



# TEST DATA OF CHS3002428

Regulated DC Power Supply  
July 23, 2019

Approved by :

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**COSEL CO.,LTD.**



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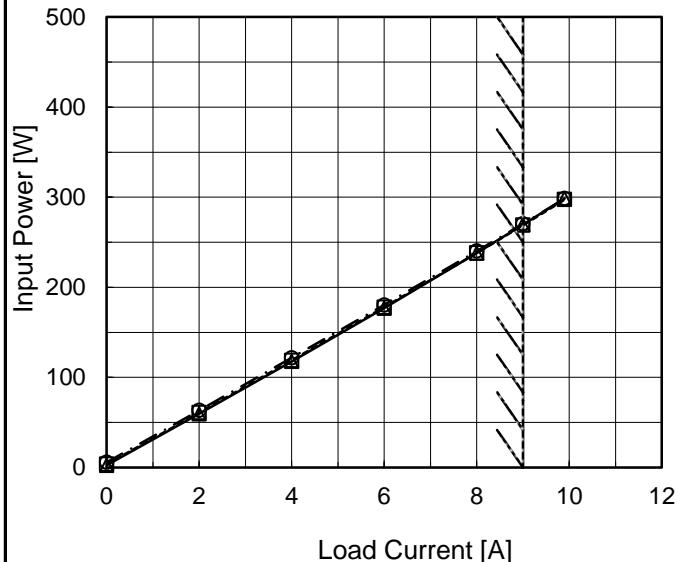
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2.Values	<table border="1"> <thead> <tr> <th rowspan="2">Load Current [A]</th> <th colspan="3">Input Power [W]</th> </tr> <tr> <th>Input Volt. 18[V]</th> <th>Input Volt. 24[V]</th> <th>Input Volt. 36[V]</th> </tr> </thead> <tbody> <tr><td>0.0</td><td>2.3</td><td>3.5</td><td>5.7</td></tr> <tr><td>2.0</td><td>59.5</td><td>60.8</td><td>63.2</td></tr> <tr><td>4.0</td><td>117.6</td><td>118.9</td><td>121.7</td></tr> <tr><td>6.0</td><td>176.8</td><td>177.8</td><td>180.4</td></tr> <tr><td>8.0</td><td>237.9</td><td>238.1</td><td>240.2</td></tr> <tr><td>9.0</td><td>269.5</td><td>269.0</td><td>270.6</td></tr> <tr><td>9.9</td><td>298.7</td><td>297.4</td><td>298.4</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>			Load Current [A]	Input Power [W]			Input Volt. 18[V]	Input Volt. 24[V]	Input Volt. 36[V]	0.0	2.3	3.5	5.7	2.0	59.5	60.8	63.2	4.0	117.6	118.9	121.7	6.0	176.8	177.8	180.4	8.0	237.9	238.1	240.2	9.0	269.5	269.0	270.6	9.9	298.7	297.4	298.4	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-
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<p>The graph plots Efficiency [%] on the y-axis (44 to 100) against Input Voltage [V] on the x-axis (10 to 50). Two data series are shown: Load 50% (dashed line with square markers) and Load 100% (solid line with triangle markers). Both series show a slight decrease in efficiency as input voltage increases. 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>17</td><td>-</td><td>-</td></tr> <tr><td>18</td><td>95.4</td><td>93.3</td></tr> <tr><td>19</td><td>95.3</td><td>93.4</td></tr> <tr><td>20</td><td>95.2</td><td>93.5</td></tr> <tr><td>24</td><td>94.6</td><td>93.8</td></tr> <tr><td>30</td><td>93.7</td><td>93.3</td></tr> <tr><td>36</td><td>92.8</td><td>93.1</td></tr> <tr><td>40</td><td>92.1</td><td>92.7</td></tr> <tr><td>--</td><td>-</td><td>-</td></tr> </tbody> </table>				