

TEST DATA OF TUHS3F24

Regulated DC Power Supply
February 28, 2014

Approved by : Nobuyuki Shiraishi
Nobuyuki Shiraishi Design Manager

Prepared by : Takayuki Yamamoto
Takayuki Yamamoto Design Engineer

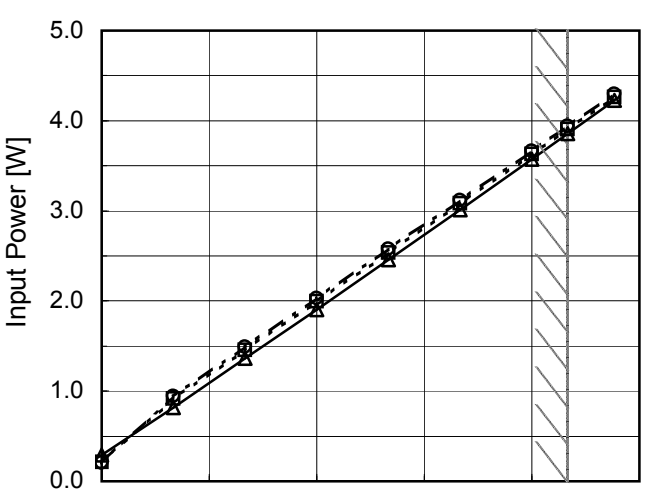
COSEL CO.,LTD.

