# UG412: Class 4, 30 W, 12 V EMI-Compliant, Isolated EVB for the Si34061

The Si34061 isolated Flyback evaluation board is a reference design for power supplies in Power over Ethernet (PoE) Powered Device (PD) applications.

The Si34061-EVB-EXT-12V maximum output is Class 4 power (30 W with isolated 12 V output).

The Si34061 IC integrates an IEEE 802.03at compatible PoE+ interface as well as a peak-current-control dc-dc controller.

**KEY FEATURES**

- IEEE 802.03at compatible
- High converter efficiency (> 90%)
- EMI compliant design
- Synchronous rectification
- High flexibility
- Integrated transient overvoltage protection
- Thermal shutdown protection
- 5x5 mm 24-pin QFN

| Parameter | Condition | Specifications |
|---|---|---|
| Ordering part number | — | Si34061FB12V4KIT |
| PSE input voltage range | Up to Pout = 25.5 W, Connector J1 | 42.5 to 57 V |
| | Up to Pout = 12.95 W, Connector J1 | 37 to 57 V |
| Wall adapter input voltage range | Connector J3 | 33 to 57 V |
| PoE Type/Class | Type 2/Class 4 | IEEE 802.3at |
| Output voltage/current | Connectors J4-J5 | 12 V / 2.5 A |
| Efficiency, end-to-end | $V_{IN}$ = 48 V from wall adapter | 92.5 % |
| Efficiency, dc-dc converter | $V_{IN}$ = 50 V from PSE | 92.5 % |
| Efficiency, end-to-end | $V_{IN}$ = 50 V from PSE | 89.8 % |
| Switching frequency | $R_{FREQ}$ (R14) = 95.3 kΩ | 200 kHz |
| Conducted EMI | EN55032, average and peak detector | Passed |
| Radiated EMI | EN55032 Class B | Passed |

# Table of Contents

# 1. Kit Description and Powering up the Si34061-EVB-EXT-12V

The Si34061-EVB-EXT-12V Flyback based evaluation board is a reference design for power supplies in Power over Ethernet (PoE+) Powered Device (PD) applications. The Si34061 device is described more completely in the data sheet and application notes.

The Si34061-EVB-EXT-12V board is shown on the cover page.

To achieve high efficiency, this board is set up with external Schottky diode bridges; however, a silicon type external diode bridge can be used as well. In that case, the CT/SP pins should be connected to the PSE (RJ45 – J1).

To compensate for the reverse leakage of Schottky type diode bridges at high temperatures, the recommended detection resistor should be adjusted to the values listed in the following table:

**Table 1.1. Recommended Detection Resistor Values**

| External Diode Bridge | $R_{DET}$ (R21) |
|---|---|
| Silicon Type | 24.3 kΩ |
| Schottky Type | 24.9 kΩ |

Ethernet data and power are applied to the board through the RJ45 connector (J1). The Ethernet data can be obtained from J2. The design can be used in Gigabit (10/100/1000) systems as well.

Power may be applied in the following ways:
- Using any IEEE 802.3-2015-compliant, PoE-capable PSE, or
- Using a laboratory power supply unit (PSU)

Powering the PD using a PSU:
- Connecting a dc source between blue/white-blue and brown/white-brown of the Ethernet cable (either polarity), (End-span) as shown below:

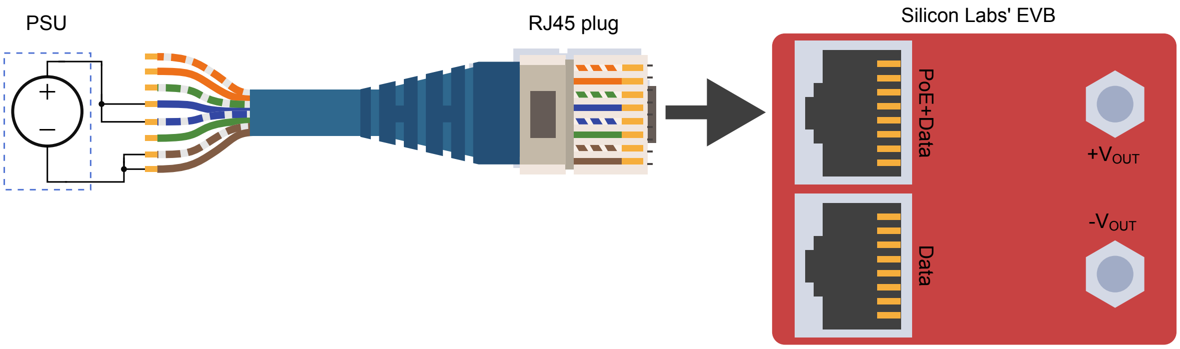



**Figure 1.1. Endspan Connection Using Laboratory Power Supply**

- Connecting a dc source between green/white-green and orange/white-orange of the Ethernet cable (either polarity), (Mid-span) as shown below:

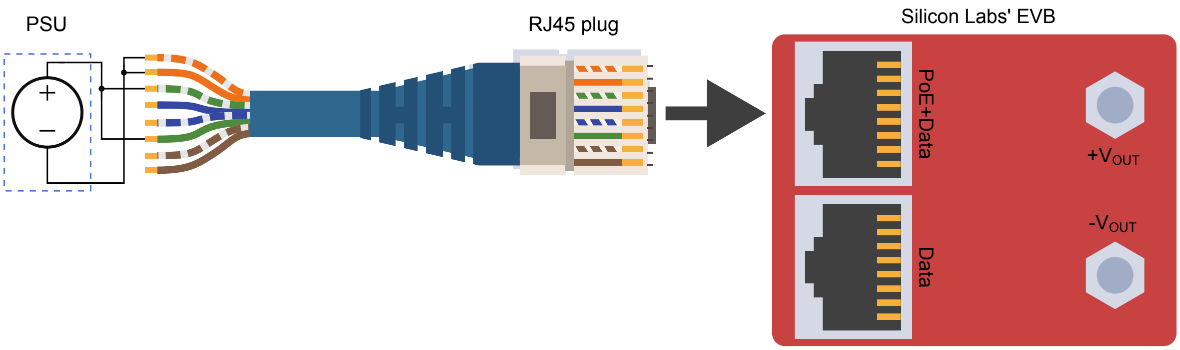



**Figure 1.2. Midspan Connection Using Laboratory Power Supply**

## 2. Si34061-EVB-EXT-12V Board Schematics

The following figure shows the input interface portion of the schematic:

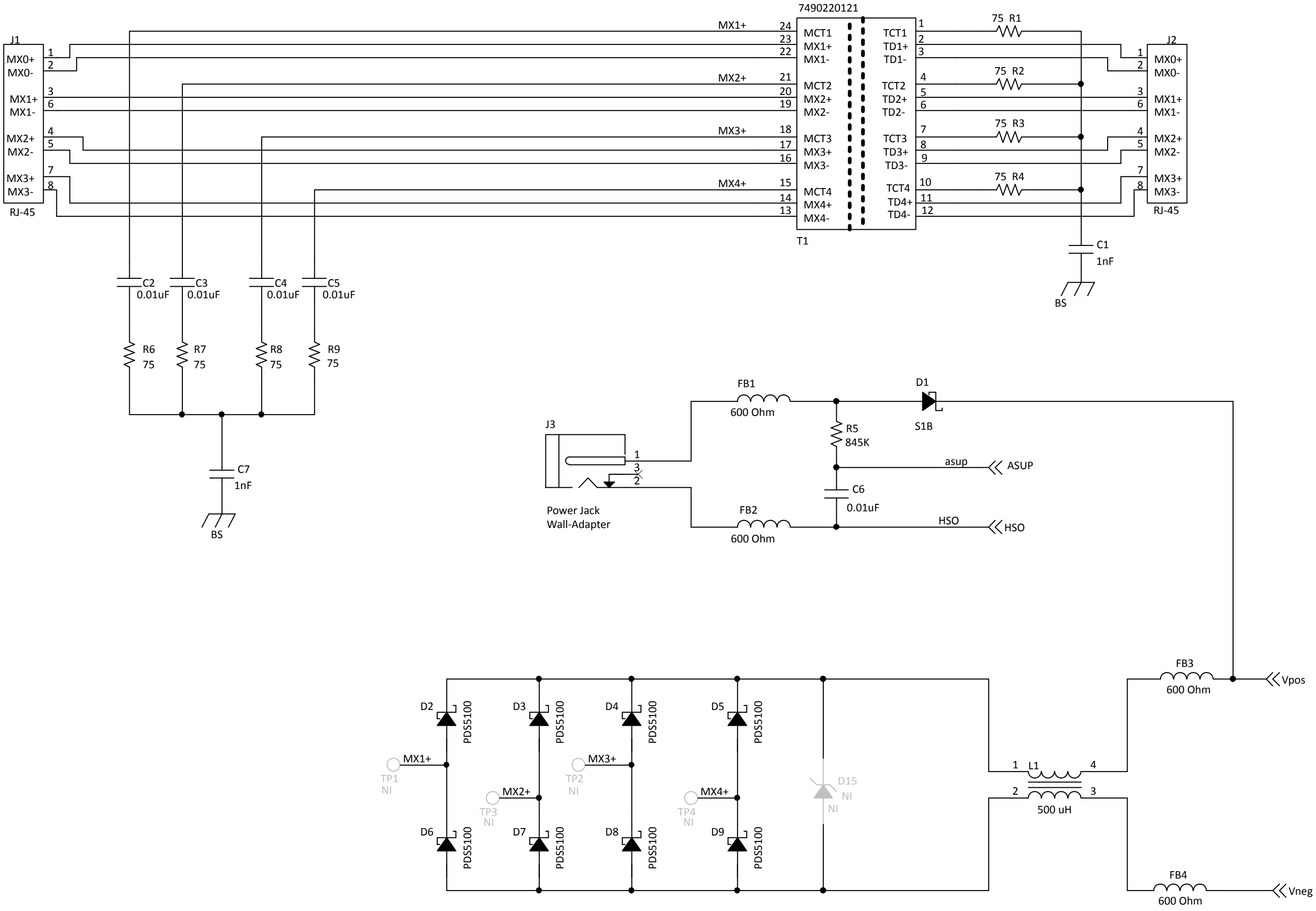



**Figure 2.1. Si34061-EVB-EXT-12V Schematic: Input Interface**

The Si34061 PD controller includes an integrated 100 V protection device that offers adequate protection for indoor applications and passes the IEC 61000-4-5 combination wave test (1.2/50 µs open circuit voltage, 8/20 µs short-circuit current) up to 4.4 kV common-mode and differentially to > 400 V.

In special installation classes where high differential and common-mode surge immunity are required, an external TVS protection device (e.g., SMDJ58A) may be installed between VNEG and VPOS to increase the surge immunity – D15.

With the external protection installed, common-mode surge immunity up to 6 kV and differential immunity up to 2 kV can be achieved.

The Si34061-EVB-EXT can also be powered from a wall adapter through connector J3. The following figure shows the dc-dc converter part of the schematic:

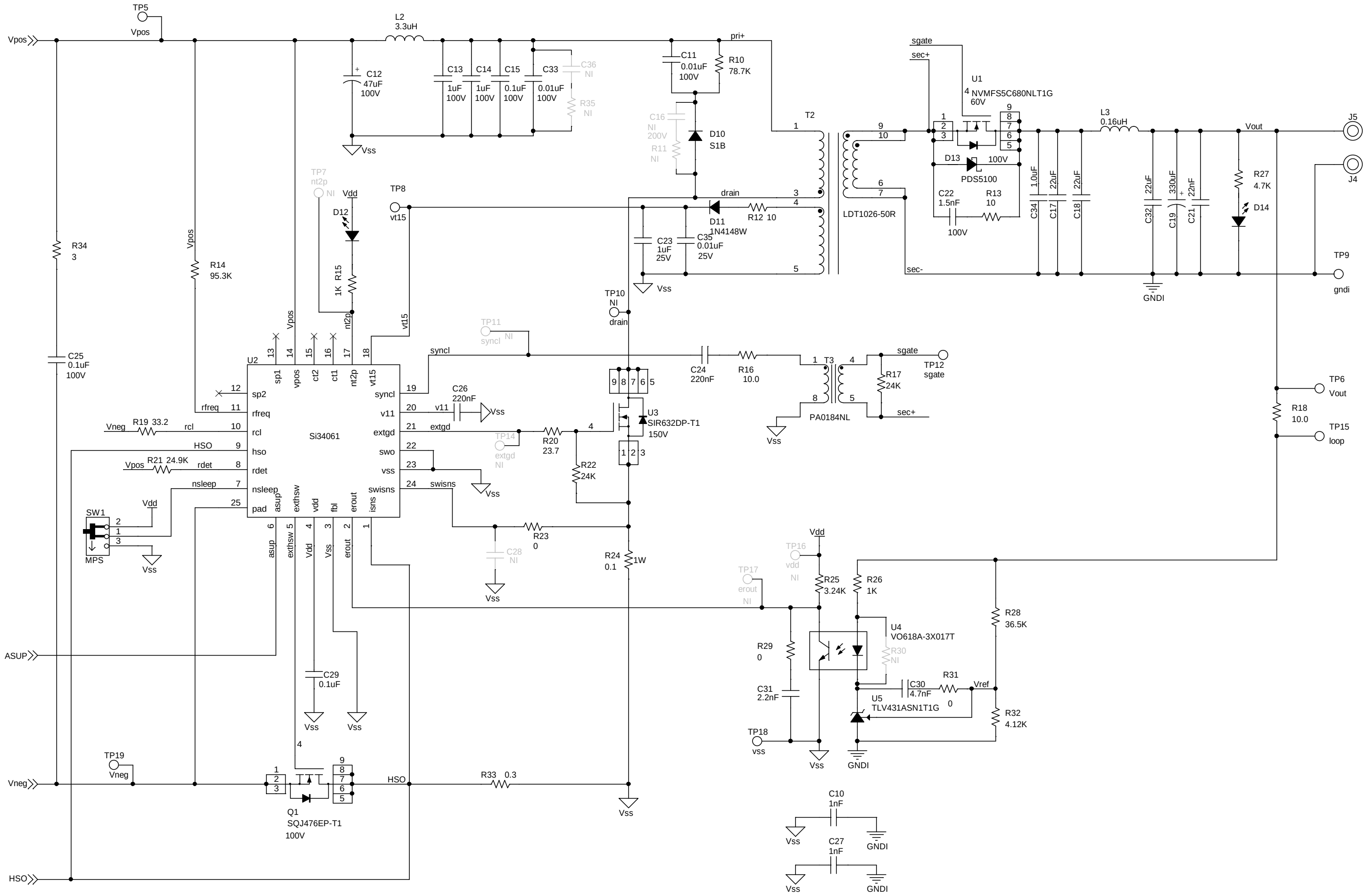



**Figure 2.2. Si34061-EVB-EXT-12V Schematic: DC-DC Converter**

## 3. Conversion Efficiency of the Si34061-EVB-EXT-12V Board

The figures below show the conversion efficiency of the Si34061-EVB-EXT-12V board with 12 V output. The charts present:

