

TEST DATA OF TUHS10F15

Regulated DC Power Supply
August 29, 2017

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Kenji Shiho Design Manager

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COSEL CO.,LTD.



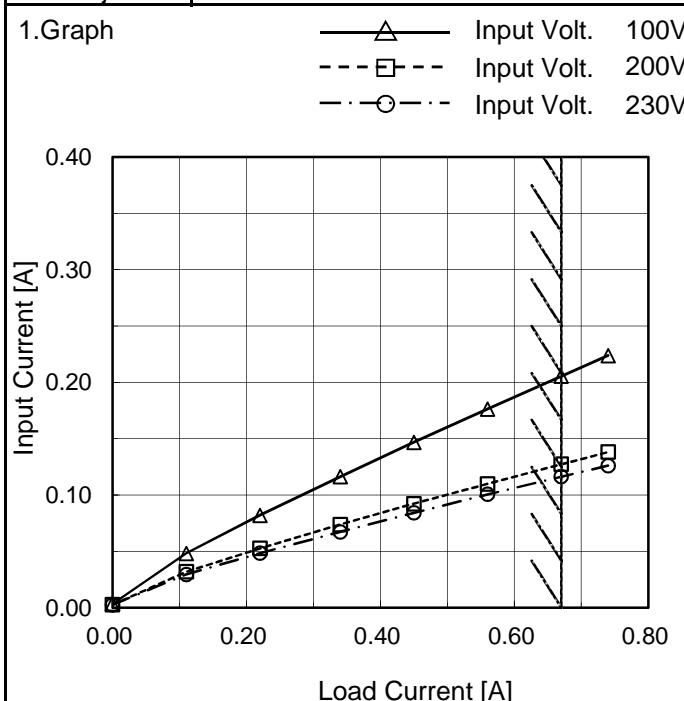
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Model	TUHS10F15
Item	Input Current (by Load Current)
Object	_____



Temperature 25°C
Testing Circuitry Figure A

2.Values

Load Current [A]	Input Current [A]		
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]
0.00	0.004	0.003	0.003
0.11	0.048	0.032	0.029
0.22	0.082	0.053	0.048
0.34	0.116	0.074	0.067
0.45	0.147	0.092	0.084
0.56	0.176	0.110	0.101
0.67	0.206	0.127	0.116
0.74	0.224	0.138	0.126
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Note: Slanted line shows the range of the rated load current.

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Item	Input Power (by Load Current)	Temperature 25°C	Testing Circuitry Figure A																																																			
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1.Graph	<p>The graph plots Input Power [W] on the Y-axis (0.0 to 20.0) against Load Current [A] on the X-axis (0.00 to 0.80). Three curves are shown for different input voltages: 100V (solid line with open triangle markers), 200V (dashed line with open square markers), and 230V (dash-dot line with open circle markers). A slanted line is drawn through the origin, representing the rated load current range.</p> <table border="1"> <thead> <tr> <th>Load Current [A]</th> <th>Input Volt. 100V [W]</th> <th>Input Volt. 200V [W]</th> <th>Input Volt. 230V [W]</th> </tr> </thead> <tbody> <tr><td>0.00</td><td>0.10</td><td>0.13</td><td>0.14</td></tr> <tr><td>0.11</td><td>2.12</td><td>2.25</td><td>2.30</td></tr> <tr><td>0.22</td><td>3.94</td><td>4.09</td><td>4.14</td></tr> <tr><td>0.34</td><td>5.95</td><td>6.08</td><td>6.13</td></tr> <tr><td>0.45</td><td>7.83</td><td>7.90</td><td>7.96</td></tr> <tr><td>0.56</td><td>9.71</td><td>9.75</td><td>9.80</td></tr> <tr><td>0.67</td><td>11.62</td><td>11.60</td><td>11.65</td></tr> <tr><td>0.74</td><td>12.84</td><td>12.79</td><td>12.84</td></tr> </tbody> </table>			Load Current [A]	Input Volt. 100V [W]	Input Volt. 200V [W]	Input Volt. 230V [W]	0.00	0.10	0.13	0.14	0.11	2.12	2.25	2.30	0.22	3.94	4.09	4.14	0.34	5.95	6.08	6.13	0.45	7.83	7.90	7.96	0.56	9.71	9.75	9.80	0.67	11.62	11.60	11.65	0.74	12.84	12.79	12.84															
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Model	TUHS10F15	Temperature	25°C																																
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1.Graph		2.Values																																	
<p>Efficiency [%]</p> <p>Input Voltage [V]</p> <p>Legend: Load 50% (dashed line with squares), Load 100% (solid line with triangles)</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>85.3</td> <td>85.5</td> </tr> <tr> <td>85</td> <td>85.5</td> <td>85.9</td> </tr> <tr> <td>100</td> <td>85.5</td> <td>86.5</td> </tr> <tr> <td>120</td> <td>85.1</td> <td>86.9</td> </tr> <tr> <td>200</td> <td>83.8</td> <td>86.8</td> </tr> <tr> <td>230</td> <td>83.2</td> <td>86.4</td> </tr> <tr> <td>264</td> <td>82.0</td> <td>85.8</td> </tr> <tr> <td>280</td> <td>81.2</td> <td>85.5</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> </tbody> </table>		Input Voltage [V]	Efficiency [%]		Load 50%	Load 100%	75	85.3	85.5	85	85.5	85.9	100	85.5	86.5	120	85.1	86.9	200	83.8	86.8	230	83.2	86.4	264	82.0	85.8	280	81.2	85.5	--	-	-
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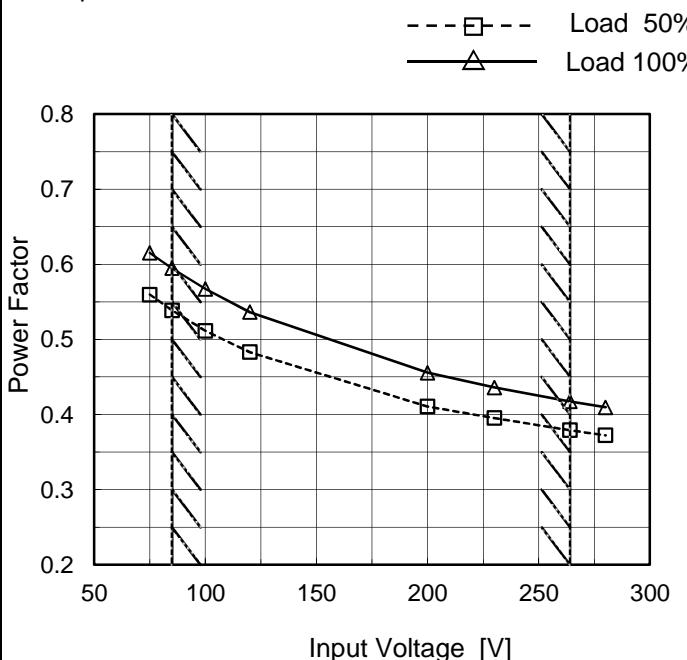
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1.Graph	<p>Graph showing Efficiency (%) vs Load Current [A] for TUHS10F15 at 25°C. The graph plots Efficiency (%) on the Y-axis (40 to 90) against Load Current [A] on the X-axis (0.00 to 0.80). Three curves are shown for different input voltages: 100V (solid line with open triangle markers), 200V (dashed line with open square markers), and 230V (dash-dot line with open circle markers). A vertical slanted line is drawn through the curves at approximately 0.74A, indicating the rated load current range.</p> <table border="1"> <thead> <tr> <th>Load Current [A]</th> <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>0.11</td><td>77.8</td><td>72.1</td><td>69.4</td></tr> <tr><td>0.22</td><td>83.8</td><td>79.8</td><td>78.8</td></tr> <tr><td>0.34</td><td>85.8</td><td>83.3</td><td>82.2</td></tr> <tr><td>0.45</td><td>86.5</td><td>85.0</td><td>84.1</td></tr> <tr><td>0.56</td><td>86.6</td><td>85.8</td><td>85.2</td></tr> <tr><td>0.67</td><td>86.6</td><td>86.5</td><td>85.9</td></tr> <tr><td>0.74</td><td>86.6</td><td>86.6</td><td>86.2</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 Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]	0.00	-	-	-	0.11	77.8	72.1	69.4	0.22	83.8	79.8	78.8	0.34	85.8	83.3	82.2	0.45	86.5	85.0	84.1	0.56	86.6	85.8	85.2	0.67	86.6	86.5	85.9	0.74	86.6	86.6	86.2	--	-	-	-	--	-	-	-	--	-	-	-			
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Model	TUHS10F15
Item	Power Factor (by Input Voltage)
Object	_____

