2.0 – 5.0 GHz GaAs Ultra Low Noise Amplifier

Features

- Operating frequency 2.0 GHz to 5.0 GHz
- Small signal gain @ 3600 MHz: 17.5 dB
- Noise figure @ 3600 MHz: 0.4 dB
- OP_{1dB} @ 3600 MHz: 19.5 dBm
- OIP3 @ 3600 MHz: 32.5 dBm
- 5 V typical operating voltage
- Bias current adjustable with one external resistor

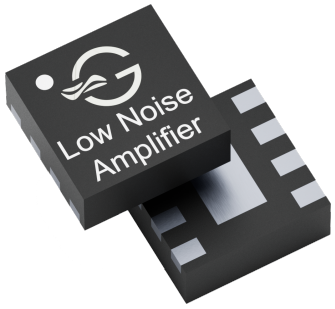

Figure 1: TL0375J in 2.0 x 2.0 mm^2 DFN 8-pin package, top and bottom view.

Applications

- 4G/5G infrastructure radios
- Small cells and cellular repeaters
- Phased array radar
- SDARS
- Datalinks
- Drones
- Ham radio

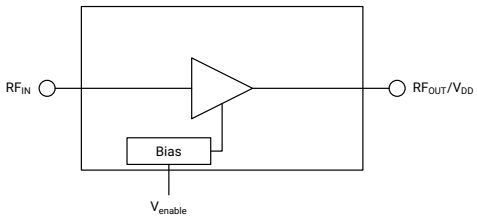

Figure 2: TL0375J functional block diagram [top view]

General Description

The TL0375J is a high frequency version of the TagoreTech TL0374J broadband, ultra-low noise amplifier (LNA). With a simple input and output match, the LNA can be tuned for different frequency bands targeting LTE (small cells and infrastructure), radar and any other applications requiring low noise, high gain, and linearity.

The TL0375J is housed in a compact, low-cost $2.0 \times 2.0\,mm^2$ 8-lead Dual Flat No-lead (DFN) plastic package.

RoHS

RoHS10/REACH/Halogen free

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Ordering information

Table 1: Ordering Information

Device Part Number	Package Type	Notes
TL0375J	8 Pin 2.0x2.0x0.75 mm^3 DFN	Core part number
TL0375JMTRPBF[1]	330 mm reel, 5 000 pcs	Full reel
TL0375J-EVB-A	Evaluation Board	Tuned, 3300 – 3800 MHz
TL0375J-EVB-B	Evaluation Board	Tuned, 3700 – 4200 MHz
TL0375J-EVB-C	Evaluation Board	Tuned, 4400 – 5000 MHz
TL0375J-EVB-D	Evaluation Board	Tuned, 2900 – 3300 MHz
TL0375J-EVB-E[2]	Evaluation Board	Tuned, 4700 – 6000 MHz

[1] MTRPBF - M: Manufacturing, TR: Tape and Reel, and PBF: lead free.
[2] The band extends above the specified operating frequency range of 2.0 – 5.0 GHz.

Table 2: Tape and Reel Information

Form	Quantity	Reel Diameter	Reel Width
Tape and Reel	5 000	13” (330mm)	18mm

Evaluation boards and application notes

Each evaluation board is supported by its own application note with schematic, bill of materials, bias procedure and measured performance. Please click the blue links.

All evaluation boards use the same Rogers RO4350B, 20 mil, 1 oz copper PCB with SMA connectors on RF_{IN} and RF_{OUT} and a header for V_{enable}, V_{DD} and ground. The input is matched with a series capacitor and shunt positions on both sides of it (M1, M2, M3), the output with a series capacitor and a shunt position after it (M11, M12); on EVB A and D an extra series position (M13) is cut into the output line. Component positions that are not assembled on a given board are shown dashed grey in the schematics and marked DNP (Do Not Populate) in the bills of materials. The DC-feed and bias parts (V_{enable} resistor M4 and the drain feed M6, M7 to V_{DD}) set the operating point, see Figure 14.

Table 3: TL0375J evaluation boards and application notes

Evaluation board	Frequency range	Bias	Application note
TL0375J-EVB-A	3300 – 3800 MHz	5 V, 60 mA	TL0375J_EVB_A.pdf
TL0375J-EVB-B	3700 – 4200 MHz	5 V, 60 mA	TL0375J_EVB_B.pdf
TL0375J-EVB-C	4400 – 5000 MHz	5 V, 60 mA	TL0375J_EVB_C.pdf
TL0375J-EVB-D	2900 – 3300 MHz	5 V, 65 mA	TL0375J_EVB_D.pdf
TL0375J-EVB-E[1]	4700 – 6000 MHz	5 V, 70 mA	TL0375J_EVB_E.pdf

[1] The band extends above the specified operating frequency range of 2.0 – 5.0 GHz.

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Pin Assignment

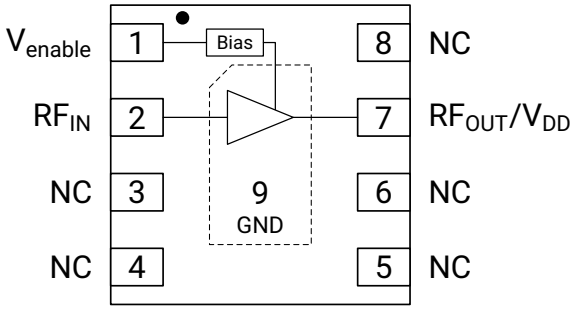

Figure 3: TL0375J pin assignment [top view]

Table 4: Pin Definition

Pin Number	Pin Name	Description
1	V_{enable}	Enable input. V_{enable} together with the series resistor sets I_{DQ}. $V_{enable} < 0.2\,V$ disables the device.
2	RF_{IN}	RF input. A DC blocking capacitor is required.
3, 4, 5, 6, 8	NC	No internal connection, can be connected to ground.
7	RF_{OUT}/V_{DD}	RF output. V_{DD} is supplied through an external choke inductor.
9 (paddle)[1]	GND	DC and RF ground, also provides the thermal path. Multiple vias are recommended.

[1] The backside ground slug of the package must be grounded directly to the ground plane through multiple vias to ensure proper operation. Adequate heat sinking is required.

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Absolute Maximum Ratings

Table 5: Absolute Maximum Ratings $T_A = +25$°C unless otherwise specified[1].

Parameter	Symbol	Value	Unit
Electrical Ratings			
Supply voltage, V_{DD} and V_{enable}	V_{DD}	+6	V
Drain current	I_{DQ}	70	mA
RF input power, CW	RF_{IN}	23	dBm
Storage Temperature Range	T_{st}	-55 to +150	°C
Operating Temperature Range	T_{op}	-40 to +105	°C
Maximum Junction Temperature	T_j	+170	°C
Thermal Ratings			
Thermal Resistance (junction-to-case) – Bottom side	$R_{\theta jc}$	15.0	°C/W
Soldering Temperature	T_{solder}	+260	°C
ESD Ratings			
Human Body Model (HBM)	Level 1B	500 – $<$1000	V
Charged Device Model (CDM)	Level C	$\geq$1000	V
Moisture Rating			
Moisture Sensitivity Level[2]	MSL	1	

[1] Maximum ratings are absolute ratings. Exposure to absolute maximum rating conditions for extended periods may affect device reliability and can cause permanent damage to the device. Exceeding one or a combination of the absolute maximum ratings may cause permanent and irreversible damage to the device and/or to surrounding circuit. Functional operation of the device is not implied in any conditions above those indicated in the Electrical Specifications section.

[2] Tagore recommends to store parts in moisture barrier bag to preserve solderability.

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Recommended DC Operating Conditions

Table 6: Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Drain voltage	V_{DD}		+5.0		V
Enable voltage	V_{enable}		+5.0		V
Drain bias current, set by external resistor[1]	I_{DQ}	45	60		mA
Enable bias current	I_{bias}		3.0		mA
Operating temperature range	T_{op}	-40	+25	+105	°C

[1] V_{enable} together with the series resistor on the V_{enable} pin sets I_{DQ}, see Figure 14. $V_{enable} < 0.2$ V disables the device.

Table 7: Switching Time

Parameter	Test Condition	Typical	Unit
Switching rise time	10/90% of the RF value	300	ns
Switching fall time	10/90% of the RF value	350	ns

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RF Electrical Specifications

The values below are typical ranges across the band of each tuned evaluation board. Noise figure is given both de-embedded to the device reference plane and as measured on the evaluation board (EVB noise figure, including connector and PCB losses).

Table 8: EVB A, 3300 – 3800 MHz: $V_{enable} = 5$ V, $I_{DD} = 60$ mA, $V_{DD} = 5$ V, $T_A = +25$°C unless otherwise specified.

Parameter	Test Condition	Minimum	Typical	Maximum	Unit
Gain	Across the band		17.4 – 18.2		dB
Noise figure	Across the band		0.45 – 0.55		dB
EVB noise figure	Across the band		0.5 – 0.6		dB
Input return loss	Across the band		-16 to -15		dB
Output return loss	Across the band		-10.6 to -8.4		dB
OP_{1dB}	Across the band		19.3 – 20		dBm
OIP3	Across the band, 0 dBm per tone, tone spacing 1 MHz		32.5 – 33.5		dBm

Table 9: EVB B, 3700 – 4200 MHz: $V_{enable} = 5$ V, $I_{DD} = 60$ mA, $V_{DD} = 5$ V, $T_A = +25$°C unless otherwise specified.

Parameter	Test Condition	Minimum	Typical	Maximum	Unit
Gain	Across the band		15.5 – 16.5		dB
Noise figure	Across the band		0.5 – 0.6		dB
EVB noise figure	Across the band		0.6 – 0.7		dB
Input return loss	Across the band		-12 to -8		dB
Output return loss	Across the band		-12 to -8		dB
OP_{1dB}	Across the band		19 – 20.5		dBm
OIP3	Across the band, 0 dBm per tone, tone spacing 1 MHz		33 – 34		dBm

Table 10: EVB C, 4400 – 5000 MHz: $V_{enable} = 5$ V, $I_{DD} = 60$ mA, $V_{DD} = 5$ V, $T_A = +25$°C unless otherwise specified.

Parameter	Test Condition	Minimum	Typical	Maximum	Unit
Gain	Across the band		16		dB
Noise figure	Across the band		0.55 – 0.65		dB
EVB noise figure	Across the band		0.7 – 0.8		dB
Input return loss	Across the band		-12.4 to -10.4		dB
Output return loss	Across the band		-9 to -7.5		dB
OP_{1dB}	Across the band		18 – 20		dBm
OIP3	Across the band, 0 dBm per tone, tone spacing 1 MHz		33 – 36		dBm

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Table 11: EVB D, 2900 – 3300 MHz: $V_{enable} = 5$ V, $I_{DD} = 65$ mA, $V_{DD} = 5$ V, $T_A = +25$°C unless otherwise specified.

Parameter	Test Condition	Minimum	Typical	Maximum	Unit
Gain	Across the band		17.9 – 18.5		dB
Noise figure	Across the band		0.35 – 0.45		dB
EVB noise figure	Across the band		0.4 – 0.5		dB
Input return loss	Across the band		-19 to -13		dB
Output return loss	Across the band		-8.3 to -6		dB
OP_{1dB}	Across the band		19.3 – 19.4		dBm
OIP3	Across the band, 0 dBm per tone, tone spacing 1 MHz		33.8 – 35.5		dBm

Table 12: EVB E, 4700 – 6000 MHz[1]: $V_{enable} = 5$ V, $I_{DD} = 70$ mA, $V_{DD} = 5$ V, $T_A = +25$°C unless otherwise specified.

Parameter	Test Condition	Minimum	Typical	Maximum	Unit
Gain	Across the band		14.2 – 14.9		dB
Noise figure	Across the band		0.7 – 1.0		dB
EVB noise figure	Across the band		0.8 – 1.2		dB
Input return loss	Across the band		-20.7 to -12.4		dB
Output return loss	Across the band		-6.0 to -4.5		dB
OP_{1dB}	Across the band		19 – 20		dBm
OIP3	Across the band, 0 dBm per tone, tone spacing 1 MHz		31.5 – 33.0		dBm

[1] The band extends above the specified operating frequency range of the TL0375J (2.0 – 5.0 GHz).

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Evaluation Boards

EVB A, 3300 – 3800 MHz

Measured performance of this board is given in Table 8. Bias: 5 V, 60 mA.
Application note: TL0375J-EVB-A application note.

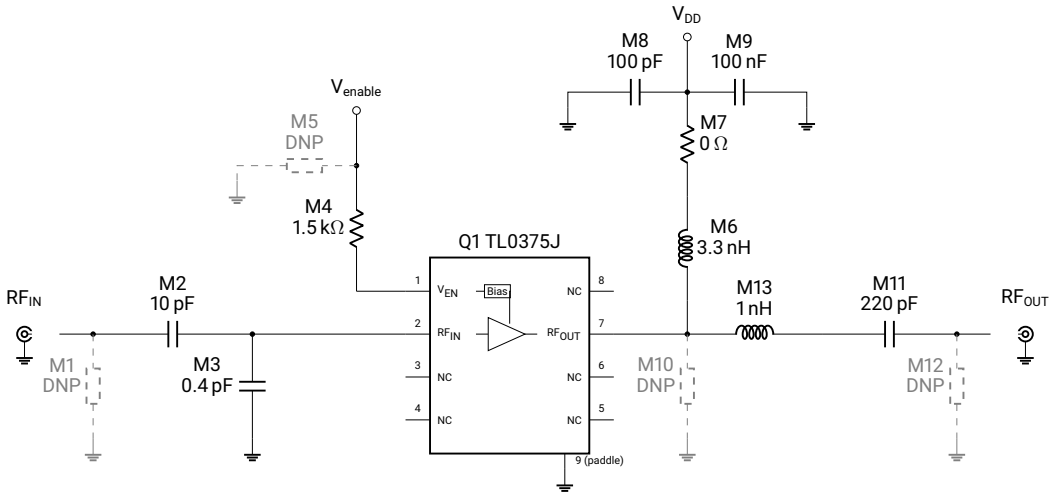

Figure 4: Schematic of TL0375J-EVB-A, 3300 – 3800 MHz. Dashed grey positions are not assembled (DNP).

