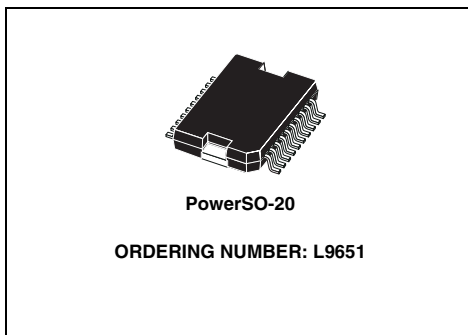


## SMART QUAD SWITCH

- Modified VDMOS Power Stage ( $U_{DSBR} > 80V$ )
- $RD_{SON} < 500\text{ m}\Omega$  ( $T_j = 25^\circ C$ )
- CMOS Compatible Inputs
- Enable Input (Reset)
- Outputs Capable of up to 2.2 Amperes
- Outputs Internally Clamped at 70V for Fast Inductive Load Switch Off
- Wide operating supply voltage from 4.7V up to 30V
- DIAGNOSTIC FUNCTIONS
- Open Load Detection (Output off, 100 $\mu$ s-filtering time)
- Short to Ground Detection (Output off, 100 $\mu$ s-filtering time)
- Short to Battery Detection (Output on)
- Over temperature detection (Output on)
- Storage of last fault in 8 Bit - Serial Register
- Fault Signal Indication at Serial Data Out without need to read out the Serial Interface
- Daisy Chainable Serial Diagnostic

