

DALLAS

SEMICONDUCTOR

DS1589/DS1593

Serialized Real Time Clocks

FEATURES

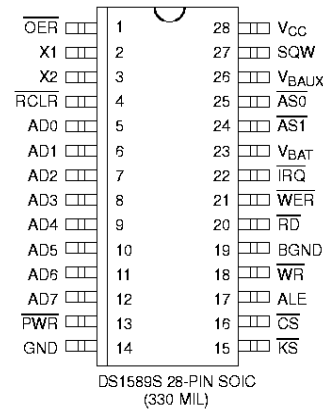
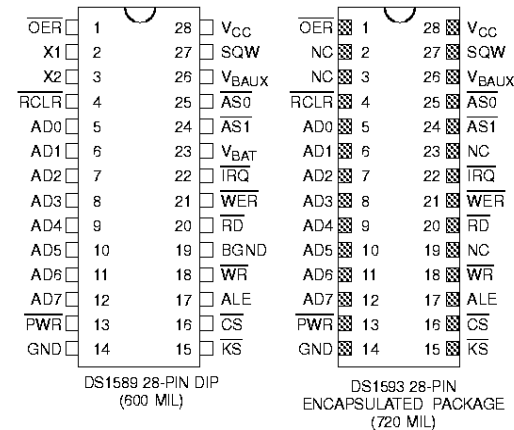
Incorporates industry standard DS1287 PC clock plus enhanced features:

- 64-bit Silicon serial number
- Power control circuitry supports system power on from date/time alarm or key closure
- 114 bytes user NVRAM
- 8K bytes additional NVRAM
- Auxiliary battery input
- RAM clear input
- Century register
- 32 kHz output for power management
- Compatible with existing BIOS for original DS1287 functions
- AD7–AD0 are open drain to allow interface to +3V logic
- Available as chip (DS1589) or stand-alone module (DS1593) with embedded lithium battery and crystal

PIN DESCRIPTION

$\overline{\text{OER}}$	-	RAM output enable
X1	-	Crystal input
X2	-	Crystal output
$\overline{\text{RCLR}}$	-	RAM clear input
AD0-AD7	-	Mux'ed address/data bus; open drain
$\overline{\text{PWR}}$	-	Power on interrupt output; open drain
$\overline{\text{KS}}$	-	Kickstart input
$\overline{\text{CS}}$	-	RTC Chip select input
ALE	-	RTC address strobe
$\overline{\text{WR}}$	-	RTC write data strobe
$\overline{\text{RD}}$	-	RTC read data strobe
$\overline{\text{WER}}$	-	RAM write data strobe
$\overline{\text{IRQ}}$	-	Interrupt request output
$\overline{\text{AS1}}$	-	RAM upper address strobe
$\overline{\text{AS0}}$	-	RAM lower address strobe
SQW	-	Square wave output
V _{CC}	-	+5V supply
GND	-	Ground
V _{BAT}	-	Battery + supply
V _{BAUX}	-	Auxiliary battery supply
BGND	-	Battery ground

PIN ASSIGNMENT



ORDERING INFORMATION

DS1589	RTC Chip; 28-pin DIP
DS1589S	RTC Chip; 28-pin SOIC
DS1593	RTC Module; 28-pin DIP

DESCRIPTION

The DS1589 and DS1593 are RAMified real time clocks (RTC's) designed as upward-compatible successors to the industry standard DS1287, DS1387, and DS1488 PC real time clocks. As such, these devices incorporate a number of enhanced features including a silicon serial number, power on/off control circuitry, 114 bytes of user NVSRAM, and 8K bytes of additional NVSRAM.

The DS1589 is a clock/calendar chip with the features described above. An external crystal and battery are the only components required to maintain time-of-day and memory status in the absence of power. The DS1593 incorporates the DS1589 chip, a 32.768 kHz

crystal, and a lithium battery in a complete, self-contained timekeeping module. The entire unit is fully tested at Dallas such that a minimum of 10 years of timekeeping and data retention in the absence of V_{CC} is guaranteed.