 Temperature 25°C
 Testing Circuitry Figure A

1.Graph



2.Values

Input Voltage [V]	Power Factor	
	Load 50%	Load 100%
75	0.560	0.615
85	0.539	0.595
100	0.512	0.567
120	0.483	0.536
200	0.411	0.456
230	0.395	0.436
264	0.379	0.417
280	0.372	0.409
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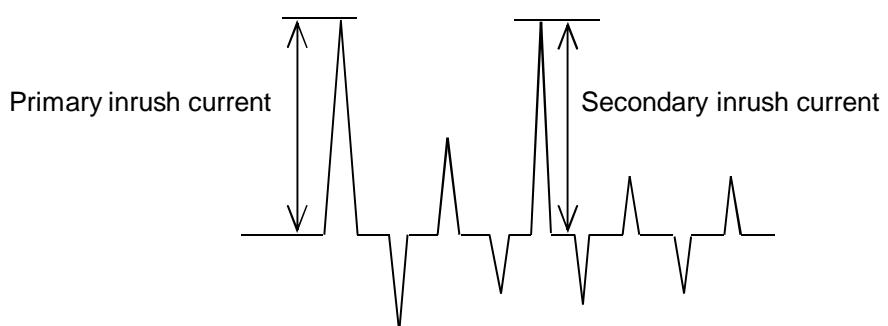
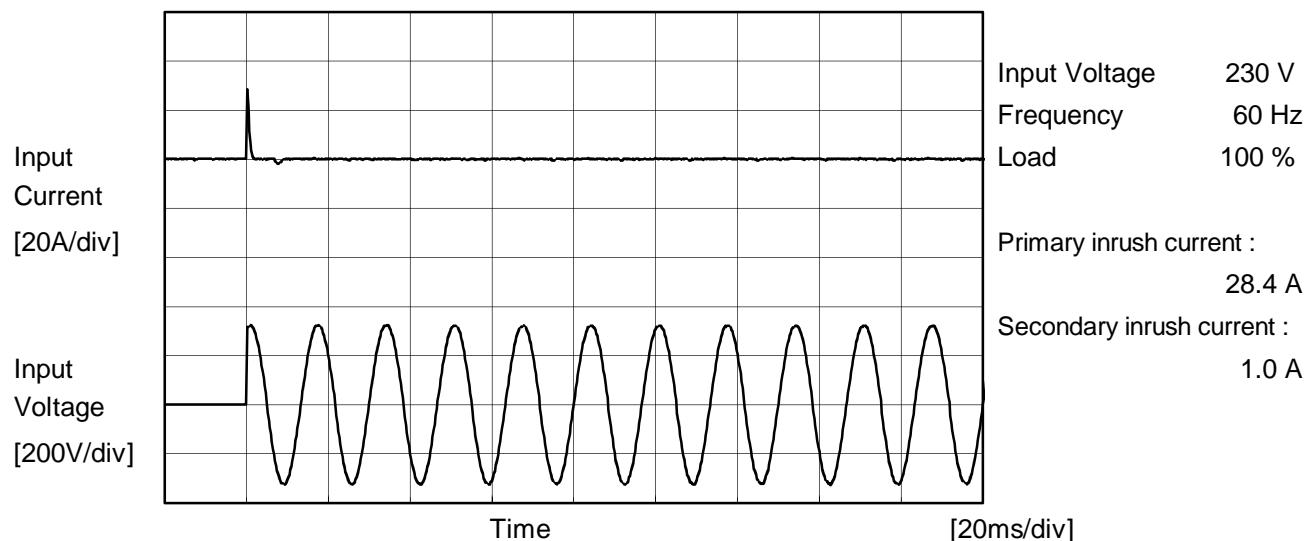
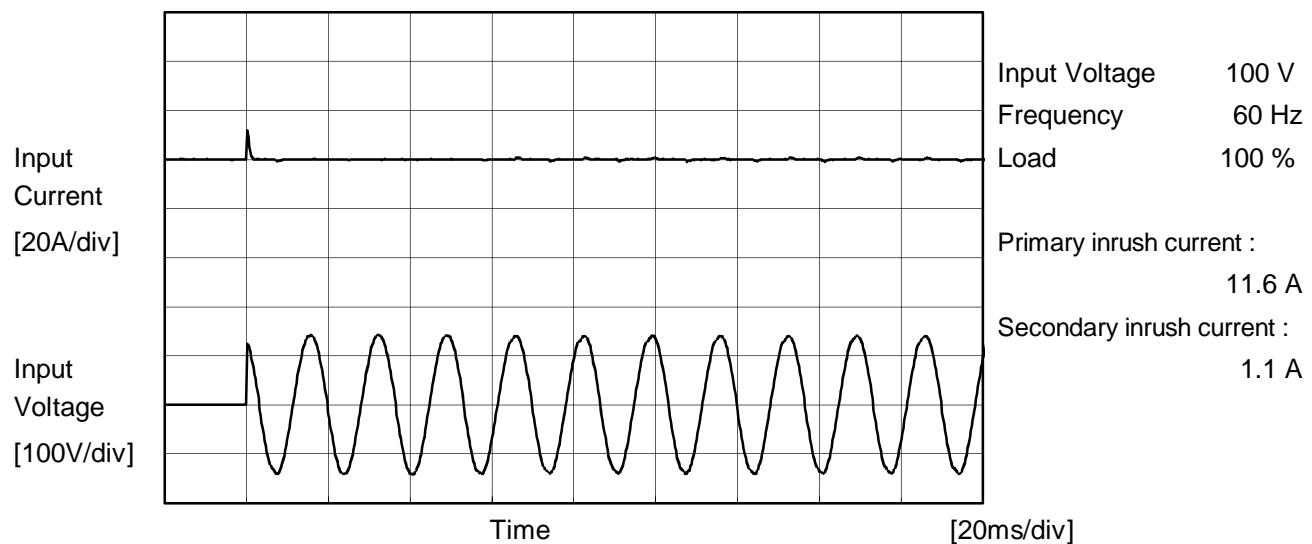
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Item	Power Factor (by Load Current)	Testing Circuitry	Figure A																																																			
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Model	TUHS10F15	Temperature Testing Circuitry 25°C Figure A
Item	Inrush Current	
Object	_____	





