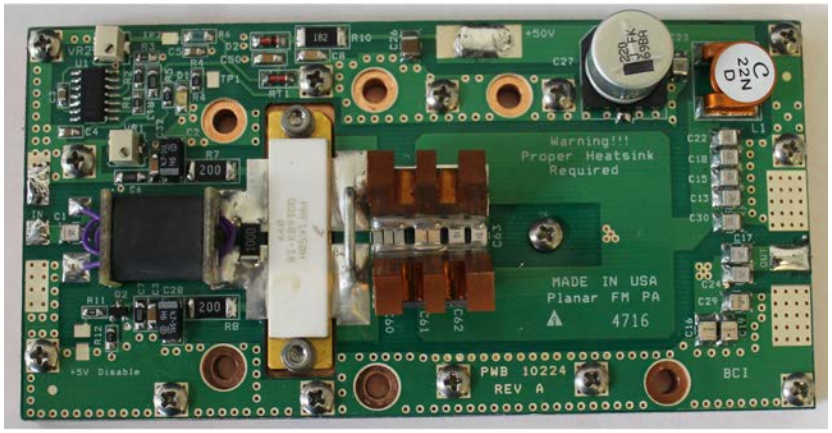
Broadcast Concepts Inc
11700 NW 102nd Road Suite 4Medley FL 33178
Tel: 305.887.8400 FAX 305.887.8444

Model MRF1K50-PLA FM Pallet Amplifier

This amplifier module is ideal for final output stages in FM Broadcast Applications.

- **87.5 – 108.1MHz (FM BAND)**
- **50 Volts**
- **Input/output 50 ohms**
- **Pout: 1250W minimum**
- **Up to 85% efficiency**
- **22dB Gain**
- **NXP MRF1K50 Mosfet**
- **Planar RF Transformers**



Dimension (L x W x H inch) [5.0” x 2.5” x 0.9”]

Electrical Specifications				
Characteristics	min	typ	max	unit
Operating Frequency range	87.5		108.1	MHz
peak saturated power (@ 50V)	1250	1325	1350	W
P1dB @ 50V	-	--	-	W
Power Input	-	-	12.5	W
Input VSWR		1.5	1.8	VSWR
Power Gain	21	22	23	dB
Amplifier efficiency @ 1000W	82	85	87	%
Absolute maximum current rating	-	-	34	A dc
Insertion Phase variation (unit to unit)	-	+/-3.5	-	degrees
Power gain (unit to unit)	-	+/-1.0	-	dB
F2 Second Harmonic	-	-35	-30	dB
F3 Third Harmonic	-	-35	-30	dB
Bias Current Factory set @50V. 25C	275	300	300	MA dc
Drain voltage supply	24	50	52	V
Base plate operating temperature	0	n/a	70	Celsius
Load Mismatch (All phase angles, Id=32A, 10 seconds)			65:1	VSWR
Shipping Weight		1.2		LBS

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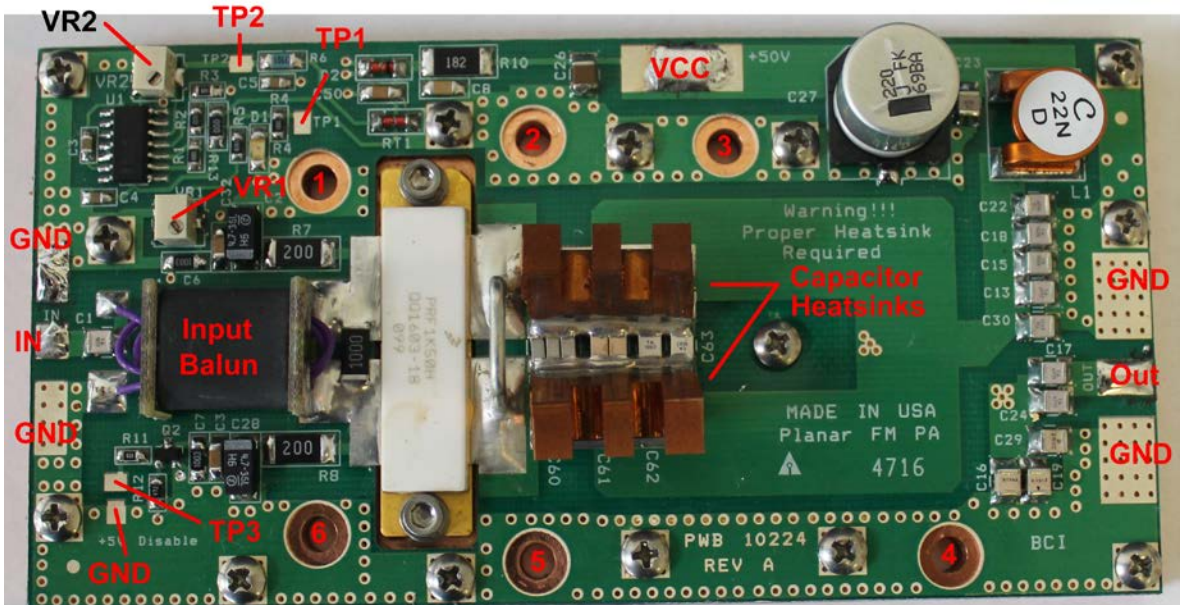
Electrical Drawing: Figure 1



