GRF7001

Preliminary

High Linearity Mixer with Integrated LO Buffer

Features

Reference: RF: 808 MHz; LO: 965 MHz
IF: 157 MHz; Bias: 3.0V/9mA

- Conversion Loss: 6.0 dB
- SSB NF: 7.1 dB
- IIP3: 25.4 dBm
- IP1dB: 19.0 dBm

- RF/IF Range: 0.01 to 4.0 GHz
- LO Range: 0.1 to 4.0 GHz
- Flexible Bias Voltage
- Process: GaAs pHEMT

Applications

- Bi-directional Mixer for High-linearity Transmit/Receive Chains

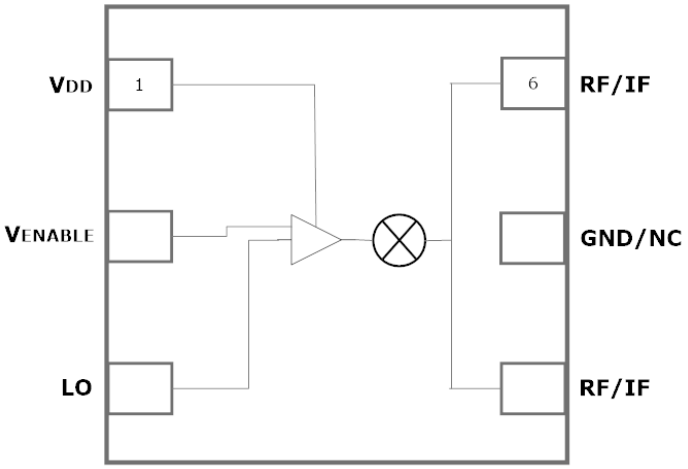
Product Description

GRF7001 is a broadband, high-linearity mixer with integrated LO buffer that can be used as either an up or down converter.

The device inputs and outputs are single-ended and are easily matched to 50 ohms. Implementation requires an external image-reject filter on the RF port and an IF bandpass filter on the IF port. Pins 4 and 6 can be used for either RF or IF with appropriate filtering in place.

The integrated LO buffer is operated from a single positive supply of 3.0 to 5.0 V for both the V_{DD} and V_{ENABLE} inputs.

Consult with the GRF applications engineering team for custom tuning/evaluation board data.



1.5 x 1.5 mm DFN-6

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Absolute Ratings:

Parameter	Symbol	Min.	Max.	Unit
LO Buffer Supply Voltage	V_{DD}	0	6.0	V
Buffer Enable Voltage	V_{ENABLE}	0	V_{DD}	
RF/IF Input Power: (Load VSWR < 2:1; V_D: 5.0 volts)	$P_{IN\ MAX}$		23	dBm
LO Input Power: (Load VSWR < 2:1; V_D: 5.0 volts)	$P_{IN\ MAX}$		20	dBm
Operating Temperature (Package Heat Sink)	T_{AMB}	-40	105	°C
Maximum Channel Temperature (MTTF > 10^6 Hours)	T_{MAX}		170	°C
Maximum Dissipated Power	$P_{DISS\ MAX}$		200	mW
Electrostatic Discharge:				
Charged Device Model:	CDM	1500		V
Human Body Model:	HBM	250		V
Storage:				
Storage Temperature	T_{STG}	-65	150	°C
Moisture Sensitivity Level	MSL		1	--

Caution! ESD Sensitive Device

Exceeding Absolute Maximum Rating conditions may cause permanent damage to the device.

Note: For manufacturing information, see the Guerrilla-RF.com website for the following document located on the GRF7001 landing page: Manufacturing Note—MN-001 Product Tape and Reel, Solderability and Package Outline Specification.