Model	TUHS10F15	Temperature Testing Circuitry	25°C Figure B
Item	Leakage Current		
Object	<hr/>		

1. Results

Standards		Input Volt.			Note
		100 [V]	200 [V]	230 [V]	
DEN-AN	Both phases	0.005	0.007	0.008	Operation
	One of phases	0.004	0.010	0.011	Stand by
IEC60950-1	Both phases	0.003	0.006	0.007	Operation
	One of phases	0.004	0.010	0.010	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.

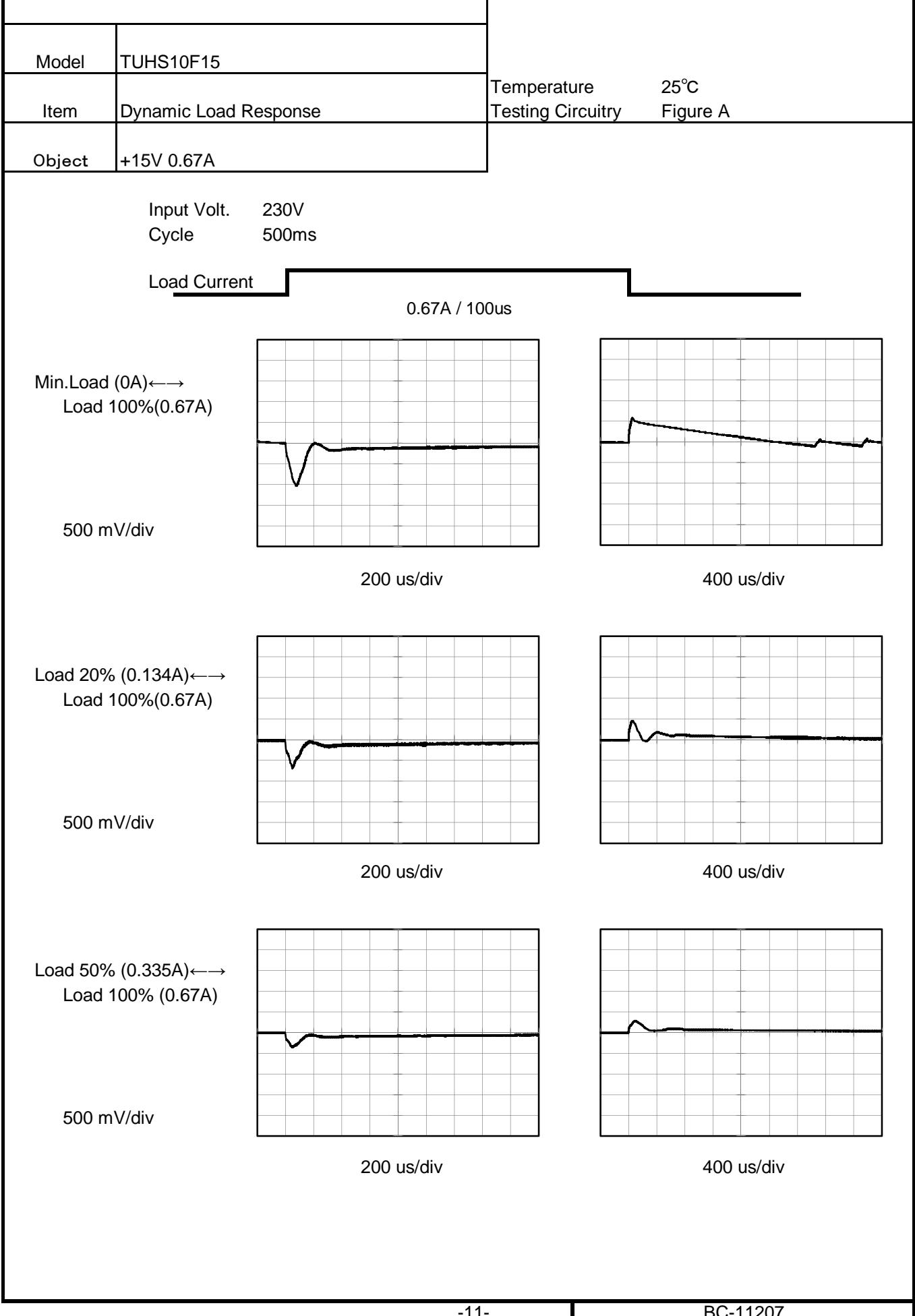
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Item	Line Regulation	Temperature 25°C Testing Circuitry Figure A																																
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COSEL

