# EV6005-K-00B

**High Efficiency Flyback/Forward Controller**
**Secondary-Side Regulate Forward EV Board**

## DESCRIPTION

EV6005-K-00B Evaluation Board is designed to demonstrate the capability of MP6005. The MP6005 is a high power, high efficiency flyback and forward controller. It is specifically designed for both low cost, small size isolated solution with primary-side regulate (PSR) flyback application, and high efficiency secondary-side regulate (SSR) active-clamped forward application. It also can be used in SSR flyback topology.

MP6005 senses the third winding waveform on primary side to regulate output in PSR mode, saves the traditional complex opto-isolator circuit. MP6005 can also be set as SSR mode, while the SYNC driver provides high efficiency solution for active-clamped forward topology.

The MP6005 also features with 2A GATE driver, frequency dithering, over load protection and over voltage protection.

The MP6005 is available in MSOP10 package.

## Electrical Specification

| Parameter | Symbol | Value | Units |
|---|---|---|---|
| Input Voltage | $V_{IN}$ | 36-57 | V |
| Output Voltage | $V_{OUT}$ | 5 | V |
| Output Current | $I_{OUT}$ | 4.8 | A |

## FEATURES

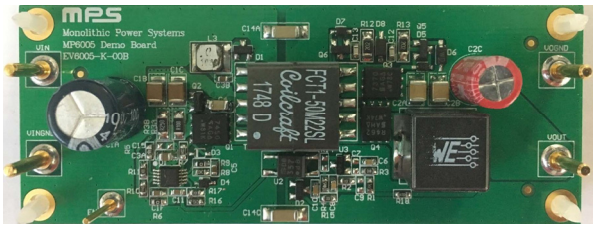
- 36V to 57V Input Voltage Range
- 5V Output Voltage and 4.8A Output Current
- High Efficiency Active-clamped Forward Solution
- 250kHz Fixed Switching Frequency
- EMI Reduction with Frequency Dithering
- Auxiliary Winding Supply VCC to Save IC Loss
- 2A GATE and 0.8A SYNC Drivers
- 160mV Switching Current Sense Limit
- Hiccup Protection for OLP, SCP, OVP and Thermal Shutdown
- Available in MSOP10 Package

## APPLICATIONS

- Security Camera
- Video Telephone
- Wireless AP
- POS System
- Industrial Isolated Power Supply

All MPS parts are lead-free, halogen free, and adhere to the RoHS directive. For MPS green status, please visit MPS website under Quality Assurance.
"MPS" and "The Future of Analog IC Technology" are Registered Trademarks of Monolithic Power Systems, Inc.

