



# TEST DATA OF MODULE D

(RB series)

Regulated DC Power Supply  
November 25, 2019

Approved by : Yoshimichi Hirokawa  
Yoshimichi Hirokawa Design Manager

Prepared by : Yutaka Murai  
Yutaka Murai Design Engineer

**COSEL CO.,LTD.**



CONTENTS

1.Line Regulation . . . . . 1  
 2.Load Regulation . . . . . 2  
 3.Dynamic Load Response . . . . . 3  
 4.Ripple Voltage (by Load Current) . . . . . 4  
 5.Ripple-Noise . . . . . 5  
 6.Ripple Voltage (by Ambient Temperature) . . . . . 6  
 7.Ambient Temperature Drift . . . . . 7  
 8.Output Voltage Accuracy . . . . . 8  
 9.Time Lapse Drift . . . . . 9  
 10.Overcurrent Protection . . . . . 10  
 11.Overvoltage Protection . . . . . 11  
 12.Figure of Testing Circuitry . . . . . 12

(Final Page 12)



<b>COSEL</b>																																		
Model	MODULE D																																	
Item	Line Regulation	Temperature 25°C Testing Circuitry Figure A																																
Object	+24V0.65A																																	
<p>1.Graph</p> <div style="text-align: right;"> <p>---□--- Load 50%</p> <p>—△— Load 100%</p> </div> <p style="text-align: center;">Input Voltage [V]</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">Output Voltage [V]</th> </tr> <tr> <th>Load 50%</th> <th>Load 100%</th> </tr> </thead> <tbody> <tr><td>85</td><td>24.478</td><td>24.475</td></tr> <tr><td>90</td><td>24.478</td><td>24.475</td></tr> <tr><td>100</td><td>24.477</td><td>24.475</td></tr> <tr><td>120</td><td>24.478</td><td>24.475</td></tr> <tr><td>200</td><td>24.478</td><td>24.475</td></tr> <tr><td>230</td><td>24.478</td><td>24.475</td></tr> <tr><td>264</td><td>24.478</td><td>24.475</td></tr> <tr><td>280</td><td>24.478</td><td>24.475</td></tr> <tr><td>--</td><td>-</td><td>-</td></tr> </tbody> </table>	Input Voltage [V]	Output Voltage [V]		Load 50%	Load 100%	85	24.478	24.475	90	24.478	24.475	100	24.477	24.475	120	24.478	24.475	200	24.478	24.475	230	24.478	24.475	264	24.478	24.475	280	24.478	24.475	--	-	-
Input Voltage [V]	Output Voltage [V]																																	
	Load 50%	Load 100%																																
85	24.478	24.475																																
90	24.478	24.475																																
100	24.477	24.475																																
120	24.478	24.475																																
200	24.478	24.475																																
230	24.478	24.475																																
264	24.478	24.475																																
280	24.478	24.475																																
--	-	-																																

