



**1.1 kW C-Band,  
 1:1 Indoor Rack Mount**



**600W C-Band,  
 1:2 Indoor Rack Mount  
 Phase Combined System**

## DESCRIPTION

Teledyne Paradise Datacom's family of indoor packaged, phase combined solid state power amplifier (SSPA) systems provide the highest degree of redundancy and system reliability. Phase Combined systems can be configured using any combination of Teledyne Paradise Datacom's Indoor Packaged amplifiers.

1:1 Phase Combined Systems are an economical solution to providing high output power capability with the addition of soft-fail redundancy.

1:2 Phase Combined Systems can provide full output power redundancy to mission critical applications which cannot tolerate any decrease in output power capability.

## FEATURES

- Extremely High Power Density:
  - To 1.1 kW C-Band
  - To 1.0 kW X-Band
  - To 500 W Ku-Band
- True Redundant Chassis Architecture
- Universal Power Factor Corrected Power Supply
- System Output Power Monitor
- 1RU FPRC-1100 / FPRC-1200 System Controller

## OPTIONS

- Reflected Power Monitor
- L-Band Input operation
- SSPA and Controller Remote Panels
- Auxiliary / Maintenance Output Switch
- Cold Standby Amplifier Operation for Prime Power Savings
- External Exhaust Air Ducting Kit
- Custom Configurations

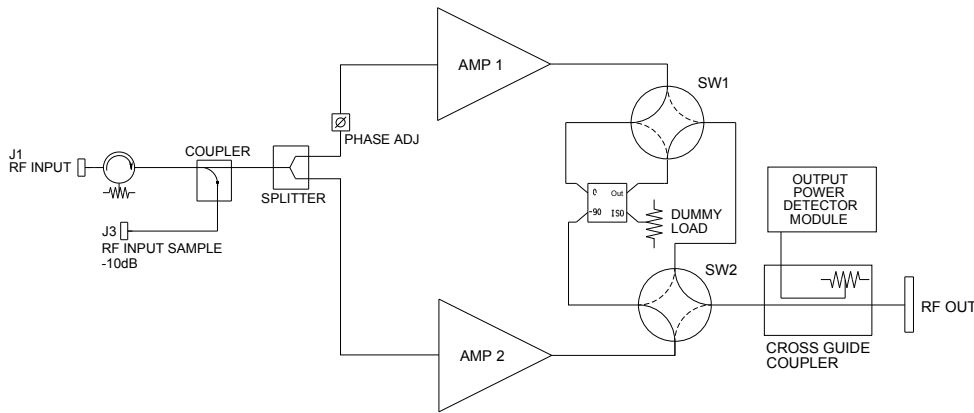
## SPECIFICATIONS

- 3 RU SSPA Chassis:
  - 19.0 X 5.22 X 24.13
  - 66 lbs (30 kg)
- 4 RU SSPA Chassis:
  - 19.0 X 7.0 X 28.0
  - 75 lbs (34 kg) ≤ 250W
  - 100 lbs (45 kg) >250W
- 6 RU SSPA Chassis:
  - 19.0 X 10.47 X 30.0
  - 180 lbs (82 kg)
- 7 RU SSPA Chassis:
  - 19.0 X 12.22 X 30.0
  - 180 lbs (82 kg)

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### 1:1 Phase Combined / Redundant System

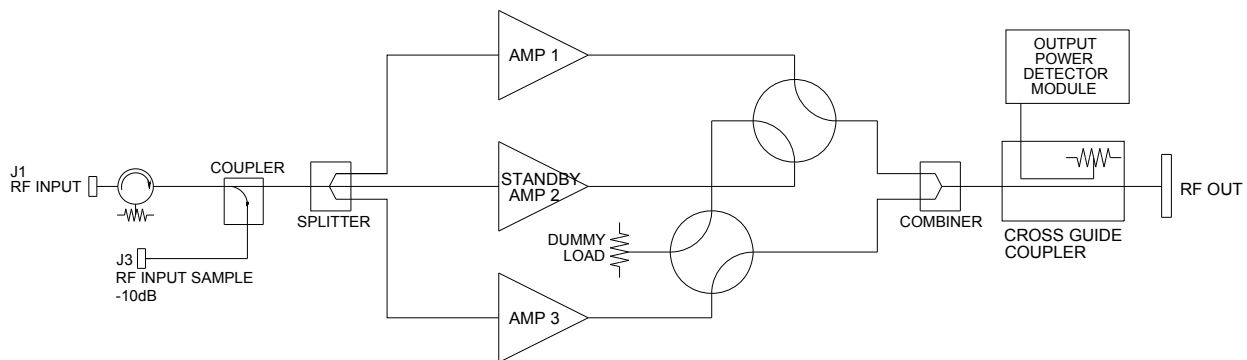
The 1:1 Fixed Phase Combined Redundant System is a popular system architecture that enables two Solid State Power Amplifiers to operate as a normal 1:1 redundant system or a phase combined system. The basic system topology is very similar to a 1:1 redundant system and is shown in the block diagram. An additional switch is included which allows either amplifier to be individually connected to the antenna or connect both amplifiers to a waveguide combiner. The system includes an integrated input sample port along with system level output power detection.



