



7RU SSPA Chassis

DESCRIPTION

Teledyne Paradise Datacom's 7RU Indoor, High Power Rack Mount series of SSPAs represent the industry's highest power density and most reliable high power amplifier systems.

The High Power Rack Mount SSPA employs a modular design, which allows quick and easy replacement in the event of a catastrophic failure of one of the SSPA components. These modular assemblies include: hot-swap SSPA modules, front and rear fan trays; and a rear panel controller card. These amplifiers are powered via a separate power supply chassis.

The power supply is configured as a n+1 redundant, hot swappable, power supply comprised of up to four modules. The power supply is configured such that one module is redundant. In the event of a single power supply module failure, the HPA system will not fail. The power supply module can then be changed without ever taking the HPA out of service.

FEATURES

- Extremely High Power Density:
to 1.5 kW C-Band;
to 1.2 kW X-Band;
to 1.0 kW Ku-Band.
- Hot Swap, n+1 Redundant Power Supply
- Power Factor Corrected Power Supply
- Modular (soft-fail) Architecture
- Removable fan assemblies
- Ethernet Port
- RF Output Sample Port
- Built-in 1:1 Redundancy Control
- Built-in Maintenance Switch Controller

OPTIONS

- Extended Frequency Band
- L-Band Input
- Reflected Power Monitor
- Phase Combined Systems
- Remote Control Panel
- RF Input Sample Port
- Rear Panel Air Intake and Exhaust
- Waveguide Arc Protection Kit

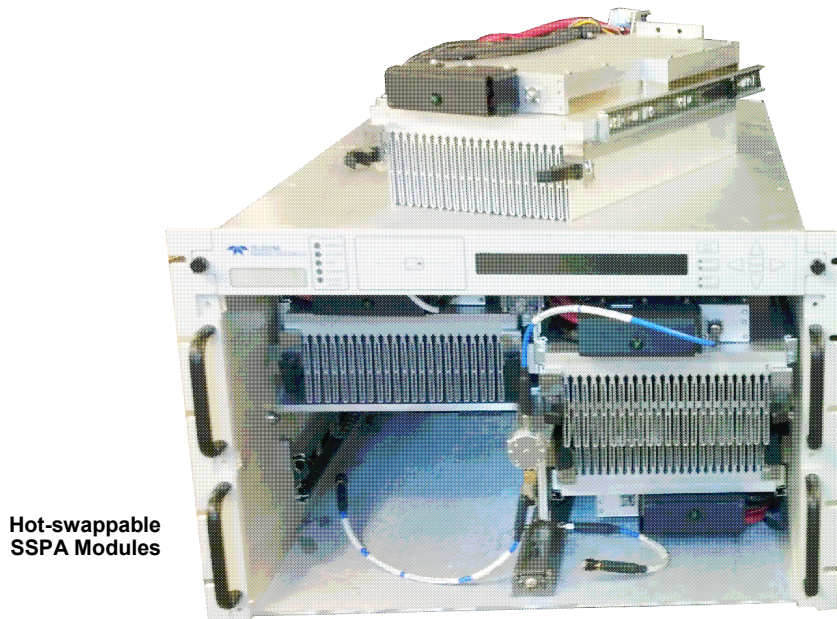
SPECIFICATIONS

- SSPA Chassis housing:
7 Rack Units (RU)
19.0 X 12.22 X 30.0 in
483 X 310 X 762 mm
180 lbs / 82 kg
- 1RU Power Supply:
19.0 X 1.75 X 16.1 in
483 X 44 X 409 mm
29 lbs / 13 kg
- Gray powder coat finish
- Operating temperature:
0 to +50 °C

Modular Design

The 7RU Rack Mountable SSPA features a modular design which makes it easy to maintain.

Four SSPA modules are phase combined inside the 7RU Rack Mountable SSPA to produce the amplifier's total output power. Each of the SSPA modules is hot-swappable, allowing the unit to remain in service while a failed SSPA module is replaced.



Hot-swappable
SSPA Modules

Front and rear fan assemblies are also field replaceable without taking the amplifier offline. The ability to remove the fan trays makes it easy to perform regular inspection and cleaning of the heatsink fins.



Field Replaceable
Fan Assemblies

In addition, the Monitor and Control circuit card assembly and front display panel may be replaced while the amplifier is operating.

