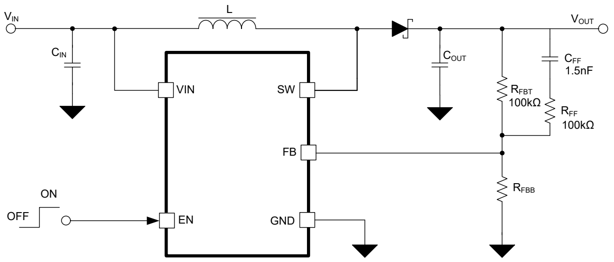
TLV61040-Q1 Automotive Low-Power DC-DC Boost Converter in SOT-23 Package

1 Features

- AEC-Q100 qualified
  - Device temperature grade 1: –40°C to +125°C ambient operating temperature range
- Functional Safety-Capable
  - Documentation available to aid functional safety system design
- 1.8V to 20V Input voltage range
- Up to 28V adjustable output voltage range
- 400mA internal switch current limit
- Up to 2MHz switching frequency
- 25µA typical no load quiescent current
- 0.4µA typical shutdown current
- Internal soft start
- Space-saving, 5-pin SOT-23 package

2 Applications

- Automotive telematics, ecall, and tolling
- Infotainment and clusters
- Advanced driver assistance system (ADAS)
- LCD bias supplies
- White-LED supplies for LCD backlights
- Dual-CELL NiMH/NiCd or single-CELL li-ion battery-powered systems
- Standard 3.3V or 5V to 12V conversions



Typical Application Diagram

3 Description

The TLV61040-Q1 devices are high-frequency boost converters for automotive applications. The devices are designed for generating output voltages up to 28V from a pre-regulated low voltage rail, dual-cell NiMH/NiCd, or a single-cell Li-Ion battery, supporting input voltages from 1.8V to 20V.

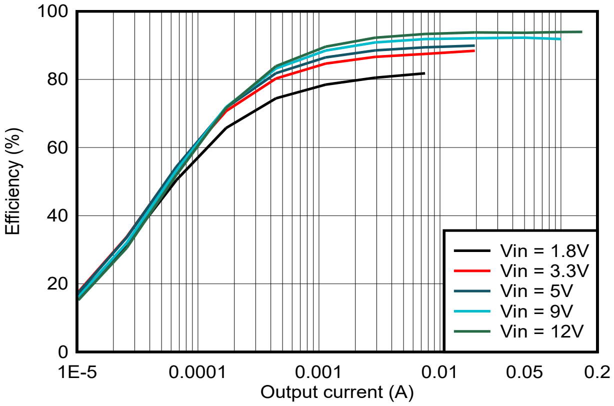
The TLV61040-Q1 devices operate with a switching frequency up to 2MHz, allowing the use of small external components such as ceramic as well as tantalum output capacitors. Combined with the space-saving, 5-pin SOT-23 package, the TLV61040-Q1 devices accomplish a small overall design size. The TLV61040-Q1 device has an internal 400mA switch current limit, offering lower output voltage ripple and allowing the use of a smaller form factor inductor for lower-power applications.

The TLV61040-Q1 devices operate in a pulse frequency modulation (PFM) scheme with constant peak current control. The combination of low quiescent current (25µA typical) and the optimized control scheme enable operation of the devices at high efficiency over the entire load current range.

Package Information

PART NUMBER	PACKAGE(1)	PACKAGE SIZE(2)
TLV61040-Q1	DDC (SOT-23-THN, 5)	2.9mm × 2.8mm

(1) For more information, see Section 10.
(2) The package size (length × width) is a nominal value and includes pins, where applicable.



Efficiency vs Output Current, V_{OUT} = 18V

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4 Pin Configuration and Functions

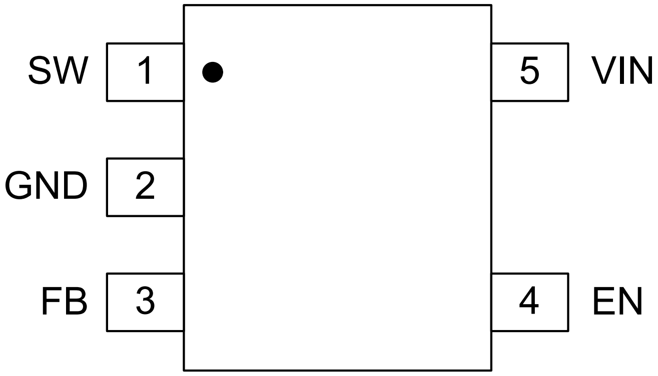


Figure 4-1. DDC Package 5 Pin SOT-23-THN (Top View)

Table 4-1. Pin Functions

PIN		TYPE[1]	DESCRIPTION
NAME	NO.		
EN	4	I	This pin is the enable pin of the device. Pulling this pin to ground forces the device into shutdown mode reducing the supply current to less than 1μA. This pin must not be left floating and must be terminated.
FB	3	I	This pin is the feedback pin of the device. Connect this pin to the external voltage divider to program the desired output voltage.
GND	2	—	Ground
SW	1	I	Connect the inductor and the Schottky diode to this pin. This pin is the switch pin and is connected to the drain of the internal power MOSFET.
V_{IN}	5	I	Supply voltage pin

(1) I = input, O = output

5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) (1)

		MIN	MAX	UNIT
Voltage range at terminals (2)	VIN,EN	–0.3	20.5	V
	SW	–0.3	32	V
	FB	–0.3	6	V
Operating junction temperature range, T_J		–40	150	°C
Storage temperature, T_{stg}		–65	150	°C

(1) Operation outside the *Absolute Maximum Ratings* may cause permanent device damage. *Absolute Maximum Ratings* do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Conditions*. If used outside the *Recommended Operating Conditions* but within the *Absolute Maximum Ratings*, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.

(2) All voltage values are with respect to network ground terminal.