Input Voltage [V]	Efficiency Load 50% [%]	Efficiency Load 100% [%]	17	-	-	18	95.4	93.3	19	95.3	93.4	20	95.2	93.5	24	94.6	93.8	30	93.7	93.3	36	92.8	93.1	40	92.1	92.7	--	-	-
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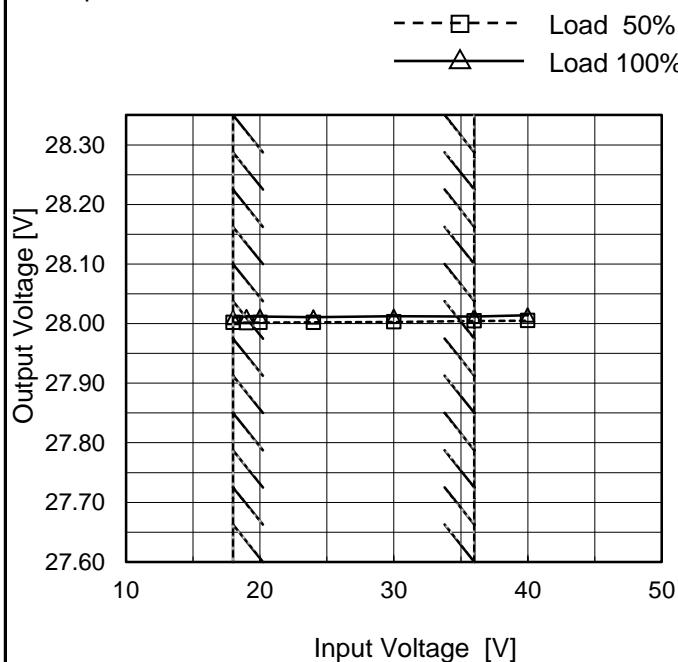
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<p>The graph plots Efficiency [%] on the y-axis (44 to 100) against Load Current [A] on the x-axis (0 to 12). Three data series are shown for Input Volt. 18V (solid line with triangles), Input Volt. 24V (dashed line with squares), and Input Volt. 36V (dash-dot line with circles). All series show efficiency starting at ~95% at 2A and decreasing slightly to ~92% at 10A. A slanted line on the right indicates the rated load current range.</p>		<table border="1"> <thead> <tr> <th rowspan="2">Load Current [A]</th> <th colspan="3">Efficiency [%]</th> </tr> <tr> <th>Input Volt. 18[V]</th> <th>Input Volt. 24[V]</th> <th>Input Volt. 36[V]</th> </tr> </thead> <tbody> <tr><td>0.0</td><td>-</td><td>-</td><td>-</td></tr> <tr><td>2.0</td><td>94.4</td><td>92.4</td><td>88.9</td></tr> <tr><td>4.0</td><td>95.4</td><td>94.4</td><td>92.3</td></tr> <tr><td>6.0</td><td>95.0</td><td>94.6</td><td>93.2</td></tr> <tr><td>8.0</td><td>94.2</td><td>94.2</td><td>93.3</td></tr> <tr><td>9.0</td><td>93.3</td><td>93.8</td><td>93.1</td></tr> <tr><td>9.9</td><td>93.0</td><td>93.4</td><td>92.9</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>		Load Current [A]	Efficiency [%]			Input Volt. 18[V]	Input Volt. 24[V]	Input Volt. 36[V]	0.0	-	-	-	2.0	94.4	92.4	88.9	4.0	95.4	94.4	92.3	6.0	95.0	94.6	93.2	8.0	94.2	94.2	93.3	9.0	93.3	93.8	93.1	9.9	93.0	93.4	92.9	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-
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Item	Line Regulation	Testing Circuitry	Figure A
Object	+28V9A		

