

EVALUATION DATA

MODEL NAME : ECD1000A28

Tested by : *Shintaro Oki*
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Approved by : *Tomas Isaksson*
Tomas Isaksson

P R

B X

POWERBOX

A Cosel Group Company

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Remark:

Unless specified the test condition shall be

Input voltage / Frequency: 230 [Vac] / 50 [Hz]

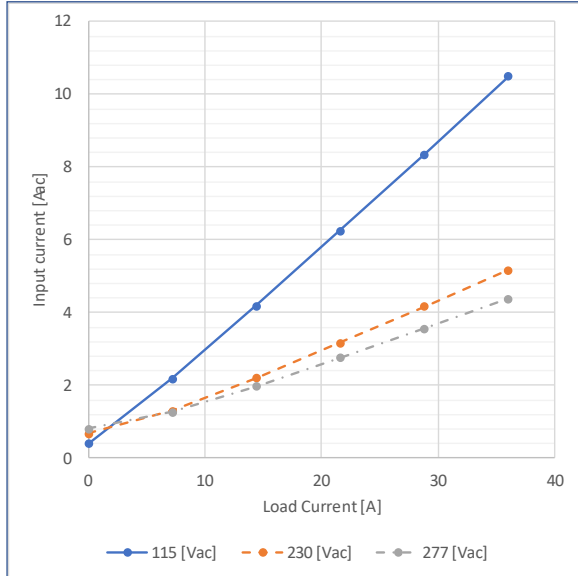
Load current: 36.0 [A]

Baseplate temperature: 25 [°C]

1. Input Current (by Load Current)

Test Circuitry : Figure A

Graph



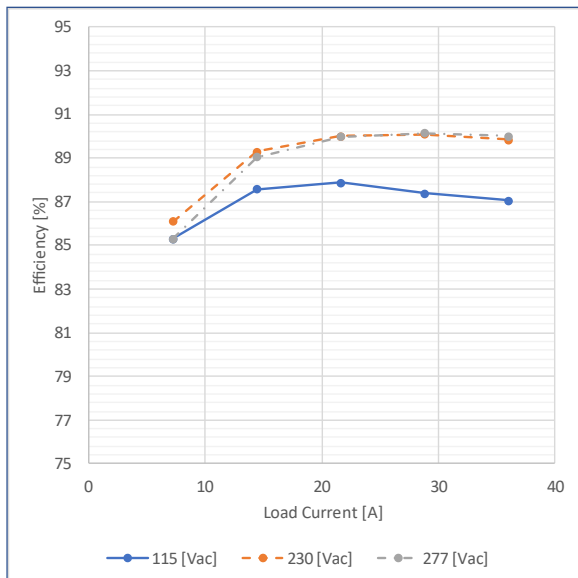
Value

| Load Current [A] | Input Current [Aac] | | |
|------------------|---------------------|-----------|-----------|
| | Input Voltage | | |
| | 115 [Vac] | 230 [Vac] | 277 [Vac] |
| 0.00 | 0.394 | 0.686 | 0.813 |
| 7.20 | 2.183 | 1.306 | 1.265 |
| 14.40 | 4.189 | 2.207 | 1.973 |
| 21.60 | 6.245 | 3.173 | 2.752 |
| 28.80 | 8.345 | 4.165 | 3.562 |
| 36.00 | 10.490 | 5.173 | 4.388 |

2. Efficiency (by Load Current)

Test Circuitry : Figure A

Graph



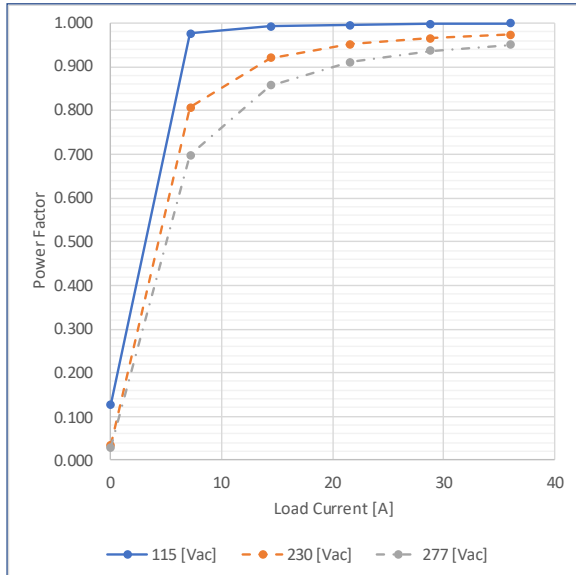
Value

| Load Current [A] | Efficiency [%] | | |
|------------------|----------------|-----------|-----------|
| | Input Voltage | | |
| | 115 [Vac] | 230 [Vac] | 277 [Vac] |
| 0.00 | - | - | - |
| 7.20 | 85.315 | 86.107 | 85.322 |
| 14.40 | 87.578 | 89.311 | 89.047 |
| 21.60 | 87.881 | 90.002 | 89.989 |
| 28.80 | 87.385 | 90.077 | 90.149 |
| 36.00 | 87.053 | 89.837 | 90.017 |

3. Power Factor (by Load Current)

Test Circuitry : Figure A

Graph



Value

| Load Current [A] | Power Factor | | |
|------------------|---------------|-----------|-----------|
| | Input Voltage | | |
| | 115 [Vac] | 230 [Vac] | 277 [Vac] |
| 0.00 | 0.128 | 0.035 | 0.029 |
| 7.20 | 0.976 | 0.807 | 0.698 |
| 14.40 | 0.992 | 0.920 | 0.857 |
| 21.60 | 0.996 | 0.952 | 0.911 |
| 28.80 | 0.998 | 0.965 | 0.936 |
| 36.00 | 0.999 | 0.973 | 0.950 |
| | | | |

4. Leakage Current

Test Circuitry : See table

Test Equipment: Simpson 228

Value

| Standard | Testing Circuitry | Measuring Method | Leakage Current [mA] | | | Note |
|------------|-------------------|------------------|----------------------|-----------|-----------|-----------|
| | | | Input Voltage | | | |
| | | | 100 [Vac] | 230 [Vac] | 277 [Vac] | |
| IEC62368-1 | Figure B-1 | Both phases | 0.25 | 0.60 | 0.74 | Operation |
| | | One of phases | 0.44 | 1.20 | 1.45 | Stand by |
| | Figure B-2 | Both phases | 0.25 | 0.60 | 0.74 | Operation |
| | | One of phases | 0.44 | 1.20 | 1.45 | Stand by |

5. Inrush Current

Test Circuitry : Figure A

— C1: Input Voltage (200V/div)
 — C4: Input Current (20A/div)

Waveform



Input Voltage : 100 [Vac]
 (100ms/div)

- ① Primary Inrush Current : 12.5 [A]
- ② Secondary Inrush Current : 28.3 [A]

