USER GUIDE

UG412: Class 4, 30 W, 12 V EMI-Compliant, Isolated Evaluation Board (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 802.3bt compatible
- High converter efficiency (>90%)
- EMI compliant design
- Synchronous rectification
- High flexibility
- Integrated transient overvoltage protection
- Thermal shutdown protection
- 5 x 5 mm 24-pin QFN

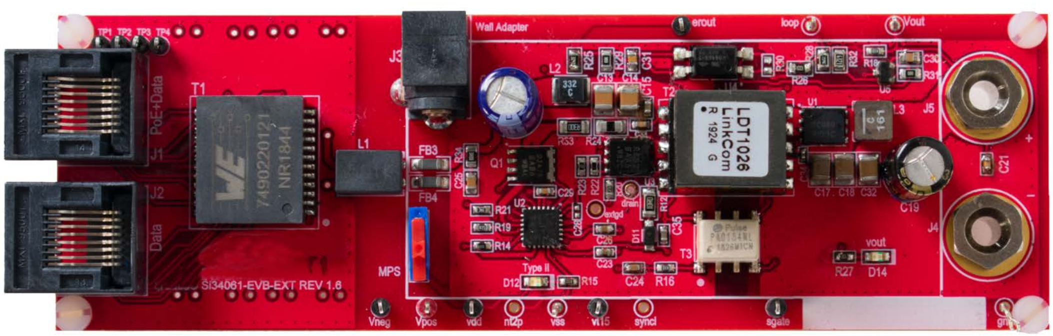

Table 1. SI34061FB12V4KIT Specifications

Parameter	Condition	Specifications
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	VIN = 48 V from wall adapter	92.5%
Efficiency, dc-dc converter	VIN = 50 V from PSE	92.5%
Efficiency, end-to-end	VIN = 50 V from PSE	89.8%
Switching frequency	RFREQ (R14) = 95.3 kΩ	200 kHz
Conducted EMI	EN55032, average and peak detector	Passed
Radiated EMI	EN55032 Class B	Passed

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 PoE+ PD applications. The Si34061 is described more completely in the data sheet and application notes.

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 via the RJ45 connector, J1.

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

Table 2. 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.

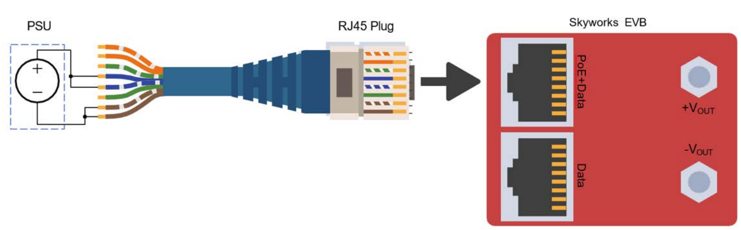

Figure 1. Endspan Connection Using Laboratory Power Supply

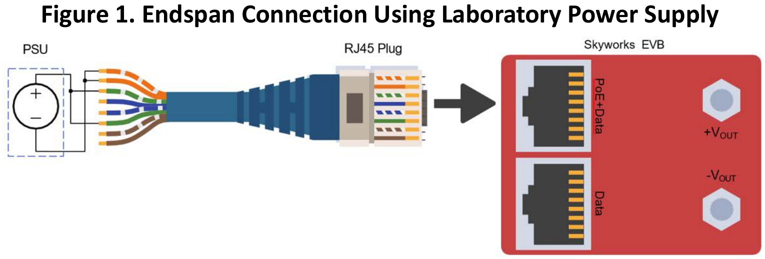

Figure 2. Midspan Connection Using Laboratory Power Supply

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

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

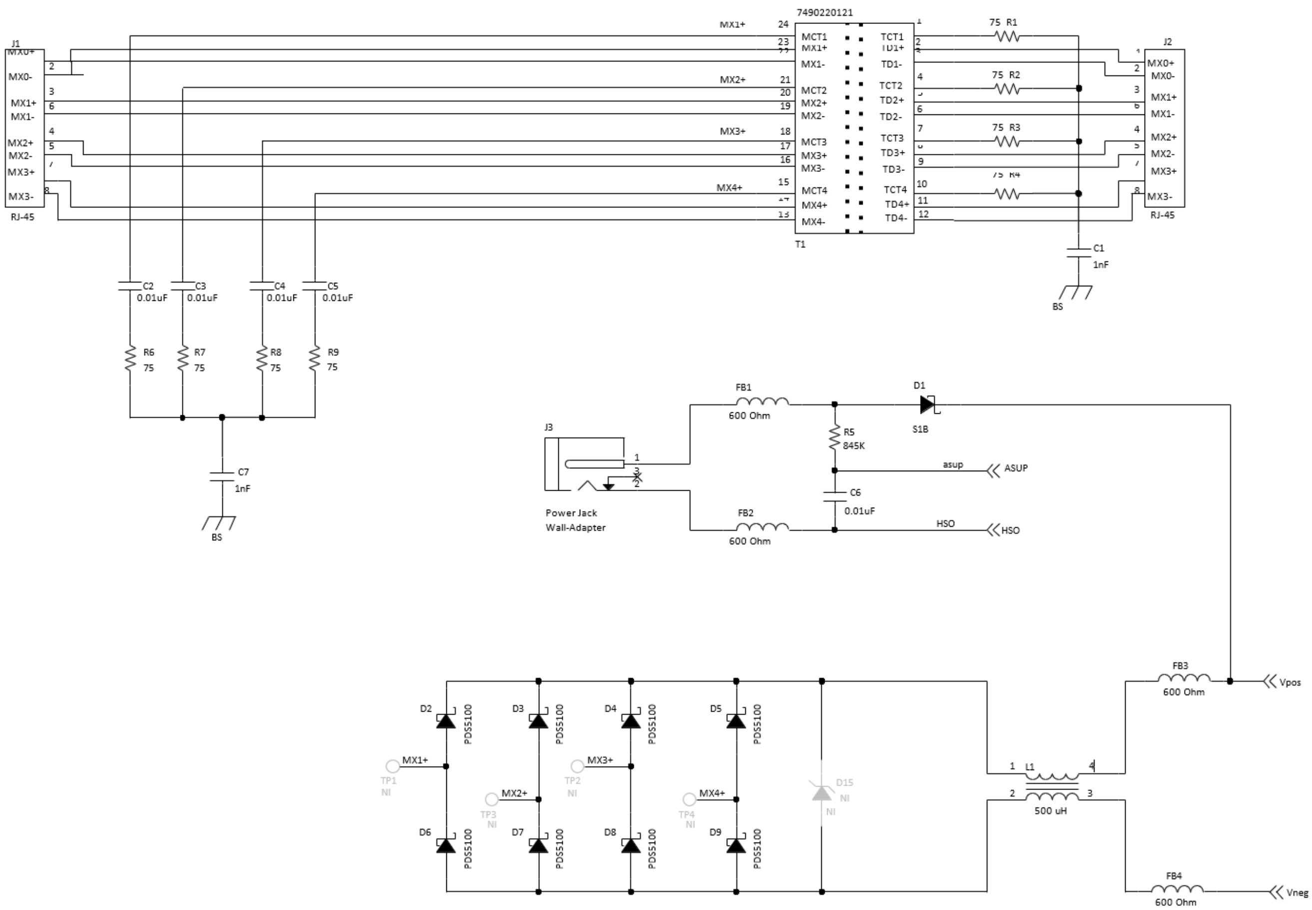

Figure 3. Input Interface

The Si34061 PD controller includes an integrated 100 V protection device 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 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.

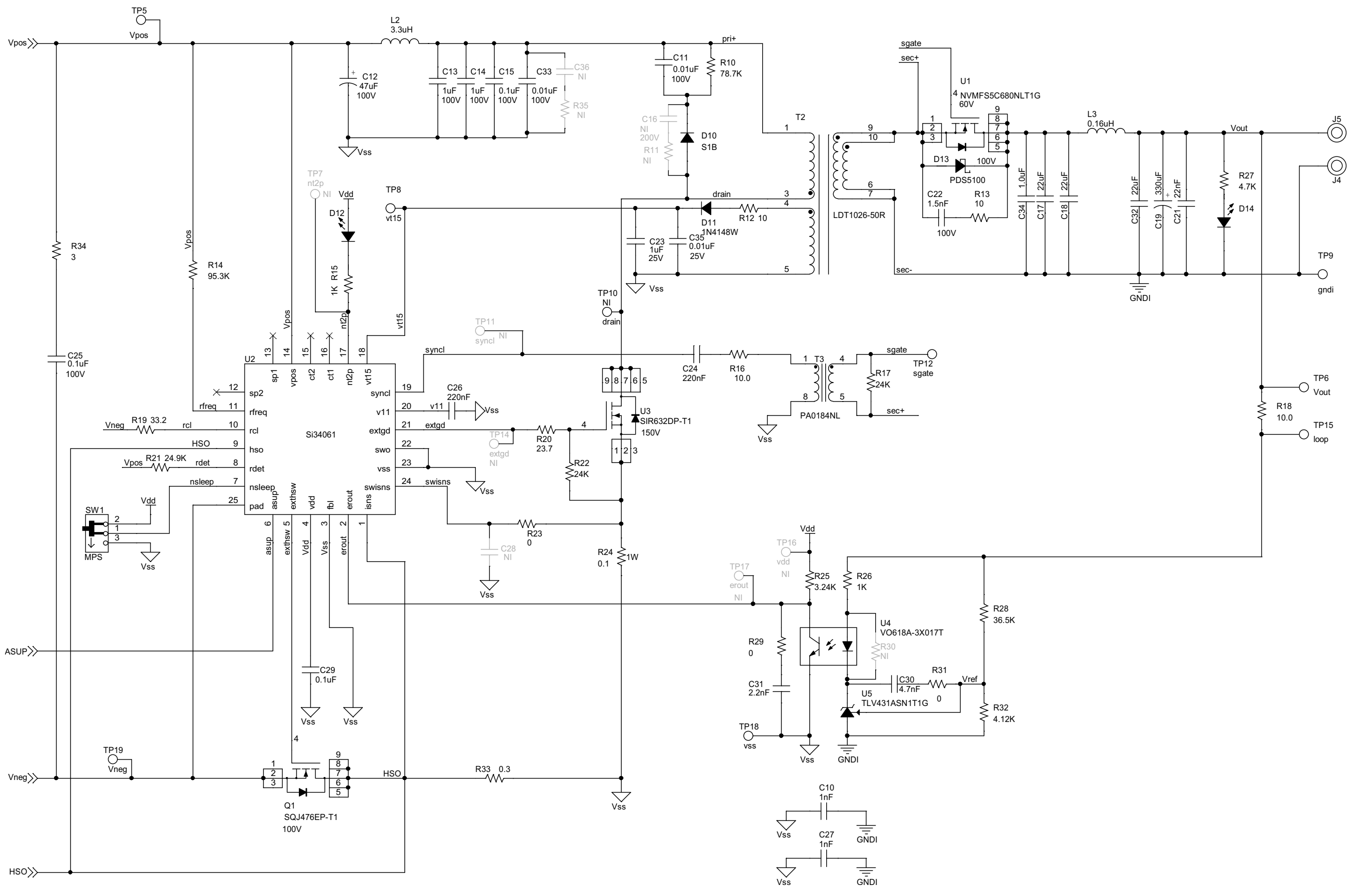

Figure 4. DC-DC Converter

3. Si34061-EVB-EXT-12V Board Conversion Efficiency

The figures below show the Si34061-EVB-EXT-12V conversion efficiency with 12 V output.

