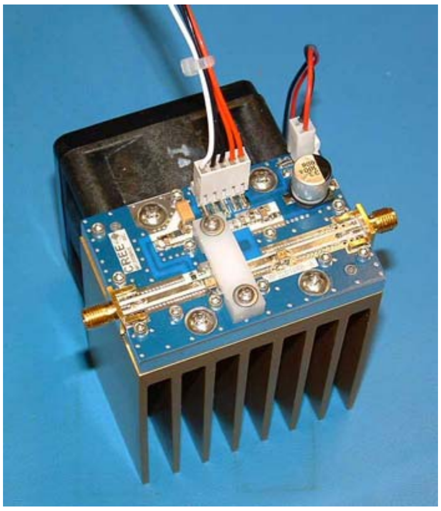
Evaluation Board for CRF-22010 Version A (Narrowband)



Features

- Ready-to-Go RF Amplifier
- Requires Two Power Supplies
- Externally Adjustable Gate Bias Voltage
- Solderless Transistor Changeout
- Includes Heat Sink, Fan, and Wiring Harness
- Designed for Narrowband Operation

Description

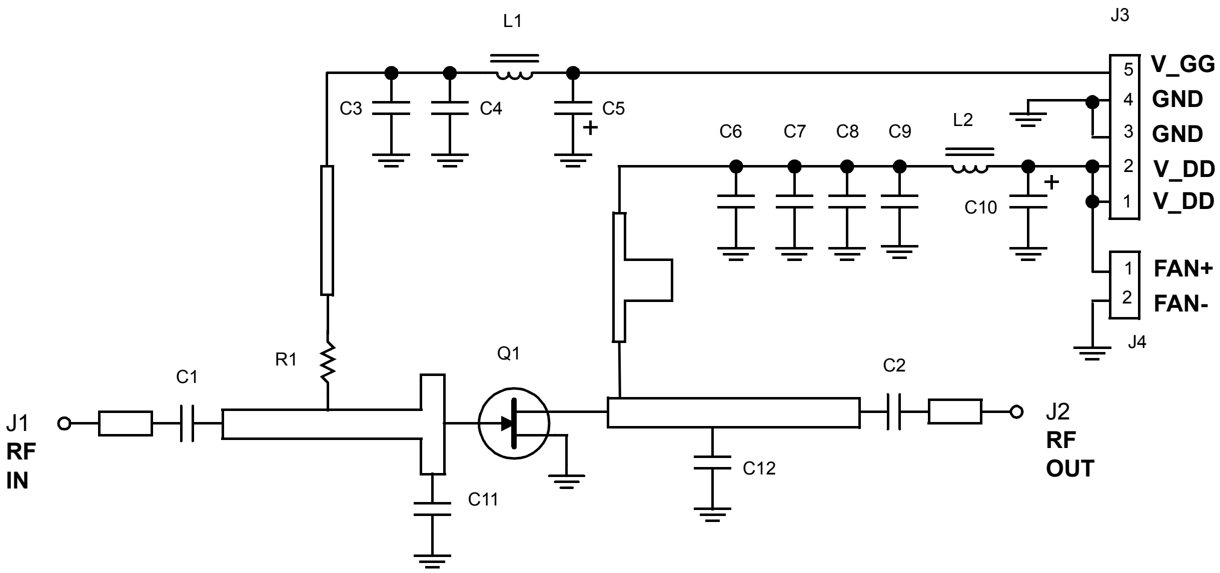
Cree's CRF-22010-TB-A is a complete 10 watt RF single band power amplifier. The evaluation board is pretuned for a specified frequency (generally between 1.8 and 2.2 GHz) and is supplied with CRF-22010 silicon carbide MESFETs in the 101 style flange-mount package. The CRF-22010-TB-A requires a positive 48 VDC drain power supply and a negative adjustable gate power supply (capable of providing up to -15 VDC) for operation. This board will assist the designer in testing and evaluating the CRF-22010.

