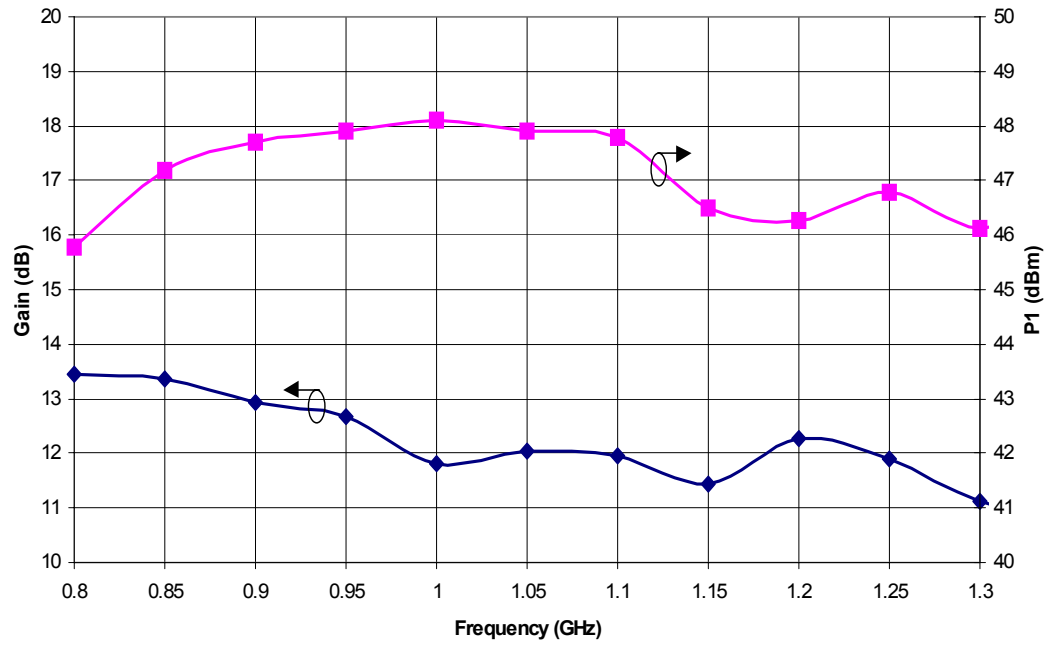
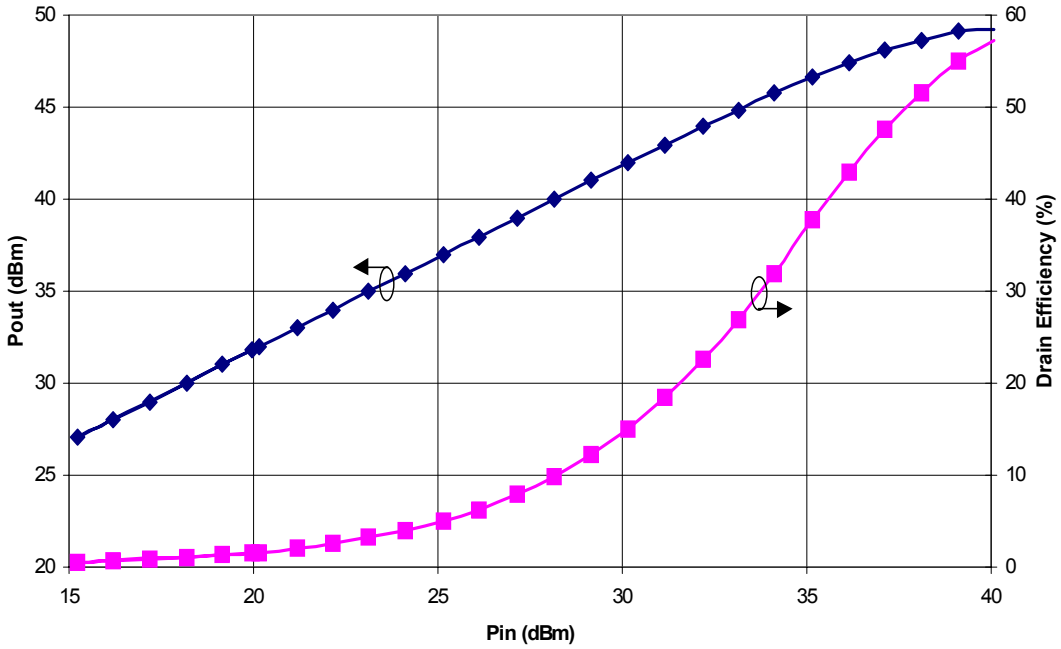
Typical Performance (V_{DS} = 48 V, I_{DQ} = 2000 mA in the Flange Package)

