



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 1.1 kW X-Band;  
to 800W 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

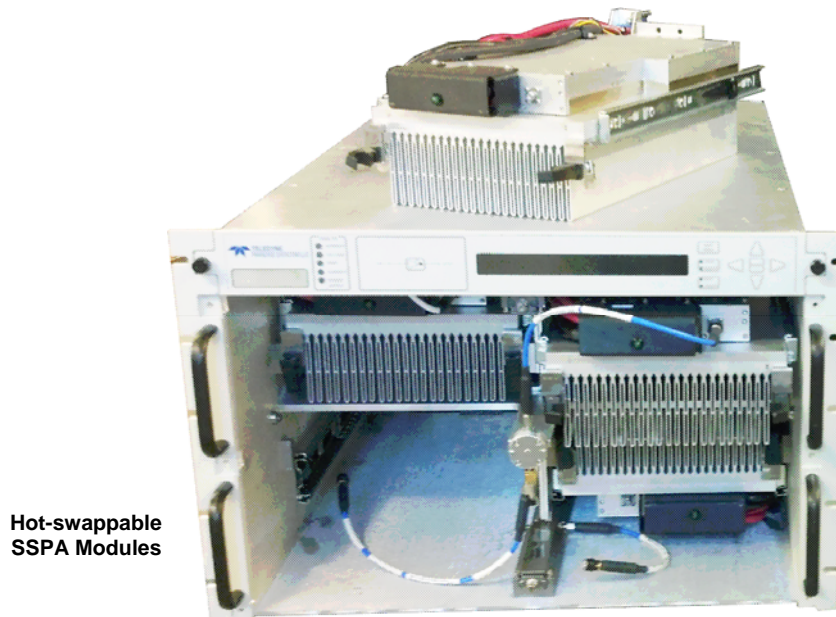
## SPECIFICATIONS

- 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.



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.



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"<br>Frequency selection "H"<br>Frequency selection "C" <sup>2</sup><br>Frequency selection "A"<br>Frequency selection "B" <sup>2</sup><br>Frequency selection "D" | 4.400 to 5.000<br>5.715 to 5.790<br>5.750 to 6.670<br>5.850 to 6.425<br>5.850 to 6.725<br>6.425 to 7.025 | GHz<br>GHz<br>GHz<br>GHz<br>GHz<br>GHz |
| Output Power @: Saturation/ $P_{Linear}^1$<br>(Typical/Guaranteed minimum)          | HPAC711KARXXDXXG<br>HPAC715KARXXDXXG   | $P_{sat} / P_{Linear}$<br>60.4 (1100) / 57.4 (550)<br>61.8 (1500) / 58.8 (750)                           | dBm (W)<br>dBm (W)                     |
| Power Requirements<br>Line Frequency<br>Line Power (Voltage)<br>(typical @ 220 VAC) | power factor corrected<br><br>HPAC711KARXXDXXG<br>HPAC715KARXXDXXG   | <br>47 to 63<br>6000 / 5200 (180 to 265)<br>7200 / 6400 (180 to 265)                                     | <br>Hz<br>W (VAC)<br>W (VAC)           |
| Receive Band Noise Power Density  | without filter   | -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.

### Specifications, X-Band SSPAs

| PARAMETER   | NOTES   | LIMITS   | UNITS                      |
|---|---|--|----------------------------|
| Frequency Range   | Frequency selection "F"<br>Frequency selection "D"<br>Frequency selection "A" | 7.10 to 7.40<br>7.70 to 8.40<br>7.90 to 8.40       | GHz<br>GHz<br>GHz          |
| Output Power @: Saturation/ $P_{Linear}^1$<br>(Typical/Guaranteed minimum)          | HPAX711KARXXDXXG  | $P_{sat} / P_{Linear}$<br>60.4 (1100) / 57.4 (550) | dBm (W)                    |
| Power Requirements<br>Line Frequency<br>Line Power (Voltage)<br>(typical @ 220 VAC) | power factor corrected<br><br>HPAX711KARXXDXXG                                | <br>47 to 63<br>6000 / 5200 (180 to 265)           | <br>Hz<br>W (VAC)          |
| Receive Band Noise Power Density  | without optional filter<br>with optional filter                               | -85<br>-155  | dBW / 4 kHz<br>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.