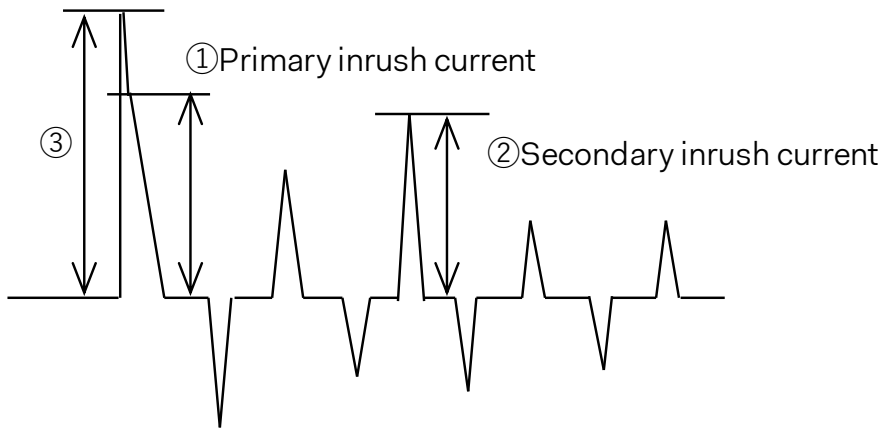


Input Voltage : 277 [Vac]
 (100ms/div)

- ① Primary Inrush Current : 37.1 [A]
- ② Secondary Inrush Current : 14.0 [A]

Remark:

A surge current flown into Line-to-Line capacitor (③) would be excluded as primary inrush current (①).

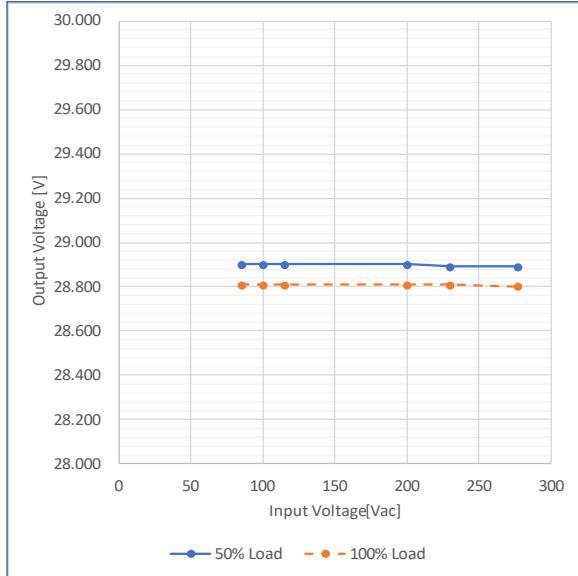


6. Line Regulation

Test Circuitry : Figure A

Change input voltage from 85 to 277 [Vac]

Graph



Value

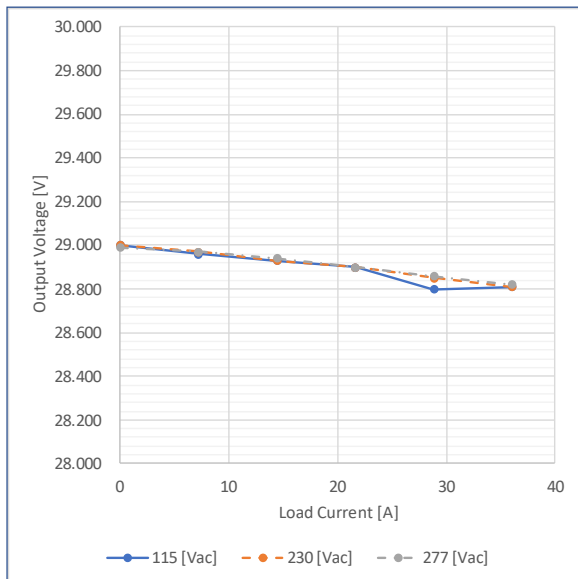
| Input Voltage [Vac] | Output Voltage [V] | |
|---------------------|--------------------|-----------|
| | Load Factor | |
| | 50% Load | 100% Load |
| 85.00 | 28.900 | 28.810 |
| 100.00 | 28.900 | 28.810 |
| 115.00 | 28.900 | 28.810 |
| 200.00 | 28.900 | 28.810 |
| 230.00 | 28.890 | 28.810 |
| 277.00 | 28.890 | 28.800 |
| | | |

7. Load Regulation

Test Circuitry : Figure A

Change Load Current from 0 to 36.0 [A]

Graph



Value

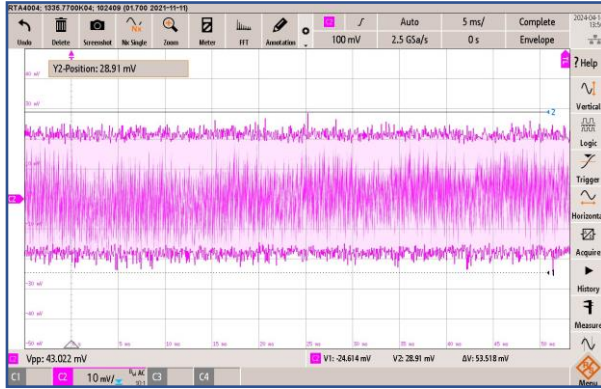
| Load Current [A] | Output Voltage [V] | | |
|------------------|--------------------|-----------|-----------|
| | Input Voltage | | |
| | 115 [Vac] | 230 [Vac] | 277 [Vac] |
| 0.00 | 29.000 | 29.000 | 28.990 |
| 7.20 | 28.960 | 28.970 | 28.970 |
| 14.40 | 28.930 | 28.930 | 28.940 |
| 21.60 | 28.900 | 28.900 | 28.900 |
| 28.80 | 28.800 | 28.850 | 28.860 |
| 36.00 | 28.810 | 28.810 | 28.820 |
| | | | |

8. Ripple Noise

Test Circuitry : Figure C

C2: Output voltage (10mV/div)
BW: 20MHz

Waveform



(5ms/div)

9. Dynamic Load Response

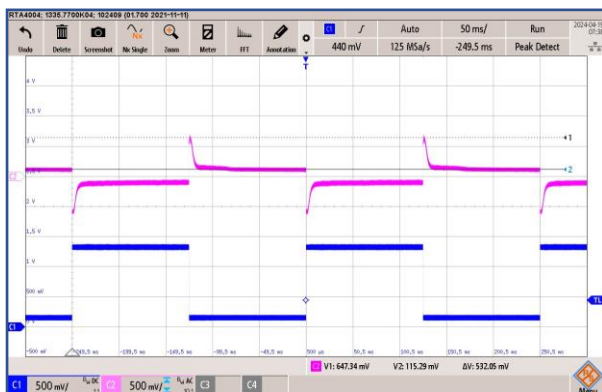
Test Circuitry : Figure A

Load Current 3.5 [A] <-> 32 [A]

C2: Output voltage (500mV/div)
C1: Output current (11.85A/div)

Waveform

Load changes from 10% to 90% of rated current.

