



## **FEB 400-001**

### **FAN6921 BCM PFC+ QR PWM Combo Controller 19V/90W Evaluation Board**

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## 1. General Specification

| Specification             | Min | Max  | Units |
|---------------------------|-----|------|-------|
| <b>Input</b>              |     |      |       |
| Voltage                   | 90  | 264  | Vac   |
| Frequency                 | 60  | 50   | Hz    |
| <b>Output</b>             |     |      |       |
| Output Voltage 1          |     | 19   | V     |
| Output Current 1          | 0   | 4.74 | A     |
| <b>Total Output Power</b> |     |      |       |
| Full-load Output Power    |     | 90   | W     |

## Electrical Specifications

| Specification                      |             |
|------------------------------------|-------------|
| Input wattage at no load condition | < 0.3W      |
| Turn on time                       | < 2s        |
| DC output rising time              | < 30ms      |
| Line & load regulation             | 1%          |
| Efficiency                         | > 87%       |
| Output ripple & noise              | < 200mV     |
| Over power protection              | 120% ~ 150% |
| Hold up time                       | > 20ms      |
| Surge test                         | 4.4KV       |



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|                         |   |
|-------------------------|---|
| <b>Test Model</b>       | FEB400-001  |
| <b>Test Date</b>        | 2010-07-21  |
| <b>Test Temperature</b> | Ambient   |
| <b>Test Equipment</b>   | AC source: Chroma 61603 AC POWER SOURCE<br>Electronic load: Chroma 63030<br>Power meter: WT210<br>Oscilloscope: Tektronix TDS3054B  |
| <b>Test Items</b>       | <ol style="list-style-type: none"> <li>1. Input current</li> <li>2. Input wattage at no load condition</li> <li>3. Turn on time</li> <li>4. DC output rising time</li> <li>5. Line &amp; load regulation</li> <li>6. Efficiency</li> <li>7. Light load spec</li> <li>8. Light load efficiency</li> <li>9. Output ripple &amp; noise</li> <li>10. Step response</li> <li>11. Over voltage protection</li> <li>12. Over power protection</li> <li>13. Hold up time</li> <li>14. Short circuit protection</li> <li>15. Brownout test</li> <li>16. Vdd voltage level</li> <li>17. Voltage stress on MOSFET &amp; rectifiers</li> <li>18. Current harmonic test</li> <li>19. EMI test</li> <li>20. Surge test</li> <li>21. ESD test</li> </ol> |



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## 1. Input current

### 1.1 Test condition

Measure the AC input current at maximum loading

### 1.2 Test result

| Input Voltage | Input current (A) | Spec. |
|---------------|-------------------|-------|
| 90V/60Hz      | 1.1161            | -     |
| 264V/50Hz     | 0.3858            |       |

## 2 Input wattage at no-load condition

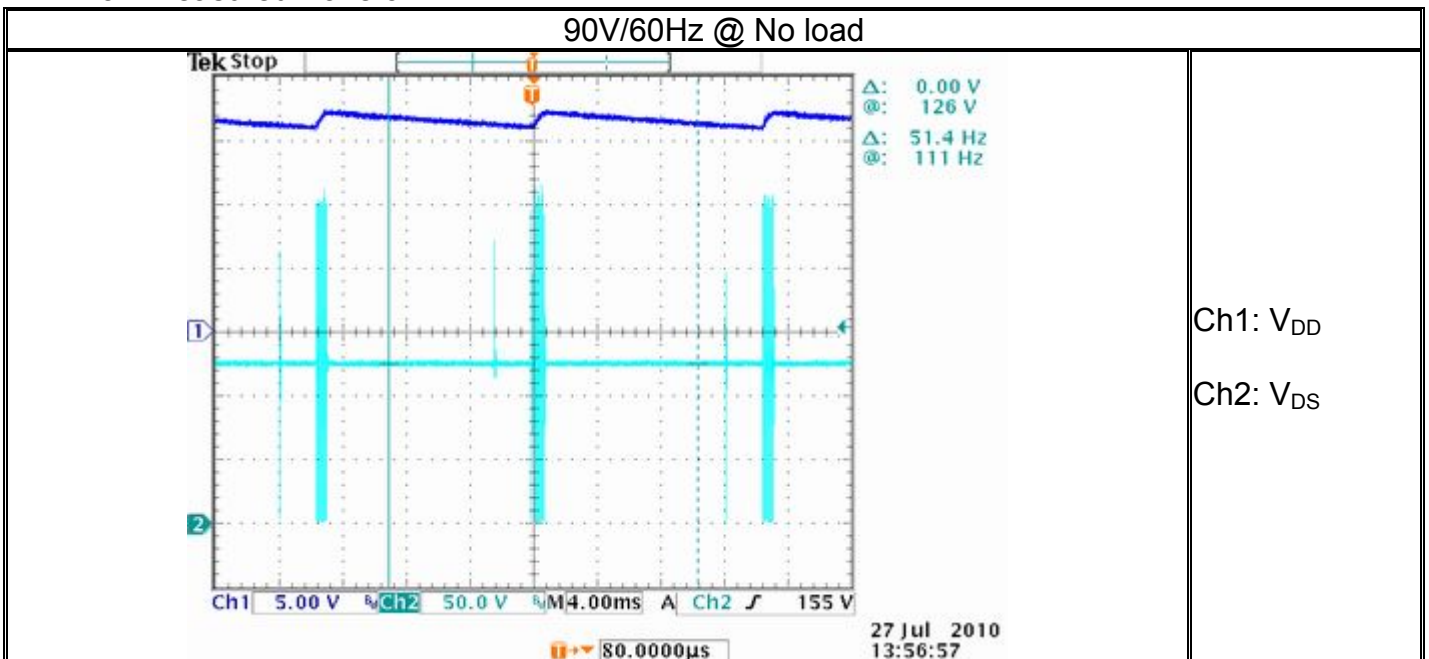
### 2.1 Test condition

Measure the input wattage and output voltage at no load

### 2.2 Test result

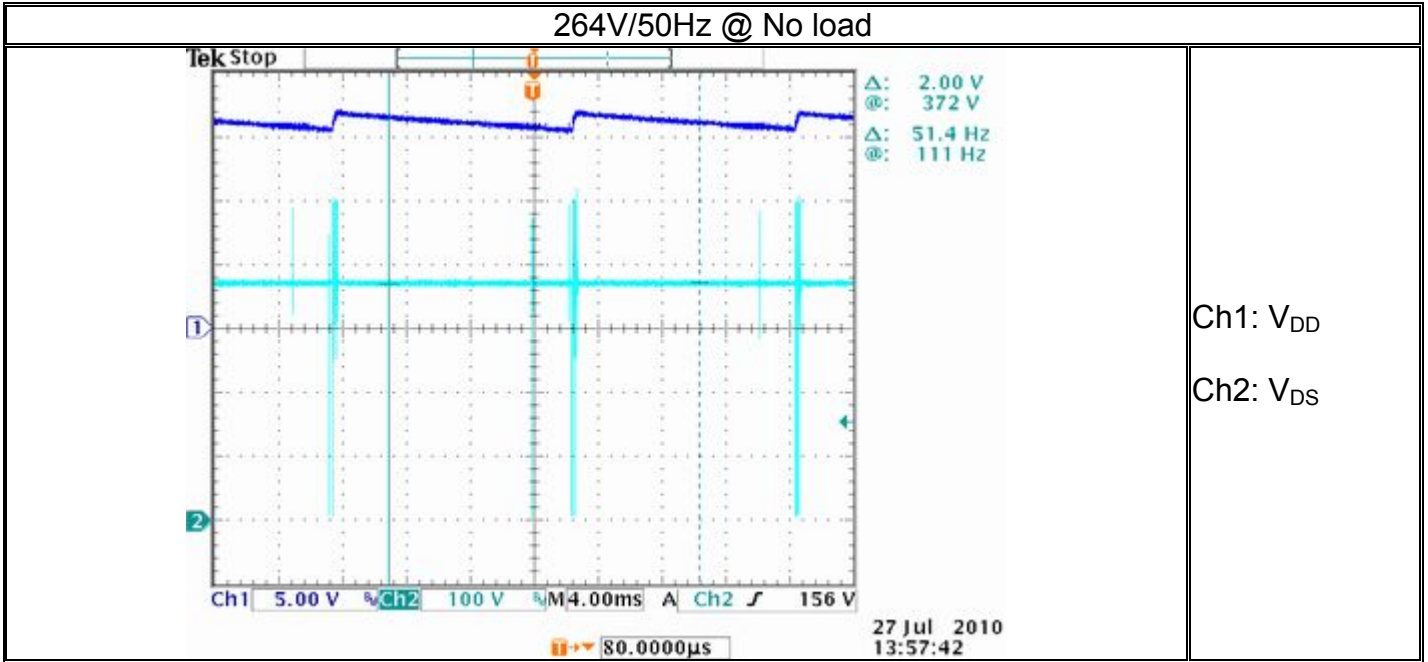
| Input Voltage | Input wattage(W) | Output voltage(V) | Spec.            |
|---------------|------------------|-------------------|------------------|
| 90V/60Hz      | 0.167            | 19.426            | 240Vac<br>< 0.3W |
| 115V/60Hz     | 0.169            | 19.426            |                  |
| 230V/50Hz     | 0.213            | 19.426            |                  |
| 240V/50Hz     | 0.219            | 19.426            |                  |
| 264V/50Hz     | 0.236            | 19.426            |                  |

### 2.3 Measured waveform





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### 3 Turn on time

#### 3.1 Test condition

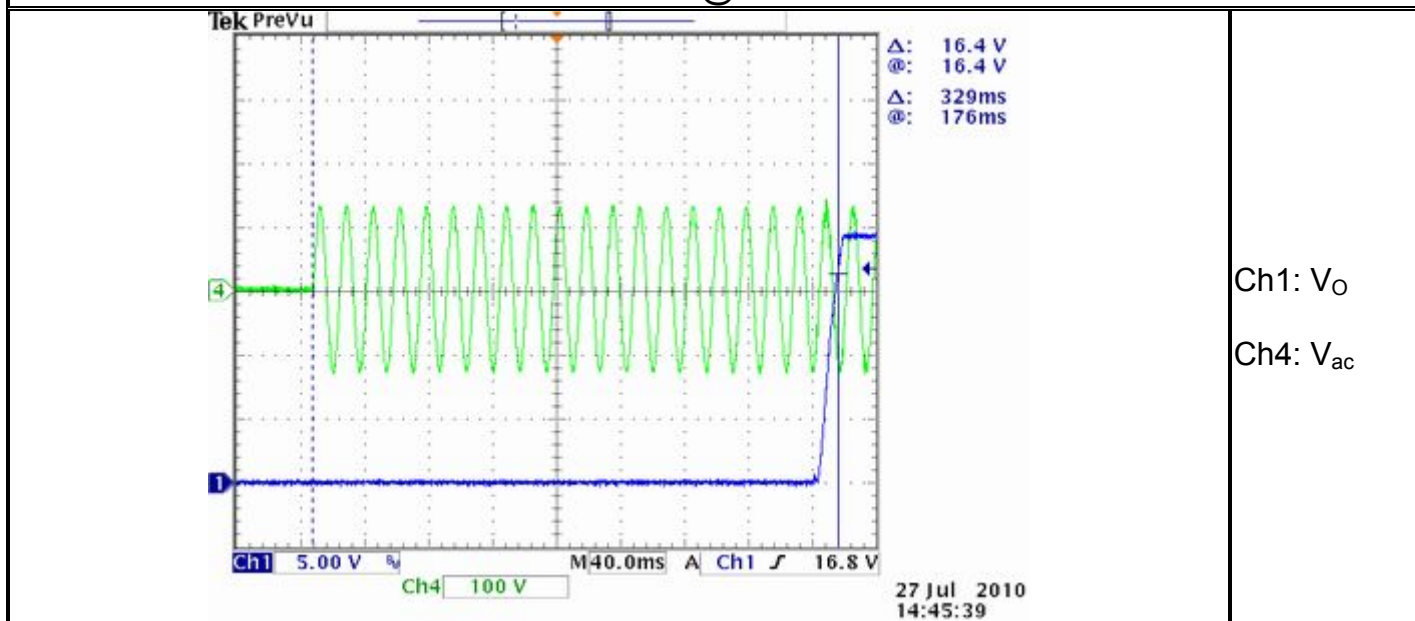
Set output at maximum loading. Measure the interval between AC plug-in and stable output.

#### 3.2 Test result

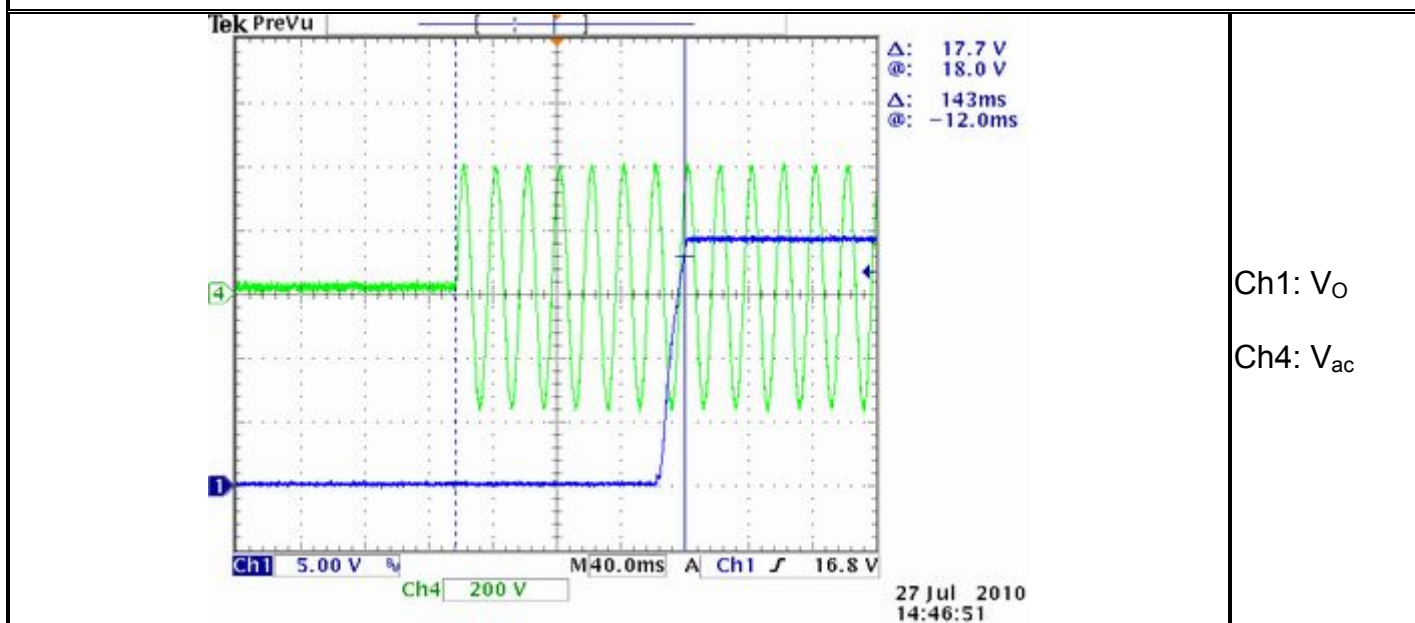
| Input Voltage | Turn on time (sec.) | Spec. |
|---------------|---------------------|-------|
| 90V/60Hz      | 0.329               | < 2S  |
| 264V/50Hz     | 0.143               |       |

#### 3.3 Measured waveform

90V/60Hz @ Max. load



264V/50Hz @ Max. load







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#### 4 DC output rising time

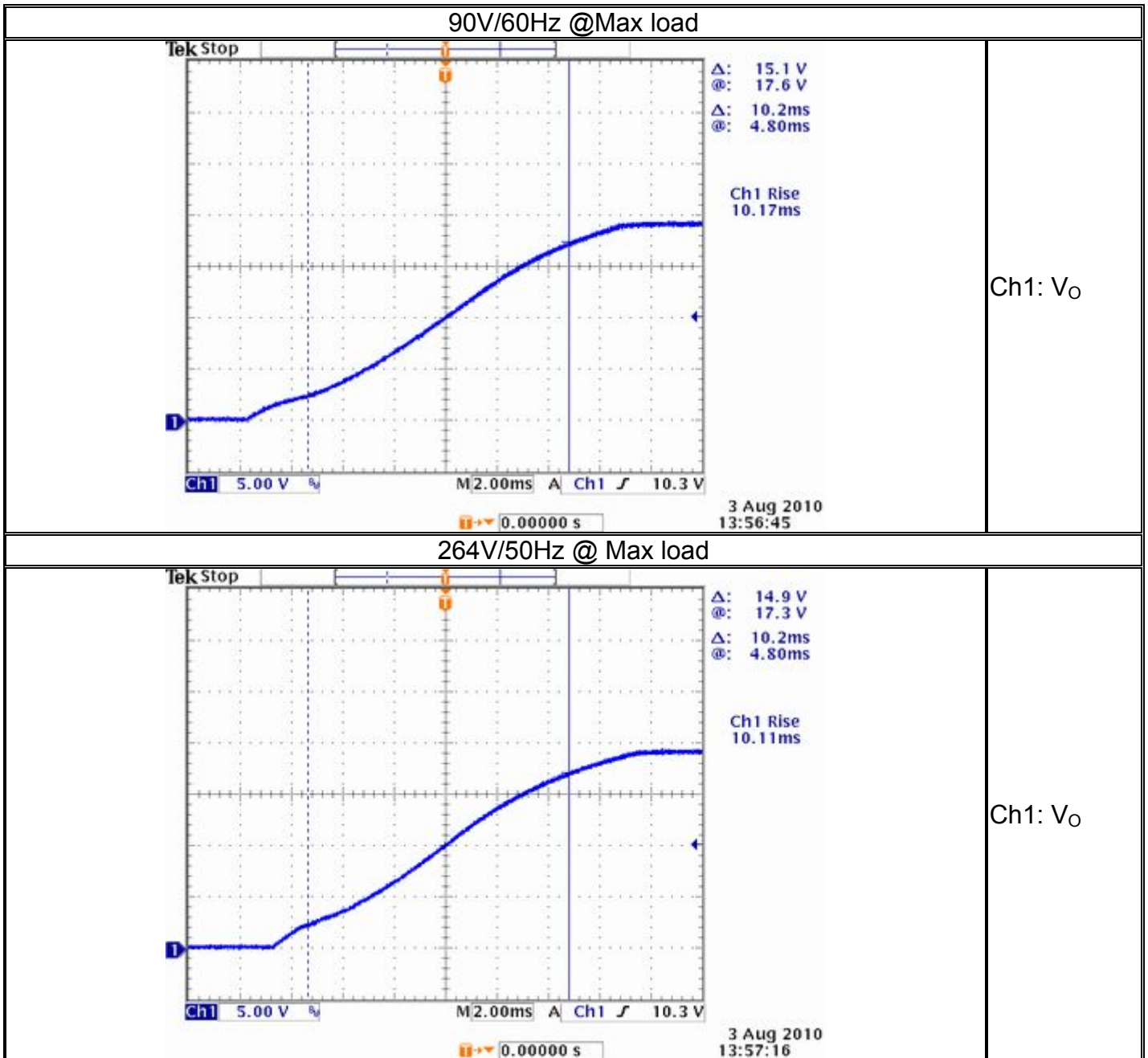
##### 4.1 Test condition

Set output at maximum loading. Measure the time interval between 10% to 90% output during startup.

##### 4.2 Test result

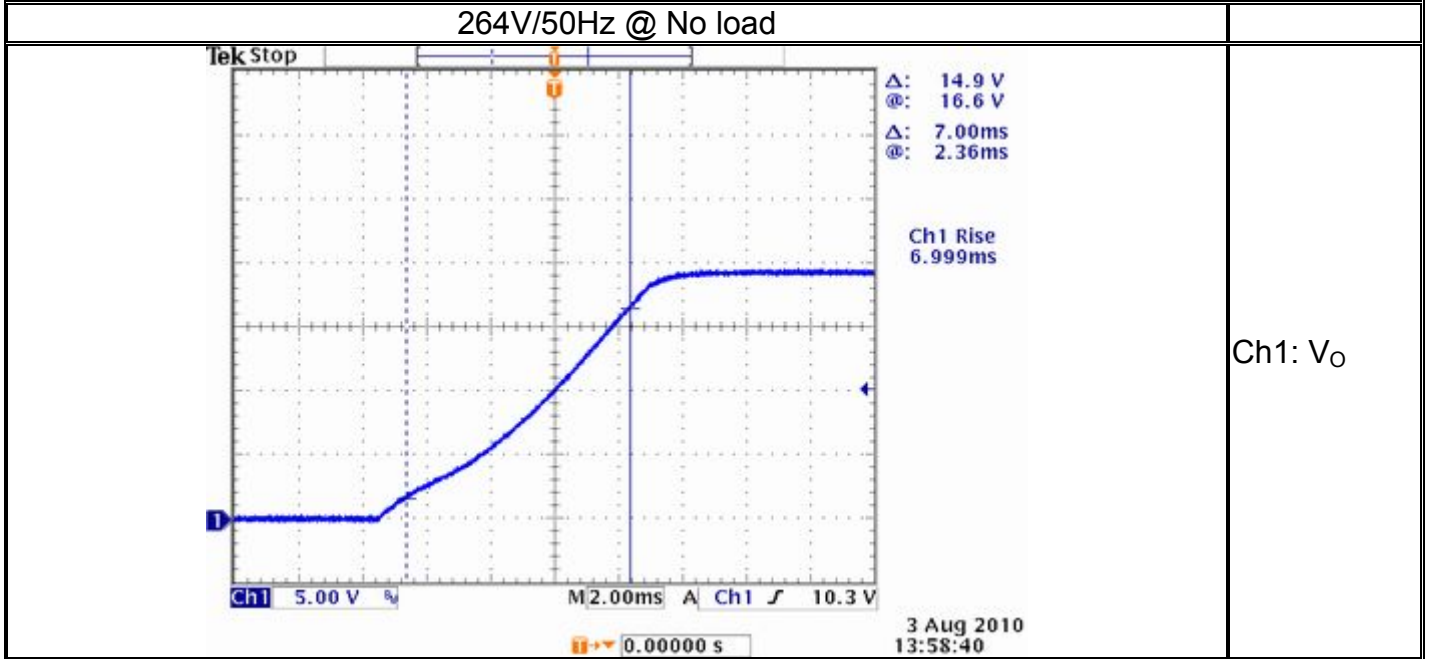
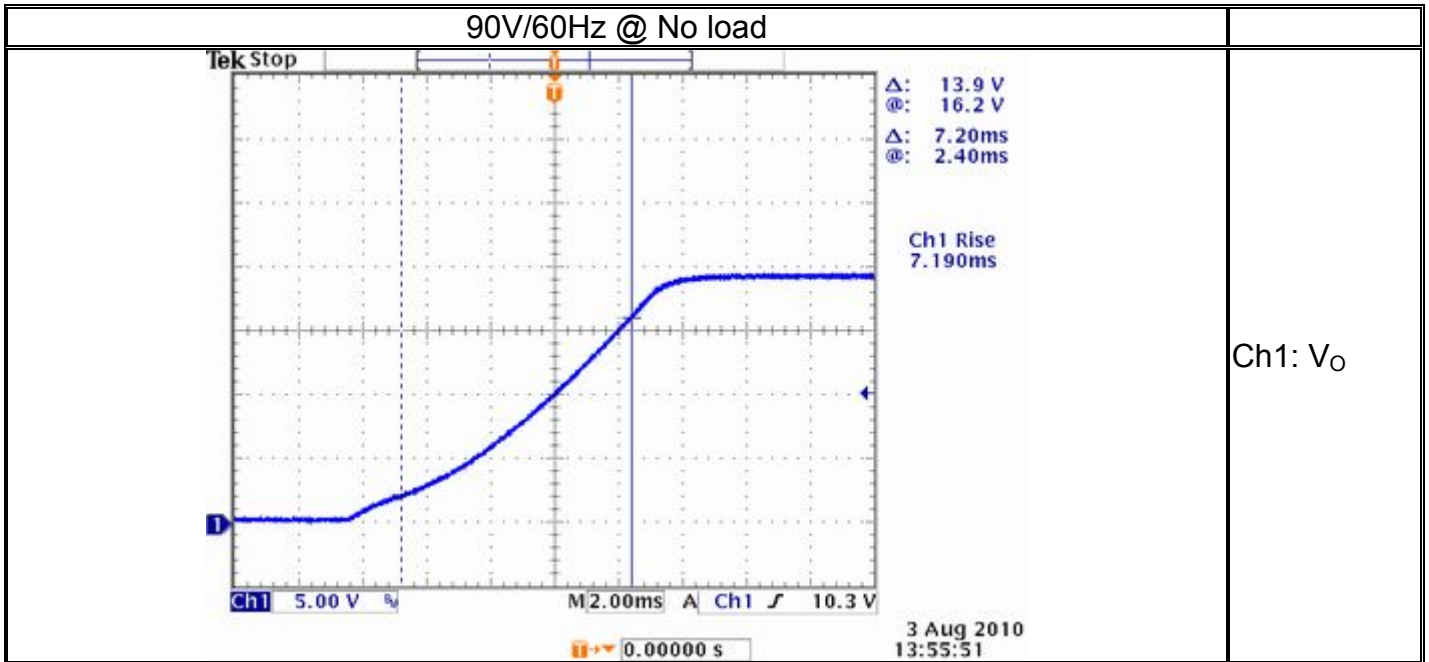
| Input Voltage | Max load(ms) | No load(ms) | Spec. |
|---------------|--------------|-------------|-------|
| 90V/60Hz      | 10.17        | 7.19        | <30ms |
| 264V/50Hz     | 10.11        | 6.09        |       |

