Fully Integrated H-bridge Motor Driver

Features

- Operating voltage: 4 to 28 V, 40 V abs. max
- Output current: 12 A
- $R_{DS(on)}$: 100 mΩ typ per half bridge
- 3 V CMOS-compatible inputs
- PWM operation up to 20 kHz
- Very low standby current, 1.5 μA max at 25°C
- Protections:
  - Cross-conduction protection
  - Overvoltage clamp
  - Undervoltage shutdown
  - Current limitation
  - Power limitation
  - Thermal shutdown
  - Output short to ground and short to V_{CC}
  - Loss of ground and loss of V_{CC}
- CS diagnostic functions:
  - Analog motor current feedback
  - OFF-state open load detection
  - Output short to ground detection
  - Output short to VCC detection
  - Thermal shutdown indication
- Flexibility of use as full bridge, dual half bridge and multi-motor driving configuration

Package Information

Part Number	Package
DIO57100	SOP16

Applications

- ePOS and currency counters
- ATMs (automated teller machines)
- Printers
- Factory automation
- Robotics
- Adjustable desks, beds and windows
- Vending machine
- Electric massage chair

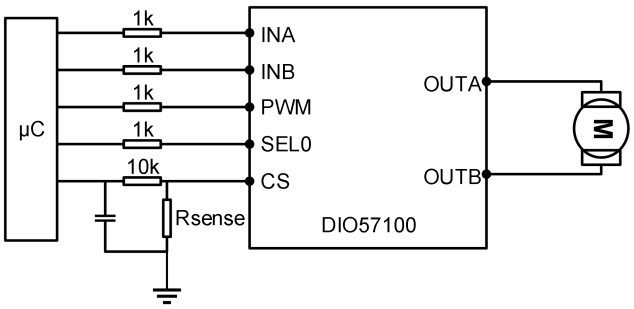
Description

The device is a fully integrated H-bridge motor driver intended for a wide range applications. The design of monolithic die in a power package offers better robustness and higher reliability.

The direction and brake operation of the motor are simply controlled by applying digital signals to the INA and INB.

The CS pin allows to monitor the motor current by delivering a current proportional to the motor current value, and it also develops a voltage flag for a failure on the relevant output in the ON state as well as the OFF state. The independent PWM pin, up to 20 kHz, allows to control the speed of the motor easily in all possible conditions. In all cases, a low level state on the PWM pin turns off both the LSA and LSB switches.

Simplified Schematic



Ordering Information

Ordering Part No.	Top Marking	MSL	RoHS	T_A	Package	
DIO57100SO16	DIOEGKV	3	Green	-40 to 125°C	SOP16	Tape & Reel, 2500

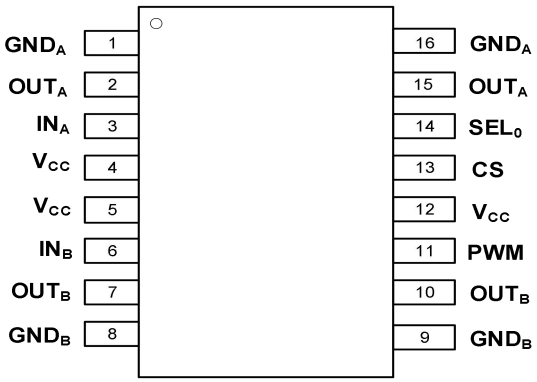
If you encounter any issue in the process of using the device, please contact our customer service at marketing@dioo.com or phone us at (+86)-21-62116882. If you have any improvement suggestions regarding the datasheet, we encourage you to contact our technical writing team at docs@dioo.com. Your feedback is invaluable for us to provide a better user experience.

Table of Contents

List of Figures

List of Tables

1. Pin Assignment and Functions



SOP16 (Top view)

Pin No.	Name	I/O	Description
1, 16	GND_A	GND	Source of low-side switch A.
2, 15	OUT_A	O	Source of high-side switch A / drain of low-side switch A.
3	IN_A	I	Clockwise input.
4, 5, 12	V_{CC}	Power	Power supply voltage.
6	IN_B	I	Counter clockwise input.
7, 10	OUT_B	O	Source of high-side switch B / drain of low-side switch B.
8, 9	GND_B	GND	Source of low-side switch B.
11	PWM	I	Voltage controlled input pin with hysteresis, CMOS compatible. Gates of low-side FETS get modulated by the PWM signal during their on phase allowing speed control of the motor. Active high.
13	CS	O	Multiplexed analog sense output pin. Delivers a current proportional to the motor current.
14	SEL_0	I	In combination with IN_A, INB, the pin addresses the current-sense information that is available to the microcontroller according to the operative truth table. Active high and compatible with 3 V and 5 V CMOS outputs pin.

2. Absolute Maximum Ratings

Exceeding the maximum ratings listed under Absolute Maximum Ratings when designing is likely to damage the device permanently. Do not design to the maximum limits because long-time exposure to them might impact the device's reliability. The ratings are obtained over an operating free-air temperature range unless otherwise specified.

Symbol	Parameter	Rating	Unit
V_{CC}	Supply voltage	40	V
$-V_{CC}$	Reverse DC supply voltage	0.3	V
I_{max}	Maximum output current (continuous)	Internally limited	A
I_R	Reverse output current	-15	A
V_{CCPK}	Maximum transient supply voltage	40	V
V_{CCJS}	Maximum jump-start voltage for single pulse short-circuit protection	28	V
I_{IN}	Input current (IN_A and IN_B pins)	-1 to 10	mA
I_{SEL0}	SEL_0 pin DC input current	-1 to 10	mA
I_{PWM}	PWM input current	-1 to 10	mA
I_{SENSE}	DC output current on the current sense pin (V_{GND} = V_{CC} and V_{SENSE} < 0 V)	10	mA
I_{SENSE}	DC output current in reverse on the current sense pin (V_{CC} < 0 V)	-18	mA
T_J	Junction operating temperature	-40 to 150	°C
T_{STG}	Storage temperature	-55 to 150	°C

3. Recommended Operating Conditions

Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. The ratings are obtained over an operating free-air temperature range unless otherwise specified.

Symbol	Parameter	Rating	Unit
V_{CC}	Supply voltage	4 to 28	V

4. ESD Ratings

When a statically-charged person or object touches an electrostatic discharge sensitive device, the electrostatic charge might be drained through sensitive circuitry in the device. If the electrostatic discharge possesses sufficient energy, damage might occur to the device due to localized overheating.

Model	Condition		Value	Unit
Human-body model	ANSI/ESDA/JEDEC JS-001	IN_A, IN_B, PWM	±4000	V
		SEL_0	±4000	
		CS	±4000	
		V_{CC}	±4000	
		Output	±4000	
Charge-device model	JEDEC/JESD22-C101		±2000	V

5. Thermal Considerations

The thermal resistance determines the heat insulation property of a material. The higher the thermal resistance is, the lower the heat loss. Accumulation of heat energy degrades the performance of semiconductor components.

