8TR6113

Sub-GHz ISM Band RF Front-End IC

843 - 964MHz

Preliminary Datasheet

Features

- 843 - 964MHz Frequency Range
- High Efficiency Optimized for Battery Operation
- Delivers up to +26.8dBm Output Power at 3.3V
- 552mA at +27dBm Output Power at 3.3V
- 29.2dB Large Signal Tx Gain at +27dBm Output Power
- 1.93dB LNA Noise Figure at RX mode
- 70mA Tx Quiescent Current
- 2.2V to 3.6V Operation
- 1.1uA Sleep mode Current
- 3mm x 3mm x 0.45mm 16-pin QFN package
- -40°C to 125°C Temperature Range

Applications

- LoRa, SigFox, W-SUN, ZigBee, Z-Wave, Thread and Matter
- IoT (Internet of Things) / M2M Connectivity, Mesh Network
- North America 900 MHz ISM systems
- Eastern Europe 870 MHz SRD systems
- Smart grid/Smart metering/AMR/AMI
- Smart home appliances
- Remote sensor and control

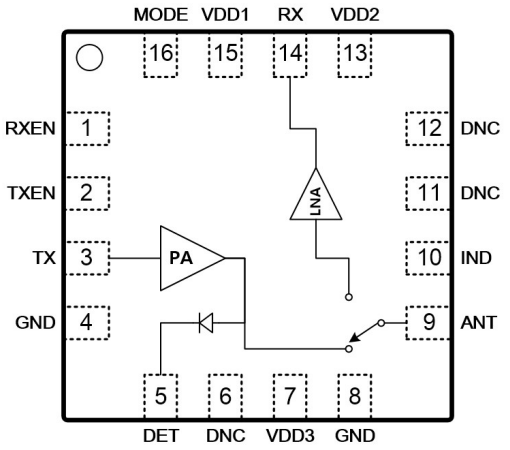


Figure 1. 8TR6113 Functional Block Diagram

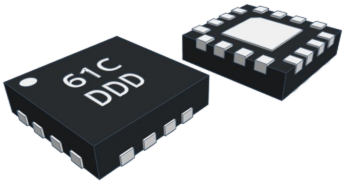
Description

The 8TR6113 is a high-performance, highly integrated RF front-end module designed for Industrial, Scientific, Medical (ISM) Band application operating in the 843 to 964 MHz frequency range.

The 8TR6113 addresses the need for aggressive size reduction for typical portable equipment RF front end design and greatly reduces the number of components outside of the chipset thus minimizing the footprint and assembly cost of the overall solution.

8TR6113 combines a transmit power amplifier (PA), a receive low noise amplifier (LNA), and a TX power Detector. It also comes integrated with filter networks and input/output matching circuitry in a 3.0 x 3.0 x 0.45mm 16-pin QFN package.

The 8TR6113 is RoHS compliant, halogen-free, and REACH Compliant. It is rated for Moisture Sensitivity Level 1 (MSL1), reflow at 260°C per JEDEC J-STD-020. Refer to IPC/JEDEC J-STD-020 for detailed solder reflow temperature and profile.



16-Lead 3mm x 3mm x 0.45mm, QFN Package

Figure 2. 8TR6113 Package Type

Ordering Information

Part Number	Description
8TR6113	Sub GHz Front-End RFIC 2500pieces per Tape and Reel
8TR6113-EVB	Fully Tested and Characterized Evaluation Board
8TR6113-DWF	Sub GHz Front-End RFIC Die in Wafer Form