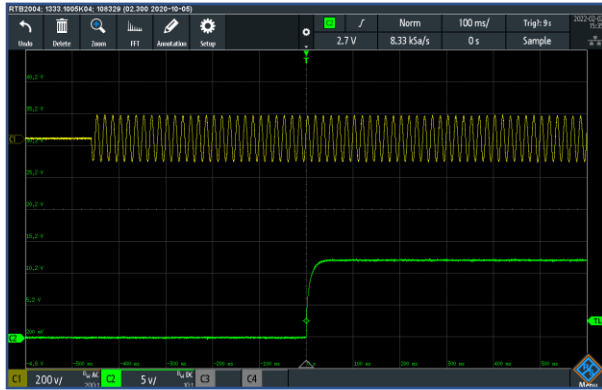


10. Rise Time Characteristics by AC ON

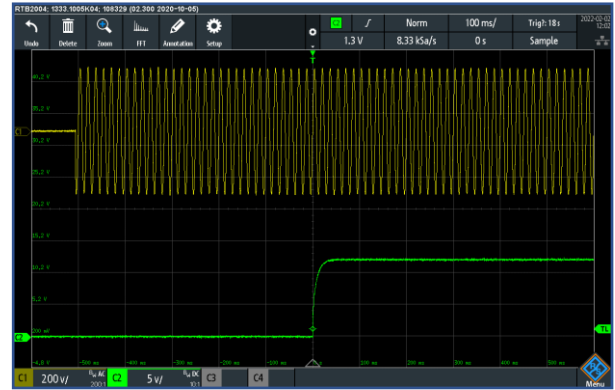
Test Circuitry : Figure A

— C1: Input voltage (200V/div)
— C2: Output voltage (5V/div)

Waveform



Input Voltage 100 [Vac]
Load Current 36.0 [A]
(100ms/div)



Input Voltage 277 [Vac]
Load Current 36.0 [A]
(100ms/div)

11. Rise Time Characteristics with RC Signal

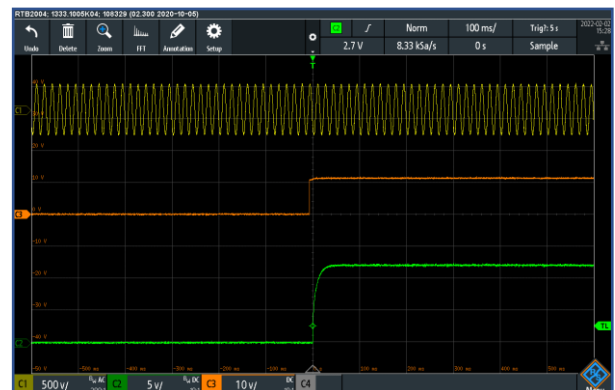
Test Circuitry : Figure D

— C1: Input voltage (500V/div)
— C2: Output voltage (5V/div)
— C3: RC signal (10V/div)

Waveform



Input Voltage 100 [Vac]
Load Current 36.0 [A]
(100ms/div)



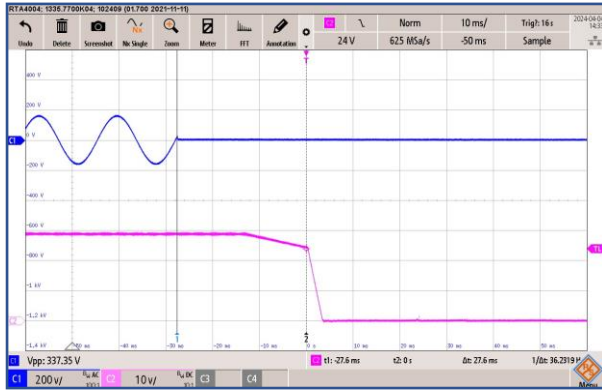
Input Voltage 277 [Vac]
Load Current 36.0 [A]
(100ms/div)

12. Fall Time / Hold-up Time

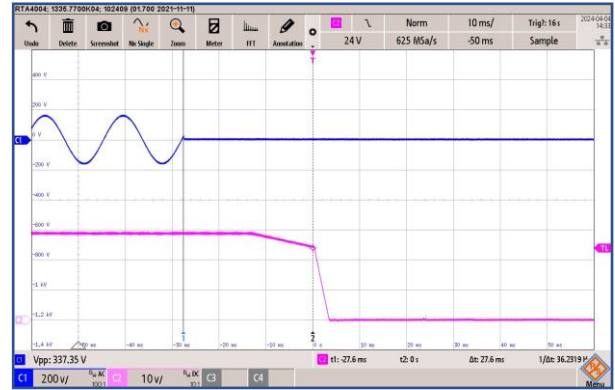
Test Circuitry : Figure A

— C1: Input voltage (200V/div)
— C2: Output voltage (5V/div)

Waveform

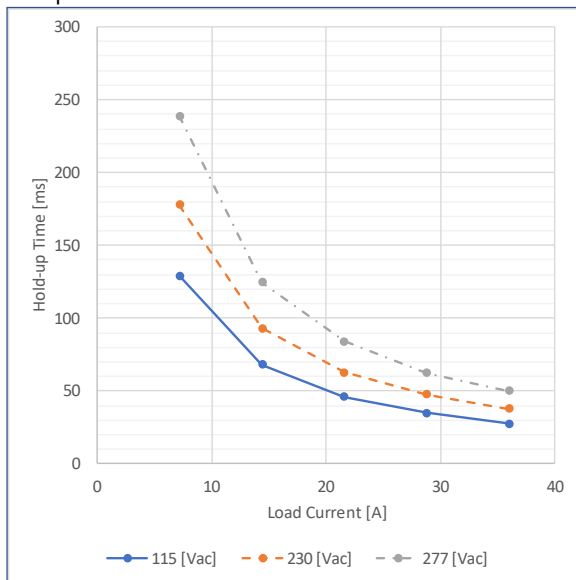


Input Voltage 115 [Vac]
Load Current 36.0 [A]
(10ms/div)



Input Voltage 277 [Vac]
Load Current 36.0 [A]
(10ms/div)

