

## Gate Driver Providing Galvanic isolation Series

# Isolation voltage 2500Vrms

# 1ch Gate Driver Providing Galvanic Isolation

## BM6102FV-C

### General Description

The BM6102FV-C is a gate driver with isolation voltage 2500Vrms, I/O delay time of 200ns, and minimum input pulse width of 100ns, and incorporates the fault signal output functions, undervoltage lockout (UVLO) function, thermal protection function, and short current protection (SCP, DESAT) function.

### Features

- Providing Galvanic Isolation
- Active Miller Clamping
- Fault signal output function (Adjustable output holding time)
- Undervoltage lockout function
- Thermal protection function (Adjustable threshold voltage)
- Short current protection function (Adjustable threshold voltage)
- Soft turn-off function for short current protection
- UL1577 Recognized:File No. E356010
- AEC-Q100 Qualified<sup>(Note 1)</sup> (Note 1:Grade1)

### Key Specifications

- |                               |                   |
|-------------------------------|-------------------|
| ■ Isolation voltage:          | 2500 [Vrms] (Min) |
| ■ Maximum gate drive voltage: | 20 [V] (Max)      |
| ■ I/O delay time:             | 200 [ns] (Max)    |
| ■ Minimum input pulse width:  | 100 [ns] (Max)    |

### Package

SSOP-B20W

W(Typ) × D(Typ) × H(Max)

6.50 mm × 8.10 mm × 2.01 mm



### Applications

- Automotive isolated IGBT/MOSFET inverter gate drive
- Automotive DC-DC converter
- Industrial inverters systems
- UPS systems

### Typical Application Circuits

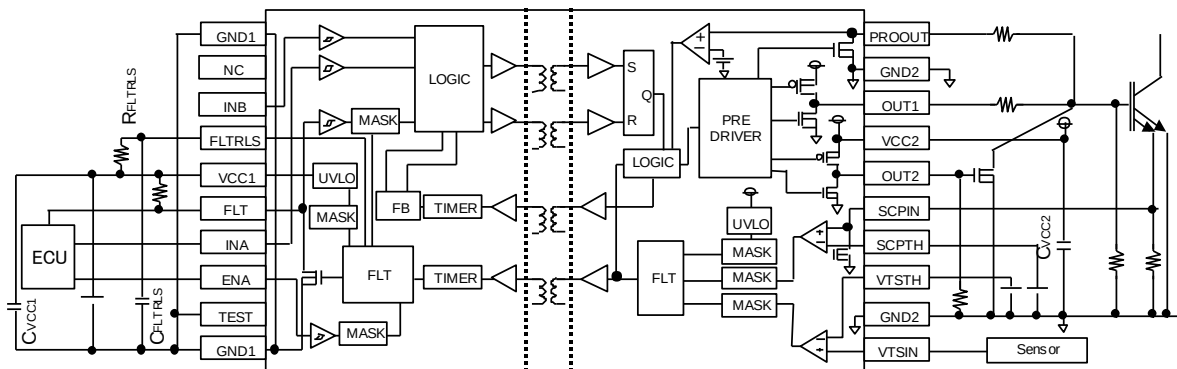


Figure 1. For using 4-pin IGBT (for using SCP function)

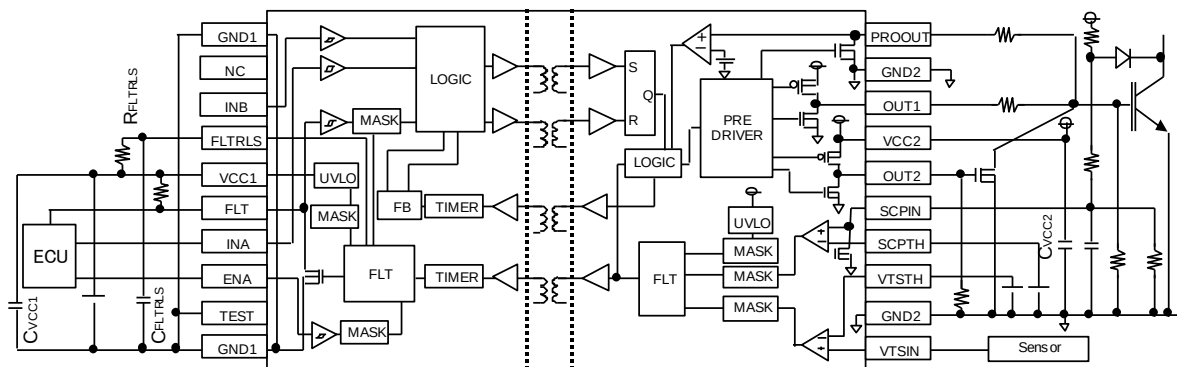


Figure 2. For using 3-pin IGBT (for using DESAT function)

○Product structure : Silicon monolithic integrated circuit ○This product is not designed protection against radioactive rays

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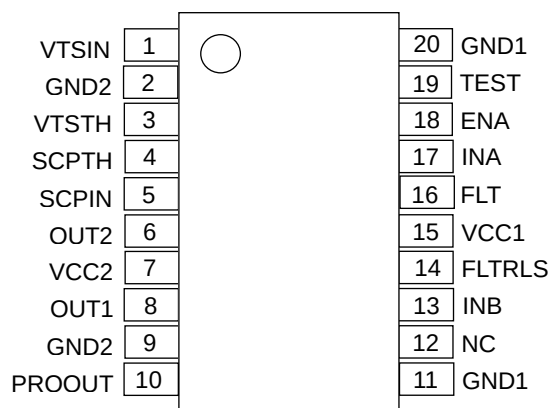
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## Recommended range of external constants

| Pin Name | Symbol            | Recommended Value |      |      | Unit |
|----------|-------------------|-------------------|------|------|------|
|          |                   | Min.              | Typ. | Max. |      |
| FLTRLS   | CFLTRLS           | -                 | 0.01 | 0.47 | μF   |
|          | RFLTRLS           | 50                | 200  | 1000 | kΩ   |
| VCC1     | C <sub>VCC1</sub> | 0.1               | 1.0  | -    | μF   |
| VCC2     | C <sub>VCC2</sub> | 0.33              | -    | -    | μF   |

## Pin Configuration

(TOP VIEW)



## Pin Description

| Pin No. | Pin Name | Function                                      |
|---------|----------|-----------------------------------------------|
| 1       | VTSIN    | Thermal detection pin                         |
| 2       | GND2     | Output-side ground pin                        |
| 3       | VTSTH    | Thermal detection threshold setting pin       |
| 4       | SCPTH    | Short current detection threshold setting pin |
| 5       | SCPIN    | Short current detection pin                   |
| 6       | OUT2     | MOS FET control pin for Miller Clamp          |
| 7       | VCC2     | Output-side power supply pin                  |
| 8       | OUT1     | Output pin                                    |
| 9       | GND2     | Output-side ground pin                        |
| 10      | PROOUT   | Soft turn-off pin                             |
| 11      | GND1     | Input-side ground pin                         |
| 12      | NC       | No Connect                                    |
| 13      | INB      | Invert / non-invert selection pin             |
| 14      | FLTRLS   | Fault output holding time setting pin         |
| 15      | VCC1     | Input-side power supply pin                   |
| 16      | FLT      | Fault output pin                              |
| 17      | INA      | Control input pin                             |
| 18      | ENA      | Input enabling signal input pin               |
| 19      | TEST     | Mode setting pin                              |
| 20      | GND1     | Input-side ground pin                         |

**Description of pins and cautions on layout of board**

## 1) VCC1 (Input-side power supply pin)

The VCC1 pin is a power supply pin on the input side. To suppress voltage fluctuations due to the current to drive internal transformers, connect a bypass capacitor between the VCC1 and the GND1 pins.

## 2) GND1 (Input-side ground pin)

The GND1 pin is a ground pin on the input side.

## 3) VCC2 (Output-side power supply pin)

The VCC2 pin is a power supply pin on the output side. To reduce voltage fluctuations due to OUT1, OUT2 pin output current and due to the current to drive internal transformers, connect a bypass capacitor between the VCC2 and the GND2 pins.

## 4) GND2 (Output-side ground pin)

The GND2 pin is a ground pin on the output side. Connect the GND2 pin to the emitter / source of a power device.

## 5) IN (Control input terminal)

The IN pin is a pin used to determine output logic.

| ENA | INB | INA | OUT1 |
|-----|-----|-----|------|
| L   | X   | X   | L    |
| H   | L   | L   | L    |
| H   | L   | H   | H    |
| H   | H   | L   | H    |
| H   | H   | H   | L    |

## 6) FLT (Fault output pin)

The FLT pin is an open drain pin used to output a fault signal when a fault occurs (i.e., when the undervoltage lockout function (UVLO), short current protection function (SCP) or thermal protection function is activated).

This pin is I/O pin and if L voltage is externally input, the output is set to L status regardless of other input logic.

Consequently, be sure to connect the pull-up resistor between VCC1 pin and the FLT pin even if this pin is not used.

| Pin                                                                         | FLT  |
|-----------------------------------------------------------------------------|------|
| While in normal operation                                                   | Hi-Z |
| When an Fault occurs<br>(When UVLO, SCP or thermal protection is activated) | L    |

## 7) FLTRLS (Fault output holding time setting pin)

The FLTRLS pin is a pin used to make setting of time to hold a fault signal. Connect a capacitor between the FLTRLS pin and the GND1 pin, and a resistor between it and the VCC1 pin.

The fault signal is held until the FLTRLS pin voltage exceeds a voltage set with the  $V_{FLTRLS}$  parameter. To set holding time to 0 ms, do not connect the capacitor. Short-circuiting the FLTRLS pin to the VCC1 pin will cause a high current to flow in the FLTRLS pin and, in an open state, may cause the IC to malfunction. To avoid such trouble, be sure to connect a resistor between the FLTRLS and the VCC1 pins.

## 8) OUT1 (Output pin)

The OUT1 pin is a pin used to drive the gate of a power device.

## 9) OUT2 (MOS FET control pin for Miller Clamp)

The OUT2 pin is a pin for controlling the external MOS switch for preventing increase in gate voltage due to the miller current of the power device connected to OUT1 pin.

## 10) PROOUT (Soft turn-off pin)

The PROOUT pin is a pin used to put the soft turn-off function of a power device in operation when the SCP function is activated. This pin combines with the gate voltage monitoring pin for Miller Clamp function.

## 11) SCPIN (Short current detection pin), SCPTH (Short current detection threshold setting pin)

The SCPIN pin is a pin used to detect current for short current protection. When the SCPIN pin voltage exceeds a voltage set with the SCPTH pin voltage, the SCP function will be activated. This may cause the IC to malfunction in an open state. To avoid such trouble, short-circuit the SCPIN pin to the GND2 pin and SCPTH pin to the VCC2 pin if the short current protection is not used. In order to prevent the wrong detection due to noise, the noise mask time  $t_{SCPMASK}$  (typ 3.0μs) is set.

## 12) VTSIN (Thermal detection pin), VTSTH (Thermal detection threshold setting pin)

The VTSIN pin is a temperature sensor voltage input pin, which can be used for thermal protection of a power device.

If VTSIN pin voltage becomes VTSTH pin voltage or less, OUT1 pin is set to L. In the open status, the IC may malfunction, so be sure to supply the VTSIN more than VTSTH if the thermal protection function is not used. In order to prevent the wrong detection due to noise, the noise mask time  $t_{TSMASK}$  (typ 10μs) is set.

13) TEST (Mode setting pin)

The TEST pin is an operation mode setting pin. This pin is usually connected to GND1 pin. If the TEST pin is connected to the VCC1 pin, Input-side UVLO function is disabled.

## Description of functions and examples of constant setting

### 1) Miller Clamp function

When OUT1=L and PROOUT pin voltage < V<sub>OUT2ON</sub>(typ 2.0V), H is output from OUT2 pin and the external MOS switch is turned ON. When OUT1=H, L is output from OUT2 pin and the external MOS switch is turned OFF. While the short-circuit protection function is activated, L is output from OUT2 pin and the external MOS switch is turned OFF.

| Short current | SCPIN                     | IN<br>(INA EXOR INB) | PROOUT                     | OUT2 |
|---------------|---------------------------|----------------------|----------------------------|------|
| Detected      | Not less than $V_{SCPTH}$ | X                    | X                          | L    |
| Not detected  | X                         | L                    | Not less than $V_{OUT2ON}$ | L    |
|               | X                         | L                    | Less than $V_{OUT2ON}$     | H    |
|               | X                         | H                    | X                          | L    |

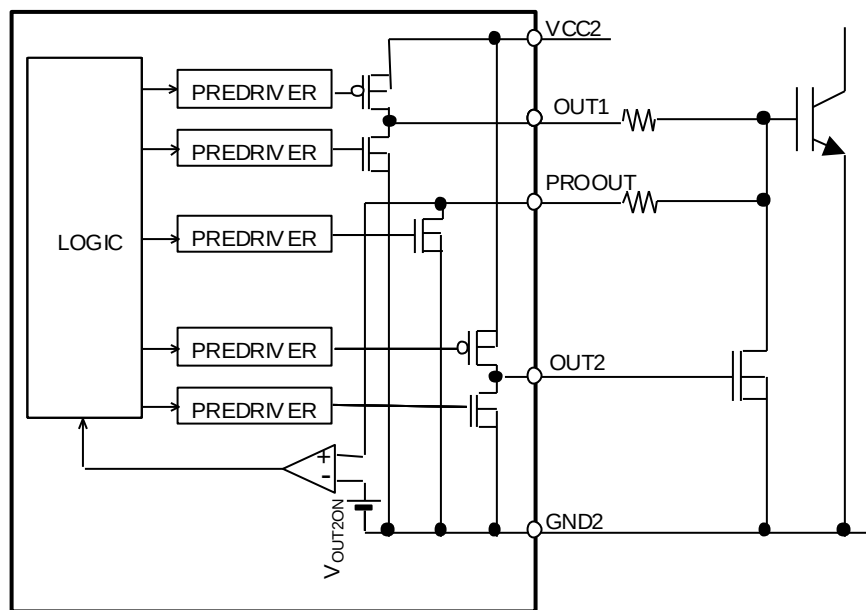


Figure 3. Block diagram of Miller Clamp function

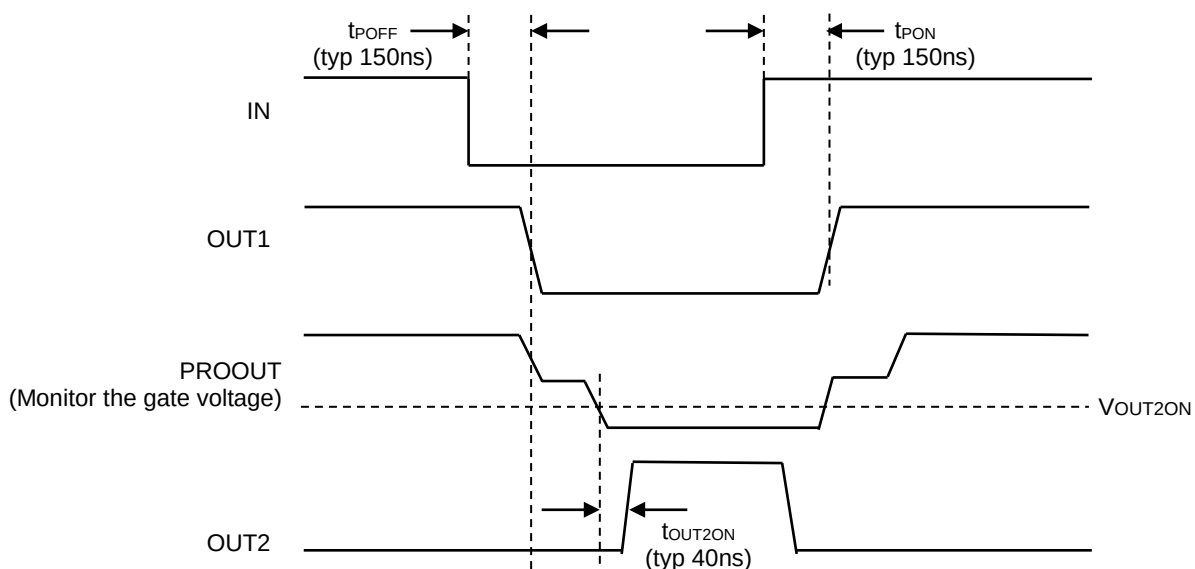


Figure 4. Timing chart of Miller Clamp function

## 2) Fault status output

This function is used to output a fault signal from the FLT pin when an fault occurs (i.e., when the undervoltage lockout function (UVLO), short current protection function (SCP) or thermal protection function is activated) and hold the fault signal until the set Fault output holding time is completed. The fault output holding time  $t_{FLTRLS}$  is given as the following equation with the settings of capacitor  $C_{FLTRLS}$  and resistor  $R_{FLTRLS}$  connected to the FLT pin. For example, when  $C_{FLTRLS}$  is set to 0.01 $\mu$ F and  $R_{FLTRLS}$  is set to 200k $\Omega$ , the holding time will be set to 2 ms.

