μPD166011T1J

INTELLIGENT POWER DEVICE

R07DS0851EJ0100
Rev.1.00
Aug 20, 2012

1. Overview

1.1 Description

Dual N-channel high-side switch with charge pump, diagnostic feedback with load current sense and embedded protection functions.

1.2 Features

- Built-in charge pump
- Low on-state resistance
- Short circuit protection
  — Shutdown by over current detection and over load detection
- Over temperature protection
  — Shutdown with auto-restart on cooling
- Built-in diagnostic function
  — Proportional load current sensing
  — Defined fault signal in case of abnormal load condition
- Loss of ground protection
- Under voltage lock out
- Active clamp operation at inductive load switch off
- AEC Qualified
- RoHS compliant with pure tin plating

1.3 Application

- Light bulb (~55 W) switching
- Switching of all types of 14 V DC grounded loads, such as LED, inductor, resistor and capacitor

2. Ordering Information

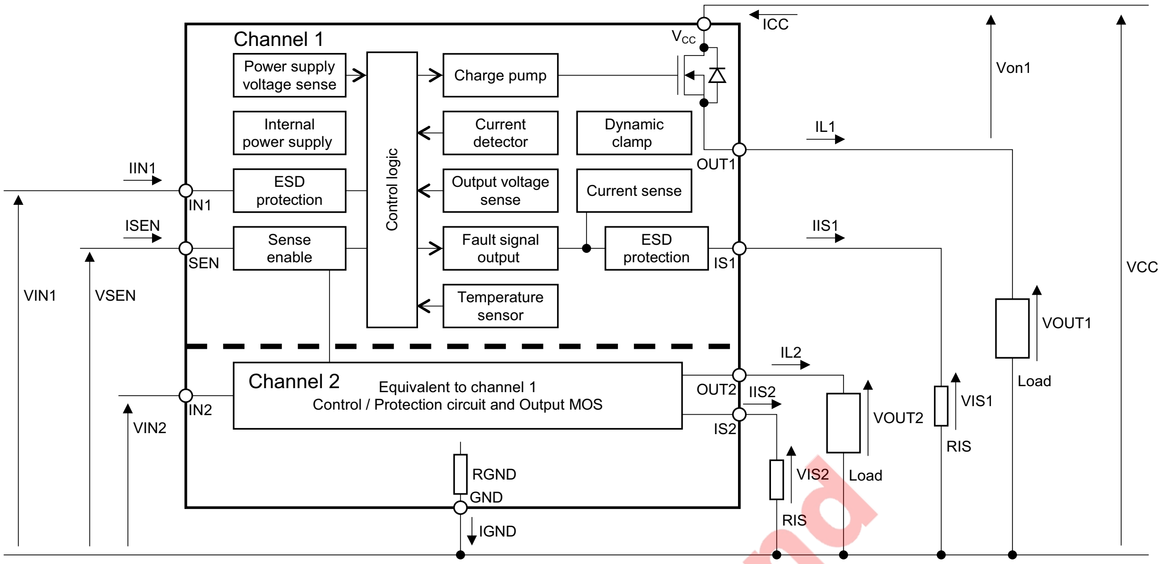
Part No.	Lead Plating	Packing	Package
μPD166011T1J-E1-AY *1	Pure Mate Sn	Tape 1500 p/reel	12-pin Power HSSOP (PRSP0013FA-A)

Note: *1 Pb-free (This product does not contain Pb in the external electrode)

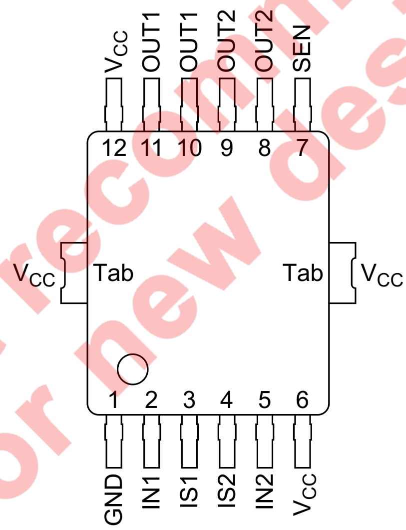
Note: The information contained in this document is the one that was obtained when the document was issued, and may be subject to change.

3. Specification

3.1 Block Diagram



3.2 Pin Arrangement



(Top view)

3.2.1 Pin Function

Pin Name	Pin Function	Recommended Connection
GND	Ground connection	Connected to GND
INn	Input signal for channel n (n = 1 to 2)	Connected to MCU port through 2 k-10 k serial resistor
ISn	Current sense and Diagnosis output signal channel n (n = 1 to 2)	Connected to GND through a 2 k-5 k resistor
SEN	Sense enable input	Connected to MCU port through 2 k-10 k serial resistor
OUTn	Protected high-side power output channel n (n = 1 to 2)	Connected to load with small 50-100 nF capacitor in parallel
V_{CC}	Positive power supply for logic supply as well as output power supply	Connected to battery voltage with small 100 nF capacitor in parallel

3.3 Absolute Maximum Ratings

(T_A = 25°C, unless otherwise specified)

Parameter	Symbol	Rating	Unit	Test Conditions	
V_{CC} voltage	V_{CC1}	28	V		
V_{CC} voltage at reverse battery condition	V_{CC2}	–16	V	At nominal load current.	
V_{CC} voltage for full short circuit protection	V_{CC3}	28	V		
V_{CC} voltage under load dump condition	V_{CC4}	40	V	R_I = 1 Ω, R_L = 3.2 Ω, R_{IS} = 2 kΩ, t_d = 400 ms	
Load current	I_L	Self limited	A		
Total power dissipation for whole device (DC)	P_D	2.0	W	T_A = 85°C, Device on 50 mm × 50 mm × 1.5 mm epoxy PCB FR4 with 6 cm^2 of 70 μm copper area	
Voltage at IN pin	V_{IN}	–0.5 to 10	V	V_{CC} = 9 V to 16 V	
		V_{CC2} to 0		R_{IN} = 2 kΩ, At reverse battery condition, t < 2 min.	
Voltage at SEN pin	V_{SEN}	–0.5 to 10	V	V_{CC} = 9 V to 16 V	
		V_{CC2} to 0		R_{SEN} = 2 kΩ, At reverse battery condition, t < 2 min.	
Voltage at IS pin	V_{IS}	–0.5 to V_{CC} + 0.5	V	V_{CC} = 9 V to 16 V	
		V_{CC2} to 0		R_{IS} = 2 kΩ, At reverse battery condition, t < 2 min.	
Inductive load switch-off energy dissipation single pulse	E_{AS}	64	mJ	V_{CC} = 13.5 V, I_L = 5.5 A, $T_{ch,start}$ < 150°C	
Maximum allowable energy under short circuit condition	$E_{AS(SC)}$	120	mJ	V_{CC} = 18 V, $T_{ch,start}$ < 150°C, R_{supply} = 10 mΩ, R_{short} = 50 mΩ, L_{supply} = 5 μH, L_{short} = 15 μH	
Channel temperature	T_{ch}	–40 to +150	°C		
Dynamic temperature increase while switching	ΔT_{ch}	60	°C		
Storage temperature	T_{stg}	–55 to +150	°C		
ESD susceptibility	V_{ESD}	2000	V	HBM	AEC-Q100-002 std. R = 1.5 kΩ, C = 100 pF
		200	V	MM	AEC-Q100-003 std. R = 0 Ω, C = 200 pF

Note: All voltages refer to ground pin of the device.

3.4 Thermal Characteristics

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Test Conditions	
Thermal characteristics	$R_{th(ch-a)}$	—	30	—	°C/W	All channel	Device on 50 mm × 50 mm × 1.5 mm epoxy PCB FR4 with 6 cm^2 of 70 μm copper area
	$R_{th(ch-c)}$	—	1.3	—	°C/W	All channel	

3.5 Electrical Characteristics

3.5.1 Operation Function

(T_{ch} = –40 to 150°C, V_{CC} = 9 to 16 V, unless otherwise specified)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Test Conditions	
Operating voltage	V_{CC}	5.5	—	28	V	V_{IN} = 4.5 V, V_{on} < 0.5 V, R_L = 12 Ω	
Operating current per channel	I_{GND}	—	2.5	5.5	mA	one channel	V_{IN} = 5 V
		—	5.0	10		all channel	
Standby current	$I_{CC(off)}$	—	0.1	1.0	μA	T_{ch} = 25°C	V_{IN} = 0 V, V_{SEN} = 0 V, V_{OUT} = 0 V, V_{IS} = 0 V
		—	—	8.0		T_{ch} = 125°C	
		—	—	24		T_{ch} = –40 to 150°C	
On state resistance per channel	R_{on}	—	19	25	mΩ	I_L = 5 A, T_{ch} = 25°C	
		—	35	48		I_L = 5 A, T_{ch} = 150°C	
Output voltage drop limitation at small load current	$V_{on(NL)}$	—	50	—	mV	I_L < 0.5 A	
Output clamp	$V_{on(CL)}$	20	24	28	V	V_{CC} = 13.5 V, I_L = 40 mA	
Output leakage current per channel	$I_{L(OFF)}$	—	—	5	μA	V_{IN} = 0 V	
Input resistance *1	R_{IN}	—	100	—	Ω		
Low level input voltage	V_{IL}	–0.3	—	1.0	V		
High level input voltage	V_{IH}	3.0	—	10	V		
Low level input current	I_{IL}	2	—	30	μA	V_{IN} = 0.4 V	
High level input current	I_{IH}	5	—	75	μA	V_{IN} = 5 V	
Sense enable input resistance *1	R_{SEN}	—	100	—	Ω		
Sense enable low level input voltage	V_{SENL}	–0.3	—	1.0	V		
Sense enable high level input voltage	V_{SENH}	3.0	—	10	V		
Sense enable low level input current	I_{SENL}	2	—	30	μA	V_{SEN} = 0.4 V	
Sense enable high level input current	I_{SENH}	5	—	75	μA	V_{SEN} = 5 V	
Turn on delay time to 10% V_{CC}	$t_{d(on)}$	—	30	100	μs	V_{CC} = 13.5 V, R_L = 3.2 Ω	
Turn off delay time to 90% V_{CC}	$t_{d(off)}$	—	220	600	μs		
Turn on time to 90% V_{CC}	t_{on}	—	100	250	μs		
Turn off time to 10% V_{CC}	t_{off}	—	270	700	μs		
Slew rate 30% to 70% V_{CC}	dv/dton	0.08	0.33	0.6	V/μs		
Slew rate 70% to 30% V_{CC}	–dv/dtoff	0.05	0.35	0.85	V/μs		
Energy at turn on	Eon	—	0.65	—	mJ		
Energy at turn off	Eoff	—	0.55	—	mJ		

Note: *1 Not tested, specified by design

3.5.2 Protection Function

(T_{ch} = –40 to 150°C, V_{CC} = 9 to 16 V, unless otherwise specified)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Test Conditions	
Short circuit detection current	$I_{L5.5,5(SC)}$	—	—	55	A	T_{ch} = –40°C	V_{CC} = 5.5 V, V_{on} = 5 V
		12	28	—		T_{ch} = 25°C	
		10	26	—		T_{ch} = 105°C	
		8	24	—		T_{ch} = 150°C	
	$I_{L13.5,5(SC)}$	—	—	110		T_{ch} = –40°C	V_{CC} = 13.5 V, V_{on} = 5 V
		42.5	75	—		T_{ch} = 25°C	
		33	63	—		T_{ch} = 105°C	
		29.5	55	—		T_{ch} = 150°C	
	$I_{L16,5(SC)}$	—	—	130		T_{ch} = –40°C	V_{CC} = 16 V, V_{on} = 5 V
		55	86	—		T_{ch} = 25°C	
		42.5	70	—		T_{ch} = 105°C	
		38	60	—		T_{ch} = 150°C	
Driving capability	Dr(capa)	200	—	—	mΩ	T_{ch} = 25°C, V_{CC} = 16 V	
		260	—	—		T_{ch} = 105°C, V_{CC} = 16 V	
		290	—	—		T_{ch} = 150°C, V_{CC} = 16 V	
Over load detection voltage 1	$V_{on(OvL)1}$	4.0	5.2	6.4	V		
Over load detection voltage 2	$V_{on(OvL)2}$	0.45	1	1.6	V		
Turn-on check delay after input signal positive slope	$t_{d(OC)}$	400	—	—	μs		
Thermal shutdown temperature	T_{th}	150	175	—	°C		
Thermal hysteresis	ΔT_{th}	—	10	—	°C		
Output voltage drop per channel in case of reverse battery condition	Vds(rev)	—	0.8	0.85	V	T_{ch} = 25°C	I_L = –3.5 A, V_{CC} = –13.5 V
		—	0.61	0.66		T_{ch} = 150°C	
Reverse current through GND pin *1	$-I_{GND}$	—	90	—	mA	V_{CC} = –13.5 V	
Integrated resistor in GND line *1	R_{GND}	—	140	—	Ω		
Output current while GND disconnected *1	$I_{L(GND)}$	—	—	1	mA	I_{IN} = 0 A, I_{SEN} = 0 A, I_{GND} = 0 A, I_{IS} = 0 A	