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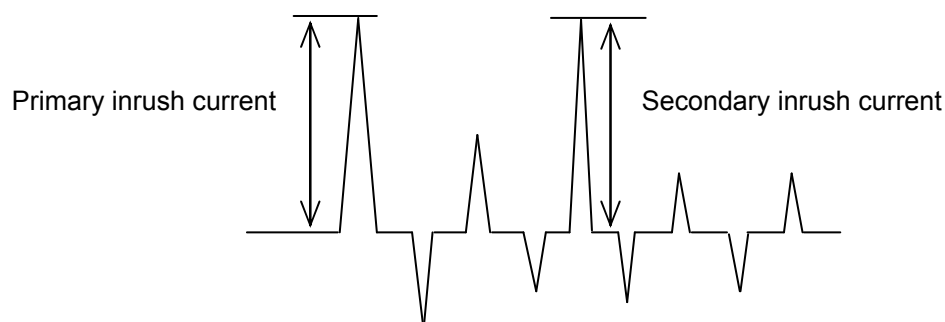
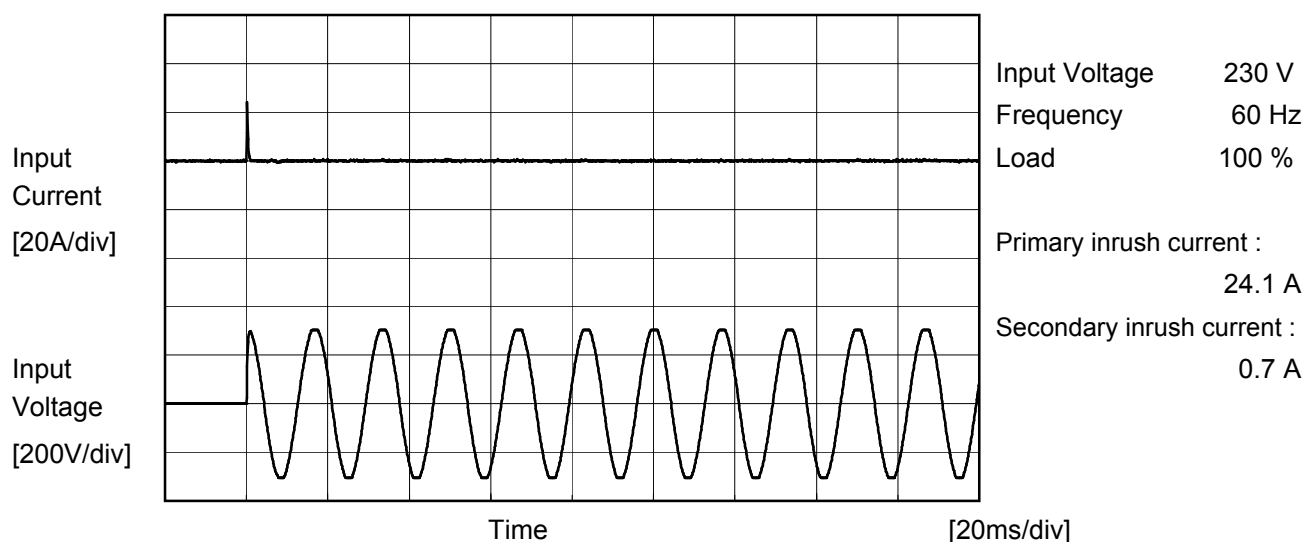
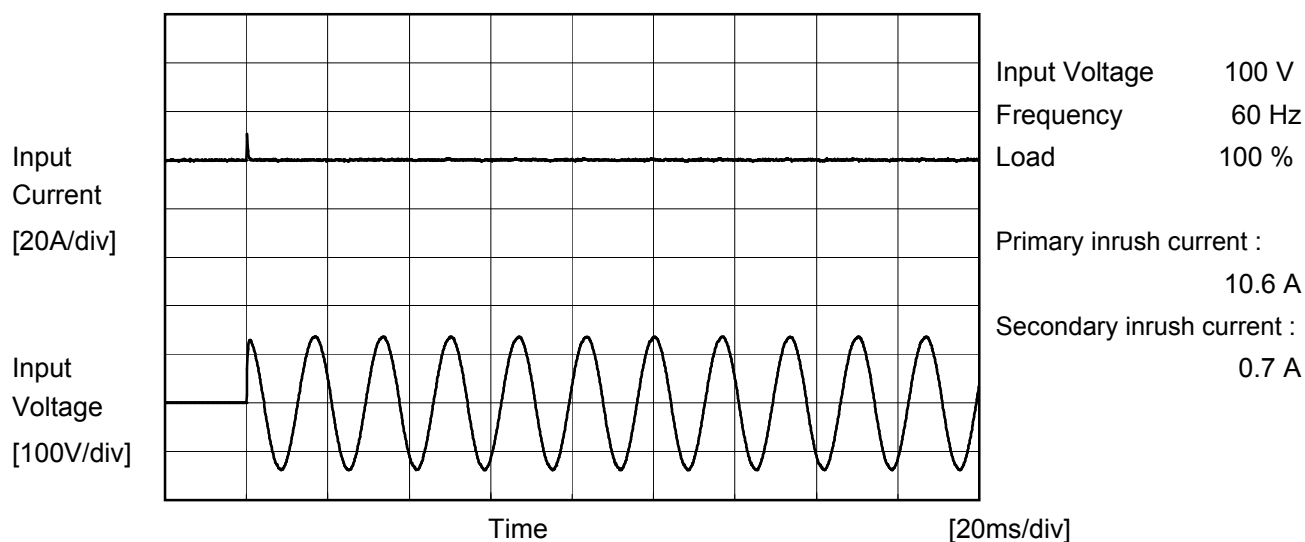
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Item	Inrush Current		
Object	_____		



		Temperature 25°C Testing Circuitry Figure B
Model	TUHS3F24	
Item	Leakage Current	
Object	_____	

1.Results

[mA]

