

# Solid State Broadband High Power Amplifier

**2253**
**1750 - 2120 MHz / 3.5kW<sub>RMS</sub> / 7kW<sub>PK</sub>**

The 2253 is comprised of multi-drawer integrated liquid-cooled sub-systems suitable for high power modulated, CW, and pulse applications. It utilizes high power GaN on SiC solid-state devices that provide wide frequency response, high gain, high peak power capability, and low distortions. Exceptional performance, long-term reliability and high efficiency are achieved by employing advanced broadband RF matching networks and combining techniques, EMI/RFI filters, and all qualified components. Each amplifier drawer is a full gain with integrated single phase power supply, liquid-cooling and blind-mate interface connectors. It also features gain and phase control and fully hot serviceable in case of amplifier drawer failure.

The amplifier system includes a built-in control and monitoring system, with protection functions, which preserve maximum output availability and reliability. Remote management and diagnostics are via the Ethernet port to a LAN with either Web browser or M2M (Machine-to-Machine) interface (Web-API) or using the local touchscreen panel. The control system runs an embedded OS (Linux), has a built-in non-volatile memory for factory setup recovery features.

Empower RF's ISO9001:2015 Quality Assurance Program assures consistent performance and the highest reliability.

- Solid-state class AB design
- Suitable for CW, AM, FM, Pulse and linear applications
- 50 ohm input/output impedance,
- Built-in Control, Monitoring and Protection functions
- Compact Modular design, High reliability and ruggedness



## ELECTRICAL SPECIFICATIONS over temperature conditions (-10 to +50°C) unless specified

Parameter	Symbol	Min	Typ	Max	Unit
Operating Frequency	BW	1750		2120	MHz
Output Power @ 3.5dB PAR (PEP) <sup>NOTE 1 &amp; 2</sup>	P <sub>OUT</sub>	3500 (7000)			Watt
Peak-to-Average Ratio	PAR		3.5		dB
Power Gain @ Rated output	G <sub>P</sub>	70	75	80	dB
Input Power Range	L-Band	-10	-5	0	dBm
	S-Band	-10			
Leveled ALC – Flatness	ΔG			±1.0	dB
Gain Slope over any 4 MHz BW	G <sub>SLOPE4</sub>			±0.25	dB
Gain Flatness over any 4 MHz BW	G <sub>Δ4</sub>			±0.25	dB
Power Adjustment Range (48-65.4 dBm)	P <sub>ADJ_R</sub>			17.4	dB
Reported Output Power Accuracy <sup>NOTE 4</sup>	P <sub>ACCU</sub>			±0.4	dB
Power Adjustment Step Size (M2M Only)	V <sub>VASTEP</sub>	0.1			dB
Gain Stability	G <sub>24H</sub>			±0.5 / ±0.2	dB
Mode ALC / AGC (after 5 minutes)	G <sub>TEMP</sub>	15 to 30°C		±0.5	dB
HPA Stability Settling Time	T <sub>STABILITY</sub>	-10 to 50°C	5	10	Minute
Group Delay Variation over any 4 MHz BW	Delay			25	nS
Input Return Loss (equal to 1.3:1 VSWR max.)	S <sub>11</sub>			-17.7	dB
Noise Figure @ maximum gain	NF		8	10	dB
Inter-modulation Distortion <sup>NOTE 3</sup>	IMD			-27	dBc
2-Tone @ 62.44dBm/Tone, 100kHz Spacing					
Harmonics @ P <sub>OUT</sub> = 3500W <sub>RMS</sub> (with LPF)	2 <sup>ND</sup> -5 <sup>TH</sup>			-72	dBc
Spurious Signals up to 6GHz	Spur			-72	dBc
Noise Power Density	NPD			-85	dBm/Hz
RF Sample Ports (Response Curve Table provided)	RF <sub>SAMPLE</sub>	-62	-60	-58	dBc
Residual AM	RA			-60	dBc
AM/PM Noise (Power) Conversion	AM/PM			6	Deg/dB
Operating Voltage – (3-phase, line-to-line), 47-66 Hz	V <sub>AC</sub>	185	208	270	Volt
Power Consumption @ 3500W <sub>RMS</sub>	P <sub>D</sub>			20	kVA
Output Power back-off if one booster drops	P <sub>BK_OFF</sub>		-1.2		dB
Load VSWR without fold-back/Alarm	P <sub>OUT</sub>	≤3.5kW <sub>RMS</sub>	Load VSWR		2.2 : 1
		≤7kW <sub>PEP</sub>			

