



Wideband 0.6-2GHz GaAs Low Noise Amplifier

Description

BHWL160 is an ultra-low noise amplifier designed in advanced GaAs E/D-pHEMT process, featuring wideband operation from 600MHz to 2GHz. For GNSS, it provides simultaneous, uncompromised performance across all frequency bands of all major constellations including GPS, Beidou, GLONASS and Galileo. The device is housed in an ultra-compact 1.45x1mm 6-Lead DFN (Dual Flat No-Lead) package, provides 0.5dB noise figure (GNSS High-Band), and the industry's highest-class input P1dB and IIP3/IIP2, with adjustable current as low as sub-2mA for 1.2V to 3.6V operation. BHWL160 has integrated ESD protection on all pins, and requires only one external inductor and capacitor for conventional GNSS bands from 1550-1610MHz.

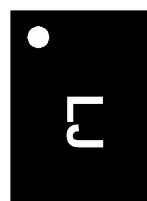
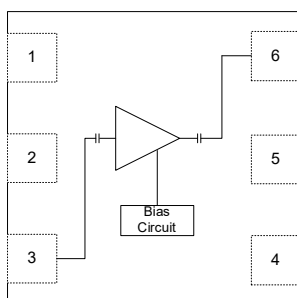
Key Features

- Advanced GaAs E/D-pHEMT Process
- 0.6-2GHz Operation Frequency Range
- Low Noise Figure: 0.5~0.7dB (GNSS Full Band)
- Power Gain: 15.5 ~16.5dB
- High Input P1dB: -5.5dBm@2.8V (GPS L1)
- Low Current: 7mA/2mA at 2.8V/1.2V
- Adjustable Current 1.5~9mA at 1.0~3.6V
- Integrated ESD for 1KV HBM & >2KV CDM
- Ultra-Small 1.45x1mm DFN Package

Key Applications

- GNSS for Smart Watches, Wearables
- GNSS for PNDs, Drones/UAVs
- GNSS for Vehicles, ADS Systems
- UHF 600/700/868/915MHz Systems
- 2.4GHz BLE AoA/AoD Systems
- 2.4GHz Remote Controls
- Other Generic Radios from Sub-GHz to 2.5GHz

Functional Block and Package Information

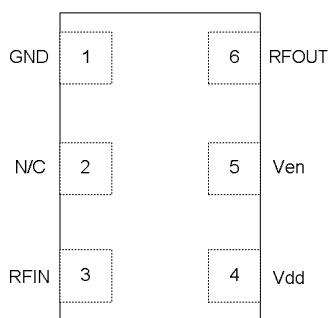


1.45x1x0.55mm 6L DFN



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Pin Assignment and Pin Description



(Top "See-Through" View)

Pin Number	Pin Name	Description
1	GND	Ground
2	N/C	No Connection. Can be connected to GND in PCB layout.
3	RFIN	RF Input
4	Vdd	DC Voltage Supply
5	Ven	LNA Enable Voltage
6	RFOUT	RF Output

Absolute Maximum Ratings

Parameter		Rating	Unit
Supply Voltage	Vdd	5	V
Enable Voltage	Ven	3.6	V
Maximum Input Power		+10	dBm
Maximum Current		25	mA
Junction Temperature		+150	°C
Operation Temperature		-40 to +85	°C
Storage Temperature		-40 to +150	°C
Moisture Sensitivity Level		MSL1	

Note: Do not exceed any single or combination of the above parameters. Sustained operation at or above the Absolute Maximum Ratings may result in permanent damage to the device. Maximum Input Power Rating assumes 50-Ohm load impedance.



