MCPF1412M06 Evaluation Board User Guide

EV37R94A

Introduction

The MCPF1412M06 is a 16V, 12A converter designed to deliver high power density and efficiency. This evaluation board allows the user to evaluate the device's performance and demonstrates its key features.

Features

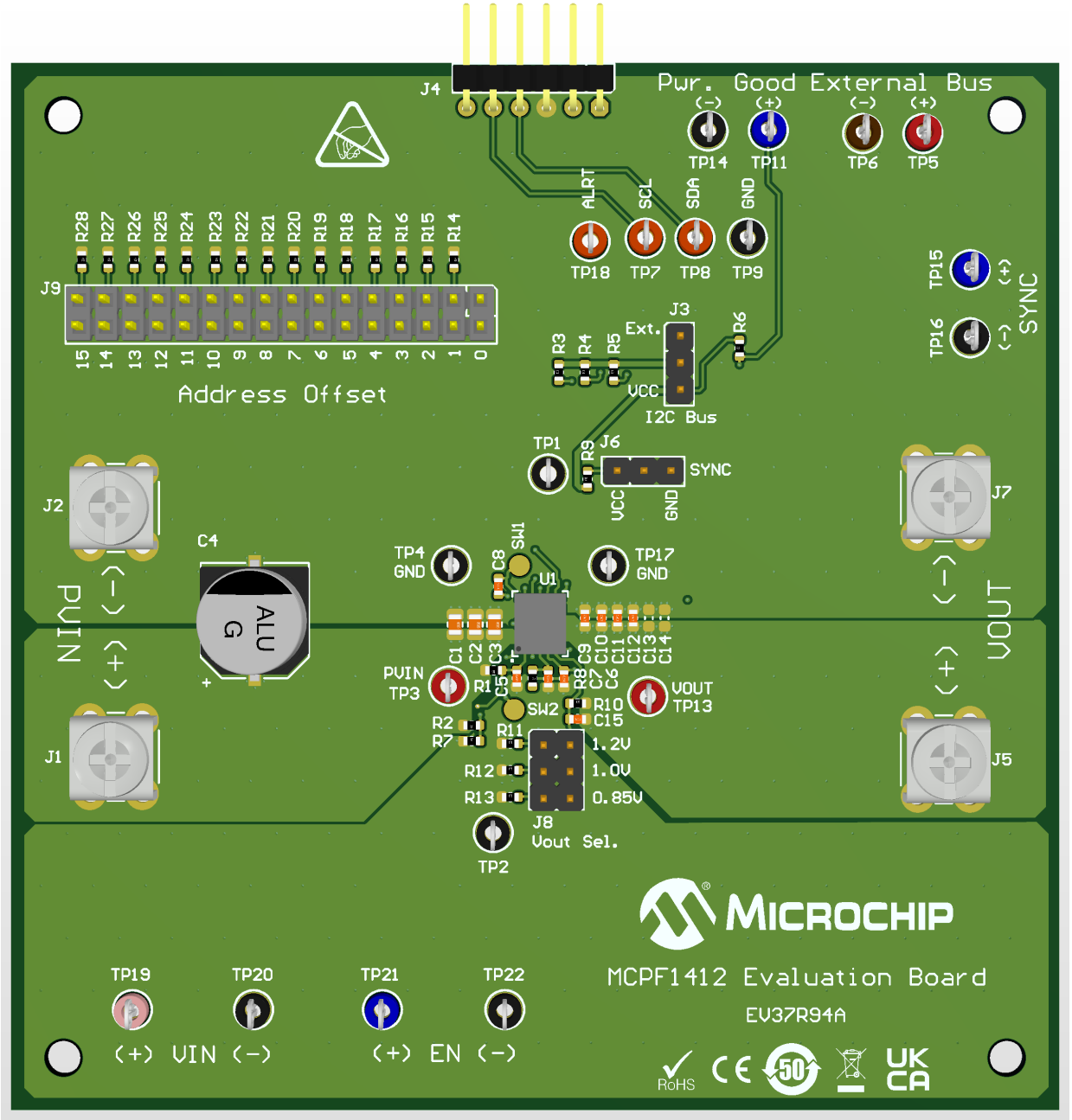
- POL Module With Output Inductor Included
- Small Size: 5.8 mm x 4.9 mm x 1.7 mm
- Continuous 12A Load Capability
- Wide Input Voltage Range: 4.5V to 16V
- Adjustable Output Voltage: 0.6V to 1.8V
- No External Compensation Required
- Programmable Operation Using I^2C and PMBus™
- Enable Input, Programmable Undervoltage Lockout (UVLO) Circuit
- Power-Good Indicator
- Built-in Protection Features
- Operating Temperature From -40°C to +125°C
- Lead-Free and Halogen-Free
- Compliant With EU REACH and RoHS

Kit Contents

The MCPF1412M06 Evaluation Board kit includes:

- MCPF1412M06 Evaluation Board

Figure 1. MCPF1412M06 Evaluation Board (Top View)



1. Setup and Configuration

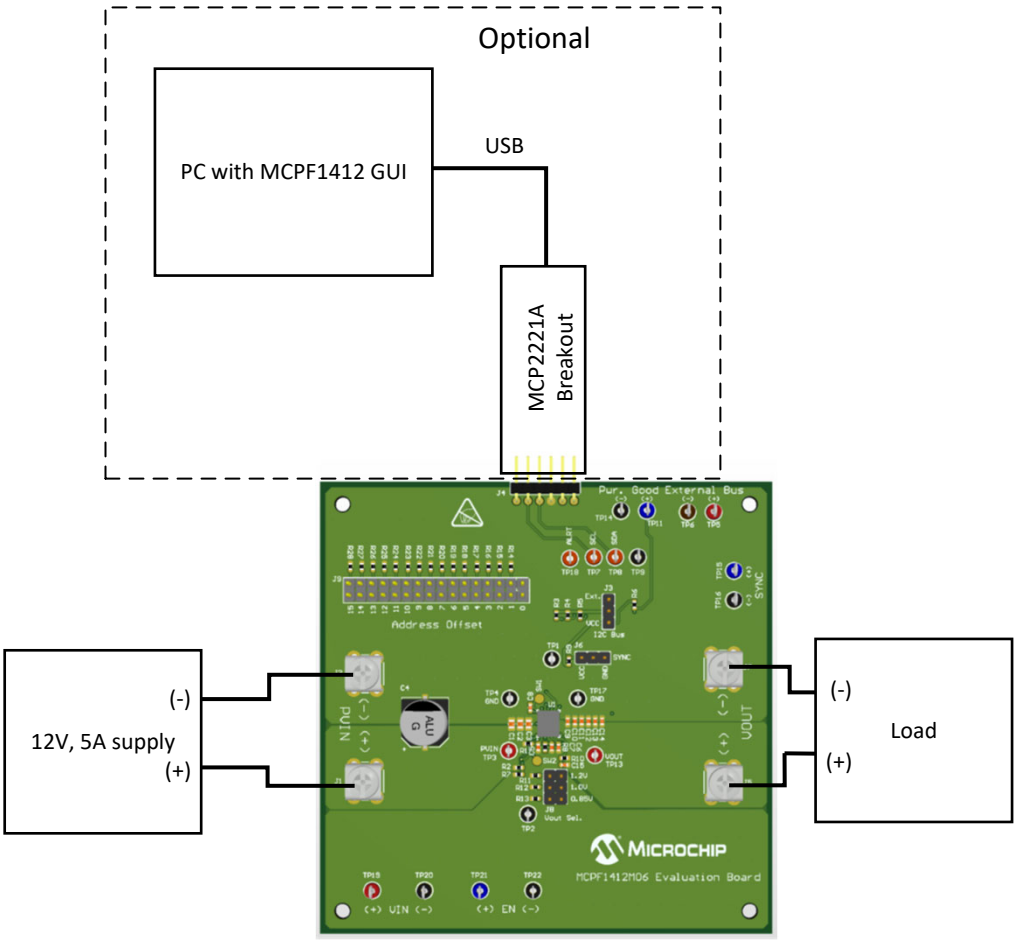
The following sections explain how to start and configure the board.

