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(Note 1) (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

	W(Typ) x D(Typ) x H(Max)
SSOP-B20W	6.50 ㎜ × 8.10 ㎜ × 2.01 ㎜

Applications

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

Typical Application Circuits

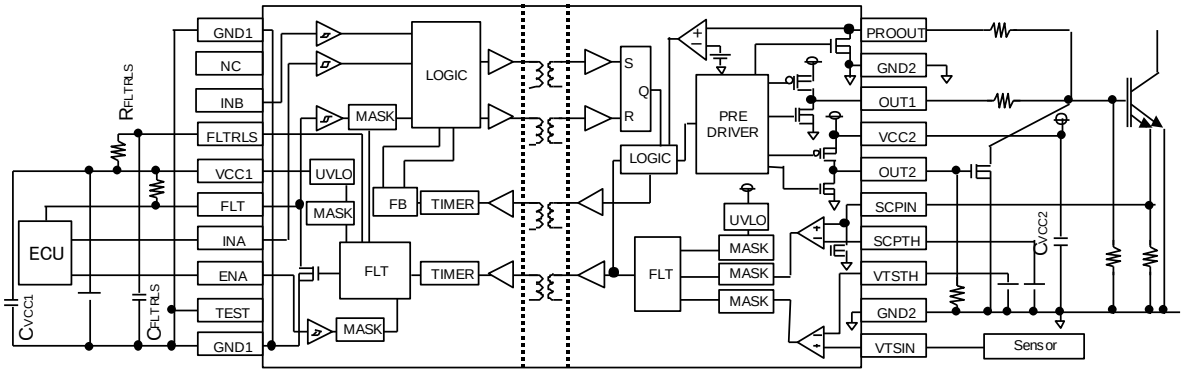


Figure 1. For using 4-pin IGBT (for using SCP function)

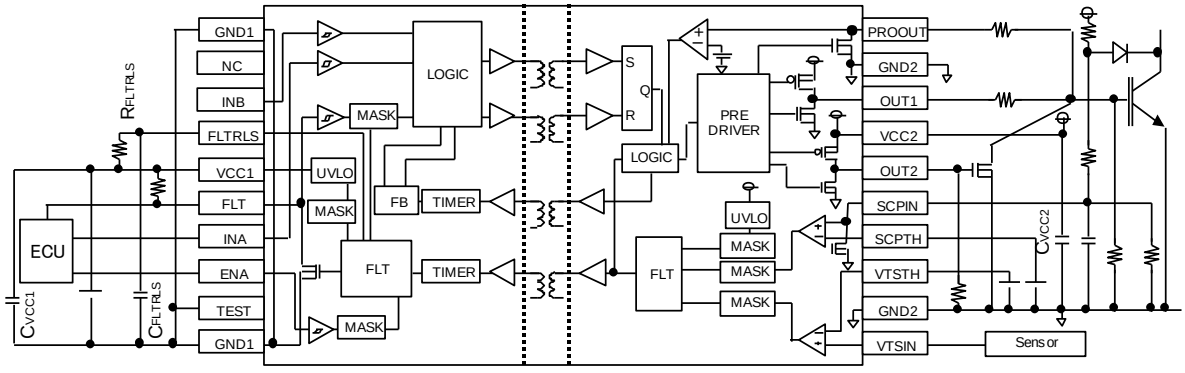


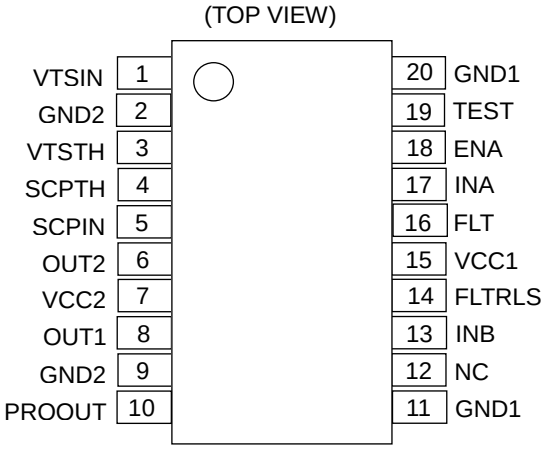
Figure 2. For using 3-pin IGBT (for using DESAT function)

Recommended range of external constants

Pin Name	Symbol	Recommended Value			Unit
		Min.	Typ.	Max.	
FLTRLS	C_{FLTRLS}	-	0.01	0.47	μF
	R_{FLTRLS}	50	200	1000	kΩ
VCC1	C_{VCC1}	0.1	1.0	-	μF
VCC2	C_{VCC2}	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 (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 devise 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_{SCPMSK}(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_{TSMSK}(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_{OUT2ON}(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 (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

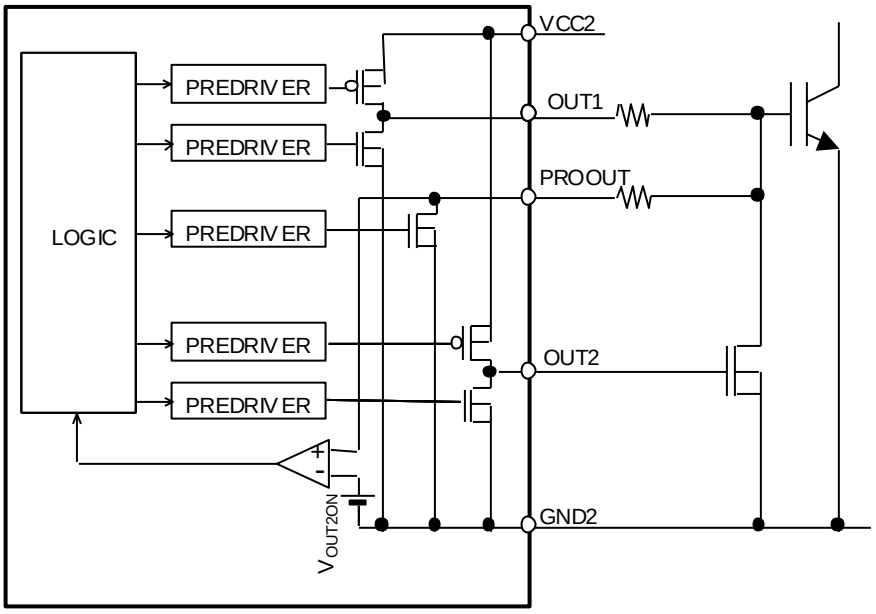


Figure 3. Block diagram of Miller Clamp function

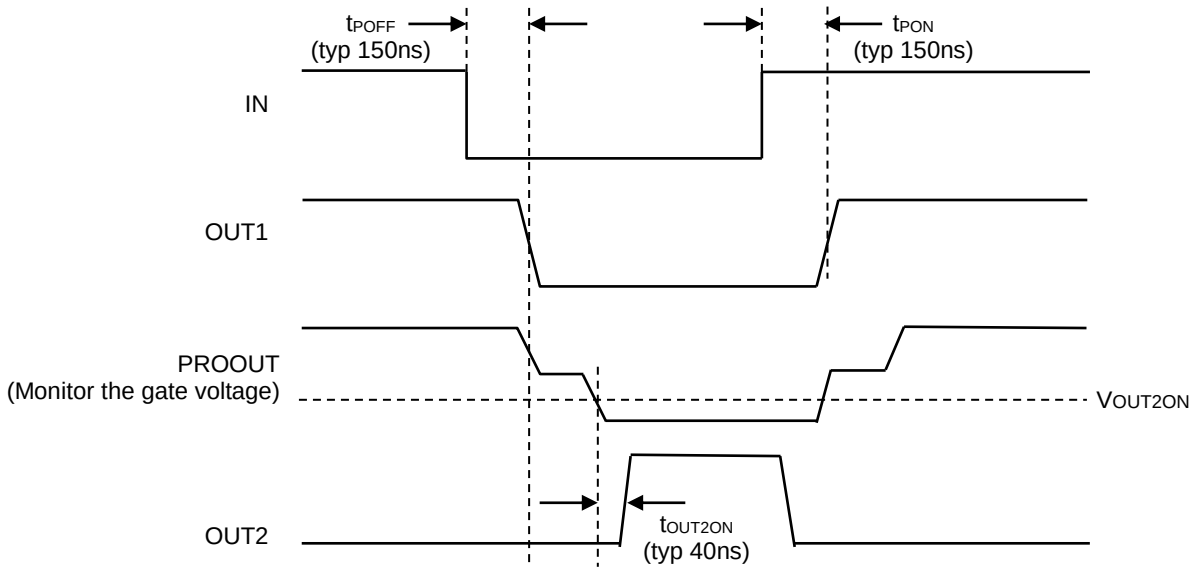


Figure 4. Timing chart of Miller Clamp function

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 FLTRLS pin. For example, when C_{FLTRLS} is set to 0.01µF and R_{FLTRLS} is set to 200kΩ, the holding time will be set to 2 ms.

t_{FLTRLS} [ms]= C_{FLTRLS} [µF]•R_{FLTRLS} [kΩ]

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

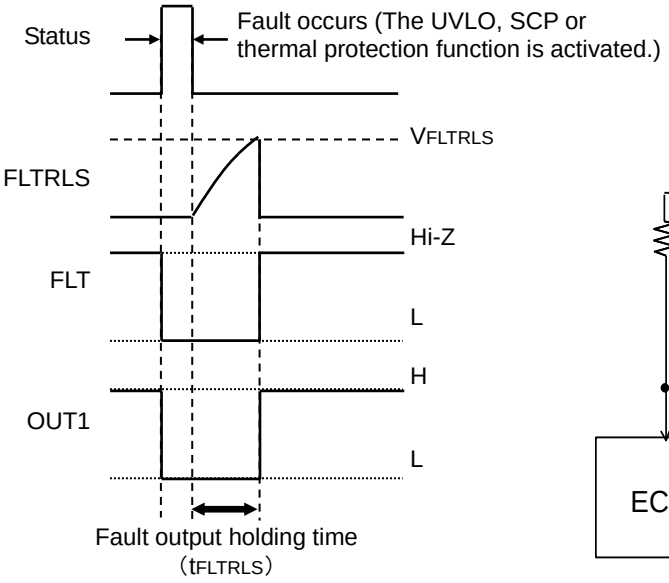


Figure 5. Fault Status Output Timing Chart

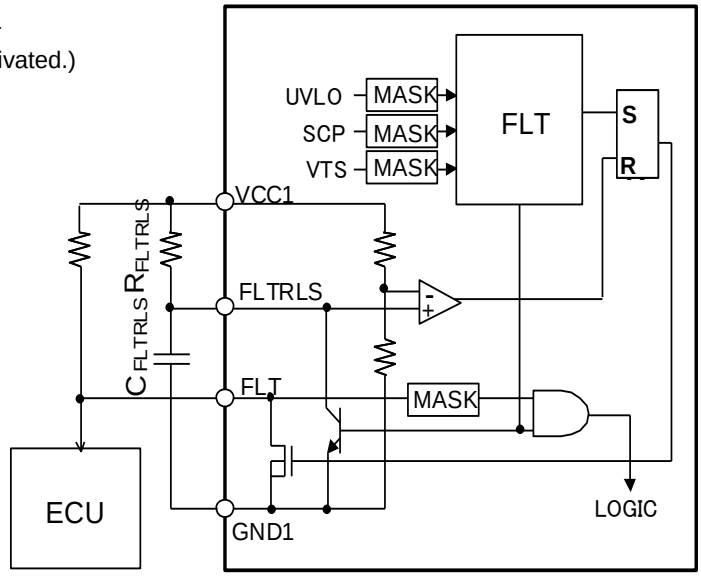


Figure 6. Fault Output Block Diagram

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 10µs) and $t_{UVLO2MSK}$(typ 10µs) are set on both low and high voltage sides.

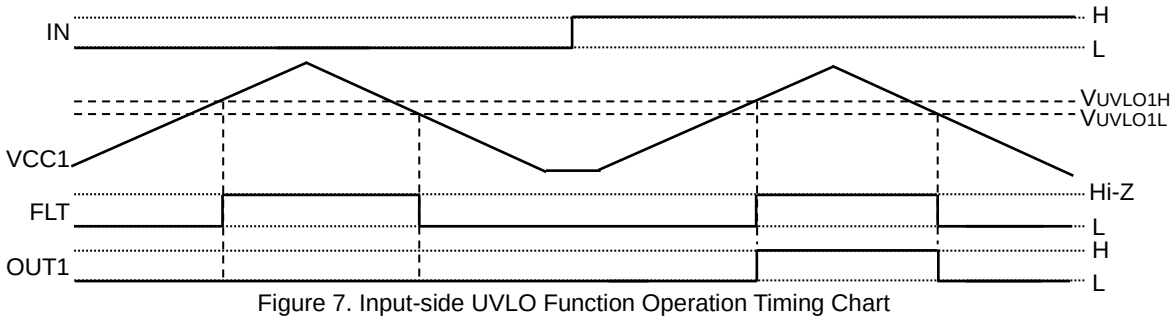


Figure 7. Input-side UVLO Function Operation Timing Chart

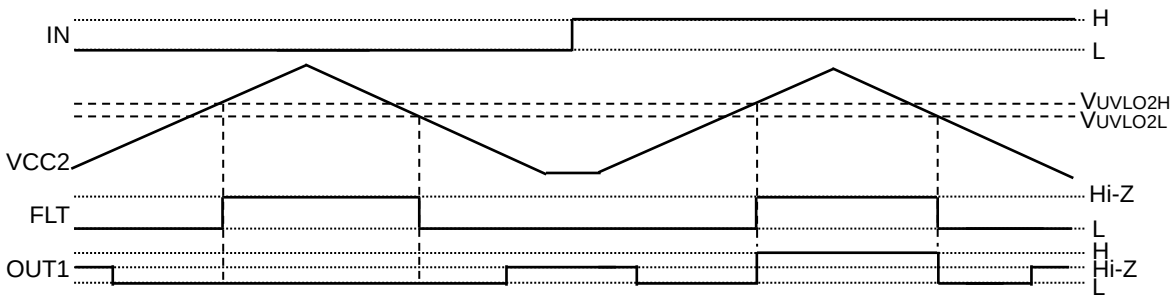


Figure 8. Output-side UVLO Operation Timing Chart

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 30μs, max 110μs) 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;

