

Motor Drivers for Digital Still Cameras

6-Channel System Lens Driver for Digital Still Cameras

BD6753KV
General Description

The BD6753KV is a motor driver that integrates 4 Full-ON type H-Bridges and 2 PWM Constant-Current type H-bridges. The device is intended to drive two stepping motors for auto focus system, either zoom or iris. It is also available for the new system like a lens barrier.

Features

- Low ON-Resistance Power DMOS Output
- Charge Pump for the High-Side DMOS Gate
- Drive Mode Switch Function
- Three wire serial Interface
- Peak Current Control for PWM Constant-Current Driver
- Under Voltage Locked Out Protection & Thermal Shut Down Circuit

Applications

- Mobile system
- Home appliance
- Amusement system, etc

Key Specifications

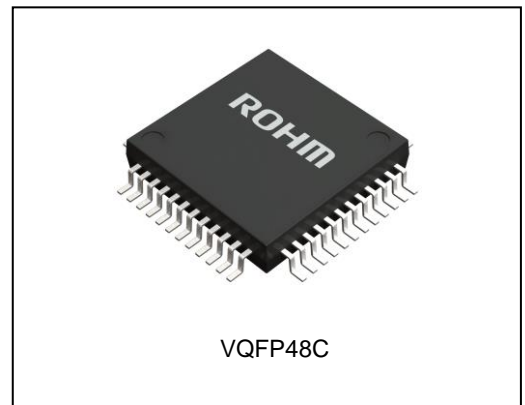
- Power Supply Voltage Range: 2.7V to 5.5V
- Motor Power Supply Voltage Range (VM1): 4.5V to 10.5V
- Motor Power Supply Voltage Range (VM2 to VM4): 2.0V to 10.5V
- Circuit Current: 2.2mA(Typ)
- Stand-By Current: 10μA(Max)
- Control Input Voltage Range: 0V to V_{CC}V
- H-Bridge Output Current: -0.5A/ch to +0.5A/ch
- Output ON-Resistance (Each Channel): 1.2Ω(Typ)
- Operating Temperature Range: -25°C to +75°C

Package

VQFP48C

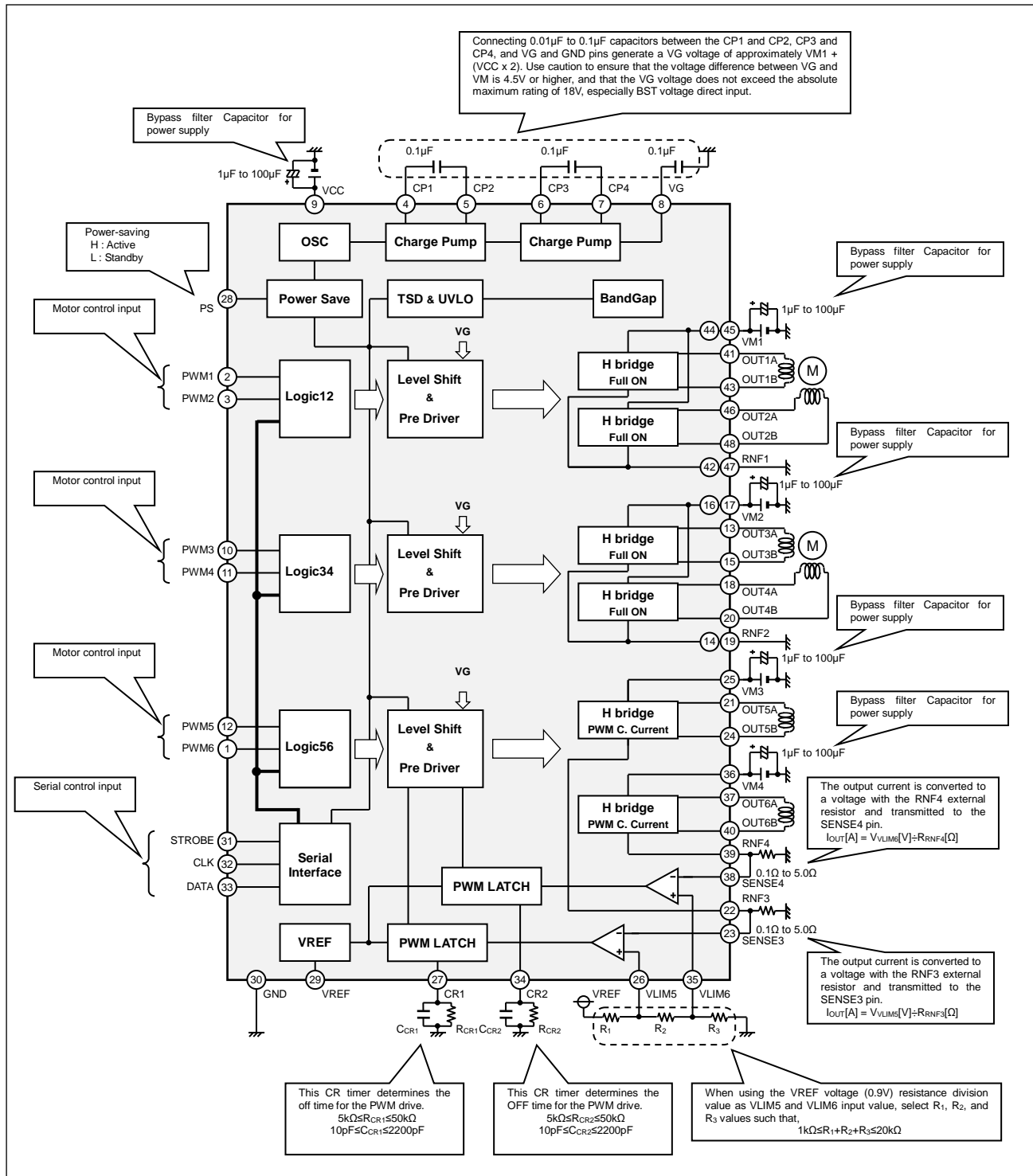
W(Typ) x D(Typ) x H(Max)

