Smart High-Side Power Switch
RM76018TXS Datasheet

1.Basic Features

- Overload protection
- Current limitation
- Short circuit protection
- Over temperature protection
- Over voltage protection
- Clamp of negative voltage at output with inductive loads
- Fast demagnetization of inductive loads
- CMOS diagnostic output
- CMOS compatible input
- Open load detection in ON-state
- Reverse battery protection
- Electrostatic discharge (ESD) protection
- Green Product (RoHS compliant)
- AEC-Q100 qualified

2.Description

RM76018TXS is a Smart High-side Power Switch, Reverse battery protection by self turn on of power MOSFET, current controlled input and diagnostic feedback with load current sense.It can connect to various loads such as inductive loads, resistive loads, capacitive loads, etc.

RM76018TXS integrates multiple protection functions. Overload protection, Current limitation, Short circuit protection, Over temperature protection, Over voltage protection, Clamp of negative voltage at output, Fast deenergizing of inductive loads, Electrostatic discharge (ESD) protection.

3.Application

- µC compatible power switch with diagnostic feedback for 12 V and 24 V DC grounded loads
- All types of resistive, inductive and capacitve loads
- Replaces electromechanical relays, fuses and discrete circuits

4.Product Summary

Overvoltage protection	$V_{bb(AZ)}$	63	V
Operating voltage	$V_{bb(ON)}$	4.5...42	V
On-state resistance	R_{ON}	18	mΩ
Load current (ISO)	$I_{L(ISO)}$	21	A
Current limitation	$I_{L(SCr)}$	70	A

5.Ordering Code

Device	Package Type	Marking	Materials	Package			Package Qty
RM76018T4S	TO-263-4L	RM76018T4S	Halogen free	Tape&reel	5 reels/box	4k /box	800 /reel
RM76018T5S	TO-220NB-5L	RM76018T5S	Halogen free	tube	100 tubes /box	5k /box	50 /tube

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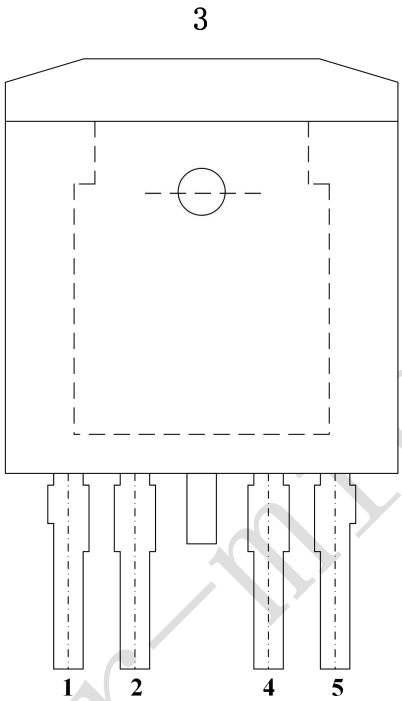
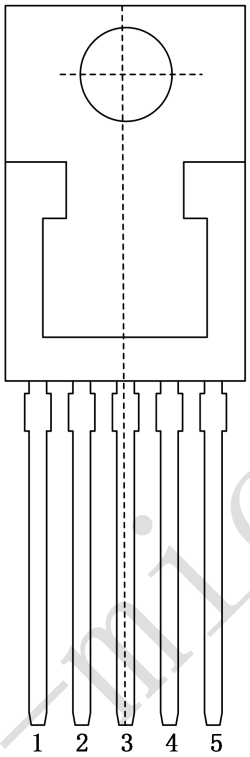
6. Pin Configuration

RM76018T4S(TO-263-4L)



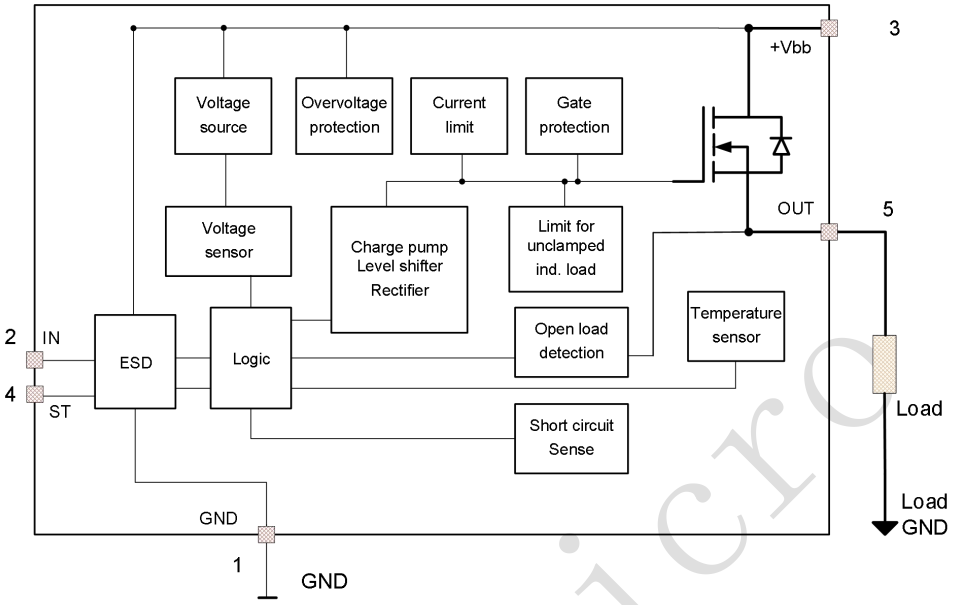
Pin	Symbol	Function
1	GND	Logic ground
2	IN	Input; activates the power switch in case of logical high signal
3	Vbb	Positive power supply voltage; the tab is shorted to this pin
4	ST	Diagnostic feedback; low on failure
5	OUT	Output to the load

RM76018T5S(TO-220NB-5L)



Pin	Symbol	Function
1	GND	Logic ground
2	IN	Input; activates the power switch in case of logical high signal
3	Vbb	Positive power supply voltage; the tab is shorted to this pin
4	ST	Diagnostic feedback; low on failure
5	OUT	Output to the load.

7.Block Diagram



8.Absolute Maximum Ratings

(Maximum Ratings at T j = 25 °C unless otherwise specified)

Parameter	Symbol	Values	Unit
Supply voltage	V_{bb}	63	V
Load dump protection $V_{LoadDump}=U_A+Vs$, U_A=13.5V, R_I=2Ω, R_L=1.1Ω, t_d=200ms, IN, IS= low or high	$V_{Load\ dump}$	80	V
Power dissipation (DC), $T_C \leq 25$ °C	P_{tot}	167	W
Junction temperature	T_j	-40 to 150	℃
Ambient temperature	T_a	-40 to 125	℃
Storage temperature	T_{stg}	-55 to 150	℃
Thermal resistance junction - ambient (free air)	R_{thJA}	91.49	K/W
Thermal resistance chip - case	R_{thJC}	0.73	K/W

Notes:

1. Stresses above the ones listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

9.Electrical Characteristics

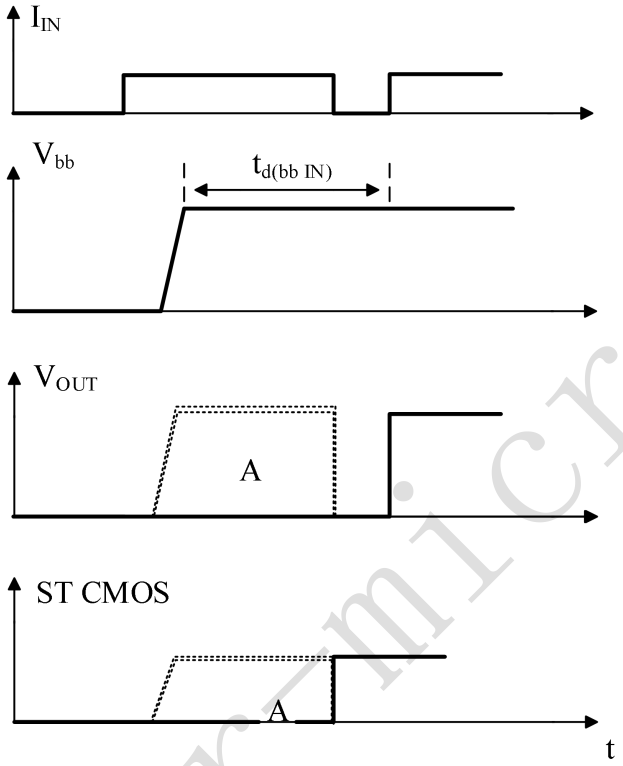
T_J =25°C, V_{bb}= 12V; (unless otherwise specified)

