L6375

0.5A INDUSTRIAL INTELLIGENT POWER SWITCH

PRELIMINARY DATA

- 0.5A OUTPUT CURRENT
- 8V TO 35V SUPPLY VOLTAGE RANGE
- NON DISSIPATIVE SHORT CIRCUIT PROTECTION
- THERMAL SHUTDOWN
- OPEN GROUND PROTECTION
- NEGATIVE VOLTAGE CLAMPING FOR FAST DEMAGNETIZATION
- UNDERVOLTAGE LOCKOUT WITH HYSTERESIS
- OPEN LOAD DETECTION
- TWO DIAGNOSTIC OUTPUTS
- OUTPUT STATUS LED DRIVER
- IMMUNITY AGAINST BURST TRANSIENT (IEC 801-4), see application schematic.
- ESD PROTECTION (HUMAN BODY MODEL ±2KV)

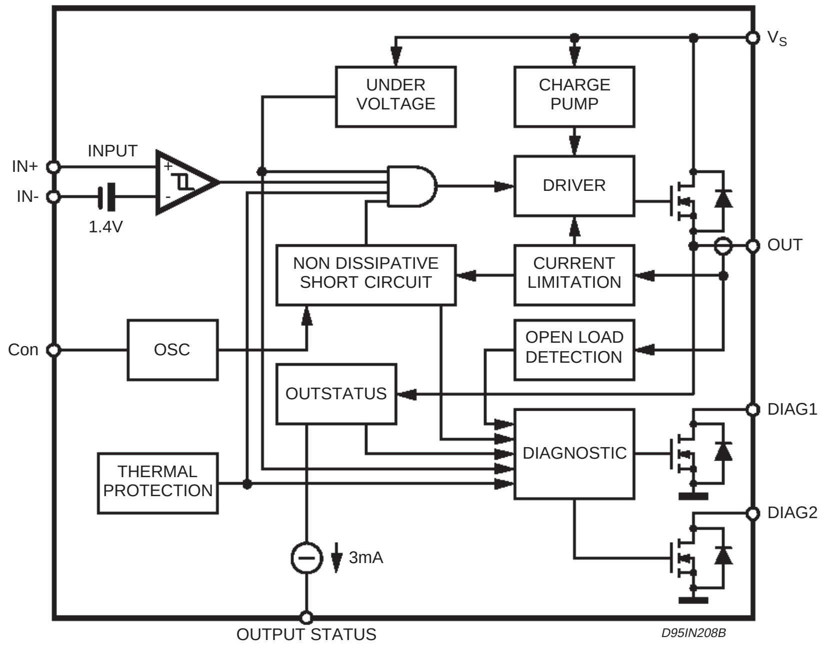
MULTIPOWER BCD TECHNOLOGY

SO20	MINIDIP
ORDERING NUMBERS:	
L6375D	L6375

DESCRIPTION

The L6375 is a monolithic fully protected, full diagnostic 0.5A Intelligent Power Switch. it is designed to drive any kind of R-L-C load with controlled output voltage slew rate and non dissipative short circuit protection. An internal Clamping Diode enables the fast demagnetization of inductive loads. Diagnostic for CPU feedback and extensive use of electrical protections make this device extremely rugged and specially suitable for industrial automation applications.

