SGS-THOMSON MICROELECTRONICS

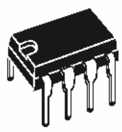
L6377

0.5A HIGH-SIDE DRIVER INTELLIGENT POWER SWITCH

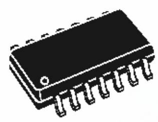
PRODUCT PREVIEW

- 0.5 A OUTPUT CURRENT
- 8 TO 35 V SUPPLY VOLTAGE RANGE
- EXTERNALLY PROGRAMMABLE CURRENT LIMIT
- NON-DISSIPATIVE OVER-CURRENT PROTECTION
- THERMAL SHUTDOWN
- UNDER VOLTAGE LOCKOUT WITH HYSTERESYS
- DIAGNOSTIC OUTPUT FOR UNDER VOLTAGE, OVER TEMPERATURE AND OVER CURRENT
- EXTERNAL ASYNCHRONOUS RESET INPUT
- PRESETTABLE DELAY FOR OVERCURRENT DIAGNOSTIC
- OPEN GROUND PROTECTION
- PROTECTION AGAINST SURGE TRANSIENT (IEC 801-5)
- IMMUNITY AGAINST BURST TRANSIENT (IEC 801-4)
- ESD PROTECTION (HUMAN BODY MODEL ±2KV)

MULTIPOWER BCD TECHNOLOGY



MINIDIP



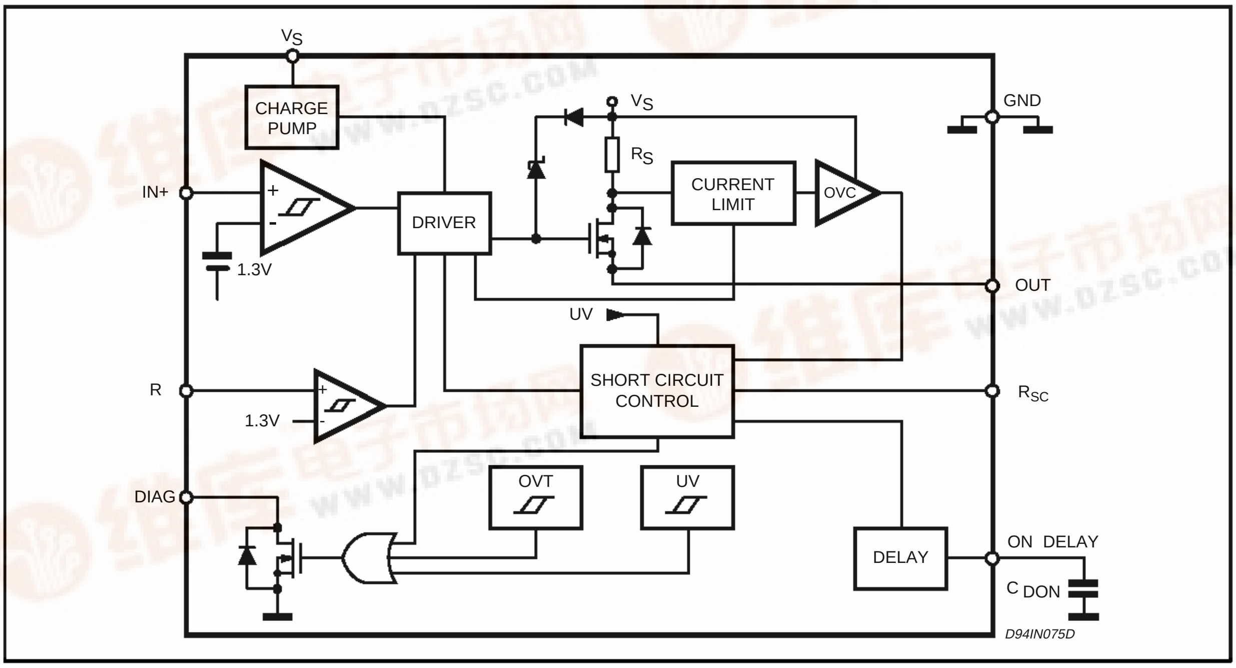
SO14

ORDERING NUMBERS: L6377 (MINIDIP)
L6377D (SO)

DESCRIPTION

This device is a monolithic Intelligent Power Switch in Multipower BCD Technology for driving inductive, capacitive or resistive loads.
Diagnostic for CPU feedback and extensive use of electrical protections make this device inherently indistructible and suitable for general purpose industrial applications.