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

$$V_{CC2_{MIN}}[V] > V_{SCPTH} \bullet \frac{R3+R2+R1}{R3}$$

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

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

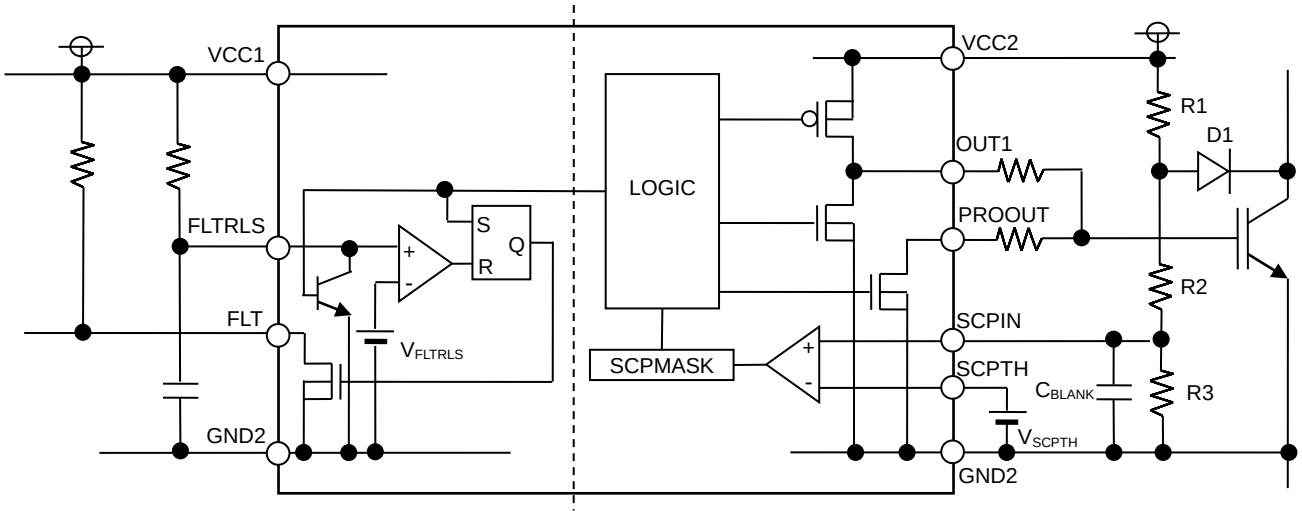


Figure 9. Block Diagram for DESAT

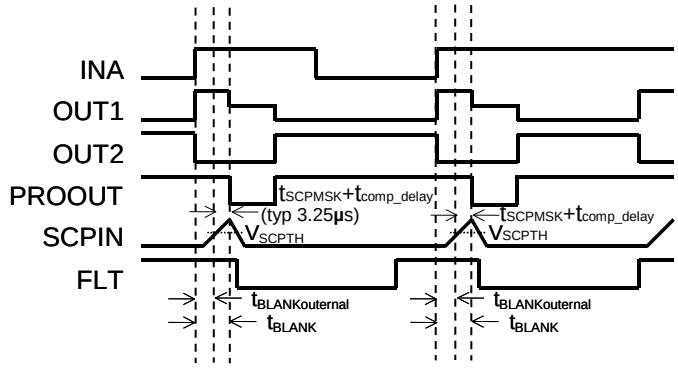
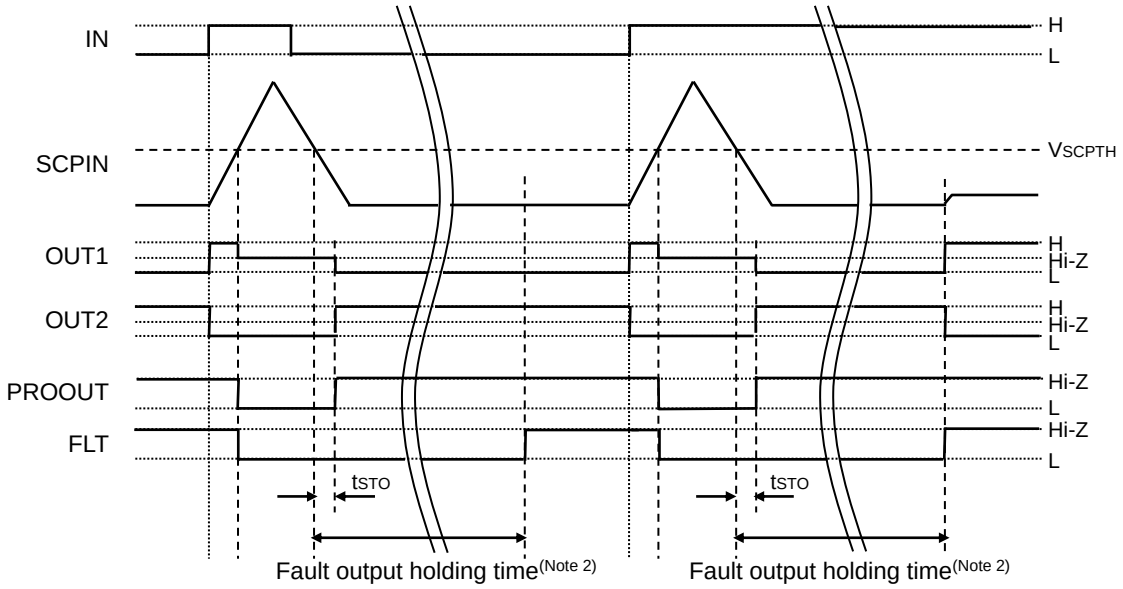


Figure 10. DESAT Operation Timing Chart



(Note 2) “2) Fault status output” section on page 5

Figure 11. SCP Operation Timing Chart

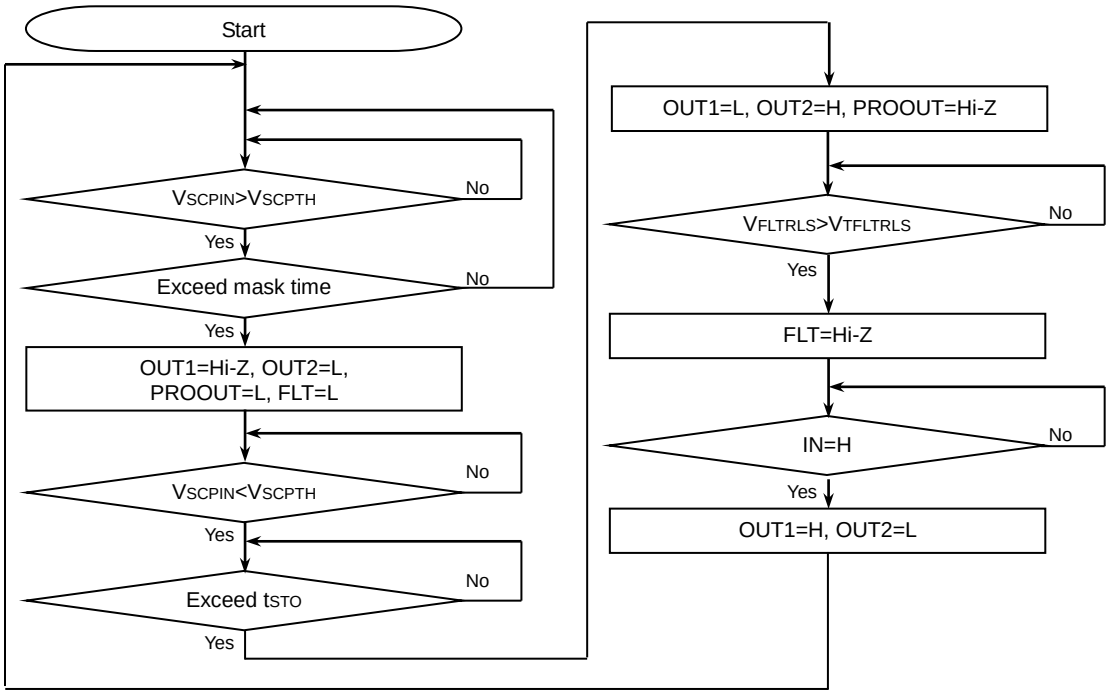


Figure 12. SCP Operation Status Transition Diagram

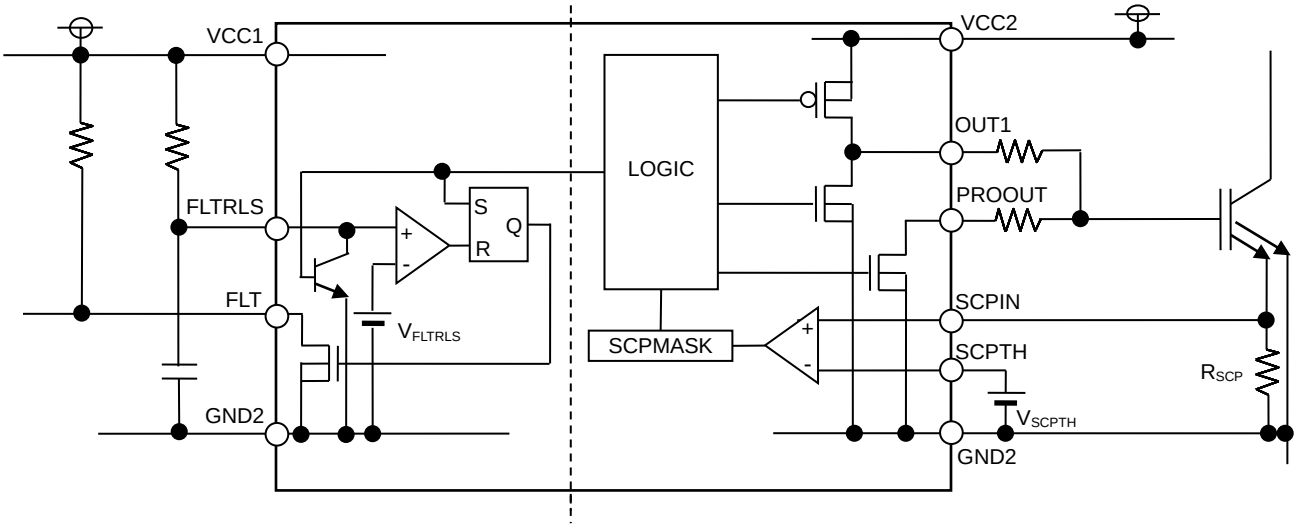


Figure 13. Block Diagram for SCP

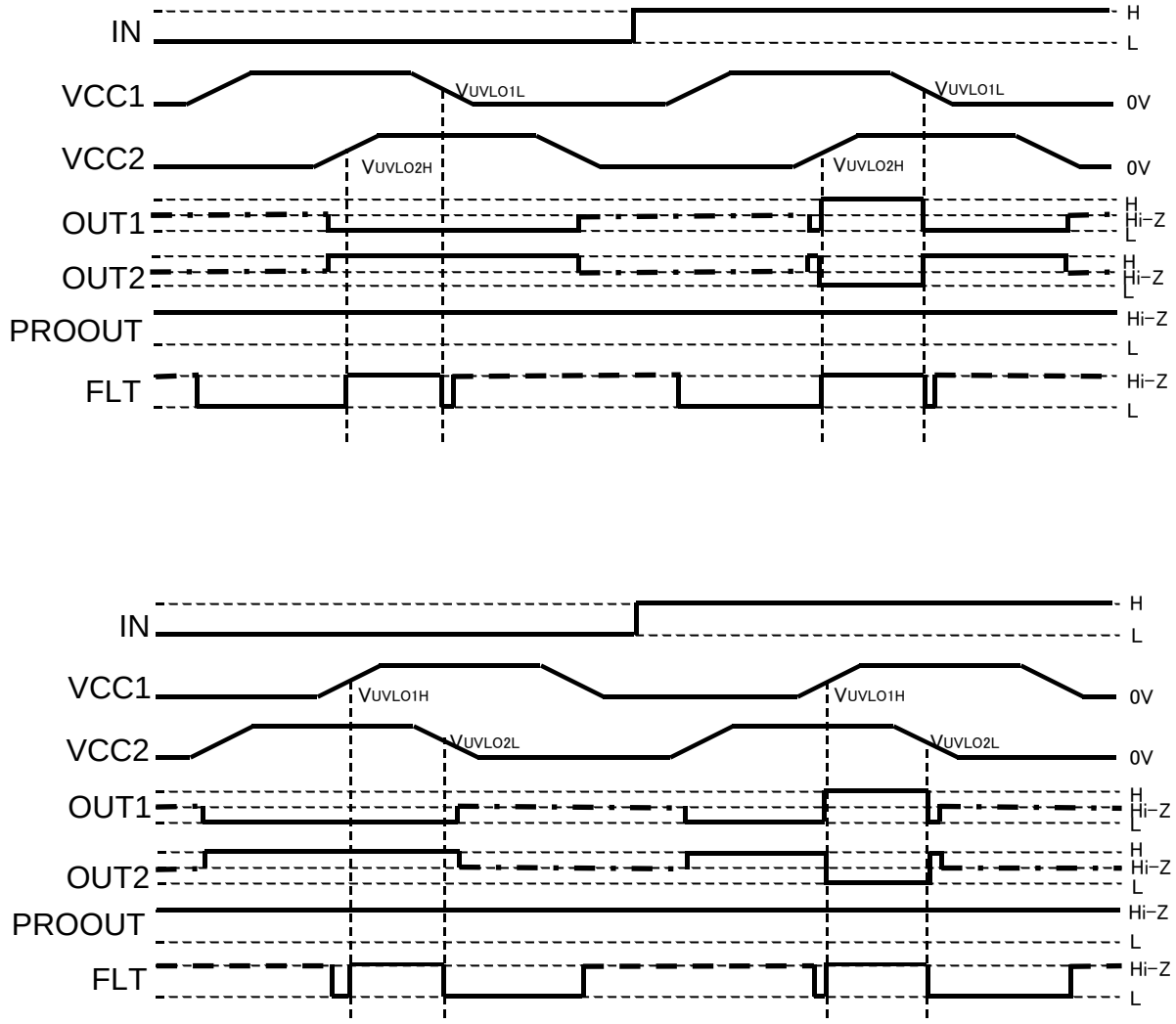
5）I/O condition table

No.	Status	Input									Output			
		VCC1	VCC2	VTSIN	SCPIN	FLT	ENA	INB	INA	PROOUT	OUT1	OUT2	PROOUT	FLT
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	○	○	H	L	H	L	X	X	H	L	L	Hi-Z	Hi-Z
6		○	○	H	L	H	L	X	X	L	L	H	Hi-Z	Hi-Z
7	FLT external input	○	○	H	L	L	X	X	X	H	L	L	Hi-Z	Hi-Z
8		○	○	H	L	L	X	X	X	L	L	H	Hi-Z	Hi-Z
9	SCP	○	○	X	H	X	X	X	X	X	Hi-Z	L	L	L
10	Thermal protection	○	○	L	L	X	X	X	X	H	L	L	Hi-Z	L
11		○	○	L	L	X	X	X	X	L	L	H	Hi-Z	L
12	Non-invert operation L input	○	○	H	L	H	H	L	L	H	L	L	Hi-Z	Hi-Z
13		○	○	H	L	H	H	L	L	L	L	H	Hi-Z	Hi-Z
14	Non-invert operation H input	○	○	H	L	H	H	L	H	X	H	L	Hi-Z	Hi-Z
15	Invert operation L input	○	○	H	L	H	H	H	L	X	H	L	Hi-Z	Hi-Z
16	Invert operation H input	○	○	H	L	H	H	H	H	H	L	L	Hi-Z	Hi-Z
17		○	○	H	L	H	H	H	H	L	L	H	Hi-Z	Hi-Z

○: VCC1 or VCC2 > 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



: Since the VCC2 pin voltage is low and the output MOS does not turn ON, the output pins become Hi-Z conditions.