Absolute Maximum Ratings (not simultaneous) at 25°C

Parameter	Symbol	Rating	Units
Drain Supply Voltage	V_{DSMAX}	50	VDC
Drain Supply Current	I_{DSMAX}	+2	ADC
Gate Supply Voltage	V_{GSMAX}	-15	VDC
Gate Supply Current	I_{GSMAX}	0.1	ADC
Total Device Dissipation	P_D	66	W
Storage Temperature	T_{STG}	125	°C
Thermal Resistance, Junction to Base[1]	$R_{\theta JB}$	4.5	°C/W

[1]Amplifier and carrier without heatsink and fan assembly

Schematic (Rev. A)

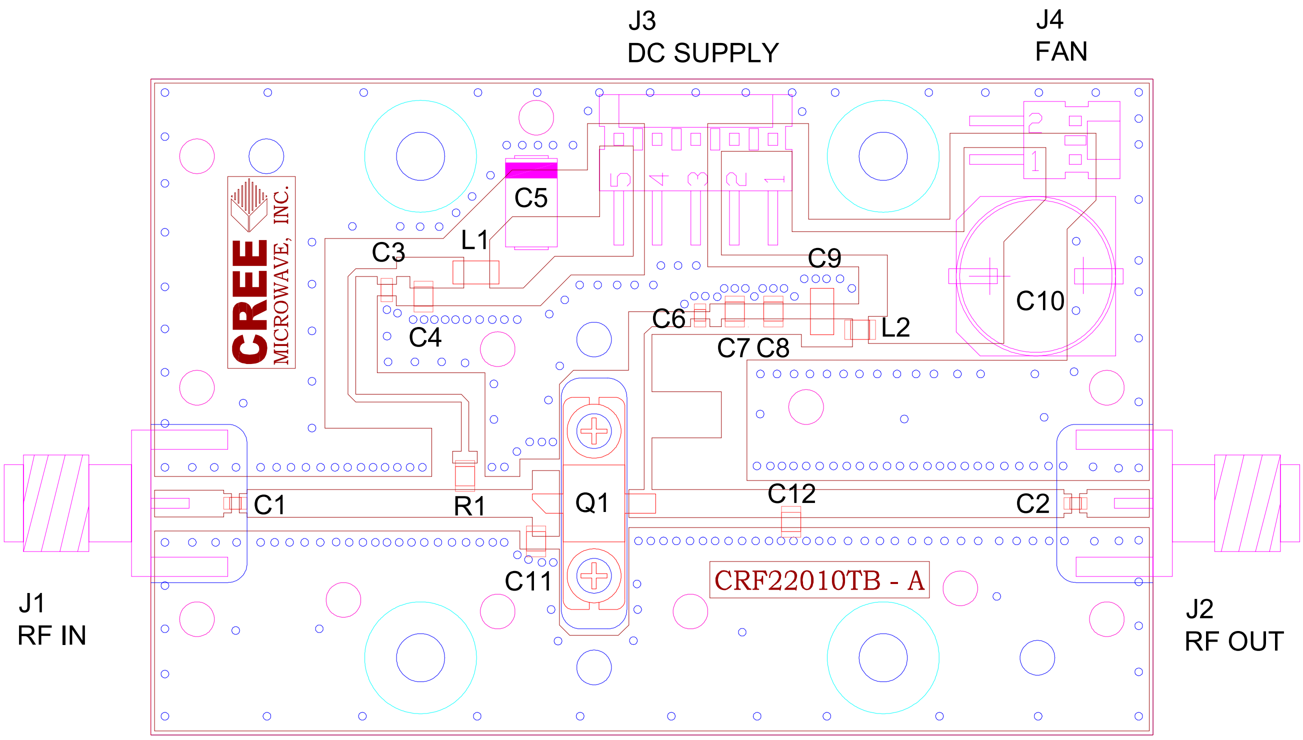


Parts List

Designator	Value	Designator	Value
R1	39 Ω, 0.1 W, 0805 Chip Resistor	C1, C2, C3, C6	27 pF, 100V Ceramic Capacitor, ATC 12061C104MAT2A
L1	Ferrite, 80 ohms, Steward HI1206K101R	C4	0.1 uF, 25V, 0805 Ceramic Capacitor
L2	Ferrite, Murata BLM21P220SG	C5	10 uF, 25V Tantalum Capacitor
J1, J2	Flange Mount SMA Female Connector	C7	2.2 nF, 100V Ceramic Capacitor, AVX 08051C222MAT2A
J3	5-pin Molex Male Connector	C8	10 nF, 100V, 0805 Ceramic Capacitor
J4	2-pin Molex Male Connector	C9	0.1 uF, 100V, 1206 Ceramic Capacitor
Q1	CRF-22010	C10	33 uF, 100V, Aluminum Electrolytic Capacitor
Substrate	Rogers RO4003, ε_r=3.38, h=32 mil	C11	3.3 pF, 150V Porcelain Capacitor, ATC 100B3R3OBW500X (exact value depends on tuning)
Heatsink	Thermalloy 74605 Extrusion, 2 in long	C12	2.2 pF, 150V Porcelain Capacitor, ATC 100B2R2OBW500X (exact value depends on tuning)
Fan	Comair-Rotron FS48B3, 60 mm, 48V, 0.05 A, 18 cfm		

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

Layout



Operating Instructions

As per normal RF amplifier operation, observe correct polarity . Do not power up the evaluation board unless the RF input and output ports are properly terminated.

