

System Reference series for Automotive application

REFRPT001-EVK-001 EMC test report

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1. Evaluation Summary

1-1. Objective

The reference board (REFRPT001-EVK-001) according to CISPR25 Class5

Measurement items

- CISPR25 conducted noise (Voltage method), radiated noise measurements
- Measured in an anechoic chamber

1-2. Evaluation target

ADAS/INFO display power tree reference board : REFRPT001-EVK-001 (Here in after DUT)

1-3. Evaluation items

Table 1. Evaluation items

Evaluation items	Frequency	Antenna
Conducted noise measurement	150kHz to 108MHz	—
Radiated noise measurement	150KHz to 1GHz	Vertical position
	30MHz to 1GHz	Horizontal position

Note 1) Measures the difference of conducted noise with or without common mode filter.

1-4. Equipment

Table 2. Equipment machine list

Equipment	Vendor	Type	Serial No.
12V Battery	Panasonic	-	-
LISN (GND side)	NETZNACHBILDUNG	NNBM8125	81251638
LISN (VIN side)	NETZNACHBILDUNG	NNBM8125	81251639
Spectrum analyzer	SCHWARZBECK	ESU26	100165
Antenna (150KHz to 30MHz)	ETS-LINDGREN	3301C	211493
Antenna (30MHz to 300MHz)	ETS-LINDGREN	3110B	3376
Antenna (300MHz to 1GHz)	SCHWARZBECK	9118A	784