1:1 Phase Combined System Simplified Block Diagram

### 1:2 Phase Combined / Redundant System

The 1:2 Phase Combined Redundant System is a system architecture that enables Solid State Power Amplifiers to achieve higher output power levels while building in a level of redundancy. The basic system topology is similar to a 1:2 redundant system shown in the block diagram below. Amplifiers #1 and #3 are normally online. The outputs of #1 and #3 are directed by the waveguide switches into a low loss power combiner. In the event of a failure of either on line amplifier, the standby amplifier, #2, can be switched in place of either #1 or #3 and the system maintains **full output power**. The system includes an integrated input sample port along with system level output power detection.



1:2 Phase Combined System Simplified Block Diagram



**Single 3RU Chassis  
 Output Power Levels**

C Band: 25W - 300W  
 X Band: 60W - 200W  
 Ku Band: 10W - 150W



**Single 4RU Chassis  
 Output Power Levels**

C Band: 50W - 600W  
 X Band: 50W - 500W  
 Ku Band: 35W - 250W



**Single 6RU Chassis  
 Output Power Levels**

C Band: 800W - 1.1 kW  
 X Band: 700W - 1.0 kW  
 Ku Band: 400W - 500W



**Single 7RU Chassis  
 Output Power Levels**

C Band: 800W - 1.1 kW  
 X Band: 700W - 1.0 kW  
 Ku Band: 250W - 500W

### System Output Power Capacity

Due to the output waveguide and switches, there is always some residual loss in the output of phase combined HPA systems. This results in slightly less than the ideal 3 dB power addition to the output power of a single HPA unit.

On 1:1 phase combined systems, the typical additive output power is 2.70 dB above the output power of a single HPA. On 1:2 phase combined systems, the typical additive output power is 2.50 dB above the output power of a single HPA.

For example, a 125W Ku-Band Compact Outdoor SSPA in a 1:1 phase combined system would have the following output power:

Single HPA:  $P_{1dB} = 50.0 \text{ dBm}$ ;  $P_{sat} = 51.0 \text{ dBm}$

1:1 phase combined system:  $P_{1dB} = 52.7 \text{ dBm}$ ;  $P_{sat} = 53.7 \text{ dBm}$

