



TEST DATA OF PMA60F-24

Regulated DC Power Supply
June 4, 2010

Approved by : Katsumi Ishikawa
Katsumi Ishikawa Design Manager

Prepared by : Shintaro Oki
Shintaro Oki Design Engineer

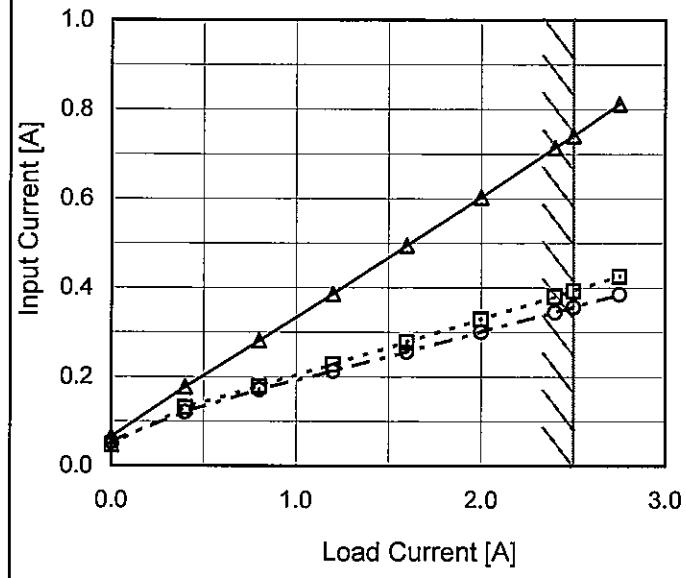
COSEL CO.,LTD.

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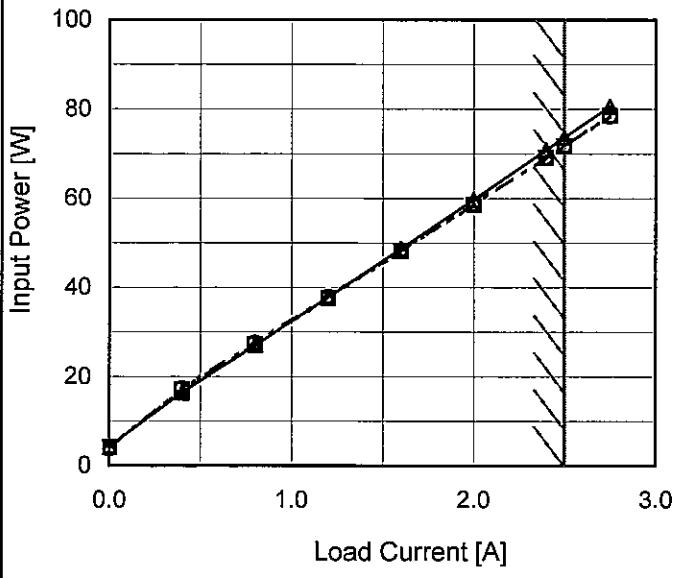
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Model	PMA60F-24		
Item	Input Current (by Load Current)		
Object	_____		
1. Graph			
	—△— Input Volt. 100V - -□--- Input Volt. 200V - -○--- Input Volt. 230V		
			
2. Values			
Load Current [A]	Input Current [A]		
Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]	
0.00	0.065	0.046	0.053
0.40	0.177	0.131	0.121
0.80	0.281	0.179	0.171
1.20	0.386	0.228	0.213
1.60	0.494	0.278	0.256
2.00	0.603	0.329	0.301
2.40	0.714	0.380	0.345
2.50	0.741	0.393	0.356
2.75	0.812	0.426	0.385
--	-	-	-
--	-	-	-

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

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Model	PMA60F-24		
Item	Input Power (by Load Current)		
Object	—		
1. Graph	<p>—△— Input Volt. 100V - - -□- - Input Volt. 200V - - ○- - Input Volt. 230V</p>  <p>The graph plots Input Power [W] on the Y-axis (0 to 100) against Load Current [A] on the X-axis (0.0 to 3.0). Three curves are shown for input voltages of 100V, 200V, and 230V. The 100V curve starts at (0,0) and ends at approximately (2.7, 80). The 200V curve starts at (0,0) and ends at approximately (2.7, 75). The 230V curve starts at (0,0) and ends at approximately (2.7, 70). A slanted line is drawn through the origin, passing through the points (1.2, 48) and (2.7, 75), representing the rated load current range.</p>		
Temperature	25°C		
Testing Circuitry	Figure A		
2. Values			
Load Current [A]	Input Power [W]		
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]
0.00	4.30	4.10	3.70
0.40	16.40	17.10	17.40
0.80	27.00	27.30	27.60
1.20	37.80	37.60	37.90
1.60	48.70	48.10	48.30
2.00	59.70	58.60	58.70
2.40	70.80	69.20	69.10
2.50	73.60	71.80	71.70
2.75	80.60	78.50	78.40
--	-	-	-
--	-	-	-