1-5. Test environment

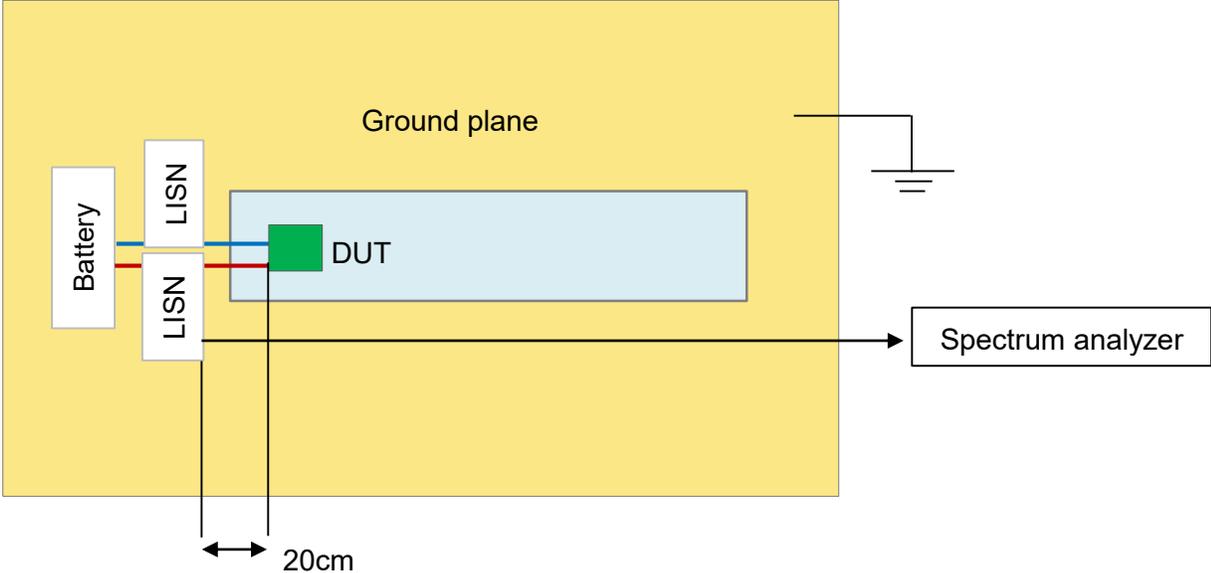


Figure 1. Top view of conducted noise measurement setup

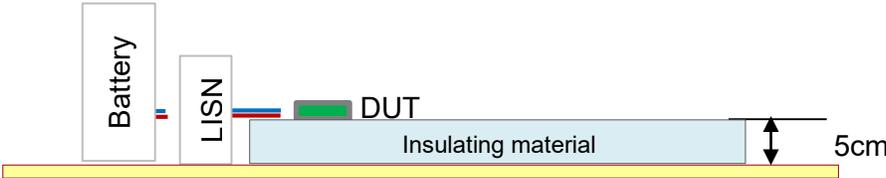


Figure 2. Side view of conducted noise measurement setup

LISN : Line Impedance Stabilization Network

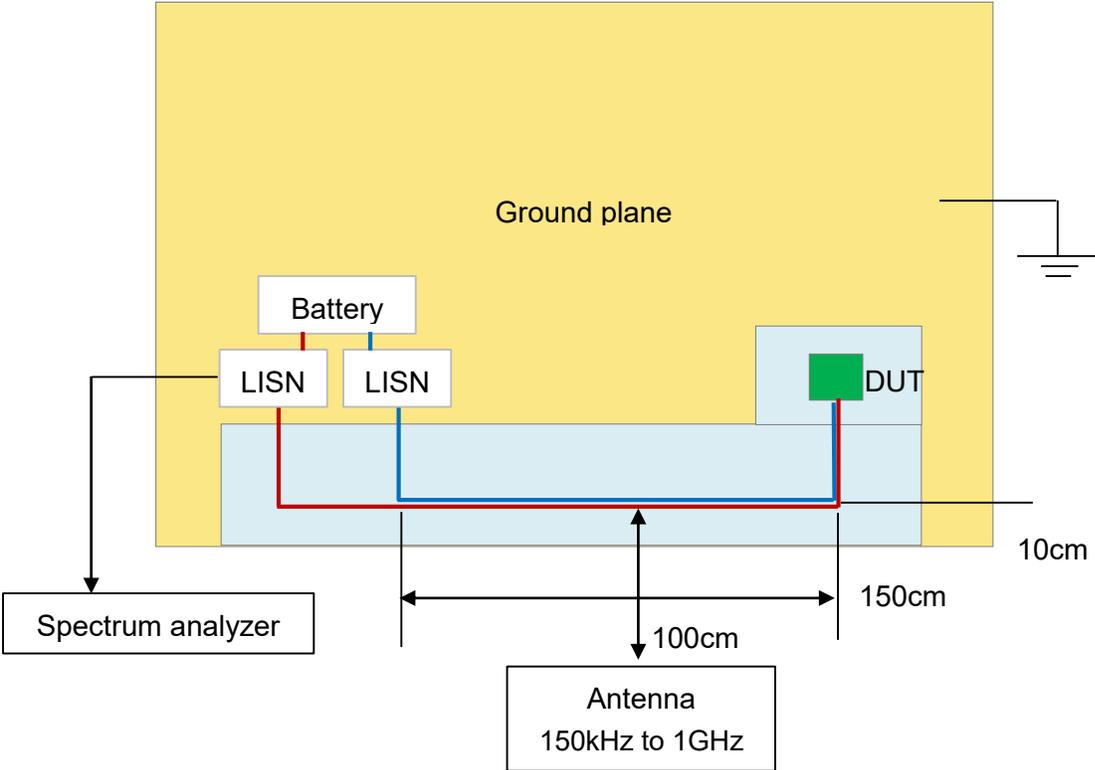


Figure 3. Top view of radiated noise measurement setup

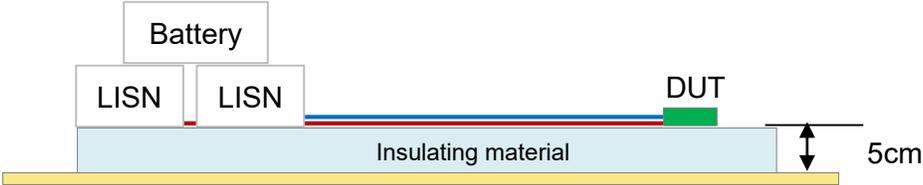


Figure 4. Side view of radiated noise measurement setup

1-6. Measurement condition

Table3. Measurement condition

Item	Condition
Ambient Temperature (Ta)	Room temperature (Ta=27 deg.C)
Input voltage (VBAT)	12V Battery

Table 4. Measurement specification

Symbol name	Output voltage (V)	Load current (A)	Operating condition
DCDC_P5V	5.00	0.3	Spread spectrum, forced PWM mode
DCDC_P5V_S1V25	1.25	1.3	-
DCDC_P5V_S3V3	3.30	0.3	-
DCDC_P3V	3.30	-	Spread spectrum, forced PWM mode
DCDC_P3V_S1V0	1.00	2.2	forced PWM mode
DCDC_P3V_S1V5	1.50	1.5	forced PWM mode
DCDC_P3V_S1V8	1.80	1.2	-
DCDC_P3V_PSW	3.30	0.4	-

(Note 1) This test is performed in our anechoic chamber according to CISPR25.

(Note 2) However, we have not obtained official certification from a certification body.

This data is for reference only.

1-7. Reference board overview

System diagram of reference board is shown below.

Please refer to REFRPT001-EVK001 User's Guide (62UG072E Rev.001) for the circuit schematic and parts list.

