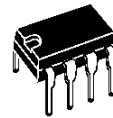


0.5A HIGH-SIDE DRIVER INTELLIGENT POWER SWITCH

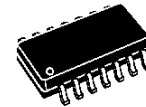
PRODUCT PREVIEW

- 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 HYSTERESIS
- 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 $\pm 2\text{KV}$)

MULTIPOWER BCD TECHNOLOGY



MINIDIP



SO14

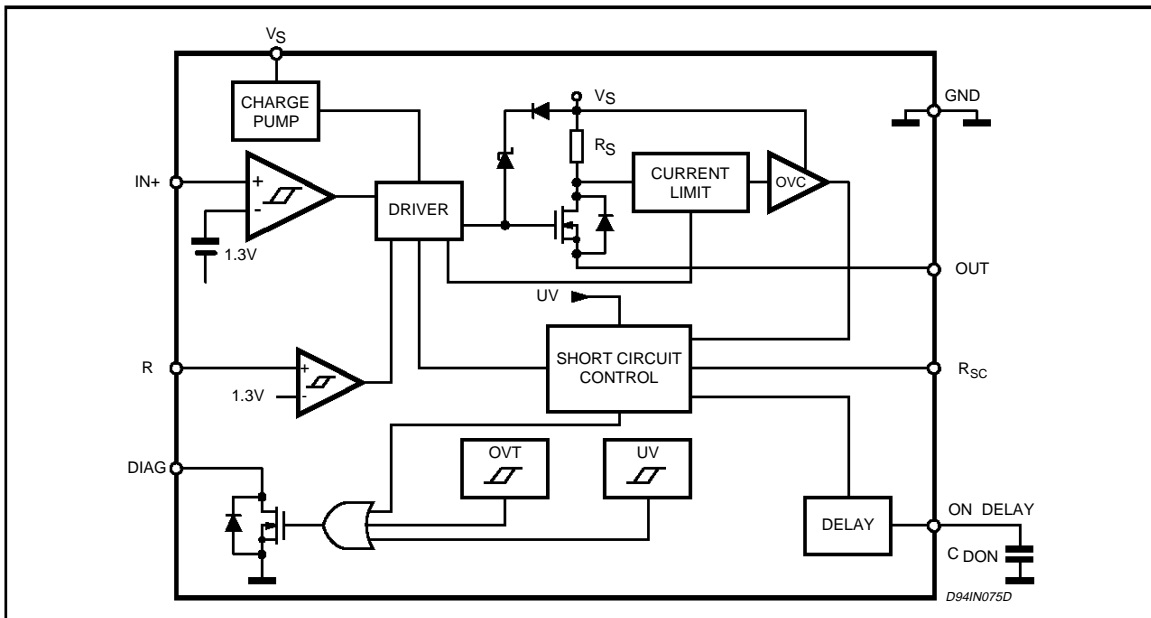
ORDERING NUMBERS: L6377 (MINIDIP)
L6377D (SO)

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.

