NF v1

Ka-Band (29-31GHz) Long SSPA

(TSA-214145)

Summary

This is a GaN based Hermetically Sealed SSPA which produces **41dBm minimum Linear Power**[1] **(42dBm typical)** over the entire **29-31GHz** bandwidth and operating temperature range. When coupled with Teledyne's Dual Band BUC with Integrated IF Linearizer it can produce **42dBm minimum Linear Power (43dBm typical – see Figure 1)**.

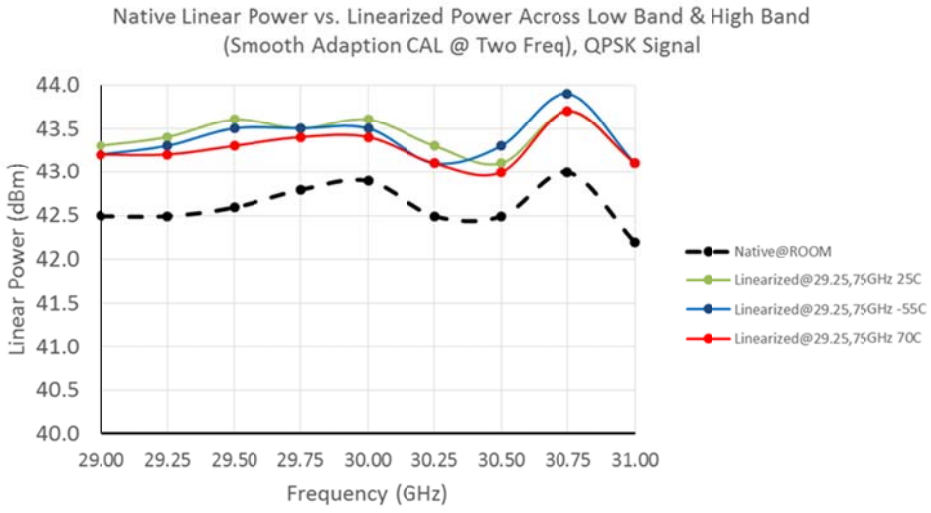

Figure 1. Performance enhancement gained through the use of the adaptive IF linearizer function in the TSA-214145 BUC with If linearizer (modulation parameters as described in note [1]).

[1] When a QPSK signal with a data rate of 10Msps and a root raised cosine filter with a roll-off factor (α) of 0.2 is injected into the SSPA, the power level at which the spectral regrowth 1 symbol rate offset from the carrier (10MHz in this case) is 30dBc relative to the carrier is defined as the **Linear Power. Note:** The input modulated signal should have a spectral regrowth of at least 55dBc.

The unit has an integrated waveguide dual directional coupler at the output enabling both the detection and reporting of the output power, as well as providing an RF feedback signal to the adaptive IF linearizer when used with the Teledyne Dual Band BUC (TSA-214144). If the linearizer is not used, the feedback port should be terminated in 50 Ω, or it can be used to monitor the RF output of the amplifier. The reverse coupler senses reflected power from a short and self protects the unit by disabling it.

Included features are 20dB gain control, true output power monitoring, high reflected power shutdown capability, internal temperature monitoring, enable/disable control, and fault indication. Most of this is done through the RS-422 interface. The unit also includes a hard wired, TTL controlled pin for disabling the unit should the RS-422 communications link fail.

The total weight is 2.0 lbs max and the size is 6.6” L x 3.7” W x 1” H. See the outline drawing attached. The unit has a wide operating voltage of +20.5V to +32.5V.

Specifications

Table 1: SSPA Specifications

Parameter	Value
Operating Frequency Range	29 to 31 GHz
Operating Temperature Range	-55 to +70 ˚C
Small-Signal Gain Range *(Controlled Via RS-422)*	35 dB to 55 dB
Forward Gain Flatness (29-31GHz)	2 dB_{pk-pk} max
Feedback Gain Flatness (29-31GHz)	2 dB_{pk-pk} max
Gain Variation Over Temperature	3 dB_{pk-pk} max
Gain Step	0.1dB steps
Input Return Loss	14dB min
Feedback Return Loss	12dB min
Output Return Loss	12dB min
Spurious @ Pout = 42dBm *(29-31GHz) In Band*	-60dBc
Spurious @ Pout = 42dBm *(18.3-21.2GHz) Receive Band*	-60dBc
Noise Power Density *(29-31GHz) In Band @ Maximum Gain*	-90dBm/Hz max
Linear Power (see def. on pg. 1)	41dBm min (42dBm min w/ Adaptive IF Linearizer)
Power at Feedback Port @ P_{OUT}=42dBm	-15dBm typ.[2]
Detected Power Accuracy *(Read Via RS-422)*	±0.75dB typ
Max RF Input Power	+13dBm
Reflected Power when Unit Shuts Down	36 to 37dBm typ.
RF Enable/Disable Time *Via RS422* *Via Pin 10*	 1ms typ. 100µs max
DC Power *(RF disabled)*	3W max
DC Power *(RF enabled, P_{OUT}=42dBm))*	125W max
DC Voltage Range	+20.5 to +32.5V
RF Input Connector	2.92mm (female)
RF Feedback Connector	2.92mm (female)
RF Output Interface	WR-28 Cover Flange with O-Ring Groove
DC Supply/Command/Monitor Interface	25 pin Micro-D Connector (MIL-DTL-83513/2)
Size	6.6” L x 3.7” W x 1” H
Weight	2 lbs max