Symbol	Metric	Value	Unit
$R_{\theta JA}$	Junction-to-ambient thermal resistance	40	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	7.6	°C/W

6. Electrical Characteristics

6.1. General characteristics

The values are obtained under these conditions unless otherwise specified: V_{CC} = 7 V up to 28 V; -40°C < T_J < 150°C.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Power section						
V_{CC}	Operating supply voltage		4		28	V
I_S	Supply current	OFF-state (standby); IN_A = IN_B = 0; SEL_0 = 0; PWM = 0; V_{CC} = 13 V; T_J = 25°C;			1.5	µA
		OFF-state (standby); IN_A = IN_B = 0; SEL_0 = 0; PWM = 0; V_{CC} = 13 V; T_J = 85°C			2	µA
		OFF-state (standby) IN_A = IN_B = 0; SEL_0 = 0; PWM = 0; V_{CC} = 13 V; T_J = 125°C			3	µA
		OFF-state (no standby) IN_A = IN_B = 0; SEL_0 = 5 V; PWM = 0		2	4	mA
		ON-state: IN_A or IN_B = 5 V; PWM = 0 or PWM = 5; SEL_0 = X		3.5	6	mA
t_{D_STBY}	Standby mode blanking time	V_{CC} = 13 V; IN_A = IN_B = PMW = 0 V; V_{SEL0} from 5 V to 0 V	1	2.5	5.5	ms
R_{ONHS}(2)	Static high-side resistance	I_{OUT} = 2.5 A; T_J = 25°C		60		mΩ
		I_{OUT} = 2.5 A; T_J = -40 to 150°C			120	mΩ
R_{ONLS}(2)	Static low-side resistance	I_{OUT} = 2.5 A; T_J = 25°C		40		mΩ
		I_{OUT} = 2.5 A; T_J = -40°C to 150°C			80	mΩ
V_f(2)	Free-wheeling diode forward voltage	I_{OUT} = -2.5 A; T_J = 150°C		0.7	0.9	V
$I_{L(off)}$	OFF-state output current of one leg	IN_A = IN_B = 0; PWM = 0; V_{CC} = 13 V; T_J = 25 °C	0		0.5	µA
		IN_A = IN_B = 0; PWM = 0; V_{CC} = 13 V; T_J = 125 °C	0		3	µA
$I_{L(off\_h)}$	OFF-state output current of one leg with other HSD on	IN_A = 0; IN_B = 5 V; PWM = 0; V_{CC} = 13 V	20		60	µA
V_{IL}	Input low level voltage				0.9	V
V_{IH}	Input high level voltage		2.1			V
V_{IHYST}	Input hysteresis voltage		0.2			V
V_{ICL}	Input clamp voltage	I_{IN} = 0.5 mA	6		8	V
		I_{IN} = -1 mA		-0.7		V

I_{INL}	Input low level current	V_{IN} = 0.9 V	1			µA
I_{INH}	Input high level current	V_{IN} = 2.1 V			10	µA

SEL_0 (V_{CC} = 7 V up to 18 V; -40°C < T_J < 150°C)

V_{SELL}	Input low level voltage				0.9	V
I_{SELL}	Low level input current	V_{SEL} = 0.9 V	1			µA
V_{SELH}	Input high level voltage		2.1			V
I_{SELH}	High level input current	V_{SEL} = 2.1 V			10	µA
$V_{SEL(hyst)}$	Input hysteresis voltage		0.2			V
V_{SELCL}	Input clamp voltage	I_{SEL} = 0.5 mA	6		8	V
		I_{SEL} = -1 mA		-0.7		V

PWM (V_{CC} = 7 V up to 28 V; -40°C < T_J < 150°C)

V_{PWM}	Input low level voltage				0.9	V
I_{PWM}	Low level input current	V_{PWM} = 0.9 V	1			µA
V_{PWM}	Input high level voltage		2.1			V
I_{PWMH}	High level input current	V_{PWM} = 2.1 V			10	µA
$V_{PWM(hyst)}$	Input hysteresis voltage		0.2			V
V_{PMWCL}	Input clamp voltage	I_{PWM} = 0.5 mA	6		8	V
		I_{PWM} = -1 mA		-0.7		V

Note:

(1) Specifications subject to change without notice.

(2) Guaranteed by design.

6.2. Switching

The values are obtained under these conditions unless otherwise specified: V_{CC} = 13 V, R_{LOAD} = 5.2 Ω.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
f (1)	PWM frequency		0		20	kHz
$t_{d(on)}$(3)(6)	Turn-on delay time	Input rise time < 1 µs		20		µs
$t_{d(off)}$(3)(6)	Turn-off delay time	Input rise time < 1 µs		13		µs
t_r(5)(6)	Rise time			0.7	1.5	µs
t_f(5)(6)	Fall time			0.2	0.5	µs
T_{cross}(1)(4)	Low-side turn-on delay time	Input rise time < 1 µs	40	150	350	µs

Note:

(1) Parameter guaranteed by design and characterization; not subjected to production test.

(2) Specifications subject to change without notice.

(3) See Figure 4.

(4) See Figure 5.

(5) See Figure 3.

(6) Guaranteed by design.

6.3. Protections and diagnostics

The values are obtained under these conditions unless otherwise specified: V_{CC} = 7 V up to 18 V, -40°C < T_J < 150°C.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{USD}	Undervoltage shutdown				4	V
$V_{USDreset}$	Undervoltage shutdown reset				4	V
$V_{USDHyst}$	Undervolatge shutdown Hysteresis			0.2		V
I_{LIM_H}(3)	High-side current limitation		12	18	24	A
I_{SD_LS}(3)	Shutdown low-side current		13	19	25	A
t_{SD_LS}(3)	Time to shutdown for the low-side	V_{INA} = V_{INB} = 0 V; PWM = 5 V (See Figure 6)		5		µs
V_{CL_HSD}(3)	High-side clamp voltage (V_{CC} to OUT_A = 0 or OUT_B = 0)	I_{OUT} = 100 mA; t_{CLAMP} = 1 ms	40	46		V
V_{CL_LSD}(3)	Low-side clamp voltage (OUT_A = V_{CC} or OUT_B = V_{CC} to GND)	I_{OUT} = 100 mA; t_{CLAMP} = 1 ms	40	46		V
T_{TSD_HS}(3)	High-side thermal shutdown temperature	IN_x = 2.1 V	160	175	190	°C
T_{TR_HS}(3)	High-side thermal reset temperature		135			°C
T_{HYST_HS}(3)	High-side thermal hysteresis (T_{SD_HS} - T_{R_HS})			15		°C
T_{TSD_LS}(3)	Low-side thermal shutdown temperature	IN_x = 0 V	160	175	190	°C
V_{CL}(3)	Total clamp voltage (V_{CC} to GND)	I_{OUT} = 100 mA; t_{CLAMP} = 1 ms	40	46		V
V_{OL}	OFF-state open-load voltage detection threshold	IN_A = IN_B = 0; PWM = 0; V_{SEL0} = 5 V for CHA; V_{SEL0} = 0 V and within t_{D_STBY} for CHB	2	3	4	V
$I_{L(off2)}$	OFF-state output sink current	IN_A = IN_B = 0; $V_{OUT}x$ = V_{OL}; PWM = 0 V; $VSEL_0$ = 5 V for CHA; V_{SEL0} = 0 V and within t_{D_STBY} for CHB	- 100		- 15	µA
t_{DSTKON}	OFF-state diagnostic delay time from falling edge of INPUT (See Figure 2)	IN_A = 5 V to 0 V; IN_B = 0 V; V_{SEL0} = 5 V; I_{OUT} = 0 A; V_{OUTA} = 4 V; PWM = 0 V	40	150	350	µs
t_{D_VOL}(1)	OFF-state diagnostic delay time from rising edge of V_{OUT} (See Figure 9)	IN_A = IN_B = 0 V; PWM = 0 V; V_{OUTx} = 0 V to 4 V; V_{SEL0} = 5 V for CHA; V_{SEL0} = 0 V and within t_{D_STBY} for CHB		5	30	µs
$t_{Latch\_RST\_HD}$	Input reset time for highside fault unlatch (See Figure 7)	V_{INx} = 5 V to 0 V; HSDx faulting	3	10	20	µs

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$t_{Latch\_RST\_LS}$	Input reset time for lowside fault unlatch (See Figure 8)	V_{INx} = 0 V to 5 V; LSDx faulting	3	10	20	µs

Note:

(1) Parameter guaranteed by design and characterization; not subjected to production test.

