AN-2054 Evaluation Board for LM10000 - PowerWise™ AVS System Controller

1 LM10000 Overview

The LM10000 is used to enable Adaptive Voltage Scaling (AVS) to non-AVS regulators. It includes a complete Slave Power Controller (SPC 2.0) to communicate to the PowerWise™ Interface (PWI 2.0), and a programmable current output DAC that allows voltage control to any regulator utilizing a feedback node/resistors to set the output voltage.

In addition to enabling AVS, the LM10000 allows the system to control power states such as sleep and shutdown and to configure the voltage step slew rate from the PWI.

2 Evaluation Board Overview

The LM10000 evaluation board provides all the circuitry needed to conveniently demonstrate PowerWise AVS on non-AVS regulators.

It is configured to operate with the following conditions:

Parameter	Default Voltage	Programming Range
VDD	3.0 - 5.5	
VAVS[1]		0.6-1.2V (7-bit)

(1) VAVS range assumes the slave regulator has a 0.6V feedback voltage, and 10 kΩ feedback resistors.

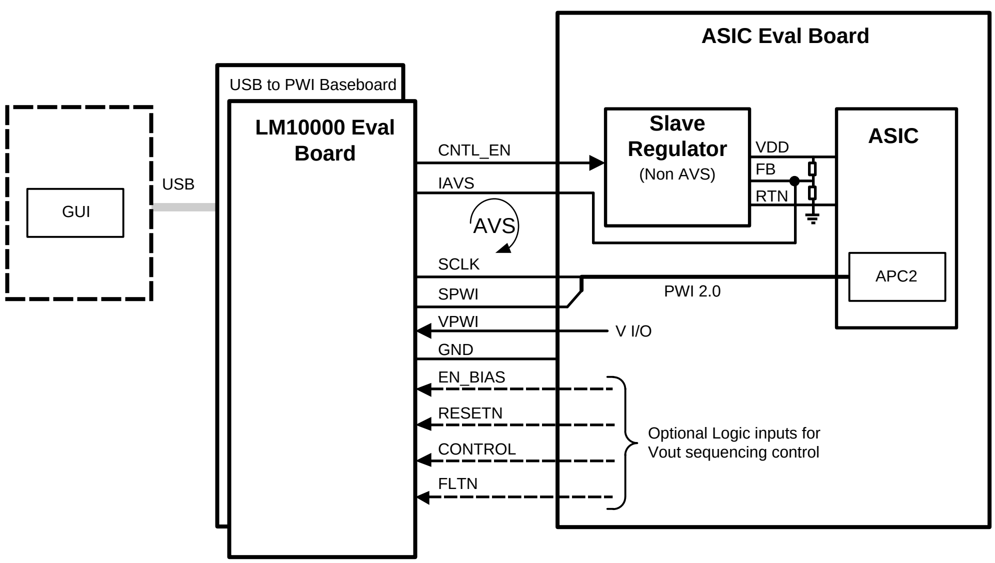

Figure 1. LM10000 Evaluation Board

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3 LM10000 Evaluation Board Quick Start

A typical set up using LM10000 requires an LM10000 evaluation board, a USB to PWI baseboard, a PC with USB port, and a slave regulator with external feedback resistors. The slave regulator should be specified for the needs of the load (output power, input voltage range, and so on).

