



R/C UAV Testing on Government Contract

RE: Form 442 Q4: Government Project Description, Exhibit

File Number: EL221414

Confirmation Number: 1319-EX-ST-2020

Date: August 2020

This application is an amendment to 0796-EX-ST-2020, Call Sign WQ9XNZ to add Camp Edwards (R-4101).

Systems & Technology Research (STR) is leading an effort on the DARPA Mercury program. The program involves a series of technology maturation tests to be performed by the STR team throughout CY2020 and early CY2021 at Fort Devens MA and Camp Edwards, Mashpee, MA culminating in a system test not addressed within this request.

The contract number is FA8650-19-C-7927. The contracting agency is USAF, AFMC, Air Force Research Laboratory, 2130 Eighth Street, Building 45, Wright-Patterson AFB, OH 4543307541

This test is being conducted as part of the Mercury Program. Mercury is a classified DoD mission which includes the use of several UAVs carrying classified payloads. The UAVs must autonomously fly to predetermined waypoints, hover at those waypoints, and return to base.

The frequency request is specific to the requirement to test the RF Payload functionality onboard the aircraft. The RF Payload test is designed as a bent pipe test, with a ground transmitter illuminating the aircraft payload, and the payload re-transmitting the signal back to the ground receiver. A series of tests between September and February are planned, with up to 4 sequential day tests each month. Tests will be held at Fort Devens Restricted Operation Zone for UAV operations within R-4102 A&B, and Army National Guard Base Camp Edwards within R4101.

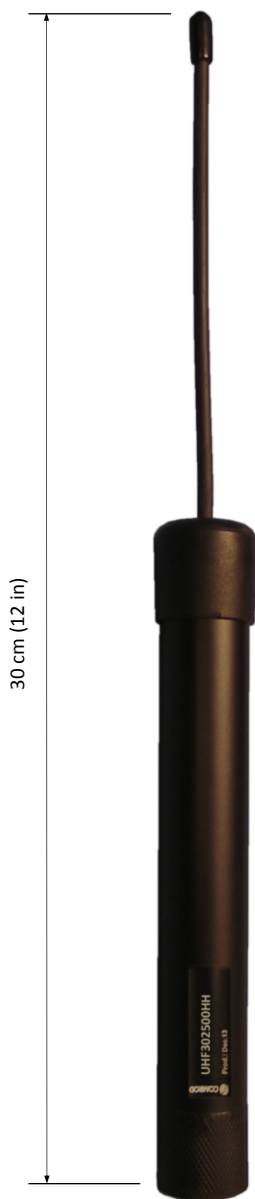
The test includes a ground transmitter composed of a signal generator, power amplifier, and a horn antenna. The aircraft will receive the signal, add a delay, and re-transmit to the ground receiver over an omni-directional antenna on board the aircraft. The low power emitters will be airborne, and the high power emitters will be on the ground utilizing directional antennas.

This test will confirm the fundamental functionality of the RF payload during flight, providing significant risk mitigation prior to the system demonstration at a separate facility.

Tests will be conducted by Systems & Technology Research, LLC (STR) and the Charles Stark Draper Laboratory, Inc. (Draper). The Air Force Research Laboratory



(AFRL) will serve as the Lead Test Organization (LTO). The test team is comprised of members from AFRL/RYZ, STR, Draper, GeoScout, L3Harris, and Centauri.



Description

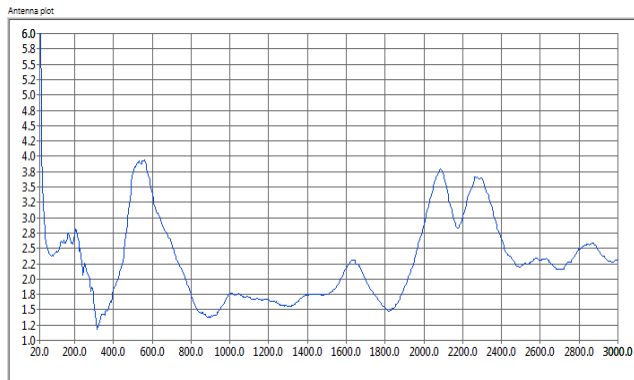
- Wideband antenna for hand-held radios
- Covering VHF, UHF & L-Band
- Small form factor only 30 cm (12 in) long
- Power rating 10 Watts
- Designed to meet MIL-STD-810-G

Electrical Specification

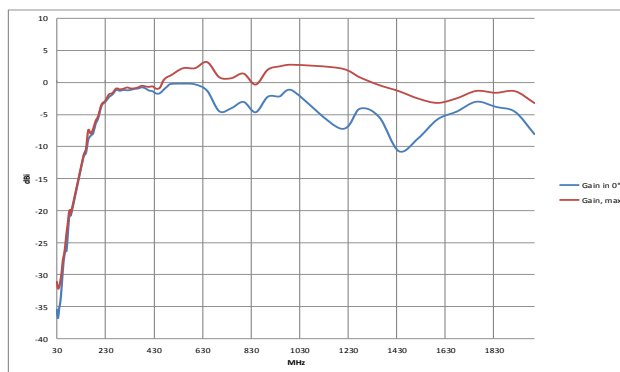
Frequency	30-2500 MHz
VSWR	See Curve
Gain	See Curve
Polarization	Vertical
Impedance	50 Ω
Power Rating	10 W

Mechanical Specification

Length	30 cm (12 in)
Diameter	22 mm (0.87 in)
Weight	137 g (5 oz)
Connector	TNC Male
Color	Black



VSWR



Gain (dBi)

Coaxial

High Power Amplifier

ZHL-100W-272+

50Ω 100W 700 to 2700 MHz

The Big Deal

- High output power, 100W typ.
- High gain, 48 dB typ.
- Excellent reverse isolation, 89 dB typ.
- Built-in over-temperature protection with temperature alarm



CASE STYLE: BT2247

Product Overview

The ZHL-100W-272+ is a high power amplifier module supply which can be used for a wide variety of laboratory testing applications. This rugged amplifier is capable of amplifying signals up to 100W output power over its entire operating frequency range of 700 – 2700 MHz. Built-in safety features include over-temperature protection. The amplifier's output stage is further protected in the event of a fault condition, allowing high power operation for up to 5 minutes into an OPEN or SHORT load (refer to the maximum input power specifications), preventing amplifier damage and providing excellent reliability.

Key Features

Feature	Advantages
Wide frequency range	700 – 2700 MHz frequency range covers popular wireless communications, SATCOM and radar bands in a single instrument, useful for many test applications.
100W output power	Supports high power test applications such as EMI, max power handling, and reliability testing
High Gain	48 dB typical gain allows the ZHL-100W-272+ to be driven to full output power with nearly all commercially available signal generators
High Reverse Isolation	Isolates load reflections to protect sensitive signal sources from potential damage and performance variation due to load pulling
Built-in protection	The unit shuts OFF when the internal amplifier reaches a set temperature of 85±5°C, preventing damage to the amplifier and providing added reliability.

Coaxial High Power Amplifier

50Ω 100W 700 to 2700 MHz

ZHL-100W-272+

Features

- High output power, 100W typ.
- High gain, 48 dB typ.
- Excellent reverse isolation, 89 dB typ.
- Built-in over-temperature protection

Applications

- Laboratory test instrument
- RF Power stress test
- EMI and antenna testing
- Reliability testing



CASE STYLE: BT2247

Connectors	Model
IN SMA-F	ZHL-100W-272+
OUT N-TYPE-F	
D-SUB MALE	

+RoHS Compliant

The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Electrical Specifications at 25°C

Parameter	Condition (MHz)	Min.	Typ.	Max.	Units
Frequency Range		700	—	2700	MHz
Gain	700 - 2700	45	48	—	dB
Gain Flatness	700 - 2700	—	±1.7	±2.1	dB
Output Power at 1dB compression	700 - 2700	—	+49	—	dBm
Output Power at 3dB compression	700 - 2700	+48	+50.6	—	dBm
Noise Figure	700 - 2700	—	8.2	10	dB
Output third order intercept point	700 - 2700	—	+50	—	dBm
Input VSWR	700 - 2700	—	1.5	—	:1
Output VSWR	700 - 2700	—	1.5	—	:1
DC Supply Voltage	DC	28	30	32	V
Supply Current	DC	—	12	16	A

Maximum Ratings¹

Parameter	Ratings
Operating Ambient Temperature	0°C to +40°C
Storage Temperature	-20°C to +70°C
DC Voltage	32V
Input RF Power (no damage)	+7 dBm ² -3 dBm ³

1. Specifications apply to CW signals only permanent damage may occur if any of these limits are exceeded.

2. Into 50 ohm load

3. Into open or short load, for up to 5 minutes.

D-Sub Male Connector Pin connections*

Pin #	Description
1,2,5,6,7	No Connection
3	TEMP. Alarm (TTL High)
4	+5V (max. 100mA)
8,9	Ground