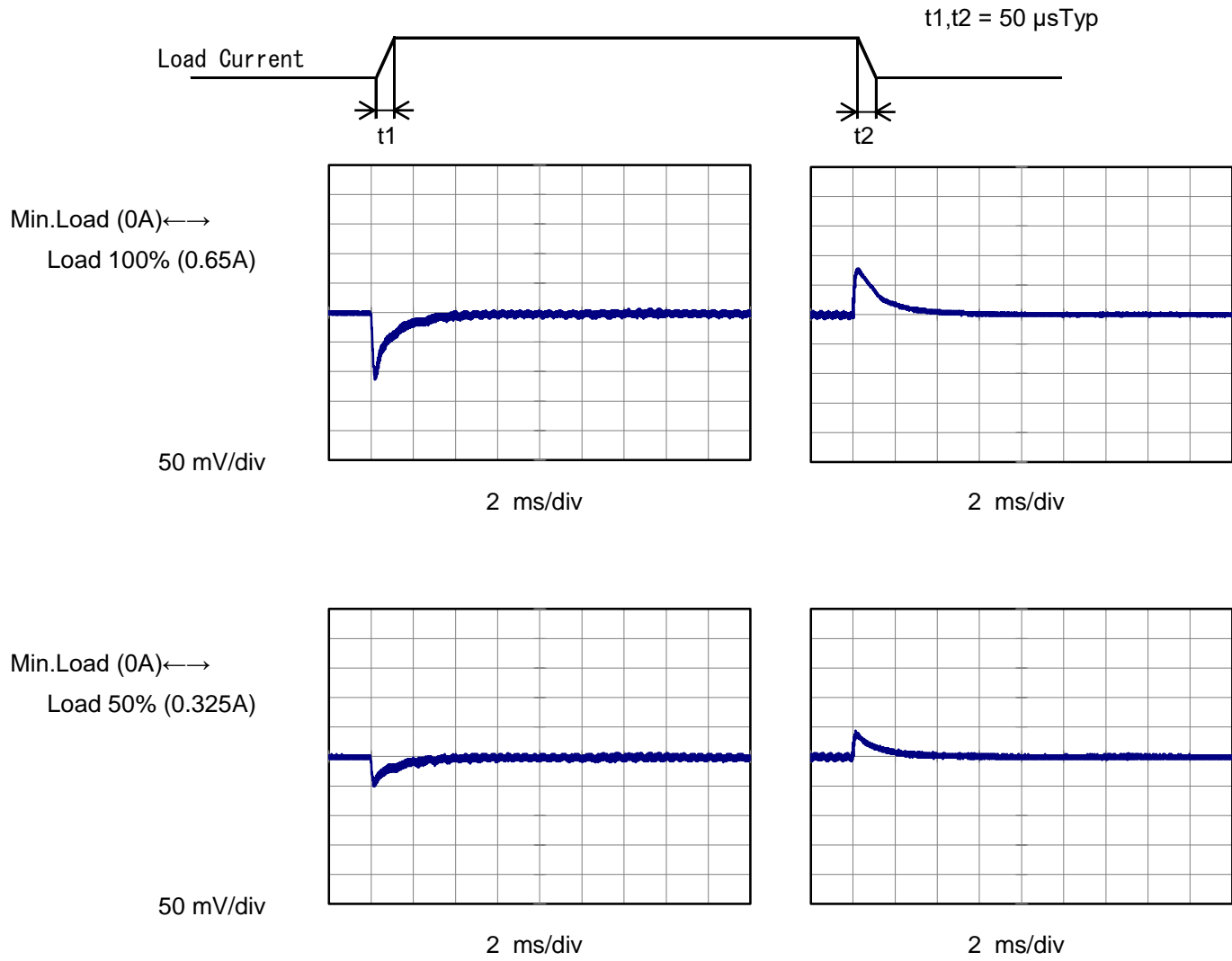


<p>Model MODULE D</p>		<p>Temperature 25°C Testing Circuitry Figure A</p>																																																			
<p>Item Load Regulation</p>																																																					
<p>Object +24V0.65A</p>																																																					
<p>1.Graph</p> <p>                     —△— Input Volt. 100V                      - - - □ - - - Input Volt. 200V                      - · - ○ - · - - Input Volt. 230V                 </p> <p>Output Voltage [V]</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">Output Voltage [V]</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>0.000</td><td>24.482</td><td>24.481</td><td>24.481</td></tr> <tr><td>0.100</td><td>24.480</td><td>24.479</td><td>24.479</td></tr> <tr><td>0.200</td><td>24.478</td><td>24.478</td><td>24.478</td></tr> <tr><td>0.300</td><td>24.478</td><td>24.478</td><td>24.478</td></tr> <tr><td>0.400</td><td>24.478</td><td>24.477</td><td>24.477</td></tr> <tr><td>0.500</td><td>24.476</td><td>24.476</td><td>24.476</td></tr> <tr><td>0.600</td><td>24.475</td><td>24.475</td><td>24.475</td></tr> <tr><td>0.650</td><td>24.475</td><td>24.475</td><td>24.475</td></tr> <tr><td>0.715</td><td>24.475</td><td>24.474</td><td>24.475</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]	Output Voltage [V]			Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]	0.000	24.482	24.481	24.481	0.100	24.480	24.479	24.479	0.200	24.478	24.478	24.478	0.300	24.478	24.478	24.478	0.400	24.478	24.477	24.477	0.500	24.476	24.476	24.476	0.600	24.475	24.475	24.475	0.650	24.475	24.475	24.475	0.715	24.475	24.474	24.475	--	-	-	-	--	-	-	-
Load Current [A]	Output Voltage [V]																																																				
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]																																																		
0.000	24.482	24.481	24.481																																																		
0.100	24.480	24.479	24.479																																																		
0.200	24.478	24.478	24.478																																																		
0.300	24.478	24.478	24.478																																																		
0.400	24.478	24.477	24.477																																																		
0.500	24.476	24.476	24.476																																																		