- 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

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

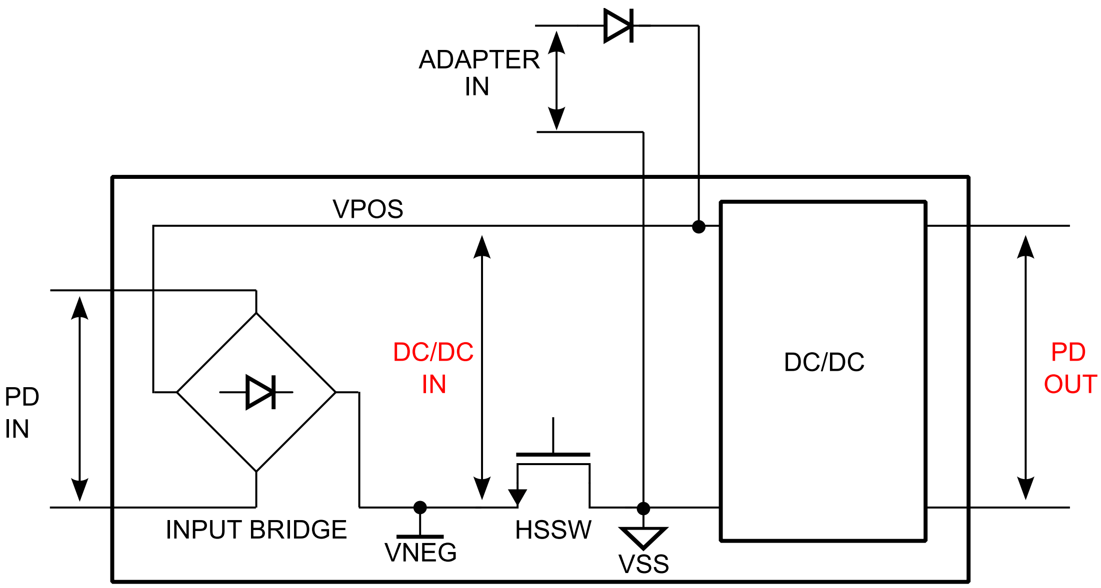

Figure 5. DC-DC Conversion Efficiency Measurement Setup

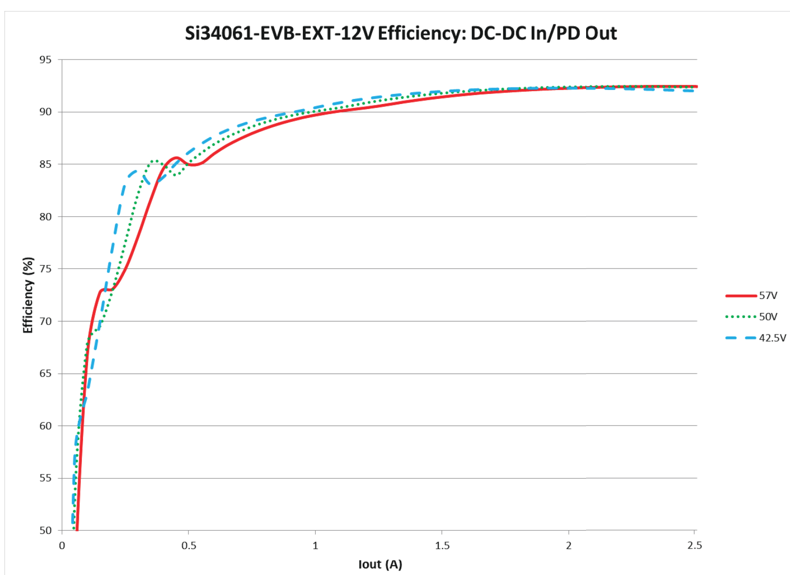

Figure 6. DC-DC Conversion Efficiency

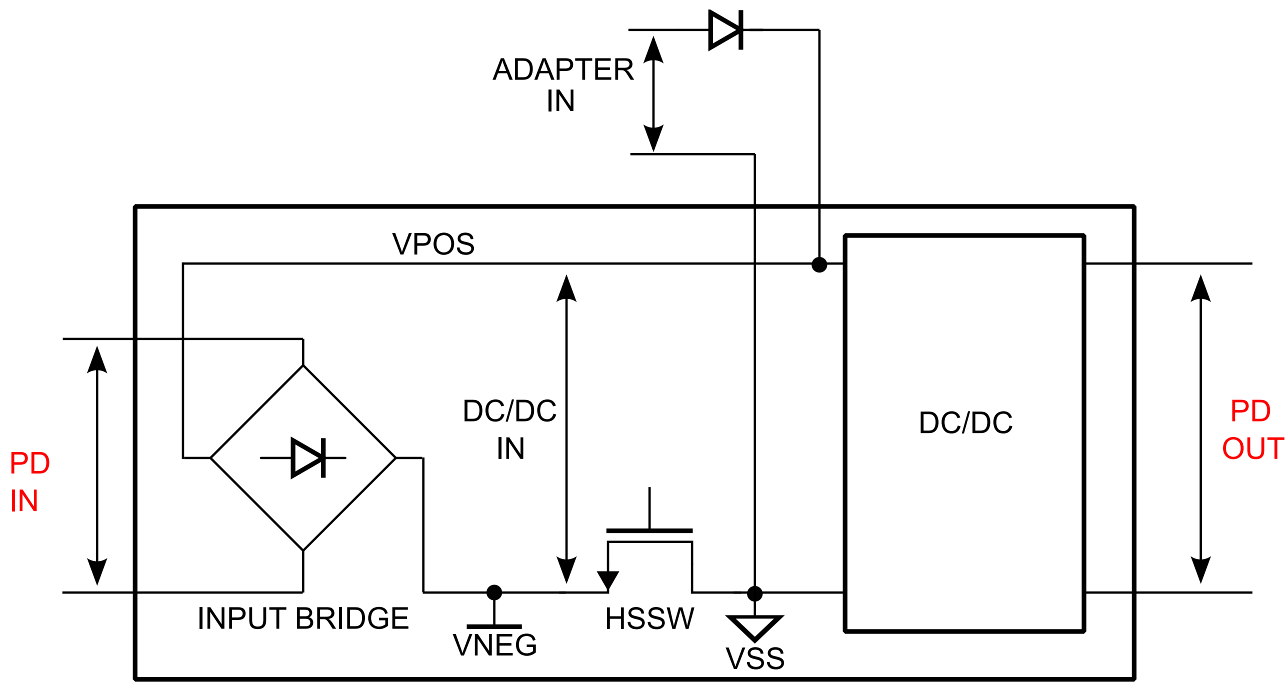

Figure 7. End-to-End Conversion Efficiency Measurement Setup

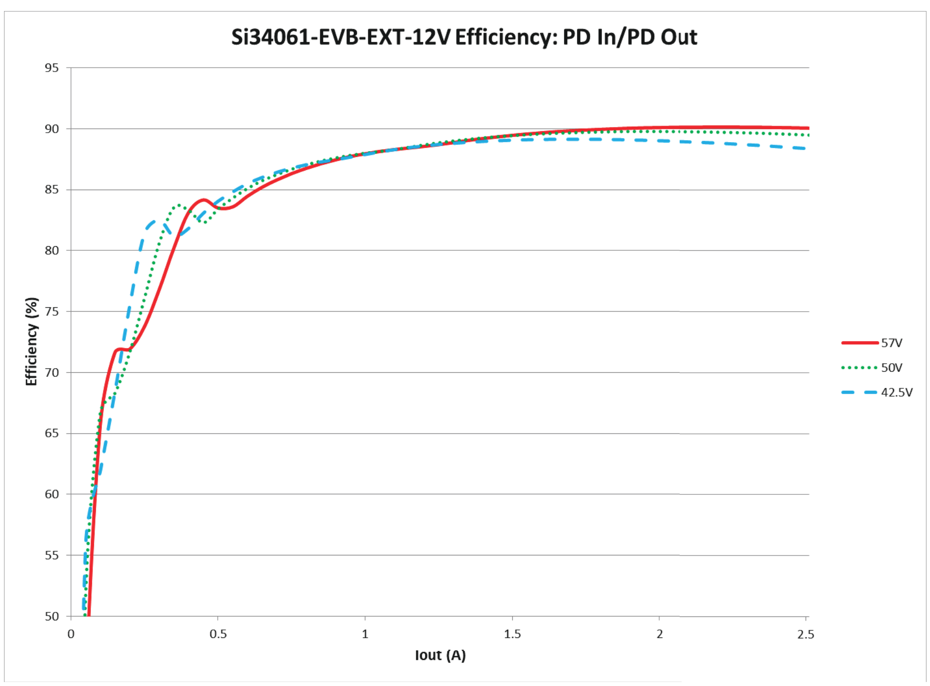

Figure 8. End-to-End Conversion Efficiency

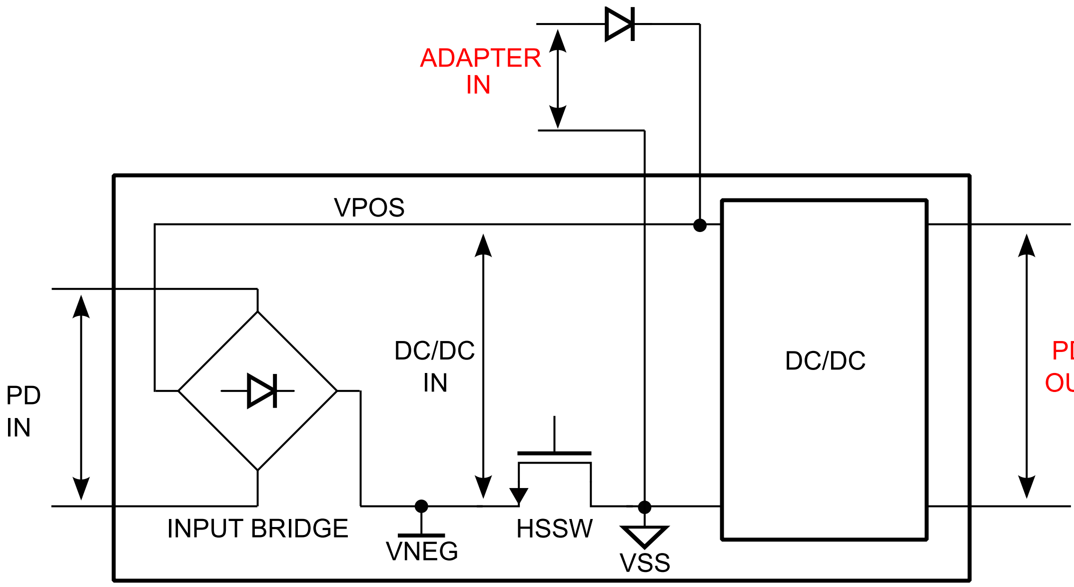

Figure 9. Wall Adapter Conversion Efficiency Measurement Setup

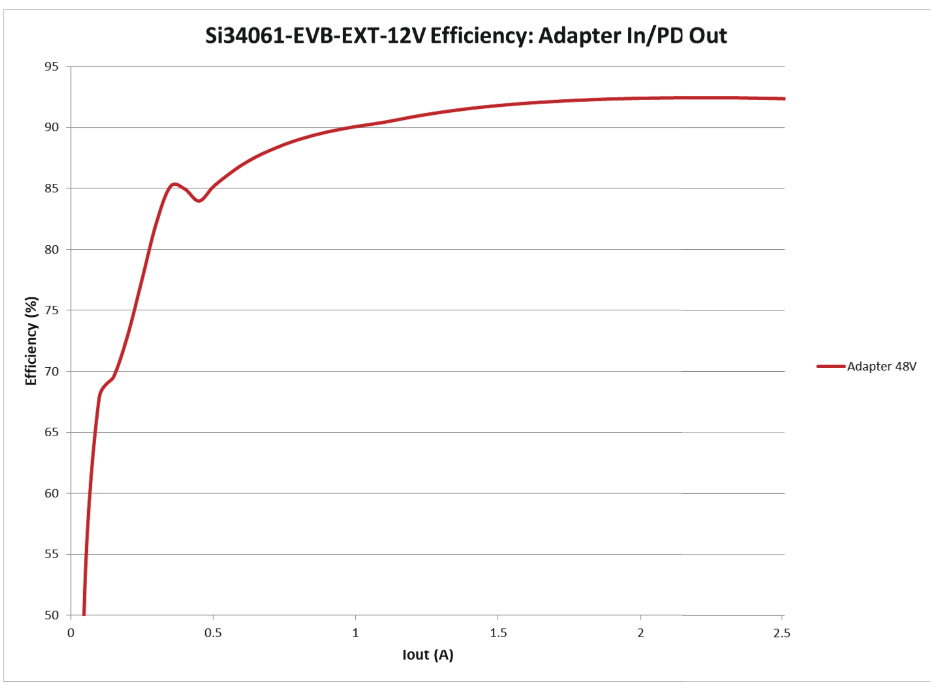

Figure 10. Conversion Efficiency Powered from 48 V Wall Adapter

4. PoE Compatibility Test Results

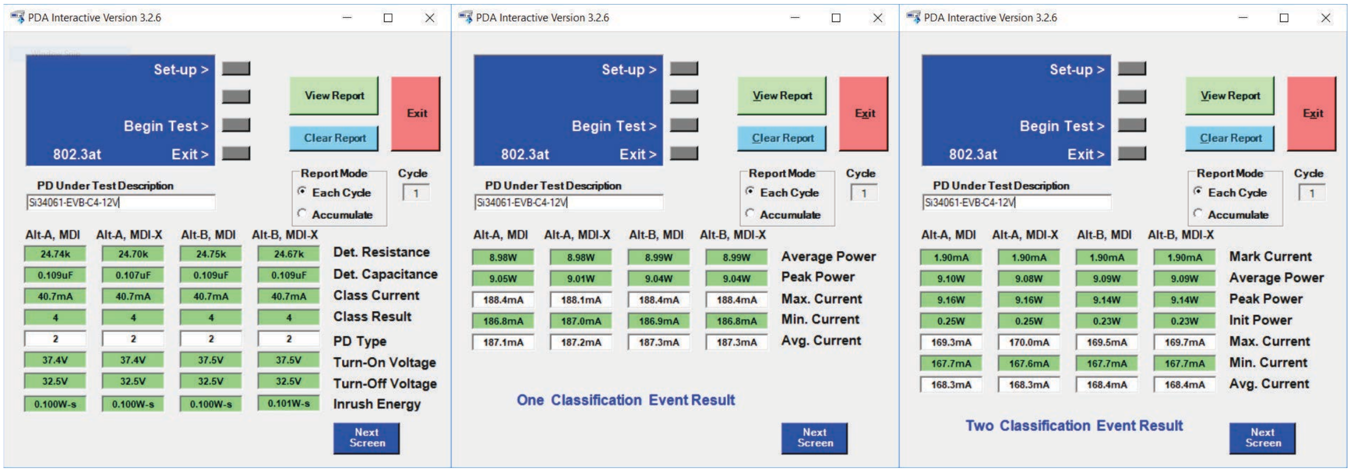

Figure 11. PoE Compatibility Test Results: Pass

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 assure 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.

Loop gain and loop phase shift measurements verify the loop stability.

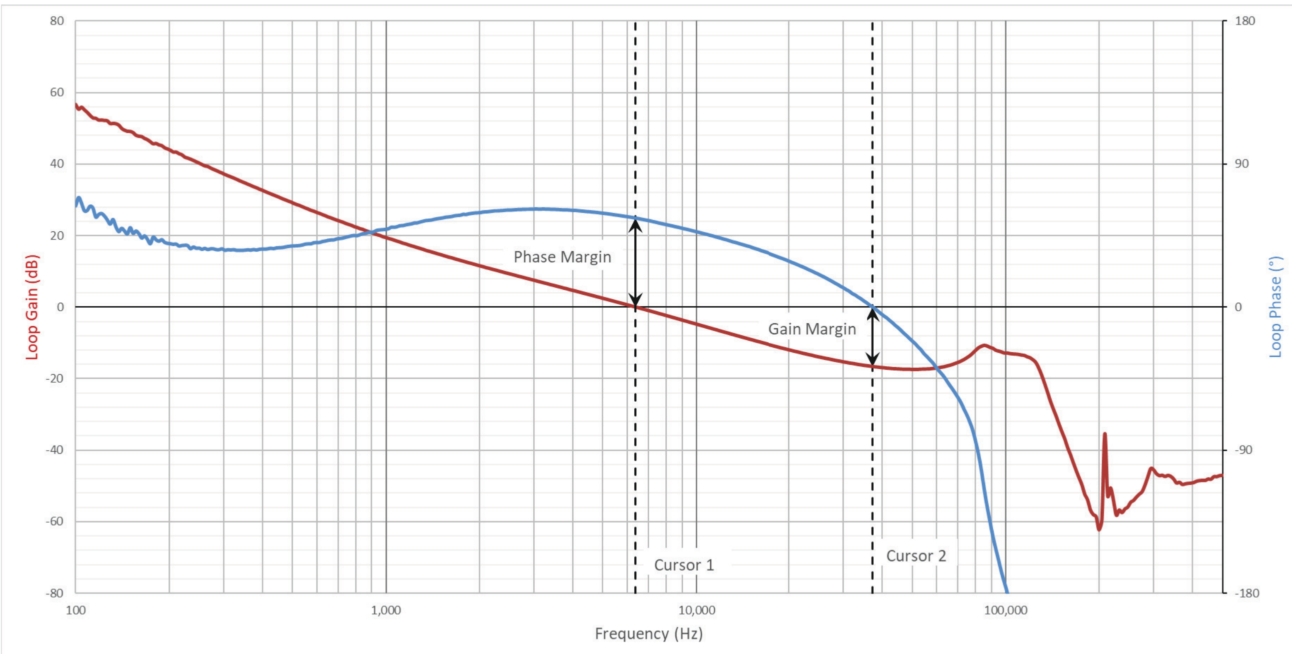

Figure 12. Measured Loop-Gain and Phase-Shift Measured at Full Load

