Isolator Series

Isolation Voltage 3750 V_{RMS} 4ch High-Speed Isolated Switch Driver

BM79331FV-LB

General Description

This product is a rank product for the industrial equipment market. This is the best product for use in these applications.

BM79331FV-LB is switch driver with isolation element, Isolation Voltage 3750 V_{RMS}. This IC drives the MOSFET connected to the output pins of the source/sink type, which is commonly used in industrial equipment. Use of this product enables standardization of the source/sink output circuit.

Features

- Floating Voltage Output (4ch)
- With Isolation Element (4ch)
- With UVLO
- UL1577 (pending) Isolation Voltage 3750 V_{RMS}
- With Low-Delay Circuit

Applications

- Industrial Equipment
- PLC
- Sequencer
- PC for Industrial
- Overall of Source/Sink Output Pins for Industrial Equipment

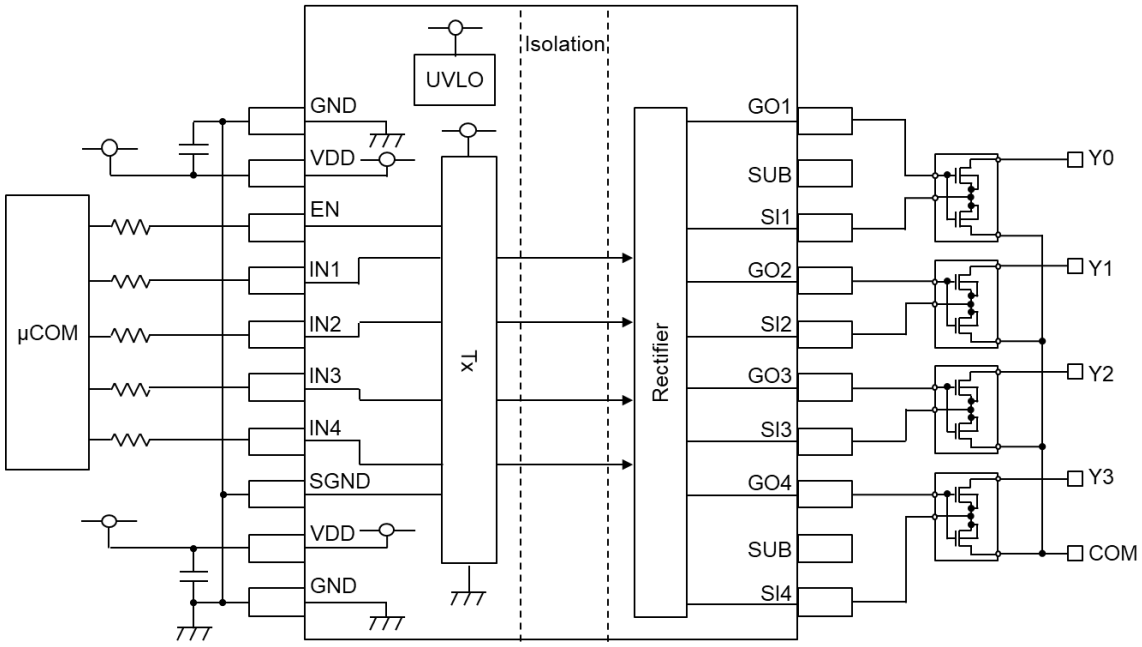
Key Specifications

- Supply Voltage: 4.5 V to 5.5 V
- Supply Current: 74 mA (Max)
- Propagation Delay: 2 µs (Max)
- Operating Temperature Range: -40 °C to +125 °C

Package	W (Typ) x D (Typ) x H (Max)
SSOP-B20WR1	6.5 mm x 8.1 mm x 2.01 mm

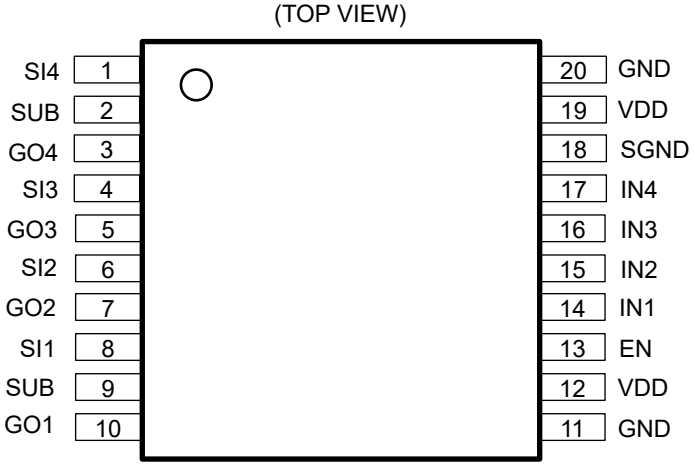
SSOP-B20WR1

Typical Application Circuit



Contents

Pin Configuration

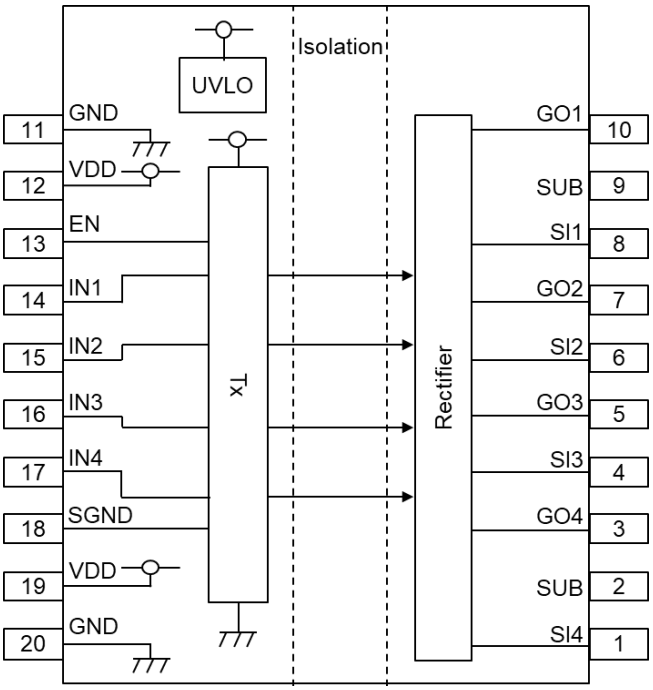


Pin Descriptions

Pin No.	Pin Name	Function	Pin treatment when unused
1	SI4	External MOSFET source connection pin channel 4	Open
2	SUB	Connection to the output chip SUB*(Note 1)*	Open
3	GO4	External MOSFET gate connection pin channel 4	Open
4	SI3	External MOSFET source connection pin channel 3	Open
5	GO3	External MOSFET gate connection pin channel 3	Open
6	SI2	External MOSFET source connection pin channel 2	Open
7	GO2	External MOSFET gate connection pin channel 2	Open
8	SI1	External MOSFET source connection pin channel 1	Open
9	SUB	Connection to the output chip SUB*(Note 1)*	Open
10	GO1	External MOSFET gate connection pin channel 1	Open
11	GND	Ground pin	GND
12	VDD	Power supply pin*(Note 2)*	VDD
13	EN	Enable pin (High: Active, Low: Power down)	VDD
14	IN1	Input channel 1	GND
15	IN2	Input channel 2	GND
16	IN3	Input channel 3	GND
17	IN4	Input channel 4	GND
18	SGND	Ground pin	GND
19	VDD	Power supply pin*(Note 2)*	VDD
20	GND	Ground pin	GND

(Note 1) Use with Open.
(Note 2) Place a bypass capacitor near the VDD-GND pins.

