

## TP0310K – 27dBm (0.5W) CW, 0.1 – 3.8 GHz Power Low Noise Amplifier

### 1.0 Features

- Small signal gain @ 1850MHz:16.5dB
- OP1dB @ 1850MHz: 27.5dBm
- NF:1.0dB
- OIP3 @1850MHz: 39dBm
- 5V Typical operation
- Operating frequency: 0.1GHz to 3.8GHz



**Figure 1.1 Device Image**  
(16 Pin 3x3x0.8mm QFN Package)

### 2.0 Applications

- 4G/5G Infrastructure Radios
- Small Cells and Cellular Repeaters
- L, S band Phase Array Radar
- Mil/Comms Radios
- SDARS

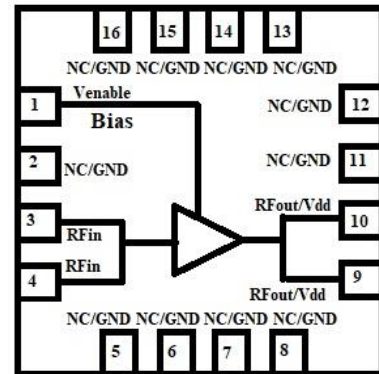


**RoHS/REACH/Halogen Free  
Compliance**

### 3.0 Description

The TP0310K is a power Low Noise Amplifier (LNA) providing high gain and linearity. With a simple input and output match, this LNA can be tuned for different frequency bands targeting low noise, high power and high linearity.

The TP0310K is packaged in a compact, low cost Dual Flat No Lead (QFN) 3x3x0.8mm, 16 pin plastic package.



**Figure 3.1 Function Block Diagram**  
(Top View)

### 4.0 Ordering Information

**Table 4.1 Ordering Information**

Base Part Number	Package Type	Form	Qty	Reel Diameter	Reel Width	Orderable Part Number
TP0310K	16Pin 3x3x0.8mm DFN	Tape and Reel	3000	13" (330mm)	18mm	TP0310KMTRPBF
Tuned Evaluation Board, 1700 - 2000MHz						TP0310K-EVB-A
Tuned Evaluation Board, 2300 - 2700MHz						TP0310K-EVB-B
Tuned Evaluation Board, 3300 - 3800MHz						TP0310K-EVB-C

## 5.0 Pin Description

**Table 5.1 Pin Definition**

Pin Number	Pin Name	Description
2,5-8, 11-16	NC	No internal connection, can be connected to ground
1	Venable	Venable along with series resistor, sets the Idq. Venable <0.2V disables the device
3,4	RF <sub>IN</sub>	RF Input. DC blocking cap required
9,10	RF <sub>OUT</sub> /V <sub>dd</sub>	RF Output. V <sub>dd</sub> supplied through an external choke inductor
Package Base	Paddle/Slug	DC and RF Ground. Also provides thermal relief. Multiple vias are recommended

**Note:** [1] The backside ground slug of the device must be grounded directly to the ground plane through multiple vias to ensure proper operation. Adequate heatsinking required.

## 6.0 Absolute Maximum Ratings

**Table 6.1 Absolute Maximum Ratings** @T<sub>A</sub>=+25°C Unless Otherwise Specified

Parameter	Symbol	Value	Unit
<b>Electrical Ratings</b>			
Supply voltage, Venable	V <sub>dd</sub>	+6	V
Drain current	I <sub>DQ</sub>	150	mA
RF input power CW	RF <sub>IN</sub>	23	dBm
Storage Temperature Range	T <sub>st</sub>	-55 to +150	°C
Operating Temperature Range	T <sub>op</sub>	-40 to +105	°C
Maximum Junction Temperature	T <sub>J</sub>	170	°C
<b>Thermal Ratings</b>			
Thermal Resistance (junction-to-case) – Bottom side	R <sub>θJC</sub>	10	°C/W
Soldering Temperature	T <sub>SOLD</sub>	260	°C
<b>ESD Ratings</b>			
Human Body Model (HBM)	Level 1B	500 to <1000	V
Charged Device Model (CDM)	Level C	≥1000	V
<b>Moisture Rating</b>			
Moisture Sensitivity Level	MSL	1	-

### Attention:

Maximum ratings are absolute ratings. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Exceeding one or a combination of the absolute maximum ratings may cause permanent and irreversible damage to the device and/or to surrounding circuit.

## 7.0 Recommended DC Operating Conditions

**Table 7.1 Recommended Operating Conditions**

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Drain Voltage	$V_{DD}$		+5.0		V
Venable Voltage	$V_{enable}$		+5.0		V
Drain Bias Current	$I_{DQ}$ , Set by external resistor		140		mA
Venable Bias Current	$I_{bias}$		3.5	4	mA
Operating Temperature Range		-40	+25	+105	°C

## 8.0 RF Electrical Specifications for 1700 - 2000MHz, 2300 - 2700MHz and 3300 – 3800MHz EVB

**Table 8.1 1700 – 2000MHz EVB @ $T_A=+25^{\circ}C$  Unless Otherwise Specified; Venable = High**

Parameter	Test Condition	Minimum	Typical	Maximum	Unit
Gain	Across Band		16-17		dB
Noise Figure	Across Band		1.0		dB
EVB Noise Figure	Across Band		1.05		dB
Input Return Loss	Across Band		11-14		dB
Output Return Loss	Across Band		10-13		dB
OP1dB	Across Band		27-27.5		dBm
OIP3	Across Band, 8dBm per tone, Tone Spacing 2MHz		39		dBm
Switching Rise Time	10/90% of the RF value		4		nsec
Switching Fall Time	10/90% of the RF value		1000		nsec