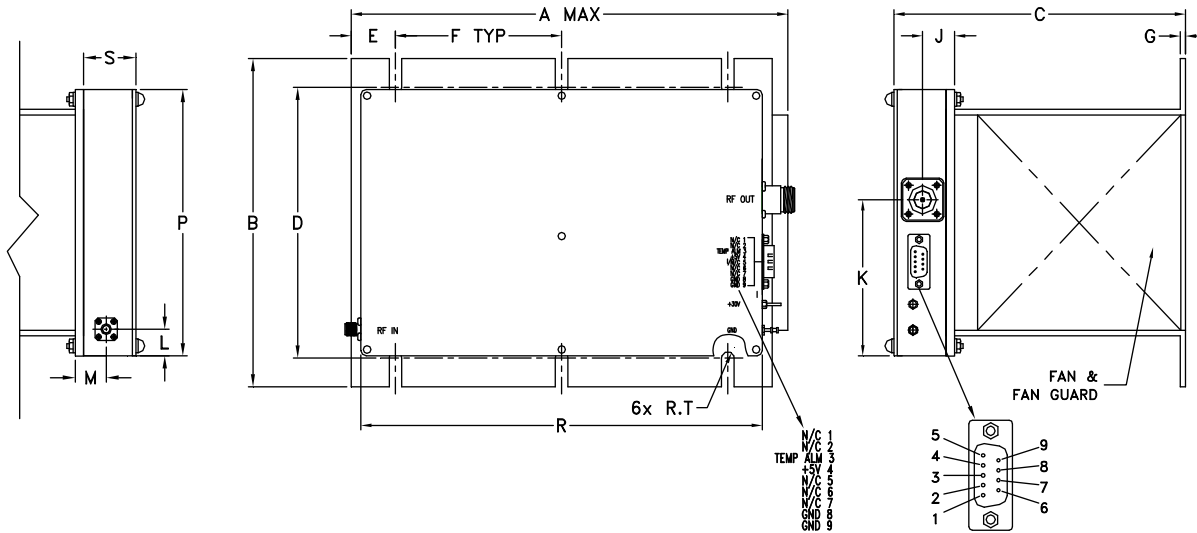
*Each amplifier will come with additional D-sub female connector for mating with amplifier.



www.minicircuits.com P.O. Box 350166, Brooklyn, NY 11235-0003 (718) 934-4500 sales@minicircuits.com

REV. A
M170866
ZHL-100W-272+
SK/MM/CP
181105
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Outline Drawing

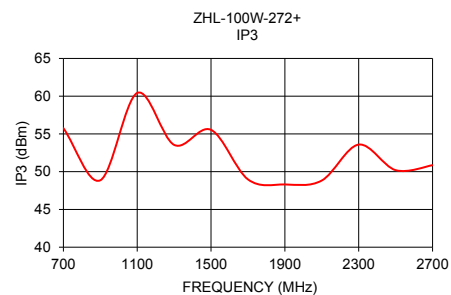
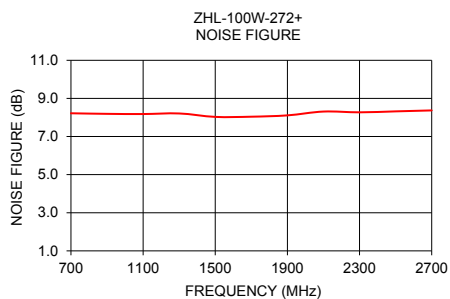
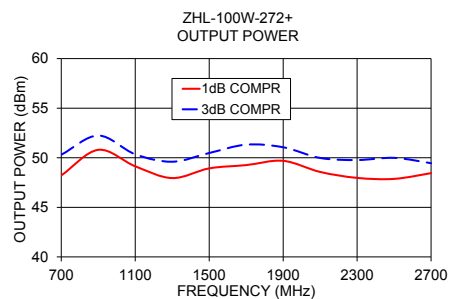
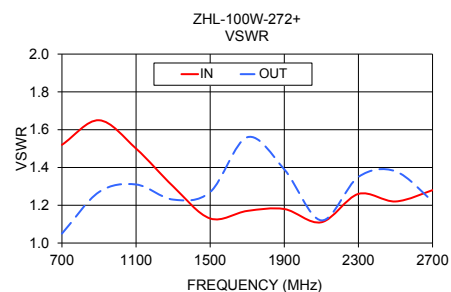
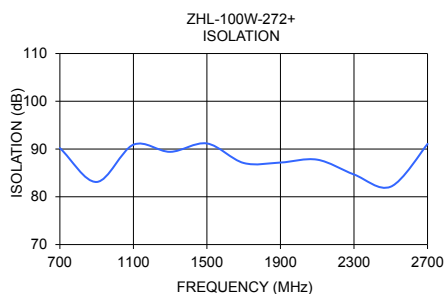
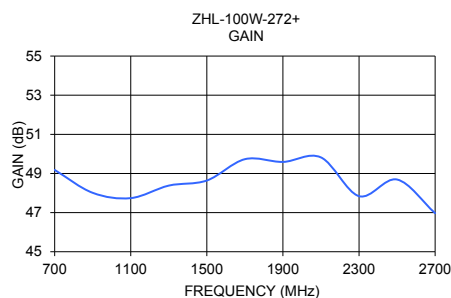


Outline Dimensions (inch/mm)

A	B	C	D	E	F	G	J	K	L	M	P	R	S	T	wt
9.85	7.3	6.6	6.00	.98	3.75	.13	.72	3.46	.59	.70	5.91	9.06	1.18	.135	grams
250.19	185.42	167.64	152.40	24.89	95.25	3.30	18.29	87.88	14.99	17.78	150.11	230.12	29.97	3.43	5350

Typical Performance Data

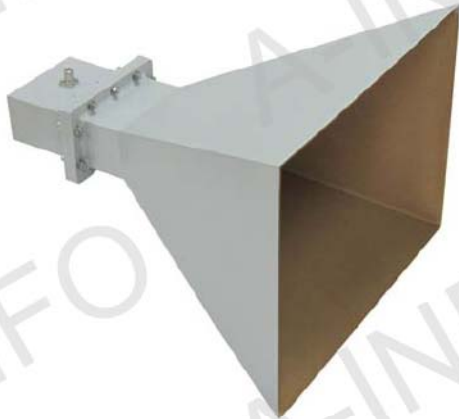
FREQUENCY (MHz)	GAIN (dB)	ISOLATION (dB)	VSWR (:1)		POUT at 1 dB COMPR. (dBm)	POUT at 3 dB COMPR. (dBm)	NOISE FIGURE (dB)	IP3 (dBm)
			IN	OUT				
700	49.2	90.2	1.5	1.1	48.2	50.3	8.2	55.8
900	48.0	83.1	1.7	1.3	50.8	52.2	8.2	48.9
1100	47.7	90.9	1.5	1.3	49.1	50.4	8.2	60.4
1300	48.4	89.4	1.3	1.2	48.0	49.6	8.2	53.6
1500	48.6	91.2	1.1	1.3	48.9	50.5	8.0	55.5
1700	49.7	87.1	1.2	1.6	49.3	51.3	8.0	49.0
1900	49.6	87.2	1.2	1.4	49.7	51.1	8.1	48.3
2100	49.8	87.8	1.1	1.1	48.6	50.0	8.3	48.8
2300	47.8	84.7	1.3	1.4	48.0	49.8	8.3	53.6
2500	48.7	82.1	1.2	1.4	47.9	50.0	8.3	50.2
2700	47.0	91.1	1.3	1.2	48.5	49.5	8.4	50.9



Additional Notes

- Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

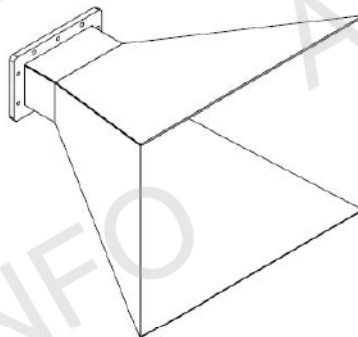
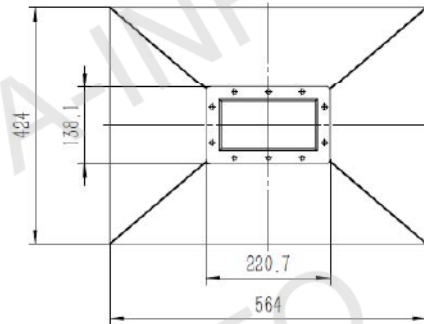
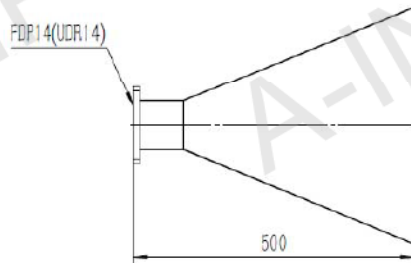
Technical Specification



