Von B. Vetterli, Keller AG für Druckmesstechnik

App Note S30X-011 RS485 and Current Loop

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Document name	App Note RS485 and Current Loop X-Line
Abstract	The Series 30 transmitters provide a 4-20mA 2-L current loop and a RS4895 digital interface. This document explains the operation of the RS485 interface when used at the same time with the current loop measurement and certain precautions which must be taken in order to ensure proper operation.

1 Operating modes

1.1 4-20 mA used only

If only the current loop is used then both **RS485A and RS485B connections must be isolated.**
As an alternative, the RS485A can be connected to the RS485B, and then together isolated against other potentials.

In any case the RS485 lines **must not** be connected to either OUT/GND or earth!

1.2 RS485 used only

The transmitter can operate with the digital interface only. However, the user must consider the 2-L control loop has a serial resistance of 39 ohm in the GND line. Thus an additional voltage drop of 39 Ohm * 50 mA = 2.0V (at 120 over RSW485) has to be taken into account. Ideally, the “digital only version” or “voltage version” should be utilized for digital only applications. However, if 4-20mA + RS485 version must be used in an RS485-only mode, then use CCS30 to reconfigure the analog output section, setting the current loop to minimum by inputting the maximum pressure value of 10X nominal FS for 20mA output.

1.3 4-20 mA and RS485

There are two critical cases when the current loop and the RS485 are used simultaneously:

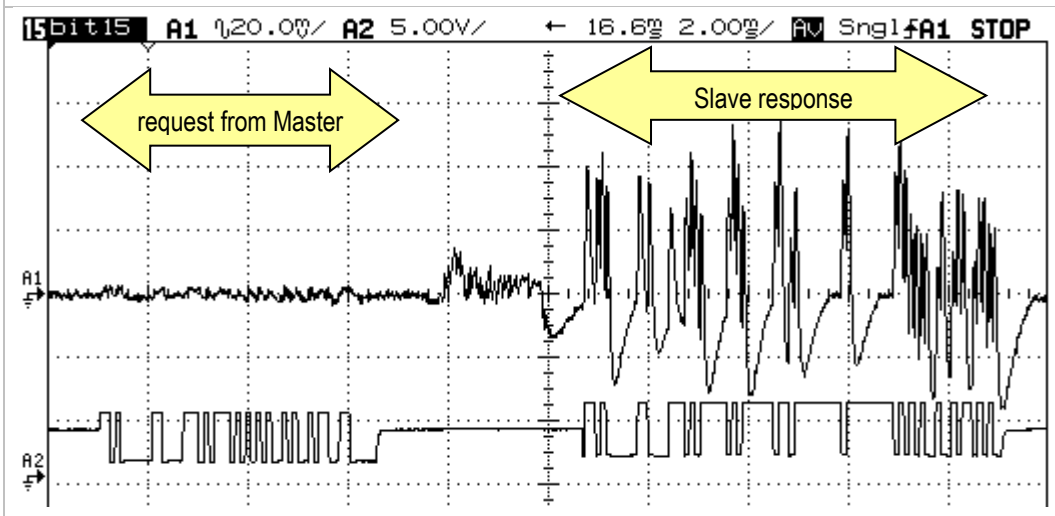
A) Even when not actually communicating, i.e., standby mode, a small current flows over the RS485 lines. This current cannot be measured because it does not flow through the current measurement resistance. This causes a measuring error of 0…±0.5% FS (0…±80µA) in the +SUPPLY line, depending on potential difference between the transmitter and interface converter. The signal current in the OUT/GND line is not similarly distorted! Therefore best practice is signal current measurement only in the OUT/GND line and not in the +SUPPLY line!

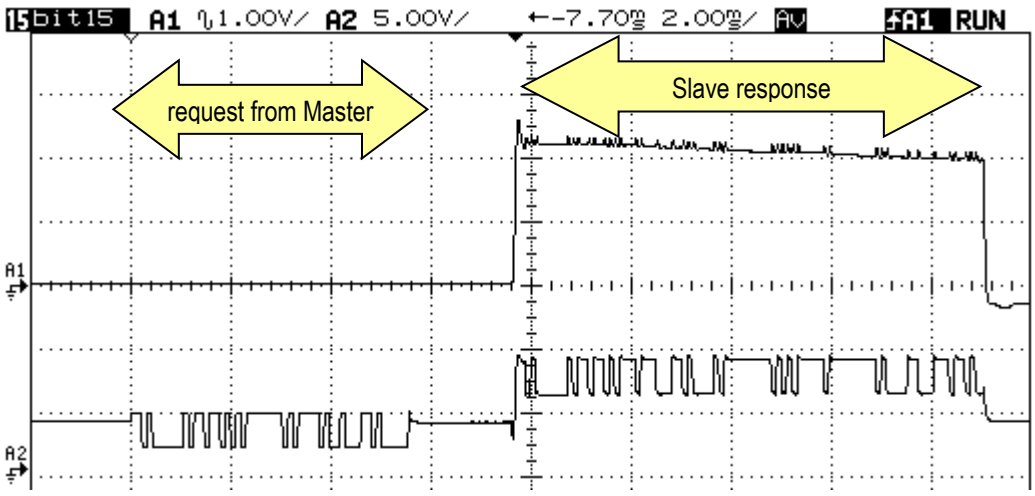
B) When the transmitter has to give an answer, it needs up to 50 mA supply current depending on termination of the RS485 lines. Of course, this cannot be compensated and therefore will appear as interference on the 2-L analog output. This is particularly noticeable because the fail-safe RS485 driver is used and therefore current peaks of approximately 2% FS may appear during answer. This interference can be filtered very well because of its high dynamic characteristic.

