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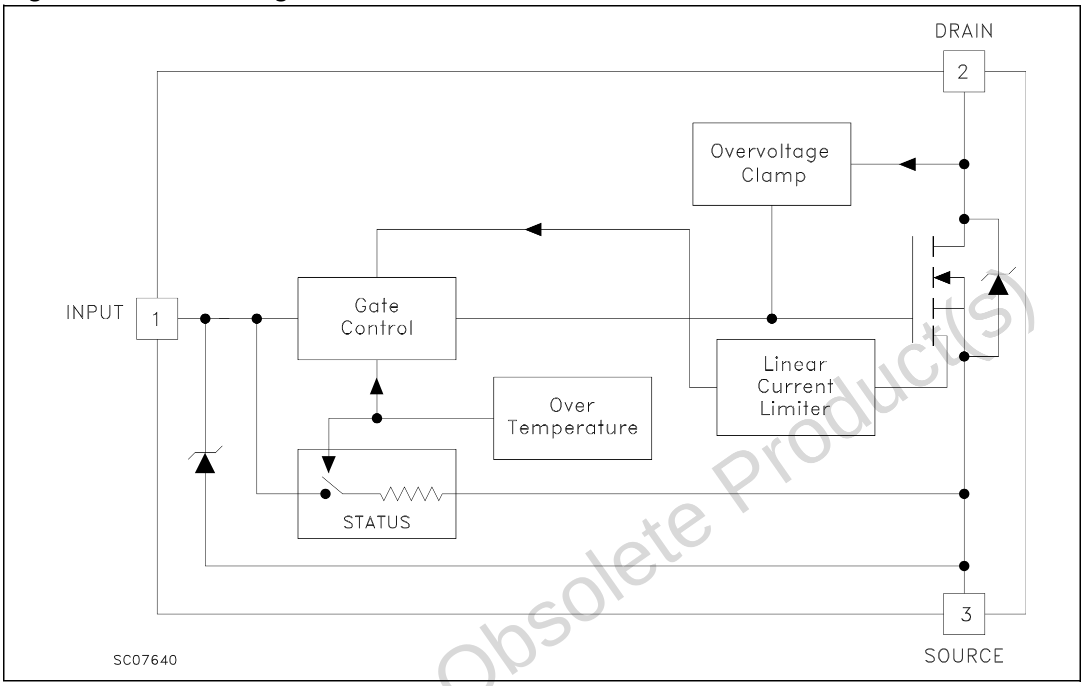
1 Block diagram

Figure 1. Block diagram



1. PowerSO-10 pin configuration : INPUT = 6,7,8,9,10; SOURCE = 1,2,4,5; DRAIN = TAB

2 Electrical specification

2.1 Absolute maximum rating

Table 2. Absolute maximum rating

Symbol	Parameter	Value		Unit
		PowerSO-10 D2PAK	SOT-82FM	
V_{DS}	Drain-source voltage (V_{in} = 0)	Internally clamped		V
V_{in}	Input voltage	18		V
I_D	Drain current	Internally limited		A
I_R	Reverse DC output current	-14		A
V_{esd}	Electrostatic discharge (C = 100 pF, R=1.5 KΩ)	2000		V
P_{tot}	Total dissipation at T_c = 25 °C	50	9.5	W
T_j	Operating junction temperature	Internally limited		°C
T_c	Case operating temperature	Internally limited		°C
T_{stg}	Storage temperature	-55 to 150		°C

2.2 Thermal data

Table 3. Thermal data

Symbol	Parameter	PowerSO-10	SOT82-FM	D2PAK	Unit
$R_{thj-case}$	Thermal resistance junction-case max	2.5	13	2.5	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max	50	100	62.5	°C/W

2.3 Electrical characteristics

T_{case} =25 °C unless otherwise specified.

Table 4. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Off						
V_{CLAMP}	Drain-source clamp voltage	I_D = 200 mA V_{in} = 0	36	42	48	V
V_{CLTH}	Drain-source clamp threshold voltage	I_D = 2 mA V_{in} = 0	35			V
V_{INCL}	Input-source reverse clamp voltage	I_{in} = -1 mA	-1		-0.3	V

Table 4. Electrical characteristics (continued)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{DSS}	Zero input voltage drain current (V_{in} = 0)	V_{DS} = 13 V V_{in} = 0 V_{DS} = 25 V V_{in} = 0			50 200	µA µA
I_{ISS}	Supply current from input pin	V_{DS} = 0 V V_{in} = 10 V		250	500	µA
On[(1)]						
$V_{IN(th)}$	Input threshold voltage	V_{DS} = V_{in} I_D + I_{in} = 1 mA	0.8		3	V
$R_{DS(on)}$	Static drain-source on resistance	V_{in} = 10 V I_D = 7 A V_{in} = 5 V I_D = 7 A			0.7 0.1	Ω Ω
Dynamic						
g_{fs} [(1)]	Forward transconductance	V_{DS} = 13 V I_D = 7 A	8	10		S
C_{oss}	Output capacitance	V_{DS} = 13 V f = 1 MHz V_{in} = 0		400	500	pF
Switching[(2)]						
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on delay time Rise time Turn-off delay time Fall time	V_{DD} = 15 V I_d = 7 A V_{gen} = 10 V R_{gen} = 10 Ω (see *Figure 26*)		60 160 250 100	120 300 400 200	ns ns ns ns
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on delay time Rise time Turn-off delay time Fall time	V_{DD} = 15 V I_d = 7 A V_{gen} = 10 V R_{gen} = 1000 Ω (see *Figure 26*)		300 1.5 5.5 1.8	500 2.2 7.5 2.5	ns µs µs µs
$(di/dt)_{on}$	Turn-on current slope	V_{DD} = 15 V I_D = 7 A V_{in} = 10 V R_{gen} = 10 Ω		120		A/µs
Q_i	Total input charge	V_{DD} = 12 V I_D = 7 A V_{in} = 10 V		30		nC
Source drain diode						
V_{SD} [(1)]	Forward on voltage	I_{SD} = 7 A V_{in} = 0			1.6	V
t_{rr} [(2)] Q_{rr} [(2)] I_{RRM} [(2)]	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 7 A di/dt = 100 A/µs V_{DD} = 30 V T_j = 25 °C (see test circuit, *Figure 28*)		110 0.34 6.1		ns µC A
Protection						
I_{lim}	Drain current limit	V_{in} = 10 V V_{DS} = 13 V V_{in} = 5 V V_{DS} = 13 V	10 10	14 14	20 20	A A
t_{dlim} [(2)]	Step response Current limit	V_{in} = 10 V V_{in} = 5 V		30 80	60 150	µs µs
T_{jsh} [(2)]	Overtemperature shutdown		150			°C
T_{jrs} [(2)]	Overtemperature reset		135			°C