The DS1589 chip and DS1593 module are identical in function to the DS1585 and DS1587, respectively, with the exception that the AD7-AD0 data bus pins are open drain. This allows easy interface to +3V logic in mixed supply systems. The operational characteristics specific to the DS1589/DS1593 are described in this data sheet. All other operational details are discussed in the DS1585/DS1587 data sheet.

ABSOLUTE MAXIMUM RATINGS*

Voltage on Any Pin Relative to Ground	-0.3V to +7.0V
Operating Temperature	0°C to 70°C
Storage Temperature	-40°C to +70°C
Soldering Temperature	260°C for 10 seconds

* This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

RECOMMENDED DC OPERATING CONDITIONS

(0°C to 70°C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Power Supply Voltage	V _{CC}	4.5	5.0	5.5	V	1
Input Logic 1	V _{IH}	2.2		V _{CC} +0.3	V	1
Input Logic 0	V _{IL}	-0.3		+0.8	V	1
Battery Voltage	V _{BAT}	2.5		3.7	V	10
Auxiliary Battery Voltage	V _{BAUX}	2.5		3.7	V	10

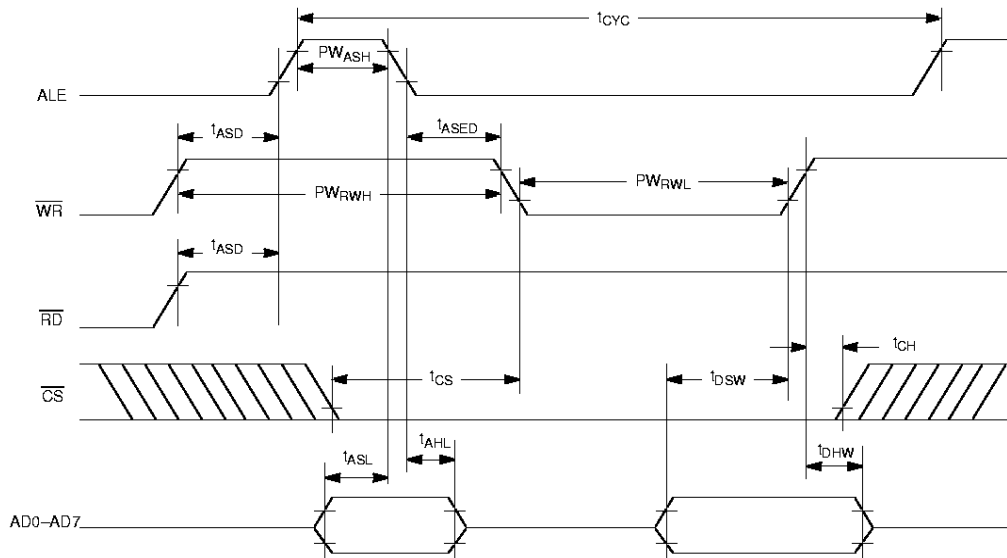
DC ELECTRICAL CHARACTERISTICS

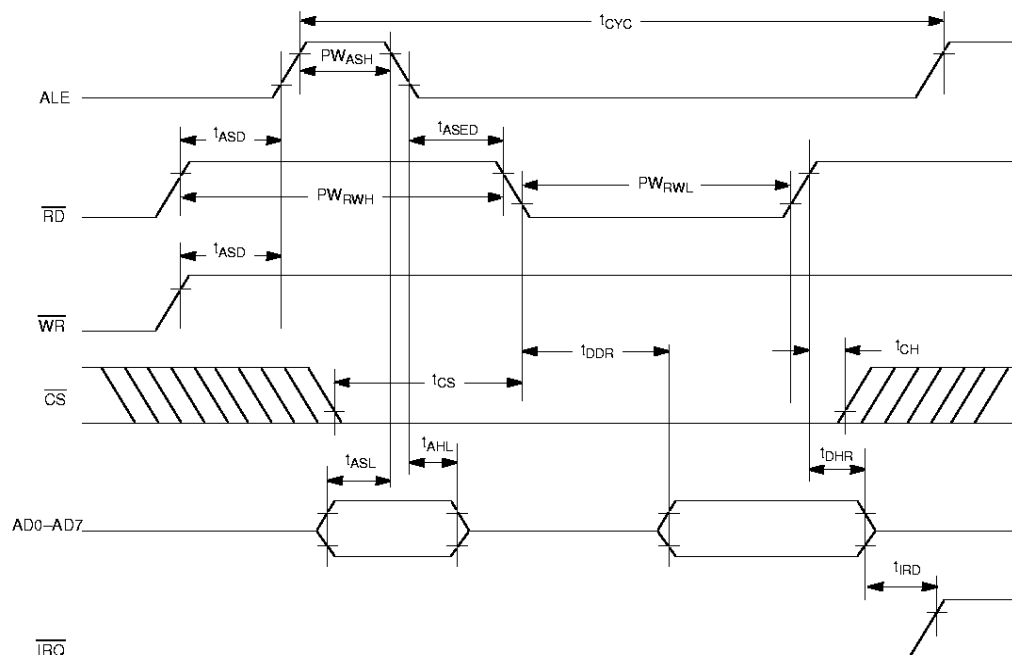
(0°C to 70°C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Power Supply Current	I _{CC1}		35	50	mA	2
Standby Current $\overline{CS} = V_{CC} - 0.3V$	I _{CC2}		1	5.0	mA	6
Input Leakage	I _{IL}	-1.0		+1.0	μA	3