0.600	24.475	24.475	24.475																																																		
0.650	24.475	24.475	24.475																																																		
0.715	24.475	24.474	24.475																																																		
--	-	-	-																																																		
--	-	-	-																																																		



Model		MODULE D	Temperature 25°C Testing Circuitry Figure A
Item		Dynamic Load Response	
Object		+24V0.65A	

Input Volt. 100 V  
Cycle 1000 ms





<b>COSEL</b>																																								
Model	MODULE D																																							
Item	Ripple Voltage (by Load Current)	Temperature 25°C Testing Circuitry Figure B																																						
Object	+24V0.65A																																							
<p>1. Graph</p> <div style="text-align: right;"> <p>—△— Input Volt. 100V</p> <p>-·-○-·- Input Volt. 230V</p> </div> <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>2. Values</p> <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. 230 [V]</th> </tr> </thead> <tbody> <tr><td>0.00</td><td>20</td><td>20</td></tr> <tr><td>0.10</td><td>20</td><td>20</td></tr> <tr><td>0.20</td><td>20</td><td>20</td></tr> <tr><td>0.30</td><td>20</td><td>20</td></tr> <tr><td>0.40</td><td>20</td><td>20</td></tr> <tr><td>0.50</td><td>25</td><td>25</td></tr> <tr><td>0.60</td><td>25</td><td>25</td></tr> <tr><td>0.650</td><td>25</td><td>25</td></tr> <tr><td>0.715</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. 230 [V]	0.00	20	20	0.10	20	20	0.20	20	20	0.30	20	20	0.40	20	20	0.50	25	25	0.60	25	25	0.650	25	25	0.715	30	30	--	-	-	--	-	-
Load Current [A]	Ripple Voltage [mV]																																							
	Input Volt. 100 [V]	Input Volt. 230 [V]																																						
0.00	20	20																																						
0.10	20	20																																						
0.20	20	20																																						
0.30	20	20																																						
0.40	20	20																																						
0.50	25	25																																						
0.60	25	25																																						
0.650	25	25																																						
0.715	30	30																																						
--	-	-																																						
--	-	-																																						
<p>Fig. Complex Ripple Wave Form</p>																																								



