LM5066H1 Evaluation Module

Description

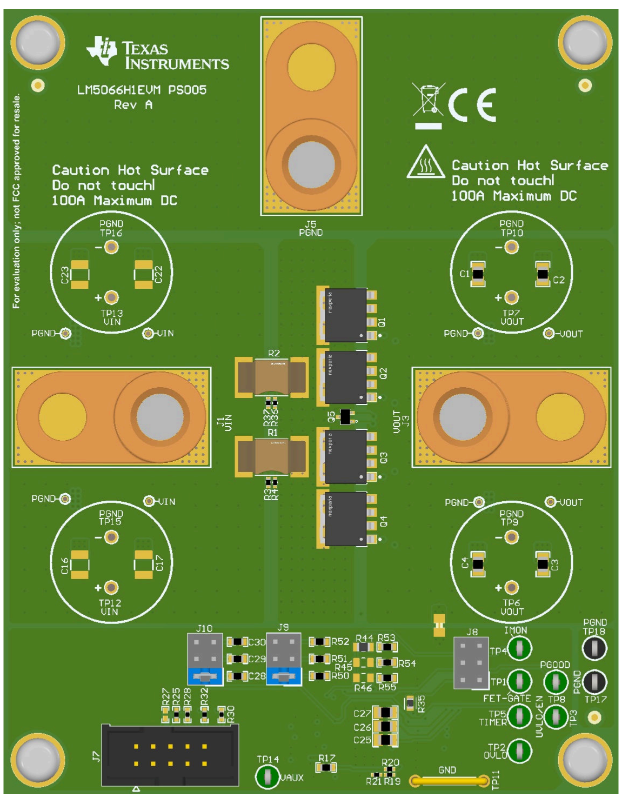
This user's guide describes the LM5066H1EVM. The LM5066H1EVM contains evaluation and reference circuitry for the LM5066H1 hot-swap controller. The LM5066H1 device combines a high-performance hot-swap controller with a PMBus interface to accurately measure, protect, and control the electrical operating conditions of systems connected to a backplane power bus.

Features

- 40V to 60V (typical) operation
- 40A to 200A programmable overcurrent threshold using PMBus
- Adjustable output voltage slew rate control
- Adjustable transient current blanking timer using PMBus
- TVS diode for input and Schottky diode for output transient protections
- Programmable current limiting and power limiting for complete SOA protection
- Programmable fault timer to eliminate nuisance shutdowns
- Programmable undervoltage and overvoltage protection
- Programmable power good indicator
- Programmable auto-retry or latch options
- Real-time monitoring of VIN, VOUT, IIN, PIN, TEMP, EIN, and VAUX

Applications

- Input hot-swap and hot-plug
- Server and high performance computing
- Network interface cards
- Graphics and hardware accelerator cards
- Data center switches and routers
- Fan trays
- Switches and routers



LM5066H1EVM

1 Evaluation Module Overview

1.1 Introduction

The LM5066H1EVM evaluation board provides the design engineer with a fully functional intelligent monitoring and protection controller board designed for positive voltage systems. This user's guide describes the various functions of the board, how to test and evaluate it, and how to utilize the GUI design tool to modify components for a specific application. To use the advanced telemetry and monitoring capabilities of this device, the user needs to use the LM5066HxEVM-GUI; however, the LM5066H1 can act as a hot-swap and protection circuit without any software installation. This EVM demonstrates a 5kW, 54V hot-swap solution for AI-powered enterprise datacenters.

This user's guide describes the evaluation module (EVM) for the LM5066H1 hot-swap controller.

CAUTION

Caution

Caution Hot Surface.
Contact may cause burns.
Do not touch !

1.2 Kit Contents

Table 1-1. LM5066H1EVM: Kit Contents

Item	Description	Quantity
LM5066H1EVM	Evaluation module for LM5066H1 hot-swap controller	1

USB-TO-GPIO2 adapter is not included in the kit. It needs to be separately ordered at USB-TO-GPIO2 Evaluation board | TI.com.

1.3 Specification

LM5066H1EVM specifications are summarized in Table 1-2.

Table 1-2. LM5066H1EVM Design Specifications

PARAMETER	VALUE
Input voltage range (V_{IN})	40V to 60V
Maximum RMS load current ($I_{OUT(max)}$)	100A
Over-current protection threshold (I_{TRIP})	100A
Maximum output capacitance (C_{LOAD})	5mF
Are all the loads off until the PG is asserted?	No
Maximum ambient temperature	70°C
Fault timer	350µs, 520µs, and 1ms
Output voltage slew rate	0.7V/ms
Need to survive a hot-short on the output condition?	Yes
Need to survive a power-up into short condition?	Yes
Can a board be hot-plugged in or power cycled?	Yes
Load current monitoring needed?	Yes

Table 1-2. LM5066H1EVM Design Specifications (continued)

PARAMETER	VALUE
Fault response	Latch-off

1.4 Device Information

The LM5066H1EVM enables the evaluation of the LM5066H1 hot-swap controller from the LM5066Hx family, along with driving four (4) PSMN2R3-100SSE MOSFETs in parallel. The input power is applied across the connectors J1 and J5, while J3 and J5 provide the output connection for the EVM. Refer to the schematic in Figure 4-1 and EVM test setup in Figure 3-1. TVS diodes D1 and D2 provide the input protection from transient overvoltages. Schottky diodes D3 and D4 protect the output by clamping the negative voltage excursion at the OUT pins of the LM5066H1 hot-swap controller within the minimum absolute rating.

The connector J7 is used to interface the LM5066H1EVM with the USB-to-GPIO2 adapter to access the LM5066HxEVM-GUI. TP6 & TP9 and TP7 & TP10 connectors are the placeholders, used to connect additional output capacitors if needed for the experiment. TP12 & TP15 and TP13 & TP16 connectors, C15 to C18, and C21 to C24 capacitors are the placeholders, used to connect additional input capacitors if needed to reduce the input voltage drop during an output hot-short event because of higher input impedance between the power supply and the EVM.

The LM5066HxEVM-GUI provides access to the LM5066H1 evaluation module GUI **only through the USB-to-GPIO2 a**dapter.

Table 1-3. LM5066H1EVM Evaluation Board Options and Settings

EVM Function	Vin UVLO Threshold	Vin OVLO Threshold	Analog Fault TIMER	Output Slew Rate (dv/dt)	IMON	PLIM	ILIM
Performance evaluation of LM5066H1 hot-swap controller	UVH = 37V UVL = 34V	OVH = 65V OVL = 63V	Selectable - 350µs, 520µs, and 1ms	Selectable - 0.7V/ms, 0.35V/ms, and 0.23V/ms	Selectable - 33.6mV, 66.5mV, and 167mV per 1mV of V_{SNS} (Differential voltage across VIN_K and SENSE pins)	Selectable - 180W, 240W, and 300W with R_{SNS} of 250µΩ	~ 100A with V_{CL} of 25mV

CAUTION
Do not leave the EVM powered on when unattended

WARNING
Signal traces, components, and component leads are located on the bottom of the circuit module. There can be exposed voltages, hot surfaces, or sharp edges as a result. When operating the board, do not reach under.

CAUTION
The communication interface is not isolated on the EVM. Make sure there is no ground potential between the computer and the EVM. Note that the computer is referenced to the ground potential of the EVM.

2 Hardware

2.1 General Configurations

2.1.1 Physical Access

The LM5066H1EVM Evaluation Board input and output connectors functionalities are listed in Table 2-1. The availability of test points and the functionalities of the jumpers are described in Table 2-2 and Table 2-3.

Table 2-1. Input and Output Connector Functionality

Connector	Label	Description
J1	VIN (+)	Positive terminal for the input power to the EVM
J3	VOUT (+)	Positive terminal for the output power from the EVM
J5	PGND (–)	Negative terminal for the EVM (Common for both input and output)

Table 2-2. Test Points Description

Test Points	Label	Description
TP1	FET GATE	MOSFET gate voltage
TP2	OVLO	Voltage at the OVLO pin of the device
TP3	UVLO/EN	Voltage at the UVLO/EN pin of the device
TP4	IMON	Load current monitor during steady state
TP5	TIMER	TIMER pin voltag
TP8	PGOOD	Power Good indicator
TP11	GND	Device ground
TP14	VAUX	Auxiliary ADC input
TP17 and TP18	PGND	Power ground

Table 2-3. Jumper Descriptions and Default Positions

Jumper	Label	Description	Default Jumper Position
J8	HS-GATE	1-2 Position sets the output slew rate to ~0.7V/ms	1-2
		3-4 Position sets the output slew rate to ~0.35V/ms	
		5-6 Position sets the output slew rate to ~0.23V/ms	
J9	PWR	1-2 Position sets the power limit to ~180W with R_{SNS} of 250μΩ	1-2
		3-4 Position sets the power limit to ~240W with R_{SNS} of 250μΩ	
		5-6 Position sets the power limit to ~300W with R_{SNS} of 250μΩ	
J10	TIMER	1-2 Position sets the analog fault timer duration of 350μs	1-2
		3-4 Position sets the analog fault timer duration of 520μs	
		5-6 Position sets the analog fault timer duration of 1ms	

2.1.2 Test Equipment and Setup

2.1.2.1 Power Supplies

One adjustable power supply with 0V to 80V output and 0A to 200A output current limit.

2.1.2.2 Meters

Two Digital Multi Meters (DMM).

2.1.2.3 Oscilloscope

A DPO2024 or equivalent, three 10x voltage probes, and a DC current probe of 150A rated.

2.1.2.4 Loads

One resistive load or equivalent, which can tolerate up to 200A DC load at 80V.

2.1.2.5 USB-to-GPIO Interface Adapter

A communication adapter is required between the LM5066H1EVM and the host computer to use the LM5066HxEVM-GUI. **The GUI communicates with the Texas Instruments USB-to-GPIO2 USB interface adapter evaluation module only.** This adapter can be purchased at USB-TO-GPIO2 Evaluation board | TI.com.

The LM5066H1EVM kit does not include this USB-TO-GPIO2 adapter.

Note

The LM5066HxEVM-GUI does not communicate with any other adapter.

