

Antenna Under Test Report

Model : FCM604

Measurement Date : March 11-12, 2025

Approver : Takayuki Tanaka

Company name : Fujikura Ltd.

1. Antenna Information

This module incorporates 64 elements phased array antenna for beamforming. This antenna is integrated PCB and provides uniform performance over the entire from 57 to 66GHz.

Table 1-1: Antenna Specifications

Antenna Specification	Description
Antenna Type	Phased array antenna
Number of antennas	64Tx+64Rx patch array antenna consisting of 16 RF ports and 4 sub-array patch antennas per port
Polarization	Vertical polarization
Frequency Range	57 to 66 GHz Number of channels: 4
Antenna Gain	Refer to Table 1-2
EIRP	Refer to Table 1-3
Beamforming	Refer to Table 1-3 Beamforming operating direction is azimuth only
Modulation	Refer to Table 1-4

Table 1-2: Channels, Center Frequencies and Antenna Gain

channel	Center Frequency [GHz]	Frequency Range [GHz]	Max Gain [dBi] *Boresight
Channel 1	58.32	57.24 – 59.40	18
Channel 2	60.48	59.40 – 61.56	19
Channel 3	62.64	61.56 – 63.72	20
Channel 4	64.8	63.72 – 65.88	20.5

Table 1-3: EIRP () and Beamforming Azimuth

Parameter	Min	Typ.	Max	Unit
EIRP	35	37.5	40	dBm
Beamforming Azimuth	-45	0	45	deg

Table 1-4: Modulation Code and Raw PHY Data Rates

MCS Index	Modulation	Code Rate	PHY Data Rate (Mbps)
MCS0	DBPSK	1/2	27.5
MCS1	$\pi/2$ BPSK	1/2	385
MCS2	$\pi/2$ BPSK	1/2	770
MCS 3	$\pi/2$ BPSK	5/8	962.5
MCS 4	$\pi/2$ BPSK	3/4	1155
MCS 5	$\pi/2$ BPSK	13/16	1251.3
MCS 6	$\pi/2$ QPSK	1/2	1540
MCS 7	$\pi/2$ QPSK	5/8	1925
MCS 8	$\pi/2$ QPSK	3/4	2310
MCS 9	$\pi/2$ QPSK	13/16	2502.5
MCS 10	$\pi/2$ 16QAM	1/2	3080
MCS 11	$\pi/2$ 16QAM	5/8	3850
MCS 12	$\pi/2$ 16QAM	3/4	4620

2. Measurement Method

Measurement Location and Environmental Conditions

- Measurement Location: Fujikura Ltd., Sakura Facility in Japan, RF Shielded chamber
- Chamber Temperature: $25 \pm 5^\circ\text{C}$
- Chamber Humidity: $40 \pm 10\%$

Measurement Procedure

1) Measurement of Conducted Power of a single RF port in the EUT

P1 as RF conducted power was measured by connecting directly using a test board without antenna.

2) EUT Installation

The EUT was placed at a height of 1.2 meters above the floor.

3) Turntable Operation

The turntable was rotated $\pm 90^\circ$ to measure the radiation pattern of the EUT.

4) Distance Between Receiving Antenna and EUT

The receive antenna was positioned at a distance of 1.5 meters from the EUT.

5) Spectrum Analyzer Settings

The spectrum analyzer was configured with the following settings:

- RBW (Resolution Bandwidth): 1.0 MHz
- VBW (Video Bandwidth): 1.0 MHz
- Detector: Peak

6) Calculation

P2 as receive power measured with the configuration and procedures from steps 2 to 5.

The following formulas were used for the analysis:

$$\text{FSPL}(\text{Free Space Path Loss}) = 20 \log_{10} \left(\frac{4\pi r}{\lambda} \right) \quad \text{Equation(1)}$$

$$\text{EIRP} = \text{P2} - \text{RX Ant Gain} + \text{FSPL} \quad \text{Equation (2)}$$

$$\text{Eut Antenna Gain} = \text{EIRP} - \text{P1} + 12 \text{ (Antenna gain of 16 RF port)} \quad \text{Equation (3)}$$

where:

(r) is the distance between EUT and Receive antennas (meters)

(λ) is the wavelength of operating frequency (meters)

(P1) is the conducted power of RF port in EUT (dBm)

(P2) is the measured power at the receive antenna (dBm)

