TAOGLAS

Datasheet

GNSS Front End Module covering L1+B1+G1 / L2 and L-band

Part No:

TFM.112A

Description

Surface mount GNSS front-end module covering L1+B1+G1/L2+L-band

Features:

Two Stage LNA and SAW Filter Design

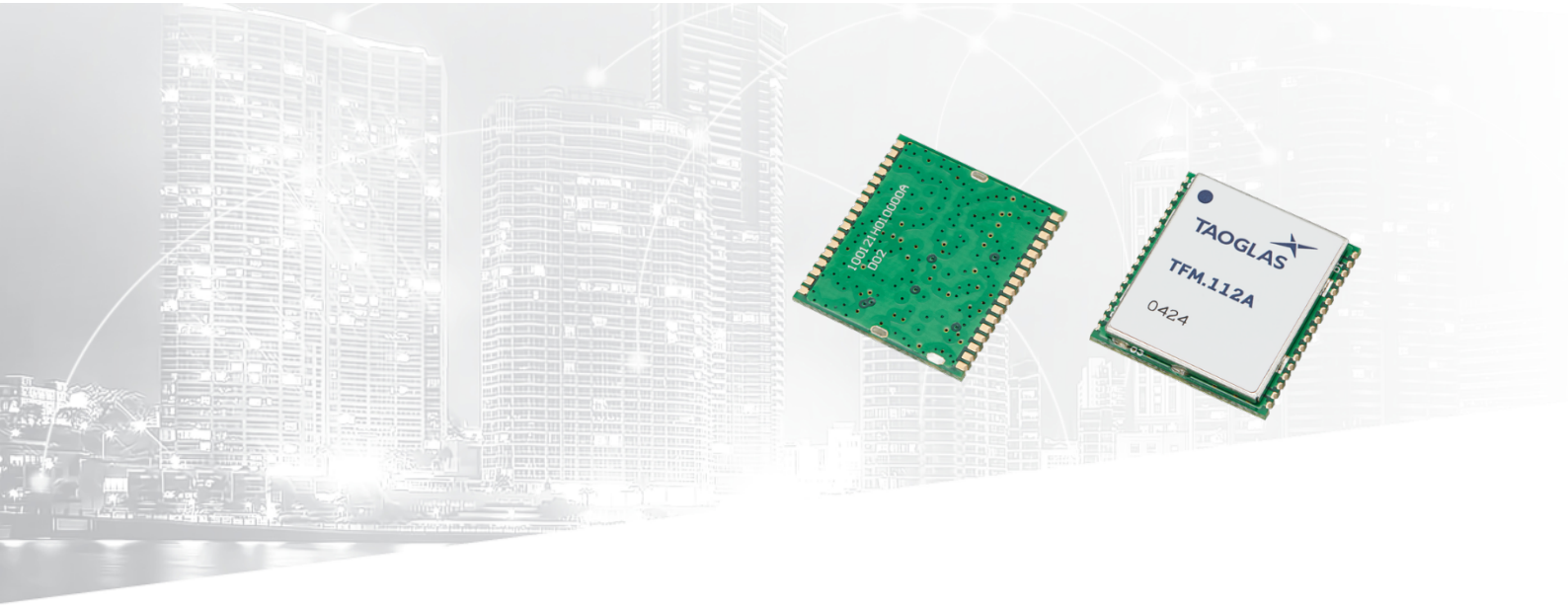
Vin = +1.8 to +5.5 VDC

Compact, easy to integrate surface-mount solution

Dimensions: 20 x 18 x 2.76mm

RoHS & Reach Compliant

1. Introduction



The Taoglas TFM.112A is a surface-mount GNSS front-end which covers L1+B1+G1 / L2 and L-band for multi-band high-precision applications that require the full spectrum of GNSS constellations. The TFM.112A is a dual input single output 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.

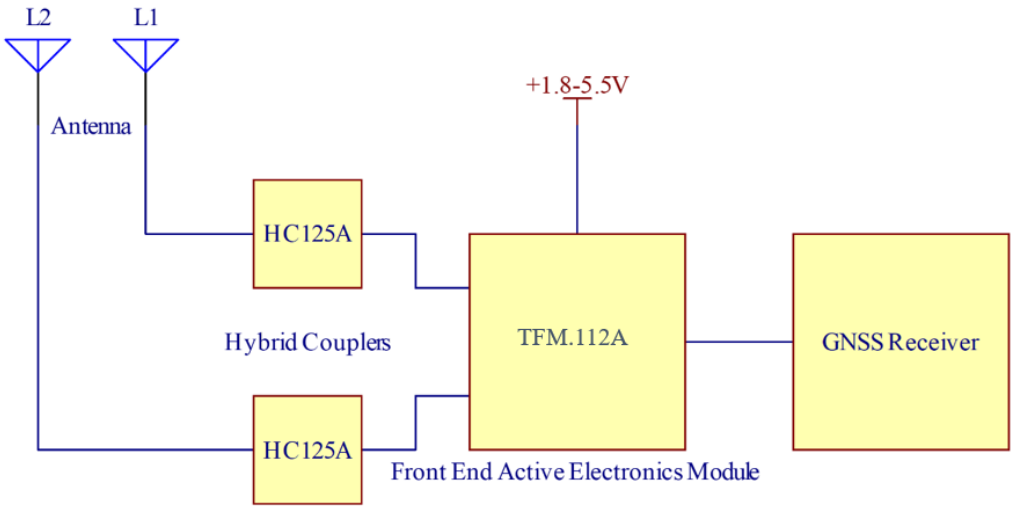
Many currently available dual-band GNSS receivers require additional RF circuits between the antenna and the receiver to properly set the overall system noise figure. This requires additional development time for an otherwise simple module integration. Many organizations don't have the RF expertise to effectively design such a solution. The TFM.112A captures the required additional RF circuits in modular form, allowing the designer to simply place the TFM.112A between their GNSS antenna and GNSS receiver.

The TFM.112A offers > 25 dB gain across all applicable bands while maintaining a high Input P1dB of-25 dBm or better. Noise Figure is < 3.5 dB in the low bands and < 4.0 dB in the high bands. A wide input voltage of +1.8 to +5.5 VDC allows for easy integration in most GNSS systems.

TFM.112AA 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.112A.

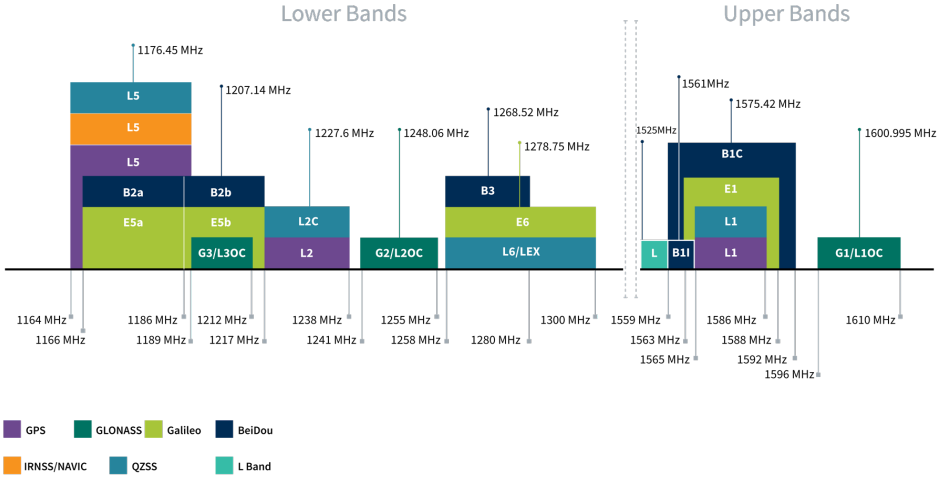
We used the HP24510A to demonstrate the integration of this module but please note that we have other compatible antennas that can also be used alongside the TFM.112A please see table below.

Compatible Antennas
HP24510A (Hybrid Coupler Required)
GPDF357.A (No Hybrid Coupler Required)
GPDF357.B (No Hybrid Coupler Required)

Taoglas also offers the TFM.115A for L1/L5+L-Band applications. View the full series of TFM modules here.

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

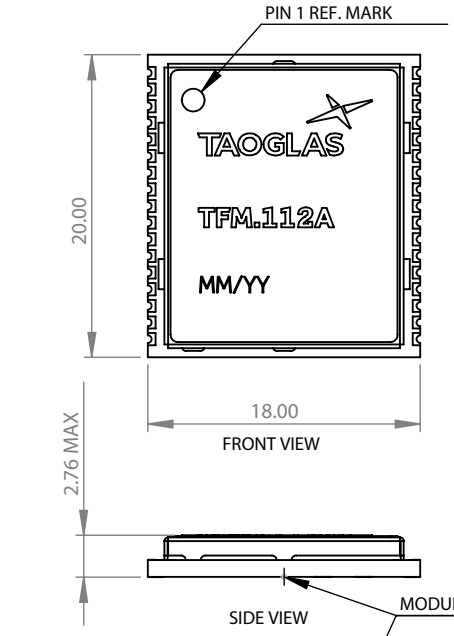
Electrical						
Frequency (MHz)	**1227**	**1248**	**1542**	**1561**	**1575.42**	**1602**
Noise Figure (dB)*	3.5	3.4	2.5	2.6	2.3	2.5
Gain (dB)	29.1	26.8	27.3	28.3	28.1	26.4
Group Delay (ns)	29.6	33.9	16.3	16.4	15.9	19.9
Input Return Loss (dB)	-18.7	-11.0	-14.4	-19.6	-10.9	-15.9
Output Return Loss	-7.9	-7.8	-6.2	-7.3	-5.9	-6.1
Vin	+1.8 to +5.5 VDC					
Typical Current (@1.8V)	7.5 – 9.0mA					

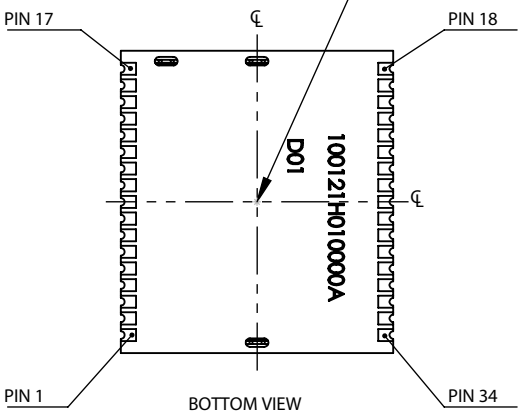
***Note: Tested on an evaluation board. Board losses removed.**

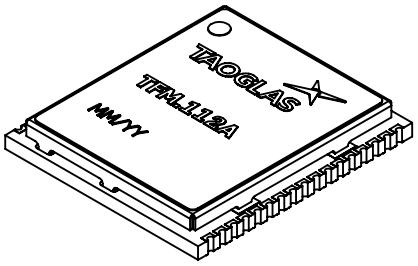
Mechanical	
Height	2.76 mm max.
Planar Dimension	20 x 18 mm
Weight	2g