---

3 Implementation Results

3.1 Test Setup and Procedures

In this user's guide, the test procedure is described for the LM5066H1 hot swap controller. Make sure the evaluation board has the default jumper settings as shown in Table 3-1.

Table 3-1. Default Jumper Setting for LM5066H1EVM eFuse Evaluation Board

J8	J9	J10
1-2	1-2	1-2

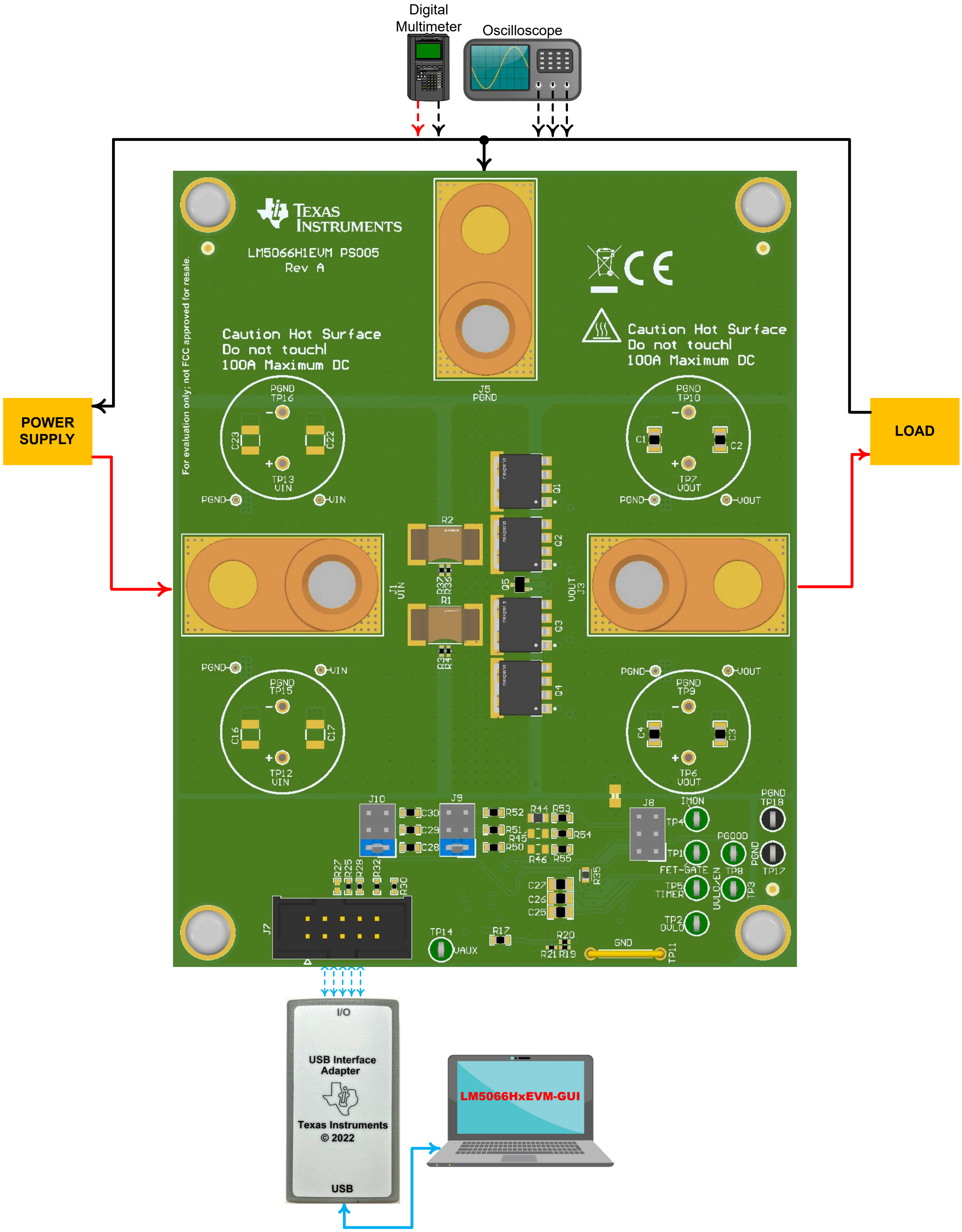


Figure 3-1. LM5066H1EVM Setup with Test Equipment

Follow these instructions before starting any test and repeat before moving to the next test:

- Set the input power supply voltage to the desired operating input voltage and current limit
- Turn the power supply off

- Connect the positive voltage lead from the power supply to J1 (VIN)
- Connect the ground lead from the power supply to J5 (PGND)
- Adjust the jumper positions on EVM to the default configuration, as shown in Table 3-1.
- Turn the power supply on
- Vary the input voltage and add load current as necessary for test purposes
- Apply fault conditions to observe fault performance as necessary

3.2 Test Results

This section provides typical performance waveforms for the LM5066H1EVM with V_{IN} = 54 V. Actual performance data is affected by measurement techniques and environmental variables; therefore, these curves are presented for reference and may differ from actual results obtained.

3.2.1 Input Hot-Plug

Test Conditions: V_{IN} = 54V, C_{IN} = 100nF, C_{OUT} = ~ 1mF, and C_{DVDT} = 33nF

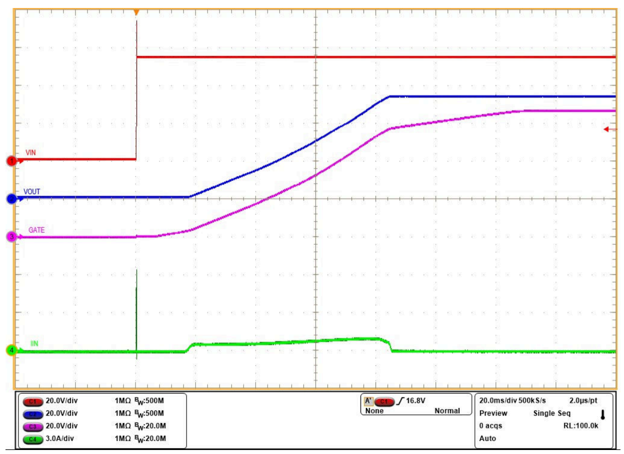


Figure 3-2. Input Hot Plug Profile (Zoomed out) and Insertion Delay

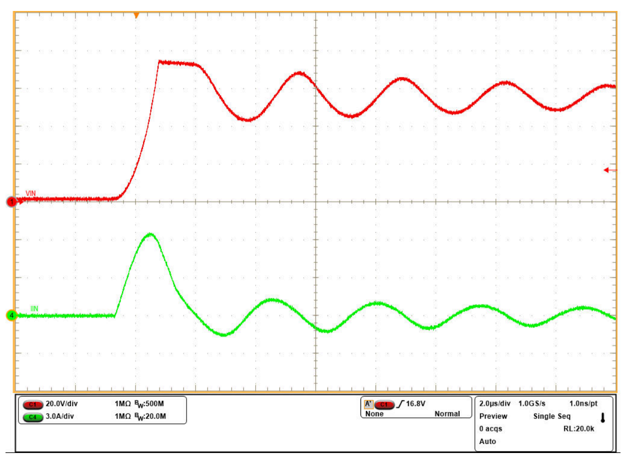


Figure 3-3. Input Hot Plug Profile (Zoomed in)

3.2.2 Start-up with Enable

3.2.2.1 Only Output Capacitor

Test Conditions: V_{IN} = 54V, C_{OUT} = ~ 5mF, and C_{DVDT} = 33nF

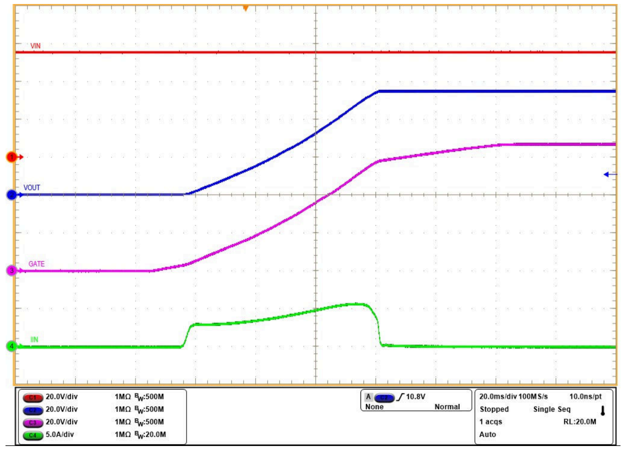


Figure 3-4. Start-up Profile with only Output Capacitor

3.2.2.2 Output Capacitor and Constant Current Load

Test Conditions: V_{IN} = 54V, C_{OUT} = ~ 5mF, I_{LOAD} = 3A, $V_{TH(ON)}$ = 10V, and C_{DVDT} = 33nF

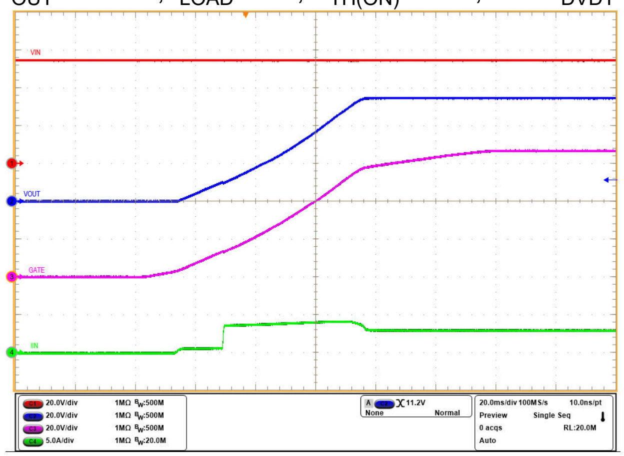


Figure 3-5. Start-up Profile with Output Capacitor and Constant Current Load

3.2.2.3 Failed Start-up with Output Capacitor and Constant Current Load

Test Conditions: V_{IN} = 54V, C_{OUT} = ~ 5mF, I_{LOAD} = 5A, $V_{TH(ON)}$ = 10V, C_{DVDT} = 33nF, and retry for 8 times

