

OVERVIEW

The NR8576 Series devices are serial-interface type real-time clock module ICs with built-in crystal oscillator elements. They feature timer counter circuits that keep track of time from the current second to the current year, automatic leap-year adjustment, and a supply voltage detect function. Also, a 32.768 kHz/1 Hz select output function is incorporated for independent hardware control. They are available in compact 14-pin SOPs (NR8576A×) and miniature 18-pin SOPs (NR8576B×).

FEATURES

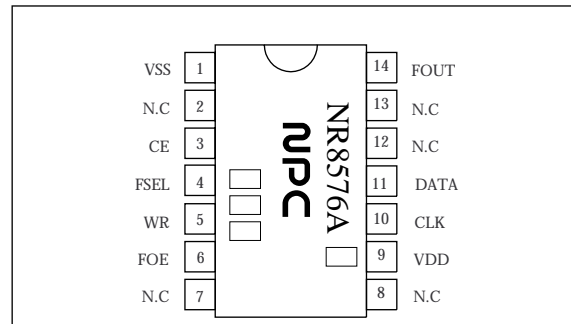
- Crystal oscillator element built-in for adjustment-free use
- Timer counters for second, minute, hour, day, day of the week, month, and year
- 2.5 to 5.5 V operating voltage range
- 1.7 ± 0.3 V supply voltage detection threshold
- 1.0 μA at 3.0 V (typ) current consumption
- Automatic leap-year calendar adjustment
- 32.768 kHz and 1 Hz output selectable
- Package
 - 14-pin SOP (NR8576A×)
 - 18-pin SOP (NR8576B×)

SERIES CONFIGURATION

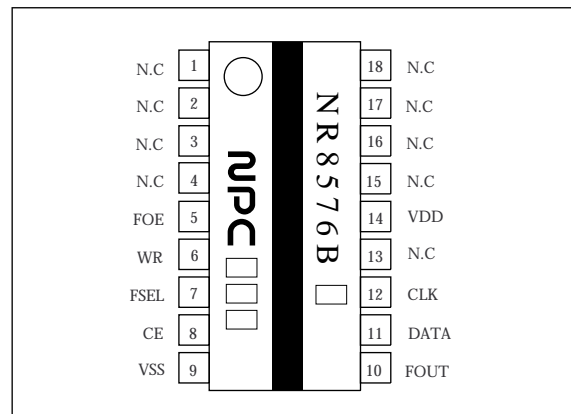
Device	Package	Frequency deviation
NR8576AA	14-pin SOP	5 ± 12 ppm
NR8576AB	14-pin SOP	5 ± 23 ppm
NR8576BA	18-pin SOP	5 ± 12 ppm
NR8576BB	18-pin SOP	5 ± 23 ppm