3.1 Basic Setup (Open Loop Voltage Scaling)

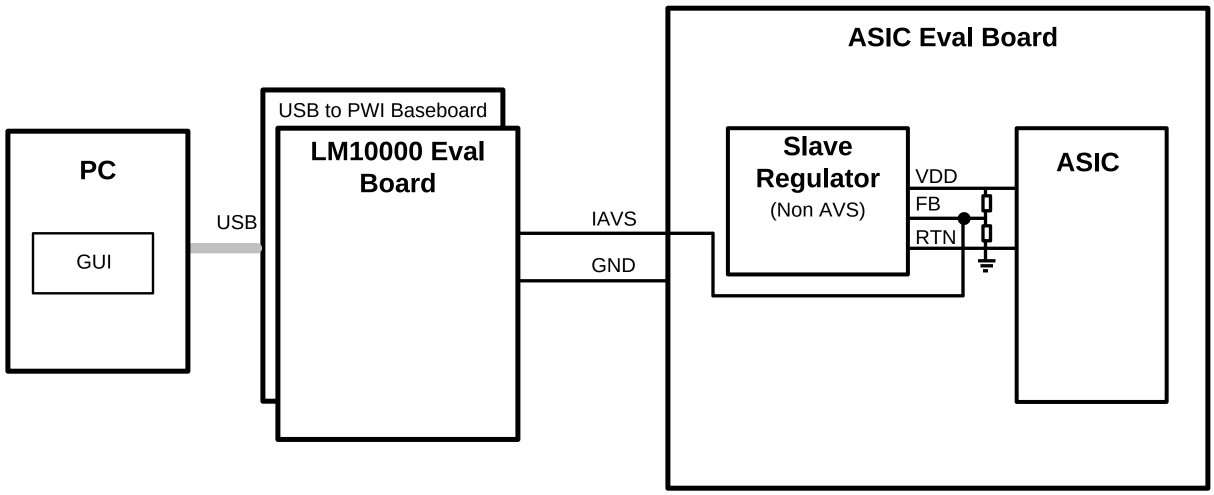

Figure 2. Basic Setup

1. Install the LM10000 GUI on a PC in close proximity to the LM10000 set up.
2. Insure that LM10000 eval board is connected to USB to PWI base board.
3. Connect a wire from IAVS to the center of the feedback resistor divider on the slave regulator board.
4. Connect a wire from the LM10000 evaluation board ground to the slave regulator board ground.
5. Connect a USB cable from a PC to the LM10000 Evaluation board. See Note.
6. Apply power to the input of the slave regulator.
7. Use the GUI to program IAVS and observe slave regulator voltage scaling on a scope or DMM.

NOTE: The LM10000 evaluation board can be powered by the USB to PWI baseboard or externally. See Section 5. Once power is applied, the LM10000 enable and logic input pins are pulled up by on-board pull-up resistors , except the FLT_N and CONTROL pin. If the GUI is used, please press the two buttons for FLT_N and CONTROL down (set to 1) and the device is active. If the 20-pin connector is used, please make sure these two pins are high (push-pull connection on the board).

3.2 Advanced (Enable Power Management and Voltage Scaling)

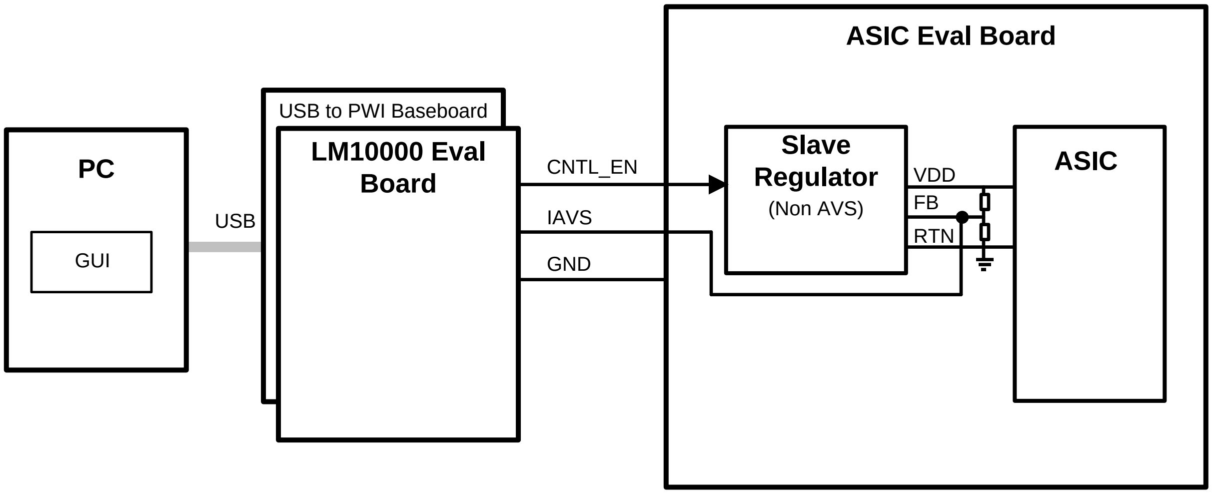

Figure 3. Advanced Setup

1. Install the LM10000 GUI on a PC in close proximity to the LM10000 set up.
2. Insure that LM10000 eval board is connected to USB to PWI base board.
3. Connect a wire from IAVS to the center of the feedback resistor divider on the slave regulator board.
4. Connect a wire from CNTL_EN to the enable input of the slave regulator (requires the slave regulator to have a logic enable input).
5. Connect a wire from the LM10000 evaluation board ground to the slave regulator board ground.
6. Connect a USB cable from a PC to the LM10000 Evaluation board. See Note.
7. Apply power to the input of the slave regulator.
8. Use the GUI to program IAVS and power states (active, sleep, shutdown); observe slave regulator voltage on a scope or DMM.

NOTE: The LM10000 evaluation board can be powered by the USB to PWI baseboard or externally. See Section 5. Once power is applied, the LM10000 enable and logic input pins are pulled up by on-board pull-up resistors except the FLT_N and CONTROL. If the GUI is used, please press the two buttons for FLT_N and CONTROL down (set to 1) and the device is active. If the 20-pin connector is used, please make sure these two pins are high (push-pull connection on the board).

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4 In Situ PowerWise® AVS Evaluation Using LM10000 Evaluation Board

The LM10000 evaluation board can be used to facilitate AVS evaluation of a non-AVS application. In many cases, it is desired to understand how much power savings can be achieved by lowering the voltage of an ASIC or FPGA. With a couple connections from the LM10000 evaluation board to the system board, power savings analysis can be done without disrupting the power layout of the system board.