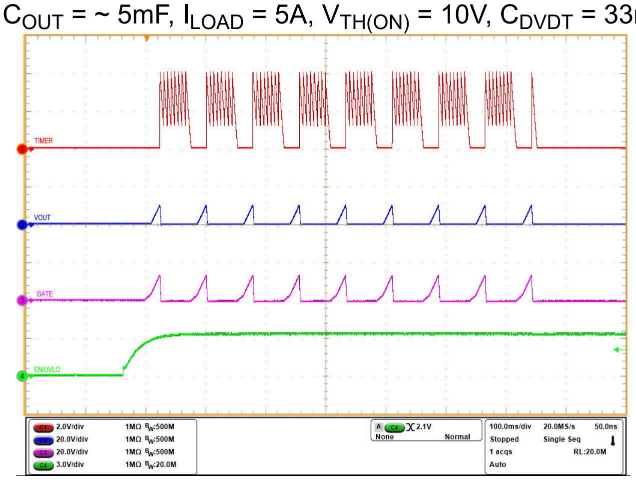


Figure 3-6. Failed Start-up Profile with Output Capacitor and Constant Current Load

3.2.2.4 Foldback Current Limit-based Start-up

Test Conditions: V_{IN} = 54V, C_{OUT} = ~ 5mF, C_{DVDT} = 33nF, V_{CL} = 10mV, R_{SNS} = 250µΩ, and foldback current-limit enabled to 5% of the current-limit threshold (which is 2A)

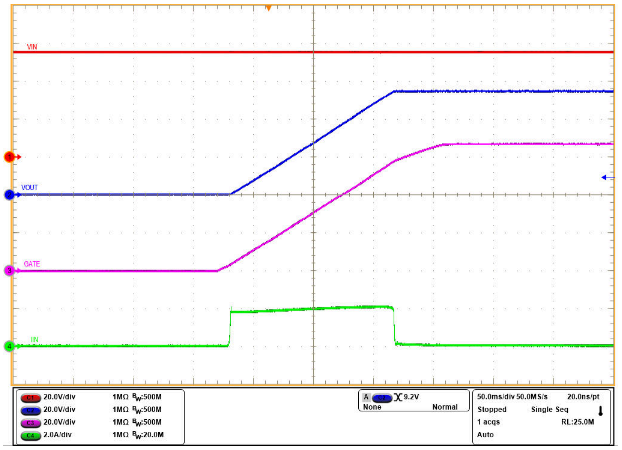


Figure 3-7. Start-up Profile with Foldback Current-limit

3.2.3 Power Up Into Short

3.2.3.1 Latch-off and Lower TIMER Sink Current

Test Conditions: V_{IN} = 54V, C_{TMR} = 5.6nF, R_{PWR} = 6.81k, R_{SNS} = 250µΩ, and TIMER sink current = 2.5µA

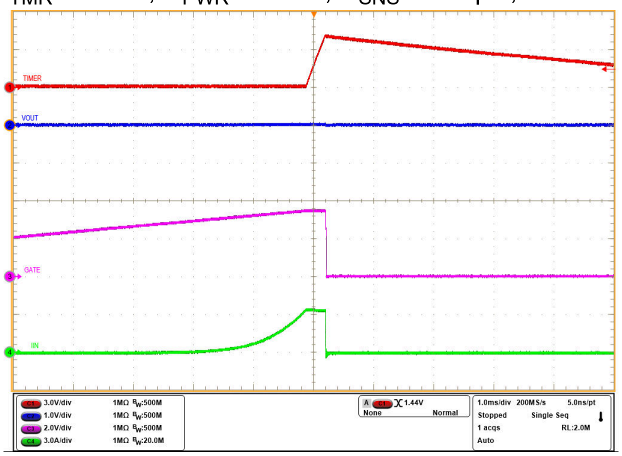


Figure 3-8. Power Up Into Output Short Response (Latch-off and Lower TIMER Sink Current)

3.2.3.2 Auto-retry and Lower TIMER Sink Current

Test Conditions: V_{IN} = 54V, C_{TMR} = 5.6nF, R_{PWR} = 6.81k, R_{SNS} = 250µΩ, and TIMER sink current = 2.5µA

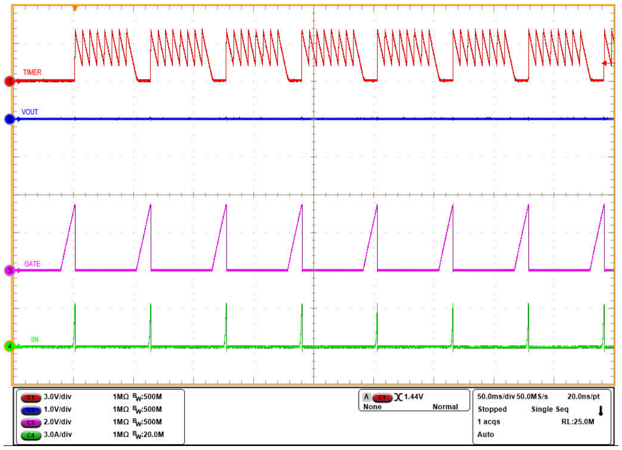


Figure 3-9. Power Up Into Output Short Response (Auto-retry and Lower TIMER Sink Current)

3.2.3.3 Latch-off and Higher TIMER Sink Current

Test Conditions: V_{IN} = 54V, C_{TMR} = 5.6nF, R_{PWR} = 6.81k, R_{SNS} = 250µΩ, and TIMER sink current = 75µA

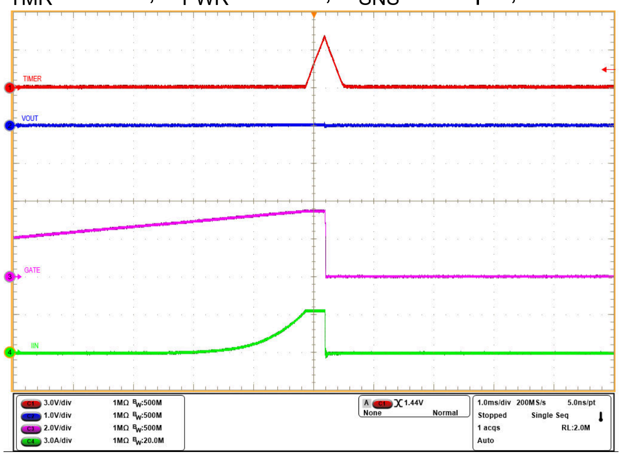


Figure 3-10. Power Up Into Output Short Response (Latch-off and Lower TIMER Sink Current)

3.2.3.4 Auto-retry and Higher TIMER Sink Current

Test Conditions: V_{IN} = 54V, C_{TMR} = 5.6nF, R_{PWR} = 6.81k, R_{SNS} = 250µΩ, and TIMER sink current = 75µA

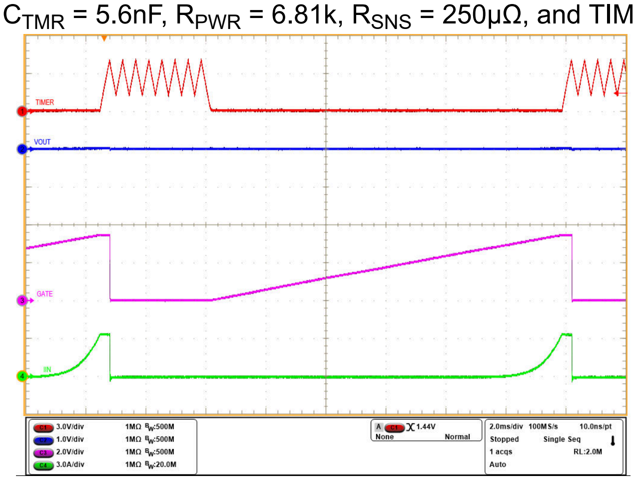


Figure 3-11. Power Up Into Output Short Response (Latch-off and Lower TIMER Sink Current)

3.2.4 Undervoltage Lockout

Test Conditions: $V_{INUVLO\text{-}Rising}$ = 38V, $V_{INUVLO\text{-}Falling}$ = 35V, I_{LOAD} = 5A, and V_{IN} is ramped down from 54V to 30V and ramped up to 54V

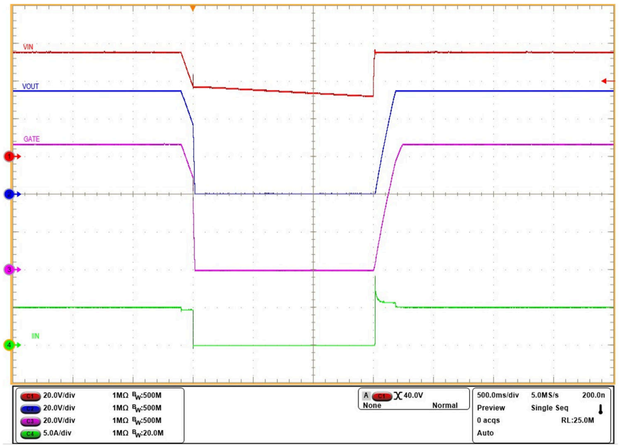


Figure 3-12. Undervoltage Lockout and Recovery Responses (Zoomed out)

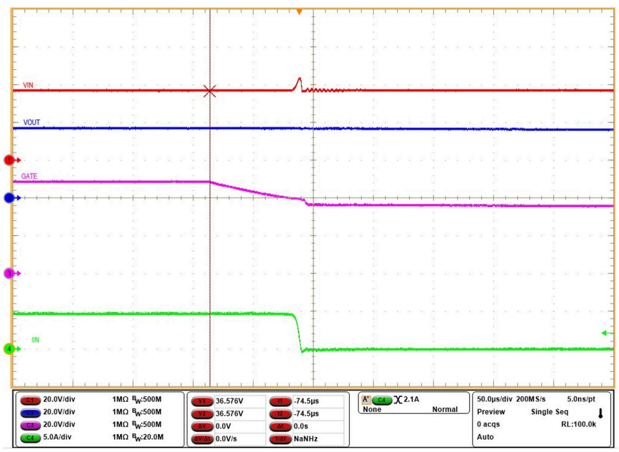


Figure 3-13. Undervoltage Lockout Response (Zoomed in)

