

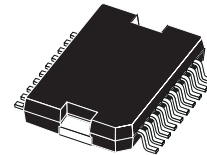
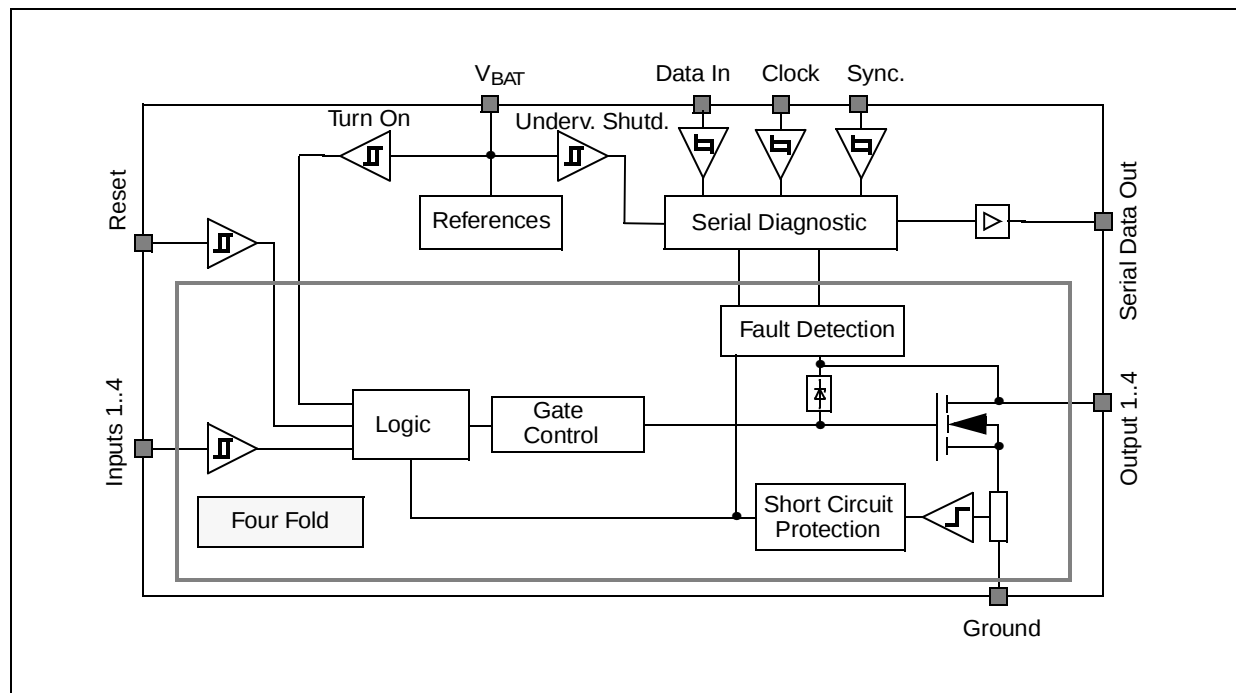
SMART QUAD SWITCH

- Modified VDMOS Power Stage ($U_{DSBR} > 80V$)
- RDS(on) < 500 mOhm ($T_j = 25^\circ C$)
- 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

