COSEL

TEST DATA OF PCA600F-15-P2

Regulated DC Power Supply
March 14, 2017

Approved by : _Koji Todo_ _____

Koji Todo   Design Manager

Prepared by : _Yutaka Tamura_ _____

Yutaka Tamura   Design Engineer

COSEL CO.,LTD.

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Model	PCA600F-15-P2
Item	Input Current (by Load Current)
Object	————————

Temperature   25°C
Testing Circuitry   Figure A

1.Graph

— △ — Input Volt. 100V
--- ⊟ --- Input Volt. 200V
—·— ○ —·— Input Volt. 230V

Input Current [A] vs Load Current [A]

Note: Slanted line shows the range of the rated load current.

2.Values

Load Current [A]	Input Current [A]		
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]
0.0	0.193	0.147	0.152
8.0	1.431	0.751	0.673
16.0	2.706	1.375	1.213
24.0	4.010	2.012	1.765
32.0	5.340	2.674	2.345
40.0	6.680	3.321	2.906
43.0	7.200	3.560	3.118
47.3	7.930	3.920	3.422
--	-	-	-
--	-	-	-
--	-	-	-

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Model	PCA600F-15-P2
Item	Input Power (by Load Current)
Object	_____

Temperature 25°C
Testing Circuitry Figure A

1.Graph

———△——— Input Volt. 100V
- - -◻- - - Input Volt. 200V
—·—○—·— Input Volt. 230V

Input Power [W]
Load Current [A]

Note: Slanted line shows the range of the rated
load current.

2.Values

Load Current [A]	Input Power [W]		
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]
0.0	13.5	10.5	10.3
8.0	140.7	138.1	138.1
16.0	268.6	264.7	264.2
24.0	399.0	392.9	392.0
32.0	532.0	523.4	523.0
40.0	666.0	653.1	652.0
43.0	717.0	702.0	700.0
47.3	791.0	773.0	771.0
--	-	-	-
--	-	-	-
--	-	-	-

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Model	PCA600F-15-P2
Item	Efficiency (by Input Voltage)
Object	

Temperature   25°C
Testing Circuitry   Figure A

1.Graph

- - - ⊟ - - -   Load 50%
———△———   Load 100%

Efficiency [%] vs Input Voltage [V]

Note: Slanted line shows the range of the rated input voltage.
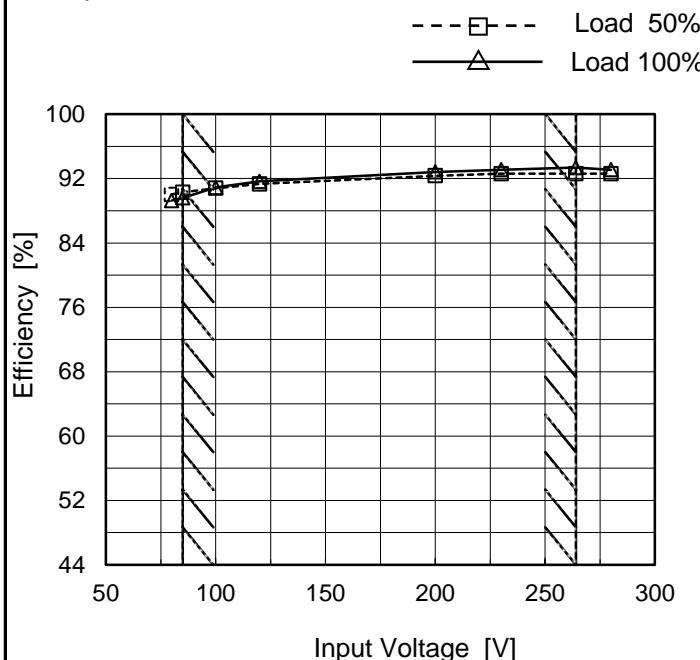
2.Values

Input Voltage [V]	Efficiency [%]	
	Load 50%	Load 100%
80	90.0	89.3
85	90.3	89.6
100	90.8	90.9
120	91.3	91.7
200	92.3	92.8
230	92.6	93.1
264	92.6	93.4
280	92.6	93.1
--	-	-

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Model	PCA600F-15-P2
Item	Efficiency (by Load Current)
Object	————————

Temperature   25°C
Testing Circuitry   Figure A

1.Graph

— △ — Input Volt. 100V
- - - ⊟ - - - Input Volt. 200V
— · — ○ — · — Input Volt. 230V

Efficiency [%] (vertical axis)
Load Current [A] (horizontal axis)

2.Values

Load Current [A]	Efficiency [%]		
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]
0.0	-	-	-
8.0	86.1	87.7	87.7
16.0	90.2	91.5	91.7
24.0	91.2	92.6	92.8
32.0	91.2	92.7	92.7
40.0	91.0	92.8	93.0
43.0	90.9	92.8	93.1
47.3	90.6	92.7	93.0
--	-	-	-
--	-	-	-
--	-	-	-

Note: Slanted line shows the range of the rated load current.

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Model	PCA600F-15-P2
Item	Power Factor (by Input Voltage)
Object	

Temperature   25°C
Testing Circuitry   Figure A

1.Graph

--- ⊟ ---   Load 50%
——△——   Load 100%

Power Factor vs Input Voltage [V]

Note: Slanted line shows the range of the rated input voltage.
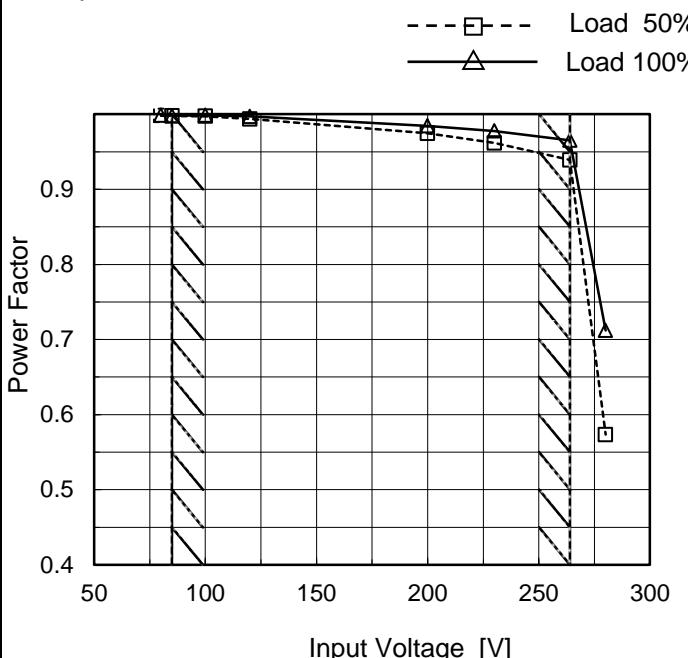
2.Values

Input Voltage [V]	Power Factor	
	Load 50%	Load 100%
80	0.998	0.999
85	0.998	0.998
100	0.997	0.999
120	0.994	0.997
200	0.975	0.985
230	0.962	0.978
264	0.939	0.965
280	0.573	0.712
--	-	-

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Model	PCA600F-15-P2
Item	Power Factor (by Load Current)
Object	

Temperature 25°C
Testing Circuitry Figure A

1.Graph

	Input Volt.	100V
△	Input Volt.	100V
⊟	Input Volt.	200V
○	Input Volt.	230V

Power Factor vs Load Current [A]

Note: Slanted line shows the range of the rated load current.

