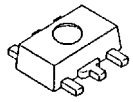
Single High Side Switch

■ GENERAL DESCRIPTION

The NJW4830 is the single high-side switch that can supply 0.5A.
The active clamp circuit, overcurrent and thermal shutdown are built-in with Pch MOS FET.

It can be controlled by a logic signal (3V/5V) directly. Therefore, it is suitable for Car accessory, Industrial Equipments and other applications.

■ PACKAGE OUTLINE

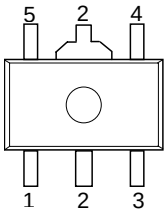


NJW4830U2

■ FEATURES

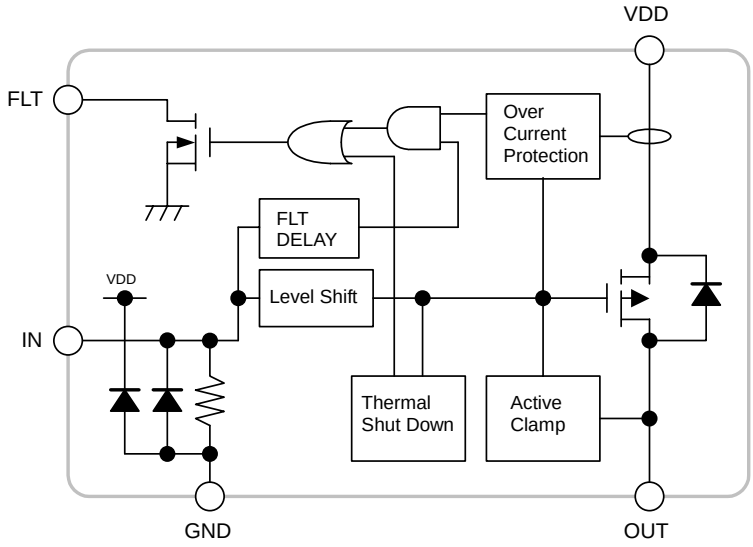
- Drain-Source Voltage 45V
- Drain Current 0.5A
- Corresponding with Logic Voltage Operation: 3V/5V
- Low On-Resistance 0.35Ω (typ.)
- Low Consumption Current 110μA (typ.)
- Active Clamp Circuit
- Over Current Protection
- Thermal Shutdown
- Package Outline SOT89-5

■ PIN CONFIGURATION



1. IN
2. GND
3. FLT
4. VDD
5. OUT

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	SYNBOL	RATINGS	UNIT	REMARK
Drain-Source Voltage	V_{DS}	+45	V	VDD–OUT Pin
Supply Voltage	V_{DD}	+45	V	VDD–GND Pin
Input Voltage	V_{IN}	–0.3 to +6	V	IN–GND Pin
FLT Pin Voltage	V_{FLT}	–0.3 to +6	V	FLT–GND Pin
Power Dissipation	P_D	625 (*1) 2,400 (*2)	mW	–
Active Clamp Tolerance (Single Pulse)	E_{AS}	10	mJ	–
Active Clamp Current	I_{AP}	0.5	A	–
Junction Temperature	T_j	–40 to +150	°C	–
Operating Temperature	T_{opr}	–40 to +85	°C	–
Storage Temperature	T_{stg}	–50 to +150	°C	–

(*1): Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard size, 2Layers, Cu area 100mm^2)

(*2): Mounted on glass epoxy board. (76.2×114.3×1.6mm:based on EIA/JDEC standard, 4Layers)

(For 4Layers: Applying 74.2×74.2mm inner Cu area and a thermal via hall to a board based on JEDEC standard JESD51-5)

■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	REMARK
Drain–Source Voltage	V_{DS}	0	–	40	V	VDD–OUT Pin
Supply Voltage	V_{DD}	4.6	–	40	V	VDD–GND Pin
Output Current	I_O	0	–	0.5	A	VDD–OUT Pin
Input Pin Voltage	V_{IN}	0	–	5.5	V	IN–GND Pin
FLT Pin Voltage	V_{FLT}	0	–	5.5	V	FLT–GND Pin

■ ELECTRICAL CHARACTERISTICS

(Unless otherwise noted, V_{DS}=13V, Ta=25°C)