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Model	PMA60F-24	Temperature	25°C																																
Item	Efficiency (by Input Voltage)	Testing Circuitry	Figure A																																
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<p>The graph plots Efficiency [%] on the y-axis (30 to 86) 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 efficiency increasing with input voltage. A slanted line on the graph indicates the rated input voltage range.</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>75.8</td><td>79.8</td></tr> <tr><td>85</td><td>76.4</td><td>80.9</td></tr> <tr><td>100</td><td>77.0</td><td>81.9</td></tr> <tr><td>120</td><td>77.4</td><td>82.8</td></tr> <tr><td>200</td><td>77.2</td><td>84.0</td></tr> <tr><td>230</td><td>76.8</td><td>84.0</td></tr> <tr><td>264</td><td>76.0</td><td>84.0</td></tr> <tr><td>280</td><td>76.6</td><td>84.2</td></tr> <tr><td>--</td><td>-</td><td>-</td></tr> </tbody> </table>				Input Voltage [V]	Efficiency Load 50% [%]	Efficiency Load 100% [%]	75	75.8	79.8	85	76.4	80.9	100	77.0	81.9	120	77.4	82.8	200	77.2	84.0	230	76.8	84.0	264	76.0	84.0	280	76.6	84.2	--	-	-		
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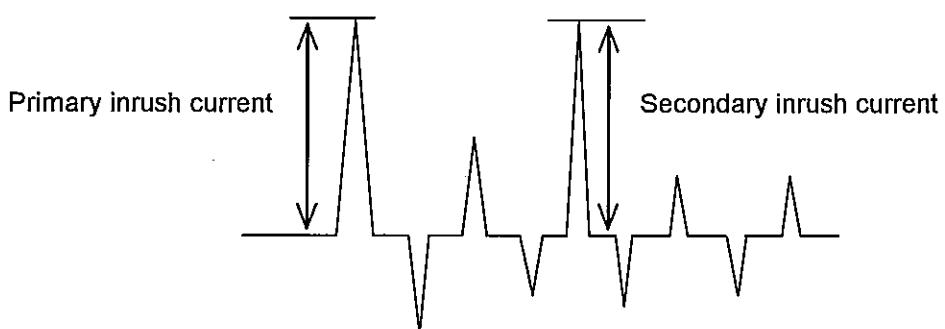
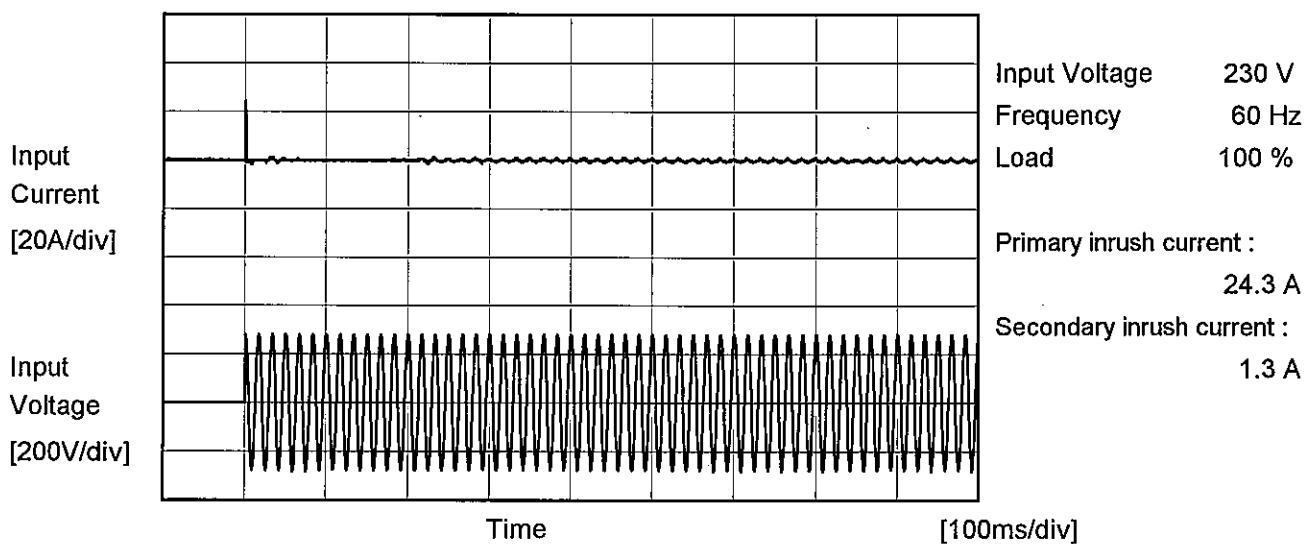
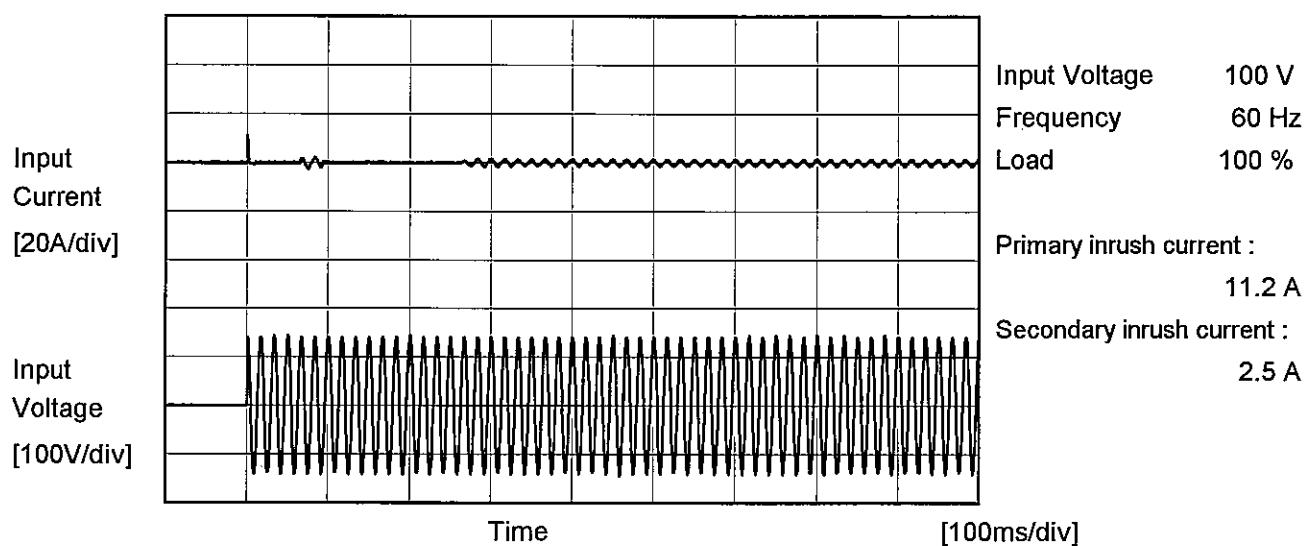
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Item	Power Factor (by Load Current)	Testing Circuitry	Figure A																																																			
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Model	PMA60F-24	Temperature	25°C
Item	Inrush Current	Testing Circuitry	Figure A
Object	_____		





Model	PMA60F-24	Temperature	25°C
Item	Leakage Current	Testing Circuitry	Figure B
Object	_____		

1. Results

Standards		Input Volt.			Note
		100 [V]	200 [V]	240 [V]	
IEC60601	Both phases	0.05	0.12	0.14	Operation
	One of phases	0.08	0.19	0.21	Stand by

