

Approval NO.	
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Antenna approval sheet

NAME : TGU ANTENNA(WIFI)

MODEL : HAG-TGU-WIFI-D

HANKOOK ANTENNA	WRITTEN	CHECK	CHECK	APPROVED
				
DASAN NETWORKS	WRITTEN	CHECK	CHECK	APPROVED

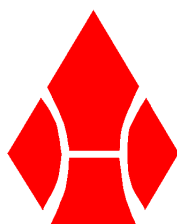


MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	1/17

TGU ANTENNA(WIFI)

MODEL : HAG-TGU-WIFI-D

**CODE : 02M-19-060
(P0M-00-446)**



	Charge	Check	Review	Approval
Sign				
Date	23-12-04			23-12-04

MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	3/17

Index

1. Product specification

- 1.1 Electrical specification
- 1.2 Mechanical specification
- 1.3 Product drawing
- 1.4 Appearance (3D)

2. Measurement

- 2.1 V.S.W.R

3. Reliability test

- 3.1 Temperature Cycle Test
- 3.2 Humidity Test
- 3.3 Vibration Test
- 3.4 Drop test
- 3.5 Waterproofing Test
- 3.6 Salt spray test

4. Result Data

- 4.1 V.S.W.R
- 4.2 Isolation
- 4.3 Efficiency

MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	4/17

1. Product specification

1.1 Electrical specification

Frequency	2,400~2,483 MHz & 5,150~5,850 MHz	
V.S.W.R	2,400~2,483 & 5,150~5,850 MHz	Less than 2.0
Gain (Peak)	2,400~2,483 MHz	≥ 3 dBi
	5,150~5,850 MHz	≥ 4 dBi
Impedance	50Ω	
Polarization	Vertical	

1.2 Mechanical specification

Division	Description	Remark
Element	FR4	
Cover / Base	PC/ABS	Black color
Dimension	130 × 130 × 90.6 mm ± 1 mm	Without cable length
Connector	SMA-Male(Nickel plate)	Label
Cable	RG-316/D, 200 ± 10mm	
Waterproof	IP69	
Operating Temperature	-40 ~ +85°C	

MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	5/17

1.3 Product drawing

MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	6/17

1.4 Appearance (3D)

MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	7/17

2. Measurement

2.1 V.S.W.R

2.1.1 Equipment

Network Analyzer

2.1.2 Setup

2.1.3 Method

- (1) Turn on the power and set the measurement conditions.
 - Start Frequency : 2,000 MHz
 - Stop Frequency : 6,000 MHz
- (2) Press CAL key to run Calibration with the Calibration Kit.
- (3) After connecting the antenna to be measured to the calibration-completed port, measure the V.S.W.R value and check if it fits the specific.
- (4) Set the measurement conditions.
 - Start Frequency : 2,000 MHz
 - Stop Frequency : 6,000 MHz
- (5) Press CAL key to run Calibration with the Calibration Kit.
- (6) After connecting the antenna to be measured to the calibration-completed port, measure the V.S.W.R value and check if it fits the specific.

MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	8/17

3. Reliability test

3.1 Temperature Cycle Test

Condition

- Sample n=3, Freq. 2,400~2,483 MHz, 5,150~5,850 MHz

Method

Low Cycling Temperature: $T_{LC} = -40^{\circ}\text{C}$

High Cycling Temperature: $T_{HC} = +85^{\circ}\text{C}$

Put the Antenna in the Climatic Chamber and keep it at -40°C for 1 hour

-> Maintain a temperature rise $\diamond$ of $+85^{\circ}\text{C}$ for 1 hour at $+85^{\circ}\text{C}$ for 2 hours

-> For 2 hours - Lower the temperature to 40°C .

