

Smart Quad Low-Side Switch

Features

- Shorted circuit protection
- Overtemperature protection
- Overvoltage protection
- Open Load Detection
- Direct parallel control of the inputs
- Inputs high or low active programmable
- · General fault flag
- Very low standby quiescent current
- Compatible with 3V microcontrollers
- Electostatic discharge (ESD) protection

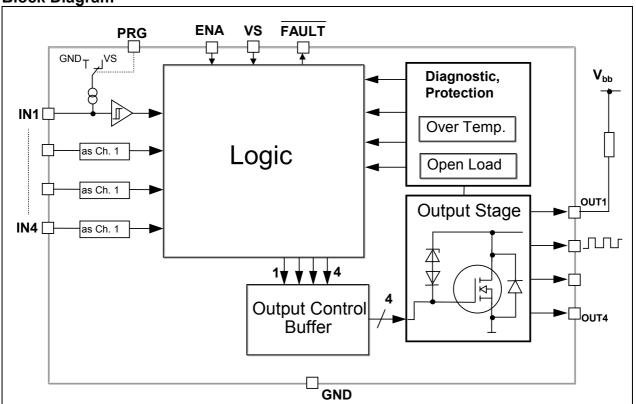
Application

- μC compatible power switch for 12 V applications
- · Switch for automotive and industrial systems
- · Line, relay or lamp driver

General description

Quad channel Low-Side Switch in Smart Power Technology (SPT) with four separate inputs and four open drain DMOS output stages. The TLE 6225 G is protected by embedded protection functions and designed for automotive and industrial applications, to drive lines, lamps and relays.

Block Diagram



Product Summary

Supply voltage	V_S	4.5 - 32	V
Drain source voltage	$V_{DS(AZ)max}$	60	V
On resistance	R_{ON}	1.7	Ω
Output current(each)	$I_{D(NOM)}$	350	mΑ
(individ.)		500	mΑ





Pin Description

Pin	Symbol	Function		
1	IN1	Input Channel 1		
2	IN2	Input Channel 2		
3	FAULT	General Fault Flag		
4	GND	Ground		
5	GND	Ground		
6	GND	Ground		
7	GND	Ground		
8	VS	Supply Voltage		
9 IN3		Input Channel 3		
10	IN4	Input Channel 4		
11	ENA	Enable for all channels/Standby		
12	OUT4	Power Output channel 4		
13	OUT3	Power Output channel 3		
14	GND	Ground		
15	GND	Ground		
16	GND	Ground		
17 GND		Ground		
18 OUT2		Power Output channel 2		
19	OUT1	Power Output channel 1		
20	PRG	Program (inputs high or low active)		

Pin Configuration (Top view)

IN1	1•	20	PRG
IN2	2	19	OUT1
FAULT	3	18	OUT2
GND	4	17	GND
GND	5	16	GND
GND	6	15	GND
GND	7	14	GND
VS	8	13	OUT3
IN3	9	12	OUT4
IN4	10	11	ENA

P-DSO-20-6



Maximum Ratings for $T_j = -40$ °C to 150°C

Parameter	Symbol	Values	Unit
Supply Voltage	V _S	-0.3 +40	V
Continuous Drain Source Voltage (OUT1OUT4)	V _{DS}	-0.7 +45	V
Input Voltage, IN1 - IN4	V _{IN}	- 0.3 + 7	V
Input Voltage, PRG, ENA	V _{IN}	- 0.3 + 40	V
Output Load Dump Protection V _{Load Dump} =U _P +U _S ; U _P =13.5 V	V _{Load Dump} ²)	75	V
With Automotive Relay Load R_L = 70 Ω	·		
$R_{l}^{1)}=2 \Omega$; $t_{d}=400$ ms; IN = low or high			
FAULT Output Voltage	V_{Fault}	- 0.3 + 40	V
Operating Temperature Range	T _j	- 40 + 150	°C
Storage Temperature Range	\mathcal{T}_{stg}	- 55 + 150	
Output Current per Channel (see electrical characteristics)	$I_{D(lim)}$	I _{D(lim) min}	Α
Output Clamping Energy	<i>E</i> _{AS}	10	mJ
I _D = 0.2 A			
Power Dissipation (DC) @ T_A = 25 °C (on PCB 6 cm ² cooling area)	P _{tot}	2.5	W
Electrostatic Discharge Voltage (Human Body Model)	V _{ESD}	2000	V
according to MIL STD 883D, method 3015.7 and EOS/ESD assn. standard S5.1 - 1993			
DIN Humidity Category, DIN 40 040		E	
IEC Climatic Category, DIN IEC 68-1		40/150/56	
Thermal Resistance			
junction - pin	R_{thJP}	23	K/W
junction - ambient @ min. footprint	R_{thJA}	80	
junction - ambient @ 6 cm ² cooling area	R_{thJA}	45	

¹⁾ R_l =internal resistance of the load dump test pulse generator LD200 $V_{\rm LoadDump}$ is setup without DUT connected to the generator per ISO 7637-1 and DIN 40 839.