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

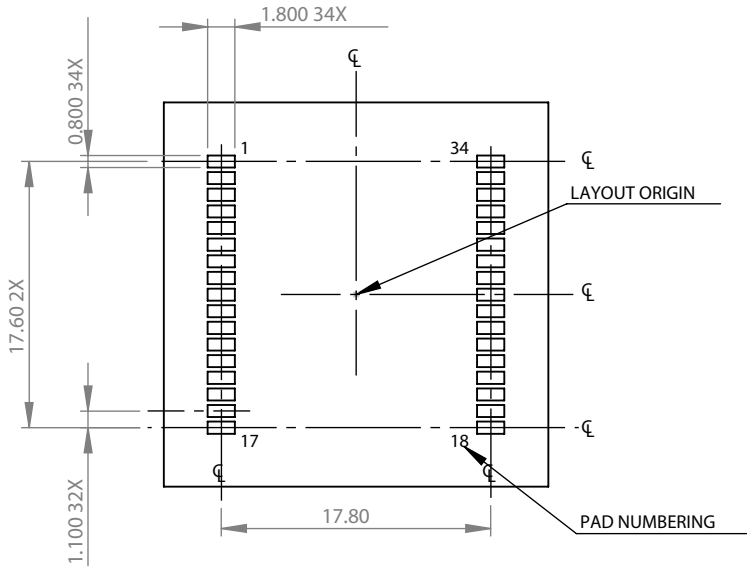
3. Mechanical Drawing



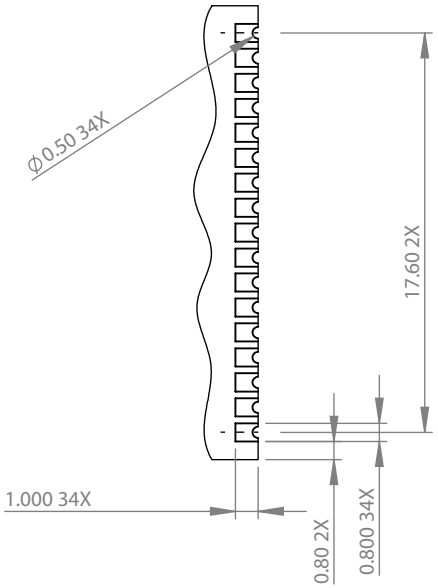




ISO VIEW



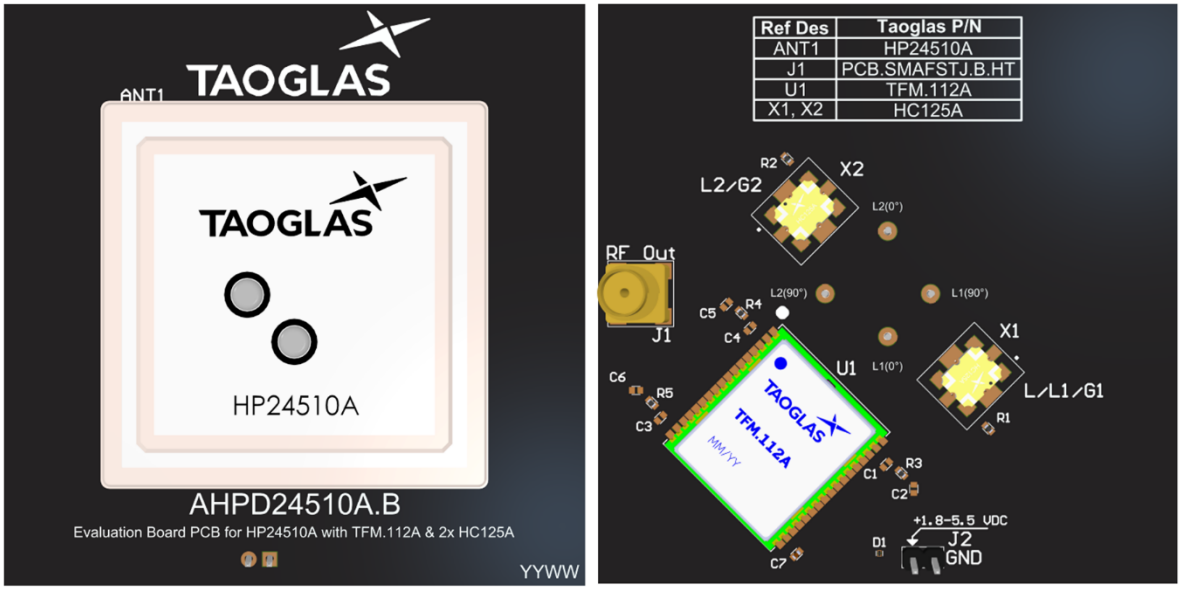
PCB FOOTPRINT



BOTTOM VIEW
MODULE SOLDER PAD DETAIL
SCALE 3 : 1

4. Module Integration

The following is an example on how to integrate the TFM.112A into a design. In this example, the HP24510A (L1/L2) is used as the antenna. This antenna has four pins, two pins are used for the L1 band, and two pins are used for the L2 band. Hybrid couplers (HC125A) are used to combine the feeds for each of the bands, to create a Right hand circular polarized (RHCP) signal, before being presented to the corresponding inputs on the TFM.112A. The TFM.112A is powered from a separate power DC supply (1.8V-5.5V). The output of the TFM.112A can then be fed to a relevant GNSS receiver module. Taoglas recommends using a minimum of 70x70mm ground plane (PCB) to ensure optimal performance.

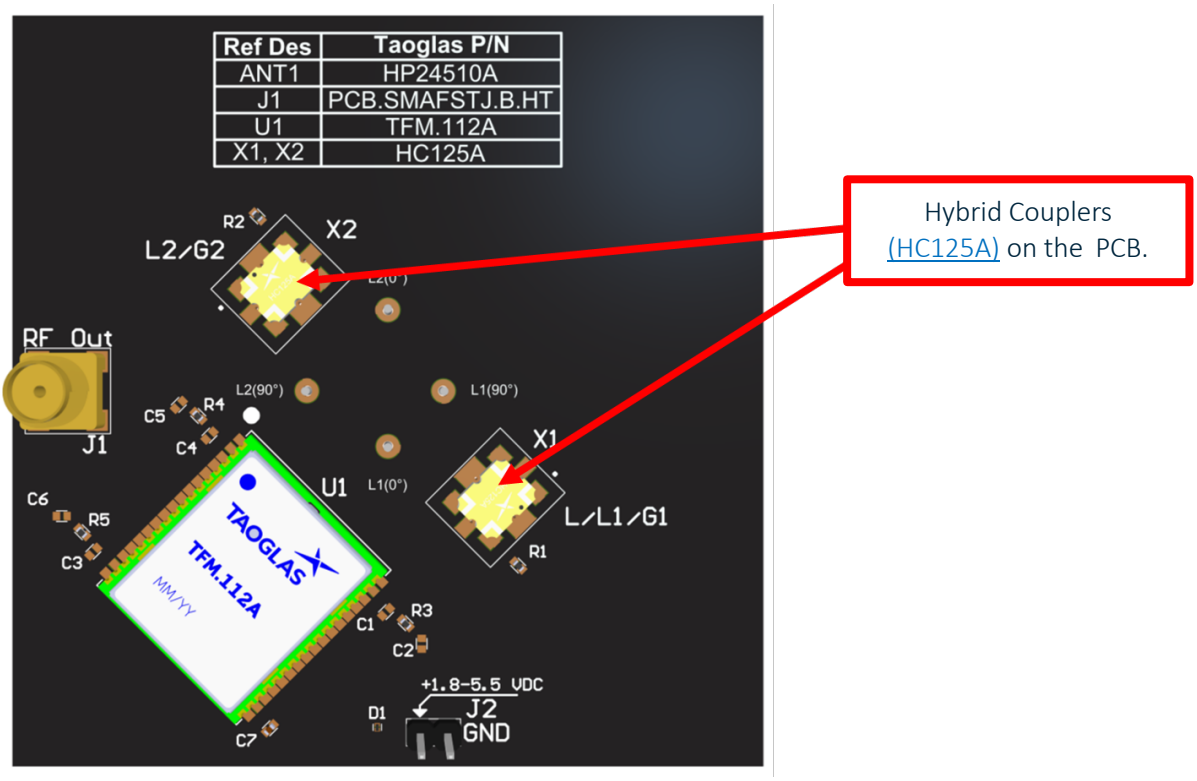


Top and bottom view of PCB.

Please find the Integration files in Altium, 2D formats and the 3D model for the TFM.112A on the product page here:

https://www.taoglas.com/product/tfm-112a-gnss-front-end-module-covering-l1b1g1-l2l-band/

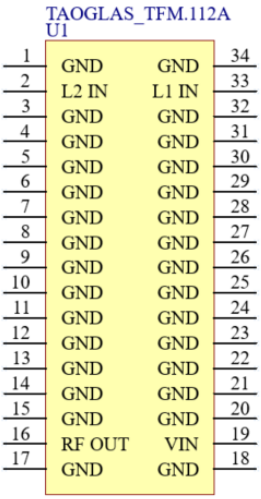
4.1 Schematic Symbol and Pin Definitions



Above are the 3D models of the TFM.112A and HC125A on the PCB.

The circuit symbol for the TFM.112A is shown below. The module has 34 pins as indicated below.

Pin	Description
1, 3-15, 17-18, 20-32, 34	Ground
2	L2 Input
16	RF Signal Output
19	Voltage Input
33	L1 Input



Above is a schematic symbol of TFM.112A and a table of the pin definitions.

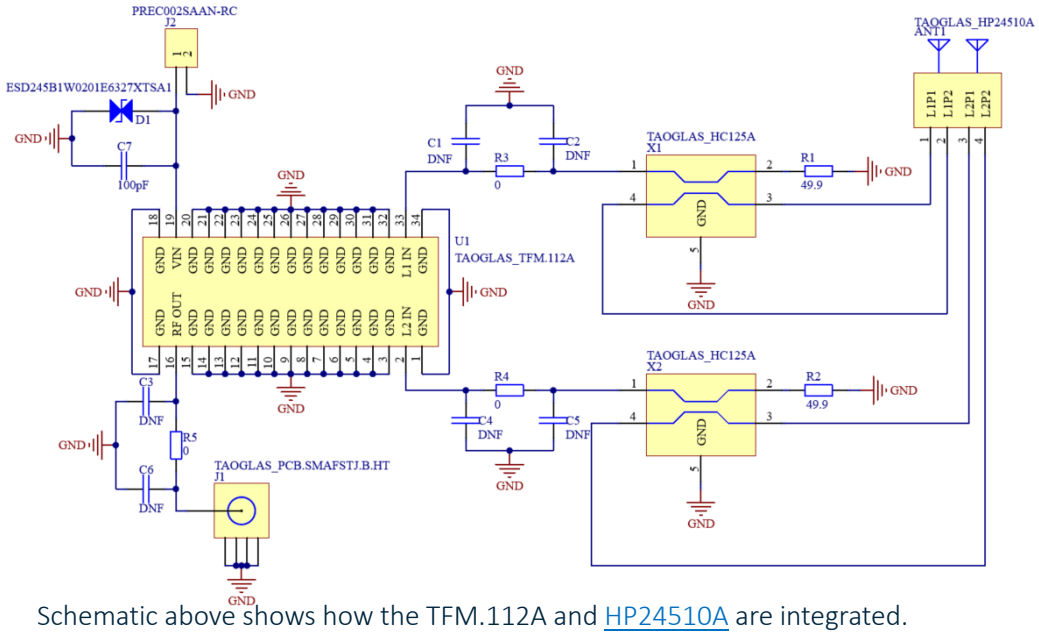
4.2 Schematic Layout

The HP24510A 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.