Graph



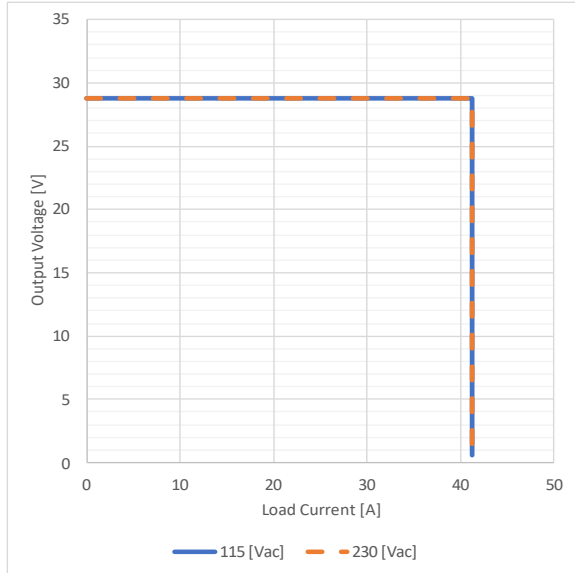
Value

| Load Current [A] | Hold-up Time [ms] | | |
|------------------|-------------------|-----------|-----------|
| | Input Voltage | | |
| | 115 [Vac] | 230 [Vac] | 277 [Vac] |
| 0.00 | - | - | - |
| 7.20 | 129.0 | 178.0 | 239.0 |
| 14.40 | 68.0 | 93.0 | 124.5 |
| 21.60 | 46.2 | 62.6 | 84.2 |
| 28.80 | 35.0 | 47.8 | 62.4 |
| 36.00 | 27.6 | 37.9 | 50.2 |

13. Over Current Protection

Test Circuitry : Figure A

Graph



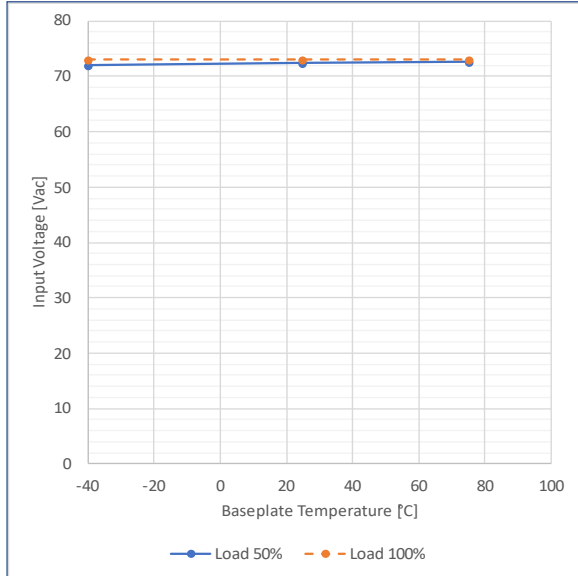
Value

| Output Voltage [V] | Load Current [A] | |
|--------------------|------------------|-----------|
| | Input Voltage | |
| | 115 [Vac] | 230 [Vac] |
| 28.00 | 41.200 | 41.200 |
| 23.33 | 41.200 | 41.200 |
| 18.67 | 41.200 | 41.200 |
| 14.00 | 41.300 | 41.300 |
| 9.33 | 41.200 | 41.200 |
| 4.67 | 41.200 | 41.200 |
| | | |

14. Minimum Input Voltage for Regulated Output Voltage

Test Circuitry : Figure A

Graph



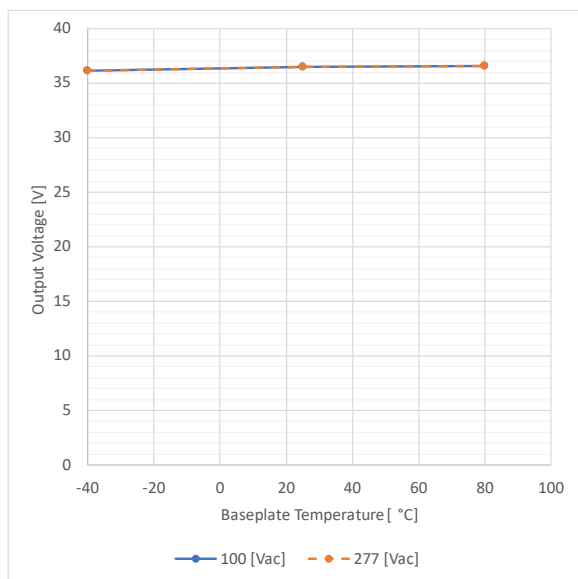
Value

| Baseplate Temperature [°C] | Input Voltage [Vac] | |
|----------------------------|---------------------|-----------|
| | Load Current | |
| | Load 50% | Load 100% |
| -40 | 72.0 | 73.0 |
| 25 | 72.4 | 73.0 |
| 75 | 72.6 | 73.0 |
| | | |
| | | |
| | | |
| | | |

15. Over Voltage Protection

Test Circuitry : Figure A

Graph



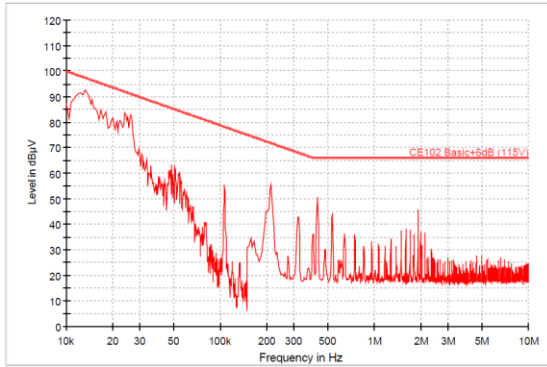
Value

| Baseplate Temperature [°C] | Output Voltage [V] | |
|----------------------------|--------------------|-----------|
| | Input Voltage | |
| | 100 [Vac] | 277 [Vac] |
| -40 | 36.160 | 36.160 |
| 25 | 36.450 | 36.460 |
| 80 | 36.570 | 36.570 |
| | | |
| | | |
| | | |
| | | |

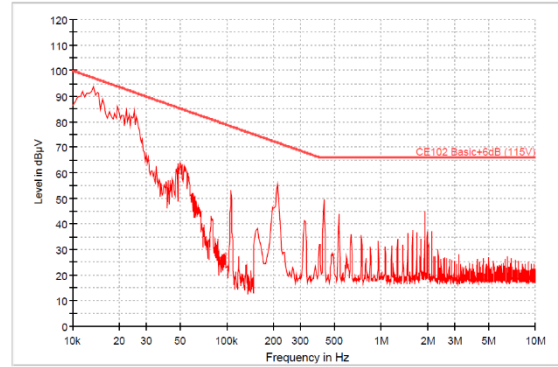
16. Conducted Emission

Input Voltage : 115Vac / 230Vac 50Hz

Load : 100 %

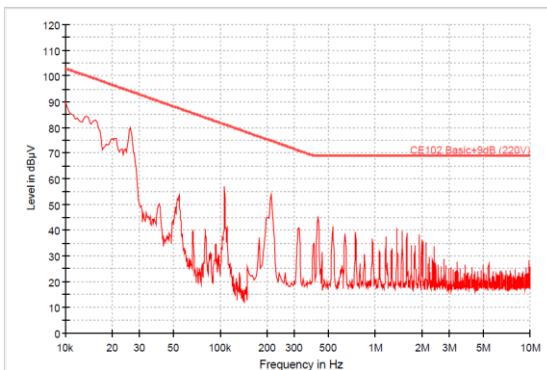


30054 0159 CE102 115V/AC EUTS L
 PK+_MAXH CE102 Basic+6dB (115V)