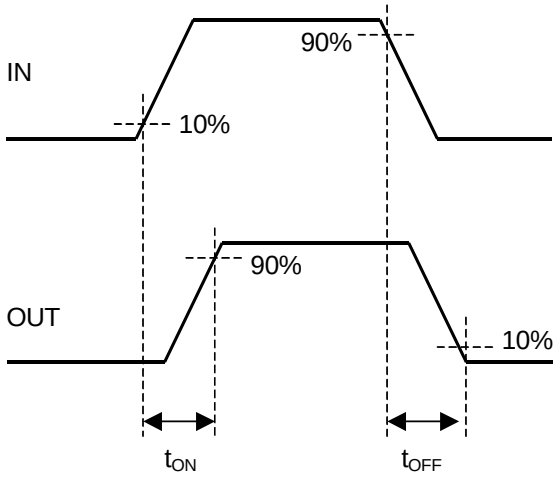
PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Drain-Source Output Clamp Voltage	V_{DSS_CL}	V_{IN}=0V, I_O=1mA, V_{DD}=40V	V_{DD}-45	–	–	V
High Level Input Voltage	V_{IH}	I_O=10mA	2.64	–	–	V
Low Level Input Voltage	V_{IL}	I_O=100μA	–	–	0.9	V
Protection Circuit Function Input Voltage Range	V_{IN_opr}		2.64	–	5.5	V
OUT Pin Leak Current at OFF State	$I_{OLEAKOUT}$	V_{IN}=0V, V_{DD}=40V	–	–	1	μA
Quiescent Current 1	I_{DD1}	V_{IN}=0V, V_{DD}=40V	–	–	1	μA
Quiescent Current 2	I_{DD2}	V_{IN}=5V	–	110	150	μA
Input Current	I_{IN}	V_{IN}=5V	–	150	190	μA
On-state Resistance	R_{DS_ON}	V_{IN}=5V, I_O=0.5A	–	0.35	0.6	Ω
Over Current Protection1	I_{LIMIT1}	V_{IN}=5V, V_{DS}=5V	0.5	0.75	1.2	A
Over Current Protection2	I_{LIMIT2}	V_{IN}=5V, V_{DD}=V_{DS}=40V	0.1	0.4	–	A
Turn-on Time	t_{ON}	V_{IN}=0 to 5V, I_O=0.5A	–	20	–	μs
Turn-off Time	t_{OFF}	V_{IN}=5 to 0V, I_O=0.5A	–	20	–	μs
OUT–VDD Voltage Difference	V_{PDOV}	V_{IN}=0V, I_{ORH}=1A	–	0.85	1.2	V
FLT Pin Low Level Output Voltage	V_{VFLT}	I_{FLT}=500μA	–	0.25	0.5	V
FLT Pin Leak Current at High Level	$I_{OLEAKFLT}$	V_{FLT}=5.5V	–	–	1	μA
FLT Delay Time	t_{DFLT}	V_{IN}=0 to 5V, V_{DS}=22V	–	5	–	ms

■ TRUTH TABLE

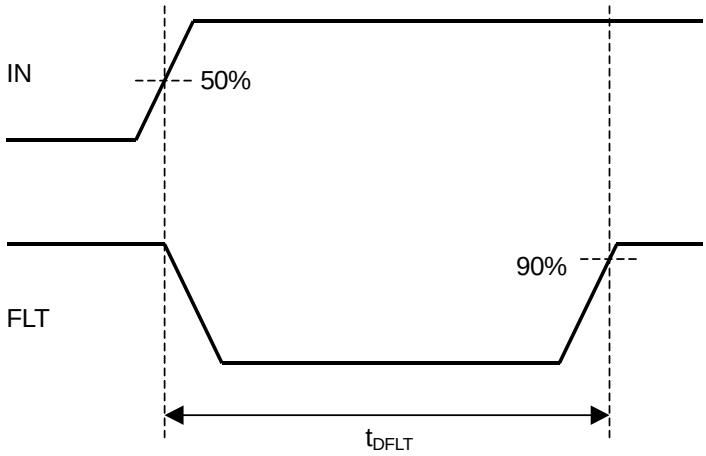
Input Signal	Operating Condition	FLT Pin	Output Status
L	Normal	H	OFF
H		L	ON
L	Over Current I_{LIMIT1}	H	OFF
H		L	I_{LIMIT1}
L	Over Current I_{LIMIT2}	H	OFF
H		L	I_{LIMIT2}
L	T_j>150°C	H	OFF
H		H	OFF