9.00mm x 9.00mm x 1.60mm

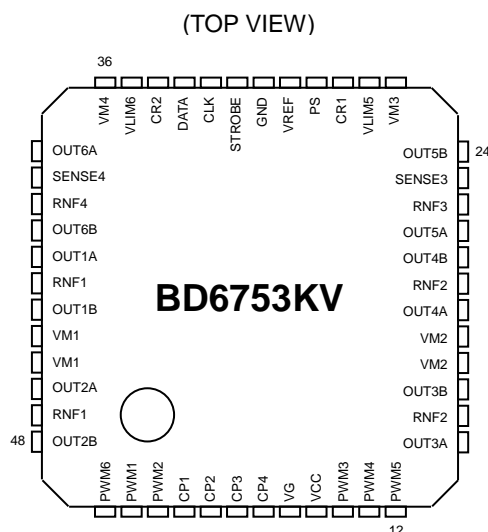


VQFP48C

Typical Application Circuit



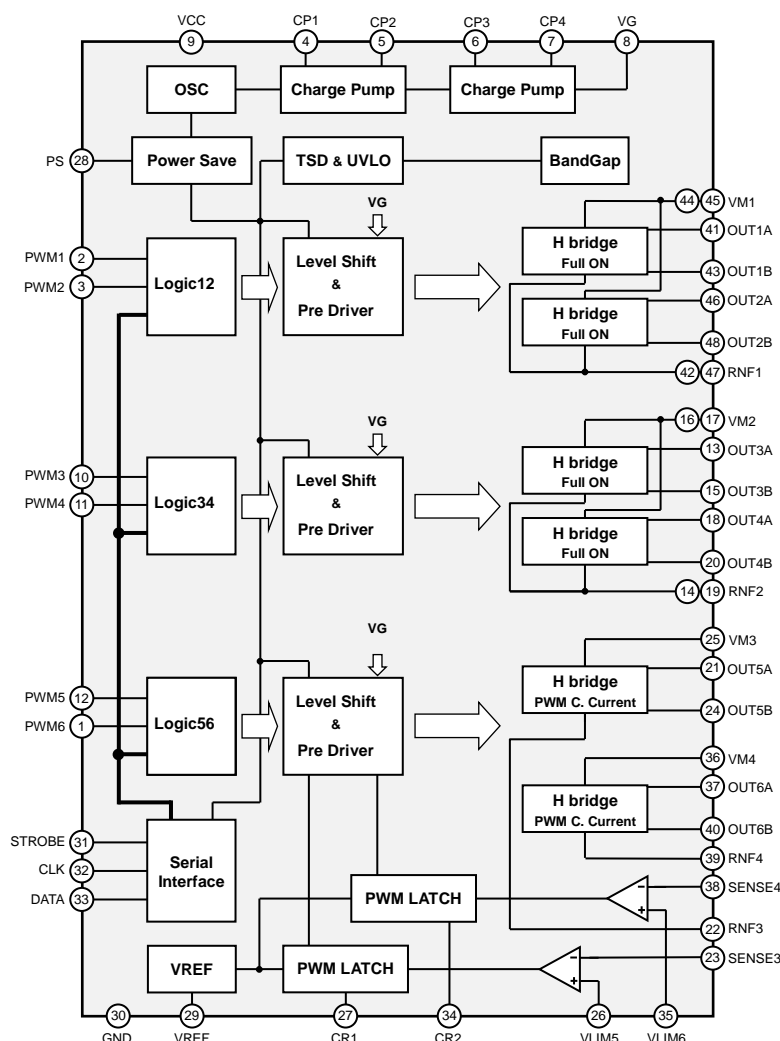
Pin Configurations



Pin Descriptions

Pin No.	Pin Name	Function	Pin No.	Pin Name	Function
1	PWM6	PWM control logic input 6	25	VM3	Motor power supply ch.5
2	PWM1	PWM control logic input 1	26	VLIM5	Output current setting ch.5
3	PWM2	PWM control logic input 2	27	CR1	CR timer setting ch.5
4	CP1	1 st Bucket stage with capacitor 1	28	PS	Power-saving
5	CP2	1 st Bucket stage with capacitor 2	29	VREF	Reference voltage output
6	CP3	2 nd Bucket stage with capacitor 3	30	GND	Ground
7	CP4	2 nd Bucket stage with capacitor 4	31	STROBE	Serial enable input
8	VG	Charge pump output with capacitor	32	CLK	Serial clock input
9	VCC	Power supply	33	DATA	Serial data input
10	PWM3	PWM control logic input 3	34	CR2	CR timer setting ch.6
11	PWM4	PWM control logic input 4	35	VLIM6	Output current setting ch.6
12	PWM5	PWM control logic input 5	36	VM4	Motor power supply ch.6
13	OUT3A	H-bridge output 3A	37	OUT6A	H-bridge output 6A
14	RNF2	Motor ground ch.3, ch.4	38	SENSE4	Output current detection ch.6
15	OUT3B	H-bridge output 3B	39	RNF4	Current detect resistor ch.6
16	VM2	Motor power supply ch.3, ch.4	40	OUT6B	H-bridge output 6B
17	VM2	Motor power supply ch.3, ch.4	41	OUT1A	H-bridge output 1A
18	OUT4A	H-bridge output 4A	42	RNF1	Motor ground ch.1, ch.2
19	RNF2	Motor ground ch.3, ch.4	43	OUT1B	H-bridge output 1B
20	OUT4B	H-bridge output 4B	44	VM1	Motor power supply ch.1, ch.2
21	OUT5A	H-bridge output 5A	45	VM1	Motor power supply ch.1, ch.2
22	RNF3	Current detect resistor ch.5	46	OUT2A	H-bridge output 2A
23	SENSE3	Output current detection ch.5	47	RNF1	Motor ground ch.1, ch.2
24	OUT5B	H-bridge output 5B	48	OUT2B	H-bridge output 2B

Block Diagram



Description of Blocks

1. Power-Saving Function

A power-saving function is included, which allows the system to save power when not driving the motor. The voltage level on this pin should be set high so as to keep the operation mode. (See the Electrical Characteristics; p.7/16)

2. Motor Control Input

(a) PWM1 to PWM6 Pins

Logic level controls the output logic of H-Bridge.