- Notes:**
1. RMS measurement performed in MGC Mode (Manual Gain Control).
  2. Factory configurable output capability for 3.5 kilowatts RMS or 7 kilowatts PEP @ 0.5dB compression.
  3. Measured without DPD. Refer to intermodulation product table at the end of datasheet.
  4. Calibrated at these frequencies: 1800.00 MHz and 2075.00 MHz

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Empower RF also offers a DPD (Digital-Pre-Distortion) module to correct the intermodulation and improve the spectral mask.

**MECHANICAL SPECIFICATIONS**

Parameter	Value	Unit
Dimensions W x H x D	24 x 84 x 48 (19" Rack)	Inch
Weight	~1500	Pound
Main RF Connectors – Input / Output	Input: N-type, Female Output: WR430 CPRG	RF IN RF OUT
RF Sample Connectors	N-type, Female	Forward/Reverse
Blanking Input Connector	N-type, Female	Blanking
Cooling System – Liquid	Pressure: 20psi typ. / Liquid Flow rate: 70gpm typ.	PSI/GPM

**ENVIRONMENTAL CHARACTERISTICS (Qualification Data available for review):**

Parameter	Symbol	Min	Typ	Max	Unit
Operating Ambient Temperature	T <sub>A</sub>	-10		+50	°C
Non-operating Temperature	T <sub>STG</sub>	-30		+85	°C
Relative Humidity (non-condensing)	RH			95	%
Shock / Vibration - MIL-STD-810F Shock Method 516.5, Vibration Method 514.5	SH / VI				

**PROTECTIONS:**

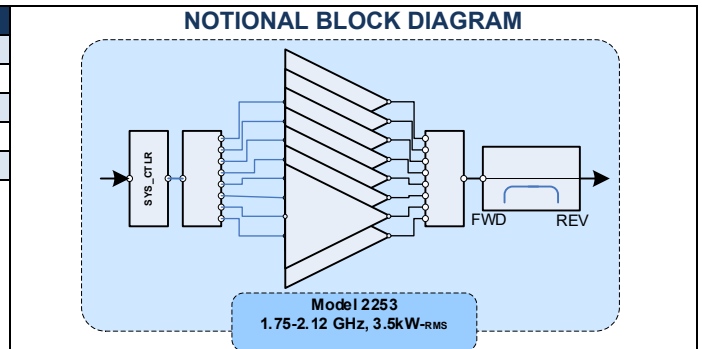
Parameter	Specification	Unit
Input Overdrive	0 dBm	Max
VSWR Protection with Fault Clear	At 2.2:1 – PA backs-off output power to a safe operating level – no system shutdown, "On Air" time is maximized	-
Thermal Overload with Fault Clear	75	Deg C
Default Data Recovery	Factory Default Calibration Recovery	-

**COMMUNICATION INTERFACES:**

Function	Utility	Connector
Ethernet	Network management of device / web interface	RJ45
USB	Mass storage / Expansion Bus	USB 1.x/2.0 compatible
RS-232 Standard, RS-422 (optional)	Serial management of device / local operator access	D-Sub 9-position Male

**Available Options**

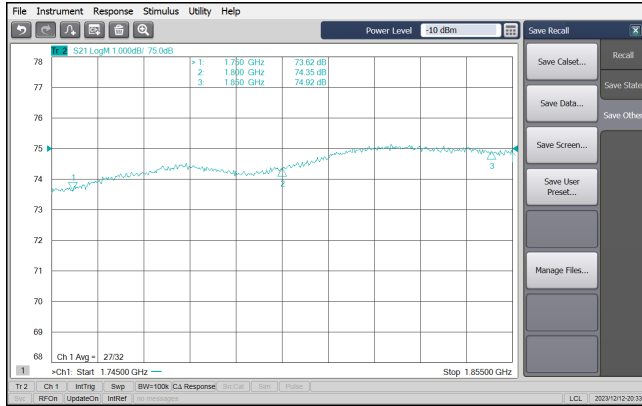
<b>2253-xxx</b>
-001 208 VAC, 3-phase-Delta, 47-66 Hertz, Rack Assy System
-002 TBD
Contact us for other available options; <a href="mailto:sales@empowerrf.com">sales@empowerrf.com</a>
<b>Standard Feature:</b>
-LCD Control, Ethernet & Serial Comm
-RF Input Connector: N-Type, Female
-RF Sample Connectors: N-Type, Female
-Blanking/Gating Port: N-Type, Female