Link to manufacturing note

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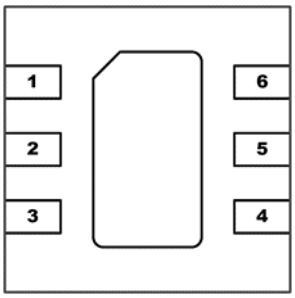
Pin Out (Top View)



Pin Assignments:

Pin	Name	Description	Note
1	V_{DD}	LO buffer voltage input	V_{DD}: 3.0 to 5.0 volts
2	V_{ENABLE}	LO buffer control input	Buffer enabled: 3.0 to 5.0 volts; V_{ENABLE} < =0.2 volts disables the LO buffer. V_{ENABLE} <= V_{DD}
3	LO	Input to LO buffer	Optimal LO input power: 0 dBm +/- 3 dB
4	RF/IF	RF/IF input or output	External filtering required. Please see note on page 8
5	NC/GND	No Connect or Ground	No internal connection to die
6	RF/IF	RF/IF input or output	External filtering required. Please see note on page 8
PKG BASE	GND	Ground	Provides DC and RF ground for LNA, as well as thermal heat sink. Recommend multiple 8 mil vias beneath the package for optimal RF and thermal performance. Refer to evaluation board top layer graphic on schematic page.

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Nominal Operating Parameters:

Parameter	Symbol	Specification			Unit	Condition
		Min.	Typ.	Max.		
						V_{DD} = V_{ENABLE} = 3.0 V LO: 0 dBm; T_A: 25°C
RF Frequency (Down conversion)	F_{RF}		808		MHz	
LO Frequency:	F_{LO}		965		MHz	
IF Frequency:	F_{IF}		157		MHz	
Evaluation Board Conversion Gain	S21		-6.0		dB	
Evaluation Board SSB Noise Figure	NF		7.1		dB	
Input 3rd Order Intercept Point	IIP3		25.4		dBm	
Input 1dB Compression Point	IP1dB		19.0		dBm	
LO Drive Level	LO_IN		0		dBm	
LO Buffer Current	I_{BUFFER}		9		mA	Measured with LO: 0 dBm with band-specific matching
LO Buffer Enable Current	I_{ENABLE}		1.0		mA	
Thermal Data						
Thermal Resistance (measured via IR scan)	Θjc		300		°C/W	On standard evaluation board
Channel Temperature @ +85 C Reference (Package Heat Sink)	$T_{CHANNEL}$		93 (See note)		°C	V_{DD}: 3.0 V; I_{BUFFER}:9 mA; No RF Pdiss:27mW

Note: MTTF >10^6 hours for $T_{CHANNEL}$ < =170 degrees C.

