MOTOROLA
Semiconductor Technical Data

Order Number: MC33289/D
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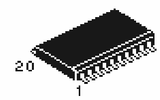
Advance Information

Automotive Dual High Side Switch

MC33289

AUTOMOTIVE DUAL HIGH SIDE SWITCH

SEMICONDUCTOR TECHNICAL DATA



DW SUFFIX
SO20WB Package
CASE 751D-05

The MC33289DW is a Dual High Side Switch (DHSS) dedicated for use in automotive applications. It is designed to drive typical inductive loads such as solenoid valves.

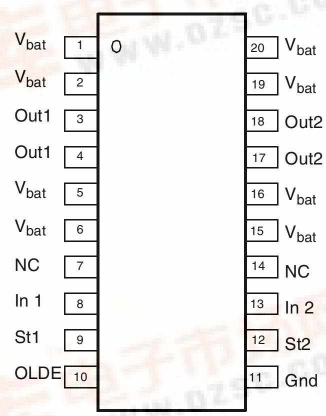
This device consists of two independent 40mOhm Rdson MOSFET channels plus corresponding control circuitry in a surface mount package. The MC33289DW can be interfaced directly to a microcontroller for input control and monitoring of diagnostic output.

Each switch offers independent protection and diagnosis during overcurrent, overvoltage, and undervoltage conditions, as well as an overtemperature shutdown feature.

A logic low on the Open Load Detect Enable pin (OLDE) minimizes bias current drain by disabling the open load circuitry current source. The device also has a very low quiescent current in standby mode.

- Designed to drive Automotive Inductive loads
- Junction Temperature Range from -40°C to 150°C
- Operating Voltage Range from 6V to 27V
- Maximum Breakdown Voltage greater than 40V
- Surface Mount Package
- 40mΩ Rdson at 25°C
- Overtemperature Protection with Hysteresis
- Overcurrent protection
- Under Voltage Shutdown
- Over Voltage Shutdown
- Open Load Detection in Off-State
- Independent Diagnostic Output
- ESD Protection 2kV
- Standby Current less than 5µA at V_{bat} below 14V

