DS1244/DS1244P
256k NV SRAM with Phantom Clock

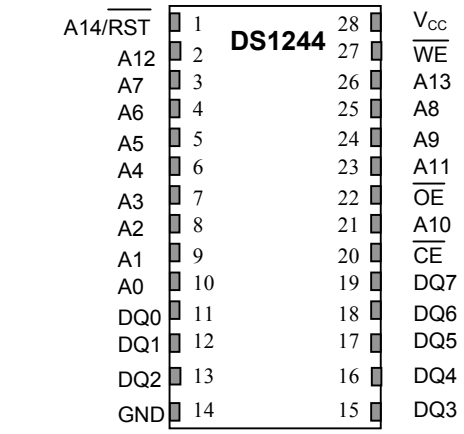
FEATURES

- Real-Time Clock (RTC) Keeps Track of Hundredths of Seconds, Minutes, Hours, Days, Date of the Month, Months, and Years
- 32k x 8 NV SRAM Directly Replaces Volatile Static RAM or EEPROM
- Embedded Lithium Energy Cell Maintains Calendar Operation and Retains RAM Data
- Watch Function is Transparent to RAM Operation
- Month and Year Determine the Number of Days in Each Month; Valid Up to 2100
- Full 10% Operating Range
- Operating Temperature Range: 0°C to +70°C
- Over 10 Years of Data Retention in the Absence of Power
- Lithium Energy Source is Electrically Disconnected to Retain Freshness Until Power is Applied for the First Time
- DIP Module Only
- Standard 28-Pin JEDEC Pinout
- PowerCap® Module Board Only
  - Surface Mountable Package for Direct Connection to PowerCap Containing Battery and Crystal
  - Replaceable Battery (PowerCap)
  - Pin-for-Pin Compatible with DS1248P and DS1251P
- Underwriters Laboratory (UL) Recognized
- Available in Lead-Free Package

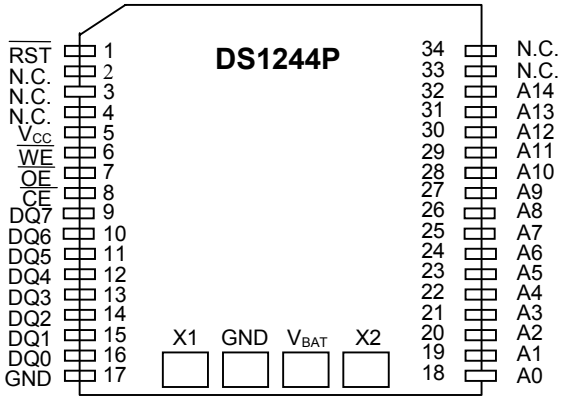
PowerCap is a registered trademark of Dallas Semiconductor.

PIN CONFIGURATIONS

TOP VIEW

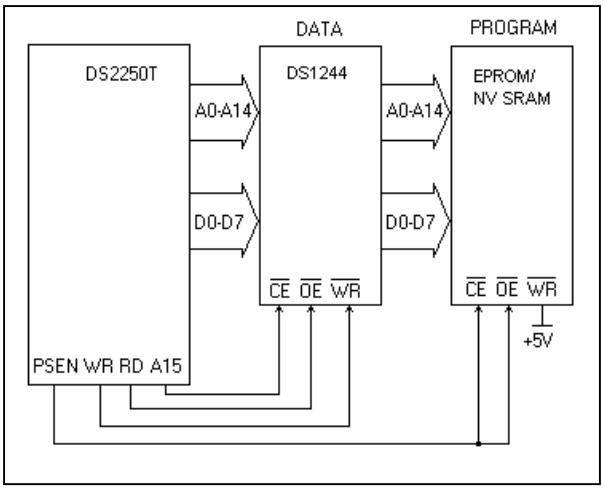


EDIP Module
(740 mils)



PowerCap Module
(Uses DS9034PCX PowerCap)