: Since the VCC1 pin voltage is low and the FLT output MOS does not turn ON, the output pins become Hi-Z conditions.

Figure 14. Power supply startup / shutoff sequence

Absolute maximum ratings

Parameter	Symbol	Limits	Unit
Input-side supply voltage	V_{CC1}	-0.3 to +7.0(Note 3)	V
Output-side supply voltage	V_{CC2}	-0.3 to +25.0(Note 4)	V
INA, INB, ENA pin input voltage	V_{IN}	-0.3 to +VCC1+0.3 or +7.0(Note 3)	V
FLT pin input voltage	V_{FLT}	-0.3 to +VCC1+0.3 or +7.0(Note 3)	V
FLTRLS pin input voltage	V_{FLTRLS}	-0.3 to +VCC1+0.3 or +7.0(Note 3)	V
VTSIN pin input voltage	V_{VTSIN}	-0.3 to +7.0(Note 4)	V
SCPIN pin input voltage	V_{SCPIN}	-0.3 to +VCC2+0.3V or +25.0(Note 4)	V
VTSTH pin input voltage	V_{VTSTH}	-0.3 to +7.0(Note 4)	V
SCPTH pin input voltage	V_{SCPTH}	-0.3 to +VCC2+0.3V or +25.0(Note 4)	V
OUT1, PROOUT pin output current (Peak 10us)	$I_{OUT1PEAK}$	5.0(Note 5)	A
OUT2 pin output current (Peak 10us)	$I_{OUT2PEAK}$	1.0(Note 5)	A
FLT output current	I_{FLT}	10	mA
Power dissipation	P_d	1.19(Note 6)	W
Operating temperature range	T_{opr}	-40 to +125	°C
Storage temperature range	T_{stg}	-55 to +150	°C
Junction temperature	T_{jmax}	+150	°C

(Note 3) Relative to GND1.
(Note 4) Relative to GND2.
(Note 5) Should not exceed Pd and Tj=150°C.
(Note 6) Derate above Ta=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(Note 7)	V_{CC1}	4.5	5.5	V
Output-side positive supply voltage(Note 8)	V_{CC2}	14.0	20.0	V
Short current detection common mode input voltage	V_{SCCM}	0.0	2.5	V
Thermal detection common mode input voltage	V_{TSCM}	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_{IO}=500V)	R_S	$>10^9$	Ω
Insulation Withstand Voltage / 1min	V_{ISO}	2500	Vrms
Insulation Test Voltage / 1sec	V_{ISO}	3000	Vrms

Electrical characteristics

（Unless otherwise specified T_a=-40°C to 125°C, V_{CC1}=4.5V to 5.5V, V_{CC2}=14V to 20V）

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
General						
Input side circuit current 1	I_{CC11}	0.10	0.35	0.60	mA	OUT1=L
Input side circuit current 2	I_{CC12}	0.10	0.35	0.60	mA	OUT1=H
Input side circuit current 3	I_{CC13}	1.1	1.9	2.7	mA	INA =10kHz, Duty=50%
Input side circuit current 4	I_{CC14}	2.0	3.4	4.8	mA	INA =20kHz, Duty=50%
Output side circuit current 1	I_{CC25}	1.6	2.6	3.6	mA	OUT1=L
Output side circuit current 2	I_{CC26}	1.0	1.7	2.4	mA	OUT1=H
Logic block						
Logic high level input voltage	V_{INH}	$0.7 \times V_{CC1}$	-	V_{CC1}	V	INA, INB, ENA, FLT
Logic low level input voltage	V_{INL}	0	-	$0.3 \times V_{CC1}$	V	INA, INB, ENA, FLT
Logic pull-down resistance	R_{IND}	25	50	100	kΩ	INA, INB, ENA
Logic input minimum pulse width	t_{INMin}	-	-	100	ns	INA, INB
ENA, FLT mask time	t_{FLTMSK}	4	10	20	µs	ENA, FLT
Output						
OUT1 ON resistance (Source)	R_{ONH}	0.7	1.8	4.0	Ω	I_{OUT1}=40mA
OUT1 ON resistance (Sink)	R_{ONL}	0.4	0.9	2.0	Ω	I_{OUT1}=40mA
OUT1 maximum current	$I_{OUT1MAX}$	3.0	4.5	-	A	VCC2=15V, design assurance
PROOUT ON resistance	R_{ONPRO}	0.4	0.9	2.0	Ω	I_{PROOUT}=40mA
Turn ON time	t_{PON}	100	150	200	ns	No load between OUT1-GND2
Turn OFF time	t_{POFF}	100	150	200	ns	No load between OUT1-GND2
Propagation distortion	t_{PDIST}	-20	0	20	ns	t_{POFF} - t_{PON}
Rise time	t_{RISE}	-	50	-	ns	10nFbetween OUT1-GND2
Fall time	t_{FALL}	-	50	-	ns	10nFbetween OUT1-GND2
OUT2 ON resistance (Source)	R_{ON2H}	5	10	20	Ω	I_{OUT2}=40mA
OUT2 ON resistance (Sink)	R_{ON2L}	1.7	3.5	7	Ω	I_{OUT2}=40mA
OUT2 ON threshold	V_{OUT2ON}	1.8	2	2.2	V	
OUT2 output delay time	t_{OUT2ON}	-	40	80	ns	
Common Mode Transient Immunity	CM	100	-	-	kV/µs	design assurance
Protection functions						
Input-side UVLO OFF voltage	V_{UVLO1H}	4.05	4.25	4.45	V	
Input-side UVLO ON voltage	V_{UVLO1L}	3.95	4.15	4.35	V	
Input-side UVLO mask time	$t_{UVLO1MSK}$	2	10	30	µs	
Output-side UVLO OFF voltage	V_{UVLO2H}	11.5	12.5	13.5	V	
Output-side UVLO ON voltage	V_{UVLO2L}	10.5	11.5	12.5	V	
Output-side UVLO mask time	$t_{UVLO2MSK}$	4	10	30	µs	
Short current detection offset voltage	V_{SCDET}	-3.25	1.00	5.25	mV	
Short current detection mask time	t_{SCPMSK}	2.1	3.0	3.9	µs	
SCPIN Input voltage	V_{SCPIN}	-	0.25	0.55	V	I_{SCPIN}=1mA
Soft turn OFF release time	t_{STO}	30		110	µs	
Thermal detection offset voltage	V_{TSDET}	-5.50	-1.25	3.00	mV	
Thermal detection mask time	t_{TSMSK}	4	10	30	µs	
FLT output low voltage	V_{FLTL}	-	0.18	0.40	V	I_{FLT}=5mA
FLTRLS threshold	$V_{TFLTRLS}$	$0.64 \times V_{CC1}$ -0.1	$0.64 \times V_{CC1}$	$0.64 \times V_{CC1}$ +0.1	V	

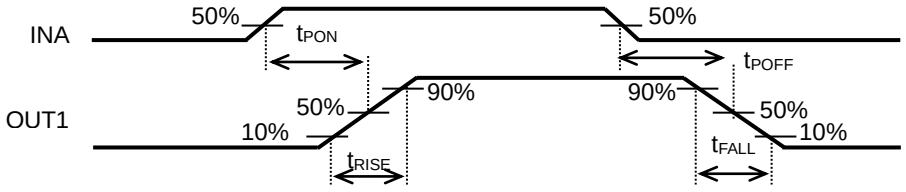


Figure 15. INA-OUT1 Timing Chart

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	℃	
Maximum Junction Temperature	150	℃	
Maximum Strage Temperature	150	℃	
Maximum Data Transmission Rate	2.5	MHz	

Typical Performance Curves

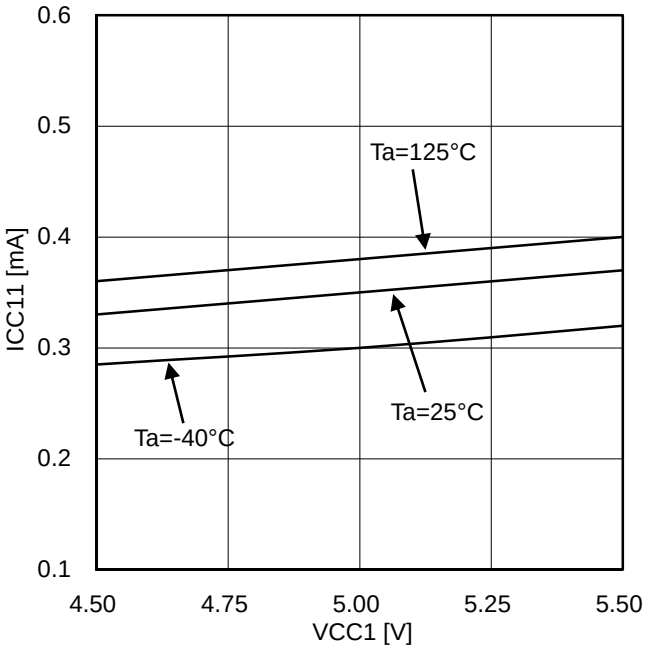


Figure 16. Input side circuit current (at OUT1=L)

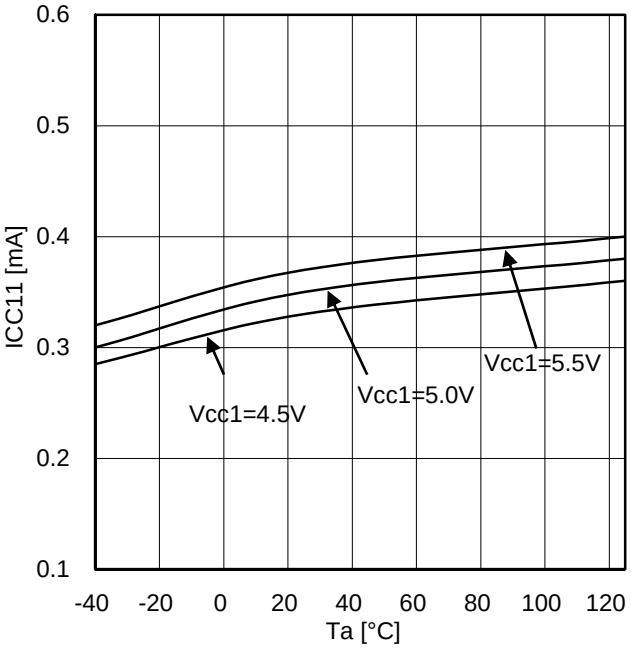


Figure 17. Input side circuit current (at OUT1=L)

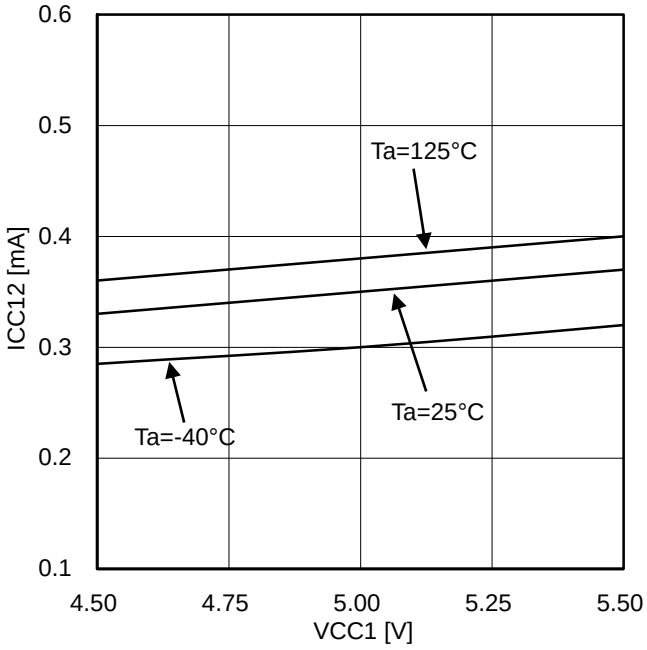


Figure 18. Input side circuit current (at OUT1=H)

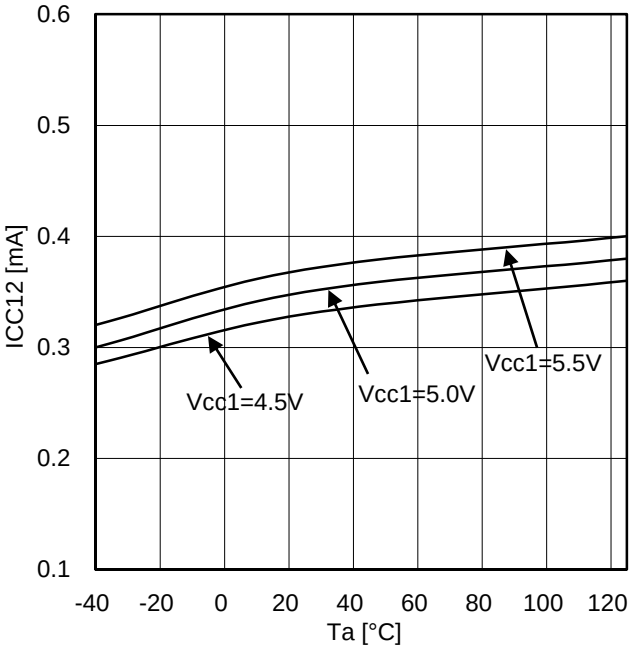


Figure 19. Input side circuit current (at OUT1=H)

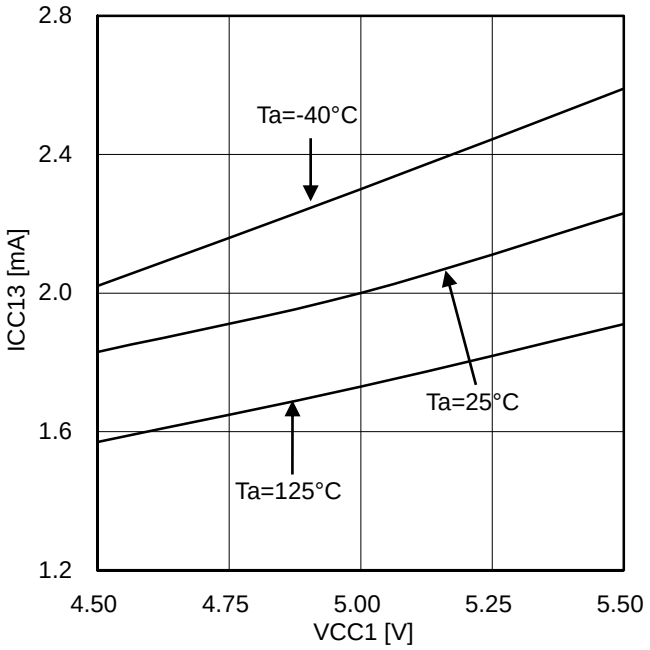


Figure 20. Input side circuit current
(at INA=10kHz and Duty=50%)

