# EVM3690-50D-BF-00A

## 16V, 50A, High-Efficiency, Synchronous Step-Down Module Evaluation Board

## DESCRIPTION

The EVM3690-50D-BF-00A evaluation board is designed to demonstrate the capabilities of the MPM3690-50D, a fully integrated, high-efficiency, synchronous, 50A output current, step-down power module with a PMBus interface.

The MPM3690-50D adopts internally compensated constant-on-time (COT) control to provide fast transient response and ease loop stabilization. Refer to the MPM3690-50D datasheet for more detailed information.

It is recommended to read the datasheet for the MPM3690-50D prior to making any changes to the EVM3690-50D-BF-00A.

## PERFORMANCE SUMMARY (1)

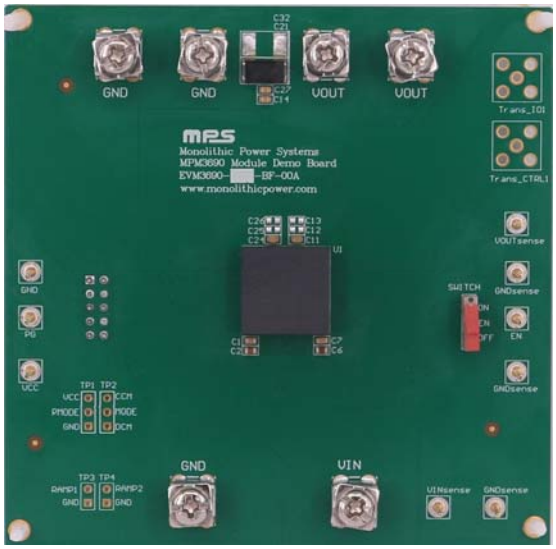
Specifications are at $T_A$ = 25°C, unless otherwise noted.

| Parameters | Conditions | Value |
|---|---|---|
| Input voltage ($V_{IN}$) range | | 3.2V to 16V (2) |
| Output voltage ($V_{OUT}$) | $V_{IN}$ = 3.2V to 16V, $I_{OUT}$ = 0A to 50A | 1.2V |
| Maximum output current ($I_{OUT}$) | $V_{IN}$ = 3.2V to 16V, $V_{OUT}$ = 1.2V | 50A |
| Full load efficiency | $V_{IN}$ = 12V, $V_{OUT}$ = 1.2V, $I_{OUT}$ = 50A, $f_{SW}$ = 600kHz | 89.68% |
| Peak efficiency | $V_{IN}$ = 12V, $V_{OUT}$ = 1.2V, $I_{OUT}$ = 15A, $f_{SW}$ = 600kHz | 92.95% |
| Default switching frequency | | 600kHz |

**Notes:**

1) For different $V_{IN}$ and $V_{OUT}$ specifications with different output capacitors, the application circuit parameters may require changes.
2) If $V_{IN}$ < 4V, an external 3.3V $V_{CC}$ is required.

## EVALUATION BOARD




**(LxWxH) 10cmx10cmx1.5cm**

| Board Number | MPS IC Number |
|---|---|
| EVM3690-50D-BF-00A | MPM3690GBF-50D |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## QUICK START GUIDE

The EVM3690-50D-BF-00A evaluation board is easy to set up and use to evaluate the performance of the MPM3690-50D. For proper measurement equipment set-up, refer to Figure 1 on page 3 and follow the procedure below:

1. Preset the power supply ($V_{IN}$) between 4V and 16V, then turn off the power supply. (3)
2. Connect the power supply terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
3. Connect the load terminals to: (4)
   a. Positive (+): VOUT
   b. Negative (-): GND
4. After making the connections, turn on the power supply. The board should automatically start up.
5. Check for the proper output voltage ($V_{OUT}$) between VOSENSE and VOGNDSEN.
6. Once the proper $V_{OUT}$ is established, adjust the load within the operating range, then measure the efficiency, output ripple voltage, and other parameters. (5)
7. After completing all tests, adjust the load to 0A, then turn off the input power supply.

**Notes:**

3) Ensure that $V_{IN}$ does not exceed 16V.
4) There is no initial load by default.
5) When measuring the output voltage ripple or input voltage ripple, do not use the oscilloscope probe's long ground lead.


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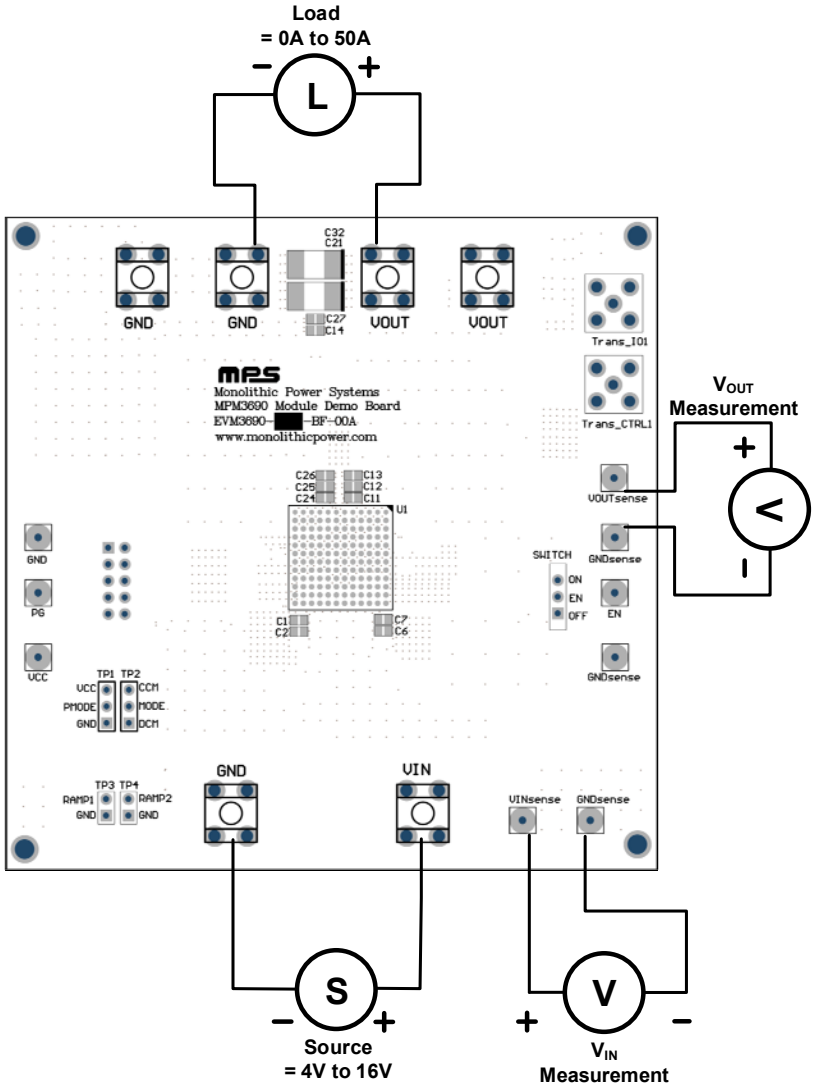