Micro D Connector Pinout Descriptions

[2] Can be specified differently depending upon length of cable used from SSPA to BUC.

The Micro D Connector on the SSPA consists of 25 pins with the pinouts as described by Table 2. Tie all +VDC pins together. Similarly tie all GND (ground) pins together. The RS-422 GND is internally connected to the GND pins but is provided as a separate output to connect with the source RS-422 connection. Please see Figure 2 on how to interface the SSPA RS-422 with the system or source RS-422.

Table 2: 25 Pin Micro D Connector Pinout Description

J1: 25 PIN MICRO D CONNECTOR
PER MIL-DTL-83513/2

PIN	FUNCTION	COLOR
J1-1	+VDC	BLACK
J1-2	+VDC	BROWN
J1-3	+VDC	RED
J1-4	+VDC	ORANGE
J1-5	GND	YELLOW
J1-6	GND	GREEN
J1-7	GND	BLUE
J1-8	-TX (RS422)	VIOLET
J1-9	+RX (RS422)	GREY
J1-10	RFTXEN (OPTIONAL, +3.3V=ON, 0V=OFF)	WHITE
J1-11	GND (RS422)	BLACK
J1-12	RESERVED (DO NOT CONNECT)	BROWN
J1-13	RESERVED (DO NOT CONNECT)	RED
J1-14	+VDC	ORANGE
J1-15	+VDC	YELLOW
J1-16	+VDC	GREEN
J1-17	GND	BLUE
J1-18	GND	VIOLET
J1-19	GND	GREY
J1-20	GND	WHITE
J1-21	+TX (RS422)	BLACK
J1-22	-RX (RS422)	BROWN
J1-23	SUMFLT (OPTIONAL, +3.3V=FAULT)	RED
J1-24	RESERVED (DO NOT CONNECT)	ORANGE
J1-25	RESERVED (DO NOT CONNECT)	YELLOW

– +VDC VOLTAGE RANGES FROM +20.5V TO +32.5V APPLY SAME VOLTAGE TO ALL +VDC PINS

* DO NOT GROUND OPTIONAL PINS IF NOT USED, FLOAT IF NOT USED

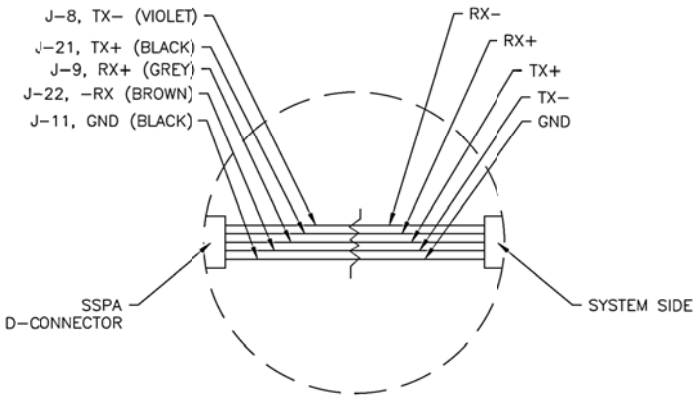

Figure 1: RS-422 connection with system

Communication with the SSPA is done through RS-422. However, there are two discrete pins: RFTXEN and SUMFLT. RFTXEN is a hardwired TTL controlled pin for disabling RF power in case of emergency. This pin is high through an internal pull-up. To disable the unit, simply ground this pin. SUMFLT is a hardwired TTL level (+3.3V high) signal that indicates a fault when HIGH and no fault when LOW. The fault status can be read through the RS-422.

The serial format is shown in Table 3. As standard, a high-to-low transition indicates the start of the data. A newline ("\n") following the command indicates the end of the command.

In terms of defaults, at power the gain is set to the minimum gain of 35dB. In order to adjust this, use the gain control command from Table 4. See Example 5, for a sample command to set the gain control to +10.7dB.