Two HC125A's are required for this GNSS antenna, one for the high band (1559- 1610MHz) and another for the low band (1189MHz – 1254MHz). These hybrid couplers should be placed close to the antenna pins and terminated correctly using a 49.9 Ohm resistor. In addition, the RF Feeds from the antenna pins for each band to the hybrid couplers must be equal in length. (Please refer to our integration files)

The output of each of the hybrid couplers can be fed into the relevant inputs of the TFM.112A module. Matching components with the TFM.112A 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.112A and the HC125A's. Matching components should also be placed between the RF output pin and the GNSS receiver module input pin.

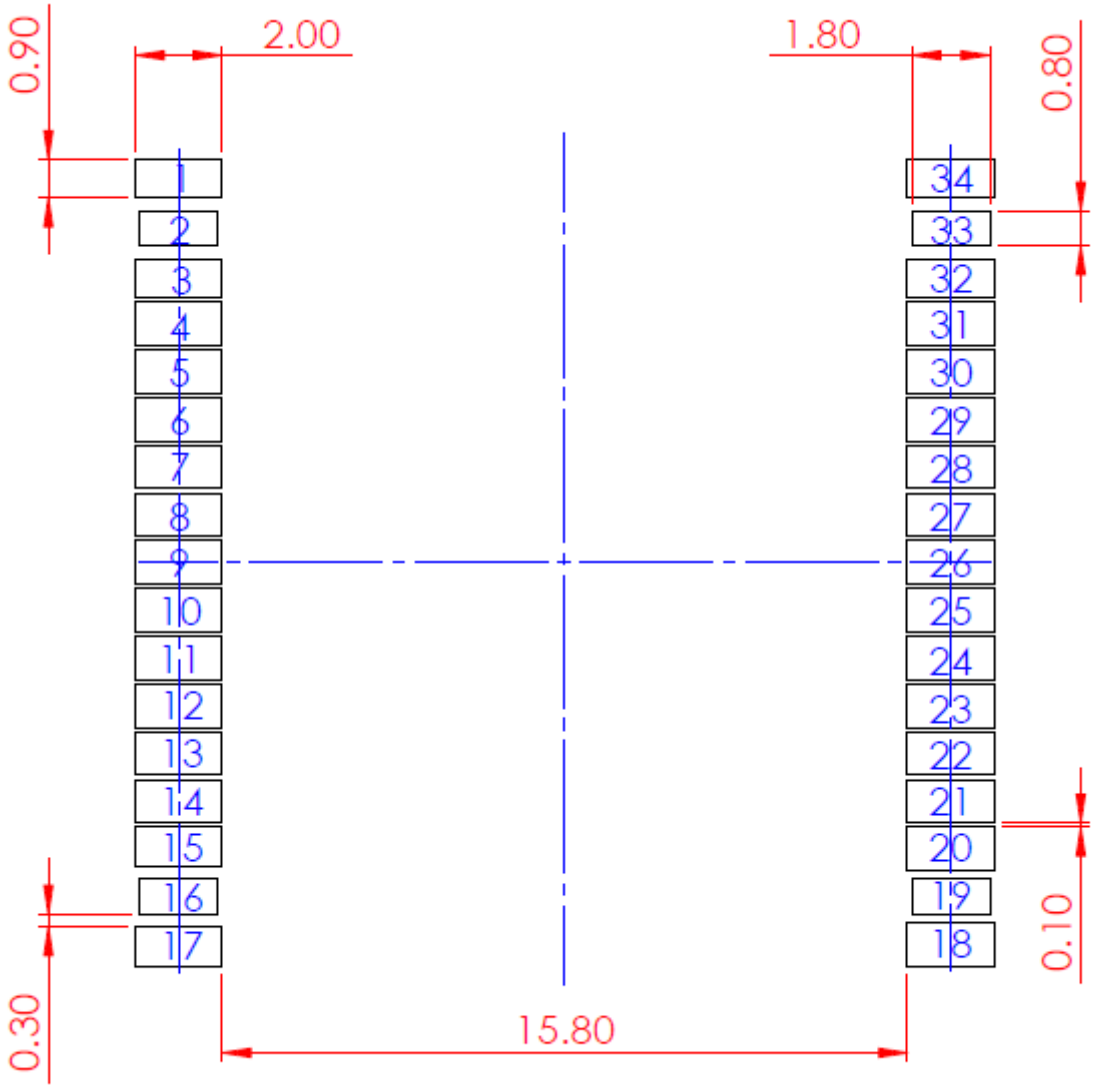
Taoglas recommends placing an ESD diode and decoupling capacitor (100pF) on the input pin of the supply rail.
Note: The RF In & RF out of the TFM module are all DC-blocked internally. External DC block capacitors are not required.



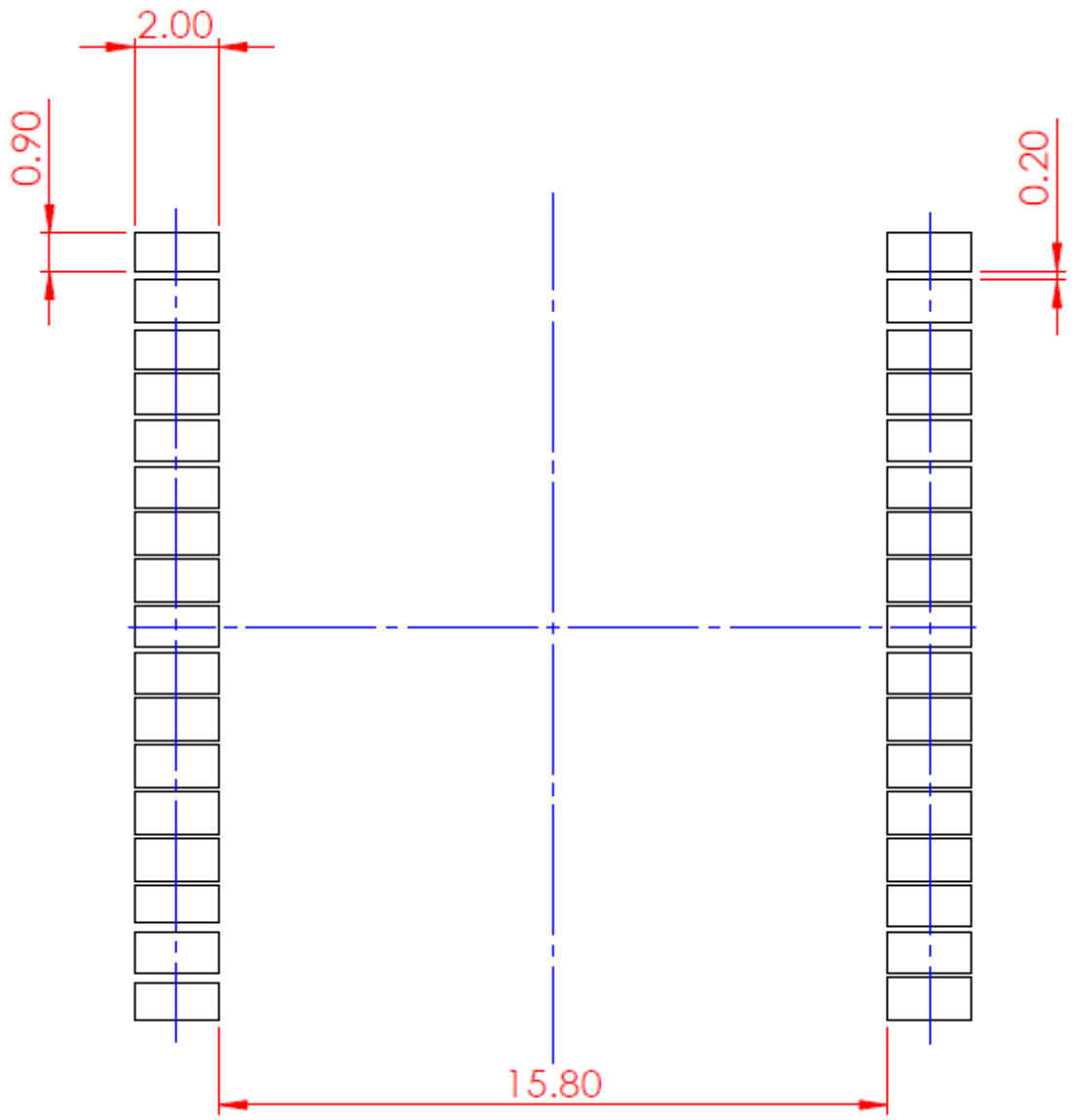
Schematic above shows how the TFM.112A and HP24510A are integrated.

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
R1, R2	Resistor	49.9 Ohms	Panasonic	ERJ-2RKF49R9X
R3, R4, R5	Resistor	0 Ohms	YAGEO	RC0402JR-070RL

