TAI-SAW TECHNOLOGY CO., LTD.
No. 3, Industrial 2nd Rd., Ping-Chen Industrial District,
Taoyuan, 324, Taiwan, R.O.C.
TEL: 886-3-4690038 FAX: 886-3-4697532
E-mail: tstsales@mail.taisaw.com Web: www.taisaw.com

Product Specifications Approval Sheet

Product Name: GPS L2 Band 1227.6MHz Front-End Module 1.5x1.1 mm**(BW=25MHz)**

TST Parts No.: TN0125A (This Part is qualified with AEC-Q200)

Customer Part No.:_____

Company:_____

Division:_____

Approved by :_____

Date:_____

Checked by:_____Jerry Xu_____

Approval by:_____Ryan Huang_____

Date:_____2019/04/02_____

1. Customer signed back is required before TST can proceed with sample build and receive orders.
2. Orders received without customer signed back will be regarded as agreement on the specifications.
3. Any specifications changes must be approved upon by both parties and a new revision of specifications shall be released to reflect the changes.

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GPS L2 Band Front-End Module 1.5x1.1 mm

MODEL NO.: TN0125A REV. NO.:1.0

A. GENERAL DESCRIPTION:

RoHS Compliant
Lead free
Lead-free soldering

1. The TN0125A is a front-end module (FEM) designed for GPS L2 band applications.
2. The TN0125A offers low noise figure, high linearity, and high out-band rejection characteristics brought by included high performance pre-SAW filter and low noise amplifier (LNA).
3. The TN0125A offers only two external components, and very small package that is 1.5x1.1mm.

Electrostatic **S**ensitive **D**evice (**ESD**)

B. RECOMMENDED OPERATING CONDITION: (Ta=25 ℃)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{DD}	1.5	-	3.42	V

C. ABSOLUTE MAXIMUM RATINGS:

1. Supply voltage: V_{DD}=5 V
2. Control voltage: V_{CTL}=5 V
3. Input power:
   - P_{IN} (inband): +10 dBm(V_{DD}=2.8 V, f=1227.6, 1215~1239.6 MHz)
   - P_{IN} (outband): +25 dBm(V_{DD}=2.8 V, f=50~1050, 1250~4000 MHz)
4. Power dissipation: P_D=500 mW(4-layer FR4 PCB with through-hole(101.5x114.5 mm), Tj=100 ℃)
5. Terminating source impedance: Zs = 50 (Single-ended)
   Terminating load impedance: ZL = 50 (Single-ended)
6. Operating temperature range: -40 ℃ to +105 ℃
7. Storage temperature range: -40 ℃ to +110 ℃

D. FEATURES:

1. Low supply voltage: 1.8/ 2.8 V typ.
2. Low current consumption:
   - 3.0/3.7mA typ.(at V_{DD}=1.8/ 2.8 V, V_{CTL}=1.8 V)
   - 0.1μA typ.(at V_{DD}=1.8/ 2.8 V, V_{CTL}=0 V (Stand-by mode))
3. High gain: 15.5/16.0dB typ.(at V_{DD}=1.8/2.8 V,V_{CTL}=1.8 V, f=1227.6 MHz, 1215~1239.6 MHz)
4. Low noise figure:
   - 1.65/1.6dB typ.(at V_{DD}=1.8/ 2.8 V, V_{CTL}=1.8 V, f=1227.6 MHz)
5. High out band rejection(at V_{DD}=1.8/ 2.8 V, V_{CTL}=1.8 V):

- 40 dBc typ.(f=1559~1606 MHz, relative to 1227.6 MHz)
- 50 dBc typ.(f=1710~1980 MHz, relative to 1227.6 MHz)
- 70 dBc typ.(f=2400~2500 MHz, relative to 1227.6 MHz)

6. Small package size: HFFP10-CD: 1.5mmx1.1mm (typ.), t=0.5mm (max.)
7. Moisture Sensitivity Level: Level 3

E. ELECTRICAL CHARACTERISTICS 1 (DC):

(General conditions: T_a=+25 ℃)

Parameters Description		Symbol	Unit	Min.	Typ.	Max.
Supply Voltage		V_{DD}	V	1.5	-	3.3
Control Voltage (High)		$V_{CTL(H)}$	V	1.5	1.8	3.3
Control Voltage (Low)		$V_{CTL(L)}$	V	0	0	0.3
Supply Current 1	RF OFF, V_{DD}=2.8 V, V_{CTL}=1.8 V	I_{DD1}	mA	-	3.7	-
Supply Current 2	RF OFF, V_{DD}=1.8 V, V_{CTL}=1.8 V	I_{DD2}	mA	-	3.0	-
Supply Current 3	RF OFF, V_{DD}=2.8 V, V_{CTL}=0 V	I_{DD3}	μA	-	0.1	3.0
Supply Current 4	RF OFF, V_{DD}=1.8 V, V_{CTL}=0 V	I_{DD4}	μA	-	0.1	3.0
Control Current	V_{CTL}=1.8 V	I_{CTL}	μA	-	5.0	12.0

F. ELECTRICAL CHARACTERISTICS 2 (RF):

(General conditions: V_{DD}=2.8 V, V_{CTL}=1.8 V, f_{RF}=1227.6 MHz, 1215~1239.6, T_a=+25 ℃, Z_s=Z_l=50 ohm, with application circuit)

Parameters Description		Symbol	Unit	Min.	Typ.	Max.
Small Signal Gain (GPS)	f=1227.6MHz (GPS) Exclude PCB, Connector Losses(0.17 dB)	GainGPS1	dB	-	17.5	-
Noise Figure (GPS)	f=1227.6 MHz (GPS) Exclude PCB,Connector Losses (0.09 dB)	NFGPS1	dB	-	2.25	-
Input Power at 1dB Gain, Compression Point	f=1227.6 MHz	P-1dB(IN)1	dBm	-	-9.8	-
Input 3rd Order Intercept Point	f1=1227.6 MHz, f2=f1 +/-1 MHz, Pin=-30 dBm	IIP3_1	dBm	-	-1.5	-
Low Band Rejection	f= 704 to 915MHz, relative to 1176.45 MHz	BR_L1	dBc	-	43	-
GPS, GNS, BeiDou Rejection	f=1559 to 1606 MHz, relative to 1227.6 MHz	BR_G1	dBc		40	

High Band Rejection	f=1710 to 1980 MHz, relative to 1227.6 MHz	BR_H	dBc	-	49	-
WLAN Band Rejection	f=2400 to 2500 MHz, relative to 1227.6 MHz	BR_W	dBc	-	75	-
RF IN Return Loss (GPS)	f=1227.6 MHz (GPS L2)	RLiGPS	dB	-	11.9	-
RF OUT Return Loss(GPS)	f=1227.6 MHz (GPS L2)	RLoGPS	dB	-	21.3	-
Group Delay Time Deviation	f=1215 to 1237 MHz (GPS L2)	GDTGLN1	ns	-	10	-

ELECTRICAL CHARACTERISTICS 3 (RF):

(General conditions: V_{DD}=1.8 V, V_{CTL}=1.8 V, f_{RF}=1227.6 MHz, 1215 to 1239.6, T_a=+25 ℃, Z_s=Z_l=50 ohm, with application circuit)

