Freescale Semiconductor
Advance Information

Document Number: MC33289
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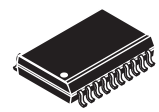
Dual High-Side Switch 40 mΩ

33289

DUAL HIGH-SIDE SWITCH



DW SUFFIX)
98ASB42343B
20-PIN SOICW

ORDERING INFORMATION		
Device	**Temperature Range (T_A)**	**Package**
MC33289DW/R2	-40°C to 125°C	20 SOICW

The 33289 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 40 mΩ R_{DSON} MOSFET channels plus corresponding control circuitry in a surface mount package. The 33289 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.

FEATURES

- Designed to drive Automotive Inductive loads
- Operating Voltage Range from 6.0 V to 27 V
- Maximum Breakdown Voltage greater than 40 V
- 40 mΩ R_{DSON} 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 2.0 kV
- Standby Current less than 5.0 µA at V_{BAT} below 14 V

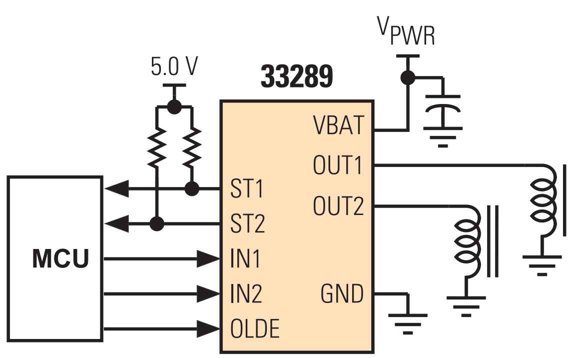


Figure 1. 33289 Simplified Application Diagram

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

PIN CONNECTIONS

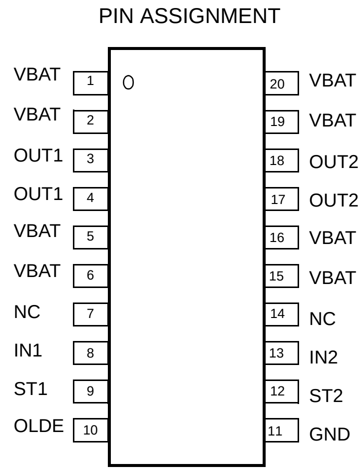


Figure 2. 33289 Pin Connections

Table 1. Pin Function Description

Pin Number	Pin Name	Pin Function	Definition
1, 2, 5, 6, 15, 16, 19, 20	VBAT	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 behavior of the device in conducting the heat from the switching MOSFET to the printed circuit board.
3, 4, 18, 17	OUT1 OUT2	OUTPUT Channel 1 OUTPUT Channel 2	Pins 3 and 4 are the output 1 pins. Pins 17 and 18 are the output 2 pins. 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 R_{DSON} is 40 mΩ max per output at 25°C and will increase to a maximum of 75 mΩ at 150°C junction temperature.
8, 13	IN1 IN2	INPUT Channel 1 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 ST2	Status for Channel 1 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 6.0 V. An external pull up resistor connected to V_{DD} (5.0 V) is needed. This is an active low 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.