##### 4.3 Measured waveform





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## 5 Line & load regulation

### 5.1 Test condition

Measure line & load regulation according to below table.(Without cable)

### 5.2 Test result

| Input Voltage       | Output V at Max. load (V) | Output V at Min. load (V) | Load regulation (%) | Spec. |
|---------------------|---------------------------|---------------------------|---------------------|-------|
| 90V/60Hz            | 19.394                    | 19.426                    | 0.17                | < 1%  |
| 115V/60Hz           | 19.394                    | 19.426                    | 0.17                |       |
| 132V/60Hz           | 19.394                    | 19.426                    | 0.17                |       |
| 180V/50Hz           | 19.392                    | 19.426                    | 0.18                |       |
| 230V/50Hz           | 19.392                    | 19.426                    | 0.18                |       |
| 264V/50Hz           | 19.392                    | 19.426                    | 0.18                |       |
| Line regulation (%) | 0.01                      | 0                         |                     |       |

## 6 Efficiency

### 6.1 Test condition

Output at 25% 50% 75% 100% load(Without cable)

### 6.2 Test result

| Output Watt | 22.5W  | 45W    | 67.5W  | 90W    | Avg.   | Spec. |
|-------------|--------|--------|--------|--------|--------|-------|
| 115V/60Hz   | 90.52% | 90.41% | 90.87% | 90.62% | 90.60% | > 87% |
| 230V/50Hz   | 90.06% | 89.15% | 90.32% | 91.13% | 90.17% |       |

## 7 Light load spec

### 7.1 Test condition

Output Wattage at light load(Without cable)

### 7.2 Test result

| Output Watt. | Actual Output Watt. | Input Watt. | Spec.             |
|--------------|---------------------|-------------|-------------------|
| 0W           | 115Vac              | 0           | Input Watt <0.3W  |
|              | 230Vac              | 0           |                   |
| 0.5W         | 115Vac              | 0.51        | Input Watt <1W    |
|              | 230Vac              | 0.51        |                   |
| 1W           | 115Vac              | 1.01        | Input Watt <1.7W  |
|              | 230Vac              | 1.01        |                   |
| 1.15W        | 115Vac              | 1.20        | Input Watt <2.16W |
|              | 230Vac              | 1.20        |                   |
| 1.5W         | 115Vac              | 1.52        | Input Watt <2.4W  |
|              | 230Vac              | 1.52        |                   |
| 1.7W         | 115Vac              | 1.70        | Input Watt <2.4W  |
|              | 230Vac              | 1.70        |                   |



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## 8 Light load efficiency

### 8.1 Test condition

Output Efficiency at light load(Without cable)

### 8.2 Test result

| Output Watt. | Output Watt. | Input Watt. | Efficiency | Spec.  |       |
|--------------|--------------|-------------|------------|--------|-------|
| ≤1W          | 115Vac       | 0.997       | 1.411      | 70.66% | ≥ 58% |
|              | 230Vac       | 0.997       | 1.424      | 70.01% |       |
| ≤1.7W        | 115Vac       | 1.70        | 2.199      | 77.31% | ≥ 68% |
|              | 230Vac       | 1.70        | 2.184      | 77.84% |       |
| ≤2.4W        | 115Vac       | 2.396       | 3.195      | 75.00% | ≥ 73% |
|              | 230Vac       | 2.396       | 3.177      | 75.41% |       |
| ≤14W         | 115Vac       | 13.986      | 15.79      | 88.58% | ≥ 83% |
|              | 230Vac       | 13.986      | 16.00      | 87.41% |       |
| ≤22W         | 115Vac       | 21.994      | 24.56      | 89.55% | ≥ 85% |
|              | 230Vac       | 21.994      | 24.70      | 89.04% |       |

## 9 Output ripple & noise

### 9.1 Test condition

Ripple & noise are measured by using 20MHz bandwidth limited oscilloscope with a 10μF capacitor paralleled with a high-frequency 0.1μF capacitor across each output.

### 9.2 Test result

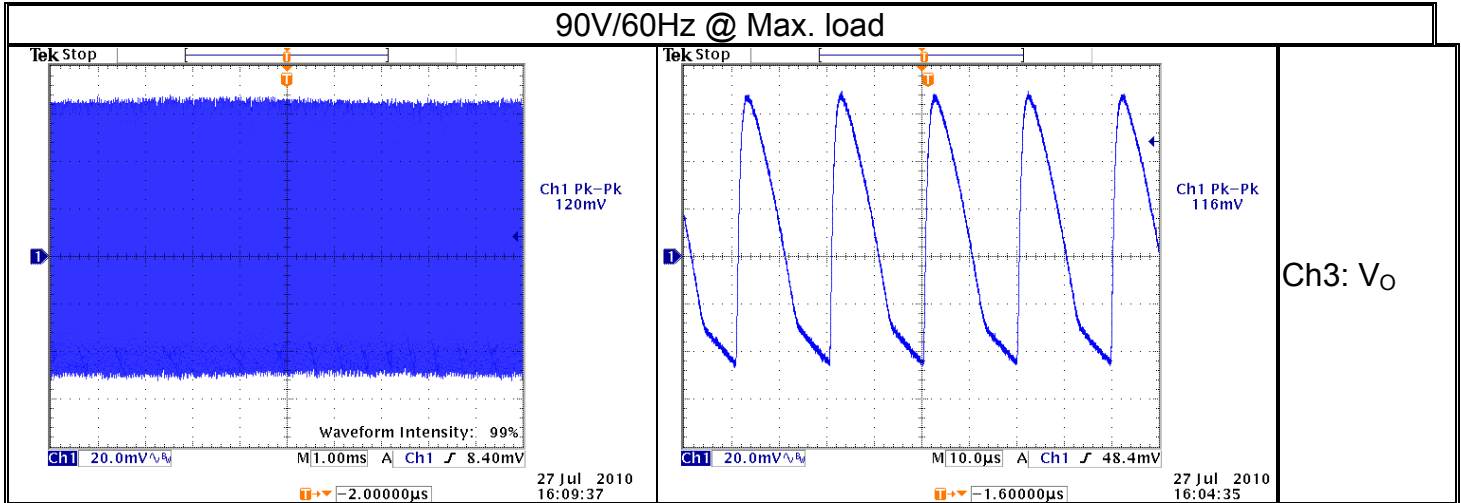
| Input Voltage | Max. load(mV) | Min. load(mV) | Spec.   |
|---------------|---------------|---------------|---------|
| 90V/60Hz      | 120           | 28            | < 190mV |
| 115V/60Hz     | 117           | 28            |         |
| 230V/50Hz     | 104           | 30            |         |
| 264V/50Hz     | 105           | 31            |         |



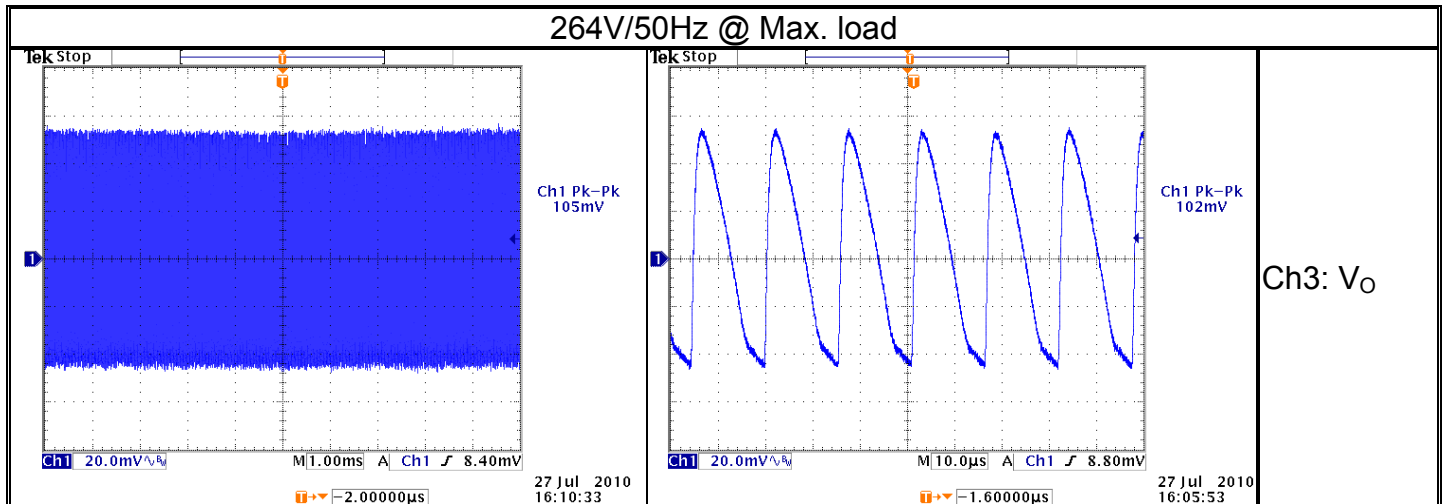
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9.3 Measured waveform

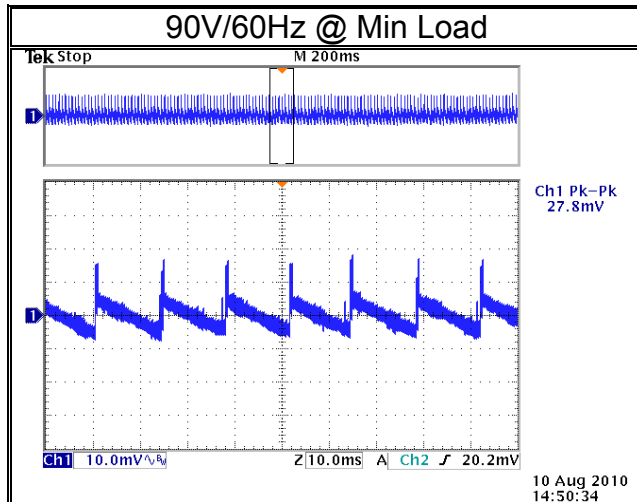
90V/60Hz @ Max. load



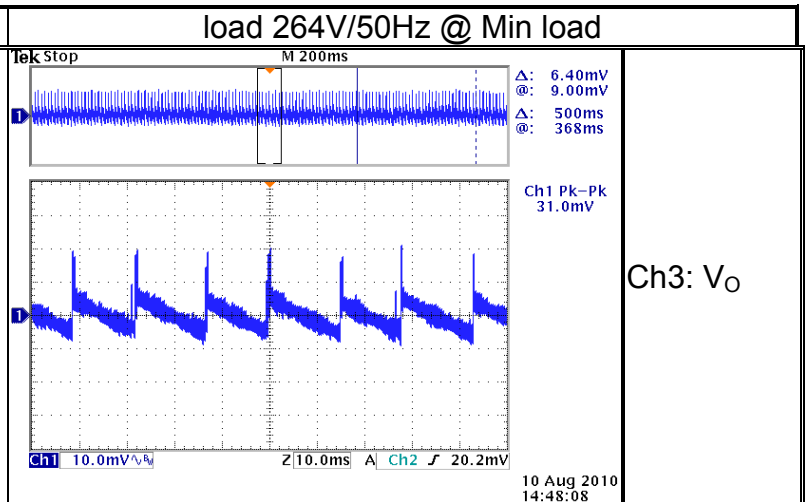
264V/50Hz @ Max. load



90V/60Hz @ Min Load



load 264V/50Hz @ Min load





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**10 Step response**

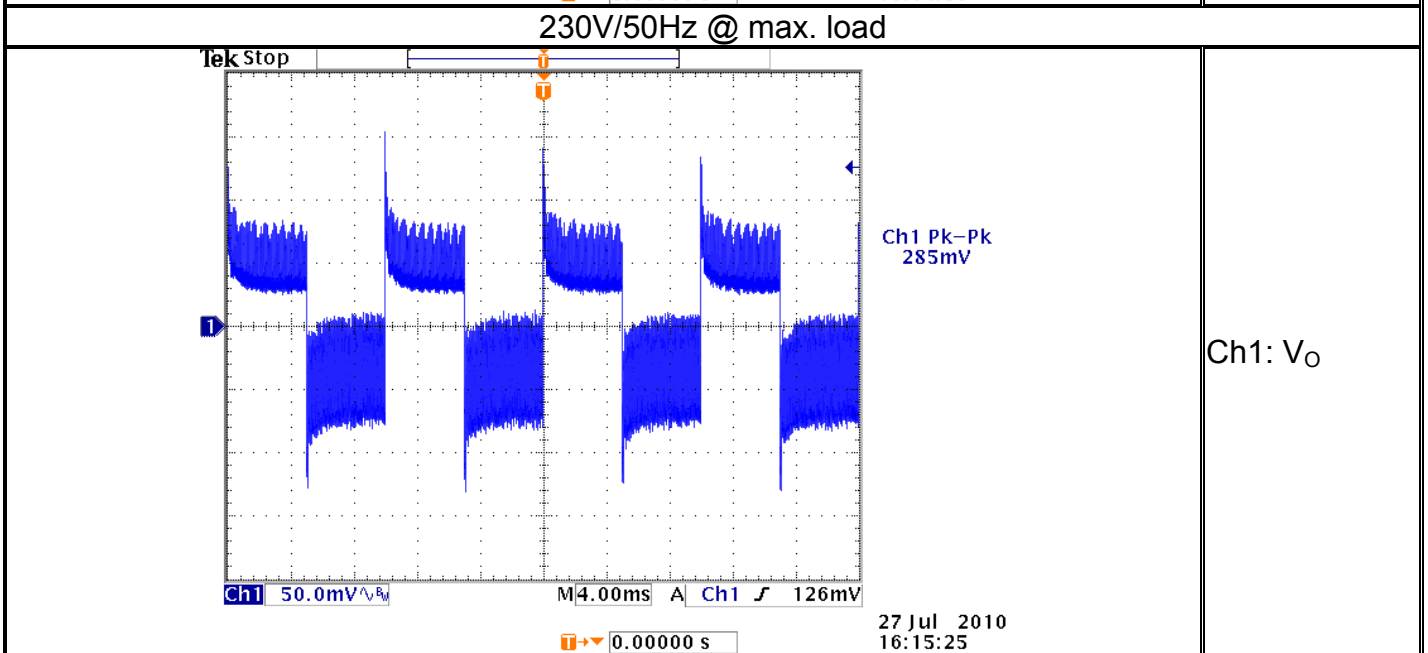
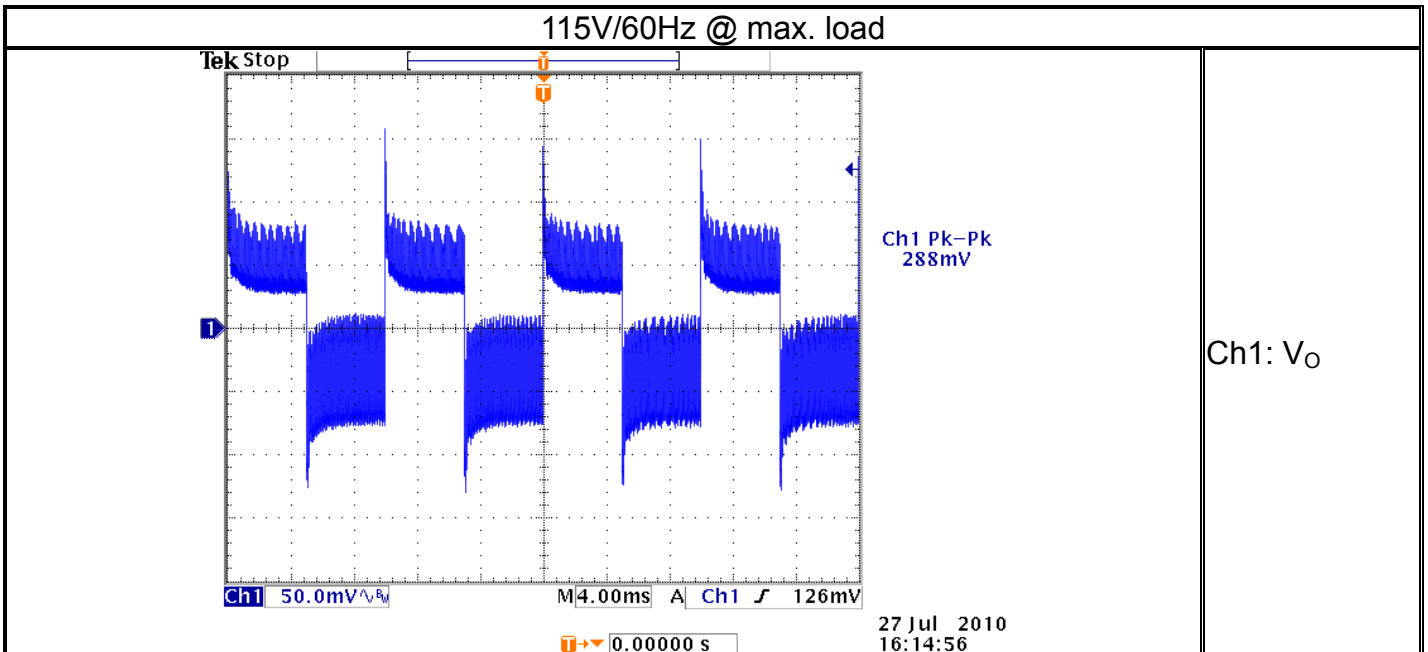
10.1 Test condition

Dynamic loading (20%~80% of the full load, 5msec duty cycle, 2.5A/usec rise/fall time)

10.2 Test result

| Input Voltage | Over shoot (mV) | Under shoot (mV) | Spec. |
|---------------|-----------------|------------------|-------|
| 115V/60Hz     | 162             | 126              | -     |
| 230V/50Hz     | 151             | 134              |       |

10.3 Measured waveform





|           |                                    |               |      |
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## 11 Over Voltage Protection

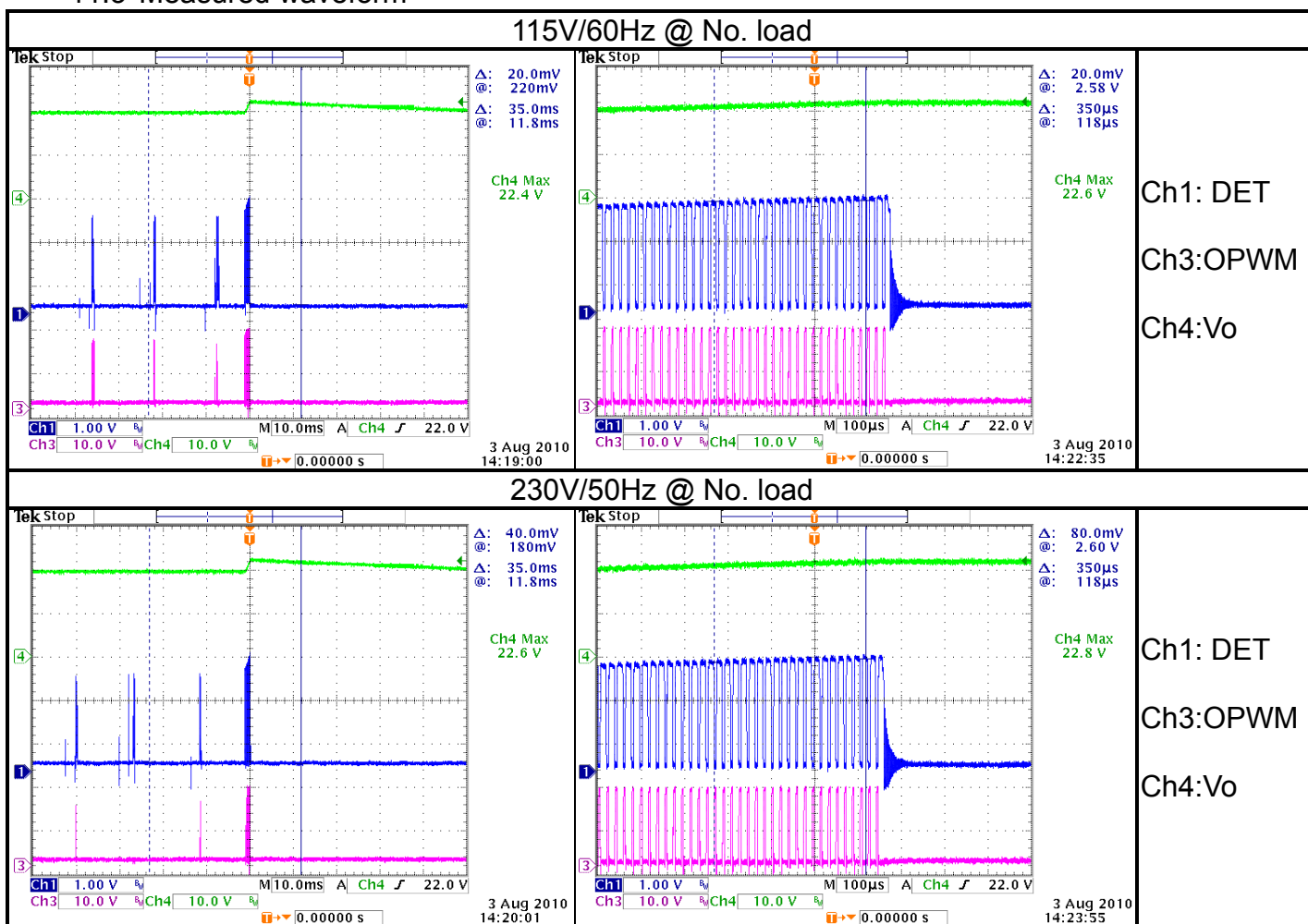
### 11.1 Test condition

Short the secondary side of optocoupler at no load.

### 11.2 Test result

| Input Voltage | Output voltage (max value)(V) | Spec. |
|---------------|-------------------------------|-------|
| 115V/60Hz     | 22.6                          |       |
| 230V/50Hz     | 22.8                          |       |

### 11.3 Measured waveform





|           |                                    |               |      |
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## 12 Over Power Protection

### 12.1 Test Condition

Increase output loading gradually.

### 12.2 Test Result

| Input Voltage | Output Power(W) | Output Current(A) | Spec                     |
|---------------|-----------------|-------------------|--------------------------|
| 90V/60Hz      | 126 (140%)      | 6.54              | >120%<br><150% Full Load |
| 115V/60Hz     | 126 (140%)      | 6.54              |                          |
| 230V/50Hz     | 118 (131%)      | 6.11              |                          |
| 264V/50Hz     | 118 (131%)      | 6.11              |                          |

## 13 Hold-up Time

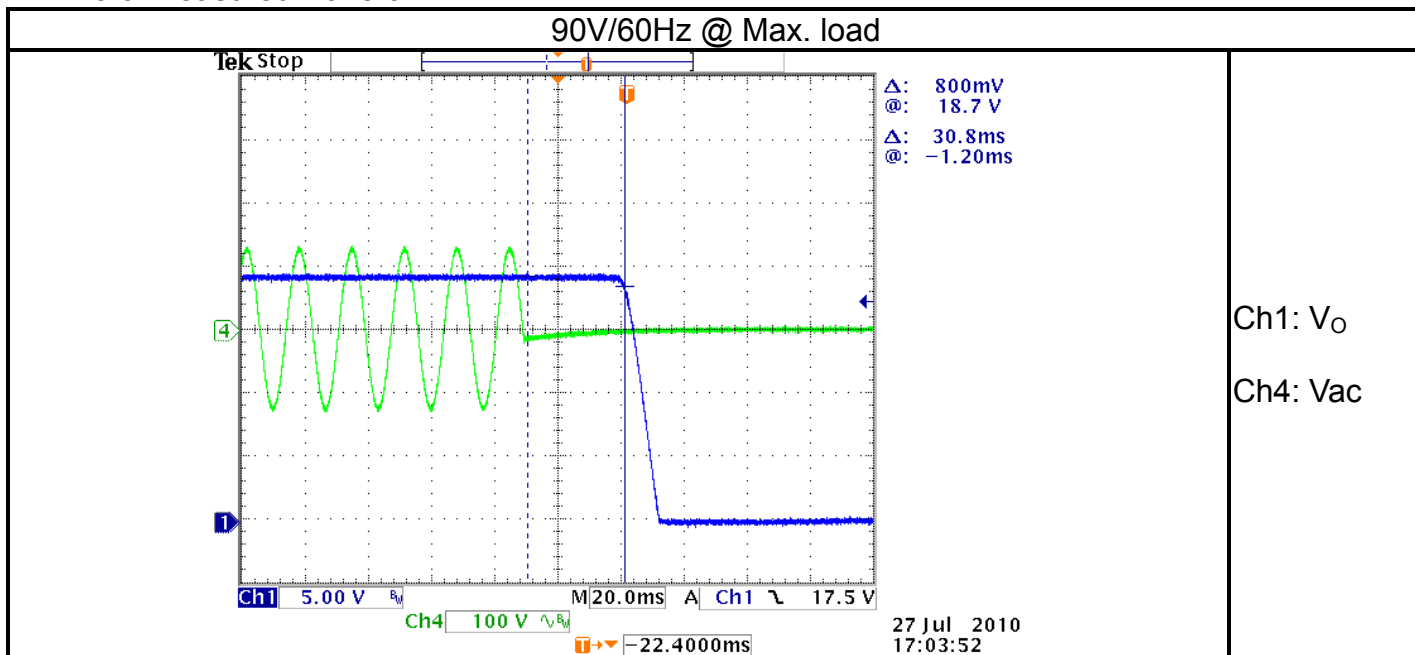
### 13.1 Test condition

Set output at maximum load. Measure the time interval between AC off and output voltage falling to lower limit of rated value. The AC waveform should be off at zero degree.

