



Datasheet

L1/L5 Surface Mount GNSS Front-End Module

Part No:
TFM.100B

Description

Surface mount GNSS front-end module covering L1/L5

Features:

Two-stage LNA providing >25 dB Gain across all bands

Low Noise Figure: <3.0 dB in all bands

Vin = +1.8 to +5.5 VDC

Easy to integrate surface-mount module

Dimensions: 20 mm x 18 mm

RoHS & Reach Compliant

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1. Introduction



The Taoglas TFM.100B is a surface-mount GNSS front-end module which covers L1 /L5 for dual-band high-precision applications. The TFM.100B is a dual input, single output module and features a SAW/LNA/SAW/LNA topology in both the low and high band signal paths to prevent unwanted out-of-band interference from overdriving the GNSS LNAs or receiver. The SAW filters have been carefully selected and placed to provide excellent out-of-band rejection while also maintaining low noise figure.

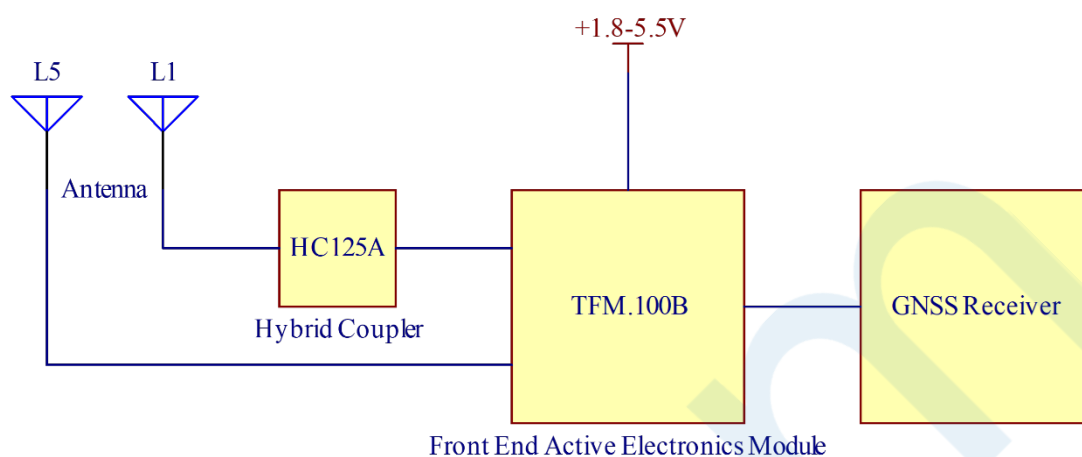
Many currently available dual-band GNSS receivers require additional RF circuits between the antenna and the receiver to properly set the overall system noise figure. This requires additional development time for an otherwise simple module integration. Many organizations don't have the RF expertise to effectively design such a solution. The TFM.100B captures the required additional RF circuits in modular form, allowing the designer to simply place the TFM.100B between their GNSS antenna and GNSS receiver.

The TFM.100B offers > 25 dB gain across all applicable bands while maintaining a high P1dB of -26 dBm or better. Noise Figure is < 3.0 dB in all applicable bands. A wide input voltage of +1.8 to +5.5 VDC allows for easy integration in most GNSS systems.

TFM.100B Features and Benefits:

- Ease-of-integration – Single-package solution combines impedance matching, filter efficiency and low noise design for easy, drop-in use with any antenna or GNSS receiver
- Low-noise System Design – Integrated pre-filters deliver exceptional out-of-band rejection across multiple band configurations and neighboring interference to properly set noise figure
- Dual-gain Stage Architecture – Cascaded LNAs, pre-filters and optimized impedance matching deliver sufficient gain to the GNSS receiver without signal-to-noise overload
- Low-profile Form Factor – Small footprint and low-profile design saves valuable real estate without the need for external components and routing
- Accelerated Development Cycles – 2+ years of development by antenna and RF design experts, delivering the highest levels of integration, manufacturability and robustness in a single package

For further information, please contact your regional Taoglas customer support team.



Block diagram of the integration for the TFM.100B.

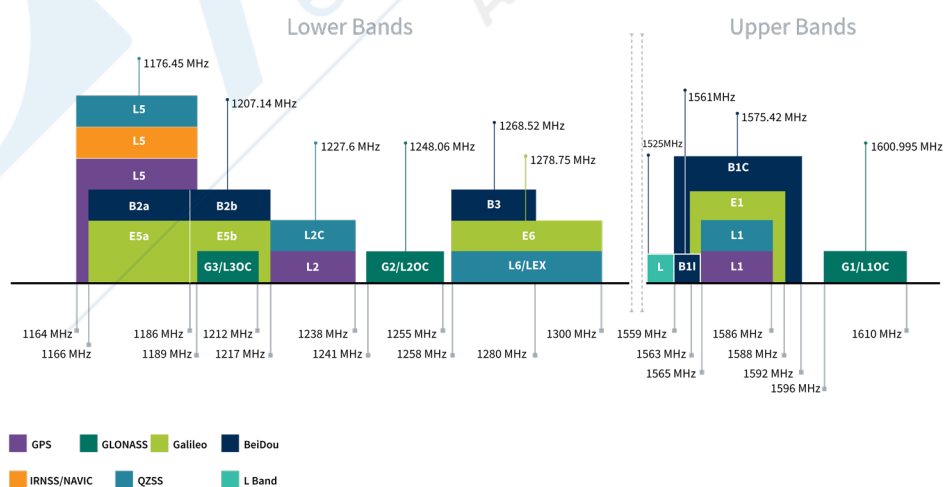
We used the [HP54510A](#) to demonstrate the integration of this module but please note that we have other compatible antennas that can also be used alongside the TFM.100B please see table below.

Compatible Antennas
HP54510A
HP5354.A

Taoglas also offers the [TFM.100A](#) for L1+B1+G1/L2 applications.

2. Specification

GNSS Frequency Bands					
GPS	L1 1575.42 MHz	L2 1227.6 MHz	L5 1176.45 MHz		
	■	□	■		
GLONASS	G1 1602 MHz	G2 1248 MHz	G3 1207 MHz		
	■	□	□		
Galileo	E1 1575.24 MHz	E5a 1176.45 MHz	E5b 1201.5 MHz	E6 1278.75 MHz	
	■	□	□	□	
BeiDou	B1C 1575.42 MHz	B1I 1561 MHz	B2a 1176.45 MHz	B2b 1207.14 MHz	B3 1268.52 MHz
	■	□	■	□	□
L-Band	L-Band 1542 MHz				
	□				
QZSS (Regional)	L1 1575.42 MHz	L2C 1227.6 MHz	L5 1176.45 MHz	L6 1278.75e6	
	■	□	■	□	
IRNSS (Regional)	L5 1176.45 MHz				
	■				
SBAS	L1/E1/B1 1575.42 MHz	L5/B2a/E5a 1176.45 MHz	G1 1602 MHz	G2 1248 MHz	G3 1207 MHz
	■	■	■	□	□



GNSS Bands and Constellations

Electrical						
Frequency (MHz)	1166	1176	1186	1559	1575.42	1606
Noise Figure (dB)	2.2	2.3	2.5	2.5	2.2	2.9
Gain (dB)	28	28	28	26	27	25
Group Delay (ns)	35	35	39	39	29	32
Input P1dB (dBm)	-25	-25	-24	-22	-22	-21
Input Return Loss (dB)	-12	-19	-18	-15	-15	-10
Output Return Loss	-6	-6	-6	-8	-8	-8
Vin	+1.8 to +5.5 VDC					
Typical Current (@1.8V)	7.5 – 9.0mA					

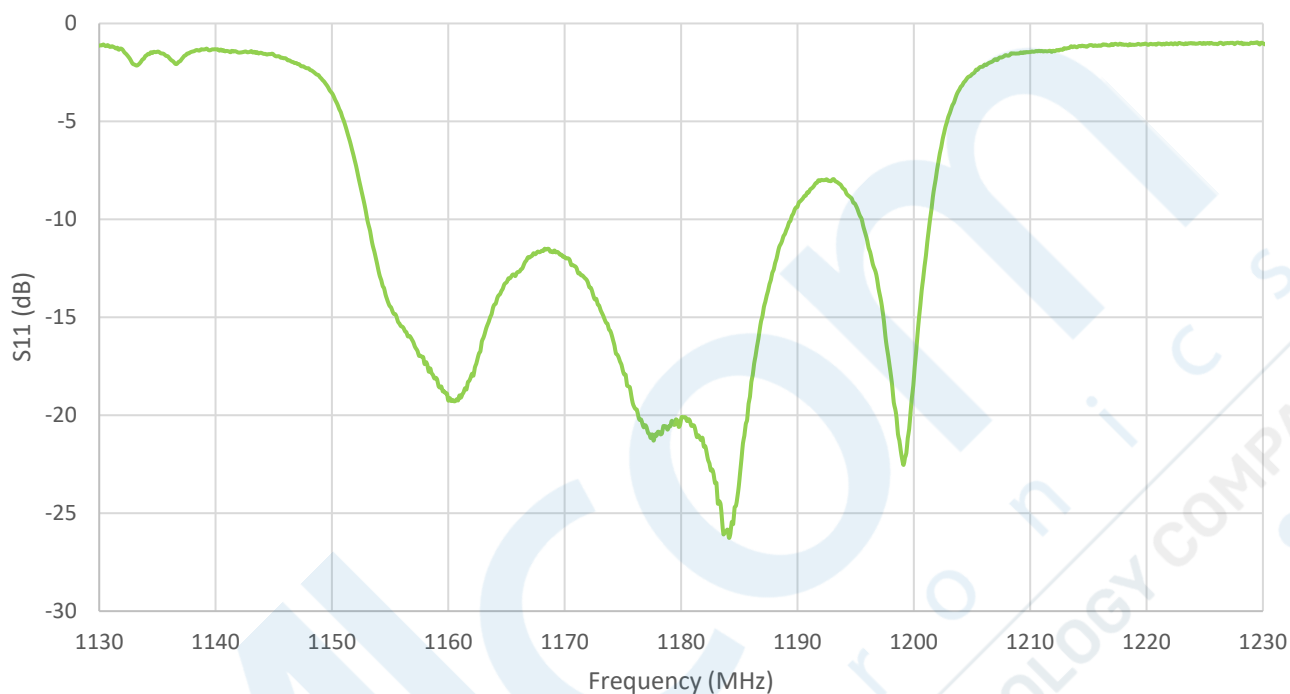
*Note: Tested on an evaluation board. Board losses removed.