Specifications, C-Band SSPAs

PARAMETER	NOTES	LIMITS	UNITS
Frequency Range	Frequency selection "L" Frequency selection "H" ² Frequency selection "C" ² Frequency selection "A" Frequency selection "B" ² Frequency selection "E" Frequency selection "F"	4.400 to 5.000 5.715 to 5.790 5.750 to 6.670 5.850 to 6.425 5.850 to 6.725 6.425 to 6.725 6.725 to 7.025	GHz GHz GHz GHz GHz GHz GHz
Output Power @: Saturation/ P_{Linear}^1 (Typical/Guaranteed minimum)	HPAC711KARXXXXPG HPAC715KARXXXXPG HPAC717KARXXXXPG	P_{sat} / P_{Linear} 60.4 (1100) / 57.4 (550) 61.8 (1500) / 58.8 (750) 62.4 (1700) / 59.4 (870)	dBm (W) dBm (W) dBm (W)
Power Requirements Line Frequency Line Power (Voltage) (typical @ 220 VAC)	power factor corrected HPAC711KARXXXXPG HPAC715KARXXXXPG HPAC717KARXXXXPG	47 to 63 6000 / 5200 (180 to 265) 7200 / 6400 (180 to 265) 9200 / 6800 (180 to 265)	Hz W (VAC) W (VAC) W (VAC)
Receive Band Noise Power Density	without filter	-155	dBW / 4 kHz

Specifications, X-Band SSPAs

PARAMETER	NOTES	LIMITS	UNITS
Frequency Range	Frequency selection "F" Frequency selection "D" Frequency selection "A"	7.10 to 7.40 7.70 to 8.40 7.90 to 8.40	GHz GHz GHz
Output Power @: Saturation/ P_{Linear}^1 (Typical/Guaranteed minimum)	HPAX710KARXXXXPG HPAX712KARXXXXPG	P_{sat} / P_{Linear} 60.0 (1000) / 57.0 (500) 61.0 (1280) / 58.0 (638)	dBm (W) dBm (W)
Power Requirements Line Frequency Line Power (Voltage) (typical @ 220 VAC)	power factor corrected HPAX710KARXXXXPG HPAX712KARXXXXPG	47 to 63 5200 / 4000 (180 to 265) 6400 / 5200 (180 to 265)	Hz W (VAC) W (VAC)
Receive Band Noise Power Density	without optional filter with optional filter	-85 -155	dBW / 4 kHz dBW / 4 kHz

Specifications, Ku-Band SSPAs

PARAMETER	NOTES	LIMITS	UNITS
Frequency Range	Frequency selection "F" Frequency selection "B" Frequency selection "A" Frequency selection "C" Frequency selection "D"	12.75 to 13.25 13.75 to 14.50 14.00 to 14.50 14.50 to 14.70 15.10 to 15.40	GHz GHz GHz GHz GHz
Output Power @: Saturation/ P_{Linear}^1 (Typical/Guaranteed minimum)	HPAK7500ARXXXXPG HPAK7700ARXXXXPG HPAK7800ARXXXXPG HPAK710KARXXXXPG	P_{sat} / P_{Linear} 57.1 (513) / 54.1 (257) 58.5 (700) / 55.5 (350) 59.1 (812) / 56.1 (407) 60.1 (1023) / 57.1 (513)	dBm (W) dBm (W) dBm (W) dBm (W)
Power Requirements Line Frequency Line Power (Voltage) (typical @ 220 VAC)	power factor HPAK7500ARXXXXPG HPAK7700ARXXXXPG HPAK7800ARXXXXPG HPAK710KARXXXXPG	.98 47 to 63 4000 / 3400 (180 to 265) 4800 / 3680 (180 to 265) 6000 / 4000 (180 to 265) 6400 / 5000 (180 to 265)	Hz W (VAC) W (VAC) W (VAC) W (VAC)
Receive Band Noise Power Density ³		-155	dBW / 4 kHz

Note 1: P_{Linear} = maximum output power at which third order intermodulation products < -25 dBc (for two tones separated by 5 MHz) or spectral regrowth on a single QPSK at 1.5 x symbol rate or OQPSK at 1.0 x symbol rate is < -30 dBc.

Note 2: Output power decreases over the extended portion of the frequency range. Both P_{sat} and P_{Linear} de-rate by 1 dB from 5.85 to 5.75 GHz and from 6.425 to 6.725 GHz.

Note 3: All Ku-Band SSPAs are fitted with a receive band reject bulkhead filter, standard. An optional pressure window is available.