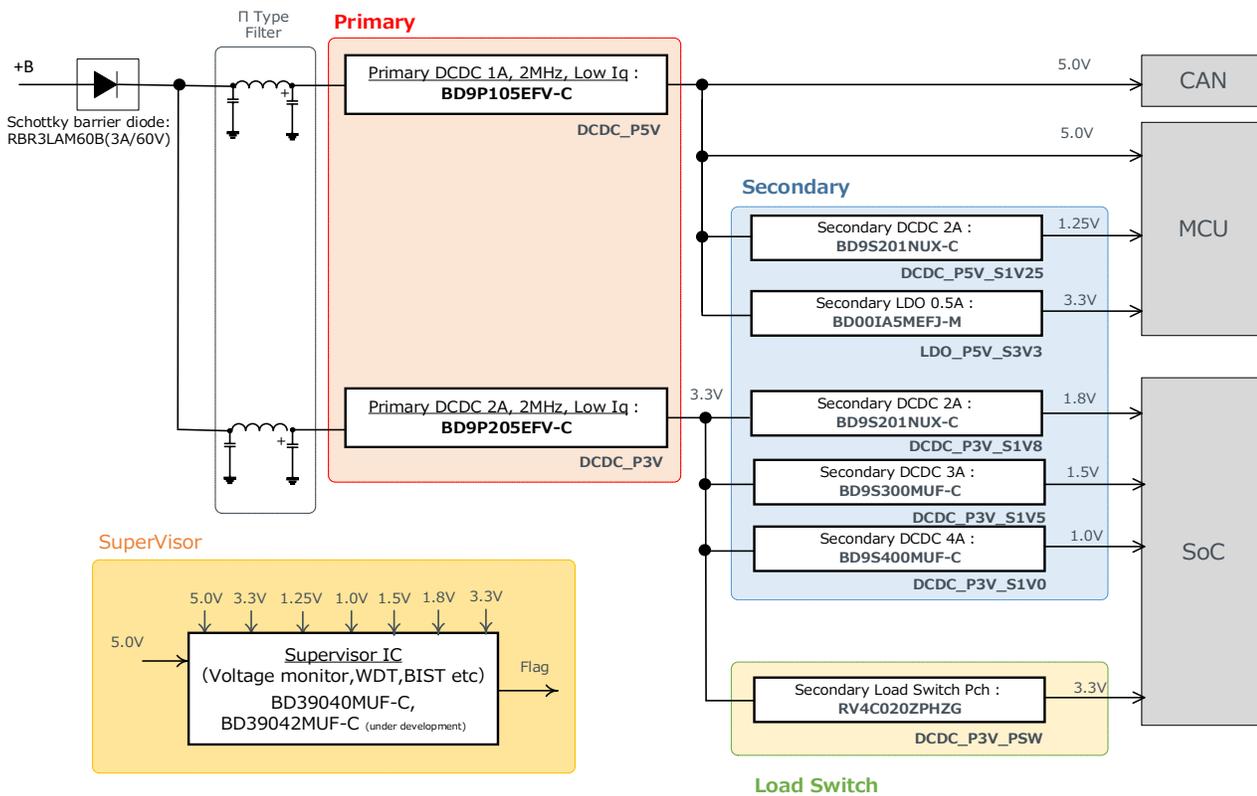


Figure 5. Reference board overview

1-8. Reference board image

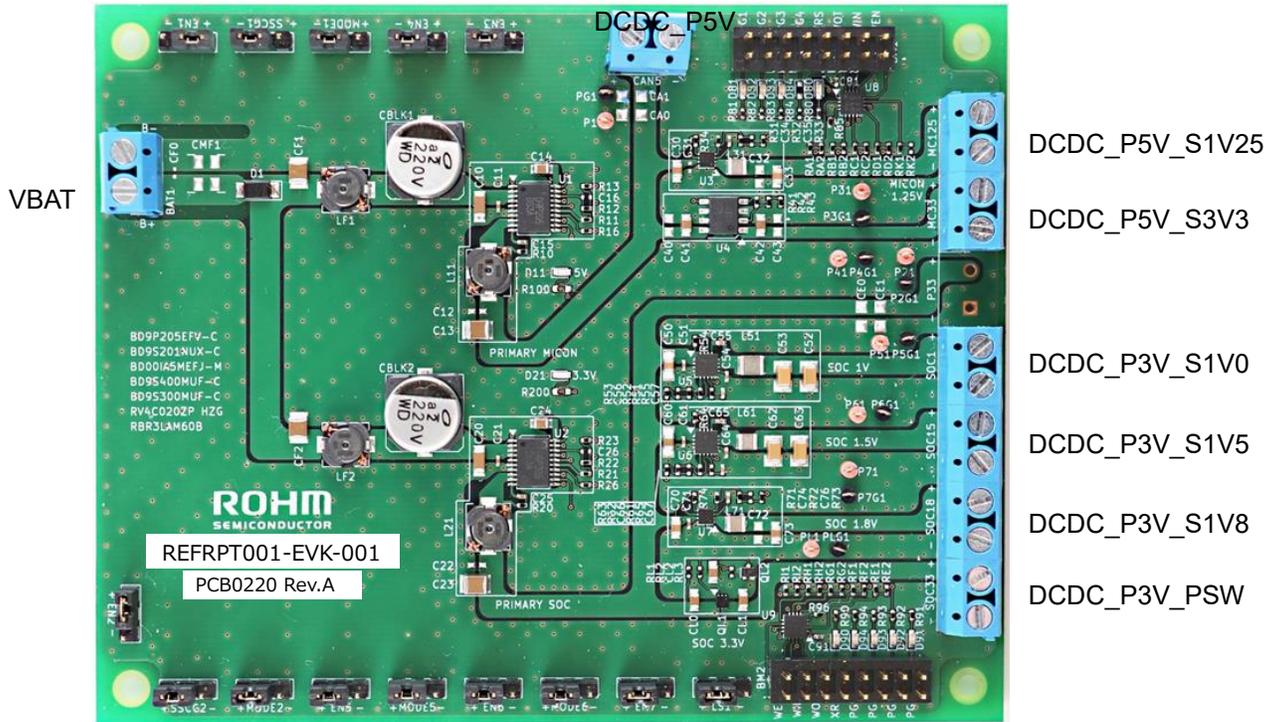


Figure 6. Reference board image

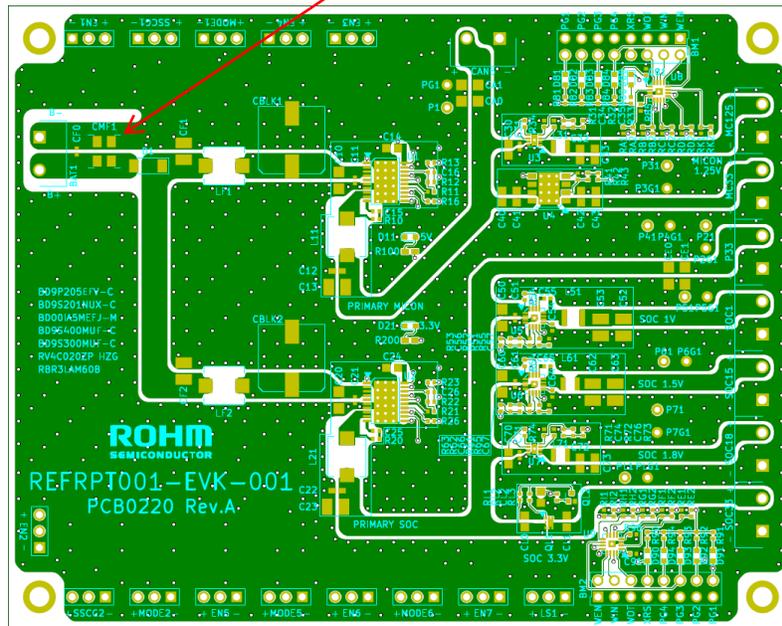
1-9. PCB pattern of reference board

PCB structure and layer spec is as shown below.

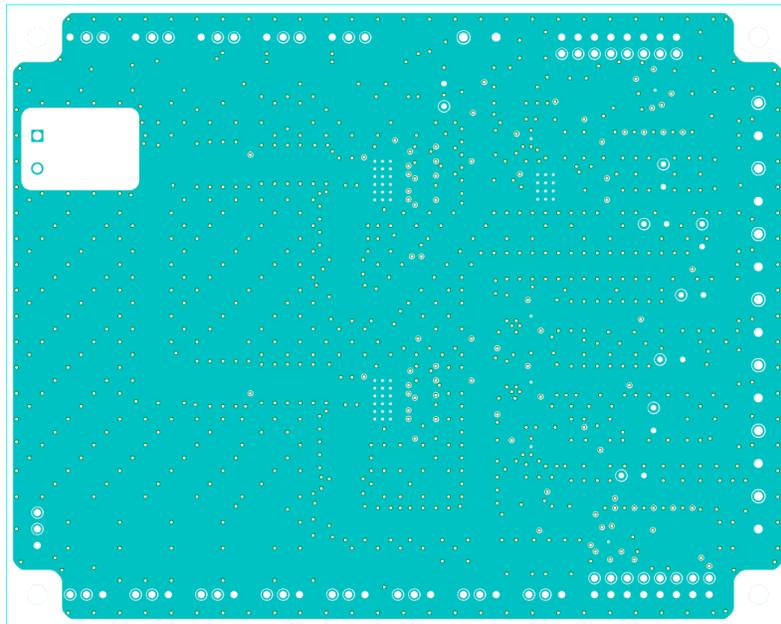
