

# Compact Outdoor Gallium Nitride (GaN) Solid State Power Amplifiers



**400W C-Band GaN  
Compact Outdoor SSPA**

## Description

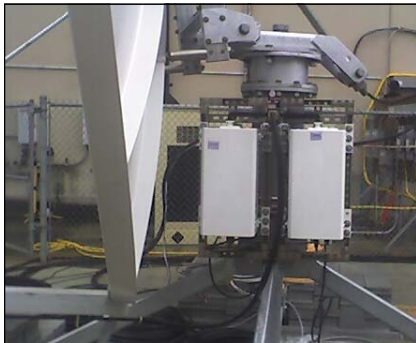
The Teledyne Paradise Datacom Compact Outdoor Solid State Power Amplifier (SSPA) is built for extreme environmental conditions and high reliability operation. Along with the robust construction exists the highest power density in the industry. This allows solid state technology to be used in applications that have long been reserved for TWTAs. Weighing 44 lbs. (20 kg) and being only slightly larger than a shoe box, these SSPAs are available in output power levels of:

**S-Band: 50W, 100W, 200W, 300W, 400W, 500W**

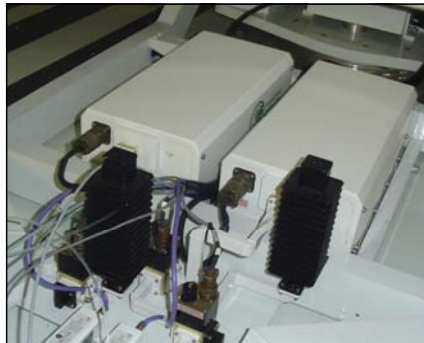
**C-Band: 300W, 400W**

**X-Band: 300W, 400W**

**Ku-Band: 100W, 150W, 200W, 250W**



Antenna-mount 1:1 system w/ mounting frame



SNG-mount 1:1 system w/ side-mount AC input

## FEATURES

- Compact size and weight
- CE Compliance Tested
- Integrated forced-air cooling system
- 20 dB RF Gain Adjustment
- Extreme Environmental Testing
- RF Output Sample Port
- Maintenance Free Operation
- Universal, Power Factor Corrected Power Supply
- Built-in 1:1 Redundancy Control
- Built-in Maintenance Switch Controller
- True Output Power Detection

## OPTIONS

- Hand Held Controller
- Antenna Mounting Kit
- Remote Control Panel
- L-Band Input
- FSK monitor & control via IFL
- Phase Combined Systems
- Low line voltage operation
- Fiber Optic Input
- Optional side-mount AC input for SNG installations
- Receive Band Reject Filter
- -55 °C Operation

## SPECIFICATIONS

- Compact Outdoor housing  
10.0 X 19.5 X 6.50 in  
254 X 495 X 165 mm  
44.0 lbs. / 20.0 kg
- White powder coat finish
- Operating temperature:  
-40 to +60 °C

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## Specifications, S-Band SSPAs