The mechanical drawing may be downloaded in DXF format: http://broadcastconcepts.com/177300/PCB10224.DXF

Heatsink Mounting/Hardware

Tips for Mechanical Mounting:

1 All mounting holes (1-6) are 0.156 inch thru and they are designed for a #6 Screw. Stainless Steel mounting hardware is recommended, grade 18-8 or better. A lock washer of same material should also be used.
2 Ensure mounting surface is flat to better than 0.0025”
3 Use a thin layer of thermal compound on the backside of the PA - no more than 0.001” - 0.002” thickness!
4 Torque all screws to 10-12 in-lbs

Use of cooling air on top of pallet to keep the PCB cool is recommended. There is a thermal pad under the output side of the PCB. Most of the heat is dissipated through the ¼ inch copper base plate; however, a large amount of heat is also dissipated from the microwave capacitors. Airflow across the copper heatsinks in the output will reduce the operating temperatures. With no air flow the capacitors between the copper heatsinks will run at 130C which is still safe for these parts.

Warning: Failure to use a proper heat sink and/or improper installation will cause the transistors to burn out. This type of failure is not covered by warranty. This product can be ordered with a custom heat sink. Please contact factory for more information.

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Electrical Notes:

There is 1 +50V pad "VCC in photo" for the main power supply. The Meanwell RSP1500 or RSP2000 are the suggested power supplies for this amplifier. Do not attempt to connect ground to the pallet or modify the PCB for ground attachment. Ground can be attached to the heat sink that the pallet is mounted on. If operation close to peak saturated power is required, then the RSP2000 is the best option. It's a good practice not to load the power supply to more than 80% of its maximum output.

The pot VR1 marked "Bias" controls the bias current for MRF1K50. The factory setting is 300 ma and adjustment is not required.

The adjustment pot VR2 marked sets up the thermal compensation slope. Adjustment of this pot is not required; however, if it is accidently tampered with simply re-adjust it until "7.2 volts" is present at TP1 as this is the factory setting. "Bias disable" TP3 removes bias voltage from the transistor. A voltage above 2.0V is required to activate the "bias disable" condition.

If coax cables are being soldered to the module use Teflon cables MIL-C-17 rated only. Do not use a coax larger than RG402 on the output. Attempting to solder large coax cables like LMR400 directly to the PCB may damage the pallet and render it beyond economical repair. The best cable for the output is 0.141 inch conformable 50 ohm type.

If transistor replacement is necessary always verify that the bias circuits are functioning before installing new parts. Transistor pocket must be cleaned with alcohol, all debris removed and new thermal compound applied prior to installing new transistor. Bias voltage should be adjusted to 0.5V before new part is installed. We assume no responsibility for self repairs. Please consider sending pallet back to factory for service.
When bias adjustment is required always use a small lab supply that is current limited. This will prevent accidental over bias and loss of a transistor.

Warning: **Solid state amplifiers can be easily destroyed! Operating the amplifier outside of its specifications will cause the mosfets to fail. These failures are not covered by warranty.**

- Do not over drive the amplifier.
- Do not run the amplifier into an open circuit. Do not run the amplifier when the SWR is unknown. System integrator must foresee adding VSWR protection if there is a risk that the amplifier will be subjected to high VSWR conditions. Do not adjust the bias settings or attempt transistor replacement without a current limited lab supply.
- Do not allow the amplifier to overheat. Do not let the base plate temp exceed 70C. This amplifier is capable of dissipating over 350W in the maximum working condition. **This product requires prior experience working with high power RF amplifiers. This is not for beginners.**
- This amplifier has been designed for analog FM broadcast. Performance in digital FM has not been evaluated.
- Expensive test equipment like RF wattmeters, dummy loads, Ammeters and thermal meters are required to verify proper installation. Operating this amplifier without this equipment is like driving blind. You won't be able to see what's really going on and the end result could be transistors that burn out.

