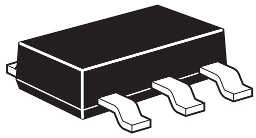
BSP75N

60V SELF-PROTECTED LOW-SIDE INTELLIFET MOSFET SWITCH

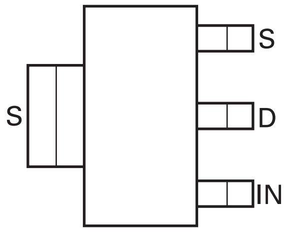


Summary

Continuous drain source voltage	**V_{DS}=60V**
On-state resistance	**500mΩ**
Maximum nominal load current[(a)]	**1.1A (V_{IN} = 5V)**
Minimum nominal load current[(c)]	**0.7A (V_{IN} = 5V)**
Clamping energy	**550mJ**

Description

Self-protected low side MOSFET. Monolithic over temperature, over current, over voltage (active clamp) and ESD protected logic level functionality. Intended as a general purpose switch.

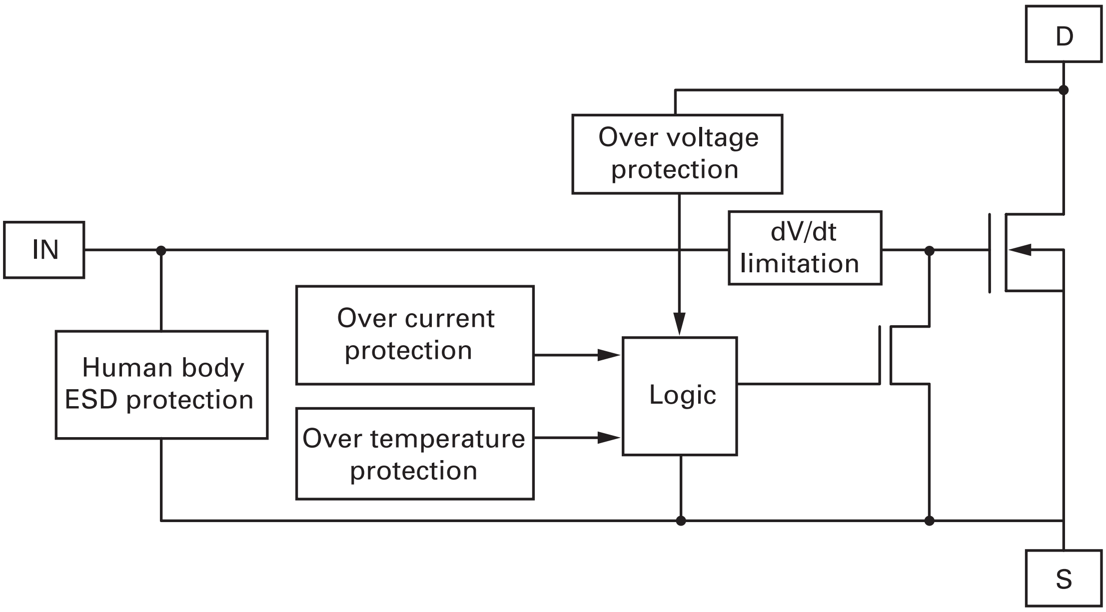


Features

- Short circuit protection with auto restart
- Over-voltage protection (active clamp)
- Thermal shutdown with auto restart
- Over-current protection
- Input protection (ESD)
- High continuous current rating
- Load dump protection (actively protects load)
- Logic level input

Note:
The tab is connected to the source pin and must be electrically isolated from the drain pin. Connection of significant copper to the drain pin is recommended for best thermal performance.

Functional block diagram



Applications

- Especially suited for loads with a high in-rush current such as lamps and motors.
- All types of resistive, inductive and capacitive loads in switching applications.
- μC compatible power switch for 12V and 24V DC applications.
- Automotive rated.
- Replaces electromechanical relays and discrete circuits.

