

**MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA**

Product Preview

**Single Low Side Driver with
Integrated Freewheeling Diode
and Output dv/dt & di/dt Control**

The Short-circuit Protected Low Side Driver will be used for PWM switchmode current control of an inductive load.

If one or both of the two inputs (Reset or PWM) switch at the low level input voltage, the output transistor will be turned off. Only if both inputs are at the high level input voltage, the output will be turned on. Reset and PWM inputs have Schmitt-Trigger input characteristics.

To protect the device and a possible external shunt for current measurements against short-circuit to positive battery voltage, the on-state output current is limited to a maximum value of 7 A.

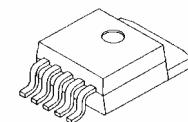
The output driver will be switched off if the junction temperature exceeds its maximum value. This thermal shutdown is monitored by an hysteresis. In order to reduce RFI, the output voltage and supply current rise and fall times are limited.

At a Vs voltage lower than approximately 6V, the driver will be switched off by the undervoltage shutdown circuit. Down to this voltage the driver will work correctly.

MC33185

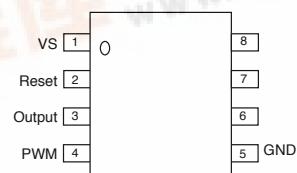
**SINGLE LOW SIDE
DRIVER**

SILICON MONOLITHIC
INTEGRATED CIRCUIT



D²PAK

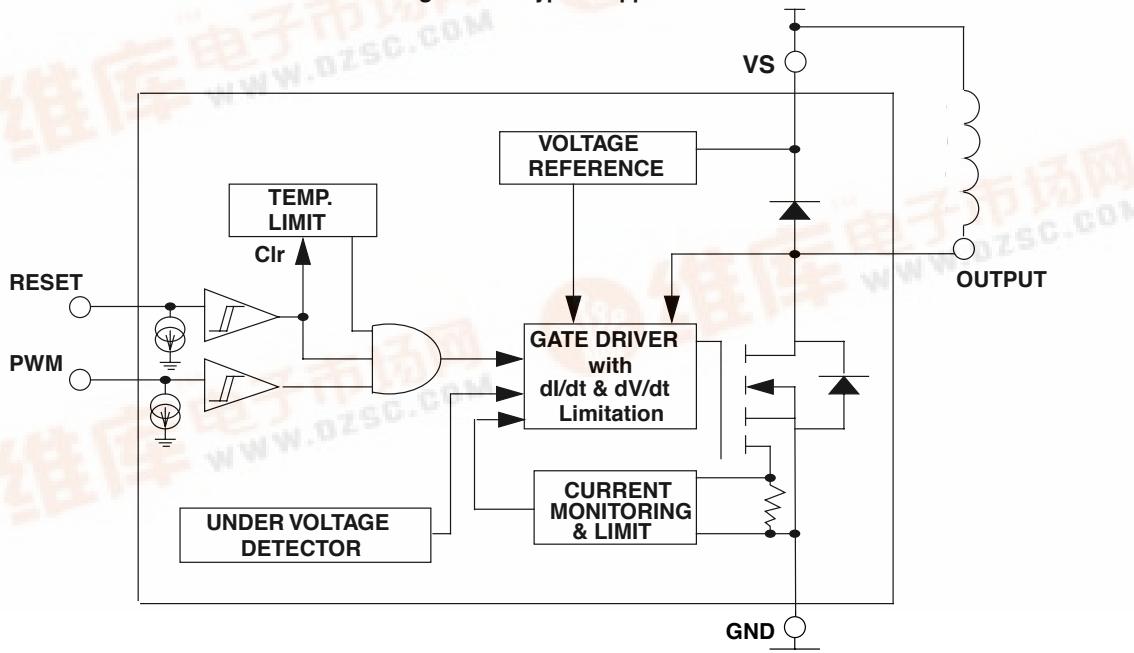
PIN ASSIGNMENT



ORDERING INFORMATION

Device	Temperature Range	Package
MC33185D2T	- 40°C to +125°C	D ² PAK

Block Diagram and Typical Application



MC33185

MAXIMUM RATINGS $T_c = -40$ to 125°C unless otherwise noted.