**Table 8.2 2300 – 2700MHz EVB @ $T_A=+25^{\circ}C$  Unless Otherwise Specified; Venable = High**

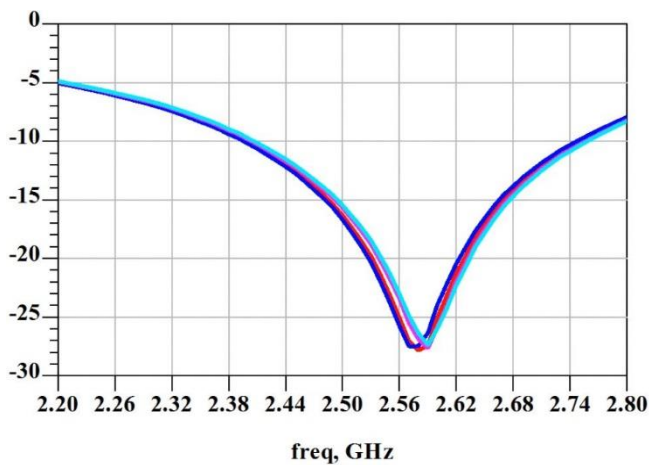
Parameter	Test Condition	Minimum	Typical	Maximum	Unit
Gain	2500MHz	13	14		dB
Noise Figure	2500MHz		1.1		dB
EVB Noise Figure	2500MHz		1.2		dB
Input Return Loss	2500MHz		16		dB
Output Return Loss	2500MHz		18		dB
OP1dB	2500MHz	25.5	27		dBm
OIP3	2500MHz, 8dBm per tone, Tone Spacing 2MHz	35	37		dBm
Switching Rise Time	10/90% of the RF value		4		nsec
Switching Fall Time	10/90% of the RF value		1000		nsec

**Table 8.3 3300 – 3800MHz EVB @ $T_A=+25^{\circ}C$  Unless Otherwise Specified; Venable = High**

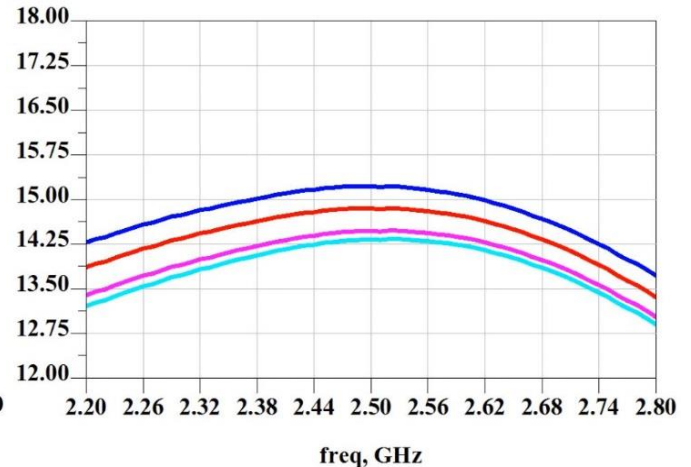
Parameter	Test Condition	Minimum	Typical	Maximum	Unit
Gain	Across Band		11-11.5		dB
Noise Figure	Across Band		0.85-1.15		dB
EVB Noise Figure	Across Band		1-1.3		dB
Input Return Loss	Across Band		7-11		dB
Output Return Loss	Across Band		17-24		dB
OP1dB	Across Band		27.5		dBm
OIP3	Across Band, 8dBm per tone, Tone Spacing 2MHz		41-42		dBm
Switching Rise Time	10/90% of the RF value		4		nsec
Switching Fall Time	10/90% of the RF value		1000		nsec

## 9.0 Typical Characteristics

### 9.1 2300 - 2700MHz tuned EVB ( $V_{DD}=5V$ , $I_{DQ}=140mA$ ), $-40^{\circ}C$ , $25^{\circ}C$ , $85^{\circ}C$ , $105^{\circ}C$ , Narrowband



