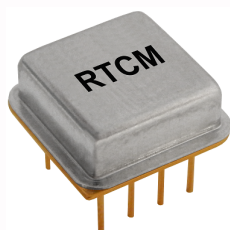


Helping Customers Innovate, Improve & Grow



HM-4201-RTCM

Product Description & Applications

High Temp Real Time Clock/Calendar Module with Build-In 32.768KHz Crystal Oscillator. Timing, Calendar and Alarm functions can be set via I2C BUS. The entire HT RTC Module is fully operational from 2.7V to 3.6V. The Timing/Calendar function is operational down to 1.8V range.

Features

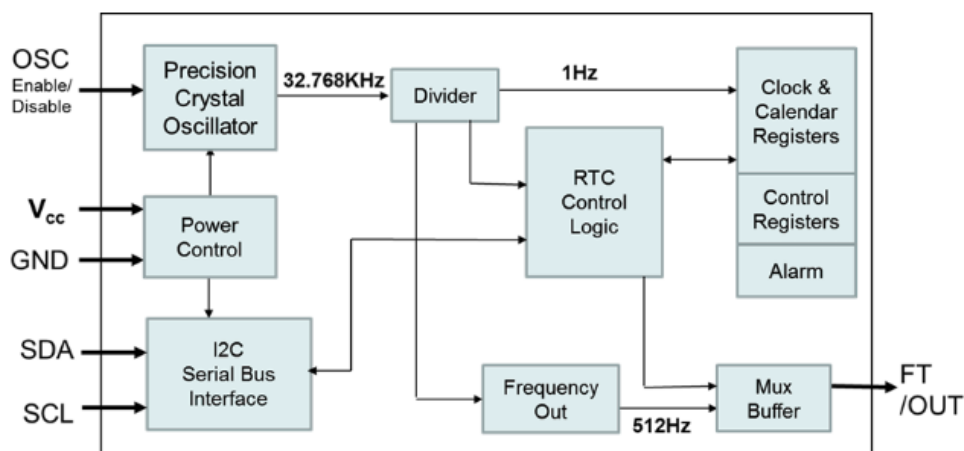
- Driven by Build-in High-Temp Crystal Oscillator at 32.768KHz
- Timing, Calendar and Alarm functions set via I2C BUS
 - Timing: Hours, Min, Sec and Sub-sec
 - Calendar: Day of the Wk, Day, Month and Year
 - Software Alarm: Sec, Min, Hr, Day of the Wk, Day, Month
- Wide Operating Temp: -40°C to +200°C
- Low Current Consumption: 100uA for HM-4201-RTCM1
- 512Hz Frequency Output for Calibration
- RoHS Compliant
- 8-Pin 1/2 DIP Hermetically Seal Package
- 4-Point crystal mount for Harsh Environment Applications
- Design to meet 3000kg shock & 36gms vibration
- ECCN: EAR99
- COO: USA

Applications

- Oil / Gas downhole tool
- Geophysical services
- High temperature industrial process control
- Extended temperature Military/Aerospace
- Avionics
- Engine control



Block Diagram



Performance Specifications

Frequency Stabilities ¹					
Parameter	Min	Typ	Max	Units	Condition
Operating temperature range					-20°C to +180 °C (RTCM 1) -40°C to +200 °C (RTCM 2)
Continuous operating life	2000			hours	
Temperature Stability of internal Oscillator	-100 -150		+100 +150	ppm ppm	-20°C to +180 °C (RTCM 1) -40°C to +200 °C (RTCM 2)
Supply Voltage	2.970	3.3	3.630	VDC	+/-10%
Supply Current (at 25°C)		100 600		uA uA	-20°C to +180 °C (RTCM 1) -40°C to +200 °C (RTCM 2)
Output (FT and OUT can be set via the configuration register)					
512 Hz Frequency Output (FT)	512 Hz Frequency Output (FT) feature provides an RF frequency source for calibration purpose				
Digital Output (OUT)	Digital Output (OUT) feature is intended to use with alarm function for event triggering purpose				This pin is an open drain output and requires external pull-up resistor

Serial Interface Specification

HM-4201-RTC1 has an I2C serial bus interface that provides access to the control and status registers and the user SRAM. The I2C serial bus interface is compatible with industrial standard I2C serial bus protocol using a bidirectional data signal (SDA) and a serial clock signal (SCL) for communication between the Master and the Slave devices. Our HM-4201-RTC1 device serves as a Slave unit. The Master unit, such as a microcontroller will initiate data transfers and provides the serial clock for both transmit and receive operations.