Pin Description

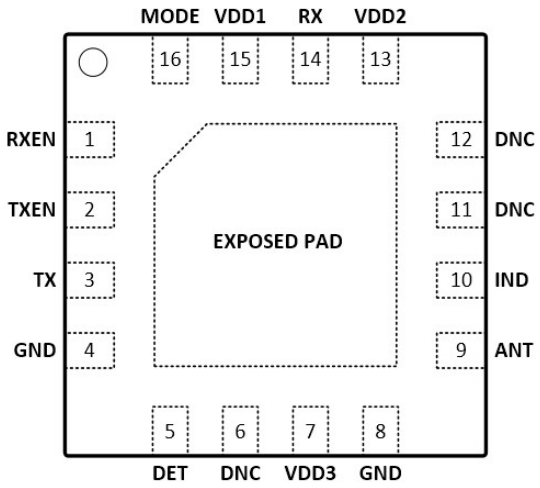


Figure 3. 8TR6113 Pinout (Top View)

Table 1. 8TR6113 Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	RXEN	Control Logic Pin	9	ANT	Antenna Port (DC shorted to GND)
2	TXEN	Control Logic Pin	10	IND	ANT Matching Inductor
3	TX	Transmit Port (DC shorted to GND)	11	DNC	Do Not Connect
4	GND	Ground	12	DNC	Do Not Connect
5	DET	PA Output Detect	13	VDD2	DC Voltage Supply
6	DNC	Do Not Connect	14	RX	Receive Port (DC shorted to GND)
7	VDD3	DC Voltage Supply	15	VDD1	DC Voltage Supply
8	GND	Ground	16	MODE	Control Logic Pin
EXPOSED PAD		Exposed pad should be connected to GND.			

Electrical and Mechanical Specifications

The absolute maximum ratings of the 8TR6113 are provided in Table 2. The recommended operating conditions are specified in Table 3.
The electrical specifications are provided in Tables 4 through 8, as measured on 8TR6113 evaluation board(Figure 5).
The state of the 8TR6113 is determined by the logic provided in Table 9.

Table 2. 8TR6113 Absolute Maximum Ratings

Parameter		Units	Minimum	Maximum	Remark
Supply Voltage (VDD)		V	0	3.8	
Control Logic Pin (TXEN, RXEN, MODE)		V	0	VDD	
Transmit Input Power at TX Port		dBm		6	
Receive Input power at ANT Port		dBm		10	
Storage Temperature		°C	-40	150	
ESD - HBM[1]	All pins	V		±1000	
MSL[2]		Level		MSL1	

Note: Sustained operation at or above the Absolute Maximum Ratings for any single or combinations of the above parameters may result in permanent damage to the device and is not recommended. All Maximum RF Input Power Ratings assume 50Ω terminal impedance.
1. Electrostatic discharge Human Body Model(HBM) Reference Document: ANSI/ESDA/JEDEC JS-001-2017
2. Moisture Sensitivity Level(MSL) Reference Document: JEDEC Standard J-STD-020

Table 3. 8TR6113 Recommended Operating Conditions

Parameter	Units	Minimum	Typical	Maximum
Supply Voltage (VDD)[1]	V	2.2	3.3	3.6
Control Pin - Logic High State	V	1.2		VDD[2]
Control Pin - Logic Low State	V	0		0.4
Operating Frequency Range	MHz	843		964
Operating Temperature	°C	-40	25	125

1. Functional working with degraded performance for the supply voltage range 2.2V to 2.7V.
2. For Control Voltages > 3.0V, a 10kΩ series resistor should be used at the Control Logic Pins.

Table 4. 8TR6113 Electrical Specifications: Transmit Mode

(VDD = 3.3V, TXEN = High, RXEN = High or Low, MODE = High or Low, $T_{Ambient}$ = 25°C, Excluding PCB and Connector Loss, Unless Otherwise Noted)

