

28 V

USB Type-C Power Delivery High Voltage Protection of CC Pins USB Type-C Power Delivery Controller

BD93F50MWV

General Description

BD93F50MWV is a full function USB Type-C Power Delivery (PD) Controller that supports USB PD using base-band communication. It is compatible with USB Type-C Specification and Power Delivery specification. BD93F50MWV includes support for the PD policy engine and communicates with an Embedded Controller or the SoC via host interface.

Features

- 32 Bit ARM[®] Cortex[®]-M0 Processor Embedded
- USB Type-C Specification Ver.1.3 Compatible
- USB PD Specification Ver.3.0 Compatible
- Integrated VBUS N-ch MOSFET Switch Gate Driver
- Integrated VBUS Discharge Switch
- Protection Voltage of CC Pins is 28 V
- Supports Dead Battery operation
- I2C Interface for Host Communication

Key Specifications

- 3.67 V to 22 V VBUS Voltage Range:
 - 3.1 V to 5.5 V VSVR Voltage Range: -30 °C to +85 °C
- **Operating Temperature Range:**
- Protection Voltage of CC Pins:

FW Revision

Rev.7611(1DBBh)

Applications

- Wall outlets
- Printers
- Drone controllers
- **Mobile Batteries**
- -USB PD source ports

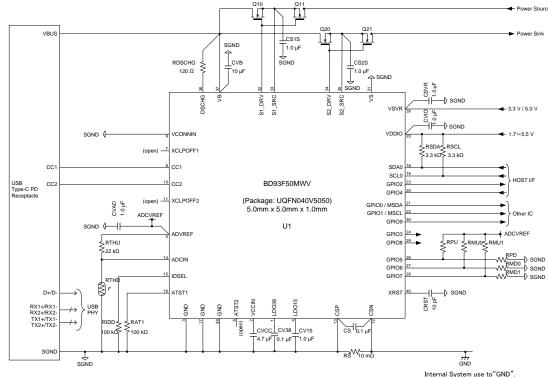
Package

UQFN040V5050

W (Typ) x D (Typ) x H (Max) 5.0 mm x 5.0 mm x 1.0 mm



Typical Application Circuits



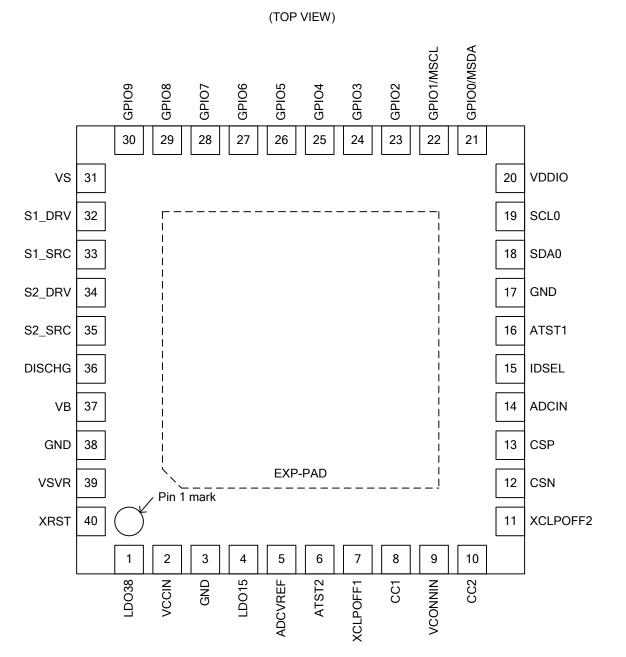
"ARM® Cortex® "is a registered trademark of Arm Limited.

OProduct structure : Silicon integrated circuit OThis product has no designed protection against radioactive rays.