Standards		Input Volt.			Note
		100 [V]	200 [V]	230 [V]	
DEN-AN	Both phases	0.003	0.004	0.004	Operation
	One of phases	0.003	0.005	0.006	Stand by
IEC60950-1	Both phases	0.002	0.005	0.005	Operation
	One of phases	0.003	0.005	0.005	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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<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> <p>Output Voltage [V]</p> <p>Load Current [A]</p> <p>Note: Slanted line shows the range of the rated load current.</p>		<table><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><tr><td>0.00</td><td>24.110</td><td>24.111</td><td>24.107</td></tr><tr><td>0.02</td><td>24.108</td><td>24.111</td><td>24.109</td></tr><tr><td>0.04</td><td>24.106</td><td>24.110</td><td>24.108</td></tr><tr><td>0.06</td><td>24.104</td><td>24.108</td><td>24.107</td></tr><tr><td>0.08</td><td>24.102</td><td>24.106</td><td>24.105</td></tr><tr><td>0.10</td><td>24.099</td><td>24.103</td><td>24.103</td></tr><tr><td>0.12</td><td>24.097</td><td>24.101</td><td>24.101</td></tr><tr><td>0.13</td><td>24.095</td><td>24.100</td><td>24.099</td></tr><tr><td>0.14</td><td>24.094</td><td>24.098</td><td>24.098</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]	Output Voltage [V]			Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]	0.00	24.110	24.111	24.107	0.02	24.108	24.111	24.109	0.04	24.106	24.110	24.108	0.06	24.104	24.108	24.107	0.08	24.102	24.106	24.105	0.10	24.099	24.103	24.103	0.12	24.097	24.101	24.101	0.13	24.095	24.100	24.099	0.14	24.094	24.098	24.098	--	-	-	-	--	-	-	-
Load Current [A]	Output Voltage [V]																																																					
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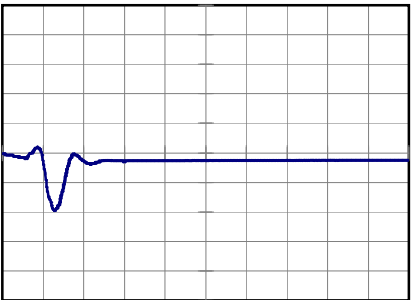
Model		TUHS3F24	
Item		Dynamic Load Response	Temperature 25°C Testing Circuitry Figure A
Object		+24V 0.13A	

Input Volt. 230V
Cycle 500ms

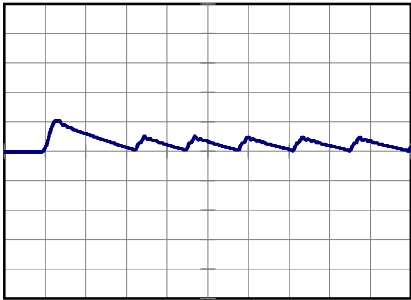
Load Current  0.13A / 100us

Min.Load (0A)←→
Load 100%(0.13A)

500 mV/div



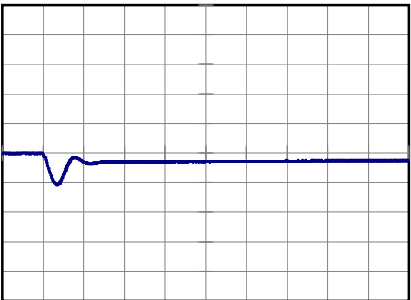
200 us/div



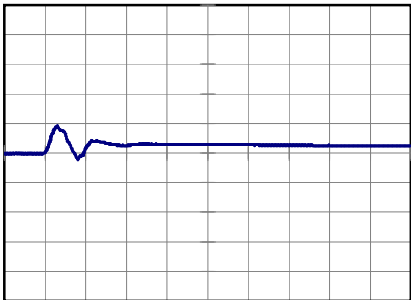
200 us/div

Load 20% (0.026A)←→
Load 100%(0.13A)

500 mV/div



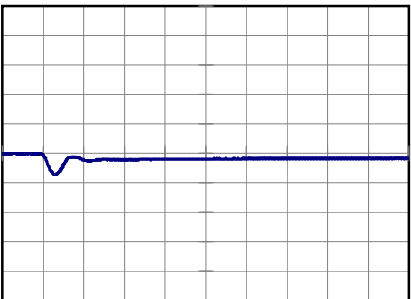
200 us/div



200 us/div

Load 50% (0.065A)←→
Load 100% (0.13A)