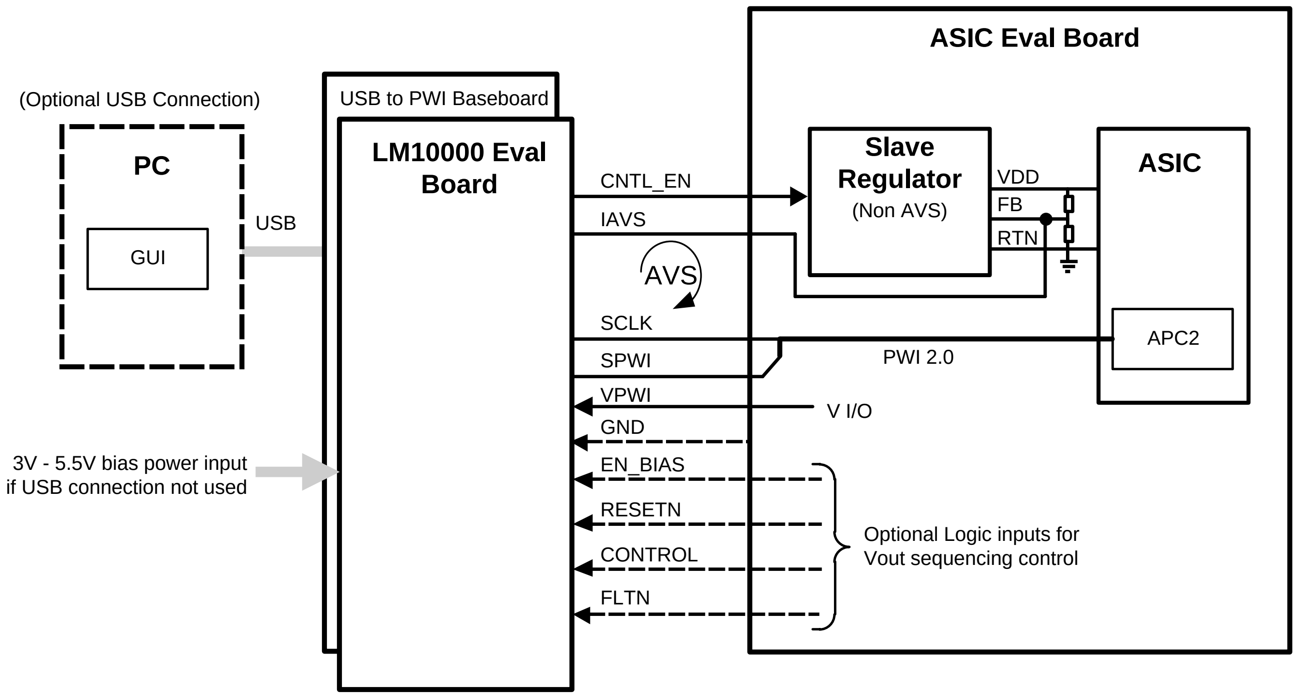

Figure 4. In Situ PowerWise® AVS Setup (Closed Loop Voltage Scaling)

5 Jumper Settings

Table 1. Jumper Settings

Jumper	Connection	Description
P1		VPWI external input
P2		VDD external input
P3		20-pin header to connect all necessary signals to application board for closed-loop AVS evalution
P4	VDD to VBAT	VDD powered by USB to PWI baseboard (3.6V)
	VDD to VDD_EXT	VDD powered externally
P5		IAVS_MIR measurement
P6	VPWI to VBAT	VPWI powered by USB to PWI baseboard
	VPWI to VPWI_EXT	VPWI powered externally

6 Bill of Materials

Table 2. Bill of Materials

Designator	Comp. Type	Value	Package Reference	Description	Manufacturer	Part Number
C1	Capacitor	0.1uF	0603	Ceramic, Y5V, 16V, 80%	TDK	C1608Y5V1C104Z
C2	Capacitor	1uF	0603	Ceramic, X5R, 6.3V, 10%	TDK	C1608X5R0J105K
C3	Capacitor	0.1uF	0603	Ceramic, X7R, 16V, 10%	TDK	C1608X7R1C104K
R1	Resistor	1.50k	0805	1%, 0.125W	Vishay-Dale	CRCW08051K50FKEA
R2	Resistor	1.50k	0603	1%, 0.1W	Vishay-Dale	CRCW06031K50FKEA
R3, R4, R5, R6	Resistor	1.00k	0603	1%, 0.1W	Vishay-Dale	CRCW06031K00FKEA
R7, R9, R12, R13	Resistor	10.0k	0603	1%, 0.1W	Vishay-Dale	CRCW060310K0FKEA
R8	Resistor	27	0603	5%, 0.1W	Vishay-Dale	CRCW060327R0JNEA
R10	Resistor	40.2k	0805	1%, 0.125W	Vishay-Dale	CRCW080540K2FKEA
R11	Resistor	1.00	0603	1%, 0.1W	Vishay-Dale	CRCW06031R00FNEA
R14	Resistor	54.9k	0805	1%, 0.125W	Vishay-Dale	CRCW080554K9FKEA
U1	IC		LLP 14		Texas Instruments	LM10000SDE NOPB