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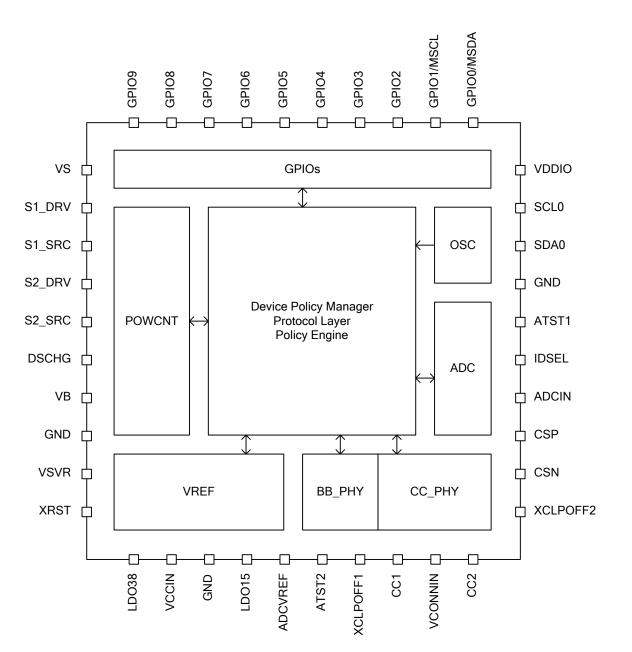
Pin Configuration



Pin Description

| Description | | |
|-------------|------------|--|
| Pin No. | Pin Name | Function |
| 1 | LDO38 | Internal LDO 3.8 V |
| 2 | VCCIN | Internal power supply (for internal use only) |
| 3 | GND | Ground |
| 4 | LDO15 | Internal LDO 1.5 V |
| 5 | ADCVREF | Reference voltage for ADC |
| 6 | ATST2 | Analog test pin. Short to GND. |
| 7 | XCLPOFF1 | Disable clamper of CC1 L: Dead-battery not support, Open: Dead-battery support |
| 8 | CC1 | Configuration channel 1 for Type-C |
| 9 | VCONNIN | Input power for VCONN |
| 10 | CC2 | Configuration channel 2 for Type-C |
| 11 | XCLPOFF2 | Disable clamper of CC2 L: Dead-battery not support, Open: Dead-battery support |
| 12 | CSN | Current sensing negative input |
| 13 | CSP | Current sensing positive input |
| 14 | ADCIN | Input voltage to ADC |
| 15 | IDSEL | I2C Device ID Select |
| 16 | ATST1 | Analog test pin. Short to GND. |
| 17 | GND | Ground |
| 18 | SDA0 | I2C slave data |
| 19 | SCL0 | I2C slave clock |
| 20 | VDDIO | GPIO H level voltage input |
| 21 | GPIO0/MSDA | GPIO / I2C Master SDA |
| 22 | GPIO1/MSCL | GPIO / I2C Master SCL |
| 23 | GPIO2 | GPIO |
| 24 | GPIO3 | GPIO |
| 25 | GPIO4 | GPIO |
| 26 | GPIO5 | GPIO |
| 27 | GPIO6 | GPIO |
| 28 | GPIO7 | GPIO |
| 29 | GPIO8 | GPIO |
| 30 | GPIO9 | GPIO |
| 31 | VS | Source voltage monitor input |
| 32 | S1_DRV | Power path FET gate control |
| 33 | S1_SRC | Power path FET BG/SRC voltage |
| 34 | S2_DRV | Power path FET gate control |
| 35 | S2_SRC | Power path FET BG/SRC voltage |
| 36 | DISCHG | Discharge NMOS drain (Max 28 V) |
| 37 | VB | Power supply from VBUS |
| 38 | GND | Ground |
| 39 | VSVR | Power supply from 3.3 V / 5 V system voltage rail |
| 40 | XRST | System reset signal input |
| - | EXP-PAD | EXP-PAD connects with substrate of IC. On the board, this PAD shall be shorted to Ground or be open condition. |

Block Diagram



Description of Block

(VREF)

VREF block is internal power source circuit of this LSI with the UVLO (Under Voltage Lock Out) function.