Table 5. Substrate composition

Material	FR-4
Board Thickness	1.6mm
Copper Thickness	1 oz
Number of Layers	4
Board Size	121.9X96.5mm
Minimum Copper Width	0.15mm
Minimum Air Gap	0.15mm
Minimum Hole Size	0.3mm

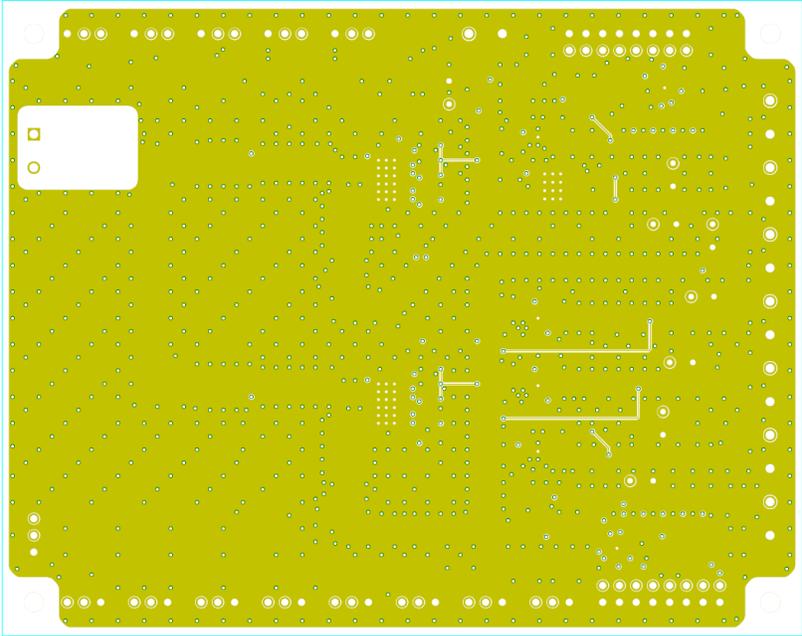
Figure 7. PCB layout
Common mode filter installation location