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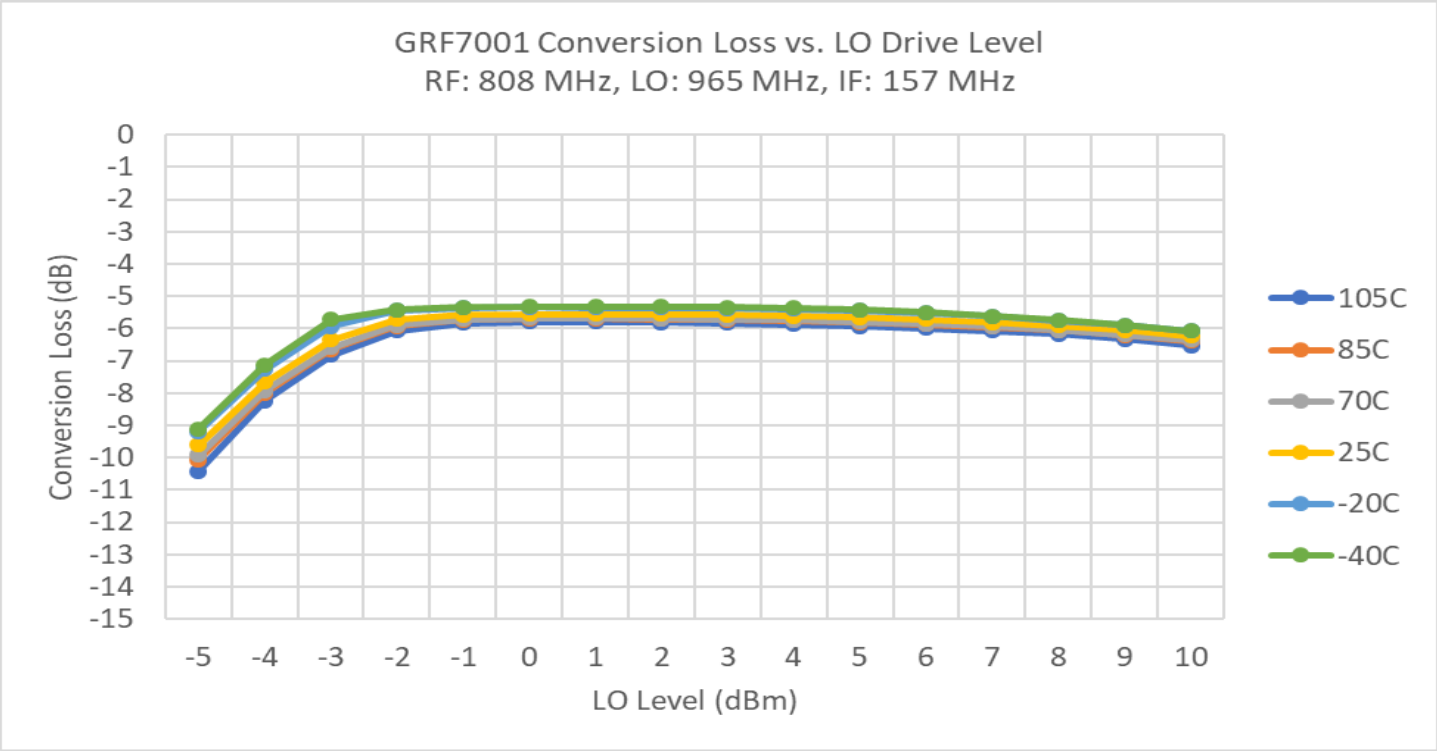
GRF7001 Measured (3-Volt) Data vs. Temperature