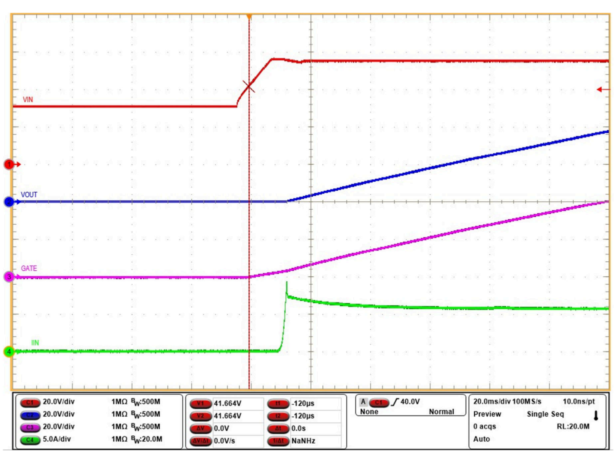


Figure 3-14. Recovery from Undervoltage Lockout Response (Zoomed in)

3.2.5 Overvoltage Lockout

Test Conditions: $V_{INOVLO-Rising}$ = 63V, $V_{INOVLO-Falling}$ = 60V, I_{LOAD} = 5A, and V_{IN} is ramped up from 54V to 65V and ramped down to 54V

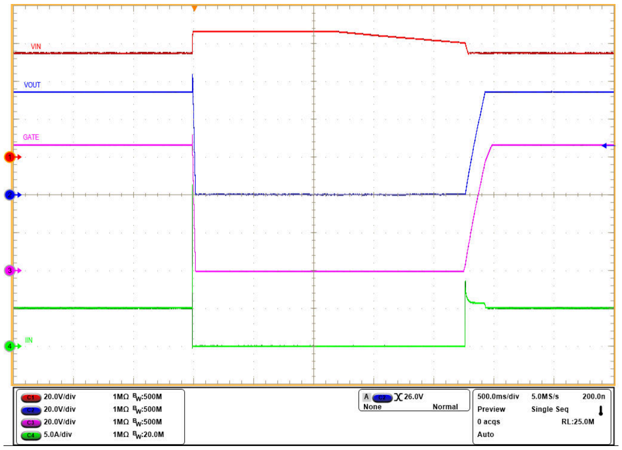


Figure 3-15. Overvoltage Lockout and Recovery Responses (Zoomed out)

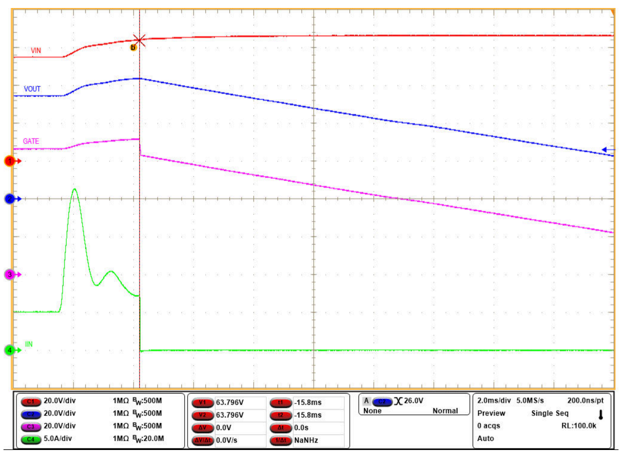


Figure 3-16. Overvoltage Lockout Response (Zoomed in)

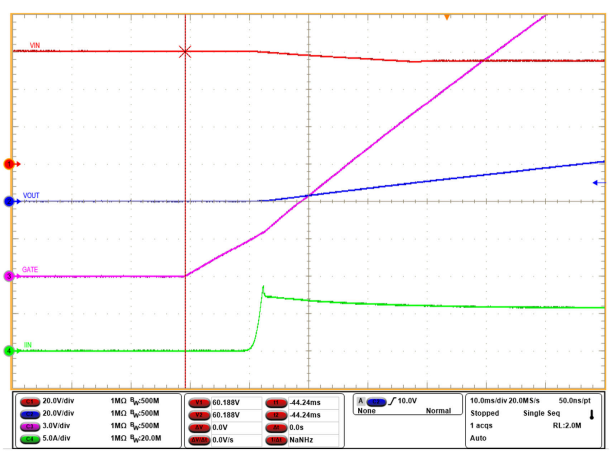


Figure 3-17. Recovery from Overvoltage Lockout Response (Zoomed in)

3.2.6 Transient Overload Performance

Test Conditions: V_{IN} = 54V, I_{CL} = 85A, I_{CBL1} = 128A (1.5 x I_{CL}), I_{CBL2} = 170A (2.0 x I_{CL}), I_{CB} = 255A (3.0 x I_{CL}), t_{FLT} = ~350µs, t_{CBL1} = 8ms, and t_{CBL2} = 4ms

The current load is increased from 80A to 120A, preventing t_{CBL2} from triggering. However, t_{CBL1} will be triggered. A current pulse of less than 8ms at 120A will pass through, but a pulse longer than 8ms will activate the hardware-programmed timer (t_{FLT}).

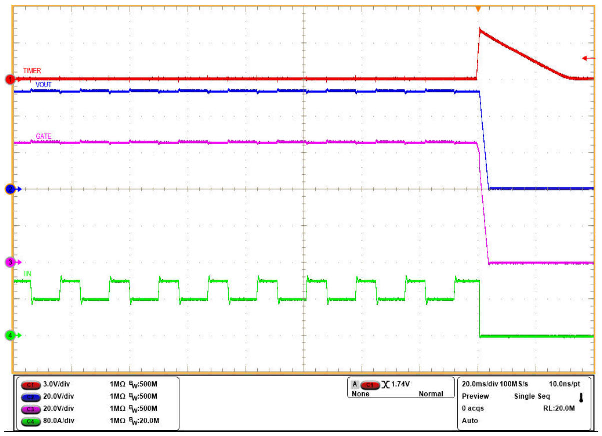


Figure 3-18. Transient Overload Response - 1

The current load is increased from 80A to 160A, at which point both t_{CBL1} and t_{CBL2} trigger for 8ms and 4ms, respectively. A current pulse of less than 4ms at 160A will pass through, but a pulse longer than 4ms will activate the hardware-programmed timer (t_{FLT}).

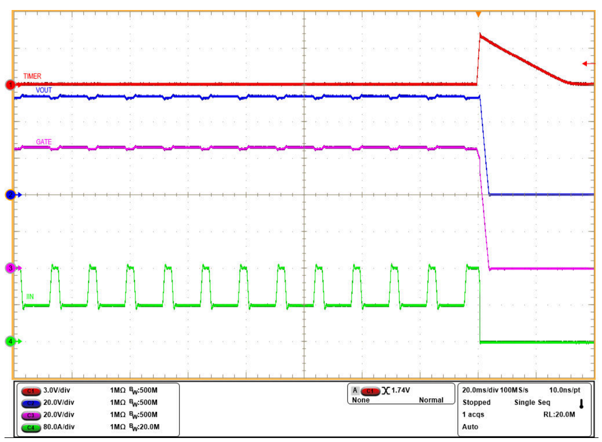


Figure 3-19. Transient Overload Response - 2

The current load is increased from 80A to 200A. A 200A current pulse falls between I_{CBL2} and I_{CB}. Therefore, no current blanking will take place, and the hardware-programmed timer (t_{FLT}) will be activated directly.

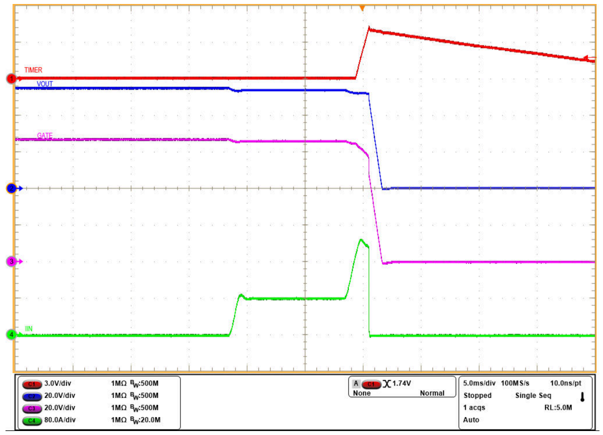


Figure 3-20. Transient Overload Response - 3

Load transients of 80A for 3ms and 160A for 3ms are applied for a prolonged duration.

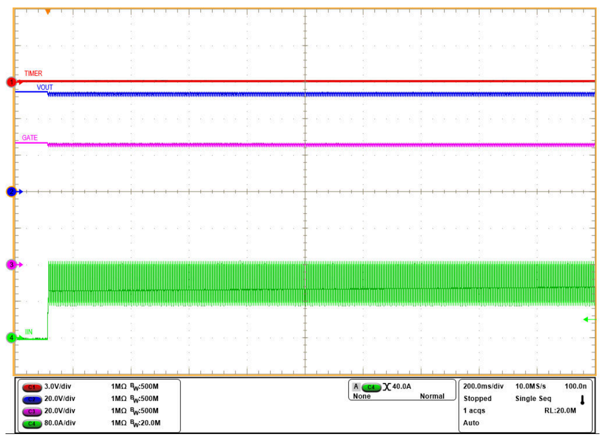


Figure 3-21. Transient Overload Response - 4

3.2.7 Overcurrent Event

Test Conditions: V_{IN} = 54V, I_{CL} = 85A, I_{CBL1} = 128A (1.5 x I_{CL}), I_{CBL2} = 170A (2.0 x I_{CL}), I_{CB} = 255A (3.0 x I_{CL}), t_{FLT} = ~350µs, t_{CBL1} = 8ms, and t_{CBL2} = 4ms

A load transient of 80A for 5ms and 160A for 5ms is applied.