Parameter	Units	Min	Typ	Max	Test Conditions
Frequency Range	MHz	843		964	
Saturated Output Power	dBm		26.8		VDD: 3.3V
Large-Signal Gain	dB		29.2		+27dBm Pout
Current Consumption	mA		522		+27dBm Pout
			289		+23dBm Pout
TX Quiescent Current	mA		70.3		No RF applied
Second Harmonic	dBm/MHz		-3.2		+26dBm Pout Without external harmonic filter
Third Harmonic	dBm/MHz		-32.2		
Input Return Loss	dB		20.3		
Output Return Loss	dB		5.6		
Power Detector Voltage	V		0.4		+5dBm Pout, 10 kΩ load
	V		1.94		+27 dBm Pout, 10 kΩ load
Load VSWR for Stability			6:1		All Non-harmonic Spurs Less than -50dBm/MHz
Load VSWR for Ruggedness			10:1		No Damage

Table 5. 8TR6113 Electrical Specifications: Receive(High current) Mode

(VDD = 3.3V, TXEN = Low, RXEN = High, MODE = High, $T_{Ambient}$ = 25°C, Excluding PCB and Connector Loss, Unless Otherwise Noted)

Parameter	Units	Min	Typ	Max	Test Conditions
Small-Signal Gain	dB		16.9		
Current Consumption	mA		11.9		-10dBm Pout
Noise Figure	dB		1.93		
Input P1dB	dBm		-2		
Input IP3	dBm		2.6		Pin = -20dBm/Tone, 1MHz spacing
Input Return Loss	dB		7.4		
Output Return Loss	dB		12.2		

Table 6. 8TR6113 Electrical Specifications: Receive(Low current) Mode

(VDD = 3.3V, TXEN = Low, RXEN = High, MODE = Low, $T_{Ambient}$ = 25°C, Excluding PCB and Connector Loss, Unless Otherwise Noted)

Parameter	Units	Min	Typ	Max	Test Conditions
Small-Signal Gain	dB		15.0		
Current Consumption	mA		8.7		-10dBm Pout
Noise Figure	dB		2.02		
Input P1dB	dBm		0.0		
Input IP3	dBm		-1.3		Pin = -20dBm/Tone, 1MHz spacing
Input Return Loss	dB		7.4		
Output Return Loss	dB		13.4		

Table 7. 8TR6113 Electrical Specifications: Shutdown Mode

(VDD = 3.3V, TXEN = Low, RXEN = Low, MODE = High or Low, $T_{Ambient}$ = 25°C, Excluding PCB and Connector Loss, Unless Otherwise Noted)

Parameter	Units	Min	Typ	Max	Test Conditions
Shutdown Current	uA		1.1		

Table 8. 8TR6113 Electrical Specifications: Switching Time

(VDD = 3.3V, $T_{Ambient}$ = 25°C, Unless Otherwise Noted)

Parameter	Units	Min	Typ	Max	Test Conditions
TX to RX	nsec		900		From 50% of TXEN to 90% of RX power
TX to Shutdown	nsec		150		From 50% of TXEN to 10% of TX power
RX to TX	nsec		1400		From 50% of TXEN to 90% of TX power
RX to Shutdown	nsec		150		From 50% of RXEN to 10% of RX power
Shutdown to TX	nsec		1500		From 50% of TXEN to 90% of TX power
Shutdown to RX	nsec		900		From 50% of RXEN to 90% of RX power

Table 9. 8TR6113 Electrical Specifications: Mode Control Logic

“1” = Logic High, “0” = Logic Low, All Control logic pins must have a state defined as either "0" or "1".

TXEN	RXEN	MODE	Operational Mode
0	0	0 or 1	Shutdown Mode
0	1	0	RX Low Current Mode
0	1	1	RX High Current Mode
1	0 or 1	0 or 1	TX Mode

Application Note

The 8TR6113 Application note provides detailed descriptions and test data over various operating conditions.
Visit www.berex.com or contact BeRex at sales@berex.com to request additional documentation.