Block Diagram



Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply Voltage	V_{DD}	-0.3 to +7.0	V
Input Pin Voltage	V_{IN}	-0.3 to V_{DD}+0.3 or +7.0*(Note 3)*	V
Voltage Between Channels of SIx Pins*(Note 4)*	V_{SIDIFF}	45	V
Maximum Junction Temperature	Tjmax	150	°C
Storage Temperature Range	Tstg	-55 to +150	°C

(Note 3) Whichever is smaller is the absolute maximum rating.
(Note 4) The voltage difference between the maximum and minimum voltages of the SIx pins in the 4 channels.

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 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.*

Caution 2: *Should by any chance the maximum junction temperature 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, design a PCB with thermal resistance taken into consideration by increasing board size and copper area so as not to exceed the maximum junction temperature rating.*

Thermal Resistance*(Note 5)*

Parameter	Symbol	Thermal Resistance (Typ)		Unit
		1s*(Note 7)*	2s2p*(Note 8)*	
SSOP-B20WR1				
Junction to Ambient	θ_{JA}	151.5	80.6	°C/W
Junction to Top Characterization Parameter*(Note 6)*	Ψ_{JT}	47	40	°C/W

(Note 5) Based on JESD51-2A (Still-Air).
(Note 6) 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 7) Using a PCB board based on JESD51-3.
(Note 8) Using a PCB board based on JESD51-7.

Layer Number of Measurement Board	Material	Board Size
Single	FR-4	114.3 mm x 76.2 mm x 1.57 mmt

Top	
Copper Pattern	Thickness
Footprints and Traces	70 µm

Layer Number of Measurement Board	Material	Board Size
4 Layers	FR-4	114.3 mm x 76.2 mm x 1.6 mmt

Top		2 Internal Layers		Bottom	
Copper Pattern	Thickness	Copper Pattern	Thickness	Copper Pattern	Thickness
Footprints and Traces	70 µm	74.2 mm x 74.2 mm	35 µm	74.2 mm x 74.2 mm	70 µm

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{DD}	4.5	5.0	5.5	V
Operating Temperature	Topr	-40	+25	+125	°C

Insulation Specifications UL1577 (pending)

Parameter	Symbol	Rating	Unit
Insulation Withstand Voltage (1 min)*(Note 9)*	V_{ISO1}	3750	V_{RMS}
Insulation Test Voltage (1 s)*(Note 10)*	V_{ISO2}	4500	V_{RMS}

(Note 9) $V_{TEST} = V_{ISO1}$, t = 60 s, accredited test conditions
(Note 10) $V_{TEST} = V_{ISO2}$, t = 1 s, 100 % shipping test performed

Electrical Characteristics

Unless otherwise specified, Ta = -40 °C to +125 °C, V_{DD} = 4.5 V to 5.5 V
The typical value is defined at Ta = 25 °C, V_{DD} = 5.0 V

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Supply Current Specifications						
Supply Current 1	I_{CC1}	-	1	3	mA	V_{IN} = 0 V
Supply Current 2	I_{CC2}	-	35	56	mA	$V_{IN} = V_{DD}$
Supply Current 3	I_{CC3}	-	50	74	mA	f = 200 kHz
Power Down Supply Current	I_{CCPD}	-	70	200	µA	EN pin: Low
Digital Input/Output Specifications						
High Level Input Voltage	V_{IH}	$0.7V_{DD}$	-	-	V	
Low Level Input Voltage	V_{IL}	-	-	$0.3V_{DD}$	V	
Low Level Input Current 1	I_{IL1}	-10	-	-	µA	IN1, IN2, IN3, IN4 pin EN pin: Low
Low Level Input Current 2	I_{IL2}	-100	-50	-30	µA	EN pin
High Level Input Current 1	I_{IH1}	-	-	10	µA	IN1, IN2, IN3, IN4 pin EN pin: Low
High Level Input Current 2	I_{IH2}	-	-	10	µA	EN pin IN1, IN2, IN3, IN4 pin: Low
High Level Output Voltage	V_{OH}	3.0	-	6.5	V	C_L = 300 pF, R_L = 10 MΩ V_{DD} = 5.0 V Ta = -40 °C to +125 °C
Low Level Output Voltage	V_{OL}	0	-	1.0	V	
Output Pull-down Resistance	R_{OPD}	70	100	130	kΩ	Ta = 25 °C GOx - SIx = 0.2 V (x = 1 to 4)
Input Pin Capacitance	C_I	-	5	-	pF	V_{DD} = 5.0 V, f = 1 MHz IN1, IN2, IN3, IN4 pin
Switching Specifications						
Propagation Delay Time (Low to High)	t_{PLH}	-	1	2	µs	C_L = 300 pF, R_L = 10 MΩ Ta = 25 °C
Propagation Delay Time (High to Low)	t_{PHL}	-	1	2	µs	
AC Specifications						
Common-Mode Transient Immunity	C_{MTI}	75	-	-	kV/µs	Guaranteed by design
UVLO Function						
Positive Threshold Voltage	V_{UVP}	-	3.6	4.0	V	
Negative Threshold Voltage	V_{UVN}	2.9	3.5	-	V	
Hysteresis Voltage	V_{UVHY}	0.06	0.1	-	V	

Typical Performance Curves

(Reference data)

