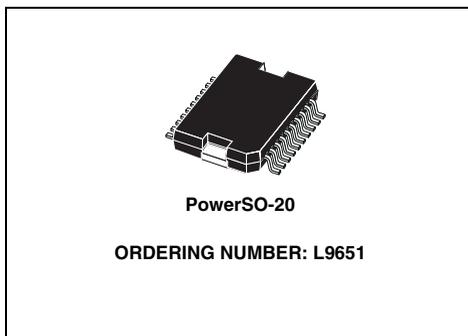


SMART QUAD SWITCH

- 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 μ s-filtering time)
- Short to Ground Detection (Output off, 100 μ 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

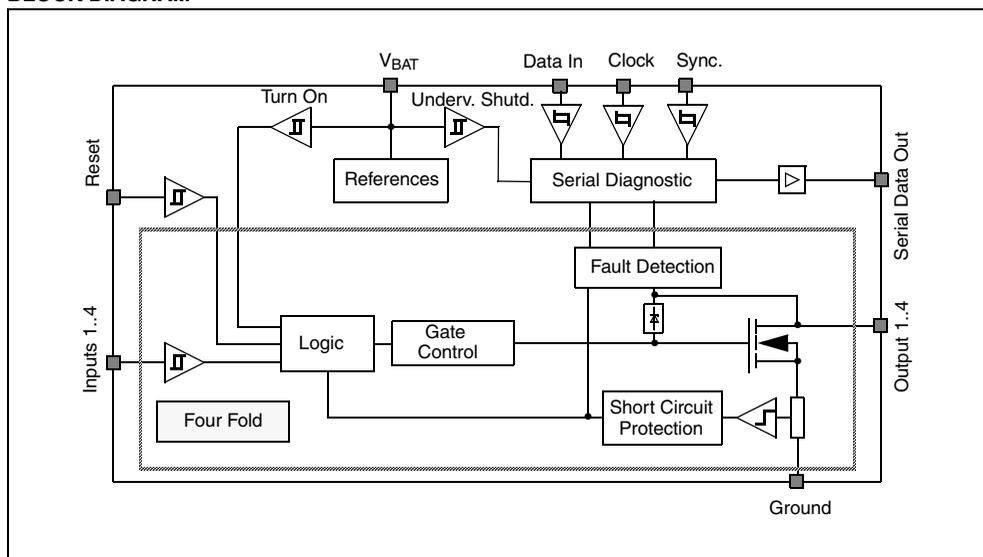


- Serial Interface Clock Frequency up to 500kHz

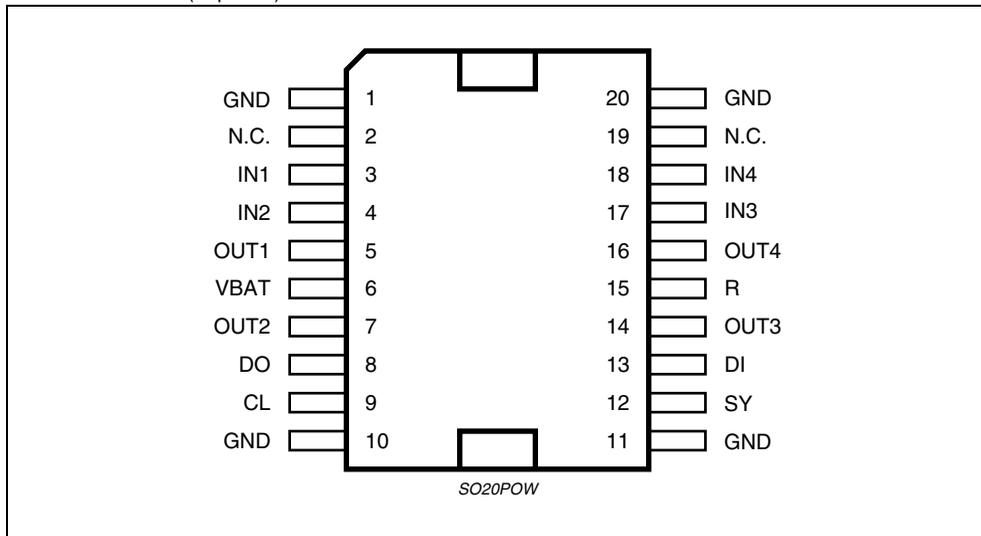
DESCRIPTION

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 _{STG} | Storage Temperature | -55 to 150 | °C |
| T _J | Operating Junction Temperature | -40 to 150 | °C |
| V _{BAT} | DC Supply Voltage | -2 to 30 | V |
| V _{BATtr} | Transient Supply Voltage; t < 400ms | 40 | V |
| V _{OUT} | Output Voltage | 65 | V |
| V _{OUTtr} | Transient Output Voltage; during clamping | 78 | V |
| E _{CL} | Output Clamping energy; repetition rate < 100 Hz | 10 | mJ |
| -I _{OUT} | Output reverse current | 2 | A |
| V _R , V _{INI} , V _{DI} , V _{CLVSY} | Control Input voltage | -0.3 to 6.5 | V |
| V _{DO} | Control Output voltage | -0.3 to 6.5 | V |

THERMAL DATA

| Symbol | Parameter | Value | Unit |
|------------------------|-------------------------------------|-------|------|
| R _{th j-case} | Thermal Resistance Junction to Case | 2.5 | °C/W |

ELECTRICAL CHARACTERISTICS (6.5V < V_{BAT} < 25V, -40 < T_J < 150°C)

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|--|--|---|------|------|------|------|
| Supply Voltage | | | | | | |
| V _{BATU} | Turn on threshold voltage | | 2.0 | | 4.7 | V |
| I _{BAT} | Supply current | V _{BAT} = 14V V _{OUTi} > 0V | 4 | 10 | 15 | mA |
| Output stage | | | | | | |
| R _{DSON} | On resistance | V _{BAT} = 14V T _J = 25°C; I _{out} = 1A | | | 500 | mΩ |