Symbol	Parameter	Test Condition	Values			Unit
			Min	Typ	Max	
R_{ON}	On-state resistance	I_L=5A, T_j=25℃	-	18	23	mΩ
		I_L=5A, T_j=150℃	-	28	60	
$I_{L(ISO)}$	Nominal load current	V_{on}=0.5V	17	21	-	A
$I_{L(GNDhigh)}$	GND Output current	V_{IN}=0V, GND disconnected or GND pulled up,	-	-	1	mA
t_{on}	Turn-on time	R_L=12Ω, V_{IN} turn-on to 90% V_{OUT}	10	-	350	us
t_{off}	Turn-off time	R_L=12Ω, V_{IN} turn-off to 10% V_{OUT}	10	-	130	us
$dv/dt_{(on)}$	Turn-ON Slew rate	R_L=12Ω, From 10%V_{OUT} to 30%V_{OUT}	0.2	-	2	V/us
$dv/dt_{(off)}$	Turn-OFF Slew rate	R_L=12Ω, From 70%V_{OUT} to 40%V_{OUT}	0.4	-	5	V/us
$V_{bb(on)}$	Operating voltage	T_j=-40..+150℃	4.5		42	V
$V_{bb(under)}$	Undervoltage shutdown	T_j=-40..+150℃	2.4	-	4.5	V
$V_{bIN(u\ rst)}$	Undervoltage restart	T_j=-40..+150℃	-	-	4.5	V
$V_{bb(ucp)}$	Undervoltage restart of charge pump	T_j=-40..+150℃	-	6.5	7.5	V
$\Delta V_{bb(under)}$	Undervoltage hysteresis	$\Delta V_{bb(under)}=V_{bIN(urst)}-V_{bb(under)}$ T_j=-40..+150℃	-	0.2	-	V
$I_{bb(off)}$	Standby current	V_{IN}=0, I_{ST}=0	-	-	25	uA
$I_{L(SCp)}$	Initial peak short circuit current	$V_{ON}>V_{ON(SC)}$	45	-	140	A
$I_{L(SCr)}$	Repetitive short circuit current limit		30	70	-	A
$V_{ON(SC)}$	Output clamp		-	8.3	-	V
$t_{d(SC)}$	Short circuit shutdown delay	$V_{ON}>V_{ON(SC)}$, T_j=-40..+150℃	80	-	400	us
$V_{ON(CL)}$	Output clamp (inductive load switch off)	$V_{OUT}=V_{bb}-V_{ON(CL)}$, I_L=30mA	50	58	73	V
T_{jt}	Thermal overload trip temperature		150	-	-	℃

ΔT_{jt}	Thermal hysteresis		-	10	-	K
$V_{bb(over)}$	Overvoltage shutdown	T_j=-40..+150℃	42	-	52	V
$V_{bb(o\ rst)}$	Overvoltage restart	T_j=-40..+150℃	42	-	-	V
$\Delta V_{bb(over)}$	Overvoltage hysteresis	T_j=-40..+150℃	-	0.2	-	V
$V_{bb(AZ)}$	Overvoltage protection	I_{bb}=10mA T_j=25..+150℃	63	67	-	V
$I_{L(off)}$	Leakage output current	V_{IN}=0	-	-	15	uA
I_{GND}	Operating current	V_{IN}=5V	-	0.5	1	mA
$-V_{bb}$	Reverse battery		-	-	32	V
R_{bb}	Integrated resistor in V_{bb} line		-	120	-	Ω
$I_{L(OL)}$	Open load detection current		2	-	3500	mA
Input and Status Feedback						
$V_{IN(T+)}$	Input turn-on threshold voltage	T_j=-40..+150℃	1.5	-	2.4	V
$V_{IN(T-)}$	Input turn-off threshold voltage	T_j=-40..+150℃	1.0	-	-	V
ΔV_{IN}	Input threshold hysteresis		0.2	0.5	0.6	V
$I_{IN(off)}$	Off state input current	V_{IN}=0.4V	10	-	30	uA
$I_{IN(on)}$	On state input current	V_{IN}=3.5V	10	25	50	uA
$t_{d(ST\ SC)}$	short circuit time	T_j=-40..+150℃	80	200	400	us
$t_{d(ST)}$	open load time	T_j=-40..+150℃	350	-	1600	us
$V_{ST(high)}$	Status output	T_j=-40..+150℃, I_{ST}=-50uA	4.4	5.1	6.5	V
$V_{ST(low)}$		T_j=-40..+150℃, I_{ST}=1.6mA	-	-	0.4	
$-I_{ST}$		current source (out)	-	-	0.25	mA
$+I_{ST}$		current sink (in)	-	-	1.6	

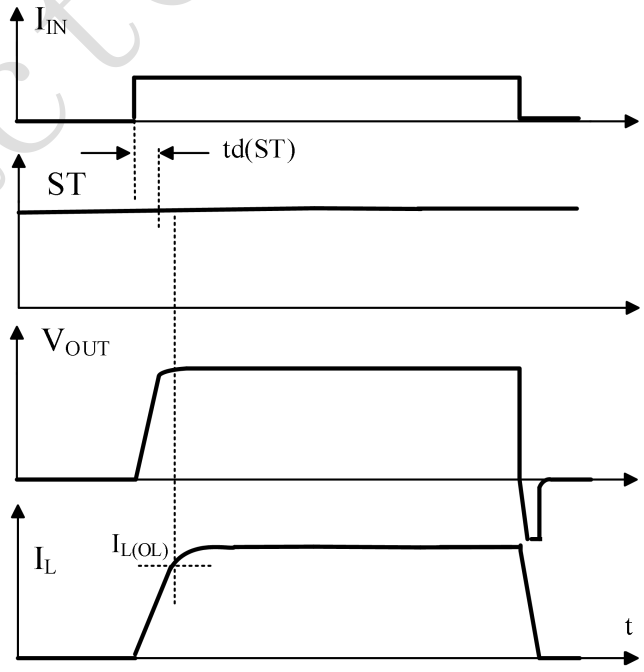
10.Timing diagrams

Figure 1: Vbb turn on:



in case of too early V_{IN}=high the device may not turn on (curve A)

Figure 2a: Switching an inductive load:



if the time constant of load is too large, open-load-status may occur.