Linear mode capability - the current-limiting protection circuitry is designed to de-activate at low Vds, in order not to compromise the load current during normal operation. The design maximum DC operating current is therefore determined by the thermal capability of the package/board combination, rather than by the protection circuitry. This does not compromise the products ability to self protect itself at low V_{DS}.

Absolute maximum ratings

Parameter	Symbol	Limit	Unit
Continuous drain-source voltage	V_{DS}	60	V
Drain-source voltage for short circuit protection V_{IN} = 5V	$V_{DS(SC)}$	36	V
Drain-source voltage for short circuit protection V_{IN} = 10V	$V_{DS(SC)}$	20	V
Continuous input voltage	V_{IN}	-0.2 ... +10	V
Peak input voltage	V_{IN}	-0.2 ... +20	V
Operating temperature range	T_j,	-40 to +150	°C
Storage temperature range	T_{stg}	-55 to +150	°C
Power dissipation at T_A =25°C (a)	P_D	1.5	W
Power dissipation at T_A =25°C (c)	P_D	0.6	W
Continuous drain current @ V_{IN}=10V; T_A=25°C (a)	I_D	1.3	A
Continuous drain current @ V_{IN}=5V; T_A=25°C (a)	I_D	1.1	A
Continuous drain current @ V_{IN}=5V; T_A=25°C (c)	I_D	0.7	A
Continuous source current (body diode) (a)	I_S	2.0	A
Pulsed source current (body diode) (b)	I_S	3.3	A
Unclamped single pulse inductive energy	E_{AS}	550	mJ
Load dump protection	$V_{LoadDump}$	80	V
Electrostatic discharge (human body model)	V_{ESD}	4000	V
DIN humidity category, DIN 40 040		E	
IEC climatic category, DIN IEC 68-1		40/150/56	

Thermal resistance

Parameter	Symbol	Limit	Unit
Junction to ambient (a)	$R_{\Theta JA}$	83	°C/W
Junction to ambient (b)	$R_{\Theta JA}$	45	°C/W
Junction to ambient (c)	$R_{\Theta JA}$	208	°C/W

NOTES:

(a) For a device surface mounted on 25mm x 25mm x 1.6mm FR4 board with a high coverage of single sided 2oz weight copper. Allocation of 6cm^2 copper 33% to source tab and 66% to drain pin with tab and drain pin electrically isolated.
(b) For a device surface mounted on FR4 board as (a) and measured at t<=10s.
(c) For a device surface mounted on FR4 board with the minimum copper required for connections.

Electrical characteristics (at T_{AMB} = 25°C unless otherwise stated)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Static characteristics						
Drain-source clamp voltage	$V_{DS(AZ)}$	60	70	75	V	I_D=10mA
Off-state drain current	I_{DSS}		0.1	3	µA	V_{DS}=12V, V_{IN}=0V
Off-state drain current	I_{DSS}		3	15	µA	V_{DS}=32V, V_{IN}=0V
Input threshold voltage (*)	$V_{IN(th)}$	1	2.1		V	V_{DS}=V_{GS}, I_D=1mA
Input current	I_{IN}		0.7	1.2	mA	V_{IN}=+5V
Input current	I_{IN}		1.5	2.7	mA	V_{IN}=+7V
Input current	I_{IN}		4	7	mA	V_{IN}=+10V
Static drain-source on-state resistance	$R_{DS(on)}$		520	675	mΩ	V_{IN}=+5V, I_D=0.7A
Static drain-source on-state resistance	$R_{DS(on)}$		385	550	mΩ	V_{IN}=+10V, I_D=0.7A
Current limit (†)	$I_{D(LIM)}$	0.7	1.0	1.5	A	V_{IN}=+5V, V_{DS}>5V
Current limit(†)	$I_{D(LIM)}$	1.0	1.8	2.3	A	V_{IN}=+10V, V_{DS}>5V
Dynamic characteristics						
Turn-on time (V_{IN} to 90% I_D)	t_{on}		3.0	10	µs	R_L=22Ω, V_{DD}=12V, V_{IN}=0 to +10V
Turn-off time (V_{IN} to 90% I_D)	t_{off}		13	20	µs	R_L=22Ω, V_{DD}=12V, V_{IN}=+10V to 0V
Slew rate on (70 to 50% V_{DD})	$-dV_{DS}/dt_{on}$		8	20	V/µs	R_L=22Ω, V_{DD}=12V, V_{IN}=0 to +10V
Slew rate off (50 to 70% V_{DD})	DV_{DS}/dt_{off}		3.2	10	V/µs	R_L=22Ω, V_{DD}=12V, V_{IN}=+10V to 0V
Protection functions (‡)						
Required input voltage for over temperature protection	V_{PROT}	4.5			V	
Thermal overload trip temperature	T_{JT}	150	175		°C	
Thermal hysteresis			1		°C	
Unclamped single pulse inductive energy T_j=25°C	E_{AS}	550			mJ	$I_{D(ISO)}$=0.7A, V_{DD}=32V
Unclamped single pulse inductive energy T_j=150°C		200			mJ	$I_{D(ISO)}$=0.7A, V_{DD}=32V
Inverse diode						
Source drain voltage	V_{SD}			1	V	V_{IN}=0V, $-I_D$=1.4A