The main power input is VSVR. And for supporting dead battery operation, VB can become power source of this LSI when VSVR does not exist.

VREF block monitors VSVR and VB, and chooses an appropriate power supply by detecting normal condition or dead battery condition. From the voltage it chose, it generates VCCIN and LDO15 for internal circuits.

(OSC)

OSC block is reference clock circuit of this LSI. This LSI does not need another external clock source.

(I/F Bus)

I/F Bus block have I2C Slave for Host Control and I2C Master. The I2C Slave is intended to communicate with HOST MCU such as the EC.

I2C Master is used to control peripheral LSI such as authentication, SS MUX and DCDC.

(Device Policy Manager)

Device Policy Manager manages USB Type-C Power Delivery operation. It is constructed in internal MCU and program memory. It is accessible using Host IF Bus from external host MCU. And the writing access to program memory is possible from Host IF Bus.

(Policy Engine / Protocol Layer)

Policy Engine and Protocol Layer carry out USB Power Delivery operation. These blocks are constructed in internal MCU and the program memory in the same way as Device Policy Manager.

(CC_PHY)

CC_PHY block is a physical layer of USB Type-C. It supports the following function >Dual Role Port (Dual Role Data and Dual Role Power) >Pull-up Current Source (for USB 1.5 A / 3.0 A) >Pull-down Resistor for Up Facing Port (UFP) >CC terminal clamper for dead battery >VBUS Detecting

(BB_PHY)

BB_PHY block is a physical layer of USB Power Delivery. By control from Protocol Layer, it performs coding, decoding and judgment of CRC and communicates Base Band PD signal.

(POWCONT)

POWCONT block is power path control circuit of VBUS. It has two gate drivers for N-ch MOSFET switch, high withstand discharge switch for VBUS and over voltage protection (OVP).

(ADC)

ADC block is a general-purpose ADC. It is used for the monitoring of various operating states. Monitoring object is external input voltage for thermistor circuit, VBUS voltage, system Voltage, die temperature and source current

Absolute Maximum Ratings (Ta = 25 °C)

| Parameter | Symbol | Rating | Unit |
|--|------------------|---------------------------------|------|
| Supply Voltage [VSVR] | Vsvr | -0.3 to +6.0 | V |
| VBUS Voltage [VB] | VB | -0.3 to +28 | V |
| I/O Voltage [VDDIO] | Vddio | -0.3 to V _{SVR} | V |
| Maximum Junction Temperature | Tjmax | +150 | °C |
| Storage Temperature Range | Tstg | -55 to +150 | °C |
| S1_SRC, S2_SRC Voltage | VSRC | -0.3 to +22 | V |
| S1_DRV, S2_DRV Voltage | V _{DRV} | -0.3 to (V _{SRC} +6.0) | V |
| DSCHG, CC1, CC2, VS Voltage | V _{HV} | -0.3 to +28 | V |
| LDO15, ADCVREF, ADCIN Voltage | VLV | -0.3 to +2.1 | V |
| Differential Voltage Between CSN and CSP | Vcs | -0.15 to +0.15 | V |
| All Other Pins | Vотн | -0.3 to +6.0 | V |

Caution 1: 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

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Thermal Resistance (Note 1)

| Decemptor | Symbol | Thermal Res | Unit | | |
|---|--------------------|------------------------|---------------|------|--|
| Parameter | Symbol | 1s ^(Note 3) | 2s2p (Note 4) | Unit | |
| UQFN040V5050 | | | • | | |
| Junction to Ambient | θја | 113.6 | 24.5 | °C/W | |
| Junction to Top Characterization Parameter (Note 2) | Ψ_{JT} | 8 | 3 | °C/W | |

(Note 1) Based on JESD51-2A (Still-Air). (Note 2) The thermal characterization parameter to report the difference between junction temperature and the temperature at the top center of the outside surface of the component package.