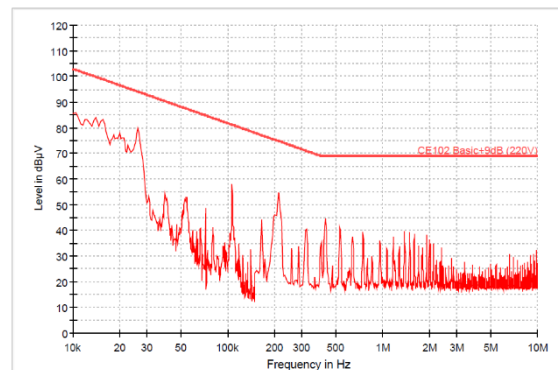


30054 0160 CE102 115V/AC EUTS N
 PK+_MAXH CE102 Basic+6dB (115V)

Fig. 16.1 MIL-STD-461F CE102 Result, ECD1000A28, 115V, Line and Neutral



30054 0150 CE102 230V/AC EUTS L
 PK+_MAXH CE102 Basic+9dB (220V)



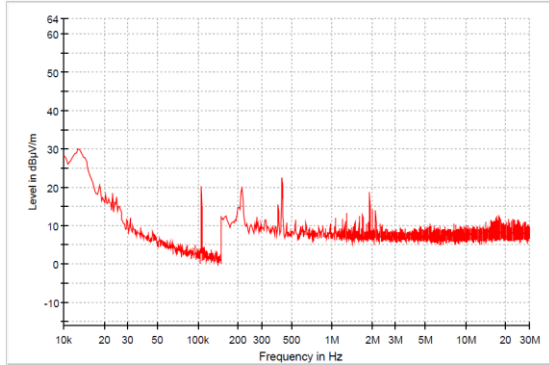
30054 0149 CE102 230V/AC EUTS N
 PK+_MAXH CE102 Basic+9dB (220V)

Fig. 16.2 MIL-STD-461F CE102 Result, ECD1000A28, 230V, Line and Neutral

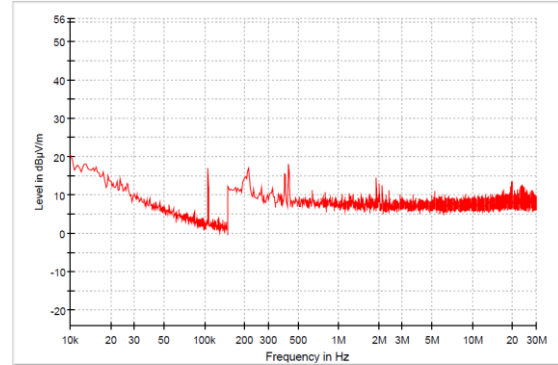
17. Radiated Emission

Input Voltage : 115Vac / 230Vac 50Hz

Load : 100 %

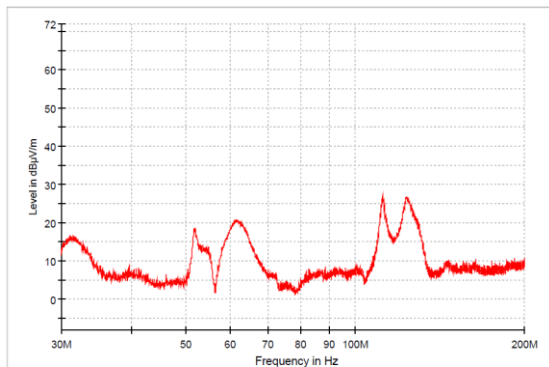


30054 0155 RE102 10k-30M 115VAC EUT5
PK+_CLRWR

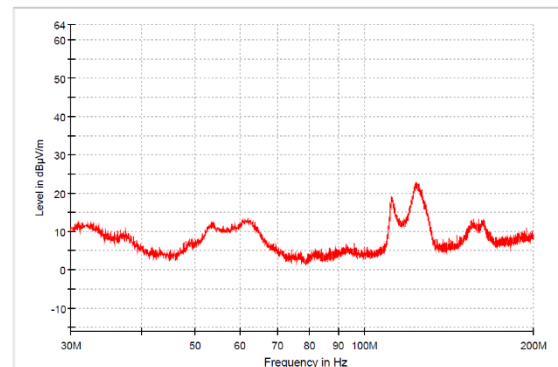


30054 0154 RE102 10k-30M 230VAC EUT5
PK+_CLRWR

Fig. 17.1 MIL-STD-461F RE102 10kHz to 30MHz Result, ECD1000A28, 115V and 230V

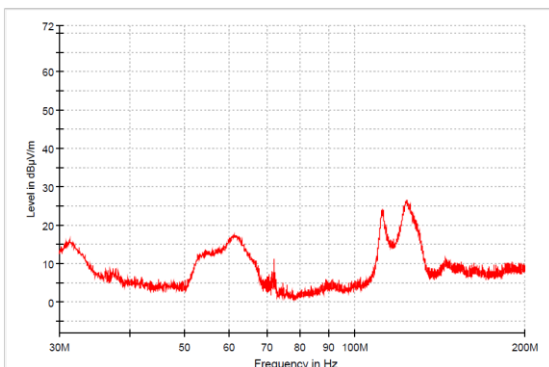


30054 0161 RE102 30M-200M 115V EUT5 VER
PK+_CLRWR

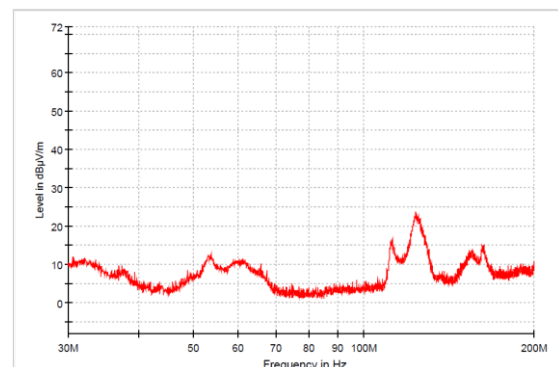


30054 0162 RE102 30M-200M 115V EUT5 HOR
PK+_CLRWR

Fig. 17.2 MIL-STD-461F RE102 30MHz to 200MHz Result, ECD1000A28, 115V, Vertical and Horizontal