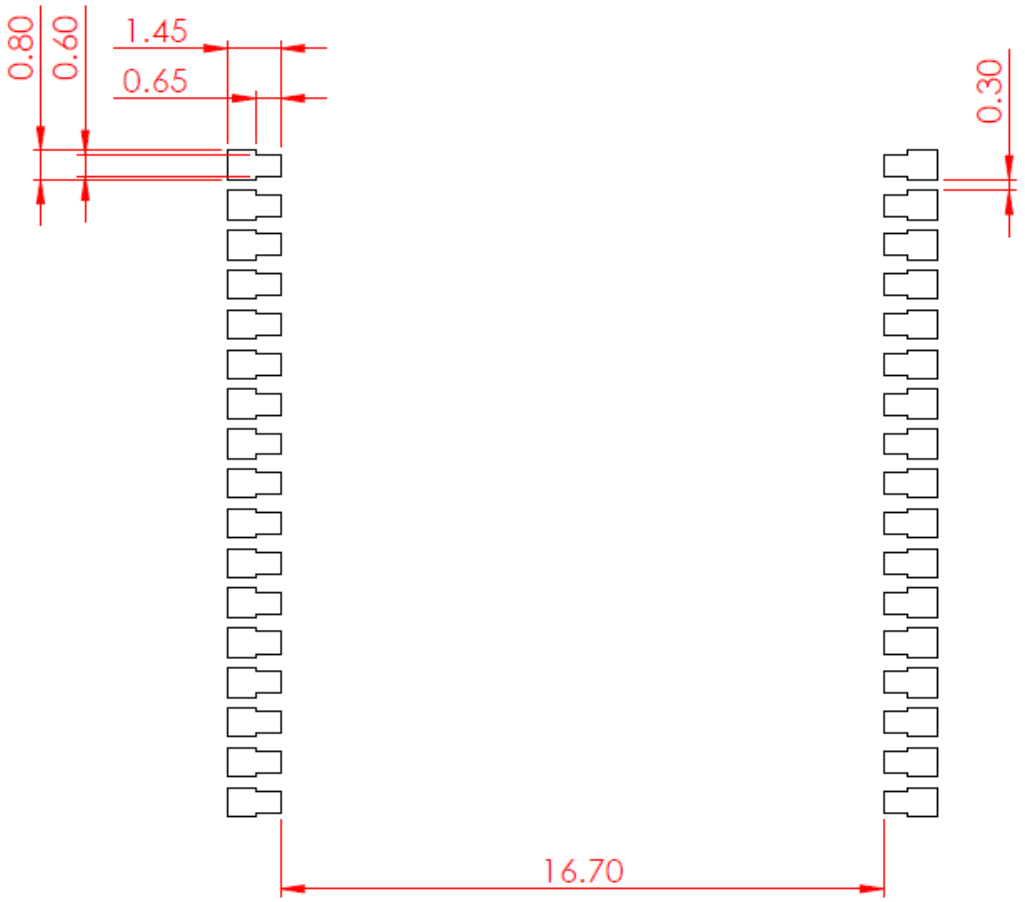
4.3 Module Footprint



4.4 Solder Mask



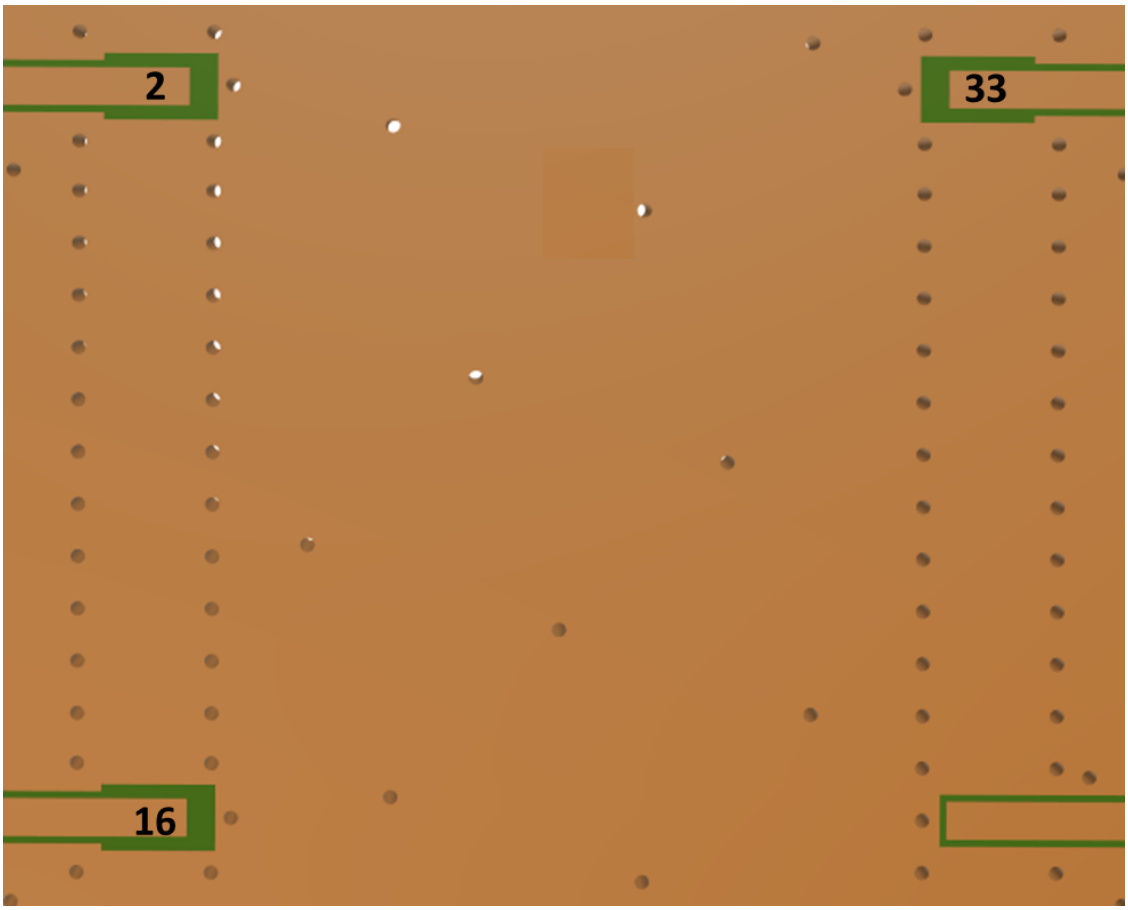
4.5 Solder Paste



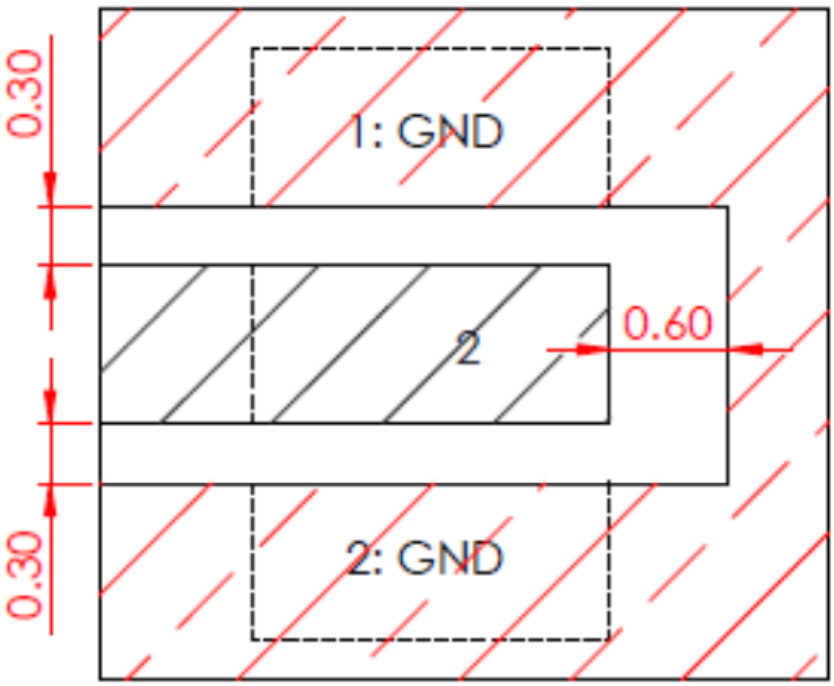
4.6 Copper Clearance

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.112A clearance area for Pin 16 (RF OUT Pad) and Pin 33 (L1 IN Pad). This clearance also applies to Pin 2 (L2 IN Pad). The copper keep out area only applies to the same layer that the TFM.112A has been placed on.

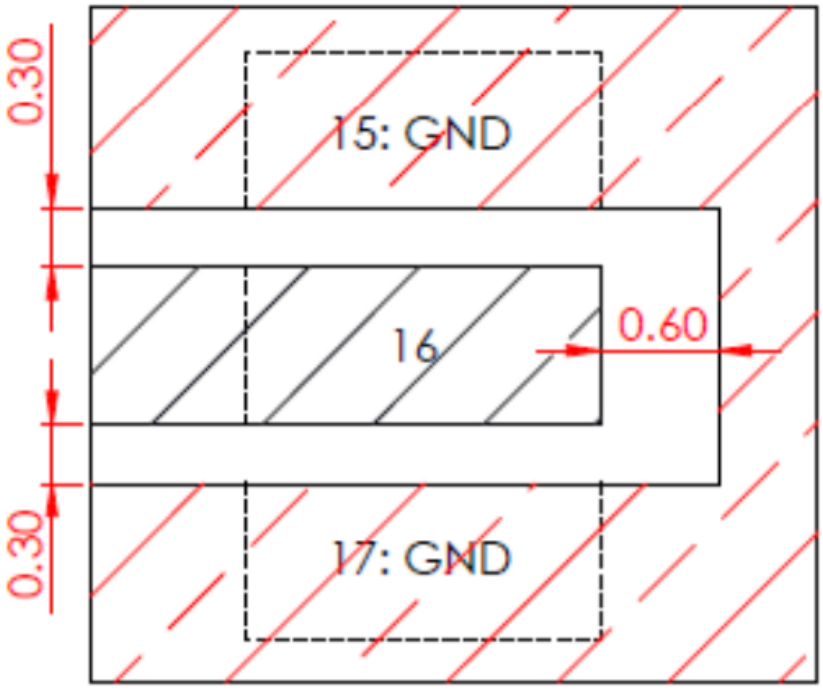
There should be 0.3mm copper clearance between the feed pad and ground pads with at least a 0.6mm copper clearance from the ground plane.



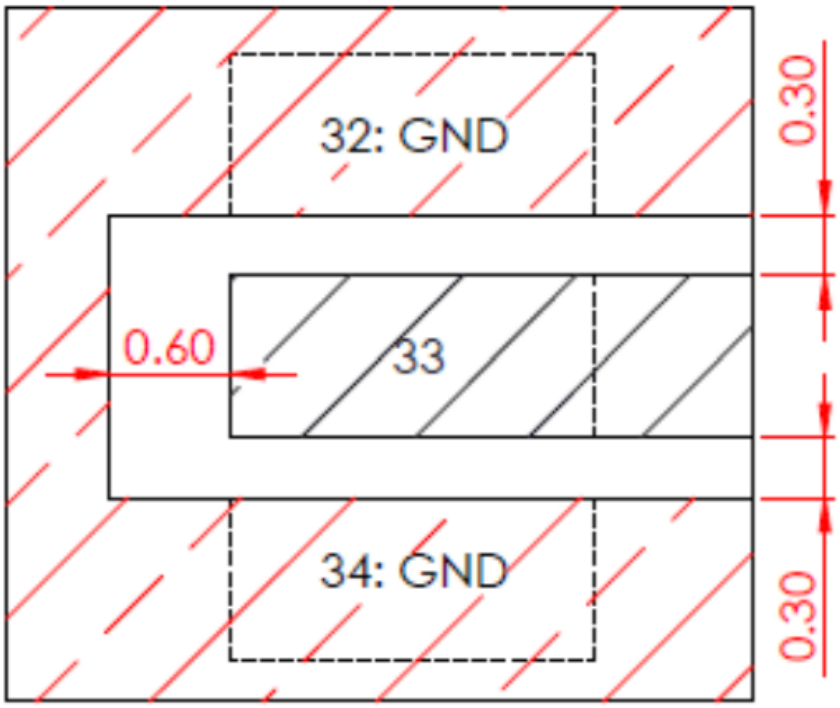
3D Image of Copper Clearances for TFM.112A.



Copper Clearance for Pin 2 (L2 IN Pad) of the TFM.112A.