(See the Electrical Characteristics; p.7/16, and I/O Truth Table; p.9/16)

(b) Serial Interface

It is possible to set the logic as EN/IN mode or IN/IN via serial interface.

(See the Electrical Characteristics; p.7/16 and I/O Truth Table; p.9/16)

3. H-bridge

Each H-bridge can be controlled independently. It is therefore possible to drive the H-bridges simultaneously, as long as the package thermal tolerances are not exceeded. Because the output transistors consist of power DMOS that can be controlled the charge pump output V_G , the total ON-Resistance of high and low-side transistor is dependent on V_G voltage V_G . Further, the whole application must be designed so that the maximum current of each channel may be 500mA or below. (See the Recommended Operating Conditions; p.6/16)

Description of Blocks – continued

4. Drive System of PWM Constant-Current H-bridge (Channel 5, Channel 6)

(a) Output Current Detection & Current Settings

A low-value (0.1Ω to 5.0Ω) resistor can be placed between the RNF3 or RNF4 pins and ground to detect the motor winding current. When making the RNF3 and SENSE3 pins or RNF4 and SENSE4 short-circuit, the internal circuits can output the accurate constant current by comparing the external voltage of VLIM5 or VLIM6 pin with detecting voltage. The internal reference voltage (VREF pin: $0.9V \pm 10\%$) can be divided using external resistors ($1k\Omega$ to $20k\Omega$). The resulting value can be input as the set voltage. It is also necessary to connect a resistor and capacitor to the CR1 and CR2 pins in order to determine the PWM drive OFF time.

(b) PWM Constant-Current Control Operation

The motor current rises through the winding at a rate dependent upon the voltage and inductance of the winding. If the RNF3 or RNF4 voltage reaches the threshold voltage set with the VLIM5 or VLIM6 voltage, the internal current limiting comparator changes the logic of H-Bridges into short brake mode. Because both of low-side DMOS transistors are on, the motor's inductance causes the current to freewheel through them. During this freewheeling time, the current decreases until the CR timer reaches constant OFF time (t_{OFF}). After this sequence, the high-side DMOS transistor is enabled to increase the winding current again. For repeating this cycle, the motor winding current will be regulated by the motor's inductance.

(c) Noise Cancellation Function

The device has a noise cancellation time (T_n) to blank detection of the motor winding current. A noise cancellation time blanks the output of the current limiting comparator when the output transistors are switched. The noise cancellation time defines the minimum on time for PWM constant current, and it depends on the internal resistor, external resistor and capacitor of CR pin.

(d) CR Timer

The moment output logic are switched to short brake mode, the voltage of CR pin is clamped at approximately $0.9V$. Because the external capacitor discharges toward ground through the external resistor during the short brake mode, the voltage of CR pin decreases until approximately $0.4V$. That time defines the OFF time (t_{OFF}). As soon as the voltage of CR pin reaches $0.4V$, the external capacitor charges toward V_{CC} voltage. That cycle continues to repeat with the capacitor alternately charging and discharging. The interval over which the capacitor charges from $0.4V$ to approximately $0.8V$ defines the noise cancellation time (T_n). The t_{OFF} and T_n depend upon the external resistor and capacitor values connected to the CR pin. Because a low-value resistor will prevent the voltage of CR pin from reaching the clamp voltage, select within the range of $5k\Omega$ to $50k\Omega$. The capacitor values should be set within the range of $10pF$ to $2200pF$. The use of a capacitor in excess of $2200pF$ will lengthen the noise cancellation time and control the output current unstably. Setting a longer OFF time may reduce both the average current and the motor rotational efficiency to increase the ripple of motor winding current.