Note: *1 Not tested, specified by design

3.5.3 Diagnosis Function

(T_{ch} = –40 to 150°C, V_{CC} = 9 to 16 V, V_{SEN} = 5 V, unless otherwise specified)

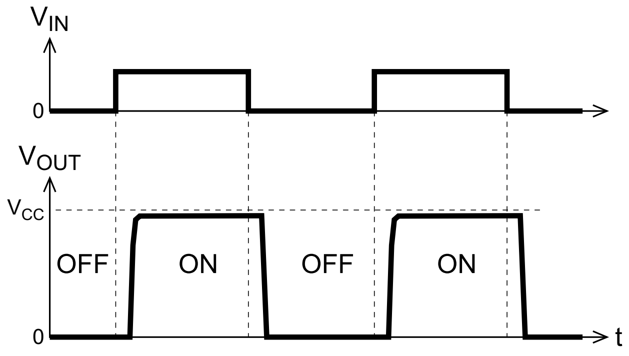
Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Test Conditions
Open load detection threshold at off-state	$V_{OUT(OL)}$	2.0	3.2	4.4	V	V_{IN} = 0 V
Sense signal in case of fault condition	$V_{IS,fault}$	5.0	6.2	8.0	V	V_{IN} = 0 V, I_{IS} = 2.5 mA
Sense signal current limitation	$I_{IS,lim}$	4	—	—	mA	V_{IN} = 0 V
Sense signal invalid after negative input slope	$t_{d(fault)}$	—	—	1.2	ms	V_{IN} = 5 V to 0 V, V_{OUT} = V_{CC}
Fault signal settling time	$t_{s(fault)}$	—	—	200	μs	V_{IN} = 0 V, R_{IS} = 2 kΩ, V_{OUT} = 0 to >$V_{OUT(OL)}$
Current sense ratio	K_{ILIS}	3940	4595	5250		T_{ch} = –40°C, I_L = 6.0 A, V_{IN} = 5 V
		4150	4580	5010		T_{ch} = 25°C, I_L = 6.0 A, V_{IN} = 5 V
		4080	4425	4770		T_{ch} = 150°C, I_L = 6.0 A, V_{IN} = 5 V
		4050	4810	5570		T_{ch} = –40°C, I_L = 3.0 A, V_{IN} = 5 V
		4020	4705	5390		T_{ch} = 25°C, I_L = 3.0 A, V_{IN} = 5 V
		4050	4460	4870		T_{ch} = 150°C, I_L = 3.0 A, V_{IN} = 5 V
		4100	5100	6100		T_{ch} = –40°C, I_L = 0.5 A, V_{IN} = 5 V
		4410	5130	5850		T_{ch} = 25°C, I_L = 0.5 A, V_{IN} = 5 V
		4250	5050	5850		T_{ch} = 150°C, I_L = 0.5 A, V_{IN} = 5 V
Current sense voltage limitation	$V_{IS(lim)}$	5.0	6.2	8.0	V	I_{IS} = 0.5 mA, I_L = 5 A
Current sense leakage/offset current	$I_{IS(LH)}$	—	—	3	μA	V_{IN} = 5 V, I_L = 0 A
Current sense leakage, while diagnostic disable	$I_{IS(dis)}$	—	—	5	μA	V_{SEN} = 0 V, I_L = 5 A
Current sense settling time to IIS static ±10% after positive input slope *1	$t_{sIS(ON)}$	—	—	300	μs	V_{IN} = 0 to 5 V, R_L = 3.2 Ω, R_{IS} = 2 kΩ
Current sense settling time to IIS static ±10% after change of load current *1	$t_{sIS(LC)}$	—	—	50	μs	V_{IN} = 5 V, R_{IS} = 5 kΩ, I_L = 3 A to 5 A
Sense signal settling time	$t_{sIS(SEN)}$	—	—	10	μs	V_{SEN} = 0 V to 5 V, V_{IN} = 0 V, R_{IS} = 5 kΩ, V_{OUT} > $V_{OUT(OL)}$
Sense signal deactivation time *1	$t_{dIS(SEN)}$	—	—	10	μs	V_{SEN} = 5 V to 0 V, V_{IN} = 0 V, R_{IS} = 5 kΩ, V_{OUT} > $V_{OUT(OL)}$

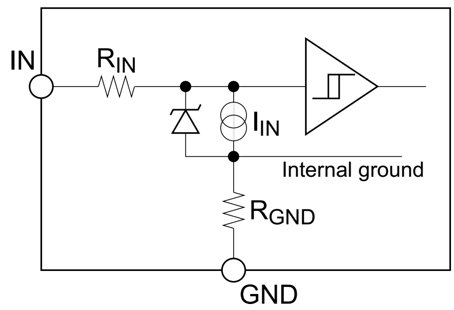
Note: *1 Not tested, specified by design

3.6 Function Description

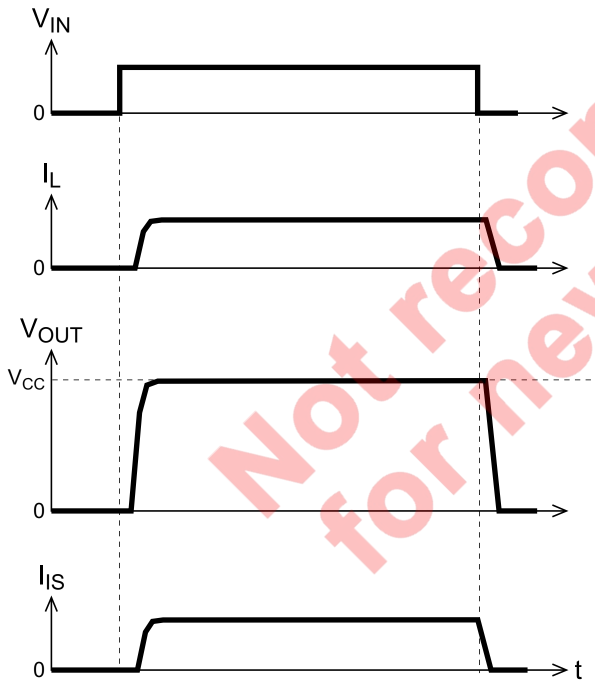
3.6.1 Driving Circuit

The high-side output is turned on, if the input pin is over V_{IH}. The high-side output is turned off, if the input pin is open or the input pin is below V_{IL}. Threshold is designed between V_{IH} min and V_{IL} max with hysteresis. IN pin is pulled down with constant current source.

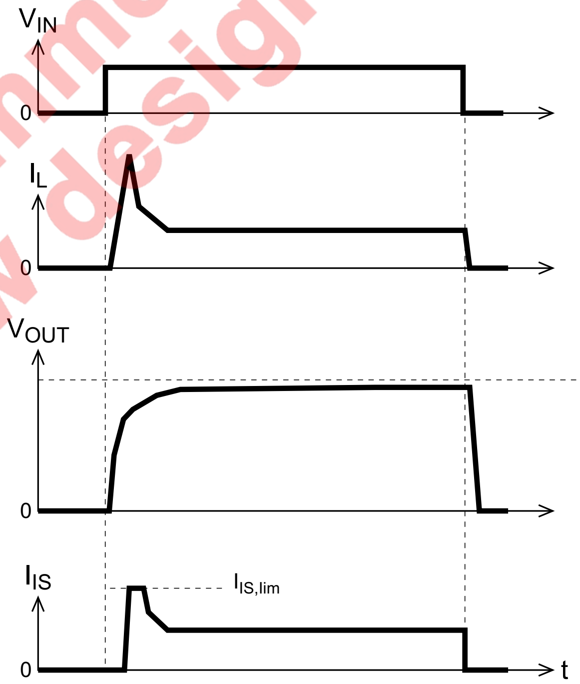




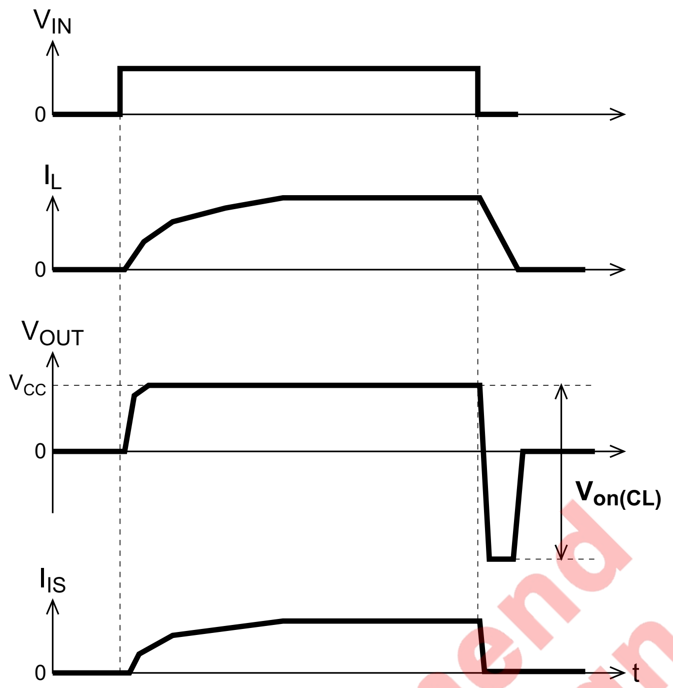
Switching a resistive load



Switching lamps



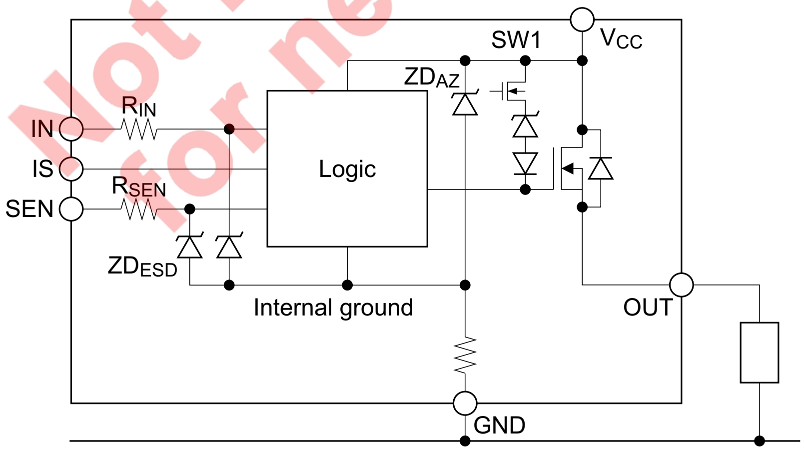
Switching an inductive load



The dynamic clamp circuit works only when the inductive load is switched off. When the inductive load is switched off, the voltage of OUT falls below 0 V. The gate voltage of SW1 is then nearly equal to GND. Next, the voltage at the source of SW1 (= gate of output MOS) falls below the GND voltage.

SW1 is turned on, and the clamp diode is connected to the gate of the output MOS, activating the dynamic clamp circuit.

When the over-voltage is applied to V_{CC}, the gate voltage and source voltage of SW1 are both nearly equal to GND. SW1 is not turned on, the clamp diode is not connected to the gate of the output MOS, and the dynamic clamp circuit is not activated.