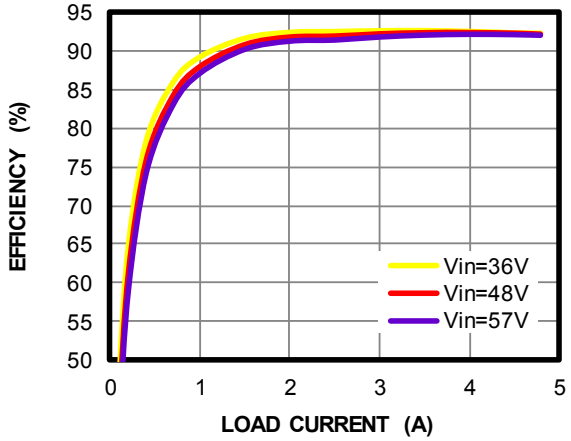
## EV6005-K-00B EVALUATION BOARD




**(L x W x H) 9cm x 3.5cm x 2cm**

| Board Number | MPS IC Number |
|---|---|
| EV6005-K-00B | MP6005GK |

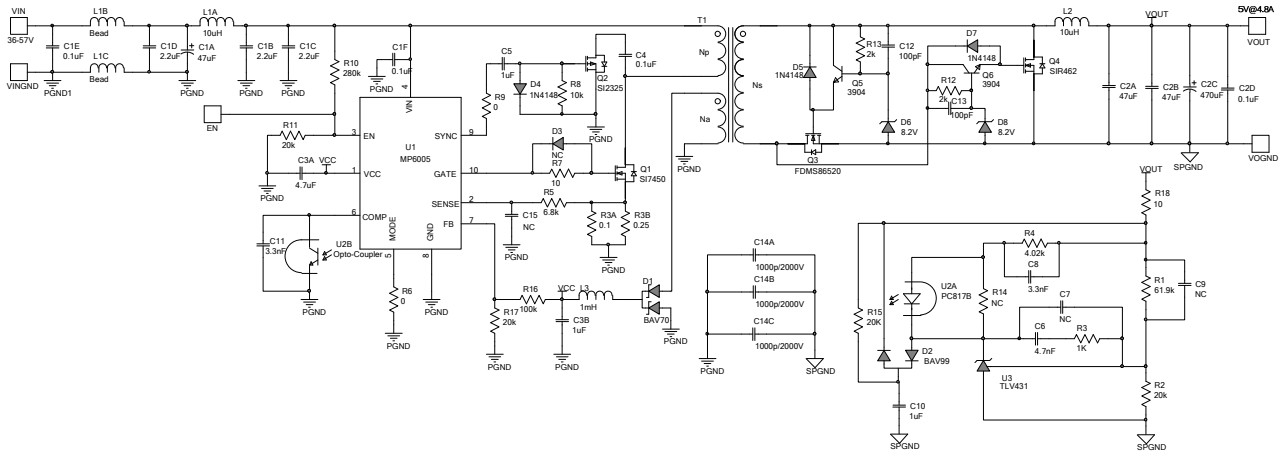
**Efficiency vs. Load Current**





MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2019 MPS. All Rights Reserved.

## EVALUATION BOARD SCHEMATIC (1)




**NOTE:**

1.) EV6005-K-00B is setting in frequency dither mode for better EMI performance, if stable switch is needed, please set R5 lower than 1.3k.

## BILL OF MATERIALS

| Qty | Ref | Value | Description | Package | Manufacturer | Part Number |
|---|---|---|---|---|---|---|
| 1 | C1A | 47µF | 47µF E-cap | DIP | Jianghai | 47µF/100V |
| 3 | C1B, C1C, C1D | 2.2µF | Ceramic Cap.,100V,X7R | 1210 | muRata | GRM32ER72A225KA88L |
| 1 | C1E | 0.1µF | Ceramic Cap.,100V,X7R | 0805 | muRata | GRM21BR72A104KA01D |
| 1 | C1F | 0.1µF | Ceramic Cap.,100V,X7R | 0603 | muRata | GRM188R72A104KA01D |
| 2 | C2A, C2B | 47µF | Ceramic Cap.,10V,X7R | 1210 | muRata | GRM32ER71A476KA88L |
| 1 | C2C | 470µF | 470µF E-cap | DIP | wurth | 860080274011 |
| 1 | C2D | 0.1µF | Ceramic Cap.,25V,X7R | 0603 | muRata | GRM188R71E104KA01D |
| 1 | C3A | 4.7µF | Ceramic Cap.,25V,X7R | 0805 | muRata | GRM21BR71E475KA01D |
| 3 | C3B, C5, C10 | 1µF | Ceramic Cap.,25V,X7R | 0603 | muRata | GRM188R71E105KA01D |
| 1 | C4 | 0.1µF | Ceramic Cap.,200V,X7R | 1206 | muRata | GRM31CR72D104KW03L |
| 1 | C6 | 4.7nF | Ceramic Cap.,16V,X7R | 0603 | muRata | GRM188R71C472KA01D |
| 5 | C7, C9, C15, R14, D3 | NC | | | | |
| 2 | C8, C11 | 3.3nF | Ceramic Cap.,16V,X7R | 0603 | muRata | GRM188R71C332KA01D |
| 2 | C12, C13 | 100pF | Ceramic Cap.,50V,X7R | 0603 | muRata | GRM188R71H101KA01D |
| 3 | C14A, C14B, C14C | 1000p/ 2000V | Ceramic Cap.,2000V X7R | 1808 | muRata | GR442QR73D102KW01L |
| 1 | D1 | BAV70 | Series diodes | SOT-23 | Fairchild | BAV70 |
| 1 | D2 | BAV99 | Series diodes | SOT-23 | Fairchild | BAV99 |
| 3 | D4, D5, D7 | 1N4148 | Diode Switch, 75V, 400mW | SOD-323 | Diodes Inc. | 1N4148W-7 |
| 2 | D6, D8 | 8.2V | Diode Zener, 500mW, 8.2V | SOD-123 | Diodes Inc. | BZT52C8V2-7 |
| 1 | L1A | 10µH | Isat=4.9A, Rdc=40.9mΩ | SMD | Coilcraft | XAL5050-103MEC |


MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2019 MPS. All Rights Reserved.

