

8-Module C-Band Systems

SSPA Module Power Level	8-Module RF Output Power		7-Module Redundant RF Output Power	
	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)
50 W	55.0 (316)	52.0 (159)	53.8 (240)	50.8 (120)
100 W	58.3 (676)	55.3 (335)	57.1 (507)	54.1 (254)
150 W	60.0 (1000)	57.0 (500)	58.8 (760)	55.8 (380)
200 W	61.5 (1500)	58.5 (708)	60.3 (1100)	57.3 (540)
300 W	63.0 (2000)	60.0 (1000)	61.9 (1530)	58.9 (767)
400 W	64.3 (2661)	61.3 (1334)	63.1 (2042)	60.1 (1023)
650 W	66.4 (4315)	63.4 (2163)	65.2 (3273)	62.2 (1640)
800 W	67.3 (5300)	64.3 (2661)	66.1 (4027)	63.1 (2018)

16-Module C-Band Systems

SSPA Module Power Level	16-Module RF Output Power		15-Module Redundant RF Output Power	
	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)
50 W	58.0 (630)	55.0 (316)	57.2 (525)	54.2 (263)
100 W	61.0 (1200)	58.0 (631)	60.4 (1096)	57.4 (550)
150 W	62.8 (1900)	59.8 (955)	62.2 (1700)	59.2 (832)
200 W	64.0 (2500)	61.0 (1200)	63.4 (2188)	60.4 (1096)
300 W	65.8 (3800)	62.8 (1900)	65.2 (3300)	62.2 (1660)
400 W	67.0 (5000)	64.0 (2500)	66.4 (4365)	63.4 (2188)
650 W	69.1 (8128)	66.1 (4074)	68.5 (7079)	65.5 (3548)
800 W	70.0 (10000)	67.0 (5000)	69.4 (8710)	66.4 (4365)

8-Module X-Band Systems

SSPA Module Power Level	8-Module RF Output Power		7-Module Redundant RF Output Power	
	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)
300 W	63.0 (2000)	60.0 (1000)	61.8 (1500)	58.8 (752)
400 W	64.2 (2600)	61.2 (1300)	63.0 (2000)	60.0 (1000)
650 W	66.3 (4227)	63.3 (2118)	65.1 (3200)	62.1 (1600)
800 W	67.2 (5200)	64.2 (2606)	66.0 (4000)	63.0 (2000)

16-Module X-Band Systems

SSPA Module Power Level	16-Module RF Output Power		15-Module Redundant RF Output Power	
	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)
300 W	65.6 (3700)	62.6 (1850)	65.0 (3220)	62.0 (1614)
400 W	66.9 (4875)	63.9 (2440)	66.3 (4246)	63.3 (2130)
650 W	69.0 (8000)	66.0 (4000)	68.4 (7000)	65.4 (3500)
800 W	70.0 (10000)	67.0 (5000)	69.3 (8500)	66.3 (4250)

8-Module Ku-Band Systems

SSPA Module Power Level	8-Module RF Output Power		7-Module Redundant RF Output Power	
	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)
50 W	55.0 (313)	52.0 (157)	53.8 (237)	50.8 (119)
80 W	57.0 (500)	54.0 (250)	55.8 (376)	52.8 (188)
100 W	58.0 (624)	55.0 (313)	56.8 (473)	53.8 (237)
150 W	59.8 (944)	56.8 (473)	58.6 (716)	55.6 (359)
200 W	61.0 (1245)	58.0 (624)	59.8 (944)	56.8 (473)
300 W	62.8 (1884)	59.8 (944)	61.6 (1429)	58.6 (716)
400 W	64.0 (2500)	61.0 (1245)	62.8 (1884)	59.8 (944)
500 W	65.0 (3100)	62.0 (1600)	63.8 (2370)	60.8 (1200)

16-Module Ku-Band Systems

SSPA Module Power Level	16-Module RF Output Power		15-Module Redundant RF Output Power	
	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)
50 W	57.6 (575)	54.6 (288)	57.0 (500)	54.0 (251)
80 W	59.6 (912)	56.6 (457)	59.0 (794)	56.0 (400)
100 W	60.6 (1148)	57.6 (575)	60.0 (1000)	57.0 (500)
150 W	62.4 (1740)	59.4 (871)	61.8 (1514)	58.8 (759)
200 W	63.6 (2291)	60.6 (1148)	63.0 (2000)	60.0 (1000)
300 W	65.4 (3467)	62.4 (1740)	64.8 (3020)	61.8 (1514)
400 W	66.6 (4571)	63.6 (2291)	66.0 (4000)	63.0 (2000)
500 W	67.6 (5800)	64.6 (2900)	67.0 (5000)	64.0 (2500)

PowerMAX Systems

Patented Modular Power Combining

Pure Parallel Redundant Systems

Extremely High Linear Output Power Capability

Field Scalable

True RF Output Power Detection

Simplified "Single" Chassis Operation via Local or Remote Control

Gallium Nitride SSPA Modules



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Modular amplifier systems have been in use in Satcom systems for almost 20 years. These systems offer tremendous reliability advantages over traditional SSPAs and TWTAs. The maintainability advantage of hot swap modules is critical in remote Satcom amplifier installations. **Teledyne Paradise Datacom's** premiere modular SSPA system is the **PowerMAX**. The **PowerMAX** is a patented modular microwave amplifier system that can be arranged with a variety of RF amplifier modules ranging from two to sixteen.

The **PowerMAX** architecture is based on the (n+1) redundancy philosophy where the amplifier should be sized such that one module failure can be tolerated and the system will still be able to maintain full specified output power.

