SMART AIR TEMPERATURE, PRESSURE AND HUMIDITY SENSOR

**TPR159**

Description and user manual
TECHNICAL DESCRIPTION

TPR159 is in intelligent sensor for atmospheric pressure, air temperature and relative humidity measurements. It has a built in CMOS microprocessor, which enables additional processing of measured parameters and various printout formats.

TPR159 uses three different sensors for its operation:

**Measurement of atmospheric pressure**

For atmospheric pressure measurements TPR159 uses SMD-hibrid integrated circuit, including piezoresistive pressure sensor and AD converter.

**Measurement of air temperature.**

Pt100 resistance is used as temperature sensor.

**Measurement of relative humidity**

For relative humidity measurement a kompenzated semiconductor detector is used.

Detectos are shielded from sun radiation and rainfall with ribbed casing made of white UV-resistant plastic.

On bottom end of transistor there are a mechanical element for fixing and a 4-pin water-resistant connector for computer connection.

Sensor is mounted in vertical position on demanded height; all electrical wires must be protected from overvoltage. Connection with sensor is made with 4-wire shielded cable and is independent from wires resistances.

Depending on sensor distance from control computer there are optins for RS232, RS485(two-wire) or SDI-12 communication.

- RS232 protocol maksimal cable length up to 20 m
- RS485 protocol maksimal cable length up to 1200 m (2x shielded twisted pair)
- SDI-12 protocol maksimal cable length up to 60 m

Sensor enables measurement of current (1 sec) and average (1, 2, 5, 10, 30 ali 60 min) values of individual parameters.

Data from sensor TPR159 can be obtained in two ways (depends on settings)

- sensor sends data every second or at the end of averaging time.
- data is called with an appropriate command
For setting-up sensor via RS232 bus, we must use an appropriate cable and a terminal program.

<table>
<thead>
<tr>
<th>PIN</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGNAL</td>
<td>A - TX</td>
<td>B - RX</td>
<td>+5-15V</td>
<td>GND</td>
</tr>
</tbody>
</table>

Connector on sensor

<table>
<thead>
<tr>
<th>PIN</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGNAL</td>
<td>-</td>
<td>TX</td>
<td>RX</td>
<td>-</td>
<td>GND</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

For connection to computer a standard 9 pin female (DB9F) connector is used.

Schematic diagram of power supply and RS232 connection between sensor and computer.
The sensors operational mode is set in system menu. All settings are saved in EEPROM for later use.

After every measurement interval instrument saves average, minimal and maximal data including time and date. This data can be obtained later with proper command from control computer.

Commands for sensor TPR159

For communication between interface and personal computer we can use terminal program with following settings:

- **COM X** (No. of communication port on which interface is connected X = 1, 2, 3, 4. etc.)
- **Baud rate 38400** Primary data transfer speed is 38400
- **Data: 8**
- **Parity: none**
- **Stop: 1**
- **Flow control: none**

HELP

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STIME H:M:S D/M/Y</td>
<td>Set time-date</td>
</tr>
<tr>
<td>AVG t</td>
<td>t = 1, 2, 5, 10, 30, 60 [ min ]</td>
</tr>
<tr>
<td>VALI n</td>
<td>n = 0 - 100 [%]</td>
</tr>
<tr>
<td>SN n</td>
<td>Serial number</td>
</tr>
<tr>
<td>TIME</td>
<td>Read time-date</td>
</tr>
<tr>
<td>SERMODE</td>
<td>ON, OFF Interval, INS Instant print</td>
</tr>
<tr>
<td>DEFAULT</td>
<td>Restore DEFAULT</td>
</tr>
<tr>
<td>SPEED b</td>
<td>b = 1200,2400,2400,9600,19200,38400</td>
</tr>
<tr>
<td>SPP x0 y0 x1 y1</td>
<td>p=par. x0 y0 x1 y1 set straight</td>
</tr>
<tr>
<td>OFSP p n</td>
<td>p=par. n=offset</td>
</tr>
<tr>
<td>BPp</td>
<td>p=par. Read par BIN</td>
</tr>
<tr>
<td>CFG</td>
<td>Read configuration</td>
</tr>
<tr>
<td>TA</td>
<td>Read instant data</td>
</tr>
<tr>
<td>PA</td>
<td>Read average data</td>
</tr>
<tr>
<td>PINS</td>
<td>Read instant data AMES</td>
</tr>
<tr>
<td>PAVG</td>
<td>Read average data AMES</td>
</tr>
</tbody>
</table>

Temp RH Press Sun Speed Dir Chc(8) <STX>24.7<T>43.1<T>954.7<T>-9999<T>-99.9<T>-999<T>093<ETX>

Command is always confirmed with sign <CR>==<ENTER>
**STIME** \(<\text{H:M:S D/M/Y}>\)

Command to set time and date on sensor.