5.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per AEC Q100-002, all pins(1)	±2000	V
		Charged device model (CDM), per AEC Q100-011, all pins	±750	V

(1) AEC Q100-002 indicates that HBM stressing must be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

5.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	TYP	MAX	UNIT
V_{IN}	Input voltage range	1.8		20	V
V_{OUT}	Output voltage range	4.5		28	V
L	Inductance range	2.2	10	22	µH
C_{IN}	Effective input capacitance range	1	10		µF
C_{OUT}	Effective output capacitance range	1	10	120	µF
T_J	Operating junction temperature	–40		125	°C

5.4 Thermal Information

THERMAL METRIC(1)		TLV61040-Q1 DDC (SOT23) 5 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	145.8	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	77.6	
$R_{\theta JB}$	Junction-to-board thermal resistance	56.5	
Ψ_{JT}	Junction-to-top characterization parameter	28.5	
Ψ_{JB}	Junction-to-board characterization parameter	54.9	
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	NA	

(1) For more information about traditional and new thermal metrics, see the Semiconductor and IC Package Thermal Metrics application note.

5.5 Electrical Characteristics

T_J = –40°C to 150°C, V_{IN} = 5.0V. Typical values are at T_J = 25°C, unless otherwise noted.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
POWER SUPPLY						
V_{IN}	Input voltage range		1.8		20	V
V_{IN_UVLO}	Undervoltage lockout threshold	V_{IN_UVLO} rising		1.7	1.79	V
		V_{IN_UVLO} falling		1.55	1.64	
V_{IN_HYS}	V_{IN_UVLO} hysteresis			150		mV
I_{Q_VIN}	Quiescent current into VIN pin	IC enabled, no load, no switching, V_{IN} = 2.6V to 20V, FB = 1.4V, T_J = –40°C to 125°C		25	50	µA
I_{SD}	Shutdown current into VIN pin	IC disabled, V_{IN} = 2.6V to 20V, T_J= –40°C to 125°C		0.4	2.1	µA
I_{FB_LKG}	Leakage current into FB pin	T_J= –40°C to 125°C			50	nA
I_{SW_LKG}	Leakage current into SW pin	IC disabled, SW = 28V, T_J = –40°C to 125°C			500	nA
OUTPUT						
V_{OUT}	Output voltage range		4.5		28	V
V_{REF}	Reference Voltage at FB pin	T_J = –40°C to 125°C	1.209	1.233	1.258	V
POWER SWITCH						
$R_{DS(on)}$	Low-side MOSFET on resistance	V_{IN} = 5V, V_{OUT} = 12V		200		mΩ
t_{OFF_min}	Minimum off time			400	500	ns
t_{ON_min}	Minimum on time			45	150	ns
I_{LIM_SW}	TLV61040-Q1 Peak switch current limit	V_{IN} = 5V	320	400	480	mA
D_{min}	Minimum duty cycle	V_{OUT} = 4.5V to 28V		13.5%	16.5%	
$t_{STARTUP}$	Soft startup time	Internal SS ramp time, from 0V to V_{REF}		2.5		ms
LOGIC INTERFACE						
V_{EN_H}	EN Logic high threshold				1.2	V
V_{EN_L}	EN Logic low threshold		0.4			V
R_{EN}	EN pulldown resistor			1		MΩ
PROTECTION						
T_{SD}	Thermal shutdown threshold	T_J rising		170		°C
T_{SD_HYS}	Thermal shutdown hysteresis	T_J falling below T_{SD}		20		°C