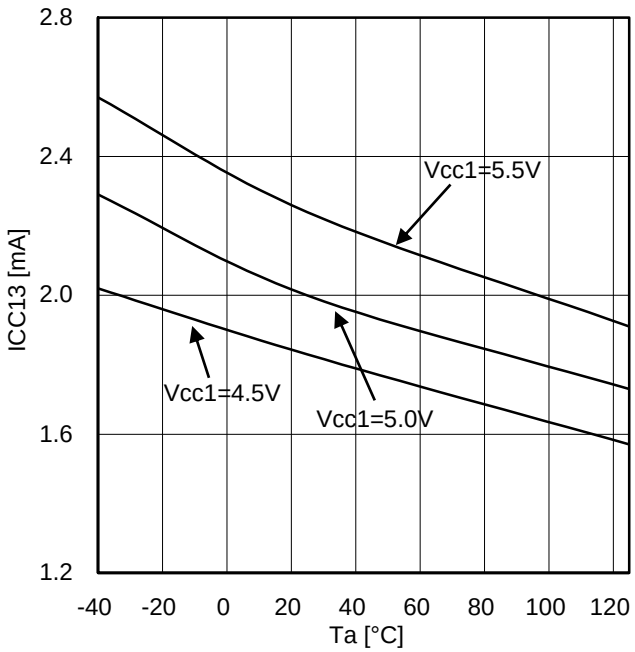


Figure 21. Input side circuit current
(at INA=10kHz and Duty=50%)

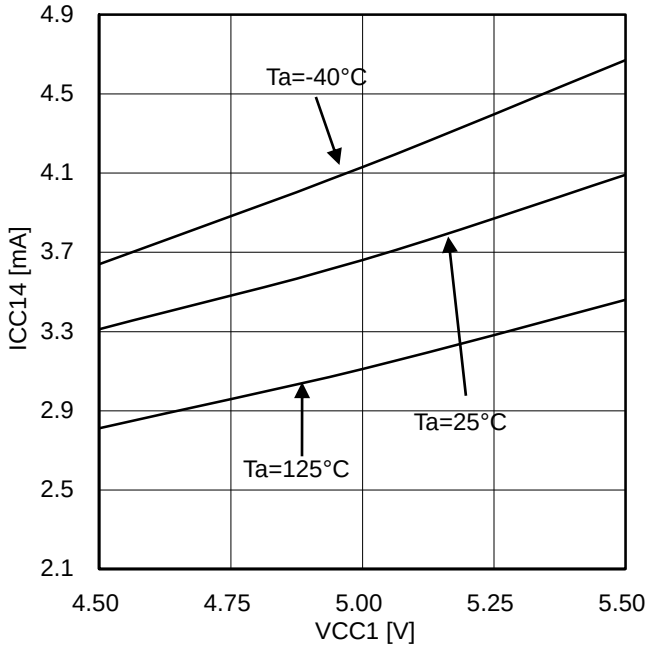


Figure 22. Input side circuit current
(at INA=20kHz and Duty=50%)

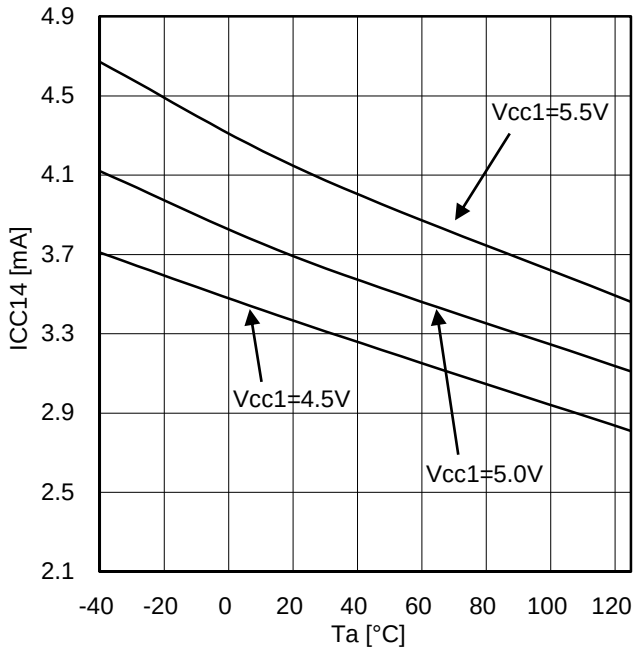


Figure 23. Input side circuit current
(at INA=20kHz and Duty=50%)

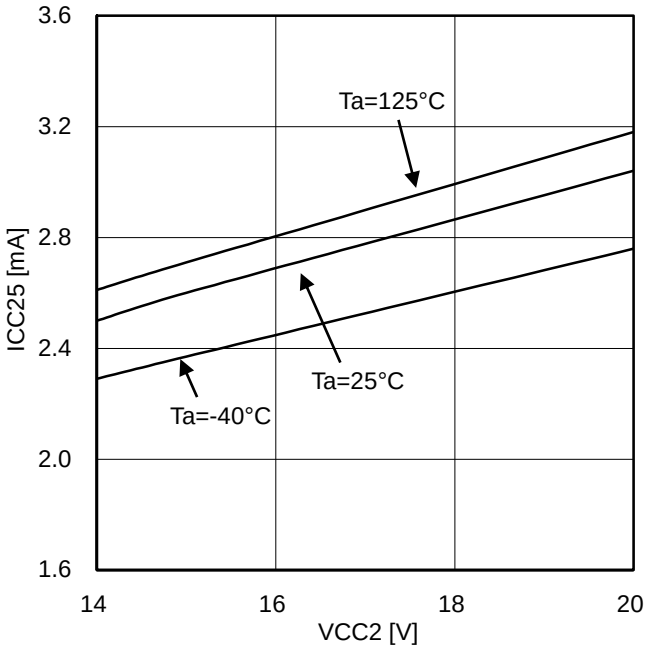


Figure 24. Output side circuit current (at OUT1=L)

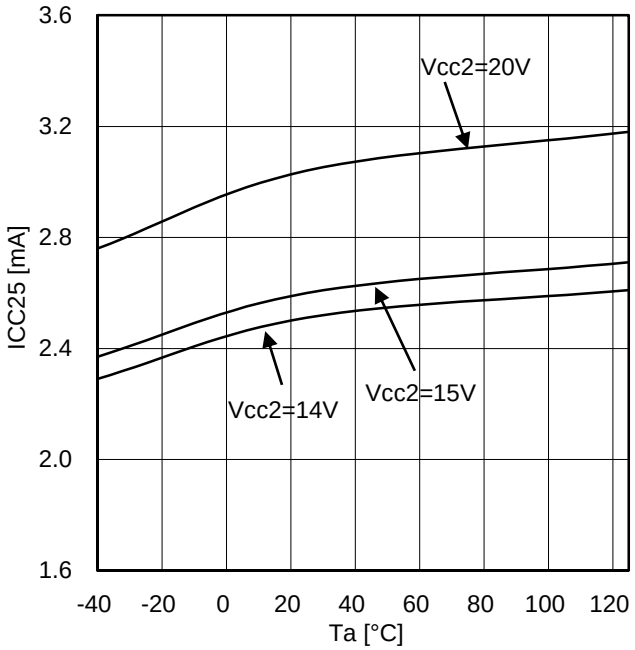


Figure 25. Output side circuit current (at OUT1=L)

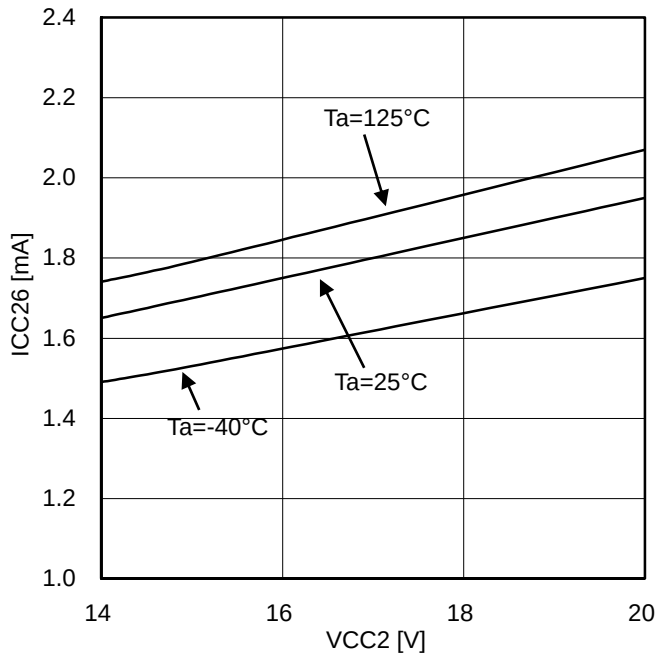


Figure 26. Output side circuit current (at OUT1=H)

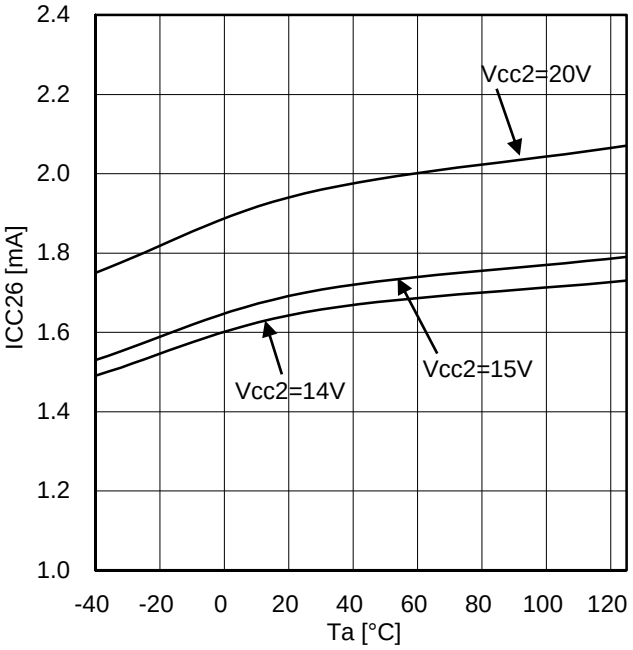


Figure 27. Output side circuit current (at OUT1=H)

