

### DESCRIPTION

The EV163-S-00A Evaluation Board is designed to demonstrate the capabilities of MP163. The MP163 is a primary-side constant voltage regulator providing accurate constant voltage (CV) regulation without Opto-coupler. It supports Buck, Buck-Boost, Boost and Flyback topologies.

The EV163-S-00A Evaluation Board is designed as Buck application. EV163-S-00A typically drives a 12V/200mA, 5V/50mA output from 85VAC to 265VAC, at 60/50Hz.

The EV163-S-00A has an excellent efficiency and meets 1kV IEC61000-4-5 surge immunity and EN55022 conducted EMI requirements. MP163 features various protections, including thermal shutdown (TSD), VCC under-voltage lockout (UVLO), over-load protection (OLP), short-circuit protection (SCP), and open loop protection.

MP163 is available in SOIC8-7B and SOIC16 packages.

This board built with MP163CGS-5. It can be used for evaluation of the whole MP163 SOIC8-7 package family with simple drop in replacement.

### ELECTRICAL SPECIFICATION

| Parameter       | Symbol     | Value     | Units |
|-----------------|------------|-----------|-------|
| Input Voltage   | $V_{IN}$   | 85 to 265 | VAC   |
| Output Voltage1 | $V_{OUT1}$ | 12        | V     |
| Output Current1 | $I_{OUT1}$ | 200       | mA    |
| Output Voltage2 | $V_{OUT2}$ | 5         | V     |
| Output Current2 | $I_{OUT2}$ | 50        | mA    |

### FEATURES

- Primary-Side non-isolated Constant Voltage (CV) Control
- Integrated 700V MOSFET
- < 30mW No-load power consumption
- Peak-Current Control with Peak Current Compression
- Low  $V_{CC}$  operating current
- Limited Maximum Frequency
- Frequency Foldback
- Multiple Protections: SCP, OCP, OTP, and VCC UVLO
- Low Cost and Simple External circuit
- Internal high-voltage current source
- Built in LDO

### APPLICATIONS

- Home Appliance, white goods and consumer electronics
- Industrial Controls
- Standby Power

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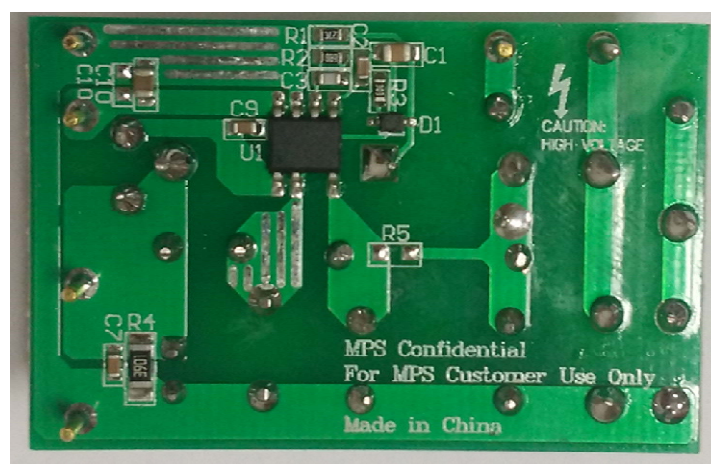


**Warning:** Although this board is designed to satisfy safety requirements, the engineering prototype has not been agency approved. Therefore, all testing should be performed using an isolation transformer to provide the AC input to the prototype board.

## EV163-S-00A EVALUATION BOARD



**TOP VIEW**



**BOTTOM VIEW**

(L x W x H) 47mm x 30mm x 17mm

| Board Number | MPS IC Number |
|--------------|---------------|
| EV163-S-00A  | MP163CGS-5    |

