Appendix User Manual
Digital Sensor

Document Revision

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Modification</th>
<th>Prepared</th>
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<th>Released</th>
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<td>1</td>
<td>30.07.2015</td>
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<td>3</td>
<td>18.01.2016</td>
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<td>ALB</td>
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<td>JON</td>
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<td>Updated definition of recommended sensor cable 3.2 &quot;Wiring Diagram&quot;</td>
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Warnings and Safety

The installation of the DSA should be performed only by qualified electricians. The wrong or incorrect installation may damage the system and/or puts the safety of users at risk.

STATIC ELECTRICITY
The instrument and the sensors contain CMOS devices. During installation and service, care must be taken to prevent damage due to static electricity. This is very important to ensure long-term reliability of the devices.

In this manual “Ethernet cable cat 5e” refer ONLY to the type of cable required in this installation. DO NOT CONNECT THE SENSOR CABLE TO ANY RJ45 PLUG OR CROSSOVER ADAPTER THAT IS ON AN ETHERNET NETWORK. THE DSA SYSTEM WILL POTENTIALLY DAMAGE ANY SWITCH, ROUTER, HUB OR ANY OTHER NETWORK DEVICE IF CONNECTED.

NOTE: Cable colour may change depending on manufacturer. Please verify that the wiring is done according to carried signal on the cable.

WARNING!
Do not connect an analog sensor to the digital sensor port of the GMSplus. It may damage the sensor. Observe the label near the connector.

Symbols and Abbreviations

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSA</td>
<td>Digital Sensor Array</td>
<td></td>
</tr>
<tr>
<td>SPS</td>
<td>Samples Per Second</td>
<td></td>
</tr>
</tbody>
</table>

Caution. Refer to the instructions next to the marking, or refer to the relevant section of this user manual.

Direct current. This symbol indicates a direct current (DC) power line derived from an alternating current (AC) power source.

Earth terminal.

CE. This symbol indicates that the device conforms to all legal requirements needed to achieve free movement and sale of the product through the European Economic Area (EEA).
1. Introduction

When more external sensors are needed, it is possible to setup a configuration which allows the GMSplus to record data from up to 4 sensors using the Digital Sensor Array (DSA).

This feature is fully supported by the GMSplus by adding an optional module board (OPT4-B) which can manage up to 4 sensor nodes. A GMSplus in this configuration is called **GMSplusD**.

This appendix is part of the full user manual of the GMSplus and is applicable when the DSA configuration is available.

![Digital Sensor Overview](image)

Figure 1. Digital Sensor Overview

2. Minimum requirements

The minimum hardware and software requirements to use the Digital Sensors Array are:

- GMSplus with optional module board installed
- armDAS version ≥ 21.12.00
- Linux Kernel ≥ 2.6.39.4-r9
- Web Interface ≥ 1.8-r2
3. Installation

The installation of the DSA should be performed only by qualified electricians. The wrong or incorrect installation may damage the system itself and/or puts the safety of users at risk.

### Required Tools

1. Slotted screwdriver 2x0.3 mm
2. Wire Stripper
3. Pliers
4. End Sleeves (e.g. 0.25mm² for AWG24 wires)
5. Crimping Tool

See GMSplus and AC-73x user manuals for the further about required tools for installation.

3.1. Power consumption

The power consumption of the instrument differs from the standard GMSplus. At time of order, a suitable power supply can be offered. When the power adapter is not requested at order, Table 1 lists the maximal power consumption of the instrument:
### External Sensors

<table>
<thead>
<tr>
<th>External Sensors</th>
<th>Max Power Consumption</th>
<th>Recommended power supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>19.5 W</td>
<td>minimum 1.3 A, 15 VDC</td>
</tr>
<tr>
<td>4</td>
<td>30 W</td>
<td>minimum 2 A, 15 VDC</td>
</tr>
</tbody>
</table>

Table 1. Maximum Power Consumption

The power consumption mentioned above is valid when the total length of the sensors cable doesn’t exceed 100 meters. When longer cables are used is necessary to include the dissipated power along the cable (Table 2); the cable type must be **Ethernet cable cat. 5e or cat. 6**, see section 3.2 for further details.

