



## Wideband 0.7-2.5GHz Low Noise Amplifier in 1x1mm DFN

### Description

BHWL161 is an ultra-low noise amplifier designed in advanced GaAs E/D-pHEMT process, featuring wideband operation from 700MHz to 2.5GHz. For GNSS, it provides simultaneous, uncompromised performance across all frequency bands of all major constellations including GPS, Beidou, Galileo, NavIC and GLONASS. The device is housed in an ultra-compact 1x1mm 4-Lead DFN (Dual Flat No-Lead) package, provides 0.4dB 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. BHWL161 has integrated ESD protection on all pins, and requires only one external inductor and capacitor for conventional GNSS bands from 1550-1610MHz.

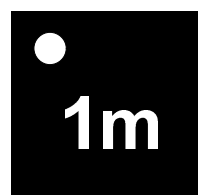
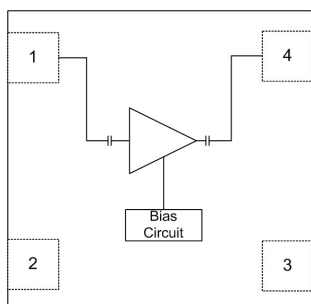
### Key Features

- Advanced GaAs E/D-pHEMT Process
- 0.7-2.5GHz Operation Frequency Range
- Low Noise Figure: 0.4~0.8dB (GNSS Full Band)
- Power Gain: 15.5 ~17dB
- High Input P1dB: -3dBm at 3.3V (GPS L1)
- High IIP3: +5dBm at 3.3V (GPS L1)
- Adjustable Current 1.5~7mA at 1.2~3.6V
- Integrated ESD for 1KV HBM & >2KV CDM
- Ultra-Compact 1x1mm DFN-4L 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 Angle-of-Arrival Solutions
- 2.4GHz Remote Controls
- Other Generic Radios from Sub-GHz to 2.5GHz

### Functional Block and Package Information

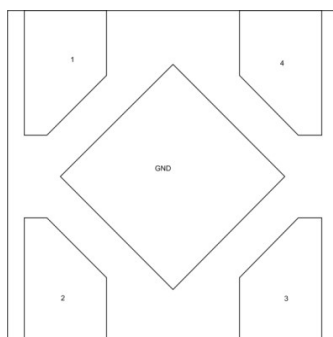


1.0x1.0x0.45mm DFN-4L



## Wideband 0.7-2.5GHz Low Noise Amplifier in 1x1mm DFN

### Pin Assignment and Pin Description



(Top "See-Through" View)

Pin Number	Pin Name	Description
1	RFIN	RF Input
2	Ven	LNA Enable Voltage
3	Vdd	DC Voltage Supply
4	RFOUT	RF Output
Center Pad	GND	DC/RF Ground. Recommended PCB Via Diameter 0.3mm

### 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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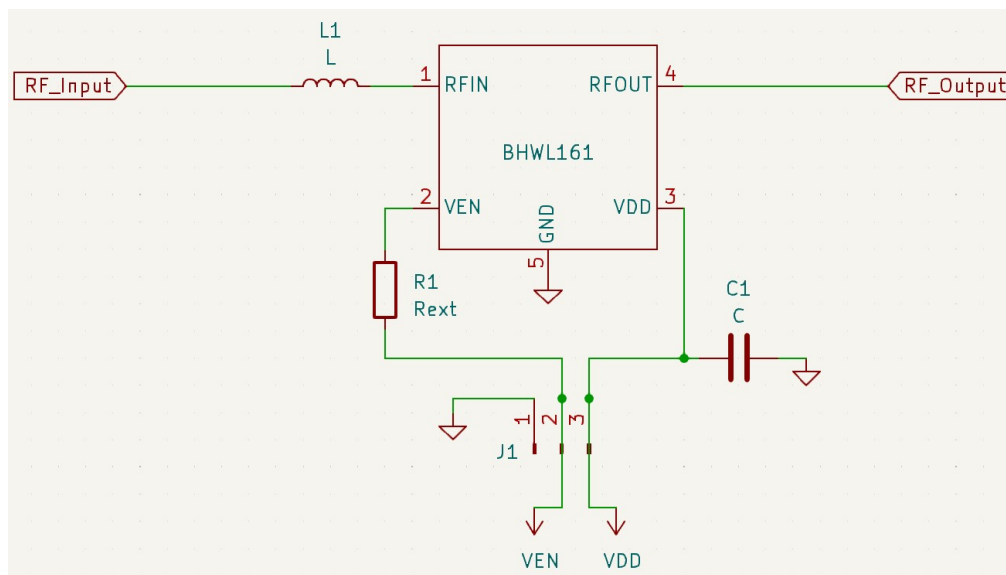
## Electrical Specifications (GNSS High-Band)\*