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

2. Condition

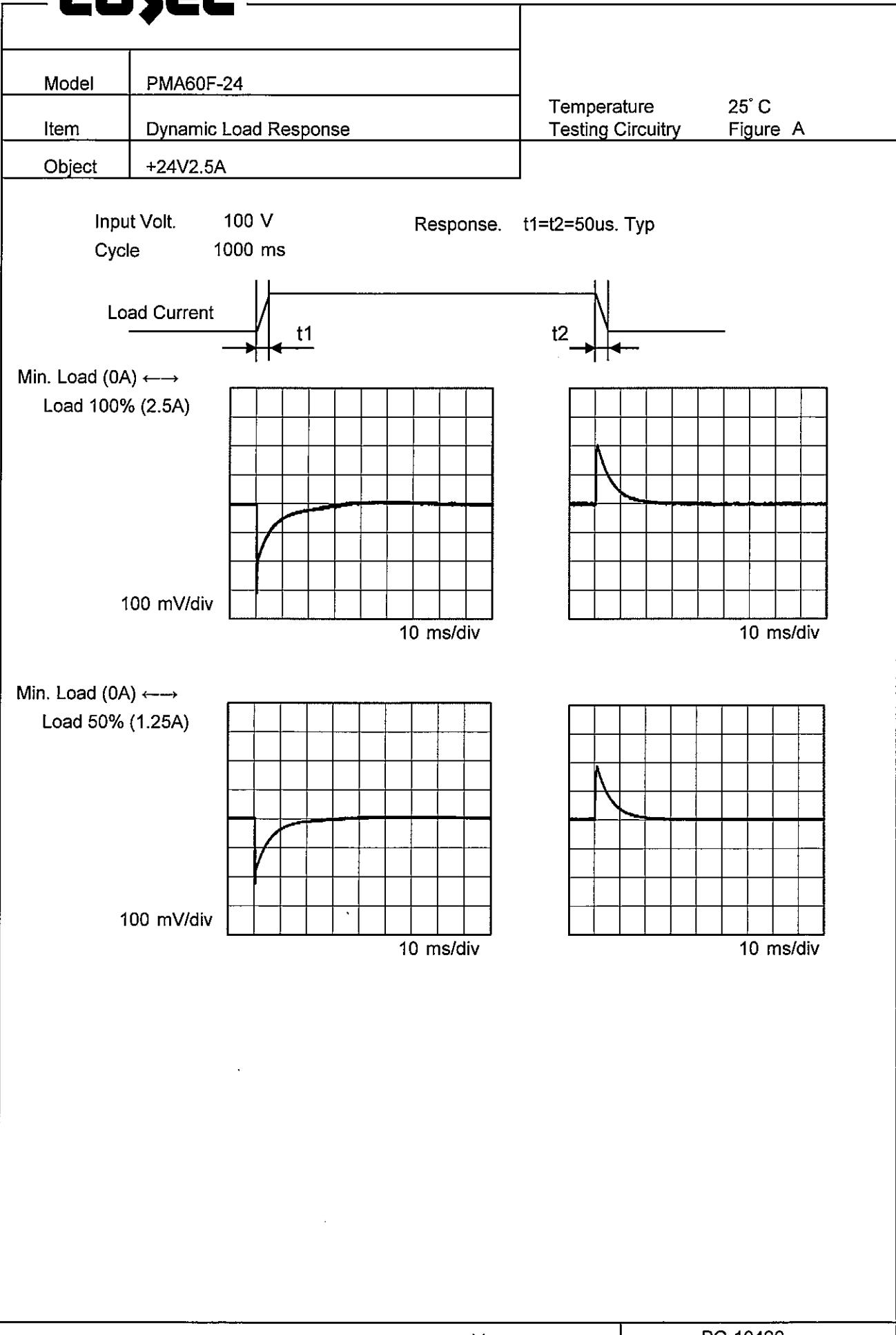
Leakage current value is concluded after measuring both phases of AC input and by choosing the larger one.

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Item	Line Regulation																																	
Object	+24V2.5A																																	
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Item	Load Regulation	Testing Circuitry	Figure A																																																			
Object	+24V2.5A																																																					
1.Graph	<p>—▲— Input Volt. 100V - - - □ - - Input Volt. 200V - - - ○ - - Input Volt. 230V</p> <table border="1"> <caption>Data points from Graph 1</caption> <thead> <tr> <th>Load Current [A]</th> <th>Output Voltage [V] (100V)</th> <th>Output Voltage [V] (200V)</th> <th>Output Voltage [V] (230V)</th> </tr> </thead> <tbody> <tr><td>0.0</td><td>24.082</td><td>24.082</td><td>24.082</td></tr> <tr><td>0.40</td><td>24.080</td><td>24.080</td><td>24.080</td></tr> <tr><td>0.80</td><td>24.080</td><td>24.079</td><td>24.079</td></tr> <tr><td>1.20</td><td>24.079</td><td>24.079</td><td>24.079</td></tr> <tr><td>1.60</td><td>24.079</td><td>24.079</td><td>24.079</td></tr> <tr><td>2.00</td><td>24.079</td><td>24.078</td><td>24.078</td></tr> <tr><td>2.40</td><td>24.078</td><td>24.078</td><td>24.078</td></tr> <tr><td>2.50</td><td>24.078</td><td>24.078</td><td>24.078</td></tr> <tr><td>2.75</td><td>24.078</td><td>24.078</td><td>24.077</td></tr> </tbody> </table>			Load Current [A]	Output Voltage [V] (100V)	Output Voltage [V] (200V)	Output Voltage [V] (230V)	0.0	24.082	24.082	24.082	0.40	24.080	24.080	24.080	0.80	24.080	24.079	24.079	1.20	24.079	24.079	24.079	1.60	24.079	24.079	24.079	2.00	24.079	24.078	24.078	2.40	24.078	24.078	24.078	2.50	24.078	24.078	24.078	2.75	24.078	24.078	24.077											
Load Current [A]	Output Voltage [V] (100V)	Output Voltage [V] (200V)	Output Voltage [V] (230V)																																																			
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Note:	Slanted line shows the range of the rated load current.																																																					