## BILL OF MATERIALS *(continued)*

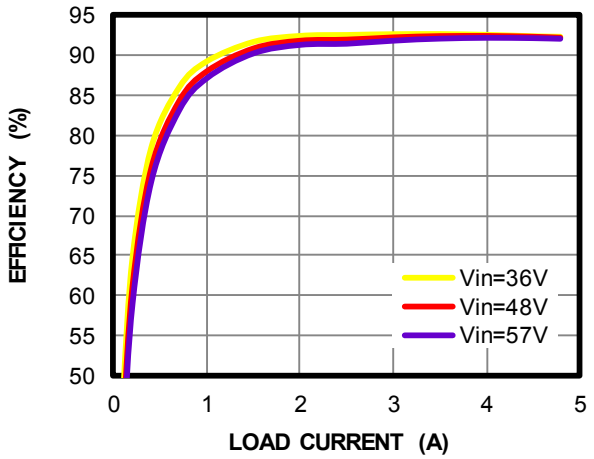
| Qty | Ref | Value | Description | Package | Manufacturer | Part Number |
|---|---|---|---|---|---|---|
| 2 | L1B, L1C | 600Ω | Irms=3A, Rdc=42mΩ | 1210 | KEMET | Z1210C601BPWZT |
| 1 | L2 | 10μH | Isat=9A, Rdc=15mΩ | SMD | Wurth | 744 332 100 0 |
| 1 | L3 | 1mH | Isat=0.1A, Rdc=16.4mΩ | SMD | Coilcraft | LPS4414-105MLC |
| 1 | Q1 | SI7450 | 80mΩ 200V N-MOSFET | PowerPak SO-8 | Vishy | SI7450DP |
| 1 | Q2 | SI2325 | 1.3Ω 150V P-MOSFET | SOT-23 | Vishy | SI2325DS |
| 1 | Q3 | FDMS86520 | 7.4mΩ 60V N-MOSFET | PowerPAK SO-8 | Fairchild | FDMS86520 |
| 1 | Q4 | SIR462 | 7.9mΩ 30V N-MOSFET | PowerPAK SO-8 | Vishay | SiR462DP |
| 2 | Q5, Q6 | 3904 | 40V NPN | SOT-23 | Fairchild | MMBT3904 |
| 1 | R1 | 61.9k | Film Res.,1% | 0603 | ROYAL | RC0603FR-0761K9L |
| 4 | R2, R11, R15, R17 | 20k | Film Res.,1% | 0603 | ROYAL | RC0603FR-0720KL |
| 1 | R3 | 1k | Film Res.,1% | 0603 | ROYAL | RC0603FR-071KL |
| 1 | R3A | 0.1 | Film Res.,1% | 1206 | ROYAL | RC1206FR-070R1L |
| 1 | R3B | 0.25 | Film Res.,1% | 1206 | ROYAL | RC1206FR-070R25L |
| 1 | R4 | 4.02k | Film Res.,1% | 0603 | ROYAL | RC0603FR-074K02L |
| 1 | R5 | 6.8k | Film Res.,1% | 0603 | ROYAL | RC0603FR-076k8L |
| 2 | R6, R9 | 0 | Film Res.,1% | 0603 | ROYAL | RC0603FR-070RL |
| 2 | R7, R18 | 10 | Film Res.,1% | 0603 | ROYAL | RC0603FR-0710RL |
| 1 | R8 | 10k | Film Res.,1% | 0603 | ROYAL | RC0603FR-0710KL |
| 1 | R10 | 280k | Film Res.,1% | 0603 | ROYAL | RC0603FR-07280KL |
| 2 | R12, R13 | 2k | Film Res.,1% | 1206 | ROYAL | RC1206FR-072KL |
| 1 | R16 | 100k | Film Res.,1% | 0603 | ROYAL | RC0603FR-07100KL |
| 1 | T1 | FCT1-50M22SL | Forward transformer | EP13 | Coilcraft | FCT1-50M22SL |
| 1 | U1 | MP6005GK | Fly-back/Forward controller | MSOP10 | MPS | MP6005GK |
| 1 | U2 | PC357 | Opto-coupler | 4-pin Mini-flat | SHARP | PC357 |
| 1 | U3 | TLV431 | 1.24V regulator | SOT-23 | NXP | TLVH431DMQDBZR |


MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2019 MPS. All Rights Reserved.

