



BK5306 series is a small size (12.0x10.0x1.85mm size) and light weight step-down converter, which has achieved 20W. Since it can correspond from ultra low output voltage of 0.8V, it can be used for the latest DSP, ASIC applications. Due to high efficiency by synchronous rectification circuit technology and with SMD package etc, an excellent performance beyond our common sense has been achieved.

<Features>

- | | |
|---|--|
| <ul style="list-style-type: none"> -Ultra Small Size 12.0x10.0mm -Ultra Thin 1.85mm -Over-Current Protection -Under Voltage Lock Out -Up to 20W output power -RoHS compliance | <ul style="list-style-type: none"> -Master/slave configuration for paralleling -Non-Isolated DC-DC Converter -Remote ON/ OFF Control -Surface Mount Package (SMD) -Operating Temp. Range -40°C to +85°C (Temp. Derating required) -External resistor divider output voltage select |
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<Model, Rating>

Model	Input Voltage Range Vdc	Output Voltage Range Vdc	Output V Accuracy %(max.)	Line Reg. %(typ.)	Load Reg. %(typ.)	Output Current A	Temp. Rating °C	Package
BK5306GQ	2.4 to 5.5	0.8 to 3.3	±2.0	0.5	0.5	6.0	-40 to 85	58-pin QFN

NOTE1 : All the products are Tape & Reel.

NOTE2 : $0.6V \leq V_{IN} - V_o$

<Specification>

Operating Input Voltage	2.4-5.5V
Output Voltage	0.8-3.3 ($0.6V \leq V_{IN} - V_o$)
Accuracy	±2.0% (Over line, load and temperature)
Standby Current	50µA typ. (Enable=0V)
Switching Frequency	5MHz typ.
Line Regulation	0.5% typ. ($V_{in}=2.4$ to $5.0V$)
Load Regulation	0.5% typ. ($I_{LOAD}=0$ to $6A$)
ENABLE Pin Logic Low Threshold	0.8V max. (Max voltage to ensure the converter is disabled)
ENABLE Pin Logic High Threshold	1.8V min. ($2.4V \leq V_{IN} \leq 5.5V$)
Over-Current Protection	9A typ. (Auto recovery type)
POK low voltage	0.4V max.
Max POK Voltage	5.5V max.
Thermal Shutdown	150°C typ.
Thermal Shutdown Hysteresis	20°C typ.
Thermal Resistance: Junction to Case	1.5°C/W typ.
Thermal Resistance: Junction to Ambient	20°C/W typ. *1
Moisture Sensitive Level	Level 3
Operating Temp. Range	-40 °C to 85°C
Weight	TBD
Outline	SMD type W=12.0 L=10.0 H=1.85 typ. (mm) (For detail dimensions refer to the outline on page 2.)

*1 : Follows JEDEC EIJ/JESD 51 Standards, the device heat sunk to a heavy copper plated four-layer PC board.

NOTE1: Unless condition is specified, above specification is regulated as rating value.

NOTE2: $V_{IN}=5.5V$ over operating temperature range unless otherwise noted. Typical values are at $T_A = 25^\circ C$.

NOTE3: Depending on the ambient air temp. conditions, air flow is required.

NOTE4: Measurements of electrical characteristics with an additional multilayer ceramic capacitor of 47µF to the input and 47µF to the output.