## EVALUATION BOARD SCHEMATIC

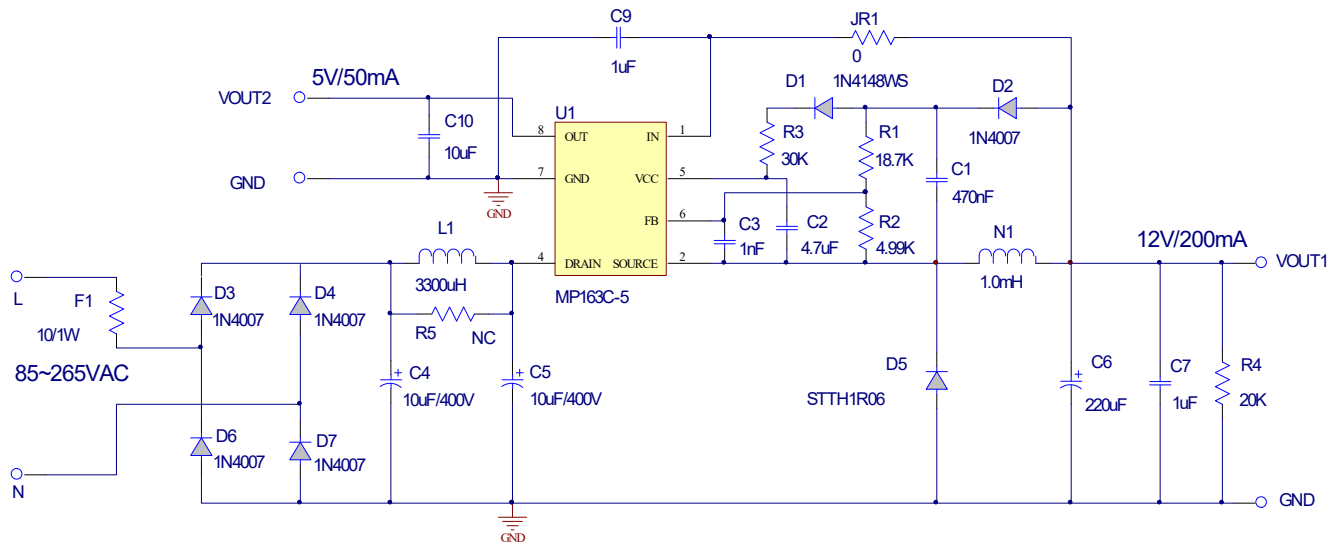


Figure 1—Schematic

## PCB LAYOUT (SINGLE-SIDED)

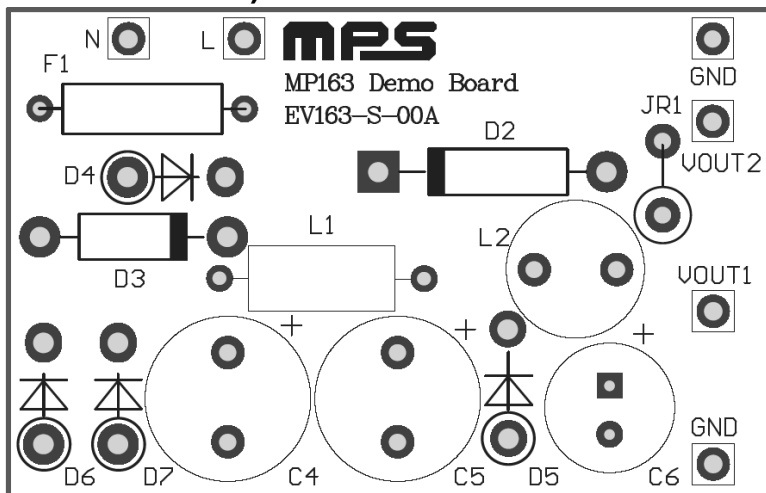


Figure 2—Top Layer

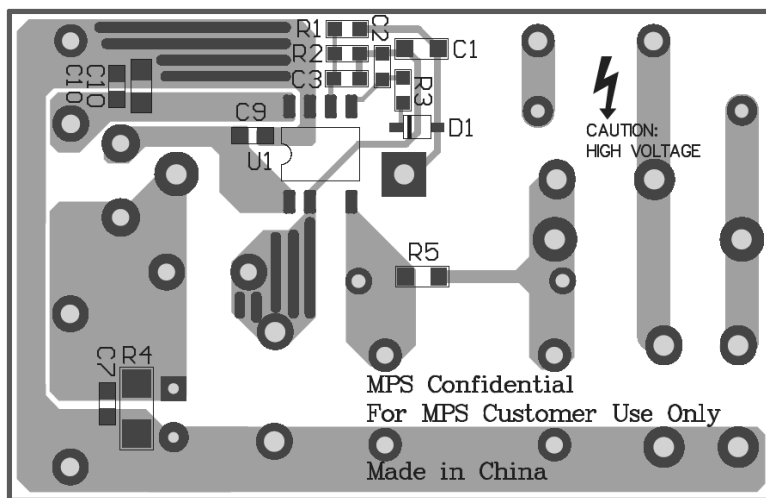


Figure 3—Bottom Layer

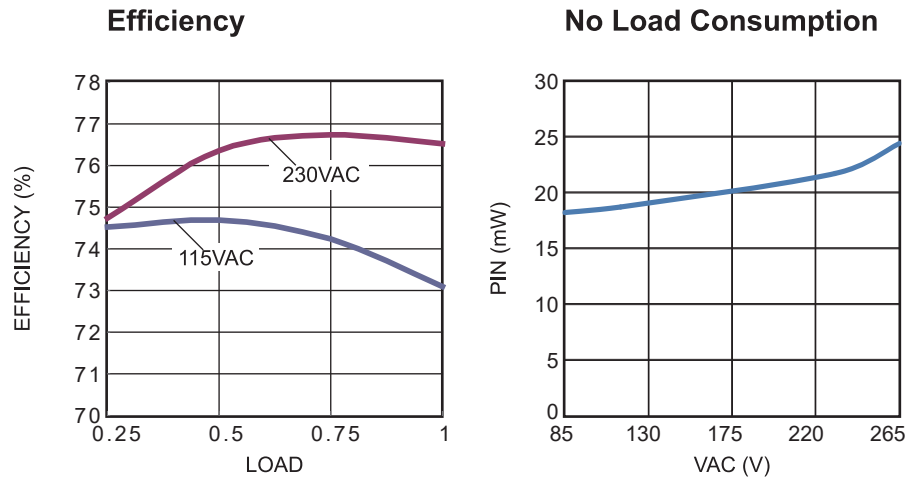
**EV163-S-00A BILL OF MATERIALS**

| Qty | Ref                      | Value    | Description                         | Package  | Manufacture | Manufacture_PN     |
|-----|--------------------------|----------|-------------------------------------|----------|-------------|--------------------|
| 1   | C1                       | 470nF    | Ceramic Capacitor;<br>25V;X7R       | 0805     | TDK         | C2012X7R1E474K     |
| 1   | C2                       | 4.7μF    | Ceramic Capacitor;<br>10V;X7R       | 0603     | muRata      | GRM188R71A475KE15D |
| 1   | C3                       | 1nF      | Ceramic Capacitor;<br>50V;X7R       | 0603     | muRata      | GRM188R71H102KA01D |
| 2   | C4, C5                   | 10μF     | Electrolytic Capacitor;<br>400V;20% | DIP      | Chengxing   | 400V 10μF          |
| 1   | C6                       | 220μF    | Electrolytic Capacitor;<br>25V      | DIP      | Jianghai    | CD110-25V220       |
| 2   | C7,C9                    | 1μF      | Ceramic Capacitor;<br>25V;X7R       | 0603     | muRata      | GRM188R71E105KA12D |
| 1   | C10                      | 10μF     | Ceramic Capacitor;<br>10V;X5R       | 0805     | muRata      | GRM21BR1A106KE19L  |
| 1   | D1                       | 1N4148WS | Diode;75V;0.15A                     | SOD-323  | Diodes      | 1N4148WS-7-F       |
| 5   | D2, D3,<br>D4, D6,<br>D7 | 1N4007   | Diode;1000V;1A                      | DO-41    | Diodes      | 1N4007             |