I/O Leakage	I _{LO}	-1.0		+1.0	μA	3, 4
Output @ 2.4V	I _{OH}	-1.0			mA	1, 4
Output @ 0.4V	I _{OL}			2.0	mA	1
Power Fail Trip Point	V _{PF}		4.25		V	1
PWR Output @ 0.4V	I _{OLPWR}			10.0	mA	1

RTC AC TIMING CHARACTERISTICS(0°C to 70°C; $V_{CC} = 4.5V$ to 5.5V)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Cycle Time	t_{CYC}	335		DC	ns	5, 12
Pulse Width, $\overline{RD}/\overline{WR}$ Low	PW_{RWL}	155			ns	5, 12
Pulse Width, $\overline{RD}/\overline{WR}$ High	PW_{RWH}	150			ns	5, 12
Input Rise and Fall Time	t_R, t_F			30	ns	
Chip Select Setup Time Before \overline{WR} , or \overline{RD}	t_{CS}	20			ns	
Chip Select Hold Time	t_{CH}	0			ns	
Read Data Hold Time	t_{DHR}	10		80	ns	
Write Data Hold Time	t_{DHW}	0			ns	
Muxed Address Valid Time to ALE Fall	t_{ASL}	30			ns	
Muxed Address Hold Time from ALE fall	t_{AHL}	10			ns	
\overline{RD} or \overline{WR} High Setup to ALE Rise	t_{ASD}	25			ns	
Pulse Width ALE High	PW_{ASH}	60			ns	5, 12
ALE Low Setup to \overline{RD} or \overline{WR} Fall	t_{ASED}	40			ns	
Output Data Delay Time from \overline{RD}	t_{DDR}	20		150	ns	5, 12
Data Setup Time	t_{DSW}	100			ns	
\overline{TRQ} Release from \overline{RD}	t_{IRD}			2	μs	

DS1589/DS1593 BUS TIMING FOR WRITE CYCLE TO RTC

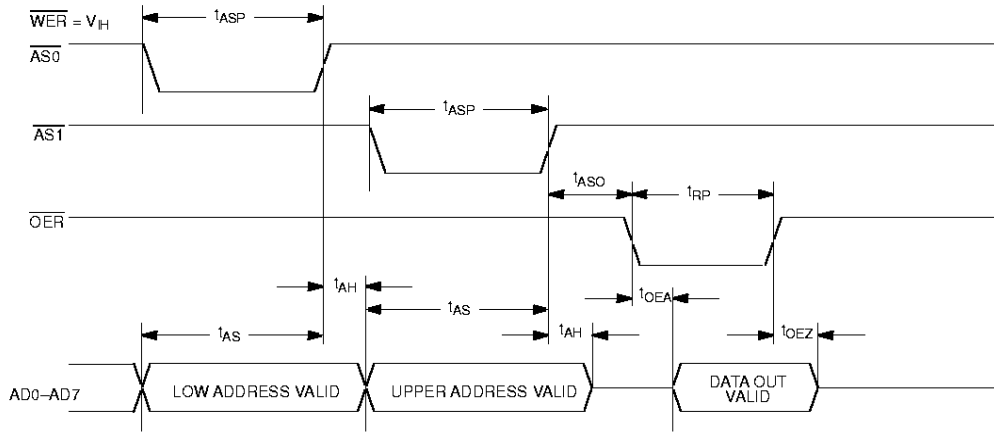
DS1589/DS1593 BUS TIMING FOR READ CYCLE TO RTC**NOTE:**

