SDI-12 Protocol

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SDI-12 Discussion Topics

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SDI-12 Overview

SDI-12: Serial-Digital Interface at 1200 baud.

SDI-12 is a standard for interfacing data recorders with microprocessor-based sensors.
SDI-12 Overview

SDI-12 supports systems requiring

- Low Power (i.e. Battery powered)
- Low system cost
- One data recorder, multiple sensors, one cable
The SDI-12 bus is capable of having at least 10 sensors connected to it, each with 200 feet of cable. With fewer sensors, longer cable lengths are possible.
Only one data recorder may poll SDI-12 sensors.

An additional recorder must be placed in Listen-only “Evesdropping” mode to avoid contention.

Listen-only recorders retrieve samples at the sampling rate of the polling recorder.
SDI-12 Advantages

• Self Calibration and Storage
• Sensor Interchangeability
• Design Simplification
• Design Independence
• Minimized Learning Curve
Serial byte frame format: 1200, 7, E, 1

Commands/Responses: Printable ASCII characters.
The data recorder starts by sending a break to wake up the sensors on the data line.

* A break is continuous spacing on the data line for at least 12 milliseconds.

The data recorder then sends a command.
SDI-12 COMMUNICATIONS
Recorder Command

Commands begin with a unique sensor address that specifies the sensor the recorder wants to communicate with.

\[ a<\text{Command}>! \]

Other sensors on the SDI-12 bus ignore the command and return to low-power standby mode.

All commands are terminated with a ‘!’.
SDI-12 COMMUNICATIONS
Sensor Response

a<Response><CR><LF>

Sensors only respond if they have been sent a command.

The first character of a response is the address of the responding sensor.

All responses are terminated with a <CR><LF>.
# Basic SDI-12 Command/Response Set

<table>
<thead>
<tr>
<th>Command Name</th>
<th>Command</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acknowledge Active</td>
<td>a!</td>
<td>a&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Send Identification</td>
<td>aI!</td>
<td>allccccccccmmmmmmmvvxx...xx&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Change Address</td>
<td>aAb!</td>
<td>b&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Address Query</td>
<td>?!</td>
<td>a&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Start Measurement*</td>
<td>aM!</td>
<td>atttn&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Start Measurement and Request CRC*</td>
<td>aMC!</td>
<td>atttn&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Send Data</td>
<td>aD0! Thru aD9!</td>
<td>a&lt;values&gt;&lt;CR&gt;&lt;LF&gt; OR a&lt;values&gt;&lt;CRC&gt;&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Additional Measurements*</td>
<td>aM1! Thru aM9!</td>
<td>atttn&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Additional Measurements, Request CRC*</td>
<td>aMC1!...aMC9!</td>
<td>atttn&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Start Verification*</td>
<td>aV!</td>
<td>atttn&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Start Concurrent Measurement</td>
<td>aC!</td>
<td>attttn&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Additional Concurrent Measurement</td>
<td>aCC!</td>
<td>attttn&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Additional Concurrent Measurements</td>
<td>aC1!...aC9!</td>
<td>attttn&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Additional Concurrent Measurements, Request CRC</td>
<td>aCC1!...aCC9!</td>
<td>attttn&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Continuous Measurements</td>
<td>aR0!...aR9!</td>
<td>a&lt;values&gt;&lt;CR&gt;&lt;LF&gt;</td>
</tr>
<tr>
<td>Continuous Measurements, Request CRC*</td>
<td>aRC0!...aRC9!</td>
<td>a&lt;values&gt;&lt;CR&gt;&lt;LF&gt;</td>
</tr>
</tbody>
</table>

*This command may result in a service request a<CR><LF> from the sensor.*
SDI-12 COMMUNICATIONS

Typical Measurement Sequence

Data Recorder

SDI-12 Bus

SDI-12 Sensor 0

SDI-12 Sensor 1

SDI-12 Sensor 2

aM! - Start Measurement

attn<cr><lf> - Sensor Rsp

a<cr><lf> - Service Request

aD0! - Send Data

a<values><cr><lf>

<=15mS
SDI-12 Measure Command Response

\[atttn<CR><LF>\]

\[a\] - the sensor address

\[ttt\] - the specified time, in seconds, until the sensor will have the measurement(s) ready

\[n\] - the number of measurement values the sensor will make and return in one or more subsequent D commands; \(n\) is a single digit integer with a valid range of 1 to 9
SDI-12 Measurement Example

If measured data exceeds 35 bytes, multiple data buffers are needed to retrieve all parameters.
Legacy ALERT Constraints

The ALERT value range is 0 - 2047.

Decimal points are not included in the transmitted value.

A value greater than 2047 will be based on a multiple of 2048.

In all cases, if there is a rollover in the data calculation, the remainder value will be sent.
## Legacy ALERT Constraints

Including Precision in ALERT

Example of Positive Range

<table>
<thead>
<tr>
<th>SDI-12 Sensor Value</th>
<th>Precision</th>
<th>ALERT value</th>
<th>Base Station Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.530</td>
<td>0</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>18.530</td>
<td>1</td>
<td>185</td>
<td>0.1</td>
</tr>
<tr>
<td>18.530</td>
<td>2</td>
<td>1853</td>
<td>0.01</td>
</tr>
<tr>
<td>185.30</td>
<td>0</td>
<td>185</td>
<td>1</td>
</tr>
<tr>
<td>185.30</td>
<td>1</td>
<td>1853</td>
<td>0.1</td>
</tr>
<tr>
<td>185.30</td>
<td>2</td>
<td>98</td>
<td>0.01</td>
</tr>
</tbody>
</table>
**ALERT2 vs ALERT?**

ALERT2 can transmit values as float, integer or signed integer.

- 18.53 is transmitted as 18.53
- 185.3 is transmitted as 185.3
- -3000.5 is transmitted as -3000.5
SDI-12 Sensor - Setup / Diagnostics

SDI-12 Transparent Mode

User interface allowing users to send SDI-12 commands and read the response.

Allows users to submit extended commands that are custom to the sensor. i.e. Calibration or setup commands.

Allows users to verify an SDI-12 sensor is functioning properly.

All data recorders provide a transparent mode.
SDI-12 Sensor - Setup / Diagnostics
SDI-12 Sensor - Setup / Diagnostics

High Sierra Insight Software

Note: SDI-12 sampling and reporting operations are interrupted until this tab is closed.
SDI-12 Sensor – Setup / Diagnostics