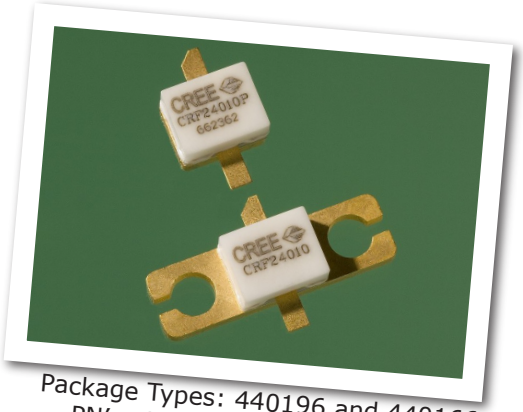
PRELIMINARY

CRF24010

10 W, SiC RF Power MESFET

Cree's CRF24010 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 Types: 440196 and 440166
PN's: CRF24010P and CRF24010F

FEATURES

- 15 dB Small Signal Gain
- High Efficiency
- 10 W minimum P_{1dB}
- Up to 2700 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 1950 MHz
- IMD -31 dBc at 1950 MHz
- 15 dB Gain at 1950 MHz

Note: Measured in amplifier circuit CRF24010-TB at V_{DS} = 48 V, I_{DQ} = 500 mA.

Rev 1.8 – August 2007

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	$R_{\theta JC}$	5.6	˚C/W
Soldering Temperature	T_S	225	˚C

Electrical Characteristics (T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold Voltage	$V_{GS(th)}$	-12	-10	–	VDC	V_{DS} = 10 V, I_D = 0.5 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-9	–	VDC	V_{DS} = 48 V, I_D = 400 mA
Zero Gate Voltage Drain Current	I_{DSS}	1.2	1.5	1.8	A	V_{DS} = 10 V, V_{GS} = 0 V
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	100	–	–	VDC	V_{GS} = 18, I_D = 10 mA
Forward Transconductance	g_m	140	160	–	mS	V_{DS} = 48 V, I_D = 250 mA
Case Operating Temperature	T_C	-30	–	125	˚C	
Screw Torque[1]	T	–	–	60	in-oz	
RF Characteristics						
Gain	G_{SS}	13	15	–	dB	V_{DD} = 48 V, I_{DQ} = 500 mA, f = 1950 MHz
Power Output at 1 dB Compression	P_{1dB}	10	12	–	W	V_{DD} = 48 V, I_{DQ} = 500 mA, f = 1950 MHz
Power Output at 3 dB Compression	P_{3dB}	15	17	–	W	V_{DD} = 48 V, I_{DQ} = 500 mA, f = 1950 MHz
Drain Efficiency[2,3]	η	40	45	–	%	V_{DD} = 48 V, I_{DQ} = 250 mA, f = 1950 MHz P_{OUT} = P_{1dB}
Intermodulation Distortion	IMD_3	–	-31	–	dBc	V_{DD} = 48 V, I_{DQ} = 250 mA, f_1 = 1950 MHz, f_2 = 1950.1 MHz, P_{OUT} = 10W PEP
Minimum Noise Figure	NF_{min}	–	3.1	–	dB	V_{DD} = 48 V, I_{DQ} = 500 mA, f_1 = 1950 MHz
Output Mismatch Stress	VSWR	10 : 1	–	–	Ψ	No damage at all phase angles, V_{DD} = 48 V, I_{DQ} = 500 mA, f = 1950 MHz, P_{OUT} = 10W CW
Dynamic Characteristics						
Input Capacitance	C_{DS}	–	2.5	–	pF	V_{DS} = 48 V, V_{GS} = -16 V, f = 1 MHz
Output Capacitance	C_{GS}	–	1.9	–	pF	V_{DS} = 48 V, V_{GS} = -16 V, f = 1 MHz
Reverse Transfer Capacitance	C_{GD}	–	0.45	–	pF	V_{DS} = 48 V, V_{GS} = -16 V, f = 1 MHz

Notes:
[1] Torque for the 440166 package type.
[2] Drain Efficiency = P_{OUT} / P_{DC}
[3] Power Added Efficiency (PAE) = (P_{OUT} - P_{IN}) / P_{DC}

