

# TEST DATA OF TUHS15F24

Regulated DC Power Supply  
February 20, 2015

Approved by : Takayuki Fukuda Design Manager

Prepared by : Takayuki Yamamoto Design Engineer

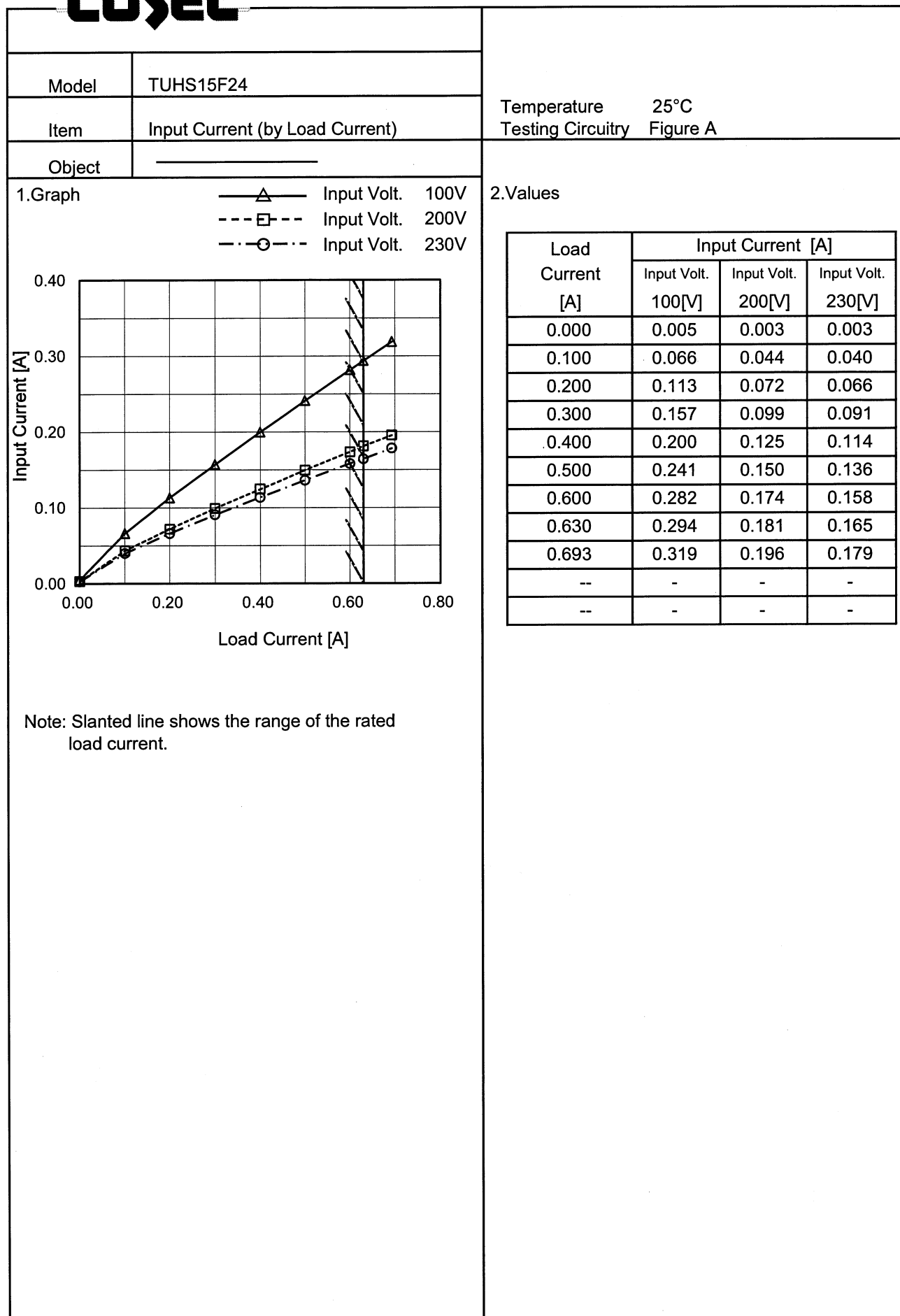
**COSEL CO.,LTD.**

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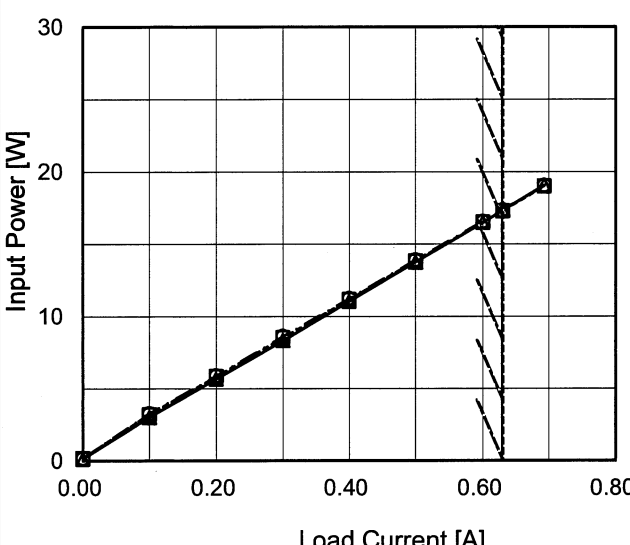
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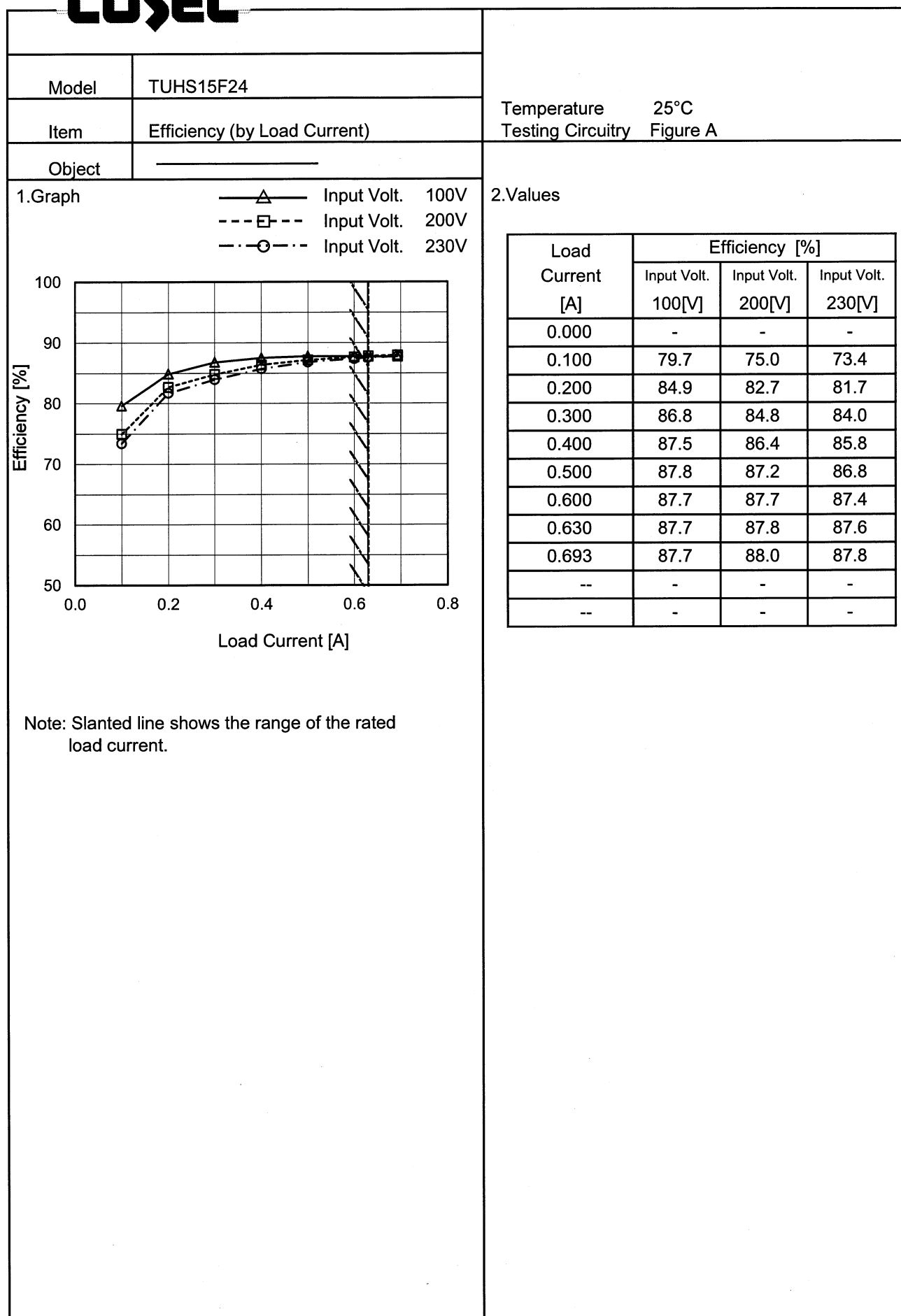
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Model		TUHS15F24		Temperature 25°C																																																				
Item		Input Power (by Load Current)		Testing Circuitry Figure A																																																				
Object																																																								
1.Graph		<div><div><div>—△—</div><div>Input Volt.</div><div>100V</div></div><div><div>---□---</div><div>Input Volt.</div><div>200V</div></div><div><div>-·-○-·-</div><div>Input Volt.</div><div>230V</div></div></div> 		2.Values																																																				
		<table><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><tr><td>0.000</td><td>0.14</td><td>0.16</td><td>0.17</td></tr><tr><td>0.100</td><td>3.02</td><td>3.21</td><td>3.27</td></tr><tr><td>0.200</td><td>5.68</td><td>5.84</td><td>5.89</td></tr><tr><td>0.300</td><td>8.34</td><td>8.53</td><td>8.61</td></tr><tr><td>0.400</td><td>11.05</td><td>11.17</td><td>11.24</td></tr><tr><td>0.500</td