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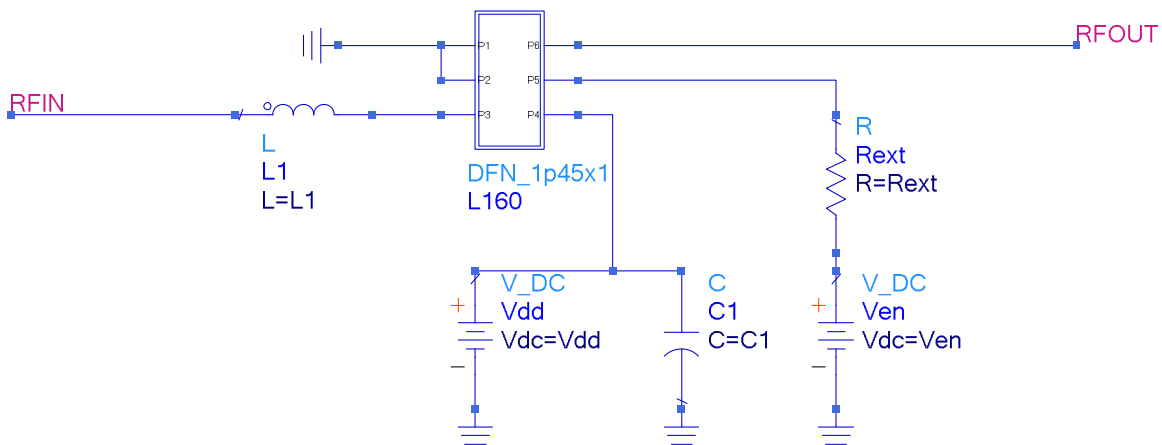
Electrical Specifications (GNSS High-Band)*

Parameter	Condition	Specification			Unit
		Min.	Typ.	Max.	
Operating Frequency		1550	1575	1610	MHz
Operating Voltage		1.2	2.8	3.6	V
Quiescent Current	VDD=VEN=2.8V, No RF Input		7	9	mA
Shutdown Current	VDD=3.3V, VEN=0			1	uA
Small-Signal Gain	Pin=-30dBm		15.5		dB
Noise Figure			0.5		dB
Input Return Loss		9	11		dBm
Output Return Loss		12	16		dB
Isolation		22	24		dB
Input P1dB	At VDD=VEN=2.8V		-5.5		dBm
In-Band IIP3	f1/f2=1575/1576MHz, -30dBm per Tone, 2.8V		+3		dBm
Out-of-Band IIP3	f1/f2=1712.7/1850MHz, -30dBm per Tone, 2.8V		+4		dBm

*As measured on BHWL160 EVB with 9.1nH input inductor, VDD=VEN=2.8V. Refer to BHWL160 Application Note for additional test data in details.

Application Schematic (GNSS High-Band)