### 13.2 Test result

| Input Voltage | Hold-up time (mSec) | Spec. |
|---------------|---------------------|-------|
| 90V/60Hz      | 31                  | >20mS |
| 115V/60Hz     | 31                  |       |
| 230V/50Hz     | 80                  |       |
| 264V/50Hz     | 80                  |       |

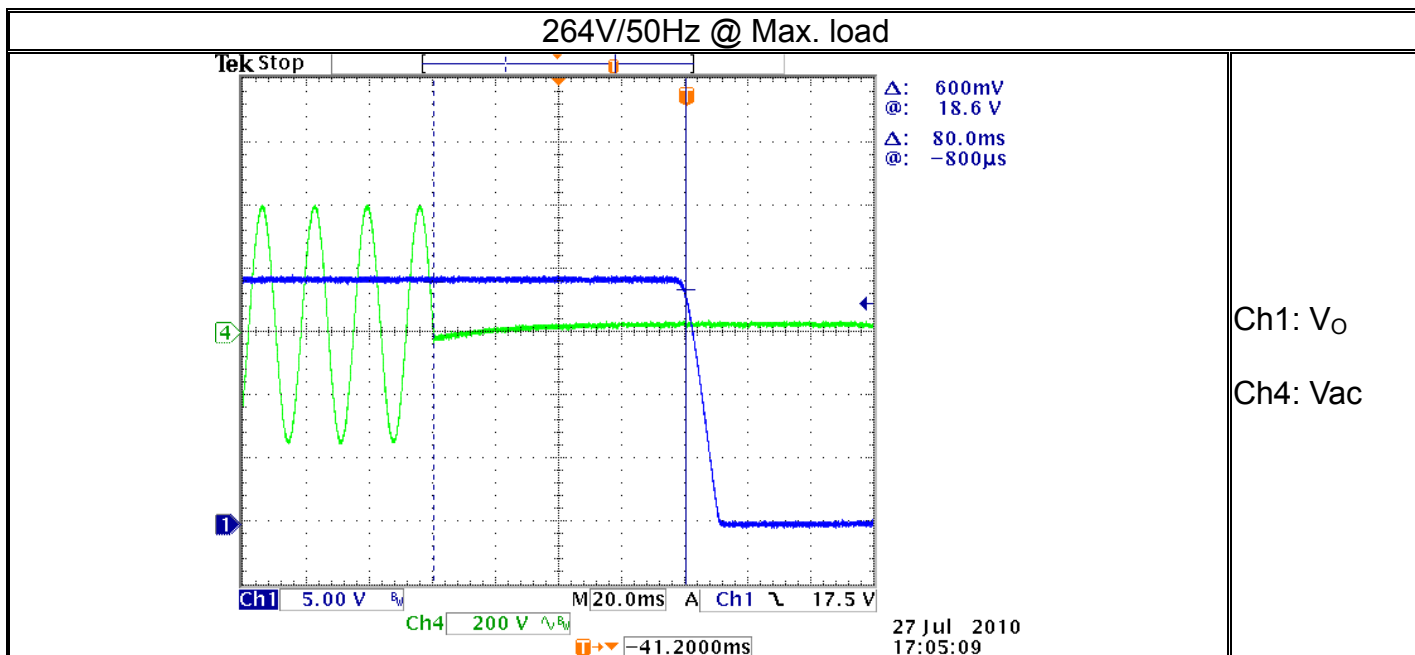
### 13.3 Measured waveform







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## 14 Short circuit protection

### 14.1 Test condition

Short the output of the power supply. The power supply should enter hiccup mode protection with less than 2W input voltage.

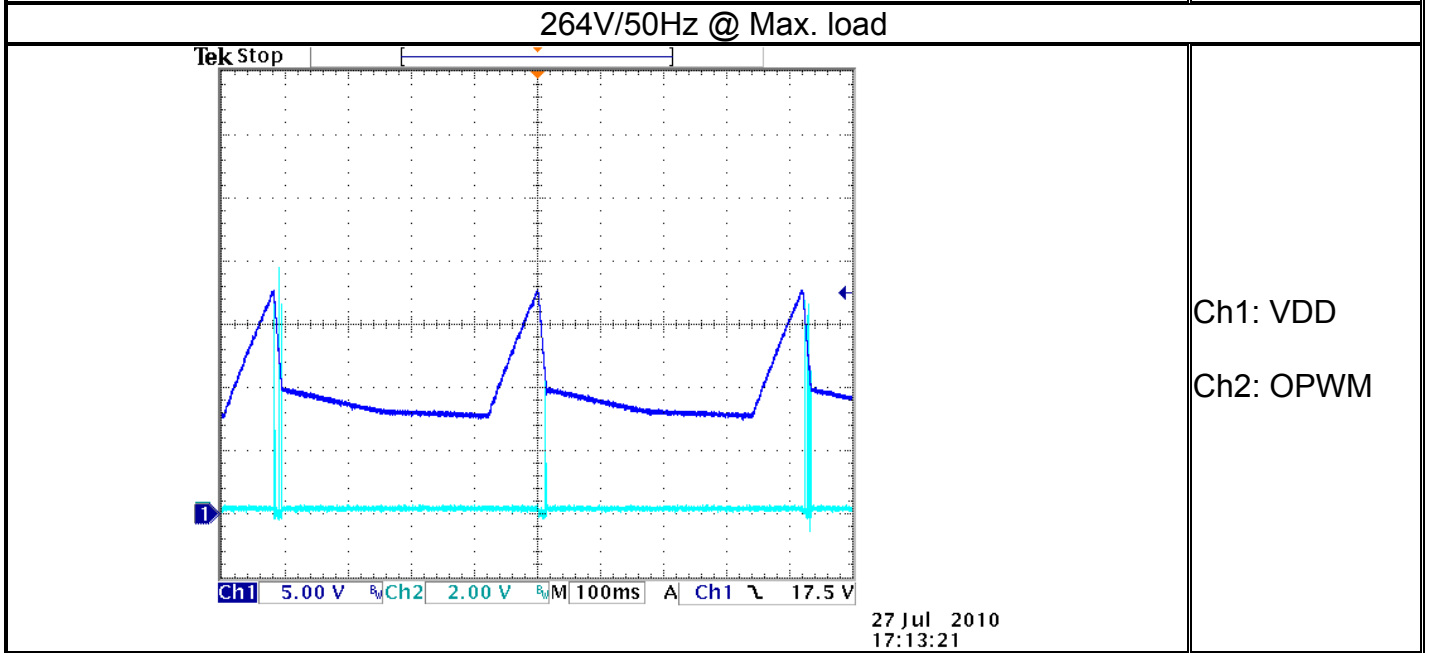
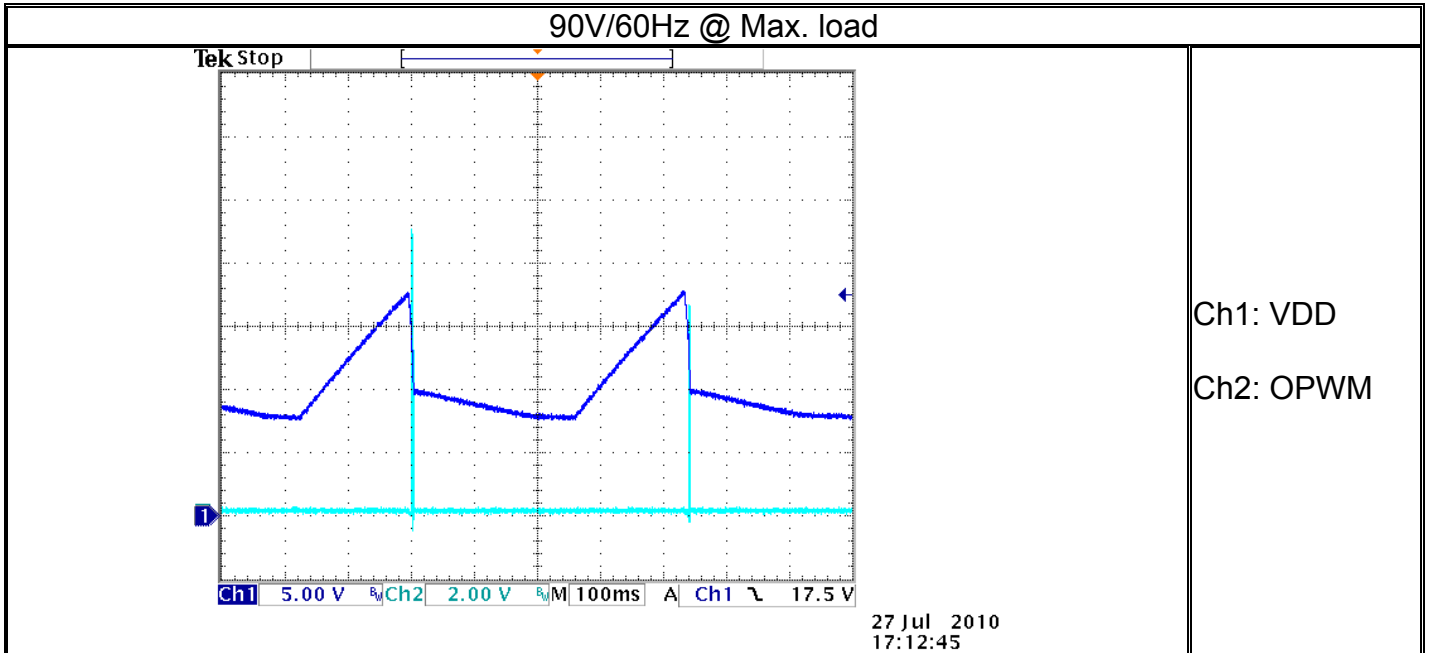
### 14.2 Test result

| Input Voltage | Input wattage at maximum loading(W) | Input wattage at minimum loading(W) | Spec. |
|---------------|-------------------------------------|-------------------------------------|-------|
| 90V/60Hz      | 0.276                               | 0.289                               | <2W   |
| 264V/50Hz     | 0.801                               | 0.763                               |       |



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14.3 Measured waveform





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## 15 Brown out test

### 15.1 Test condition

Set output at maximum loading. Decrease input voltage with 1VAC step. Record input wattage and output voltage. After the output is off, increase the AC voltage gradually and record the recovery voltage.

### 15.2 Test result

| Input voltage | Input Wattage | Output Voltage |
|---------------|---------------|----------------|
| 90V/60Hz      | 100.51        | 19.394         |
| 85V/60Hz      | 100.91        | 19.394         |
| 80V/60Hz      | 101.40        | 19.394         |
| 75V/60Hz      | 102.12        | 19.394         |
| 70V/60Hz      | 103.96        | 19.394         |
| 65V/60Hz      | 0             | 0              |

Recovery voltage: 81 Vac

## 16 VDD voltage level

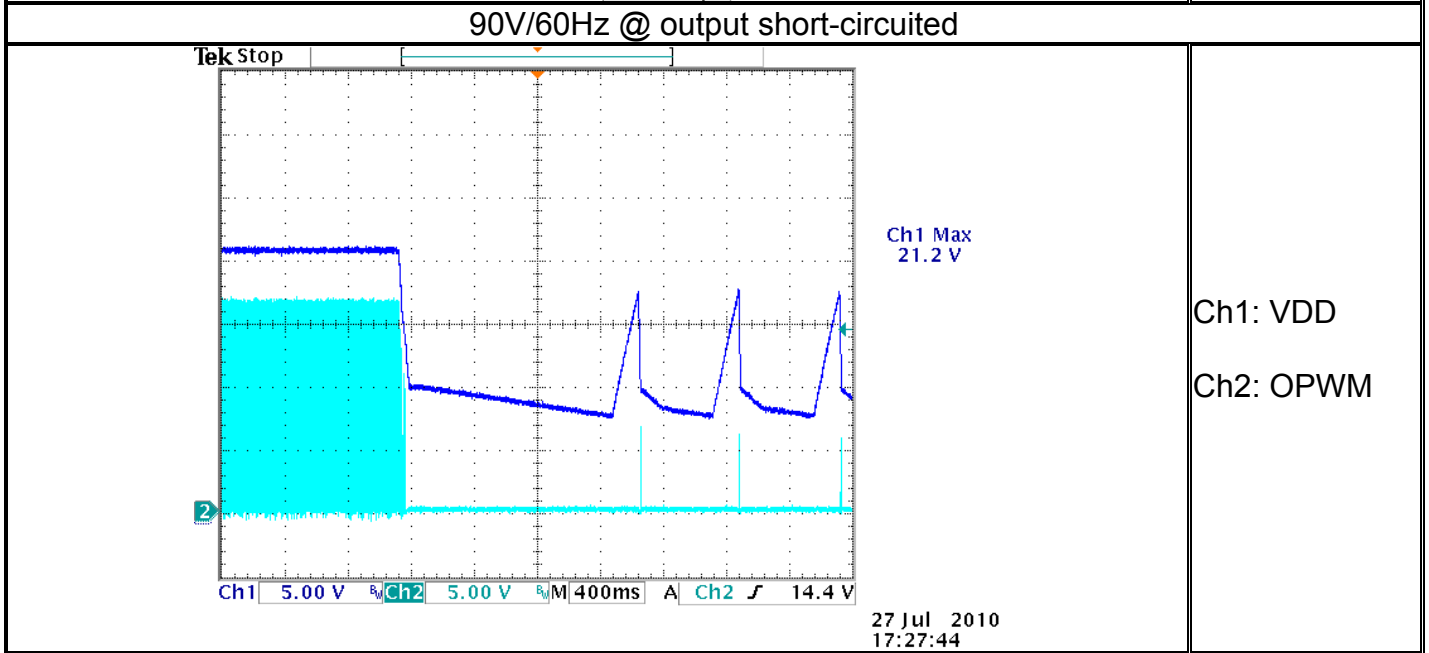
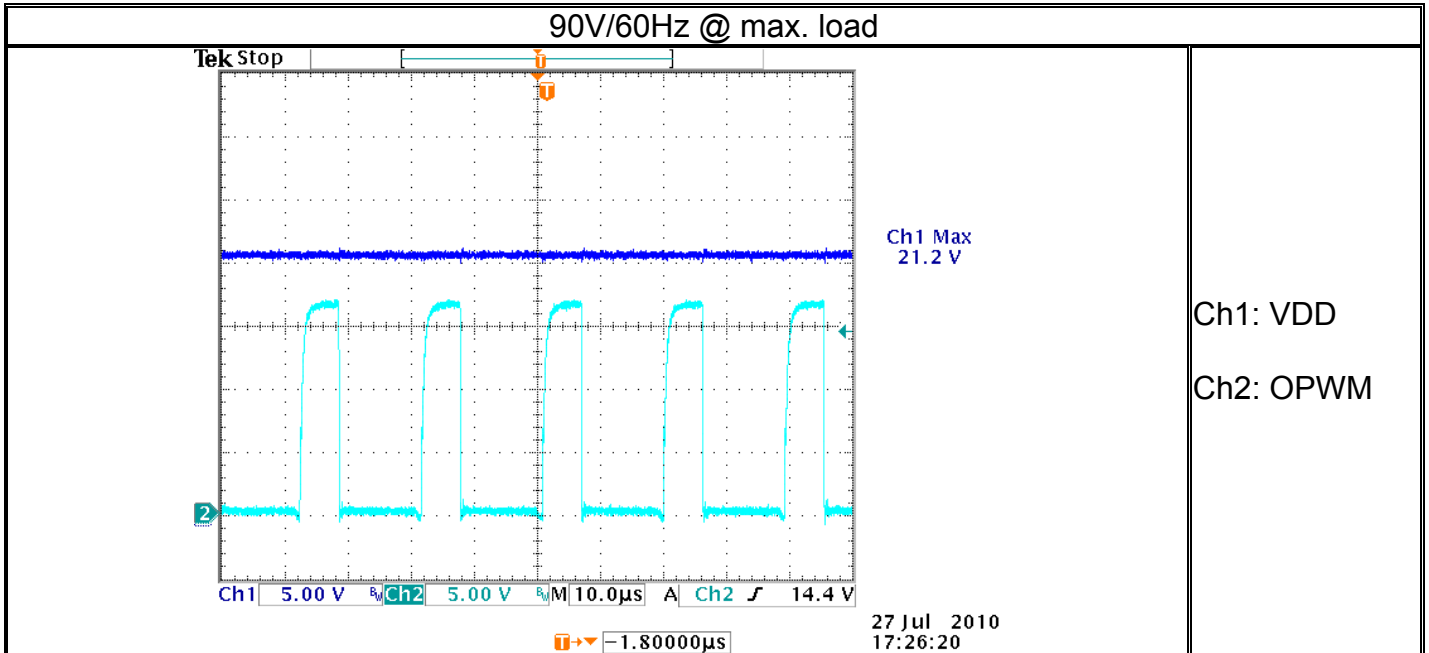
### 16.1 Test result

| Input voltage | Max. load(V) | Near OPP(V) | Output S.C. (V)<br>(max value) | Spec. |
|---------------|--------------|-------------|--------------------------------|-------|
| 90V/60Hz      | 20.8         | 23          | 21.2                           | -     |
| 264V/50Hz     | 20           | 21          | 20.2                           |       |



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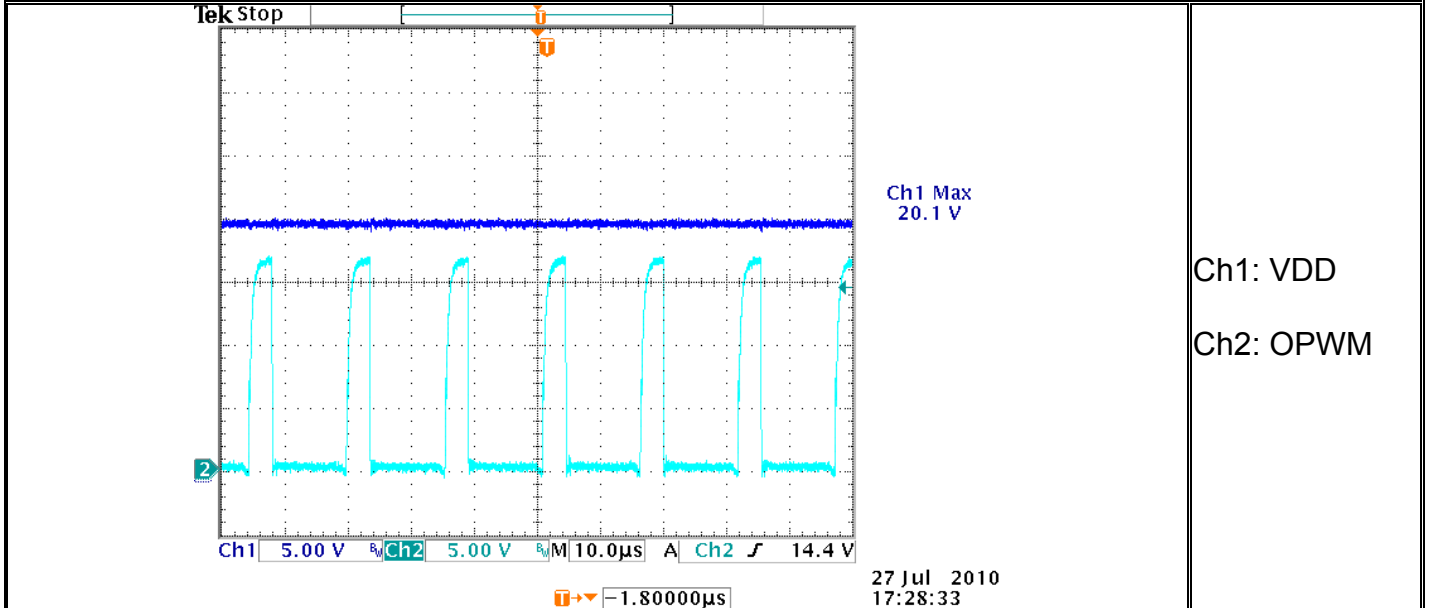
16.2 Measured waveform



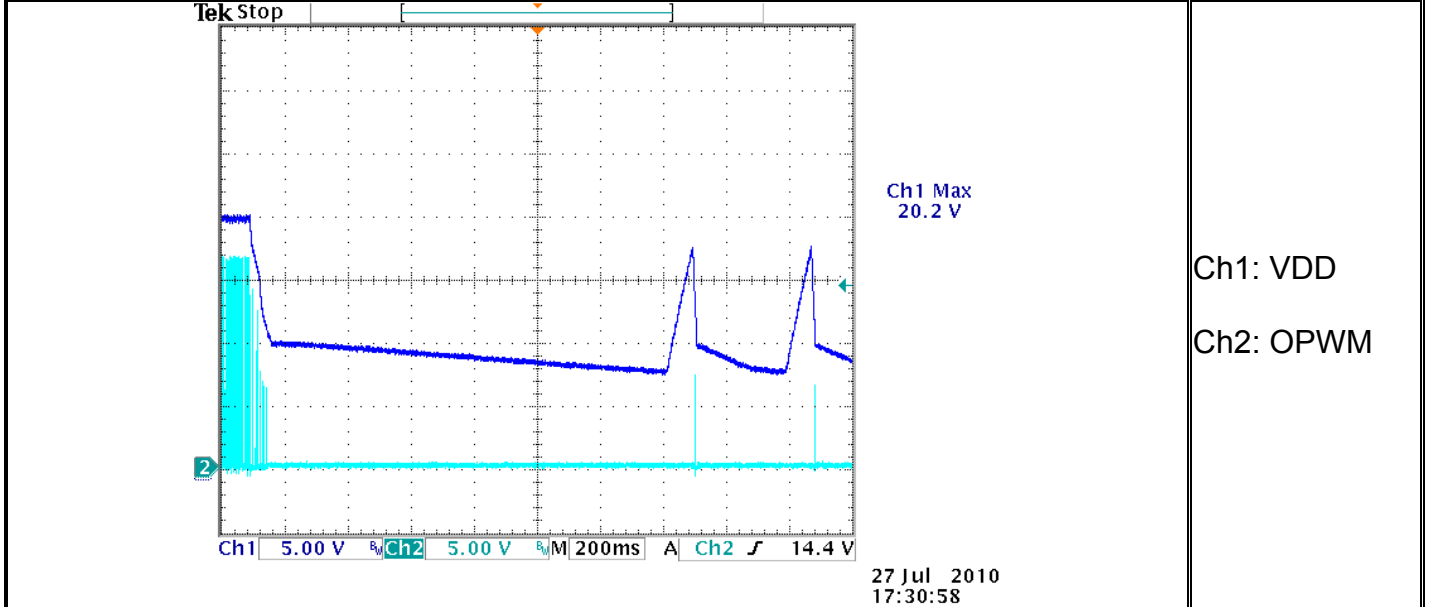


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264V/50Hz @ max. load



264V/50Hz @ output short-circuited





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## 17 Voltage stress on MOSFET & rectifiers

### 17.1 Test condition

Measure the voltage stress on MOSFET and secondary rectifiers under below specified condition