><td>13.76</td><td>13.84</td><td>13.90</td></tr><tr><td>0.600</td><td>16.50</td><td>16.52</td><td>16.57</td></tr><tr><td>0.630</td><td>17.33</td><td>17.30</td><td>17.36</td></tr><tr><td>0.693</td><td>19.07</td><td>19.01</td><td>19.04</td></tr><tr><td>--</td><td>-</td><td>-</td><td>-</td></tr><tr><td>--</td><td>-</td><td>-</td><td>-</td></tr></table>				Load Current [A]	Input Power [W]			Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]	0.000	0.14	0.16	0.17	0.100	3.02	3.21	3.27	0.200	5.68	5.84	5.89	0.300	8.34	8.53	8.61	0.400	11.05	11.17	11.24	0.500	13.76	13.84	13.90	0.600	16.50	16.52	16.57	0.630	17.33	17.30	17.36	0.693	19.07	19.01	19.04	--	-	-	-	--	-	-	-
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Model		TUHS15F24	
Item		Efficiency (by Input Voltage)	
Object			
1.Graph		2.Values	

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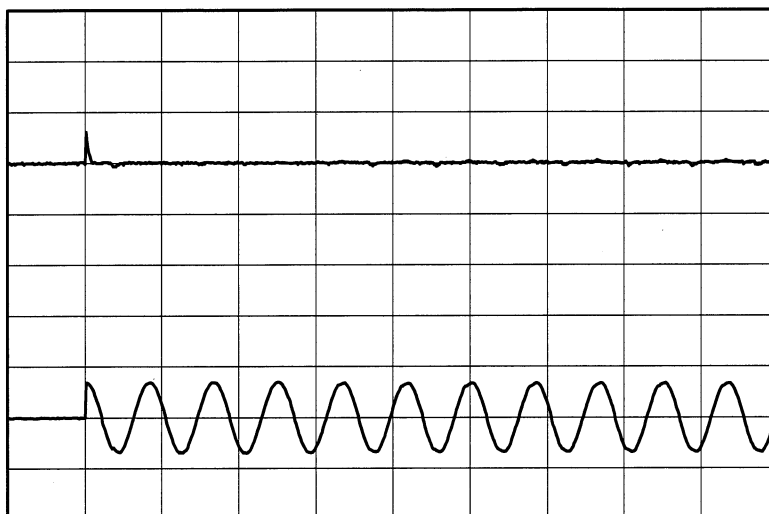
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Note: Slanted line shows the range of the rated load current.																																																						



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Model	TUHS15F24	Temperature 25°C Testing Circuitry Figure A	
Item	Inrush Current		
Object	_____		

Input  
Current  
[20A/div]



Input Voltage 100 V  
Frequency 60 Hz  
Load 100 %

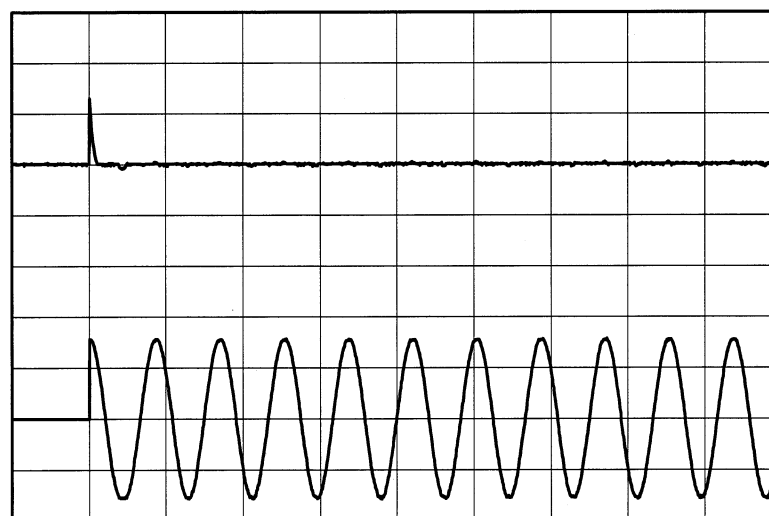
Primary inrush current 12.3 A  
Secondary inrush current 1.2 A