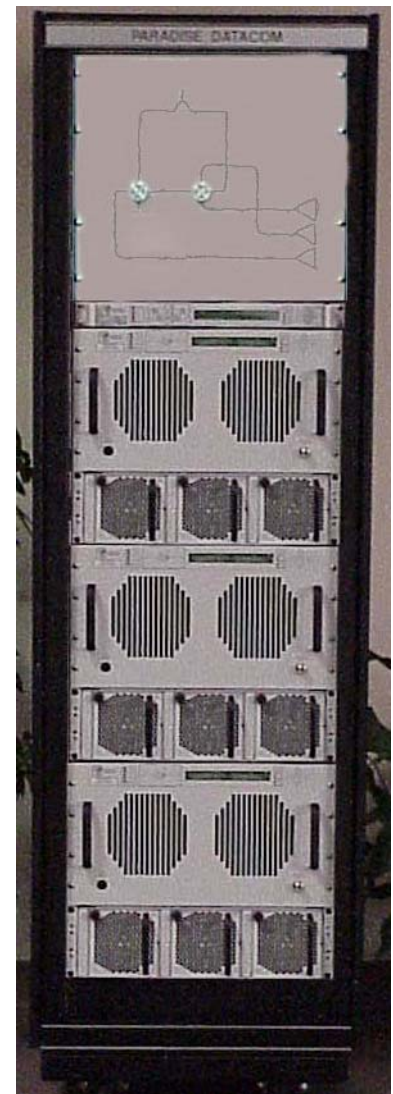


◀ **400W C-Band (4RU)  
1:1 Phase Combined System**



◀ **300W C-Band (3RU)  
1:1 Phase Combined System**

**2kW C-Band, 1:2 Phase Combined SSPA System ▶**



### General System Specifications

| PARAMETER                           | NOTES   | LIMITS                           | UNITS                                   |
|-------------------------------------|---|----------------------------------|---|
| Gain                                | minimum<br>minimum (units with L-Band input)                    | 70<br>67                         | dB<br>dB                                |
| Gain Flatness                       | full band (All except Extended C-Band)<br>Extended C-Band units | $\pm 1.0$<br>$\pm 1.5$           | dB<br>dB                                |
| Gain Slope                          | per 40 MHz  | $\pm 0.3$                        | dB/40 MHz                               |
| Gain Variation vs. Temperature      | 0°C to +50°C  | $\pm 1.0$                        | dB                                      |
| Gain Stability                      | at constant temperature   | $\pm 0.25$                       | dB/24 hours                             |
| Gain Adjustment                     | 0.1 dB resolution   | 20                               | dB                                      |
| Intermodulation Distortion          | 3dB back off relative to P <sub>1dB</sub>                       | -25                              | dBc                                     |
| AM/PM Conversion                    | (@ rated P <sub>1dB</sub> )<br>(@ P <sub>1dB</sub> - 3dB)       | 3.5<br>0.5                       | °/dB<br>°/dB                            |
| Spurious Harmonics                  | (@ rated P <sub>1dB</sub> )<br>(@ rated P <sub>1dB</sub> - 3dB) | -65<br>-50                       | dBc<br>dBc                              |
| Input/Output VSWR                   |   | 1.50:1                           |   |
| Noise Figure                        | at maximum gain   | 12                               | dB                                      |
| Group Delay<br>(per 40 MHz segment) | Linear<br>Parabolic<br>Ripple                                   | 0.01<br>0.003<br>1.0             | ns/MHz<br>ns/MHz <sup>2</sup><br>ns p-p |
| Noise Output                        | TX Band<br>RX Band (C-, Ku-Bands)<br>RX Band (X-Band)           | -75<br>- 150<br>- 100            | dBW/4 KHz<br>dBW/4 KHz<br>dBW/4 KHz     |
| Residual AM Noise                   | 0 - 10 KHz<br>10 KHz - 500 KHz<br>500 KHz - 1 MHz               | -45<br>-20 (1.25 + log F)<br>-80 | dBc<br>dBc<br>dBc                       |
| Phase Noise                         |   | IESS -308/309 - 10 dB            |   |