PARAMETER	NOTES	LIMITS	UNITS
Frequency Range	Frequency selection "G" Frequency selection "A" Frequency selection "B"	1.750 to 2.120 2.020 to 2.120 2.200 to 2.300	GHz GHz GHz
Output Power Typical, $P_{sat}$ Guaranteed minimum, $P_{Linear}^1$	<b>A Series</b> HPAS2050ACXXXXXG HPAS2100ACXXXXXG HPAS2200ACXXXXXG HPAS2300ACXXXXXG HPAS2400ACXXXXXG HPAS2500ACXXXXXG <b>B Series</b> HPAS2050BCXXXXXG HPAS2100BCXXXXXG HPAS2200BCXXXXXG HPAS2300BCXXXXXG HPAS2400BCXXXXXG HPAS2500BCXXXXXG	$P_{sat} / P_{Linear}$ 47.5 (56) / 43.0 (20) 50.0 (100) / 47.0 (50) 53.0 (200) / 50.0 (100) 54.8 (300) / 51.8 (150) 56.0 (400) / 53.0 (200) 57.0 (500) / 54.0 (250) 47.5 (56) / 43.0 (20) 50.0 (100) / 47.0 (50) 53.0 (200) / 50.0 (100) 54.8 (300) / 51.8 (150) 56.0 (400) / 53.0 (200) 57.0 (500) / 54.0 (250)	dBm (W) dBm (W) dBm (W) dBm (W) dBm (W) dBm (W) dBm (W) dBm (W) dBm (W) dBm (W) dBm (W) dBm (W)
Power Requirements Line Frequency Line Power (Voltage) (typical @ 220 VAC)	power factor  HPAS2050ACXXXXXG HPAS2100ACXXXXXG HPAS2200ACXXXXXG HPAS2300ACXXXXXG HPAS2400ACXXXXXG HPAS2500ACXXXXXG	.98 47 to 63 400 / 300 (90-265) 500 / 400 (90-265) 800 / 700 (90-265) 1300 / 1000 (180-265) <sup>2</sup> 1600 / 1300 (180-265) <sup>2</sup> 1800 / 1500 (180-265) <sup>2</sup>	Hz W (VAC) W (VAC) W (VAC) W (VAC) W (VAC) W (VAC)
Receive Band Noise Power Density	without optional filter with optional filter	- 95 - 155	dBW / 4 KHz 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:** Low line voltage (90-265 VAC) option not available.

## Specifications, C-Band SSPAs

PARAMETER	NOTES	LIMITS	UNITS
Frequency Range	Frequency selection "L" Frequency selection "H" Frequency selection "C" <sup>2</sup> Frequency selection "A" Frequency selection "B" <sup>2</sup> Frequency selection "D"	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 7.025	GHz GHz GHz GHz GHz GHz
Output Power Typical, $P_{sat}$ Guaranteed minimum, $P_{Linear}^1$	HPAC2300ACXXXXXG HPAC2400ACXXXXXG	$P_{sat} / P_{Linear}$ 54.8 (300) / 51.8 (150) 56.0 (400) / 53.0 (200)	dBm (W) dBm (W)
Power Requirements Line Frequency Line Power (Voltage) (typical @ 220 VAC)	power factor  HPAC2300ACXXXXXG HPAC2400ACXXXXXG	.98 47 to 63 $P_{sat} / P_{Linear}$ 1500 / 1300 (180-265) <sup>3</sup> 1800 / 1600 (180-265) <sup>3</sup>	Hz W (VAC) 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.

**Note 3:** Available with low line voltage option, 90 to 265 VAC.

## 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 Typical, $P_{sat}$ Guaranteed minimum, $P_{Linear}^1$	HPAX2300ACXXXXXG HPAX2400ACXXXXXG	$P_{sat} / P_{Linear}$ 54.8 (300) / 51.8 (150) 56.0 (400) / 53.0 (200)	dBm (W) dBm (W)
Power Requirements Line Frequency Line Power (Voltage) (typical @ 220 VAC)	power factor  HPAX2300ACXXXXXG HPAX2400ACXXXXXG	.98 47 to 63 $P_{sat} / P_{Linear}$ 1500 / 1300 (180-265) <sup>2</sup> 2000 / 1700 (180-265) <sup>2</sup>	Hz  W (VAC) W (VAC)
Receive Band Noise Power Density	without optional filter with optional filter	- 85 - 155	dBW / 4 KHz 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:** Available with low line voltage option, 90 to 265 VAC.

