

MPM3695-25 Evaluation Kit (EVKT-MPM3695-25-A)



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# **Overview**

# Introduction

The EVKT-MPM3695-25-A is an evaluation kit for the single-phase configuration of the MPM3695-25. The MPM3695-25 is a 4mm tall, scalable, and fully integrated power module with a PMBus interface. The MPM3695-25 offers a complete power solution that achieves up to 25A of output peak current with excellent load and line regulation over a wide input voltage range. MPS's proprietary, multi-phase constant-on-time (MCOT) control provides ultra-fast transient response and simple loop compensation. This kit allows for quick evaluation and module configurations through PMBus interface.

#### Kit Contents

EVKT-MPM3695-25-A Kit contents: (items listed below can be ordered separately, and the GUI installation file and supplemental documents can be downloaded from the MPS website):

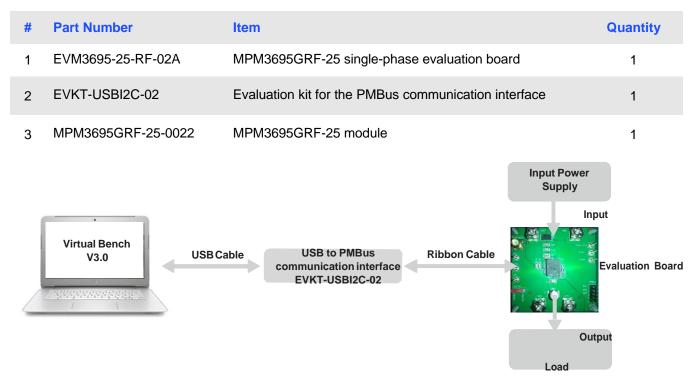


Figure 1: EVKT-MPM3695-25-A Evaluation Kit Set-Up



## **Features and Benefits**

The MPM3695 is highly customizable. Users can program the power module via the MPS PMBus and multi-time programming (MTP) memory.

 $\triangle$  Values written to the registers via PMBus will NOT be retained once the module is powered-sown unless they are written into the MTP memory

A To write to the MTP memory, the input voltage must be greater than 8V.

The key programmable features are highlighted below:

- Current limit
- Switching frequency
- Operation mode pulse skip mode (PSM) or continuous conduction mode (CCM)
- Output voltage
- Soft-start time
- Fault threshold

#### **Kit Specifications**

Features	Specification
Input Voltage	4V - 16V (without external VCC) 3V - 16V (with external 3.3V VCC)
Output Voltage	0.5V to 5V (default: 1.8V)
Maximum Output Current	20A continuous, 25A peak
Default Switching Frequency	600kHz
Operating Systems Supported	Windows 7 or later
System Requirements	Minimum 22.2 MB free
EVB Size (L x W)	6.4cm x 6.4cm



# **Section 1. Hardware Specifications**

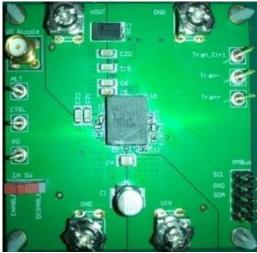
# **1.1 Personal Computer Requirements**

The following minimum requirement must be met to use the EVKT-MPM3695-25-A.

- Operating System of Windows XP, 7 or later
- Net Framework 4.0
- PC with a minimum of one available USB port
- At least 22.2 MB of free space

# 1.2 EVM3695-10-QQ-03A Specifications

The EVM3695-25-RF-02A is the evaluation board for the MPM3695GRF-25. For more information regarding the evaluation board, please refer to the EVM3695-25-RF-02A datasheet.



Feature	
Input Voltage	
Output Voltage	
Maximum Output Current	
EVB Size (L x W)	

Figure 2: EVM3695-25-RF-02A Evaluation Board

# 1.3 EVKT-USBI2C-02 Specifications

The EVKT-USBI2C-02 is the PMBus and I2C communication interface device, which connects the EVB and the PC, and its supporting accessories. Together with MPS Virtual Bench Pro GUI tool, it provides a quick and easy way to evaluate the performance of MPS digital products. For more details, refer to the EVKT-USBI2C-02 datasheet.