BLOCK DIAGRAM

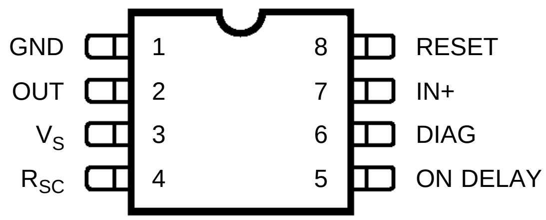


This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

ABSOLUTE MAXIMUM RATINGS

Symbol	Pin	Parameter	Value	Unit
V_s	3	Supply Voltage ($t_w \leq$ 10ms)	50	V
		Supply Voltage (DC)	40	V
V_s - V_{out}	3 vs 2	Supply to Output Differential voltage	internally limited	
V_{od}	5	Externally Forced Voltage	-0.3 to 7	V
I_{od}		Externally Forced Current	±1	mA
I_{RESET}	4	Reset Input Current (forced)	±2	mA
V_{RESET}		Reset Input Voltage	-0.3 to 40	V
I_{out}	2	Output Current (see also I_{sc})	internally limited	
V_{out}		Output Voltage	internally limited	
E_{il}		Total Energy Inductive Load (T_j = 125°C)	50	mJ
P_{tot}		Power Dissipation	internally limited	
V_{diag}	6	External voltage	-0.3 to 40	V
I_{diag}		Externally forced current	-10 to 10	mA
I_i	7	Input Current	20	mA
V_i		Input Voltage	-10 to V_s +0.3	V
T_{op}		Ambient temperature, operating range	-25 to 85	°C
T_j		Junction temperature, operating range (see Overtemperature Protection)	-25 to 125	°C
T_{stg}		Storage temperature	-55 to 150	°C

PIN CONNECTION (Top view)



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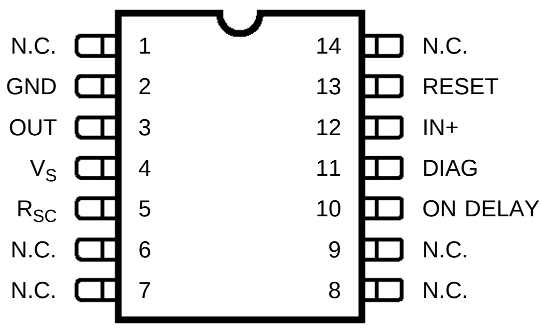


D96IN368

PIN DESCRIPTION

No	Pins	Description
1	GND	Ground pin.
2	OUT	High side output. Controlled output with current limitation.
3	V_S	Supply voltage. Range with under voltage monitoring
4	Rsc	Current limiting setting.
5	ON DELAY	Delay setting for overcurrent diagnostic
6	DIAG	Diagnostic open drain output for over temperature, under voltage and overcurrent
7	IN+	Comparator non inverting input
8	RESET	Asynchronous reset input

THERMAL DATA

Symbol	Parameter		MINIDIP	SO14	Unit
$R_{th\ j\text{-}amb}$	Thermal Resistance, Junction Ambient	Max.	100	150	°C/W

ELECTRICAL CHARACTERISTICS (V_s = 24V; T_j = -25 to 125°C; unless otherwise specified.)