Electrical Characteristics

Parameter and Conditions	Symbol		Values		
$V_S = 4.5 \text{ to } 32 \text{ V} ; T_j = -40 \text{ °C to } + 150 \text{ °C}$		min	typ	max	
(unless otherwise specified)					
1. Power Supply					
Supply Voltage	V _S	4.5		32	V
Supply Current (ENA = H, Outputs ON)	I _{S(ON)}		1	2	mA
Supply Current in Standby Mode (ENA = L)	I _{S(stby)}			10	μA
2. Power Outputs					
ON Resistance $V_S \ge 6 \text{ V}$; $I_D = 300 \text{ mA}$ $T_J = 25^{\circ}\text{C}$	R _{DS(ON)}		1.7	2	Ω
$T_J = 150$ °C			3	3.6	
Output Clamping Voltage Output OFF	V _{DS(AZ)}	45	50	60	V
Current Limit	I _{D(lim)}	500	750	1000	mA
Output Leakage Current V _{ENA} = L	I _{D(lkg)}			5	μA
Turn-On Time I _D = 200 mA, resistive load	ton		5	10	μs
Turn-Off Time I _D = 200 mA, resistive load	t_{OFF}		5	10	μs
3. Digital Inputs (IN1 – IN4, ENA, PRG)	-	1			ı
Input Low Voltage (IN1 – IN4, PRG)	V_{INL}	- 0.3		1	V
Input Low Voltage (ENA)	V _{INL}	- 0.3		0.8	V
Input High Voltage	V_{INH}	2.0			V
Input Voltage Hysteresis (IN1 – IN4, PRG)	V_{INHys}	50	100		mV
Input Voltage Hysteresis (ENA)	V_{INHys}	20	100		mV
Input Pull Up Current (IN1IN4) @ PRG = L,	I _{IN(14)PU}	20	50	100	μΑ
$V_{IN} = 0V$					
Input Pull Down Current (IN1IN4) @ PRG = H,	I _{IN(14)PD}	20	50	100	μA
$V_{IN} < V_S; V_{IN} < 6$					
PRG, ENA Pull Down Current $V_{IN} = 5 V$	I _{IN(PRG,ENA)}	20	50	100	μA
PRG, ENA Pull Down Current $V_{IN} = 14 \text{ V}$	I _{IN(PRG,ENA)}			200	μA
4. Digital Output (FAULT)			T	T	
FAULT Output Low Voltage $I_{FAULT} = 1.6 \text{ mA}$	V_{FAULTL}			0.4	V
5. Diagnostic Functions					
Open Load/Short to Ground Detection Voltage	$V_{\mathrm{DS}(\mathrm{OL})}$	0.4*V _S	0.5*V _S	0.6*V _S	V
Output Pull Down Current	I _{PD(OL)}	20	50	200	μΑ
Fault Delay Time; V _S = 12V	t _{d(fault)}	50	100	200	μs
Overtemperature Shutdown Threshold	$T_{th(sd)}$	170		200	°C
Hysteresis	T_{hys}		10		K



Functional Description

The TLE 6225 G is a quad channel low-side switch with four power DMOS stages. The power transistors are protected against short to V_{BB} , overload, overtemperature and against overvoltage by zenerclamp.

The diagnostic logic recognises a fault condition which is indicated by a fault flag.

Circuit Description

Output Stage Control

Each output is independently controlled by an input pin and a common enable line, which enables/disables all four outputs. The parallel inputs are high or low active depending on the PRG pin. If the parallel input pins are not connected (independent of high or low activity) it is guaranteed that the outputs 1 to 4 are switched OFF. ENA - and PRG - pin itself are internally pulled down when they are not connected.

ENA - Enable pin. ENA = High: Active mode. Channels are enabled

ENA = Low (GND): Sleep mode. Channels are switched off. Less than

1 μA current consumption.

PRG - Program pin. PRG = High: Parallel inputs Channel 1 to 4 are high active

PRG = Low (GND): Parallel inputs Channel 1 to 4 are low active.

Power Transistors

Each of the four output stages has its own zenerclamp. This causes a voltage limitation at the power transistors when inductive loads are switched off. The outputs are provided with a current limitation set to a minimum of 500 mA.

Each output is protected by embedded protection functions³⁾. In the event of an overload or short to supply, the current is internally limited. If this operation leads to an overtemperature condition, a second protection level (about 170 °C) will turn the effected output into a PWM-mode (selective thermal shutdown with restart) to prevent critical chip temperatures. The temperature hysteresis is typically 10K.

Diagnostic

The FAULT pin is an open drain output. The logic status depends on the programming pin PRG.