$$t_{FLTRLS} [ms] = C_{FLTRLS} [\mu F] \cdot R_{FLTRLS} [k\Omega]$$

To set the fault output holding time to “0” ms, only connect the resistor  $R_{FLTRLS}$ .

|              |         |
|--------------|---------|
| Status       | FLT pin |
| Normal       | Hi-Z    |
| Fault occurs | L       |

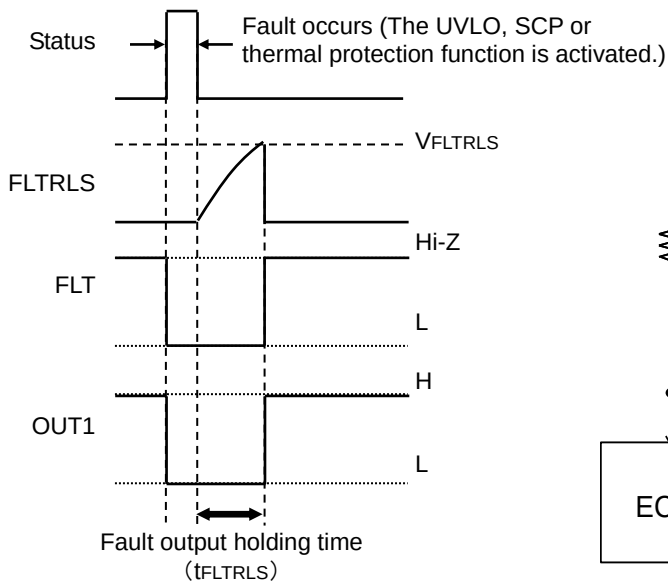


Figure 5. Fault Status Output Timing Chart

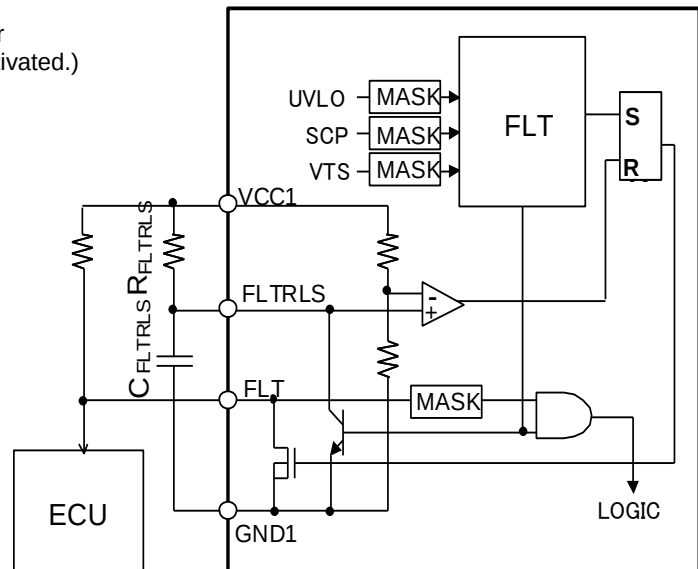


Figure 6. Fault Output Block Diagram

### 3) Undervoltage Lockout (UVLO) function

The BM6102FV-C incorporates the undervoltage lockout (UVLO) function both on the low and the high voltage sides. When the power supply voltage drops to the UVLO ON voltage (low voltage side typ 4.15V, high voltage side typ 11.5V), the OUT1 pin and the FLT pin both will output the “L” signal. When the power supply voltage rises to the UVLO OFF voltage (low voltage side typ 4.25V, high voltage side typ 12.5V), these pins will be reset. However, during the fault output holding time set in “2) Fault status output” section, the OUT1 pin and the FLT pin will hold the “L” signal. In addition, to prevent malfunctions due to noises, mask time  $t_{UVLO1MSK}$  (typ 10 $\mu$ s) and  $t_{UVLO2MSK}$  (typ 10 $\mu$ s) are set on both low and high voltage sides.

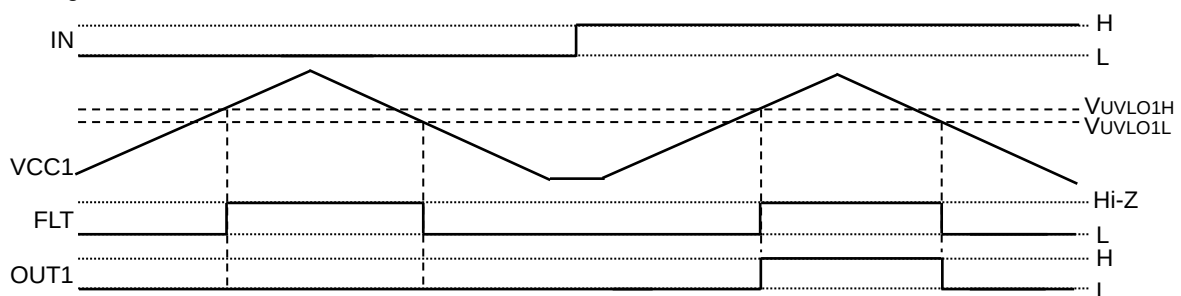


Figure 7. Input-side UVLO Function Operation Timing Chart

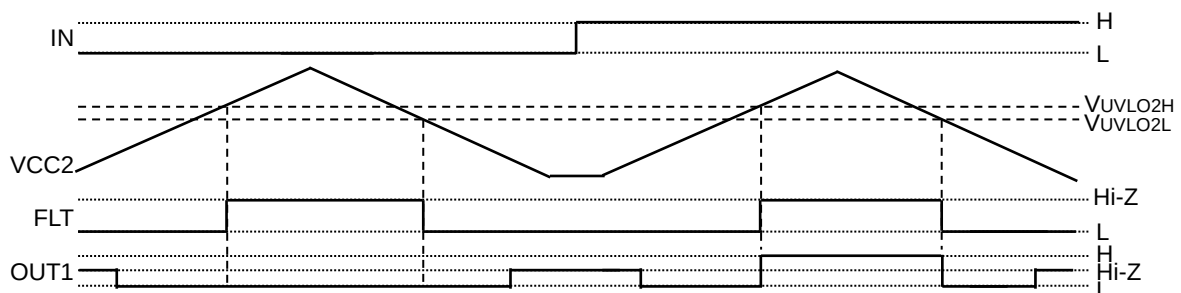


Figure 8. Output-side UVLO Operation Timing Chart

## 4) Short current protection function (SCP, DESAT)

When the SCPIN pin voltage exceeds a voltage set with the SCPTH pin voltage, the SCP function will be activated. When the SCP function is activated, the OUT1 pin voltage will be set to the "Hi-Z" level first, and then the PROOUT pin voltage to the "L" level (soft turn-off). Next, after  $t_{STO}$  (min 30 $\mu$ s, max 110 $\mu$ s) has passed after the short-circuit current falls below the threshold value, OUT1 pin becomes L and PROOUT pin becomes Hi-Z. Finally, when the fault output holding time set in "2) fault status output" section on page 5 is completed, the SCP function will be released.

$V_{COLLECTOR}/V_{DRAIN}$  which Desaturation Protection starts operation ( $V_{DESAT}$ ) and the blanking time ( $t_{BLANK}$ ) can be calculated by the formula below;

$$V_{DESAT} [V] = V_{SCPTH} \cdot \frac{R3 + R2}{R3} - V_{F_{D1}}$$

$$V_{CC2\_MIN} [V] > V_{SCPTH} \cdot \frac{R3 + R2 + R1}{R3}$$

$$t_{BLANK\text{outermal}} [s] = -\frac{R2 + R1}{R3 + R2 + R1} \cdot R3 \cdot (C_{BLANK} + 9 \cdot 10^{-12}) \cdot \ln\left(1 - \frac{R3 + R2 + R1}{R3} \cdot \frac{V_{SCPTH}}{V_{CC2}}\right) + 0.2 \cdot 10^{-6}$$

| $V_{DESAT}$ | Reference Value (In case of SCPTH=0.7V) |                |                |
|-------------|-----------------------------------------|----------------|----------------|
|             | R1                                      | R2             | R3             |
| 4.0V        | 15 k $\Omega$                           | 39 k $\Omega$  | 6.8 k $\Omega$ |
| 4.5V        | 15 k $\Omega$                           | 43 k $\Omega$  | 6.8 k $\Omega$ |
| 5.0V        | 15 k $\Omega$                           | 36 k $\Omega$  | 5.1 k $\Omega$ |
| 5.5V        | 15 k $\Omega$                           | 39 k $\Omega$  | 5.1 k $\Omega$ |
| 6.0V        | 15 k $\Omega$                           | 43 k $\Omega$  | 5.1 k $\Omega$ |
| 6.5V        | 15 k $\Omega$                           | 62 k $\Omega$  | 6.8 k $\Omega$ |
| 7.0V        | 15 k $\Omega$                           | 68 k $\Omega$  | 6.8 k $\Omega$ |
| 7.5V        | 15 k $\Omega$                           | 82 k $\Omega$  | 7.5 k $\Omega$ |
| 8.0V        | 15 k $\Omega$                           | 91 k $\Omega$  | 8.2 k $\Omega$ |
| 8.5V        | 15 k $\Omega$                           | 82 k $\Omega$  | 6.8 k $\Omega$ |
| 9.0V        | 15 k $\Omega$                           | 130 k $\Omega$ | 10 k $\Omega$  |
| 9.5V        | 15 k $\Omega$                           | 91 k $\Omega$  | 6.8 k $\Omega$ |
| 10.0V       | 15 k $\Omega$                           | 130 k $\Omega$ | 9.1 k $\Omega$ |

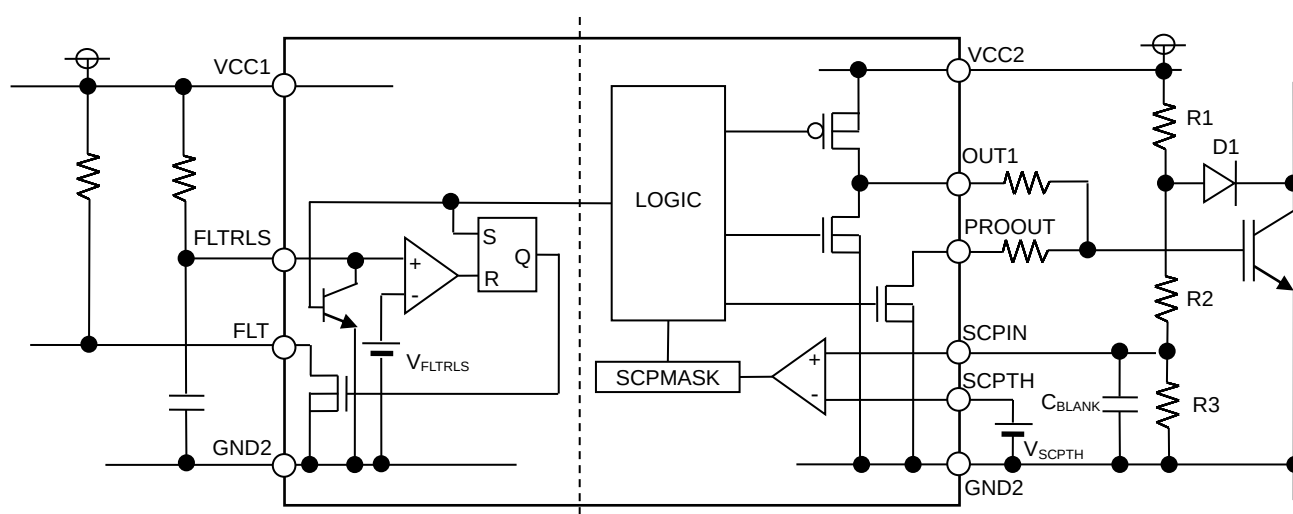


Figure 9. Block Diagram for DESAT

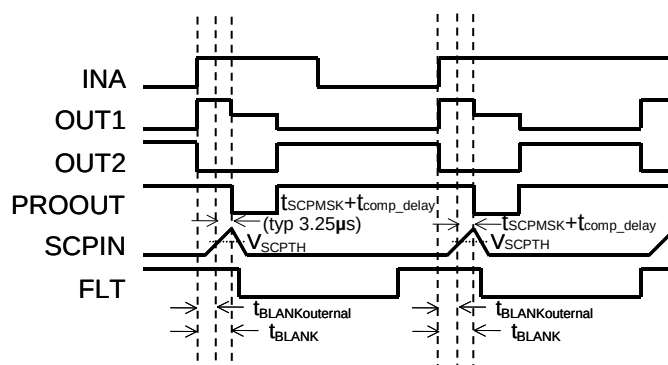
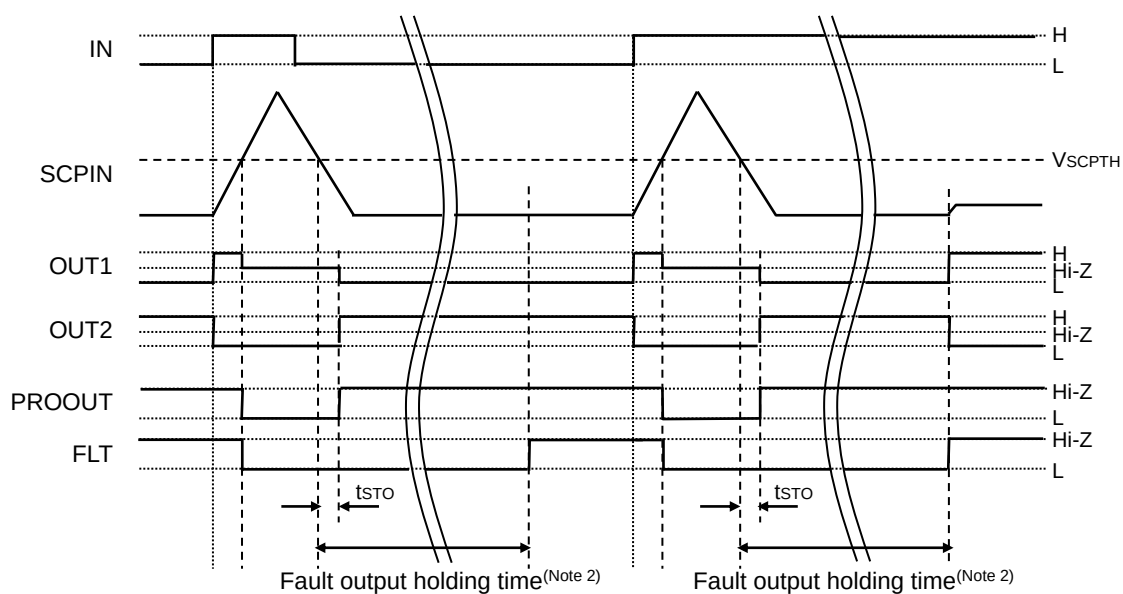