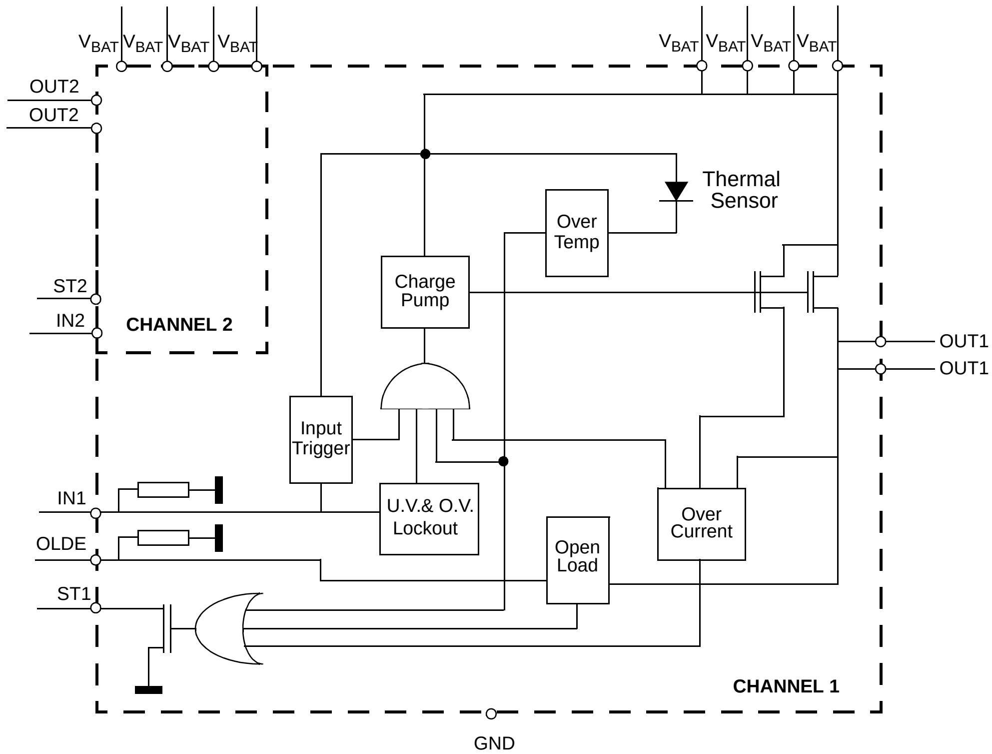


Figure 3. Simplified Internal Block Diagram

ELECTRICAL CHARACTERISTICS

MAXIMUM RATINGS

Table 2. Maximum Ratings

All voltages are with respect to ground unless otherwise noted. Exceeding these ratings may cause a malfunction or permanent damage to the device.

Ratings	Symbol	Value	Unit
ELECTRICAL RATINGS			
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}	-4.0 to 41	V
OUT1, OUT2 to V_{BTAP} Voltage: Continuous	V_{OUT}	41	V
ST1, ST2 Voltage: Continuous/Pulse	V_{ST}	-0.3 to 7.0	V
IN1, IN2 Voltage: Continuous	V_{IN}	-0.3 to 7.0	V
IN1, IN2, ST1, ST2, OLDE Current	I_{IN}	+/-4.0	mA
ESD all Pins Human Body Model (1) Machine Model (1)	 V_{ESD1} V_{ESD2}	 +/-2000 +/-200	 V V
THERMAL RATINGS			
Operating Junction Temperature	T_J	-40 to 150	°C
Storage Temperature	T_{ST}	-55 to 150	°C
Thermal Resistance Junction to Ambient (2)	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. EDS1 testing is performed in accordance with the Human Body Model (Czap = 100 pF, Rzap = 1500 Ω) EDS2 testing is performed in accordance with the Machine Model (Czap = 100 pF, Rzap = 0 Ω)
2. With minimum PCB dimensions.

STATIC ELECTRICAL CHARACTERISTICS

Table 3. Static Electrical Characteristics

Characteristics noted under conditions 7.0 V ≤ V_{SUP} ≤ 18 V, -40°C ≤ T_A ≤ 125°C, GND = 0 V unless otherwise noted. Typical values noted reflect the approximate parameter means at T_A = 25°C under nominal conditions unless otherwise noted.

Characteristic	Symbol	Min	Typ	Max	Unit
POWER INPUT					
Operating Voltage	V_{BAT}	6.0		V_{OV}	V
Supply Current: Both Channels On V_{BAT} = 13.5 V; OLDE High	I_{BAT1}		6.0	16	mA
Supply Current: One Channel On V_{BAT} = 13.5 V; OLDE High	I_{BAT2}		5.0	10	mA
Supply Current: Both Channels Off V_{BAT} = 12.6 V; OLDE Low, T_J < 125°C	I_{BAT3}			5.0	µA
Supply Current: Any State V_{BAT} = 13.5 V	I_{BAT_MAX}			30	mA
Output Off state leakage current per channel V_{BAT} = 13.5 V; IN1, 2, OLDE low, Both output grounded, T_J < 125°C	I_{DSS}		0.1	5.0	µA
Drain-Source On Resistance V_{BAT} > 10 V, T_{AMB} = 25°C	R_{DSON1}			40	mΩ
Drain-Source On Resistance V_{BAT} > 10 V, T_{AMB} = 150°C	R_{DSON2}			75	mΩ
Negative Inductive Clamp Voltage I_{OUT} = 1 A	V_{CLAMP}	-4.0		-1.0	V
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
Logic Input Current V_{IN} = 1.5 V	I_{IN}	3.0			µA
Logic Input Current V_{IN} = 3.25 V	I_{IN}			32.5	µA
Logic Input Clamp Voltage At I_{IN} = 1 mA	V_{CLMP}	5.5		7.0	V
Input Capacitance IN1, IN2 R_{IN} = 47 kΩ @ 100 kHz	C_{IN}			80	pF
STATUS CHARACTERISTICS					
Status Voltage I_{ST} = 1 mA; Output in fault	V_{ST}			0.5	V
Status Leakage Current V_{ST} = 5 V	I_{STLK}			10	µA