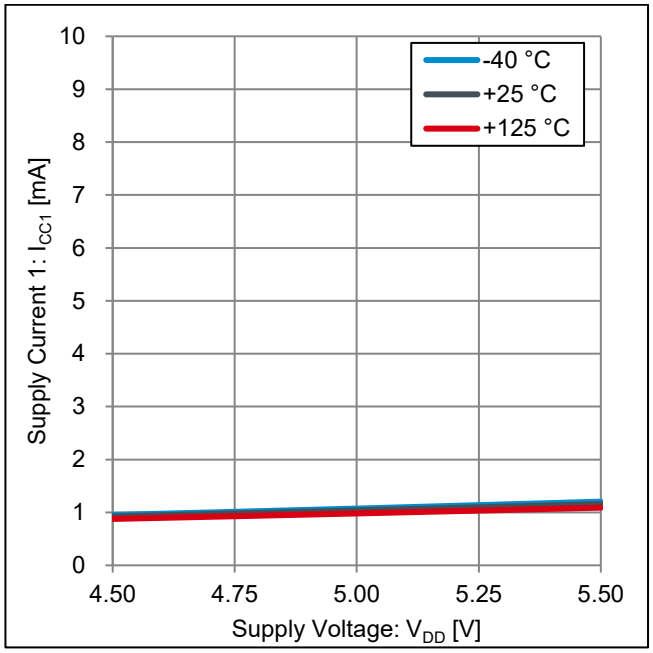


Figure 1. Supply Current 1 vs Supply Voltage

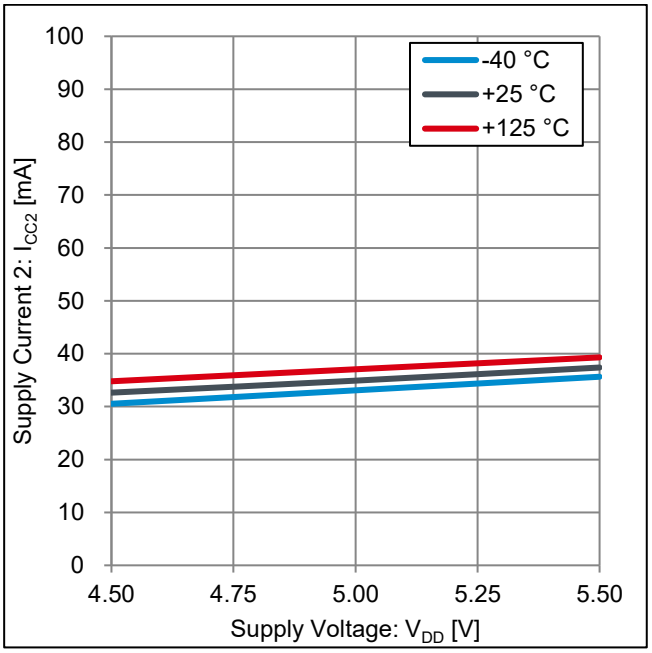


Figure 2. Supply Current 2 vs Supply Voltage

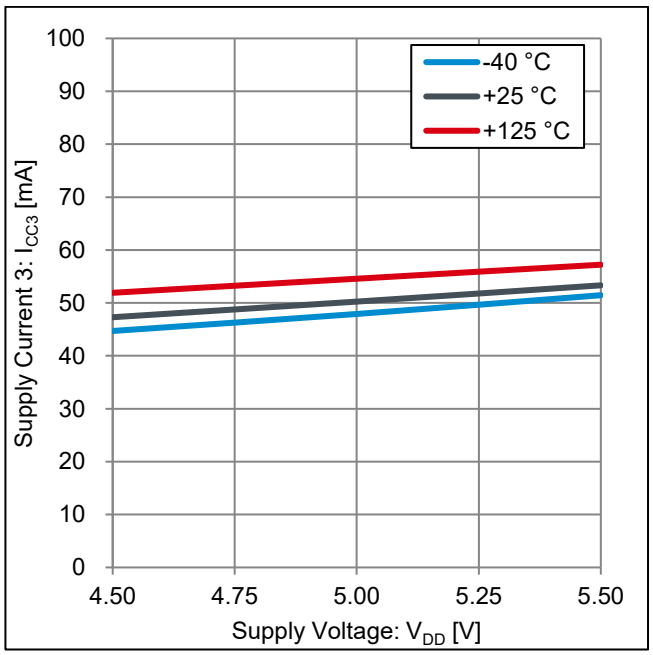


Figure 3. Supply Current 3 vs Supply Voltage

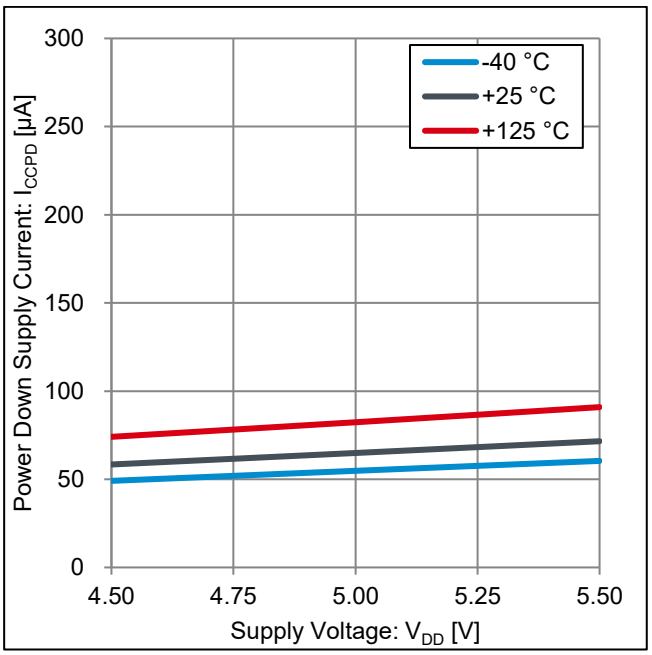


Figure 4. Power Down Supply Current vs Supply Voltage

Typical Performance Curves - continued
(Reference data)