Model	TUHS10F15																																																					
Item	Load Regulation																																																					
Object	+15V0.67A																																																					
1.Graph	—▲— Input Volt. 100V ---□--- Input Volt. 200V ---○--- Input Volt. 230V																																																					
<p>The graph plots Output Voltage [V] on the Y-axis (from 14.40 to 15.20) against Load Current [A] on the X-axis (from 0.00 to 0.80). Three curves are shown for different input voltages: 100V (solid line with triangles), 200V (dashed line with squares), and 230V (dash-dot line with circles). All curves show a slight initial decrease in output voltage as load current increases, followed by a sharp drop-off. A vertical dashed line marks the rated load current of approximately 0.67A.</p>			2.Values																																																			
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COSEL



COSEL

Model	TUHS10F15																																							
Item	Ripple Voltage (by Load Current)	Temperature 25°C Testing Circuitry Figure C																																						
Object	+15V0.67A																																							
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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>																																								

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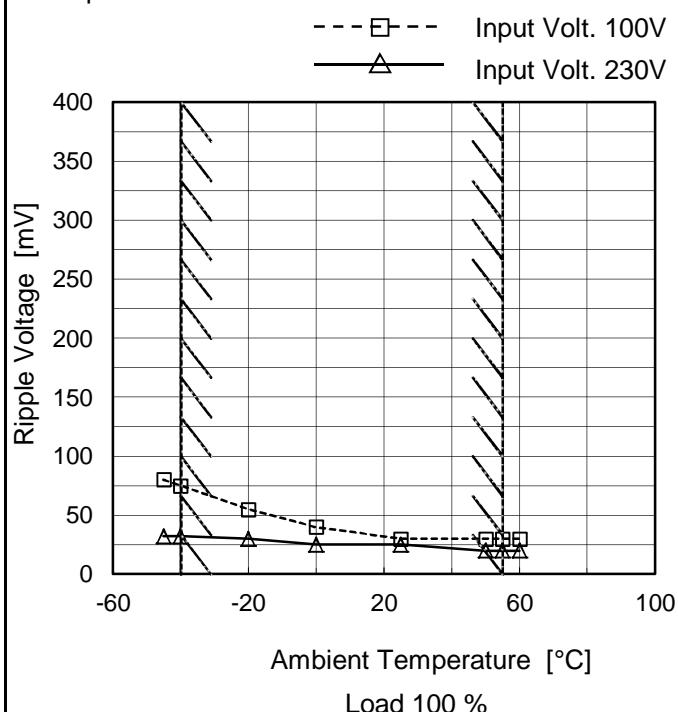
Model	TUHS10F15	Temperature	25°C																																						
Item	Ripple-Noise	Testing Circuitry	Figure C																																						
Object	+15V0.67A																																								
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<p>Graph showing Ripple-Noise [mV] vs Load Current [A]. The Y-axis ranges from 0 to 400 mV, and the X-axis ranges from 0.00 to 0.80 A. Two curves are plotted: one for Input Volt. 100V (solid line with open triangles) and one for Input Volt. 230V (dashed line with open circles). A slanted line indicates the range of the rated load current.</p>		<table border="1"> <thead> <tr> <th rowspan="2">Load Current [A]</th> <th colspan="2">Ripple-Noise [mV]</th> </tr> <tr> <th>Input Volt. 100 [V]</th> <th>Input Volt. 230 [V]</th> </tr> </thead> <tbody> <tr><td>0.00</td><td>115</td><td>200</td></tr> <tr><td>0.11</td><td>10</td><td>20</td></tr> <tr><td>0.22</td><td>15</td><td>20</td></tr> <tr><td>0.34</td><td>20</td><td>20</td></tr> <tr><td>0.45</td><td>25</td><td>25</td></tr> <tr><td>0.56</td><td>35</td><td>25</td></tr> <tr><td>0.67</td><td>50</td><td>35</td></tr> <tr><td>0.74</td><td>60</td><td>35</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>		Load Current [A]	Ripple-Noise [mV]		Input Volt. 100 [V]	Input Volt. 230 [V]	0.00	115	200	0.11	10	20	0.22	15	20	0.34	20	20	0.45	25	25	0.56	35	25	0.67	50	35	0.74	60	35	--	-	-	--	-	-	--	-	-
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<p>Fig. Complex Ripple Wave Form</p>		<p>- 13 -</p>																																							