5.6 Typical Characteristics

TLV61040-Q1, T_A = 25°C, unless otherwise noted

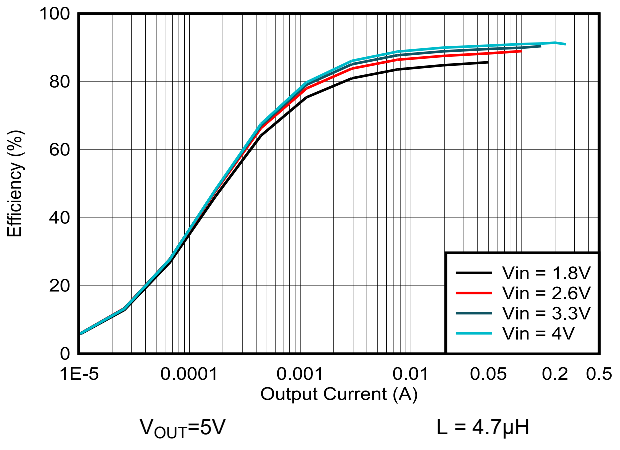


Figure 5-1. Efficiency vs Output Current

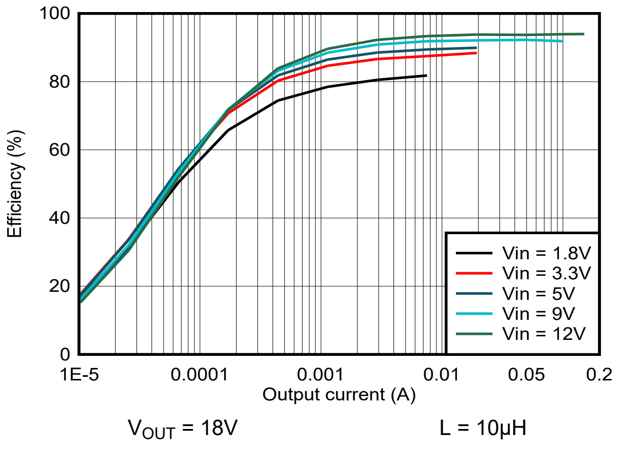


Figure 5-2. Efficiency vs Output Current

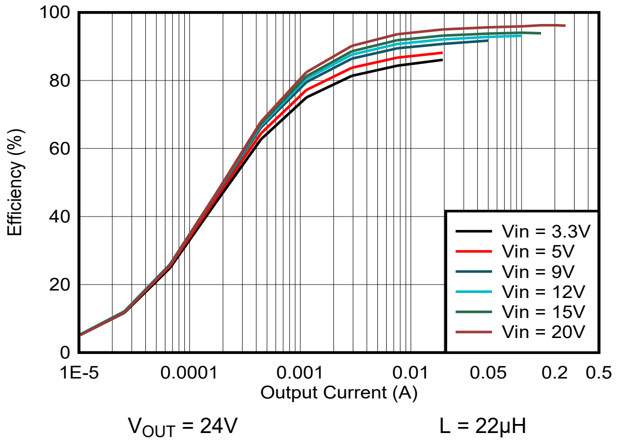


Figure 5-3. Efficiency vs Output Current

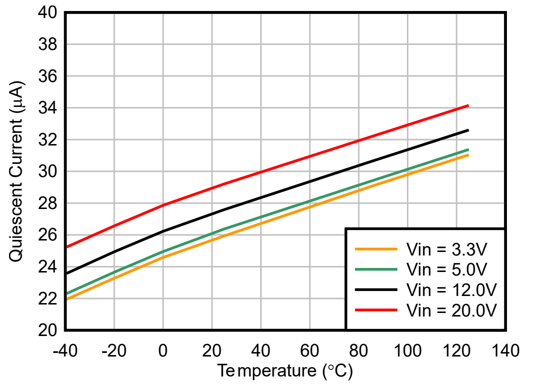


Figure 5-4. Quiescent Current vs Temperature

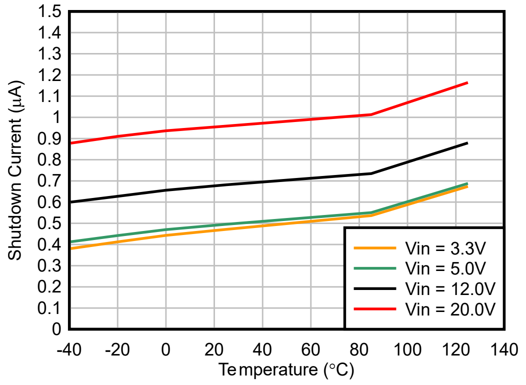


Figure 5-5. Shutdown Current vs Temperature

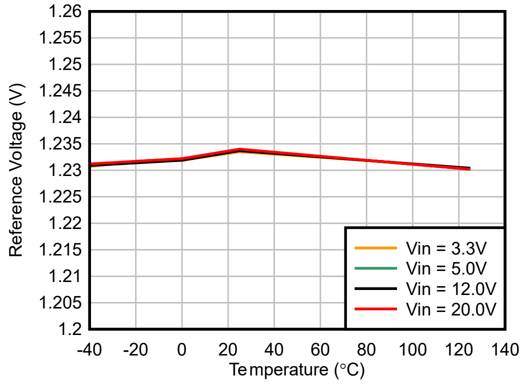


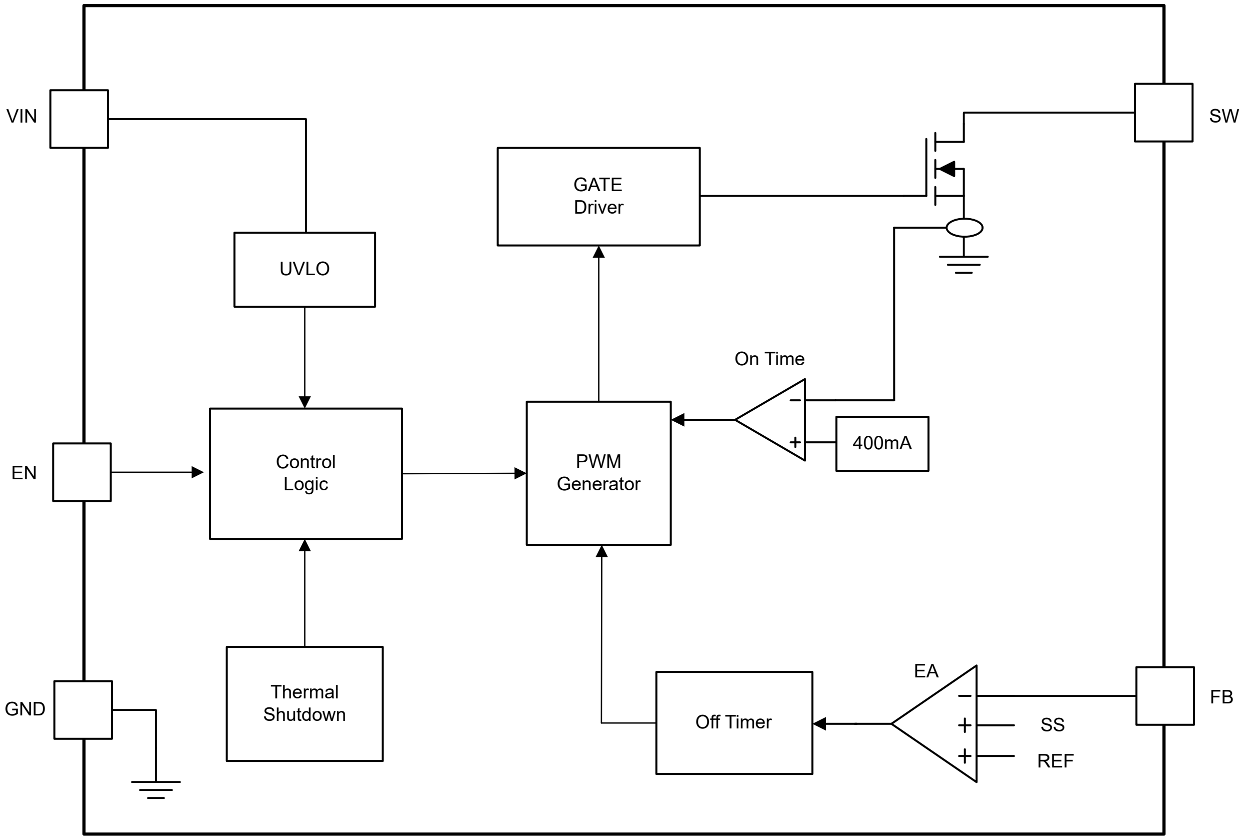
Figure 5-6. Reference Voltage vs Temperature

6 Detailed Description

6.1 Overview

The TLV61040-Q1 is a high-frequency boost converter dedicated for small-to-medium LCD bias supply and white-LED backlight supplies. The device is designed for generating output voltages up to 28V from a dual-cell NiMH/NiCd, a single-cell device Li-Ion battery, or 3.3V, 5V, 12V standard voltage bus.