- Connection to the Evaluation Board
- Headers, Connectors, Jumpers
- Programming/Debugging
- Hardware Description

1.1. Connection to the Evaluation Board

Connect a standard 12V power supply and a DC electronic load to the evaluation board as shown in Figure 1-1. For I^2C and/or PMBus communication with the MCPF1412M06 device, an optional MCP2221A breakout board (sold separately) can also be connected as shown. After confirming that all jumpers are set to the desired positions, power on the supply first, followed by the load. Adjust the load current as needed.

Figure 1-1. Basic Board Connections



1.2. Headers, Connectors, Jumpers

The MCPF1412M06 evaluation board includes several jumpers and test points that allow users to modify the board's functionality. These include:

- J3: This jumper selects the termination voltage source for the I^2C bus. In the “VCC” position, the I^2C bus is terminated using the on-board 5V regulator and on-board resistors (R4 and R5). In the "Ext." position, an external voltage source—applied at the "External Bus" test points (TP5 and TP6)—is used for termination, still utilizing the on-board resistors. If on-board termination resistors are not required, they may be removed, provided that appropriate termination is available elsewhere on the I^2C bus.
- J6: This jumper configures the termination for the SYNC pin on the MCPF1412M06. If the SYNC function is not in use, the jumper should remain in the "GND" position. Setting the jumper to "VCC" pulls the SYNC pin to VCC through a 4.99 kΩ resistor (R9), suitable for driving the SYNC pin with an open-collector or open-drain output. Removing the jumper allows the SYNC pin to float, in which case it must be driven externally. Test points TP15 and TP16 are provided for this purpose.
- J8: This jumper allows selection of one of three preconfigured output voltages: 1.2V, 1.0V, or 850 mV. The selected position connects the appropriate biasing resistor to a voltage divider, which is then connected to the FB pin of the MCPF1412M06. Removing the jumper disconnects the voltage divider biasing resistor, resulting in the FB pin being connected to the output voltage through a resistance. In this configuration, the output voltage can be adjusted directly using PMBus commands or register values.
- J9: This jumper is used to select the offset applied to the base I^2C and PMBus addresses for communication. By default this jumper is in the “0” position, resulting in an I^2C address of 0x08 and a PMBus address of 0x70. Offsets up to 0xF (15 decimal) can be selected by changing the jumper position. The base addresses are stored in register 0x21 (I2C_BASE for I^2C and PMBUS_BASE for PMBus, allowing for full address space configuration.

1.3. Programming/Debugging

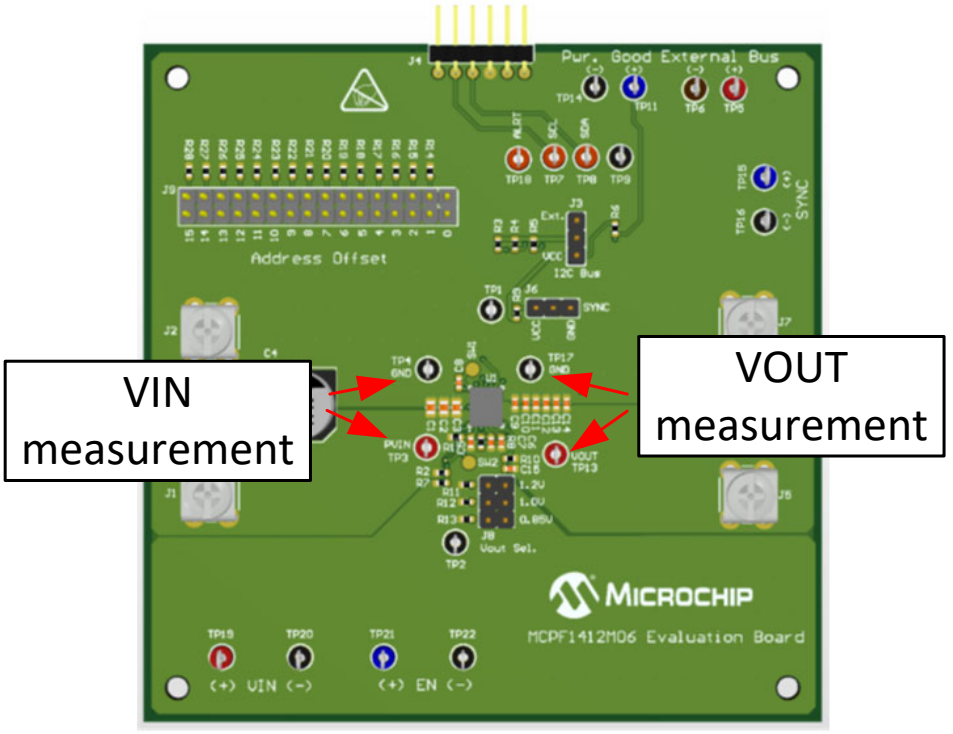
The MCPF1412M06 has both an I^2C register level access and a PMBus 1.3 compliant access mechanism. For detailed information on available registers and supported PMBus commands, refer to the MCPF1412M06 Data Sheet.

The MCPF1412M06 features on-board non-volatile memory that can be programmed. For detailed information, refer to the MCPF1412M06 Data Sheet.

1.4. Hardware Description

The MCPF1412M06 evaluation board is a four-layer board with 2 oz. copper on all layers. The board measures 100 mm x 100 mm, providing convenient handling for laboratory use. Test points are strategically located near the relevant circuitry to facilitate accurate measurement of input and output voltages, which is essential for efficiency evaluations, as shown in Figure 1-2.