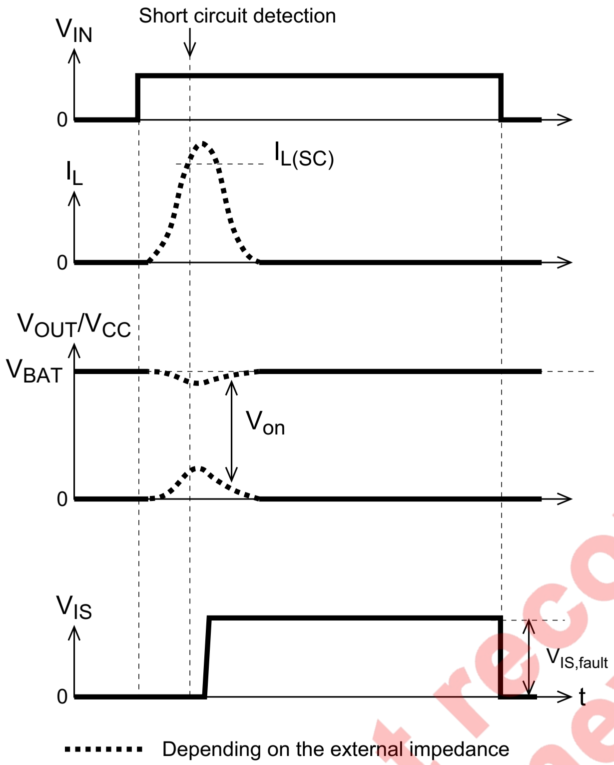


3.6.2 Short Circuit Protection

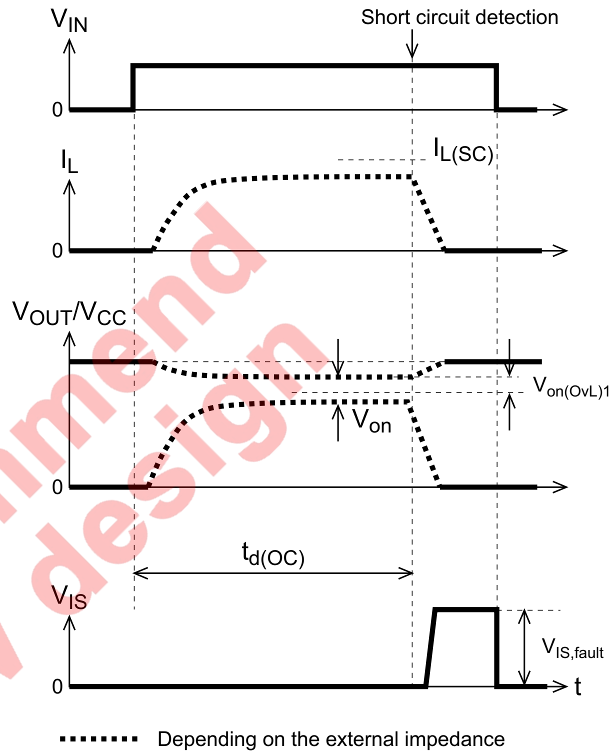
Case 1: IN pin is high in an overload condition, which includes a short circuit condition.
The device shuts down automatically when either or both of following conditions (a, b) is detected. The sense signal is fixed at $V_{IS,fault}$. Shutdown is latched until the next reset via input. The device shuts down automatically when condition (c) is detected with auto restart by cooling down.

(a) $I_L > I_{L(SC)}$
(b) $V_{on} > V_{on(OvL)1}$ after $t_{d(OC)}$
(c) Tch > Tth

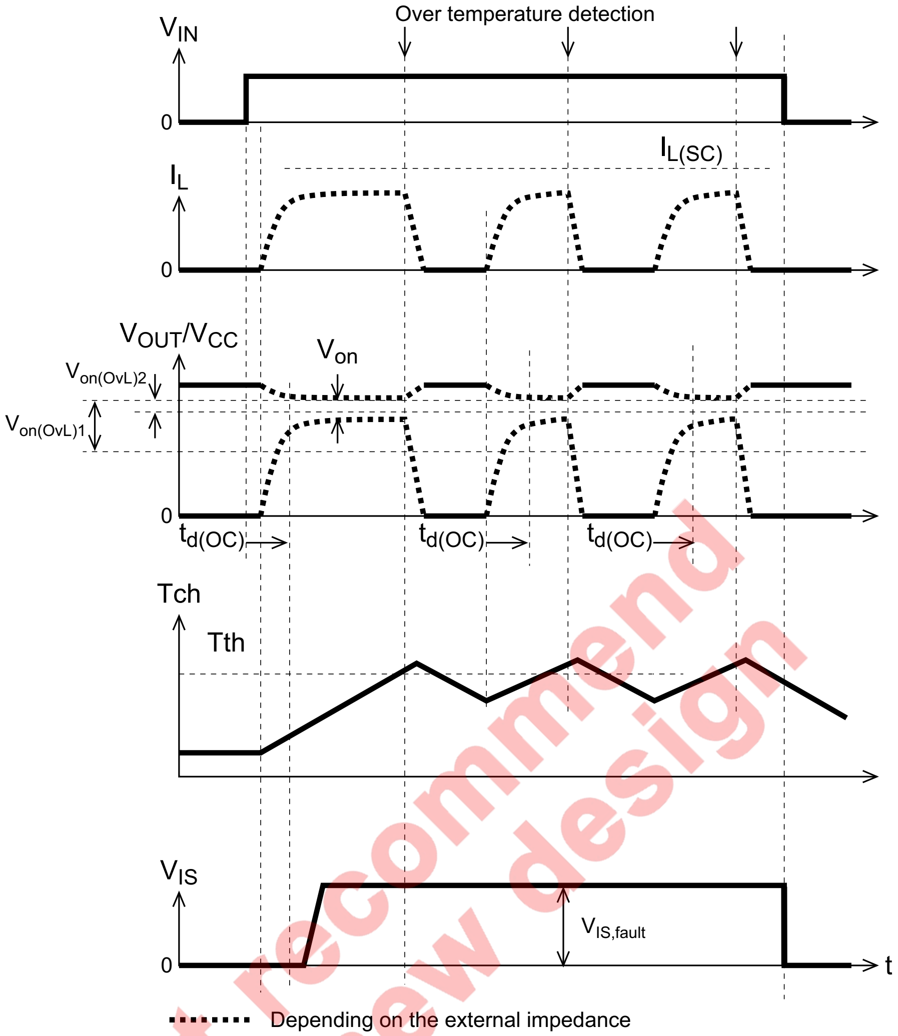
Case 1-(a) $I_L > I_{L(SC)}$



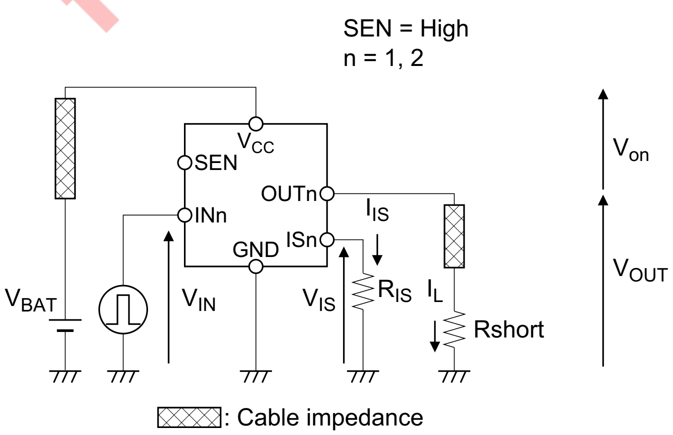
Case 1-(b) $V_{on} > V_{on(OvL)1}$ after $t_{d(OC)}$



Case1-(c) Tch > Tth



(Evaluation circuit)



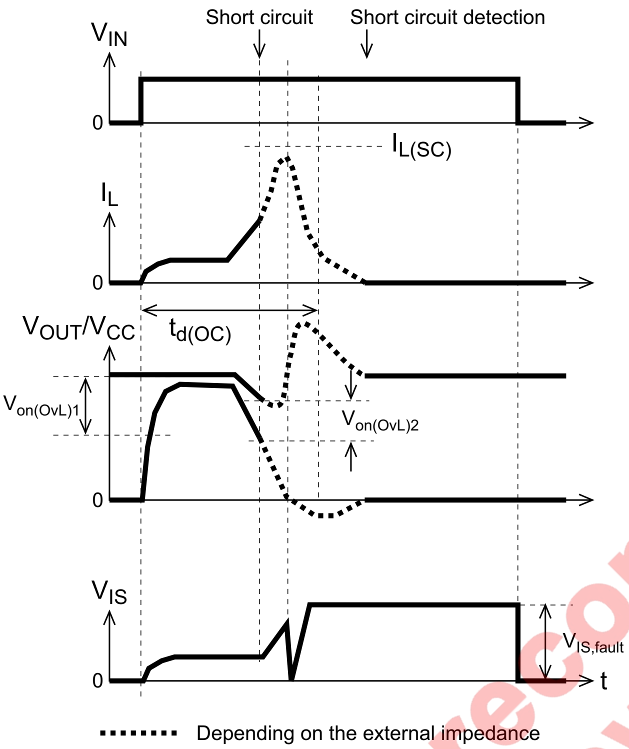
Case 2: Short circuit during on-condition

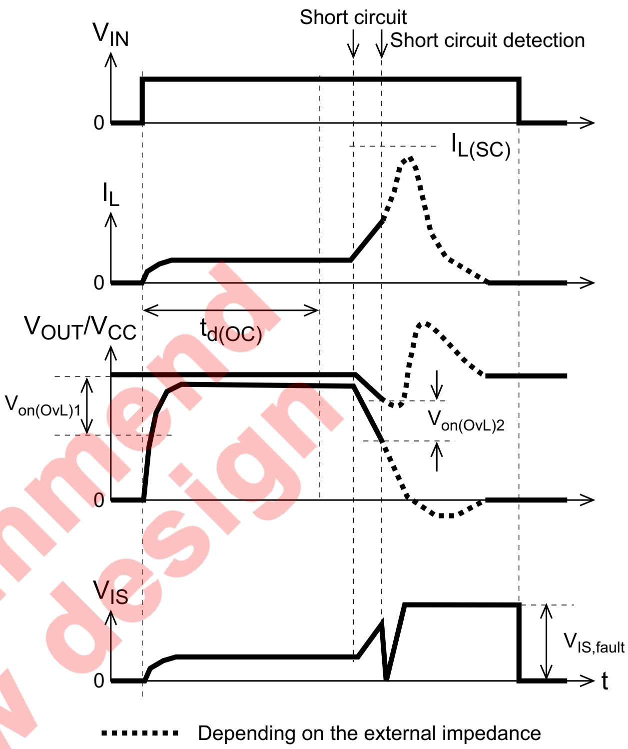
The device shuts down automatically when either or both of following conditions (a) is detected. Detection (a) value is activate after $V_{on(OvL)2}$. There is hysteresis between detection (a) value and activate (a) value. The sense signal is fixed at $V_{IS,fault}$. Shutdown is latched until the next reset via input. The device shuts down automatically when condition (b) is detected with auto restart by cooling down.

