# MP020

## Customer Support Report

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAE</td>
<td>Alan Zhu</td>
</tr>
<tr>
<td>AE</td>
<td>Siran Wang</td>
</tr>
<tr>
<td>Manager</td>
<td>En Li</td>
</tr>
</tbody>
</table>
Contents

1. Specification
2. Schematic
3. Circuit Board
   3.1 PCB Layout
   3.2 Board Photograph
4. Bill of Materials
5. Transformer Information
   5.1 Winding Spec
6. Performance Data
   6.1 Test Setup
      6.1.1 Test Equipment
   6.2 Efficiency
      6.2.1 Efficiency
      6.2.1 No Load Power Consumption
   6.3 Output and Timing
      6.3.1 Load Regulation
      6.3.2 Output Voltage Ripple
      6.3.3 Startup Time
6.4 Protection
   6.4.1 Short Circuit Protection
   6.4.3 Over Load Protection
6.5 EMC and Safety
   6.5.1 Conducted Emission
6.6 Stress and Steady Status
   6.6.1 Steady Status
   6.6.2 Mosfet VDS
   6.6.3 Output Diode VRRM
6.7 Thermal
   6.7.1 Parts Thermal
## 1. Specification

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Supply Voltage</td>
<td>$V_{IN}$</td>
<td>2 Wire</td>
<td>85</td>
<td>220</td>
<td>265</td>
<td>VAC</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>$V_O$</td>
<td></td>
<td>9</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>LED Current</td>
<td>$I_{LED}$</td>
<td></td>
<td>600</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>
3. Circuit Board

3.1 PCB Layout

TOP & TSK

BOT & BSK
3. Circuit Board

3.2 Board Photograph

L*W*H=49mm*32mm*15mm

Note: Dimension is strongly needed.
## 4. Bill of Materials

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>RefDes</th>
<th>Value</th>
<th>Description</th>
<th>Package</th>
<th>Manufacturer</th>
<th>Manufacturer_P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>C1</td>
<td>4.7uF</td>
<td>Electrolytic Capacitor;400V</td>
<td>DIP</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>C2</td>
<td>2.2uF</td>
<td>Electrolytic Capacitor;400V</td>
<td>DIP</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>C3</td>
<td>4.7uF</td>
<td>Electrolytic Capacitor;50V</td>
<td>DIP</td>
<td>Jianghai</td>
<td>CD287-50V4.7</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>C4</td>
<td>470pF</td>
<td>Ceramic Capacitor;1000V</td>
<td>DUP</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>C5</td>
<td>470uF</td>
<td>Electrolytic Capacitor;16V</td>
<td>DIP</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>CY1</td>
<td>1nF</td>
<td>Y1 Capacitor;4000V</td>
<td>DIP</td>
<td>Hongke</td>
<td>JN09E102MY02N</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>D2,3,5,6</td>
<td>1N4007</td>
<td>Diode;1000V;1A;</td>
<td>DO-41</td>
<td>Diodes</td>
<td>1N4007</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>D7</td>
<td>WS364</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>FR1</td>
<td>10</td>
<td>Fuse Resistor;5%;1W</td>
<td>DIP</td>
<td>Yageo</td>
<td>FKN1WSJT-52-10R</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>L1</td>
<td>1mH</td>
<td>Inductor;1mH;8;100mA</td>
<td>DIP</td>
<td>Yageo</td>
<td>CKL0510-102</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>R1</td>
<td>10K</td>
<td>Film Resistor;5%;</td>
<td>0805</td>
<td>Yageo</td>
<td>RC0805JR-0710KL</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>R2</td>
<td>0</td>
<td>Film Resistor;5%;</td>
<td>0805</td>
<td>Yageo</td>
<td>RC0805JR-070L</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>R3</td>
<td>200K</td>
<td>Film Resistor;5%;</td>
<td>1206</td>
<td>Yageo</td>
<td>RC1206JR-07200KL</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>R4</td>
<td>200</td>
<td>Film Resistor;5%;</td>
<td>1206</td>
<td>Yageo</td>
<td>RC1206JR-07200L</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>R5</td>
<td>14.7K</td>
<td>Film Resistor;1%;</td>
<td>0603</td>
<td>Yageo</td>
<td>RC0603FR-0714K7L</td>
</tr>
<tr>
<td>16</td>
<td>1</td>
<td>R6</td>
<td>26.7K</td>
<td>Film Resistor;1%;</td>
<td>0603</td>
<td>Yageo</td>
<td>RC0603FR-0726K7L</td>
</tr>
<tr>
<td>17</td>
<td>1</td>
<td>R7</td>
<td>6.2K</td>
<td>Film Resistor;5%;</td>
<td>0805</td>
<td>Yageo</td>
<td>RC0805JR-076K2L</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
<td>T1</td>
<td>EE16,N1 inductance=1.59mH, N0:N1:N2:N3=44:132:17:14</td>
<td>DIP</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>1</td>
<td>U1</td>
<td>MP020</td>
<td>MP020, primary side regulator</td>
<td>SOIC8-7A</td>
<td>MPS</td>
<td>MP020</td>
</tr>
</tbody>
</table>