Frequency Range(GHz)	1.12 -1.70
Gain(dB)	15 Typ.
3dB Beamwidth(deg)	30 Typ.
Waveguide	WR650(UDR14)
Material	Al
Output	A Type: FDP14 C Type: N-F or SMA-F or 7/16-F
Size(mm)	A Type: 564x424x500 C Type: 564x424x650
Net Weight(Kg)	A Type: 5.50 Around C Type: 6.95 Around

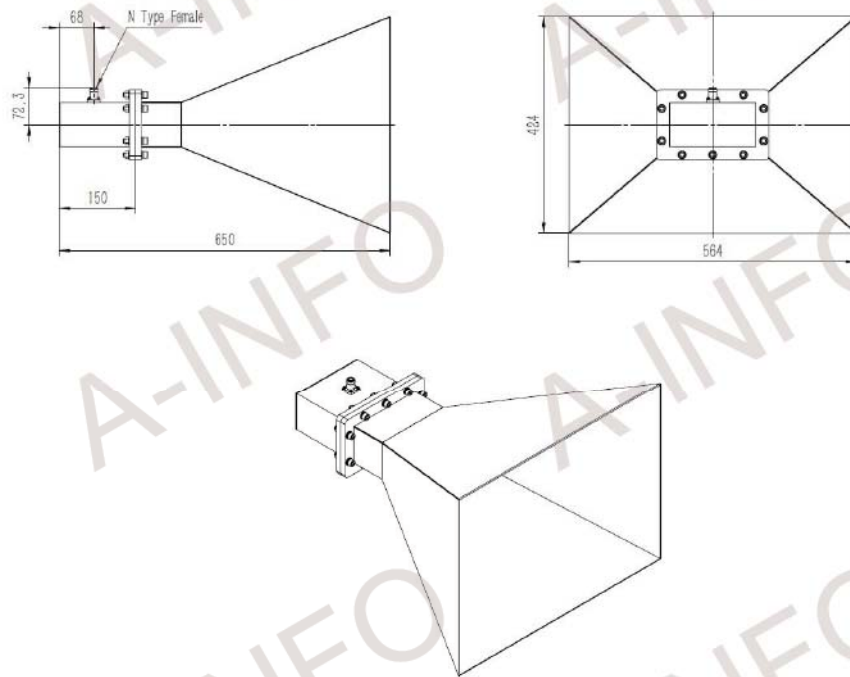
Outline Drawing (Size: mm)

A Type (With FDP14 Output)



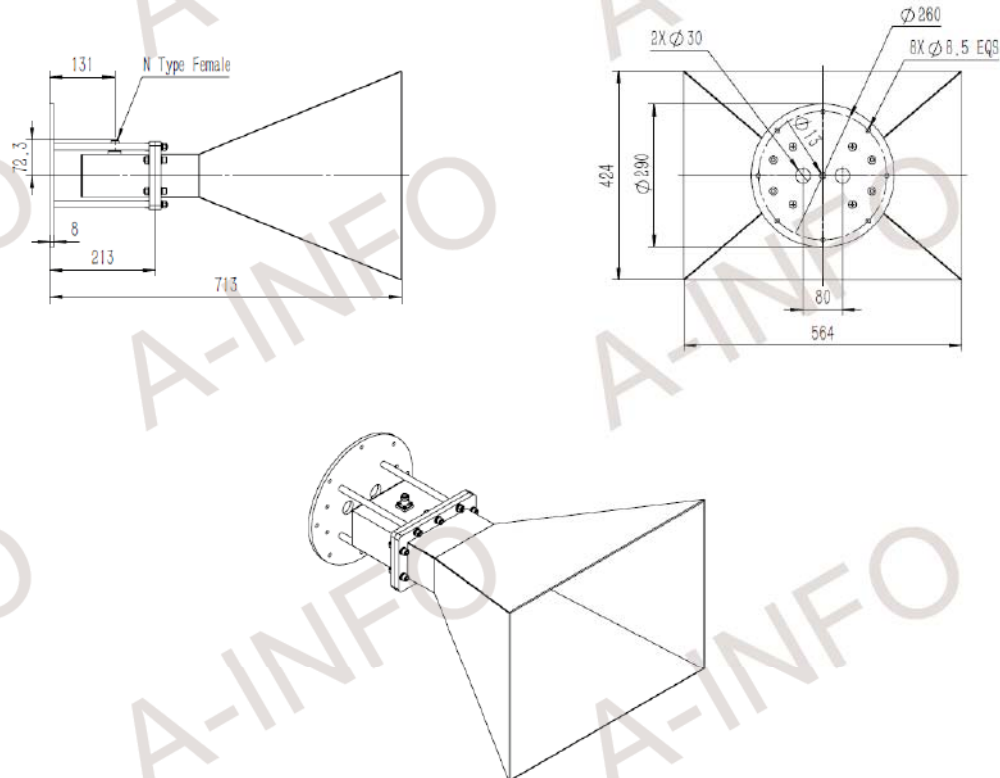
C Type (With N type Female Output)

For SMA-Female or 7/16-Female output outline drawing, please contact A-INFO.



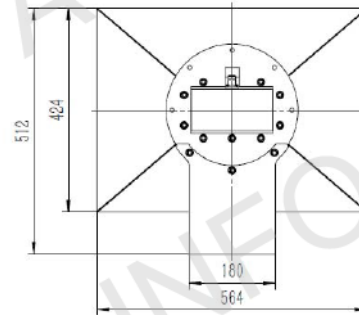
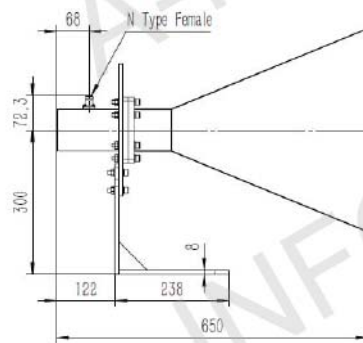
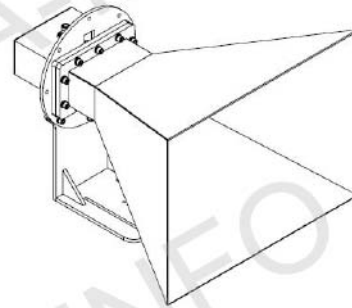
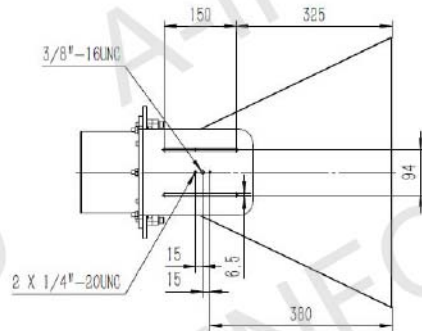
C Type (With N type Female Output & Round Mounting Bracket)

For SMA-Female or 7/16-Female output outline drawing, please contact A-INFO.

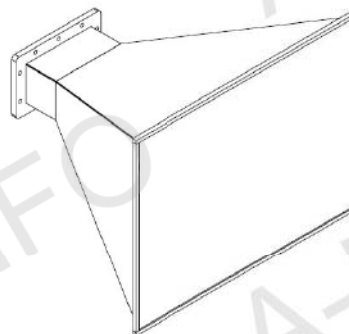
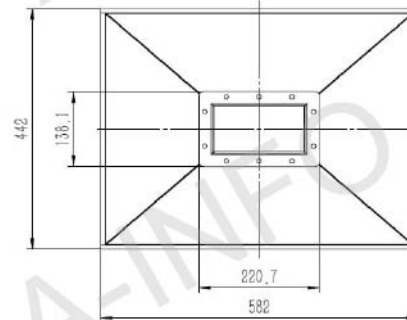
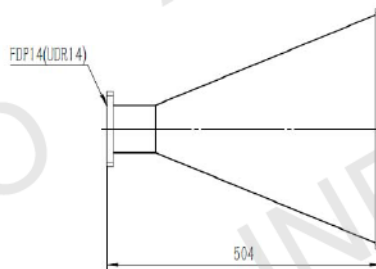


C Type (With N type Female Output & L Type Mounting Bracket)

For SMA-Female or 7/16-Female output outline drawing, please contact A-INFO.

