WTM1 Weatherproof Temperature Monitor
Serial Interface Protocol Document

WTM1 Description:

The WTM1 Weatherproof Temperature Monitor, developed by Bradshaw Communication Systems, is a serial interfaced temperature monitoring unit providing both local ambient temperature monitoring as well as remote temperature monitoring capability via optional remote temperature sensors. The base unit is supplied with a built in local temperature probe which measures temperature at the unit. As few as one and a many as sixteen additional temperature sensor/s can optionally be added to provide additional remote monitoring.

Protocol Overview:

The WTM1 serial data is sent (unsolicited) as a “readable” hexadecimal data frame for each sensor. Each frame consists of a fixed start byte, 8 bytes containing the serial number for a given sensor, and finally 9 bytes containing the temperature data and CRC. Each temperature sensor is polled by the WTM1 and its data frame transmitted consecutively until all connected temperature sensors have been polled, then an approximate 3-second delay will occur until the start of the next polling/transmission cycle. This cycle then continues as long as power is supplied to the WTM1. Each digital temperature sensor has a unique 64-bit serial number stored onboard and this serial number is permanently marked on the exterior of each temperature sensor and is printed on the inside cover label for the local sensor. This allows each sensor to be identified individually while on the parallel 3-wire buss. The WTM1 serial output is compliant with ANSI Standards TIA/EIA-422-B and TIA/EIA-485-A.

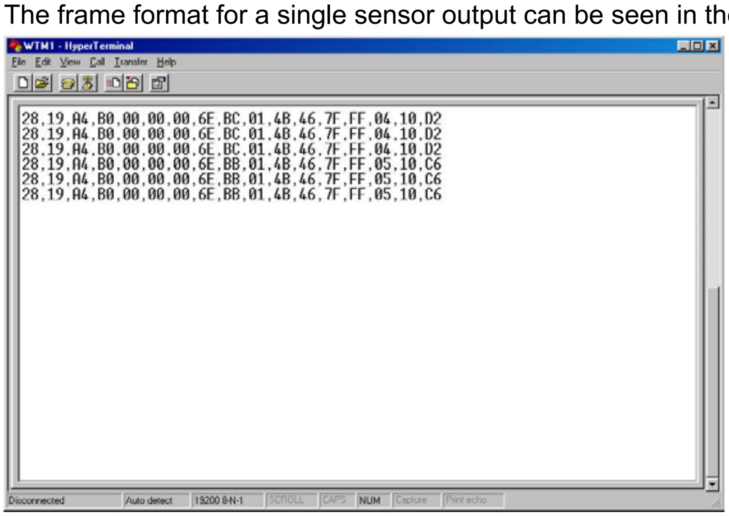
The sensors are based on the Dallas/Maxim Semiconductor DS18B20 1-Wire Digital Thermometer IC providing a 12-bit centigrade temperature output. With a temperature measurement range of -55°C to +125°C and an accuracy of 0.5°C from -10°C to +85°C on each temperature sensor, the WTM1 provides great flexibility for use in many applications. Temperature sensor resolution is provided in 0.0625°C increments.

Communication Parameters:

Transmission System:	RS422/RS485
Baud Rate:	19200
Bits:	8
Parity:	None
Stop Bits:	1

Protocol Specifics:

The frame format for a single sensor output can be seen in the following terminal emulator screenshot:



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Let's pull apart the first frame shown in the image above.

28, 19, A4, B0, 00, 00, 00, 6E, BC, 01, 4B, 46, 7F, FF, 04, 10, D2

64 Bit Serial Number | Scratch Pad

The 64 Bit Serial Number is unique to each sensor and must be provided to the host software to allow identification of a specific sensor. The Scratch Pad digital output data can be further broken down as follows:

Scratch Pad	BYTE	Example
Temperature LSB	0	BC
Temperature MSB	1	01
User Byte 1	2	4B
User Byte 2	3	46
Reserved	4	7F
Reserved	5	FF
Count Remain	6	04
Count per Degree C	7	10
CRC	8	D2

Byte 0 and 1 are all that are required to determine the temperature in centigrade. Bytes 2 through 7 are not needed for this application. Byte 8 is the cyclical redundancy checksum (CRC) and should be calculated from the first seven bytes and compared to the read value of byte 8 to confirm read validity. More information regarding the method used to calculate the CRC can be found in the DS18B20 Data Sheet and CRC Application Note, which can be found at http://pdfserv.maxim-ic.com/en/ds/DS18B20.pdf and http://www.maxim-ic.com/appnotes.cfm/appnote_number/27 respectively. Additionally, more information about the format of the WTM1 data output can also be found in this data sheet. The WTM1 handles the interface and polling of as few as one and as many as 17 DS18B20 temperature sensors and passes the DS18B20 data sequentially back to the host via the RS422 interface port. The serial number and scratch pad data is concatenated into one frame, however, remains unchanged and is simply serialized and passed through to the host for further use utilizing a CRLF separation between each sensor's returned data frame.

