Güralp 5TDE

Operator's Guide

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1 Preliminary Notes

1.1 Proprietary Notice

The information in this document is proprietary to Güralp Systems Limited and may be copied or distributed for educational and academic purposes but may not be used commercially without permission.

Whilst every effort is made to ensure the accuracy, completeness and usefulness of the information in the document, neither Güralp Systems Limited nor any employee assumes responsibility or is liable for any incidental or consequential damages resulting from the use of this document.

1.2 Warnings, Cautions and Notes

Warnings, cautions and notes are displayed and defined as follows:



Caution: A yellow triangle indicates a chance of damage to or failure of the equipment if the caution is not heeded.



Note: A blue circle indicates indicates a procedural or advisory note.

1.3 Manuals and Software

All manuals and software referred to in this document are available from the Güralp Systems website: www.guralp.com unless otherwise stated.

1.4 Conventions

Throughout this manual, examples are given of command-line interactions. In these examples, a fixed-width typeface will be used:

```
Example of the fixed-width typeface used.
```

Commands that you are required to type will be shown in bold:

`Example of the fixed-width, bold typeface.`

Where data that you type may vary depending on your individual configuration, such as parameters to commands, these data are additionally shown in italics:

`Example of the fixed-width, bold, italic typeface.`

Putting these together into a single example:

`System prompt:` **`user input with`** ***`variable parameters`***

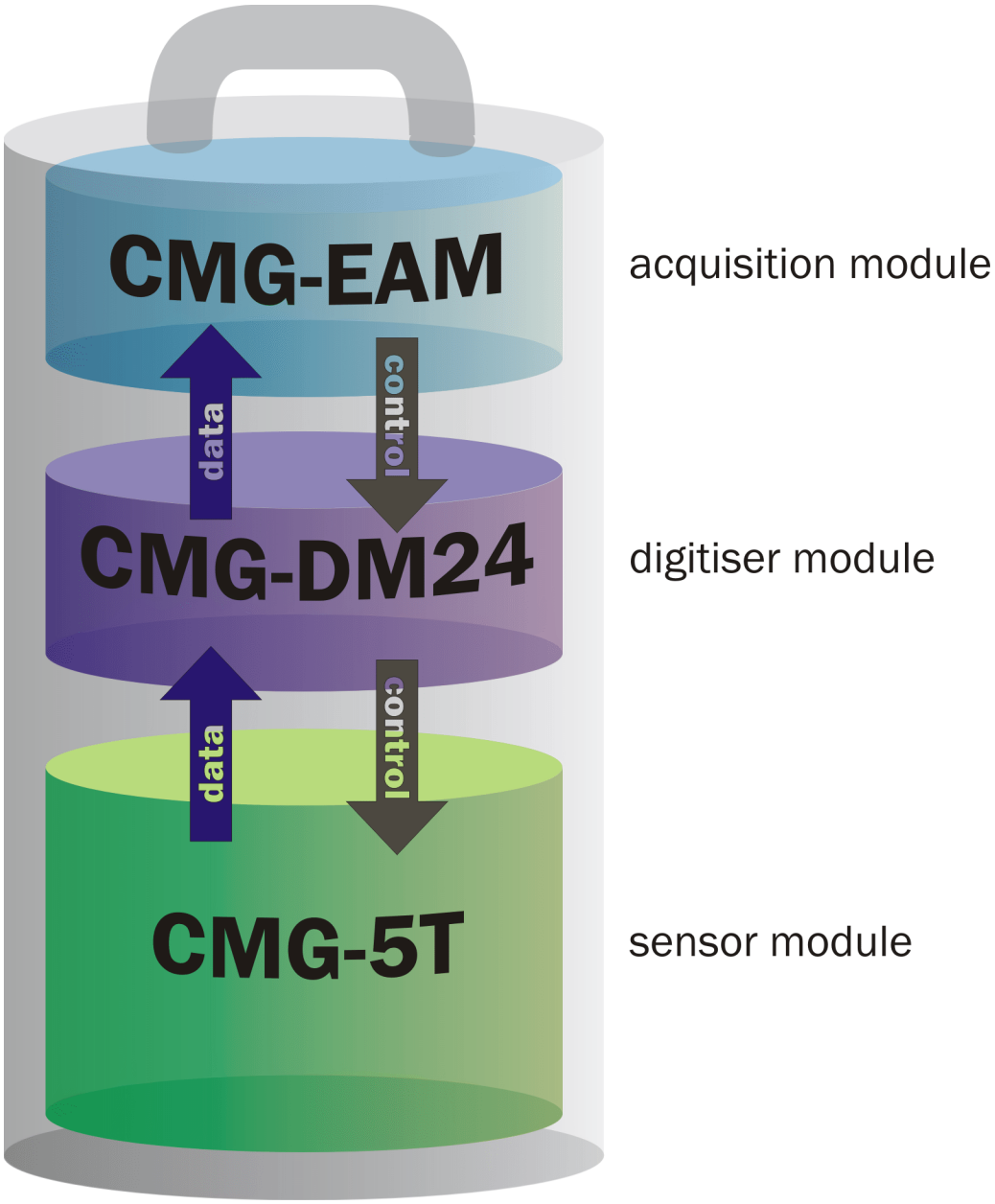
2 Introduction

The Güralp 5TDE accelerometer is a three-axis, strong-motion, force- feedback accelerometer packaged together with a 24-bit digitiser and a flexible data acquisition and storage unit, all in a single sealed case. The entire system is self- contained except for its power supply and GPS receiver, which is used for time-stamping seismic data.

The 5T system combines low-noise components with a high feedback-loop gain to provide a linear, precision transducer with a very large dynamic range. In order to exploit the whole dynamic range, two separate outputs are available, one with high gain and one with low gain. Normally, the high gain outputs are set to output a signal 10 times stronger than that from the low gain outputs. See section 2.1 on page 6 for details.



Full-scale low-gain sensitivity is available from 4.0 g down to 0.1 g. The most common configuration is for the 5T unit to output 5 V single-ended output for 1 g (≈ 9.81 ms^{-2}) input acceleration. The standard frequency pass-band is flat to acceleration from DC to 100 Hz (although other low pass corners can be ordered.) A high frequency option provides flat response from DC to 200 Hz.



The integrated digitiser is a Güralp DM24, a low-noise, 24-bit ADC module specifically designed for seismic data. The built-in digital signal processor (DSP) provides simultaneous, multiple sample-rate data streams at user-selectable rates. Up to 6 streams of data for each component are available at sample rates from 1 to 1000 samples/s. A precision microprocessor-controlled time-base synchronizes the analogue-to-digital converters to the DSP and provides time-stamps for data. A separate microprocessor system handles configuration and sensor control, including mass centring and calibration.

The integrated data acquisition system is a Güralp EAM, which provides serial and Ethernet communications, along with a convenient web-based interface to all functions, including digitiser and sensor configuration and control. It can act as a data recorder as well as a protocol converter and communications controller. Based around the powerful and stable Linux operating system, the

Güralp EAM offers unrivalled flexibility, even including the ability to run user-installed scripts.

Each instrument is delivered with a detailed calibration sheet showing its serial number, measured frequency response in both the long period and the short period sections of the seismic spectrum, sensor DC calibration levels, and the transfer function in poles/zeros notation.

2.1 Setting the gain

The built in 5T sensor has a very large dynamic range. In order to exploit the whole of this range, two separate outputs are available, one with high gain and one with low gain. Normally, the high gain outputs are set to output a signal 10 times stronger than that from the low gain outputs. Only one set of outputs – low gain or high gain – is sent to the digitiser and selection is made using internal jumpers.



Note: To change the gain, it is necessary to open the instrument. This work must be carried out in a clean environment in order to prevent contamination of the mechanical components by air-borne dust.



Caution: ESD: The Güralp 5TDE include components which can be damaged by electrostatic discharge. Always work on a properly grounded dissipative surface and wear a suitable grounded wristband. Ground yourself by touching an earthed conductor before handling any of the circuit boards.

In order to change the gain-setting jumpers, remove the instrument's lid as follows:

- Use a large, flat-bladed screwdriver to remove the pressure-release screw located on the instrument's lid next to the bubble-level.

  Caution: Instruments are assembled at sea-level so there may be a considerable pressure difference if opened at altitude. Take care that the pressure-release screw does not fly off during removal.

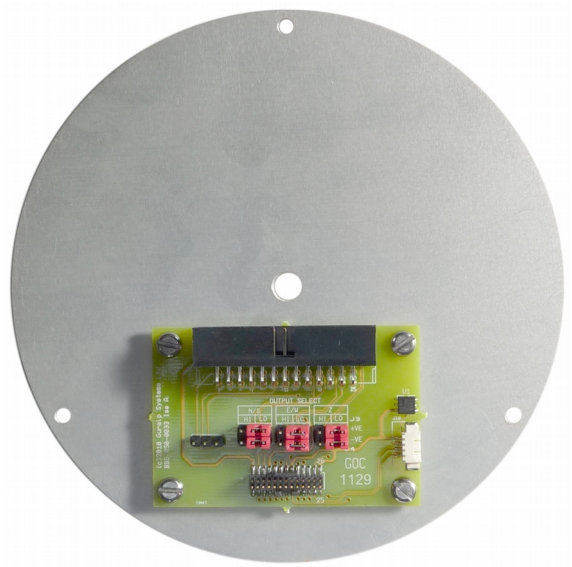
- Use a small, flat-bladed screwdriver to remove the six small screws located around the edge of the top of the lid.
- Note the location of the lid with respect to the body. Use a pencil or adhesive tape to mark both so that the instrument can be reassembled in the correct orientation.
- Using a medium, flat-bladed screwdriver, gently prise the lid away from the body. A slot is provided in the top of the cylinder for this purpose.