Table 13: Bill of materials, TL0375J-EVB-A

Component ID	Value	Manufacturer	Recommended part number
M2	10 pF	Murata	GJM1555C1H100JB01
M3	0.4 pF	Murata	GJM1555C1HR40BB01
M4	1.5 kΩ	Panasonic	ERJ-2RKF1501X
M6	3.3 nH	Coilcraft	0402HP-3N3XGE
M7	0 Ω	Panasonic	ERJ-2GE0R00X
M8	100 pF	AVX	04025A101JAT4A
M9	100 nF	TDK	C1005X7R1H104K050BE
M11	220 pF	Kemet	C0402C221K5GACAUTO
M13[1]	1 nH	Coilcraft	0402HP-1N0XJE
M1, M5, M10, M12	DNP		
Q1	GaAs LNA	TagoreTech	TL0375J
PCB	Rogers RO4350B, 20 mil, 1 oz copper		

[1] Extra series position cut into the output RF line between the drain node (M10) and M11.

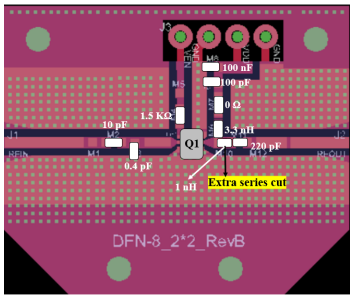

Figure 5: Layout of TL0375J-EVB-A.

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EVB B, 3700 – 4200 MHz

Measured performance of this board is given in Table 9. Bias: 5 V, 60 mA.
Application note: TL0375J-EVB-B application note.

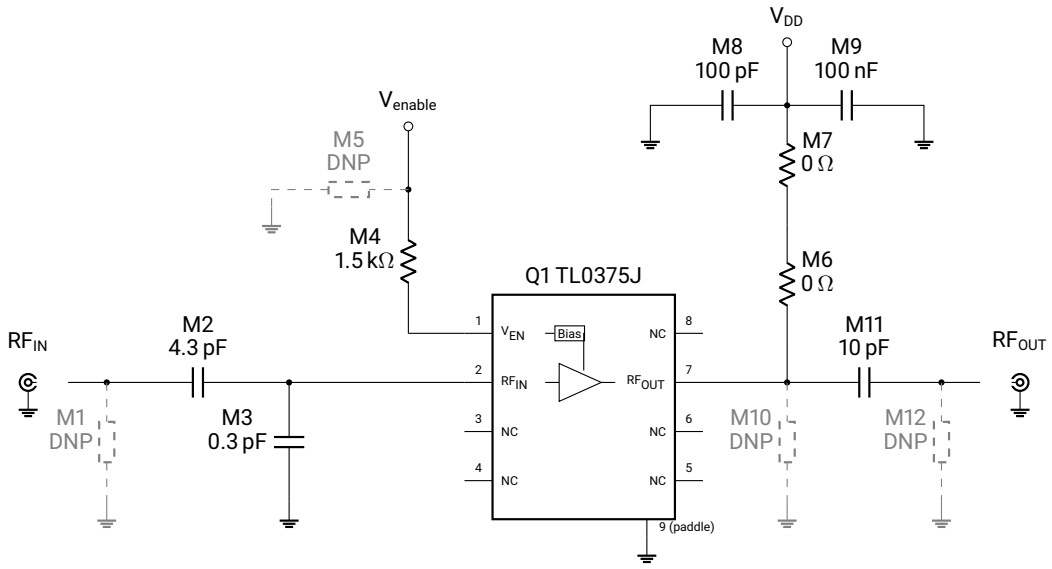

Figure 6: Schematic of TL0375J-EVB-B, 3700 – 4200 MHz. Dashed grey positions are not assembled (DNP).

Table 14: Bill of materials, TL0375J-EVB-B

Component ID	Value	Manufacturer	Recommended part number
M2	4.3 pF	Murata	GJM1555C1H4R3BB01
M3	0.3 pF	Murata	GJM1555C1HR30BB01
M4	1.5 kΩ	Panasonic	ERJ-2RKF1501X
M6, M7	0 Ω	Panasonic	ERJ-2GE0R00X
M8	100 pF	AVX	04025A101JAT4A
M9	100 nF	TDK	C1005X7R1H104K050BE
M11	10 pF	AVX	04025A100JAT4A
M1, M5, M10, M12	DNP		
Q1	GaAs LNA	TagoreTech	TL0375J
PCB	Rogers RO4350B, 20 mil, 1 oz copper		

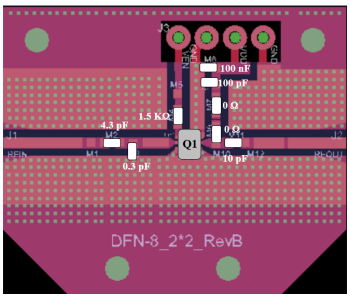

Figure 7: Layout of TL0375J-EVB-B.

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EVB C, 4400 – 5000 MHz

Measured performance of this board is given in Table 10. Bias: 5 V, 60 mA.
Application note: TL0375J-EVB-C application note.

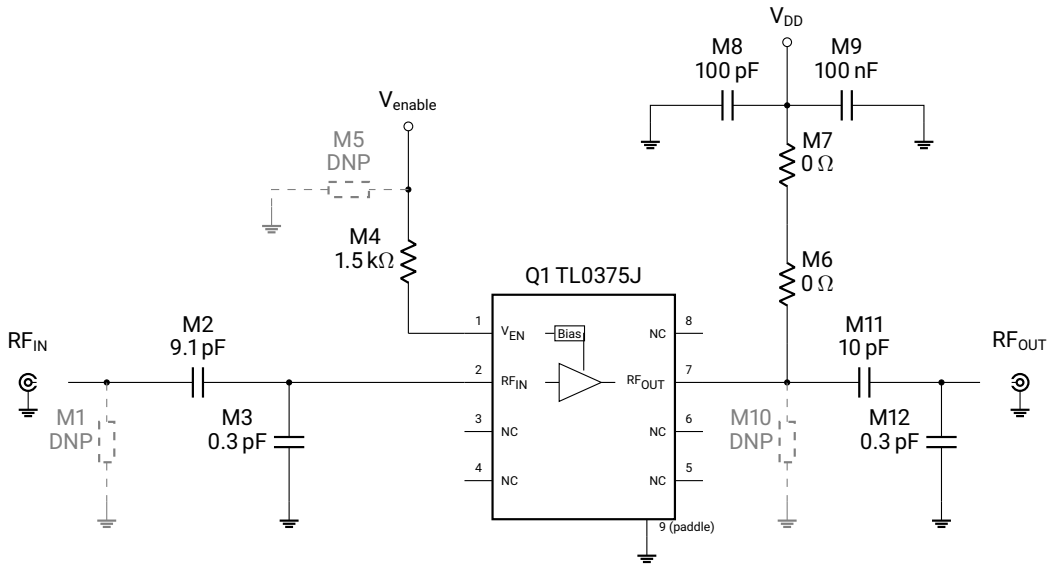

Figure 8: Schematic of TL0375J-EVB-C, 4400 – 5000 MHz. Dashed grey positions are not assembled (DNP).

Table 15: Bill of materials, TL0375J-EVB-C

Component ID	Value	Manufacturer	Recommended part number
M2	9.1 pF	Murata	GJM1555C1H9R1BB01
M3	0.3 pF	Murata	GJM1555C1HR30BB01
M4	1.5 kΩ	Panasonic	ERJ-2RKF1501X
M6, M7	0 Ω	Panasonic	ERJ-2GE0R00X
M8	100 pF	AVX	04025A101JAT4A
M9	100 nF	TDK	C1005X7R1H104K050BE
M11	10 pF	AVX	04025A100JAT4A
M12	0.3 pF	Murata	GJM1555C1HR30BB01
M1, M5, M10	DNP		
Q1	GaAs LNA	TagoreTech	TL0375J
PCB	Rogers RO4350B, 20 mil, 1 oz copper		

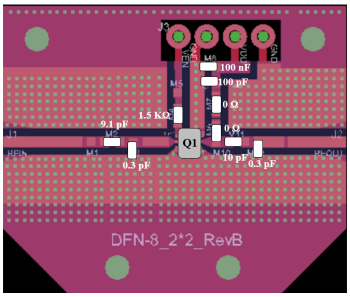

Figure 9: Layout of TL0375J-EVB-C.

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EVB D, 2900 – 3300 MHz

Measured performance of this board is given in Table 11. Bias: 5 V, 65 mA.
Application note: TL0375J-EVB-D application note.

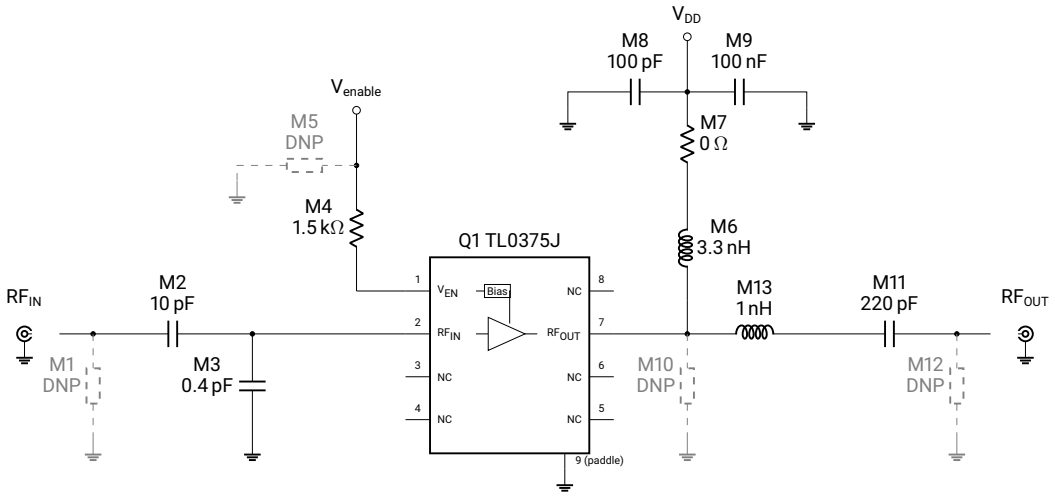

Figure 10: Schematic of TL0375J-EVB-D, 2900 – 3300 MHz. Dashed grey positions are not assembled (DNP).

Table 16: Bill of materials, TL0375J-EVB-D

Component ID	Value	Manufacturer	Recommended part number
M2	10 pF	Murata	GJM1555C1H100JB01
M3	0.4 pF	Murata	GJM1555C1HR40BB01
M4	1.5 kΩ	Panasonic	ERJ-2RKF1501X
M6	3.3 nH	Coilcraft / Würth Elektronik	0402HP-3N3XGE / 744916033
M7	0 Ω	Panasonic	ERJ-2GE0R00X
M8	100 pF	AVX	04025A101JAT4A
M9	100 nF	TDK	C1005X7R1H104K050BE
M11	220 pF	Kemet	C0402C221K5GACAUTO
M13[1]	1 nH	Coilcraft / Würth Elektronik	0402HP-1N0XJE / 744916010
M1, M5, M10, M12	DNP		
Q1	GaAs LNA	TagoreTech	TL0375J
PCB	Rogers RO4350B, 20 mil, 1 oz copper		

[1] Extra series position cut into the output RF line between the drain node (M10) and M11.

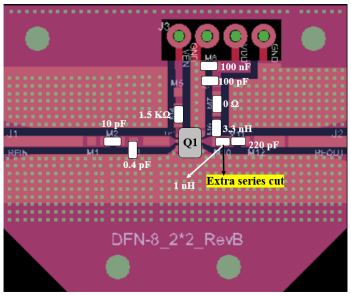

Figure 11: Layout of TL0375J-EVB-D.

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EVB E, 4700 – 6000 MHz

TL0375J-EVB-E is tuned for 4700 – 6000 MHz; the band extends above the specified operating frequency range of the TL0375J (2.0 – 5.0 GHz). Measured performance of this board is given in Table 12. Bias: 5 V, 70 mA.
Application note: TL0375J-EVB-E application note.

