

TEST DATA OF TUHS25F15

Regulated DC Power Supply
August 29, 2017

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COSEL CO.,LTD.

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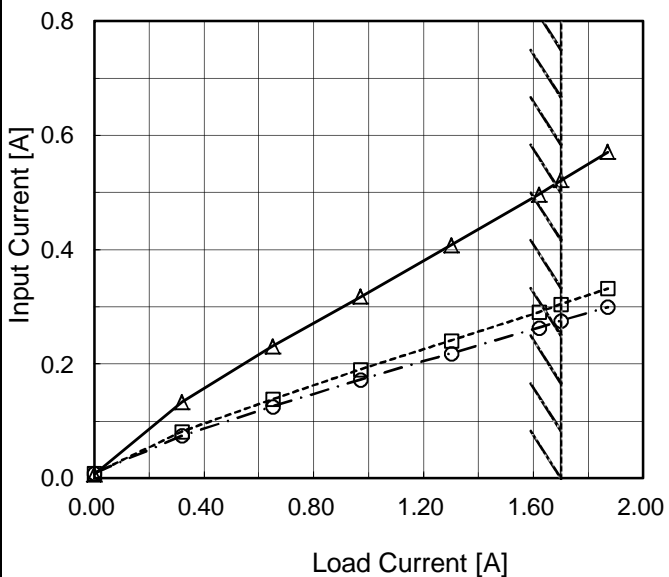
(Final Page 25)



Model	TUHS25F15
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



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]
0.00	0.007	0.009	0.009
0.32	0.134	0.082	0.075
0.65	0.231	0.139	0.126
0.97	0.318	0.190	0.173
1.30	0.408	0.241	0.218
1.62	0.496	0.291	0.263
1.70	0.522	0.305	0.276
1.87	0.571	0.332	0.300
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COSEL																																																						
Model	TUHS25F15	Temperature	25°C																																																			
Item	Input Power (by Load Current)	Testing Circuitry	Figure A																																																			
Object	_____																																																					
<p>1.Graph</p> <p> Input Volt. 100V Input Volt. 200V Input Volt. 230V </p> <p style="text-align: center;">Input Power [W]</p> <p style="text-align: center;">Load Current [A]</p>		<p>2.Values</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2">Load Current [A]</th> <th colspan="3">Input Power [W]</th> </tr> <tr> <th>Input Volt. 100[V]</th> <th>Input Volt. 200[V]</th> <th>Input Volt. 230[V]</th> </tr> </thead> <tbody> <tr><td>0.00</td><td>0.12</td><td>0.17</td><td>0.19</td></tr> <tr><td>0.32</td><td>5.86</td><td>6.12</td><td>6.24</td></tr> <tr><td>0.65</td><td>11.27</td><td>11.54</td><td>11.66</td></tr> <tr><td>0.97</td><td>16.45</td><td>16.81</td><td>16.97</td></tr> <tr><td>1.30</td><td>21.87</td><td>22.11</td><td>22.25</td></tr> <tr><td>1.62</td><td>27.15</td><td>27.30</td><td>27.46</td></tr> <tr><td>1.70</td><td>28.49</td><td>28.58</td><td>28.73</td></tr> <tr><td>1.87</td><td>31.38</td><td>31.32</td><td>31.45</td></tr> <tr><td>--</td><td>-</td><td>-</td><td>-</td></tr> <tr><td>--</td><td>-</td><td>-</td><td>-</td></tr> <tr><td>--</td><td>-</td><td>-</td><td>-</td></tr> </tbody> </table>		Load Current [A]	Input Power [W]			Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]	0.00	0.12	0.17	0.19	0.32	5.86	6.12	6.24	0.65	11.27	11.54	11.66	0.97	16.45	16.81	16.97	1.30	21.87	22.11	22.25	1.62	27.15	27.30	27.46	1.70	28.49	28.58	28.73	1.87	31.38	31.32	31.45	--	-	-	-	--	-	-	-	--	-	-	-
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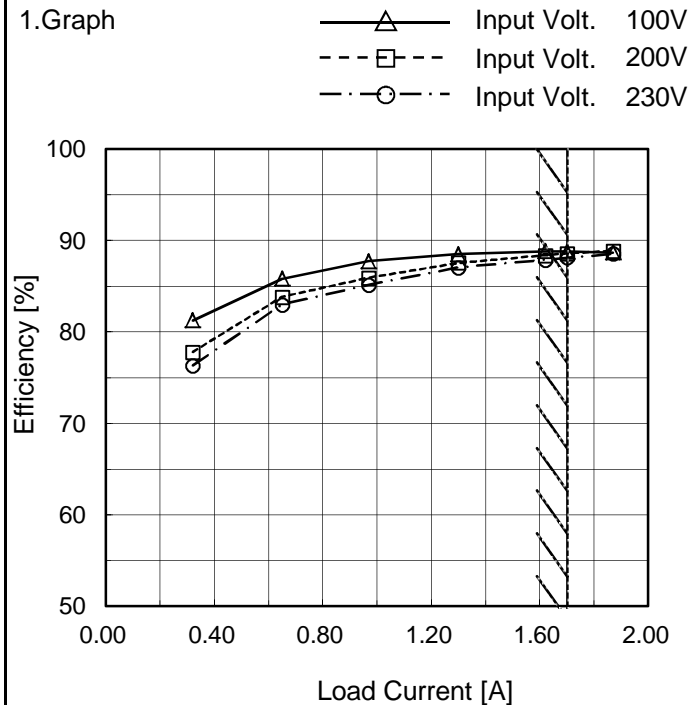


<p>Model TUHS25F15</p>		<p>Temperature 25°C Testing Circuitry Figure A</p>																																
<p>Item</p>	<p>Efficiency (by Input Voltage)</p>																																	
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<p>1.Graph</p> <p>---□--- Load 50% —△— Load 100%</p> <p>Note: Slanted line shows the range of the rated input voltage.</p>		<p>2.Values</p> <table border="1"> <thead> <tr> <th rowspan="2">Input Voltage [V]</th> <th colspan="2">Efficiency [%]</th> </tr> <tr> <th>Load 50%</th> <th>Load 100%</th> </tr> </thead> <tbody> <tr> <td>75</td> <td>87.2</td> <td>87.6</td> </tr> <tr> <td>85</td> <td>87.3</td> <td>88.2</td> </tr> <tr> <td>100</td> <td>87.1</td> <td>88.7</td> </tr> <tr> <td>120</td> <td>86.7</td> <td>89.0</td> </tr> <tr> <td>200</td> <td>85.1</td> <td>88.5</td> </tr> <tr> <td>230</td> <td>84.2</td> <td>88.1</td> </tr> <tr> <td>264</td> <td>83.0</td> <td>87.6</td> </tr> <tr> <td>280</td> <td>82.4</td> <td>87.3</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> </tbody> </table>	Input Voltage [V]	Efficiency [%]		Load 50%	Load 100%	75	87.2	87.6	85	87.3	88.2	100	87.1	88.7	120	86.7	89.0	200	85.1	88.5	230	84.2	88.1	264	83.0	87.6	280	82.4	87.3	--	-	-
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Model	TUHS25F15
Item	Efficiency (by Load Current)
Object	_____

