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MICROMASTER (MM4), SINAMICS G120 (CU2x0x): Guidelines for reliable USS communication from PLC to an inverter

This FAQ applies only to the SINAMICS G120/G120D Control Units without “-2” in the product name and MICROMASTER 4 inverters.

EMC correct installation

This is very important to prevent noise causing communications failures and damage to USS drivers.

Unlike PROFIBUS, the USS com port is not optically isolated, so much more care has to be taken to ensure that the installation practices do not lead to communication failures or damage to USS drivers.

The minimum measures that should be adopted are:
1) Motor cables to be screened - the screen to be correctly earthed at both ends. Typically and EMC gland making 360 degree contact with the screen is used at the motor, and a brass or copper P clip on the cubicle backplate at the drive. Try to avoid joins in the cable - if this is not possible then care must be taken to ensure EMC correct continuity of the screen at the join.

2) All nodes are to be well earthed (EMC earth).

3) All relay coils etc to be suppressed.

4) Pay attention to cable segregation - keep USS-communication-cables away from other cables, particularly motor cables.

5) Ensure the screens of USS-communication-cables are correctly earthed.

Further information
Can be found in MICROMASTER 4: EMC Design Guidelines; Entry-ID: › 18162267

Bus termination and biasing

The bus must be correctly terminated at both ends, and biased too.

MICROMASTER 4
If a MICROMASTER 4 is the first or last node on the bus, the supplied USS termination/ biasing network (A5E00151017) must be fitted (refer to Fig. 1).

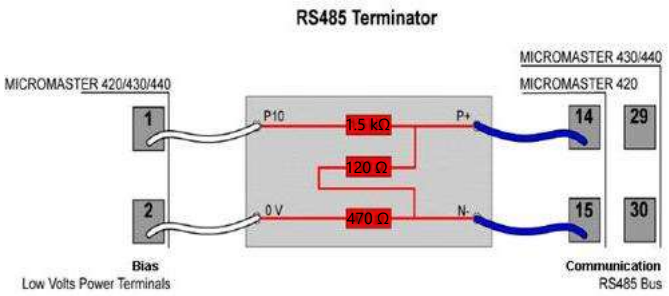

Fig. 1 – USS termination/biasing network for MM4

More information you will find in the operating instructions for MICROMASTER 4:
- Operating Instructions: MICROMASTER 440 0,12 kW - 250 kW, Chapter 3.7.1.3 USS bus configuration via COM link (RS485); Entry-ID: › 24294529
- Operating Instructions: MICROMASTER 420 0,12 kW - 11 kW, Chapter 3.7.1.3 USS bus configuration via COM link (RS485); Entry-ID: › 24523400

SINAMICS G110 and G120
If a SINAMICS G110 or a SINAMICS G120 with a Control Unit CU240S or CU240E is the first or last node on the bus, the build in the drive / control unit bus termination resistor must be used for bus termination.

This is achieved by setting the Bus Termination DIP switches on the front of the inverter to the ‘Bus Termination’ position (refer to Fig. 2). It is important that both DIP switches (2 and 3) are set to the ‘Bus Termination’ position (not in the OFF position). A small screwdriver will be required to change the position of the DIP switches.

Fig. 2 – DIP switches for bus termination on G110

More information you will find in the Operating instructions: SINAMICS G110, Chapter 3.3 Basic Commissioning; Entr-ID: > 22102965

On the CU240S the USS termination can be activated via the Bus Termination Switch on the right side of the housing of the Control Unit (refer to Fig. 3). The switch is set in the position “ON”

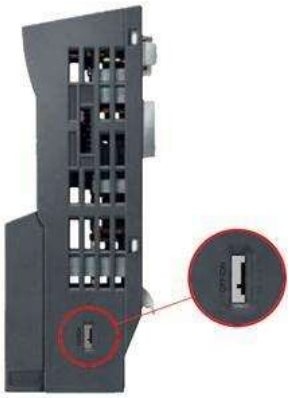

Fig. 3 – DIP switch for bus termination on CU240S

More information you will find in the Operating Instructions: Control Unit CU240S, CU240S DP, CU240S DP-F, CU240S PN, CU240S PN-F, Chapter 4.3 Connecting a CU240S via USS on RS485; Entry-ID: > 27864729

On the CU240E the USS termination can be activated via the Bus Termination Switch on the front side of the housing of the Control Unit (refer to Fig. 4). The switch is set in the position “ON”.

