# Si9143 High-Performance Processor Controller Demo Board

## FEATURES

- Voltage Mode Control
- Synchronous Buck Converter
- Short Circuit Current Limiting
- Over-Voltage Protection
- Output Current to 15 A
- Power Good Signal
- +5 V or +12 V Input
- Switching Frequency = 200 kHz
- Output Voltage Adjustable 1.8 V to 3.5 V

## DESCRIPTION

The Si9143 is a voltage-mode, synchronous buck controller designed for point-of-use dc-to-dc conversion in high-performance servers and desktop computers. High efficiency at full load is accomplished by driving high- and low-side n-channel MOSFETS. The input voltage range has been designed for 4.75 V to 13.2 V to allow use of either 5 V or 12 V. This demo board is capable of handling 15 A of continuous output current. And the output voltage can be set easily to the desired value (from 1.8 V to 3.5 V in 0.1 V increments) by adjusting the five voltage identification pins on the connector. Table 1 shows the logic settings for various output voltages.

The Si9143 is designed to provide automatic true current sharing between parallel power supplies. To use this function, all the Si9143s have to be synchronized by tying their SYNC pins and all the PWM pins together. These two pins are left open on the demo board.

The Bill-of-Materials (Table 2) and Demo Board Schematic are attached to this document. Refer to Table 1 for different voltage settings.

## ORDERING INFORMATION

Part Number Si9143DB

## TEST SETUP AND OPERATION

1. The Si9143 Demo Board requires an input power source and a load. The input power source may be either +5 V or +12 V. If +5 V is used as an input, be sure it is capable of sourcing at least 15 A; if +12 V is used as an input, be sure it is capable of sourcing at least 8 A. An electronic load is recommended for the load; be sure that it is capable of sinking 60W, and that it will operate with an input voltage as low as 1.5 V. Also required for the demonstration described here are an oscilloscope, two DVMs, and two ammeters.

2. There is a 40-pin connector socket availabe on board, which is mechanically compatible with Intel's VRM Header 8, revision 3.0. If no connector will be used, input/output power can be connected at separate pins on the demo board. Connections between the load and demo board and the electronic load should be made with heavy gauge wire (AWG #14 or larger) and should be as short as possible. For a specific output voltage set point, certain voltage identification pins (VIDx) need to be grounded.