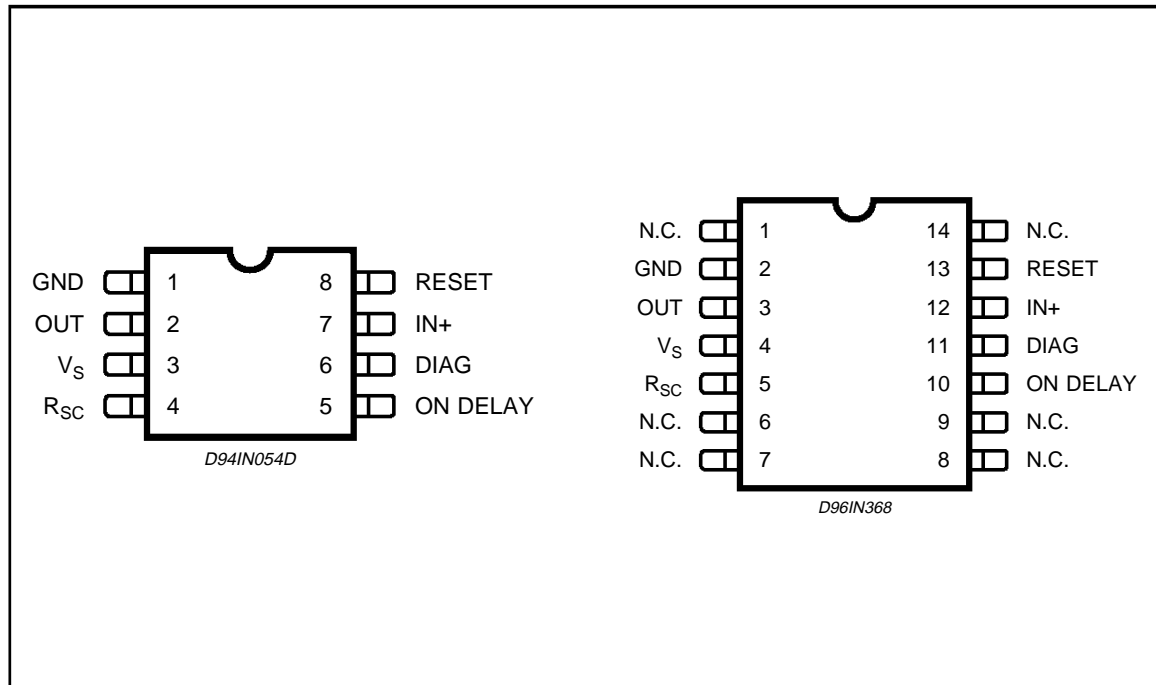
BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Pin	Parameter	Value	Unit
V_s	3	Supply Voltage ($t_w \leq 10\text{ms}$)	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 ($T_j = 125^\circ\text{C}$)	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	$^\circ\text{C}$
T_j		Junction temperature, operating range (see Overtemperature Protection)	-25 to 125	$^\circ\text{C}$
T_{stg}		Storage temperature	-55 to 150	$^\circ\text{C}$

PIN CONNECTION (Top view)



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-amb}	Thermal Resistance, Junction Ambient Max.	100	150	°C/W

ELECTRICAL CHARACTERISTICS ($V_s = 24V$; $T_j = -25$ to $125^\circ C$; 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	$I_{diag} = 5mA$;			1.5	V
V_{don}	2	Output Voltage Drop	$I_{out} = 625mA$; $T_j = 25^\circ C$		250	350	mV
			$I_{out} = 625mA$; $T_j = 125^\circ C$		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 $\approx 300\mu s$	48	53	58	V
I_{sc}		Short Circuit Output Current	$V_s = 8$ to $35V$; $R_l = 2\Omega$; $R_{sc} = 5$ to $30K\Omega$	$5/R_{sc} = K\Omega$			A
		$V_s = 8$ to $35V$; $R_l = 2\Omega$; $R_{sc} < 5 K\Omega$	0.75	1.1	1.5	A	
T_{max}		Over Temperature Upper Threshold			150	$^\circ C$	
T_{hys}		Over Temperature Hysteresis			20	$^\circ C$	

AC OPERATION

Symbol	Pin	Parameter	Test Condition	Min.	Typ.	Max.	Unit
t_r - t_f	2	Rise or Fall Time	$V_s = 24V$; $R_I = 70\Omega$ R_I to ground		20		μs
t_d		Delay Time			5		μs
dV/dt		Slew Rate (Rise and Fall Edge)	$V_s = 24V$; $R_I = 70\Omega$ R_I to ground	0.7	1	1.5	$V/\mu s$
t_{ON}	5	On time during Short Circuit Condition	$50pF < C_{DON} < 2nF$		1.28		$\mu s/pF$
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	$I_{fSD} = 500mA$; $dI_{fSD}/dt = 25A/\mu s$		200		ns
t_{fr}	Forward Recovery Time			50		ns