500 mV/div



200 us/div



200 us/div

Model	TUHS3F24																																								
Item	Ripple Voltage (by Load Current)	Temperature	25°C																																						
		Testing Circuitry	Figure C																																						
Object	+24V0.13A																																								
1.Graph		2.Values																																							
<div><div><div><div></div><div>—△—</div><div>Input Volt. 100V</div></div><div><div></div><div>-.-○-.-</div><div>Input Volt. 230V</div></div></div><div><p>Ripple Voltage [mV]</p><p>Load Current [A]</p></div></div>		<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>5</td><td>200</td></tr><tr><td>0.02</td><td>5</td><td>5</td></tr><tr><td>0.04</td><td>10</td><td>5</td></tr><tr><td>0.06</td><td>15</td><td>10</td></tr><tr><td>0.08</td><td>20</td><td>10</td></tr><tr><td>0.10</td><td>20</td><td>10</td></tr><tr><td>0.12</td><td>25</td><td>10</td></tr><tr><td>0.13</td><td>30</td><td>10</td></tr><tr><td>0.14</td><td>40</td><td>10</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	5	200	0.02	5	5	0.04	10	5	0.06	15	10	0.08	20	10	0.10	20	10	0.12	25	10	0.13	30	10	0.14	40	10	--	-	-	--	-	-
Load Current [A]	Ripple Voltage [mV]																																								
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<p>Measured by 100 MHz Oscilloscope.</p> <p>Ripple Voltage is shown as p-p in the figure below.</p> <p>Note: Slanted line shows the range of the rated load current.</p>																																									
<div><div><div></div><div>T1: Due to AC Input Line</div><div>T2: Due to Switching</div></div><div><p>Ripple [mVp-p]</p><p>T1</p><p>T2</p></div></div>																																									
Fig. Complex Ripple Wave Form																																									

Model	TUHS3F24		
Item	Ripple-Noise	Temperature	25°C
Object	+24V0.13A	Testing Circuitry	Figure C
1.Graph		2.Values	
<div><div><div><div><div></div><div></div></div><div><div></div><div></div></div></div><div><div></div><div></div></div></div><div><div></div><div></div></div><div><div></div><div></div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> 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		Testing Circuitry Figure C																																				
Model	TUHS3F24																																					
Item	Ripple Voltage (by Ambient Temp.)																																					
Object	+24V0.13A																																					
1.Graph		2.Values																																				
<div><div><div>---□---</div><div>Input Volt. 100V</div></div><div><div>—△—</div><div>Input Volt. 200V</div></div></div> <table><thead><tr><th>Ambient Temperature [°C]</th><th>Input Volt. 100V [mV]</th><th>Input Volt. 230V [mV]</th></tr></thead><tbody><tr><td>-45</td><td>25</td><td>10</td></tr><tr><td>-40</td><td>20</td><td>10</td></tr><tr><td>-20</td><td>25</td><td>10</td></tr><tr><td>0</td><td>25</td><td>10</td></tr><tr><td>25</td><td>30</td><td>10</td></tr><tr><td>50</td><td>35</td><td>10</td></tr><tr><td>70</td><td>40</td><td>10</td></tr><tr><td>85</td><td>45</td><td>10</td></tr><tr><td>90</td><td>45</td><td>15</td></tr><tr><td>--</td><td>-</td><td>-</td></tr><tr><td>--</td><td>-</td><td>-</td></tr></tbody></table> <p>Measured by 100 MHz Oscilloscope. Note: Slanted line shows the range of the rated ambient temperature.</p>		Ambient Temperature [°C]	Input Volt. 100V [mV]	Input Volt. 230V [mV]	-45	25	10	-40	20	10	-20	25	10	0	25	10	25	30	10	50	35	10	70	40	10	85	45	10	90	45	15	--	-	-	--	-	-	
Ambient Temperature [°C]	Input Volt. 100V [mV]	Input Volt. 230V [mV]																																				
-45	25	10																																				
-40	20	10																																				
-20	25	10																																				
0	25	10																																				
25	30	10																																				
50	35	10																																				
70	40	10																																				
85	45	10																																				
90	45	15																																				
--	-	-																																				
--	-	-																																				

Ambient Temperature [°C]	Ripple Voltage [mV]	
	Input Volt. 100V	Input Volt. 230V
-45	25	10
-40	20	10
-20	25	10
0	25	10
25	30	10
50	35	10
70	40	10
85	45	10
90	45	15
--	-	-
--	-	-