This process shall be tested 10 times repeatedly and tested to satisfy electrical characteristics without noticeable deformation or mechanical abnormalities (see Figure 1)

Equipment

- constant temperature and humidity, Network Analyzer

MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	9/17

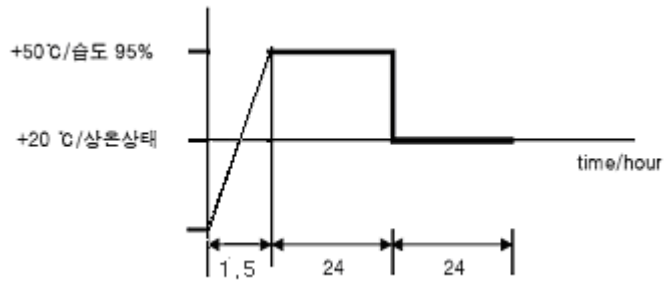
3.2 Humidity Test

Condition

- Sample n=3, Freq. 2,400~2,483 MHz, 5,150~5,850 MHz

Method

- Leave the antenna at ambient temperature +50°C and relative humidity of 95% for 24 hours, leave it at room temperature and humidity for 24 hours, and inspect it to satisfy electrical properties without any noticeable deformation or mechanical abnormalities. (See Figure 2)



Equipment

- constant temperature and humidity, Network Analyzer

MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	10/17

3.3 Vibration Test

Condition

- Sample n=3, Freq. 2,400~2,483 MHz, 5,150~5,850 MHz

Method

- After fixing the antenna to the vibration tester, apply the sine wave vibration of frequency 5- >150->5 Hz (1 CYCLE), amplitude 1.5 mm, acceleration 6G, 1 Octave/min (Logarithmic) in each of the three directions X, Y, and Z for 1 hour and inspect it to satisfy the electrical characteristics without any noticeable deformation or mechanical abnormalities. (See Figure 3)

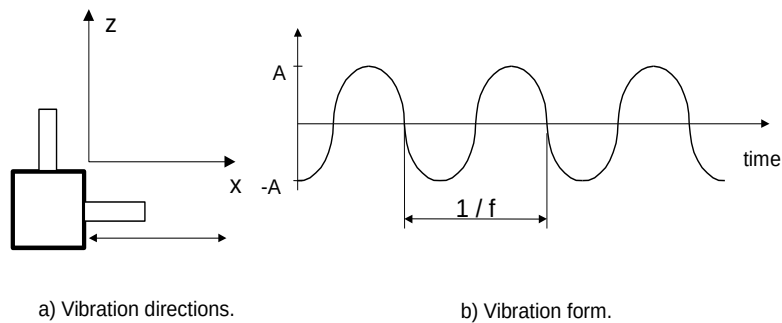


Figure 3

Equipment

- Vibration test, Network Analyzer

MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	11/17

3.4 Drop test

Condition

- Sample n=3, Freq. 2,400~2,483 MHz, 5,150~5,850 MHz

Method

- After installing the Antenna in the drop tester, there shall be no visible deformation or mechanical abnormalities after 5 DROPS on each side (6 sides) and shall satisfy electrical characteristics.

Condition

- Drop height : 1.5 M
- Drop angle: Antenna each 6 side (6 sides)
- Cycles : 5cycles

Equipment

- Free falling machine, Network Analyzer

MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	12/17

3.5 Waterproofing Test

Condition

Sample n=3, Freq. 2,400~2,483 MHz, 5,150~5,850 MHz

Method

The electrical characteristics of the antenna shall meet the specifications after spraying at high pressure and high temperature for 3 minutes at a distance of 0.15 to 0.2 (m) to rotate the antenna slowly on the turntable based on IP69.