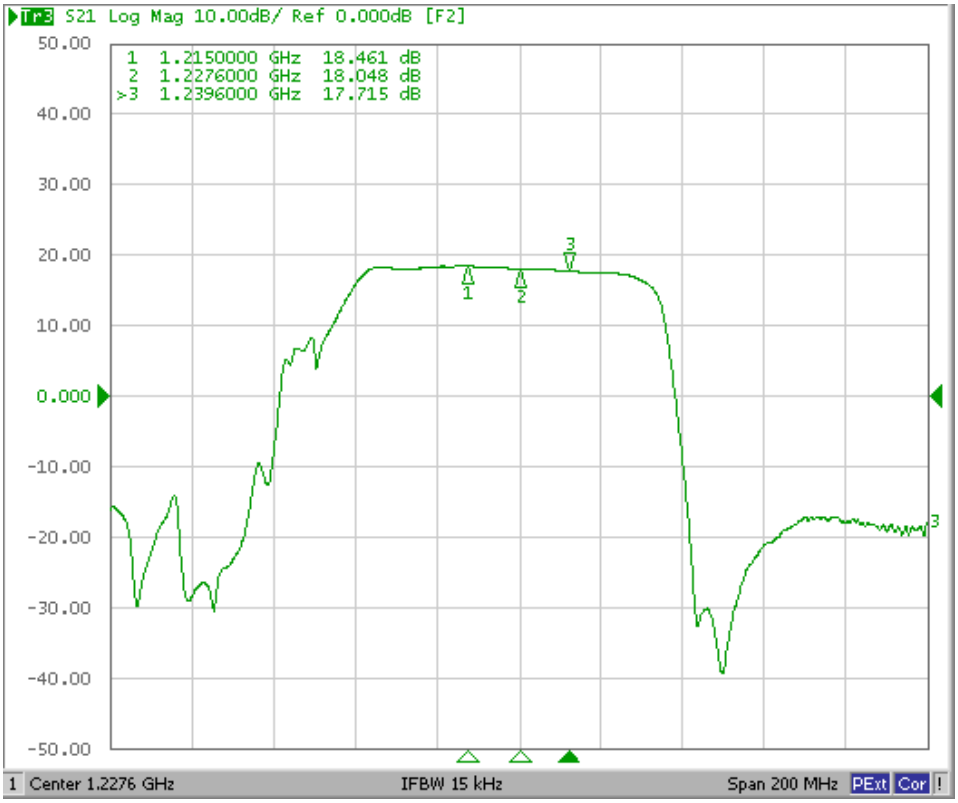
Parameters Description		Symbol	Unit	Min.	Typ.	Max.
Small Signal Gain (GPS)	f=1227.6MHz (GPS) Exclude PCB, Connector Losses(0.17 dB)	GainGPS 1	dB	-	17	-
Noise Figure (GPS)	f=1227.6 MHz (GPS) Exclude PCB,Connector Losses (0.09 dB)	NFGPS1	dB	-	2.28	-
Input Power at 1dB Gain, Compression Point	f=1227.6 MHz	P-1dB(IN) 1	dBm	-	-9.8	-
Input 3rd Order Intercept Point	f1=1227.6 MHz, f2=f1 +/-1 MHz, Pin=-30 dBm	IIP3_1	dBm	-	-1.5	-
Low Band Rejection	f= 704 to 915MHz, relative to 1227.6 MHz	BR_L1	dBc	-	43	-
GPS, GNS, BeiDou Rejection	f=1559 to 1606 MHz, relative to 1227.6 MHz	BR_G1	dBc		40	
High Band Rejection	f=1710 to 1980 MHz, relative to 1227.6 MHz	BR_H	dBc	-	49	-
WLAN Band Rejection	f=2400 to 2500 MHz, relative to 1227.6 MHz	BR_W	dBc	-	75	-
RF IN Return Loss (GPS)	f=1227.6 MHz (GPS L2)	RLiGPS	dB	-	11.5	-
RF OUT Return Loss(GPS)	f=1227.6 MHz (GPS L2)	RLoGPS	dB	-	20	-
Group Delay Time Deviation	f=1215 to 1237 MHz (GPS L2)	GDTGLN	ns	-	10	-

FREQUENCY CHARACTERISTICS 1:

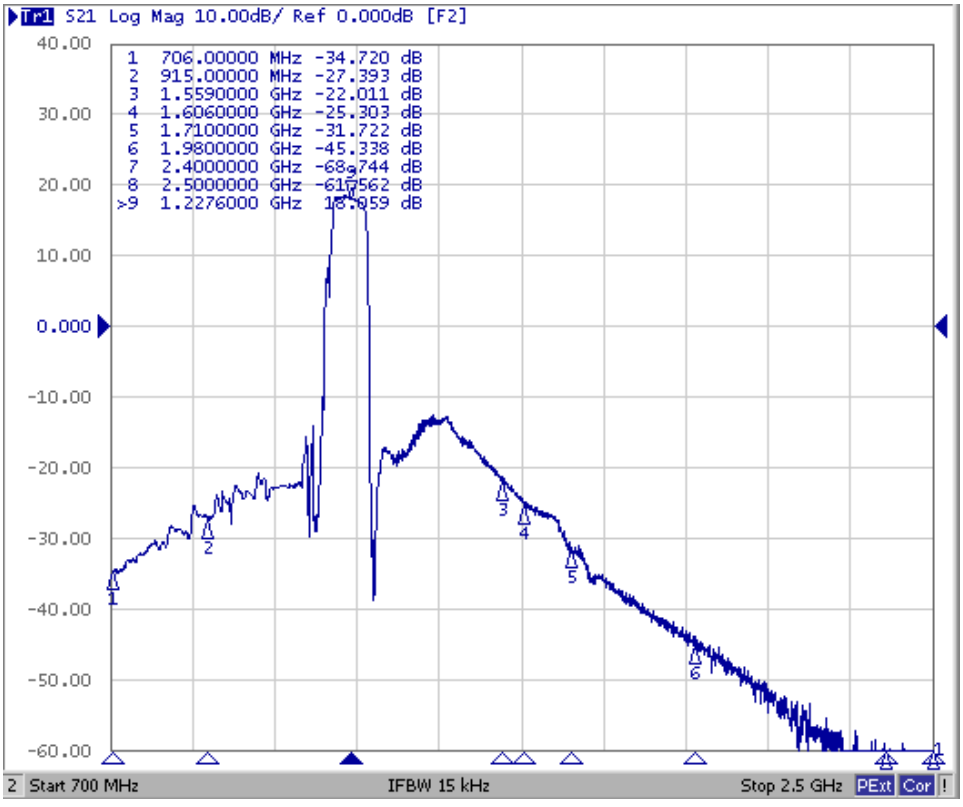
(Conditions: V_{DD}=2.8 V, V_{CTL}=1.8 V, Ta=25 ℃, Z_s=Z_l=50 ohm, with application circuit.)