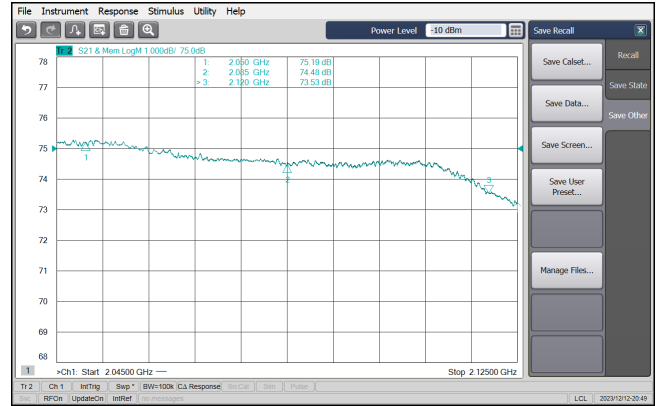
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**TYPICAL PERFORMANCE PLOTS**

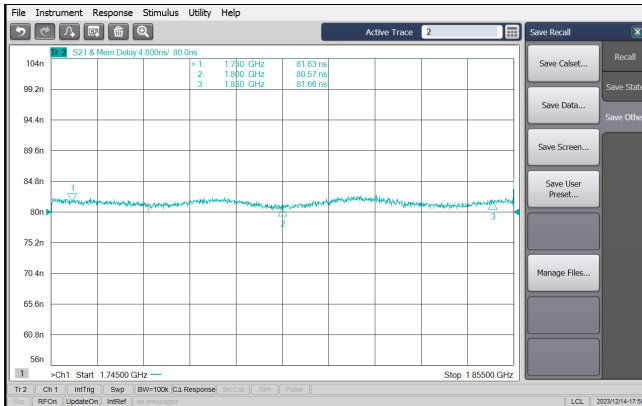
**Plot 1 – Leveled ALC Flatness, 1750-1850 MHz**  
 Mode ALC @ 3.5kW<sub>RMS</sub>, P<sub>IN</sub>= -10dBm  
 Reference: 75dB, 1dB/div.



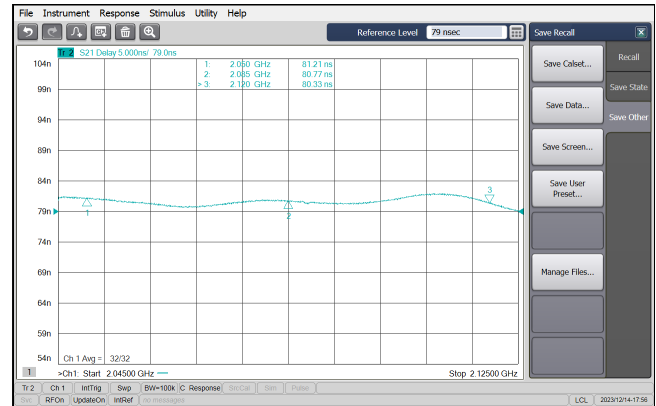
**Plot 2 – Leveled ALC Flatness, 2050-2120 MHz**  
 Mode ALC @ 3.5kW<sub>RMS</sub> @ P<sub>IN</sub>= -10dBm  
 Reference: 75dB, 1dB/div.



**Plot 3 – Group Delay Flatness, 1750-1850 MHz**  
 Mode ALC @ 3.5kW<sub>RMS</sub>, P<sub>IN</sub>= -10dBm  
 Reference: 80ns, 4.8ns/div.



**Plot 4 – Group Delay Flatness, 2050-2120 MHz**  
 Mode ALC @ 3.5kW<sub>RMS</sub>, P<sub>IN</sub>= -10dBm  
 Reference: 79ns, 5ns/div.


**INTERMODULATION PRODUCT TABLE:**

Intermodulation Product	2-Tone @ 62.44 dBm/Tone 100kHz Spacing <sup>NOTE 3</sup> (dBc)
3rd	-27
5th	-36
7th	-42
9th	-47
11th	-50
13th	-53
15th	-55
17th	-58
19th	-66