Figure2b: Switching a lamp

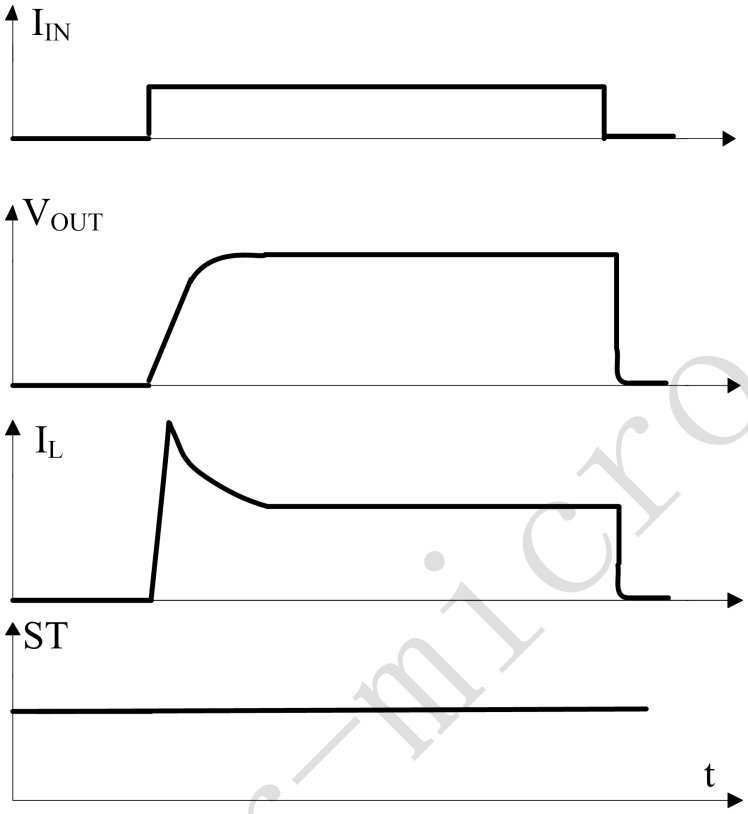
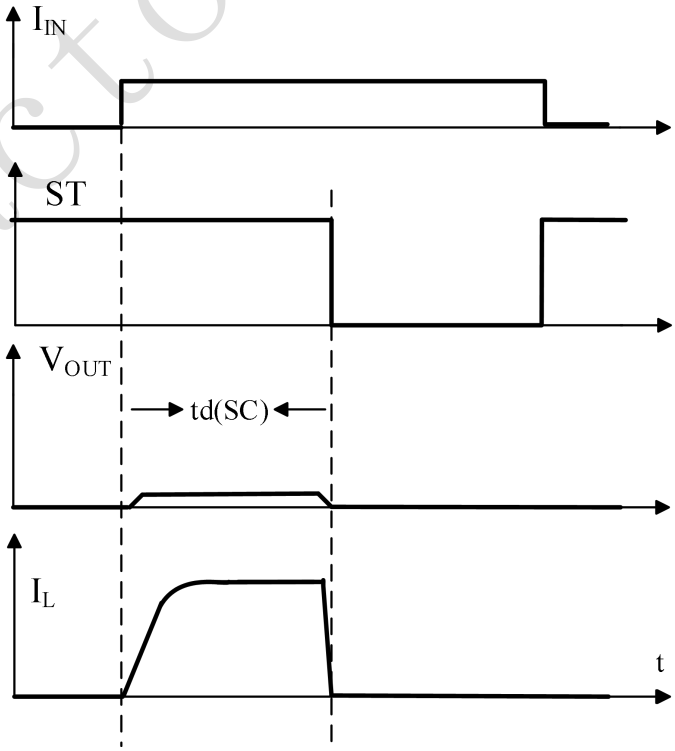


Figure3a: Turn on into short circuit



$t_{d(SC)}$ approx. 200µs if V_{bb} - V_{OUT} > 8.3 V typ.

Figure3b: Turn on into overload

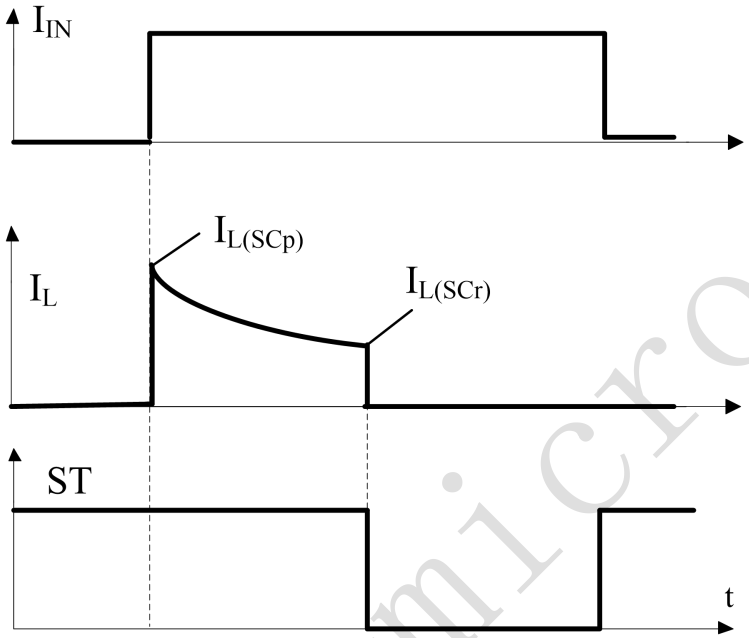
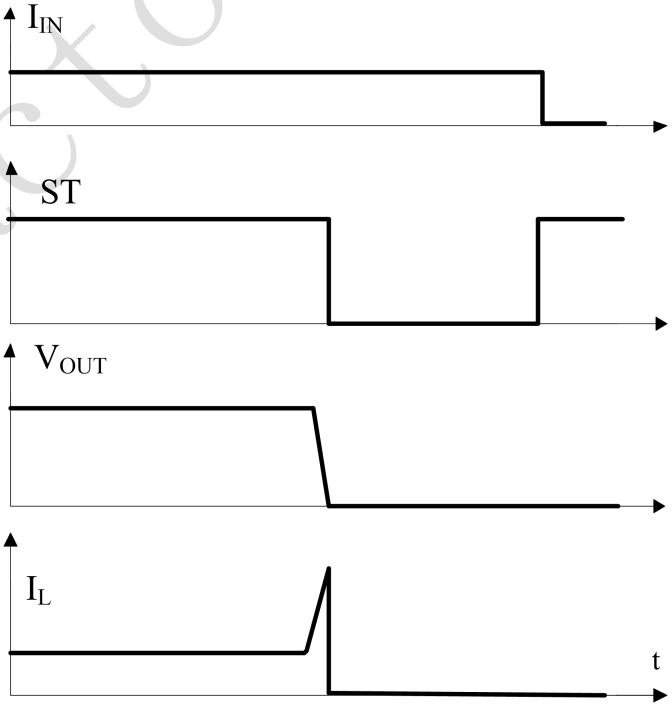


Figure 3c: Short circuit while on:



current peak approx. 20 µs

Figure 4a:Overtemperature

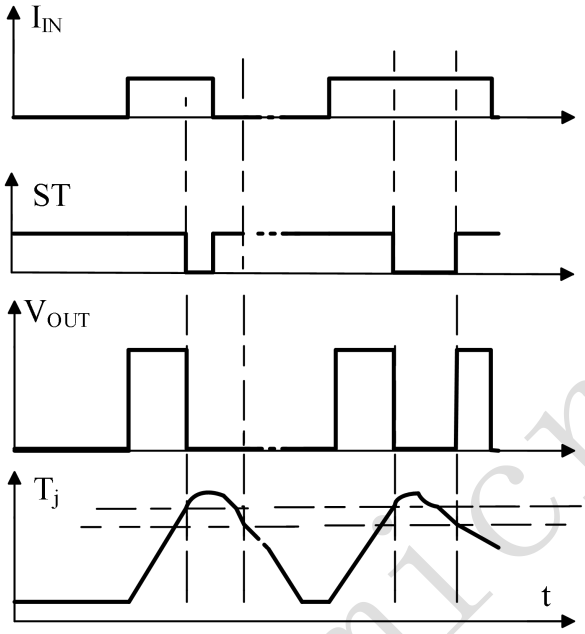


Figure 5a: Open load: detection in ON-state, turn on/off to open load

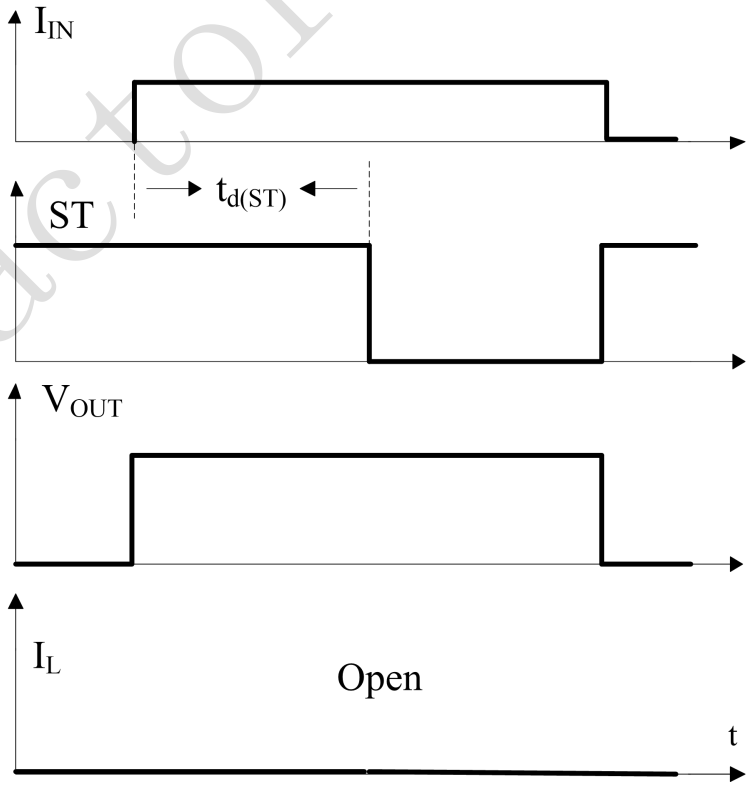


Figure 5b:Open load: detection in ON-state, open load occurs in on-state

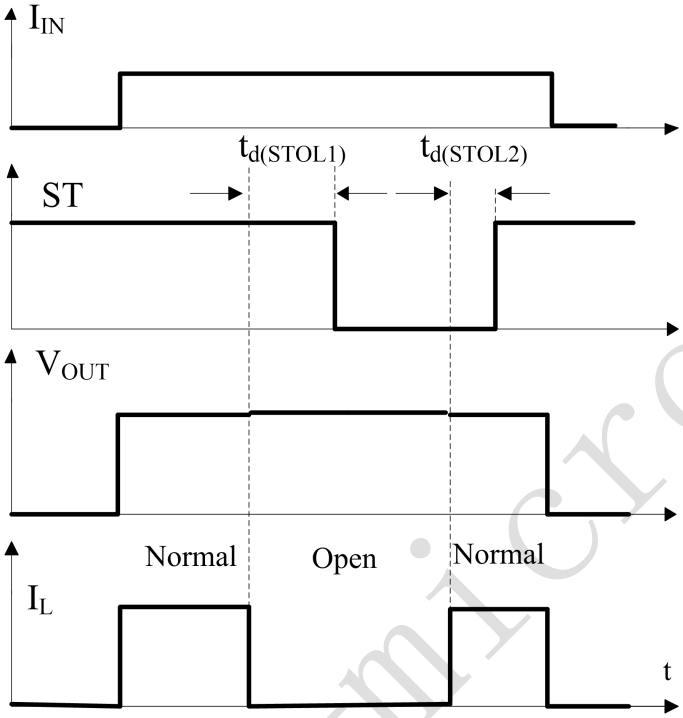


Figure 6a: Undervoltage:

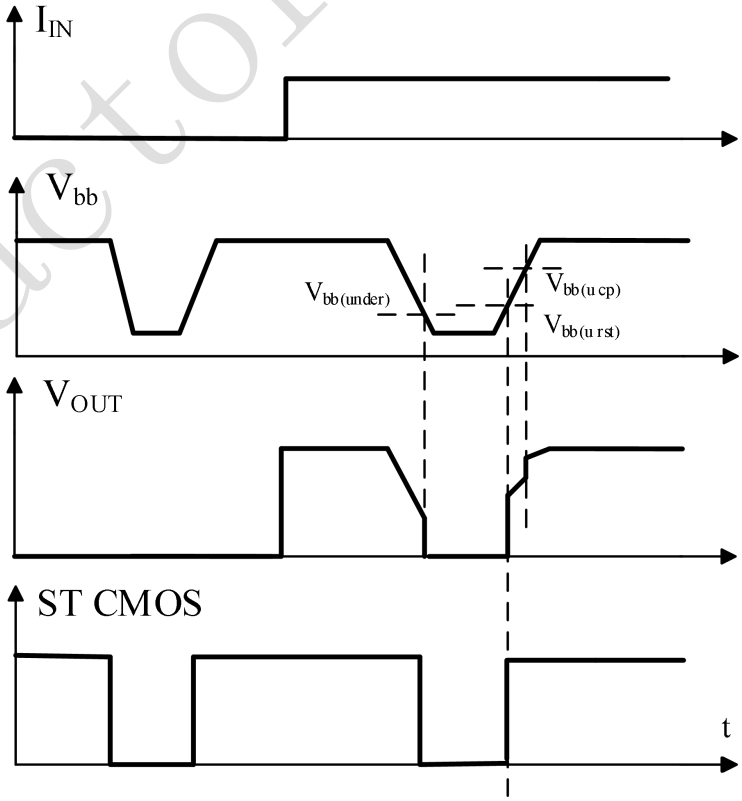
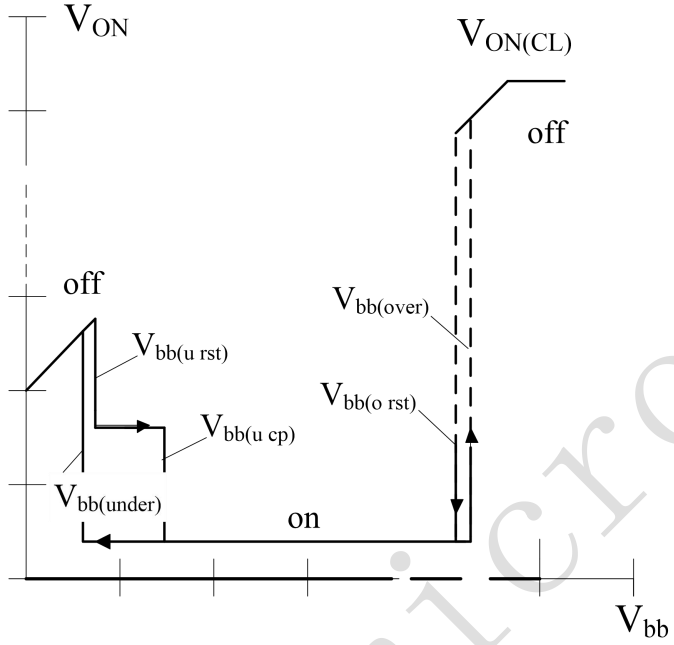
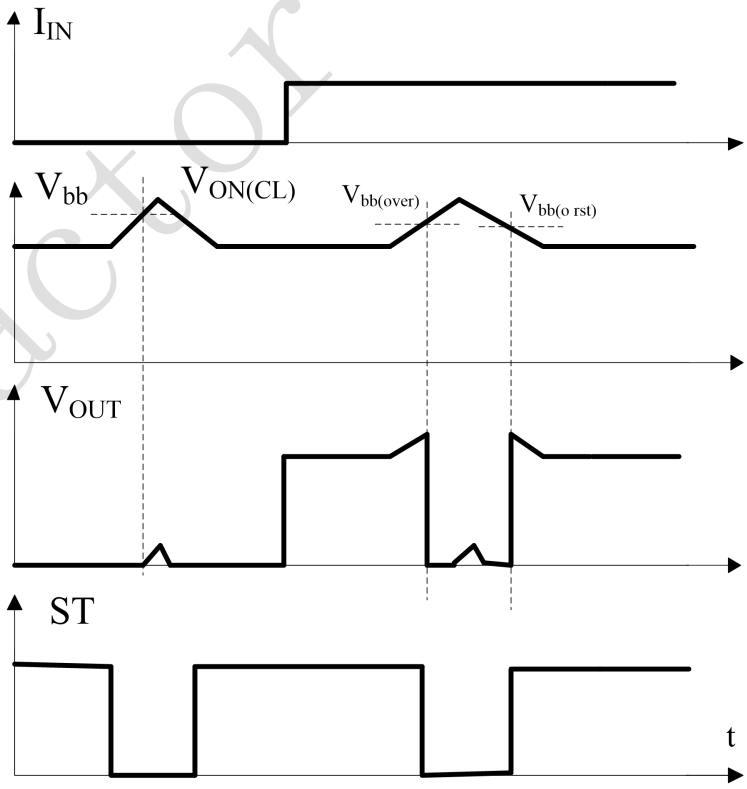


Figure 6b: Undervoltage restart of charge pump V_{ON}



charge pump starts at Vbb(ucp) =6.5 V typ.