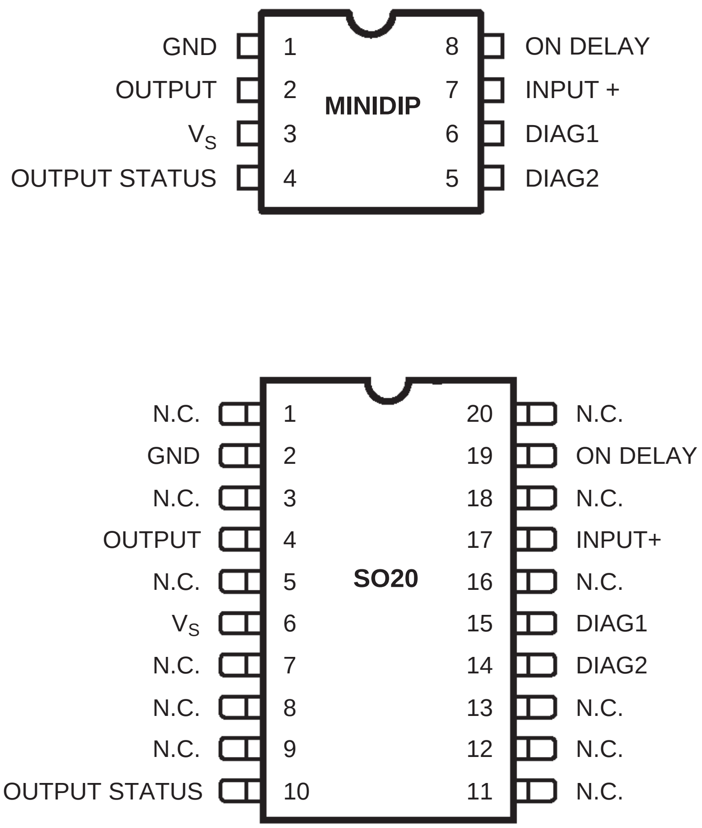
BLOCK DIAGRAM



PIN FUNCTION (Pin numbering referred to Minidip package)

N°	Pin	Description
1	GND	Ground
2	OUT	High side output. Controlled output with current limitation
3	Vs	Supply voltage input. Range with under voltage monitoring
4	OUTPUT STATUS	Led driver to signal the status of the output pin. The pin is active (sources current) when the output is considered high. (See fig. 1)
5	DIAG1	Diagnostic 1 output. This open drain reports the IC working conditions. (See Diagnostic truth table)
6	DIAG2	Diagnostic 2 output. This open drain reports the IC working conditions. (See Diagnostic truth table)
7	IN+	Comparator non inverting input
8	ON DELAY	Delay setting for overcurrent diagnostic

PIN CONNECTION (Top view)



ABSOLUTE MAXIMUM RATINGS (Pin numbering referred to Minidip package)

Symbol	Pin	Parameter	Value	Unit
V_S	3	Supply Voltage (tw < 10 ms)	50	V
V_S	3	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}	5	Externally Forced Current	±1	mA
I_{out}	2	Output Current (see also Isc)	internally limited	
V_{out}	2	Output Voltage	internally limited	V
P_{tot}		Power Dissipation	internally limited	
V_{diag}	5.6	External voltage	-0.3 to 40	V
I_{diag}	5.6	Externally forced current	-10 to 10	mA
I_i	7	Input Current	20	mA
V_i	7	Input Voltage	-10 to Vs +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
E_I		Energy Induct. Load T_J = 85°C	200	mJ

THERMAL DATA

Symbol	Parameter		Minidip	SO20	Unit
$R_{th\ j\text{-}case}$	Thermal Resistance Junction to Case	Max.			°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction to Ambient	Max.	100	90	°C/W

ELECTRICAL CHARACTERISTCS

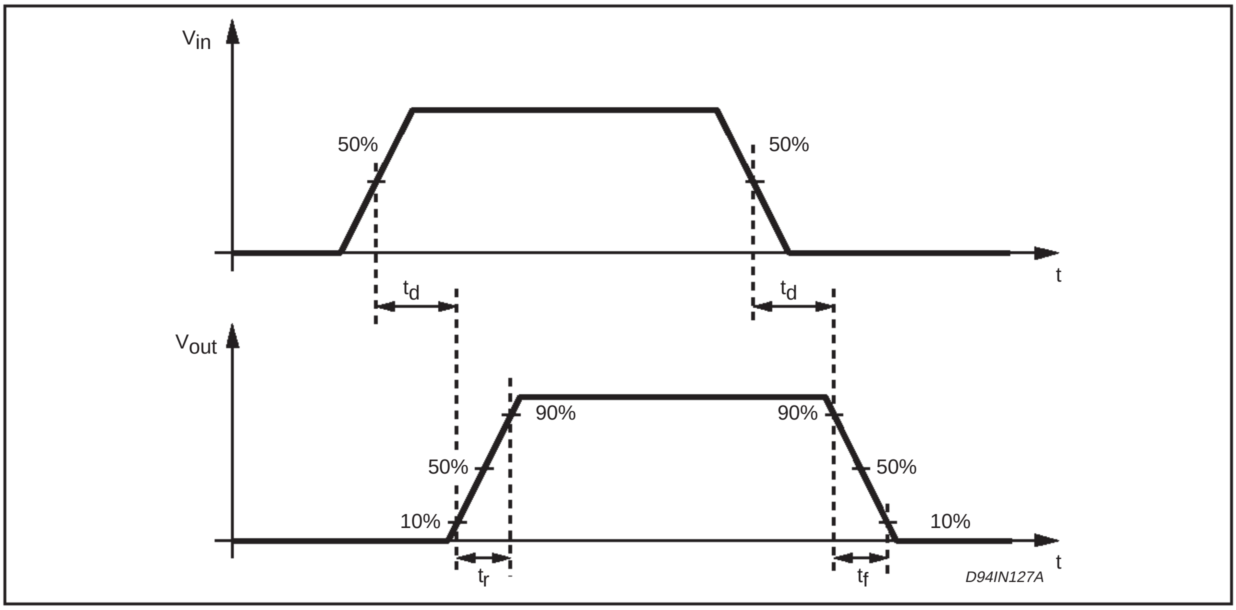
(V_S = 24V; T_j = –25 to +125°C, unless otherwise specified; pin numbering referred to Minidip package)