Table 4. Electrical characteristics (continued)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{gf} (2)	Fault sink current	V_{in} = 10 V V_{DS} = 13 V V_{in} = 5 V V_{DS} = 13 V		50 20		mA mA
E_{as} (2)	Single pulse avalanche energy	starting T_j = 25°C V_{DD} = 20 V V_{in} = 10 V R_{gen} = 1 KΩ L = 10 mH	0.65			J

1. Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %
2. Parameters guaranteed by design/characterization

3 Protection features

During normal operation, the Input pin is electrically connected to the gate of the internal power MOSFET. The device then behaves like a standard power MOSFET and can be used as a switch from DC to 50 kHz. The only difference from the user's standpoint is that a small DC current (I_{iss}) flows into the Input pin in order to supply the internal circuitry.

The device integrates:

- Overvoltage clamp protection: internally set at 42 V, along with the rugged avalanche characteristics of the Power MOSFET stage give this device unrivalled ruggedness and energy handling capability. This feature is mainly important when driving inductive loads.
- Linear current limiter circuit: limits the drain current Id to Ilim whatever the Input pin voltage. When the current limiter is active, the device operates in the linear region, so power dissipation may exceed the capability of the heatsink. Both case and junction temperatures increase, and if this phase lasts long enough, junction temperature may reach the overtemperature threshold T_{jsh}.
- Overtemperature and short circuit protection: these are based on sensing the chip temperature and are not dependent on the input voltage. The location of the sensing element on the chip in the power stage area ensures fast, accurate detection of the junction temperature. Overtemperature cutout occurs at minimum 150 °C. The device is automatically restarted when the chip temperature falls below 135 °C.
- Status feedback: in the case of an overtemperature fault condition, a Status Feedback is provided through the Input pin. The internal protection circuit disconnects the input from the gate and connects it instead to ground via an equivalent resistance of 100 Ω. The failure can be detected by monitoring the voltage at the Input pin, which will be close to ground potential.

Additional features of this device are ESD protection according to the Human Body model and the ability to be driven from a TTL Logic circuit (with a small increase in $R_{DS(on)}$).