**Figure 9.1 S11 (IRL) vs Freq**



**Figure 9.2 S21 (Gain) vs Freq**

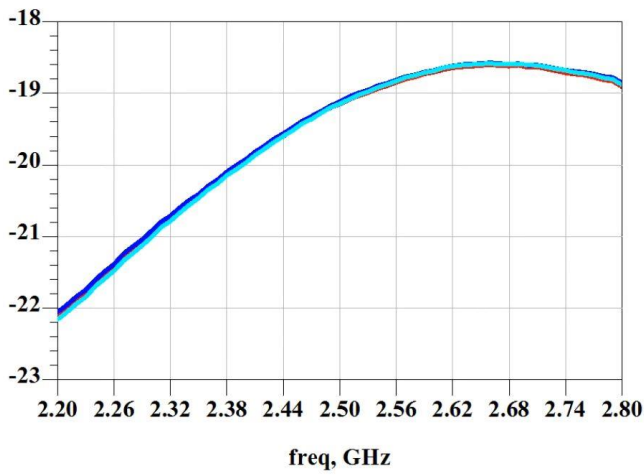


Figure 9.3 S12 (Rev Iso) vs Freq

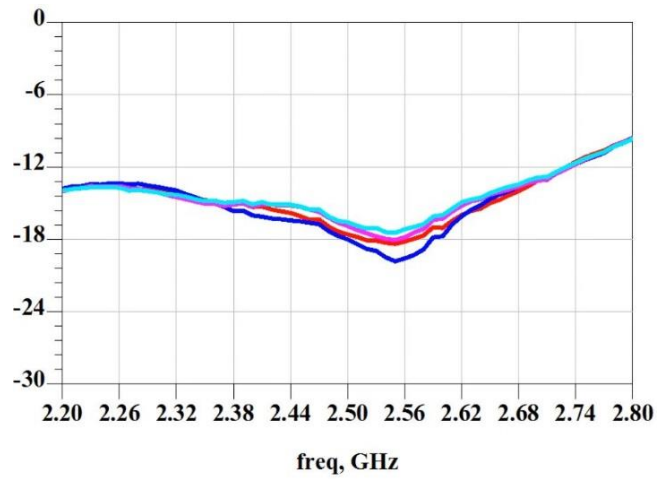


Figure 9.4 S22 (ORL) vs Freq

**9.2 2300 - 2700MHz tuned EVB (Vdd=5V, I<sub>DQ</sub>=140mA), -40°C, 25°C, 85°C, 105°C, Broadband**

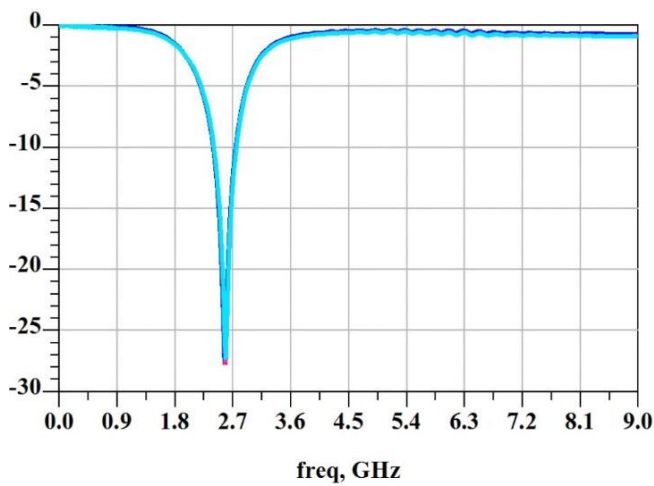


Figure 9.5 S11 (IRL) vs Freq

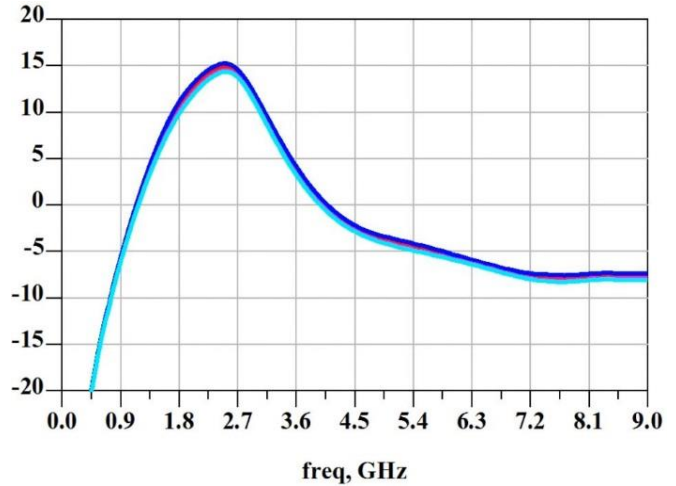


Figure 9.6 S21 (Gain) vs Freq

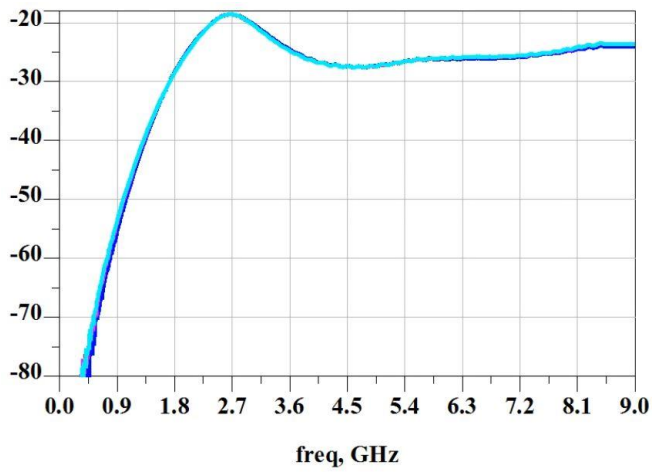


Figure 9.7 S12 (Rev Iso) vs Freq