NOTES:

(*) The drain current is limited to a reduced value when V_{DS} exceeds a safe level.

(†) Protection features may operate outside spec for V_{IN}<4.5V.

(‡) Integrated protection functions are designed to prevent IC destruction under fault conditions described in the datasheet. Fault conditions are considered as "outside" normal operating range. Protection functions are not designed for continuous, repetitive operation.

Application information

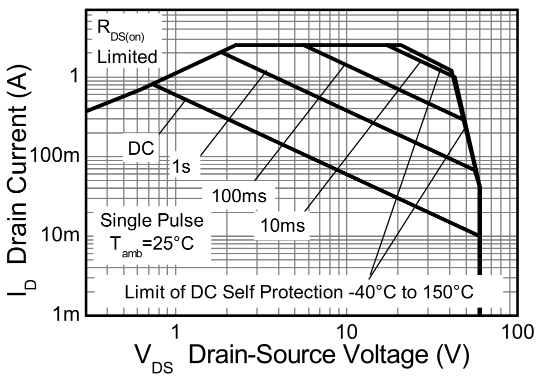
The current-limit protection circuitry is designed to de-activate at low V_{DS} to prevent the load current from being unnecessarily restricted during normal operation. The design max DC operating current is therefore determined by the thermal capability of the package/board combination, rather than by the protection circuitry (see graph on page 7 'Typical Output Characteristic'). This does not compromise the products ability to self protect at low V_{DS}.

The overtemperature protection circuit trips at a minimum of 150°C. So the available package dissipation reduces as the maximum required ambient temperature increases. This leads to the following maximum recommended continuous operating currents.

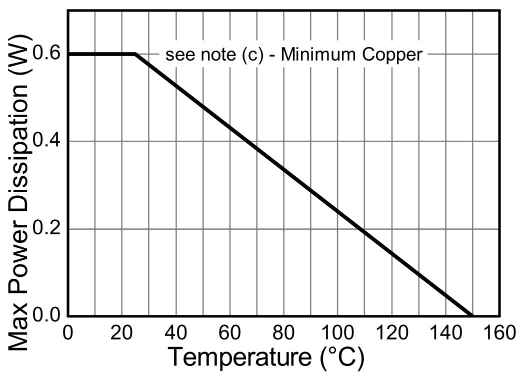
Minimum copper area characteristics

For minimum copper condition as described in note (c)