<table>
<thead>
<tr>
<th>Cable length (meters)</th>
<th>Dissipated Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>1 W</td>
</tr>
<tr>
<td>500</td>
<td>1.5 W</td>
</tr>
<tr>
<td>750</td>
<td>2 W</td>
</tr>
<tr>
<td>1000</td>
<td>3 W</td>
</tr>
</tbody>
</table>

Table 2. Dissipated Power on cable valid for **Ethernet cable cat. 5e**

### 3.2. Wiring Diagram

This section concerns only the digital sensors array. Please follow the GMSplus user manual to install any other peripherals.

The solution is designed to support long cables up to 1000 meters. However some rules must be observed:

- The recommended sensor cable is **Ethernet cable cat. 5e or cat. 6** (shielded, 4 twisted pairs, AWG 22/7, 24/7 or 26/7 stranded wires).
- The maximum total cable length, from the GMSplus to the last node in the array, is 1000 meters.

The use of unshielded cables is generally not recommended. When an unshielded cable is used the following limitation must be taken into account:

- The maximum total cables length, from the GMSplus to the last node in the array, must not exceed 100 meters.
- To ensure the integrity of the measurement, each sensor must be electrically connected to a proper ground potential.

For further details about the cable length and specification contact GeoSIG.
• If 4 nodes are connected, the maximum allowed cable length between two adjacent nodes, or from the GMSplus to the first node, is 250 meters.

Figure 2. 4 sensors cable configuration

• If 3 sensors are connected, the maximum allowed cable length between two adjacent nodes, or from the GMSplus to the first node, is 300 meters.

Figure 3. 3 sensors cable configuration
• If 2 sensors are connected, the maximum allowed cable length between two adjacent nodes is 500 meters.

![DIAGRAM: 2 sensors cable configuration]

Figure 4. 2 sensors cable configuration

• If only one sensor is connected, the maximum allowed cable length from the GMSplus to the node is 1000 meters.

![DIAGRAM: 1 sensor cable configuration]

Figure 5. 1 sensor cable configuration
3.2.1. GMSplus to Sensor Connector

In this chapter is described the installation procedure of the sensor’s cabling.

The wiring of the sensor must be done according to Figure 9; pay attention to connect the sensors in the GMSplus **bottom-left** connector.

**WARNING!**

*Digital sensor must be connected to the digital sensor port indicated below in green. Do not connect an analog sensor to the digital sensor port. It way damage the sensor.*

Plug one end of the **Adapter GMSplus to DSA (B)** to the GMSplus, in the **bottom-left** connector, and the other end connect to the small **Binder connector (A)**. (*Binder connector, series 713*).

Please follow the instructions under section 0 to mount the **Binder connector (A) and (B)** on the sensor cable.
Mounting the Binder connector on the sensor cable

1. Open the Binder connector as shown in the Figure 10.

![Figure 10. Internal view of Binder Connector](image)

2. Let the sensor cable pass through the *pressing screw* (7), the *pinch ring* (6), the *seal* (5), the *shielding ring* (4) and the *sleeve* (3).

![Figure 11. Preparation of the sensor cable and installation in the connector](image)
3. Prepare the cable as shown in Figure 11: remove about 35-40 mm of the cable jacket (Figure 12) and short the shield leaving 6 mm (Figure 13).

![Figure 12. Step 3, removing cable jacket](image12.png)

![Figure 13. Step 3, shorting the shield](image13.png)

4. Strip the end of each wire of 5 mm (Figure 14) and apply end sleeve of the proper size (e.g. 0.25mm² for AWG24 wires)

![Figure 14. Step 4, strip wires and apply end sleeves](image14.png)
5. Screw the wires according to Table 3.