Environmental Compliance

Environmental Compliance		
Vibration-Sine	20g to 2kHz Sine	MIL-STD-202 Method 204 Condition D
Vibration-Random	20grms to 2kHz Random	MIL-STD-202 Method 214 Condition I-F
Shock	1000g, 0.5ms	MIL-STD-202 Method 213 Condition E
Seal Test	Fine	MIL-STD-883 Method 1014 Condition A2
Seal Test	Gross	MIL-STD-202 Method 112 Condition D
Temperature Cycling	10 Cycles minimum	MIL-STD-883 Method 1010 Condition B
Acceleration	5000g Y1 axis	MIL-STD-883 Method 2001 Condition A

Performance Specifications

Register Memory Description											
Address	BIT								Register Section	Register Name	Register Range
	7	6	5	4	3	2	1	0			
00h	0	10 seconds			Seconds				RTC	Seconds	0 to 59
01h	1	10 Minutes			Minutes					Minutes	0 to 59
02h	0	0	10 Hours		Hours					Hours	0 to 23
03h	0	0	0	0	0	Day				Day	1 to 7
04h	0	0	10 Date		Date					Date	1 to 31
05h	0	0	0	10 Month	Month					Month	1 to 12
06h	10 Year				Year					Year	0 to 99
07h	Out	512 Hz Out	0	0	0	0	0	0	Control	Output C	N/A
08h	0	Alarm E	0	0	0	0	0	0		Alarm E	N/A
09h	Reserved - Do Not Use								Reserved		N/A
0Ah	Reserved - Do Not Use								Reserved		N/A
0Bh	AARS	0	0	0	0	Alarm	1	RTCM Fail	Status	Alarm	N/A
0Ch	Esec	10 Seconds			Seconds				Alarm	Seconds	00 to 59
0Dh	Emin	10 Minutes			Minutes					Minutes	00 to 59
0Eh	Ehour	0	10 Hours		Hours					Hours	0 to 23
0Fh	Edate	0	10 Date		Date					Date	1 to 31
10h	Emonth	0	0	10 Month	Month					Month	1 to 12
11h	Eday	0	0	0	0	Day				Day	1 to 7
12h-18h	Reserved - Do Not Use								Reserved		N/A
19h	Initializa- tion	0	0	0	0	0	0	0	Device Initialization	INT1	N/A
1Ah-3Eh	Reserved - Do Not Use								Reserved		N/A
3Fh	0	0	0	0	0	0	0	Initialization	Device Initialization	INT2	N/A
Note 1: Unless otherwise specified, the state of the registers is not defined when power is first applied.											
Note 2: Unless otherwise specified, a 0 must be set to “0”											
Note 3: Unless otherwise specified, a 1 must be set to “1”											
Note 4: Writing to a reserved area could cause an undefined state of operation.											
Note 5: Device initialization is required after every power cycle.											
Table 1 Register Memory Map											

- Note 1: Unless otherwise specified, the state of the registers is not defined when power is first applied.
 Note 2: Unless otherwise specified, a 0 must be set to "0"
 Note 3: Unless otherwise specified, a 1 must be set to "1"
 Note 4: Writing to a reserved area could cause an undefined state of operation.
 Note 5: Device initialization is required after every power cycle.

Table 1 Register Memory Map

Register Information

The slave address contains the 7-bit RTCM address, which is 1101000x. The x represents the direction bit read or write, for a read x=1 and for a write x=0.

The contents of registers 0x00 thru 0x07 can be modified by performing a byte or page write. If performing a byte write, the address will increment to the following address after the write has been completed. When the address pointer reaches 0x07 it wraps around to location 0x00. If doing a page write the address will wrap around after reaching 0x07 to address 0x00.

All registers above 0x07 can only be modified via a byte write operation. Accessing the registers for reading follows the same set of guidelines as writing to the registers.

Performance Specifications

Real Time Clock Register Address (0x00h thru 0x06h)

The real time clock (RTC) registers contains the time and date information. This information is stored in a binary-coded decimal (BCD) format. The time and date information is initialized or updated by writing to the appropriate register after a power cycle.

When reading the minutes register the MSB (bit 7) will always be a "1". When writing to this register, the MSB (bit 7) is a don't care, and can be written either as a "1" or "0".

The day of the week (Day) register is a user defined register, which has a range from 1 to 7. This register will increment by one at midnight every day. The user can assign any day of the week to any number they choose, as long as the days of the week are in sequential order (i.e., if 1 equals Sunday, then 2 equals Monday and so on).

The date, month and year registers automatically adjust for months with less than 31 days, and takes into account leap years. The only exception is the year 2100 the leap year will not be taken into effect.

0x00 – Contains the BCD seconds and 10 seconds. The range is 00 to 59.