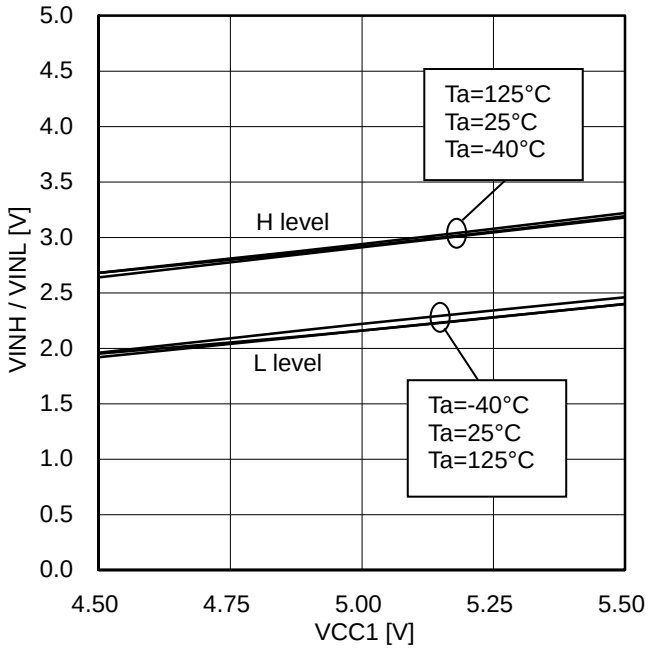


Figure 28. Logic (INA/INB) High/Low level input voltage

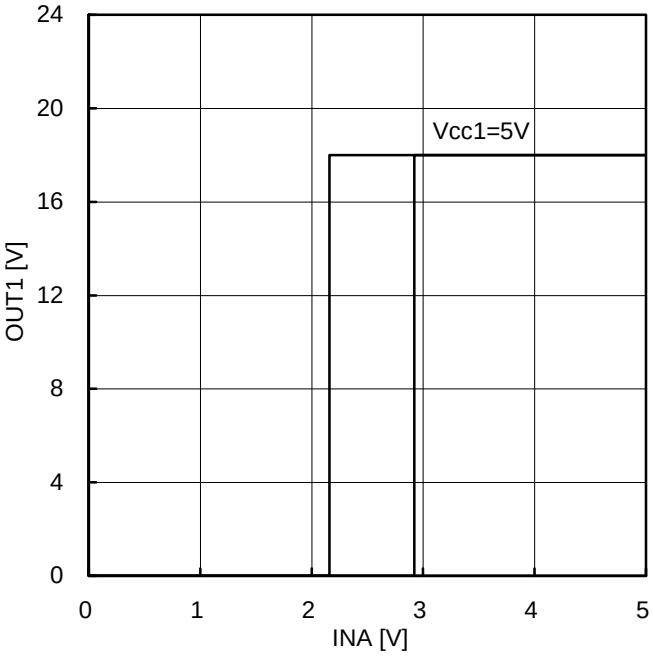


Figure 29. Logic (INA/INB) High/Low level input voltage at Ta=25°C

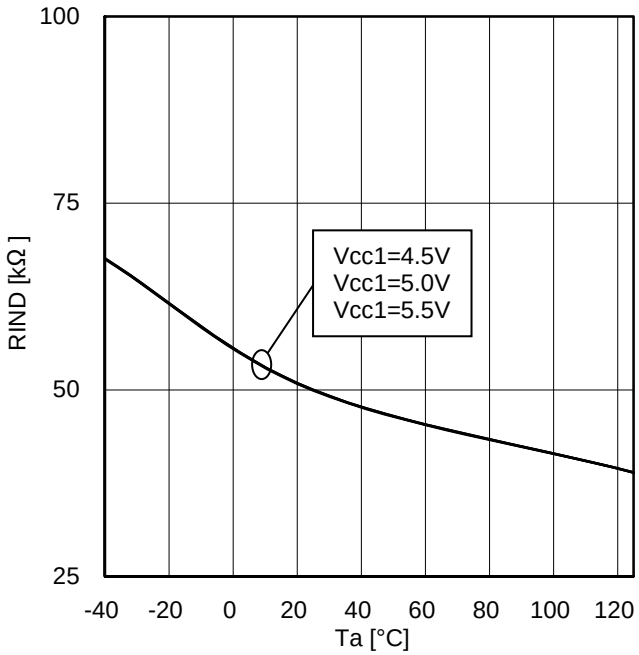


Figure 30. Logic pull-down resistance

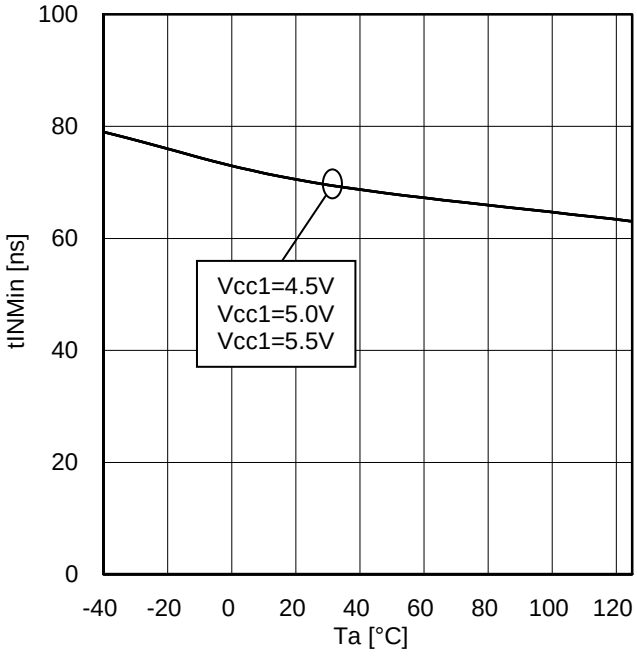


Figure 31. Logic input minimum pulse width（H pulse）

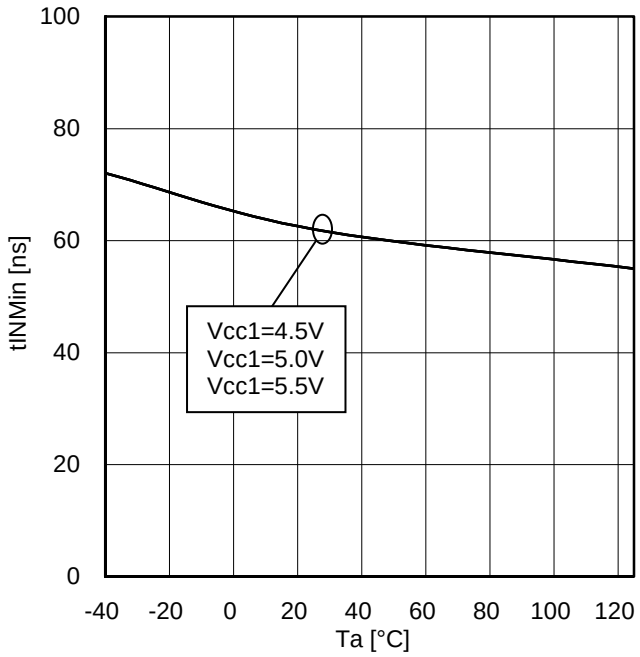


Figure 32. Logic input minimum pulse width（L pulse）

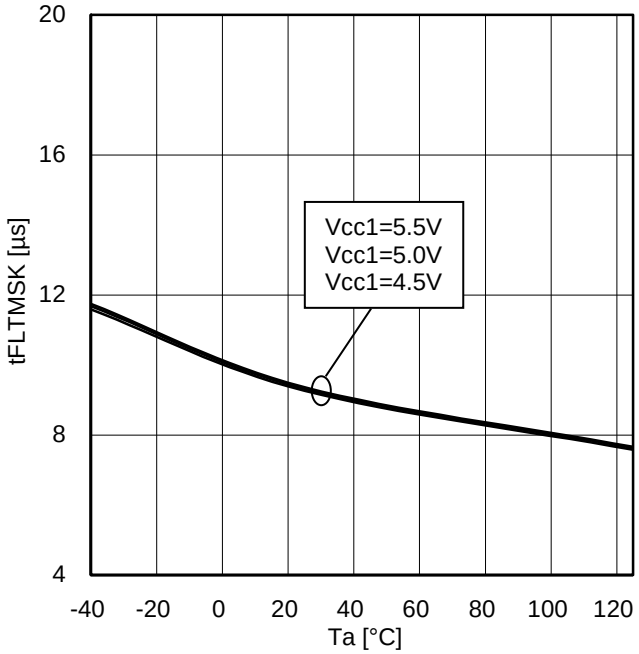


Figure 33. ENA input mask time

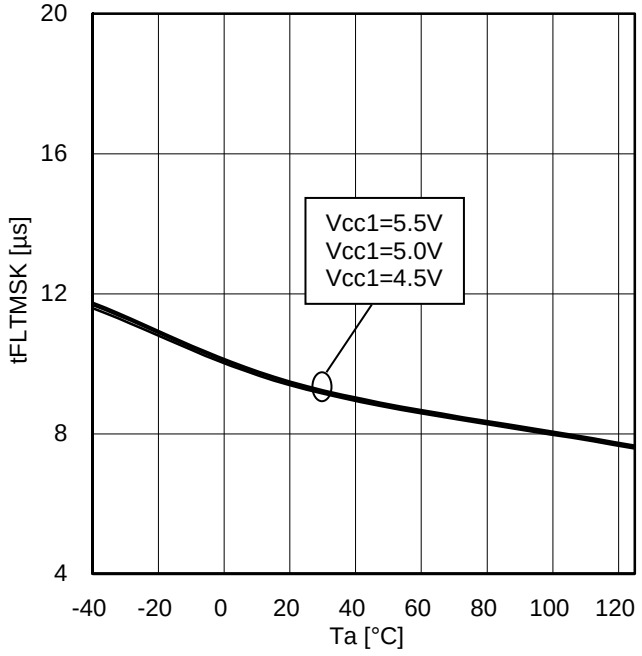


Figure 34. FLT input mask time

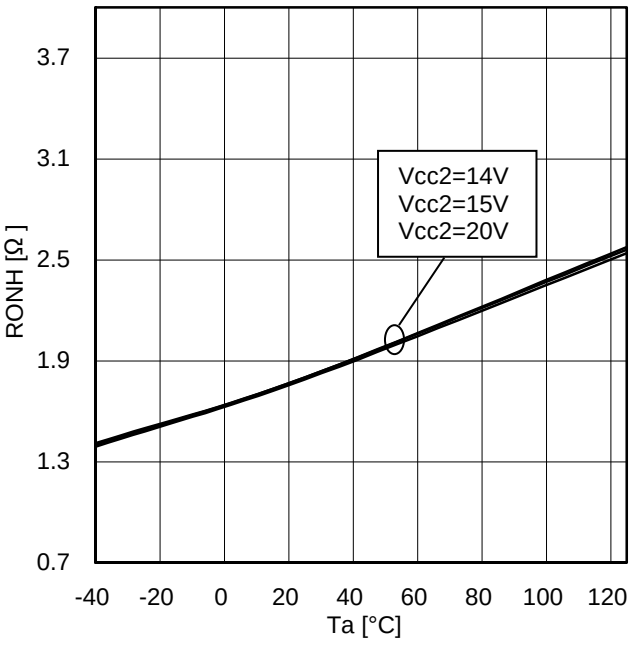


Figure 35. OUT1 ON resistance (Source)

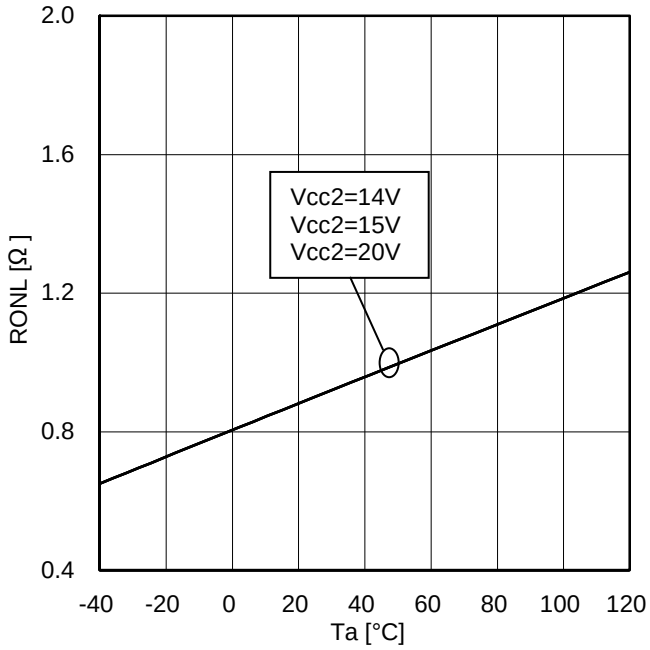


Figure 36. OUT1 ON resistance (Sink)

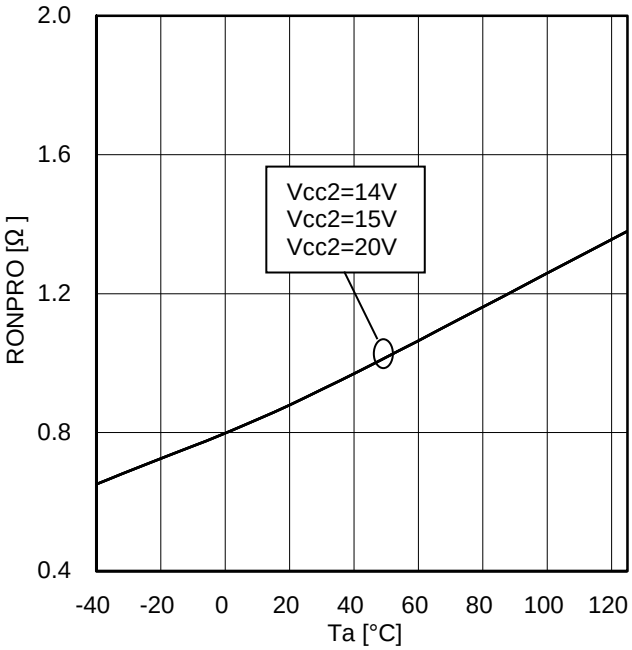


Figure 37. PROOUT ON resistance

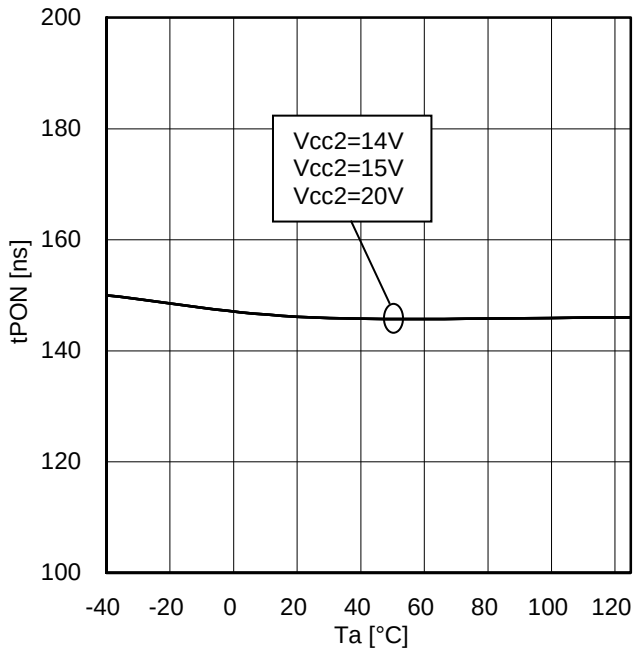


Figure 38. Turn ON time

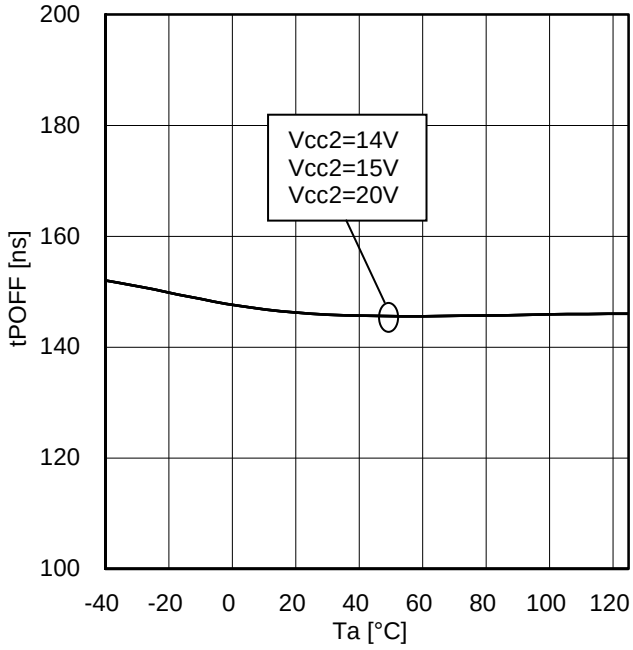


Figure 39. Turn OFF time

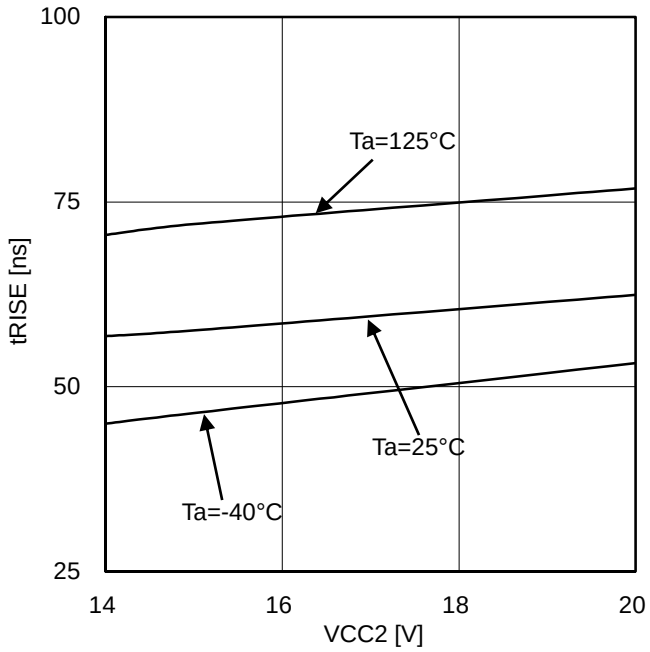


Figure 40. Rise time
(10000pF between OUT1-GND2)

