Statement for RF Exposure

Statement No.	**15073959H-R1**
Customer	**Sumitomo Electric Industries, Ltd.**
Description of EUT	**Pedestrian Sensor**
Model Number of EUT	**SWR-A002**
FCC ID	**2A8U2SWR-A002**
Issue Date	**February 1, 2024**
Approver	
	Ryota Yamanaka **Engineer**
The Information provided from the customer is as follows; - Customer, Description of Equipment, Model Number of Equipment The laboratory is exempted from liability of any results affected from the above information.	

[FCC rule]
§1.1310 Radiofrequency radiation exposure limits.
The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

Table 1—Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density
Note 1 to Table 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
Note 2 to Table 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

[About fundamental measurement (Average)]

Test Procedure
The test was performed based on “Procedures for testing millimeter-wave systems” of ANSI C63.10-2013.
The peak power were measured with an RF detector that has a detection bandwidth that encompasses the 57-71 GHz band and has a video bandwidth of at least 10 MHz.

The carrier levels were measured in the far field. The distance of the far field was calculated from follow equation.

$$r = \frac{2D^2}{\lambda}$$

where

r is the distance from the radiating element of the EUT to the edge of the far field, in m
D is the largest dimension of both the radiating element and the test antenna (horn), in m
Lambda is the wavelength of the emission under investigation [300/f (MHz)], in m

Frequency	Wavelength	Maximum Dimention			Far Field Boundary	Tested Distance
		EUT	Test Antenna	Maximum		
	Lambda			*D*	*r*	
[GHz]	[mm]	[m]	[m]	[m]	[m]	[m]
61	4.9	0.00700	0.03759	0.03759	0.575	0.75

The test was performed based on stages 1-4 following;
Stage 1:
Connect the measurement antenna for the fundamental frequency band to the mm-wave RF detector.
Place the measurement antenna at a test distance that is in the far-field of the measurement antenna.
Place the measurement antenna in the main beam of the EUT then maximize the fundamental emission.
The maximum direction was searched under carefully since beam-widths are extremely narrow.
Record the peak voltage from DSO as DSO Reading.

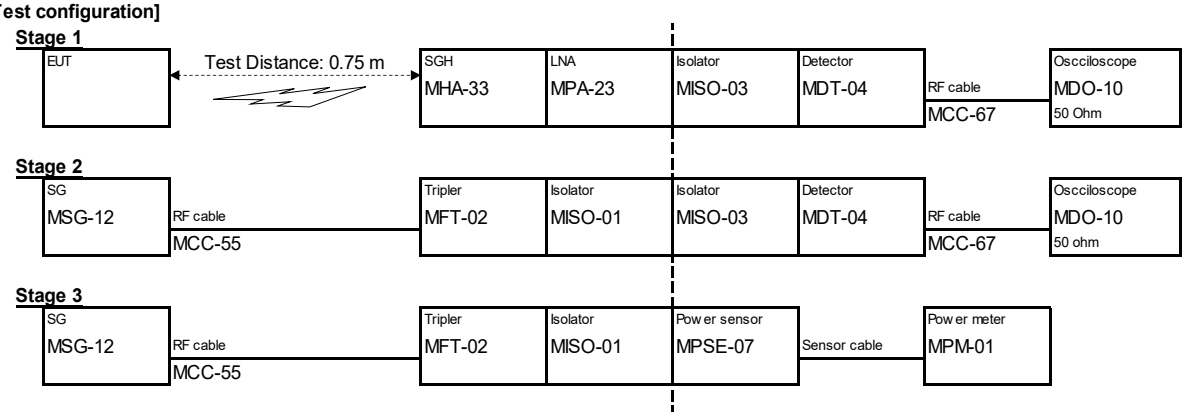
Stage 2:
Disconnect the measurement antenna from the RF input port of the instrumentation system.
Connect a mm-wave source to the RF input port of the instrumentation system via a waveguide variable attenuator.
The mm-wave source shall be unmodulated.
Adjust the frequency of the mm-wave source to the center of the frequency range occupied by the transmitter.
Adjust the amplitude of the mm-wave source and/or the variable attenuator such that the DSO indicates a voltage equal to the peak voltage recorded in Stage 1.
The output level of mm-wave source at this time is recorded as SG Reading.

Stage 3:
Disconnect the waveguide variable attenuator from the RF input port of the instrumentation system.
Without changing any settings, connect the waveguide variable attenuator to a wideband mm-wave power meter with a thermocouple detector or equivalent.
Measure the power and record it as PM reading.