Equipment

- Network Analyzer, Spray equipment

3.6 Salt spray test

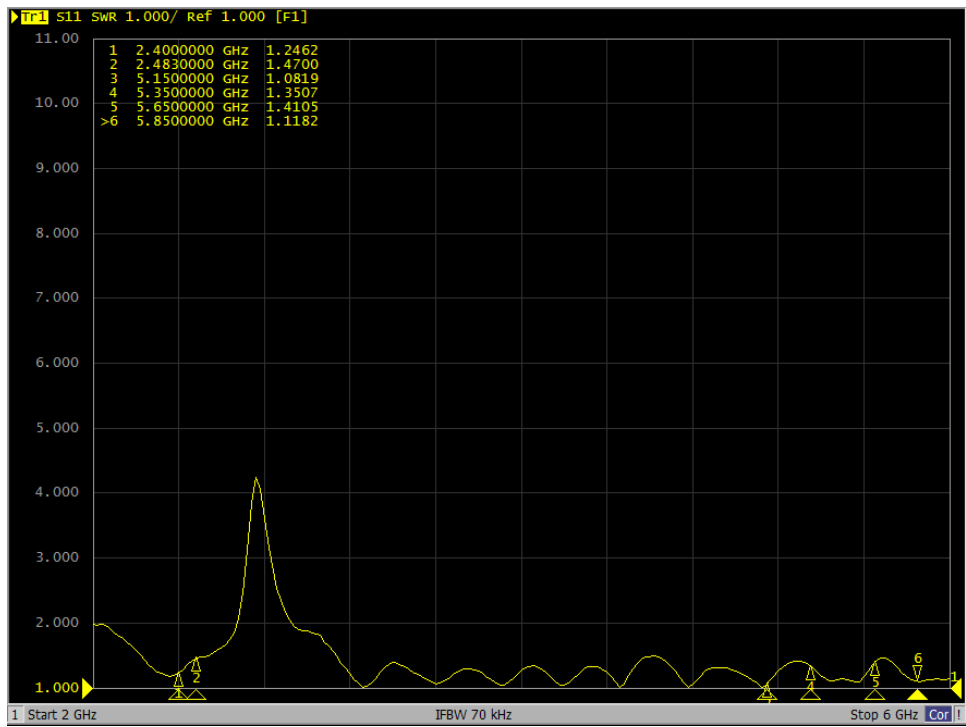
- Condition : Salt spray temperature _ 35°C
Salt concentration _ 5%
Hold time_ 96hrs

MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	13/17

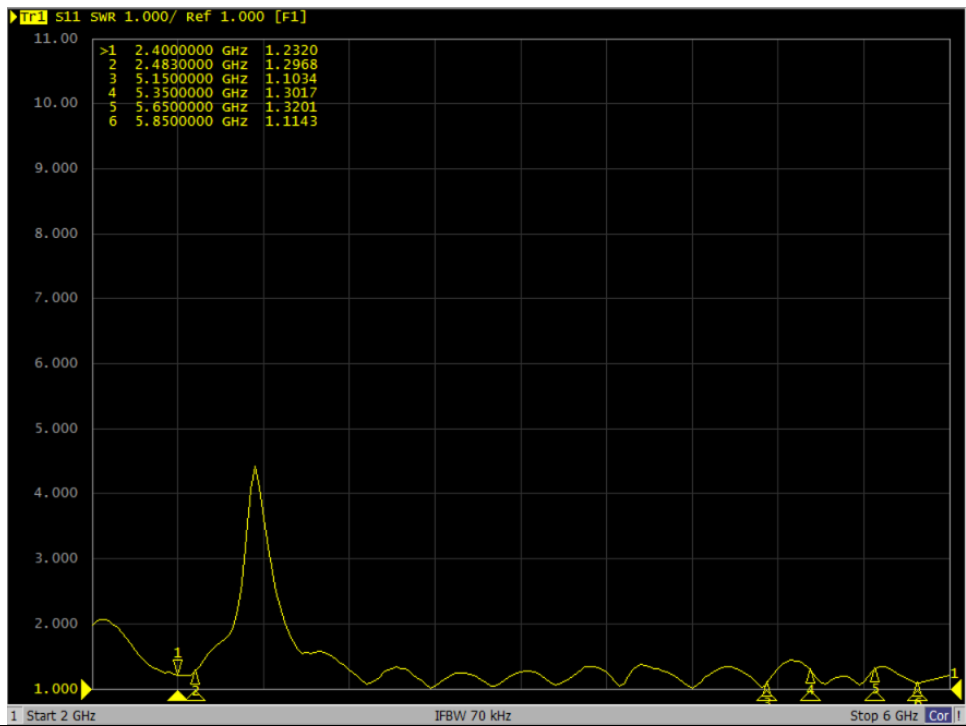
4. Result Data

4.1 V.S.W.R

<Port1>

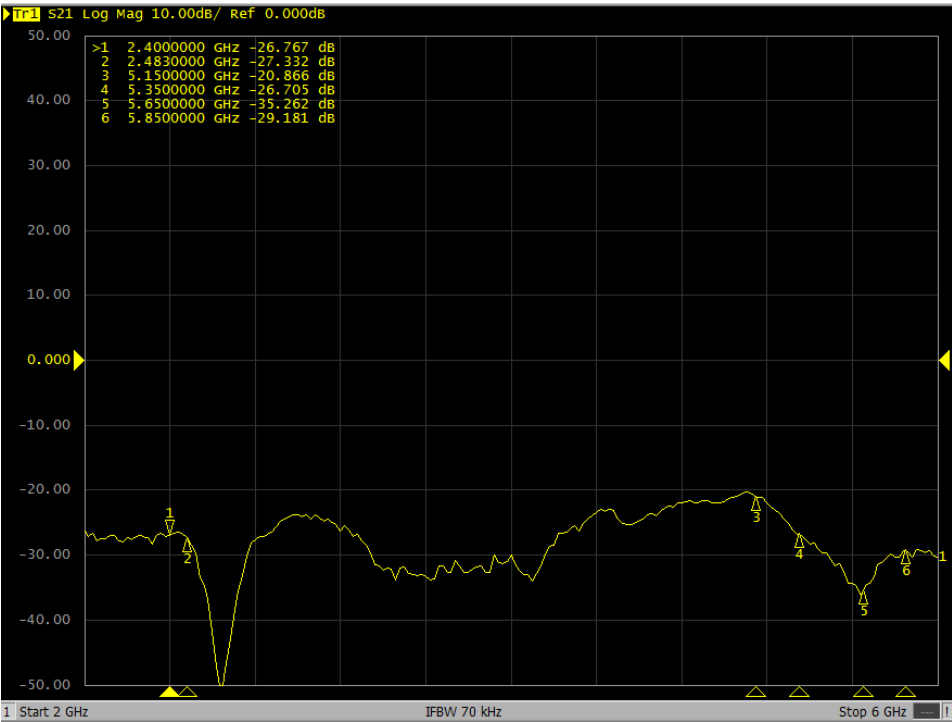


<Port2>



MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	14/17

4.2 Isolation



MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	15/17

4.3 Efficiency

<2,400~2,483 MHz(Port1)>

	1	2	3			
Frequency [MHz]	2400	2440	2483			
Efficiency [dB]	-0.42	0.00	-0.76			
Efficiency [%]	90.8	100.0	84.0			
TRG _g [dB]	-0.86	-0.54	-1.44			
Gain _{g Peak} [dBi]	4.42	4.34	3.43			
Gain _{g Min} [dBi]	-27.55	-32.33	-30.15			
TRG _g [dB]	-10.63	-9.35	-9.15			
Gain _{g Peak} [dBi]	-4.75	-2.92	-2.78			
Gain _{g Min} [dBi]	-34.64	-39.62	-40.86			
UHRG [dB]	-2.14	-1.74	-2.51			
UHRG/TRG [%]	67.34	66.96	66.79			
H-Plane	0.26	0.52	-0.45			
E1-Plane, AVG [dB]	-1.74	-1.09	-1.72			
E2-Plane, AVG [dB]	-1.66	-1.54	-2.50			
Peak Gain [dBi]	4.61	4.57	3.63			
Directivity [dB]	5.04	4.57	4.39			
Minimum Gain [dBi]	-25.03	-20.56	-19.84			