### Mechanical

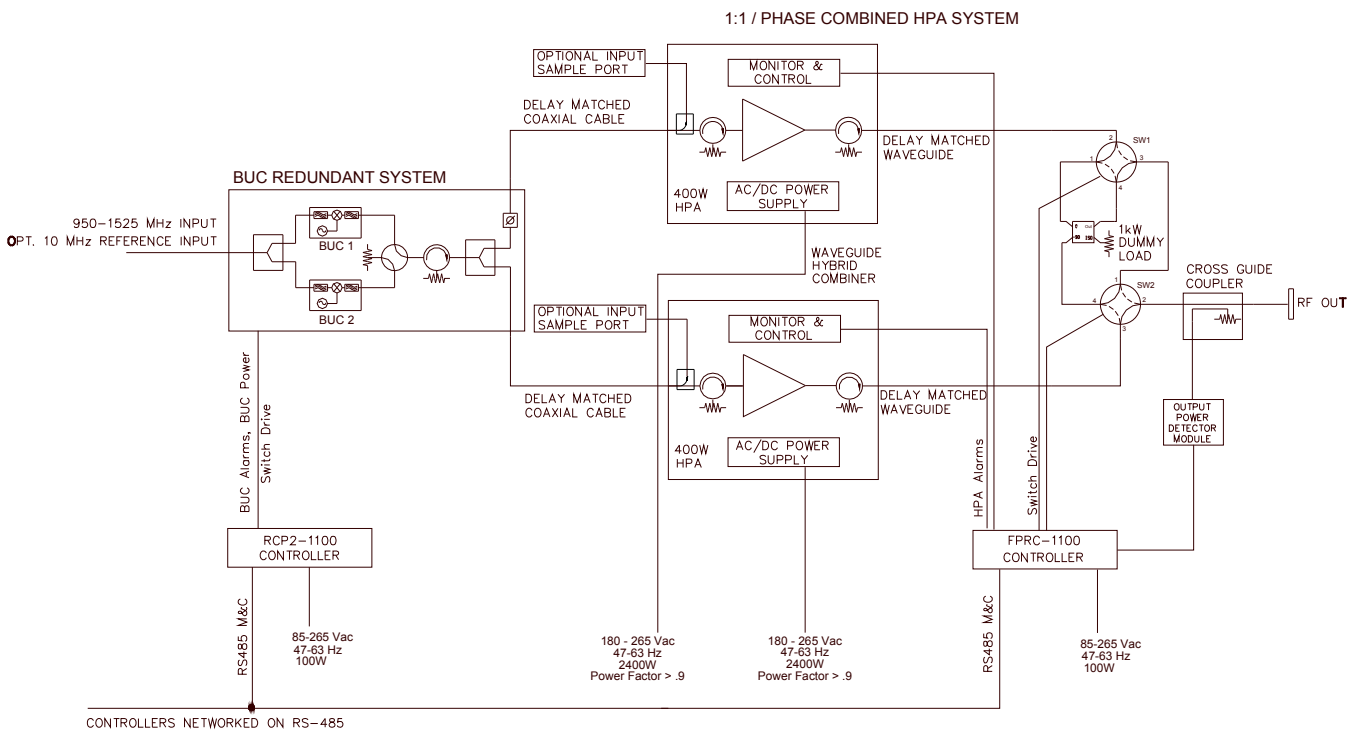
|                          |                |                                       |             |
|--------------------------|----------------|---------------------------------------|-------------|
| Size                     |                | width x height x depth                |             |
| 3RU HPA Chassis          |                | 19.0 x 5.22 x 24.13 (483 x 133 x 613) | inches (mm) |
| 4RU HPA Chassis          |                | 19.0 x 7.0 x 28.0 (483 x 178 x 711)   | inches (mm) |
| 6RU HPA Chassis          |                | 19.0 x 10.47 x 30.0 (483 x 266 x 762) | inches (mm) |
| 7RU HPA Chassis          |                | 19.0 x 12.22 x 30.0 (483 x 310 x 762) | inches (mm) |
| 1RU Power Supply Chassis |                | 19.0 x 1.75 x 16.1 (483 x 44 x 409)   | inches (mm) |
| Weight                   |                |                                       |             |
| 3RU HPA Chassis          |                | 66 (30)                               | lbs. (kg)   |
| 4RU HPA Chassis          |                | 75 (34)                               | lbs. (kg)   |
| 4RU HPA Chassis          | ≤ 250W Chassis | 100 (45)                              | lbs. (kg)   |
| 6RU HPA Chassis          | > 250W Chassis | 180 (82)                              | lbs. (kg)   |
| 7RU HPA Chassis          |                | 180 (82)                              | lbs. (kg)   |
| 1RU Power Supply Chassis |                | 29 (13)                               | lbs. (kg)   |
| Finish                   |                | powder coat                           | Gray        |

### Environmental

|                       |            |            |    |
|-----------------------|------------|------------|----|
| Operating Temperature | Ambient    | 0 to +50   | °C |
| Relative Humidity     | Condensing | 95         | %  |
| Cooling System        | Integrated | Forced air |    |

## L-Band Operation

Teledyne Paradise Datacom Phase Combined HPA Systems can be configured for L-Band Input operation. For optimum RF phase combining over the entire bandwidth of a communication amplifier, the frequency translation part of the system must be separated from the phase combining loop. Therefore, systems with L-Band input are configured with a separate 1:1 system of L-Band Block Up Converters that feed the 1:1 or 1:2 Phase Combined HPA system. If L-Band redundancy is not required, the system can be configured with a single thread L-Band Block Up Converter.



The Block Up Converter system is housed in a 1RU rack-mountable enclosure and controlled by a RCP2-1100 Redundant Controller. The Up Converters can be configured with internal reference oscillators or external reference oscillators. The Paradise Datacom ZBUC<sup>®</sup> architecture allows a converter that is fitted with an internal reference oscillator to automatically detect and switch to an externally applied 10 MHz reference signal.

Optional input sample ports on each SSPA chassis are available on L-Band Input Phase Combined Systems to allow the user to monitor the output of the block up converter.

### 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<sup>®</sup> 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 5, 10, 20, 25, or 50 MHz without modification.
- zBUC converter can accept a wide range of external reference power (-10 to +5 dBm).