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	3	Operative Supply Voltage		8	24	35	V
V_{sth1}	3	Undervoltage Threshold 1	(See fig. 2)	7	7.5	8	V
V_{sth2}	3	Undervoltage Threshold 2	(See fig. 2)	6.5	7	7.5	V
V_{shys}	3	Under Voltage Hysteresis		300	500	700	mV
I_q	3	Quiescent Current	Output Open		800		µA
I_{qo}	3	Quiescent Current	Output On		1.6		mA
V_{ith}	7	Input Threshold Voltage		0.8	1.3	2	V
V_{iths}	7	Input Threshold Hysteresis		50		400	mV
V_{il}	7	Input Low Level Voltage		-7		0.8	V
V_{ih}	7	Input High Level Voltage	V_S< 18V	2		V_S -3	V
V_{ih}	7	Input High Level Voltage	V_S> 18V	2		15	V
I_{ib}	7	Input Bias Current	V_i = -7 to 15V	-250		250	µA
I_{dch}	5	Delay Capacitor Charging Current	ON DELAY pin shorted to Ground		2.5		µA
V_{don}		Output Voltage Drop	I_{out} = 500mA T_j = 25°C T_j = 125°C I_{out} = 625mA T_j = 25°C T_j = 125°C		200 320 250 400	280 440 350 550	mV mV mV mV
I_{olk}	2	Output Leakage Current	V_i = LOW; V_{out}=0			100	µA
V_{ol}	2	Output Low State Voltage	V_i = HIGH; pin floating		0.8	1.5	V
V_{cl}	2	Internal Voltage Clamp (V_S-V_{out})	I_O = 200mA single pulsed =300µs	48	53	58	V
I_{sc}	2	Short Circuit Output Current	V_S = 8 to 35V; R_l = 2Ω;	0.75	1.1	1.5	A
I_{old}	2	Open Load Detection Current	V_i = V_{ih}; T_{amb} = 0 to +85°C	1	3	6	mA
V_{oth1}	5.6	Output Status Threshold 1 Voltage	(See fig. 1)	4.5	5	5.5	V
V_{oth2}	5.6	Output Status Threshold 2 Voltage	(See fig. 1)	4	4.5	5	V
V_{ohys}	5.6	Output Status Threshold Hysteresis	(See fig. 1)	300	500	700	mV
I_{osd}	5.6	Output Status Source Current	V_{out} > V_{oth1} ; V_{os} = 2.5V	2		4	mA

ELECTRICAL CHARACTERISTCS (Continued)

Symbol	Pin	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{osd}	5.6	Active Output Status Driver Drop Voltage	$V_S - V_{os}$; I_{os} = 2mA T_{amb} = 0 to +85°C		1.5	3	V
I_{oslk}	5.6	Output Status Driver Leakage Current	$V_{out} < V_{oth2}$; V_{os} = 0V V_S = 18 to 35V			25	µA
V_{dgl}	5.6	Diagnostic Drop Voltage	D1 / D2 = L ; I_{diag} = 0.5mA D1 / D2 = L ; I_{diag} = 3mA		40 250		mV mV
I_{dglk}	5.6	Diagnostic Leakage Current	D1 / D2 = H ; $0 < V_{dg} < V_s$ V_S = 15.6 to 35V			5	µA
T_{max}		Over Temperature Upper Threshold			150		°C
T_{hys}		Over Temperature Hysteresis			20		°C
AC OPERATION (pin numbering referred to Minidip package)							
t_r - t_f	2	Rise or Fall Time	Vs = 24V; R_l =70Ω R_l to ground		20		µs
t_d	2	Delay Time	Vs = 24V; Rl =70Ω R_l to ground		5		µs
dV/dt	2	Slew Rate (Rise and Fall Edge)	50pF < C_{DON} < 2nF	7	1	15	V/µs
t_{ON}	8	On time during Short Circuit Condition			128		µs/pF
t_{OFF}	8	Off time during Short Circuit Condition			64		µs/pF
f_{max}		Maximum Operating Frequency			25		KHz
SOURCE DRAIN NDMOS DIODE							
V_f		Forward On Voltage	@ Ifsd = 625mA		1	1.5	V
I_{fD}		Forward Peak Voltage	t = 10ms; d = 20%			2	A
t_{rr}		Reverse Recovery Time	I_f = 625mA di/dt = 25A/µs		200		ns
t_{fr}		Forward Recovery Time			50		ns