- DC-DC converter efficiency at three different input voltages: 42.5, 50, and 57 V
- End-to-end efficiency powered from a PSE at three different input voltages: 42.5, 50, and 57 V
- End-to-end efficiency powered from a 48 V wall adapter

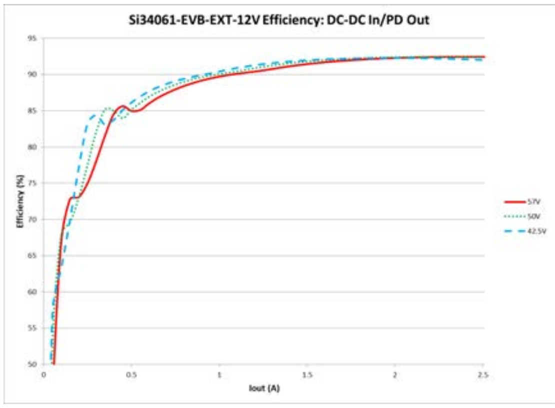



**Figure 3.1. DC-DC Conversion Efficiency**

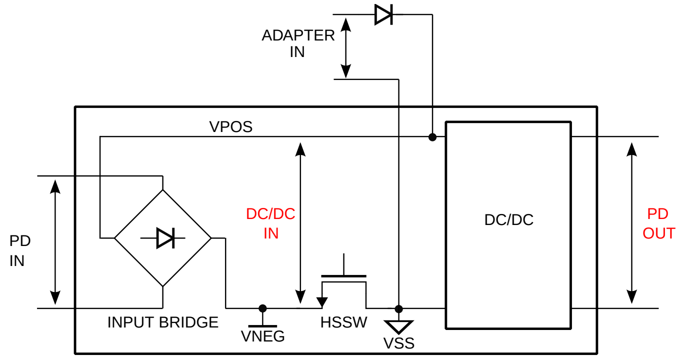



**Figure 3.2. DC-DC Conversion Efficiency Measurement Setup**

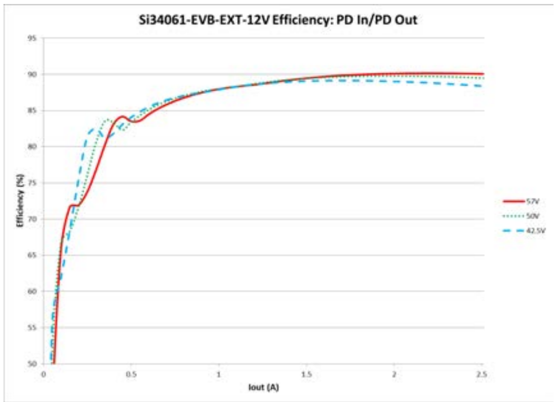



**Figure 3.3. End-to-End Conversion Efficiency**

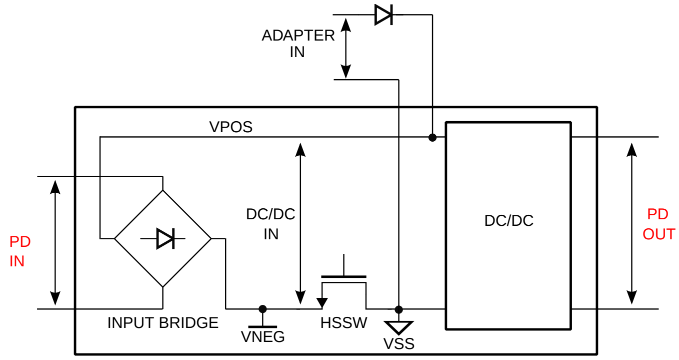



**Figure 3.4. End-to-End Conversion Efficiency Measurement Setup**

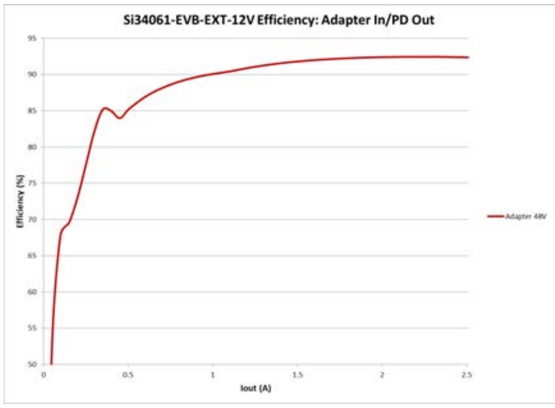



**Figure 3.5. Conversion Efficiency Powered from 48 V Wall Adapter**

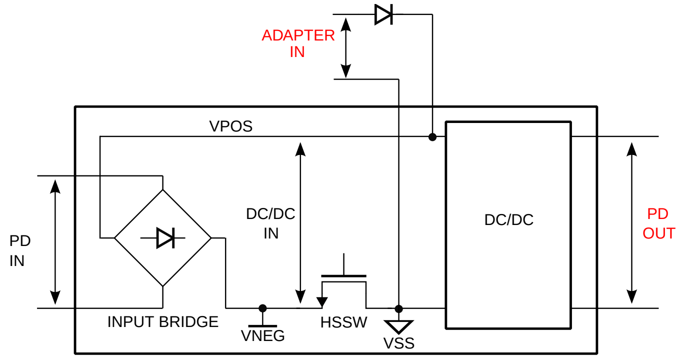



**Figure 3.6. Wall Adapter Conversion Efficiency Measurement Setup**

**Note:** During the efficiency measurements, D12 and D14 LEDs were removed since they are merely indicators and not required parts of the design.

## 4. SIFOS PoE Compatibility Test Results

The PDA-300 Powered Device Analyzer is a single-box comprehensive solution for testing IEEE 802.3at PoE Powered Devices (PDs).

The following figure shows the passing SIFOS Test report of the Si34061-EVB-EXT-12V board.


**Figure 4.1. Si34061-EVB-EXT-12V PD SIFOS PoE Compatibility Test Results**

## 5. Feedback Loop Phase and Gain Measurement Results (Bode Plots)

The Si34061 integrates a current-mode-controlled switching-mode power supply controller circuit; therefore, the application is a closed-loop system. To guarantee a stable power supply output voltage and reduce the influence of input supply voltage variations and load changes on the output voltage, the feedback loop must be stable.

To verify the stability of the loop, the loop gain and loop phase shift have been measured.

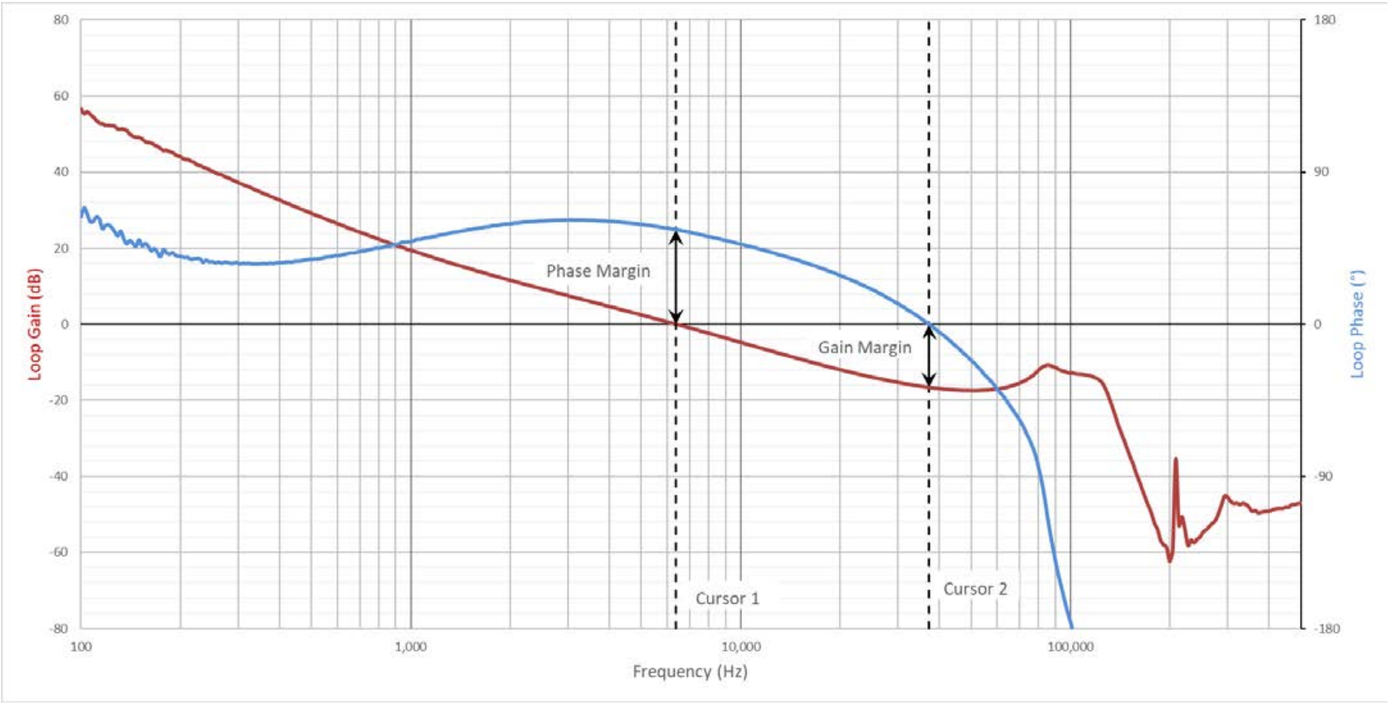



**Figure 5.1. Si34061-EVB-EXT-12V Measured Loop-Gain and Phase-Shift Measured at Full Load**

**Table 5.1. Measured Loop Gain and Phase Shift of the Si34061-EVB-EXT-12V**

| | Frequency | Gain | Phase |
|---|---|---|---|
| Phase Margin (Cursor 1) | 6.4 kHz | 0 dB | 56° |
| Gain Margin (Cursor 2) | 37 kHz | –16 dB | 0 ° |

## 6. Load Step Transient Measurement Results

The Si34061-ISO-FB EVB board's output has been tested with a step load function to verify the converter's output dynamic response.

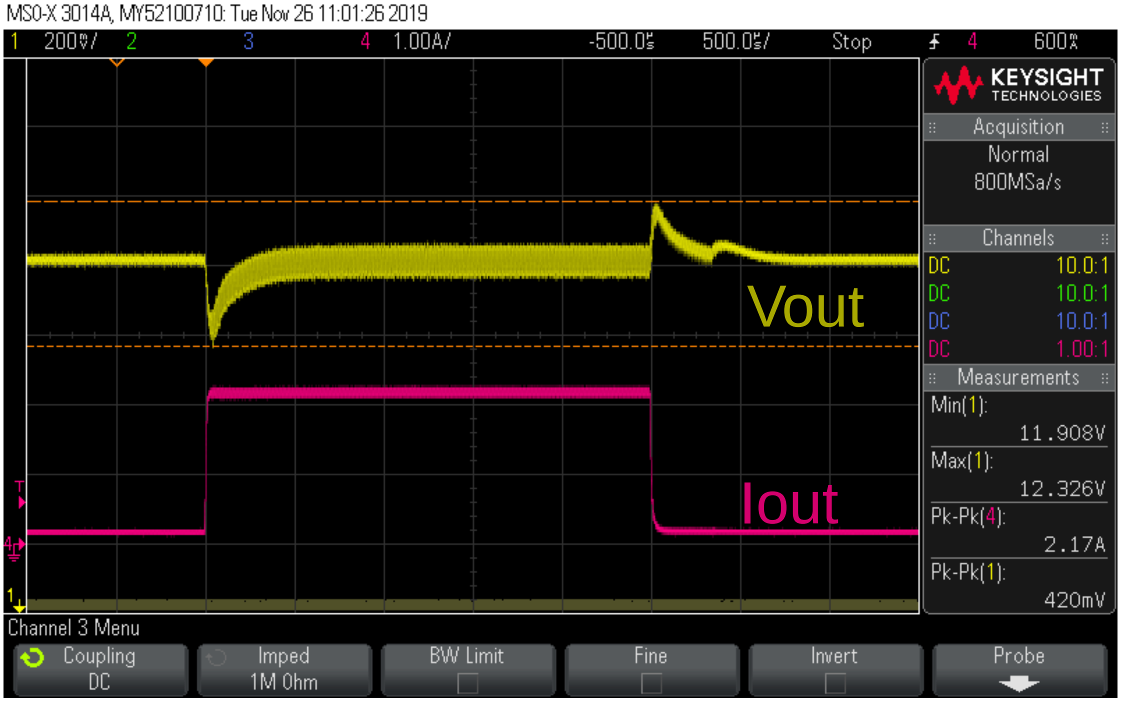



**Figure 6.1. Si34061-EVB-EXT-12V Output Load Step Transient Test**

**Table 6.1. Output Load Step Transient**

| | From (Output Current) | To (Output Current) | $V_{OUT}$ Change |
|---|---|---|---|
| Load step | 0.2 A | 2.2 A | 12 V – 210 mV |
| Load step | 2.2 A | 0.2 A | 12 V + 210 mV |

## 7. Output Voltage Ripple

The Si34061-EVB-EXT-12V board`s output voltage ripple has been measured at no-load and full-load conditions. The following figures show the respective results.