7 Layout Artwork

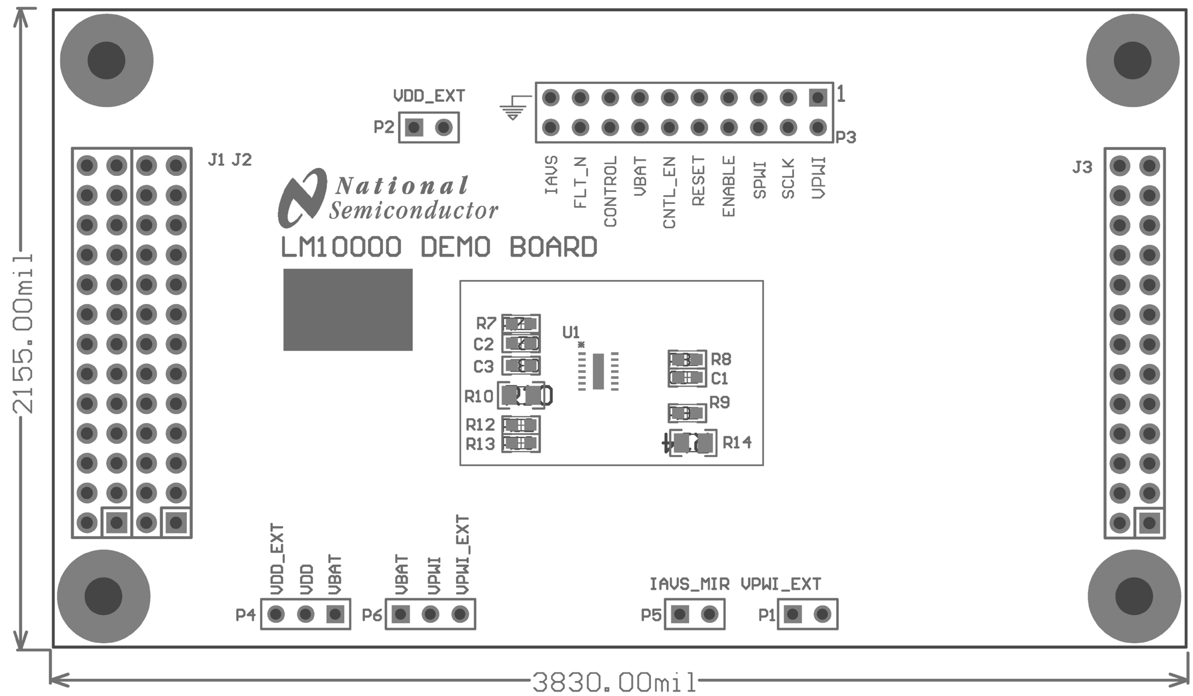

Figure 5. Evaluation Board (Top View)