6.2 Functional Block Diagram



6.3 Feature Description

6.3.1 Peak Current Control

The internal switch turns on until the inductor current reaches the typical peak current limit (I_{LIM}) of 400mA. Due to the internal propagation delay of typical 60ns, the actual current exceeds the peak current limit threshold by a small amount. Use Equation 1 to calculate the typical peak current limit:

$$I_{peak(typ)} = I_{LIM} + \frac{V_{IN}}{L} \times 60ns \tag{1}$$

where

- V_{IN}= Input voltage
- L= Selected inductor value
- I_{LIM} = Typical peak current limit, 400mA

The higher the input voltage and the lower the inductor value, the greater the peak.

By selecting the TLV61040-Q1, tailoring the design to the specific application current limit requirements is possible. A lower current limit supports applications requiring lower output power and allows the use of an inductor with a lower current rating and a smaller form factor. A lower current limit typically has a lower output-voltage ripple as well.

6.3.2 Soft Start

The soft-start feature helps the regulator to gradually reach the steady state operating point, therefore reducing start-up stresses and surge. When the input voltage is applied, the output capacitor is charged to VIN through the inductor and high side rectifier diode. After reaching the 1.7V (typical) UVLO rising threshold and EN logic high, the internal soft-start control circuit initiates to ramp the reference voltage with slew rate from 0V to 1.233V within 2.5ms (typical).

All inductive step-up converters exhibit high inrush current during start-up if no special precaution is made. This action can cause voltage drops at the input rail during start-up and can result in an unwanted or early system shutdown. The TLV61040-Q1 limits this inrush current by increasing the current limit in two steps starting from I_{LIM} / 4 for 256 cycles to I_{LIM} / 2 for the next 256 cycles, and then full current limit (see Figure 7-2).

6.3.3 Enable

Pulling the enable (EN) to ground shuts down the device, reducing the shutdown current to 0.4μA (typical). Because there is a conductive path from the input to the output through the inductor and Schottky diode, the output voltage is equal to the input voltage during shutdown. The enable pin must be terminated and must not be left floating.

6.3.4 Undervoltage Lockout

An undervoltage lockout prevents misoperation of the device at input voltages below typical 1.55V. When the input voltage is below the undervoltage threshold, the main switch is turned off.

6.3.5 Thermal Shutdown

An internal thermal shutdown is implemented and turns off the internal MOSFETs when the typical junction temperature of 170°C is exceeded. The thermal shutdown has a hysteresis of typically 20°C. This data is based on statistical means and is not tested during the regular mass production of the IC.

6.4 Device Functional Modes

The TLV61040-Q1 operates with an wide input voltage range of 1.8V to 20V and can generate output voltages up to 28V. The device operates in a pulse frequency modulation (PFM) scheme with constant peak current control. This control scheme maintains high efficiency over the entire load current range, and with a switching frequency up to 2MHz, the device enables the use of very small external components.

The converter monitors the output voltage, and the feedback voltage is connected to error amplifier with reference voltage of typically 1.233V. The output of error amplifier controls the off-time timer. After the timer ends, the internal switch turns on and the current ramps up. The switch turns off as soon as the inductor current reaches the internally set peak current of typically 400mA. See also *Section 6.3.1*. The second criteria that turns off the switch is the maximum ON-time of 6μs (typical). This action is to limit the maximum ON-time of the converter to cover for extreme conditions. As the switch is turned off, the external Schottky diode is forward biased, delivering the current to the output. The switch remains off for a minimum of 400ns (typical), or until the off timer is down. Using this PFM peak-current control scheme, the switching frequency of the converter depends on the output current, which results in high efficiency over the entire load current range.

7 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

7.1 Application Information

The TLV61040-Q1 is designed for output voltages up to 28V with an input voltage range of 1.8V to 20V. The TLV61040-Q1 can operate up to 400mA typical peak load current. The device operates in a pulse-frequency-modulation (PFM) scheme with constant peak-current control. This control scheme maintains high efficiency over the entire load current range, and with a switching frequency up to 2MHz, the device enables the use of very small external components.

7.2 Typical Application

The following section provides a step-by-step design approach for configuring the TLV61040-Q1 as a voltage-regulating boost converter for LCD bias supply, as shown in Figure 7-1.