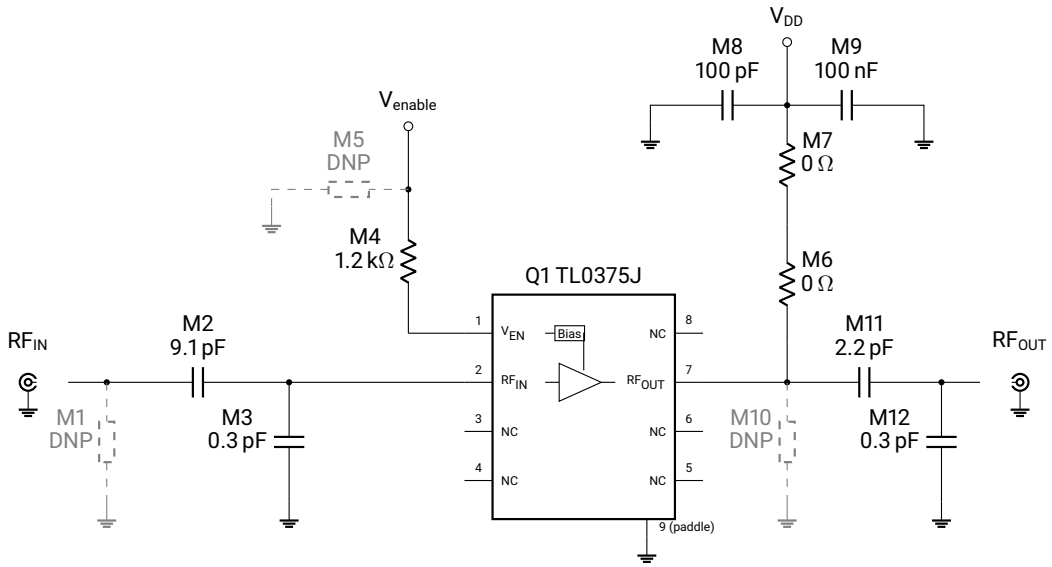

Figure 12: Schematic of TL0375J-EVB-E, 4700 – 6000 MHz. Dashed grey positions are not assembled (DNP).

Table 17: Bill of materials, TL0375J-EVB-E

Component ID	Value	Manufacturer	Recommended part number
M2	9.1 pF	Murata	GJM1555C1H9R1BB01
M3, M12	0.3 pF	Murata	GJM1555C1HR30BB01
M4	1.2 kΩ	Panasonic	ERJ-2RKF1201X
M6, M7	0 Ω	Panasonic	ERJ-2GE0R00X
M8	100 pF	AVX	04025A101JAT4A
M9	100 nF	TDK	C1005X7R1H104K050BE
M11	2.2 pF	Murata	GJM1555C1H2R2BB01
M1, M5, M10	DNP		
Q1	GaAs LNA	TagoreTech	TL0375J
PCB	Rogers RO4350B, 20 mil, 1 oz copper		

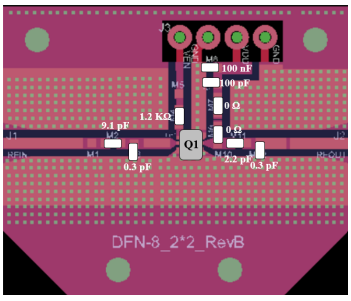

Figure 13: Layout of TL0375J-EVB-E.

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Typical characteristics

The S-parameters below are measured Touchstone data of the evaluation boards at $T_A = +25$°C, at the bias of each board given in the figure captions. The reference planes are at the SMA connectors, so connector and PCB losses are included. The shaded area and the thick line in the Smith charts mark the band the board is tuned for. For each board the wideband plots and the Smith charts of S_{11} and S_{22} (normalised to 50 Ω) are shown first, followed by the tuned band on an expanded frequency scale. The wideband plots start at 30 MHz and end at the upper end of the measured data (5 GHz for EVB A, B and C, 8.5 GHz for EVB D and E). The gain on the expanded scale uses a 10 dB window (1 dB/div) placed around the gain of each board.

Stability factors

The stability factors μ (load) and μ' (source) shown for each board are calculated from the S-parameters:

$$\mu = \frac{1 - |S_{11}|^2}{|S_{22} - \Delta S_{11}^*| + |S_{12}S_{21}|}, \qquad \mu' = \frac{1 - |S_{22}|^2}{|S_{11} - \Delta S_{22}^*| + |S_{12}S_{21}|}, \qquad \Delta = S_{11}S_{22} - S_{12}S_{21}.$$

$\mu > 1$ (or $\mu' > 1$) is the necessary and sufficient condition for unconditional stability; the value is the distance from the centre of the Smith chart to the nearest unstable load (source) impedance.

Bias resistor

The drain current is set by V_{enable} and the series resistor on the V_{enable} pin (M4 on the evaluation boards).

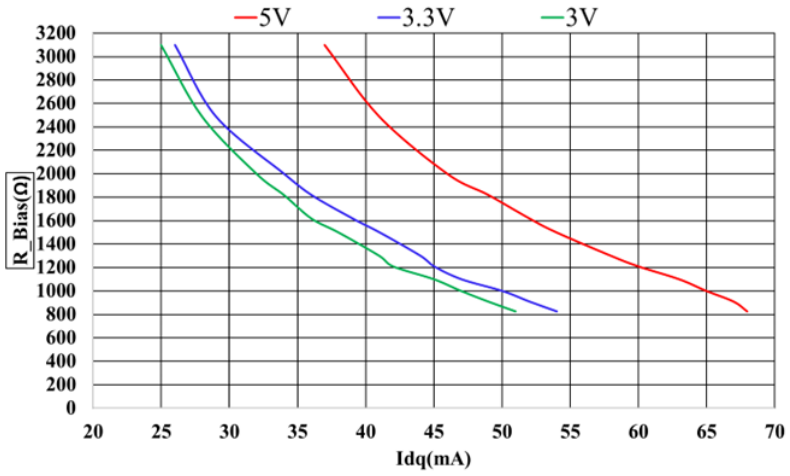

Figure 14: Bias resistor on V_{enable} vs. I_{DQ}.

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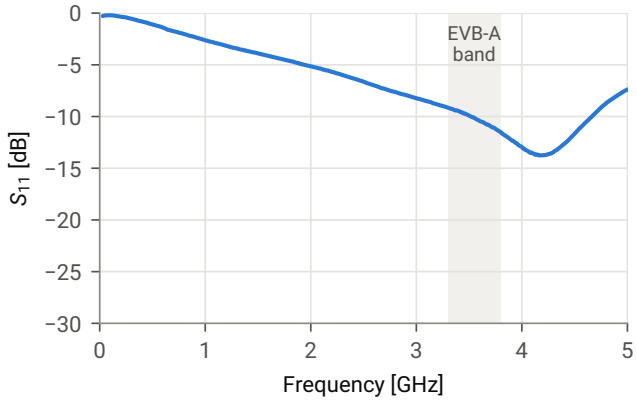
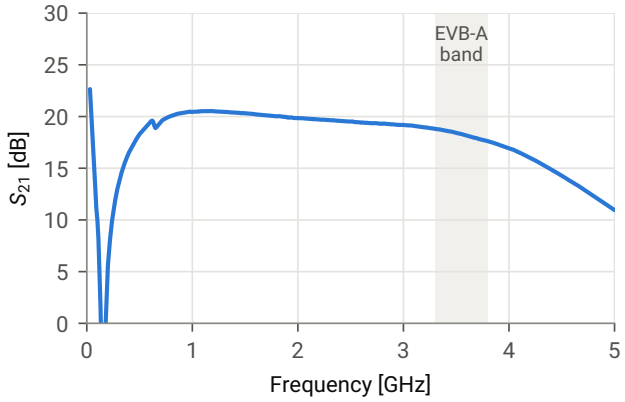
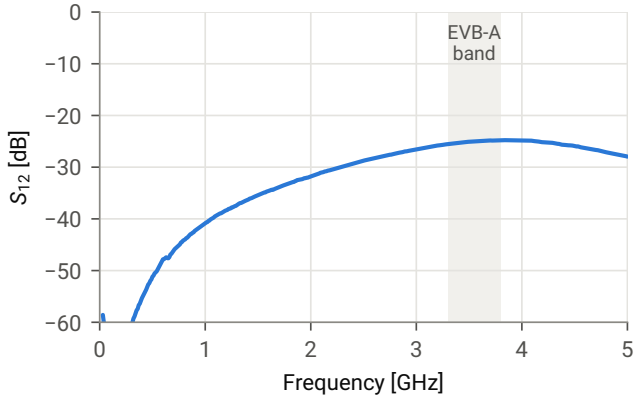
EVB A, wideband S-parameters and Smith charts



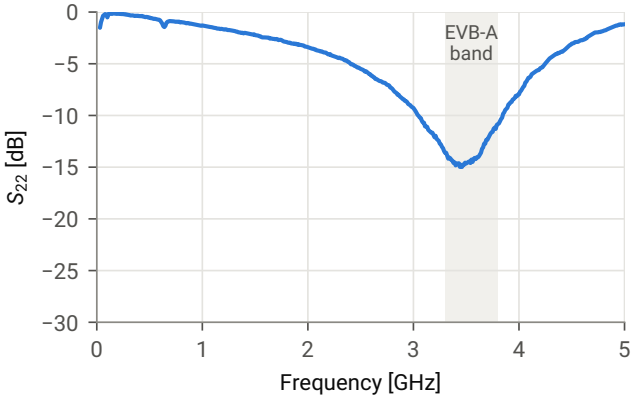
(a) S_{11} (input return loss) vs. frequency.



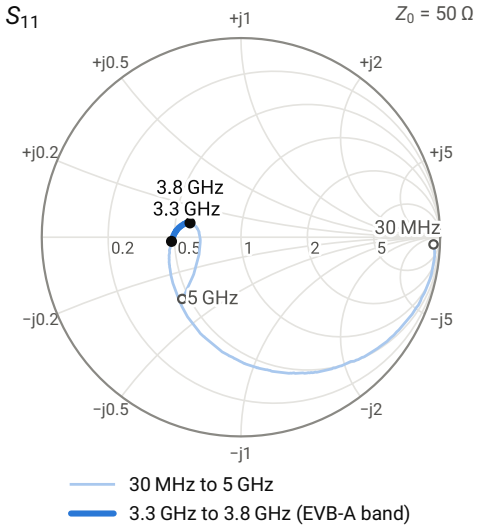
(b) S_{21} (gain) vs. frequency.



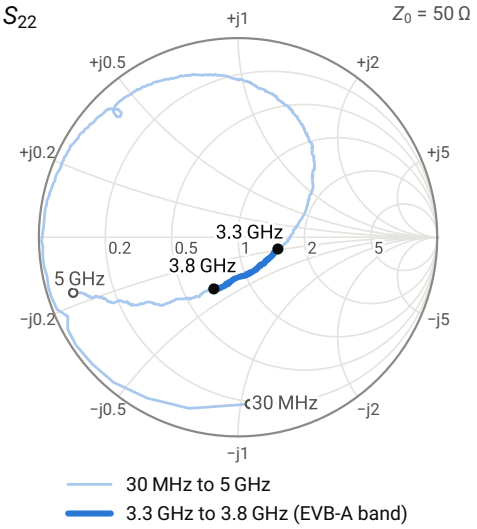
(c) S_{12} (reverse isolation) vs. frequency.



(d) S_{22} (output return loss) vs. frequency.



(e) S_{11} Smith chart, input impedance.



(f) S_{22} Smith chart, output impedance.

Figure 15: TL0375J-EVB-A S-parameters, 30 MHz to 5 GHz, $+25$°C, 5 V, 60 mA. Shaded and thick line: 3300 – 3800 MHz tuned band.

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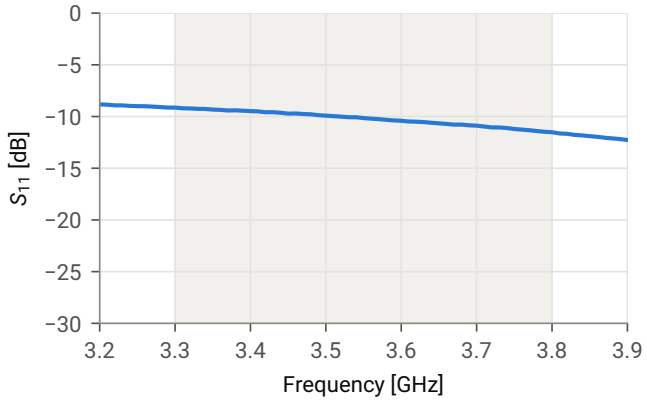
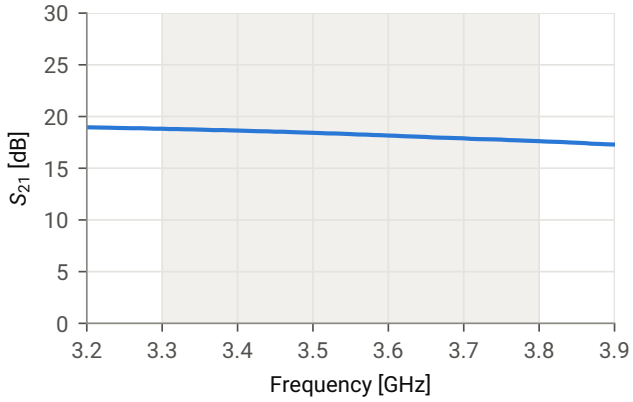
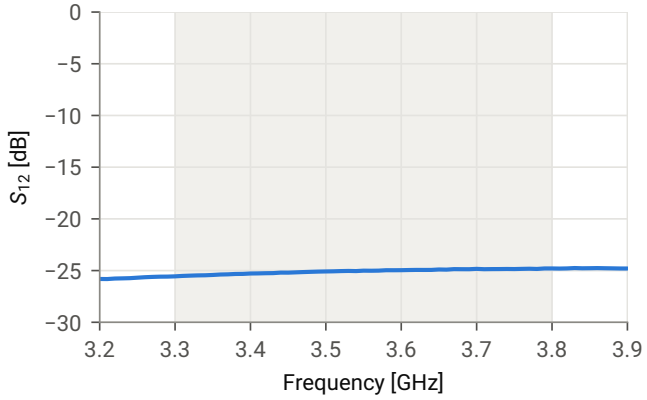
EVB A, narrowband S-parameters



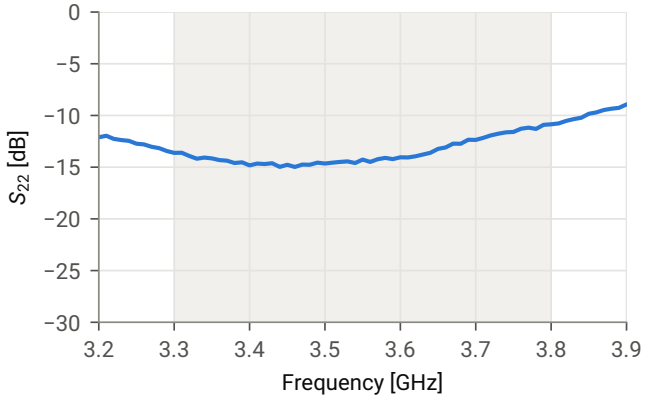
(a) S_{11} (input return loss) vs. frequency.



