Application Note

AN2003

DLS-C / FLS-C

RS-422 connection to RS-485

V 1.03
Please check www.dimetix.com
for the latest version

Abstract

This application shows how to display a measured distance value on a standard external numeric digital display. Description of the wiring and sensor configuration are included as well as two samples are given.

Dimetix AG • Degersheimerstr. 14 • 9100 Herisau • Switzerland • Phone +41 71 353 00 00 • Fax +41 71 353 00 01 • info@dimetix.com • www.dimetix.com

Table of content

1 Introduction

The DLS/FLS-C(H) includes a RS-422 interface that can also be used as RS-485 interface.

RS-485 is a bidirectional and differential communication bus to connect several devices to a master. It can be established by a simple change at the wiring of the RS-422 interface The necessary bus arbitration among the different sensors is done by DLS/FLS-C's firmware.

2 Prerequisites

Before you start with RS-485 you must ensure following conditions as described in sections 2.1 to 2.3.

2.1 Firmware version

To support RS-485, firmware version **V5.21** or later is required.

RS-485 is only supported on DLS-C (H) and FLS-C (H) devices.

Earlier firmware versions do not handle RS-485 bus conflicts yet and can lead to shorts on the wire!

2.2 Interface 2 configuration (RS-422 / SSI)

On every sensor that is attached to the RS-485 line, **SSI must be** switched **off**. If it is switched on, reconfigure the device at a RS-232 cable by command *sNSSI+0* followed by command *sNs*.

2.3 ID switch position

The connected devices need to have different ID switch positions not to disturb each other. 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).

3 Configuration

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 to up to 10 DLS/FLS-C devices can be created on 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.

The bus arbitration is done by DLS/FLS-C's firmware. The firmware ignores all answers from allowed commands which start with *gN...* . In this way errors on wrong commands are suppressed.