Figure 2. Thermal impedance for D2PAK/PowerSO-10

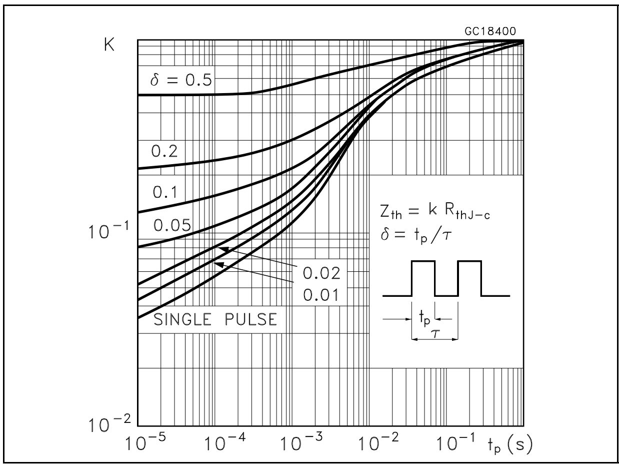


Figure 3. Derating curve

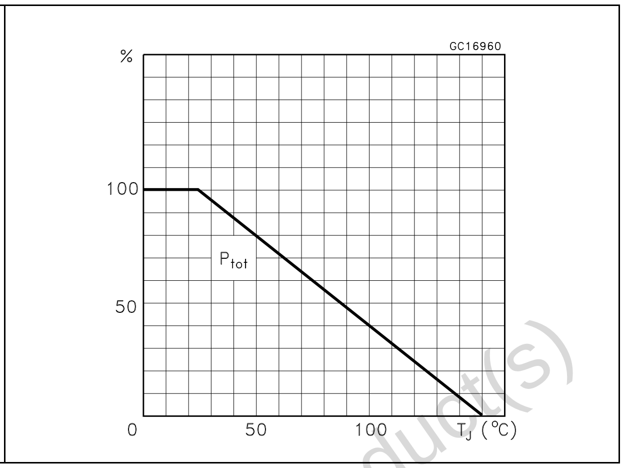


Figure 4. Output characteristics

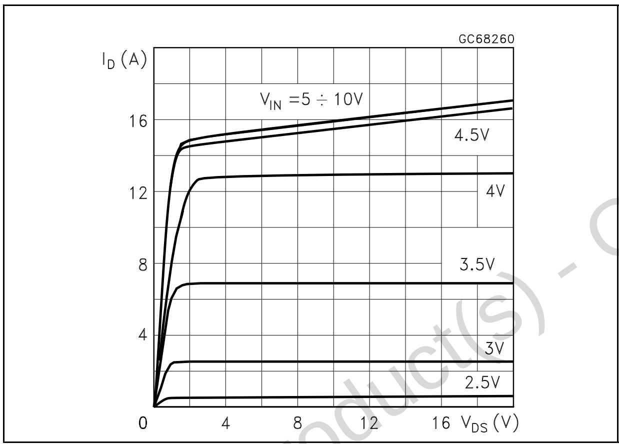


Figure 5. Transconductance

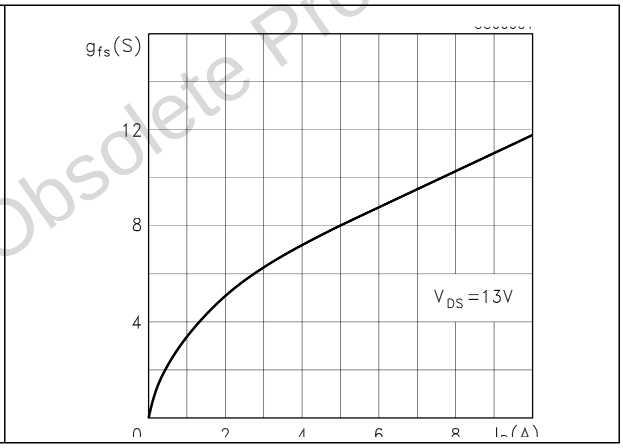


Figure 6. Static drain-source on resistance vs input voltage

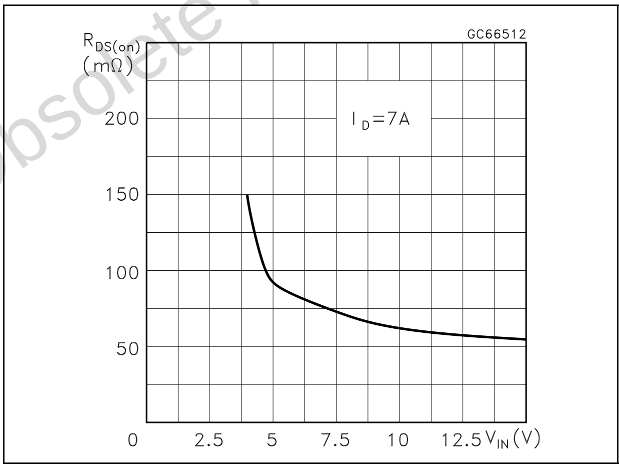


Figure 7. Static drain-source on resistance (part 1/2)

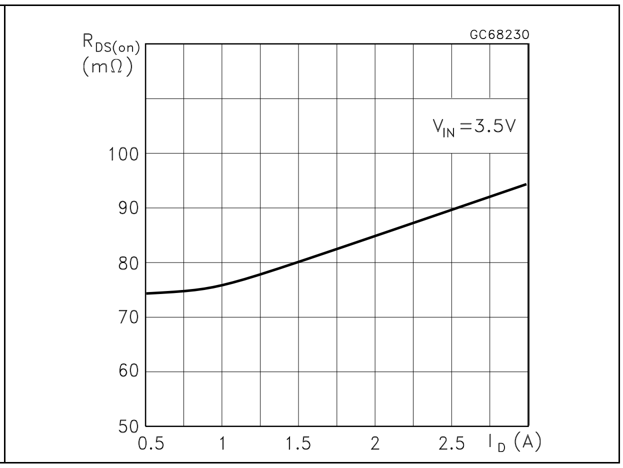


Figure 8. Static drain-source on resistance (part 2/2)