Typical CW Gain and P1dB vs Frequency



CW Power Sweep at 1.0 GHz



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Typical Package S-Parameters
(Small Signal, V_{DS} = 48 V, I_{DQ} = 2000 mA, magnitude / angle)

Frequency	S(1,1)	S(2,1)	S(1,2)	S(2,2)
100.0MHz	0.938 / -118.952	11.369 / 117.037	0.027 / 27.543	0.733 / -167.222
200.0MHz	0.924 / -147.861	6.296 / 100.583	0.030 / 11.594	0.786 / -173.220
300.0MHz	0.921 / -159.138	4.291 / 92.762	0.031 / 4.279	0.798 / -175.909
400.0MHz	0.919 / -165.208	3.247 / 87.448	0.031 / -0.529	0.803 / -177.489
500.0MHz	0.919 / -169.113	2.610 / 83.182	0.031 / -4.290	0.806 / -178.595
600.0MHz	0.919 / -171.919	2.183 / 79.451	0.031 / -7.515	0.807 / -179.462
700.0MHz	0.919 / -174.094	1.878 / 76.032	0.031 / -10.429	0.809 / 179.805
800.0MHz	0.919 / -175.877	1.648 / 72.813	0.031 / -13.144	0.810 / 179.152
900.0MHz	0.919 / -177.401	1.470 / 69.730	0.031 / -15.722	0.811 / 178.547
1.000GHz	0.919 / -178.747	1.328 / 66.746	0.031 / -18.201	0.812 / 177.972
1.100GHz	0.919 / -179.968	1.212 / 63.837	0.032 / -20.607	0.813 / 177.413
1.200GHz	0.919 / 178.901	1.116 / 60.986	0.032 / -22.954	0.814 / 176.861
1.300GHz	0.919 / 177.835	1.036 / 58.182	0.032 / -25.254	0.815 / 176.310
1.400GHz	0.919 / 176.816	0.967 / 55.418	0.032 / -27.516	0.816 / 175.755
1.500GHz	0.920 / 175.830	0.908 / 52.686	0.032 / -29.746	0.817 / 175.192
1.600GHz	0.920 / 174.867	0.858 / 49.982	0.032 / -31.948	0.818 / 174.618
1.700GHz	0.920 / 173.917	0.813 / 47.301	0.033 / -34.128	0.819 / 174.029
1.800GHz	0.920 / 172.974	0.775 / 44.640	0.033 / -36.288	0.820 / 173.425
1.900GHz	0.920 / 172.032	0.741 / 41.996	0.033 / -38.432	0.821 / 172.802
2.000GHz	0.920 / 171.086	0.711 / 39.365	0.033 / -40.563	0.821 / 172.158
2.100GHz	0.920 / 170.130	0.685 / 36.744	0.034 / -42.685	0.821 / 171.492
2.200GHz	0.920 / 169.160	0.661 / 34.131	0.034 / -44.800	0.822 / 170.802
2.300GHz	0.919 / 168.172	0.641 / 31.522	0.035 / -46.911	0.822 / 170.086
2.400GHz	0.919 / 167.163	0.623 / 28.915	0.035 / -49.022	0.823 / 169.342
2.500GHz	0.919 / 166.127	0.607 / 26.305	0.035 / -51.135	0.823 / 168.568
2.600GHz	0.918 / 165.062	0.594 / 23.689	0.036 / -53.255	0.823 / 167.762
2.700GHz	0.918 / 163.962	0.582 / 21.064	0.037 / -55.386	0.823 / 166.921
2.800GHz	0.917 / 162.824	0.572 / 18.426	0.037 / -57.530	0.822 / 166.043
2.900GHz	0.916 / 161.642	0.564 / 15.770	0.038 / -59.694	0.821 / 165.125
3.000GHz	0.915 / 160.412	0.557 / 13.091	0.039 / -61.880	0.820 / 164.164

Download this s-parameter file in ".s2p" format at http://www.cree.com/products/wireless_s-parameters.asp

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Typical Package S-Parameters
(Small Signal, V_{DS} = 48 V, I_{DQ} = 1000 mA, magnitude / angle)