Figure 1-2. Efficiency Measurement Test Points



Serial bus communication can be monitored using TP7 (“SCL”) and TP8 (“SDA”), which are located near J4, the connection point for the optional MCP2221A breakout module. The EN pin can be externally controlled via test points TP21 and TP22, labeled “EN”.

2. Graphical User Interface (GUI)

A GUI that allows access to the individual registers is available for download in the software section of the MCPF1412M06 product page. To use the GUI, an MCP2221A breakout module is required (available separately as either the MCP2221A Breakout Module or MCP2221A Breakout Board USB C. This module can be connected as shown in Figure 1-1.

Using the GUI

1. Power on the evaluation board using the input power supply.
2. Launch the GUI application.

The GUI program will automatically detect and connect to the MCPF1412M06 device and begin communication. At the top of the window is a check box labeled “Check connection status periodically.” When checked, the GUI will periodically send write commands to verify the connection status. If the MCPF1412M06 becomes disconnected or is powered down while this option is selected, the GUI will detect the disconnection in the status bar at the bottom of the application window. Once the device is reconnected or powered up, the GUI will automatically re-establish communication.

Clicking the “Read All” button will read all values in the relevant section. Clicking the “Write All” button will write all displayed values to the MCPF1412M06. Within the GUI, register bits are color-coded as follows:

- Green: Read/Write access
- Red: Reserved or unused bits
- Grey: Read-only access

Figure 2-1 illustrates the register access page of the GUI. From this page, all device registers can be accessed and, where permitted, modified. The left side of the screen displays decoded information for key registers, which can be read or written using the associated controls. On the right side, individual registers can be accessed directly at the bit level (using the bar at the top) or by entering hexadecimal values in the adjacent cells. A running log of device communication is displayed at the bottom of the window. In the top right corner, the “Status” section includes a “Read automatically” checkbox, which, when selected, will periodically update the values shown in the “Status” area.

Figure 2-1. MCPF1412M06 EVB GUI – Register Access Tab

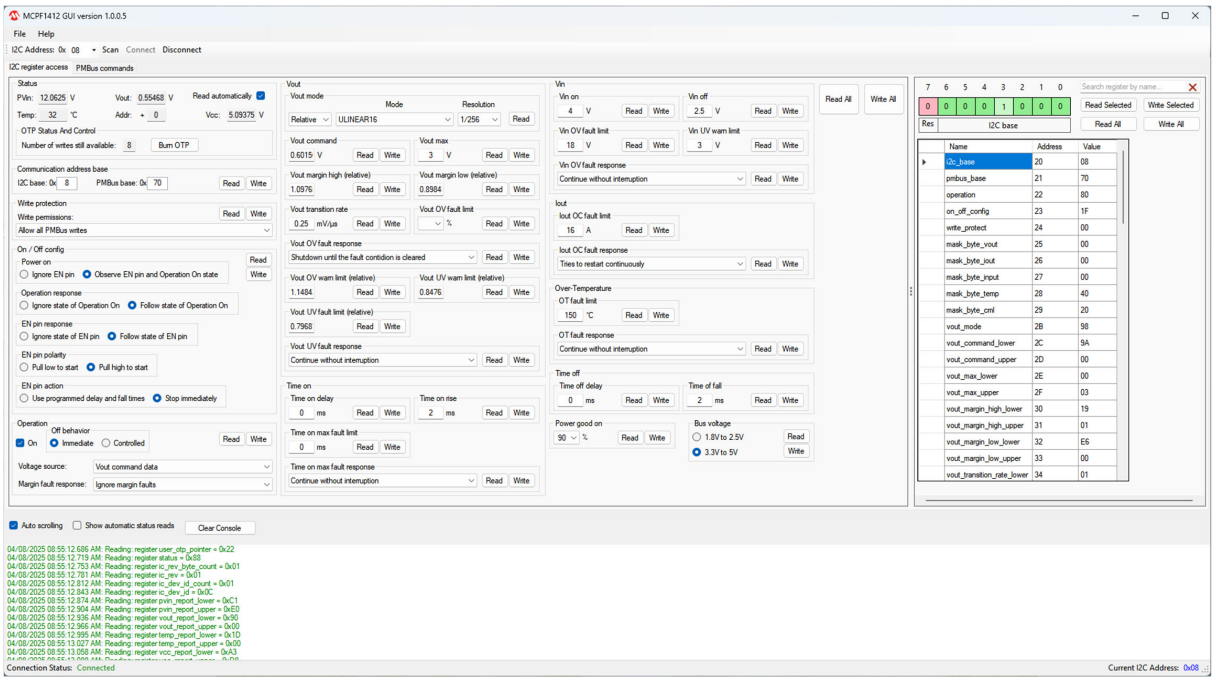
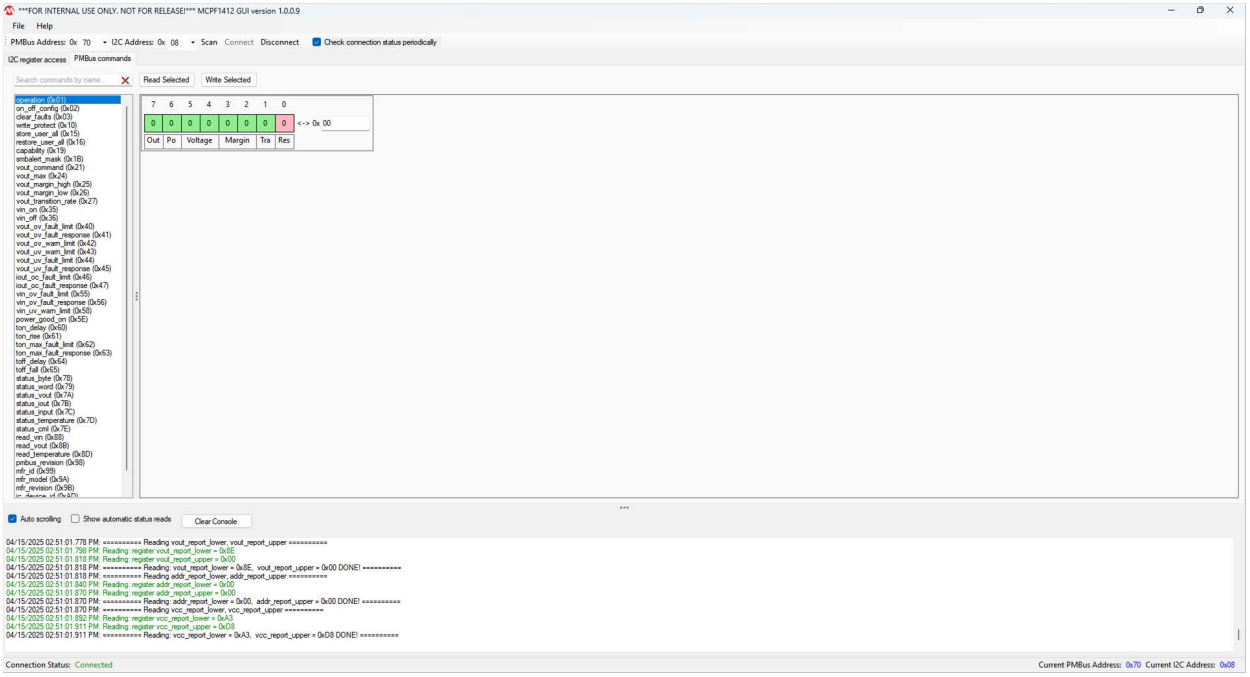


Figure 2-2 illustrates the PMBus access section of the GUI, where all supported PMBus commands can be accessed. The left side of the screen displays a list of available PMBus commands. Selecting a command from this list populates the right side of the window with controls for configuring and executing that command. At the top of the window, there are buttons to read from or write to the selected command. Some PMBus commands do not require data and simply instruct the MCPF1412M06 to perform a specific action. In these cases, clicking the Write button will send the command to the device and initiate the corresponding action.