See command examples on the following page. The command part is bolded and the response is un-bolded.

Table 3: Serial Format

Baud Rate	*115200 bps*
Data Bits	*8*
Parity	*None*
Stop Bits	*1*
Flow Control	*None*

Table 4: RS-422 Command List

"VER"	Indicates Firmware Version
"SN"	Indicates Unit Serial Number
"ECHO 0"	Turns Command Echo OFF (command sent is not repeated back)
"ECHO 1"	Turns Command Echo ON (command send is repeated back)
"RF0"	Turns RF Power OFF
"RF1"	Turns RF Power ON
"STA"	Reports Fault Status
"POUTF"	Reports Forward Output Power (dBm)
"POUTR"	Reports Approx. Reverse Output Power (dBm)
"GC WORD HHHH"	Gain Control (+0dB to +20dB), 4 digit HEX value (HHHH) represents the gain control value 0 to 200 where the right most digit represents the tenths decimal place.
"TEMP"	Reports PA Temperature (˚C)

Example 1: Turn on RF Power, Echo disabled

RF1\n

PA ON

Example 2: Turn on RF Power, Echo enabled

RF1\n
RF1
PA ON

Example 3: Fault Status (No Fault), Echo disabled

STA\n
FAULT = 0

Example 4: Temperature, Echo disabled

TEMP\n
TEMPERATURE = 25.1

Example 5: Set Gain control to +10.7dB, Echo disabled

GC WORD 006B\n
DAC VALUE = XXXX

The response from this command will be changed in future revisions. This was used for DEBUG purposes.

