

TEST DATA OF TUHS3F12

Regulated DC Power Supply
February 28, 2014

Approved by : Nobuyuki Shiraishi
Nobuyuki Shiraishi Design Manager

Prepared by : Takayuki Yamamoto
Takayuki Yamamoto Design Engineer

COSEL CO.,LTD.

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<p>The graph plots Efficiency [%] on the y-axis (30 to 90) against Input Voltage [V] on the x-axis (50 to 300). Two data series are shown: Load 50% (dashed line with square markers) and Load 100% (solid line with triangle markers). Both series show a general downward trend as input voltage increases. Two vertical slanted lines indicate the rated input voltage range from approximately 85V to 264V.</p> <table border="1"> <thead> <tr> <th>Input Voltage [V]</th> <th>Efficiency Load 50% [%]</th> <th>Efficiency Load 100% [%]</th> </tr> </thead> <tbody> <tr><td>75</td><td>77.1</td><td>80.6</td></tr> <tr><td>85</td><td>76.9</td><td>80.9</td></tr> <tr><td>100</td><td>76.7</td><td>81.1</td></tr> <tr><td>120</td><td>76.1</td><td>81.1</td></tr> <tr><td>200</td><td>73.1</td><td>79.6</td></tr> <tr><td>230</td><td>71.7</td><td>78.9</td></tr> <tr><td>264</td><td>69.4</td><td>77.5</td></tr> <tr><td>280</td><td>68.1</td><td>76.6</td></tr> <tr><td>--</td><td>-</td><td>-</td></tr> </tbody> </table>			Input Voltage [V]	Efficiency Load 50% [%]	Efficiency Load 100% [%]	75	77.1	80.6	85	76.9	80.9	100	76.7	81.1	120	76.1	81.1	200	73.1	79.6	230	71.7	78.9	264	69.4	77.5	280	68.1	76.6	--	-	-		
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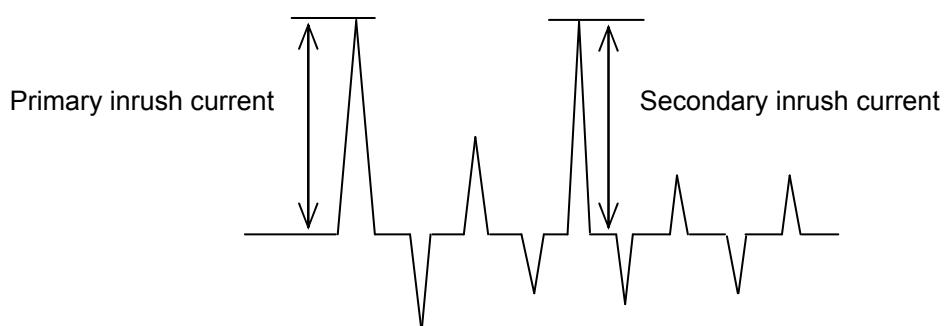
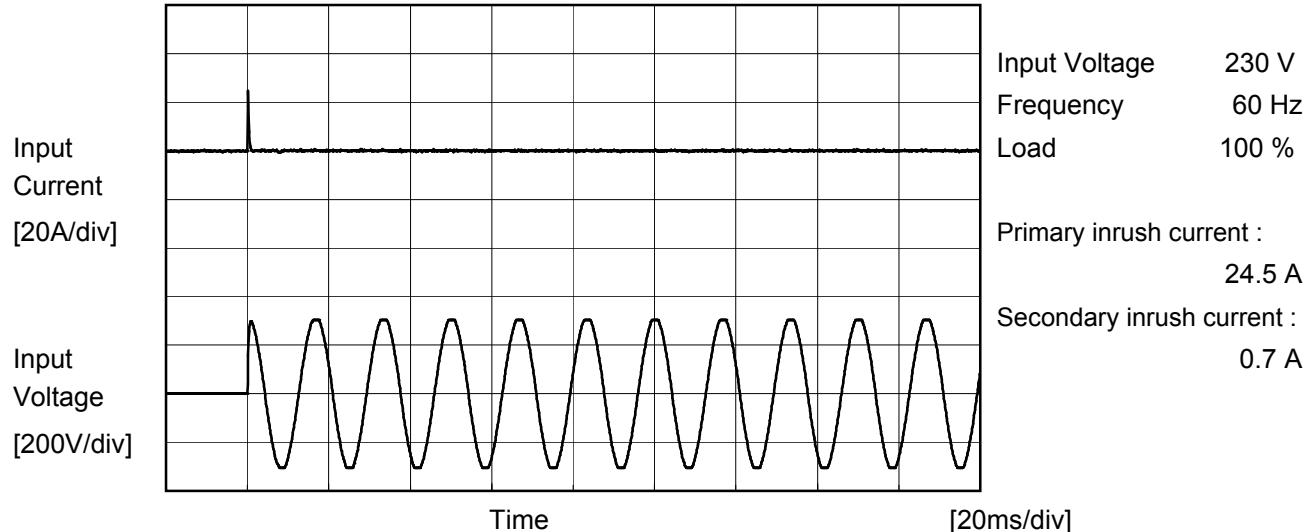
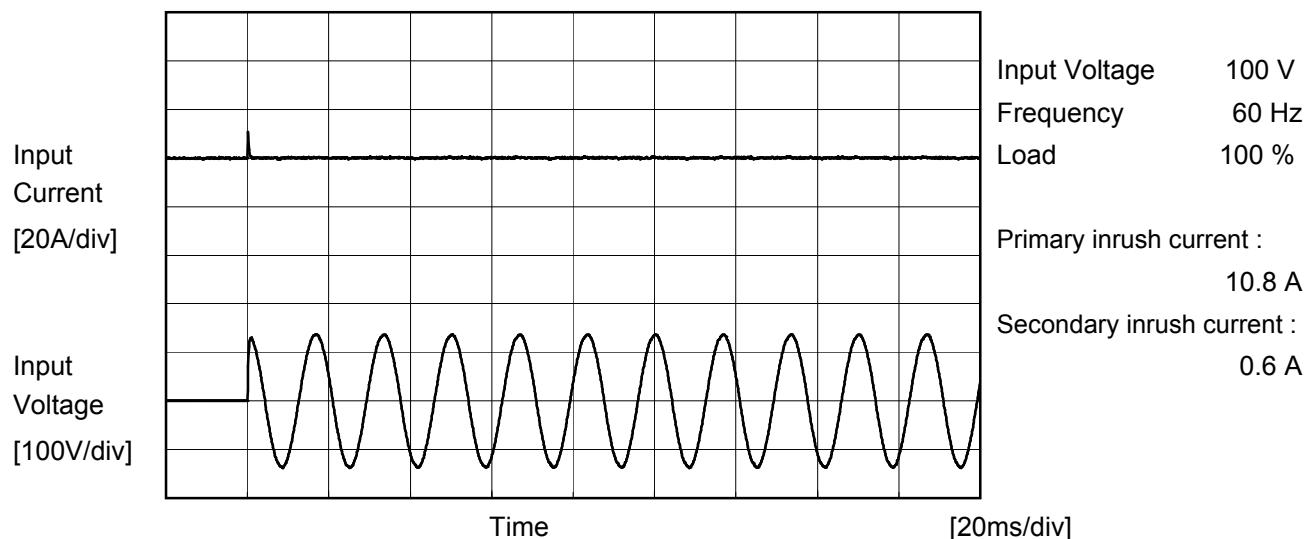
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COSEL