Figure 10. DESAT Operation Timing Chart



(Note 2) "2) Fault status output" section on page 5

Figure 11. SCP Operation Timing Chart

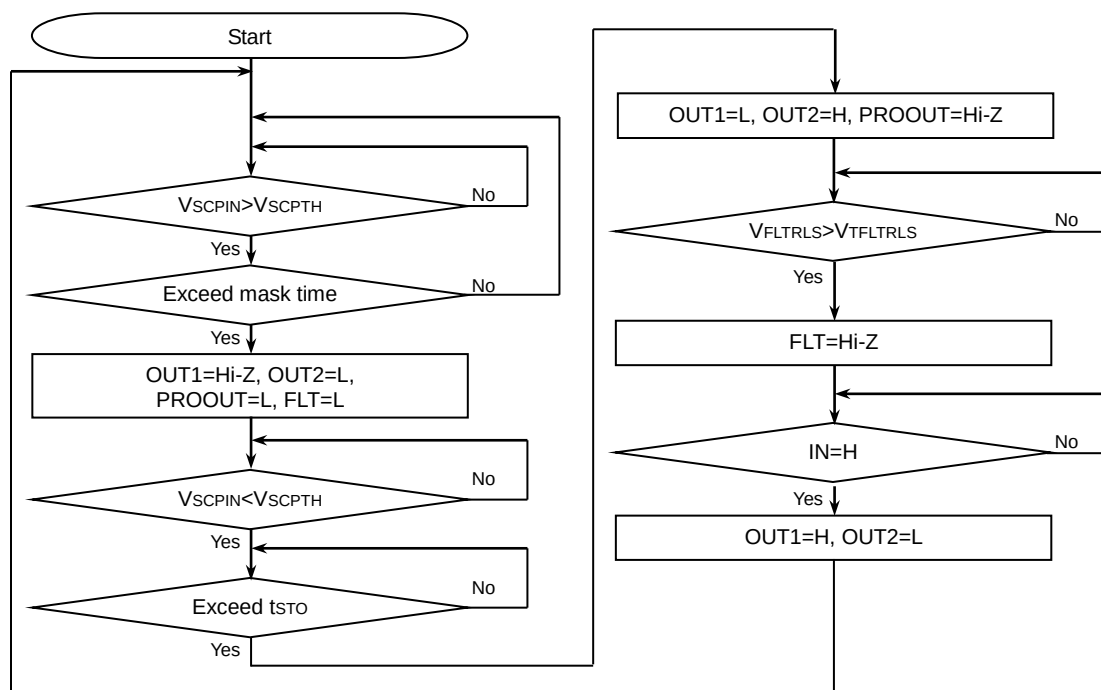


Figure 12. SCP Operation Status Transition Diagram

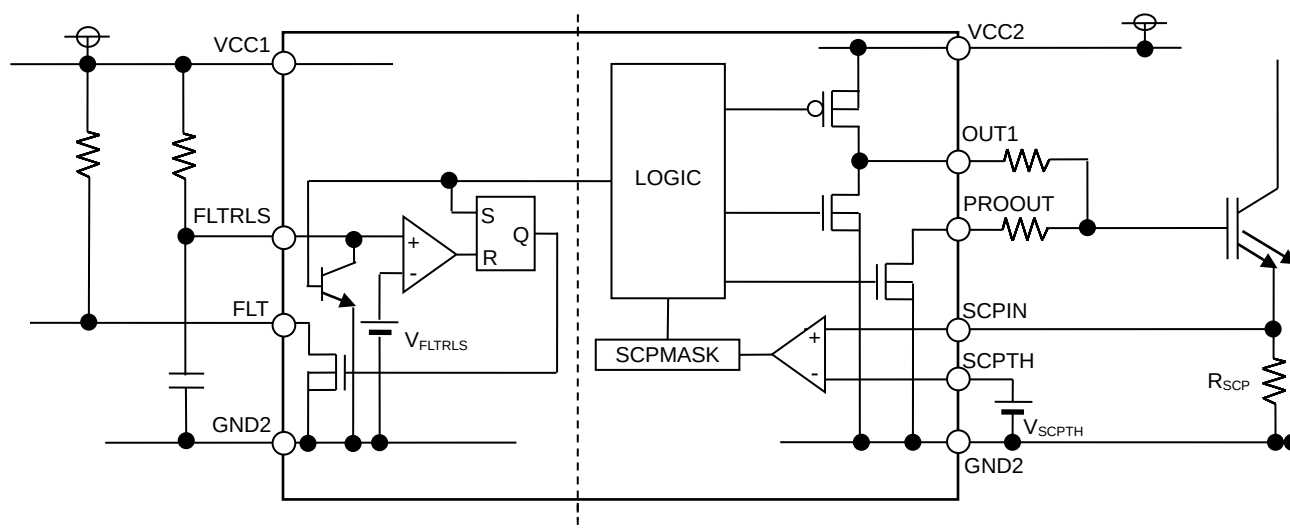


Figure 13. Block Diagram for SCP



## 5) I/O condition table

| No. | Status                       | Input            |                  |                       |                       |             |             |             |             |                            | Output           |                  |                            |             |
|-----|------------------------------|------------------|------------------|-----------------------|-----------------------|-------------|-------------|-------------|-------------|----------------------------|------------------|------------------|----------------------------|-------------|
|     |                              | V<br>C<br>C<br>1 | V<br>C<br>C<br>2 | V<br>T<br>S<br>I<br>N | S<br>C<br>P<br>I<br>N | F<br>L<br>T | E<br>N<br>A | I<br>N<br>B | I<br>N<br>A | P<br>R<br>O<br>O<br>U<br>T | O<br>U<br>T<br>1 | O<br>U<br>T<br>2 | P<br>R<br>O<br>O<br>U<br>T | F<br>L<br>T |
| 1   | VCC1UVLO                     | UVLO             | X                | X                     | L                     | X           | X           | X           | X           | H                          | L                | L                | Hi-Z                       | L           |
| 2   |                              | UVLO             | X                | X                     | L                     | X           | X           | X           | X           | L                          | L                | H                | Hi-Z                       | L           |
| 3   | VCC2UVLO                     | X                | UVLO             | X                     | L                     | X           | X           | X           | X           | H                          | L                | L                | Hi-Z                       | L           |
| 4   |                              | X                | UVLO             | X                     | L                     | X           | X           | X           | X           | L                          | L                | H                | Hi-Z                       | L           |
| 5   | Disable                      | O                | O                | H                     | L                     | H           | L           | X           | X           | H                          | L                | L                | Hi-Z                       | Hi-Z        |
| 6   |                              | O                | O                | H                     | L                     | H           | L           | X           | X           | L                          | L                | H                | Hi-Z                       | Hi-Z        |
| 7   | FLT external input           | O                | O                | H                     | L                     | L           | X           | X           | X           | H                          | L                | L                | Hi-Z                       | Hi-Z        |
| 8   |                              | O                | O                | H                     | L                     | L           | X           | X           | X           | L                          | L                | H                | Hi-Z                       | Hi-Z        |
| 9   | SCP                          | O                | O                | X                     | H                     | X           | X           | X           | X           | X                          | Hi-Z             | L                | L                          | L           |
| 10  | Thermal protection           | O                | O                | L                     | L                     | X           | X           | X           | X           | H                          | L                | L                | Hi-Z                       | L           |
| 11  |                              | O                | O                | L                     | L                     | X           | X           | X           | X           | L                          | L                | H                | Hi-Z                       | L           |
| 12  | Non-invert operation L input | O                | O                | H                     | L                     | H           | H           | L           | L           | H                          | L                | L                | Hi-Z                       | Hi-Z        |
| 13  |                              | O                | O                | H                     | L                     | H           | H           | L           | L           | L                          | L                | H                | Hi-Z                       | Hi-Z        |
| 14  | Non-invert operation H input | O                | O                | H                     | L                     | H           | H           | L           | H           | X                          | H                | L                | Hi-Z                       | Hi-Z        |
| 15  | Invert operation L input     | O                | O                | H                     | L                     | H           | H           | H           | L           | X                          | H                | L                | Hi-Z                       | Hi-Z        |
| 16  | Invert operation H input     | O                | O                | H                     | L                     | H           | H           | H           | H           | H                          | L                | L                | Hi-Z                       | Hi-Z        |
| 17  |                              | O                | O                | H                     | L                     | H           | H           | H           | H           | L                          | L                | H                | Hi-Z                       | Hi-Z        |

O: VCC1 or VCC2 &gt; UVLO, X: Don't care

(Caution) When other errors are complicated immediately after the SCP function is activated, SCP function (soft turn-off) is given to priority.

## 6) Power supply startup / shutoff sequence

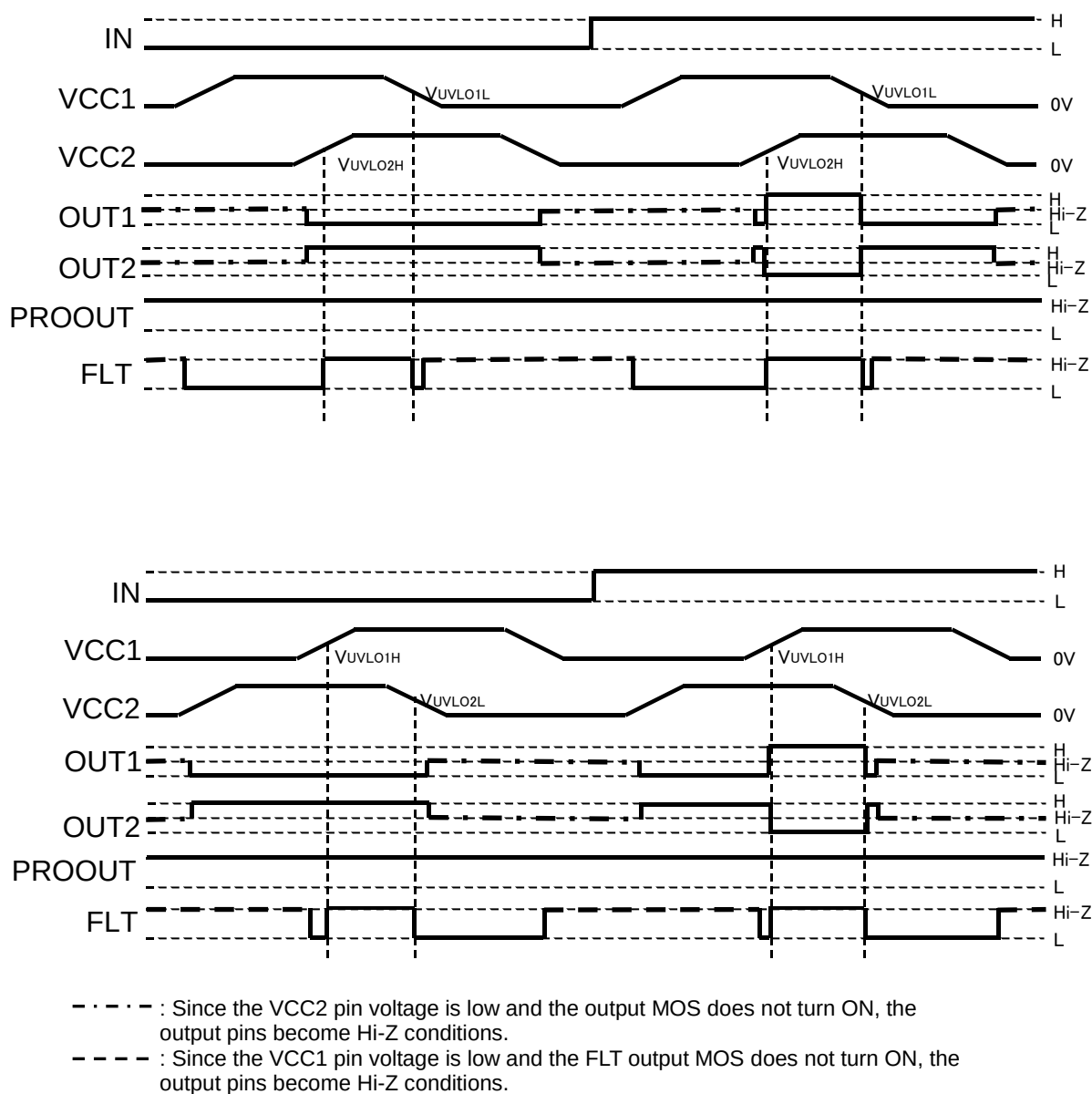


Figure 14. Power supply startup / shutoff sequence

## Absolute maximum ratings

| Parameter                                   | Symbol                | Limits                                                       | Unit |
|---------------------------------------------|-----------------------|--------------------------------------------------------------|------|
| Input-side supply voltage                   | V <sub>CC1</sub>      | -0.3 to +7.0 <sup>(Note 3)</sup>                             | V    |
| Output-side supply voltage                  | V <sub>CC2</sub>      | -0.3 to +25.0 <sup>(Note 4)</sup>                            | V    |
| INA, INB, ENA pin input voltage             | V <sub>IN</sub>       | -0.3 to +V <sub>CC1</sub> +0.3 or +7.0 <sup>(Note 3)</sup>   | V    |
| FLT pin input voltage                       | V <sub>FLT</sub>      | -0.3 to +V <sub>CC1</sub> +0.3 or +7.0 <sup>(Note 3)</sup>   | V    |
| FLTRLS pin input voltage                    | V <sub>FLTRLS</sub>   | -0.3 to +V <sub>CC1</sub> +0.3 or +7.0 <sup>(Note 3)</sup>   | V    |
| VTSIN pin input voltage                     | V <sub>VTSIN</sub>    | -0.3 to +7.0 <sup>(Note 4)</sup>                             | V    |
| SCPIN pin input voltage                     | V <sub>SCPIN</sub>    | -0.3 to +V <sub>CC2</sub> +0.3V or +25.0 <sup>(Note 4)</sup> | V    |
| VTSTH pin input voltage                     | V <sub>VTSTH</sub>    | -0.3 to +7.0 <sup>(Note 4)</sup>                             | V    |
| SCPTH pin input voltage                     | V <sub>SCPTH</sub>    | -0.3 to +V <sub>CC2</sub> +0.3V or +25.0 <sup>(Note 4)</sup> | V    |
| OUT1, PROOUT pin output current (Peak 10us) | I <sub>OUT1PEAK</sub> | 5.0 <sup>(Note 5)</sup>                                      | A    |
| OUT2 pin output current (Peak 10us)         | I <sub>OUT2PEAK</sub> | 1.0 <sup>(Note 5)</sup>                                      | A    |
| FLT output current                          | I <sub>FLT</sub>      | 10                                                           | mA   |
| Power dissipation                           | P <sub>d</sub>        | 1.19 <sup>(Note 6)</sup>                                     | W    |
| Operating temperature range                 | T <sub>opr</sub>      | -40 to +125                                                  | °C   |
| Storage temperature range                   | T <sub>stg</sub>      | -55 to +150                                                  | °C   |
| Junction temperature                        | T <sub>jmax</sub>     | +150                                                         | °C   |

(Note 3) Relative to GND1.

(Note 4) Relative to GND2.

(Note 5) Should not exceed P<sub>d</sub> and T<sub>j</sub>=150°C.(Note 6) Derate above T<sub>a</sub>=25°C at a rate of 9.5mW/°C. Mounted on a glass epoxy of 70 mm × 70 mm × 1.6 mm.

**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. | Max. | Units |
|---------------------------------------------------------|-------------------|------|------|-------|
| Input-side supply voltage <sup>(Note 7)</sup>           | V <sub>CC1</sub>  | 4.5  | 5.5  | V     |
| Output-side positive supply voltage <sup>(Note 8)</sup> | V <sub>CC2</sub>  | 14.0 | 20.0 | V     |
| Short current detection common mode input voltage       | V <sub>SCCM</sub> | 0.0  | 2.5  | V     |
| Thermal detection common mode input voltage             | V <sub>TSCM</sub> | 0.0  | 3.0  | V     |

(Note 7) Relative to GND1.

(Note 8) Relative to GND2.

