

## Dual Half Bridge Driver with Boost Converter

### ■ GENERAL DESCRIPTION

The **NJW4813** is a dual half bridge driver with boost converter IC.

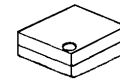
Output voltage boost from Li-ion battery and a 5V power supply and can drive a piezo device by two half bridge drivers.

The NJW4813 is able to stable startup by soft start function in boost SW.REG.

The dual half bridge driver improves control characteristics from a microcomputer in response to independent signal input in each channel.

The input frequency operates to 300kHz and in the case of failure, it can output a fault flag.

### ■ PACKAGE OUTLINE



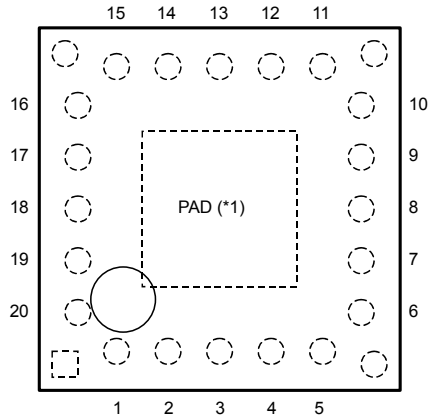
**NJW4813SE3**

### ■ FEATURES

- |   |   |   |
|---|---|---|
| <ul style="list-style-type: none"> <li>● Boost Converter Block</li> </ul>   | <ul style="list-style-type: none"> <li>Output Switch Voltage</li> <li>Switching Current</li> <li>PWM Control</li> <li>Operating Voltage Range</li> <li>Oscillation Frequency Range</li> <li>Soft Start Function</li> <li>Over Current Protection</li> </ul>   | <ul style="list-style-type: none"> <li>40V max.</li> <li>1A min.</li> <li></li> <li>2.7 to 5.5V</li> <li>380k to 810kHz</li> <li>17ms typ.</li> <li></li> </ul> |
| <ul style="list-style-type: none"> <li>● Half Bridge Driver Block</li> </ul>  | <ul style="list-style-type: none"> <li>Internal 2-Channel Half Bridge</li> <li>Each Channel Operates Individually</li> <li>Output Switch Peak Current</li> <li>Operating Voltage Range</li> <li>Switching Frequency</li> <li>Output Shut Down Control</li> <li>Over Current Protection</li> <li>Fault Indicator Output</li> </ul> | <ul style="list-style-type: none"> <li></li> <li></li> <li>+280 / -250mA typ.</li> <li>8.0 to 35V</li> <li>300kHz max.</li> <li></li> <li></li> </ul>           |
| <ul style="list-style-type: none"> <li>● Under Voltage Lockout</li> <li>● Built-in Thermal Shutdown</li> <li>● Standby Function</li> <li>● Package Outline</li> </ul> | <ul style="list-style-type: none"> <li></li> <li></li> <li></li> <li>NJW4813SE3 : PCSP20-E3</li> </ul>  | <ul style="list-style-type: none"> <li></li> <li></li> <li></li> <li></li> </ul>  |

# NJW4813

## ■ PIN CONFIGURATION



< Top View >

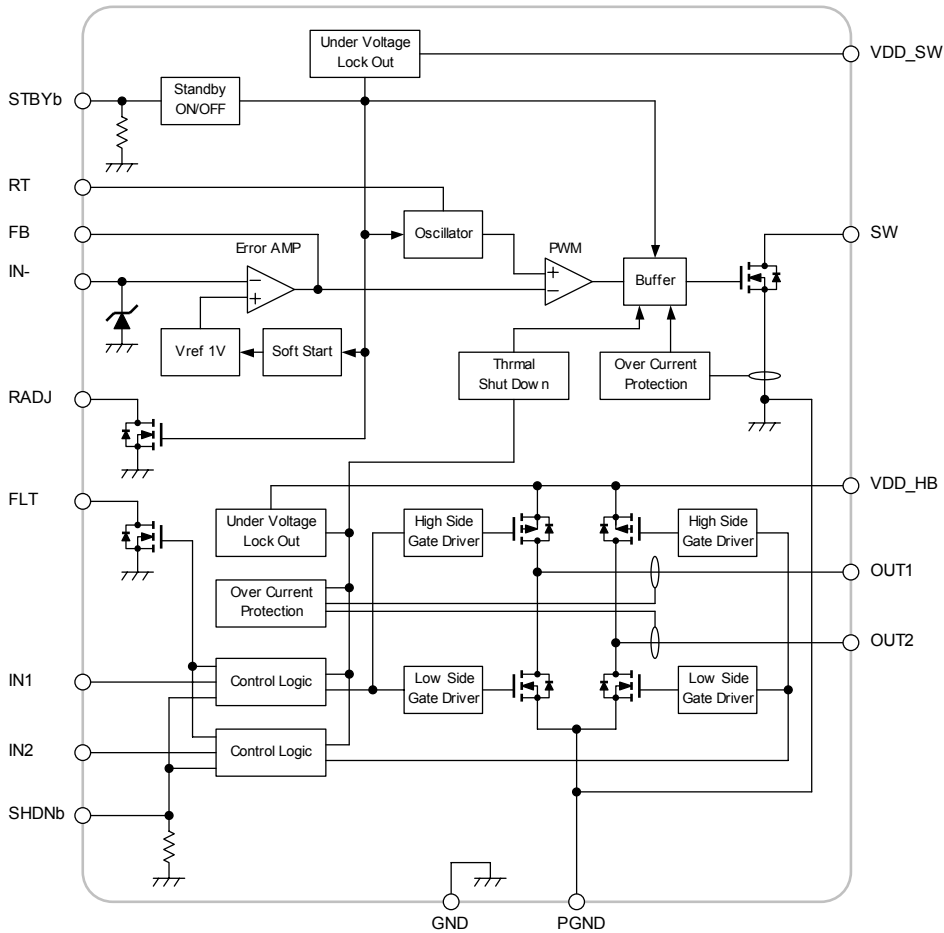
### PIN FUNCTION

- |           |            |
|-----------|------------|
| 1. VDD_SW | 11. VDD_HB |
| 2. STBYb  | 12. OUT1   |
| 3. SHDNb  | 13. PGND   |
| 4. IN1    | 14. PGND   |
| 5. IN2    | 15. SW     |
| 6. FLT    | 16. SW     |
| 7. RT     | 17. NC     |
| 8. GND    | 18. RADJ   |
| 9. PGND   | 19. FB     |
| 10. OUT2  | 20. IN-    |

(\*1) The PAD is not connected to an IC chip electrically.