2.Values

Load Current [A]	Power Factor		
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]
0.0	0.702	0.359	0.296
8.0	0.985	0.920	0.893
16.0	0.994	0.963	0.948
24.0	0.995	0.977	0.966
32.0	0.998	0.979	0.970
40.0	0.999	0.984	0.976
43.0	0.999	0.985	0.978
47.3	0.999	0.987	0.980
--	-	-	-
--	-	-	-
--	-	-	-

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Model	PCA600F-15-P2
Item	Inrush Current
Object	————————
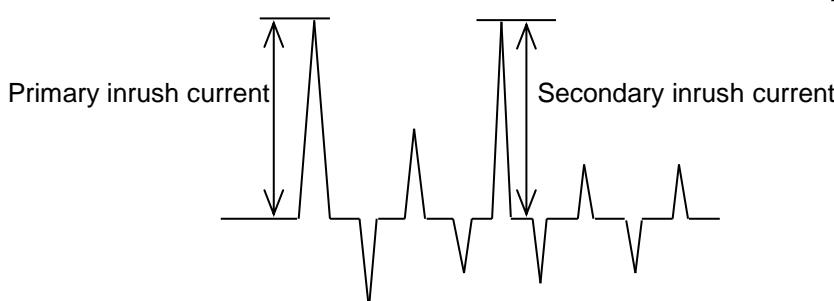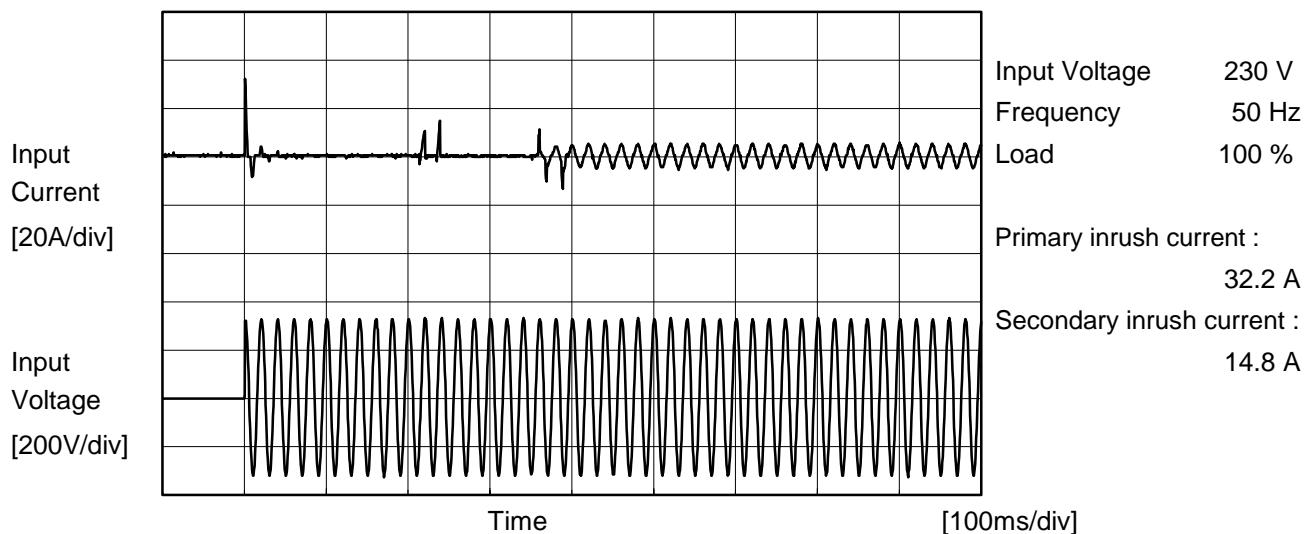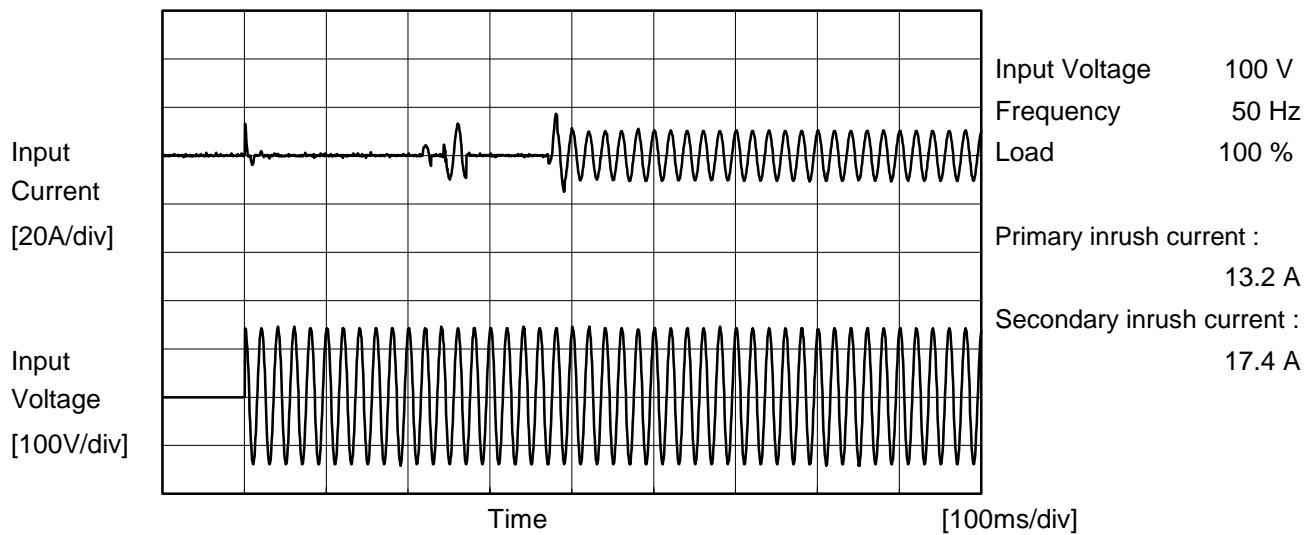
Temperature 25°C
Testing Circuitry Figure A