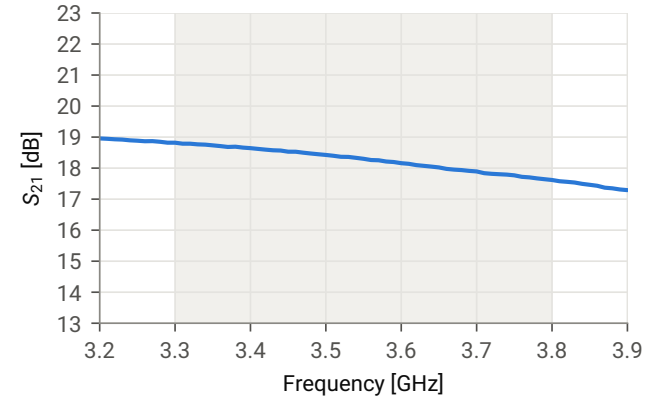
(b) S_{21} (gain) vs. frequency.



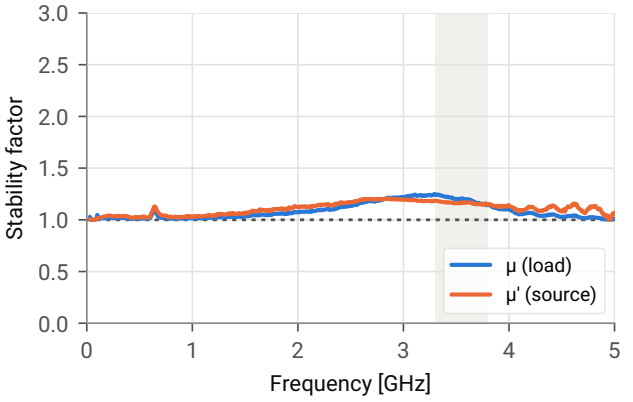
(c) S_{12} (reverse isolation) vs. frequency.



(d) S_{22} (output return loss) vs. frequency.



(e) S_{21} (gain) vs. frequency, expanded scale.



(f) Stability factors μ and μ' vs. frequency, 30 MHz to 5 GHz.

Figure 16: TL0375J-EVB-A S-parameters, 3300 – 3800 MHz band, $+25$°C, 5 V, 60 mA.

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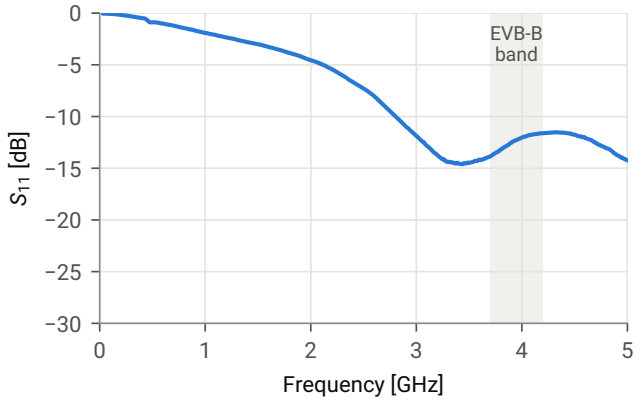
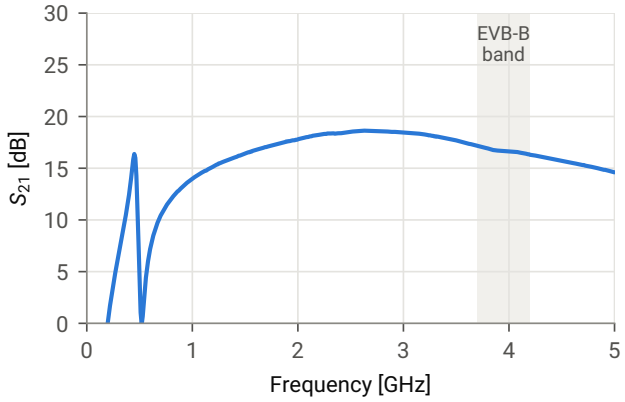
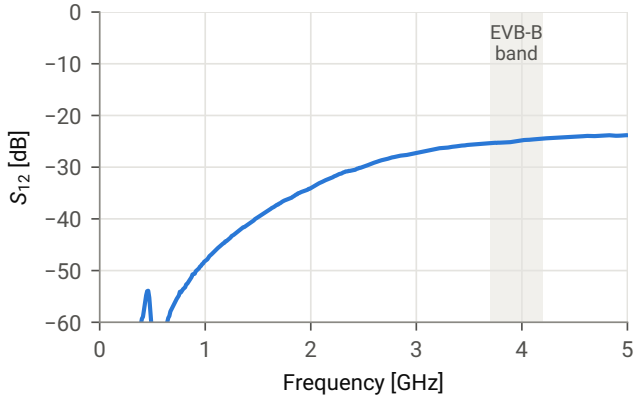
EVB B, wideband S-parameters and Smith charts



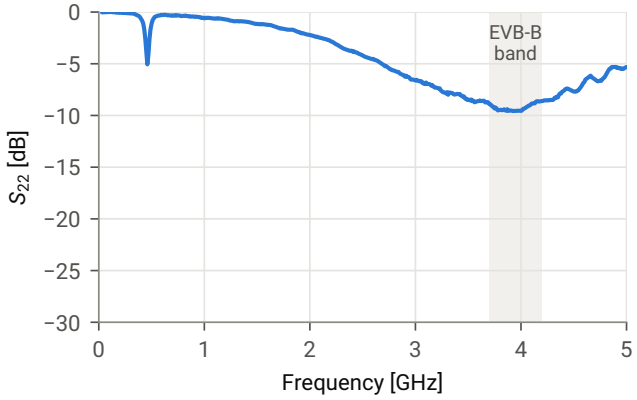
(a) S_{11} (input return loss) vs. frequency.



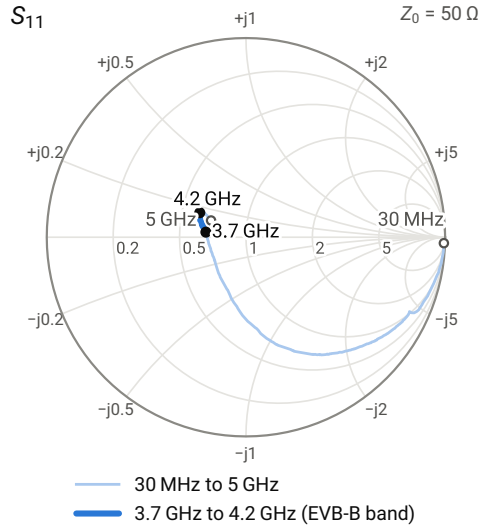
(b) S_{21} (gain) vs. frequency.



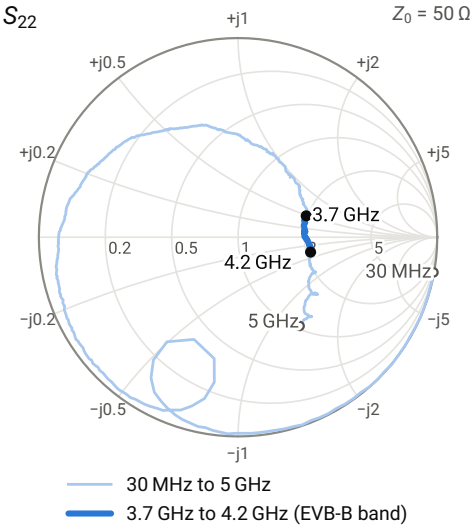
(c) S_{12} (reverse isolation) vs. frequency.



(d) S_{22} (output return loss) vs. frequency.



(e) S_{11} Smith chart, input impedance.



(f) S_{22} Smith chart, output impedance.

Figure 17: TL0375J-EVB-B S-parameters, 30 MHz to 5 GHz, $+25$°C, 5 V, 60 mA. Shaded and thick line: 3700 – 4200 MHz tuned band.

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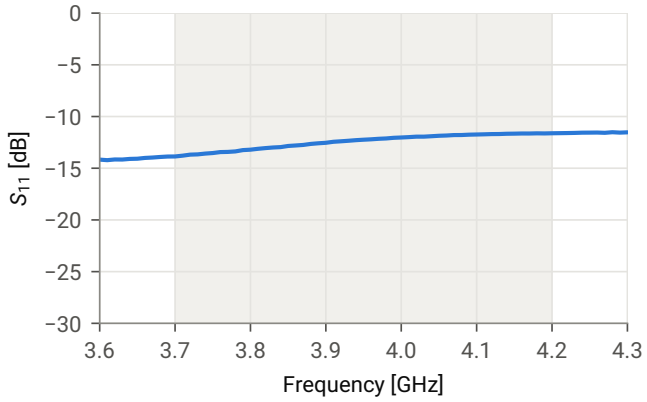
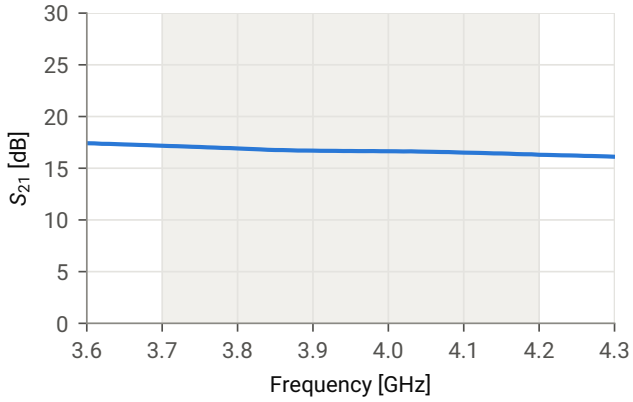
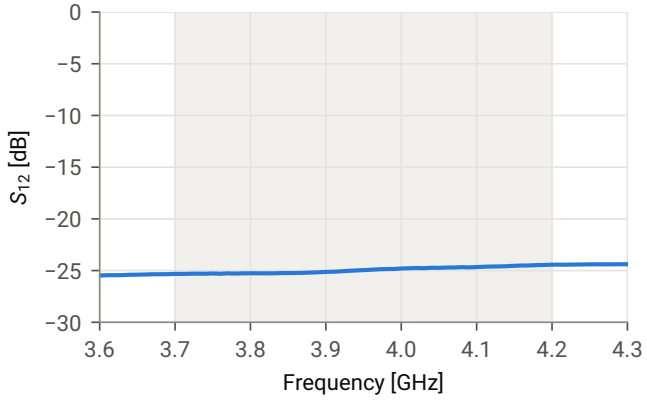
EVB B, narrowband S-parameters



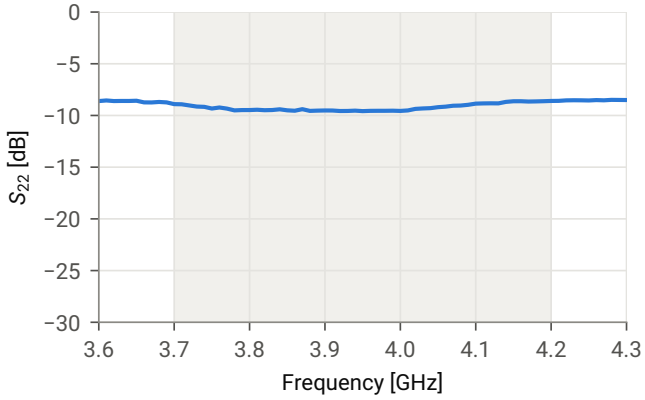
(a) S_{11} (input return loss) vs. frequency.



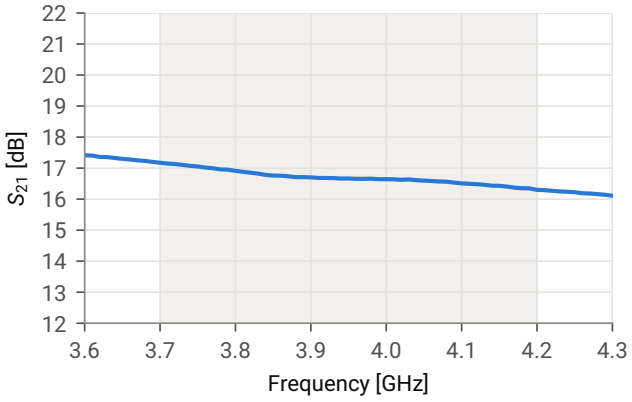
(b) S_{21} (gain) vs. frequency.