Input  
Voltage  
[200V/div]

Time

[20ms/div]

Input  
Current  
[20A/div]



Input Voltage 230 V  
Frequency 60 Hz  
Load 100 %

Primary inrush current 25.9 A  
Secondary inrush current 1.2 A

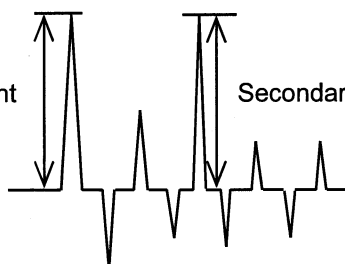
Input  
Voltage  
[200V/div]

Time

[20ms/div]

Primary inrush current

Secondary inrush current





		Temperature 25°C Testing Circuitry Figure B
Model	TUHS15F24	
Item	Leakage Current	
Object		

## 1.Results

[mA]

Standards		Input Volt.			Note
		100 [V]	200 [V]	230 [V]	
DEN-AN	Both phases	0.005	0.008	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	0.009	0.010	Stand by

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

## 2.Condition

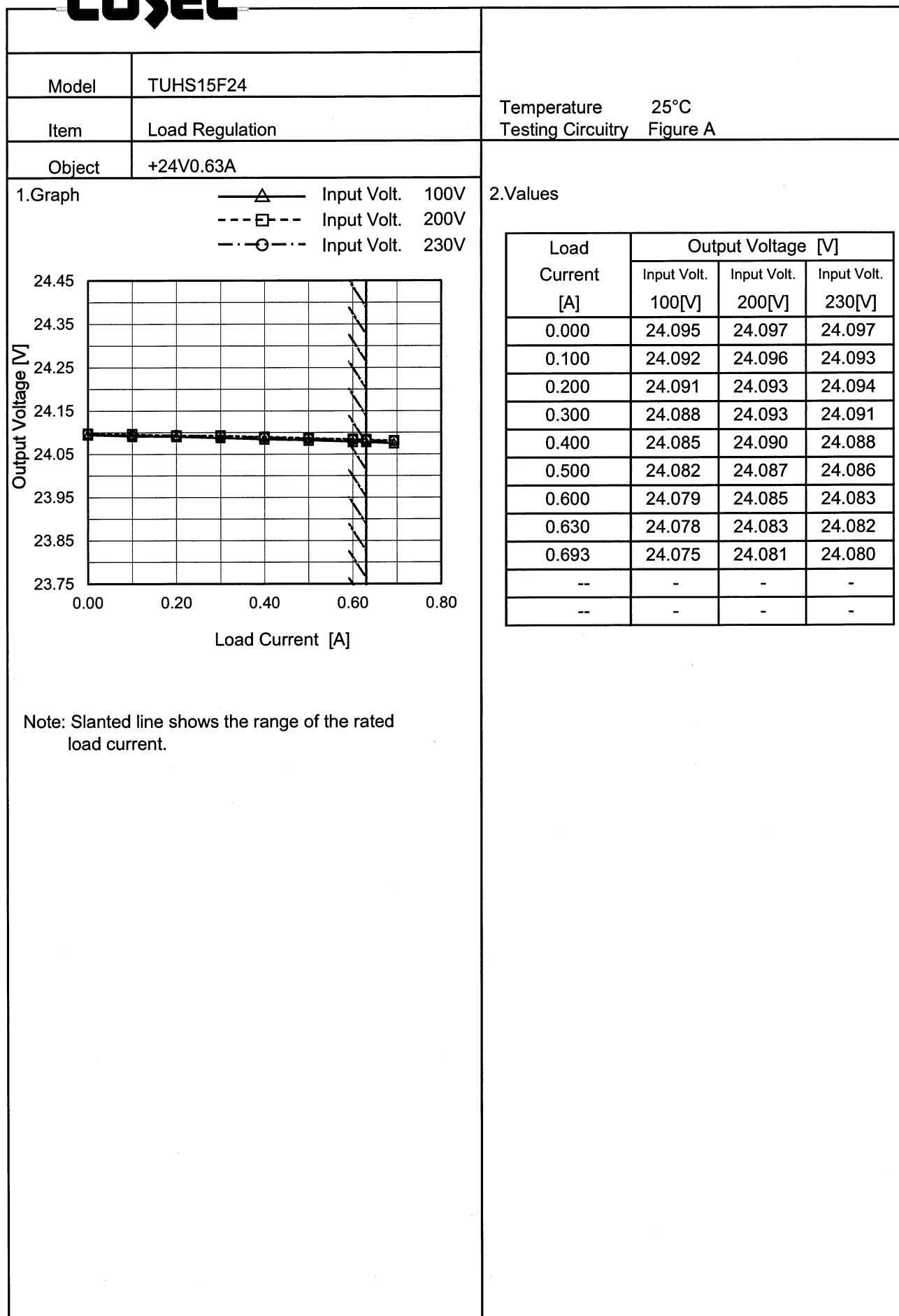
Leakage current value is concluded after measuring both phases of AC input and by choosing the larger one.

There is no FG in TUHS series and it is a reinforced insulation power supply of the class 2.



Model	TUHS15F24	Temperature25°C Testing CircuitryFigure A																															
Item	Line Regulation																																
Object	+24V0.63A																																
1.Graph		2.Values																															
<div><div><div>-----□----- Load 50%</div><div>-----△----- Load 100%</div></div><table><thead><tr><th>Input Voltage [V]</th><th>Output Voltage [V] Load 50%</th><th>Output Voltage [V] Load 100%</th></tr></thead><tbody><tr><td>75</td><td>24.086</td><td>24.078</td></tr><tr><td>85</td><td>24.086</td><td>24.078</td></tr><tr><td>100</td><td>24.086</td><td>24.078</td></tr><tr><td>120</td><td>24.086</td><td>24.079</td></tr><tr><td>200</td><td>24.090</td><td>24.083</td></tr><tr><td>230</td><td>24.090</td><td>24.084</td></tr><tr><td>264</td><td>24.090</td><td>24.084</td></tr><tr><td>280</td><td>24.090</td><td>24.083</td></tr><tr><td>--</td><td>-</td><td>-</td></tr></tbody></table></div>		Input Voltage [V]	Output Voltage [V] Load 50%	Output Voltage [V] Load 100%	75	24.086	24.078	85	24.086	24.078	100	24.086	24.078	120	24.086	24.079	200	24.090	24.083	230	24.090	24.084	264	24.090	24.084	280	24.090	24.083	--	-	-		
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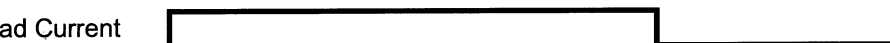