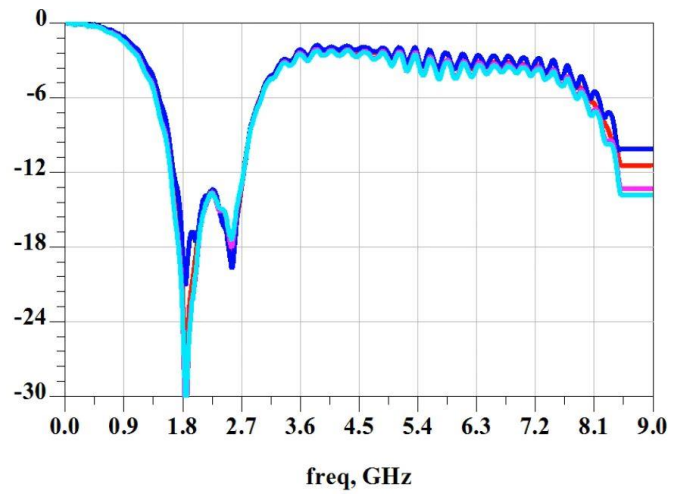


Figure 9.8 S22 (ORL) vs Freq

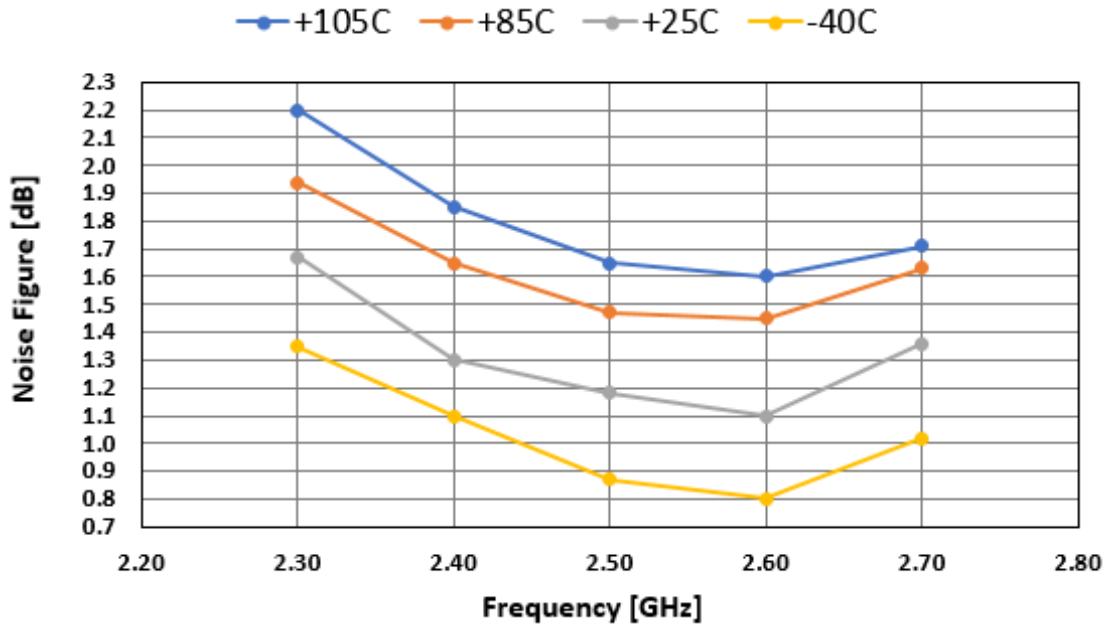


Figure 9.9 Noise Figure (EVB) vs Freq

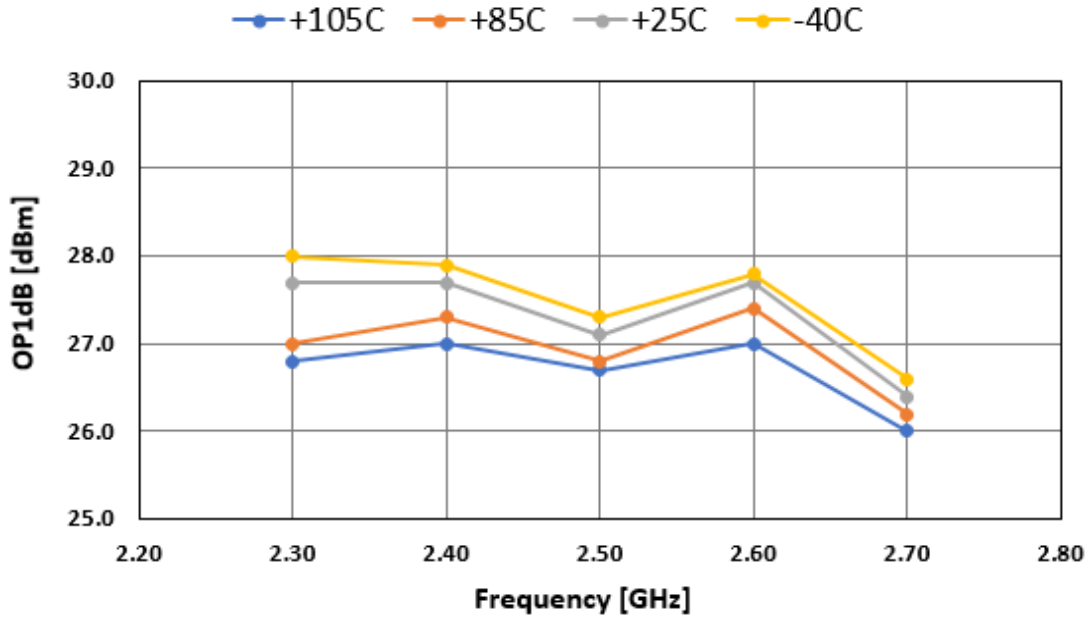


Figure 9.10 Output P1dB vs Freq

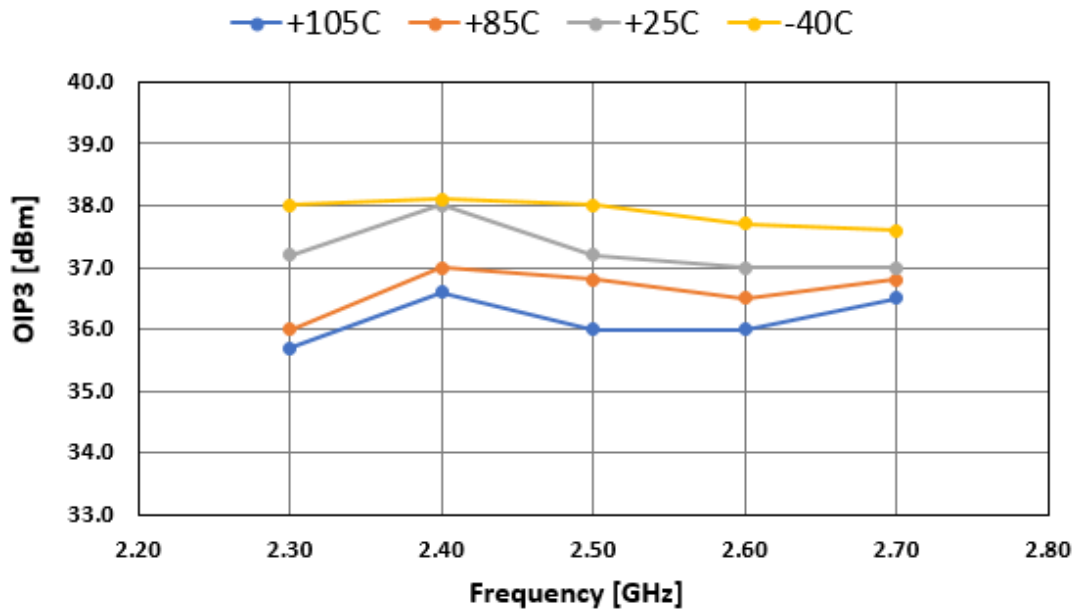


Figure 9.11 Output IP3 vs Freq

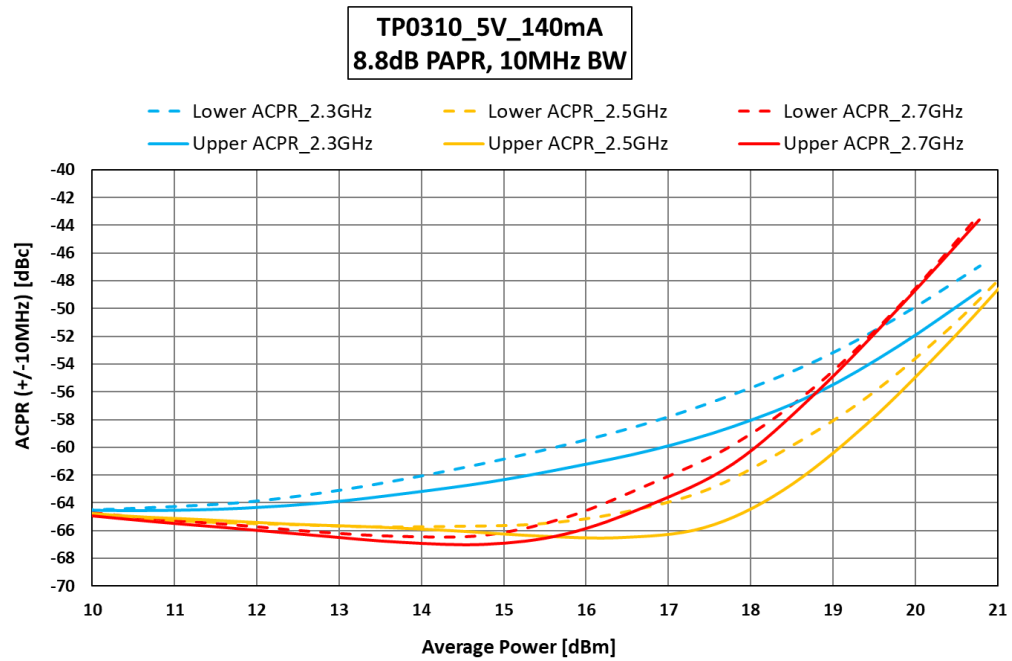


Figure 9.12 ACPR vs Average Power

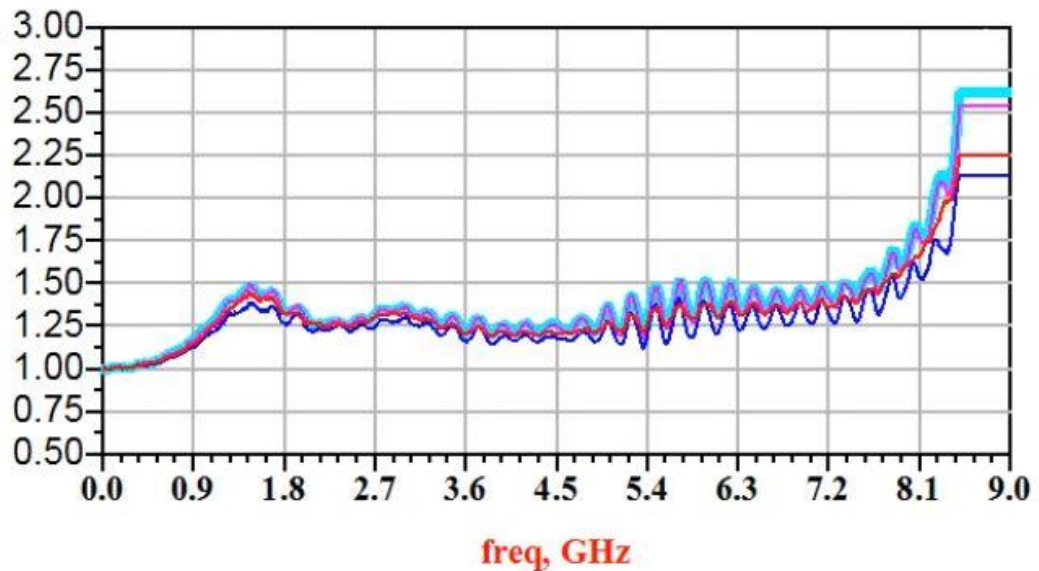


Figure 9.13 Mu1 vs Freq



## 10.0 Evaluation Boards

### 10.1 1700 - 2000MHz EVB

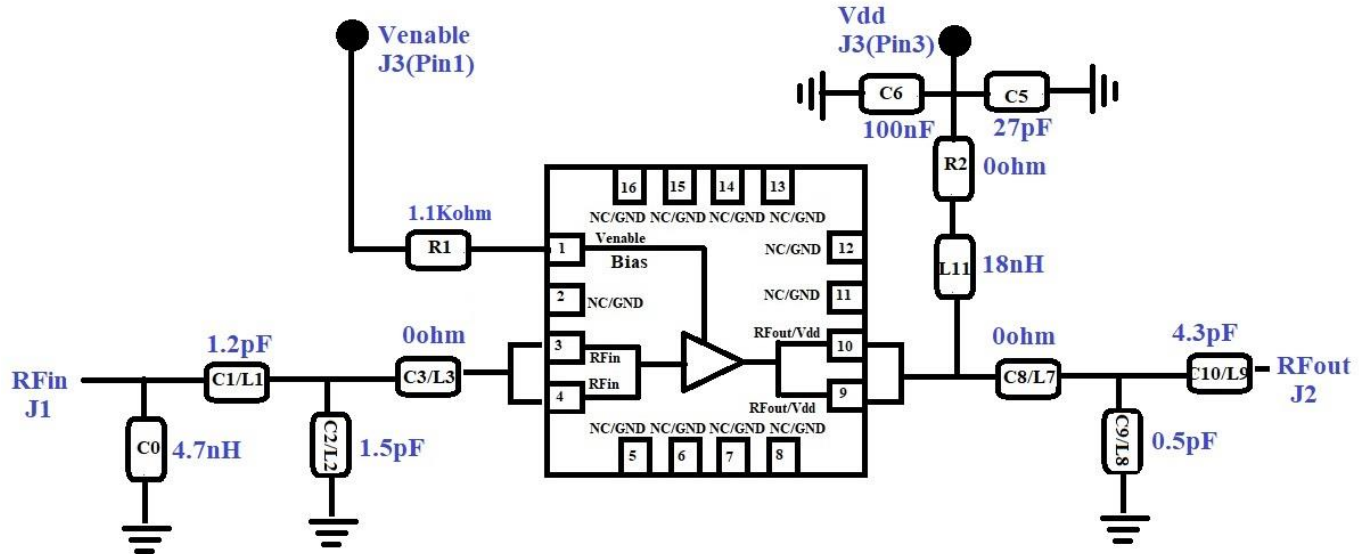


Figure 10.1 Schematic of the 1700 - 2000MHz EVB

Table 10.1 BOM of the 1700 - 2000MHz EVB

Component ID	Value	Manufacturer	Recommended Part Number
C0	4.7nH	Coilcraft	0402HP-4N7XE
C1	1.2pF	Murata	GJM1555C1H1R2BB01
C2	1.5pF	Murata	GJM1555C1H1R5BB01
R1	1.1K	Panasonic	ERJ-2RKF1101X
C9	0.5pF	Murata	GJM1555C1HR50BB01
C10/L9	4.3pF	Murata	GJM1555C1H4R3BB01
C3/L3	0 ohm	Panasonic	ERJ-2GE0R00X
C8/L7	0 ohm	Panasonic	ERJ-2GE0R00X
R2	0 ohm	Panasonic	ERJ-2GE0R00X
L11	18nH	Coilcraft	0402HP-18NXE
C5	100nF	TDK	C1005X7R1H104K050BE
C6	27pF	AVX	04025A270JAT4A
PCB	Rogers RO4350B, 20 mils, 1 oz copper		