Parameter	Condition	Specification			Unit
		Min.	Typ.	Max.	
Operating Frequency		1550	1575	1610	MHz
Operating Voltage		1.2	3.3	3.6	V
Quiescent Current	VDD=VEN=3.3V, No RF Input	4	6	10	mA
Shutdown Current	VDD=3.3V, VEN=0		0.3		uA
Small-Signal Gain	Pin=-30dBm		16		dB
Noise Figure			0.4		dB
Input Return Loss			11		dBm
Output Return Loss			25		dB
Isolation			22		dB
Input P1dB	At VDD=VEN=3.3V		-3		dBm
In-Band IIP3	f1/f2=1575/1576MHz, -30dBm per Tone, 3.3V		+5		dBm
Out-of-Band IIP3	f1/f2=1712.7/1850MHz, -30dBm per Tone, 3.3V		+6		dBm

\*Refer to BHW AppNote #015 for additional test data in details.

## Application Schematic (GNSS High-Band)

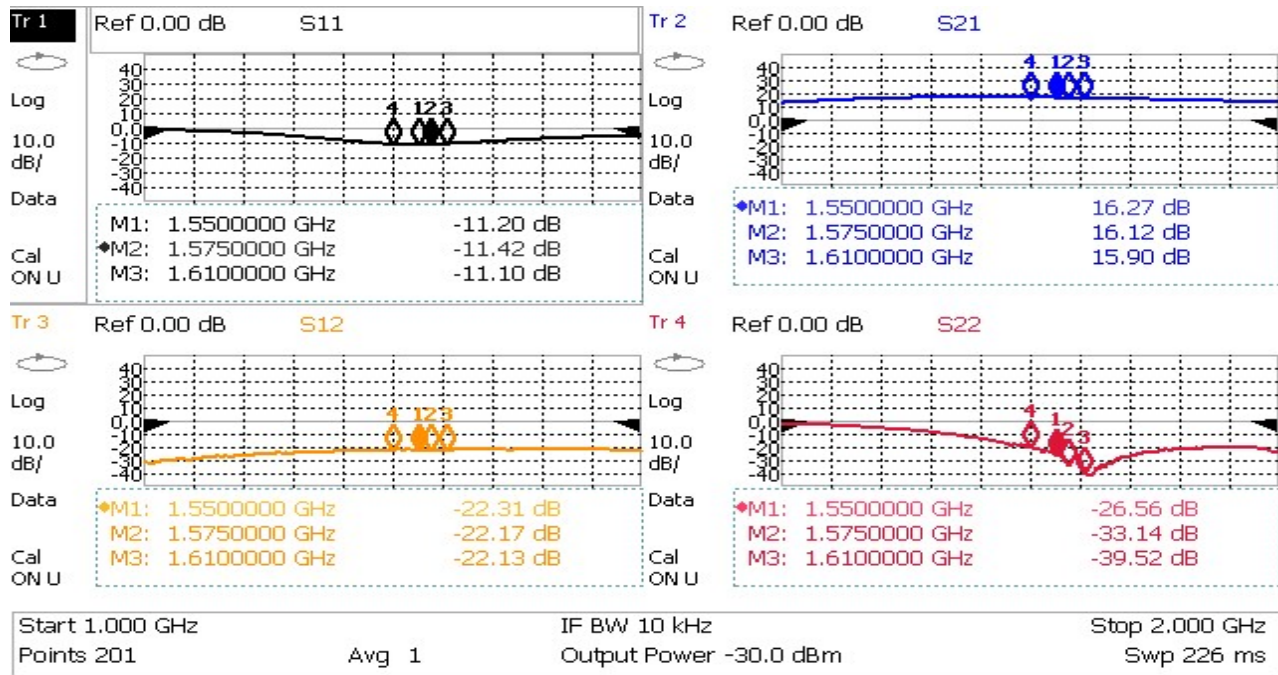
(Refer to BHW AppNote #015 for Details)