(a) $V_{on} > V_{on(OvL)2}$ after $V_{on} < V_{on(OvL)2}$

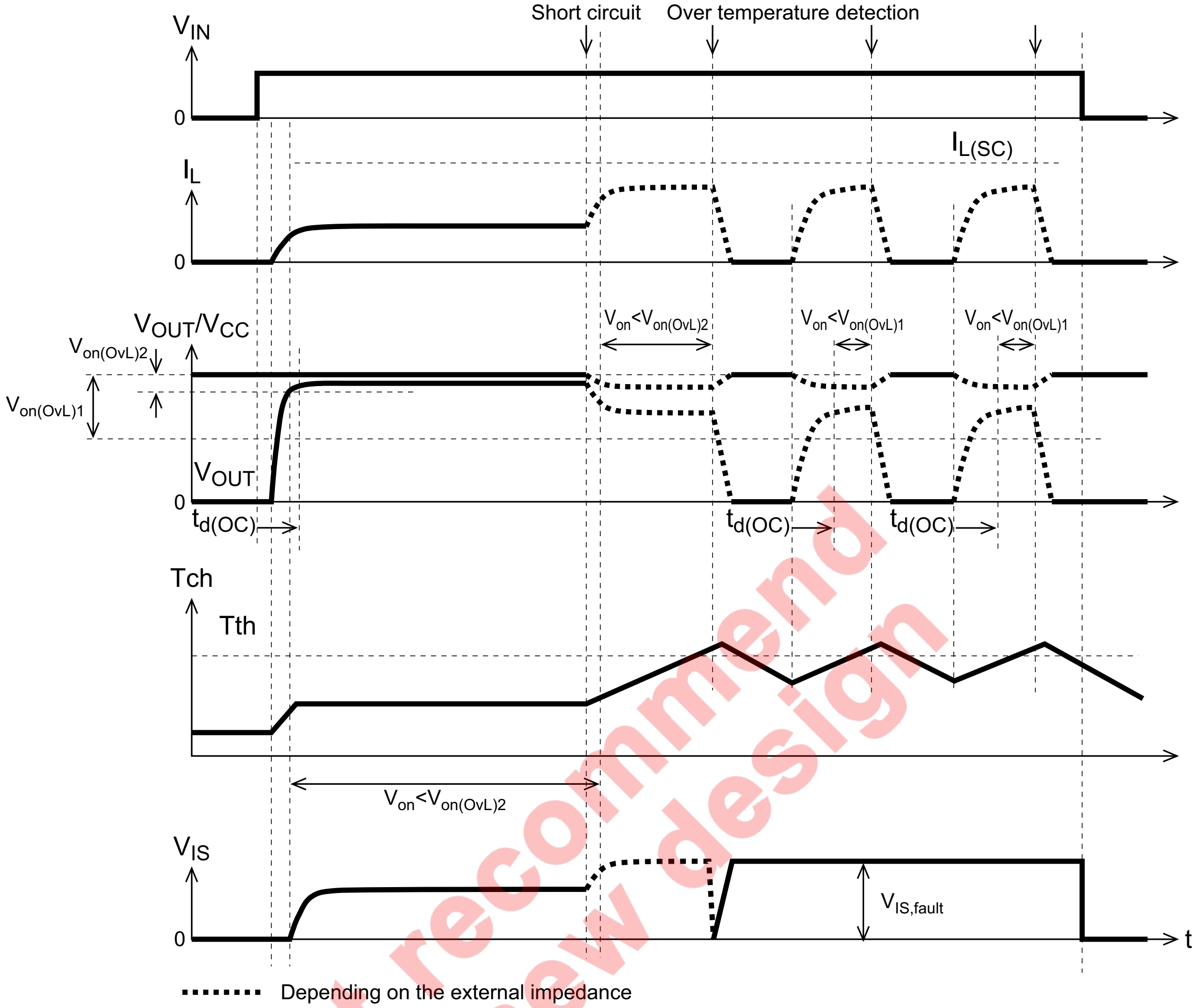
(b) Tch > Tth

Case 2-(a) $V_{on} > V_{on(OvL)2}$ after $V_{on} < V_{on(OvL)2}$



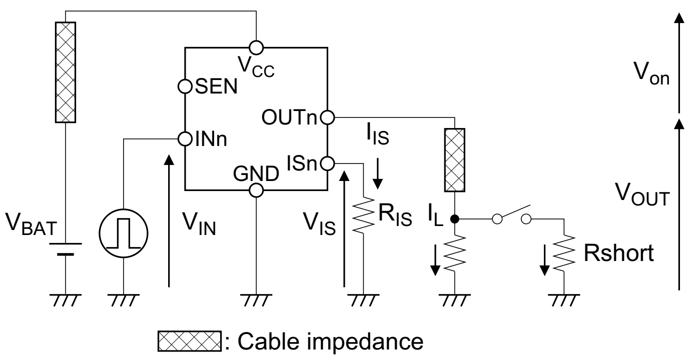


Case2-(b) Tch > Tth



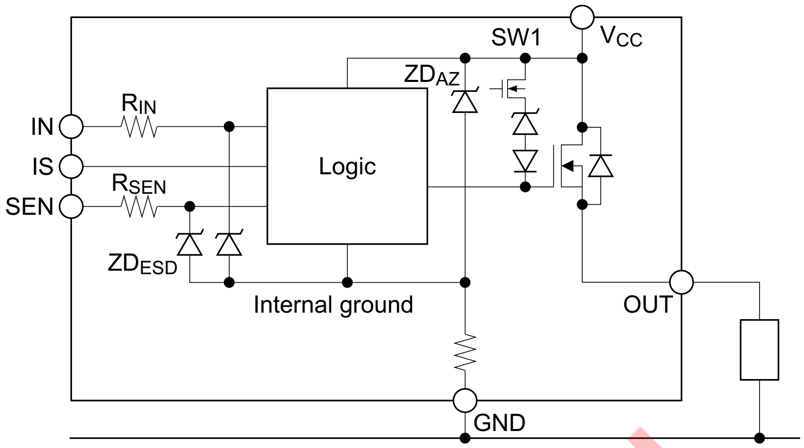
(Evaluation circuit)

SEN = High
n = 1, 2



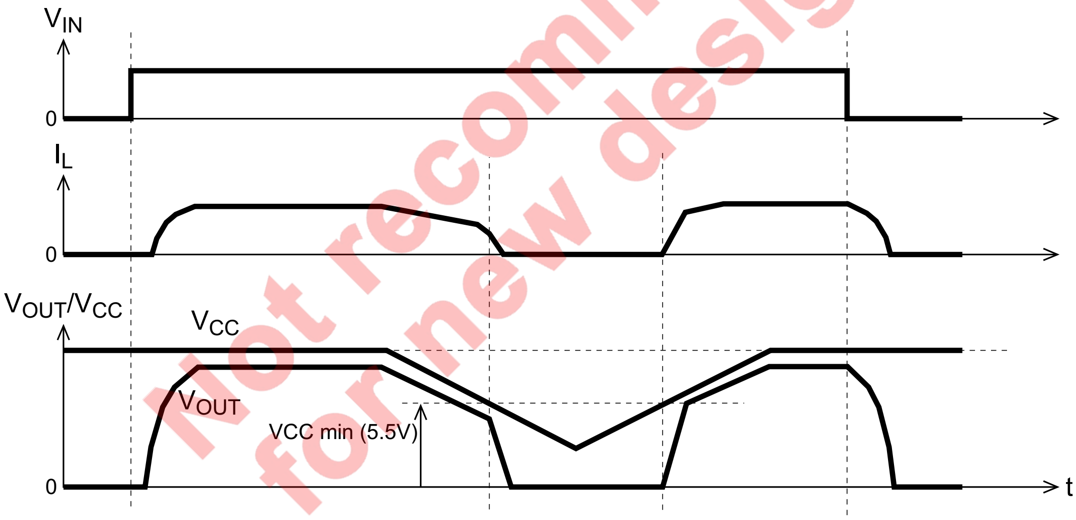
3.6.3 Device Behavior at Over Voltage Condition

In case of supply voltage greater than V_{CC4}, logic part is clamped by ZD_{AZ}. And current through of logic part is limited by internal ground resistor. In addition, the power transistor switches off in order to protect the load from over voltage. Supply voltage at V_{CC} pin must not apply over V_{CC4}.



3.6.4 Device Behavior at Low Voltage Condition

If the voltage supply (V_{CC}) goes down under V_{CC} min (5.5 V), the device shuts down the output. If voltage supply (V_{CC}) increase over V_{CC} min (5.5 V), the device turns on the output automatically. The device keeps off state after under voltage shutdown.



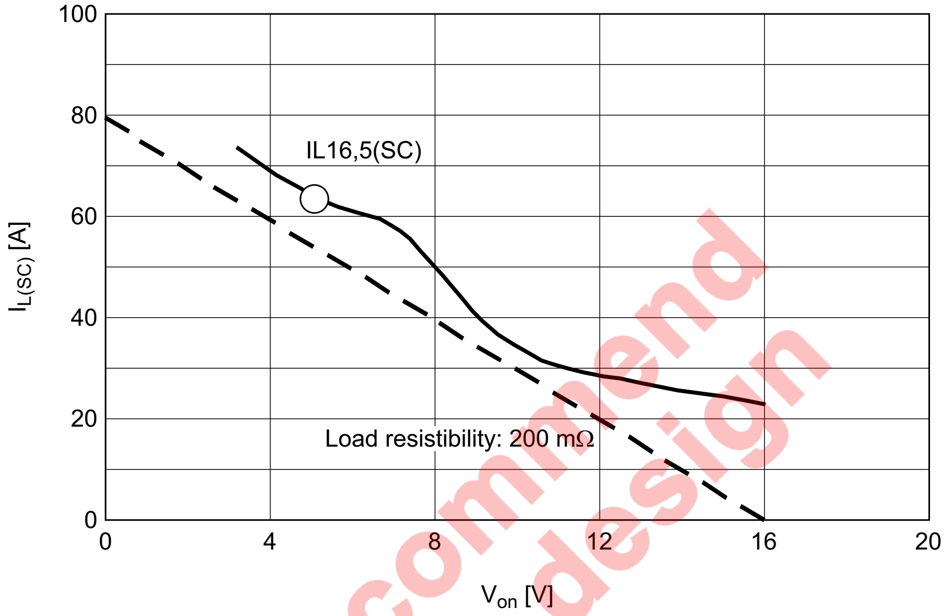
3.6.5 Loss of Ground Protection

In case of complete loss of the device ground connections, but connected load ground, the device keeps in on state or securely changes to or keeps in off state depend on V_{IN} condition.

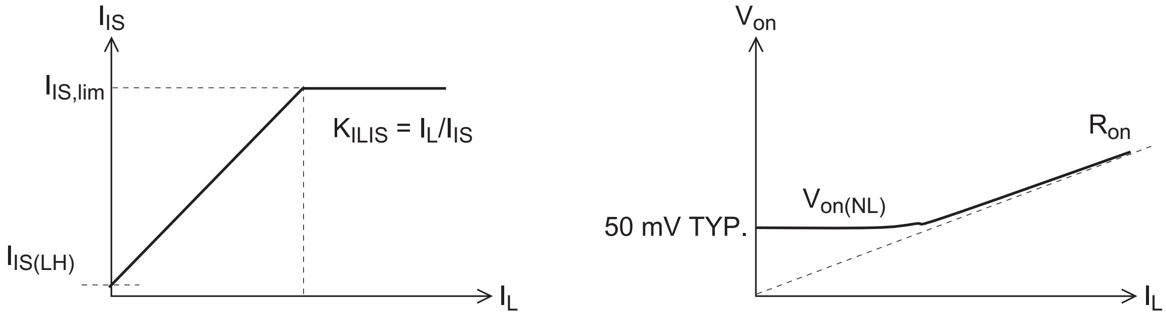
3.6.6 Driving Capability

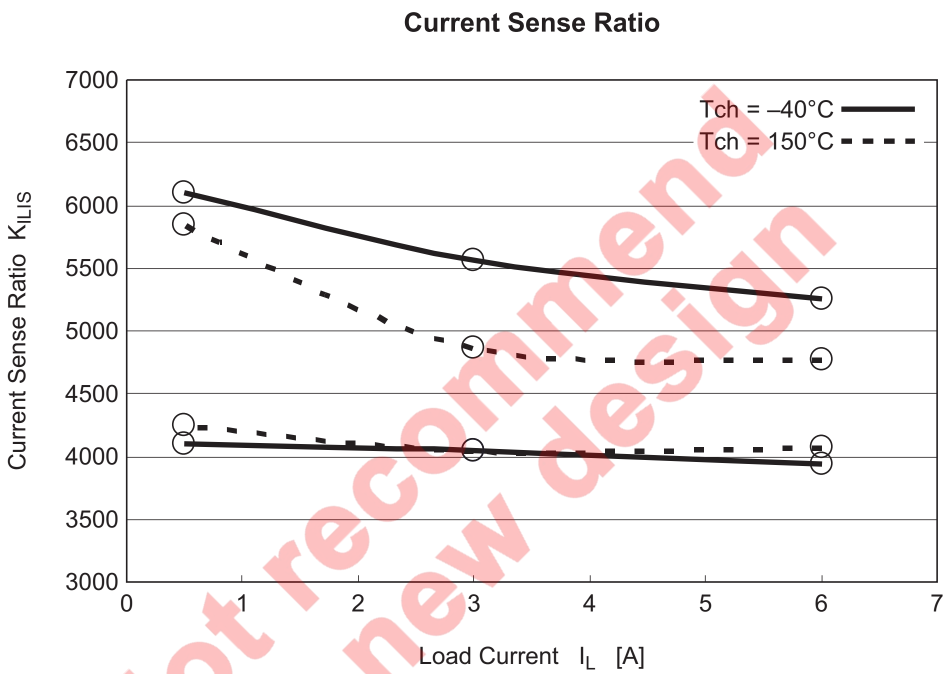
μPD166011 can drive above 200 mΩ as load resistibility include load itself, wire harness, contact resistance of connector, wiring resistibility of PCB at V_{CC} = 9 to 16 V, Tch = 25°C condition.

The short circuit detection current changes according V_{CC} voltage and V_{on} voltage for the purpose of to be strength of the robustness under short circuit condition.