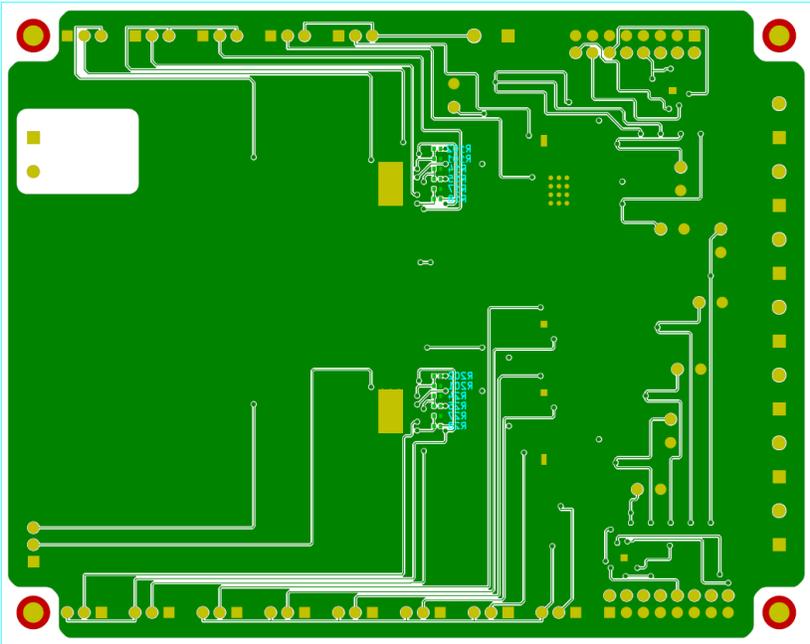
a) Top metal, Silk layer



b) Inner layer1



c) Inner layer2



d) Bottom metal layer

2.Measurement results

2-1. conducted noise measurement

2-1-1. Without common mode filter

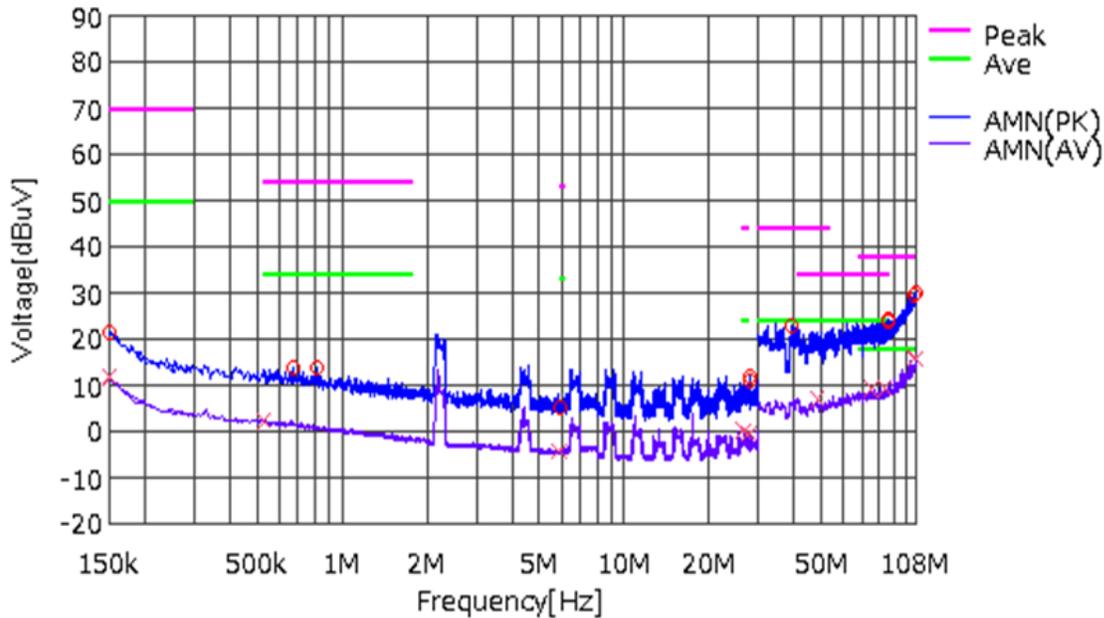


Figure 8. Measurement result - Without common mode filter

(Note 1) Pink colored line indicate Peak limit value of CISPR25 Class5.