Figure 1: Undervoltage Comparator Hysteresis

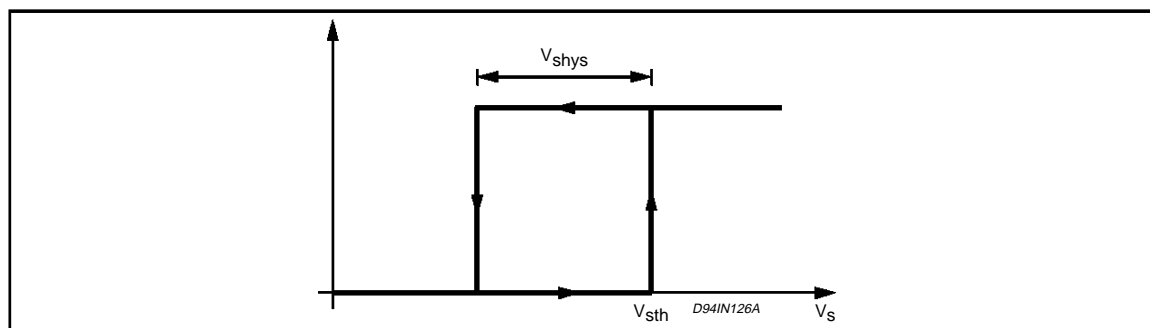
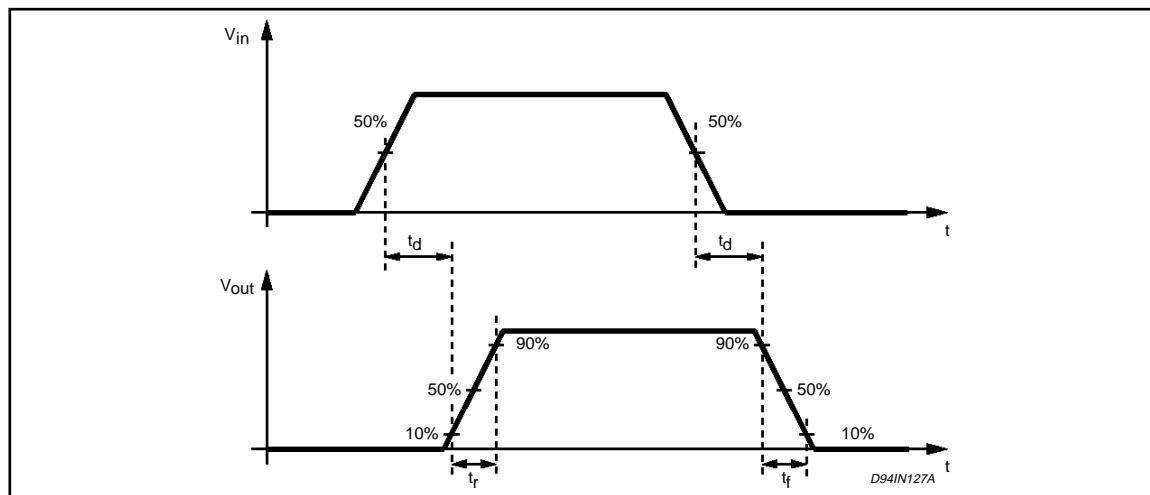


Figure 2: Switching Waveforms



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 provide an excellent protection of the device in extreme conditions. Whenever the temperature - measured on a central portion of the chip- exceeds $T_{max}=150\text{ C}$ (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 $T_{max}-Thys=130\text{ C}$ (typical value). The hysteresis avoid that 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 V_s falls below $V_{sth}-V_{shys}$ (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 V_s exceeds V_{sth} . 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 I_{sc} value. This I_{sc} 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:

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

with

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

For

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

I_{sc} is limited to $I_{sc}=1.1\text{ A}$ (typical value).