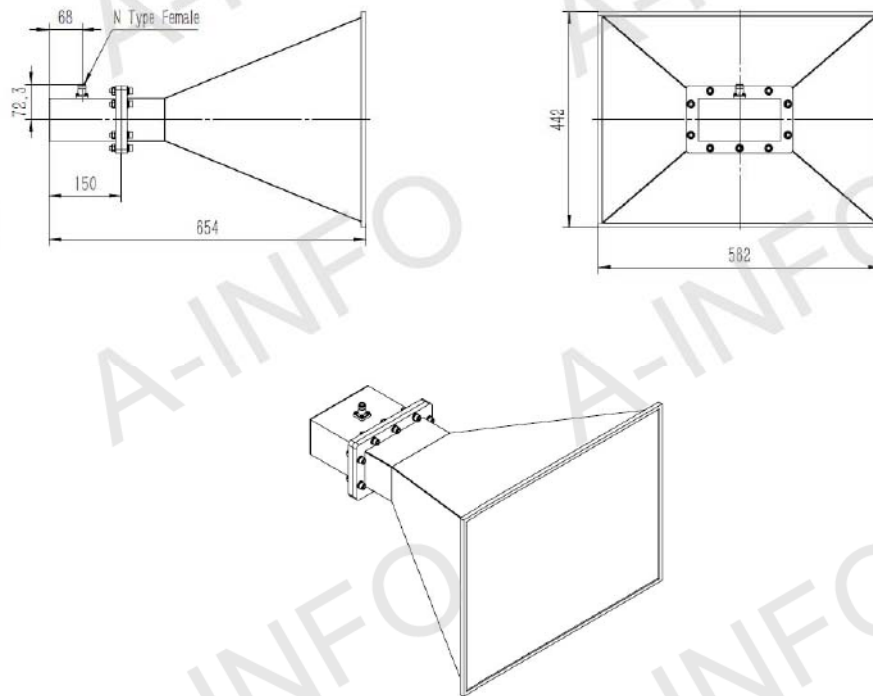


A Type (With Radome)



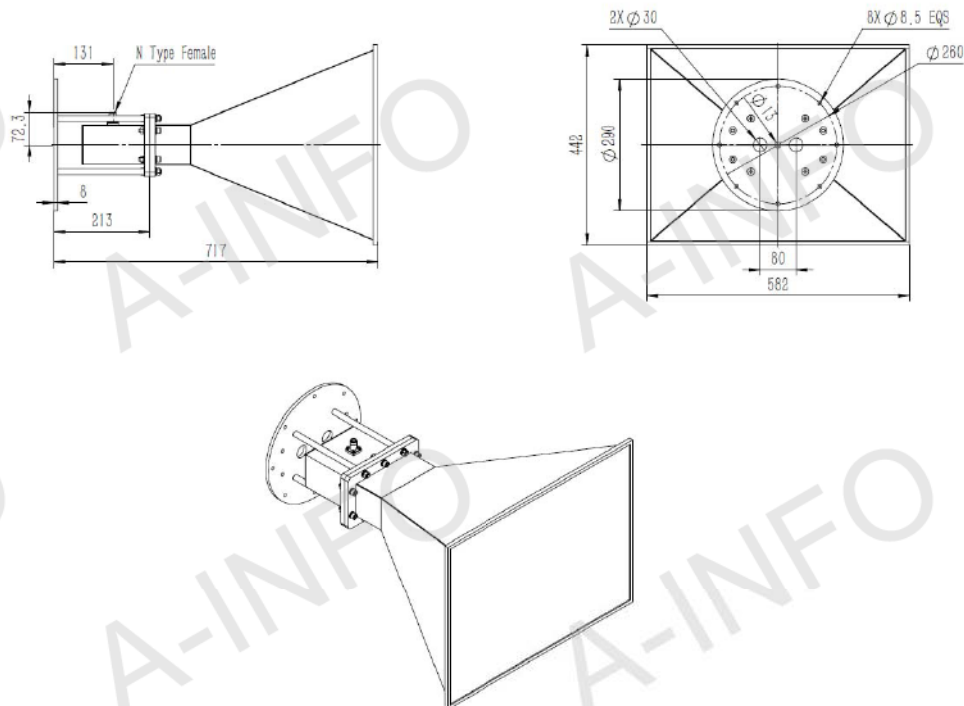
C Type (With N type Female Output & Radome)

For SMA-Female or 7/16-Female output outline drawing, please contact A-INFO.

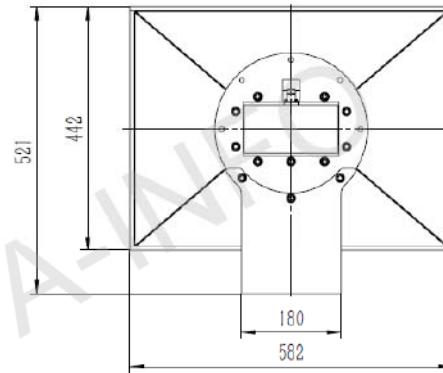
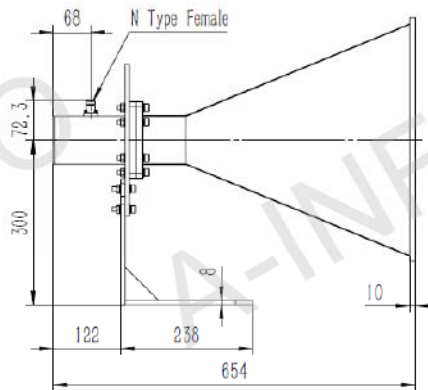
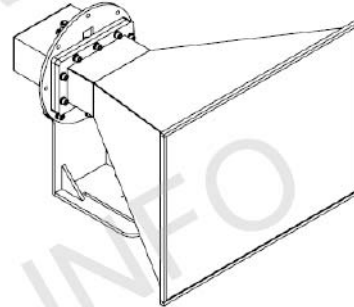
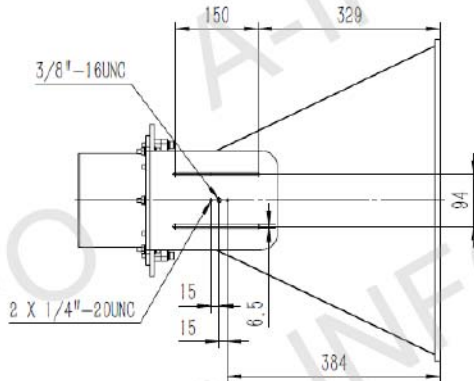


C Type (With N type Female Output & Round Mounting Bracket & Radome)

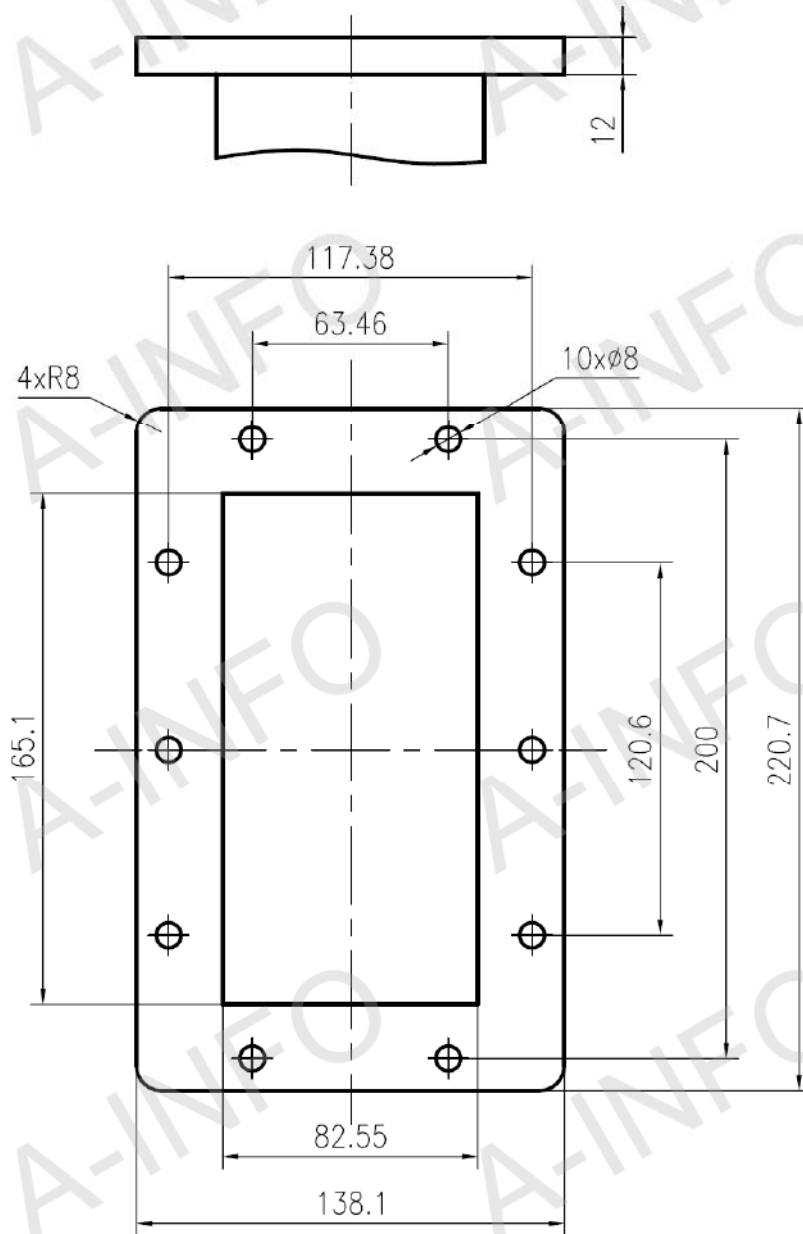
For SMA-Female or 7/16-Female output outline drawing, please contact A-INFO.