(Note 2) Green colored line indicate Average limit value of CISPR25 Class5.

Table 6. Measurement result(data) - Without common mode filter

Band ID	Freq. [MHz]	Pol	Result			Limit			Margin			Judge
			PK	AV	QP	PK	AV	QP	PK [dB]	AV [dB]	QP [dB]	
LW	0.15	AMN	21.31	---	---	70.0	---	---	48.69	---	---	OK
MW	0.67	AMN	13.85	---	---	54.0	---	---	40.15	---	---	OK
SW	5.91	AMN	5.14	---	---	53.0	---	---	47.86	---	---	OK
CB	27.88	AMN	11.01	---	---	44.0	---	---	32.99	---	---	OK
VHF	39.30	AMN	22.94	---	---	44.0	---	---	21.06	---	---	OK
TV I	86.05	AMN	24.37	---	---	34.0	---	---	9.63	---	---	OK
VHF	86.50	AMN	23.68	---	---	38.0	---	---	14.32	---	---	OK
FM	107.80	AMN	29.84	---	---	38.0	---	---	8.16	---	---	OK
LW	0.15	AMN	---	11.93	---	---	50.0	---	---	38.07	---	OK
MW	0.53	AMN	---	2.14	---	---	34.0	---	---	31.86	---	OK
SW	5.90	AMN	---	-4.32	---	---	33.0	---	---	37.32	---	OK
CB	27.80	AMN	---	-0.47	---	---	24.0	---	---	24.47	---	OK
VHF	48.45	AMN	---	7.01	---	---	24.0	---	---	16.99	---	OK
TV I	74.90	AMN	---	9.18	---	---	24.0	---	---	14.82	---	OK
VHF	83.65	AMN	---	9.40	---	---	18.0	---	---	8.60	---	OK
FM	107.90	AMN	---	15.73	---	---	18.0	---	---	2.27	---	OK

(Note 1) The above data is an actual measurement value, not a guaranteed value.

2-1-2. With common mode filter

* DLW5BTM102TQ2(Murata)

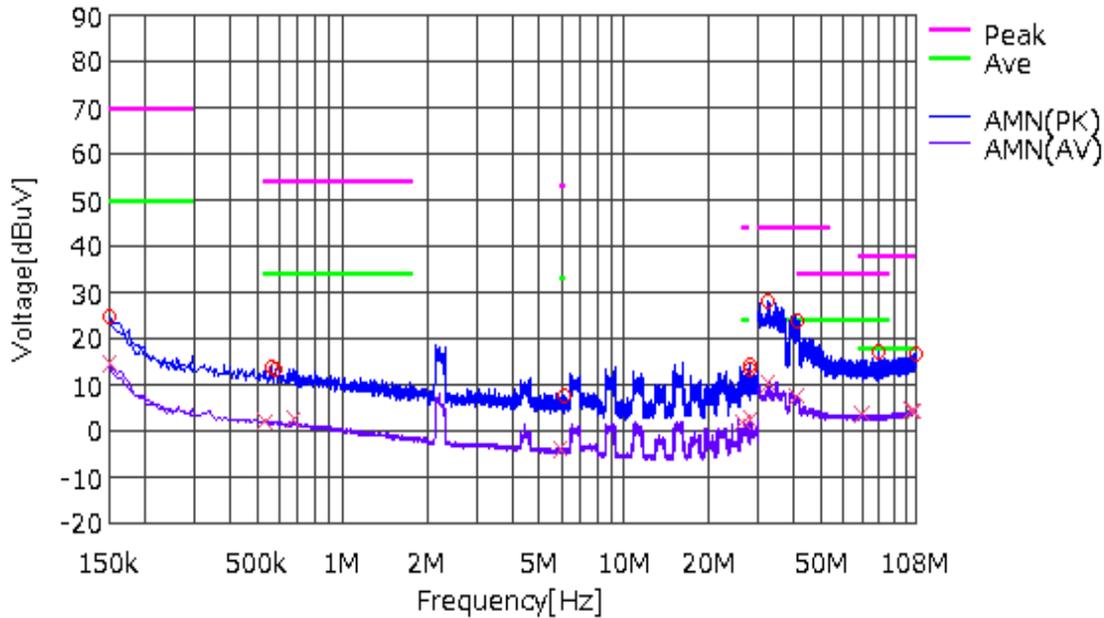


Figure 9. Measurement result - With common mode filter

(Note 1) Pink colored line indicate Peak limit value of CISPR25 Class5.

(Note 2) Green colored line indicate Average limit value of CISPR25 Class5.