DC OPERATION

Symbol	Pin	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{smin}	3	Supply Voltage for Valid Diagnostic	I_{diag} = >0.5mA; V_{diag} = 1.5V;	4		35	V
V_s		Operative Supply Voltage		8	24	35	V
V_{sth}		Under Voltage Lower Threshold		7		8	V
V_{shys}		Under Voltage Hysteresis		300	500	700	mV
I_q		Quiescent Current	Output Open		800		µA
I_{qo}		Quiescent Current	Output On		1.6		mA
V_{ith}	7	Input Threshold Voltage		0.8	1.3	2	V
V_{iths}		Input Threshold Hysteresis		50		400	mV
V_{il}		Input Low Level Voltage		-7		0.8	V
V_{ih}		Input High Level Voltage	V_s< 18V	2		V_s -3	V
			V_s> 18V	2		15	V
I_{ib}		Input Bias Current	V_i = -7 to 15V	-250		250	µA
V_{rth}	8	Reset Threshold Voltage		0.8	1.3	2	V
V_{rl}		Reset Low Level Voltage		0		0.8	V
V_{rh}		Reset High Level Voltage		2		40	V
I_{rb}		Reset Pull Down Current			5		µA
I_{dch}	5	Delay Capacitor Charging Current	ON DELAY pin shorted to Ground		2.5		µA
V_{rsc}	4	Output Voltage on R_{sc} pin	R_{sc} pin floating		1.25		V
I_{rsc}		Output Current on R_{sc} pin	R_{sc} pin shorted to GND			300	µA
I_{dlkg}	6	Diagnostic Output Leakage Curr.	Diagnostic Off			25	µA
V_{diag}		Diagnostic Output Voltage Drop	Idiag =5mA;			1.5	V
V_{don}	2	Output Voltage Drop	I_{out} =625mA; T_j =25°C		250	350	mV
			I_{out} =625mA; T_j =125°C		400	550	mV
I_{olk}		Output Leakage Current	V_i = LOW; V_{out}=0			100	µA
V_{ol}		Output Low State Voltage	V_i = HIGH; pin floating		0.8	1.5	V
V_{cl}		Internal Voltage Clamp (V_s-V_{out})	I_o=200mA single pulsed =300µs	48	53	58	V
I_{sc}		Short Circuit Output Current	V_s=8 to 35V; R_l =2Ω; R_{sc} =5 to 30KΩ	5/R_{sc} = KΩ			A
			V_s=8 to 35V; R_l =2Ω; R_{sc} <5 KΩ	0.75	1.1	1.5	A
T_{max}		Over Temperature Upper Threshold			150		°C
T_{hys}		Over Temperature Hysteresis			20		°C

AC OPERATION

Symbol	Pin	Parameter	Test Condition	Min.	Typ.	Max.	Unit
t_r - t_f	2	Rise or Fall Time	V_s = 24V; R_l = 70Ω R_l to ground		20		µs
t_d		Delay Time			5		µs
dV/dt		Slew Rate (Rise and Fall Edge)	V_s = 24V; R_l = 70Ω R_l to ground	0.7	1	1.5	V/µs
t_{ON}	5	On time during Short Circuit Condition	50pF < C_{DON} < 2nF		1.28		µs/pF
t_{OFF}		Off time during Short Circuit Condition			64		t_{ON}
f_{max}		Maximum Operating Frequency			25		kHz

SOURCE DRAIN NDMOS DIODE

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{fsd}	Forward On Voltage	I_{fsd} = 625mA		1	1.5	V
I_{fp}	Forward Peak Current	t_p = 10ms; duty cycle = 20%			1.5	A
t_{rr}	Reverse Recovery Time	I_{fsd} = 500mA; dI_{fsd}/dt = 25A/µs		200		ns
t_{fr}	Forward Recovery Time			50		ns