Evaluation Board Schematic and PCB Layout

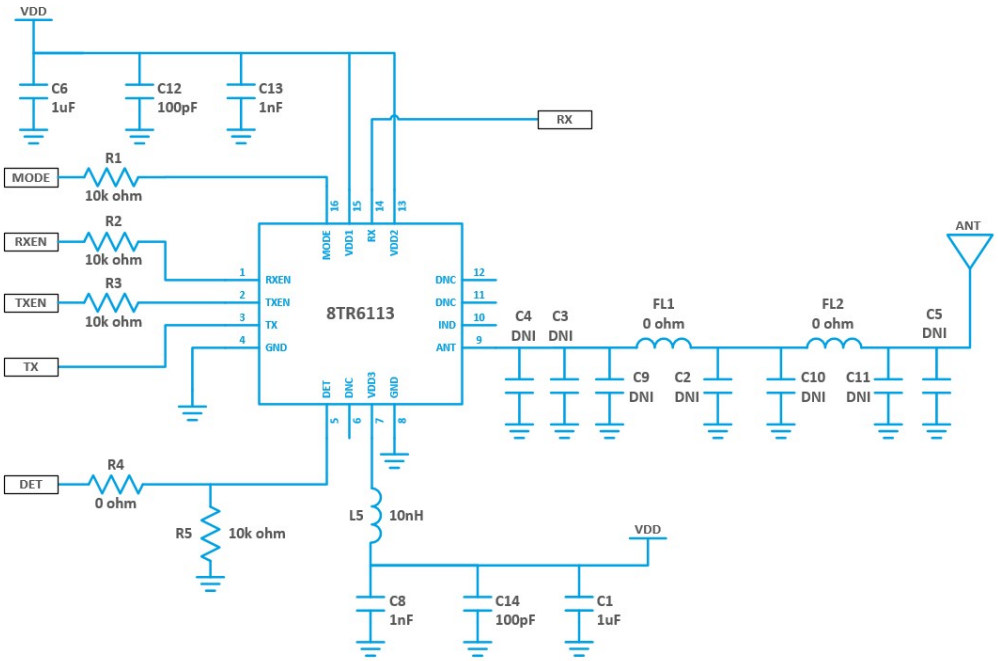


Figure 4. 8TR6113 Evaluation Board Schematic

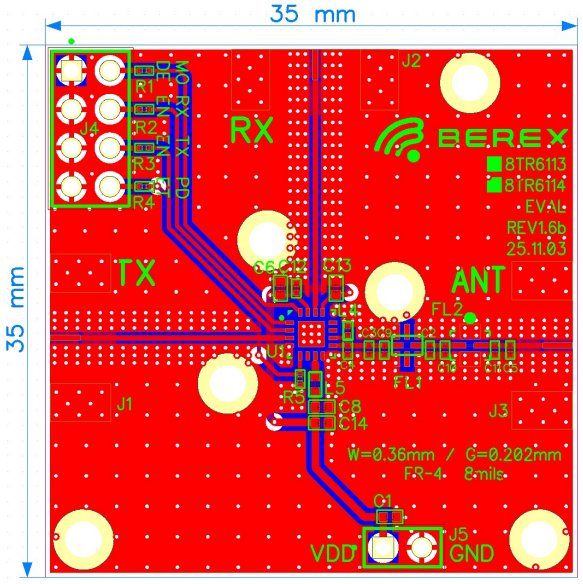
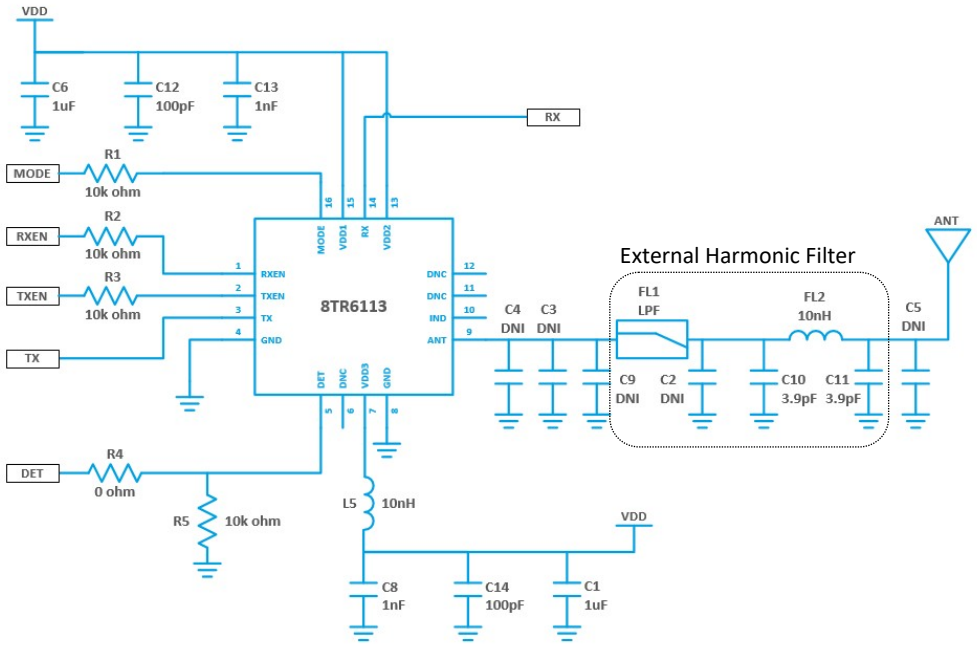