This condition (current limited to the I_{sc} value) lasts for a T_{on} time interval, that can be set by means of a capacitor (C_{don}) connected to the ON DELAY pin according to the following formula:

$$T_{on} = 1.28 \text{ msec/pF}$$

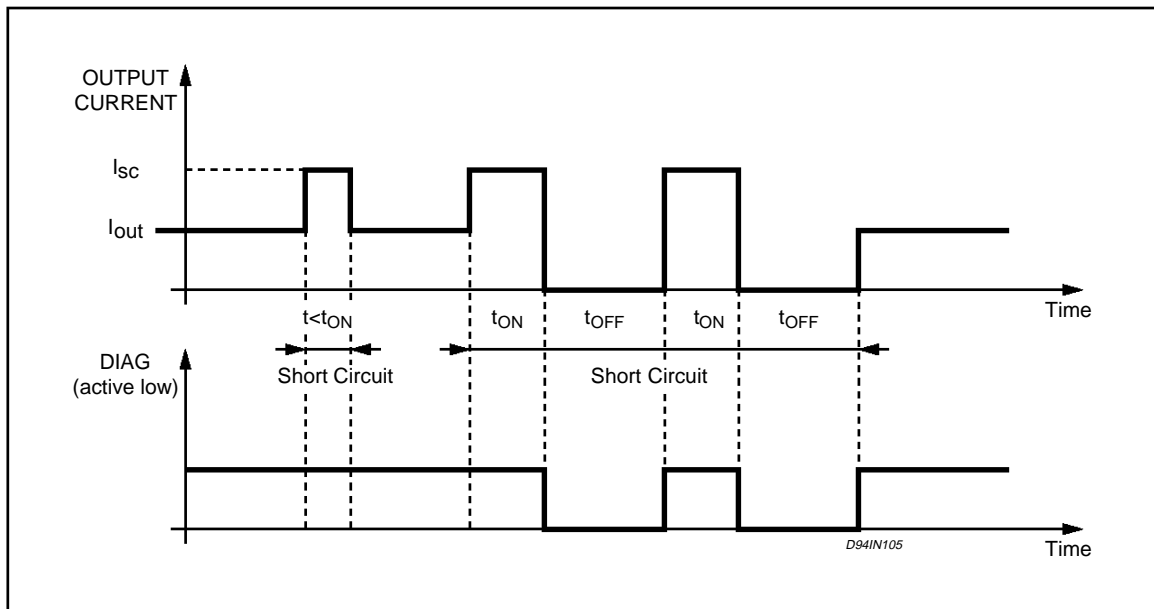
for

$$50\text{pF} < C_{don} < 2\text{nF}$$

After the T_{on} interval has expired the output power MOS is switched off for the T_{off} time interval with:

$$T_{off} = 64 * T_{on}.$$

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 I_{sc}) for another T_{on} , 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 T_{on} interval (i.e. the value of the C_{don} capacitor) a delay (the T_{on} 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 $T_{on} = 0$ but with the output current still limited to I_{sc} , 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 V_s (see fig 5 and 6). The breakdown voltage of the external Zener Diode must be chosen considering the internal clamping voltage (V_{cl}) and the supply voltage (V_s) 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 V_s .

Figure 4: Input Comparator Hysteresis

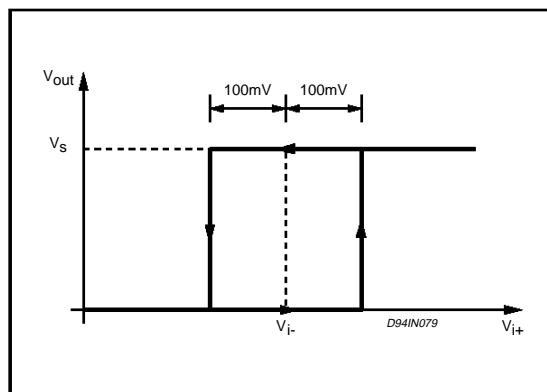


Figure 5: External Demagnetisation Circuit (versus ground)

