Absolute Maximum Ratings

IO Voltage Range to GND....................................-0.5V to +4.0V
IO Sink Current..20mA
Operating Temperature Range..........................-40°C to +85°C
Junction Temperature ....+150°C
Storage Temperature Range...........................-55°C to +125°C
Lead Temperature (TDFN, TSOC only; soldering, 10s)..+300°C
Soldering Temperature (TDFN, TSOC only; reflow)........+260°C

Note: The SFN package is qualified for electro-mechanical contact applications only, not for soldering. For more information, refer to Application Note 4132: *Attachment Methods for the Electro-Mechanical SFN Package*.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Electrical Characteristics

(T_A = -40°C to +85°C, unless otherwise noted.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
IO PIN: GENERAL DATA						
1-Wire Pullup Voltage	V_{PUP}	(Note 2)	2.97		3.63	V
1-Wire Pullup Resistance	R_{PUP}	V_{PUP} = 3.3V ±10% (Note 3)	300		1500	Ω
Input Capacitance	C_{IO}	(Notes 4, 5)		1500		pF
Input Load Current	I_L	IO pin at V_{PUP}		5	19.5	µA
High-to-Low Switching Threshold	V_{TL}	(Notes 6, 7)		0.65 x V_{PUP}		V
Input Low Voltage	V_{IL}	(Notes 2, 8)			0.3	V
Low-to-High Switching Threshold	V_{TH}	(Notes 6, 9)		0.75 x V_{PUP}		V
Switching Hysteresis	V_{HY}	(Notes 6, 10)		0.3		V
Output Low Voltage	V_{OL}	I_{OL} = 4mA (Note 11)			0.4	V
Recovery Time	t_{REC}	R_{PUP} = 1500Ω (Notes 2, 12)	5			µs
Time Slot Duration	t_{SLOT}	(Notes 2, 13)	13			µs
IO PIN: 1-Wire RESET, PRESENCE-DETECT CYCLE						
Reset Low Time	t_{RSTL}	(Note 2)	48		80	µs
Reset High Time	t_{RSTH}	(Note 14)	48			µs
Presence-Detect Sample Time	t_{MSP}	(Notes 2, 15)	8		10	µs
IO PIN: 1-Wire WRITE						
Write-Zero Low Time	t_{W0L}	(Notes 2, 16)	8		16	µs
Write-One Low Time	t_{W1L}	(Notes 2, 16)	1		2	µs
IO PIN: 1-Wire READ						
Read Low Time	t_{RL}	(Notes 2, 17)	1		$2 - \delta$	µs
Read Sample Time	t_{MSR}	(Notes 2, 17)	$t_{RL} + \delta$		2	µs

Electrical Characteristics (continued)

(T_A = -40°C to +85°C, unless otherwise noted.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
EEPROM						
Programming Current	I_{PROG}	V_{PUP} = 3.63V (Notes 5, 18)			1	mA
Programming Time for a 32-Bit Segment or Page Protection	t_{PRD}	**Refer to the full data sheet.**				ms
Programming Time for the Secret	t_{PRS}					ms
Write/Erase Cycling Endurance	N_{CY}	T_A = +85°C (Notes 21, 22)	100k			—
Data Retention	t_{DR}	T_A = +85°C (Notes 23, 24, 25)	10			Years
SHA-256 ENGINE						
Computation Current	I_{CSHA}	**Refer to the full data sheet.**				mA
Computation Time	t_{CSHA}					ms

Note 1: Limits are 100% production tested at T_A = +25°C and/or T_A = +85°C. Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization. Typical values are not guaranteed.

Note 2: System requirement.

Note 3: Maximum allowable pullup resistance is a function of the number of 1-Wire devices in the system and 1-Wire recovery times. The specified value here applies to systems with only one device and with the minimum 1-Wire recovery times.

Note 4: Typical value represents the internal parasite capacitance when V_{PUP} is first applied. Once the parasite capacitance is charged, it does not affect normal communication.

Note 5: Guaranteed by design and/or characterization only. Not production tested.

Note 6: V_{TL}, V_{TH}, and V_{HY} are a function of the internal supply voltage, which is a function of V_{PUP}, R_{PUP}, 1-Wire timing, and capacitive loading on IO. Lower V_{PUP}, higher R_{PUP}, shorter t_{REC}, and heavier capacitive loading all lead to lower values of V_{TL}, V_{TH}, and V_{HY}.

Note 7: Voltage below which, during a falling edge on IO, a logic 0 is detected.

Note 8: The voltage on IO must be less than or equal to $V_{IL(MAX)}$ at all times the master is driving IO to a logic 0 level.

Note 9: Voltage above which, during a rising edge on IO, a logic 1 is detected.

Note 10: After V_{TH} is crossed during a rising edge on IO, the voltage on IO must drop by at least V_{HY} to be detected as logic 0.

Note 11: The I-V characteristic is linear for voltages less than 1V.

Note 12: Applies to a single device attached to a 1-Wire line.

Note 13: Defines maximum possible bit rate. Equal to $1/(t_{W0L(MIN)} + t_{REC(MIN)})$.