Input Levels = 0.8 volts and 2.2 volts.
Output Levels = 0.4 volts and 2.4 volts.

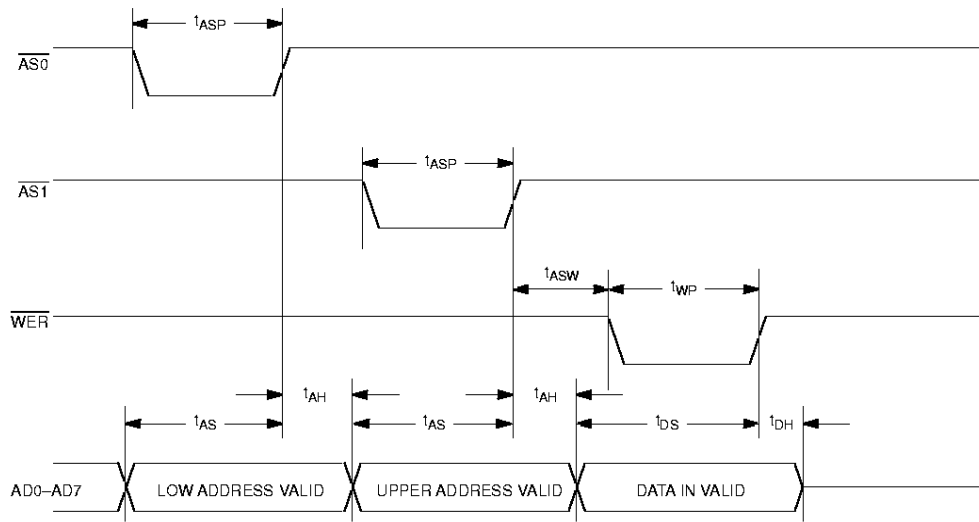
8K X 8 AC TIMING CHARACTERISTICS(0°C to 70°C; $V_{CC} = 5V \pm 10\%$)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Address Setup Time	t_{AS}	50			ns	
Address Hold Time	t_{AH}	0			ns	
Data Setup Time	t_{DS}	75			ns	
Data Hold Time	t_{DH}	0			ns	
Output Enable Access Time	t_{OEA}			200	ns	8
Write Pulse Width	t_{WP}	125			ns	
\overline{OER} to Output in High Z	t_{OEZ}			50	ns	
\overline{OER} Pulse Width	t_{RP}	200			ns	
$\overline{AS0}$, \overline{AST} Pulse Width	t_{ASP}	75			ns	
$\overline{AS0}$, \overline{AST} High to \overline{OER} Low	t_{ASO}	20			ns	
$\overline{AS0}$, \overline{AST} High to \overline{WER} Low	t_{ASW}	20			ns	

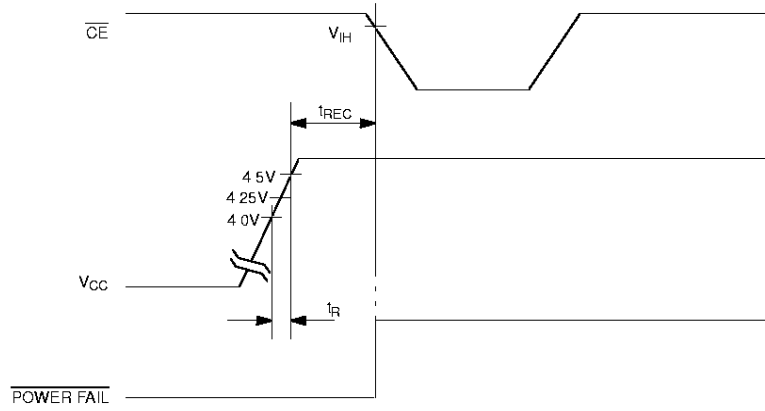
BUS TIMING FOR READ CYCLE TO 8K X 8 NV SRAM