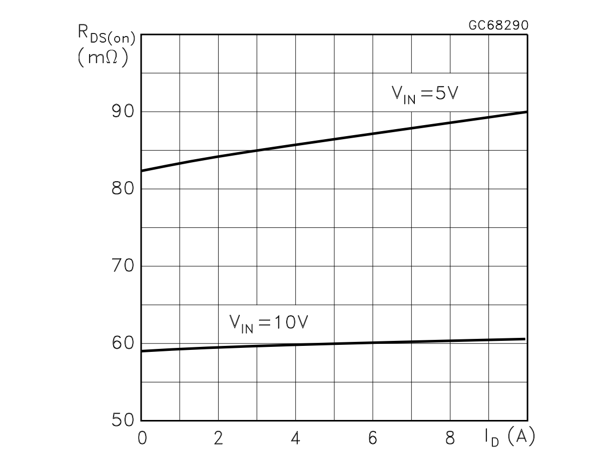


Figure 9. Input charge vs input voltage

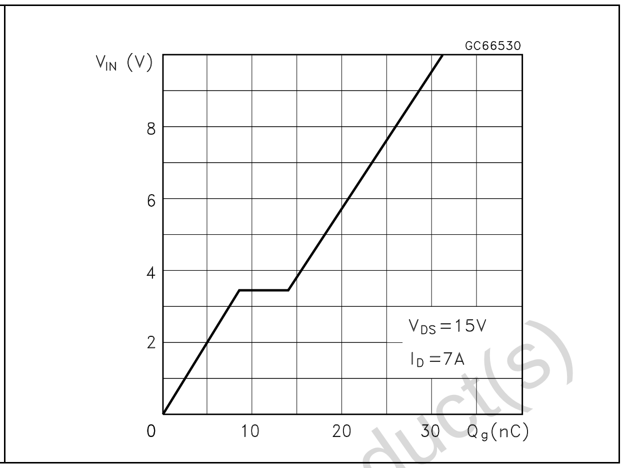


Figure 10. Capacitance variations

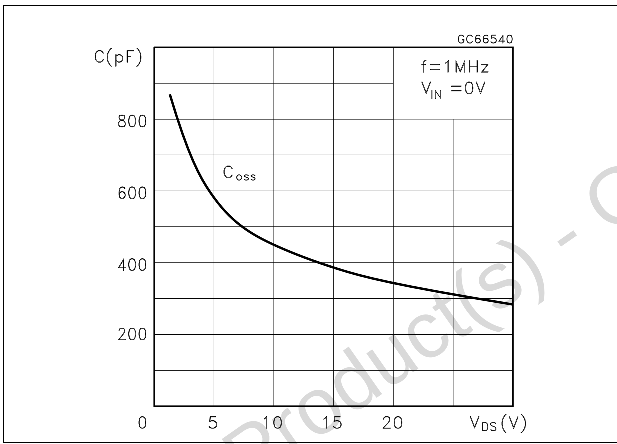


Figure 11. Normalized input threshold voltage vs temperature

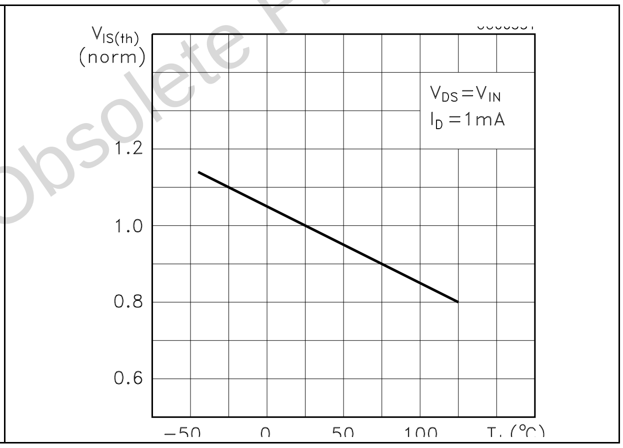


Figure 12. Normalized on resistance vs temperature (part 1/2)

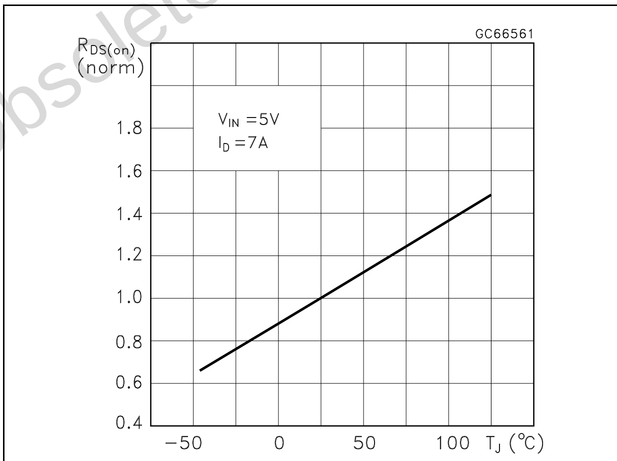


Figure 13. Normalized on resistance vs temperature (part 2/2)

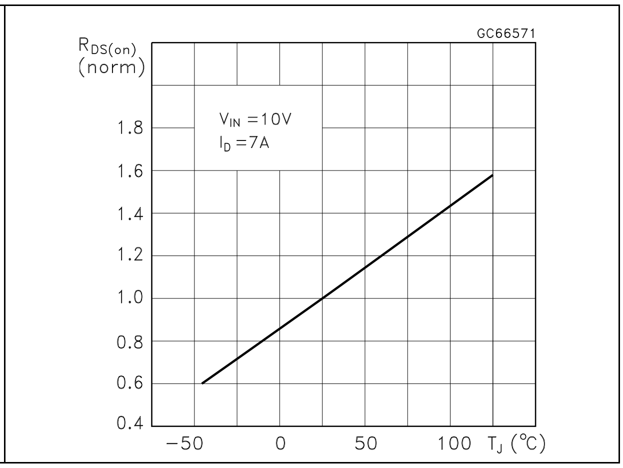


Figure 14. Turn-on current slope(part 1/2)

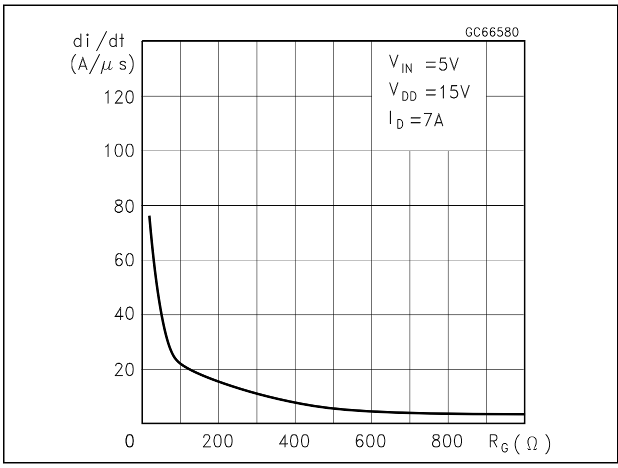


Figure 15. Turn-on current slope (part 2/2)