## Insulation related characteristics

| Parameter                                     | Symbol           | Characteristic   | Units            |
|-----------------------------------------------|------------------|------------------|------------------|
| Insulation Resistance (V <sub>IO</sub> =500V) | R <sub>S</sub>   | >10 <sup>9</sup> | Ω                |
| Insulation Withstand Voltage / 1min           | V <sub>ISO</sub> | 2500             | V <sub>rms</sub> |
| Insulation Test Voltage / 1sec                | V <sub>ISO</sub> | 3000             | V <sub>rms</sub> |

## Electrical characteristics

(Unless otherwise specified Ta=-40°C to 125°C, V<sub>CC1</sub>=4.5V to 5.5V, V<sub>CC2</sub>=14V to 20V)

| Parameter                              | Symbol                | Min.                            | Typ.                    | Max.                            | Unit  | Conditions                                 |
|----------------------------------------|-----------------------|---------------------------------|-------------------------|---------------------------------|-------|--------------------------------------------|
| <b>General</b>                         |                       |                                 |                         |                                 |       |                                            |
| Input side circuit current 1           | I <sub>CC11</sub>     | 0.10                            | 0.35                    | 0.60                            | mA    | OUT1=L                                     |
| Input side circuit current 2           | I <sub>CC12</sub>     | 0.10                            | 0.35                    | 0.60                            | mA    | OUT1=H                                     |
| Input side circuit current 3           | I <sub>CC13</sub>     | 1.1                             | 1.9                     | 2.7                             | mA    | INA =10kHz, Duty=50%                       |
| Input side circuit current 4           | I <sub>CC14</sub>     | 2.0                             | 3.4                     | 4.8                             | mA    | INA =20kHz, Duty=50%                       |
| Output side circuit current 1          | I <sub>CC25</sub>     | 1.6                             | 2.6                     | 3.6                             | mA    | OUT1=L                                     |
| Output side circuit current 2          | I <sub>CC26</sub>     | 1.0                             | 1.7                     | 2.4                             | mA    | OUT1=H                                     |
| <b>Logic block</b>                     |                       |                                 |                         |                                 |       |                                            |
| Logic high level input voltage         | V <sub>INH</sub>      | 0.7 × V <sub>CC1</sub>          | -                       | V <sub>CC1</sub>                | V     | INA, INB, ENA, FLT                         |
| Logic low level input voltage          | V <sub>INL</sub>      | 0                               | -                       | 0.3 × V <sub>CC1</sub>          | V     | INA, INB, ENA, FLT                         |
| Logic pull-down resistance             | R <sub>IND</sub>      | 25                              | 50                      | 100                             | kΩ    | INA, INB, ENA                              |
| Logic input minimum pulse width        | t <sub>INMin</sub>    | -                               | -                       | 100                             | ns    | INA, INB                                   |
| ENA, FLT mask time                     | t <sub>FLTMASK</sub>  | 4                               | 10                      | 20                              | μs    | ENA, FLT                                   |
| <b>Output</b>                          |                       |                                 |                         |                                 |       |                                            |
| OUT1 ON resistance (Source)            | R <sub>ONH</sub>      | 0.7                             | 1.8                     | 4.0                             | Ω     | I <sub>OUT1</sub> =40mA                    |
| OUT1 ON resistance (Sink)              | R <sub>ONL</sub>      | 0.4                             | 0.9                     | 2.0                             | Ω     | I <sub>OUT1</sub> =40mA                    |
| OUT1 maximum current                   | I <sub>OUT1MAX</sub>  | 3.0                             | 4.5                     | -                               | A     | V <sub>CC2</sub> =15V,<br>design assurance |
| PROOUT ON resistance                   | R <sub>ONPRO</sub>    | 0.4                             | 0.9                     | 2.0                             | Ω     | I <sub>PROOUT</sub> =40mA                  |
| Turn ON time                           | t <sub>PON</sub>      | 100                             | 150                     | 200                             | ns    | No load<br>between OUT1-GND2               |
| Turn OFF time                          | t <sub>POFF</sub>     | 100                             | 150                     | 200                             | ns    | No load<br>between OUT1-GND2               |
| Propagation distortion                 | t <sub>PDIST</sub>    | -20                             | 0                       | 20                              | ns    | t <sub>POFF</sub> - t <sub>PON</sub>       |
| Rise time                              | t <sub>RISE</sub>     | -                               | 50                      | -                               | ns    | 10nFbetween OUT1-GND2                      |
| Fall time                              | t <sub>FALL</sub>     | -                               | 50                      | -                               | ns    | 10nFbetween OUT1-GND2                      |
| OUT2 ON resistance (Source)            | R <sub>ON2H</sub>     | 5                               | 10                      | 20                              | Ω     | I <sub>OUT2</sub> =40mA                    |
| OUT2 ON resistance (Sink)              | R <sub>ON2L</sub>     | 1.7                             | 3.5                     | 7                               | Ω     | I <sub>OUT2</sub> =40mA                    |
| OUT2 ON threshold                      | V <sub>OUT2ON</sub>   | 1.8                             | 2                       | 2.2                             | V     |                                            |
| OUT2 output delay time                 | t <sub>OUT2ON</sub>   | -                               | 40                      | 80                              | ns    |                                            |
| Common Mode Transient Immunity         | CM                    | 100                             | -                       | -                               | kV/μs | design assurance                           |
| <b>Protection functions</b>            |                       |                                 |                         |                                 |       |                                            |
| Input-side UVLO OFF voltage            | V <sub>UVLO1H</sub>   | 4.05                            | 4.25                    | 4.45                            | V     |                                            |
| Input-side UVLO ON voltage             | V <sub>UVLO1L</sub>   | 3.95                            | 4.15                    | 4.35                            | V     |                                            |
| Input-side UVLO mask time              | t <sub>UVLO1MSK</sub> | 2                               | 10                      | 30                              | μs    |                                            |
| Output-side UVLO OFF voltage           | V <sub>UVLO2H</sub>   | 11.5                            | 12.5                    | 13.5                            | V     |                                            |
| Output-side UVLO ON voltage            | V <sub>UVLO2L</sub>   | 10.5                            | 11.5                    | 12.5                            | V     |                                            |
| Output-side UVLO mask time             | t <sub>UVLO2MSK</sub> | 4                               | 10                      | 30                              | μs    |                                            |
| Short current detection offset voltage | V <sub>SCDET</sub>    | -3.25                           | 1.00                    | 5.25                            | mV    |                                            |
| Short current detection mask time      | t <sub>SCPMSK</sub>   | 2.1                             | 3.0                     | 3.9                             | μs    |                                            |
| SCPIN Input voltage                    | V <sub>SCPIN</sub>    | -                               | 0.25                    | 0.55                            | V     | I <sub>SCPIN</sub> =1mA                    |
| Soft turn OFF release time             | t <sub>STO</sub>      | 30                              |                         | 110                             | μs    |                                            |
| Thermal detection offset voltage       | V <sub>TSDDET</sub>   | -5.50                           | -1.25                   | 3.00                            | mV    |                                            |
| Thermal detection mask time            | t <sub>TSMASK</sub>   | 4                               | 10                      | 30                              | μs    |                                            |
| FLT output low voltage                 | V <sub>FLTL</sub>     | -                               | 0.18                    | 0.40                            | V     | I <sub>FLT</sub> =5mA                      |
| FLTRLS threshold                       | V <sub>TFLTRLS</sub>  | 0.64 × V <sub>CC1</sub><br>-0.1 | 0.64 × V <sub>CC1</sub> | 0.64 × V <sub>CC1</sub><br>+0.1 | V     |                                            |

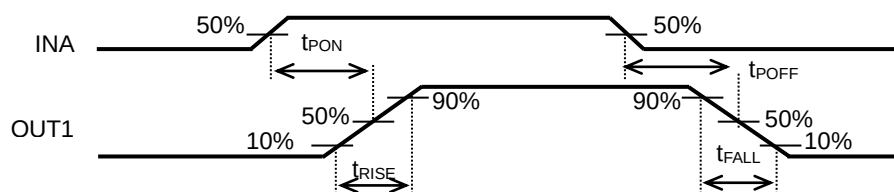


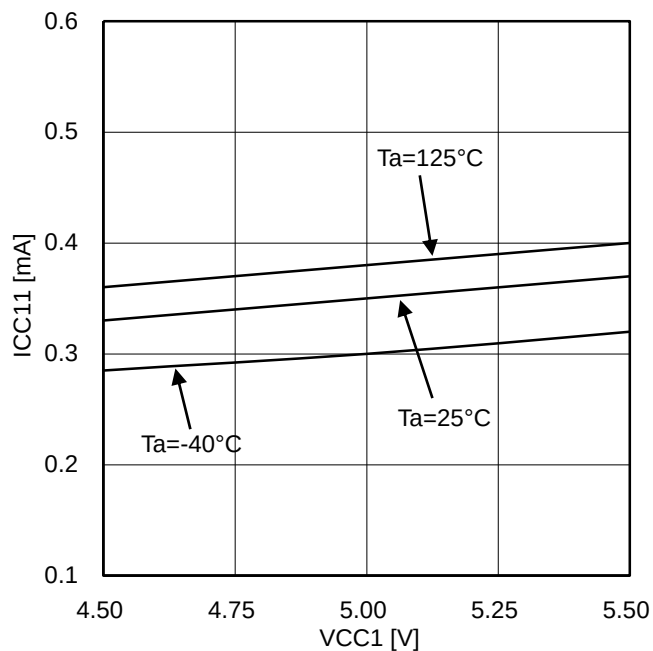
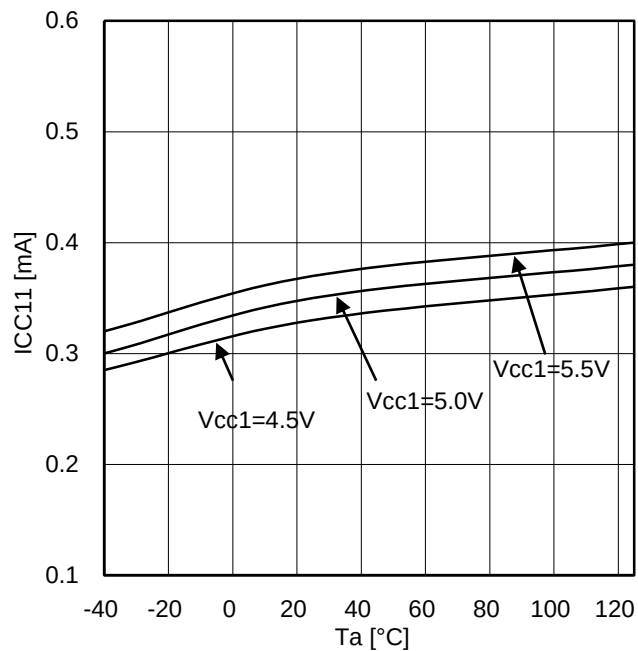
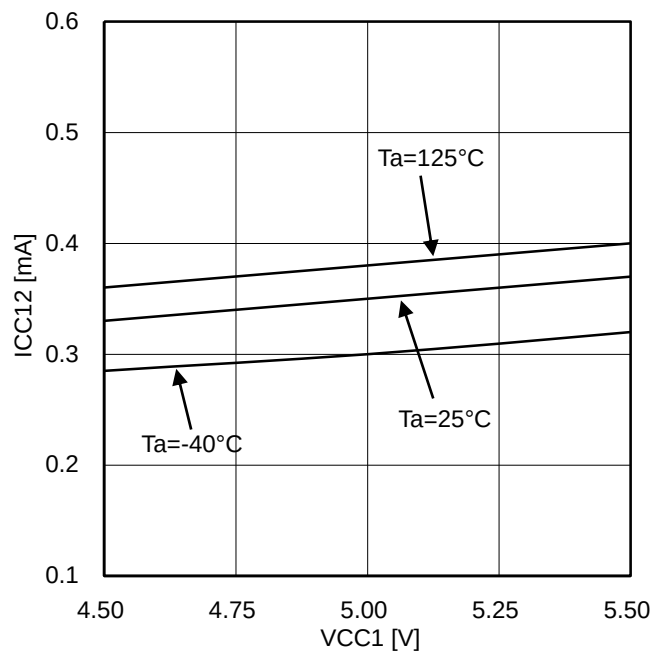
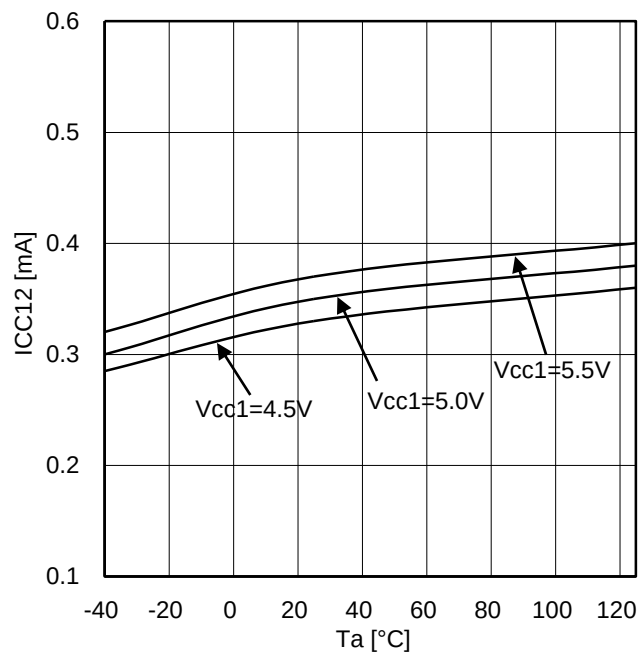
Figure 15. INA-OUT1 Timing Chart

**UL1577 Ratings Table**

Following values are described in UL Report.

| Parameter                               | Values | Units | Conditions        |
|-----------------------------------------|--------|-------|-------------------|
| Side 1 (Input Side) Circuit Current     | 0.35   | mA    | VCC1=5.0V, OUT1=L |
| Side 2 (Output Side) Circuit Current    | 2.6    | mA    | VCC2=15V, OUT1=L  |
| Side 1 (Input Side) Consumption Power   | 1.75   | mW    | VCC1=5.0V, OUT1=L |
| Side 2 (Output Side) Consumption Power  | 39     | mW    | VCC2=15V, OUT1=L  |
| Isolation Voltage                       | 2500   | Vrms  |                   |
| Maximum Operating (Ambient) Temperature | 125    | °C    |                   |
| Maximum Junction Temperature            | 150    | °C    |                   |
| Maximum Storage Temperature             | 150    | °C    |                   |
| Maximum Data Transmission Rate          | 2.5    | MHz   |                   |

## Typical Performance Curves

Figure 16. Input side circuit current (at  $OUT1=L$ )Figure 17. Input side circuit current (at  $OUT1=L$ )Figure 18. Input side circuit current (at  $OUT1=H$ )Figure 19. Input side circuit current (at  $OUT1=H$ )

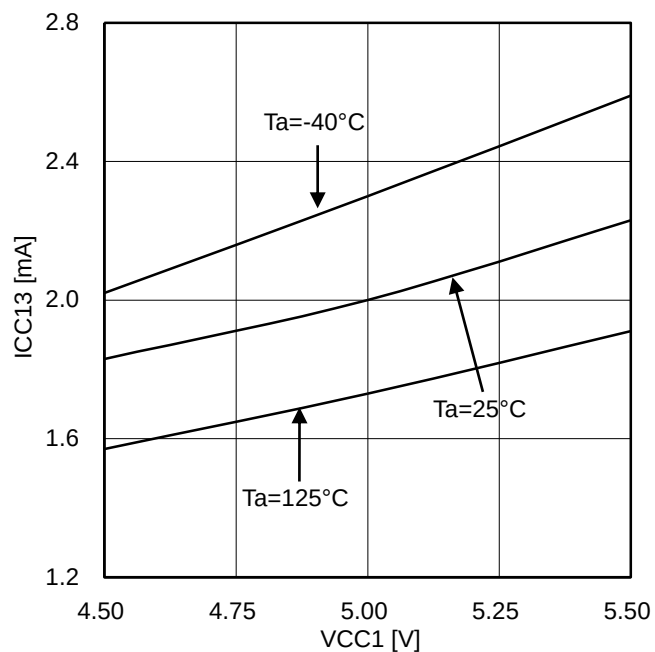


Figure 20. Input side circuit current  
(at INA=10kHz and Duty=50%)

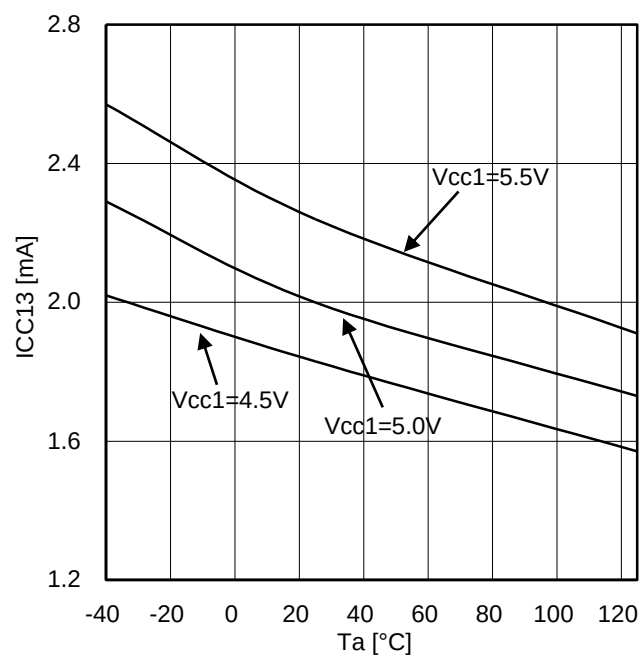


Figure 21. Input side circuit current  
(at INA=10kHz and Duty=50%)

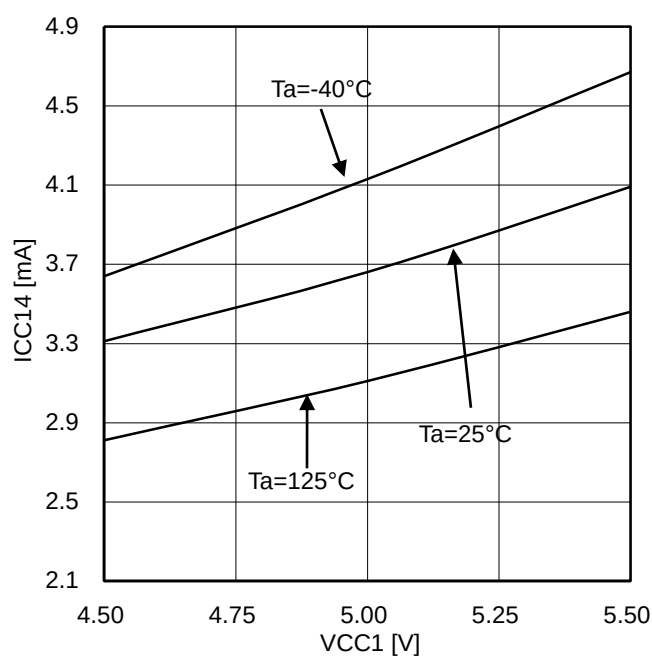


Figure 22. Input side circuit current  
(at INA=20kHz and Duty=50%)