Frequency	S(1,1)	S(2,1)	S(1,2)	S(2,2)
100.0MHz	0.927 / -116.548	11.083 / 117.528	0.033 / 28.066	0.682 / -162.593
200.0MHz	0.909 / -146.266	6.173 / 100.326	0.037 / 11.402	0.745 / -170.406
300.0MHz	0.904 / -157.893	4.209 / 91.937	0.038 / 3.552	0.760 / -173.673
400.0MHz	0.903 / -164.137	3.182 / 86.138	0.038 / -1.708	0.767 / -175.463
500.0MHz	0.903 / -168.127	2.554 / 81.430	0.038 / -5.879	0.771 / -176.632
600.0MHz	0.903 / -170.973	2.132 / 77.286	0.039 / -9.485	0.774 / -177.490
700.0MHz	0.903 / -173.162	1.829 / 73.477	0.039 / -12.756	0.777 / -178.179
800.0MHz	0.904 / -174.945	1.602 / 69.888	0.039 / -15.808	0.780 / -178.772
900.0MHz	0.905 / -176.460	1.424 / 66.455	0.039 / -18.705	0.783 / -179.309
1.000GHz	0.906 / -177.792	1.282 / 63.140	0.039 / -21.483	0.785 / -179.817
1.100GHz	0.906 / -178.998	1.167 / 59.919	0.039 / -24.169	0.788 / 179.689
1.200GHz	0.907 / 179.888	1.070 / 56.776	0.039 / -26.777	0.791 / 179.195
1.300GHz	0.908 / 178.839	0.989 / 53.699	0.039 / -29.319	0.794 / 178.696
1.400GHz	0.909 / 177.835	0.920 /50.680	0.039 / -31.803	0.797 / 178.185
1.500GHz	0.910 / 176.863	0.861 / 47.714	0.039 / -34.236	0.800 / 177.657
1.600GHz	0.911 / 175.912	0.809 / 44.794	0.039 / -36.623	0.803 / 177.111
1.700GHz	0.912 / 174.974	0.764 / 41.917	0.039 / -38.968	0.806 / 176.543
1.800GHz	0.912 / 174.040	0.725 / 39.077	0.039 / -41.277	0.809 / 175.952
1.900GHz	0.913 / 173.105	0.690 / 36.272	0.039 / -43.551	0.811 / 175.335
2.000GHz	0.914 / 172.165	0.659 / 33.498	0.039 / -45.796	0.814 / 174.693
2.100GHz	0.914 / 171.213	0.632 / 30.751	0.040 / -48.014	0.816 / 174.023
2.200GHz	0.915 / 170.247	0.608 / 28.027	0.040 / -50.210	0.819 / 173.325
2.300GHz	0.915 / 169.262	0.587 / 25.323	0.040 / -52.387	0.821 / 172.596
2.400GHz	0.916 / 168.255	0.568 / 22.635	0.040 / -54.549	0.823 / 171.837
2.500GHz	0.916 / 167.221	0.552 / 19.959	0.041 / -56.701	0.824 / 171.046
2.600GHz	0.916 / 166.157	0.537 / 17.290	0.041 / -58.846	0.826 / 170.220
2.700GHz	0.916 / 165.058	0.525 / 14.625	0.042 / -60.988	0.827 / 169.358
2.800GHz	0.916 / 163.922	0.514 / 11.959	0.042 / -63.134	0.828 / 168.459
2.900GHz	0.916 / 162.742	0.505 / 9.286	0.043 / -65.287	0.829 / 167.519
3.000GHz	0.915 / 161.514	0.497 / 6.601	0.044 / -67.452	0.829 / 166.536