10.2 2300 - 2700MHz EVB

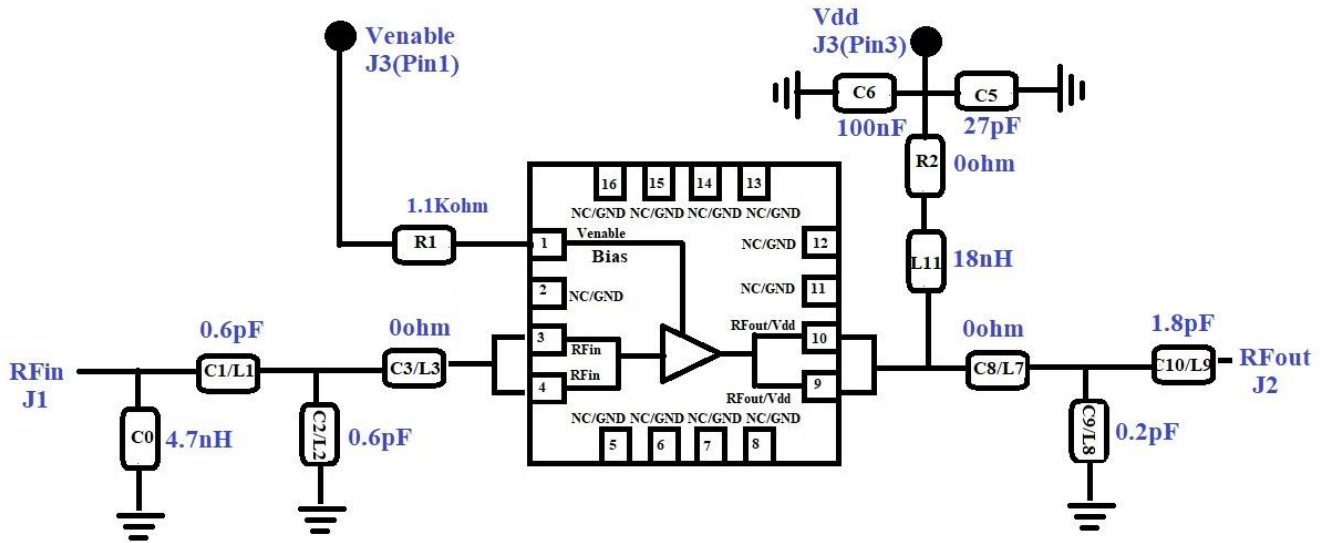


Figure 10.2 Schematic of the 2300 - 2700MHz EVB

Table 10.2 BOM for 2300 - 2700MHz EVB

Component ID	Value	Manufacturer	Recommended Part Number
C0	4.7nH	Coilcraft	0402HP-4N7XE
C1	0.6pF	Murata	GJM1555C1HR60BB01
C2	0.6pF	Murata	GJM1555C1HR60BB01
C3/L3	0 ohm	Panasonic	ERJ-2GE0R00X
R2	0 ohm	Panasonic	ERJ-2GE0R00X
C8/L7	0 ohm	Panasonic	ERJ-2GE0R00X
R1	1.1K	Panasonic	ERJ-2RKF1101X
C9	0.2pF	Murata	GJM1555C1HR20BB01
C10/L9	1.8pF	Murata	GJM1555C1H1R8BB01
L11	18nH	Coilcraft	0402HP-18NXE
C5	100nF	ATC	600S1R0CT250XT
C6	27pF	AVX	04025A270JAT4A
PCB	Rogers RO4350B, 20 mils, 1 oz copper		

10.3 3300 - 3800MHz EVB

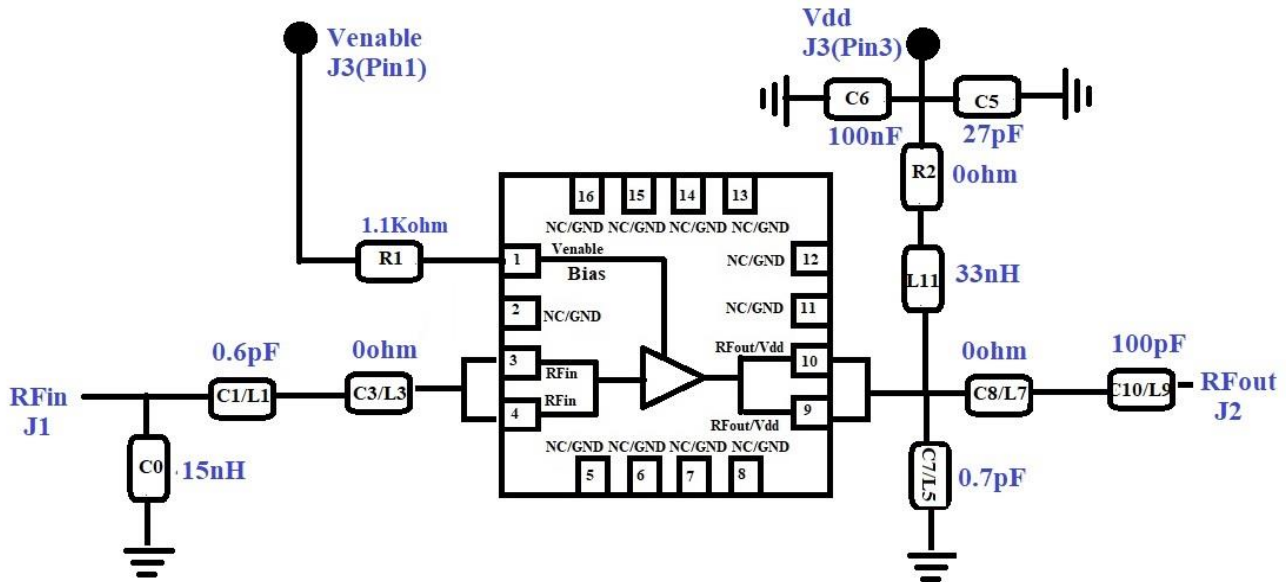
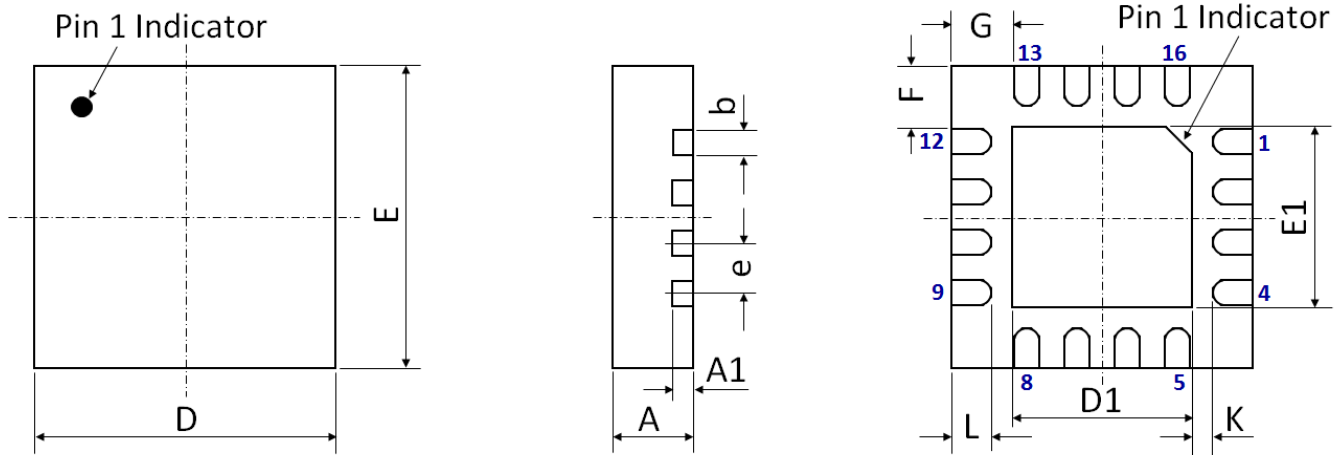