Common Electrical Specifications

PARAMETER	NOTES	LIMITS	UNITS
Gain	range	55-75	dB
Gain Flatness	full band	± 1.0	dB
	full band (Extended C-Band)	± 1.5	dB
Gain Slope	per 40 MHz	± 0.3	dB/40 MHz
Gain Variation vs. Temperature	0 °C to +50 °C	± 1.0	dB
Gain Stability	at constant temperature	± 0.25	dB/24 hours
Gain Adjustment	0.1 dB resolution	20	dB
Intermodulation Distortion (Two-tone, 5 MHz spacing)	At P_{Linear} ($P_{sat} - 3$ dB)	-25	dBc
AM/PM Conversion	@ rated P_{Linear}	≤ 1.0	°/dB
Spurious Harmonics (SSPA only)	@ rated P_{Linear}	-65	dBc
	@ rated P_{Linear}	-50	dBc
Input/Output VSWR	All except Extended C-Band	1.30:1	
	Extended C-Band	1.50:1	
Noise Figure	at maximum gain	10	dB
Group Delay (per 40 MHz segment)	Linear	0.01	ns/MHz
	Parabolic	0.003	ns/MHz ²
	Ripple	1.0	ns p-p
Transmit Band Noise Output Power Density	TX Band	-75	dBW/4 KHz
Residual AM Noise, typical	Offset frequency from carrier		
	1 Hz	-110	dBc/Hz
	10 Hz	-120	dBc/Hz
	100 Hz	-130	dBc/Hz
	1 KHz	-135	dBc/Hz
	10 KHz	-140	dBc/Hz
	100 KHz	-140	dBc/Hz
	1 MHz	-140	dBc/Hz
Residual Phase Noise, typical (SSPA only)	Offset frequency from carrier		
	10 Hz	-90	dBc/Hz
	100 Hz	-100	dBc/Hz
	1 KHz	-110	dBc/Hz
	10 KHz	-120	dBc/Hz
	100 KHz	-125	dBc/Hz
	1 MHz	-130	dBc/Hz
True RF Power Detector	Range Accuracy	P_{sat} to ($P_{sat} - 20$) ± 0.75	dB dBm

Specifications are subject to change without notice.

L-Band Operation

Teledyne Paradise Datacom amplifiers are available with an integrated L-Band Block Up Converter. L-Band units utilize Teledyne Paradise Datacom's proprietary zBUC technology. The addition of a zBUC[®] converter to the SSPA typically increases the gain by 2-4 dB. The advantages of zBUC technology include:

- zBUC converter can detect and switch to an externally supplied reference.
- Optional internal high stability (10MHz) reference.
- zBUC converter can lock to an externally supplied reference of 10 or 50 MHz.
- zBUC converter can accept a wide range of external reference power (-10 to +5 dBm).

Table 6-1: zBUC Converter Frequency Specifications

Band	Frequency Plan*	IF Input	LO Frequency	RF Output
C	Sub-Band "A"	950 - 1525 MHz	4.900 GHz	5.850 - 6.425 GHz
C	Sub-Band "B"	950 - 1825 MHz	4.900 GHz	5.850 - 6.725 GHz
C	Sub-Band "C"	950 - 1870 MHz	4.800 GHz	5.750 - 6.670 GHz
C	Sub-Band "E"	950 - 1250 MHz	5.475 GHz	6.425 - 6.725 GHz
C	Sub-Band "F"	950 - 1250 MHz	5.775 GHz	6.725 - 7.025 GHz
C	Sub-Band "L"	950 - 1550 MHz	3.450 GHz	4.400 - 5.000 GHz
X	Sub-Band "A"	950 - 1450 MHz	6.950 GHz	7.900 - 8.400 GHz
Ku	Sub-Band "A"	950 - 1450 MHz	13.050 GHz	14.00 - 14.50 GHz
Ku	Sub-Band "B"	950 - 1700 MHz	12.800 GHz	13.75 - 14.50 GHz
Ku	Sub-Band "F"	950 - 1450 MHz	11.800 GHz	12.75 - 13.25 GHz