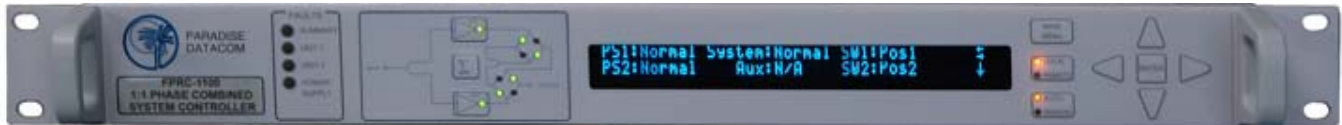
### Available Frequency Plans

| 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      |

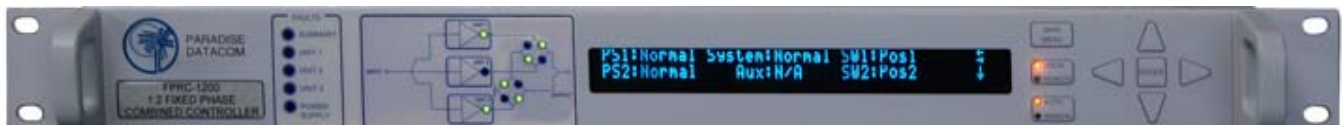
### Electrical Specifications for RM SSPA System with zBUC converter

| 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            | 0 to +50 °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                  | -60                  | -50                   | dBc/Hz    |
|                           | 100 Hz   | -60                    | -80                  | -75                  | -65                   | dBc/Hz    |
|                           | 1 KHz  | -70                    | -80                  | -75                  | -72                   | dBc/Hz    |
|                           | 10 KHz   | -80                    | -85                  | -100                 | -90                   | dBc/Hz    |
|                           | 100 KHz  | -90                    | -120                 | -110                 | -110                  | 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 | 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 (-20 to +85 °C)     | ± 3 • 10 <sup>-8</sup> |                      |                      |                       |           |

## System Controllers



**FPRC-1100 1:1 Phase Combined System Controller**



**FPRC-1200 1:2 Phase Combined System Controller**

The FPRC-1X00 is the heart of the Phase Combined SSPA System. It provides an extremely user friendly interface for complete monitor and control of the high power amplifiers. The front panel mimic display shows the on-line amplifiers and the switch positions. Fault lights are provided for easy indication of system status.

All FPRC-1X00 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 FPRC-1X00.

The FPRC-1X00 System Controller allows the Phase Combined System of amplifiers to be controlled as if it were a single SSPA. The FPRC is the single point of interface for either local, front panel, or remote control. System monitor and control capability include gain adjustment, output power monitoring (dBm or Watts), and alarms.

The FPRC-1X00 is a 1RU indoor control unit that contains its own internal redundant components including fully redundant power supplies.

**Note:** Systems can be configured without the use of a system controller. Consult the factory for operation of phase combined systems without a system controller.