Figure 8: Overvoltage



11.Truth Table

Operation Mode	Input Current level	Output level	Current Sense
Normal operation	L H	L H	H H
Open load	L H	Z[1)] H	H L
Short circuit to GND	L H	L L	H L
Short circuit to Vbb	L H	H H	H H(L[2)])
Over temperature	L H	L L	H L
Under voltage	L H	L L	L[3)] L[3]
Over voltage	L H	L L	H H

L = "Low" Level,

H = "High" Level

Z = high impedance, potential depends on external circuit

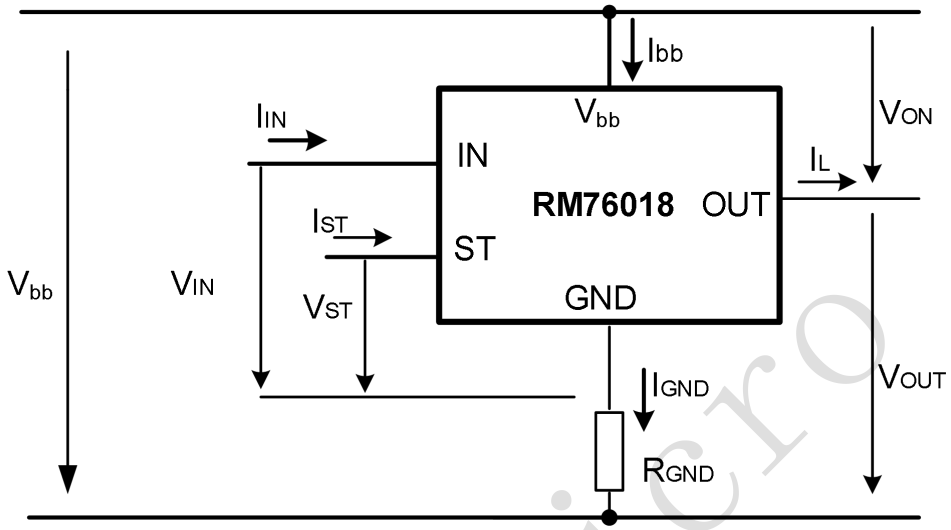
(1)Power Transistor off, high impedance

(2)Low resistance short Vbb to output may be detected in ON-state by the no-load-detection

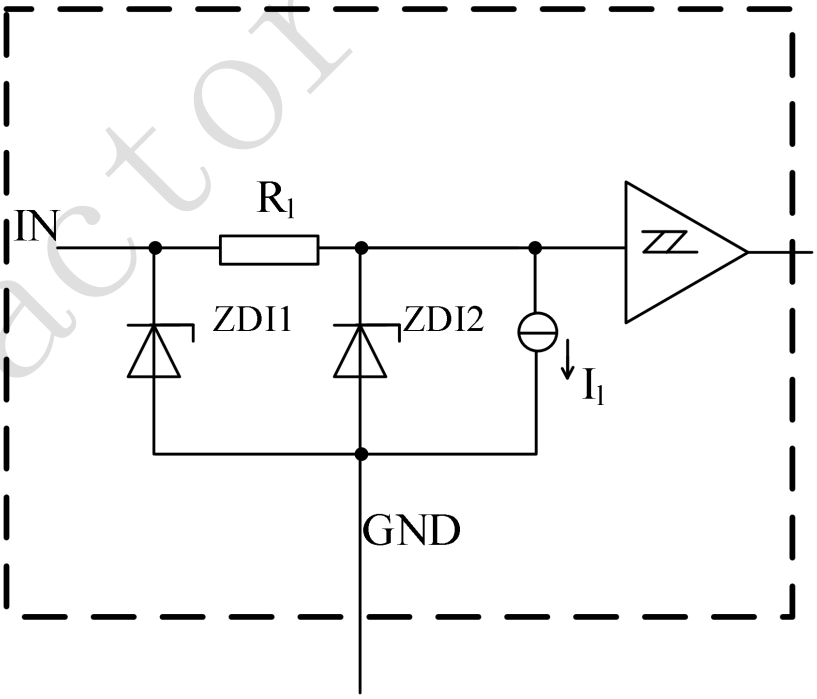
(3)No current sink capability during undervoltage shutdown

