

1. Basic Features

- Very low standby current
- Overload protection
- Current limitation
- Short circuit protection
- Over temperature protection
- Over voltage protection
- Clamp of negative voltage at output
- Fast deenergizing of inductive loads
- Open load detection via current sense
- Diagnostic feedback with load current sense
- Electrostatic discharge (ESD) protection
- Green Product (RoHS compliant)
- AEC-Q100 qualified

3. Application

- Suitable for 12 V and 24 V Trucks and Transportation System
- Most suitable for loads with high inrush current like lamps and motors, all types of resistive and inductive loads
- Replaces electromechanical relays, fuses and discrete circuits

2. Description

RM76006TS 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.

RM76006TS 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.

4. Product Summary

Overvoltage protection	$V_{Z,IN}$	66	V
Operating voltage	$V_{bb(ON)}$	5...34	V
On-state resistance	R_{ON}	4.8	m Ω
Nominal load current	$I_{L(NOM)}$	17	A
Short circuit current limitation	$I_{L(SC)}$	130	A
Current sense ratio	$I_{L:IS}$	14000	

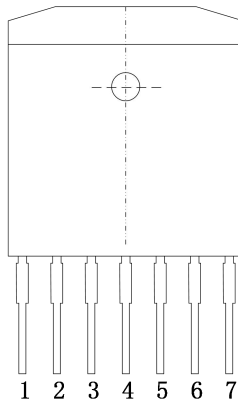
5. Ordering Code

Part number	Package Type	Marking	Materials	Package			Package Qty
				Tape&reel	5 reels/box	4k/box	
RM76006TS	TO-263-7L	RM76006TS	Halogen free	Tape&reel	5 reels/box	4k/box	800 /reel

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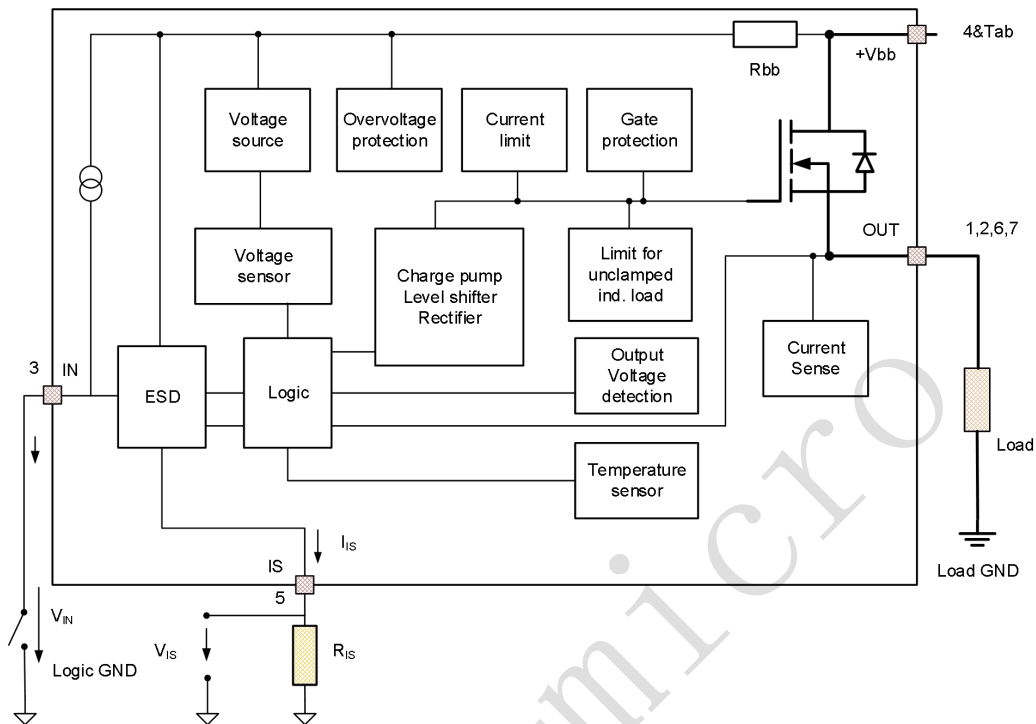
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6.Pin Configuration



Pin	Symbol	Function
1/2/6/7	OUT	Output; Output to the load; The pins 1, 2, 6 and 7 must be shorted with each other especially in high current applications
3	IN	Input; has an internal pull up; activates the power switch in case of short to ground
4/Tab	V _{bb}	Supply voltage; Positive power supply voltage, tab and pin 4 are internally shorted
5	IS	Sense Output; Diagnostic feedback providing a sense current proportional to the load current; zero current on failure

7. Block Diagram



8. Absolute Maximum Ratings¹⁾

(Maximum Ratings at $T_J=25\text{ }^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Values	Unit	
Supply voltage	V_{bb}	42	V	
Supply voltage for short circuit protection	V_{bb}	34	V	
Load dump protection	$V_{Load\ dump}$	75	V	$V_{LoadDump}=U_A+V_s$, $U_A=13.5V$, $R_I=2\Omega$, $R_L=0.54\Omega$, $t_d=200ms$, IN, IS=open or grounded
Current through input pin (DC)	I_{IN}	-250 to 15	mA	
Current through current sense status pin (DC)	I_{IS}	-250 to 15	mA	
Power dissipation (DC), $T_c \leq 25\text{ }^\circ\text{C}$	P_{tot}	139	W	
Operating temperature	T_J	-40 to 150	$^\circ\text{C}$	
Ambient temperature	T_A	-40 to 125	$^\circ\text{C}$	
Storage temperature	T_{STG}	-55 to 150	$^\circ\text{C}$	
Thermal resistance junction - ambient (free air)	R_{thJA}	89.51	K/W	
Thermal resistance chip - case	R_{thJC}	0.9	K/W	

Notes:

- 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

$T_J = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$, $V_{bb} = 12\text{V}$, (unless otherwise specified)