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Model	TUHS15F24
Item	Dynamic Load Response
Object	+24V 0.63A

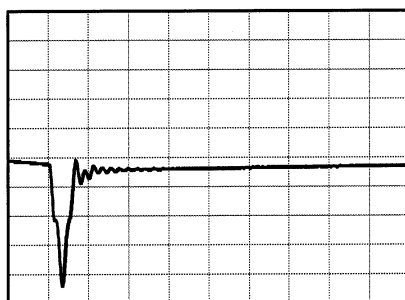
Temperature 25°C  
Testing Circuitry Figure A

Input Volt. 230V  
Cycle 500ms

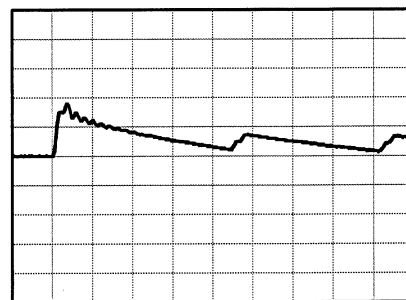
Load Current   
0.63A / 100us

Min.Load (0A) ←→  
Load 100%(0.63A)

500 mV/div



200 us/div



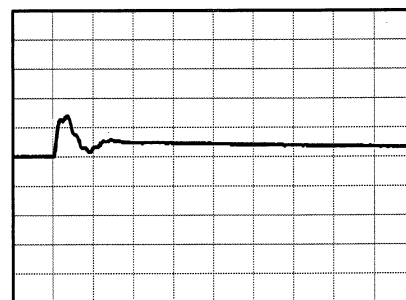
200 us/div

Min.Load (0.126A) ←→  
Load 100%(0.63A)

500 mV/div



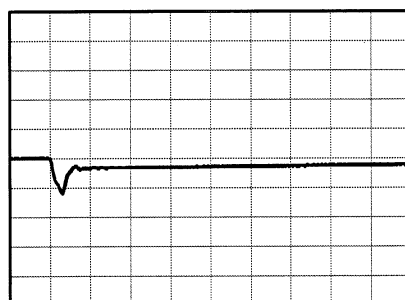
200 us/div



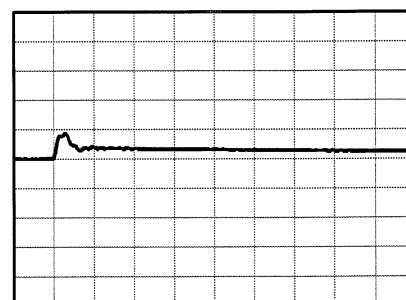
200 us/div

Load 50% (0.315A) ←→  
Load 100% (0.63A)

500 mV/div



200 us/div



200 us/div

Model	TUHS15F24	Temperature 25°C Testing Circuitry Figure C																																							
Item	Ripple Voltage (by Load Current)																																								
Object	+24V0.63A																																								
1.Graph		2.Values																																							
<div><div><div>—△—</div><div>Input Volt. 100V</div></div><div><div>- - ○ - -</div><div>Input Volt. 230V</div></div></div> <p>Ripple Voltage [mV]</p> <p>Load Current [A]</p>		<table><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. 230 [V]</th></tr><tr><td>0</td><td>170</td><td>290</td></tr><tr><td>0.125</td><td>5</td><td>5</td></tr><tr><td>0.250</td><td>10</td><td>10</td></tr><tr><td>0.375</td><td>15</td><td>10</td></tr><tr><td>0.500</td><td>25</td><td>10</td></tr><tr><td>0.630</td><td>40</td><td>10</td></tr><tr><td>0.693</td><td>50</td><td>10</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></table>		Load Current [A]	Ripple Voltage [mV]		Input Volt. 100 [V]	Input Volt. 230 [V]	0	170	290	0.125	5	5	0.250	10	10	0.375	15	10	0.500	25	10	0.630	40	10	0.693	50	10	--	-	-	--	-	-	--	-	-	--	-	-
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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.																																									
<div><div>T1: Due to AC Input Line</div><div>T2: Due to Switching</div></div> <p>Ripple [mVp-p]</p> <p>T1</p> <p>T2</p>																																									
Fig. Complex Ripple Wave Form																																									

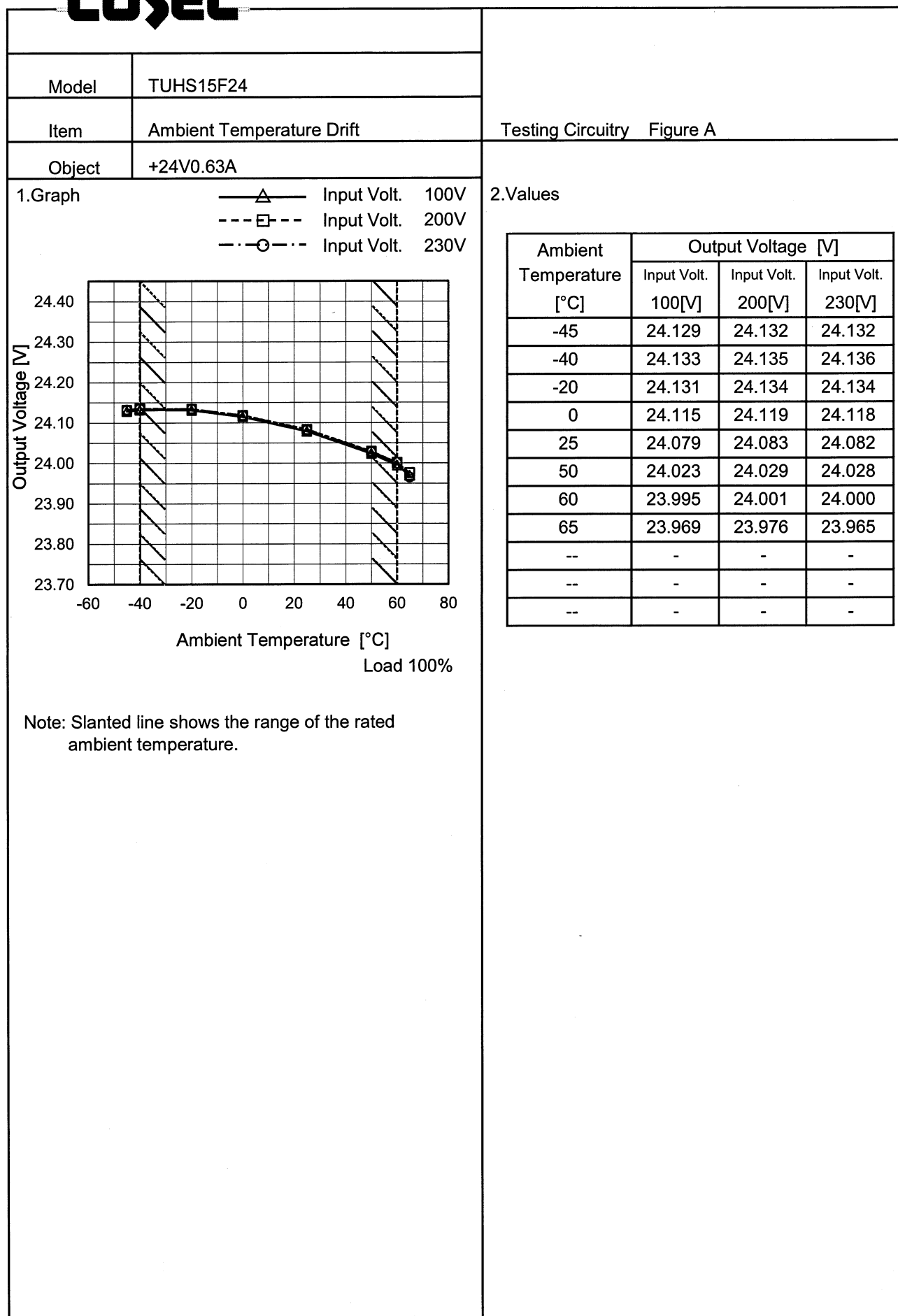
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Model	TUHS15F24	Temperature 25°C Testing Circuitry Figure C																																							
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Fig. Complex Ripple Wave Form																																									