12.Functions

12.1 Terms

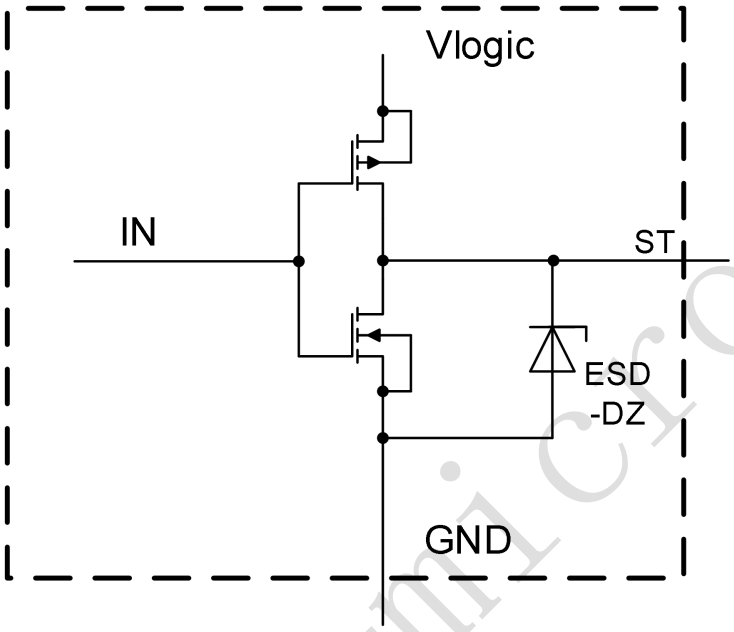


12.2 Input circuit (ESD protection)



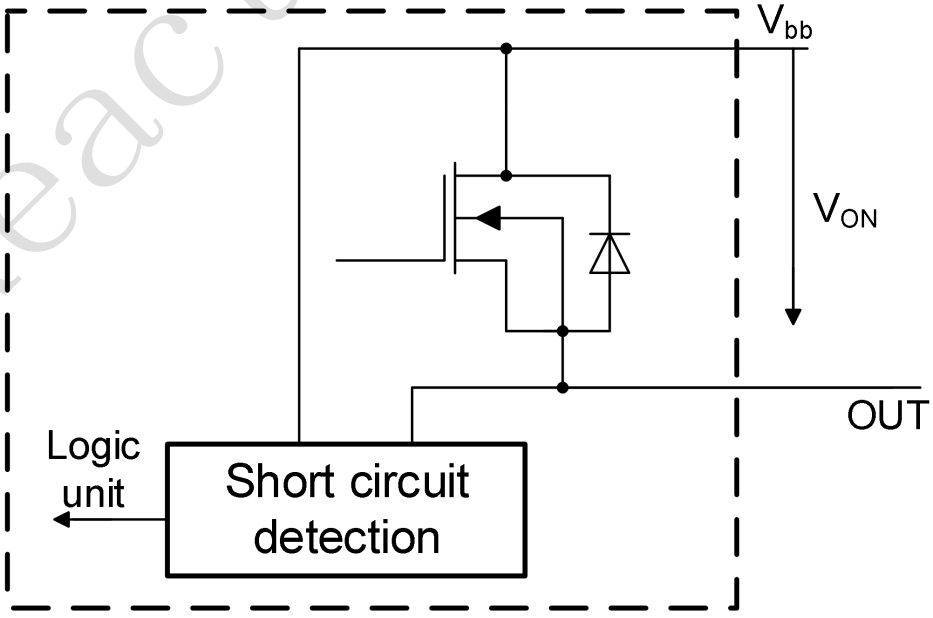
ZDI1 6.1 V typ., ESD zener diodes are not to be used as voltage clamp at DC conditions. Operation in this mode may result in a drift of the zener voltage (increase of up to 1 V).

12.3 Status output



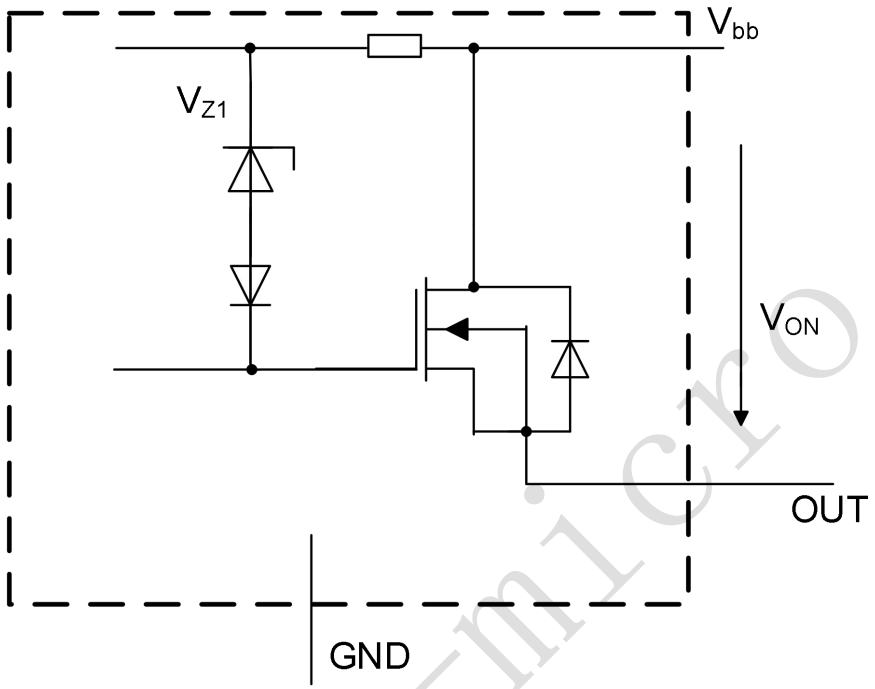
Zener diode: 6.1 V typ., max 5 mA, VLogic 5 V typ, ESD zener diodes are not to be used as voltage clamp at DC conditions. Operation in this mode may result in a drift of the zener voltage (increase of up to 1 V).

12.4 Short Circuit detection



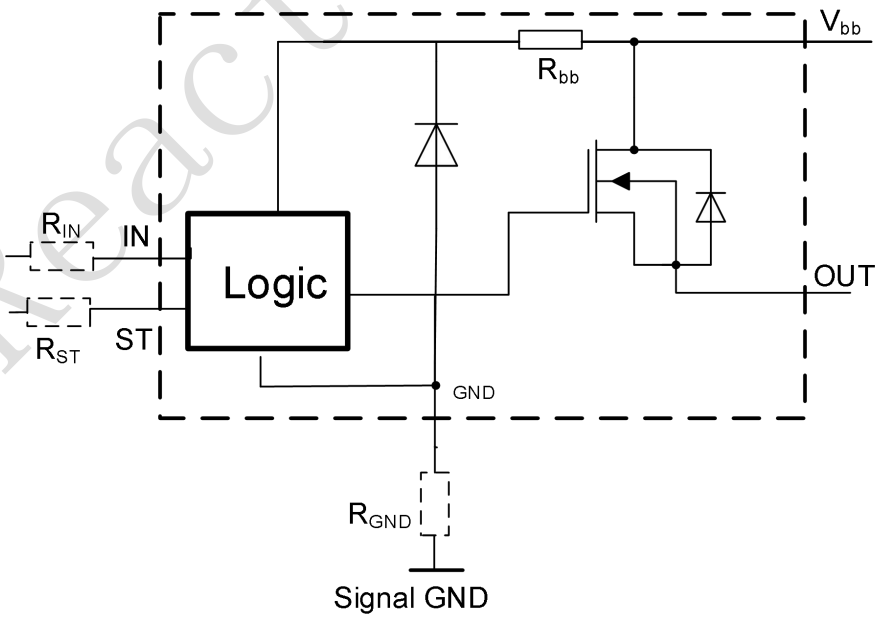
Fault Condition: V_{ON} > 8.3 V typ.; IN high

12.5 Inductive and overvoltage output clamp



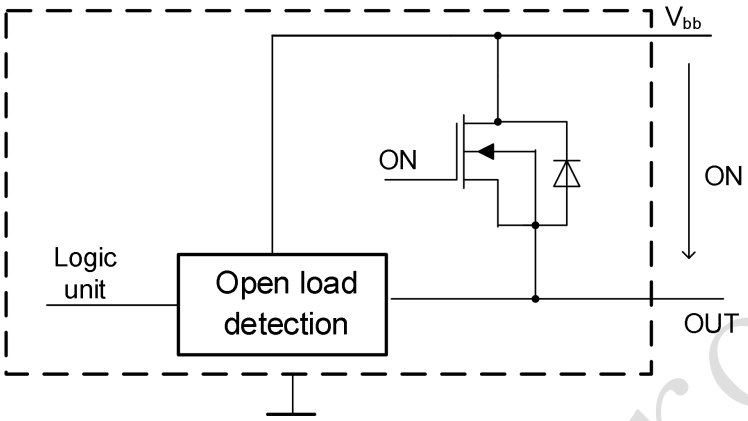
V_{ON} clamped to 58 V typ.

12.6 Overvolt. and reverse batt. protection



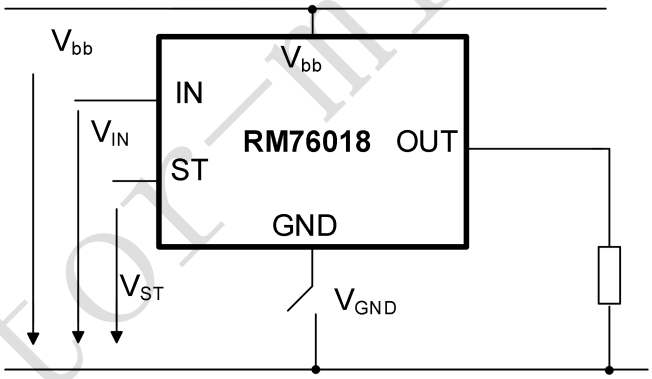
R_{bb}=120Ω typ., V_Z+R_{bb}*40mA=67V typ., add R_{GND}, R_{IN}, R_{ST} for extended protection

12.7 Open-load detection



ON-state diagnostic condition: $V_{ON} < R_{ON} * I_{L(OL)}$; IN high

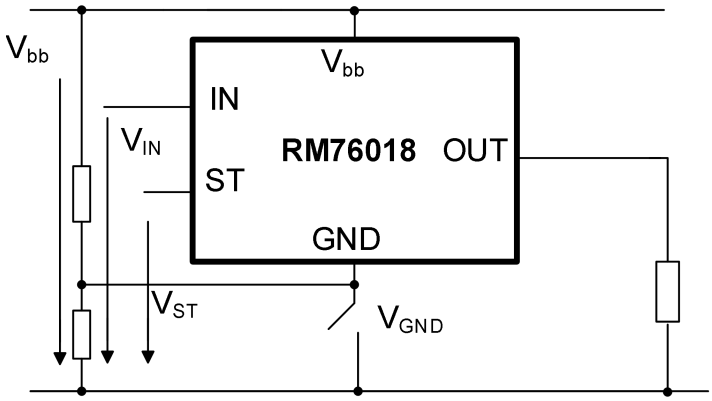
12.8 GND disconnect



Any kind of load. In case of Input=high is $V_{OUT} \approx V_{IN} - V_{IN(T+)}$.