Symbol	Parameter	Test Condition	Values			Unit
			Min	Typ	Max	
R_{on}	On-state resistance	$I_L = 20\text{A}$, $T_J = 25^{\circ}\text{C}$	-	4.8	6.4	m Ω
		$V_{IN} = 0\text{V}$, $I_L = 20\text{A}$, $T_J = 150^{\circ}\text{C}$		7.9	10.5	
$I_{L(ISO)}^{(1)}$	Nominal load current (ISO)	$V_{ON} = 0.5\text{V}$, $T_C = 85^{\circ}\text{C}$	55	70	-	A
$I_{L(NOM)}$	Nominal load current	$V_{ON} \leq 0.5\text{V}$, $T_A = 85^{\circ}\text{C}$	13.6	17	-	A
t_{on}	Turn-ON time	$R_L = 2\Omega$, I_{IN} Turn-ON time to 90% V_{OUT}	30	-	400	us
t_{off}	Turn-OFF time	$R_L = 2\Omega$, I_{IN} Turn-OFF time to 10% V_{OUT}	20	-	110	us
dV/dt_{on}	Turn-ON Slew rate	$R_L = 2\Omega$, From 10% to 30% V_{OUT}	-	1	-	V/us
$-dV/dt_{off}$	Turn-OFF Slew rate	$R_L = 2\Omega$, From 70% to 40% V_{OUT}	-	1.5	-	V/us
$V_{bb(on)}$	Operating voltage		5	-	34	V
$V_{bIN(u)}$	Under voltage shutdown		1.5	3.0	4.5	V
$V_{bIN(ucp)}$	Under voltage start of charge pump		3.0	4.5	6.0	V
$I_{bb(off)}$	Standby current	$I_{IN} = 0$, $V_{bb} = 35\text{V}$, $T_J = 25^{\circ}\text{C}$	-	0.1	1.0	uA
$I_{L(SC)}$	Short circuit current limit	$V_{bb} = 12\text{V}$, $V_{out} = \text{GND}$, $T_J = -40^{\circ}\text{C}$	-	90	-	A
		$V_{bb} = 12\text{V}$, $V_{out} = \text{GND}$, $T_J = 25^{\circ}\text{C}$	70	130	300	A
		$V_{bb} = 12\text{V}$, $V_{out} = \text{GND}$, $T_J = 125^{\circ}\text{C}$	-	140	-	A
$V_{ON(SC)}$	Short circuit shutdown detection voltage		-	5.8	-	V
$t_{d(SC)}$	Short circuit shutdown delay after input current positive slope	$V_{bb} = 12\text{V}$, $V_{OUT} = \text{GND}$, $T_J = 25^{\circ}\text{C}$	80	-	350	us
$V_{ON(CL)}$	Output clamp (inductive load switch off)	$V_{IN} = 30\text{V}$, $I_L = 40\text{mA}$	36	42	47	V
$-V_{OUT(CL)}$	Output clamp (inductive load switch off)	$V_{IN} = 12\text{V}$, $I_L = 40\text{mA}$	14	16.5	20	V
T_{Jt}	Thermal overload trip temperature		150	-	-	$^{\circ}\text{C}$
ΔT_{Jt}	Thermal hysteresis		-	10	-	K
$I_{IN(ON)}$	Input and operating current	$V_{IN} = 0\text{V}$	-	0.65	1.5	mA
$I_{IN(OFF)}$	Input current for		-	15	80	uA

	turn-off					
$V_{Z,IN}$	Overvoltage protection	$R_{IS-GND}=1K\Omega$, V_{OUT} , V_{IN} floating, $T_J=25^\circ C \dots 150^\circ C$, $I_{bb}=4mA$	62	66	-	V
Inverse Load Current Operation:						
$R_{ON(INV)}$	On-state resistance	$V_{bb}=12V$, $I_L=-20A$, $T_J=25^\circ C$	-	4.8	6.4	m Ω
		$V_{bb}=12V$, $I_L=-20A$, $T_J=150^\circ C$	-	7.9	10.5	m Ω
$I_{L(INV)}$	Nominal inverse load current	$V_{ON}=-0.5V$, $T_J=85^\circ C$	55	70	-	A
$-V_{ON}$	Drain-source diode voltage	$I_L=-20A$, $I_{IN}=0$, $T_J=25^\circ C$	-	-	0.85	V
Diagnostic Characteristics:						
$K_{I,IS}$	Current sense ratio	$I_L=10A$, $I_L=20A$	10800	14000	18500	
$I_{S,lim}$	Sense current saturation		3.5	-	-	mA
$I_{S(LL)}$	Current sense leakage current	$I_{IN}=0$	-	-	0.5	μA
$I_{S(LH)}$		$V_{IN}=0$, $I_L=0$	-	2	65	
$V_{Z,IS}$	Current sense over voltage protection	$I_{bb}=4mA$, $T_J=-40^\circ C$	62	-	-	V
		$I_{bb}=4mA$, $T_J=25^\circ C \dots 150^\circ C$	62	66	-	V
$t_{S,IS}$	Current sense settling time	$R_L=4\Omega$	-	-	500	μs
NOTE:1) not subject to production test, specified by design						

10. Timing diagrams

Figure 1: Switching a Resistive Load Timing

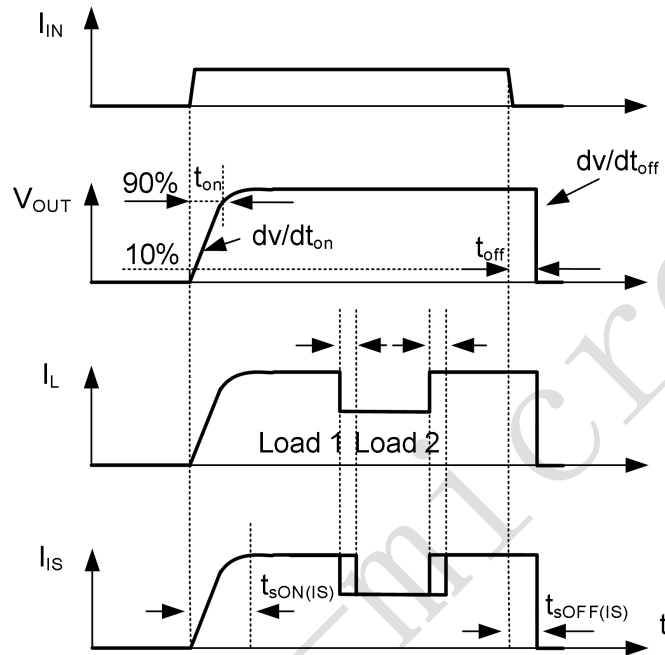
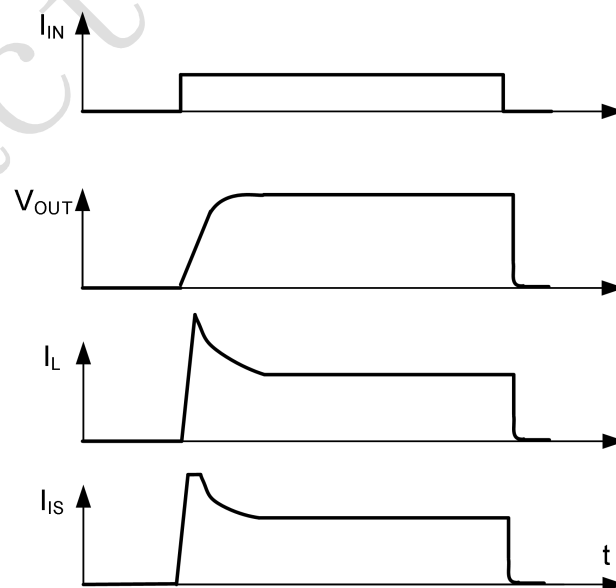