# COSEL





		Testing Circuitry Figure A
Model	TUHS15F24	
Item	Output Voltage Accuracy	
Object	+24V0.63A	

### 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 - 60°C

Input Voltage : 100 - 230V

Load Current : 0 - 0.63A

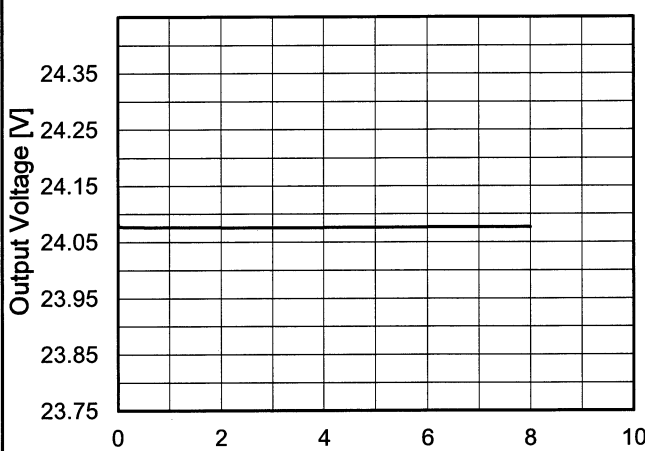
\* Output Voltage Accuracy =  $\pm(\text{Maximum of Output Voltage} - \text{Minimum of Output Voltage}) / 2$

\* 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	-40	264	0	24.172	±84	±0.4
Minimum Voltage	60	200	0.63	24.004		