### Specifications, Ku-Band SSPAs

| PARAMETER   | NOTES   | LIMITS   | UNITS                           |
|---|---|--|---------------------------------|
| Frequency Range   | Frequency selection "F"<br>Frequency selection "B"<br>Frequency selection "A"<br>Frequency selection "C"<br>Frequency selection "D" | 12.75 to 13.25<br>13.75 to 14.50<br>14.00 to 14.50<br>14.50 to 14.70<br>15.10 to 15.40 | GHz<br>GHz<br>GHz<br>GHz<br>GHz |
| Output Power @: Saturation/ $P_{Linear}^1$<br>(Typical/Guaranteed minimum)          | HPAK7500ARXXDXXG<br>HPAK2800ARXXDXXG  | $P_{sat} / P_{Linear}$<br>57.0 (500) / 54.0 (250)<br>59.0 (800) / 56.0 (400)           | dBm (W)<br>dBm (W)              |
| Power Requirements<br>Line Frequency<br>Line Power (Voltage)<br>(typical @ 220 VAC) | power factor<br><br>HPAK7500ARXXDXXG<br>HPAK2800ARXXDXXG  | <br>.98<br>47 to 63<br>6400 / 4400 (180 to 265)<br>8400 / 6000 (180 to 265)            | <br>Hz<br>W (VAC)<br>W (VAC)    |
| Receive Band Noise Power Density <sup>2</sup>                                       |   | -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:** All Ku-Band SSPAs are fitted with a receive band reject bulkhead filter, standard. An optional pressure window is available.

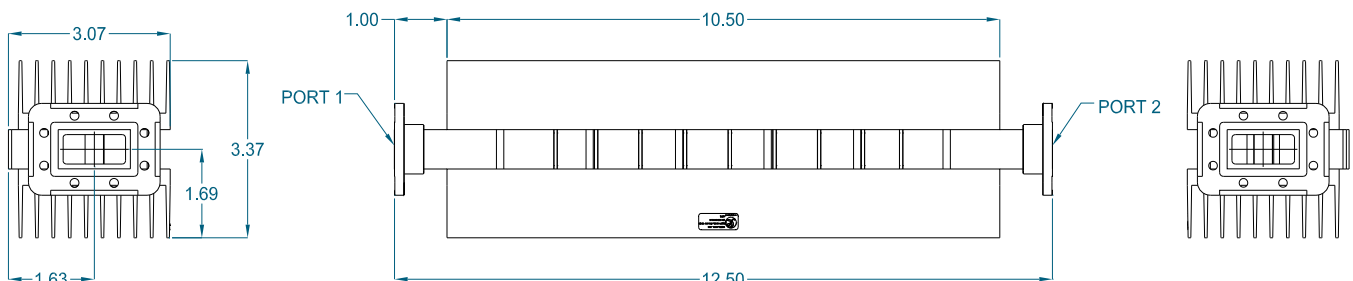
### Common Electrical Specifications

| 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<br>(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<br>(per 40 MHz segment)                     | Linear                              | 0.01                            | ns/MHz              |
|   | Parabolic                           | 0.003                           | ns/MHz <sup>2</sup> |
|   | Ripple                              | 1.0                             | ns p-p              |
| Transmit Band Noise<br>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<br>(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                               | $P_{sat}$ to ( $P_{sat} - 20$ ) | dB                  |
|   | Accuracy                            | ± 0.75                          | dBm                 |

Specifications are subject to change without notice.

### Receive Band Filter Option

X-Band amplifiers may be ordered with an external receive band reject filter.



### 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).

### Available Frequency Plans

| Band | Frequency Band    | IF Input       | LO Frequency | RF Output         | Gain Change |
|------|-------------------|----------------|--------------|-------------------|-------------|
| C    | Standard C-Band   | 950 - 1525 MHz | 4.900 GHz    | 5.850 - 6.425 GHz | 0-4 dB      |
| C    | Extended C-Band   | 950 - 1825 MHz | 4.900 GHz    | 5.850 - 6.725 GHz | 0-4 dB      |
| C    | Palapa Band       | 950 - 1250 MHz | 5.475 GHz    | 6.425 - 6.725 GHz | 0-4 dB      |
| C    | Insat Band        | 950 - 1250 MHz | 5.775 GHz    | 6.725 - 7.025 GHz | 0-4 dB      |
| C    | Extended C-Band 2 | 950 - 1675 MHz | 4.800 GHz    | 5.750 - 6.475 GHz | 0-4 dB      |
| C    | Low C-Band        | 840 - 1000 MHz | 4.250 GHz    | 5.090 - 5.250 GHz | 0-4 dB      |
| X    | Standard X-Band   | 950 - 1450 MHz | 6.950 GHz    | 7.900 - 8.400 GHz | 0-2 dB      |
| Ku   | Standard Ku-Band  | 950 - 1450 MHz | 13.050 GHz   | 14.00 - 14.50 GHz | 0-2 dB      |
| Ku   | Extended Ku-Band  | 950 - 1700 MHz | 12.800 GHz   | 13.75 - 14.50 GHz | 0-2 dB      |