| | | V _{BAT} = 14V T _J = 150°C; I _{out} = 1A | | | 850 | mΩ |
| V _{CL} | Clamping voltage, inductive load | I _{out} = 0.5 A | 63 | 70 | 76 | V |
| I _{OUTi} | Over current shutdown (Shutdown latch resets with pos. slope at INi) | T _J = -40°C | 3.0 | | 4.3 | A |
| | | T _J = 25°C | 2.5 | | 3.7 | A |
| | | T _J = 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 |
|---|---|---|------|------|------|------|
| Logic Inputs IN1...IN4, SY, CL, DI, R | | | | | | |
| V _{INILH} V _{SYLH} V _{CLLH} V _{RLH} V _{DILH} | Input High level | | 3.5 | | 6.5 | V |
| V _{INiHL} V _{SYHL} V _{CLHL} V _{RHL} V _{DIHL} | Input Low level | | -0.3 | | 1.5 | V |
| V _{INih} V _{SYih} V _{CLih} V _{Rih} V _{DIih} | Hysteresis | | 0.2 | | 1 | V |
| - I _{INi} - I _{SY} - I _{CL} - I _R | Input current IN1 ... IN4, SY, CL, R (Internal pull up current source) | V _{INi} = 0V | 10 | 40 | 120 | μA |
| | | 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 | μA |
| Timing | | | | | | |
| t _{don} | Turn on delay | | | 7.5 | | μs |
| t _{doff} | Turn off delay | | | 7.5 | | μs |
| S _{on} | Switch on slew rate | | | 10 | | V/μs |
| S _{off} | Switch off slew rate | | | 15 | | V/μs |
| t _{oc} | Over current detection time | | | 0.5 | | μs |
| t _v | Open load filtering time | | 60 | 100 | 200 | μs |
| t _v | Short to GND filtering time | | 60 | 100 | 200 | μs |
| f _{CL} | Serial clock frequency | | 0 | | 500 | kHz |
| t _{vDV} | DO: Data valid time | | 0.03 | | 1 | μs |
| t _{vset} | DI: Data settling time | | 0.5 | | | μs |
| t _{vhold} | DI: Data hold time | | 0 | | | μs |
| Diagnostic | | | | | | |
| 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 | μA |