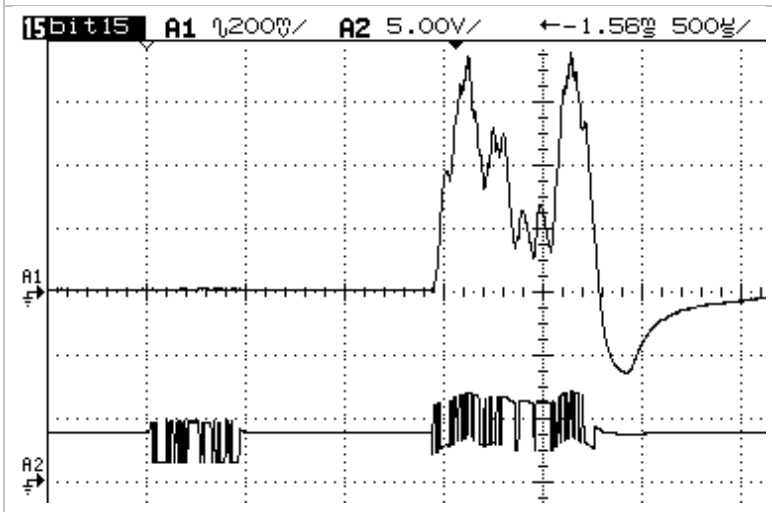
   The following recommendations are therefore considered best practice:
   Use a minimal line termination when the environmental noise is not too high (e.g. 1.5 kOhm) and run communication with 115200 baud instead of 9600 baud. This reduces the interference by factor 10.

2 Measurement

2.1 Influence of the communication on the 4-20 mA signal

RS485: 9600 baud, **no termination,** output value of the transmitter = 4.0 mA	
	A1: current measured in GND/-OUT: **200 µA/DIV** A2: RS485 communication During the response there are distortions of +400/-300 µA

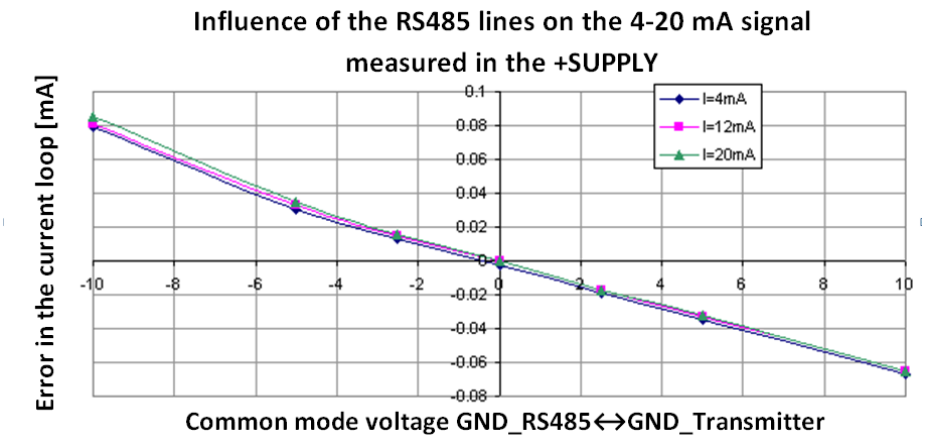
RS485: 9600 baud, **termination = 120 Ohm,** output value of the transmitter = 4.0 mA	
	A1: AC current measured in GND/-OUT: **10 mA/DIV** A2: RS485 communication During the response, the transmitter has to drive 30 mA!

Baud rate = 115200 baud, termination: **1 kOhm**, output value = 6.0 mA → response time: 1.0 ms	
	With 115200 baud the response time is shortened by factor 12, this makes filtering much easier. Here is a compromise for the termination of the RS485 with 1 kOhm instead of 120 Ohm: the noise signal has the peaks of +8mA; A filter over 1 second and 1 communication per second yield max error of 0.025 % FS.

2.2 Influence of the RS485 in standby mode

In standby mode (i.e., the transmitter gives no answer) connecting of the RS485 can have an influence on the current loop signal:

- Only the current in the +SUPPLY is influenced
  (Explanation: the transmitter measures the current in OUT/GND for the controller)
- The current in the OUT/GND will not be interfered
- The influence depends on common mode



→ When the RS485 is connected, the precise current measurement is performed only in the OUT/GND line, not in the +SUPPLY line.

→ Typical error in the supply is 0...0.5 % FS depending on voltage difference between the transmitter and the RS485 converter.