0x01 – Contains the BCD minutes and 10 minutes. The range is 00 to 59.

0x02 – Contains the BCD hours and 10 hours. The range is 00 to 23.

0x03 – Contains the BCD day of the week. The range is 1 to 7.

0x04 – Contains the BCD date and 10 date. The range is 1 to 31.

0x05 – Contains the BCD month and 10 month. The range is 1 to 12.

0x06 – Contains the BCD year and 10 year. The range is 0 to 99.

The following example shows how to write the current time and date using either the byte write or page write method. Setting the time and date to: 10:02:36 AM Friday 03/15/13 (assuming Friday is day 6 of the week)

Using the byte write method: (Write the following data to the corresponding register address)

Register Name	Register	Data	Transmit
Seconds	0x00	0x36	~00~36
Minutes	0x01	0x02	~01~02
Hours	0x02	0x10	~02~10
Day	0x03	0x06	~03~06
Date	0x04	0x15	~04~15
Month	0x05	0x03	~05~03
Year	0x06	0x13	~06~13

Using the page write method: (The bold leading zeros are the seconds register address)

~00~36~02~10~06~15~03~13

Control Register Address (0x07h thru 0x08h)

The control register consists of register 0x07 and 0x08.

Register 0x07 contains the FT/OUT (pin 7) pin output control. Enabling bit 6 of this register will enable the 512Hz frequency output, regardless of the state of bit 7. Disabling bit 6 will enable the use of the FT/OUT pin as a logic output. When using the logic output function, enabling bit 7 will cause a high logic state.

Out (0x07 bit 7)	512Hz Out (0x07 bit 6)	FT/OUT Pin Output
x (don't care)	1	512 Hz Frequency
0	0	"0" Logic
1	0	"1" Logic

Table 2 FT/OUT Pin Output

Register 0x08 contains the alarm enable (AlarmE) bit. This bit must be enabled to use the alarm function of the RTCM.

Performance Specifications

Status Register Address (0x0Bh)

The status register contains two status flags (RTCM fail and Alarm) and the auto alarm reset (AARS) bit.

After a power cycle or when applying power for the first time, the "RTCM Fail" flag will be enabled. The RTCM Fail flag alerts the user that the RTCM has lost power. Writing a "0" to this bit will manually clear the RTCM Fail flag.

When the RTCM alarm is triggered, the "Alarm" flag will enable. Writing a "0" to this bit will manually clear the Alarm flag. Both status flags can only be written to as a "0" to clear the flag. Writing a "1" to either of these bits is not a valid command.

To automatically clear the "RTCM Fail" and the "Alarm" flags after a valid read of the Status register, enable the AARS bit. If a manual reset of the status flags is preferred, then disable the AARS bit.

Alarm Register Address (0x0Ch thru 0x11h)

The alarm works by comparing the RTC to the Alarm; if they match the alarm flag will be enabled.

Bit 7 of the alarm registers contains the enable bit for the corresponding register. Enabling bit 7 will cause that register to be used in the comparison between the RTC and the Alarm. See table 3 for an explanation of when the alarm will trigger by using the enable bits.

0x0C – Contains the BCD seconds and 10 seconds for the alarm. The range is 00 to 59.

0x0D – Contains the BCD minutes and 10 minutes for the alarm. The range is 00 to 59.

0x0E – Contains the BCD hours and 10 hours for the alarm. The range is 00 to 23.

0x0F – Contains the BCD date and 10 date for the alarm. The range is 01 to 31.

0x10 – Contains the BCD month and 10 month for the alarm. The range is 1 to 12.

0x11 – Contains the BCD day of the week. The range is 1 to 7.

Enable bits of the corresponding registers						
Esec	Emin	Ehour	Edate	Emonth	Eday	Alarm Triggered
1	0	0	0	0	0	When seconds match
0	1	0	0	0	0	When minutes match
0	0	1	0	0	0	When hours match
0	0	0	1	0	0	When the date matches
0	0	0	0	1	0	When the month matches
0	0	0	0	0	1	When the day of the week matches
1	1	0	0	0	0	When seconds and minutes match
1	1	1	0	0	0	When seconds, minutes and hours match
1	1	1	1	1	1	When seconds, minutes, hours, date, month and day of the week match
0	0	0	0	0	0	Alarm will not trigger

Table 3 Alarm trigger table

Performance Specifications

Device Initialization Register Address (0x19h and 0x3Fh)

The RTMC requires a device initialization after every power cycle to ensure proper internal triggering. It is recommended that the device initialization be the first priority after a power cycle.

Follow the steps in order listed below to properly complete the device initialization.