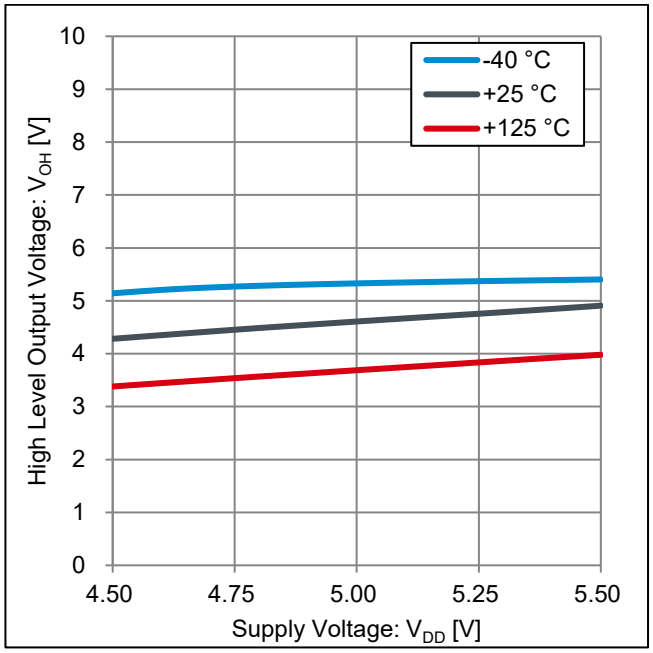


Figure 5. High Level Output Voltage vs Supply Voltage

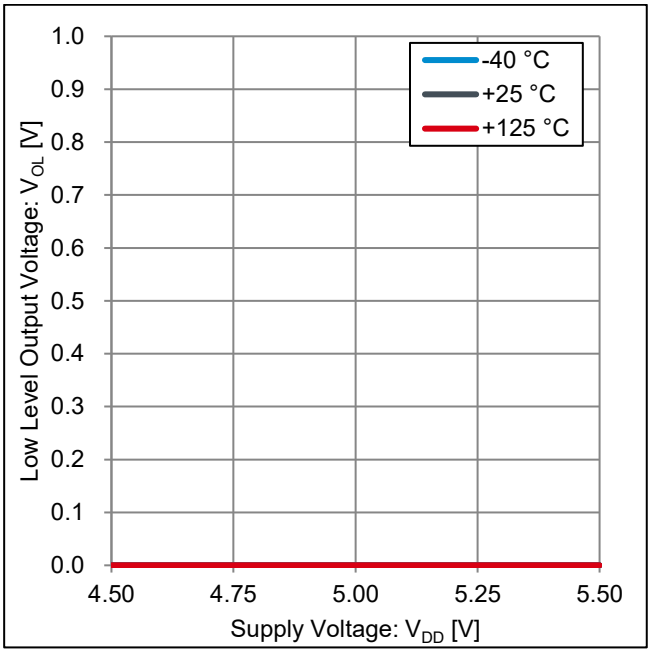


Figure 6. Low Level Output Voltage vs Supply Voltage

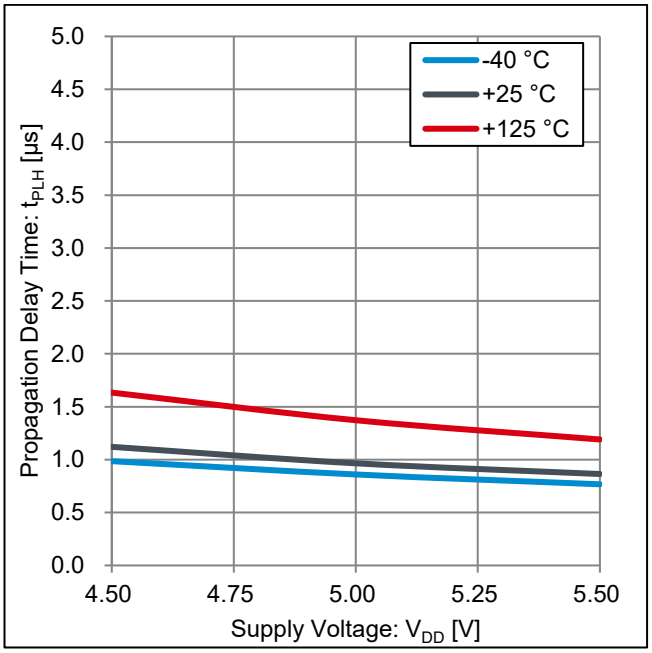


Figure 7. Propagation Delay Time (Low to High) vs Supply Voltage

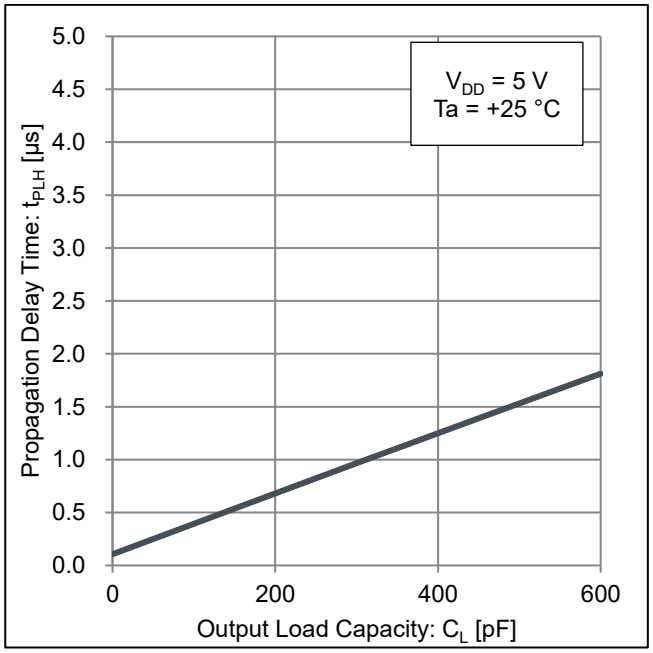


Figure 8. Propagation Delay Time (Low to High) vs Output Load Capacity

Typical Performance Curves - continued

(Reference data)