Temperature 25°C
Testing Circuitry Figure A



2.Values

Load Current [A]	Efficiency [%]		
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]
0.00	-	-	-
0.32	81.2	77.8	76.3
0.65	85.8	83.8	83.0
0.97	87.7	85.9	85.1
1.30	88.5	87.6	87.0
1.62	88.8	88.4	87.9
1.70	88.8	88.6	88.1
1.87	88.7	88.9	88.5
--	-	-	-
--	-	-	-
--	-	-	-

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



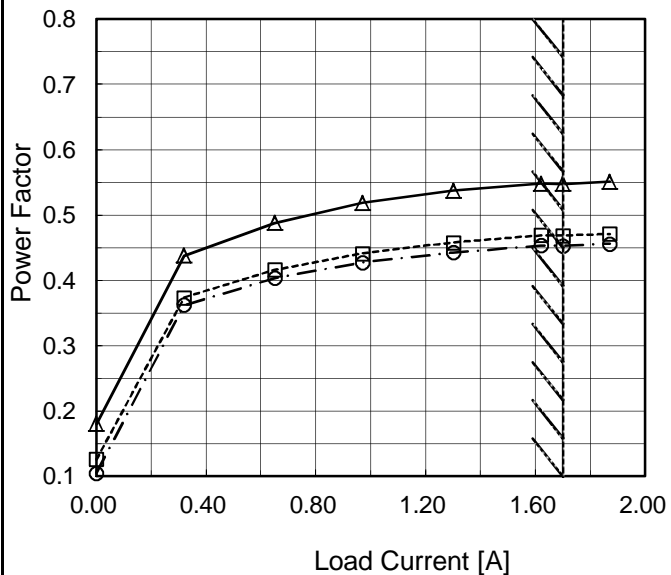
COSEL																																			
Model	TUHS25F15	Temperature	25°C																																
Item	Power Factor (by Input Voltage)	Testing Circuitry	Figure A																																
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<p>1.Graph</p> <p style="text-align: right;"> ---□--- Load 50% —△— Load 100% </p>		<p>2.Values</p> <table border="1"> <thead> <tr> <th rowspan="2">Input Voltage [V]</th> <th colspan="2">Power Factor</th> </tr> <tr> <th>Load 50%</th> <th>Load 100%</th> </tr> </thead> <tbody> <tr><td>75</td><td>0.564</td><td>0.586</td></tr> <tr><td>85</td><td>0.543</td><td>0.564</td></tr> <tr><td>100</td><td>0.518</td><td>0.538</td></tr> <tr><td>120</td><td>0.491</td><td>0.509</td></tr> <tr><td>200</td><td>0.429</td><td>0.464</td></tr> <tr><td>230</td><td>0.413</td><td>0.444</td></tr> <tr><td>264</td><td>0.398</td><td>0.426</td></tr> <tr><td>280</td><td>0.393</td><td>0.419</td></tr> <tr><td>--</td><td>-</td><td>-</td></tr> </tbody> </table>		Input Voltage [V]	Power Factor		Load 50%	Load 100%	75	0.564	0.586	85	0.543	0.564	100	0.518	0.538	120	0.491	0.509	200	0.429	0.464	230	0.413	0.444	264	0.398	0.426	280	0.393	0.419	--	-	-
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Model	TUHS25F15
Item	Power Factor (by Load Current)
Object	_____

Temperature 25°C
Testing Circuitry Figure A

1.Graph
 —△— Input Volt. 100V
 - - - □ - - - Input Volt. 200V
 - · - ○ - · - - Input Volt. 230V