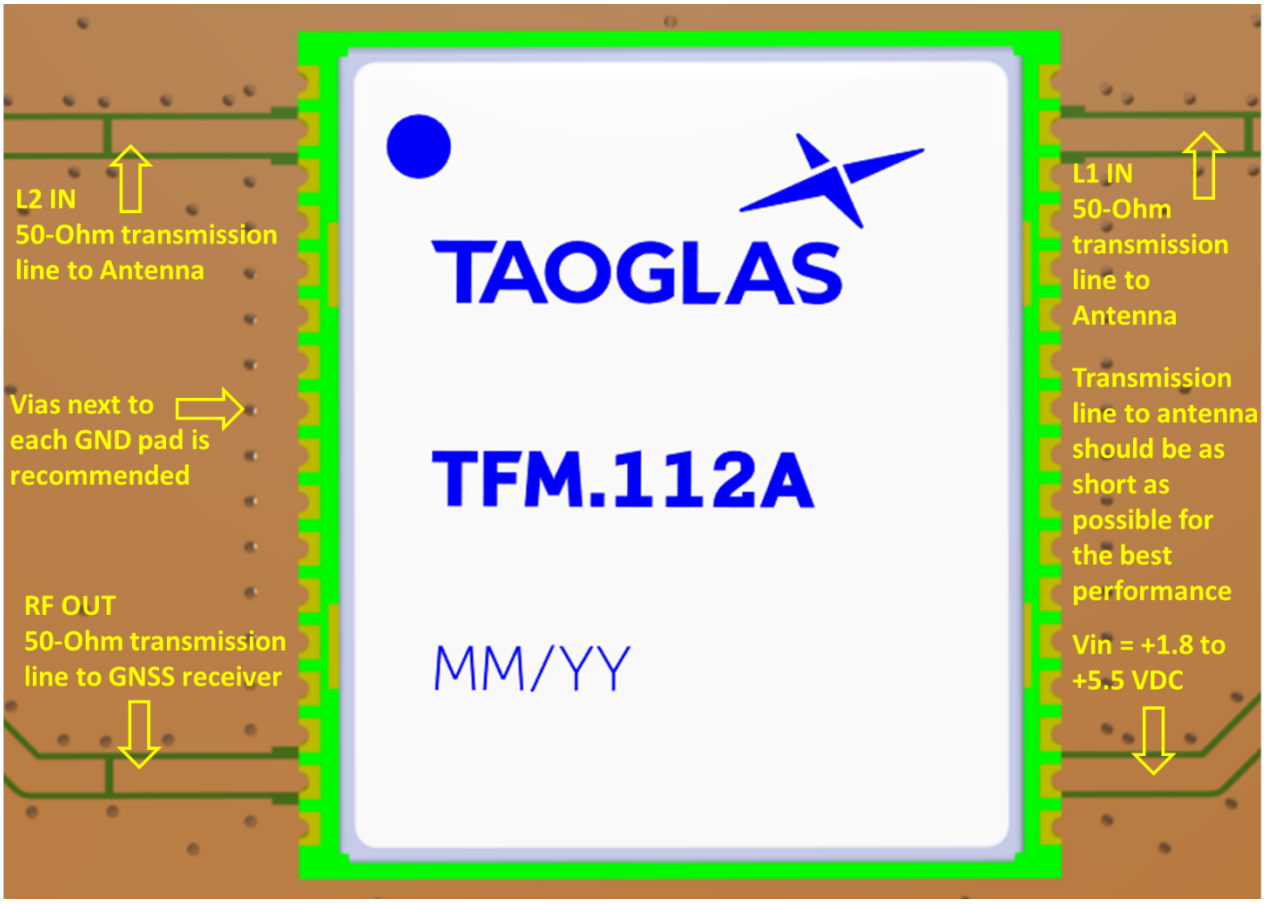
Copper Clearance for Pin 16 (RF OUT Pad) of the TFM.112A.



Copper Clearance for Pin 33 (L1 IN Pad) of the TFM.112A.

4.7 Module Integration

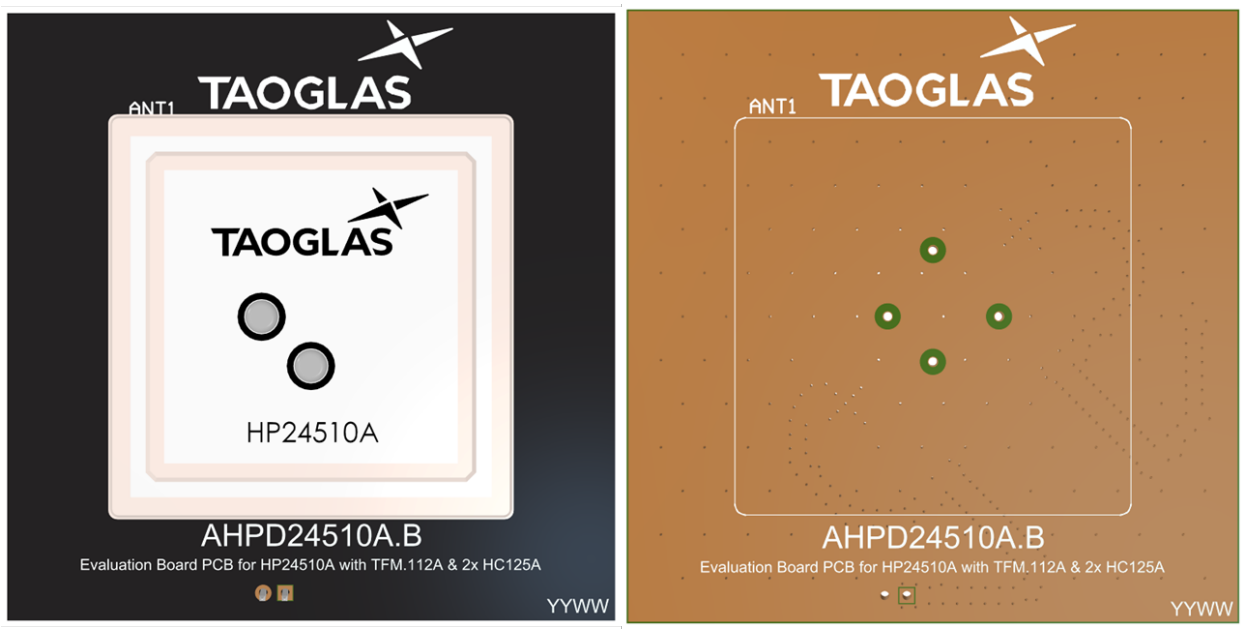
The TFM.112A should be placed as close to the signal input and output as possible to shorten the length of the transmission lines. The RF IN/OUT traces must maintain a 50 Ohm transmission line. A Pi Matching Network is recommended for the RF IN transmission lines, the values and components for the matching 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.



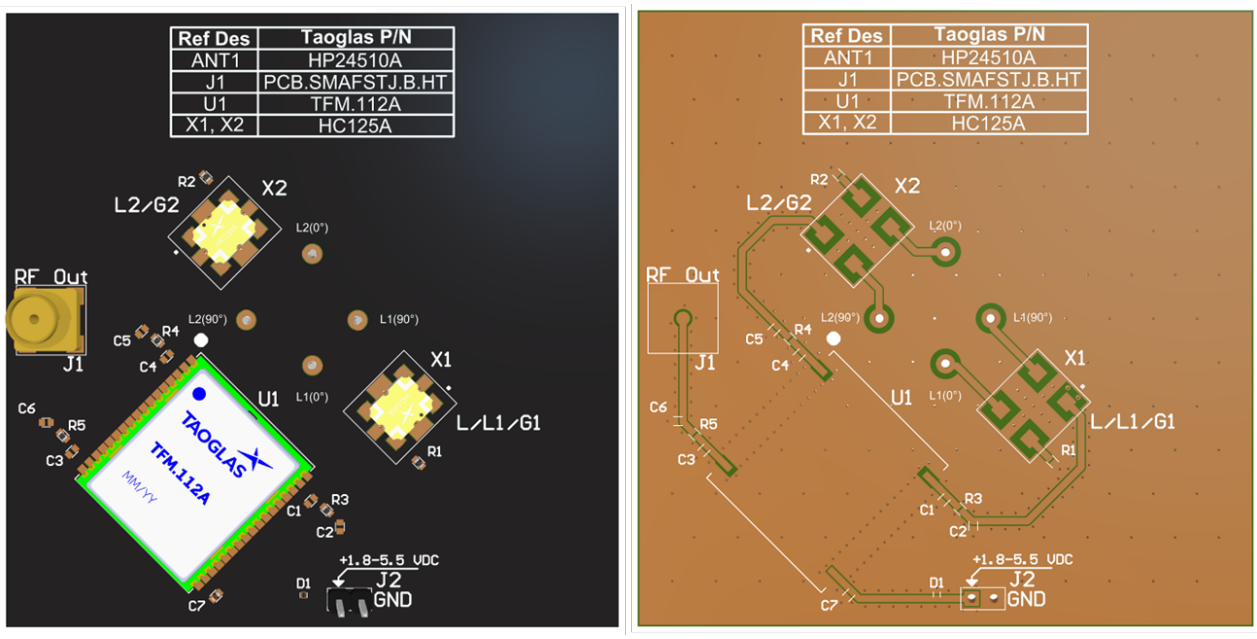
TFM.112A module mounted on a PCB, showing transmission lines and integration notes.

4.8 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.112A 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.112A 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.



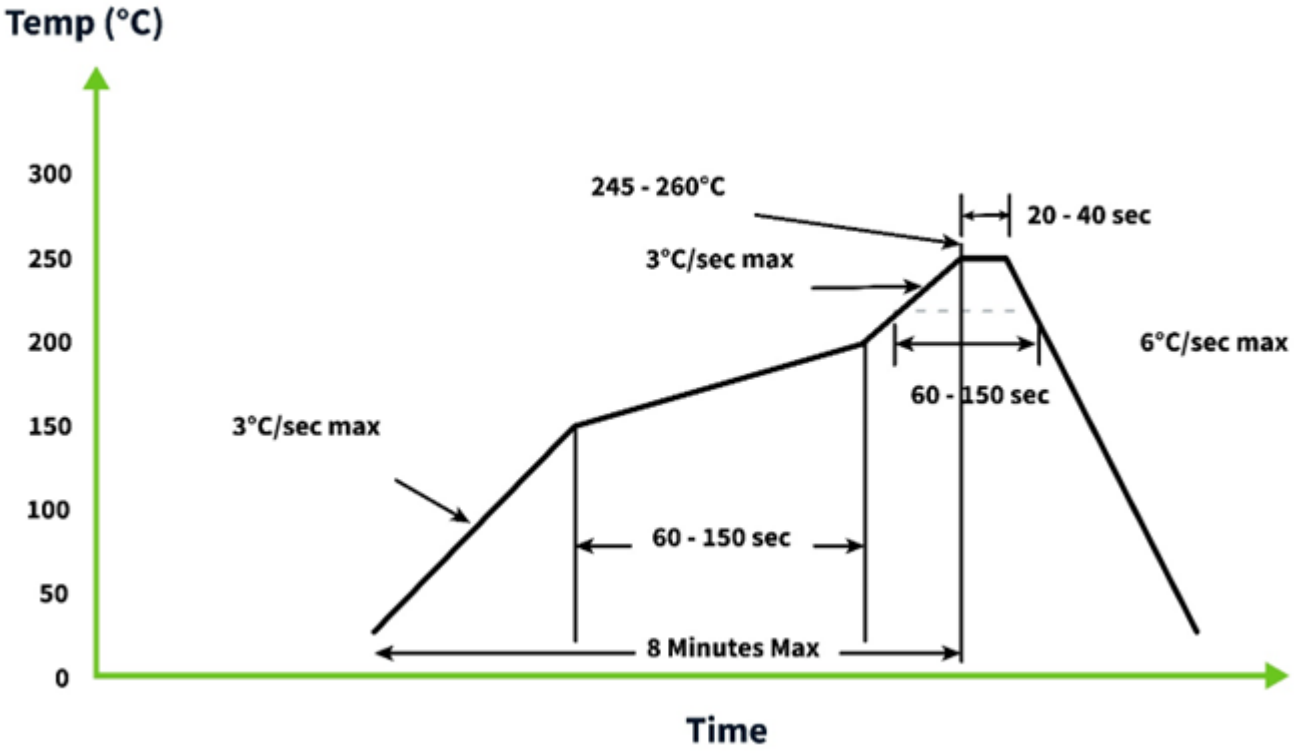
Top Side (HP24510A placement on 70x70mm PCB)