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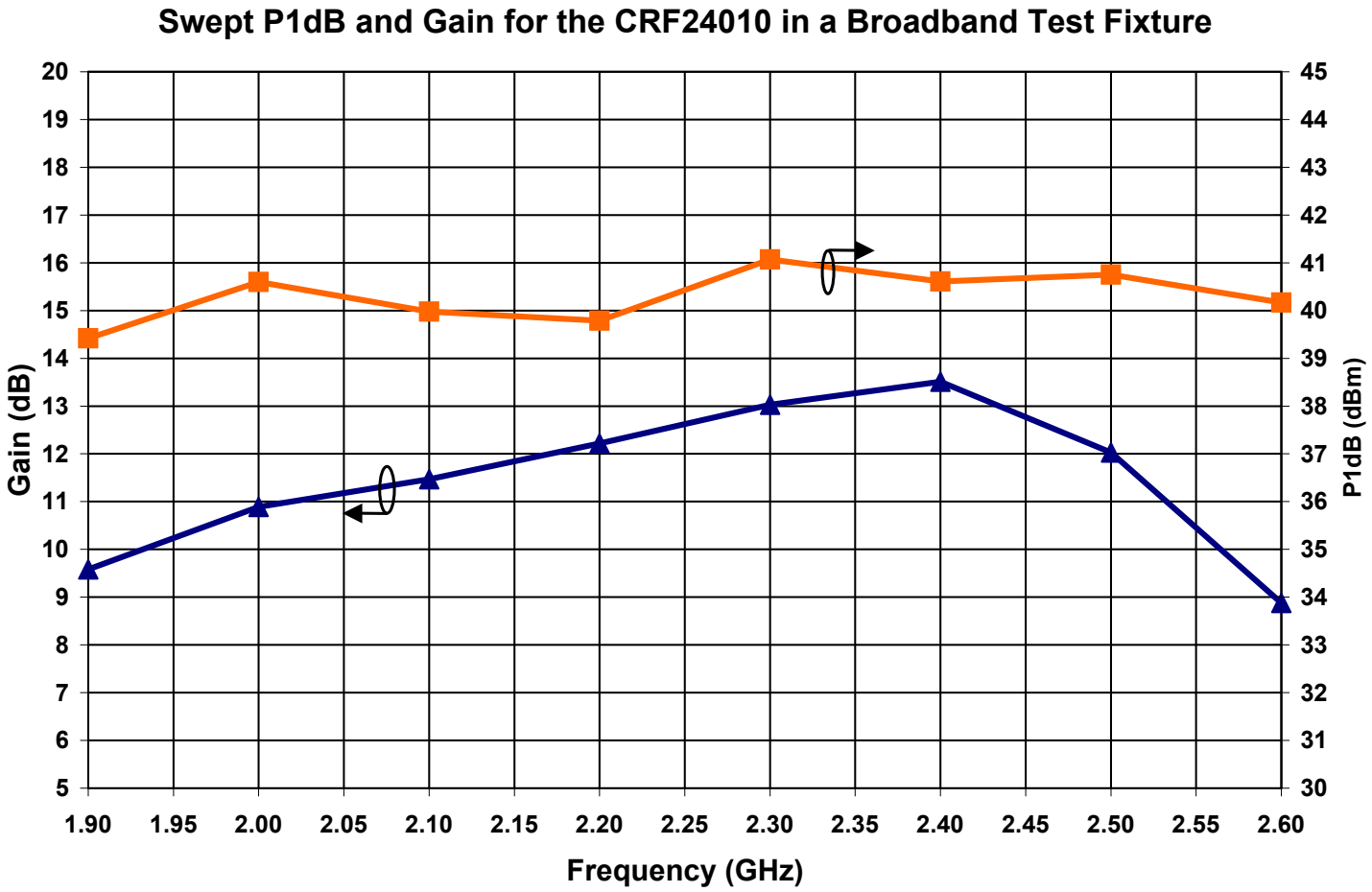
Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1B	JESD22-A114
Charge Device Model	CDM	C5	JESD22-C101

Broadband Performance (T_C = 25°C, V_{DS} = 48 V, I_{DQ} = 500 mA in Flange Package)