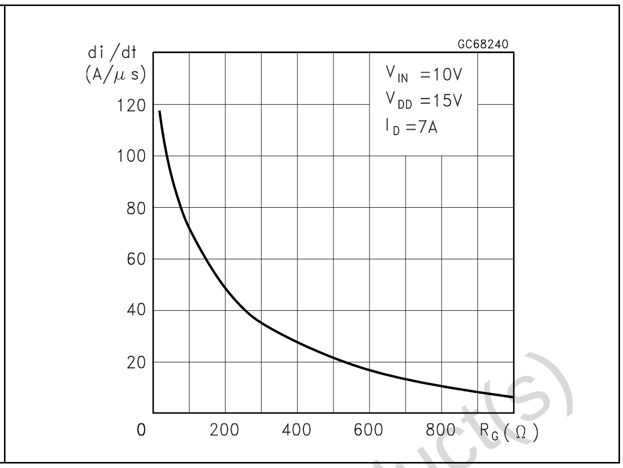


Figure 16. Turn-off drain-source voltage slope (part 1/2)

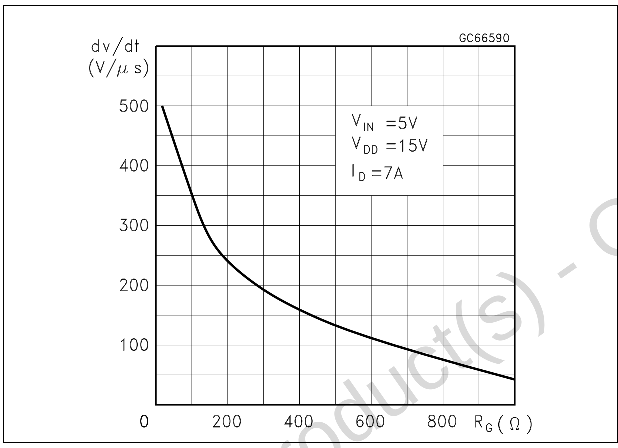


Figure 17. Turn-off drain-source voltage slope (part 2/2)

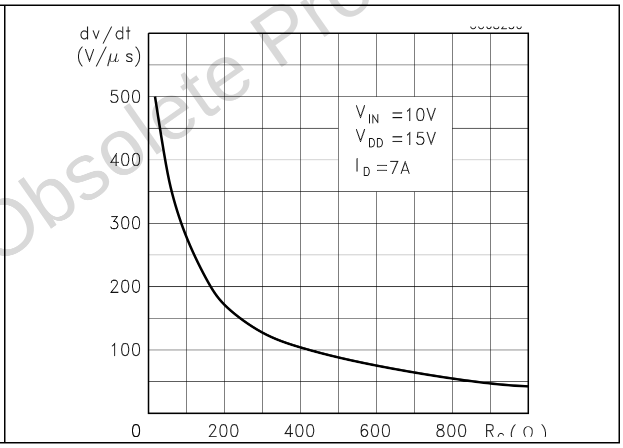


Figure 18. Switching time resistive load (part 1/3)

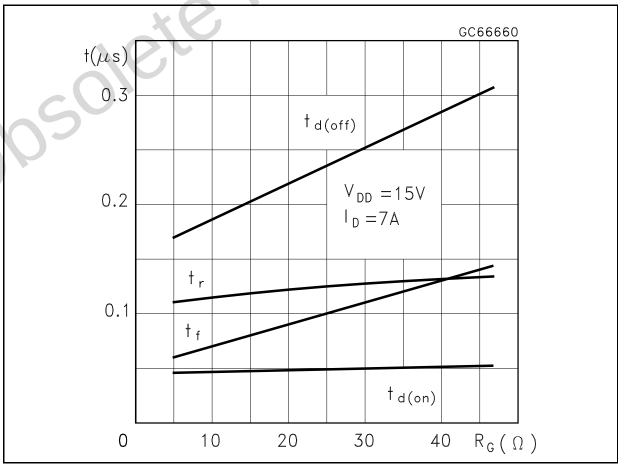


Figure 19. Switching time resistive load (part 2/3)

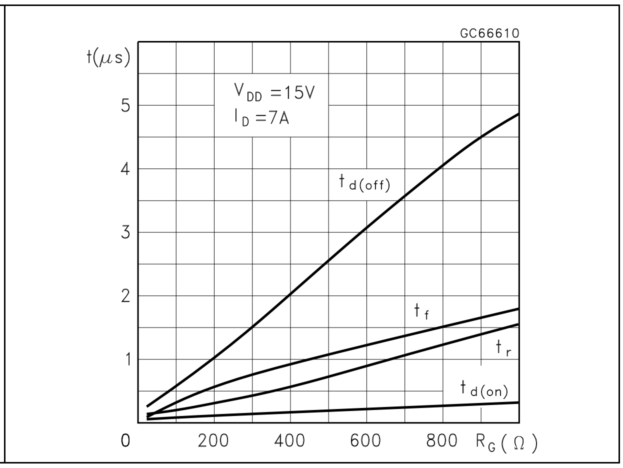


Figure 20. Switching time resistive load (part 3/3)