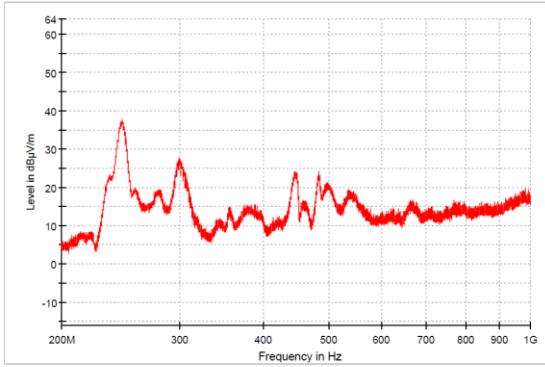


30054 0164 RE102 30M-200M 230V EUT5 VER
PK+_CLRWR

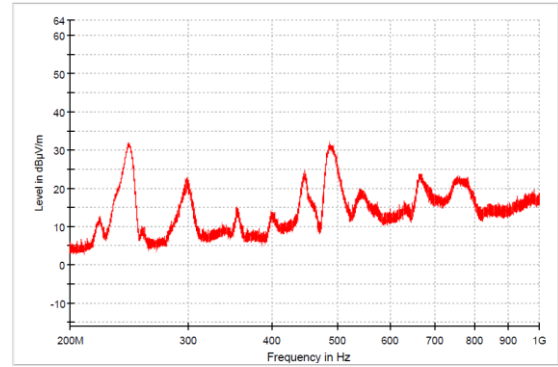


30054 0163 RE102 30M-200M 230V EUT5 HOR
PK+_CLRWR

Fig. 17.3 MIL-STD-461F RE102 30MHz to 200MHz Result, ECD1000A28, 230V, Vertical and Horizontal

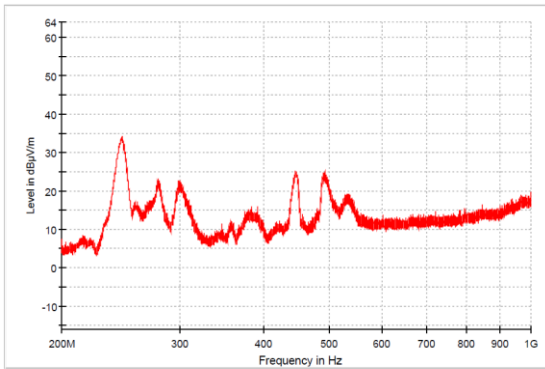


30054 0176 RE102 200M-1G 115V EUT5 VER
PK+_CLRWR

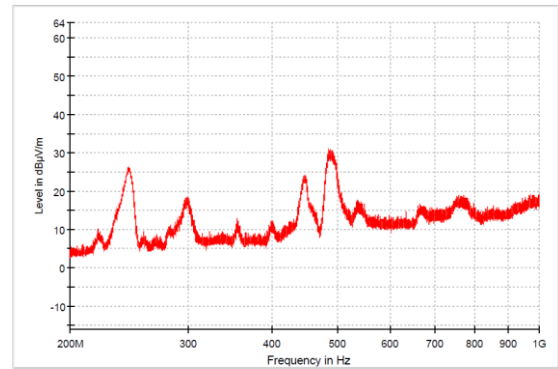


30054 0175 RE102 200M-1G 115V EUT5 HOR
PK+_CLRWR

Fig. 17.4 MIL-STD-461F RE102 200MHz to 1GHz Result, ECD1000A28, 115V, Vertical and Horizontal

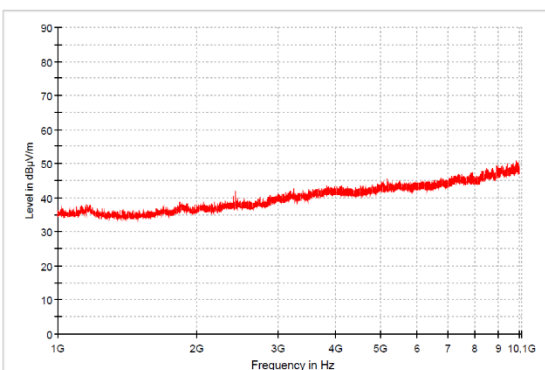


30054 0173 RE102 200M-1G 230V EUT5 VER
PK+_CLRWR

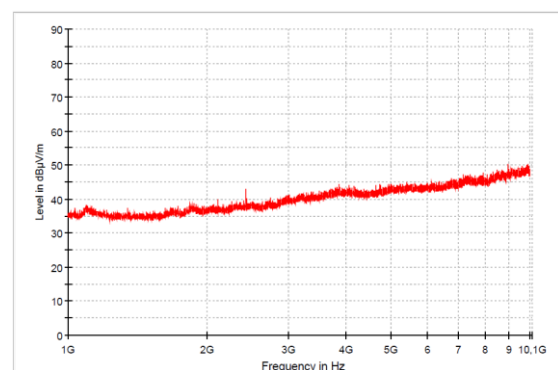


30054 0174 RE102 200M-1G 230V EUT5 HOR
PK+_CLRWR

Fig. 17.5 MIL-STD-461F RE102 200MHz to 1GHz Result, ECD1000A28, 230V, Vertical and Horizontal

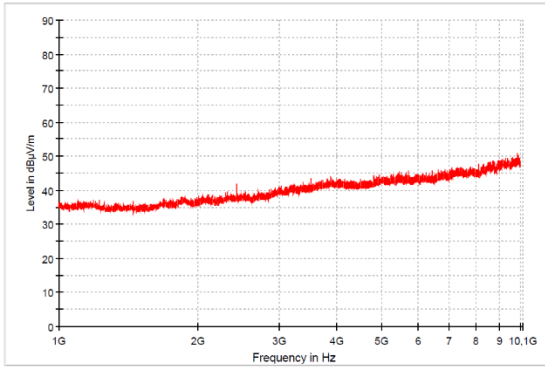


30054 0182 RE102 1G-10G 115V EUT5 VER
PK+_CLRWR

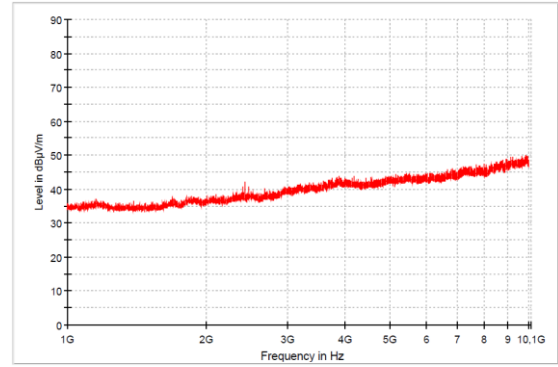


30054 0183 RE102 1G-10G 115V EUT5 HOR
PK+_CLRWR

Fig. 17.6 MIL-STD-461F RE102 1GHz to 10GHz Result, ECD1000A28, 115V, Vertical and Horizontal

