

**Title: Spec of TN0; TN9; TM series.**

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# 1 General Description

This doc describes Spec of TNm Series (TN0; TN9; TM..).

This spec subject to change without notice.

This data sheet contains information specific to products manufactured at the time of its publication, Contents herein do not constitute a warranty.

## 2 Specification

### 2.1 Absolute Maximum Rating

Characteristics	Symbol	Ratings
DC Supply Voltage	$V_+$	<7.0V
Input Voltage Range	$V_{IN}$	-0.5V to $V_+ + 0.5V$

**Note:** Stresses beyond those given in the Absolute Maximum Rating table may cause operational errors or damage to the device. For normal operational conditions see AC/DC Electrical Characteristics.

### 2.2 DC Characteristics

(VDD = 3.0V,  $T_A = 25$  )

Characteristics	Symbol	Limit			Unit	Test condition
		Min	Typ.	Max		
Operating Voltage	VDD	2.5	-	3.6	V	
Operating Current	$I_{OP}$	-	4	6	mA	VDD = 3.0V, $F_{CPU} = 600KHz$
Standby Current	$I_{STBY}$	-	2	3	$\mu A$	VDD = 3.0V
Input High Level	$V_{IH}$	2.0	-	-	V	VDD = 3.0V
Input Low Level	$V_{IL}$	-	-	0.8	V	VDD = 3.0V
Output High I	$I_{OH}$	-	-2.0	-	mA	VDD = 3.0V, $V_{OH} = 2.4V$
Output Sink I	$I_{OL}$	-	2.5	-	mA	VDD = 3.0V, $V_{OH} = 0.8V$

(VDD = 4.5V,  $T_A = 25$  )

Characteristics	Symbol	Limit			Unit	Test condition
		Min	Typ.	Max		
Operating Voltage	VDD	3.6	-	5.0	V	
Operating Current	$I_{OP}$	-	6	9	mA	VDD = 4.5V, $F_{CPU} = 600KHz$
Standby Current	$I_{STBY}$	-	3	4.5	$\mu A$	VDD = 4.5V
Input High Level	$V_{IH}$	3.0	-	-	$\mu A$	VDD = 4.5V
Input Low Level	$V_{IL}$	-	-	0.8	$\mu A$	VDD = 4.5V
Output High I	$I_{OH}$	-	-2.0	-	mA	VDD = 4.5V, $V_{OH} = 3.5V$
Output Sink I	$I_{OL}$	-	2.5	-	mA	VDD = 4.5V, $V_{OL} = 0.8V$

### 2.3 Pin Assignment of TN0; TN9

Warning: The Dimension in this drawing is for reference only.

For actual dimension, please download from <http://www.ZyTemp.com/products/download/ExtDrawing.asp>

- V: Vdd
- D: Data (Serial Data)
- A: Action Pin ( pull low to measure, floating to WriteData into the IRT)
- G: GND
- C: Clock (Serial Clock)

Note: TN0; TN9 has the same pin assignment.