Stage 4:
Correct the peak substitution power at the input to the measurement instrument, as recorded in Stage 3, for any external gain and/or attenuation between the measurement antenna and the measurement instrument that was not included in the substitution power measurement.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

[Test configuration]



Test data : APPENDIX
Test result : Pass

EIRP
(Test data)

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No. 3
Date	December 7, 2023
Temperature / Humidity	22 deg. C / 40 % RH
Engineer	Junki Nagatomi
Mode	Tx Normal operating mode

Normal operating mode — Stage 1 — Stage 2 — Stage 3 — Stage 4

Transmission Pattern	Test Antenna	Test Mode	Frequency [GHz]	DSO Reading (RMS) [mV]	S/G Setting Power [dBm]	P/M Reading [dBm]	LNA Gain [dB]	Rx Ant. Gain [dBi]	Tested Distance [m]	FSL [dB]	EIRP (Burst Average) Result [dBm]	EIRP (Burst Average) Result [mW]	Duty Factor *1) [dB]	EIRP (Timed Average) Result [dBm]	EIRP (Timed Average) Result [mW]
1	Tx 1 / Tx 3	FMCW	61.133	41.8	16.98	-1.51	24.97	23.80	1.00	68.17	17.89	61.52	9.20	8.69	7.40
2	Tx 1 / Tx 3	FMCW	61.365	39.2	16.59	-1.67	24.86	23.80	1.00	68.20	17.88	61.38	9.20	8.68	7.38

Calculating formula:
FSL (Free Space path Loss) = 10 * log10((4 * Pi * Tested Distance / Lambda) ^2)
EIRP (Burst Average) = P/M Reading - Rx Ant. Gain - LNA Gain + FSL
EIRP (Timed Average) = EIRP (Burst Average) - Duty Factor

*1) Duty Factor calculation is shown follows;

Computations of Normal operating mode for Burst Average calculations

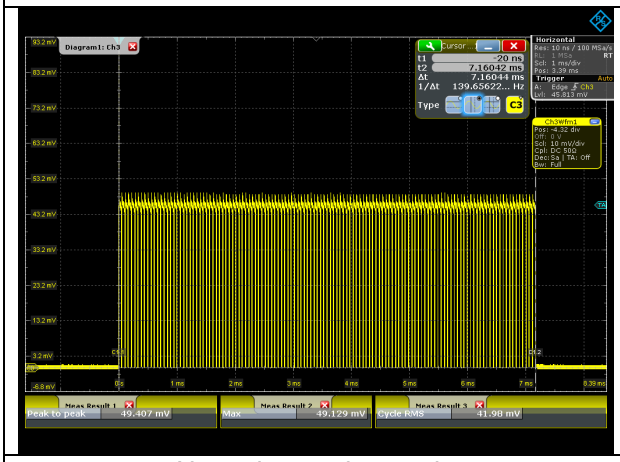
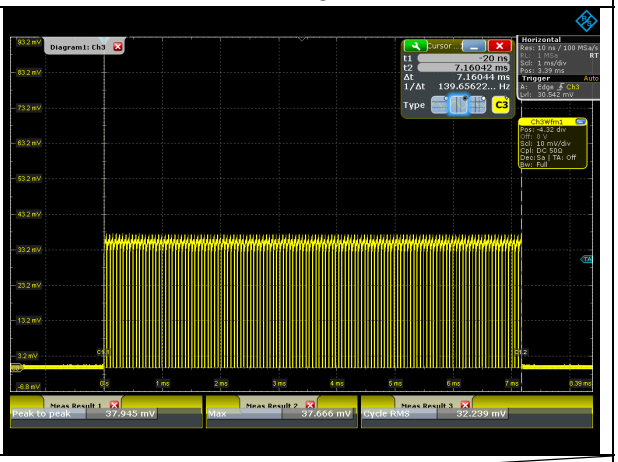
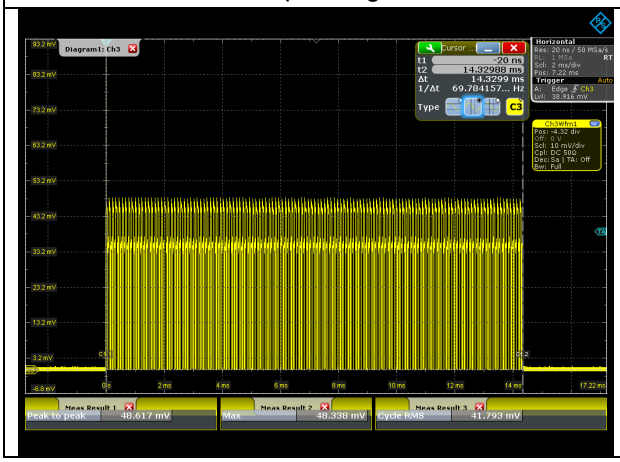
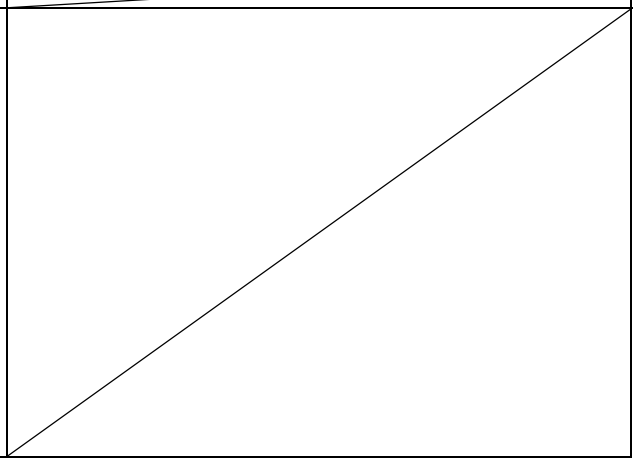
Transmission Pattern	Test Antenna	Test Mode	Tx1 Chirp ON time *2) [us]	Tx3 Chirp ON time *2) [us]	Number of Chirp *2)	Total ON Time [ms]	Total ON+OFF Time [ms]	Duty Factor [dB]
1	Tx 1 / Tx 3	FMCW	47.035	47.073	256	12.050	100.002	9.2
2	Tx 1 / Tx 3	FMCW	47.036	47.036	256	12.050	100.002	9.2