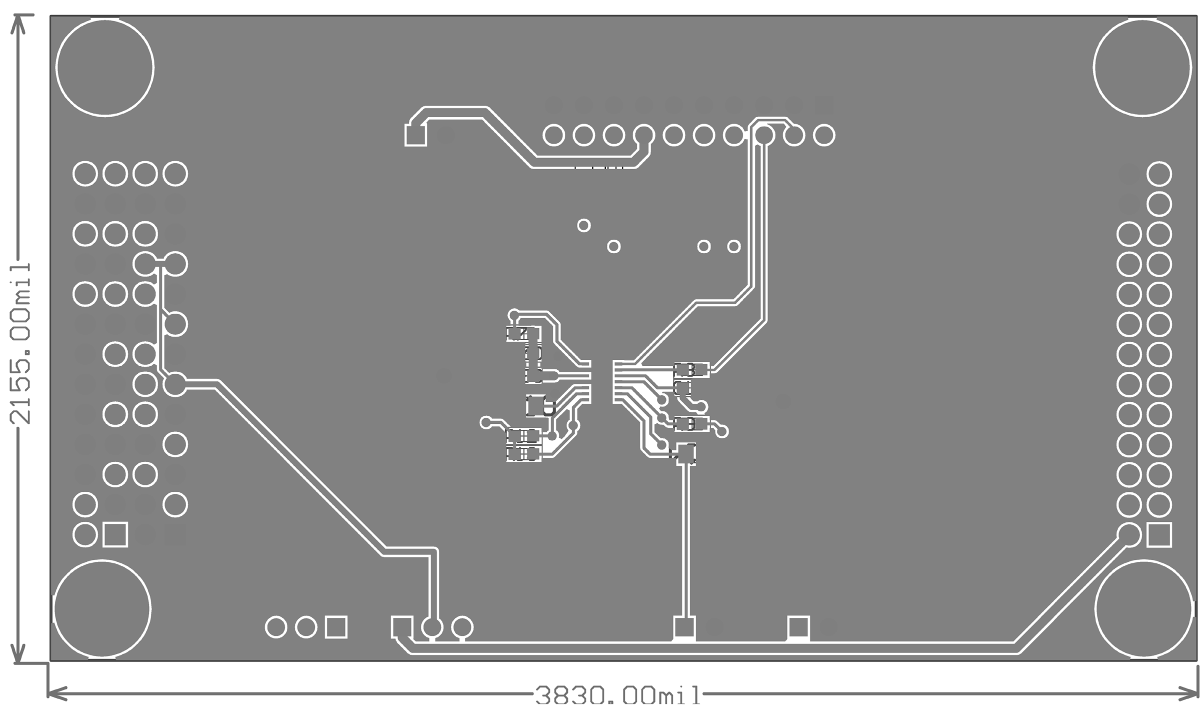

Figure 6. Top Layer

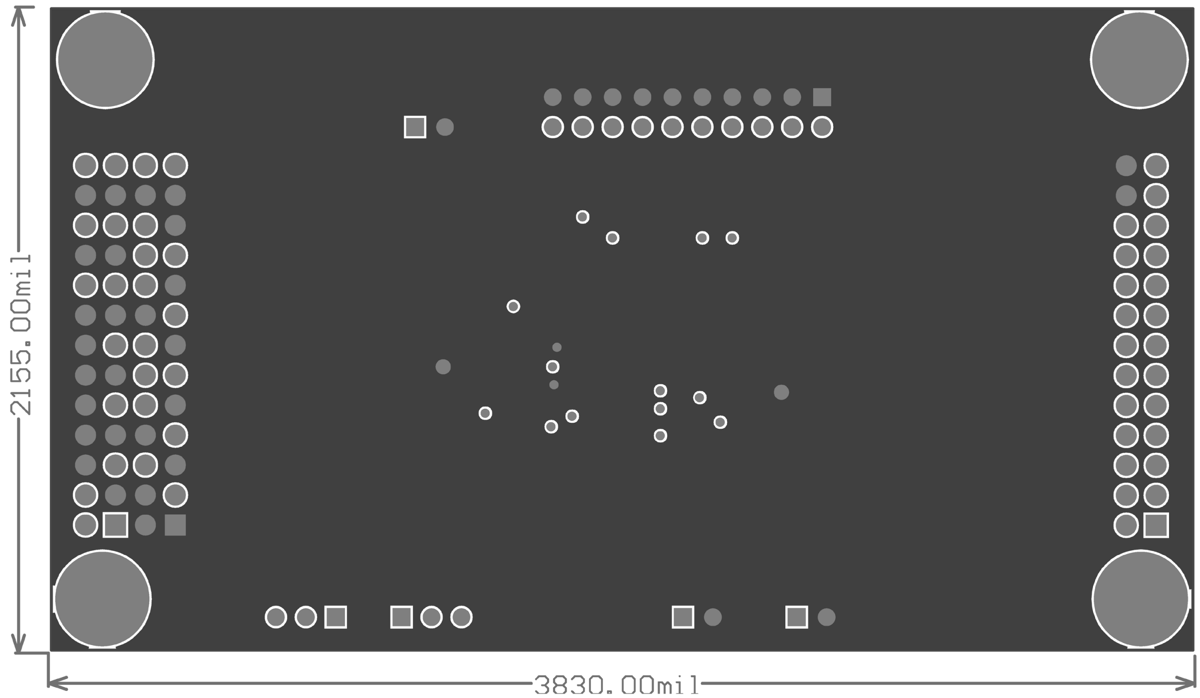

Figure 7. Mid-Layer 1