C Type (With N type Female Output & L Type Mounting Bracket & Radome)
For SMA-Female or 7/16-Female output outline drawing, please contact A-INFO.



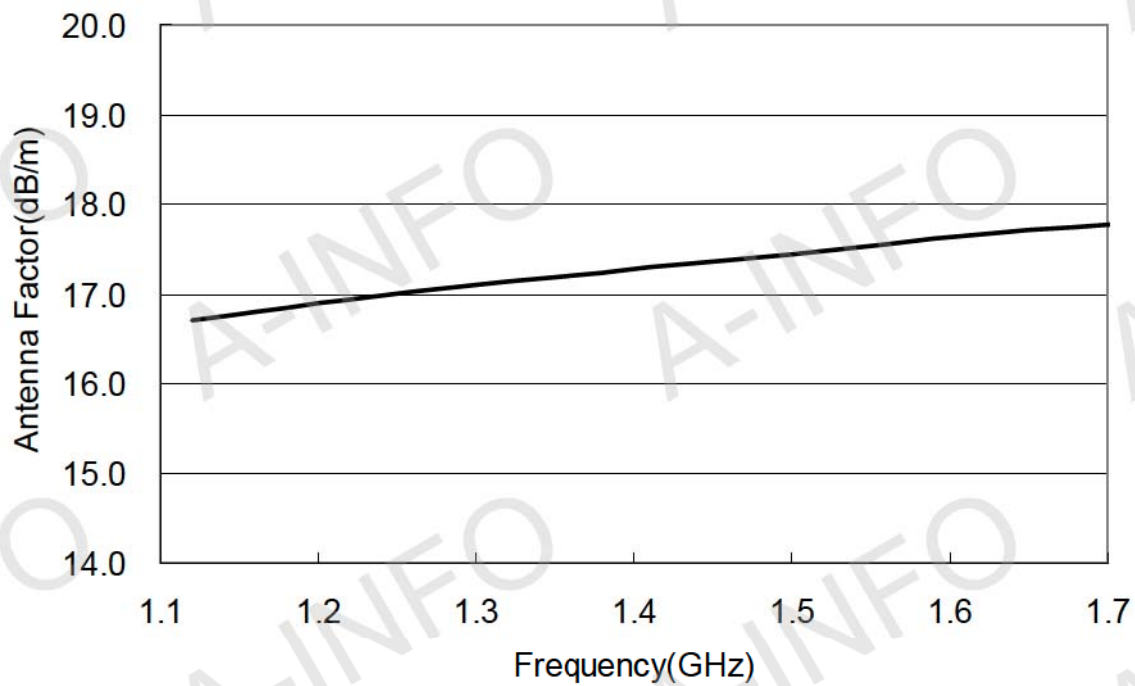
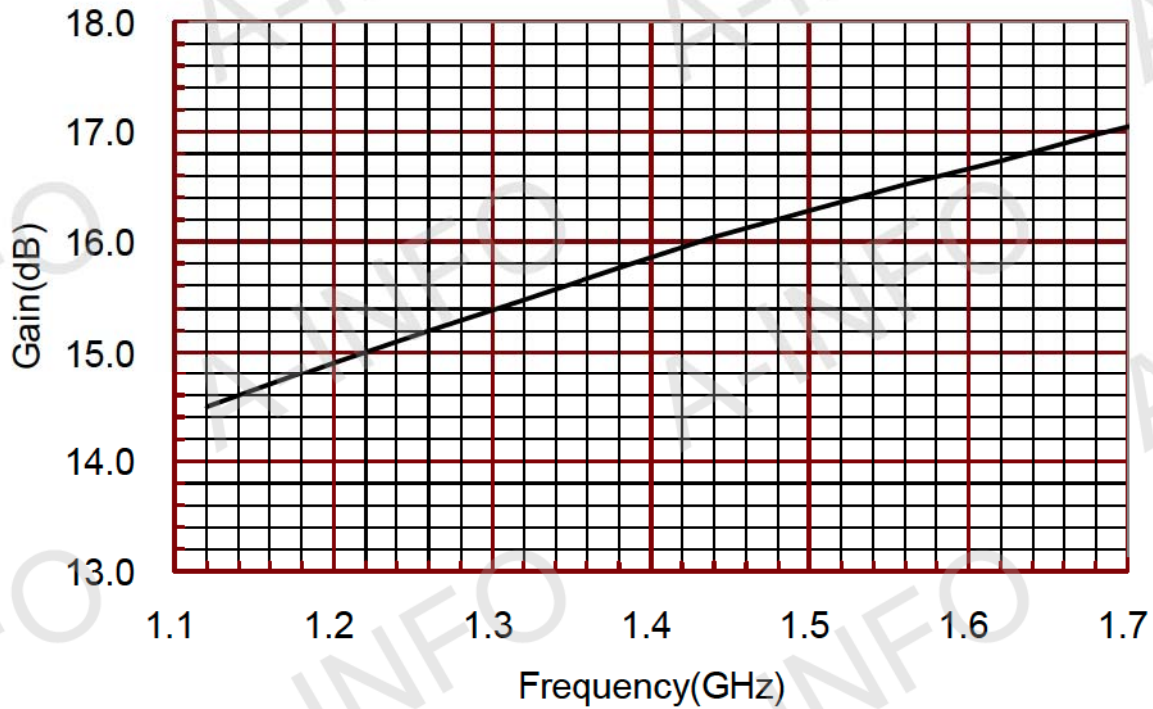
Flange Drawing (Size: mm)



