

Application Note

AN2003

D-Series

RS-422 connection to RS-485

V 1.04

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Abstract

This Application Note shows how to use one or several D-Series devices at the RS-485 two wire interface. To use more than one D-Series sensor on a single RS-485 line the device ID of every device has to be configured with different ID's.

This Application Note is provided as is without any warranty for any problems this sample may cause.



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1 Introduction

The D-Series sensor includes a RS-422 interface that can also be used as RS-485 interface.

The RS-485 interface works in a half duplex mode but it is still possible to connect several devices to a master as long as the devices only transmit data when requested by a master command. Therefore the command tracking with buffering needs to be used.

The RS-485 interface can be established by a simple change of the wiring of the RS-422 interface.

2 Prerequisites

Before you start with RS-485 you must ensure that the interface board firmware is version V1.17 or higher because older versions had a RS-485 bug. More details how to update the firmware follows in chapter 3.

3 Configuration

This chapter is a step by step configuration example. Just do each single step described later in this to configure the sensor for a RS-485 application.

3.1 Deactivate SSI

| Steps | Description |
|-------|--|
| 1 | Connect the laser sensor over USB or RS-232 to the PC, start the Laser Sensor Utility software and check the connection. Download and install the latest "Laser Sensor Utility" software (www.dimetix.com/UtilitySW). |
| 2 | Check the right firmware version of the D-Series interface board: V1.17 (or newer) because older versions had a RS-485 bug. Otherwise update the laser sensor firmware according firmware update instructions on the Dimetix knowledge base. https://dimetix.com/en/services/knowledge-base/#how-can-the-sensor-firmware-be-updated |
| 3 | Choose the "Configuration" tab and the "SSI" sub tab |
| 4 | Check that the RS-422 is selected |
| 5 | Press the "Download to device" button to send and save the chosen configuration to the laser sensor Information: The warning message can be accepted by clicking on the OK button. |