(2) Specifications subject to change without notice.

(3) Guaranteed by design.

6.4. Current sense

The values are obtained under these conditions unless otherwise specified: 7 V < V_{CC} < 18 V, -40°C < T_J < 150°C.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{SENSE_CL}(4)	MultiSense clamp voltage	V_{CC} = 18 V; I_{SENSE} = -5 mA		11		V
		V_{CC} = 18 V; I_{SENSE} = 5 mA	-13		-9	V
K_0	I_{OUT}/I_{SENSE}	I_{OUT} = 0.05 A; V_{SENSE} = 0.5 V; T_J = -40°C to 150°C	536			
K_1	I_{OUT}/I_{SENSE}	I_{OUT} = 0.2 A; V_{SENSE} = 0.5 V; T_J = -40°C to 150°C	710	1190	1670	
K_2	I_{OUT}/I_{SENSE}	I_{OUT} = 2.5 A; V_{SENSE} = 4 V; T_J = -40°C to 150°C	1015	1120	1229	
K_3	I_{OUT}/I_{SENSE}	I_{OUT} = 4 A; V_{SENSE} = 4 V; T_J = -40°C to 150°C	1040	1120	1200	
dK_0/K_0(1)(2)	Analog sense current drift	I_{OUT} = 0.05 A; V_{SENSE} = 0.5 V; T_J = -40°C to 150°C	-25		25	%
dK_1/K_1(1)(2)	Analog sense current drift	I_{OUT} = 0.2 A; V_{SENSE} = 0.5 V; T_J = -40°C to 150°C	-21		21	%
dK_2/K_2(1)(2)	Analog sense current drift	I_{OUT} = 2.5 A; V_{SENSE} = 4 V; T_J = -40°C to 150°C	-5		5	%
dK_3/K_3(1)(2)	Analog sense current drift	I_{OUT} = 4 A; V_{SENSE} = 4 V; T_J = -40°C to 150°C	-4		4	%
V_{SENSE_SAT}	Max analog sense output voltage	V_{CC} = 7 V; R_{SENSE} = 10 kΩ; V_{SEL0} = 5 V; I_{OUTA} = 4 A; V_{INA} = 5 V; PWM = 0; T_J = 150 °C	5			V
I_{SENSE0}	MultiSense leakage current	I_{OUT} = 0 A; V_{SENSE} = 0 V; IN_x = 0 V; SEL_0 = 0; T_J = -40°C to 150°C (standby)	0		0.5	µA
		I_{OUT} = 0 A; V_{SENSE} = 0 V; IN_x = 0 V; SEL_0 = 5 V; T_J = -40°C to 150°C (no standby)	0		0.5	µA
		IN_x = 5 V; PWM = 5 V: T_J = -40°C to 150°C; I_{OUT} = 0 A	0		5	µA

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{SENSEH}	MultiSense output voltage in fault condition	V_{CC} = 13 V; R_{SENSE} = 1 kΩ – E.g: OUT_A in open-load IN_A = 0 V; I_{OUTA} = 0 A; V_{OUTA} = 4 V; V_{SEL0} = 5 V	3.6		7	V
I_{SENSEH}	MultiSense output current in fault condition	9 V < V_{CC} < 18 V; V_{SENSE} = V_{SENSEH}	8	18	28	mA

Note:

(1) Analog sense current drift is deviation of factor K for a given device over -40°C to 150°C and 9 V < V_{CC} < 18 V, with respect to its value measured at T_J = 25°C, V_{CC} = 13 V.

(2) Parameter guaranteed by design and characterization; not subjected to production test.

(3) Specifications subject to change without notice.

(4) Guaranteed by design.