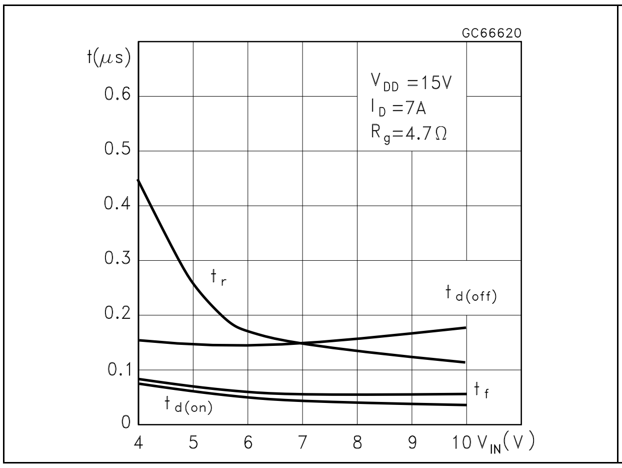


Figure 21. Current limit vs junction temperature

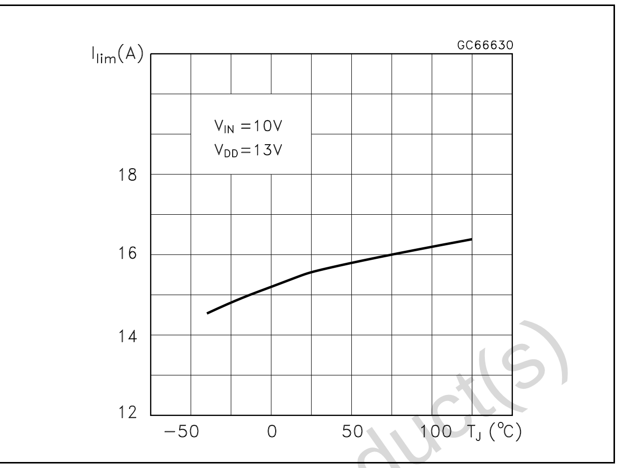


Figure 22. Step response current limit

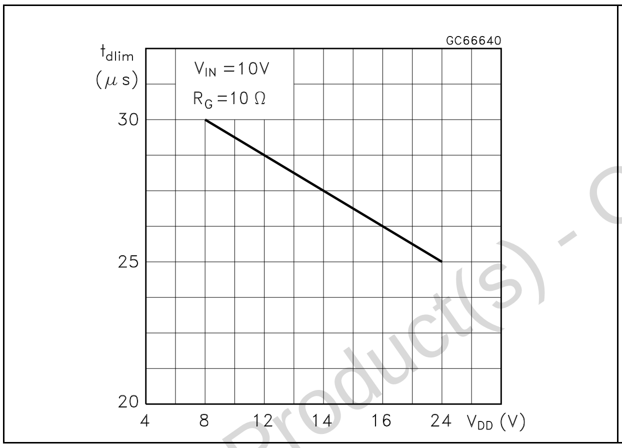


Figure 23. Source drain diode forward characteristics

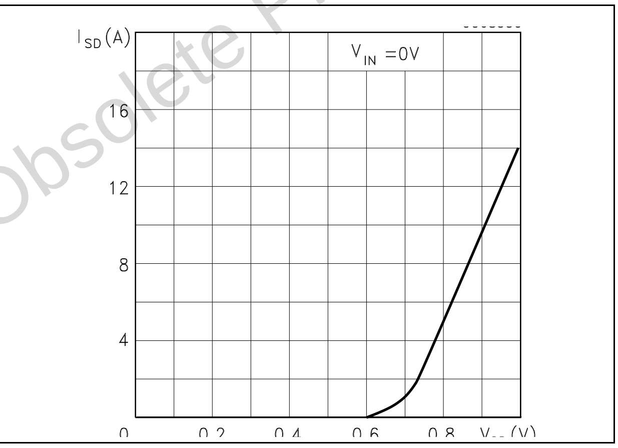


Figure 24. Unclamped inductive load test circuits

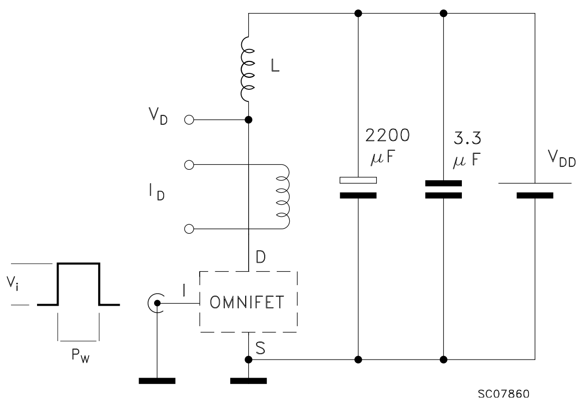


Figure 25. Unclamped inductive waveforms

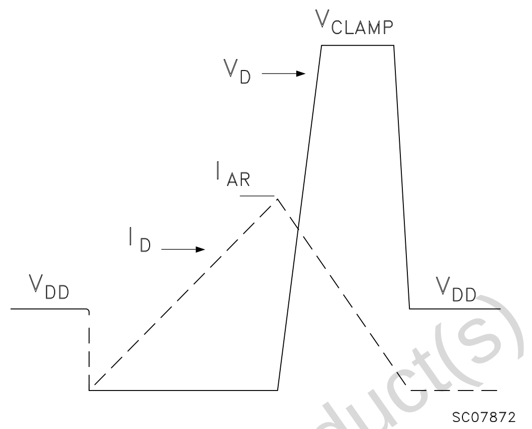


Figure 26. Switching times test circuits for resistive load

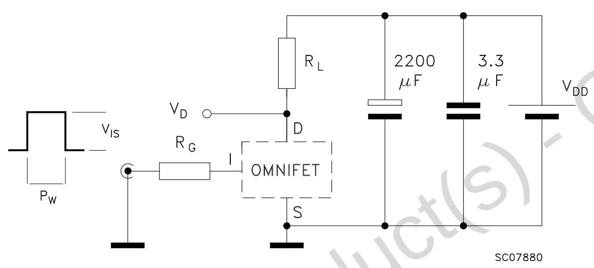


Figure 27. Input charge test circuit

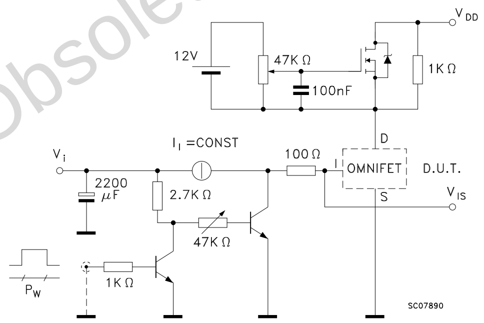


Figure 28. Test circuit for inductive load switching and diode recovery times

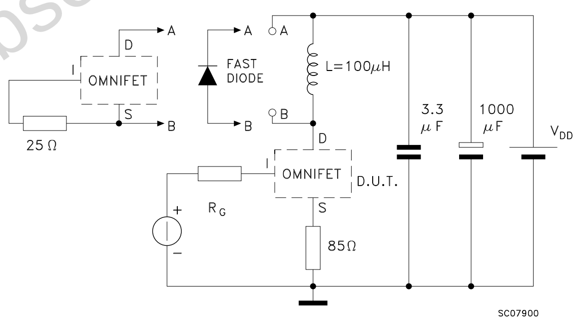
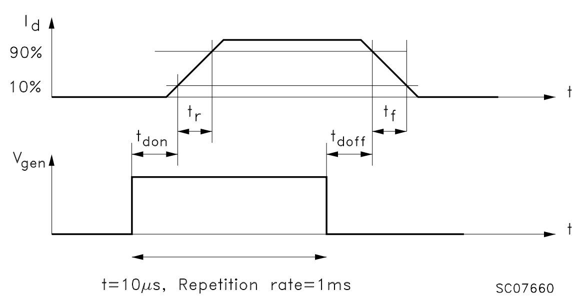


Figure 29. Waveforms