Figure 2-2. MCPF1412M06 EVB GUI – PMBus Tab



3. Layout

Figure 3-1. Schematic

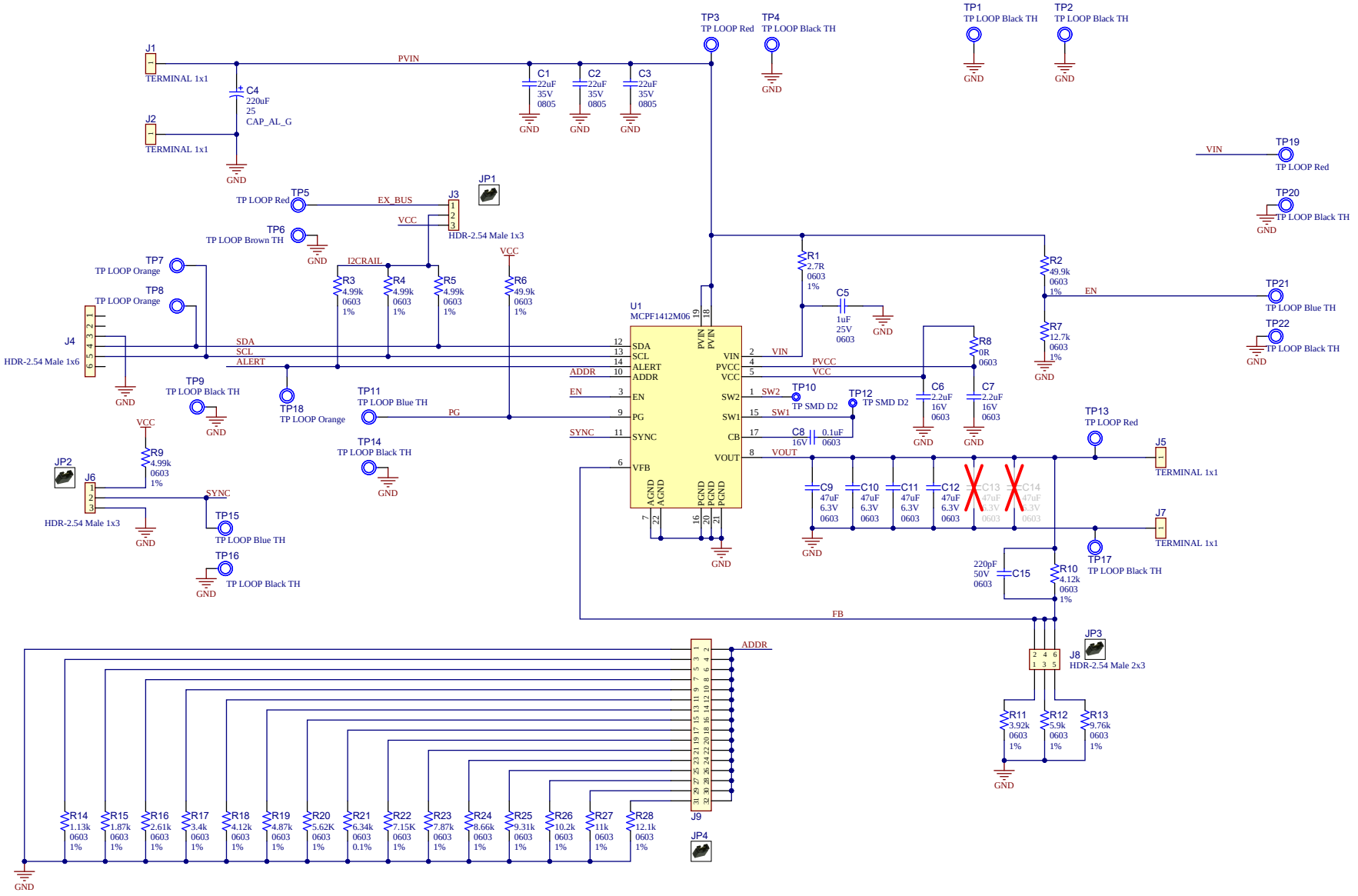


Figure 3-2. Top Silk

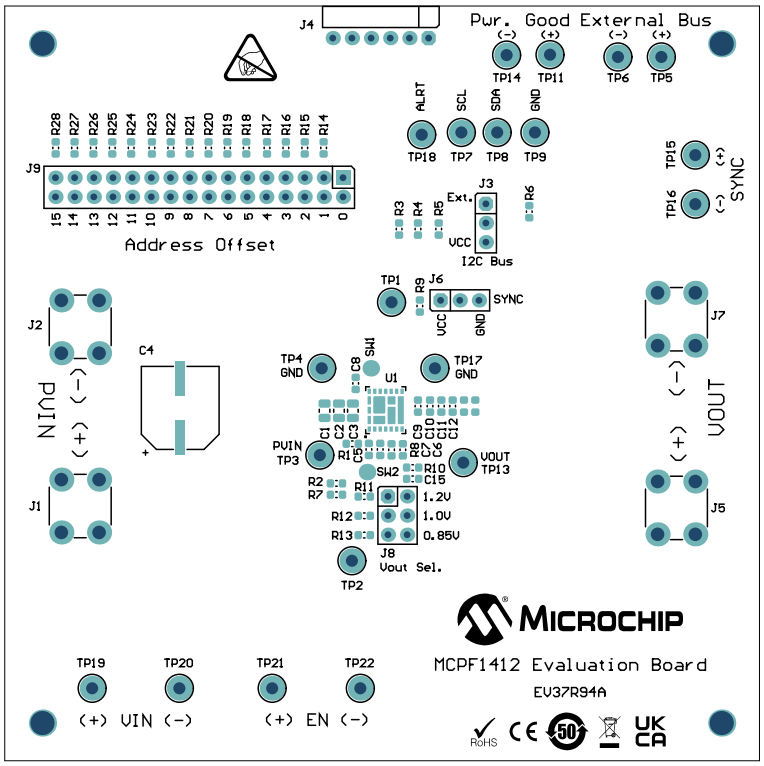


Figure 3-3. Top Copper and Silk

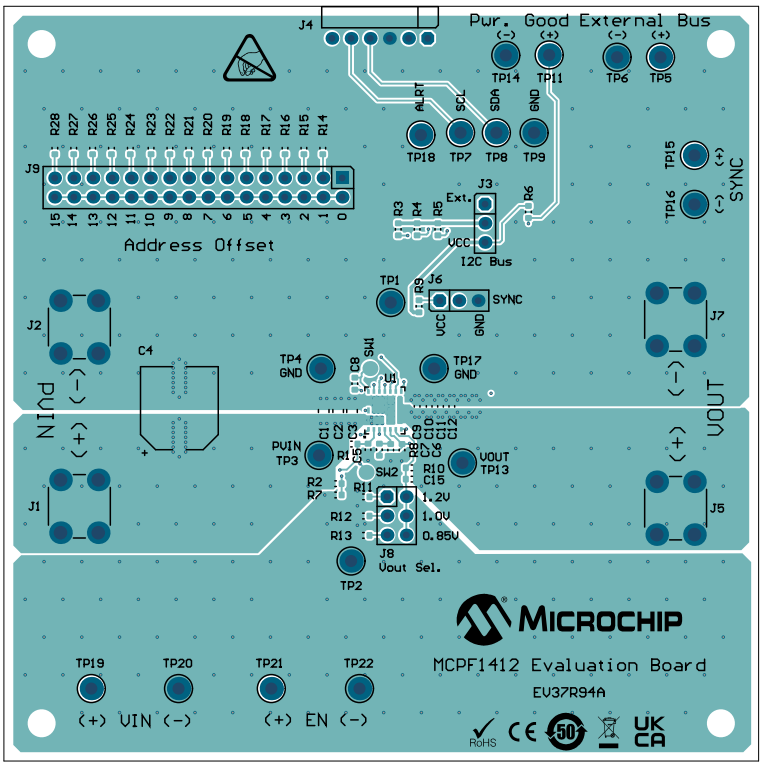


Figure 3-4. Top Copper

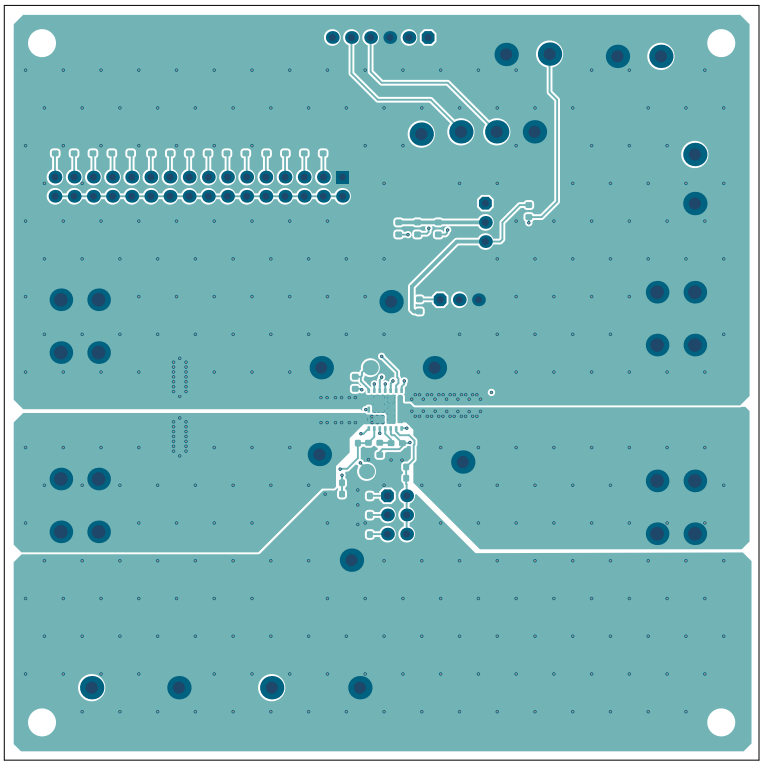


Figure 3-5. Layer 1

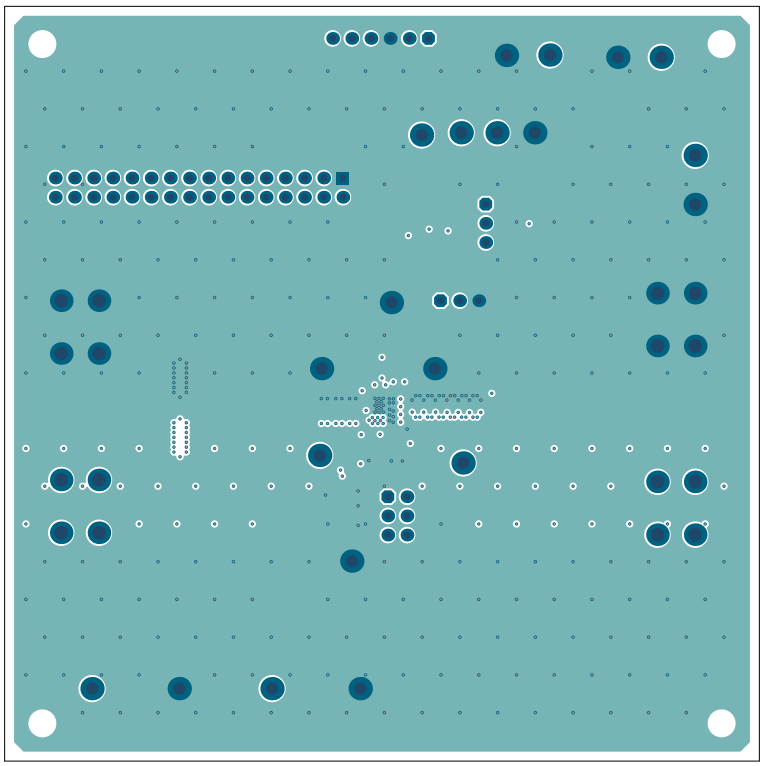


Figure 3-6. Layer 2

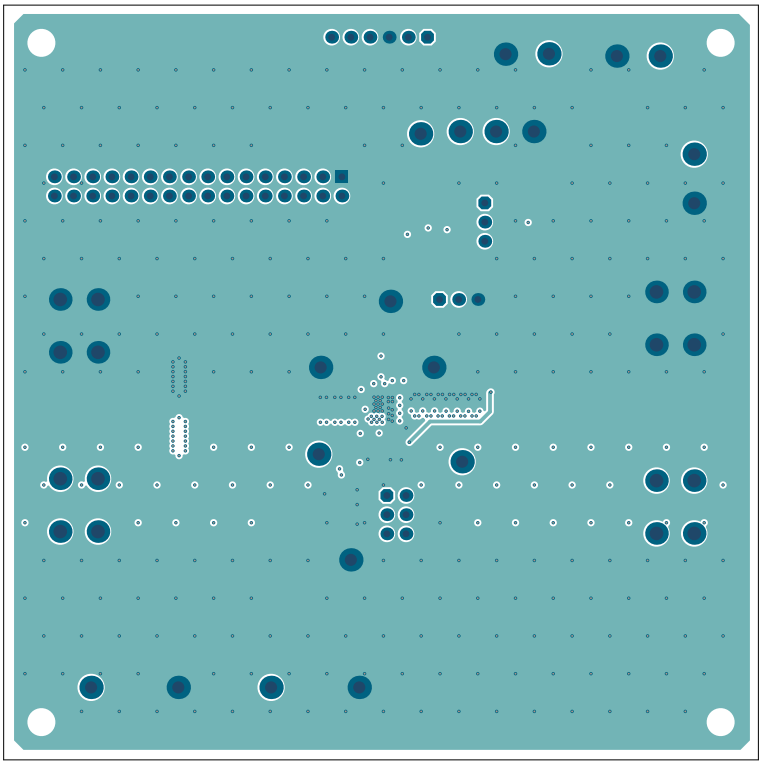
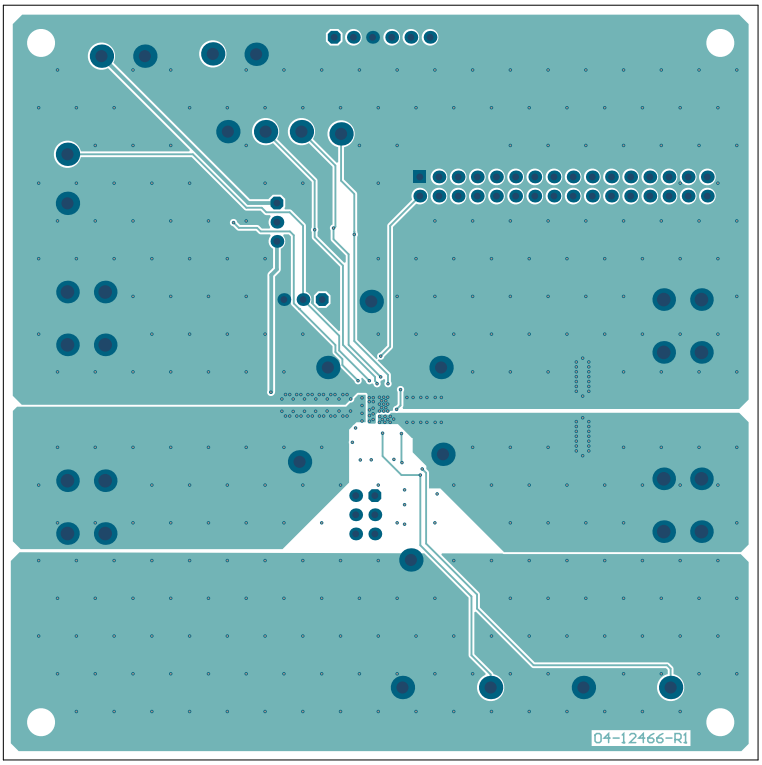


Figure 3-7. Bottom Copper (Mirrored)



4. Bill of Materials (BOM)

Table 4-1. Bill of Materials (BOM)

Qty.	Reference	Description	Manufacturer	Part Number
3	C1, C2, C3	Capacitor, Ceramic, 22 µF, 35V, 20%, X5R, SMD, 0805	TDK Corporation	C2012X5R1V226M125AC
1	C4	Capacitor, Aluminum, 220 µF, 25V, 20%, SMD, G	Würth Elektronik	875075561008
1	C5	Capacitor, Ceramic, 1 µF, 25V, 20%, X5R, SMD, 0603	TDK Corporation	C1608X5R1E105M080AC
2	C6, C7	Capacitor, Ceramic, 2.2 µF, 16V, 80%, Y5V, SMD, 0603	Yageo Corporation	CC0603ZRY5V7BB225