Model	TUHS3F24																																																						
Item	Ambient Temperature Drift	Testing Circuitry Figure A																																																					
Object	+24V0.13A																																																						
1.Graph		2.Values																																																					
<div><div>—△— Input Volt. 100V</div><div>---□--- Input Volt. 200V</div><div>-·-○-·- Input Volt. 230V</div></div> <p>Output Voltage [V]</p> <p>Ambient Temperature [°C]</p> <p>Load 100%</p>		<table><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><tr><td>-45</td><td>24.186</td><td>24.189</td><td>24.189</td></tr><tr><td>-40</td><td>24.187</td><td>24.189</td><td>24.190</td></tr><tr><td>-20</td><td>24.177</td><td>24.180</td><td>24.181</td></tr><tr><td>0</td><td>24.151</td><td>24.155</td><td>24.155</td></tr><tr><td>25</td><td>24.095</td><td>24.100</td><td>24.099</td></tr><tr><td>50</td><td>24.027</td><td>24.034</td><td>24.034</td></tr><tr><td>70</td><td>23.951</td><td>23.959</td><td>23.959</td></tr><tr><td>85</td><td>23.899</td><td>23.909</td><td>23.910</td></tr><tr><td>90</td><td>23.848</td><td>23.859</td><td>23.861</td></tr><tr><td>--</td><td>-</td><td>-</td><td>-</td></tr><tr><td>--</td><td>-</td><td>-</td><td>-</td></tr></table>			Ambient Temperature [°C]	Output Voltage [V]			Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]	-45	24.186	24.189	24.189	-40	24.187	24.189	24.190	-20	24.177	24.180	24.181	0	24.151	24.155	24.155	25	24.095	24.100	24.099	50	24.027	24.034	24.034	70	23.951	23.959	23.959	85	23.899	23.909	23.910	90	23.848	23.859	23.861	--	-	-	-	--	-	-	-
Ambient Temperature [°C]	Output Voltage [V]																																																						
	Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]																																																				
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Note: Slanted line shows the range of the rated ambient temperature.																																																							



Model		TUHS3F24	Testing Circuitry Figure A
Item		Output Voltage Accuracy	
Object		+24V0.13A	

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 - 85°C

Input Voltage : 85 - 264V

Load Current : 0 - 0.13A

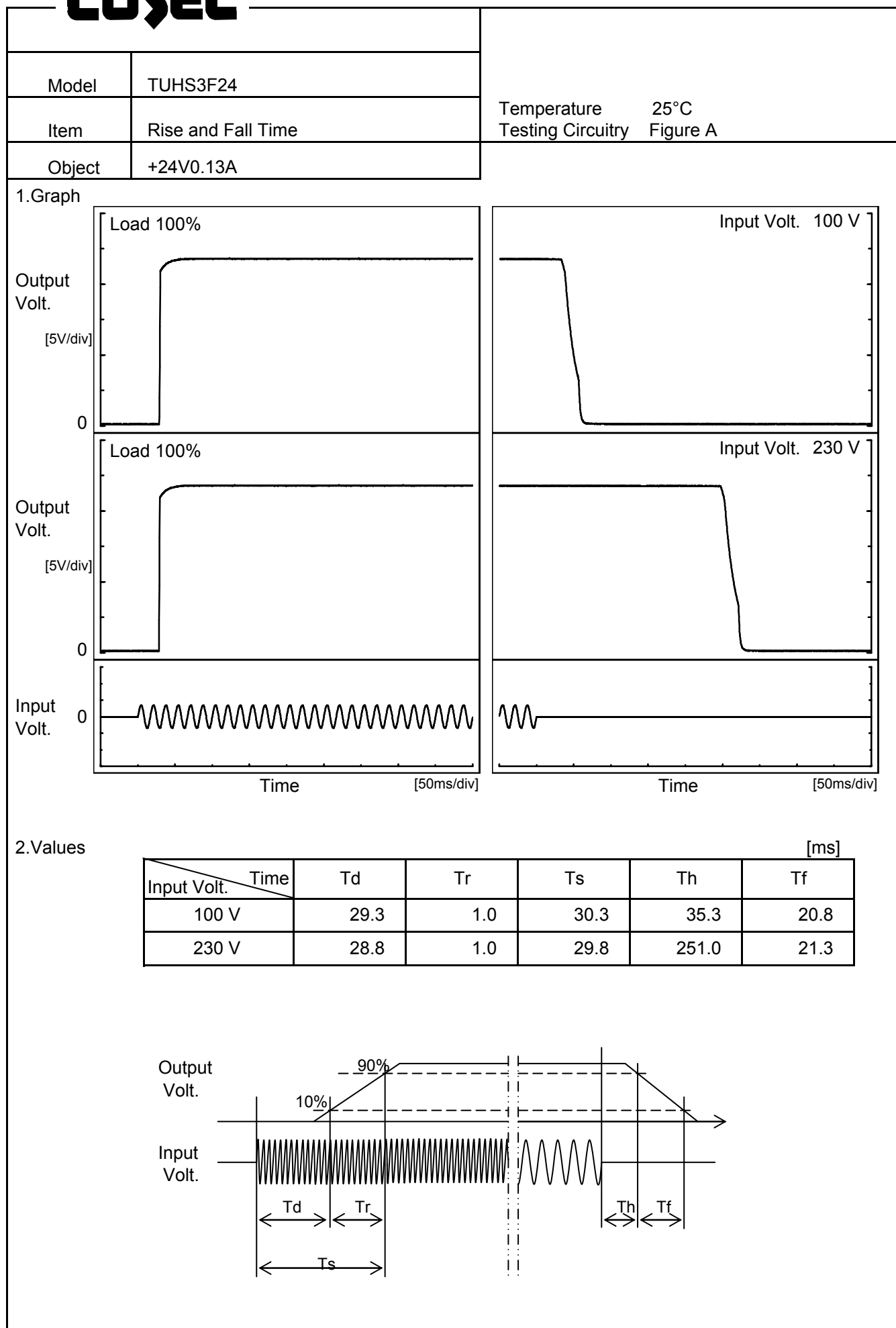
* Output Voltage Accuracy = $\pm(\text{Maximum of Output Voltage} - \text{Minimum of Output Voltage}) / 2$