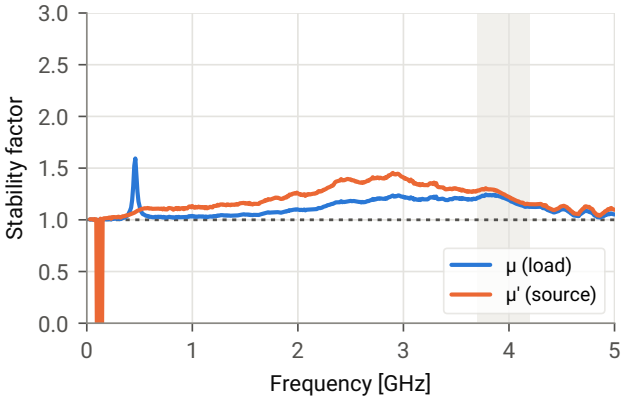
(c) S_{12} (reverse isolation) vs. frequency.



(d) S_{22} (output return loss) vs. frequency.



(e) S_{21} (gain) vs. frequency, expanded scale.



(f) Stability factors μ and μ' vs. frequency, 30 MHz to 5 GHz.

Figure 18: TL0375J-EVB-B S-parameters, 3700 – 4200 MHz band, $+25$°C, 5 V, 60 mA.

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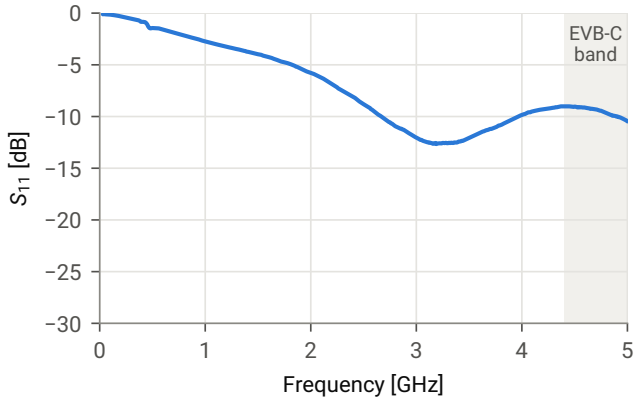
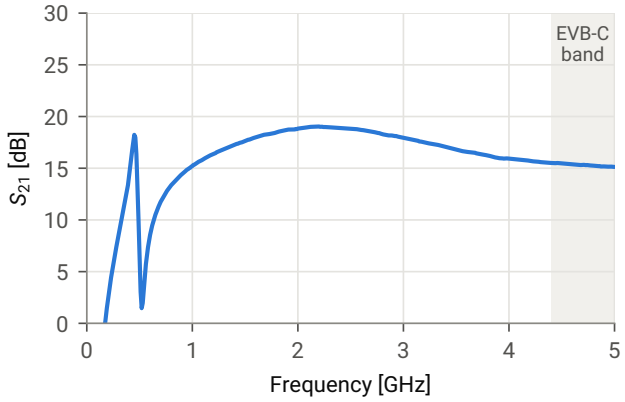
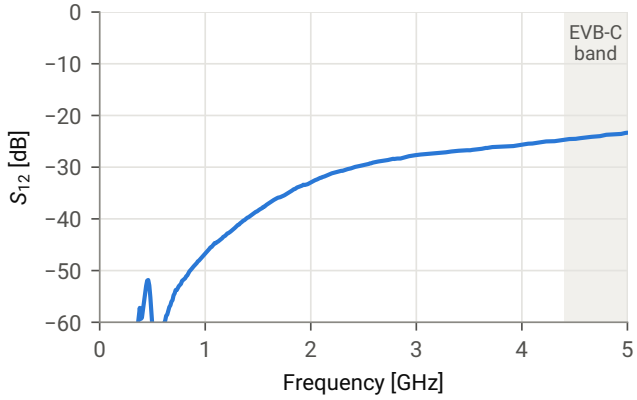
EVB C, wideband S-parameters and Smith charts



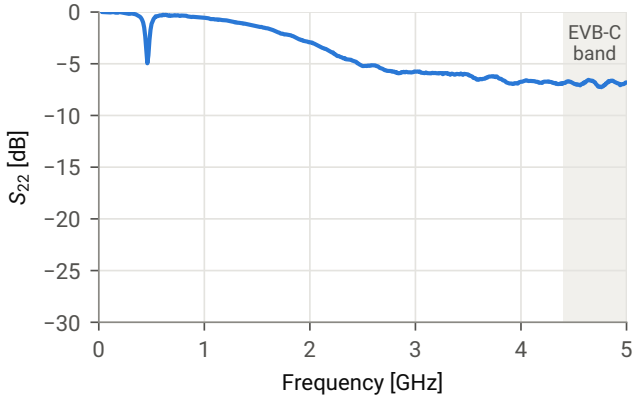
(a) S_{11} (input return loss) vs. frequency.



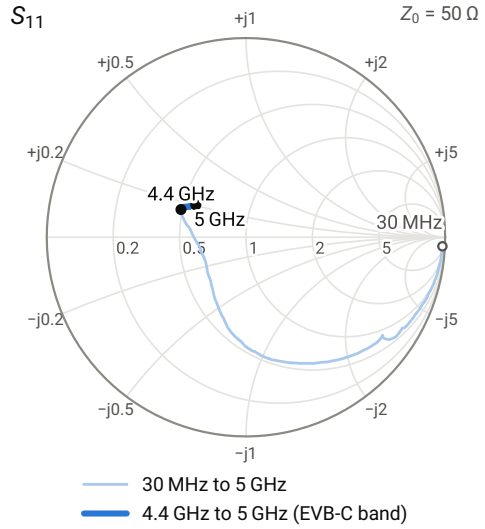
(b) S_{21} (gain) vs. frequency.



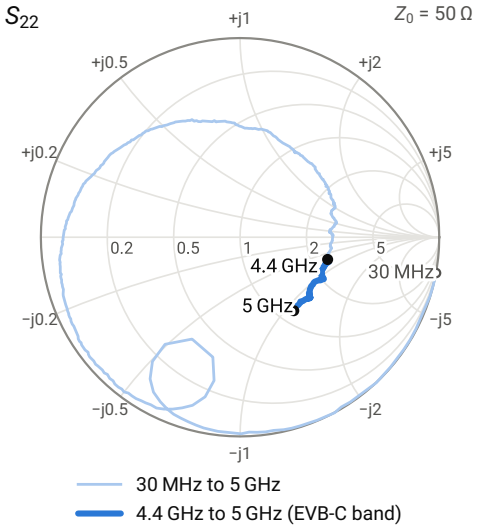
(c) S_{12} (reverse isolation) vs. frequency.



(d) S_{22} (output return loss) vs. frequency.



(e) S_{11} Smith chart, input impedance.



(f) S_{22} Smith chart, output impedance.

Figure 19: TL0375J-EVB-C S-parameters, 30 MHz to 5 GHz, $+25$°C, 5 V, 60 mA. Shaded and thick line: 4400 – 5000 MHz tuned band.

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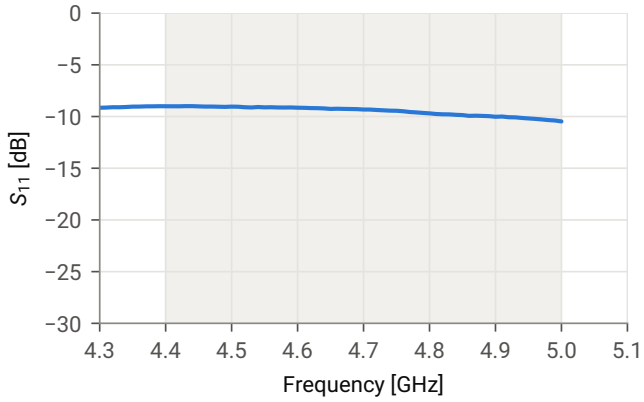
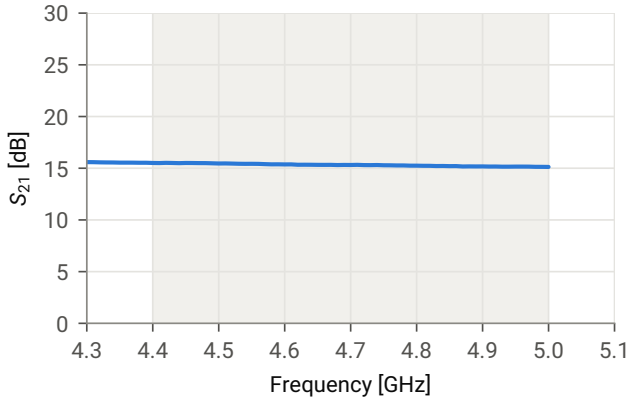
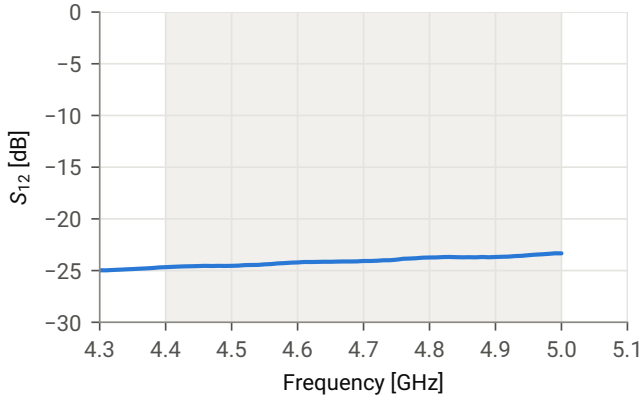
EVB C, narrowband S-parameters



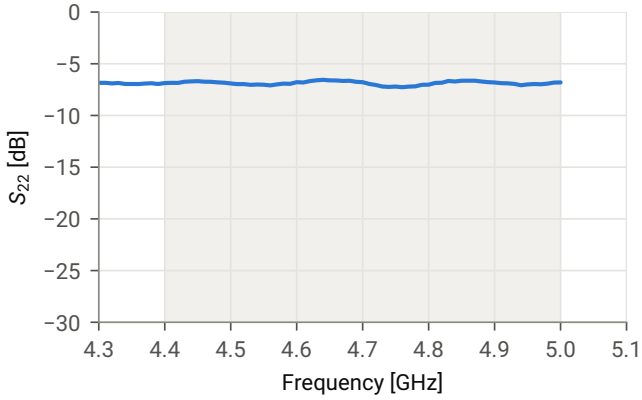
(a) S_{11} (input return loss) vs. frequency.



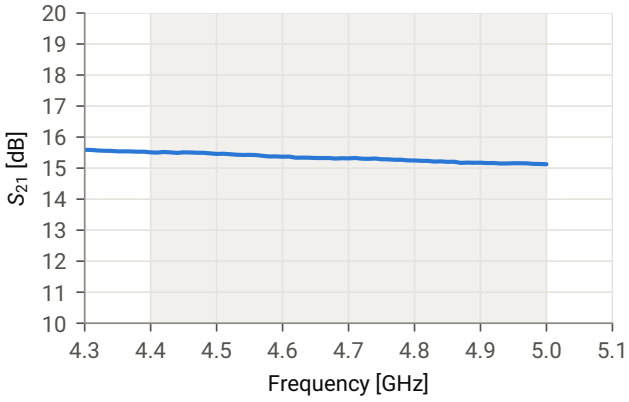
(b) S_{21} (gain) vs. frequency.



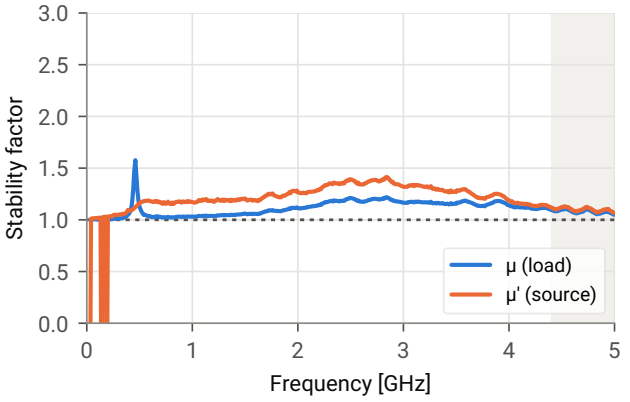
(c) S_{12} (reverse isolation) vs. frequency.



(d) S_{22} (output return loss) vs. frequency.



(e) S_{21} (gain) vs. frequency, expanded scale.



(f) Stability factors μ and μ' vs. frequency, 30 MHz to 5 GHz.

Figure 20: TL0375J-EVB-C S-parameters, 4400 – 5000 MHz band, $+25$°C, 5 V, 60 mA.