Model	TUHS3F12	Temperature Testing Circuitry Figure A	25°C
Item	Inrush Current		
Object	_____		





Model	TUHS3F12	Temperature Testing Circuitry	25°C Figure B
Item	Leakage Current		
Object	_____		

1. Results

Standards		Input Volt.			Note
		100 [V]	200 [V]	230 [V]	
DEN-AN	Both phases	0.003	0.004	0.004	Operation
	One of phases	0.003	0.005	0.006	Stand by
IEC60950-1	Both phases	0.002	0.005	0.005	Operation
	One of phases	0.003	0.005	0.005	Stand by

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

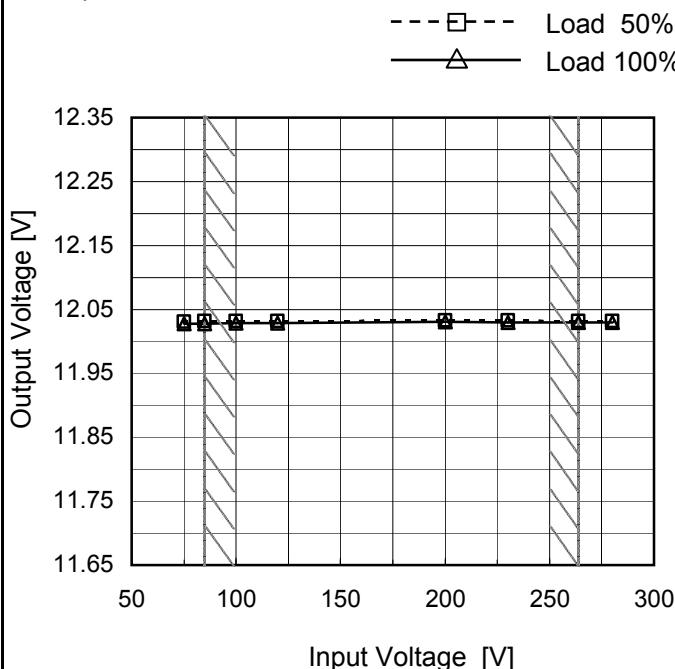
2. Condition

Leakage current value is concluded after measuring both phases of AC input and by choosing the larger one.
 There is no FG in TUHS series and it is a reinforced insulation power supply of the class 2.