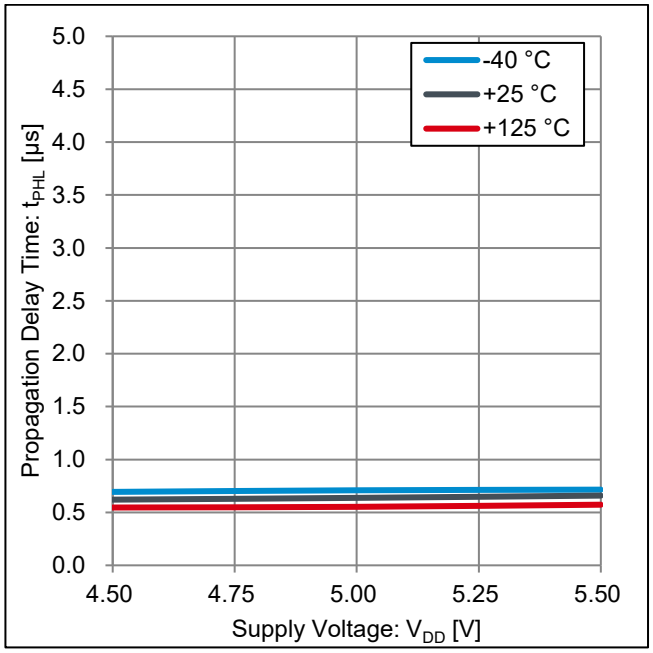


Figure 9. Propagation Delay Time (High to Low) vs Supply Voltage

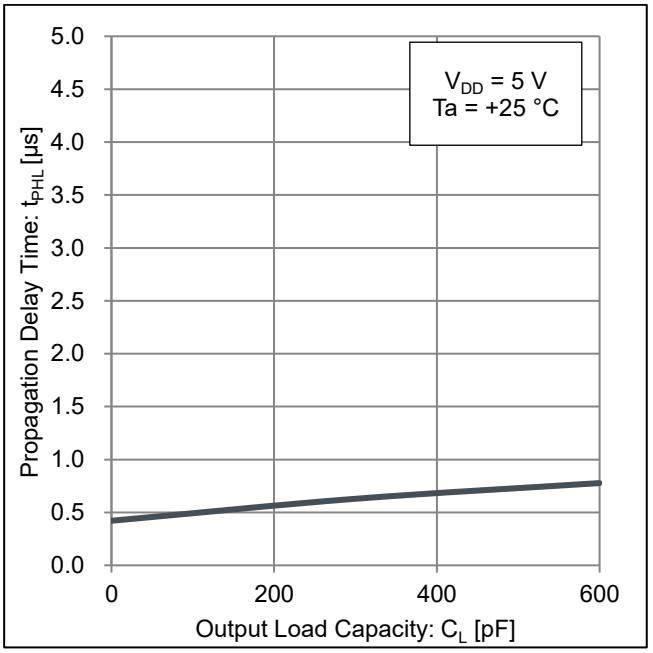


Figure 10. Propagation Delay Time (High to Low) vs Output Load Capacity

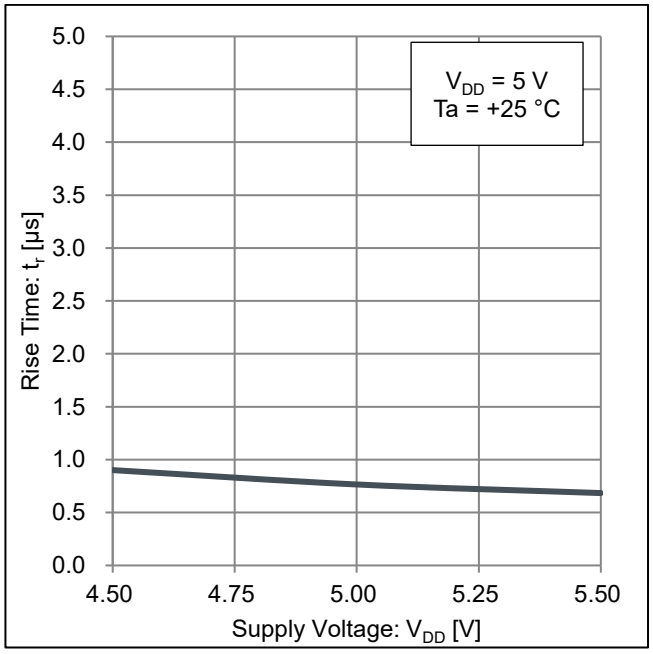


Figure 11. Rise Time vs Supply Voltage

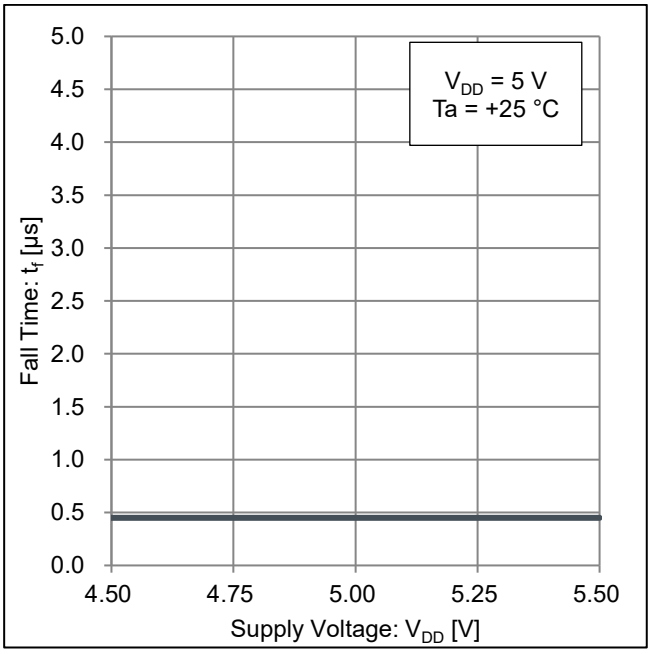


Figure 12. Fall Time vs Supply Voltage

Power Supply Sequence

Unless otherwise specified, Ta =-40 °C to +125 °C

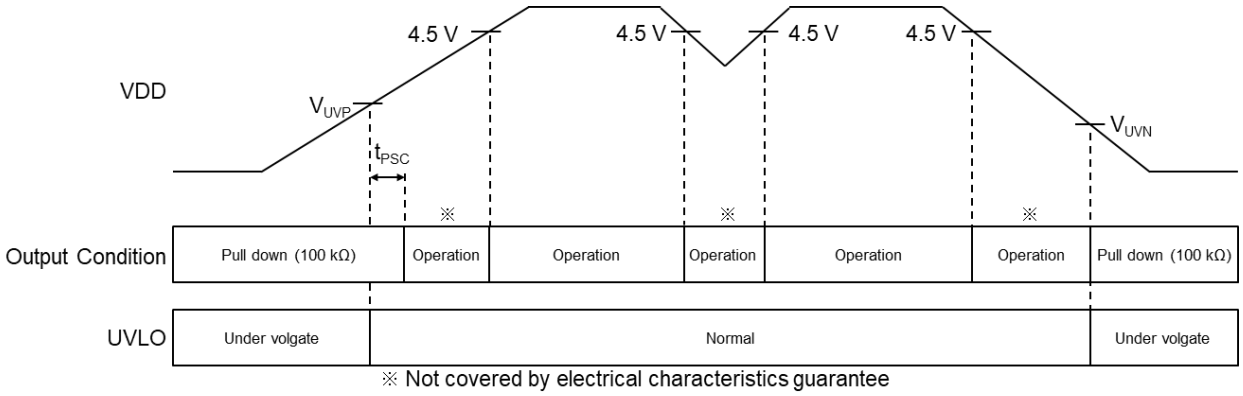


Figure 13. Power Supply Sequence Chart

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Input Wait Time after Power-up	t_{PSC}	5	-	-	µs	EN = VDD

After the "t_{PSC}" time has elapsed after the power supply exceeds the UVLO rise detection voltage, input the signal.

Delay Time

The delay time is the time it takes for the MOSFET control signal to propagate from input to output.

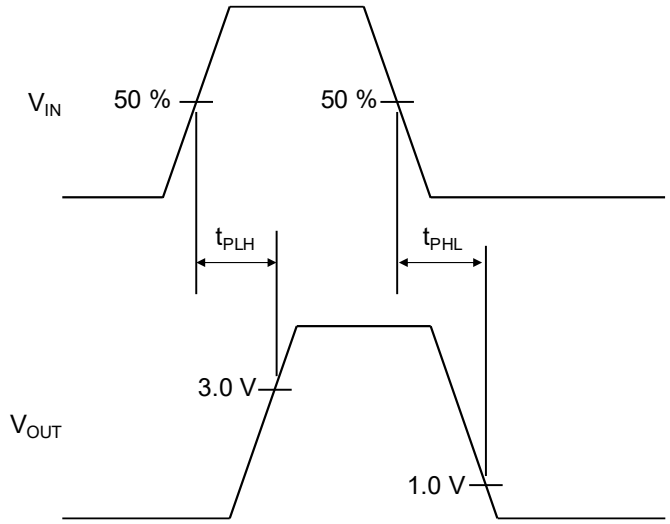


Figure 14. Input / Output Timing Chart

Rise Time / Fall Time

Rise Time / Fall Time is a parameter that represents the time required for the logic of the output V_{OUT} to transition.