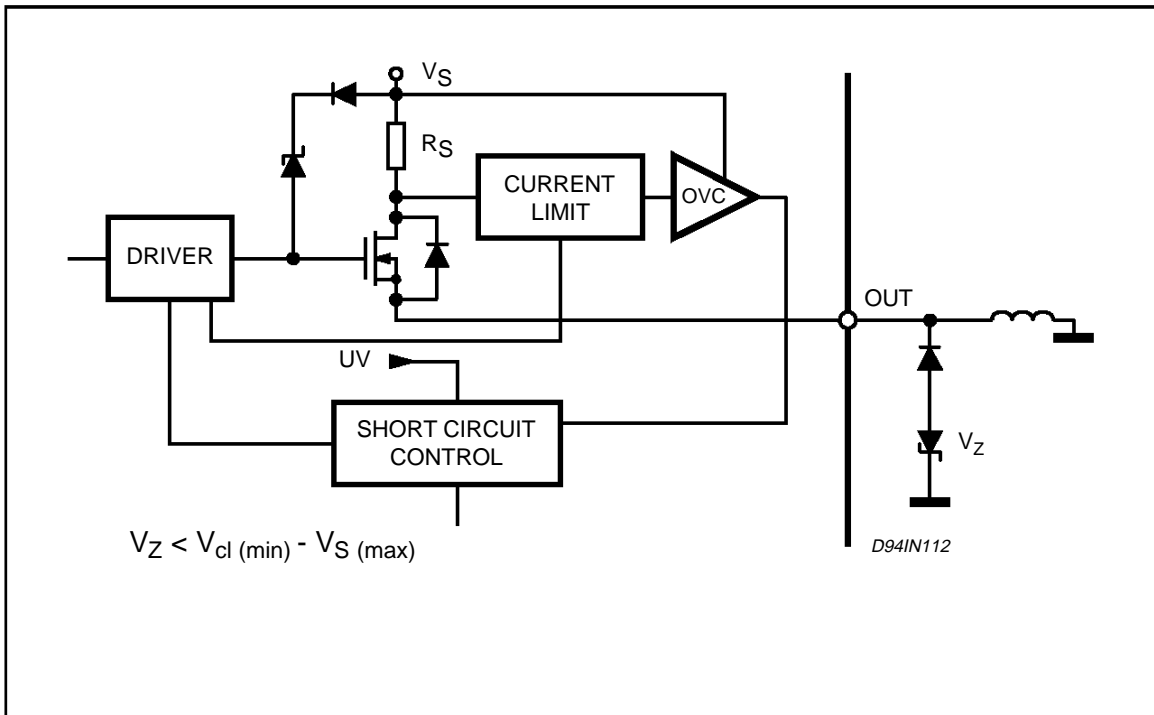
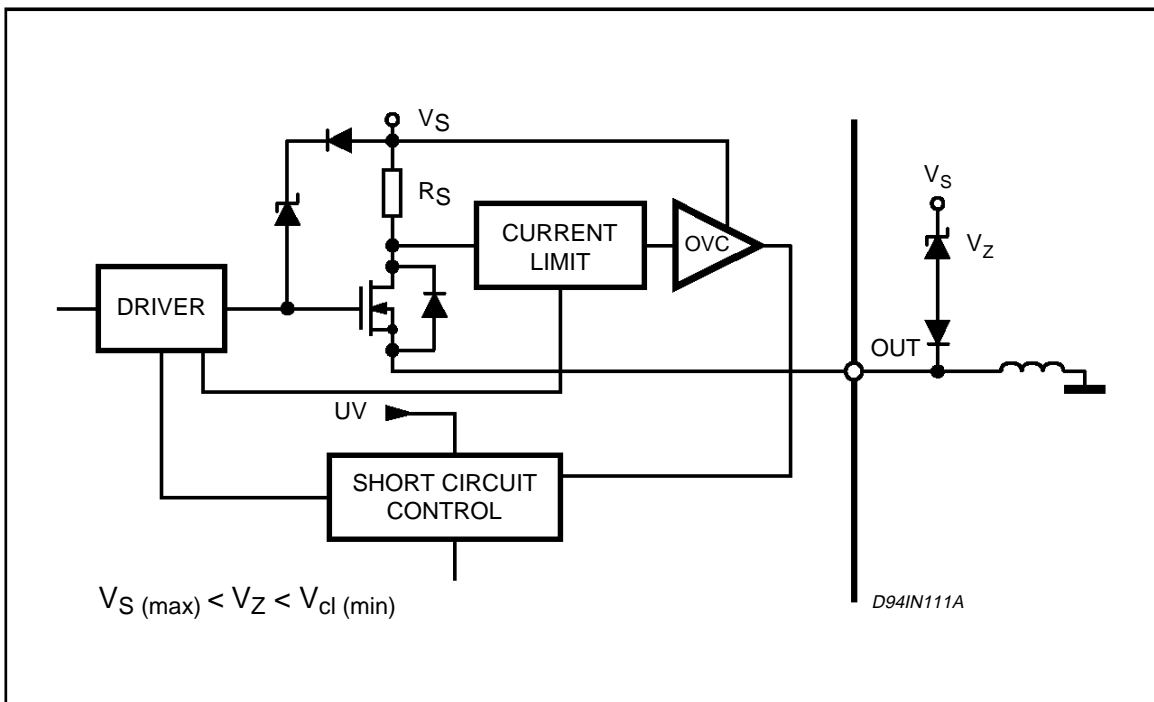