### 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)<br>(Extended C-Band)      | -50                    |                      |                      |                       | dBc       |
|                           | Close to Carrier Spurious (≤ 20 MHz)                          | -40                    |                      |                      |                       | dBc       |
|                           | Local Oscillator  | -50                    |                      |                      |                       | dBc       |
|                           |   | -30                    |                      |                      |                       | dBm       |
| Noise Figure              | At 75 dB gain setting   | 20                     |                      |                      |                       | dB        |
| Input VSWR                | L-Band  | 1.5 : 1                |                      |                      |                       |           |
| Internal Reference Option | Reference Accuracy (initial)                                  | ± 1 • 10 <sup>-8</sup> |                      |                      |                       |           |
|                           | Aging per day (after 30 days)                                 | ± 1 • 10 <sup>-9</sup> |                      |                      |                       |           |
|                           | Aging per year (after 30 days)                                | ± 6 • 10 <sup>-8</sup> |                      |                      |                       |           |
|                           | Reference Stability over Temperature (-40 to +40 °C, ambient) | ± 1 • 10 <sup>-8</sup> |                      |                      |                       |           |

## Mechanical Specifications

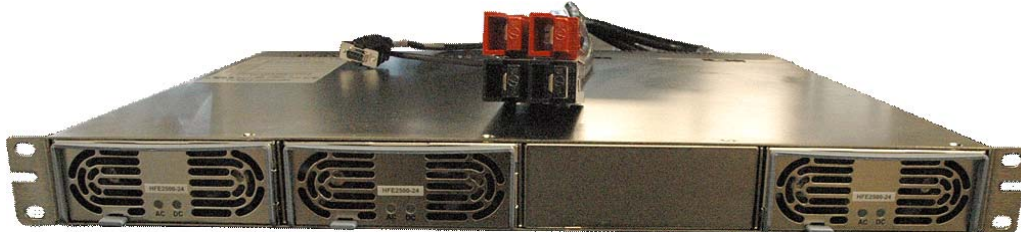
| PARAMETER   | NOTES                  | LIMITS                                 | UNITS                  |
|---|------------------------|--|------------------------|
| Size<br>HPA Chassis                                 | width X height X depth | 19.0 X 10.47 X 30.0<br>483 X 266 X 762 | inches<br>mm           |
| Power Supply Chassis                                | width X height X depth | 19.0 X 1.75 X 16.1<br>483 X 44 X 409   | inches<br>mm           |
| Weight<br>HPA Chassis<br>Power Supply Chassis (1RU) |                        | 180 (82)<br>29 (13)                    | lbs. (kg)<br>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<br>Rear Panel - Exhaust |       |
| Altitude                    | No temperature de-rating up to 10,000 ft. (3000 m)<br>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. Depending on the power requirements of the SSPA module, the power supply chassis is populated with two, three or four 2500W hot-swappable modules. 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

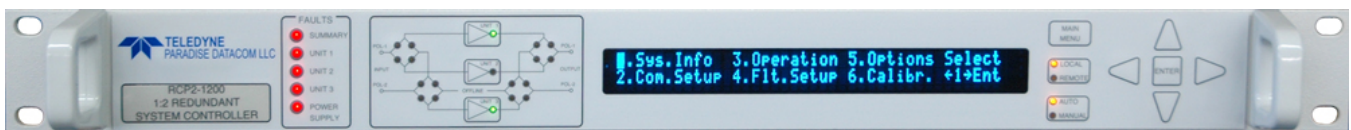
Due to residual losses inherent in redundant system configurations (waveguide bends; switch and coupler losses), reduce the typical output power specification of a single amplifier by approximately 0.2 dB for 1:1 and by 0.4 dB for 1:2 systems.