Electrical Specifications for 7RU RM SSPA with ZBUC converter

PARAMETER	NOTES	LIMITS				UNITS
Gain	Nominal setting	75				dB
Gain Flatness	full band (C-,X-,Ku-bands)	± 2.0				dB
Gain Slope	per 40 MHz (C-,X-,Ku-bands)	± 0.5				dB/40 MHz
Gain Adjusted Range		20				dB
	Typical C-Band Adj. Range	60 - 80				dB
	Typical Ku-Band Adj. Range	57 - 77				dB
Gain Stability	-40 to +60 °C	± 1.5				dB
Phase Noise	Offset frequency from carrier	<u>Absolute max.</u>	<u>C-band (typ.)</u>	<u>X-band (typ.)</u>	<u>Ku-band (typ.)</u>	
	10 Hz	-30	-60	-58	-56	dBc/Hz
	100 Hz	-60	-74	-70	-67	dBc/Hz
	1 KHz	-70	-84	-80	-78	dBc/Hz
	10 KHz	-80	-100	-94	-91	dBc/Hz
	100 KHz	-90	-105	-97	-94	dBc/Hz
	1 MHz	-90	-125	-122	-120	dBc/Hz
Spurious	In-Band Signal Related (C-/Ku-Band)	-50				dBc
	(Extended C-Band)	-40				dBc
	Close to Carrier Spurious (≤ 20 MHz)	-50				dBc
	Local Oscillator	-30				dBm
Noise Figure	At Maximum gain	20				dB
Transmit Band Noise Output Power Density	Tx Band at Maximum gain	-65				dBW/4kHz
Input VSWR	L-Band	1.5 : 1				
Internal Reference Option	Reference Accuracy (initial)	± 1 • 10 ⁻⁸				
	Aging per day (after 30 days)	± 1 • 10 ⁻⁹				
	Aging per year (after 30 days)	± 6 • 10 ⁻⁸				
	Reference Stability over Temperature (-40 to +40 °C, ambient)	± 1 • 10 ⁻⁸				

Mechanical Specifications

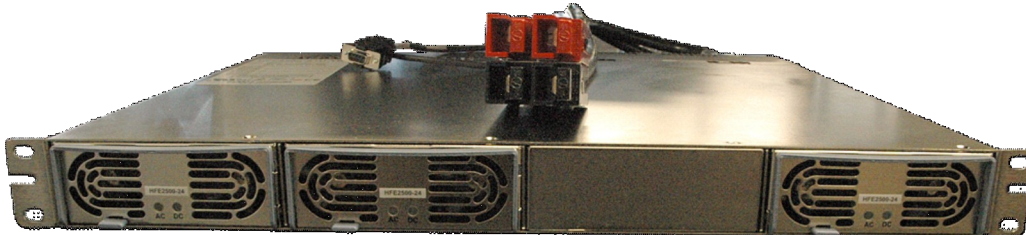
PARAMETER	NOTES	LIMITS	UNITS
Size HPA Chassis	width X height X depth	19.0 X 10.47 X 30.0 483 X 266 X 762	inches mm
Power Supply Chassis	width X height X depth	19.0 X 1.75 X 16.1 483 X 44 X 409	inches mm
RF Output Flanges	C-Band units X-Band units Ku-Band units	CPRG-137 CPRG-112 WR75 (grooved)	
Weight HPA Chassis, typical Power Supply Chassis (1RU)		180 (82) 29 (13)	lbs. (kg) lbs. (kg)
Finish		powder coat	Gray

Environmental Specifications

PARAMETER	NOTES	LIMITS	UNITS
Operating Temperature	Ambient	0 to +50	°C
Storage Temperature	Ambient	-20 to +75	°C
Operating Relative Humidity	Non-condensing	95	%
Storage Relative Humidity	Non-condensing	90	%
Cooling System	Forced Convection Air Cooling	Front Panel - Intake Rear Panel - Exhaust	
Altitude	No temperature de-rating up to 10,000 ft. (3000 m) De-rate maximum temperature by 2 °C per 1,000 ft (300 m) beyond 10,000 ft.		

1RU N+1 Redundant Power Supply

The addition of a separate, fully redundant power supply is an excellent means of obtaining the ultimate system reliability. The power supply is an N+1 redundant configuration, meaning that there is one more power supply module available than is required to operate the SSPA. A failure of one power supply module will not take the amplifier off the air.



In addition, the power supply modules are removable from the front panel while in operation. There is never a need to remove the power supply chassis from the equipment rack.

The power supply has a single phase, universal AC input rating from 180-265 VAC, 46-63 Hz. It is power factor corrected to 0.99.

Redundant and Phase Combined Systems

Teledyne Paradise Datacom's 7RU Rack Mount SSPAs can be configured in a variety of redundant and phase combined configurations.

- 1:1 Redundant System with Internal Redundancy Control
- 1:1 Redundant System with RCP2-1100 Redundant System Controller
- 1:1 Fixed Phase Combined System with FPRC-1100 Phase Combined System Controller
- 1:2 Redundant System with Internal Redundancy Control
- 1:2 Redundant System with RCP2-1200 Redundant System Controller
- 1:2 Fixed Phase Combined System with FPRC-1200 Phase Combined System Controller

System Output Power Capacity

Due to residual losses inherent in redundant system configurations (waveguide bends; switch and coupler losses), reduce the typical output power specification of a single amplifier by approximately 0.2 dB for 1:1 and by 0.4 dB for 1:2 systems.