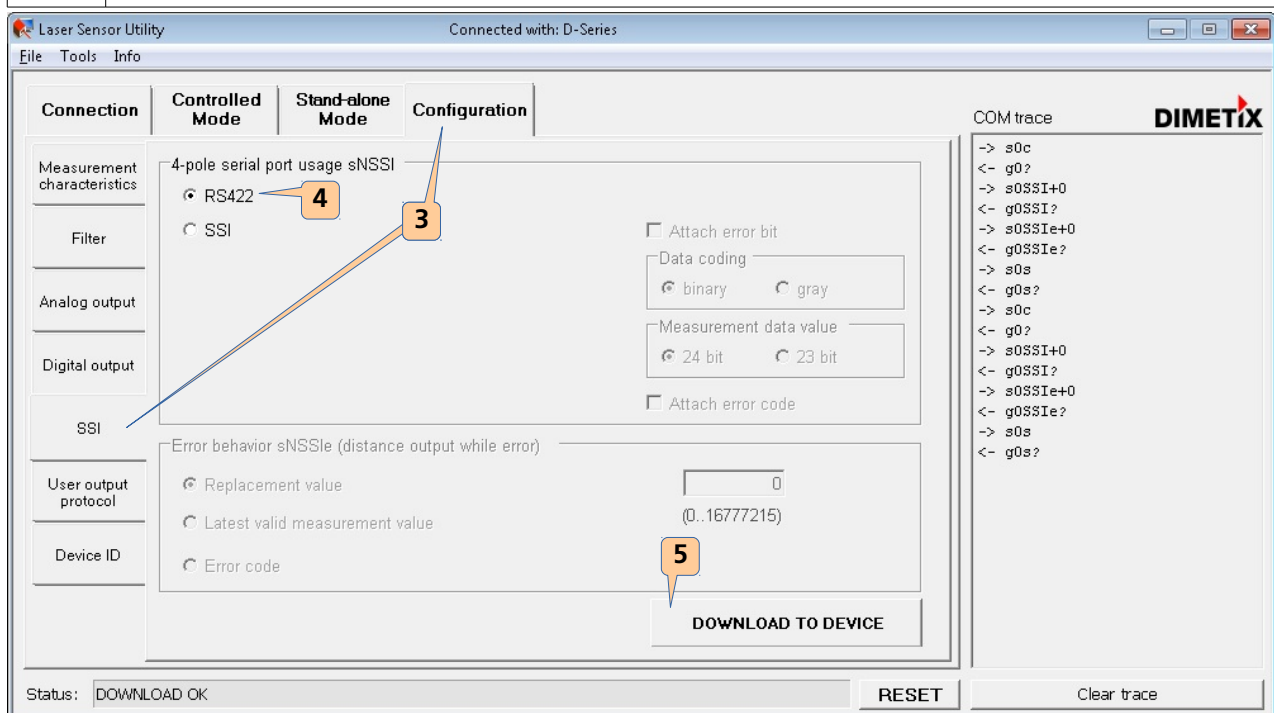


Fig. 1: Activation of the RS-422 interface (RS-485)

3.2 Set ID for device

It is necessary to configure a unique device ID on every sensor. Two sensors with the same ID would return command answers at the same time to the shared bus which would lead to invalid character strings. In the worst scenario it could happen that these would be considered as new commands and produce a new answer or an unknown command error output (E203).

To set a new ID do the following steps.

| Steps | Description |
|-------|---|
| 6 | Choose the "Configuration" tab and the "Device ID" sub tab |
| 7 | Select a new device ID which is not already used |
| 8 | Press the "Download to device" button to send and save the chosen configuration to the laser sensor |

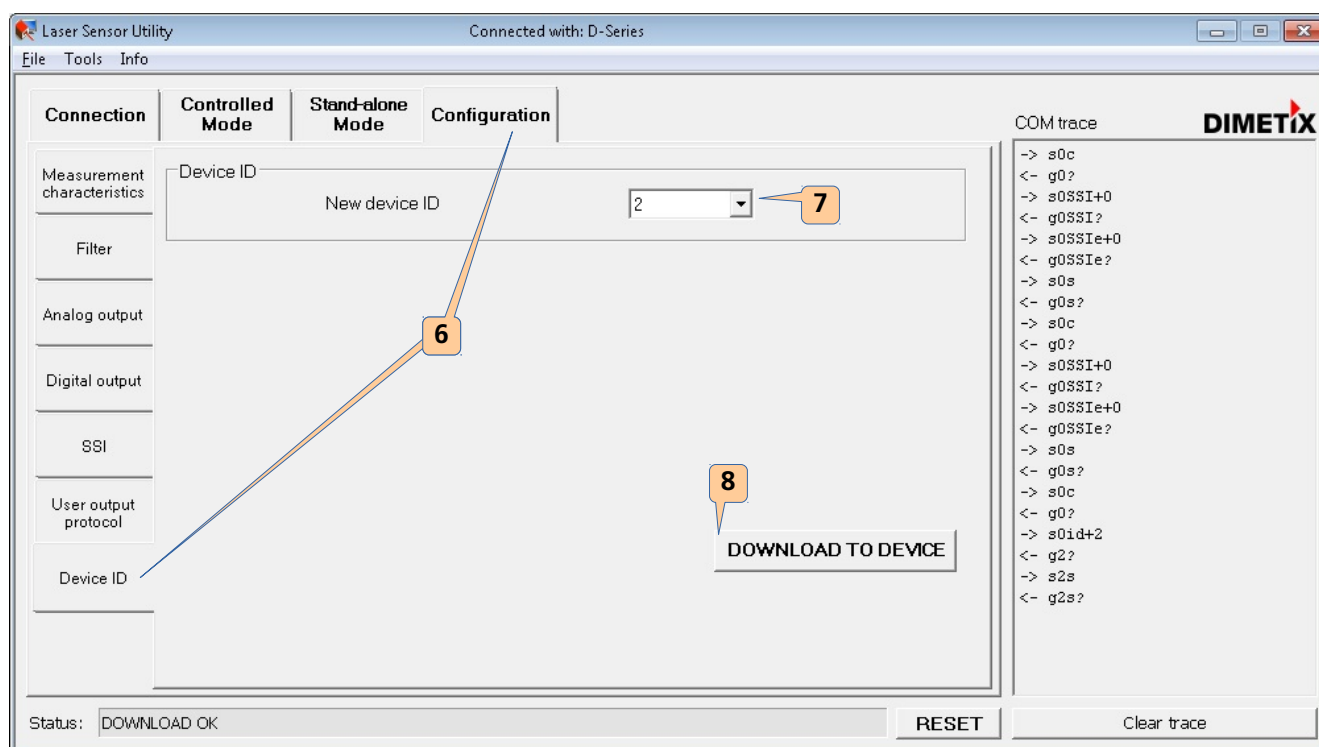


Fig. 2: Set a new ID for the device



4 Wiring

To convert the existing RS-422 interface into a RS-485 one, all you have to do is to connect both pairs of receive and transmit line poles by shorts (R+ with T+ and R- with T-).