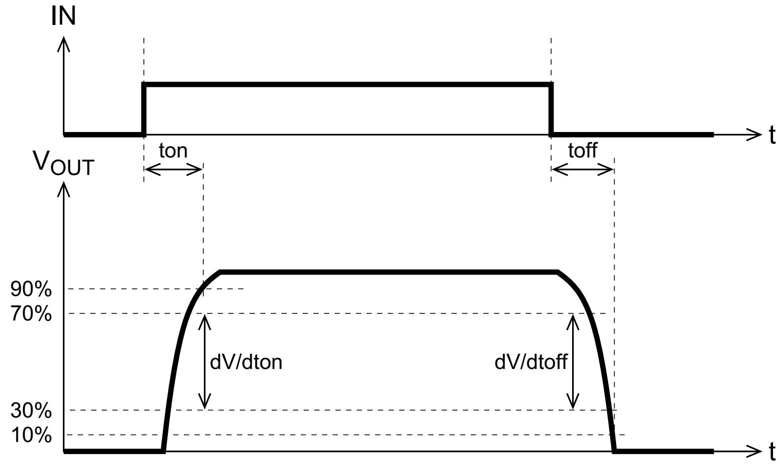
3.6.7 Current Sense Output





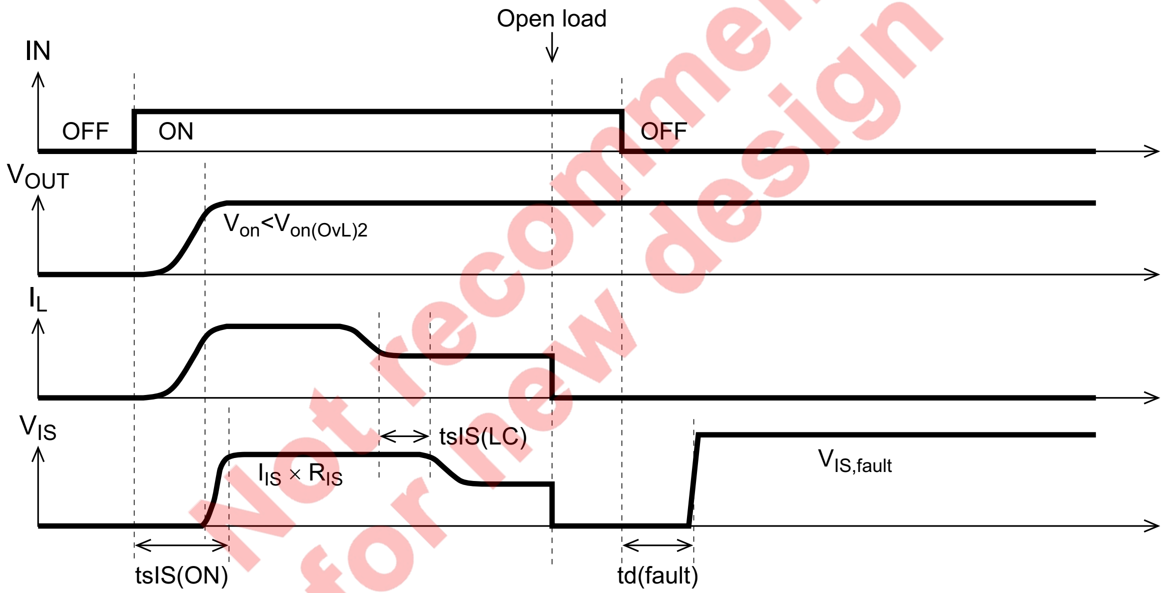
3.6.8 Measurement Condition

Switching waveform of OUT pin

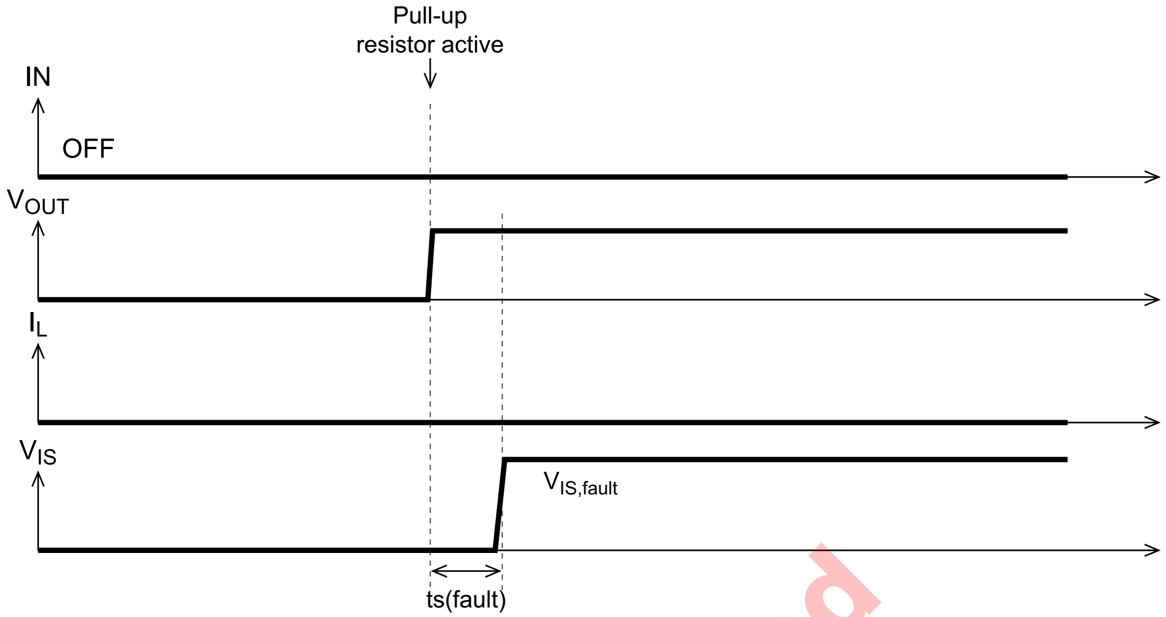


3.6.9 Diagnostics

- Normal operation to open load condition, pull-up resistor active condition



- Pull-up resistor inactive to active during open load condition



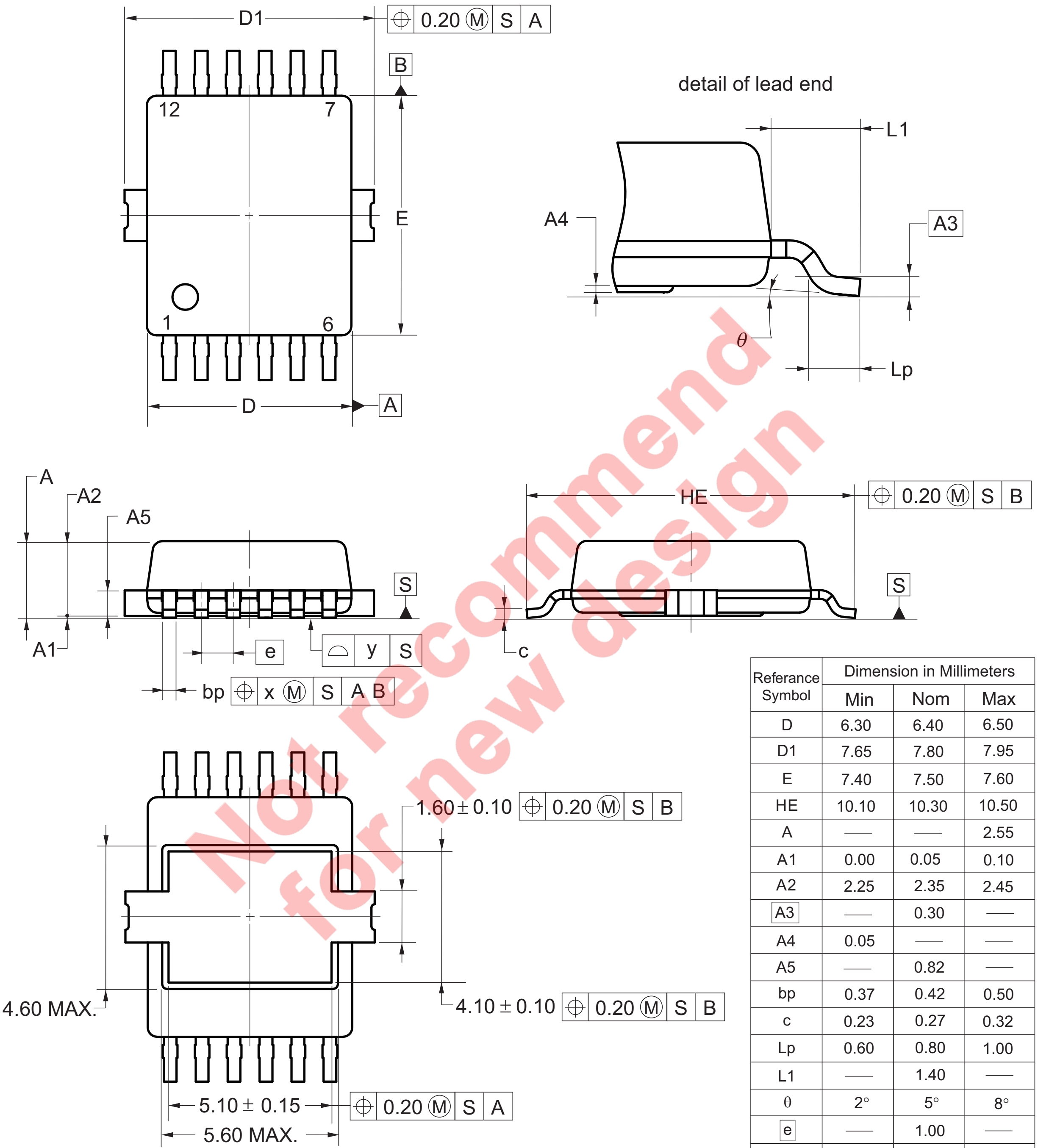
3.6.10 Truth Table

	SEN	INPUT	OUTPUT	Diagnostic Output
Normal operation	H	H	V_{CC}	$I_{IS} = I_L/K_{ILIS}$
	H	L	L *1	L *2
Short circuit to GND	H	H	L *1	$V_{IS,fault}$
	H	L	L *1	L *2
Short circuit to V_{CC}	H	H	V_{CC}	$< I_{IS} = I_L/K_{ILIS}$
	H	L	V_{CC}	$V_{IS,fault}$
Over temperature	H	H	L *1	$V_{IS,fault}$ *3
	H	L	L *1	L *2
Open load	H	H	V_{CC}	L *2
	H	L	Hi-Z	$V_{IS,fault}$ in case of OUT>$V_{OUT(OL)}$

Notes: *1 In case of OUT pin is connected to GND via load.
*2 In case of IS pin is connected to GND via resistor.
*3 IS pin keeps $V_{IS,fault}$ as long as input signal activate after the first thermal shutdown.

3.7 Package Drawings (Unit: mm)

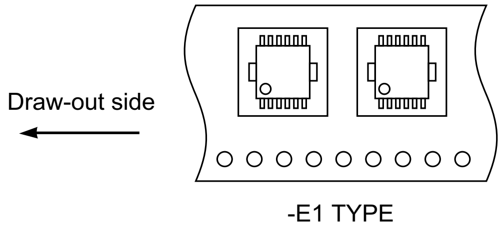
JEITA Package Code	RENESAS Code	Previous Code	MASS (TYP.) [g]
-	PRSP0013FA-A	P12S1-100-111	0.4



Referance Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	6.30	6.40	6.50
D1	7.65	7.80	7.95
E	7.40	7.50	7.60
HE	10.10	10.30	10.50
A	—	—	2.55
A1	0.00	0.05	0.10
A2	2.25	2.35	2.45
A3	—	0.30	—
A4	0.05	—	—
A5	—	0.82	—
bp	0.37	0.42	0.50
c	0.23	0.27	0.32
Lp	0.60	0.80	1.00
L1	—	1.40	—
θ	2°	5°	8°
e	—	1.00	—
x	—	—	0.20
y	—	—	0.10

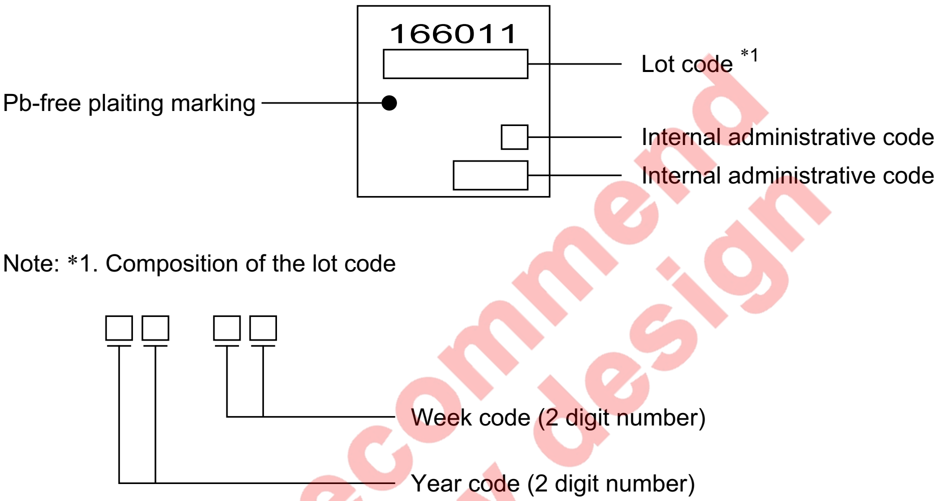
3.8 Taping Information

This is one type (E1) of direction of the device in the career tape.