## 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 Typical, $P_{sat}$ Guaranteed minimum, $P_{Linear}^1$	HPAK2100ACXXXXXG HPAK2150ACXXXXXG HPAK2200ACXXXXXG HPAK2250ACXXXXXG	$P_{sat} / P_{Linear}$ 50.0 (100) / 47.0 (50) 51.8 (150) / 48.8 (75) 53.0 (200) / 50.0 (100) 54.0 (250) / 51.0 (125)	dBm (W) dBm (W) dBm (W) dBm (W)
Power Requirements Line Frequency Line Power (Voltage) (typical @ 220 VAC)	power factor  HPAK2100ACXXXXXG HPAK2150ACXXXXXG HPAK2200ACXXXXXG HPAK2250ACXXXXXG	.98 47 to 63 $P_{sat} / P_{Linear}$ 900 / 750 (90-265) 1000 / 850 (90-265) 1200 / 920 (180-265) <sup>3</sup> 1500 / 1000 (180-265) <sup>3</sup>	Hz  W (VAC) W (VAC) W (VAC) 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.

**Note 3:** Available with low line voltage option, 90 to 265 VAC.

## 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
	full band (S-Band)	± 0.75	dB
Gain Slope	per 40 MHz	± 0.3	dB/40 MHz
	per 10 MHz (S-Band)	± 0.3	dB/10 MHz
Gain Variation vs. Temperature	-40 °C to +60 °C	± 1.5	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
	@ rated $P_{Linear}$ (S-Band)	-30	dBc
Input/Output VSWR	Extended C-Band	1.30:1	
	Output VSWR: Ku-Band with bulkhead filter	1.50:1	
		1.40:1	
Noise Figure	at maximum gain	10	dB
	at maximum gain (S-Band)	8	dB
Group Delay (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 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<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 10 or 50 MHz.
- zBUC converter can accept a wide range of external reference power (-10 to +5 dBm)
- zBUC converter can accept FSK monitor and control signal via the IFL for complete amplifier remote control.