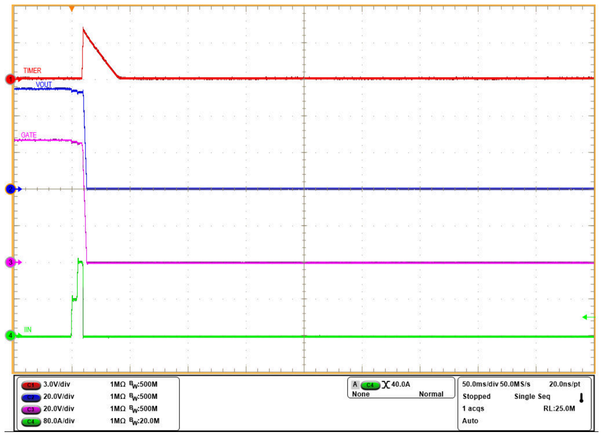


Figure 3-22. Persistent Overload Response - Latch-off

A load transient of 80A for 5ms and 160A for 5ms is applied.

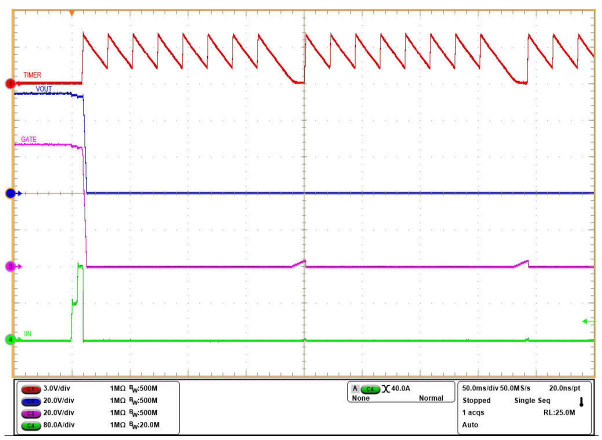


Figure 3-23. Persistent Overload Response - Auto-retry

A load transient of 80A for 5ms and 160A for 5ms is applied.

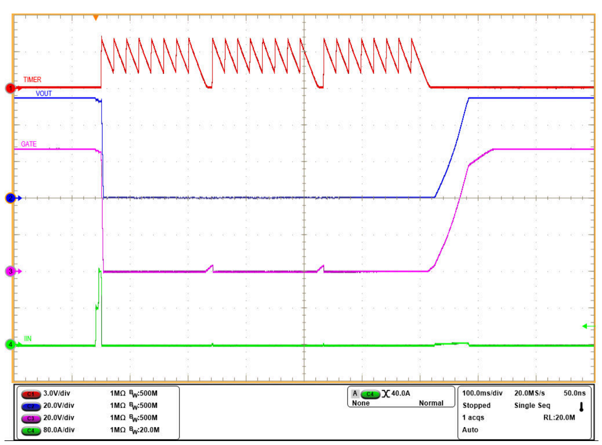


Figure 3-24. Persistent Overload Response - Auto-retry and Recovery

3.2.8 Load Current Monitoring

Test Conditions: V_{IN} = 54V, and a load transient of 80A for 10ms and 160A for 3ms is applied.

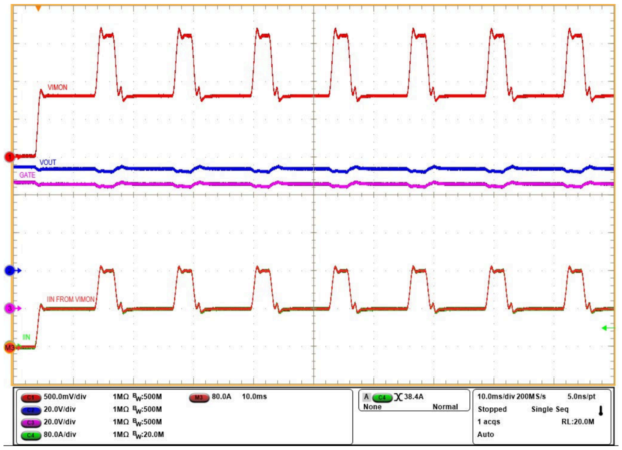


Figure 3-25. Load Current Monitoring - 1

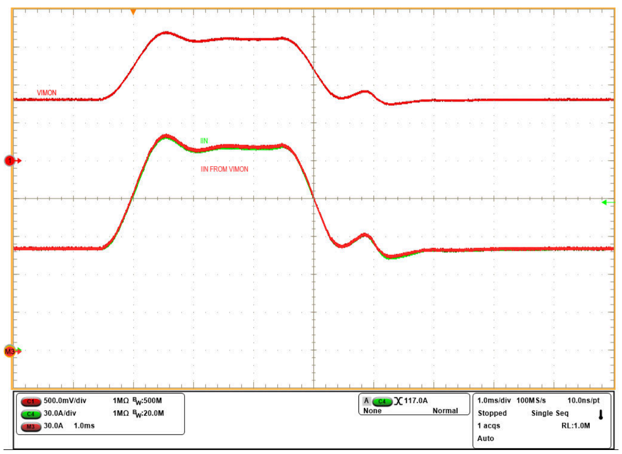


Figure 3-26. Load Current Monitoring - 2

3.2.9 Output Hot Short

Test Conditions: V_{IN} = 54V, I_{SCP} = ~ 160A, and C_{OUT} = 1mF

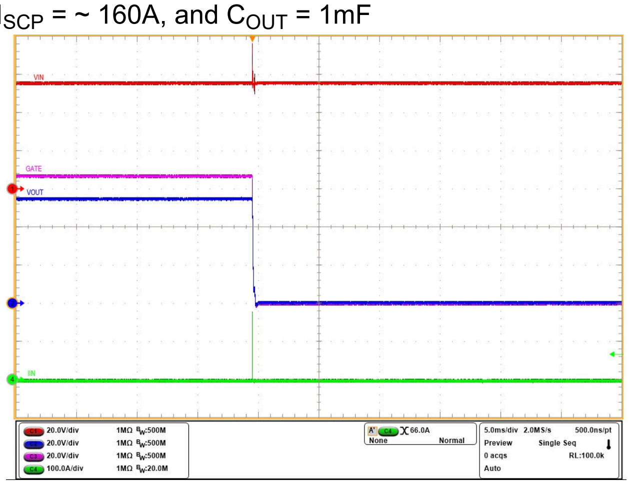


Figure 3-27. Output Hot Short Response (zoomed out) in LM5066H1EVM

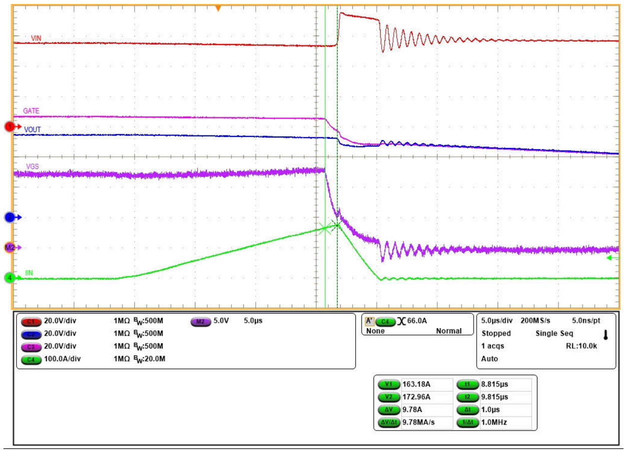


Figure 3-28. Output Hot Short Response (zoomed in) in LM5066H1EVM

Test Conditions: V_{IN} = 54V, I_{SCP} = ~ 100A, C_{OUT} = 1mF, and bit 7 of the DEVICE_SETUP4 (CDh, Read/Write Word) register set to 1 by default (No instant retry after 30µs)

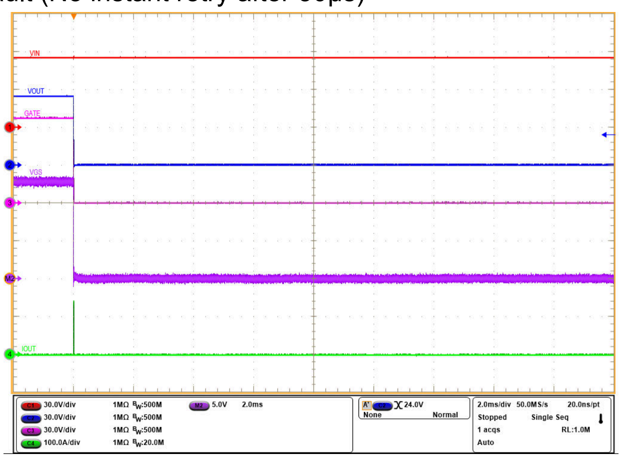


Figure 3-29. Output Hot Short Response in LM5066H1EVM (No instant retry after 30µs)

Test Conditions: V_{IN} = 54V, I_{SCP} = ~ 100A, C_{OUT} = 1mF, and bit 7 of the DEVICE_SETUP4 (CDh, Read/Write Word) register set to 0 (Instant retry after 30µs)

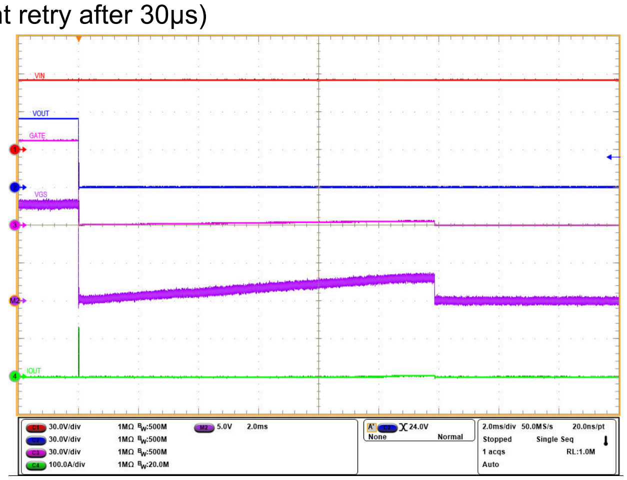


Figure 3-30. Output Hot Short Response in LM5066H1EVM (Instant retry after 30µs)

Test Conditions: V_{IN} = 54V, I_{SCP} = ~ 400A, I_{LOAD} = 150A, and C_{OUT} = 1mF

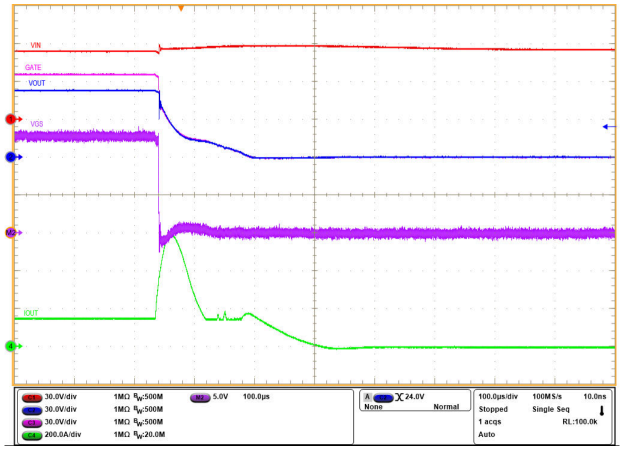


Figure 3-31. Output Hot Short Response in LM5066H1EVM with the Presence of DC Load Current

---

Note

Make sure there is a sufficient input capacitor to eliminate voltage dips at the input. A combination of electrolytic and ceramic capacitors is preferred. With these capacitors, a large current can be provided for a short period of time during a short circuit.