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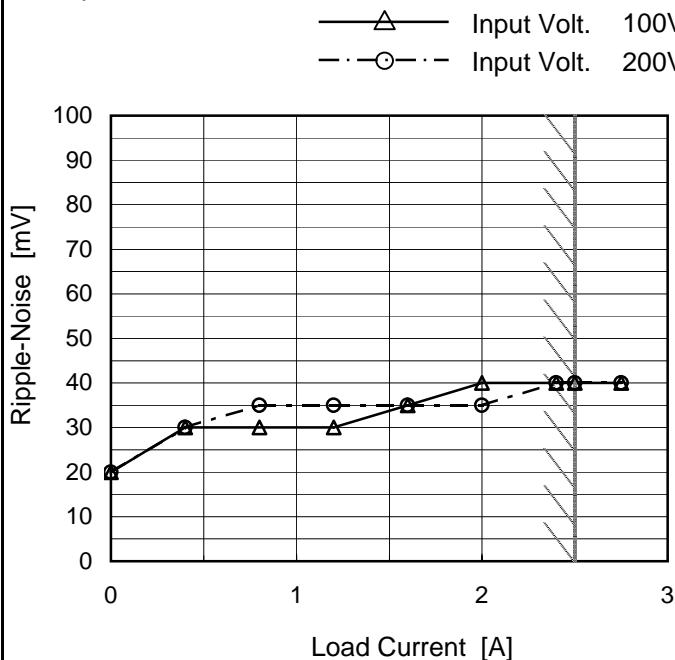
Model	PMA60F-24																																							
Item	Ripple Voltage (by Load Current)	Temperature 25°C Testing Circuitry Figure A																																						
Object	+24V2.5A																																							
1. Graph																																								
<p>Graph showing Ripple Voltage [mV] vs Load Current [A]. The Y-axis ranges from 0 to 100 mV, and the X-axis ranges from 0 to 3 A. Two curves are shown: one for Input Volt. 100V (solid line with open circles) and one for Input Volt. 200V (dashed line with open circles). Both curves show a slight increase in ripple voltage as load current increases, leveling off around 30 mV for higher currents.</p>																																								
2. Values																																								
<table border="1"> <thead> <tr> <th rowspan="2">Load Current [A]</th> <th colspan="2">Ripple Voltage [mV]</th> </tr> <tr> <th>Input Volt. 100 [V]</th> <th>Input Volt. 200 [V]</th> </tr> </thead> <tbody> <tr> <td>0.00</td> <td>15</td> <td>15</td> </tr> <tr> <td>0.40</td> <td>25</td> <td>25</td> </tr> <tr> <td>0.80</td> <td>25</td> <td>25</td> </tr> <tr> <td>1.20</td> <td>30</td> <td>30</td> </tr> <tr> <td>1.60</td> <td>30</td> <td>30</td> </tr> <tr> <td>2.00</td> <td>30</td> <td>30</td> </tr> <tr> <td>2.40</td> <td>30</td> <td>30</td> </tr> <tr> <td>2.50</td> <td>30</td> <td>30</td> </tr> <tr> <td>2.75</td> <td>30</td> <td>30</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> <tr> <td>--</td> <td>-</td> <td>-</td> </tr> </tbody> </table>			Load Current [A]	Ripple Voltage [mV]		Input Volt. 100 [V]	Input Volt. 200 [V]	0.00	15	15	0.40	25	25	0.80	25	25	1.20	30	30	1.60	30	30	2.00	30	30	2.40	30	30	2.50	30	30	2.75	30	30	--	-	-	--	-	-
Load Current [A]	Ripple Voltage [mV]																																							
	Input Volt. 100 [V]	Input Volt. 200 [V]																																						
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--	-	-																																						
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<p>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.</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	PMA60F-24
Item	Ripple-Noise
Object	+24V2.5A

Temperature 25°C
Testing Circuitry Figure A

1. Graph



2. Values

Load Current [A]	Ripple-Noise [mV]	
	Input Volt. 100 [V]	Input Volt. 200 [V]
0.00	20	20
0.40	30	30
0.80	30	35
1.20	30	35
1.60	35	35
2.00	40	35
2.40	40	40
2.50	40	40
2.75	40	40
--	-	-
--	-	-

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.

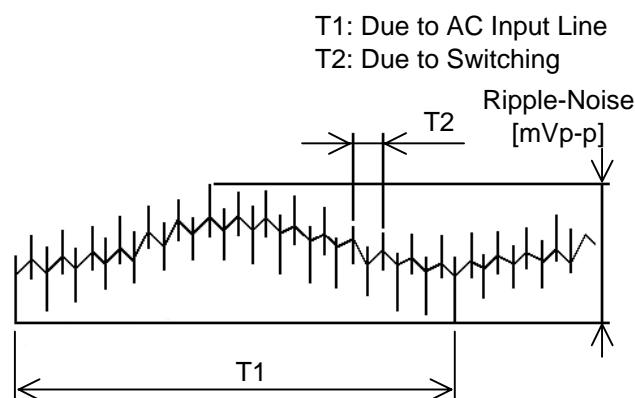
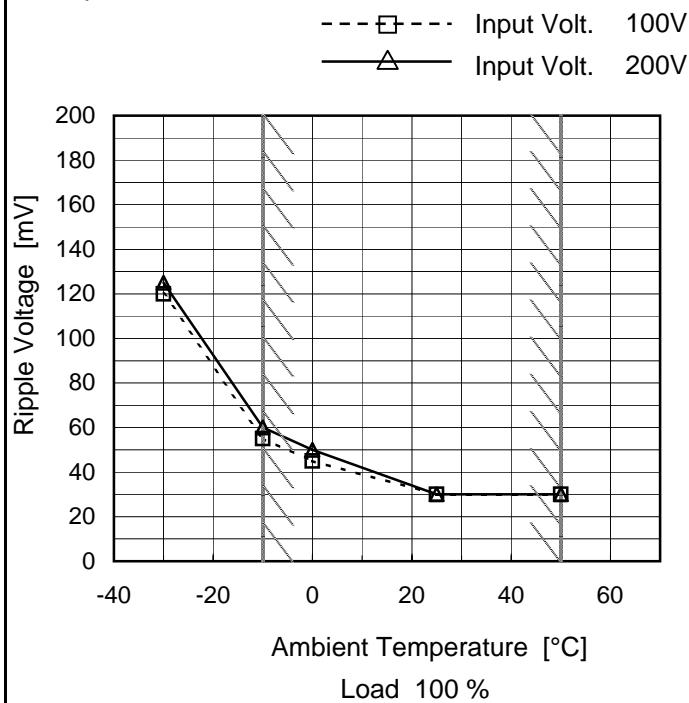