Input
Current
[20A/div]

Input
Voltage
[100V/div]

Time [100ms/div]

Input Voltage 100 V
Frequency 50 Hz
Load 100 %

Primary inrush current :
13.2 A
Secondary inrush current :
17.4 A

Input
Current
[20A/div]

Input
Voltage
[200V/div]

Time [100ms/div]

Input Voltage 230 V
Frequency 50 Hz
Load 100 %

Primary inrush current :
32.2 A
Secondary inrush current :
14.8 A

Primary inrush current   Secondary inrush current

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Model	PCA600F-15-P2	
Item	Leakage Current	Temperature 25°C
Object	―――――――――	Testing Circuitry Figure B

1.Results

[mA]

Standards	Testing Circuitry	Measuring Method	Input Volt.			Note
			100 [V]	230 [V]	240 [V]	
DEN-AN	Figure B-1	Both phases	0.13	0.30	0.31	Operation
		One of phases	0.25	0.56	0.58	Stand by
IEC62368-1	Figure B-2	Both phases	0.12	0.29	0.30	Operation
		One of phases	0.25	0.54	0.56	Stand by
	Figure B-3	Both phases	0.12	0.29	0.30	Operation
		One of phases	0.25	0.54	0.57	Stand by
IEC60601-1	Figure B-4	Both phases	0.12	0.29	0.30	Operation
		One of phases	0.24	0.53	0.55	Stand by

The value for "One of phases" is the reference value only.

2.Condition
Leakage current value is concluded after measuring both phases of
AC input and by choosing the larger one.

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Model	PCA600F-15-P2
Item	Line Regulation
Object	+15V43A

Temperature 25°C
Testing Circuitry Figure A

1.Graph

---□--- Load 50%
—△— Load 100%

Output Voltage [V] vs Input Voltage [V]

Note: Slanted line shows the range of the rated
input voltage.

2.Values

Input Voltage [V]	Output Voltage [V]	
	Load 50%	Load 100%
80	15.184	15.182
85	15.184	15.182
100	15.184	15.182
120	15.184	15.182
200	15.184	15.182
230	15.184	15.182
264	15.184	15.182
280	15.184	15.182
--	-	-

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Model	PCA600F-15-P2
Item	Load Regulation
Object	+15V43A

Temperature 25°C
Testing Circuitry Figure A

1.Graph

		Input Volt.	100V
		Input Volt.	200V
		Input Volt.	230V

Output Voltage [V] vs Load Current [A]

Note: Slanted line shows the range of the rated load current.

2.Values

Load Current [A]	Output Voltage [V]		
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]
0.0	15.185	15.186	15.186
8.0	15.185	15.186	15.185
16.0	15.184	15.185	15.184
24.0	15.184	15.183	15.184
32.0	15.182	15.183	15.184
40.0	15.182	15.182	15.183
43.0	15.181	15.181	15.181
47.3	15.181	15.181	15.180
--	-	-	-
--	-	-	-
--	-	-	-

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Model	PCA600F-15
Item	Dynamic Load Response
Object	+15V43A

Temperature   25°C
Testing Circuitry   Figure A

Input Volt.   100 V
Cycle   1000 ms

t1,t2 = 50 μ s

Load Current

t1   t2

Min.Load (0A)←→
　Load 100% (43A)

1 V/div

2 ms/div   10 ms/div

Min.Load (0A)←→
　Load 50% (21.5A)

1 V/div

2 ms/div   10 ms/div

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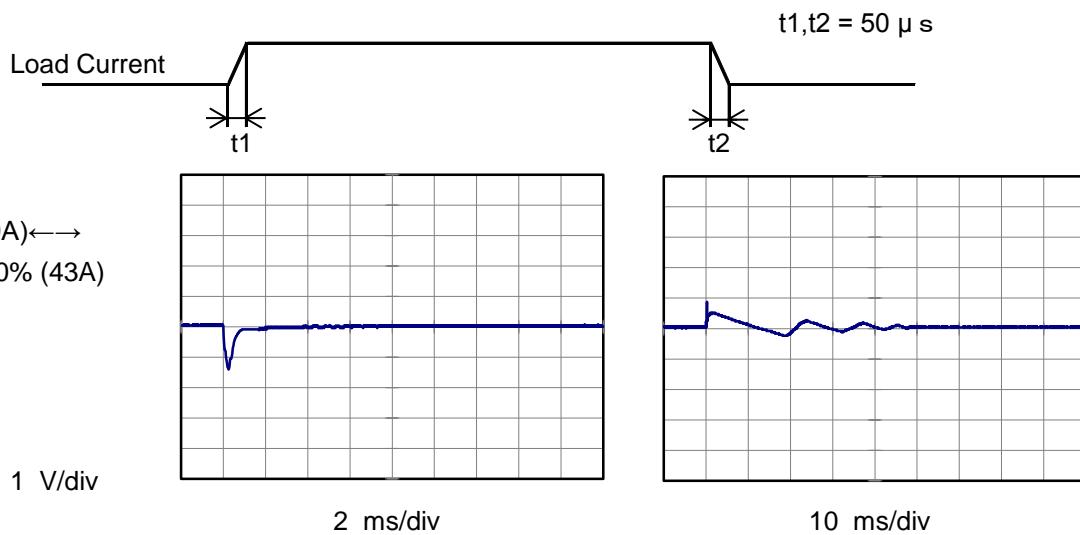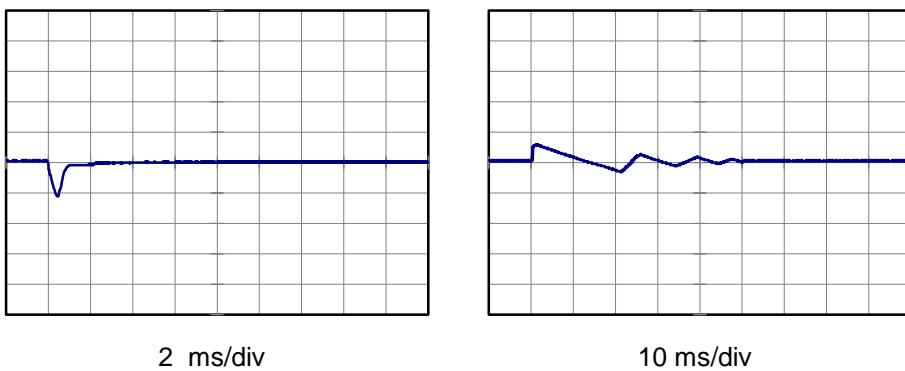
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Model	PCA600F-15-P2
Item	Ripple Voltage (by Load Current)
Object	+15V43A