TYPICAL OPERATING CIRCUIT



ORDERING INFORMATION

PART	TEMP RANGE	PIN-PACKAGE	VOLTAGE (V)	TOP MARK
DS1244W-120	0°C to +70°C	28 EMOD (0.740a)	3.3	DS1244W-120
DS1244W-120+	0°C to +70°C	28 EMOD (0.740a)	3.3	DS1244W-120+
DS1244W-120IND	-40°C to +85°C	28 EMOD (0.740a)	3.3	DS1244W-120IND
DS1244W-120IND+	-40°C to +85°C	28 EMOD (0.740a)	3.3	DS1244W-120IND+
DS1244WP-120	0°C to +70°C	34 PowerCap*	3.3	DS1244WP-120
DS1244WP-120+	0°C to +70°C	34 PowerCap*	3.3	DS1244WP-120+
DS1244WP-120IND	-40°C to +85°C	34 PowerCap*	3.3	DS1244WP-120IND
DS1244WP-120IND+	-40°C to +85°C	34 PowerCap*	3.3	DS1244WP-120IND+
DS1244Y-70	0°C to +70°C	28 EMOD (0.740a)	5.0	DS1244Y-70
DS1244Y-70+	0°C to +70°C	28 EMOD (0.740a)	5.0	DS1244Y-70+
DS1244YP-70	0°C to +70°C	34 PowerCap*	5.0	DS1244YP-70
DS1244YP-70+	0°C to +70°C	34 PowerCap*	5.0	DS1244YP-70+

+ Denotes a lead-free/RoHS-compliant device.
** DS9034PCX (PowerCap) required. (Must be ordered separately.)*

DESCRIPTION

The DS1244 256k NV SRAM with a Phantom clock is a fully static nonvolatile RAM (NV SRAM) (organized as 32k words by 8 bits) with a built-in real-time clock. The DS1244 has a self-contained lithium energy source and control circuitry, which constantly monitors V_{CC} for an out-of-tolerance condition. When such a condition occurs, the lithium energy source is automatically switched on and write protection is unconditionally enabled to prevent garbled data in both the memory and real-time clock.

The phantom clock provides timekeeping information for hundredths of seconds, seconds, minutes, hours, days, date, months, and years. The date at the end of the month is automatically adjusted for months with fewer than 31 days, including correction for leap years. The phantom clock operates in either 24-hour or 12-hour format with an AM/PM indicator.

PACKAGES

The DS1244 is available in two packages: 28-pin encapsulated DIP and 34-pin PowerCap module. The 28-pin DIP-style module integrates the crystal, lithium energy source, and silicon all in one package. The 34-pin PowerCap module board is designed with contacts for connection to a separate PowerCap (DS9034PCX) that contains the crystal and battery. This design allows the PowerCap to be mounted on top of the DS1244P after the completion of the surface mount process. Mounting the PowerCap after the surface mount process prevents damage to the crystal and battery due to the high temperatures required for solder reflow. The PowerCap is keyed to prevent reverse insertion. The PowerCap module board and PowerCap are ordered separately and shipped in separate containers. The part number for the PowerCap is DS9034PCX.

RAM READ MODE

The DS1244 executes a read cycle whenever $\overline{WE}$ (write enable) is inactive (high) and $\overline{CE}$ (chip enable) is active (low). The unique address specified by the 15 address inputs (A0–A14) defines which of the 32,768 bytes of data is to be accessed. Valid data is available to the eight data-output drivers within t_{ACC} (access time) after the last address input signal is stable, providing that $\overline{CE}$ and $\overline{OE}$ (output enable) access times and states are also satisfied. If $\overline{OE}$ and $\overline{CE}$ access times are not satisfied, then data access must be measured from the later occurring signal ($\overline{CE}$ or $\overline{OE}$) and the limiting parameter is either t_{CO} for $\overline{CE}$ or t_{OE} for $\overline{OE}$, rather than address access.

RAM WRITE MODE

The DS1244 is in the write mode whenever the $\overline{WE}$ and $\overline{CE}$ signals are in the active (low) state after address inputs are stable. The latter occurring falling edge of $\overline{CE}$ or $\overline{WE}$ will determine the start of the write cycle. The write cycle is terminated by the earlier rising edge of $\overline{CE}$ or $\overline{WE}$. All address inputs must be kept valid throughout the write cycle. $\overline{WE}$ must return to the high state for a minimum recovery time (t_{WR}) before another cycle can be initiated. The $\overline{OE}$ control signal should be kept inactive (high) during write cycles to avoid bus contention. However, if the output bus has been enabled ($\overline{CE}$ and $\overline{OE}$ active) then $\overline{WE}$ will disable the outputs in t_{ODW} from its falling edge.