Fig. Complex Ripple Wave Form

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Model	PMA60F-24
Item	Ripple Voltage (by Ambient Temp.)
Object	+24V2.5A

1. Graph



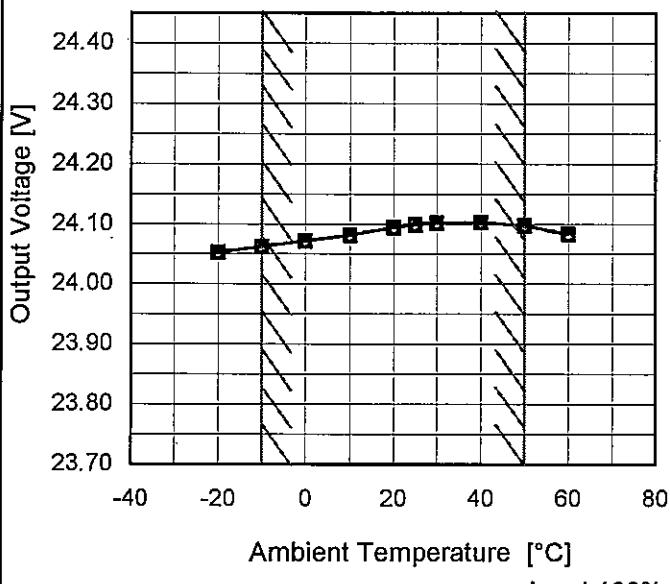
Measured by 20 MHz Oscilloscope.

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

Testing Circuitry Figure A

2. Values

Ambient Temperature [°C]	Ripple Voltage [mV]	
	Input Volt. 100 [V]	Input Volt. 200 [V]
-30	120	125
-10	55	60
0	45	50
25	30	30
50	30	30
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-

Model	PMA60F-24	Testing Circuitry Figure A		
Item	Ambient Temperature Drift			
Object	+24V2.5A	2.Values		
1.Graph	<p>—△— Input Volt. 100V - - -□--- Input Volt. 200V - - -○--- Input Volt. 230V</p>  <p>Output Voltage [V]</p> <p>Ambient Temperature [°C]</p> <p>Load 100%</p>			
		Ambient Temperature [°C]	Output Voltage [V]	
Ambient Temperature [°C]	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]	
-20	24.052	24.053	24.053	
-10	24.062	24.062	24.062	
0	24.071	24.071	24.072	
10	24.082	24.082	24.082	
20	24.094	24.094	24.095	
25	24.099	24.099	24.099	
30	24.102	24.102	24.102	
40	24.103	24.103	24.103	
50	24.097	24.097	24.097	
60	24.083	24.083	24.083	
--	-	-	-	-

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



Model	PMA60F-24	Testing Circuitry Figure A
Item	Output Voltage Accuracy	
Object	+24V2.5A	

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 : -10 - 50°C

Input Voltage : 85 - 264V

Load Current : 0 - 2.5A

* 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

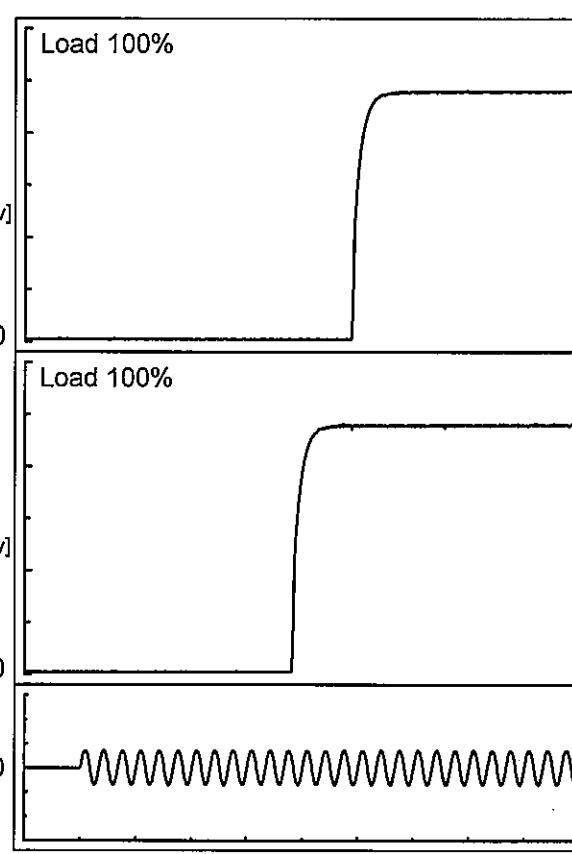
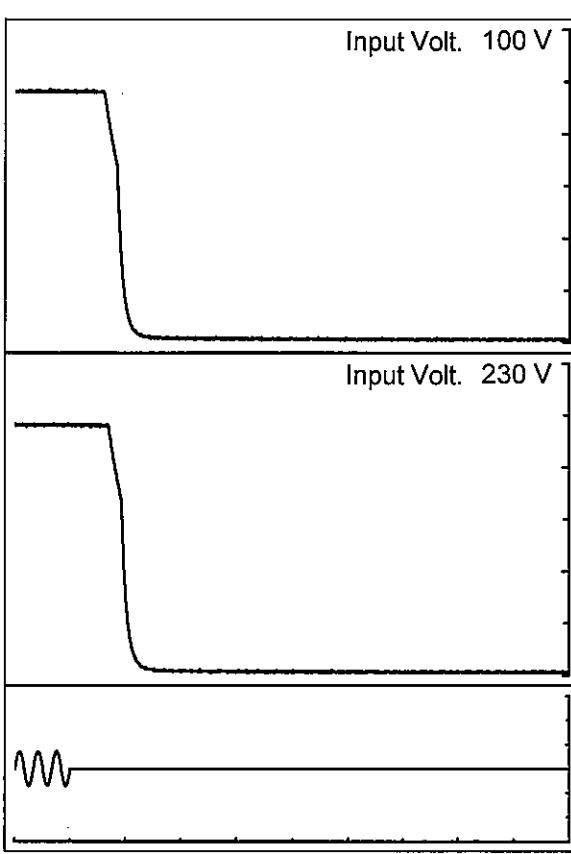
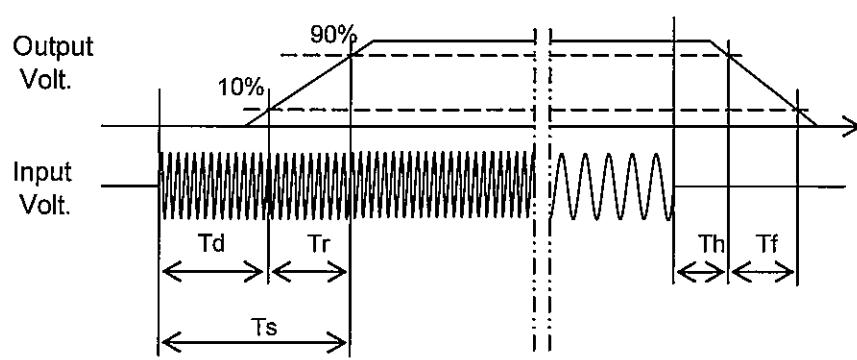
Item	Temperature [°C]	Input Voltage[V]	Output		Output Voltage Accuracy	
			Current[A]	Voltage[V]	Value [mV]	Ration [%]
Maximum Voltage	40	264	0	24.106	± 22	± 0.1
Minimum Voltage	-10	85	2.5	24.062		