Figure 2a: Switching motors and lamps



Sense current saturation can occur at very high inrush currents

Figure 2b: Switching an inductive load

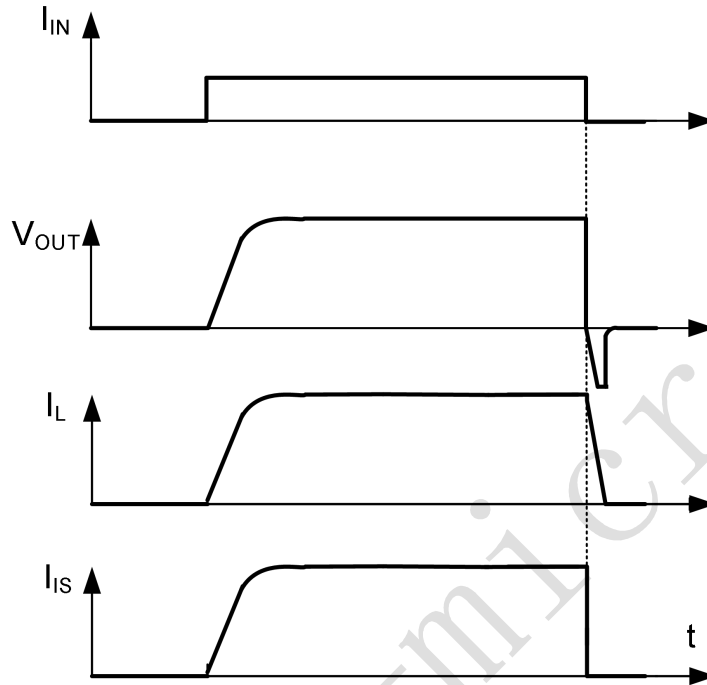


Figure 3: Short circuit

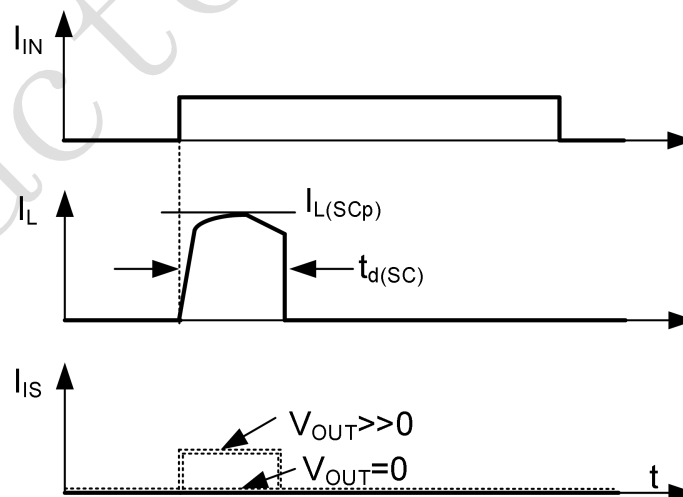
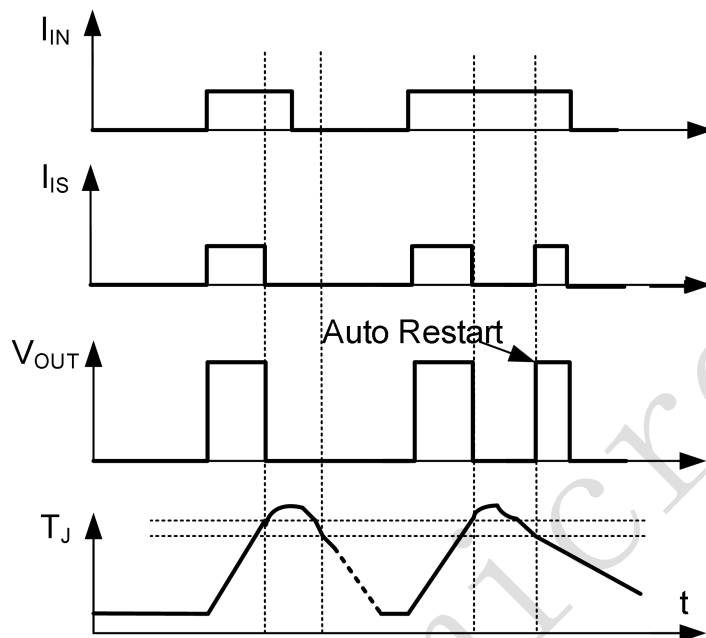
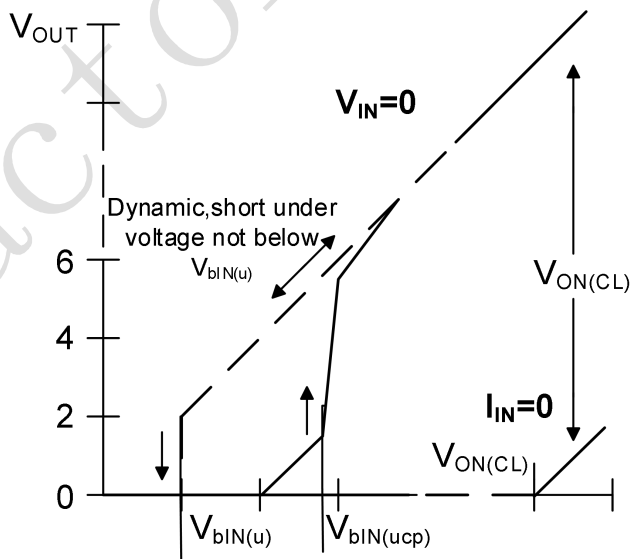