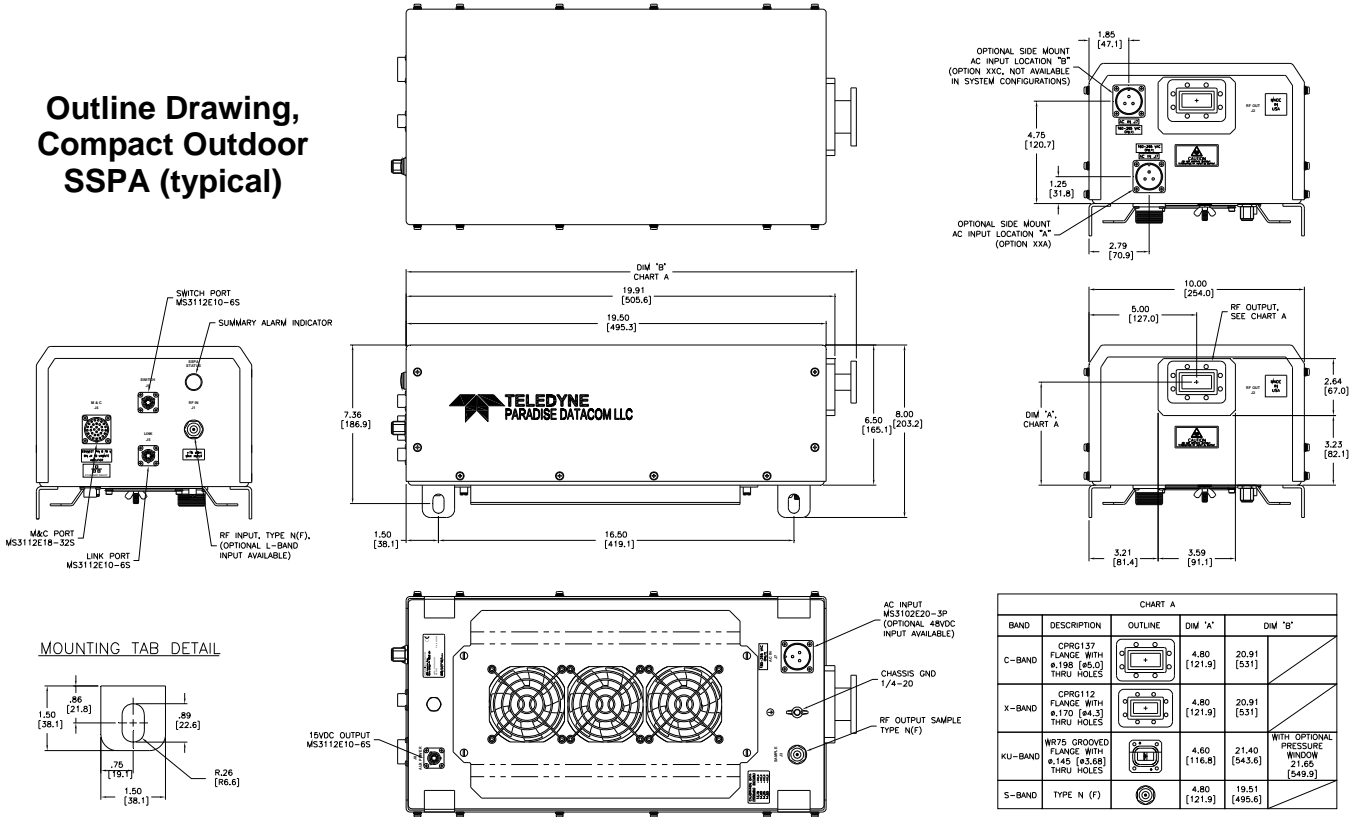
### Available Frequency Plans

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 Compact Outdoor 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	-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) (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>				

## Outline Drawing, Compact Outdoor SSPA (typical)



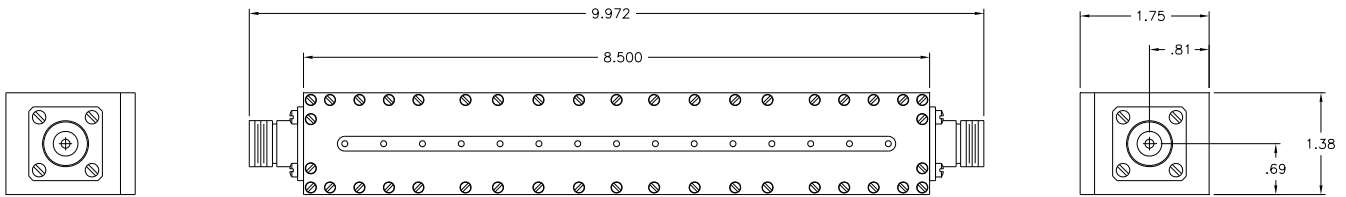
## Mechanical & Environmental Specifications

PARAMETER	NOTES	LIMITS	UNITS
Size	width X length X height	10.0 X 19.5 X 6.50 254 X 495 X 165	inches mm
Weight	Base Unit With Internal zBUC	44 (20.0) ± 3% +1.7 (+0.8)	lbs.(kg) lbs.(kg)
Finish		Paint	White; powder coat
Connectors	RF Input RF Output (S-Band, to 300W) RF Output (S-Band, > 300W) RF Output (C-Band) RF Output (X-Band) RF Output (Ku-Band) RF Output Sample Line Power Monitor and Control Link Port Redundancy Switch Auxiliary +15VDC LNB Power (500 mA)	Type N Type N 7/16 DIN WR137 Waveguide WR112 Waveguide WR75 Waveguide Type N 3-pin MS-type 32-pin MS-type 6-pin MS type 6-pin MS-type 6-pin MS-type	Female Female Female CPR137G flange (PDR-70) CPR112G flange (PDR-84) Grooved flange Female Plug Socket Socket Socket Socket
Operating Temperature	Ambient	-40 to +60	°C
Relative Humidity	Condensing	100	%
Cooling System	Integrated, Forced air	103	CFM
Ingress Protection Rating	With connectors properly sealed	IP 54	
Audible Noise	Measured 1m from unit, at P <sub>sat</sub>	74.0	dBA
Altitude	No temperature de-rating up to 10,000 ft. (3,000 m) De-rate maximum temperature by 2 °C per 1,000 ft (300 m) beyond 10,000 ft.		
Shock	50 g p-p, 11 msec pulses		
Vibration	3g rms 30 min. 5-2000 Hz		