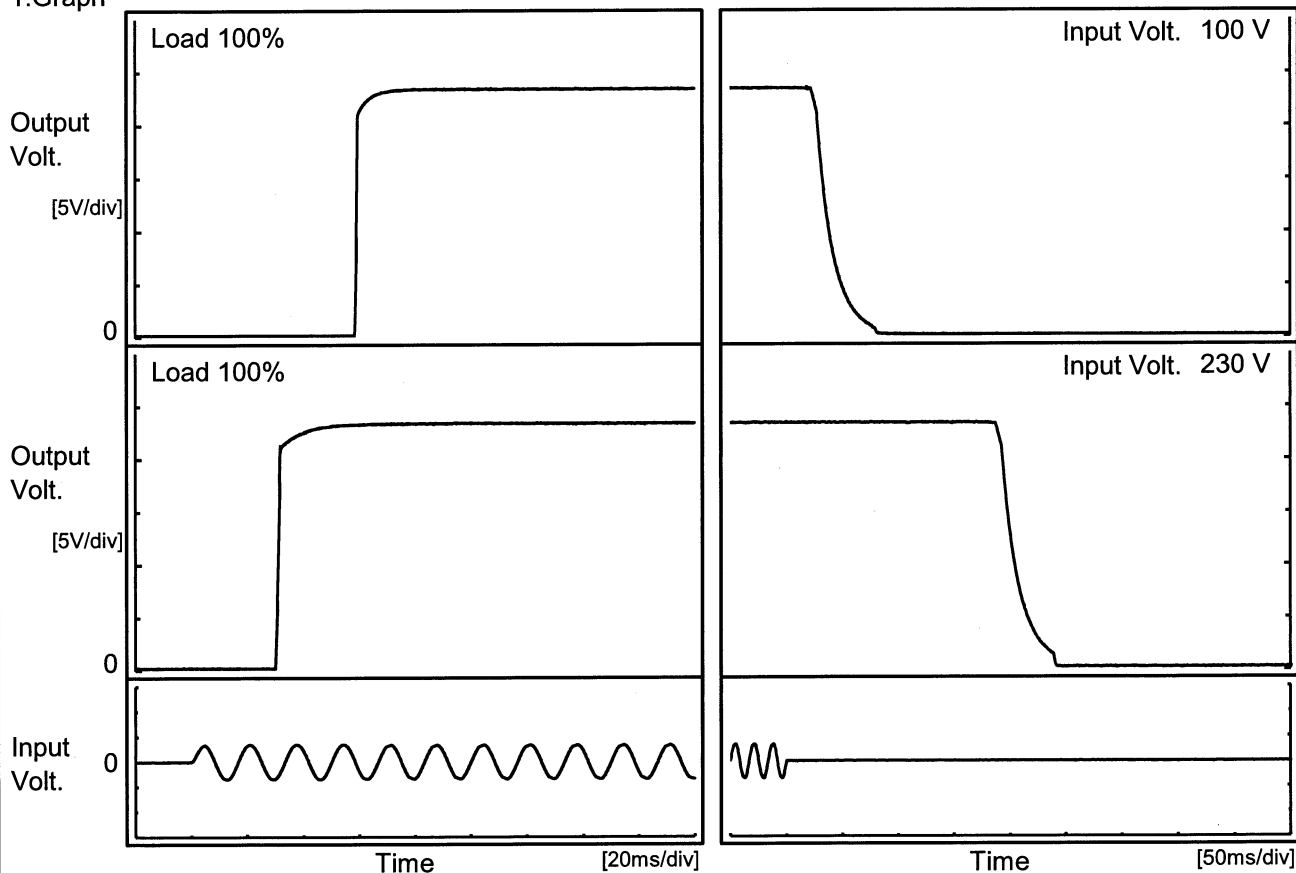
# COSEL

Model	TUHS15F24	Temperature 25°C Testing Circuitry Figure A																							
Item	Time Lapse Drift																								
Object	+24V0.63A																								
1.Graph		2.Values																							
<div><p>Output Voltage [V]</p><p>Time [H]</p><p>Input Volt. 100V Load 100%</p></div>		<table><tr><th>Time since start [H]</th><th>Output Voltage [V]</th></tr><tr><td>0.0</td><td>24.089</td></tr><tr><td>0.5</td><td>24.077</td></tr><tr><td>1.0</td><td>24.077</td></tr><tr><td>2.0</td><td>24.077</td></tr><tr><td>3.0</td><td>24.076</td></tr><tr><td>4.0</td><td>24.076</td></tr><tr><td>5.0</td><td>24.076</td></tr><tr><td>6.0</td><td>24.077</td></tr><tr><td>7.0</td><td>24.077</td></tr><tr><td>8.0</td><td>24.077</td></tr></table>		Time since start [H]	Output Voltage [V]	0.0	24.089	0.5	24.077	1.0	24.077	2.0	24.077	3.0	24.076	4.0	24.076	5.0	24.076	6.0	24.077	7.0	24.077	8.0	24.077
Time since start [H]	Output Voltage [V]																								
0.0	24.089																								
0.5	24.077																								
1.0	24.077																								
2.0	24.077																								
3.0	24.076																								
4.0	24.076																								
5.0	24.076																								
6.0	24.077																								
7.0	24.077																								
8.0	24.077																								
* The characteristic of AC230V is equal.																									

**COSEL**

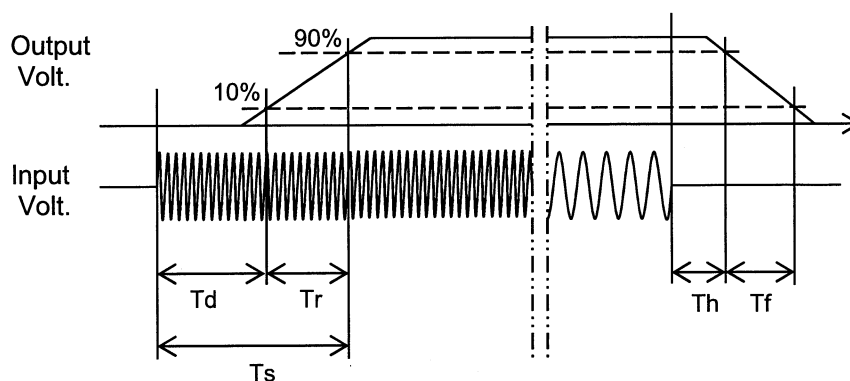
Model	TUHS15F24	Temperature	25°C
Item	Rise and Fall Time	Testing Circuitry	Figure A
Object	+24V0.63A		

## 1.Graph



## 2.Values

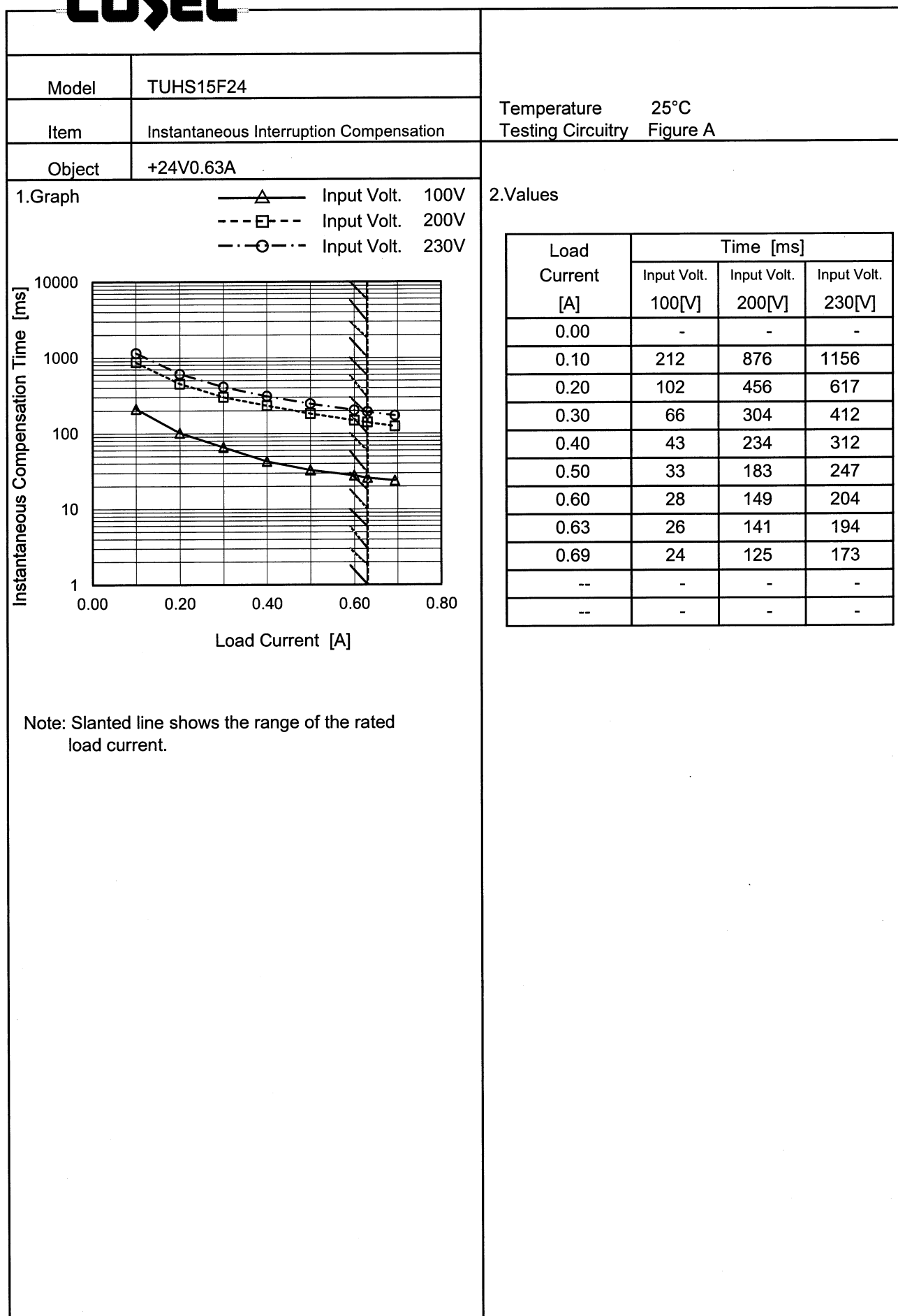
Input Volt.	Time	Td	Tr	Ts	Th	Tf
100 V		58.7	2.3	61.0	26.3	35.8
230 V		56.4	2.7	59.1	390.5	36.0