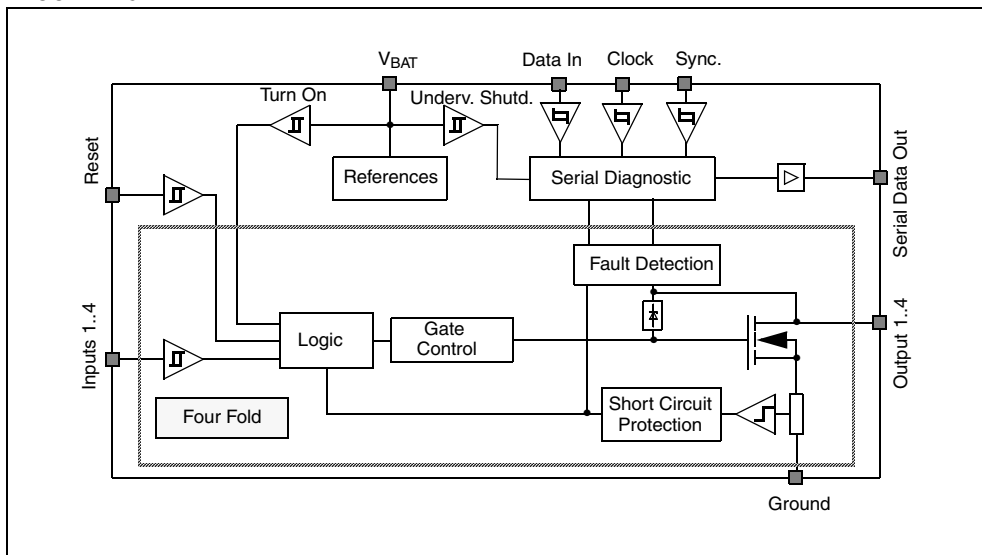


- Serial Interface Clock Frequency up to 500kHz

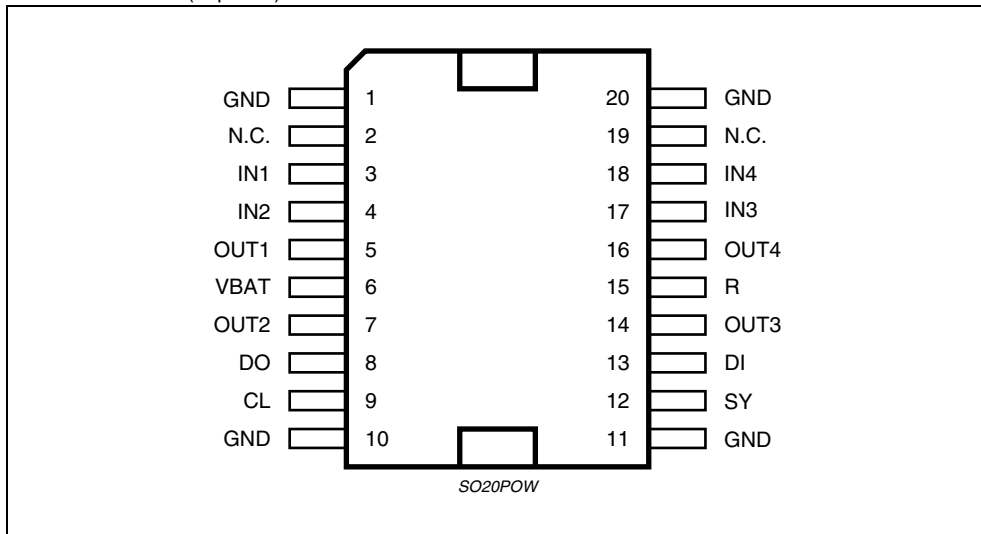
### DESCRIPTION

The L9651 consists of four identical low side power switches. A serial diagnostic interface indicates failure mode of each switch (short circuit to  $V_{BAT}$  or ground and open load or over temperature).

### BLOCK DIAGRAM



## PIN CONNECTION (Top view)



## PIN FUNCTION

N°	Pin	Function
1, 10, 11, 20	GND	Ground
2, 19	N.C.	Not Connected
3	IN1	Input 1
4	IN2	Input 2
5	OUT1	Output 1
6	VBAT	Supply Voltage
7	OUT2	Output 2
8	DO	Serial Data Out
9	CL	Clock
12	SY	Synchronization
13	DI	Serial Data In
14	OUT3	Output 3
15	R	Reset
16	OUT4	Output 4
17	IN3	Input 3
18	IN4	Input 4

**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
T <sub>STG</sub>	Storage Temperature	-55 to 150	°C
T <sub>J</sub>	Operating Junction Temperature	-40 to 150	°C
V <sub>BAT</sub>	DC Supply Voltage	-2 to 30	V
V <sub>BATTr</sub>	Transient Supply Voltage; t < 400ms	40	V
V <sub>OUT</sub>	Output Voltage	65	V
V <sub>OUTTr</sub>	Transient Output Voltage; during clamping	78	V
E <sub>CL</sub>	Output Clamping energy; repetition rate < 100 Hz	10	mJ
-I <sub>OUT</sub>	Output reverse current	2	A
V <sub>R</sub> , V <sub>INi</sub> , V <sub>DI</sub> , V <sub>CLVSY</sub>	Control Input voltage	-0.3 to 6.5	V
V <sub>DO</sub>	Control Output voltage	-0.3 to 6.5	V

**THERMAL DATA**

Symbol	Parameter	Value	Unit
R <sub>th j-case</sub>	Thermal Resistance Junction to Case	2.5	°C/W

**ELECTRICAL CHARACTERISTICS** (6.5V < V<sub>BAT</sub> < 25V, -40 < T<sub>J</sub> < 150°C)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
<b>Supply Voltage</b>						
V <sub>BATU</sub>	Turn on threshold voltage		2.0		4.7	V
I <sub>BAT</sub>	Supply current	V <sub>BAT</sub> = 14V V <sub>OUTi</sub> > 0V	4	10	15	mA
<b>Output stage</b>						
R <sub>DSON</sub>	On resistance	V <sub>BAT</sub> = 14V T <sub>J</sub> = 25°C; I <sub>out</sub> = 1A			500	mΩ
		V <sub>BAT</sub> = 14V T <sub>J</sub> = 150°C; I <sub>out</sub> = 1A			850	mΩ
V <sub>CL</sub>	Clamping voltage, inductive load	I <sub>out</sub> = 0.5 A	63	70	76	V
I <sub>OUTi</sub>	Over current shutdown (Shutdown latch resets with pos. slope at INi)	T <sub>J</sub> = -40°C	3.0		4.3	A
		T <sub>J</sub> = 25°C	2.5		3.7	A
		T <sub>J</sub> = 150°C	2.2		3.5	A
Output leakage current see: Open load diagnostic current						

## ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
<b>Logic Inputs IN1...IN4, SY, CL, DI, R</b>						
$V_{IN1H}$ $V_{SYLH}$ $V_{CLLH}$ $V_{RLH}$ $V_{D1LH}$	Input High level		3.5		6.5	V
$V_{IN1L}$ $V_{SYHL}$ $V_{CLHL}$ $V_{RHL}$ $V_{D1HL}$	Input Low level		-0.3		1.5	V
$V_{IN1h}$ $V_{SYh}$ $V_{CLh}$ $V_{Rh}$ $V_{D1h}$	Hysteresis		0.2		1	V
- $I_{Ni}$ - $I_{SY}$ - $I_{CL}$ - $I_R$	Input current IN1 ... IN4, SY, CL, R (Internal pull up current source)	$V_{INi} = 0V$	10	40	120	$\mu A$
		$V_{SY} = 0V$ $V_{CL} = 0V$ $V_R = 0V$	10		80	
- $I_{DI}$	Input current DI (Internal pull up current source)	$V_{DI} = 0V$	120	220	250	$\mu A$
<b>Timing</b>						
$t_{don}$	Turn on delay			7.5		$\mu s$
$t_{doff}$	Turn off delay			7.5		$\mu s$
$S_{on}$	Switch on slew rate			10		V/ $\mu s$
$S_{off}$	Switch off slew rate			15		V/ $\mu s$
$t_{oc}$	Over current detection time			0.5		$\mu s$
$t_v$	Open load filtering time		60	100	200	$\mu s$
$t_v$	Short to GND filtering time		60	100	200	$\mu s$
$f_{CL}$	Serial clock frequency		0		500	kHz
$t_{vDV}$	DO: Data valid time		0.03		1	$\mu s$
$t_{vset}$	DI: Data settling time		0.5			$\mu s$
$t_{vhold}$	DI: Data hold time		0			$\mu s$
<b>Diagnostic</b>						
$V_{BATDU}$	Under voltage threshold		4.7		7.5	V
Serial Data output (External pull up required)						
$V_{DO}$	Data output low voltage	$I_{DO} < 1.6mA$ $7.5V < V_{BAT} < 22V$	0		0.45	V
$ I_{DO} $	Data output leakage current				10	$\mu A$

**ELECTRICAL CHARACTERISTICS** (continued)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
Output voltage monitoring Output off						
V <sub>OL</sub>	Open load threshold voltage (fault detected if V <sub>OUTi</sub> < V <sub>OL</sub> )	7.5V < V <sub>BAT</sub> < 22V		2/3V <sub>BAT</sub>		
V <sub>SG</sub>	Short to GND threshold voltage (fault detected if V <sub>OUTi</sub> < V <sub>SG</sub> )	7.5V < V <sub>BAT</sub> < 22V		1/3V <sub>BAT</sub>		
Open load diagnostic current Output off						
	Open load output voltage	I <sub>OUT</sub> = 0 A V <sub>INI</sub> = 5V 7.5V < V <sub>BAT</sub> < 22V		1/2V <sub>BAT</sub>		
- I <sub>OUTi</sub>	Output current	V <sub>OUT</sub> = 1V V <sub>INI</sub> = 5V	50	100	150	μA
I <sub>OUTi</sub>	Output current	V <sub>OUT</sub> = V <sub>BAT</sub> V <sub>INI</sub> = 5V 7.5V < V <sub>BAT</sub> < 22V	200	320	500	μA
Overload Diagnostic						
	Over temperature diagnostic	T <sub>J</sub>		175		°C
I <sub>OUTi</sub>	Over current	T <sub>J</sub> = -40°C	3.0		4.3	A
		T <sub>J</sub> = 25°C	2.5		3.7	A
		T <sub>J</sub> = 150°C	2.2		3.5	A