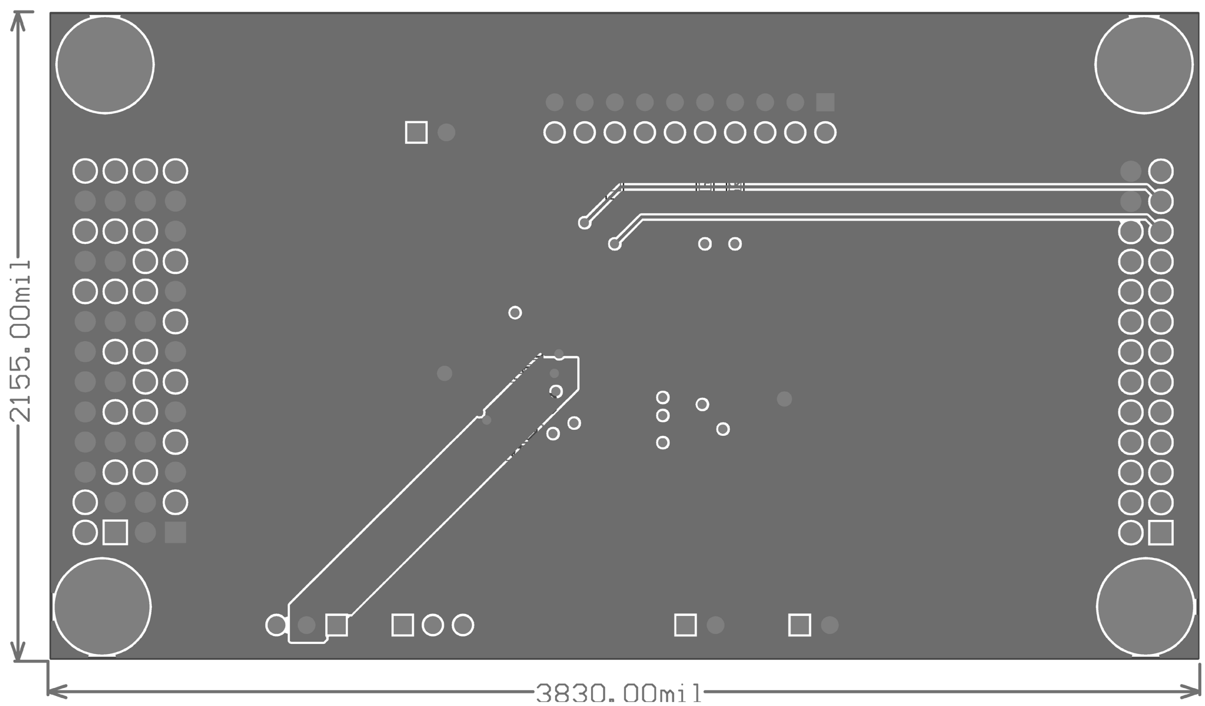

Figure 8. Mid-Layer 2

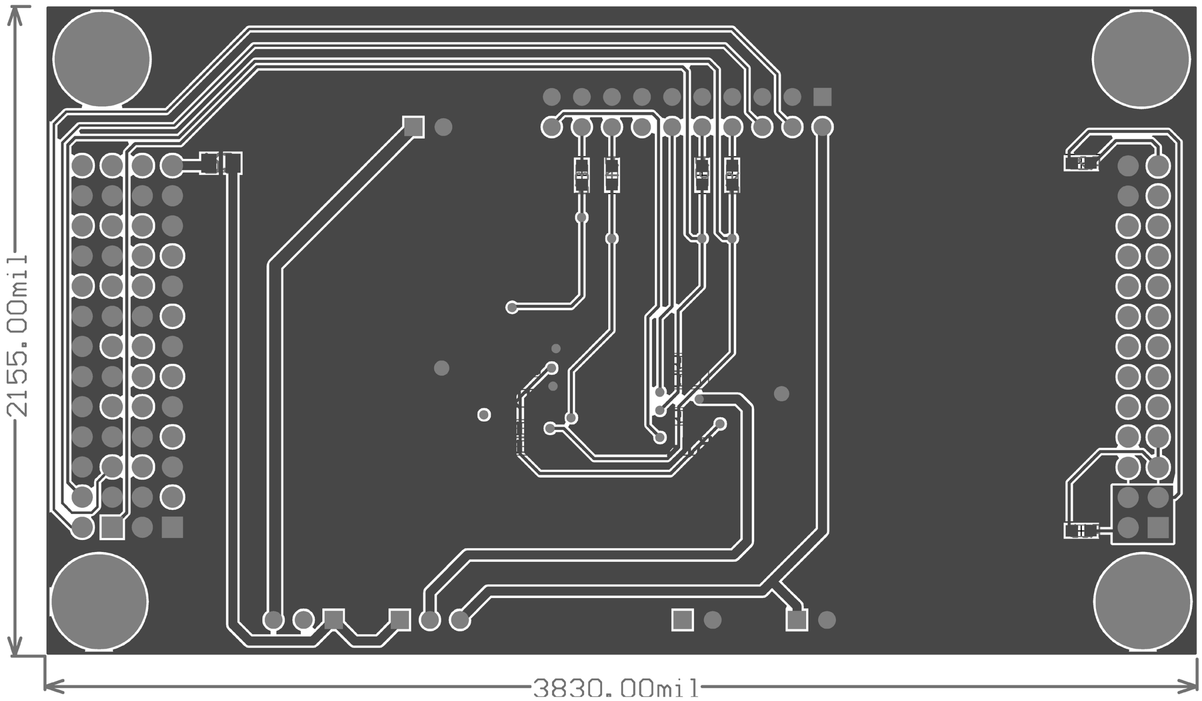

Figure 9. Bottom Layer

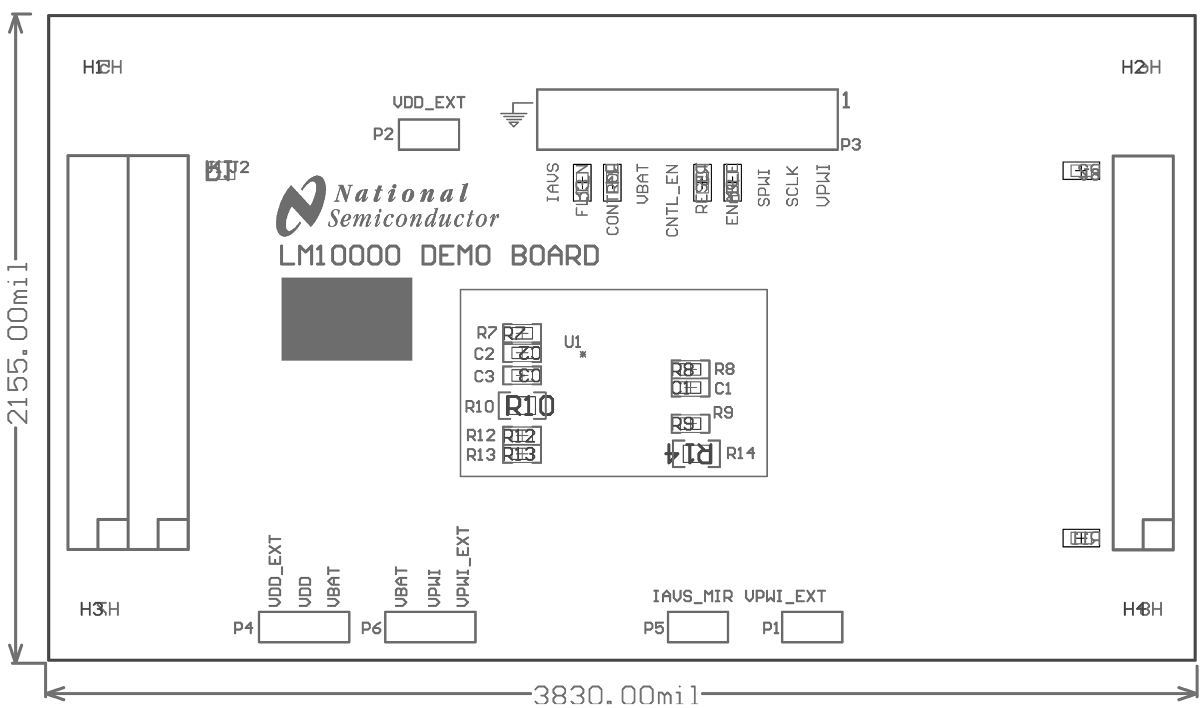