Bottom side (TFM.112A placement including HC125A's)

5. Solder Recommendations

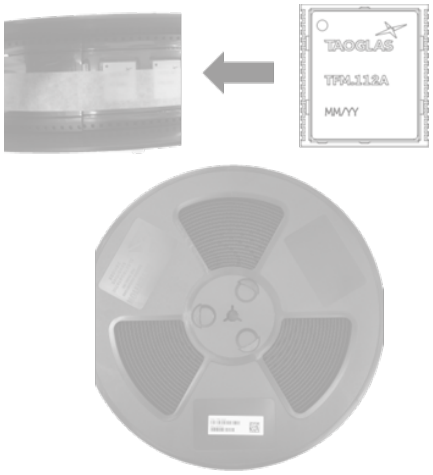
The TFM.112A can be assembled by following the recommended soldering temperatures as follows:



Smaller components are typically mounted on the first pass, however, we do advise mounting the TFM.112A when placing larger components on the board during subsequent reflows.

6. Packaging

600pcs per tape and reel
1 pcs humidity indicator card
2 pcs desiccant 3g



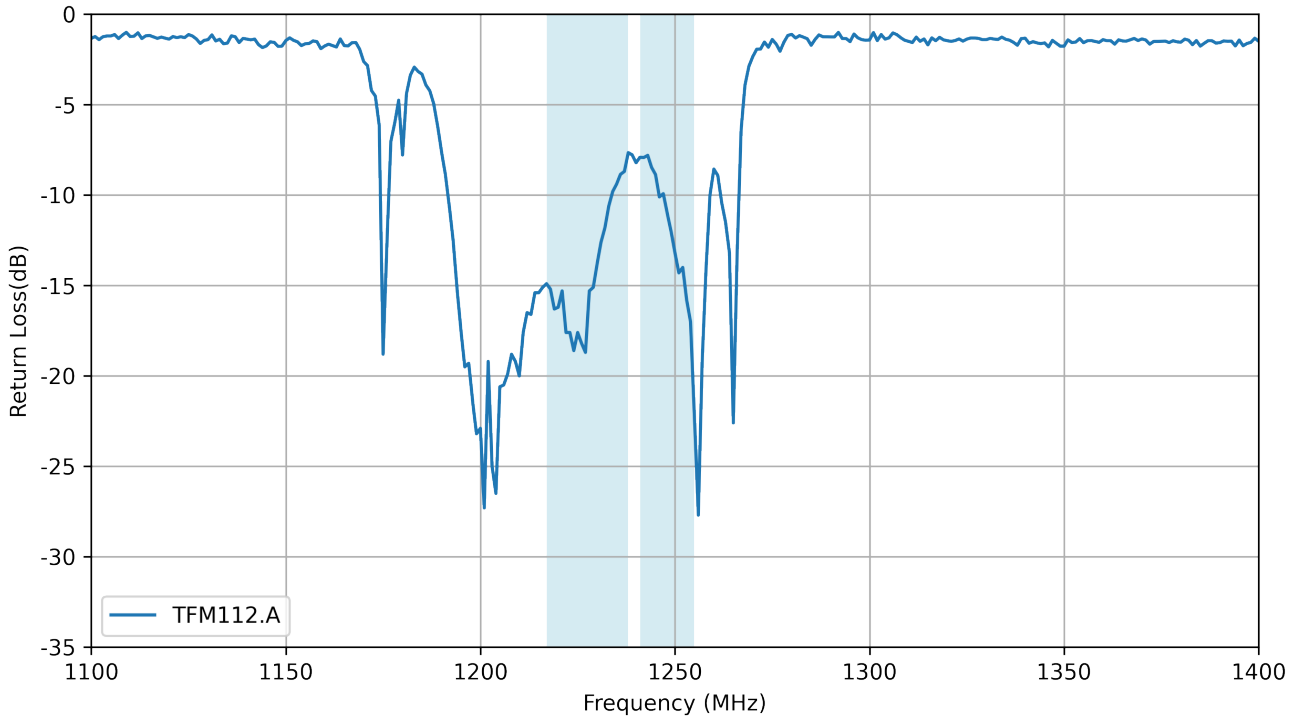
600pcs per vacuum bag

600pcs per box
Box dimensions: 350 x 340 x 67mm
Weight: 2Kg

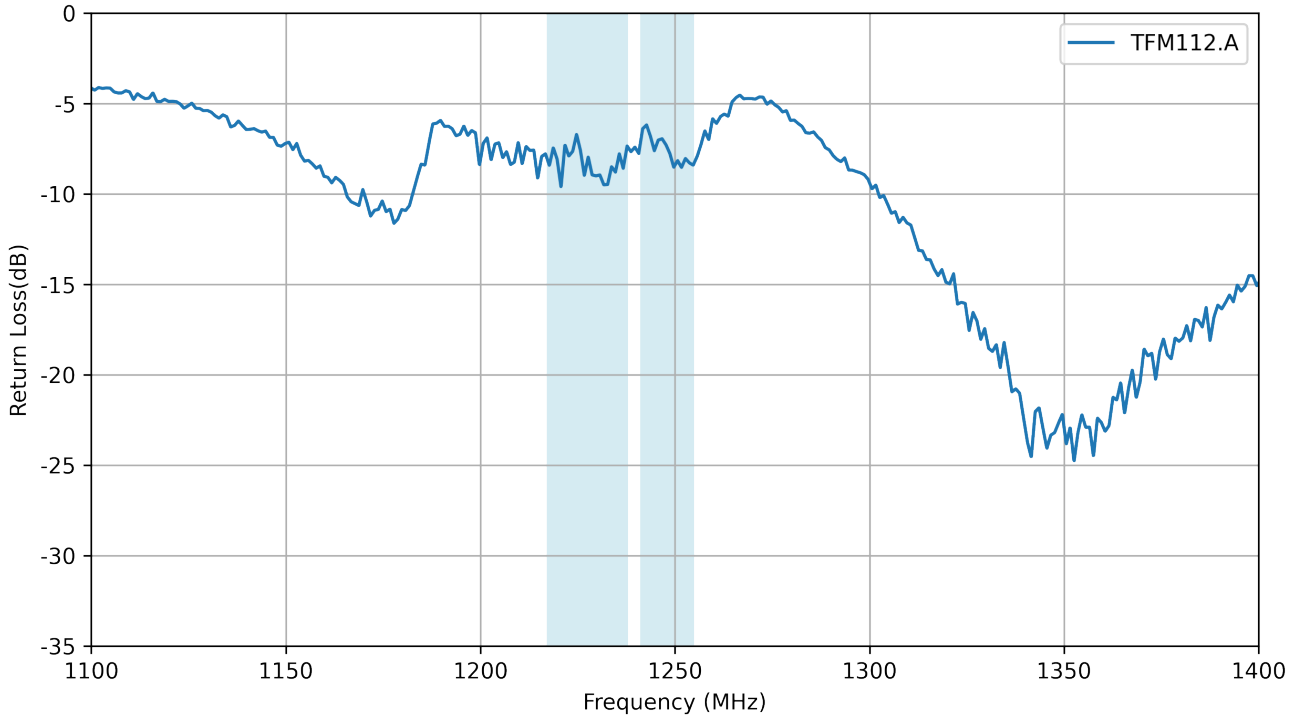
2400pcs per carton
Box dimensions: 370 x 360 x 275mm
Weight: 8.8Kg