Ultra small, 6A DC-DC Converter with Integrated Inductor BK5306 Series



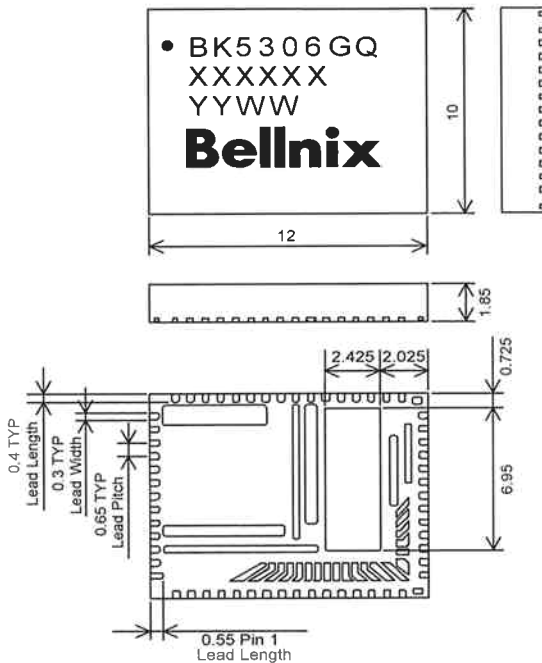
<Absolute Maximum Ratings>

CAUTION: Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

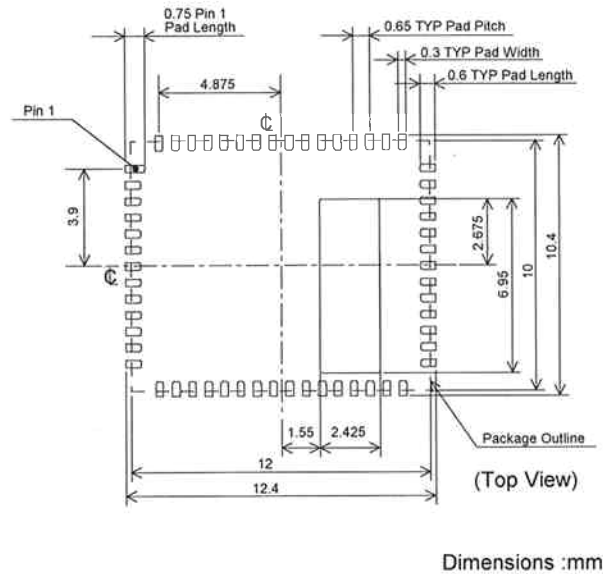
Maximum Electrical Ratings	MIN	MAX
Voltages on:VIN	-0.5V	7.0V
Voltages on:ENABLE	-0.5V	V _{IN}
Voltages on:XFB,XOV	-0.5V	V _{IN}
Voltages on:EAIN,EAOUT,COMP	-0.5V	2.5V
Voltages on:PWM,M/S	-0.5V	2.5V

Maximum Electrical Ratings	MIN	MAX
Storage Temperature Range	-65°C	+150°C
Operating Junction Temperature	-40°C	+150°C
Reflow Peak Body Temperature (10 sec)		+260°C

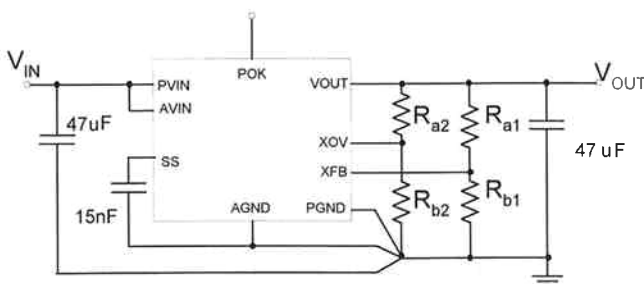
<Package Dimensions>



<Recommended footprint for PCB.>



<Typical Application Circuit>



- It is a prerequisite for this product to be mounted onto a board, thereby heat radiation is done.
- When not using enable operation, keep the enable operation high.
- Be sure to perform output voltage programme.
- Be sure to connect the sense pin and output pin on the board.
- Please add capacitor to input and output side with the thick and short wiring.