Ratings	Symbol	Value	Unit
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ELECTRICAL RATINGS

Supply Voltage	Vs-Gnd		V
DC Voltage		40	V
Transient Voltage (400ms, no repetitive, no operation)	Note1	- 2 to 40	V
Output Voltage	Q-Gnd		V
DC Voltage		- 0,5 to Vs +1,5	V
Transient (Schaffner Pulses). Note 1b			V
Output Current (internally protected)			
Freewheeling Diode Reverse Voltage (Q = GND)	VS-Q		V
DC Voltage		40	V
Transient (Schaffner Pulses). Note 1a, 1b			
Freewheeling Diode Forward Current			
DC Current	Vffw	1,7	A
Transient (200ms)	Vffwtr	3,3	A
Peak (10μs)	Vffwpk	10	A
MOS Body Diode Forward Current			A
DC Current	Ibd	1,7	A
Peak (10μs)	Ibdpk	10	A
Input Voltages (Reset & PWM pins)	Vreset & Vpwm	- 0,3 to 6	V
ESD Voltage Capability. Note 2	Vesd	2000	V

THERMAL RATINGS

Storage Temperature	Tstg	- 55 to 175	°C
Operating Junction Temperature	T _j	- 40 to 150	°C
Power Dissipation @ $T_c = 110^\circ\text{C}$	P _d	13	W
Thermal Resistance Junction to Case	R _{thJC}	3	°C/W
Thermal Resistance Junction to Ambient	R _{thJA}	65	°C/W
Maximum Lead Temperature for Soldering 1/8" from case for 5s.	T _L	275	°C

MC33185

ELECTRICAL CHARACTERISTICS. $7V \leq Vs \leq 24V$, $-40^{\circ}C \leq T_j \leq 150^{\circ}C$ unless otherwise specified.

Parameters	Symbol	Min	Typ	Max	Unit
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VS PIN 1

Supply Voltage Operating Maximum. Note 3 Turn On Threshold (fully functional)	V _s			24 7	V V
Quiescent Vs Supply Current ($V_s = Q = 12V$, IN1 & IN2 = L)	I _{sby}	1		5	mA
Undervoltage Detection. Note 7		5,5		6,9	V

RESET PIN 2

Input Current High level ($7,0V \leq Vs \leq 40,0V$) High level (- 2V $\leq Vs \leq 40,0V$) Low level (- 2V $\leq Vs \leq 40,0V$)	I _{ih} I _{ih} I _{il}	5,0 - 10 - 10		10 10 10	μA μA μA
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OUTPUT PIN 3

Drain to Source On Resistance. Note 4 (with IN1 & IN2 = H, Active High) I _{out} = 1,5A & Vs $\geq 10,0V$ I _{out} = 1,5A & 7,0V $\leq V_{bat} < 10,0V$ T _j = 25°C, I _{out} = 1,5A & V _{bat} = 12V	R _{dson}			0,450 0,500 0,250	Ohm Ohm Ohm
Off State MOS Output Leakage Current Vs = Q = 40V, IN1 & IN2 = L	V _{outlk}			1	mA
Forward Voltage of MOS Body Diode VF @ If = 1,7A. Note 5	V _{fbd}			2	V
Switchmode Output Current Continuous Transient (200ms, T _c = 125°C)	I _{sw} I _{swpk}			1,7 3,3	A A
Short-Circuit Current Limit. Note 6	I _{sc}	3,5	5,25	7	A
Overtemperature Shutdown Overtemperature Hysteresis. Note 8	T _{lim} Thys	155	20		°C °C

PWM PIN 4

Input (CMOS Compatible) Output On Threshold Output Off Threshold Input Hysteresis Voltage	V _{ion} V _{ioff} V _{ihys}	2,0 1,0	1	3,0 2,0	V V
Input Current High level ($7,0V \leq Vs \leq 40,0V$) High level (- 2V $\leq Vs \leq 40,0V$) Low level (- 2V $\leq Vs \leq 40,0V$)	I _{ih} I _{ih} I _{il}	5,0 - 10 - 10		10 10 10	μA μA μA

FREEWHEELING DIODE CHARACTERISTICS $7V \leq Vs \leq 24V$, $-40^{\circ}C \leq T_j \leq 150^{\circ}C$ unless otherwise noted

Forward Voltage T _j = 25°C, If = 1,7A T _j = 125°C, If = 1,7A				1,5 1,3	V V
Reverse Leakage Current (Vs = V _q = 40V)	I _{fwlk}			500	μA
Leakage Current from Vs-GND Vs = 40V during Freewheeling. Note 9, If = 1,7A				22	μA

MC33185

ELECTRICAL CHARACTERISTICS. $7V \leq V_s \leq 24V$, $-40^\circ C \leq T_j \leq 150^\circ C$ unless otherwise specified.

Parameters	Symbol	Min	Typ	Max	Unit
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TIMING CHARACTERISTICS $7V \leq V_s \leq 24V$, $-40^\circ C \leq T_j \leq 150^\circ C$ unless otherwise specified.