| 1   | D5                       | STTH1R06 | Diode;600V;1A                       | DO-41    | ST          | STTH1R06           |
| 1   | F1                       | 10       | Resistor;5%;1W                      | DIP      | Any         | Any                |
| 1   | L1                       | 3.3mH    | Inductor;3300μH;27Ω;<br>40mA        | DIP      | Any         | Any                |
| 1   | L2                       | 1mH      | Inductor;1mH;2.08Ω;<br>500mA        | DIP      | Würth       | 768772102          |
| 1   | R1                       | 18.7k    | Film Resistor;1%                    | 0603     | Yageo       | RC0603FR-0718K7L   |
| 1   | R2                       | 4.99k    | Film Resistor;1%                    | 0603     | Yageo       | RC0603FR-074K99L   |
| 1   | R3                       | 30k      | Film Resistor;1%                    | 0603     | Yageo       | RC0603FR-0730KL    |
| 1   | R4                       | 20k      | Film Resistor;1%                    | 1206     | Yageo       | RC1206FR-0720KL    |
| 1   | R5                       | NC       |                                     |          |             |                    |
| 1   | JR1                      | Jumper   |                                     |          |             |                    |
| 1   | U1                       | MP163C-5 | Primary side regulator              | SOIC8-7B | MPS         | MP163CGS-5         |

## EVB TEST RESULTS

Performance waveforms are tested on the evaluation board with MP163CGS-5.

$V_{IN} = 85\sim 265VAC$ ,  $V_{OUT1} = 12V$ ,  $I_{OUT1} = 200mA$ ,  $V_{OUT2} = 5V$ ,  $I_{OUT2} = 50mA$ ,  $T_A = 27^{\circ}C$ , unless otherwise noted.