PINOUTS

14-pin SOP



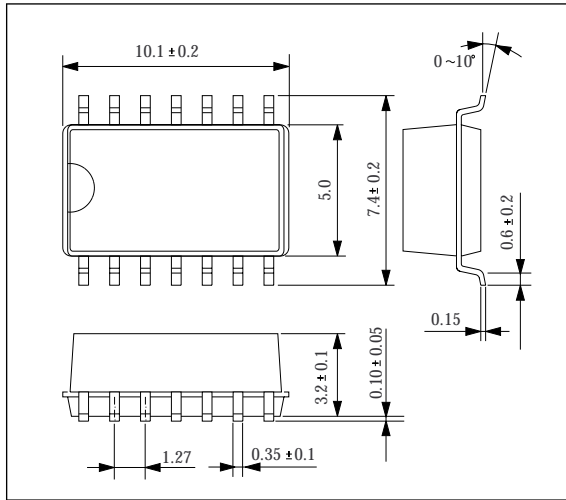
18-pin SOP



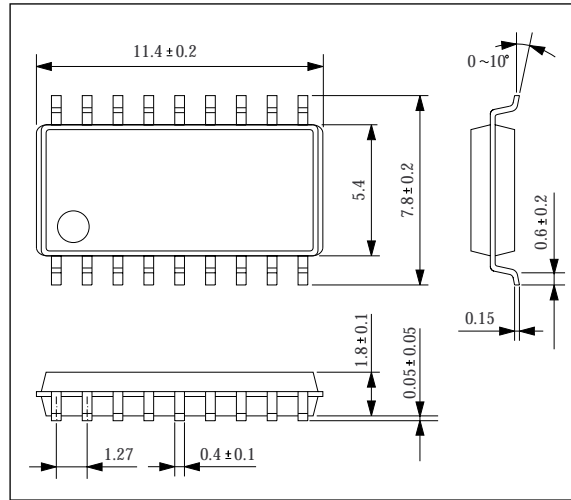
PACKAGE DIMENSIONS

Unit: mm

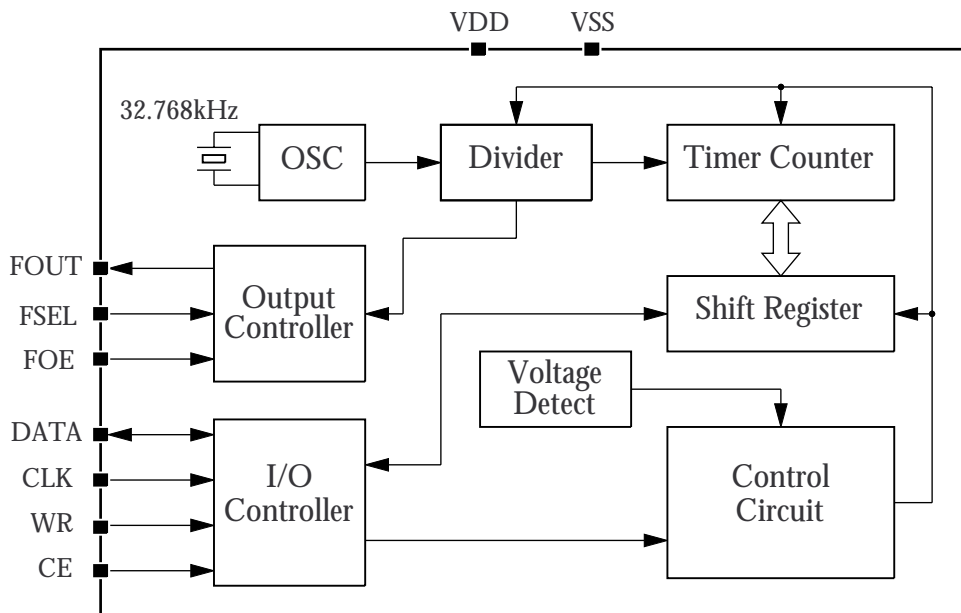
14-pin SOP



18-pin SOP



BLOCK DIAGRAM



PIN DESCRIPTION

Name	I/O	Description
VSS	-	Ground
CE	I	Chip enable. HIGH: Enable LOW: DATA goes high impedance; input on WR, CLK, and DATA stops; and the TM bit is cleared.
FSEL	I	FOUT output frequency select. HIGH: 1 Hz LOW: 32.768 kHz
WR	I	DATA input/output control switch. HIGH: Data input mode (RTC write) LOW: Data output mode (RTC read)
FOE	I	FOUT output enable control. HIGH: The frequency selected by FSEL is output on FOUT. LOW: FOUT goes high impedance.
VDD	-	Supply voltage. Connect a $\geq 0.1 \mu\text{F}$ capacitor between VDD and VSS.
CLK	I	System clock input. Data is input (RTC write mode) and output (RTC read mode) on the rising edge of CLK.
DATA	I/O	Data read and write input/output
FOUT	O	Frequency output (output controlled by FOE and frequency selected by FSEL). In 1 Hz output mode, the 1 Hz signal is synchronized to the internal 1 second signal. FOUT output is not affected by the CE signal.
N. C	-	No connection. Leave open for normal use.