## 1.Graph



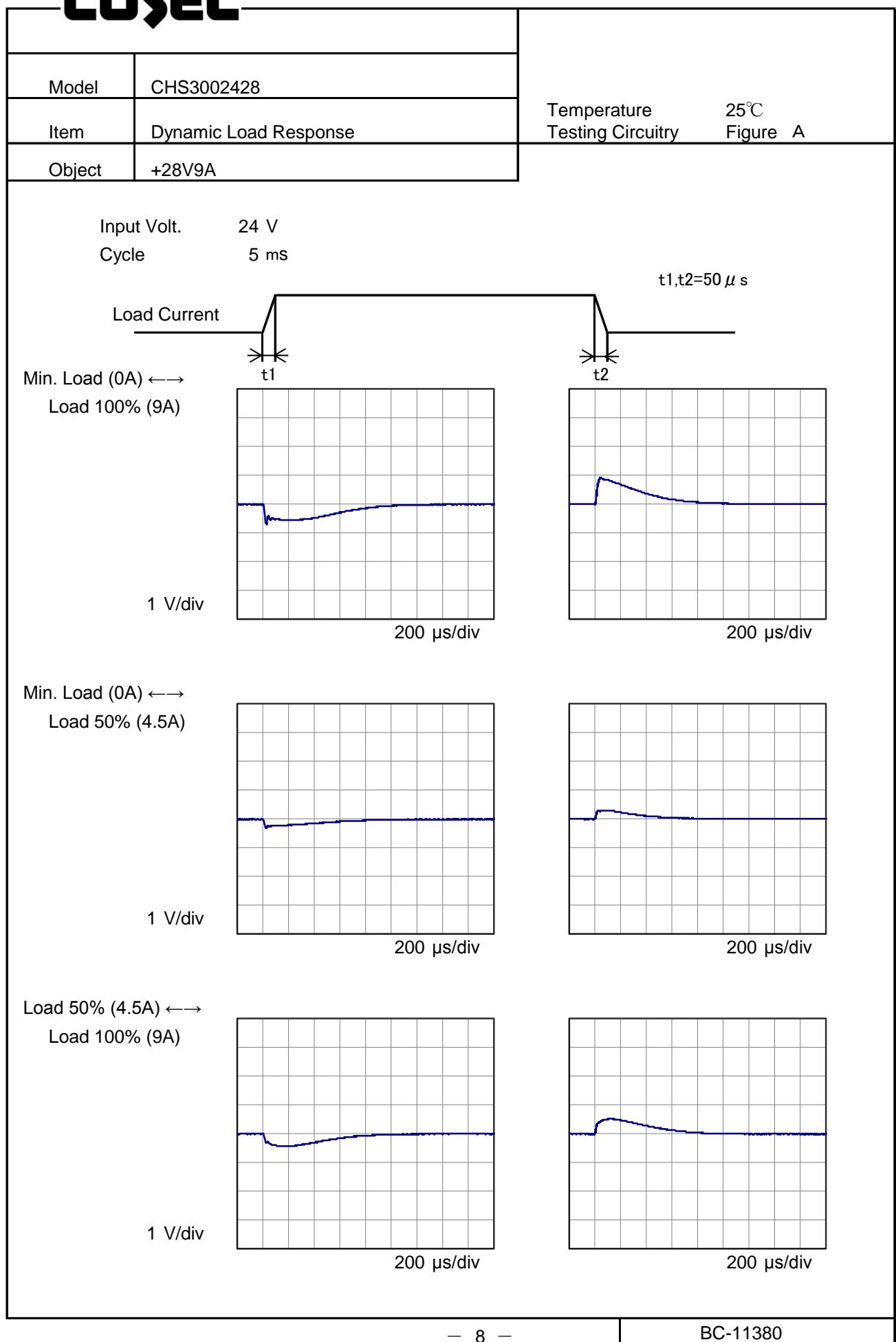
## 2.Values

Input Voltage [V]	Output Voltage [V]	
	Load 50%	Load 100%
17	0.000	0.000
18	28.002	28.010
19	28.002	28.012
20	28.002	28.012
24	28.002	28.011
30	28.003	28.012
36	28.004	28.012
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<p>—△— Input Volt. 18V        - - -□--- Input Volt. 24V        - - -○--- Input Volt. 36V</p> <p>The graph plots Output Voltage [V] on the y-axis (27.60 to 28.30) against Load Current [A] on the x-axis (0 to 12). Three data series are shown for input voltages of 18V, 24V, and 36V. Each series consists of horizontal segments at a constant output voltage followed by a sharp vertical drop. A slanted line connects the points where the voltage begins to drop, spanning from approximately 0.5A to 9.0A.</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. 18[V]</th> <th>Input Volt. 24[V]</th> <th>Input Volt. 36[V]</th> </tr> </thead> <tbody> <tr><td>0.0</td><td>28.010</td><td>28.013</td><td>28.011</td></tr> <tr><td>2.0</td><td>28.009</td><td>28.011</td><td>28.011</td></tr> <tr><td>4.0</td><td>28.007</td><td>28.010</td><td>28.010</td></tr> <tr><td>6.0</td><td>28.007</td><td>28.009</td><td>28.010</td></tr> <tr><td>8.0</td><td>28.008</td><td>28.009</td><td>28.010</td></tr> <tr><td>9.0</td><td>28.010</td><td>28.011</td><td>28.012</td></tr> <tr><td>9.9</td><td>28.013</td><td>28.012</td><td>28.013</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>		Load Current [A]	Output Voltage [V]			Input Volt. 18[V]	Input Volt. 24[V]	Input Volt. 36[V]	0.0	28.010	28.013	28.011	2.0	28.009	28.011	28.011	4.0	28.007	28.010	28.010	6.0	28.007	28.009	28.010	8.0	28.008	28.009	28.010	9.0	28.010	28.011	28.012	9.9	28.013	28.012	28.013	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-
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Load Current [A]	Ripple Voltage [mV]																																							
	Input Volt. 18 [V]	Input Volt. 36 [V]																																						
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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>Ripple [mVp-p]</p> <p>Fig.Complex Ripple Wave Form</p>																																								