4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com.

ECOPACK® is an ST trademark.

Figure 30. TO-263 (D2PAK) mechanical data

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.3		4.6	0.169		0.181
A1	2.49		2.69	0.098		0.106
B	0.7		0.93	0.027		0.036
B2	1.25		1.4	0.049		0.055
C	0.45		0.6	0.017		0.023
C2	1.21		1.36	0.047		0.053
D	8.95		9.35	0.352		0.368
E	10		10.28	0.393		0.404
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.624
L2	1.27		1.4	0.050		0.055
L3	1.4		1.75	0.055		0.068

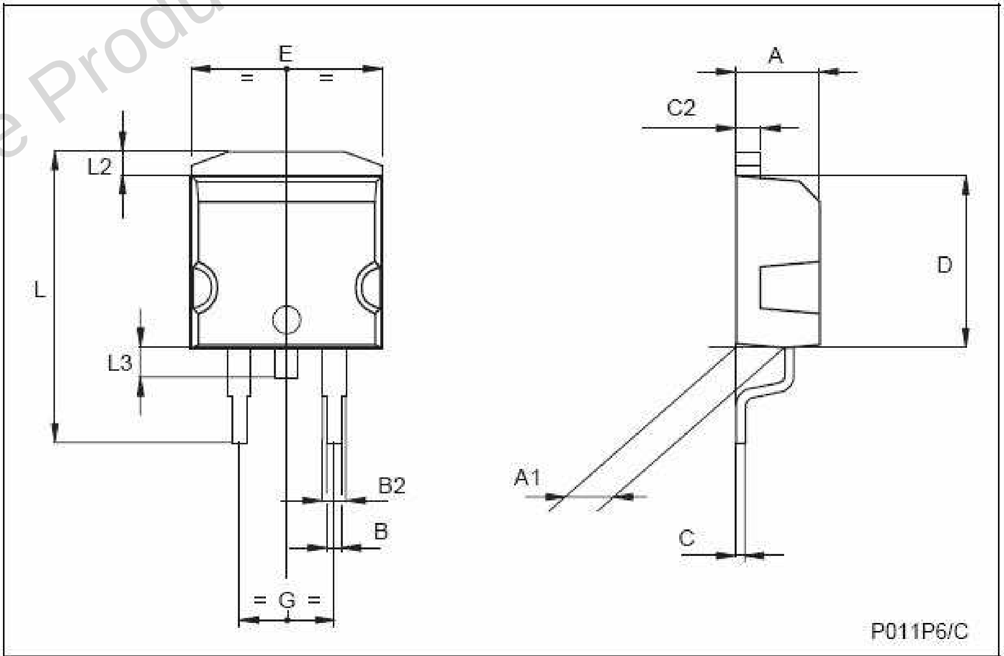


Figure 31. SOT82-FM mechanical data

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.85		3.05	1.122		1.200
A1	1.47		1.67	0.578		0.657
b	0.40		0.60	0.157		0.236
b1	1.4		1.6	0.551		0.630
b2	1.3		1.5	0.511		0.590
c	0.45		0.6	0.177		0.236
D	10.5		10.9	4.133		4.291
e	2.2		2.8	0.866		1.102
E	7.45		7.75	2.933		3.051
L	15.5		15.9	6.102		6.260
L1	1.95		2.35	0.767		0.925