**Figure 1: Proper Measurement Equipment Set-Up**


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## VIRTUAL BENCH PRO 3.0 GUI

The Virtual Bench Pro 3.0 is a powerful graphic user interface (GUI) developed for MPS's digitally configurable power modules and ICs. The software supports a wide range of functions including read/write (R/W) registers, monitoring the operation status, issue diagnosis, and load/save configuration files. The software also supports auto-update features to help users keep the software up to date. This tool requires the EVKT-USBI2C-02 USB to $I^2C$ communication interface to communicate between a power module/IC and a host computer (see Figure 2). Follow the steps below to get started with the Virtual Bench Pro 3.0 GUI.

The latest version of the Virtual Bench Pro 3.0 GUI can be downloaded on the MPS website.

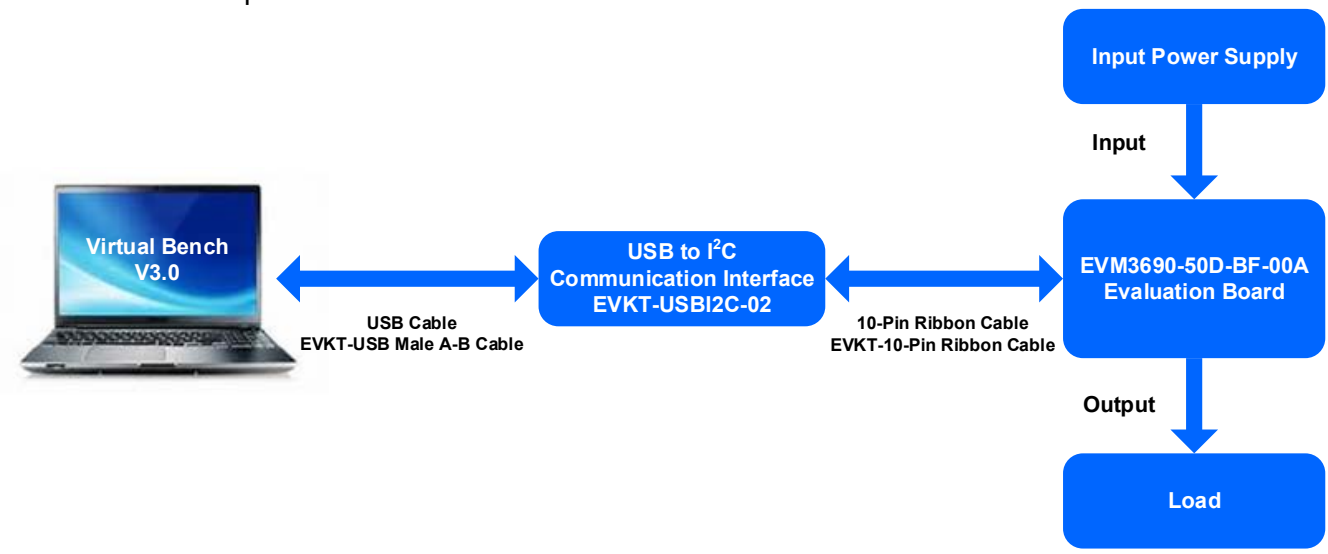


**Figure 2: Virtual Bench Pro 3.0 and Evaluation Board Connection**

Prior to use, the hardware must be properly configured. Follow the instructions below to set up the evaluation board:

1. Connect the PMBus cable to both the EVB and EVKT-USBI2C-02 communication interface device. The data and clock signal are labeled as SDA and SCL, respectively.
2. Connect the EVKT-USBI2C-02 communication interface device to the PC using the USB cable.
3. Start up the EVB following the steps listed in the Quick Start Guide on page 2. Once the EVB is turned on, use the Virtual Bench Pro GUI to configure and monitor the power module.
4. Open the Virtual Bench Pro GUI to automatically scan the connected power module. When the GUI detects the power module, an address appears on the left panel next to the MPM3690-50D and the indicator to the left of the MPM3690-50D turns green to show a successful connection (see Figure 3 on page 5).