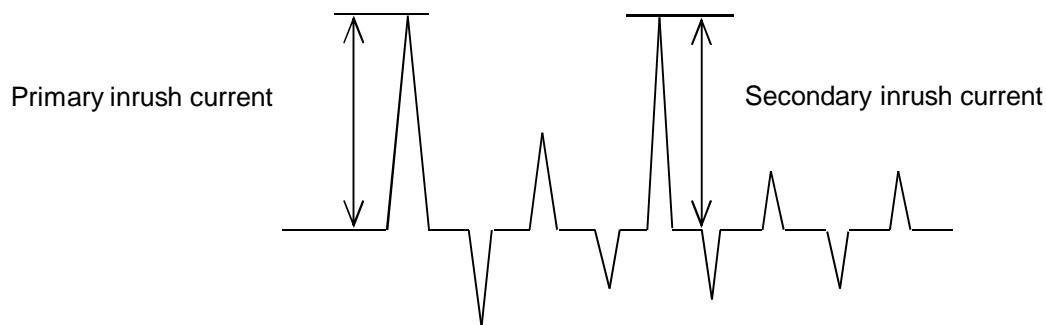
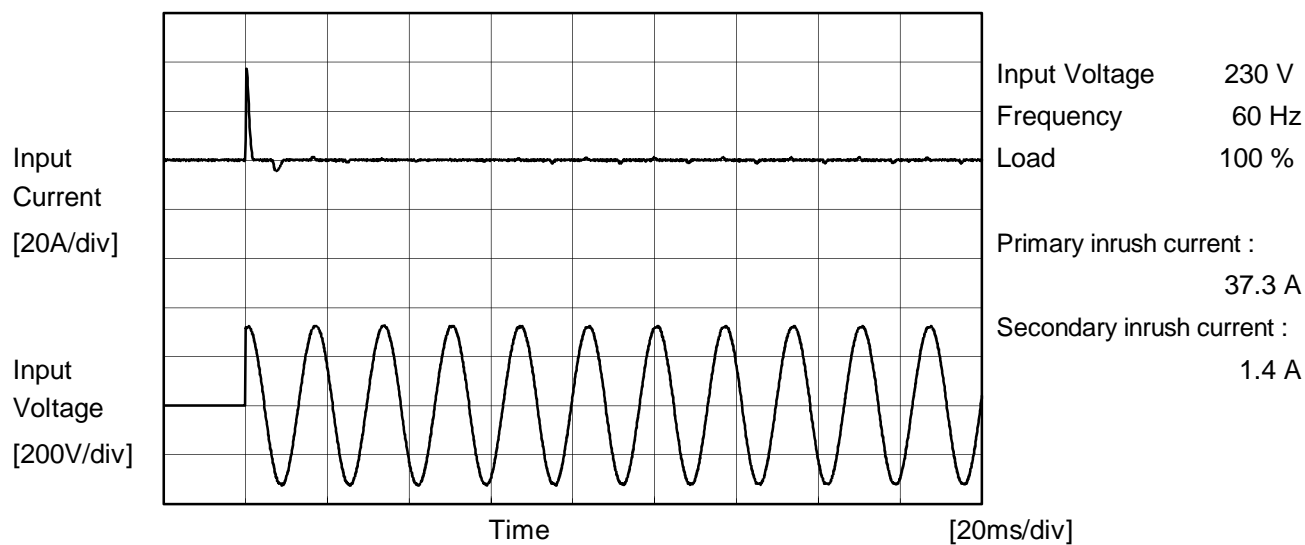
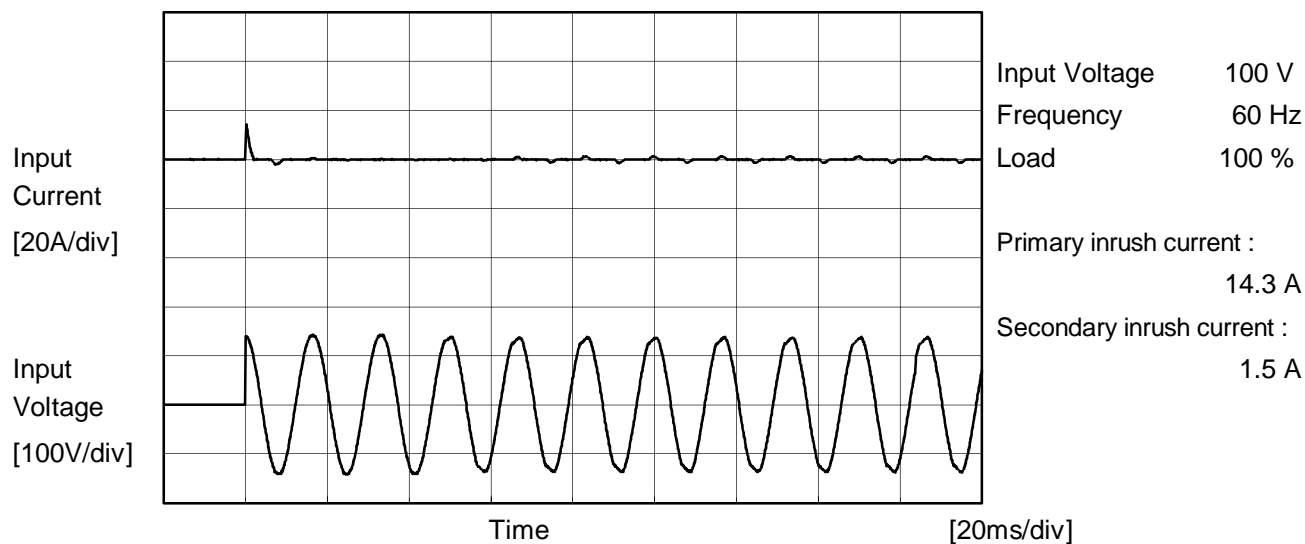
Note: Slanted line shows the range of the rated load current.

2.Values

Load Current [A]	Power Factor		
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]
0.00	0.180	0.126	0.105
0.32	0.438	0.373	0.362
0.65	0.488	0.416	0.403
0.97	0.519	0.441	0.427
1.30	0.537	0.458	0.443
1.62	0.548	0.469	0.453
1.70	0.547	0.469	0.453
1.87	0.551	0.471	0.456
--	-	-	-
--	-	-	-
--	-	-	-



COSEL			
Model	TUHS25F15	Temperature	25°C
Item	Inrush Current	Testing Circuitry	Figure A
Object	_____		





COSEL		
Model	TUHS25F15	Temperature 25°C Testing Circuitry Figure B
Item	Leakage Current	
Object	_____	

1.Results

Standards		Input Volt.			Note
		100 [V]	200 [V]	230 [V]	
DEN-AN	Both phases	0.008	0.010	0.010	Operation
	One of phases	0.008	0.017	0.020	Stand by
IEC60950-1	Both phases	0.006	0.011	0.014	Operation
	One of phases	0.008	0.016	0.020	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.



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Model	TUHS25F15	Temperature	25°C																																
Item	Line Regulation	Testing Circuitry	Figure A																																
Object	+15V1.7A																																		
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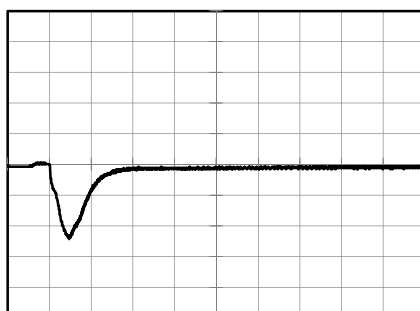
Model		TUHS25F15	
Item		Dynamic Load Response	Temperature 25°C Testing Circuitry Figure A
Object		+15V 1.7A	

Input Volt. 230V
Cycle 500ms

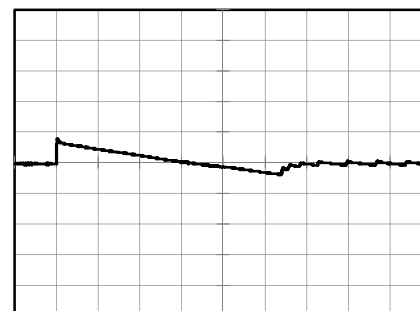
Load Current  1.7A / 100us

Min.Load (0A) ←→
Load 100%(1.7A)