3.9 Marking Information

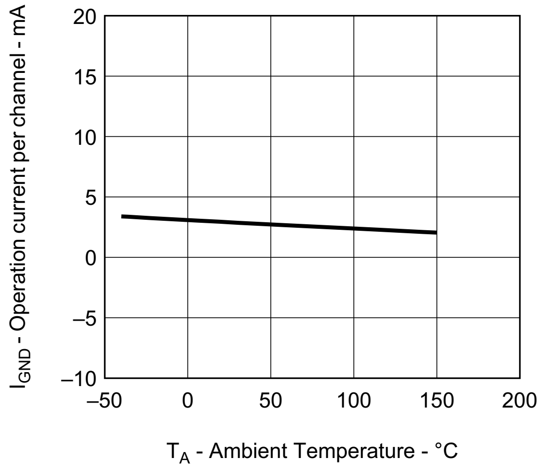
This figure indicates the marking items and arrangement. However, details of the letterform, the size and the position aren't indicated.



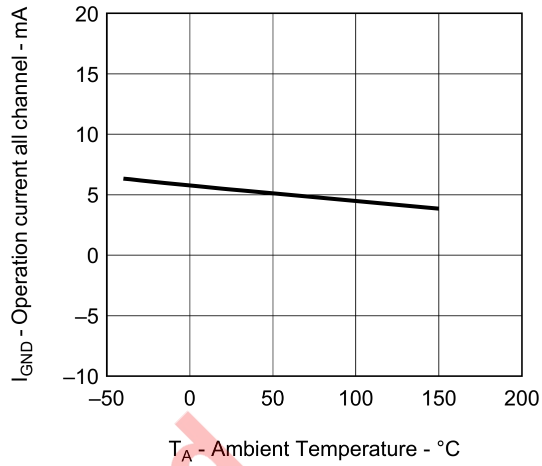
4. Typical Characteristics

(T_{ch} = 25°C, V_{CC} = 12 V, unless otherwise specified)

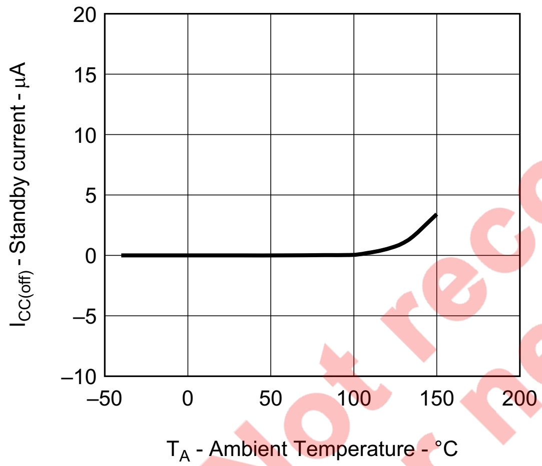
OPERATION CURRENT PER CHANNEL
vs. AMBIENT TEMPERATURE



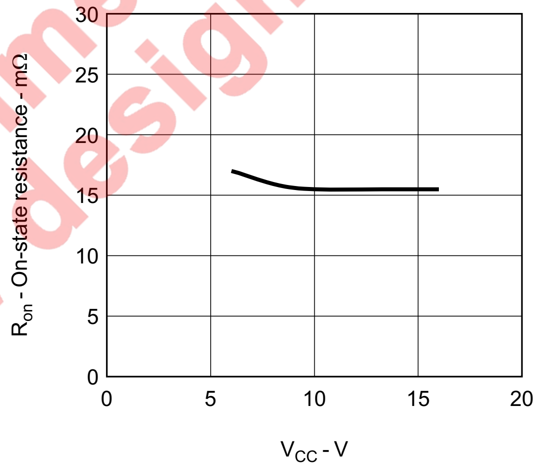
OPERATION CURRENT ALL CHANNEL
vs. AMBIENT TEMPERATURE



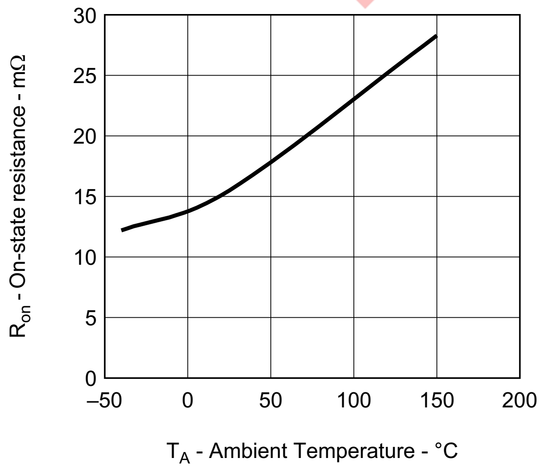
STANDBY CURRENT
vs. AMBIENT TEMPERATURE



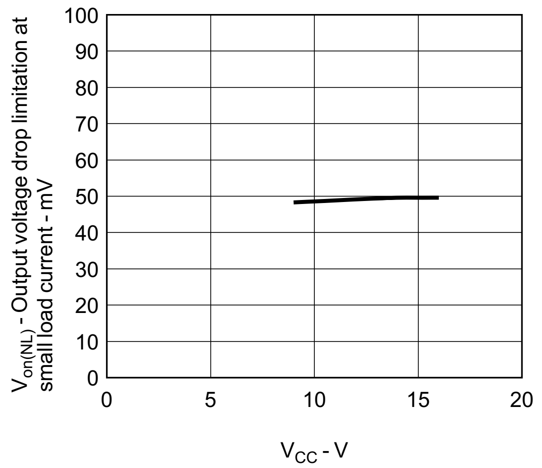
ON STATE RESISTANCE
vs. V_{CC} VOLTAGE



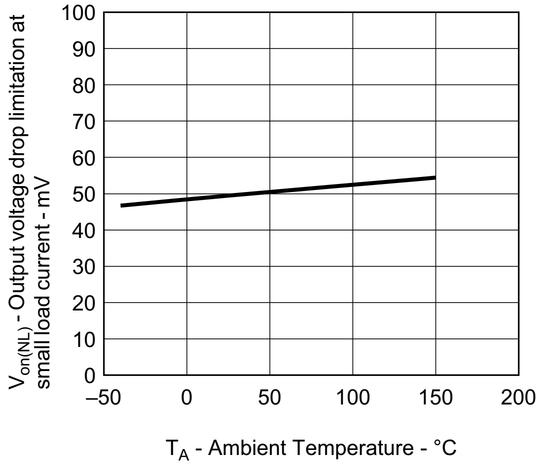
ON STATE RESISTANCE
vs. AMBIENT TEMPERATURE



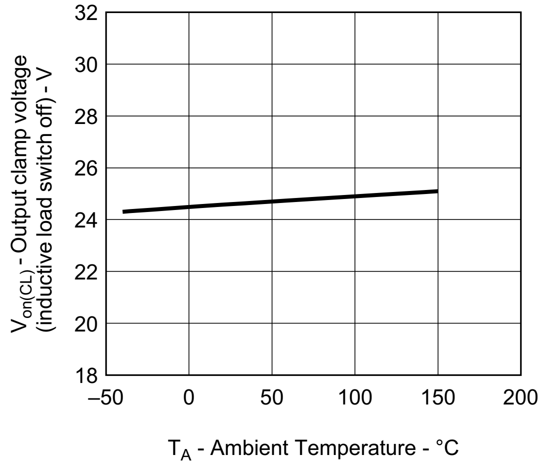
OUTPUT VOLTAGE DROP LIMITATION AT
SMALL LOAD CURRENT vs. V_{CC} VOLTAGE



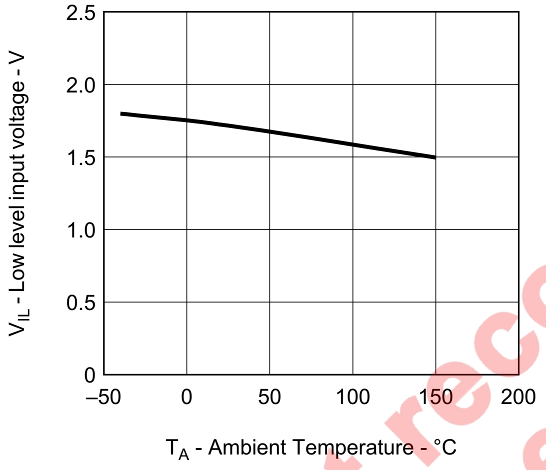
OUTPUT VOLTAGE DROP LIMITATION AT SMALL LOAD CURRENT vs. AMBIENT TEMPERATURE



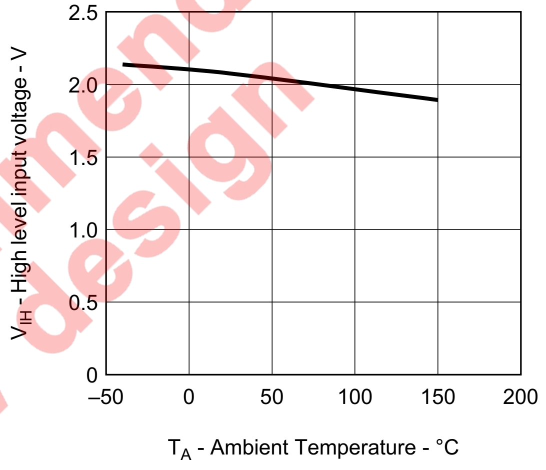
OUTPUT CLAMP VOLTAGE (INDUCTIVE LOAD SWITCH OFF) vs. AMBIENT TEMPERATURE



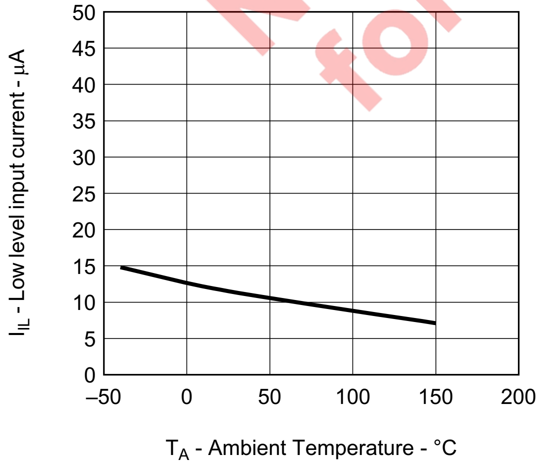
LOW LEVEL INPUT VOLTAGE vs. AMBIENT TEMPERATURE



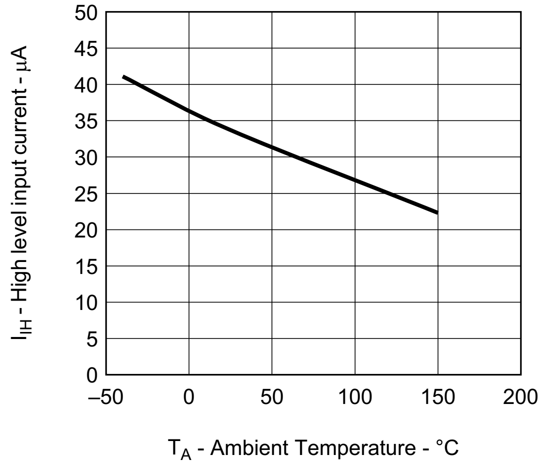
HIGH LEVEL INPUT VOLTAGE vs. AMBIENT TEMPERATURE