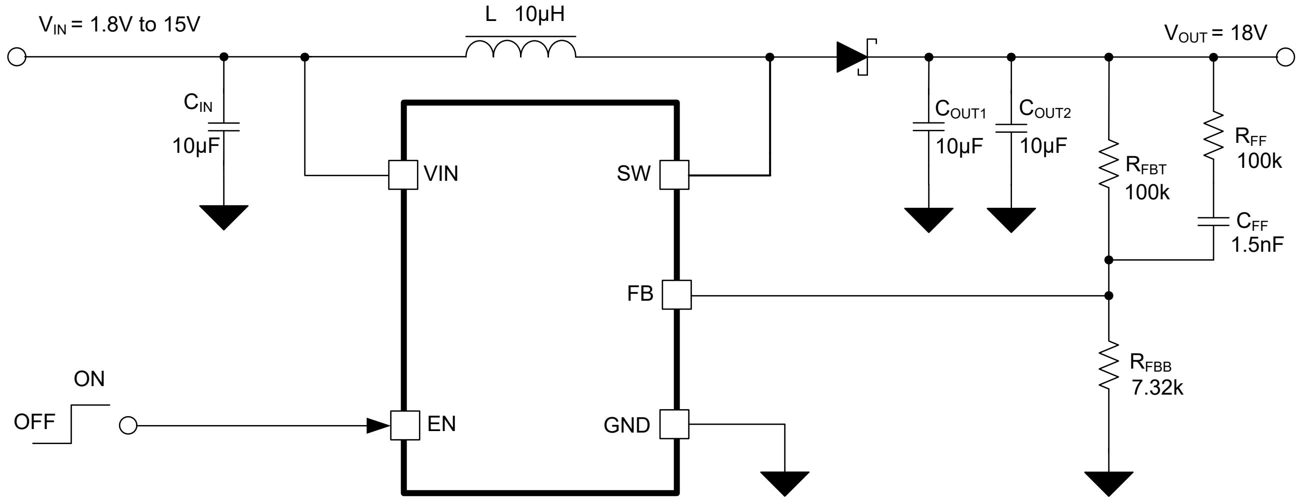


Figure 7-1. LCD Bias Supply

7.2.1 Design Requirements

Table 7-1 lists the design parameters for this example.

Table 7-1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Input voltage	1.8V to 6V or 9V to 15V
Output voltage	18V
Output current	10mA (V_{IN} = 1.8V to 6V) 50mA (V_{IN} = 9V to 15V)

7.2.2 Detailed Design Procedure

7.2.2.1 Inductor Selection, Maximum Load Current

Because the PFM peak-current control scheme is inherently stable, the inductor value does not affect the stability of the regulator. Depending on the application, TI recommends inductor values from 2.2µH to 47µH. And the final inductor value must selected by the following instructions.

There are two conditions that limit the maximum inductor value. The maximum inductor value is firstly determined by the maximum on-time of the switch, typically 6µs. The peak current limit of 400mA (typically) must be reached within this 6µs period for proper operation. Use Equation 2 to calculate the maximum inductor value.

$$L_{max1} = V_{IN(\min)} \times \frac{6\mu s}{I_{LIM}} \tag{2}$$

Where:

- $V_{IN(min)}$= minimum input voltage
- I_{LIM} = 400mA

The other limitation of maximum inductor value is inductor current ripple cannot be lower than 100mA. The minimum inductor current ripple occurs when load is heavy to trigger minimum off time of 400ns (typically). Use Equation 3 to calculate the maximum inductor value.

$$L_{max2} = \left(V_{OUT} - V_{IN(\max)}\right) \times \frac{400ns}{100mA} \tag{3}$$

Where:

- $V_{IN(max)}$= maximum input voltage
- V_{OUT}= target output voltage

The inductor value need to be lower than both L_{max1} and L_{max2}.

There is also a minimum limitation of the inductor value that the current limit must not be triggered during minimum on-time. Use Equation 4 to calculate the minimum inductor value.

$$L_{min} = V_{IN(\max)} \times \frac{150ns}{I_{LIM}} \tag{4}$$

The inductor value can be selected within the limitation. Besides, the inductor value also affects the maximum available load current. The larger the inductor value, the larger the maximum available load current. After selecting the inductor value, maximum available load current must be checked. If the actual load current is higher than maximum available load current, the V_{OUT} drops. Use Equation 5 to calculate the maximum available load current.

$$I_{Load(max)} = \begin{cases} \dfrac{\eta L I_{LIM}^2}{2\left(\dfrac{L I_{LIM}}{V_{IN(min)}} + 400ns\right)\left(V_{OUT} - V_{IN(\min)}\right)}, \ if\ \dfrac{V_{OUT} - V_{IN(min)}}{L \div 400ns} > I_{LIM} \\ \dfrac{\eta V_{IN(\min)}}{V_{OUT}}\left(I_{LIM} - \dfrac{V_{OUT} - V_{IN(\min)}}{2L} \times 400ns\right), \ if\ \dfrac{V_{OUT} - V_{IN(min)}}{L \div 400ns} \le I_{LIM} \end{cases} \tag{5}$$

Where:

- $V_{IN(min)}$= minimum input voltage
- V_{OUT}= target output voltage
- I_{LIM} = 400mA
- L = selected inductor value
- η = expected converter efficiency. Typically 80% to 95% at maximum available load current

A smaller inductor value gives a higher converter switching frequency, but lowers the efficiency and the maximum available inductor current.

The next step is to calculate the switching frequency at the nominal load current using Equation 6:

$$f_{sw}(I_{Load}) = \frac{2 \times I_{Load}(V_{OUT} - V_{IN})}{\eta L I_{peak}^2} \tag{6}$$

Where:

- I_{peak} = peak current as described in the *Peak Current Control* section
- L = selected inductor value
- I_{Load} = nominal load current

Lastly, the selected inductor must have a saturation current that exceeds the maximum peak current of the converter (as calculated in the *Peak Current Control* section). Use the maximum value for I_{LIM} for this calculation.

Another important inductor parameter is the DC resistance. The lower the DC resistance, the higher the efficiency of the converter. Table 7-2 lists a few typical inductors for LCD bias supply design (see Figure 7-1), but customers must verify and validate the typical inductors to check whether the typical inductors are designed for the customer's application.

Table 7-2. Typical Inductors for LCD Bias Supply

PART NUMBER	L(µH)	DCR MAX (mΩ)	SATURATION CURRENT TYPICAL (A)	VENDOR[1]
XFL3012-223ME	22	630	0.52	Coilcraft
XFL3012-103ME	10	306	0.74	Coilcraft
XFL3012-472ME	4.7	171	1.2	Coilcraft

(1) See the *Third-Party Products Disclaimer*.