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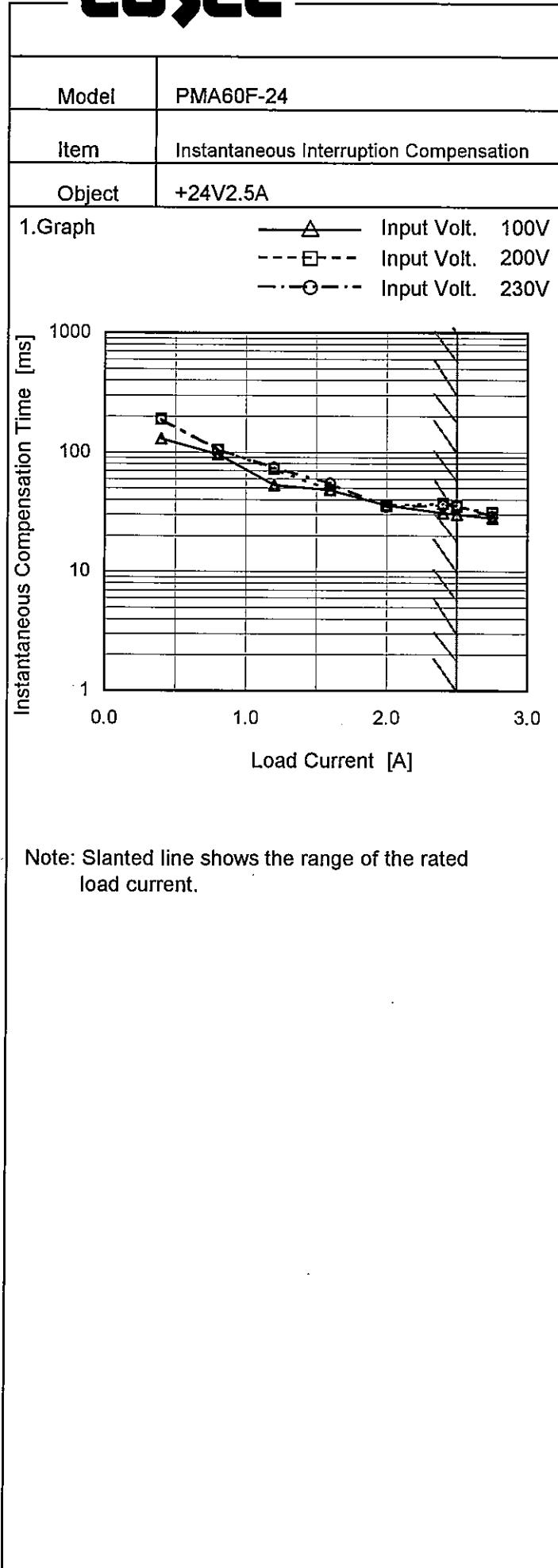
Model	PMA60F-24	Temperature Testing Circuitry 25°C Figure A																					
Item	Time Lapse Drift																						
Object	+24V2.5A																						
1.Graph		2.Values																					
<p>The graph plots Output Voltage [V] on the Y-axis (ranging from 23.70 to 24.40) against Time [H] on the X-axis (ranging from 0 to 10). A single horizontal line is drawn at approximately 24.078V, representing the output voltage over an 8-hour period. The graph shows no change in output voltage over time.</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>24.078</td></tr> <tr><td>0.5</td><td>24.078</td></tr> <tr><td>1.0</td><td>24.078</td></tr> <tr><td>2.0</td><td>24.079</td></tr> <tr><td>3.0</td><td>24.079</td></tr> <tr><td>4.0</td><td>24.079</td></tr> <tr><td>5.0</td><td>24.079</td></tr> <tr><td>6.0</td><td>24.079</td></tr> <tr><td>7.0</td><td>24.079</td></tr> <tr><td>8.0</td><td>24.079</td></tr> </tbody> </table> <p>Input Volt. 100V Load 100%</p>		Time since start [H]	Output Voltage [V]	0.0	24.078	0.5	24.078	1.0	24.078	2.0	24.079	3.0	24.079	4.0	24.079	5.0	24.079	6.0	24.079	7.0	24.079	8.0	24.079
Time since start [H]	Output Voltage [V]																						
0.0	24.078																						
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1.0	24.078																						
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4.0	24.079																						
5.0	24.079																						
6.0	24.079																						
7.0	24.079																						
8.0	24.079																						

* The characteristic of AC200V is equal.