<p>Model MODULE D</p> <p>Item Ripple-Noise</p> <p>Object +24V0.65A</p>		<p>Temperature 25°C</p> <p>Testing Circuitry Figure B</p>																																						
<p>1.Graph</p> <div style="display: flex; justify-content: space-around;"> <div> <p>—△— Input Volt. 100V</p> <p>- - -○- - - Input Volt. 230V</p> </div> </div>		<p>2.Values</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>30</td><td>30</td></tr> <tr><td>0.10</td><td>30</td><td>30</td></tr> <tr><td>0.20</td><td>30</td><td>30</td></tr> <tr><td>0.30</td><td>30</td><td>30</td></tr> <tr><td>0.40</td><td>35</td><td>35</td></tr> <tr><td>0.50</td><td>35</td><td>35</td></tr> <tr><td>0.60</td><td>40</td><td>40</td></tr> <tr><td>0.650</td><td>40</td><td>40</td></tr> <tr><td>0.715</td><td>40</td><td>40</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	30	30	0.10	30	30	0.20	30	30	0.30	30	30	0.40	35	35	0.50	35	35	0.60	40	40	0.650	40	40	0.715	40	40	--	-	-	--	-	-
Load Current [A]	Ripple-Noise [mV]																																							
	Input Volt. 100 [V]	Input Volt. 230 [V]																																						
0.00	30	30																																						
0.10	30	30																																						
0.20	30	30																																						
0.30	30	30																																						
0.40	35	35																																						
0.50	35	35																																						
0.60	40	40																																						
0.650	40	40																																						
0.715	40	40																																						
--	-	-																																						
--	-	-																																						
<p>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.</p>																																								
<p>T1: Due to AC Input Line                  T2: Due to Switching</p> <p>Ripple-Noise [mVp-p]</p>																																								
<p>Fig. Complex Ripple Wave Form</p>																																								



<b>COSEL</b>																																								
Model	MODULE D																																							
Item	Ripple Voltage (by Ambient Temp.)	Testing Circuitry Figure B																																						
Object	+24V0.65A																																							
<p>1.Graph</p> <div style="text-align: right;"> <p>---□--- Input Volt. 100V</p> <p>—△— Input Volt. 230V</p> </div> <p style="text-align: center;">Ambient Temperature [°C] Load 100 %</p>		<p>2.Values</p> <table border="1"> <thead> <tr> <th rowspan="2">Ambient Temperature [°C]</th> <th colspan="2">Ripple Voltage [mV]</th> </tr> <tr> <th>Input Volt. 100 [V]</th> <th>Input Volt. 230 [V]</th> </tr> </thead> <tbody> <tr><td>-30</td><td>55</td><td>55</td></tr> <tr><td>-20</td><td>45</td><td>45</td></tr> <tr><td>0</td><td>25</td><td>25</td></tr> <tr><td>25</td><td>25</td><td>25</td></tr> <tr><td>50</td><td>15</td><td>15</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>	Ambient Temperature [°C]	Ripple Voltage [mV]		Input Volt. 100 [V]	Input Volt. 230 [V]	-30	55	55	-20	45	45	0	25	25	25	25	25	50	15	15	--	-	-	--	-	-	--	-	-	--	-	-	--	-	-	--	-	-
Ambient Temperature [°C]	Ripple Voltage [mV]																																							
	Input Volt. 100 [V]	Input Volt. 230 [V]																																						
-30	55	55																																						
-20	45	45																																						
0	25	25																																						
25	25	25																																						
50	15	15																																						
--	-	-																																						
--	-	-																																						
--	-	-																																						
--	-	-																																						
--	-	-																																						
--	-	-																																						
<p>Measured by 20 MHz Oscilloscope.</p> <p>Note: Slanted line shows the range of the rated ambient temperature.</p>																																								