* 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	85	0	24.195	±148	±0.6
Minimum Voltage	85	85	0.13	23.899		

Model	TUHS3F24		
Item	Time Lapse Drift	Temperature	25°C
		Testing Circuitry	Figure A
Object	+24V0.13A		
1.Graph		2.Values	
<div><div><div>Output Voltage [V]</div><div><div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></di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Model	TUHS3F24																																		
Item	Hold-Up Time	Temperature	25°C																																
		Testing Circuitry	Figure A																																
Object	+24V0.13A																																		
1.Graph		2.Values																																	
<div><div>---□--- Load 50%</div><div>—△— Load 100%</div></div> <p>Hold-Up Time [ms]</p> <p>Input Voltage [V]</p> <p>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.</p>		<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>39</td><td>14</td></tr><tr><td>85</td><td>54</td><td>22</td></tr><tr><td>100</td><td>79</td><td>35</td></tr><tr><td>120</td><td>120</td><td>56</td></tr><tr><td>200</td><td>360</td><td>185</td></tr><tr><td>230</td><td>482</td><td>251</td></tr><tr><td>264</td><td>642</td><td>337</td></tr><tr><td>280</td><td>724</td><td>383</td></tr><tr><td>--</td><td>-</td><td>-</td></tr></table>		Input Voltage [V]	Hold-Up Time [ms]		Load 50%	Load 100%	75	39	14	85	54	22	100	79	35	120	120	56	200	360	185	230	482	251	264	642	337	280	724	383	--	-	-
Input Voltage [V]	Hold-Up Time [ms]																																		
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75	39	14																																	