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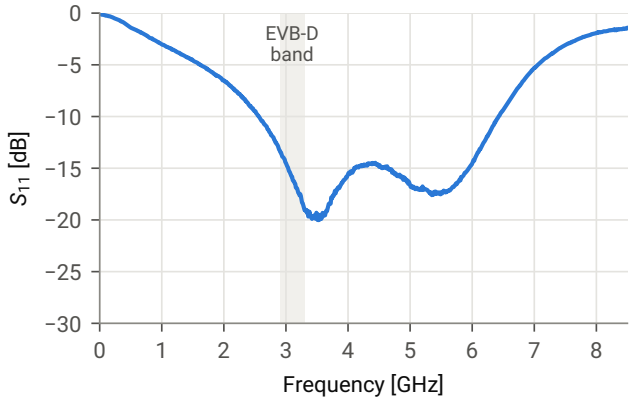
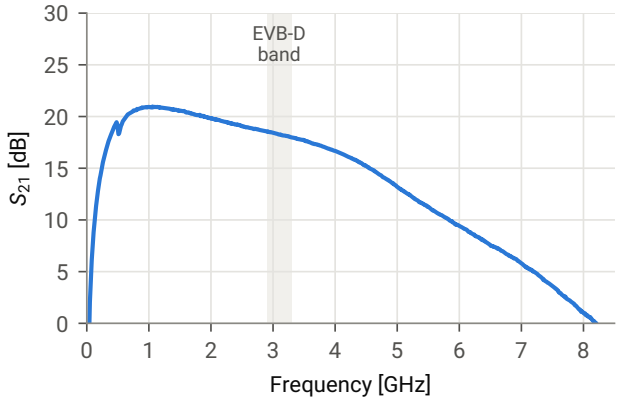
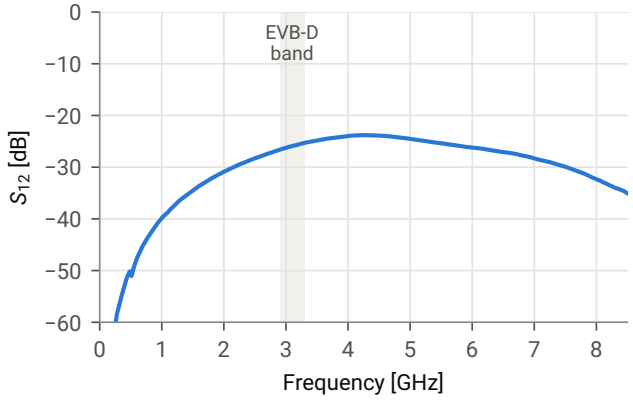
EVB D, wideband S-parameters and Smith charts



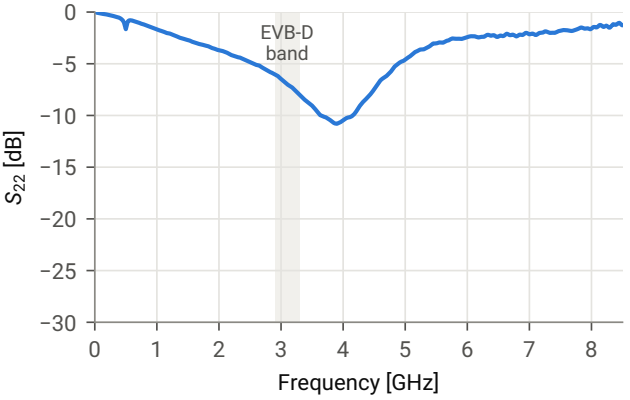
(a) S_{11} (input return loss) vs. frequency.



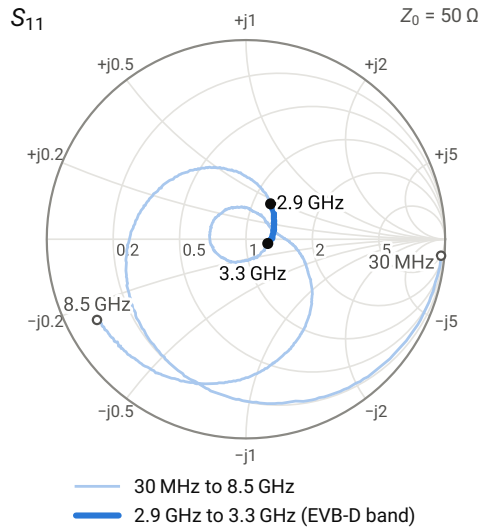
(b) S_{21} (gain) vs. frequency.



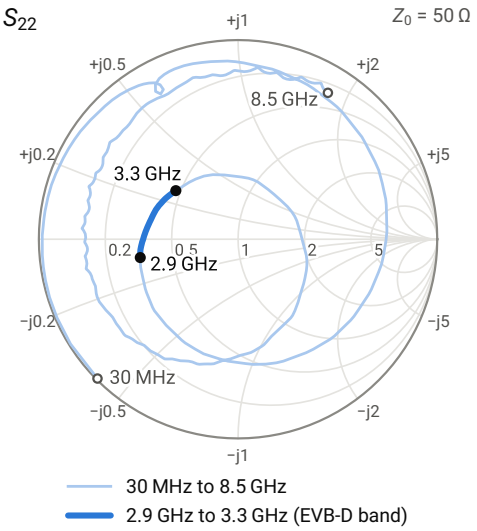
(c) S_{12} (reverse isolation) vs. frequency.



(d) S_{22} (output return loss) vs. frequency.



(e) S_{11} Smith chart, input impedance.



(f) S_{22} Smith chart, output impedance.

Figure 21: TL0375J-EVB-D S-parameters, 30 MHz to 8.5 GHz, $+25$°C, 5 V, 65 mA. Shaded and thick line: 2900 – 3300 MHz tuned band.

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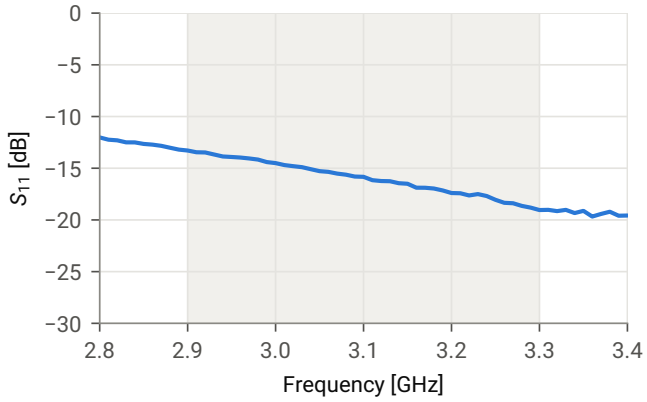
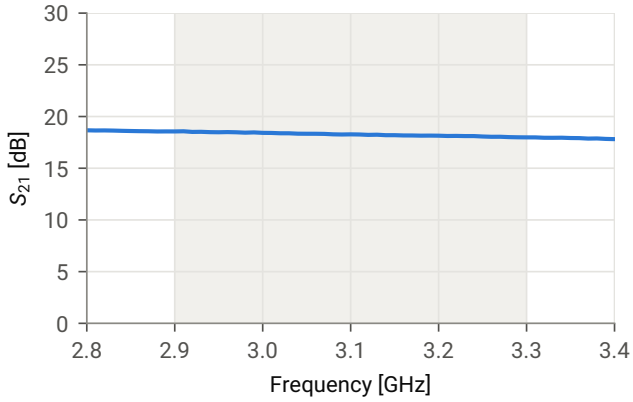
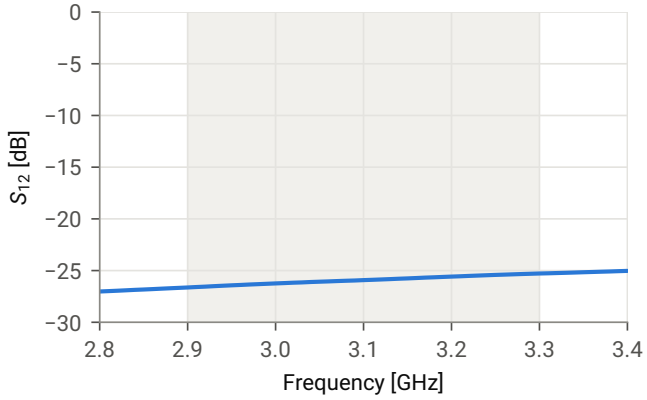
EVB D, narrowband S-parameters



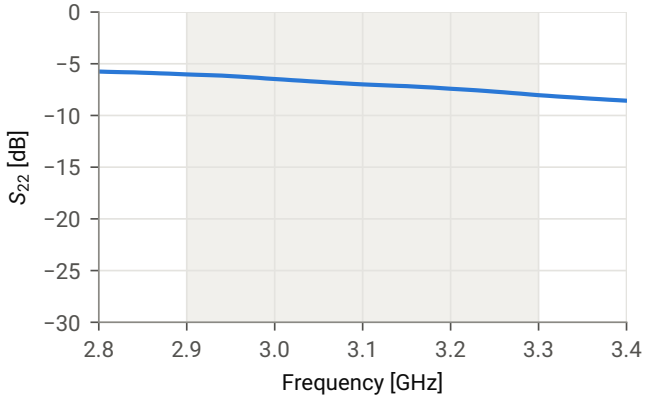
(a) S_{11} (input return loss) vs. frequency.



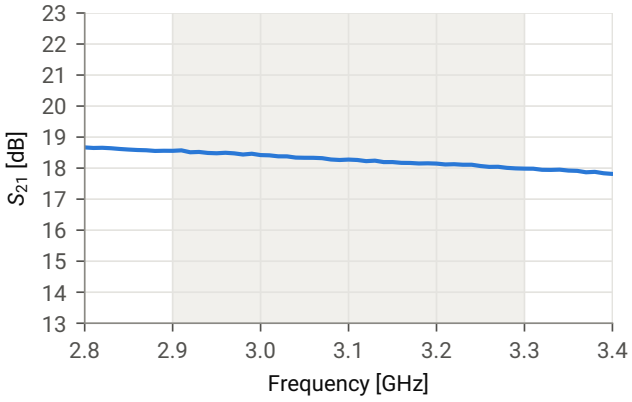
(b) S_{21} (gain) vs. frequency.



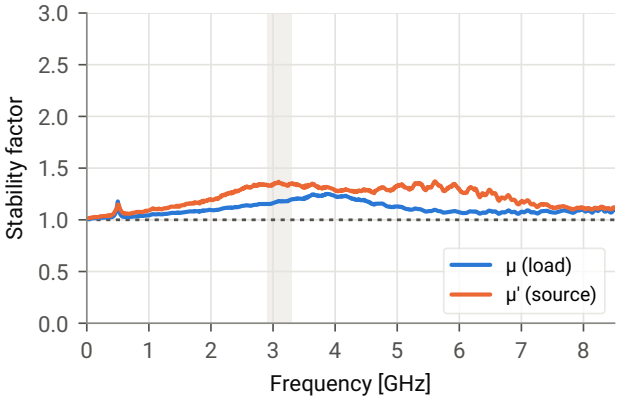
(c) S_{12} (reverse isolation) vs. frequency.



(d) S_{22} (output return loss) vs. frequency.



(e) S_{21} (gain) vs. frequency, expanded scale.



(f) Stability factors μ and μ' vs. frequency, 30 MHz to 8.5 GHz.

Figure 22: TL0375J-EVB-D S-parameters, 2900 – 3300 MHz band, $+25$°C, 5 V, 65 mA.

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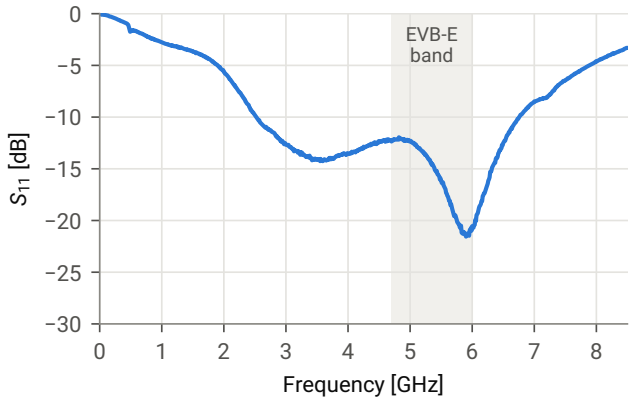
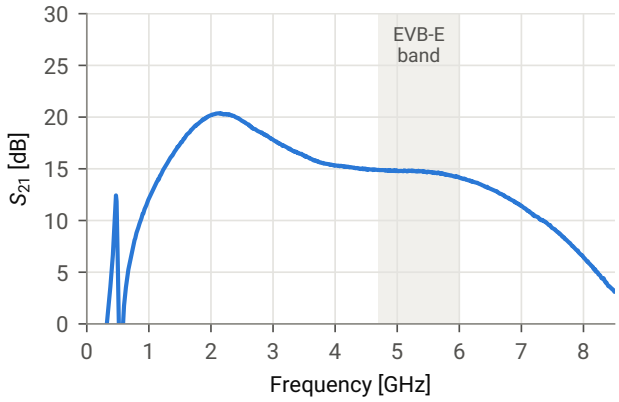
EVB E, wideband S-parameters and Smith charts

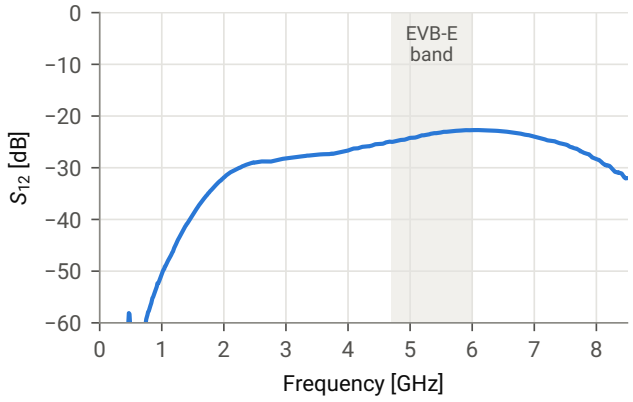
The band of TL0375J-EVB-E extends above the specified operating frequency range of 2.0 – 5.0 GHz.



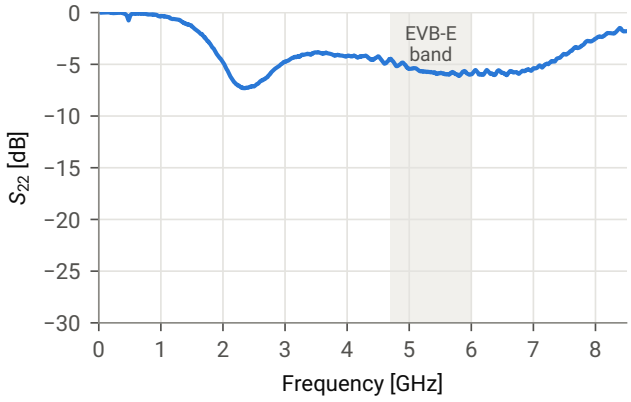
(a) S_{11} (input return loss) vs. frequency.