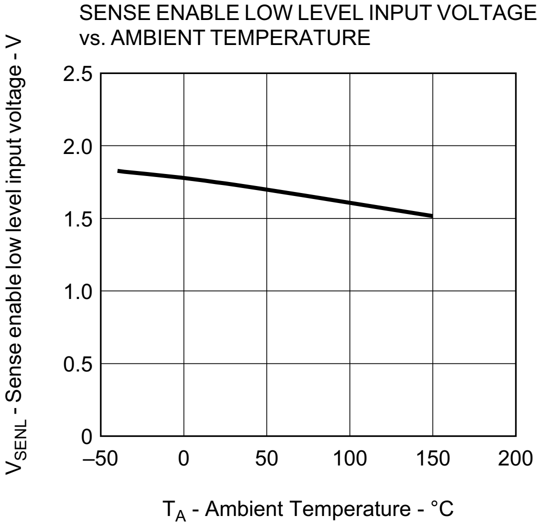


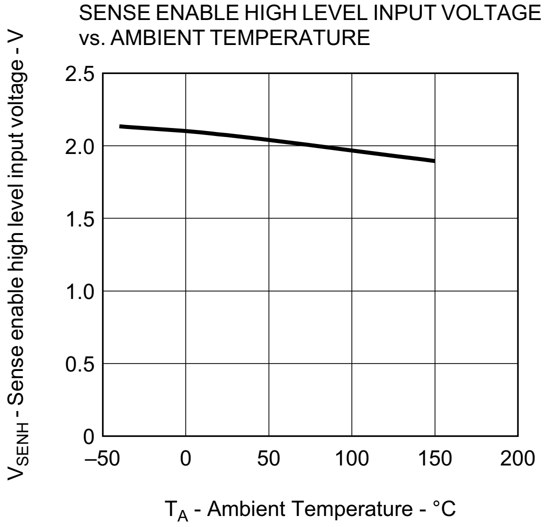
LOW LEVEL INPUT CURRENT vs. AMBIENT TEMPERATURE

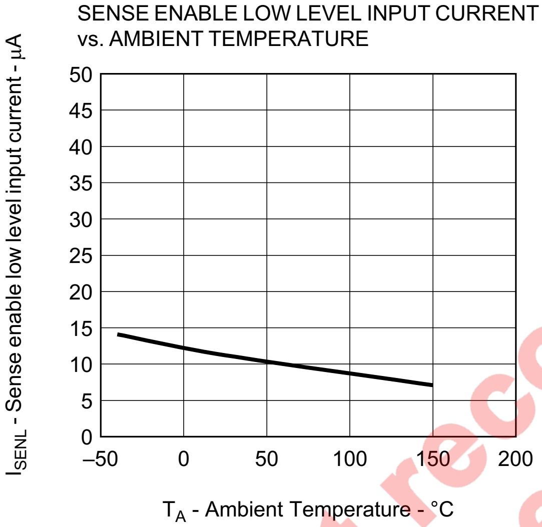


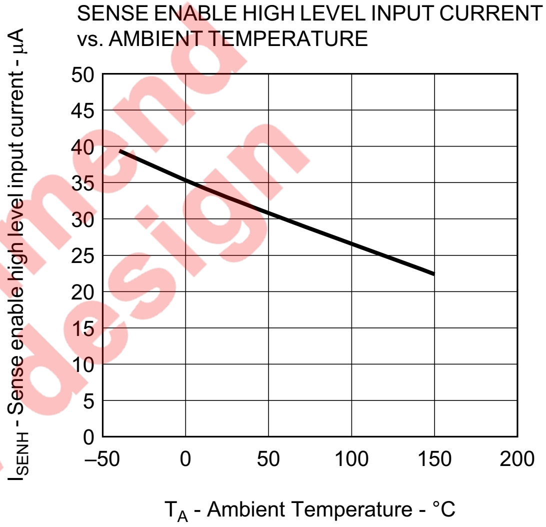
HIGH LEVEL INPUT CURRENT vs. AMBIENT TEMPERATURE

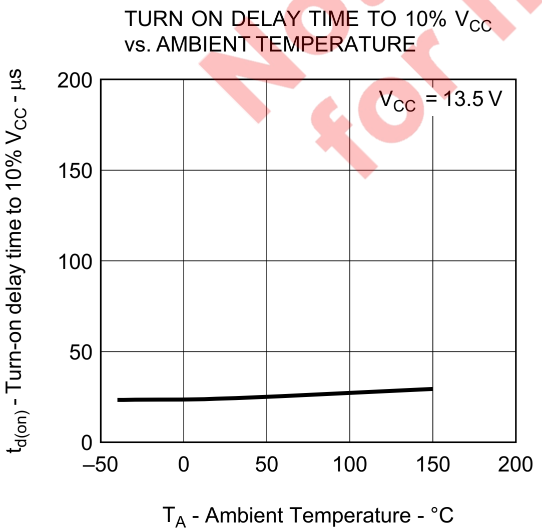


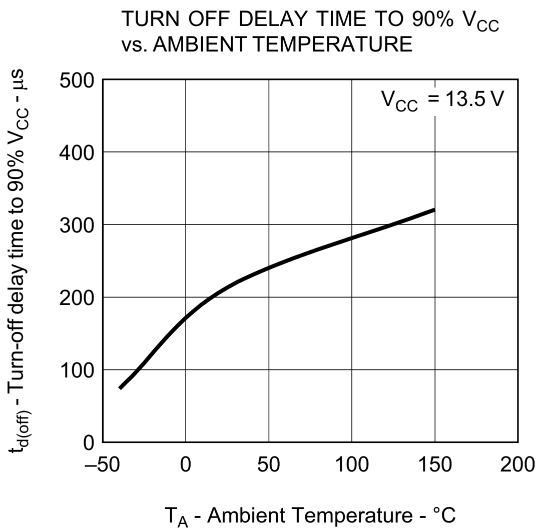

SENSE ENABLE LOW LEVEL INPUT VOLTAGE
vs. AMBIENT TEMPERATURE
VSENL - Sense enable low level input voltage - V
TA - Ambient Temperature - °C


SENSE ENABLE HIGH LEVEL INPUT VOLTAGE
vs. AMBIENT TEMPERATURE
VSENH - Sense enable high level input voltage - V
TA - Ambient Temperature - °C

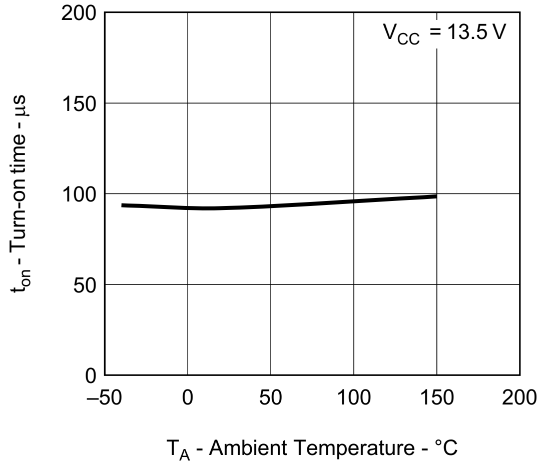

SENSE ENABLE LOW LEVEL INPUT CURRENT
vs. AMBIENT TEMPERATURE
ISENL - Sense enable low level input current - μA
TA - Ambient Temperature - °C


SENSE ENABLE HIGH LEVEL INPUT CURRENT
vs. AMBIENT TEMPERATURE
ISENH - Sense enable high level input current - μA
TA - Ambient Temperature - °C

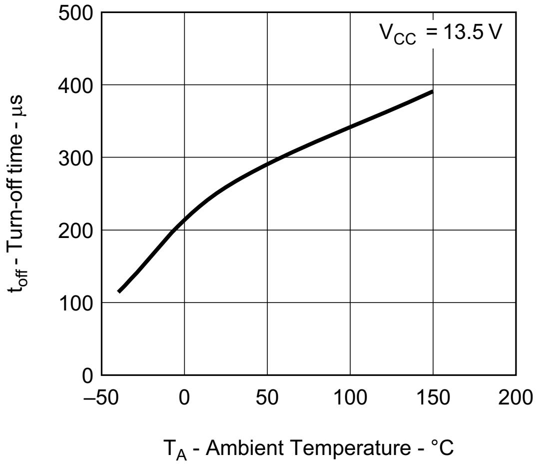

TURN ON DELAY TIME TO 10% VCC
vs. AMBIENT TEMPERATURE
VCC = 13.5 V
td(on) - Turn-on delay time to 10% VCC - μs
TA - Ambient Temperature - °C


TURN OFF DELAY TIME TO 90% VCC
vs. AMBIENT TEMPERATURE
VCC = 13.5 V
td(off) - Turn-off delay time to 90% VCC - μs
TA - Ambient Temperature - °C

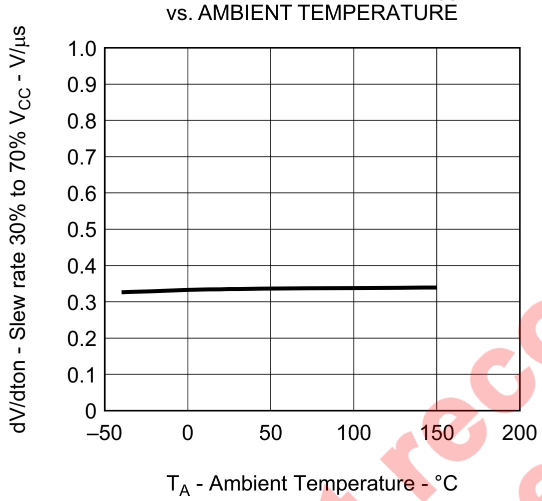
TURN ON TIME
vs. AMBIENT TEMPERATURE



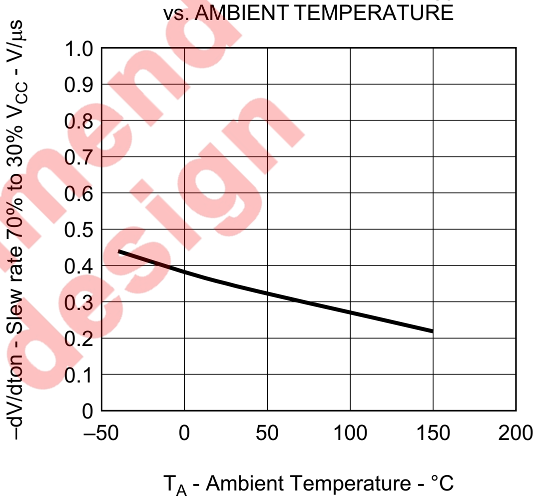
TURN OFF TIME
vs. AMBIENT TEMPERATURE



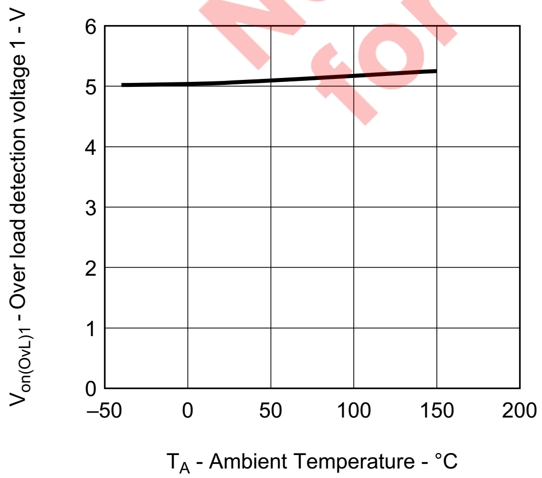
SLEW RATE 30% TO 70% V_{CC}
vs. AMBIENT TEMPERATURE



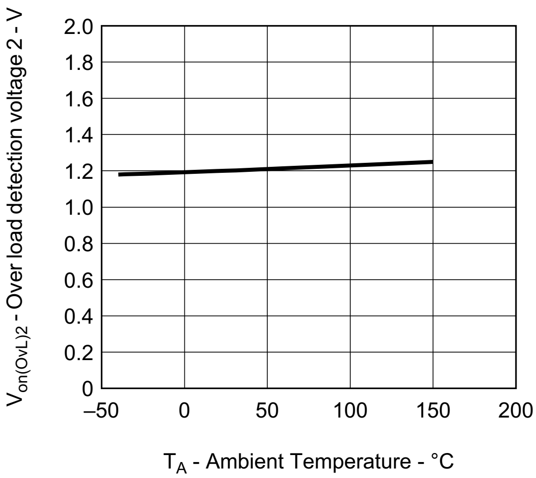
SLEW RATE 70% TO 30% V_{CC}
vs. AMBIENT TEMPERATURE