Figure 4: Over temperature



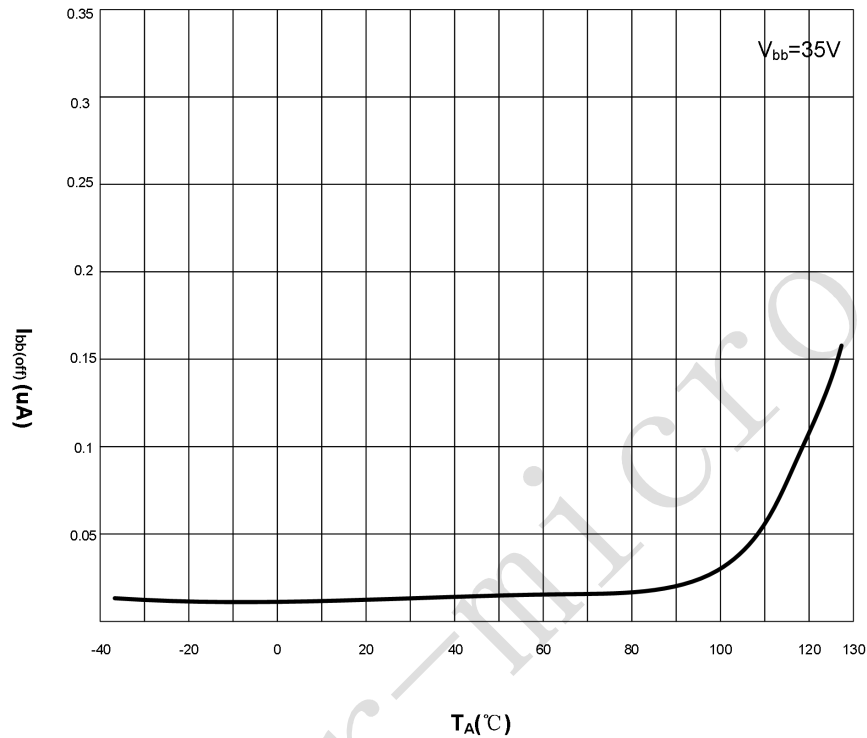
Reset if $T_J < T_{JT}$.

Figure 5: Undervoltage restart of charge pump, overvoltage clamp

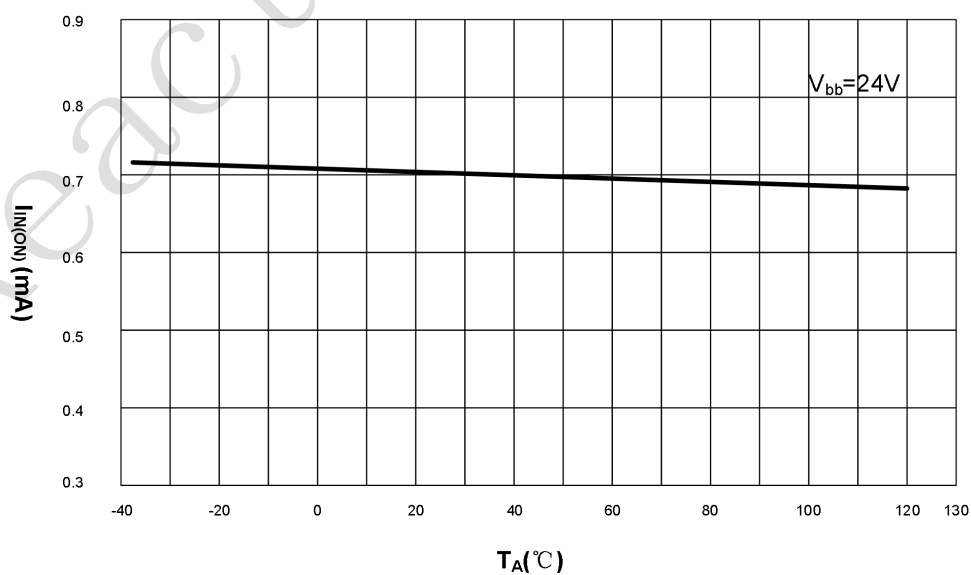


11. General Product Characteristics

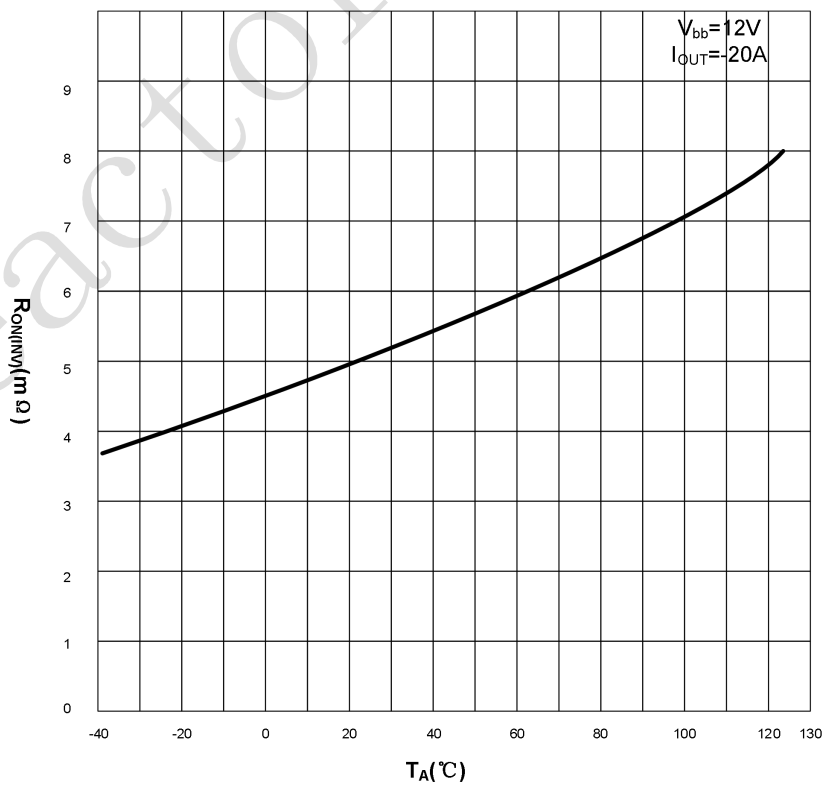
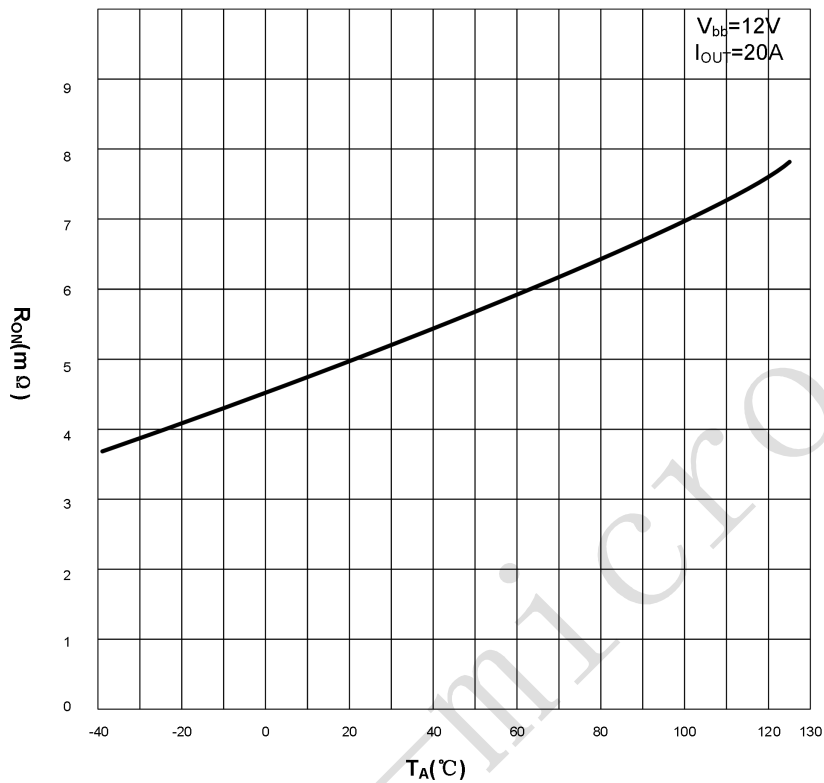
11.1 Standby Current