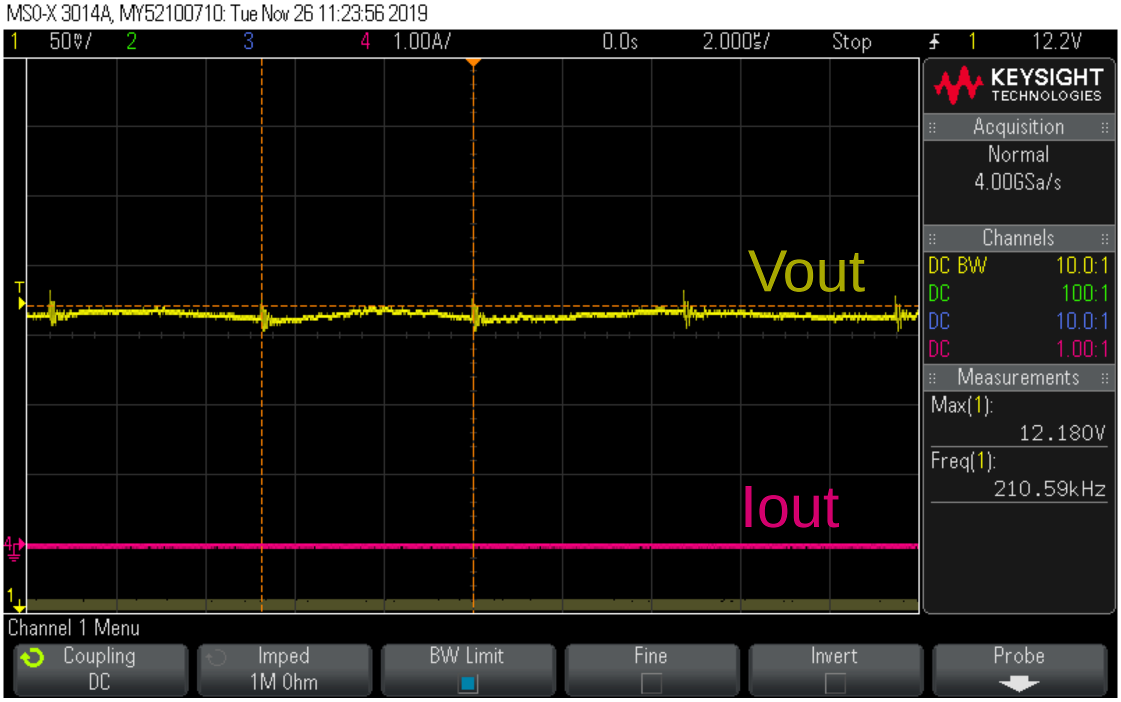



**Figure 7.1. Si34061-EVB-EXT-12V Output Voltage Ripple at No-Load Condition: 25 mV**

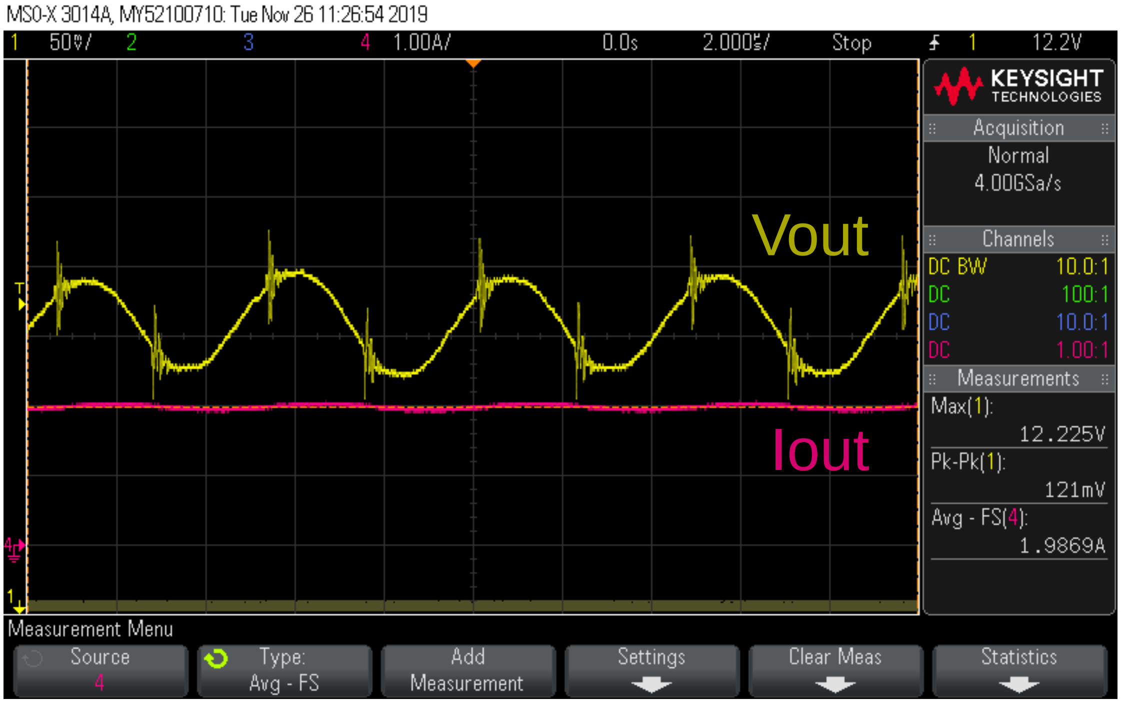



**Figure 7.2. Si34061-EVB-EXT-12V Output Voltage Ripple at 2 A Output: 121 mV**

## 8. Soft Start Protection

The Si34061 has an integrated dynamic soft-start protection mechanism to avoid stressing the components with the sudden current or voltage changes associated with initial charging of the output capacitors.

The Si34061 intelligent adaptive soft-start mechanism does not require any external components to install. The controller continuously measures the input current of the PD and dynamically adjusts the internal $I_{PEAK}$ limit during soft-start, adjusting the output voltage ramp-up time as a function of the attached load.

The controller allows the output voltage to rise faster in a no-load (or light load) condition. With a heavy load at the output, the controller slows down the output voltage ramp to avoid exceeding the desired regulated output voltage value.

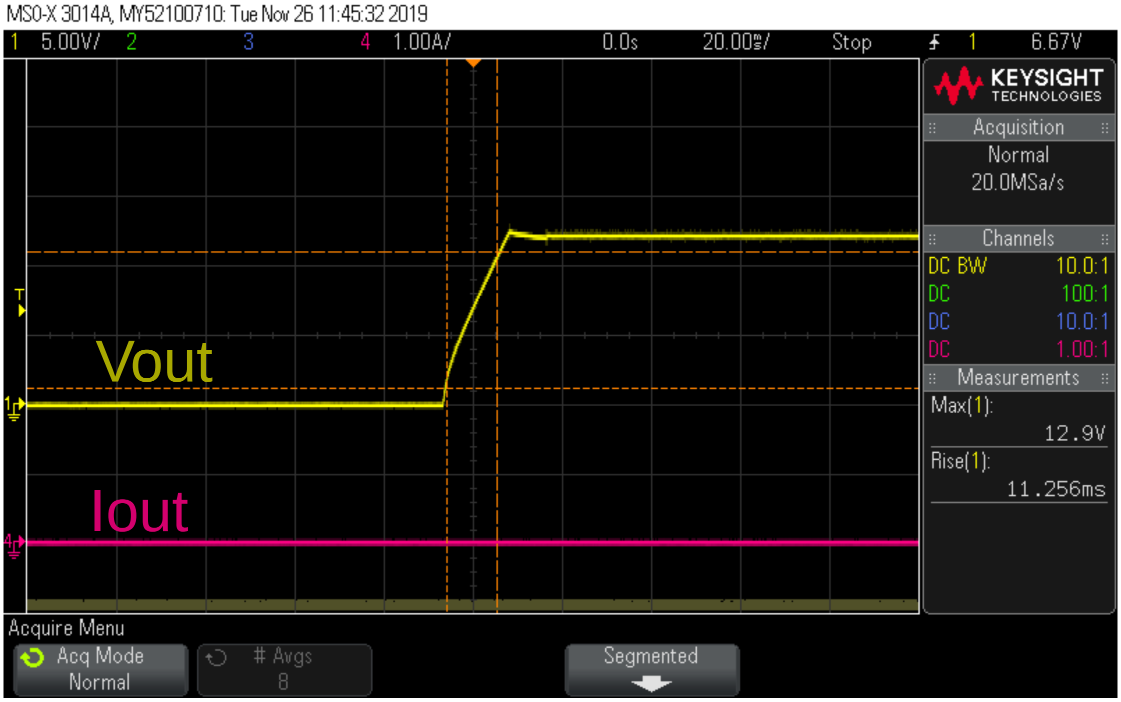



**Figure 8.1. Si34061-EVB-EXT-12V Soft-Start with No Load**

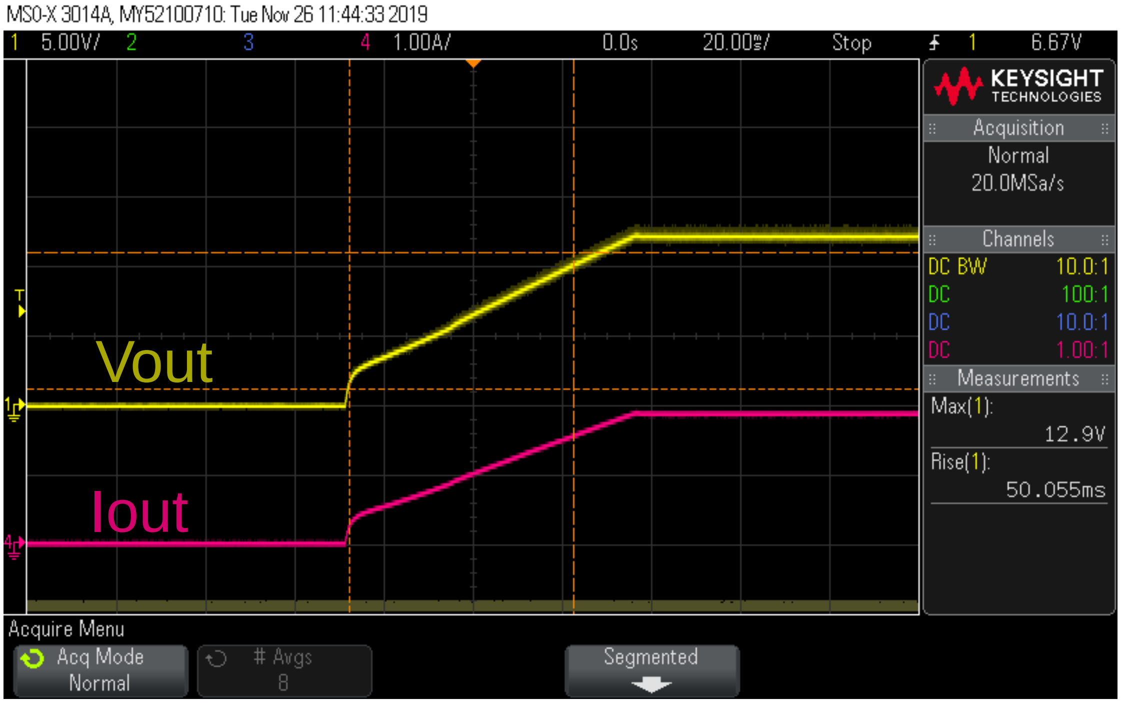



**Figure 8.2. Si34061-EVB-EXT-12V Soft-Start with Heavy Load**

## 9. Output Short Protection

The Si34061 PD device has an integrated output short-protection mechanism that protects the IC itself and the surrounding external components from overheating in case of an electrical short on the output. This case is depicted in the figure below by showing the PD's input current and the PD's output voltage when the short is present.

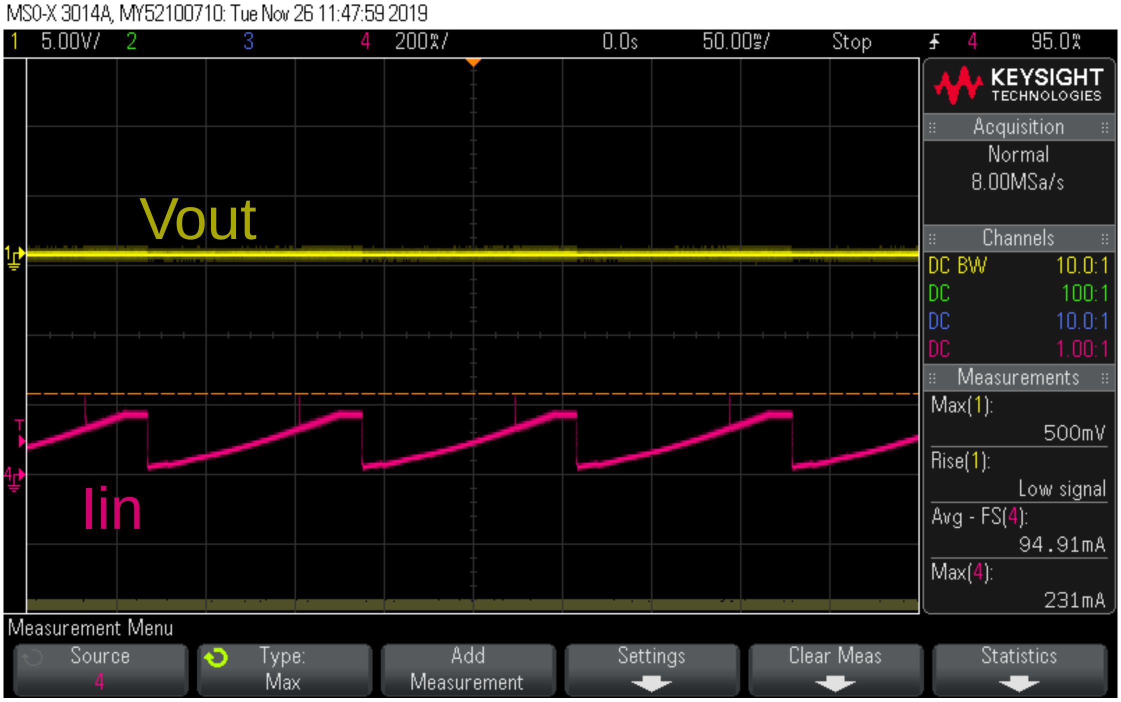



**Figure 9.1. Si34061-EVB-EXT-12V Output Short Protection Mechanism**

## 10. Pulse Skipping at No-Load Condition

As the output load decreases, the controller starts to reduce the pulse width of the PWM signal (switcher ON time). At some point, even the minimum width pulse will provide higher energy than the application requires, which could result in loss of voltage regulation.