■ TIMING CHRAT

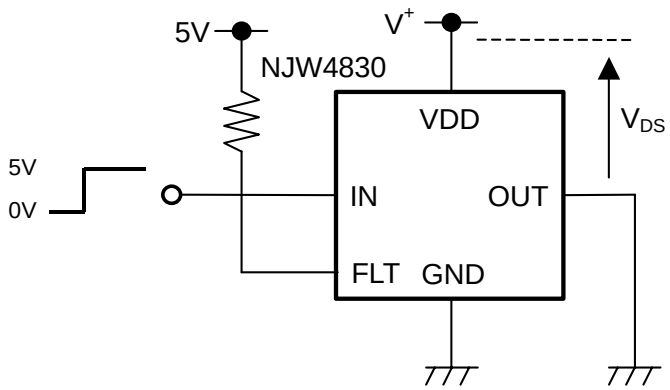
ON, OFF Switching Time (V_{IN}=0 to 5V, V_{DD}=13V, I_O=0.5A)

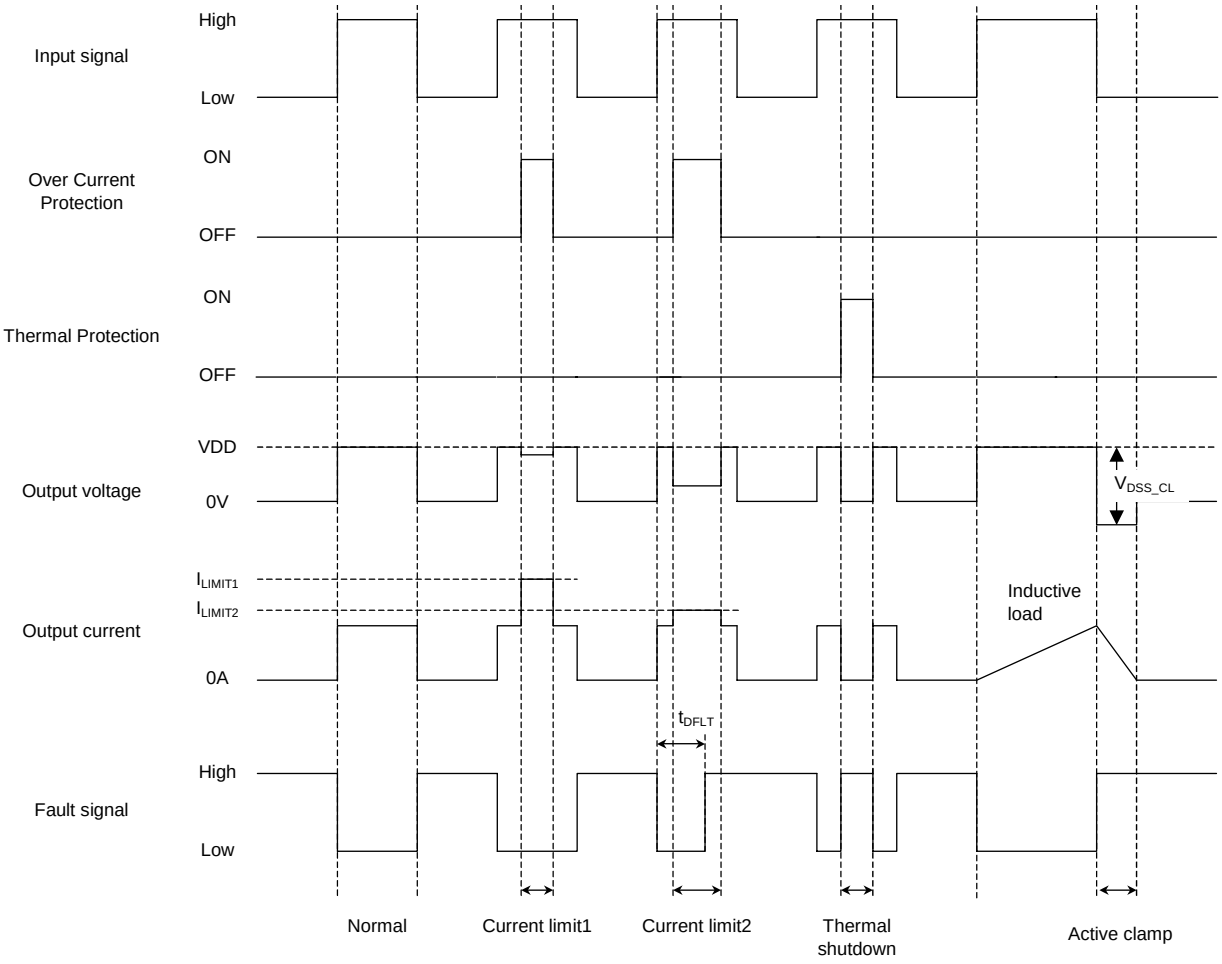


FLT Delay Time (V_{IN}=0 to 5V, V_{DD}=V_{DS}=22V)