### 17.2 Test result

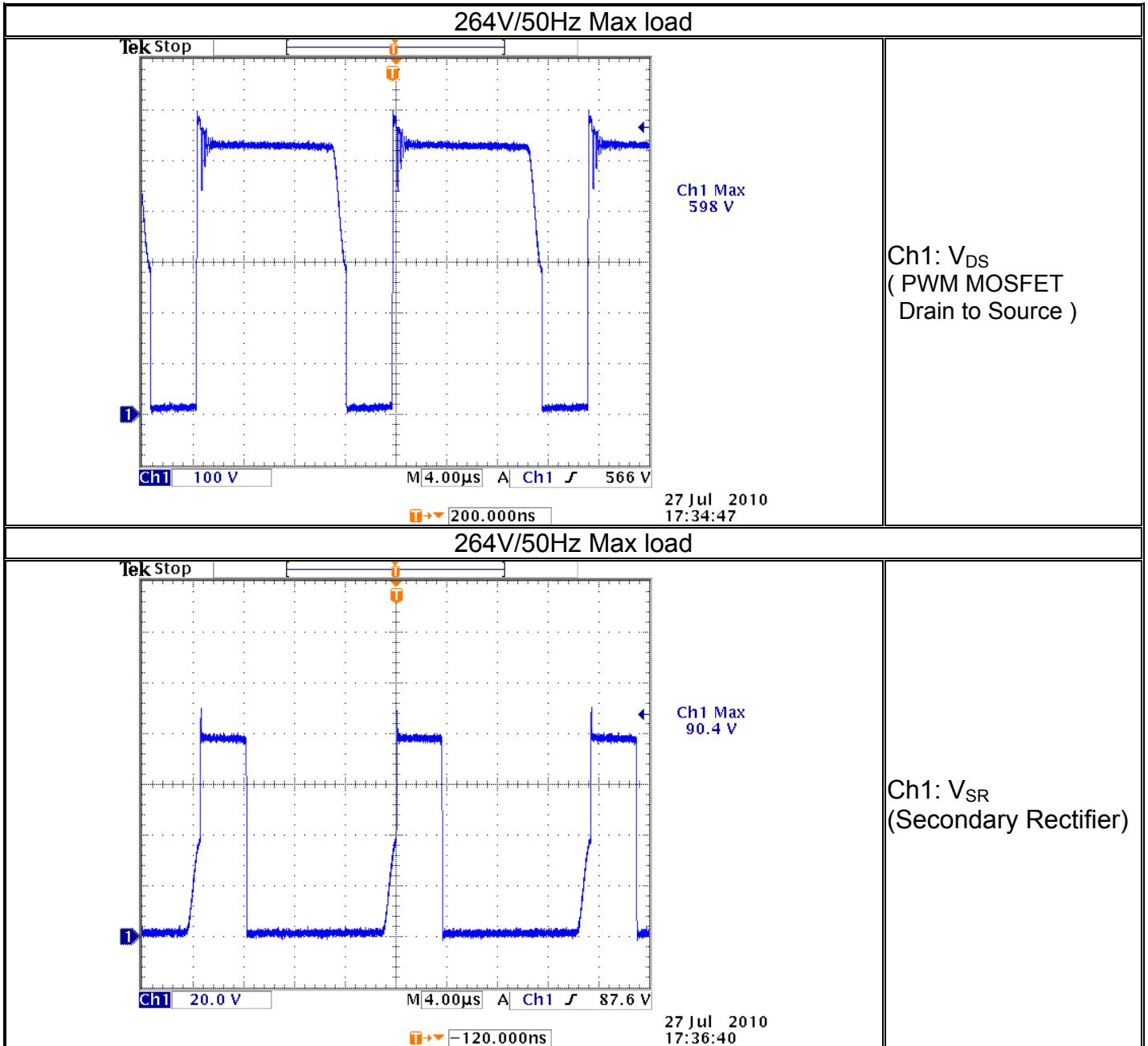
| Input voltage                      | Stress on MOSFET ( $V_{DS}$ ) | Rating | Stress on output rectifier ( $V_{SR}$ ) | Rating |
|------------------------------------|-------------------------------|--------|---|--------|
| 264V/50Hz, max. load               | 598                           | 650V   | 91                                      | 100    |
| 264V/50Hz, max. load, startup      | 616                           |        | 92                                      |        |
| 264V/50Hz, max. load, output short | 606                           |        | 92                                      |        |
| 264V/50Hz, max. load, Turn off     | 606                           |        | 92                                      |        |





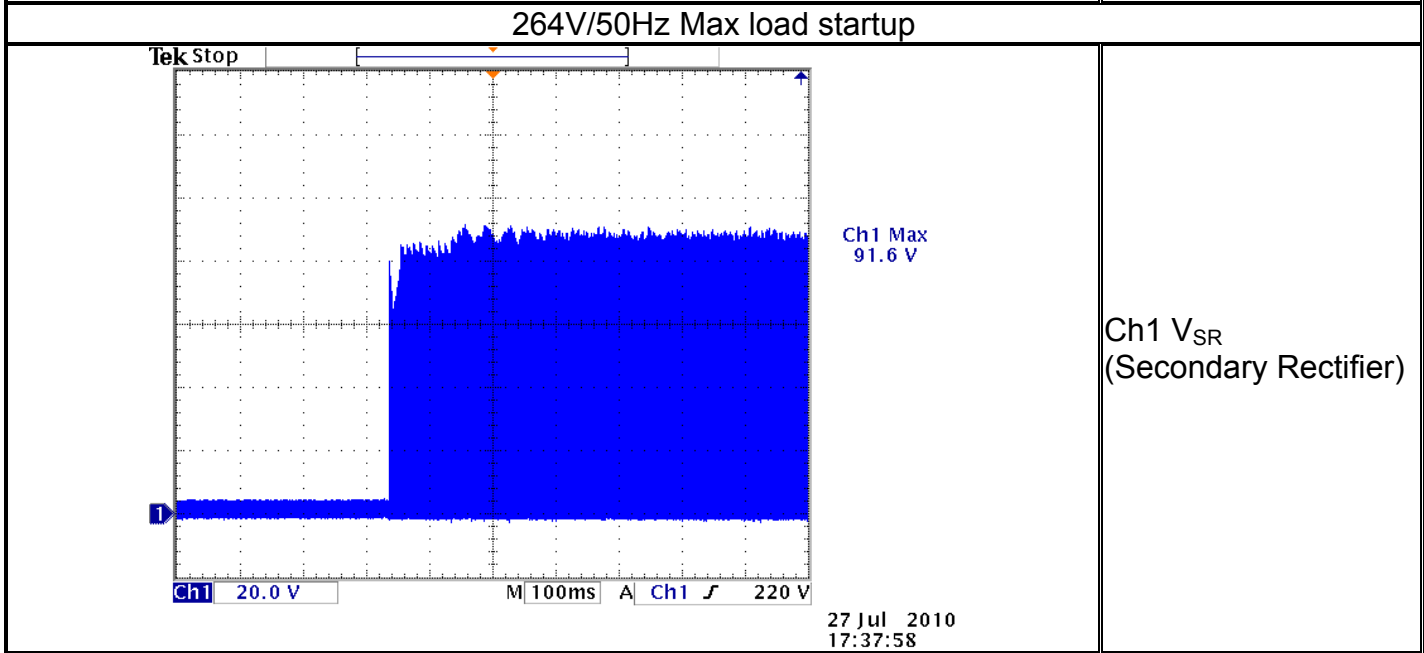
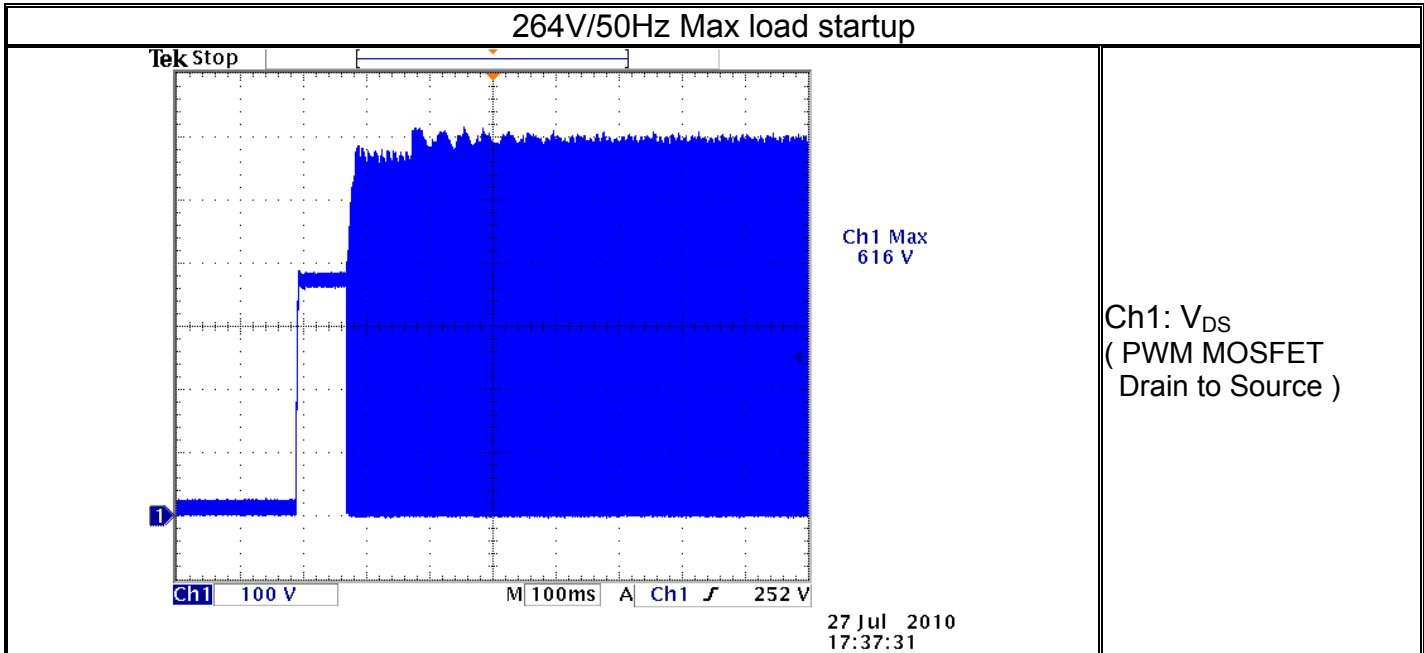
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17.3 Measured waveform



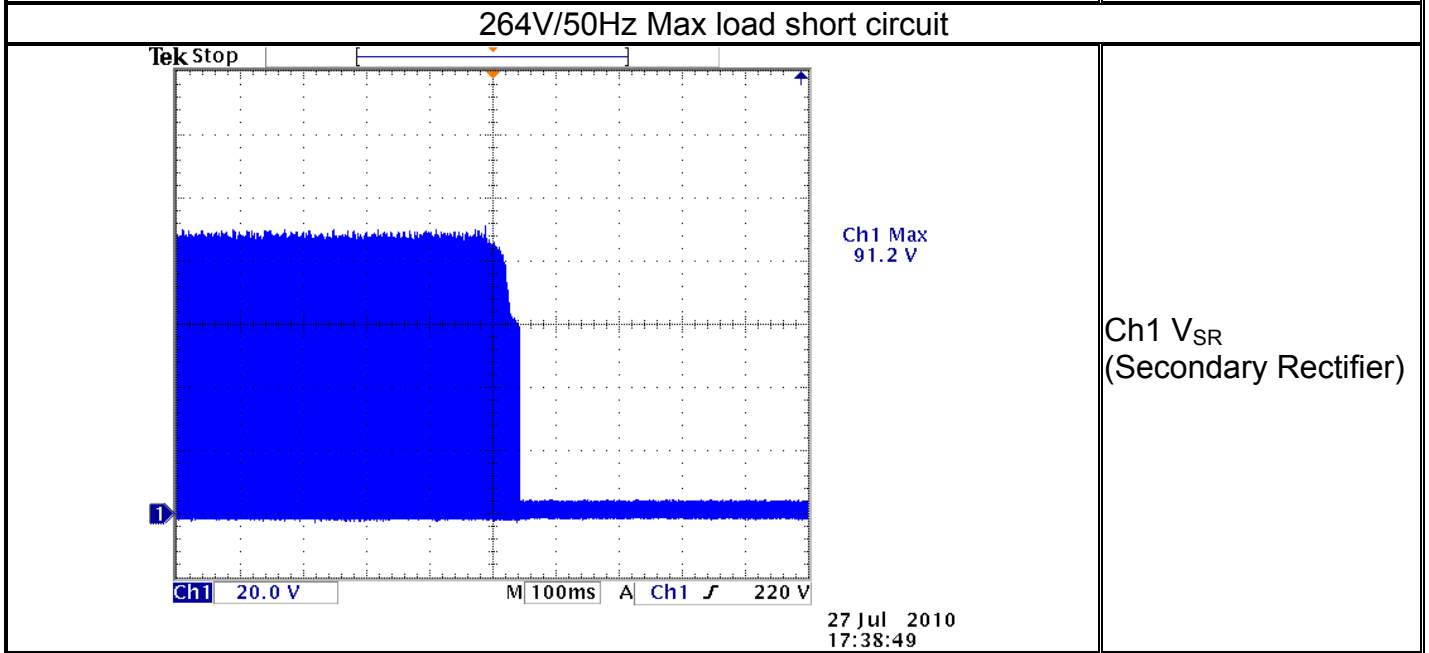
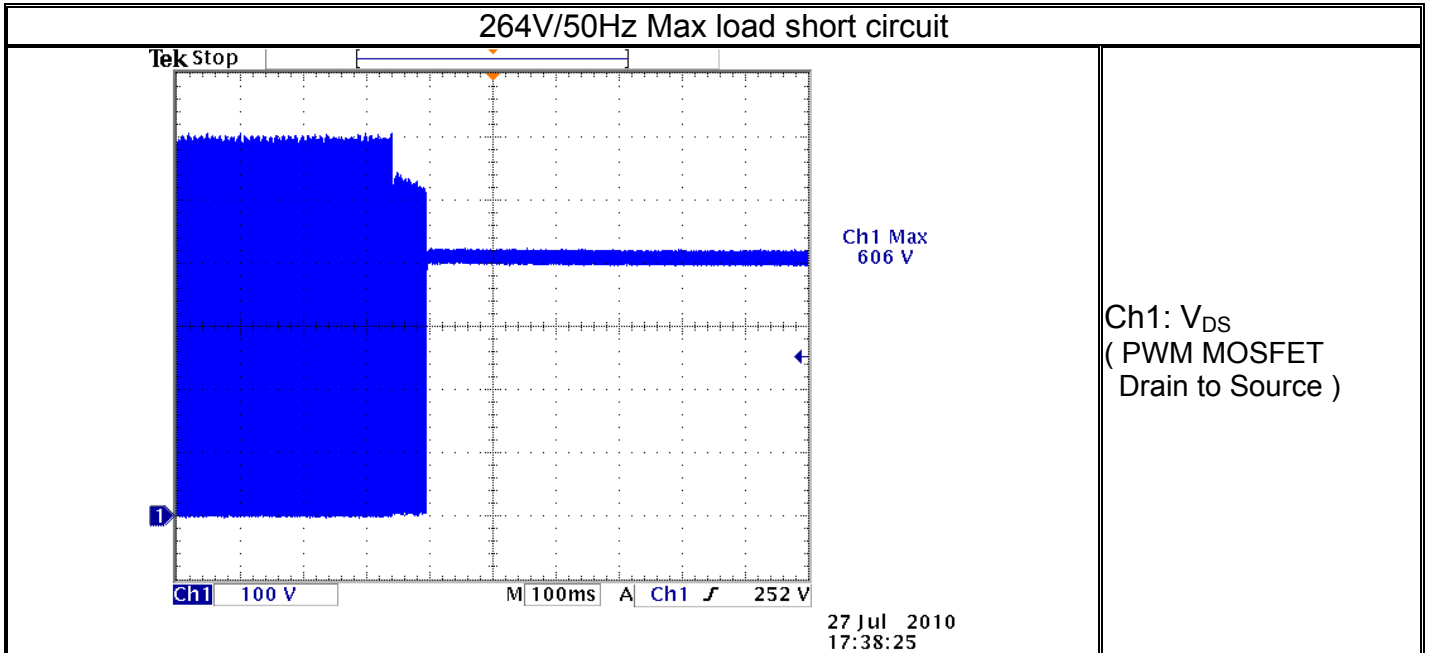


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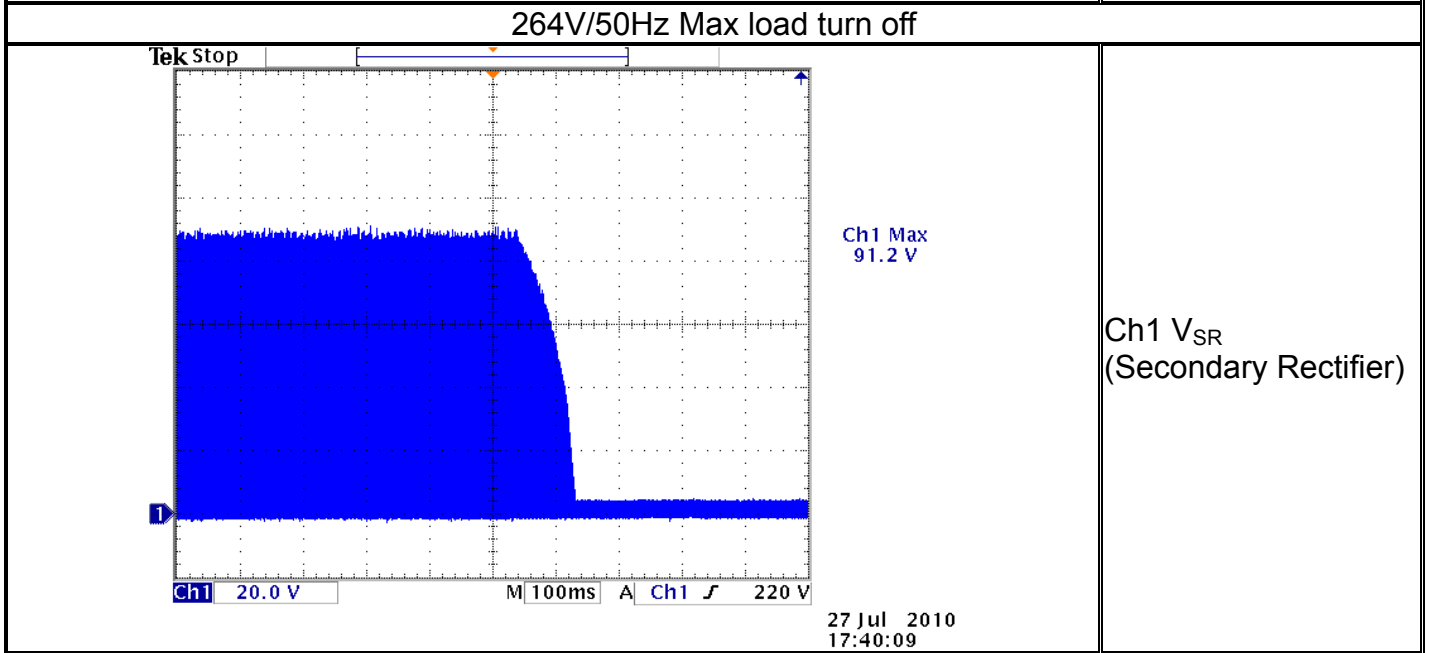
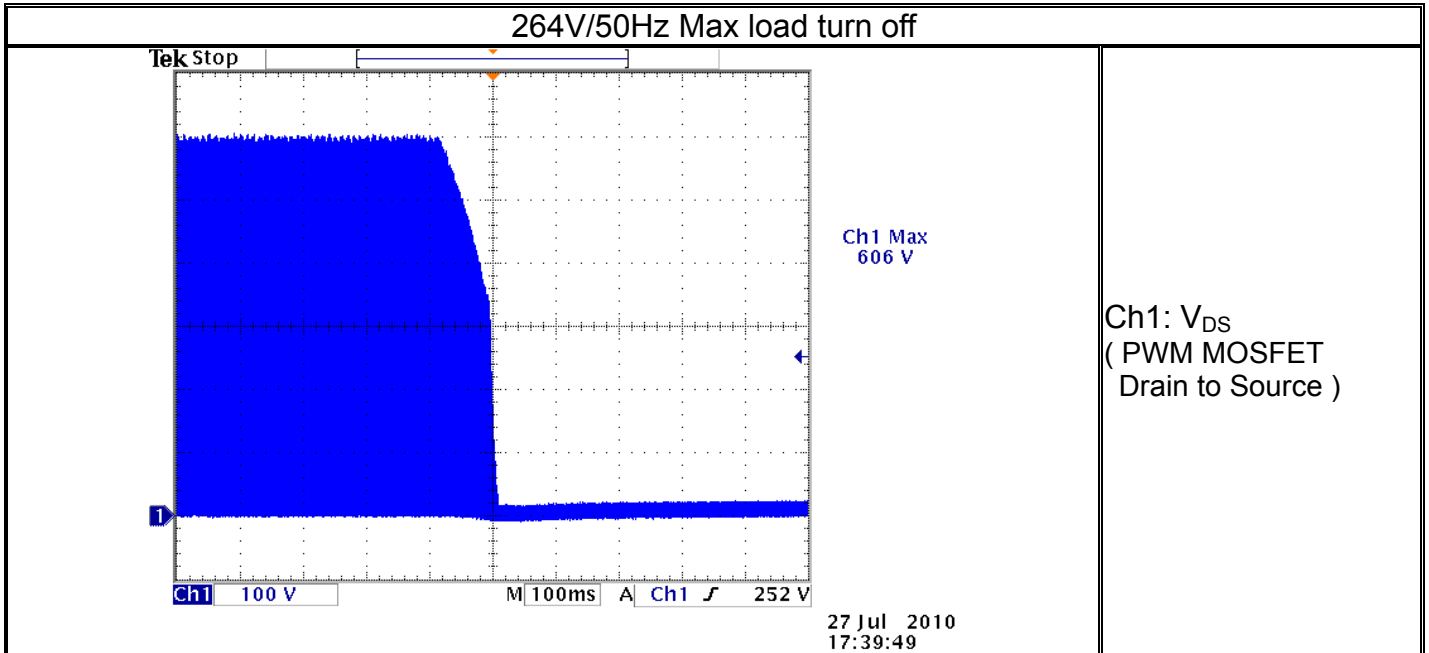


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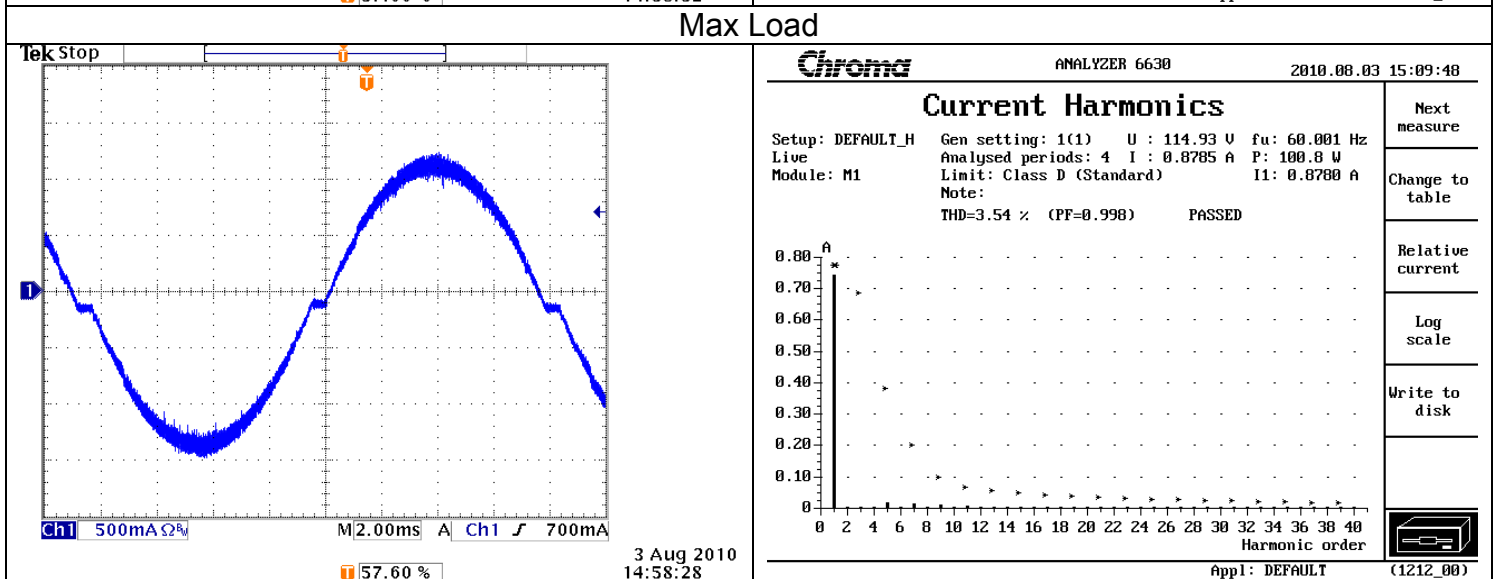
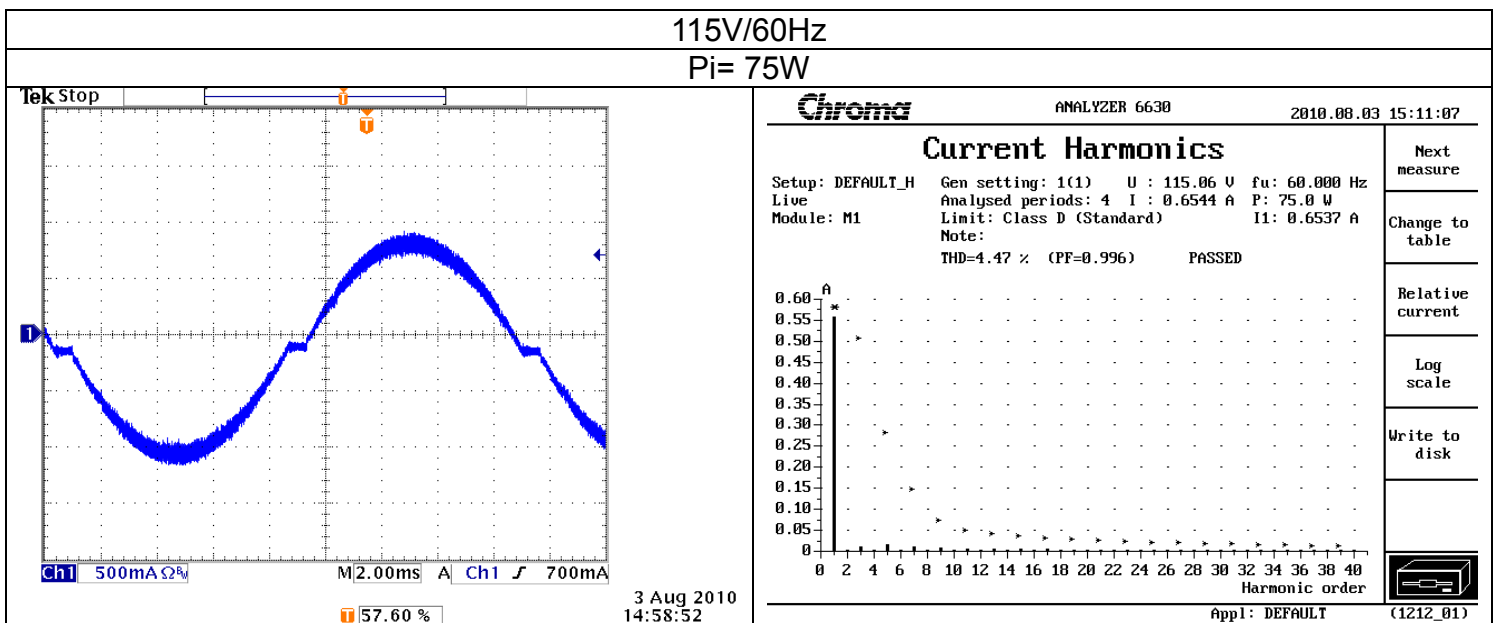
### 18 Current Harmonic test