Teledyne Paradise Datacom takes the (n+1) philosophy to a new level of high reliability. Many modular amplifier systems only provide redundancy of the RF amplifier modules. The **PowerMAX** architecture provides total parallel system reliability right down to the embedded controller in each RF module. Every aspect of the system is parallel redundant including: RF amplifier modules, power supply modules, cooling fans, and monitor & control cards.

The **PowerMAX** architecture is now available with Gallium Nitride, GaN, RF device technology. **Teledyne Paradise Datacom** has been at the forefront of adoption of GaN technology. GaN microwave amplifiers have been in production for nearly 10 years¹. GaN technology enables modular SSPA systems to achieve extremely high linear power levels with efficiencies that meet or exceed efficiency that was previously achievable only with TWTAs technology^{2,3}.

Extremely efficient microwave power combining structures are at the heart of the **PowerMAX** system. State-of-the-Art 3D electromagnetic modeling and simulation enable **PowerMAX** systems to achieve very low loss RF power combining. The design of these combiners make it very easy to reconfigure systems in the field. This allows easy upgrade of four module systems to eight or sixteen module systems.

Another 'industry first' that has been introduced by **Teledyne Paradise Datacom** in the **PowerMAX** system is the use of true RF output power detection. This allows the system to measure and report the RF output power of the system with near power meter accuracy. This accuracy is maintained in the presence of multiple carriers and independent of modulation types.

The **PowerMAX** system is also extremely easy to operate. A single-point of control is maintained via the system's sophisticated embedded controller design. A master-slave hierarchy is maintained which allows the operator to interface with the multi-module system as if it were a single box amplifier. This ease of interface is realized with both local front panel control or by remote control. Remote control is facilitated by either RS485 or Ethernet.

PowerMAX systems utilizing present production amplifier modules are able to achieve saturated output power levels up to 10 kW in C and X Band. Ku Band systems are available with saturated output power levels up to 6 kW. In all GaN based **PowerMAX** systems, the linear output power is 3 dB below the saturated output power level.

The GaN **PowerMAX** architecture delivers the best of all worlds for the Satcom amplifier system:

- Extremely High Linear Power Levels
- High Efficiency relative to High Power Microwave Amplifiers
- Very High Reliability and Maintainability
- Ease of Operation and Maintenance

¹ Turner, S.D. and Turner, C.J., "High Efficiency, Broadband GaN Amplifier for Amateur Radio", Proceedings of the 2007 AMSAT-North America Space Symposium, pp 155-168, Oct. 2007

² Turner, Stephen and Dekker, Tom, "SSPA Technology Achieves 10kW CW at S-Band", Microwave Journal, pp 1152-156, Oct. 2012

³ Turner, Stephen, "Solid State High Power Amplifier Technology for the 21st Century", IEEE International Microwave Symposium — Workshop on SSPA and TWTAs Technology Comparisons, Seattle, WA. June 2013.

For additional details and quotations, contact the **Teledyne Paradise Datacom** sales department at (814) 238-3450 or sales@paradisedata.com.

Specifications are subject to change without notice. PowerMAX is covered by U.S. Patent Nos. 8,189,338 B2 and 8,411,447 B2.

4-Module C-Band Systems				
SSPA Module Power Level	4-Module RF Output Power		3-Module Redundant RF Output Power	
	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)
50 W	52.5 (178)	49.5 (90)	50.1 (102)	47.0 (50)
100 W	55.5 (355)	52.5 (178)	53.1 (204)	50.1 (102)
150 W	57.3 (537)	54.3 (269)	54.9 (309)	51.9 (155)
200 W	58.5 (700)	55.5 (355)	56.0 (400)	53.0 (200)
300 W	60.0 (1000)	57.0 (500)	57.8 (620)	54.8 (300)
400 W	61.5 (1413)	58.5 (708)	59.1 (813)	56.1 (407)
650 W	63.6 (2290)	60.6 (1150)	61.2 (1318)	58.2 (661)
800 W	64.5 (2818)	61.5 (1413)	62.1 (1622)	59.1 (813)

4-Module X-Band Systems				
SSPA Module Power Level	4-Module RF Output Power		3-Module Redundant RF Output Power	
	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)
300 W	60.2 (1047)	57.2 (525)	57.8 (603)	54.8 (302)
400 W	61.4 (1393)	58.4 (700)	59.0 (802)	56.0 (400)
650 W	63.5 (2259)	60.5 (1132)	61.1 (1300)	58.1 (652)
800 W	64.4 (2780)	61.4 (1393)	62.0 (1600)	59.0 (800)

4-Module Ku-Band Systems				
SSPA Module Power Level	4-Module RF Output Power		3-Module Redundant RF Output Power	
	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)	P _{sat} (typical) dBm (W)	P _{linear} (min.) dBm (W)
50 W	52.3 (170)	49.3 (85)	50.0 (100)	47.0 (50)
80 W	54.3 (270)	51.3 (135)	51.9 (155)	48.9 (78)
100 W	55.3 (339)	52.3 (170)	52.9 (195)	50.0 (100)
150 W	57.1 (513)	54.1 (257)	54.7 (295)	51.7 (148)
200 W	58.3 (676)	55.3 (339)	56.0 (400)	53.0 (200)
300 W	60.1 (1023)	57.1 (513)	57.7 (589)	54.7 (295)
400 W	61.3 (1350)	58.3 (676)	58.9 (776)	55.9 (389)
500 W	62.3 (1700)	59.3 (850)	60.0 (1000)	57.0 (500)