Figure 2: EVKT-USBI2C-02 Communication Interface Device

# **Section 2. Software Requirements**

# 2.1 Software Installation

The MPS Virtual Bench Pro GUI tool provide an easy way to access the registers, program the MTP memory, and monitor the key parameters of MPS power modules. Follow the instructions below to install the software.

Note: This software can be downloaded directly from the MPS website.

- 1. Visit the MPM3695-25 GUI page at https://www.monolithicpower.com/en/virtual-bench-pro-3-0.html
- 2. Click the "Download" button in the upper right-hand corner.
- 3. Double click the .exe file to open the set-up guide (see Figure 4).
- 4. Follow the prompts in the set-up guide.
- 5. Wait for status screen to verify that installation is complete.

🕼 Setup - VirtualBenchPro3.0				×
Select Destination Location Where should VirtualBenchPro3.0 be installed?				Ð
Setup will install VirtualBenchPro3.0 into the following folder.				
To continue, click Next. If you would like to select a different folder,	click	Brow	se.	
D:\Setup\VirtualBenchPro3.0		Bro	owse	
At least 15.6 MB of free disk space is required.				
Nex	d >		Ca	ancel

Figure 3: MPS Virtual Bench Pro GUI Set-Up Guide



# Section 3. Evaluation Kit Test Set-Up

## 3.1 Hardware Set-Up

The hardware must be properly configured prior to use. Follow the instructions below to set up the EVB.

- 1. Connect the PMBus cable to the evaluation board and the EVKT-USBI2C-02 communication interface device.
- 2. Connect the EVKT-USBI2C-02 communication interface device to your PC using the USB cable, and follow the instructions below to set up the EVB.



Figure 5: EVB to MPS I<sup>2</sup>C Communication Interface Device Wire Connection

# 3.2 Powering up the EVB

- 1. Connect the positive and negative terminals of the load to the VOUT and GND pins, respectively.
- 2. Set the output voltage of a bench power supply between 4V and 16V before connecting to the EVB to prevent damage. Then turn off the power supply.
- 3. Connect the positive and negative terminals of the power supply to the VIN and GND pins, respectively.
- 4. Turn the power supply on. The EVB will power up automatically.

# 3.3 Software Set-Up

After connecting the hardware according to steps above, please follow the following steps to set-up software.

- 1. Open Virtual Bench Pro. The software will scan the connected power modules.
  - If the GUI detects the power module, an address will appear below the "MPM3695-25" on the left panel. Additionally, the indicator to the left of "MPM3695-25" will turn green (see Figure 6).
  - Please refer to the troubleshooting section if the power module cannot be detected automatically.