A simple two wire (differential) communication from one RS-485 master up to 100 D-Series sensors can be created in this way. Read and write lines are the same. Furthermore the signal ground should be connected from each device to the RS-485 master to avoid a floating common mode voltage on the wires.

To prevent communication errors, the sensor may only answer to the master commands and must ignore the other sensor answers. For this the sensor firmware examines the first character of the communication string (all master commands allowed for RS-485 communication begin with a 's', sensor answers begin with a 'g').

4.1 RS-485 Connection

Figure 3 shows the connection of up to 10 devices (DLS-C/FLS-C(H)) to a RS-485 bus master.

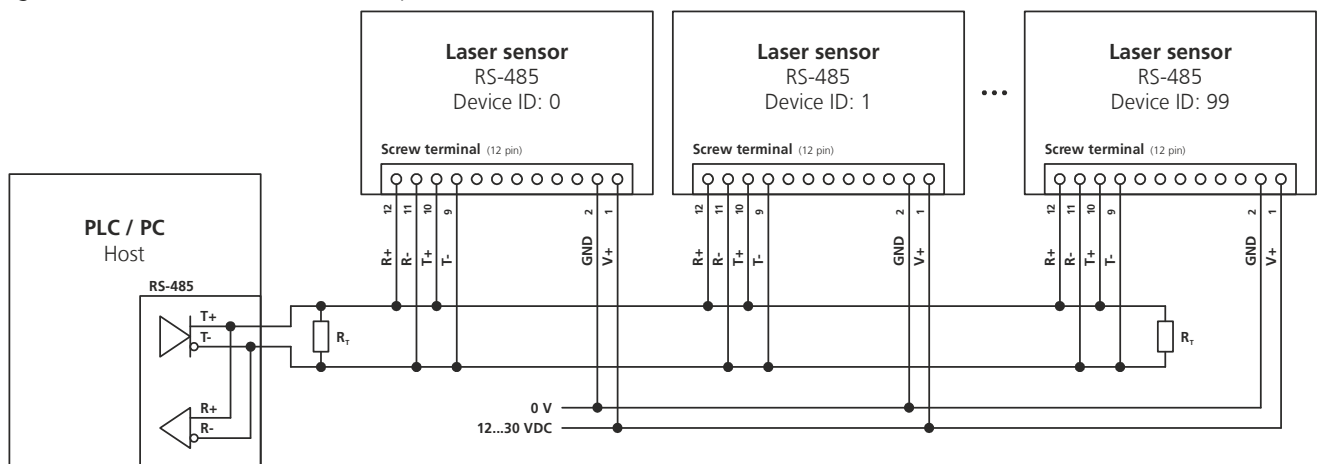


Fig. 3: Laser sensors connected to a RS-485 line

The devices can be attached to the RS-485 bus at the RS-485 bus master in any ID order. As the allowed range for the device IDs is 0 to 99, the maximum possible number of devices connected to the RS-485 bus is 100.

4.2 RS-485 bus termination

On both sides of the RS-485 chain, a bus termination should be attached (for longer buses and higher data rates compulsory) to avoid reflections. This can be realized by a terminator resistance T_R which can be attached at the furthest and closest cable end. The device order does not need to be like in Figure 3.

The termination resistance must be equal to the cable impedance (recommended: 120 Ω impedance cable).

Instead of that, in noisy environments, low pass filters can be used to filter out common mode noise. To do this, the termination resistance can be divided into two serial resistances of half the resistance and a capacitor which goes from their connection point to ground.



5 Remarks

5.1 Cable length

The laser sensor devices connected to the RS-485 bus master may have 520 m distance from the master at the furthest for default baud rate configuration (7).

The table below shows the maximum cable length for different baud rate settings.