Figure 10. Top Silk Screen

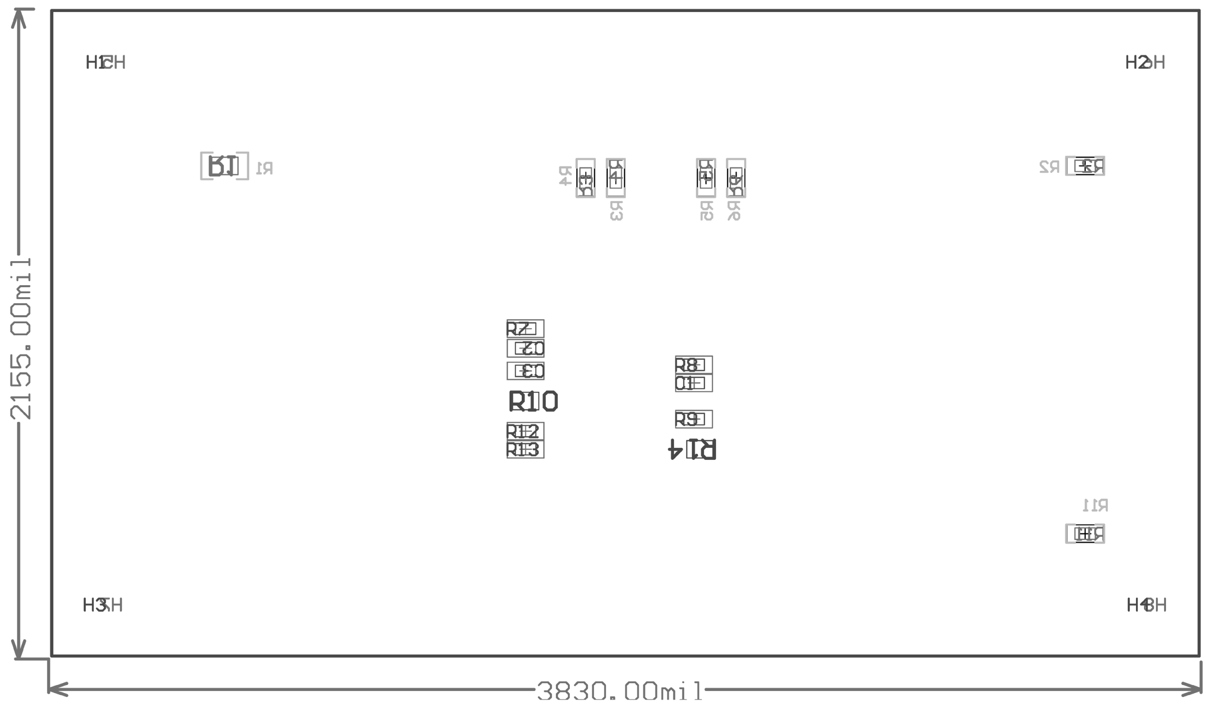

Figure 11. Bottom Silk Screen

8 Schematic