Model	TUHS3F12
Item	Line Regulation
Object	+12V0.25A

Temperature 25°C
Testing Circuitry Figure A

1.Graph



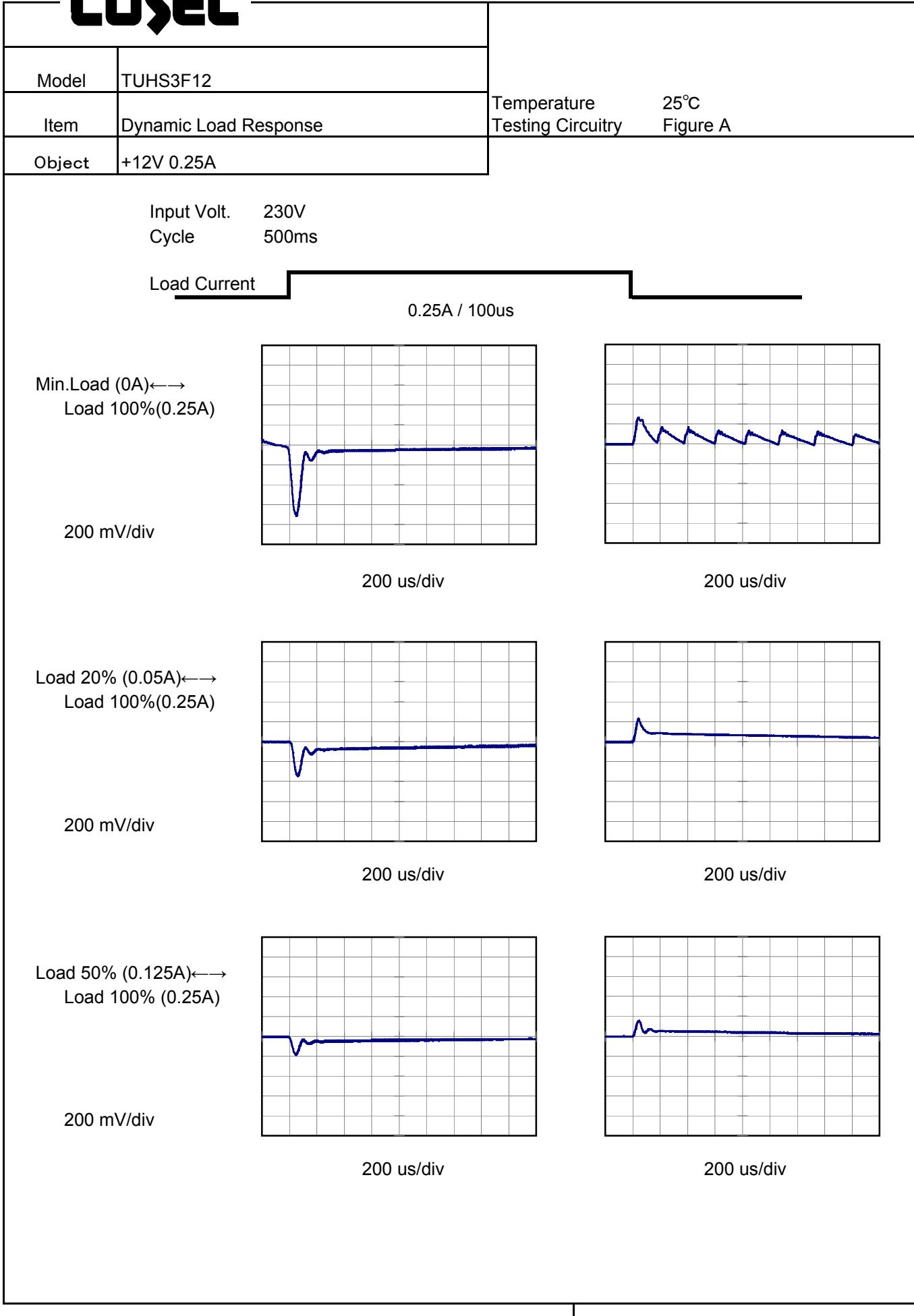
2.Values

Input Voltage [V]	Output Voltage [V]	
	Load 50%	Load 100%
75	12.031	12.028
85	12.031	12.028
100	12.032	12.029
120	12.032	12.029
200	12.033	12.030
230	12.033	12.030
264	12.032	12.030
280	12.032	12.030
--	-	-

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

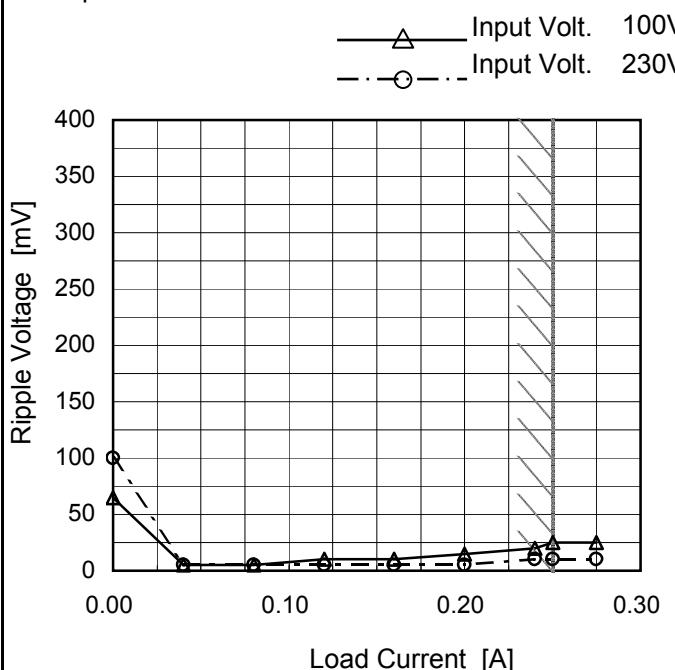
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COSEL



Model	TUHS3F12	Temperature 25°C Testing Circuitry Figure C
Item	Ripple Voltage (by Load Current)	
Object	+12V0.25A	

1.Graph



Measured by 100 MHz Oscilloscope.

Ripple Voltage 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 Voltage [mV]	
	Input Volt. 100 [V]	Input Volt. 230 [V]
0	65	100
0.04	5	5
0.08	5	5
0.12	10	5
0.16	10	5
0.20	15	5
0.24	20	10
0.25	25	10
0.28	25	10
--	-	-
--	-	-

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

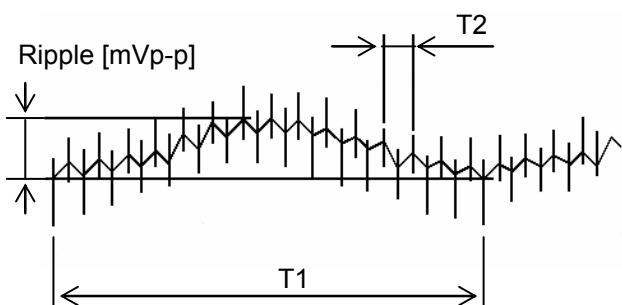


Fig. Complex Ripple Wave Form

COSEL

Model	TUHS3F12																																							
Item	Ripple-Noise	Temperature 25°C Testing Circuitry Figure C																																						
Object	+12V0.25A																																							
1.Graph																																								
<p>Graph showing Ripple Voltage [mV] vs Load Current [A]. The Y-axis ranges from 0 to 400 mV, and the X-axis ranges from 0.00 to 0.30 A. Two curves are plotted: one for Input Volt. 100V (solid line with open circles) and one for Input Volt. 230V (dashed line with open circles). A slanted line indicates the range of the rated load current.</p>																																								
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<p>Diagram illustrating a Complex Ripple Wave Form. The waveform consists of two main components: T1 (Due to AC Input Line) and T2 (Due to Switching). The total Ripple-Noise [mVp-p] is indicated by a vertical arrow.</p>																																								
<p>Fig. Complex Ripple Wave Form</p>																																								