Figure 10.3 Schematic of the 3300 - 3800MHz EVB

Table 10.3 BOM of the 3300 - 3800MHz EVB

Component ID	Value	Manufacturer	Recommended Part Number
C0	15nH	Coilcraft	0402HP-15NXE
C1	0.6pF	Murata	GJM1555C1HR60BB01
C3/L3	0 ohm	Panasonic	ERJ-2GE0R00X
R1	1.1K	Panasonic	ERJ-2RKF1101X
C7	0.7pF	Murata	GJM1555C1HR70BB01
C8/L7	0 ohm	Panasonic	ERJ-2GE0R00X
C10/L9	100pF	AVX	04025A101JAT4A
R2	0 ohm	Panasonic	ERJ-2GE0R00X
L11	33nH	Coilcraft	0402HP-33NXE
C5	100nF	ATC	600S1R0CT250XT
C6	27pF	AVX	04025A270JAT4A
PCB	Rogers RO4350B, 20 mils, 1 oz copper		

### 11.0 Device Package Information



**Figure 11.1 Device Package Drawing**  
(All dimensions are in mm)

**Table 11.1 Device Package Dimensions**

Dimension (mm)	Value (mm)	Tolerance (mm)	Dimension (mm)	Value (mm)	Tolerance (mm)
A	0.80	±0.05	E	3.00 BSC	±0.05
A1	0.203	±0.02	E1	1.70	±0.05
b	0.25	+0.05/-0.07	F	0.625	±0.05
D	3.00 BSC	±0.05	G	0.625	±0.05
D1	1.70	±0.05	L	0.25	±0.05
e	0.50 BSC	±0.05	K	0.40	±0.05

**Note:** Lead finish: Pure Sn without underlayer; Thickness: 7.5µm ~ 20µm (Typical 10µm ~ 12µm)

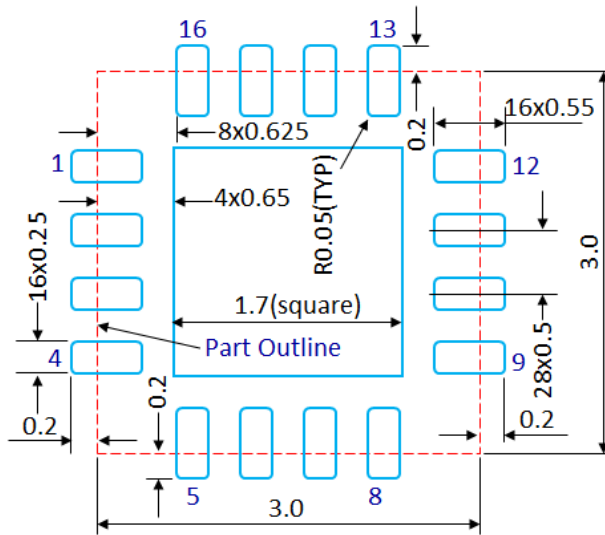
**Attention:**

Please refer to application notes [TN-001](http://www.tagoretech.com) and [TN-002](http://www.tagoretech.com) at <http://www.tagoretech.com> for PCB and soldering related guidelines.

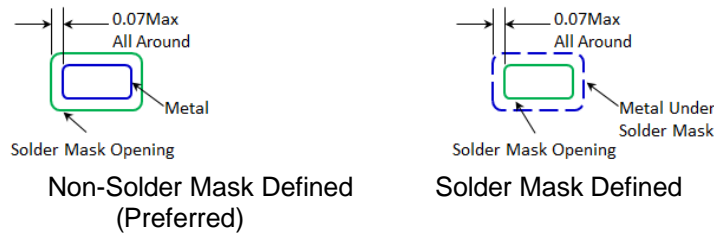
## 12.0 PCB Land Design

### Guidelines:

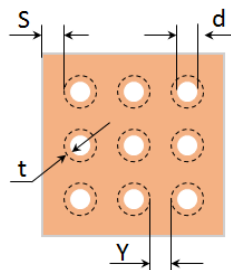
- [1] 2-layer PCB is recommended
- [2] Via diameter is recommended to be 0.3mm to prevent solder wicking inside the vias
- [3] Thermal vias shall only be placed on the center pad and should be filled/plugged with solder or copper
- [4] The maximum via number for the center pad is  $3(X) \times 3(Y) = 9$



**Figure 12.1 PCB Land Pattern**  
(Dimensions are in mm)



**Figure 12.2 Solder Mask Pattern**  
(Dimensions are in mm)



**Figure 12.3 Thermal Via Pattern**

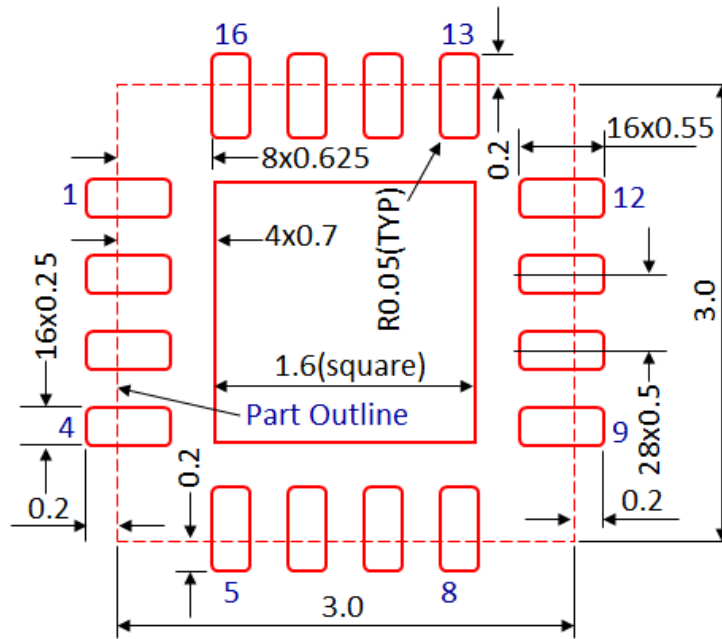
(Recommended Values:  $S \geq 0.15\text{mm}$ ;  $Y \geq 0.20\text{mm}$ ;  $d = 0.3\text{mm}$ ; Plating Thickness  $t = 25\mu\text{m}$  or  $50\mu\text{m}$ )