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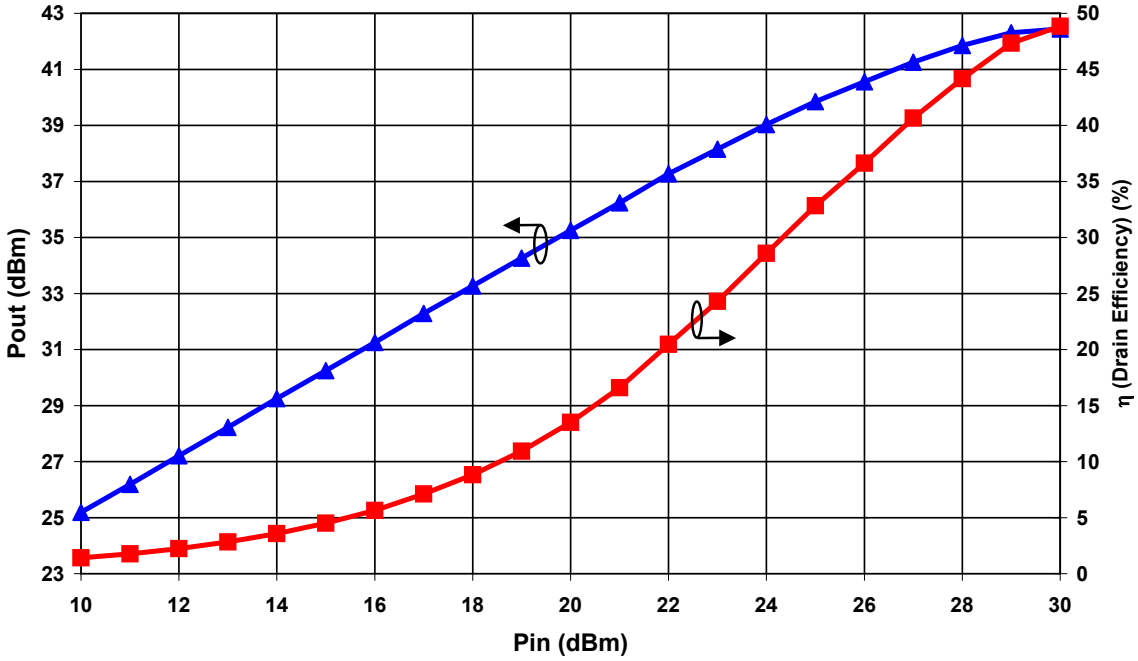
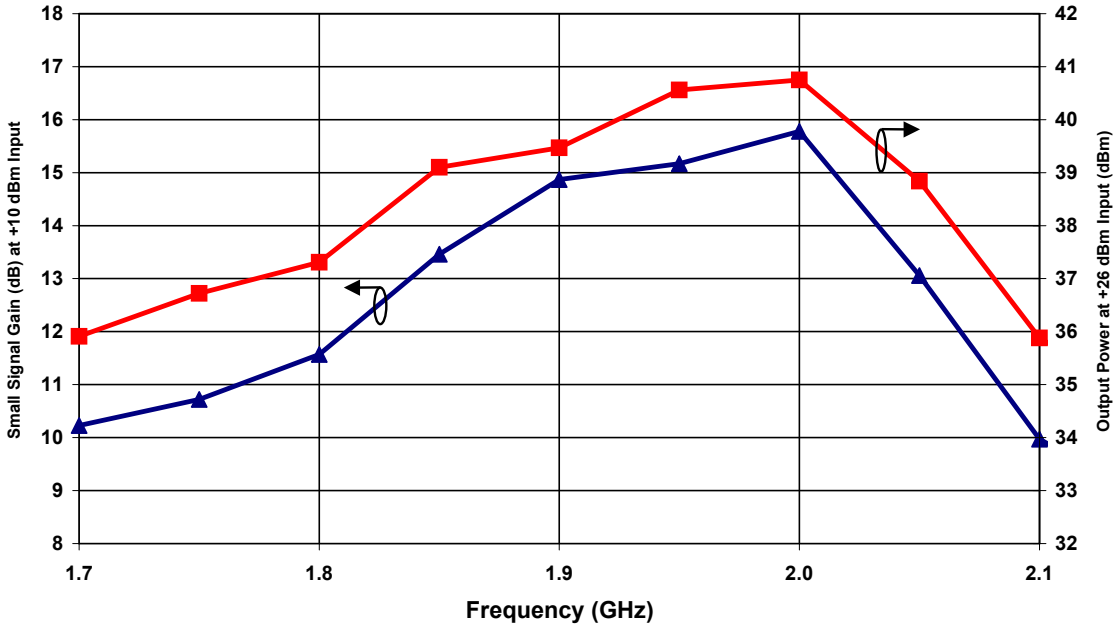
Typical CRF24010-TB Performance (V_{DS} = 48 V, I_{DQ} = 500 mA in the Flange Package)

Swept CW Data vs Power at 1950 MHz



Swept CW Data vs Frequency



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Typical Package S-Parameters
(Small Signal, V_{DS} = 48 V, I_{DQ} = 250 mA, magnitude / angle)