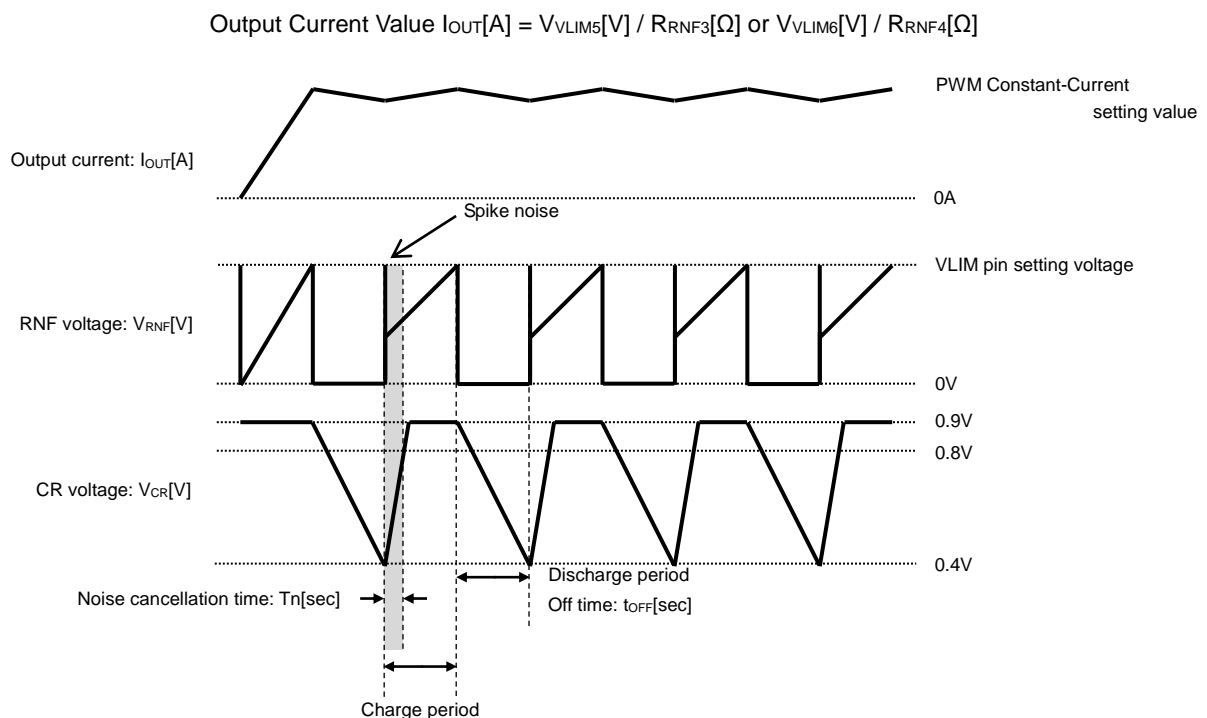


Figure 1.
Peak Current Control PWM Constant-Current Drive with the CR Timer

Description of Blocks – continued

If the VLIM5 or VLIM6 pin is shorted to the VCC pin (or the same voltage as the VCC is set) and the SENSE3 pin or SENSE4 and RNF3 pin or RNF4 are shorted to the ground, these channels can drive as a Full-ON type H-bridge like other channels.

5. Charge Pump

Because the respective output transistors consist of power N-channel DMOS, the gate voltage V_G should be higher than the V_M voltage to drive the high-side N-channel DMOS. The device includes the charge pump circuit that generates V_G voltage by connecting three external capacitors. The approximately ($V_{M1} + (V_{CC} \times 2)$) voltage is output on the VG pin in the state with which a capacitor (0.1 μ F) is connected respectively between CP1 pin and CP2, CP3 and CP4, VG and GND. The charge pump's output voltage is approximately ($V_{M1} + V_{CC}$) voltage when connecting a capacitor (0.1 μ F) respectively between CP1 and CP2 pin, VG and GND pin, in addition to be shorted CP4 pin and VG, and to be open CP3 pin. It is possible to set the different voltages to each VM pin (VM1 to VM4). In order to provide better performance, the voltage difference between V_G and V_M must be 4.5V or above, and the V_G voltage must not exceed the absolute maximum rating of 18V.

Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Limit	Unit
Power Supply Voltage	V_{CC}	-0.5 to +7.0	V
Motor Power Supply Voltage	V_M	-0.5 to +12.5	V
Charge Pump Voltage	V_G	18.0	V
Control Input Voltage	V_{IN}	-0.5 to + $V_{CC}+0.5$	V
Power Dissipation	P_d	1.12 (Note 1)	W
H-bridge Output Current	I_{OUT}	-0.8 to +0.8 (Note 2)	A/ch
Storage Temperature Range	T_{stg}	-55 to +150	°C
Junction Temperature	T_{jmax}	150	°C

(Note 1) Reduced by 9.0mW/°C over 25°C, when mounted on a glass epoxy board (70mm x 70mm x 1.6mm)

(Note 2) Must not exceed P_d , ASO, or T_{jmax} of 150°C

Caution: Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	V_{CC}	2.7	-	5.5	V
Motor Power Supply Voltage(VM1)	V_{M1}	4.5	-	10.5	V
Motor Power Supply Voltage(VM2 to VM4)	V_{M2} to V_{M4}	2.0	-	10.5	V
Control Input Voltage	V_{IN}	0	-	V_{CC}	V
H-bridge Output Current ^(Note 3)	I_{OUT}	-0.5	-	+0.5	A/ch
Output Current Control Voltage Range	V_{LIM}	0	-	0.5	V
PWM Signal Input Frequency	f_{PWM}	0	-	0.1	MHz
Operating Temperature Range	T_{opr}	-25	-	+75	°C

(Note 3) Must not exceed P_d , ASO, or T_{jmax} of 150°C

Electrical Characteristics (Unless otherwise specified $V_{CC}=3.3V$, $V_M=10.5V$, $T_a=25^{\circ}C$)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
All Circuits						
Stand-By Current	I_{CCST}	-	0	10	μA	$V_{PS}=0V$
Circuit Current	I_{CC}	-	2.2	3.0	mA	$V_{PS}=3.3V$ with no signal, CRx open
Power-Saving (PS)						
High-Level Input Voltage	V_{PSH}	2.0	-	V_{CC}	V	
Low-Level Input Voltage	V_{PSL}	0	-	0.7	V	
High-Level Input Current	I_{PSH}	25	50	100	μA	$V_{PS}=3.3V$
Low-Level Input Current	I_{PSL}	-1	0	-	μA	$V_{PS}=0V$
Control Input (IN=STROBE, CLK, DATA, PWM1 to PWM6)						
High-Level Input Voltage	V_{INH}	2.0	-	V_{CC}	V	
Low-Level Input Voltage	V_{INL}	0	-	0.7	V	
High-Level Input Current	I_{INH}	16.5	33	66	μA	$V_{IN}=3.3V$
Low-Level Input Current	I_{INL}	-1	0	-	μA	$V_{IN}=0V$
Pull-down Resistor	R_{IN}	50	100	200	k Ω	
Charge Pump						
Charge Pump Voltage	V_{CP}	16	16.5	-	V	
Under Voltage Locked Out (UVLO)						
UVLO Voltage	V_{UVLO}	1.6	-	2.5	V	
Full-ON Drive Block (Channel 1 to Channel 4)						
Output ON-Resistance	R_{ON}	-	1.2	1.5	Ω	$I_{OUT}=\pm 400mA$, $V_G=16.5V$, total
PWM Linear Constant-Current Drive Block (Channel 5, Channel 6)						
Output ON-Resistance	R_{ON}	-	1.2	1.5	Ω	$I_{OUT}=\pm 400mA$, $V_G=16.5V$, total
VLIM Input Current	I_{VLIM}	-1	-0.2	-	μA	$V_{LIMx}=0V$, $V_{SENSEx}=0.5V$
SENSE Input Current	I_{SENSE}	-1	-0.2	-	μA	$V_{LIMx}=0.5V$, $V_{SENSEx}=0V$
Output Limit Voltage	V_{OL}	485	500	515	mV	$V_{LIMx}=500mV$
CR Clamp Voltage	V_{CR}	0.8	0.9	1.0	V	$R=10k\Omega$
CR Switching High Voltage	V_{CRH}	0.72	0.80	0.88	V	
CR Switching Low Voltage	V_{CRL}	0.36	0.40	0.44	V	
Minimum ON Time	t_{MINON}	0.1	0.5	1.0	μs	$C=470pF$, $R=10k\Omega$
Constant Voltage Power Supply						
VREF Output Voltage	V_{REF}	0.81	0.90	0.99	V	$I_{OUT}=0mA$ to 1mA