Model	TUHS10F15
Item	Ripple Voltage (by Ambient Temp.)
Object	+15V0.67A

Testing Circuitry Figure C

1. Graph



2. Values

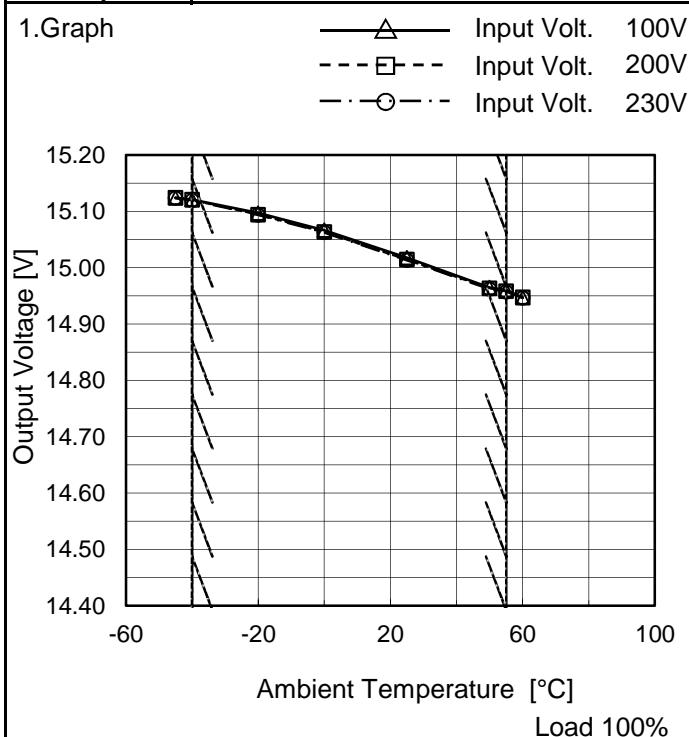
Ambient Temperature [°C]	Ripple Voltage [mV]	
	Input Volt. 100V	Input Volt. 230V
-45	80	32
-40	75	32
-20	55	30
0	40	25
25	30	25
50	30	20
55	30	20
60	30	20
--	-	-
--	-	-
--	-	-

Measured by 100 MHz Oscilloscope.

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

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Model	TUHS10F15
Item	Ambient Temperature Drift
Object	+15V0.67A



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	15.124	15.124	15.124
-40	15.121	15.121	15.120
-20	15.097	15.095	15.094
0	15.067	15.064	15.063
25	15.018	15.014	15.013
50	14.965	14.964	14.962
55	14.961	14.958	14.957
60	14.947	14.948	14.947
--	-	-	-
--	-	-	-
--	-	-	-

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



Model	TUHS10F15	Testing Circuitry Figure A
Item	Output Voltage Accuracy	
Object	+15V0.67A	

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 - 55°C

Input Voltage : 85 - 264V

Load Current : 0 - 0.67A

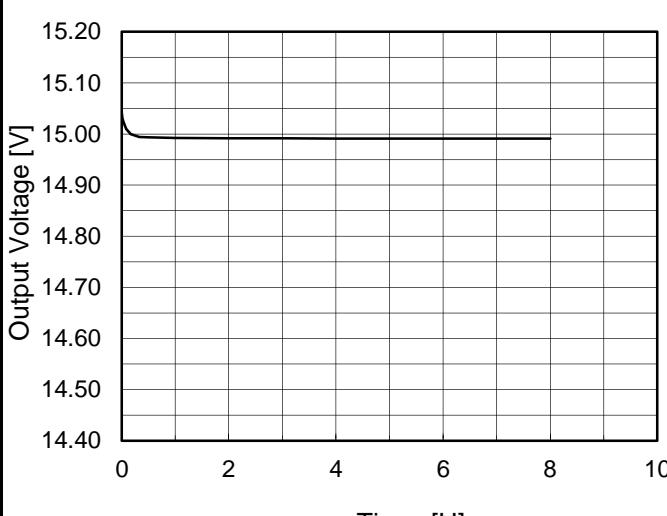
* Output Voltage Accuracy = $\pm(\text{Maximum of Output Voltage} - \text{Minimum of Output Voltage}) / 2$

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

2. Values

Item	Temperature [°C]	Input Voltage[V]	Output		Output Voltage Accuracy	
			Current[A]	Voltage[V]	Value [mV]	Ration [%]
Maximum Voltage	-40	200	0	15.121	±82	±0.5
Minimum Voltage	55	230	0.67	15.957		