When the controller detects a light load condition (which requires less ON time than the minimum pulse width), the controller enters into burst or light-load skipping mode. This mode is shown in the figure below, which depicts the switching node of the primary FET (U3) at a no-load condition.

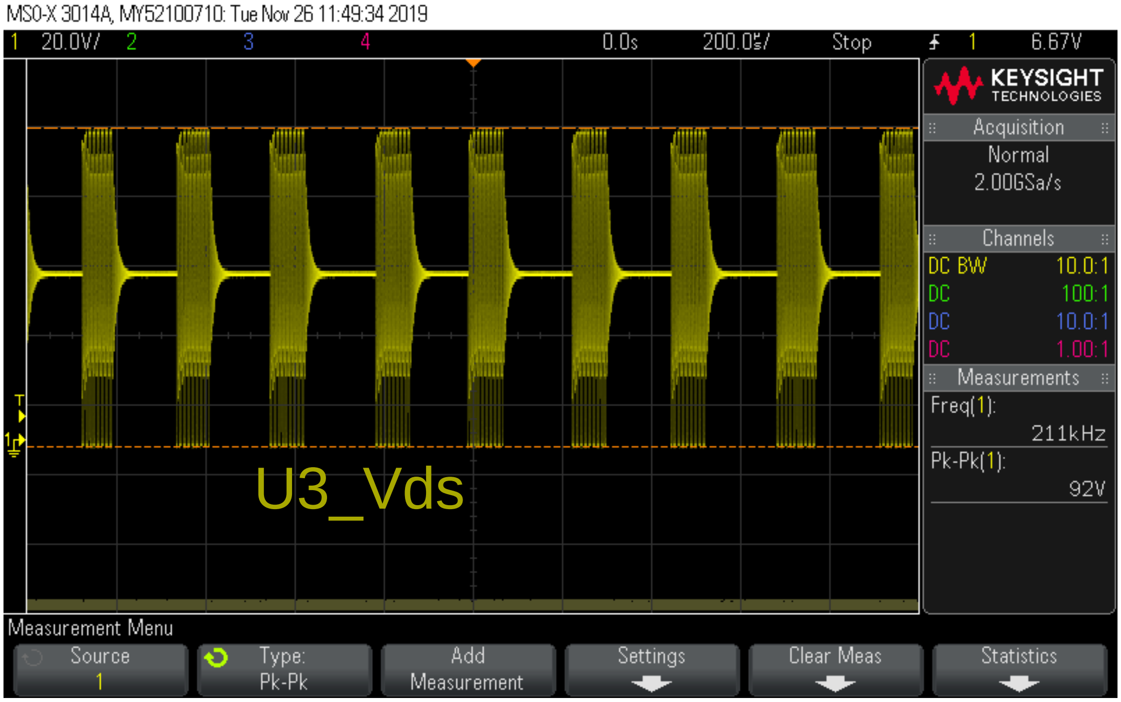



**Figure 10.1. Pulse Skipping at No-load Condition**

# 11. Adjustable EVB Current Limit

For additional safety, the Si34061 has an adjustable EVB current limit feature.

The Si34061 controller measures the voltage on the $R_{SENSE}$ (R33) through the ISNS pin. Attention must be paid when this voltage goes below VSS. When $V_{RSENSE}$ reaches –270 mV (referenced to VSS), the current limiter restarts the circuit to protect the application.

The $R_{SENSE}$ value also defines the power level at which the external-HSSW (Q1) and synchronous-FET (U1) are enabled.

When the $V_{RSENSE}$ value is < –30 mV (referenced to VSS), the controller is in low-power mode:

- Q1 - EXT-HSSW is disabled
- U1 – Synchronous FET is disabled

When the $V_{RSENSE}$ value is > –30 mV (referenced to VSS), the controller enters high-power mode:

- Q1 - EXT-HSSW is enabled
- U1 – Synchronous FET is enabled

When $V_{RSENSE}$ reaches –30 mV (referenced to VSS), the current EXTHSSW pin goes up, and the SYNCL pin starts to drive the synchronous FET.

The EVB current limit for Class 4 applications can be calculated with the following formula:

$$R_{SENSE} = 0.3\Omega$$

$$I_{LIMIT} = \frac{270mV}{R_{SENSE}} = \frac{270mV}{0.3\Omega} = 0.9A$$

**Equation 1.**

With the selected $R_{SENSE}$ value, the external HSSW (Q1) and synchronous-FET (U1) are enabled at the input current calculated below:

$$I_{power\text{-}mode} = \frac{30mV}{R_{SENSE}} = \frac{30mV}{0.3\Omega} = 0.1A$$

**Equation 2.**

Below the calculated value from Equation 2, the internal HSSW conducts, and rectification is accomplished through the D13 diode.

Above the value of Equation 2, the external HSSW conducts and synchronous rectification is accomplished by the U1 FET.

## 12. Tunable Switching Frequency

The switching frequency of the oscillator is selected by choosing an external resistor, R14, connected between the RFREQ and VPOS pins. The following figure will aid in selecting the RFREQ value to achieve the desired switching frequency.

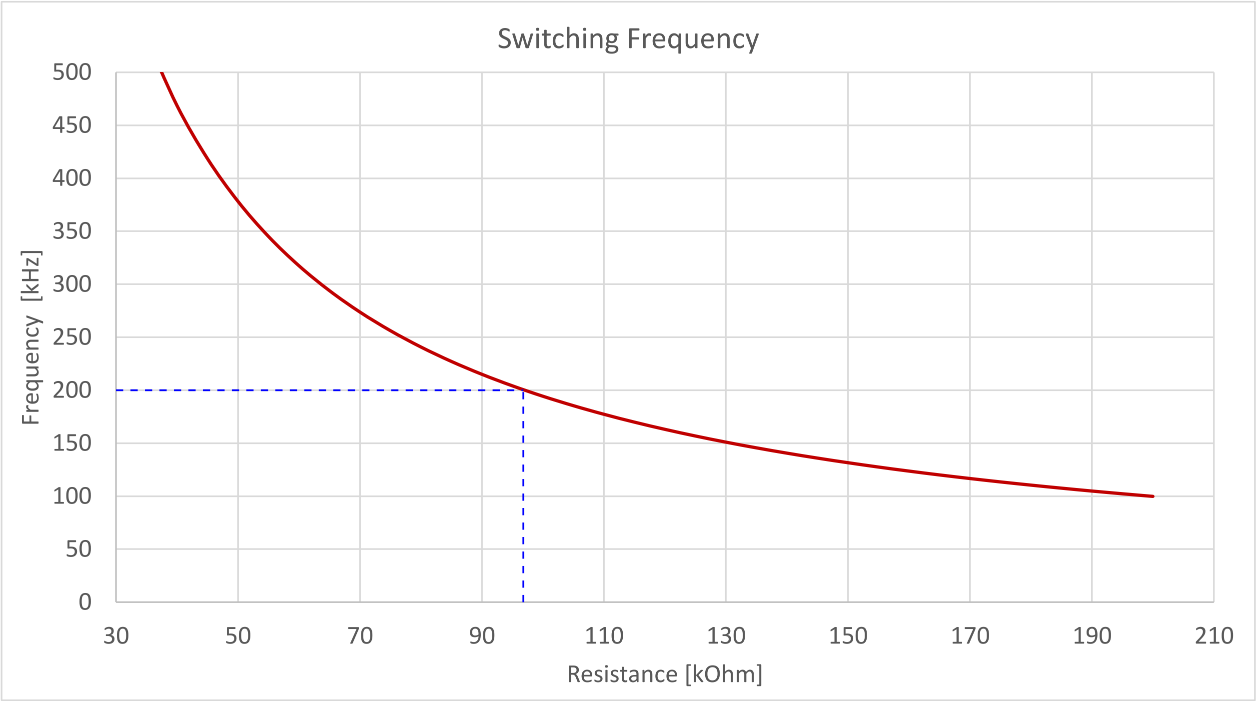



**Figure 12.1. Switching Frequency vs. $R_{FREQ}$ Value**

The selected switching frequency for Si34061-EVB-EXT-12V is 200 kHz, which is achieved by setting the R33 resistor to 95.3 kΩ.

## 13. Synchronous Rectification

The Si34061 device has a synchronous gate driver (SYNCL) to drive the synchronous-MOSFET.

At low-load (below Equation 1 value), the SYNCL driver is disabled, and the converter can work in discontinuous current mode (DCM). In this mode, the drain-source voltage waveform of U3 has a ringing waveform, which is typical for a DCM operation. The drain-source voltage waveform is depicted in the following figure:

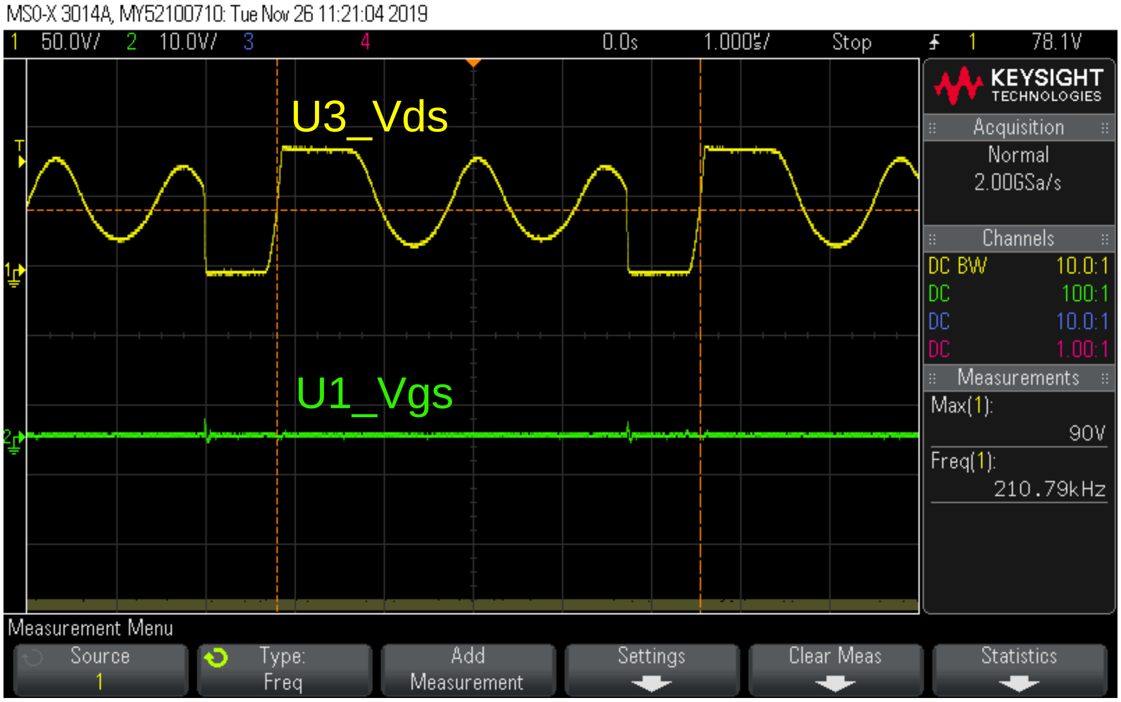



**Figure 13.1. Discontinuous Current Mode at Low-Load Condition**

At heavy load, the synchronous rectification driver is enabled, and the converter runs in continuous current mode (CCM) as shown in the following figure:

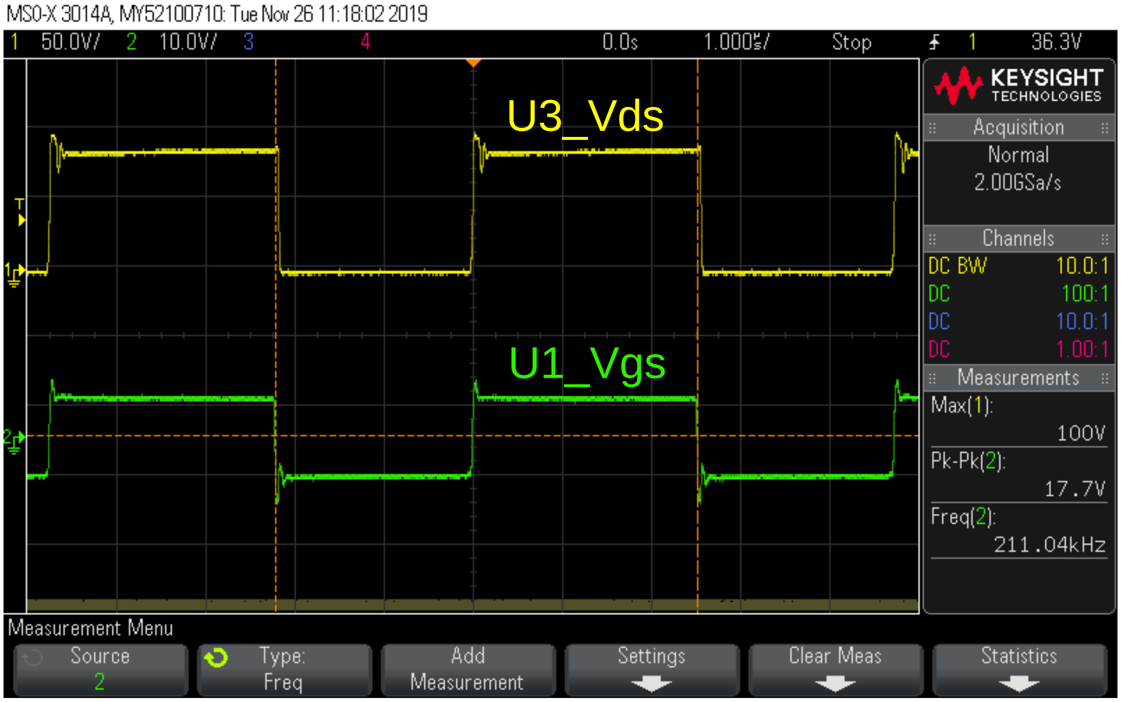



**Figure 13.2. Continuous Current Mode at High-Load Condition**

## 14. Maintain Power Signature

The Si34061 device integrates an MPS circuit that ensures connection with the PSE if the PD application current drops below the PSE maintain-power-signature threshold level. When nSLEEP is low at startup, MPS generation depends on the total average current consumption. The controller detects the low consumption and, in order to keep the connection with the PSE, starts to generate the MPS pulses. This case is depicted in the following figure:

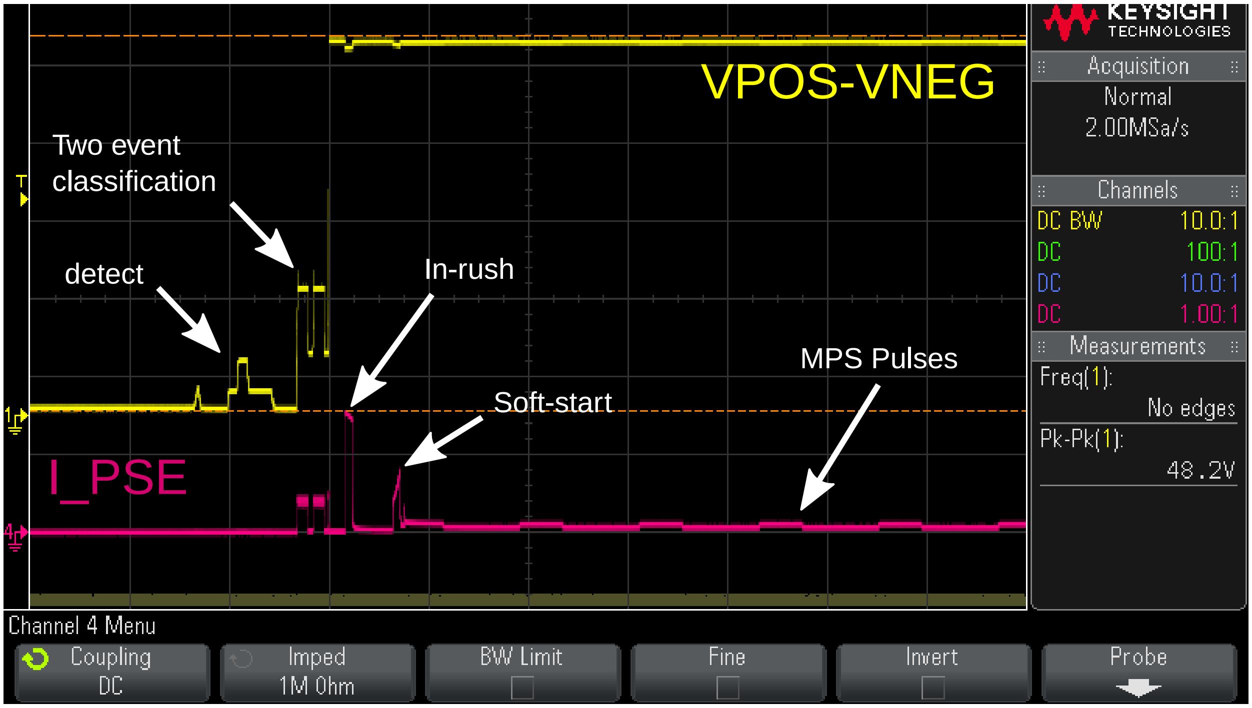



**Figure 14.1. MPS Enabled: Connection is Kept with PSE**

When nSLEEP is high at startup, MPS generation is disabled. Due to the low port current, the PSE will disconnect the port. In this mode (when nSLEEP is low at startup), MPS generation can be controlled (enabled/disabled) by the user by toggling nSLEEP between low and high.

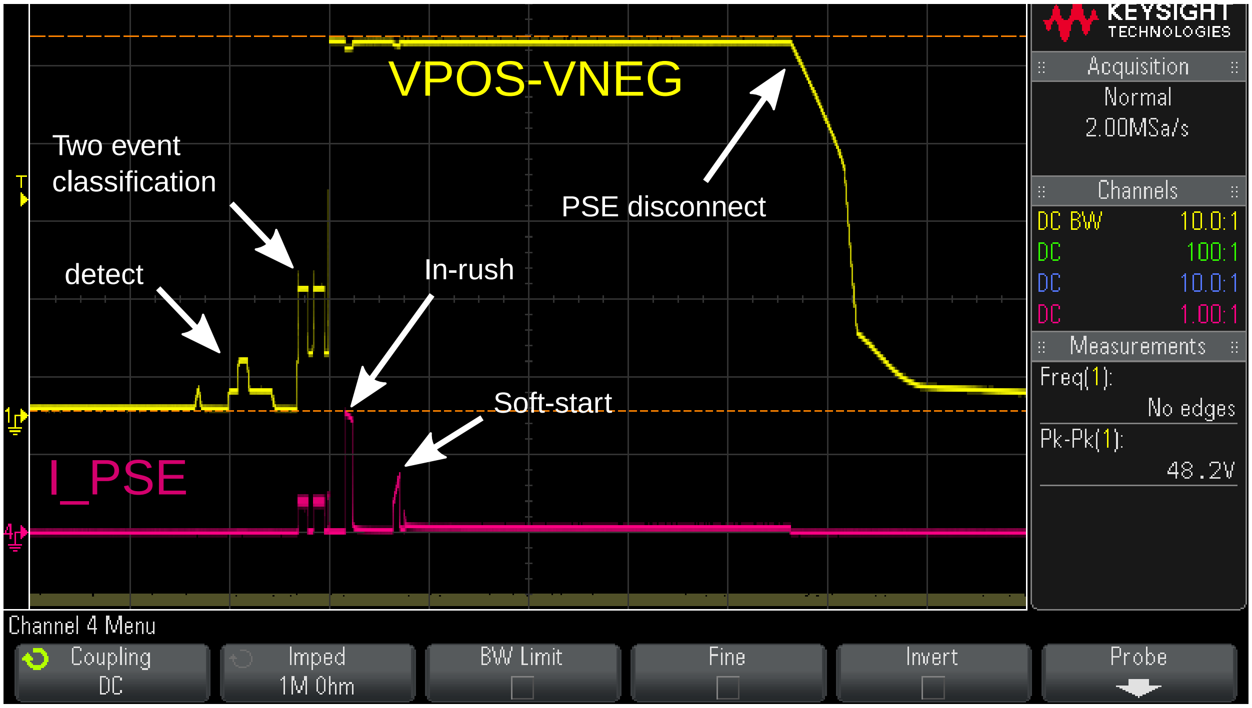



**Figure 14.2. MPS Disabled: PSE Disconnects the Port**

## 15. Wall Adapter Support with Priority over PSE

The Si34061-EVB-EXT-12V board can be driven from a wall adapter instead of a PSE. The wall adapter has higher priority than the PSE.

The figure below shows a regular Type-2 startup sequence with the PSE; then, a wall adapter is plugged in. Through the ASUP digital input pin, the Si34061 automatically detects the presence of the wall adapter and starts drawing power from it.

During the transition from the PSE to the wall adapter, there is no interrupt on the output voltage (application).

In wall adapter mode, the Si34061 shows a non-valid detection signature toward the PSE. Therefore, until the wall adapter voltage is present, the PSE is unable to detect and turn ON the PD.

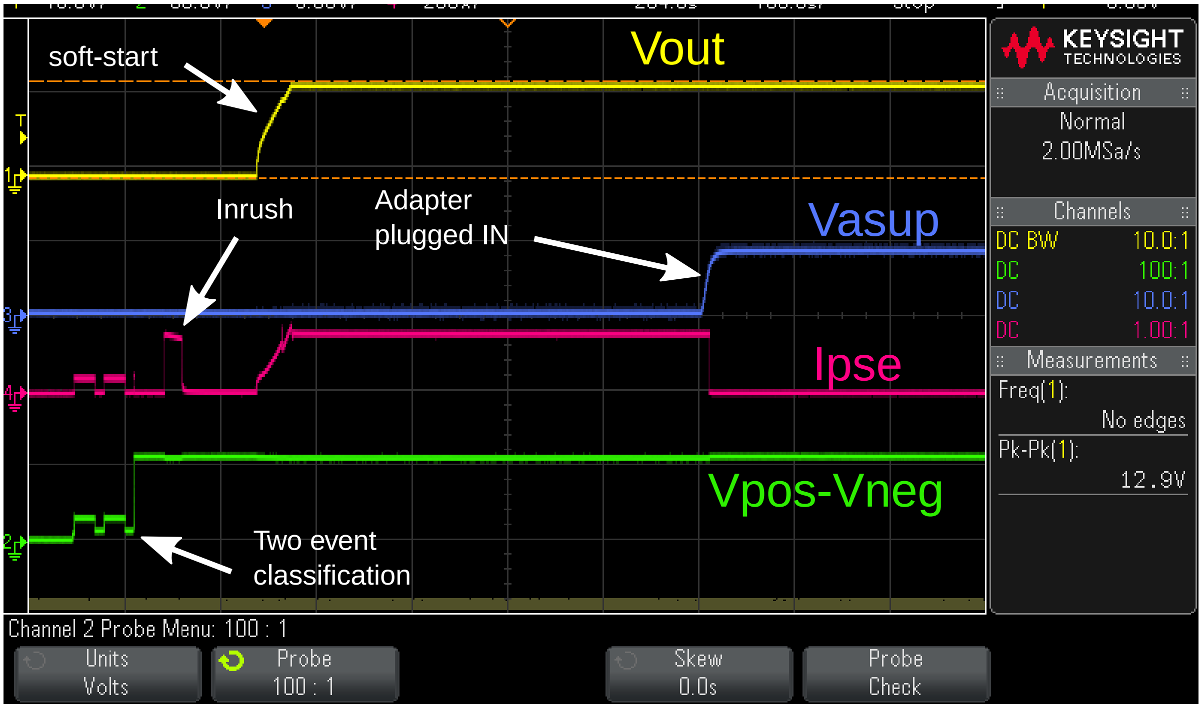



**Figure 15.1. Wall Adapter Sequence Using ASUP Pin**

# 16. Radiated Emissions Measurement Results—EN55032 Class B

Radiated emissions of the Si34061-EVB-EXT-12V board have been measured with 50 V input voltage and a full load connected to the output (30 W).

As shown in the following figure, the Si34061-EVB-EXT-12V board is fully compliant with international EN 55032 Class B emissions standards:

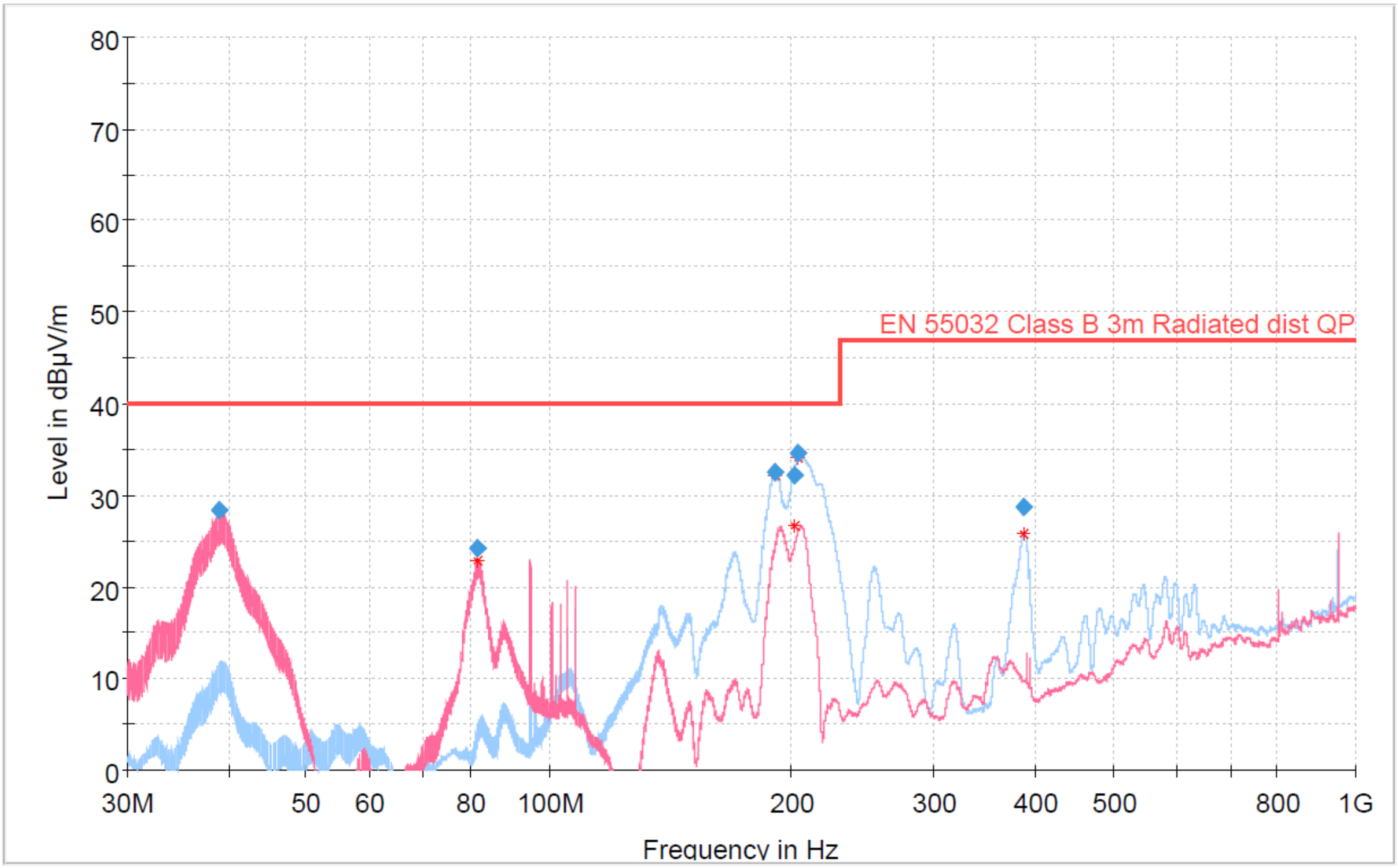



**Figure 16.1. Si34061-EVB-EXT-12V Radiated Emissions Measurement Results with 50 V Input and 30 W Output Load**

## 16.1 Radiated EMI Measurement Process

The EVB is measured at full load with peak detection in both vertical and horizontal polarizations. This is a relatively fast process that produces a red curve (vertical polarization) and a blue curve (horizontal polarization).