**PAY ATTENTION TO THE PIN ORDER. The wrong or incorrect installation may permanently damage the system and/or puts the safety of users at risk.**

![Male Connector Diagram](image1.png)

<table>
<thead>
<tr>
<th>PIN</th>
<th>WIRE COLOR</th>
<th>PIN</th>
<th>WIRE COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>White/Blue</td>
<td>1</td>
<td>White/Orange</td>
</tr>
<tr>
<td>2</td>
<td>Blue</td>
<td>2</td>
<td>RX - A</td>
</tr>
<tr>
<td>3</td>
<td>White/Orange</td>
<td>3</td>
<td>RX - B</td>
</tr>
<tr>
<td>4</td>
<td>Orange</td>
<td>4</td>
<td>TX - Z</td>
</tr>
<tr>
<td>5</td>
<td>White/Green</td>
<td>5</td>
<td>TX - Y</td>
</tr>
<tr>
<td>6</td>
<td>Green</td>
<td>6</td>
<td>+48V</td>
</tr>
<tr>
<td>7</td>
<td>White/Brown</td>
<td>7</td>
<td>+48V</td>
</tr>
<tr>
<td>8</td>
<td>Brown</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

**PAY ATTENTION TO THE PIN ORDER IN THE CONNECTOR**

<table>
<thead>
<tr>
<th>PIN</th>
<th>WIRE COLOR</th>
<th>PIN</th>
<th>WIRE COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>White/Blue</td>
<td>1</td>
<td>White/Orange</td>
</tr>
<tr>
<td>2</td>
<td>Blue</td>
<td>2</td>
<td>RX - A</td>
</tr>
<tr>
<td>3</td>
<td>White/Orange</td>
<td>3</td>
<td>RX - B</td>
</tr>
<tr>
<td>4</td>
<td>Orange</td>
<td>4</td>
<td>TX - Z</td>
</tr>
<tr>
<td>5</td>
<td>White/Green</td>
<td>5</td>
<td>TX - Y</td>
</tr>
<tr>
<td>6</td>
<td>Green</td>
<td>6</td>
<td>+48V</td>
</tr>
<tr>
<td>7</td>
<td>White/Brown</td>
<td>7</td>
<td>+48V</td>
</tr>
<tr>
<td>8</td>
<td>Brown</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Wiring diagram of digital sensor connector

**NOTE: Cable colour may change depending on manufacturer. Please verify that the wiring is done according to carried signal on the cable.**
6. Screw the sleeve on the insert. Bend the cable shield (Figure 15) on the shielding ring, and push it on the sleeve (Figure 16). Use the pliers close the sleeve.

![Figure 15. Step 6, bending the cable shield](image1.png)

![Figure 16. Step 6, pushing the shielding ring into the sleeve](image2.png)

7. Push the seal and the pinch ring and tighten the pressing screw, if necessary use the pliers.

![Figure 17. Step 7, ensuring the seal, pinch ring and tight the pressing screw](image3.png)
4. Configuration

4.1. First run hardware setup

This procedure is only to configure the external digital sensors. For the full configuration of the GMSplus and the accessories please refer to the GMSplus user manual.

1. Open the instrument removing the 4 screws of the cover plate.
2. If the battery is not plugged, connect the battery with its connector.
3. Connect the internal serial port (CONSOLE) to your computer using a RS-232 cable; open a terminal with baud rate 115200 and 8n1.
4. Push the POWER button of the GMSplus for 2 seconds, the RUN led will start blinking.
5. As soon as the following message appears on the serial console, press ‘CTRL + Z’ in your keyboard

GMSplus s/n 123456. Firmware in the Linux image: 21.12.00-a10
############################################################
##### Test and Initial Configuration Mode ######
############################################################
Press Ctrl+Z to enter the test mode....