Figure 5. 8TR6113 Evaluation Board PCB Layout

Table 10. 8TR6113 Evaluation Board Bill of Materials (BOM)

Component	Value	Manufacturer	Mfr Part Number	Size	Description
C1, C6	1uF	Murata	GRM155Z71A105KE01J	0402	CAP CER 1UF 10V X7R 0402
C2 - C5, C9 - C11	DNI	-	-	-	
C8	1nF	Murata	GRM033R71E102KA01D	0402	CAP CER 1000PF 25V X7R 0201
C12	100pF	Murata	GRM0335C1H101JA01D	0201	CAP CER 100PF 50V C0G/NP0 0201
C13	1nF	Murata	GRM0335C1H101JA01D	0201	CAP CER 100PF 50V C0G/NP0 0201
C14	100pF	Murata	GRM1555C1H101JA01D	0402	CAP CER 100PF 50V C0G/NP0 0402
L5	10nH	Murata	LQG15WZ10NH02D	0402	FIXED IND 10NH 500MA 190 MOHM
FL1, FL2, R4	0Ω	Panasonic	ERJ-1GN0R00C	0201	RES SMD 0 OHM JUMPER 1/20W 0201
R1 - R3, R5	10kΩ	Panasonic	ERJ-1GNF1002C	0201	RES SMD 10K OHM 1% 1/20W 0201
J1 - J3	SMA	KJ Comtech	CN2911-7/2	SMA EDGE	SMA 50Ω End Launch Jack Receptacle
J4	HEADER 2x4	Adam Tech	PH2RA-08-UA	2x4	HEADER DR RA TH 2x4
J5	HEADER 1x2	Adam Tech	PH2RA-02-UA	1x2	HEADER DR RA TH 1x2
U1	8TR6113	BeRex	8TR6113	QFN 3x3	Sub-GHz ISM Band RF Front-End IC

Application Schematic



※ External Harmonic Filter

Performance is sensitive to PCB parasitics. Therefore, custom PCB layout should emulate the Evaluation Board PCB layout attached to this design as closely as possible.
All components must be populated and located as close as possible to ANT pin. Use ceramic multi-layer inductors for effective filtering.
Depending on layout, all inductor and capacitor values may require minor value tweaks for optimum impedance matching.