(Note 3) Using a PCB board based on JESD51-3.

| (Note 4) Using a PCB board based of | | | | | |
|--|-----------|----------------------------------|-----------|----------------------|----------------------|
| Layer Number of Measurement Board | Material | Board Size | | | |
| Single | FR-4 | 114.3 mm x 76.2 mm x | (1.57 mmt | | |
| Тор | | | | | |
| Copper Pattern | Thickness | | | | |
| Footprints and Traces | 70 µm | | | | |
| | 70 pm | | | | |
| Layer Number of | | Doord Size | | Thermal Via | (Note 5) |
| | Material | Board Size | | Thermal Via Pitch | (Note 5) Diameter |
| Layer Number of | | Board Size 114.3 mm x 76.2 mm | x 1.6 mmt | | |
| Layer Number of Measurement Board | Material | | | Pitch | Diameter Φ0.30 mm |
| Layer Number of Measurement Board 4 Layers | Material | 114.3 mm x 76.2 mm | | Pitch 1.20 mm | Diameter Φ0.30 mm |

(Note 5) This thermal via connects with the copper pattern of all layers.

Recommended Operating Conditions

| Parameter | Symbol | Min | Тур | Max | Unit |
|-----------------------|------------------|------|-----|-----|------|
| Operating Temperature | Topr | -30 | +25 | +85 | °C |
| Supply Voltage | V _{SVR} | 3.1 | 3.3 | 5.5 | V |
| VBUS Voltage | VB | 3.67 | - | 22 | V |
| VDDIO Voltage | VDDIO | 1.7 | 3.3 | 5.5 | V |

Internal Memory Cell Characteristic (Unless otherwise specified V_{SVR} = V_{DDIO} = 3.3 V, V_B = 5.0 V)

| Parameter | Symbol | Min | Тур | Max | Unit | Conditions |
|---|--------|-----|-----|-----|--------|-----------------------|
| Memory Data rewrite cycles (Note 6) | Mrw | 100 | - | - | cycles | Ta = -30 °C to +85 °C |
| Memory Data retention life (Note 7) | Mrl | 20 | - | - | years | Ta = -30 °C to +85 °C |
| (Note 6) BD03E50MW/V cannot rewrite EW/ ROHM cannot guarantee if EW/ is rewriting | | | | | | |

(Note 6) BD93F50MWV cannot rewrite FW. ROHM cannot guarantee if FW is rewriting. (Note 7) Not 100% Tested

Electrical Characteristic (Unless otherwise specified $V_{SVR} = V_{DDIO} = 3.3 \text{ V}$, $V_B = 5.0 \text{ V}$, Ta = 25 °C)