Table 3. Measured Loop Gain and Phase Shift

	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 output has been tested with a step load function to verify the converter output dynamic response.

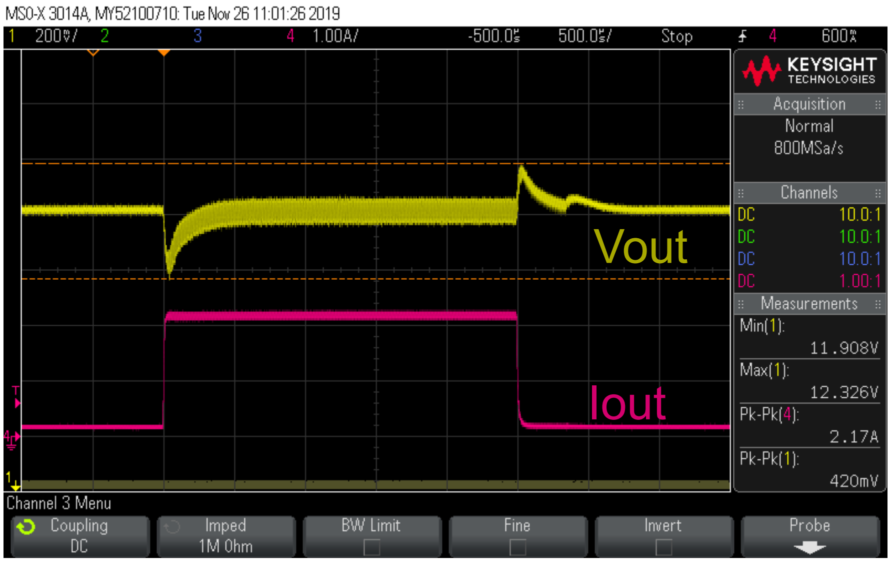

Figure 13. Output Load Step Transient Test

Table 4. Output Load Step Transient

	From (Output Current)	To (Output Current)	VOUT 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 output voltage ripple has been measured at no-load and full-load conditions.

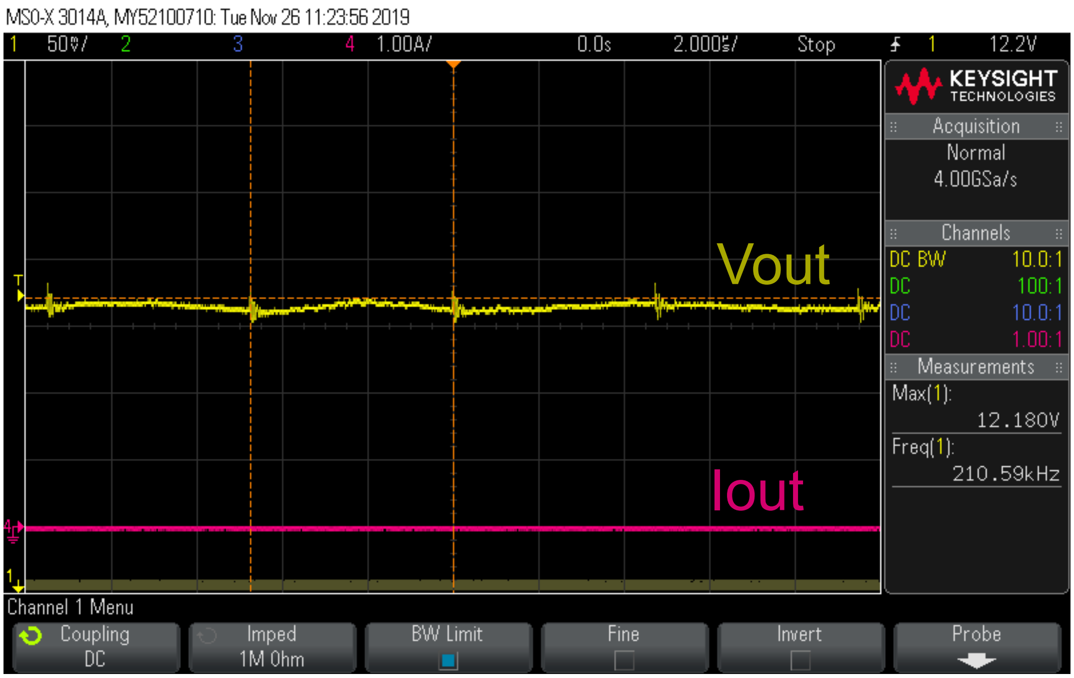

Figure 14. Output Voltage Ripple at No-Load Condition: 25 mV

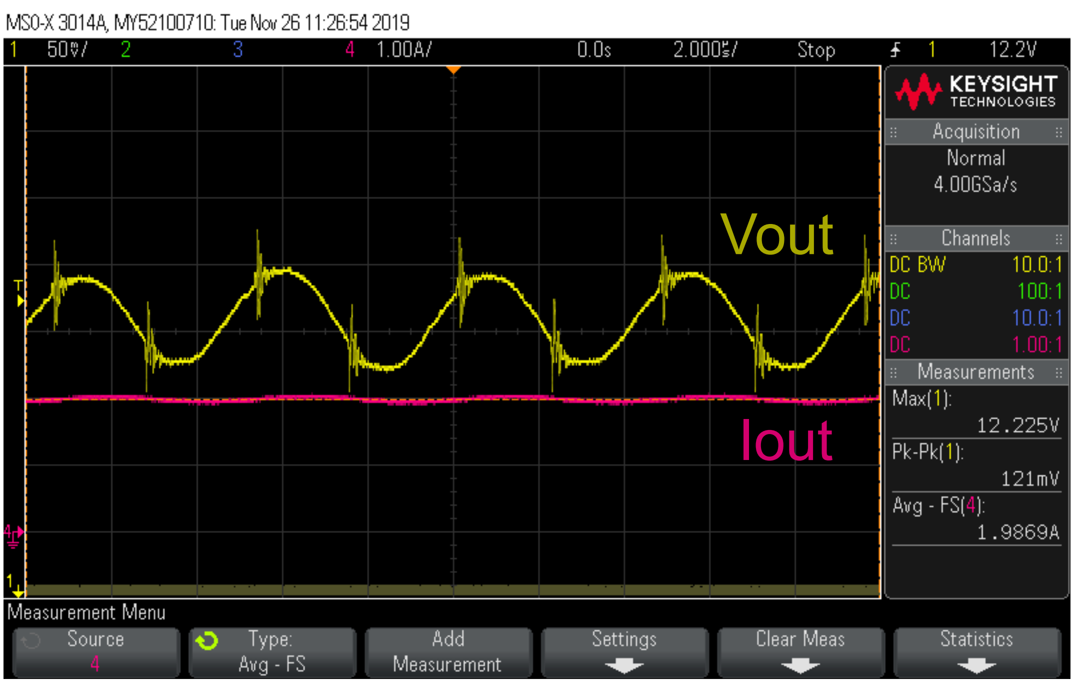

Figure 15. Output Voltage Ripple at 2 A Output: 121 mV

8. Soft Start Protection

The Si34061 has an integrated intelligent adaptive 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 controller continuously measures the PD input current and dynamically adjusts the internal I_{PEAK} limit during soft-start, adjusting 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. The controller slows down the output voltage ramp under heavy load to avoid exceeding the desired regulated output voltage.