Figure 6. 8TR6113 Application Schematic

Table 11. 8TR6113 Application Board Bill of Materials (BOM)

Component	Value	Manufacturer	Mfr Part Number	Size	Description
C1, C6	1uF	Murata	GRM155Z71A105KE01J	0402	CAP CER 1UF 10V X7R 0402
C2 - C5, C9	DNI	-	-	-	
C8	1nF	Murata	GRM033R71E102KA01D	0402	CAP CER 1000PF 25V X7R 0201
C10, C11	3.9pF	Murata	GRM0335C1H3R9BA01D	0201	CAP CER 3.9PF 50V C0G/NP0 0201
C12	100pF	Murata	GRM0335C1H101JA01D	0201	CAP CER 100PF 50V C0G/NP0 0201
C13	1nF	Murata	GRM0335C1H101JA01D	0201	CAP CER 100PF 50V C0G/NP0 0201
C14	100pF	Murata	GRM1555C1H101JA01D	0402	CAP CER 100PF 50V C0G/NP0 0402
L5	10nH	Murata	LQG15WZ10NH02D	0402	FIXED IND 10NH 500MA 190 MOHM
FL1	860MHz LPF	ACX	LF2012-AR86FAB	0805	Multilayer Chip Low-Pass Filters
FL2	10nH	Murata	LQP03TN10NH02D	0201	FIXED IND 10NH 250MA 700 MOHM
R1 - R3, R5	10kΩ	Panasonic	ERJ-1GNF1002C	0201	RES SMD 10K OHM 1% 1/20W 0201
R4	0Ω	Panasonic	ERJ-1GN0R00C	0201	RES SMD 0 OHM JUMPER 1/20W 0201
J1 - J3	SMA	KJ Comtech	CN2911-7/2	End Launch	SMA 50Ω End Launch Jack Receptacle
J4	HEADER 2x4	Adam Tech	PH2RA-08-UA	2x4	HEADER DR RA TH 2x4
J5	HEADER 1x2	Adam Tech	PH2RA-02-UA	1x2	HEADER DR RA TH 1x2
U1	8TR6113	BeRex	8TR6113	QFN 3x3	Sub-GHz ISM Band RF Front-End IC

Package Dimensions

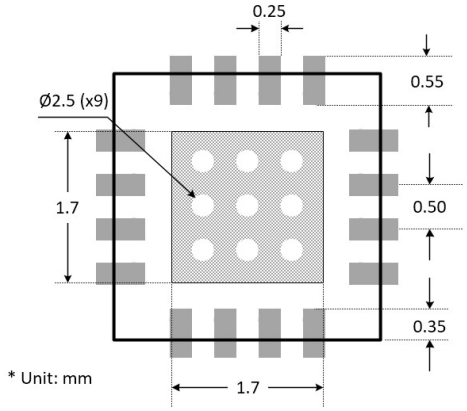
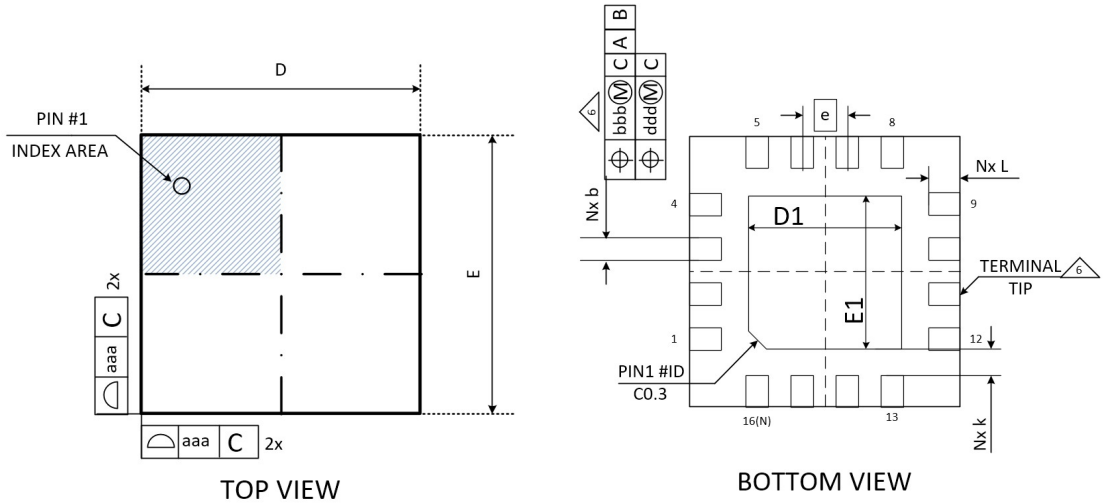
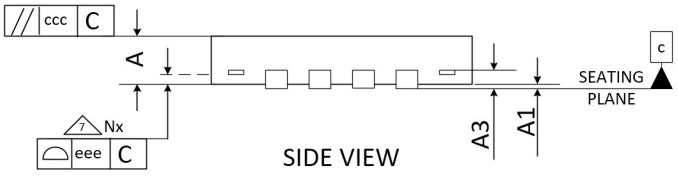