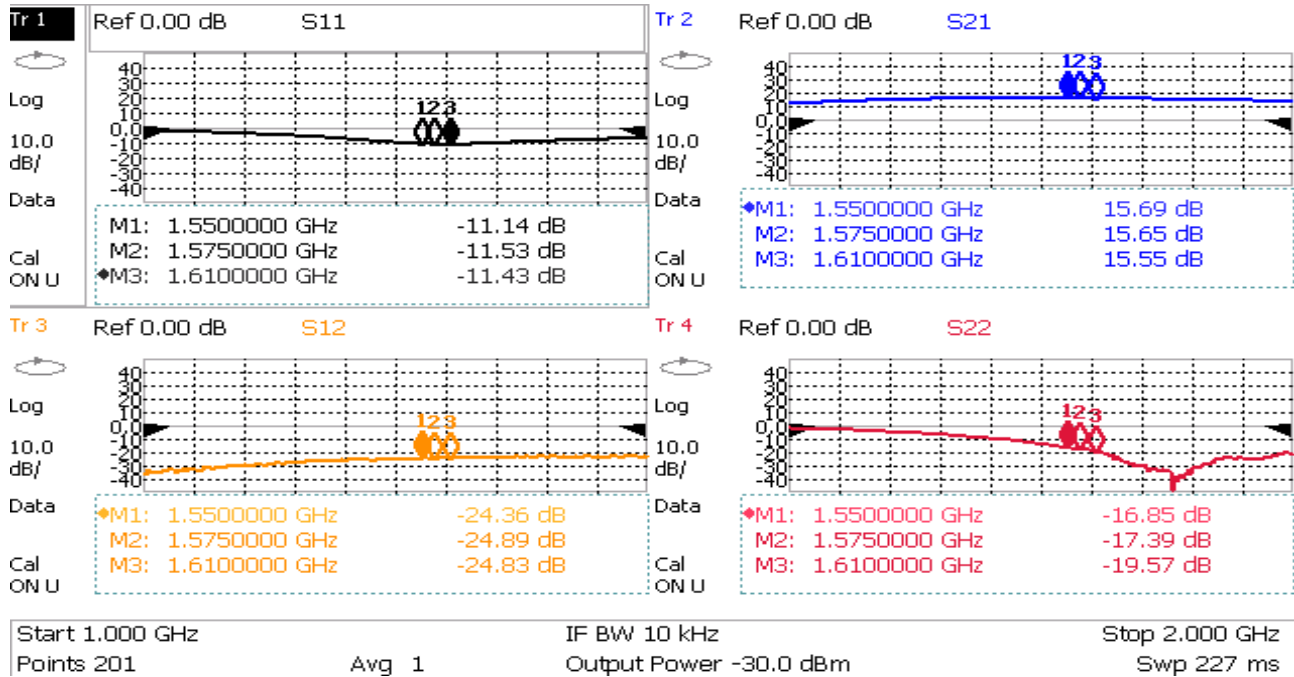
(Refer to BHWL160 Application Note for Details)



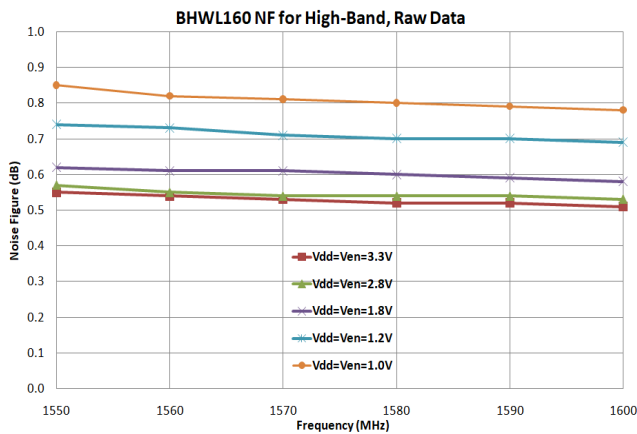


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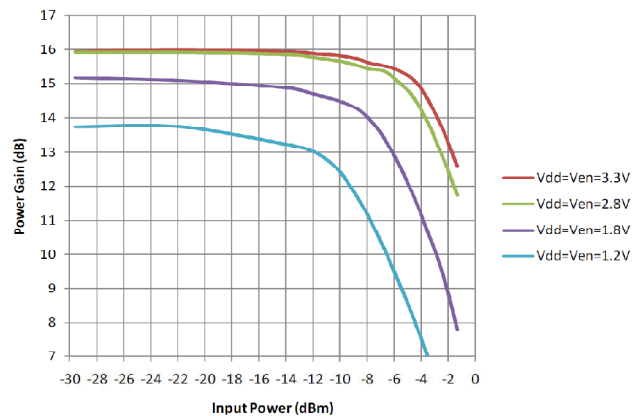
RF Characteristics (GNSS High-Band)