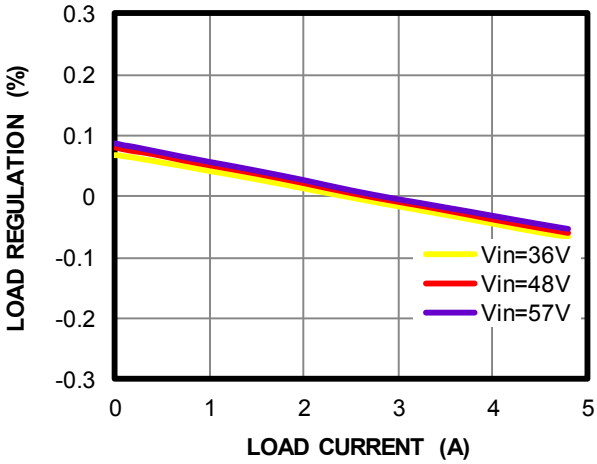
## EVB TEST RESULTS

**$V_{IN}$ = 48V, $V_{OUT}$= 5V, $I_{OUT}$= 4.8A, $T_A$ = 25°C, unless otherwise noted.**

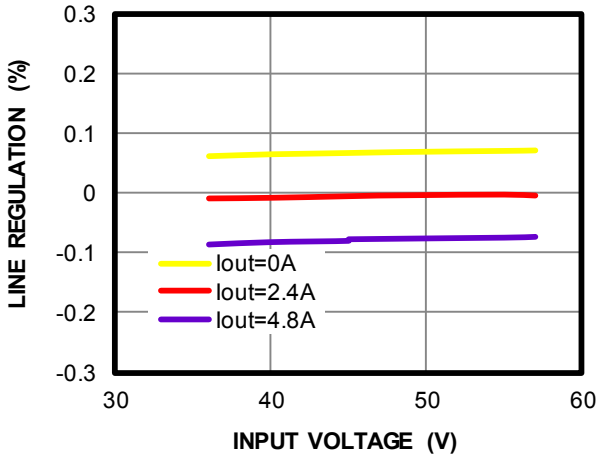
### Efficiency vs. Load Current




### Load Regulation vs. Load Current

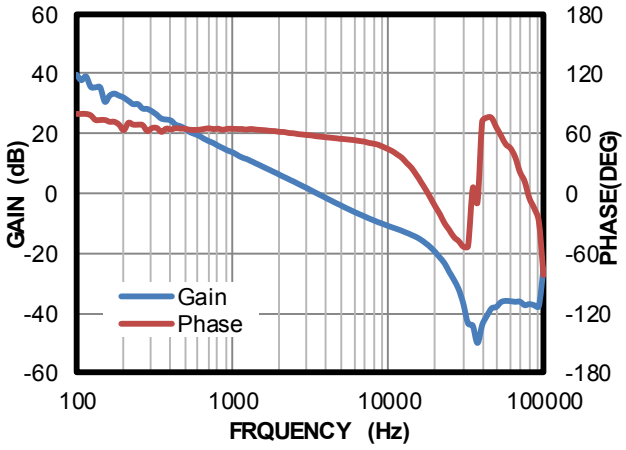



### Line Regulation vs. Input Voltage



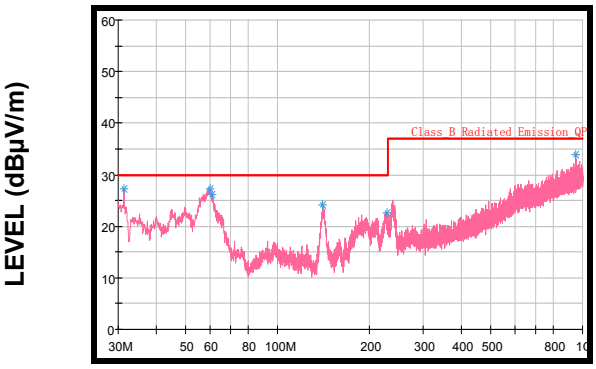

### Bode Plot

$I_{OUT}$=4.8A



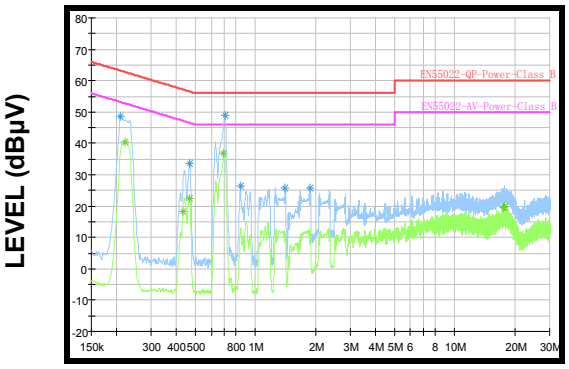

### Radlated Emission Results

$I_{OUT}$=4.8A




### Conducted Emission Results

$I_{OUT}$=4.8A



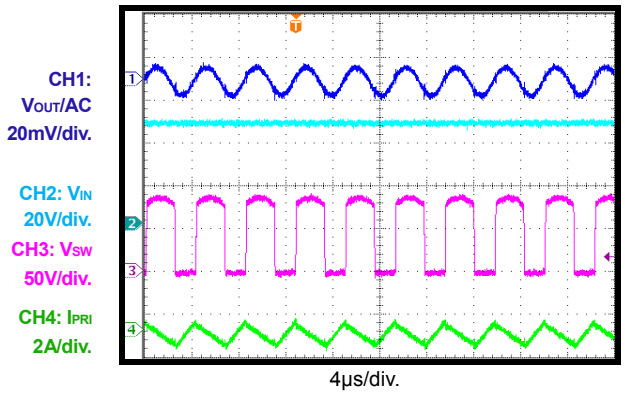


MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2019 MPS. All Rights Reserved.