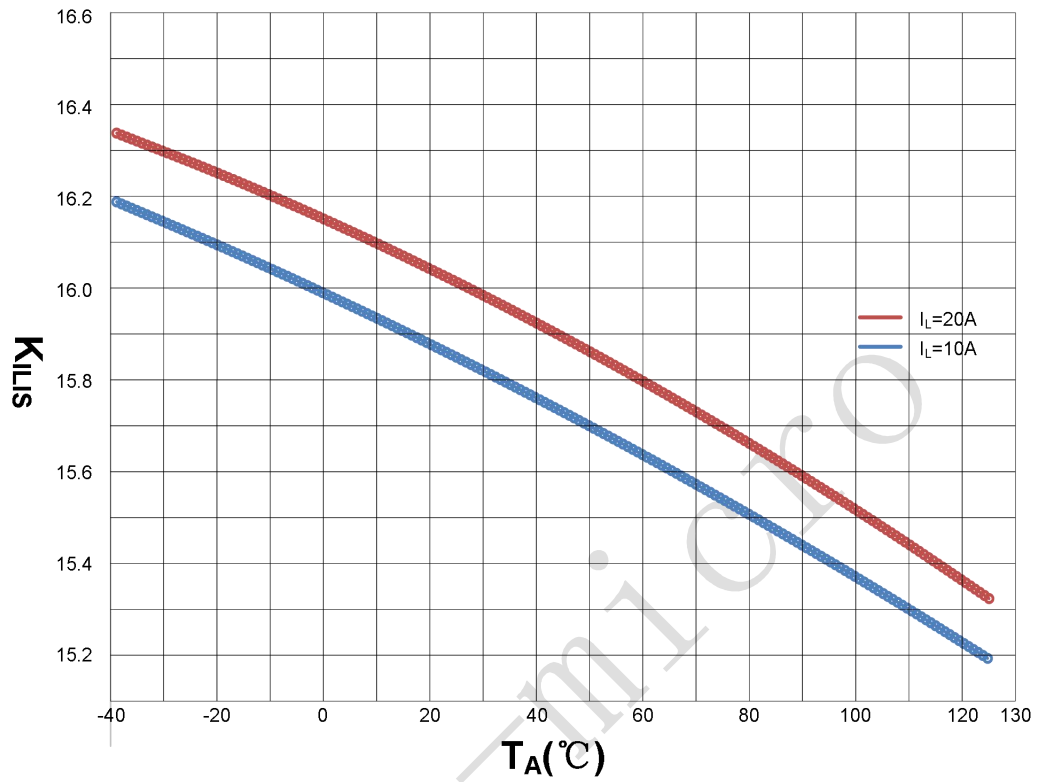
11.2 Input and operating current



11.3 Typical ON-State Resistance



11.4 Current Sense



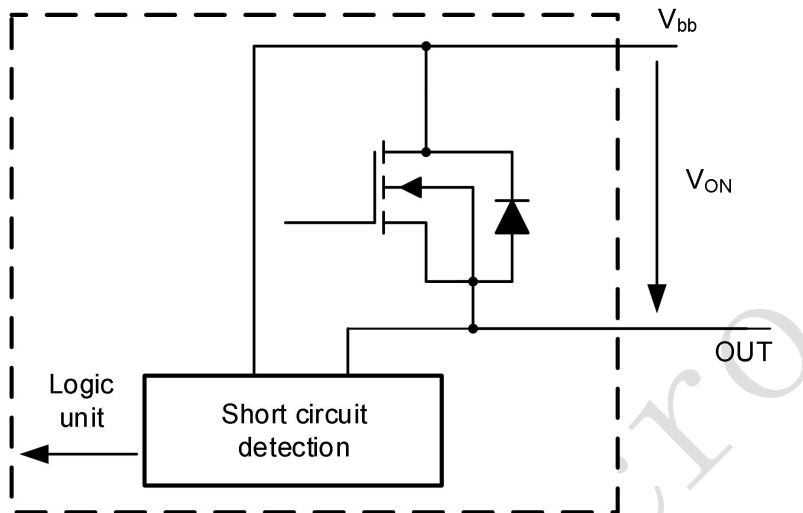
12. Truth Table

Operation Mode	Input Current level	Output level	Current Sense I_{IS}	Remark
Normal operation	L	L	0	$=I_L/K_{ILIS}$, up to $I_{IS}=I_{IS,lim}$
	H	H	Nominal	
Very high load current	H	H	$I_{IS,lim}$	up to $V_{ON}=V_{ON(Fold\ back)}$ I_{IS} no longer proportional to I_L
Current-limitation	H	H	0	$V_{ON}>V_{ON(SC)}$, shutdown will occur
Short circuit to GND	L	L	0	
	H	L	0	
Over temperature	L	L	0	
	H	L	0	
Short circuit to V_{bb}	L	H	0	
	H	H	Nominal ⁽¹⁾	
Open load	L	Z ⁽²⁾	0	
	H	H	0	
Negative output voltage clamp	L	L	0	
Inverse load current	L	H	0	
	H	H	0	

L="Low" Level, H="High" Level

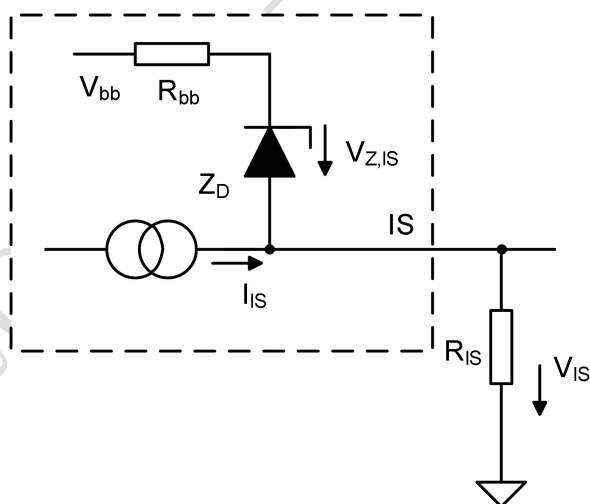
- 1) Low ohmic short to V_{bb} may reduce the output current I_L and can thus be detected via the sense current I_{IS} .
- 2) Power Transistor "OFF", potential defined by external impedance.