Compension         Temperature         Mic           M         Operation         Voltage         Quek Setting         PMM           O VOUT_COMMAND         IIII         V         Voltage         Quek Setting         PMM           O VOUT_SCALE_LOOP         0335         0335         0111         1000-epipelia         <	egister Map MPM3695_250x30:CH0				•	Monitor	
• VOUT_COMMAND         III         v           • VOUT_COMMAND         III         v           • VOUT_SCALE_LOOP         0335         1200           • MER_CIRLOPS         5370         3720						Output Voltage	1.78875 V
VOUT_COMMAND       1:8       v         • WOUT_SCALE_LOOP       0.335       0.335         • MER_COR_JONS       0.335       0.335         • MER_COR_JONN(x)       0.000-0200.11]       •         • MER_COR_PHASE_LIMIT       0.2, ind.       27         • MER_COR_PHASE_LIMIT       0.2, ind.       270         • MER_COR_PHASE_LIMIT       0.2, ind.       0.2, ind.         • MER_COR_PHASE_LIMIT       0.2, ind.       0.2, ind.         • MER_COR_PHASE_LIMIT       0.2, ind.       0.2, ind.         • MER_COR_PHASE_LIMIT       0.2,	All Ope	ation	Voltage	Quick Setting	PWM	Temperature	29 °C
VOUT,COMMAND         1.18           VOUT,COMMAND         USDO           VOUT,SCALE LOOP         0.335           OKER,CTRL,OPS         0.335           SMER,CTRL,OPS         0.3370           SMER,CTRL,OPS         0.3000-1000-11]           SMER,CTRL,OPS         0.3720           SMER,CTRL,OPS         0.0000-1000-11]           SMER,CTRL,OPS         0.0000-1000-11]           SMER,CTRL,OPS         0.0000-1000-11]           SMER,CTRL,OPS         0.0000-1000-11]           SMER,CTRL,COMP         1.786           MARP         44.7mv[pb10]           AMP         44.7mv[pb10]	VOUT_COMMAND					12.02-	_
• Your Scale Loop         Your Scale Oop         • MEX CTRL OPS         SMFC CMS / SREQUENCY         SMFC CMS / SREQUENCY         SMFC CMS / SREQUENCY         C. (mit         27         A         MRA CTRL COMP         MARP         4.4 Triv/[bil0]         •         VOUT Scale Oop         234         234         234         234         234         234         234         234         234         235         234         234         235         236         237         236         237         236         237         236         237         236         237         238         238         238         238         238         238         238         238         238         238         238         238         238	VOUT_COMMAND	1.8	v				<u> </u>
VOUT_SCALE         0.335           Image: MER_CCRL_OPS         5000000000000000000000000000000000000	NOUT SCALE LOOP						
MER_CORE       SWTICHED_GFREQUENCY     10000+cgbs11       SWTICHED_GFREQUENCY     10000+cgbs11       SWTICHED_GFREQUENCY     10000+cgbs11       SWTICHED_GFREQUENCY     10000+cgbs11       OKEN     1000       MER_CORE_COMP     1000       RAMP     417mv[0b120]		0.335				11.98	VV VVVV V
SWITCH00_FRAQUENCY         10000H2(bill •           SWITCH00_FRAQUENCY         5000 3710 3720 3720 3730 3730           SWITCH00_FRAQUENCY         5000 3710 3720 3730 3730           SWITCH00_FRAQUENCY         Forced CCM[bil] •           OMER_CERE_COMP         1294           RAMP         44.7mr/[bill] •						11.96	
SMITCHNG/HAQUARCY ILLOWAQUELI						3700 3710	3720 3730 3740 3750
S69_COL(51%C) Fored CCL([51]    MRCOC_PHASE_LIMIT  OC_[mit 27 A MARP 447mv[[5110]							
OC_Simit         27         A           Image: Mercent comp         1.78         1.78           RAMP         (47mv[0b10])         •         1.78           Image: Comp comp comp comp comp comp comp comp c	SKIP_CCM(SYNC)	Forced CCM[0b	4] •]			4	- Va
MRR_CTRL_COMP RAMP 44.7mv/[0b110] • 44.7mv/[0b110] • 44.7mv/[0b	MFR_OC_PHASE_LIMIT					1.792	
MERCENILCOMP         1786-0         1780-0         3700         3720         3730         3730           RAMP         447mi/[0b110]         • <td< td=""><td>OC_limit</td><td>27</td><td>A</td><td></td><td></td><td></td><td></td></td<>	OC_limit	27	A				
RAMP (417mi/[bi10] •	MFR CTRL COMP						
294- 292- 292- 284- 285- 286-		44.7mV[0b110]	•]			atreation at a second s	
292- 293- 288- 286-						3/00 3/10	3/20 3/30 3/40 3/50
29 28.8 28.6						29.4-	- Temperatu
28.8							
						29-	
						4	
3700 3710 3720 3730 3740 3759							
						3700 3710	3720 3730 3740 3750

Figure 6: Green Indicator Shows Successful Connection

2. The Register Control menu will appear in the middle panel. The values stored in the registers of the module will be read automatically (see Figure 7).

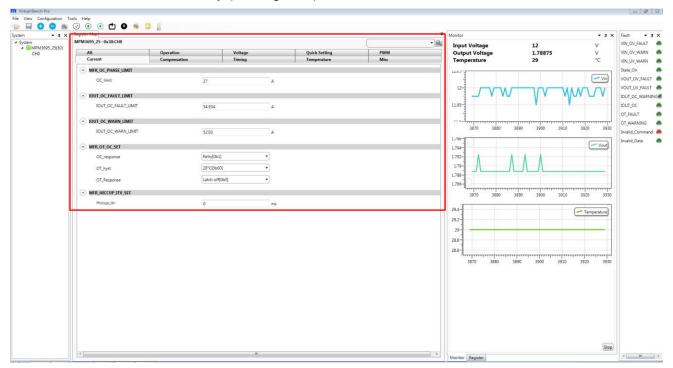


Figure 7: Values in the Register of the Module are Displayed

3. Change the register value as desired. A valid input must be entered. Otherwise, an alert will appear, and the entered value will not be accepted. (see Figure 8).