Next, specific frequencies are selected (red stars) for quasi-peak measurements. The board is measured again at those specific frequencies with a quasi-peak detector, which is a very slow but accurate measurement. The results of this quasi-peak detector measurement are the blue rhombuses.

The blue rhombuses represent the final result of the measurement process. To have passing results, the blue rhombuses should be below the highlighted EN 55032 Class B limit.

# 17. Conducted Emissions Measurement Results—EN55032

The Si34061-EVB-EXT-12V board's conducted emissions have been measured with both peak and average detectors. The following figure shows the conducted EMI measurement setup.

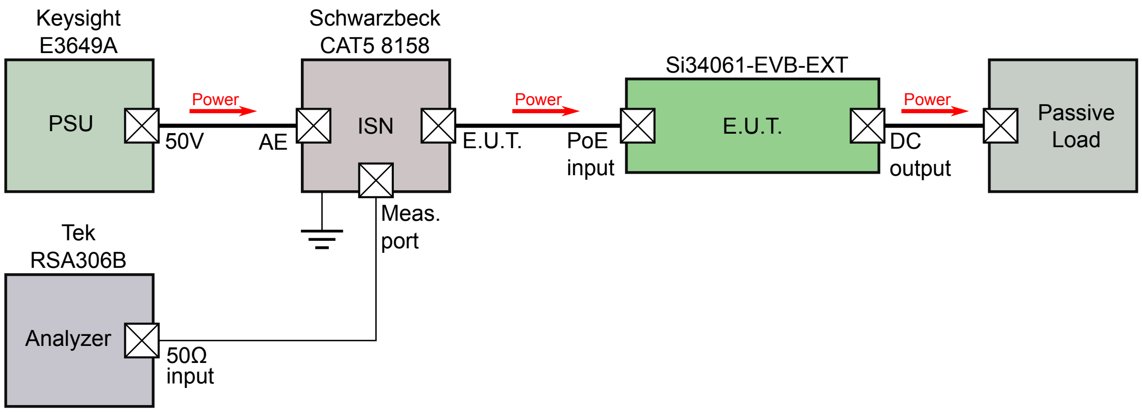



**Figure 17.1. Conducted EMI Measurement Setup**

The following figures show the measured results.

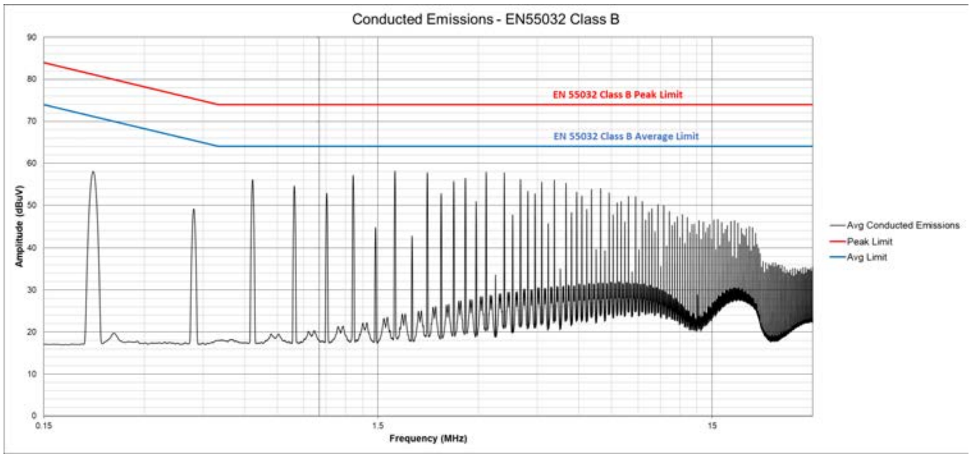



**Figure 17.2. Si34061-EVB-EXT-12V Conducted Emissions Measurement Results with 50 V Input and 30 W Output Load**

## 18. Thermal Measurements

The Si34061-EVB-EXT-12V board's top and bottom side thermal images at full load are shown in the following figures.