* Derived from the customer’s board.
5. Transformer Information

5.1 Winding Spec

Electric Characteristic

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Inductance</td>
<td>L_p (1-4)</td>
<td>1.589mH ± 5%</td>
</tr>
<tr>
<td>Leakage Inductance</td>
<td></td>
<td>50µH (Max)</td>
</tr>
<tr>
<td>Core/Bobbin</td>
<td></td>
<td>EE16</td>
</tr>
<tr>
<td>Core material</td>
<td></td>
<td>PC40</td>
</tr>
</tbody>
</table>

Winding Order

<table>
<thead>
<tr>
<th>Tape Layer</th>
<th>Winding No.</th>
<th>Margin Tape (Pri. Side)</th>
<th>Start &amp; End</th>
<th>Margin Tape (Sec. Side)</th>
<th>Turns</th>
<th>Magnet Wire (Φ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ncomp</td>
<td>\</td>
<td>1 to NC</td>
<td>\</td>
<td>44</td>
<td>0.15*1</td>
</tr>
<tr>
<td>1</td>
<td>Np</td>
<td>\</td>
<td>2 to 1</td>
<td>\</td>
<td>132</td>
<td>0.2*1</td>
</tr>
<tr>
<td>1</td>
<td>Naux</td>
<td>\</td>
<td>5 to 4</td>
<td>\</td>
<td>17</td>
<td>0.15*1</td>
</tr>
<tr>
<td>3</td>
<td>Ns</td>
<td>\</td>
<td>10 to 6</td>
<td>\</td>
<td>14</td>
<td>T.I.W0.6*1</td>
</tr>
</tbody>
</table>

Electrical Diagram

Winding Diagram
6. Performance Data

6.1 Test Setup

6.1.1 Test Equipment

- **AC Source:** Chroma, Model 61601
- **Power Meter:** Yokogawa, Model WT210
- **Oscilloscope:** Tektronix, Model TDS3014C
- **Current Probe/Amplifier:** Tektronix, Model TCP305/TCPA300
- **EMC Receiver:** Rohde & Schwarz, Model ESPI3+ESPI-B2
6.2 Efficiency

6.2.1 Efficiency

Test Conditions:
- The unit was set to maximum load and well pre-heated until temperature stabilization was achieved.

Criteria To Pass:
- The average efficiency must be > 75%

<table>
<thead>
<tr>
<th>Pin(W)</th>
<th>Vo(V)</th>
<th>Io(mA)</th>
<th>Po(W)</th>
<th>Efficiency(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>220Vac</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.81</td>
<td>9.04</td>
<td>150</td>
<td>1.36</td>
<td>74.9</td>
</tr>
<tr>
<td>3.54</td>
<td>9.05</td>
<td>300</td>
<td>2.72</td>
<td>76.7</td>
</tr>
<tr>
<td>5.25</td>
<td>9.05</td>
<td>450</td>
<td>4.07</td>
<td>77.6</td>
</tr>
<tr>
<td>6.95</td>
<td>9.05</td>
<td>600</td>
<td>5.43</td>
<td>78.1</td>
</tr>
</tbody>
</table>

Comment: Pass
6.2.2 No-load Power Consumption

**Test Conditions:**
- The unit was set to maximum load and well pre-heated.
- The no-load input power measurements were recorded after stabilization of the input power reading.

**Criteria To Pass:**
- The power consumption must be < 100mW at the maximum input voltage.

<table>
<thead>
<tr>
<th>V\text{AC} (mW)</th>
<th>220V</th>
<th>265V</th>
</tr>
</thead>
<tbody>
<tr>
<td>P\text{IN}(mW)</td>
<td>24.5mW</td>
<td>29.2mW</td>
</tr>
</tbody>
</table>

**Comment: Pass**
6. Performance Data

6.3 Output and Timing

6.3.1 Load Regulation

Test Conditions:

- The output voltage deviation was measured while the load current was increased from 0 to 600mA

Criteria To Pass:

- The output voltage must remain within ±2%.

Comment: Pass
6. Performance Data

6.3.2 Output Voltage Ripple

Test Conditions:
➢ The output voltage ripple and noise are measured at output terminal with full load.