Figure 7. 8TR6113 PCB Layout Footprint

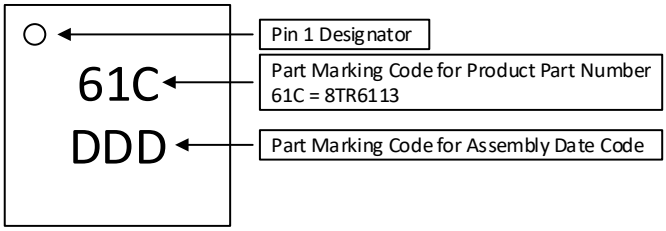




	MIN.	NOM.	MAX.
A	0.41	0.45	0.50
A1	0.00	0.02	0.05
A3	---	0.127 Ref	MAX.
b	0.20	0.25	0.3
D		3.00 BSC	
E		3.00 BSC	
e		0.50 BSC	
D1	1.60	1.70	1.80
E1	1.60	1.70	1.80
L	0.25	0.35	0.45
K	0.20	---	---
aaa		0.05	
bbb		0.10	
ccc		0.10	
ddd		0.05	
eee		0.08	
N		16	

Figure 8. 8TR6113 Package Dimension

Package Marking



Note: The part marking: 61C represents the Product Part Number: 8TR6113.
Due to the size limitations of this package, only three (3) characters can be marked on each of two (2) rows.
Therefore the Product Part Number is represented in the part marking by a 3-character code.