To obtain repeatable and similar short-circuit testing results is very difficult. The following contributes to the variation in results:

- Source bypassing
- Input leads
- Board layout
- Component selection
- Output shortening method
- Relative location of the short
- Instrumentation

The actual short exhibits a certain degree of randomness because the short microscopically bounces and arcs. Make sure that the configuration and methods are used to obtain realistic results. Hence, do not expect to see waveforms exactly like the waveforms in this user's guide because every setup is different.

3.2.10 Thermal Performance

Test Conditions: V_{IN} = 54V, I_{LOAD} = 100A, T_A = 27°C, and No External Air Flow

Figure 3-32. Thermal Performance of LM5066H1EVM

4 Hardware Design Files

4.1 Schematic

The EVM schematic is shown in Figure 4-1.

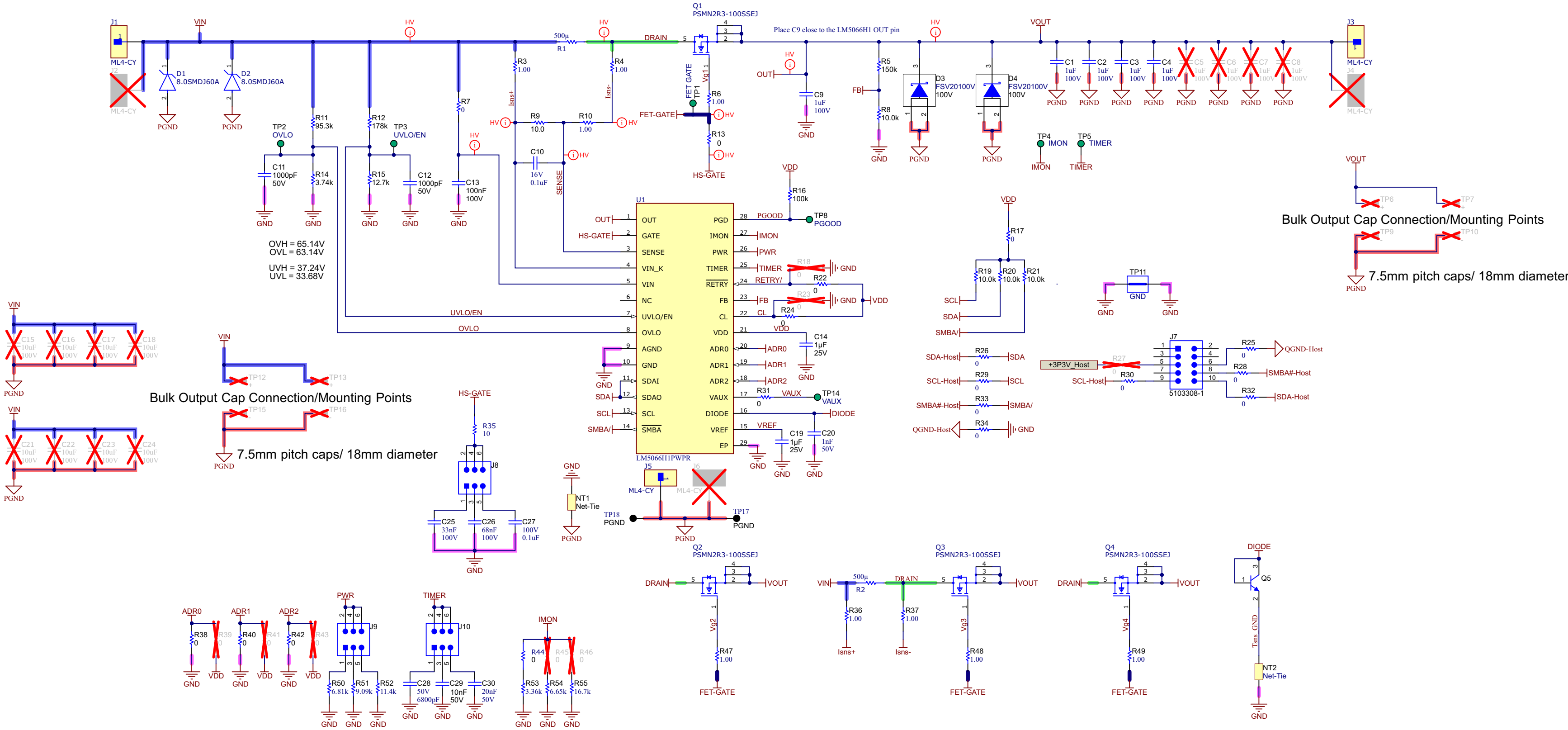


Figure 4-1. LM5066H1EVM Board Schematic

4.2 PCB Drawings

The component placements of the EVM are shown in Figure 4-2 and Figure 4-3.