## NJW4813SE3

## ■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	SYMBOL	MAXIMUM RATINGS	UNIT
<b>Boost Converter Block</b>			
Supply Voltage	$V_{DD\_SW}$	+6	V
SW pin Voltage	$V_{SW}$	+40	V
RADJ pin Voltage	$V_{RADJ}$	+6 (*2)	V
IN- pin Voltage	$V_{IN-}$	-0.3 to +6 (*2)	V
STBYb pin Voltage	$V_{STBYb}$	-0.3 to +6 (*2)	V
<b>Half Bridge Driver Block</b>			
Supply Voltage	$V_{DD\_HB}$	+40	V
SHDNb pin Voltage	$V_{SHDNb}$	-0.3 to +6 (*2)	V
Input Voltage	$V_{IN1}$ $V_{IN2}$	-0.3 to +6 (*2)	V
FLT pin Voltage	$V_{FLT}$	-0.3 to +6	V
Power Dissipation	$P_D$	The back pad is mounted. 560 (*3) 980 (*4) The back pad is not mounted. 550 (*3) 850 (*4)	mW
Junction Temperature Range	$T_j$	-40 to +150	°C
Operating Temperature Range	$T_{opr}$	-40 to +85	°C
Storage Temperature Range	$T_{stg}$	-40 to +150	°C

(\*2): When Supply voltage is less than +6V, the absolute maximum voltage is equal to the Supply voltage.

(\*3): Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard, 2Layers)

(\*4): Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard, 4Layers),  
internal Cu area: 74.2×74.2mm

This product may be damaged with electric static discharge (ESD).

Please handle with care to avoid these damages.

## ■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>Boost Converter Block</b>					
Supply Voltage	$V_{DD\_SW}$	2.7	—	5.5	V
STBYb pin Voltage	$V_{STBYb}$	0	—	$V_{DD\_SW}$	V
Timing Resistor	$R_T$	95	100	146	kΩ
Oscillating Frequency	$f_{OSC}$	380	700	810	KHz
<b>Half Bridge Driver Block</b>					
Supply Voltage	$V_{DD\_HB}$	8	—	35	V
Output Switch DC Current	$I_{OM}$	0	—	20	mA
SHDNb pin Voltage	$V_{SHDNb}$	0	—	$V_{DD\_SW}$	V
Input Voltage	$V_{IN1}, V_{IN2}$	0	—	$V_{DD\_SW}$	V
FLT pin Voltage	$V_{FLT}$	0	—	5.5	V

# NJW4813

## ■ ELECTRICAL CHARACTERISTICS

### Boost Converter Block

(Unless otherwise noted,  $V_{DD\_SW}=V_{STBYb}=3.7V$ ,  $R_T=100k\Omega$ ,  $T_a=25^\circ C$ )

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
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### Under Voltage Lockout Block

UVLO Release Voltage	$V_{RUVLO\_SW}$		2.1	2.4	2.7	V
UVLO Operate Voltage	$V_{DUVLO\_SW}$		2.0	2.2	2.5	V
UVLO Hysteresis Voltage	$\Delta V_{UVLO\_SW}$	$V_{RUVLO\_SW} - V_{DUVLO\_SW}$	–	0.2	–	V

### Soft Start Block

Soft Start Time	$T_{SS}$	$V_B=0.95V$	8	17	28	ms
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### Oscillator Block

Oscillation Frequency	$f_{OSC}$		630	700	770	kHz
Oscillation Frequency deviation (Supply voltage)	$f_{DV}$	$V_{DD\_SW}=3.0$ to $5.5V$	–	1	–	%
Oscillation Frequency deviation (Temperature)	$f_{DT}$	$T_a= -40$ to $+85^\circ C$	–	3	–	%

### Error Amplifier Block

Reference Voltage	$V_B$	Short IN- and FB, Measuring IN- Pin	-1.0%	1.00	+1.0%	V
Input Bias Current	$I_B$	$V_B=1.0V$	-0.1	–	+0.1	$\mu A$
Open Loop Gain	$A_V$		–	80	–	dB
Gain Bandwidth	$G_B$		–	1	–	MHz
Output Source Current	$I_{OM+}$	$V_{FB}=1V$ , $V_{IN-}=0.9V$	8	16	24	$\mu A$
Output Sink Current	$I_{OM-}$	$V_{FB}=1V$ , $V_{IN-}=1.1V$	0.9	1.4	4	mA
IN- pin Clamp Voltage	$V_{CLIN-}$	$V_{STBYb}=0V$ , $V_{DD\_SW}=5.5V$ , $I_{CLIN-}=10\mu A$	4.8	5.2	5.6	V
RADJ pin FET ON Resistance	$R_{ON\_RADJ}$	$I_{RADJ}=0.1mA$	–	200	280	$\Omega$
RADJ pin FET Leak Current	$I_{LEAK\_RADJ}$	$V_{STBYb}=0V$ , $V_{RADJ}=3.3V$	–	–	1	$\mu A$

### PWM Compare Block

Maximum Duty Cycle	$M_{AXDUTY}$	$V_{IN-}=0.9V$	82	87	92	%
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### Output Block

Output ON Resistance	$R_{ON\_SW}$	$I_{SW}=100mA$	–	0.6	1.2	$\Omega$
Switching Current Limit	$I_{LMT\_SW}$		1	2	–	A
Switching Leak Current	$I_{LEAK\_SW}$	$V_{STBYb}=0V$ , $V_{SW}=40V$	–	–	1	$\mu A$

## ■ ELECTRICAL CHARACTERISTICS

### Half Bridge Driver Block

(Unless otherwise noted,  $V_{DD\_SW}=3.7V$ ,  $V_{DD\_HB}=25V$ ,  $V_{STBYb}=V_{SHDNb}=3.7V$ ,  $R_T=100k\Omega$ ,  $T_a=25^\circ C$ )

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
<b>Under Voltage Lockout Block</b>						
UVLO Release Voltage	$V_{RUVLO\_HB}$		5.6	6.2	6.8	V
UVLO Operate Voltage	$V_{DUVLO\_HB}$		5.0	5.6	6.2	V
UVLO Hysteresis Voltage	$\Delta V_{UVLO\_HB}$	$V_{RUVLO\_HB} - V_{DUVLO\_HB}$	–	0.6	–	V