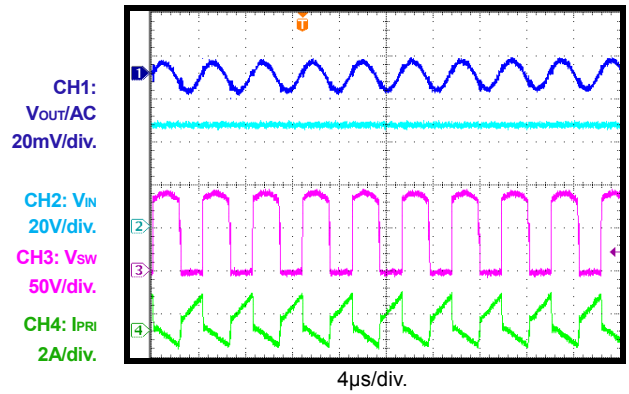
## EVB TEST RESULTS *(continued)*

**$V_{IN}$ = 48V, $V_{OUT}$= 5V, $I_{OUT}$= 4.8A, $T_A$ = 25°C, unless otherwise noted.**

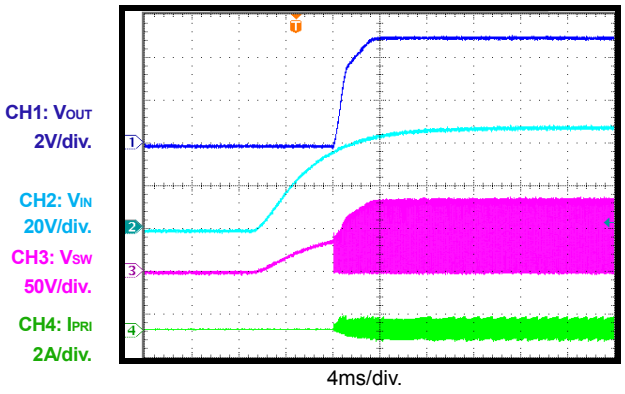
### Steady State
$I_{OUT}$=0A



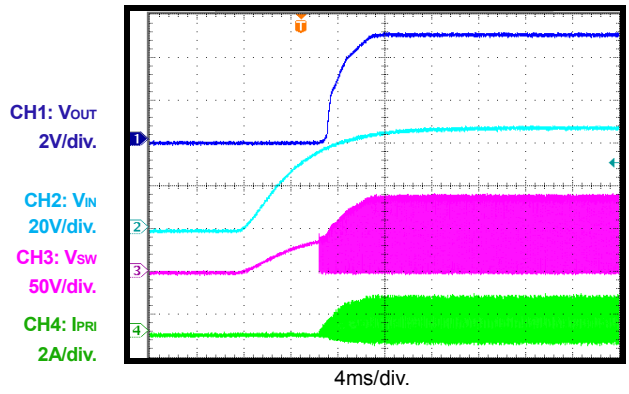

### Steady State
$I_{OUT}$=4.8A



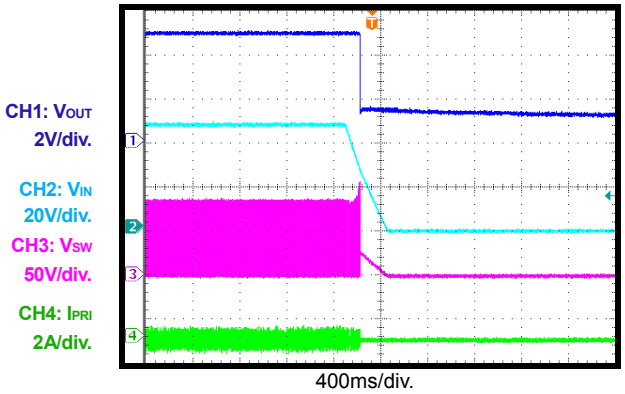

### VIN Start-Up
$I_{OUT}$=0A



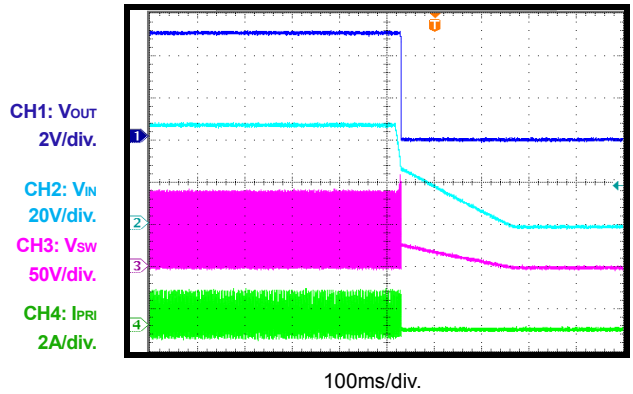

### VIN Start-Up
$I_{OUT}$=4.8A




### VIN Shutdown
$I_{OUT}$=0A




### VIN Shutdown
$I_{OUT}$=4.8A





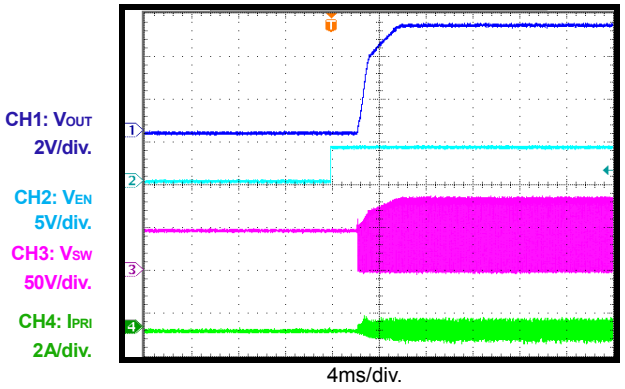
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2019 MPS. All Rights Reserved.