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Calculating Die Temperature:

How do you know if the amplifier is running to hot? There are symptoms to watch for. If there is a significant drop in power of more than 5% over a short period of time the amplifier is likely overheating.

There is a scientific method that must be used to verify that the amplifier is installed and running within thermal limits. We do not recommend the “dropping power with time test” described above.

Use the thermal resistance (Rth) of the device to calculate the junction temperature. The Rth from the junction to the device flange for the MRF1K50 is 0.11 °C /W. If the device is soldered down to the pallet baseplate, this same value can be used to determine Tj. If the device is greased down to the pallet baseplate, the Rth(j-h) value becomes 0.26K/W, as the thermal resistivity for the grease layer from the flange to the baseplate is approximately 0.15 °C /W.

Note: *We always use thermal grease under transistors because soldering them directly would render the pallets unserviceable.*

Example: Assuming that the device is running at 950W with the RF output power at 48V while consuming 25.3 amps on a pallet baseplate (e.g. 70 °C). Tj can be determined based on this condition for the given baseplate temperature:
• Dissipated power (Pd) = (48V x 25.3A) – (950W) = 264.4W
• Temperature rise (Tr) = Pd ´ Rth = 264.4W (0.26 °C/W) = 68.7 °C
• Junction temperature (Tj) = Th + Tr = 70°C + 68.7 °C = 138.7 °C

The best way to make this calculation is to measure the temperature of the transistor flange directly. In this case temperature rise is calculated using 0.11°C/W.

The maximum junction temperature for most LDMOS devices is 200C. We suggest staying under 175C. In the example above a base plate temperature of 70C was used. When the pallet is mounted to an efficient heatsink like one of our bonded fin models base plate temperatures in the 50C range are easily maintained at full output power.