Calculating formula:
Total ON time =(Tx1 Chirp ON time + Tx3 Chirp ON time) * Number of Chirp / 2
Duty factor = 10 * log (Total On + Off time / Total On time)

*2) Refer to Duty Cycle data page.

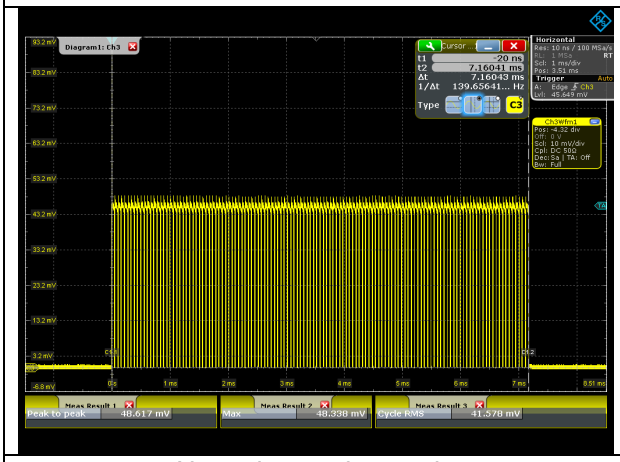
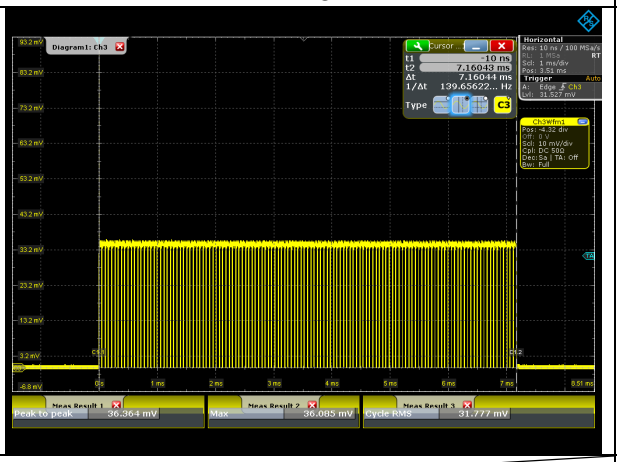
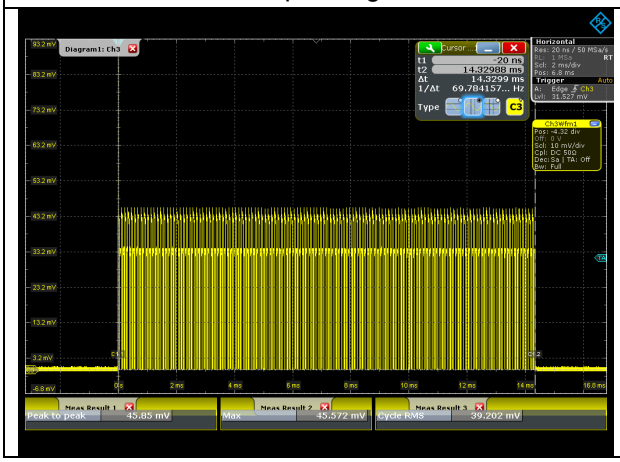
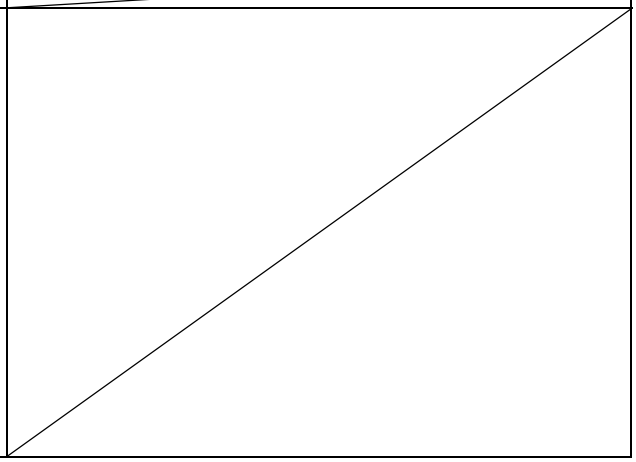
EIRP