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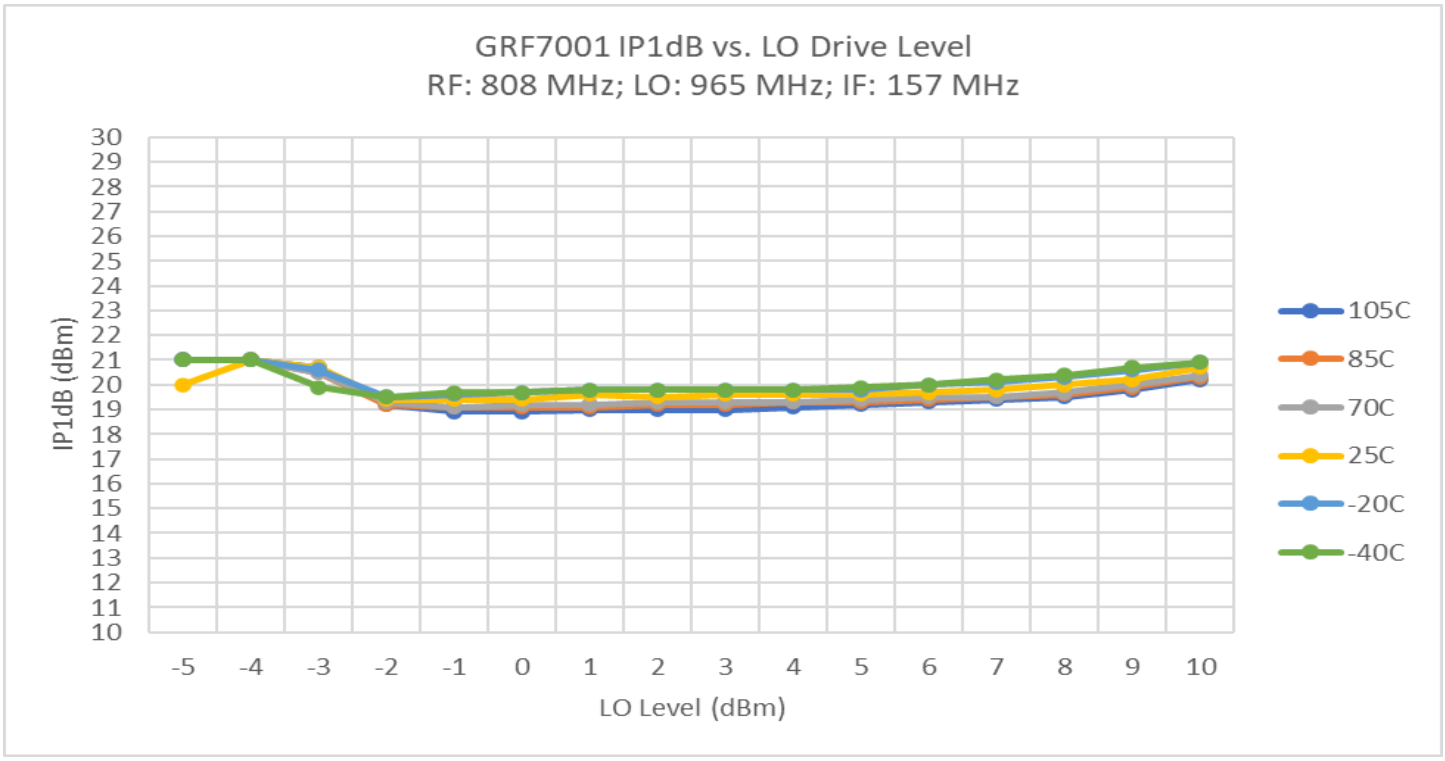
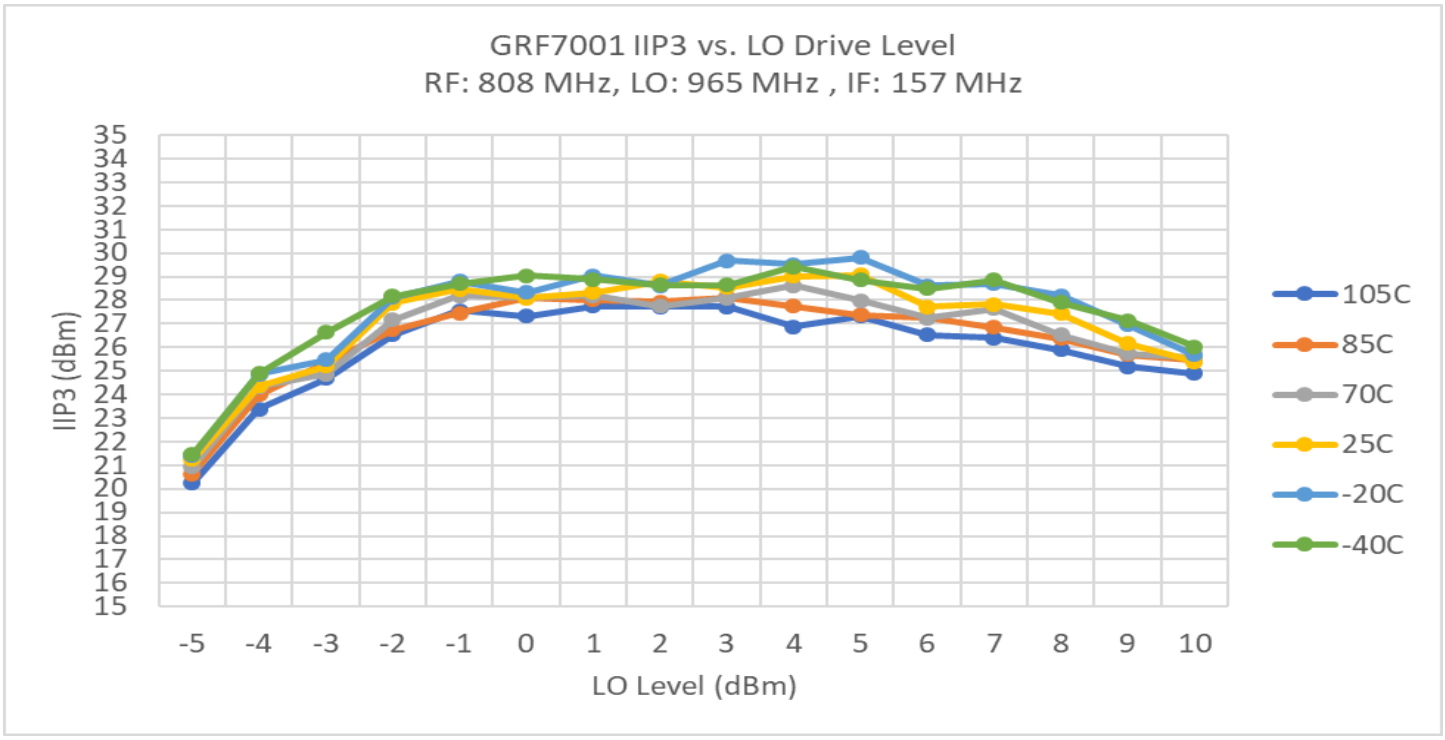
GRF7001 Measured (3-Volt) Data vs. Temperature