In phase combined systems, these same losses result in slightly less than the ideal addition of 3 dB to the output power of a single HPA unit. For 1:1 phase combined systems, the typical additive output power is approximately 2.70 dB above the output power of a single HPA. For 1:2 phase combined systems, the typical additive output power is approximately 2.50 dB above the output power of a single HPA.

Actual system losses will vary based on the system options.

System Controllers

The RCP2/FPRC-1100/1200 system controller provides an extremely user friendly interface for complete monitor and control of the amplifier system.



RCP2-1200 Redundant System Controller

The front panel mimic display shows the on-line amplifiers and the switch positions. Fault lights are provided for easy identification of system status. All system monitor and control is available locally at the front panel LCD display, as well as remotely by the RS232, RS485, or Ethernet interface ports. Audible alarms and a full compliment of parallel I/O signal are available at the rear panel of the controller.

Indoor Rack Mount Hot-Swap Modular (7RU GaN) High Power SSPA Chassis

Part Number Configuration Matrix

Power Level (Watts)		Standalone Unit or System Package	
C-Band	1100 (11K), 1500 (15K), 1700 (17K)	R	Standalone amplifier
X-Band	1000 (10K), 1200 (12K)	S	System with Cabinet, Top Mounted Waveguide Switching
Ku-Band	500, 700, 800, 1000 (10K)	T	System without Cabinet, Top Mounted Waveguide Switching
		Y	System with Cabinet, Rear Mounted Waveguide Switching
		Z	System without Cabinet, Rear Mounted Waveguide Switching

Band	Rack Height
C-Band	7RU
X-Band	7
Ku-Band	

Block Up Converter	Configuration Modifier 3
M	Internal Reference BUC
P	External Reference BUC
X	No BUC
	P
	Standard (N+1 Power Supply)
	L
	N+1 P.S. + Rear Exhaust Adapters
¹ Not available with package options Y and Z	

MODEL: HPA **C 7 1 1 K A R M X X X P G**

Frequency Sub Band			
C-Band		X-Band	
A¹	5.850 to 6.425 GHz	A¹	7.90 to 8.40 GHz
B¹	5.850 to 6.725 GHz	D	7.70 to 8.40 GHz
C¹	5.750 to 6.670 GHz	F	7.10 to 7.40 GHz
E¹	6.425 to 6.725 GHz	Ku-Band	
F¹	6.725 to 7.025 GHz	A¹	14.00 to 14.50 GHz
H	5.715 to 5.790 GHz	B¹	13.75 to 14.50 GHz
L¹	4.400 to 5.000 GHz	F¹	12.75 to 13.25 GHz
		G	14.75 to 15.25 GHz

¹ Available with optional BUC

GaN Device Designator	
G	GaN Device

Configuration Modifier 2	
X	Standard
R	Rx Band Reject Filter
V	Reflected Power Monitor
C	V + R (see above)

Configuration Modifier 1	
X	Standard
S	Input Sample Port

Standalone Unit or System Configuration	
X	Standalone amplifier
A¹	1:1 System, Input Switching, Internal Control
B	1:1 System, Input Splitter, Internal Control
C¹	1:2 System, Input Switching, RCP2-1200 ²
D¹	1:2 System, Input Switching, Internal Control
E	1:2 Phase Combined system, Input Splitter, FPRC-1200 ²
F	1:1 System, Input Splitter, RCP2-1100 ²
G	1:1 Phase Combined system, Input Splitter, FPRC-1100 ²
H¹	1:1 System, Input Switching, RCP2-1100 ²
J	1:2 Phase Combined system, Input splitter, Internal Control

¹ Switched input with external reference BUC requires reference distribution box.

² Standard location for controller is directly above HPA1.

Example - A standalone 1100W GaN C-Band 7RU Rack Mount GaN SSPA with standard N+1 external power supply and an optional internal reference block up converter is part number: **HPAC711KARMXXXPG**.

Use and Disclosure of Data

The items described herein are controlled by the U.S. Government and authorized for export only to the country of ultimate destination for use by the ultimate consignee or end-user(s) herein identified. They may not be resold, transferred, or otherwise disposed of, to any other country or to any person other than the authorized ultimate consignee or end-user(s), either in their original form or after being incorporated into other items, without first obtaining approval from the U.S. government or as otherwise authorized by U.S. law and regulations.

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