Single Analogue Output

Modbus eXpansion Board ‘D’

Specification

110210

Revision 1.10

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Revision History

1.01 - The first draft
1.02 - Circuit change and a reduced specification, (removal of Voltage ranges).
1.03 - Added 3D Model and removed “Alert” LED.
1.04 - Updated Configuration screen and text.
1.05 - Added Scaling & Editing page.
1.06 - Changed 3D Model to a **real** picture of card.
1.07 - Changed DIL Switch assignments; Added stand-alone Slave mode; Added RTC info to the Event Log. Added DAC Calibration screen.
1.08 - Updated LED information DIL switch usage and changed the Event Log date format.
1.09 - Added Slave Modbus Registers
1.10 - Updated Modbus poll periods to correspond with those of LCD.

Overview

This document describes the features and specification of an Analogue Output card for use in RS485 Modbus RTU systems.

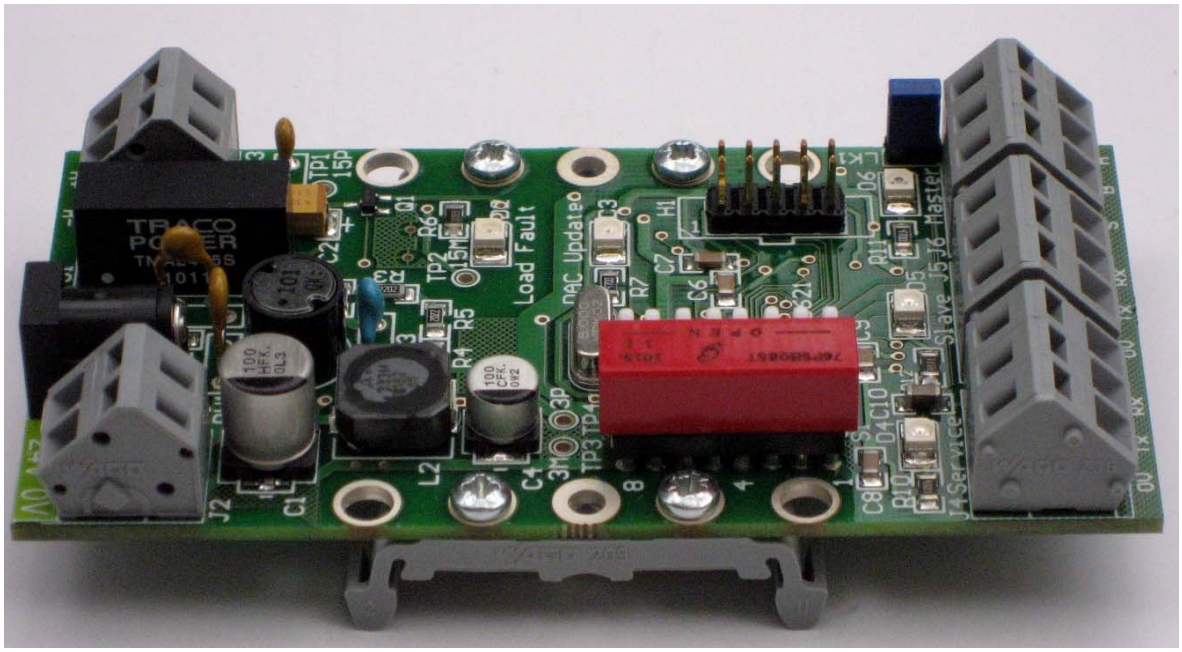


Figure 1 – XBD Assembly

Operation

A maximum of 16 XBD cards may be attached to the system. Connectivity is achieved by designating one card as a Master and the rest as passive Slaves. All cards may be set for either role.

A user Modbus Table may be programmed and saved. Each card can be set to a particular Modbus register and the associated data is then impressed upon the analogue output. More than one card may use the same register. Selection is either by using the DIL Switch, or via the configuration screen.