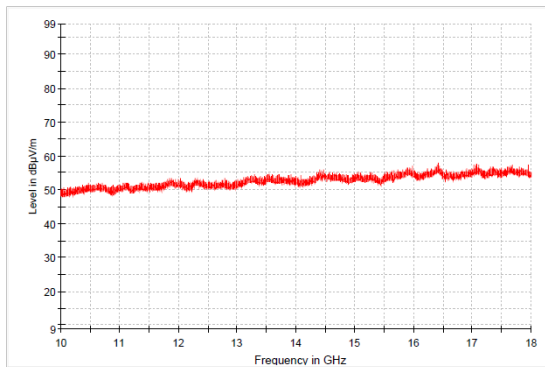


30054 0180 RE102 1G-10G 230V EUT5 VER
PK+_CLRWR

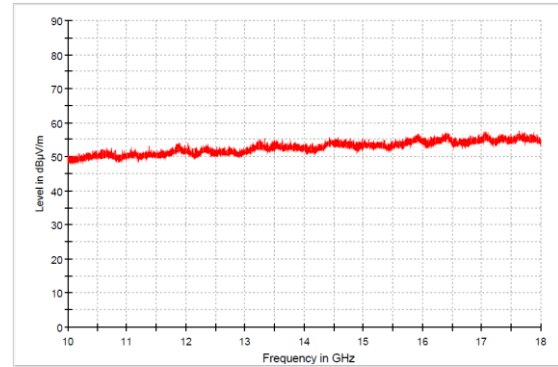


30054 0181 RE102 1G-10G 230V EUT5 HOR
PK+_CLRWR

Fig. 17.7 MIL-STD-461F RE102 1GHz to 10GHz Result, ECD1000A28, 230V, Vertical and Horizontal

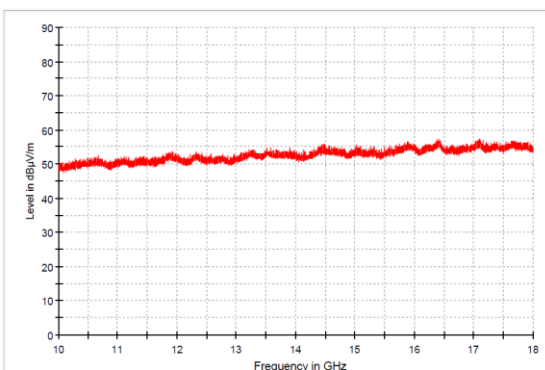


30054 0184 RE102 10G-18G 115V EUT5 VER
PK+_CLRWR

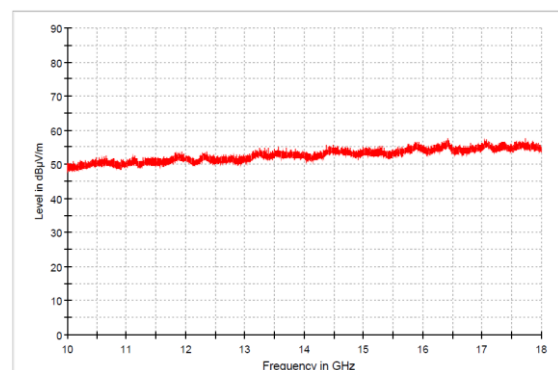


30054 0185 RE102 10G-18G 115V EUT5 HOR
PK+_CLRWR

Fig. 17.8 MIL-STD-461F RE102 10GHz to 18GHz Result, ECD1000A28, 115V, Vertical and Horizontal



30054 0187 RE102 10G-18G 230V EUT5 VER
PK+_CLRWR



30054 0188 RE102 10G-18G 230V EUT5 HOR
PK+_CLRWR

Fig. 17.9 MIL-STD-461F RE102 10GHz to 18GHz Result, ECD1000A28, 230V, Vertical and Horizontal