6.5. Detailed figures

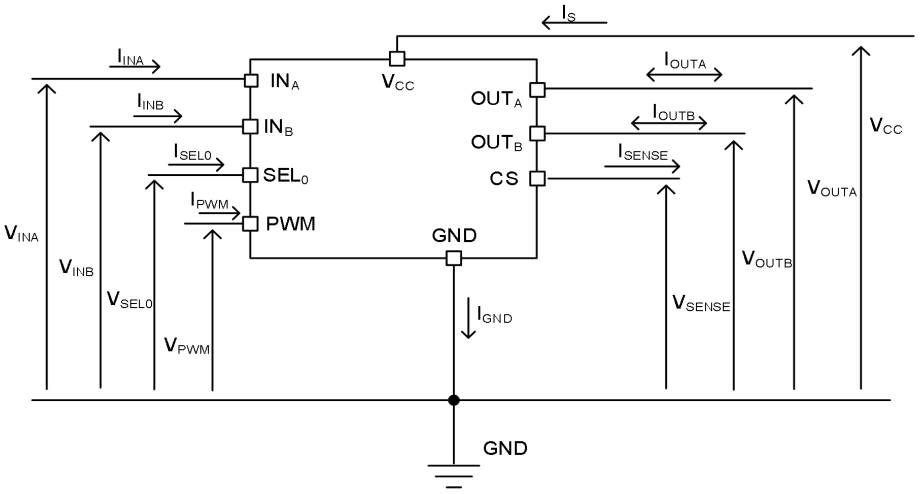


Figure 1. Current and voltage conventions

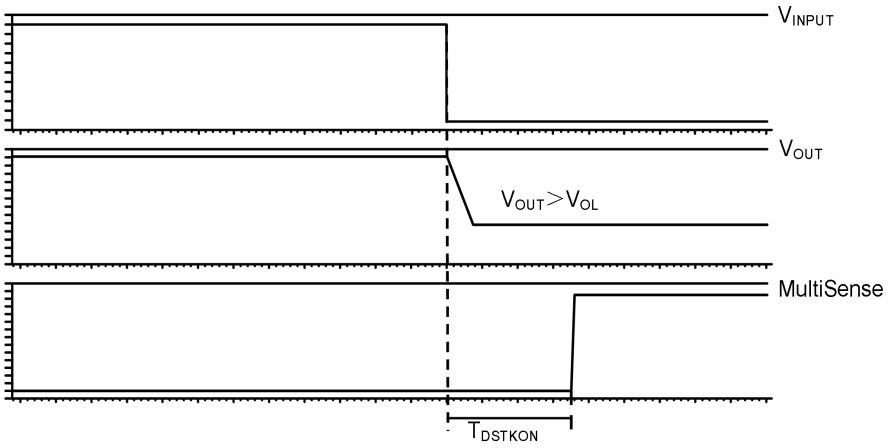


Figure 2. t_{DSTKON}

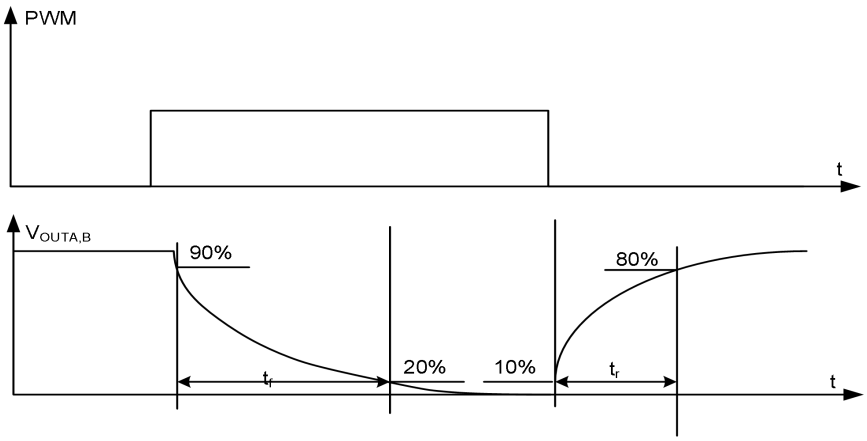


Figure 3. Definition of the low-side switching times

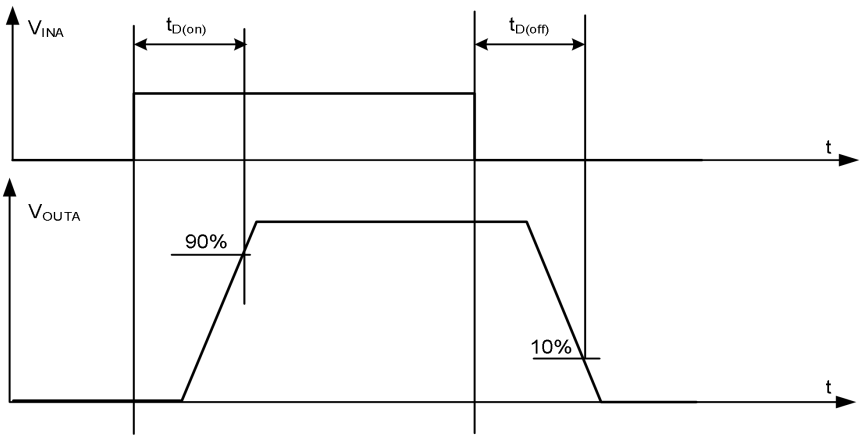


Figure 4. Definition of the high-side switching times

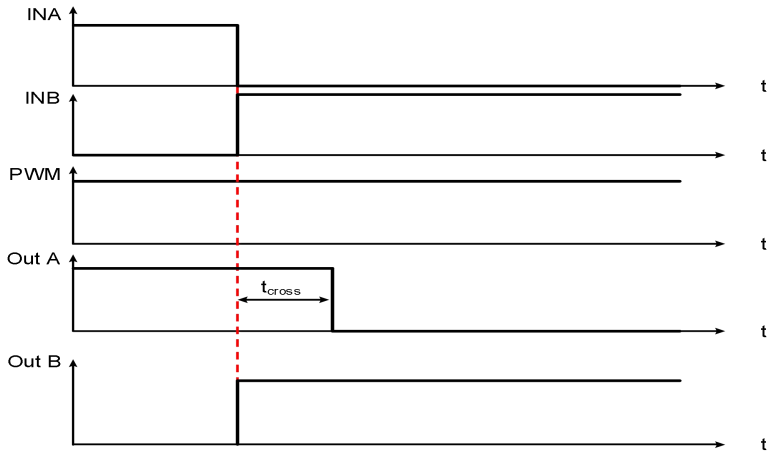


Figure 5. Low-side turn-on delay time

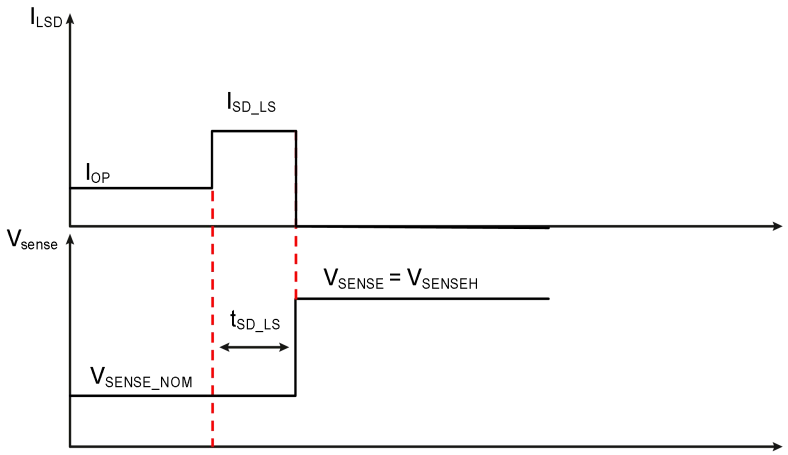


Figure 6. Time to shutdown for the low-side driver

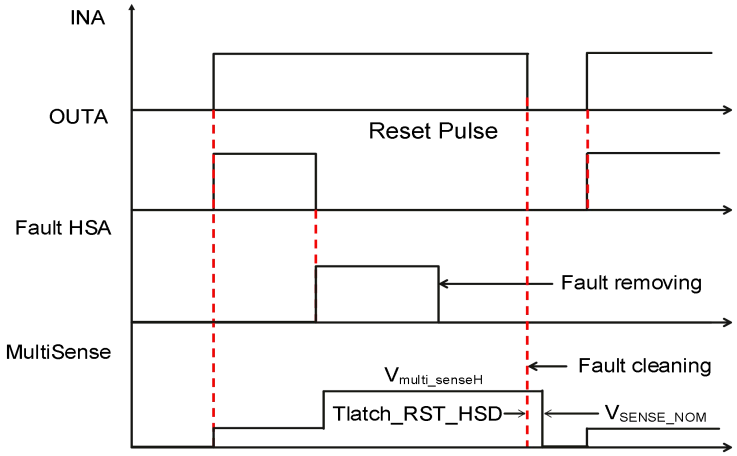


Figure 7. Input reset time for HSD - fault unlatch

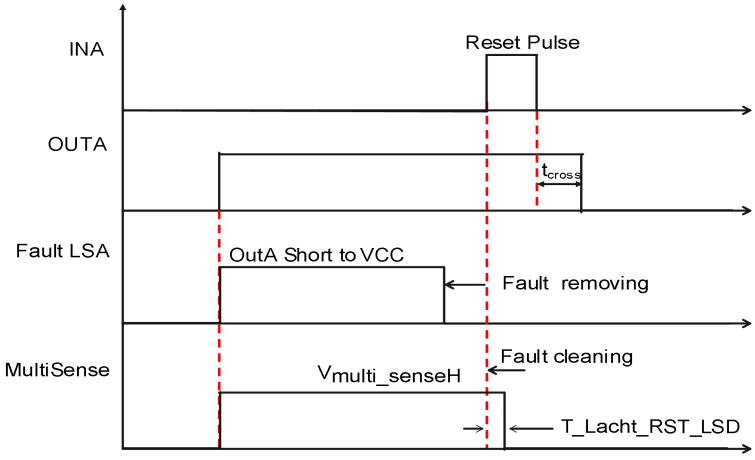


Figure 8. Input reset time for LSD - fault unlatch

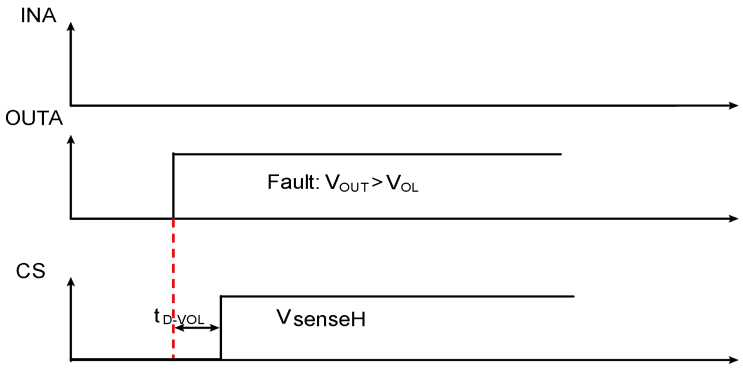


Figure 9. OFF-state diagnostic delay time from rising edge of V_{OUT} (t_{D_VOL})