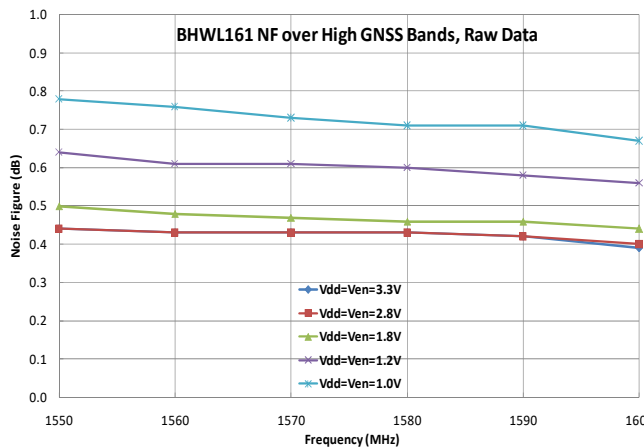


# Wideband 0.7-2.5GHz Low Noise Amplifier in 1x1mm DFN

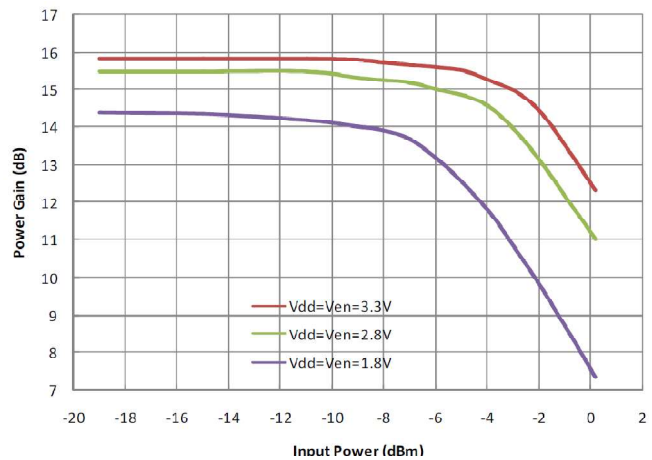
## RF Characteristics (GNSS High-Band)



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



Noise Figure vs Frequency and Vdd/Ven



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



# Wideband 0.7-2.5GHz Low Noise Amplifier in 1x1mm DFN

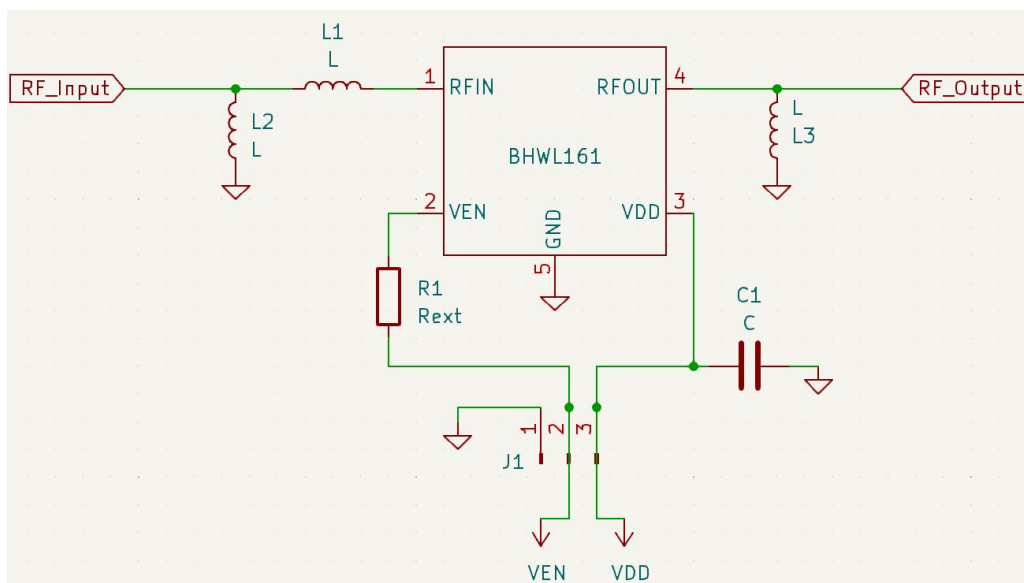
## Electrical Specifications (GNSS Full-Band)\*