7. Press ‘K’ to setup the hardware parameters.

Bootloader Menu of the GMSplus s/n 123456
Access level: Powerful User

--- Flash Images and Boot Options ---
L - List flash images
Q - Reset instrument configuration to the user default
V - Reset instrument configuration to the factory default
S - Boot now
X - Reboot the instrument
Y - Power off

--- Hardware Setup and Monitor ---
K - Instrument hardware parameters
N - Network settings
T - Battery installation dates

--- Security ---
O - Set password
J - Reset all passwords

-->
8. Press ‘A’ and enter the total number of sensors present in your installation, including internal and external nodes.

9. Select ‘B’ and setup each node.
   a. Press ‘B’ and select the number of channels of the sensor (standard 3 channel for x, y and z axis)
   b. Press ‘D’ and select “external” for the digital sensors, “internal” for the internal sensor (if available).
   c. If the node is external, press ‘E’ until “DSA interface” is selected.

   e. Press ‘+’ to configure the next sensor node.
   f. Optionally for each sensor you can enter the sensor S/N pressing ‘A’.

   | All the identifier of the external node must be different. |
   | Example: |
   | 1st Node, ID=1 |
   | 2nd Node, ID=2 |
   | ... |
10. Press ‘ESC’ to return to the main menu, and press ‘S’ to save the configuration when the following message appears.

```
Configuration is complete. (S)ave, (D)iscard or continue (E)diting?
```

11. Press ‘5’ to start the instrument.

### 4.2. armDAS Settings through the local Console

In this section is described how to setup the instrument to record data from the digital sensors. The same procedure can be done from the Web Interface ad describe in section 4.3 of this manual.

1. Connect the internal serial port (CONSOLE) to your computer using a RS-232 cable; open a terminal with baud rate 115200 and 8n1 and start the instrument if is not running. Wait until the main user menu is available on the console.

```
GMSplus s/n 123456 version 21.12.00-a10
Main menu:
C - Configuration
M - Messages ->
S - Shell command
L - list firmware images
X - Display errors (0) and warnings (0)
W - Clear errors and warnings
F - View/reset RTC trim values
T - File statistics
G - View RTC status
D - View DSA status
P - View GPS information
H - Set RTC time
U - User request
R - Restart
Q - Quit
```
2. Press ‘C’ to enter in the configuration menu, and select ‘C’ to modify the current configuration. The following menu will appears.

<table>
<thead>
<tr>
<th>Main Menu</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) Station description ................... GeoSIG Station</td>
</tr>
<tr>
<td>B) Station code ............................. GSGMS</td>
</tr>
<tr>
<td>C) Location description ................... Default location</td>
</tr>
<tr>
<td>D) Seismic network code ................... GS</td>
</tr>
<tr>
<td>E) Number of Channels .................... 15</td>
</tr>
<tr>
<td>F) Number of Output Streams ............. 4</td>
</tr>
<tr>
<td>G) Number of Trigger Sets ............... 1</td>
</tr>
<tr>
<td>H) Number of PresetTriggers .......... 0</td>
</tr>
<tr>
<td>I) Channel Parameters .................... -&gt;</td>
</tr>
<tr>
<td>J) Stream Parameters ..................... -&gt;</td>
</tr>
<tr>
<td>K) Trigger Parameters ..................... -&gt;</td>
</tr>
<tr>
<td>M) File Storage and Policy ............. -&gt;</td>
</tr>
<tr>
<td>N) Communication Parameters .......... -&gt;</td>
</tr>
<tr>
<td>O) Miscellaneous Parameters .......... -&gt;</td>
</tr>
</tbody>
</table>