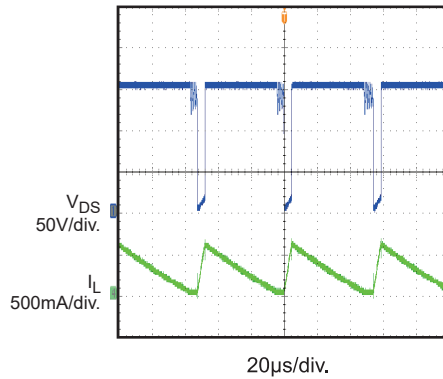
## EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board with MP163CGS-5.

$V_{IN} = 85\sim 265VAC$ ,  $V_{OUT1} = 12V$ ,  $I_{OUT1} = 200mA$ ,  $V_{OUT2} = 5V$ ,  $I_{OUT2} = 50mA$ ,  $T_A = 27^{\circ}C$ , unless otherwise noted.

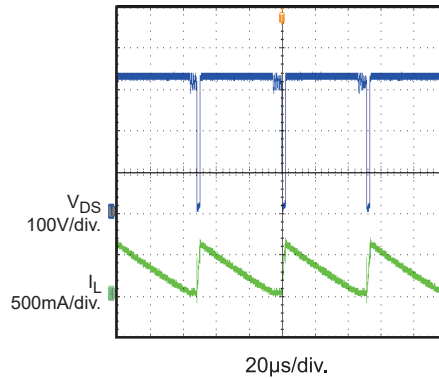
### Normal Operation

$V_{IN}=115VAC$ , Full Load



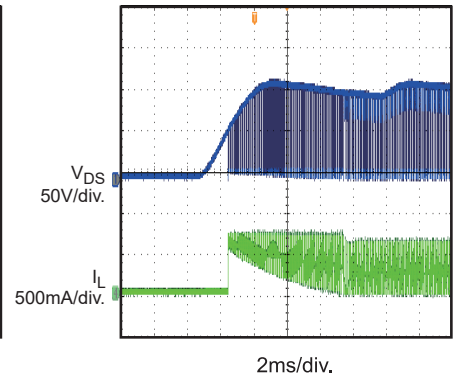
### Normal Operation

$V_{IN}=230VAC$ , Full Load



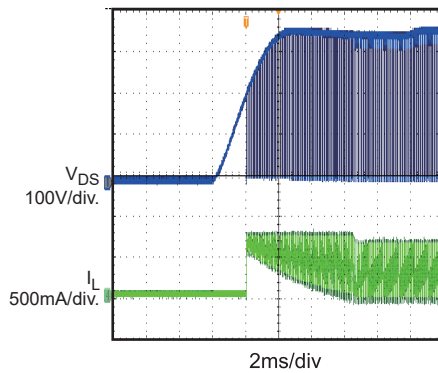
### Soft Start

$V_{IN}=85VAC$



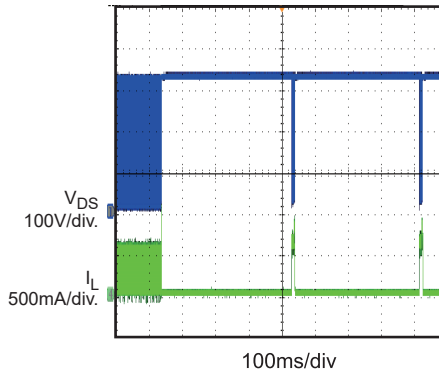
### Soft Start

$V_{IN}=265VAC$