(Rx Ant Gain) is the gain of the receive antenna (dBi)

(EIRP) is the Effective Isotropic Radiated Power of a single antenna and RF port (dBm)

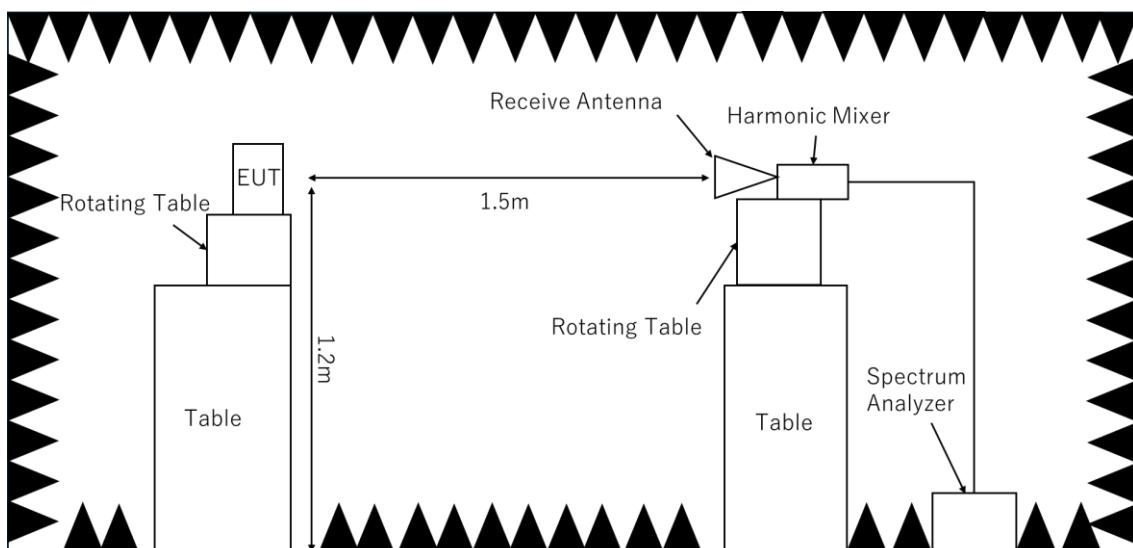


Figure 3-1: Test set up diagrams

3. List Of Test Equipment

Type	Manufacturer	Model	Cal. date (yy/mm/dd)	S/N	Soft Ware
Spectrum Analyzer	Keysight	N9020B	24/09/04	SG57430846	X-Series Signal Analyzer X-Apps 2019 Update 3.0
Harmonic Mixer	Keysight	M1971E Opt. 003	24/05/13	MY56130144	—
Receive Antenna	SAGE Millimeter	SAR-2013-15-S2	21/3/23	16735-01	—

4. Measurement Data

Table 4-1: Measurement Data

	CH1	CH2	CH3	CH4
Max P1[dBm]	12.9	12.2	11.9	11.2
Max P2[dBm]	-33.0	-32.8	-32.2	-32.5
Receive Antenna Gain [dBi]	19.4	19.6	19.8	20.0