7.2.2.2 Setting The Output Voltage

The output voltage is calculated as:

$$V_{OUT} = 1.233\ V \times \left(1 + \frac{R_{FBT}}{R_{FBB}}\right) \tag{7}$$

For automotive applications, TO does not recommend a a resistor over 100kΩ. To minimize leakage current from feedback network, TI recommends R_{FBT} as 100kΩ so R_{FBB} can be variable to adjust V_{OUT}.

In TLV61040-Q1, the inductor current is limited to 400mA, so during start-up, the output voltage cannot rise fast enough to follow internal reference. Then the internal error amplifier output goes high and even gets saturated. So after V_{OUT} reaches the target, the error amplifier needs time to exit saturation and enter normal regulation. During this time, the V_{OUT} continue rising, causing overshoot. A feedforward capacitor of 1.5nF and a feedforward resistor of 100kΩ across the upper feedback resistor R_{FBT} is required to prevent the overshoot. Without a feedforward resistor, whose value is too small, the TLV61040-Q1 shows *double pulses* or a pulse burst instead of single pulses at the switch node (SW), causing higher output voltage ripple.

7.2.2.3 Input and Output Capacitor Selection

The output capacitor is mainly selected to meet the requirements for output ripple and loop stability. This ripple voltage is related to the capacitor capacitance and the equivalent series resistance (ESR). Assuming a ceramic capacitor with zero ESR, use Equation 8 to calculate the minimum capacitance needed for a given ripple.

$$C_{OUT} = \frac{I_{Load} D_{max}}{f_{sw} V_{ripple}} \tag{8}$$

Where:

- I_{Load} = Nominal load current
- D_{max} = Maximum duty cycle in the application
- f_{sw} = Switching frequency at the nominal load current as calculated previously
- V_{ripple} = Target peak to peak output voltage ripple

The ESR impact on the output ripple must be considered if tantalum or aluminum electrolytic capacitors are used.

Take care when evaluating the derating of a ceramic capacitor under DC bias, aging, and AC signal. For example, the DC bias can significantly reduce capacitance. A ceramic capacitor can lose more than 50% of the capacitance at the rated voltage. Therefore, always leave margin on the voltage rating to make sure of adequate capacitance at the required output voltage.

TI recommends using the output capacitor with effective capacitance 10µF, which covers the major applications. TI also recommends placing a small 1µF capacitor right across the rectifier diode cathode to the GND pin of the TLV61040-Q1 to reduce the high RMS current loop inductance. The output capacitor affects the small signal control loop stability of the boost regulator. If the output capacitor is below the range, the boost regulator can potentially become unstable. Increasing the output capacitor makes the output voltage ripple smaller in PWM mode.

But if total output capacitance is too large, because the boost converter cannot control inductor current when V_{IN} is close to V_{OUT}, the inductor current increases to a high level during start-up until V_{OUT} is high enough. The larger the C_{OUT} and V_{IN}, the higher the peak inrush current. If the peak inductor current is higher than 2.5A, the device has risk to damage. TI recommends total output capacitance for TLV61040-Q1 to be less than 120µF.

Table 7-3 lists the recommended capacitor for the TLV61040-Q1.

Table 7-3. Recommended Output Capacitors for the TLV61040-Q1

PART NUMBER	C_{OUT} (µF)	RATING	PACKAGE	VENDOR[1]
TMK316BLD106KL	10	25V, X5R	1206	Taiyo Yuden
CC1206KKX5R8BB106	10	25V, X5R	1206	Yageo
CGA5L1X7R1H106K160AC	10	50V, X7R	1206	TDK

(1) See the *Third-Party Products Disclaimer*.

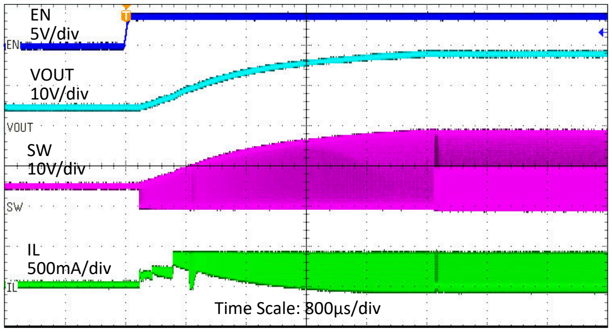
The ceramic capacitors are an excellent choice for the input decoupling of the step-up converter because the ceramic capacitors have extremely low ESR and are available in small footprints. Input capacitors must be located as close as possible to the device. While a 10µF input capacitor or equivalent is sufficient for the most applications, larger values can be used to reduce input current ripple.

Take care when using only ceramic input capacitors. When a ceramic capacitor is used at the input and the power is being supplied through long wires, such as from a wall adapter, a load step at the output can induce ringing at the VIN pin. This ringing can couple to the output and be mistaken as loop instability or can even damage the device. Additional "bulk" capacitor (electrolytic or tantalum) in this circumstance, must be placed between C_{IN} and the power source lead to reduce ringing that can occur between the inductance of the power source leads and C_{IN}.

7.2.2.4 Diode Selection

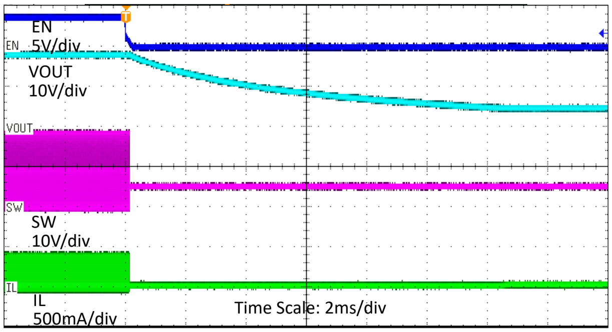
A Schottky diode is the preferred type due to the low forward voltage drop and small reverse recovery charge. Low reverse leakage current is important parameter when selecting the Schottky diode. The diode must be rated to handle the maximum output voltage plus any switching node ringing. Also, the diode must be able to handle the average output current.