The CRF-22010-TB-A is supplied fully assembled but without any transistors installed; since they are ESD-sensitive devices, they are packaged separately in protective packaging. The test board is only designed for use with the flange style package. To install a transistor, remove the plastic clamp. Place the transistor into the cavity with the angled gate lead towards the input connector J1. Use the two 2-56 hex screws and washers to attach the flange to the board. Replace the clamp and retighten to effect positive contact between the circuit's microstrip lines and the part's leads. Reverse this procedure to remove the device.

The evaluation board is fastened to an aluminum carrier to provide heat spreading and sinking, but this thermal mass is not a sufficient heat sink for extended (i.e., for more than 30 seconds) operation. An optional heatsink and fan assembly is supplied with the fixture. A thermal compound such as Wakefield #120-2 should be used at the carrier-to-heatsink interface to ensure adequate heat transfer. Thermal compound should be used sparingly in order to minimize the thermal drop across the interface; refer to manufacturer instructions for proper application of thermal compound. **Failure to provide adequate heatsinking will result in RF performance degradation and/or component failure.**

Handle and test the board in an ESD-protected environment. With all power off, connect the RF and DC cables. Standard SMA cables will mate to the RF input and output connectors. Connect an external 48 VDC power supply to the board's GROUND and DRAIN plugs. The supply should be capable of supplying 1.5 A minimum. Connect an external adjustable supply to the board's GROUND and GATE plugs. **Observe correct polarity:** the GATE voltage is negative with respect to ground, and the DRAIN voltage is positive with respect to ground. **Observe proper supply sequencing:** the negative gate voltage **must** be turned on before the positive drain voltage. Adjust the gate voltage so that the CRF-22010 will be operating Class A at V_{DS} = 48 V and I_{DS} ~ 500 mA for initial checkout.

Connect a 20 dBm, 2.0 GHz source to RF IN and measure output power at RF OUT. The 1 dB gain compression point should be reached with an input power of 27 dBm to 30 dBm.

Note that, for convenience, the fan uses the board's 48VDC supply through J4. For monitoring drain current from the V_DD supply lead, the fan should either be disconnected and supplied separately, or its operating current should be determined without a transistor installed in the fixture and then subtracted from later measured current values.