SPECIFICATIONS

Absolute Maximum Ratings

$$V_{SS} = 0 \text{ V}$$

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range	V_{DD}	$T_a = 25 \text{ }^\circ\text{C}$	-0.3 to 7.0	V
Input voltage range	V_{IN}	$T_a = 25 \text{ }^\circ\text{C}$	$V_{SS} - 0.3$ to $V_{DD} + 0.3$	V
Output voltage range	V_{OUT}	$T_a = 25 \text{ }^\circ\text{C}$	$V_{SS} - 0.3$ to $V_{DD} + 0.3$	V
Storage temperature range	T_{stg}		-55 to 125	$^\circ\text{C}$
Soldering temperature	T_{sld}		260	$^\circ\text{C}$
Soldering time	t_{sld}		10	s

Recommended Operating Conditions

$$V_{SS} = 0 \text{ V}$$

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range	V_{DD}		2.5 to 5.5	V
Clock supply voltage range	V_{CLK}		1.4 to 5.5	V
Operating temperature range	T_{opr}		-40 to 85	$^\circ\text{C}$

Oscillator Characteristics

Parameter	Symbol	Condition	Rating	Unit	
Frequency deviation	$\Delta f/f_0$	$T_a = 25\text{ }^\circ\text{C}$, $V_{DD} = 5.0\text{ V}$	NR8576xA	5 ± 12	ppm
			NR8576xB	5 ± 23	ppm
Frequency temperature characteristic	T_{op}	$T_a = -10\text{ to }70\text{ }^\circ\text{C}$, $V_{DD} = 5.0\text{ V}$, $25\text{ }^\circ\text{C}$ std	$+10/-120$	ppm	
Frequency voltage characteristic	f/V	$T_a = 25\text{ }^\circ\text{C}$, $V_{DD} = 2.0\text{ to }5.5\text{ V}$	± 2	ppm/V	
Oscillator start time	t_{STA}	$T_a = 25\text{ }^\circ\text{C}$, $V_{DD} = 2.5\text{ V}$	3	s	
Aging	f_A	$T_a = 25\text{ }^\circ\text{C}$, $V_{DD} = 5.0\text{ V}$, first year	± 5	ppm	

DC Electrical Characteristics

$V_{SS} = 0\text{ V}$, $V_{DD} = 5.0\text{ V} \pm 10\%$, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$ unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit	
			min	typ	max		
Current consumption	I_{DD1}	$V_{DD} = 5.0\text{ V}$	CE = V_{SS} , FOE = V_{SS} , FSEL = V_{DD} , FOUT: floating	-	1.5	3.0	μA
	I_{DD2}	$V_{DD} = 3.0\text{ V}$		-	1.0	2.0	μA
	I_{DD3}	$V_{DD} = 2.0\text{ V}$		-	0.5	1.0	μA
	I_{DD4}	$V_{DD} = 5.0\text{ V}$	CE = V_{SS} , FOE = V_{DD} , FSEL = V_{SS} , FOUT: 32 kHz output	-	4.0	10.0	μA
	I_{DD5}	$V_{DD} = 3.0\text{ V}$		-	2.5	6.5	μA
	I_{DD6}	$V_{DD} = 2.0\text{ V}$		-	1.5	4.0	μA
HIGH-level input voltage	V_{IH}	CE, FSEL, WR, FOE, CLK, DATA	$0.8V_{DD}$	-	-	V	
LOW-level input voltage	V_{IL}	CE, FSEL, WR, FOE, CLK, DATA	-	-	$0.2V_{DD}$	V	
Input OFF leakage current	I_{OFF}	CE, FSEL, WR, FOE, CLK; $V_{IN} = V_{DD}$ or V_{SS}	-	-	0.5	μA	
HIGH-level output voltage	V_{OH1}	$V_{DD} = 5.0\text{ V}$	$I_{OH} = -1.0\text{ mA}$; DATA, FOUT	4.5	-	-	V
	V_{OH2}	$V_{DD} = 3.0\text{ V}$		2.0	-	-	V
LOW-level output voltage	V_{OL1}	$V_{DD} = 5.0\text{ V}$	$I_{OL} = 1.0\text{ mA}$; DATA, FOUT	-	-	0.5	V
	V_{OL2}	$V_{DD} = 3.0\text{ V}$		-	-	0.8	V
Output load fanout	N/C _L	FOUT	2 LSTTL/30 pF max.				
Output leakage current	I_{OZH}	$V_{OUT} = 5.5\text{ V}$; DATA, FOUT	-1.0	-	1.0	μA	
	I_{OZL}	$V_{OUT} = 0\text{ V}$; DATA, FOUT	-1.0	-	1.0	μA	
Supply voltage detect threshold voltage	V_{DT}		1.4	1.7	2.0	V	