Typical Performance Curves

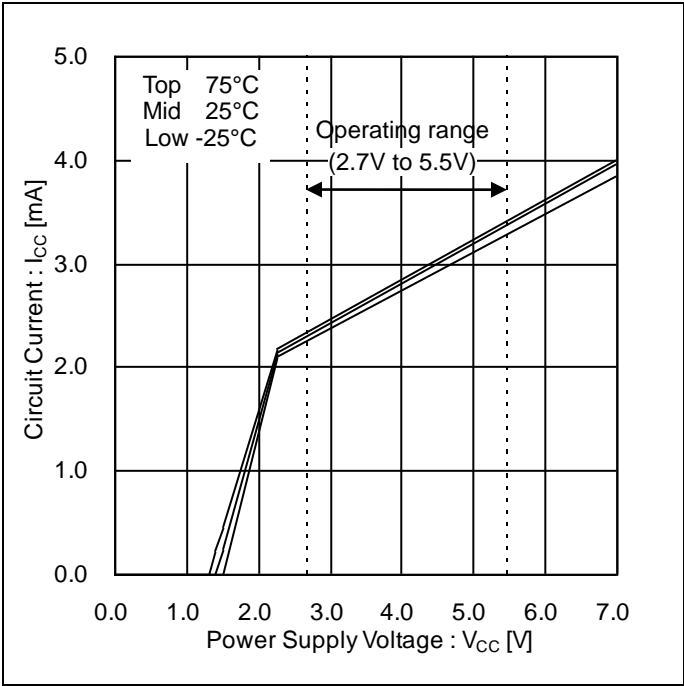


Figure 2.
Circuit Current vs Supply Voltage

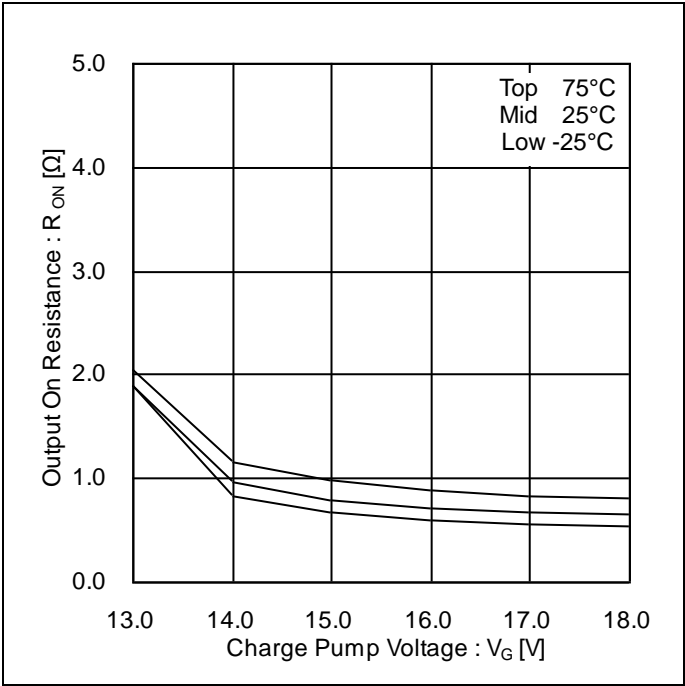


Figure 3.
Output ON-Resistance vs Charge Pump Voltage (V_M=10.5V)

Timing chart

Table 1. I/O Truth Table

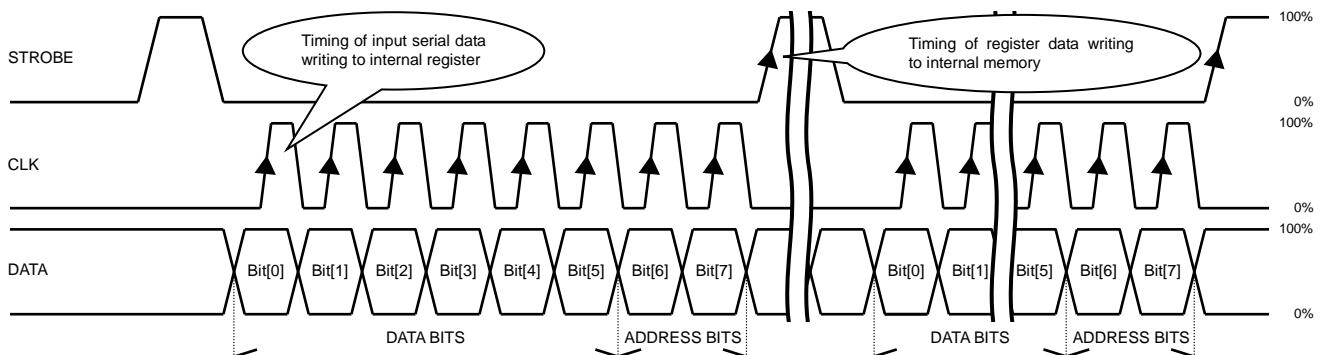
Input Mode	INPUT				OUTPUT		
	Serial data		Pin	PWMx	OUTxA	OUTxB	Output Mode ^(Note 4)
	modx	pxa	pxb				
IN/IN	L	L	L	X	Z	Z	OPEN
		L	H	L	L	H	CCW
		L	H	H	L	L	Short Brake
		H	L	L	H	L	CW
		H	L	H	L	L	Short Brake
		H	H	X	L	L	Short Brake
EN/IN	H	L	X	X	Z	Z	OPEN
		H	L	L	H	L	CW
		H	L	H	L	H	CCW
		H	H	X	L	L	Short Brake