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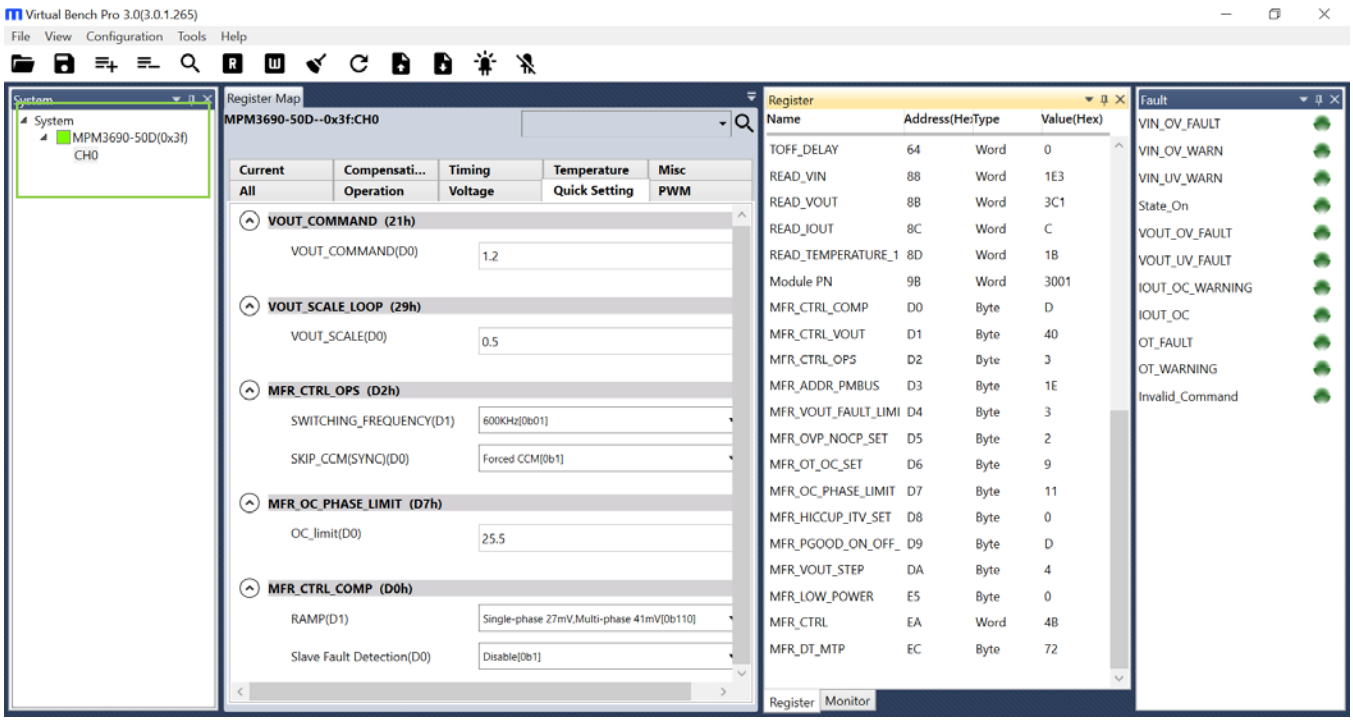


**Figure 3: Green Indicator Shows Successful Connection**

5. The Register control menu should appear in the middle panel. The values stored in the registers of the module are read automatically (see Figure 4).

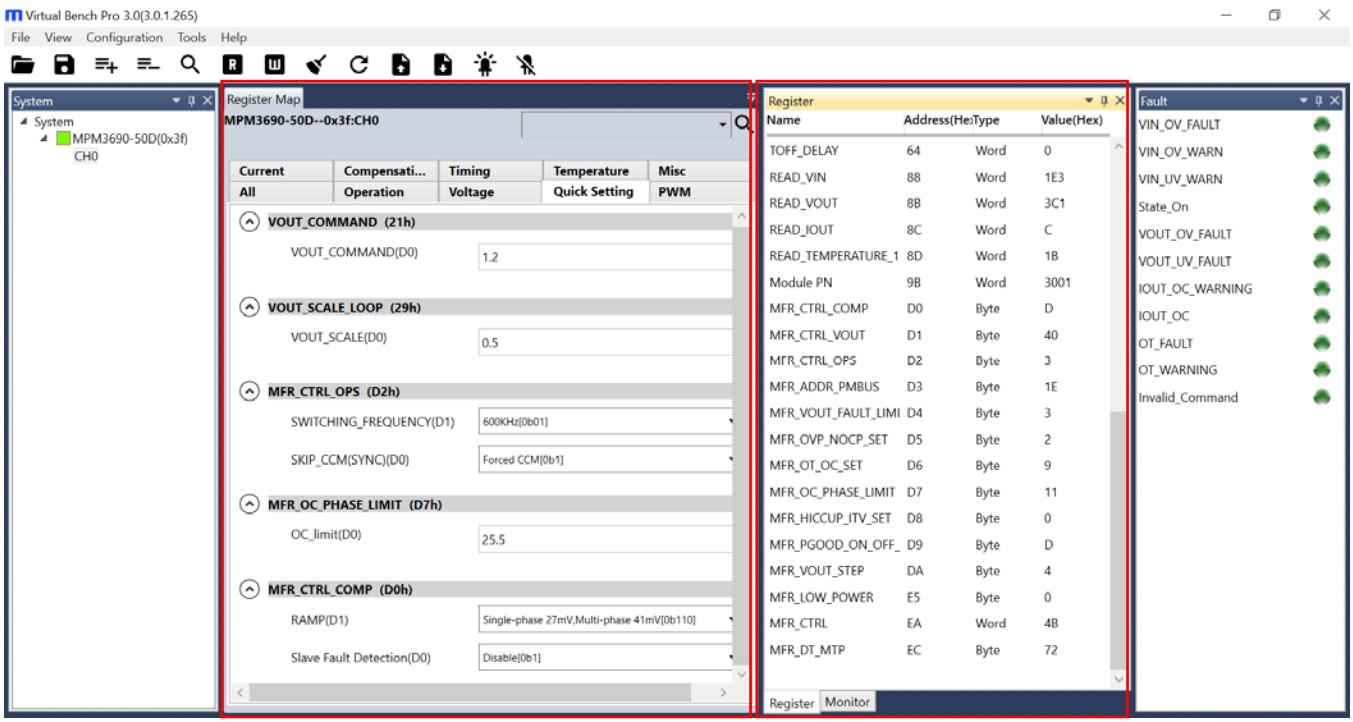


**Figure 4: Register Control Menu and Register Values**


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6. Program the registers to desired values. A valid input must be entered or an alert appears and the entered value is not accepted (see Figure 5).