Figure 1: Undervoltage Comparator Hysteresis

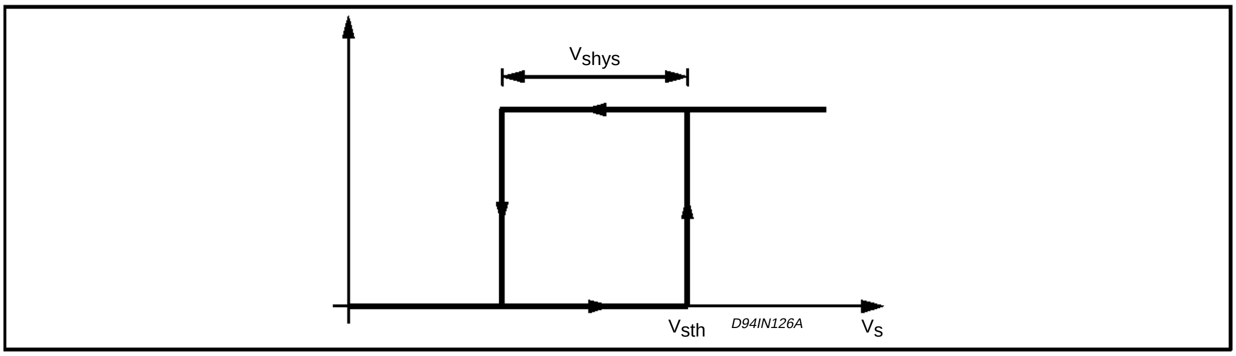
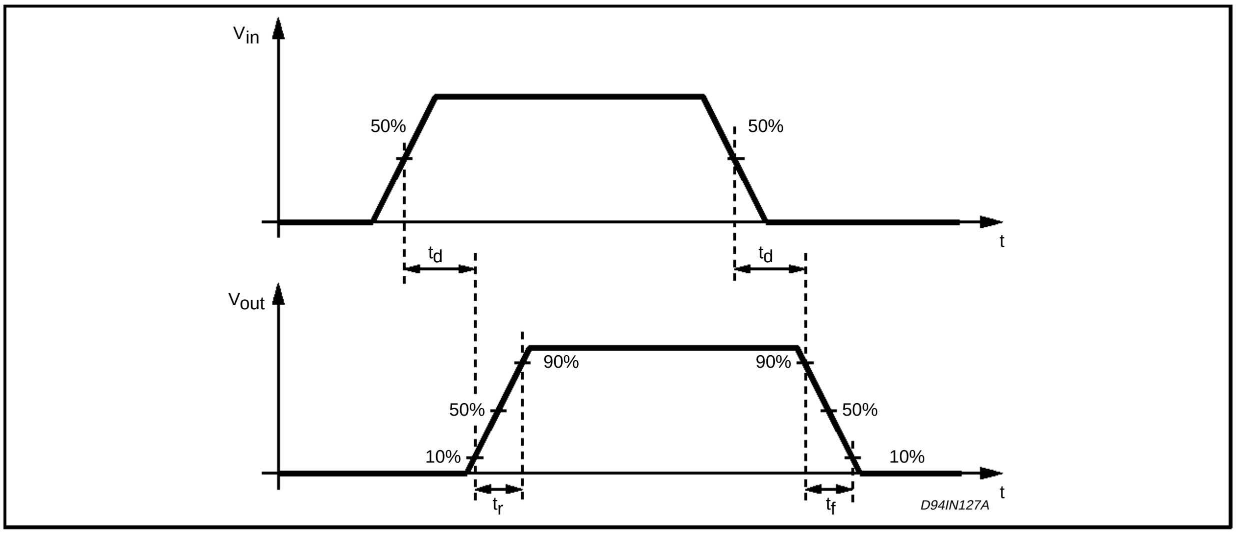


Figure 2: Switching Waveforms



INPUT SECTION

An Input and Asynchronous RESET, both TTL/CMOS compatible with wide voltage range and high noise immunity (thanks to a built in hysteresis) are available.

OVER TEMPERATURE PROTECTION (OVT)

An on-chip Over Temperature Protection providse an excellent protection of the device in extreme conditions. Whenever the temperature - measured on a central portion of the chip- exceeds Tmax=150 C (typical value) the device is shut off, and the DIAG output goes LOW.

Normal operation is resumed as the chip temperature (normally after few seconds) falls below Tmax-Thys= 130 C (typical value). The hysteresis avoid thats an intermittent behaviour take place.

UNDER VOLTAGE PROTECTION (UV)

The supply voltage is expected to range from 8 to 35 V. In this range the device operates correctly. Below 8 V the overall system has to be considered not reliable. To avoid any misfunctioning the supply voltage is continuously monitored to provide an under voltage protection. As Vs falls below Vsth-Vshys (typically 7.5 V, see fig.1) the output power MOS is switched off and DIAG output goes LOW. Normal operation is resumed as soon as Vs exceeds Vsth. The hysteretic behaviour prevents intermittent operation at low supply voltage.