Temperature 25°C
Testing Circuitry Figure A

1.Graph

—△— Input Volt. 100V
—·-○-·— Input Volt. 230V
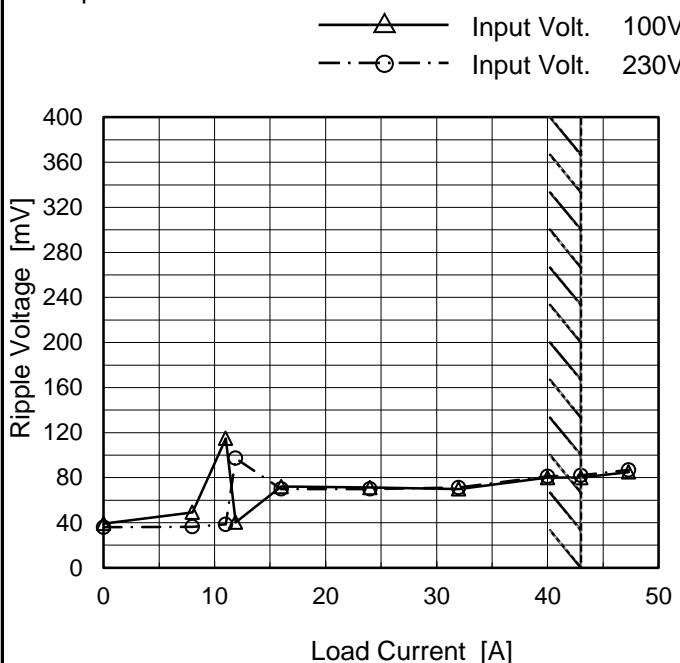
Load Current [A]

2.Values

Load Current [A]	Ripple Voltage [mV]	
	Input Volt. 100 [V]	Input Volt. 230 [V]
0.0	39	36
8.0	49	36
11.0	115	39
11.9	40	97
16.0	72	70
24.0	71	70
32.0	70	71
40.0	80	81
43.0	80	82
47.3	85	87
--	-	-

Measured by 20 MHz Oscilloscope.
Ripple Voltage is shown as p-p in the figure below.
Note: Slanted line shows the range of the rated
load current.

T1: Due to AC Input Line
T2: Due to Switching
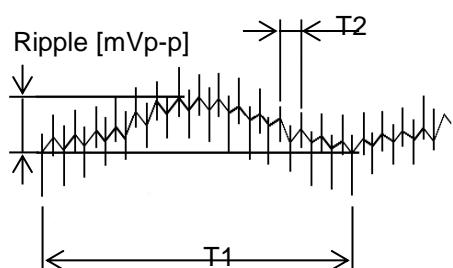
Ripple [mVp-p]

Fig. Complex Ripple Wave Form

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Model	PCA600F-15-P2
Item	Ripple-Noise
Object	+15V43A

Temperature 25°C
Testing Circuitry Figure A

1.Graph

```
—△—  Input Volt.  100V
—·-○-·—  Input Volt.  230V
```


Load Current [A]

Measured by 20 MHz Oscilloscope.
Ripple-Noise is shown as p-p in the figure below.
Note: Slanted line shows the range of the rated
    load current.

2.Values

Load Current [A]	Ripple-Noise [mV]	
	Input Volt. 100 [V]	Input Volt. 230 [V]
0.0	40	37
8.0	50	37
11.0	117	42
11.9	42	100
16.0	74	70
24.0	74	72
32.0	80	86
40.0	95	95
43.0	105	105
47.3	110	110
--	-	-

T1: Due to AC Input Line
T2: Due to Switching

Fig. Complex Ripple Wave Form

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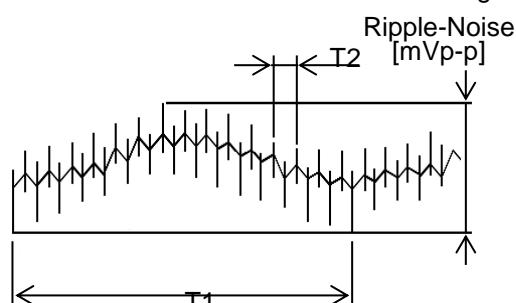
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Model	PCA600F-15-P2
Item	Ripple Voltage (by Ambient Temp.)
Object	+15V43A

Testing Circuitry   Figure A

1.Graph

2.Values

--- ⊟ --- Input Volt.   100V
—△— Input Volt.   230V

Ambient Temperature [°C]

Load   100 %
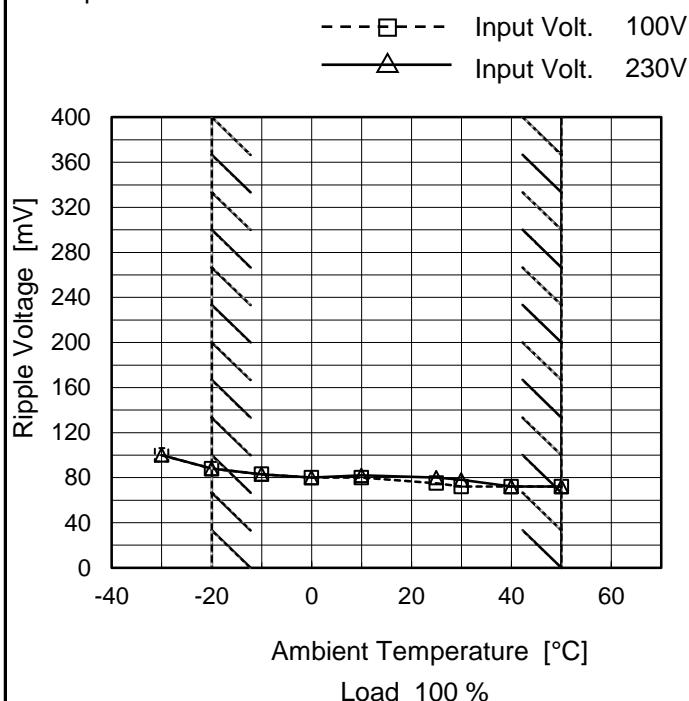
Ambient Temperature [°C]	Ripple Voltage [mV]	
	Input Volt. 100 [V]	Input Volt. 230 [V]
-30	100	100
-20	88	88
-10	83	83
0	80	80
10	80	82
25	75	80
30	72	78
40	72	72
50	72	72
--	-	-
--	-	-

Measured by 20 MHz Oscilloscope.
Note: Slanted line shows the range of the rated
        ambient temperature.