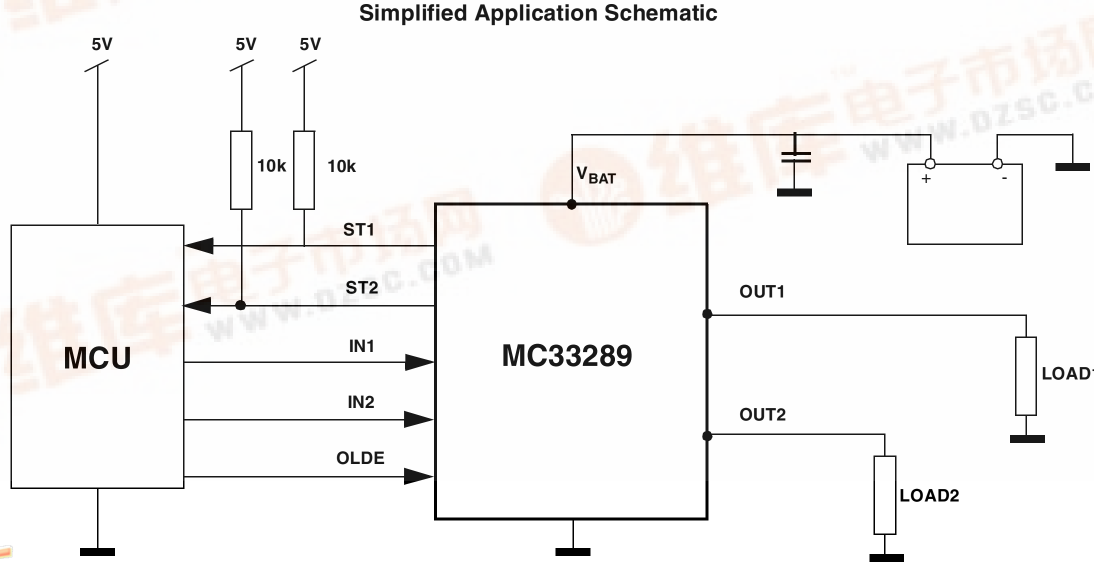
PIN ASSIGNMENT



ORDERING INFORMATION

Device	Operating Temperature Range	Package
PC33289DW	TA=-40° to +125°C	SO20

Simplified Application Schematic

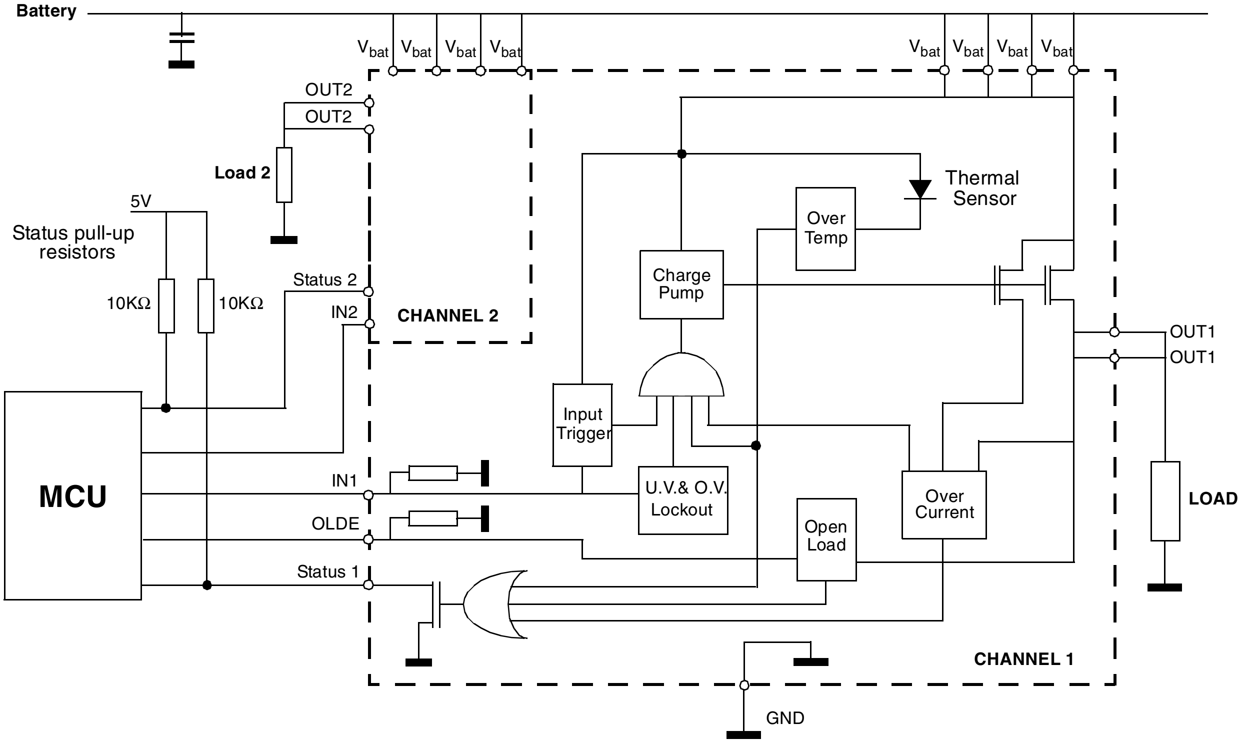


This document contains information on a new product. Specifications and information herein are subject to change without notice.

PINS FUNCTION DESCRIPTION

Pin No.	Name/Function	Description
1, 2, 5, 6, 15, 16, 19, 20	V_{bat} Supply Voltage	These are the power supply pins of the device. These pins are directly connected with the lead frame of the package and are tied to the drain of the switching MOSFET. These pins can be directly connected to the battery voltage. In addition to their supply function, these pins participate to the thermal behaviour of the device in conducting the heat from the switching MOSFET to the printed circuit board.
3, 4, 18, 17	OUT1 OUTPUT Channel 1 OUT 2 OUTPUT Channel 2	Pins 3 and 4 are the output 1 terminals. Pins 17 and 18 are the output 2 terminals. They are directly connected to the source of the power MOSFET. These pins are used by the control circuitry to sense the device output voltage. The Rdson is 40mΩ max per output at 25°C and will increase to a maximum of 75mΩ at 150°C junction temperature.
8, 13	IN 1 INPUT Channel 1 IN 2 INPUT Channel 2	These are the device input pins which directly control their associated outputs. The levels are CMOS compatible. When the input is a logic low, the associated output MOSFET is in the off state. When input is high, the MOSFET is turned on and the load is activated. When both inputs are low, the device is in standby mode and its supply current is reduced. Each input pin has an internal active pull down, so that it will not float if disconnected.
9, 12	St1 Status for Channel 1 St2 Status for Channel 2	These pins are the channel 1 and channel 2 fault detection flags. Their internal structure is an open drain architecture with an internal clamp at 6V. An external pull up resistor connected to Vdd (5V) is needed. This is an active loaw output. If the device is in its normal condition the status lines will be high. If open load or other fault occurs, the associated channel' status flag will be pulled low. See Functional Truth Table.
10	OLDE Open Load Detection Enable	This pin is a digital input which enables the open load current diagnostic circuitry. When OLDE is a logic low, the open load circuitry is not powered and the device's bias current draw is at a minimum. If OLDE is a logic high, the open load circuitry is functional at the price of a higher bias current draw. OLDE pin has a pull down resistor.
11	GND GROUND	This is the Gnd pin of the device.