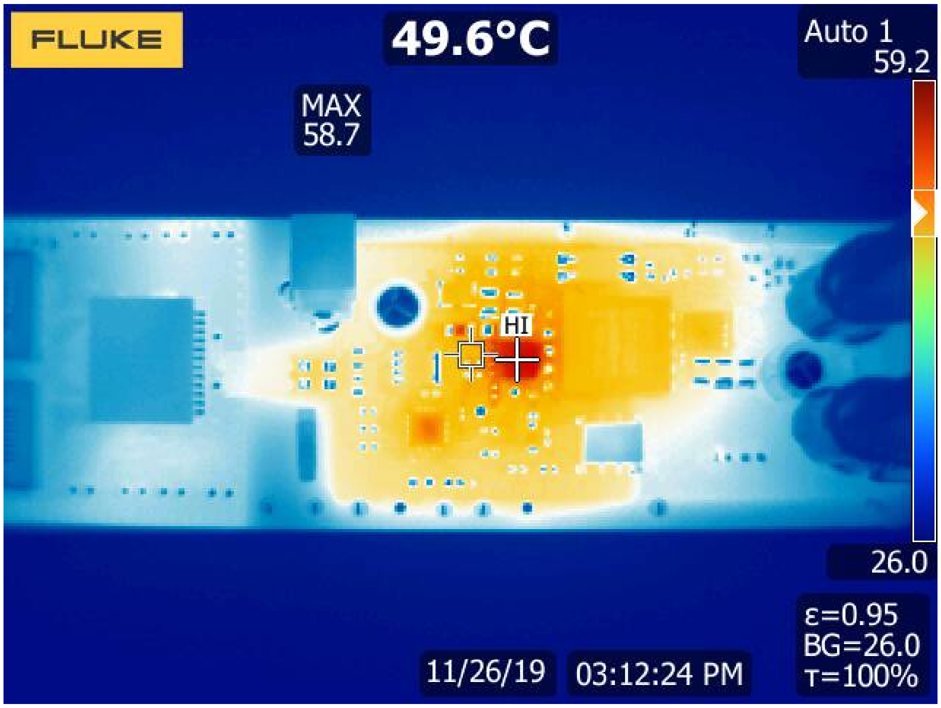



**Figure 18.1. Si34061-EVB-EXT-12V Thermal Image at Full Load—Top Side**

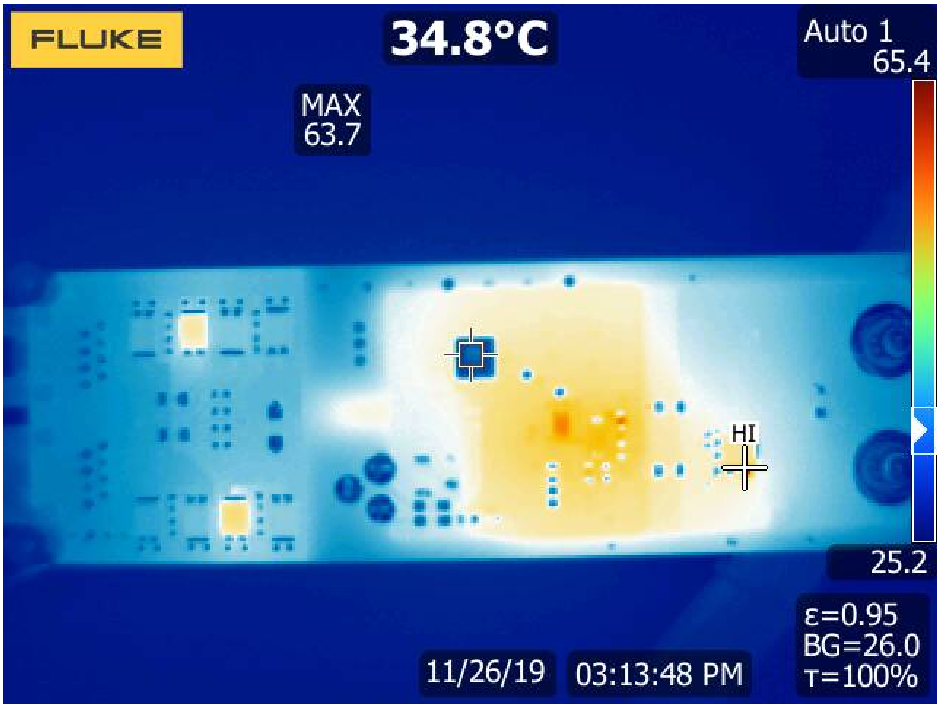



**Figure 18.2. Si34061-EVB-EXT-12V Thermal Image at Full Load—Bottom Side**

**Note:** Ambient temperature was 26 °C.

## 19. Layout

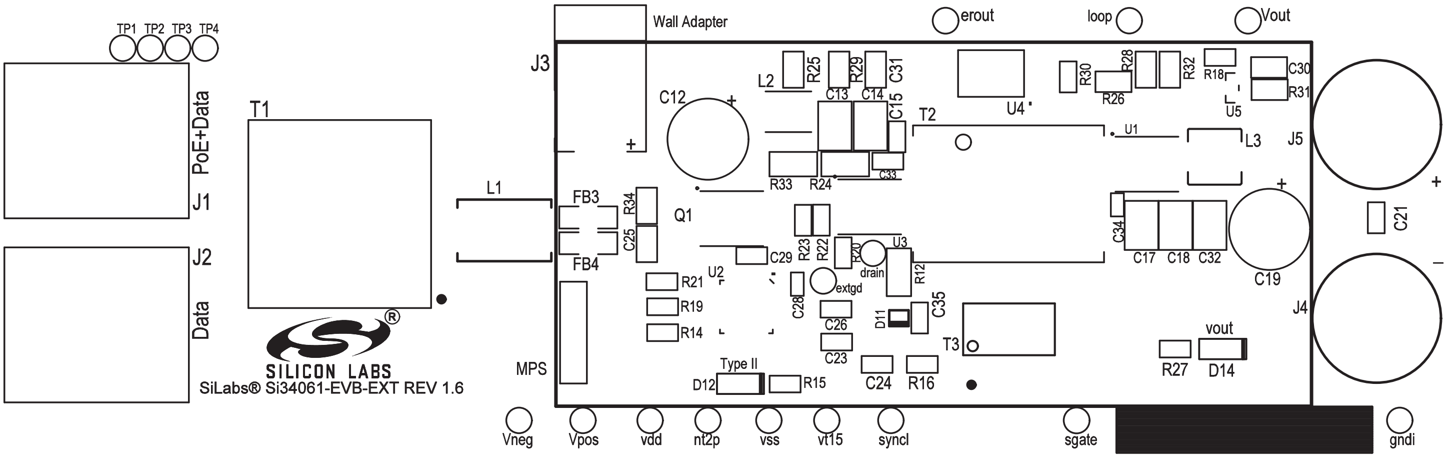



**Figure 19.1. Primary Silkscreen**

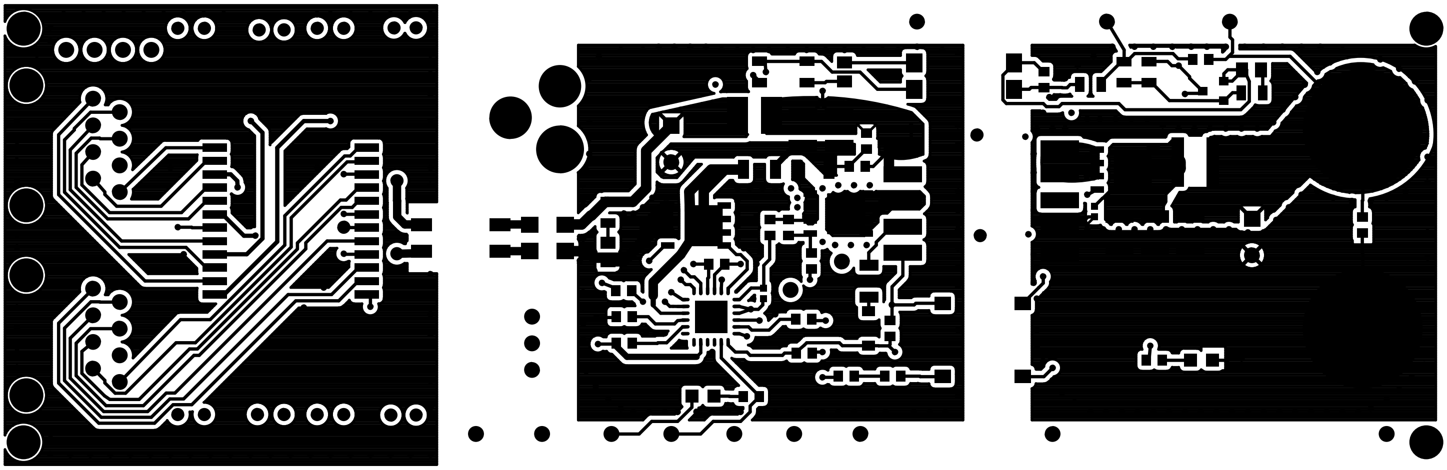


**Figure 19.2. Top Layer**

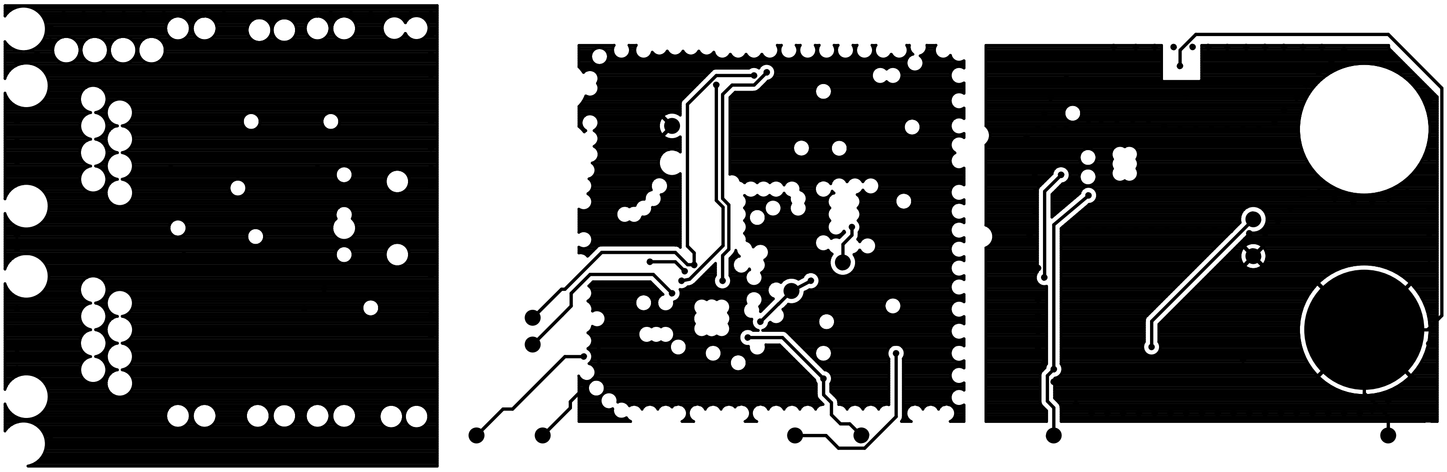


**Figure 19.3. Internal 1 Layer**

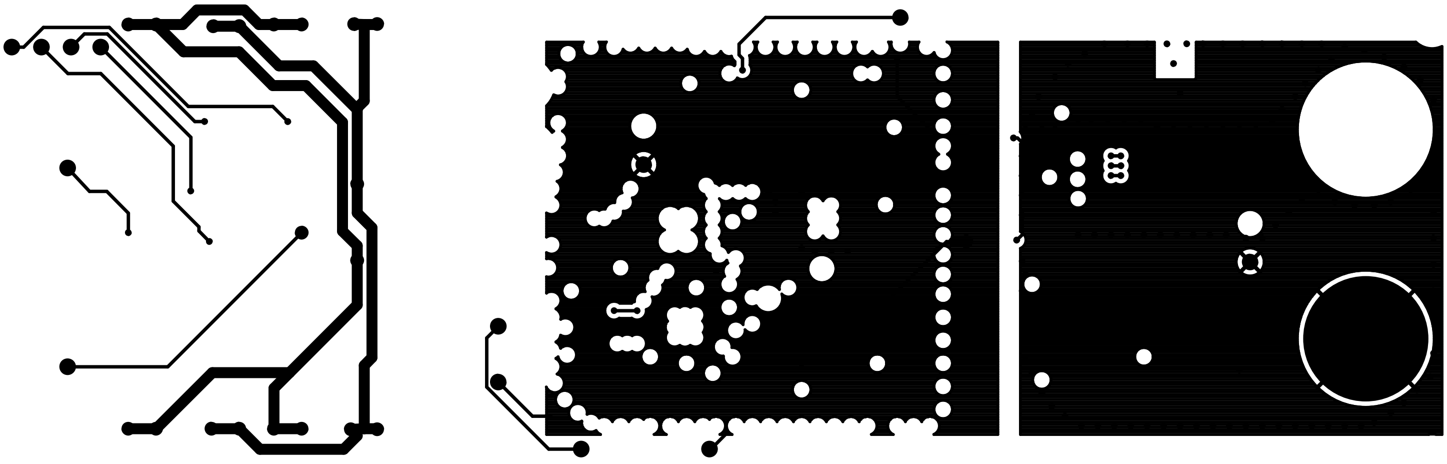


**Figure 19.4. Internal 2 Layer**

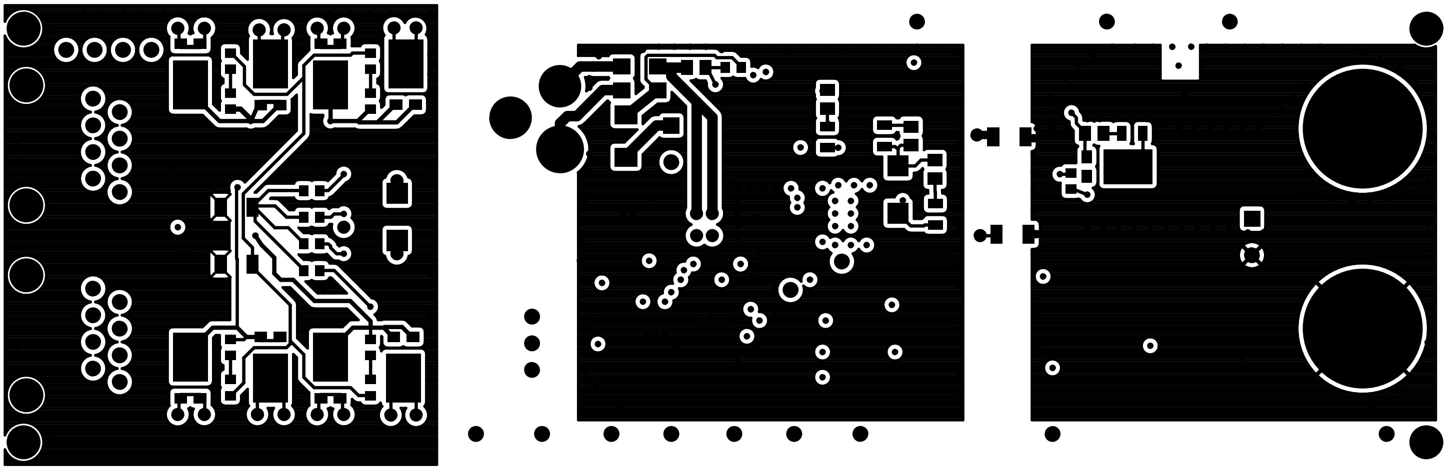


**Figure 19.5. Bottom Layer**

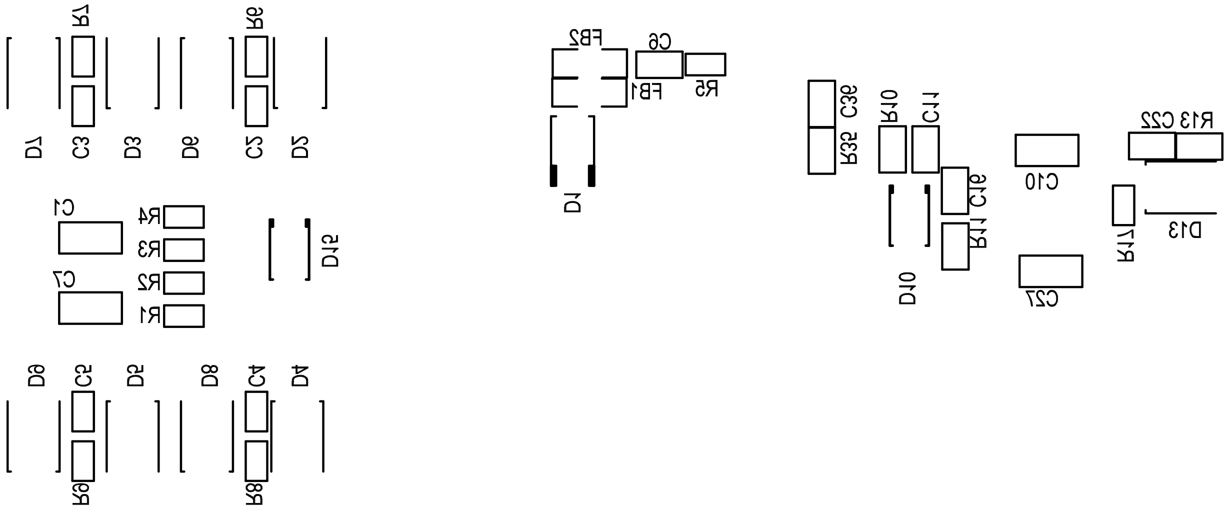



**Figure 19.6. Bottom Silkscreen**

## 20. Bill of Materials

| Reference Designator | Quantity | Description | Manufacturer | Manufacturer PN |
|---|---|---|---|---|
| C1, C7, C10, C27 | 4 | CAP, 1 nF, 2000 V, ±5%, X7R, 1206 | Kemet | C1206C102JGRACTU |
| C2, C3, C4, C5, C33 | 5 | CAP, 0.01 µF, 100 V, ±10%, X7R, 0603 | Venkel | C0603X7R101-103K |
| C6, C11 | 2 | CAP, 0.01 µF, 100 V, ±10%, X7R, 0805 | Venkel | C0805X7R101-103K |
| C12 | 1 | CAP, 47 µF, 100 V, ±20%, AL, RAD | Panasonic | ECA2AM470 |
| C13, C14 | 2 | CAP, 1 µF, 100 V, ±10%, X7R, 1210 | Venkel | C1210X7R101-105K |
| C15 | 1 | CAP, 0.1 µF, 100 V, ±10%, X7R, 0603 | Venkel | C0603X7R101-104K |
| C16 | 1 | CAP, 100 pF, 200 V, ±5%, NP0 HIGH Q, 0805 | Venkel | C0805HQN201-101J |
| C17, C18, C32 | 3 | CAP, 22 µF, 16 V, ±20%, X5R, 1206 | KEMET | C1206C226M4PAC7800 |
| C19 | 1 | CAP, 330 µF, 16 V, ±20%, AL, 8X11.5MM, PTH | Panasonic | ECA-1CM331 |
| C21 | 1 | CAP, 22 nF, 16 V, ±20%, X7R, 0603 | Venkel | C0603X7R160-223M |
| C22 | 1 | CAP, 1.5 nF, 100 V, ±10%, X7R, 0805 | Venkel | C0805X7R101-152K |
| C23 | 1 | CAP, 1 µF, 25 V, ±10%, X5R, 0603 | Venkel | C0603X5R250-105K |
| C24, C26 | 2 | CAP, 220 nF, 16 V, ±5%, X7R, 0603 | Kemet | C0603C224J4RACTU |
| C25 | 1 | CAP, 0.1 µF, 100 V, ±10%, X7R, 0805 | Venkel | C0805X7R101-104K |
| C29 | 1 | CAP, 0.1 µF, 10 V, ±10%, X7R, 0603 | Venkel | C0603X7R100-104K |
| C30 | 1 | CAP, 4.7 nF, 25 V, ±2%, C0G, 0805 | Venkel | C0805C0G250-472G |
| C31 | 1 | CAP, 2.2nF, 16V, ±2%, C0G, 0805 | Venkel | C0805C0G160-222G |
| C34 | 1 | CAP, 1.0 µF, 16 V, ±10%, X5R, 0402 | Venkel | C0402X5R160-105KN |
| C35 | 1 | CAP, 0.01 µF, 25 V, ±10%, X8R, 0603 | KEMET | C0603C103K3HACAUTO |
| D1 | 1 | DIO, SINGLE, 100 V, 1.0 A, SMA | Fairchild | S1B |
| D2, D3, D4, D5, D6, D7, D8, D9, 13 | 9 | DIO, SCHOTTKY, 100 V, 5 A, PowerDI-5 | Diodes Inc. | PDS5100H-13 |
| D10 | 1 | DIO, SINGLE, 100 V, 1.0 A, SMA | Fairchild | RS1B |
| D11 | 1 | DIO, fAST, 100 V, 2 A, SOD123 | Diodes Inc | 1N4148W |
| D12, D14 | 2 | LED, GREEN, 0805 | LITE_ON INC | LTST-C170GKT |
| FB1, FB2, FB3, FB4 | 4 | FERRITE BEAD, 600 Ω @100 MHz, 1206 | MuRata | BLM31PG601SN1 |
| J1, J2 | 2 | CONN, RJ-45, 1 Port, Tab Down, 0.050" Pitch, PTH | MOLEX | 95001-2881 |
| J3 | 1 | CONN, POWER JACK, RA, 2.1 mm, PTH | Adam Tech | ADC-002-1 |
| J4, J5 | 2 | CONN, BANANA JACK, Threaded unin-sulated | ABBATRON HH SMITH | 101 |
| LB1 | 1 | LABEL, PDB, POLYIMIDE, WHITE, 1.00 in. X 0.187 in., FONT 2 | Silabs | LABEL-Si34061-EVB-EXT-BOM-R1.7-12V |
| L1 | 1 | CM Choke, 500 µH, 1 A, 1 kΩ, SMT | Bourns | SRF0905-501Y |