Example 6: Read Power

POUTF\n
FWD POUT = 40.5

Example 7: Turn off RF Power, Echo disabled

RF0\n
PA OFF

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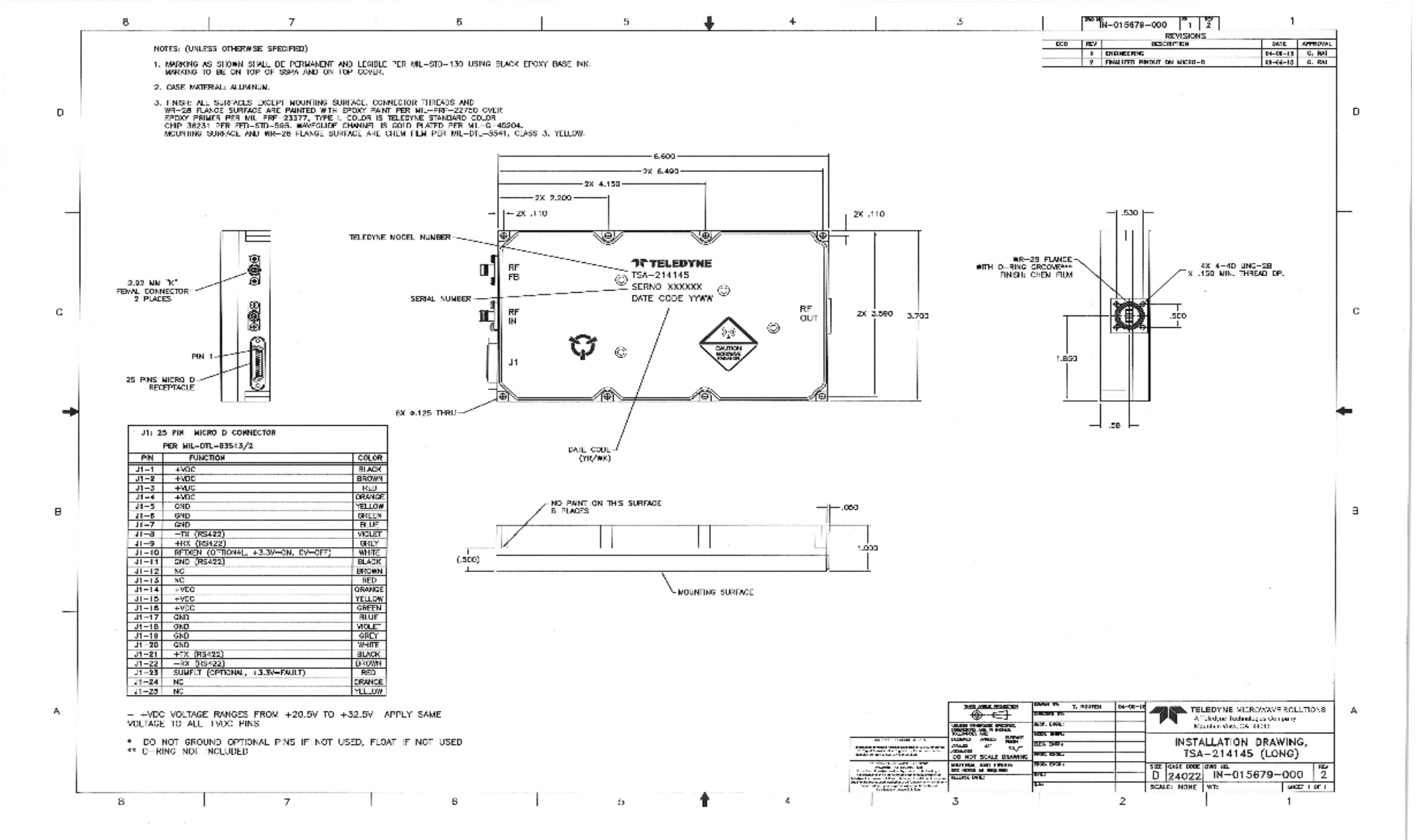
NOTES: (UNLESS OTHERWISE SPECIFIED)
1. MARKING AS SHOWN SHALL BE PERMANENT AND LEGIBLE PER MIL-STD-130 USING BLACK EPOXY BASE INK. MARKING TO BE ON TOP OF SSPA AND ON TOP COVER.
2. CASE MATERIAL: ALUMINUM.
3. FINISH: ALL SURFACES EXCEPT MOUNTING SURFACE, CONNECTOR THREADS AND WR-28 FLANGE SURFACE ARE PAINTED WITH EPOXY PAINT PER MIL-PRF-22750 OVER EPOXY PRIMER PER MIL PRF 23377, TYPE I, COLOR IS TELEDYNE STANDARD COLOR CHIP 36231 PER FED-STD-595. WAVEGUIDE CHANNEL IS GOLD PLATED PER MIL-G-45204. MOUNTING SURFACE AND WR-28 FLANGE SURFACE ARE CHEM FILM PER MIL-DTL-5541, CLASS 3, YELLOW.
IN-015679-000
REVISIONS
ECO REV DESCRIPTION DATE APPROVAL
1 ENGINEERING 04-08-13 G. RAI
2 FINALIZED PINOUT ON MICRO-D 08-04-15 G. RAI
6.600
2X 6.400
2X 4.150
2X 3.200
2X .110
2X .110
TELEDYNE MODEL NUMBER
TELEDYNE
TSA-214145
SERNO XXXXXX
DATE CODE YYWW
SERIAL NUMBER
RF FB
RF IN
RF OUT
J1
2X 3.560
3.700
6X ø.125 THRU
DATE CODE (YR/WK)
2.92 MM "K" FEMAL CONNECTOR 2 PLACES
PIN 1
25 PINS MICRO D RECEPTACLE
.530
WR-28 FLANGE WITH O-RING GROOVE** FINISH: CHEM FILM
4X 4-40 UNC-2B X .150 MIN. THREAD DP.
.500
1.800
.56
NO PAINT ON THIS SURFACE 6 PLACES
.060
1.000
(.500)
MOUNTING SURFACE
J1: 25 PIN MICRO D CONNECTOR PER MIL-DTL-83513/2
PIN FUNCTION COLOR
J1-1 +VDC BLACK
J1-2 +VDC BROWN
J1-3 +VDC RED
J1-4 +VDC ORANGE
J1-5 GND YELLOW
J1-6 GND GREEN
J1-7 GND BLUE
J1-8 -TX (RS422) VIOLET
J1-9 +RX (RS422) GRAY
J1-10 RFTXEN (OPTIONAL, +3.3V=ON, 0V=OFF) WHITE
J1-11 GND (RS422) BLACK
J1-12 NC BROWN
J1-13 NC RED
J1-14 +VDC ORANGE
J1-15 +VDC YELLOW
J1-16 +VDC GREEN
J1-17 GND BLUE
J1-18 GND VIOLET
J1-19 GND GRAY
J1-20 GND WHITE
J1-21 +TX (RS422) BLACK
J1-22 -RX (RS422) BROWN
J1-23 SUMFLT (OPTIONAL, +3.3V=FAULT) RED
J1-24 NC ORANGE
J1-25 NC YELLOW
- -VDC VOLTAGE RANGES FROM +20.5V TO +32.5V APPLY SAME VOLTAGE TO ALL -VDC PINS
* DO NOT GROUND OPTIONAL PINS IF NOT USED, FLOAT IF NOT USED
** O-RING NOT INCLUDED
DO NOT SCALE DRAWING
TELEDYNE MICROWAVE SOLUTIONS
INSTALLATION DRAWING, TSA-214145 (LONG)
SIZE D CAGE CODE 24022 DWG NO. IN-015679-000 REV 2
SCALE: NONE WT: SHEET 1 OF 1