### Enable Control Block

High Side SW ON Resistance	$R_{DSH}$	$I_{OSOURCE}=20mA$	–	6.0	8.0	$\Omega$	
Low Side SW ON Resistance	$R_{DSL}$	$I_{OSINK}=20mA$	–	7.0	9.0	$\Omega$	
Output Current Limit Circuit	Over Current Detection Current	$I_{DCTH}$	High-Side	230	280	330	mA
		$I_{DCTL}$	Low-Side	200	250	300	mA
	Over Current Release Current	$I_{RCVH}$	High-Side	2.5	5	10	mA
		$I_{RCVL}$	Low-Side	5	10	20	mA
	Output Short Current	$I_{SHTH}$	$V_{OUT1}=V_{OUT2}=0V$	10	25	50	mA
$I_{SHTL}$		$V_{OUT1}=V_{OUT2}=V_{DD\_HB}$	10	25	50	mA	
Output Rise Time	$t_r$	$V_{IN}=0$ to 3.3V	–	400	–	ns	
Output Fall Time	$t_f$	$V_{IN}=0$ to 3.3V	–	400	–	ns	
Rise Dead Time	$D_{tr}$	$V_{IN}=0$ to 3.3V	–	150	–	ns	
Fall Dead Time	$D_{tf}$	$V_{IN}=0$ to 3.3V	–	150	–	ns	
Rise Delay Time	$t_{d\_ON}$	$V_{IN}=0$ to 3.3V	–	250	–	ns	
Fall Delay Time	$t_{d\_OFF}$	$V_{IN}=0$ to 3.3V	–	250	–	ns	
Rise – Fall Delay Time Difference	$t_{d\_ON} \pm t_{d\_OFF}$	$V_{IN}=0$ to 3.3V	–	20	–	ns	
Input Frequency	$f_{IN}$		–	–	300	kHz	
High Side SW OFF Leak Current	$I_{OLEAKOUTH}$	$V_{SHDNb}=0V$ , $V_{DD\_HB}=25V$ $V_{OUT1}=V_{OUT2}=0V$	–	–	1	$\mu A$	
Low Side SW OFF Leak Current	$I_{OLEAKOUTL}$	$V_{SHDNb}=0V$ , $V_{DD\_HB}=25V$ $V_{OUT1}=V_{OUT2}=25V$	–	–	1	$\mu A$	
OUT pin – VDD pin Potential Difference	$V_{PDOV}$	$V_{SHDNb}=0V$ , $I_{ORH}=20mA$	–	0.7	1.0	V	
GND pin – OUT pin Potential Difference	$V_{PDGO}$	$V_{SHDNb}=0V$ , $I_{ORL}=20mA$	–	0.7	1.0	V	

### Shutdown Circuit Block

SHDNb pin High Voltage (Operating Mode)	$V_{IHSHDNb}$		1.6	–	$V_{DD\_SW}$	V
SHDNb pin Low Voltage (Shutdown Mode)	$V_{ILSHDNb}$		0	–	0.6	V
SHDNb pin Pull Down Resistance	$R_{PDSDNB}$	$V_{SHDNb}=3.3V$	210	300	390	$k\Omega$

### Input Circuit Block

IN1, IN2 pin High Voltage	$V_{IHIN1}$ , $V_{IHIN2}$		1.6	–	$V_{DD\_SW}$	V
IN1, IN2 pin Low Voltage	$V_{ILIN1}$ , $V_{ILIN2}$		0	–	0.6	V
IN1, IN2 pin Input Current	$I_{IIN1}$ , $I_{IIN2}$	$V_{IN}=3.3V$	–	–	1	$\mu A$

# NJW4813

## ■ ELECTRICAL CHARACTERISTICS

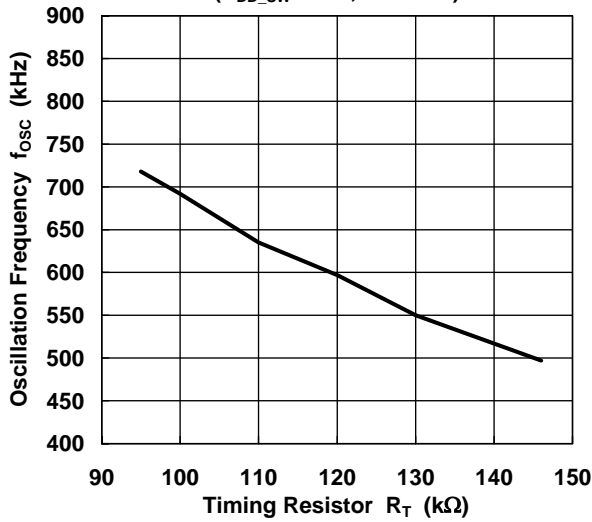
### General Characteristics

(Unless otherwise noted,  $V_{DD\_SW}=3.7V$ ,  $V_{DD\_HB}=25V$ ,  $V_{STBYb}=V_{SHDNb}=3.7V$ ,  $R_T=100k\Omega$ ,  $T_a=25^\circ C$ )

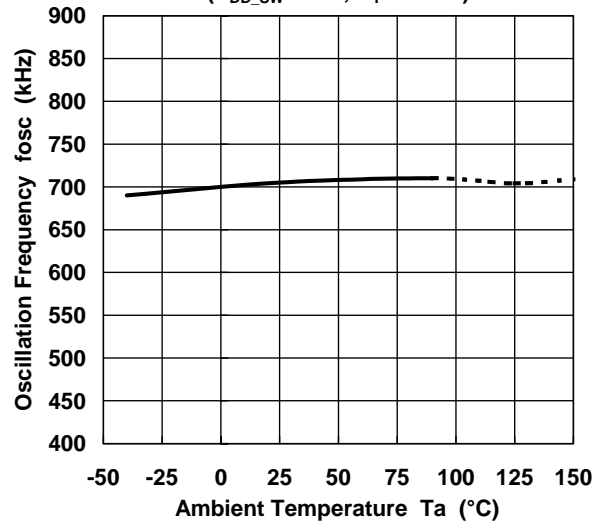
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
STBYb pin High Voltage (Operating Mode)	$V_{IHSTBYb}$		1.6	–	$V_{DD\_SW}$	V
STBYb pin Low Voltage (Standby Mode)	$V_{ILSTBYb}$		0	–	0.6	V
STBYb pin Pull Down Resistance	$R_{PDSTBYb}$	$V_{STBYb}=3.3V$	210	300	390	$k\Omega$
FLT pin Low Level Output Voltage	$V_{LFLT}$	$I_{FLT}=500\mu A$	–	0.25	0.5	V
FLT pin OFF Leak Current	$I_{OLEAKFLT}$	$V_{FLT}=5.5V$	–	–	1	$\mu A$
Quiescent Current (Switching Regulator Block)	$I_{QSW}$	$R_T=100k\Omega$ , No Load	–	1.9	2.8	mA
Quiescent Current (Half Bridge Driver Block)	$I_{QHB}$	$f_{IN1}=f_{IN2}=10kHz$ antiphase 50% Duty Cycle	–	0.7	1.0	mA
Quiescent Current (Standby)	$I_{QSTBY}$	$V_{DD\_HB}=0V$ , $V_{STBYb}=V_{SHDNb}=0V$	–	0.9	1.8	$\mu A$