[Data]

Pattern 1	
Tx 1	Tx 3
	
Normal operating mode	
	

EIRP

[Data]

Pattern 2	
Tx 1	Tx 3
	
Normal operating mode	
	

Duty Cycle

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No. 3
Date	December 10, 2023
Temperature / Humidity	22 deg. C / 42 % RH
Engineer	Junki Nagatomi
Mode	Transmission Pattern 1 (Normal operating mode)

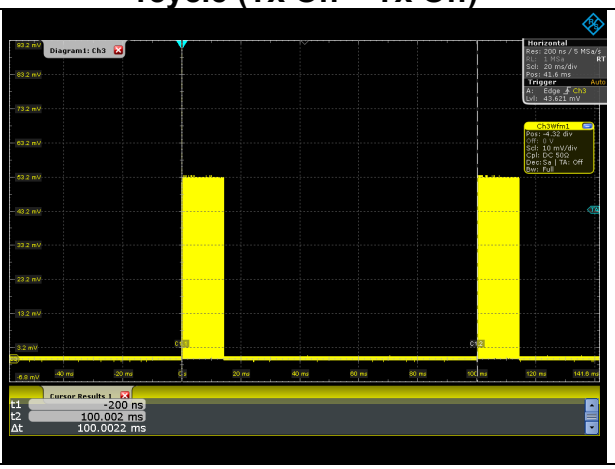
	Tx On + Tx Off time [ms]	Tx1 Chirp ON time [us]	Tx3 Chirp ON time [us]	Number of Chirp	Tx On time [ms]	Duty [%]
Measured	100.002	47.035	47.073	256	12.046	12.0

Calculating formula:

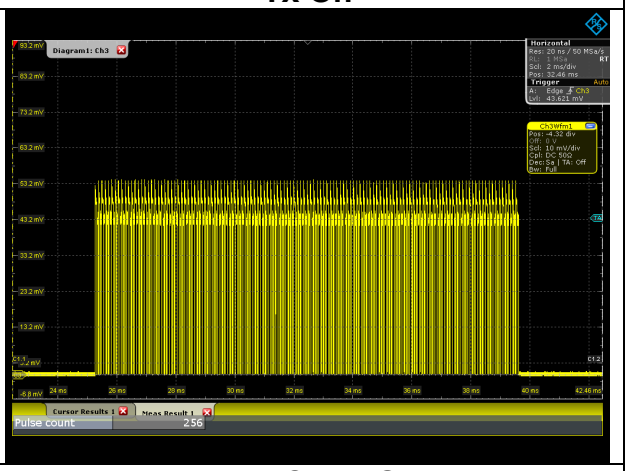
Tx On time = (Tx Chirp ON time +Tx3 Chirp ON time) * Number of Chirp / 2