*Example: STIME 12:37:46 18/8/9 <CR>*
*Answer: T= 12:37:46 D= 18/08/09<CR><LF>*

**AVG t**

Command to set averaging time.

\([1]= 1 \text{ min} , [2]= 2 \text{ min} , [5]= 5 \text{ min} , [10]= 10 \text{ min} , [30]= 30 \text{ min} , [60]= 60 \text{ min}\)

*Example: AVG 1 <CR>*
*Answer: Average 1 min<CR><LF>*

Averaging time was set to 1 min.

**VALI n**

Command to set sensor, how many percent of measurements in averaging interval must be valid. Otherwise parameter generates an error status.

\(n = 0 - 100 \ [%]\)

*Example: VALI 70 <CR>*
*Answer: Validity=70% Count-mea=1260<CR><LF>*

At least 70% of data in averaging interval must be valid to declare interval with no error.

**SN n**

Command to set sensors serial number.

*Example: SN 3 <CR>*
*Answer: Serial Number: 00003<CR><LF>*

Serial number is now SN 00003.

**TIME**

Command to retrieve current time and date.

*Example: TIME <CR>*
*Answer: 12:37:50 18/04/13<CR><LF>*

**SERMODE** ( ON, OFF ali INS )
TPR 159 – Temperature, pressure and humidity sensor

SERMODE ON <cr> Command enables printout of calculated values to serial port
SERMODE INS <cr> Command enables constant printout of current values to serial port
SERMODE OFF <cr> Command disables printout of calculated values to serial port

**DEFAULT**
Command sets sensors preprogrammed values to EEPROM

*Example:* DEFAULT <CR>

*Answer:* Resore default !<CR><LF>

**SPEED b**
Command sets sensor speed of serial transmission
b = 1200, 2400, 4800, 9600, 19200, 38400 (default 38400 bps)

*Example:* SPEED 19200 <CR>

*Answer:* Serspeed Com0 19200 bps<CR><LF>

**SPp x0 y0 x1 y1**
Command directly sets sensor constants for calculation of parameter value
P10 Temperature  P35 Relative humidity  P47 Atmospheric pressure

P10 is temperature parameter.

*Example:* SP10 16002 87.25 22001 127.34 <CR>

*Answer:*

```
  ar.   Code  x0   y0   x1   y1
  T1   P 10  16002  87.25 ohm(-40.0 C)  22001   127.34 ohm(40.0 C)
** SAVE   EEPROM ! **<CR><LF>
```

**OFSP p n**
Command enables setting offset for parameter
P10 Temperature  P35 Relative humidity  P47 Atmospheric pressure

*Example:* OFSP 10 -0.2<CR>

*Answer:*

```
P 1 Offset: - 0.2
** SAVE EEPROM ! **
```

Temperature was lowered for 0.2 deg.C in whole range!

BPp
Command for constant print out of binary values of parameter p, with key <ESC> printout is canceled.
P=30 e.g. is parameter for water temperature.

*Example: BP10 <CR> (temperature)*

*Answer:*

```
P10  CH=02  20853 bin  T1= 86.4 degC  < ESC >
P10  CH=02  20852 bin  T1= 86.4 degC  < ESC >
P10  CH=02  20852 bin  T1= 86.4 degC  < ESC >
P10  CH=02  20852 bin  T1= 86.4 degC  < ESC >
P10  CH=02  20852 bin  T1= 86.4 degC  < ESC >
< ESC > returns station in measurement mode
```

*Example: BP35 <CR> (relative humidity)*

*Answer:*

```
P35  CH=---- ---- bin  RH= 46.1 %  < ESC >
P35  CH=---- ---- bin  RH= 46.0 %  < ESC >
P35  CH=---- ---- bin  RH= 46.0 %  < ESC >
P35  CH=---- ---- bin  RH= 46.0 %  < ESC >
P35  CH=---- ---- bin  RH= 46.0 %  < ESC >
< ESC > returns station in measurement mode
```