Figure 1. Switching Waveforms



INPUT SECTION

An Single ended Input TTL/CMOS compatible with wide voltage range and high noise immunity (thanks to a built in hysteresis) is available.

OVER TEMPERATURE PROTECTION (OVT)

An on-chip Over Temperature Protection provides 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 DIAG2 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. 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 DIAG1 and DIAG2 (see Diagnostic truth table). 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 (1.1A 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.

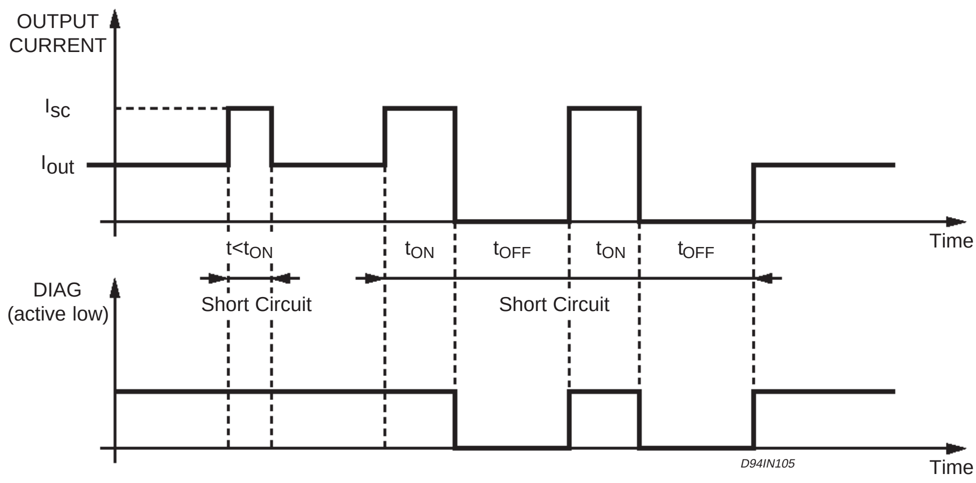
When also the Toff interval has expired, the out-put power MOS is switched ON. At this point in time two conditions may occur

A) the overload is still present, and then the output power MOS is again driven in linear mode (limiting the output current to Isc) for another Ton, starting a new cycle, or

B) the overload condition is removed, and the output power MOS is no longer driven in linear mode. All these occurrences are presented on the DIAG2 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 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 DIAG2 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.

Figure 2. Non Dissipative Short Circuit Protection Operation



DIAGNOSTIC LOGIC

The operating conditions of the device are permanently monitored and the following occurrences are signalled via the DIAG1/DIAG2 open-drain output pins see: diagnostic Truth Table.

- Short Circuit versus ground.
- Short Circuit versus V_S.
- Under Voltage(UV)
- Over Temperature (OVT)
- Open Load, if the output current is less than 3mA (typical value).

DEMAGNETIZATION OF INDUCTIVE LOADS

An internal zener diode, limiting the voltage across the Power MOS to between 50 and 60V (V_{cl}), provides safe and fast demagnetization of inductive loads without external clamping devices. The maximum energy that can be absorbed from an inductive load is specified as 200mJ (at T_j = 85°C)

DIAGNOSTIC TRUTH TABLE

Diagnostic Conditions	Input	Output	DIAG1	DIAG2
Normal Operation	L H	L H	H H	H H
Open Load Condition ($I_o < I_{old}$)	L H	L H	H L	H H
Short to V_S	L H	H H	L L	H H
Short Circuit to Ground ($I_O = I_{SC}$) (pin ON-DELAY grounded)	H	H L	H H	H H
Output DMOS Open	L H	L L	H L	H H
Overtemperature	L H	L L	H H	L L
Sumplay Undervoltage ($V_S < V_{sth2}$)	L H	L L	L L	L L