BLOCK DIAGRAM



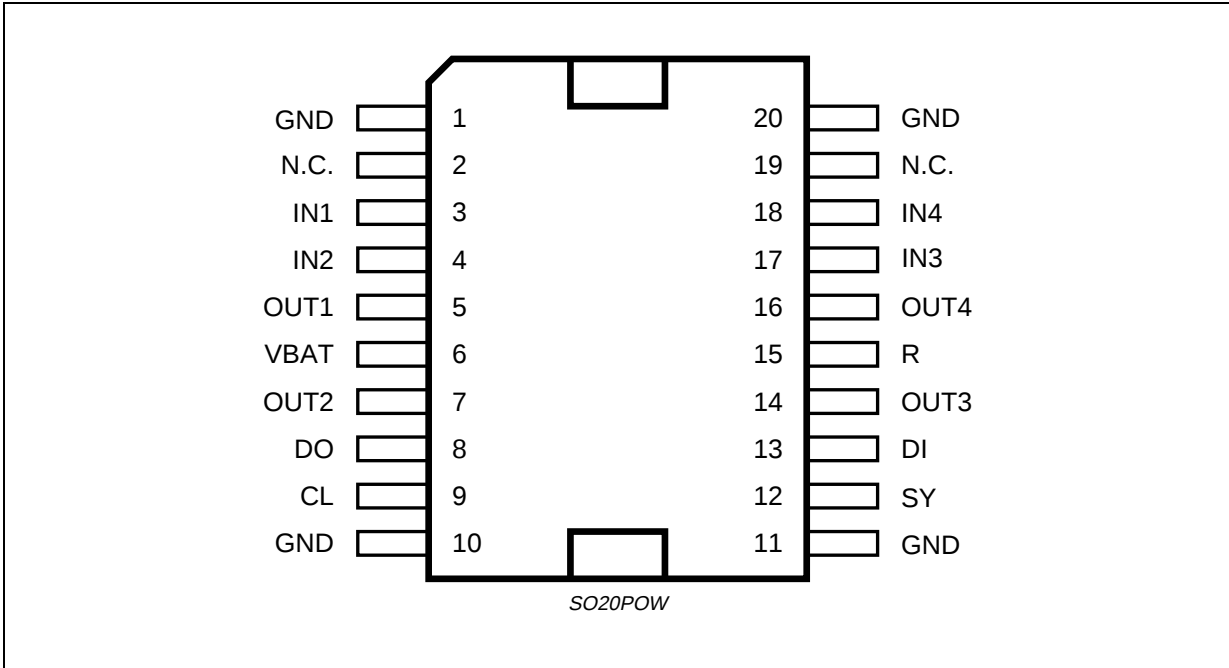
PowerSO-20

ORDERING NUMBER: L9651

- 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).

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_{BATr}	Transient Supply Voltage; $t < 400ms$	40	V
V_{OUT}	Output Voltage	65	V
V_{OUTr}	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
$V_R, V_{INi}, V_{DI}, V_{CL}, V_{SY}$	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 ($6.5V < V_{BAT} < 25V, -40 < T_J < 150^\circ C$)

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 V _{BAT} = 14V T _J = 150°C; I _{out} = 1A			500 850	mΩ 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 T _J = 25°C T _J = 150°C	3.0 2.5 2.2		4.3 3.7 3.5	A A 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 _{SYh} V _{CLh} V _{Rh} V _{Dih}	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

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
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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