Duty = (Tx On time / Tx On + Tx Off time) * 100

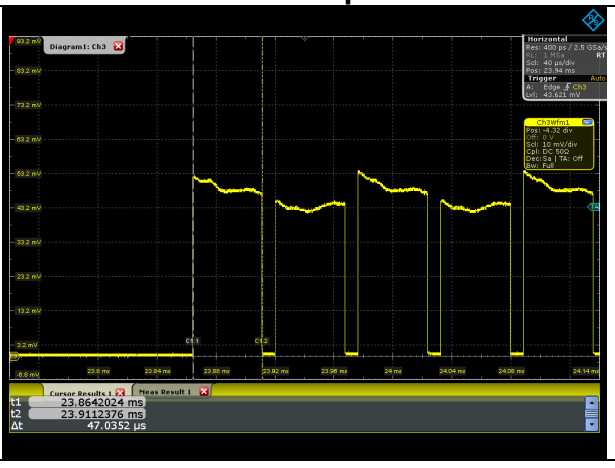
1cycle (Tx On + Tx Off)



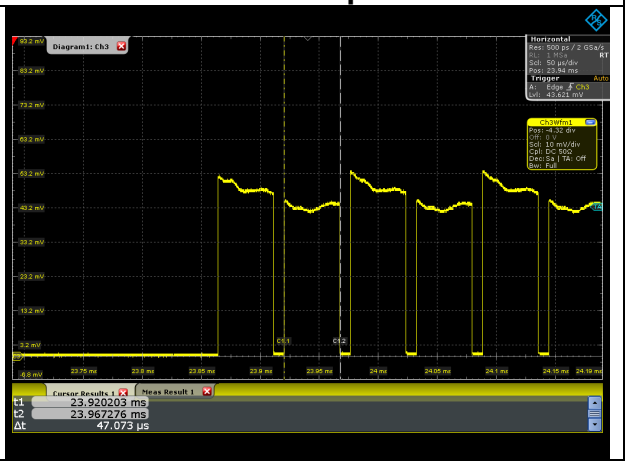
Tx On



Tx1 1 Chirp ON



Tx3 1 Chirp ON



Duty Cycle

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No. 3
Date	December 10, 2023
Temperature / Humidity	22 deg. C / 42 % RH
Engineer	Junki Nagatomi
Mode	Transmission Pattern 2 (Normal operating mode)

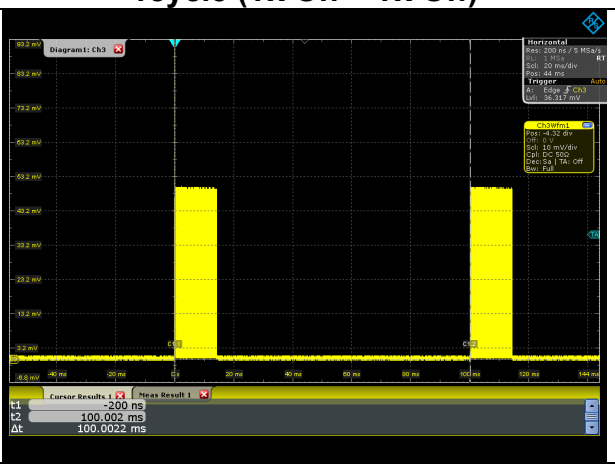
	Tx On + Tx Off time [ms]	Tx1 Chirp ON time [us]	Tx3 Chirp ON time [us]	Number of Chirp	Tx On time [ms]	Duty [%]
Measured	100.002	47.036	47.036	256	12.041	12.0

Calculating formula:

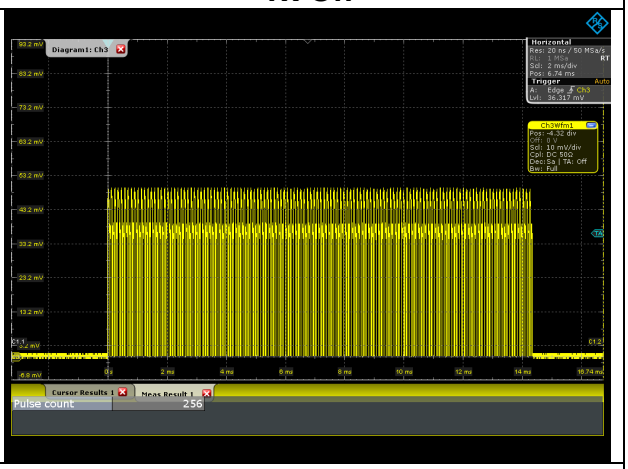
Tx On time = (Tx Chirp ON time +Tx3 Chirp ON time) * Number of Chirp / 2

