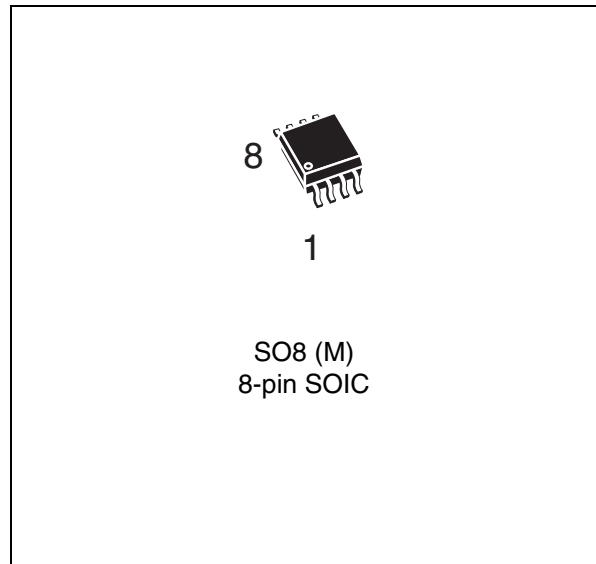


Serial access real-time clock with alarm

Not recommended for new design

Features

- For all new designs other than automotive, use M41T81S (contact the ST sales office for automotive grade)
- Counters for tenths/hundredths of seconds, seconds, minutes, hours, day, date, month, year, and century
- 32 KHz crystal oscillator integrating load capacitance (12.5 pF) providing exceptional oscillator stability and high crystal series resonance operation
- Serial interface supports I²C bus (400 kHz protocol)
- Ultra-low battery supply current of 0.6 μ A (typ at 3 V)
- 2.0 to 5.5 V clock operating voltage
- Automatic switch-over and deselect circuitry (for 3 V application select M41T81S datasheet)
- Power-down time stamp (HT bit) allowing determination of time elapsed in battery backup
- Programmable alarm and interrupt function (valid even during battery backup mode)
- Accurate programmable watchdog timer (from 62.5 ms to 128 s)
- Software clock calibration to compensate crystal deviation due to temperature
- Operating temperature of -40 to 85 °C
- ECOPACK[®] package available



1 Description

The M41T81 is a low-power serial RTC with a built-in 32.768 kHz oscillator (external crystal controlled). Eight bytes of the SRAM are used for the clock/calendar function and are configured in binary coded decimal (BCD) format. An additional 12 bytes of SRAM provide status/control of alarm, watchdog and square wave functions. Addresses and data are transferred serially via a two line, bidirectional I²C interface. The built-in address register is incremented automatically after each WRITE or READ data byte.

The M41T81 has a built-in power sense circuit which detects power failures and automatically switches to the battery supply when a power failure occurs. The energy needed to sustain the SRAM and clock operations can be supplied by a small lithium button supply when a power failure occurs.

Functions available to the user include a non-volatile, time-of-day clock/calendar, alarm interrupts, watchdog timer and programmable square wave output. The eight clock address locations contain the century, year, month, date, day, hour, minute, second and tenths/hundredths of a second in 24-hour BCD format. Corrections for 28, 29 (leap year - valid until year 2100), 30 and 31 day months are made automatically.

The M41T81 is supplied in an 8-pin SOIC.

Figure 1. Logic diagram

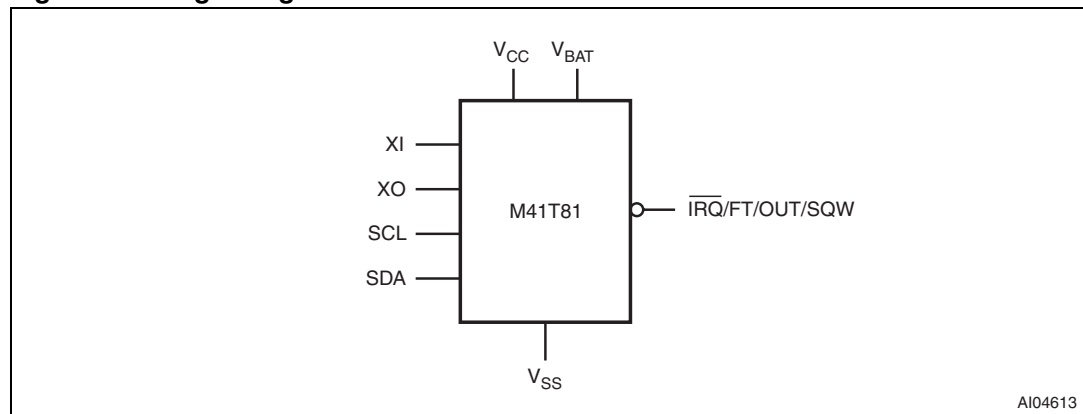


Table 1. Signal names

XI	Oscillator input
XO	Oscillator output
$\overline{\text{IRQ}}/\text{OUT}/\text{FT}/\text{SQW}$	Interrupt / output driver / frequency test / square wave (open drain)
SDA	Serial data input/output
SCL	Serial clock input
V _{BAT}	Battery supply voltage
V _{CC}	Supply voltage
V _{SS}	Ground

