SK6648D 1.5MHz, 1.2A Synchronous Step-Down Converter

GENERAL DESCRIPTION

The SK6648D is 1.5MHz constant frequency, current mode step-down converters. The devices integrate a main switch and a synchronous rectifier for high efficiency without an external Schottky diode. It is ideal for powering portable equipment that runs from a single cell Lithium-Ion (Li+) battery. The output voltage can be regulated as low as 0.6V. The SK6648D can also run at 100% duty cycle for low dropout operation, extending battery life in portable system. The devices offer two operation modes, PWM control and PFM Mode switching control, which allows a high efficiency over the wider range of the load.

FEATURES

- High Efficiency: Up to 96%(@3.3V)
- 1.5MHz Constant Frequency Operation
- 1.2A Output Current
- No Schottky Diode Required
- 2.5V to 6.0V Input Voltage Range
- Output Voltage as Low as 0.6V
- 100% Duty Cycle in Dropout
- Low Quiescent Current: 40µA
- Slope Compensated Current Mode Control for Excellent Line and Load Transient Response
- Soft Start time for 1ms
- Short Circuit Protection with Frequency reduction mode
- Thermal Fault Protection
- Inrush Current Limit and Soft Start
- Input over voltage protection (OVP)
- <1µA Shutdown Current
- Available DFN2x2-6L Packages

APPLICATIONS

- Cellular and Smart Phones
- Wireless and DSL Modems
- Digital Still and Video Cameras

TYPICAL APPILCATION CIRCUIT

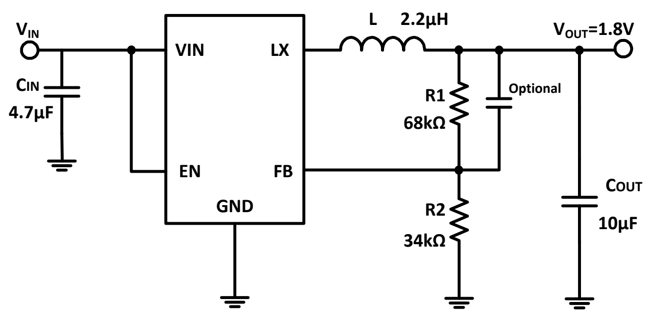
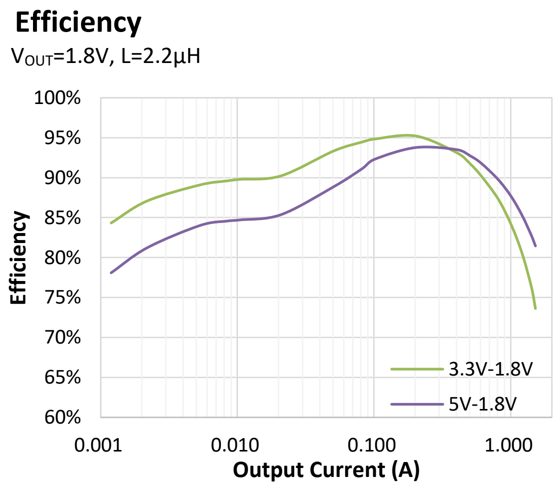
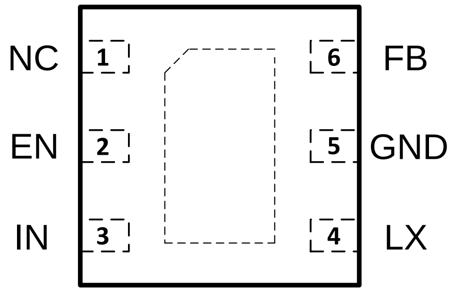


Figure 1. Basic Application Circuits



PIN CONFIGURATION

Top View



DFN2x2-6

PIN FUNCTION

Pin	Name	Function
1	NC	No Connection
2	EN	Chip Enable Pin. Drive EN above 1.5V to turn on the part. Drive EN below 0.4V to turn it off. Do not leave EN floating.
3	VIN	Power Supply Input. Must be closely decoupled to GND with a 4.7µF or greater ceramic capacitor.
4	LX	Power Switch Output. It is the switch node connection to Inductor.
5	GND	Ground Pin.
6	FB	Output Voltage Feedback Pin.