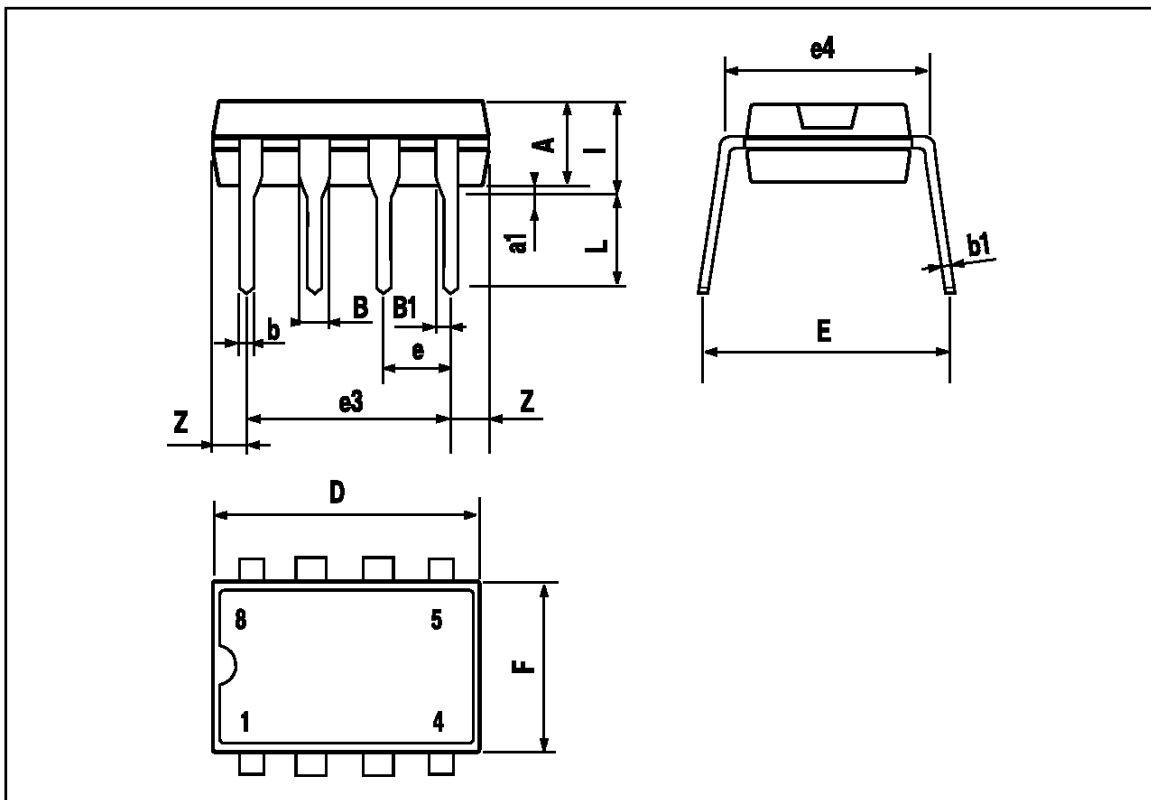