Figure 9. 8TR6113 Typical Part Marking

ESD Handling Information

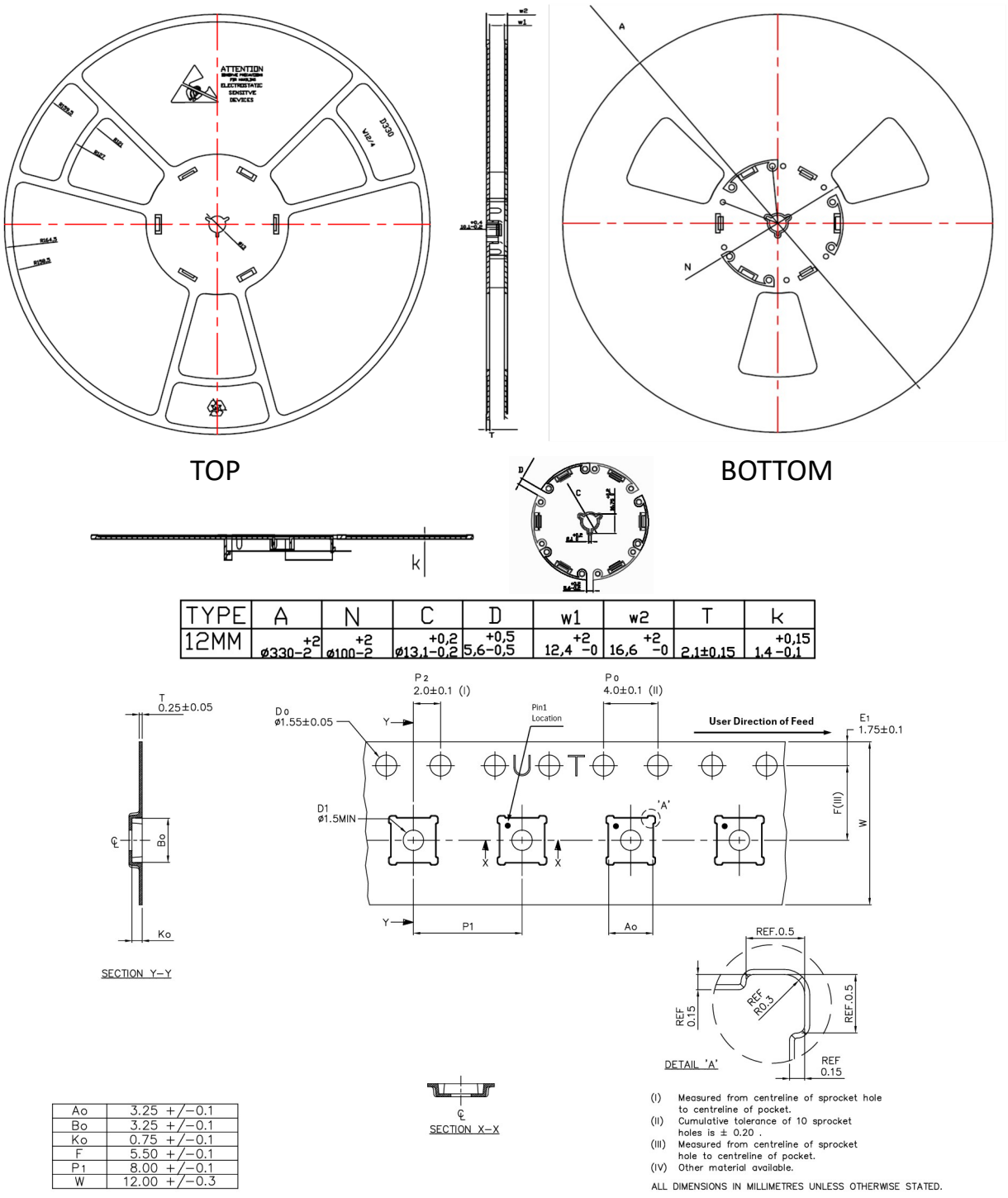
Electrostatic Discharge(ESD) can cause immediate (or latent) failures in semiconductor Integrated Circuits (ICs). BeRex, Inc. RFIC products are designed with integral ESD protection structures, and all IC products are tested to meet industry standards for ESD event survival. Users must adhere to all precautions for handling ESD sensitive devices throughout the manufacturing, test, shipping, handling, or operational processes, and during field service operations in order to achieve optimum system performance and life expectancy. Production quantities of this product are shipped in a standard tape and reel format.

RoHS Compliance

This part is compliant with Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive 2011/65/EU as amended by Directive 2015/863/EU.

This part is lead-free, halogen-free and compliant with a concentration of the Substances of Very High Concern (SVHC) candidate list which are contained in a quantity of less than 0.1%(w/w) in each component of a product and/or its packaging placed on the European Community market by the BeRex and Suppliers.

Tape & Reel



TYPE	A	N	C	D	w1	w2	T	k
12MM	+2 ø330−2	+2 ø100−2	+0,2 ø13,1−0,2	+0,5 5,6−0,5	+2 12,4 −0	+2 16,6 −0	2,1±0,15	+0,15 1,4 −0,1

Ao	3.25 +/−0.1
Bo	3.25 +/−0.1
Ko	0.75 +/−0.1
F	5.50 +/−0.1
P1	8.00 +/−0.1
W	12.00 +/−0.3

Figure 10. 8TR6113 Tape and Reel Dimension