The baud rate setting number is the one that was given with the *sNbr* command. See manual for more information.

| Baud rate setting number | Baud rate [Baud] | Maximum cable length of RS-485 line [m] |
|--------------------------|------------------|---|
| 1,6 | 9600 | 1040 |
| 2, 7 | 19200 | 520 |
| 10,11 | 115200 | 86 |

The maximum cable length also depends on the cable quality (capacitance) and the RS-485 bus master driver voltage levels and their voltage rising/falling time.

For longer cables and higher data rates, a terminator resistance is necessary as described in section 4.2.



5.2 Command set

The commands from the latest D-Series manual may be used. Some exceptions are listed in 5.2.3 Forbidden commands for RS-485.

Compatible commands to earlier devices are not allowed and lead to erroneous function in RS-485 usage.

In section 5.2.2 some commands which do not make sense with RS-485 or which only work under special circumstances are listed.

5.2.1 Allowed RS-485 commands

N is the device ID

| Command | Explanation | Command | Explanation | Command | Explanation |
|------------|------------------------------------|-------------|---|--------------|---|
| <i>sNg</i> | Distance measurement | <i>sNvm</i> | Set/Get analog output min level | <i>sNsn</i> | Get serial number |
| <i>sNf</i> | Tracking with buffering – Start | <i>sNve</i> | Set/Get analog output value in error case | <i>sNuof</i> | Set/Get user distance offset |
| <i>sNq</i> | Read out - Tracking with buffering | <i>sNv</i> | Set/Get analog output distance range | <i>sNuga</i> | Set/Get user distance gain |
| <i>sNc</i> | STOP/CLEAR command | <i>sNn</i> | Set/Get digital output levels | <i>sNum</i> | Set user mode |
| <i>sNt</i> | Temperature measurement | <i>sNfi</i> | Set/Get measurement filter configuration | <i>sNafi</i> | Set/Get additional measurement filter configuration |
| <i>sNo</i> | Laser ON | <i>sNs</i> | Save configuration parameters | | |
| <i>sNc</i> | Laser OFF | <i>sNd</i> | Set configuration parameters to factory default | | |
| <i>sNA</i> | Set auto start configuration | <i>sNsv</i> | Get software version | | |

5.2.2 Controversial commands for RS-485

N is the device ID

| Command | Explanation | Remark |
|--------------|--|--|
| <i>sNbr</i> | Set communication parameter | Only makes sense when all sensors are switched to same communication setting |
| <i>sNmc</i> | Measuring characteristic configuration | In a facility, sensors normally use the same measurement settings |
| <i>sNm+x</i> | Signal measurement | x=0:single signal measurement: allowed x=1: multiple signal measurement: forbidden! |
| <i>sNuo</i> | User output protocol | User output protocol is only active in controlled operation. Allowed for command <i>sNug</i> only. |



5.2.3 Forbidden commands for RS-485

Generally, all commands that produce autonomous character output are not allowed.

This behavior can lead to bus conflicts as another sensor can output at the same time and the message will be corrupt. Basically, all sensor outputs, that are not from kind *gNxxx*, are handled as commands by all sensors as the read and write lines are connected and thus lead to errors.

N is the device ID

| Command | Explanation | Remark |
|---------------|--|--|
| <i>sNh</i> | Single sensor tracking | Produces autonomous output on the RS-485 bus which is interpreted as commands by all connected sensors and is an access violation on the RS-485 bus. |
| <i>sNh+xx</i> | Single sensor tracking with timer | Produces autonomous output on the RS-485 bus which is interpreted as commands by all connected sensors and is an access violation on the RS-485 bus. |
| <i>dg</i> | Get device generation and type | No ID included in command -> Every sensor answers at the same time -> access violation on the RS-485 bus |
| <i>dt</i> | Get device type | No ID included in command -> Every sensor answers at the same time -> access violation on the RS-485 bus |
| <i>sNSSI</i> | Interface 2 configuration (RS-422 / SSI) | Interface 2 configuration must be set to RS-422. Otherwise all input is interpreted as SSI clock and corresponding SSI output is generated. |
| <i>sNSSIe</i> | Set/Get error value on SSI output | SSI cannot be used while using RS-485 |
| <i>sNDI1</i> | Configure digital input | Digital input is used in stand-alone sensor usage, output values can interfere with other traffic on RS-485 bus. |
| <i>sNRI</i> | Read digital input | Only works if digital input is active, see above. |