Select <A>...<O>. <Esc> to exit

3. Press ‘E’ and enter the total number of channels available in your installation.

4. Press ‘I’ to configure each channel.

Select <A>...<W>, <+> Next, <-> Prev, <Esc> back to Main Menu +

| Main Menu | Channel 4 of 15 |
|------------|
| A) Data source ...................... EXT-DSA-S02-C01 |
| E) Channel name ...................... X |
| F) Location code ...................... E1 |
| G) Source data unit ..................... g |
| H) LSB factor ......................... 2.6491e-07 |
| I) Sampling rate, sps ................... 200 (0xC8) |
| K) Negative axis ...................... No |
| L) Offset compensation .............. Yes |
| N) Maintain the ringbuffer ......... Yes |
| O) Online preprocessing .......... None |
| S) Decimation and peaks .......... None |

Select <A>...<W>, <+> Next, <-> Prev, <Esc> back to Main Menu

Refer to the GMSplus user manual to configure internal sensors, here only how to configure the external digital channels is explained.

5. To configure the external digital channels:

a. Press ‘A’ to select the data source of the channel. The external digital sensors are recognized as EXT-DSA-Sxx-Cyy where xx is the sensor number as defined in the hardware configuration, and yy is the channel identifier. Normally the channel identifier 01 correspond to x axis, 02 to y axis and 03 to z axis.

b. It is possible to change the channel name pressing ‘E’ and the location code pressing ‘F’.

c. Enter the data unit and the LSB factor according to the sensor type. Formula for calculation of LSB can be found in the GMSplus user manual in section “Calculation of the LSB factor” (10.3.3).
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d. Press ‘I’ to specify the sampling rate according to the following table of supported rates:

<table>
<thead>
<tr>
<th>Number of external sensors</th>
<th>Maximum SPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1000</td>
</tr>
<tr>
<td>2</td>
<td>500</td>
</tr>
<tr>
<td>3 or 4</td>
<td>200</td>
</tr>
</tbody>
</table>

When you enter the SPS in the first channel of the sensor, it will automatically set for the remaining channels. It is not possible to set different sampling rates for each channel of a sensor. But it is possible to set different sampling rates for different sensors.

6. Press ‘ESC’ to back to the main menu, press ‘C’ to save the configuration when asked.

```
Save as (C)urrent, save to a (F)ile or just (E)xit without saving....>
```

7. Restart the instrument pressing ‘R’ to apply the new configuration.
4.3. armDAS setting from Web Interface

The same settings described in section 4.2 can be done from the Web Interface. Login in to the web interface as described in the GMSplus user manual (see sections “The Web Interface” and “Detailed Configuration of the Instrument”).

1. Go to Configuration → armdas Configuration → Channel Settings

2. Select “Add New Sensor Channel” and a new channel appears on the list. Check the box of the channel and click “Configure Selected Sensor Channel”
3. In the following window it is possible to set up the channel parameters for each sensor. The channels of external digital sensors are recognized (parameter Input Source) as EXT-DSA-Sxx-Cyy where xx is the sensor number as defined in the hardware configuration, and yy is the channel identifier. Normally the channel identifier 01 correspond to x axis, 02 to y axis and 03 to z axis.

4. Enter the data unit and the LSB factor according to the sensor type. Formula for calculation of LSB can be found in the GMSplus user manual in section “Calculation of the LSB factor” (10.3.3).

5. Specify the sampling rate according to the following table of supported rates:

<table>
<thead>
<tr>
<th>Number of external sensors</th>
<th>Maximum SPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1000</td>
</tr>
<tr>
<td>2</td>
<td>500</td>
</tr>
<tr>
<td>3 or 4</td>
<td>200</td>
</tr>
</tbody>
</table>

When you enter the SPS in the first channel of the sensor, it will automatically set for the remaining channels. It is not possible to set different sampling rates for each channel of a sensor. But it is possible to set different sampling rates for different sensors.

6. To easily identify the sensors in the array it is possible to rename the nodes using the fields channel name and location code.
7. Click “Accept” to confirm the new configuration. Repeat the steps 2 and 3 to add all the channels in your hardware configuration. Click on “Save configuration to Device”, and restart the instrument.

After rebooting, the system is configured and ready to processing data from the DSA.