Mechanical	
Height	2.76 mm max.
Planar Dimension	20 mm x 18 mm
Weight	2g

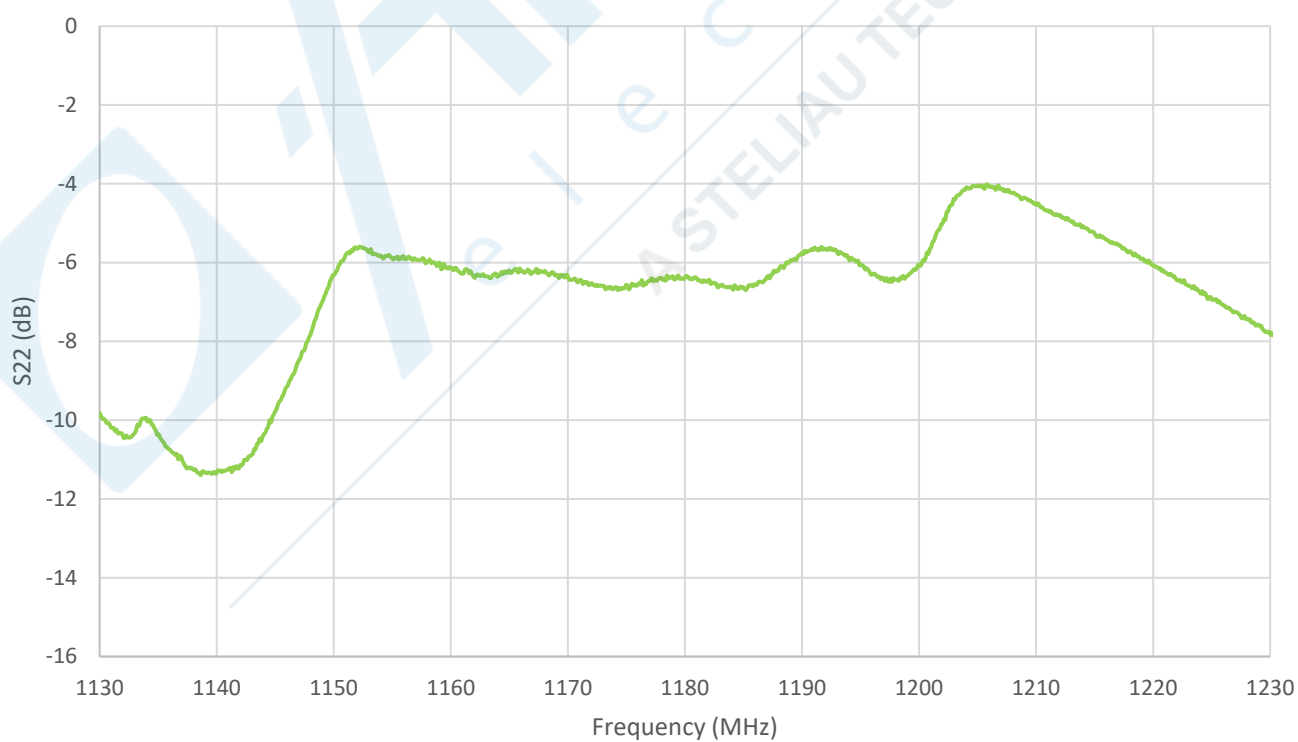
Environmental	
Temperature Range	-40°C to 85°C
RoHS Compliant	Yes
REACH Compliant	Yes
Moisture Sensitivity Level (MSL)	3