L: Low, H: High, X: Don't care, Z: Hi impedance

(Note 4) CW: Current flows from OUTxA to OUTxB, CCW: Current flows from OUTxB to OUTxA (x=1 to 6)

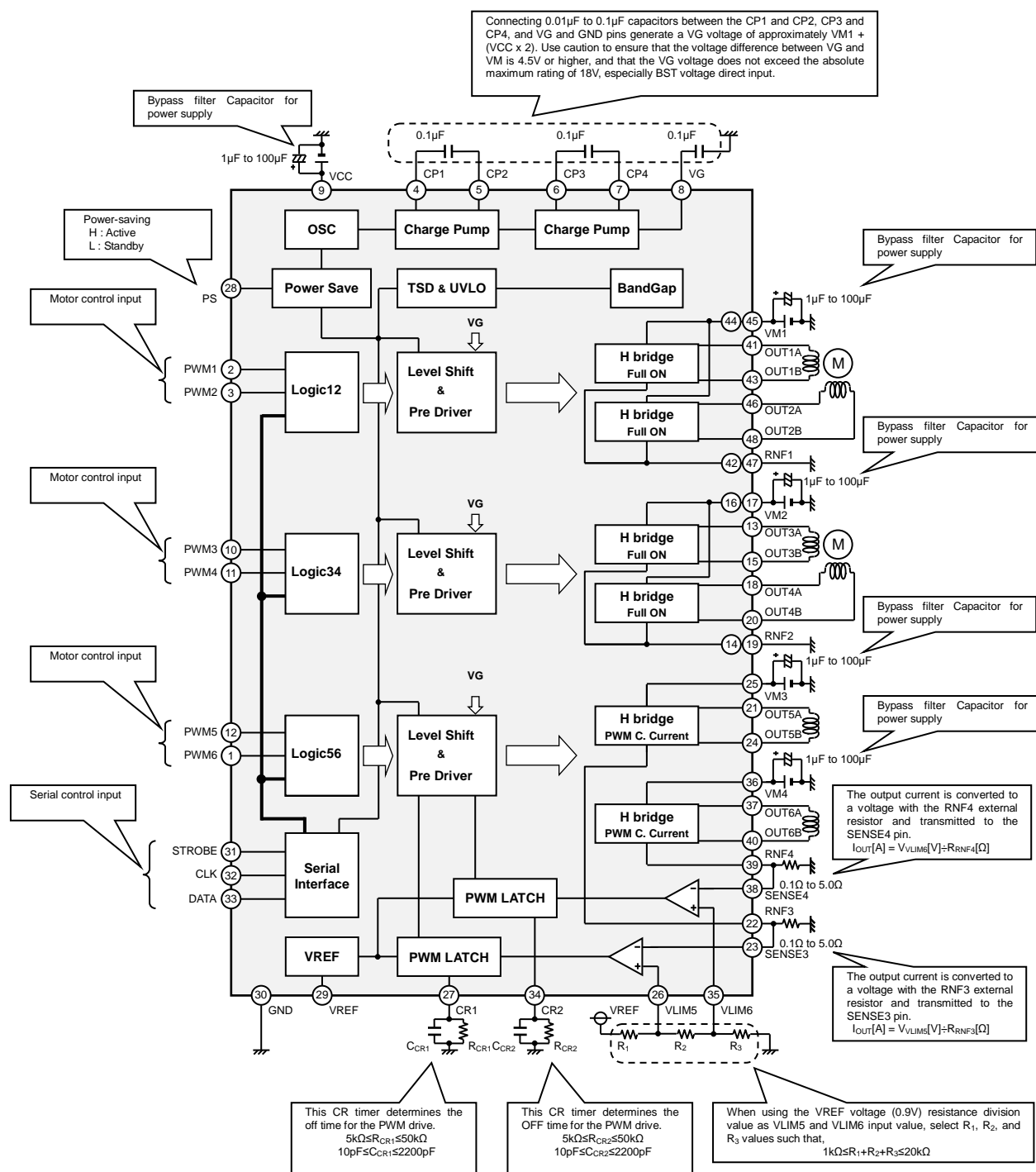
Table 2. Serial Resistor Bit Map

No.	ADDRESS BIT		DATA BIT					
	Bit[7]	Bit[6]	Bit[5]	Bit[4]	Bit[3]	Bit[2]	Bit[1]	Bit[0]
00H	0	0	mod2	mod1	p2a	p2b	p1a	p1b
01H	0	1	mod4	mod3	p4a	p4b	p3a	p3b
02H	1	0	mod6	mod5	p6a	p6b	p5a	p5b

Figure 4.
Serial Input Sequence

The device provides 8-bit and 3-line serial interface in order to set output logic modes. The DATA is sent to the internal shift register during the STROBE logic low interval at the CLK rising edge. Shift register data is written to the internal 6-bit memory simultaneously with STROBE rising edge, according to the addresses stored in Bit[7] and Bit[6]. The serial data input order is Bit[0] to Bit[7]. The stand-by condition is cleared all serial data, and also the UVLO fault condition.

Application Example



Selection of Components Externally Connected

When using the circuit with changes to the external circuit constants, make sure to leave an adequate margin for external components including static and transitional characteristics as well as dispersion of the IC.