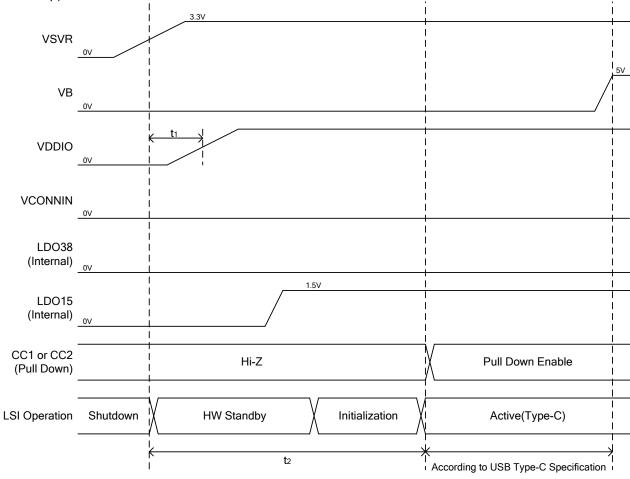
| Parameter | Symbol | Min | Тур | Max | Unit | Conditions |
|--------------------------------------|-------------------|-----------------------------|-----|-------------------------|------|---|
| Current Consumption | L. | 1 | | | | |
| Shutdown Current | Isd | - | 30 | 70 | μA | XRST = "L" V _{SVR} Current |
| Stop Current | I _{SP} | - | 150 | - | μA | USB-C Un-Attached V _{SVR} Current The option function stops. |
| Standby Current | Ist | - | 2 | - | mA | USB-C Attached, PD Standby V _{SVR} Current |
| VREF | | | | | | |
| VCCIN Voltage | V _{CCIN} | - | 3.3 | - | V | Standby |
| LDO38 Output Voltage | V ₃₈ | - | 3.8 | - | V | Standby V _B = 5 V |
| LDO15 Output Voltage | V _{15D} | - | 1.5 | - | V | Standby |
| VSVR UVLO release | VDBSVR | - | - | 3.10 | V | |
| VB UVLO release | VBUSDET | - | - | 3.67 | V | |
| VDDIO UVLO release | Vdbddio | - | 1.0 | 1.7 | V | |
| Digital DC Characteristics (GPIOx: x | x = 2 to 9) | | | | | |
| Input "H" Voltage 1 | VIH1 | 0.8 x Vddio | - | V _{DDIO} + 0.3 | V | |
| Input "L" Voltage 1 | VIL1 | -0.3 | - | 0.2 x Vddio | V | |
| Input Leak Current 1 | lı∟1 | -5 | 0 | +5 | μA | |
| Output "H" Voltage 1 | V _{OH1} | 0.85 x V _{DDIO} | - | - | V | IL = +1 mA |
| Output "L" Voltage 1 | V _{OL1} | - | - | 0.3 | V | IL = -1 mA |
| Digital DC Characteristics (SDA0,S0 | CL1) | | | | | |
| Output "L" Voltage 2 | V _{OL2} | - | - | 0.4 | V | IL = -3 mA |
| SCL Frequency | fscl | 0 | - | 400 | kHz | |
| CC_PHY | | | | | | |
| Pull-Up Current for USB Default | I _{IP1} | 64 | 80 | 96 | μA | |
| Pull-Up Current for 1.5A mode | I _{IP2} | 166 | 180 | 194 | μA | |
| Pull-Down Resistor | R _{RD} | 4.6 | 5.1 | 5.6 | kΩ | |

Electrical Characteristic - continued

| Parameter | Symbol | Min | Тур | Max | Unit | Conditions | | |
|---|---------------------|------|------|------|------|-------------------------------|--|--|
| Voltage Measurement | Voltage Measurement | | | | | | | |
| ADVREF Voltage | V _{ADC} | 1.45 | 1.50 | 1.55 | V | | | |
| VB/VS Voltage Measurement Range | VRv | 0 | - | 28 | V | | | |
| External Input Voltage Measurement Range | VRIN | 0 | - | 1.5 | V | | | |
| POWCNT | | | | | | | | |
| Output Voltage between S1_DRV and S1_SRC or S2_DRV and S2_SRC | Vosw | 4.4 | 5.5 | 6.6 | V | Sx_SRC = 5.0 V (x = 1 or 2) | | |
| Discharge Switch on Resistance | R _{DSC} | - | 2.0 | - | Ω | DSCHG = 0.2 V | | |
| OVP Detecting Voltage Accuracy | ACOVP | -5 | - | +5 | % | OVP Detecting Voltage = 6.0 V | | |