Figure 4-1 to Figure 4-4 show integrated plots for the radiation pattern

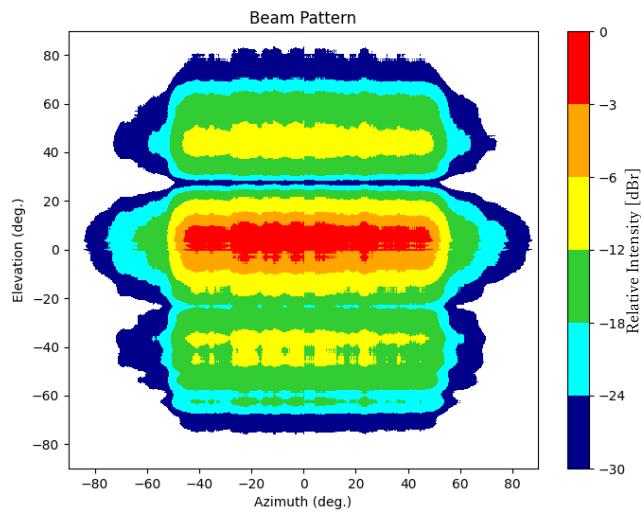


Figure 4-1: 2D surface plot showing radiation pattern for CH.1

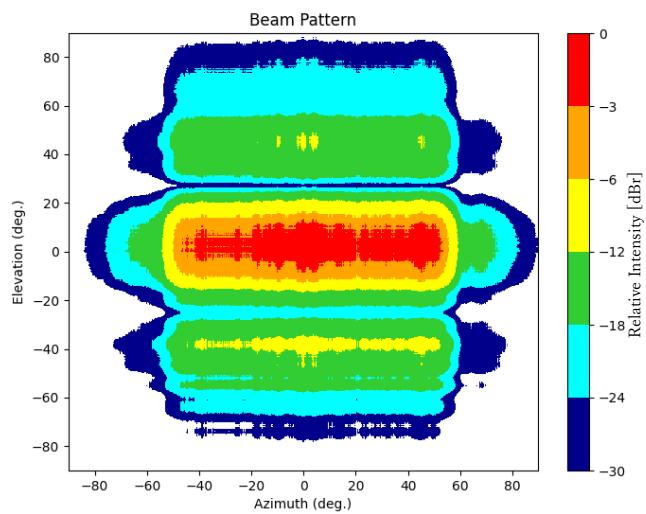


Figure 4-2: 2D surface plot showing radiation pattern for CH.2

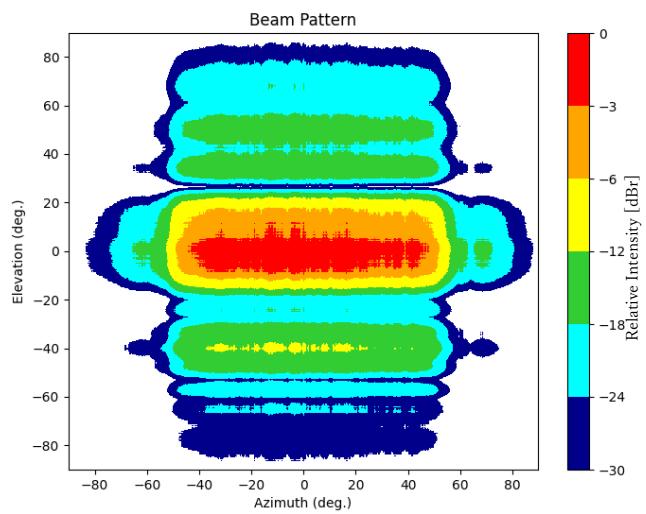


Figure 4-3: 2D surface plot showing radiation pattern for CH.3

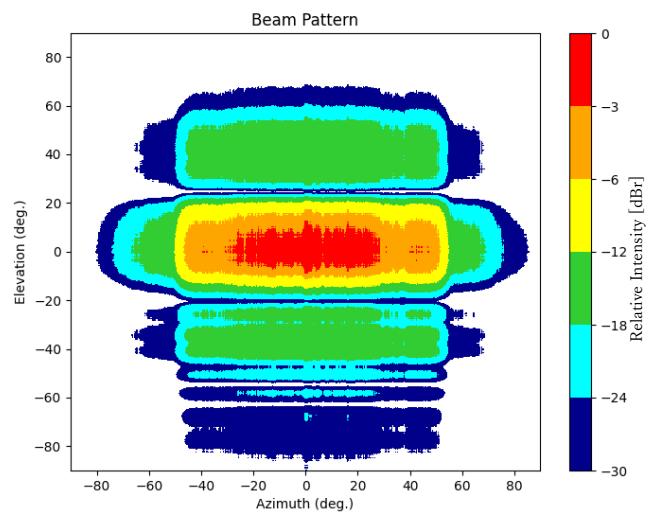


Figure 4-4: 2D surface plot showing radiation pattern for CH.4

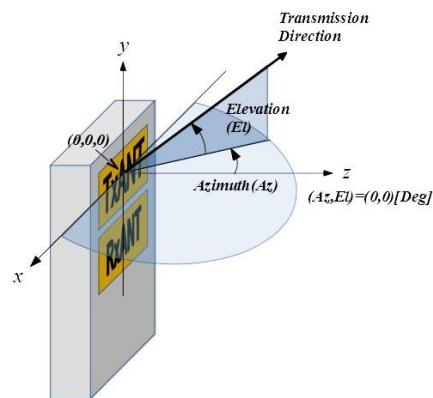


Figure 4-5: Diagram of Antenna Axis