Table 7. Measurement result(data) - With common mode filter

Band ID	Freq. [MHz]	Pol	Result			Limit			Margin			Judge
			PK	AV	QP	PK	AV	QP	PK	AV	QP	
									[dB]	[dB]	[dB]	
LW	0.15	AMN	24.61	---	---	70.0	---	---	45.39	---	---	OK
MW	0.56	AMN	13.97	---	---	54.0	---	---	40.03	---	---	OK
SW	6.16	AMN	7.48	---	---	53.0	---	---	45.52	---	---	OK
CB	27.90	AMN	14.40	---	---	44.0	---	---	29.60	---	---	OK
VHF	32.35	AMN	28.10	---	---	44.0	---	---	15.90	---	---	OK
TV I	41.10	AMN	23.65	---	---	34.0	---	---	10.35	---	---	OK
VHF	79.55	AMN	17.31	---	---	38.0	---	---	20.69	---	---	OK
FM	107.45	AMN	16.74	---	---	38.0	---	---	21.26	---	---	OK
LW	0.15	AMN	---	14.57	---	---	50.0	---	---	35.43	---	OK
MW	0.68	AMN	---	2.48	---	---	34.0	---	---	31.52	---	OK
SW	5.96	AMN	---	-3.90	---	---	33.0	---	---	36.90	---	OK
CB	27.94	AMN	---	2.60	---	---	24.0	---	---	21.40	---	OK
VHF	32.20	AMN	---	10.38	---	---	24.0	---	---	13.62	---	OK
TV I	41.00	AMN	---	7.39	---	---	24.0	---	---	16.61	---	OK
VHF	69.70	AMN	---	3.60	---	---	18.0	---	---	14.40	---	OK
FM	107.00	AMN	---	4.30	---	---	18.0	---	---	13.70	---	OK

(Note 1) The above data is an actual measurement value, not a guaranteed value.

2-2. Radiated noise measurements

2-2-1. Antenna in horizontal position, Without common mode filter

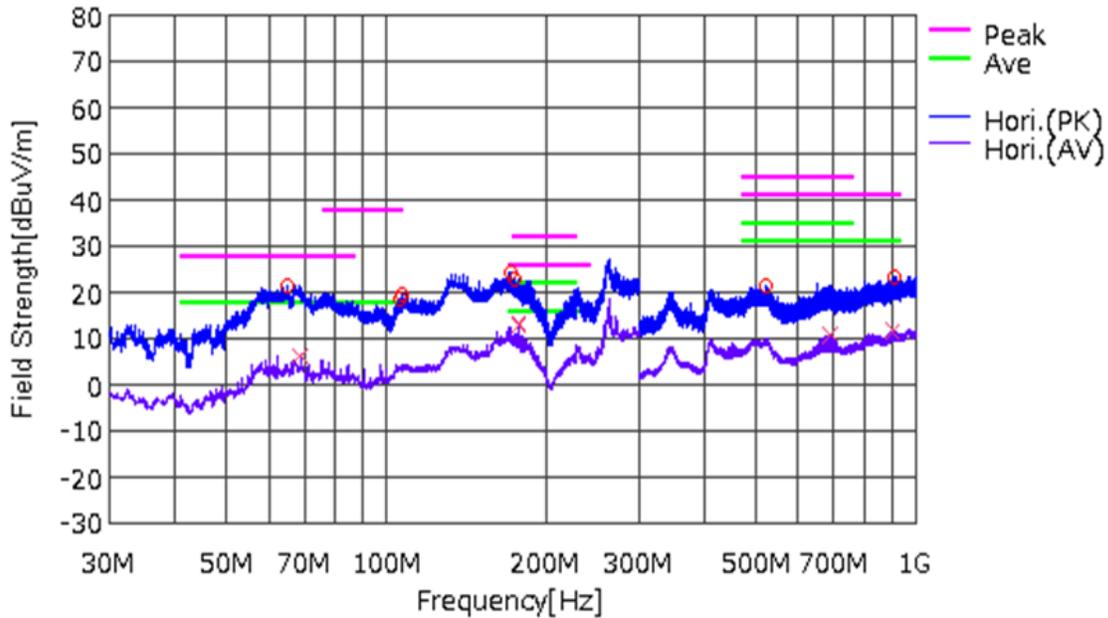


Figure 10. Radiated noise measurement result - Antenna in horizontal position

(Note1) Pink colored line indicate Peak limit value of CISPR25 Class5.

(Note 2) Green colored line indicate Average limit value of CISPR25 Class5.

Table 8. Radiated noise measurement result(data) - Antenna in horizontal position

Band ID	Freq. [MHz]	Pol	Result			Limit			Margin			Judge
			PK	AV	QP	PK	AV	QP	PK	AV	QP	
									[dB]	[dB]	[dB]	
TV I	65.30	Hori.	21.25	---	---	28.0	---	---	6.75	---	---	OK
FM	106.00	Hori.	18.56	---	---	38.0	---	---	19.44	---	---	OK
DAB III	171.20	Hori.	24.49	---	---	26.0	---	---	1.51	---	---	OK
TV III	174.80	Hori.	22.77	---	---	32.0	---	---	9.23	---	---	OK
DTTV	519.15	Hori.	21.27	---	---	45.0	---	---	23.73	---	---	OK
TV IV	908.45	Hori.	23.52	---	---	41.0	---	---	17.48	---	---	OK
TV I	68.95	Hori.	---	6.22	---	---	18.0	---	---	11.78	---	OK
DAB III	177.90	Hori.	---	12.80	---	---	16.0	---	---	3.20	---	OK
TV III	177.95	Hori.	---	13.21	---	---	22.0	---	---	8.79	---	OK
DTTV	690.20	Hori.	---	10.81	---	---	35.0	---	---	24.19	---	OK
TV IV	901.90	Hori.	---	11.61	---	---	31.0	---	---	19.39	---	OK

(Note 1) The above data is an actual measurement value, not a guaranteed value.