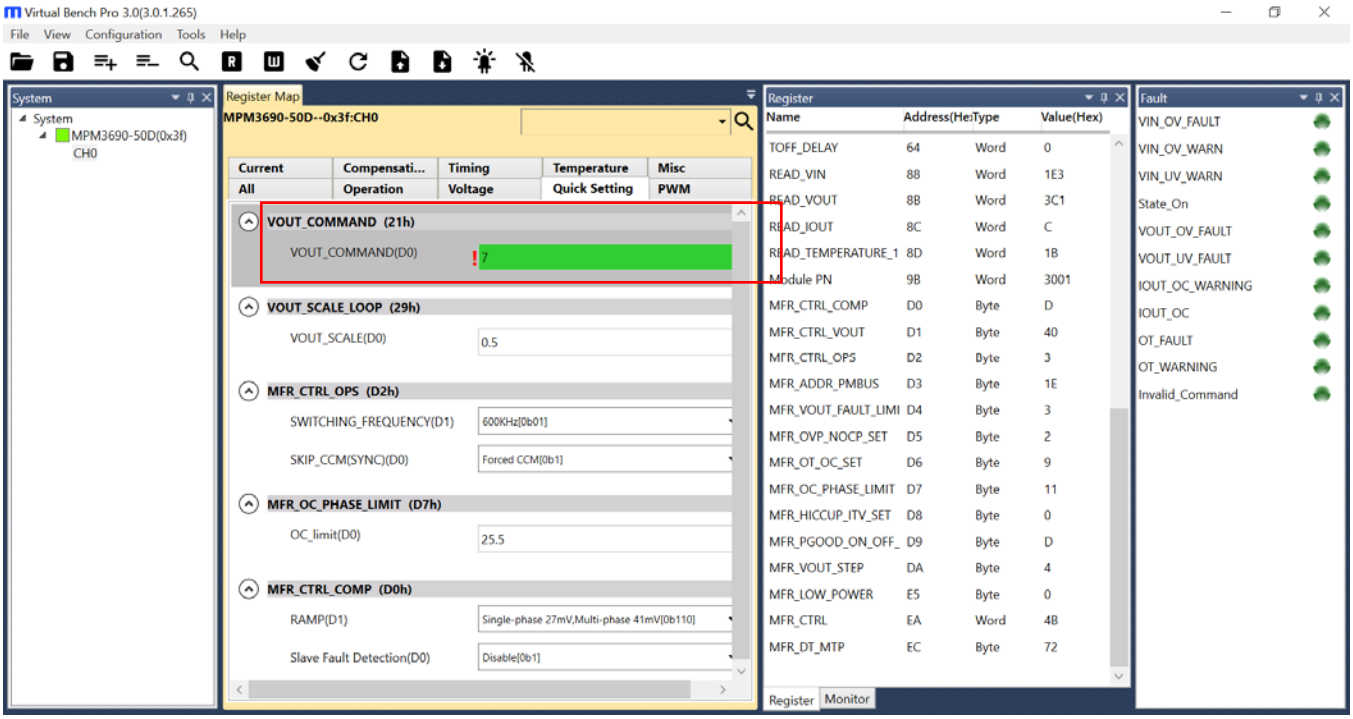


**Figure 5: Enter Desired Values in the Register**

7. Click the “Write to chip” button to write the desired values to the register (see Figure 6).

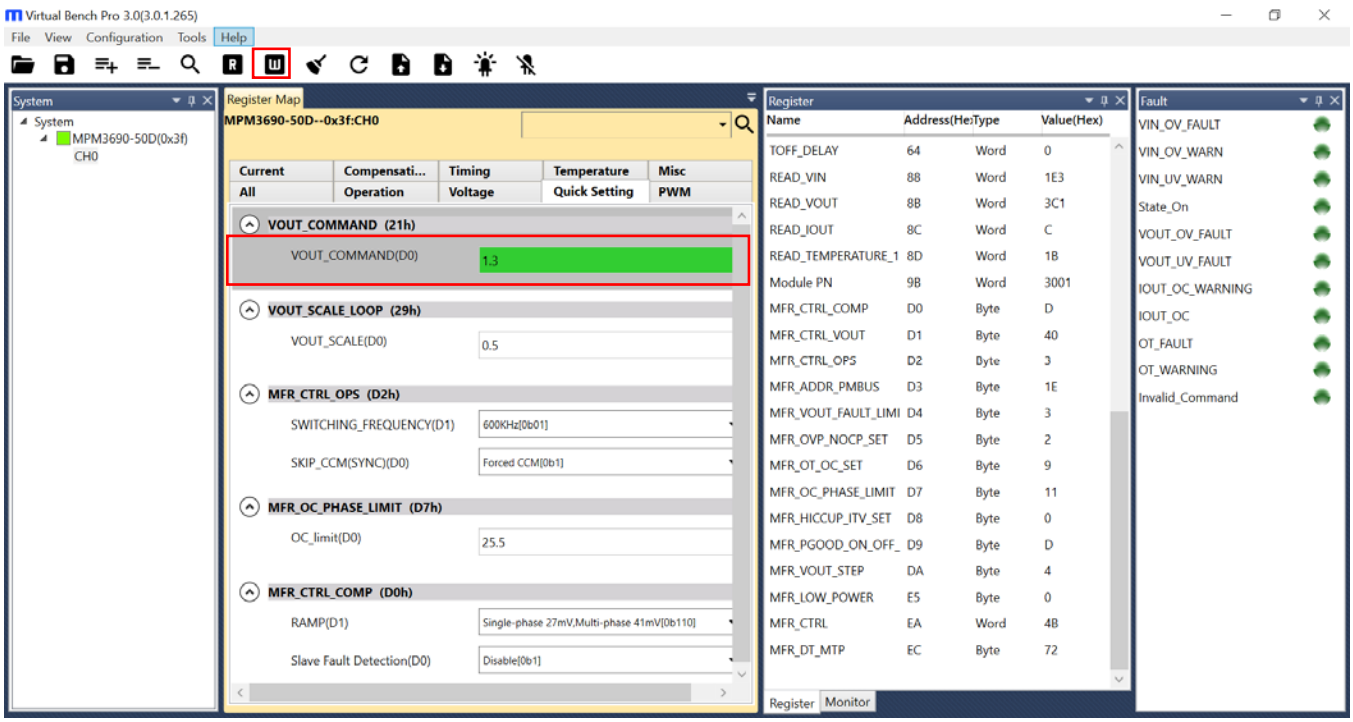


**Figure 6: Write Values to Register**


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8. Note that the values written to the register are not saved once the EVB shuts down unless they are written into the multiple-time programmable (MTP) memory.
9. To save the values to the MTP, click the “Write to MTP” button and wait until the writing action is complete (see Figure 7). Shut down the power supply to the EVB, wait 3 seconds, then start it up again for the new configuration to take effect.
10. Note that the input voltage ($V_{IN}$) must be set between 8V and 16V for writing to the MTP.