ABSOLUTE MAXIMUM RATINGS

Voltage Range on Any Pin Relative to Ground……..-0.3V to +6.0V
Storage Temperature Range……-40ºC to +85ºC (noncondensing)
Soldering Temperature…….See IPC/JEDEC J-STD-020 (DIP) (Note 13)

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

OPERATING RANGE

RANGE	TEMP RANGE (NONCONDENSING)	V_{CC}
Commercial	0°C to +70°C	3.3V ±10% or 5V ±10%
Industrial	-40°C to +85°C	3.3V ±10% or 5V ±10%

RECOMMENDED DC OPERATING CONDITIONS

Over the operating range

PARAMETER		SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Input Logic 1	V_{CC} = 5V ±10%	V_{IH}	2.2		V_{CC} + 0.3V	V	11
	V_{CC} = 3.3V ±10%		2.0		V_{CC} + 3V		
Input Logic 0	V_{CC} = 5V ±15%	V_{IL}	-0.3		0.8	V	11
	V_{CC} = 3.3V ±10%		-0.3		0.6		

DC ELECTRICAL CHARACTERISTICS

Over the operating range (5V)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Input Leakage Current	I_{IL}	-1.0		+1.0	µA	12
I/O Leakage Current $\overline{CE} \geq V_{IH} \leq V_{CC}$	I_{IO}	-1.0		+1.0	µA	
Output Current at 2.4V	I_{OH}	-1.0			mA	
Output Current at 0.4V	I_{OL}	2.0			mA	
Standby Current $\overline{CE}$ = 2.2V	I_{CCS1}		5	10	mA	
Standby Current $\overline{CE}$ = V_{CC} - 0.5V	I_{CCS2}		3.0	5.0	mA	
Operating Current t_{CYC} = 70ns	I_{CC01}			85	mA	
Write Protection Voltage	V_{PF}	4.25	4.37	4.50	V	11
Battery Switchover Voltage	V_{SO}		V_{BAT}		V	11

DC ELECTRICAL CHARACTERISTICS

Over the operating range (3.3V)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Input Leakage Current	I_{IL}	-1.0		+1.0	µA	12
I/O Leakage Current $\overline{CE} \geq V_{IH} \leq V_{CC}$	I_{IO}	-1.0		+1.0	µA	
Output Current at 2.4V	I_{OH}	-1.0			mA	
Output Current at 0.4V	I_{OL}	2.0			mA	
Standby Current $\overline{CE}$ = 2.2V	I_{CCS1}		5	7	mA	
Standby Current $\overline{CE}$ = V_{CC} - 0.5V	I_{CCS2}		2.0	3.0	mA	
Operating Current t_{CYC} = 70ns	I_{CC01}			50	mA	
Write Protection Voltage	V_{PF}	2.80	2.86	2.97	V	11
Battery Switchover Voltage	V_{SO}		V_{BAT} or V_{PF}		V	11

CAPACITANCE

(T_A = +25°C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Input Capacitance	C_{IN}		5	10	pF	
Input/Output Capacitance	$C_{I/O}$		5	10	pF	

MEMORY AC ELECTRICAL CHARACTERISTICS

Over the operating range (5V)