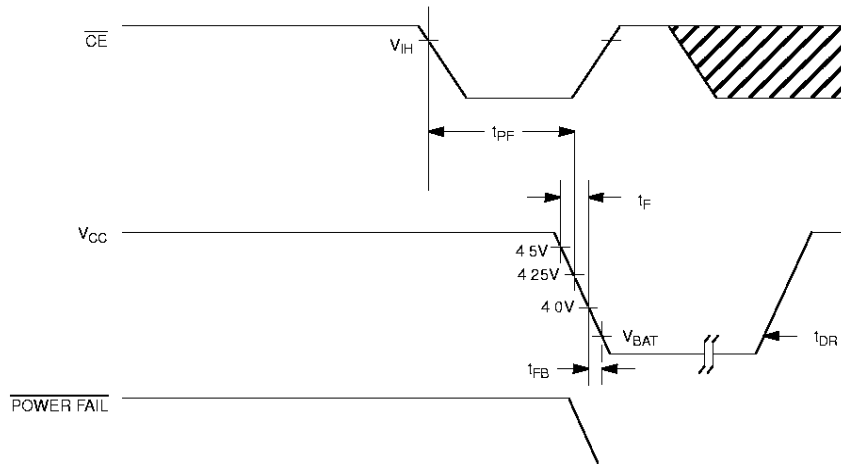
BUS TIMING FOR WRITE CYCLE TO 8K X 8 SRAM



POWER-UP CONDITION



POWER-DOWN CONDITION



POWER-UP POWER-DOWN TIMING $(t_A = 25^\circ\text{C})$

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
$\overline{\text{CE}}$ High to Power Fail	t_{PF}			0	ns	
Recovery at Power Up	t_{REC}		150		ms	
V_{CC} Slew Rate Power Down	t_{F} $4.0 \leq V_{\text{CC}} \leq 4.5\text{V}$	300			μs	
V_{CC} Slew Rate Power Down	t_{FB} $3.0 \leq V_{\text{CC}} \leq 4.0\text{V}$	10			μs	
V_{CC} Slew Rate Power Up	t_{R} $4.5\text{V} \geq V_{\text{CC}} \geq 4.0\text{V}$	0			μs	
Expected Data Retention	t_{DR}	10			years	9

WARNING:

Under no circumstances are negative undershoots, of any amplitude, allowed when device is in battery back-up mode.