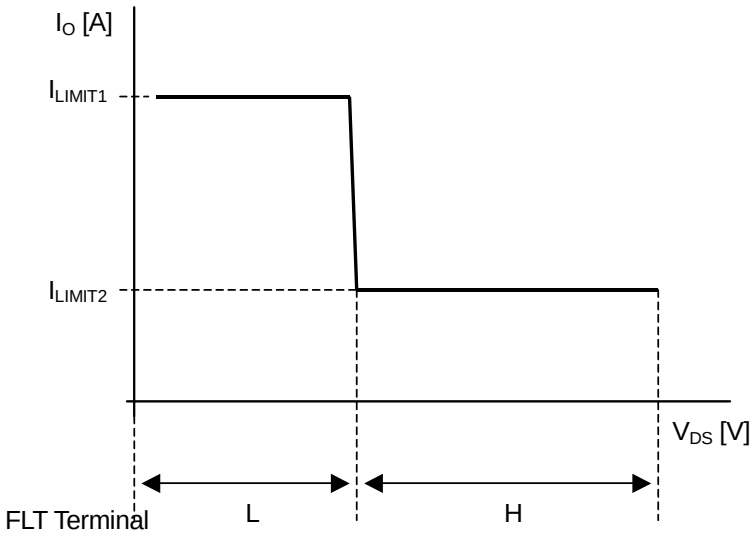


FLT Delay Time Measurement Circuit

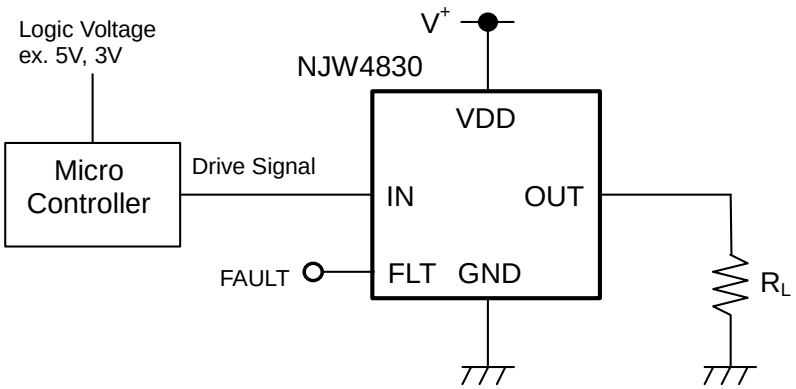



Input signal
High
Low
Over Current Protection
ON
OFF
Thermal Protection
ON
OFF
Output voltage
VDD
0V
V_{DSS_CL}
Output current
I_{LIMIT1}
I_{LIMIT2}
0A
Inductive load
t_{DFLT}
Fault signal
High
Low
Normal
Current limit1
Current limit2
Thermal shutdown
Active clamp

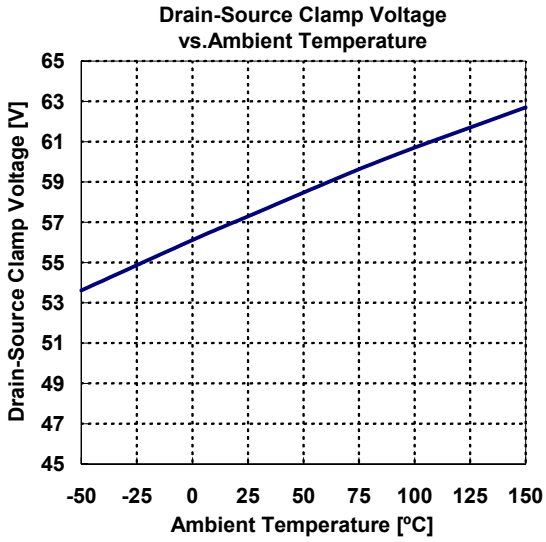
■ OVER CURRENT PROTECTION CHARACTERISTIC