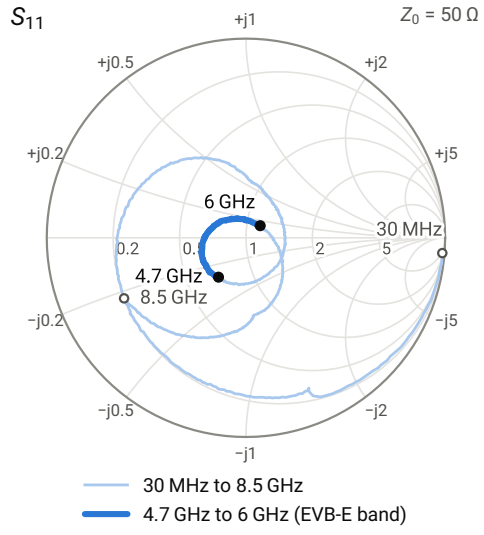
(b) S_{21} (gain) vs. frequency.



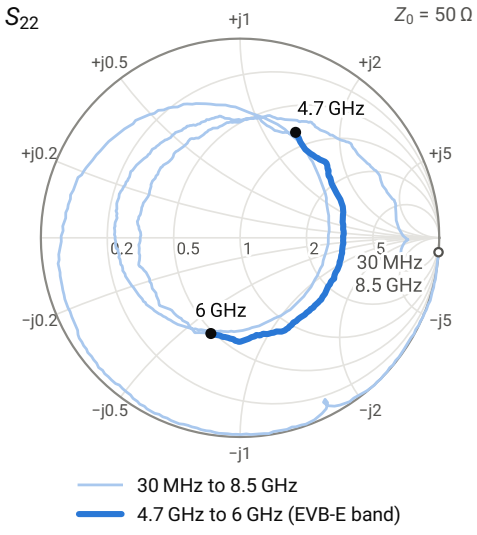
(c) S_{12} (reverse isolation) vs. frequency.



(d) S_{22} (output return loss) vs. frequency.



(e) S_{11} Smith chart, input impedance.



(f) S_{22} Smith chart, output impedance.

Figure 23: TL0375J-EVB-E S-parameters, 30 MHz to 8.5 GHz, $+25$°C, 5 V, 70 mA. Shaded and thick line: 4700 – 6000 MHz tuned band.

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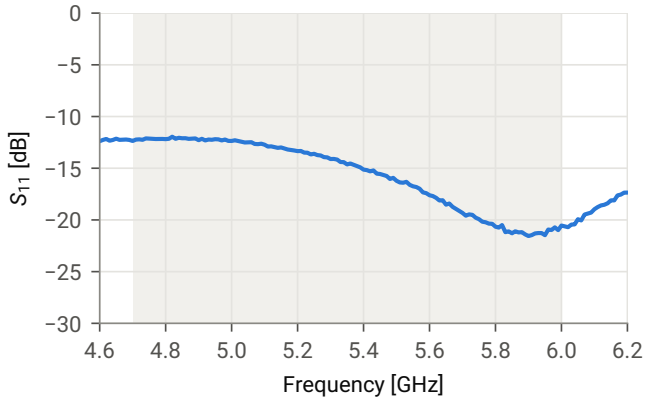
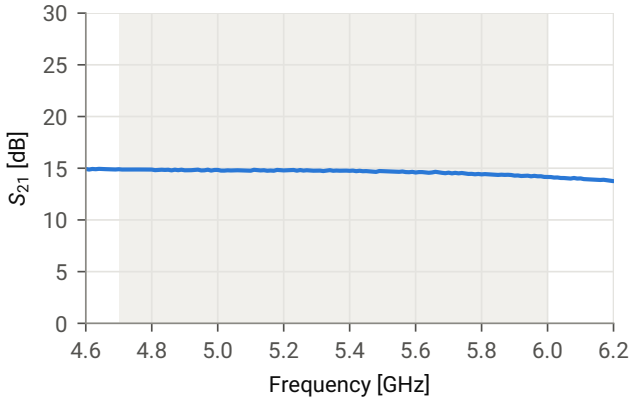
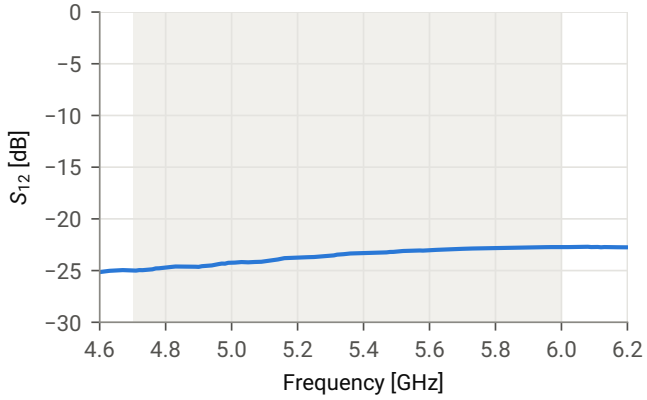
EVB E, narrowband S-parameters



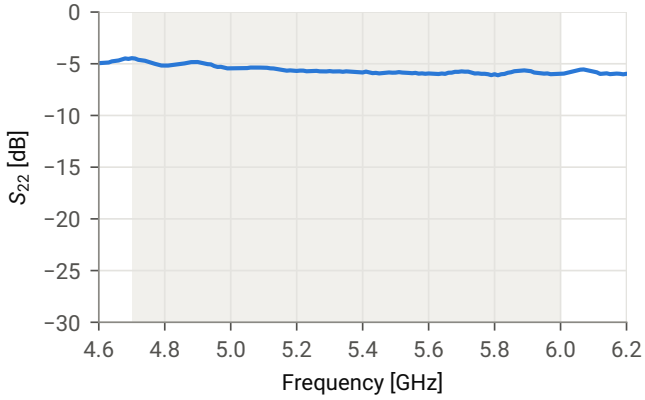
(a) S_{11} (input return loss) vs. frequency.



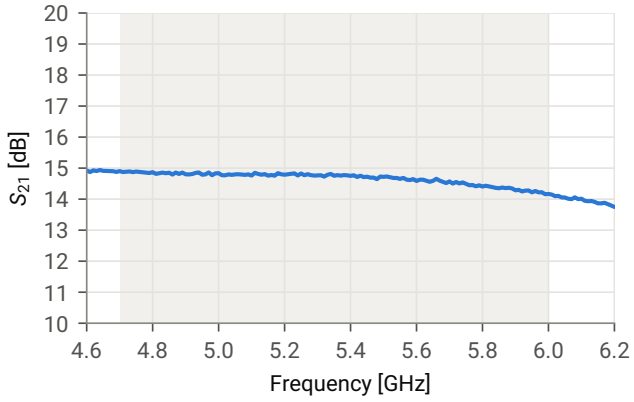
(b) S_{21} (gain) vs. frequency.



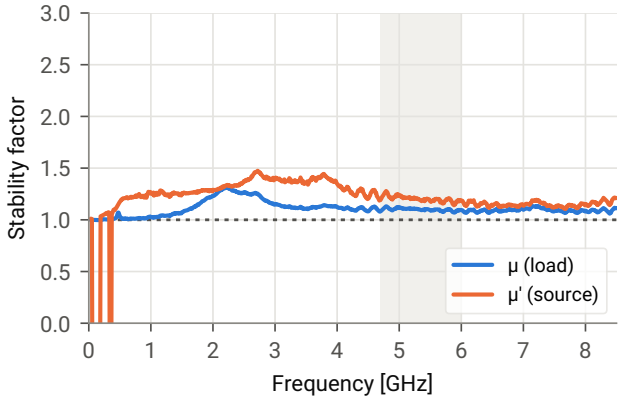
(c) S_{12} (reverse isolation) vs. frequency.



(d) S_{22} (output return loss) vs. frequency.



(e) S_{21} (gain) vs. frequency, expanded scale.



(f) Stability factors μ and μ' vs. frequency, 30 MHz to 8.5 GHz.

Figure 24: TL0375J-EVB-E S-parameters, 4700 – 6000 MHz band, $+25$°C, 5 V, 70 mA.

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Test Procedures

TL0375J-EVB-A Biasing Sequence

TagoreTech recommends following the biasing sequence below every time the evaluation board is powered up or down. Applying RF power to an amplifier that is not yet biased, removing the bias while RF power is still present, or letting a supply overshoot during switching can stress the input transistor and damage the device or reduce its long-term reliability. The sequence is part of the board's normal operating procedure, not an optional step.

Before switching on, set the current limit of the supply to about 70 mA, the absolute maximum drain current, and make sure that the supply does not overshoot V_{DD} or V_{enable} above the +6 V absolute maximum rating when it is switched on. The RF input power must stay below the absolute maximum of 23 dBm CW. The TL0375J is ESD sensitive (HBM class 1B); handle the board with ESD precautions and connect the ground before any other connection.

Table 18: TL0375J-EVB-A bias and sequencing

Turn on	Turn off
1. Connect the supply ground to the ground test point.	1. Turn the RF power off.
2. Set V_{enable} to +5 V.	2. Turn V_{DD} off.
3. Set V_{DD} to +5 V and check that the quiescent current is $I_{DQ} \approx 60$ mA.	3. Turn V_{enable} off.
4. Apply the RF power.	4. Disconnect the ground last.

I_{DQ} is set by V_{enable} and the series resistor M4; a quiescent current clearly different from 60 mA indicates a wrong supply voltage, a wrong M4 value or an assembly problem, and the RF power should not be applied before the cause is found. $V_{enable} < 0.2$ V disables the device. When V_{enable} and V_{DD} are supplied from the same 5 V source, as in the test set-up of Figure 26, they rise and fall together; the RF power must still be applied only after the supply has settled and removed before the supply is switched off.

S-parameter test set-up

The TL0375J-EVB-A is shipped fully assembled and tested; Figure 25 shows an evaluation board. Figure 26 shows the basic test set-up for evaluating the S-parameters (gain, input and output return loss, reverse isolation) with a vector network analyzer.

1. Connect the ground test point to the ground terminal of the power supply.
2. Connect the V_{enable} and V_{DD} test points to the output of a 5 V supply capable of sourcing approximately 60 mA.
3. Connect a calibrated network analyzer to the RF_{IN} and RF_{OUT} SMA connectors. Sweep the frequency from 1 GHz to 6 GHz with a source power of -25 dBm.

The TL0375J-EVB-A is expected to show a gain of 17.5 dB at 3.6 GHz; see Table 8 for the expected results.

Additional test equipment is required for a comprehensive evaluation. For noise figure, use a noise figure analyzer or a spectrum analyzer with noise option, together with a low excess noise ratio (ENR) noise source. For the third-order intercept point, use two signal generators, a high-isolation power combiner and a spectrum analyzer. For power compression and power handling, use a signal generator and a two-channel power meter; make sure that the driver amplifier has sufficient output power and that couplers and attenuators have adequate power handling.

Measurements taken at the SMA connectors include the losses of the connectors and the PCB. The through line on the board, consisting of an RF input and an RF output line of equal length, should be measured to calibrate these effects.

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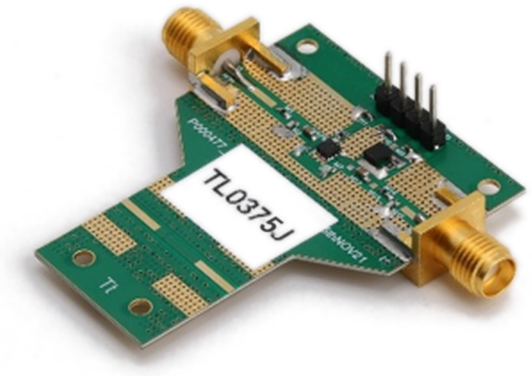

Figure 25: TL0375J evaluation board.

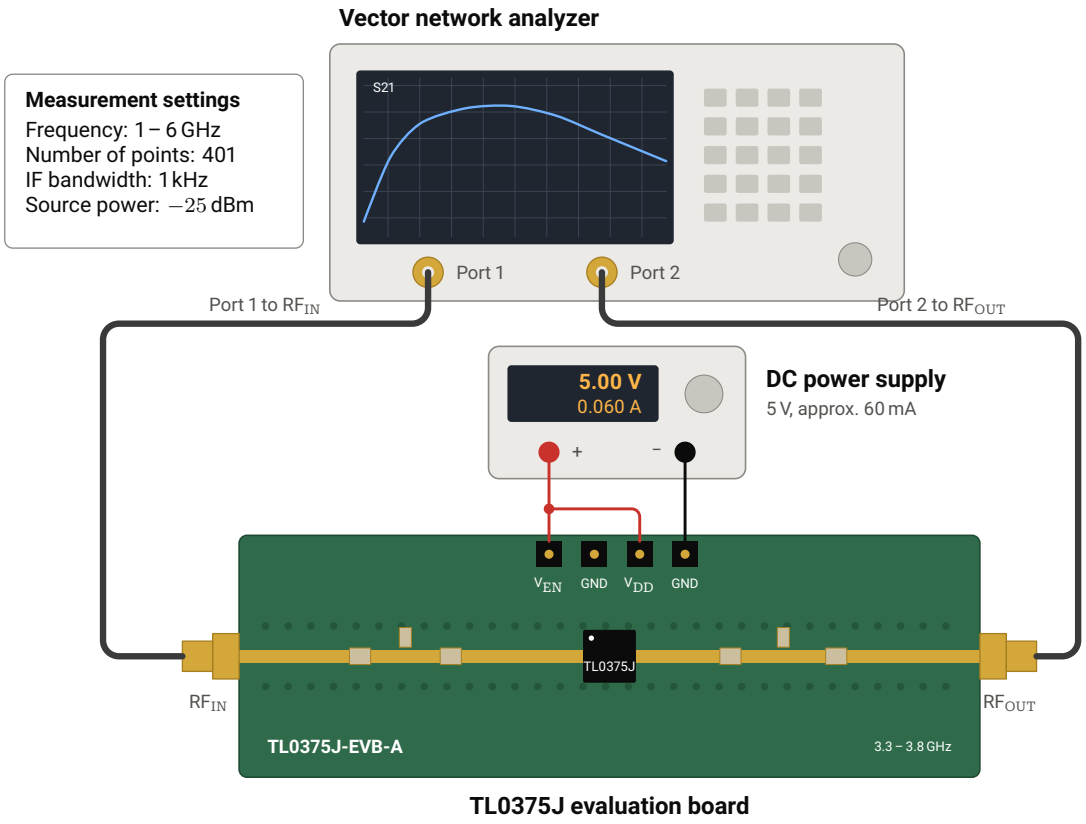

Figure 26: Test set-up for S-parameter measurements.