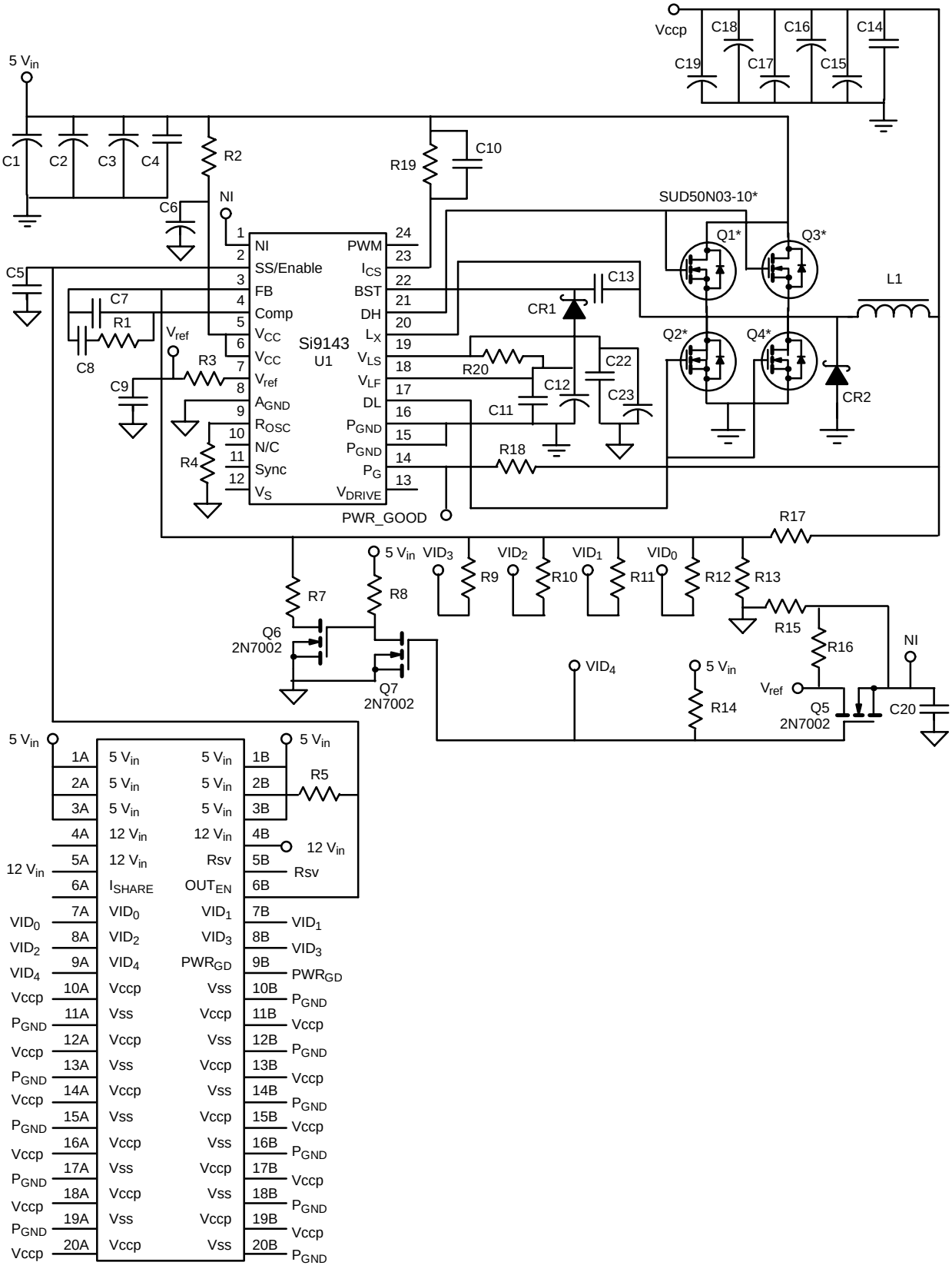
3. Attach the first DVM to the input of the Si9143 demo board. The attachments should be made as close as possible to the board, NOT at the power supply. Attach the second DVM to the output of the demo board. Again, the attachments should be made as close as possible to the board, NOT at the electronic load. In particular, do not rely on the built-in meters of the power supply and the electronic load for voltage measurements, because of the voltage dropped along the connection wires. Set input voltage and load current to zero before powering up.

4. Put an oscilloscope ground to the output ground. Then connect Ch1 probe to pin 21 (DH), Ch2 probe to pin 17 (DL), and Ch3 probe to pin 20 (Lx) of Si9143. Set the scope scale to 5 V/div. for all channels. At 6-V input voltage and 2.8-V/1-A output, the resulting waveform will appear approximately as shown in Figure 1.

5. Basic Operation: After powering up the power source, slowly increase the voltage until the DVM at the input reads 5 V. Adjust the load current within the operating range and observe the regulation of output voltage. Voltage/current data at the input and output can be recorded to calculate the efficiency of the demo board.