  Caution: The lid-to-body seal uses 'O'-rings. Take care that the lid does not suddenly fly off when this seal is broken.

- Lift the lid and the attached electronics vertically out of the cylindrical body and disconnect the ribbon cable at either end, noting the orientation of the cable.

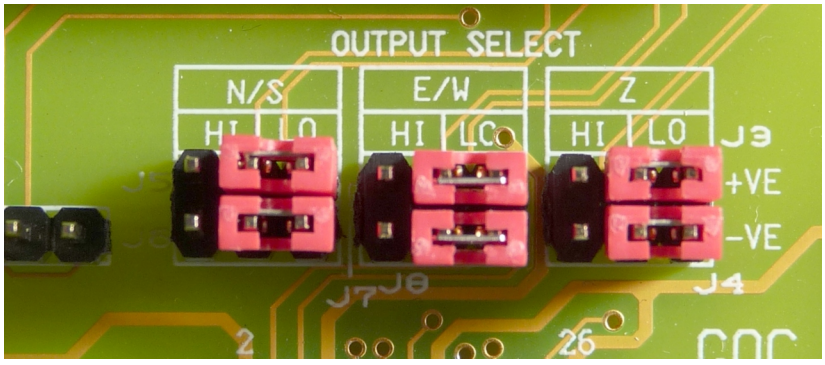
Looking down into the body of the instrument, you will see a small printed circuit board mounted on an aluminium disc. This board contains the gain-setting jumpers, which are coloured red to aid identification.



Each component (vertical, North/South and East/West) has two associated jumpers (one for each leg of the differential connection) and these must always be moved in pairs. It is possible to select different gains for different channels but this is rarely desirable. Consult the markings on the printed circuit board and the pictures below to select the desired gain:

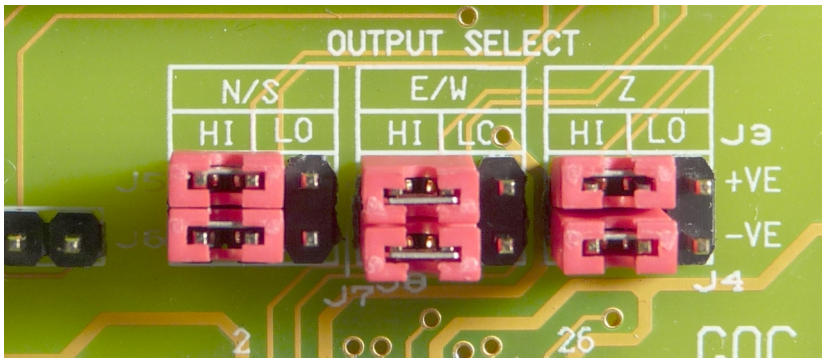
2.1.1 Jumper configuration for low gain operation

Arrange the jumpers as in the picture below:



2.1.2 Jumper configuration for high gain operation

Arrange the jumpers as in the picture below:



2.1.3 Reassembly

Once the desired gain selection has been made, reconnect the ribbon cable and gently lower the lid onto the instrument, taking care not to knock the electronic assemblies or snag any cables. Ensure that the lid is rotated to the correct orientation using the marks you made previously and then gently ease it over the 'O'-ring seal and into place. Secure using the six small screws and, finally, replace the large pressure release screw.

2.2 Connections

The Güralp 5TDE has five connectors on the top panel, the uses of which are described in this section.

2.2.1 DATA

The DATA port is the power input and also a general-purpose serial port. It is a command line terminal running at 115,200 Baud in the default configuration but it can also be used for GCF output (suitable for serial connection to Scream!) , PPP network connections, inbound GCF (from a digital instrument, for example), NMEA functions, TCP serial conversion or as a recorder to store and forward data from any instrument with a serial output.

2.2.2 NET

The NET port is a 100BASE-TX Ethernet connection. The supplied cable supports connection to a hub, switch or router. If direct connection to a PC or laptop is desired, an optional cross-over cable can be ordered.