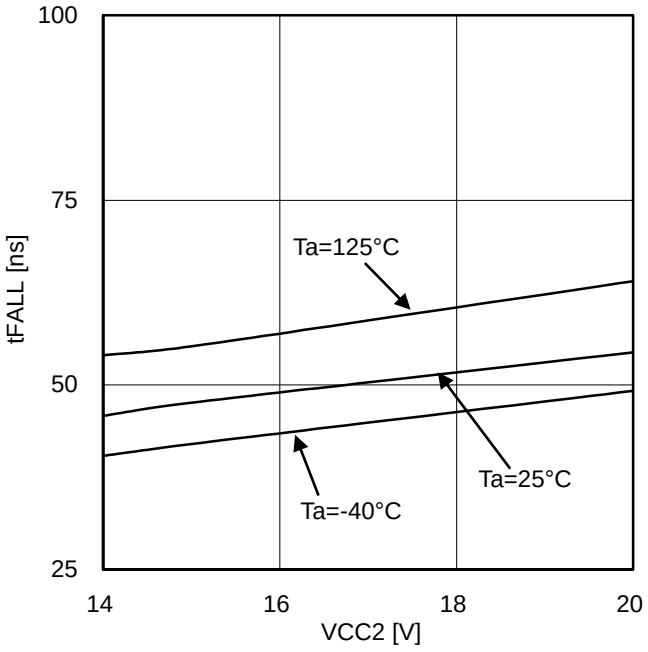


Figure 41. Fall time
(10000pF between OUT1-GND2)

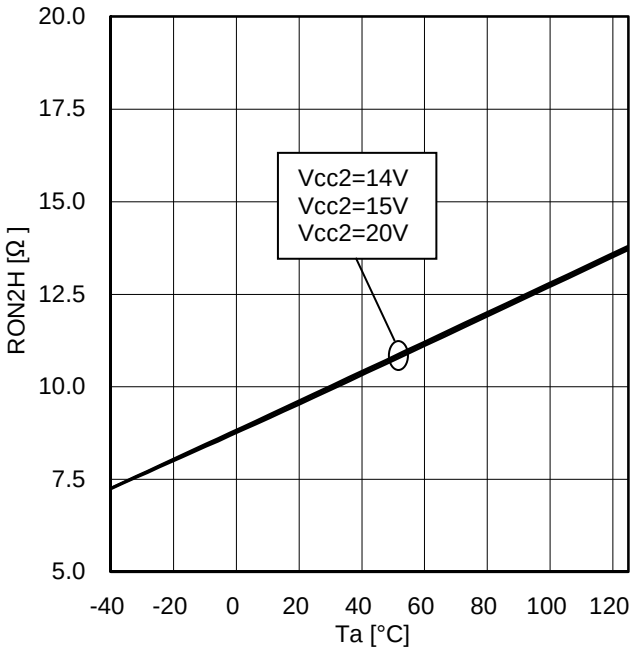


Figure 42. OUT2 ON resistance (Source)

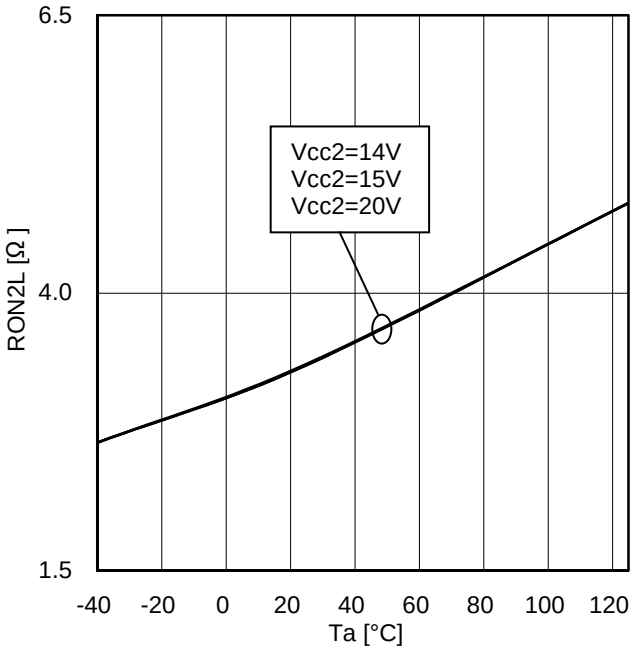


Figure 43. OUT2 ON resistance (Sink)

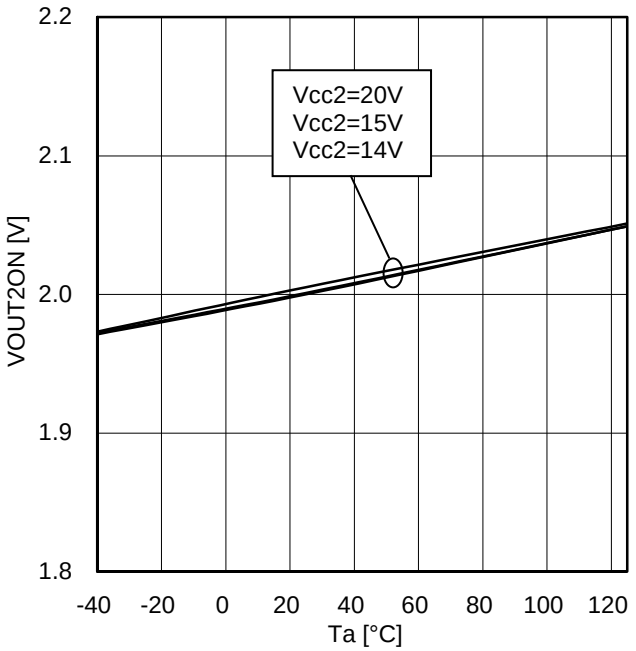


Figure 44. OUT2 ON threshold voltage

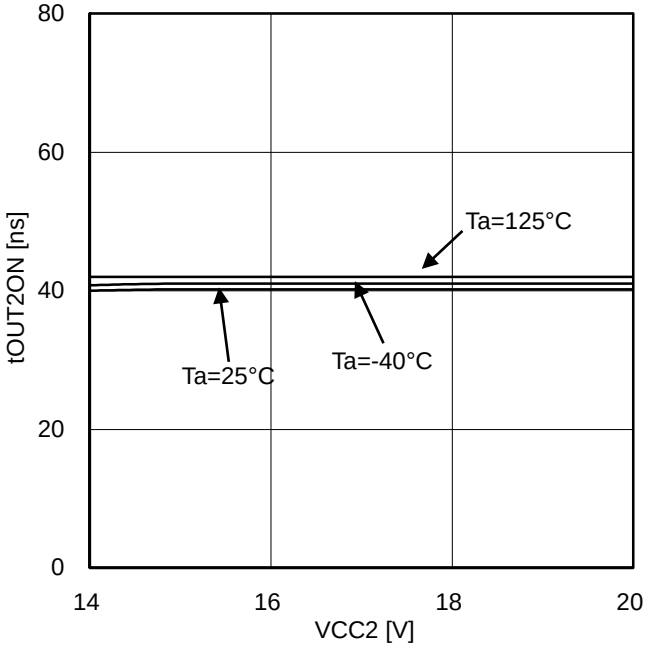


Figure 45. OUT2 output delay time

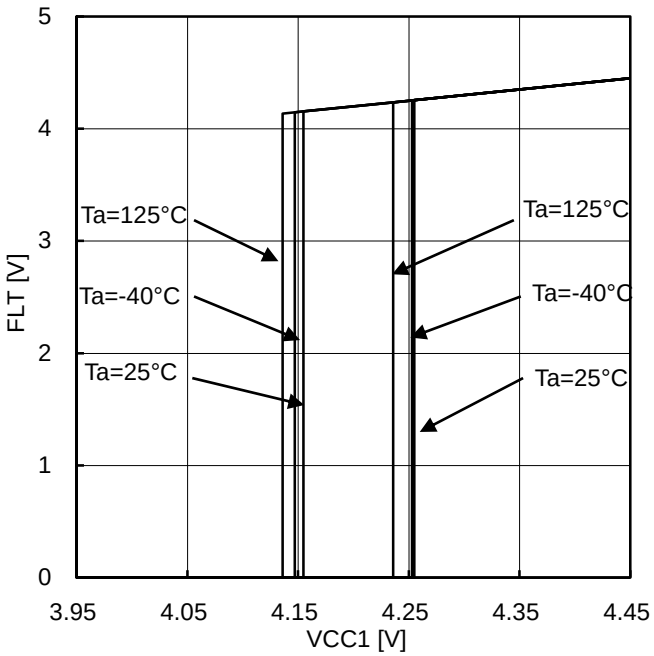


Figure 46. VCC1 UVLO ON/OFF voltage

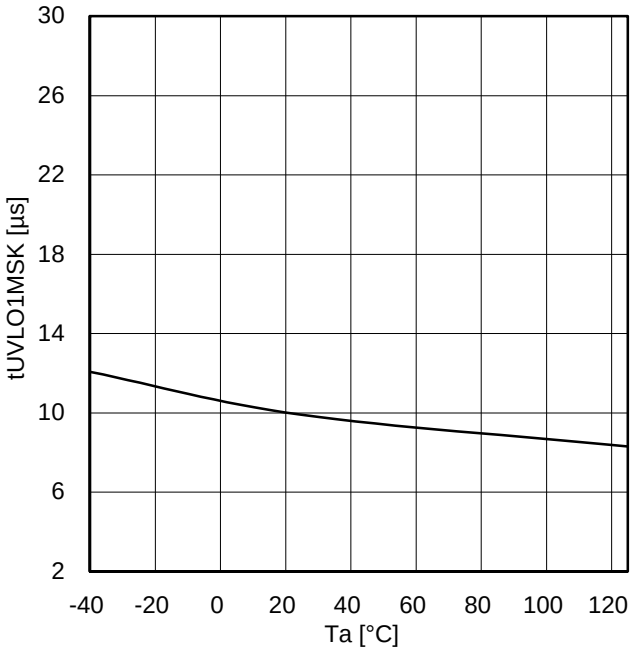


Figure 47. VCC1 UVLO mask time

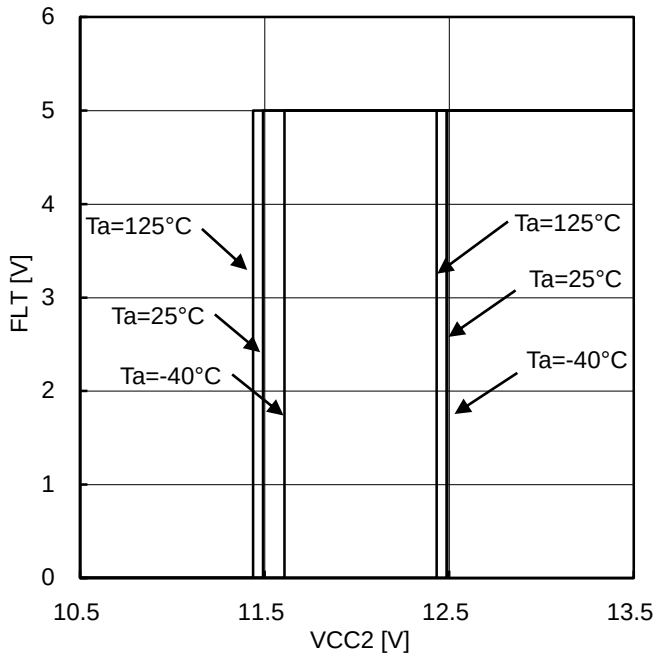


Figure 48. VCC2 UVLO ON/OFF voltage (at VCC1=5V)

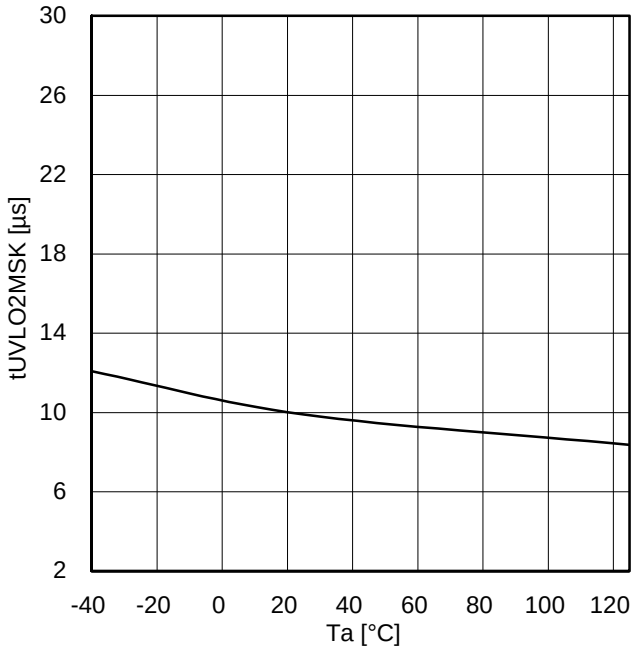


Figure 49. VCC2 UVLO mask time

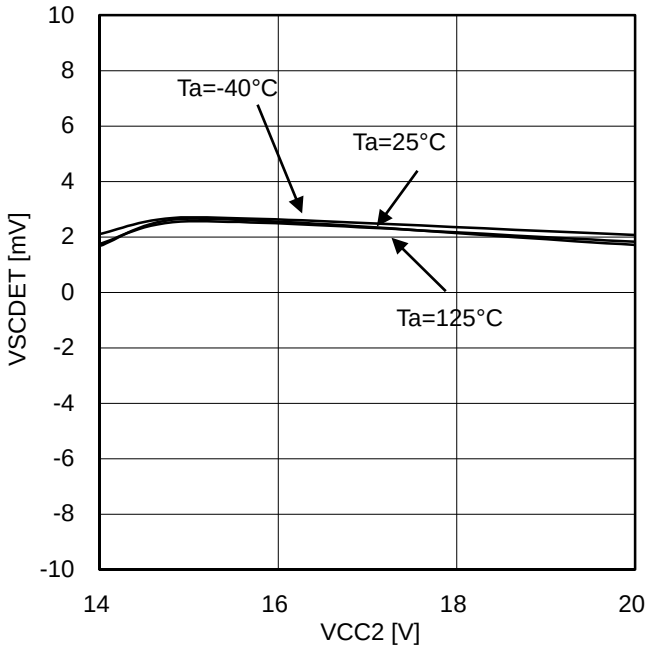


Figure 50. SCP offset voltage (at SCPTH=0.7V)