Small-Signal S-Parameters at Vdd=Ven=2.8V, Pin=-30dBm



Noise Figure vs Frequency and Vdd/Ven



Power Gain vs Input Power & Vdd/Ven at 1575MHz



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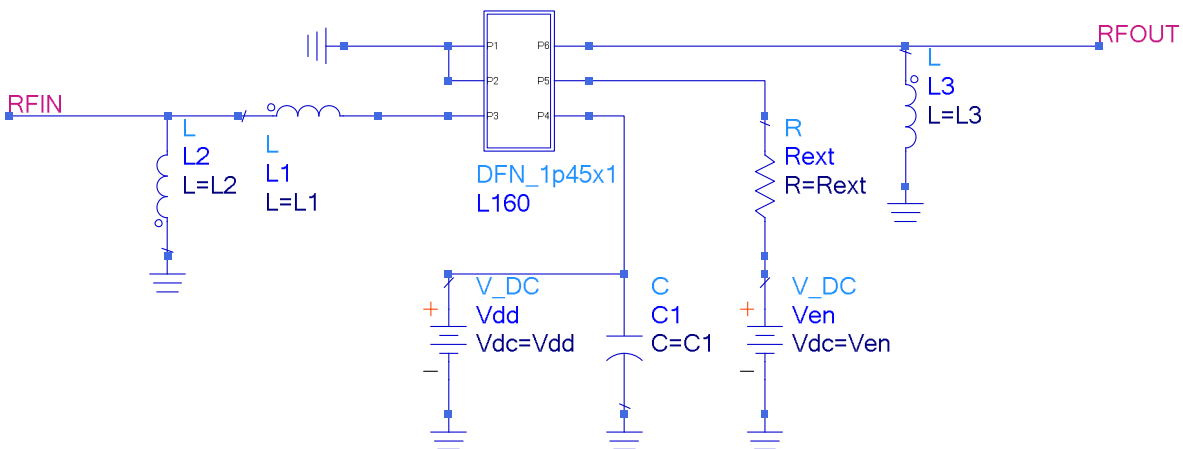
Electrical Specifications (GNSS Full-Band)*

Parameter	Condition	Specification			Unit
		Min.	Typ.	Max.	
Operating Frequency		1165	1575	1610	MHz
Operating Voltage		1.2	2.8	3.3	V
Quiescent Current	VDD=VEN=2.8V, No RF Input		7	9	mA
Shutdown Current	VDD=3.3V, VEN=0			1	uA
Small-Signal Gain	Pin=-30dBm		15.5		dB
Noise Figure			0.7		dB
Input Return Loss		6	10		dBm
Output Return Loss		10	15		dB
Isolation		22	24		dB
Input P1dB	At VDD=VEN=2.8V	-9	-6		dBm
In-Band IIP3 (Low-Band)	f1/f2=1176/1177MHz, -30dBm per Tone, 2.8V		+2		dBm
In-Band IIP3 (High-Band)	f1/f2=1575/1576MHz, -30dBm per Tone, 2.8V		+3		dBm

*Refer to BHWL160 Application Note for additional test data in details.

Application Schematic (GNSS Full-Band)