Model		MODULE D		Testing Circuitry Figure A																																																			
Item		Ambient Temperature Drift																																																					
Object		+24V0.65A																																																					
1.Graph			—△— Input Volt. 100V - - - □ - - - Input Volt. 200V - · - ○ - · - - Input Volt. 230V	2.Values																																																			
			<table border="1"> <thead> <tr> <th rowspan="2">Ambient Temperature [°C]</th> <th colspan="3">Output Voltage [V]</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>-30</td><td>24.394</td><td>24.394</td><td>24.396</td></tr> <tr><td>-20</td><td>24.412</td><td>24.412</td><td>24.414</td></tr> <tr><td>-10</td><td>24.432</td><td>24.432</td><td>24.433</td></tr> <tr><td>0</td><td>24.449</td><td>24.450</td><td>24.450</td></tr> <tr><td>10</td><td>24.463</td><td>24.463</td><td>24.463</td></tr> <tr><td>25</td><td>24.475</td><td>24.475</td><td>24.475</td></tr> <tr><td>30</td><td>24.477</td><td>24.476</td><td>24.477</td></tr> <tr><td>40</td><td>24.481</td><td>24.480</td><td>24.480</td></tr> <tr><td>50</td><td>24.483</td><td>24.482</td><td>24.482</td></tr> <tr><td>60</td><td>24.487</td><td>24.486</td><td>24.486</td></tr> <tr><td>--</td><td>-</td><td>-</td><td>-</td></tr> </tbody> </table>		Ambient Temperature [°C]	Output Voltage [V]			Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]	-30	24.394	24.394	24.396	-20	24.412	24.412	24.414	-10	24.432	24.432	24.433	0	24.449	24.450	24.450	10	24.463	24.463	24.463	25	24.475	24.475	24.475	30	24.477	24.476	24.477	40	24.481	24.480	24.480	50	24.483	24.482	24.482	60	24.487	24.486	24.486	--	-	-	-
Ambient Temperature [°C]	Output Voltage [V]																																																						
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]																																																				
-30	24.394	24.394	24.396																																																				
-20	24.412	24.412	24.414																																																				
-10	24.432	24.432	24.433																																																				
0	24.449	24.450	24.450																																																				
10	24.463	24.463	24.463																																																				
25	24.475	24.475	24.475																																																				
30	24.477	24.476	24.477																																																				
40	24.481	24.480	24.480																																																				
50	24.483	24.482	24.482																																																				
60	24.487	24.486	24.486																																																				
--	-	-	-																																																				
Note: Slanted line shows the range of the rated ambient temperature.																																																							



<b>COSEL</b>		
Model	MODULE D	
Item	Output Voltage Accuracy	Testing Circuitry Figure A
Object	+24V0.65A	

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 : -20 - 50°C

Input Voltage : 85 - 264V

Load Current : 0 - 0.65A

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

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

2. Values

Item	Temperature [°C]	Input Voltage[V]	Output		Output Voltage Accuracy	
			Current[A]	Voltage[V]	Value [mV]	Ratio [%]
Maximum Voltage	50	85	0.00	24.484	±41	±0.2
Minimum Voltage	-20	85	0.65	24.402		



