

TAOGLAS GPDF5012.A

Multiband High Precision GNSS Stacked Patch Antenna Part No: GPDF5012.A

Description

Passive Multiband High Precision GNSS Stacked Patch Antenna

Features:

Bands Covered:

- GPS (L1/L2/L5)
- IRNSS (L5)
- QZSS (L1/L2C/L5)
- Galileo (E1/E5a/E5b
- GLONASS (G1/G2/G3
- BeiDou (B1/B2a/B2b)

Dual pin, dual feed, 4-pin configuration

RoHS & Reach Compliant

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Introduction

1.



The Taoglas GPDF5012.A is a high performance, multi-band passive GNSS antenna that has been carefully designed to provide fantastic positional accuracy on the full GNSS spectrum. It covers GPS/QZSS L1/L2/L5, GLONASS G1/G2/G3, Galileo E1/E5a/E5b, BeiDou B1/B2a/B2b, NAVIC L5, as well as SBAS (WAAS/EGNOS/GAGAN/SDCM/SNAS).

Correct implementation of the GPDF5012.A allows the user to achieve higher location accuracy, as well as stability of position tracking in urban environments. The stacked patch construction has excellent performance across the full bandwidth of the antenna. Its design has an even gain across the hemisphere, giving excellent axial ratio, which in turn makes it extremely resilient to multipath rejection and provides excellent phase centre stability.

Typical applications that benefit from high precision capabilities include:

- Autonomous Driving
- Precision Positioning for Robotics
- Precision Agriculture
- Telematics & Container / Asset Tracking
- Timing Accuracy Synchronization



The GPDF5012.A is the latest embedded addition to Taoglas' product portfolio of high precision GNSS antennas. When used on the base and/or the rover as part of an RTK configuration, the GPDF5012.A can achieve genuine cm-level accuracy with proven results.

Full integration guidelines are contained in Section 8 of this datasheet including the Taoglas HC125.A hybrid coupler that will be required for use for dual pin feed patch integrations. An active version of this antenna, the ADFGP.50A.07.0100C is available and supplied with 100mm cable and I-PEX MHFI connector as standard.

Contact your local Taoglas Customer Services team for more information on any of the products listed above or for support regarding integration.

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2. Specification

		GNSS Frequ	iency 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



			GNSS Electri	cal			
Frequency (MHz)	1176.45	1207.14	1227.6	1248.06	1561	1575.42	1602
VSWR (max.)	1.11:1	1.31:1	1.47:1	1.35:1	1.18:1	1.06:1	1.17:1
Efficiency (%)	41.03	80.05	50.76	28.48	54.28	67.61	68.36
Average Gain (dB)	-3.87	-0.96	-2.94	-5.45	-2.65	-1.70	-1.65
Peak Gain (dBi)	1.47	4.07	1.99	-0.49	2.66	3.54	3.48
Axial Ratio (dB)	6.80	4.44	2.21	2.31	3.59	3.87	4.64
PCO x (cm)	1.69	1.43	1.42	1.32	1.05	1.05	1.18
PCO y (cm)	0.37	0.38	0.62	0.70	0.88	0.82	0.75
PCV (cm)	0.006	0.015	0.014	0.017	0.005	0.005	0.004
Polarization				RHCP			
Impedance				50 Ω			
					• • • • • • • • • • • • •		

Note: The antenna with Hybrid coupler was tested on a 70x70 mm ground plane

	Mechanical
Height	12.5 mm
Planner Dimension	50 x 50 mm diameter
Weight	86 g

	Environmental
Temperature Range	-40°C to 85°C
RoHS Compliant	Yes
REACH Compliant	Yes





NOTES: 1. Soldermask Area: 2. Adhesive Tape : 22223 3. Silver : 52223 4. Release paper : 100000









Packaging

8pcs GPDF5012.A per Tray Weight: 690g





128pcs GPDF5012.A per Inner Carton

32pcs GPDF5012.A per Inner Carton Dimensions: 263*154*96 mm

Weight: 3Kg

Dimensions: 327*280*218 mm Weight: 12.5Kg





Antenna Characteristics (with hybrid coupler)























6.





Chamber Test Set-up











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Field Test Results

This section outlines the field test result for GPDF5012.A antenna. The test was performed when the antenna was mounted on a static rooftop test set up in an open sky environment for a minimum of **6 hours**.

Taoglas will show the field test results using the following receivers:



Receiver features:

7.

- Multi-band GNSS: 184-channel GPS L1C/A L2C, GLONASS: L1OF L2OF, Galileo: E1B/C E5b, BeiDou: B1I B2I, QZSS: L1C/A L2C
- Multi-band RTK with fast convergence times and reliable performance
- Nav. update rate RTK up to 20 Hz
- Position accuracy = RTK 0.01 m + 1 ppm CEP

		Positioning A	ccuracy Table (2	D Accuracy)	
Test Condition	DRMS(cm)	CEP (50%)	DRMS (68%)	2DRMS (95-98.2%)	TTFF (sec)
70x70mm	RTK DISABLED	46.6	56.4	112.8	32
Plane	RTK ENABLED	1.0	1.2	2.4	32







7.2 Ublox NEO-F9P-15B

Receiver features:

- Multi-band GNSS: GPS / QZSS (L1C/A, L5) GLONASS (L1OF) Galileo (E1-B/C, E5a) BeiDou (B1I, B2a) NavIC (SPS-L5)
- Multi-band PPP-RTK with fast convergence times and reliable performance
- Nav. update rate RTK up to 25 Hz
- Position accuracy = RTK 0.01 m + 1 ppm CEP

		Positioning A	ccuracy Table (2	D Accuracy)	
Test Condition	DRMS(cm)	CEP (50%)	DRMS (68%)	2DRMS (95-98.2%)	TTFF (sec)
70x70mm	PPP-RTK DISABLED	103.19	123.52	247.06	27
Plane	PPP-RTK ENABLED	16.7	20.04	40.08	33

*The RTK correction service used in previous measurements provides superior corrections compared to the PPP-RTK service used for measurements on the NEO-F9P.







Evaluation Board Drawing (Units: mm)

NOTES: 2. Soldermask Area: 3. Adhesive Tape : ZZZZ 4. Silver : SZZZ

8.





	Name	P/N	Material	Finish	5
1	GPDF5012.A Patch 50x50x12mm	013A8BAZ00J04D	Ceremic	Clear	1
2	PC8_70x70x1.0mm	02110213040100	FR-4	Black	1
3	SMA(M) Connector	02104220000040	Copper	Gold	1
4	Hybrid Coupler	02121139061000	-	Silver	2
5	Power Divider	02102NPD092210	-	Block	1



Antenna Integration Guide

9.

The following is an example on how to integrate the GPDF5012.A into a design. This antenna has four pins, two pins are used for the L1 band, and the other two pins are used for the L2/L5 bands. A Hybrid coupler (HC125A) is used to combine the feeds for the L1 & L2/L5 bands, to create a Right Hand Circular Polarized (RHCP) signal at the output of the hybrid coupler. Taoglas recommends using a minimum of 70x70mm ground plane (PCB) to ensure optimal performance.



Top and bottom view of PCB reference design.

Please find the Integration files in Altium, 2D formats and the 3D model for the GPDF5012.A here: https://www.taoglas.com/product/multiband-high-precision-gnss/



9.1 Schematic Symbol and Pin Definitions



The circuit symbol for the GPDF5012.A is shown below. The antenna has 4 pins as indicated below.

Pin	Description
1	L1P1 (0°)
2	L1P2 (-90°)
3	L2P1 (0°)
4	L2P2 (-90°)



Above is a schematic symbol of GPDF5012.A and a table of the pin definitions.



9.2 Schematic Layout

The GPDF5012.A 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 <u>HC125A</u>, a high-performance hybrid coupler specifically engineered for use with our multi feed patches.

Two <u>HC125As</u> are required for this antenna, one for the high GNSS band of operation (1559-1610MHz) and another for the low GNSS band (1164MHz-1300MHz). This hybrid coupler should be placed close to the antenna pins and terminated correctly using a 49.9 Ohm resistors.

The output of each of the hybrid couplers can feed into separate paths for high and low band GNSS filtering and amplification.



Designator	Туре	Value	Manufacturer	Manufacturer Part Number
C1, C2, C3, C4	Capacitor	Not Fitted	-	-
R1, R2	Resistor	49.9 Ohms	Murata	RC0402FR-0749R9L
R3, R4	Resistor	0 Ohm	Murata	RC0402JR-070RL















BOTTOM COPPER





BOTTOM SOLDER MASK



9.5 Copper Clearance

The footprint and clearance on the PCB must comply with the antenna's specification. The PCB layout shown in the diagrams below demonstrates the GPDF5012.A clearance area. The copper keep out area differs between layers that are below the GPDF5012.A for each of the 4 pins.

The copper clearance area for the bottom layer should be Ø3.5mm around the antenna pads. The copper clearance area for the top and internal layers should Ø3mm around the antenna pads.





9.6 Antenna Integration

The GPDF5012.A should be placed in the centre, as close to the edge on the long side of the PCB as possible, to take advantage of the ground plane. The RF trace must maintain a 50 Ohm transmission line. A "pi" Matching Network is recommended for the RF transmission line, the values and components for the matching circuit will depend on the tuning needed. Ground vias should be placed around the transmission line and the copper clearance area.



Back view of PCB reference design, showing the transmission line and integration notes.



9.7 Final Integration

The top side image shown below highlights the antenna transmission line. Taoglas recommends using a minimum of 70x70mm ground plane (PCB) to ensure optimal performance.



Top Side (GPDF5012.A placement on 70x70mm PCB reference design)



Bottom Side (<u>HC125A</u> placement)



 Changelog for the datasheet

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 Notes:
 Full datasheet update.

 Author:
 Gary West

Previous Revisions

Revision: E	
Date:	2023-07-25
Notes:	Updated Antenna Field Testing
Author:	Gary West
Revision: D	
Date [.]	2023-05-16
Notes:	Updated test data
Author:	Gary West
Revision: C	
Date:	2022-01-11
Notes:	Added integration guide
Author:	Gary West
Revision: B	
Date:	2022-01-11
Notes:	Added integration guide
Author:	Gary West
Revision: A (Origina	l First Release)
Date:	2020-10-14
Notes:	Initial Release
Author:	Jack Conroy





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