7. Typical Characteristics

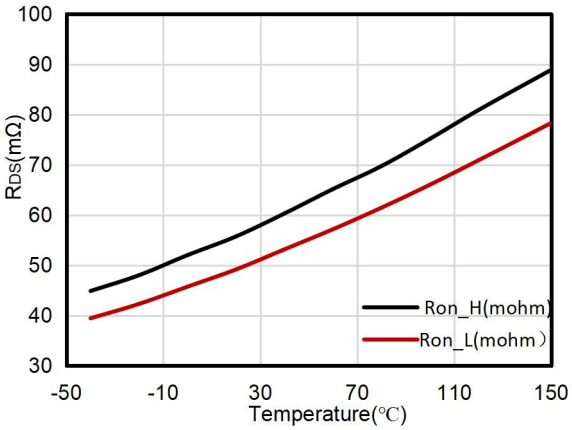


Figure 10. $R_{DS(on)}$ vs. Temperature

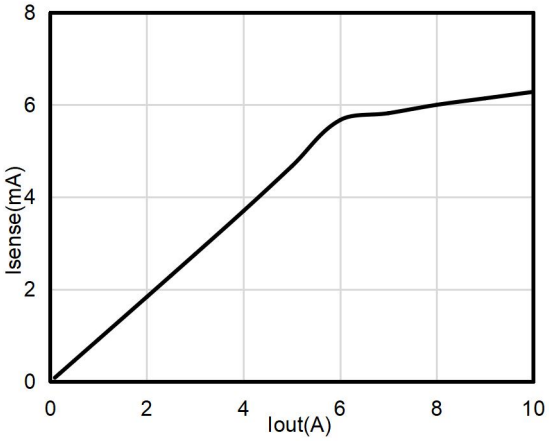
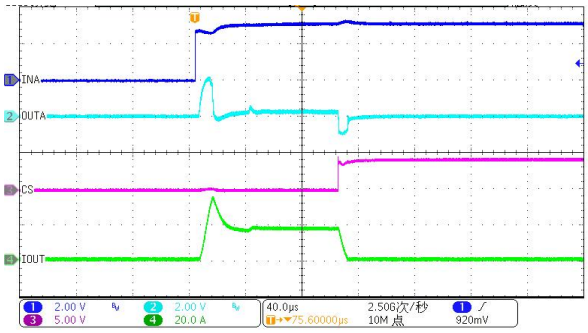
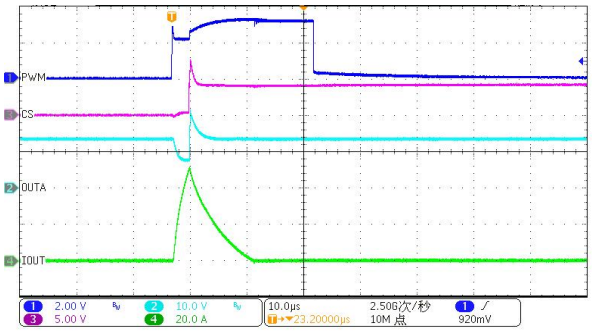


Figure 11. I_{SENSE} vs I_{OUT}



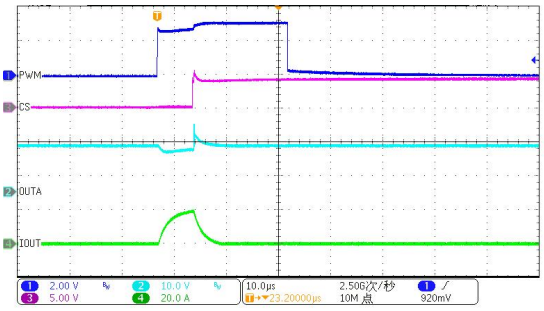
VCC = 13.5 V, SEL0 = 1

Figure 12. Protection-output short to GND



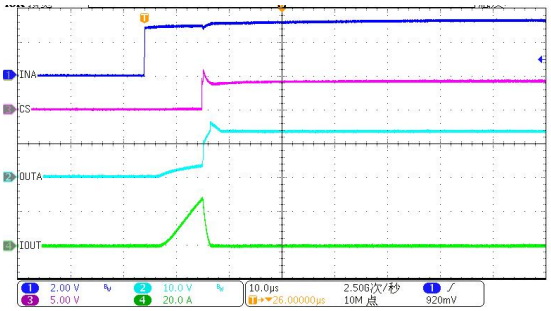
VCC = 13.5 V, SEL0 = 0, INA = 1, INB = 0

Figure 13. Protection-output hard short to VCC



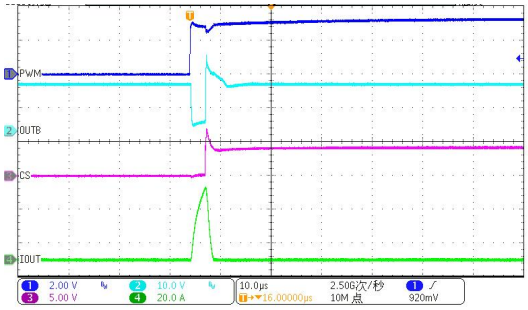
VCC = 13.5 V, SEL0 = 0, INA = 1, INB = 0

Figure 14. Protection-output soft short to VCC



VCC = 13.5 V, SEL0 = 0, PWM = 1

Figure 15. OUT_A short to OUT_B - LSB ON then HSA switched ON



VCC = 13.5 V, SEL0 = 0, INB = 1

Figure 16. OUT_A short to OUT_B - HSB ON then LSA switched ON

8. Truth Tables

Table 1. Truth table: operative condition

Pin Status					HSDs and LSDs Status			
INA	INB	SEL0	PWM	Current Sense	HSDA	LSDA	HSDB	LSDB
1	1	1	X	Current monitoring HSDA	On	Off	On	Off
		0		Current monitoring HSDB				
1	0	1	1	Current monitoring HSDA	On	Off	Off	On
			0		On	Off	Off	Off
1	0	0	1	Hi-Z	On	Off	Off	On
			0		On	Off	Off	Off
0	1	1	1	Hi-Z	Off	On	On	Off
			0		Off	Off	On	Off
0	1	0	1	Current monitoring HSDB	Off	On	On	Off
			0		Off	Off	On	Off
0	0	1	1	Hi-Z	Off	On	Off	On
		0						
0	0	1	0	X (1)	Off	Off	Off	Off
		0(2)			Off	Off	Off	Off

Note:

(1) Refer to Table 3.