Model	TUHS3F12	Testing Circuitry Figure C																																			
Item	Ripple Voltage (by Ambient Temp.)																																				
Object	+12V0.25A																																				
1.Graph		2.Values																																			
<p>Graph showing Ripple Voltage [mV] vs Ambient Temperature [°C] for TUHS3F12 at Load 100%.</p> <p>Legend:</p> <ul style="list-style-type: none"> - - - □ - - - Input Volt. 100V — △ — Input Volt. 200V <table border="1"> <thead> <tr> <th>Ambient Temperature [°C]</th> <th>Ripple Voltage [mV] (Input Volt. 100V)</th> <th>Ripple Voltage [mV] (Input Volt. 200V)</th> </tr> </thead> <tbody> <tr><td>-45</td><td>25</td><td>10</td></tr> <tr><td>-40</td><td>20</td><td>10</td></tr> <tr><td>-20</td><td>25</td><td>10</td></tr> <tr><td>0</td><td>25</td><td>10</td></tr> <tr><td>25</td><td>25</td><td>10</td></tr> <tr><td>50</td><td>25</td><td>10</td></tr> <tr><td>70</td><td>25</td><td>10</td></tr> <tr><td>85</td><td>25</td><td>10</td></tr> <tr><td>90</td><td>30</td><td>10</td></tr> <tr><td>--</td><td>-</td><td>-</td></tr> <tr><td>--</td><td>-</td><td>-</td></tr> </tbody> </table>		Ambient Temperature [°C]	Ripple Voltage [mV] (Input Volt. 100V)	Ripple Voltage [mV] (Input Volt. 200V)	-45	25	10	-40	20	10	-20	25	10	0	25	10	25	25	10	50	25	10	70	25	10	85	25	10	90	30	10	--	-	-	--	-	-
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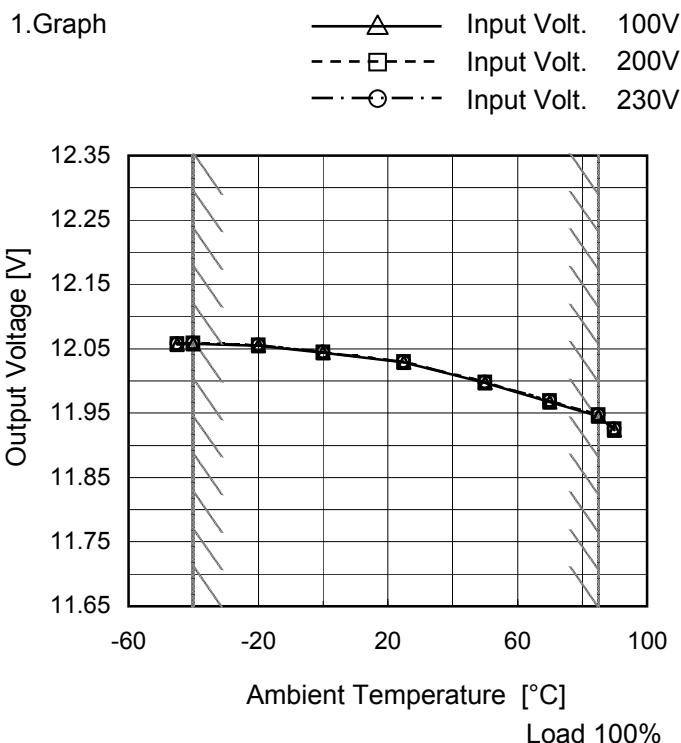
Measured by 100 MHz Oscilloscope.

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

Model TUHS3F12

Item Ambient Temperature Drift

Object +12V0.25A



Testing Circuitry Figure A

2.Values

Ambient Temperature [°C]	Output Voltage [V]		
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]
-45	12.057	12.058	12.058
-40	12.058	12.059	12.059
-20	12.055	12.055	12.055
0	12.044	12.045	12.045
25	12.029	12.030	12.030
50	11.997	11.998	11.998
70	11.968	11.969	11.969
85	11.945	11.947	11.947
90	11.923	11.926	11.925
--	-	-	-
--	-	-	-

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



Model	TUHS3F12	Testing Circuitry Figure A
Item	Output Voltage Accuracy	
Object	+12V0.25A	

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 : -40 - 85°C

Input Voltage : 85 - 264V

Load Current : 0 - 0.25A

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

$$\text{* Output Voltage Accuracy (Ration)} = \frac{\text{Output Voltage Accuracy}}{\text{Rated Output Voltage}} \times 100$$

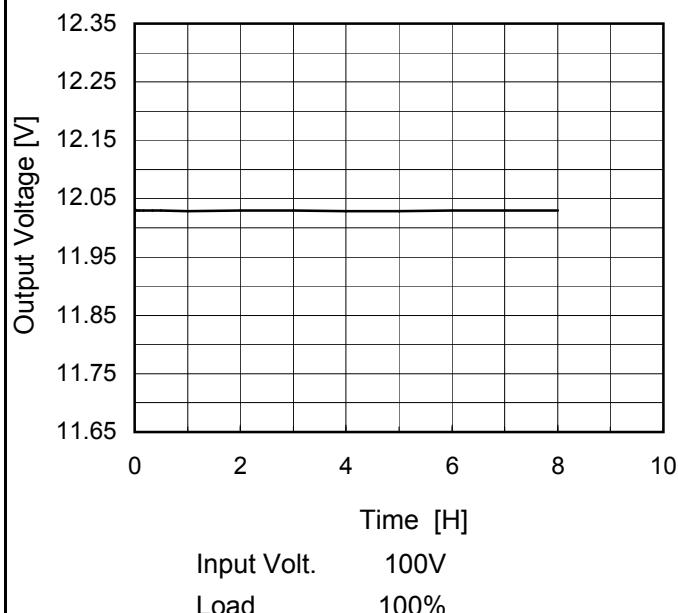
2. Values

Item	Temperature [°C]	Input Voltage[V]	Output		Output Voltage Accuracy	
			Current[A]	Voltage[V]	Value [mV]	Ration [%]
Maximum Voltage	-40	85	0	12.060	±58	±0.5
Minimum Voltage	85	85	0.25	11.945		