Transfer function:

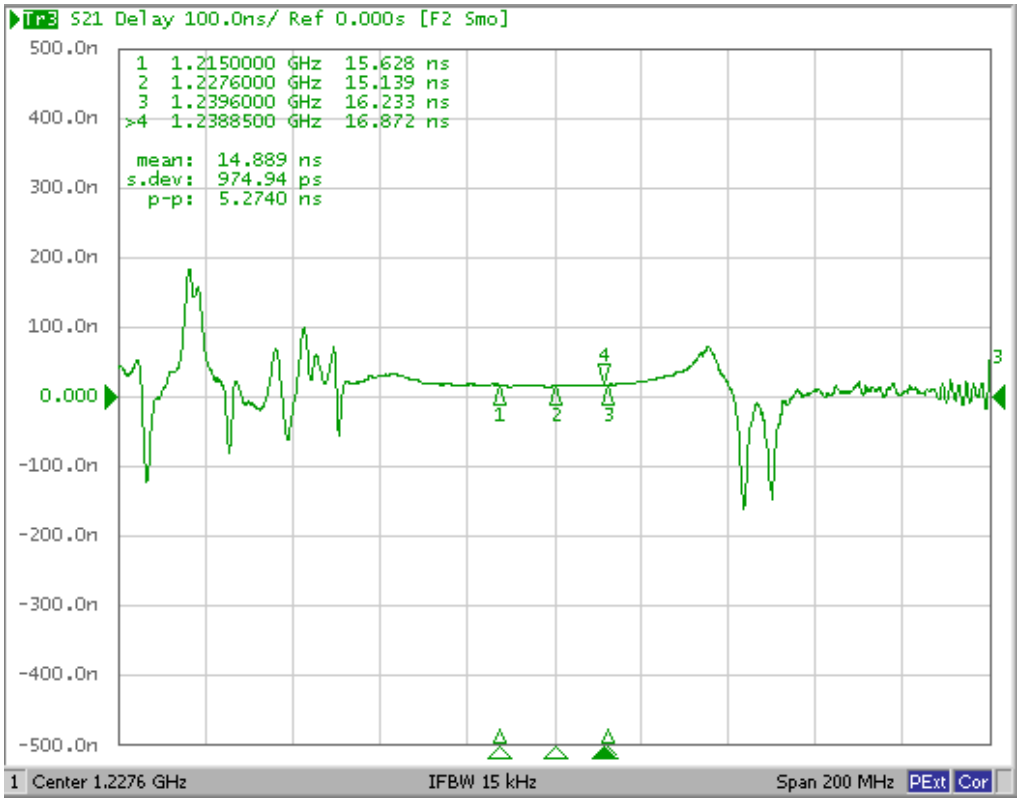
S21 response (span: 200 MHz)



S21 response

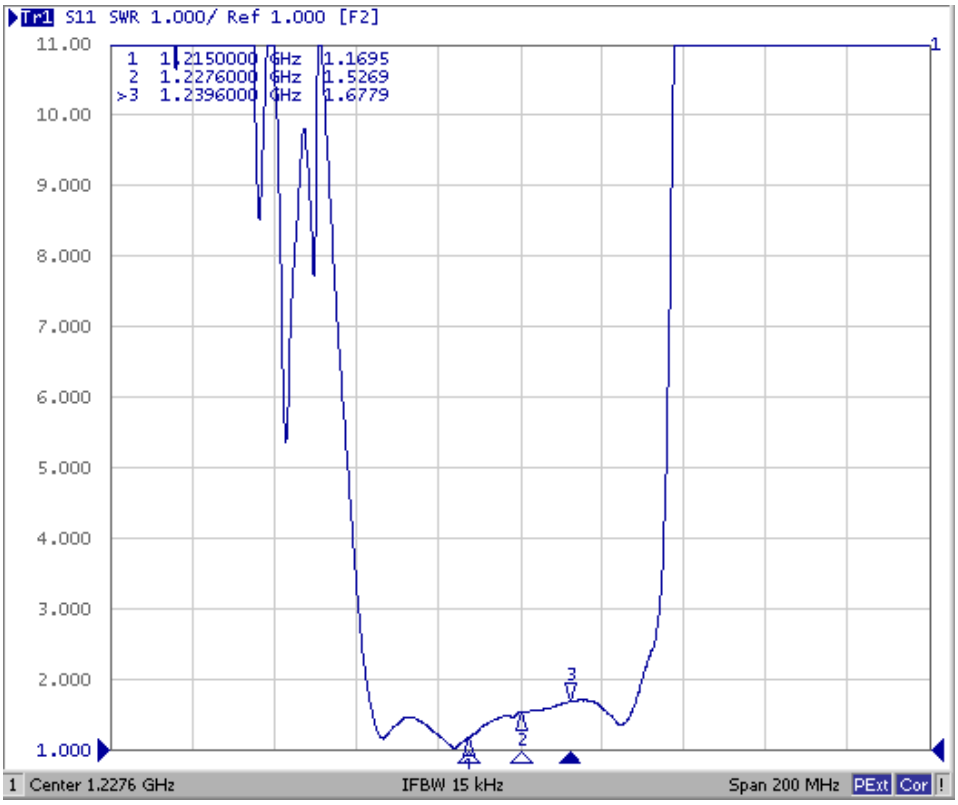


Group Delay

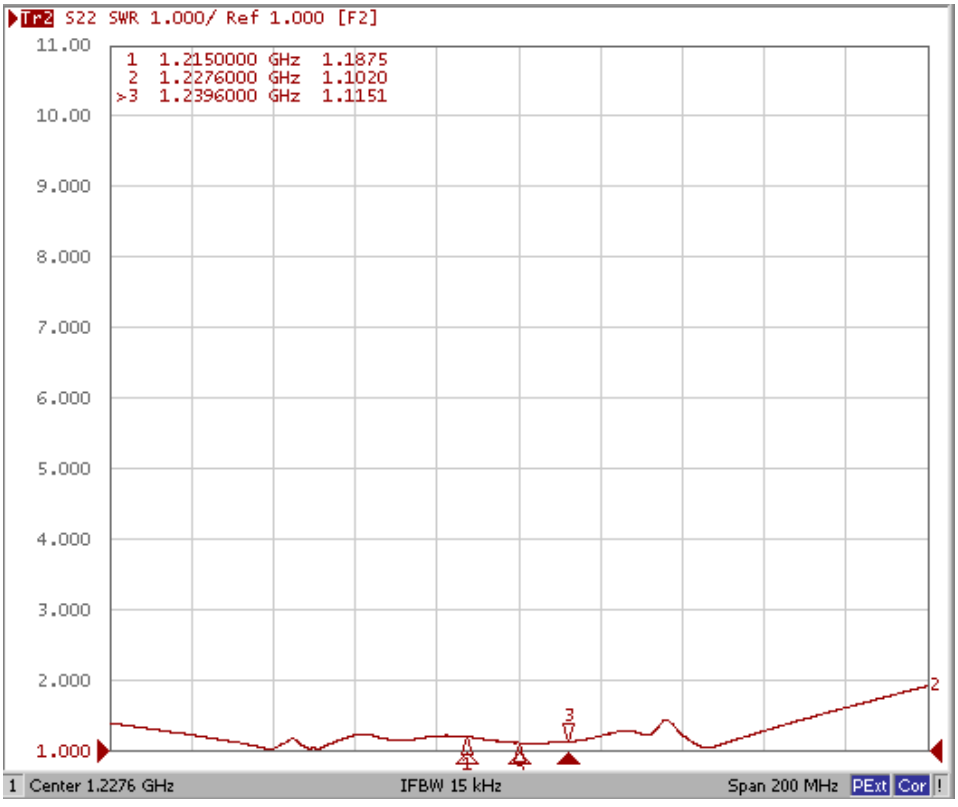

Tr3 S21 Delay 100.0ns/ Ref 0.000s [F2 Smo]
1 1.2150000 GHz 15.628 ns
2 1.2276000 GHz 15.139 ns
3 1.2396000 GHz 16.233 ns
>4 1.2388500 GHz 16.872 ns
mean: 14.889 ns
s.dev: 974.94 ps
p-p: 5.2740 ns
500.0n
400.0n
300.0n
200.0n
100.0n
0.000
-100.0n
-200.0n
-300.0n
-400.0n
-500.0n
1 Center 1.2276 GHz
IFBW 15 kHz
Span 200 MHz
PExt
Cor

Reflection functions:

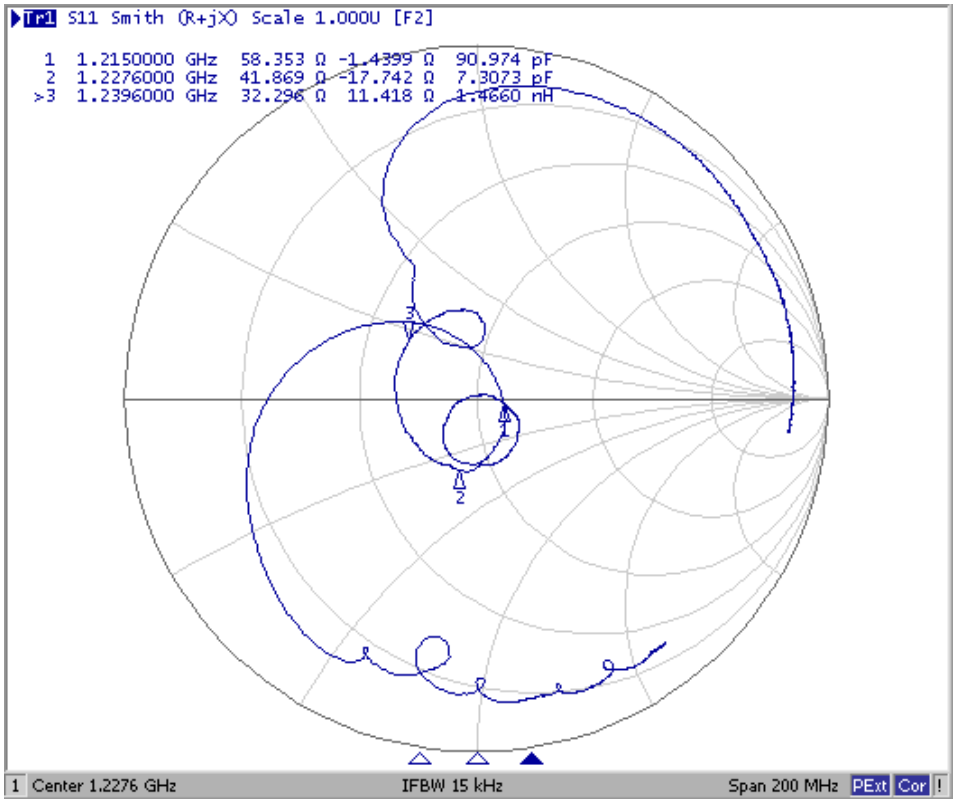
S11 VSWR



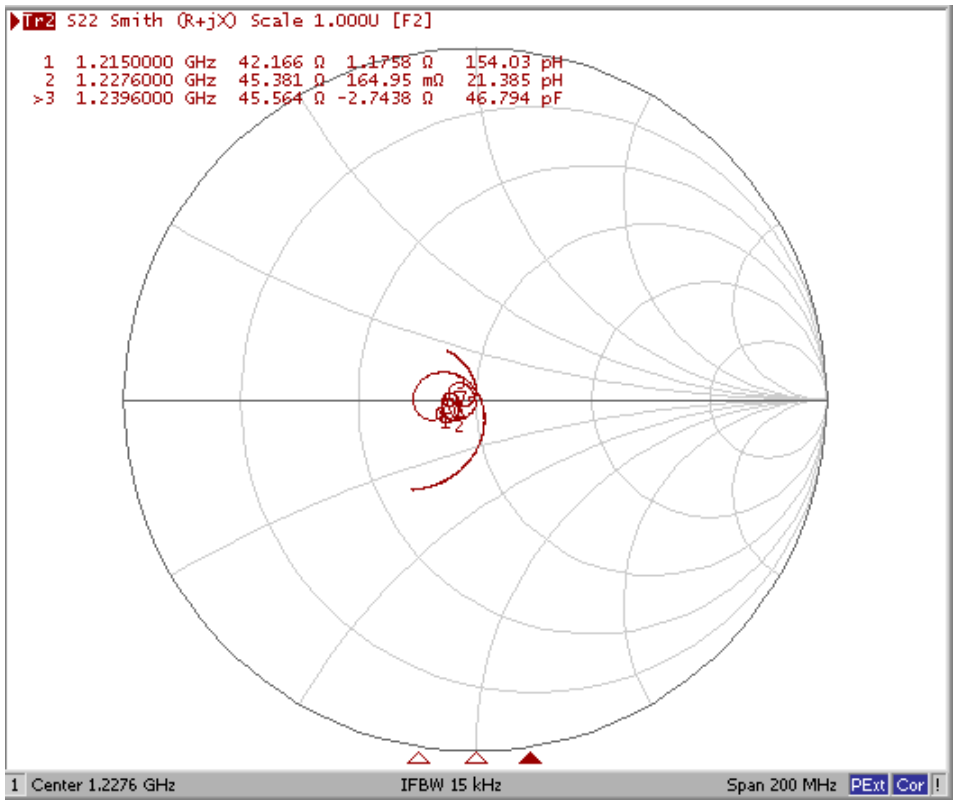
S22 VSWR



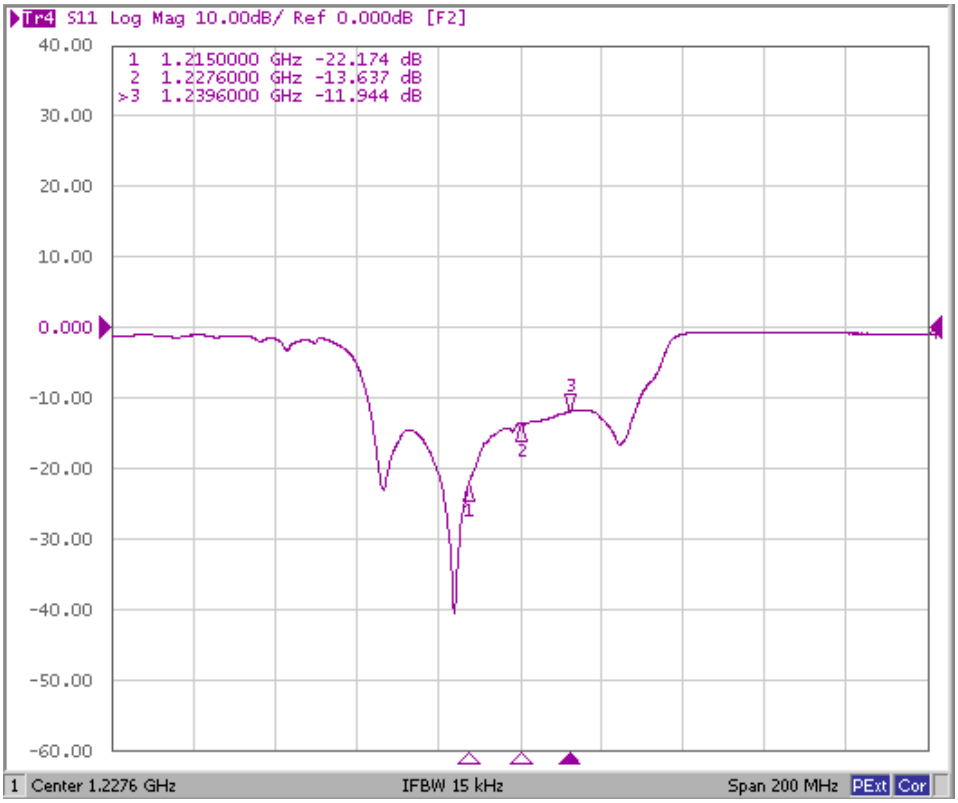
S11 Smith Chart



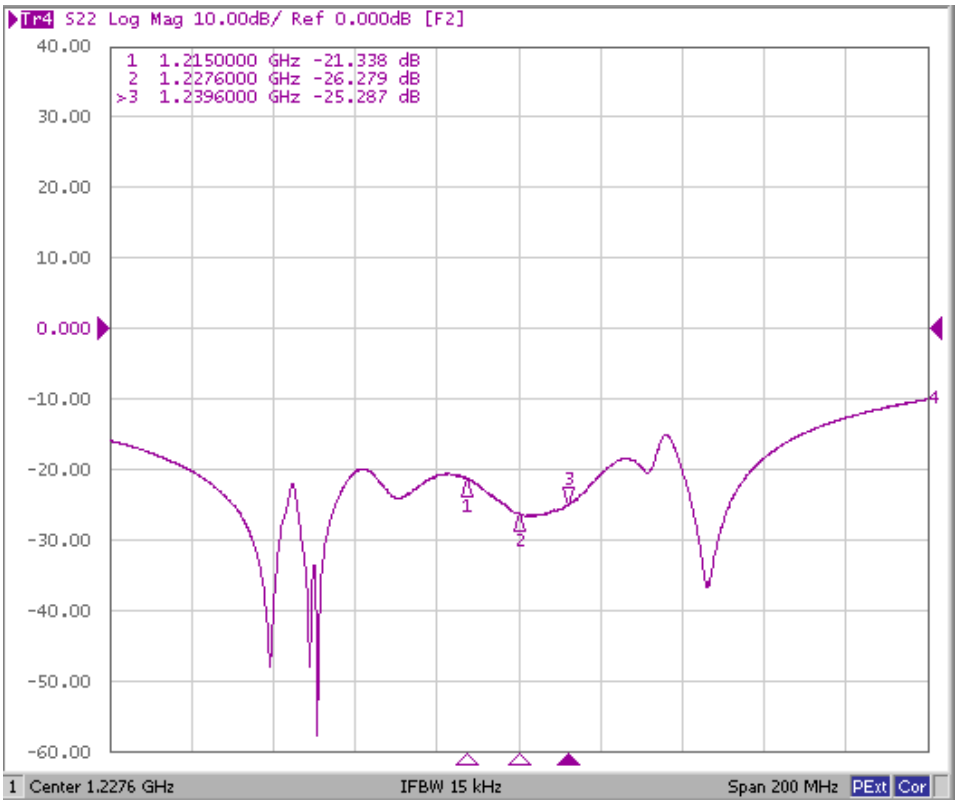
S22 Smith Chart



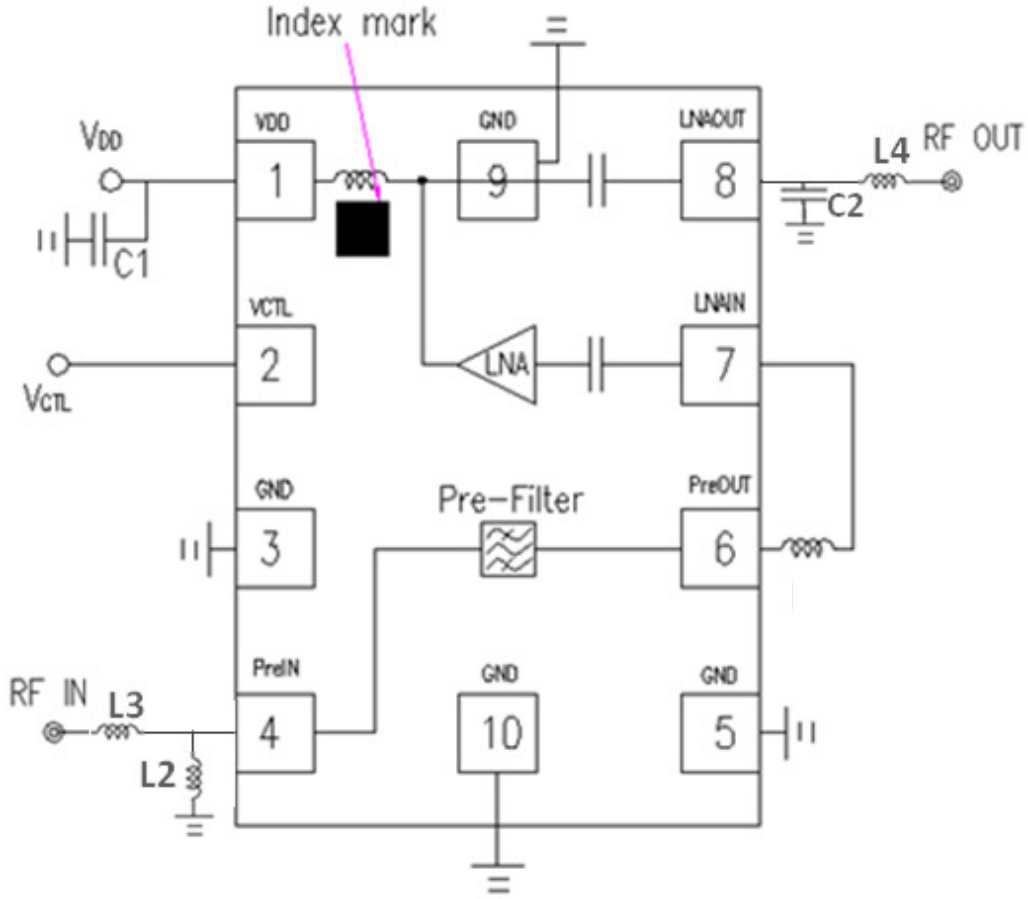
S11 Return Loss



S22 Return Loss



G. MEASUREMENT CIRCUIT:

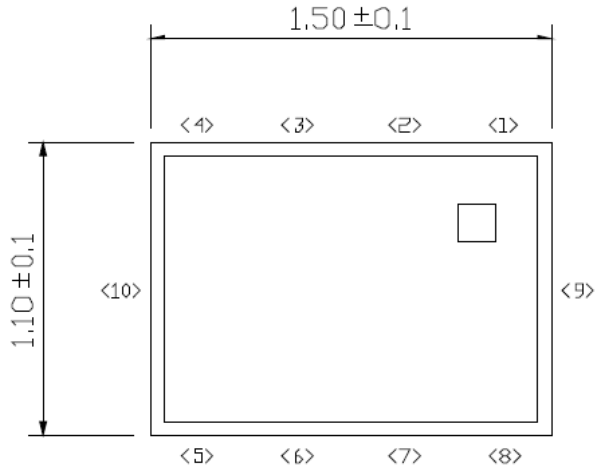


Parts ID	Manufacture	Value
L1	Murata LQW15A _00 Series	24nH
C1	Murata GRM03 Series	1000pF
L3	Murata LQW15A Series	22pF
L2	Murata LQW15A Series	10nH
C2	Murata GRM03 Series	1.2pF
L4	Murata GRM03 Series	6.8nH

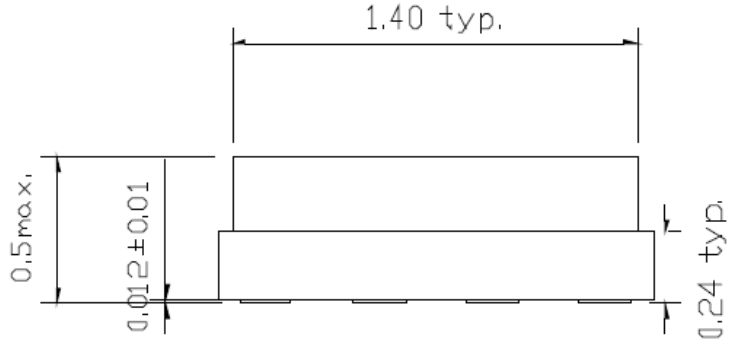
H. PACKAGE OUTLINE:

UNIT: mm

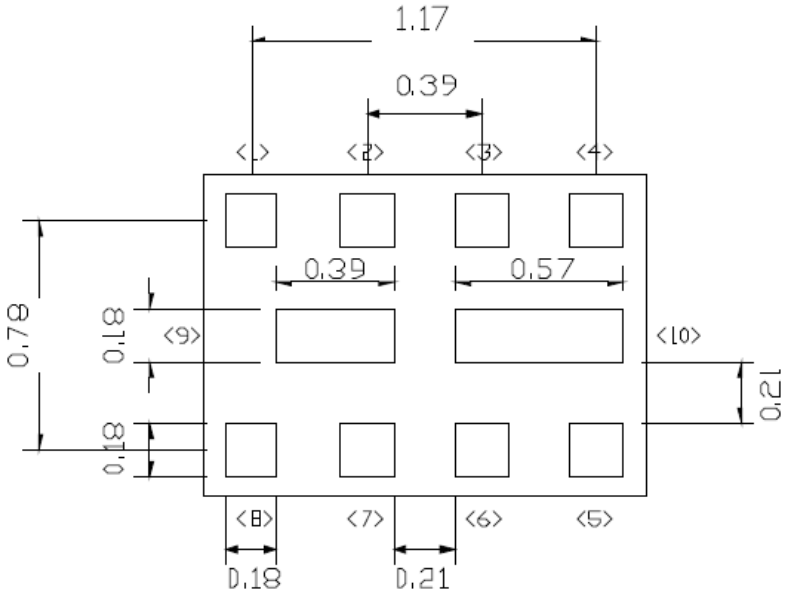
Top View



Side View



Bottom View



Electrode Dimensions clearance: ±0.05 mm

Stand-off: 0.1 mm max.

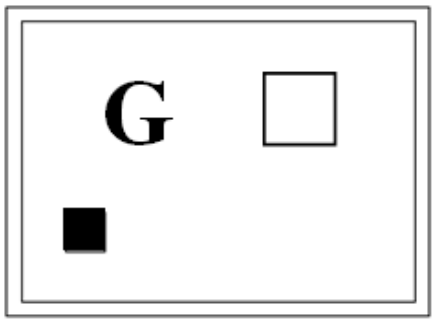
Substrate: Ceramic

Terminal treat: Au

Lid: SnAg/Kovar/Ni

Weight (typ.): 5 mg

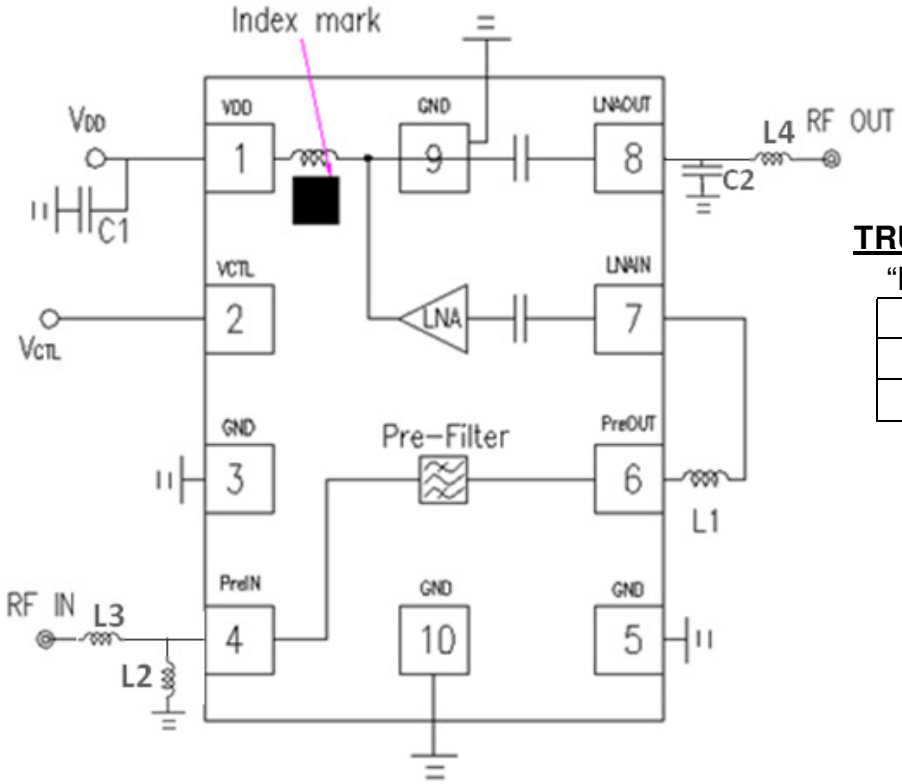
I. OUTLINE DRAWING:



☐ : Year/Month Code (Follow the table)

YEAR/Month	1	2	3	4	5	6	7	8	9	10	11	12
2013	A	B	C	D	E	F	G	H	J	K	L	M
2014	N	P	Q	R	S	T	U	V	W	X	Y	Z
2015	a	b	c	d	e	f	g	h	j	k	l	m
2016	n	p	q	r	s	t	u	v	w	x	y	z
2017	A	B	C	D	E	F	G	H	J	K	L	M
2018	N	P	Q	R	S	T	U	V	W	X	Y	Z
2019	a	b	c	d	e	f	g	h	j	k	l	m
2020	n	p	q	r	s	t	u	v	w	x	y	z

J. PIN CONFIGURATION:



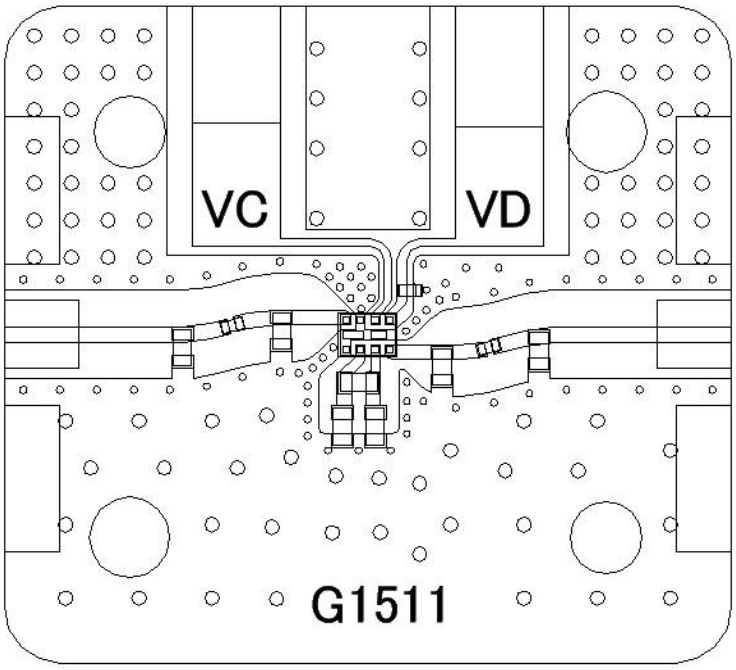
TRUTH TABLE

"H"=V_{CTL}(H), "L"=V_{CTL}(L)