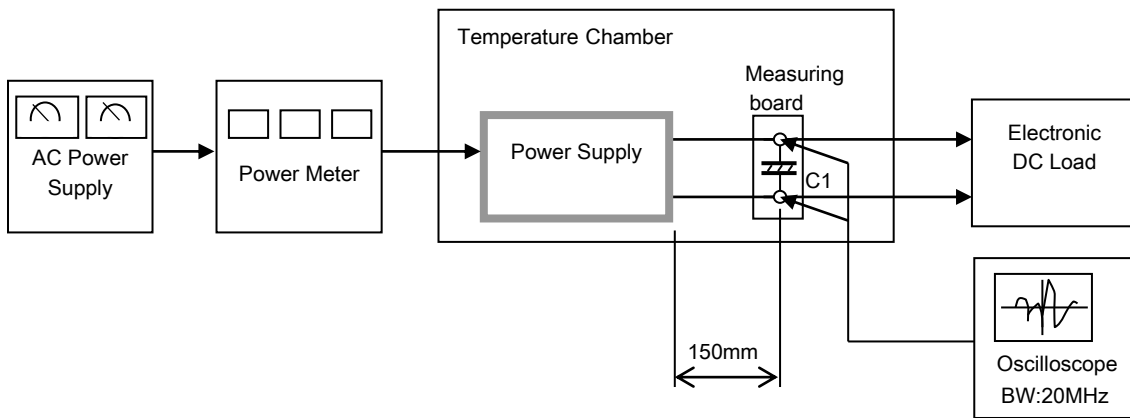
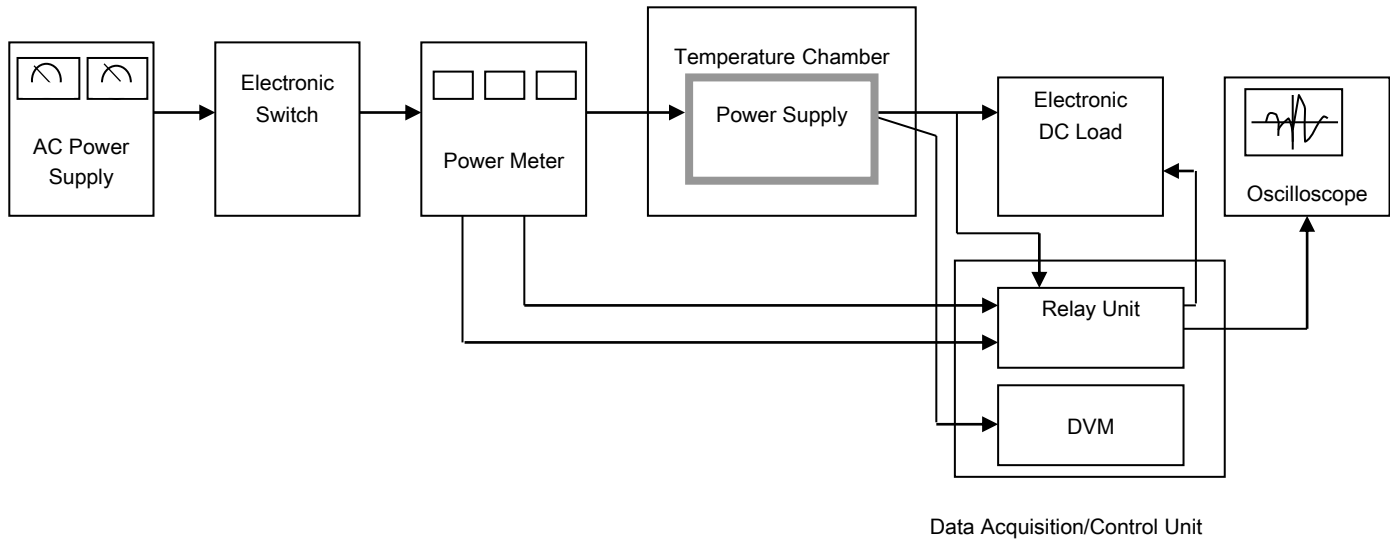
<b>COSEL</b>																								
Model	MODULE D																							
Item	Time Lapse Drift	Temperature 25°C Testing Circuitry Figure A																						
Object	+24V0.65A																							
<p>1.Graph</p> <p style="text-align: center;">Time [H]</p> <p>Input Volt. 100V Load 100%</p>		<p>2.Values</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>24.401</td></tr> <tr><td>0.5</td><td>24.409</td></tr> <tr><td>1.0</td><td>24.405</td></tr> <tr><td>2.0</td><td>24.407</td></tr> <tr><td>3.0</td><td>24.409</td></tr> <tr><td>4.0</td><td>24.405</td></tr> <tr><td>5.0</td><td>24.408</td></tr> <tr><td>6.0</td><td>24.406</td></tr> <tr><td>7.0</td><td>24.407</td></tr> <tr><td>8.0</td><td>24.406</td></tr> </tbody> </table>	Time since start [H]	Output Voltage [V]	0.0	24.401	0.5	24.409	1.0	24.405	2.0	24.407	3.0	24.409	4.0	24.405	5.0	24.408	6.0	24.406	7.0	24.407	8.0	24.406
Time since start [H]	Output Voltage [V]																							
0.0	24.401																							
0.5	24.409																							
1.0	24.405																							
2.0	24.407																							
3.0	24.409																							
4.0	24.405																							
5.0	24.408																							
6.0	24.406																							
7.0	24.407																							
8.0	24.406																							
<p>* The characteristic of AC230V is equal.</p>																								