COSEL

Model	TUHS3F12
Item	Time Lapse Drift
Object	+12V0.25A

1.Graph



Temperature 25°C
Testing Circuitry Figure A

2.Values

Time since start [H]	Output Voltage [V]
0.0	12.034
0.5	12.030
1.0	12.029
2.0	12.029
3.0	12.029
4.0	12.029
5.0	12.029
6.0	12.029
7.0	12.029
8.0	12.029

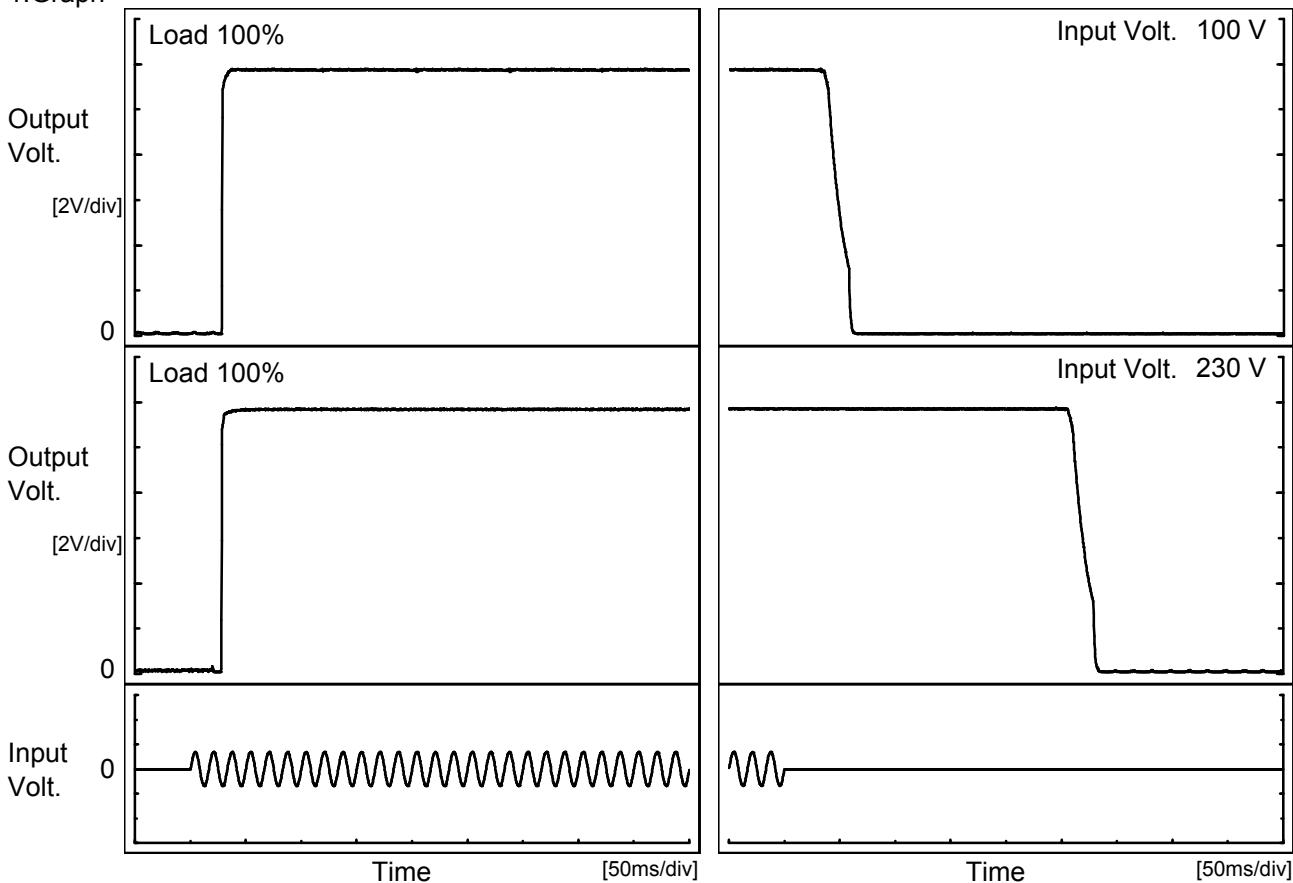
* The characteristic of AC230V is equal.