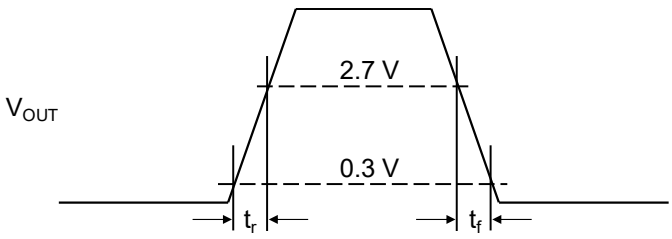


Figure 15. Rise Time / Fall Time

Operation Description

This product drives an insulated transformer with a modulated INx (x = 1 to 4) signal on/off keying (OOK) to generate a voltage for MOS drive. The electromagnetic induction current generated in the insulated transformer is rectified to generate an output voltage V_{OUT} between the GOx - SIx pins.

Controls the power down using the EN pin. When the EN pin is low, the oscillator circuit stops and the GOx - SIx pins are pulled down with a resistance of 100 kΩ. When the EN signal is high, the oscillator circuit starts and the IC becomes active. In operation, the logic corresponding to the INx signal is output according to the truth table below.

This product has a built-in UVLO circuit so that the output status does not become indeterminate when the VDD power supply voltage drops. If the VDD voltage drops below the UVLO detection voltage, the GOx - SIx pins are pulled down with a resistance of 100 kΩ.

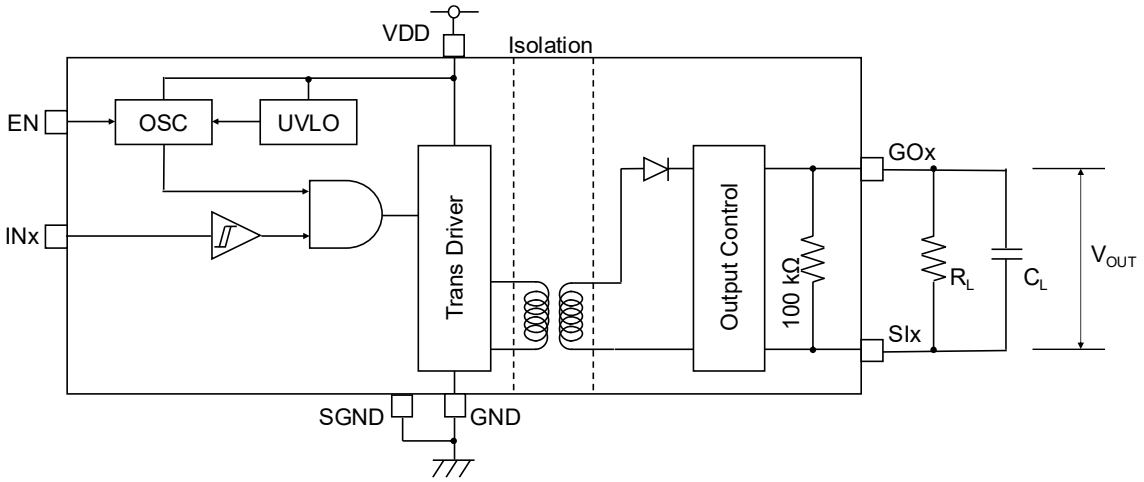


Figure 16. Block Diagram

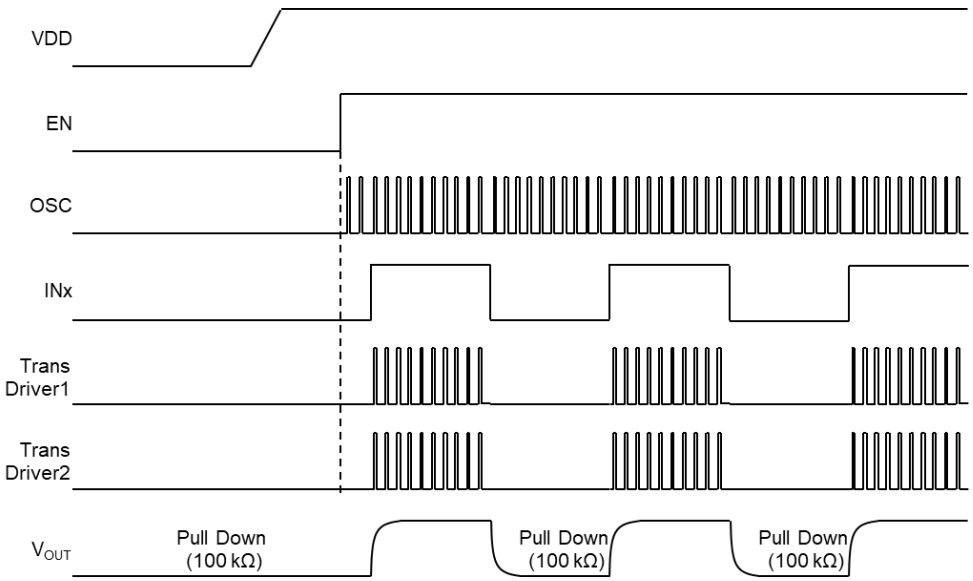


Figure 17. Timing Chart

Truth table

UVLO	Enable EN*(Note 11)*	Input INx*(Note 11)*	Output V_{OUT}*(Note 12)*	Comments
Normal	L	X	L	Power down
	H or NC	L	L	Operation
	H or NC	H	H	Operation
Under Voltage	L	L	L	
	H or NC	X	L	

(Note 11) L = "Low" level, H = "High" level, X = don't care, NC = Unconnected
(Note 12) L = "Low" level (pull-down 100 kΩ typ), H = "High" level