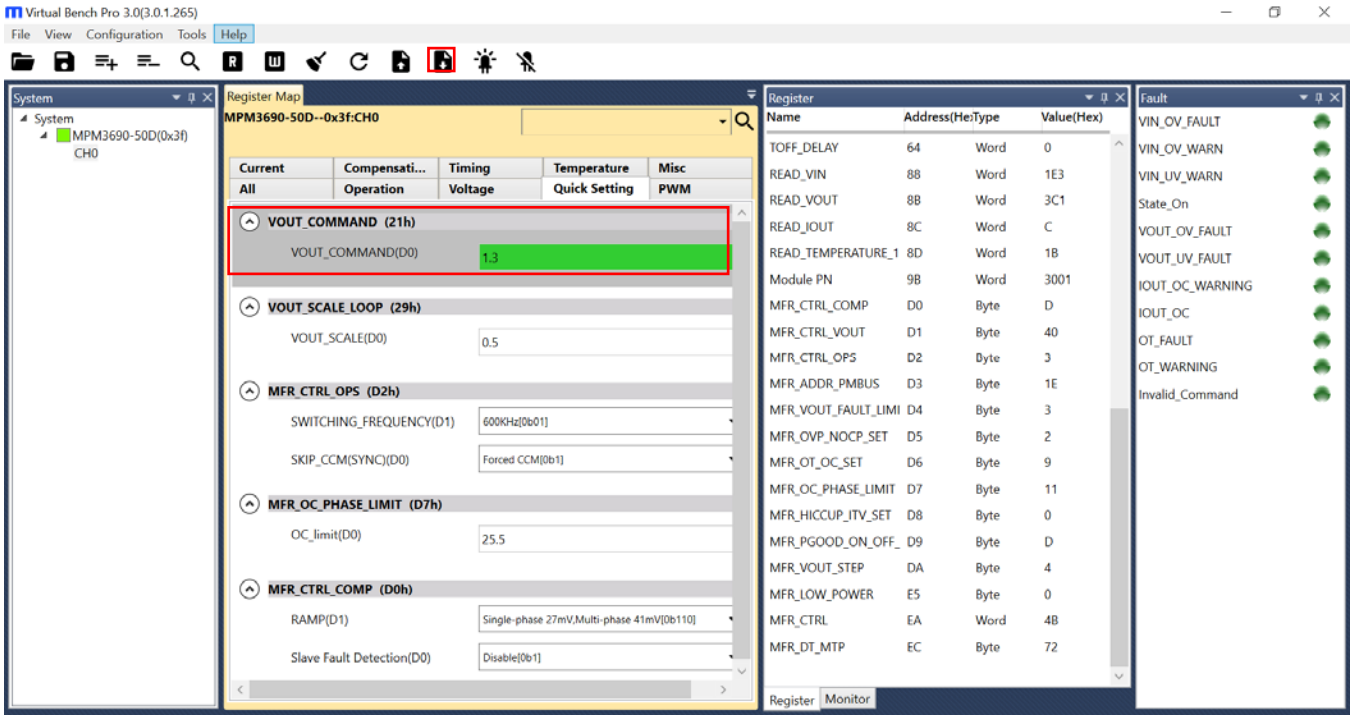


**Figure 7: Write to the MTP**


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# EVALUATION BOARD SCHEMATIC