Figure 3. Inductive Load Equivalent Circuit

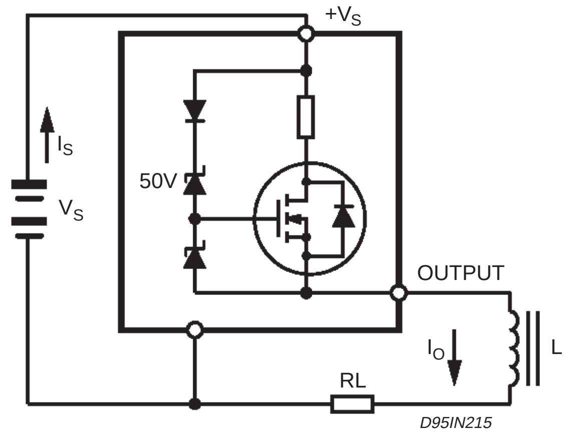


Figure 4. External Demagnetisation Circuit (versus ground)

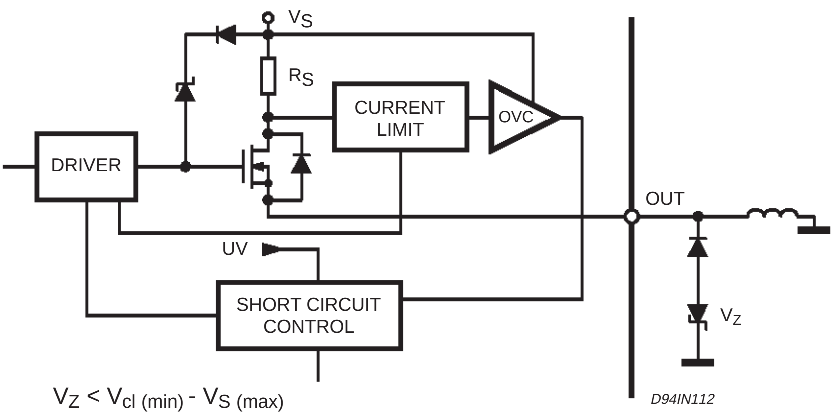


Figure 5. External Demagnetisation Circuit (versus V_S)