OVER CURRENT OPERATION

In order to implement a short circuit protection the output power MOS is driven in linear mode to limit the output current to the Isc value. This Isc limit is externally settable by means of an external 1/4 W resistor connected from Rsc pin and GND. The value of the resistor must be chosen according to the following formula:

$$I_{sc}\,(A) = 5/R_{sc}\,(kohm)$$

with

$$5 < R_{sc} < 30\ (kohm)$$

For

$$R_{sc} < 5\ (kohm)$$

Isc is limited to Isc=1.1 A (typical value).

This condition (current limited to the Isc value) lasts for a Ton time interval, that can be set by means of a capacitor (Cdon) connected to the ON DELAY pin according to the following formula:

Ton = 1.28 msec/pF

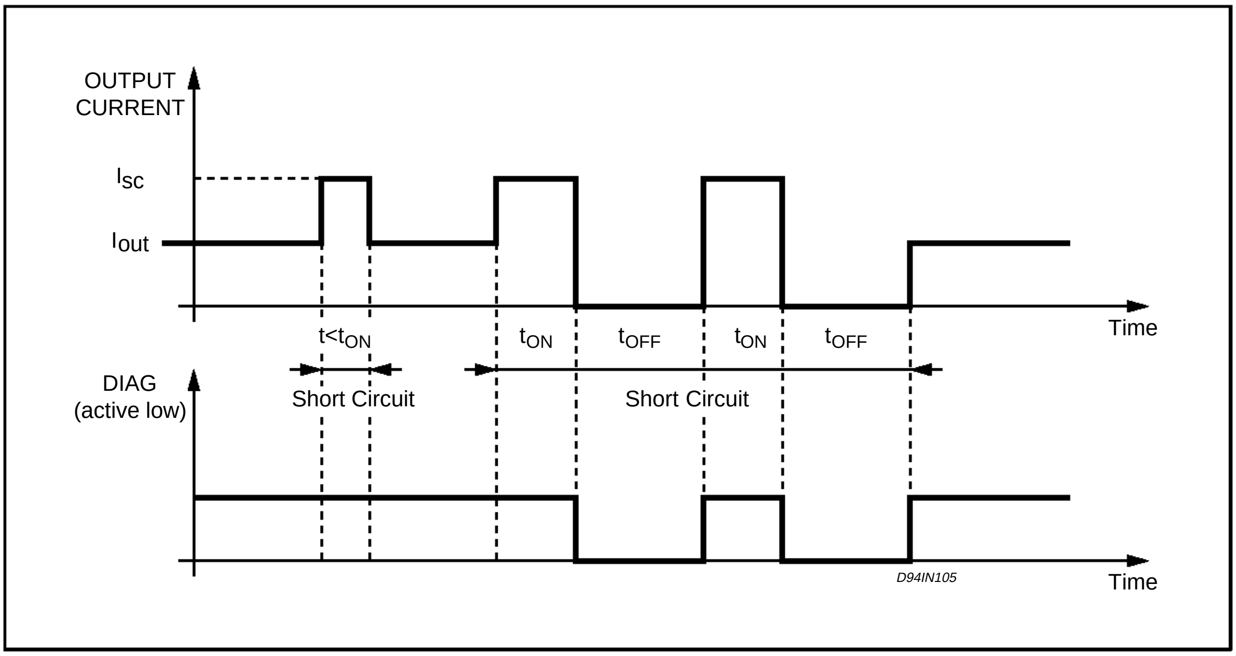
for

50pF<Cdon< 2nF

After the Ton interval has expired the output power MOS is switched off for the Toff time interval with:

Toff = 64*Ton.

Figure 3: Short Circuit Operation Waveforms



When also the Toff interval has expired, the output power MOS is switched ON.

Now two conditions may occur

- the overload is still present. In this case the output power MOS is again driven in linear mode (limiting the output current to Isc) for another Ton, starting a new cycle, or

- the overload condition is removed, and the output power MOS is no longer driven in linear mode.