1 V/div



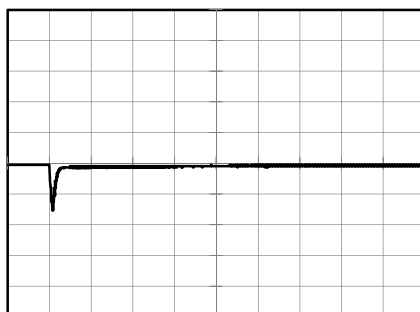
200 us/div



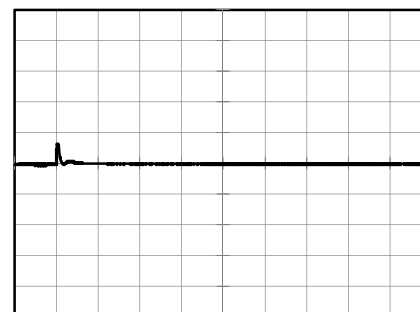
1 ms/div

Load 20% (0.34A) ←→
Load 100%(1.7A)

1 V/div



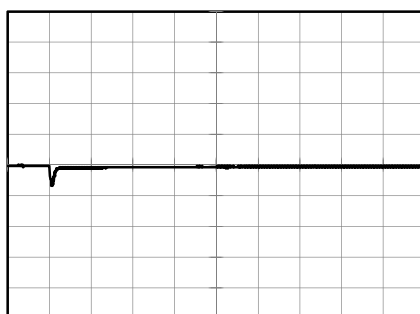
200 us/div



1 ms/div

Load 50% (0.85A) ←→
Load 100% (1.7A)

1 V/div



200 us/div



1 ms/div

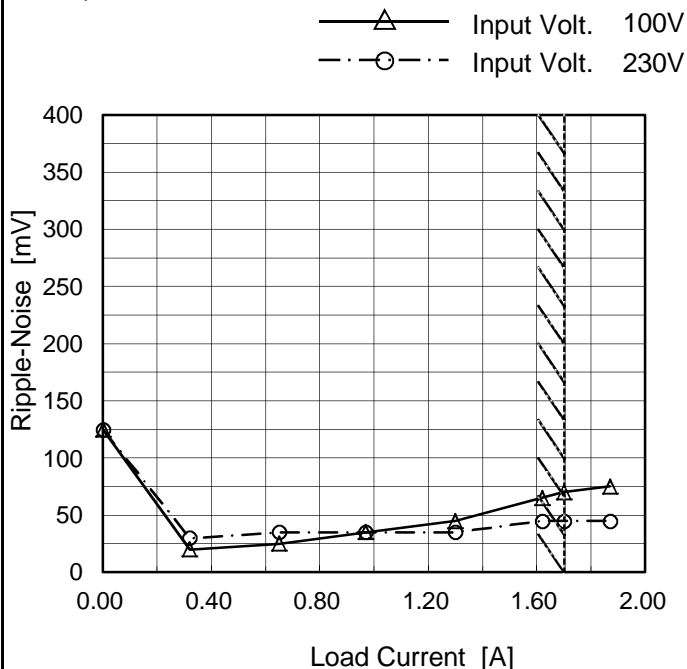
<p>Model TUHS25F15</p>		<p>Temperature 25°C Testing Circuitry Figure C</p>																																						
Item	Ripple Voltage (by Load Current)																																							
Object	+15V1.7A																																							
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Load Current [A]	Ripple Voltage [mV]																																							
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<p>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.</p>																																								
<p>T1: Due to AC Input Line T2: Due to Switching</p>																																								
<p>Fig. Complex Ripple Wave Form</p>																																								



Model	TUHS25F15
Item	Ripple-Noise
Object	+15V1.7A

Temperature 25°C
Testing Circuitry Figure C

1. Graph



2. Values

Load Current [A]	Ripple-Noise [mV]	
	Input Volt. 100 [V]	Input Volt. 230 [V]
0.00	125	125
0.32	20	30
0.65	25	35
0.97	35	35
1.30	45	35
1.62	65	45
1.70	70	45
1.87	75	45
--	-	-
--	-	-
--	-	-

Measured by 100 MHz Oscilloscope.
Ripple-Noise is shown as p-p in the figure below.
Note: Slanted line shows the range of the rated load current.