**Figure 1. Typical Timing Diagram for Serial Diagnostic**

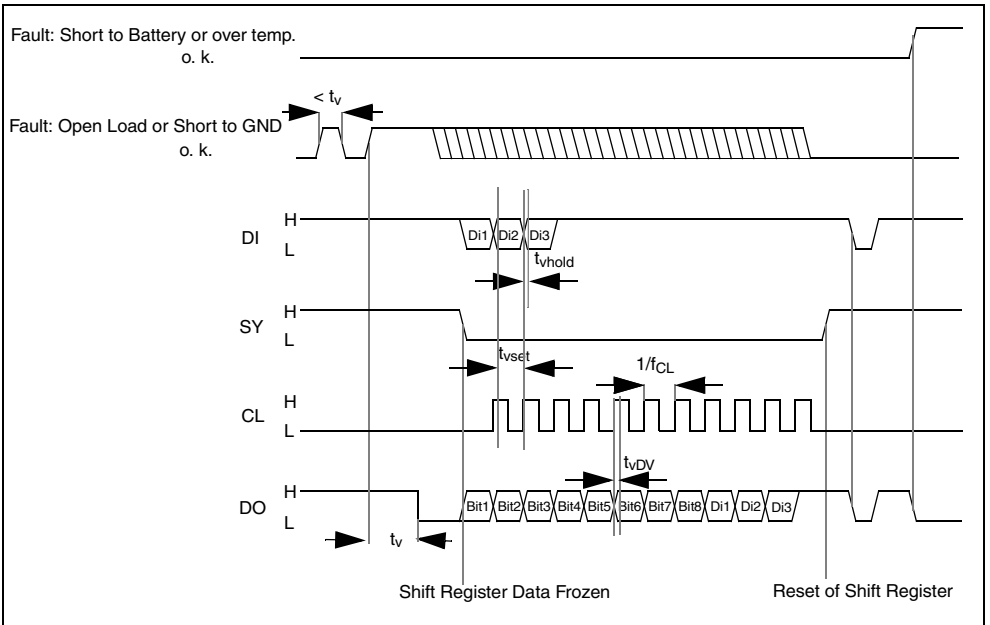


Figure 2. Serial Interface Error Coding