**COSEL**

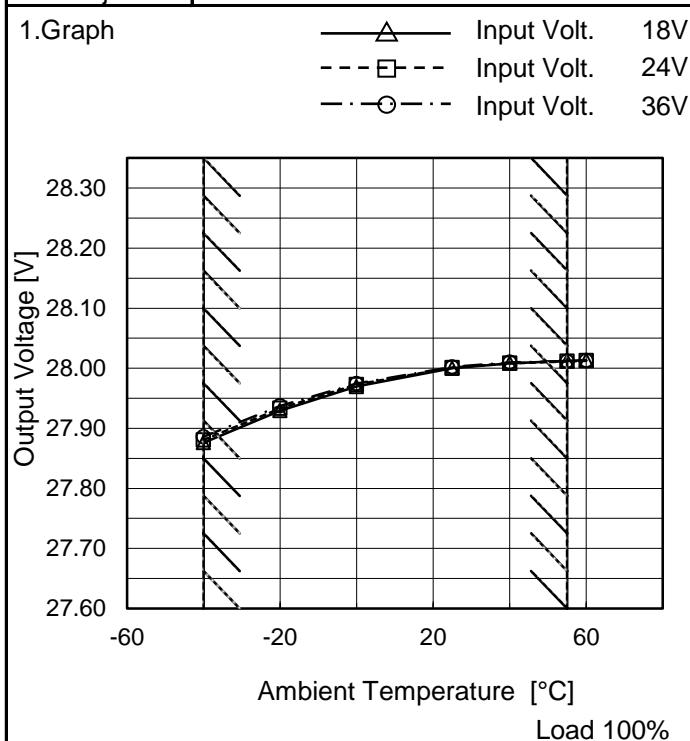
Model	CHS3002428																																							
Item	Ripple-Noise	Temperature 25°C Testing Circuitry Figure B																																						
Object	+28V9A																																							
1.Graph																																								
		2.Values																																						
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Load Current [A]	Ripple-Noise [mV]																																							
	Input Volt. 18 [V]	Input Volt. 36 [V]																																						
0.000	80	145																																						
2.250	80	145																																						
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6.750	80	155																																						
9.000	85	165																																						
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<p>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.</p>																																								
Fig.Complex Ripple Noise Wave Form																																								

**COSEL**

Model	CHS3002428	Testing Circuitry    Figure B																							
Item	Ripple Voltage (by Ambient Temp.)																								
Object	+28V9A																								
1.Graph		2.Values																							
<p>Graph showing Ripple Voltage [mV] vs Ambient Temperature [°C]. The Y-axis ranges from 0 to 300 mV, and the X-axis ranges from -60 to 100 °C. Two data series are plotted: Load 50% (dashed line with square markers) and Load 100% (solid line with triangle markers). Both series show a slight decrease in ripple voltage as temperature increases. A slanted line indicates the rated ambient temperature range.</p> <table border="1"> <thead> <tr> <th>Ambient Temperature [°C]</th> <th>Ripple Voltage [mV] (Load 50%)</th> <th>Ripple Voltage [mV] (Load 100%)</th> </tr> </thead> <tbody> <tr><td>-40</td><td>110</td><td>110</td></tr> <tr><td>-20</td><td>100</td><td>100</td></tr> <tr><td>0</td><td>100</td><td>100</td></tr> <tr><td>25</td><td>95</td><td>95</td></tr> <tr><td>40</td><td>95</td><td>95</td></tr> <tr><td>55</td><td>95</td><td>95</td></tr> <tr><td>60</td><td>90</td><td>90</td></tr> </tbody> </table>		Ambient Temperature [°C]	Ripple Voltage [mV] (Load 50%)	Ripple Voltage [mV] (Load 100%)	-40	110	110	-20	100	100	0	100	100	25	95	95	40	95	95	55	95	95	60	90	90
Ambient Temperature [°C]	Ripple Voltage [mV] (Load 50%)	Ripple Voltage [mV] (Load 100%)																							
-40	110	110																							
-20	100	100																							
0	100	100																							
25	95	95																							
40	95	95																							
55	95	95																							
60	90	90																							
<p>Input Volt.      24V</p> <p>Measured by 100 MHz Oscilloscope. Note: Slanted line shows the range of the rated ambient temperature.</p>																									