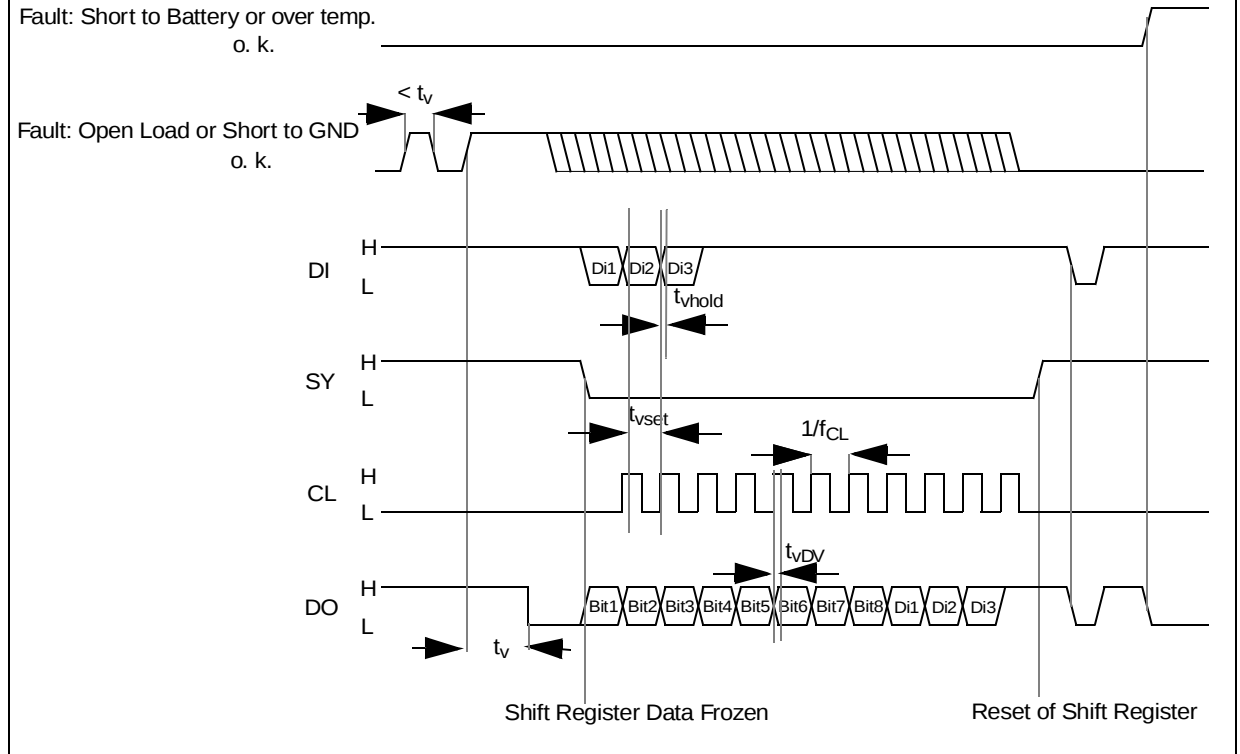


Figure 2. Serial Interface Error Coding

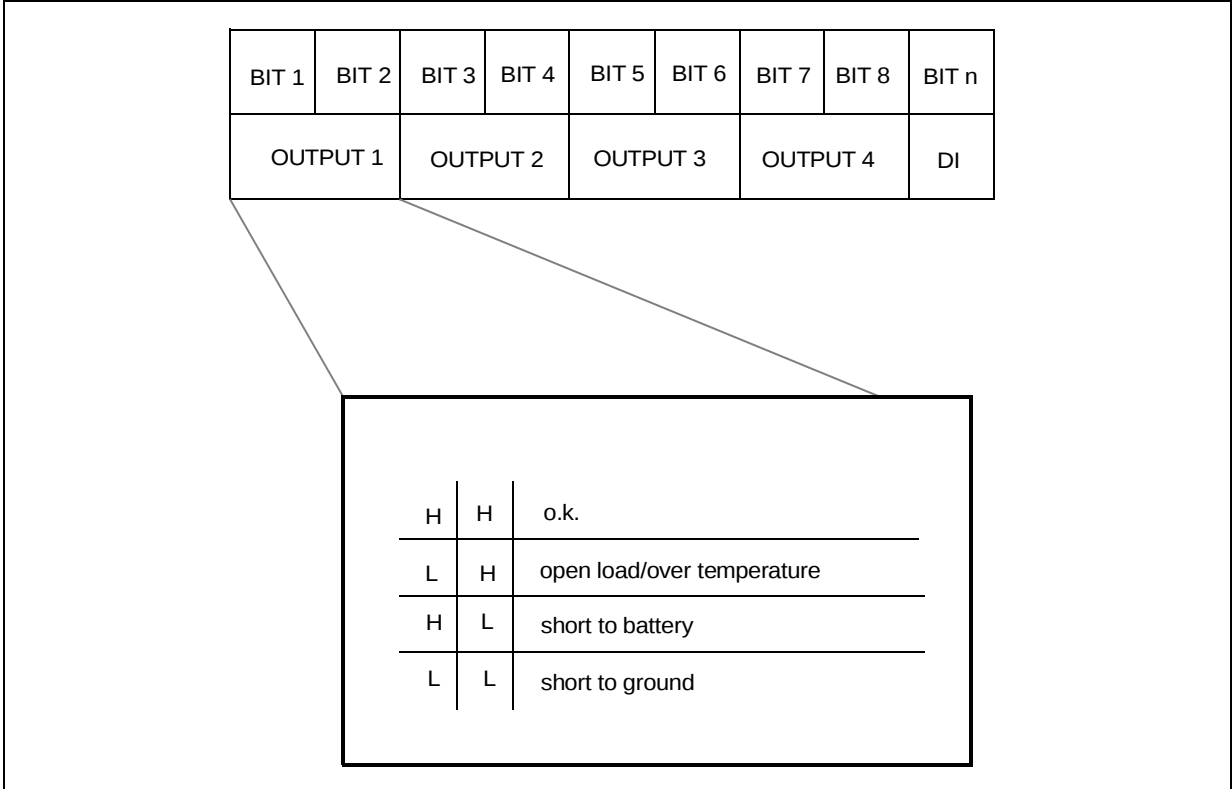