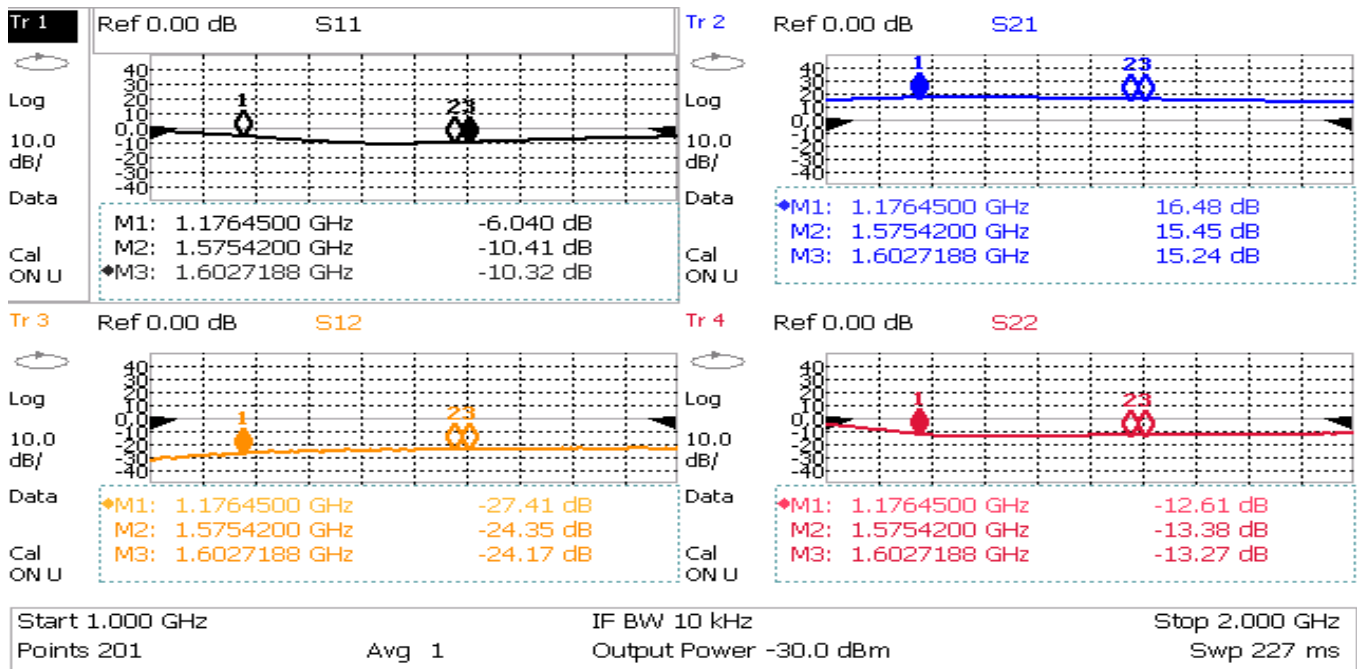
(Refer to BHWL160 Application Note for Details)



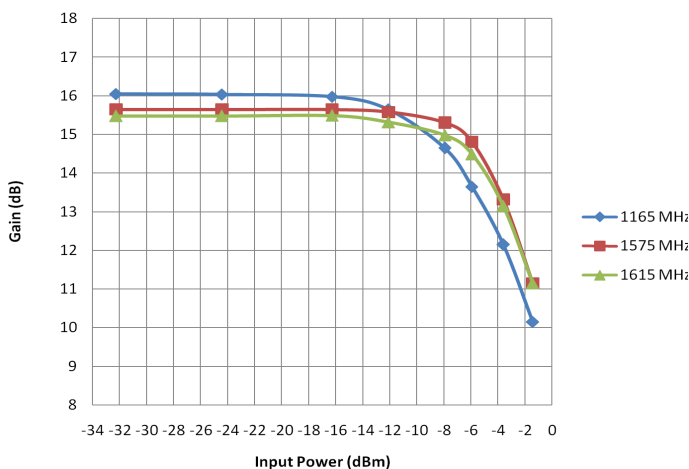


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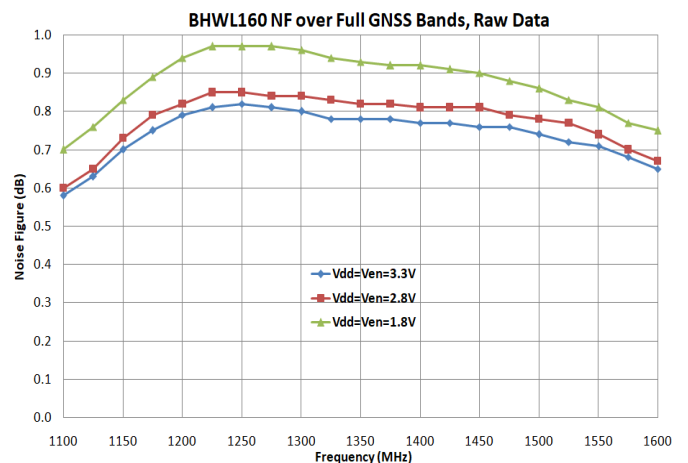
RF Characteristics (GNSS Full-Band)