(2) For IN_A = IN_B = SEL_0 = PWM = 0, the device enters in standby after t_{D_STBY}.

Table 2. Truth table: ON-state fault conditions

Digital Input Pins				Current Sense	Comment
INA	INB	PWM	SEL0		
0	0	1	0	VsenseH	LSB protection triggered; LSB latched off
0	0	1	1	VsenseH	LSA protection triggered; LSA latched off
0	1	X	0	VsenseH	HSB protection triggered; HSB latched off
0	1	1	1	VsenseH	LSA protection triggered; LSA latched off
1	0	1	0	VsenseH	LSB protection triggered; LSB latched off
1	0	X	1	VsenseH	HSA protection triggered; HSA latched off
1	1	X	0	VsenseH	HSB protection triggered; HSB latched off
1	1	X	1	VsenseH	HSA protection triggered; HSA latched off

Table 3. Truth table: off-state

IN_A	IN_B	SEL_0	PWM	Out_A	Out_B	CS	Description
Off-state diagnostic							
0	0	1	0	$V_{outA} > V_{OL}$	X	V_{SENSEH}	Case 1. OUT_A shorted to V_{CC} if no pull-up resistor is applied Case 2. No open-load in full bridge configuration with an external pull-up resistor on OUT_B Case 3. open-load in half bridge configuration with an external pull-up resistor on OUT_A (motor connected between OUT_A and Ground)
				$V_{outA} < V_{OL}$	X	Hi-Z	Case 1. Open-load in full bridge configuration with an external pull-up resistor on OUT_B Case 2. No open-load in half bridge configuration with an external pull-up resistor on OUT_A (motor connected between OUT_A and Ground)
		0(1)(2)		X	$V_{outB} > V_{OL}$	V_{SENSEH}	Case 1. OUT_B shorted to V_{CC} if no pull-up resistor is applied Case 2. No open-load in full bridge configuration with an external pull-up resistor on OUT_A Case 3. Open-load in half bridge configuration with an external pull-up resistor on OUT_B (motor connected between OUT_B and Ground)
				X	$V_{outB} < V_{OL}$	Hi-Z	Case1. Open-load in full bridge configuration with an external pull-up resistor on OUT_A Case 2. No open-load in half bridge configuration with an external pull-up resistor on OUT_B (motor connected between OUT_B and Ground)

Note:

(1) The device enters standby mode after standby mode blanking time.

(2) To power on the device from the standby, toggle IN_A or IN_B from 0 to 1 first and then PWM from 0 to 1 to avoid any over-stress on the device in case of short-to-battery.