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<Pin Configuration>



PIN	NAME	FUNCTION
1-3	NC	NO CONNECT – Do not electrically connect these pins to each other or to any other electrical signal. CAUTION!: May be internally connected.
4-5	NC	NO CONNECT – Do not electrically connect these pins to each other or to any other electrical signal. CAUTION!: Internally connected to switching node. Take care to route signals away from these pins.
6-13	NC	NO CONNECT – Do not electrically connect these pins to each other or to any other electrical signal. CAUTION!: May be internally connected.
14-20	VOUT	Regulated converter output. Connect these pins to the load and place output capacitor from these pins the PGND pins 24-26.
21-23	NC	NO CONNECT – Do not electrically connect these pins to each other or to any other electrical signal. CAUTION!: Internally connected to switching node. Take care to route signals away from these pins.
24-29	PGND	Input/Output power ground. Connect these pins to the ground electrode of the Input and output filter capacitors. Refer to layout guideline section for details.
30-35	PVIN	Input power supply. Connect to input power supply. Decouple with input capacitor to PGND (pins 24-29).
36-37	NC	NO CONNECT – Do not electrically connect these pins to each other or to any other electrical signal. CAUTION!: May be internally connected.
38	NC	NO CONNECT – Do not electrically connect these pins to each other or to any other electrical signal. CAUTION!: May be internally connected.
39	AVIN	Analog voltage input for the controller circuits. Connect this pin to the input power supply.
40	AGND	Analog ground for the controller circuits.
41-42	NC	NO CONNECT – Do not electrically connect these pins to each other or to any other electrical signal. CAUTION!: May be internally connected.
43	XFB	Feedback pin for external voltage divider network.
44	XOV	Over voltage programming feedback pin.
45	NC	NO CONNECT – Do not electrically connect these pins to each other or to any other electrical signal. CAUTION!: May be internally connected.
46	POK	Power OK is an open drain transistor for power system state indication. POK is a logic high when VOUT is with -10% to +20% of VOUT nominal.

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PIN	NAME	FUNCTION
47	NC	NO CONNECT – Do not electrically connect these pins to each other or to any other electrical signal. CAUTION! : May be internally connected.
48	SS	Soft-Start. The soft-start capacitor is connected between this pin and AGND. The value of this capacitor determines the startup timing.
49	EAIN	Optional Error Amplifier input. Allows for customization of the control loop.
50	EAOUT	Optional Error Amplifier output. Allows for customization of the control loop.
51	COMP	Optional Error Amplifier Buffer output. Allows for customization of the control loop.
52	ENABLE	Input Enable. Applying a logic high, enables the output and initiates a soft-start. Applying a logic low disables the output.
53	PWM	PWM input/output. Used for optional master/slave configuration. When M/S pin is asserted "low", PWM will output the gate-drive PWM waveform. When the M/S pin is asserted "high", the PWM pin is configured as an input for PWM signal from the "master" device. PWM pin can drive up to 3 slave devices.
54	NC	NO CONNECT – Do not electrically connect these pins to each other or to any other electrical signal. CAUTION! : May be internally connected.
55	M/S	Optional Master/Slave select pin. Asserting pin "low" places device in Master Mode for current sharing. PWM pin (53) will output PWM drive signal. Asserting pin "high" will place the device in Slave Mode. PWM pin (53) will be configured to input (receive) PWM drive signal from "Master" device.
56-58	NC	NO CONNECT – Do not electrically connect these pins to each other or to any other electrical signal. CAUTION! : May be internally connected.

< Programming Output Voltage and OVP >

The BK5306 output voltage is programmed using a simple resistor divider network. Figure below shows the resistor divider configuration.

The BK5306 output voltage and over voltage thresholds are determined by the voltages presented at the XFB and XOV pins respectively. These voltages are set by way of resistor dividers between VOUT and AGND with the midpoint going to XFB and XOV.

It is recommended that Rb1 and Rb2 resistor values be ~2kΩ. Use the following equation to set the resistor Ra1 for the desired output voltage:

$$Ra1 = \frac{(V_{out} - 0.75V) \times Rb1}{0.75V}$$

If over-voltage protection is desired, use the following equation to set the resistor Ra2 for the desired OVP trip-point:

$$Ra2 = \frac{(OVP_{trip} - 0.90V) \times Rb2}{0.90V}$$

By design, if both resistor dividers are the same, the OV trip-point will be 20% above the nominal output voltage.