4 Wiring

4.1 RS-485 Connection

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

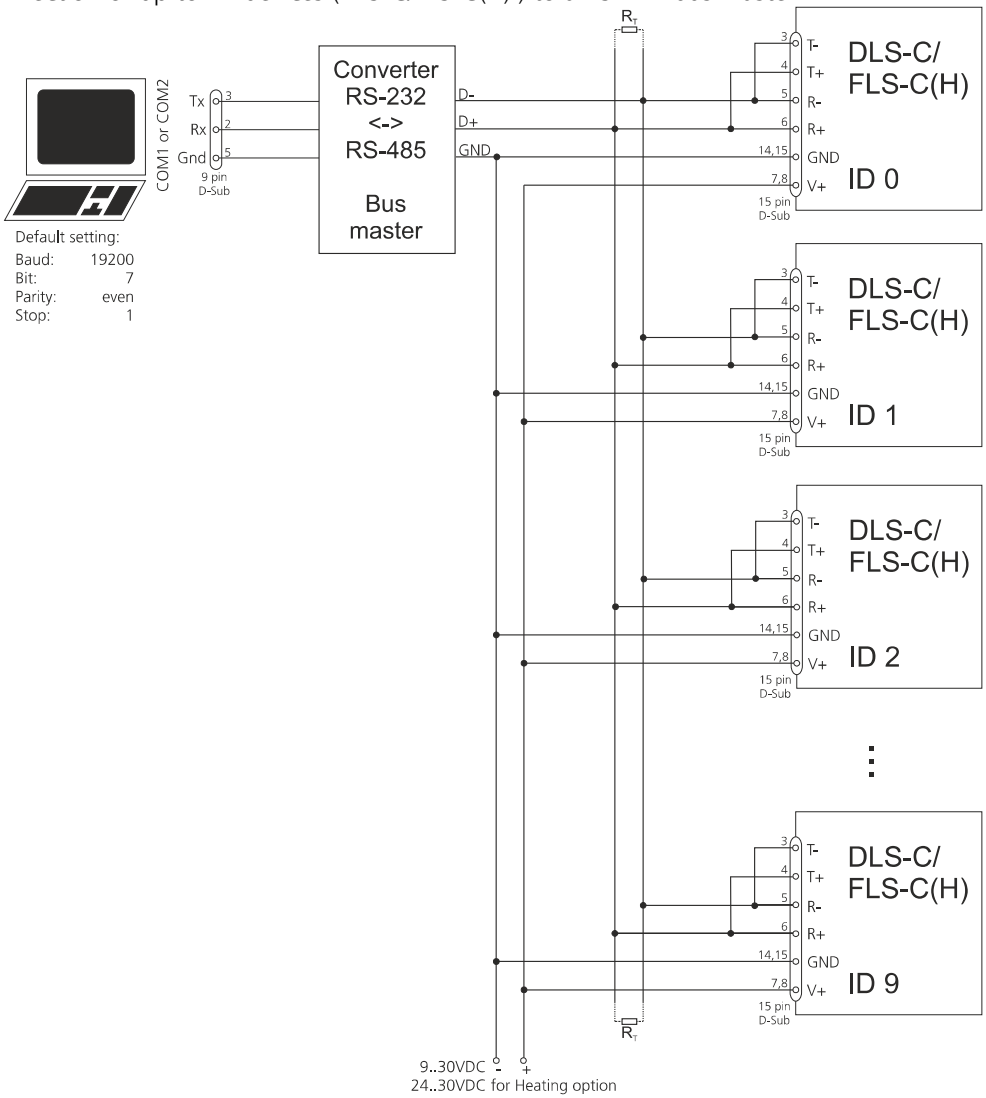

Illustration 1: Several DLS/FLS-C (H) sensors connected to a RS-485 line

The devices can be attached to the RS-485 bus at the RS-485 bus master in any ID order. As the ID switch at the Dimetix devices has 10 positions, the number of devices at the RS-485 bus is limited to 10.

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 1.

The termination resistance must be equal to the cable impedance (recommended: 120Ω 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 Dimetix DLS/FLS-C (H) 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]**
0, 3	1200	8320
4	2400	4160
5	4800	2080
1,6	9600	1040
2, 7	19200	520
8, 9	38400	260
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 DLS-C/FLS-C 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
sNg	Distance measurement
sNf	Tracking with buffering – Start
sNq	Read out - Tracking with buffering
sNc	STOP/CLEAR command
sNt	Temperature measurement
sNo	Laser ON
sNp	Laser OFF
sNA	Set auto start configuration

Command	Explanation
sNvm	Set/Get analog output min level
sNve	Set/Get analog output value in error case
sNv	Set/Get analog output distance range
sNn	Set/Get digital output levels
sNfi	Set/Get measurement filter configuration
sNs	Save configuration parameters
sNd	Set configuration parameters to factory default
sNsv	Get software version

Command	Explanation
sNsn	Get serial number
sNug	User distance measurement
sNuf	User tracking with buffering – Start
sNuq	Read out – User tracking with buffering
sNuA	Set user auto start configuration
sNuof	Set/Get user distance offset
sNuga	Set/Get user distance gain

5.2.2 Controversial commands for RS-485

N is the device ID

Command	Explanation	Remark
sNbr	Set communication parameter	Only makes sense when all sensors are switched to same communication setting
sNuc	Measuring characteristic configuration	In a facility, sensors normally use the same measurement settings
sNm+x	Signal measurement	x=0:single signal measurement: allowed x=1: multiple signal measurement: **forbidden**!
sNuo	User output protocol	User output protocol is only active in controlled operation. Allowed for command *sNug* 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
sNh	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.
sNh+xx	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.
sNuh	User 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.
sNuh+x	User 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.
dg	Get device generation and type	No ID included in command -> Every sensor answers at the same time -> access violation on the RS-485 bus
dt	Get device type	No ID included in command -> Every sensor answers at the same time -> access violation on the RS-485 bus
sNSSI	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.
sNSSIe	Set/Get error value on SSI output	SSI cannot be used while using RS-485
sNDI1	Configure digital input	Digital input is used in stand-alone sensor usage, output values can interfere with other traffic on RS-485 bus.
sNRI	Read digital input	Only works if digital input is active, see above.