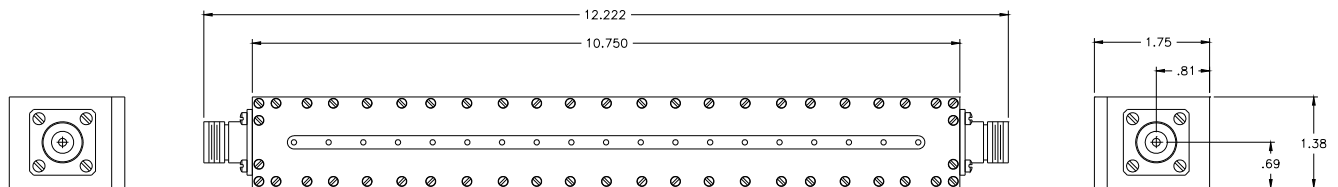
## Receive Band Filter Options

A variety of receive band reject filters are available for S-Band amplifiers. On certain models, these filters may be integrated inside the Compact Outdoor amplifier enclosure, while on others the filter will have to be externally connected to the amplifier. Consult with the factory for details.

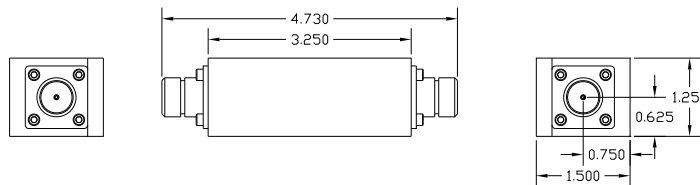
The filter used for frequency band 2.02 - 2.12 GHz is model L205250-S3-TX.



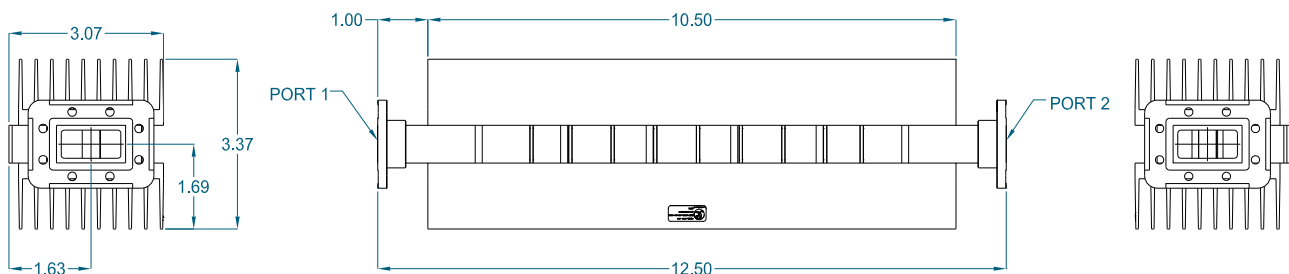
The filter used for frequency band 2.20 - 2.30 GHz is model L205250-S4-TX.



The filter used for frequency band 1.70 - 2.12 GHz is model L205250-S11-TX.



X-Band GaN Compact Outdoor amplifiers may be ordered with an external receive band reject filter. The filter used for frequency band 7.90 - 8.40 GHz is model L205250-X6-TX.



## Optional Accessories

### Remote Control Panel (RCP2-1000-CO)



The RCP2-1000-CO is a Remote Control Panel for the Compact Outdoor SSPA. It requires 1RU of cabinet space and provides a similar local interface as exists on Teledyne Paradise Datacom Indoor Rack Mount amplifiers. Reference specification sheet **209728**.