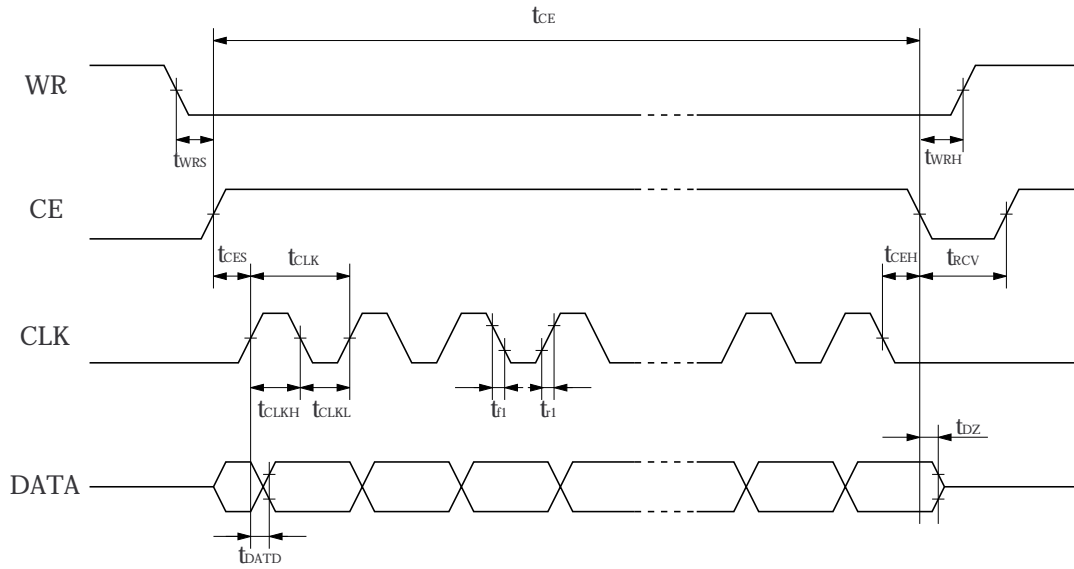
AC Characteristics

$V_{DD} = 3.0\text{ V}$, $V_{SS} = 0\text{ V}$, $T_a = 25\text{ }^\circ\text{C}$ unless otherwise noted