| TABLE 1. VOLTAGE IDENTIFICATION CODE | | | | | |
|---|---|---|---|---|---|
| Processor Pins: 0 = Connected to ground; 1 = Open or pull-up to $V_{in}$ | | | | | $V_{out}$ |
| VID4 | VID3 | VID2 | VID1 | VID0 | (VDC) |
| 0 | 1 | 1 | 1 | 1 | * |
| 0 | 1 | 1 | 1 | 0 | * |
| 0 | 1 | 1 | 0 | 1 | * |
| 0 | 1 | 1 | 0 | 0 | * |
| 0 | 1 | 0 | 1 | 1 | * |
| 0 | 1 | 0 | 1 | 0 | * |
| 0 | 1 | 0 | 0 | 1 | * |
| 0 | 1 | 0 | 0 | 0 | * |
| 0 | 0 | 1 | 1 | 1 | * |
| 0 | 0 | 1 | 1 | 0 | * |
| 0 | 0 | 1 | 0 | 1 | 1.80 |
| 0 | 0 | 1 | 0 | 0 | 1.85 |
| 0 | 0 | 0 | 1 | 1 | 1.90 |
| 0 | 0 | 0 | 1 | 0 | 1.95 |
| 0 | 0 | 0 | 0 | 1 | 2.00 |
| 0 | 0 | 0 | 0 | 0 | 2.05 |
| 1 | 1 | 1 | 1 | 1 | No CPU |
| 1 | 1 | 1 | 1 | 0 | 2.1 |
| 1 | 1 | 1 | 0 | 1 | 2.2 |
| 1 | 1 | 1 | 0 | 0 | 2.3 |
| 1 | 1 | 0 | 1 | 1 | 2.4 |
| 1 | 1 | 0 | 1 | 0 | 2.5 |
| 1 | 1 | 0 | 0 | 1 | 2.6 |
| 1 | 1 | 0 | 0 | 0 | 2.7 |
| 1 | 0 | 1 | 1 | 1 | 2.8 |
| 1 | 0 | 1 | 1 | 0 | 2.9 |
| 1 | 0 | 1 | 0 | 1 | 3.0 |
| 1 | 0 | 1 | 0 | 0 | 3.1 |
| 1 | 0 | 0 | 1 | 1 | 3.2 |
| 1 | 0 | 0 | 1 | 0 | 3.3 |
| 1 | 0 | 0 | 0 | 1 | 3.4 |
| 1 | 0 | 0 | 0 | 0 | 3.5 |