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Model	PCA600F-15-P2
Item	Ambient Temperature Drift
Object	+15V43A

Testing Circuitry   Figure A

1.Graph

— △ — Input Volt. 100V
--- ▣ --- Input Volt. 200V
—·— ○ —·— Input Volt. 230V

Ambient Temperature [°C]

Load 100%

Note: Slanted line shows the range of the rated
      ambient temperature.
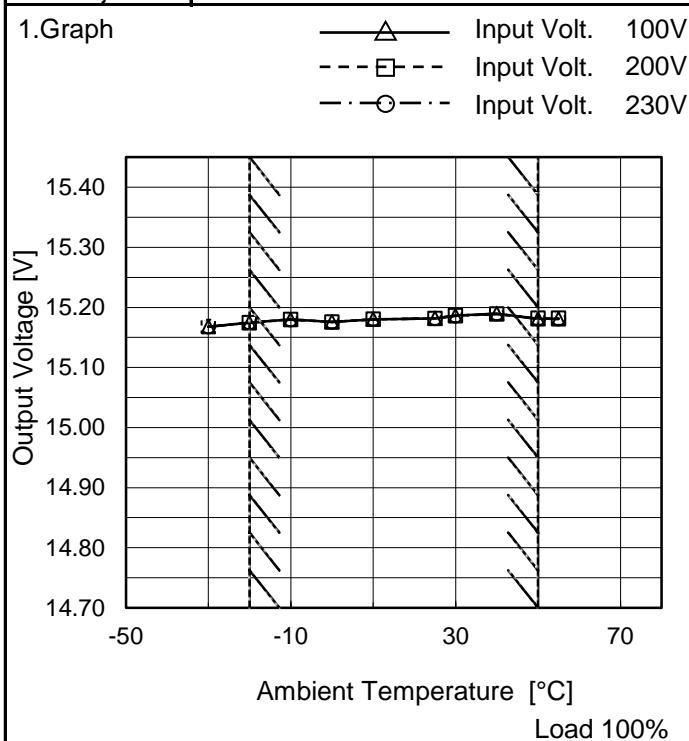
2.Values

Ambient Temperature [°C]	Output Voltage [V]		
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]
-30	15.168	15.168	15.168
-20	15.175	15.175	15.174
-10	15.180	15.180	15.179
0	15.176	15.176	15.176
10	15.180	15.180	15.180
25	15.182	15.182	15.182
30	15.186	15.186	15.186
40	15.190	15.189	15.190
50	15.181	15.182	15.181
55	15.181	15.182	15.181
--	-	-	-

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Model	PCA600F-15-P2
Item	Output Voltage Accuracy
Object	+15V43A

Testing Circuitry   Figure A

1.Output Voltage Accuracy

This is defined as the value of the output voltage, regulation load, ambient temperature and input voltage varied at random in the range as specified below.

Temperature　:　-20　-　50°C
Input Voltage　:　85　-　264V
Load Current　:　0　-　43A

* Output Voltage Accuracy = ±(Maximum of Output Voltage - Minimum of Output Voltage) / 2

* Output Voltage Accuracy (Ratio) = $\dfrac{\text{Output Voltage Accuracy}}{\text{Rated Output Voltage}}$ × 100

2.Values

Item	Temperature [°C]	Input Voltage[V]	Output		Output Voltage Accuracy	
			Current[A]	Voltage[V]	Value [mV]	Ratio [%]
Maximum Voltage	40	200	0	15.203	±11	±0.1
Minimum Voltage	-20	200	43	15.182		

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Model	PCA600F-15-P2
Item	Time Lapse Drift
Object	+15V43A

Temperature　　25°C
Testing Circuitry　Figure A

1.Graph

Output Voltage [V]

15.50
15.40
15.30
15.20
15.10
15.00
14.90
14.80

0　　2　　4　　6　　8　　10

Time [H]

Input Volt.　　230V
Load　　　　100%

 * The characteristic of AC100V is equal.

2.Values

Time since start [H]	Output Voltage [V]
0.0	15.138
0.5	15.147
1.0	15.147
2.0	15.148
3.0	15.148
4.0	15.148
5.0	15.148
6.0	15.148
7.0	15.148
8.0	15.148

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Model	PCA600F-15-P2
Item	Rise and Fall Time
Object	+15V43A

Temperature 25°C
Testing Circuitry Figure A

1.Graph

Load 100%

Output
Volt.

[2V/div]

0

Input Volt. 100 V

Load 100%

Output
Volt.

[2V/div]

0

Input Volt. 230 V

Input
Volt.

0

Time [100ms/div]