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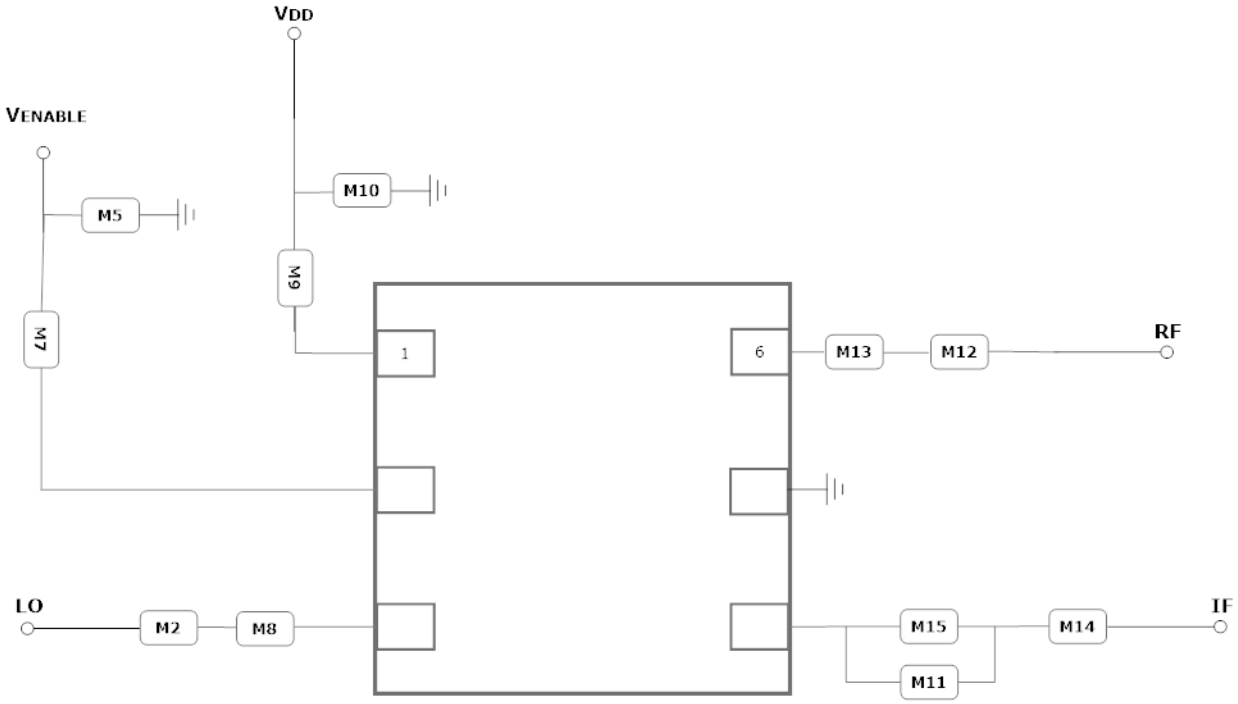
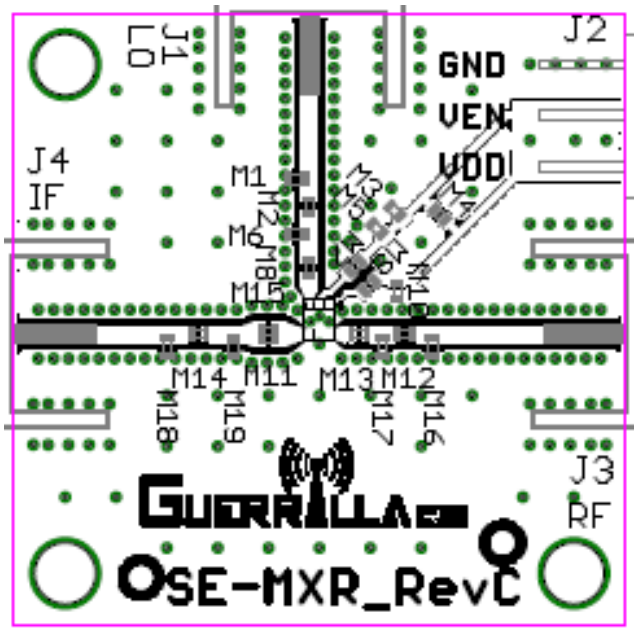