Power Dissipation

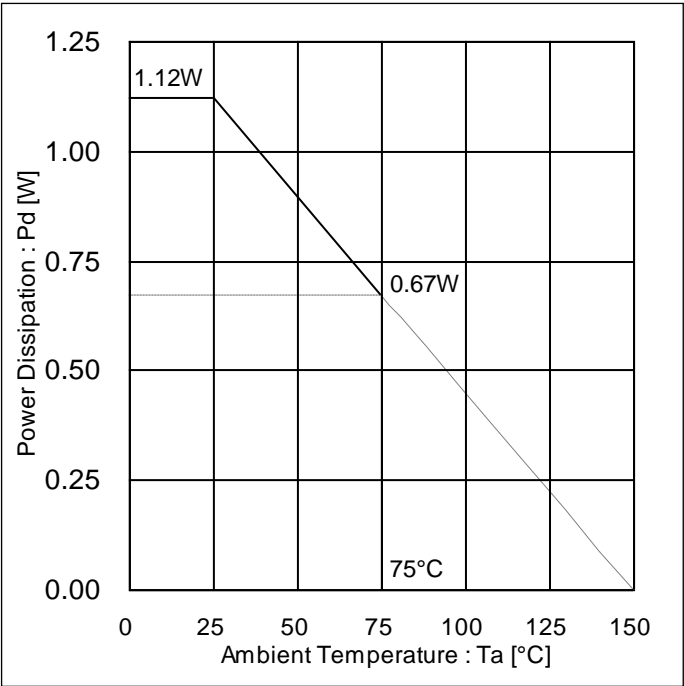
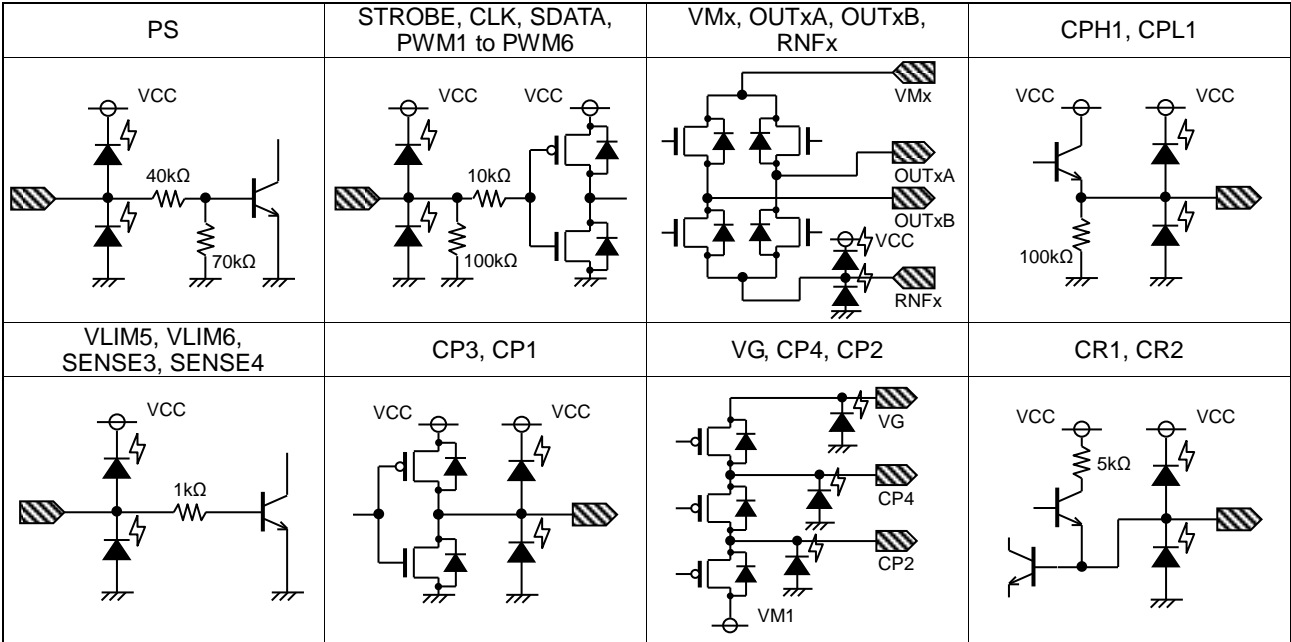


Figure 5.
Power Dissipation vs Ambient Temperature

I/O Equivalent Circuits



Operational Notes

1. Reverse Connection of Power Supply

Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply pins.

2. Power Supply Lines

Design the PCB layout pattern to provide low impedance supply lines. Separate the ground and supply lines of the digital and analog blocks to prevent noise in the ground and supply lines of the digital block from affecting the analog block. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

3. Ground Voltage

Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

4. Ground Wiring Pattern

When using both small-signal(GND) and large-current ground(RNF) traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

5. Thermal Consideration

Should by any chance the power dissipation rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. In case of exceeding this absolute maximum rating, increase the board size and copper area to prevent exceeding the Pd rating.

6. Recommended Operating Conditions

These conditions represent a range within which the expected characteristics of the IC can be approximately obtained. The electrical characteristics are guaranteed under the conditions of each parameter.

7. Inrush Current

When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

8. Operation Under Strong Electromagnetic Field

Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

9. Testing on Application Boards

When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

10. Inter-pin Short and Mounting Errors

Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

11. Unused Input Pins

Input pins of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input pins should be connected to the power supply or ground line.

Operational Notes – continued

12. Regarding the Input Pin of the IC

This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of the P layers with the N layers of other elements, creating a parasitic diode or transistor. For example (refer to figure below):

When $GND > Pin\ A$ and $GND > Pin\ B$, the P-N junction operates as a parasitic diode.

When $GND > Pin\ B$, the P-N junction operates as a parasitic transistor.

Parasitic diodes inevitably occur in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions that cause these diodes to operate, such as applying a voltage lower than the GND voltage to an input pin (and thus to the P substrate) should be avoided.