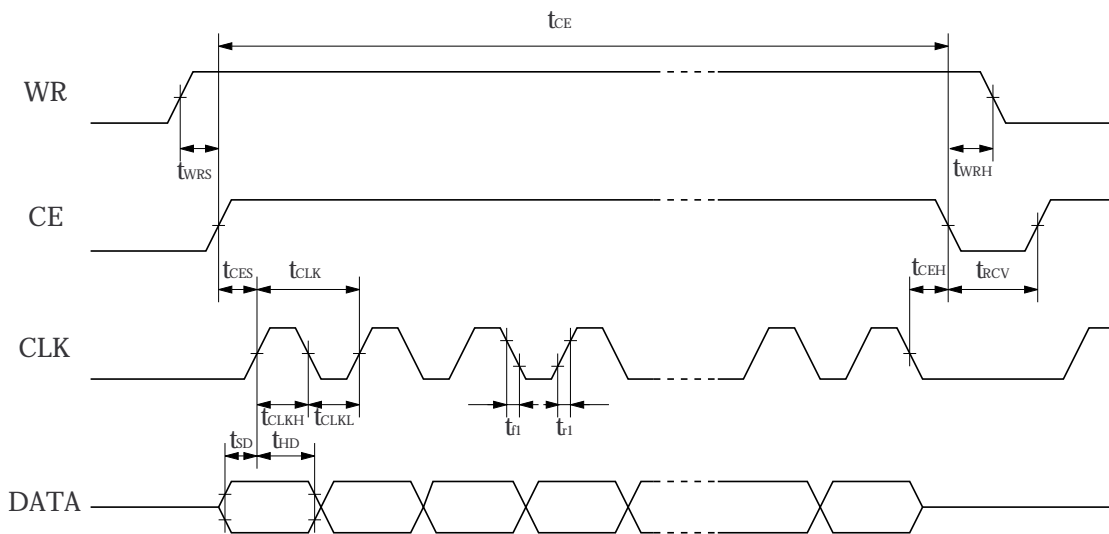
Parameter	Symbol	Rating				Unit
		$V_{DD} = 5\text{ V} \pm 10\%$		$V_{DD} = 3\text{ V} \pm 10\%$		
		min	max	min	max	
CLK clock period	t_{CLK}	0.75	7800	1.5	7800	μs
CLK LOW-level pulsewidth	t_{CLKL}	0.375	3900	0.75	3900	μs
CLK HIGH-level pulsewidth	t_{CLKH}	0.375	3900	0.75	3900	μs
CE setup time	t_{CES}	0.375	3900	0.75	3900	μs
CE hold time	t_{CEH}	0.375	–	0.75	–	μs
CE enable time	t_{CE}	–	0.9	–	0.9	s
Write data setup time	t_{SD}	0.1	–	0.2	–	μs
Write data hold time	t_{HD}	0.1	–	0.1	–	μs
WR setup time	t_{WRS}	100	–	100	–	ns
WR hold time	t_{WRH}	100	–	100	–	ns
DATA output delay time	t_{DATD}	–	0.2	–	0.4	μs
DATA output floating time	t_{DZ}	–	0.1	–	0.2	μs
Clock rise time	t_{r1}	–	50	–	100	ns
Clock fall time	t_{f1}	–	50	–	100	ns
FOUT rise time ($C_L = 30\text{ pF}$)	t_{r2}	–	100	–	200	ns
FOUT fall time ($C_L = 30\text{ pF}$)	t_{f2}	–	100	–	200	ns
Disable time ($C_L = 30\text{ pF}$)	t_{HZ}	–	100	–	200	ns
	t_{LZ}	–	100	–	200	ns
Enable time ($C_L = 30\text{ pF}$)	t_{ZH}	–	100	–	200	ns
	t_{ZL}	–	100	–	200	ns
FOUT duty cycle ($C_L = 30\text{ pF}$)	Duty	40	60	40	60	%
Wait time	t_{RCV}	0.95	–	1.9	–	μs