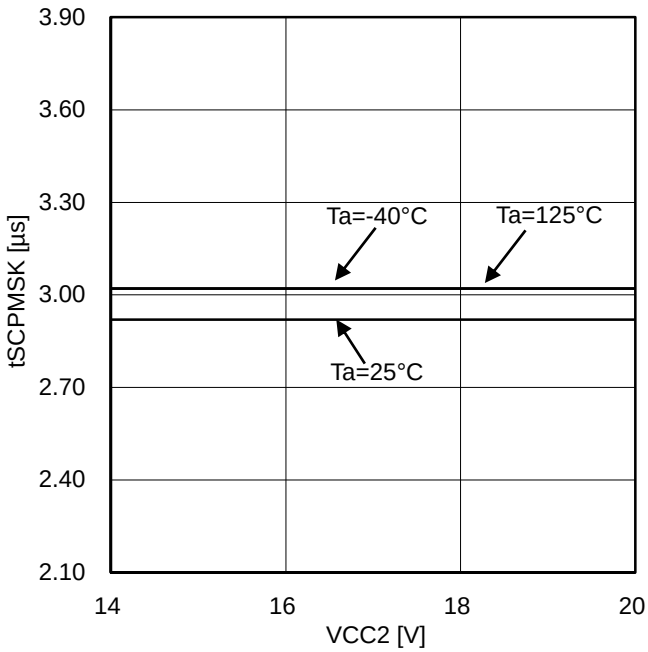


Figure 51. SCP detection mask time

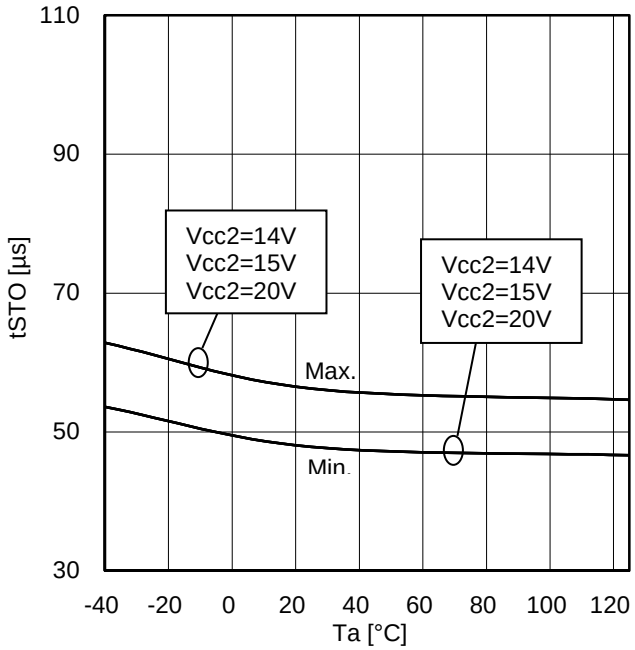


Figure 52. Soft turn OFF release time

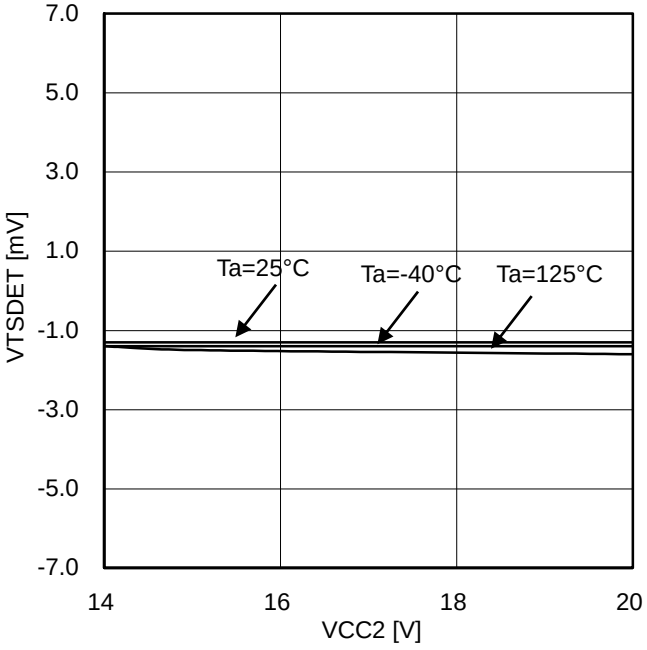


Figure 53. VTS offset voltage (at VTSTH=1.7V)

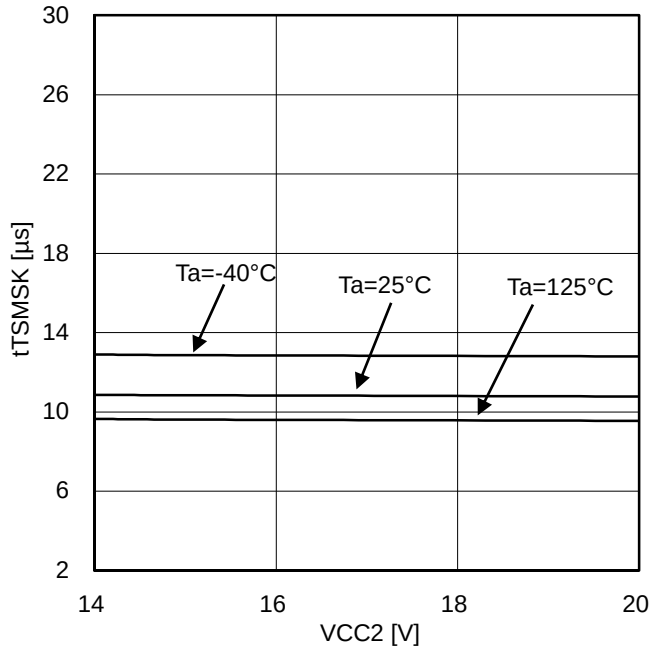


Figure 54. Thermal detection mask time

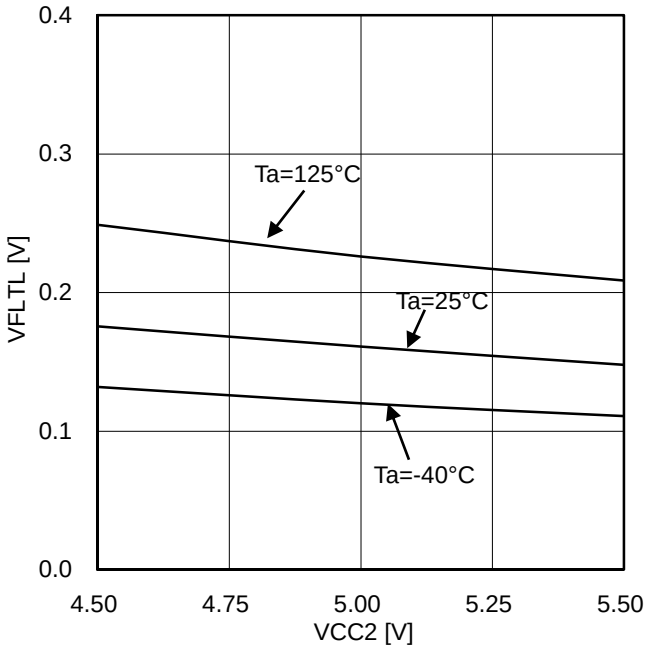


Figure 55. FLT output low voltage (IFLT=5mA)

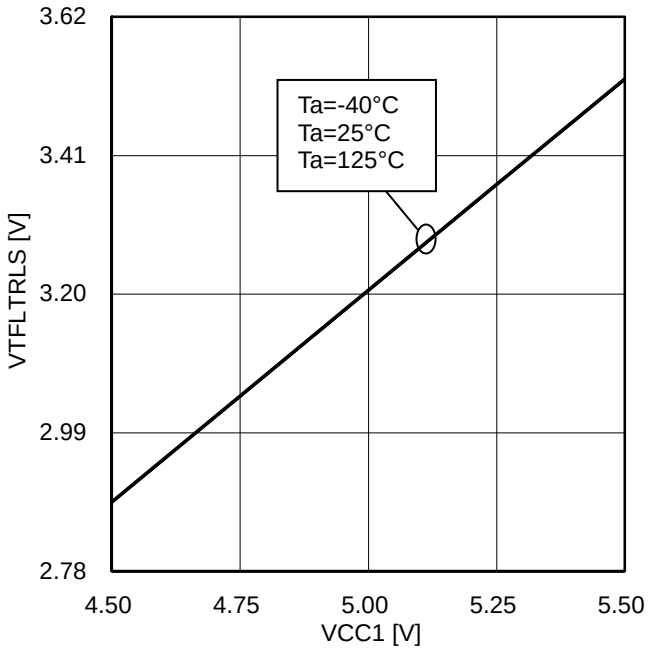


Figure 56. FLTRLS threshold

Selection of Components Externally Connected

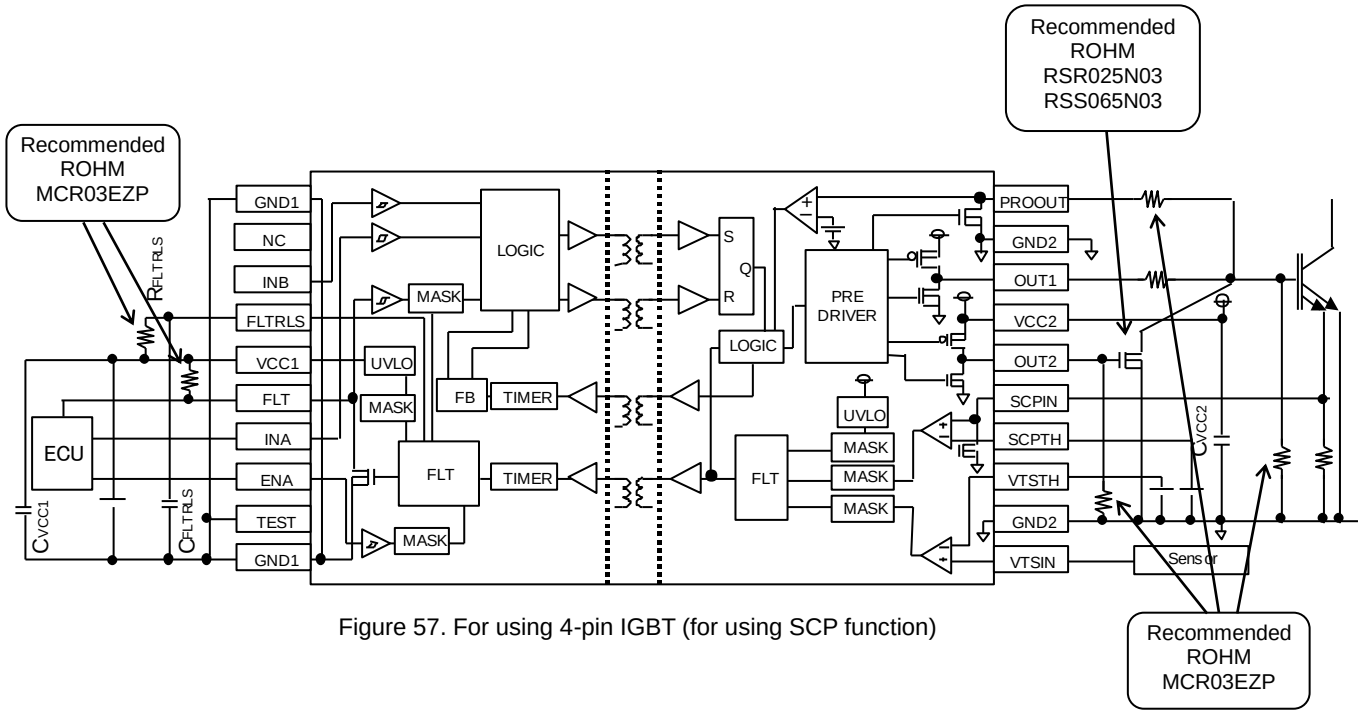


Figure 57. For using 4-pin IGBT (for using SCP function)