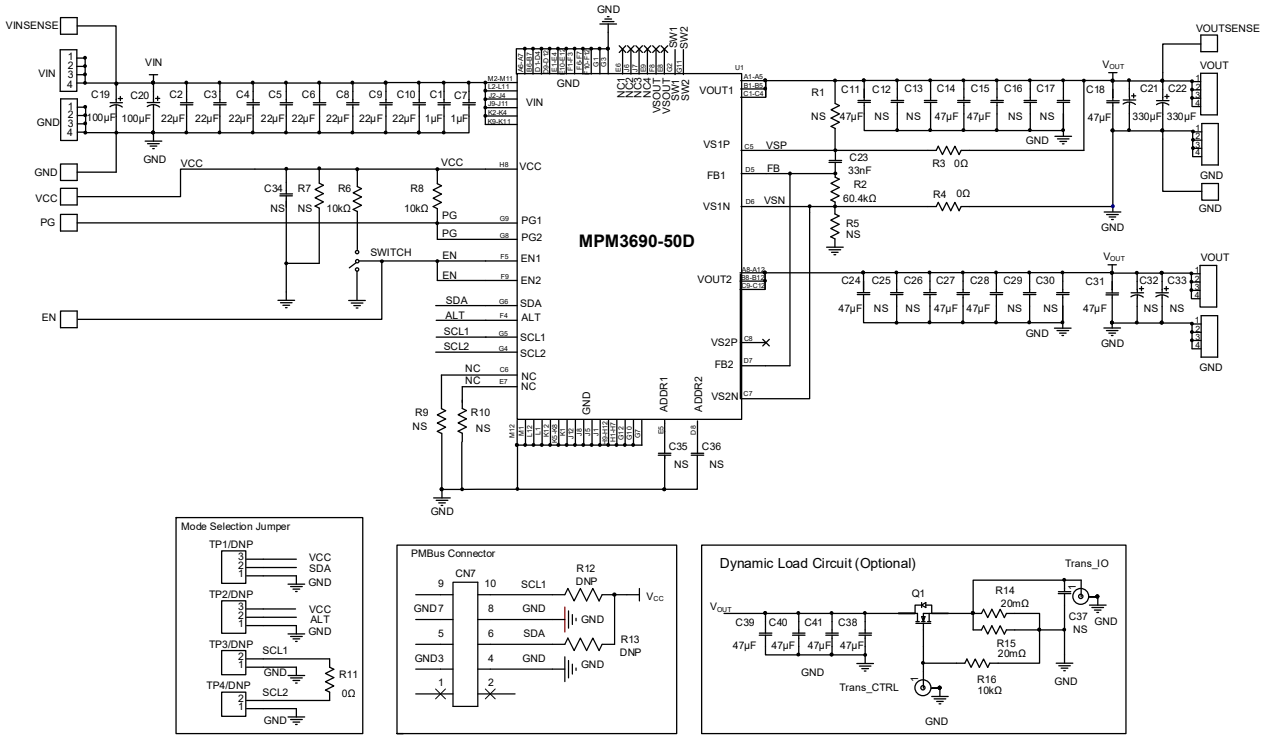


**Figure 8: Evaluation Board Schematic**


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## EVM3690-50D-BF-00A BILL OF MATERIALS

| Qty | Ref | Value | Description | Package | Manufacturer | Manufacturer PN |
|---|---|---|---|---|---|---|
| 2 | C19, C20 | 100µF | Surface-mount, aluminum polymer capacitor, 25V | OSCON E7 | Panasonic | 25SVPF100M |
| 8 | C11, C14, C15, C18, C24, C27, C28, C31 | 47µF | Ceramic capacitor, 6.3V | 0805 | Murata | GRM21BR60J476 ME15L |
| 8 | C2, C3, C4, C5, C6, C8, C9, C10 | 22µF | Ceramic capacitor, 25V | 0805 | Murata | GRM21BR61E226 ME44L |
| 2 | C1, C7 | 1µF | Ceramic capacitor, 25V | 0805 | Murata | GRM219R71E105 KA88D |
| 2 | C35, C36 | NS | | | | |
| 1 | C23 | 33nF | Ceramic capacitor, 50V | 0603 | Wurth | 885012206092 |
| 3 | R3, R4, R11 | 0Ω | Resistor, 1% | 0603 | Yageo | RC0603FR-070RL |
| 2 | R9, R10 | NS | | | | |
| 2 | R6, R8 | 10kΩ | Resistor, 1% | 0603 | Yageo | RC0603FR-0710KL |
| 1 | R2 | 60.4kΩ | Resistor, 1% | 0603 | Yageo | RC0603FR-0760K4L |
| 1 | SWITCH | 500mA | SPDT slide switch | 10mmx 2.5mm | Wurth | 450301014042 |
| 2 | C21, C22 | 220µF | Tantalum capacitor, 6.3V, 15mΩ | SMD | Panasonic | EEFCX0J221R |
| 1 | CN7 | 2x5 pin | Dual-row header | 10.16mmx 20.5mm | Wurth | 612010235121 |
| 1 | U1 | MPM3690 -50D | 16V, 50A step-down power module | BGA (16mmx 16mmx 5.18mm) | MPS | MPM3690GBF-50D |


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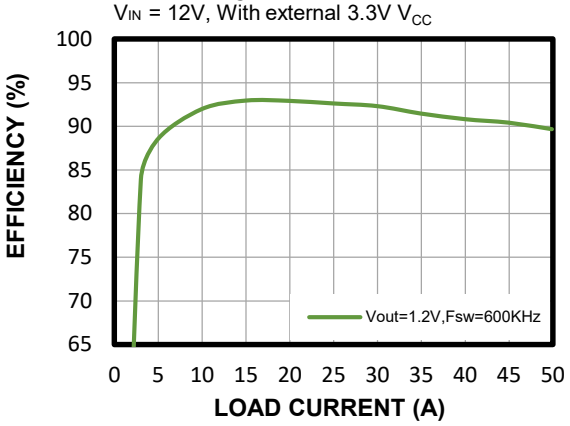
## EVB TEST RESULTS

**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 12V, $V_{OUT}$ = 1.2V, $f_{SW}$ = 600kHz, $T_A$ = 25°C, unless otherwise noted.**

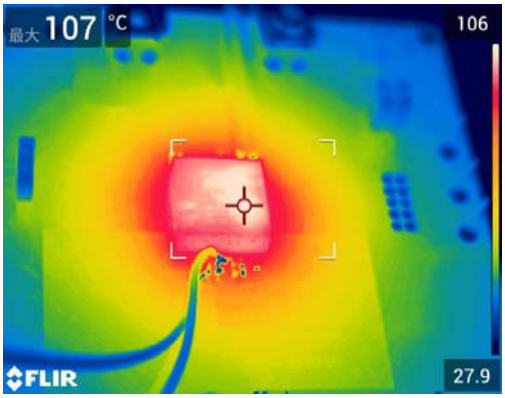
### Efficiency vs. Load Current

$V_{IN}$ = 12V, With external 3.3V $V_{CC}$




### Thermal Performance

$I_{OUT}$ = 50A, no forced airflow, $T_A$ = 28°C, $T_{CASE}$ = 107°C





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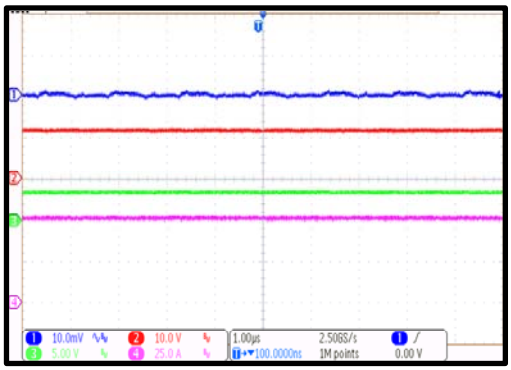
## EVB TEST RESULTS *(continued)*