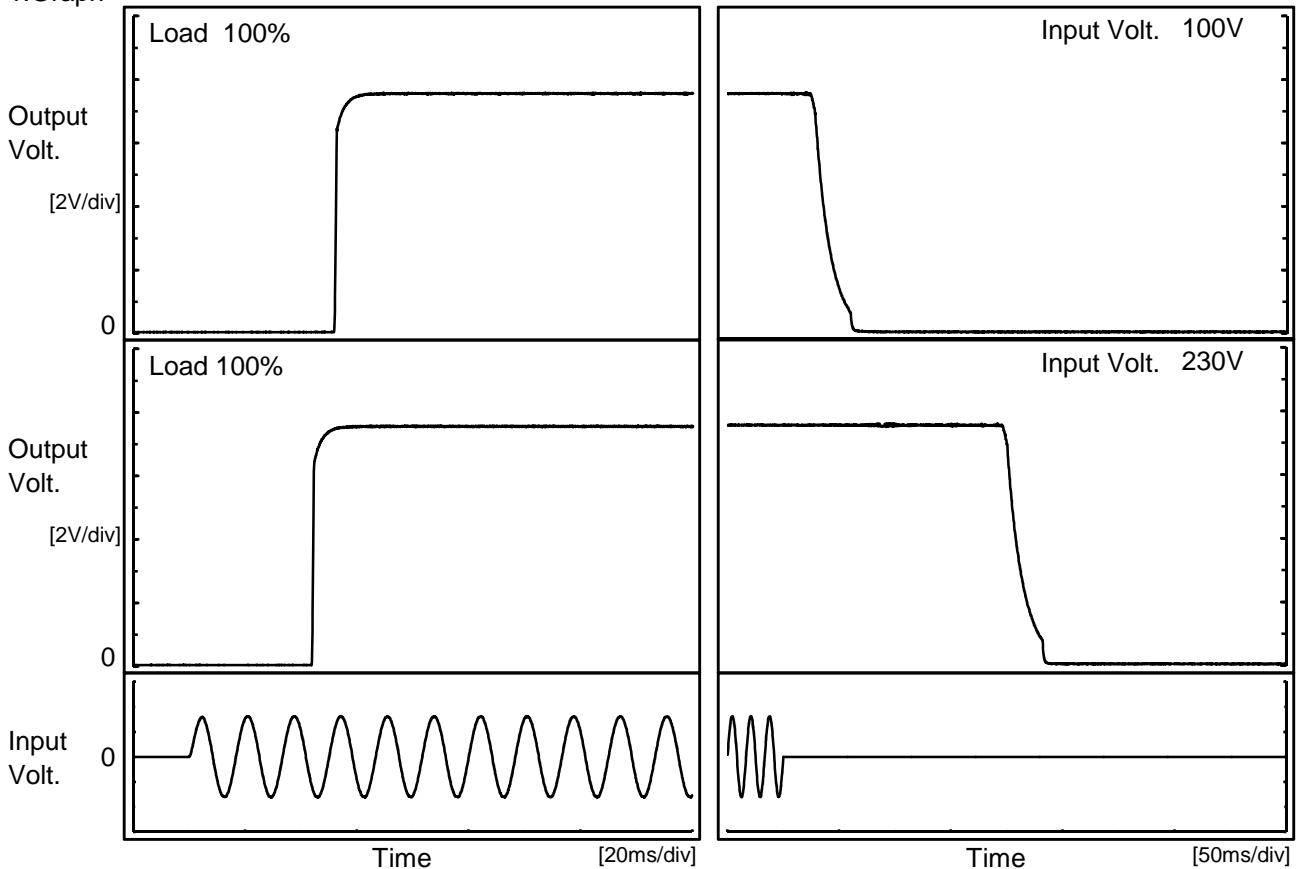
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Model	TUHS10F15	Temperature	25°C																						
Item	Time Lapse Drift	Testing Circuitry	Figure A																						
Object	+15V0.67A																								
1. Graph			2. Values																						
 <p>Output Voltage [V]</p> <p>Time [H]</p> <p>Input Volt. 100V Load 100%</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>15.043</td></tr> <tr><td>0.5</td><td>14.994</td></tr> <tr><td>1.0</td><td>14.993</td></tr> <tr><td>2.0</td><td>14.992</td></tr> <tr><td>3.0</td><td>14.992</td></tr> <tr><td>4.0</td><td>14.991</td></tr> <tr><td>5.0</td><td>14.991</td></tr> <tr><td>6.0</td><td>14.991</td></tr> <tr><td>7.0</td><td>14.991</td></tr> <tr><td>8.0</td><td>14.991</td></tr> </tbody> </table>	Time since start [H]	Output Voltage [V]	0.0	15.043	0.5	14.994	1.0	14.993	2.0	14.992	3.0	14.992	4.0	14.991	5.0	14.991	6.0	14.991	7.0	14.991	8.0	14.991
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COSEL

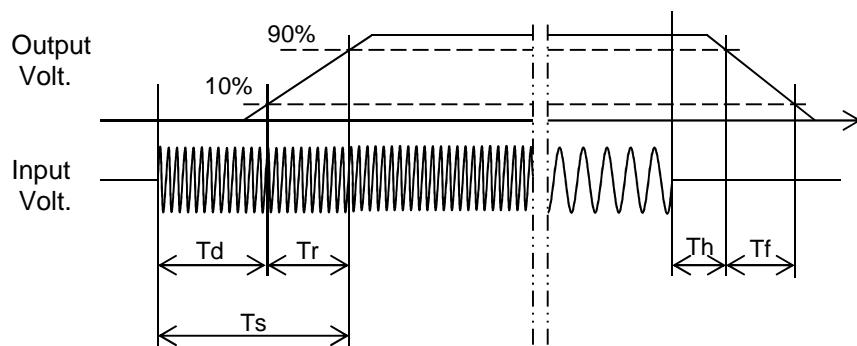
Model	TUHS10F15	Temperature	25°C
Item	Rise and Fall Time	Testing Circuitry	Figure A
Object	+15V0.67A		

1. Graph



2. Values

Input Volt.	Time	Td	Tr	Ts	Th	Tf	[ms]
100V		52.1	1.8	53.9	28.8	29.0	
230V		44.0	1.8	45.8	200.5	31.5	

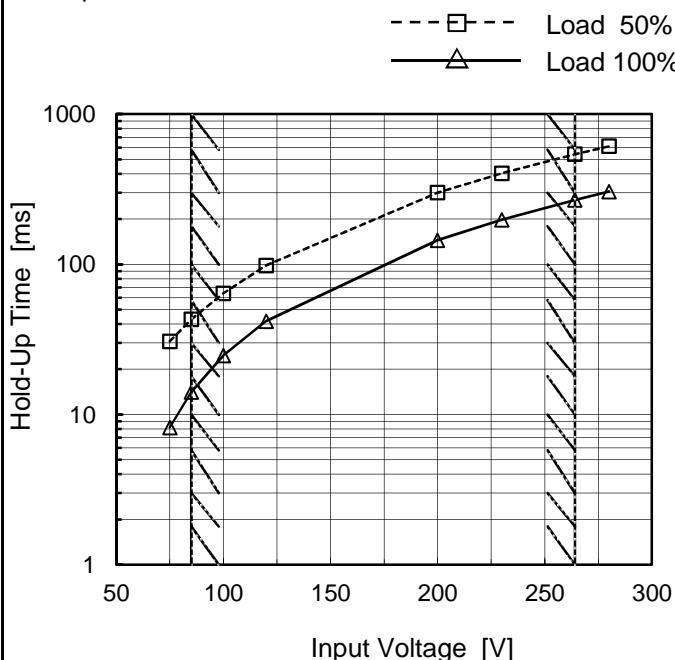


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Model	TUHS10F15
Item	Hold-Up Time
Object	+15V0.67A

 Temperature 25°C
 Testing Circuitry Figure A

1.Graph



2.Values

Input Voltage [V]	Hold-Up Time [ms]	
	Load 50%	Load 100%
75	31	8
85	43	14
100	64	25
120	98	42
200	300	145
230	403	198
264	540	268
280	612	306
--	-	-