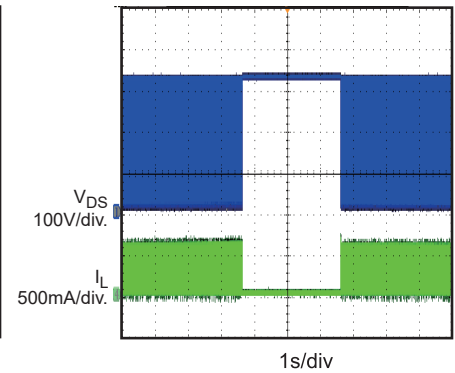
### SCP Protection

$V_{IN}=230VAC$



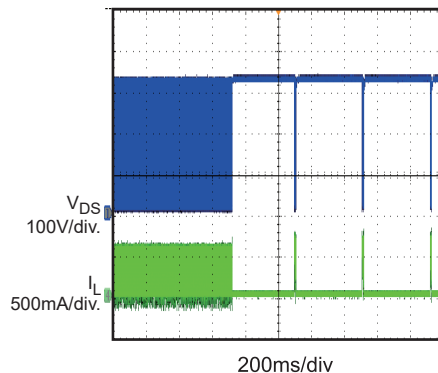
### Thermal Down

$V_{IN}=230VAC$



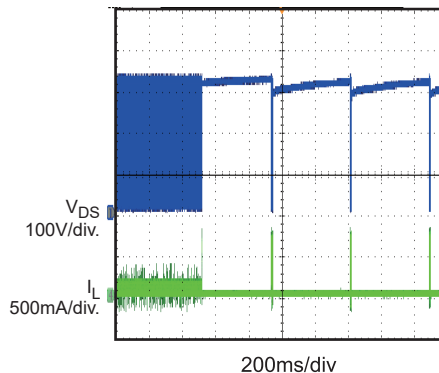
### Open Loop

$V_{IN}=230VAC$ , Full Load



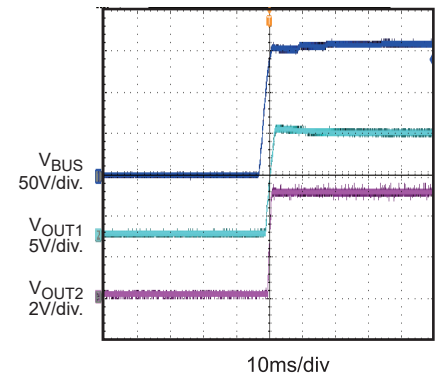
### Open Loop

$V_{IN}=230VAC$ , No Load



### Turn-On Delay

$V_{IN}=115VAC$ , No Load



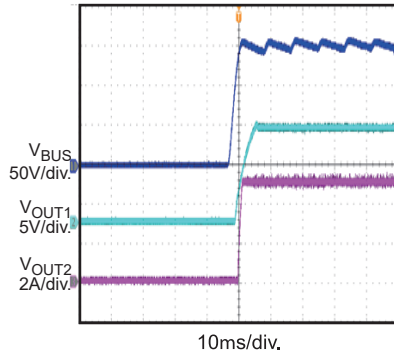
## EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board with MP163CGS-5.

$V_{IN} = 85\sim 265VAC$ ,  $V_{OUT1} = 12V$ ,  $I_{OUT1} = 200mA$ ,  $V_{OUT2} = 5V$ ,  $I_{OUT2} = 50mA$ ,  $T_A = 27^{\circ}C$ , unless otherwise noted.