7. FEM Low Band Characteristics

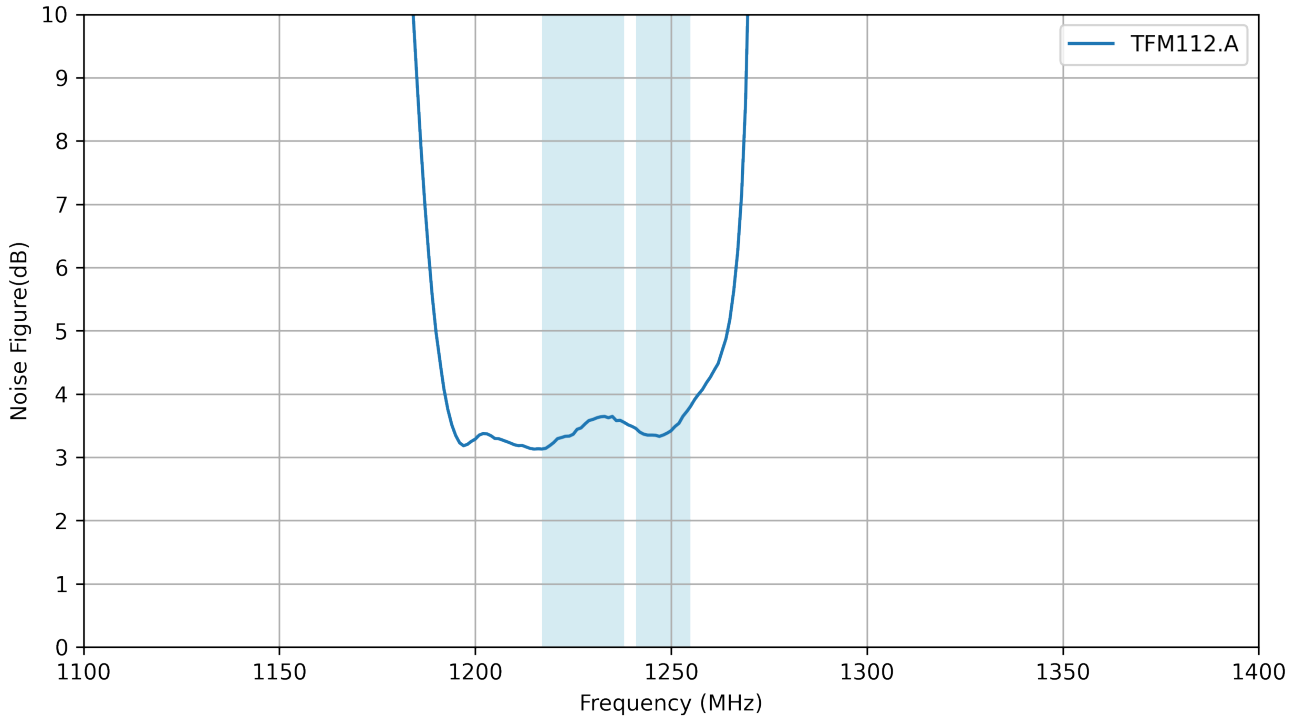
7.1 Low-Band Input Return Loss



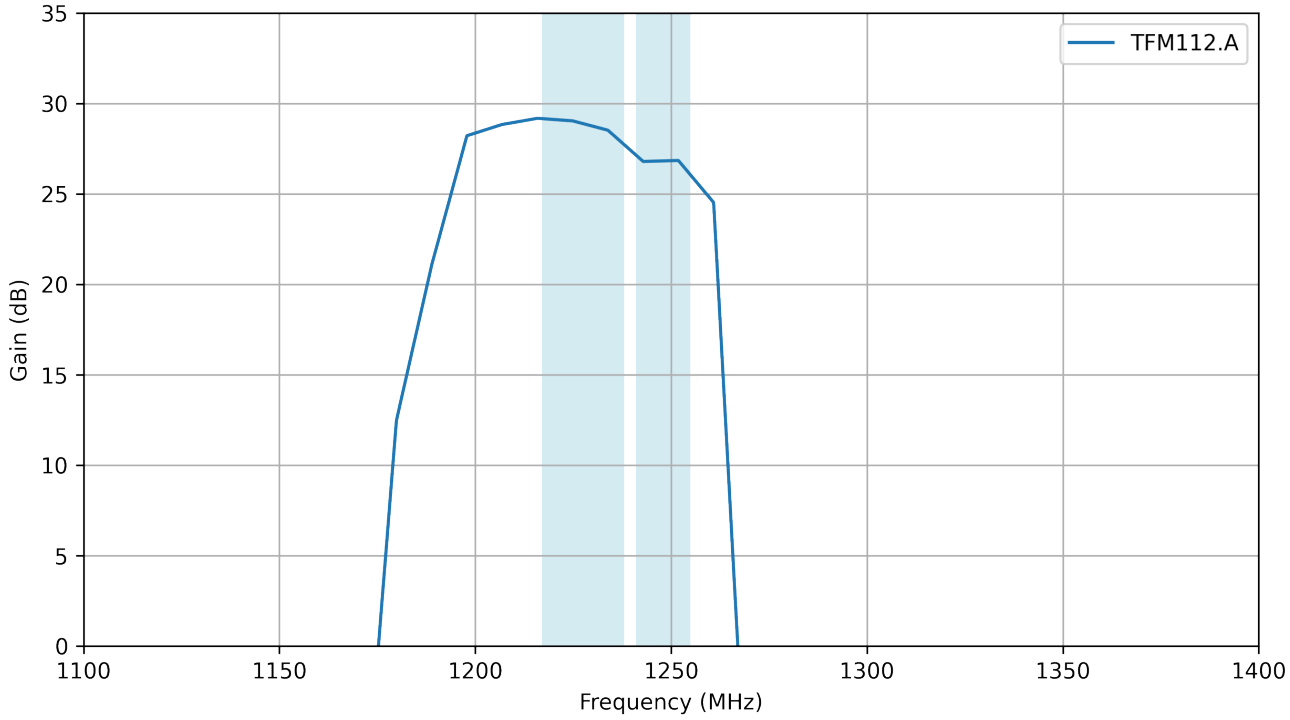
7.2 Low Band Output Return Loss



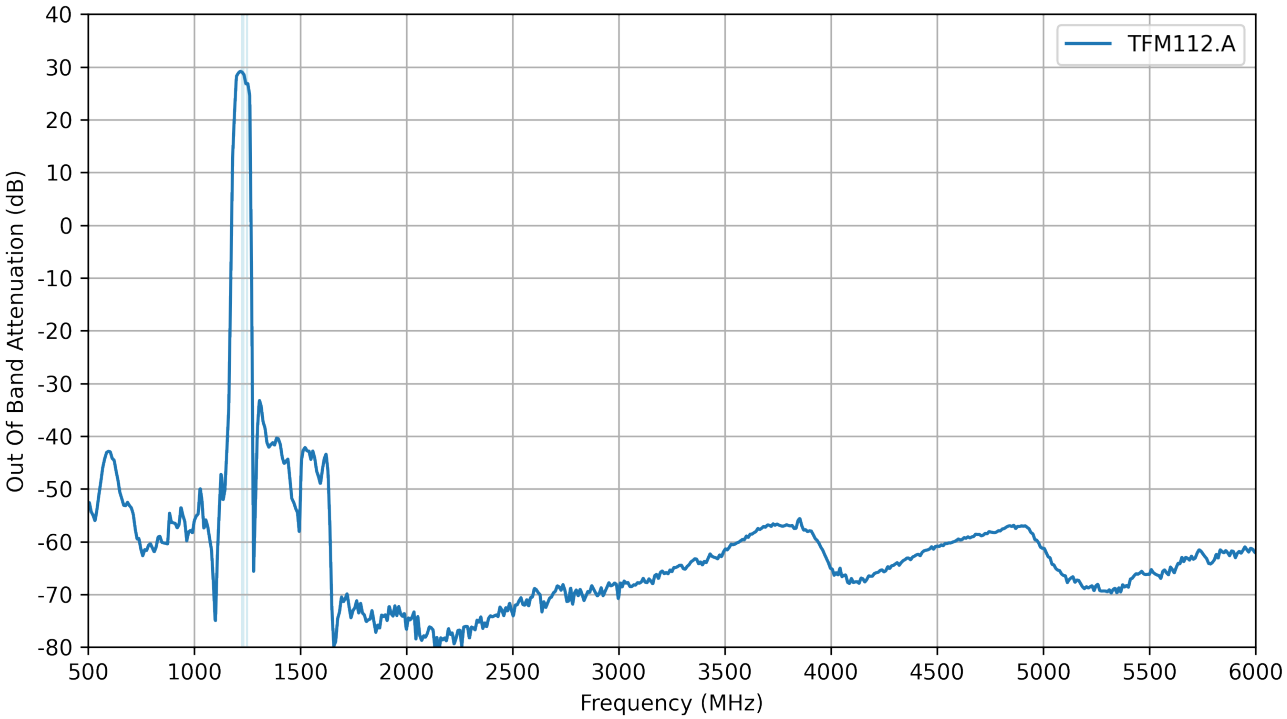
7.3 Low Band Noise Figure



7.4 Low Band Gain

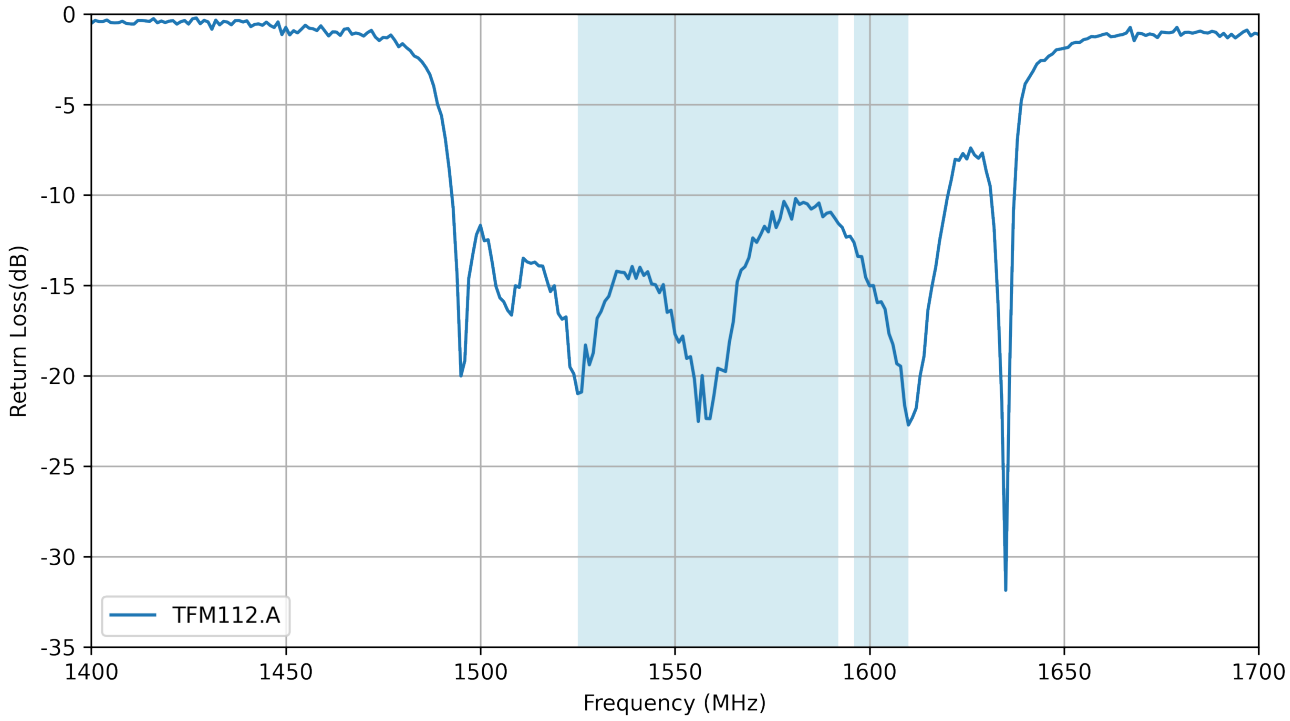


7.5 Low Band Gain and Attenuation

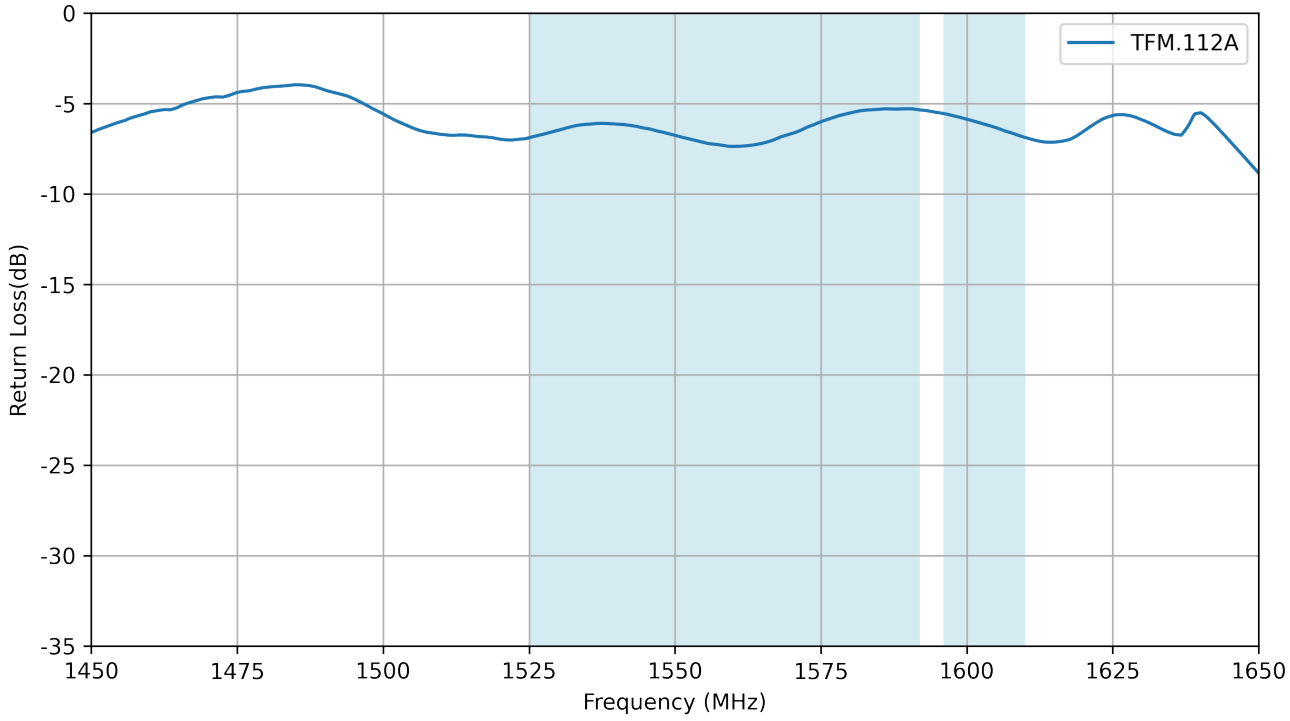


8. FEM High Band Characteristics

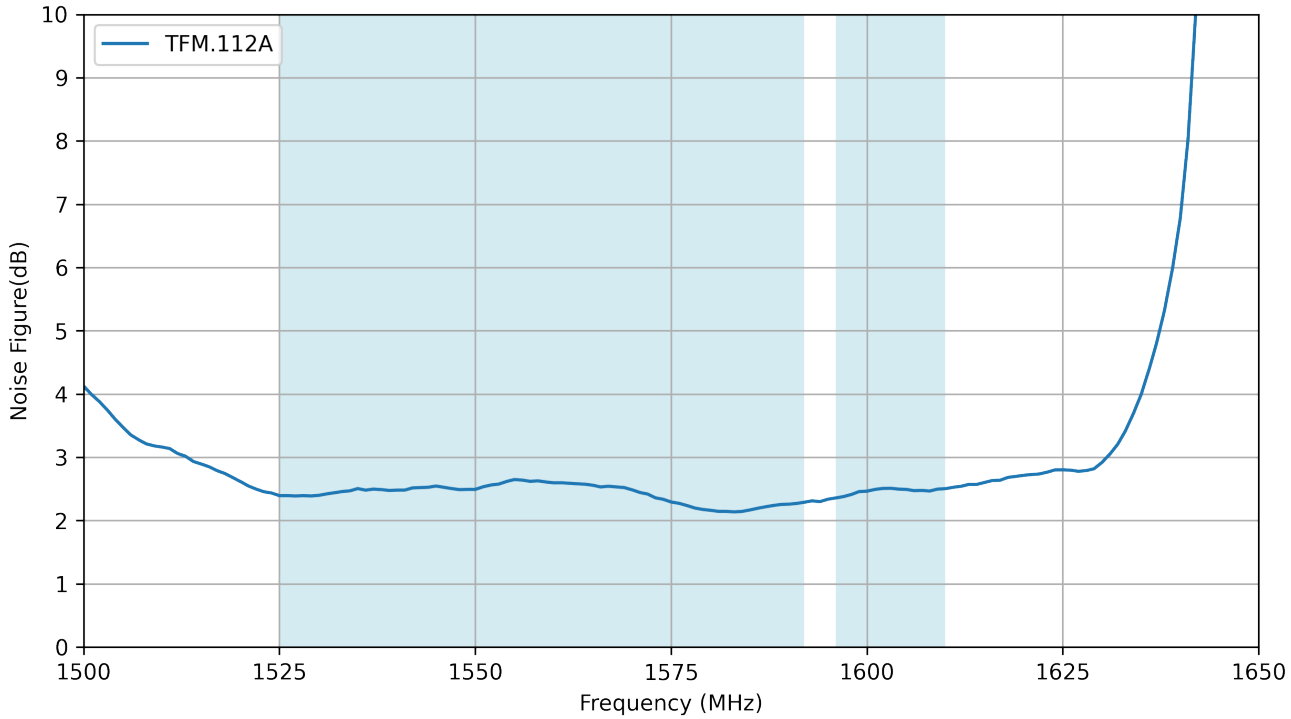