### Part Number Configuration, 3 RU Chassis

HPA  3

|   |  |  |  |
|---|--|--|--|
| <p><b>Band</b></p> <p>C - C-Band<br/>X - X-Band<br/>K - Ku-Band</p>   | <p><b>Power Level (in Watts)</b></p> <p><u>C-Band</u><br/>025, 030, 040, 050, 075, 100, 140, 200, 250, or 300</p> <p><u>X-Band</u><br/>060, 075, 100, 140 or 200</p> <p><u>Ku-Band</u><br/>010, 020, 025, 035, 040, 050, 070, 100 or 125</p> | <p><b>Configuration Modifier 3</b></p> <p>X = Standard<br/>E<sup>1</sup> = Rear Panel Exhaust Adapters<br/>P = External 1RU N+1 Power Supply<br/>L<sup>1</sup> = External 1RU N+1 Power Supply &amp; Rear Panel Exhaust Adapters<br/><small><sup>1</sup> Not available with Package options 'Y' or 'Z'.</small></p>                            | <p><b>Configuration Modifier 2</b></p> <p>X = Standard<br/>V = Reflected Power Monitor<br/>P<sup>1</sup> = Front Panel Power Switch<br/>R<sup>1</sup> = Reflected Power Monitor &amp; Front Panel Power Switch<br/><small><sup>1</sup> Not available with External 1RU N+1 Power Supply.</small></p> |
| <p><b>Frequency Sub Band</b></p> <p><u>C-Band</u><br/>A<sup>1</sup> – 5.850 to 6.425 GHz<br/>B<sup>1</sup> – 5.850 to 6.725 GHz<br/>C – 5.750 to 6.670 GHz<br/>E<sup>1</sup> – 6.425 to 6.725 GHz (Palapa)<br/>F<sup>1</sup> – 6.725 to 7.025 GHz (Insat)<br/>G<sup>1</sup> – 5.750 to 6.475 GHz<br/>V<sup>1,2</sup> – 5.850 to 6.725 GHz</p> <p><u>X-Band</u><br/>A<sup>1</sup> - 7.90 to 8.40 GHz<br/>B - 7.50 to 8.50 GHz<br/>C - 9.50 to 10.50 GHz<br/>D - 7.70 to 8.40 GHz</p> <p><u>Ku-Band</u><br/>A<sup>1</sup> – 14.00 to 14.50 GHz<br/>B<sup>1</sup> – 13.75 to 14.50 GHz</p> <p><small><sup>1</sup> Available with optional BUC.<br/><sup>2</sup> With 1.3:1 VSWR.</small></p> | <p><b>Configuration Modifier 1</b></p> <p>X = Standard<br/>R = 90° Output W/G Flange<br/>S = Input Sample Port<br/>T = 90° Output W/G Flange with Input Sample Port</p>  | <p><b>System Configuration</b></p> <p>S = Custom<br/>E = 1:2 Fixed Phase Combined System, Input Splitter, FPRC-1200*<br/>G = 1:1 Fixed Phase Combined System, Input Splitter, FPRC-1100*<br/>J = 1:2 Fixed Phase Combined System, Input Splitter, Internal Redundancy Control<br/><small>* Standard location of FPRC is above HPA1</small></p> | <p><b>Block Up Converter</b></p> <p>M = Internal Reference ZBUC<br/>P = External Reference ZBUC<br/>X = None</p>   |
| <p style="text-align: center;"><b>Package</b></p> <p>S = Rack Mount, Top Mounted Switching, with Cabinet<br/>T = Rack Mount, Top Mounted Switching, without Cabinet<br/>Y = Rack Mount, Rear Mounted Switching, with Cabinet<br/>Z = Rack Mount, Rear Mounted Switching, without Cabinet</p>  |  |  |  |

### Part Number Configuration, 4 RU Chassis

HPA  2

**Band**  
 C - C-Band  
 K - Ku-Band  
 X - X-Band

**Power Level (in Watts)**  
C-Band  
 050, 075, 100, 140, 200, 250, 300, 400, 500, 600  
X-Band  
 060, 075, 100, 140, 200, 250, 350, 500  
Ku-Band  
 025, 035, 040, 050, 070, 100, 125, 200, 250

**Frequency Sub Band**  
C-Band  
 A<sup>1</sup> - 5.850 to 6.425 GHz  
 B<sup>1</sup> - 5.850 to 6.725 GHz  
 C - 5.750 to 6.670 GHz  
 E<sup>1</sup> - 6.425 to 6.725 GHz (Palapa)  
 F<sup>1</sup> - 6.725 to 7.025 GHz (Insat)  
 G<sup>1</sup> - 5.750 to 6.475 GHz  
 V<sup>1,2</sup> - 5.850 to 6.725 GHz  
X-Band  
 A<sup>1</sup> - 7.90 to 8.40 GHz  
 B - 7.50 to 8.50 GHz  
 C - 9.50 to 10.50 GHz  
 D - 7.70 to 8.40 GHz  
Ku-Band  
 A<sup>1</sup> - 14.00 to 14.50 GHz  
 B<sup>1</sup> - 13.75 to 14.50 GHz  
<sup>1</sup> Available with optional BUC.  
<sup>2</sup> With 1.3:1 VSWR.

**Package**  
 S = Top Mount Switching, w/ Cabinet  
 T = Top Mount Switching, w/o Cabinet  
 Y = Rear Mount Switching, w/ Cabinet  
 Z = Rear Mount Switching, w/o Cabinet

**Configuration Modifier 3**  
 X = Standard  
 D = 48V Input  
 E<sup>1</sup> = Rear Panel Exhaust Adapters  
 P = External 1RU N+1 Power Supply  
 J<sup>1</sup> = 48V Input & Rear Panel Exhaust Adapters  
 L<sup>1</sup> = External 1RU N+1 Power Supply & Rear Panel Exhaust Adapters  
<sup>1</sup> Not available with Package options Y or Z.