## ■ TYPICAL CHARACTERISTICS (Boost Converter Block)

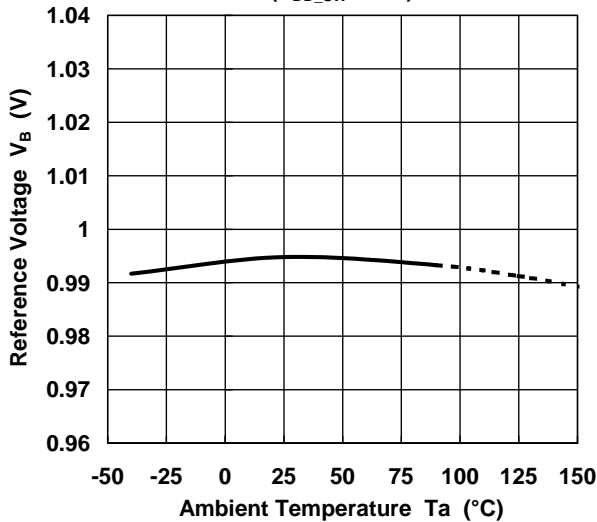
Timing Resistor vs. Oscillation Frequency  
( $V_{DD\_SW}=3.7V$ ,  $T_a=25^\circ C$ )



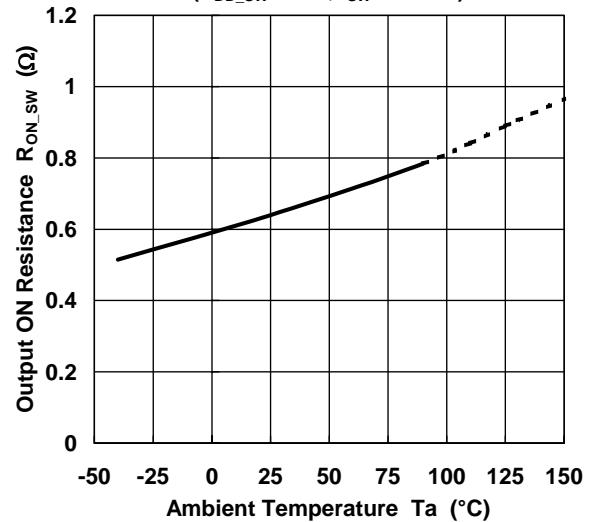
Oscillation Frequency vs. Temperature  
( $V_{DD\_SW}=3.7V$ ,  $R_T=100k\Omega$ )



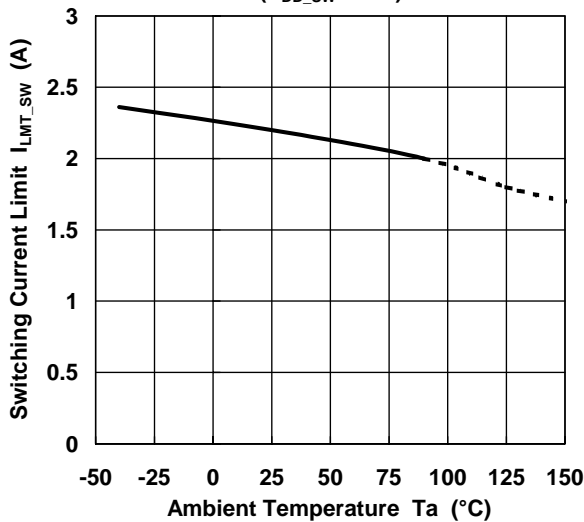
Reference Voltage vs. Temperature  
( $V_{DD\_SW}=3.7V$ )



Output ON Resistance vs. Temperature  
( $V_{DD\_SW}=3.7V$ ,  $I_{SW}=100mA$ )

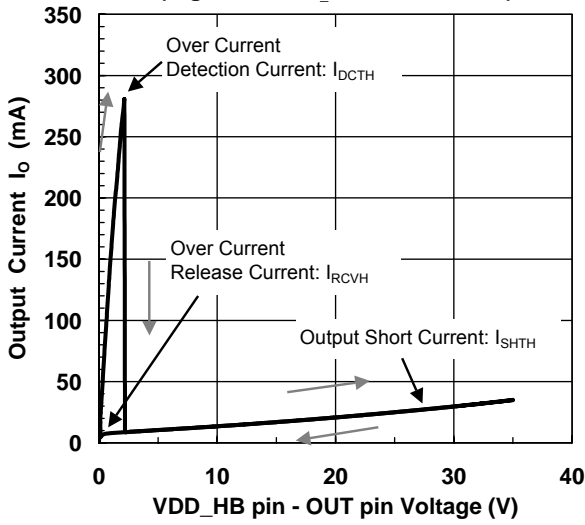


Switching Current Limit vs. Temperature  
( $V_{DD\_SW}=3.7V$ )