# COSEL

Model	TUHS15F24																																		
Item	Hold-Up Time	Temperature	25°C																																
		Testing Circuitry	Figure A																																
Object	+24V0.63A																																		
1.Graph		2.Values																																	
<div><div>---□--- Load 50%</div><div>—△— Load 100%</div><div>Hold-Up Time [ms]</div><div>Input Voltage [V]</div></div>		<table><tr><th rowspan="2">Input Voltage [V]</th><th colspan="2">Hold-Up Time [ms]</th></tr><tr><th>Load 50%</th><th>Load 100%</th></tr><tr><td>75</td><td>29</td><td>11</td></tr><tr><td>85</td><td>43</td><td>15</td></tr><tr><td>100</td><td>67</td><td>26</td></tr><tr><td>120</td><td>99</td><td>43</td></tr><tr><td>200</td><td>295</td><td>141</td></tr><tr><td>230</td><td>394</td><td>194</td></tr><tr><td>264</td><td>535</td><td>260</td></tr><tr><td>280</td><td>599</td><td>294</td></tr><tr><td>--</td><td>-</td><td>-</td></tr></table>		Input Voltage [V]	Hold-Up Time [ms]		Load 50%	Load 100%	75	29	11	85	43	15	100	67	26	120	99	43	200	295	141	230	394	194	264	535	260	280	599	294	--	-	-
Input Voltage [V]	Hold-Up Time [ms]																																		
	Load 50%	Load 100%																																	
75	29	11																																	
85	43	15																																	
100	67	26																																	
120	99	43																																	
200	295	141																																	
230	394	194																																	
264	535	260																																	
280	599	294																																	
--	-	-																																	
<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>																																			

# COSEL



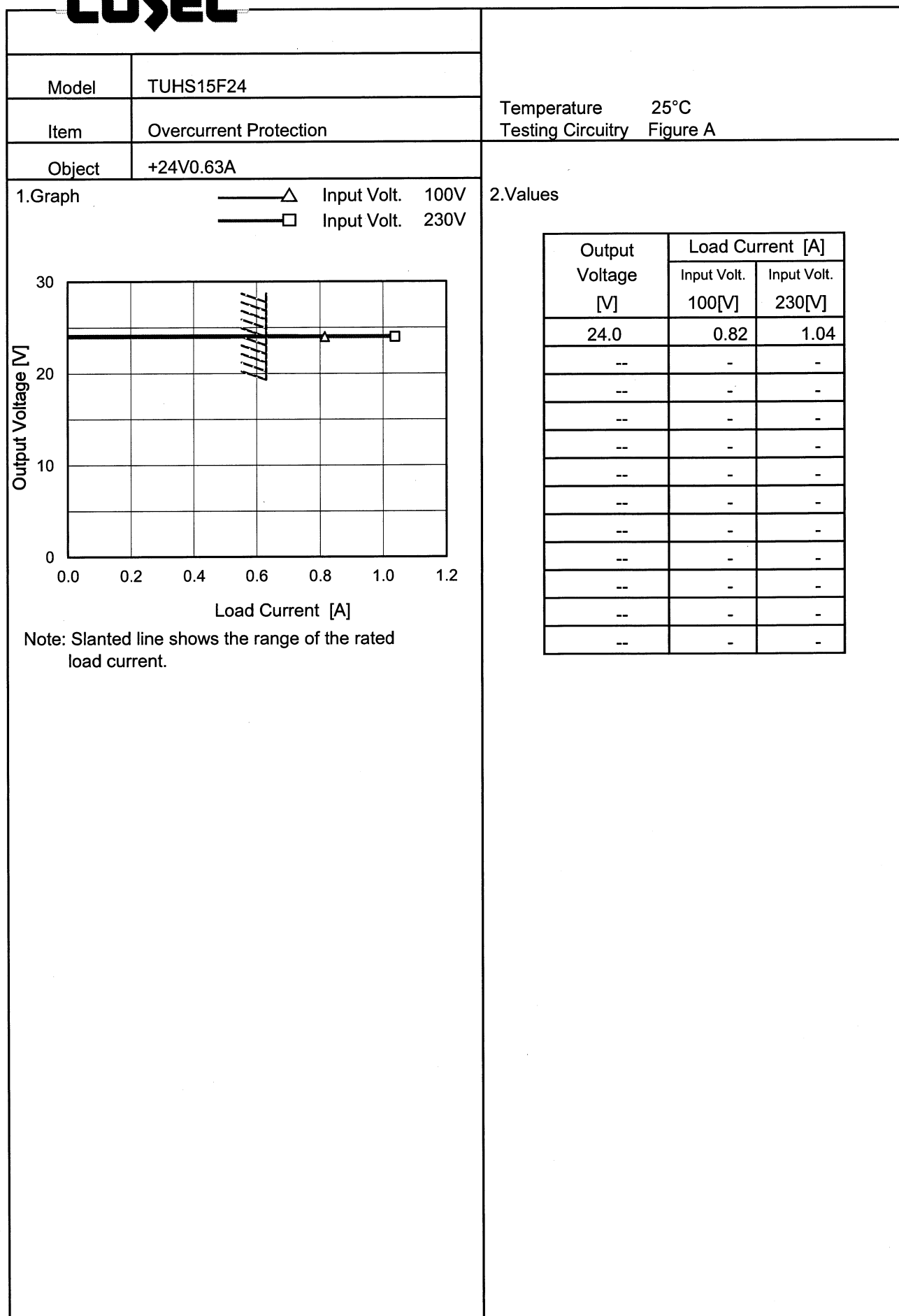
# COSEL

Model		TUHS15F24
Item		Minimum Input Voltage for Regulated Output Voltage
Object		+24V0.63A

1.Graph

<

# COSEL





# COSEL

Model		TUHS15F24
Item		Overvoltage Protection
Object		+24V0.63A

1.Graph

△

Input Volt. 100V

□

Input Volt. 230V

Operating Point [V]

Ambient Temperature [°C]

Load 30%

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	30.4	29.8
-40	30.6	29.9
-20	31.3	30.6
0	31.8	31.1
25	32.3	31.5
50	32.7	32.0
60	33.1	32.5
65	33.4	32.8
--	-	-
--	-	-
--	-	-