Modbus Master

Using the RS485 Modbus Port, the Master device polls all of the defined registers in the selected Modbus Table and outputs its selected register's data to the analogue port.

NB: There can only be one Master in a system

Modbus Passive Master (SNOOP)

In this mode, the card listens to the Modbus queries from the Master device and retrieves all register data associated with its selected Port address.

Modbus Relay

For the occasional system that requires a SCADA connection **and** Analogue outputs, the solution is to employ the RS485 LCD, which acts as the Master and offers an isolated RS485 Slave port. All other cards are set as SNOOP; additionally, the LCD shows the data on eight selected registers.

Modbus Slave Mode

A software-only configuration setting permits the XBD to operate as a stand-alone slave device to an external Master. Registers allow the remote Master to update the DAC, set the Control options, read the Status and to reset the respective device. Only registers prefixed DAC1 are applicable to the XBD; DAC2-prefixed registers are meaningful on the proposed Dual-DAC XBA card.

Modbus Registers

Eight Registers are defined starting at address 40750.

Table 1 – Slave Modbus Registers

Register	Name	Function	Type
751	DAC1DATA	DAC1 Data Register	Read/Write
752	DAC2DATA	DAC2 Data Register	Read/Write
753	DAC1CNTL	DAC1 Control Register	Read/Write
754	DAC1STAT	DAC1 Status Register	Read Only
755	DAC2CNTL	DAC2 Control Register	Read/Write
756	DAC2STAT	DAC2 Status Register	Read Only
757	DAC1RES	DAC1 Reset Register	Write Only
758	DAC2RES	DAC2 Reset Register	Write Only

Specification

Designation: XBD – (eXpansion Board 'D')

Environmental

Temperature Rating:

Operational:	-10C to 75°C
Storage:	-10C to 85°C

Relative Humidity: 0 to 90%, non-condensing

Mechanical

Dimensions:	The assembly size is 53mm x 100mm, (l x w). This is one third of a standard length single Eurocard.
Weight:	TBD
Fixing:	Two insulated DIN-Rail mounting clips

Electrical

Input Power Supply:	24Vdc +/-10%; Reverse-voltage protection, with re-settable fuses.
Supply Current:	~45mA at nominal supply voltage and 20mA output current.
Connection:	Two-pole connector and inverted Jack socket.

Analogue Output

Channels:	One channel
Resolution:	+/- Least Significant Bit of Output Range, (LSB=1/65535)
Accuracy:	+/-0.2% of full scale
Isolation:	1kV dc
Ranges:	Selectable from one of the following four current spans: Disabled, 0-20mA, 4-20mA or 0-24mA
Update:	When data changes
Vectoring:	A Source channel may be chosen from any of the available Modbus registers, via the appropriate VT100 configuration screen, or DIL Switch.
Ramp-Rate:	Software selectable with 5 settings for 0>100>0% output swing: 10us, 10ms, 100ms, 1s, 10s
Save Output Level:	Switches after a Bus Inactivity Timeout period: Minimum, Disabled or Hold
Output Selection:	Software selectable, see below.
Connection:	Two-pole connector.

The Analogue output uses a 16-Bit DAC which is software configurable to provide one of three output ranges; 0>20mA; 4>20mA; 0>24mA. VT100 configuration screens on the Service Port, allow selection of the DAC's output modes. A voltage output may be obtained by selecting the 0-20/24mA range and using a suitable burden resistor at the destination. For example the 0>20mA output with a 500R burden will deliver a 0>10V output.

RS485 Port

CONFIGURATION

Protocol:	RS485 Modbus Master/Snoop interface
Address:	Programmable
Baud Rate:	Programmable Baud Rate: 1200, 2400, 4800, 9600, 14400, 19200, 38400; default 9600 Baud 8,1,N
Termination:	User-selectable
Polling Period:	Programmable: 1 to 30s
Connection:	Three-pole connector

Modbus RS232 Port (Relay)

CONFIGURATION

Protocol:	RS232 Modbus RTU Slave interface
Address:	Programmable
Baud Rate:	Programmable Baud Rate: 1200, 2400, 4800, 9600, 14400, 19200, 38400; default 9600 Baud 8,1,N
Polling Period:	Minimum: 1s
Connection:	Three-pole connector

RS232 Service Port

A PDA/Notebook/NetBook serial interface, allowing system set-up and viewing of current data.