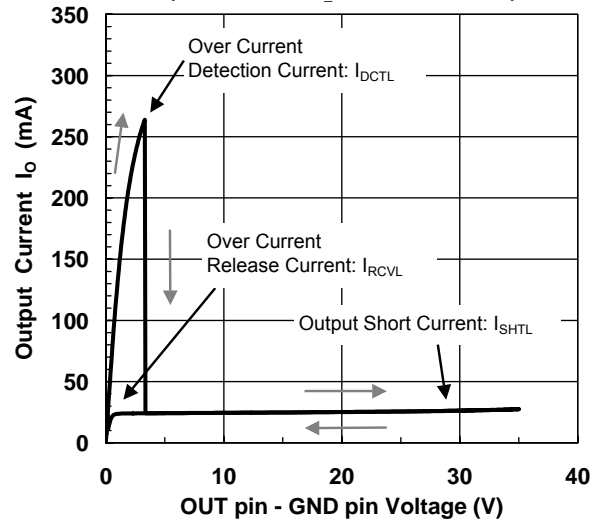


## ■ TYPICAL CHARACTERISTICS (Half Bridge Driver Block)

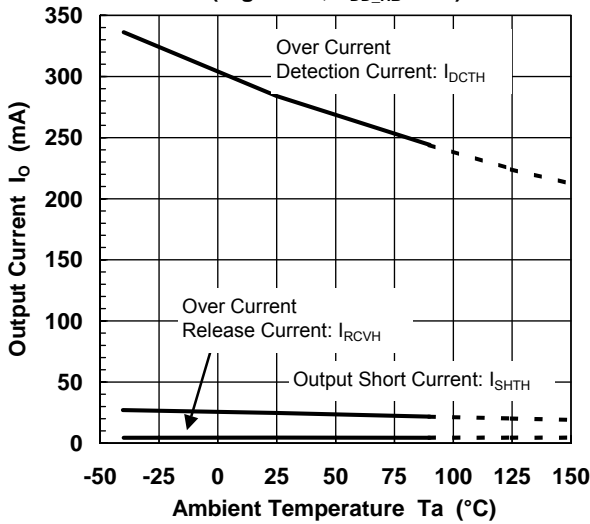
**Output Current Limit Characteristics (High Side,  $V_{DD\_HB}=35V$ ,  $T_a=25^\circ C$ )**



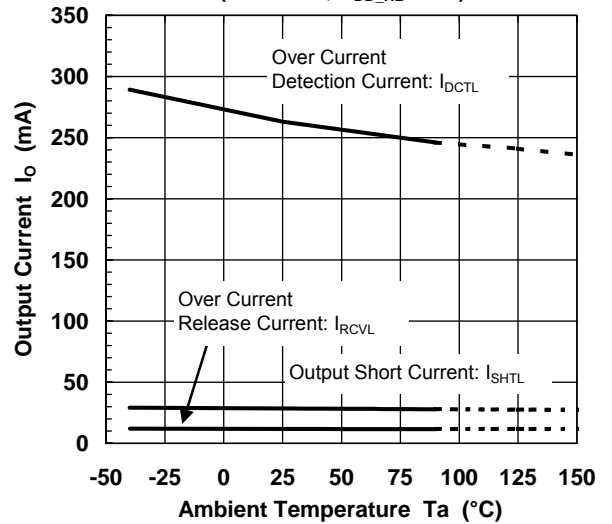
**Output Current Limit Characteristics (Low Side,  $V_{DD\_HB}=35V$ ,  $T_a=25^\circ C$ )**



**Output Current Limit vs. Temperature (High Side,  $V_{DD\_HB}=35V$ )**



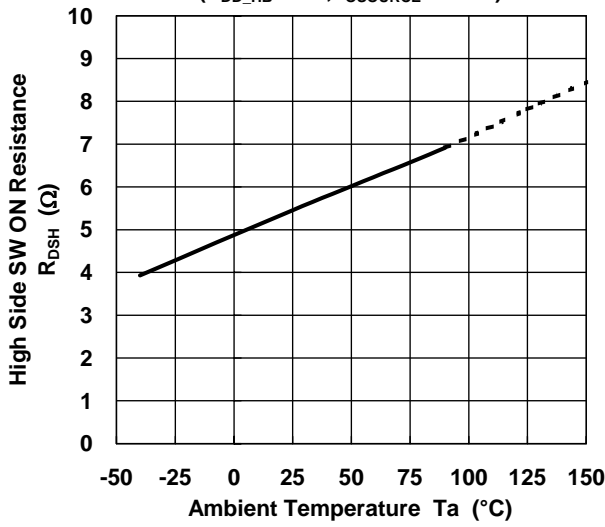
**Output Current Limit vs. Temperature (Low Side,  $V_{DD\_HB}=35V$ )**



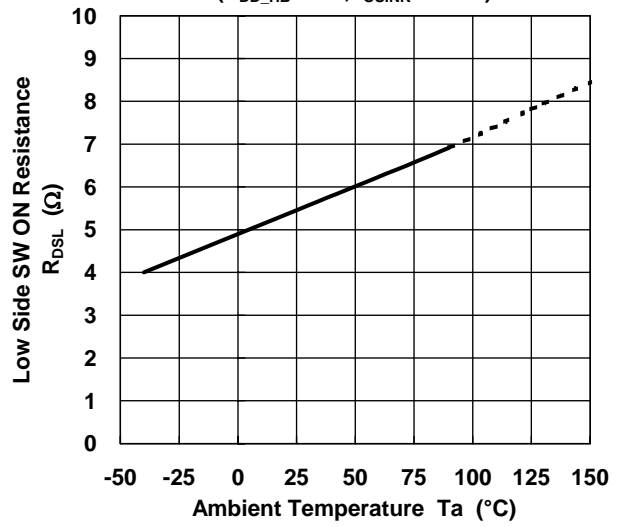


■ TYPICAL CHARACTERISTICS (Half Bridge Driver Block)

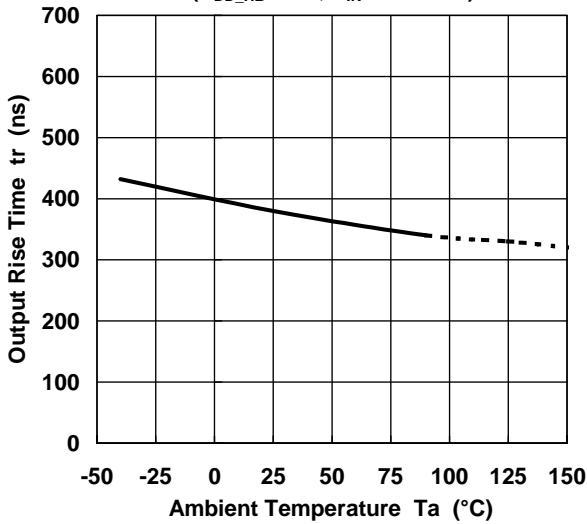
High Side SW ON Resistance vs. Temperature  
( $V_{DD\_HB}=25V$ ,  $I_{OSOURCE}=20mA$ )