VCTL	Mode
H	Active mode
L	Stand-by mode

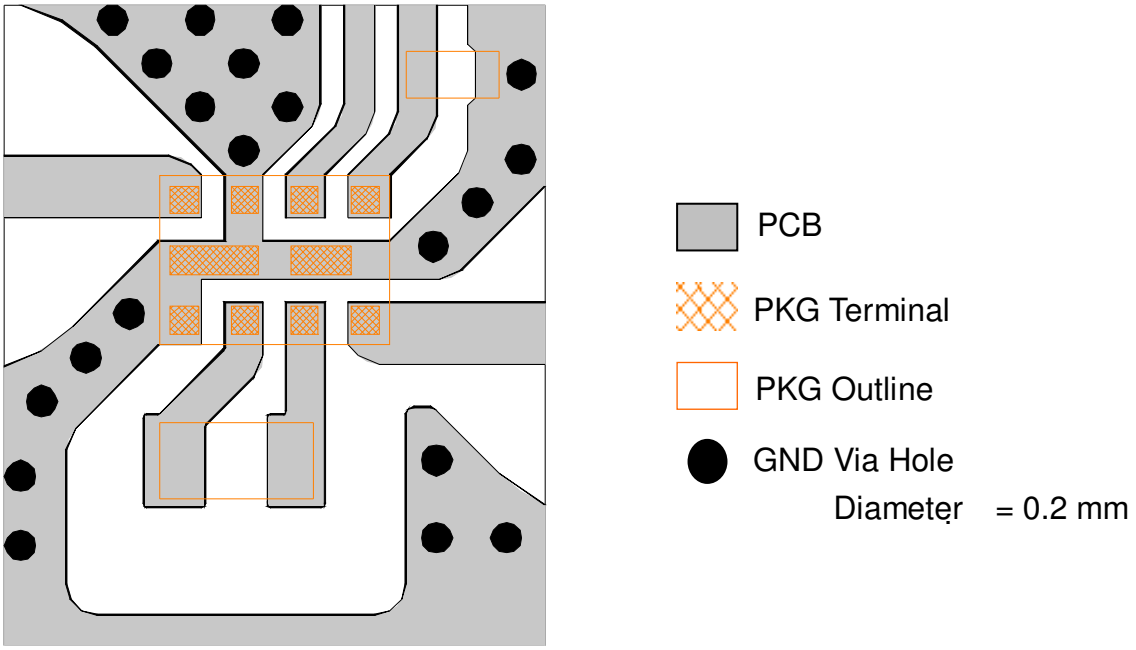
No.	SYMBOL	DESCRIPTION
1	VDD	Supply voltage terminal. Please connect bypass capacitor C1 with ground as close as possible.
2	VCTL	Control voltage terminal.
3	GND	Ground terminal. This terminal should be connected to the ground plane as close as possible for excellent RF performance.
4	PreIN	RF input terminal. This terminal connects to input of pre-SAW filter.
5	GND	Ground terminal. This terminal should be connected to the ground plane as close as possible for excellent RF performance.
6	PreOUT	Pre-SAW filter output terminal. This terminal connects to LNAIN with L1.
7	LNAIN	RF input terminal. This terminal requires only a matching inductor L1, and does not require DC blocking capacitor because of integrated capacitor.
8	LNAOUT	RF output terminal. This terminal requires no DC blocking capacitor since this terminal has integrated DC blocking capacitor.
9	GND	Ground terminal. This terminal should be connected to the ground plane as close as possible for excellent RF performance.
10	GND	Ground terminal. This terminal should be connected to the ground plane as close as possible for excellent RF performance.

K. EVALUATION BOARD:



PCB
Substrate: TLX-9
Thickness: 0.12 mm
Microstrip line width: 0.322 mm(Z_0=50 Ω)
Size: 14.0 mm x 14.0 mm

<PCB LAYOUT GUIDELINE>



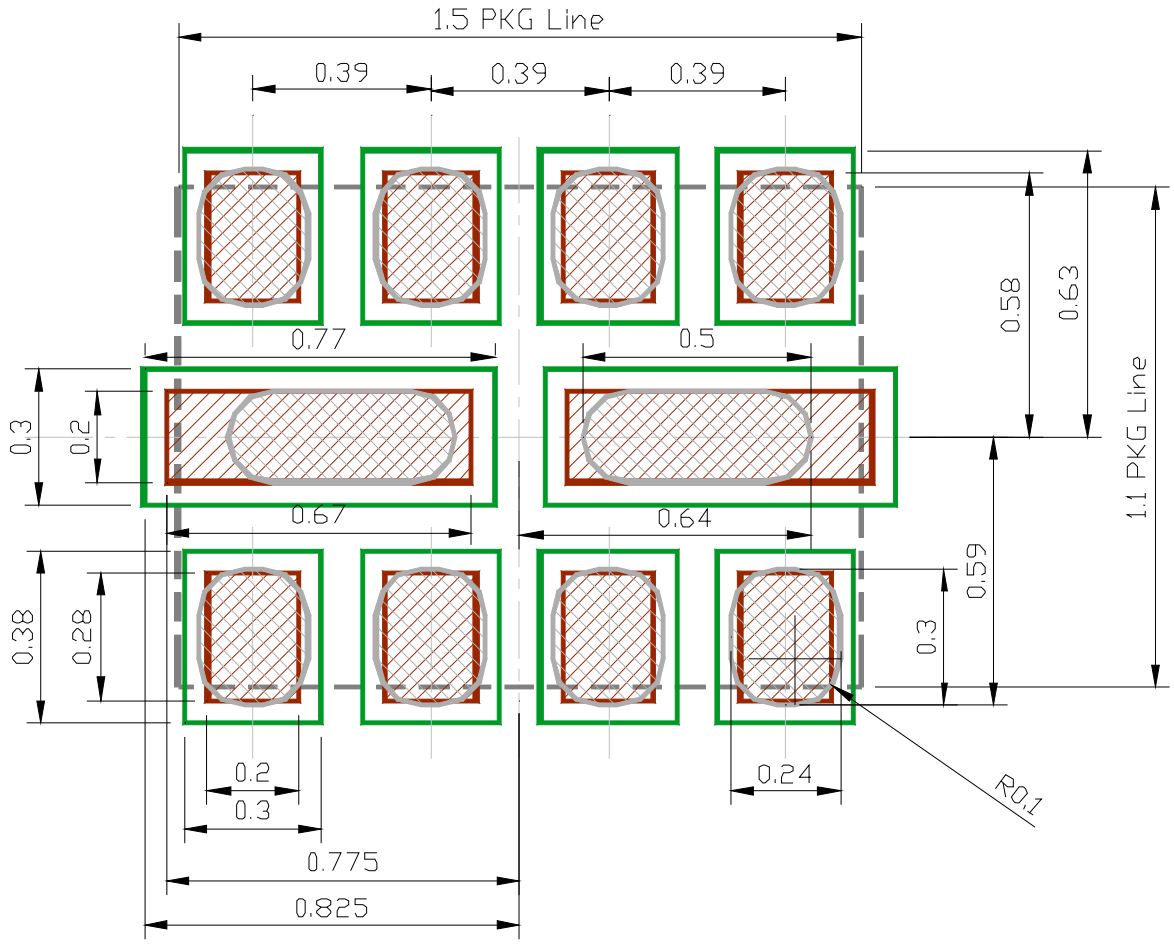
PRECAUTIONS

- Please layout ground pattern under this FEM in order not to couple with RFIN and RFOUT terminal.
- All external parts should be placed as close as possible to the FEM.
- For good RF performance, all GND terminals must be connected to PCB ground plane of substrate, and via-holes for GND should be placed near the FEM.