**COSEL**

Model	CHS3002428
Item	Ambient Temperature Drift
Object	+28V9A



Testing Circuitry Figure A

## 2.Values

Ambient Temperature [°C]	Output Voltage [V]		
	Input Volt. 18[V]	Input Volt. 24[V]	Input Volt. 36[V]
-40	27.876	27.881	27.886
-20	27.929	27.933	27.938
0	27.970	27.973	27.975
25	28.000	28.001	28.002
40	28.008	28.008	28.010
55	28.012	28.012	28.012
60	28.013	28.013	28.013
--	-	-	-
--	-	-	-
--	-	-	-
--	-	-	-

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



Model	CHS3002428	Testing Circuitry Figure A
Item	Output Voltage Accuracy	
Object	+28V9A	

### 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 : 18 - 36V

Load Current : 0 - 9A

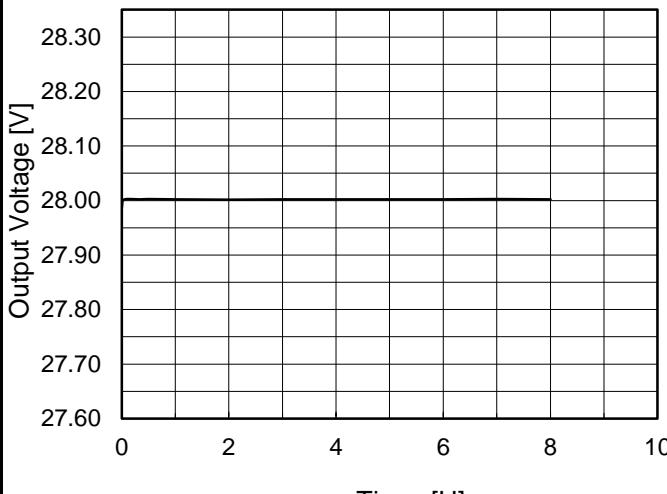
\* Output Voltage Accuracy =  $\pm(\text{Maximum of Output Voltage} - \text{Minimum of Output Voltage}) / 2$

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

### 2. Values

Item	Temperature [°C]	Input Voltage[V]	Output		Output Voltage Accuracy	
			Current[A]	Voltage[V]	Value [mV]	Ratio [%]
Maximum Voltage	55	18	9	28.012	±75	±0.3
Minimum Voltage	-40	36	0	27.862		