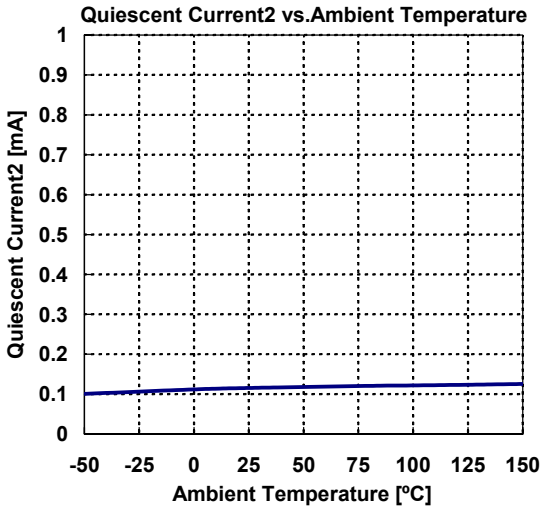


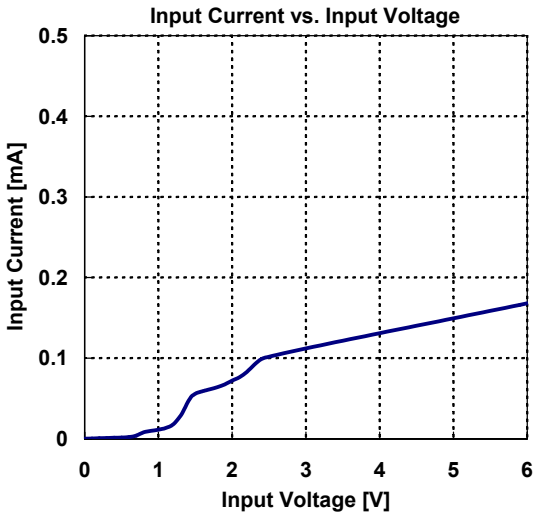
■ TYPICAL APPLICATION

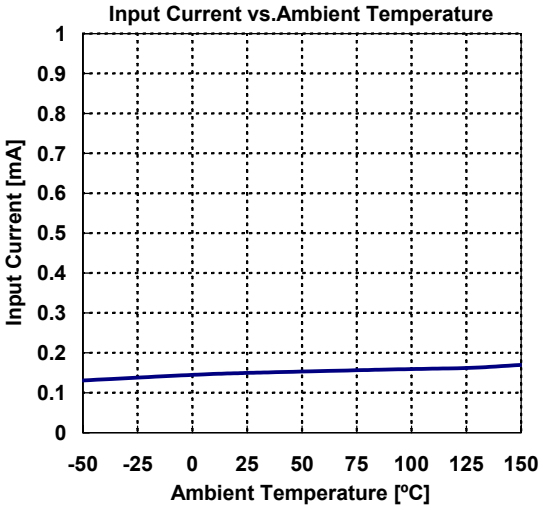


■ CHARACTERISTICS









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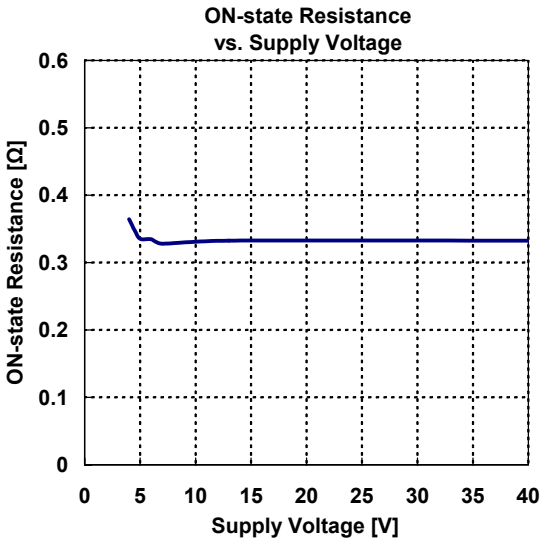