2.2.3 GPIO

The GPIO (***G***eneral ***P***urpose ***I***nput/***O***utput) port fulfils three functions: it provides a serial console to the EAM, which can be used for monitoring, configuration and

control; it provides USB access from a PC or laptop to the internal FLASH storage for data collection (Use of this feature is described in the EAM manual, MAN-EAM-0003) and it provides a number of tri-state lines which can be used to control or monitor external equipment. One application is as tamper detection lines, which can be connected to external switches and monitors as part of a secure installation.



2.2.4 USB

The USB port allows connection of an external USB storage device for data collection. It is also possible to perform firmware upgrades using this port in situations where internet access is not available.

2.2.5 GPS

The GPS port allows connection of a GSL GPS receiver for use as a timing source for time-stamping seismic data. An additional serial port, ttySA2, is also available on this connector. It can be used for any of the functions available from the DATA connector (see section 2.2.1, above).

3 Getting started

The Güralp 5TDE accelerometer is preconfigured for terminal access at 115,200 Baud from the DATA connector, to provide serial console access at 38,400 Baud via the GPIO connector and to configure its Ethernet interface (on the NET connector) using DHCP.

The easiest way to configure the Güralp 5TDE is via the web interface so, if you have a DHCP server on your network, simply connect the provided network lead to the NET connector and apply 12 VDC power via the supplied lead to the DATA connector. Allow the instrument thirty seconds to boot and then check the log of the DHCP server to ascertain the allocated IP address. You can then enter this into the address bar of your web browser (using http or https) and immediately access the status information and configuration interface.

If you have a network but do not have a DHCP server, you need to manually configure an IP address using a serial connection. Connect the provided network lead to the NET connector, 12 VDC power via the supplied lead to the DATA connector, and a serial port on your PC to the GPIO connector. Start your terminal emulation software, such as PuTTY or Minicom (configured for 38,400 Baud), and then follow the instructions in section 2.2.2 of the EAM manual to set a temporary IP address. You can then enter this into the address bar of your web browser (using http or https) and immediately access the status information and configuration interface. You should set a permanent IP address at this point as the temporary address that you have just set will not persist after a reboot. See section 6.1 of the EAM manual for more details.

If you do not have a network, you can still access the configuration interface using the serial console. Connect 12 VDC power via the supplied lead to the DATA connector and a serial port on your PC to the GPIO connector. Start your terminal emulation software, such as PuTTY or Minicom (configured for 38,400 Baud), and then follow the instructions in section 3.2 of the EAM manual.

4 Understanding the manuals

The Güralp 5TDE is a complex piece of equipment, the true flexibility of which can only be fully appreciated by studying the manuals. The instrument is covered by four separate documents:

- **MAN-050-0006** - This document, which provides an overview, a getting-started guide and a list of other relevant manuals;
- **MAN-EAM-0003** - The Güralp EAM manual, which covers use of the data acquisition module, including configuration of the digitiser and control of the sensor. All of the instrument's external connectors are described in the Güralp EAM manual but, for convenience, this information is reproduced in section 5 of this manual.
- **MAN-050-0001** - The Güralp 5T Operator's Manual, which describes the construction and operation of sensor.
- **MAN-D24-0004** - The Güralp DM24 digitiser manual, which describes the features of and command-line interaction with the digitiser. Note that, thanks to the EAM's convenient web and menu-based interfaces, direct use of the digitiser's command line is seldom necessary.

5 Connector pin-outs

5.1 DATA

This is a standard 10-pin military-specification bayonet plug, conforming to MIL-DTL-26482 (formerly MIL-C-26482). A typical part-number is 02E-12-10P although the initial “02E” varies with manufacturer.

Suitable mating connectors have part-numbers like ***-12-10S and are available from Amphenol, ITT Cannon and other manufacturers.



The pin-out is the same as the serial output of a Güralp DM24 digitiser and any GSL digital instrument, allowing you to insert an instrument with an embedded Güralp EAM into a pre-existing installation and maintain connectivity.

Pin	Function
A	Power input, 0 V
B	Power input, +10 to +35 V
C	RS232 CTS (input)
D	RS232 RTS (output)
E	External trigger relay output: normally-open contact
F	External trigger relay output: common contact
G	RS232 ground
H	External Trigger input
J	RS232 data input (RxD)
K	RS232 data output (TxD)



Wiring details for the compatible socket, ***-12-10S, as seen from the cable end (i.e. during assembly).