Due to V_{GND} >0, no V_{ST} = low signal available

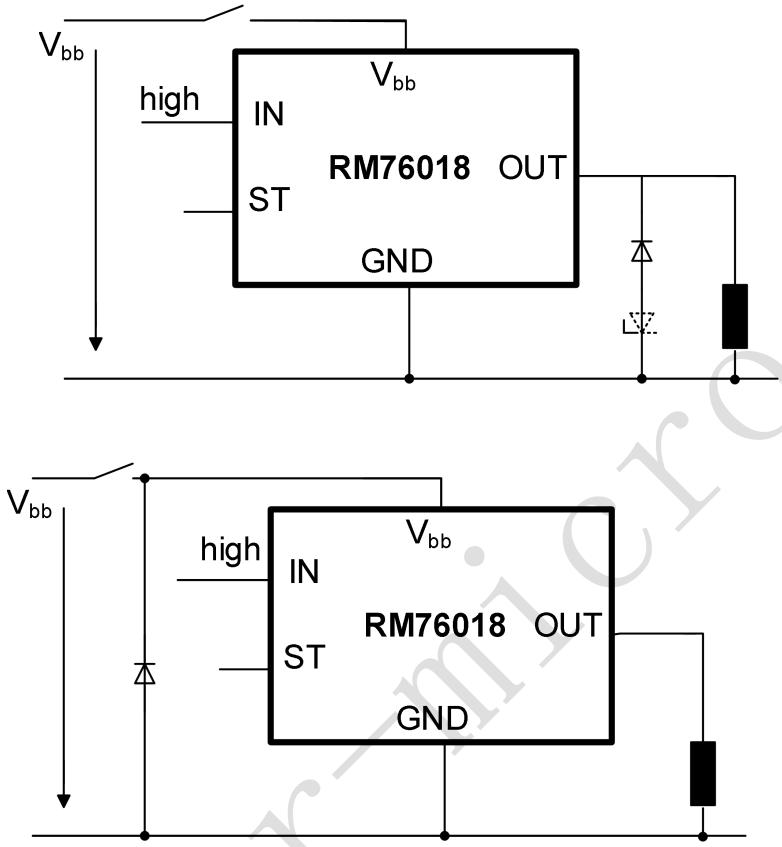
12.9 GND pull up



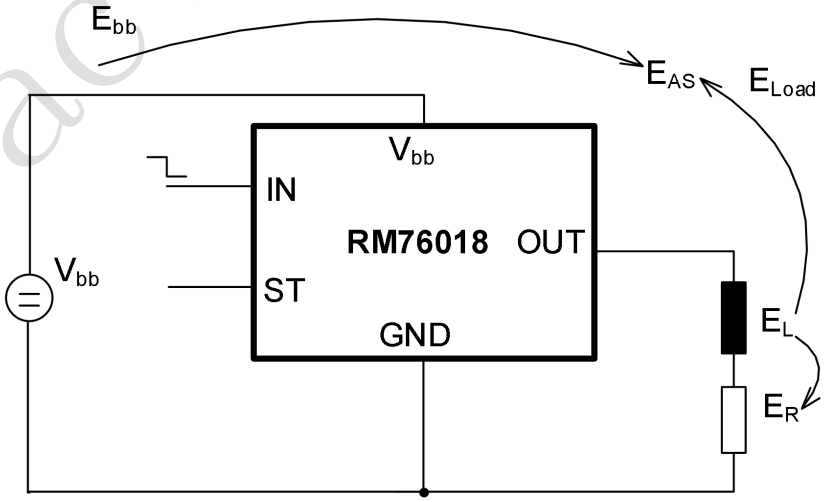
Any kind of load. If $V_{GND} > V_{IN} - V_{IN(T+)}$ device stays off.

Due to V_{GND} >0, no V_{ST} = low signal available.

12.10 Vbb disconnect with charged inductive load



12.11 Inductive Load switch-off energy dissipation



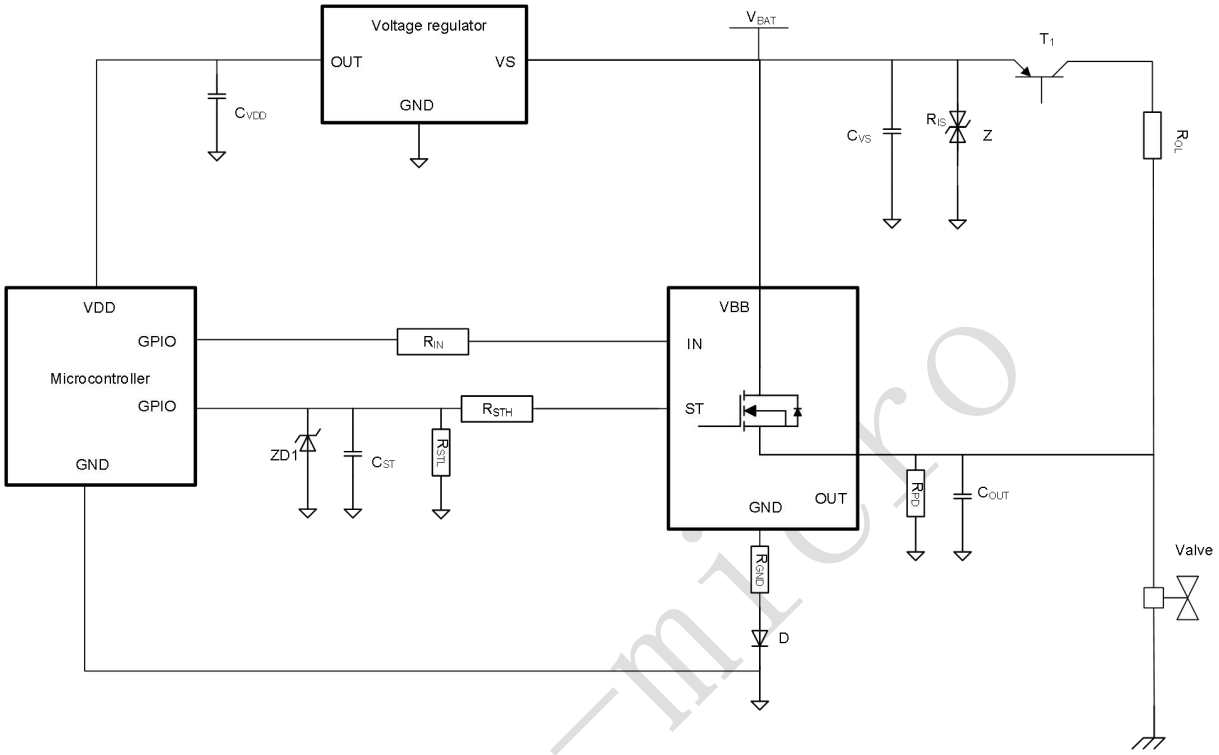
Energy dissipated in RM76018TXS:

$$E_{AS} = E_{bb} + E_L - E_R$$

$$E_{Load} < E_L$$

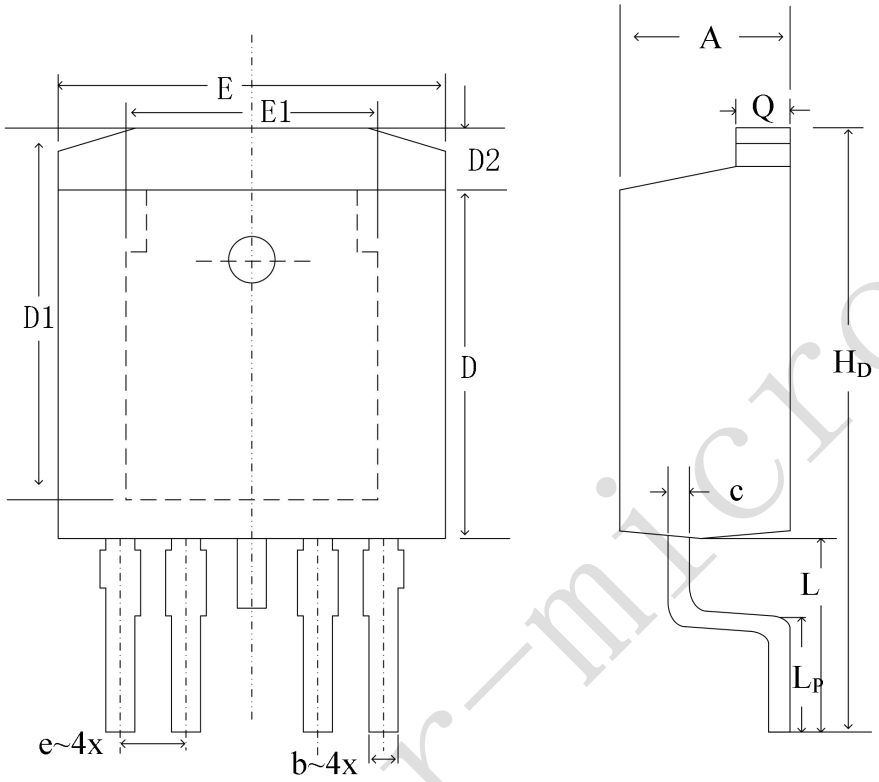
$$E_L = \frac{I_L^2 * L}{2}$$

13.Application Information



14.Package

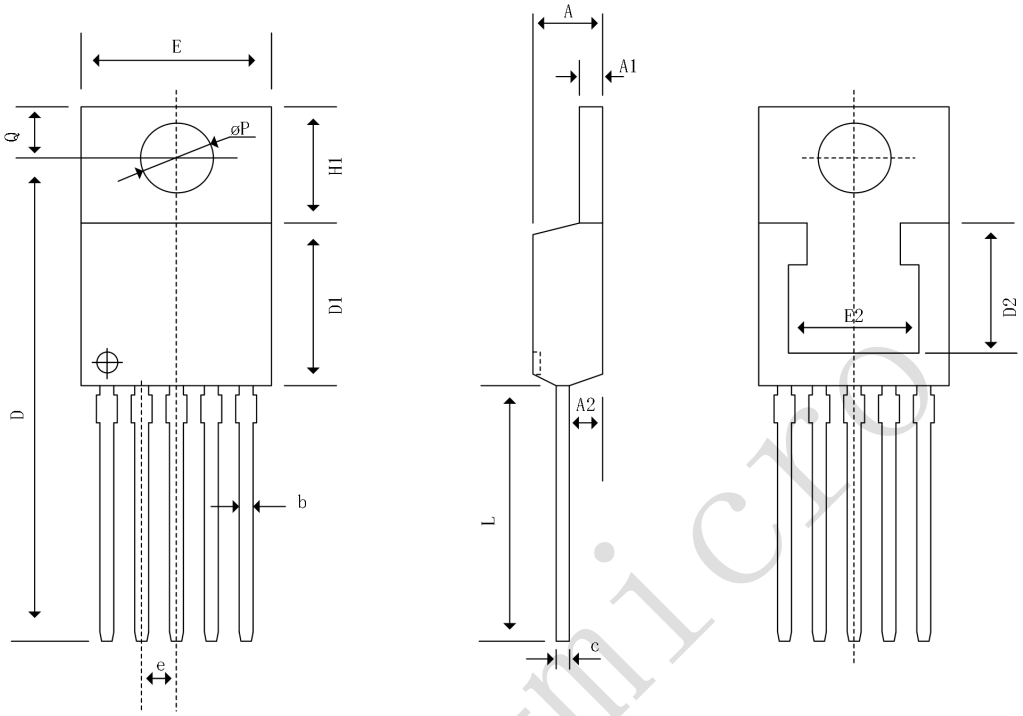
TO-263-4L



Unit :mm

Symbol	MIN	NOM	MAX
A	4.064	4.445	4.826
b	0.508	0.750	0.991
c	0.381	0.560	0.737
Q	1.143	1.397	1.651
D	8.382	9.017	9.652
D1	6.858	6.905	-
E	9.652	10.160	10.668
E1	6.223	-	8.000
e	1.702 BSC.		
H_D	14.605	15.240	15.875
L_P	1.778	-	2.794
D2	-	1.550	1.676
L	-	5.100	5.280

TO-220NB-5L

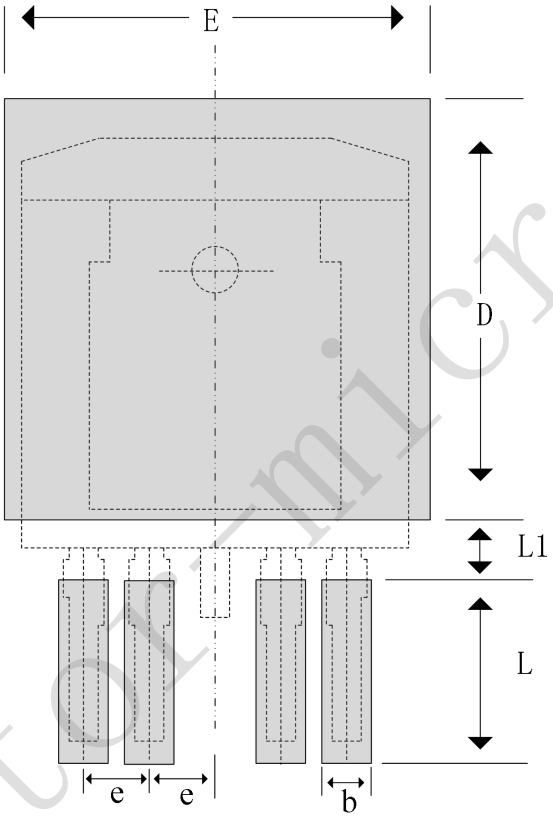


Unit:mm

Symbol	MIN	NOM	MAX
A	4.37	4.57	4.77
A1	1.17	1.27	1.42
A2	-	2.67	-
b	0.76	0.89	1.02
c	0.33	0.38	0.64
D	25.65	26.00	26.35
D1	8.38	8.70	9.00
D2	5.50	-	-
E	9.86	10.26	10.39
E2	7.30	-	-
e	1.55	1.70	1.85
H1	6.10	6.35	6.60
L	13.34	13.74	14.10
Φp	3.70	-	3.95
Q	2.54	-	3.05

15. Recommended Soldering Footprint

TO-263-4L



Unit : mm

Symbol	NOM	Symbol	NOM
E	10.8	D	9.4
L1	2.2	L	4.6
b	1.1	e	1.702

16.Revision History

Version	Change Description	Date
1.0	Initial Version	2024/08/16