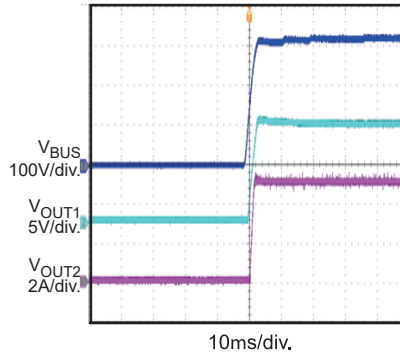
### Turn-On Delay

$V_{IN} = 115VAC$ , Full Load



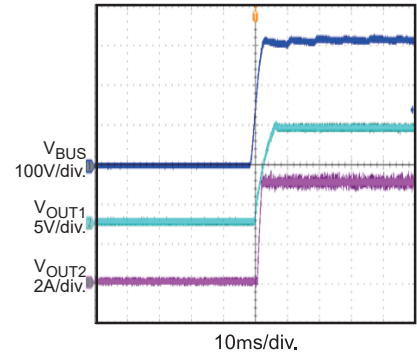
### Turn-On Delay

$V_{IN} = 230VAC$ , No Load



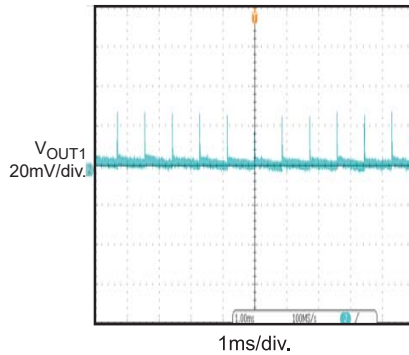
### Turn-On Delay

$V_{IN} = 230VAC$ , Full Load



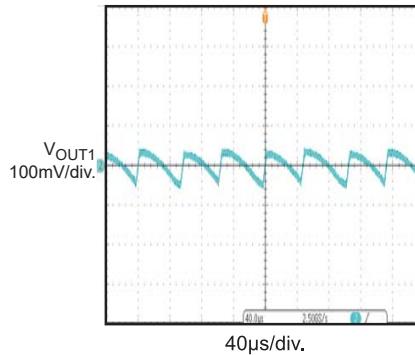
### Output1 Ripple

$V_{IN} = 115VAC$ , No Load



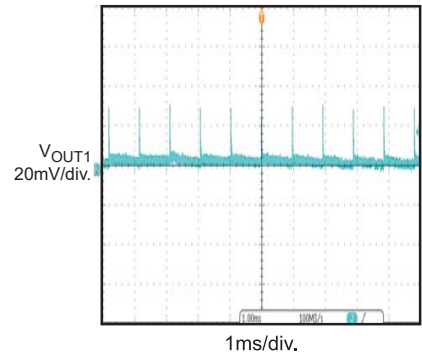
### Output1 Ripple

$V_{IN} = 115VAC$ , Full Load



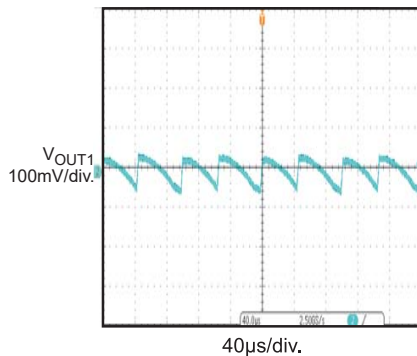
### Output1 Ripple

$V_{IN} = 230VAC$ , No Load



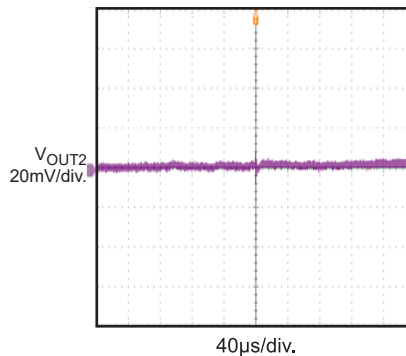
### Output1 Ripple

$V_{IN} = 230VAC$ , Full Load



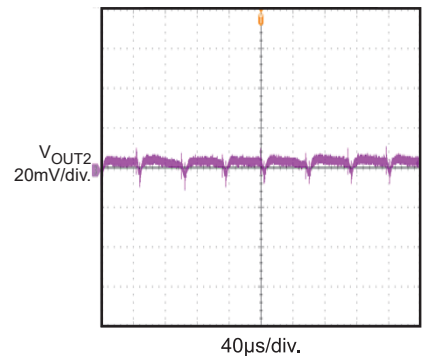
### Output2 Ripple

$V_{IN} = 115VAC$ , No Load



### Output2 Ripple

$V_{IN} = 115VAC$ , Full Load



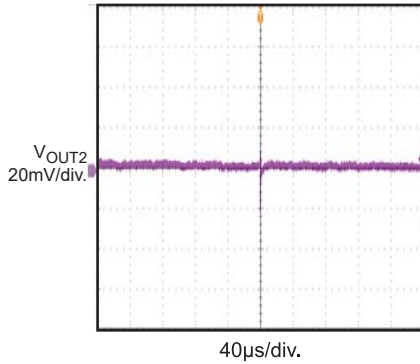
## EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board with MP163CGS-5.

$V_{IN} = 85\sim 265VAC$ ,  $V_{OUT1} = 12V$ ,  $I_{OUT1} = 200mA$ ,  $V_{OUT2} = 5V$ ,  $I_{OUT2} = 50mA$ ,  $T_A = 27^{\circ}C$ , unless otherwise noted.