Timing Chart

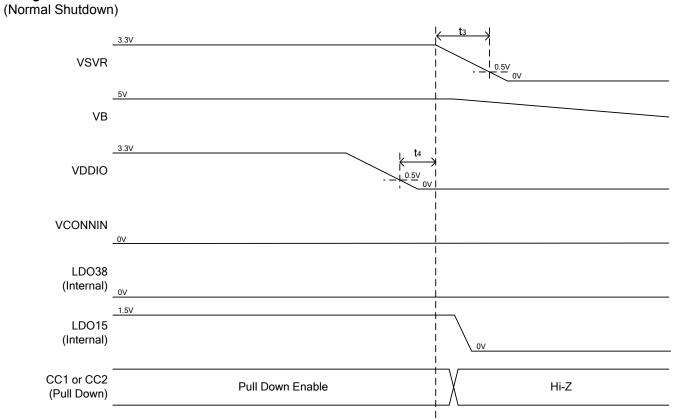




Timing Characteristic (Ta = 25 °C)

| Parameter | Symbol | Min | Тур | Max | Unit | Conditions |
|---------------------------------------|--------|-----|-----|-----|------|---|
| VDDIO Input Timing from VSVR Input | t1 | 0 | - | - | ms | |
| LSI Wakeup Time | t2 | - | - | 100 | ms | Not emergency operating. I2C (Master and Slave) is disable. |

Timing Chart - Continued



Timing Characteristic (Ta = 25 °C)

| Parameter | Symbol | Min | Тур | Max | Unit | Conditions |
|-------------------|----------------|-----|-----|-----|------|------------|
| VSVR Falling Time | t ₃ | - | - | 400 | ms | |

As for the timing of t₄, it is arbitrary. But LSI may not maintain action of USB Type-C PD when it is lost during LSI action.

I/O Equivalence Circuits

| PIN No. | Pin Name | Equivalence Circuit Diagram |
|------------|----------------------|-----------------------------|
| 1 | LDO38 | Pin GND GND GND |
| 4 5 | LDO15 ADCVREF | |
| 7 11 | XLCPOFF1 XCLPOFF2 | Pin GND |
| 8 10 | CC1 CC2 | Pin GND GND GND |
| 12 13 | CSN CSP | Pin GND GND GND |
| 14 | ADCIN | |

I/O Equivalence Circuits - Continued

| Pin No. | ence Circuits - Continued Pin Name | Equivalence Circuit Diagram |
|--|--|-----------------------------|
| 15 | IDSEL | |
| 18 19 21 22 23 24 25 26 27 28 29 30 | SDA0 SCL0 GPI00 GPI01 GPI02 GPI03 GPI04 GPI05 GPI06 GPI07 GPI08 GPI09 | |
| 32 34 | S1_DRV S2_DRV | Pin Sx_SRC |
| 33 35 | S1_SRC S2_SRC | Pin Sx_DRV |
| 31 36 | VS DSCHG | Pin GND GND |
| 40 | XRST | |

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 and large-current ground 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. Recommended Operating Conditions

The function and operation of the IC are guaranteed within the range specified by the recommended operating conditions. The characteristic values are guaranteed only under the conditions of each item specified by the electrical characteristics.

6. 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.

7. 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.

8. 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.

9. 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

10. 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.

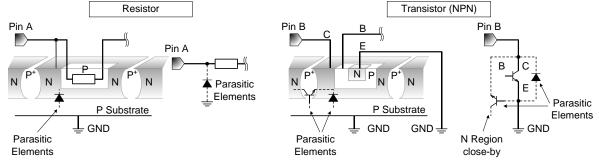


Figure 1. Example of Monolithic IC Structure

11. Ceramic Capacitor

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

12. 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 maximum junction temperature rating. If however the rating is exceeded for a continued period, the junction temperature (Tj) will rise which will activate the TSD circuit that will turn OFF power output pins. When the Tj 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.

