P400-VHF-H

High Power RF Amplifiers and Accessories

400W VHF Band III TV Linear Pallet Amplifier

The **P400-VHF-H** is an integrated TV linear amplifier designed for the television integrator. Providing a minimum of 350W Pk linear power, the P400-VHF-H is the perfect amplifier for any high band VHF transmitter. Featuring quadrature input and output combining, this unit is isolated from most external circuit problems.

- No RF assembly or circuit tuning!
- 400 Watts of Linear Output Power!
- Combined Video and Aural at full rated power!
- 16dB typical gain at Channel 13!
- Modular Construction for ease of Integration!

Specifications:

Vsup=+28V$_{dc}$, I$_{dq}$=1.6A, 170-230MHz

Parameter	Min	Typ	Max	Units
Power Out, P1dB		56		+dBm
Linear Power Out, Pk Sync Full Field Red, NTSC-NA, IMD-54dBc	350			Watts
Power Input, Pk Sync		6	11	Watts
Power Gain	15	16		dB
Drain Current Pout = 200W Pk Sync		17		A
Input VSWR		1.2:1	1.5:1	
Insertion Phase Variation (unit to unit)		±5		°
Power Gain Variation (unit to unit)		±1		dB
F2 Second Harmonic		-40		dBc
F3 Second Harmonic		-23		dBc
Baseplate Operating Temp	0		+70	°C
Physical Dimensions	6.5" x 4.0" x 1.5" / 17cm x 10cm x 4cm			

Performance data is given for +28.0V. Operation at +32.0VDC will allow full 400W broadband and sacrifice some efficiency.
This amplifier is designed to yield a very robust 1 kW Pk Sync Analog Output Power when configured in a combined 4-way array. It is possible, but not recommended, to use in a 2-way configuration for 1kW, but extra measures such as pre-correction / distortion and extra cooling will be required.

Absolute Maximum Ratings:

Parameter	Value	Units
Maximum Operating Voltage	+34.0	V DC
Stable Operating Voltage	+26.0 to +32.0	V DC
Maximum Bias Current Per side. Factory set to 0.8A per side.	3.0	A
Maximum Drain Current Note - J100 connector rated for 20A maximum	24	A
Maximum Input Power	43	+dBm
Load Mismatch Survival At all phase angles with the base plate held at 40C and Id current limited to 12A, 2 seconds maximum	5:1	
Storage Temperature	-40 to +105	°C
Maximum Operating Baseplate Temperature	+70	°C

Features Include:

- Temperature Compensated Bias
- Temperature Controller- Analog Temp Output
- High Temp alarm with automatic PA disable
- High Temp alarm output
- Amplifier Disable
- Current Sense, Each Transistor
- Connectorized Power and I/O

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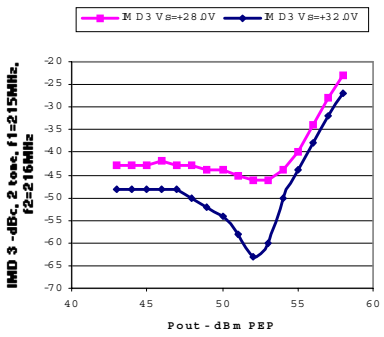
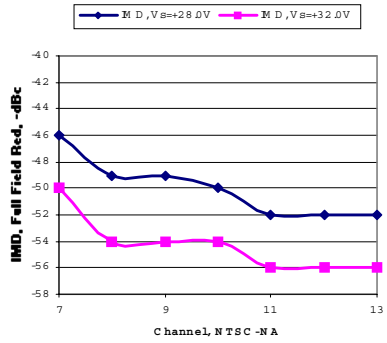
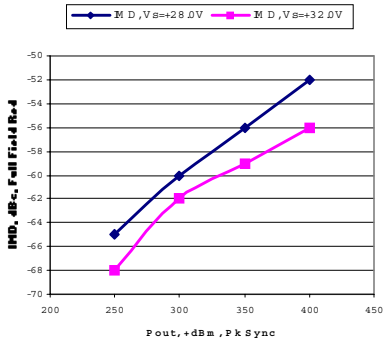
Pout vs. IMD3
2-Tone Input f1=215MHz, f2=216MHz



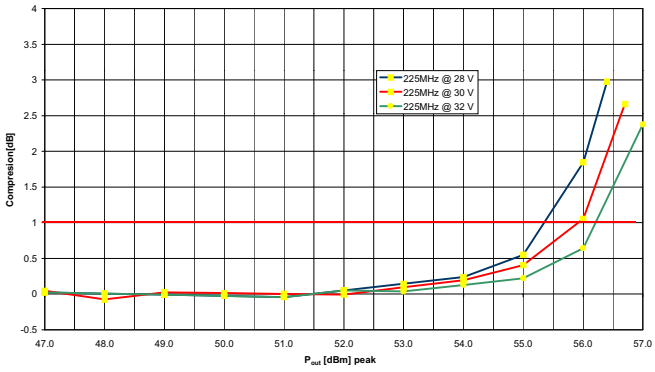
IMD vs. NTSC-NA Channel
Pout = 400W Pk Sync