Time [10ms/div]
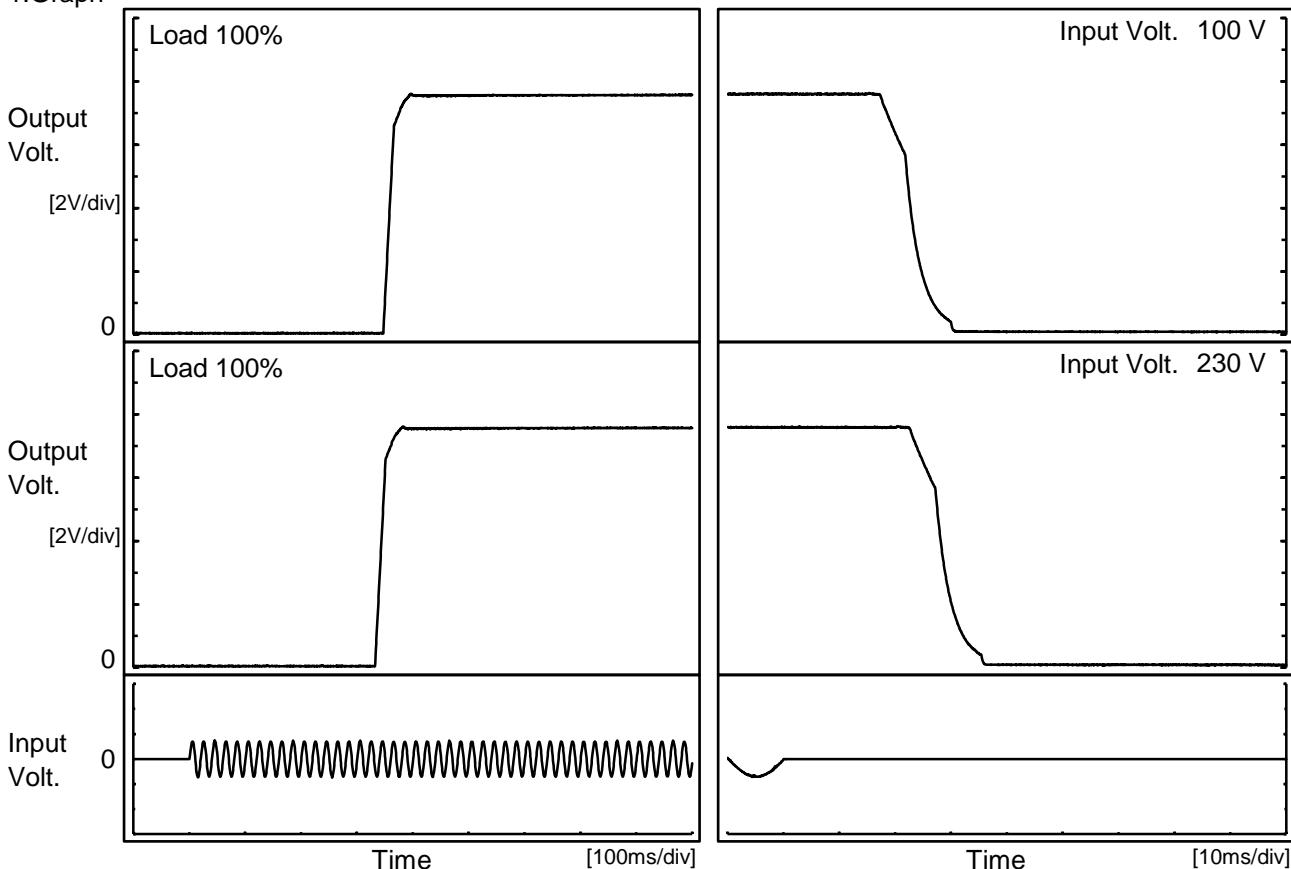
2.Values [ms]

Input Volt. \ Time	Td	Tr	Ts	Th	Tf
100 V	349.5	21.5	371.0	19.0	8.5
230 V	335.0	21.0	356.0	24.3	8.7

Output
Volt.

90%

10%

Input
Volt.

Td Tr Th Tf

Ts

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Model	PCA600F-15-P2
Item	Hold-Up Time
Object	+15V43A

Temperature   25°C
Testing Circuitry   Figure A

1.Graph

```
--- ⊟ ---    Load  50%
——— △ ———    Load 100%
```


Hold-Up Time [ms] vs Input Voltage [V]

2.Values

Input Voltage [V]	Hold-Up Time [ms]	
	Load 50%	Load 100%
80	36	18
85	36	18
100	36	18
120	36	18
200	46	23
230	46	23
264	46	23
280	46	23
--	-	-

This duration covers from Shut-off of input
voltage to the moment when output voltage
descends to the rated range of voltage accuracy.
Note: Slanted line shows the range of the rated
      input voltage.

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Model	PCA600F-15-P2
Item	Instantaneous Interruption Compensation
Object	+15V43A

Temperature 25°C
Testing Circuitry Figure A

1.Graph

— △ — Input Volt. 100V
--- ⊟ --- Input Volt. 200V
— · — ○ — · — Input Volt. 230V

Instantaneous Compensation Time [ms] vs Load Current [A]

Note: Slanted line shows the range of the rated load current.

2.Values

Load Current [A]	Time [ms]		
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]
0.0	-	-	-
8.0	89	117	118
16.0	49	63	63
24.0	33	43	43
32.0	25	32	32
40.0	20	26	26
43.0	17	24	24
47.3	15	20	22
--	-	-	-
--	-	-	-
--	-	-	-

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Model	PCA600F-15-P2
Item	Minimum Input Voltage for Regulated Output Voltage
Object	+15V43A

Testing Circuitry   Figure A

1.Graph

--- ⊟ --- Load 50%
—— △ —— Load 100%

Input Voltage [V] vs Ambient Temperature [°C]

Note: Slanted line shows the range of the rated ambient temperature.
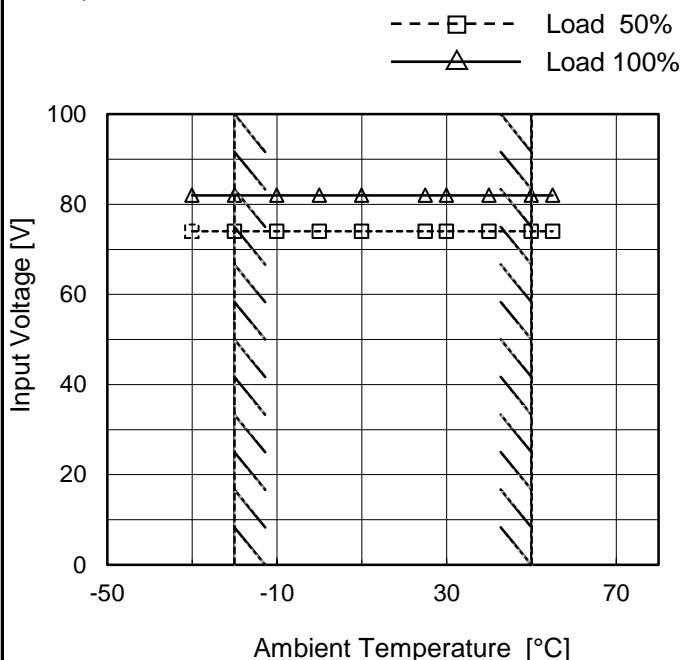
2.Values

Ambient Temperature [°C]	Input Voltage [V]	
	Load 50%	Load 100%
-30	74	82
-20	74	82
-10	74	82
0	74	82
10	74	82
25	74	82
30	74	82
40	74	82
50	74	82
55	74	82
--	-	-

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Model	PCA600F-15-P2
Item	Overcurrent Protection
Object	+15V43A