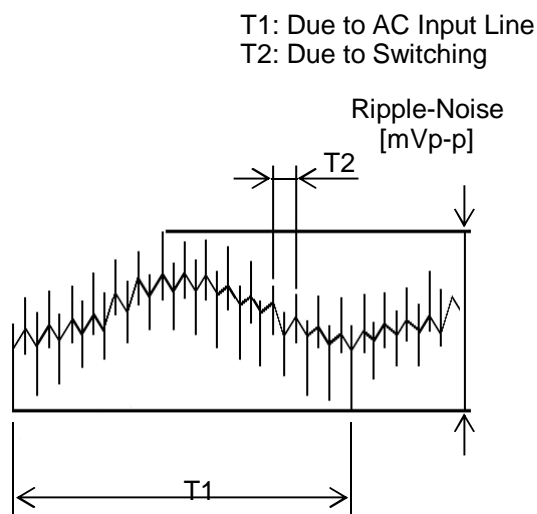


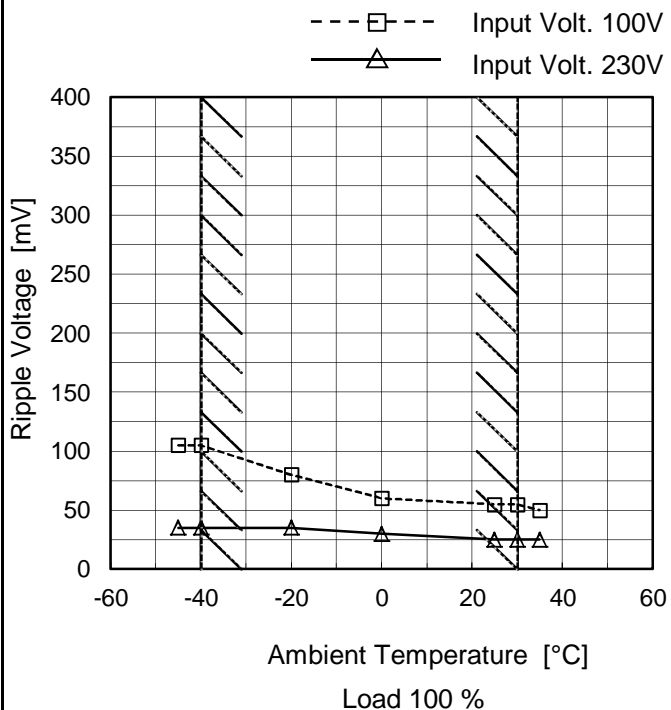
Fig. Complex Ripple Wave Form



Model	TUHS25F15
Item	Ripple Voltage (by Ambient Temp.)
Object	+15V1.7A

Testing Circuitry Figure C

1. Graph



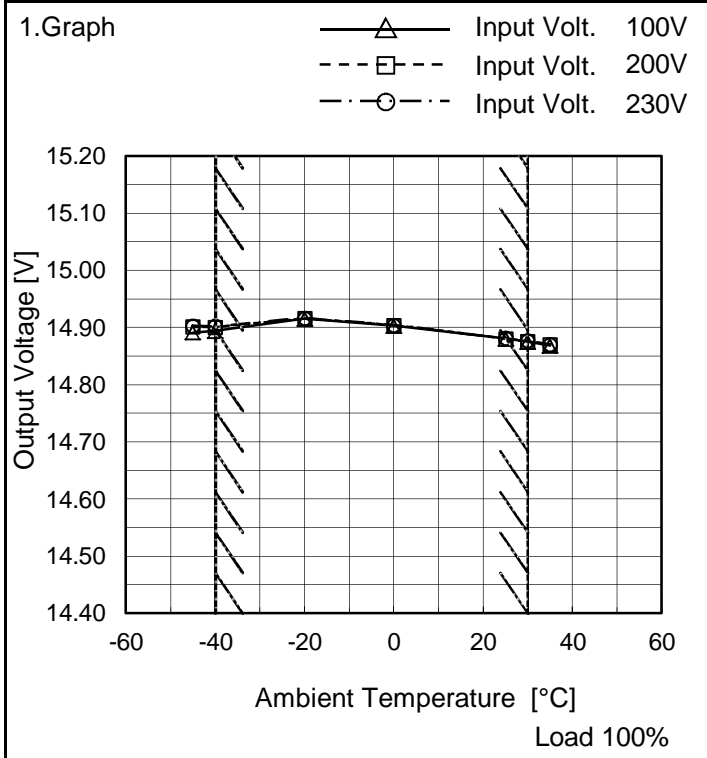
2. Values

Ambient Temperature [°C]	Ripple Voltage [mV]	
	Input Volt. 100V	Input Volt. 230V
-45	105	35
-40	105	35
-20	80	35
0	60	30
25	55	25
30	55	25
35	50	25
--	-	-
--	-	-
--	-	-
--	-	-



Model	TUHS25F15
Item	Ambient Temperature Drift
Object	+15V1.7A

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	14.891	14.901	14.903
-40	14.894	14.901	14.902
-20	14.915	14.916	14.917
0	14.903	14.904	14.904
25	14.881	14.880	14.881
30	14.875	14.876	14.877
35	14.868	14.870	14.870
--	-	-	-
--	-	-	-
--	-	-	-
--	-	-	-

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



COSEL		
Model	TUHS25F15	
Item	Output Voltage Accuracy	Testing Circuitry Figure A
Object	+15V1.7A	

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 - 30°C

Input Voltage : 85 - 264V

Load Current : 0 - 1.7A

* Output Voltage Accuracy = $\pm(\text{Maximum of Output Voltage} - \text{Minimum of Output Voltage}) / 2$

* 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	-20	85	0	14.931	±28	±0.2
Minimum Voltage	30	100	1.7	14.875		