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	TUHS10F15																																																					
Item	Instantaneous Interruption Compensation	Temperature Testing Circuitry	25°C Figure A																																																			
Object	+15V0.67A																																																					
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COSEL

Model	TUHS10F15																																				
Item	Minimum Input Voltage for Regulated Output Voltage	Testing Circuitry Figure A																																			
Object	+15V0.67A																																				
1.Graph		2.Values																																			
<p>Graph showing Minimum Input Voltage [V] vs Ambient Temperature [°C]. The Y-axis ranges from 0 to 100 V, and the X-axis ranges from -60 to 100 °C. Two curves are plotted: Load 50% (dashed line with squares) and Load 100% (solid line with triangles). Both curves show a minimum input voltage around 35-37V between -40°C and 60°C. Vertical slanted lines indicate the rated ambient temperature range for each load level.</p> <table border="1"> <thead> <tr> <th>Ambient Temperature [°C]</th> <th>Load 50% [V]</th> <th>Load 100% [V]</th> </tr> </thead> <tbody> <tr><td>-45</td><td>39</td><td>60</td></tr> <tr><td>-40</td><td>37</td><td>59</td></tr> <tr><td>-20</td><td>38</td><td>57</td></tr> <tr><td>0</td><td>37</td><td>56</td></tr> <tr><td>25</td><td>37</td><td>54</td></tr> <tr><td>50</td><td>36</td><td>53</td></tr> <tr><td>55</td><td>36</td><td>52</td></tr> <tr><td>60</td><td>36</td><td>51</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>		Ambient Temperature [°C]	Load 50% [V]	Load 100% [V]	-45	39	60	-40	37	59	-20	38	57	0	37	56	25	37	54	50	36	53	55	36	52	60	36	51	--	-	-	--	-	-	--	-	-
Ambient Temperature [°C]	Load 50% [V]	Load 100% [V]																																			
-45	39	60																																			
-40	37	59																																			
-20	38	57																																			
0	37	56																																			
25	37	54																																			
50	36	53																																			
55	36	52																																			
60	36	51																																			
--	-	-																																			
--	-	-																																			
--	-	-																																			
<p>Note: Slanted line shows the range of the rated ambient temperature.</p>																																					

COSEL

Model	TUHS10F15	
Item	Overcurrent Protection	Temperature 25°C Testing Circuitry Figure A
Object	+15V0.67A	
1.Graph		
<p>Note: Slanted line shows the range of the rated load current.</p>		

2.Values

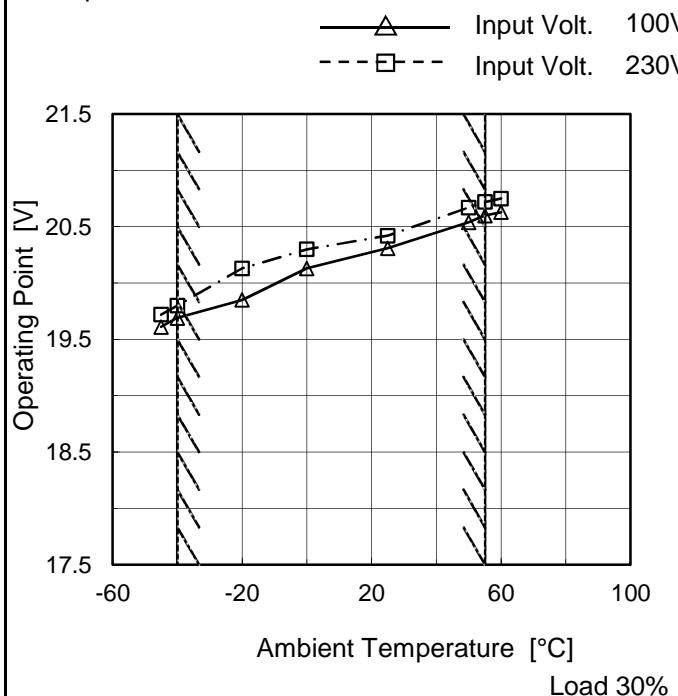
Output Voltage [V]	Load Current [A]	
	Input Volt. 100[V]	Input Volt. 230[V]
15.0	0.91	1.14
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-

COSEL

Model	TUHS10F15
Item	Overvoltage Protection
Object	+15V0.67A

Testing Circuitry Figure A

1.Graph



2.Values

Ambient Temperature [°C]	Operating Point [V]	
	Input Volt. 100[V]	Input Volt. 230[V]
-45	19.61	19.72
-40	19.69	19.80
-20	19.85	20.13
0	20.13	20.30
25	20.31	20.42
50	20.54	20.67
55	20.60	20.72
60	20.63	20.75
--	-	-
--	-	-
--	-	-