All these occurrences are presented on the DIAG pin (see fig 2). We call this unique feature **Non Dissipative Short Circuit Protection** and it ensures a very safe operation even in permanent overload conditions. Note that, of course, choosing the most appropriate value for the Ton interval (i.e. the value of the Cdon capacitor) a delay (the Ton itself) will prevent that a misleading Short Circuit information is presented on the DIAG output, when driving capacitive loads (that acts like short circuit in the very beginning) or Incandescent Lamp (a cold filament has a very low resistive value).

The Non Dissipative Short Circuit Protection can be disabled (keeping Ton = 0 but with the output current still limited to Isc, and Diagnostic disabled) simply shorting to ground the the ON DELAY pin.

DEMAGNETISATION OF INDUCTIVE LOADS

The L6377 has an internal clamping zener diode able to demagnetise inductive loads. Note that the limitation comes from the peak power that the package can handle. Attention must be paid to a proper thermal design of the board. If, for whatever reason (load current or inductive value too big) the peak power dissipation is too high, an external Zener plus Diode arrangement, can perform a demagnetisation versus Ground or versus Vs (see fig 5 and 6). The breakdown voltage of the external Zener Diode must be chosen considering the internal clamping voltage (Vcl) and the supply voltage (Vs) according to:

$$V_z < V_{cl}(min) - V_s(max)$$

for demagnetisation versus Ground or

$$V_s(max) < V_z < V_{cl}(min)$$

for demagnetisation versus Vs.

Figure 4: Input Comparator Hysteresis

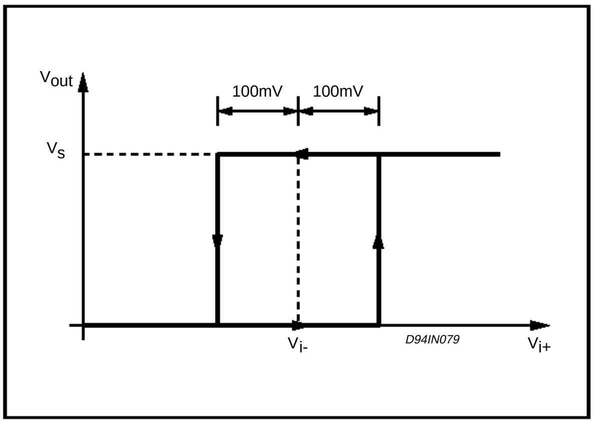


Figure 5: External Demagnetisation Circuit (versus ground)