3. FEM Low Band Characteristics

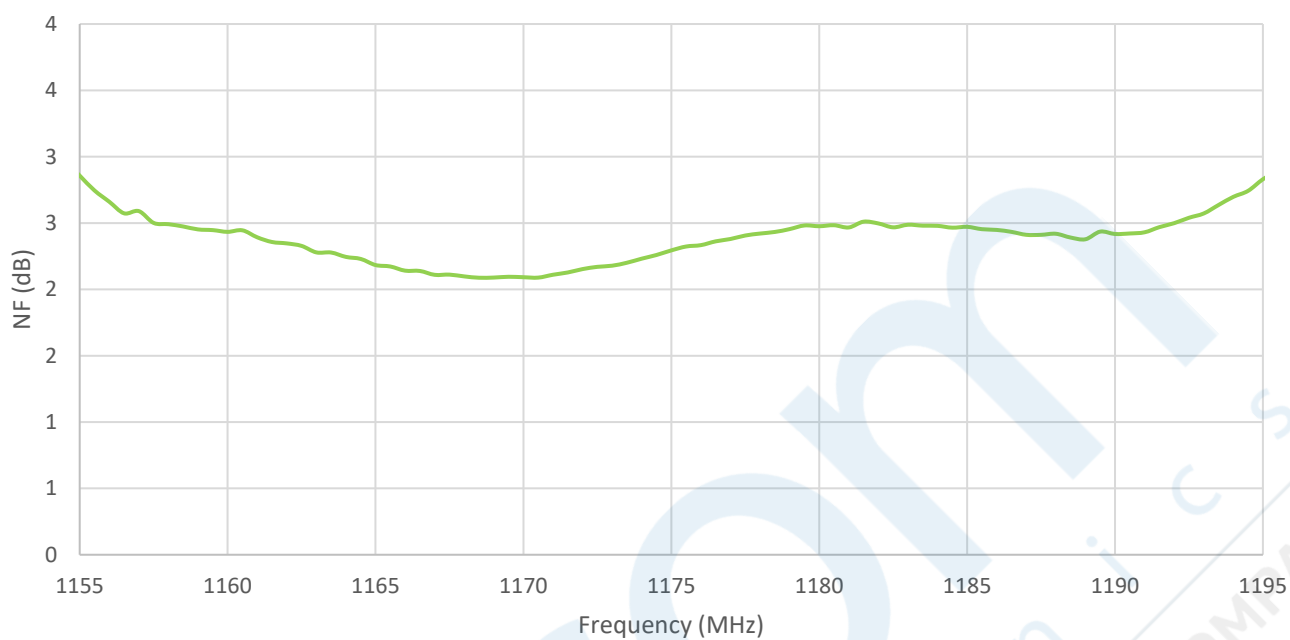
3.1 Low Band Input Return Loss



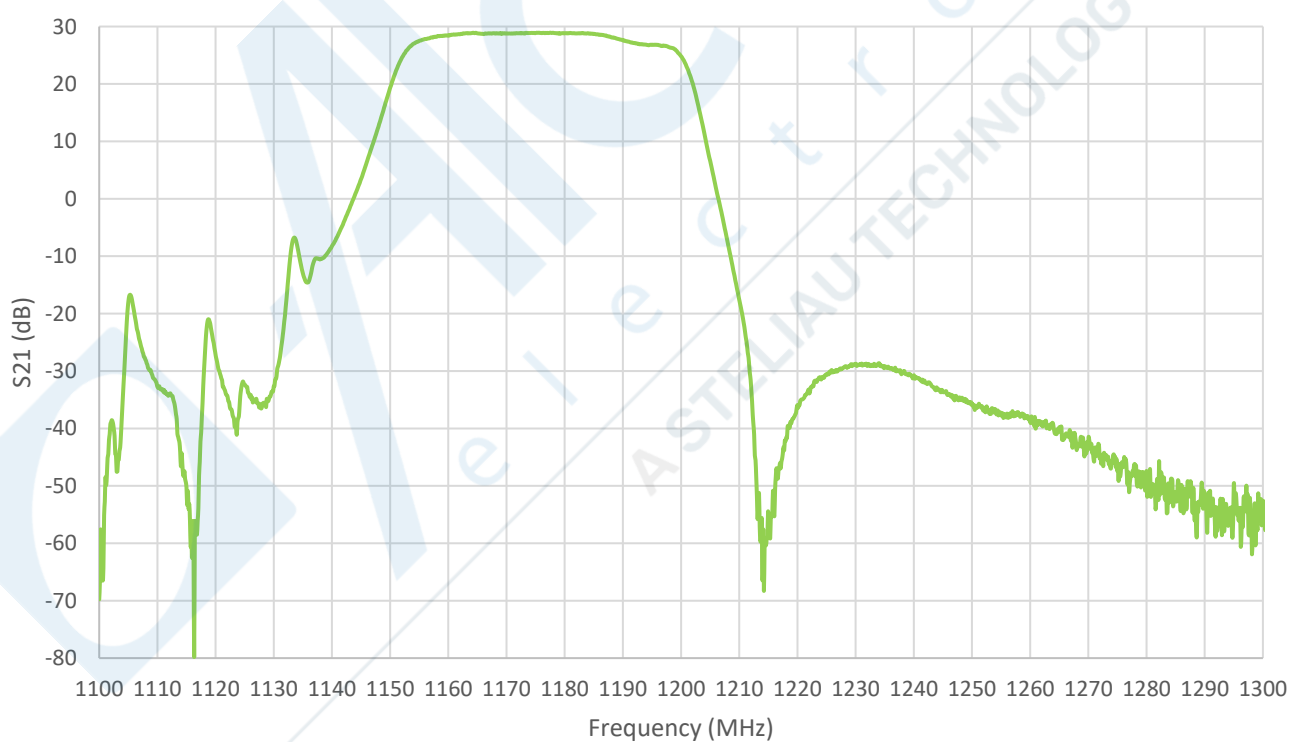
3.2 Low Band Output Return Loss



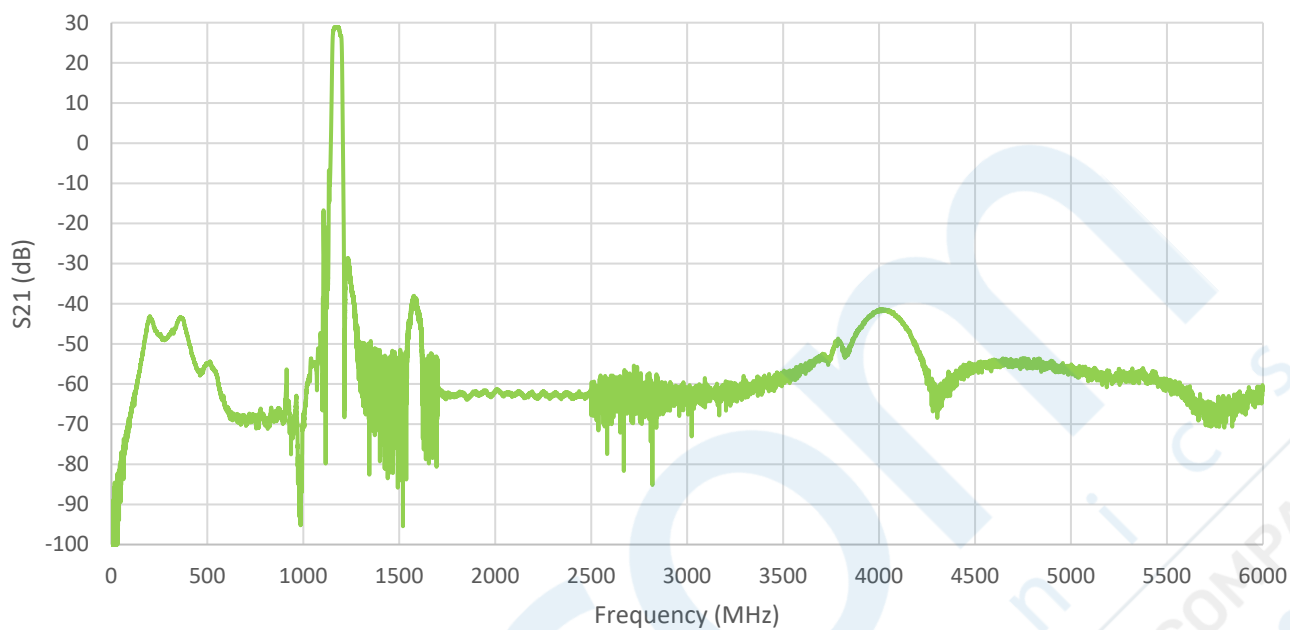
3.3 Low Band Noise Figure



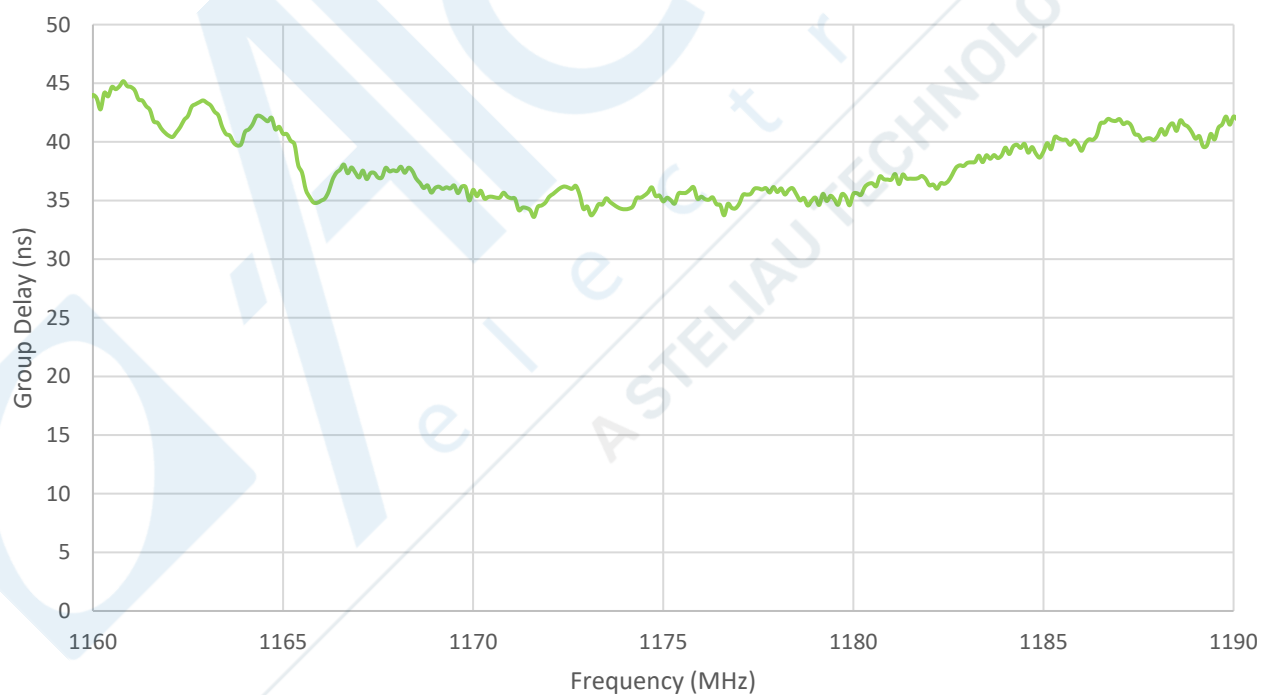
3.4 Low Band Gain



3.5 Low Band Gain and Attenuation

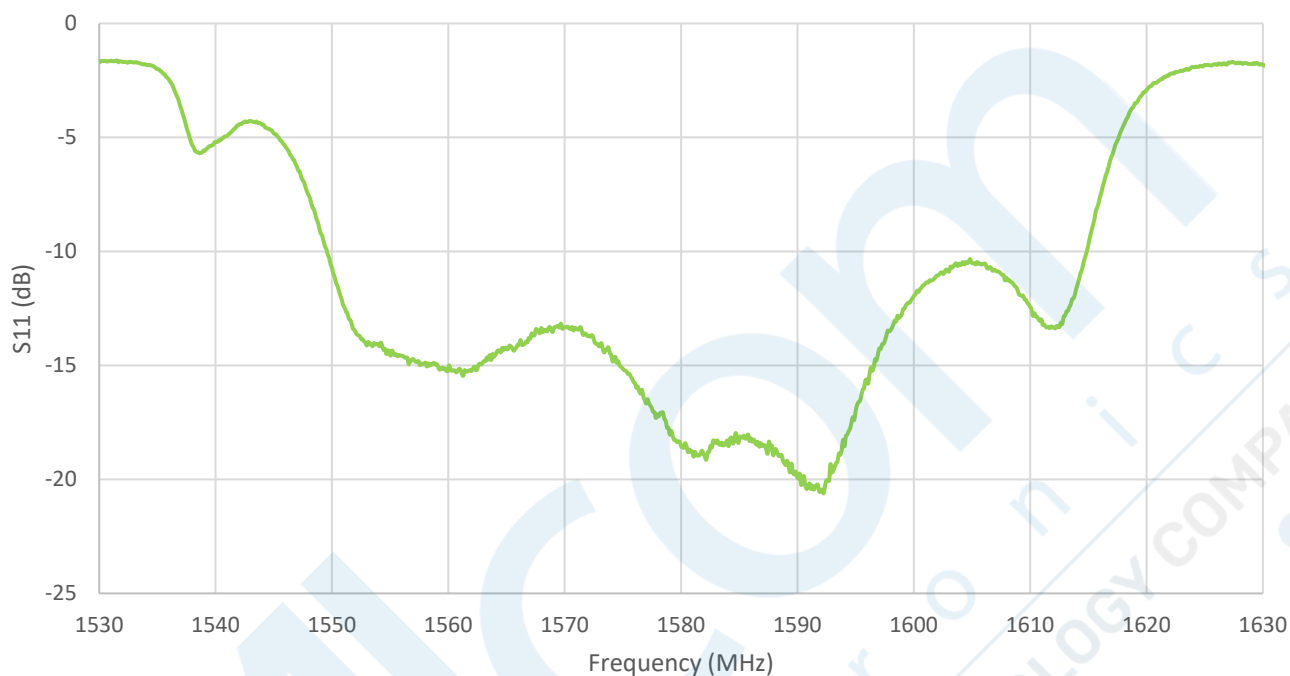


3.6 Low Band Group Delay

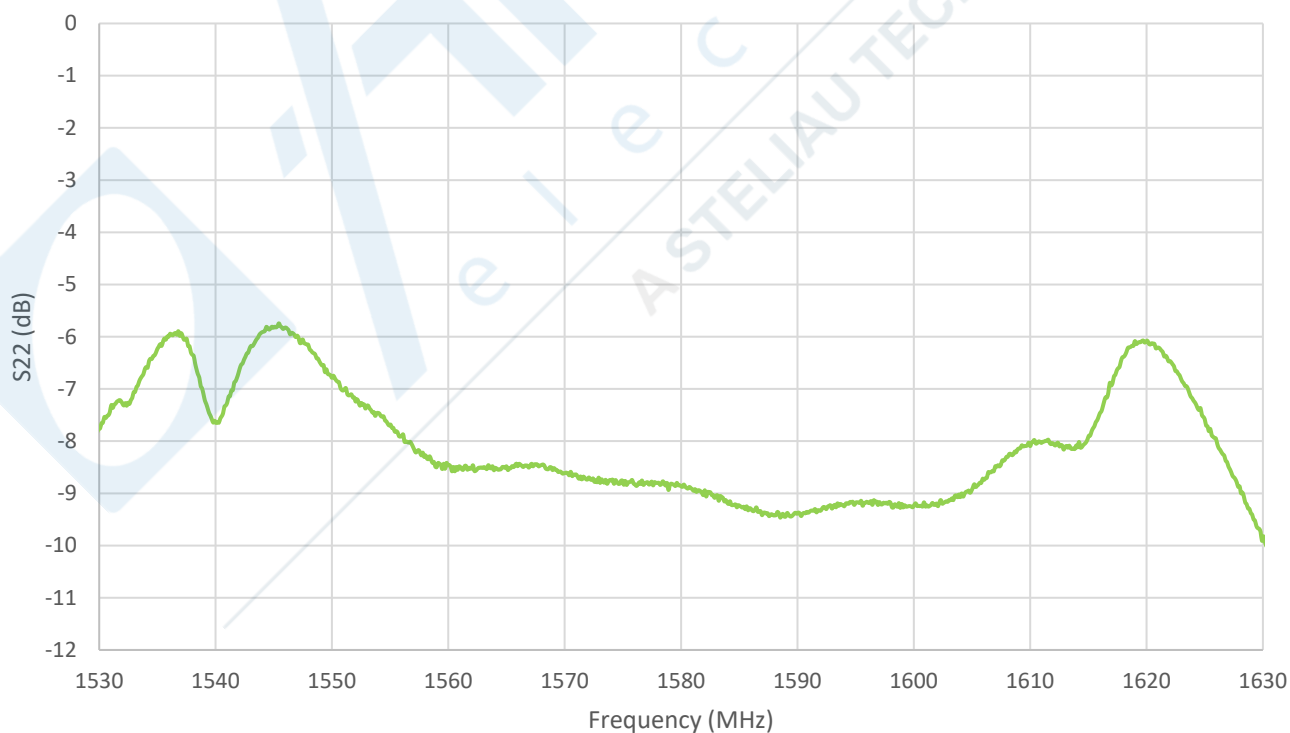


4. FEM High Band Characteristics

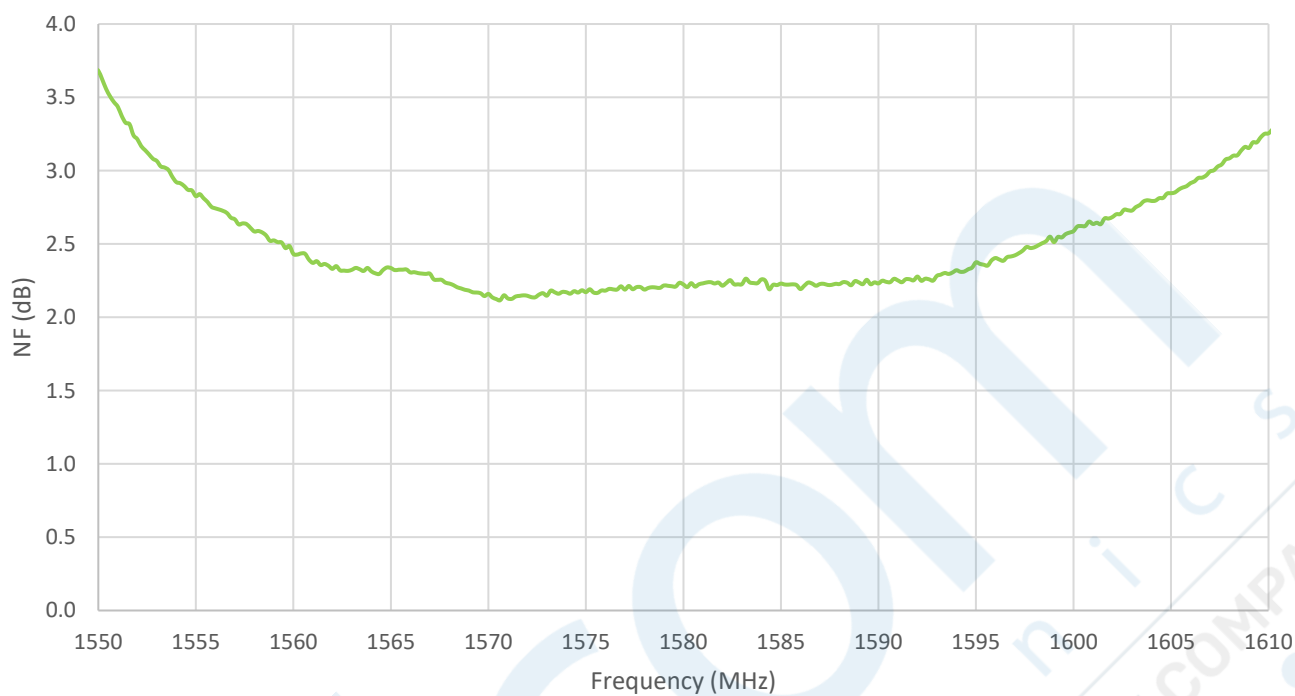
4.1 High Band Input Return Loss



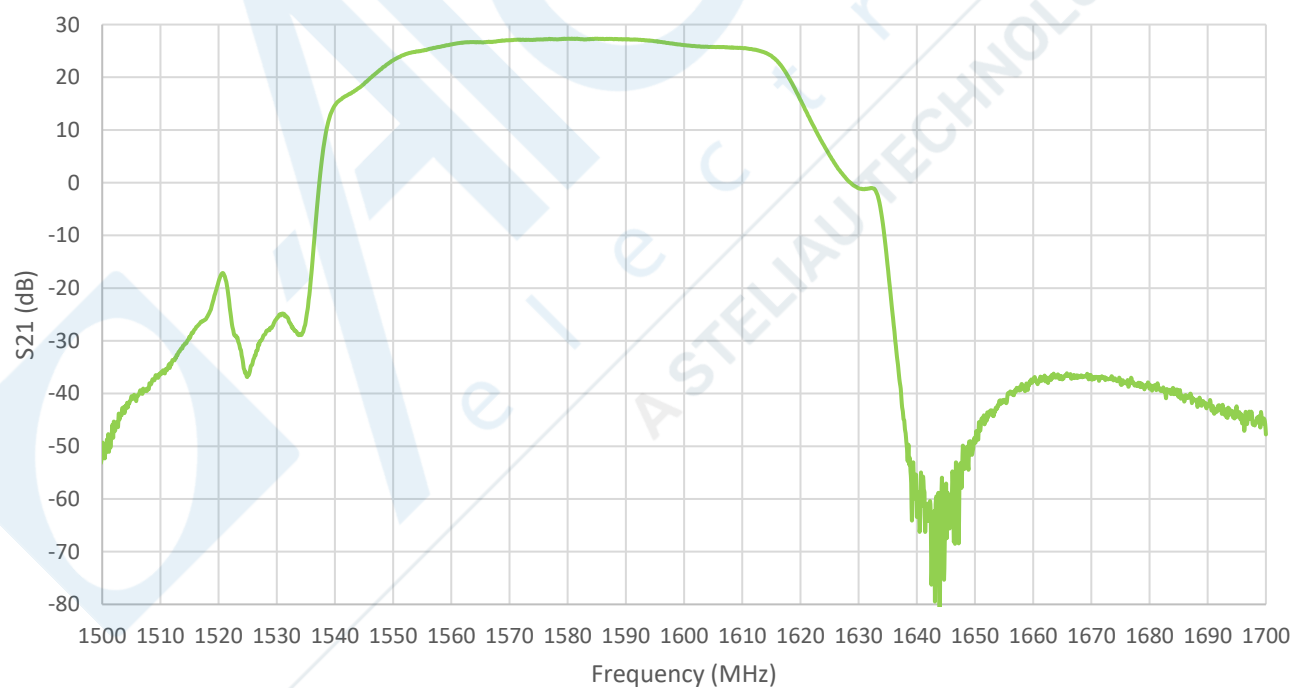
4.2 High Band Output Return Loss



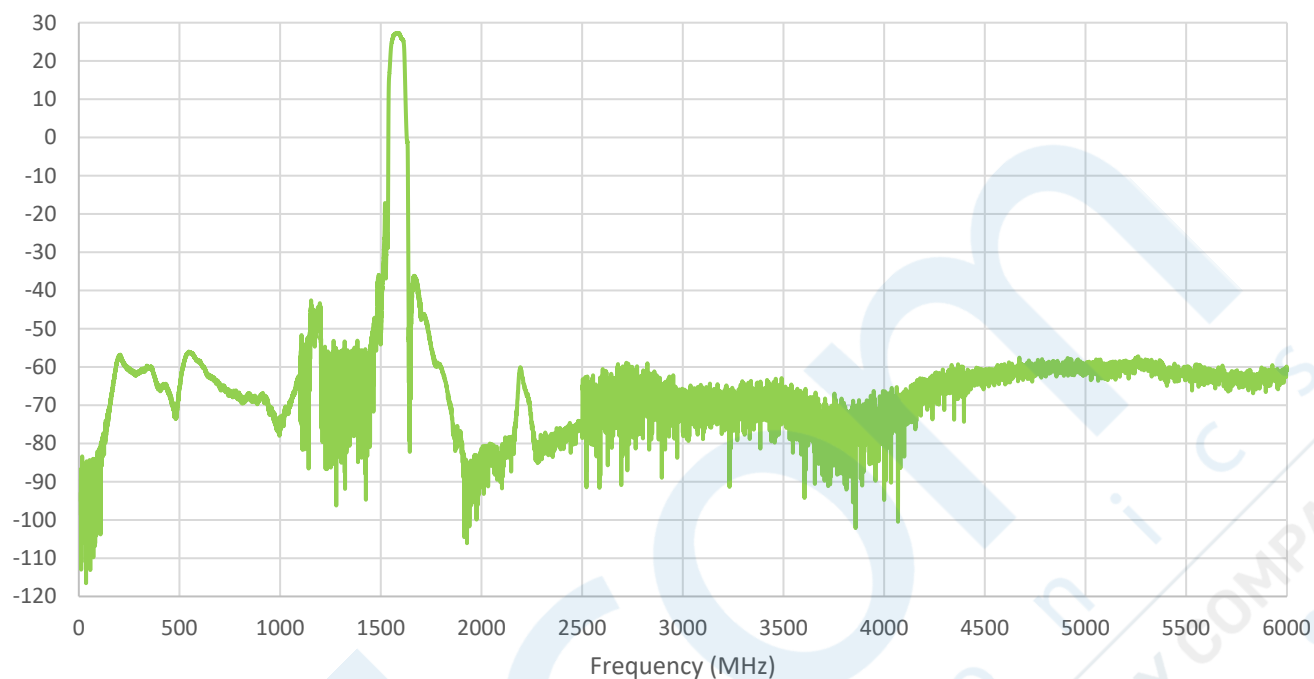
4.3 High Band Noise Figure



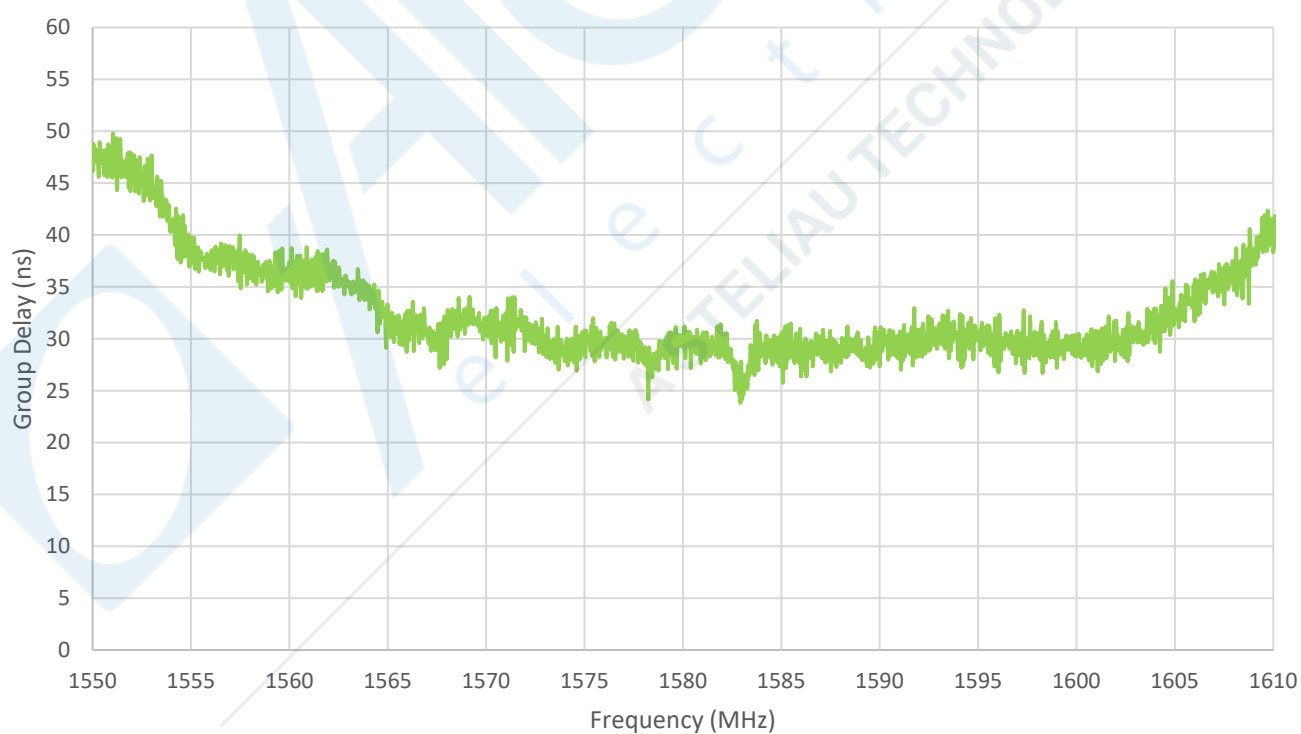
4.4 High Band Gain



4.5 High Band Gain and Attenuation



4.6 High Band Group Delay



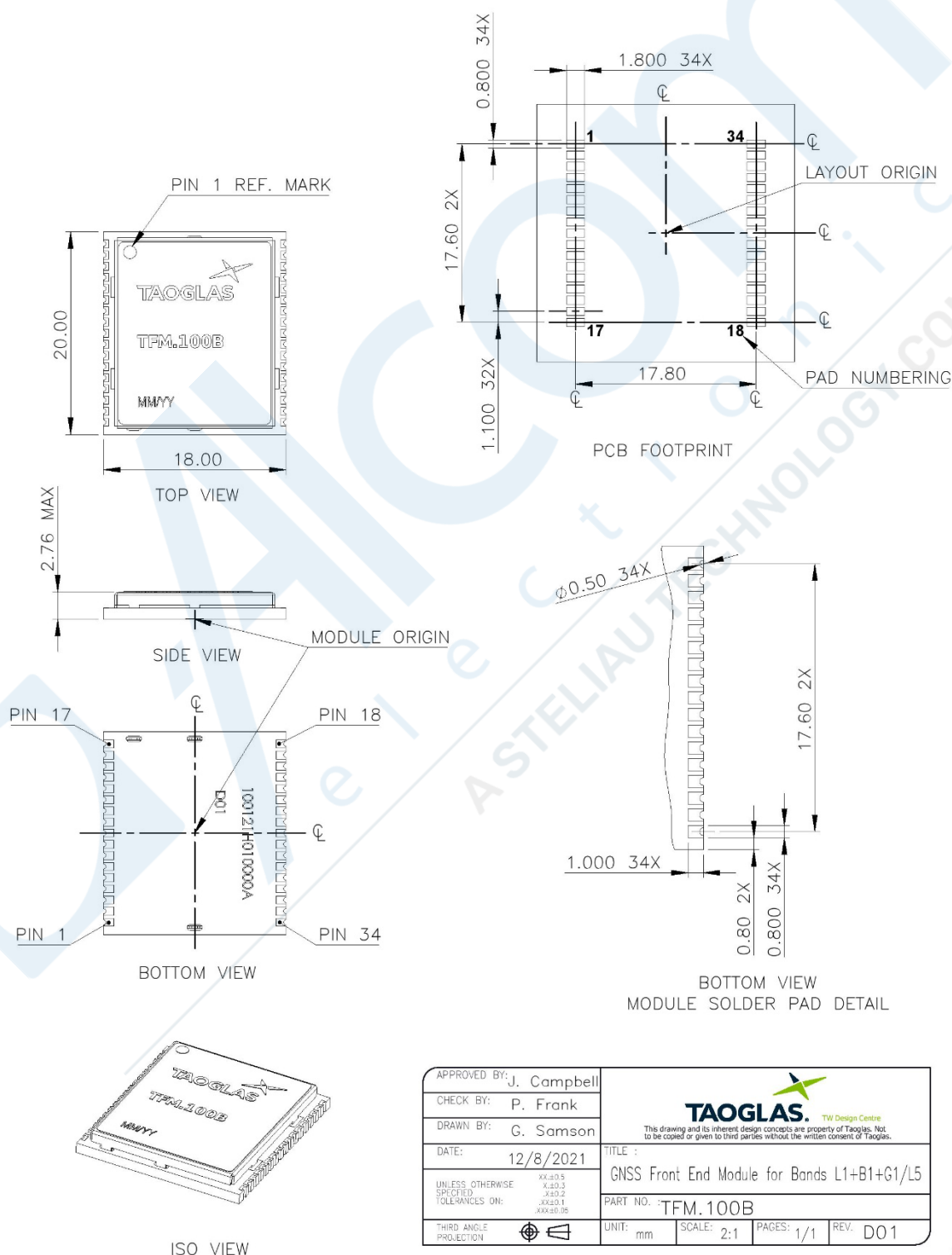
5. Mechanical Drawing

ISO NO.: EDW-21-8-1532

STATE: Released

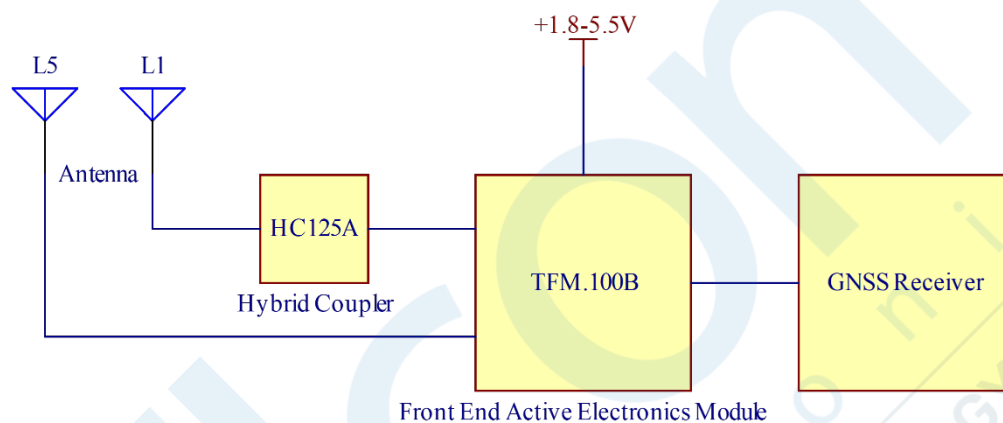
NOTES: 1. All material must be RoHS compliant.
2. Critical dimensions are indicated by an inspection symbol $\square$.