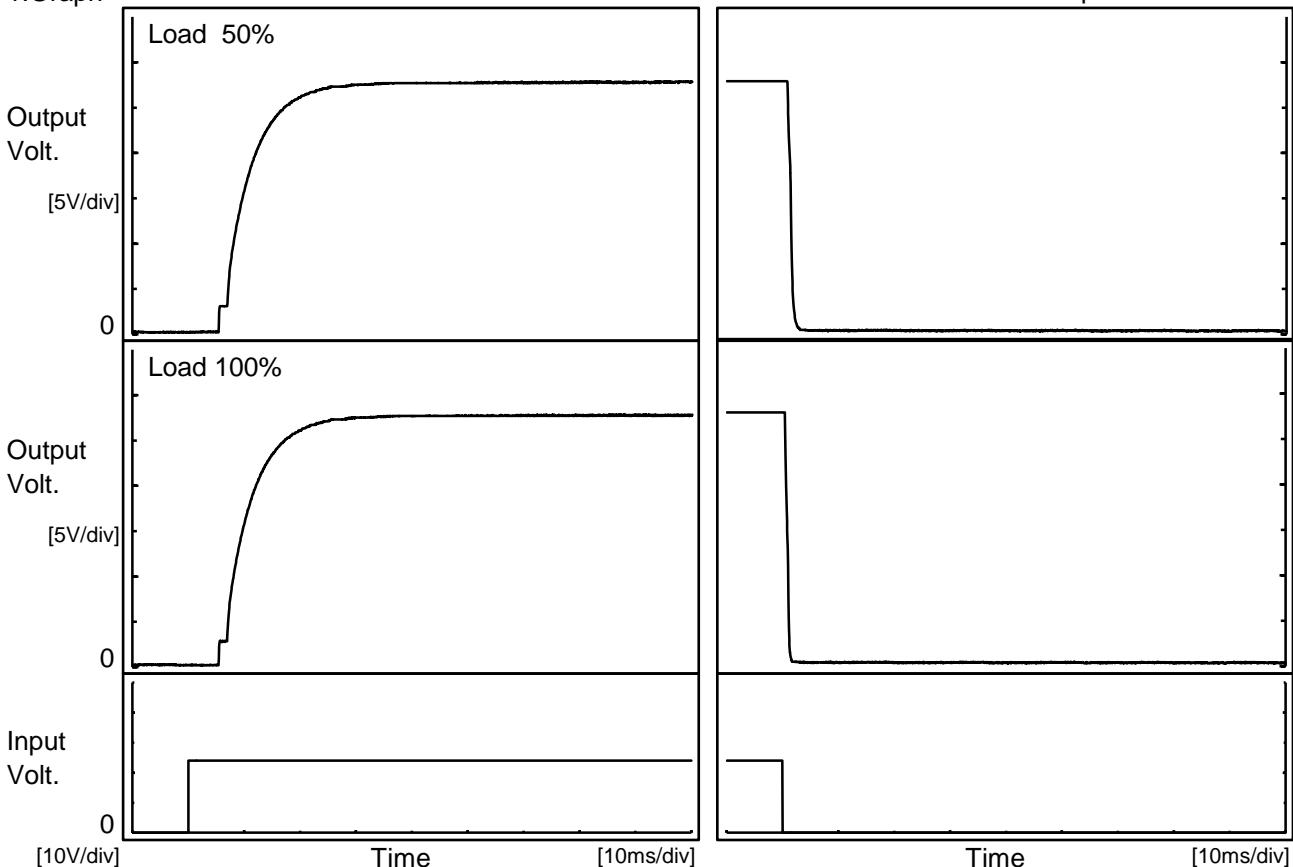
**COSEL**

Model	CHS3002428	Temperature	25°C																						
Item	Time Lapse Drift	Testing Circuitry	Figure A																						
Object	+28V9A																								
1. Graph			2. Values																						
 <p>Output Voltage [V]</p> <p>Time [H]</p> <p>Input Volt. 24V 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>27.986</td></tr> <tr><td>0.5</td><td>28.003</td></tr> <tr><td>1.0</td><td>28.002</td></tr> <tr><td>2.0</td><td>28.002</td></tr> <tr><td>3.0</td><td>28.002</td></tr> <tr><td>4.0</td><td>28.002</td></tr> <tr><td>5.0</td><td>28.002</td></tr> <tr><td>6.0</td><td>28.002</td></tr> <tr><td>7.0</td><td>28.003</td></tr> <tr><td>8.0</td><td>28.002</td></tr> </tbody> </table>	Time since start [H]	Output Voltage [V]	0.0	27.986	0.5	28.003	1.0	28.002	2.0	28.002	3.0	28.002	4.0	28.002	5.0	28.002	6.0	28.002	7.0	28.003	8.0	28.002
Time since start [H]	Output Voltage [V]																								
0.0	27.986																								
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**COSEL**

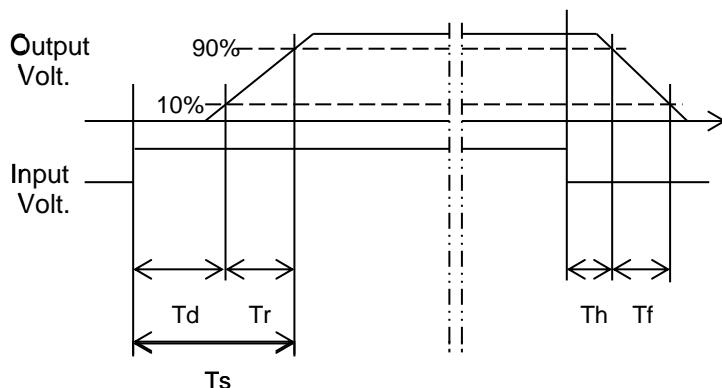
Model	CHS3002428	Temperature Testing Circuitry	25°C
Item	Rise and Fall Time		Figure A
Object	+28V9A		