13.3 Short circuit detection



Fault Condition: $V_{ON} > V_{ON(SC)}$ (5.8 V_{typ.}) and $t > t_{d(SC)}$ (80~350 μs)

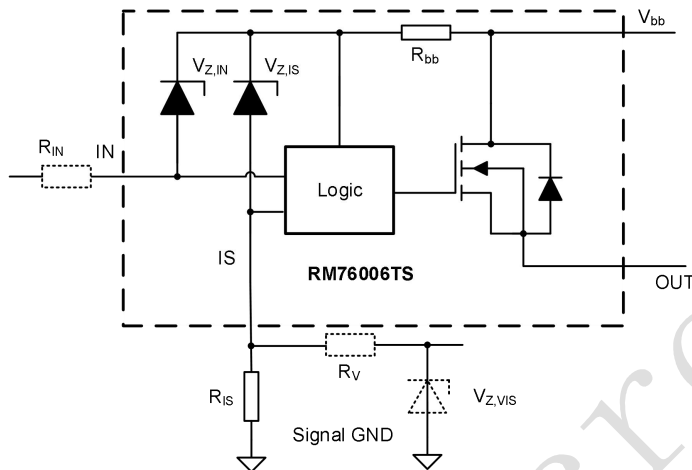
13.4 Current sense status output



$V_{Z,IS} = 66$ V (typ.), $R_{IS} = 1$ kΩ nominal (or $1\text{k}\Omega/n$, if n devices are connected in parallel). $I_S = \frac{I_L}{k_{iis}}$ can be driven only by the internal circuit as long as $V_{out} - V_{IS} > 5$ V. If you want measure load currents up to $I_{L(M)}$, R_{IS} should be less than $\frac{V_{bb} - 5V}{\frac{I_{L(M)}}{k_{iis}}}$.

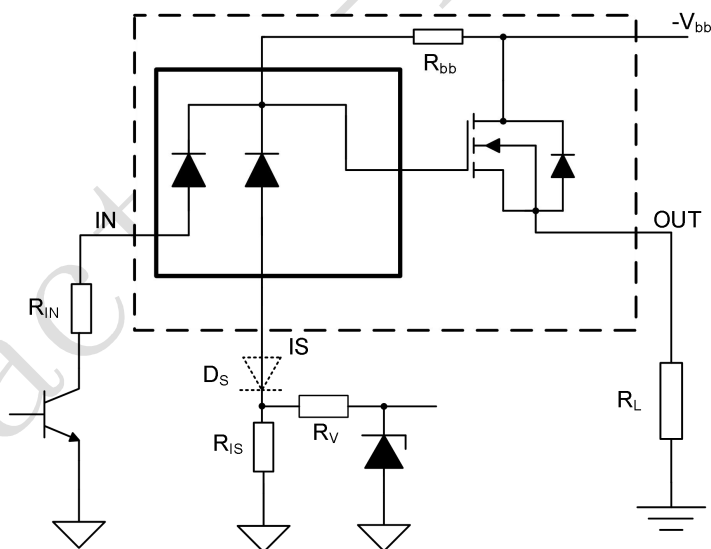
Note: For large values of R_{IS} the voltage V_{IS} can reach almost V_{bb} . See also over voltage protection. If you don't use the current sense output in your application, you can keep it grounding.

13.5 Over voltage protection of logic part



$V_{Z,IN}=V_{Z,IS}=66\text{ V typ.}$, $R_{IS}=1\text{ k}\Omega$ nominal. Note that when over voltage exceeds 71 V typ. a voltage above 5V can occur between IS and GND, if R_V , $V_{Z,VIS}$ are not used.

13.6 Reverse battery protection

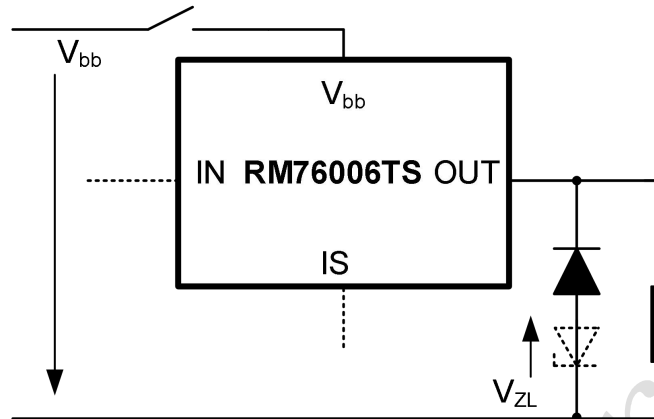


$R_V \geq 1\text{ k}\Omega$, $R_{IS}=1\text{ k}\Omega$ nominal. Add R_{IN} for reverse battery protection in applications with V_{bb} above 16V , reco