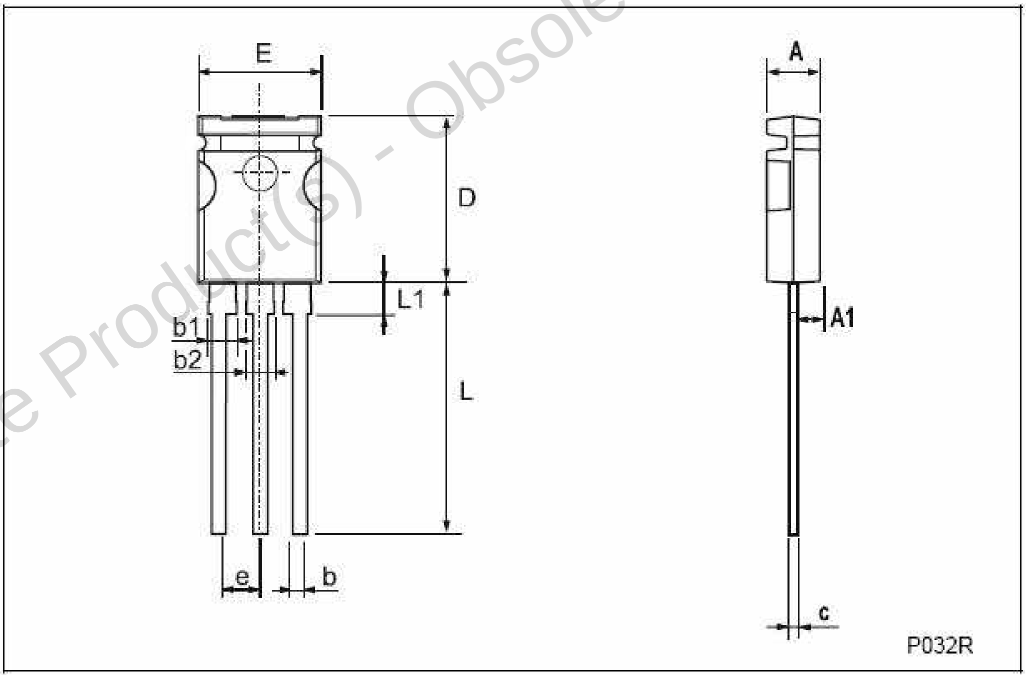
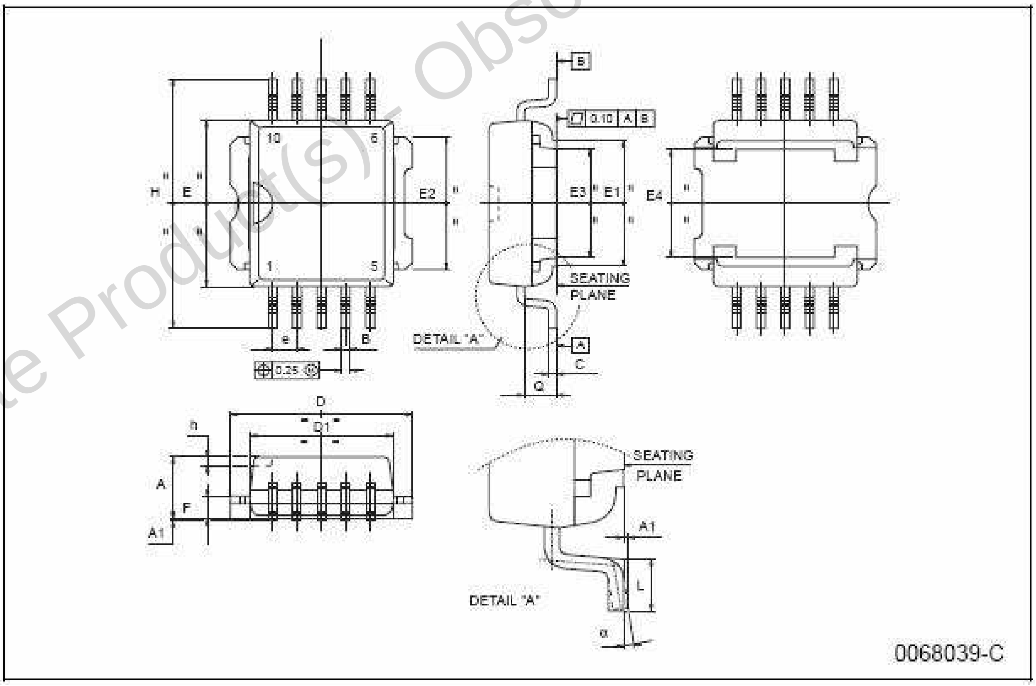


Figure 32. PowerSO-10 mechanical data

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	3.35		3.65	0.132		0.144
A1	0.00		0.10	0.000		0.004
B	0.40		0.60	0.016		0.024
c	0.35		0.55	0.013		0.022
D	9.40		9.60	0.370		0.378
D1	7.40		7.60	0.291		0.300
E	9.30		9.50	0.366		0.374
E1	7.20		7.40	0.283		0.291
E2	7.20		7.60	0.283		0.300
E3	6.10		6.35	0.240		0.250
E4	5.90		6.10	0.232		0.240
e		1.27			0.050	
F	1.25		1.35	0.049		0.053
H	13.80		14.40	0.543		0.567
h		0.50			0.002	
L	1.20		1.80	0.047		0.071
q		1.70			0.067	
α	0°		8°			



5 Revision history

Table 5. Document revision history

Date	Revision	Changes
20-Jan-1998	1	Initial release.
21-Jun-2004	5	Update.
08-Apr-2009	6	Document reformatted. Added *Table 1: Device summary on page 1*. Updated *Section 4: Package information on page 13*
25-Sep-2013	7	Updated Disclaimer.