# USER GUIDE - MPM3695-25 EVALUATION KIT (EVKT-MPM3695-25)

MPM3695_250x30:CH0				•	Monitor Input Voltage	- a 11.975 V
Current Comp		ming	Temperature	Misc	Output Voltage	1.78875 V
All Opera	tion V	oltage	Quick Setting	PWM	Temperature	28 °C
· VOUT_COMMAND					12.02-4	
VOUT_COMMAND	1.5	v				- Vi
VOUT_SCALE_LOOP						
VOUT_SCALE	0.335				11.98 IVV V V V V	
					11.96-	
MFR_CTRL_OPS     SWITCHING_FREQUENCY	1000KHz[0b11]				3960 3970	3980 3990 4000 4010
SKIP_CCM(SYNC)	Forced CCM[0b1]				1./96-	
	[Porcea CCM[UD1]				1.794	- Vout
MFR_OC_PHASE_LIMIT					1.792	
OC_limit	27	A			1.79-	
					1.786-	
RAMP	[44.7mV[0b110]	•			3960 3970	3980 3990 4000 4010
					30	
						- Temperature
					29-	
					28	VY L/VL
					3960 3970	3980 3990 4000 4010

#### Figure 8: Enter Desired Values in the Register

4. Click the "Write to chip" button to write values to the register (see Figure 9).

	250x30:CH0					Monitor     Monitor		× Fault VIN_OV_FAU
5_25(30)		Compensation	Timing	Temperature	Misc	Input Voltage     Output Voltage	11.975 V 1.78875 V	VIN_OV_WA
All		Operation	Voltage	Quick Setting	PWM	Temperature	28 °C	VIN_UV_WA
~ VC	UT_COMMAND			_		12.02-		State_On
	VOUT_COMMAND	15	v			12.02	Vin	VOUT_OV_
0.00								VOUT_UV_
	UT_SCALE_LOOP					11.98		IOUT_OC_V
	VOUT_SCALE	0.335						IOUT_OC OT_FAULT
(~) MI	R_CTRL_OPS					11.96-		
	SWITCHING_FREQUENCY	10006	Hz[0b11] •			3960 3970	3980 3990 4000 4010	Invalid_Co
	SKIP_CCM(SYNC)	Forces	H CCM[061] •			1./90	Vout	Invalid_Da
0.00	R OC_PHASE_LIMIT					1.794	Vout	
~ M	OC_limit					1.792-	Λ ΛΛ	
	OC_limit	27	A			1.79		
🔿 M	R_CTRL_COMP					1.786-		
	RAMP	44.7m	V[06110] •			3960 3970	3980 3990 4000 4010	
						39.0	2200 2220 4000 4070	
							- Temperature	
						29		
						28-		
						3960 3970	3980 3990 4000 4010	

Figure 9: Write Values Steps Shown in Table

 $\triangle$ Please note that the values written to the registers will NOT be saved once the EVB is powered down unless they are written into the MTP memory (refer to Section 3.4).



# 3.4 Device Programming Instructions

The MTP memory of MPM3695 can be custom programmed. Follow the instructions outlined below to create and export customized configurations.

- 1. Connect the EVB to a PC following the steps listed in Section 3.3.
- 2. Set the register values as desired and upload them into the registers (step 3-4 in Section 3.3).
- 3. Increase the input voltage of the EVB to 12V.
- 4. Click the write to MTP button and wait until the writing action is completed.
- 5. Turn off the power supply to the EVB, wait three seconds, and turn it on for the new configuration to take effect.