| Reference Designator | Quantity | Description | Manufacturer | Manufacturer PN |
|---|---|---|---|---|
| L2 | 1 | INDUCTOR, POWER, 3.3 µH, ±20%, 1.5 A, Unshielded | Murata | 84332C |
| L3 | 1 | INDUCTOR, POWER, Shielded, 0.16 µH, 31 A, SMD | Coilcraft | XAL5030-161ME |
| MH1, MH2, MH3, MH4 | 4 | HDW, SCREW, 4-40 x 1/4 in. Pan Head, Slotted, Nylon | Richco Plastic Co | NSS-4-4-01 |
| PCB1 | 1 | PCB, BARE BOARD, Si34061-EVB-EXT REV 1.6 | SiLabs | Si34061-EVB-EXT REV 1.6 |
| Q1 | 1 | TRANSISTOR, MOSFET, N-CHNL, 100 V, 23 A, POWERPAK-SO-8 | Vishay | SQJ476EP-T1_GE3 |
| R1, R2, R3, R4, R6, R7, R8, R9 | 8 | RES, 75 Ω, 1/16 W, ±0.5%, ThinFilm, 0603 | Susumu | RR0816Q-750-D |
| R5 | 1 | RES, 845 kΩ, 1/10 W, ±1%, ThickFilm, 0603 | Panasonic | ERJ-3EKF8453V |
| R10 | 1 | RES, 78.7 kΩ, 1/8 W, ±1%, ThickFilm, 0805 | Yageo | RC0805FR-0778K7L |
| R11 | 1 | RES, 100 Ω, 1/10 W, ±1%, ThickFilm, 0805 | Venkel | CR0805-10W-1000F |
| R12 | 1 | RES, 10 Ω, 1/4 W, ±1%, ThickFilm, 1206 | Venkel | CR1206-4W-10R0F |
| R13 | 1 | RES, 10 Ω, 1/10 W, ±1%, ThickFilm, 0805 | Venkel | CR0805-10W-10R0F |
| R14 | 1 | RES, 95.3 kΩ, 1/16 W, ±1%, ThickFilm, 0603 | Venkel | CR0603-16W-9532F |
| R15 | 1 | RES, 1 kΩ, 1/10 W, ±1%, ThickFilm, 0603 | Venkel | CR0603-10W-1001F |
| R16, R18 | 2 | RES, 10.0 Ω, 1/16 W, ±1%, ThickFilm, 0603 | Venkel | CR0603-16W-10R0F |
| R17, R22 | 2 | RES, 24 kΩ, 1/10 W, ±1%, ThickFilm, 0603 | Panasonic | ERJ-3EKF2402V |
| R19 | 1 | RES, 33.2 Ω, 1/16 W, ±1%, ThickFilm, 0603 | Venkel | CR0603-16W-33R2F |
| R20 | 1 | RES, 23.7 Ω, 1/16 W, ±1%, ThickFilm, 0603 | Venkel | CR0603-16W-23R7F |
| R21 | 1 | RES, 24.9K, 1/10W, ±1%, ThickFilm, 0603 | Venkel | CR0603-10W-2492F |
| R23 | 1 | RES, 0 Ω, 1 A, ThickFilm, 0603 | Panasonic | ERJ-3GEY0R00V |
| R24 | 1 | RES, 0.1 Ω, 1 W, ±1%, ThickFilm, 1206 | Panasonic | ERJ-8BWFR100V |
| R25 | 1 | RES, 3.24 kΩ, 1/8 W, ±1%, ThickFilm, 0805 | Vishay | CRCW08053K24FKEA |
| R26 | 1 | RES, 1 kΩ, 1/8 W, ±1%, ThickFilm, 0805 | Venkel | CR0805-8W-1001F |
| R27 | 1 | RES, 4.7 kΩ, 1/10 W, ±5%, ThickFilm, 0603 | Venkel | CR0603-10W-472J |
| R28 | 1 | RES, 36.5 kΩ, 1/10 W, ±1%, ThickFilm, 0805 | Venkel | CR0805-10W-3652F |
| R29, R31 | 2 | RES, 0 Ω, 2 A, ThickFilm, 0805 | Venkel | CR0805-10W-000 |

| Reference Designator | Quantity | Description | Manufacturer | Manufacturer PN |
|---|---|---|---|---|
| R32 | 1 | RES, 4.12K, 1/10 W, ±1%, ThickFilm, 0805 | Venkel | CR0805-10W-4121F |
| R33 | 1 | RES, 0.3 Ω, 1/2 W, ±1%, ThickFilm, 1206 | Venkel | LCR1206-R300F |
| R34 | 1 | RES, 3 Ω, 1/8 W, ±1%, ThickFilm, 0805 | Venkel | CR0805-8W-3R00FT |
| SO1, SO2, SO3, SO4 | 4 | HDW, STANDOFF, 4-40 x 1/2" , Nylon | SPC Technology | 2397 |
| SW1 | 1 | SWITCH, SPDT, SLIDE, ON-ON, 0.1 PITCH, 12V, PTH | Apem Inc. | NK236H |
| TP1, TP2, TP3, TP4 | 4 | TESTPOINT, BLACK, PTH | Kobiconn | 151-203-RC |
| TP5, TP6 | 2 | TESTPOINT, RED, 0.050 in. LOOP, PTH | Keystone | 5000 |
| TP8, TP9, TP10, TP11, TP12, TP14, TP15, TP16, TP17, TP18, TP19 | 11 | TESTPOINT, BLACK, 0.050" LOOP, PTH | Keystone | 5001 |
| T1 | 1 | Module, PoE+/PoE++ Magnetics, PULSE XFMR 1CT:1CT TX 1CT:1CT RX, SMD | Wurth | 7490220121 |
| T2 | 1 | TRANSFORMER, Flyback, 30 W, 12 V, SMD | LinkCom | LDT1026-50R |
| T3 | 1 | Gate XFMR, 1:1, 1500 Vrms, 1200 µH, 27.2 Vµsec | Pulse Engineering | PA0184NL |
| U1 | 1 | TRANSISTOR, MOSFET, N-CHNL, 60 V, 21 A, POWERPAK-SO-8 | ON Semi | NVMFS5C680NLT1G |
| U2 | 1 | IC, IEEE 802.3-Compliant POE+ PD Interface, QFN24 | SiLabs | Si34061 |
| U3 | 1 | TRANSISTOR, MOSFET, N-CHNL, 150 V, 29 A, POWERPAK-SO-8 | Vishay | SIR632DP-T1-RE3 |
| U4 | 1 | PHOTOCOUPLER, 5300 Vrms Isolation, 4-PIN SMD | Vishay | VO618A-3X017T |
| U5 | 1 | IC, ADJ PREC SHUNT REG LV SOT-23 Voltage-Output 1.24 ~ 16 V | ON Semi | TLV431ASN1T1G |
| **Not Installed Components** | | | | |
| C28 | 1 | CAP, 470 pF, 25 V, ±20%, X7R, 0402 | Venkel | C0402X7R250-471M |
| C36 | 1 | CAP, 0.01 µF, 100 V, ±10%, X7R, 0805 | Venkel | C0805X7R101-103K |
| D15 | 1 | DIO, TVS, UNIDIR, 58 V, 400 W | Littelfuse | SMAJ58A |
| R30 | 1 | RES, 1 kΩ, 1/10 W, ±1%, ThickFilm, 0603 | Venkel | CR0603-10W-1001F |
| R35 | 1 | RES, 100 Ω, 1/10 W, ±1%, ThickFilm, 0805 | Venkel | CR0805-10W-1000F |
| TP7 | 4 | TESTPOINT, BLACK, 0.050" LOOP, PTH | Keystone | 5001 |

## 21. Design and Layout Checklist

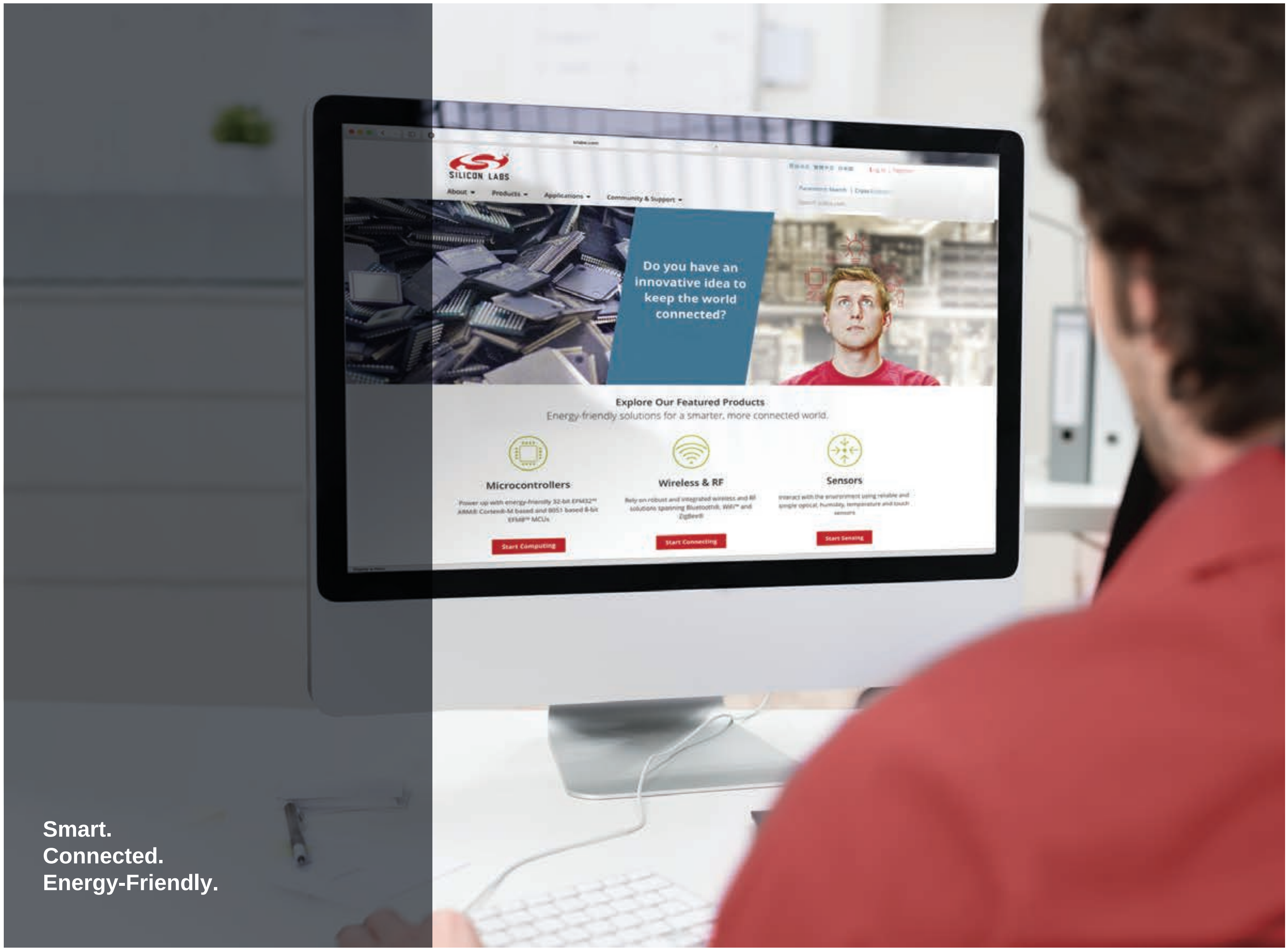
The complete EVB design databases are located at www.silabs.com/PoE link. Silicon Labs strongly recommends using these EVB schematics and layout files as a starting point to ensure robust performance and avoid common mistakes in the schematic capture and PCB layout processes.

The following is a recommended design checklist that can assist in trouble-free development of robust PD designs.

Refer also to the Si34061 data sheet and AN1130: Si3404/06x PoE-PD ControllerDesign Guide when using the following checklist.

1. Design Planning checklist:
    a. Determine if your design requires an isolated or non-isolated topology. For more information, see AN1130.
    b. Silicon Labs strongly recommends using the EVB schematics and layout files as a starting point as you begin integrating the Si34061-EVB-EXT into your system design process.
    c. Determine your load's power requirements (i.e., VOUT and IOUT consumed by the PD, including the typical expected transient surge conditions).
    d. Based on your required PD power level, select the appropriate class resistor RCLASS value by referring to AN1130.
2. General Design Checklist:
    a. Non-standard PoE injectors turns on the PD without detection and classification phases. In most cases, dV/dt is not controlled and could violate IEEE requirements. To ensure robustness with those injectors, please include a 3Ω resistors in place of R34.
3. Layout Guidelines:
    a. Make sure VNEG pin of the Si34061 is connected to the backside of the QFN package with an **adequate thermal plane**, as noted in the data sheet and AN1130.
    b. Keep the trace length from the switching FET to VSS as short as possible. Make all the power (high current) traces as short, direct, and thick as possible. It is a good practice on a standard PCB board to make the traces an absolute minimum of 15 mils (0.381 mm) per ampere.
    c. Usually, one standard via handles 200 mA of current. If the trace needs to conduct a significant amount of current from one plane to the other, use multiple vias.
    d. Keep the circular area of the loop from the switching FET to the transformer and returning from the input filter capacitors (C13, C14, C15) to VSS as small a diameter as possible. Also, minimize the circular area of the loop from the output of the transformer to the syncFET (U1) and returning through the output filter capacitor back to the transformer as small as possible. If possible, keep the direction of current flow in these two loops the same.
    e. Keep the high-power traces as short as possible.
    f. Keep the feedback and loop stability components as far from the transformer and noisy power traces as possible.
    g. If the output has a ground plane or positive output plane, do not connect the high current carrying components and the filter capacitors through the plane. Connect them together, and then connect to the plane at a single point.

To help ensure first-pass success, contact our customer support by submitting a help ticket and uploading your schematics and layout files for review.

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