FDP14

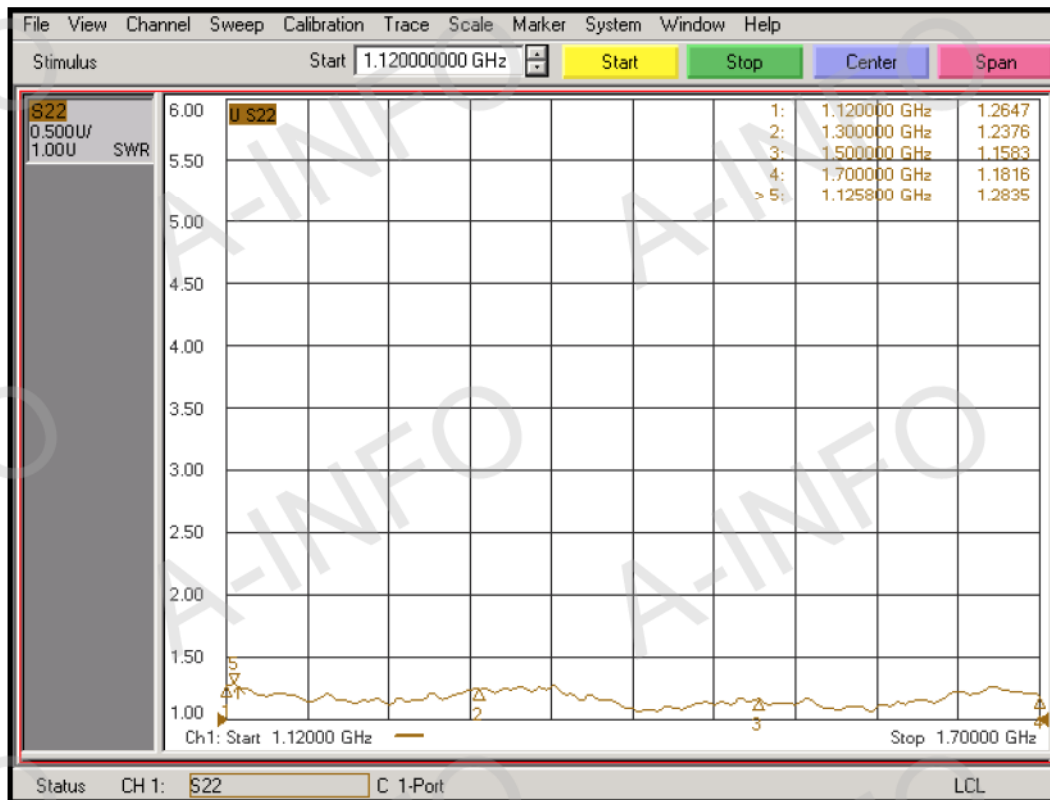
Test Results

1. Gain and Antenna Factor

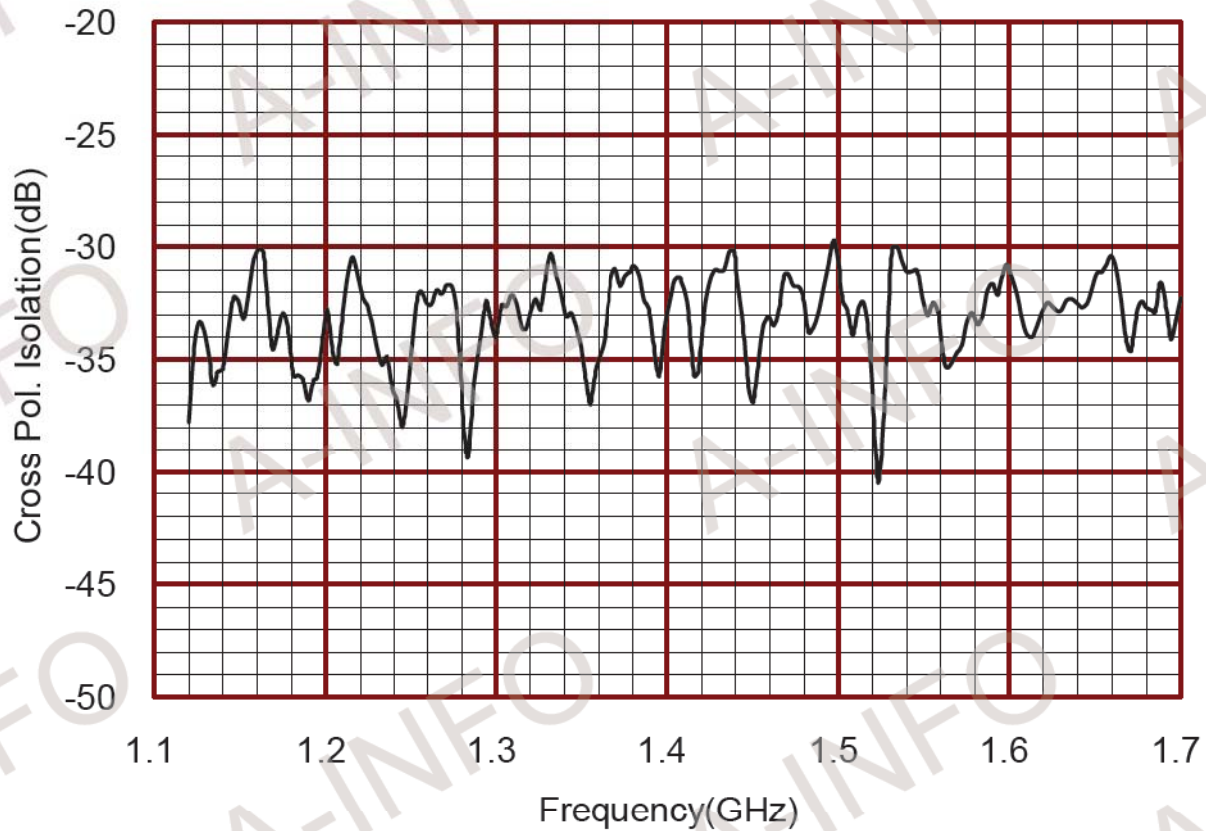


Frequency(GHz)	Gain(dB)	Antenna Factor(dB/m)
1.12	14.49	16.70
1.20	14.90	16.89
1.26	15.20	17.02
1.32	15.48	17.14
1.38	15.77	17.24
1.44	16.04	17.34
1.50	16.29	17.44
1.56	16.52	17.55
1.62	16.74	17.66
1.68	16.97	17.75
1.74	17.19	17.83

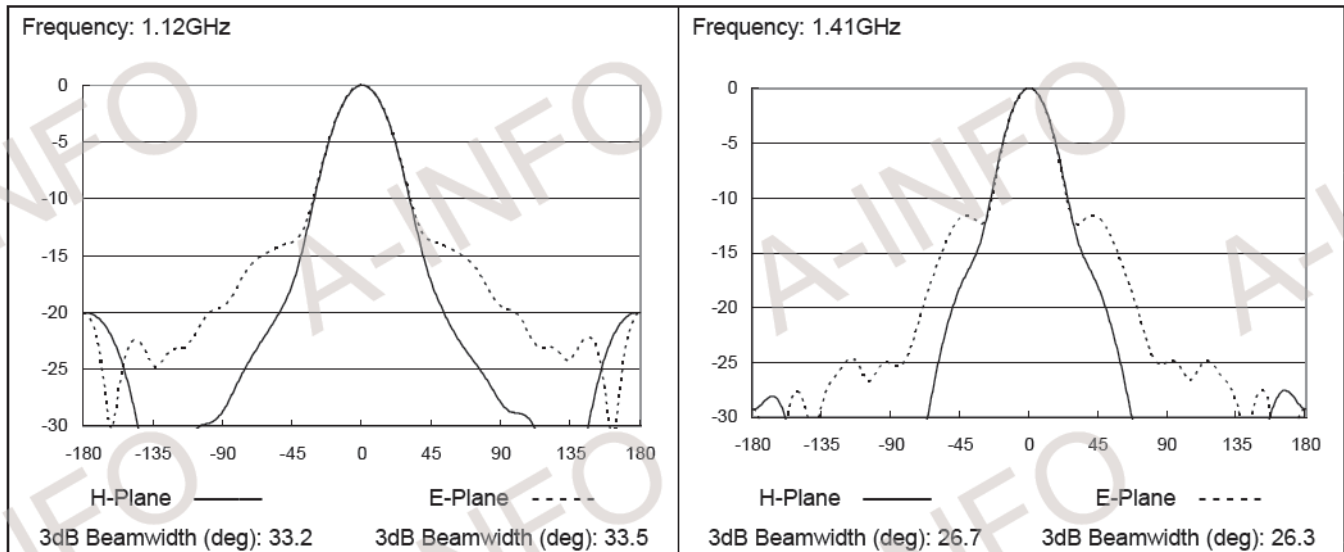
2. VSWR

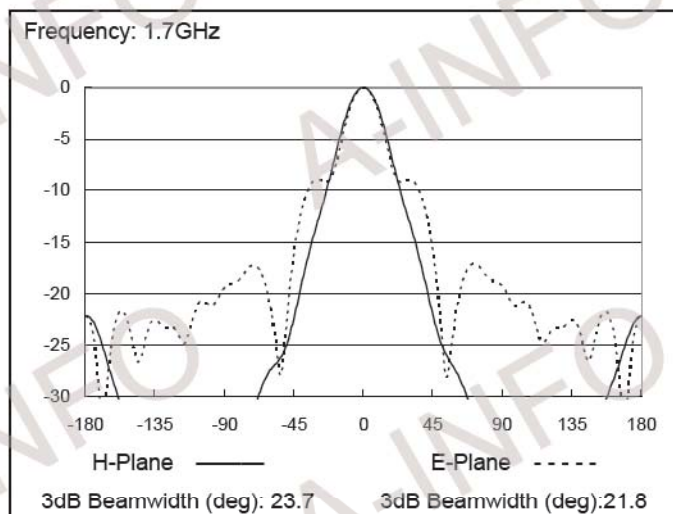


3. Cross Polarization Isolation



4. Pattern







43 dB Gain, 10 Watt Psat, 30 MHz to 2.5 GHz, High Power GaN Amplifier, SMA

TECHNICAL DATA SHEET

PE15A5011

PE15A5011 is a 10W Class AB, High Gain GaN Linear Power Amplifier operating in the 0.03 to 2.5 GHz frequency range. The amplifier offers high linear transmit power with superior EVM performance and efficiency over 40%. The amplifier has a Wide Dynamic Range with 40 dBm typical saturated power, 43 dB typical small signal gain, ± 2.0 dB gain flatness maximum. The driver amplifier requires a +32V maximum DC power supply, is unconditionally stable and includes built-in voltage regulation, bias sequencing, and reverse bias protection for added reliability. The amplifier operates over the temperature range of -20°C and +80°C.