Note 14: An additional reset or communication sequence cannot begin until the reset high time has expired.

Note 15: Interval after t_{RSTL} during which a bus master can read a logic 0 on IO if there is a DS28E15 present. The power-up presence detect pulse could be outside this interval but will be complete within 2ms after power-up.

Note 16: ε in Figure 11 represents the time required for the pullup circuitry to pull the voltage on IO up from V_{IL} to V_{TH}. The actual maximum duration for the master to pull the line low is $t_{W1L(MAX)} + t_F - \varepsilon$ and $t_{W0L(MAX)} + t_F - \varepsilon$, respectively.

Note 17: δ in Figure 11 represents the time required for the pullup circuitry to pull the voltage on IO up from V_{IL} to the input-high threshold of the bus master. The actual maximum duration for the master to pull the line low is $t_{RL(MAX)} + t_F$.

Note 18: Current drawn from IO during the EEPROM programming interval or SHA-256 computation. The pullup circuit on IO during the programming interval and SHA-256 computation should be such that the voltage at IO is greater than or equal to 2.0V.

Note 19: Refer to the full data sheet.

Note 20: Refer to the full data sheet.

Note 21: Write-cycle endurance is tested in compliance with JESD47G.

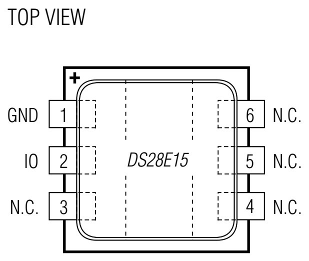
Note 22: Not 100% production tested; guaranteed by reliability monitor sampling.

Electrical Characteristics (continued)

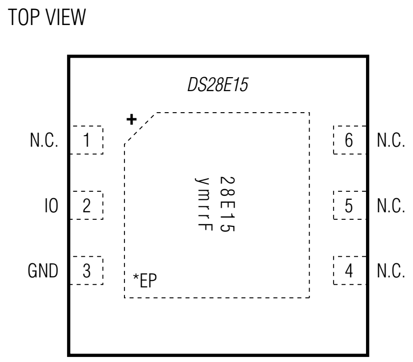
(T_A = -40°C to +85°C, unless otherwise noted.) (Note 1)

Note 23: Data retention is tested in compliance with JESD47G.
Note 24: Guaranteed by 100% production test at elevated temperature for a shorter time; equivalence of this production test to the-data sheet limit at operating temperature range is established by reliability testing.
Note 25: EEPROM writes can become nonfunctional after the data-retention time is exceeded. Long-term storage at elevated temperatures is not recommended.
Note 26: Refer to the full data sheet.

Pin Configurations

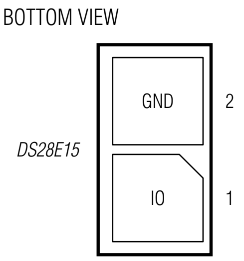


TSOC



TDFN-EP
(3mm × 3mm)

*EXPOSED PAD



SFN
(3.5mm × 6.5mm × 0.75mm)

NOTE: THE SFN PACKAGE IS QUALIFIED FOR ELECTRO-MECHANICAL CONTACT APPLICATIONS ONLY, NOT FOR SOLDERING. FOR MORE INFORMATION, REFER TO APPLICATION NOTE 4132: *ATTACHMENT METHODS FOR THE ELECTRO-MECHANICAL SFN PACKAGE.*

Pin Descriptions

PIN			NAME	FUNCTION
SFN	TDFN-EP	TSOC		
—	1, 4, 5, 6	3– 6	N.C.	Not Connected
1	2	2	IO	1-Wire Bus Interface. Open-drain signal that requires an external pullup resistor.
2	3	1	GND	Ground Reference
—	—	—	EP	Exposed Pad (TDFN Only). Solder evenly to the board's ground plane for proper operation. Refer to Application Note 3273: *Exposed Pads: A Brief Introduction* for additional information.

Note to readers: This document is an abridged version of the full data sheet. Additional device information is available only in the full version of the data sheet. To request the full data sheet, go to **www.maximintegrated.com/DS28E15** and click on **Request Full Data Sheet**.

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
DS28E15G+	-40°C to +85°C	2 SFN
DS28E15G+T	-40°C to +85°C	2 SFN (2.5k pcs)
DS28E15Q+T	-40°C to +85°C	6 TDFN-EP* (2.5k pcs)
DS28E15P+	-40°C to +85°C	6 TSOC
DS28E15P+T	-40°C to +85°C	6 TSOC (4k pcs)

+Denotes a lead(Pb)-free/RoHS-compliant package.
T = Tape and reel.
**EP = Exposed pad.*

Package Information

For the latest package outline information and land patterns (footprints), go to **www.maximintegrated.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

PACKAGE TYPE	PACKAGE CODE	OUTLINE NO.	LAND PATTERN NO.
2 SFN	T23A6N+1	21-0575	—
6 TDFN-EP	T633+2	21-0137	90-0058
6 TSOC	D6+1	21-0382	90-0321

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at www.maximintegrated.com.