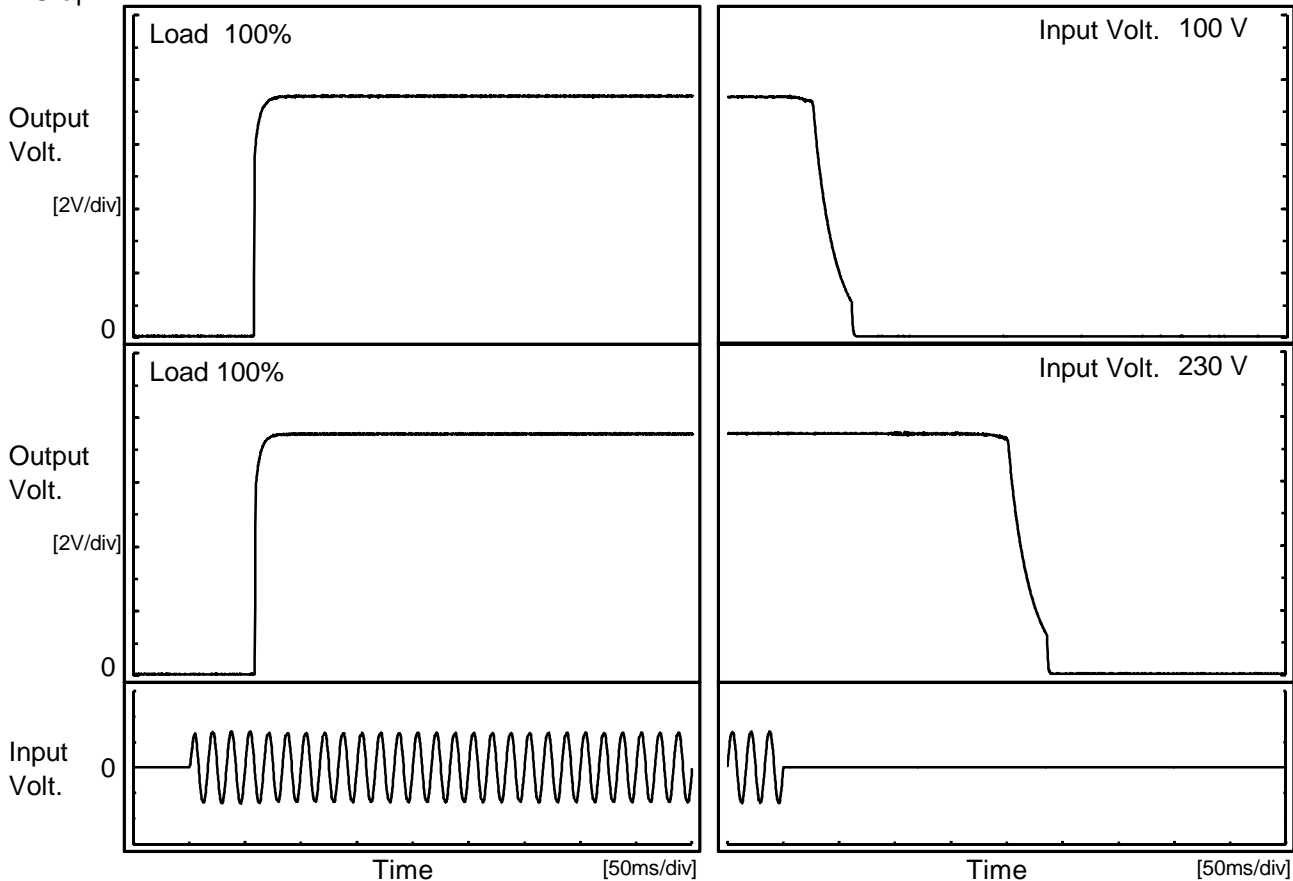


COSEL																									
Model	TUHS25F15	Temperature	25°C																						
Item	Time Lapse Drift	Testing Circuitry	Figure A																						
Object	+15V1.7A																								
<p>1.Graph</p> <p style="text-align: center;">Time [H]</p> <p>Input Volt. 100V Load 100%</p>		<p>2.Values</p> <table border="1"> <thead> <tr> <th>Time since start [H]</th> <th>Output Voltage [V]</th> </tr> </thead> <tbody> <tr><td>0.0</td><td>14.883</td></tr> <tr><td>0.5</td><td>14.827</td></tr> <tr><td>1.0</td><td>14.826</td></tr> <tr><td>2.0</td><td>14.826</td></tr> <tr><td>3.0</td><td>14.826</td></tr> <tr><td>4.0</td><td>14.826</td></tr> <tr><td>5.0</td><td>14.827</td></tr> <tr><td>6.0</td><td>14.827</td></tr> <tr><td>7.0</td><td>14.828</td></tr> <tr><td>8.0</td><td>14.828</td></tr> </tbody> </table>		Time since start [H]	Output Voltage [V]	0.0	14.883	0.5	14.827	1.0	14.826	2.0	14.826	3.0	14.826	4.0	14.826	5.0	14.827	6.0	14.827	7.0	14.828	8.0	14.828
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<p>* The characteristic of AC230V is equal.</p>																									



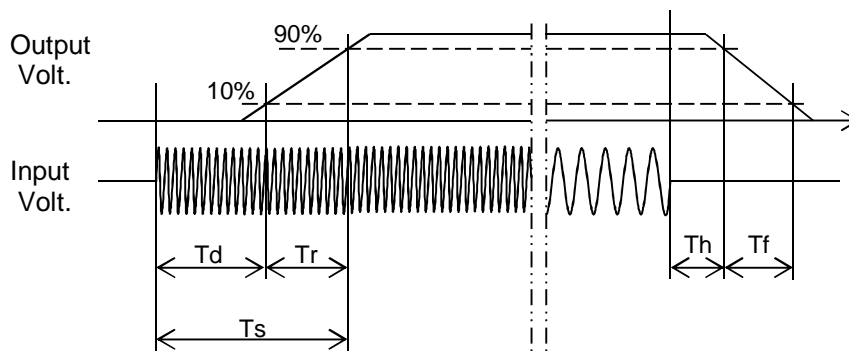
COSEL		
Model	TUHS25F15	Temperature 25°C Testing Circuitry Figure A
Item	Rise and Fall Time	
Object	+15V1.7A	

1. Graph



2. Values

		[ms]				
Input Volt.	Time	Td	Tr	Ts	Th	Tf
100V		58.0	4.8	62.8	27.8	33.8
230V		58.8	4.3	63.1	202.3	34.0

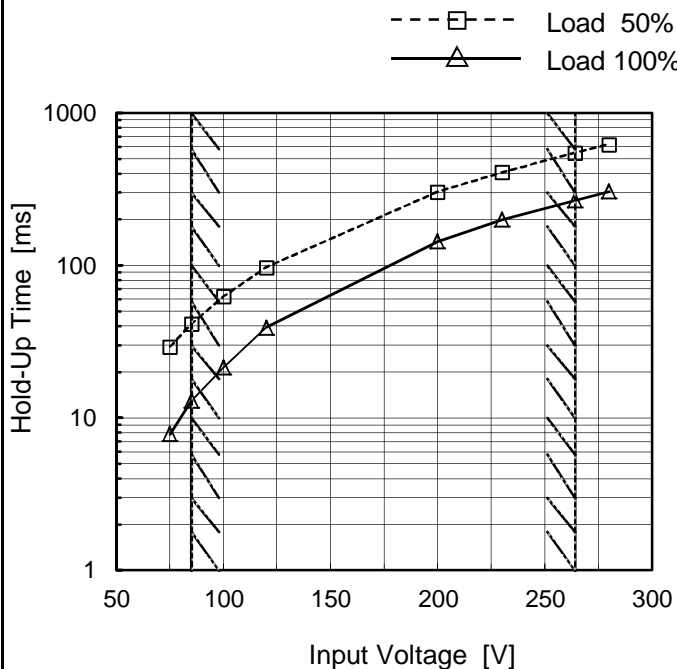




Model	TUHS25F15
Item	Hold-Up Time
Object	+15V1.7A

Temperature 25°C
Testing Circuitry Figure A

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.

2.Values

Input Voltage [V]	Hold-Up Time [ms]	
	Load 50%	Load 100%
75	29	8
85	41	13
100	63	21
120	97	39
200	304	144
230	408	200
264	549	267
280	621	305
--	-	-