ORDER INFORMATION

Part Number	Package	VFB	Quantity/ Reel
SK6648D	DFN2x2-6L	0.6 V	3000

SK6648D devices are Pb-free and RoHS compliant.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Parameter	Value	Unit
Input Supply Voltages	-0.3~6.5	V
LX Voltages	-0.3~6.5	V
EN, FB Voltage	-0.3~6.5	V
Storage Temperature Range	-65~150	°C
Junction Temperature (Note 2)	-40~160	°C
Power Dissipation	600	mW
Lead Temperature Soldering, 10Sec	260	°C

ESD RATING

Items	Description	Value	Unit
V_{ESD_HBM}	Human Body Model for all pins	±2000	V
V_{ESD_CDM}	Charger Device Model for all pins	±1000	V

JEDEC specification JS-001

RECOMMENDED OPERATING CONDITIONS

Items	Description	Min	Max	Unit
Voltage Range	VIN	2.5	6	V
T_J	Operating Junction Temperature Range	-40	125	°C

THERMAL RESISITANCE (Note 3)

Items	Description	Package	Value	Unit
θ_{JA}	Junction-to-ambient thermal resistance	DFN2x2-6L	152	°C/W
θ_{JC}	Junction-to-case thermal resistance	DFN2x2-6L	25	°C/W

ELECTRICAL CHARACTERISTICS

V_{IN}=V_{EN}=5V, V_{OUT}=1.8V, T_A = 25°C, unless otherwise noted.

Parameter	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range		2.5		6.0	V
OVP Threshold			6.2	6.5	V
UVLO Threshold			2.3		V
Quiescent Current	V_{EN}=2.0V, I_{OUT}=0A, V_{FB}=V_{REF}*105%		40	65	μA
Shutdown Current	V_{EN} =0V		0.1	10	μA
Regulated Feedback Voltage	T_A = 25°C	0.588	0.600	0.612	V
Reference Voltage Line Regulation	V_{IN} = 2.5V to 6.0V		0.04	0.40	%/V
Output Voltage Line Regulation	V_{IN} = 2.5V to 6.0V		0.04	0.4	%
Output Voltage Load Regulation			0.5		%
Oscillation Frequency	V_{OUT}=100%		1.5		MHz
Oscillation Frequency	V_{OUT}=0V		300		kHz
Soft-start time			0.5		ms
On Resistance of PMOS	I_{LX}=100mA		0.25	0.30	Ω
On Resistance of NMOS	I_{LX}=-100mA		0.10	0.15	Ω
Peak Current Limit	V_{IN}=5V, V_{OUT}=1.2V, L=4.7μH/2A	1.5		2.4	A
EN Input High Level Voltage		1.5			V
EN Input Low Level Voltage				0.4	V
EN Leakage Current			±0.01	±1.0	μA
LX Leakage Current	V_{EN}=0V, V_{IN}=V_{LX}=5V		±0.01	±1.0	μA
Thermal Shutdown Threshold (Note 4)			150		°C
Thermal Shutdown Hysteresis (Note 4)			25		°C

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: T_J is calculated from the ambient temperature T_A and power dissipation P_D according to the following formula: $T_J = T_A + (P_D) \times \theta_{JA}$.

Note 3: Measured on JESD51-7, 4-layer PCB.

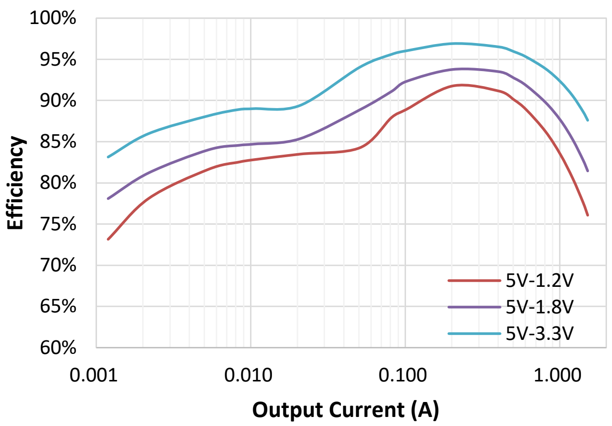
Note 4: Guaranteed by design.

TYPICAL PERFORMANCE CHARACTERISTICS

Test condition: V_{IN}=5V, V_{OUT}=1.8V, L=2.2µH, T_A=+25°C, unless other noted.