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Model	TUHS3F24																																																					
Item	Instantaneous Interruption Compensation	Temperature	25°C																																																			
Object	+24V0.13A	Testing Circuitry	Figure A																																																			
1.Graph		2.Values																																																				
<div><div>—△— Input Volt. 100V ---□--- Input Volt. 200V ---○--- Input Volt. 230V</div><p>Instantaneous Compensation Time [ms]</p><p>Load Current [A]</p></div>		<table><tr><th rowspan="2">Load Current [A]</th><th colspan="3">Time [ms]</th></tr><tr><th>Input Volt. 100[V]</th><th>Input Volt. 200[V]</th><th>Input Volt. 230[V]</th></tr><tr><td>0.00</td><td>-</td><td>-</td><td>-</td></tr><tr><td>0.02</td><td>105</td><td>460</td><td>614</td></tr><tr><td>0.04</td><td>92</td><td>410</td><td>548</td></tr><tr><td>0.06</td><td>79</td><td>360</td><td>482</td></tr><tr><td>0.08</td><td>67</td><td>310</td><td>416</td></tr><tr><td>0.10</td><td>54</td><td>260</td><td>350</td></tr><tr><td>0.12</td><td>41</td><td>210</td><td>284</td></tr><tr><td>0.13</td><td>35</td><td>185</td><td>251</td></tr><tr><td>0.14</td><td>27</td><td>152</td><td>208</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]	Time [ms]			Input Volt. 100[V]	Input Volt. 200[V]	Input Volt. 230[V]	0.00	-	-	-	0.02	105	460	614	0.04	92	410	548	0.06	79	360	482	0.08	67	310	416	0.10	54	260	350	0.12	41	210	284	0.13	35	185	251	0.14	27	152	208	--	-	-	-	--	-	-	-
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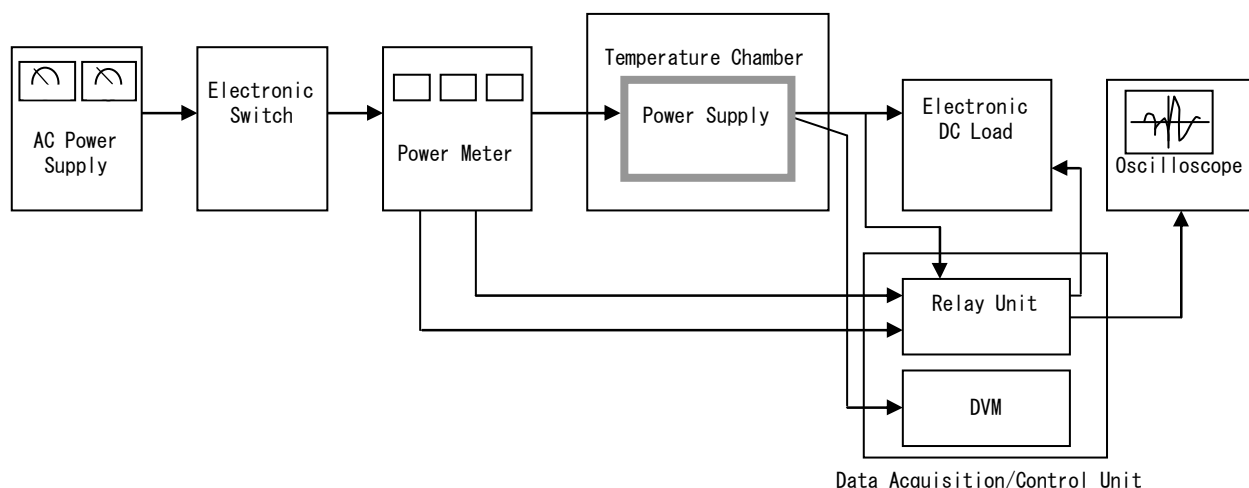


Figure A

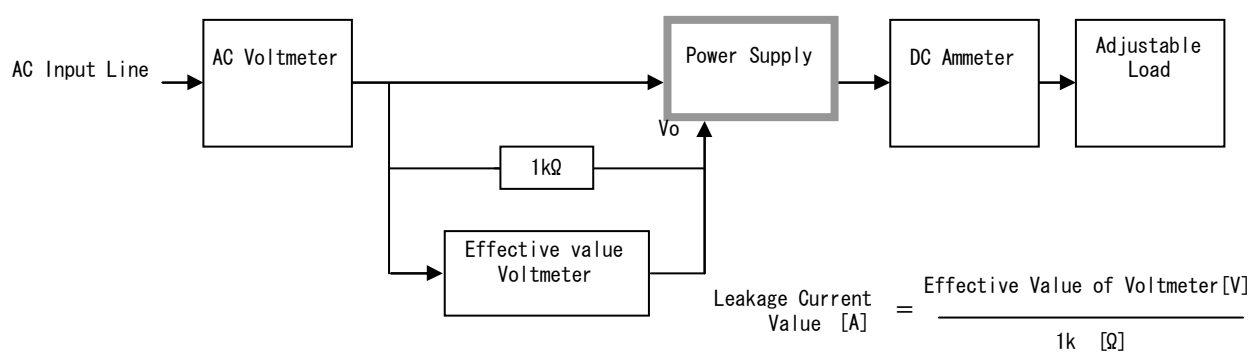


Figure B (DEN-AN)