Parameter	Condition	Specification			Unit
		Min.	Typ.	Max.	
Operating Frequency		1165	1575	1610	MHz
Operating Voltage		1.2	3.3	3.6	V
Quiescent Current	VDD=VEN=3.3V, No RF Input	4	6	10	mA
Shutdown Current	VDD=3.3V, VEN=0		0.3		uA
Small-Signal Gain	Pin=-30dBm		15.5		dB
Noise Figure	L1, L5 Bands		0.7		dB
Input Return Loss			10		dBm
Output Return Loss			12		dB
Isolation			22		dB
Input P1dB	At VDD=VEN=3.3V		-6		dBm
In-Band IIP3 (Low-Band)	f1/f2=1176/1177MHz, -30dBm per Tone, 3.3V		+3		dBm
In-Band IIP3 (High-Band)	f1/f2=1575/1576MHz, -30dBm per Tone, 3.3V		+4		dBm

\*Refer to BHW AppNote #015 for additional test data in details.

## Application Schematic (GNSS Full-Band)

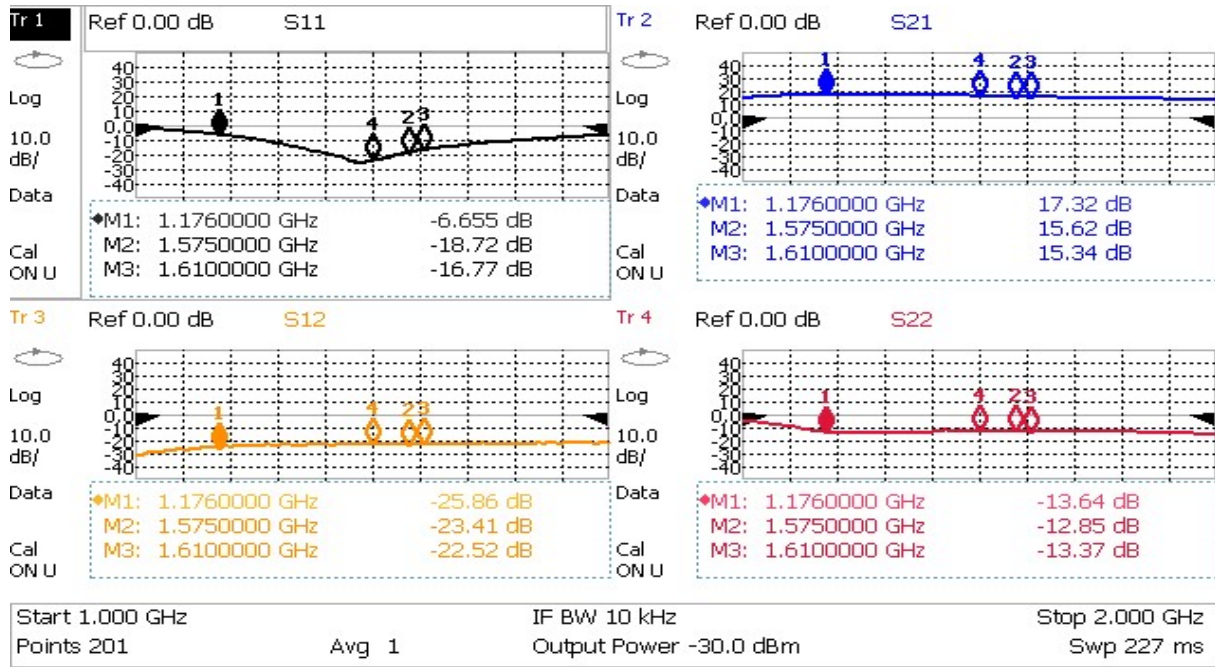
(Refer to BHW AppNote #015 for Details)