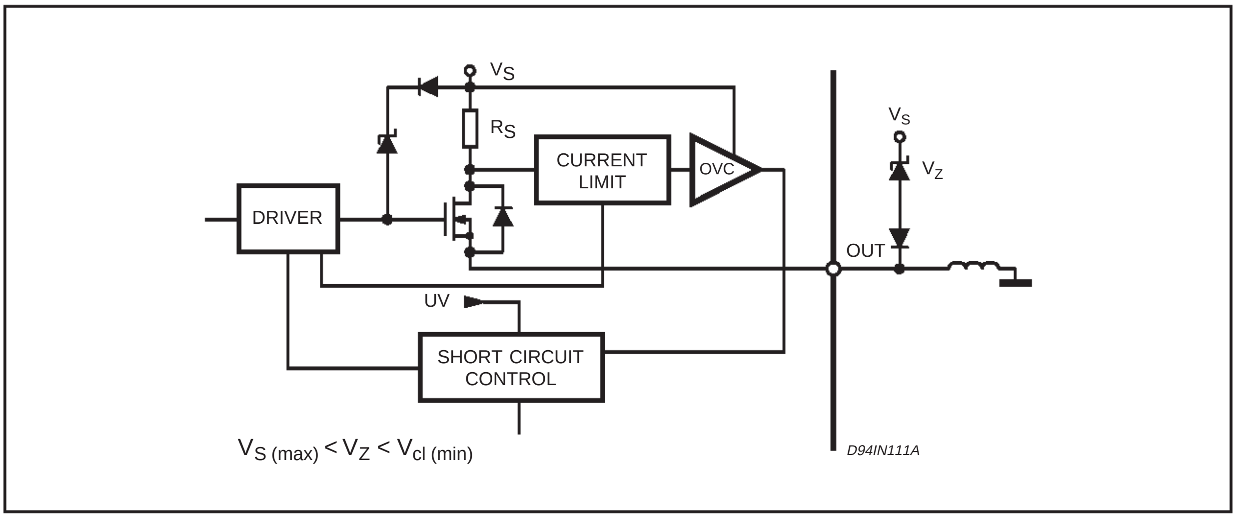
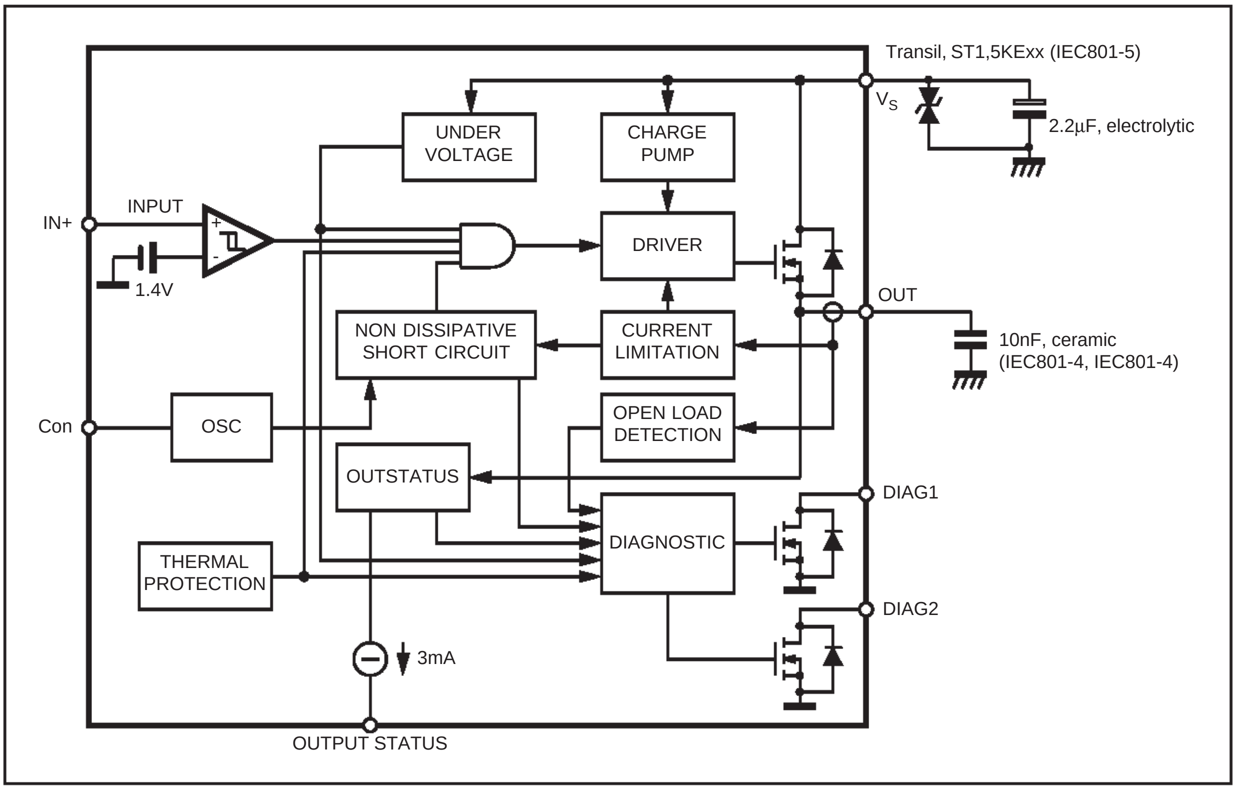
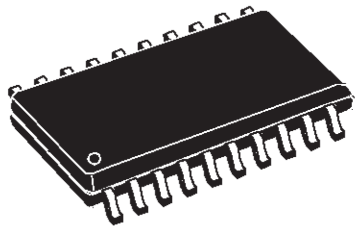