Criteria To Pass:
➢ The ripple of the output current must remain within the specified limits $V_{p-p}$: 500mV at a maximum load current.

![Graph showing output voltage ripple](image)

**CH1: V_OUT**

$V_{p-p}$: 270mV

Comment: Pass
6.3.3 Startup Time

Test Conditions:
- The Unit starts with full load.
- The startup time is measured from the time when Vcc voltage starts ramping up to the time when the output voltage ramps to 90% of the rated value.

Criteria To Pass:
- The startup time must remain in 1 second.

**220V_{\text{AC}} \text{ Input} / 600mA \text{ Output}**

Startup Time: 190ms

Comment: Pass
6. Performance Data

6.4 Protection

6.4.1 Short Circuit Protection (SCP)

Test Conditions:

➢ The unit was switched on with normal load on the output. A short circuit was applied manually to the output at the end of the cable. The mains voltage was adopted to obtain the worst-case condition.

➢ A short circuit was applied to the output at the end of the cable before startup of the unit. The unit was switched on with a short circuit at the output. The mains voltage was adopted to obtain the worse-case condition.

Criteria To Pass:

➢ The unit shall be capable of withstanding a continuous short-circuit at the output without damage or overstress of the unit under any input conditions.

➢ After removal of the short circuit, the unit shall recover automatically.

<table>
<thead>
<tr>
<th>V_{AC}</th>
<th>220</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCP</td>
<td>ok</td>
</tr>
</tbody>
</table>
# 6. Performance Data

## SCP at $220V_{AC}$

<table>
<thead>
<tr>
<th>SCP Entry</th>
<th>SCP Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH1: $V_{DS}$</td>
<td>CH1: $V_{DS}$</td>
</tr>
<tr>
<td>CH2: $V_{CC}$</td>
<td>CH2: $V_{CC}$</td>
</tr>
<tr>
<td>CH3: $V_{OUT}$</td>
<td>CH3: $V_{OUT}$</td>
</tr>
</tbody>
</table>

Comment: Pass

[Graphs showing waveform data for SCP Entry and SCP Recovery with channels CH1, CH2, and CH3.]
6.4.2 Over Load Protection (OLP)

Test Conditions:
- An overload condition was applied to the unit;
- An AC input voltage was selected so that the worst-case condition occurred.

Criteria To Pass:
- The unit should be operating in the constant current mode, in order to prevent the overload operation.

<table>
<thead>
<tr>
<th>Input</th>
<th>220</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCP</td>
<td>ok</td>
</tr>
</tbody>
</table>
V-I Characteristics at $220V_{AC}$
6.5 EMC and Safety

6.5.1 Conducted Emission

Test Conditions:
- The unit was subjected to $220\text{V}_{\text{AC}}$ line and with maximum load.
- The ground connection of the output cable was connected to EMC ground.

Criteria To Pass:
- EN55022 with -8dB margin.

Comment: Pass
6.6 Stress and Steady Status

6.6.1 Steady Status

Test Conditions:
- The main input voltage was set to $220V_{AC}$.
- The unit is loaded at maximum output current.

Criteria To Pass:
- The $V_{DS}$, $V_{CC}$, $V_{OUT}$ should be at steady status.

Comment: Pass
6.6.2 Mosfet $V_{DS}$

Test Conditions:
- The main input voltage was set to $265V_{AC}$.
- The unit is loaded at maximum output current.

Criteria To Pass:
- The mosfet $V_{DS}$ must be $< 700V$ at both startup and steady status.

<table>
<thead>
<tr>
<th>Steady</th>
<th>Startup</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Steady Startup Graph" /></td>
<td><img src="image2" alt="Startup Graph" /></td>
</tr>
</tbody>
</table>

**V_{MAX}: 576V**

**Comment: Pass**
6.6.3 Output Diode $V_{RRM}$

Test Conditions:

- The main input voltage was set to $265\,V_{AC}$.
- The unit is loaded at maximum output current.

Criteria To Pass:

- The diode $V_{RRM}$ must be $< 80\,V$ at both startup and steady status.

### Steady

- **CH1:** $V_{RRM}$
  - **$V_{MAX}$:** 54V

### Startup

- **CH1:** $V_{RRM}$
  - **$V_{MAX}$:** 54.2V

**Comment:** Pass
6. Performance Data

6.7 Thermal

6.7.1 Parts Thermal

Test Conditions:
- The input voltage was set to 220 Vac.
- The electronic load was set to the maximum output current.
- The unit was covered, and the data was recorded until temperature stabilization was achieved. Ta=25°C

Criteria To Pass:
- The $\Delta$ temperature must be < 50°C.
6. Performance Data

...Continued