## EVB TEST RESULTS *(continued)*

**$V_{IN}$ = 48V, $V_{OUT}$= 5V, $I_{OUT}$= 4.8A, $T_A$ = 25°C, unless otherwise noted.**

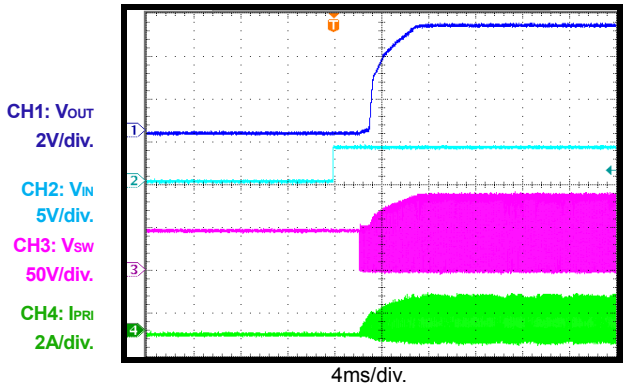
### EN Start-Up

$I_{OUT}$=0A



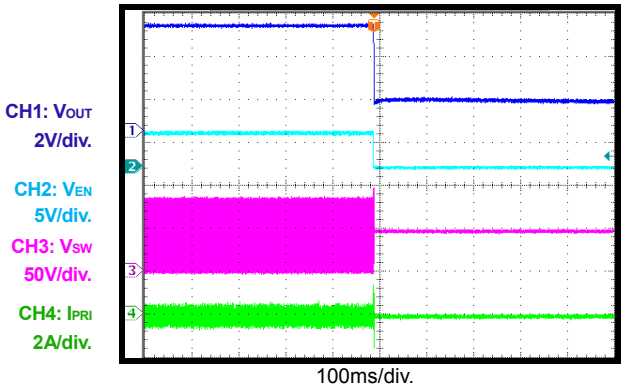

### EN Start-Up

$I_{OUT}$=4.8A



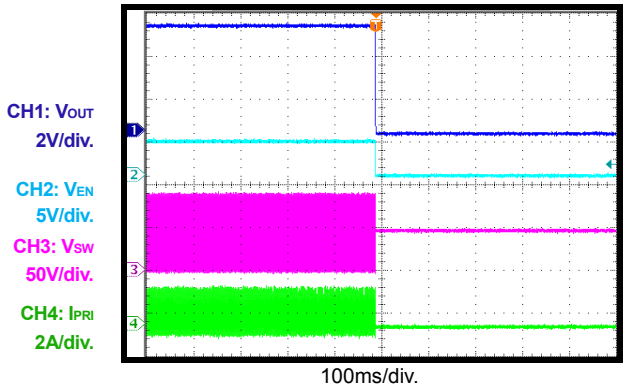

### EN Shutdown

$I_{OUT}$=0A



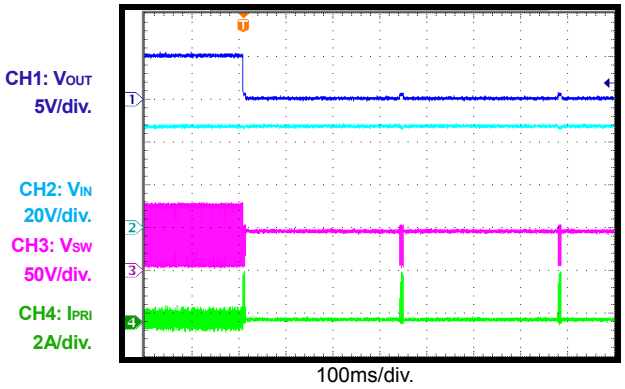

### EN Shutdown

$I_{OUT}$=4.8A



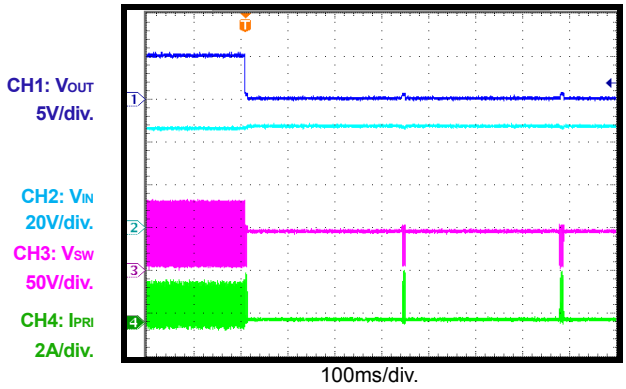

### SCP Entry

$I_{OUT}$=0A to Short




### SCP Entry

$I_{OUT}$=4.8A to Short





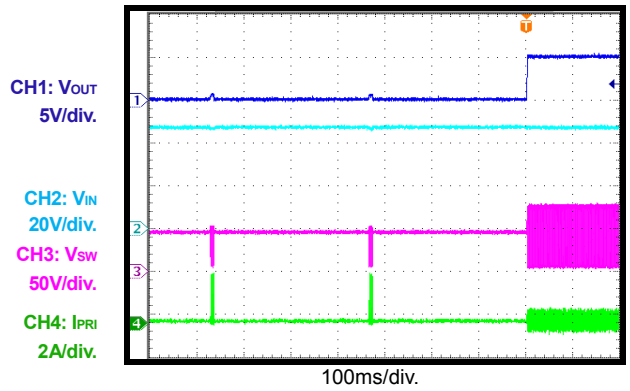
MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2019 MPS. All Rights Reserved.

## EVB TEST RESULTS *(continued)*

**$V_{IN}$ = 48V, $V_{OUT}$= 5V, $I_{OUT}$= 4.8A, $T_A$ = 25°C, unless otherwise noted.**

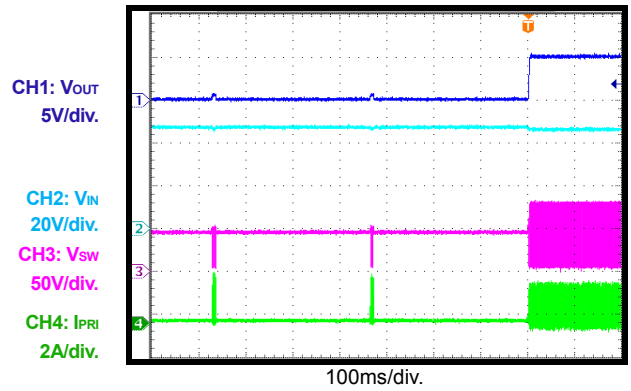
### SCP Recovery

$I_{OUT}$= Short to 0A



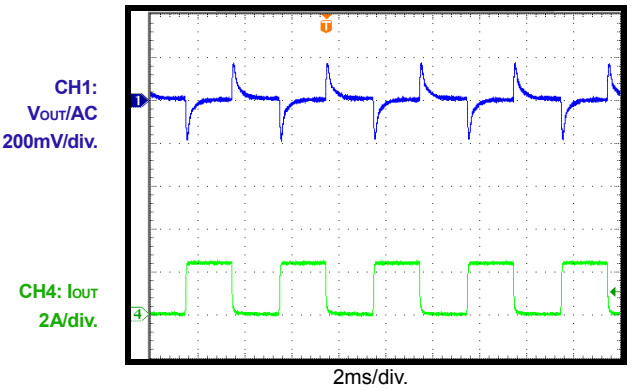

### SCP Recovery

$I_{OUT}$= Short to 4.8A



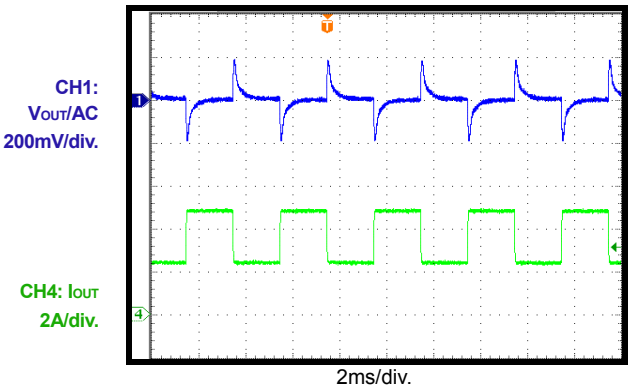

### Load Transient

$I_{OUT}$=0A-2.4A, $I_{RAMP}$=25mA/μs




### Load Transient

$I_{OUT}$=2.4A-4.8A, $I_{RAMP}$=25mA/μs





MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2019 MPS. All Rights Reserved.