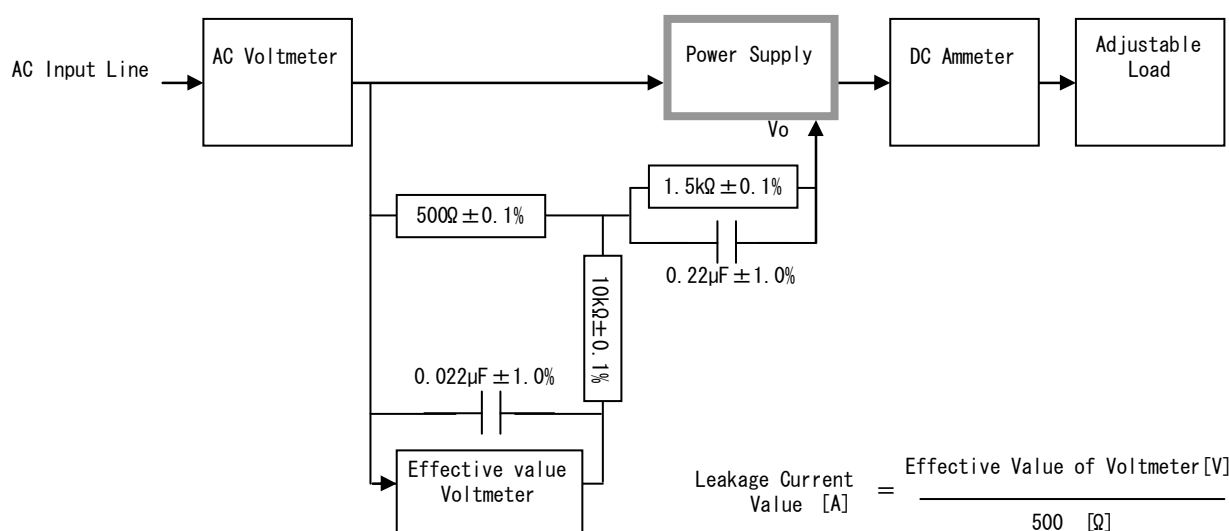


Figure B (IEC60950-1)

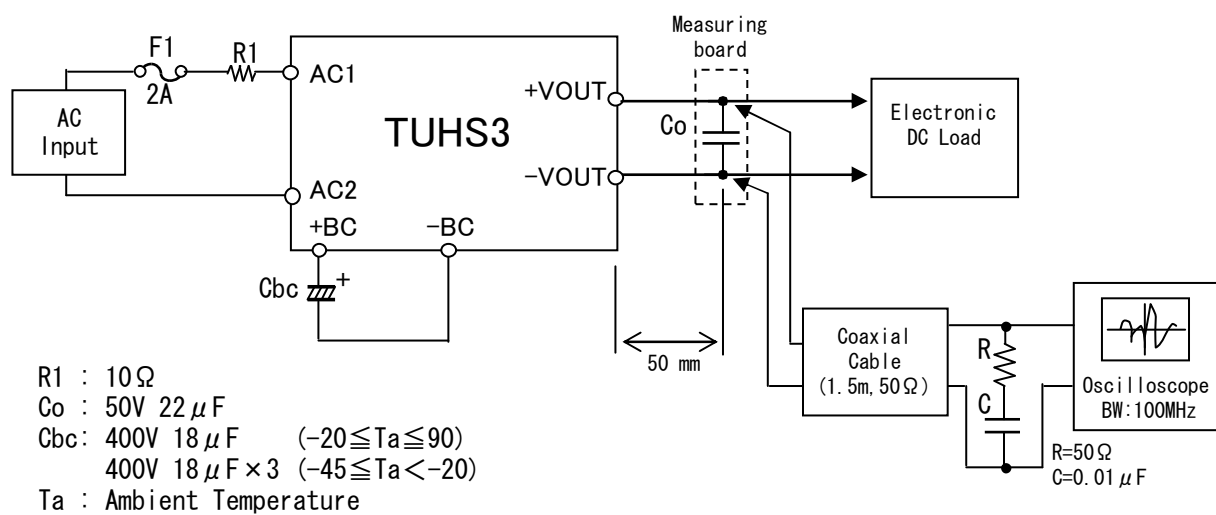


Figure C