GRF7001 Standard Application Schematic



GRF7001 Evaluation Board Assembly Drawing

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GRF7001 Standard Evaluation Board BOM: RF: 758 to 808 MHz; LO: 915 to 1015 MHz; IF: 157 MHz

Component	Type	Manufacturer	Family	Value	Package Size	Substitution
M2	Capacitor	Murata	GJM	33 pF	0402	Ok
M5	Capacitor	Murata	GRM	0.1 uF	0402	Ok
M7	Resistor	Various	5%	10k ohms	0402	Ok
M8	Inductor	Murata	LQG	5.6 nH	0402	Ok
M9	Inductor	Murata	LQG	18 nH	0402	Ok
M10	Capacitor	Murata	GRM	1000 pF	0402	Ok
M11	Capacitor	Murata	GJM	3.9 pF	0402	Ok
M12	Inductor	Murata	LQG	8.2 nH	0402	Ok
M13	Capacitor	Murata	GRM	3.9 pF	0402	Ok
M14	Capacitor	Murata	GRM	330 pF	0402	Ok
M15	Inductor	Murata	LQG	8.2 nH	0402	Ok
Evaluation Board:	SE-MXR_RevC					

Note regarding evaluation board matching: The evaluation board accommodates simple LC matching/filtering to implement a chosen frequency scheme. It should be noted that the RF and IF ports of the mixer are connected to the same node on the mixer die. This means that the IF port must reject the RF signals and vice-versa.

For this reason, GRF applications engineering cannot effectively support tuned evaluation board requests in which the lowest RF frequency is not at least 3X the highest IF frequency. Applications such as these can be viable if high-performance SAW-type filters are used to achieve the necessary RF/IF frequency separation but that effort falls on the customer to implement.

The tables on the following page show suggested RF, LO and IF LC matching,/filter values for a range of common frequency schemes.