PARAMETER	SYMBOL	DS1244Y-70		UNITS	NOTES
		MIN	MAX		
Read Cycle Time	t_{RC}	70		ns	
Access Time	t_{ACC}		70	ns	
$\overline{OE}$ to Output Valid	t_{OE}		35	ns	
$\overline{CE}$ to Output Valid	t_{CO}		70	ns	
$\overline{OE}$ or $\overline{CE}$ to Output Active	t_{COE}	5		ns	5
Output High-Z from Deselection	t_{OD}		25	ns	5
Output Hold from Address Change	t_{OH}	5		ns	
Write Cycle Time	t_{WC}	70		ns	
Write Pulse Width	t_{WP}	50		ns	3
Address Setup Time	t_{AW}	0		ns	
Write Recovery Time	t_{WR}	0		ns	
Output High-Z from $\overline{WE}$	t_{ODW}		25	ns	5
Output Active from $\overline{WE}$	t_{OEW}	5		ns	5
Data Setup Time	t_{DS}	30		ns	4
Data Hold Time from $\overline{WE}$	t_{DH}	5		ns	4

PHANTOM CLOCK AC ELECTRICAL CHARACTERISTICS

Over the operating range (5V)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Read Cycle Time	t_{RC}	65			ns	
$\overline{CE}$ Access Time	t_{CO}			55	ns	
$\overline{OE}$ Access Time	t_{OE}			55	ns	
$\overline{CE}$ to Output Low-Z	t_{COE}	5			ns	
$\overline{OE}$ to Output Low-Z	t_{OEE}	5			ns	
$\overline{CE}$ to Output High-Z	t_{OD}			25	ns	5
$\overline{OE}$ to Output High-Z	t_{ODO}			25	ns	5
Read Recovery	t_{RR}	10			ns	
Write Cycle Time	t_{WC}	65			ns	
Write Pulse Width	t_{WP}	55			ns	3
Write Recovery	t_{WR}	10			ns	10
Data Setup Time	t_{DS}	30			ns	4
Data Hold Time	t_{DH}	0			ns	4
$\overline{CE}$ Pulse Width	t_{CW}	60			ns	
$\overline{RESET}$ Pulse Width	t_{RST}	65			ns	

POWER-DOWN/POWER-UP TIMING

Over the operating range (5V)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
$\overline{CE}$ at V_{IH} before Power-Down	t_{PD}	0			µs	
V_{CC} Slew from $V_{PF(max)}$ to $V_{PF(min)}$($\overline{CE}$ at V_{PF})	t_F	300			µs	
V_{CC} Slew from $V_{PF(min)}$ to V_{SO}	t_{FB}	10			µs	
V_{CC} Slew from $V_{PF(max)}$ to $V_{PF(min)}$($\overline{CE}$ at V_{PF})	t_R	0			µs	
$\overline{CE}$ at V_{IH} after Power-Up	t_{REC}	1.5		2.5	ms	

(T_A = +25°C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Expected Data Retention Time	t_{DR}	10			years	9

Warning: **Under no circumstances are negative undershoots of any amplitude allowed when device is in battery-backup mode.**

MEMORY AC ELECTRICAL CHARACTERISTICS

Over the operating range (3.3V)

PARAMETER	SYMBOL	DS1244W-120		UNITS	NOTES
		MIN	MAX		
Read Cycle Time	t_{RC}	120		ns	
Access Time	t_{ACC}		120	ns	
$\overline{OE}$ to Output Valid	t_{OE}		60	ns	
$\overline{CE}$ to Output Valid	t_{CO}		120	ns	
$\overline{OE}$ or $\overline{CE}$ to Output Active	t_{COE}	5		ns	5
Output High-Z from Deselection	t_{OD}		40	ns	5
Output Hold from Address Change	t_{OH}	5		ns	
Write Cycle Time	t_{WC}	120		ns	
Write Pulse Width	t_{WP}	90		ns	3
Address Setup Time	t_{AW}	0		ns	
Write Recovery Time	t_{WR}	20		ns	10
Output High-Z from $\overline{WE}$	t_{ODW}		40	ns	5
Output Active from $\overline{WE}$	t_{OEW}	5		ns	5
Data Setup Time	t_{DS}	50		ns	4
Data Hold Time from $\overline{WE}$	t_{DH}	20		ns	4