1. Write 0x01 to address 0x3F
2. Write 0x80 to address 0x19
3. Write 0x00 to address 0x3F

Application Notes

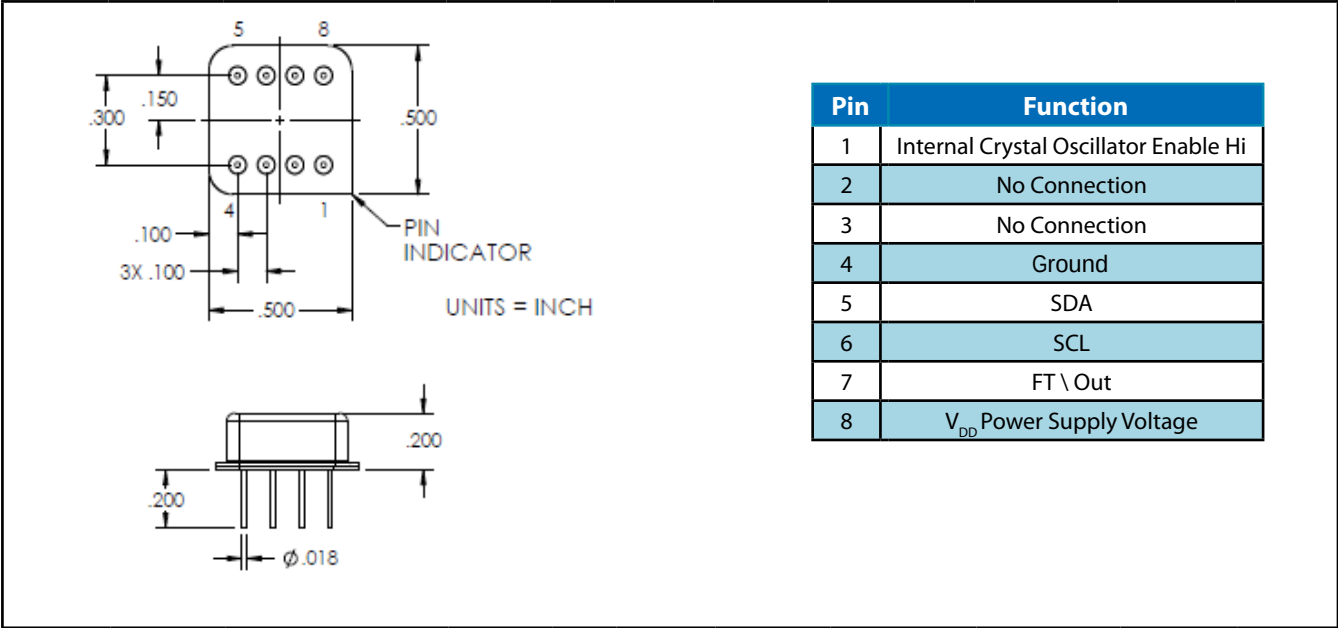
This example will walk you through the following processes:

- 1) Device initialization
- 2) Setting the time
 - a. The time will be set to 15:08:36 Friday 04/05/13
 - i. (assuming Friday is day 6 of the week)
- 3) Setting the alarm
 - a. The alarm will be set to trigger every time minutes = 30 and seconds = 45.
- 4) Enabling the alarm
- 5) Enabling the alarm auto rest bit and in the same step resting the alarm and RTCM fail flags to "0"
- 6) Enabling the 512Hz output
- 7) Read time
- 8) Read status register
- 9) Disable the 512Hz frequency output and sets the FT/OUT pin output to logic "1"

The I2C slave address for accessing the RTCM is 0xD0 for a write and 0xD1 for a read.

Operation	# of bytes to read	Register Address	Data to send	Comments
Write	N/A	~3F	~01	Device initialization
Write	N/A	~19	~80	Device initialization
Write	N/A	~3F	~00	Device initialization
Write	N/A	~00	~36~08~15~06~05~04~13	Sets the time and date information
Write	N/A	~0C	~C5	Enables and sets the alarm for seconds
Write	N/A	~0D	~B0	Enables and sets the alarm for minutes
Write	N/A	~08	~40	Enables the alarm
Write	N/A	~0B	~82	Enables alarm auto rest and resets alarm and RTCM fail flags to "0"
Write	N/A	~07	~C0	Enables the 512Hz frequency output on the FT/OUT pin output
Read	7	~00	N/A	Reads the time and date
Read	1	~0B	N/A	Reads the status register
Write	N/A	~07	~80	Disables the 512Hz frequency output and sets the FT/OUT pin output to logic "1"

Package Outline



Ordering Information