Block Diagram And Typical Application



FUNCTIONAL TRUTH TABLE

Conditions	IN1	IN2	OUT1	OUT2	St1	St2
Normal Operating Conditions	L H L H	L L H H	L H L H	L L H H	H H H H	H H H H
Overtemperature Channel 1 Overtemperature Channel 2 Overtemperature Channel 1/Channel 2	H X H	X H H	L X L	X L L	L H L	H L L
Open Load Channel 1 Open Load Channel 2	L X	X L	H X	X H	L H	H L
Overcurrent Channel 1 Overcurrent Channel 2	H X	X H	L X	X L	L H	H L
Undervoltage Condition	X	X	L	L	H	H
Overvoltage Condition	X	X	L	L	H	H

L = ‘Low level’ ; H = ‘High level’ ; X = ‘don’t care’

MAXIMUM RATINGS

Ratings	Symbol	Value	Unit
V_{bat} and V_{batc} Voltage : Continuous/Pulse	V_{bat}	-0.3 to 41	V
OUT1, OUT2 Voltage with Respect to Gnd : Continuous/ Pulse	V_{out}	-4 to 41	V
OUT1, OUT2 to V_{btap} Voltage : Continuous	V_{out}	41	V
St1, St2 Voltage : Continuous/Pulse	V_{st}	-0.3 to 7	V
IN1, IN2 Voltage : Continuous	V_{in}	-0.3 to 7	V
In1, In2, St1, St2, OLDE Current	I_{in}	+/-4	mA
ESD all Pins Human Body Model (note1) Machine Model (note2)	 V_{esd1} V_{esd2}	 +/-2000 +/-200	 V V

NOTES : 1. EDS1 testing is performed in accordance with the Human Body Model (Czap = 100pF, Rzap = 1500Ω)
2. EDS2 testing is performed in accordance with the Machine Model (Czap = 100pF, Rzap = 0Ω)

THERMAL RATINGS

	Symbol	Value	Unit
Operating Junction Temperature	T_j	-40 to 150	°C
Storage Temperature	T_{st}	-55 to 150	°C
Thermal Resistance Junction to Ambient (note 1)	R_{thja}	70	°C/W
Thermal Resistance Junction to lead : Both Channel on	R_{thjl1}	15	°C/W
Thermal Resistance Junction to lead : One Channel on	R_{thjl2}	15	°C/W
Thermal Resistance Junction to lead : Logic Die	R_{thjl3}	30	°C/W

NOTES : 1. with minimum PCB dimensions.

ELECTRICAL CHARACTERISTICS T_j from - 40°C to +150°C, V_{bat} from 6V to 24V, unless otherwise noted.Typical values reflect approximate mean at 25°C, nominal V_{bat}, at time of device characterization.