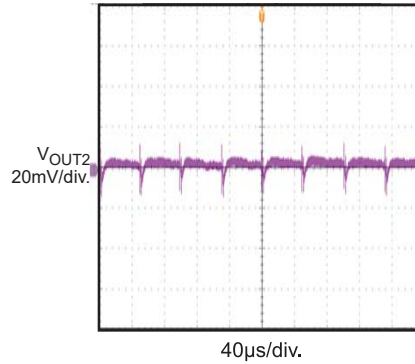
**Output2 Ripple**

$V_{IN} = 230VAC$ , No Load



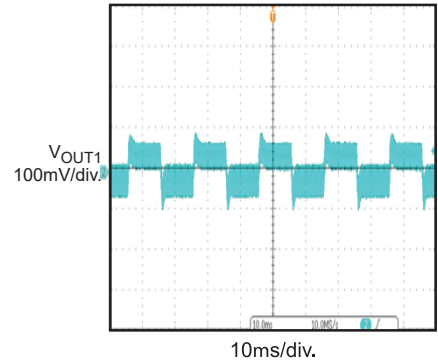
**Output2 Ripple**

$V_{IN} = 230VAC$ , No Load



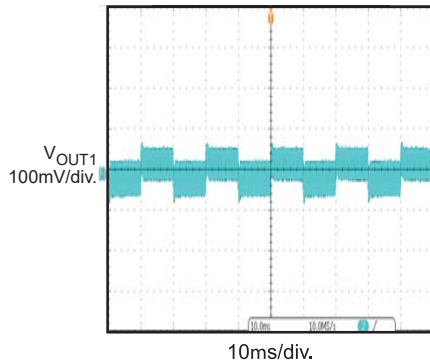
**Output1 Load Transient**

$V_{IN} = 115VAC$ , 25% Load to 50% Load



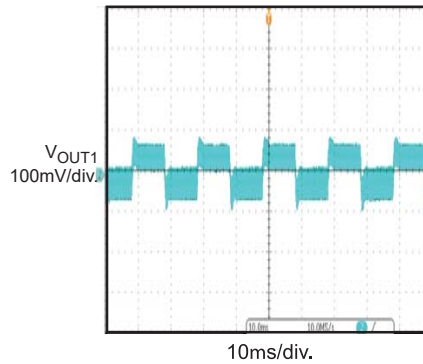
**Output1 Load Transient**

$V_{IN} = 115VAC$ , 50% Load to 75% Load



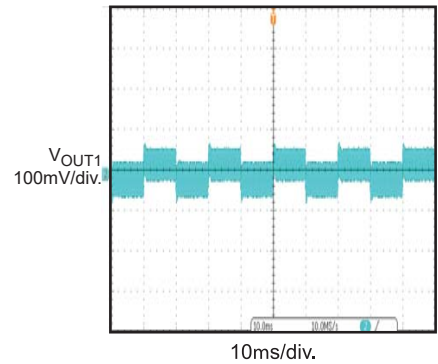
**Output1 Load Transient**

$V_{IN} = 230VAC$ , 25% Load to 50% Load



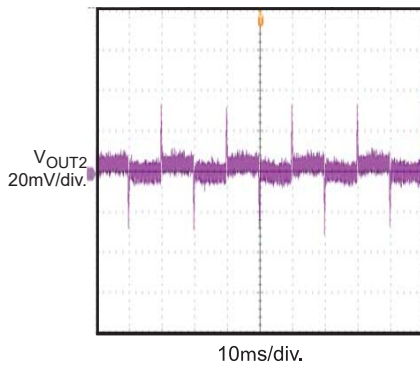
**Output1 Load Transient**

$V_{IN} = 230VAC$ , 50% Load to 75% Load



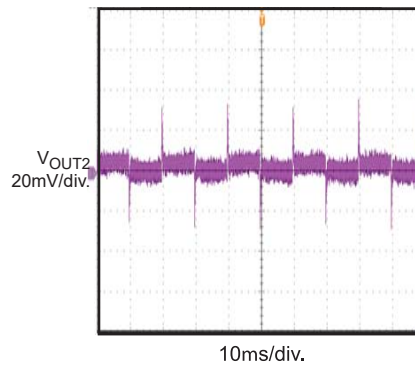
**Output2 Load Transient**

$V_{IN} = 115VAC$ , 25% Load to 50% Load



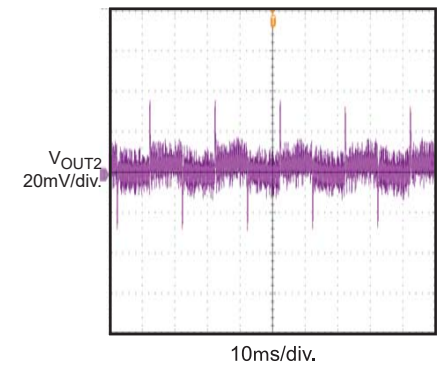
**Output2 Load Transient**

$V_{IN} = 115VAC$ , 50% Load to 75% Load



**Output2 Load Transient**

$V_{IN} = 230VAC$ , 25% Load to 50% Load



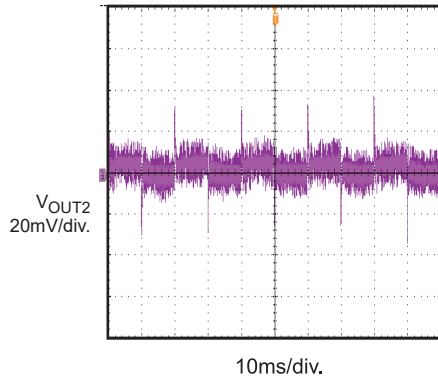
## EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board with MP163CGS-5.