7.2.3 Application Curves



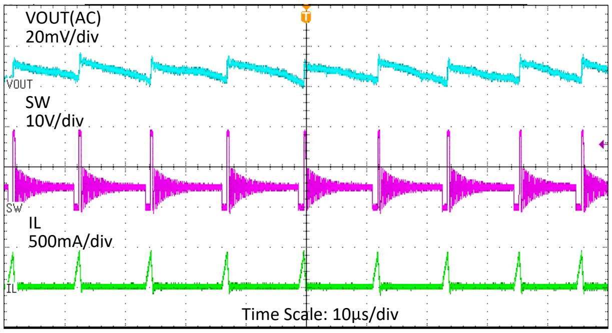
V_{IN} = 5V V_{OUT} = 18V R_{LOAD} = 600Ω

Figure 7-2. Start-up by EN Waveforms



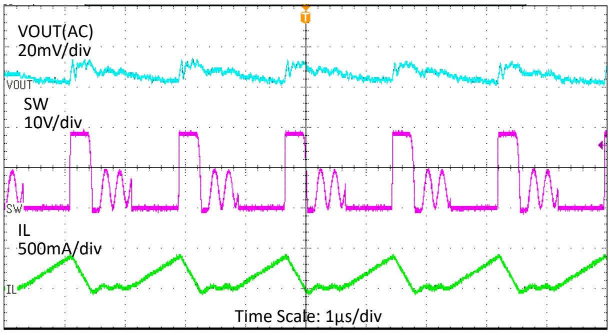
V_{IN} = 5V V_{OUT} = 18V R_{LOAD} = 600Ω

Figure 7-3. Shutdown by EN waveforms



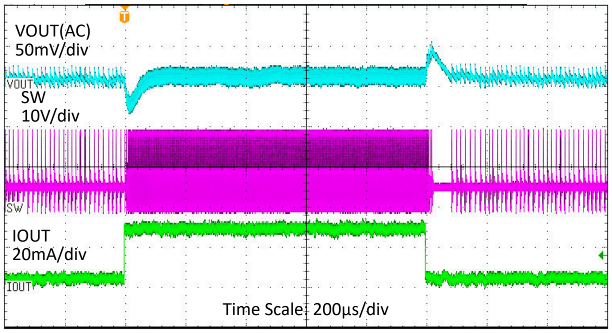
V_{IN} = 5V V_{OUT} = 18V I_{LOAD} = 5mA

Figure 7-4. Switching Waveforms in Steady State



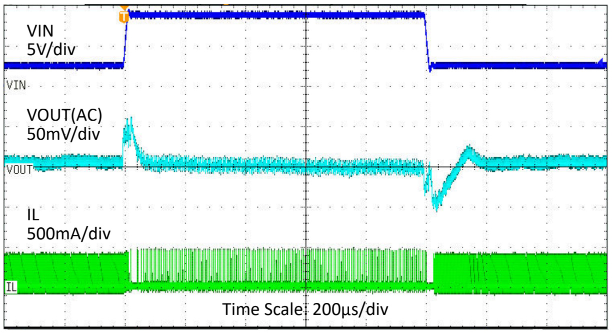
V_{IN} = 5V V_{OUT} = 18V I_{LOAD} = 30mA

Figure 7-5. Switching Waveforms in Steady State



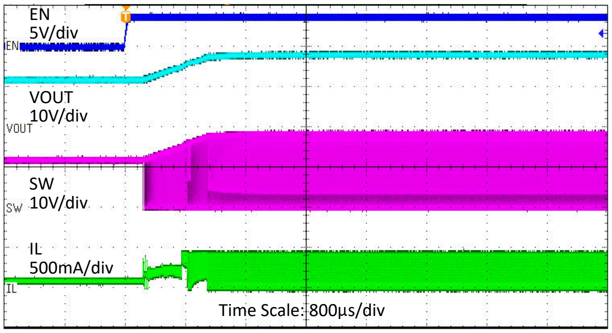
V_{IN} = 5V V_{OUT} = 18V I_{LOAD} = 5mA to 30mA

Figure 7-6. Load Transient



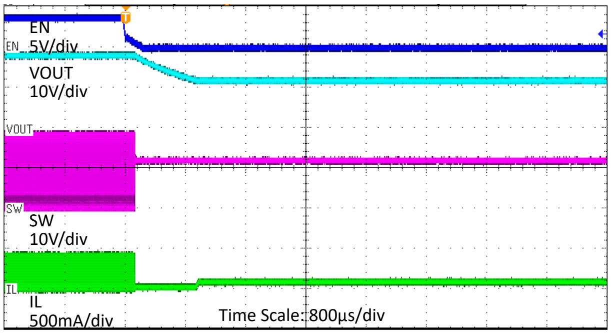
V_{IN} = 2.6V to 9V V_{OUT} = 18V I_{LOAD} = 15mA

Figure 7-7. Line Transient



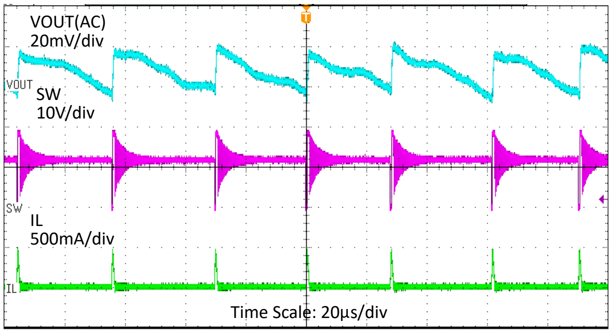
V_{IN} = 12V V_{OUT} = 18V R_{LOAD} = 180Ω