## FUNCTIONAL BLOCK DIAGRAM



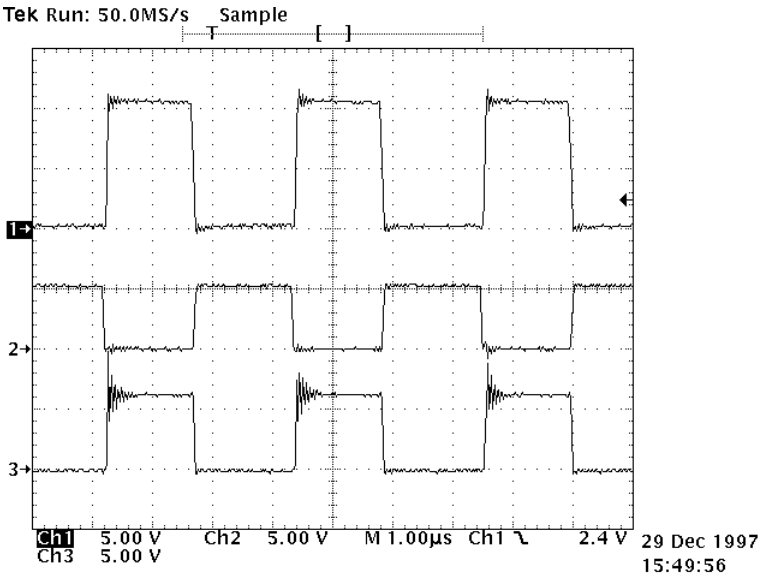



**FIGURE 1.** Si9143DB Sample Waveform

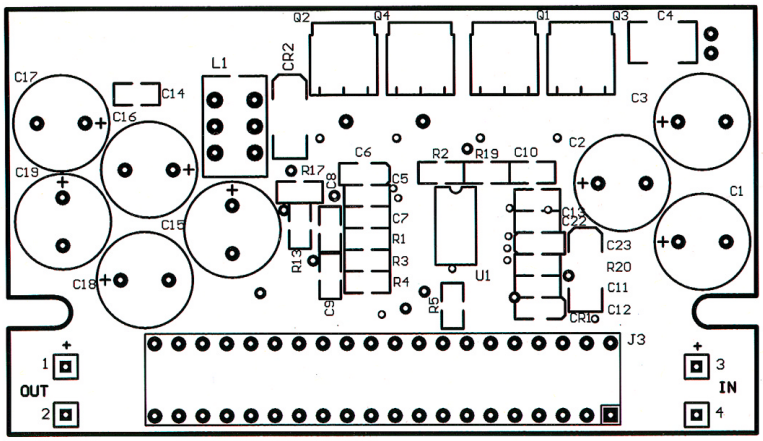



**FIGURE 2.** Si9143DB Top Layer Silk Screen

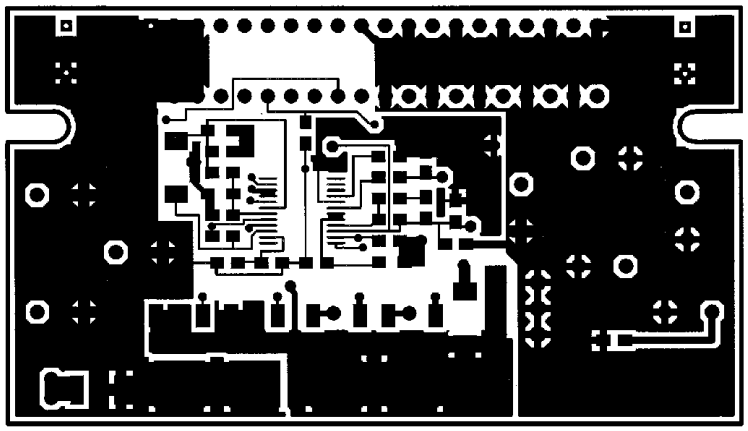


**FIGURE 3.** Si9143 DB Top Layer

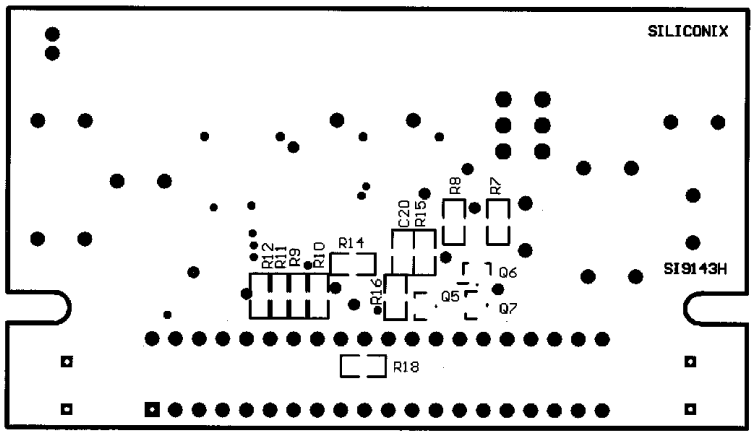



**FIGURE 4.** Si9143 DB Bottom Layer Silk Screen

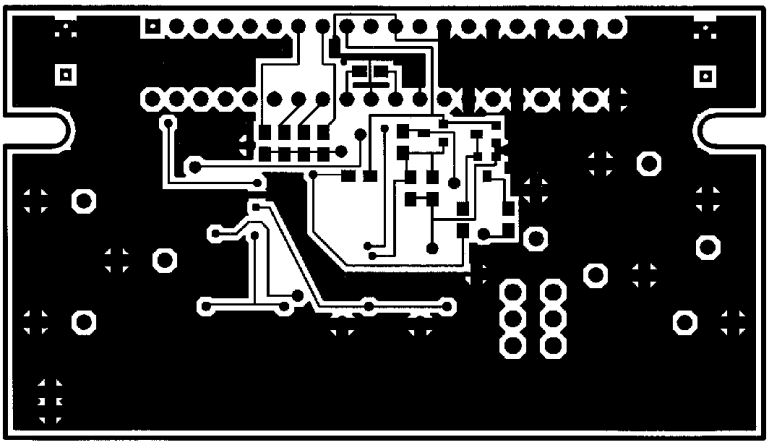


**FIGURE 5.** Si9143 DB Bottom Layer

## TABLE 2. SI9143DB BILL-OF-MATERIALS

| Pin | Used | Reference Designators | Part Type | Description | Pattern | Part Number | Manufacturer |
|---|---|---|---|---|---|---|---|
| 1 | 3 | C1, C2, C3, C15, C16 | 1000 µF | Capacitor, 1000 µF/10 V | Radial-Lead | EKE00DD410C00 | Vishay Roederstein |
| 2 | 1 | C4 | 10 µF | Ceramic | 1210 | GRM42-2X5R106K16 | Murata |
| 3 | 5 | C5, C9, C11, C14, C22 | 0.1 µF | Capacitor | 805 | VJ0805104KXXAT | Vishay Vitramon |
| 4 | 3 | C6, C12, C23 | 4.7 µF | Capacitor | 1206 | GRM42-2X5R475K16 | Murata |
| 5 | 1 | C7 | 27 pF | Capacitor | 805 | VJ0805270KXXAT | Vishay Vitramon |
| 6 | 1 | C8 | 470 pF | Capacitor | 805 | VJ0805471KXXAT | Vishay Vitramon |
| 7 | 1 | C10 | 1000 pF | Capacitor | 805 | VJ0805102KXXAT | Vishay Vitramon |
| 8 | 1 | C13 | 0.47 µF | Capacitor | 805 | VJ0805474KXXAT | Vishay Vitramon |
| 9 | 5 | C17, C18, C19 | 2200 µF | Capacitor, 2200 µF/10 V | Radial-Lead | EKE00FI422C00 | Vishay Roederstein |
| 10 | 4 | C20 | 0.01 µF | Capacitor | 805 | | Vishay Vitramon |
| | | | | | | | |
| 11 | 1 | CR1 | D1FS4 | Schottky, 40 V 1.1 A | Case 1F, SMT | DIFS4 | Shindengen |
| 12 | 1 | CR2 | DE4SC4M | Schottky, 40 V 5 A | DPAK, SMT | DE4SC4M | Shindengen |