1	C8	Capacitor, Ceramic, 0.1 µF, 16V, 10%, X7R, SMD, 0603	Taiyo Yuden Co., Ltd.	EMK107B7104KA-T
4	C9, C10, C11, C12	Capacitor, Ceramic, 47 µF, 6.3V, 20%, X5R, SMD, 0603	Kyocera AVX®	06036D476MAT2A
0	C13, C14	Capacitor, Ceramic, 47 µF, 6.3V, 20%, X5R, SMD, 0603	Kyocera AVX®	06036D476MAT2A
1	C15	Capacitor, Ceramic, 220 pF, 50V, 5%, NP0, SMD, 0603	KEMET	C0603C221J5GACTU
4	J1, J2, J5, J7	Connector, Terminal, 15A, Female, 1x1, TH, Vertical	Keystone® Electronics Corp.	7701
2	J3, J6	Connector, HDR-2.54, Male, 1x3, Gold, 5.84 MHz, TH, Vertical	Amphenol ICC (FCI)	68000-103HLF
1	J4	Connector, HDR-2.54, Male, 1x6, Gold, 5.84 MHz, TH R/A	FCI	68016-106HLF
1	J8	Connector, HDR-2.54, Male, 2x3, Gold, 5.84 MHz, TH	Würth Elektronik	61300621121
1	J9	Connector, HDR-2.54, Male, 2x16, Gold, 5.84 MHz, TH	Sullins Connector Solutions	PRPC016DFBN-RC
4	JP1, JP2, JP3, JP4	Mechanical Jumper, HW, 2.54 mm, 1x2	FCI	63429-202LF
1	R1	Resistor, Thick Film, 2.7Ω, 1%, 1/10W, SMD, 0603, AEC-Q200	Vishay® Dale	CRCW06032R70FKEA
2	R2, R6	Resistor, Thick Film, 49.9 kΩ, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF4992V
4	R3, R4, R5, R9	Resistor, Thick Film, 4.99k, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF4991V
1	R7	Resistor, Thick Film, 12.7k, 1%, 1/10W, SMD, 0603, AEC-Q200	Panasonic® - ECG	ERJ-3EKF1272V
1	R8	Resistor, Thick Film, 0Ω, 1/10W, SMD, 0603, AEC-Q200	Stackpole Electronics, Inc.	RMCF0603ZT0R00
2	R10, R18	Resistor, Thick Film, 4.12 kΩ, 1%, 1/10W, SMD, 0603, AEC-Q200	Stackpole Electronics, Inc.	RMCF0603FT4K12
1	R11	Resistor, Thick Film, 3.92 kΩ, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF3921V
1	R12	Resistor, Thick Film, 5.9 kΩ, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF5901V
1	R13	Resistor, Thick Film, 9.76 kΩ, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF9761V
1	R14	Resistor, Thick Film, 1.13 kΩ, 1%, 1/10W, SMD, 0603	ROHM Semiconductor	MCR03ERTF1131
1	R15	Resistor, Thick Film, 1.87 kΩ, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF1871V