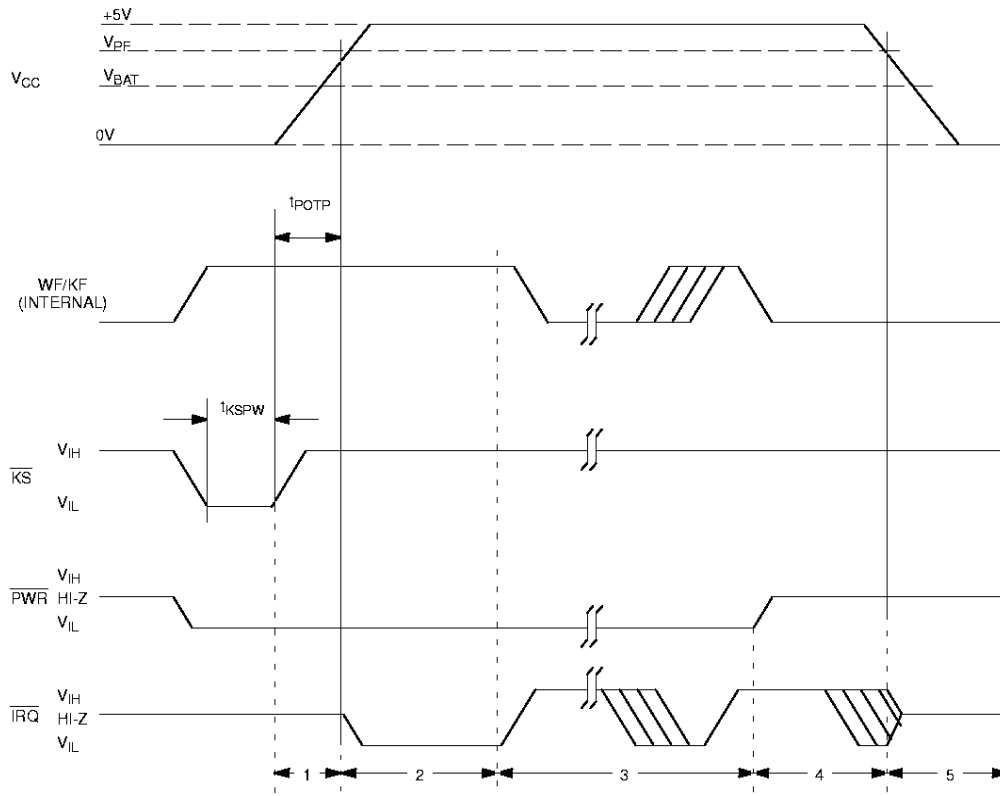
CAPACITANCE $(t_A = 25^\circ\text{C})$

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Input Capacitance	C_{IN}			12	pF	
Output Capacitance	C_{OUT}			12	pF	

WAKE UP/KICKSTART TIMING $(t_A = 25^\circ\text{C})$

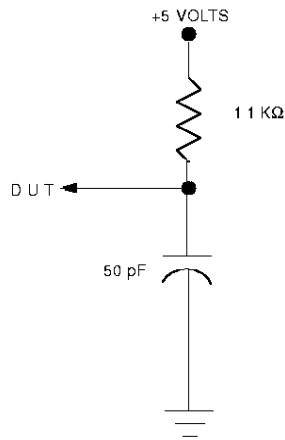
PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Kickstart Input Pulse Width	t_{KSPW}	2			μs	
Wake up/Kickstart Power On Timeout	t_{POTO}	2			seconds	11

WAKE UP/KICKSTART TIMING

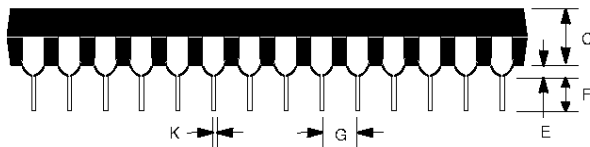
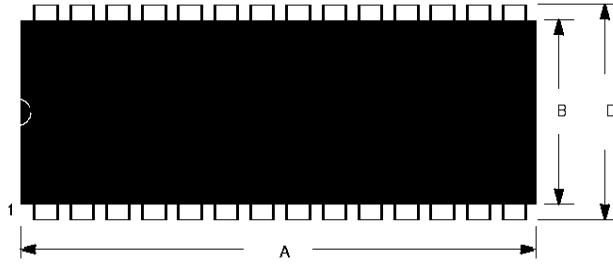


NOTES:

1. All voltages are referenced to ground.
2. All outputs are open.
3. Applies to the AD0-AD7 pins, and the SQW pin when each is in the high impedance state.
4. The $\overline{\text{TRQ}}$ and AD0-AD7 pins are open drain.
5. Measured with a load as shown in Figure 5.
6. All other inputs at CMOS levels.
7. Transition current only applies while input is switched from one state to the other. Quiescent input current given by input leakage current specification.
8. Measured with a load as shown in Figure 5.
9. The real-time clock will keep time to an accuracy of ± 1 minute per month during data retention time for the period of t_{DR} .
10. Applies to DS1589 only.
11. Wake up/Kickstart timeout generated only when the oscillator is enabled and the countdown chain is not reset.
12. Measurement is dependent upon RC time constant of output load.