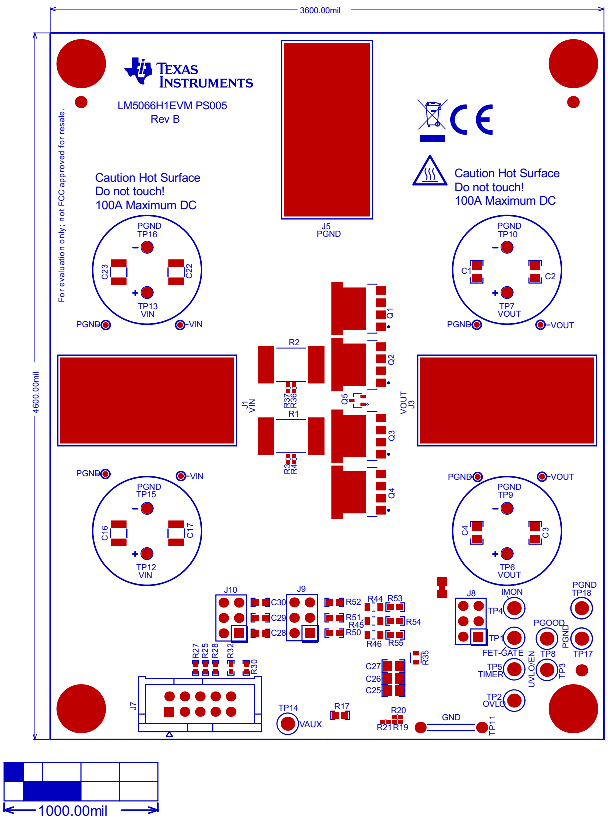


Figure 4-2. LM5066H1EVM Board: Top Assembly

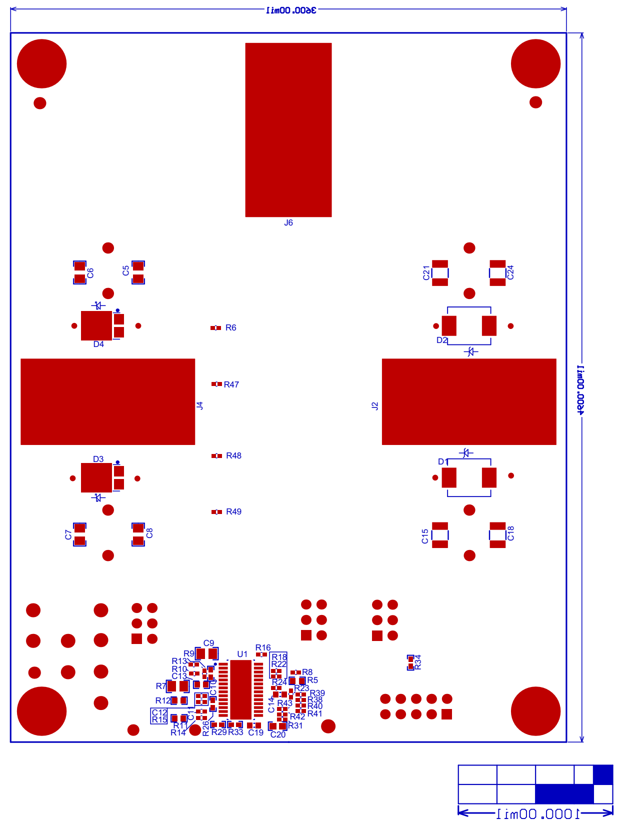


Figure 4-3. LM5066H1EVM Board: Bottom Assembly

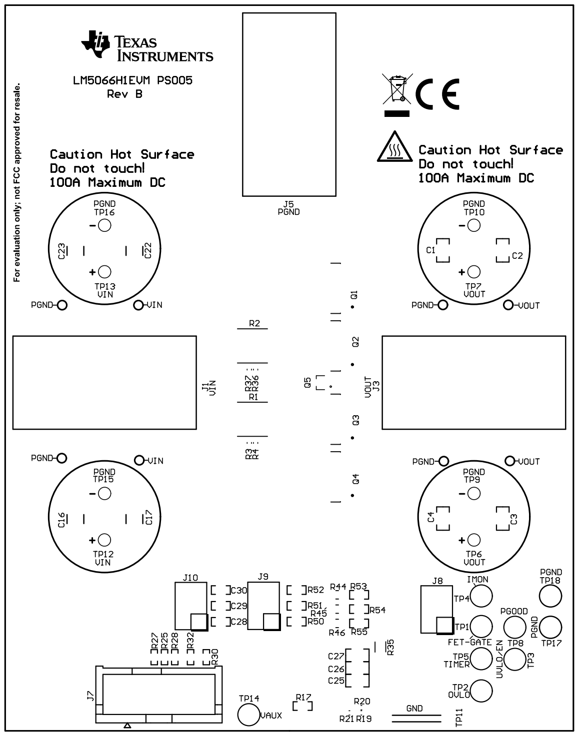


Figure 4-4. LM5066H1EVM Board: Top Overlay

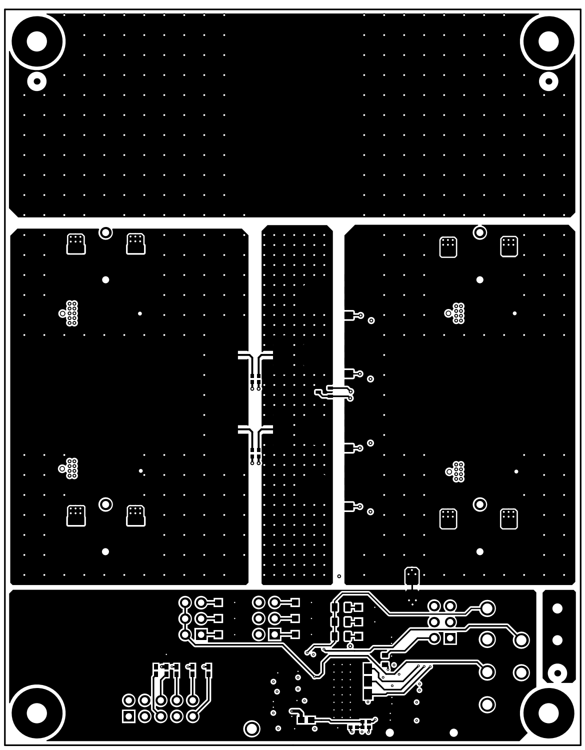


Figure 4-5. LM5066H1EVM Board: Top Layer

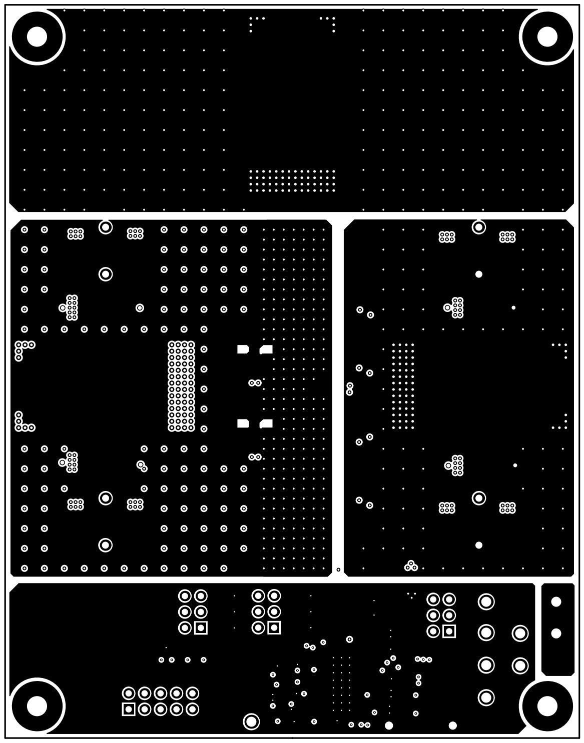


Figure 4-6. LM5066H1EVM Board: Inner Layer - 1

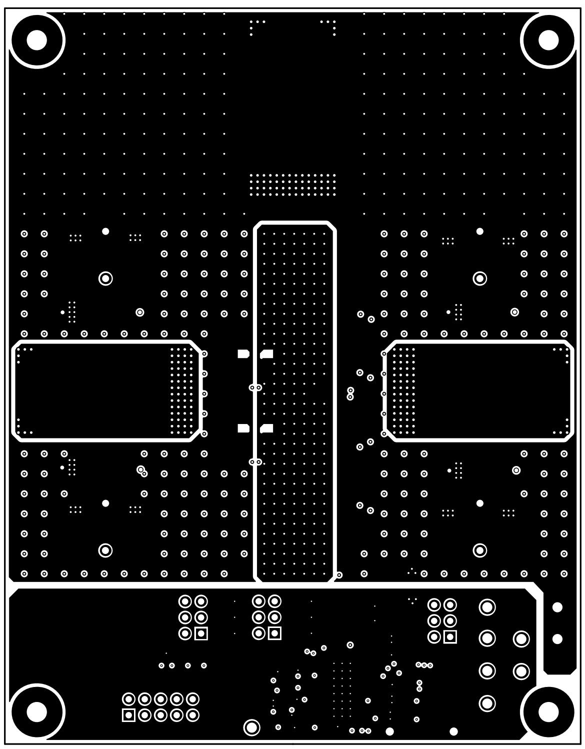


Figure 4-7. LM5066H1EVM Board: Inner Layer - 2

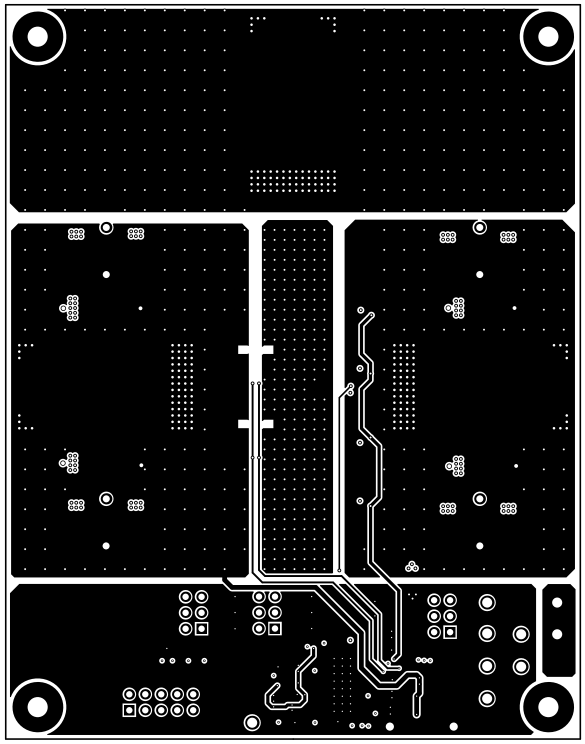


Figure 4-8. LM5066H1EVM Board: Inner Layer - 3

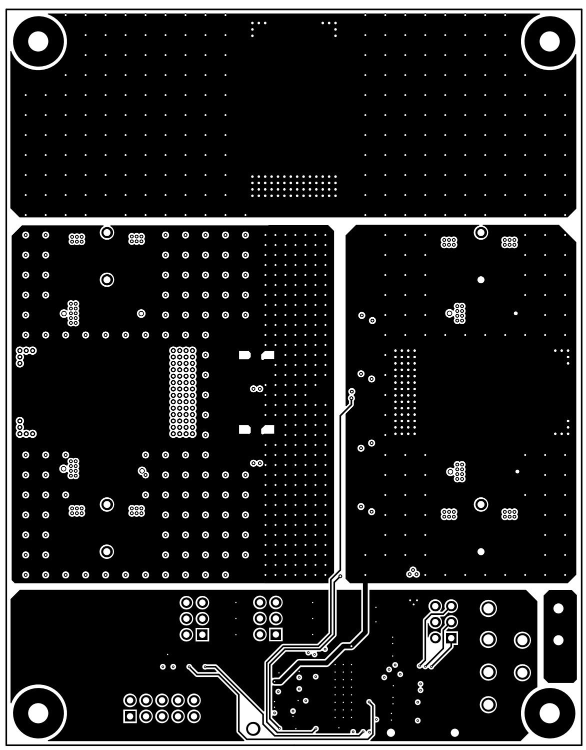


Figure 4-9. LM5066H1EVM Board: Inner Layer - 4

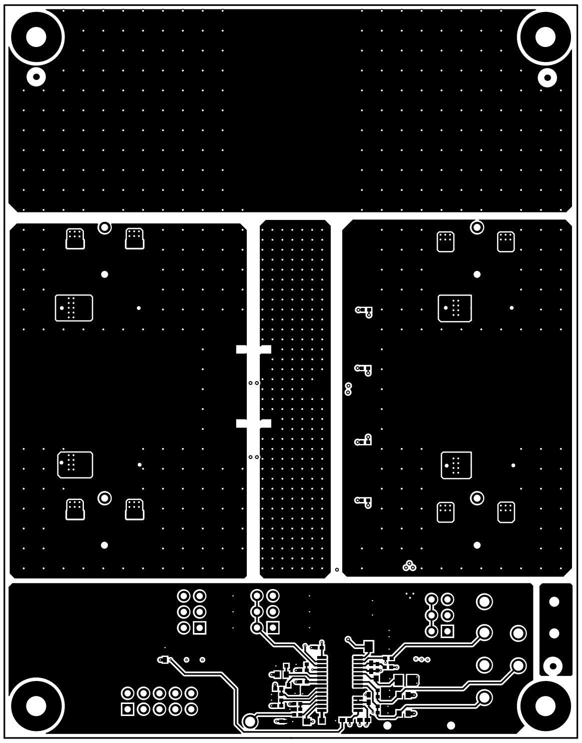


Figure 4-10. LM5066H1EVM Board: Bottom Layer

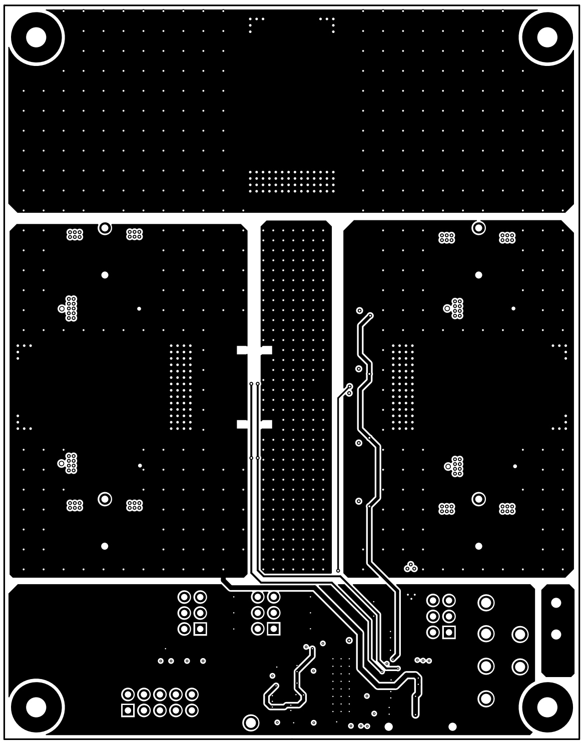


Figure 4-11. LM5066H1EVM Board: Bottom Overlay

4.3 Bill of Materials (BOM)

The EVM BOM is listed in the following table.