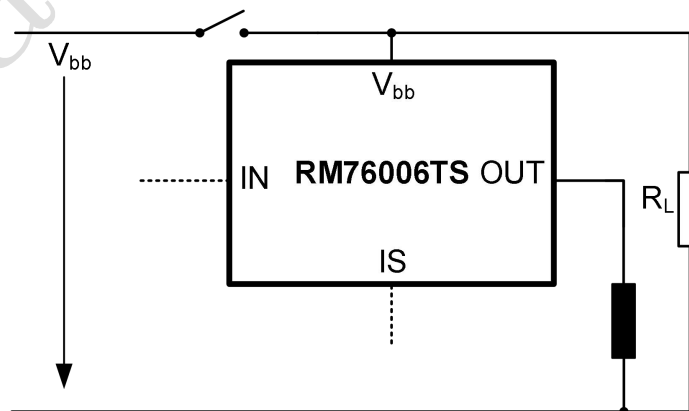
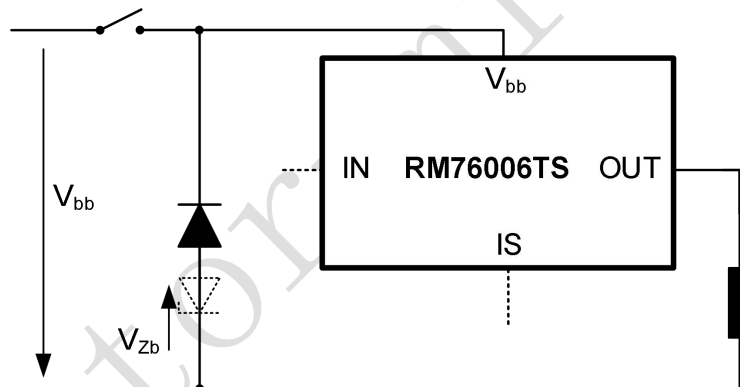
mmended value: $\frac{1}{R_V} + \frac{1}{R_{IN}} + \frac{1}{R_{IS}} = \frac{0.1A}{|V_{bb}| - 12V}$, if D_S is not used, (or $\frac{1}{R_{IN}} = \frac{0.1A}{|V_{bb}| - 12V}$ if D_S is used).

To minimize power dissipation at reverse battery operation, the overall current into the IN and IS pin should be about 120mA . The current can be provided by by using a MOSFET input switch or by proper adjusting the current through R_{IS} and R_V .

13.7 V_{bb} disconnect with energized inductive load

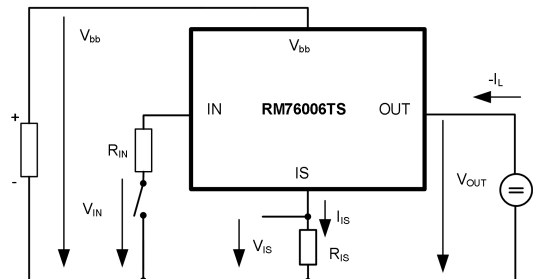


Provide a current path with load current capability by using a diode, a Z-diode, or a varistor.



Note that there is no reverse battery protection when using a diode without additional Z-diode V_{ZL} , V_{Zb} .

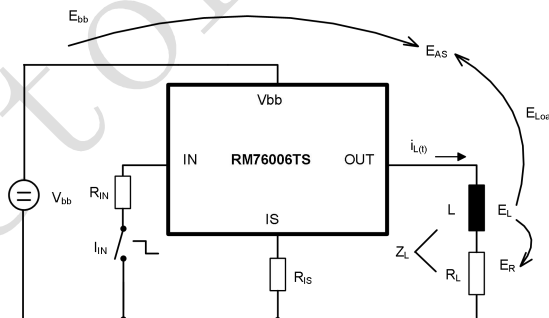
13.8 Inverse load current operation



The device is specified for inverse load current operation ($V_{OUT} > V_{bb} > 0V$). The current sense feature is not available during this kind of operation ($I_{IS} = 0$). With $I_{IN} = 0$ (e.g. input open) only the intrinsic drain source diode is conducting resulting in considerably increased power dissipation. If the device is switched on ($V_{IN} = 0$), this power dissipation is decreased to the much lower value $R_{ON(INV)} * I^2$

Note: Temperature protection during inverse load current operation is not possible!

13.9 Inductive load switch-off energy dissipation



Energy stored in load inductance:

$$E = \frac{1}{2} * L * I^2$$

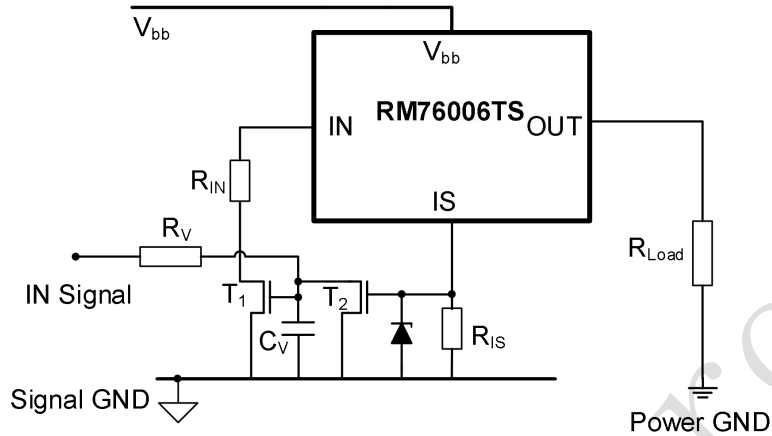
While demagnetizing load inductance, the energy dissipated in RM76006TS is:

$$E_{AS} = E_{bb} + E_L - E_R = \int V_{ON(CL)} * i_L(t) dt$$

with an approximate solution for $R_L > 0 \Omega$:

$$E_{AS} = \frac{I_L * L}{2 * R_L} (V_{bb} + |V_{OUT(CL)}|) \ln \left(1 + \frac{I_L * R_L}{|V_{OUT(CL)}|} \right)$$

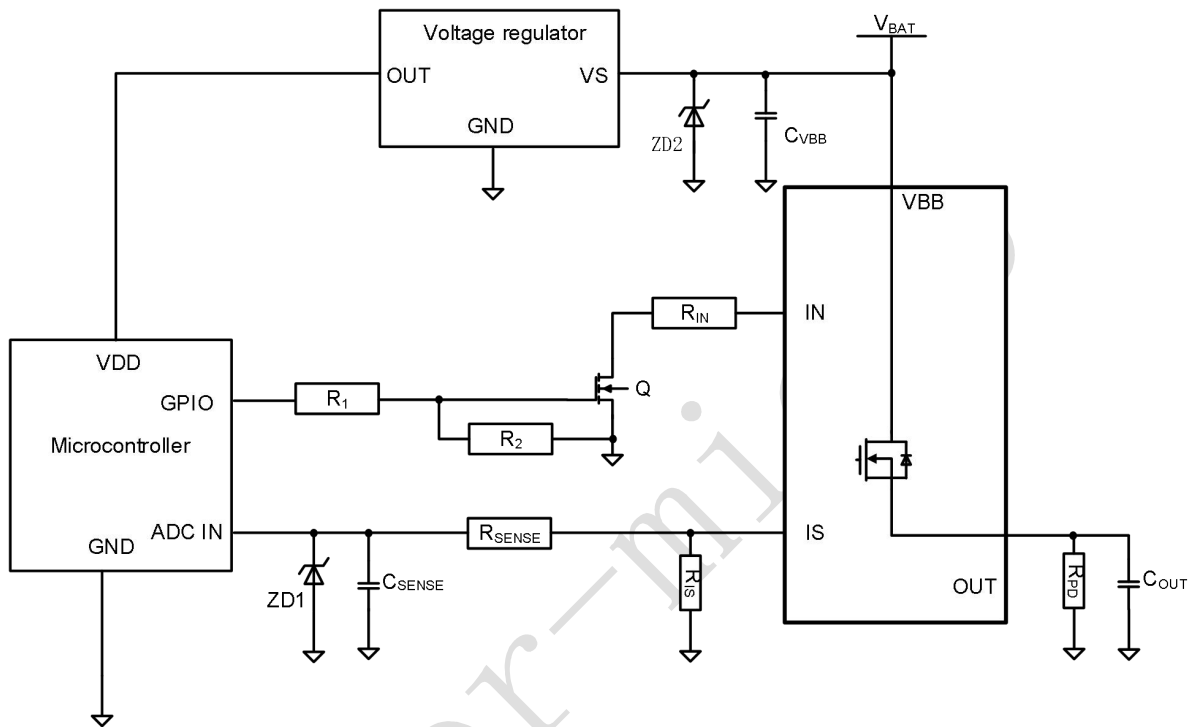
13.10 Externally adjustable current limit