FAULT - pin. FAULT = High no fault @ PRG = High

FAULT = Low no fault @ PRG = Low

³⁾ The integrated protection functions prevent an IC destruction under fault conditions and may not be used in normal operation or permanently



Diagnostic Table

Operating Condition	Enable Input	Program Input	Control Input	Power Output	Diagnostic Output
	ENA	PRG	IN	OUT	FAULT
Standby	L	X	Х	OFF	Н
Normal function	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	L L H	LHLH	ON OFF OFF ON	L L H
Overtemperature	H H	L H	ΙΓ	OFF * OFF *	H L
Open load or short to ground	H H H H	L L H	LΙLΙ	ON OFF OFF ON	L H L H

X = not relevant

Fault Distinction

Open load/short to ground is recognised in OFF-state. Overtemperature as a result of an overload or short to battery can only arise in ON-state. If there is only one fault at a time, it is possible to distinguish which channel is affected with which fault.

^{*}selective thermal shutdown for each channel at overtemperature



Typical electrical Characteristics

Drain-Source on-resistance

 $R_{DS(ON)} = f(T_j)$; $V_s = 5V$

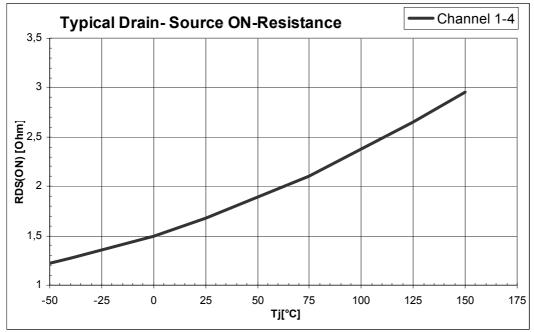


Figure 6: Typical ON Resistance versus Junction-Temperature Channel 1-4

Output Clamping Voltage

 $V_{DS(AZ)} = f(T_j)$; $V_s = 5V$

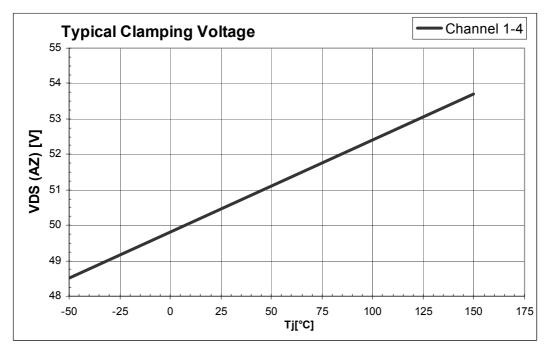
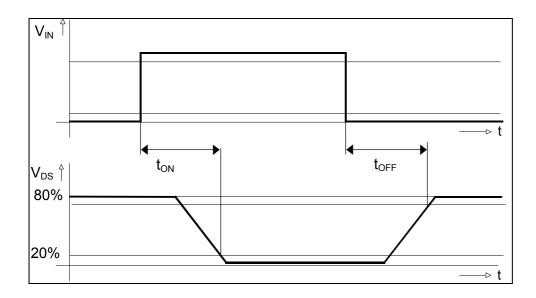


Figure 7: Typical Clamp Voltage versus Junction-Temperature Channel 1-4

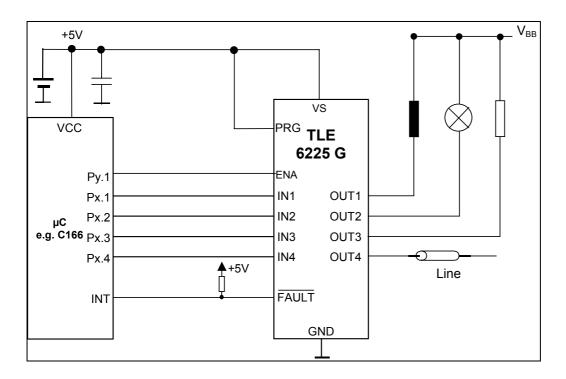


Timing Diagrams

Power Outputs



Application Circuit



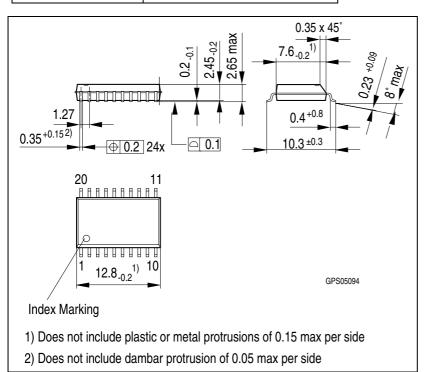


Package and ordering code

all dimensions in mm

 P - DSO - 20 - 6
 Ordering code

 TLE 6225 G
 Q 67006 A9373



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