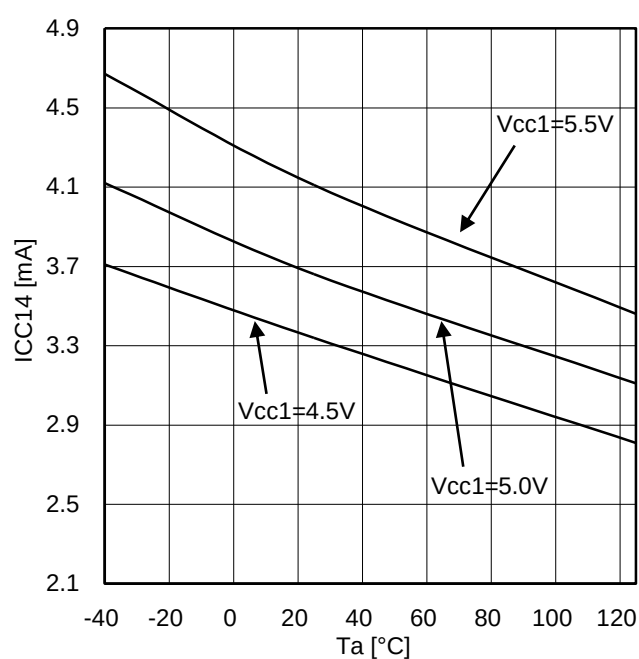
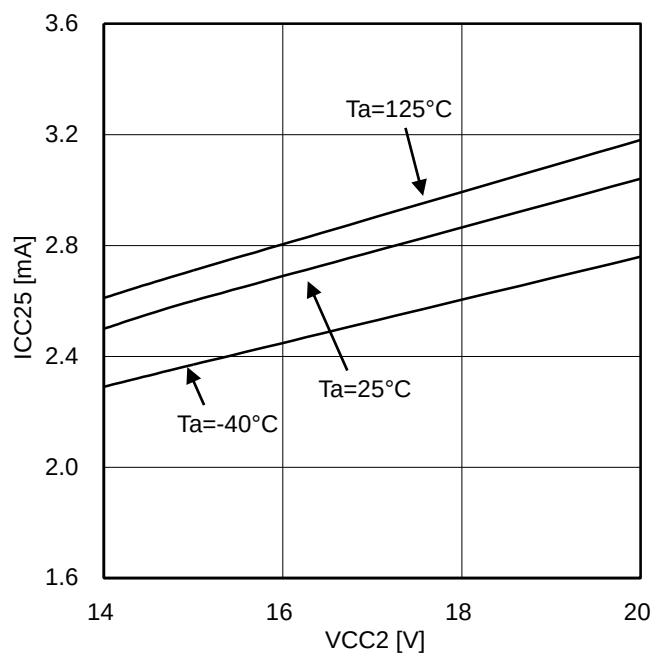
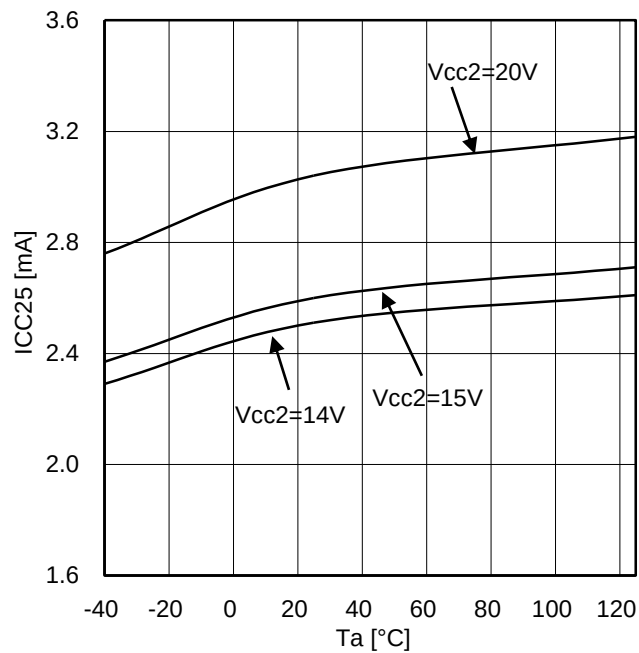
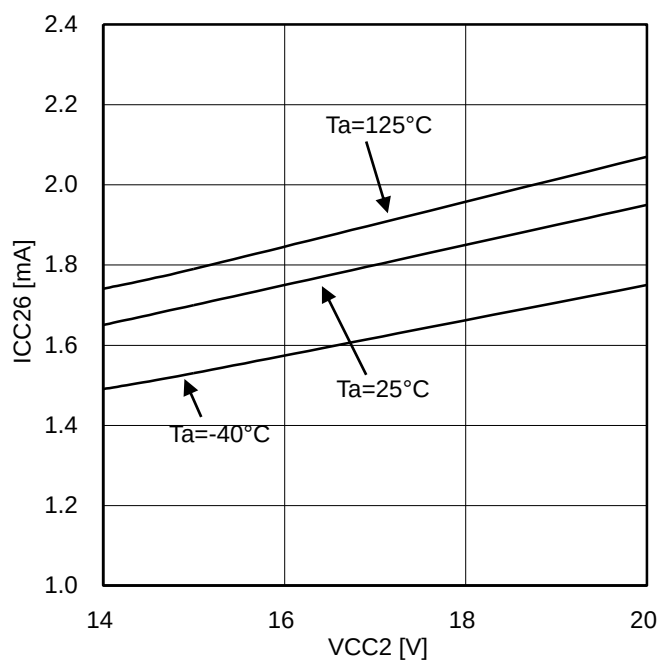
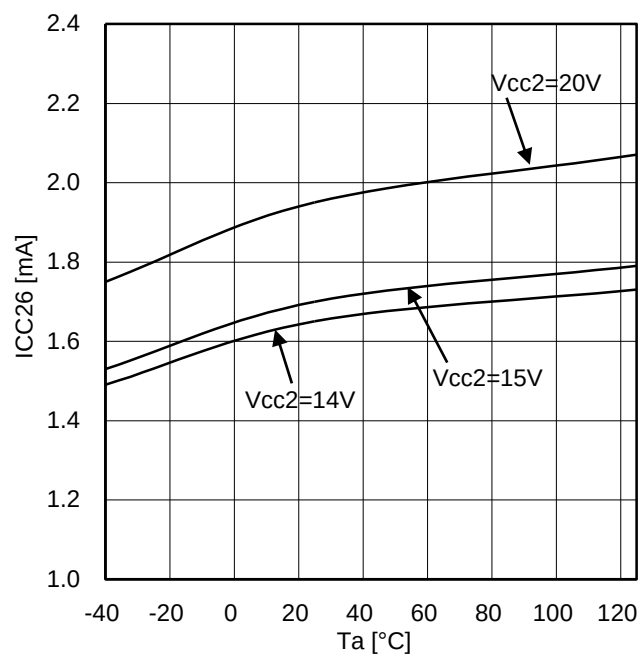


Figure 23. Input side circuit current  
(at INA=20kHz and Duty=50%)

Figure 24. Output side circuit current (at  $OUT1=L$ )Figure 25. Output side circuit current (at  $OUT1=L$ )Figure 26. Output side circuit current (at  $OUT1=H$ )Figure 27. Output side circuit current (at  $OUT1=H$ )



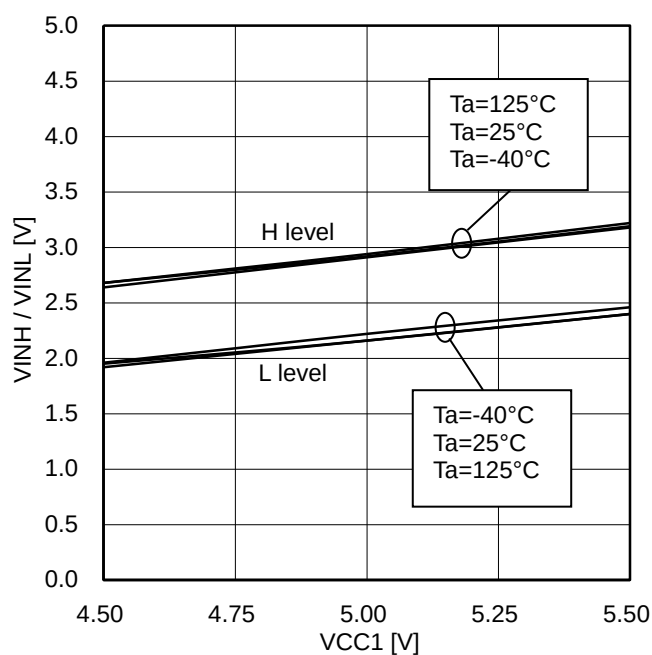


Figure 28. Logic (INA/INB) High/Low level input voltage

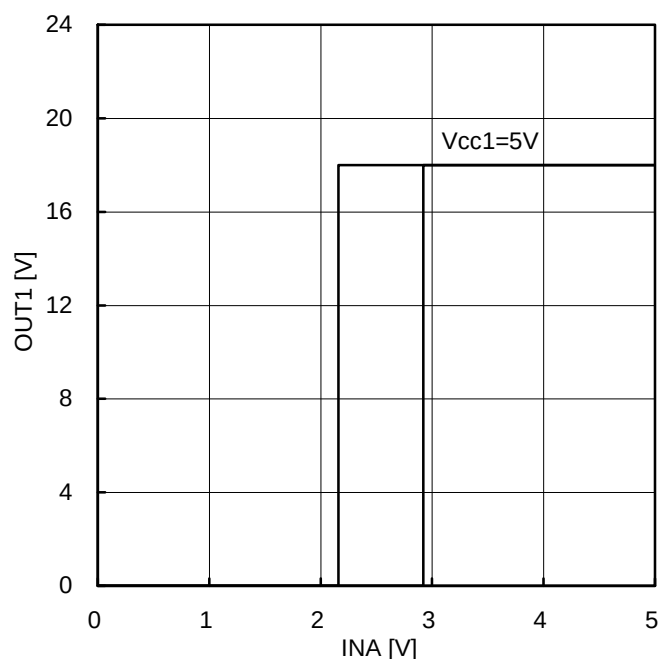


Figure 29. Logic (INA/INB) High/Low level input voltage at Ta=25°C

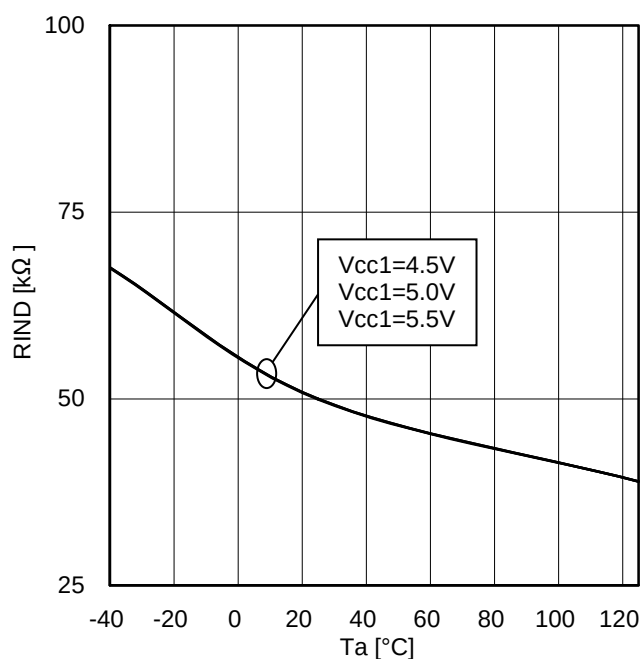


Figure 30. Logic pull-down resistance

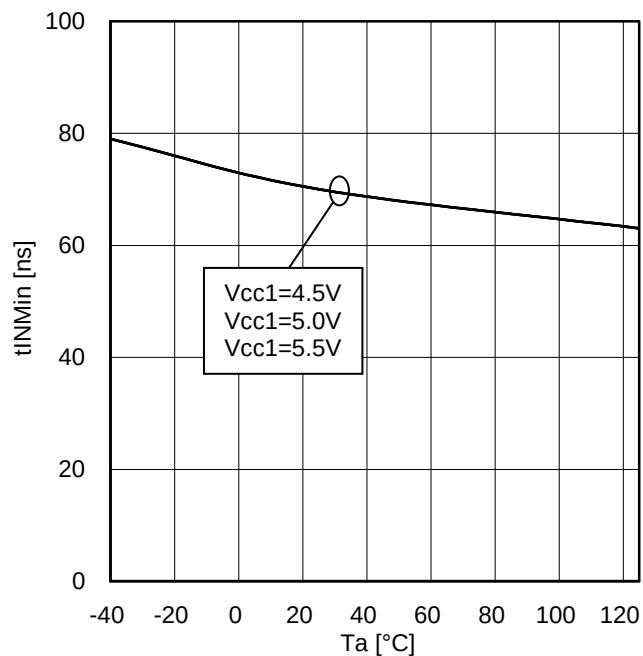


Figure 31. Logic input minimum pulse width (H pulse)

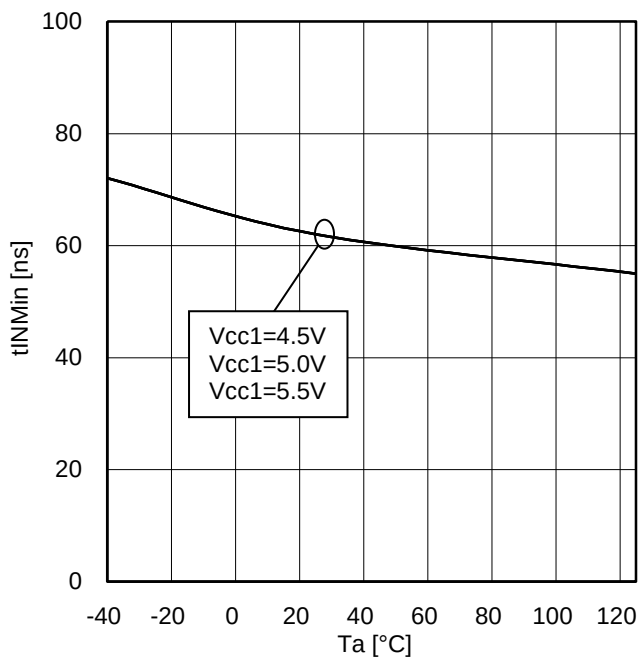


Figure 32. Logic input minimum pulse width (L pulse)

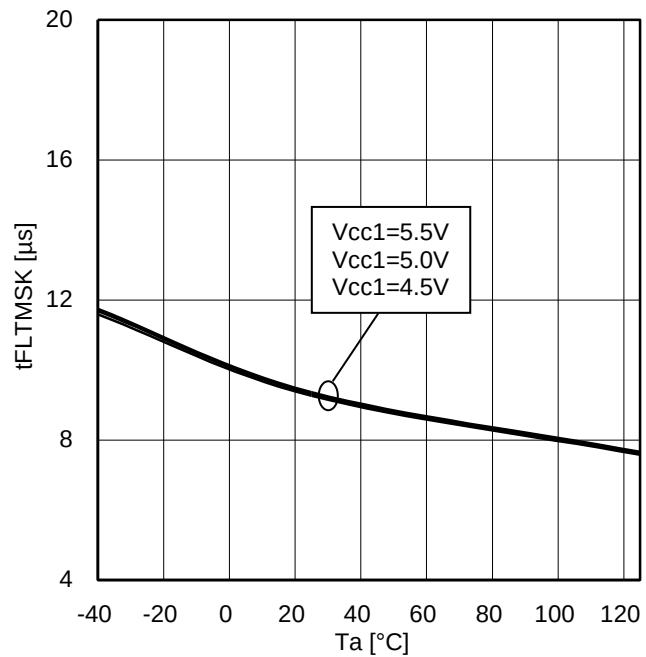


Figure 33. ENA input mask time

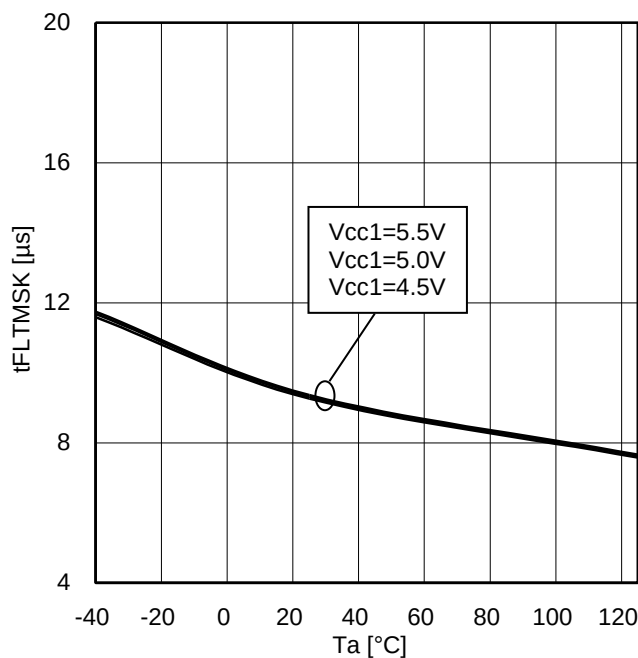


Figure 34. FLT input mask time

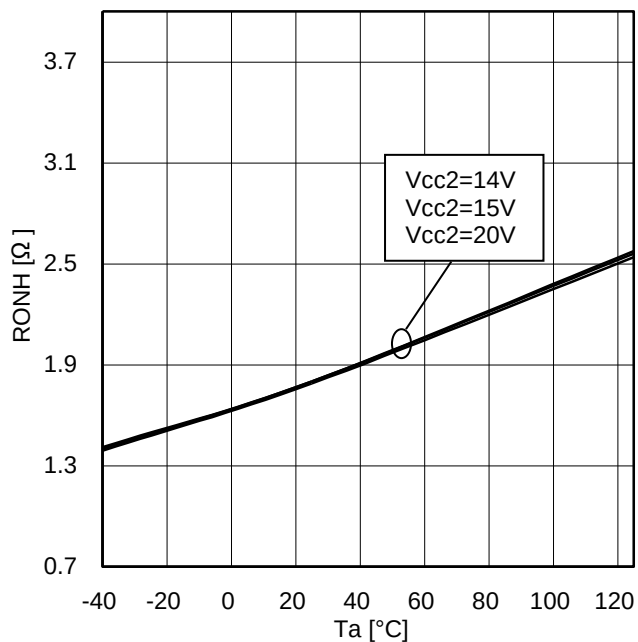


Figure 35. OUT1 ON resistance (Source)