L. RECOMMENDED FOOTPRINT PATTERN:

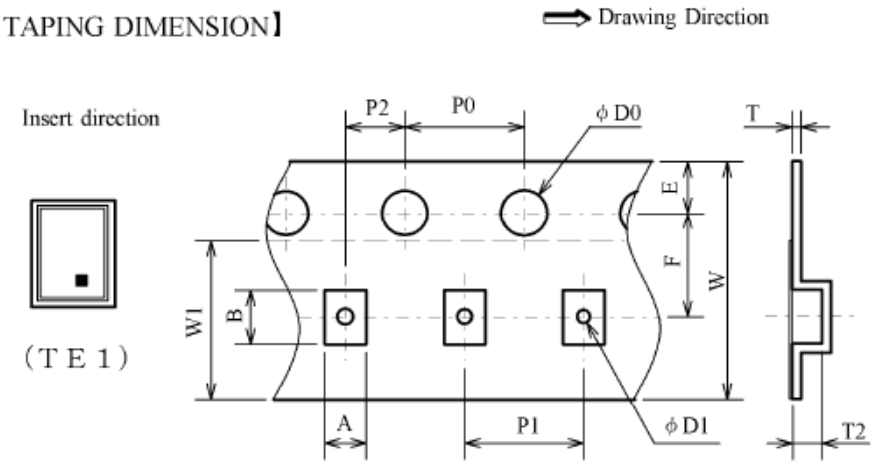
PKG: 1.5 mm x 1.1 mm
Pin pitch: 0.39 mm

: Land
: Mask (Open area) *Metal mask thickness: 100 µm
: Resist (Open area)



M. PACKING SPECIFICATION:

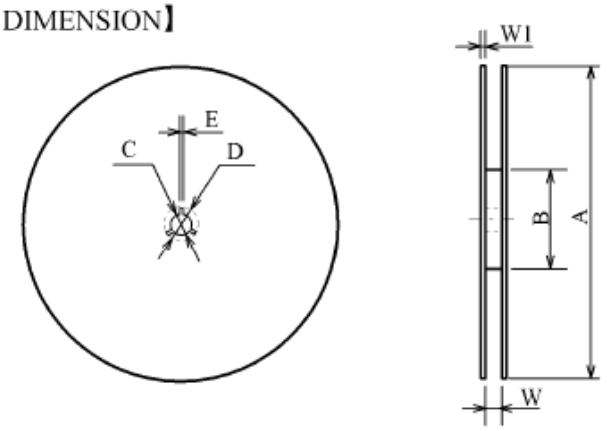
【TAPING DIMENSION】



SYMBOL	DIMENSION	REMARKS
A	1.4±0.1	BOTTOM DIMENSION
B	1.8±0.1	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{-0}$	
D1	0.5±0.05	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	0.7±0.1	
W	8.0±0.2	
W1	5.3±0.2	THICKNESS100μmMAX

*Carrier tape material: PS (Anti-static)
Cover tape material: PET (Anti-static)

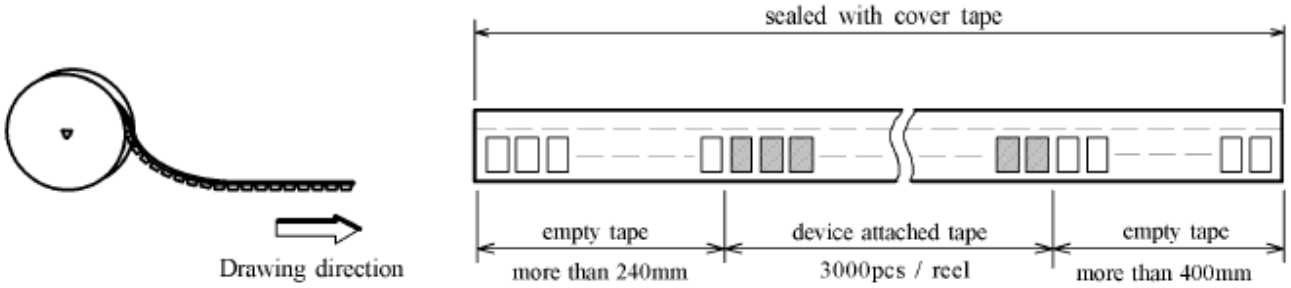
【REEL DIMENSION】



SYMBOL	DIMENSION
A	ϕ 180 $^{+0}_{-1.5}$
B	ϕ 66±0.5
C	ϕ 13±0.2
D	ϕ 21±0.8
E	2±0.5
W	$9^{+1.0}_{-0}$
W1	1.2

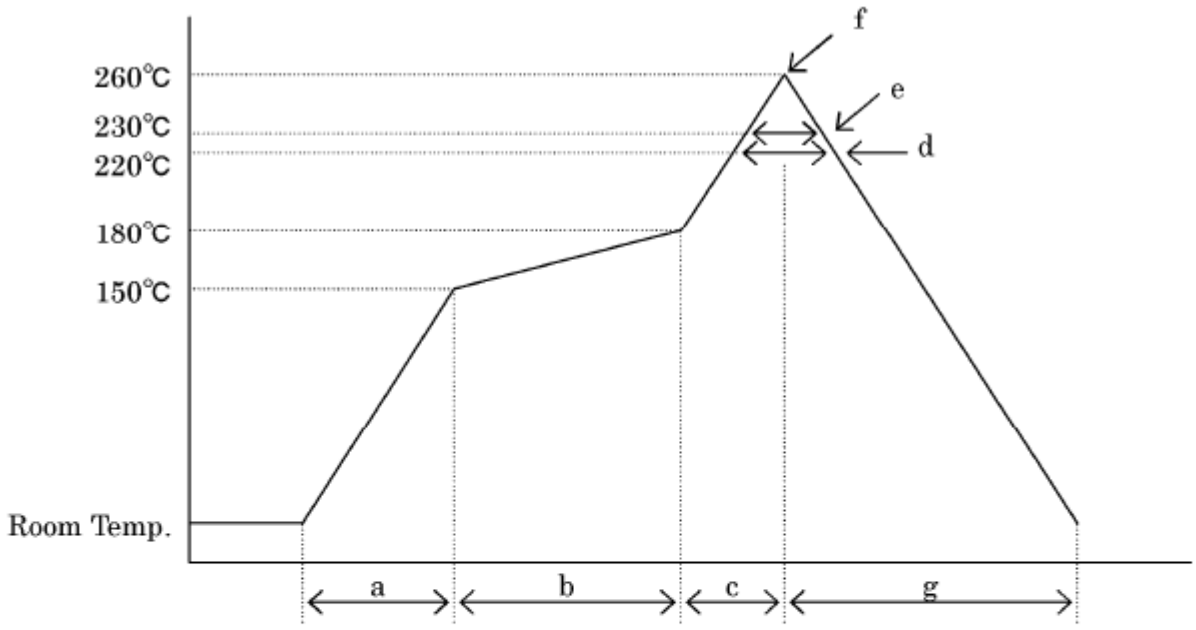
*MATERIAL : PS carbon (Anti-static)

【TAPING STATE】



N. RECOMMENDED REFLOW PROFILE:

* Recommended reflow soldering procedure



a: Temperature ramping rate	: 1 to 4℃/s
b: Pre-heating temperature	: 150 to 180℃
time	: 60 to 120s
c: Temperature ramp rate	: 1 to 4℃/s
d: 220℃ or higher time	: Shorter than 60s
e: 230℃ or higher time	: Shorter than 40s
f: Peak temperature	: Lower than 260℃
g: Temperature ramping rate	: 1 to 6℃/s

The temperature indicates at the surface of mold package.

Cautions on using this product
This product contains Gallium-Arsenide (GaAs) which is a harmful material.
- Do NOT eat or put into mouth.
- Do NOT dispose in fire or break up this product.
- Do NOT chemically make gas or powder with this product.
- To waste this product, please obey the relating law of your country.

This product may be damaged with electric static discharge (ESD) or spike voltage. Please handle with care to avoid these damages.