Fig. 4 – DIP switch for bus termination on CU240E

More information you will find in the Operating Instructions: Control Units CU240E, Chapter 6.1 Universal serial interface (USS); Entry-ID: > 27069942

If the first or last node on the bus has a 5V supply for biasing (e.g. S7-200 PLC with 226 CPU) then the standard biasing/termination resistor values should be used. These are 390R pull up and pull down (+5V to P and N to 0V), and 220R from P to N (refer to Fig. 5).

If the node has a 9 pin D connector, the Simatic Net Profibus connectors (e.g. 6SE7972-0BA41-0XA0) have these resistors built in, and are a convenient way to terminate the bus.

The first and last nodes must always be powered up; otherwise the complete USS bus may not function correctly.

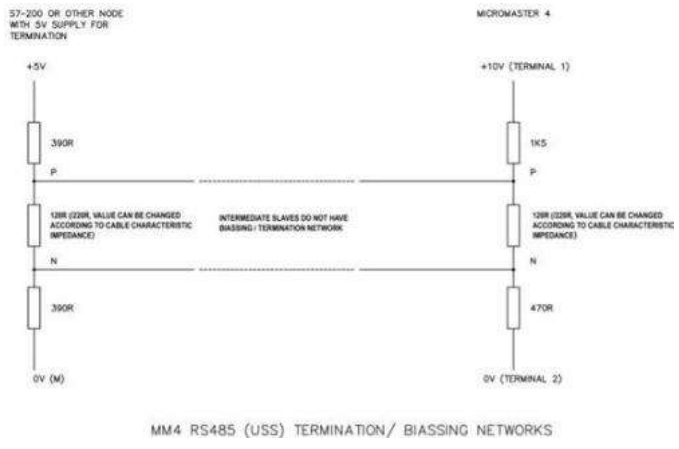

Fig. 5 – Biasing/termination of the bus on sides of the S7-200 and MICROMASTER 4

(For larger version click on image)

0V interconnections
Since the USS is referenced to 0V (M on the S7-200, refer to Fig. 5), optimum performance is usually obtained when 0V lines (MM terminal 2, S7-200 "M" terminal, refer to Fig. 5) on all nodes are connected together. This could be done as an additional core in the USS cable, or a separate wire close to it. Measures should be taken to prevent noise being coupled to this. However, if the 0V is connected to earth at one or more points, this could provide a path for additional noise. This is particularly likely at the PLC if the 24V supply (L+, M) is used for supplying other devices and/or the I/O.

In such cases better performance may result if the PLC M terminal is not connected to the drive.

More information on network installation is available in the S7-200 System Manual in the section entitled "Building Your Network" in chapter 7; Entry-ID: > 1109582

What to do if you have problems
(1) Look at the diagnostic parameters r2024 - r2031:

r2024 and r2025: If telegrams are being received by the inverter, then you should see r2024 being incremented. If it is not, then no telegrams are being received by the inverter. In a reliable system r2024 (received telegrams) should be incrementing at least fifty times faster than r2025 (rejected telegrams). If r2025 is increasing rapidly then it is likely that either the telegram structure is incorrect or that the telegrams are being corrupted (e.g. by noise interference).

r2026 - r2031: If only one of these values is being incremented, then you should look to the specific one of these in relation to the structure. In particular, if r2030 or r2031 is incrementing, this is usually a sign that communication is good but there is an error in the telegram itself.

r2026 - r2029: If these are all increasing, this is a sign of EMC or biasing problems. See above and (2) below for what to do. When there is inadequate bias, the network is highly susceptible to noise between messages. Any negative-going spike on the network may overcome the bias and be received as logic "0", which normally signifies the start of a message. The high occurrence of false start bit errors (counted by P2029) confirms this.