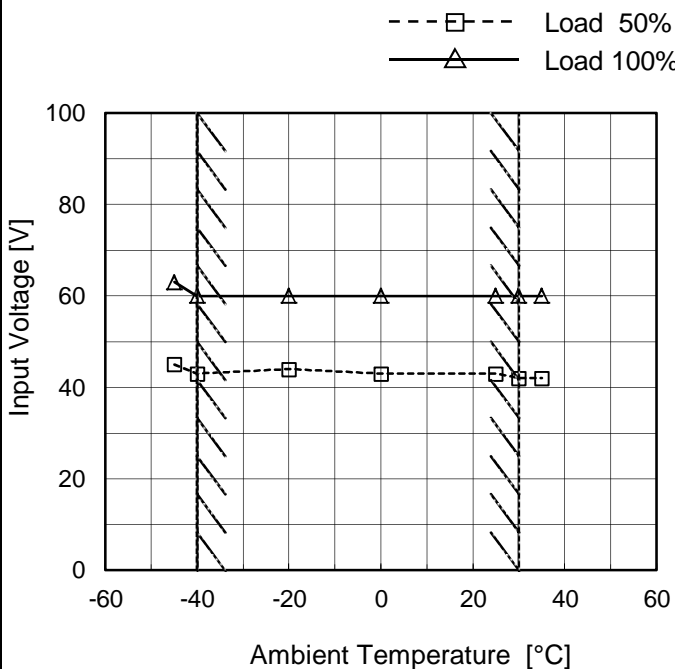
<p>Model TUHS25F15</p> <p>Item Instantaneous Interruption Compensation</p> <p>Object +15V1.7A</p>		<p>Temperature 25°C</p> <p>Testing Circuitry Figure A</p>																																																			
<p>1.Graph</p> <p>—△— Input Volt. 100V</p> <p>- - □ - - Input Volt. 200V</p> <p>- - ○ - - Input Volt. 230V</p> <p>Instantaneous Compensation Time [ms]</p> <p>Load Current [A]</p> <p>Note: Slanted line shows the range of the rated load current.</p>		<p>2.Values</p> <table border="1"> <thead> <tr> <th rowspan="2">Load Current [A]</th> <th colspan="3">Time [ms]</th> </tr> <tr> <th>Input Volt. 100[V]</th> <th>Input Volt. 200[V]</th> <th>Input Volt. 230[V]</th> </tr> </thead> <tbody> <tr><td>0.00</td><td>-</td><td>-</td><td>-</td></tr> <tr><td>0.32</td><td>176</td><td>754</td><td>1017</td></tr> <tr><td>0.65</td><td>86</td><td>397</td><td>531</td></tr> <tr><td>0.97</td><td>55</td><td>268</td><td>359</td></tr> <tr><td>1.30</td><td>38</td><td>198</td><td>268</td></tr> <tr><td>1.62</td><td>25</td><td>154</td><td>211</td></tr> <tr><td>1.70</td><td>23</td><td>145</td><td>200</td></tr> <tr><td>1.87</td><td>20</td><td>131</td><td>179</td></tr> <tr><td>--</td><td>-</td><td>-</td><td>-</td></tr> <tr><td>--</td><td>-</td><td>-</td><td>-</td></tr> <tr><td>--</td><td>-</td><td>-</td><td>-</td></tr> </tbody> </table>	Load Current [A]	Time [ms]			Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]	0.00	-	-	-	0.32	176	754	1017	0.65	86	397	531	0.97	55	268	359	1.30	38	198	268	1.62	25	154	211	1.70	23	145	200	1.87	20	131	179	--	-	-	-	--	-	-	-	--	-	-	-
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Model	TUHS25F15
Item	Minimum Input Voltage for Regulated Output Voltage
Object	+15V1.7A

Testing Circuitry Figure A

1.Graph



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

2.Values

Ambient Temperature [°C]	Input Voltage [V]	
	Load 50%	Load 100%
-45	45	63
-40	43	60
-20	44	60
0	43	60
25	43	60
30	42	60
35	42	60
--	-	-
--	-	-
--	-	-
--	-	-



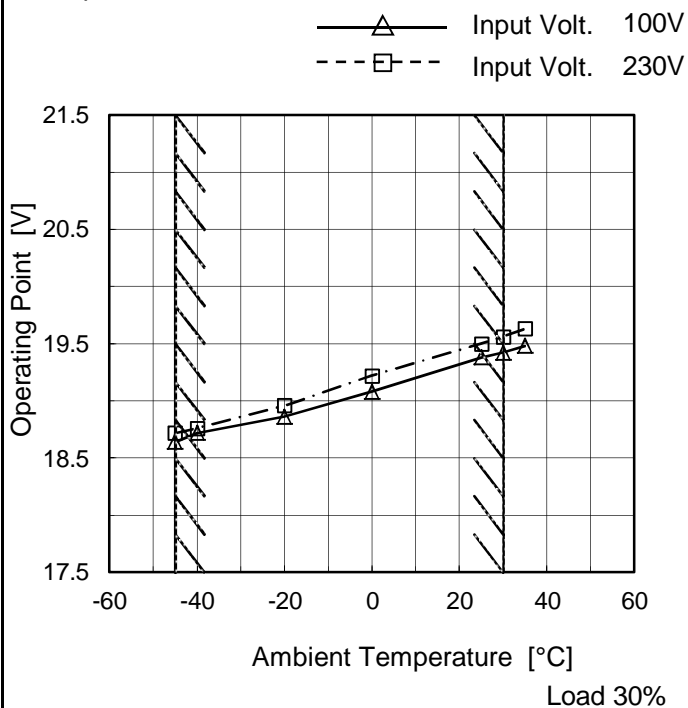
COSEL																																																		
Model	TUHS25F15	Temperature	25°C																																															
Item	Overcurrent Protection	Testing Circuitry	Figure A																																															
Object	+15V1.7A																																																	
<p>1.Graph</p> <p> Input Volt. 100V Input Volt. 230V </p> <p style="text-align: center;">Load Current [A]</p> <p>Note: Slanted line shows the range of the rated load current.</p>		<p>2.Values</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2">Output Voltage [V]</th> <th colspan="2">Load Current [A]</th> </tr> <tr> <th>Input Volt. 100[V]</th> <th>Input Volt. 230[V]</th> </tr> </thead> <tbody> <tr> <td>15.0</td> <td>2.20</td> <td>2.47</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> </tbody> </table>		Output Voltage [V]	Load Current [A]		Input Volt. 100[V]	Input Volt. 230[V]	15.0	2.20	2.47	--	-	-	--	-	-	--	-	-	--	-	-	--	-	-	--	-	-	--	-	-	--	-	-	--	-	-	--	-	-	--	-	-	--	-	-	--	-	-
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Model	TUHS25F15
Item	Overvoltage Protection
Object	+15V1.7A

Testing Circuitry Figure A

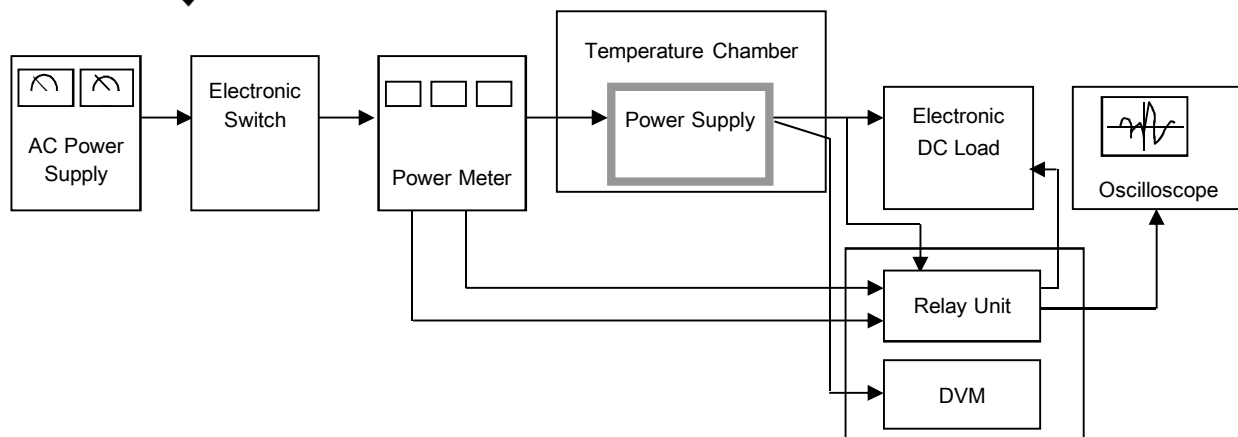
1.Graph



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]
-45	18.64	18.72
-40	18.72	18.76
-20	18.86	18.96
0	19.08	19.22
25	19.38	19.50
30	19.42	19.56
35	19.48	19.63
--	-	-
--	-	-
--	-	-
--	-	-