Timing Diagrams

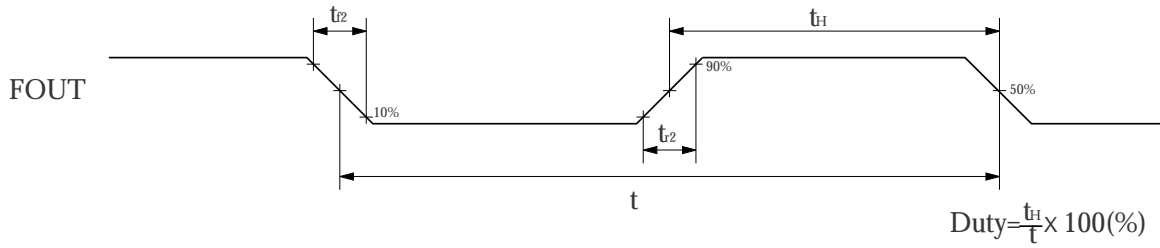
Data read



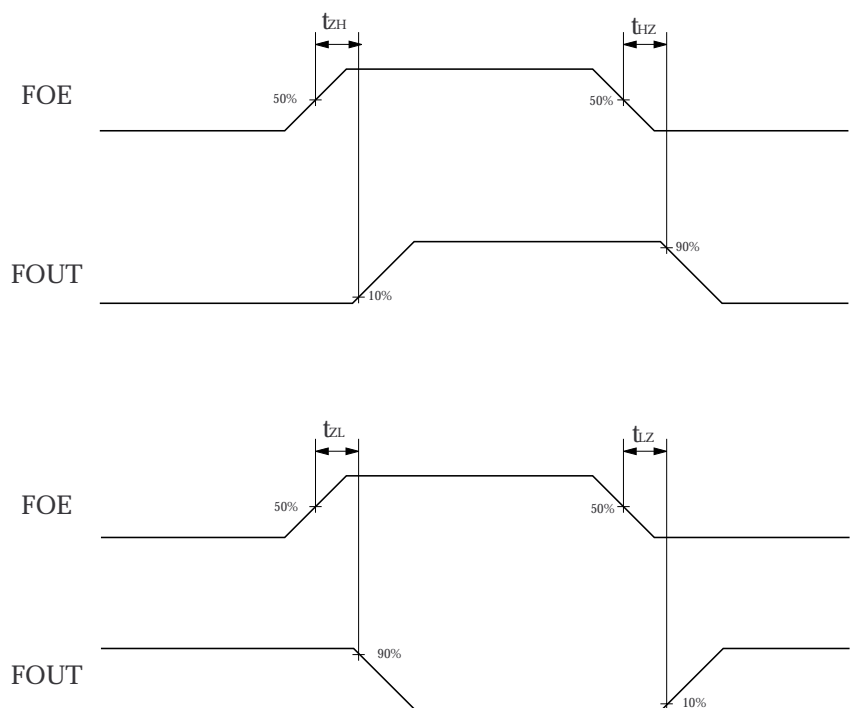
Data write



FOUT



Disable/Enable



Note that FOE and FSEL do not have chatter elimination circuits. Consequently, switching either FOE or FSEL during 32 kHz mode operation may generate chatter noise on the FOUT output. Also, note that the 1 Hz and 32 kHz oscillators are not synchronized to each other, so switching intervals shortens the duty cycle. Accordingly, a wait time (\geq chattering time + output frequency period) should be incorporated when switching intervals.

FUNCTIONAL DESCRIPTION

Timer data configuration

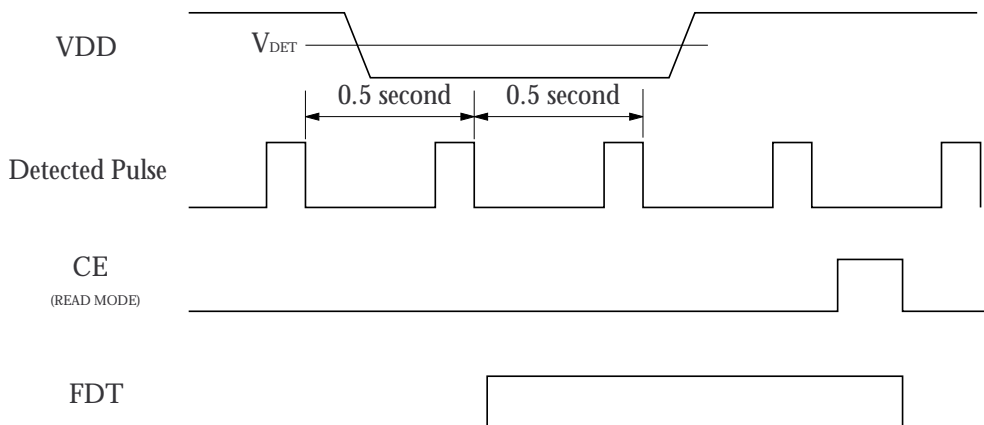
- Counter data in BCD code format
- Automatic long/short month and leap-year adjustment
- 24-hour time display
- LSB first write and read data