Small-Signal S-Parameters at Vdd=Ven=2.8V, Pin=-30dBm



Power Gain vs Pin & Frequency at Vdd/Ven=2.8V



Noise Figure over Full-Band at Different Vdd/Ven



Wideband 0.6-2GHz GaAs Low Noise Amplifier

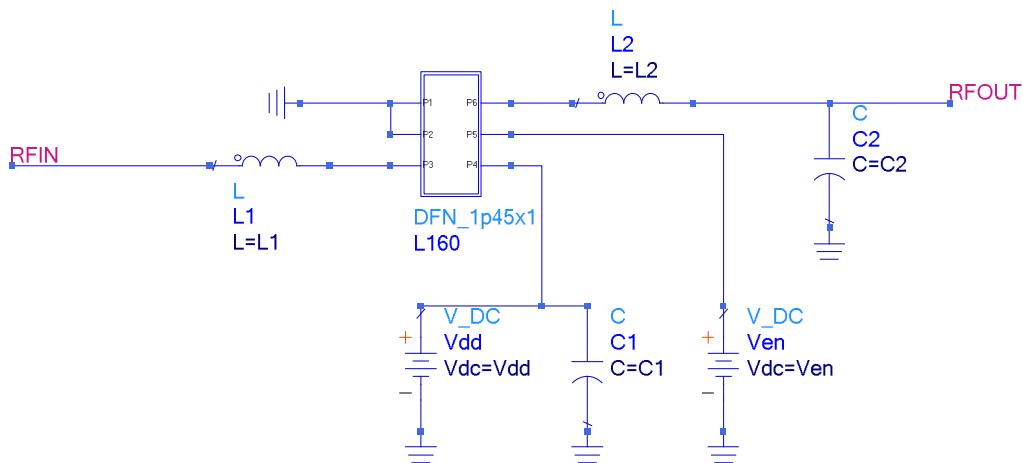
Electrical Specifications (UHF 900MHz Band)*

Parameter	Condition	Specification			Unit
		Min.	Typ.	Max.	
Operating Frequency		900	915	930	MHz
Operating Voltage		3	3.3	3.6	V
Quiescent Current	VDD=VEN=3.3V, No RF Input		8	10	mA
Shutdown Current	VDD=3.3V, VEN=0			1	uA
Small-Signal Gain	Pin=-30dBm		16.5		dB
Noise Figure			0.9		dB
Input Return Loss		9	10		dBm
Output Return Loss		10	14		dB
Isolation		28	30		dB
Input P1dB	At VDD=VEN=3.3V		-9		dBm

*Refer to BHW AppNote #004 for additional test data in details.

Application Schematic (UHF 900MHz Band)