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Device Package information

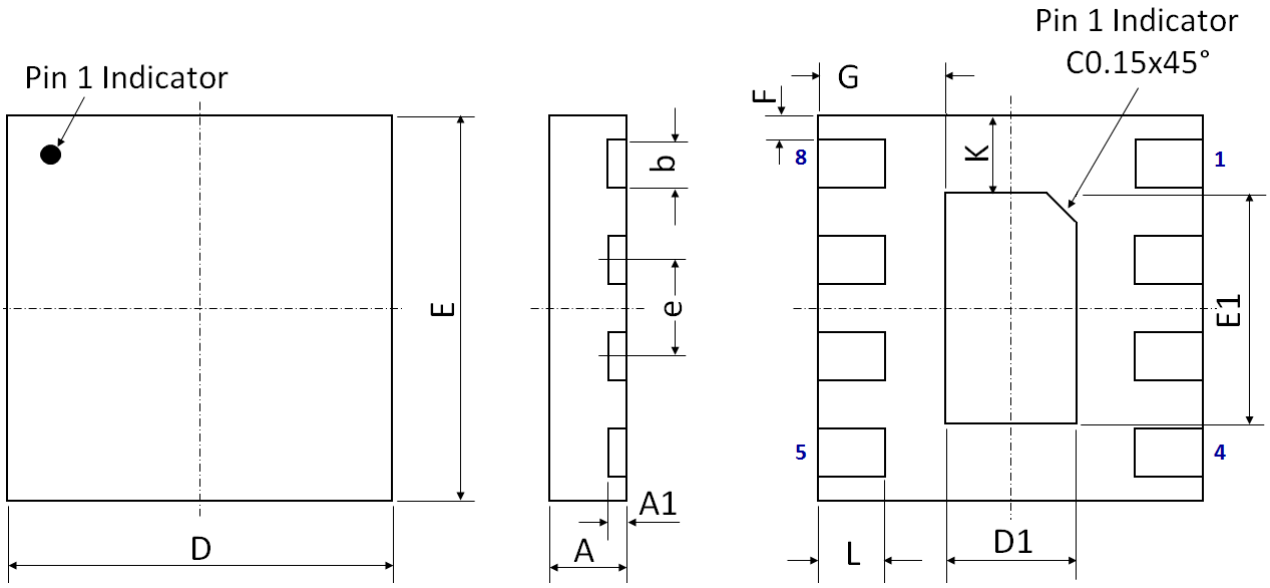

Figure 27: 8-pin DFN 2.0 x 2.0 x 0.75 mm^3 package drawing, dimensions in [mm].

Please refer to application notes TN-001 PCB Design guideline and TN-002 Solder Rework at TagoreTech web page for PCB and soldering guidelines.

Table 19: Device Package Dimensions

Dimension	Value [mm]	Tolerance [mm]	Dimension	Value [mm]	Tolerance [mm]
A	0.75	±0.05	E	2.00 BSC	±0.05
A1	0.203	±0.02	E1	1.20	±0.05
b	0.25	±0.02	F	0.125	±0.02
D	2.00 BSC	±0.05	G	0.66	±0.03
D1	0.68	±0.03	L	0.35	±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).

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PCB Land Design

Notes:

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

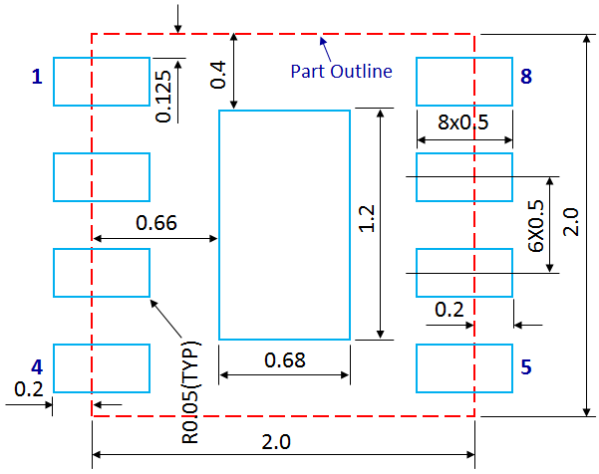

Figure 28: PCB land pattern, dimensions in [mm].



Figure 29: Solder mask pattern: non-solder mask defined (preferred, left) and solder mask defined (right), dimensions in [mm].

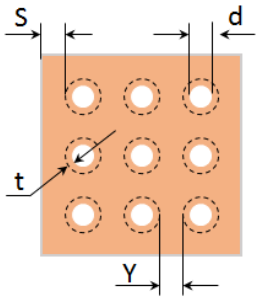

Figure 30: Thermal via pattern, recommended values: S≥0.15mm; Y≥0.20mm; d=0.3mm; plating thickness t=25μm or 50μm.

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PCB Stencil Design

Notes:

- Laser-cut, stainless steel stencil is recommended with electro-polished trapezoidal walls to improve the paste release.
- Stencil thickness is recommended to be 125μm.

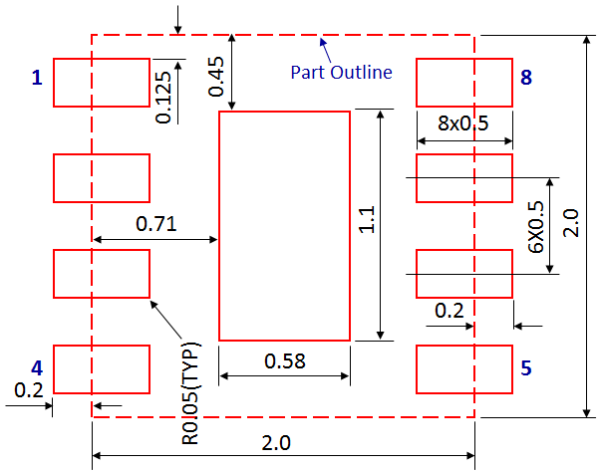

Figure 31: Stencil openings, dimensions in [mm].

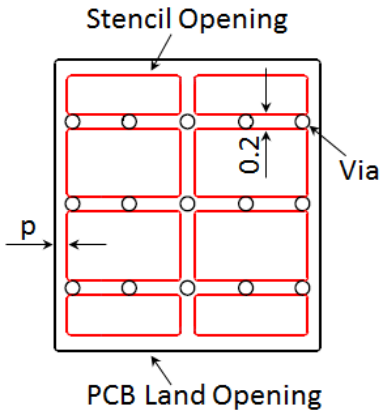

Figure 32: Stencil openings shall not cover via areas if possible, dimensions in [mm].

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Tape and Reel Information

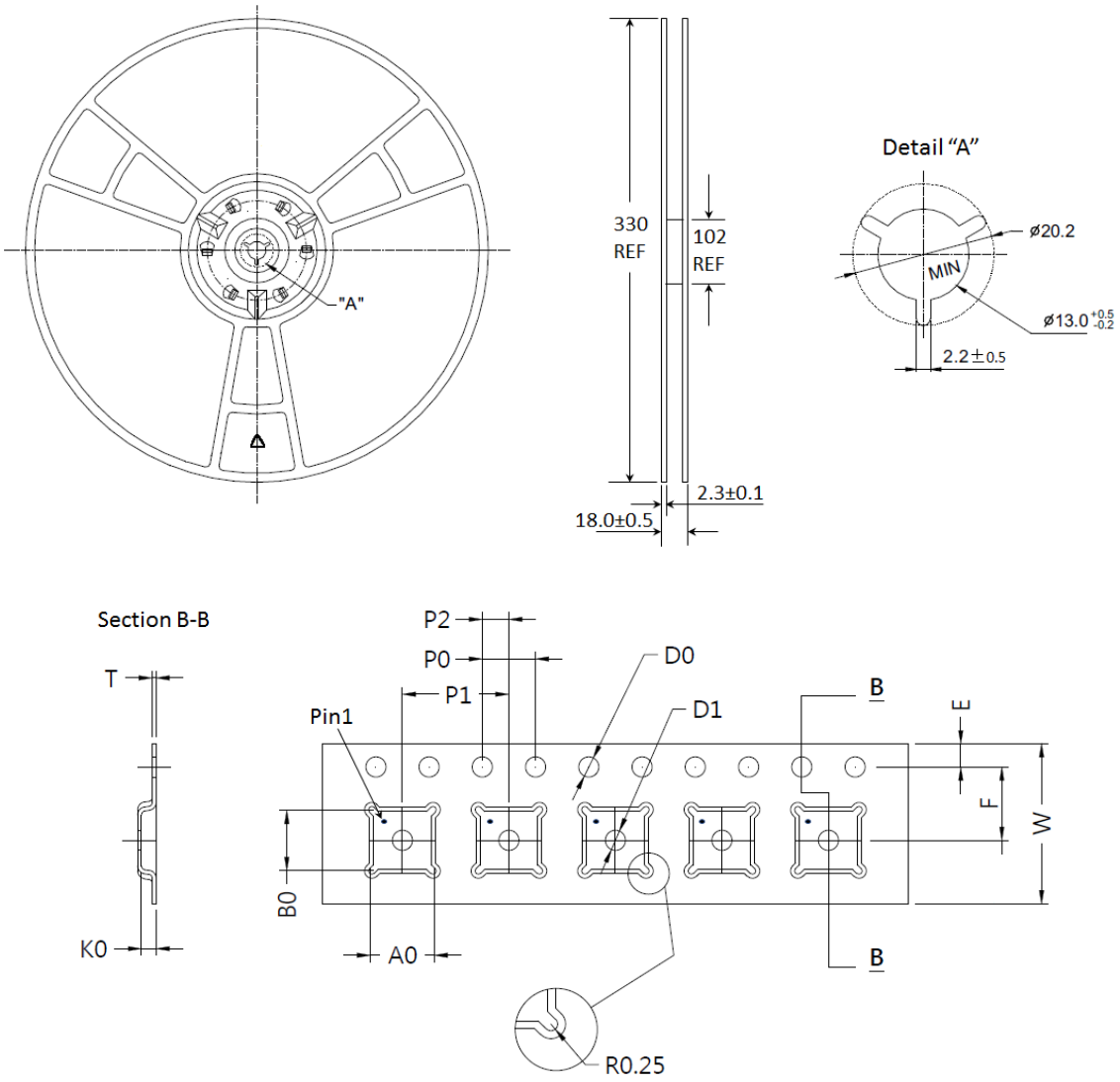

Figure 33: Tape and reel drawing.

Table 20: Tape and Reel Dimensions

Dimension	Value [mm]	Tolerance [mm]	Dimension	Value [mm]	Tolerance [mm]
A0	2.20	±0.05	K0	1.00	±0.10
B0	2.20	±0.05	P0	4.00	±0.10
D0	1.50	+0.10	P1	4.00	±0.10
D1	1.00	min.	P2	2.00	±0.05
E	1.75	±0.10	T	0.30	±0.05
F	3.50	±0.05	W	8.00	+0.30/-0.10

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Glossary

DFN	Dual Flat No-lead package
DNP	Do Not Populate: component position on the PCB that is not assembled
ENR	Excess noise ratio of a noise source
EVB	Evaluation board
IRL / ORL	Input / output return loss
LNA	Low noise amplifier
NF	Noise figure
OIP3	Output third-order intercept point
OP_{1dB}	Output power at 1 dB gain compression
μ, μ', μ_1	Single-parameter (Edwards–Sinsky) stability factors, load (μ, μ_1) and source (μ') side; $\mu > 1$ indicates unconditional stability
S_{ij}	S-parameters: S_{11} input match, S_{21} gain, S_{12} reverse isolation, S_{22} output match

Changelog

Table 21: Changelog

Date	Revision	Notes
11/29/2024	2.8	Datasheet in the previous format.
09/28/2026	3.00	Datasheet converted to the common TagoreTech document template: evaluation board schematics redrawn with not-assembled positions marked DNP, table of evaluation boards with links to the application notes, links to application notes TN-001/TN-002, QR code link to the latest datasheet, return loss given in house sign convention. S-parameter plots redrawn as vector graphics from the Touchstone data with Smith charts of S_{11} and S_{22} and stability factors μ and μ' for all evaluation boards A to E. Biasing sequence and S-parameter test set-up redrawn, photo of the evaluation board added. EVB E noise figure values corrected (de-embedded and EVB noise figure were swapped).

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Application notes of all evaluation boards are linked in the table Evaluation boards and application notes.

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