CONFIGURATION

Protocol:	RS232 – VT100 Text – use TeraTerm VT100 Emulator
Baud Rate:	Fixed 115200,8,1,N
Communication Settings:	115200 Baud 8,1,N
Connection:	Three-pole connector

Configuration Switches

Table 2 - DIL Switch Assignment

1	2	3	4	5	6	7	8	Function	Value
OFF	OFF	OFF	OFF	OFF	X	X	X	S/W-set Register	S/W Config
ON	OFF	OFF	OFF	OFF	X	X	X	Source Register	1
OFF	ON	OFF	OFF	OFF	X	X	X	Source Register	2
ON	ON	OFF	OFF	OFF	X	X	X	Source Register	3
OFF	OFF	ON	OFF	OFF	X	X	X	Source Register	4
ON	OFF	ON	OFF	OFF	X	X	X	Source Register	5
OFF	ON	ON	OFF	OFF	X	X	X	Source Register	6
ON	ON	ON	OFF	OFF	X	X	X	Source Register	7
OFF	OFF	OFF	ON	OFF	X	X	X	Source Register	8
ON	OFF	OFF	ON	OFF	X	X	X	Source Register	9
OFF	ON	OFF	ON	OFF	X	X	X	Source Register	10
ON	ON	OFF	ON	OFF	X	X	X	Source Register	11
OFF	OFF	ON	ON	OFF	X	X	X	Source Register	12
ON	OFF	ON	ON	OFF	X	X	X	Source Register	13
OFF	ON	ON	ON	OFF	X	X	X	Source Register	14
ON	ON	ON	ON	OFF	X	X	X	Source Register	15
OFF	OFF	OFF	OFF	ON	X	X	X	Source Register	16
ON	OFF	OFF	OFF	ON	X	X	X	Source Register	17
OFF	ON	OFF	OFF	ON	X	X	X	Source Register	18
ON	ON	OFF	OFF	ON	X	X	X	Source Register	19
OFF	OFF	ON	OFF	ON	X	X	X	Source Register	20
ON	OFF	ON	OFF	ON	X	X	X	Source Register	21
OFF	ON	ON	OFF	ON	X	X	X	Source Register	22
ON	ON	ON	OFF	ON	X	X	X	Source Register	23
OFF	OFF	OFF	ON	ON	X	X	X	Source Register	24
ON	OFF	OFF	ON	ON	X	X	X	Source Register	25
OFF	ON	OFF	ON	ON	X	X	X	Source Register	26
ON	ON	OFF	ON	ON	X	X	X	Source Register	27
OFF	OFF	ON	ON	ON	X	X	X	Source Register	28
ON	OFF	ON	ON	ON	X	X	X	Source Register	29
OFF	ON	ON	ON	ON	X	X	X	Source Register	30
ON	ON	ON	ON	ON	X	X	X	Reserved	N/A
X	X	X	X	X	OFF	X	X	Auto Table	OFF
X	X	X	X	X	ON	X	X	Auto Table	ON
X	X	X	X	X	X	OFF	X	Modbus Mode	Snoop
X	X	X	X	X	X	ON	X	Modbus Mode	Master
X	X	X	X	X	X	X	OFF	Defaults	S/W Config
X	X	X	X	X	X	X	ON	Defaults	38.4kbps/1

An 8-pole DIL switch may be fitted to the DIL socket. With all poles in the OFF position, the VT100 Configuration screen exclusively performs the settings. Tamper proofing is enhanced without the socket-mounted switch, alternatively, a DIL header, with solder links may be used.
The poles are arranged in two distinct groups.