REV	ZONE	DESCRIPTION	ENG	APPROVED	DATE
D01	All	Initial Release	G. Samson	I. Mendez	12/8/2021



6. Module Integration

The following is an example on how to integrate the TFM.100B into a design. In this example, the [HP54510A](#) (L1/L5) is used as the antenna. This antenna has three pins, two pins are used for L1 band and the other pin is used for the L5 band. A Hybrid coupler ([HC125A](#)) is used to combine the feeds for the L1 band, to create a Right hand circular polarized (RHCP) signal, before being presented to the corresponding inputs on the TFM.100B. The TFM.100B is powered from a separate power DC supply (1.8V-5.5V). The output of the TFM.100B can then be fed to a relevant GNSS receiver module. Taoglas recommends using a minimum of 70x70mm ground plane (PCB) to ensure optimal performance.



Block Diagram of integration of the TFM.100B



Top and bottom view of PCB.

Please find the Integration files in Altium, 2D formats and the 3D model for the TFM.100B here:

<https://www.taoglas.com/product/smt-gnss-front-end-module-l1l5/>

6.1 Schematic Symbol and Pin Definitions



Hybrid Coupler
([HC125A](#)) on the PCB.

Above is a 3D model of the TFM.100B and [HC125A](#) on the PCB.

The circuit symbol for the TFM.100B is shown below. The front-end module has 34 pins as indicated below.

Pin	Description
1, 3-15, 17-18, 20-32, 34	Ground
2	L5 Input
16	Signal Output
19	Voltage Input
33	L1 Input

U1			
1	GND	GND	34
2	L5 IN	L1 IN	33
3	GND	GND	32
4	GND	GND	31
5	GND	GND	30
6	GND	GND	29
7	GND	GND	28
8	GND	GND	27
9	GND	GND	26
10	GND	GND	25
11	GND	GND	24
12	GND	GND	23
13	GND	GND	22
14	GND	GND	21
15	GND	GND	20
16	GND	GND	19
17	RF OUT	VIN	18
	GND	GND	

TAOGLAS_TFM.100B

Above is a schematic symbol of TFM.100B and a table of the pin definitions.

6.2 Schematic Layout

The [HP54510A](#) uses two orthogonal feeds that need to be combined in a hybrid coupler to ensure optimal axial ratio and RHCP Gain is achieved. Taoglas recommends our [HC125A](#), a high-performance hybrid coupler specifically engineered for use with our multi feed patches.

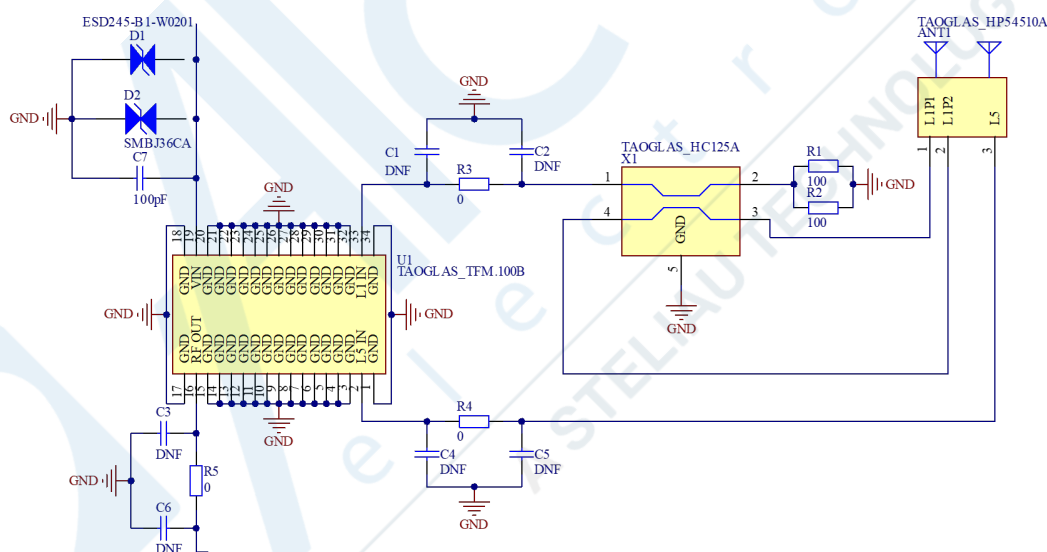