Table 3. Static Electrical Characteristics

Characteristics noted under conditions 7.0 V ≤ V_{SUP} ≤ 18 V, -40°C ≤ T_A ≤ 125°C, GND = 0 V unless otherwise noted. Typical values noted reflect the approximate parameter means at T_A = 25°C under nominal conditions unless otherwise noted.

Characteristic	Symbol	Min	Typ	Max	Unit
Status Pin Capacitance V_{ST} = 5 V	C_{ST}			80	pF
OVERLOAD PROTECTION CHARACTERISTICS					
Overcurrent latchoff threshold V_{BAT} = 13.5 V	I_{OCT}	4.0		9.0	A
Thermal Shutdown	T_{SHUT}	150	165	175	°C
Thermal Shutdown Hysteresis	T_{HYST}			10	°C
Overvoltage Shutdown Threshold Both IN1, IN2 logic high	V_{OV}	27		38	V
Overvoltage Shutdown Hysteresis Both IN1, IN2 logic high	V_{OVHYST}	0.1		2.0	V
Undervoltage Shutdown Threshold Both IN1, IN2 logic high	V_{UV}	4.75		6.0	V
Undervoltage Shutdown Hysteresis Both IN1, IN2 logic high	V_{UVHYST}	0.3	0.6	1.0	V
OPEN CIRCUIT DETECTION CHARACTERISTICS					
Open Load Detect Current V_{OUT} = 3.5 V, OLDE = 4.0 V	I_{OL}	200	290	400	µA
Open Load Threshold Voltage	V_{OL}	1.5	2.4	3.5	V
Openload threshold voltage	V_{INOL}	1.5	2.5	3.5	V

DYNAMIC ELECTRICAL CHARACTERISTICS

Table 4. Dynamic Electrical Characteristics

Characteristics noted under conditions $7.0\ V \le V_{SUP} \le 18\ V$, $-40°C \le T_A \le 125°C$, GND = 0 V unless otherwise noted. Typical values noted reflect the approximate parameter means at $T_A = 25°C$ under nominal conditions unless otherwise noted.

Description	Symbol	Min	Typ	Max	Unit
OVERLOAD PROTECTION CHARACTERISTICS					
Overcurrent latchoff delay From OverCurrent Treshold achieved to Output Voltage = 10% V_{BAT}	T_{OCTDLY}			30	µs
Overcurrent latchoff status delay From Output Voltage = 10% V_{BAT} to Status Flag <1 V	$T_{OCTSTDLY}$			50	µs
OPEN CIRCUIT DETECTION CHARACTERISTICS					
Open Load to Status Low Delay Time From IN = 1.5 to Status Flag <1.5 V	T_{OLSTDT}			100	µs
Open Load Detect BlankingTime From IN = 1.5 to Openload circuitry enable	T_{OLDBT}	3.0	10	50	µs
SWITCHING CHARACTERISTICS [3]					
Turn-on Slew Rate From 10% to V_{BAT} -3.0 V	S_{RPOUT1}	1.0		20	V/µs
Turn-on Slew Rate From V_{BAT} -3.0 V to 90%	S_{RPOUT2}	0.1		3.0	V/µs
Turn-off Slew Rate From 90% to 10%	S_{RNOUT}	1.0		20	V/µs
Turn-on Delay Time From $V_{IN}/2$ to 10% V_{BAT}	t_{DON}	1.0	2.5	15	µs
Turn-off Delay Time From $V_{IN}/2$ to 90% V_{BAT}	t_{DOFF}	1.0	5.0	15	µs