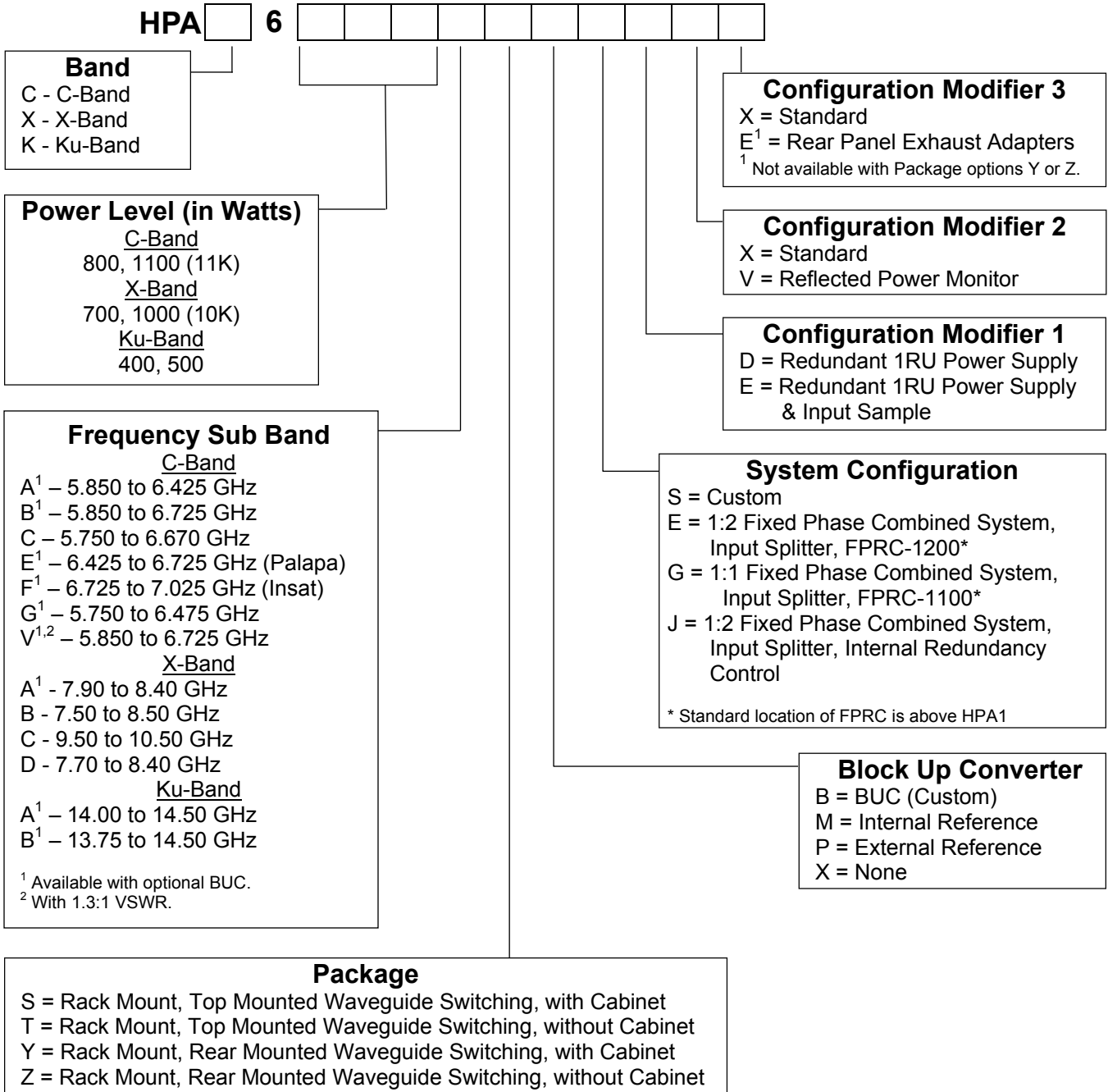
**Configuration Modifier 2**  
 X = Standard  
 V = Reflected Power Monitor

**Configuration Modifier 1**  
 X = Standard  
 K<sup>1</sup> = 110/220 VAC Operation  
 S = Input Sample Port  
 C<sup>1</sup> = Input Sample Port & 110/220 VAC Operation  
<sup>1</sup> 100-125W Ku- & 200-300W C-band only; Consult factory for X-Band.