Figure 2. 8-pin SOIC (M) connections

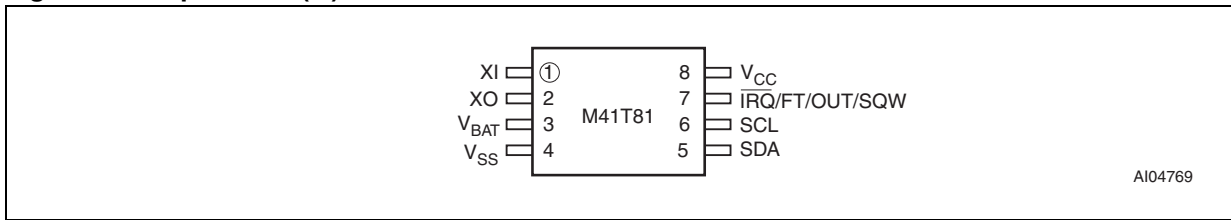
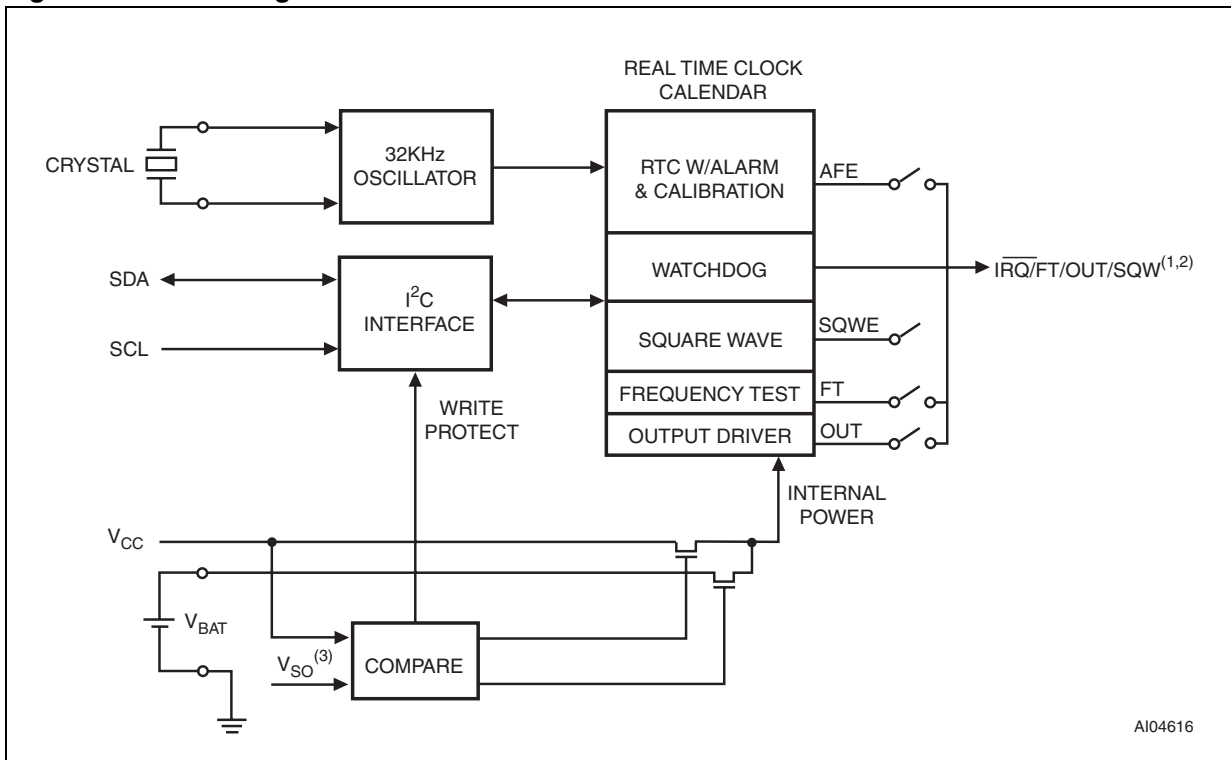


Figure 3. Block diagram



1. Open drain output
2. Square wave function has the highest priority on $\overline{\text{IRQ}}/\text{FT}/\text{OUT}/\text{SQW}^{(1,2)}$ output.
3. $V_{\text{SO}} = V_{\text{BAT}} - 0.5 \text{ V}$ (typ)