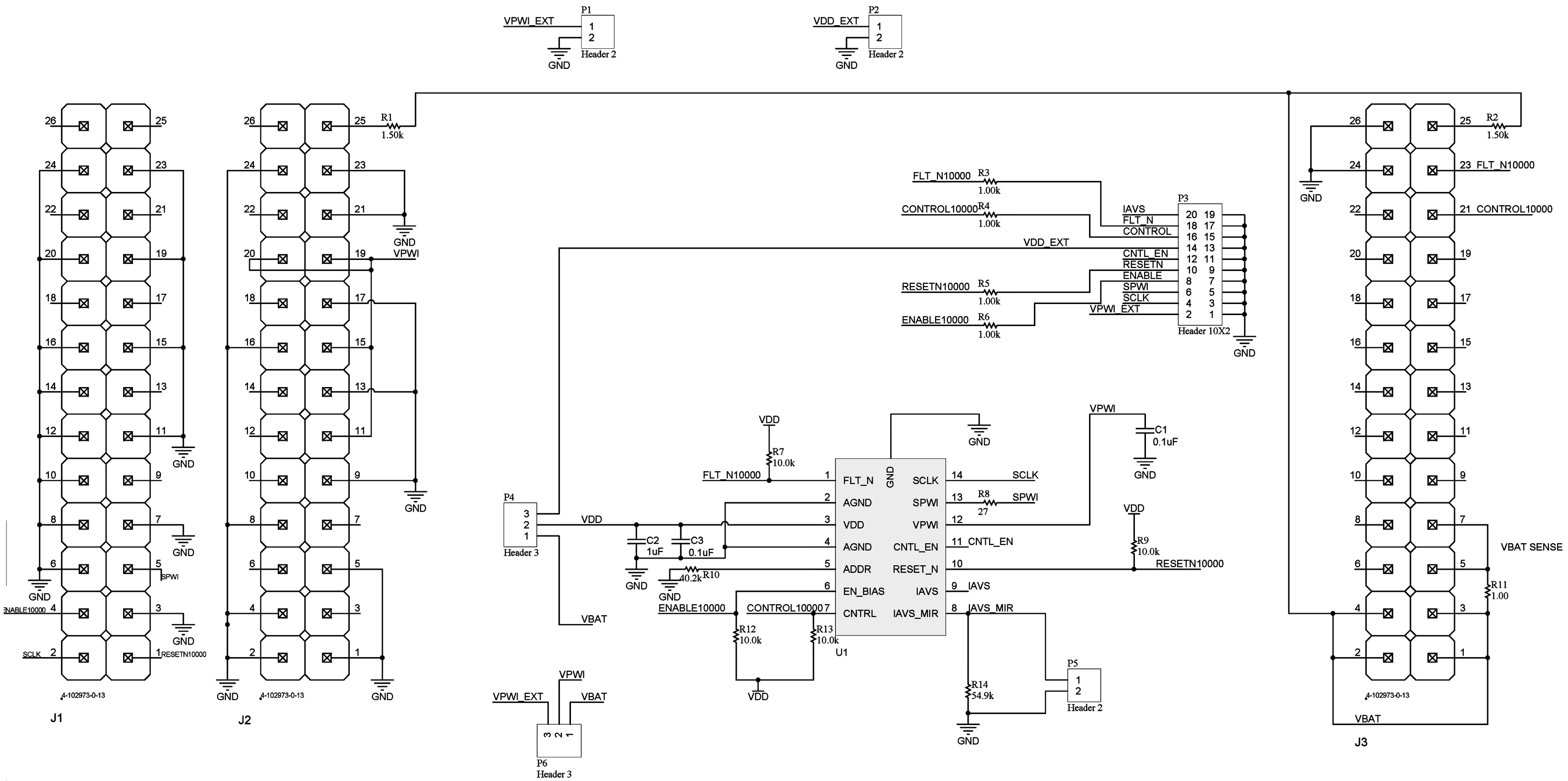

Figure 12. LM1000 AVS System Controller Schematic

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