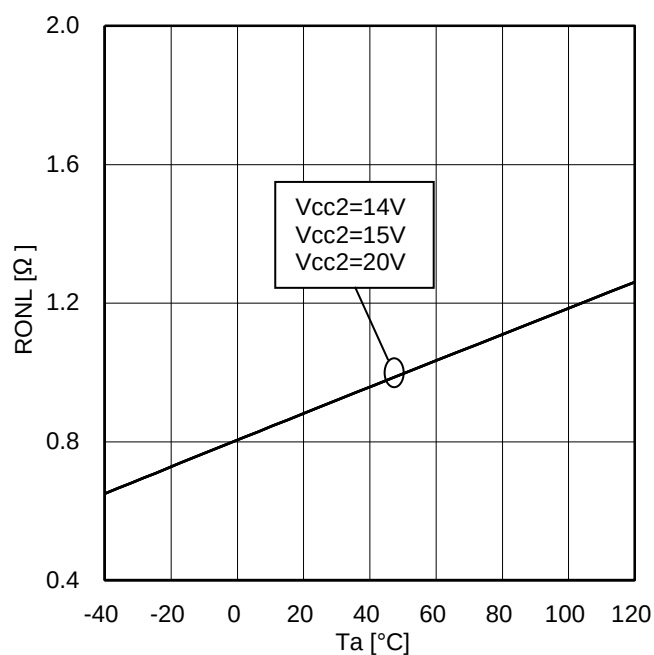


Figure 36. OUT1 ON resistance (Sink)

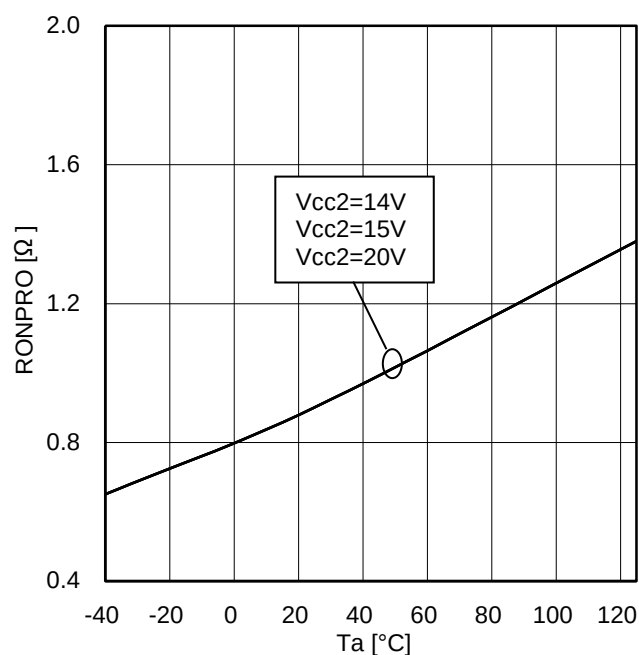


Figure 37. PROOUT ON resistance

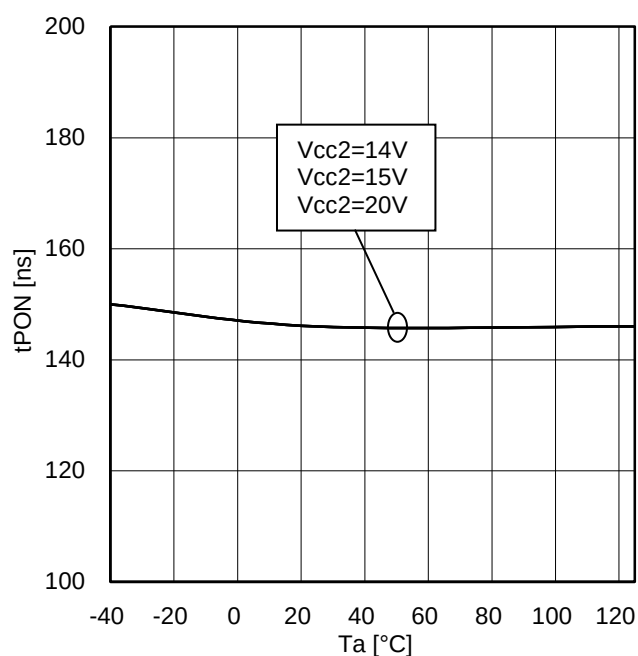


Figure 38. Turn ON time

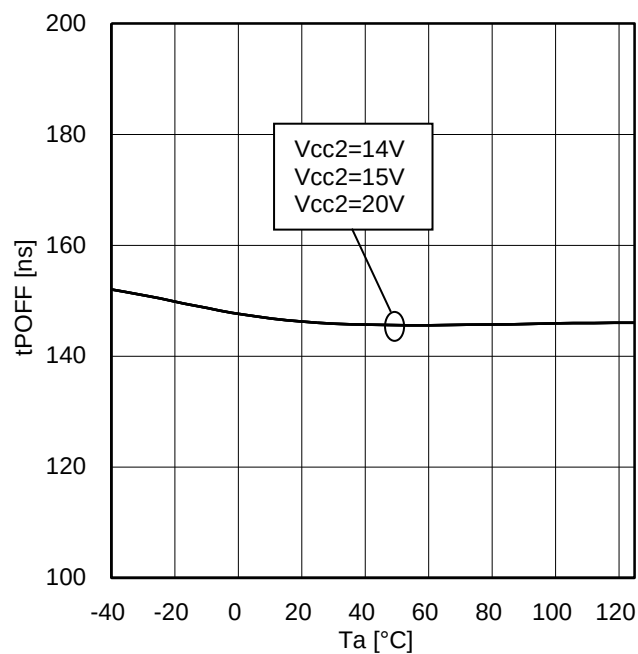


Figure 39. Turn OFF time

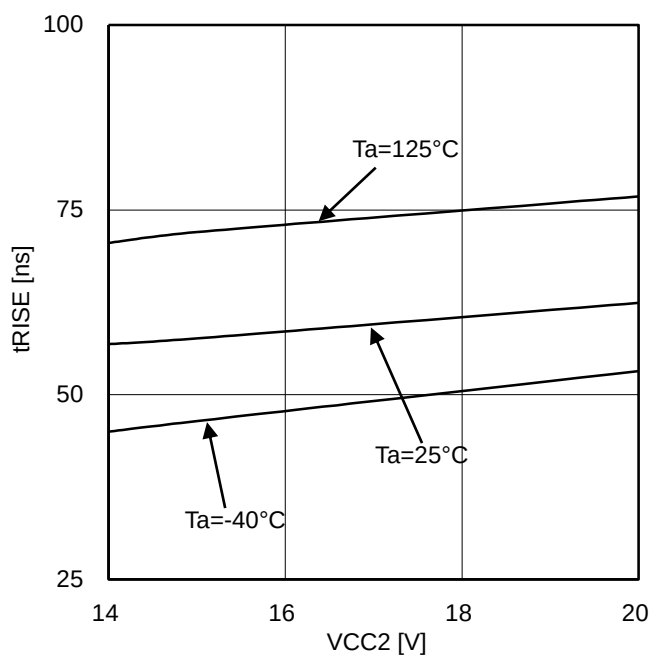


Figure 40. Rise time  
(10000pF between OUT1-GND2)

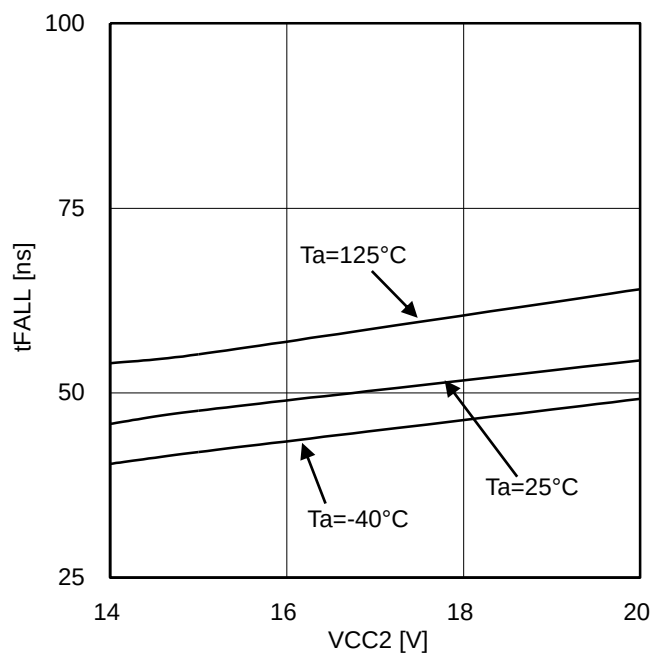


Figure 41. Fall time  
(10000pF between OUT1-GND2)

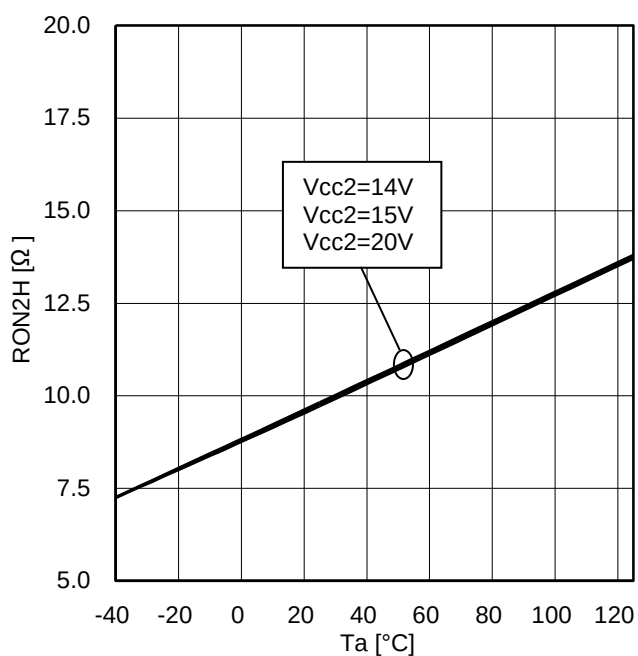


Figure 42. OUT2 ON resistance (Source)

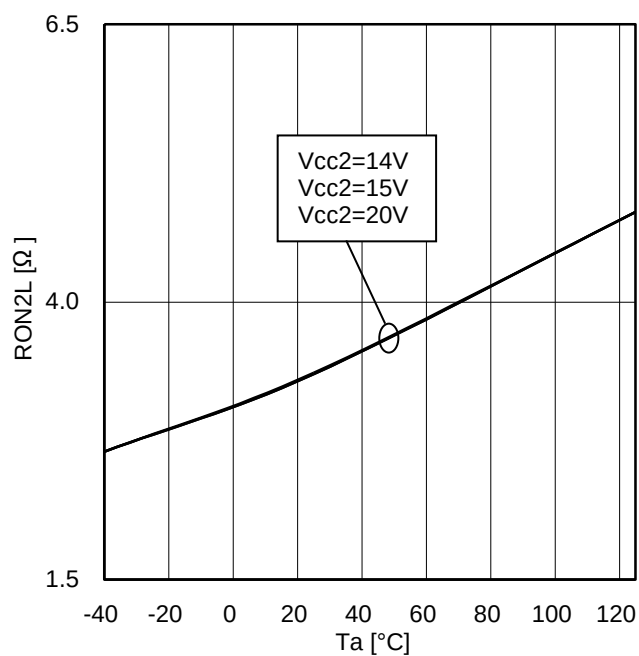


Figure 43. OUT2 ON resistance (Sink)