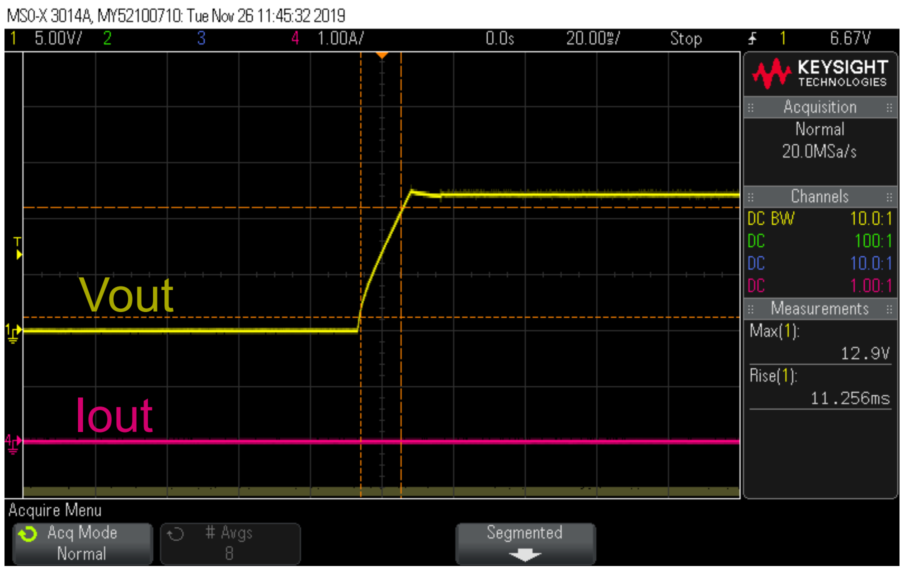

Figure 16. Soft-Start with No Load

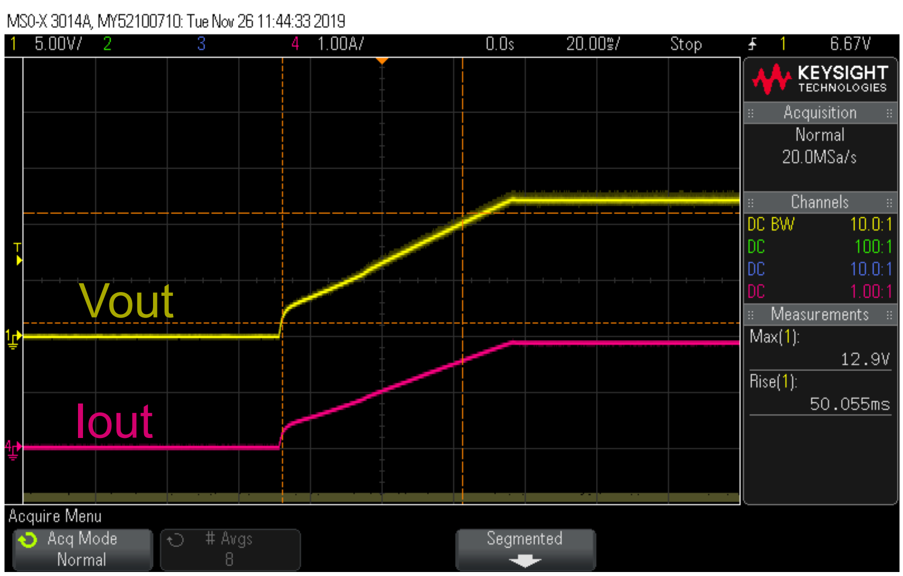

Figure 17. Soft-Start with Heavy Load

9. Output Short Protection

The Si34061 PD device has an integrated output short-protection mechanism that protects the IC 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 input current and the PD output voltage when the short is present.

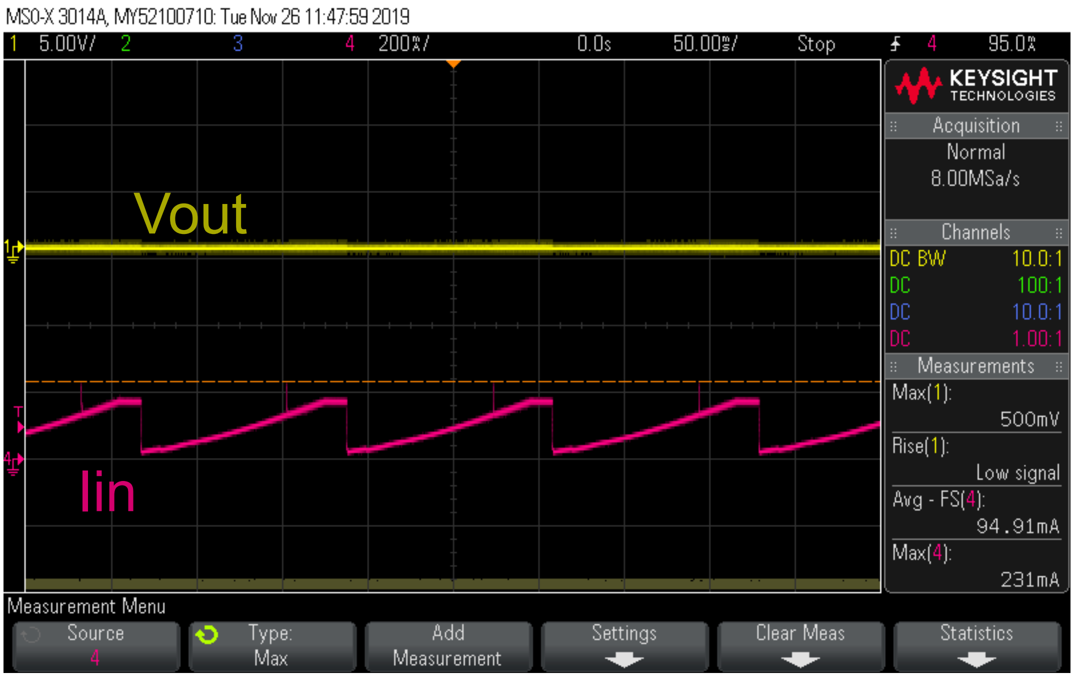

Figure 18. Output Short Protection Mechanism

10. Pulse Skipping at No-Load Condition

As the output load decreases, the controller starts to reduce the pulse width of the PWM signal (switching ON time). At some point, even the minimum pulse width provides 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.

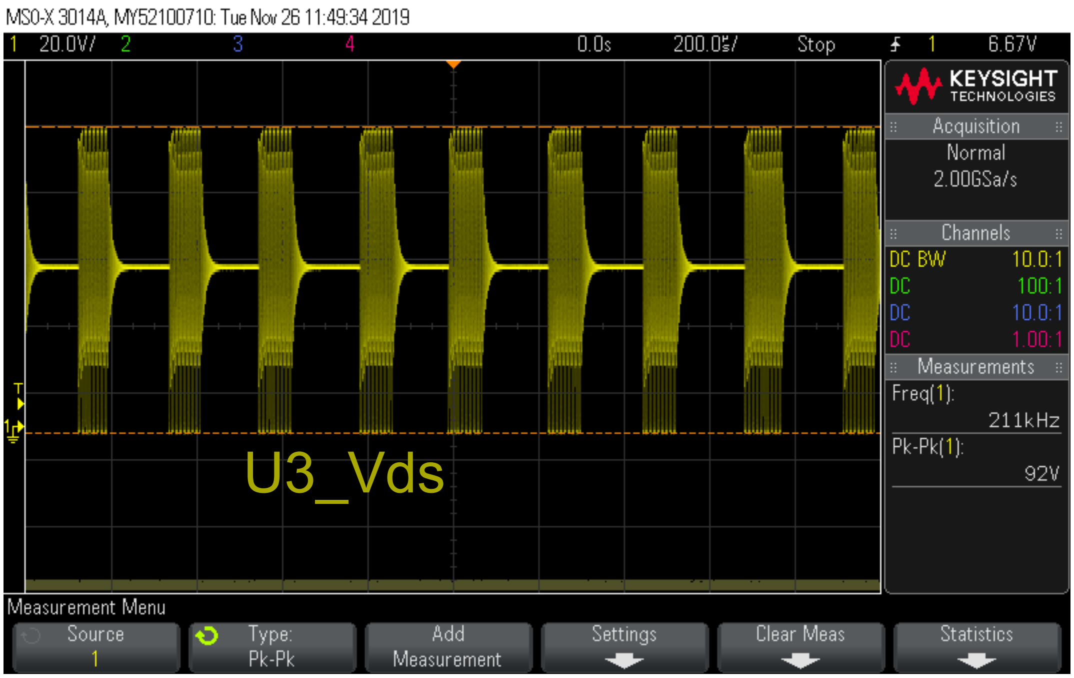

Figure 19. Pulse Skipping at No-Load Condition

11. Adjustable EVB Current Limit

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

The Si34061 controller measures the voltage on R_{SENSE} (R33) through the ISNS pin. The R_{SENSE} value also defines the power level at which the external-HSSW (Q1) and synchronous-FET (U1) are enabled.

When V_{RSENSE} goes below VSS, or when V_{RSENSE} reaches –270 mV (referenced to VSS), the current limiter restarts the circuit to protect the application.

When the VRSENSE value is less than –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 greater than –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. Class 4 Current Limit

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

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

Equation 2. Current to Enable External HSSW (Q1) and Synchronous-FET (U1)

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

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

12. Tunable Switching Frequency

The oscillator switching frequency is selected by choosing an external resistor R14 connected between the R_{FREQ} and V_{POS} pins. The figure below helps R_{FREQ} value selection at the desired switching frequency.