**System Configuration**  
 S = Custom  
 E = 1:2 Fixed Phase Combined System, Input Splitter, FPRC-1200\*  
 G = 1:1 Fixed Phase Combined System, Input Splitter, FPRC-1100\*  
 J = 1:2 Fixed Phase Combined System, Input Splitter, Internal Redundancy Control  
 \* Standard location of FPRC is above HPA1

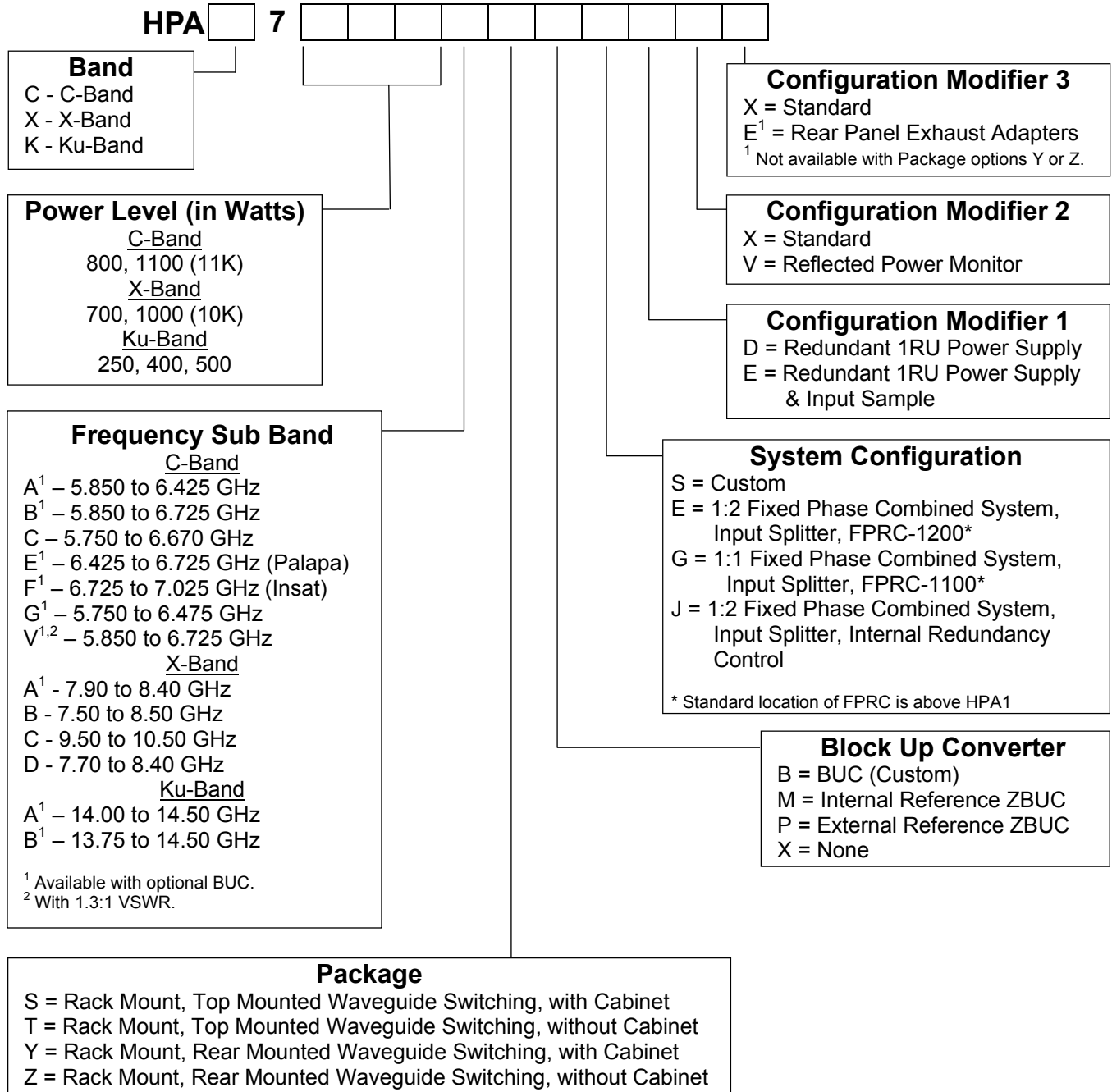
**Block Up Converter**  
 M = Internal Reference  
 P = External Reference  
 X = None

**Part Number Configuration, 6 RU Chassis**



**Example:** An in-cabinet 1.1 kW C-Band 1:2 Fixed Phase Combined Chassis System with input splitter, FPRC-1200 controller, 1RU power supplies, and rear mounted waveguide switch is part number: **HPAC611KAYXEDXX**.

**Part Number Configuration, 7 RU Chassis**



**Example:** An in-cabinet 1.1 kW C-Band 1:2 Fixed Phase Combined Chassis System with input splitter, FPRC-1200 controller, 1RU power supplies, and rear mounted waveguide switch is part number: **HPAC711KAYXEDXX**.

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