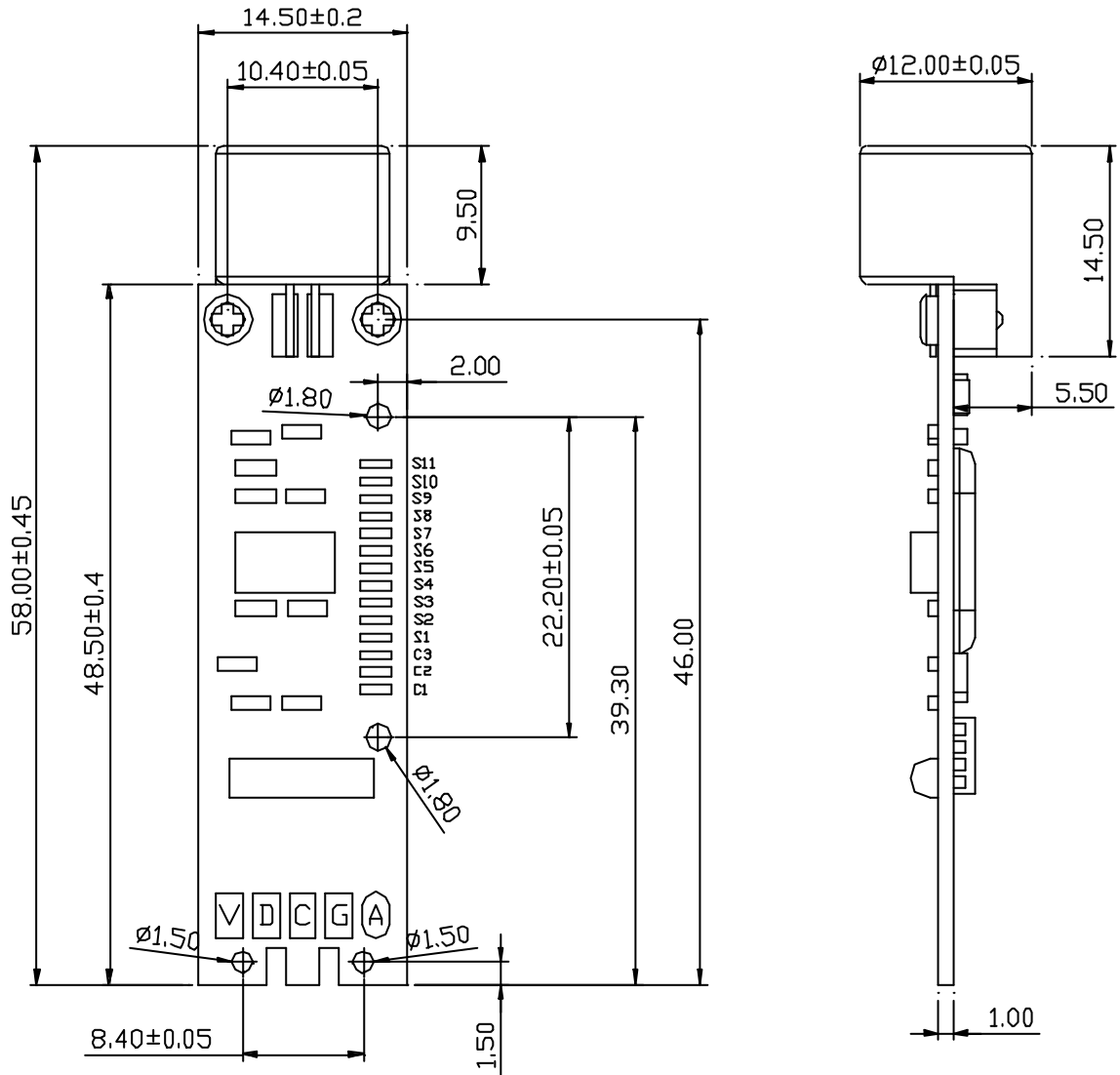
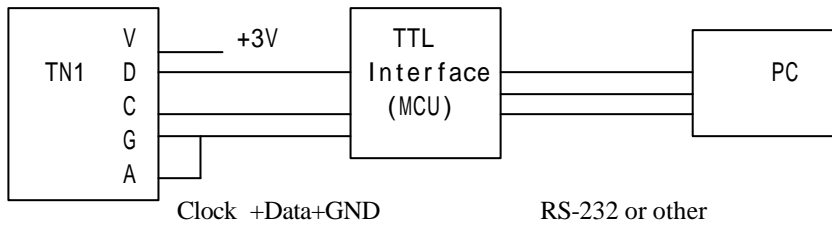


Fig. Drawing of TN0am

### 3 Serial Output

#### 3.1 Typical Diagram



DUT to TTL Interface (MCU)

V:Vcc

D:Data

C:Clock (2KHz)

G:GND

A:ActionKey (When Pull Low, the device will measure Tbb continuously.)