#### 18.1 Test condition

Load:  $P_i=75W$  & Max. load

#### 18.2 Test result

| Input Voltage |           | Full load |         | Spec. |
|---------------|-----------|-----------|---------|-------|
|               |           | PF        | THD (%) |       |
| 115V/60Hz     | $P_i=75W$ | 0.996     | 4.47    |       |
|               | Max. Load | 0.998     | 3.54    |       |
| 230V/50Hz     | $P_i=75W$ | 0.970     | 9.07    |       |
|               | Max. Load | 0.982     | 6.84    |       |

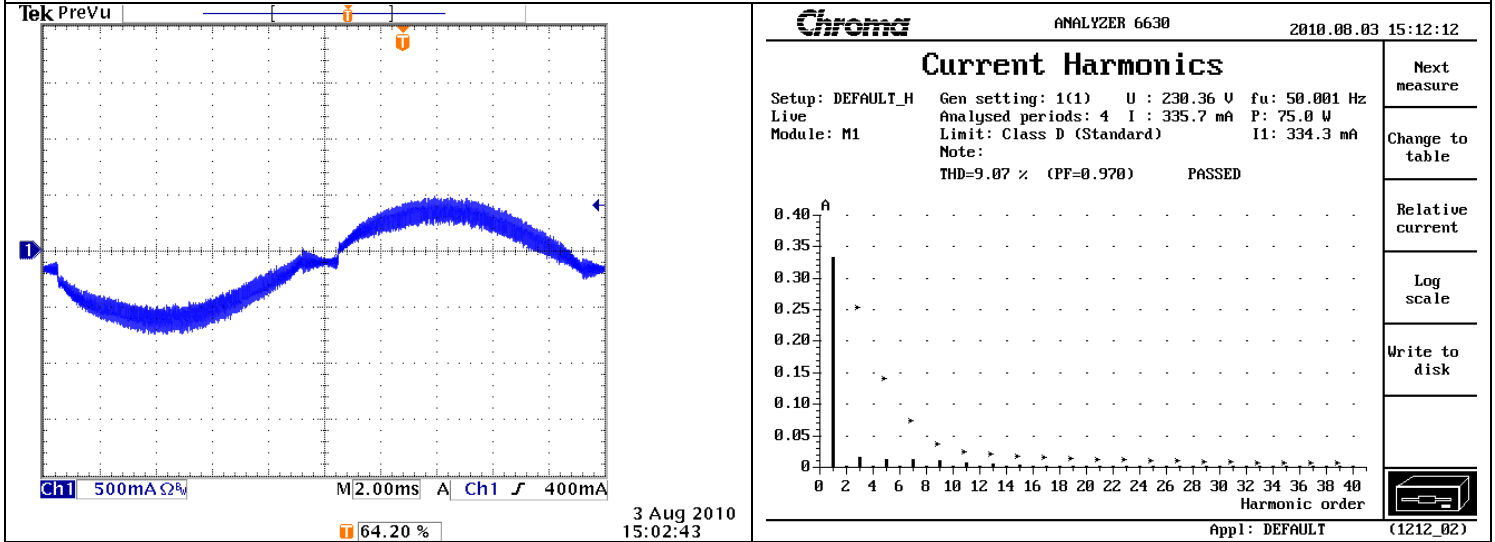




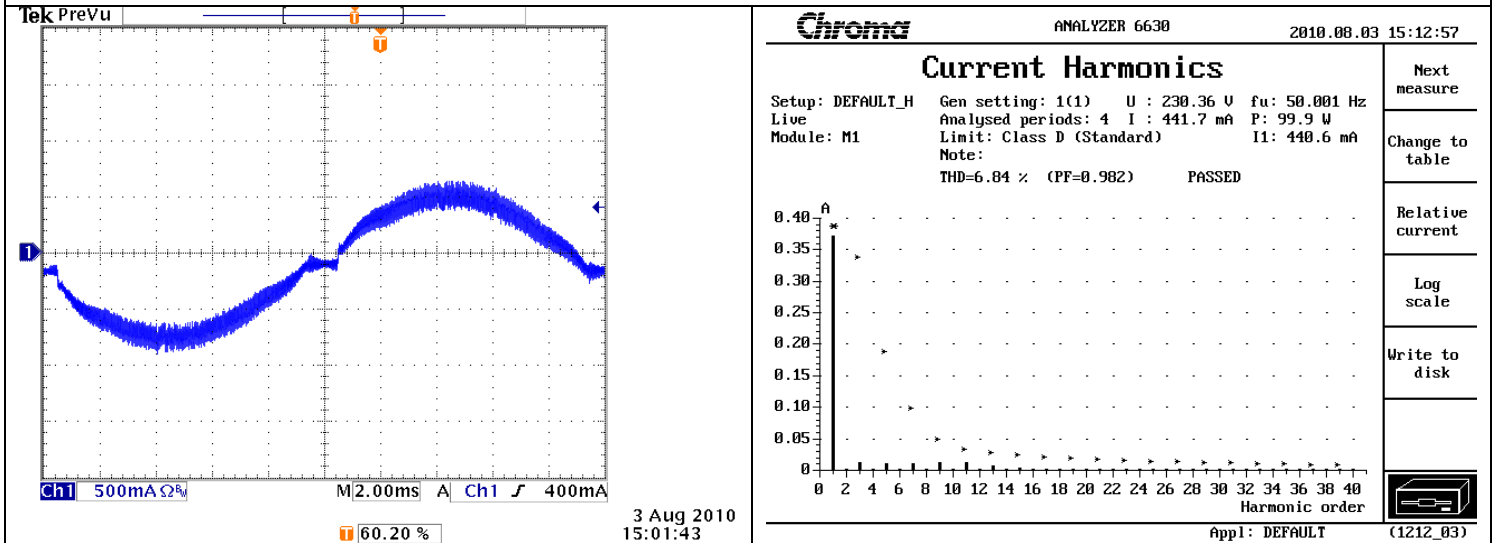
|           |                                    |               |      |
|-----------|------------------------------------|---------------|------|
| Doc.Title | FEB400-001 Functional Check Report | Instituted by | Mars |
|-----------|------------------------------------|---------------|------|

230V/50Hz

Pi= 75W



Max Load



Max Load

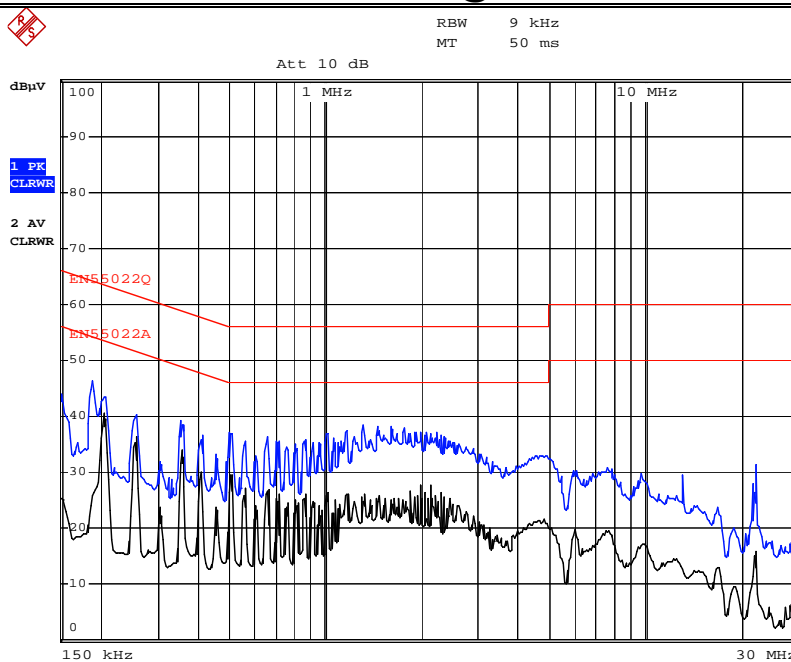




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|-----------|------------------------------------|---------------|------|
| Doc.Title | FEB400-001 Functional Check Report | Instituted by | Mars |
|-----------|------------------------------------|---------------|------|

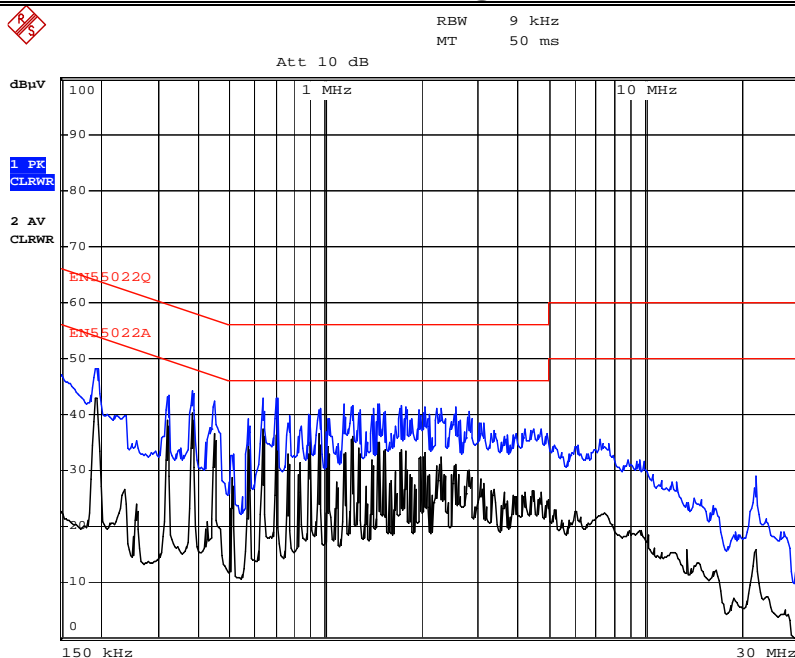
19 EMI test

Conduction-Line @ 115Vac full load



Date: 3.AUG.2010 10:37:35

Conduction-Line @ 230Vac full load

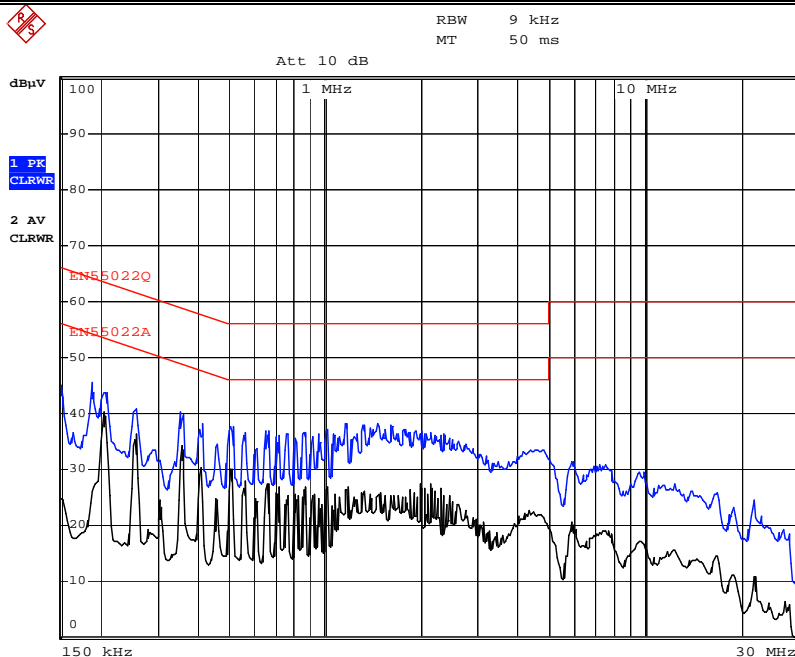


Date: 3.AUG.2010 11:04:14



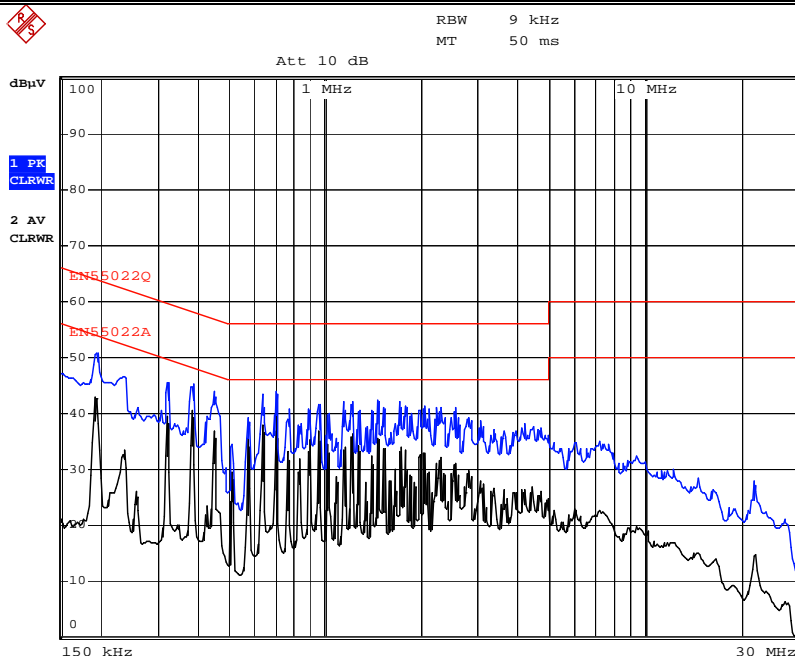
|           |                                    |               |      |
|-----------|------------------------------------|---------------|------|
| Doc.Title | FEB400-001 Functional Check Report | Instituted by | Mars |
|-----------|------------------------------------|---------------|------|

Conduction-Neutral @ 115Vac full load



Date: 3.AUG.2010 10:44:37

Conduction-Neutral @ 230Vac full load

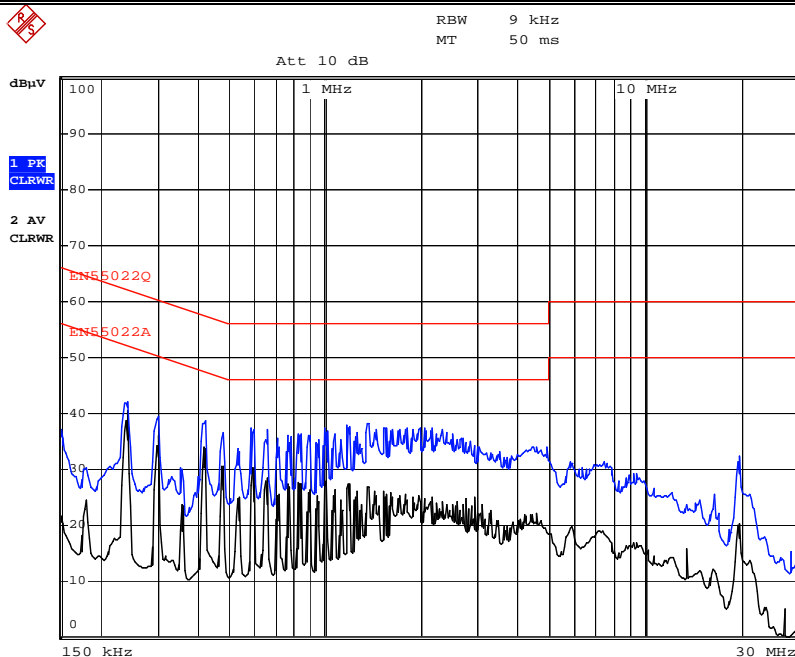


Date: 3.AUG.2010 10:54:24



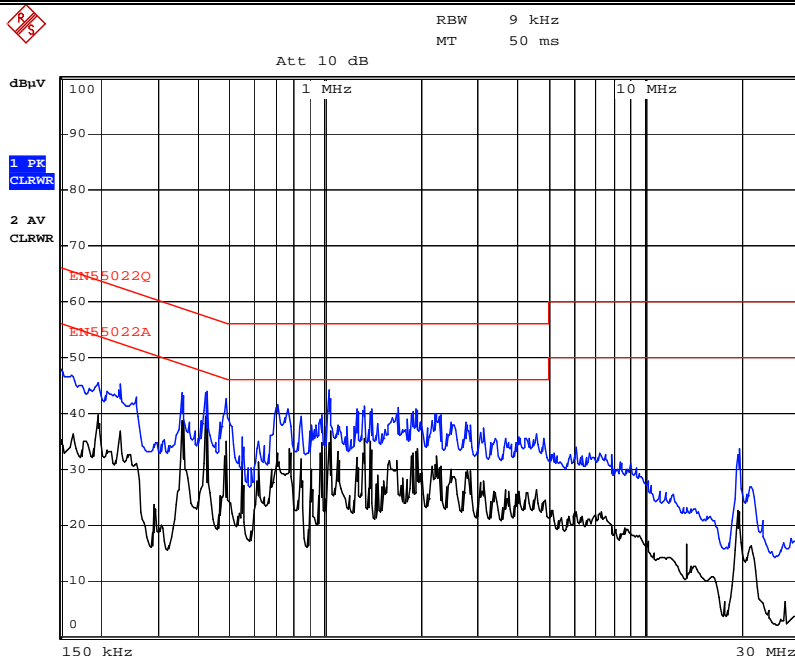
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|-----------|------------------------------------|---------------|------|
| Doc.Title | FEB400-001 Functional Check Report | Instituted by | Mars |
|-----------|------------------------------------|---------------|------|

Conduction-Line @ 115Vac 75% load



Date: 3.AUG.2010 11:39:28

Conduction-Line @ 230Vac 75% load

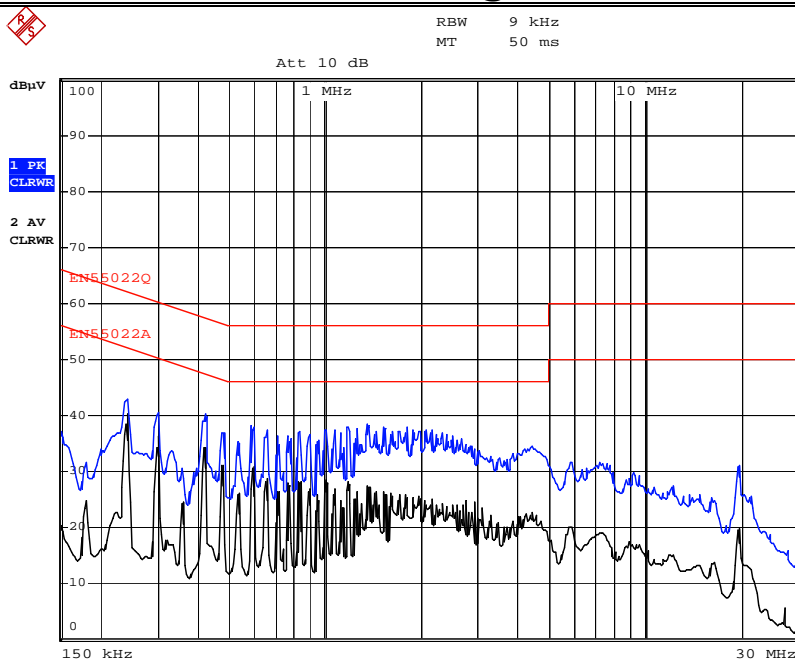


Date: 3.AUG.2010 11:18:54



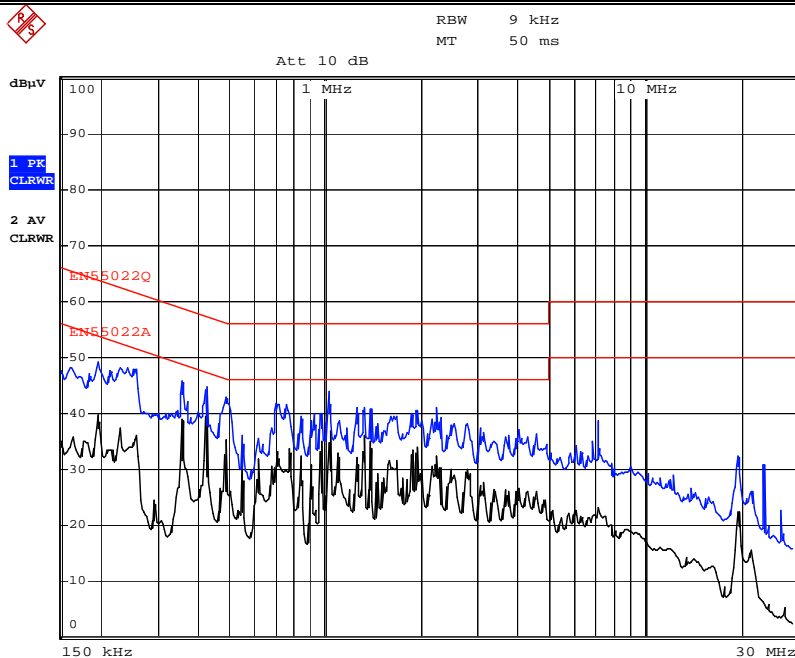
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|-----------|------------------------------------|---------------|------|
| Doc.Title | FEB400-001 Functional Check Report | Instituted by | Mars |
|-----------|------------------------------------|---------------|------|