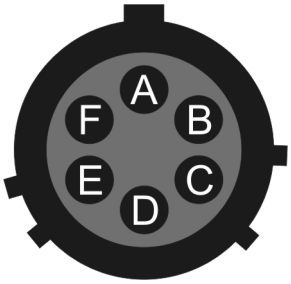
5.2 NET

This is a standard 6-pin military-specification bayonet plug, conforming to MIL-DTL-26482 (formerly MIL-C-26482). A typical part-number is 02E-10-06P although the initial “02E” varies with manufacturer.

Suitable mating connectors have part-numbers like ***-10-06S and are available from Amphenol, ITT Cannon and other manufacturers.



Pin	Function
A	Ground
B	Data transmit +ve (RJ45 pin 1)
C	Data receive +ve (RJ45 pin 3)
D	External switched power output #0
E	Data receive –ve (RJ45 pin 6)
F	Data transmit –ve (RJ45 pin 2)



Wiring details for the compatible socket, ***-10-06S, as seen from the cable end (i.e. during assembly).

5.3 GPIO

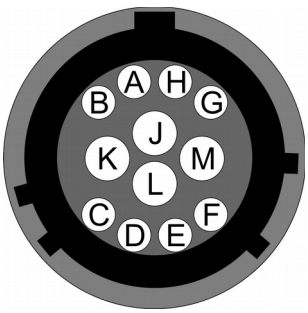
This is a standard 12-pin military-specification bayonet socket, conforming to MIL-DTL-26482 (formerly MIL-C-26482). A typical part-number is 02E-14-12S although the initial “02E” varies with manufacturer.

Suitable mating connectors have part-numbers like ***-14-12P and are available from Amphenol, ITT Cannon and other manufacturers.



The USB lines provide external host access to the internal USB memory device. When power is sensed on pin J, an internal switch disconnects the memory device from the internal circuitry and connects it to this socket.

Pin	Function
A	USB Data -ve (USB Type A pin 1) - see text above.
B	USB Data +ve (USB Type A pin 3) - see text above.
C	Anti-tamper line 4
D	Anti-tamper line 3
E	Anti-tamper line 2
F	Anti-tamper line 1
G	Console transmit (RS232 TXD)
H	Console receive (RS232 RXD)
J	USB Power input (USB Type A pin 1) - see text above.
K	Ground (USB Type A pin 4)
L	Anti-tamper line 0
M	Ground



Wiring details for the compatible plug, ***-14-12P, as seen from the cable end (i.e. during assembly).

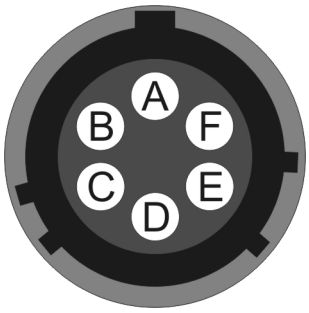
5.4 USB

This is a standard 6-pin military-specification bayonet socket, conforming to MIL-DTL-26482 (formerly MIL-C-26482). A typical part-number is 02E-10-06S although the initial “02E” varies with manufacturer.

Suitable mating connectors have part-numbers like ***-10-06P and are available from Amphenol, ITT Cannon and other manufacturers.



Pin	Function
A	+5 V DC (USB Type A pin 1)
B	Data –ve (USB Type A pin 2)
C	Data +ve (USB Type A pin 3)
D	0 V (USB Type A pin 4)
E	Shielding
F	*not connected*



Wiring details for the compatible plug, ***-10-06P, as seen from the cable end (i.e. during assembly).

5.5 GPS

This is a standard 10-pin military-specification bayonet plug, conforming to MIL-DTL-26482 (formerly MIL-C-26482). A typical part-number is 02E-12-10P although the initial “02E” varies with manufacturer.

Suitable mating connectors have part-numbers like ***-12-10S and are available from Amphenol, ITT Cannon and other manufacturers.



This pin-out is the same as the GPS input of a DM24 digitizer.

Pin	Function
A	Power 0 V
B	Power +12 V
C	1pps signal
D	*not connected*
E	Serial port (ttySA2) TxD
F	Serial port (ttySA2) RxD
G	RS232 ground
H	Serial port (ttySA2) ground
J	RS232 transmit to GPS
K	RS232 receive from GPS



Wiring details for the compatible socket, ***-12-10S, as seen from the cable end (*i.e.* when assembling).

6 Revision history

2010-08-16	A	New document.
2012-03-12	B	Updated for post 10,000 Platinum builds.
2012-09-03	C	Added gain-setting information.
2016-06-01	D	Correct DM24 manual reference and re-branded.
2017-08-10	E	Correction: Replaced modem control (DSR/DTR/CD) with external triggering lines on DATA connector and removed references to automatic modem answering.