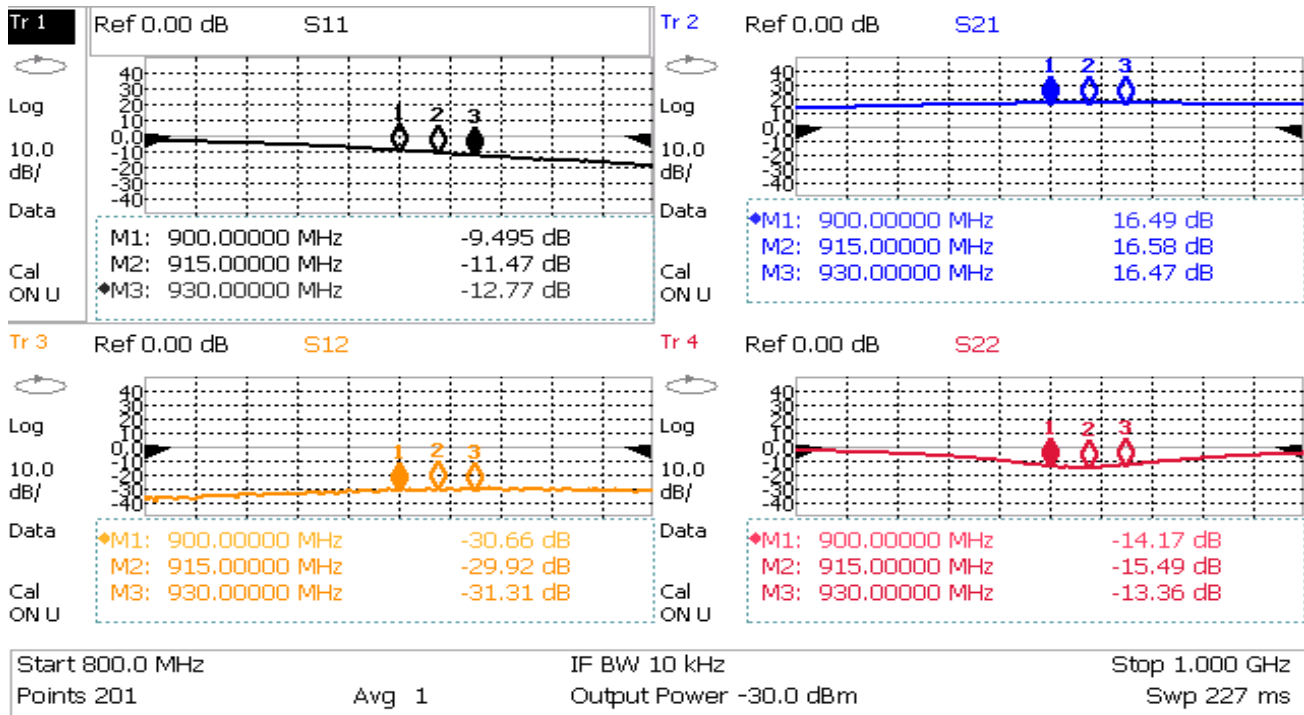
(Refer to BHW AppNote #004 for Details)



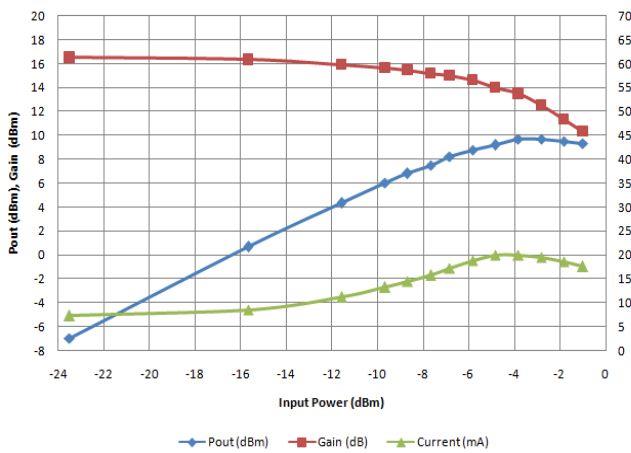


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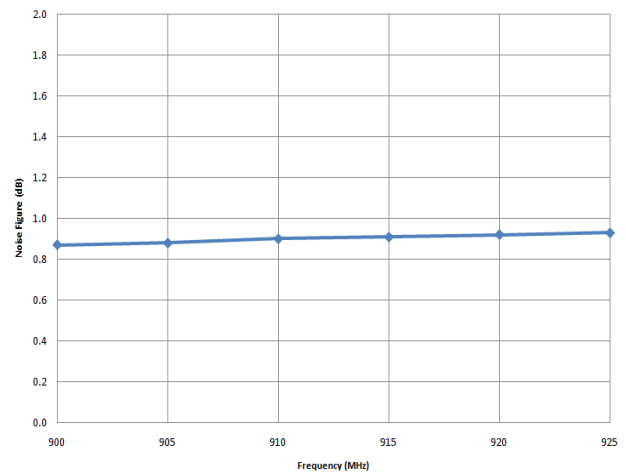
RF Characteristics (UHF 900MHz Band)