Description	Symbol	Characteristics			Unit	Conditions
		Min	Typ	Max		
STATIC CHARACTERISTICS						
Operating Voltage	V_{bat}	6		V_{ov}	V	
Supply Current : Both Channels On	I_{bat1}		6	16	mA	V_{bat} = 13.5V ; OLDE High
Supply Current : One Channel On	I_{bat2}		5	10	mA	V_{bat} = 13.5V ; OLDE High
Supply Current : Both Channels Off	I_{bat3}			5	µA	V_{bat} = 12.6V ; OLDE Low, Tj<125°C
Supply Current : Any State	I_{bat_max}			30	mA	V_{bat} = 13.5V
Output Off state leakage current per channel	I_{DSS}		0.1	5	µA	V_{bat}=13.5V; IN1,2,Olde low, Both ourput grounded, Tj<125°C
Drain-Source On Resistance	R_{dson1}			40	mΩ	V_{bat}>10V, T_{amb}=25°C
Drain-Source On Resistance	R_{dson2}			75	mΩ	V_{bat}>10V, T_{amb}=150°C
Negative Inductive Clamp Voltage	V_{clamp}	-4		-1	V	I_{OUT} = 1A
INPUT CHARACTERISTICS						
High Input Voltage (IN1, IN2)	V_{ih}	3.25			V	
High Input Voltage (OLDE)	V_{OLDEH}	3.5			V	
Low Input Voltage (IN1, IN2, OLDE)	V_{il}			1.5	V	
Logic Input Hysteresis IN1, IN2	V_{hyst}	0.4	0.6	0.8	V	

ELECTRICAL CHARACTERISTICS T_j from - 40°C to +150°C, V_{bat} from 6V to 24V, unless otherwise noted.Typical values reflect approximate mean at 25°C, nominal V_{bat}, at time of device characterization.

Description	Symbol	Characteristics			Unit	Conditions
		Min	Typ	Max		
Logic Input Current	I_{in}	3			µA	V_{in} = 1.5V
Logic Input Current	I_{in}			32.5	µA	V_{in} = 3.25V
Logic Input Clamp Voltage	V_{clmp}	5.5		7	V	At I_{in} = 1mA
Input Capacitance IN1, IN2	C_{in}			80	pF	$R_{in\,=}$ 47kΩ @ 100kHz
STATUS CHARACTERISTICS						
Status Voltage	V_{st}			0.5	V	I_{st} = 1mA; Output in fault
Status Leakage Current	I_{stlk}			10	µA	V_{st} = 5V
Status Pin Capacitance	C_{st}			80	pF	V_{st} = 5V
OVERLOAD PROTECTION CHARACTERISTICS						
Overcurrent latchoff threshold	I_{OCT}	4		9	A	V_{Bat} = 13.5V
Overcurrent latchoff delay	T_{OCTDLY}			30	µs	From OverCurrent Tresh-old achieved to Ouput Volt-age= 10%Vbatt
Overcurrent latchoff status delay	$T_{OCTST-DLY}$			50	µs	From Ouput Voltage= 10%Vbatt to Status Flag<1V
Thermal Shutdown	T_{shut}	150	165	175	°C	
Thermal Shutdown Hysteresis	T_{hyst}			10	°C	
Overvoltage Shutdown Threshold	V_{ov}	27		38	V	Both IN1, IN2 logic high
Overvoltage Shutdown Hysteresis	V_{ovhyst}	0.1		2	V	Both IN1, IN2 logic high
Undervoltage Shutdown Threshold	V_{uv}	4.75		6	V	Both IN1, IN2 logic high
Undervoltage Shutdown Hysteresis	V_{uvhyst}	0.3	0.6	1	V	Both IN1, IN2 logic high
OPEN CIRCUIT DETECTION CHARACTERISTICS						
Open Load Detect Current	I_{OL}	200	290	400	µA	V_{out} = 3.5V, OLDE = 4V
Open Load Threshold Voltage	V_{OL}	1.5	2.4	3.5	V	
Open Load to Status Low Delay Time	T_{OLSTDT}			100	µs	From IN=1.5 to Status Flag<1.5V
Open Load Detect BlankingTime	T_{OLDBT}	3	10	50	µs	From IN=1.5 to Openload circuitry enable
Openload threshold voltage	V_{inOL}	1.5	2.5	3.5	V	
SWITCHING CHARACTERISTICS (8V< V_{bat} <18V, Rload=7Ohms)						
Turn On Slew Rate	S_{rpout1}	1		20	V/µs	From 10% to V_{Bat}-3V,
Turn On Slew Rate	S_{rpout2}	0.1		3	V/µs	From V_{bat}-3V to 90%,
Turn Off Slew Rate	S_{rnout}	1		20	V/µs	From 90% to 10%,
Turn-on Delay Time	t_{don}	1	2.5	15	µs	From V_{IN}/2 to 10% V_{bat},
Turn-off Delay Time	t_{doff}	1	5	15	µs	From V_{IN}/2 to 90% V_{bat},

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