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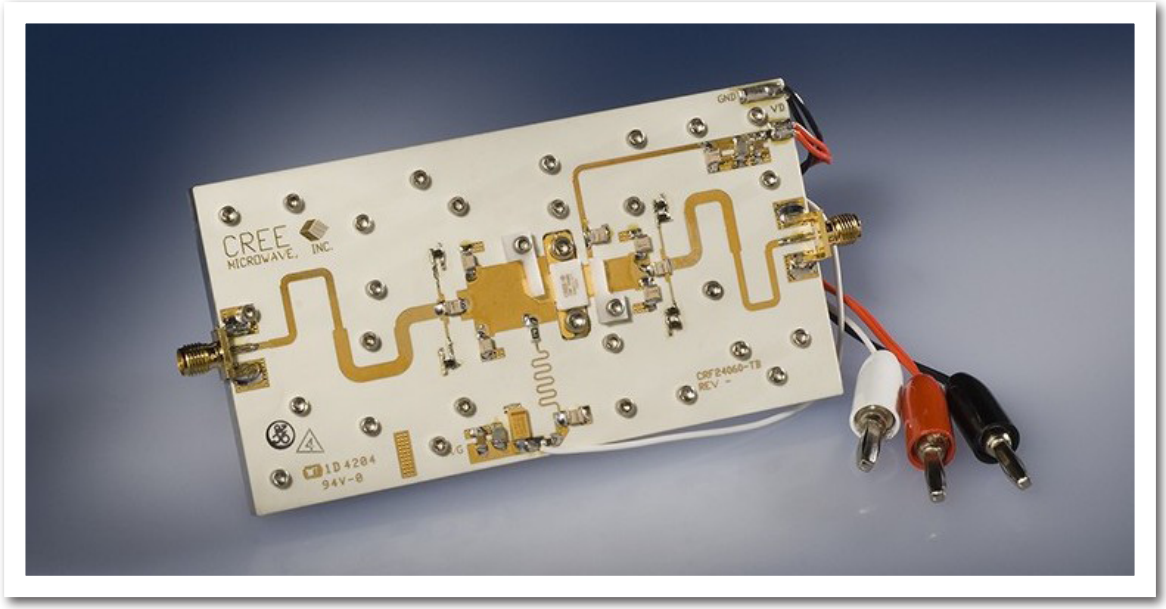
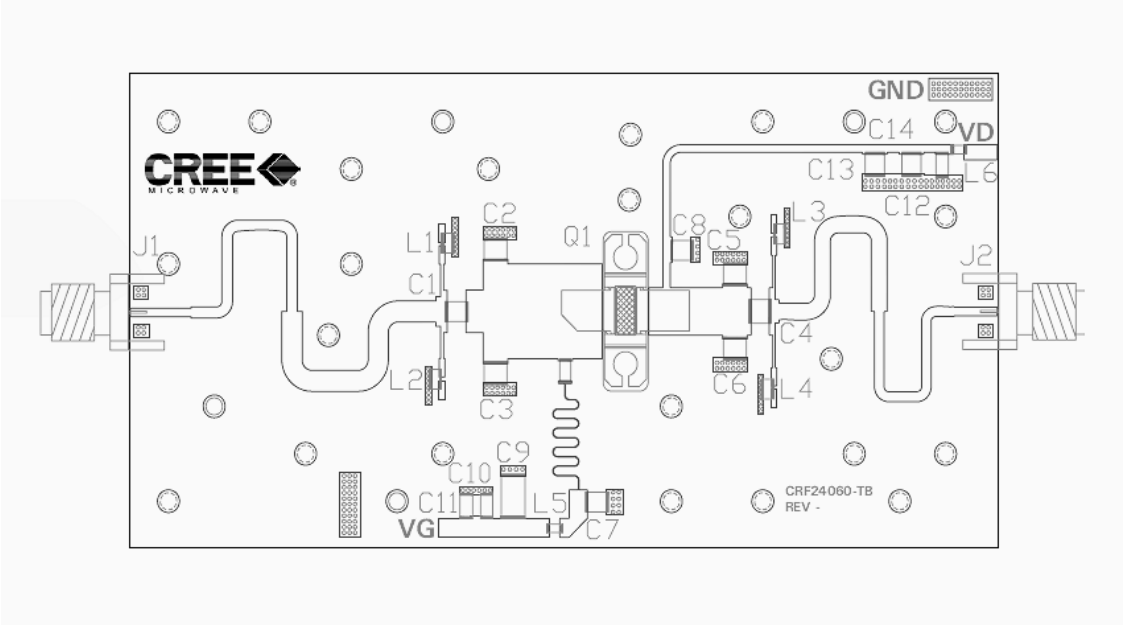
CRF24060-TB Demonstration Test Fixture