The controller communicates with the outdoor amplifier via a RS485 link. The controller then provides a wide range of interface capability including Ethernet communications. The following communication links are available at the Remote Control Panel:

- RS232 or Addressable RS485 Serial Data
- Discrete (Parallel) Interface - Form C contact outputs & Opto Isolated Inputs
- Ethernet Interface - A full compliment of Ethernet Communications including UDP, SNMP, and an internal web browser.
- Local (Manual) interface via front panel LCD display

### Universal Handheld Controller (RCH-1000)

The Universal Handheld Controller (RCH-1000) is a versatile device used to interface with a variety of Teledyne Paradise Datacom amplifiers, including Compact Outdoor SSPA, Mini Compact Outdoor SSPA, or H-Series High Power Outdoor SSPA. Reference specification sheet **211667**.

The device is housed in a ruggedized enclosure that is environmentally sealed to IP65 levels. This allows the Universal Handheld Controller (RCH-1000) to be used in most outdoor environments. The rugged construction of the device enclosure provides protection from impact and vibration.



This device allows the operator to adjust the attenuation of the connected unit, and control the mute/unmute selection, as well as monitor the status, conditions and settings of the connected unit via a serial RS-485 connection. Fault conditions and other events are tracked in the controller's internal log.



## Part Number Configuration Matrix

HPA **C 2 4 0 0 A C M X X X X G**

Band	
S-Band	<b>S</b>
C-Band	<b>C</b>
X-Band	<b>X</b>
Ku-Band	<b>K</b>

Generation	
Second	<b>2</b>

Power Level (Watts)	
S-Band	<b>050, 100, 200, 300, 400, 500</b>
C-Band	<b>300, 400</b>
X-Band	<b>300, 400</b>
Ku-Band	<b>100, 150, 200, 250</b>

Frequency Sub Band	
S-Band	
<b>A</b>	2.02 to 2.12 GHz
<b>B</b>	2.20 to 2.30 GHz
<b>G</b>	1.75 to 2.12 GHz
C-Band	
<b>A<sup>1</sup></b>	5.850 to 6.425 GHz
<b>B<sup>1</sup></b>	5.850 to 6.725 GHz
<b>C</b>	5.750 to 6.670 GHz
<b>D<sup>1</sup></b>	6.425 to 7.025 GHz
<b>H</b>	5.715 to 5.790 GHz
<b>L</b>	4.400 to 5.000 GHz
X-Band	
<b>A<sup>1</sup></b>	7.90 to 8.40 GHz
<b>D</b>	7.70 to 8.40 GHz
<b>F</b>	7.10 to 7.40 GHz
Ku-Band	
<b>A<sup>1</sup></b>	14.00 to 14.50 GHz
<b>B<sup>1</sup></b>	13.75 to 14.50 GHz
<b>C<sup>1</sup></b>	14.50 to 14.70 GHz
<b>D<sup>1</sup></b>	15.10 to 15.40 GHz
<b>F<sup>1</sup></b>	12.75 to 13.25 GHz
<b>G<sup>1</sup></b>	14.75 to 15.25 GHz

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

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

Configuration Modifier 3	
<b>X</b>	None (Standard)
<b>A</b>	Side-Mount AC Input, Location 'A'
<b>C<sup>1</sup></b>	Side-Mount AC Input, Location 'B'

<sup>1</sup> Standalone units only

Configuration Modifier 2	
<b>X</b>	Standard
<b>M</b>	MS-Connector Covers
<b>R<sup>1</sup></b>	Receive Band Reject Filter
<b>S<sup>1</sup></b>	M + R (see above)
<b>W<sup>2</sup></b>	Waveguide Pressure Window
<b>Y<sup>2</sup></b>	M + W (see above)

<sup>1</sup> S-Band and X-Band units only

<sup>2</sup> Ku-Band standalone units only

Configuration Modifier 1	
<b>X</b>	Standard
<b>K<sup>1</sup></b>	110 VAC Input Power

<sup>1</sup> Available on all C-Band units, all X-Band units, Ku-Band units > 150W

System Configuration	
<b>X</b>	Standalone amplifier

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

Package	
<b>C</b>	Standalone amplifier

**Example** - A standalone 400W GaN C-Band Compact Outdoor SSPA with an optional internal reference block up converter is part number: **HPAC2400ACMXSXXG**.

### Use and Disclosure of Data

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