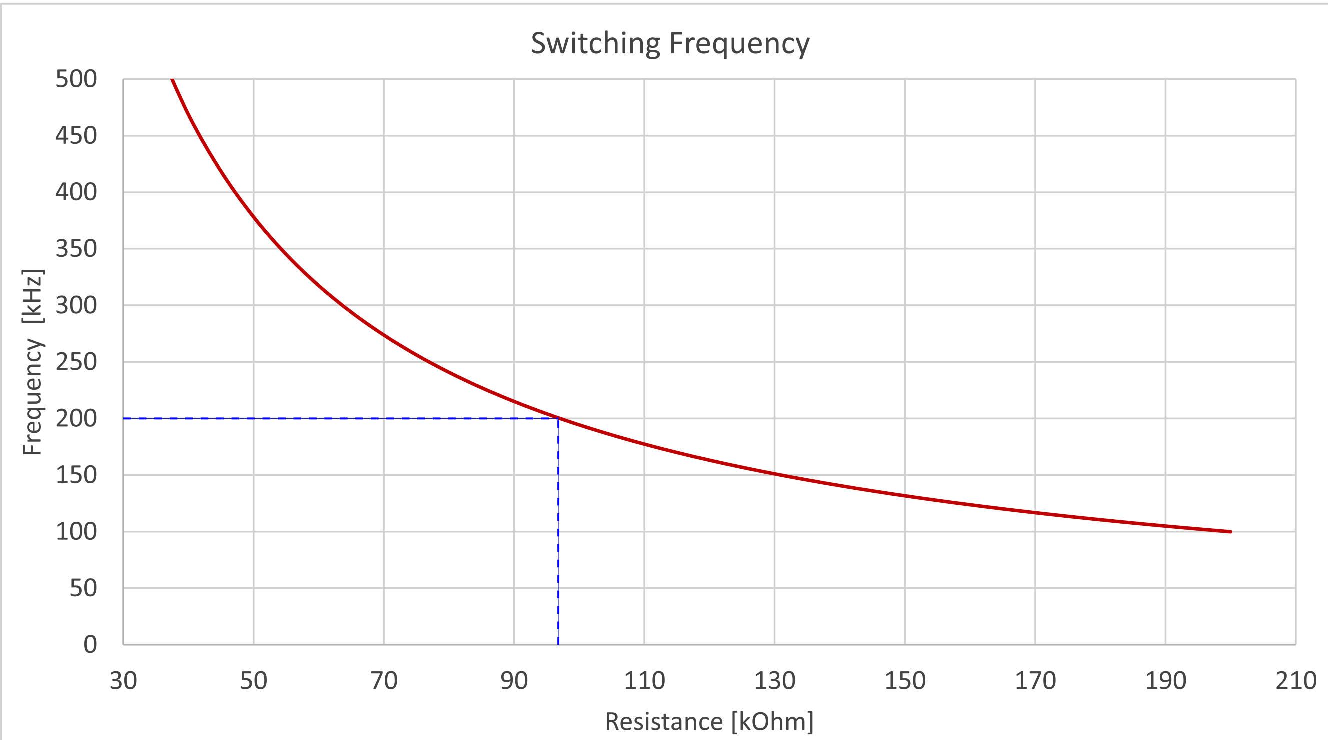

Figure 20. Switching Frequency vs. R_{FREQ} Value

The selected switching frequency is 200 kHz, achieved by setting resistor R33 to 95.3 kΩ.

13. Synchronous Rectification

The Si34061 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 DCM operation. The drain-source voltage waveform is depicted in the following figure.

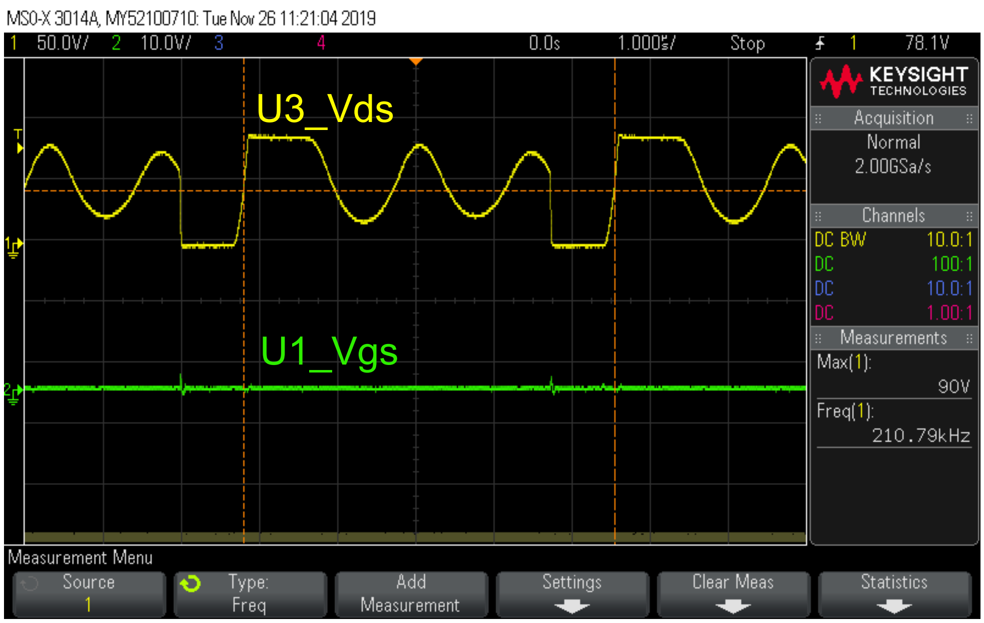

Figure 21. Discontinuous Current Mode at Low-Load Condition

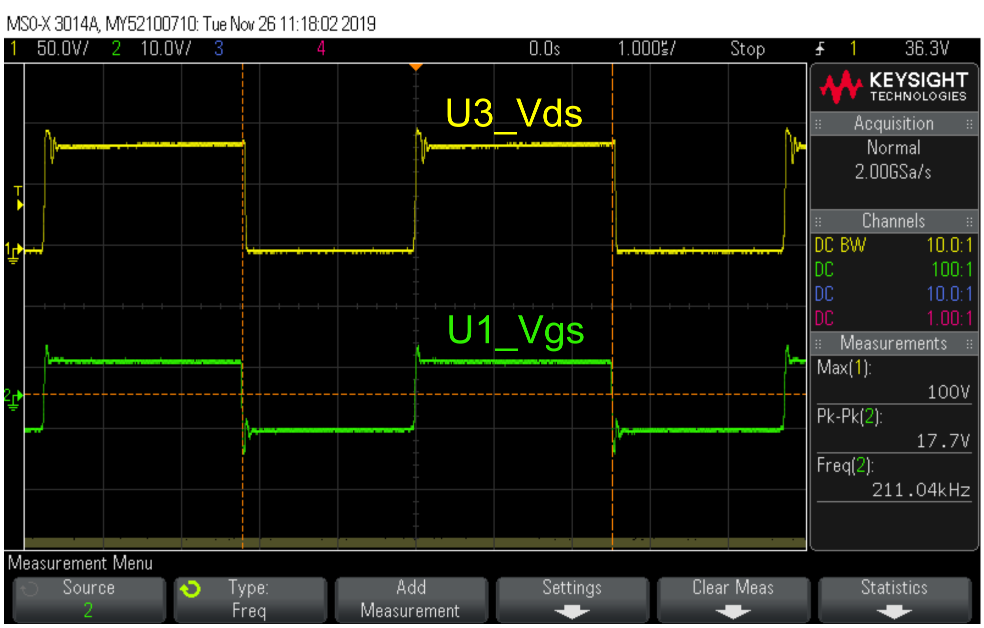

Figure 22. Continuous Current Mode at High-Load Condition

14. Maintain Power Signature (MPS)

The Si34061 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 is depicted in the following figures.

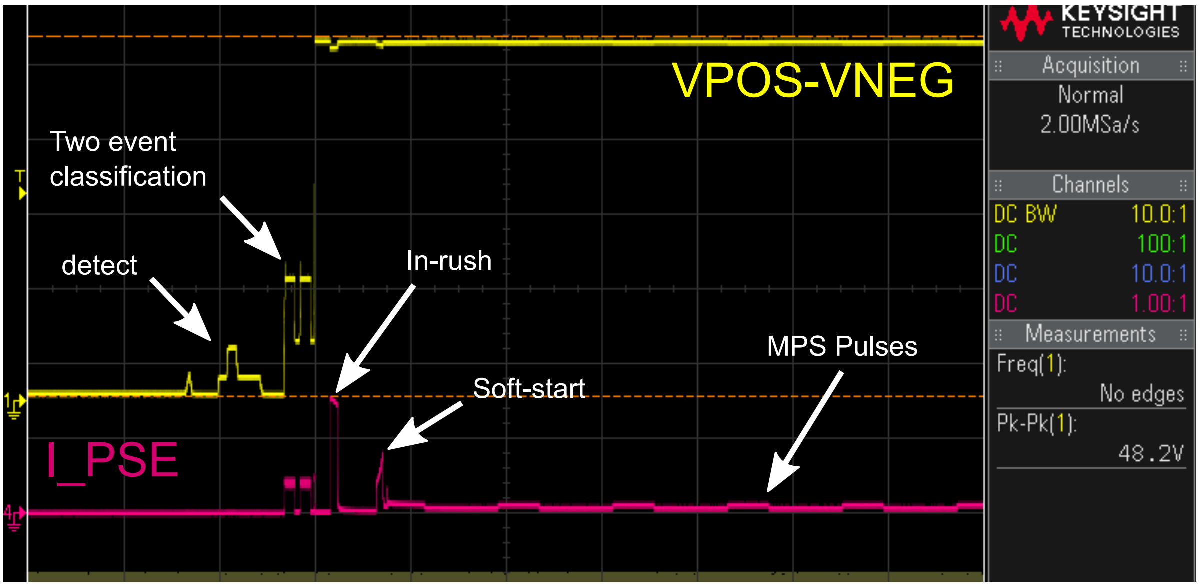

Figure 23. MPS Enabled: Connection is Kept with PSE

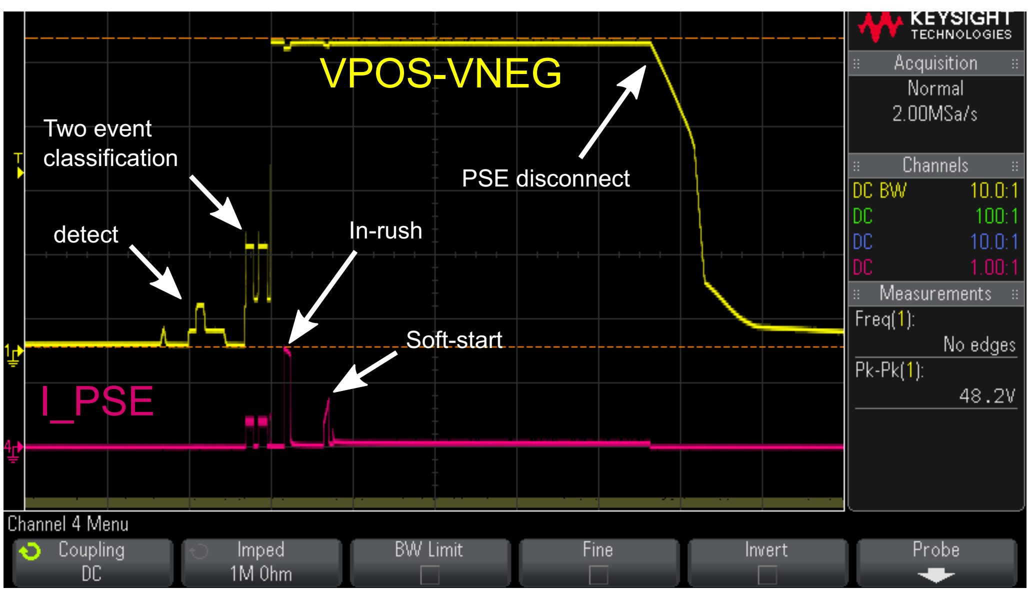

Figure 24. MPS Disabled: PSE Disconnects the Port

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 interruption to 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.