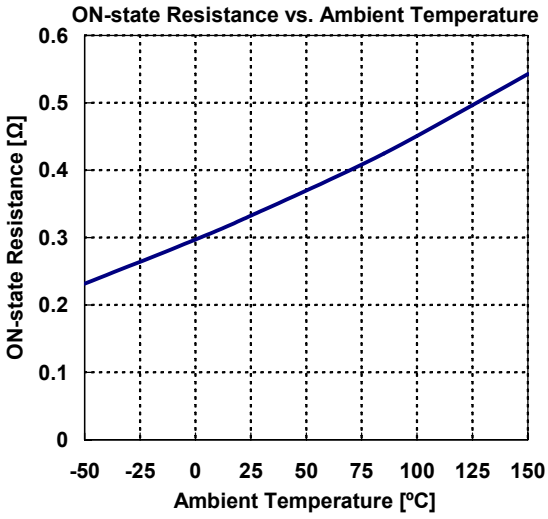

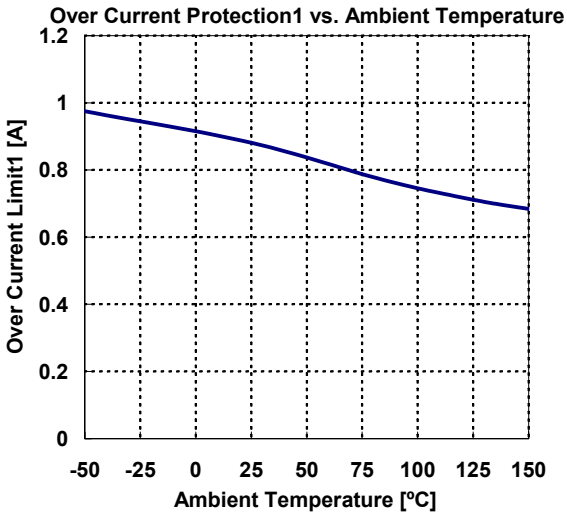

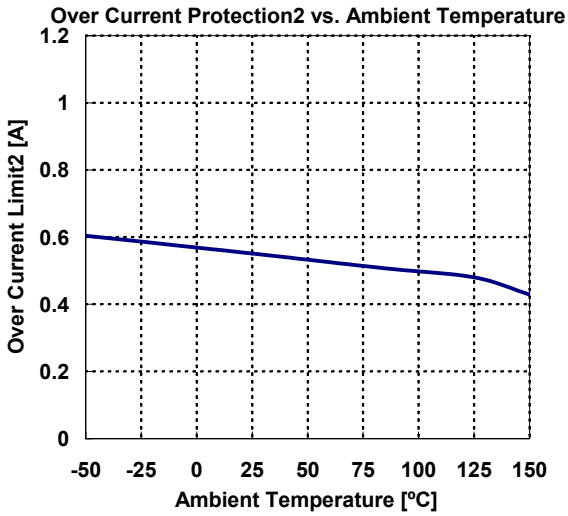

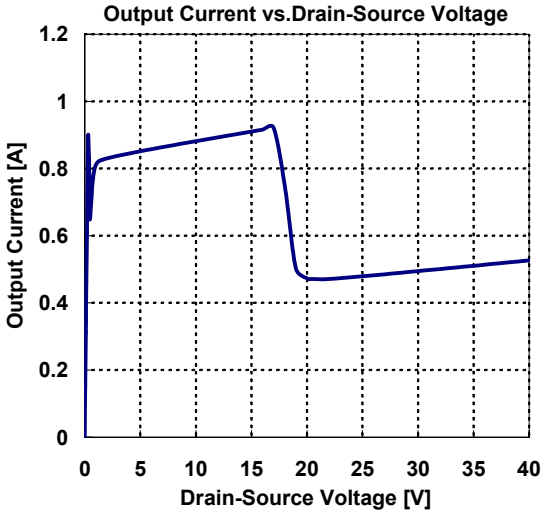

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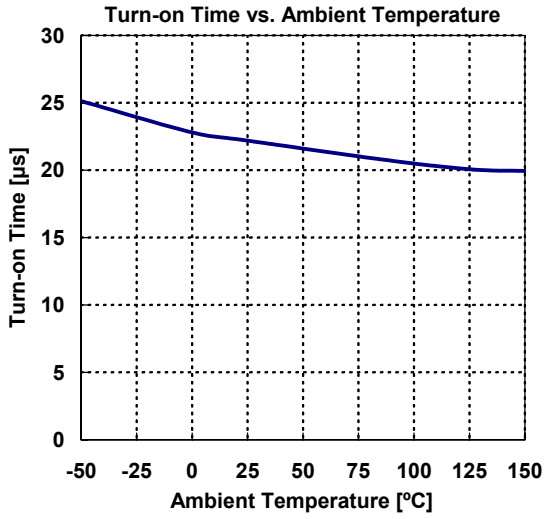