8.1 High Band Input Return Loss



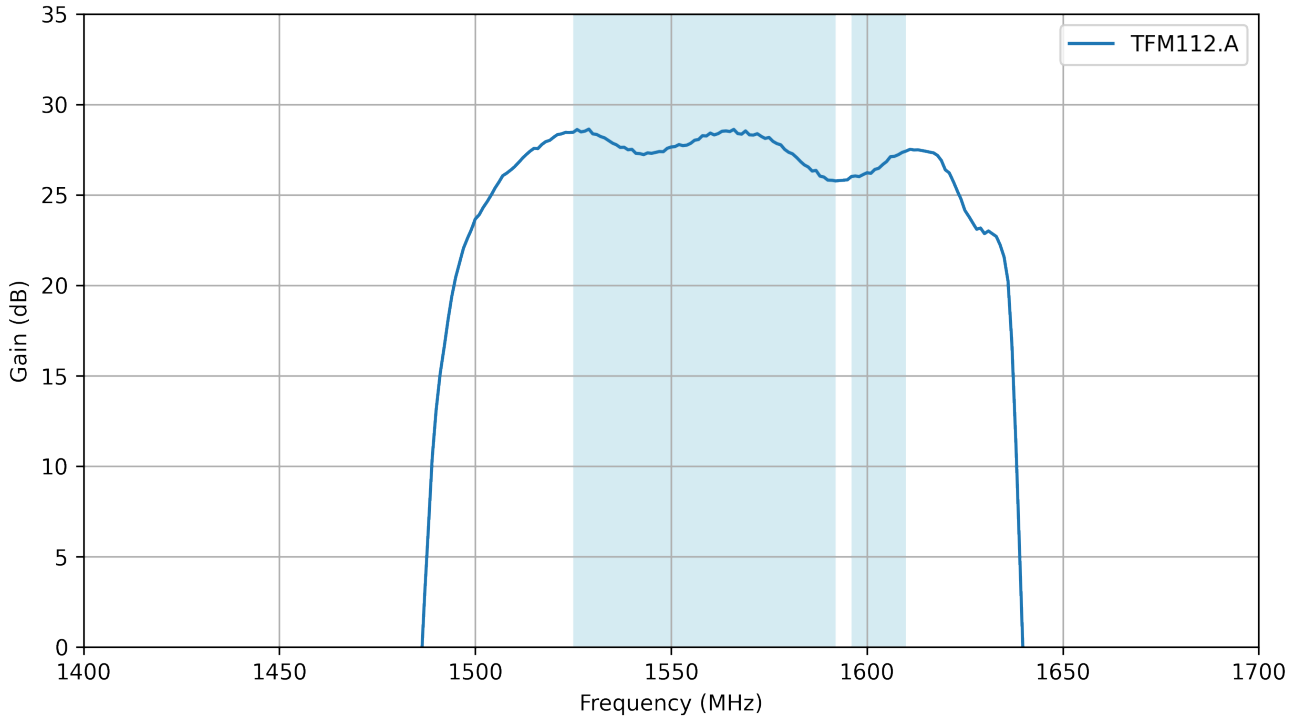
8.2 High Band Output Return Loss



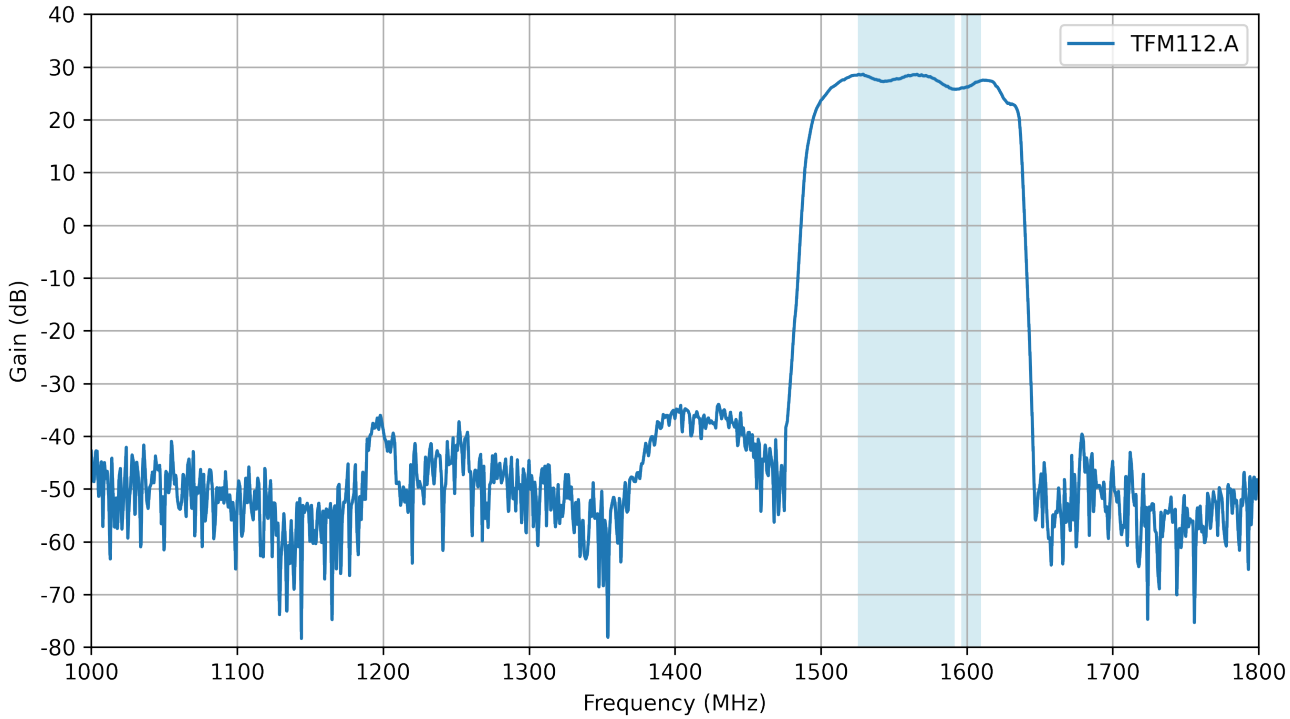
8.3 High Band Noise Figure



8.4 High Band Gain



8.5 High Band Gain and Attenuation



Changelog for Datasheet

SPE-24-8-247 – TFM112.A

Revision: A (Original First Release)	
Date:	2024-10-01
Notes:	Initial Release
Author:	Gary West

Previous Revisions

TAOGLAS®

www.taoglas.com