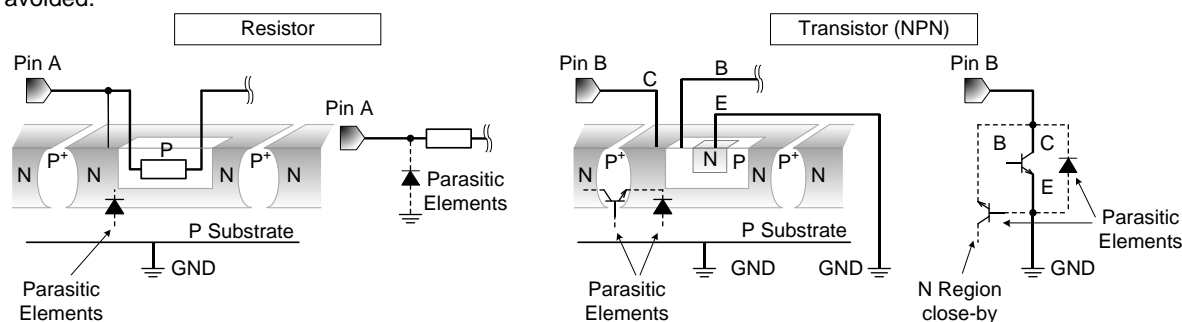


Figure 6.

Example of monolithic IC structure

13. Ceramic Capacitor

When using a ceramic capacitor, determine the dielectric constant considering the change of capacitance with temperature and the decrease in nominal capacitance due to DC bias and others.

14. Area of Safe Operation (ASO)

Operate the IC such that the output voltage, output current, and power dissipation are all within the Area of Safe Operation (ASO).

15. Thermal Shutdown Circuit(TSD)

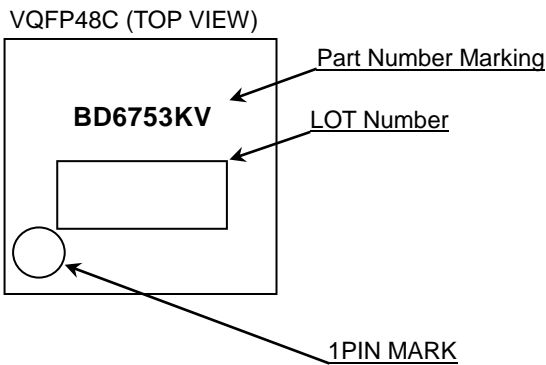
This IC has a built-in thermal shutdown circuit that prevents heat damage to the IC. Normal operation should always be within the IC's power dissipation rating. If however the rating is exceeded for a continued period, the junction temperature (T_j) will rise which will activate the TSD circuit that will turn OFF all output pins. When the T_j falls below the TSD threshold, the circuits are automatically restored to normal operation.

Note that the TSD circuit operates in a situation that exceeds the absolute maximum ratings and therefore, under no circumstances, should the TSD circuit be used in a set design or for any purpose other than protecting the IC from heat damage.

Ordering Information

B D 6 7 5 3 K V							-	
Part Number							Package KV : VQFP48C	Packaging and forming specification None: Tray

Marking Diagram



Part Number Marking	Package	Orderable Part Number
BD6753KV	VQFP48C	BD6753KV

Physical Dimension Tape and Reel Information

Package Name

VQFP48C

The drawing illustrates the mechanical specifications of the VQFP48C package. The top view shows a square body with a pin pitch of 0.5 mm. Key dimensions include a total width of 9.0 ± 0.2 mm, a body width of 7.0 ± 0.1 mm, and a pin width of 0.75 mm. The side view shows a maximum height of 1.6 mm and a pin height of 0.5 ± 0.1 mm. The detail view shows a pin diameter of 0.08 mm and a pin thickness of 0.08 mm. The package is marked with '0.08 S' and '0.08 M'.

Dimensions (mm):

- Overall width: 9.0 ± 0.2
- Body width: 7.0 ± 0.1
- Pin pitch: 0.5 ± 0.1
- Pin width: 0.75
- Pin height: 0.5 ± 0.1
- Maximum height: 1.6 MAX
- Pin diameter: 0.08
- Pin thickness: 0.08

Markings:

- Top view: 36, 25, 37, 24, 48, 1, 12
- Side view: 0.75, 13
- Detail view: $0.145^{+0.05}_{-0.03}$, $4^{\circ} +6^{\circ} -4^{\circ}$

(UNIT : mm)

PKG : VQFP48C

Drawing No. EX259-5001-1

<Tape and Reel information>	
Container	Tray
Quantity	1000pcs
Direction of feed	Direction of product is fixed in a tray

1pin

*Order quantity needs to be multiple of the minimum quantity.

Revision History

Date	Revision	Changes
09.Dec.2015	001	New Release

Notice

Precaution on using ROHM Products

- Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment ^(Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASS III	CLASS III	CLASS II b	CLASS III
CLASS IV		CLASS III	

- ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
 - Installation of protection circuits or other protective devices to improve system safety
 - Installation of redundant circuits to reduce the impact of single or multiple circuit failure
- Our Products are designed and manufactured for use under standard conditions and not under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc. prior to use, must be necessary:
 - Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
 - Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
 - Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
 - Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
 - Sealing or coating our Products with resin or other coating materials
 - Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
 - Use of the Products in places subject to dew condensation
- The Products are not subject to radiation-proof design.
- Please verify and confirm characteristics of the final or mounted products in using the Products.
- In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.
- De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.
- Confirm that operation temperature is within the specified range described in the product specification.
- ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

- When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.
- In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.
2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
 - [a] the Products are exposed to sea winds or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - [b] the temperature or humidity exceeds those recommended by ROHM
 - [c] the Products are exposed to direct sunshine or condensation
 - [d] the Products are exposed to high Electrostatic
2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.
3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.
4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

QR code printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

Precaution Regarding Intellectual Property Rights

1. All information and data including but not limited to application example contained in this document is for reference only. ROHM does not warrant that foregoing information or data will not infringe any intellectual property rights or any other rights of any third party regarding such information or data.
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Other Precaution

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4. The proper names of companies or products described in this document are trademarks or registered trademarks of ROHM, its affiliated companies or third parties.

General Precaution

1. Before you use our Products, you are requested to carefully read this document and fully understand its contents. ROHM shall not be in any way responsible or liable for failure, malfunction or accident arising from the use of any ROHM's Products against warning, caution or note contained in this document.
2. All information contained in this document is current as of the issuing date and subject to change without any prior notice. Before purchasing or using ROHM's Products, please confirm the latest information with a ROHM sales representative.
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