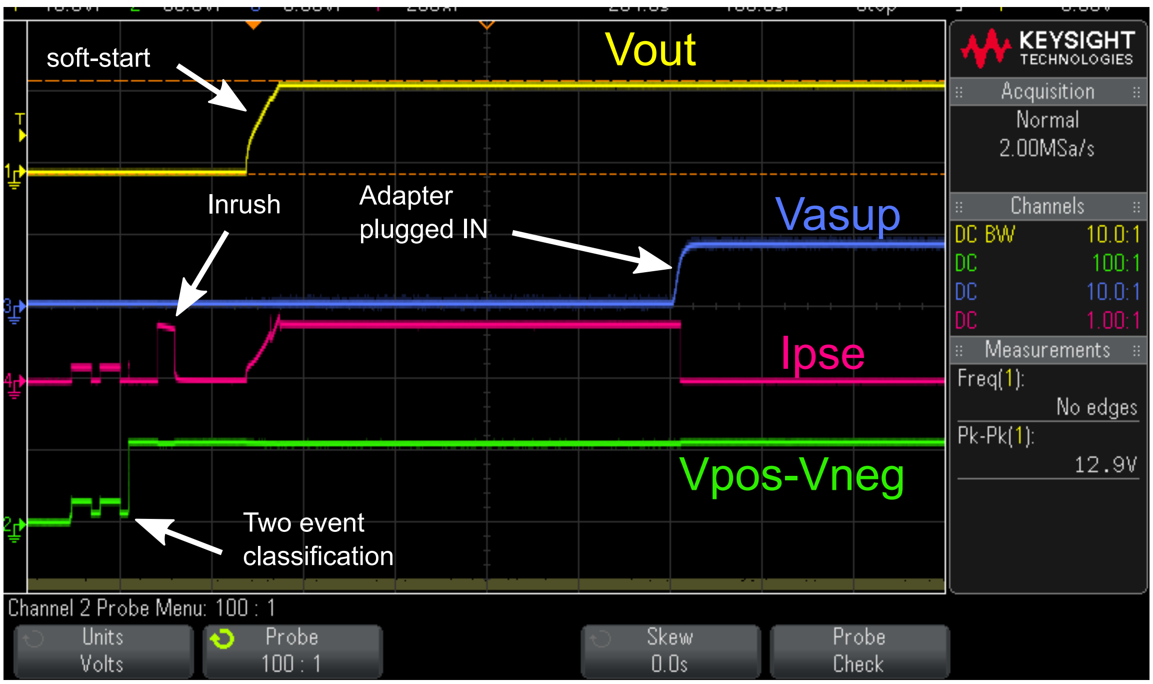

Figure 25. Wall Adapter Sequence Using ASUP Pin

16. Radiated Emissions Measurement Results: EN55032 Class B

The Si34061-EVB-EXT-12V board radiated emissions have been measured with 50 V input 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.

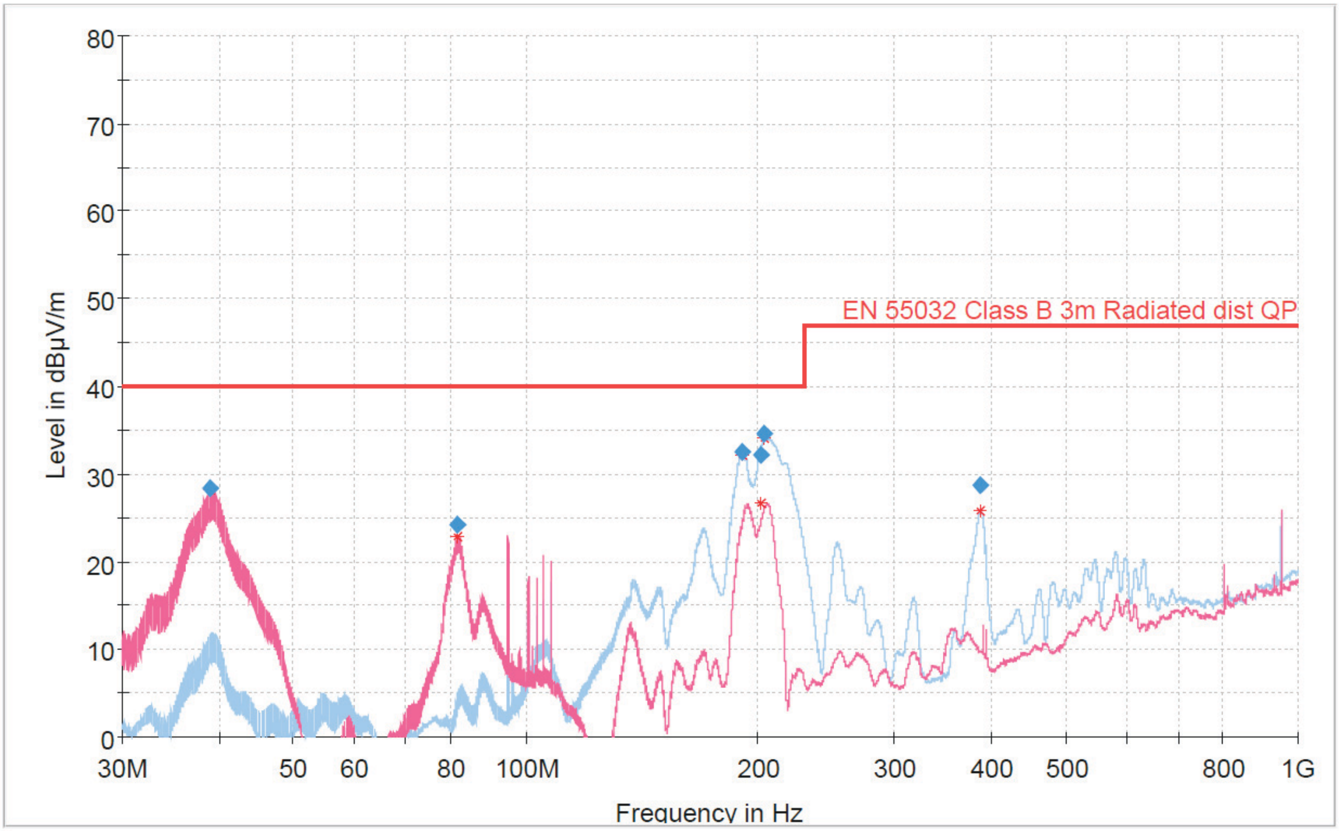

Figure 26. Radiated Emissions Measurement Results with 50 V Input and 30 W Output Load

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. The blue rhombus values must be below the highlighted EN 55032 Class B limit to pass.

17. Conducted Emissions Measurement Results: EN55032

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

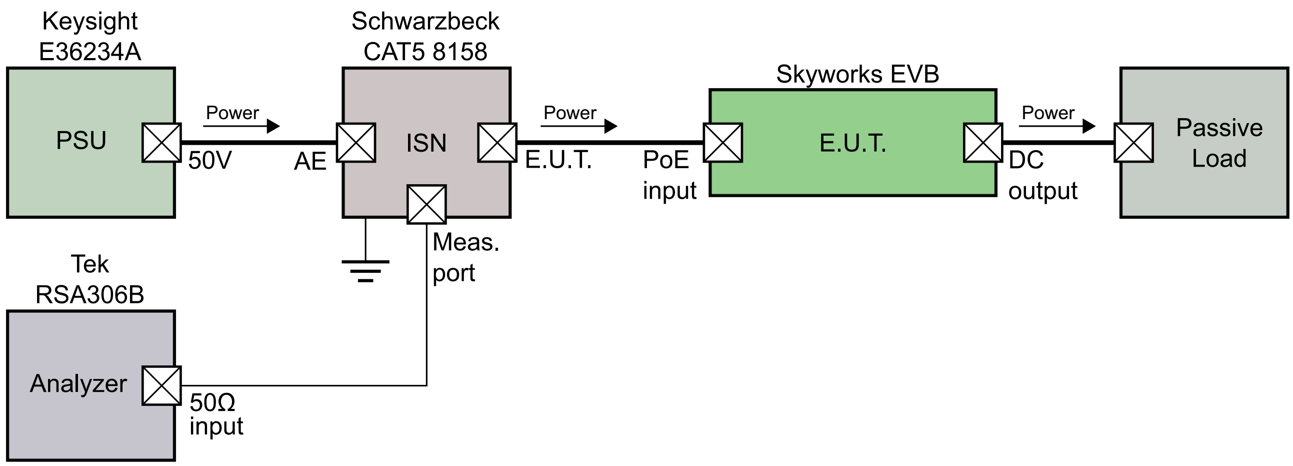

Figure 27. Conducted EMI Measurement Setup

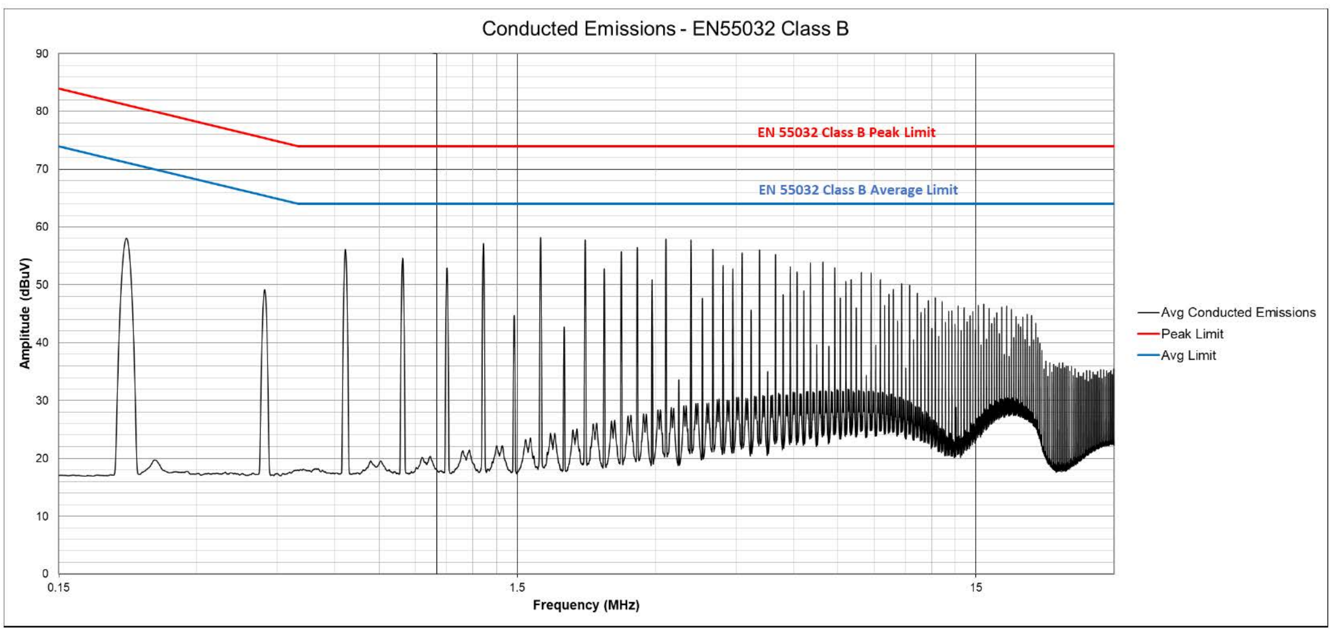

Figure 28. Conducted Emissions Measurement Results with 50 V Input and 30 W Output Load

18. Thermal Measurements

The Si34061-EVB-EXT-12V board thermal images at full load are shown below. Ambient temperature: 26 °C.