COSEL

Model	TUHS3F12
Item	Rise and Fall Time
Object	+12V0.25A

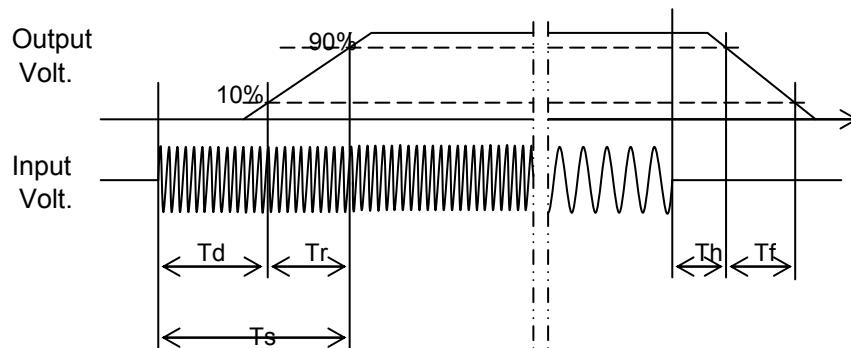
Temperature 25°C
Testing Circuitry Figure A

1. Graph



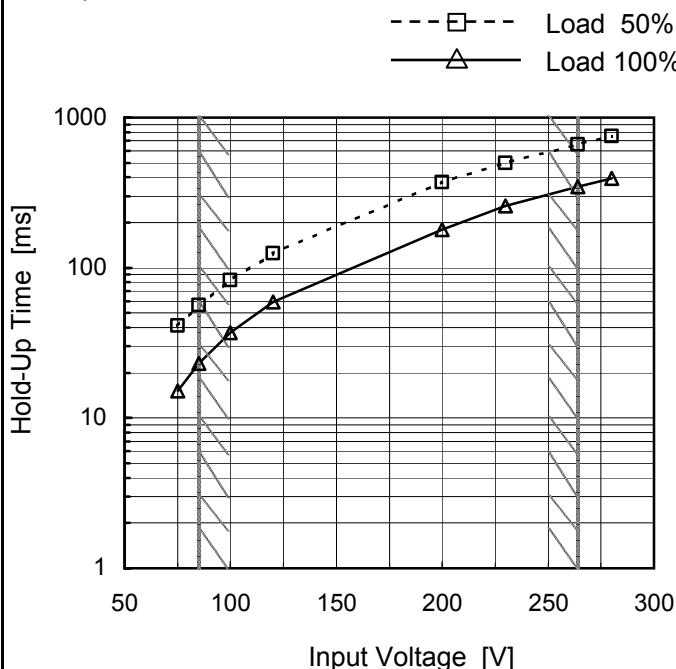
2. Values

Input Volt.	Time	Td	Tr	Ts	Th	Tf	[ms]
100 V		28.5	0.8	29.3	37.0	19.8	
230 V		28.0	1.0	29.0	257.8	20.0	



Model	TUHS3F12
Item	Hold-Up Time
Object	+12V0.25A

1. Graph



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.

Temperature 25°C
Testing Circuitry Figure A

2. Values

Input Voltage [V]	Hold-Up Time [ms]	
	Load 50%	Load 100%
75	41	15
85	57	23
100	83	37
120	125	59
200	373	180
230	499	258
264	664	348
280	750	395
--	-	-

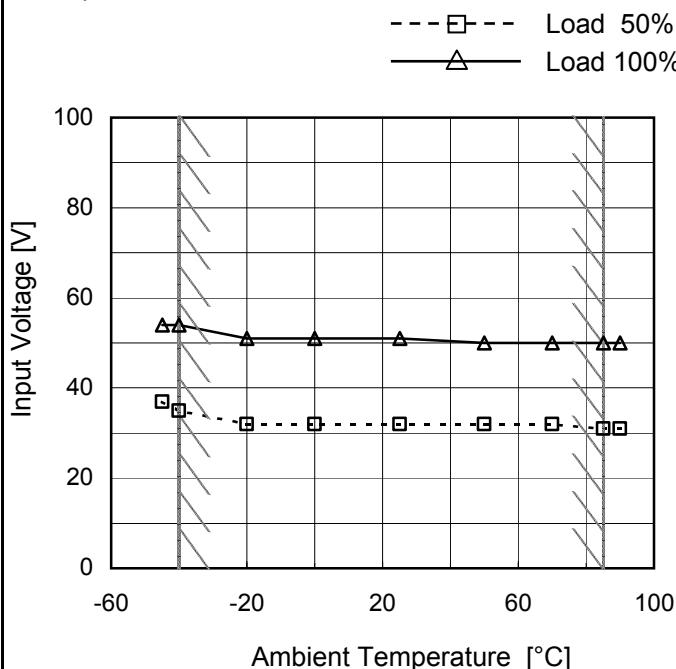
Model	TUHS3F12	Temperature Testing Circuitry 25°C Figure A																																																		
Item	Instantaneous Interruption Compensation																																																			
Object	+12V0.25A																																																			
1.Graph	<p>—△— Input Volt. 100V - - -□- - Input Volt. 200V - - ○- - Input Volt. 230V</p> <table border="1"> <caption>Data points estimated from Graph 1</caption> <thead> <tr> <th>Load Current [A]</th> <th>100V [ms]</th> <th>200V [ms]</th> <th>230V [ms]</th> </tr> </thead> <tbody> <tr><td>0.05</td><td>112</td><td>276</td><td>451</td></tr> <tr><td>0.10</td><td>83</td><td>206</td><td>336</td></tr> <tr><td>0.15</td><td>69</td><td>166</td><td>261</td></tr> <tr><td>0.20</td><td>55</td><td>136</td><td>225</td></tr> <tr><td>0.25</td><td>41</td><td>106</td><td>180</td></tr> <tr><td>0.28</td><td>37</td><td>-</td><td>158</td></tr> </tbody> </table>	Load Current [A]	100V [ms]	200V [ms]	230V [ms]	0.05	112	276	451	0.10	83	206	336	0.15	69	166	261	0.20	55	136	225	0.25	41	106	180	0.28	37	-	158																							
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Note: Slanted line shows the range of the rated load current.