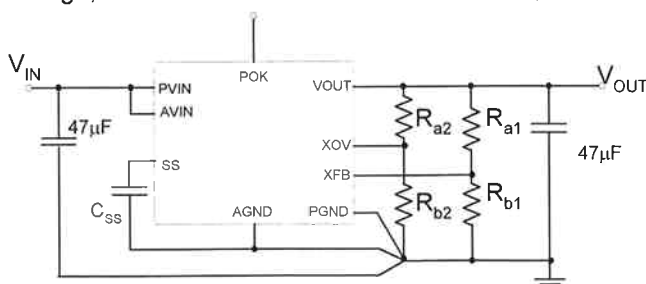


Figure: Vout and OVP resistor divider networks.

NOTE: if no OVP divider is present, there will be no over-voltage protection and POK will remain "high" as long as

V_{OUT} remains above 90% of the nominal V_{OUT} setting.

<Enable Operation>

The ENABLE pin provides a means to shut down the device, or enable normal operation. A logic low will disable the converter and cause it to shut down. A logic high will enable the converter into normal operation. When the ENABLE pin is asserted high, the device will undergo a normal soft start.

<Input Capacitor Selection>

The BK5306 requires between 40-80uF of input capacitance. Low-ESR ceramic capacitors are required with X5R or X7R rated dielectric formulation. Y5V or equivalent dielectric formulations must not be used as these loose capacitance with frequency, temperature and bias voltage.

In some applications, lower value capacitors are needed in parallel with the larger, capacitors in order to provide high frequency decoupling.

< Output Capacitor Selection >

The BK5306 has been optimized for use with approximately 50μF of output capacitance. Low ESR ceramic capacitors are required with X5R or X7R rated dielectric formulation. Y5V or equivalent dielectric formulations must not be used as these loose capacitance with frequency, temperature and bias voltage.

Output ripple voltage is determined by the aggregate output capacitor impedance. Output impedance, denoted as Z, is comprised of effective series resistance, ESR, and effective series inductance, ESL:

$$Z = \text{ESR} + \text{ESL}$$

Placing output capacitors in parallel reduces the impedance and will hence result in lower ripple voltage.

$$\frac{1}{Z_{\text{Total}}} = \frac{1}{Z_1} + \frac{1}{Z_2} + \dots + \frac{1}{Z_n}$$

Typical ripple versus capacitor arrangement is given below:

Output Capacitor Configuration	Typical Output Ripple (mVp-p)
1 x 47uF	TBD
5 x 10 uF	TBD

<Soft-Start Operation>

Soft start is a method to reduce in-rush current when the device is enabled. The output voltage is ramped up slowly upon start-up. The output rise time is controlled by choice of a soft-start capacitor, which is placed between the SS pin (pin 48) and the AGND pin (pin 40).

$$\text{Rise Time: } T_R = C_{ss} * 80K\Omega.$$

During start-up of the converter, the reference voltage to the error amplifier is gradually increased to its final level by an internal current source of typically 10uA. Typical soft-start rise time is 1mS to 3mS. Typical SS capacitor values are in the range of 15nF to 30 nF.

<POK Operation>

The POK signal is an open drain signal from the converter indicating the output voltage is within the specified range. The POK signal will be a logic high when the output voltage is above 90% of V_{OUT} and below the user programmed OVP trip-point. If the output voltage goes outside of this range, the POK signal will be a logic low until the output voltage has returned to within this range. In the event of an over-voltage condition the POK signal will go low and will remain in this condition until the output voltage has dropped to 95% of the programmed output voltage before returning to the high state (see also: Over Voltage Protection)

<Over-Current Protection>

The current limit function is achieved by sensing the current flowing through the sense P-MOSFET. When the sensed current exceeds the current limit, both NFET and PFET switches are turned off. If the over-current condition is removed, the over-current protection circuit will enable the PWM operation. If the over-current condition persists, the soft start capacitor will eventually discharge and cause the converter to go through a full soft-start cycle. This circuit is designed to provide high noise immunity.