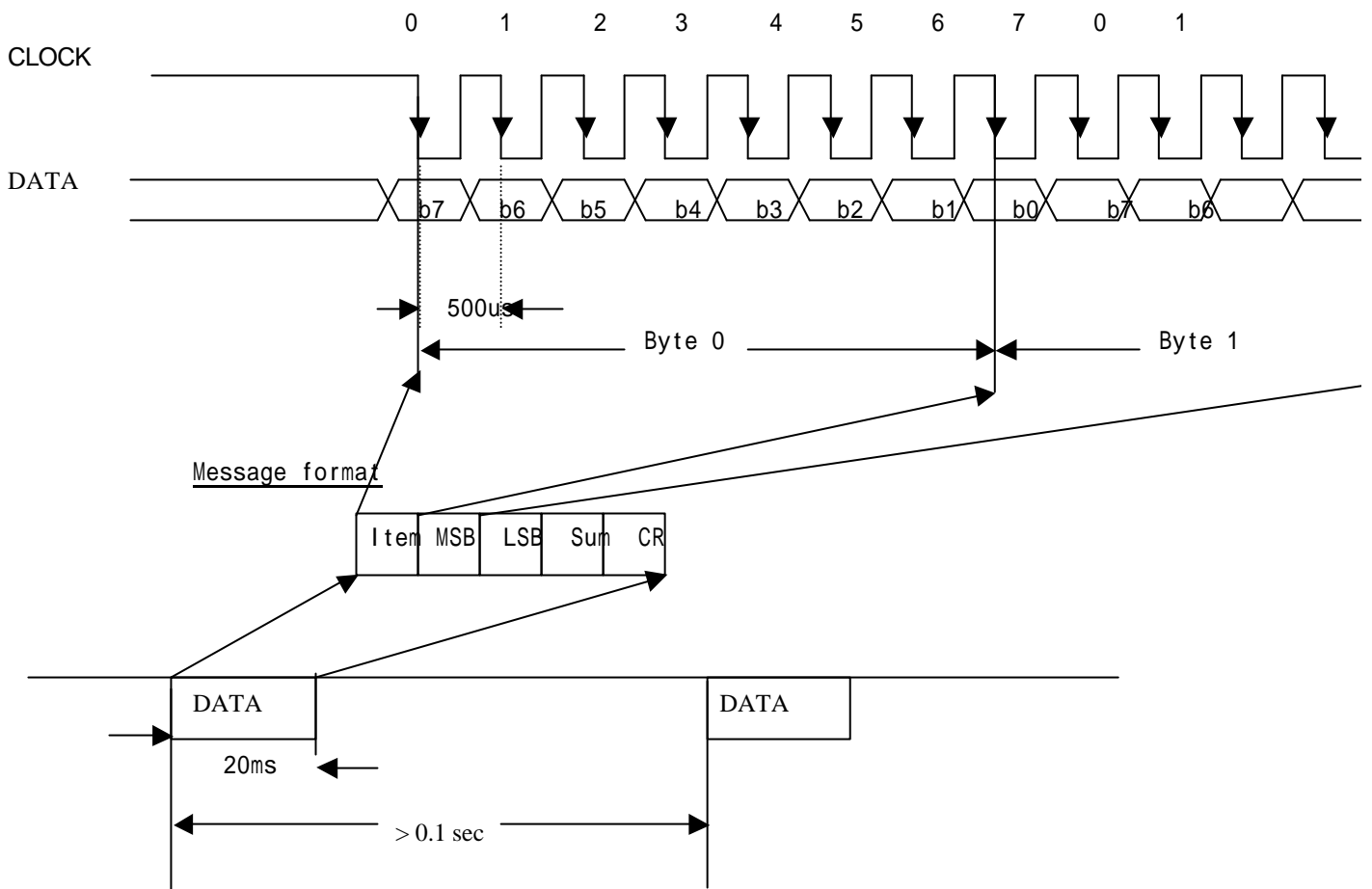
DUT is Output the data, MCU is receiving the Data

Note:

Data Pin is High when there is no data

Time Out > 2ms

#### 3.2 Timing of SPI



### 3.3 Format of Message

Item	MSB	LSB	Sum	CR
------	-----	-----	-----	----

Item

L(4CH): Tobj (Temperature of Obj)  
 f(66H): Tamb (Ambiant Temperature)  
 C(43H): Status (not available now)

MSB

16 bit Data Msb

LSB

16 bit Data Lsb

Sum

Item+MSB+LSB=SUM

CR

End of the message

#### 3.3.1 Example

##### 1. Measurement Temperature

4C	14	2A	8A	0D
----	----	----	----	----

Item

4C → 'L' meas Measurement temperature

Data

MSB 14

LSB 2A

Real Temperature Value  $[\text{Hex2Dec}(142A)]/16-273.15= 49.475$

Sum

Checksum  $4C+14+2A=8A$  (Only Low Byte)

CR

0D → 'Carriage Return' meas End of Message

##### 2. Ambient Temperature

66	12	C3	3B	0D
----	----	----	----	----

Item

66 → 'f' Ambient temperature

Data

MSB 12

LSB C3

Real Temperature Value  $[\text{Hex2Dec}(12C3)]/16-273.15= 27.03$

Sum

Checksum  $66+12+C3=13B$  (Only Low Byte)

CR

0D → 'Carriage Return' meas End of Message

##### 3. System Status (no available at 02/14/2003, under development)

43	00	00	43	0D
----	----	----	----	----

Item	43 → 'C' System Status		
Data	MSB 00 (Only 00)		
	LSB		
	bit7	Empty	(Fill Zero)
	bit6	Empty	(Fill Zero)
	bit5	0:Normal	1:Power Lower than 2.7V Alarm
	bit4	0:Normal	1:Measurement Temperature Too High Alarm
	bit3	0:Normal	1:Measurement Temperature Too Low Alarm
	bit2	0:Normal	1:Ambient Temperature Over Operation Range Alarm
	bit1	0:Normal	1:Ambient Temperature Change Too Fast Alarm
	bit0	0:Normal	1:System Error
Sum	Checksum 43+00+00=43 (Only Low Byte)		
CR	0D → 'Carriage Return' meas End of Message		

### 3.3.2 How to modify Emissivity? (How to write Emissivity into EEPROM)

Warning: misuse may result in EEPROM other data modified, this may destroy the calibration. the device may become useless!