Register Map MPM3695_250x30:CH0			• 9	Monitor     Input Voltage	• 11.975 V
Current Comper All Operati		Temperature Quick Setting	Misc PWM	Output Voltage	1.78875 V 28 °C
<ul> <li>vout_command</li> </ul>	an j vokage	Quick Schung		Temperature	28
VOUT_COMMAND		v		12.02	Vit
VOUT_SCALE_LOOP				11.98	
VOUT_SCALE	0.335				
MFR_CTRL_OPS					
SWITCHING_FREQUENCY	[1000KHz[0b11]			3960 3970	3980 3990 4000 4010
SKIP_CCM(SYNC)	Forced CCM[0b1] ·			1./96-0	Vou
MFR_OC_PHASE_LIMIT				1.792-	
OC_limit	27	A		1.79	Λ ΛΛ
A MFR.CTRL COMP				1.788-	
RAMP	44.7mV[0b110]			1.786-	
< PARINE >>	(Himilograph			3960 3970	3980 3990 4000 4010
				20	Temperature
				29	
					VV \M
				28	
				3960 3970	3980 3990 4000 4010

# Figure 10: Write to the MTP Memory

6. Export the configuration by clicking "configuration." Select the desired directory for the exported file and click "OK." Your configurations will be saved in a text file (see Figure 11).



# USER GUIDE - MPM3695-25 EVALUATION KIT (EVKT-MPM3695-25)

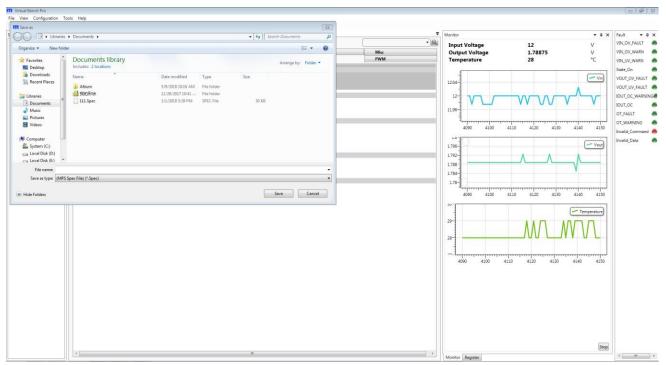


Figure 11: Select the Directory for Configuration File



## 3.5Troubleshooting Tips

Note: USBI2C-02 and USBI2C-01 drivers are not compatible. USBI2C-02 uses USBXpress and USBI2C-01 uses Cyusb3. USBI2C-02 is the recommended device for MPS PMBus and I2C.

#### EVKT-USBI2C-01

In case that the USBI2C-01 driver is not properly installed, manual installation is required. Follow the steps below.

- 1. Open the Device Manager and select update driver software (see Figure 11).
- 2. Click "Browse my computer for driver software" and find the driver located on thumb drive and install.

#### EVKT-USBI2C-02

In the case that the USBI2C-02 driver is not properly installed, manual installation is required. Follow the steps below.

Note: Check driver version. Find "USBXpress" Device in the Device Manager under USB controllers.

#### USBXpress Device

Right click and view properties. Check to make sure the driver version matches the newest version (see Figure 12).

1. Install the correct USBXpress ".exe" file.

Choose either 32 bit or 64 bit operating system.

32-bit: USBXpressInstaller\_x86.exe 64-bit: USBXpressInstaller\_x64.exe

2. Connect the EVKT-USBI2C-02 Dongle to the PC with the USB cable.



#### Figure 11: Updating the Driver Software

USBXpress Device Propert	ies X
General Driver Details	Events
USBXpress Devi	ce
Driver Provider:	Silicon Laboratories Inc.
Driver Date:	11/6/2015
Driver Version:	6.7.2.0
Digital Signer:	Microsoft Windows Hardware Compatibility Publisher
Driver Details	View details about the installed driver files.
Update Driver	Update the driver for this device.
Roll Back Driver	If the device fails after updating the driver, roll back to the previously installed driver.
Disable Device	Disable the device.
Uninstall Device	Uninstall the device from the system (Advanced).
	OK Cancel



#### EVB Connection Issue

In case that the power module cannot be automatically detected, follow the steps below to troubleshoot:

- Click on Tools  $\rightarrow$  PMBus Tool  $\rightarrow$  scan, and read the value of the slave (0x).
- Right click the "MPM3595-25" on the left pane. Click "change chip address" and enter the value of "slave(0x)". The module will be added manually.