The [HC125A](#) is required for the high GNSS band of operation (1559- 1610MHz) for this antenna. This hybrid coupler should be placed close to the antenna pins and terminated correctly using two 100 Ohm resistor's in parallel.

The output of the hybrid coupler can be fed into the relevant input of the TFM.100B module.

Matching components with the TFM.100B are required for the module to have optimal performance in the spaces specified in the schematic below. Additional matching components may be necessary for your device, Taoglas recommends incorporating extra component footprints, forming a "pi" network, between the TFM.100B and the [HC125A](#). Matching components should also be placed between the RF output pin and the GNSS receiver module input pin.

Taoglas recommends placing an ESD diode and decoupling capacitor (100pF) on the input pin of the supply rail.

Note: The RF In & RF out of the TFM module are all DC-blocked internally. External DC block capacitors are not required.

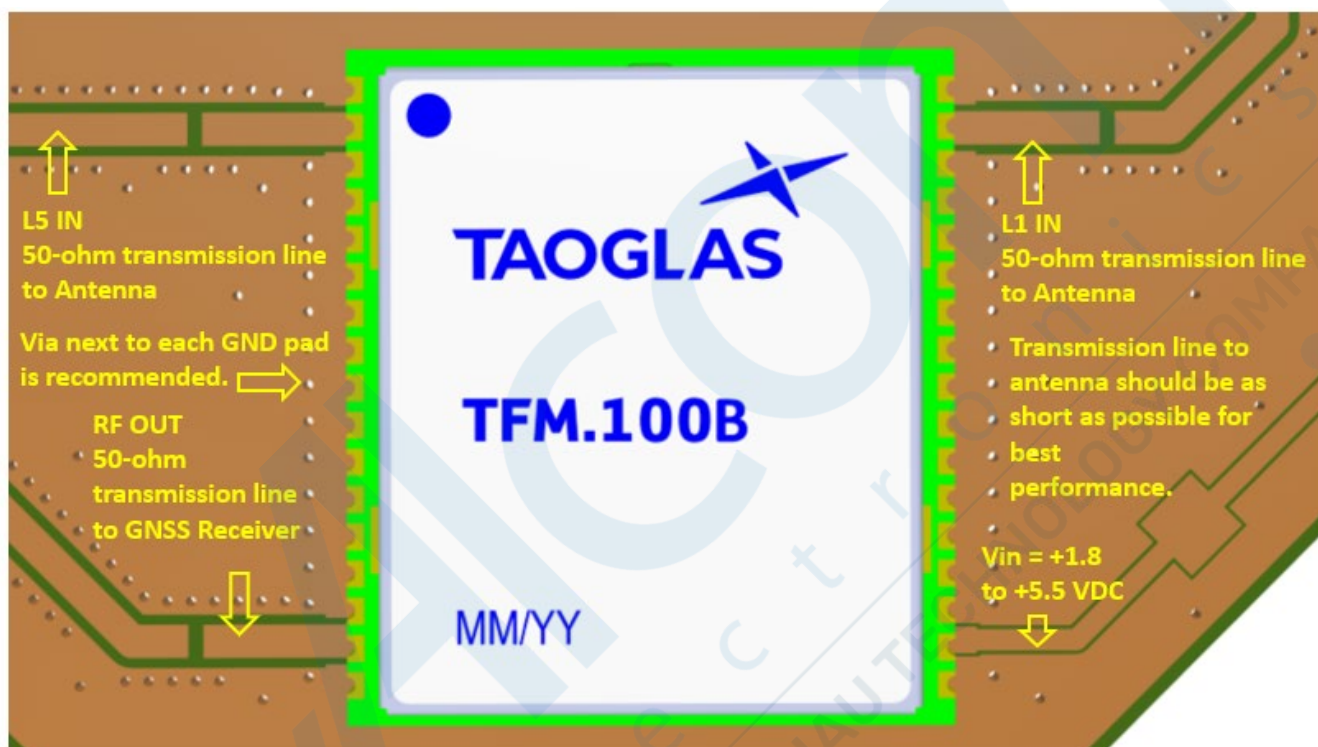


Schematic above shows how the TFM.100B and [HP54510A](#) are integrated.