	MSB				LSB			
Second (0 to 59)	FDT	S40	S20	S10	S8	S4	S2	S1
Minute (0 to 59)	*	mi40	mi20	mi10	mi8	mi4	mi2	mi1
Hour (0 to 23)	*	*	h20	h10	h8	h4	h2	h1
Week (1 to 7)					*	w4	w2	w1
Day (1 to 31)	*	*	d20	d10	d8	d4	d2	d1
Month (1 to 12)	TM	*	*	mo10	mo8	mo4	mo2	mo1
Year (0 to 99)	y80	y40	y20	y10	y8	y4	y2	y1

1. * bit: Optional write bits.

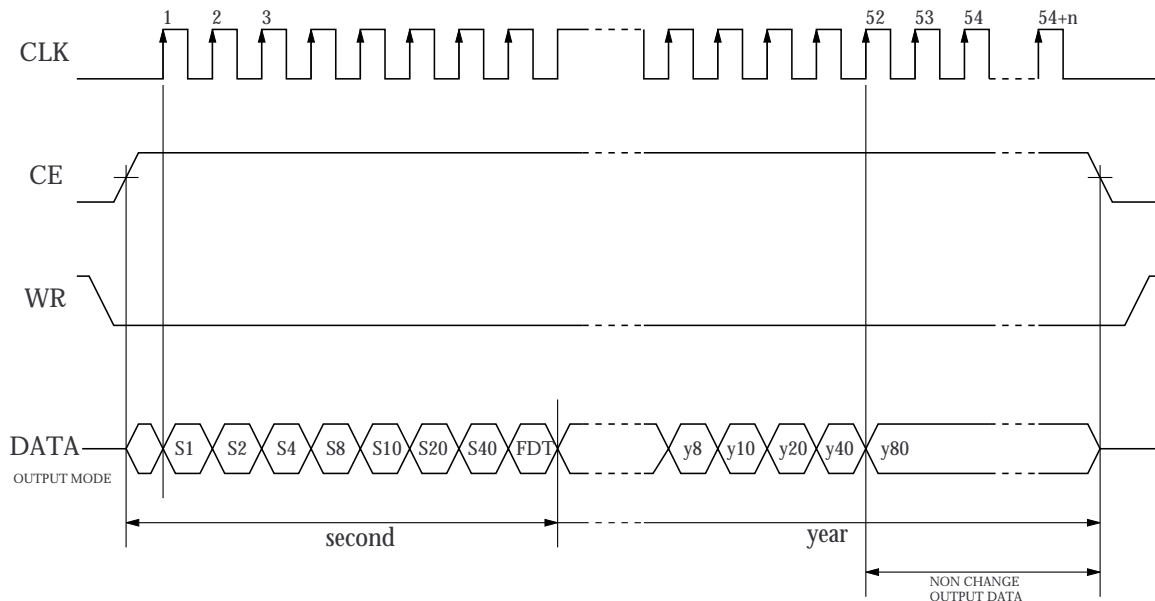
2. FDT bit: Supply voltage detect bit

- The FDT bit is set to 1 when the voltage between VDD and VSS falls below 1.7 ± 0.3 V.
- The FDT bit is reset to 0 for data reads longer than 48 bits. Note that the FDT bit is not reset to 0 for data reads of 47 bits or less.
- The read/write data bits should be set to 0. After the supply voltage is applied, the FDT bit should be set to 0.



3. TM bit: Factory test bit. Should be set to 0 for normal use.

Data Read



Data is output when WR is LOW and CE is HIGH.