Table 4-1. LM5066H1EVM Bill of Materials

Designator	Quantity	Value	Description	Footprint	Part Number	Manufacturer
!PCB1	1		Printed Circuit Board		PS005	Any
C1, C2, C3, C4, C9	5	1uF	CAP, CERM, 1 uF, 100 V, +/- 10%, X7S, 0805	0805_HV	C2012X7S2A105K125AB	TDK
C10	1	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0402	0402	GRM155R71C104KA88D	MuRata
C11, C12	2	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 10%, X7R, 0402	0402L	C0402C102K5RACTU	Kemet
C13	1	0.1uF	CAP, CERM, 0.1 uF, 100 V, +/- 10%, X7R, 0603	0603_HV	GRM188R72A104KA35J	MuRata
C14, C19	2		CAP, 1uF, 25V, 10%, X7R, 0603	0603L	CL10B105KA8NNNC	Samsung
C20	1	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 10%, X7R, 0603	0603	GRM188R71H102KA01D	MuRata
C25	1	0.033uF	CAP, CERM, 0.033 uF, 100 V, +/- 10%, X7R, 0805	0805_HV	GRM21BR72A333KA01L	MuRata
C26	1	0.068uF	CAP, CERM, 0.068 uF, 100 V, +/- 10%, X7R, 0805	0805_HV	C2012X7R2A683K085AA	TDK
C27	1	0.1uF	CAP, CERM, 0.1 uF, 100 V, +/- 10%, X5R, 0805	0805_HV	C2012X5R2A104K125AA	TDK
C28	1	6800pF	CAP, CERM, 6800 pF, 50 V,+/- 5%, C0G/NP0, 0603	0603	GRM1885C1H682JA01D	MuRata
C29	1	0.01uF	CAP, CERM, 0.01 F, 50 V,+/- 10%, X7R, 0603	0603	885012206089	Wurth Elektronik
C30	1	0.02uF	CAP, CERM, 0.02 F, 50 V,+/- 10%, X7R, 0603	0603	CC0603KRX7R9BB203	Yageo
D1, D2	2		TVS Diode, 8.0SMDJ Series, Unidirectional, 60 V, 125.1 V, DO-214AB (SMC), 2 Pins	FP-8.0SMDJ60A_DO-214AB-MFG	8.0SMDJ60A	Littelfuse
D3, D4	2	100V	Diode, Schottky, 100 V, 20 A, AEC-Q101, TO-277A	TO-277A	FSV20100V	Fairchild Semiconductor
H1, H2, H5, H6	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	NY PMS 440 0025 PH	NY PMS 440 0025 PH	B&F Fastener Supply
H3, H4, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Keystone_1902C	1902E	Keystone
J1,J2, J3	3		Terminal Connector Rectangular Lug, Grounding 4-14 AWG 1/4 Stud	FP-ML4-CY_TERMINAL_LUG-MFG	ML4-CY	Panduit
J7	1		Header (shrouded), 100mil, 5x2, Gold, TH	CONN_5103308-1	5103308-1	TE Connectivity
J8, J9, J10	3		Header, 100mil, 3x2, Tin, TH	SULLINS_PEC03DAAN	PEC03DAAN	Sullins Connector Solutions

Table 4-1. LM5066H1EVM Bill of Materials (continued)

Designator	Quantity	Value	Description	Footprint	Part Number	Manufacturer
Q1, Q2, Q3, Q4	4		MOSFET N-Channel 100 V 255A (Ta) 341W (Ta) Surface-mount LFPAK88 (SOT1235)	FP-PSMN2R3-100SSEJ_LFPAK88-MFG	PSMN2R3-100SSEJ	Nexperia
Q5	1	40 V	Transistor, NPN, 40 V, 0.2 A, SOT-323	SOT-323	MMBT3904WT1G	ON Semiconductor
R1, R2	2	500	Res Metal Strip 3920 0.0005 Ohm 1% 9W 100ppm/C Pad SMD Automotive T/R	FP-CSS2H-3920R-L500F_3920-MFG	CSS2H-3920R-L500F	Bourns
R3, R4, R6, R10, R36, R37, R47, R48, R49	9	1.00	RES, 1.00, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402L	CRCW04021R00FKED	Vishay-Dale
R5	1	150k	RES, 150 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603_HV	CRCW0603150KFKEA	Vishay-Dale
R7	1	0	RES SMD 0 OHM JUMPER 1/8W 0805	0805_HV	CRCW08050000Z0EA	Vishay Dale
R8, R19, R20, R21	4	10.0k	RES, 10.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402L	CRCW040210K0FKED	Vishay-Dale
R9, R13	2	10.0, 0	RES, 10.0, 1%, 0.063 W, AEC-Q200 Grade 0, 0402, RES, 0, 5%, 0.063 W, 0402	0402L	CRCW040210R0FKED, RC0402JR-070RL	Vishay-Dale, Yageo America
R11	1	95.3k	RES, 95.3 k, 1%, 0.1 W, 0603	0603_HV	RC0603FR-0795K3L	Yageo
R12	1	178k	RES, 178 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603_HV	CRCW0603178KFKEA	Vishay-Dale
R14	1	3.74k	RES, 3.74 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402L	CRCW04023K74FKED	Vishay-Dale
R15	1	12.7k	RES, 12.7 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402L	CRCW040212K7FKED	Vishay-Dale
R16	1	100k	RES, 100 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402L	CRCW0402100KFKED	Vishay-Dale
R17	1	0	RES, 0, 0%, 0.25 W, AEC-Q200 Grade 0, 0603	0603	RCS06030000Z0EA	Vishay-Dale
R22, R24, R31, R38, R40, R42	6	0	RES, 0, 5%, 0.063 W, 0402	0402L	RC0402JR-070RL	Yageo America
R25, R26, R28, R29, R30, R32, R33, R34	8	0	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04020000Z0ED	Vishay-Dale
R35	1	10	10 Ohms 1% 0.25W, 1/4W Chip Resistor 0603 (1608 Metric) Automotive AEC-Q200, Pulse Withstanding Thick-film	FP-RCS060310R0FKEA_0603-MFG	RCS060310R0FKEA	Vishay
R44	1		0 Ohms Jumper 0.125W, 1/8W Chip Resistor 0805 (2012 Metric) Automotive AEC-Q200 Thick-film	FP-RMCF0805ZT0R00_0805-MFG	RMCF0805ZT0R00	Stackpole Electronics
R50	1	6.81k	RES, 6.81 k, 0.1%, 0.1 W, 0603	0603	RT0603BRD076K81L	Yageo America
R51	1	9.09k	RES, 9.09 k, 0.1%, 0.1 W, 0603	0603	RT0603BRD079K09L	Yageo America
R52	1	11.4k	RES, 11.4 k, 0.1%, 0.1 W, 0603	0603	RT0603BRD0711K4L	Yageo America

Table 4-1. LM5066H1EVM Bill of Materials (continued)

Designator	Quantity	Value	Description	Footprint	Part Number	Manufacturer
R53	1	3.36k	RES, 3.36 k, 0.1%, 0.1 W, 0603	0603	RT0603BRD073K36L	Yageo America
R54	1	6.65k	RES, 6.65 k, 0.1%, 0.1 W, 0603	0603	RT0603BRD076K65L	Yageo America
R55	1	16.7k	RES, 16.7 k, 0.1%, 0.1 W, 0603	0603	RT0603BRD0716K7L	Yageo America
SH1, SH2, SH3	3		Shunt, 2.54mm, Gold, Blue	Wurth_60900213621	60900213621	Wurth Elektronik
TP1	1		Test Point, Multipurpose, Green, TH	Keystone5126	5126	Keystone
TP2	1		Test Point, Multipurpose, Green, TH	Keystone5126	5126	Keystone
TP3	1		Test Point, Multipurpose, Green, TH	Keystone5126	5126	Keystone
TP4	1		Test Point, Multipurpose, Green, TH	Keystone5126	5126	Keystone
TP5	1		Test Point, Multipurpose, Green, TH	Keystone5126	5126	Keystone
TP8	1		Test Point, Multipurpose, Green, TH	Keystone5126	5126	Keystone
TP11	1		1mm Uninsulated Shorting Plug, 10.16mm spacing, TH	Harwin_D3082-05	D3082-05	Harwin
TP14	1		Test Point, Multipurpose, Green, TH	Keystone5126	5126	Keystone
TP17, TP18	2		Test Point, Multipurpose, Black, TH	Keystone5011	5011	Keystone
U1	1		LM5066H1PWPR	PWP0028V-MFG	LM5066H1PWPR	Texas Instruments

5 Additional Information

5.1 Trademarks

All trademarks are the property of their respective owners.

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

User shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

3.3.2 *Notice for Users of EVMs Considered “Radio Frequency Products” in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社

東京都新宿区西新宿６丁目２４番１号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations*. IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265