# PRINTED CIRCUIT BOARD LAYOUT

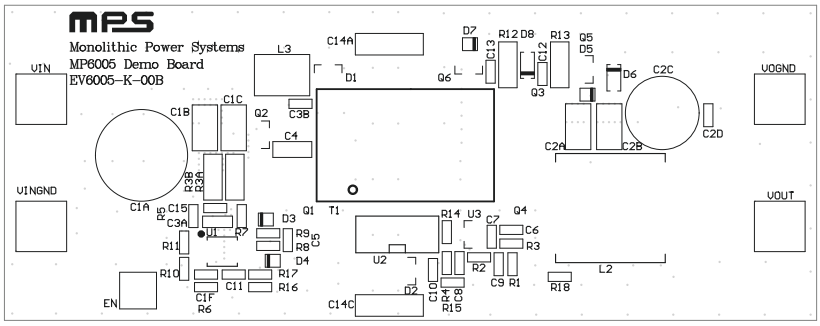



**Figure 1: Top Silk Layer**

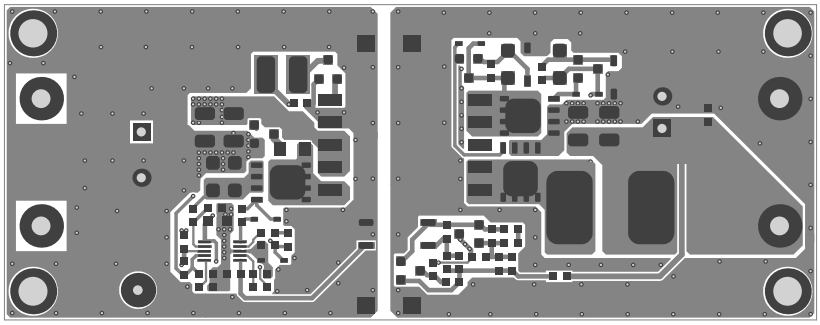


**Figure 2: Top Layer**

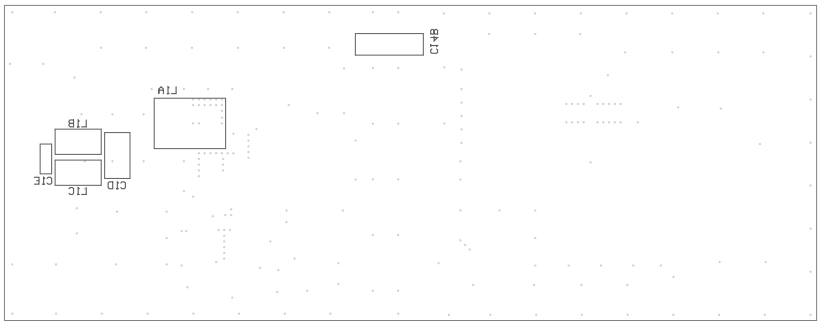


**Figure 3: Bottom Silk Layer**

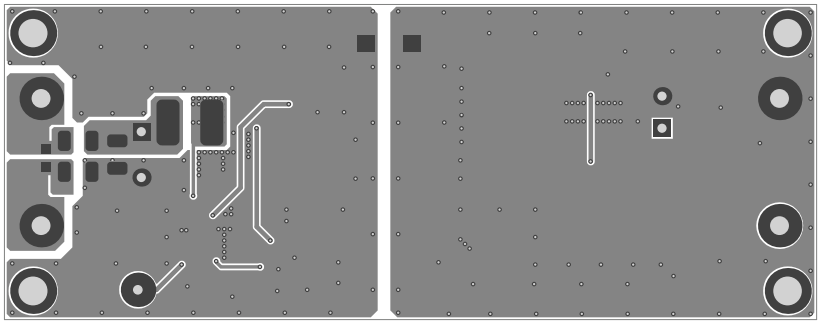


**Figure 4: Bottom Layer**


MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2019 MPS. All Rights Reserved.

## QUICK START GUIDE

The output voltage of this board is set to 5V. The board layout accommodates most commonly used components. Following blew steps to quick start EV6005-K-00B.

1. Preset Power Supply to 36V ≤ VIN ≤ 57V.
2. Turn Power Supply off.
3. Connect Power Supply terminals to:
   a. Positive (+): VIN
   b. Negative (–): VINGND
4. Connect Load to:
   a. Positive (+): VOUT
   b. Negative (–): VOGND
5. Turn Power Supply on after making connections. The MP6005 will automatically startup.

**NOTICE:** The information in this document is subject to change without notice. Please contact MPS for current specifications. Users should warrant and guarantee that third party Intellectual Property rights are not infringed upon when integrating MPS products into any application. MPS will not assume any legal responsibility for any said applications.


MPS Proprietary Information. Patent Protected. Unauthorized Photocopy and Duplication Prohibited.
© 2019 MPS. All Rights Reserved.