Small-Signal S-Parameters at Vdd=Ven=3.3V, Pin=-30dBm



CW Power Sweep at 915MHz, Vdd/Ven=3.3V

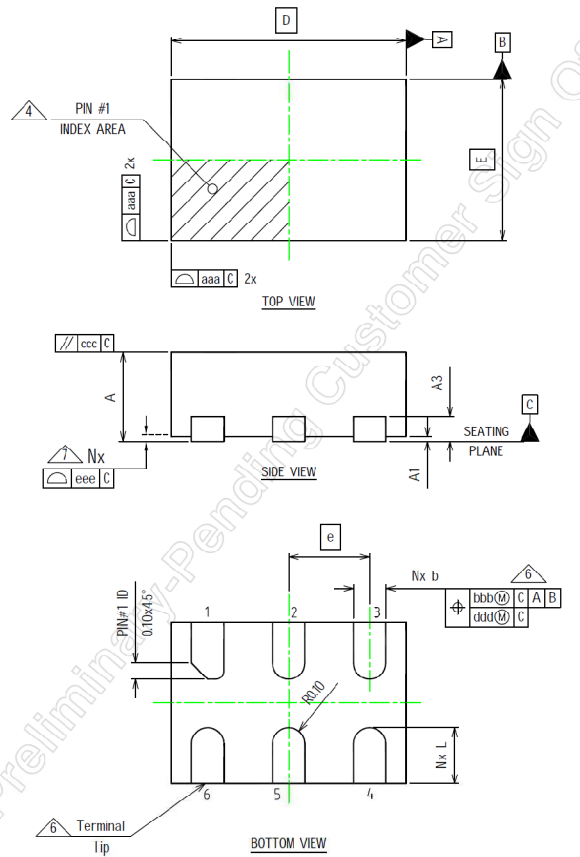


Noise Figure over 900-930MHz, Vdd/Ven=3.3V



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Package Drawing and Dimensions

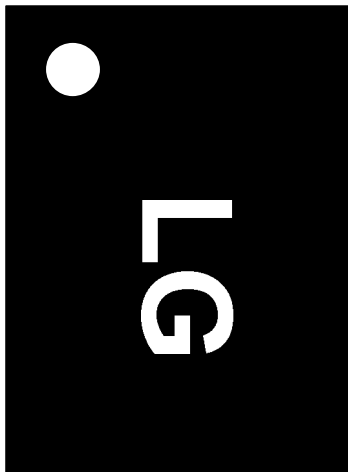


Dimension Table				
Thickness Symbol	UT			NOTE
	MINIMUM	NOMINAL	MAXIMUM	
A	0.51	0.55	0.60	
A1	0.00	0.02	0.05	
A3	---	0.15 Ref	---	
b	0.15	0.20	0.25	6
D	1.45 BSC			
E	1.00 BSC			
e	0.50 BSC			
L	0.25	0.35	0.45	
aaa	0.05			
bbb	0.10			
ccc	0.10			
ddd	0.05			
eee	0.08			
N	6			3
ND	3			5
NOTES	1, 2			
LF PART NO.	442520			
LF DWG. NO.	CARSEM-MHT-027 Rev. A			



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Package Marking and Date Code Information



← Pin 1 Indicator

← Product Code for BHWL160 (Fixed)

← Date Code: See Date Code Table

BHWL160 Datecode Table

Year	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
2019	A	B	C	D	E	F	G	H	I	J	K	M
2020	N	P	Q	R	S	T	U	V	W	X	Y	Z
2021	a	b	c	d	e	f	g	h	i	j	k	m
2022	n	p	q	r	s	t	u	v	w	x	y	z
2023	A	B	C	D	E	F	G	H	I	J	K	M
2024	N	P	Q	R	S	T	U	V	W	X	Y	Z
2025	a	b	c	d	e	f	g	h	i	j	k	m
2026	n	p	q	r	s	t	u	v	w	x	y	z