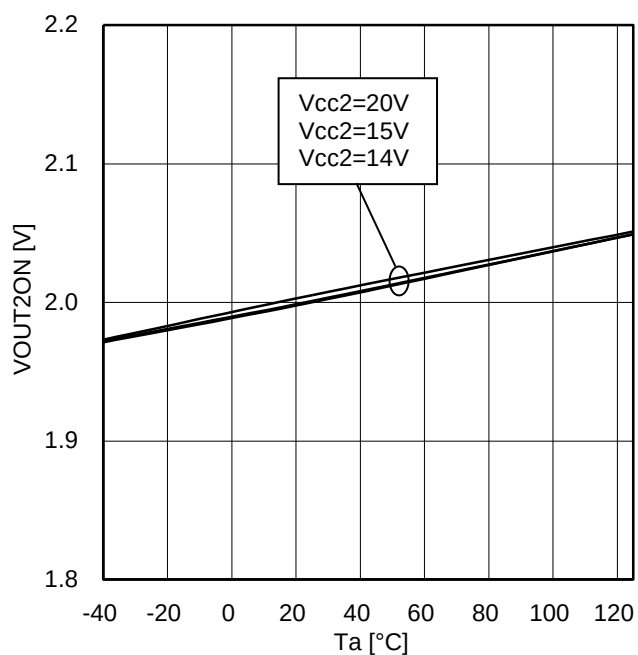


Figure 44. OUT2 ON threshold voltage

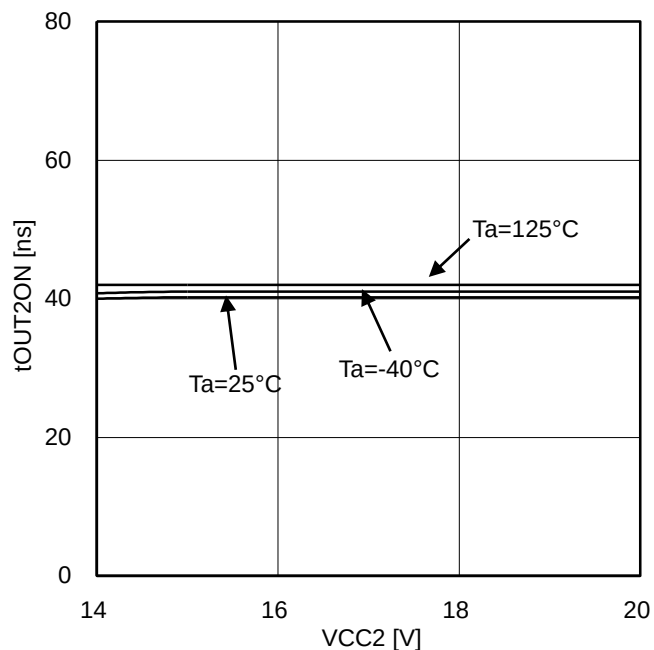


Figure 45. OUT2 output delay time

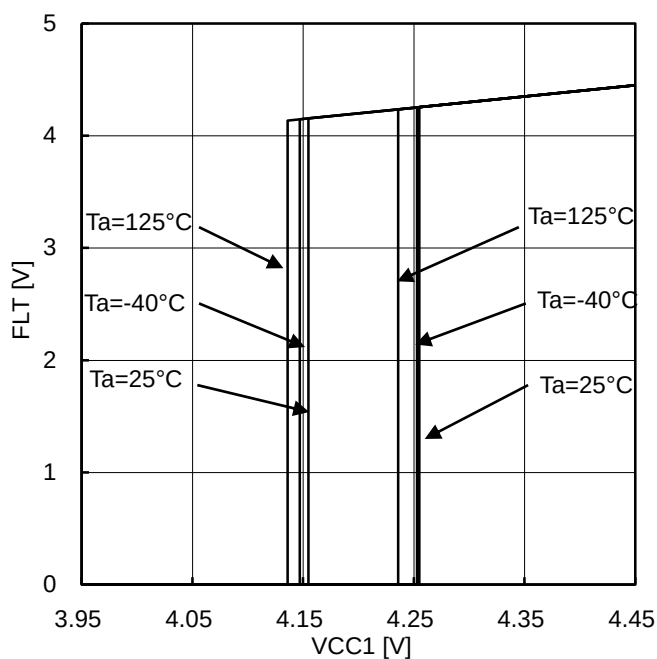


Figure 46. VCC1 UVLO ON/OFF voltage

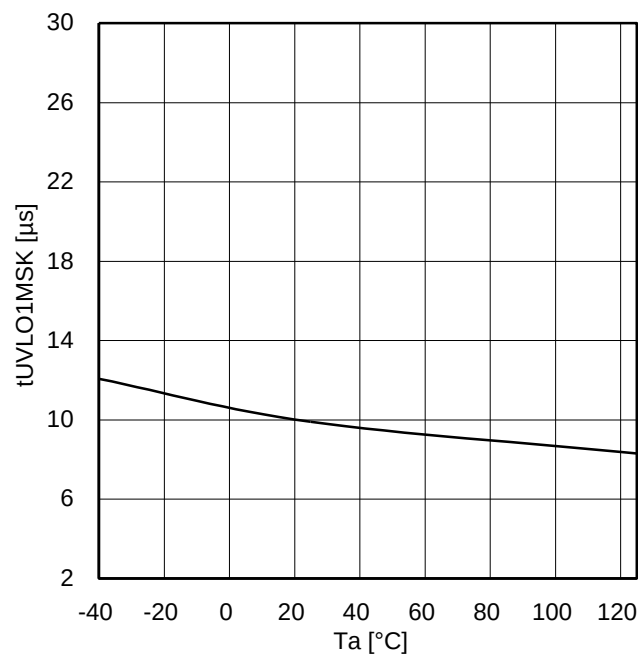


Figure 47. VCC1 UVLO mask time

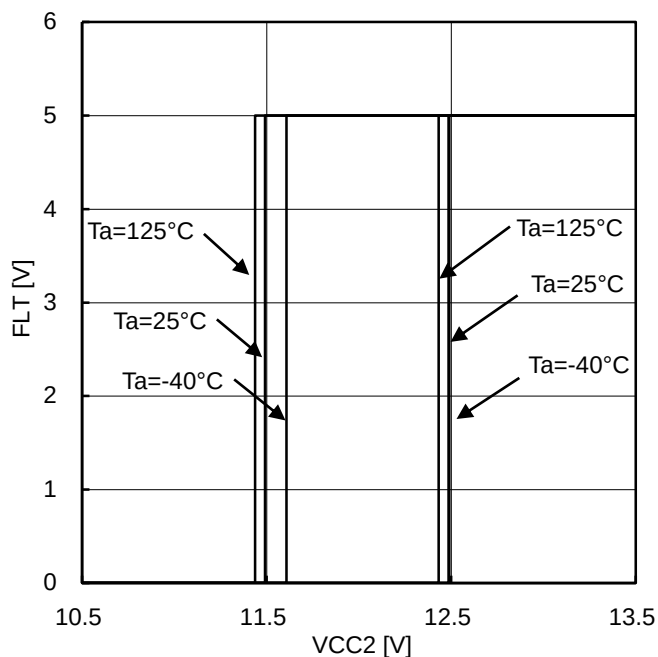


Figure 48. VCC2 UVLO ON/OFF voltage  
(at VCC1=5V)

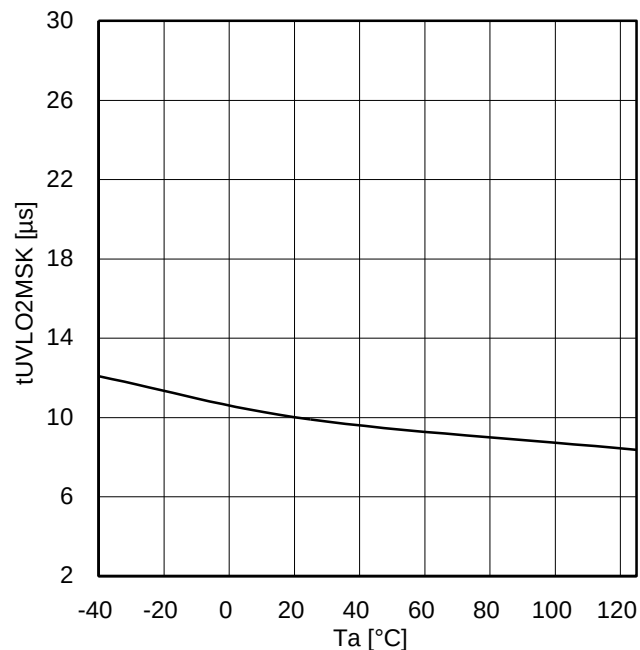


Figure 49. VCC2 UVLO mask time

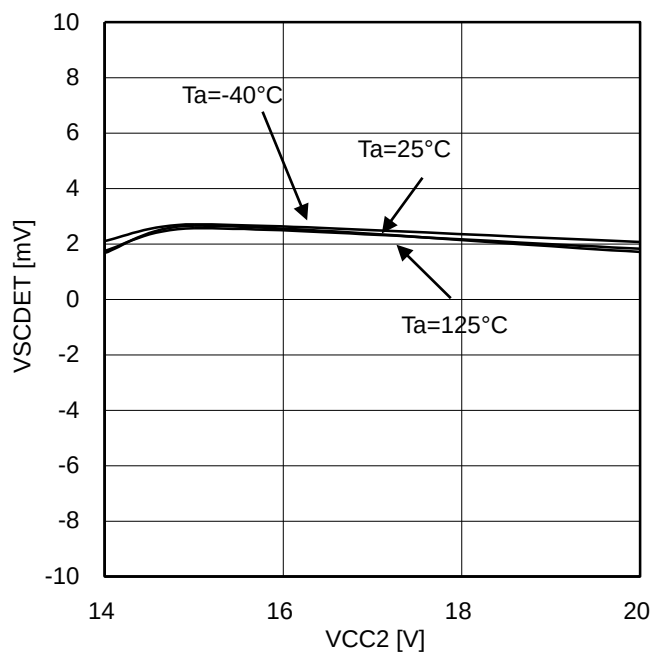


Figure 50. SCP offset voltage (at SCPTH=0.7V)

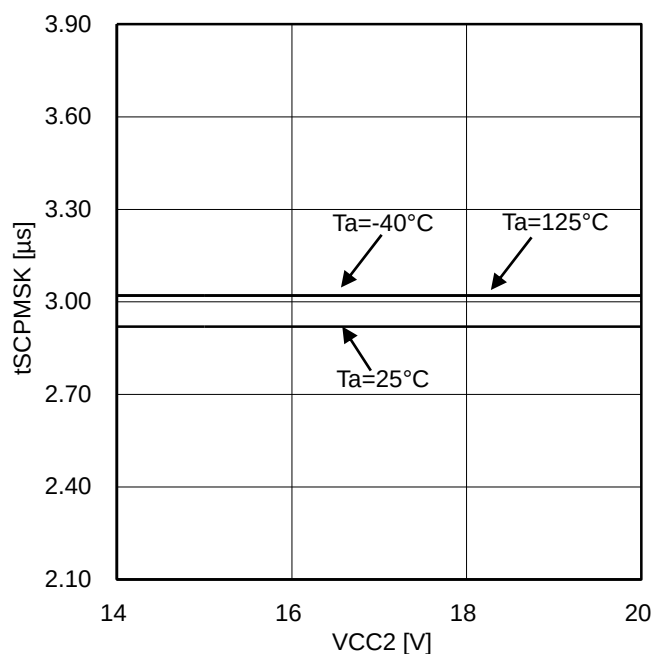


Figure 51. SCP detection mask time

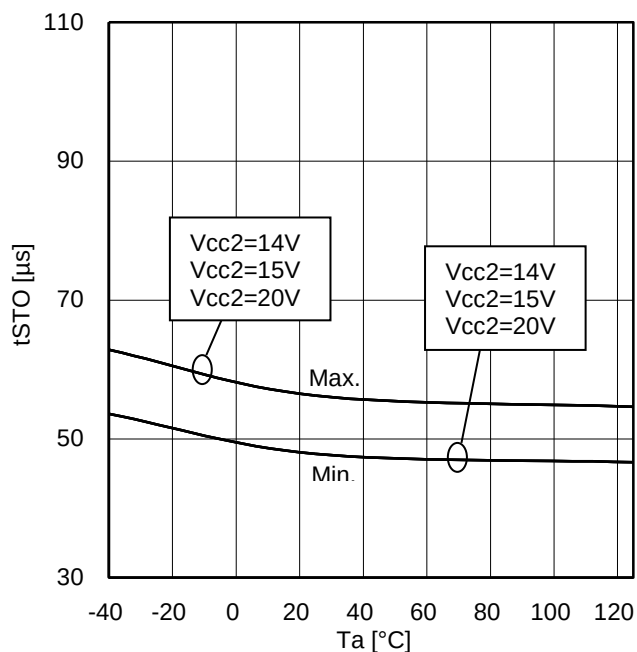


Figure 52. Soft turn OFF release time

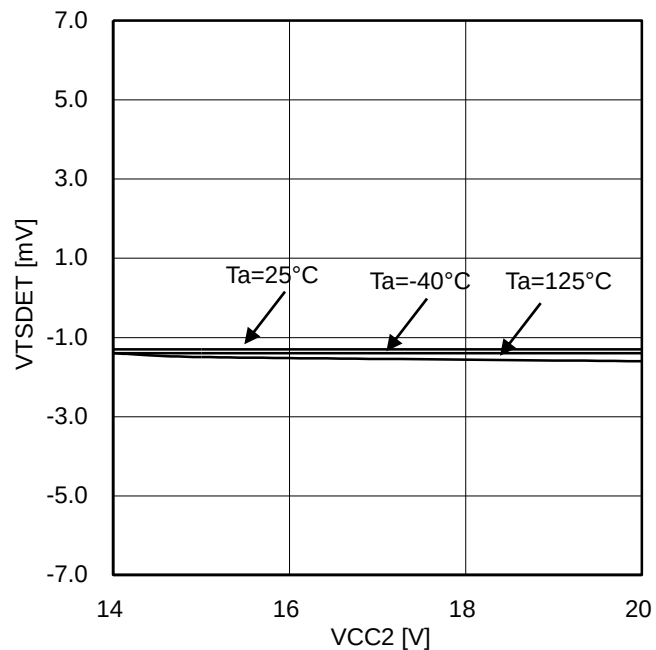
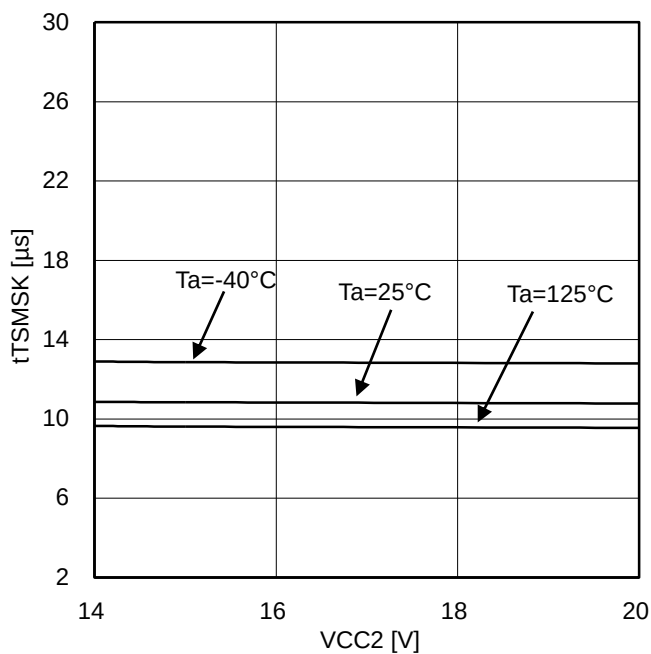
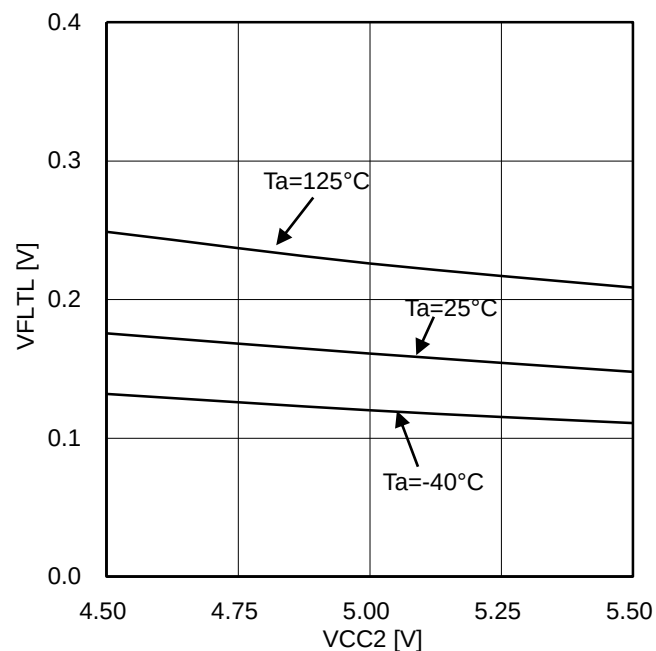
Figure 53. VTS offset voltage (at  $V_{TSTH}=1.7V$ )

Figure 54. Thermal detection mask time

Figure 55. FLT output low voltage ( $I_{FLT}=5mA$ )