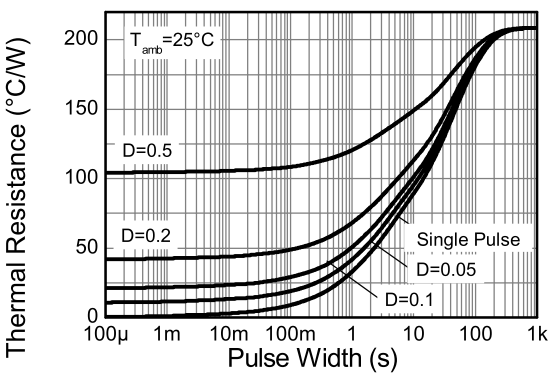
Max. ambient temperature T_{amb}	**Maximum continuous current**	
	V_{IN} = 5V	**V_{IN} = 10V**
25°C @ V_{IN} = 5V	720	840
70°C @ V_{IN} = 5V	575	670
85°C @ V_{IN} = 5V	520	605
125°C @ V_{IN} = 5V	320	375



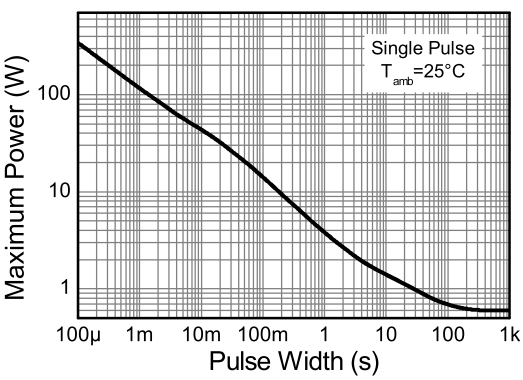
Safe Operating Area



Derating Curve



Transient Thermal Impedance

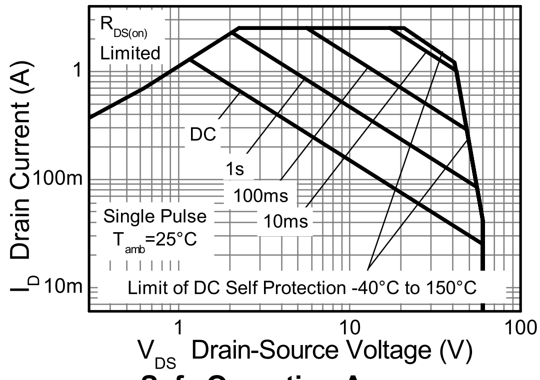


Pulse Power Dissipation

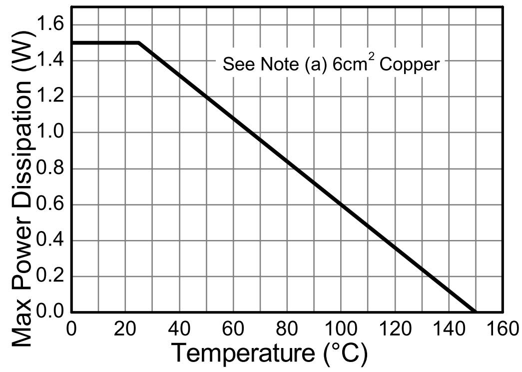
Large copper area characteristics

For large copper area as described in note (a)

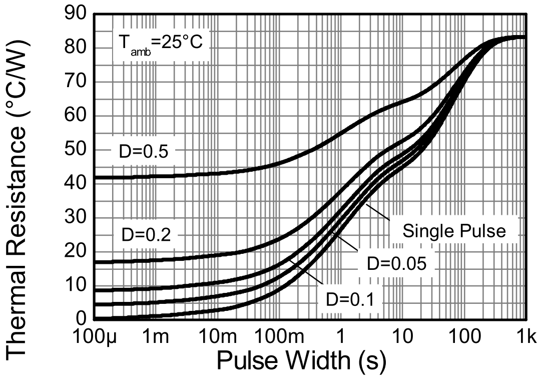
Max. ambient temperature T_{amb}	Maximum continuous current	
	V_{IN} = 5V	V_{IN} = 10V
25°C @ V_{IN} = 5V	1140	1325
70°C @ V_{IN} = 5V	915	1060
85°C @ V_{IN} = 5V	825	955
125°C @ V_{IN} = 5V	510	590