<2,400~2,483 MHz(Port2)>

	1	2	3			
Frequency [MHz]	2400	2440	2483			
Efficiency [dB]	-0.16	-0.06	-0.48			
Efficiency [%]	96.3	98.6	89.5			
TRG _g [dB]	-0.60	-0.62	-1.10			
Gain _{g Peak} [dBi]	4.96	4.86	3.69			
Gain _{g Min} [dBi]	-27.57	-33.48	-22.58			
TRG _g [dB]	-10.37	-9.22	-9.23			
Gain _{g Peak} [dBi]	-2.64	-1.18	-1.57			
Gain _{g Min} [dBi]	-40.88	-36.40	-31.39			
UHRG [dB]	-1.98	-1.87	-2.26			
UHRG/TRG [%]	65.84	65.89	66.41			
H-Plane	-0.43	-0.90	-1.07			
E1-Plane, AVG [dB]	-1.63	-1.42	-1.69			
E2-Plane, AVG [dB]	-1.25	-1.25	-1.86			
Peak Gain [dBi]	5.24	5.15	3.78			
Directivity [dB]	5.41	5.21	4.26			
Minimum Gain [dBi]	-23.75	-21.89	-20.20			

MODEL	HAG-TGU-WIFI-D	ANTENNA SPECIFICATION	DATE	2023-12-04
CODE	02M-19-060		Rev.	0
Management	R&D		Page	16/17

<5,150~5,850 MHz(Port1)>

	1	2	3	4		
Frequency [MHz]	5150	5350	5650	5850		
Efficiency [dB]	-0.81	-0.67	-2.77	-1.95		
Efficiency [%]	83.0	85.7	52.8	63.9		
TRG _g [dB]	-1.35	-1.27	-3.84	-2.86		
Gain _{g Peak} [dBi]	6.23	8.97	4.68	5.90		
Gain _{g Min} [dBi]	-25.55	-34.11	-29.52	-31.10		
TRG _p [dB]	-10.13	-9.54	-9.39	-9.15		
Gain _{p Peak} [dBi]	-2.27	-1.00	1.02	-2.46		
Gain _{p Min} [dBi]	-33.09	-37.34	-36.14	-31.30		
UHRG [dB]	-2.00	-1.66	-3.64	-2.77		
UHRG/TRG [%]	75.99	79.66	81.94	82.62		
H-Plane	-7.38	-8.72	-10.41	-7.80		
E1-Plane, AVG [dB]	0.42	-1.49	-2.65	-1.62		
E2-Plane, AVG [dB]	0.21	1.21	-3.52	-1.68		
Peak Gain [dBi]	6.25	8.99	5.51	6.24		
Directivity [dB]	7.06	9.66	8.28	8.19		
Minimum Gain [dBi]	-19.34	-18.95	-21.34	-22.92		

<5,150~5,850 MHz(Port2)>

	1	2	3	4		
Frequency [MHz]	5150	5350	5650	5850		
Efficiency [dB]	-0.14	-0.31	-2.18	-1.32		
Efficiency [%]	96.8	93.0	60.5	73.7		
TRG _g [dB]	-0.72	-0.94	-3.25	-2.33		
Gain _{g Peak} [dBi]	7.00	8.55	5.56	6.42		
Gain _{g Min} [dBi]	-26.19	-21.84	-28.78	-29.41		
TRG _p [dB]	-9.21	-9.02	-8.81	-8.17		
Gain _{p Peak} [dBi]	0.38	-1.28	2.12	-1.02		
Gain _{p Min} [dBi]	-31.26	-34.65	-49.90	-45.49		
UHRG [dB]	-1.27	-1.29	-3.03	-2.26		
UHRG/TRG [%]	77.14	79.90	82.22	80.69		
H-Plane	-6.61	-9.16	-10.14	-6.64		
E1-Plane, AVG [dB]	1.00	-0.91	-2.29	-1.52		
E2-Plane, AVG [dB]	0.69	1.14	-3.04	-1.42		
Peak Gain [dBi]	7.00	8.56	6.39	6.45		
Directivity [dB]	7.14	8.88	8.57	7.77		
Minimum Gain [dBi]	-16.41	-21.22	-22.81	-16.68		