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.

## Part Number Configuration Matrix

| Power Level (Watts) |                        | Standalone Unit or System Package |  |
|---------------------|------------------------|-----------------------------------|--|
| C-Band              | 1100 (11K), 1500 (15K) | <b>R</b>                          | Standalone amplifier                                     |
| X-Band              | 1100 (11K)             | <b>S</b>                          | System with Cabinet, Top Mounted Waveguide Switching     |
| Ku-Band             | 500, 800               | <b>T</b>                          | System without Cabinet, Top Mounted Waveguide Switching  |
|                     |                        | <b>Y</b>                          | System with Cabinet, Rear Mounted Waveguide Switching    |
|                     |                        | <b>Z</b>                          | System without Cabinet, Rear Mounted Waveguide Switching |

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

| Block Up Converter |                        |
|--------------------|------------------------|
| <b>M</b>           | Internal Reference BUC |
| <b>P</b>           | External Reference BUC |
| <b>X</b>           | No BUC                 |

| Configuration Modifier 3                                |                                  |
|---|----------------------------------|
| <b>P</b>  | Standard (N+1 Power Supply)      |
| <b>L</b>  | N+1 P.S. + Rear Exhaust Adapters |
| <sup>1</sup> 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                |                    |
| <b>A</b> <sup>1</sup> | 5.850 to 6.425 GHz | <b>A</b> <sup>1</sup> | 7.90 to 8.40 GHz   |
| <b>B</b> <sup>1</sup> | 5.850 to 6.725 GHz | <b>D</b>              | 7.70 to 8.40 GHz   |
| <b>C</b>              | 5.750 to 6.670 GHz | <b>F</b>              | 7.10 to 7.40 GHz   |
| <b>D</b> <sup>1</sup> | 6.425 to 7.025 GHz | Ku-Band               |                    |
| <b>H</b>              | 5.715 to 5.790 GHz | <b>A</b> <sup>1</sup> | 14.00 to 14.50 GHz |
| <b>L</b>              | 4.400 to 5.000 GHz | <b>B</b> <sup>1</sup> | 13.75 to 14.50 GHz |
|                       |                    | <b>F</b> <sup>1</sup> | 12.75 to 13.25 GHz |
|                       |                    | <b>G</b> <sup>1</sup> | 14.75 to 15.25 GHz |

<sup>1</sup> Available with optional BUC

| GaN Device Designator |            |
|-----------------------|------------|
| <b>G</b>              | GaN Device |

| Configuration Modifier 2       |                         |
|--------------------------------|-------------------------|
| <b>X</b>                       | Standard                |
| <b>R</b> <sup>1</sup>          | Rx Band Reject Filter   |
| <b>V</b>                       | Reflected Power Monitor |
| <sup>1</sup> X-Band units only |                         |

| Configuration Modifier 1 |                   |
|--------------------------|-------------------|
| <b>X</b>                 | Standard          |
| <b>S</b>                 | Input Sample Port |

| Standalone Unit or System Configuration |   |
|---|---|
| <b>X</b>                                | Standalone amplifier  |
| <b>A</b> <sup>1</sup>                   | 1:1 System, Input Switching, Internal Control                     |
| <b>B</b>                                | 1:1 System, Input Splitter, Internal Control                      |
| <b>C</b> <sup>1</sup>                   | 1:2 System, Input Switching, RCP2-1200 <sup>2</sup>               |
| <b>D</b> <sup>1</sup>                   | 1:2 System, Input Switching, Internal Control                     |
| <b>E</b>                                | 1:2 Phase Combined System, Input Splitter, FPRC-1200 <sup>2</sup> |
| <b>F</b>                                | 1:1 System, Input Splitter, RCP2-1100 <sup>2</sup>                |
| <b>G</b>                                | 1:1 Phase Combined system, Input Splitter, FPRC-1100 <sup>2</sup> |
| <b>H</b> <sup>1</sup>                   | 1:1 System, Input Switching, RCP2-1100 <sup>2</sup>               |
| <b>J</b>                                | 1:2 Phase Combined system, Input splitter, Internal Control       |

<sup>1</sup> Switched input with external reference BUC requires reference distribution box.  
<sup>2</sup> 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.

Specifications are subject to change without notice.