Designator	Type	Value	Manufacturer	Manufacturer Part Number
C1, C2, C3, C4, C5, C6	Capacitor	Not Fitted	-	-
C7	Capacitor	100pF	Murata	GRM1555C1H101JA01D
D1	Diode	-	Infineon	ESD245B1W0201E6327XTSA1
D2	Diode	-	Littelfuse	SMBJ36CA
R1, R2	Resistor	100 Ohms	YAGEO	RC0402JR-07100RL
R3, R4, R5	Resistor	0 Ohms	YAGEO	RC0402JR-070RL

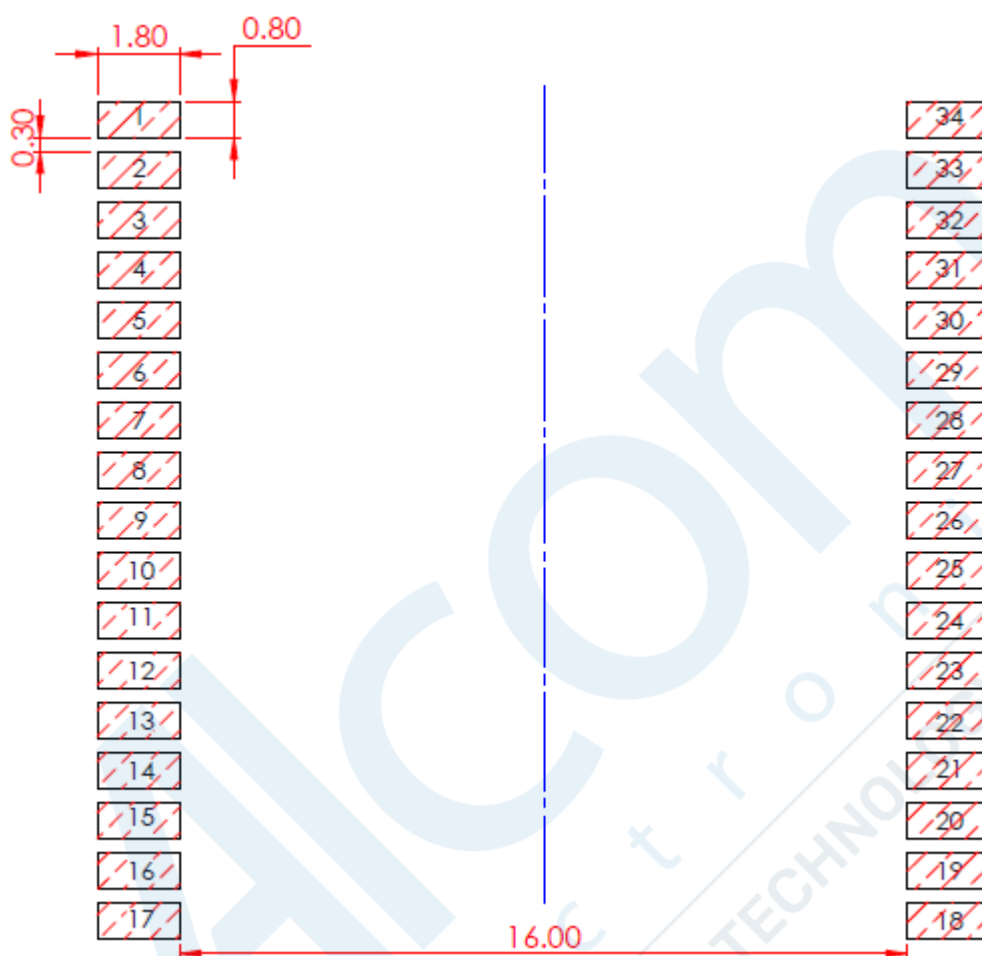
6.3 Module Integration

The TFM.100B should be placed as close to the signal input and output as possible to shorten the length of the transmission lines. The RF IN/OUT traces must maintain a 50 Ohm transmission line. A Pi Matching Network is recommended for the RF IN transmission lines, the values and components for the matching circuit will depend on the tuning needed. Ground vias should be placed beside each ground pad and the DC Voltage input should be between +1.8 and +5.5 VDC. It's recommended that the DC Voltage input should be coupled with a 100pF Capacitor and an ESD Diode.



TFM.100B module mounted on a PCB, showing transmission lines and integration notes.

6.4 Module Footprint

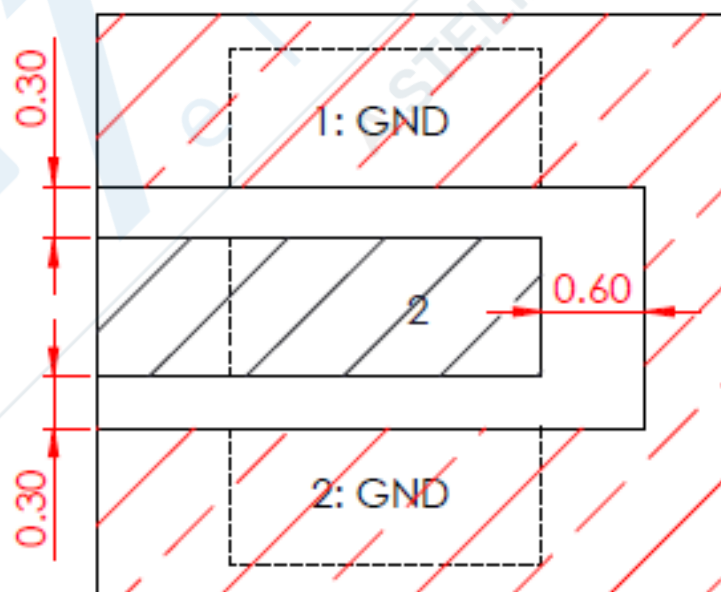


PIN	DESCRIPTION	PIN	DESCRIPTION
1	GND	18	GND
2	L5 IN	19	VIN
3	GND	20	GND
4	GND	21	GND
5	GND	22	GND
6	GND	23	GND
7	GND	24	GND
8	GND	25	GND
9	GND	26	GND
10	GND	27	GND
11	GND	28	GND
12	GND	29	GND
13	GND	30	GND
14	GND	31	GND
15	GND	32	GND
16	RF OUT	33	L1 IN
17	GND	34	GND

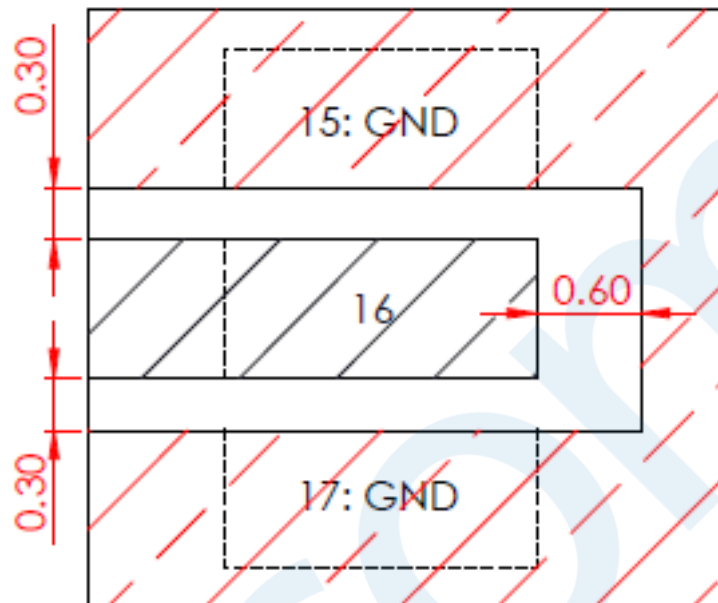
6.5 Copper Clearance for TFM.100B

The footprint and clearance on the PCB must comply with the front-end module's specification. The PCB layout shown in the diagrams below demonstrates the TFM.100B clearance area for Pin 16 (RF OUT Pad) and Pin 33 (L1 IN Pad). This clearance also applies to Pin 2 (L5 IN Pad). The copper keep out area only applies to the same layer that the TFM100.B has been placed on.

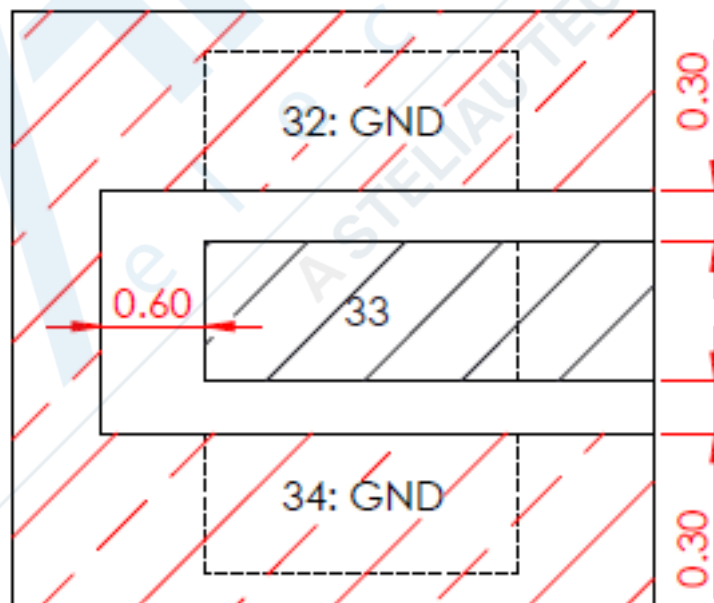
There should be 0.3mm copper clearance between the feed pad and ground pads with at least a 0.6mm copper clearance from the ground plane.