9. Waveforms

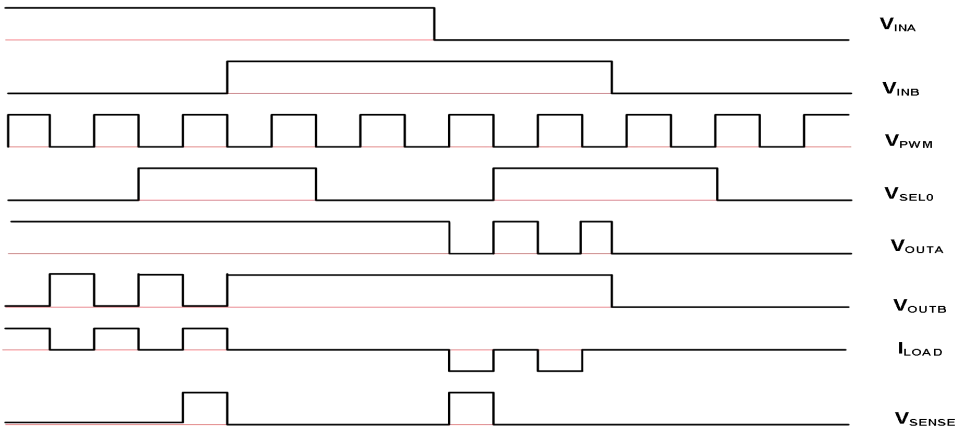


Figure 17. Normal operative conditions

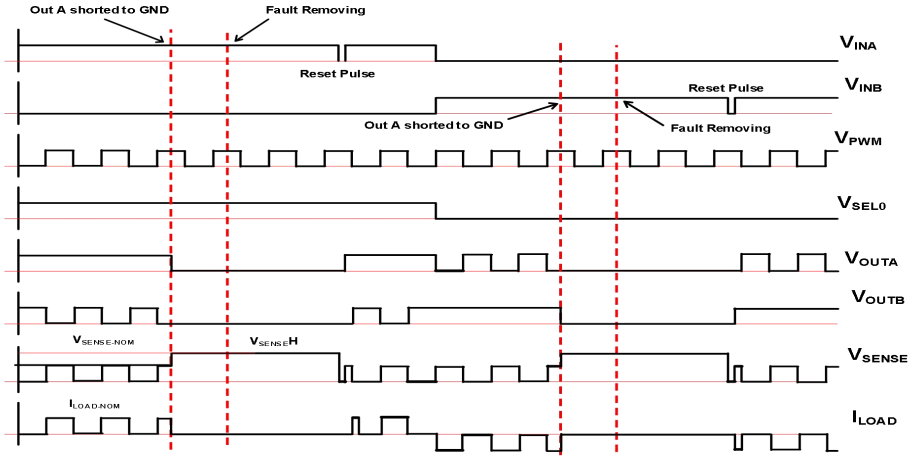


Figure 18. OUT shorted to ground and short clearing

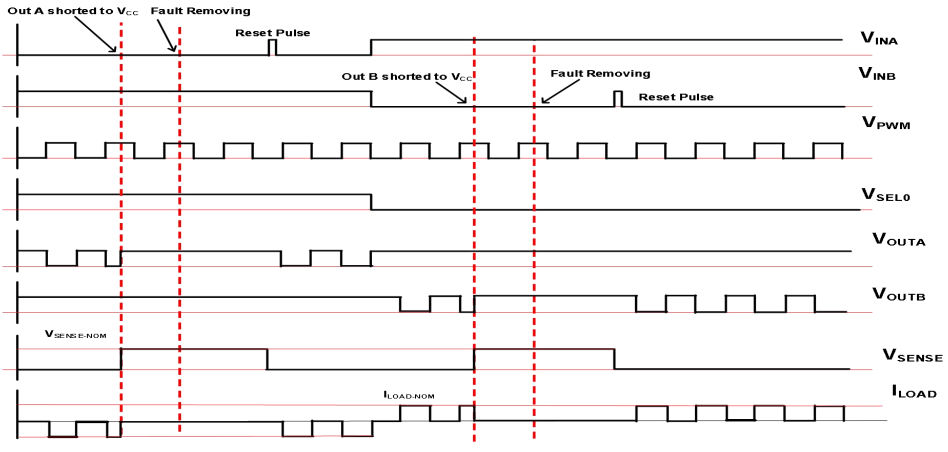
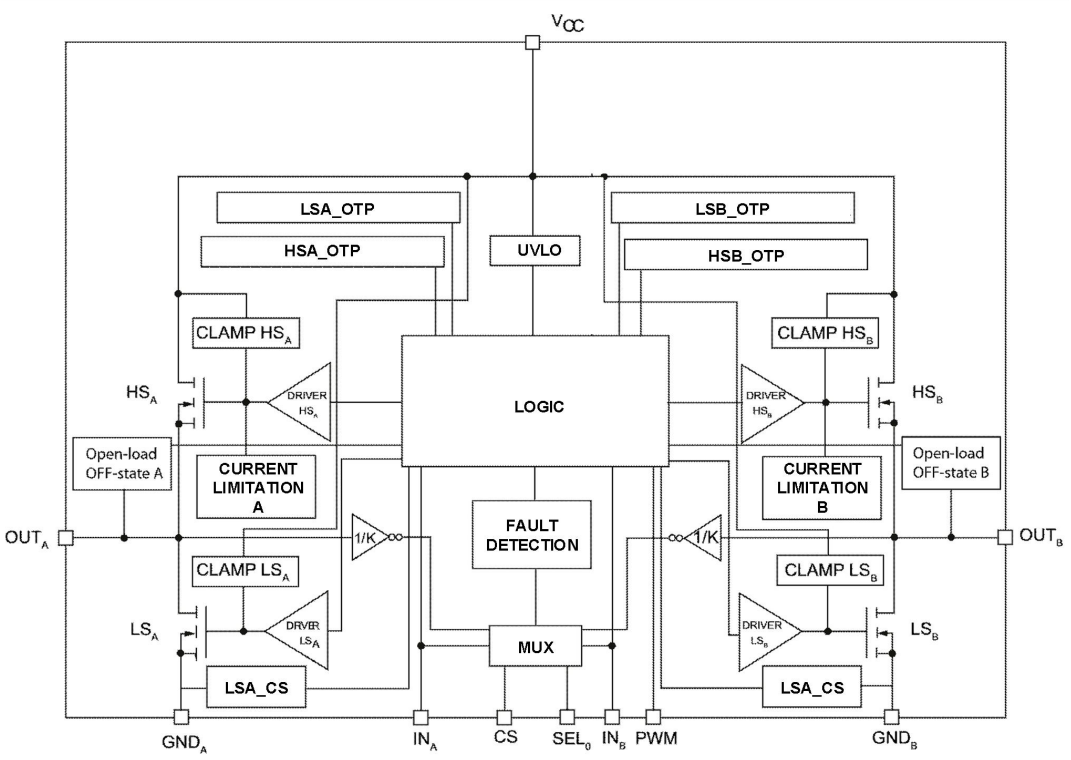


Figure 19. OUT shorted to VCC and short clearing

10. Block Diagram



Name	Description
Logic control	Controls the high-side and the low-side switches according to the truth table.
Undervoltage	Shuts down the device for battery voltage lower than 4 V.
High-side and low-side clamp voltage	Protect the high-side and the low-side switches from the high voltage on the battery line.
High-side and low-side drivers	Drive the gate of the associated switch to allow a proper R_{on} for the leg of the bridge.
Current limitation	Limits the motor current in case of short-circuit.
High-side and low-side over-temperature protection	Shuts down the associated driver to prevent degradation and to protect the die.
Low-side current sense	Detects when low side current exceeds shutdown current and latches off the associated low side.
Fault detection	Declares the abnormal behavior of the switch through MultiSense pin.
Power limitation	Limits the power dissipation of the high-side driver inside safe range in case of short to ground condition.

11. Application Information

Important notice: Validation and testing are the most reliable ways to confirm system functionality. The application information is not part of the specification and is for reference purposes only.

11.1. Reverse battery protection

Three possible solutions to protect the device from reverse battery:

- A Schottky diode D connected to V_{CC} pin
- A N-channel MOSFET connected to the GND pin
- A P-channel MOSFET connected to the V_{CC} pin

When the reverse battery protections is absent, the device sustains less than -15 A because of the tow body diodes of the power MOSFETs. Additionally, in reverse battery condition, the I/Os of the device is pulled down to the V_{CC} line (approximately -1.5 V). To limit the sink current from the microcontroller I/Os, insert a series resistor. The series resistor can be calculated from Equation (1):

$$R = \frac{V_{IOs} - V_{CC}}{I_{Rmax}} \quad (1)$$

where

V_{IOs} is the voltage on the I/Os

V_{cc} is the operating power supply

I_{Rmax} is the maximum target reverse current through microcontroller I/Os

11.2. OFF-state open-load detection

Use an external circuitry to detect an open-load in off-state.Connect the circuitry between the output and V_{Batt}.

Put one network on each leg in case of half bridge operation. Put one network on one of the output in case of full bridge. (See Table 3.)

The external circuitry has an external pull-up resistor R_{pull_up} that connects the output to a positive supply voltage V_{Batt}.

To reduce the overall standby current during the module standby mode, switch off V_{Batt} by using an external pull_up switch.

Dimension R_{pull_up} to ensure that in normal operative conditions V_{OUT} is larger than V_{OLmax}. Select the R_{pull_up} according to Equation (2) and (3).

- When the device is used in half bridge configuration,

$$R_{pull\_up} < \frac{V_{BATTmin} - V_{OLmax}}{I_{L(off2)min}} \quad (2)$$

- When the device is used in full bridge configuration,

$$R_{pull\_up} < \frac{V_{BATTmin} - V_{OLmax}}{2 \times I_{L(off2)min}} \quad (3)$$

where $I_{L(off2)}$ is minimum when V_{OL} is maximum.

11.3. Application examples

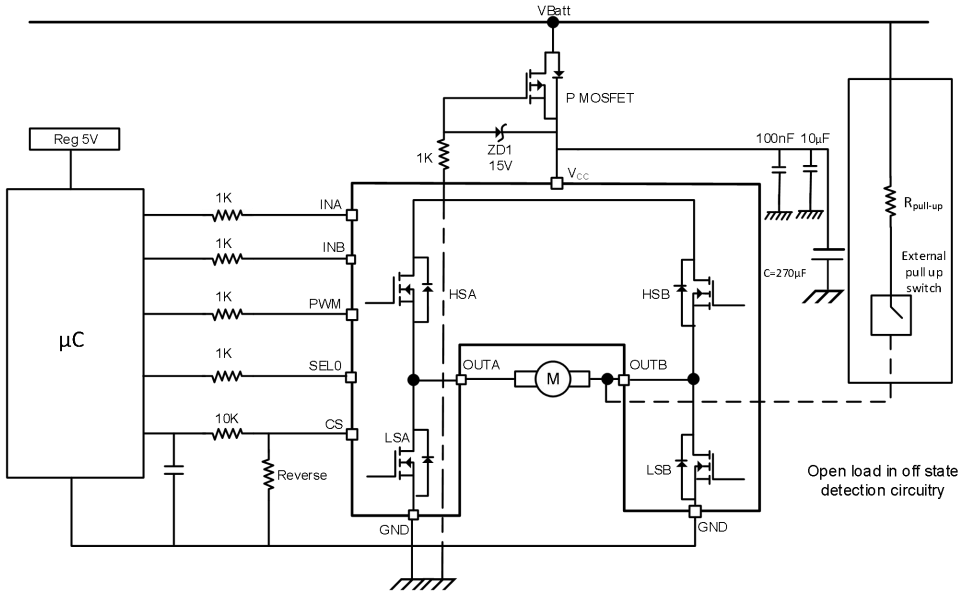


Figure 20. Application schematic with reverse battery protection connected to V_{Batt}