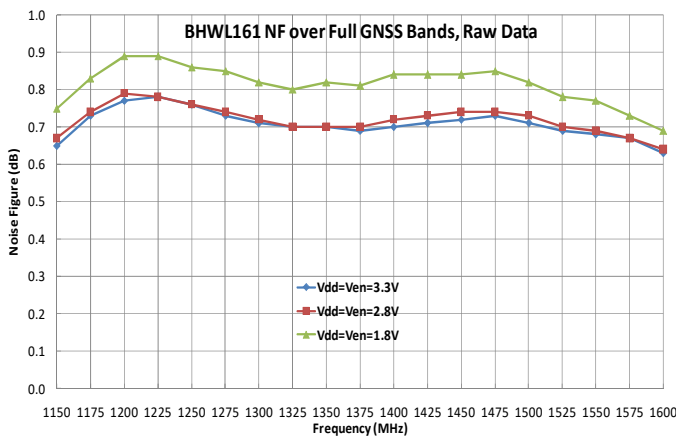


# Wideband 0.7-2.5GHz Low Noise Amplifier in 1x1mm DFN

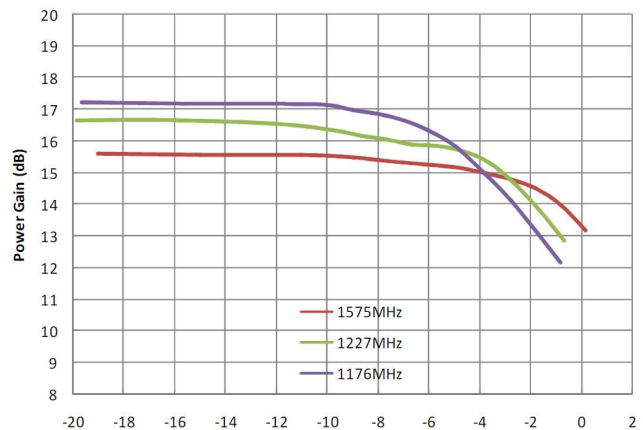
## RF Characteristics (GNSS Full-Band)



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



Noise Figure over Full-Band at Different Vdd/Ven



Power Gain vs Pin & Frequency at Vdd/Ven=3.3V



# Wideband 0.7-2.5GHz Low Noise Amplifier in 1x1mm DFN

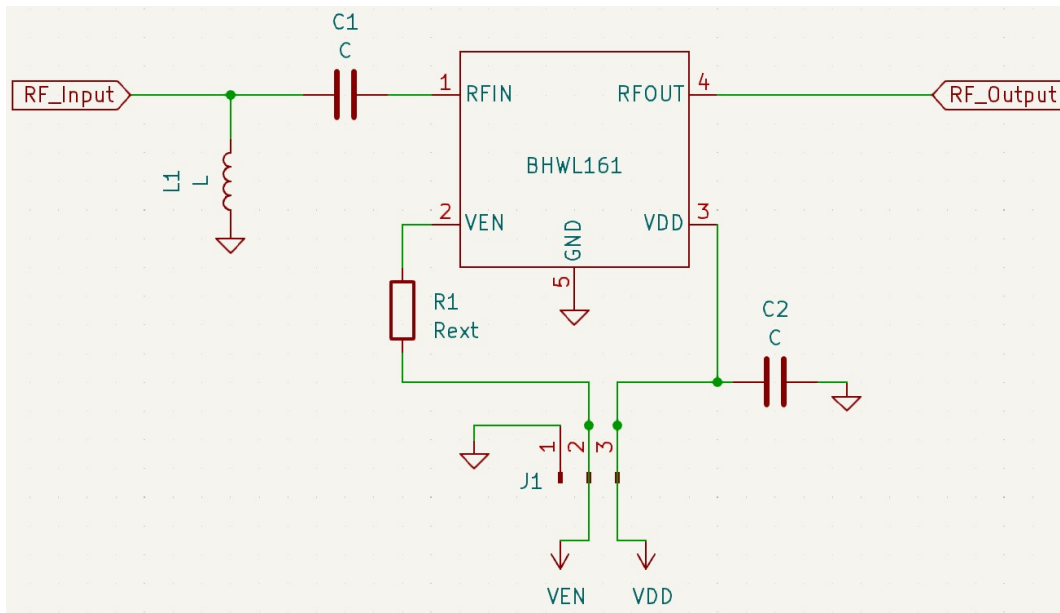
## Electrical Specifications (2.4GHz ISM Band)\*

Parameter	Condition	Specification			Unit
		Min.	Typ.	Max.	
Operating Frequency		2400	2450	2500	MHz
Operating Voltage		1.2	3.3	3.6	V
Quiescent Current	VDD=VEN=3.3V, No RF Input	4	6	10	mA
Shutdown Current	VDD=3.3V, VEN=0		0.3		uA
Small-Signal Gain	VDD=VEN=3.3V, Pin=-30dBm		12		dB
Noise Figure			1		dB
Input Return Loss			9		dBm
Output Return Loss			10		dB
Isolation			20		dB
Input P1dB	At VDD=VEN=3.3V		+1		dBm
IIP3	At VDD=VEN=3.3V		+3		dBm

\*Refer to BHW AppNote #011 for additional test data in details.