Copper Clearance for Pin 2 (L5 IN Pad) of the TFM.100B.



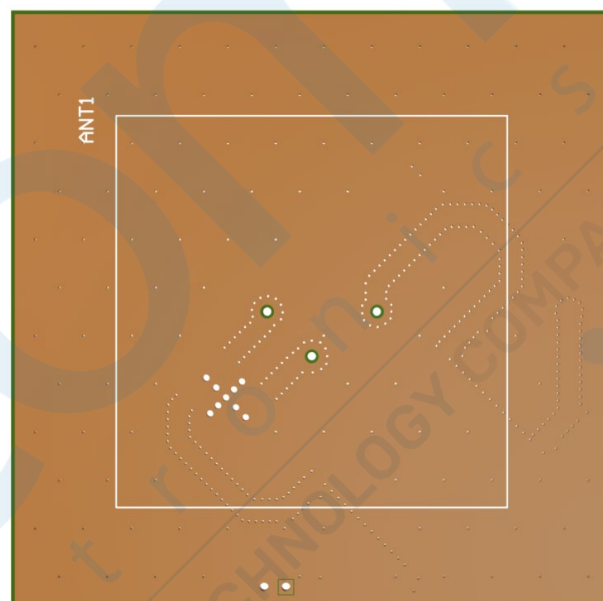
Copper Clearance for Pin 16 (RF OUT Pad) of the TFM.100B.



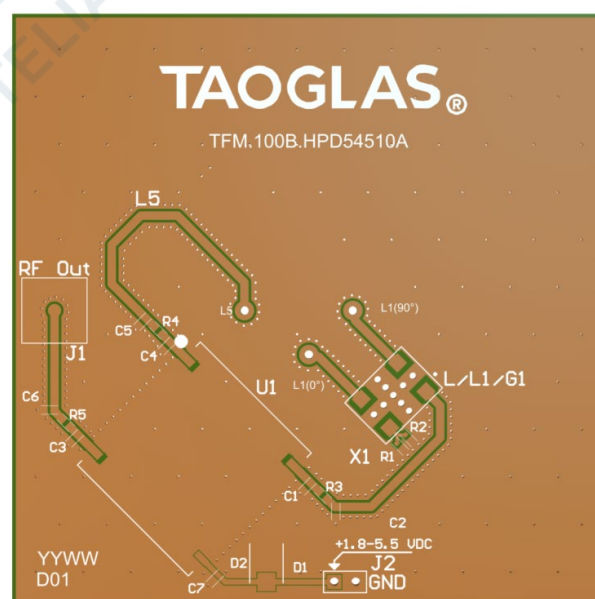
Copper Clearance for Pin 33 (L1 IN Pad) of the TFM.100B.

6.6 Final Integration

The bottom side image shown below highlights the antenna connection to the hybrid couplers ([HC125A's](#)). It highlights the outputs of the hybrid couplers connected to the relevant inputs of the TFM.100B module. It shows the 49.9 Ohm terminating resistor's necessary for the hybrid coupler's ([HC125A](#)). It also demonstrates the output of the TFM.100B module that needs to be connected to a GNSS receiver input. It displays the DC connection required with ESD diode and decoupling capacitor. Taoglas recommends using a minimum of 70x70mm ground plane (PCB) to ensure optimal performance.



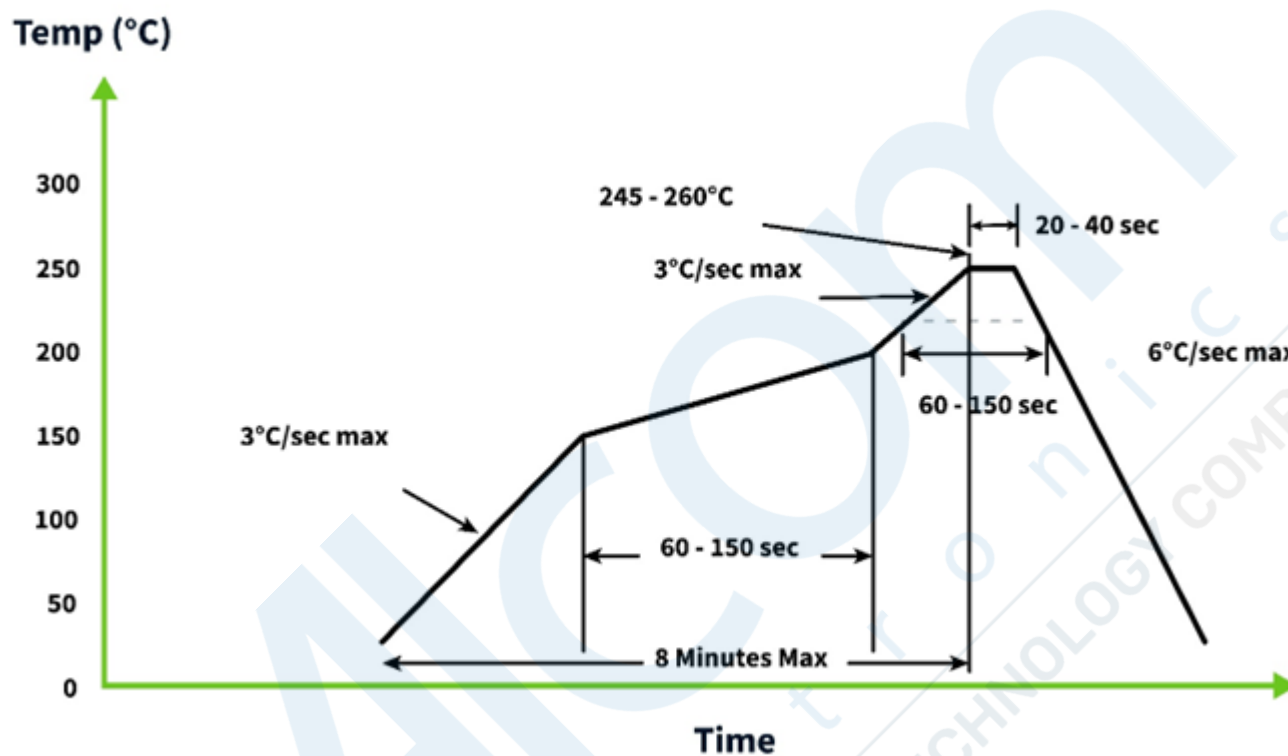
Top Side ([HP54510A](#) placement on 70x70mm PCB)



Bottom side (TFM.100B placement including [HC125A](#))

7. Solder Reflow Recommendations

The TFM.100B can be assembled by following the recommended soldering temperatures are as follows:



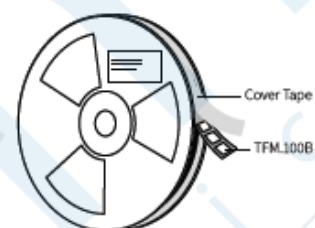
Smaller components are typically mounted on the first pass, however, we do advise mounting the TFM.100B when placing larger components on the board during subsequent reflows.

8. Packaging

600 PCS / Reel
SPQ Label



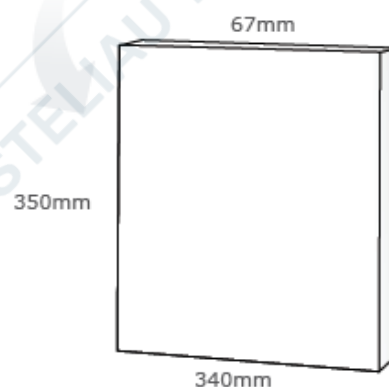
600 PCS / Vacuum bag
2 PCS / 3g Desiccant
1 PCS / Humidity test paper
SPQ Label



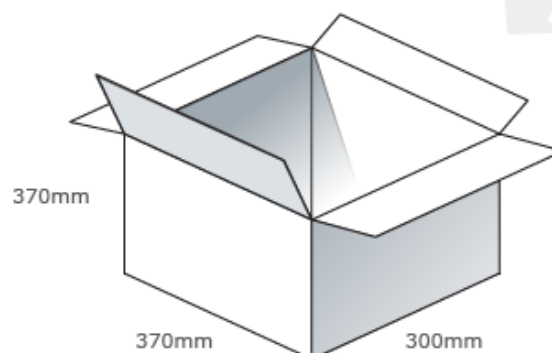
Caution Label
Product Label
SPQ Label



1 PCS / Box
Box(mm): 350x340x67
Weight (Kg): 2
SPQ Label



2400 PCS / Carton
Carton(mm): 370x370x300
Weight (Kg): 8.8
Carton Label



Changelog for the datasheet

SPE-23-8-125 – TFM.100B

Revision: D (Current Version)

Date:	2024-05-28
Notes:	Added moisture sensitivity level information to datasheet
Author:	Conor McGrath

Previous Revisions

Revision: C

Date:	2023-12-01
Notes:	Updated Module Integration Guide & ME Drawings
Author:	Gary West

Revision: B

Date:	2023-09-04
Notes:	Updated solder reflow recommendations and electrical specification table
Author:	Cesar Sousa

Revision: A (Original First Release)

Date:	2023-05-08
Notes:	Initial Release
Author:	Gary West



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