CRF24060-TB Demonstration Test Fixture Diagram



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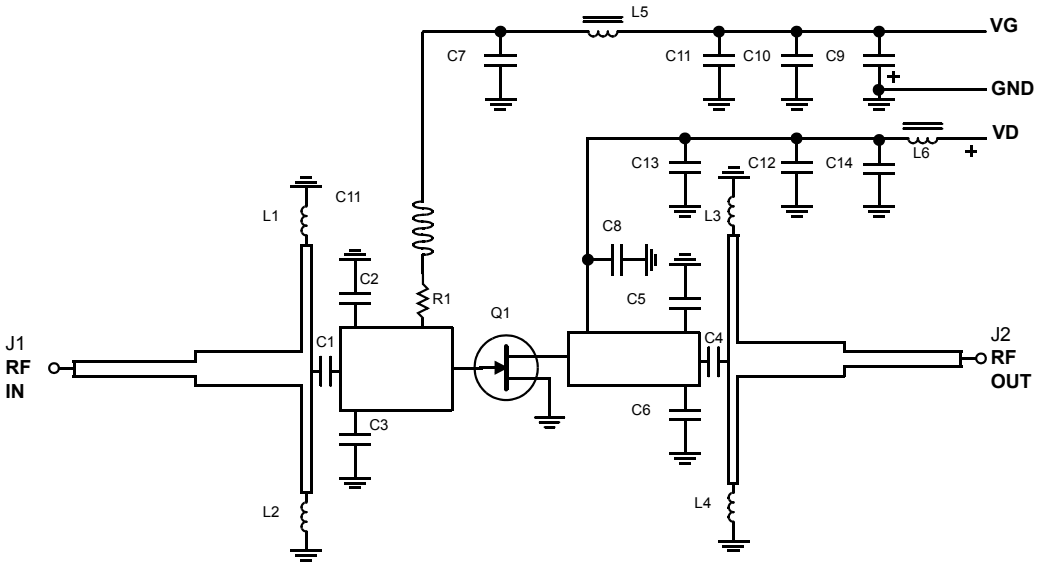
CRF24060-TB Demonstration Test Fixture Schematic



CRF24060-TB Demonstration Test Fixture Bill of Materials

Designator	Description	Qty
C1	CAP, 10pF, DILABS C17AH, 100F, 7UXL	1
C2,C3	CAP, 3.9pF, DILABS C17AH, 3R9B, 7UXL	2
C4	CAP, 8.2pF, DILABS C17AH, 8R2A, 7UXL	1
C5,C6	CAP, 2.7pF, DILABS C17AH, 2R7A, 4UXL	2
C7,C8,C13	CAP, 30pF, DILABS C17AH, 300M, 7UXL	3
C9	CAP, 10uF, 25V, TANTALUM	1
C10,C12	CAP, 180pF, DILABS C17AH, 181J, 3UX	2
C11,C14	CAP, 0.1uF, 100V, 1206, CERAMIC	2
R1	RES, 27 OHM, 0.1W, 1206	1
L1,L2, L3,L4	MICROSPRING, 3T, COILCRAFT, 0906-3J	4
L5,L6	FERRITE, MURATA BLM21P220SG	2
J1,J2	CONNECTOR, SMA, FLANGE MOUNT, FEMALE	2
Q1	CRF24060	1

Note: Some values may differ due to substitution in the event of temporarily unavailable parts.

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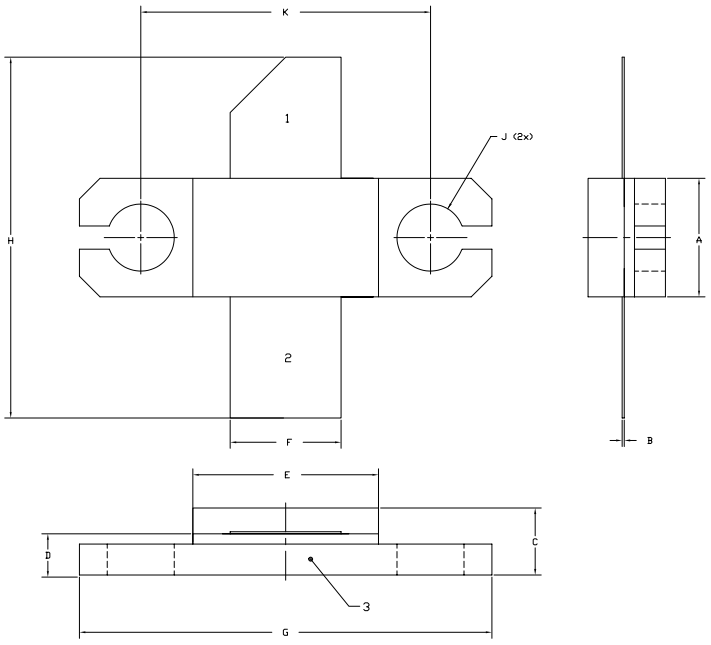
Product Dimensions - CRF24060F (Package Type — 440193)



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

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.225	0.235	5.72	5.97
B	0.004	0.006	0.10	0.15
C	0.125	0.135	3.18	3.43
D	0.077	0.087	1.96	2.21
E	0.355	0.365	9.02	9.27
F	0.210	0.220	5.33	5.59
G	0.795	0.805	20.19	20.45
H	0.670	0.730	17.02	18.54
J	ø .130		3.30	
k	0.562		14.28	

PIN 1. GATE
PIN 2. DRAIN
PIN 3. SOURCE

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