Features

- 0.03 GHz to 2.5 GHz Frequency Range
- Psat 10 Watts typ
- Small Signal Gain: 43 dB typ
- Gain Flatness: ± 2.0 dB maximum
- Switching Speed 1 usec typical
- Superior EVM performance and Efficiency over 40%
- 50 Ohms Input and Output Matched
- Unconditionally Stable
- Regulated Supply & Bias Sequencing
- SMA Female RF Connectors
- DC/Control Connector 7W2 D Sub

Applications

- L-band Military Radar
- Weather & Earth Observation Satellites
- Radar & Communication Systems
- High Gain Driver Power Amplifier
- High Gain Output Power Amplifier

Electrical Specifications (TA = +25°C, DC Voltage = 12Volts, DC Current = 2.8A)

Description	Minimum	Typical	Maximum	Units
Frequency Range	0.03		2.5	GHz
Small Signal Gain		43		dB
Gain Flatness			± 2	dB
Input Power (CW)			+5	dBm
Pout at Sat.	+38	+40		dBm
Impedance (Input)		50		Ohms
Impedance (Output)		50		Ohms
Input Return Loss		-13		dB
Switching Speed for On/Off Switch Gate		1,000	2,000	usec
TTL Control	"1": On, "0": Off, Enable: 5V, Disable: 0V			
Operating DC Voltage	9	12	32	Volts
Operating DC Current			2.8	A
Operating DC Current @ 12 Volt			2.8	A
Operating DC Current @ 28 Volt			1.2	A
Operating Temperature Range	-20		+80	°C

Click the following link (or enter part number in "SEARCH" on website) to obtain additional part information including price, inventory and certifications: [43 dB Gain, 10 Watt Psat, 30 MHz to 2.5 GHz, High Power GaN Amplifier, SMA PE15A5011](#)



43 dB Gain, 10 Watt Psat, 30 MHz to 2.5 GHz,
High Power GaN Amplifier, SMA

TECHNICAL DATA SHEET

PE15A5011

Mechanical Specifications

Size	
Length	3.75 in [95.25 mm]
Width	2 in [50.8 mm]
Height	0.52 in [13.21 mm]
Weight	0.699 lbs [317.06 g]
Input Connector	SMA Female
Output Connector	SMA Female
Cooling	HEATSINK REQUIRED use PE15C5013 or PE15G5011F

Environmental Specifications

Temperature	
Operating Range	-20 to +80 deg C
Storage Range	-65 to +150 deg C
Humidity	95%
Shock	MIL-STD-810F Method 516.5
Vibration	MIL-STD-810F Method 516.5
Altitude	30000

Compliance Certifications (see [product page](#) for current document)

Plotted and Other Data

Notes:

- Values at +25 °C, sea level
- ESD Sensitive Material, Transport material in Approved ESD bags. Handle only in approved ESD Workstation.
- Heat Sink Required for Proper Operation, Unit is cooled by conduction to heat sink.



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**43 dB Gain, 10 Watt Psat, 30 MHz to 2.5 GHz,
High Power GaN Amplifier, SMA**

TECHNICAL DATA SHEET

PE15A5011

Amplifier Power-up Precautions

- 1.) Confirm that proper ESD precautions and controls are always in place before handling any Amplifier module.
- 2.) Confirm adequate thermal management is in place to effectively dissipate heat away from the Amplifier package. The Amplifier operational baseplate temperature must be within the operational temperature range stated in the Amplifier datasheet. Depending on the design and thermal requirements, using a heatsink with cooling fan is always recommended for safe reliable operation. A heat sink without a cooling fan may also be used. Damage caused from overheating will void the warranty.
- 3.) Confirm adequate system grounding is established. The DC power supply and Amplifier must have a common ground in order to operate properly.
- 4.) Power Amplifiers may require additional DC Current when initially powered-up. Depending on the design, the input current draw could range from an additional 10% to 100% above the maximum rated DC current of the Amplifier. This varies based on product part number.
- 5.) Confirm the DC power supply, if limited, is set to allow for additional start-up current that's rated for the Power Amplifier.
- 6.) Confirm the system is designed and calibrated for 50 ohms. Any impedance mismatch may cause performance issues.
- 7.) Perform a CALIBRATION (if required) with the loads before connecting the Amplifier to the Network Analyzer to ensure proper performance.
- 8.) Use a fixed attenuator between the signal source and input port of the Amplifier to optimize the input VSWR match.
- 9.) Confirm the input power level at the input port of the amplifier does not exceed the maximum rated limit for input power (as stated in the Amplifier datasheet).
 P_{in} for Small Signal Gain = $P_{1dB-SSG} - 10$ dB
 P_{in} for P_{1dB} = $P_{1dB-SSG} + 1$ dB
- 10.) Confirm the Network Analyzer is always connected to the Amplifier first before DC power is applied to the Amplifier.
- 11.) As long as the input and output ports of the amplifier are connected to a 50 Ohm load and RF signal power is applied, the Amplifier can be powered up with DC voltage.
- 12.) Confirm the Amplifier output load is matched for a 50 Ohm impedance and will not exceed the maximum rated VSWR or Return Loss limit for the Amplifier. Exceeding the maximum rated VSWR or Return Loss limit will result in reflected signal power that could damage the Amplifier and void the warranty.
- 13.) **Power Amplifier connected to an Antenna for signal transmission** - It's strongly recommended to use a high power fixed attenuator pad or an Isolator between the output port of the Amplifier and input port to the antenna. Any reflected signal power due to impedance mismatch will likely damage the Amplifier and void the warranty.
- 14.) The attenuator or isolator used at the output port of the Amplifier must be rated to handle the output power level and operational frequency band of the amplifier.

Click the following link (or enter part number in "SEARCH" on website) to obtain additional part information including price, inventory and certifications: [43 dB Gain, 10 Watt Psat, 30 MHz to 2.5 GHz, High Power GaN Amplifier, SMA PE15A5011](#)

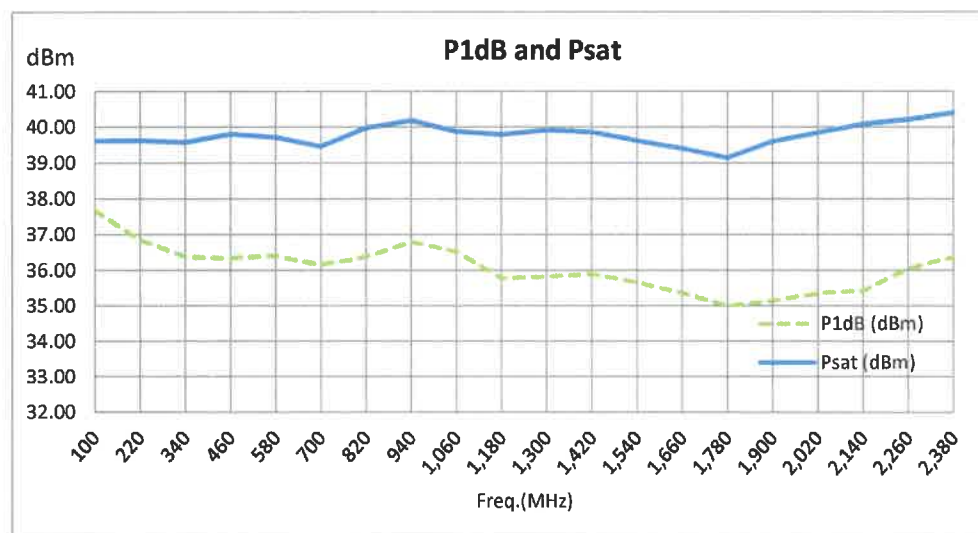
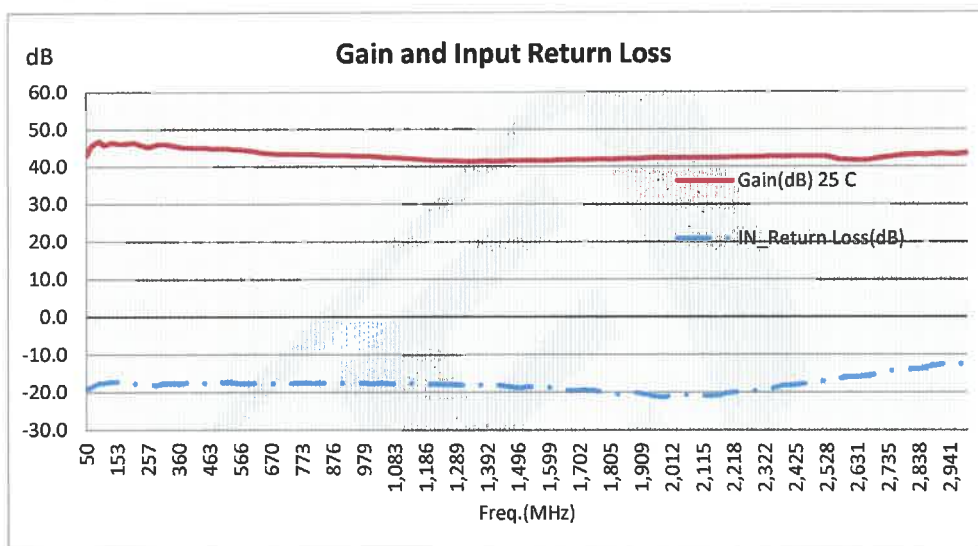