Model	TUHS3F12
Item	Minimum Input Voltage for Regulated Output Voltage
Object	+12V0.25A

Testing Circuitry Figure A

1.Graph



2.Values

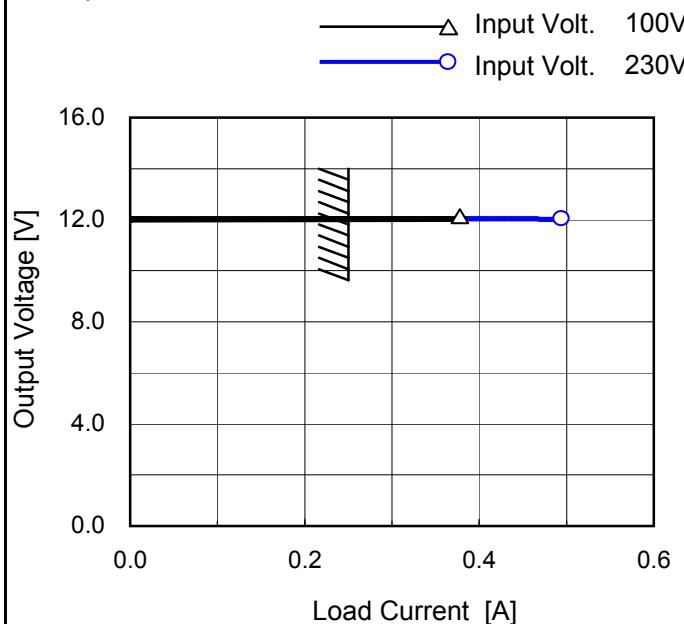
Ambient Temperature [°C]	Input Voltage [V]	
	Load 50%	Load 100%
-45	37	54
-40	35	54
-20	32	51
0	32	51
25	32	51
50	32	50
70	32	50
85	31	50
90	31	50
--	-	-
--	-	-

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

Model	TUHS3F12
Item	Overcurrent Protection
Object	+12V0.25A

Temperature 25°C
Testing Circuitry Figure A

1. Graph



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

2. Values

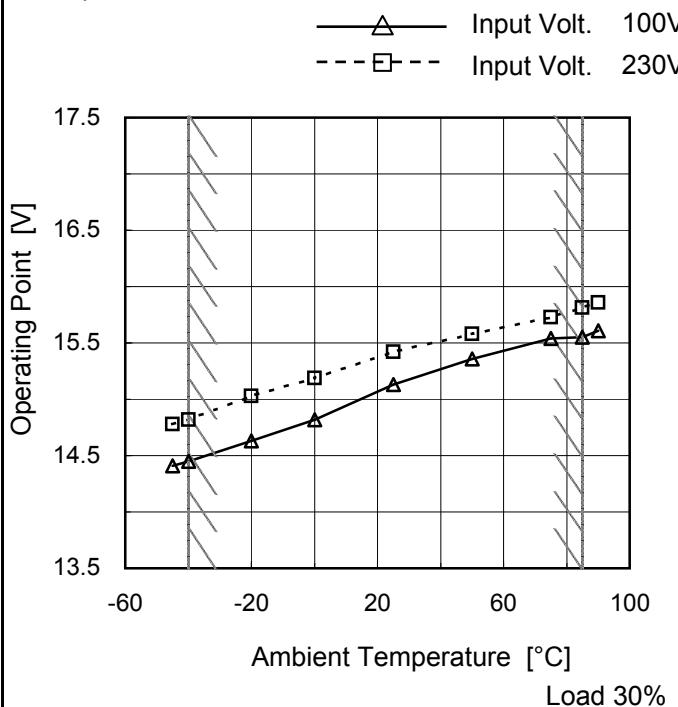
Output Voltage [V]	Load Current [A]	
	Input Volt. 100[V]	Input Volt. 230[V]
12	0.38	0.49
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-

Model TUHS3F12

Item Overvoltage Protection

Object +12V0.25A

1.Graph



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

Testing Circuitry Figure A

2.Values

Ambient Temperature [°C]	Operating Point [V]	
	Input Volt. 100[V]	Input Volt. 230[V]
-45	14.41	14.78
-40	14.45	14.82
-20	14.63	15.03
0	14.82	15.19
25	15.13	15.42
50	15.36	15.58
75	15.54	15.73
85	15.55	15.81
90	15.61	15.86
--	-	-
--	-	-