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

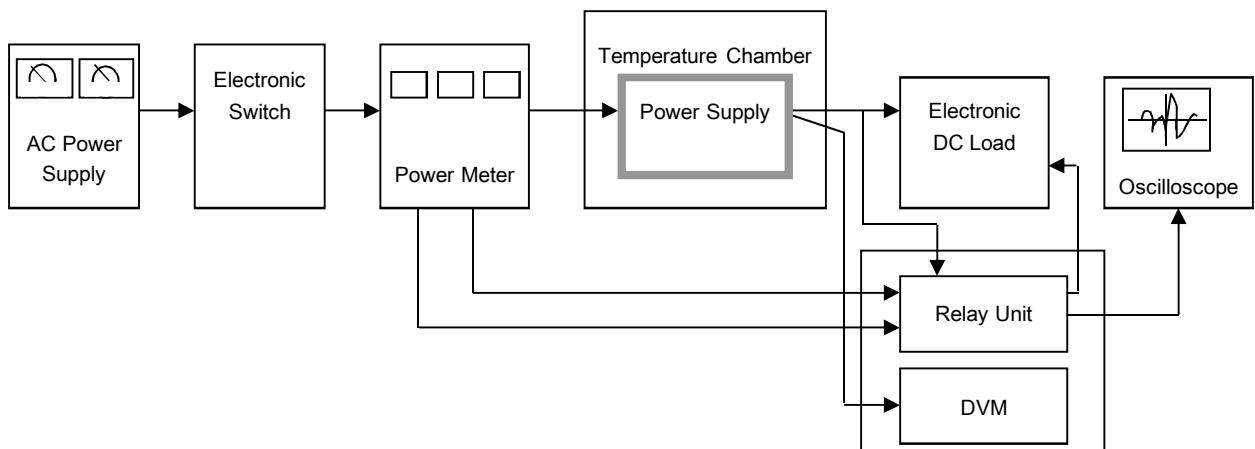


Figure A

Data Acquisition/Control Unit

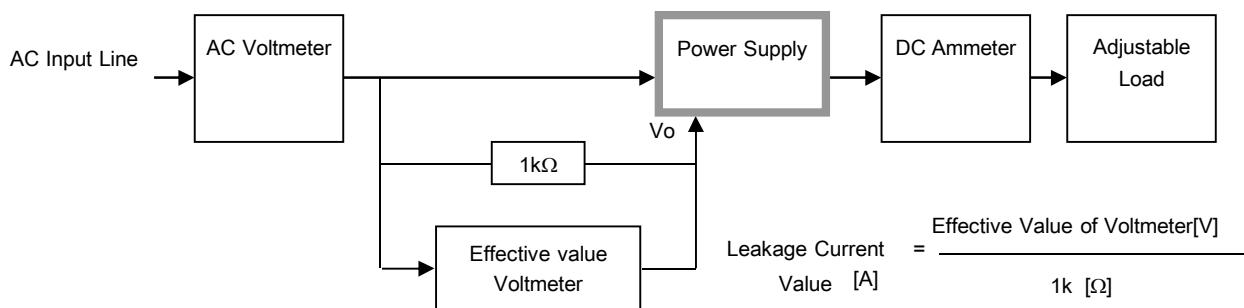


Figure B (DEN-AN)

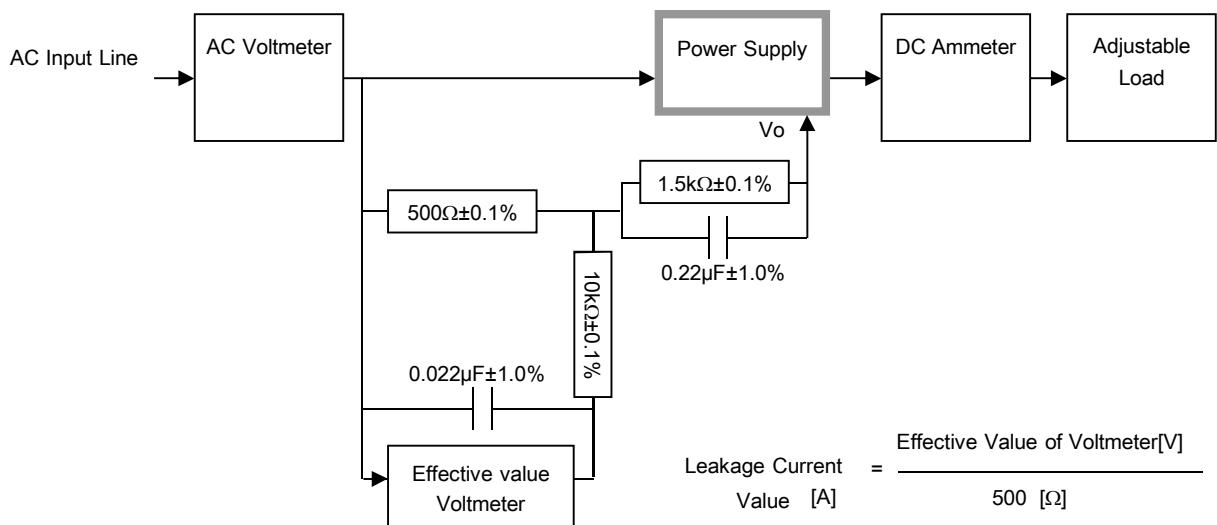


Figure B (IEC60950-1)

COSEL

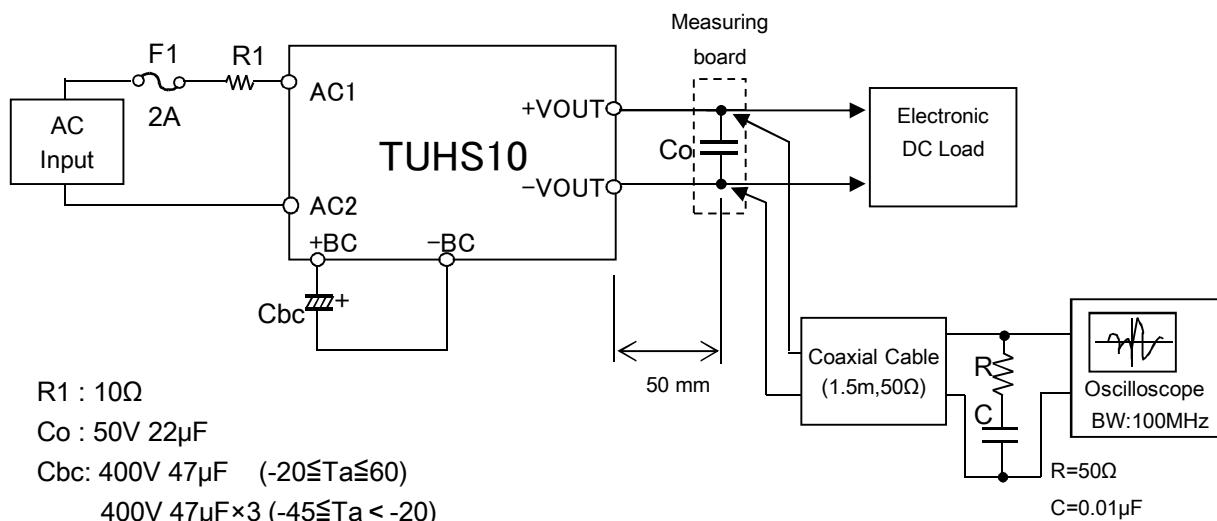


Figure C