Figure 7-8. Start-up by EN waveforms



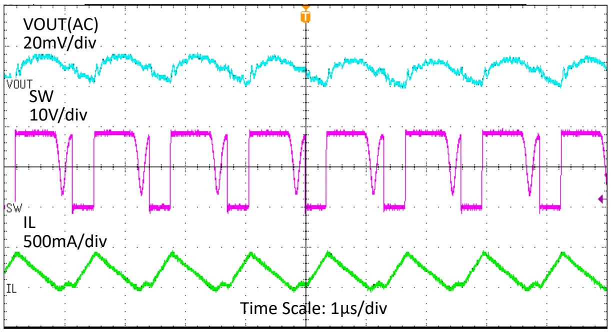
V_{IN} = 5V V_{OUT} = 18V R_{LOAD} = 180Ω

Figure 7-9. Shutdown by EN waveforms



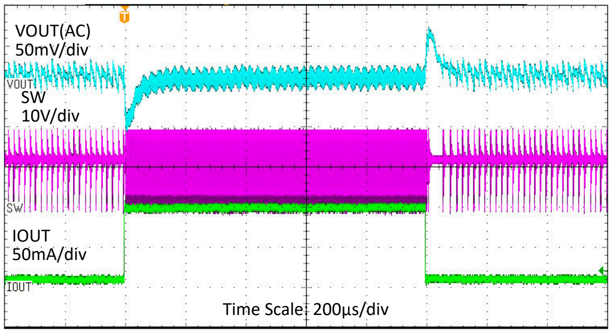
V_{IN} = 12V V_{OUT} = 18V I_{LOAD} = 5mA

Figure 7-10. Switching Waveforms in Steady State



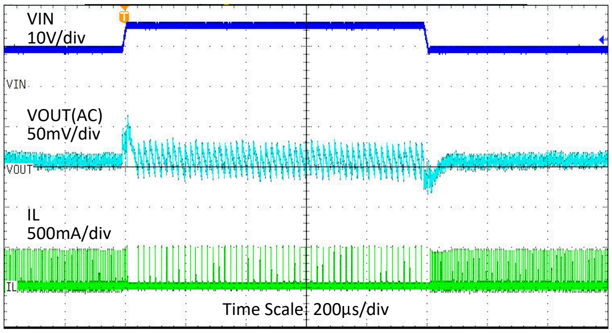
V_{IN} = 12V V_{OUT} = 18V I_{LOAD} = 0.1A

Figure 7-11. Switching Waveforms in Steady State



V_{IN} = 12V V_{OUT} = 18V I_{LOAD} = 10mA to 100mA

Figure 7-12. Load Transient



V_{IN} = 9V to 15V V_{OUT} = 18V I_{LOAD} = 0.1A

Figure 7-13. Line Transient

7.3 Power Supply Recommendations

The device is designed to operate from an input voltage supply range from 1.8V to 20V. The output current of the input power supply must be rated according to the supply voltage, output voltage, and output current of TLV61040-Q1.

7.4 Layout

7.4.1 Layout Guidelines

Typical for all switching power supplies, the layout is an important step in the design, especially at high peak currents and switching frequencies. If the layout is not carefully done, the regulator can show noise problems and duty cycle jitter.

Figure 7-14 provides an example of layout design with TLV61040-Q1.

- Place the input capacitor as close as possible to the input pin for good input voltage filtering.
- Place the inductor and diode as close as possible to the switch pin to minimize the noise coupling into other circuits.
- Keeping the switching pin and plane area short helps in minimizing the radiated emissions. Make sure to have a very low impedance switch plane to reduce the switching losses, and therefore a trade-off must be made between these two and the switching pin and plane must be optimized.
- Because the feedback pin and network is noise-sensitive, route the feedback network away from the inductor.
- Shield the feedback pin and feedback network with a ground plane or trace to minimize noise coupling into this circuit.
- A star ground connection or ground plane minimizes ground shifts and noise.

7.4.2 Layout Example

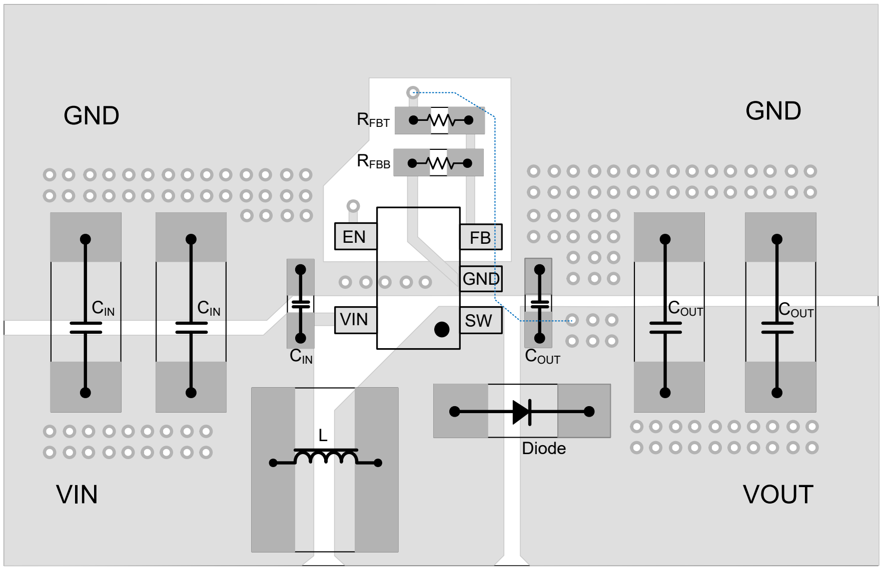


Figure 7-14. Layout Diagram

8 Device and Documentation Support

8.1 Device Support

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ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

8.6 Glossary

TI Glossary	This glossary lists and explains terms, acronyms, and definitions.

9 Revision History

DATE	REVISION	NOTES
March 2026	*	Initial Release

10 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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