**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 12V, $V_{OUT}$ = 1.2V, $f_{SW}$ = 600kHz, $T_A$ = 25°C, unless otherwise noted.**

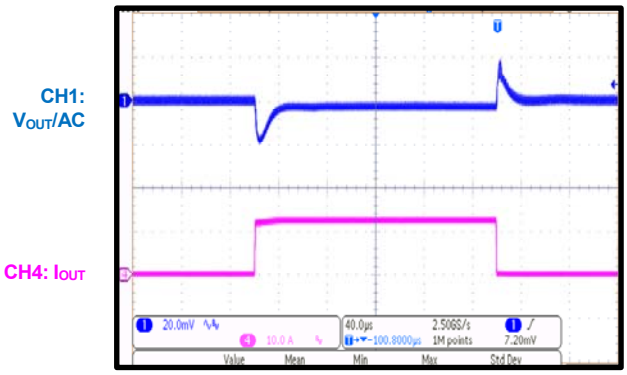
### Steady State

$I_{OUT}$ = 50A



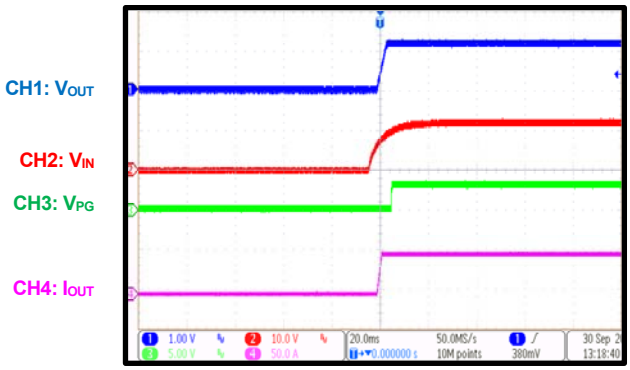

### Load Transient Ripple

$I_{OUT}$ = 0A to 12.5A, slew rate = 10A/μs



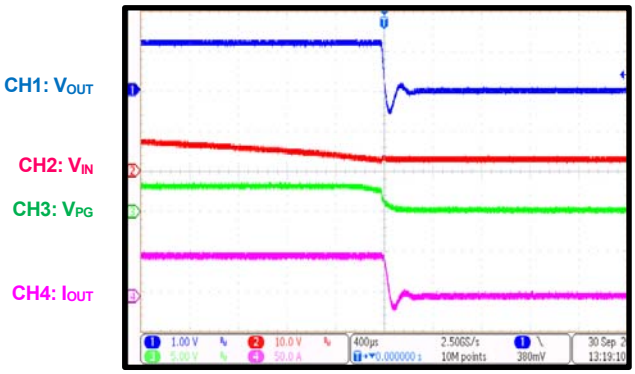

### Start-Up through VIN

$I_{OUT}$ = 50A



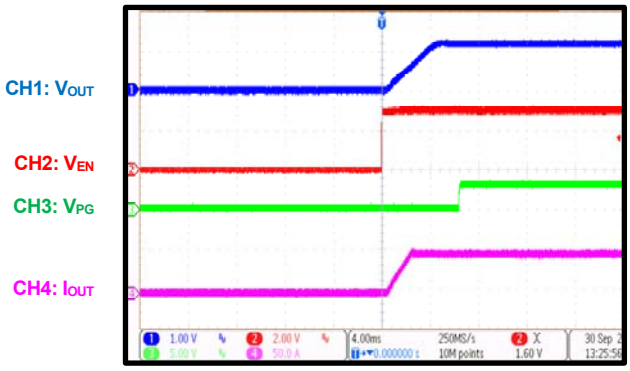

### Shutdown through VIN

$I_{OUT}$ = 50A



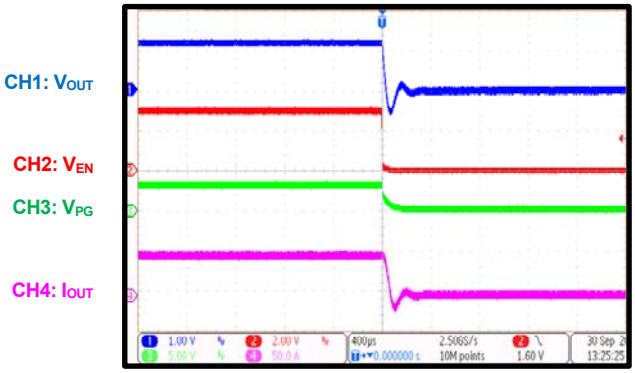

### Start-Up through EN

$I_{OUT}$ = 50A




### Shutdown through EN

$I_{OUT}$ = 50A





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## PCB LAYOUT

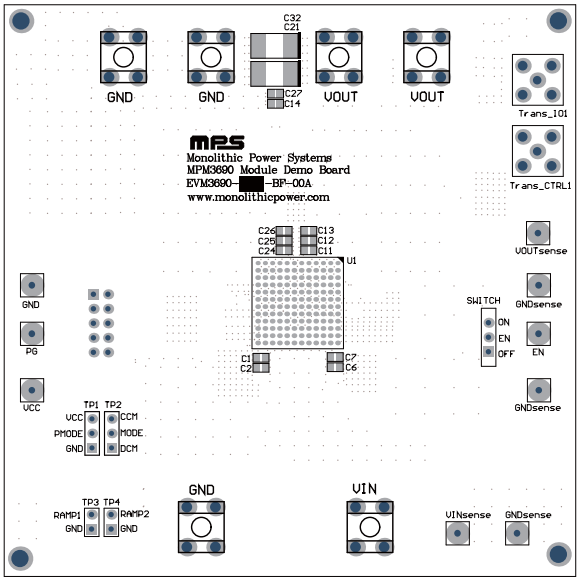