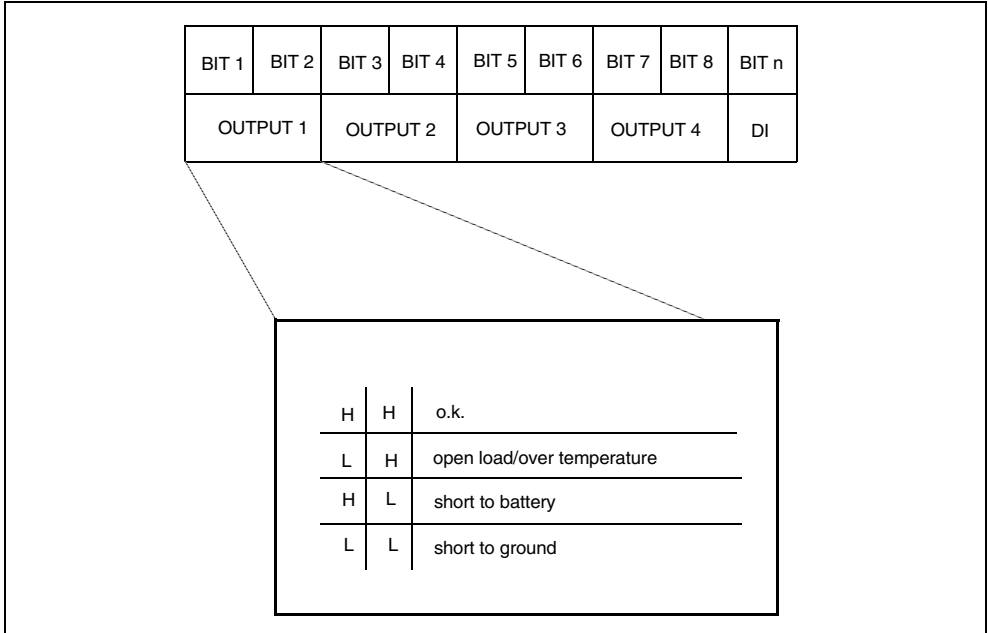


Figure 3. Output voltage TIMING for inductive load

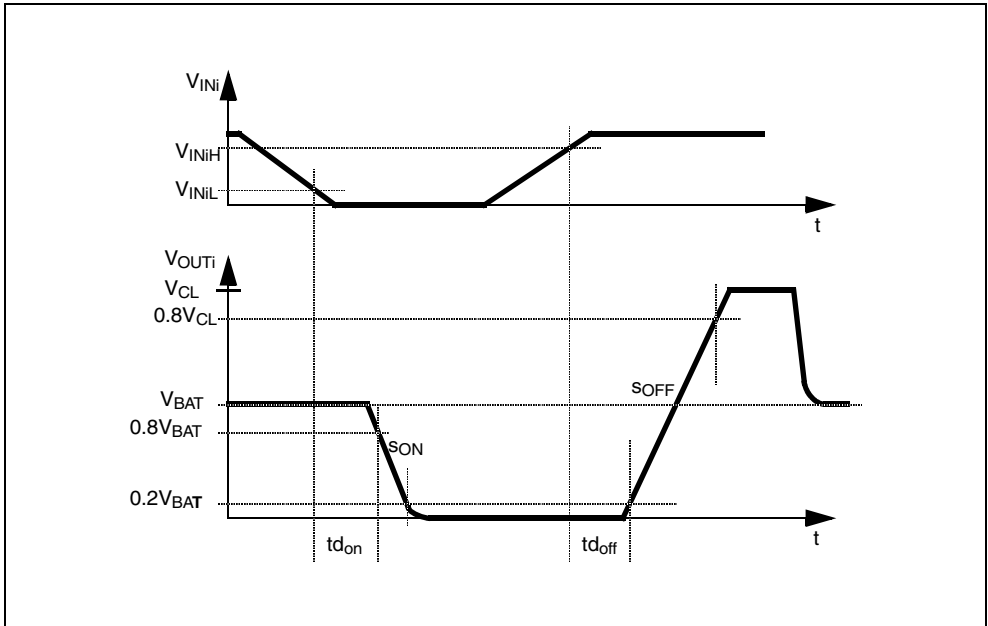
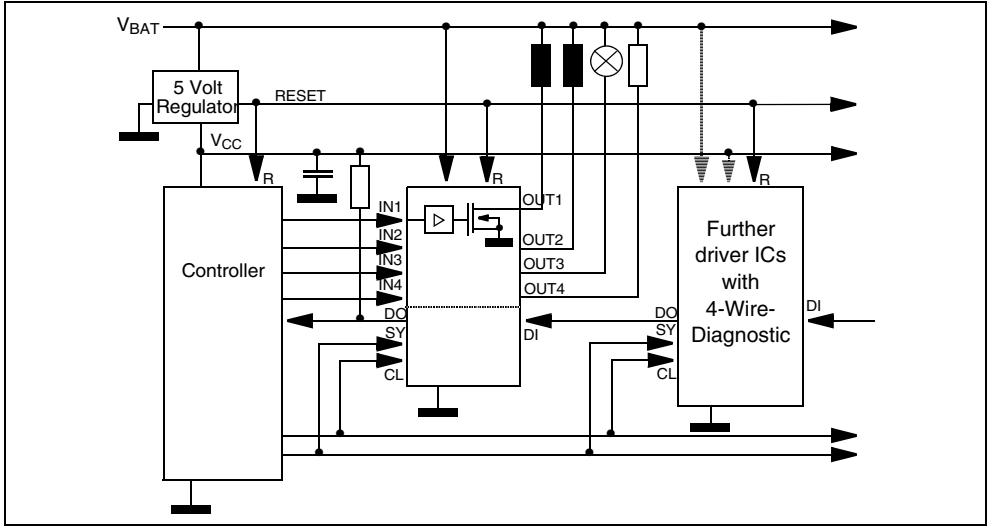