Figure 3. Output voltage TIMING for inductive load

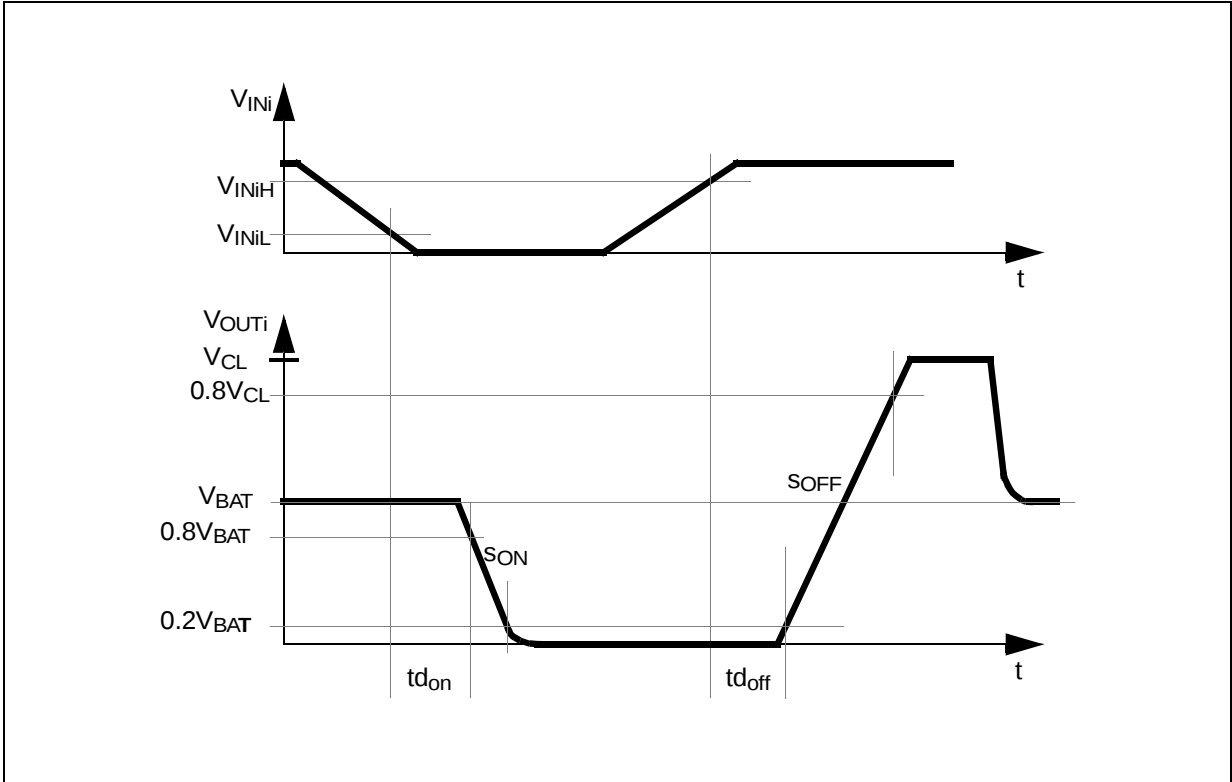
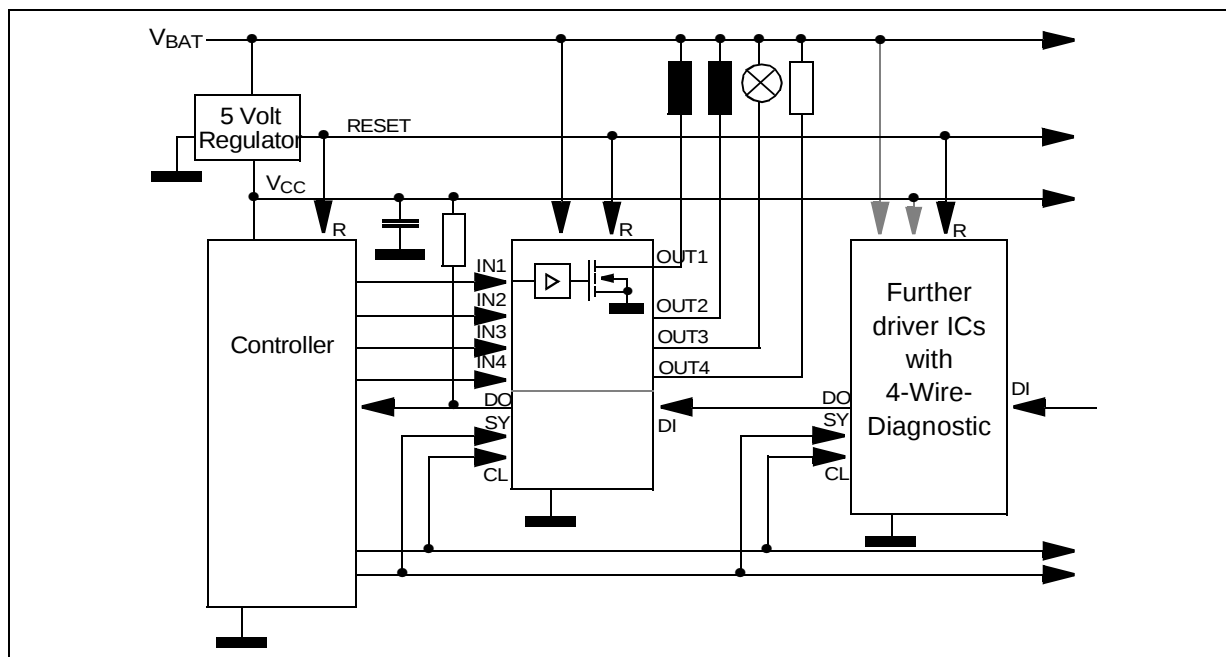