Frequency	S(1,1)	S(2,1)	S(1,2)	S(2,2)
100.0MHz	0.935 / -22.097	7.829 / 165.893	0.024 / 73.361	0.341 / -26.953
200.0MHz	0.920 / -42.676	7.370 / 152.734	0.045 / 62.187	0.356 / -50.854
300.0MHz	0.900 / -60.781	6.758 / 141.088	0.062 / 51.523	0.374 / -70.354
400.0MHz	0.881 / -76.139	6.110 / 131.067	0.074 / 42.232	0.392 / -85.633
500.0MHz	0.865 / -88.933	5.497 / 122.511	0.083 / 34.306	0.407 / -97.471
600.0MHz	0.852 / -99.537	4.950 / 115.167	0.090 / 27.540	0.420 / -106.682
700.0MHz	0.842 / -108.354	4.474 / 108.786	0.095 / 21.708	0.431 / -113.933
800.0MHz	0.834 / -115.739	4.064 / 103.160	0.098 / 16.614	0.441 / -119.725
900.0MHz	0.828 / -121.985	3.712 / 98.128	0.101 / 12.099	0.450 / -124.423
1.000GHz	0.824 / -127.324	3.408 / 93.564	0.103 / 8.043	0.458 / -128.294
1.100GHz	0.821 / -131.937	3.146 / 89.373	0.104 / 4.354	0.466 / -131.533
1.200GHz	0.819 / -135.963	2.917 / 85.485	0.105 / 0.962	0.473 / -134.284
1.300GHz	0.818 / -139.514	2.717 / 81.845	0.106 / -2.188	0.481 / -136.655
1.400GHz	0.818 / -142.674	2.541 / 78.410	0.107 / -5.136	0.488 / -138.729
1.500GHz	0.818 / -145.513	2.385 / 75.148	0.107 / -7.916	0.495 / -140.568
1.600GHz	0.818 / -148.084	2.246 / 72.032	0.107 / -10.553	0.502 / -142.219
1.700GHz	0.818 / -150.432	2.121 / 69.041	0.107 / -13.067	0.509 / -143.721
1.800GHz	0.819 / -152.591	2.009 / 66.159	0.108 / -15.476	0.516 / -145.104
1.900GHz	0.820 / -154.592	1.908 / 63.373	0.108 / -17.792	0.523 / -146.390
2.000GHz	0.821 / -156.457	1.816 / 60.670	0.108 / -20.028	0.530 / -147.598
2.100GHz	0.823 / -158.208	1.733 / 58.043	0.107 / -22.191	0.537 / -148.744
2.200GHz	0.824 / -159.860	1.657 / 55.482	0.107 / -24.290	0.544 / -149.838
2.300GHz	0.826 / -161.428	1.587 / 52.981	0.107 / -26.332	0.550 / -150.892
2.400GHz	0.824 / -162.924	1.523 / 50.536	0.107 / -28.322	0.557 / -151.911
2.500GHz	0.829 / -164.358	1.464 / 48.139	0.107 / -30.265	0.563 /-152.904
2.600GHz	0.831 / -165.738	1.410 / 45.789	0.107 / -32.166	0.569 / -153.875
2.700GHz	0.832 / -167.073	1.360 / 43.479	0.107 / -34.029	0.575 / -154.829
2.800GHz	0.834 / -168.368	1.314 / 41.208	0.106 / -35.856	0.581 / -155.768
2.900GHz	0.836 / -169.630	1.271 / 38.972	0.106 / -37.652	0.587 / -156.696
3.000GHz	0.837 / -170.865	1.231 / 36.767	0.106 / -39.418	0.592 / -157.616
3.100GHz	0.839 / -172.075	1.194 / 34.593	0.106 / -41.158	0.597 / -158.529
3.200GHz	0.841 / -173.266	1.160 / 32.446	0.106 / -42.874	0.602 / -159.437
3.300GHz	0.842 / -174.441	1.127 / 30.323	0.106 / -44.569	0.607 / -160.342
3.400GHz	0.844 / -175.604	1.098 / 28.223	0.106 / -46.244	0.612 / -161.246
3.500GHz	0.845 / -176.757	1.070 / 26.145	0.106 / -47.902	0.616 / -162.148
3.600GHz	0.846 / -177.904	1.044 / 24.085	0.106 / -49.544	0.621 / -163.051
3.700GHz	0.848 / -179.046	1.020 / 22.042	0.106 / -51.173	0.625 / -163.955
3.800GHz	0.849 / 179.813	0.997 / 20.014	0.106 / -52.790	0.628 / -164.862
3.900GHz	0.850 / 178.671	0.976 / 17.999	0.106 / -54.398	0.632 / -165.772
4.000GHz	0.852 / 177.526	0.957 / 15.996	0.106 / -55.998	0.635 / -166.687

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Typical Package S-Parameters
(Small Signal, V_{DS} = 48 V, I_{DQ} = 500 mA, magnitude / angle)