## Application Schematic (2.4GHz ISM Band)

(Refer to BHW AppNote #011 for Details)

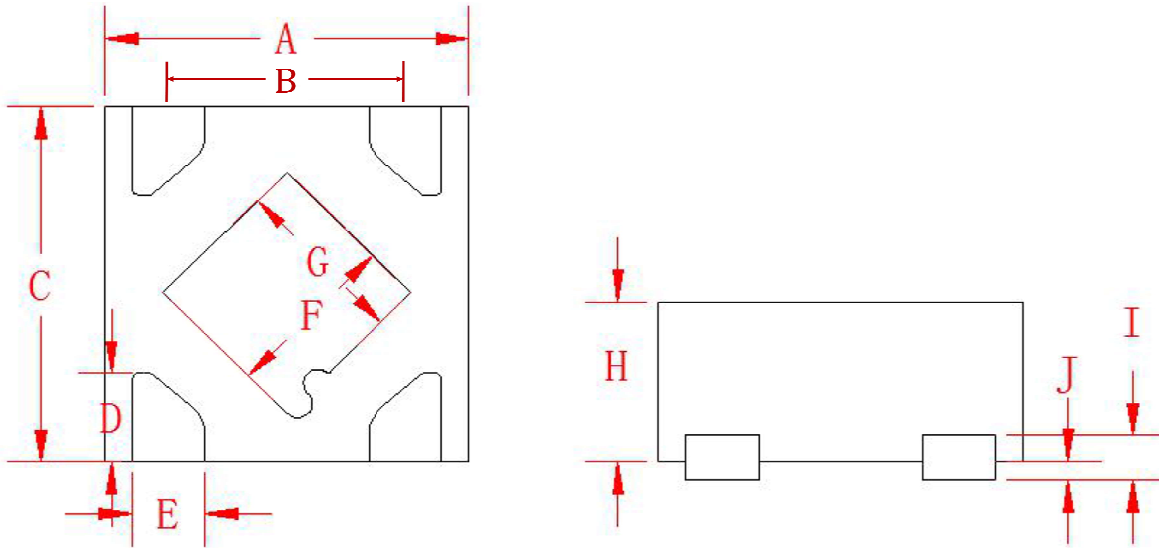






# Wideband 0.7-2.5GHz Low Noise Amplifier in 1x1mm DFN

## Package Drawing and Dimensions



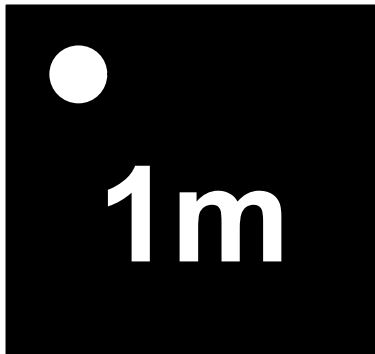
Symbol	Dimensions In Millimeters	
	Min	Max
A	0.950	1.050
B	0.65BSC	
C	0.950	1.050
D	0.150	0.350
E	0.150	0.250
F	0.380	0.580
G	0.380	0.580
H	0.400	0.500
J	0.000	0.050
I	0.125REF	





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## Package Marking and Date Code Information



← Pin 1 Indicator

← 1: Product Code for BHWL161(Fixed)  
A: Date Code: See Date Code Table

## BHWL161 Datecode Table

Year	January	February	March	April	May	June	July	August	September	October	November	December
2022	a	b	c	d	e	f	g	h	j	k	l	m
2023	n	p	q	r	s	t	u	v	w	x	y	z
2024	A	B	C	D	E	F	G	H	J	K	L	M
2025	N	P	Q	R	S	T	U	V	W	X	Y	Z
2026	a	b	c	d	e	f	g	h	j	k	l	m
2027	n	p	q	r	s	t	u	v	w	x	y	z
2028	A	B	C	D	E	F	G	H	J	K	L	M
2029	N	P	Q	R	S	T	U	V	W	X	Y	Z