ELECTRICAL CHARACTERISTICS (continued)

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

Figure 1. Typical Timing Diagram for Serial Diagnostic

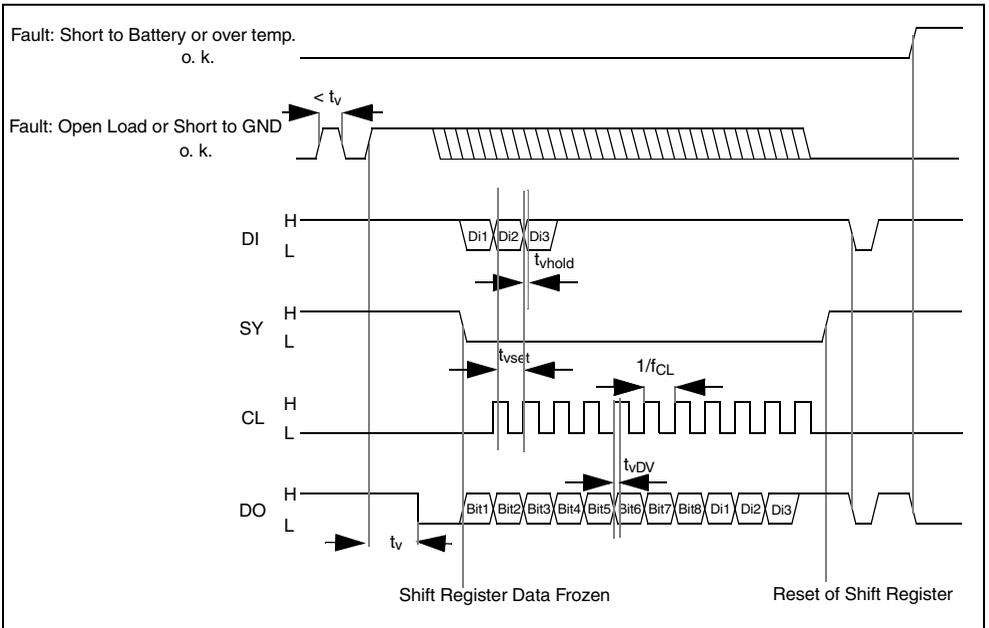