Data Acquisition/Control Unit

Figure A

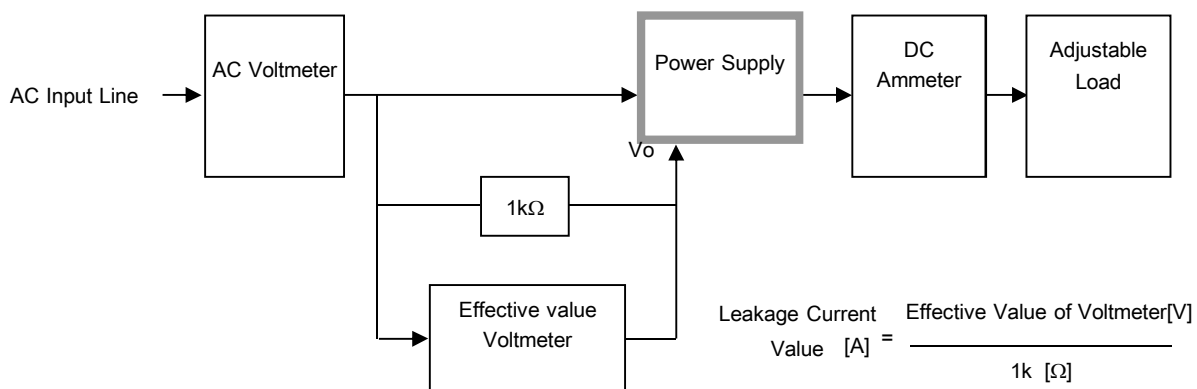


Figure B (DEN-AN)

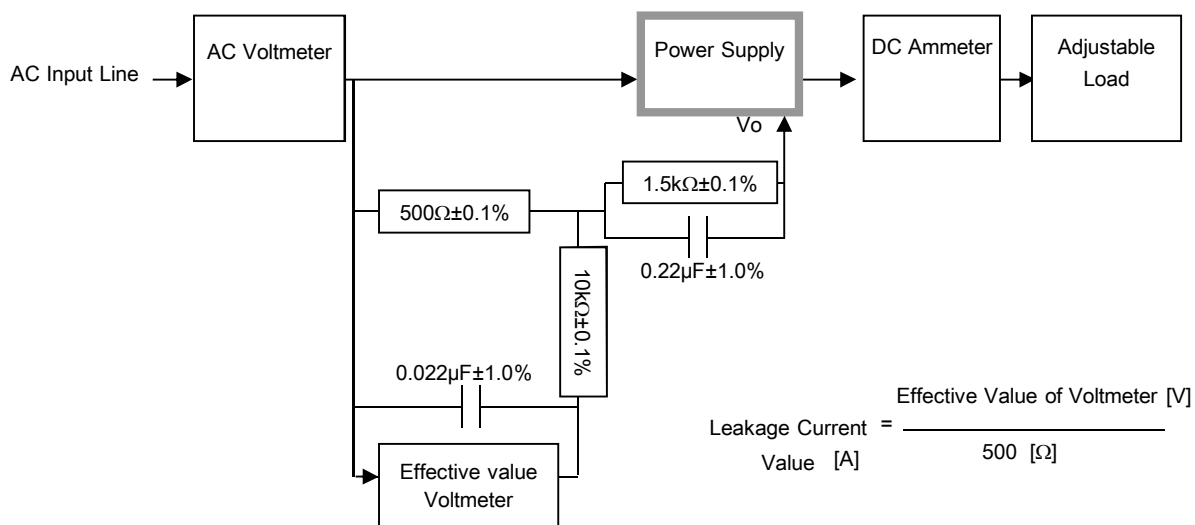


Figure B (IEC60950-1)

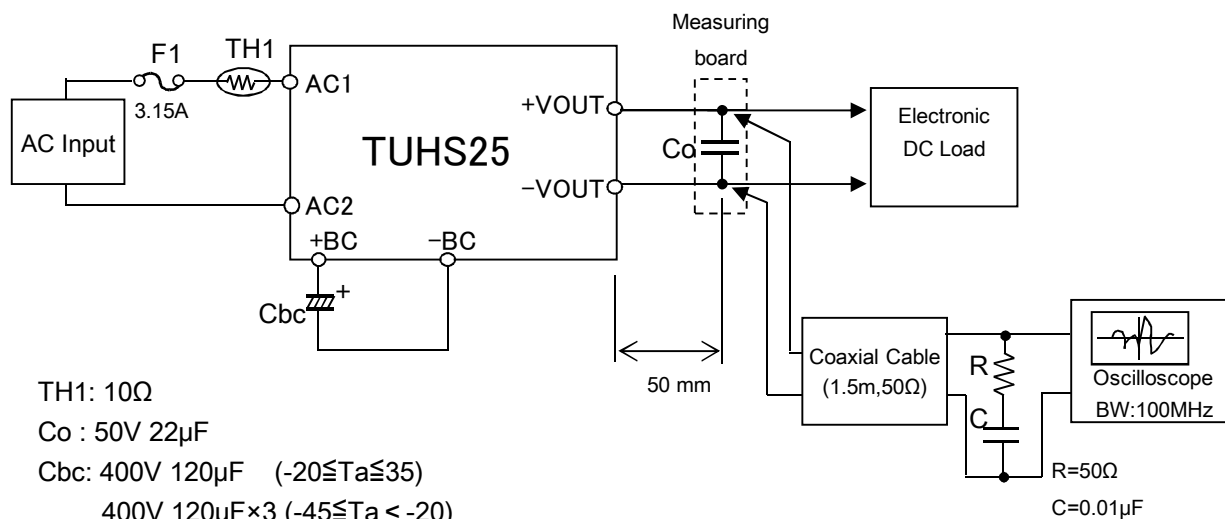


Figure C