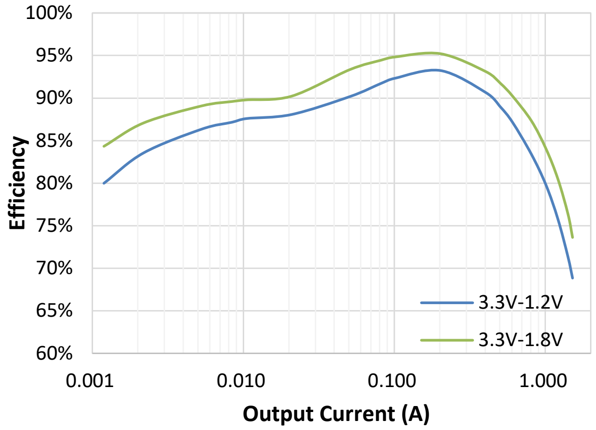
Efficiency at V_{IN}=5V

V_{IN} =5V, L=2.2µH



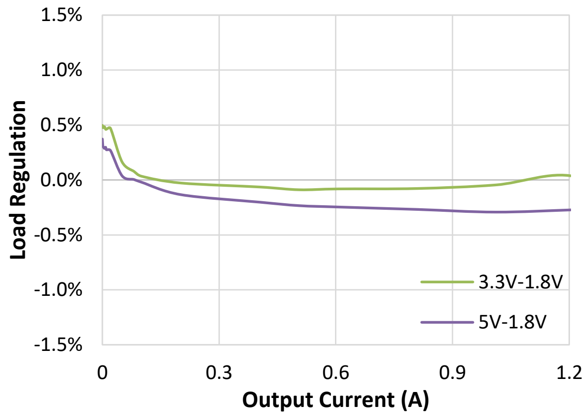
Efficiency at V_{IN}=3.3V

V_{IN} =3.3V, L=2.2µH



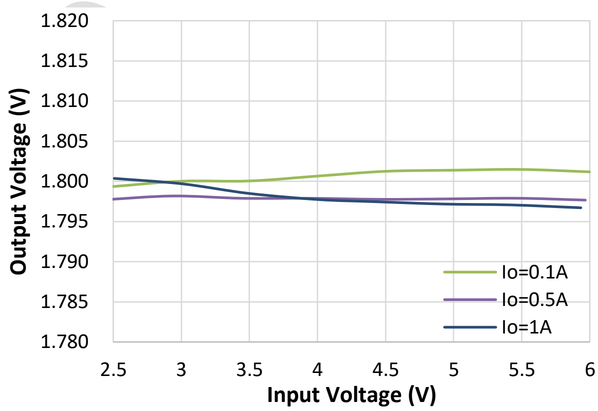
Load Regulation

V_{OUT} =1.8V, L=2.2µH, I_{OUT}=0A to 1.2A



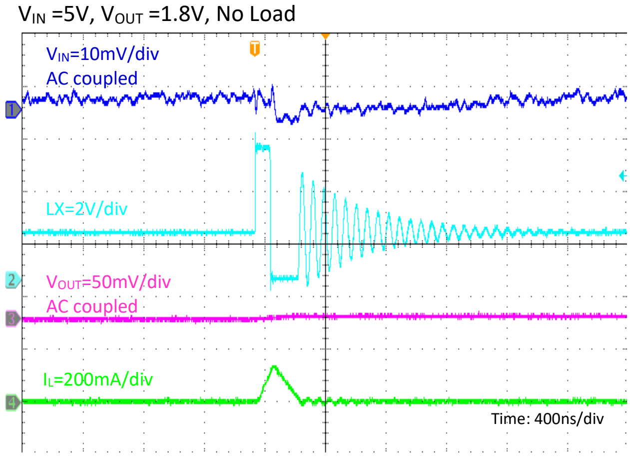
Line Regulation

V_{OUT} =1.8V, L=2.2µH, V_{IN}=2.5V to 6V



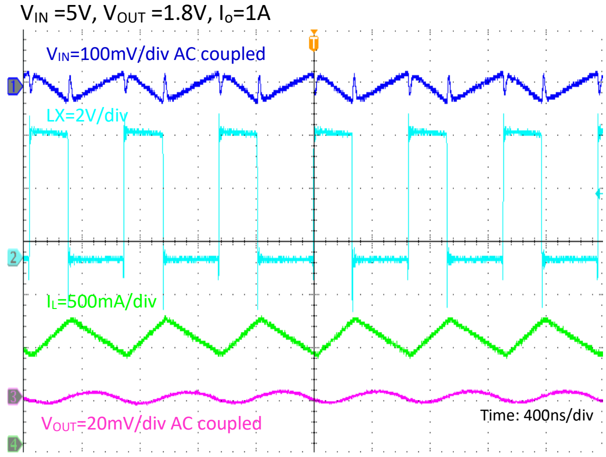
Steady State Operation

V_{IN} =5V, V_{OUT} =1.8V, No Load



Steady State Operation

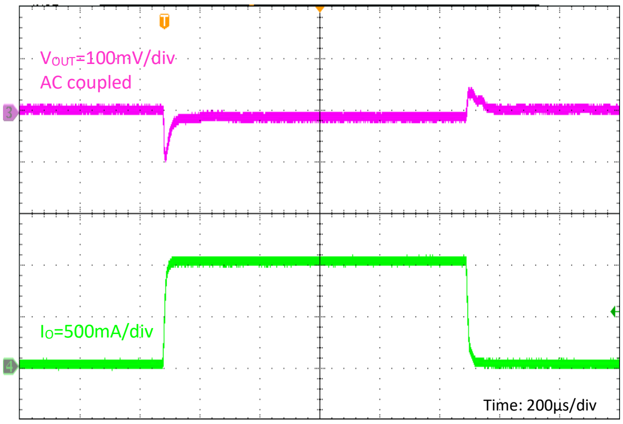
V_{IN} =5V, V_{OUT} =1.8V, I_o=1A



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

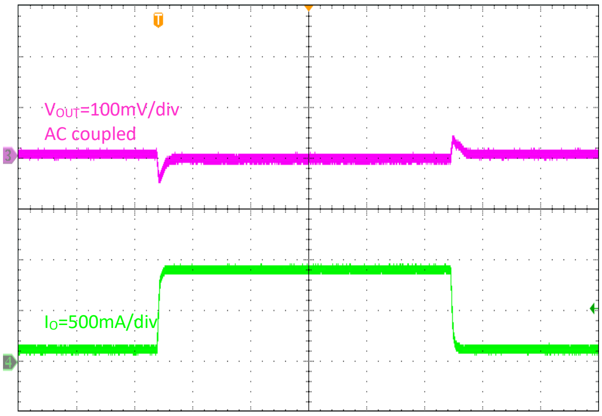
Load Transient

V_{IN} =5V, V_{OUT} =1.8V, I_o = 0A to 1A



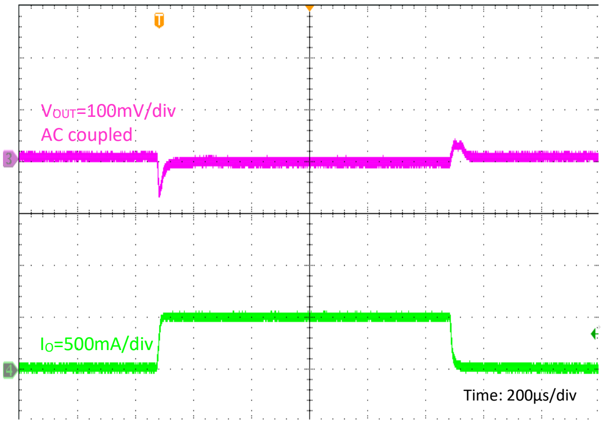
Load Transient

V_{IN} =5V, V_{OUT} =1.8V, I_o = 0.1A to 0.9A



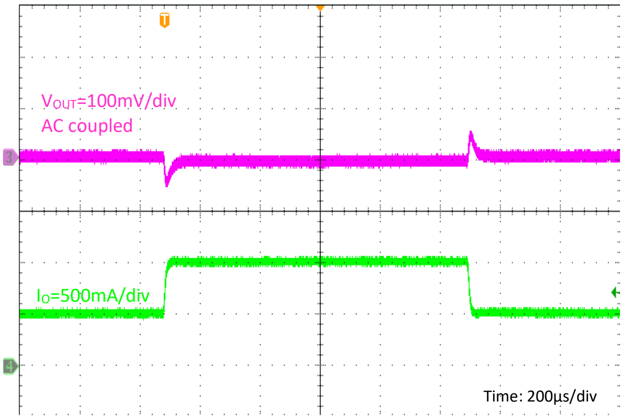
Load Transient