Chip Adre	hipAddress	ji Fr	Timing Voltage	•	Temperature Quick Setting	Misc PWM	Input Voltage Output Voltage Temperature	12 1.78875 29	V V *C	VIN_OV_WAR VIN_UV_WAR State_On VOUT_OV_FAI VOUT_UV_FAI IOUT_OC_WA IOUT_OC OT_FAULT OT_WARNING
Chip Adre	MER.CTRL.OPS  SWITCHING_FREQUENCY  SGD_CCM(SYNC)  MER.CG.PHASE_LIMIT	11 • •	.8 .335 000KHz[0b11]		Quick Setting	PWM	12.05- 12- 11.05- 11.9-	· ······		State_On VOUT_OV_FA VOUT_UV_FA IOUT_OC_WA IOUT_OC OT_FAULT OT_WARNING
	Cancel Oil VOIT_SCREE MER_CTRL_OPS SWITCHING_FREQUENCY SGP_CCM(SYNC) MER_COC_PHASE_LIMIT	0 1 3	.335 000КHz[0ь11]				12.05- 12- 11.95- 11.9-			VOUT_OV_FA VOUT_UV_FA IOUT_OC_WA IOUT_OC OT_FAULT OT_WARNIN
	VOUT_SCREE     WRFR_CTERL_OPS     SWITCHING_FREQUENCY     SUP_CCMEYINC)     MIFR_OCC_PHASE_LIMIT	0 1 3	.335 000КHz[0ь11]				12- 11.95 11.9-			VOUT_UV_F. IOUT_OC_W IOUT_OC OT_FAULT OT_WARNIN
	VOUT_SCREE     WRFR_CTERL_OPS     SWITCHING_FREQUENCY     SUP_CCMEYINC)     MIFR_OCC_PHASE_LIMIT	L Fr	000КHz[0Ь11]				11.95			IOUT_OC_W IOUT_OC OT_FAULT OT_WARNIN
	MFR_CTRL_OPS     SWITCHING_FREQUENCY     SKIP_CCM(SYNC)     MFR_OC_PHASE_LIMIT	L Fr	000КHz[0Ь11]				11.95			IOUT_OC OT_FAULT OT_WARNIN
	MFR_CTRL_OPS     SWITCHING_FREQUENCY     SKIP_CCM(SYNC)     MFR_OC_PHASE_LIMIT	L Fr	000КHz[0Ь11]				11.9-	120 130		OT_FAULT OT_WARNIN
	SWITCHING_FREQUENCY SKIP_CCM(SYNC)	6					3,,	120 130	140 150	OT_WARNIN
	SWITCHING_FREQUENCY SKIP_CCM(SYNC)	6					90 100 110	120 130	140 150	
		6		-						Invalid_Com
	MFR_OC_PHASE_LIMIT		piced CCW(np1)	· ·			1./90			Invalid_Data
	0						1.794-		Vout	
	OC_limit						1.792			
		2	7	A			1.79-			
	0						 1.788			
							1.786-			
	RAMP	4	4.7mV[0b110]	•			90 100 110		140 150	
							29.4-		- Temperature	
							29.2-		_	
							29-			
							28.8			
							28.6			
							90 100 110		140 150	
									Stop	

#### Figure 14: Change the Chip Address and the Indicator Turns Green to Indicate Successful Connection

If the power module still cannot be detected, check the connections between the EVB, dongle, and PC. Re-plug the USB into the computer and restart the GUI.

#### No Output Voltage

The MPM3695-25 features many protection features. If any of the protection functions are triggered, the power module may latch off. The indicator on the right panel indicates the specific fault. A red indicator signifies that a fault has been triggered. Please refer to the MPM3695-25 datasheet for details of any specific fault.



# **Section 4. Ordering Information**

The components of the evaluation kit can be ordered separately, depending on user needs, and the GUI installation file and supplemental documents can be downloaded from the MPS website.

Part Number	Description
EVKT-MPM3695-25-A	Complete evaluation kit
Contents of EVKT-M3695-10-A	
EVM3695-25-RF-02A	MPM3695GRF-25 single-phase evaluation board
EVKT-USBI2C-02	PMBus communication interface kit
MPM3695GRF-25-0022	MPM3695GRF-25 module

Order directly from MonolithicPower.com or our distributors.

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Authorized Distributor

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Monolithic Power Systems (MPS): EVKT-MPM3695-25-A