PHANTOM CLOCK AC ELECTRICAL CHARACTERISTICS

Over the operating range (3.3V)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Read Cycle Time	t_{RC}	120			ns	
$\overline{CE}$ Access Time	t_{CO}			100	ns	
$\overline{OE}$ Access Time	t_{OE}			100	ns	
$\overline{CE}$ to Output Low-Z	t_{COE}	5			ns	
$\overline{OE}$ to Output Low-Z	t_{OEE}	5			ns	
$\overline{CE}$ to Output High-Z	t_{OD}			40	ns	5
$\overline{OE}$ to Output High-Z	t_{ODO}			40	ns	5
Read Recovery	t_{RR}	20			ns	
Write Cycle Time	t_{WC}	120			ns	
Write Pulse Width	t_{WP}	100			ns	3
Write Recovery	t_{WR}	20			ns	10
Data Setup Time	t_{DS}	45			ns	4
Data Hold Time	t_{DH}	0			ns	4
$\overline{CE}$ Pulse Width	t_{CW}	105			ns	
$\overline{RESET}$ Pulse Width	t_{RST}	120			ns	

POWER-DOWN/POWER-UP TIMING

Over the operating range (3.3V)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
$\overline{CE}$ at V_{IH} before Power-Down	t_{PD}	0			µs	
V_{CC} Slew from $V_{PF(MAX)}$ to $V_{PF(MIN)}$($\overline{CE}$ at V_{IH})	t_F	300			µs	
V_{CC} Slew from $V_{PF(MAX)}$ to $V_{PF(MIN)}$($\overline{CE}$ at V_{IH})	t_R	0			µs	
$\overline{CE}$ at V_{IH} after Power-Up	t_{REC}	1.5		2.5	ms	

(T_A = +25°C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Expected Data Retention Time	t_{DR}	10			years	9

Warning: Under no circumstances are negative undershoots, of any amplitude, allowed when device is in battery-backup mode.

AC TEST CONDITIONS

Output Load: 50pF + 1TTL Gate
Input Pulse Levels: 0 to 3V

Timing Measurement Reference Levels
Input: 1.5V
Output: 1.5V
Input Pulse Rise and Fall Times: 5ns

NOTES:

1) $\overline{WE}$ is high for a read cycle.
2) $\overline{OE}$ = V_{IH} or V_{IL}. If $\overline{OE}$ = V_{IH} during write cycle, the output buffers remain in a high-impedance state.
3) t_{WP} is specified as the logical AND of $\overline{CE}$ and $\overline{WE}$. t_{WP} is measured from the latter of $\overline{CE}$ or $\overline{WE}$ going low to the earlier of $\overline{CE}$ or $\overline{WE}$ going high.
4) t_{DH}, t_{DS} are measured from the earlier of $\overline{CE}$ or $\overline{WE}$ going high.
5) These parameters are sampled with a 50pF load and are not 100% tested.
6) If the $\overline{CE}$ low transition occurs simultaneously with or later than the $\overline{WE}$ low transition in Write Cycle 1, the output buffers remain in a high-impedance state during this period.
7) If the $\overline{CE}$ high transition occurs prior to or simultaneously with the $\overline{WE}$ high transition, the output buffers remain in a high-impedance state during this period.
8) If $\overline{WE}$ is low or the $\overline{WE}$ low transition occurs prior to or simultaneously with the $\overline{CE}$ low transition, the output buffers remain in a high-impedance state during this period.
9) The expected t_{DR} is defined as cumulative time in the absence of V_{CC} with the clock oscillator running.
10) t_{WR} is a function of the latter occurring edge of $\overline{WE}$ or $\overline{CE}$.
11) Voltages are referencd to ground.
12) $\overline{RST}$ (Pin 1) has an internal pullup resistor.
13) RTC modules can be successfully processed through conventional wave-soldering techniques as long as temperature exposure to the lithium energy source contained within does not exceed +85°C. Post-solder cleaning with water-washing techniques is acceptable, provided that ultrasonic vibration is not used.

In addition, for the PowerCap:

1) Dallas Semiconductor recommends that PowerCap module bases experience one pass through solder reflow oriented with the label side up (“live-bug”).
2) Hand soldering and touch-up: Do not touch or apply the soldering iron to leads for more than three seconds.
   - To solder, apply flux to the pad, heat the lead frame pad, and apply solder. To remove the part, apply flux, heat the lead frame pad until the solder reflows, and use a solder wick to remove solder.