Figure 4. Application Circuit

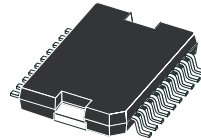


DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			3.6			0.142
a1	0.1		0.3	0.004		0.012
a2			3.3			0.130
a3	0		0.1	0.000		0.004
b	0.4		0.53	0.016		0.021
c	0.23		0.32	0.009		0.013
D (1)	15.8		16	0.622		0.630
D1 (2)	9.4		9.8	0.370		0.386
E	13.9		14.5	0.547		0.570
e		1.27			0.050	
e3		11.43			0.450	
E1 (1)	10.9		11.1	0.429		0.437
E2			2.9			0.114
E3	5.8		6.2	0.228		0.244
G	0		0.1	0.000		0.004
H	15.5		15.9	0.610		0.626
h			1.1			0.043
L	0.8		1.1	0.031		0.043
N	8°(typ.)					
S	8°(max. )					
T		10			0.394	

- (1) "D and E1" do not include mold flash or protusions.  
 - Mold flash or protusions shall not exceed 0.15mm (0.006")  
 - Critical dimensions: "E", "G" and "a3".  
 (2) For subcontractors, the limit is the one quoted in jedec MO-166

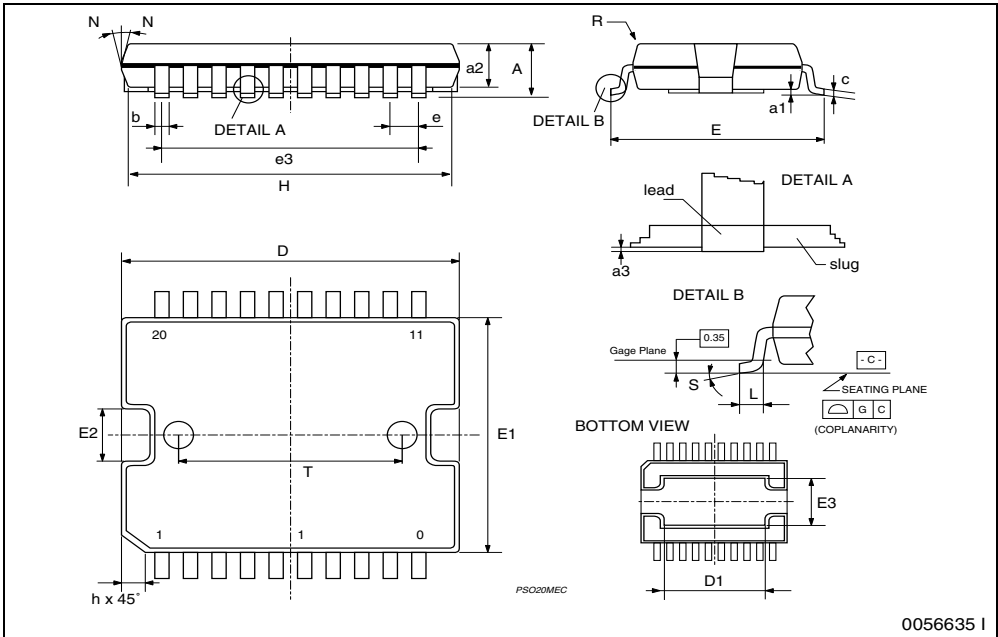
## OUTLINE AND MECHANICAL DATA

Weight: 1.9gr



JEDEC MO-166

PowerSO-20





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