<p>Model MODULE D</p> <p>Item Overcurrent Protection</p> <p>Object +24V0.65A</p>		<p>Temperature 25°C</p> <p>Testing Circuitry Figure A</p>																																																											
<p>1.Graph</p> <p> <span style="color: black;">—△</span> Input Volt. 100V  <span style="color: blue;">—□</span> Input Volt. 200V  <span style="color: orange;">—○</span> Input Volt. 230V                 </p> <p>Output Voltage [V]</p> <p>Load Current [A]</p> <p>Note: Slanted line shows the range of the rated load current.</p> <p>Intermittent operation occurs when overcurrent protection is activated.</p>		<p>2.Values</p> <table border="1"> <thead> <tr> <th rowspan="2">Output Voltage [V]</th> <th colspan="3">Load Current [A]</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>24</td> <td>0.87</td> <td>0.87</td> <td>0.87</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> <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> <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> <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>	Output Voltage [V]	Load Current [A]			Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]	24	0.87	0.87	0.87	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-
Output Voltage [V]	Load Current [A]																																																												
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]																																																										
24	0.87	0.87	0.87																																																										
--	-	-	-																																																										
--	-	-	-																																																										
--	-	-	-																																																										
--	-	-	-																																																										
--	-	-	-																																																										
--	-	-	-																																																										
--	-	-	-																																																										
--	-	-	-																																																										
--	-	-	-																																																										
--	-	-	-																																																										
--	-	-	-																																																										
--	-	-	-																																																										



<b>COSEL</b>																																								
Model	MODULE D																																							
Item	Overvoltage Protection	Testing Circuitry Figure A																																						
Object	+24V0.65A																																							
<p>1.Graph</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>—△— Input Volt. 100V</p> <p>---□--- Input Volt. 230V</p> </div> <div style="text-align: center;"> </div> </div> <p style="text-align: center;">Ambient Temperature [°C]      Load 0%</p>		<p>2.Values</p> <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>-30</td><td>31.51</td><td>31.51</td></tr> <tr><td>-20</td><td>31.53</td><td>31.54</td></tr> <tr><td>-10</td><td>31.48</td><td>31.48</td></tr> <tr><td>0</td><td>31.42</td><td>31.43</td></tr> <tr><td>10</td><td>31.52</td><td>31.52</td></tr> <tr><td>25</td><td>31.46</td><td>31.46</td></tr> <tr><td>30</td><td>31.55</td><td>31.55</td></tr> <tr><td>40</td><td>31.48</td><td>31.48</td></tr> <tr><td>50</td><td>31.57</td><td>31.57</td></tr> <tr><td>60</td><td>31.50</td><td>31.50</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]	-30	31.51	31.51	-20	31.53	31.54	-10	31.48	31.48	0	31.42	31.43	10	31.52	31.52	25	31.46	31.46	30	31.55	31.55	40	31.48	31.48	50	31.57	31.57	60	31.50	31.50	--	-	-
Ambient Temperature [°C]	Operating Point [V]																																							
	Input Volt. 100[V]	Input Volt. 230[V]																																						
-30	31.51	31.51																																						
-20	31.53	31.54																																						
-10	31.48	31.48																																						
0	31.42	31.43																																						
10	31.52	31.52																																						
25	31.46	31.46																																						
30	31.55	31.55																																						
40	31.48	31.48																																						
50	31.57	31.57																																						
60	31.50	31.50																																						
--	-	-																																						
<p>Note: Slanted line shows the range of the rated ambient temperature.</p>																																								



C1= 22  $\mu$ F  
(Electrolytic capacitor)