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GRF7001 Port Matching Values vs. Frequency

RF:

RF (MHz)	RF Port		IF Port	
	M12 (nH)	M13 (pF)	M11 (pF)	M15 (nH)
450	12	12	12	12
520	10	8.2	6.8	12
750	8.2	6.8	6.8	8.2
850	8.2	3.9	3.9	8.2
950	8.2	3.6	3.6	8.2
1300	4.3	3.3	3.3	4.7
1500	3.9	3.3	3.3	3
1900	2.4	2.4	2.4	2.4

LO:

LO (MHz)	LO port		Choke
	M8 (nH)	M2 (pF)	M9 (nH)
400	22	100	68
500	9.1	68	68
650	7.5	56	33
750	6.8	47	33
800	6.8	47	33
950	5.6	33	18
1100	5.6	30	15
1600	5.6	15	6.2
1700	5.6	15	5.1

IF:

IF (MHz)	IF Port
	M14 (pF)
10	100000
50	1000
100	470
150	330
200	220
250	100
300	100
400	100
500	100
700	100
900	100

Note: The DC blocking capacitor value used for M14 is somewhat flexible. The cap should be a reasonably good short for the IF frequency of interest.

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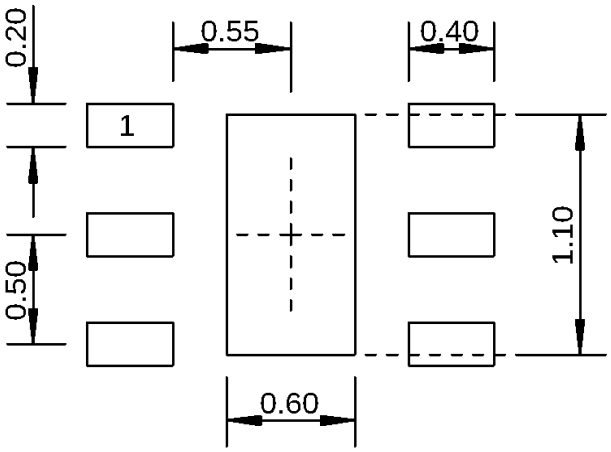
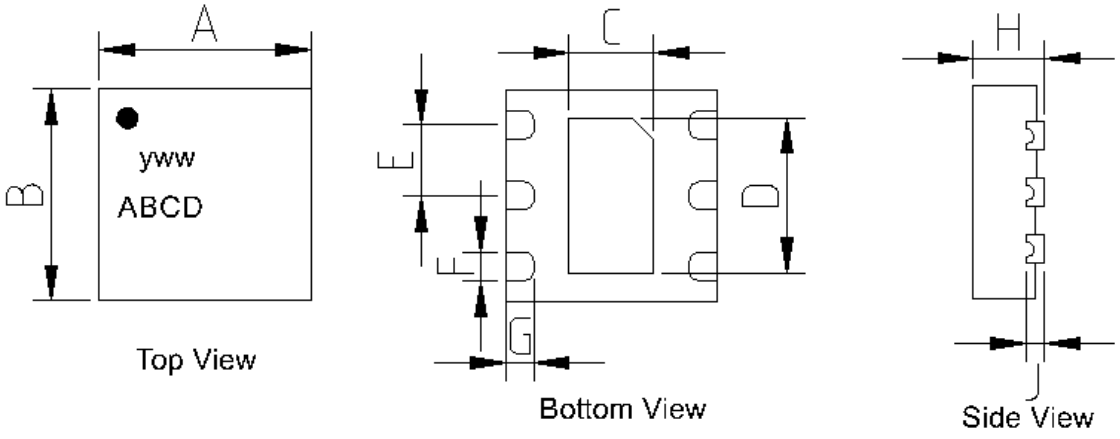


Dimensions in millimeters

1.5 mm DFN-6 Suggested PCB Footprint (Top View)



Dimensions (MM)	
A	1.5 +/- 0.050
B	1.5 +/- 0.050
C	.6 +/- 0.050
D	1.1 +/- 0.050
E	.5 Bsc
F	.2 +/- 0.050
G	.2 +/- 0.050
H	.45 +/- 0.050
J	.12 Ref.