Application Example

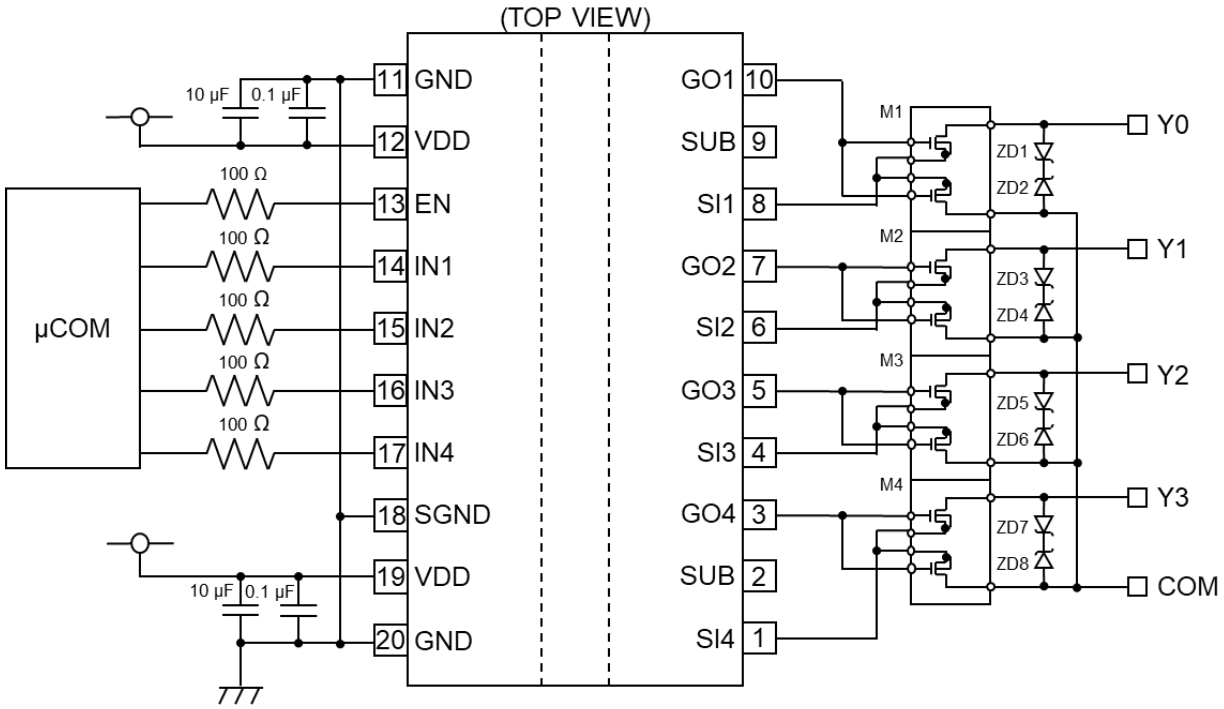


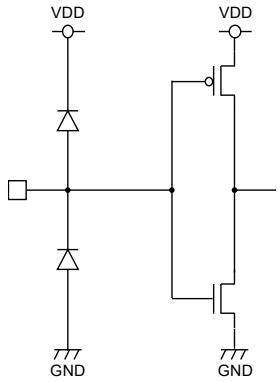
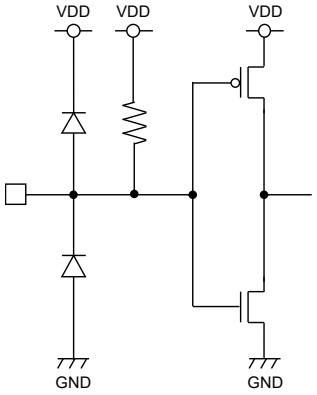
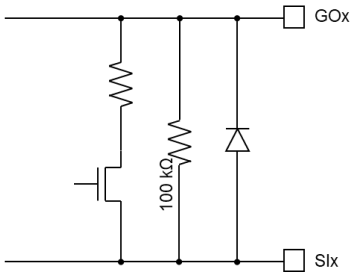
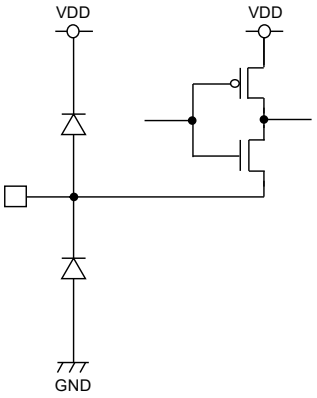
Figure 18. Application Circuit Diagram

Caution 3: Use the same source/sink format for all channels.

Recommended External Parts

Product Name	Symbol	Manufacturer	Product Number
Nch MOSFET	M1, M2, M3, M4	ROHM	QH8KC5
Zener Diode	ZD1, ZD2, ZD3, ZD4 ZD5, ZD6, ZD7, ZD8	ROHM	KDZLVTR51

I/O Equivalent Circuits

Pin Name	Equivalent Circuit Diagram	Pin Name	Equivalent Circuit Diagram
IN1 IN2 IN3 IN4		EN	
GO1 GO2 GO3 GO4 SI1 SI2 SI3 SI4		SGND	

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. 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 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.

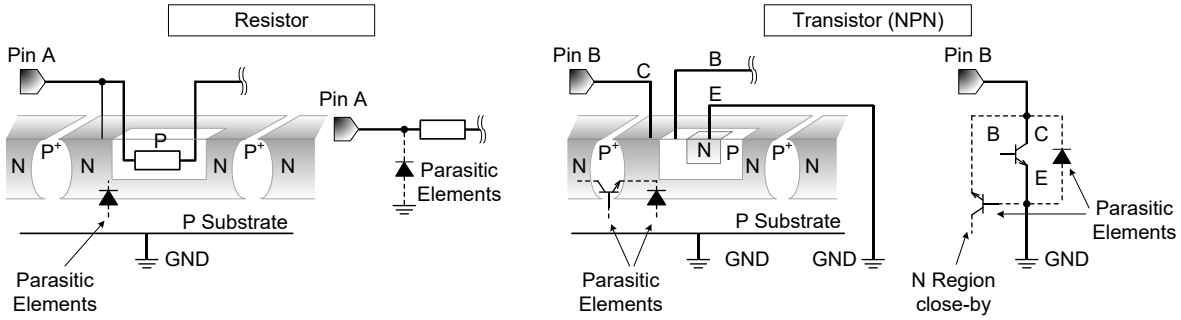
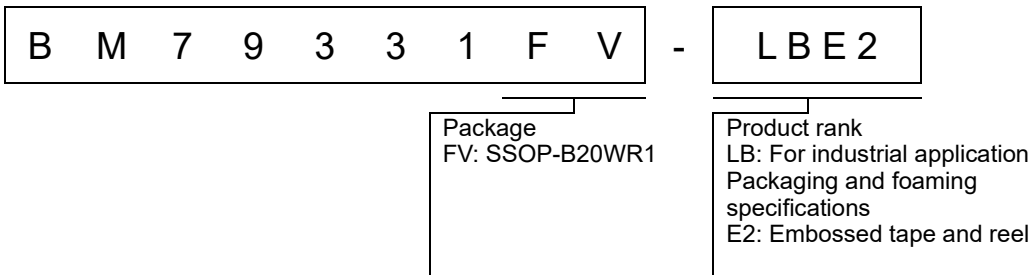


Figure 19. Example of IC Structure

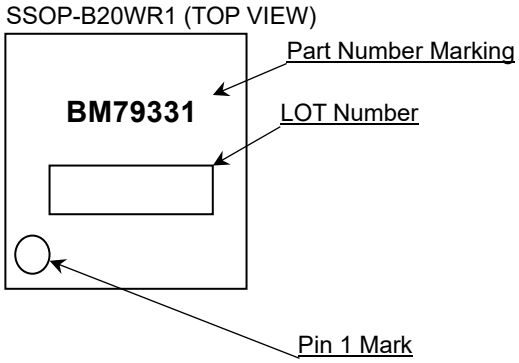
11. Ceramic Capacitor

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.