- The communication format and how to read data from DUT's CommuMode:  
ItemCode + HighByte + LowByte + CheckSum(ItemCode+HighByte+LowByte) + CR ,  
total 40 clocks(& data).
- For write Emissivity to DUT, the communication format is the same as read.  
=> 'S' + HighByte(Emissivity value) + 04H + CheckSum(ItemCode + HighByte + 04H) + CR  
Emissivity value = HighByte(hex)/100(dec),  
For example: HighByte = 5F(hex)=95(dec) -> emissivity = 95(dec)/100(dec) = 0.95.  
keep the LowByte data = 04(hex).
- The trick for write data to DUT is as below
  - Action pin need to be floating when we want to write data to DUT.
  - As you know, DUT will do routine data out by 40 clocks & datas with communication format.  
After the 40th clock, DUT will pull the CLK & DATA pin to weak high for waiting if there is External CPU want write data to DUT.  
Please let External CPU start send 1st clock at the timing T1 after the 40th clock.  
=> 5ms < T1 < 10ms
  - The frequency of CLK should be 2KHz.
  - DUT will latch the data at negative edge of CLK, so data should be ready before the negative edge of 1st writing clock.
- For example,  
Emissivity = 0.95 ==> 'S' + 5F(hex) + 04(hex) + B0(hex) + CR  
Emissivity = 0.80 ==> 'S' + 50(hex) + 04(hex) + A7(hex) + CR
- You can use the PC2HL\_6.exe to help you to understand the data transfer between DUT & Hub.  
=> Execute the F6 function key, and monitor the CLK & DATA wave waveform by Oscilloscope.
- Finally, how do we know write emmissivity success.

About 5 ms after you send CLK & DATA to DUT completely.

DUT should have 3 kinds of response.

(1) DUT will send out the same data which External CPU had write to DUT. (We call this ECHO).

That means write emissivity success.

(2) DUT will send out 'S' + FF(hex) + FF(hex) + CheckSum( 'S' + FF + FF ) + CR.

That means DUT find data checksum error = a wrong data receiving.

DUT will forget the data, and you need to re-write again.

(3) DUT have no response as above

That means DUT don't get full 40 clocks.

Please check the clock & data which control by External CPU.

Especially, is the T1 timing is right??

## 4 Interface Demo Board: Hub-D

### General Description:

Hub-D is an Interface box with LCD, for TN series.

This Box can work as an interface between the IRTm(IRT Module) and PC. see Fig.A

“Hub” has no LCD, but “Hub\_D” has a 2-line LCD, it can also work without the PC.

The Hub will show Tobj & Tamb (data from the IRTm) continuously.

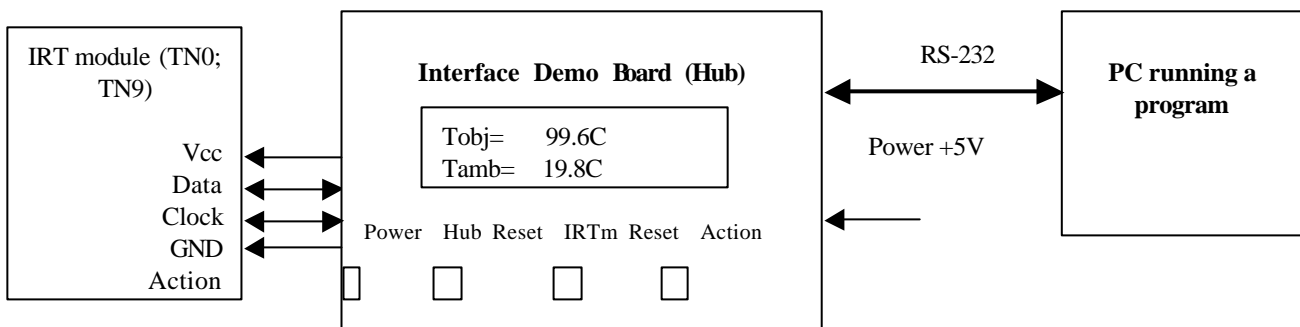


Fig. Typical Application of Hub

Model No: Hub-D

Reference Price: US\$94

Program: TN\_PC\_001.exe

Source Code: TN\_PC\_001.C

Price: to be discuss

## 5 Interface Program for PC (TN\_PC.exe)

TN\_PC\_nnn.exe is a communication program.

a Free version can be download at [www.ZyTemp.com/Products/Download/](http://www.ZyTemp.com/Products/Download/)

Running under a DOS window (in MS Windows environment)

This program will show

Tbb (Tobj) ; Tamb in degC; degF continuously

Status of IRT

Professional Screen Layout

Graph of Tbb; Tamb (under development)

Ave;Max;Min in real time (under development)

under MS window (under development..)

end of file.