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Model	PMA60F-24	Temperature	25°C																					
Item	Rise and Fall Time	Testing Circuitry	Figure A																					
Object	+24V2.5A																							
1. Graph																								
			Input Volt. 100 V																					
			Input Volt. 230 V																					
2. Values [ms]																								
<table border="1"> <thead> <tr> <th>Input Volt.</th> <th>Time</th> <th>Td</th> <th>Tr</th> <th>Ts</th> <th>Th</th> <th>Tf</th> </tr> </thead> <tbody> <tr> <td>100 V</td> <td></td> <td>245.5</td> <td>13.5</td> <td>259.0</td> <td>33.5</td> <td>18.5</td> </tr> <tr> <td>230 V</td> <td></td> <td>192.0</td> <td>13.5</td> <td>205.5</td> <td>37.8</td> <td>18.5</td> </tr> </tbody> </table>				Input Volt.	Time	Td	Tr	Ts	Th	Tf	100 V		245.5	13.5	259.0	33.5	18.5	230 V		192.0	13.5	205.5	37.8	18.5
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100 V		245.5	13.5	259.0	33.5	18.5																		
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Model	PMA60F-24	Temperature	25°C																																
Item	Hold-Up Time	Testing Circuitry	Figure A																																
Object	+24V2.5A																																		
1. Graph																																			
<p>Legend:</p> <ul style="list-style-type: none"> ---□--- Load 50% —△— Load 100% <p>Y-axis: Hold-Up Time [ms]</p> <p>X-axis: Input Voltage [V]</p>																																			
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Input Voltage [V]	Hold-Up Time [ms]																																		
	Load 50%	Load 100%																																	
75	59	27																																	
85	62	29																																	
100	64	31																																	
120	66	32																																	
200	70	35																																	
230	71	35																																	
264	72	36																																	
280	71	36																																	
--	-	-																																	
<p>This duration covers from Shut-off of input voltage to the moment when output voltage descends to the rated range of voltage accuracy.</p> <p>Note: Slanted line shows the range of the rated input voltage.</p>																																			

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Temperature 25°C
Testing Circuitry Figure A

2.Values

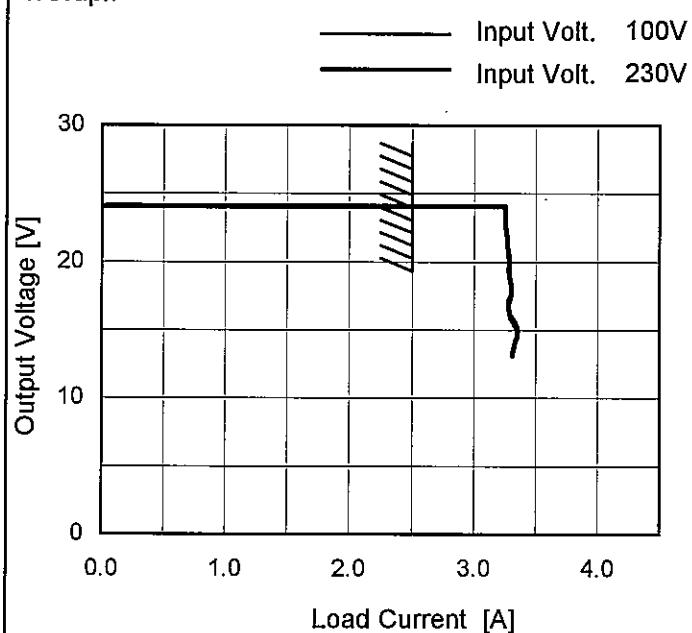
Load Current [A]	Time [ms]		
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]
0.00	-	-	-
0.40	130	189	189
0.80	96	105	105
1.20	53	72	74
1.60	48	48	55
2.00	36	36	35
2.40	31	37	36
2.50	30	35	36
2.75	28	31	29
--	-	-	-
--	-	-	-

<p>Model PMA60F-24</p> <p>Item Minimum Input Voltage for Regulated Output Voltage</p> <p>Object +24V2.5A</p>	Testing Circuitry Figure A																																						
	2.Values																																						
	<table border="1"> <thead> <tr> <th rowspan="2">Ambient Temperature [°C]</th> <th colspan="2">Input Voltage [V]</th> </tr> <tr> <th>Load 50%</th> <th>Load 100%</th> </tr> </thead> <tbody> <tr> <td>-20</td><td>41</td><td>54</td> </tr> <tr> <td>-10</td><td>40</td><td>54</td> </tr> <tr> <td>0</td><td>40</td><td>54</td> </tr> <tr> <td>10</td><td>40</td><td>53</td> </tr> <tr> <td>20</td><td>40</td><td>53</td> </tr> <tr> <td>25</td><td>40</td><td>53</td> </tr> <tr> <td>30</td><td>40</td><td>53</td> </tr> <tr> <td>40</td><td>40</td><td>54</td> </tr> <tr> <td>50</td><td>40</td><td>54</td> </tr> <tr> <td>60</td><td>40</td><td>55</td> </tr> <tr> <td>--</td><td>-</td><td>-</td> </tr> </tbody> </table>		Ambient Temperature [°C]	Input Voltage [V]		Load 50%	Load 100%	-20	41	54	-10	40	54	0	40	54	10	40	53	20	40	53	25	40	53	30	40	53	40	40	54	50	40	54	60	40	55	--	-
Ambient Temperature [°C]	Input Voltage [V]																																						
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40	40	54																																					
50	40	54																																					
60	40	55																																					
--	-	-																																					
1.Graph	<p>Input Voltage [V]</p> <p>Ambient Temperature [°C]</p> <p>Legend:</p> <ul style="list-style-type: none"> Load 50% (Squares) Load 100% (Triangles) 																																						
<p>Note: Slanted line shows the range of the rated ambient temperature.</p>																																							

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Model	PMA60F-24
Item	Overcurrent Protection
Object	+24V2.5A

1. Graph



Temperature 25°C
Testing Circuitry Figure A

2. Values

Output Voltage [V]	Load Current [A]	
	Input Volt. 100[V]	Input Volt. 230[V]
24.0	3.24	3.25
22.8	3.25	3.26
21.6	3.27	3.27
19.2	3.29	3.29
16.8	3.29	3.28
14.4	3.35	3.35
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-