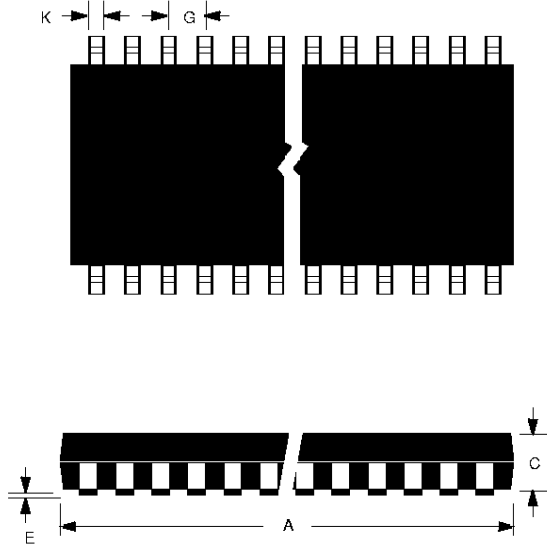
OUTPUT LOAD Figure 5

DS1589 28-PIN DIP

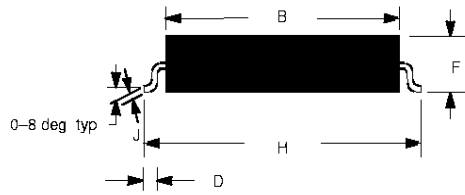


PKG	28-PIN	
	DIM	MIN
A IN	1.445	1.470
MM	36.70	37.34
B IN	0.530	0.550
MM	13.46	13.97
C IN	0.140	0.160
MM	3.56	4.06
D IN	0.600	0.625
MM	15.24	15.88
E IN	0.015	0.040
MM	0.38	1.02
F IN	0.120	0.145
MM	3.05	3.68
G IN	0.090	0.110
MM	2.29	2.79
H IN	0.625	0.675
MM	15.88	17.15
J IN	0.008	0.012
MM	0.20	0.30
K IN	0.015	0.022
MM	0.38	0.56

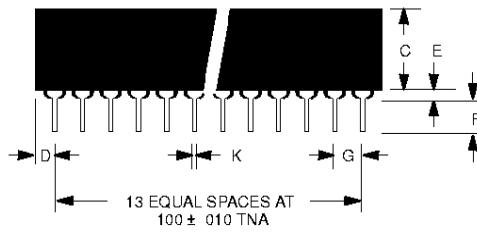
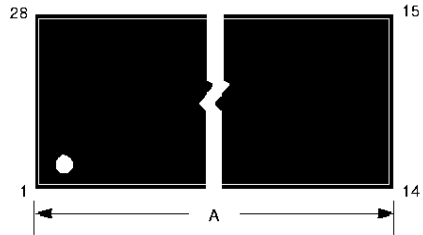
DS1589S 28-PIN SOIC



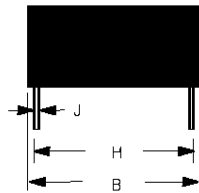
PKG	28-PIN		
	DIM	MIN	MAX
A IN	0.706	0.728	
MM	17.93	18.49	
B IN	0.338	0.350	
MM	8.58	8.89	
C IN	0.086	0.110	
MM	2.18	2.79	
D IN	0.020	0.050	
MM	0.58	1.27	
E IN	0.002	0.014	
MM	0.05	0.36	
F IN	0.090	0.124	
MM	2.29	3.15	
G IN	0.050	BSC	
MM	1.27		
H IN	0.460	0.480	
MM	11.68	12.19	
J IN	0.006	0.013	
MM	0.15	0.33	
K IN	0.014	0.020	
MM	0.36	0.51	



DS1593 28-PIN 740 MIL MODULE



PKG	28-PIN		
	DIM	MIN	MAX
A	IN MM	1.520 38.61	1.540 39.12
B	IN MM	0.695 17.65	0.720 18.29
C	IN MM	0.350 8.89	0.375 9.52
D	IN MM	0.100 2.54	0.130 3.30
E	IN MM	0.015 0.38	0.030 0.76
F	IN MM	0.110 2.79	0.140 3.56
G	IN MM	0.090 2.29	0.110 2.79
H	IN MM	0.590 14.99	0.630 16.00
J	IN MM	0.008 0.20	0.012 0.30
K	IN MM	0.015 0.38	0.021 0.53



NOTE PINS 2, 3, 19 AND 23 ARE MISSING BY DESIGN