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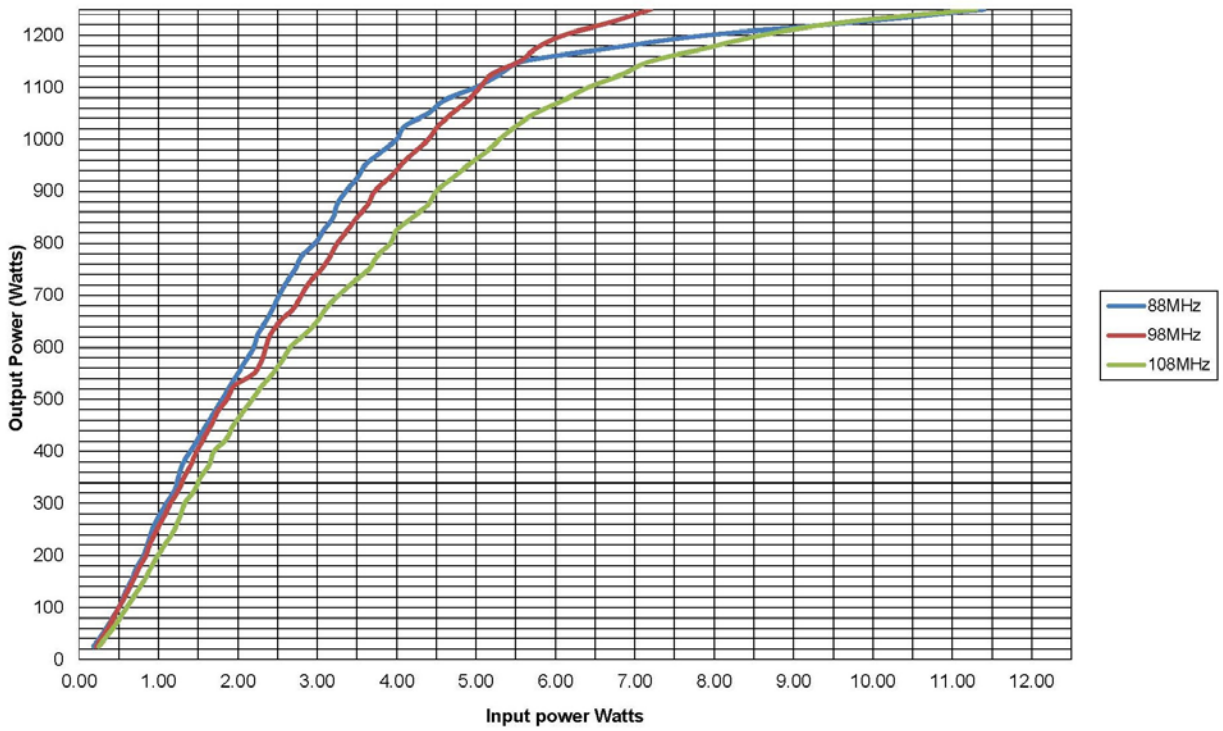
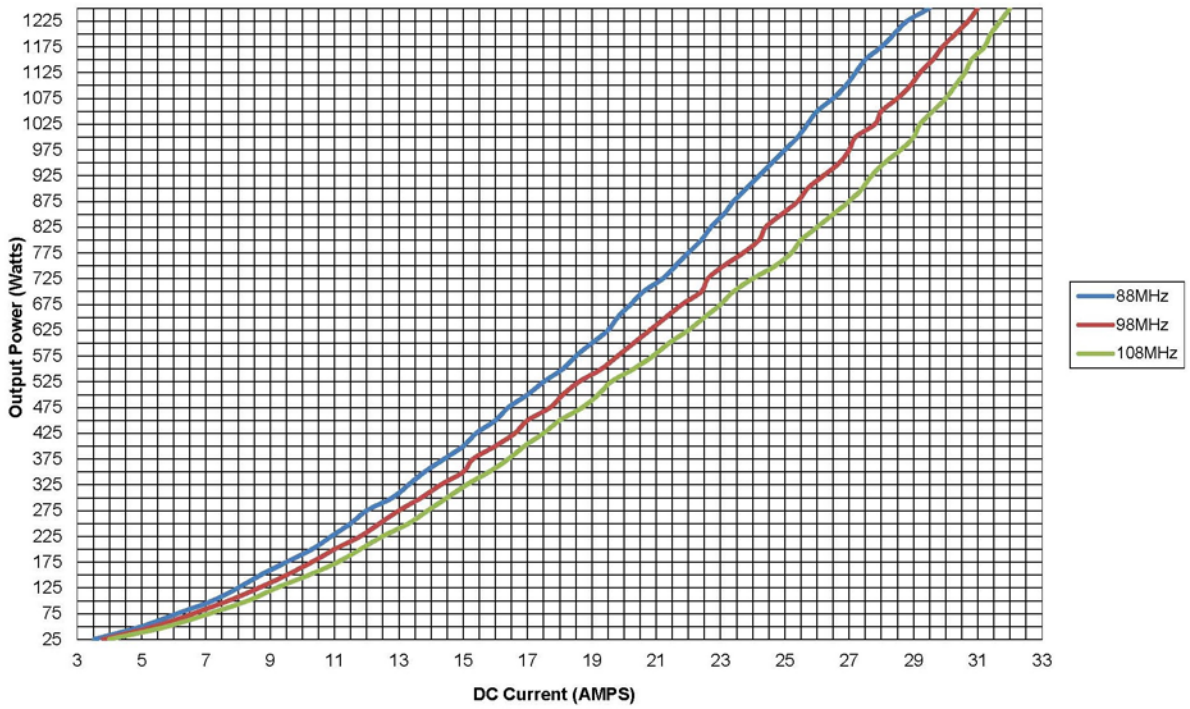
Input power & Output Power @ 50VDC; 300ma bias MRF1K50