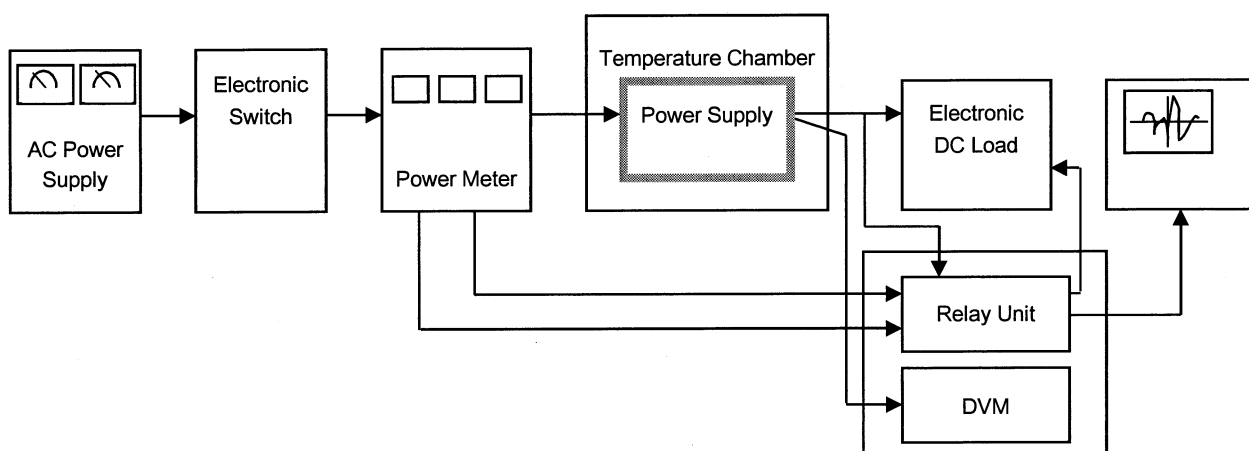


Figure A

Data Acquisition/Control Unit

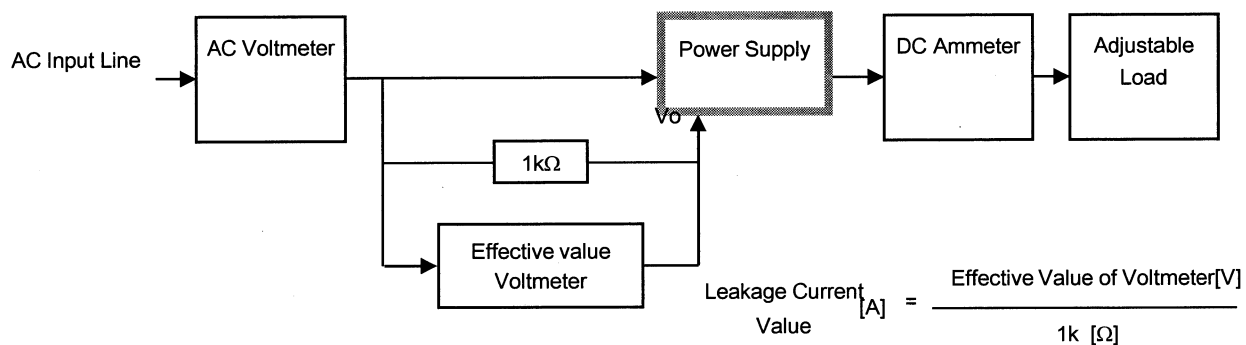


Figure B ( DEN-AN )

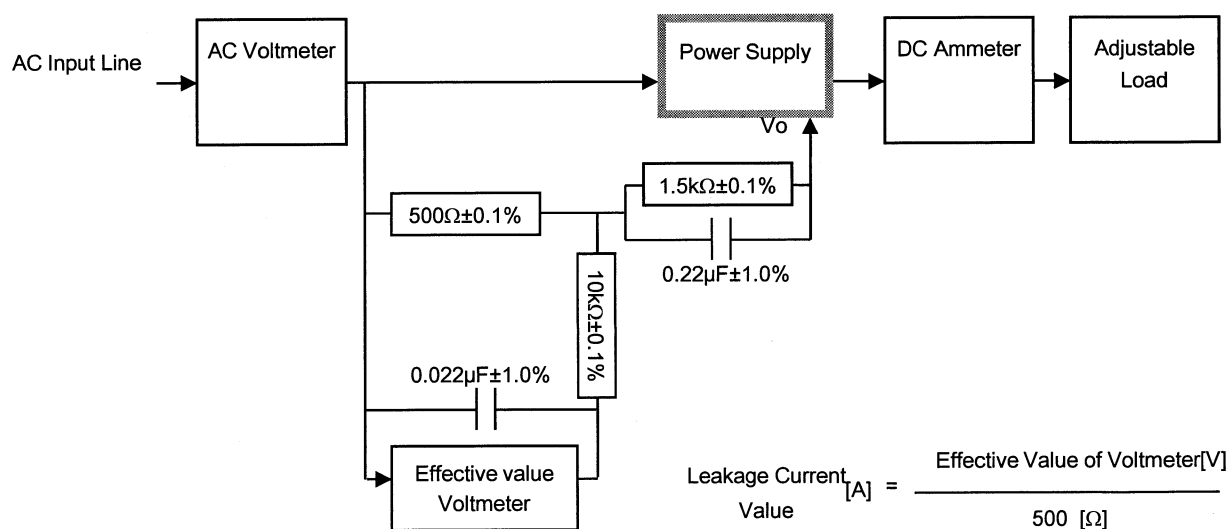


Figure B ( IEC60950-1 )

**COSEL**

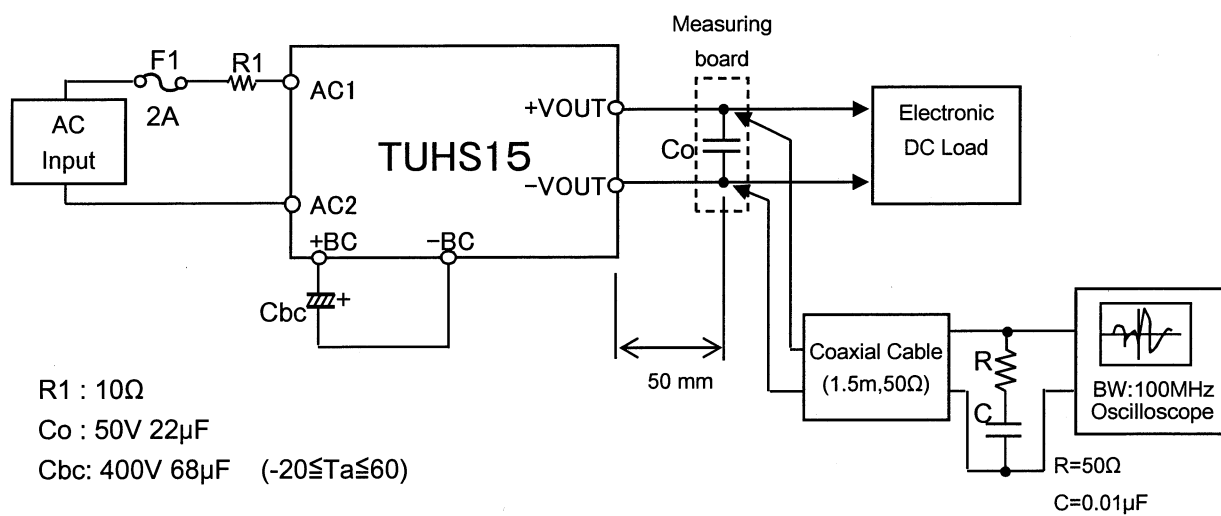


Figure C