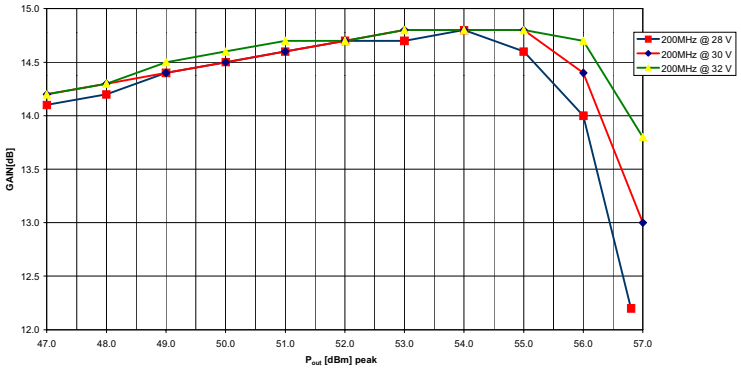
IMD vs. Pout
Channel 13, NTSC-NA



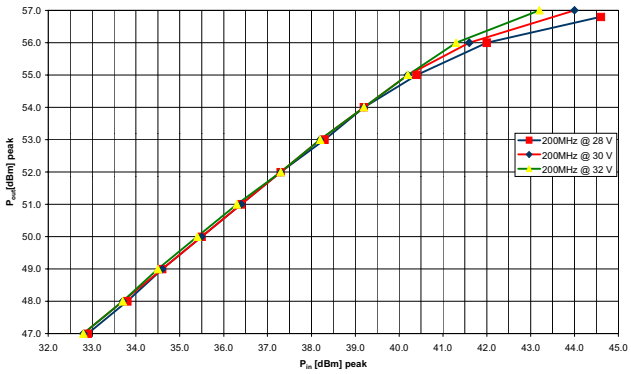
Compression point of P400-VHF-H @ 225MHz



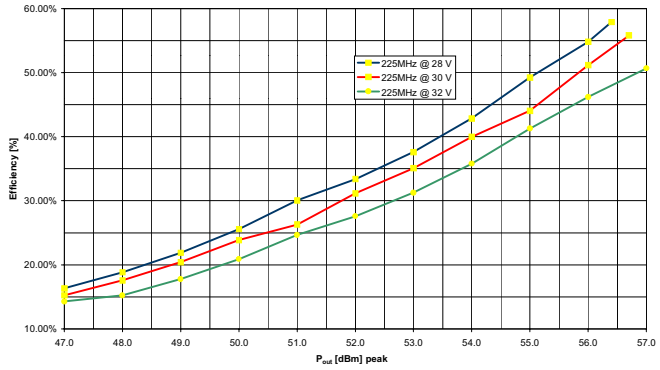
Power Gain of P400-VHF-H @ 200MHz



Pout vs Pin P400-VHF-H @ 200MHz



Efficiency of P400-VHF-H @ 225MHz



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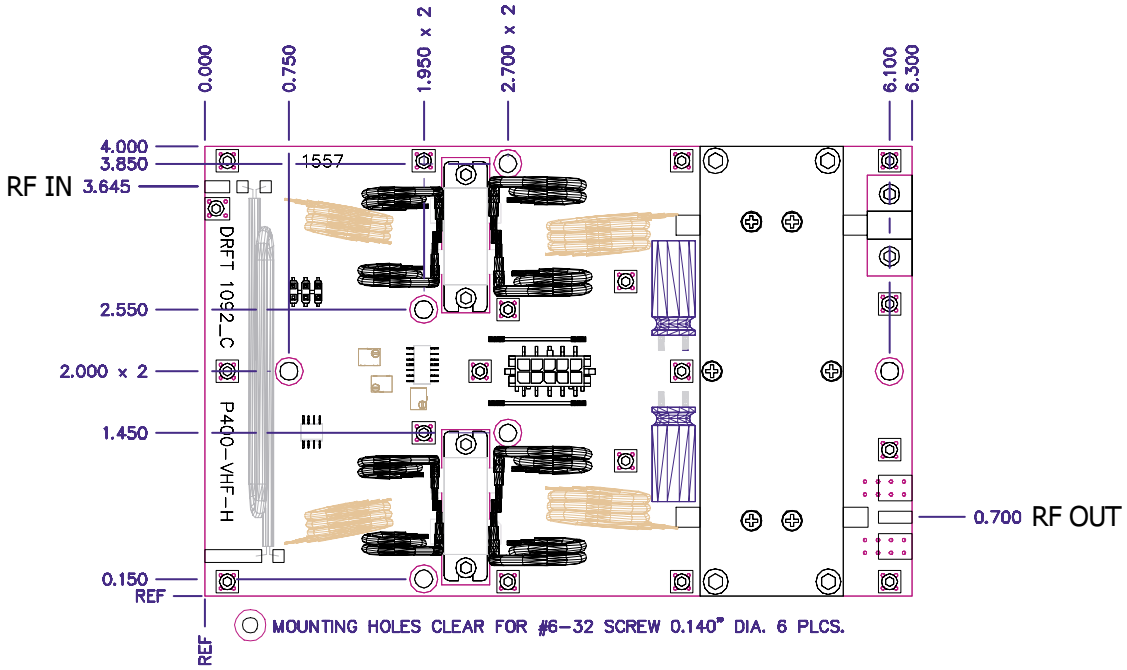