Ordering Information

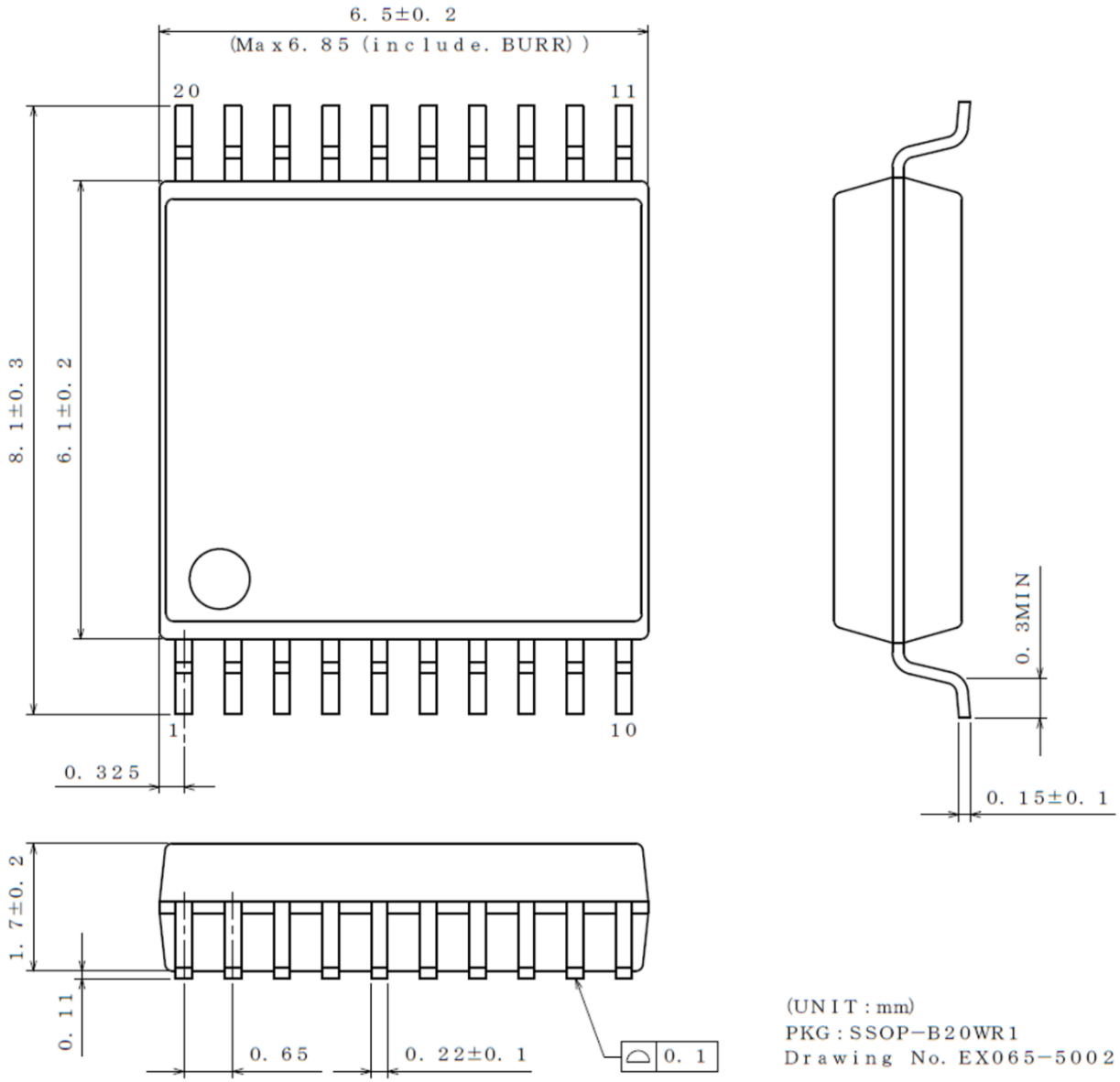


Marking Diagram



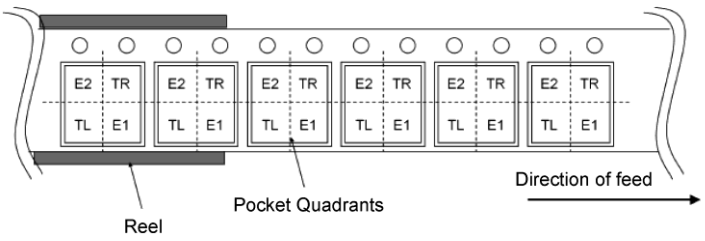
Physical Dimension and Packaging Information

Package Name	SSOP-B20WR1



< Tape and Reel Information >

Tape	Embossed carrier tape
Quantity	2000pcs
Direction of feed	E2 The direction is the pin 1 of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand



Revision History

Date	Revision	Changes
01.Apr.2025	001	New Release
21.Oct.2025	002	Name Change

Notice

Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), aircraft/spacecraft, nuclear power controllers, 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
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

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 not designed 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 Cl_2, H_2S, NH_3, SO_2, and NO_2
   [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 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 Cl_2, H_2S, NH_3, SO_2, and NO_2
   [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

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.

2. ROHM shall not have any obligations where the claims, actions or demands arising from the combination of the Products with other articles such as components, circuits, systems or external equipment (including software).

3. No license, expressly or implied, is granted hereby under any intellectual property rights or other rights of ROHM or any third parties with respect to the Products or the information contained in this document. Provided, however, that ROHM will not assert its intellectual property rights or other rights against you or your customers to the extent necessary to manufacture or sell products containing the Products, subject to the terms and conditions herein.

Other Precaution

1. This document may not be reprinted or reproduced, in whole or in part, without prior written consent of ROHM.

2. The Products may not be disassembled, converted, modified, reproduced or otherwise changed without prior written consent of ROHM.

3. In no event shall you use in any way whatsoever the Products and the related technical information contained in the Products or this document for any military purposes, including but not limited to, the development of mass-destruction weapons.

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.

3. The information contained in this document is provided on an "as is" basis and ROHM does not warrant that all information contained in this document is accurate and/or error-free. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties resulting from inaccuracy or errors of or concerning such information.