The WTM1 output temperature is calibrated in degrees Centigrade; for Fahrenheit applications, the host must use a lookup table or conversion routine. The temperature data (byte 0 and 1 of the scratch pad data) is stored as a 16-bit sign-extended two's complement in the temperature register as detailed in the following figure:

	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
LS Byte	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}

	bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8
MS Byte	S	S	S	S	S	2^6	2^5	2^4

The sign bits (S) indicate if the temperature is positive or negative: for positive numbers S=0 and for negative numbers S=1. The following chart illustrates the relationship between the register data and the corresponding temperature:

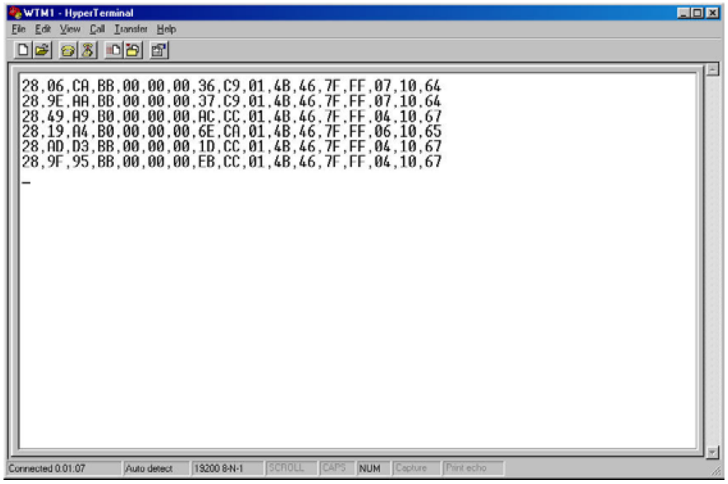
TEMPERATURE	DIGITAL OUTPUT (Binary)	DIGITAL OUTPUT (Hex)
+125°C	0000 0111 1101 0000	07D0h
+85°C*	0000 0101 0101 0000	0550h
+25.0625°C	0000 0001 1001 0001	0191h
+10.125°C	0000 0000 1010 0010	00A2h
+0.5°C	0000 0000 0000 1000	0008h
0°C	0000 0000 0000 0000	0000h
-0.5°C	1111 1111 1111 1000	FFF8h
-10.125°C	1111 1111 0101 1110	FF5Eh
-25.0625°C	1111 1110 0110 1111	FE6Fh
-55°C	1111 1100 1001 0000	FC90h

*The power-on reset value of the temperature register is +85°C

In the first screenshot example frame, the scratchpad data for temperature (bytes 0 and 1) was 01BCh. Converted to decimal this represents 444. Remembering that the temperature sensor resolution is provided in 0.0625°C units we can calculate as follows 444 * 0.0625 = 27.75°C and is signed positive.

A negative temperature value example can be demonstrated using the –10.125°C listing in the data versus temperature chart above. If the scratch pad data for temperature (bytes 0 and 1) is FF5Eh, when converted to decimal represents 65374. 65536(2E16) – 65374 = 162. 162 * 0.0625°C = 10.125°C and is signed negative.

The following screenshot represents the terminal emulator display when five remote temperature sensors are added to the WTM1 in addition to the local temperature sensor that is always present:



Notice the five new unique serial numbers (first 8 bytes) that are shown in addition to the original sensor as compared to the first screenshot depicting a single sensor connected.

The timing for the serial output can be approximated as follows:

Local Sensor read/send = ~78ms
CRLF
DELAY ~547ms
Remote Sensor 1 (Bank 1) read/send = ~78ms
CRLF
Remote Sensor 2 (Bank 1) read/send = ~78ms
CRLF
Remote Sensor 3 (Bank 1) read/send = ~78ms
CRLF
Remote Sensor 4 (Bank 1) read/send = ~78ms
CRLF
Remote Sensor 5 (Bank 1) read/send = ~78ms
CRLF
Remote Sensor 6 (Bank 1) read/send = ~78ms
CRLF
Remote Sensor 7 (Bank 1) read/send = ~78ms
CRLF
Remote Sensor 8 (Bank 1) read/send = ~78ms

CRLF
Remote Sensor 1 (Bank 2) read/send = ~78ms
CRLF
Remote Sensor 2 (Bank 2) read/send = ~78ms
CRLF
Remote Sensor 3 (Bank 2) read/send = ~78ms
CRLF
Remote Sensor 4 (Bank 2) read/send = ~78ms
CRLF
Remote Sensor 5 (Bank 2) read/send = ~78ms
CRLF
Remote Sensor 6 (Bank 2) read/send = ~78ms
CRLF
Remote Sensor 7 (Bank 2) read/send = ~78ms
CRLF
Remote Sensor 8 (Bank 2) read/send = ~78ms
CRLF
DELAY ~3.1 seconds

This timing applies whether additional sensors are connected or not (i.e. the single local sensor with no remote sensors attached will take about 78ms to read and transmit and will not be read and transmitted again for approximately 4.92 seconds).

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