Frequency	S(1,1)	S(2,1)	S(1,2)	S(2,2)
100.0MHz	0.933 / -24.697	9.470 / 164.826	0.022 / 72.184	0.281 / -34.171
200.0MHz	0.917 / -47.336	8.814 / 150.896	0.041 / 60.244	0.311 / -62.220
300.0MHz	0.898 / -66.755	7.970 / 138.866	0.055 / 49.176	0.344 / -83.098
400.0MHz	0.881 / -82.780	7.113 / 128.773	0.066 / 39.787	0.372 / -98.337
500.0MHz	0.867 / -95.802	6.332 / 120.339	0.073 / 31.953	0.394 / -109.583
600.0MHz	0.856 / -106.375	5.654 / 113.216	0.078 / 25.378	0.411 / -118.050
700.0MHz	0.847 / -115.027	5.079 / 107.100	0.082 / 19.781	0.425 / -124.563
800.0MHz	0.841 / -122.187	4.592 / 101.752	0.084 / 14.932	0.436 / -129.678
900.0MHz	0.837 / -128.190	4.179 / 96.993	0.086 / 10.659	0.445 / -133.774
1.000GHz	0.834 / -133.288	3.828 / 92.961	0.088 / 6.834	0.454 / -137.115
1.100GHz	0.831 / -137.674	3.526 / 88.750	0.089 / 3.362	0.462 / -139.886
1.200GHz	0.830 / -141.491	3.266 / 85.096	0.090 / 0.172	0.469 / -142.221
1.300GHz	0.829 / -144.852	3.039 / 81.675	0.090 / -2.790	0.475 / -144.221
1.400GHz	0.829 / -147.841	2.840 / 78.445	0.091 / -5.564	0.482 / -145.960
1.500GHz	0.828 / -150.526	2.665 / 75.375	0.091 / -8.183	0.488 / -147.492
1.600GHz	0.829 / -152.959	2.509 / 72.440	0.091 / -10.671	0.495 / -148.863
1.700GHz	0.829 / -155.183	2.370 / 69.618	0.091 / -13.047	0.501 / -150.104
1.800GHz	0.830 / -157.231	2.246 / 66.896	0.091 / -15.328	0.507 / -151.244
1.900GHz	0.830 / -159.132	2.133 / 64.258	0.091 / -17.526	0.513 / -152.301
2.000GHz	0.831 / -160.907	2.032 / 61.696	0.091 / -19.652	0.519 / -153.294
2.100GHz	0.832 / -162.576	1.940 / 59.200	0.091 / -21.714	0.525 / -154.235
2.200GHz	0.833 / -164.155	1.855 / 56.763	0.091 / -23.720	0.530 / -155.136
2.300GHz	0.834 / -165.657	1.778 / 54.379	0.091 / -25.676	0.536 / -156.004
2.400GHz	0.836 / -167.092	1.708 / 52.042	0.091 / -27.587	0.542 / -156.847
2.500GHz	0.837 / -168.471	1.643 / 49.748	0.091 / -29.458	0.547 / -157.670
2.600GHz	0.838 / -169.802	1.583 / 47.492	0.091 / -31.294	0.552 / -158.479
2.700GHz	0.839 / -171.093	1.528 / 45.273	0.091 / -33.096	0.558 / -159.277
2.800GHz	0.840 / -172.348	1.477 / 43.085	0.091 / -34.870	0.563 / -160.067
2.900GHz	0.842 / -173.575	1.430 / 40.926	0.091 / -36.616	0.568 / -160.852
3.000GHz	0.843 / -174.777	1.386 / 38.795	0.091 / -38.340	0.572 / -161.634
3.100GHz	0.844 / -175.960	1.346 / 36.687	0.091 / -40.041	0.577 / -162.415
3.200GHz	0.845 / -177.126	1.308 / 34.602	0.091 / -41.724	0.581 / -163.197
3.300GHz	0.846 / -178.281	1.273 / 32.537	0.091 / -43.390	0.586 / -163.981
3.400GHz	0.848 / -179.426	1.240 / 30.490	0.091 / -45.041	0.590 / -164.768
3.500GHz	0.849 / 179.435	1.210 / 28.259	0.091 / -46.679	0.594 / -165.559
3.600GHz	0.850 / 178.299	1.181 / 26.443	0.091 / -48.306	0.597 / -166.355
3.700GHz	0.851 / 177.164	1.155 / 24.440	0.091 / -49.924	0.601 / -167.157
3.800GHz	0.852 / 176.027	1.130 / 22.447	0.091 / -51.534	0.604 / -167.96
3.900GHz	0.853 / 174.886	1.107 / 20.464	0.091 / -53.138	0.607 / -168.783
4.000GHz	0.853 / 173.738	1.086 / 18.489	0.091 / -54.738	0.610 / -169.607