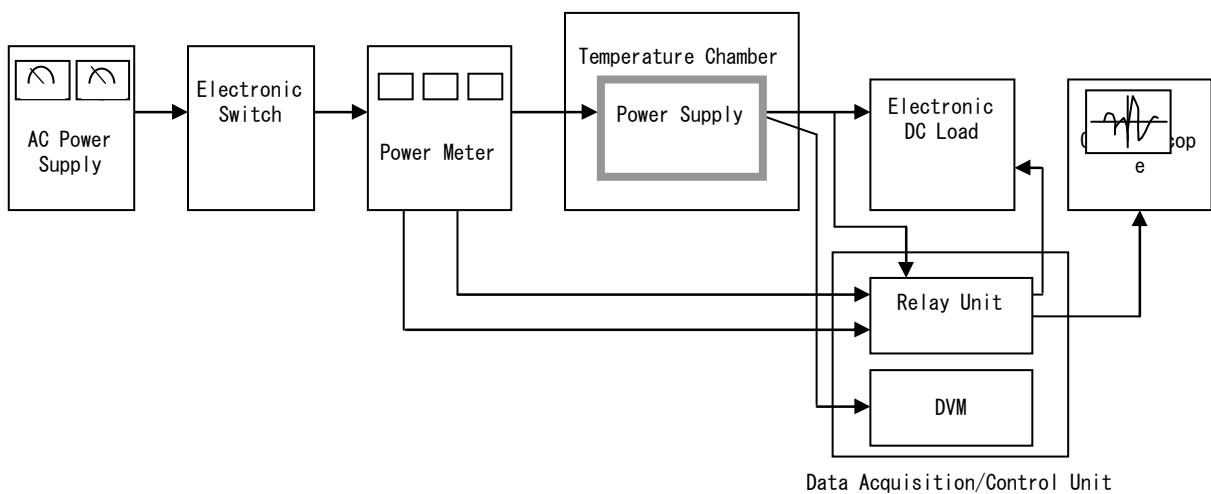


Figure A

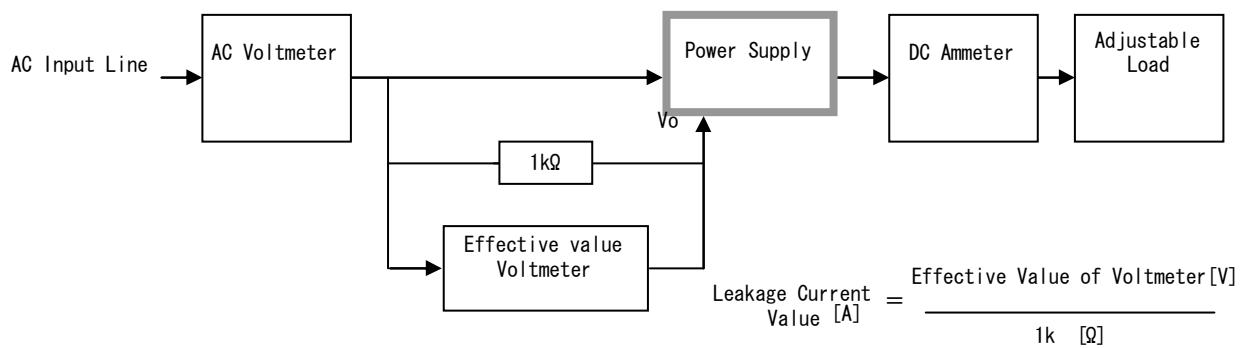


Figure B (DEN-AN)

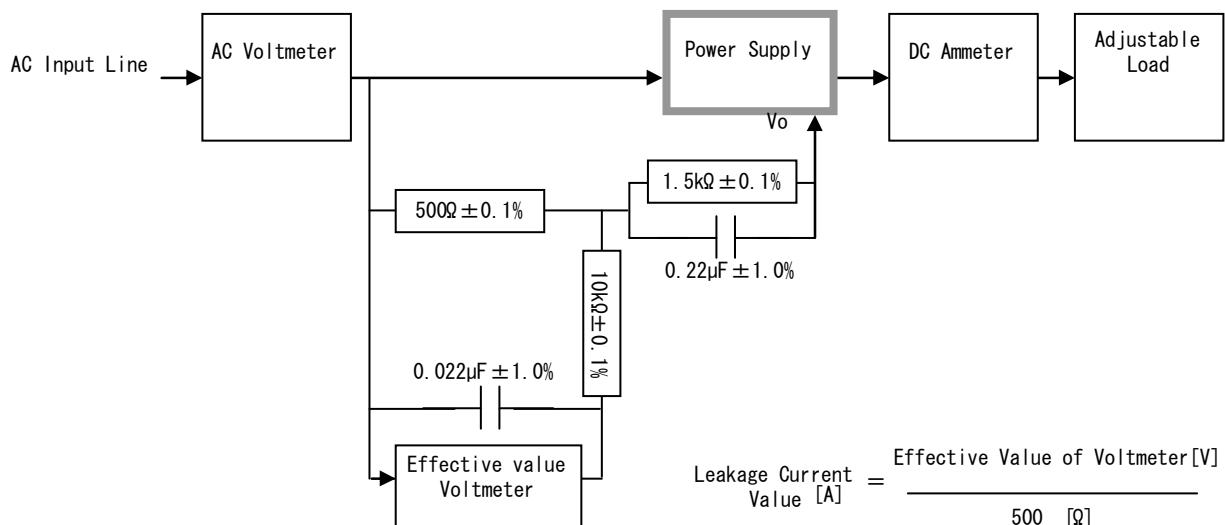


Figure B (IEC60950-1)

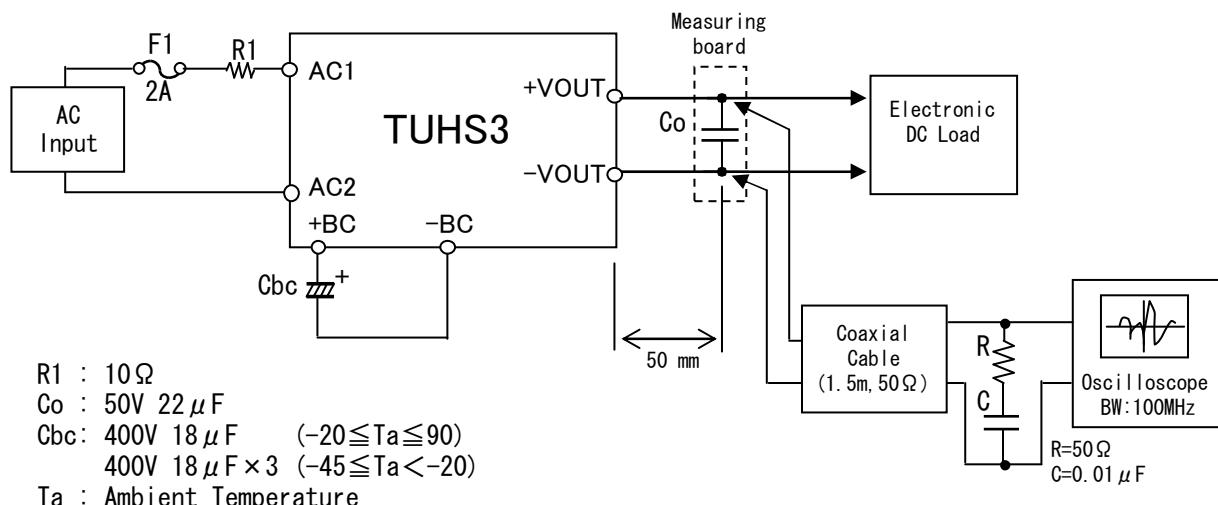
COSEL

Figure C