<table border="1"> <tr><td>Model</td><td>PMA60F-24</td></tr> <tr><td>Item</td><td>Overvoltage Protection</td></tr> <tr><td>Object</td><td>+24V2.5A</td></tr> </table>	Model	PMA60F-24	Item	Overvoltage Protection	Object	+24V2.5A	Testing Circuitry Figure A																																
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<table border="1"> <thead> <tr> <th rowspan="2">Ambient Temperature [°C]</th> <th colspan="2">Operating Point [V]</th> </tr> <tr> <th>Input Volt. 100[V]</th> <th>Input Volt. 230[V]</th> </tr> </thead> <tbody> <tr><td>-20</td><td>33.24</td><td>33.10</td></tr> <tr><td>-10</td><td>33.45</td><td>33.45</td></tr> <tr><td>0</td><td>33.66</td><td>33.66</td></tr> <tr><td>10</td><td>33.94</td><td>33.94</td></tr> <tr><td>20</td><td>34.15</td><td>34.15</td></tr> <tr><td>25</td><td>34.29</td><td>34.29</td></tr> <tr><td>30</td><td>34.43</td><td>34.36</td></tr> <tr><td>40</td><td>34.64</td><td>34.64</td></tr> <tr><td>50</td><td>34.92</td><td>34.92</td></tr> <tr><td>60</td><td>35.13</td><td>35.13</td></tr> <tr><td>--</td><td>-</td><td>-</td></tr> </tbody> </table>		Ambient Temperature [°C]	Operating Point [V]		Input Volt. 100[V]	Input Volt. 230[V]	-20	33.24	33.10	-10	33.45	33.45	0	33.66	33.66	10	33.94	33.94	20	34.15	34.15	25	34.29	34.29	30	34.43	34.36	40	34.64	34.64	50	34.92	34.92	60	35.13	35.13	--	-	-
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<p>1.Graph</p> <p>Operating Point [V]</p> <p>Ambient Temperature [°C]</p> <p>Load 0%</p> <p>Legend: —△— Input Volt: 100V ---□--- Input Volt. 230V</p>																																							
<p>Note: Slanted line shows the range of the rated ambient temperature.</p>																																							

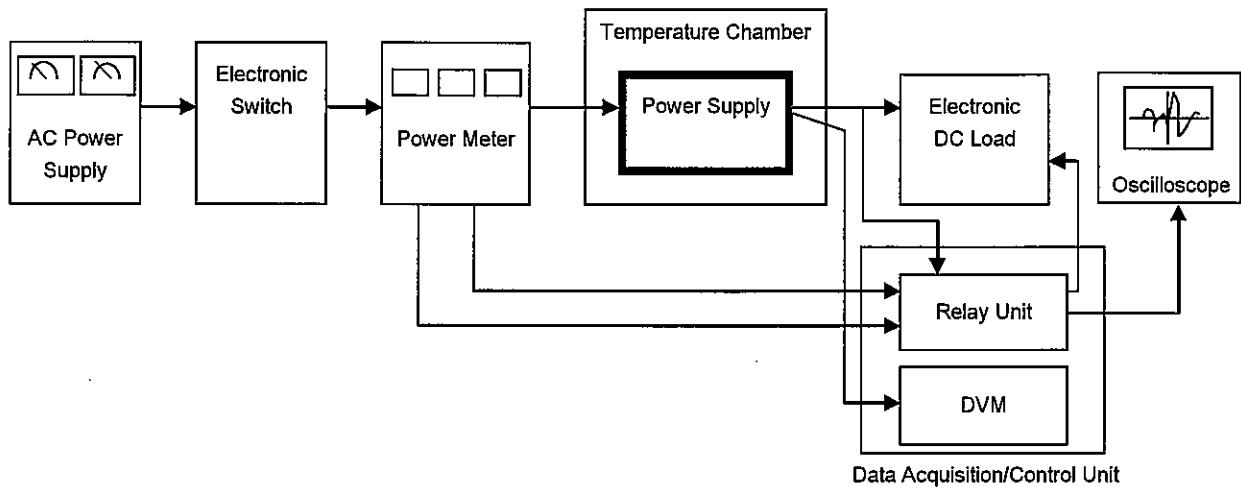


Figure A

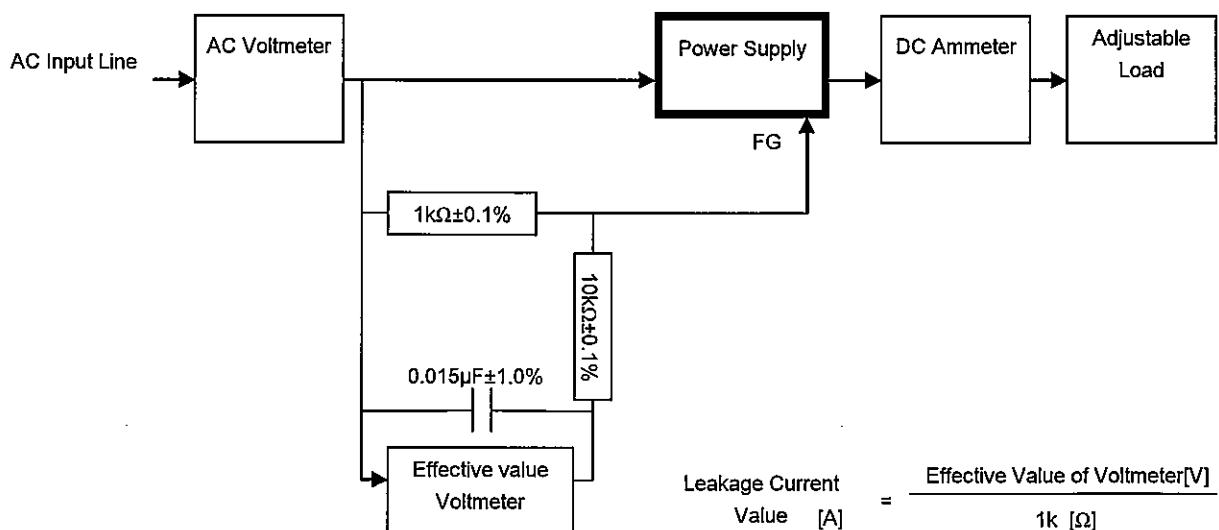


Figure B (IEC60601-1)