V_{IN} =5V, V_{OUT} =1.8V, I_o = 0A to 0.5A



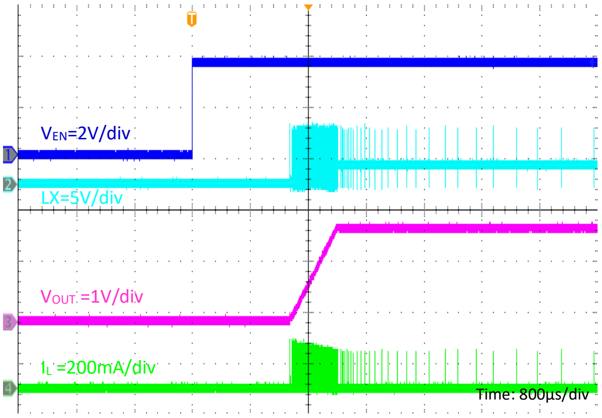
Load Transient

V_{IN} =5V, V_{OUT} =1.8V, I_o = 0.5A to 1A



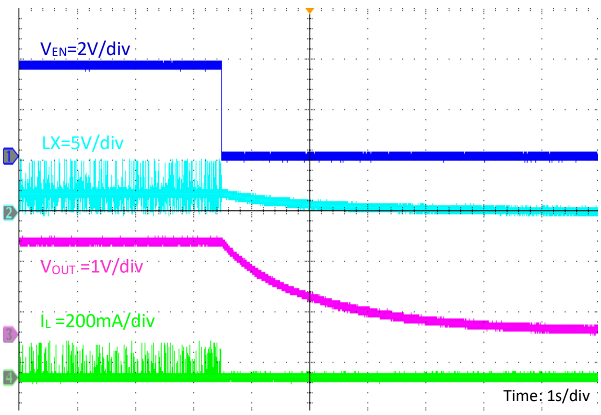
EN Enable Power On

V_{EN} =3.6V, V_{OUT} =1.8V, No Load



EN Enable Power On

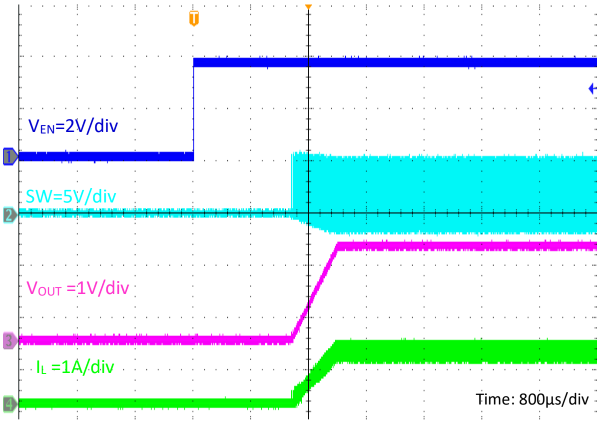
V_{EN} =3.6V, V_{OUT} =1.8V, No Load



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

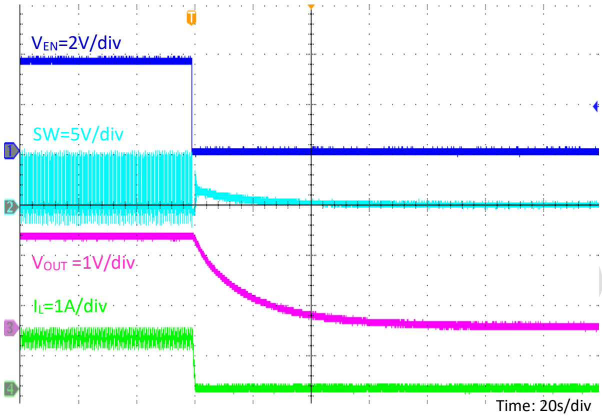
EN Enable Power On

V_{EN} =3.6V, V_{OUT} =1.8V, I_o=1A



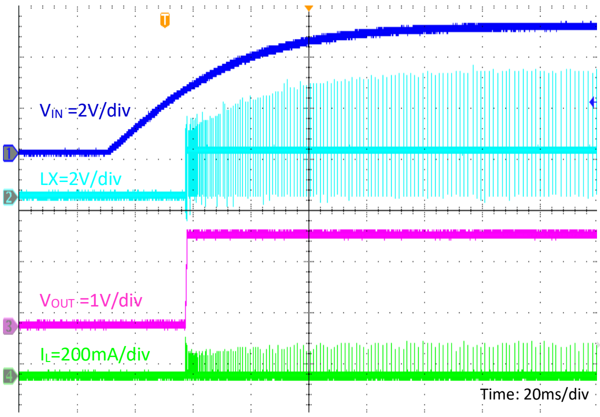
EN Enable Power On

V_{EN} =3.6V, V_{OUT} =1.8V, I_o=1A



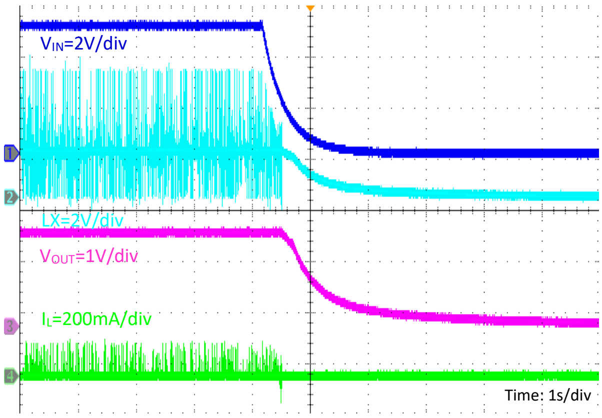
Input Power On

V_{IN} =5V, V_{OUT} =1.8V, No Load



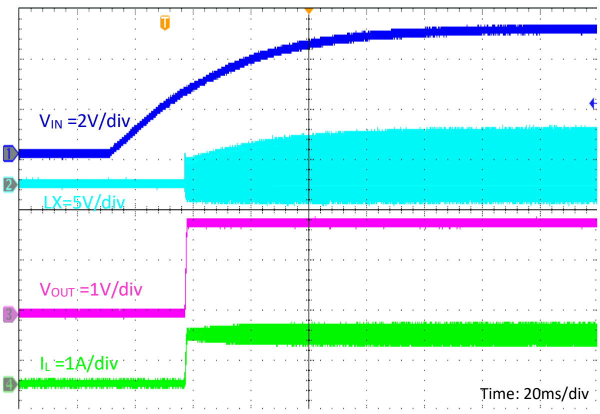
Input Power Down

V_{IN} =5V, V_{OUT} =1.8V, No Load



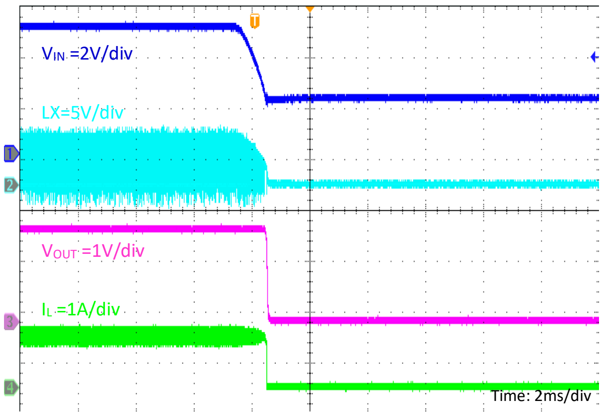
Input Power On

V_{IN} =5V, V_{OUT} =1.8V, I_o=1A



Input Power Down

V_{IN} =5V, V_{OUT} =1.8V, I_o=1A