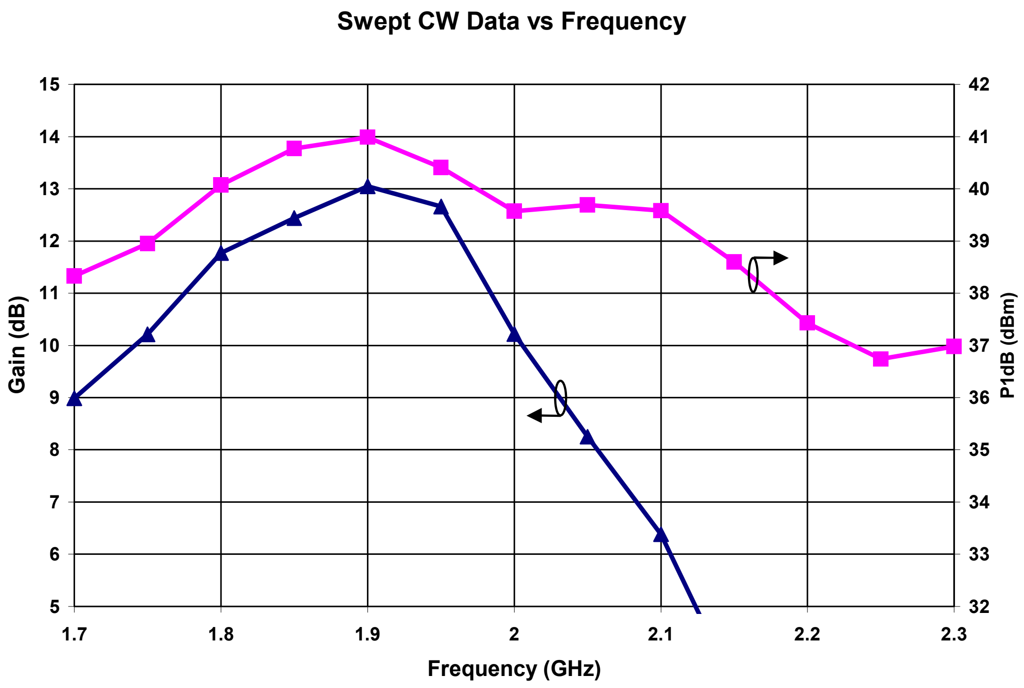
Theory of Operation

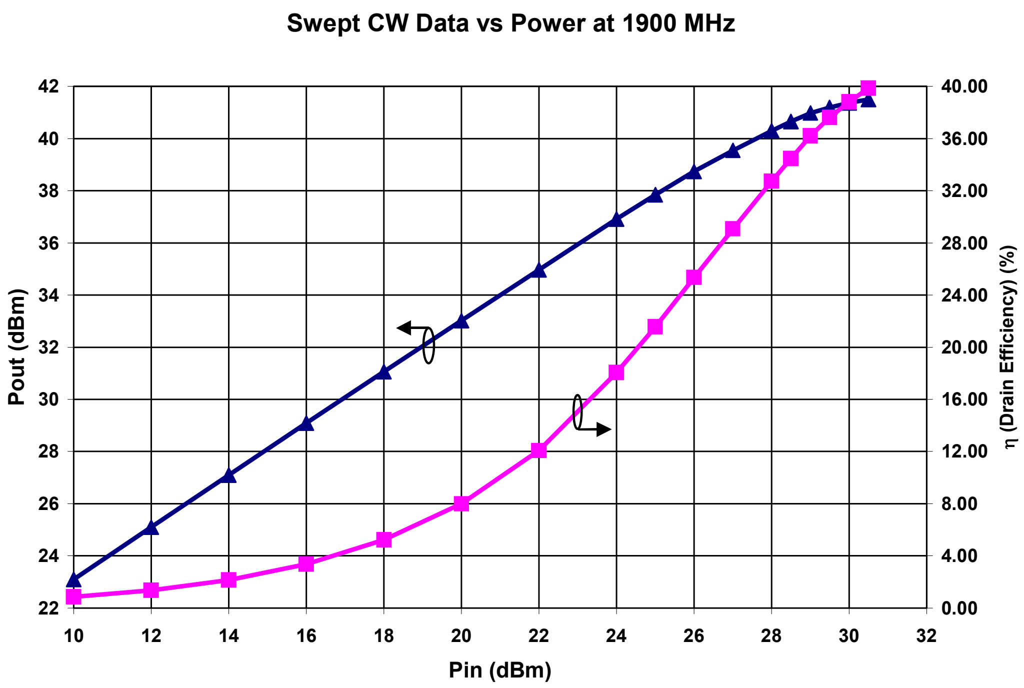
Refer to the schematic presented earlier. **This circuit is intended only for test and evaluation purposes; it is not a complete, ready-for-production amplifier.**

C1 and C2 are DC blocking capacitors. C11 and the transmission line to which it is connected constitute the input match. This matching network transforms 50Ω to the desired source impedance (see the CRF-22010 data sheet). Likewise C12 and the transmission line to which it is connected transform the desired load impedance to 50Ω. These are lowpass matching structures, and they perform impedance matching in the desired band, but they only give a high-Q, narrowband match. Gate bias is provided through a typical $\lambda/4$ line; R1 helps to isolate and stabilize the amplifier. C3 and C4 terminate the line in an RF short, and L1 and C5 provide further supply isolation. Drain bias is provided through a $\lambda/4$ line also, but the combination of C8-C10, L2, and the stub in the drain supply line provide both an RF short and a termination with good video bandwidth. DC is supplied to the test board through J3, and the fan draws its power through J4.

Some typical swept power and frequency measurements of an evaluation board are presented on the next page. These data are measured using a typical evaluation board with a typical transistor.

Typical Performance at V_{DS} = 48V, I_{DQ} = 500mA





Disclaimer: Specifications are subject to change without notice. Cree, Inc. believes the information contained within this data sheet to be accurate and reliable. However, no responsibility is assumed by Cree for its use or for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Cree. Cree makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose. “Typical” parameters are the average values expected by Cree in large quantities and are provided for information purposes only. These values can and do vary in different applications, and actual performance can vary over time. All operating parameters should be validated by customer’s technical experts for each application. Cree products are not designed, intended, or authorized for use as components in applications intended for surgical implant into the body or to support or sustain life, in applications in which the failure of the Cree product could result in personal injury or death, or in applications for the planning, construction, maintenance or direct operation of a nuclear facility. CREE is a trademark of Cree, Inc.

Contact Information:

Cree, Inc.
4600 Silicon Drive
Durham, NC 27703
919-313-5300 [sales]
919-313-5451 [fax]
Sales Email: sales@cree.com
Web: http://www.cree.com/