Duty = (Tx On time / Tx On + Tx Off time) * 100

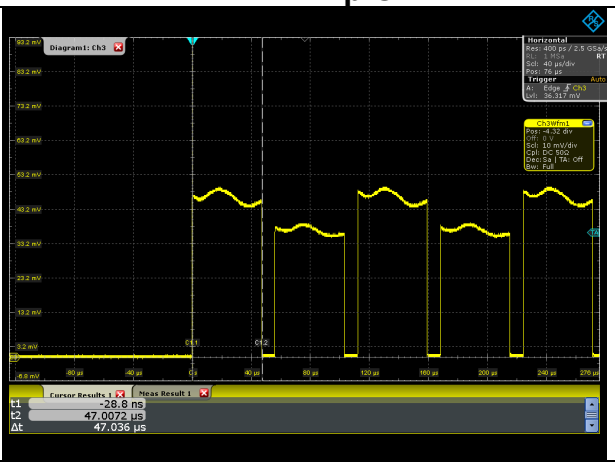
1cycle (Tx On + Tx Off)



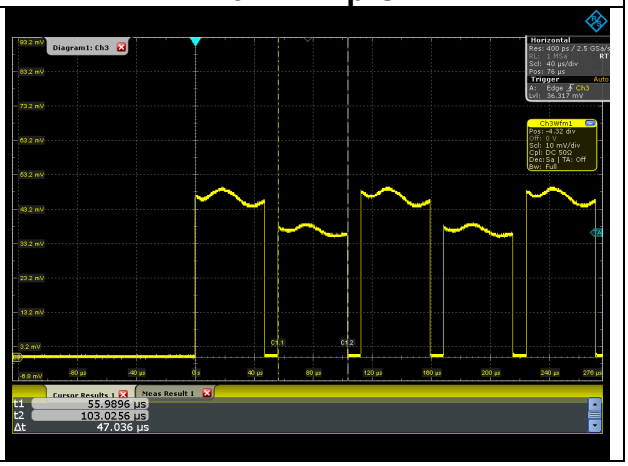
Tx On



Tx1 1 Chirp ON



Tx3 1 Chirp ON



Test instruments

Test equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
MPE	141326	Microwave Cable	Suhner	SUCOFLEX101	2874(1m) / 2877(5m)	03/07/2023	12
MPE	141328	Microwave Cable 1G-40GHz	Suhner	SUCOFLEX102	28636/2	04/10/2023	12
MPE	141532	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201197	01/17/2023	12
MPE	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	01/13/2023	12
MPE	141801	Power Meter	Keysight Technologies Inc	E4417A	GB41290639	04/11/2023	12
MPE	141892	Signal Generator	Keysight Technologies Inc	E8257D	US49280311	11/24/2023	12
MPE	141962	Digital Oscilloscope	Rohde & Schwarz	RTO1004	200355	05/16/2023	12
MPE	141978	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180899	03/06/2023	12
MPE	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/23/2022	24
MPE	142055	Power Amplifier	SAGE Millimeter, Inc.	SBP-5037532015-1515-N1	11599-01	03/22/2023	12
MPE	142183	Measure	KOMELON	KMC-36	-	10/20/2023	12
MPE	142238	Power sensor	Keysight Technologies Inc	V8486A	MY44420112	06/16/2023	12
MPE	142528	Detector	Millitech	DET-15-RPFW0	34	-	-
MPE	142545	Fullband Tripler	Millitech	MUT-15-LF000	19	-	-
MPE	142590	Waveguide Isolator	Keysight Technologies Inc	V365A	60004	-	-
MPE	142592	Waveguide Isolator	Millitech	FBI-15-RSES0	1858	-	-
MPE	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
MPE	180634	Horn Antenna	SAGE Millimeter, Inc.	SAZ-2410-15-S1	17343-01	06/20/2023	12

***Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.**

The expiration date of the calibration is the end of the expired month.
As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

Test item:

MPE: Maximum Permissible Exposure

[Results]

Mode	Average EIRP* [mW]	Separation Distance [cm]	Power Density Result [mW/cm^2]	Power Density Limit [mW/cm^2]
Average Power	61.52	20	0.01	1

Calculating formula:
Power Density = Average EIRP / (4 * Pi * Separation Distance ^ 2)

This EIRP was measured in sufficient far field of 1.00 m distance and calculated at 20 cm.

End of Statement