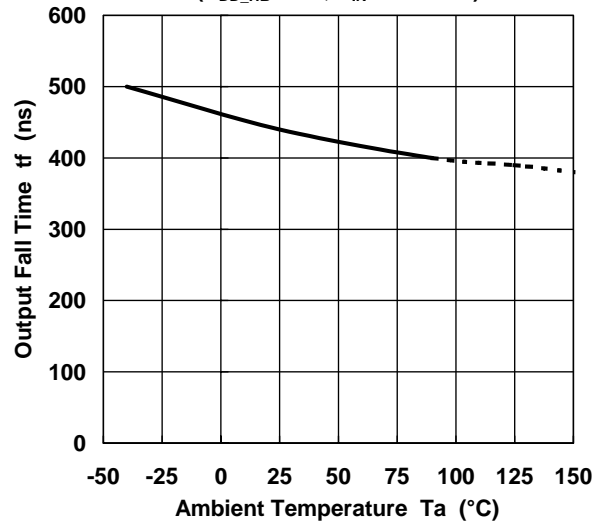
Low Side SW ON Resistance vs. Temperature  
( $V_{DD\_HB}=25V$ ,  $I_{OSINK}=20mA$ )



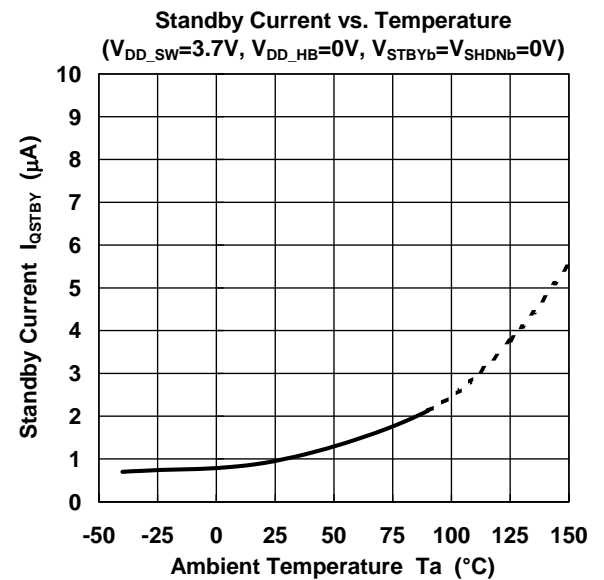
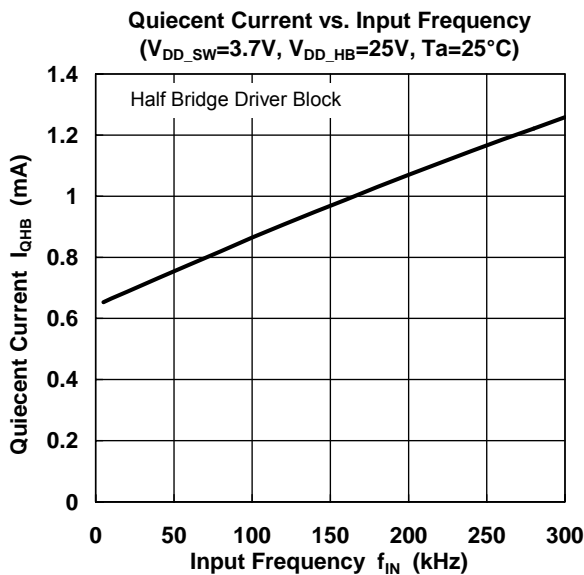
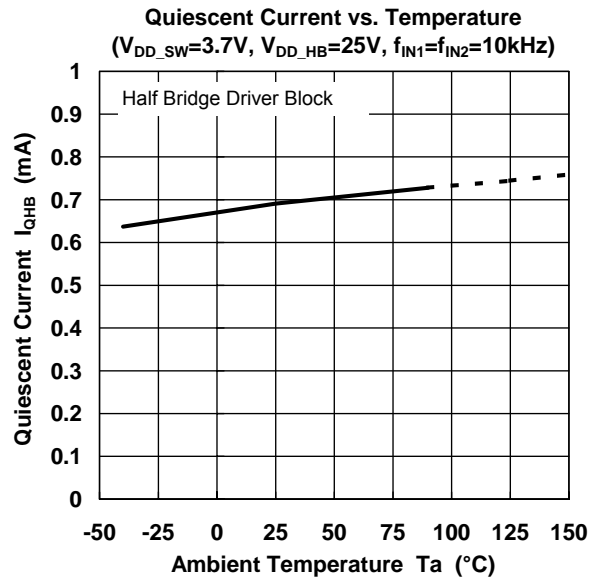
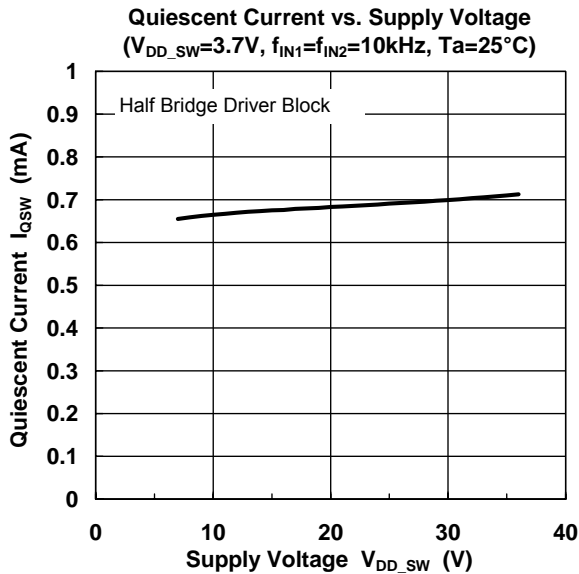
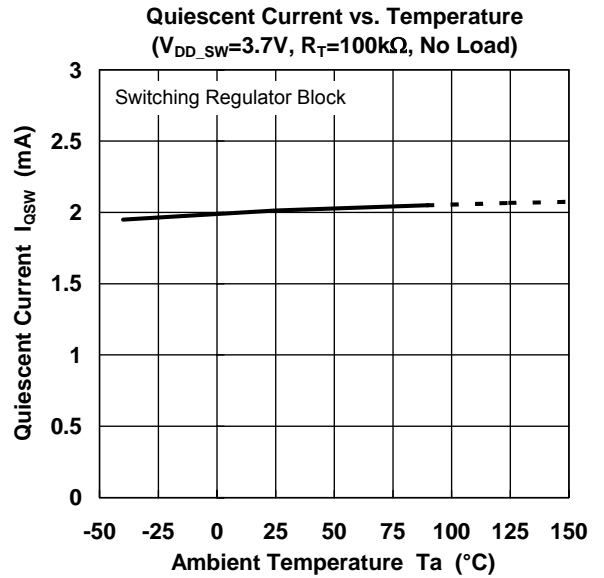
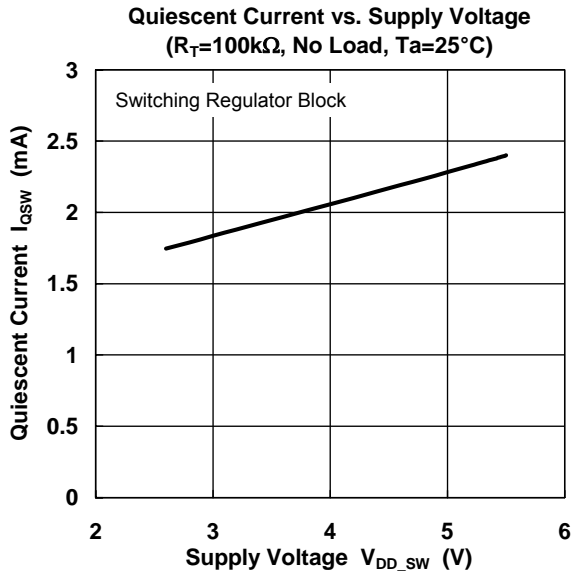
Output Rise Time vs. Temperature  
( $V_{DD\_HB}=25V$ ,  $V_{IN}=0$  to 3.3V)