1.5 mm DFN-6 Package Dimensions

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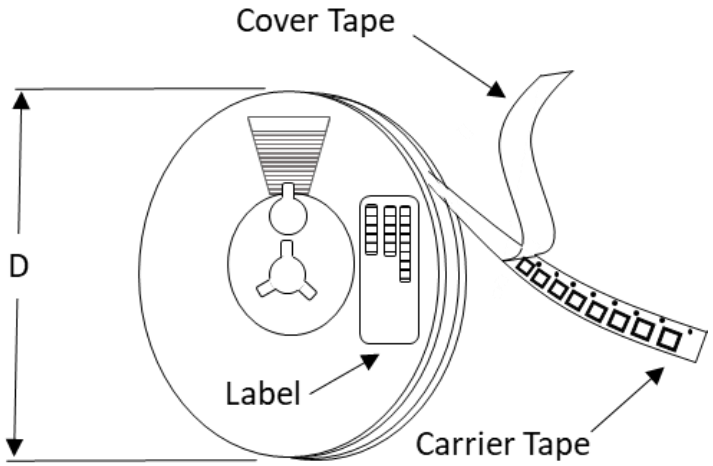
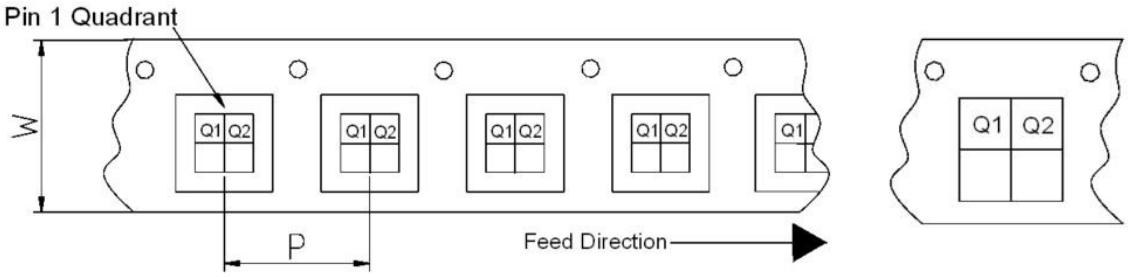
Tape and Reel Information:

Guerrilla RF's Tape and Reel specification complies with the Electronics Industries Association (EIA) standards for 'Embossed Carrier Tape of Surface Mount Components for Automatic Handling". Reference EIA-481. See the table on the following page for Tape and Reel specifications along with units per reel.

Devices are loaded with pins down into the carrier pocket with protective cover tape, wound into a plastic reel. Each reel will be packaged in a cardboard box. There will be product labels on the reel, the protective ESD bag and the outside surface of the box.



Tape and Reel Packaging with Reel Diameter Noted (D)



Carrier Tape Width (W), Pitch (P), Feed Direction and Pin 1 Quadrant Information

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Tape and Reel Specification and Device Package Information Table

Package				Carrier Tape			Reel	
Type	Dimensions (mm)	Leads	Weight (mg)	Width (W) (mm)	Pocket Pitch (P) (mm)	Pin 1 Quad-rant	Diameter (D) (inches)	Units per Reel
QFN	2.0 x 2.0 x 0.50	12	7	8	4	Q1	7	2500
QFN	3.0 x 3.0 x 0.85	16	24	12	8	Q1	7	1500
DFN	1.5 x 1.5 x 0.45	6	4	8	4	Q1	7	2500
DFN	2.0 x 2.0 x 0.75	8	12	8	4	Q1	7	2500
LFM	3.5 x 3.5 x 0.75	See note	TBD	12	8	Q2	7	1500
LFM	4.0 x 4.0 x 0.75	See note	TBD	12	8	Q2	7	1500

Note: Lead count may vary. Reference applicable product data sheet

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Data Sheet Release Status:	Notes
Advance	S-parameter and NF data based on EM simulations for the fully packaged device using foundry supplied transistor s-parameters. Linearity estimates based on device size, bias condition and experience with related devices.
Preliminary	All data based on evaluation board measurements in the Guerrilla RF Applications Lab.
Released	All data based on device qualification data. Typically, this data is nearly identical to the data found in the preliminary version. Max and min values for key RF parameters are included.

Information in this datasheet is specific to the Guerrilla RF, Inc. ("Guerrilla RF") product identified.

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