Fig. 17.10 MIL-STD-461F CE102 and RE102 test set-up

18. Figure of Test Circuitry

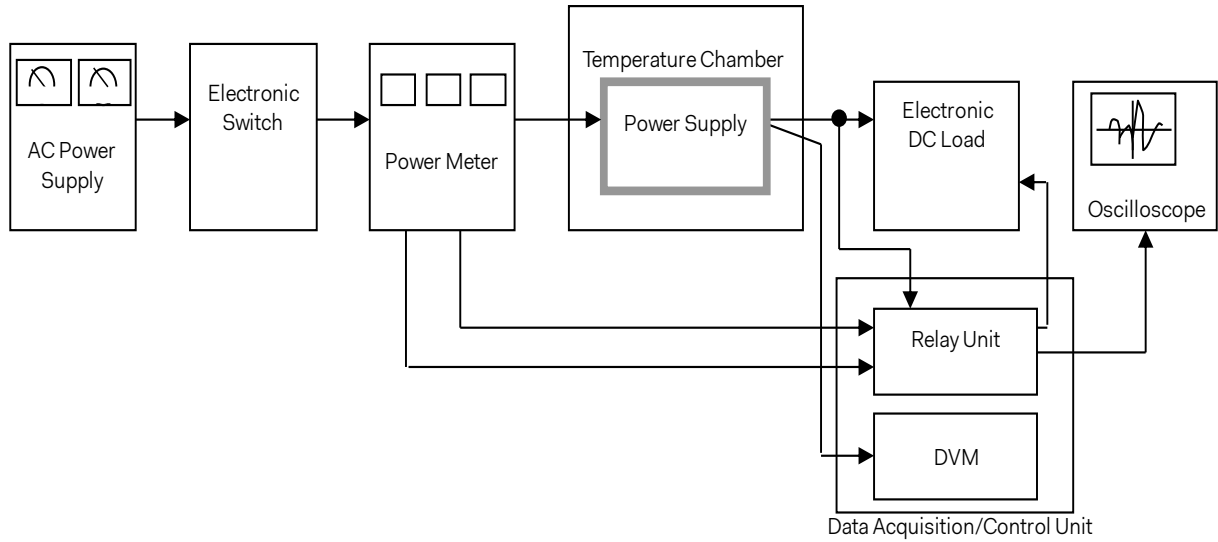


Figure A Test circuitry for general performance measurement

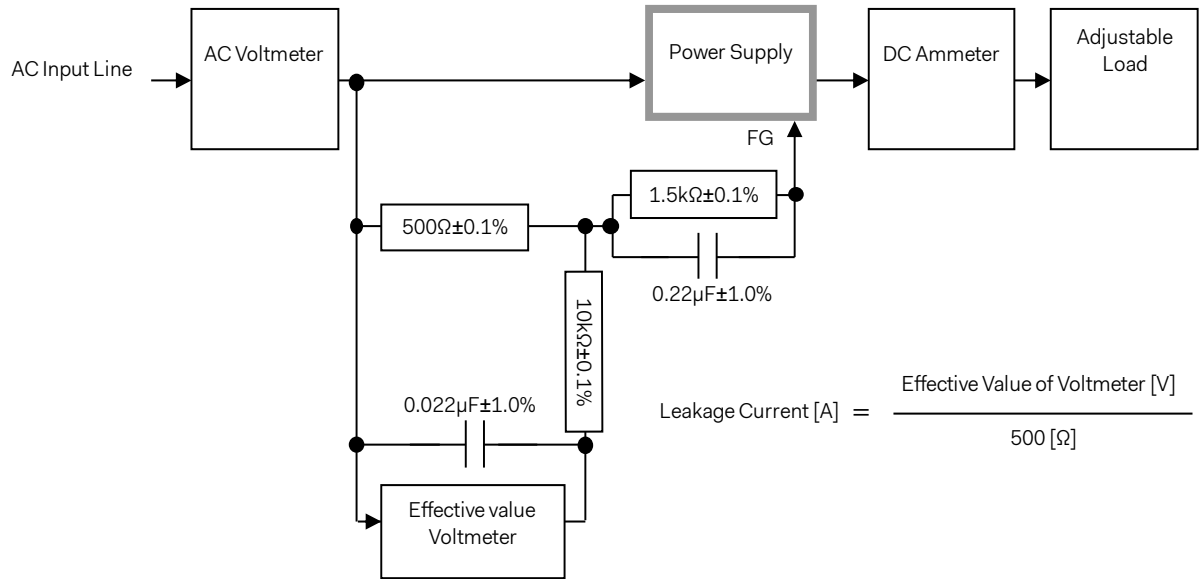


Figure B-1 Leakage current measurement (IEC62368-1, refer to IEC60990 Fig.4)

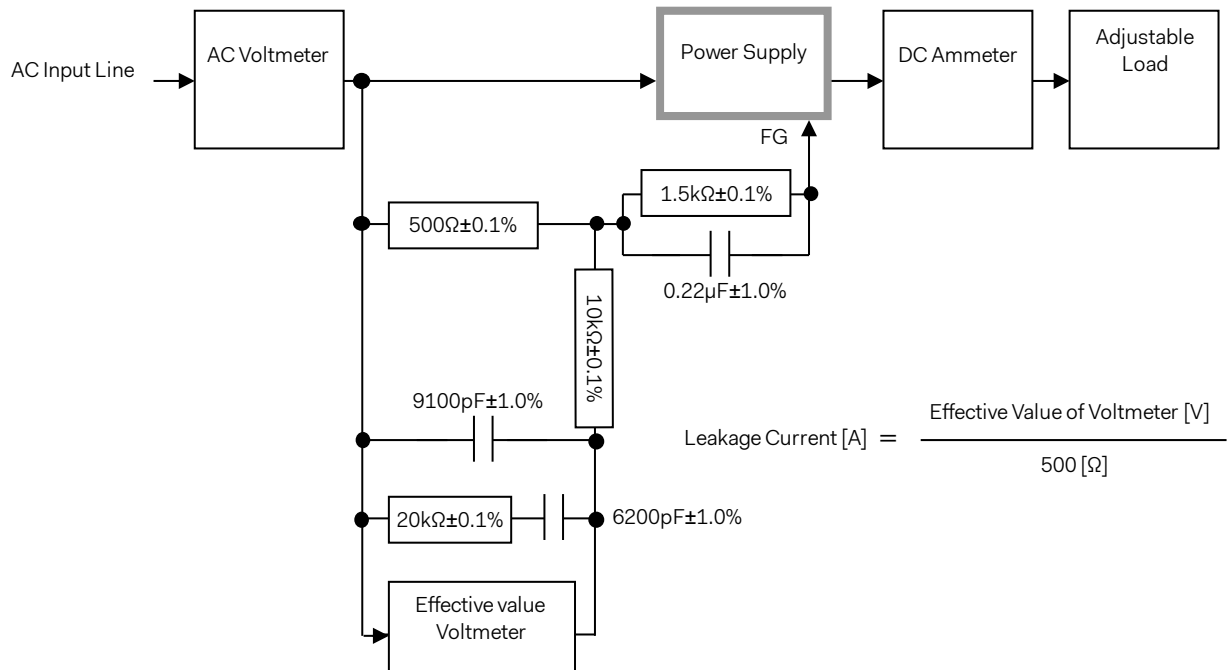


Figure B-2 Leakage current measurement (IEC62368-1, refer to IEC60990 Fig.5)

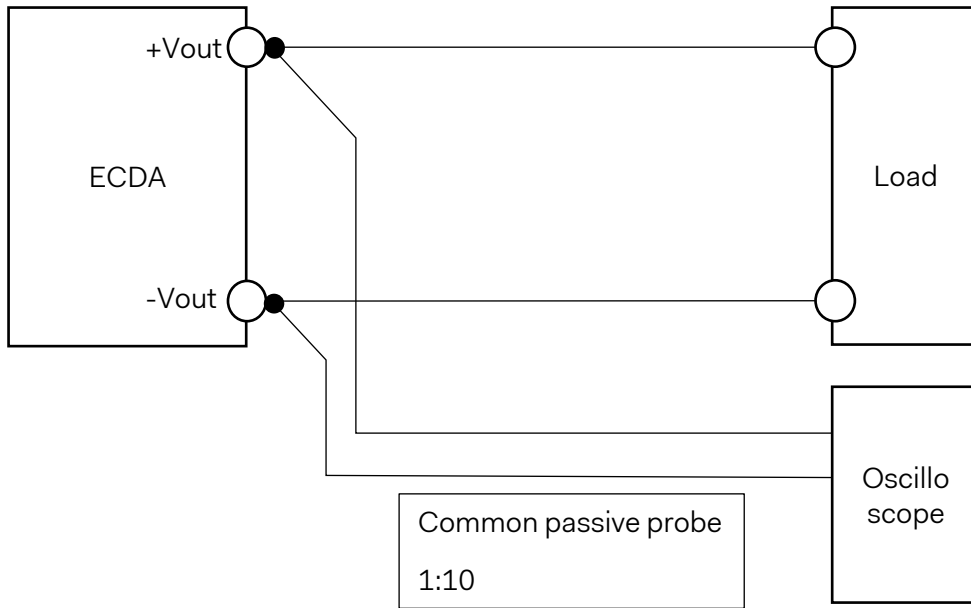


Figure C Ripple voltage measurement

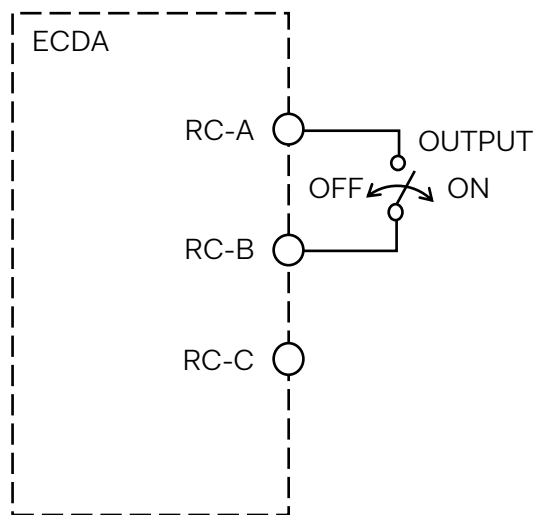


Figure D Turn on by RC measurement