Output Fall Time vs. Temperature  
( $V_{DD\_HB}=25V$ ,  $V_{IN}=0$  to 3.3V)



## ■ TYPICAL CHARACTERISTICS (General Characteristics)



■ Switching Regulator Block Pin Operation Table

INPUT		OUTPUT			Mode
STBYb	VDD_SW	FLT	Feed back Switch	Power MOS FET	
L	–	Hi-Z	OFF	OFF	Stand-by
H	$< V_{DUVLO\_SW}$	L	OFF	OFF	UVLO
H	$\geq V_{RUVLO\_SW}$	Hi-Z	ON	ON	Active

INPUT		OUTPUT			Mode
Tj	I <sub>sw</sub>	FLT	Feed back Switch	Power MOS FET	
$>165^{\circ}\text{C}$	–	L	OFF	OFF	TSD (*4)
–	$\geq I_{LMTSW}$	L	OFF	OFF	OCP (*5)

(\*4) After the TSD function operates, it returns by  $T_j < 125^{\circ}\text{C}$ .

(\*5) Power MOSFET is controlled by a pulse-by-pulse after an OCP function.

■ Switching Regulator Block Pin Operation Table

INPUT		OUTPUT	
IN1	IN2	OUT1	OUT2
L	L	L	L
L	H	L	H
H	L	H	L
H	H	H	H

INPUT				OUTPUT			Mode	
IN1, IN2	STBYb	SHDNb	VDD_HB	FLT	OUT1	OUT2	SW.REG	Half Bridge Driver
L or H	L	L	–	Hi-Z	Hi-Z	Hi-Z	Stand-by	
L or H	L	H	–	Hi-Z	Hi-Z	Hi-Z	Stand-by	
L or H	H	L	$< V_{DUVLO\_HB}$	L	Hi-Z	Hi-Z	Active	UVLO
L or H	H	L	$\geq V_{RUVLO\_HB}$	Hi-Z	Hi-Z	Hi-Z	Active	Shutdown
L or H	H	H	$< V_{DUVLO\_HB}$	L	Hi-Z	Hi-Z	Active	UVLO
L or H	H	H	$\geq V_{RUVLO\_HB}$	Hi-Z	L or H	L or H	Active	

INPUT			OUTPUT			Mode
Tj	I <sub>OUT1</sub>	I <sub>OUT2</sub>	FLT	OUT1	OUT2	
$>165^{\circ}\text{C}$	–	–	L	Hi-Z	Hi-Z	TSD (*4)
–	$\geq I_{DCTH1}, I_{DCTL1}$	–	Hi-Z	I <sub>SHTH1</sub> , I <sub>SHTL1</sub>	L or H	CC (*6)
–	–	$\geq I_{DCTH2}, I_{DCTL2}$	Hi-Z	L or H	I <sub>SHTH2</sub> , I <sub>SHTL2</sub>	CC (*6)

(\*6) After CC(Constant Current) function, an output is controlled by constant current.