Conduction-Neutral @ 115Vac 75% load



Date: 3.AUG.2010 11:47:09

Conduction-Neutral @ 230Vac 75% load

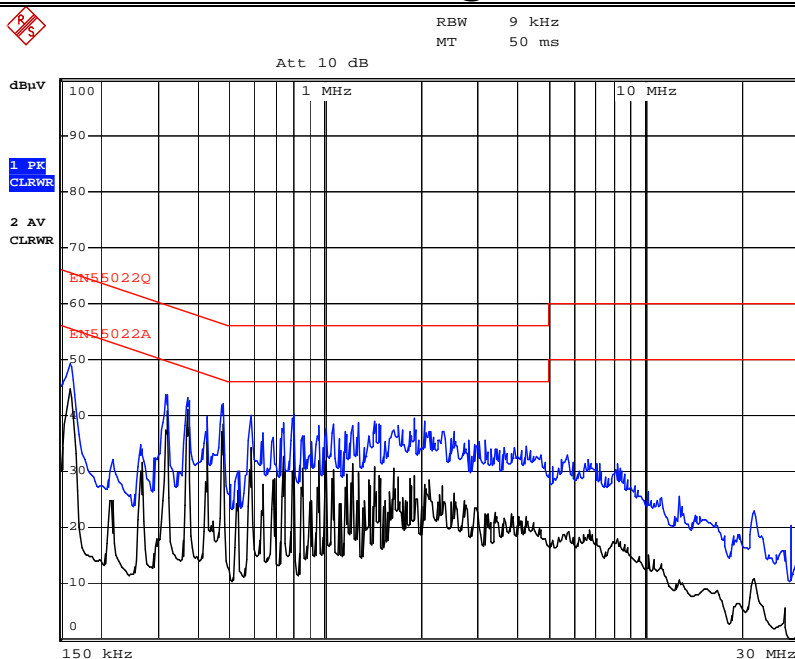


Date: 3.AUG.2010 11:25:52



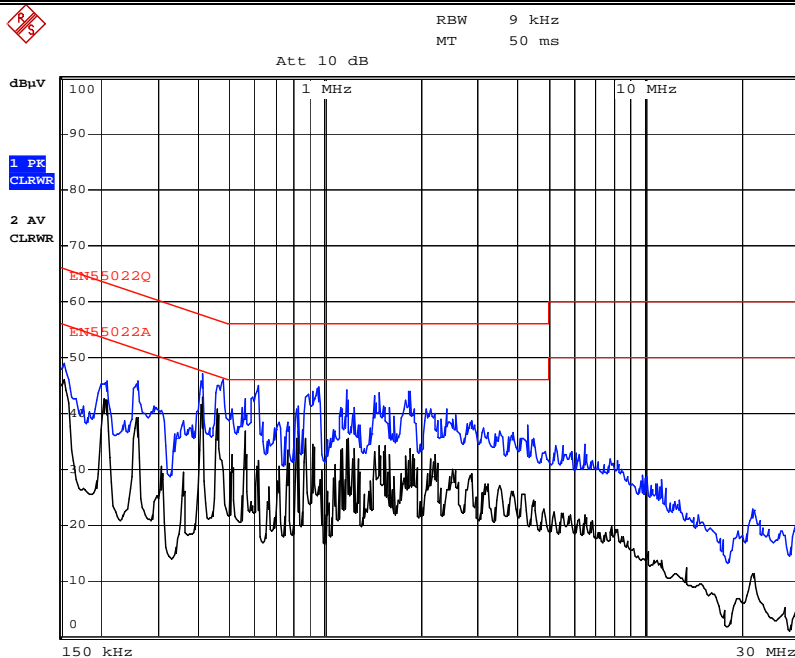
|           |                                    |               |      |
|-----------|------------------------------------|---------------|------|
| Doc.Title | FEB400-001 Functional Check Report | Instituted by | Mars |
|-----------|------------------------------------|---------------|------|

Conduction-Line @ 115Vac 50% load



Date: 3.AUG.2010 12:29:57

Conduction-Line @ 230Vac 50% load

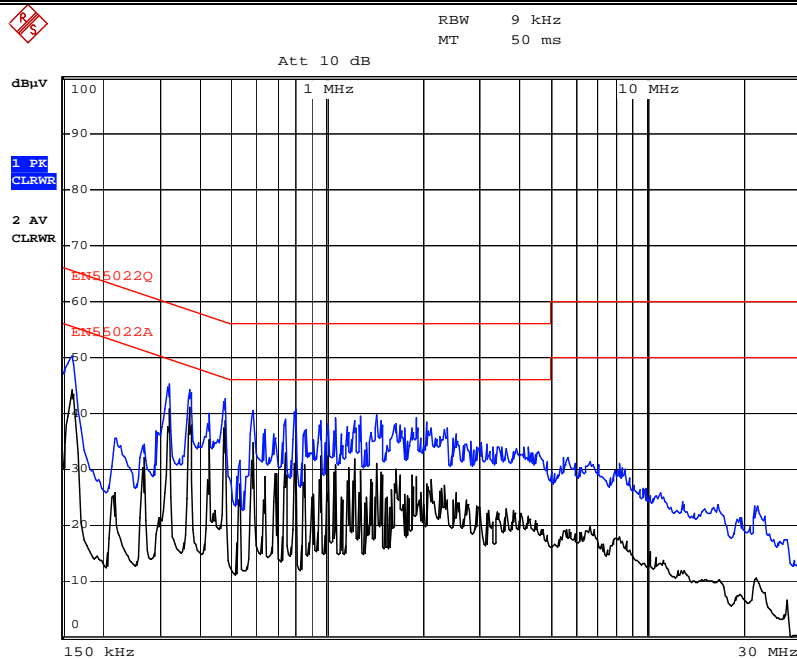


Date: 3.AUG.2010 12:06:29



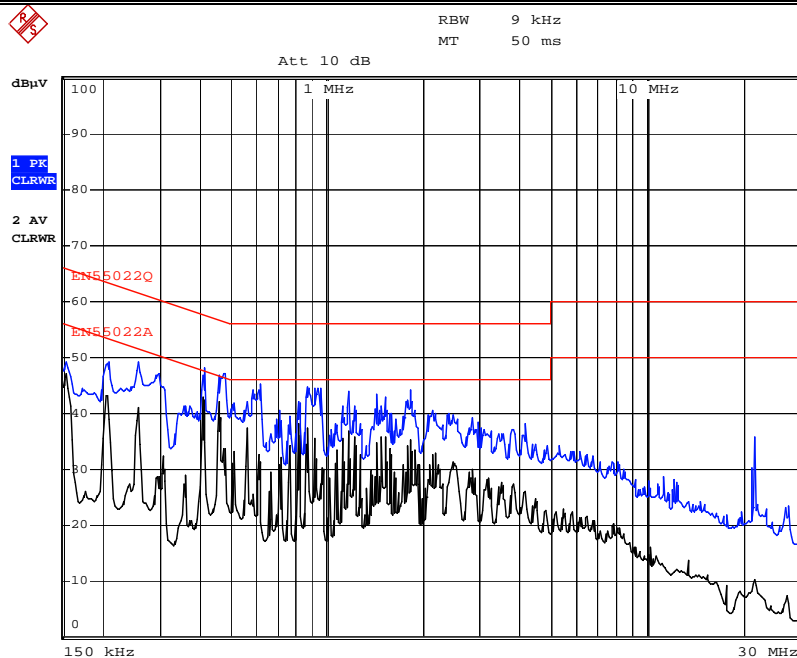
|           |                                    |               |      |
|-----------|------------------------------------|---------------|------|
| Doc.Title | FEB400-001 Functional Check Report | Instituted by | Mars |
|-----------|------------------------------------|---------------|------|

Conduction-Neutral @ 115Vac 50% load



Date: 3.AUG.2010 12:37:55

Conduction-Neutral @ 230Vac 50% load



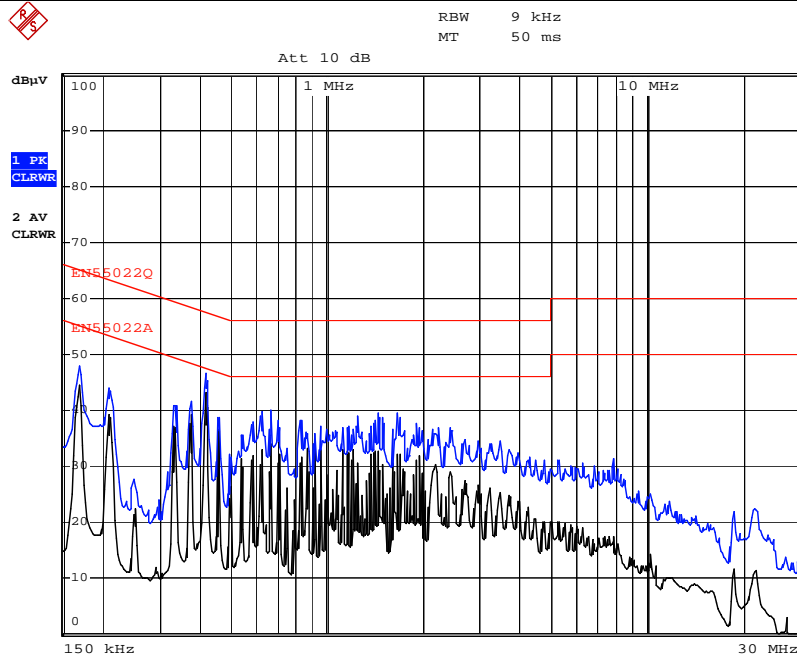
Date: 3.AUG.2010 12:15:09





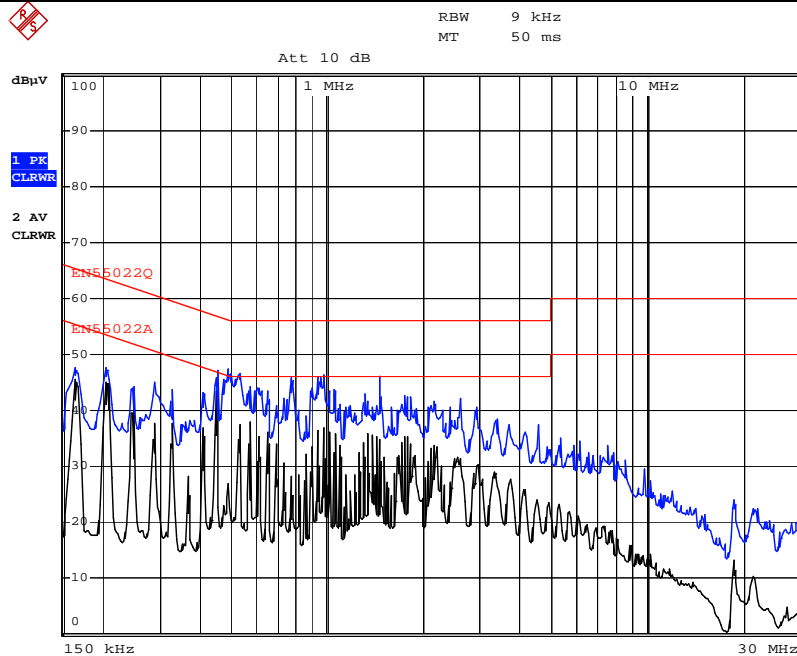
|           |                                    |               |      |
|-----------|------------------------------------|---------------|------|
| Doc.Title | FEB400-001 Functional Check Report | Instituted by | Mars |
|-----------|------------------------------------|---------------|------|

Conduction-Line @ 115Vac 25% load



Date: 4.AUG.2010 05:45:14

Conduction-Line @ 230Vac 25% load

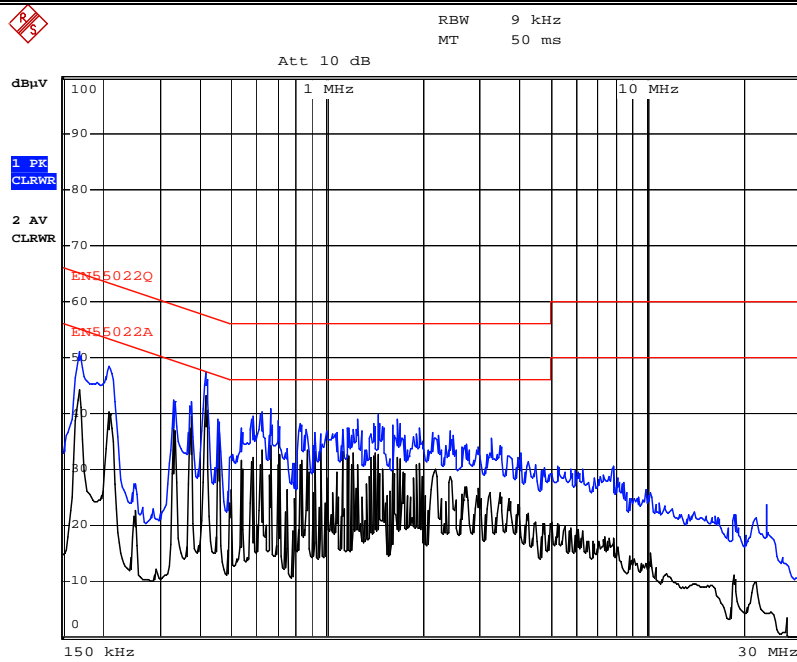


Date: 4.AUG.2010 05:16:17



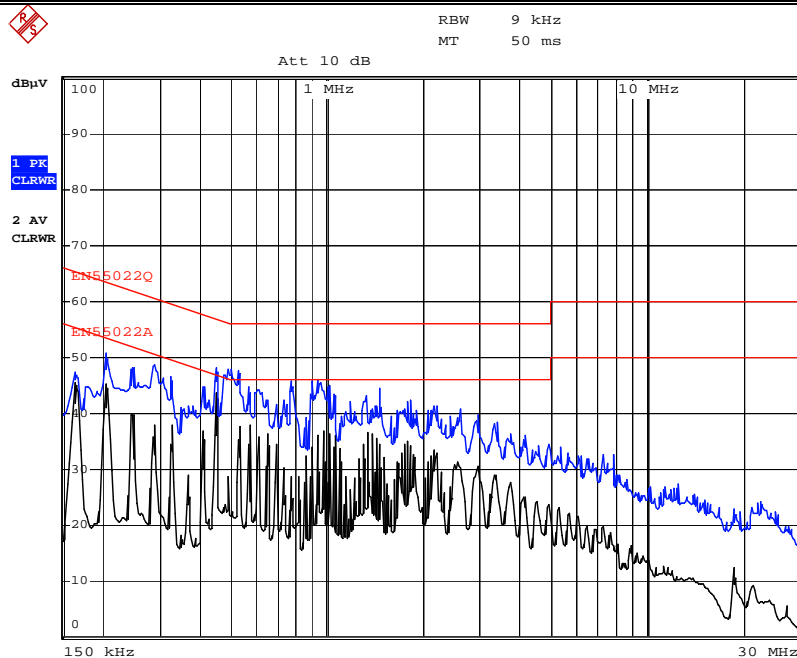
|           |                                    |               |      |
|-----------|------------------------------------|---------------|------|
| Doc.Title | FEB400-001 Functional Check Report | Instituted by | Mars |
|-----------|------------------------------------|---------------|------|

Conduction-Neutral @ 115Vac 25% load



Date: 4.AUG.2010 06:02:07

Conduction-Neutral @ 230Vac 25% load



Date: 4.AUG.2010 05:27:47



|           |                                    |               |      |
|-----------|------------------------------------|---------------|------|
| Doc.Title | FEB400-001 Functional Check Report | Instituted by | Mars |
|-----------|------------------------------------|---------------|------|

**20 Surge test**

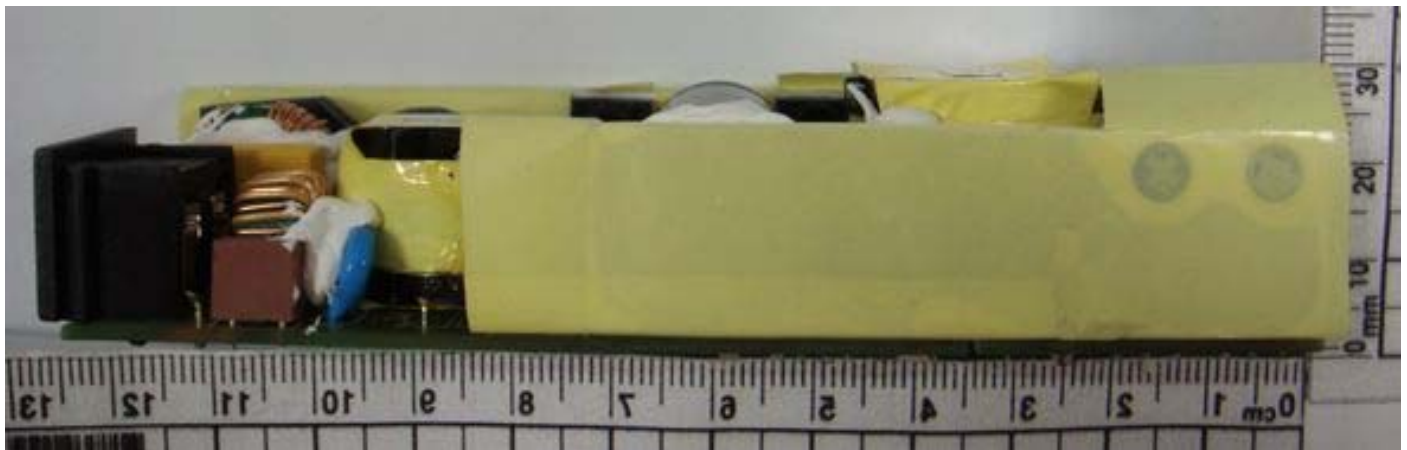
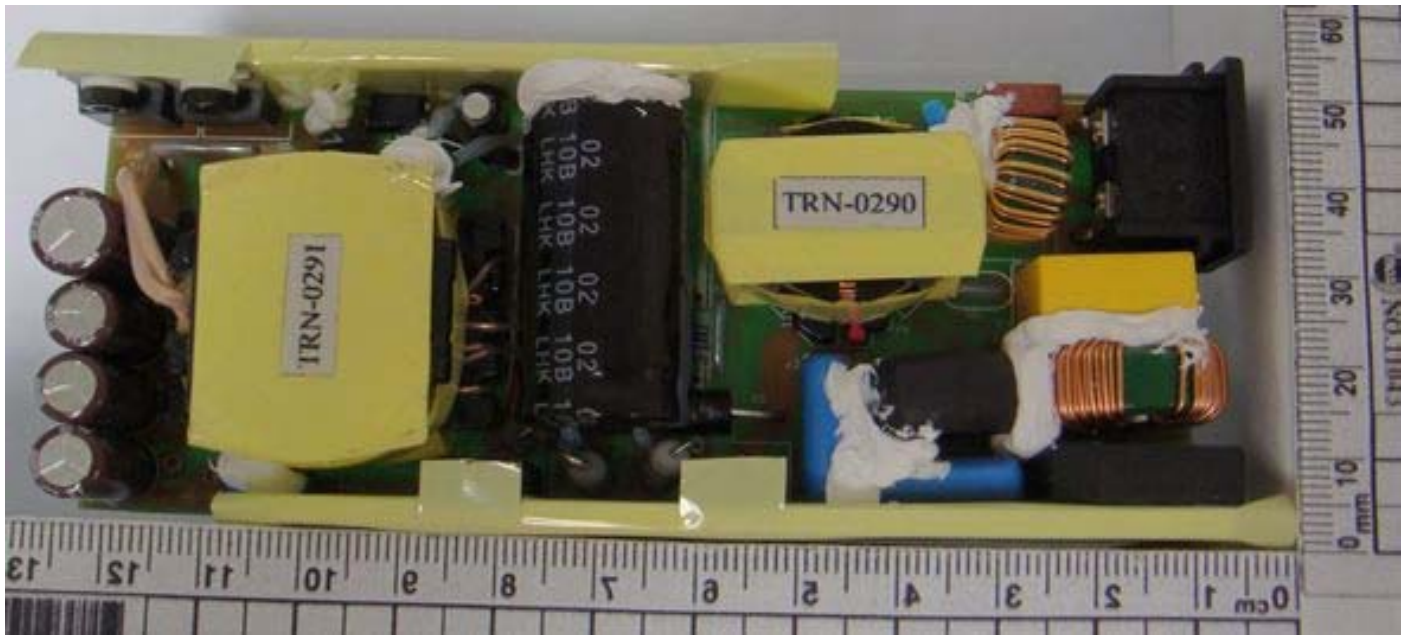
| Mode | Polarity | Phase | Voltage | Condition |
|------|----------|-------|---------|-----------|
| L-PE | +/-      | 0°    | 4.4KV   | PASS      |
|      | +/-      | 90°   |         | PASS      |
|      | +/-      | 180°  |         | PASS      |
|      | +/-      | 270°  |         | PASS      |
| N-PE | +/-      | 0°    | 4.4KV   | PASS      |
|      | +/-      | 90°   |         | PASS      |
|      | +/-      | 180°  |         | PASS      |
|      | +/-      | 270°  |         | PASS      |
| L-N  | +/-      | 0°    | 4.4KV   | PASS      |
|      | +/-      | 90°   |         | PASS      |
|      | +/-      | 180°  |         | PASS      |
|      | +/-      | 270°  |         | PASS      |

**21 ESD test**

|                           |
|---------------------------|
| Contact Discharge (8.8KV) |
| PASS                      |

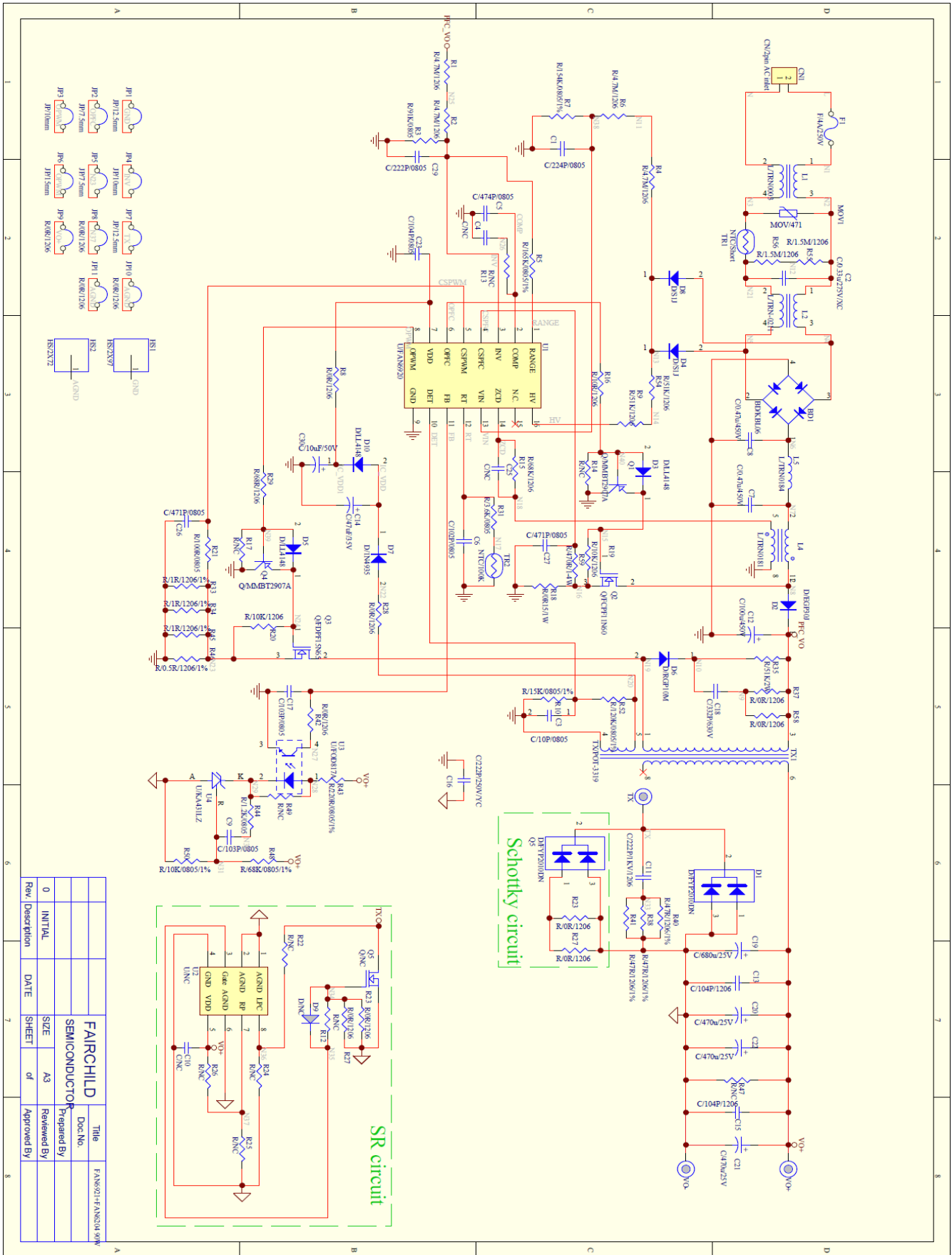


|           |                       |               |      |
|-----------|-----------------------|---------------|------|
| Doc.Title | FEB400-001 Photograph | Instituted by | Mars |
|-----------|-----------------------|---------------|------|





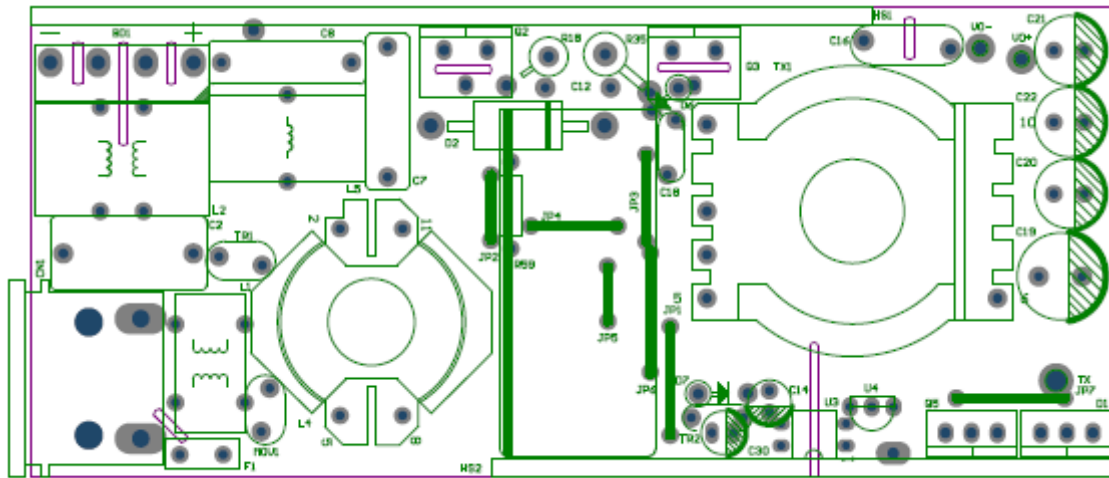
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| Doc.Title | FEB400-001 Schematic | Instituted by | Mars |
|-----------|----------------------|---------------|------|