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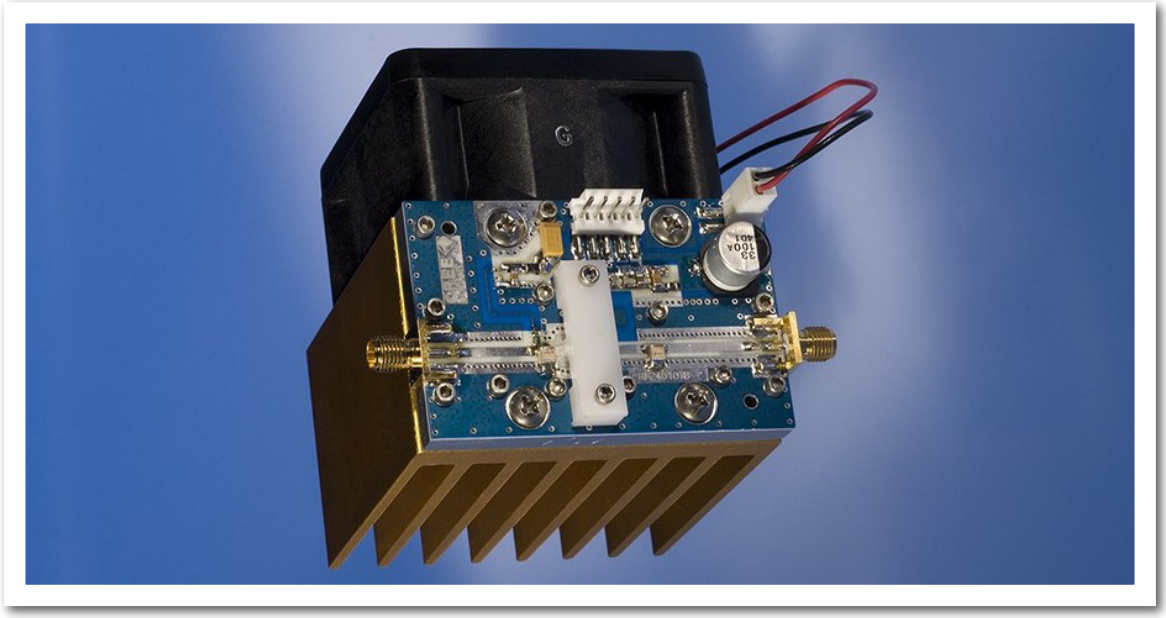
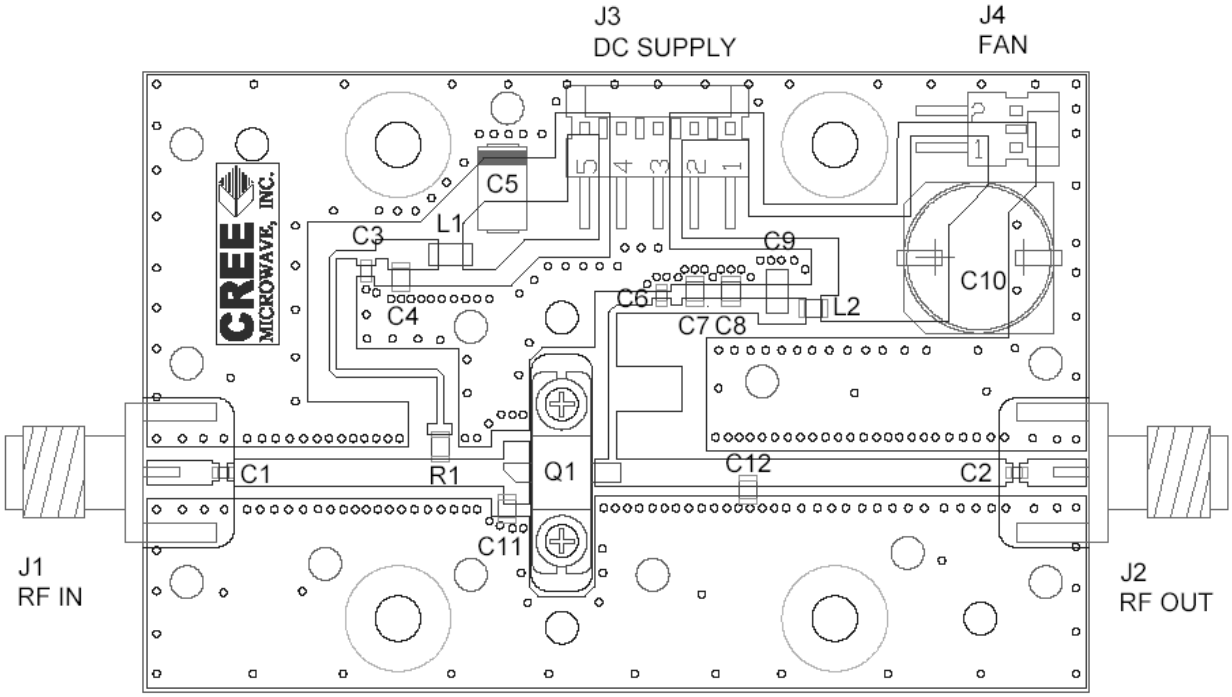
CRF24010-TB Demonstration Test Fixture