Table 4-1. Bill of Materials (BOM) (continued)

Qty.	Reference	Description	Manufacturer	Part Number
1	R16	Resistor, Thick Film, 2.61 kΩ, 1%, 1/10W, SMD, 0603	Yageo Corporation	RC0603FR-072K61L
1	R17	Resistor, Thick Film, 3.4 kΩ, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF3401V
1	R19	Resistor, Thick Film, 4.87 kΩ, 1%, 1/10W, SMD, 0603	Yageo Corporation	RC0603FR-074K87L
1	R20	Resistor, Thick Film, 5.62 kΩ, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF5621V
1	R21	Resistor, Thin Film, 6.34 kΩ, 0.1%, 1/10W, SMD, 0603, AEC-Q200	Panasonic® - ECG	ERA-3AEB6341V
1	R22	Resistor, Thick Film, 7.15 kΩ, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF7151V
1	R23	Resistor, Thick Film, 7.87 kΩ, 1%, 1/10W, SMD, 0603	Yageo Corporation	RT0603FRE077K87L
1	R24	Resistor, Thick Film, 8.66 kΩ, 1%, 1/10W, SMD, 0603	Yageo Corporation	RC0603FR-078K66L
1	R25	Resistor, Thick Film, 9.31 kΩ, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF9311V
1	R26	Resistor, Thick Film, 10.2 kΩ, 1%, 1/10W, SMD, 0603	Yageo Corporation	RC0603FR-0710K2L
1	R27	Resistor, Thick Film, 11 kΩ, 1%, 1/10W, SMD, 0603, AEC-Q200	Vishay® Dale	CRCW060311K0FKEA
1	R28	Resistor, Thick Film, 12.1 kΩ, 1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERJ-3EKF1212V
9	TP1, TP2, TP4, TP9, TP14, TP16, TP17, TP20, TP22	Connector, TP, Loop, Black, TH	Keystone® Electronics Corp.	5011
4	TP3, TP5, TP13, TP19	Connector, TP, Loop, Red, TH	Keystone® Electronics Corp.	5010
1	TP6	Connector, TP, Loop, Brown, TH	Keystone® Electronics Corp.	5125
3	TP7, TP8, TP18	Connector, TP, Loop, Orange, TH	Keystone® Electronics Corp.	5013
3	TP11, TP15, TP21	Connector, TP, Loop, Blue, TH	Keystone® Electronics Corp.	5127
1	**U1**	**Analog Switcher Buck, 0.6–1.8V, Point-of-Load, 5.8 x 4.9 LGA**	**Microchip Technology Inc.**	**MCPF1412M06**
1	PCB1	Printed Circuit Board (PCB)	—	04-12466-R1
1	PCBA1	PCB Assembly	—	02-01409-R1

5. Performance

This section provides specific operation waveforms and graphs. Refer to the MCPF1412M06 Data Sheet (DS60001885) for more information.

Figure 5-1. Typical Efficiency (PVIN = 12V, V_{OUT} = 1.0V)

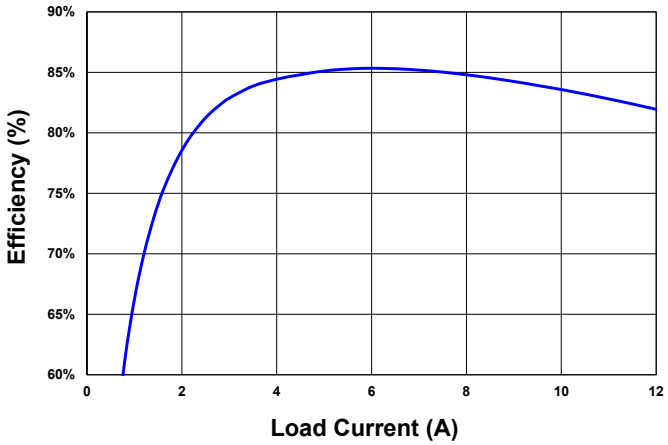


Figure 5-2. Typical Power Loss (PVIN = 12V, V_{OUT} = 1.0V)

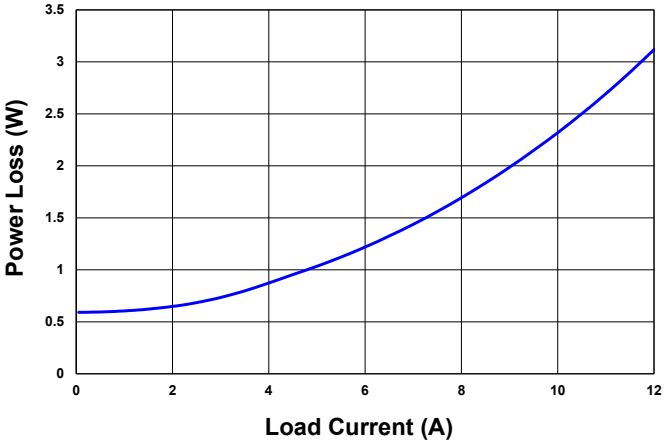


Figure 5-3. Typical Load Regulation (PVIN = 12V, V_{OUT} = 1.0V, I_{OUT} = 0-12A, Room Temeperature, No Air Flow, All Loses Included)

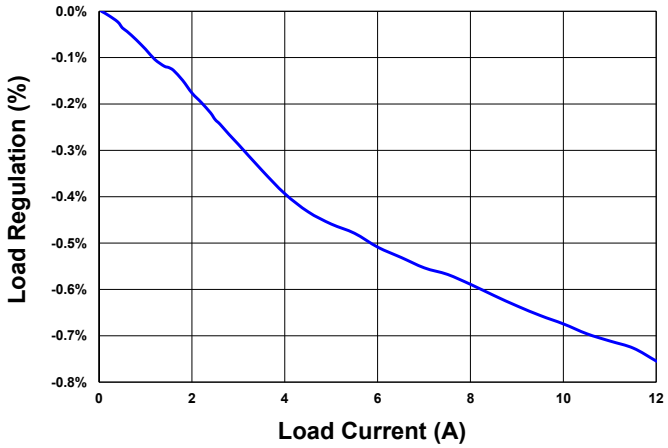


Figure 5-4. Startup (No Load)

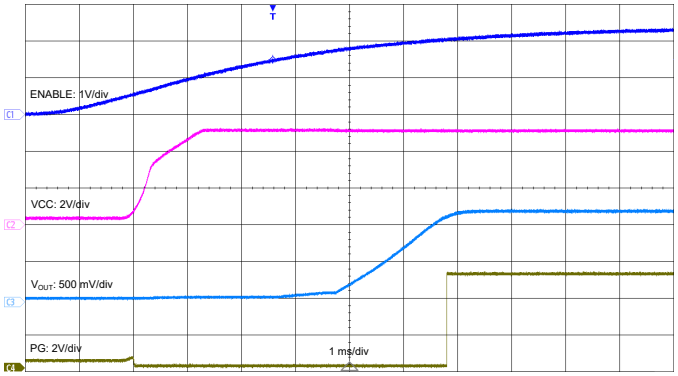


Figure 5-5. Startup (12A Load)