## ■ Timing Chart

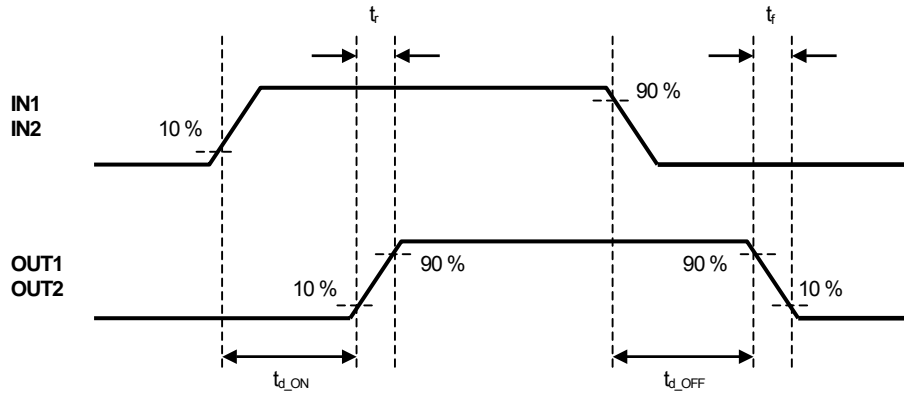


Fig. 1. Output Rise/Fall Time, Rise/Fall Delay Time

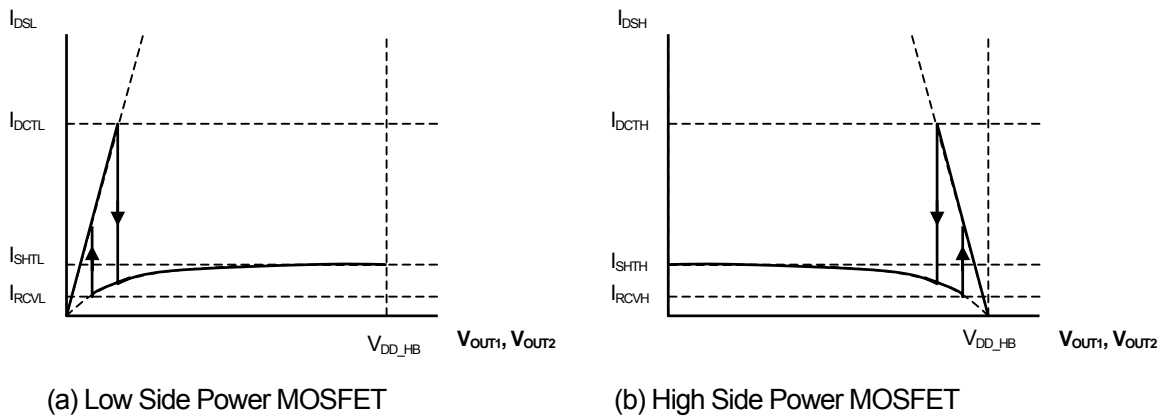
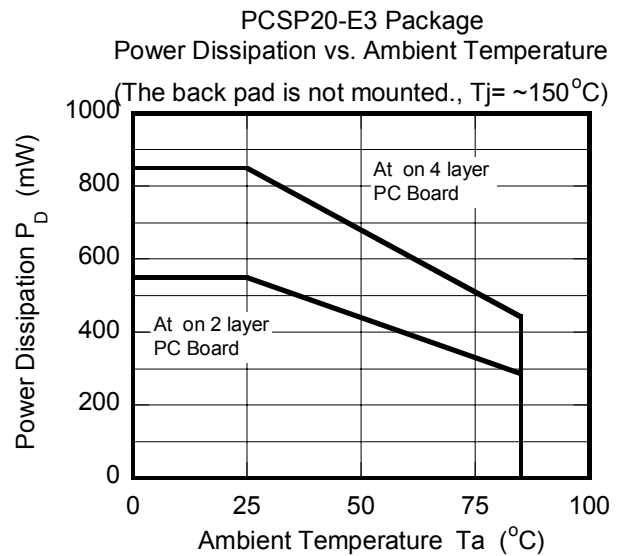
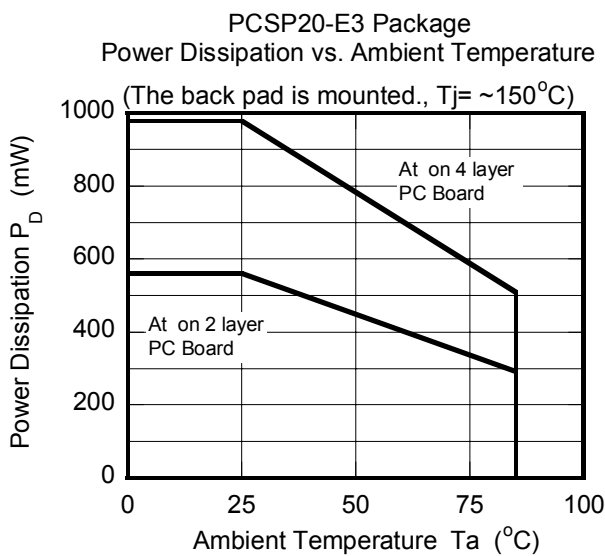
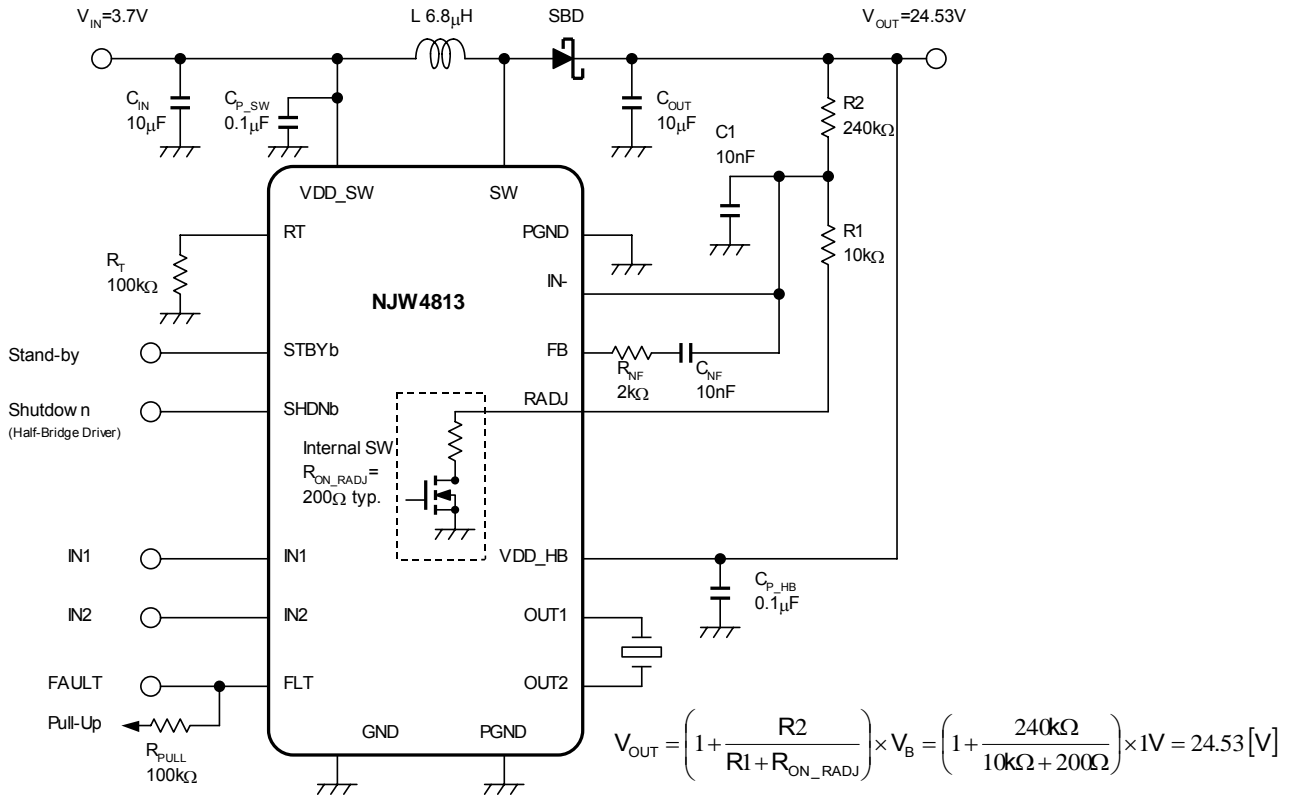


Fig. 2. Output Current Limit Circuit

## ■ Power Dissipation vs. Ambient Temperature



## APPLICATION EXAMPLE



## MEMO

**[CAUTION]**

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