Figure 6. Application Schematic

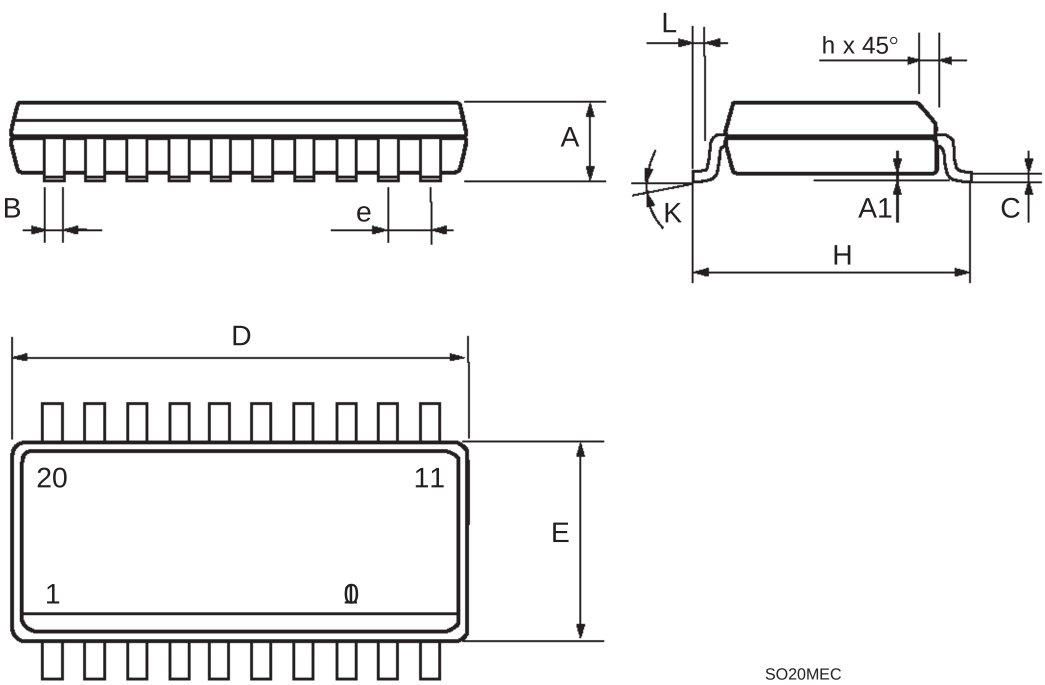


DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.1		0.3	0.004		0.012
B	0.33		0.51	0.013		0.020
C	0.23		0.32	0.009		0.013
D	12.6		13	0.496		0.512
E	7.4		7.6	0.291		0.299
e		1.27			0.050	
H	10		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
L	0.4		1.27	0.016		0.050
K	0° (min.)8° (max.)					

OUTLINE AND MECHANICAL DATA

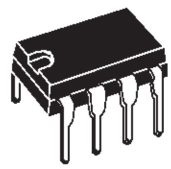


SO20

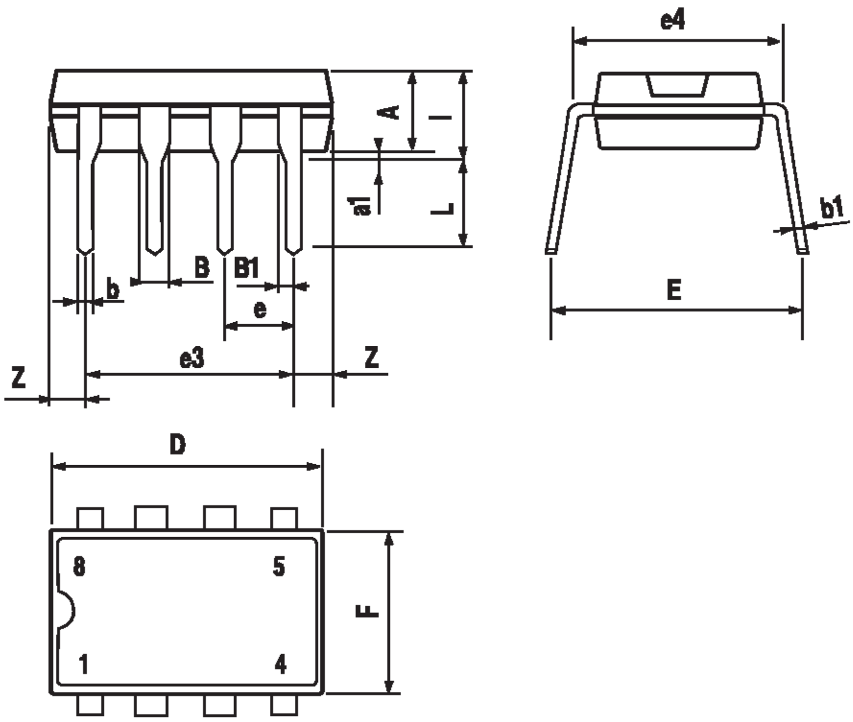


DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0.260
I			5.08			0.200
L	3.18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

OUTLINE AND MECHANICAL DATA



Minidip



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