2-2-2. Antenna in vertical position, Without common mode filter

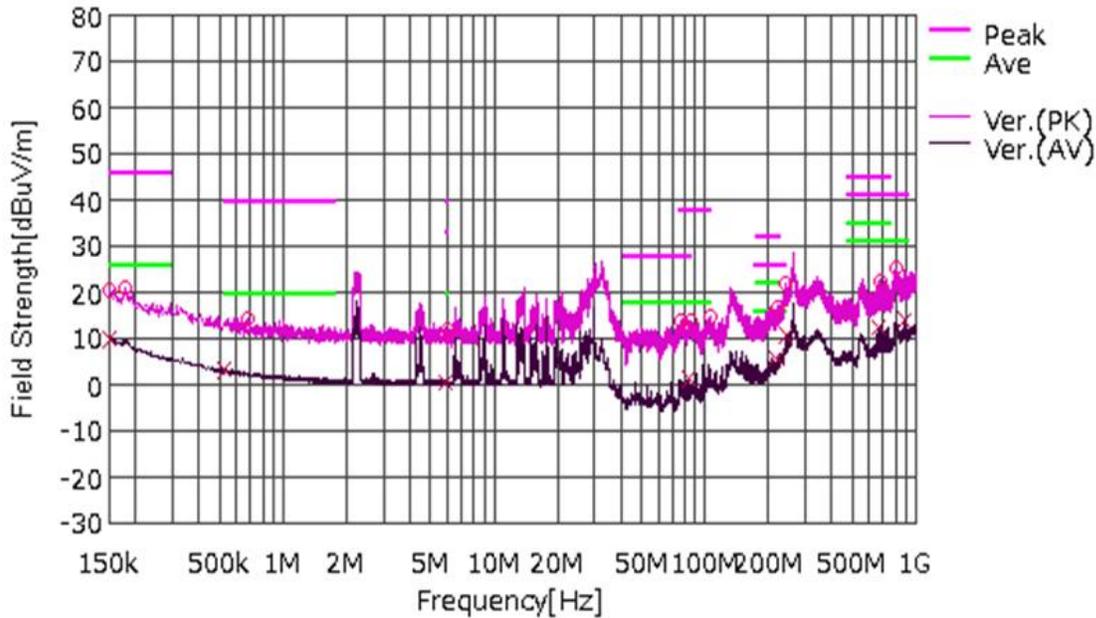


Figure 11. Radiated noise measurement result - Antenna in vertical position

(Note 1) Pink colored line indicate Peak limit value of CISPR25 Class5.

(Note 2) Green colored line indicate Average limit value of CISPR25 Class5.

Table 9. Radiated noise measurement result(data) - Antenna in vertical position

Band ID	Freq. [MHz]	Pol	Result			Limit			Margin			Judge
			PK	AV	QP	PK	AV	QP	PK [dB]	AV [dB]	QP [dB]	
LW	0.15	Ver.	20.29	---	---	46.0	---	---	25.71	---	---	OK
MW	0.68	Ver.	14.33	---	---	40.0	---	---	25.67	---	---	OK
SW	6.07	Ver.	11.93	---	---	40.0	---	---	28.07	---	---	OK
TV I	76.85	Ver.	13.76	---	---	28.0	---	---	14.24	---	---	OK
FM	106.50	Ver.	14.99	---	---	38.0	---	---	23.01	---	---	OK
TV III	219.15	Ver.	16.83	---	---	32.0	---	---	15.17	---	---	OK
DAB III	241.75	Ver.	22.10	---	---	26.0	---	---	3.90	---	---	OK
DTTV	685.25	Ver.	22.54	---	---	45.0	---	---	22.46	---	---	OK
TV IV	807.00	Ver.	25.04	---	---	41.0	---	---	15.96	---	---	OK
LW	0.15	Ver.	---	9.82	---	---	26.0	---	---	16.18	---	OK
MW	0.53	Ver.	---	3.15	---	---	20.0	---	---	16.85	---	OK
SW	5.90	Ver.	---	0.41	---	---	20.0	---	---	19.59	---	OK
TV I	84.30	Ver.	---	1.29	---	---	18.0	---	---	16.71	---	OK
TV III	219.60	Ver.	---	5.64	---	---	22.0	---	---	16.36	---	OK
DAB III	241.75	Ver.	---	10.62	---	---	16.0	---	---	5.38	---	OK
DTTV	669.75	Ver.	---	12.38	---	---	35.0	---	---	22.62	---	OK
TV IV	880.20	Ver.	---	13.90	---	---	31.0	---	---	17.10	---	OK

(Note 1) The above data is an actual measurement value, not a guaranteed value.

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