*Example: BP47 <CR> (atmospheric pressure)*

*Answer:*

```
P47  CH=---- ---- bin  Press= 953.5 hPa  < ESC >
P47  CH=---- ---- bin  Press= 953.5 hPa  < ESC >
P47  CH=---- ---- bin  Press= 953.5 hPa  < ESC >
P47  CH=---- ---- bin  Press= 953.5 hPa  < ESC >
P47  CH=---- ---- bin  Press= 953.5 hPa  < ESC >
< ESC > returns station in measurement mode
```

**CFG**

Command prints out configuration settings

*Example: CFG <CR>*

*Answer:*

```
**************************************************
** TPR159   AMES, driver  v 1.02 (c)    2012    **
**************************************************
Serial Number: 00006
Interval print OFF
Ins.Time:    1 sec
Average 1 min
Validity=70%    Count-mea=42
Par.    Code      x0      y0      x1      y1
T1      P 10    16002    88.48 ohm(-40.0 C)  22001 128.57 ohm(40.0 C)
T2      P 11     0       0.0  1000   100.0
RH      P 35     0       0.0  1000     100.0
PR      P 47     6000    600.0  10500  1050.0
```

TA
Command retrieves instant data.

*Example: TA <CR>*

*Answer:*

```
21.8 51.3 956.0 -9999 -99.9 -999 087
```

*Explanation:*

```
STX> 21.8<T> 51.3<T> 956.0<T>-9999<T>-99.9<T>-999<T>087<ETX>
```

**PA**

Command retrieves average data in last interval.

*Example: PA <CR>*  

*Answer:*

```
21.8 51.3 956.0 -9999 -99.9 -999 087
```

*Explanation:*

```
STX> 21.8<T> 51.3<T> 956.0<T>-9999<T>-99.9<T>-999<T>087<ETX>
```

**PINS**

Command retrieves instant data. (Format AMES)

*Example: TA <CR> ali PINS <CR>*

*Answer:*

```
P  0    03:41:10        11/07/12        00:00   00/00/00        C
P 10   25.2  0
P 11   25.2  0         temperature 2 for relative humidity compensation
P 35   46.9  0
P 47   952.8  0
034
```

**INSTANT DATA**

<table>
<thead>
<tr>
<th>Parameter code</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;02&gt;</td>
<td>STX</td>
</tr>
<tr>
<td>P0</td>
<td>transmittion time</td>
</tr>
</tbody>
</table>
transmission date

---------

P10 Temperature (°C) ( Instant value - 1sec )
P11 Temperature1 (°C) ( Instant value - 1sec )
P35 Relative humidity RH (%) ( Instant value - 1sec )
P47 Atmospheric pressure (hPa) ( Instant value - 1sec )

checksum in format "%03bu"<CR><LF>
( 8 bit SUM, module %256 )

<03> ETX

PA or PAVG
Command retrieves average data in last interval. (Format AMES)

Example: PA <CR> ali PAVG <CR>
Answer:

P 0  03:46:04  11/07/12  03:46  11/07/12  C
P 10 25.1  25.2  03:45  25.0  03:45  25.2  0.0  0
P 11 25.0  25.2  03:45  25.0  03:45  25.0  0.1  0
P 35 47.1  47.3  03:45  46.9  03:45  47.1  0.0  0
P 47 952.8  952.9  03:45  952.8  03:45  952.8  0.0  0
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Koda parametr Podatek

<02> STX

P0
- transmission time
- transmission date
- averaging time
| P 10  | Avg.: average value       |
| P 11  | Max.: maximal value / time of maximum |
| P 35  | Min.: minimal value / time of minimum |
| P 47  | Termin. val.: average value in last minute of interval |
|       | St. dev.: standard deviation |
|       | Validity of parameter data ( 00 – OK ) |
|       | Checksum v formatu "%03bu"<CR><LF> |
|       | ( 8 bit SUM, module %256 ) |

Explanations of CRC module %256 calculation

![CRC calculation](image)
We must add all characters from red to red included them!

21.8  51.3  956.0  -9999  -99.9  -999  087
<STX>  21.8<T>  51.3<T>  956.0<T>  -9999<T>  -99.9<T>  -999<T>  087<ETX>
|------------------------| Vse karakterje sešteješ ------------------------|

Sum is  1623  (dec)

1623/256= 6.339  ....

From this follows  256 x 6 = 1536

1623-1536= 87 (residue of module 256) (printout format is %03u that is 087)

CRC is residue of module 256

In program language C  CRC=sum%256;
APPENDIX