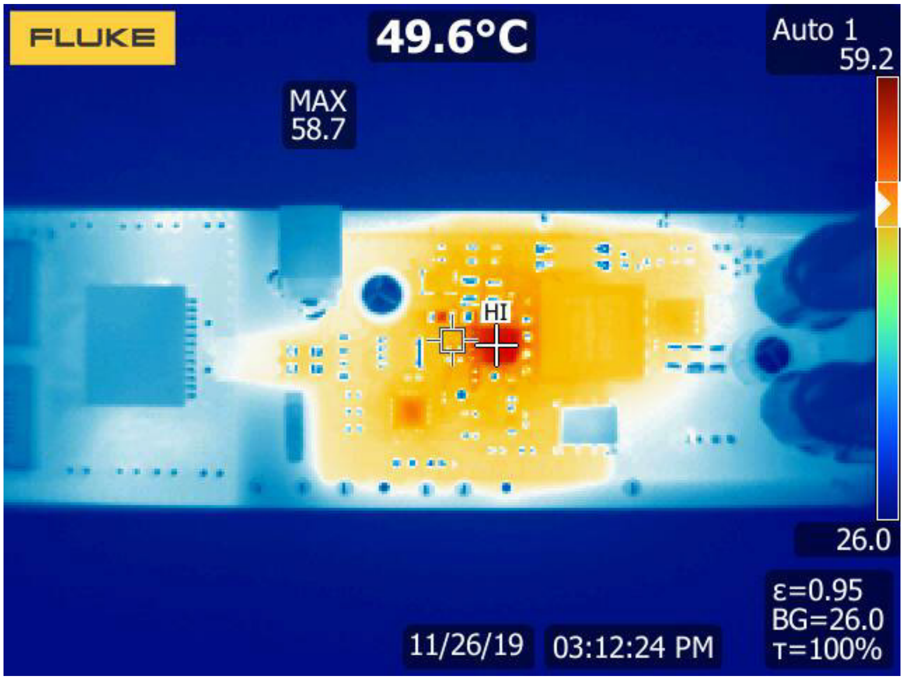

Figure 29. Thermal Image at Full Load, Top

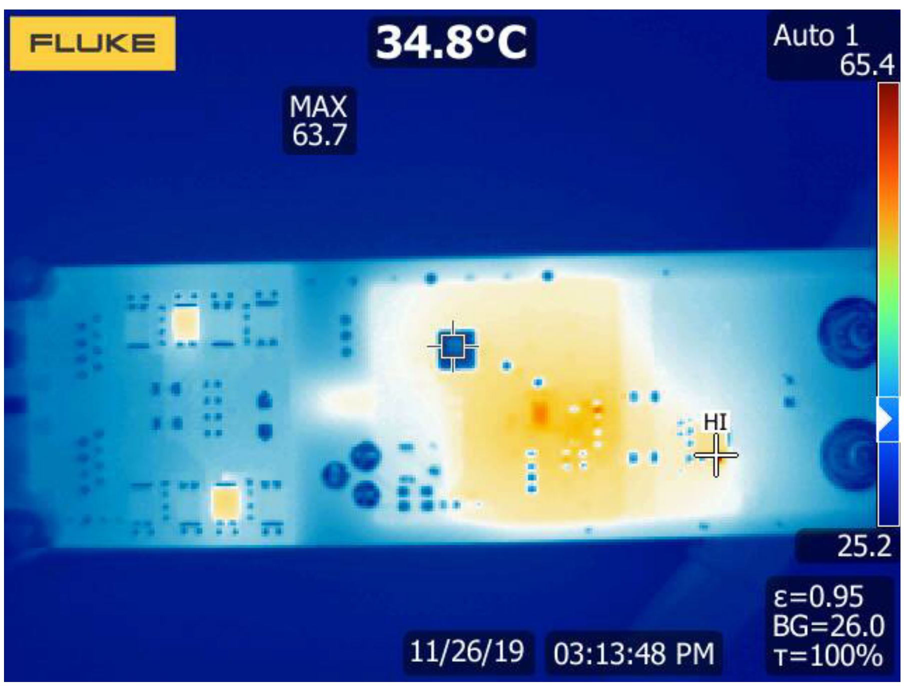

Figure 30. Thermal Image at Full Load, Bottom

19. Layout

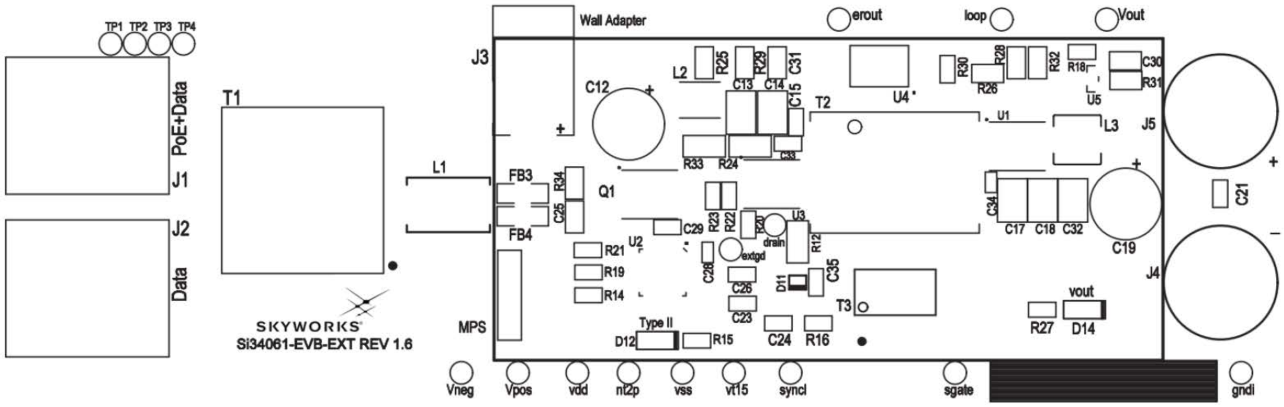

Figure 31. Primary Silkscreen

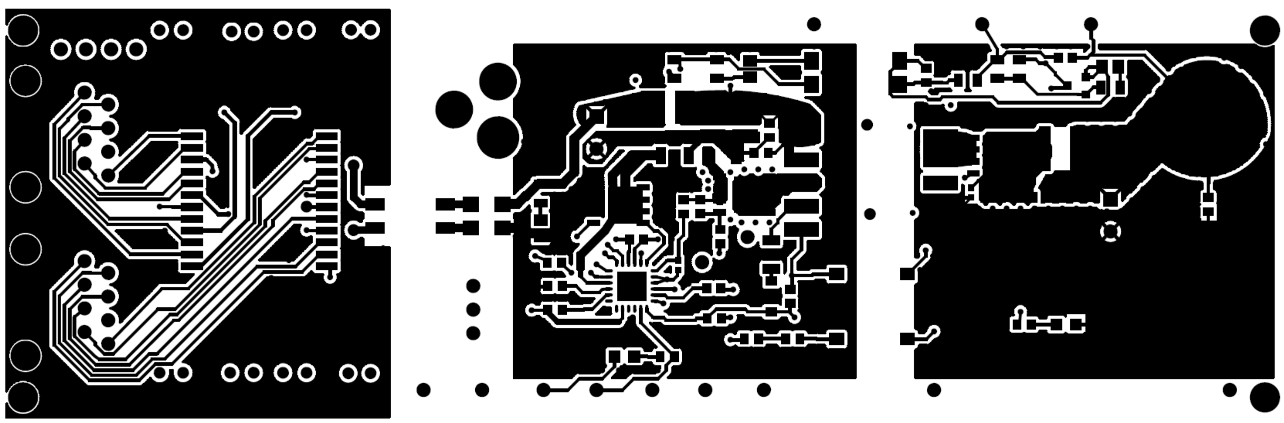

Figure 32. Top Layer

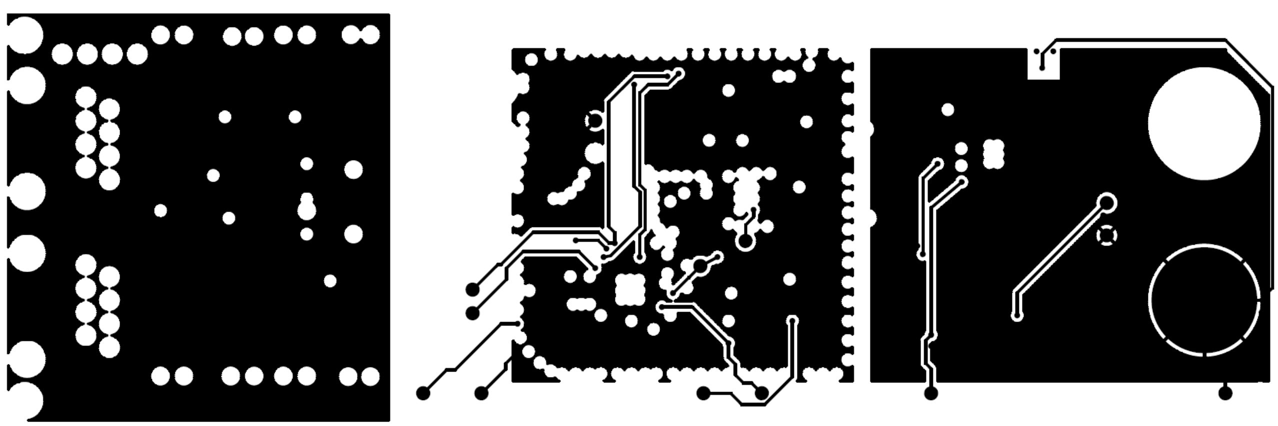

Figure 33. Internal 1 Layer

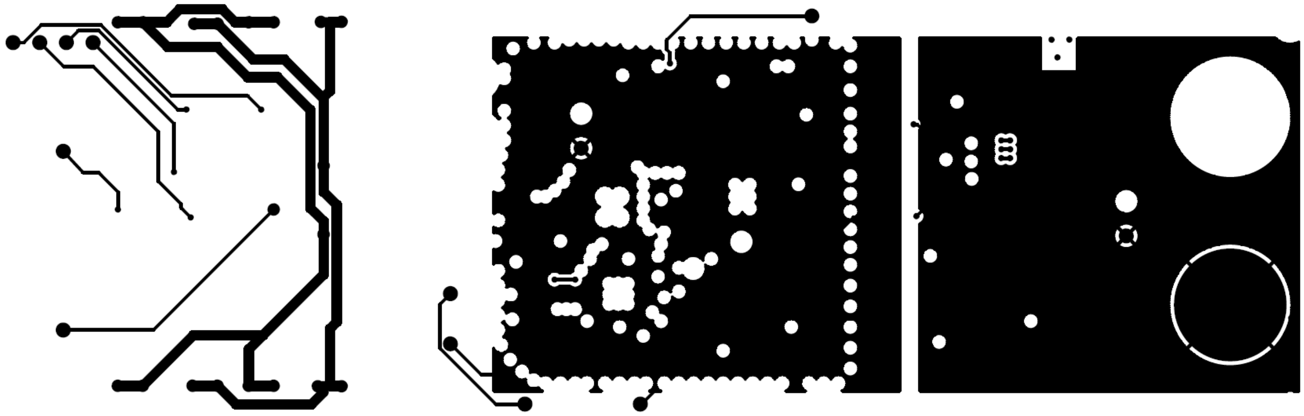

Figure 34. Internal 2 Layer

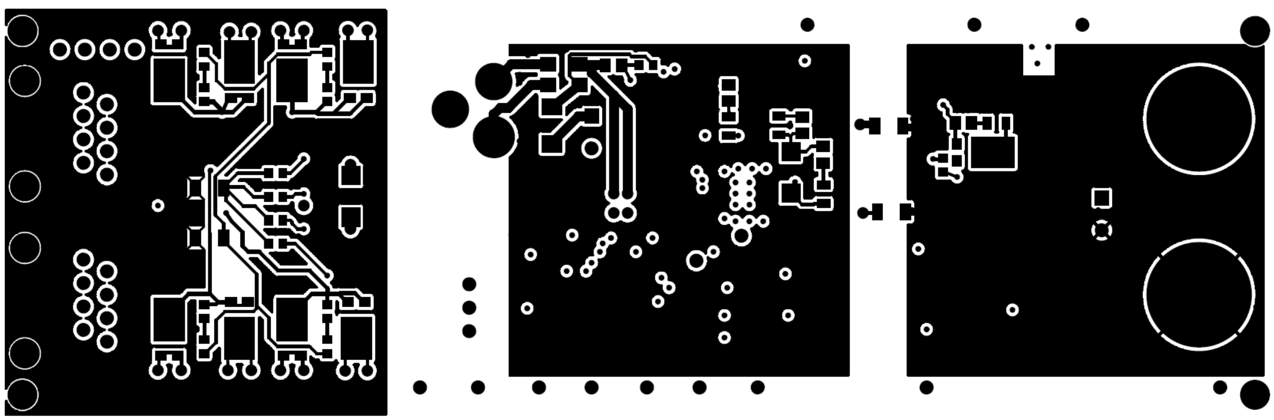

Figure 35. Bottom Layer

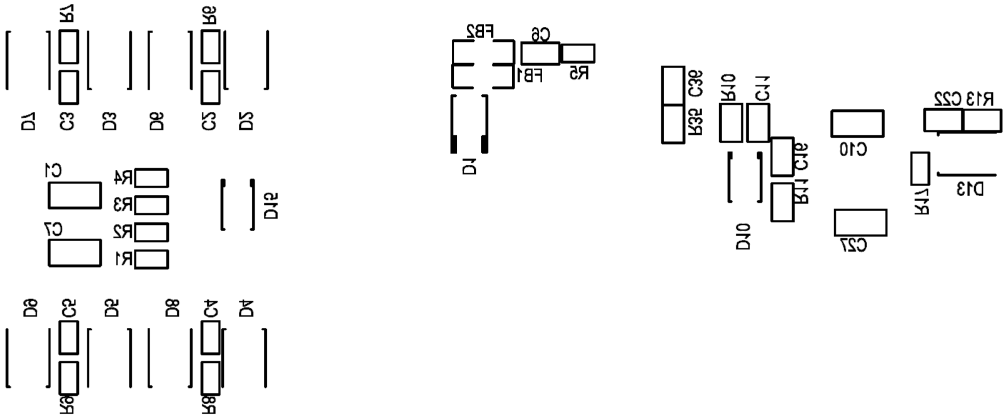

Figure 36. Bottom Silkscreen

20. Bill of Materials

Table 5. Si34061-EVB-EXT-12V Bill of Materials List

Reference	Qty	Description	Manufacturer	Part Number
C1, C7, C10, C27	4	Capacitor, 1 nF, 2000 V, ±5%, X7R, 1206	Kemet	C1206C102JGRACTU
C2, C3, C4, C5, C33	5	Capacitor, 0.01 µF, 100 V, ±10%, X7R, 0603	Venkel	C0603X7R101-103K
C6, C11	2	Capacitor, 0.01 µF, 100 V, ±10%, X7R, 0805	Venkel	C0805X7R101-103K
C12	1	Capacitor, 47 µF, 100 V, ±20%, AL, radial	Panasonic	ECA2AM470
C13, C14	2	Capacitor, 1 µF, 100 V, ±10%, X7R, 1210	Venkel	C1210X7R101-105K
C15	1	Capacitor, 0.1 µF, 100 V, ±10%, X7R, 0603	Venkel	C0603X7R101-104K
C16	1	Capacitor, 100 pF, 200 V, ±5%, NP0 high Q, 0805	Venkel	C0805HQN201-101J
C17, C18, C32	3	Capacitor, 22 µF, 16 V, ±20%, X5R, 1206	KEMET	C1206C226M4PAC7800
C19	1	Capacitor, 330 µF, 16 V, ±20%, AL, 8X11.5MM, PTH	Panasonic	EEU-FM1C331B
C21	1	Capacitor, 22 nF, 16 V, ±20%, X7R, 0603	Venkel	C0603X7R160-223M
C22	1	Capacitor, 1.5 nF, 100 V, ±10%, X7R, 0805	Venkel	C0805X7R101-152K
C23	1	Capacitor, 1 µF, 25 V, ±10%, X5R, 0603	Venkel	C0603X5R250-105K
C24, C26	2	Capacitor, 220 nF, 16 V, ±5%, X7R, 0603	Kemet	C0603C224J4RACTU
C25	1	Capacitor, 0.1 µF, 100 V, ±10%, X7R, 0805	Venkel	C0805X7R101-104K
C29	1	Capacitor, 0.1 µF, 10 V, ±10%, X7R, 0603	Venkel	C0603X7R100-104K
C30	1	Capacitor, 4.7 nF, 25 V, ±2%, C0G, 0805	Venkel	C0805C0G250-472G
C31	1	Capacitor, 2.2 nF, 16 V, ±2%, C0G, 0805	Venkel	C0805C0G160-222G
C34	1	Capacitor, 1.0 µF, 16 V, ±10%, X5R, 0402	Venkel	C0402X5R160-105KN
C35	1	Capacitor, 0.01 µF, 25 V, ±10%, X8R, 0603	KEMET	C0603C103K3HACAUTO
D1	1	Diode, single, 100 V, 1.0 A, SMA	Fairchild	S1B
D2, D3, D4, D5, D6, D7, D8, D9, 13	9	Diode, Schottky, 100 V, 5 A, PowerDI-5	Diodes Inc.	PDS5100H-13
D10	1	Diode, single, 100 V, 1.0 A, SMA	Fairchild	RS1B
D11	1	Diode, 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	Connector, RJ-45, 1 Port, tab down, 0.050" pitch, PTH	MOLEX	95001-2881
J3	1	Connector, power jack, RA, 2.1 mm, PTH	Adam Tech	ADC-002-1
J4, J5	2	Connector, banana jack, threaded uninsulated	Abbatron HH Smith	101
LB1	1	Label, PDB, polyimide, white, 1.00 in. X 0.187 in., font 2	Skyworks	LABEL-Si34061-EVB-EXT-BOM-R1.7-12V
L1	1	Choke, 500 µH, 1 A, 1 kΩ, SMT	Bourns	SRF0905-501Y
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

Table 5. Si34061-EVB-EXT-12V Bill of Materials List

Reference	Qty	Description	Manufacturer	Part Number
MH1, MH2, MH3, MH4	4	Hardware, 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	Skyworks	Si34061-EVB-EXT REV 1.6
Q1	1	Transistor, MOSFET, N-Ch, 100 V, 23 A, Powerpak-SO-8	Vishay	SQJ476EP-T1_GE3
R1, R2, R3, R4, R6, R7, R8, R9	8	Resistor, 75 Ω, 1/16 W, ±0.5%, thin film, 0603	Susumu	RR0816Q-750-D
R5	1	Resistor, 845 kΩ, 1/10 W, ±1%, thick film, 0603	Panasonic	ERJ-3EKF8453V
R10	1	Resistor, 78.7 kΩ, 1/8 W, ±1%, thick film, 0805	Yageo	RC0805FR-0778K7L
R11	1	Resistor, 100 Ω, 1/10 W, ±1%, thick film, 0805	Venkel	CR0805-10W-1000F
R12	1	Resistor, 10 Ω, 1/4 W, ±1%, thick film, 1206	Venkel	CR1206-4W-10R0F
R13	1	Resistor, 10 Ω, 1/10 W, ±1%, thick film, 0805	Venkel	CR0805-10W-10R0F