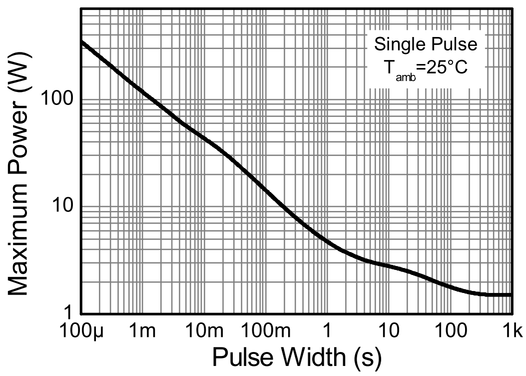
Safe Operating Area



Derating Curve

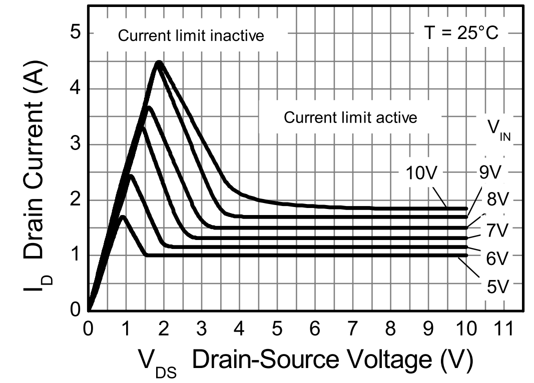


Transient Thermal Impedance

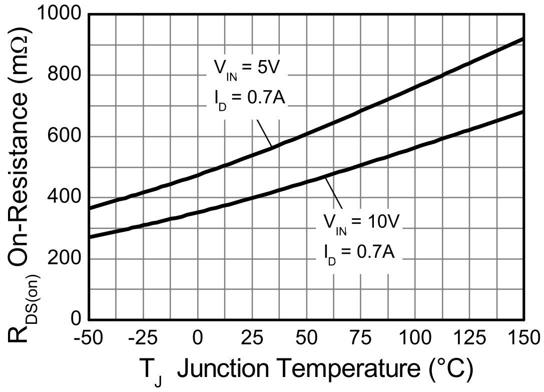


Pulse Power Dissipation

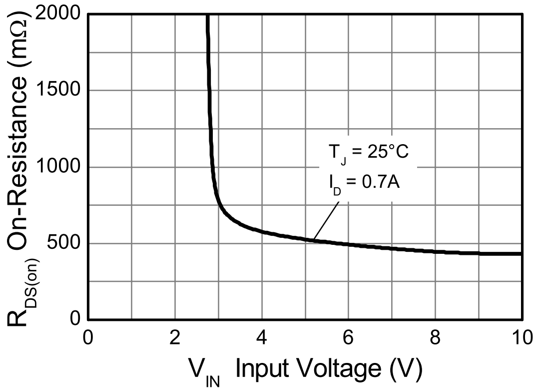
Typical characteristics



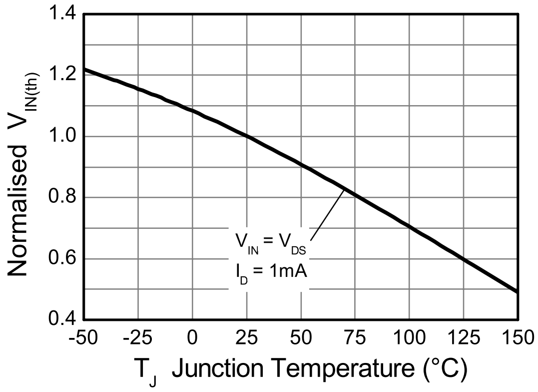
Typical Output Characteristic



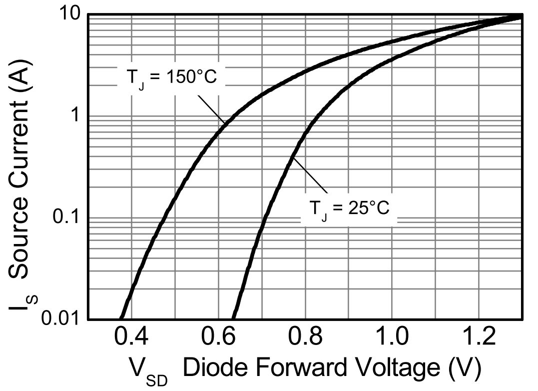
On-state Resistance vs Temperature



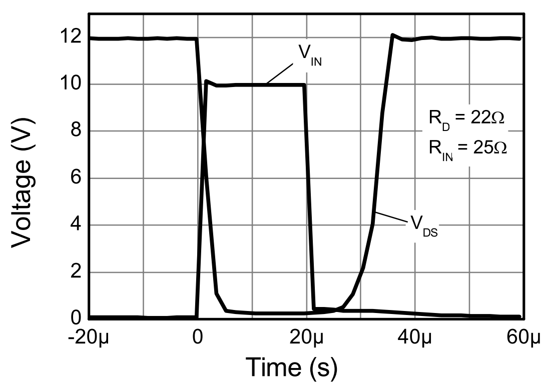
On-Resistance vs Input Voltage



Threshold Voltage vs Temperature

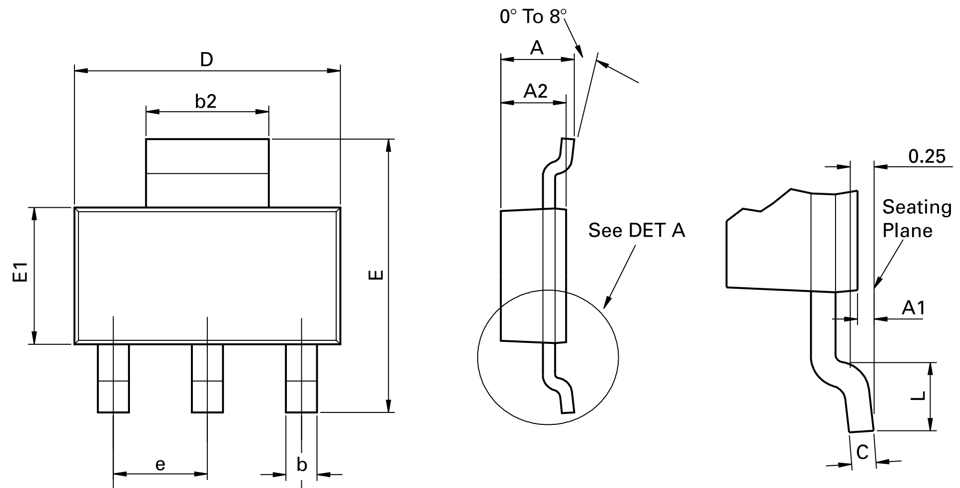


Source-Drain Diode Forward Voltage



Switching Speed

Package outline - SOT223



Enlarged View of DET A

Conforms to JEDEC TO-261 AA Issue B

Dim.	Millimeters		Inches		Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	-	1.80	-	0.071	e	2.30 BSC		0.0905 BSC	
A1	0.02	0.10	0.0008	0.004	e1	4.60 BSC		0.181 BSC	
b	0.66	0.84	0.026	0.033	E	6.70	7.30	0.264	0.287
b2	2.90	3.10	0.114	0.122	E1	3.30	3.70	0.130	0.146
C	0.23	0.33	0.009	0.013	L	0.90	-	0.355	-
D	6.30	6.70	0.248	0.264	-	-	-	-	-

Note: Controlling dimensions are in millimeters. Approximate dimensions are provided in inches