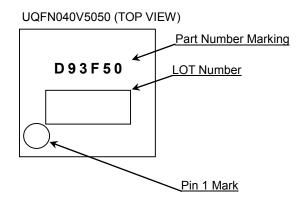
13. Over Current Protection Circuit (OCP)

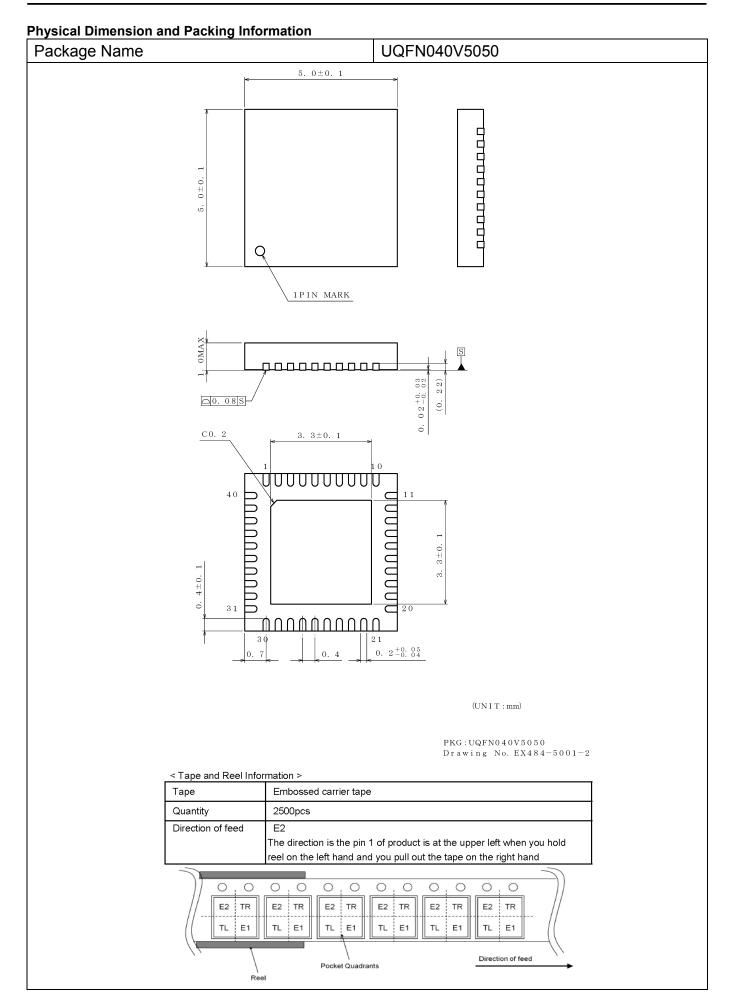
This IC incorporates an integrated overcurrent protection circuit that is activated when the load is shorted. This protection circuit is effective in preventing damage due to sudden and unexpected incidents. However, the IC should not be used in applications characterized by continuous operation or transitioning of the protection circuit.

Ordering Information



Marking Diagram





Revision History

| Date | Revision | Changes |
|--------------|----------|-------------|
| 10. Jul.2020 | 001 | New Release |

Notice

Precaution on using ROHM Products

1. Our Products are designed and manufactured for application in ordinary electronic equipment (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 |
|---|
|---|

| JÁPAN | USA | EU | CHINA |
|--------|---------|--------|---------|
| CLASSⅢ | | | CLASSII |
| CLASSⅣ | CLASSII | CLASSⅢ | CLASSI |

- 2. 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:
 - [a] Installation of protection circuits or other protective devices to improve system safety
 - [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure
- 3. 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:
 - [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
 - [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
 - [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
 - [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
 - [f] Sealing or coating our Products with resin or other coating materials
 - [g] Use of our Products without cleaning residue of flux (Exclude cases where no-clean type fluxes is used. However, recommend sufficiently about the residue.); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
 - [h] Use of the Products in places subject to dew condensation
- 4. The Products are not subject to radiation-proof design.
- 5. Please verify and confirm characteristics of the final or mounted products in using the Products.
- 6. 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.
- 7. 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.
- 8. Confirm that operation temperature is within the specified range described in the product specification.
- 9. 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

- 1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.
- 2. 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 lonizer, 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

A two-dimensional barcode 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

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General Precaution

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