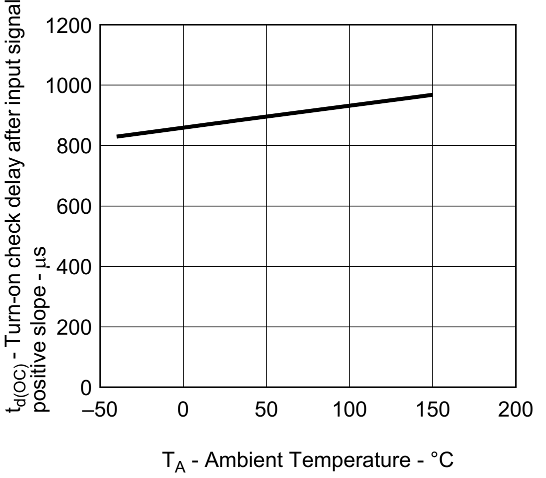
OVER LOAD DETECTION VOLTAGE 1
vs. AMBIENT TEMPERATURE



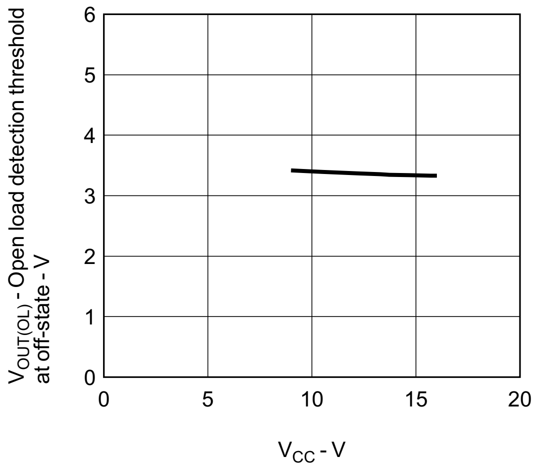
OVER LOAD DETECTION VOLTAGE 2
vs. AMBIENT TEMPERATURE



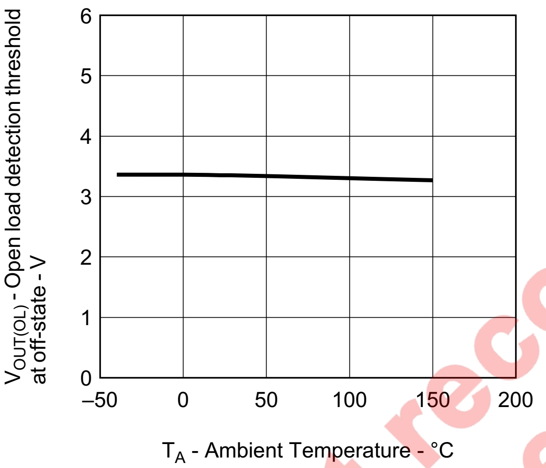
TURN ON CHECK DELAY AFTER INPUT SIGNAL POSITIVE SLOPE vs. AMBIENT TEMPERATURE



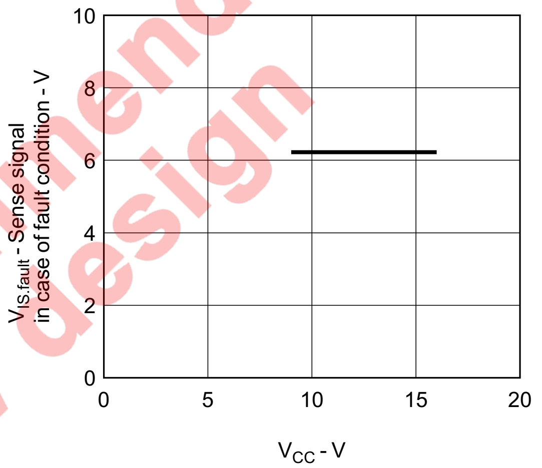
OPEN LOAD DETECTION THRESHOLD AT OFF STATE vs. V_{CC} VOLTAGE



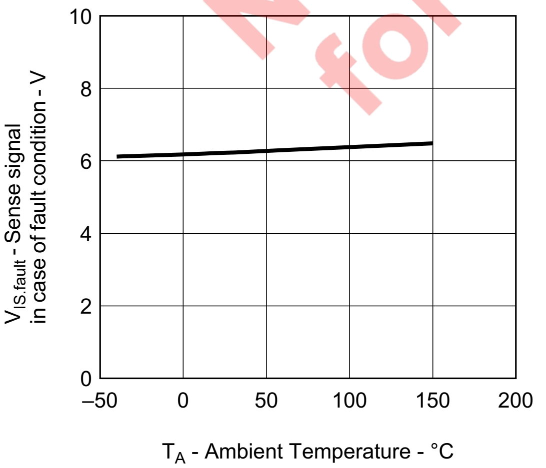
OPEN LOAD DETECTION THRESHOLD AT OFF STATE vs. AMBIENT TEMPERATURE



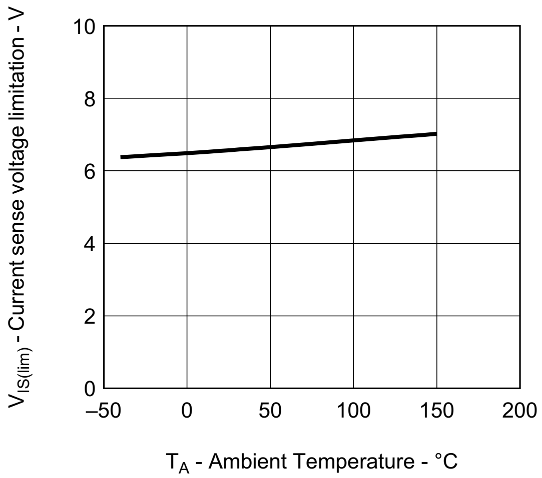
SENSE SIGNAL IN CASE OF FAULT CONDITION vs. V_{CC} VOLTAGE

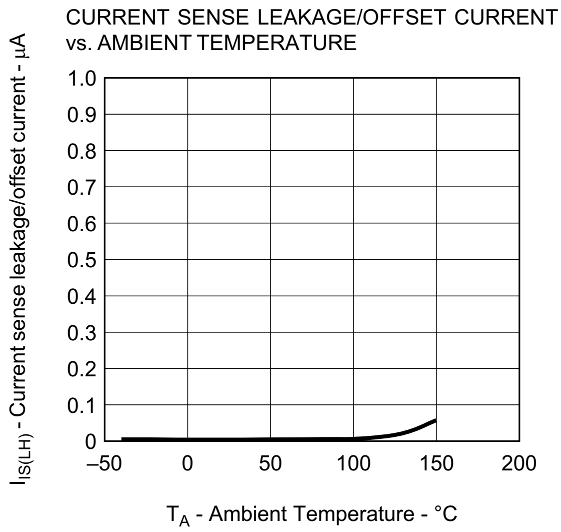


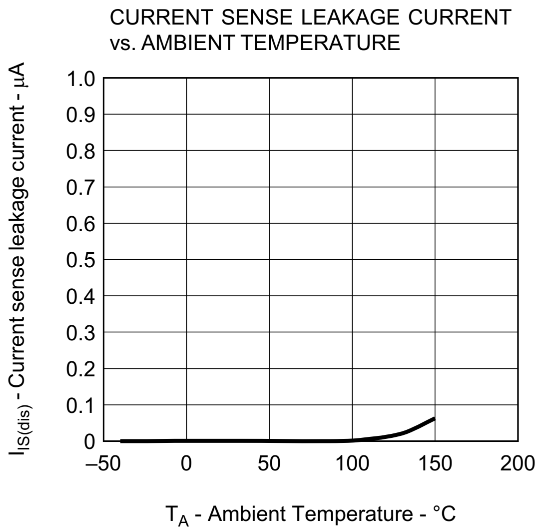
SENSE SIGNAL IN CASE OF FAULT CONDITION vs. AMBIENT TEMPERATURE



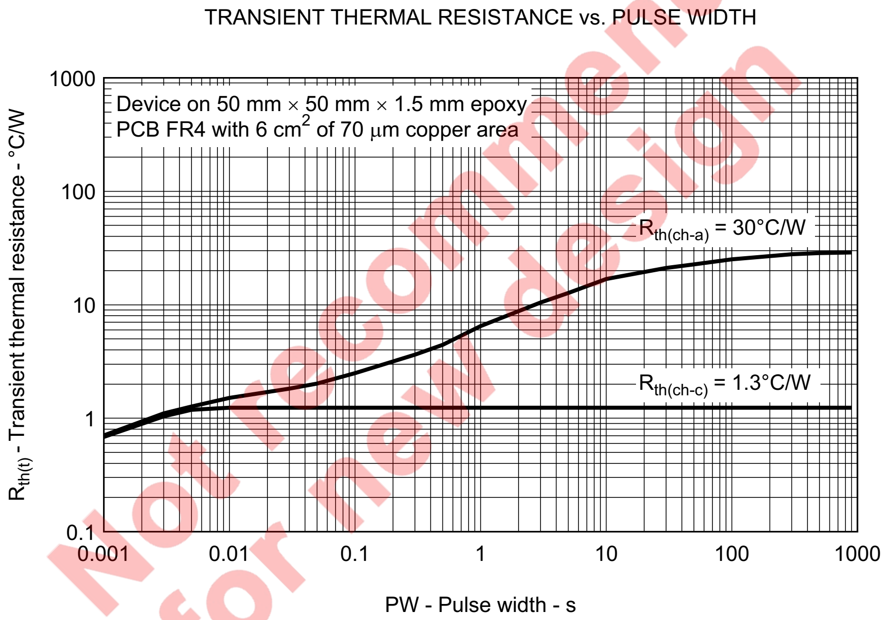
CURRENT SENSE VOLTAGE LIMITATION vs. AMBIENT TEMPERATURE



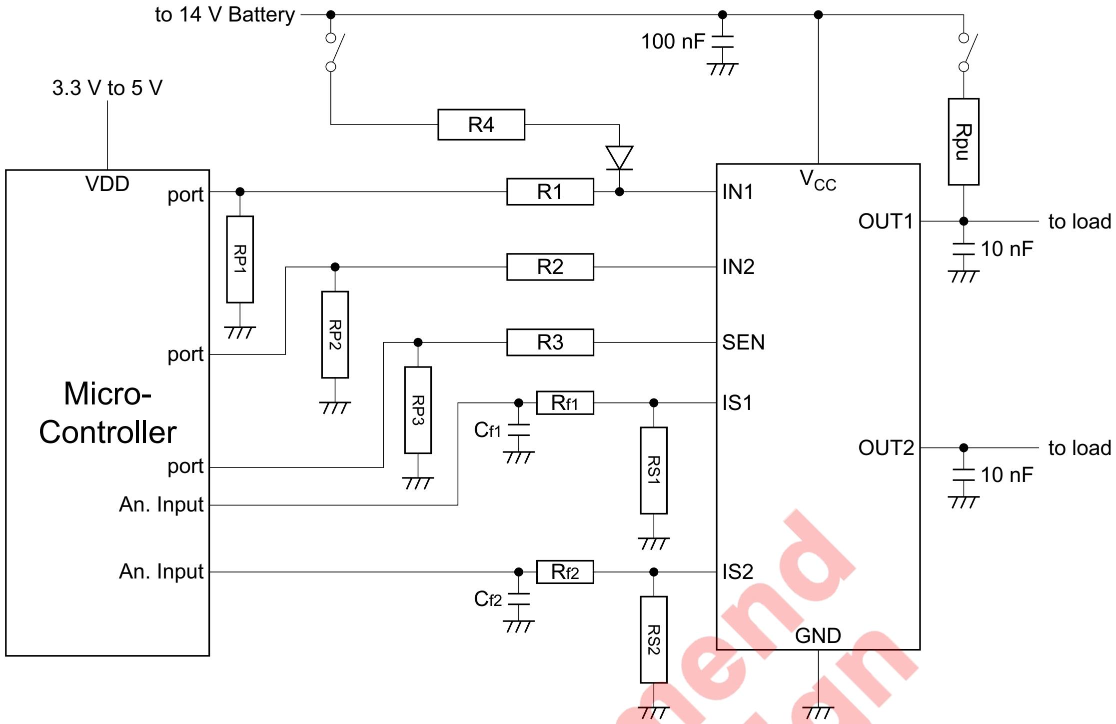




5. Thermal Characteristics



6. Application Example in Principle



Note: R4 is for Limp home mode for channel 1. When R4 is used, RP1 are necessary.

Revision History	μPD166011T1J Data Sheet

Rev.	Date	Description	
		Page	Summary
1.00	Aug 20, 2012	—	First Edition Issued

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