FUNCTION DESCRIPTION

The SK6648D are high performance 1.2A 1.5MHz monolithic step-down converters. The SK6648D require only three external power components (C_{in}, C_{out} and L). The adjustable version can be programmed with external feedback to any voltage, ranging from 0.6V to the input voltage.

At dropout, the converter duty cycle increases to 100% and the output voltage tracks the input voltage minus the $R_{ds(on)}$ drop of the high-side MOSFET.

The internal error amplifier and compensation provides excellent transient response, load, and line regulation. Soft start function prevents input inrush current and output overshoot during start up.

BLOCK DIAGRAM

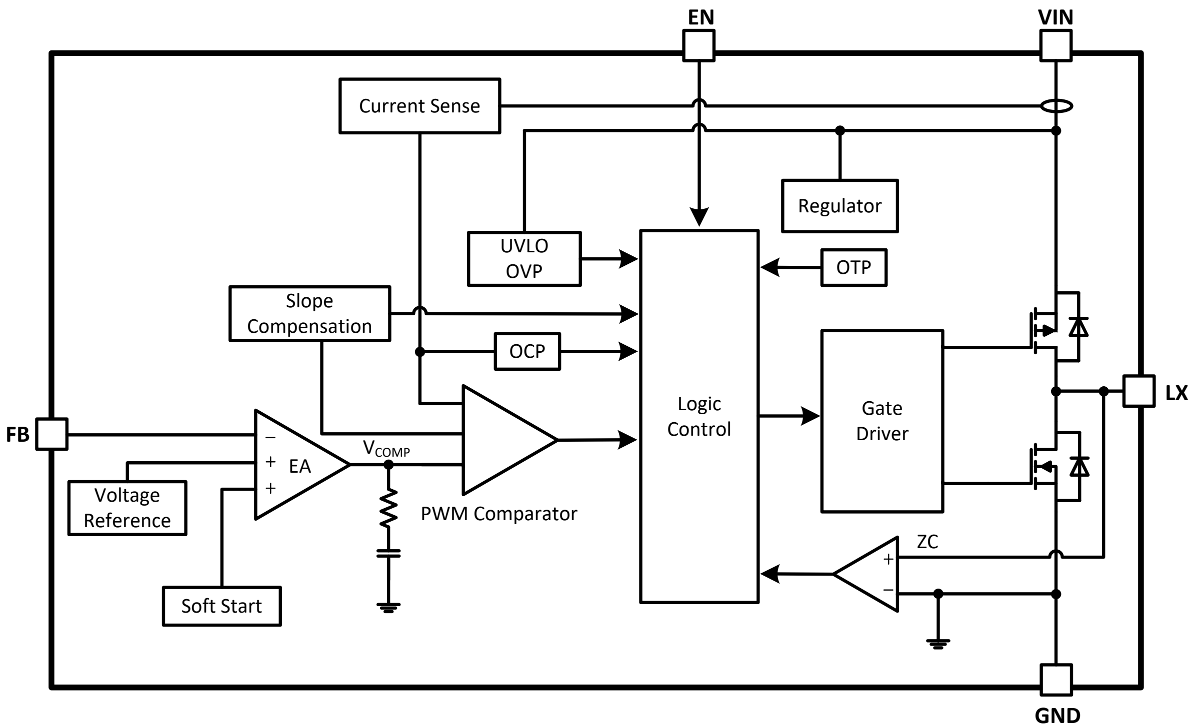


Figure 2. SK6648D Block Diagram

APPLICATION INFORMATION

Setting the Output Voltage

Figure 1 shows the basic application circuit for the SK6648D. The SK6648D can be externally programmed. Resistors R1 and R2 in Figure 1 program the output to regulate at a voltage higher than 0.6V. The external resistor sets the output voltage according to the following equation:

$$V_{OUT} = 0.6 \times (1 + \frac{R_1}{R_2})$$

$$R_1 = (V_{OUT} / 0.6 - 1) \times R_2$$

Inductor Selection

For most designs, 2.2µH inductance can satisfy most application conditions. Inductance value is related to inductor ripple current value, input voltage, output voltage setting and switching frequency. The inductor value can be derived from the following equation:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{OSC}}$$

Where ΔI_L is inductor ripple current. Large value inductors result in lower ripple current and small value inductors result in high ripple current, so inductor value has effect on output voltage ripple value. DC resistance of inductor which has impact on efficiency of DC/DC converter should be taken into account when selecting the inductor.