R14	1	Resistor, 95.3 kΩ, 1/16 W, ±1%, thick film, 0603	Venkel	CR0603-16W-9532F
R15	1	Resistor, 1 kΩ, 1/10 W, ±1%, thick film, 0603	Venkel	CR0603-10W-1001F
R16, R18	2	Resistor, 10.0 Ω, 1/16 W, ±1%, thick film, 0603	Venkel	CR0603-16W-10R0F
R17, R22	2	Resistor, 24 kΩ, 1/10 W, ±1%, thick film, 0603	Panasonic	ERJ-3EKF2402V
R19	1	Resistor, 33.2 Ω, 1/16 W, ±1%, thick film, 0603	Venkel	CR0603-16W-33R2F
R20	1	Resistor, 23.7 Ω, 1/16 W, ±1%, thick film, 0603	Venkel	CR0603-16W-23R7F
R21	1	Resistor, 24.9K, 1/10W, ±1%, thick film, 0603	Venkel	CR0603-10W-2492F
R23	1	Resistor, 0 Ω, 1 A, thick film, 0603	Panasonic	ERJ-3GEY0R00V
R24	1	Resistor, 0.1 Ω, 1 W, ±1%, thick film, 1206	Panasonic	ERJ-8BWFR100V
R25	1	Resistor, 3.24 kΩ, 1/8 W, ±1%, thick film, 0805	Vishay	CRCW08053K24FKEA
R26	1	Resistor, 1 kΩ, 1/8 W, ±1%, thick film, 0805	Venkel	CR0805-8W-1001F
R27	1	Resistor, 4.7 kΩ, 1/10 W, ±5%, thick film, 0603	Venkel	CR0603-10W-472J
R28	1	Resistor, 36.5 kΩ, 1/10 W, ±1%, thick film, 0805	Venkel	CR0805-10W-3652F
R29, R31	2	Resistor, 0 Ω, 2 A, thick film, 0805	Venkel	CR0805-10W-000
R32	1	Resistor, 4.12K, 1/10 W, ±1%, thick film, 0805	Venkel	CR0805-10W-4121F
R33	1	Resistor, 0.3 Ω, 1/2 W, ±1%, thick film, 1206	Venkel	LCR1206-R300F
R34	1	Resistor, 3 Ω, 1/8 W, ±1%, thick film, 0805	Venkel	CR0805-8W-3R00FT
SO1, SO2, SO3, SO4	4	Hardware, standoff, 4-40 x 1/2", nylon	SPC Technology	2397
SW1	1	Switch, SPDT, slide, on-on, 0.1 pitch, 12 V, PTH	Apem Inc.	NK236H
TP1, TP2, TP3, TP4	4	Test point, black, PTH	Kobiconn	151-203-RC
TP5, TP6	2	Test point, RED, 0.050 in. loop, PTH	Keystone	5000
TP8, TP9, TP10, TP11, TP12, TP14, TP15, TP16, TP17, TP18, TP19	11	Test point, black, 0.050" loop, PTH	Keystone	5001
T1	1	Module, PoE+/PoE++ magnetics, pulse xfmr 1CT:1CT TX 1CT:1CT RX, SMD	Wurth	7490220121

Table 5. Si34061-EVB-EXT-12V Bill of Materials List

Reference	Qty	Description	Manufacturer	Part Number
T2	1	Transformer, flyback, 30 W, 12 V, SMD	LinkCom	LDT1026-50R
T3	1	Gate xfmr, 1:1, 1500 Vrms, 1200 µH, 27.2 V µsec	Pulse Engineering	PA0184NL
U1	1	Transistor, MOSFET, N-CH, 60 V, 21 A, Powerpak-SO-8	ON Semi	NVMFS5C680NLT1G
U2	1	IC, IEEE 802.3-Compliant POE+ PD interface, QFN24	Skyworks	Si34061
U3	1	Transistor, MOSFET, N-CH, 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	Capacitor, 470 pF, 25 V, ±20%, X7R, 0402	Venkel	C0402X7R250-471M
C36	1	Capacitor, 0.01 µF, 100 V, ±10%, X7R, 0805	Venkel	C0805X7R101-103K
D15	1	Diode, TVS, UNIDIR, 58 V, 400 W	Littelfuse	SMAJ58A
R30	1	Resistor, 1 kΩ, 1/10 W, ±1%, thick film, 0603	Venkel	CR0603-10W-1001F
R35	1	Resistor, 100 Ω, 1/10 W, ±1%, thick film, 0805	Venkel	CR0805-10W-1000F
TP7	4	Test point, black, 0.050" loop, PTH	Keystone	5001

21. Design and Layout Checklist

Complete EVB design databases can be found on the Skyworks Power over Ethernet page. Skyworks 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.

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

Refer also to the "Si34071 Data Sheet" and "AN1130: Si3404/06x PoE-PD Controller Design 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. Skyworks 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 load 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 R_{CLASS} value by referring to AN1130.
2. General Design Checklist
   a. Non-standard PoE injectors turn 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, include a 3 Ω resistor in place of R34.
3. Layout Guidelines
   a. Make sure the Si34061 VNEG pin 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 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 must 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 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.