**Figure 9: Top Silk**

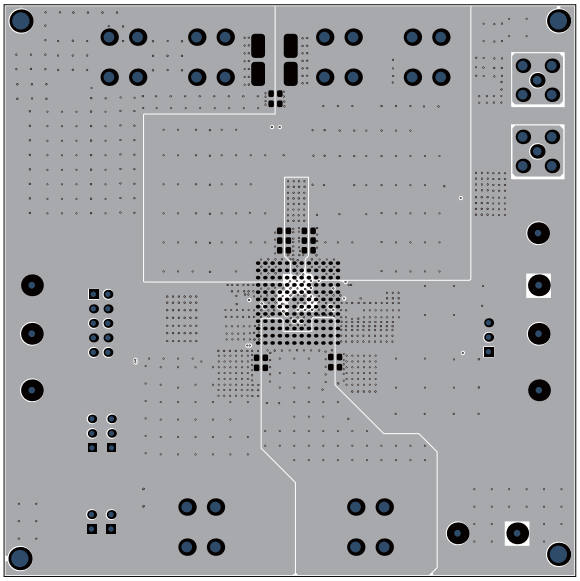

**Figure 10: Top Layer**

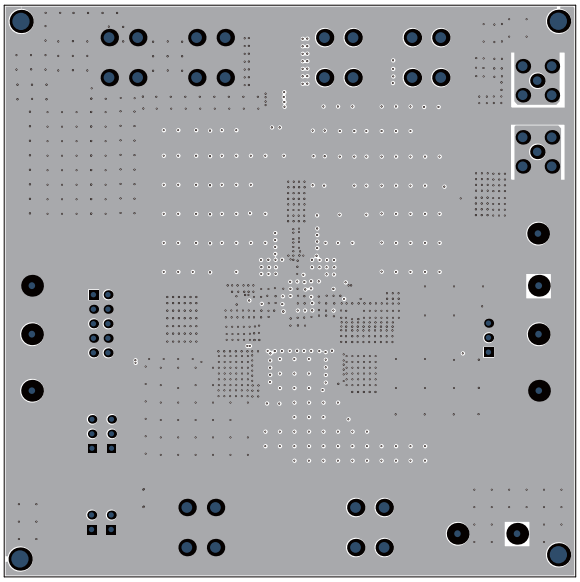

**Figure 11: Mid-Layer 1**

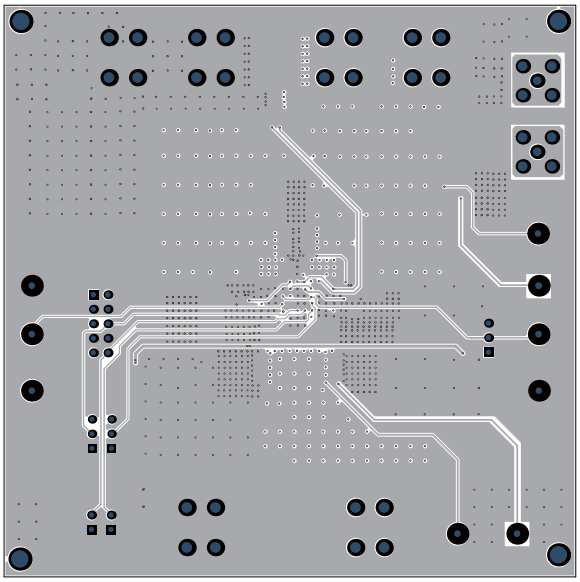

**Figure 12: Mid-Layer 2**


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## PCB LAYOUT *(continued)*

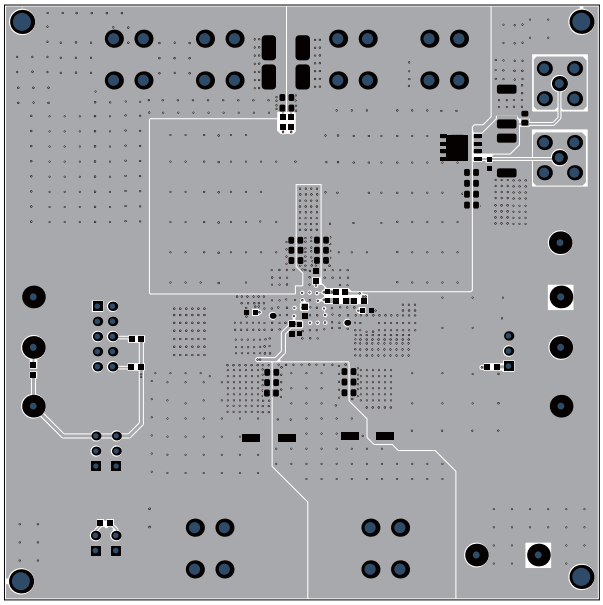

**Figure 13: Bottom Layer**

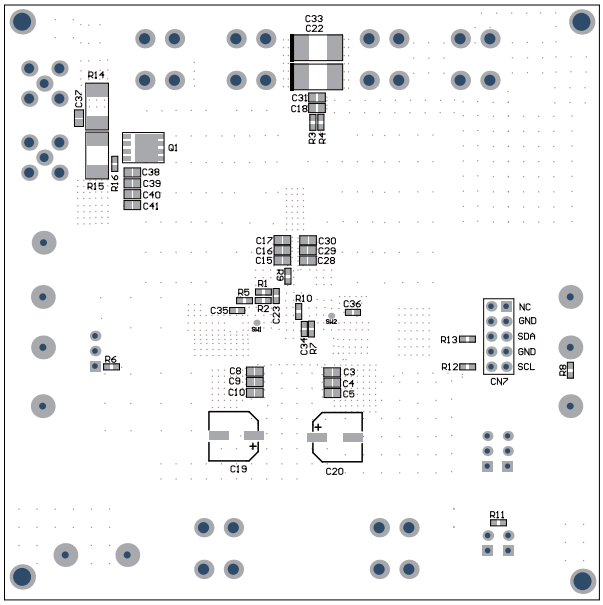


**Figure 14: Bottom Silk**


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## REVISION HISTORY

| Revision # | Revision Date | Description | Pages Updated |
|---|---|---|---|
| 1.0 | 11/18/2021 | Initial Release | - |


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