If the device is conducting, the sense current can be used to reduce the short circuit current and allow higher lead inductance (see diagram above). The device will be turned off, if the threshold voltage of T_2 is reached by $I_s \cdot R_{IS}$. After a delay time defined by $R_V \cdot C_V$ T_1 will be reset. The device is turned on again, the short circuit current is defined by $I_{L(SC)}$ and the device is shut down after $t_{d(SC)}$ with latch function.

14. Application Information

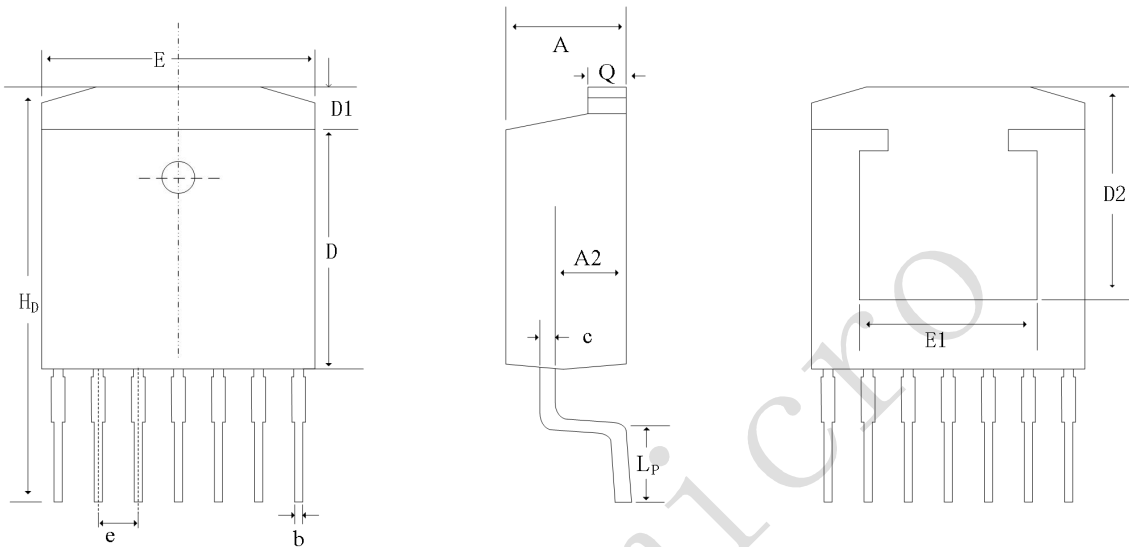
Note: The following information is given as a hint for the implementation of the device only and shall not be regarded as a description or warranty of a certain functionality, condition or quality of the device.



Note: This is a very simplified example of an application circuit. The function must be verified in the real application.

Bill of Material

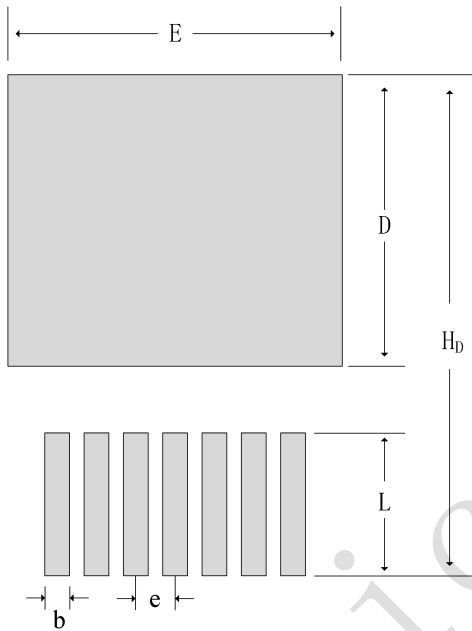
Reference	Value	Reference	Value
R _{IN}	1KΩ	R _{PD}	47KΩ
R ₁	1KΩ	C _{OUT}	10nF
R ₂	10KΩ	R _{SENSE}	10KΩ
Q	100V MOSFET	C _{SENSE}	10nF
ZD1	6.2V Zener diode	R _{IS}	1KΩ
C _{VBB}	100nF	ZD2	58V Zener diode

15.Package
TO-263-7L


Unit :mm

Symbol	MIN	NOM	MAX
A	4.25	4.4	4.55
Q	1.2	1.3	1.4
A2	2.25	2.4	2.55
b	0.5	0.6	0.7
c	0.4	0.5	0.6
D	9.05	9.25	9.45
D1	0.8	1	1.2
D2	6.9	-	-
E	9.8	10	10.2
e	1.27BSC		
E1	7.25	-	-
Hd	14.65	15	15.35
Lp	2.4	2.7	3.0

16.Recommended Soldering Footprint



Unit : mm

Symbol	NOM	Symbol	NOM
E	10.2	H_D	19
b	0.8	e	1.27
L	6	D	8.9

17.Revision History

Version	Change Description	Date
1.0	Initial version	2024/08/13
1.1	<ol style="list-style-type: none">1) Added certain parameter in the Absolute Maximum Ratings2) Revised and Added certain parameter in the Electrical Characteristics table.3) Added curves showing parameter variations with ambient temperature;4) Revised introductions for circuit functions in the Functions section.5) Revised Application Information.	2025/07/30