### 13.0 PCB Stencil Design

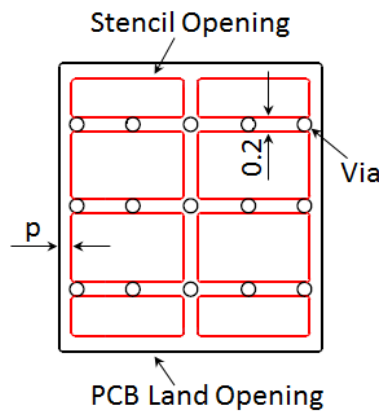
**Guidelines:**

[1] Laser-cut, stainless steel stencil is recommended with electro-polished trapezoidal walls to improve the paste release.

[2] Stencil thickness is recommended to be 125µm.

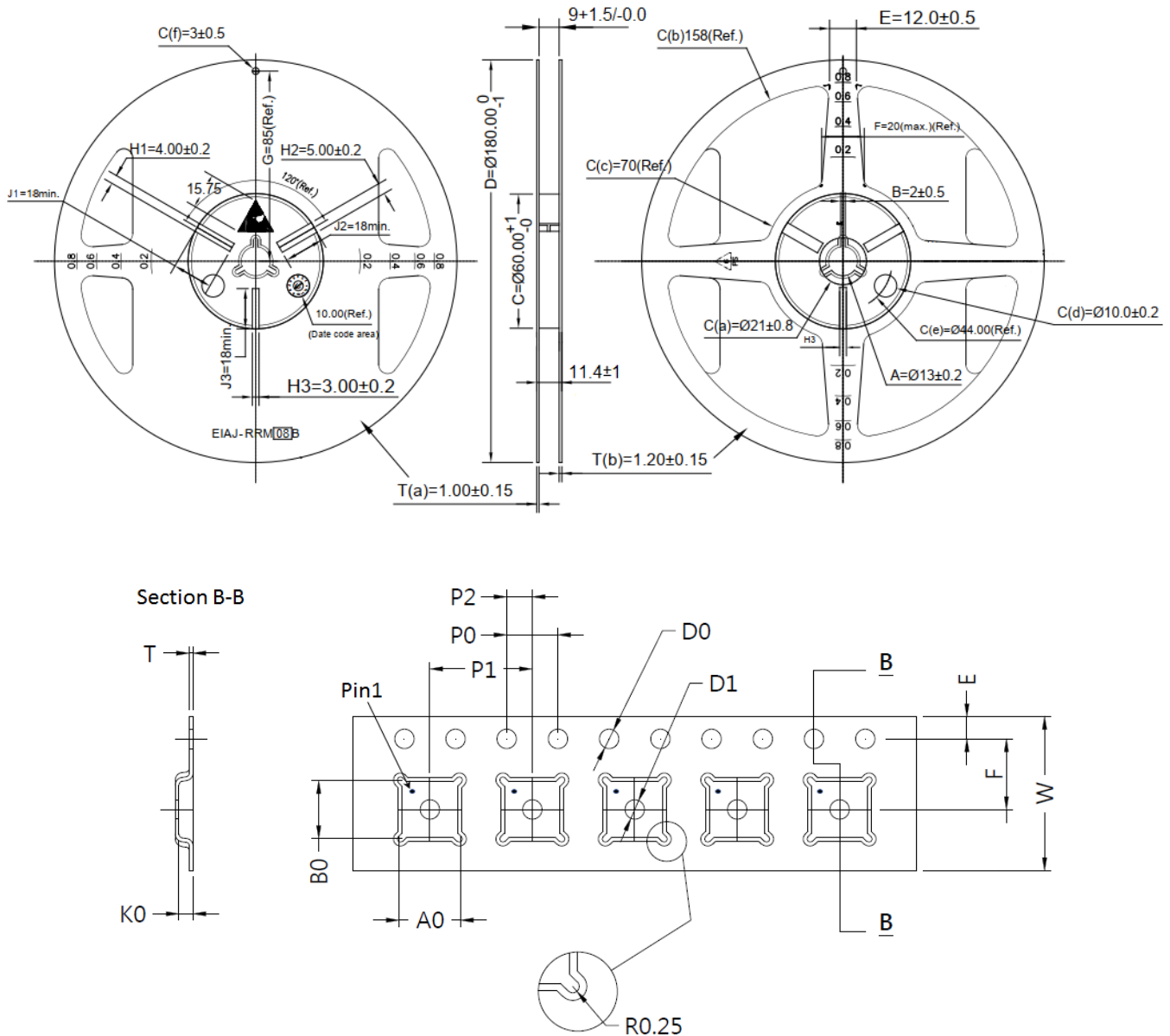


**Figure 13.1 Stencil Openings**  
(Dimensions are in mm)



**Figure 13.2 Stencil Openings Shall not Cover Via Areas If Possible**  
(Dimensions are in mm)

**14.0 Tape and Reel Information**



**Figure 14.1 Tape and Reel Drawing**

**Table 14.1 Tape and Reel Dimensions**

Dimension (mm)	Value (mm)	Tolerance (mm)	Dimension (mm)	Value (mm)	Tolerance (mm)
A0	3.35	±0.10	K0	1.10	±0.10
B0	3.35	±0.10	P0	4.00	±0.10
D0	1.50	+0.10/-0.00	P1	8.00	±0.10
D1	1.50	+0.10/-0.00	P2	2.00	±0.05
E	1.75	±0.10	T	0.30	±0.05
F	5.50	±0.05	W	12.00	±0.30

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