Figure 2. Serial Interface Error Coding

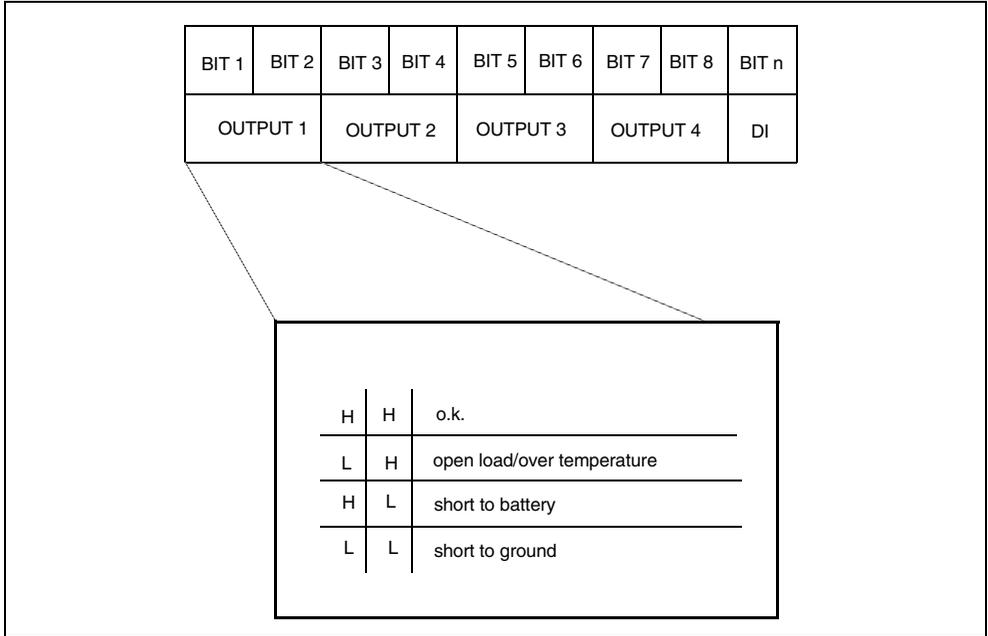


Figure 3. Output voltage TIMING for inductive load

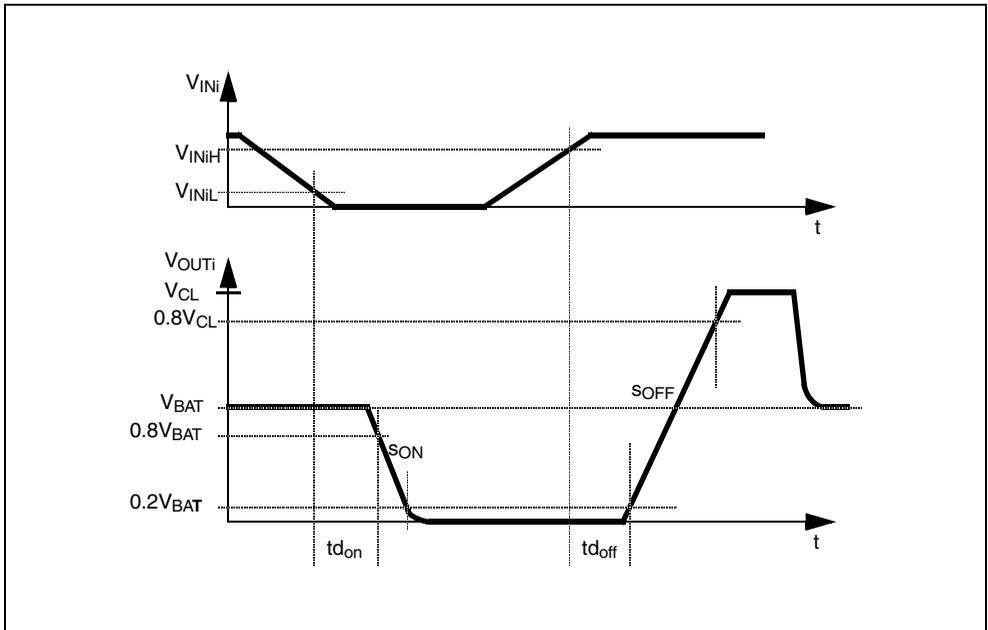
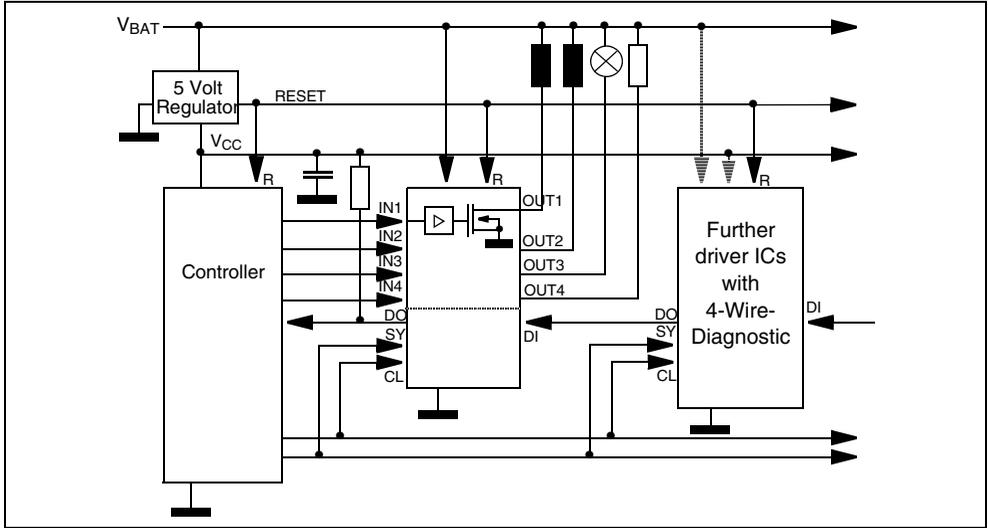