It is recommended you look at these parameters periodically. If the rate of increase of error telegrams increases with time, it is likely the USS drivers are being damaged by noise spikes. EMC induced USS driver damage usually leads to a gradual worsening of the performance, rather than sudden failure.

2) Use a lower Baud Rate if possible. Serial communications get more reliable if the Baud rate is lowered. Also, on MM440 with 2.08 or 2.09 software, it is possible that at high baud rates (> 38.4 kbaud) the processor may be overutilised if there are other processes running that make a high demand on it, such as closed-loop Vector control (SLVC), or the PID controller, or many error telegrams seen (possibly due to USS driver damage). This could lead to unstable drive operation.

(3) Look at the bus voltage on an oscilloscope. Check that the idle state bias is 0.5 - 1V; an example of a good voltage is shown below. The differential signal (P-N, top trace in the example) should be substantially free from noise. Some noise on the common mode signal (P or N to earth, bottom trace) is acceptable, but noise spikes should not exceed 5V as this may cause USS driver damage. Check all of the above points.

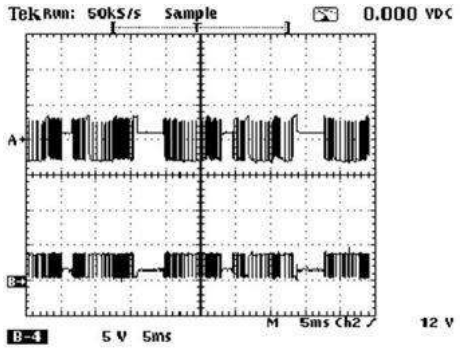

Fig. 6 – Bus voltage, 19.2 kbaud

Bus voltage, 19.2 kbaud:
Ref A = P to N
Ref B = N to earth

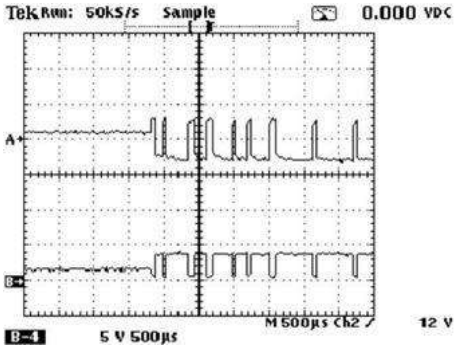

Fig. 7 – Expanded version of above including start of telegram

You will find additional information on this subject in the Operating Instructions, the Parameter Lists and in the following articles:

	Subject area	Title
1	Application	MICROMASTER 4: EMC Design Guidelines; Entry-ID: > 18162267
2	FAQ	MM4: USS Protocol Description; Entry-ID: > 5734889
3	FAQ	How do you install a communications connection between an S7-200 and a MICROMASTER 4 via Port 0 (RS485) with EMC and overvoltage protection; Entry-ID: > 21763310
4	Specification	Universal Serial Interface Protocol USS Protocol; Entry-ID: > 24178253
5	Manual	S7-200 System Manual; Entry-ID: > 1109582
6	Manual [Intranet]	Engineering Manual SIMOVERT MASTERDRIVES; Entry-ID: > 10503779
7	Updates [Intranet]	Intl. Warning Sheet and RS485 Adapter for MICROMASTER 4; Entry-ID: > 15249782

Security information

In order to protect technical infrastructures, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art IT security concept. Siemens' products and solutions constitute one element of such a concept. For more information about cyber security, please visit

https://www.siemens.com/cybersecurity#Ouraspiration.

› Entry belongs to product tree folder(s):

› This entry is associated to 255 product(s).