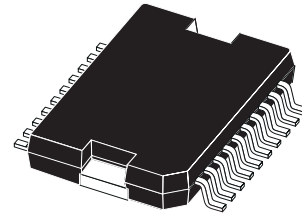
Figure 4. Application Circuit



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	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	10° (max.)					
S	8° (max.)					
T		10			0.394	

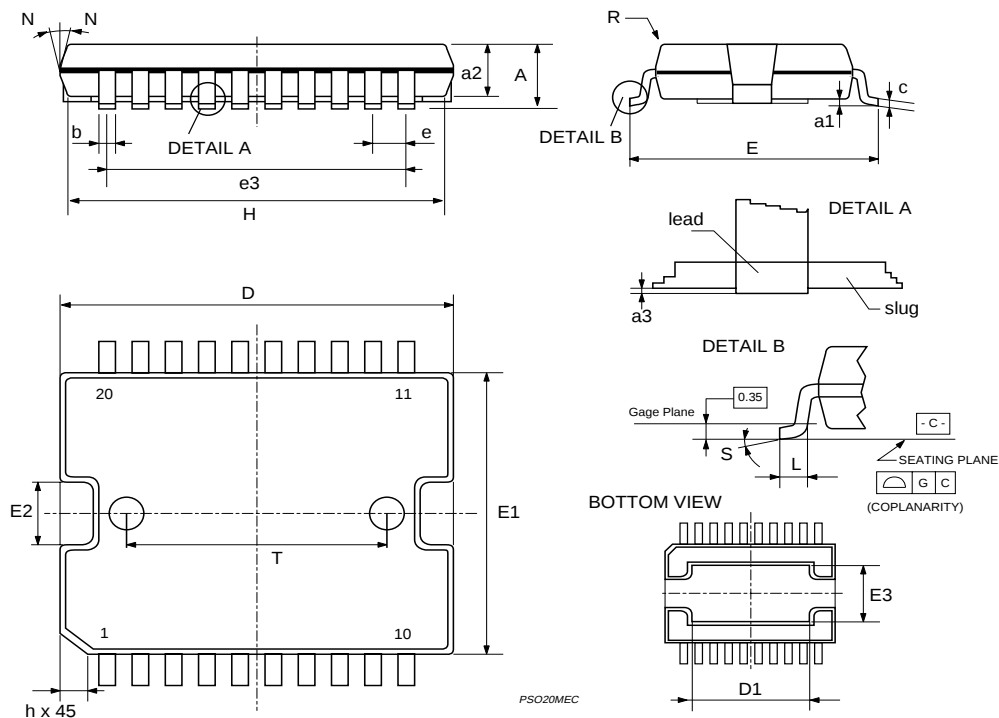
(1) "D and F" do not include mold flash or protrusions.
- Mold flash or protrusions shall not exceed 0.15 mm (0.006").
- Critical dimensions: "E", "G" and "a3"

OUTLINE AND MECHANICAL DATA



JEDEC MO-166

PowerSO20



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