Turn On Delay	tdl on			10	μs
Turn Off Delay	tdl off			10	μs
Rise Time. Note 10 Output Voltage Slope Output Current Slope	$(dV_{out}/dt)_r$ $(dI_{out}/dt)_r$	2,5 50		10 100	$V/\mu s$ $mA/\mu s$
Fall Time. Note 10 Output Voltage Slope Output Current Slope	$(dV_{out}/dt)_f$ $(dI_{out}/dt)_f$	2,5 50		10 100	$V/\mu s$ $V/\mu s$

NOTES 1a : Schaffner test, see figure 3, Pulses 1, 2, 3a, 3b, 5, 6.

NOTES 1b : Schaffner test, see figure 4, Pulses 1, 2, 3a, 3b, 5, 6.

NOTES 2 : Equivalent human body model $R = 1,5K\Omega$; $C = 200pF$.

NOTES 3 : The normal operating voltage range is $7V \leq V_s \leq 24V$. Between 24V and 40V the output stage will follow the state defined by the inputs, but the electrical characteristics are not totally specified.

NOTES 4 : Pulse tested, $tp \leq 300\mu s$, $D \leq 2\%$.

NOTES 5 : The inherent body diode (source to drain) of the output FET will conduct current if the output pin is pulled below ground.

NOTES 6 : Linear short-circuit current regulation. When the overcurrent lasts enough time to raise the junction temperature, thermal shutdown will react as described in note 8.

NOTES 7 : The driver works correctly down to the shutdown voltage. Below the shutdown voltage, the driver is off.

NOTES 8 : The output driver will be switched off if the junction temperature exceeds its maximum value. This thermal shutdown works with an hysteresis, with a self reset.

NOTES 9 : This is the current measured on GND when the device is in freewheeling. It consists in the supply current for the logic (5mA max) plus the leakage current flowing from V_s to GND. The leakage current is specified to be less than 1% of the nominal freewheeling forward current.

NOTES10 : In order to reduce RFI, the output voltage and supply current rise and fall times are limited.

Pin	Name	Description
1	V _s	The V _s pin supplies operational power to the MC33185.
2	Reset	This pin controls the turn OFF of output.
3	Output	This pin is internally connected to the DMOS output transistor which source current into the corresponding load. The output incorporates dynamic clamping to accommodate inductive load. In order to reduce RFI, the output voltage and supply current rise and fall times are limited (see figure below). In addition, the output has an overcurrent detection and current limiting.
4	PWM	This pin controls the turn ON and turn OFF of output when reset pin is at high level. It is a CMOS input.
5	GND	This pin is the circuit ground.

Figure 1. Timing Diagram

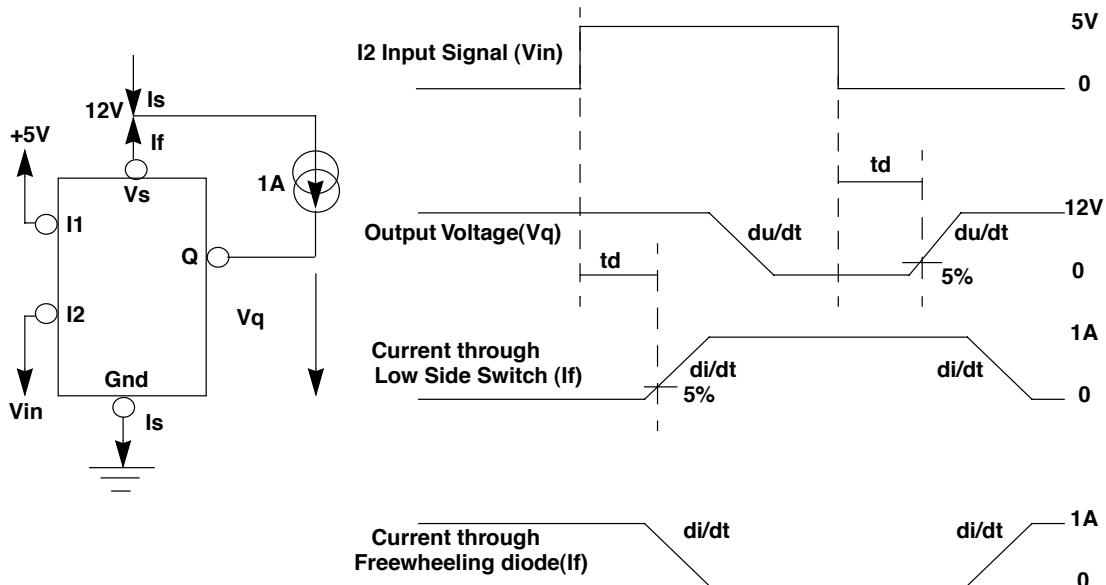


Figure 1: The minimum value is due to the fact that the product should not dissipate too much during transition.

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