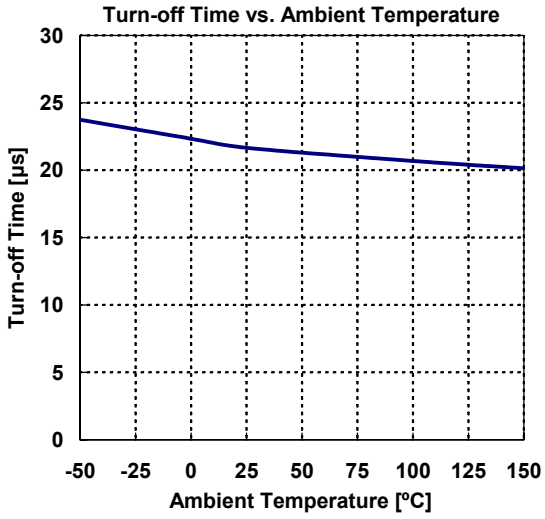

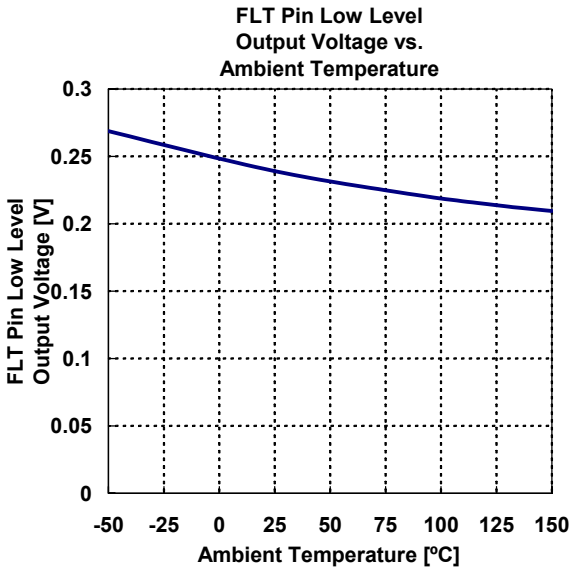

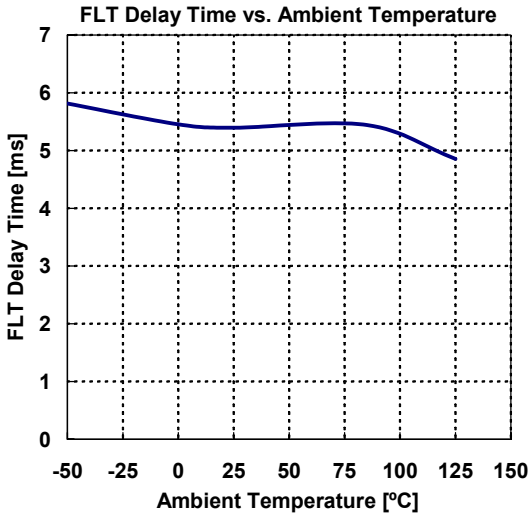

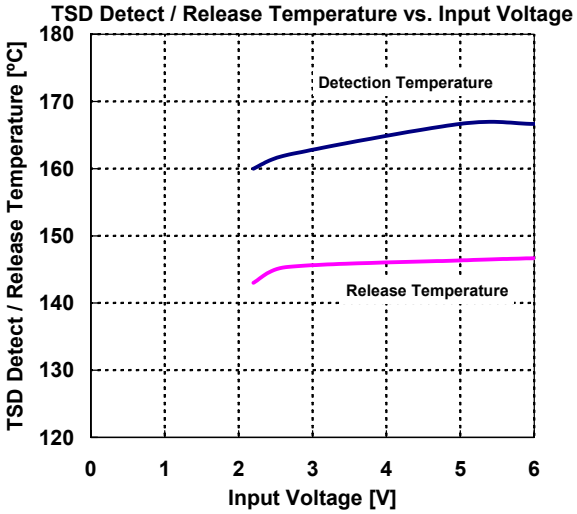

■ Regarding Active Clamp Capacity of High/Low side Switch Products

● What is “Active Clamp Capacity”.

The IC might suffer to damage by the inductive kickback at the transient time of ON state to OFF state, when an inductive load such as a solenoid or motor is used for the load of the high-side/low-side switch.

The protection circuit for the inductive kickback is the active clamp circuit. The energy that can be tolerated by the active clamp circuit is called "Active Clamp Capacity (E_{AS})".

When using an inductive load to the high-side/low-side switch, you should design so that the E_{SW} does not exceed the active clamp capability.