## 1. Graph



## 2. Values

Load	Time	Td	Tr	Ts	Th	Tf	[ms]
50 %		5.6	12.5	18.1	0.9	1.1	
100 %		7.0	11.3	18.3	0.5	0.8	

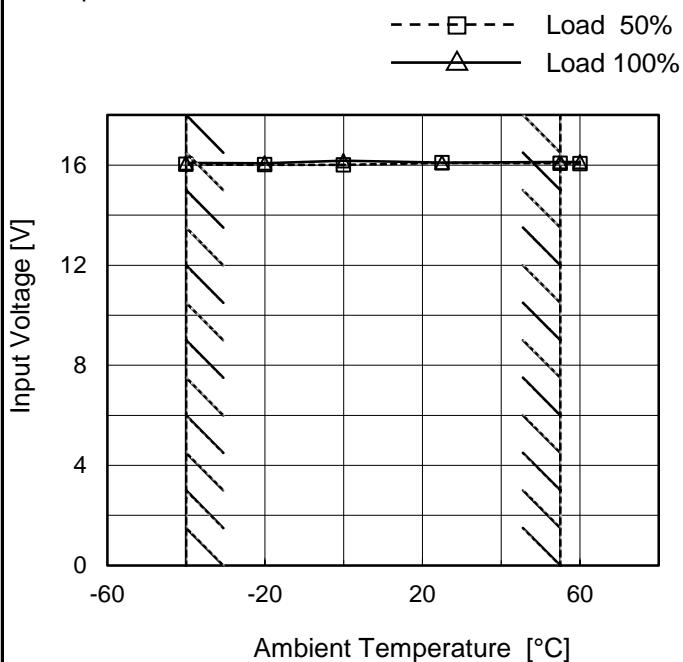


**COSEL**

Model	CHS3002428
Item	Minimum Input Voltage for Regulated Output Voltage
Object	+28V9A

Testing Circuitry Figure A

## 1. Graph



## 2. Values

Ambient Temperature [°C]	Input Voltage [V]	
	Load 50%	Load 100%
-40	16.03	16.09
-20	16.02	16.08
0	16.01	16.18
25	16.09	16.10
55	16.08	16.13
60	16.06	16.13
--	-	-
--	-	-
--	-	-
--	-	-
--	-	-

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

**COSEL**

Model	CHS3002428	Temperature Testing Circuitry	25°C Figure A																																																											
Item	Overcurrent Protection																																																													
Object	+28V9A																																																													
1.Graph		2.Values																																																												
<p>The graph plots Output Voltage [V] on the y-axis (0 to 36) against Load Current [A] on the x-axis (0 to 16). Three curves are shown for Input Voltages of 18V, 24V, and 36V. All curves remain flat at their respective input voltages until a load current of approximately 12A, after which they drop sharply. A slanted line from the origin to the point (12, 28) indicates the range of the rated load current.</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. 18[V]</th> <th>Input Volt. 24[V]</th> <th>Input Volt. 36[V]</th> </tr> </thead> <tbody> <tr><td>28.0</td><td>12.84</td><td>12.96</td><td>12.96</td></tr> <tr><td>26.6</td><td>12.96</td><td>13.10</td><td>13.07</td></tr> <tr><td>25.2</td><td>13.03</td><td>13.16</td><td>13.11</td></tr> <tr><td>23.8</td><td>13.14</td><td>13.34</td><td>13.26</td></tr> <tr><td>22.4</td><td>13.37</td><td>13.61</td><td>13.52</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. 18[V]	Input Volt. 24[V]	Input Volt. 36[V]	28.0	12.84	12.96	12.96	26.6	12.96	13.10	13.07	25.2	13.03	13.16	13.11	23.8	13.14	13.34	13.26	22.4	13.37	13.61	13.52	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-
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Note: Slanted line shows the range of the rated load current.