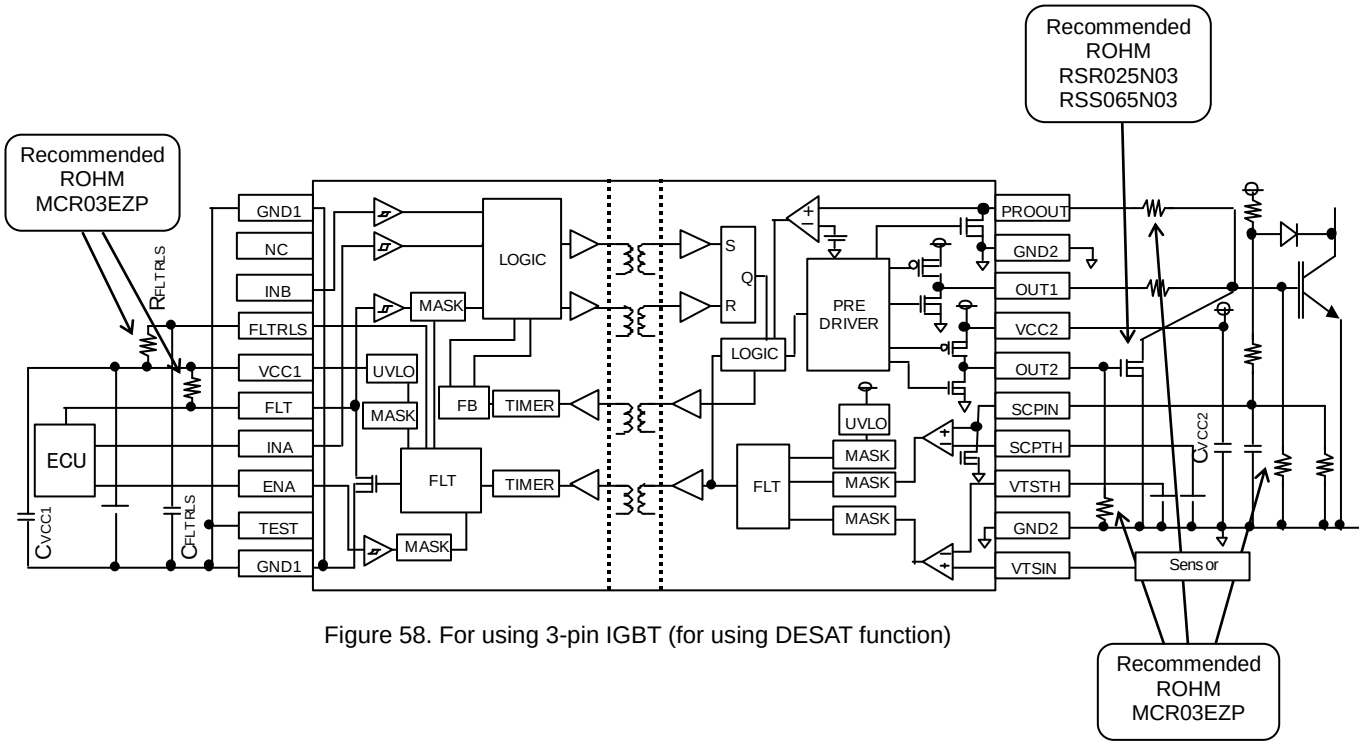
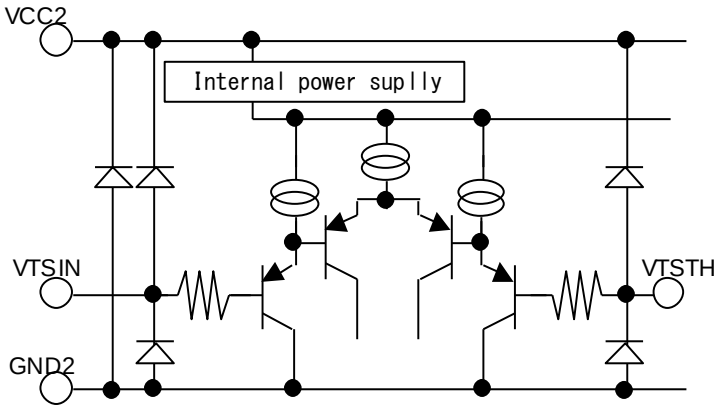
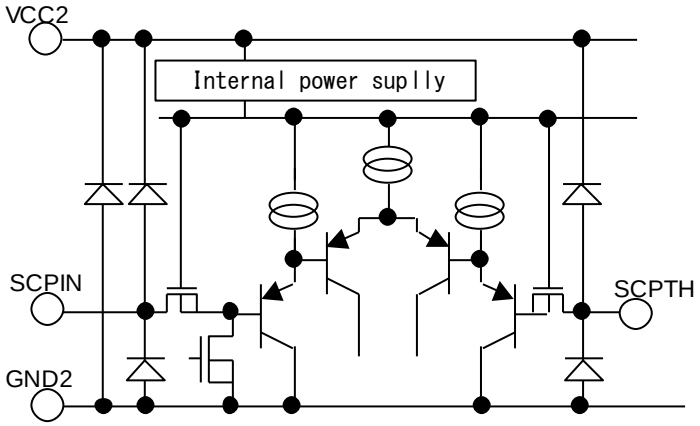
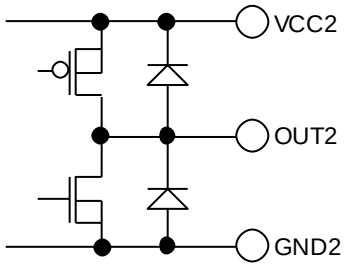
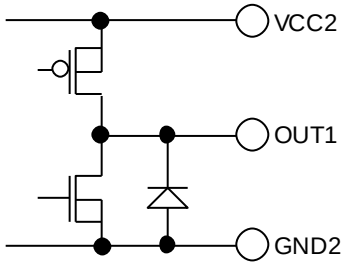
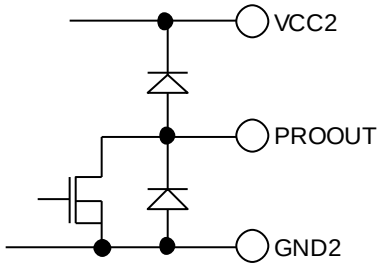
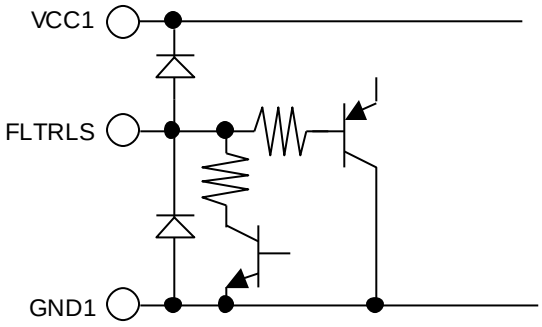
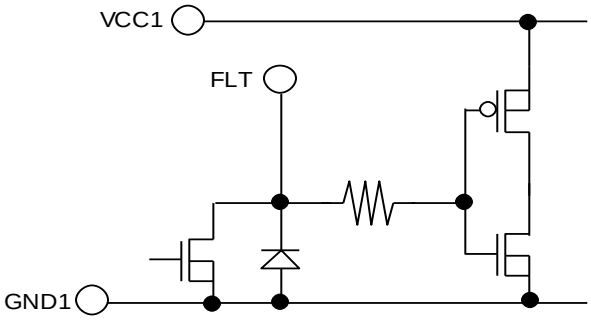
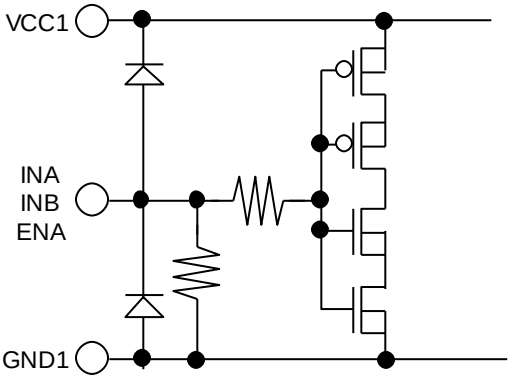
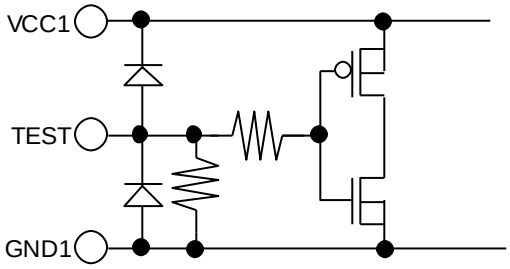


Figure 58. For using 3-pin IGBT (for using DESAT function)

I/O equivalence circuits

Pin No.	Name / Function	I/O equivalence circuits
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 / Function	I/O equivalence circuits
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

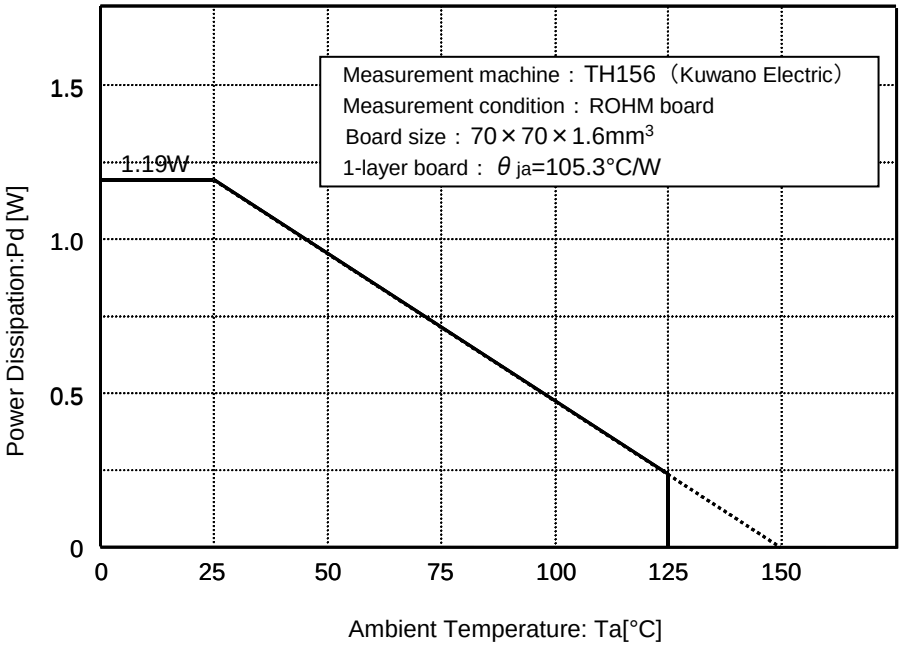


Figure 59. SSOP-B20W Derating Curve

Thermal design

Please confirm that the IC's chip temperature Tj is not over 150°C, while considering the IC's power consumption (W), package power (Pd) and ambient temperature (Ta). When Tj=150°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. Tjmax=150°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+ 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.

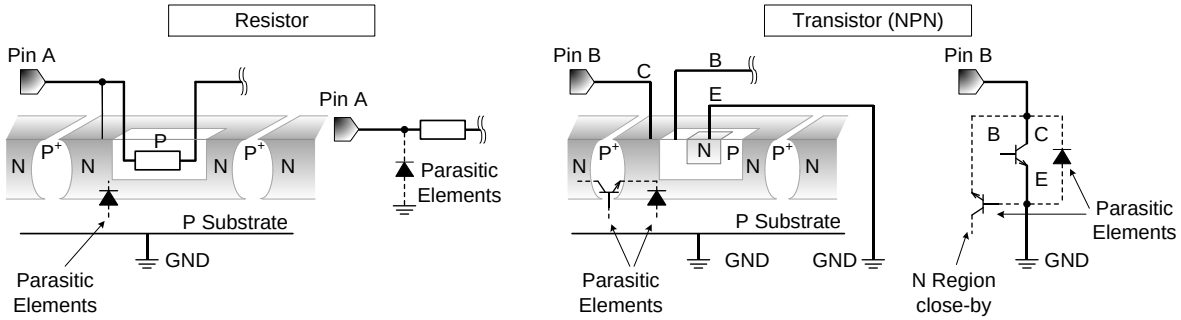


Figure 60. Example of monolithic IC structure

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

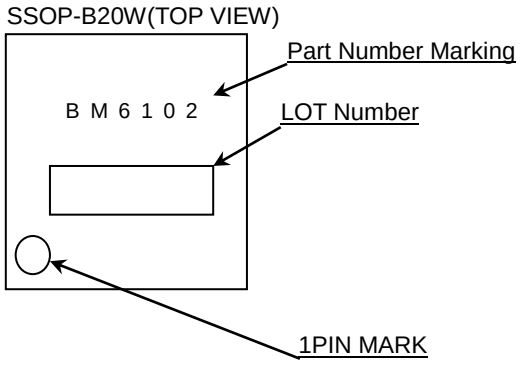
B M 6 1 0 2 F V - CE 2

Part Number

Package
FV: SSOP-B20W

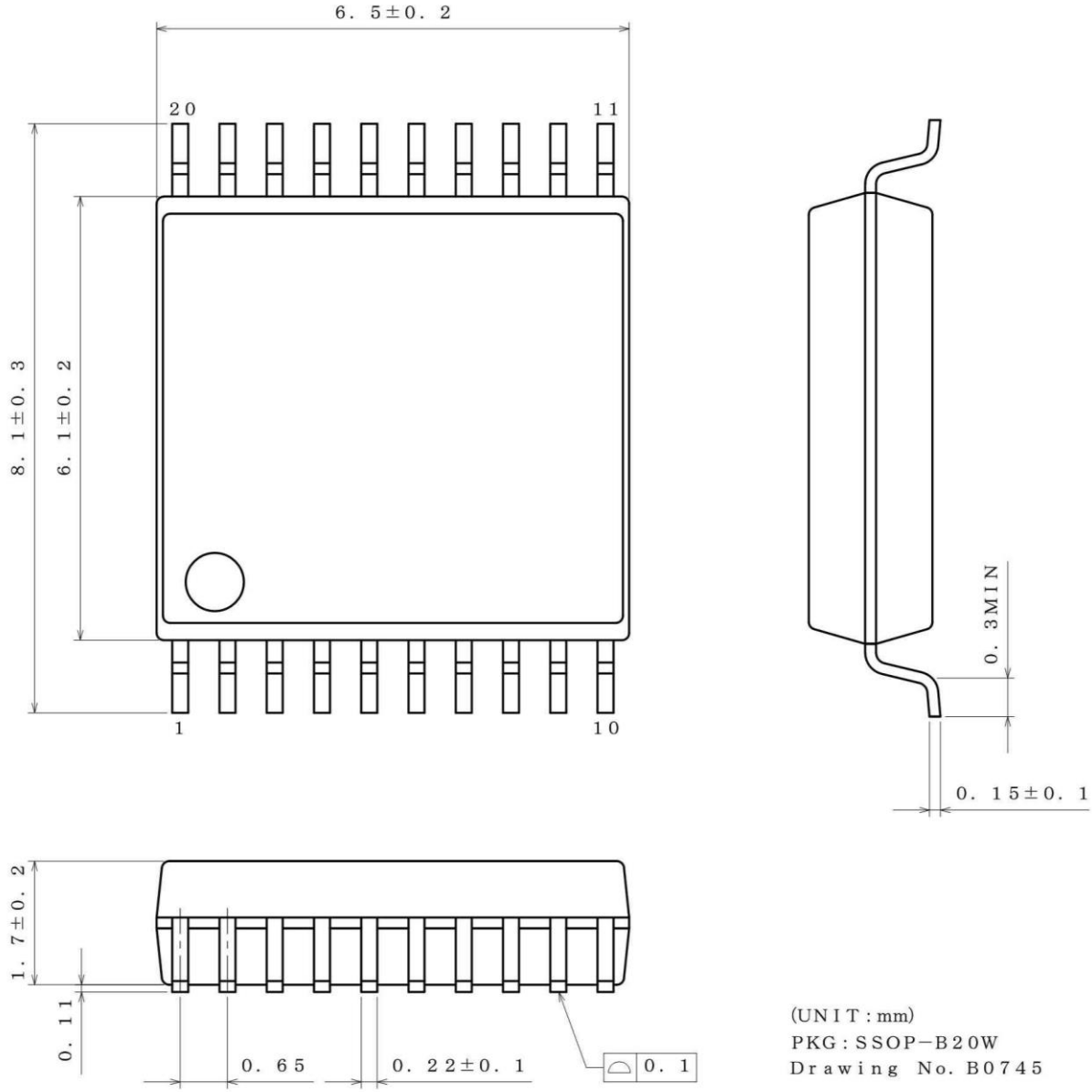
Rank
C:Automotive
Packaging and forming specification
E2: Embossed tape and reel

Marking Diagram



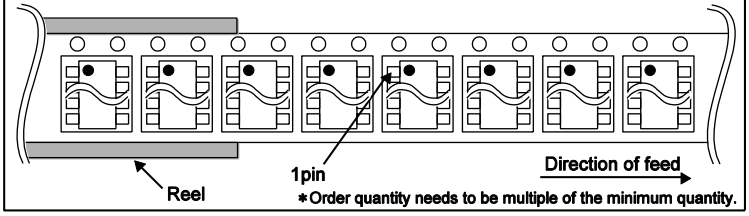
Physical Dimension, Tape and Reel Information

Package Name	SSOP-B20W



<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2000pcs
Direction of feed	E2 (The direction is the 1pin 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)



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

Revision History

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

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 (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 Cl2, H2S, NH3, SO2, and NO2
   [b] the temperature or humidity exceeds those recommended by ROHM
   [c] the Products are exposed to direct sunshine or condensation
   [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

A two-dimensional barcode printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

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

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