Temperature   25°C
Testing Circuitry   Figure A

1.Graph

———— Input Volt.   100V

———— Input Volt.   230V
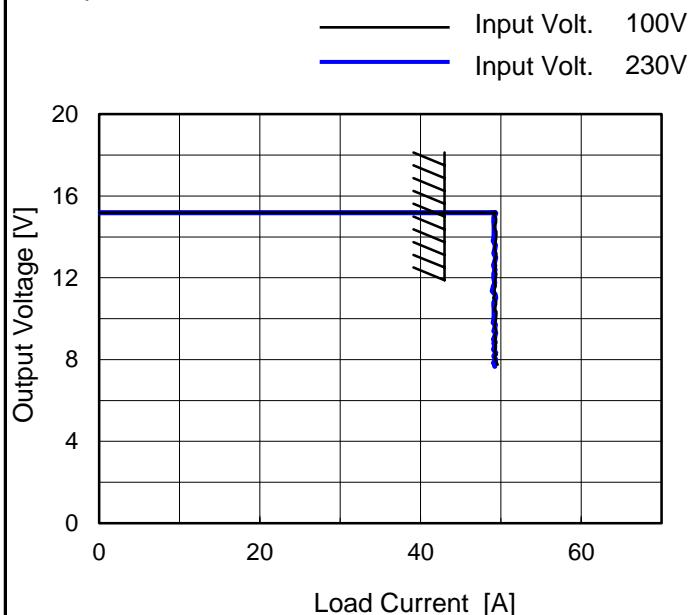
Load Current [A]

Note: Slanted line shows the range of the rated
       load current.

Intermittent operation occurs when the output
voltage is from 7.5V to 0V.

2.Values

Output Voltage [V]	Load Current [A]	
	Input Volt. 100[V]	Input Volt. 230[V]
14.3	49.44	49.15
13.5	49.28	49.31
12.0	49.37	49.11
10.5	49.13	49.16
9.0	49.39	49.23
7.7	49.34	49.37
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-

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Model	PCA600F-15-P2
Item	Overvoltage Protection
Object	+15V43A

Testing Circuitry   Figure A

1.Graph

————△———— Input Volt.   100V
– – –⊟– – – Input Volt.   230V

Ambient Temperature [°C]

Load 0%

Note: Slanted line shows the range of the rated
ambient temperature.
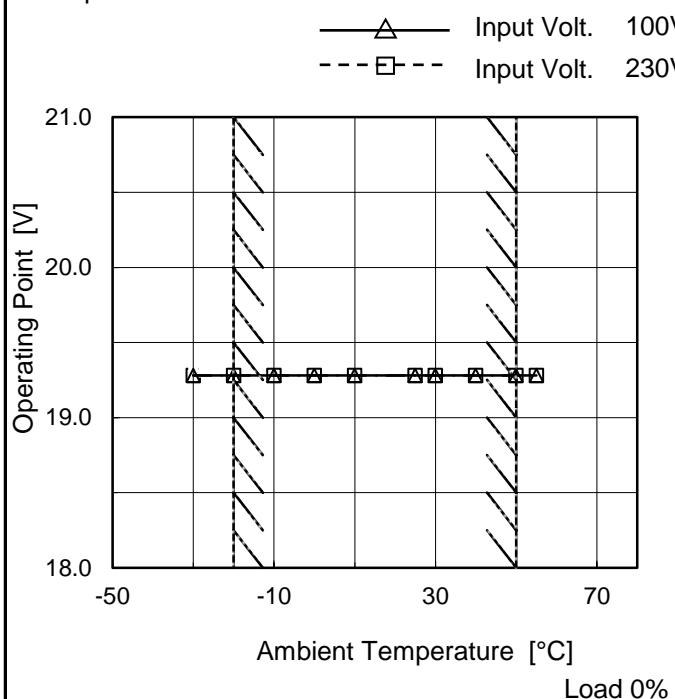
2.Values

Ambient Temperature [°C]	Operating Point [V]	
	Input Volt. 100[V]	Input Volt. 230[V]
-30	19.28	19.28
-20	19.28	19.28
-10	19.28	19.28
0	19.28	19.28
10	19.28	19.28
25	19.28	19.28
30	19.28	19.28
40	19.28	19.28
50	19.28	19.28
55	19.28	19.28
--	-	-

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Figure A

Leakage Current Value $[A] = \dfrac{\text{Effective Value of Voltmeter[V]}}{1k\ [\Omega]}$

Figure B-1 (DEN-AN)