Notes

3. **8 V<V_{BAT} <18 V, R_{LOAD} = 7 Ω**

TYPICAL APPLICATIONS

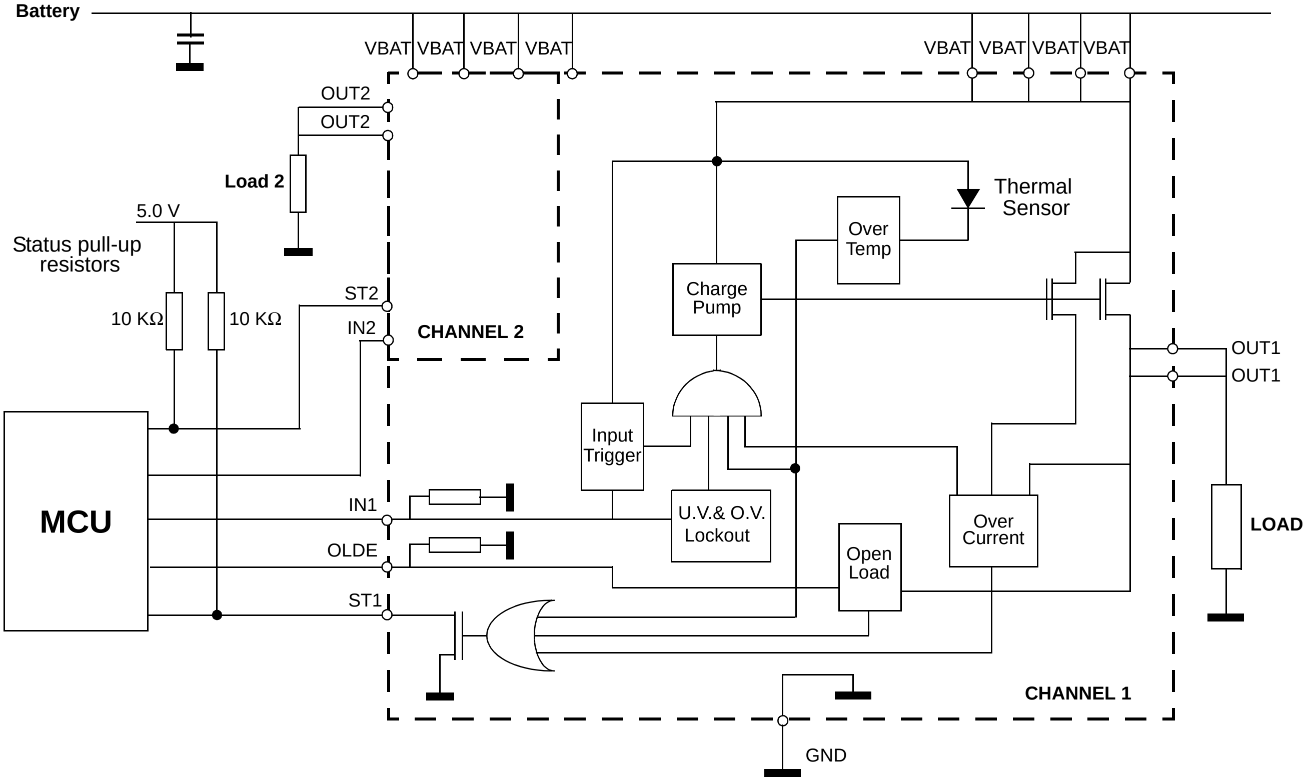


Figure 4. MC33289 Typical Application

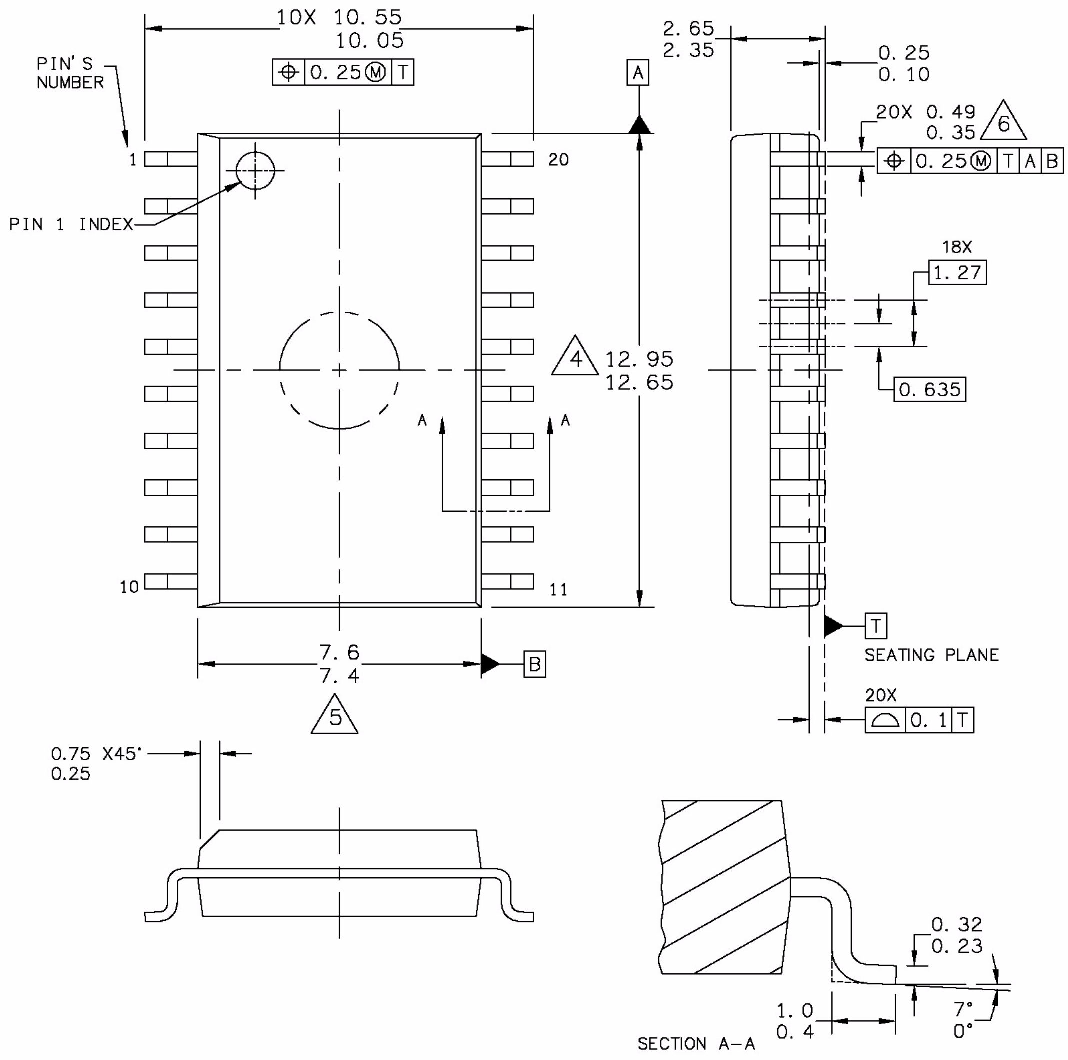
Table 5. Functional Truth Table

Conditions	IN1	IN2	OUT1	OUT2	ST1	ST2
Normal Operating Conditions	L	L	L	L	H	H
	H	L	H	L	H	H
	L	H	L	H	H	H
	H	H	H	H	H	H
Overtemperature Channel 1	H	X	L	X	L	H
Overtemperature Channel 2	X	H	X	L	H	L
Overtemperature Channel 1/Channel 2	H	H	L	L	L	L
Open Load Channel 1	L	X	H	X	L	H
Open Load Channel 2	X	L	X	H	H	L
Overcurrent Channel 1	H	X	L	X	L	H
Overcurrent Channel 2	X	H	X	L	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						

PACKAGING

PACKAGE DIMENSIONS

For the most current package revision, visit www.freescale.com and perform a keyword search using the “98A” listed below



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	CASE NUMBER: 751D–07	23 MAR 2005
	STANDARD: JEDEC MS–013AC	

DW SUFFIX
20-PIN
PLASTIC PACKAGE
98ASB42343B
ISSUE J

REVISION HISTORY

REVISION	DATE	DESCRIPTION OF CHANGES
4.0	6/2006	• Implemented Revision History page • Converted to Freescale format • Updated to the prevailing form and style

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E-mail:
support@freescale.com

USA/Europe or Locations Not Listed:
Freescale Semiconductor
Technical Information Center, CH370
1300 N. Alma School Road
Chandler, Arizona 85224
+1-800-521-6274 or +1-480-768-2130
support@freescale.com

Europe, Middle East, and Africa:
Freescale Halbleiter Deutschland GmbH
Technical Information Center
Schatzbogen 7
81829 Muenchen, Germany
+44 1296 380 456 (English)
+46 8 52200080 (English)
+49 89 92103 559 (German)
+33 1 69 35 48 48 (French)
support@freescale.com

Japan:
Freescale Semiconductor Japan Ltd.
Headquarters
ARCO Tower 15F
1-8-1, Shimo-Meguro, Meguro-ku,
Tokyo 153-0064
Japan
0120 191014 or +81 3 5437 9125
support.japan@freescale.com

Asia/Pacific:
Freescale Semiconductor Hong Kong Ltd.
Technical Information Center
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