Input Capacitor Selection

The input capacitor reduces the surge current drawn from the input and switching noise from the device. The input capacitor impedance at the switching frequency should be less than input source impedance to prevent high frequency switching current passing to the input.

A low ESR input capacitor sized for maximum RMS current must be used. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients.

A 4.7µF ceramic capacitor for most applications is sufficient. A large value may be used for improved input voltage filtering.

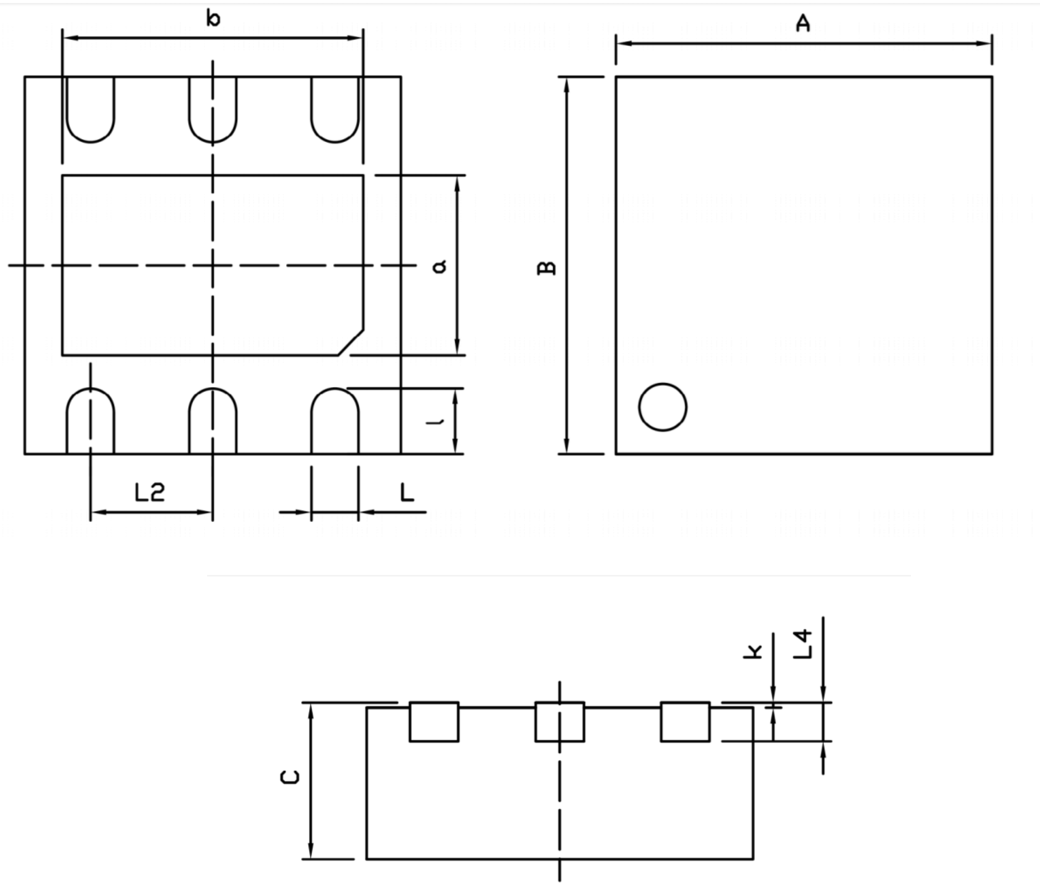
Output Capacitor Selection

The output capacitor is required to keep the output voltage ripple small and to ensure regulation loop stability. The output capacitor must have low impedance at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended due to their low ESR and high ripple current ratings. The output ripple V_{OUT} is determined by:

$$\Delta V_{OUT} \le \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times f_{OSC} \times L} \times \left(ESR + \frac{1}{8 \times f_{osc} \times C3} \right)$$

A 10µF ceramic can satisfy most applications.

PACKAGE DIMENSION : DFN2x2-6L



Unit: mm

Symbol	Dimensions In Millimeters			Symbol	Dimensions In Millimeters		
	Min	Nom	Max		Min	Nom	Max
A	1.95	2.00	2.05	L4	-	0.203	-
B	1.95	2.00	2.05	a	0.90	0.95	1.00
C	0.70	0.75	0.80	b	1.55	1.60	1.65
L	0.20	0.25	0.30	l	0.30	0.35	0.40
L2	-	0.65	-	k	0.00	-	0.05

Note:

1) All dimensions are in millimeters. Angles are in degree.