Leakage Current Value $[A] = \dfrac{\text{Effective Value of Voltmeter[V]}}{500\ [\Omega]}$
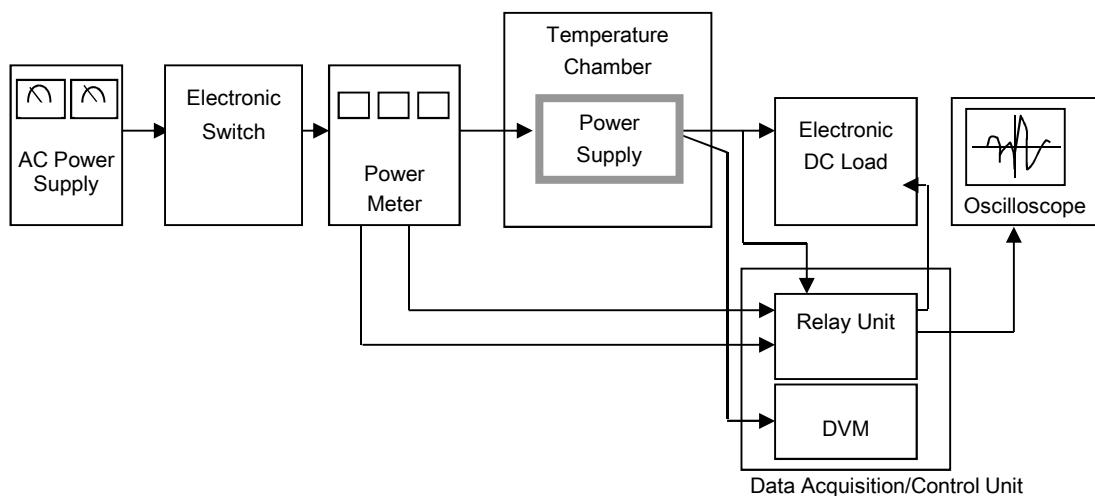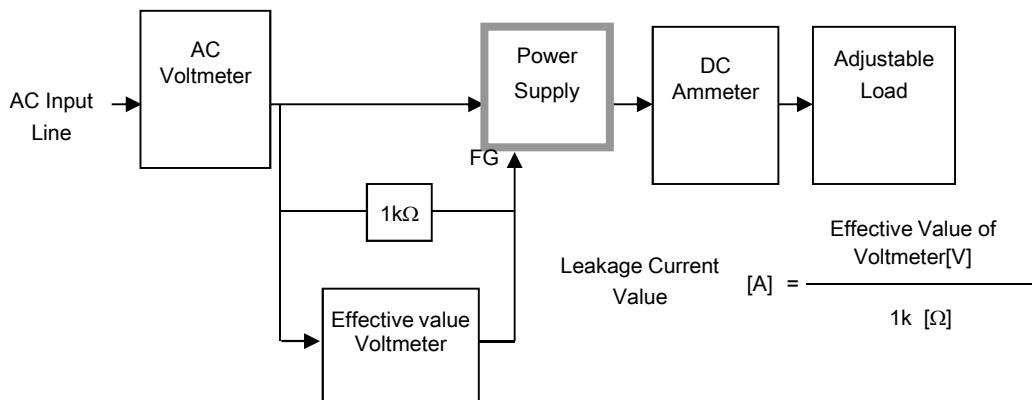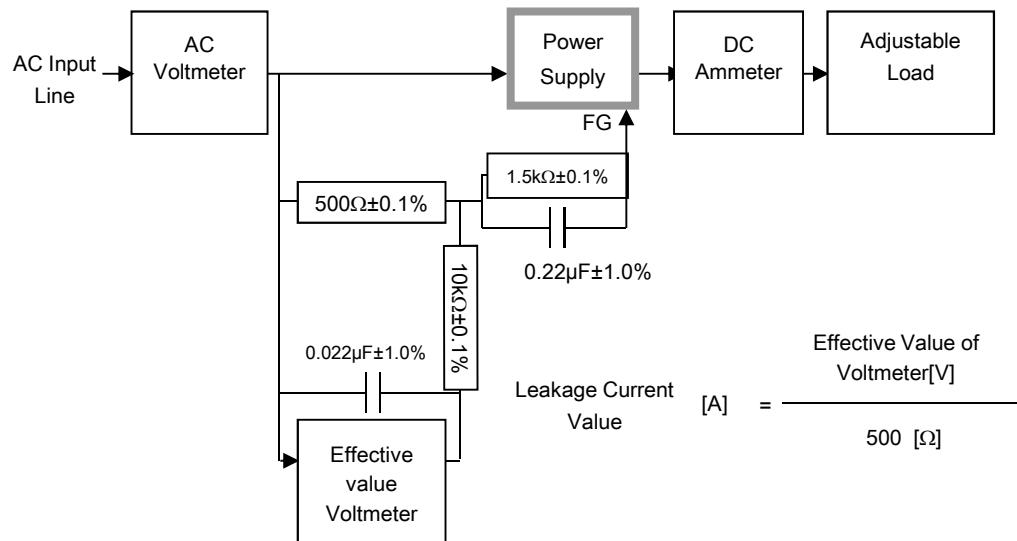
Figure B-2 (IEC62368-1 refer to IEC60990 Fig.4)

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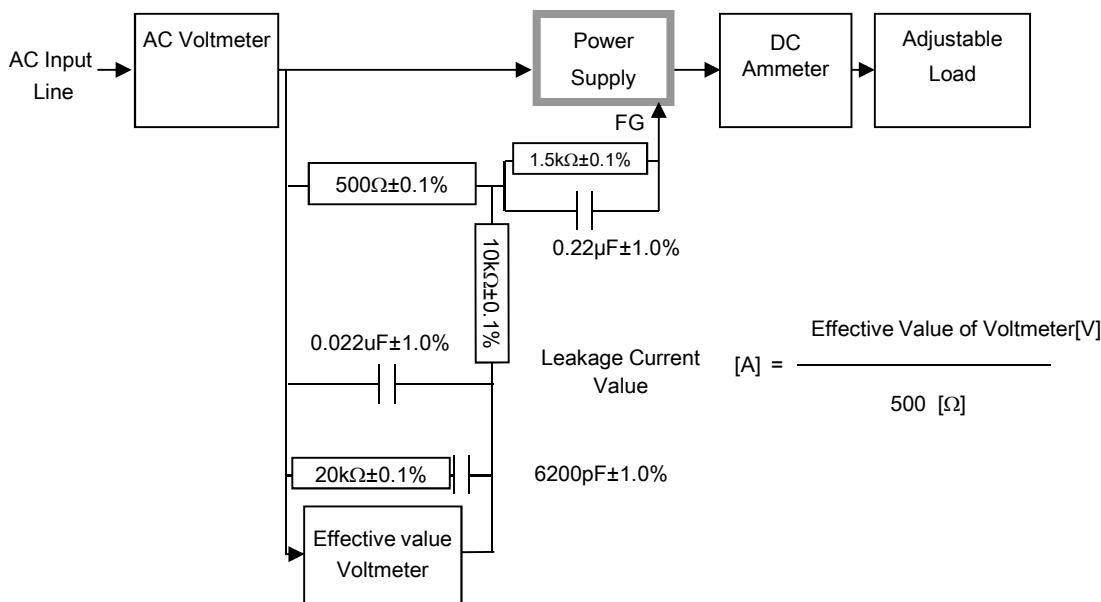
Figure B-3 (IEC62368-1 refer to IEC60990 Fig.5)

In Figure B-3:
- AC Input Line → AC Voltmeter → Power Supply → DC Ammeter → Adjustable Load
- FG
- 500Ω±0.1%
- 1.5kΩ±0.1%
- 0.22µF±1.0%
- 10kΩ±0.1%
- 0.022uF±1.0%
- 20kΩ±0.1%
- 6200pF±1.0%
- Effective value Voltmeter

Leakage Current Value

$$[A] = \frac{\text{Effective Value of Voltmeter[V]}}{500 \ [\Omega]}$$

Figure B-4 (IEC60601-1)

In Figure B-4:
- AC Input Line → AC Voltmeter → Power Supply → DC Ammeter → Adjustable Load
- FG
- 1kΩ±1.0%
- 10kΩ±1.0%
- 0.015µF±2.0%
- Effective value Voltmeter

Leakage Current Value

$$[A] = \frac{\text{Effective Value of Voltmeter[V]}}{1k \ [\Omega]}$$

Temperature Chamber
Measuring board
AC Power Supply → Power Meter → Power Supply → C1 → Electronic DC Load
150mm
Oscilloscope BW:20MHz
C1 = 22 µF
(Electrolytic capacitor)

Figure C

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