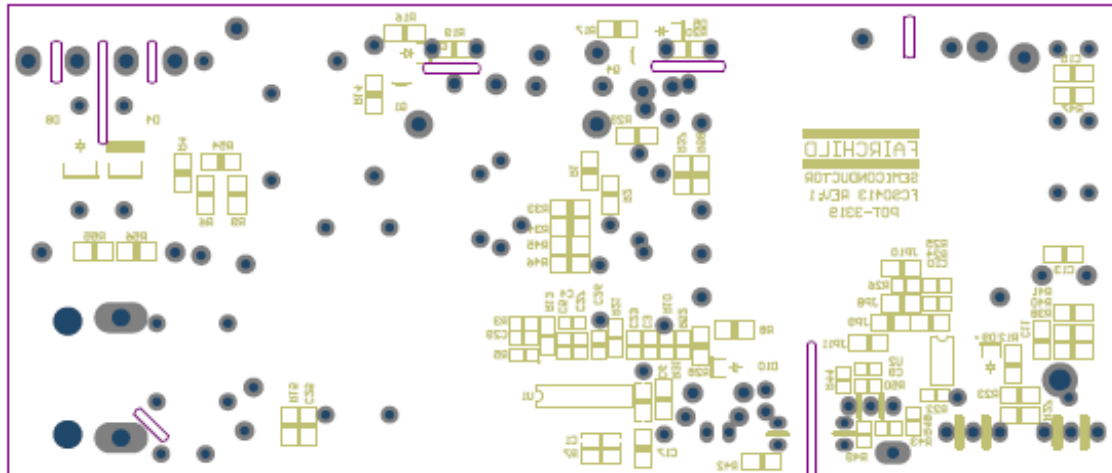
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|-----|---|---------|------|------|----|-------|----|---------------------|
| Rev | 0 | INITIAL | DATE | SIZE | A3 | SHEET | of | Approved By         |
|     |   |         |      |      |    |       |    | Title               |
|     |   |         |      |      |    |       |    | FAIRCHILD           |
|     |   |         |      |      |    |       |    | SEMICONDUCTOR       |
|     |   |         |      |      |    |       |    | Doc.No.             |
|     |   |         |      |      |    |       |    | FAN8921-FAN8924 90W |
|     |   |         |      |      |    |       |    | Prepared By         |
|     |   |         |      |      |    |       |    | Reviewed By         |
|     |   |         |      |      |    |       |    | Approved By         |



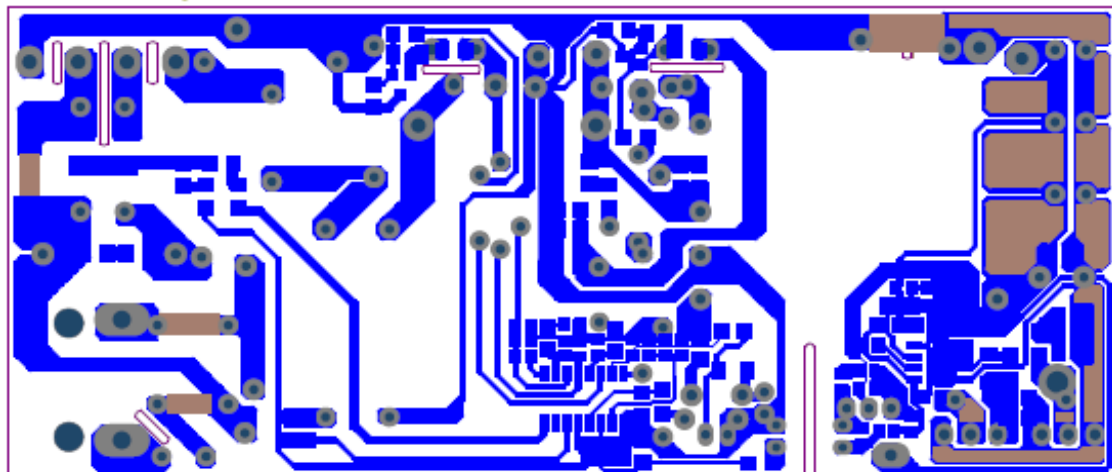
|           |                       |               |      |
|-----------|-----------------------|---------------|------|
| Doc.Title | FEB400-001 PCB Layout | Instituted by | Mars |
|-----------|-----------------------|---------------|------|



Top Overlay



Bottom Overlay



Bottom Solder Mask





|           |                     |               |      |
|-----------|---------------------|---------------|------|
| Doc.Title | FEB400-001 BOM List | Instituted by | Mars |
|-----------|---------------------|---------------|------|

| Component  | Q"ty | Part No. | Manufacturer | Reference                                       |
|--|------|----------|--------------|---|
| JUMPER WIRE 0.8 $\phi$ (mm)                              | 8    |          |              | JP1~JP7 TR1                                     |
| Non-Inductive Wire Wound Resistor 1W 0 $\Omega$ 15 +/-1% | 1    |          |              | R18   |
| Metal Film Fixed Resistor 1/4W 470 $\Omega$ +/-1%        | 1    |          |              | R59   |
| Metal Film Fixed Resistor 2W 56K $\Omega$ +/-5%          | 1    |          |              | R35   |
| Chip Resistor 0805 100 $\Omega$ +/-5%                    | 1    |          |              | R21   |
| Chip Resistor 0805 220 $\Omega$ +/-1%                    | 1    |          |              | R43   |
| Chip Resistor 0805 1K2 $\Omega$ +/-5%                    | 1    |          |              | R44   |
| Chip Resistor 0805 3K6 $\Omega$ +/-5%                    | 1    |          |              | R31   |
| Chip Resistor 0805 10K $\Omega$ +/-1%                    | 1    |          |              | R50   |
| Chip Resistor 0805 15K $\Omega$ +/-1%                    | 1    |          |              | R10   |
| Chip Resistor 0805 68K $\Omega$ +/-1%                    | 1    |          |              | R48   |
| Chip Resistor 0805 91K $\Omega$ +/-5%                    | 1    |          |              | R3  |
| Chip Resistor 0805 120K $\Omega$ +/-1%                   | 1    |          |              | R52   |
| Chip Resistor 0805 154K $\Omega$ +/-1%                   | 1    |          |              | R7  |
| Chip Resistor 0805 165K $\Omega$ +/-1%                   | 1    |          |              | R5  |
| Chip Resistor 1206 0 $\Omega$ +/-5%                      | 11   |          |              | JP8 JP9 JP10 JP11 R8<br>R23 R27 R28 R37 R42 R58 |
| Chip Resistor 1206 0 $\Omega$ 5 +/-5%                    | 1    |          |              | R46   |
| Chip Resistor 1206 1 $\Omega$ +/-5%                      | 3    |          |              | R33 R34 R45                                     |
| Chip Resistor 1206 10 $\Omega$ +/-5%                     | 1    |          |              | R16   |
| Chip Resistor 1206 47 $\Omega$ +/-1%                     | 3    |          |              | R38 R40 R41                                     |
| Chip Resistor 1206 68 $\Omega$ +/-5%                     | 1    |          |              | R29   |
| Chip Resistor 1206 10K $\Omega$ +/-5%                    | 2    |          |              | R19 R20   |
| Chip Resistor 1206 51K $\Omega$ +/-5%                    | 2    |          |              | R9 R54  |
| Chip Resistor 1206 68K $\Omega$ +/-5%                    | 1    |          |              | R15   |
| Chip Resistor 1206 1M5 $\Omega$ +/-5%                    | 2    |          |              | R55 R56   |
| Chip Resistor 1206 4M7 $\Omega$ +/-5%                    | 4    |          |              | R1 R2 R4 R6                                     |
| NTC 5 $\phi$ 100000 $\Omega$                             | 1    |          |              | TR2   |
| 0805 MLCC X7R +/-10% 10P 50V                             | 1    |          |              | C3  |
| 0805 MLCC X7R +/-10% 102P 50V                            | 1    |          |              | C6  |
| 0805 MLCC X7R +/-10% 103P 50V                            | 2    |          |              | C9 C17  |
| 0805 MLCC X7R +/-10% 104P 50V                            | 1    |          |              | C23   |
| 0805 MLCC X7R +/-10% 222P 50V                            | 1    |          |              | C29   |
| 0805 MLCC X7R +/-10% 224P 50V                            | 1    |          |              | C1  |
| 0805 MLCC X7R +/-10% 471P 50V                            | 2    |          |              | C26 C27   |
| 0805 MLCC X7R +/-10% 474P 50V                            | 1    |          |              | C5  |
| 1206 MLCC X7R +/-10% 104P 50V                            | 2    |          |              | C13 C15   |



|           |                     |               |      |
|-----------|---------------------|---------------|------|
| Doc.Title | FEB400-001 BOM List | Instituted by | Mars |
|-----------|---------------------|---------------|------|

| Component                                    | Q"ty | Part No.                       | Manufacturer | Reference   |
|--|------|--------------------------------|--------------|-------------|
| 1206 MLCC X7R +/-10% 222P 1KV                | 1    |                                |              | C11         |
| Electrolytic Capacitor 10u 50V 105°C         | 1    | 5*11 LHK                       | JACKCON      | C30         |
| Electrolytic Capacitor 47u 35V 105°C         | 1    | LHK                            | JACKCON      | C14         |
| Electrolytic Capacitor 100u 450V 105°C       | 1    | 18*35 PAG                      | NCC          | C12         |
| Electrolytic Capacitor 470u 25V 105°C RADIAL | 3    | 8*20                           |              | C20 C21 C22 |
| Electrolytic Capacitor 680u 25V 105°C LowESR | 1    | 10*20                          |              | C19         |
| MPE Capacitor 0.0033u 630V +/-10%            | 1    |                                |              | C18         |
| MPE Capacitor 0.47u 450V ±10%                | 2    | 17.3 * 5 * 13.3                |              | C7 C8       |
| X2 Capacitor 0.33u 275V +/-10%               | 1    | 17*7.5*15.5mm                  |              | C2          |
| Y1 Capacitor 222P/250V +/-20%                | 1    |                                | SEN HUEI     | C16         |
| Inductor TRN0184                             | 1    | T6026<br>L=400uH               | SEN HUEI     | L5          |
| Inductor TRN0211                             | 1    | Common Choke<br>9mH (RT181007) | SEN HUEI     | L2          |
| Inductor TRN0003                             | 1    | POF25T(S)-001                  | SEN HUEI     | L1          |
| Transformer TRN0290                          | 1    | RM-10 400uH                    | SEN HUEI     | L4          |
| Transformer TRN0291                          | 1    | POT-3319 700uH                 | SEN HUEI     | TX1         |
| Diode 1A/1000V DO-41                         | 1    | RGP10M                         | Fairchild    | D6          |
| Diode 3A/600V                                | 1    | EGP30J                         | Fairchild    | D2          |
| Diode 1A/200V                                | 1    | 1N4935                         | Fairchild    | D7          |
| SMD Diode 1A/100V SOD80                      | 3    | LL4148                         | Fairchild    | D3 D5 D10   |
| SMD Diode 1A/600V SMA                        | 2    | S1J                            | Fairchild    | D4 D8       |
| Bridge 4A600V                                | 1    | KBL06                          | Fairchild    | BD1         |
| Schottky 20A/100V TO-220                     | 2    | FYP2010DN                      | Fairchild    | D1 Q5       |
| REGULATOR KA431L +/-0.5%                     | 1    | TO92                           | Fairchild    | U4          |
| SMD Transistor MMBT2907ALT1G                 | 2    |                                | Fairchild    | Q1 Q4       |
| MOSFET 11A/600V TO-220F                      | 1    | FCPF11N60                      | Fairchild    | Q2          |
| MOSFET 15A/650V TO-220F                      | 1    | FDPF15N65                      | Fairchild    | Q3          |
| IC FOD817A DIP                               | 1    |                                | Fairchild    | U3          |
| IC FAN6921 SMD                               | 1    | SOIC-16                        | Fairchild    | U1          |
| FUSE MICRO RST 250V4A                        | 1    | Time-Lag<br>8.5*4.0mm          | Walter       | F1          |
| Varistor 7 φ 470V                            | 1    |                                |              | MOV1        |
| INLET 2P 90°                                 | 1    | R-201SN90(B06)                 | Rich Bay     | CN1         |
| Heat Sink(Pri) HS1                           | 1    | 120*20*3                       | Shun Ten     | HS1         |
| Heat Sink(Sec) HS2-1                         | 1    | 72*20*3                        | Shun Ten     | HS2         |
| PCB FCS0413 REV 1                            | 1    | For FAN6921<br>EVB 1*4         |              |             |





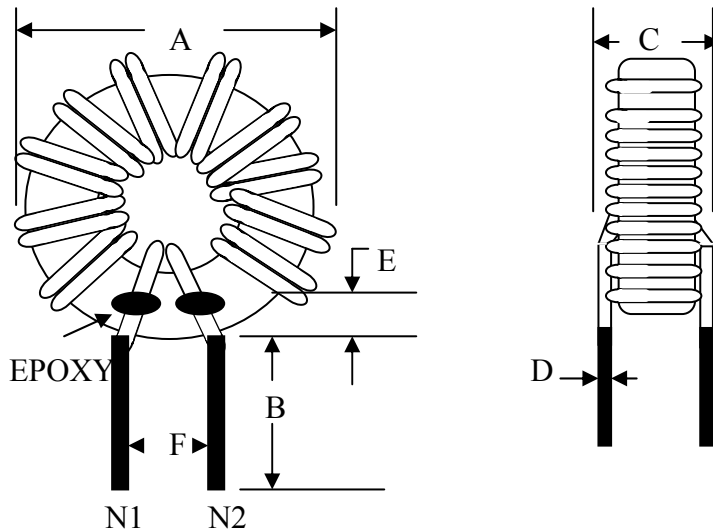
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|-----------|---------------------------------------|---------------|-------------------------------|
| Doc.Title | FEB400-001 Transformer Spec. Approval | Instituted by | SEN HUEI INDUSTRIAL CO., LTD. |
|-----------|---------------------------------------|---------------|-------------------------------|

SPECIFICATION APPROVAL

|          |                      |         |   |      |          |
|----------|----------------------|---------|---|------|----------|
| Customer | SYSTEM GENERAL CORP. |         |   | P/N: | TRN-0003 |
| DATE     | 01/02/2004           | Version | A | Page | 1/1      |

1. DIMENSION :

UNIT : mm



|   |            |
|---|------------|
| A | 16.5 max   |
| B | 10 ± 0.3   |
| C | 9.5 max    |
| D | φ0.5 ± 0.1 |
| E | 2.0 min    |
| F | 7.5 ± 0.5  |

2. ELECTRICAL SPECIFICATION : at 1KHz, 0.3V

- 2.1 INDUCTANCE : L1=L2=900 uH min
- 2.2 DC RESISTANCE : R1=R2=37 m Ohm max
- 2.3 TURN & WIRE : N1 : φ0.50x11.5TS(TEX-E)  
: N2 : φ0.50x11.5TS(2UEW)

MATERIALS LIST :

| COMPONENT | MAT'L             | MANUFACTURE   | UL FILE NO. |
|-----------|-------------------|---|-------------|
| 1. CORE   | NC-10H<br>N10.A10 | Ferrite core T12.7x7.9x7.35<br>Nicea, Encore, Acme. |             |
| 2. WIRE   | UEW-B             | Chuen Yih wire co.,ltd                              | E154709(S)  |
|           | UEW-2             | Jung Shing wire co.,ltd                             | E79029(S)   |
|           | UEW               | Tai-l electric wire & cable co.,ltd                 | E85640(S)   |
|           | TEX-E             | Furukawa electric co.,ltd                           | E157568(S)  |
| 3. EPOXY  | G-500             | Fair reach corp.                                    |             |

|  |              |                               |                |            |          |
|--|--------------|-------------------------------|----------------|------------|----------|
| UNIT   | m/m          | DRAWN                         | CHECK          | TITLE      |          |
| TEL  | (02)29450588 | Ci wun Chen                   | Guo long Huang | IDENT N O. | TRN-0003 |
| FAX  | (02)29447647 | SEN HUEI INDUSTRIAL CO., LTD. |                | D W G NO.  | I0008    |
| No.26-1, Lane 128, Sec. 2, Singnan Rd., Jhonghe City, Taipei County 235, Taiwan (R.O.C.) |              |                               |                |            |          |

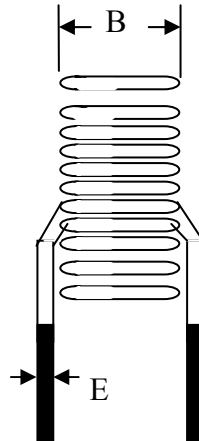
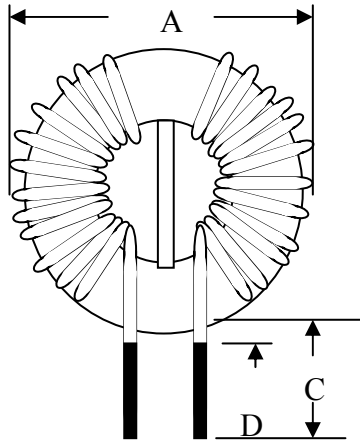


|           |                                       |               |                               |
|-----------|---------------------------------------|---------------|-------------------------------|
| Doc.Title | FEB400-001 Transformer Spec. Approval | Instituted by | SEN HUEI INDUSTRIAL CO., LTD. |
|-----------|---------------------------------------|---------------|-------------------------------|

SPECIFICATION APPROVAL

|          |                      |         |      |          |     |
|----------|----------------------|---------|------|----------|-----|
| Customer | SYSTEM GENERAL CORP. |         | P/N: | TRN-0211 |     |
| DATE     | 03/05/2007           | Version | A    | Page     | 1/1 |

1. DIMENSION :



UNIT : mm

|   |           |
|---|-----------|
| A | 25 max    |
| B | 15 max    |
| C | 5 ± 1     |
| D | 1 max     |
| E | φ0.65±0.1 |

2. ELECTRICAL SPECIFICATION : at 1KHz, 1V

- 2.1 INDUCTANCE : L1=L2 : 9.0 mH min
- 2.2 DC RESISTANCE : L1=L2 : 0.78 Ohm max
- 2.3 TURN & WIRE : L1=L2 : φ0.65 x 37.5TS

MATERIALS LIST :

| COMPONENT | MAT'L                      | MANUFACTURE                         | UL FILE NO. |
|-----------|----------------------------|-------------------------------------|-------------|
| 1. CORE   | T18x10x7                   | core T18x10x7<br>TOMITA.            |             |
| 2. WIRE   | THFN-216                   | Ta ya electric wire co.,ltd         | E197768     |
|           | UEWN/U                     | PACIFIC wire & cable co.,ltd        | E201757     |
|           | UEWE                       | Tai-l electric wire & cable co.,ltd | E85640      |
|           | UWY                        | Jang shing wire co.,ltd             | E174837     |
| 3. SOLDER | 96.5% Sn,3%<br>Ag,0.5% Cu, | Xin Yuan co.,ltd                    |             |

|  |              |                              |                |            |          |
|--|--------------|------------------------------|----------------|------------|----------|
| UNIT   | m/m          | DRAWN                        | CHECK          | TITLE      |          |
| TEL  | (02)29450588 | Ci wun Chen                  | Guo long Huang | IDENT N O. | TRN-0211 |
| FAX  | (02)29447647 | SEN HUEI INDUSTRIAL CO.,LTD. |                | D W G NO.  | I0060    |
| No.26-1, Lane 128, Sec. 2, Singnan Rd., Jhonghe City, Taipei County 235, Taiwan (R.O.C.) |              |                              |                |            |          |

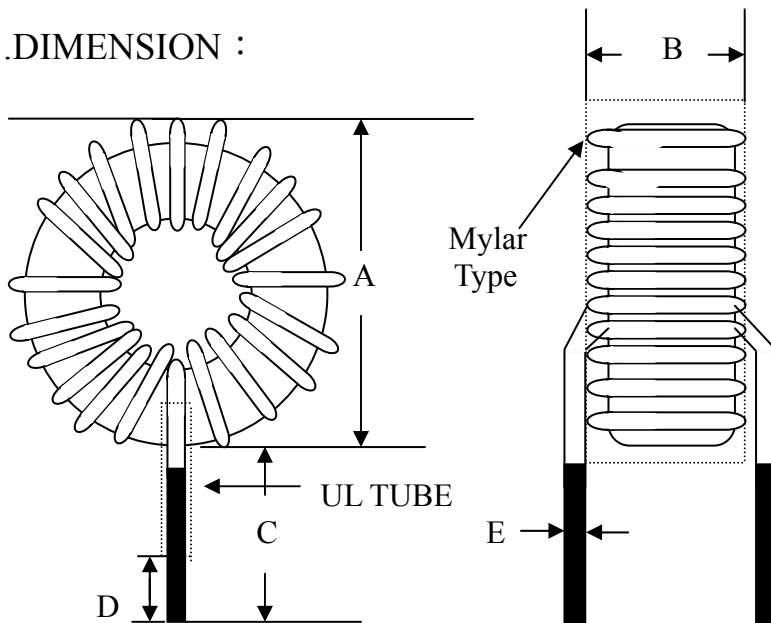


|           |                                       |               |                               |
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| Doc.Title | FEB400-001 Transformer Spec. Approval | Instituted by | SEN HUEI INDUSTRIAL CO., LTD. |
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SPECIFICATION APPROVAL

|          |                      |         |      |          |     |
|----------|----------------------|---------|------|----------|-----|
| Customer | SYSTEM GENERAL CORP. |         | P/N: | TRN-0184 |     |
| DATE     | 04/02/2004           | Version | A    | Page     | 1/1 |

1. DIMENSION :



UNIT : mm

|   |          |
|---|----------|
| A | 19.5 max |
| B | 11.5.max |
| C | 10 ± 1   |
| D | 5 ± 1    |
| E | φ0.6±0.1 |

2. ELECTRICAL SPECIFICATION : at 1KHz, 0.25V

- 2.1 INDUCTANCE : L1=400 uH ± 20%
- 2.2 DC RESISTANCE : R1=0.15 mOhm max
- 2.3 TURN & WIRE : N1 : φ0.60x84TS(2UEW)

MATERIALS LIST :

| COMPONENT | MAT'L            | MANUFACTURE                         | UL FILE NO. |
|-----------|------------------|-------------------------------------|-------------|
| 1. CORE   | 6026<br>Or equal | core 6026<br>TECH-MOUNT.            |             |
| 2. WIRE   | UEW-B            | Chuen Yih wire co.,ltd              | E154709(S)  |
|           | UEW-2            | Jung Shing wire co.,ltd             | E79029(S)   |
|           | UEW              | Tai-l electric wire & cable co.,ltd | E85640(S)   |

| UNIT   | m/m          | DRAWN                        | CHECK          | TITLE      |          |
|--|--------------|------------------------------|----------------|------------|----------|
| TEL  | (02)29450588 | Ci wun Chen                  | Guo long Huang | IDENT N O. | TRN-0184 |
| FAX  | (02)29447647 | SEN HUEI INDUSTRIAL CO.,LTD. |                | D W G NO.  | I0051    |
| No.26-1, Lane 128, Sec. 2, Singnan Rd., Jhonghe City, Taipei County 235, Taiwan (R.O.C.) |              |                              |                |            |          |