Tips for Mechanical Mounting:

1 All holes are clear for #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 0.003" / "
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

Considerations for Mechanical Mounting:

- Considerations for proper thermal design include
- Total power dissipated = Total DC Power Consumed x (1-Efficiency)
- Ambient Airflow
- Thermal Resistance of Heat Sink

For this PA, typical DC efficiency is 40%. At 400W Pk power output, 200W Average, +32.0V DC operation, 544 total watts are consumed, which leaves 344W dissipated power. If we assume an input air temperature of +25°C, and a maximum desired baseplate temperature of 55°C, this leaves a temperature differential between baseplate and ambient air of 30°C. The desired thermal resistance for heatsink mounting surface to air is therefore 30°C/344W = 0.09°C/W.
Since the baseplate is aluminum, it is important to find a heat sink that it sized at the same outline as the PA which can give this thermal resistance. For example, a 230mm x 127mm heat sink with serrated fins, 70mm in length, (40 fins across 127mm dimension) with an air velocity of 4 m / s achieves this value.

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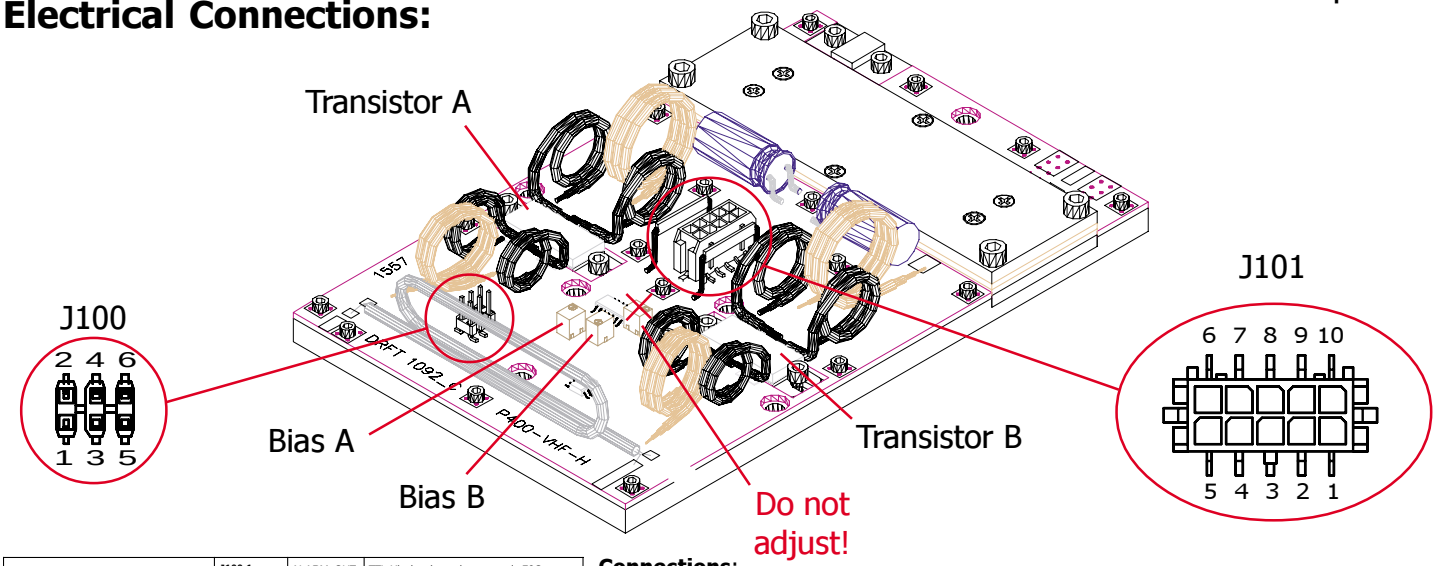
Electrical Connections:



I/O Standard 0.100" pitch DIP /IDC header: SAMTEC type IDSD, HCSD 3M type 89106-0101 AMP 102393-1, 102398-1 BERG 71602-306 -or- Solder directly to Pin in I/O connector	**J100-1**	ALARM_OUT	TTL Hi when baseplate exceeds 70C
	J100-2	ALARM_IN	Jumper to J100-1 for automatic shutdown at 70C, automatically re-enables at 60C
	J100-3	GROUND	
	J100-4	BIAS_SUP	Power to the Bias and Control circuitry Power must be applied for PA operation
	J100-5	TEMP	Baseplate Temperature
	J100-6	DISABLE	TTL Hi to Disable amplifier
Power 3.0mm Micro Connector: MOLEX 43025-1000 MOLEX Pin 43030-0001, 43030-0007 AMP 1-794617-0 AMP Pin 794610, 794606 -or- Solder directly to pad adjacent to connector	**J101-1**	CURRENT_B	Current Sense, Transistor B
	J101-2,3,8,9	GROUND	System Ground
	J101-4,5,6,7	Vsup	+28 to +32 VDC
	J101-10	CURRENT_A	Current Sense, Transistor A

Connections:
Connect amplifier to +Vsup and Ground using either 3.0mm modular 10-position plug (J101) or soldering directly to pads adjacent to connector. If using Single connection, 14 gauge wire to each side is recommended, 12 gauge ground wire. 20 gauge wire is recommended for use in modular connector, and all power connections must be used! In all cases, use of teflon insulated wire is highly recommended.
I/O connector (J100) must have +Vsup (+24V minimum) DC applied to J100-4 to supply power to bias and control circuitry. All other connections are optional.
Connect coaxial cable to input and output RF connections (semi rigid or flexible) using best RF practices. Ensure output cable is of sufficient power handling rating. Pads are provided for ground on co-axial connections.

Amplifier Startup
+Vsup should be applied to amplifier with no drive and with no bias applied. The system must allow drain voltage to reach +26V minimum before applying bias and drive or damage will result to the amplifier and void warranty. This typically takes between 2 - 10 seconds and should be verified by the system integrator. This can be accomplished in several ways:
1) Apply power to amp at J101, and remove power from J100-4. After proper voltage has been reached, apply voltage to J100-4 as described above. Amplifier is ready for use.
2) Apply power to amp at J101, and J100-4. Place a TTL Hi (+5V) to J100-6 DISABLE. After proper voltage has been reached, remove TTL Hi from J100-6 DISABLE. Amplifier is ready for use.

Bias Current:
Bias current is controlled via temperature compensated bias system that uses a hermetically sealed glass thermistor as reference. If excessive air is directed above the amplifier such that the thermistor is cooled below the temperature of the baseplate, this circuitry may not perform properly. Bias has been pre-set at the factory to 0.8A each side at +28.0V DC. This bias point has been selected to offer the optimum balance between IMD performance, efficiency, and gain. If the bias point is changed, take great care to set the same bias point on each transistor, and not to exceed the bias listed on page 1.

Fault Condition - Bad VSWR
Current sense J101-1, J101-10 should be monitored for excessive current. The voltage difference between J100-10 (transistor A) to J100-4,5,6,7 and J100-1 (transistor B) to J100-4,5,6,7 is scaled 1A per 0.010 V. If either transistor experiences currents in excess of normal operation, a fault condition exists, and the amplifier should be disabled through J100-6 DISABLE. If current on either transistor drops to below 0.5A indicated, a fault condition exists, and the amplifier should be disabled through J100-6 DISABLE.

Temperature Sense and Temperature Fault
An on board temperature controller reports temperature on pin J100-5 TEMP. This is scaled to +395mV + (Temperature °C X +6.20mV/°C) and has an output impedance of 1.5kohm typical. An output alarm, J100-1 ALARM OUT, is TTL Low when the temperature exceeds approximately 70°C, and the alarm is cleared when the baseplate temperature drops below approximately 60°C. For automatic operation, jumper J100-1 ALARM OUT to J100-2 ALARM IN and the amplifier will automatically disable by removing bias when the temperature exceeds 70°C, and automatically re-enable when the temperature drops below 60°C.

Amplifier Shutdown
To prevent damage to amplifier and surrounding systems, bias and drive should be removed prior to powering down PA. This can be accomplished by removing voltage from J100-4, or by applying TTL Hi (+5V) to J100-6 DISABLE. Power can safely be removed from PA.

Miscellaneous:
It is normal for the output quadrature and the output transformers (flexible coax on the output of transistors A and B) to get warm during operation. These components are rated for continuous operation in excess of 150°C. Placing noisy analog or digital systems, such as additional control circuitry, directly over the top of transistors or RF path can cause improper operation. Care should be taken to locate these components where they will not cause interference.