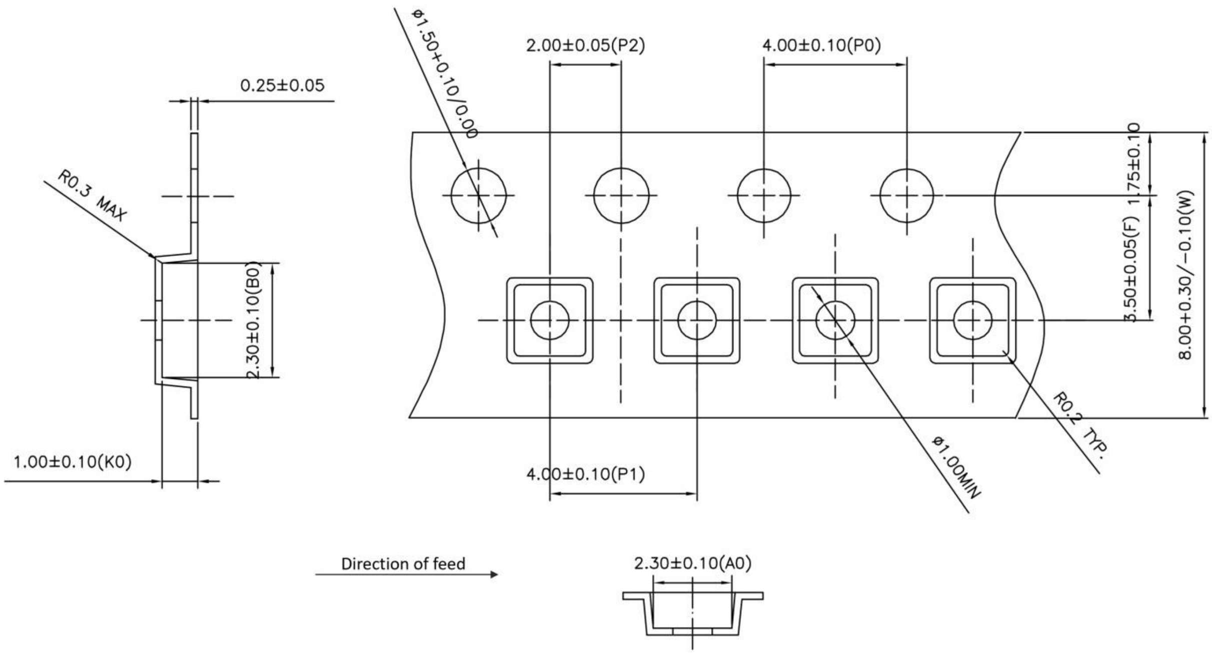
2) Dimensoning and tolerancing confirm to ASME Y14.5M-1994.

3) Unilateral coplanarity zone applies to the exposed heat sink slug as well as the thermals.

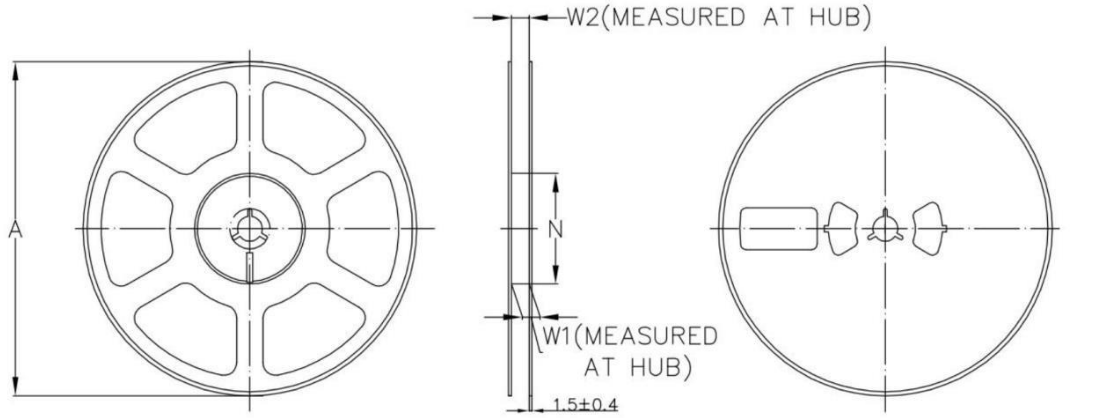
4) Dimension b applies to metallized terminal and is measured between 0.150mm to 0.30mm form the thermal tip. Dimension b should not be measured in radius area.

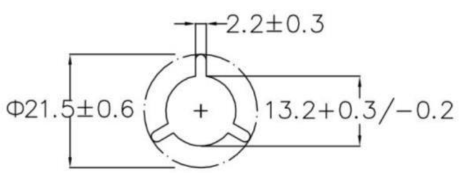
5) All specs take JEDEC MO-229 for reference.

TAPE DIMENSIONS: DFN2x2-6L



REEL DIMENSIONS: DFN2x2-6L





Customer Specifications (Unit: mm)				
TAPE WIDTH	A (±1.0)	N (±2.0)	W1 (+1.5/-0)	W2 (Max)
8	178.0	54.0	8.4	14.4

Note:

1) All Dimensions are in Millimeter
2) Quantity of Units per Reel is 3000
3) MSL level is level 3.