● IC operation without an external protection parts (Fig 1)

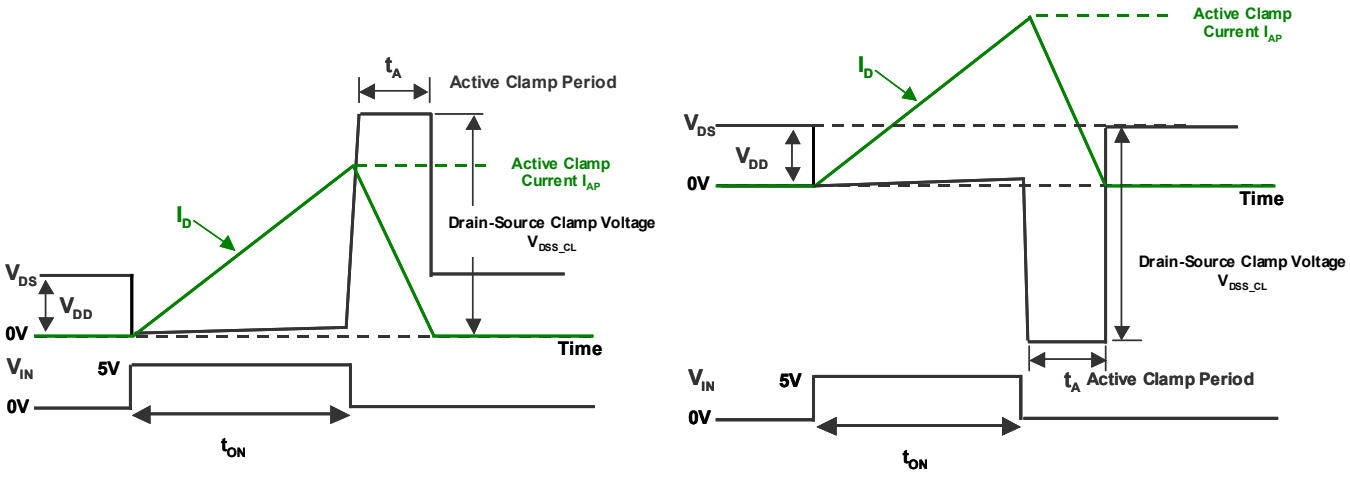

Fig1. Active Clamp Waveform (Left: Low-side Switch / Light High-side Switch)

At when the V_{IN} turns off, the drain-source voltage (V_{DS}) increases rapidly by the behavior of the inductive load that is keeping current flowing. However, it will be clamped at V_{DSS_CL} by the active clamp circuit. At the same time, the drain current is flowed by adjusting the gate voltage of the output transistor, and the energy is dissipated at the output transistor. The energy: E_{SW} is shown by the following formula.

$$E_{SW} = \int_0^{t_A} V_{DS}(t) \cdot I_D(t)dt = \frac{1}{2} L I_{AP}^{\ 2} \cdot \frac{V_{DSS\_CL}}{V_{DSS\_CL} - V_{DD}}$$

The E_{SW} is consumed inside IC as heat energy. However, the thermal shutdown does not work when the V_{IN} is 0V. Therefore in worst case the IC might break down. When using the active clamp, you should design E_{SW} does not exceed the E_{AS}.

- Application Hint

The simplest protection example is to add an external flywheel diode at the load to protect IC from an inductive kickback. (Fig.2)

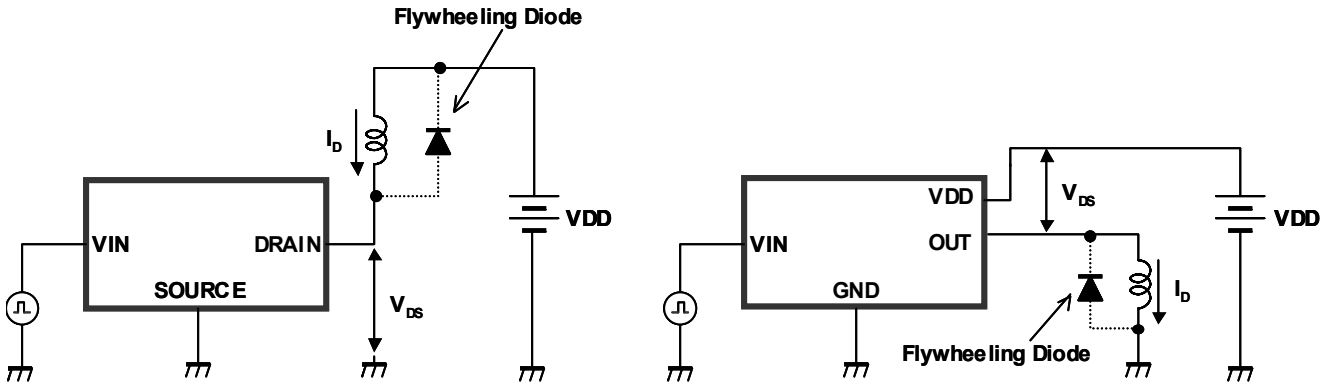

Fig 2. Application Circuit of Inductance Load Driving (Left: Low-side Switch / Light High-side Switch)

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