43 dB Gain, 10 Watt Psat, 30 MHz to 2.5 GHz,
High Power GaN Amplifier, SMA

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Typical Performance Data



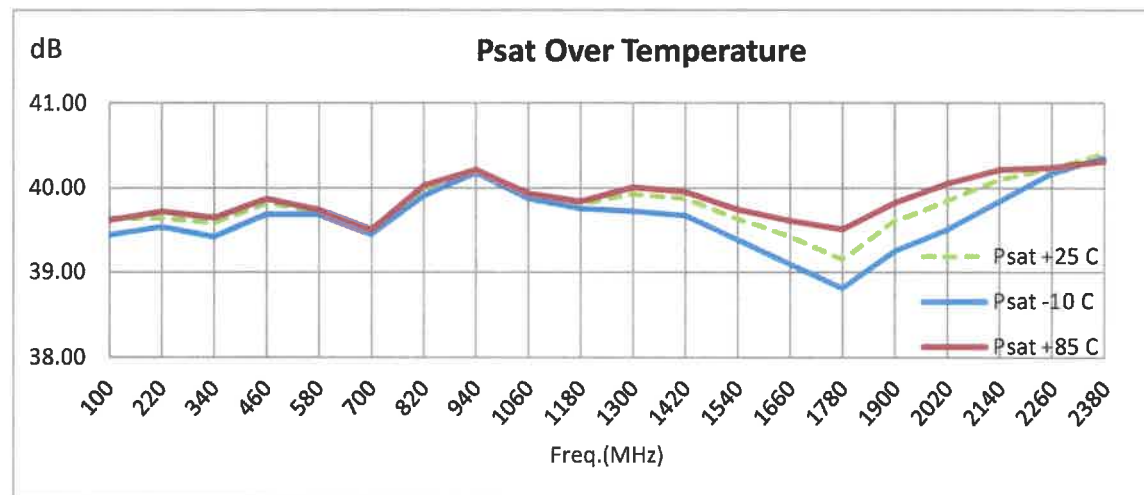
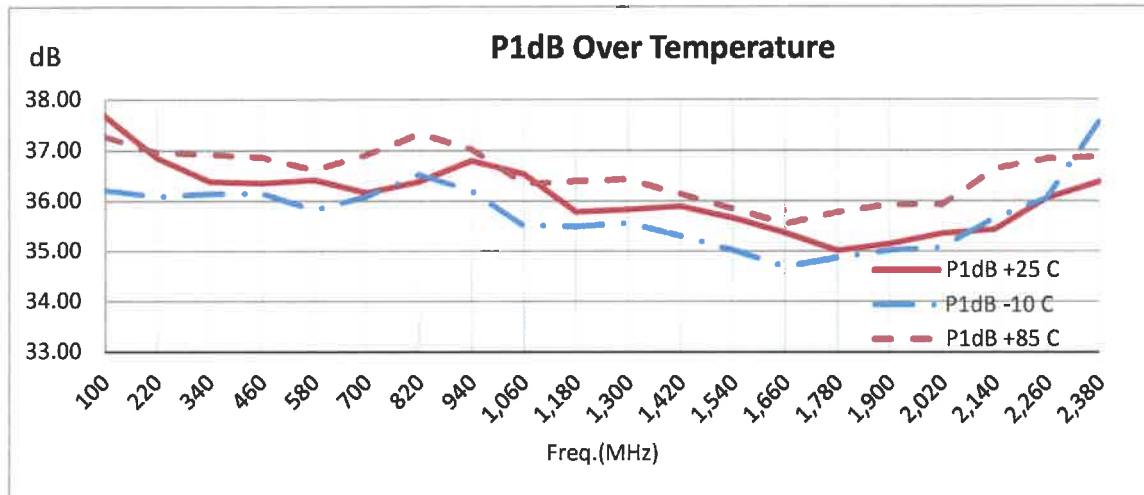
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43 dB Gain, 10 Watt Psat, 30 MHz to 2.5 GHz,
High Power GaN Amplifier, SMA

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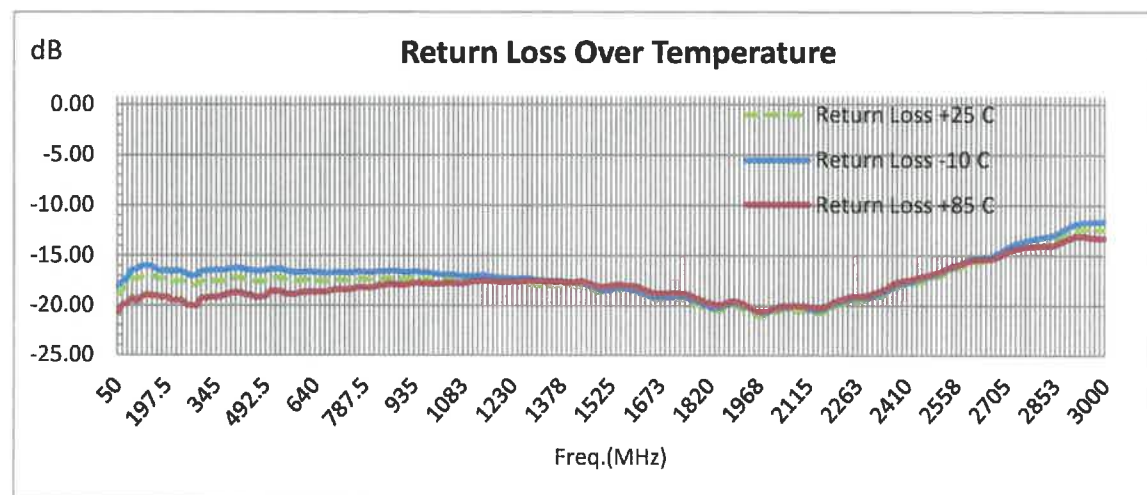
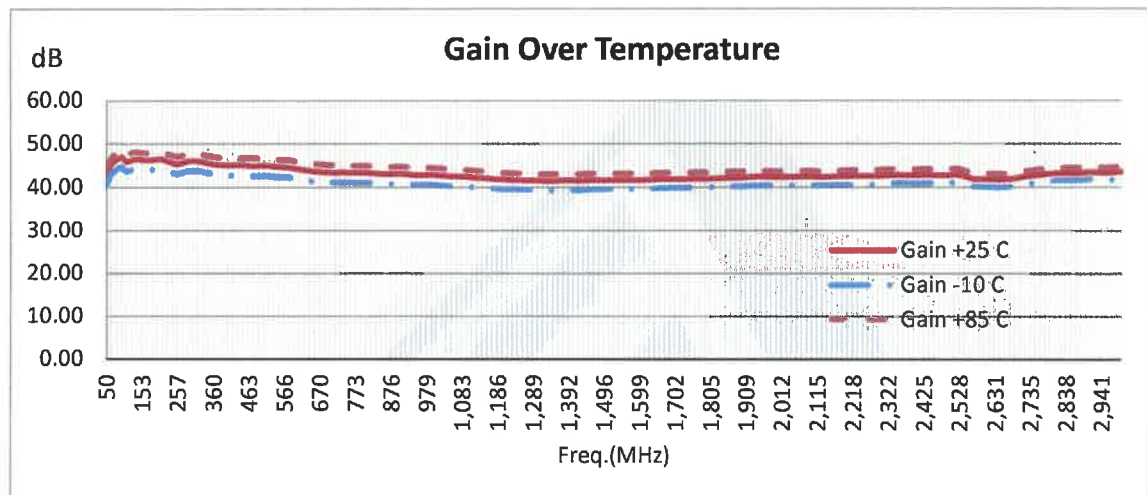
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43 dB Gain, 10 Watt Psat, 30 MHz to 2.5 GHz,
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**43 dB Gain, 10 Watt Psat, 30 MHz to 2.5 GHz,
High Power GaN Amplifier, SMA**

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43 dB Gain, 10 Watt Psat, 30 MHz to 2.5 GHz, High Power GaN Amplifier, SMA from Pasternack Enterprises has same day shipment for domestic and International orders. Our RF, microwave and millimeter wave products maintain a 99.4% availability and are part of the broadest selection in the industry.

Click the following link (or enter part number in "SEARCH" on website) to obtain additional part information including price, inventory and certifications: [43 dB Gain, 10 Watt Psat, 30 MHz to 2.5 GHz, High Power GaN Amplifier, SMA PE15A5011](https://www.pasternack.com/43-db-gain-2.5-ghz-high-power-high-gain-amplifier-sma-pe15a5011-p.aspx)

URL: <https://www.pasternack.com/43-db-gain-2.5-ghz-high-power-high-gain-amplifier-sma-pe15a5011-p.aspx>

The information contained in this document is accurate to the best of our knowledge and representative of the part described herein. It may be necessary to make modifications to the part and/or the documentation of the part, in order to implement improvements. Pasternack reserves the right to make such changes as required. Unless otherwise stated, all specifications are nominal. Pasternack does not make any representation or warranty regarding the suitability of the part described herein for any particular purpose, and Pasternack does not assume any liability arising out of the use of any part or documentation.

43 dB Gain, 10 Watt Psat, 30 MHz to 2.5 GHz, High Power GaN Amplifier, SMA



DWG TITLE

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FSCM NO. 53919

CAD FILE **101314**

SCALE N/A

SIZE A

150