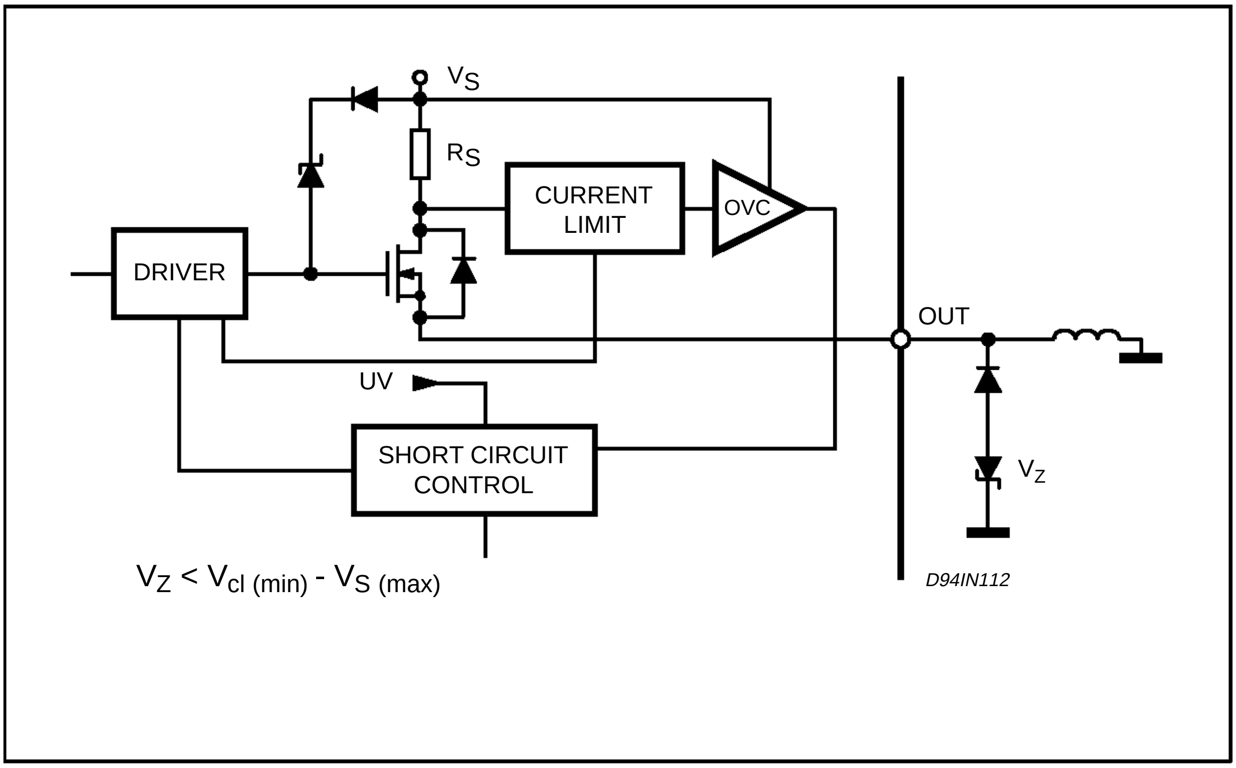
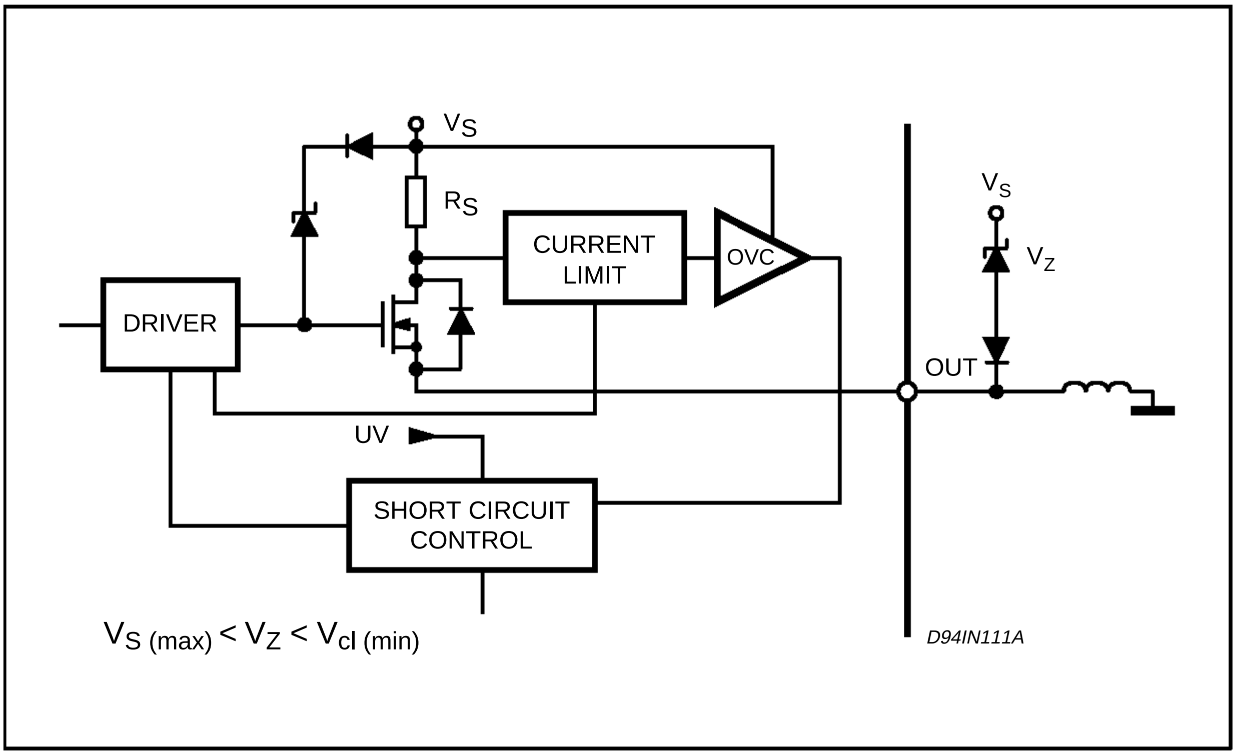
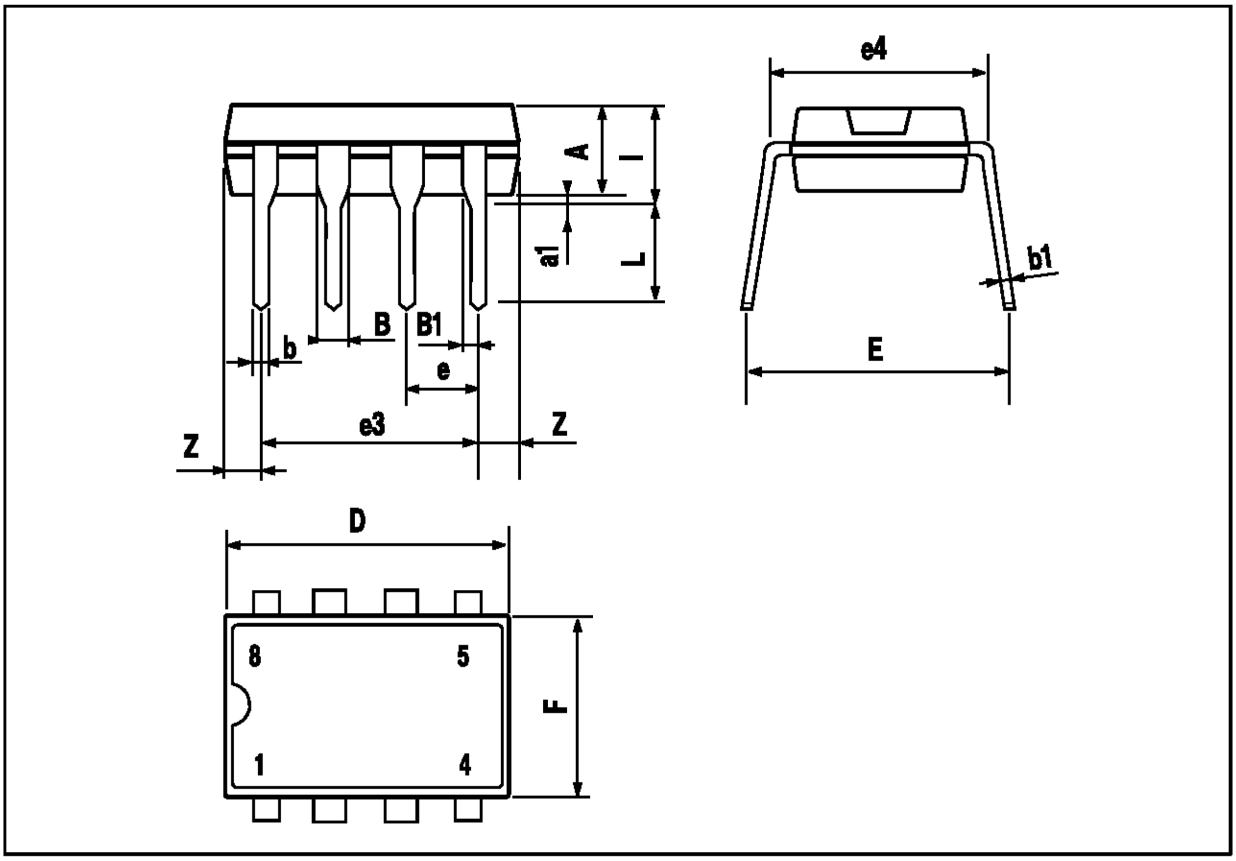


Figure 6: External Demagnetisation Circuit (versus V_S)



MINIDIP PACKAGE MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0.260
I			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060



016019	MIN	TYP	MAX	MIN	TYP	MAX
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1		45			1.772	
D		1	8.55		0.039	0.337
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F		1	3.8		0.039	0.150
G	4.6		5.3	0.181		0.209
L	0.5		1.27	0.020		0.050
M			0.68			0.027
S			8			0.315