Figure 4. Application Circuit

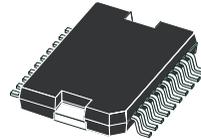


| DIM. | mm | | | inch | | |
|--------|-----------|-------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 3.6 | | | 0.142 |
| a1 | 0.1 | | 0.3 | 0.004 | | 0.012 |
| a2 | | | 3.3 | | | 0.130 |
| a3 | 0 | | 0.1 | 0.000 | | 0.004 |
| b | 0.4 | | 0.53 | 0.016 | | 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 protrusions.
 - Mold flash or protrusions shall not exceed 0.15mm (0.006")
 - Critical dimensions: "E", "G" and "a3".
 (2) For subcontractors, the limit is the one quoted in jecdec MO-166

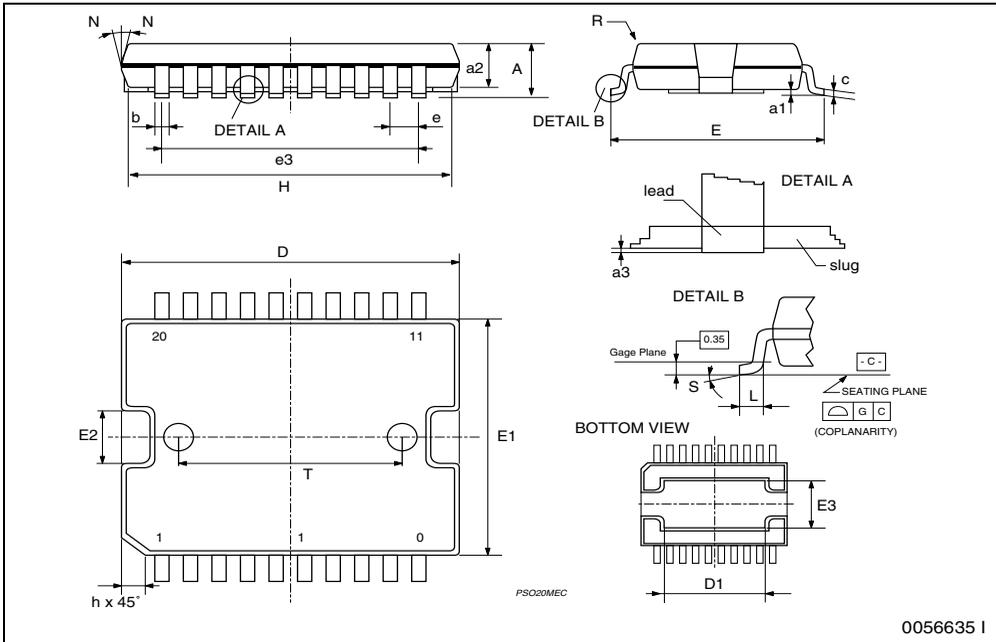
OUTLINE AND MECHANICAL DATA

Weight: 1.9gr



JEDEC MO-166

PowerSO-20



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