$V_{IN} = 85\sim 265VAC$ ,  $V_{OUT1} = 12V$ ,  $I_{OUT1} = 200mA$ ,  $V_{OUT2} = 5V$ ,  $I_{OUT2} = 50mA$ ,  $T_A = 27^\circ C$ , unless otherwise noted.

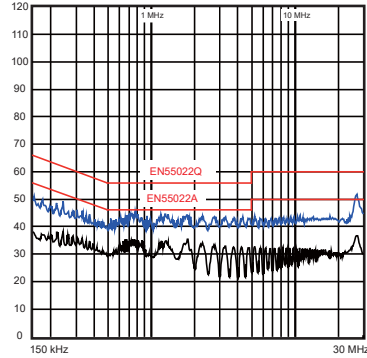
### Output2 Load Transient

$V_{IN}=230VAC$ , 50% Load to 75% Load



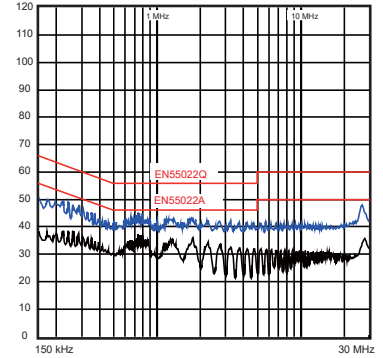
### Conducted EMI

Two-Wire Input,  $V_{IN}=230VAC$



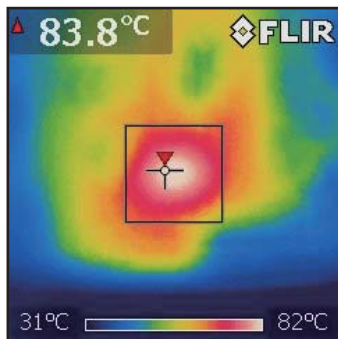
### Conducted EMI

Two-Wire Input,  $V_{IN}=230VAC$



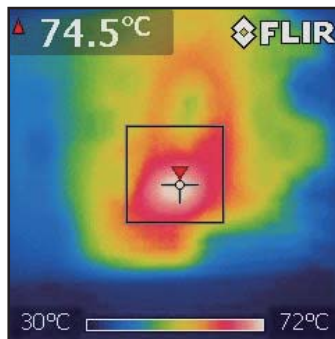
### Thermal

$V_{IN}=115VAC$ , Full Load, Open Frame



### Thermal

$V_{IN}=230VAC$ , Full Load, Open Frame



## CIRCUIT DESCRIPTION

The EV163-S-00A is configured in a buck regulator topology, it uses primary-side-control which can mostly simplify the schematic and get a cost effective BOM. It can also achieve accurate constant voltage and acceptable cross regulation.

F1 is used to protect circuit from component failure or some excessive short events; also it can restrain the inrush current.

C4, L1 and C5 compose  $\pi$  filter to guarantee the conducted EMI meet standard EN55022. C2 and C3 are also used for energy storage and protecting against line surge.

R2, C2, and D1 are used as VCC power supply. Though MP163 is equipped with an internal high voltage current source, using this circuit can achieve better efficiency.

C1 is the sample-hold capacitor, used for reflecting output voltage. R1 and R4 are resistor divider for detecting output voltage by sampling voltage on C1.

D5 is the freewheeling diode. For universal voltage applications, use a diode with a 600V reverse block voltage. Ultra-fast recovery diode is recommended for better efficiency.

C6 and C7 are output capacitors for 12V output. C6 should be low ESR electrolytic capacitor for better output ripple. C7 is ceramic capacitor to reduce high frequency voltage ripple. R6 is dummy load to lower the output voltage of 12V rail at no load condition.

C9 is the input decoupling capacitor of built in LDO. And C10 is the output capacitor of LDO.

## QUICK START GUIDE

1. Preset power supply to  $85\text{VAC} \leq V_{\text{IN}} \leq 265\text{VAC}$ .
2. Turn power supply off.
3. Connect the Line and Neutral terminals of the power supply output to L and N port.
4. Connect different loads to corresponding outputs :
  - a. Positive (+): VOUT1, VOUT2
  - b. Negative (-): GND
5. Turn power supply on after making connections.
6. When MP163A or MP163B is dropped in for evaluation, power inductor (L2) should be replaced accordingly to get excellent overall performance. The recommended values are 2.2mH and 1.8mH for MP163A and MP163B respectively.

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