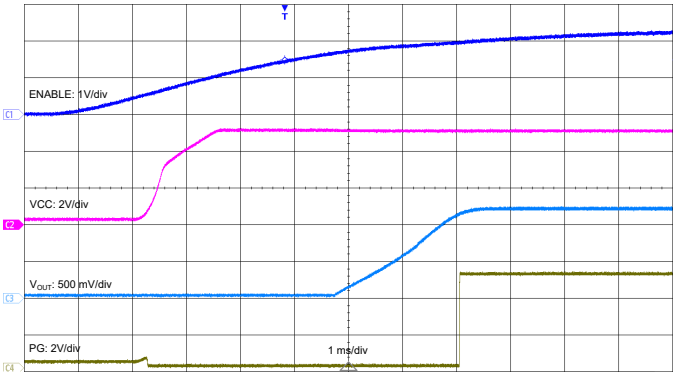


Figure 5-6. Shutdown via EN De-assertion (No Load)

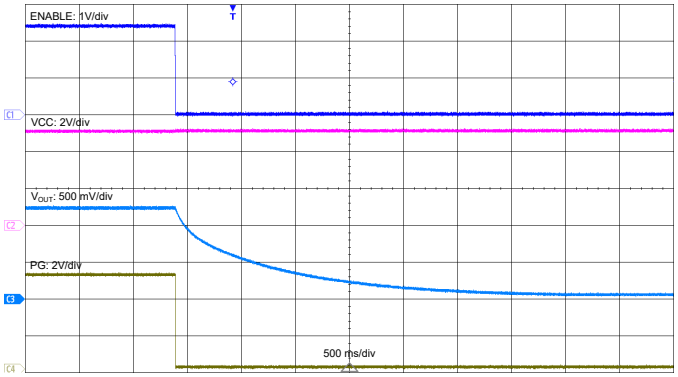


Figure 5-7. Shutdown via EN De-assertion (12A Load)

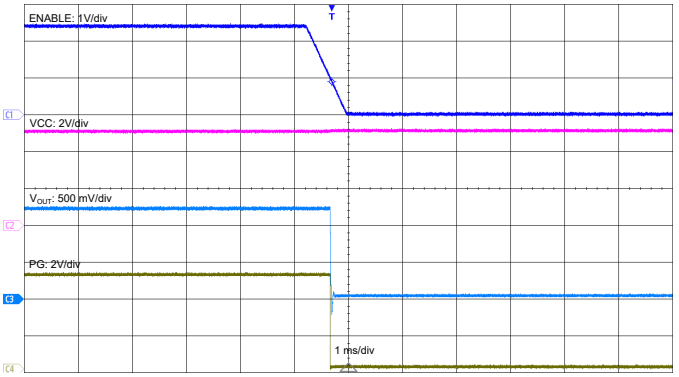


Figure 5-8. V_{OUT} Ripple

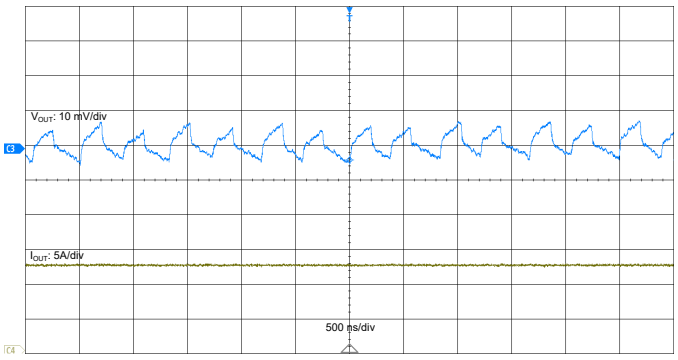


Figure 5-9. Transient Response

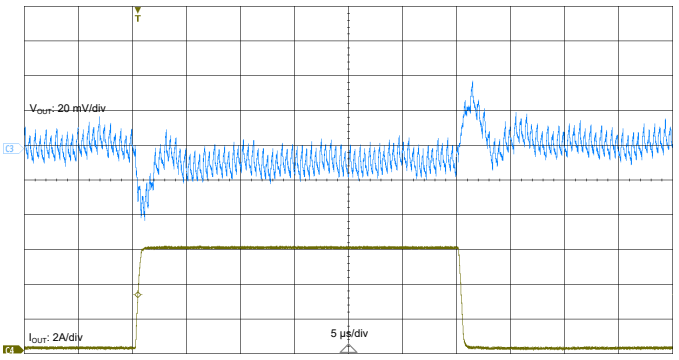
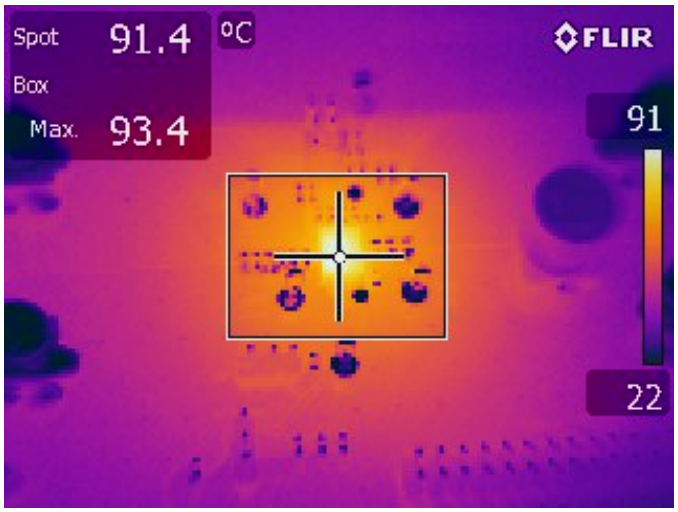


Figure 5-10. Thermal Image (V_{IN} = 12V, V_{OUT} = 1.2V, I_{OUT} = 12A)



6. Revision History

Doc. Rev.	Date	Section	Comments
B	7/2025		Updated evaluation board part number.
A	6/2025		Initial release of this document.

7. References

Table 7-1. Recommended Reading

Source	Document Title	Literature Number	Available
Microchip Technology Inc.	MCPF1412M06 - 16V, 12A Switching Buck Regulator Module	DS60001885	MCPF1412M06 Data Sheet
Microchip Technology Inc.	MCP2221A - USB 2.0 to I^2C/ UART Protocol Converter with GPIO	DS20005565	MCP2221A Data Sheet
Microchip Technology Inc.	MCP2221A Product Page	—	MCP2221A

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- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is “unbreakable”. Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.