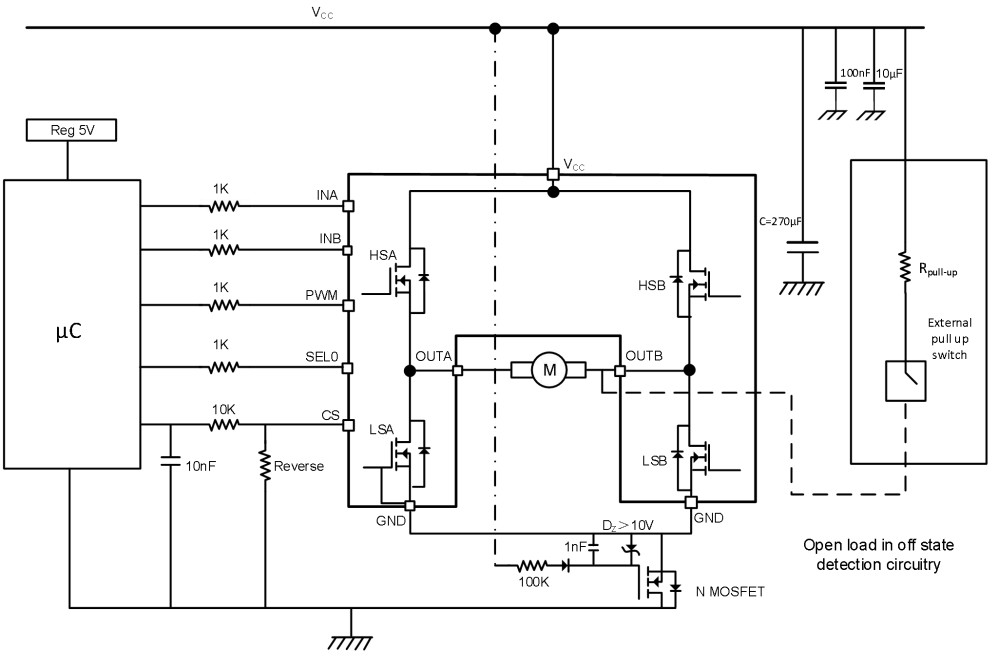


Figure 21. Application schematic with reverse battery protection connected to GND

11.4. Device configurations

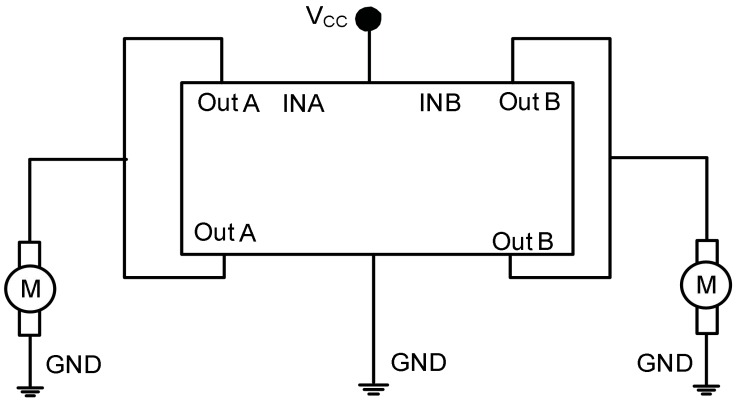


Figure 22. Half-bridge configuration (case A)

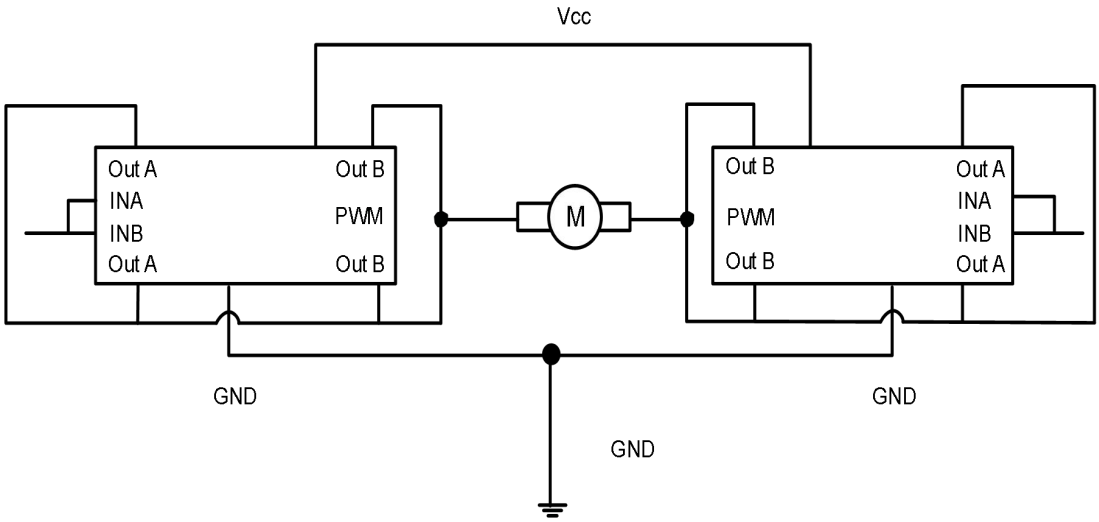
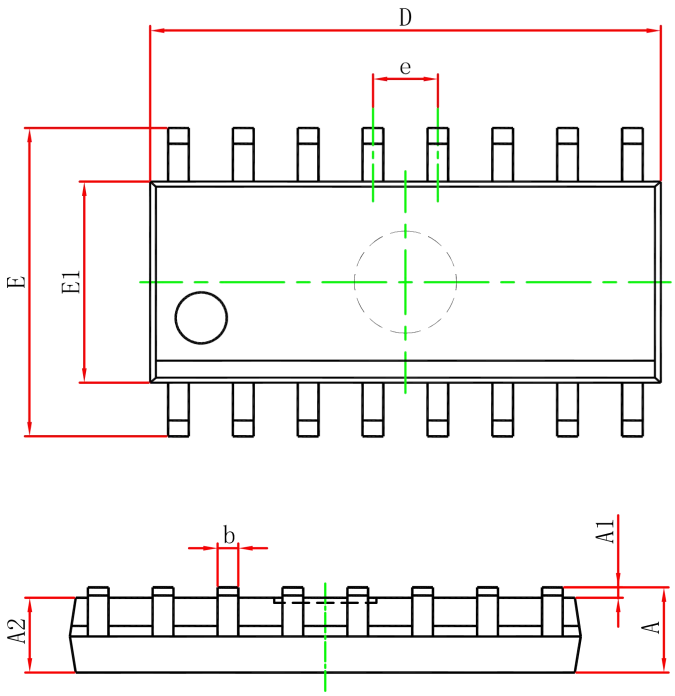


Figure 23. Half-bridge configuration (case B)

12. Physical Dimensions: SOP16



Common Dimensions (Units of measure = Millimeter)		
Symbol	**Min**	**Max**
A	-	1.750
A1	0.100	0.250
A2	1.400	1.500
b	0.330	0.510
c	0.170	0.250
D	9.800	10.200
e	1.270 BSC	
E	5.800	6.200
E1	3.800	4.000
L	0.400	1.270
θ	0°	8°

Disclaimer

This specification and information contained herein are provided on an “AS IS” basis and WITH ALL FAULTS. All product specifications, statements, information, and data (collectively, the “Information”) in this datasheet or made available on the website of www.dioo.com are subject to change without notice. The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to his/her application. All Information given herein is believed to be accurate and reliable, but it is presented without guarantee, warranty, or responsibility of any kind, express or implied.

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

DIOO:

DIO57100SO16