CRF24010-TB Demonstration Test Fixture Diagram



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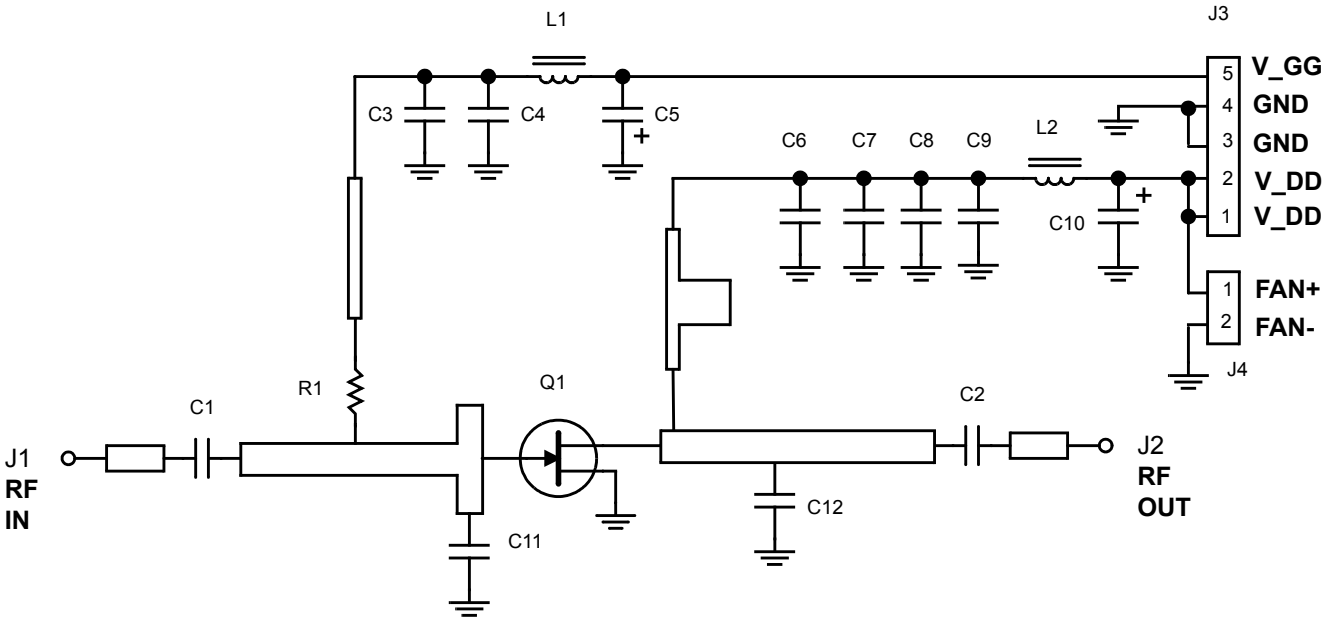
CRF24010-TB Demonstration Test Fixture Schematic



CRF24010-TB Demonstration Test Fixture Bill of Materials

Designator	Description	Qty
C1,C2,C3,C6	CAP, 27pF, 100V, ATC12061C104MAT2A	4
C4	CAP, 0.1uF, 25V, 0805, CERAMIC	1
C5	CAP, 10uF, 25V, TANTALUM	1
C7	CAP, 2.2nF, 100V, AVX08051C222MAT2A	1
C8	CAP, 10nF, 100V, 0805, CERAMIC	1
C9	CAP, 0.1uF, 100V, 1206 CERAMIC	1
C10	CAP, 33uF, 100V, ALUMINUM ELECTROLYTIC	1
C11	CAP, 3.9pF, 150V, PORCELAIN, ATC-100B3R9OBW500X	1
C12	CAP, 2.4pF, 150V, PORCELAIN, ATC-100B2R4OBW500X	1
R1	RES, 39 OHM, 0.1W, 0805	1
L1	FERRITE, 80 OHM, STEWARD HI1206K101R	1
L2	FERRITE, MURATA BLM21P220SG	1
J1,J2	CONNECTOR, SMA, FLANGE MOUNT, FEMALE	2
J3	CONNECTOR, MOLEX, 5-PIN, MALE	1
J4	CONNECTOR, MOLEX, 2-PIN, MALE	1
Q1	CRF24010	1