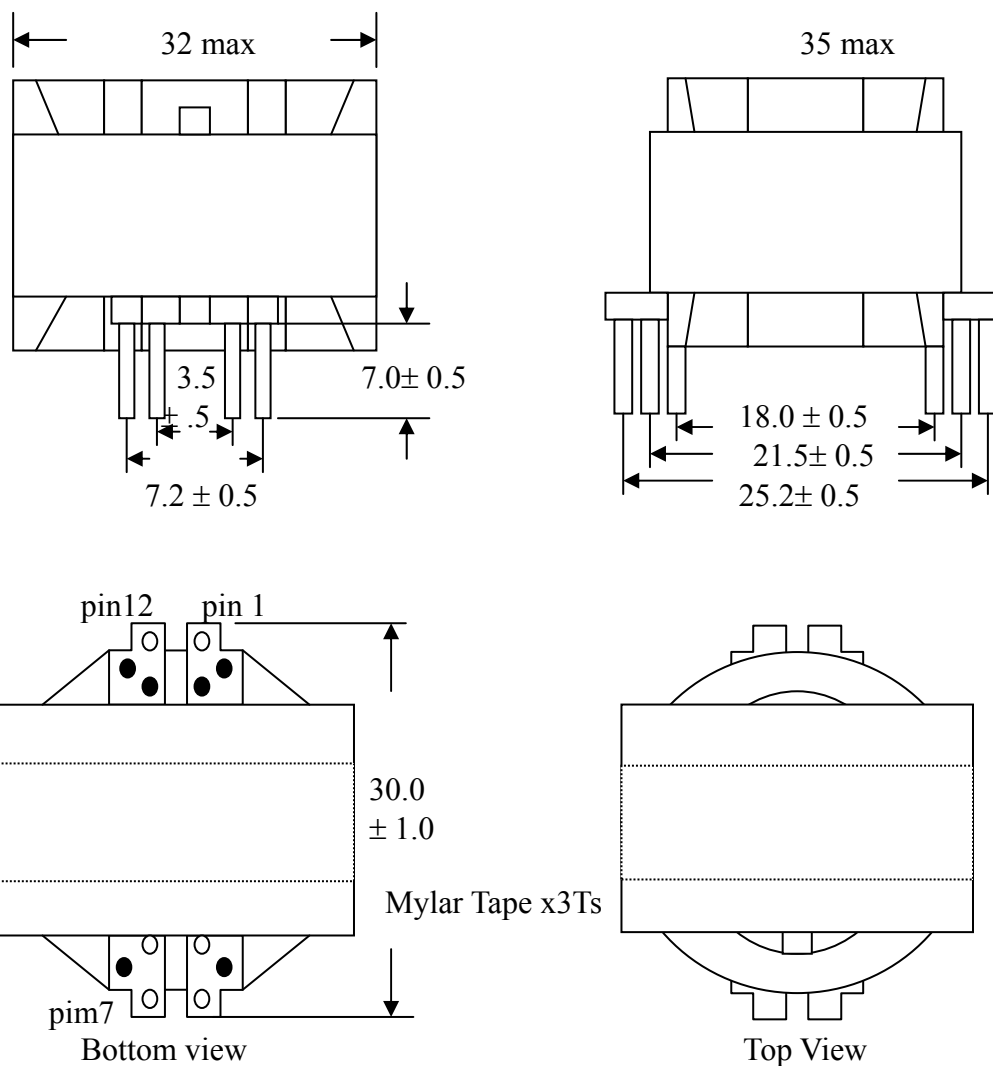


|           |                                       |               |                               |
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SPECIFICATION APPROVAL

|          |                      |         |   |      |          |
|----------|----------------------|---------|---|------|----------|
| Customer | SYSTEM GENERAL CORP. |         |   | P/N: | TRN-0290 |
| DATE     | 08/02/2010           | Version | A | Page | 1/4      |

1.DIMENSION : Unit : mm



- Note :
- 1.Cut off Pin 1,4,6,7,9,12
  2. Copper Foil tape 7mmx7 fix core .
  3. Add insulation tape \*1 turns to fix core and bobbin.

|  |              |                              |                |            |         |
|--|--------------|------------------------------|----------------|------------|---------|
| UNIT   | m/m          | DRAWN                        | CHECK          | TITLE      |         |
| TEL  | (02)29450588 | Ci wun Chen                  | Guo long Huang | IDENT N O. | TRN0290 |
| FAX  | (02)29447647 | SEN HUEI INDUSTRIAL CO.,LTD. |                | D W G N O. |         |
| No.26-1, Lane 128, Sec. 2, Singnan Rd., Jhonghe City, Taipei County 235, Taiwan (R.O.C.) |              |                              |                |            |         |

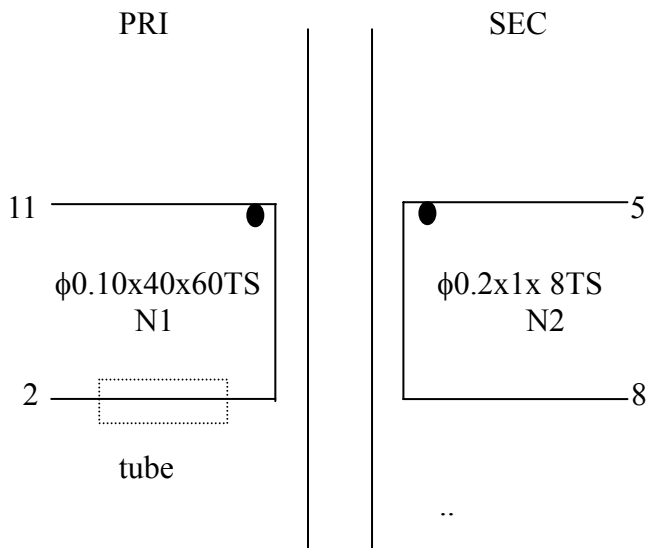


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|-----------|---------------------------------------|---------------|-------------------------------|
| Doc.Title | FEB400-001 Transformer Spec. Approval | Instituted by | SEN HUEI INDUSTRIAL CO., LTD. |
|-----------|---------------------------------------|---------------|-------------------------------|

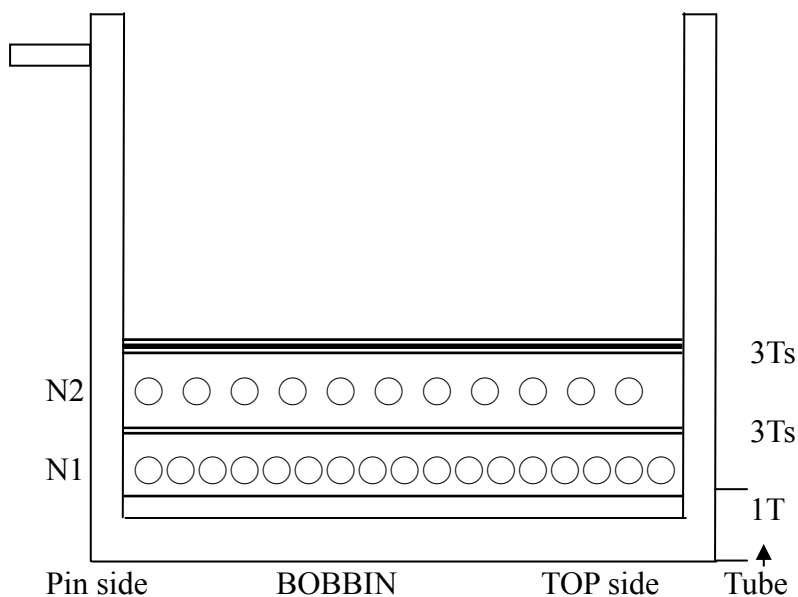
## SPECIFICATION APPROVAL

|          |                      |         |      |          |     |
|----------|----------------------|---------|------|----------|-----|
| Customer | SYSTEM GENERAL CORP. |         | P/N: | TRN-0290 |     |
| DATE     | 08/02/2010           | Version | A    | Page     | 2/4 |

### 2. SCHEMATIC :



### 2.1 SCHEMATIC :



|  |              |                              |                |            |         |
|--|--------------|------------------------------|----------------|------------|---------|
| UNIT   | m/m          | DRAWN                        | CHECK          | TITLE      |         |
| TEL  | (02)29450588 | Ci wun Chen                  | Guo long Huang | IDENT N O. | TRN0290 |
| FAX  | (02)29447647 | SEN HUEI INDUSTRIAL CO.,LTD. |                | D W G N O. |         |
| No.26-1, Lane 128, Sec. 2, Singnan Rd., Jhonghe City, Taipei County 235, Taiwan (R.O.C.) |              |                              |                |            |         |



|           |                                       |               |                               |
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## SPECIFICATION APPROVAL

|          |                      |         |   |      |          |
|----------|----------------------|---------|---|------|----------|
| Customer | SYSTEM GENERAL CORP. |         |   | P/N: | TRN-0290 |
| DATE     | 08/02/2010           | Version | A | Page | 3/4      |

### 3.ELECTRICAL SPECIFICATION :

3.1 Inductance test : at 1KHz ,1V

P(11-2) : 385 uH ± 5%

3.2 DC Resistance test at 25 ° C

P(11-2) : 142 mOhmo max

P(5-8) : 88 mOhmo

3.3 Hi-pot test :

AC 1.0 KV/60Hz/0.5mA hi-pot for one minute between pri to sec.

AC 1.0 KV/60Hz/0.5mA hi-pot for one minute between pri to core.

3.5 Insulation test :

The insulation resistance is between pri to sec and windings to core measured by DC 500V, must Be over 100 MOhm.

3.6 Terminal strength :

1.0 Kg on terminals for 30 seconds, test the breakdown.

|   |              |                              |                |               |         |
|---|--------------|------------------------------|----------------|---------------|---------|
| UNIT  | m/m          | DRAWN                        | CHECK          | TITLE         |         |
| TEL   | (02)29450588 | Ci wun Chen                  | Guo long Huang | IDENT<br>N O. | TRN0290 |
| FAX   | (02)29447647 | SEN HUEI INDUSTRIAL CO.,LTD. |                | D W G<br>N O. |         |
| No.26-1, Lane 128, Sec. 2,<br>Singnan Rd., Jhonghe City,<br>Taipei County 235, Taiwan<br>(R.O.C.) |              |                              |                |               |         |



|           |                                       |               |                               |
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| Doc.Title | FEB400-001 Transformer Spec. Approval | Instituted by | SEN HUEI INDUSTRIAL CO., LTD. |
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## SPECIFICATION APPROVAL

|          |                      |         |   |      |          |
|----------|----------------------|---------|---|------|----------|
| Customer | SYSTEM GENERAL CORP. |         |   | P/N: | TRN-0290 |
| DATE     | 08/02/2010           | Version | A | Page | 4/4      |

MATERIALS LIST : (UL: E196468)

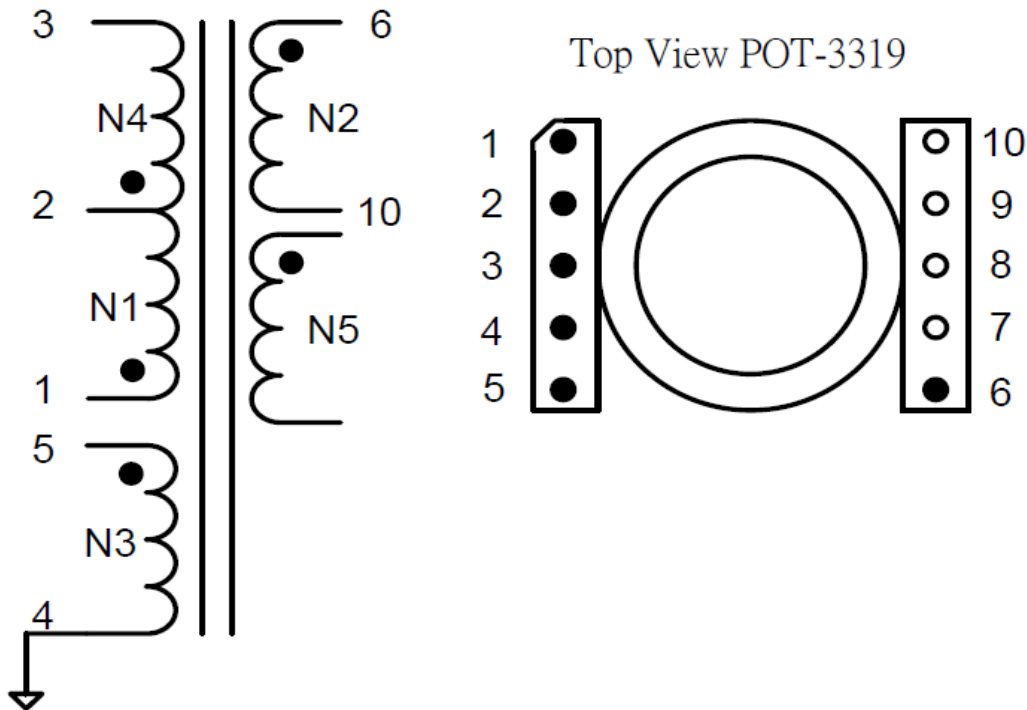
| COMPONENTM         | MAT'L                            | MANUFACTURE  | FILE NO.      |
|--------------------|----------------------------------|--|---------------|
| 1.Bobbin           | Phenolic<br>94v-0,T373J,150°C    | RM-10<br>Chang Chun plastics co. ltd.                | E59481(S)     |
| 2.Core             | PC-40,BH2                        | Ferrite core RM-10<br>TDK, Tokin.                    |               |
| 3.Wire             | UEWE<br>130°C                    | Tai-I electric wire & cable co ltd.                  | E85640 ( S )  |
|                    | UEW-2<br>130°C                   | Jung Shing wire co.,ltd                              | E174837       |
|                    | UEW-B<br>130°C                   | Chuen Yih wire co.,ltd                               | E154709 ( S ) |
| 4.Varnish          | BC-346A<br>180°C                 | John C Dolph co.,itd.                                | E51047 ( M )  |
|                    | 468-2FC<br>130°C                 | Ripley resin engineering co inc.                     | E81777 ( N )  |
| 5.Tape<br>0.025tmm | Polyester 3M<br>#1350 130°C      | Minnesota mining & MFG co.,ltd.                      | E17385 ( N )  |
|                    | #31CT 130°C                      | Nitto denko corp                                     | E34833 ( M )  |
| 6.Tube             | Teflon tube<br>TFS<br>600V,200°C | Great holding industriat co.,ltd.                    | E156256 ( S ) |
| 7.Terminals        | Tin coated-<br>Copper wire       | Will fore special wire corp                          |               |
| 8.Shield           | Copper foil                      | Hitachi cable ltd.<br>(copper foil : 0.05tx7mm+TAPE) |               |

|   |              |                              |                |               |         |
|---|--------------|------------------------------|----------------|---------------|---------|
| UNIT  | m/m          | DRAWN                        | CHECK          | TITLE         |         |
| TEL   | (02)29450588 | Ci wun Chen                  | Guo long Huang | IDENT<br>N O. | TRN0290 |
| FAX   | (02)29447647 | SEN HUEI INDUSTRIAL CO.,LTD. |                | D W G<br>N O. |         |
| No.26-1, Lane 128, Sec. 2,<br>Singnan Rd., Jhonghe City,<br>Taipei County 235, Taiwan<br>(R.O.C.) |              |                              |                |               |         |



|           |                                       |               |  |
|-----------|---------------------------------------|---------------|--|
| Doc.Title | FEB400-001 TRN-0291 Transformer Spec. | Instituted by |  |
|-----------|---------------------------------------|---------------|--|

Electrical:



Structure:

| Winding                                       | Terminal   | Wire Gauge(mm) | Turns(T) | Note           |
|---|------------|----------------|----------|----------------|
| <b>Bobbin-POT-3319</b>                        |            |                |          |                |
| N1  | 1 – 2      | 0.45mm*1       | 21       | P.S. A         |
| <b>Mylar Tape *3T</b>                         |            |                |          |                |
| <b>Copper-Foil Tape →Pin4 1.1T open loop</b>  |            |                |          |                |
| <b>Mylar Tape *3T</b>                         |            |                |          |                |
| N2  | 6-fly line | 0.55mm*2       | 6        | P.S. B, P.S. C |
| <b>Mylar Tape *3T</b>                         |            |                |          |                |
| N3  | 5 – 4      | 0.3mm*1        | 6        | P.S. D         |
| <b>Mylar Tape *3T</b>                         |            |                |          |                |
| N4  | 2 – 3      | 0.45mm*1       | 20       | P.S. A         |
| <b>Mylar Tape *3T</b>                         |            |                |          |                |
| <b>Copper-Foil Tape →Pin4 1.1T open loop</b>  |            |                |          |                |
| <b>Mylar Tape *3T</b>                         |            |                |          |                |
| N5  | 6-fly line | 0.55mm*2       | 6        | P.S. B, P.S. C |
| <b>Mylar Tape *3T</b>                         |            |                |          |                |
| <b>Core-POT-3319</b>                          |            |                |          |                |
| <b>Mylar Tape *3T</b>                         |            |                |          |                |
| <b>Copper-Foil Tape →Pin4 1.1T close loop</b> |            |                |          |                |
| <b>Mylar Tape *3T</b>                         |            |                |          |                |





|           |                                       |               |  |
|-----------|---------------------------------------|---------------|--|
| Doc.Title | FEB400-001 TRN-0291 Transformer Spec. | Instituted by |  |
|-----------|---------------------------------------|---------------|--|

P.S. A: Startpoint and endpoint of the wire must be added with Teflon tube.

P.S. B: Use triple insulated wire.

As for beginning point, wind from pin 6 and welding on it. After finishing 2nd turns, end point of 5.7cm long wire must be left with 1cm long for soldering. Teflon tube is added in the beginning & end point besides winding in the transformer.

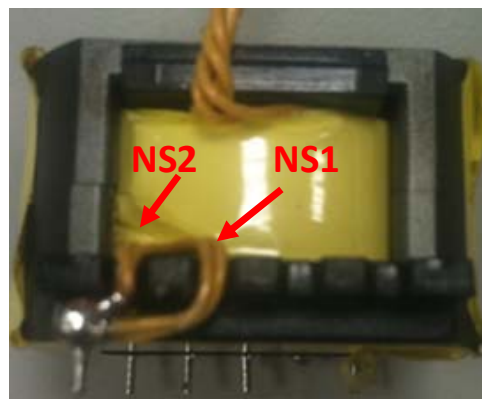
P.S. C: After welding, the length of pin 6 must be larger than 3mm,

The length of the pin →  
3mm



Solder joint

as show in figure.



NS1 and NS2 , as show in figure.

P.S. D: Have the wire loose in the middle of the transformer. Startpoint and endpoint of the wire must be added with Teflon tube.

P.S.E: Copper with width 7mm is used and covered as Fig. 1.

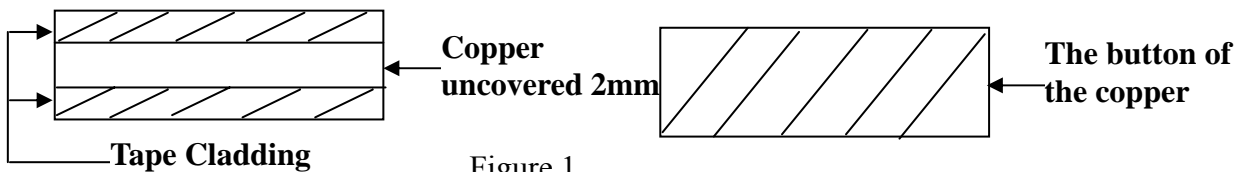


Figure 1

P.S. F: Remove pin 7, 8, 9, and 10, and cut pin 2.

Insert glue in the middle of the core, whose area needs to be larger than 70% of whole area. Twice varnishment needs to be done.

Inductance:

Pin3~Pin1: **700uH +/- 5% REF(1KHz/1V)..**

Bobbin: POT-3319

Core: POT-3319



|           |                                       |               |  |
|-----------|---------------------------------------|---------------|--|
| Doc.Title | FEB400-001 TRN-0291 Transformer Spec. | Instituted by |  |
|-----------|---------------------------------------|---------------|--|

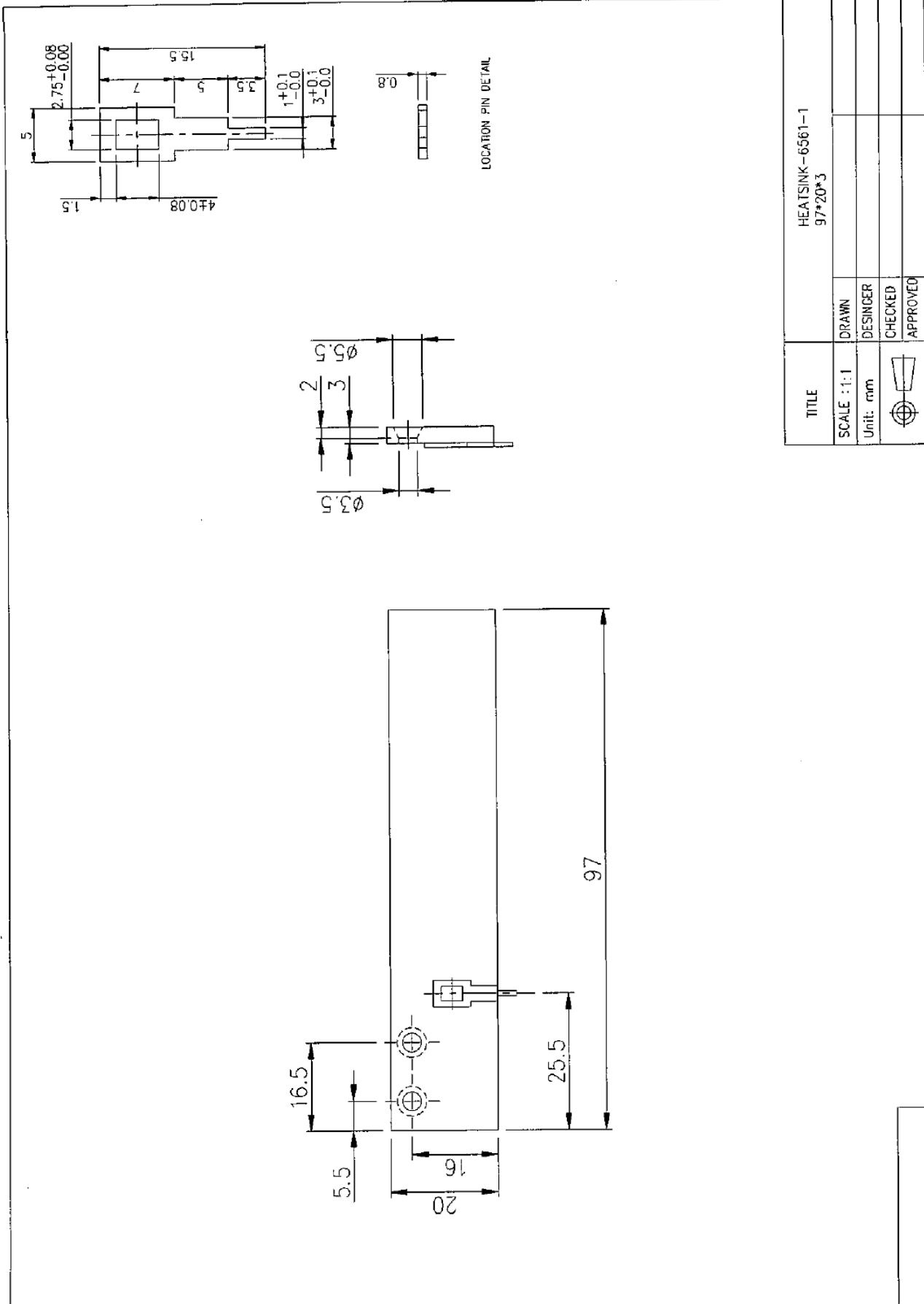
Materials List:

| COMPONENTM  | MAT'L                            | MANUFACTURE  | FILE NO.   |
|-------------|----------------------------------|--|------------|
| 1.Bobbin    | Phenolic                         | POT-3319.<br>Taiwan Shulin Enterprise co. ltd.               | E59481(S)  |
| 2.Core      | PC-44,BH2,2E6<br>3C85,NC-2H,     | Ferrite core POT-3319<br>TDK, Tokin. Tomita. Philip. Nicera. |            |
| 3.Wire      | UEWE<br>130°C                    | Tai-I electric wire & cable co ltd.                          | E85640(S)  |
|             | UEW-2<br>130°C                   | Jung Shing wire co.,ltd                                      | E174837    |
|             | UEW-B<br>130°C                   | Chuen Yih wire co.,ltd                                       | E154709(S) |
|             | TEX-E<br>105°C/120°C             | Furukawa electric co.,ltd.                                   | E206440    |
| 4.Varnish   | BC-346A<br>180°C                 | John C Dolph co.,itd.  | E51047(M)  |
|             | 468-2FC<br>130°C                 | Ripley resin engineering co inc.                             | E81777(N)  |
| 5.Tape      | 31CT 130°C                       | Nitto denk corp  | E34833(M)  |
|             | Polyester 3M<br>#1350(b) 130°C   | Minnesota mining & MFG co.,ltd.<br>CTI material group II     | E17385(N)  |
| 6.Tube      | Teflon tube<br>TFL<br>150V,200°C | Great holding industriat co.,ltd.                            | E156256(S) |
| 7.Terminals | Tin coated-<br>Copper wire       | Will fore special wire corp                                  |            |
| 8.Shield    | Copper foil                      | Hitachi cable lid.   |            |





|           |                             |               |  |
|-----------|-----------------------------|---------------|--|
| Doc.Title | FEB400-001 MCH0456 HS Spec. | Instituted by |  |
|-----------|-----------------------------|---------------|--|



|             |                            |          |         |          |
|-------------|----------------------------|----------|---------|----------|
| TITLE       | HEATSINK-6561-1<br>97*20*3 |          |         |          |
| SCALE : 1:1 | DRAWN                      | DESIGNER | CHECKED | APPROVED |
| Unit: mm    |                            |          |         |          |
|             |                            |          |         |          |