2 Operation

The M41T81 clock operates as a slave device on the serial bus. Access is obtained by implementing a start condition followed by the correct slave address (D0h). The 20 bytes contained in the device can then be accessed sequentially in the following order:

- 1st byte: tenths/hundredths of a second register
- 2nd byte: seconds register
- 3rd byte: minutes register
- 4th byte: century/hours register
- 5th byte: day register
- 6th byte: date register
- 7th byte: month register
- 8th byte: year register
- 9th byte: control register
- 10th byte: watchdog register
- 11th - 16th bytes: alarm registers
- 17th - 19th bytes: reserved
- 20th byte: square wave register

The M41T81 clock continually monitors V_{CC} for an out-of-tolerance condition. Should V_{CC} fall below V_{SO} , the device terminates an access in progress and resets the device address counter. Inputs to the device will not be recognized at this time to prevent erroneous data from being written to the device from an out-of-tolerance system. The device also automatically switches over to the battery and powers down into an ultra low current mode of operation to conserve battery life. As system power returns and V_{CC} rises above V_{SO} , the battery is disconnected, and the power supply is switched to external V_{CC} .

For more information on battery storage life refer to application note AN1012.

2.1 2-wire bus characteristics

The bus is intended for communication between different ICs. It consists of two lines: a bi-directional data signal (SDA) and a clock signal (SCL). Both the SDA and SCL lines must be connected to a positive supply voltage via a pull-up resistor.

The following protocol has been defined:

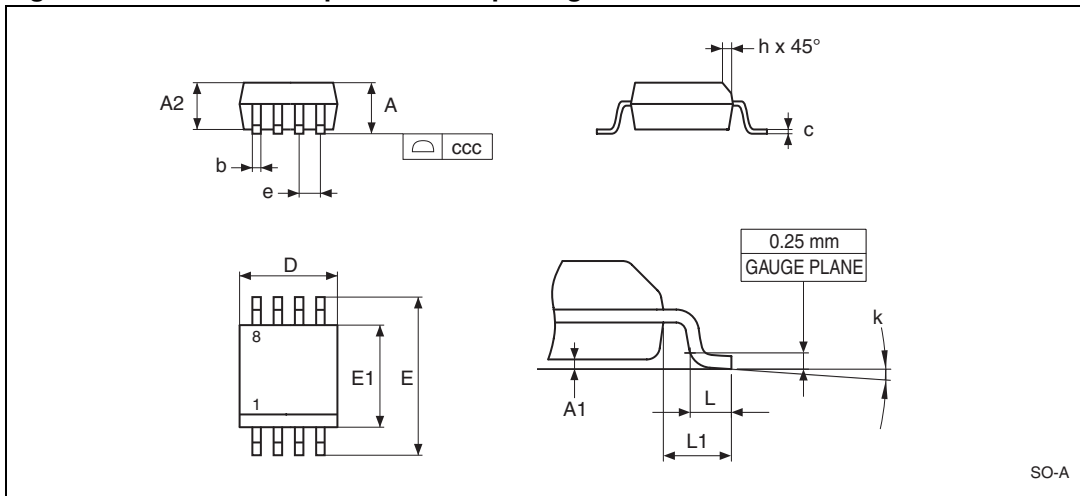
- Data transfer may be initiated only when the bus is not busy.
- During data transfer, the data line must remain stable whenever the clock line is high.
- Changes in the data line, while the clock line is high, will be interpreted as control signals.

Accordingly, the following bus conditions have been defined:

2.1.1 Bus not busy

Both data and clock lines remain high.

Figure 17. SO8 – 8-lead plastic small package outline



Note: Drawing is not to scale.

Table 14. SO8 – 8-lead plastic small outline (150 mils body width), package mechanical data

Symbol	Millimeters			inches		
	Typ	Min	Max	Typ	Min	Max
A			1.75			0.069
A1		0.10	0.25		0.004	0.010
A2		1.25			0.049	
b		0.28	0.48		0.011	0.019
c		0.17	0.23		0.007	0.009
ccc			0.10			0.004
D	4.90	4.80	5.00	0.193	0.189	0.197
E	6.00	5.80	6.20	0.236	0.228	0.244
E1	3.90	3.80	4.00	0.154	0.150	0.157
e	1.27	–	–	0.050	–	–
h		0.25	0.50		0.010	0.020
k		0°	8°		0°	8°
L		0.40	1.27		0.016	0.050
L1	1.04			0.041		

7 Part numbering

Table 15. Ordering information scheme

Example:	M41T	81	M	6	E
Device type	M41T				
Supply voltage and write protect voltage		81 = $V_{CC} = 2.0$ to 5.5 V			
Package			M = SO8		
Temperature range				6 = -40°C to 85°C	
Shipping method					E = ECOPACK [®] package, tubes F = ECOPACK [®] package, tape & reel

For other options, including automotive grade, or for more information on any aspect of this device, please contact the ST sales office nearest you.