Figure 6: External Demagnetisation Circuit (versus VS)



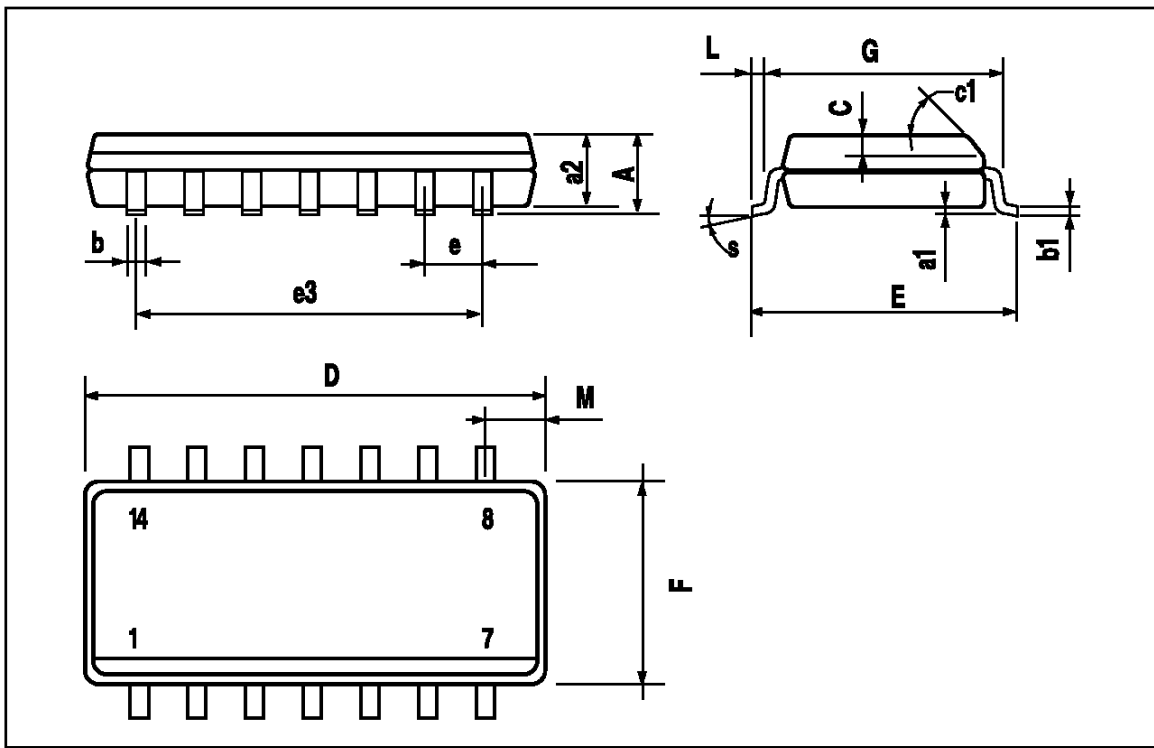
MINIDIP PACKAGE MECHANICAL DATA

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
l			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060



L6377

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



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