DC AMPS & Output Power @ 50VDC; 300ma bias MRF1K50



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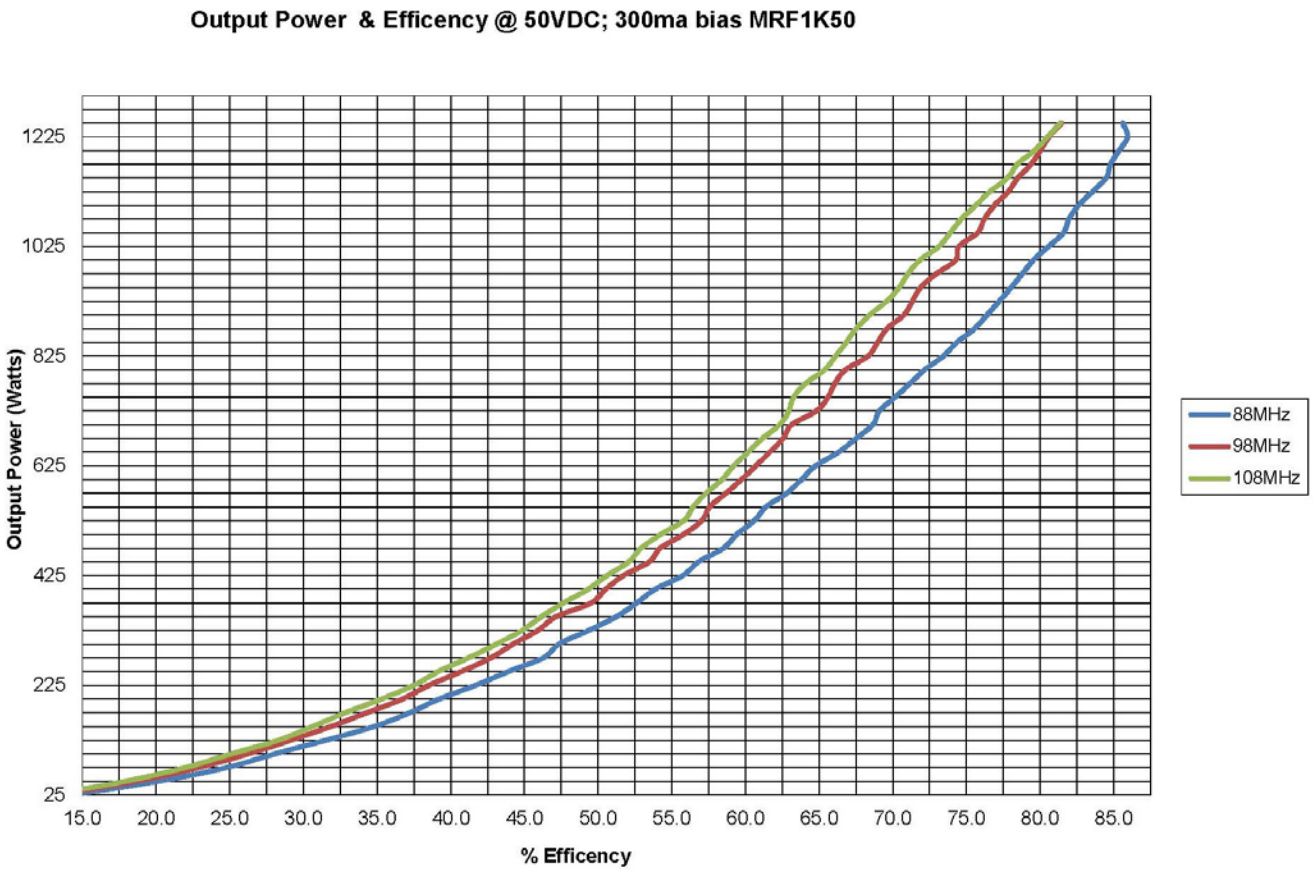

Low Pass Filter

A low pass filter is required to reduce harmonics. Harmonics from FM transmitters are regulated by most government regulatory authorities. Any of our low pass filters rated for at least 1000 watts can be used with this pallet. It is critical to install a 13 inch piece of RG400 between the pallet output and the filter input to prevent a filter reaction. When a filter reaction occurs the pallet may not perform well (poor efficiency). The cause of filter reactions is due to reflected harmonic energy. Filter reactions do not occur when 2 or more amplifiers are power combined since the combiners provide isolation from the low pass filter.

The coax between the amplifier and low pass filter provides a favorable phase for the harmonics to impact the amplifier. This length was determined by experiment to offer the highest efficiency. Harmonic absorbing low pass filters offer good efficiency because they provide a path for the harmonics; however, a standard reflective filter works fine also with the 13 inches RG400 coax.

The MRF1K50 can operate into open and short circuits without damage; however, operation into a mismatched load for even a few minutes can cause the transistor to fail from thermal stress. The MRF1K50 is not clown proof. Thermal overload and RF overdrive will still destroy the transistor. It should be noted that load mismatches that cause the transistor to draw high current are the ones that are most likely to cause a thermal failure**.**

The 1250W rating for this amplifier is a maximum rating on a 50V supply. In a broadcast system, there needs to be a low pass filter and directional coupler. These components introduce losses. We feel that this pallet can easily meet the design requirements for a 1000W system. That's 1000W after the low pass filter and directional coupler. This is a suggested operating condition with also considers the requirement that the amplifier is capable of driving loads that are less than perfect (up to 1.8:1 VSWR).

Amplifier Efficiency

The best efficiency occurs when the amplifier is running into compression which is around its maximum power rating of 1250W. If operation at lower power is desired then the supply voltage should be reduced. Reducing the supply voltage lowers the compression point of the amplifier. The combination of low output power and 50V supply will yield poor efficiency and in some cases it can cause the amplifier to overheat. Here are recommendations for lower power operation.

1000W to 1250W (45 to 50V)
800W to 1000W (40 to 46V)
Under 750W (38 to 42V)

These are just starting points. Some experimentation is required to find the best operating voltage.