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

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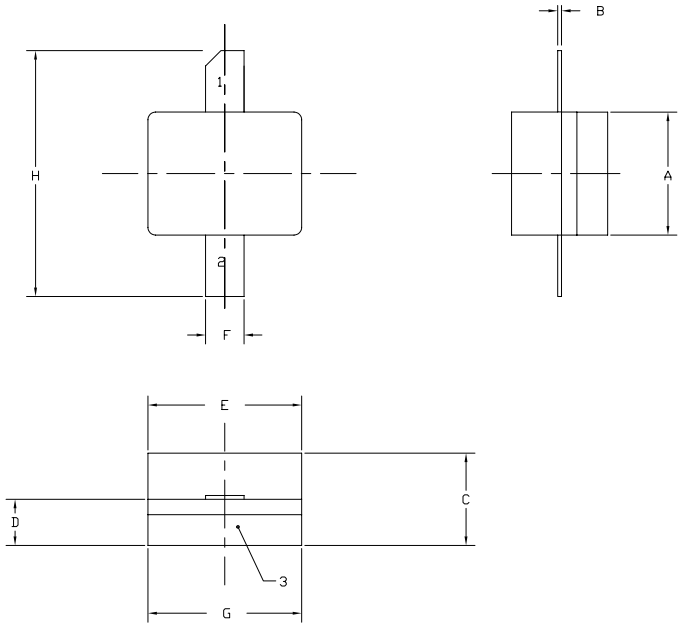
Product Dimensions - CRF24010P (Package Type — 440196)



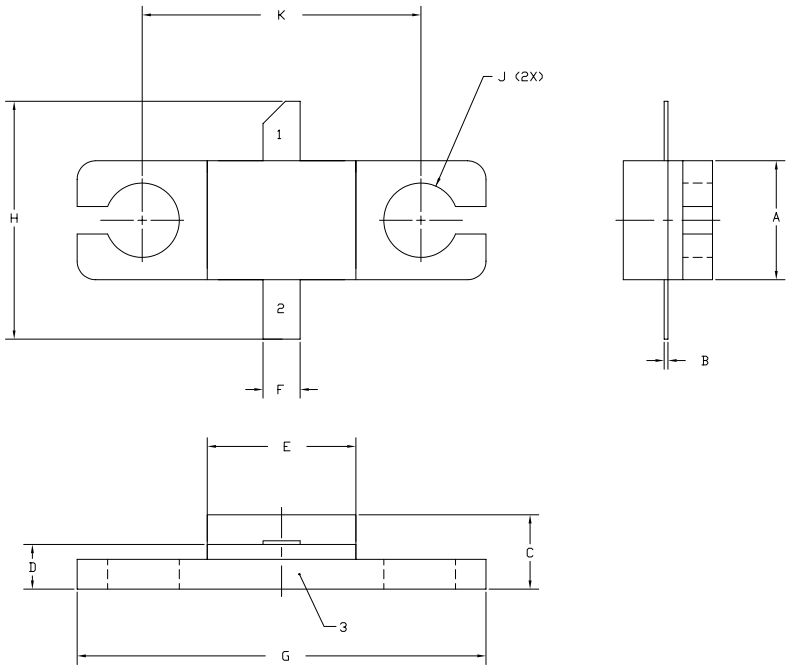
NOTES:

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	0.155	0.165	3.94	4.19
B	0.003	0.006	0.10	0.15
C	0.115	0.135	2.92	3.17
D	0.057	0.067	1.45	1.70
E	0.195	0.205	4.95	5.21
F	0.045	0.055	1.14	1.40
G	0.195	0.205	4.95	5.21
H	0.280	0.360	7.112	9.114

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

Product Dimensions - CRF24010F (Package Type — 440166)



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5. ALL PLATED SURFACES ARE NI/AU

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.155	0.165	3.94	4.19
B	0.004	0.006	0.10	0.15
C	0.115	0.135	2.92	3.43
D	0.057	0.067	1.45	1.70
E	0.195	0.205	4.95	5.21
F	0.045	0.055	1.14	1.40
G	0.545	0.555	13.84	14.09
H	0.280	0.360	7.87	8.38
J	ø .100		2.54	
K	0.375		9.53	

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

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