Model	CHS3002428																																							
Item	Overvoltage Protection																																							
Object	+28V9A																																							
1.Graph	Input Volt. 24V	Input Volt. 36V																																						
<p>Operating Point [V]</p> <p>Ambient Temperature [°C]</p> <p>Load 0%</p>																																								
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Ambient Temperature [°C]	Operating Point [V]																																							
	Input Volt. 24[V]	Input Volt. 36[V]																																						
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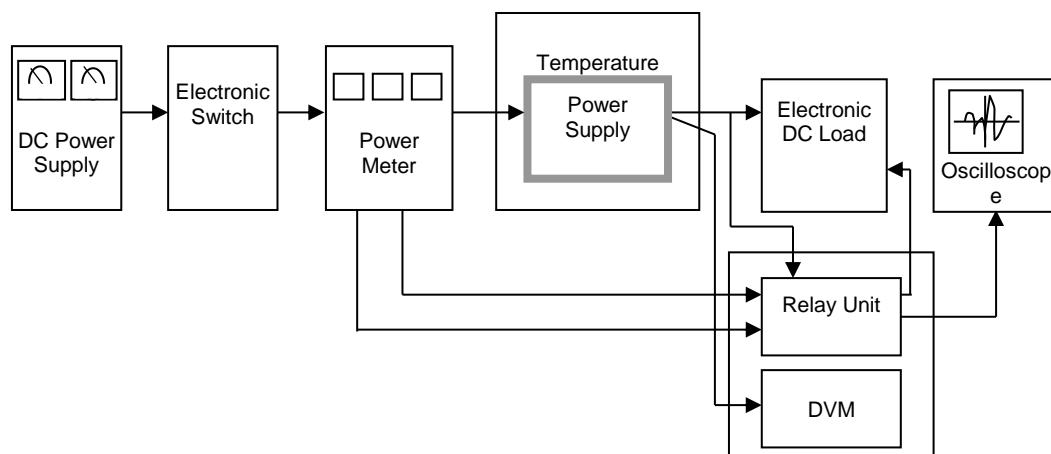


Figure A  
Data Acquisition/Control Unit

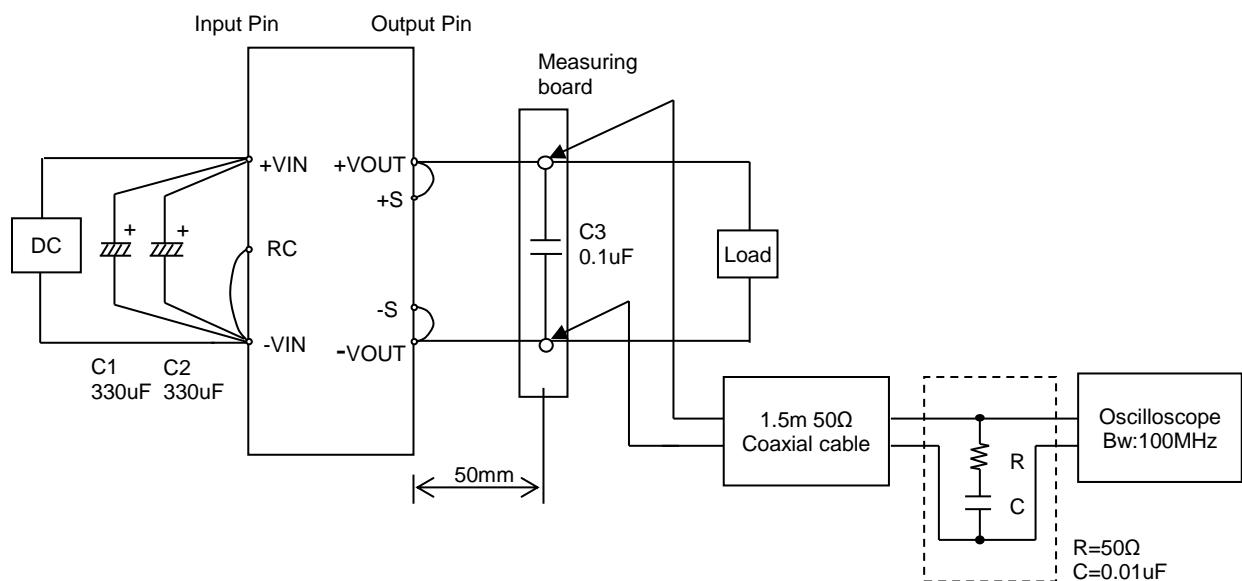


Figure B