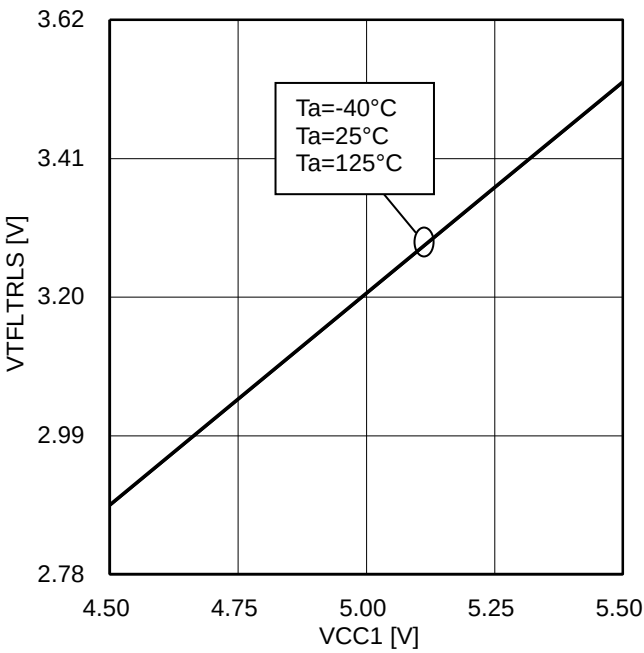
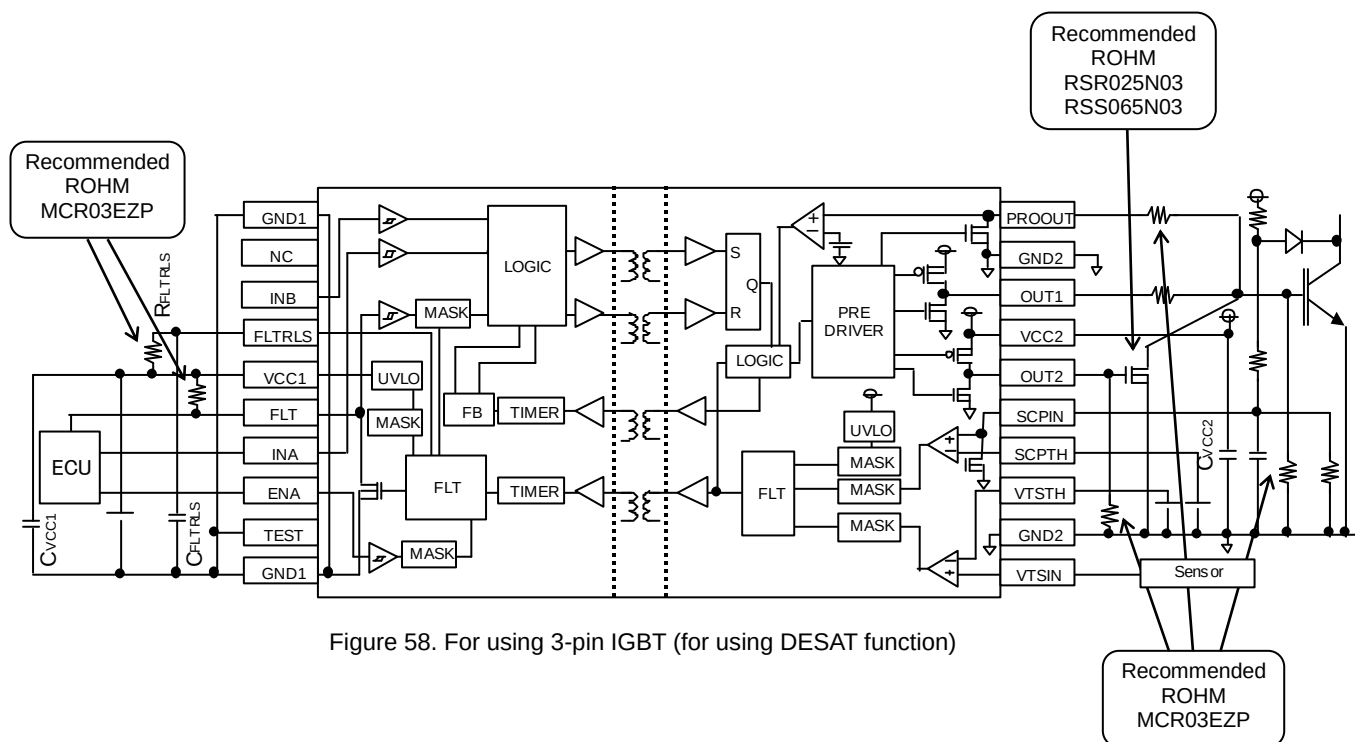
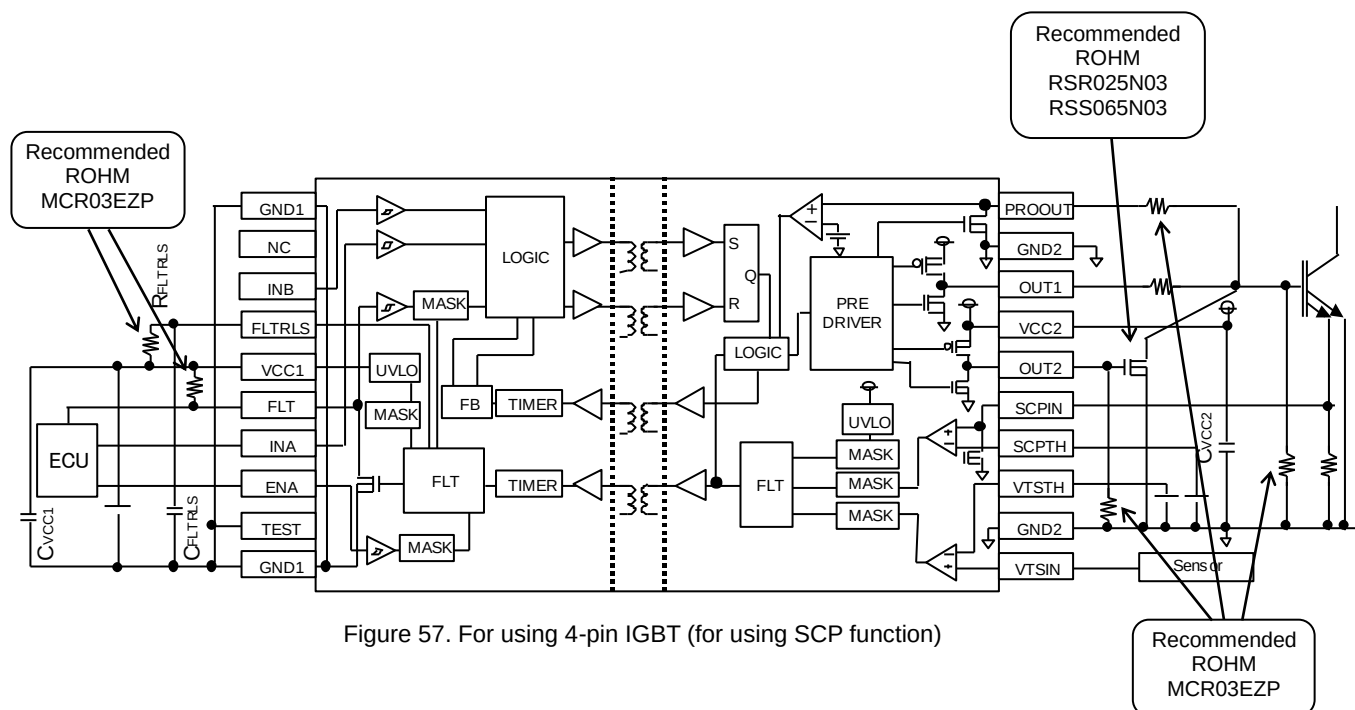


Figure 56. FLTRLS threshold



## Selection of Components Externally Connected



## I/O equivalence circuits

| Pin No. | Name                                          | I/O equivalence circuits |
|---------|-----------------------------------------------|--------------------------|
|         | Function                                      |                          |
| 1       | VTSIN                                         |                          |
|         | Thermal detection pin                         |                          |
| 3       | VTSTH                                         |                          |
|         | Thermal detection threshold setting pin       |                          |
| 4       | SCPTH                                         |                          |
|         | Short current detection threshold setting pin |                          |
| 5       | SCPIN                                         |                          |
|         | Short current detection pin                   |                          |
| 6       | OUT2                                          |                          |
|         | MOS FET control pin for Miller Clamp          |                          |
| 8       | OUT1                                          |                          |
|         | Output pin                                    |                          |
| 10      | PROOUT                                        |                          |
|         | Soft turn-off pin                             |                          |

| Pin No. | Name                                  | I/O equivalence circuits |
|---------|---------------------------------------|--------------------------|
|         | Function                              |                          |
| 14      | FLTRLS                                |                          |
|         | Fault output holding time setting pin |                          |
| 16      | FLT                                   |                          |
|         | Fault output pin                      |                          |
| 13      | INB                                   |                          |
|         | Invert / non-invert selection pin     |                          |
| 17      | INA                                   |                          |
|         | Control input pin                     |                          |
| 18      | ENA                                   |                          |
|         | Input enabling signal input pin       |                          |
| 19      | TEST                                  |                          |
|         | Test mode setting pin                 |                          |

## Power Dissipation

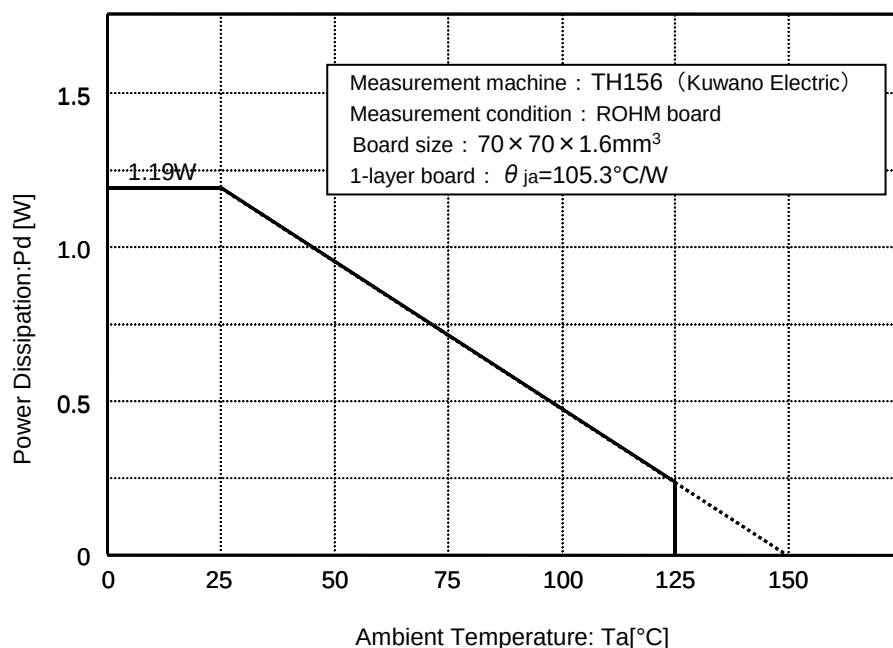


Figure 59. SSOP-B20W Derating Curve

## Thermal design

Please confirm that the IC's chip temperature  $T_j$  is not over  $150^\circ\text{C}$ , while considering the IC's power consumption (W), package power ( $P_d$ ) and ambient temperature ( $T_a$ ). When  $T_j=150^\circ\text{C}$  is exceeded the functions as a semiconductor do not operate and some problems (ex. Abnormal operation of various parasitic elements and increasing of leak current) occur. Constant use under these circumstances leads to deterioration and eventually IC may destruct.  $T_{j\text{max}}=150^\circ\text{C}$  must be strictly obeyed under all circumstances.

## 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. 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. The absolute maximum rating of the Pd stated in this specification is when the IC is mounted on a 70mm x 70mm x 1.6mm glass epoxy board. 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.

## Operational Notes – continued

**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.

**12. Regarding the Input Pin of the IC**

This monolithic IC contains P<sup>+</sup> 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.

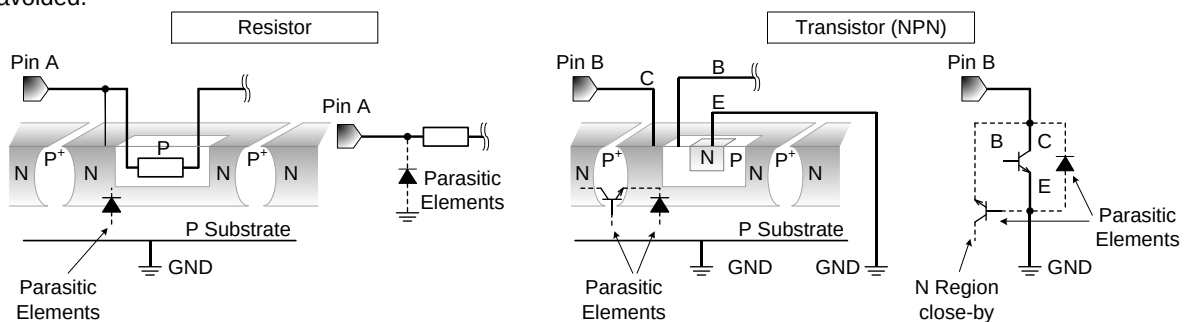


Figure 60. Example of monolithic IC structure

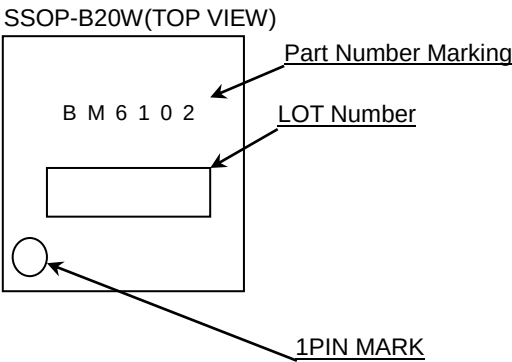
**13. Ceramic Capacitor**

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.

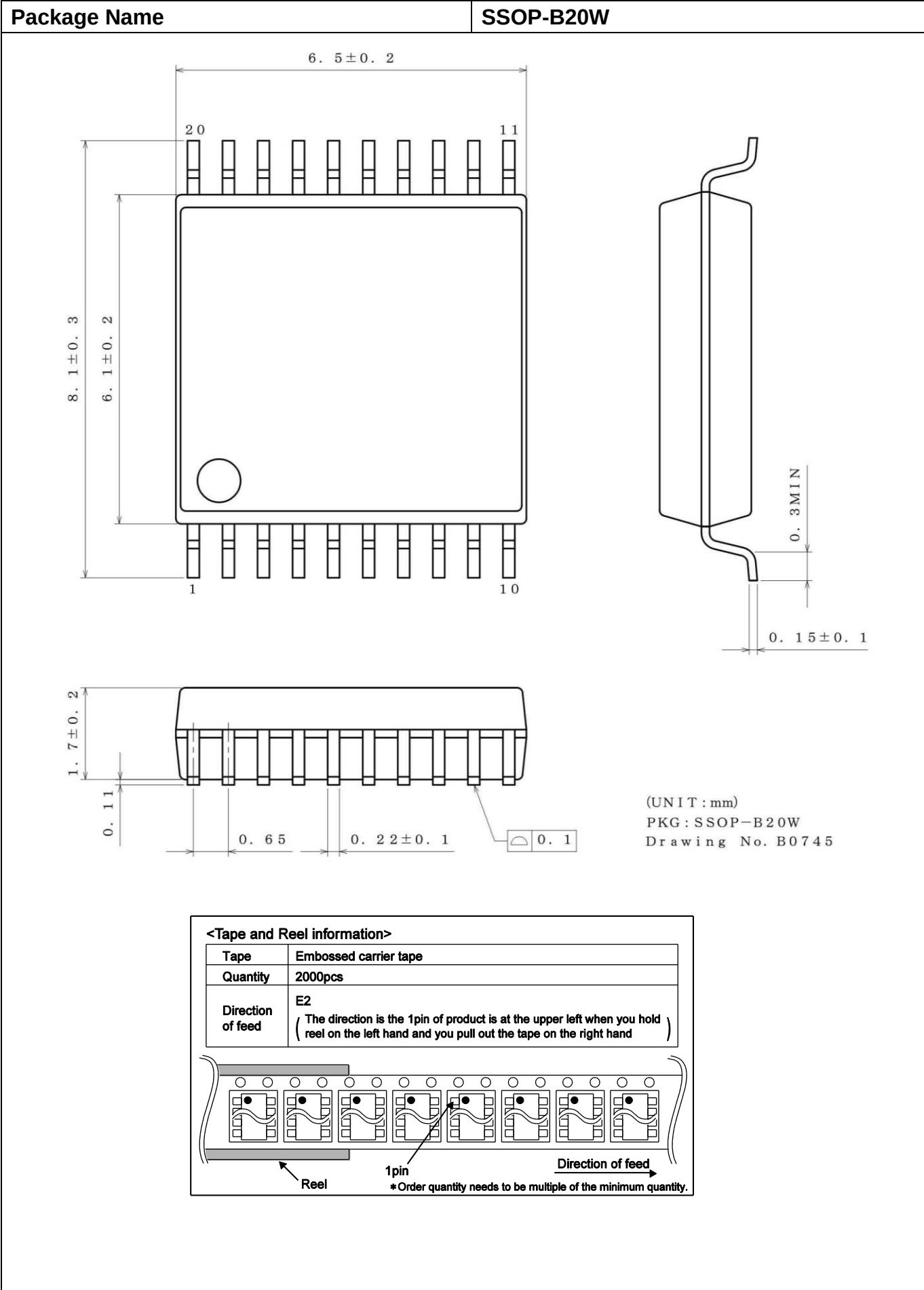
Ordering Information

|                 |  |  |  |  |  |  |                          |      |                                                                                           |
|-----------------|--|--|--|--|--|--|--------------------------|------|-------------------------------------------------------------------------------------------|
| B M 6 1 0 2 F V |  |  |  |  |  |  | -                        | CE 2 |                                                                                           |
| Part Number     |  |  |  |  |  |  | Package<br>FV: SSOP-B20W |      | Rank<br>C:Automotive<br>Packaging and forming specification<br>E2: Embossed tape and reel |

Marking Diagram



Physical Dimension, Tape and Reel Information





## Revision History

| Date        | Revision | Changes                                                                                 |
|-------------|----------|-----------------------------------------------------------------------------------------|
| 23.Jan.2014 | 001      | New Release                                                                             |
| 20.May.2015 | 002      | P.1 Features Adding item (UL1577 Recognized)<br>P.4 Description of Pins Adding TEST pin |
| 25.Dec.2015 | 003      | P.13 Adding UL1577 Rating Table                                                         |

# Notice

## Precaution on using ROHM Products

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(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  |           |

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:
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  - [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure
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  - [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<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [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 (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
  - [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<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [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.

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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.

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bm6102fv-c - Web Page

|                             |            |
|-----------------------------|------------|
| Part Number                 | bm6102fv-c |
| Package                     | SSOP-B20W  |
| Unit Quantity               | 2000       |
| Minimum Package Quantity    | 2000       |
| Packing Type                | Taping     |
| Constitution Materials List | inquiry    |
| RoHS                        | Yes        |