Time and calendar data is loaded into shift registers on the first rising edge of the clock CLK, and the seconds' digit LSB is output on DATA.

The data is then loaded and shifted in the sequence second, minute, hour, week, day, and month on the rising edge of CLK, and output on DATA. The output data is valid after 52 rising edges of the clock; data input after 52 cycles does not alter the first 52 bits of valid data.

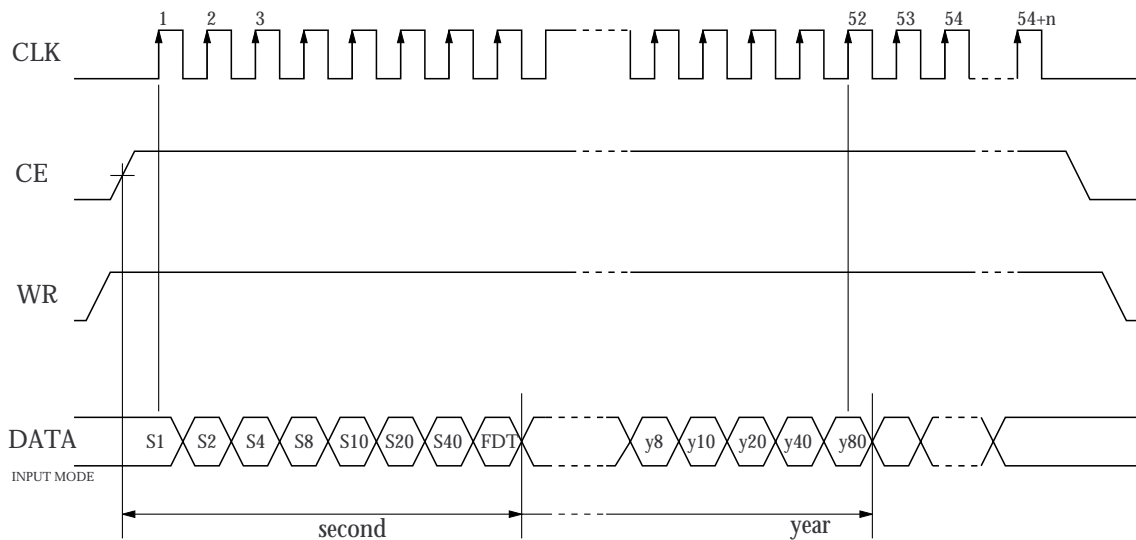
Within the 52 cycles of valid data, data already input can be output if there is a falling edge of CE after the corresponding number of cycles. For example, the data comprising the second-to-week is output is CE goes LOW after 28 clock cycles.

For continuous data reads, a wait time (t_{RCV}) is required before the next data cycle if CE has gone LOW.

Note that if an update operation (a 1 s carry) occurs during a data read, an error of -1 s in the read data is generated.

The data read time should be completed after $t_{CE} \leq 0.9$ s.

Data Write



Data is input when WR is HIGH and CE is HIGH.

The seconds' digit signal to the timer counter stops on the first falling edge of CLK and the counter remains stopped until the next rising edge of CE. The 1 Hz to 128 Hz frequency divider step counters are reset during the interval between the first and second rising edges of CLK.

The data is then input on DATA into the shift register, starting with seconds' digit LSB synchronized with the rising edge of CLK.

After the final data is input into the shift register following 52 cycles, the shift register contents are trans-

ferred to the timer counters. Note that a data write must contain 52 bits of input data. If CE goes LOW before 52 bits are input, the input data is invalid. If the input data exceeds 52 bits, data from the 53rd bit is ignored (the first 52 bits remain valid).

The data write time should be completed after $t_{CE} \leq 0.9$ s.

If a data read occurs immediately after a data write, a wait time (t_{RCV}) is required if CE has gone LOW.

Note that writing null data will cause incorrect operation. All bits must be valid data bits.

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