The nominal over current trip point is set to 9A.

<Over-Voltage Protection>

When the output voltage exceeds the user programmed OVP trip-point, the PWM operation stops, the lower N-MOSFET is turned on and the POK signal goes low. When the output voltage drops below 95% of the programmed output voltage, normal PWM operation resumes and POK returns to its high state.

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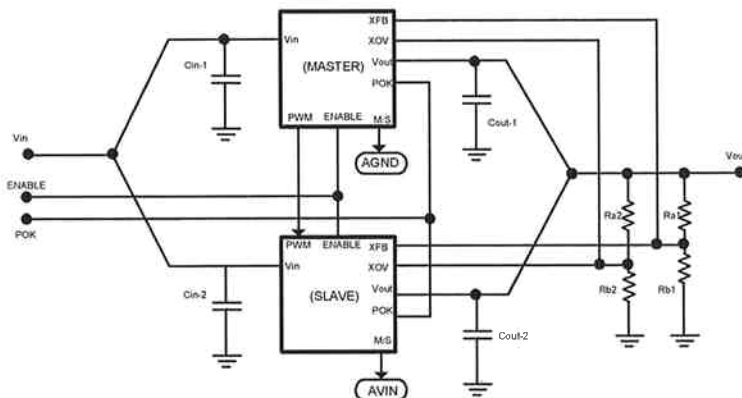
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<Parallel Device Operation>

In order to power a load that is higher than the rated 6A of the BK5306, from 2 to 4 devices can be placed in parallel for providing a single load with up to 24A of output current.

Paralleling more than 1 device is accomplished by selecting a master device and tying that M/S pin to AGND. All slave devices should have their M/S pin tied to AVIN. The PWM pin from the master device is connected to all slave device PWM pins. (See schematic below)

1. All master and slave devices should have identical placement and values of input, output and soft-start capacitors.
2. All master and slave devices should have their ENABLE pins tied together and should be operated simultaneously with a fast rising edge of 10 uSec or less, to ensure that devices start up at the same time. Startup imbalance could lead to OCP condition on first device to startup.
3. The XFB pins of the Master and Slave devices should all connect to the center tap of the output voltage programming resistor divider to ensure proper setting for protection features.
4. The XOVS pins of the Master and Slave devices should all connect to the center tap of the over-voltage set-point programming resistor divider to ensure proper setting for protection features.
5. The maximum board trace resistance between any 2 devices VOUT pins should be less than 10mΩ.
6. The maximum difference of PVIN between any 2 devices should be less than 50mV.
7. POK pins should be connected together to ensure device error conditions are properly detected.



<Precautions>

- This product is for being used in general electric equipments (business equipments, telecommunication equipments and measurement equipments). Can not be used in medical equipments, nuclear equipments and trains which would affect lives or properties directly by the failure of this product. Be sure to contact our sales when using in besides general use.
- For this product series operation are not possible.
- For mounting this product, please do not use connector of socket. The performance may not be fulfilled due to the effect of contacting resistor. Mount to print board by soldering.
- This product has a built-in over-current, short protection, but long time short circuit will cause failure, so please avoid it.
- There is possibility of damage when used under electric conditions and environmental conditions such as temperature that are out of the standards. Be sure to be use within the standards.
- There is possibility of damage by static. When the worker has electrified static, electrical discharge should be done and the working on the table so grounded may be recommended.
- Do not store in a place where corrodible gas may be generated or a dusty place.
- This product does not have a built-in fuse. Connect a fuse to the +input line for protection when over-current flows into input at abnormal. Please be sure that the supplying power has the capacity to fuse the fuse.
- No test result certificate attached to this product.