| | | | | | | | |
| 13 | 1 | L1 | 1.5 µH | Inductor, 1.5 µH | Radial-Lead | | Custom |
| | | | | | | | |
| 14 | 4 | Q1, Q2, Q3, Q4 | N-Ch MOSFET | N-Channel MOSFET | U2 | SUD50N03-10 | Vishay Siliconix |
| | | | | | | | |
| 15 | 2 | R1, R12 | 200 k | Resistor, 200 kΩ | 805 | CRCW08052003FRT1 | Vishay Dale |
| 16 | 1 | R2 | 1 | Resistor, 1 Ω | 805 | CRCW080551R0FRT1 | Vishay Dale |
| 17 | 1 | R3 | 510 | Resistor, 510 Ω | 805 | CRCW08055100FRT1 | Vishay Dale |
| 18 | 1 | R4 | 30 k | Resistor, 30 kΩ | 805 | CRCW08053002FRT1 | Vishay Dale |
| 19 | 1 | R5 | 1 K | Resistor, 1 kΩ | 805 | CRCW08051001FRT1 | Vishay Dale |
| 20 | 1 | R7 | 33.2 k | Resistor, 33.2 kΩ | 805 | CRCW08053322FRT1 | Vishay Dale |
| 21 | 5 | R8, R14, R15, R16, R18 | 10 k | Resistor, 10 kΩ | 805 | CRCW08051002FRT1 | Vishay Dale |
| 22 | 1 | R9 | 24.9 k | Resistor, 24.9 kΩ | 805 | CRCW08052492FRT1 | Vishay Dale |
| 23 | 1 | R10 | 49.9 k | Resistor, 49.9 kΩ | 805 | CRCW08054992FRT1 | Vishay Dale |
| 24 | 1 | R11 | 100 k | Resistor, 100 kΩ | 805 | CRCW08051003FRT1 | Vishay Dale |
| 25 | 1 | R13 | 28.7 k | Resistor, 28.7 kΩ | 805 | CRCW08052872FRT1 | Vishay Dale |
| 26 | 1 | R17 | 16.9 k | Resistor, 16.9 kΩ | 805 | CRCW08051692FRT1 | Vishay Dale |
| 27 | 1 | R19 | 5 K | Resistor, 5 kΩ | 805 | CRCW08055001FRT1 | Vishay Dale |
| 28 | 1 | R20 | 49.9 | Resistor, 49.9 Ω | 805 | CRCW080549R9FRT1 | Vishay Dale |
| | | | | | | | |
| 29 | 1 | U1 | PIC | Current Sharing Controller | U1 | Si9143 | Vishay Siliconix |

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*Тел: +7 (812) 336 43 04 (многоканальный)*
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