Group-1 – Source Register Selection

The first 5 poles are used to assign the DAC's source Register. The selection follows standard binary counting to provide access to all 30 registers.

Group-2 – Forced Known Behaviour

Defaults

The OFF position of Pole-8 sets the Master & Slave baud rates to 38.4kbps and addresses to 1. It also enables the functions of Poles-6 & 7.

Modbus Mode

The ON setting is MASTER, whereby the XBD will scan the slave(s) for all valid registers in the configured Modbus Table. The SNOOP setting is for collecting the register value of the configured slave address, as scanned by another MASTER. The third operational mode can only be selected from the VT100 Configuration screen; this changes the XBD into a SLAVE device allowing the remote master to set the DAC level.

Auto Table

When enabled, this allows the XBD to detect and utilise the Slave's current Modbus Table, however, the outputted register may not be appropriate. Consult the Analogue Output Scaling/Editing screen to ensure correct operation.

Indications

On-board Light Emitting Diodes, (LEDs), are used to convey operating and fault information.

Name	Colour	State	Duration	Description
SYSTEM				
Power	**Blue**	**On**	**ON/OFF**	**ON whilst 24Vdc is applied to the unit**
Service	**Green**	**Pulse-On**	**200ms**	**ON after reception of a good packet**
RS485 Modbus				
[MASTER]	**Green**	**Pulse-Off**	**200ms**	**OFF after reception of a good packet**
[SLAVE]	**Green**	**Pulse-On**	**200ms**	**ON after reception of a good packet**
RS232 Modbus	**Green**	**Pulse-On**	**200ms**	**ON after reception of a good packet**
DAC				
Update	**Yellow**	**Pulse-On**	**500ms**	**ON upon data update**
DAC Fault	**Red**	**On**	**ON/OFF**	**When the load exhibits an open-circuit, or Device over-temperature (>150°C).**

Configuration

A set of PDA-sized screens utilising the VT100 protocol to offer display and editing of the otherwise inaccessible functions. Many PDAs and NetBooks are available that are supported by third party VT100 Terminal Emulation. More importantly, VT100 Terminal emulators exist on nearly every computing platform. The screen size is 40 characters by 24 lines. PC emulators can be used and the standard 80x24 screen can be set to 40x24, for compactness.

A VT100 compatible terminal programme is required and configured for 115200bps,8,1,N.
An eminently suitable programme is the open-source freeware TeraTerm, (version 2.3):
http://www.vector.co.jp/authors/VA002416/teraterm.html
TeraTerm supports the first 16 COM Ports, but the installed configuration sets a maximum of only four. Edit the text file, “TERATERM.INI” and adjust the following entry accordingly:

```
; Max serial port number
MaxComPort=16
```

See this URL for the latest user manual:
http://ttssh2.sourceforge.jp/manual/en/
and here specifically for other INI settings:
http://ttssh2.sourceforge.jp/manual/en/setup/teraterm.html

VT100 versus GUI

Comment: "The VT100 screens look like DOS"
Response: Yes, they are both text-based, however the SCI/LCD/XBD card is producing these itself.

1. VT100 screens are effectively platform independent; they can be displayed on Unix, Macintosh, Windows, PDAs, or even a dumb terminal!
2. Basically, it works with any operating system that supports a VT100 Terminal Emulator. All windows products are shipped with HyperTerm. Whilst it isn't user-friendly, it will work, else, use the free Tera-Term package.
3. VT100 displays are produced by the actual card, you can't get closer to the hardware.
4. More information is available and there are no delays associated with the transfer. Text displays give clarity to the information; it is not masked by the cosmetic veneer of a *pretty* GUI display.
5. Applications written for a specific platform can be wiped-out overnight by the release of an OS "Upgrade". A case in point, all of our current PC applications, (e.g. Roundel, Marble), failed to run under Windows-7! They have been rebuilt and are now validated on Windows-7 installations.

Now, which would you rather have on a desert island, (or a third-world country)?
The beauty is you can have both; the PC applications come into their own with graphical display of the data.

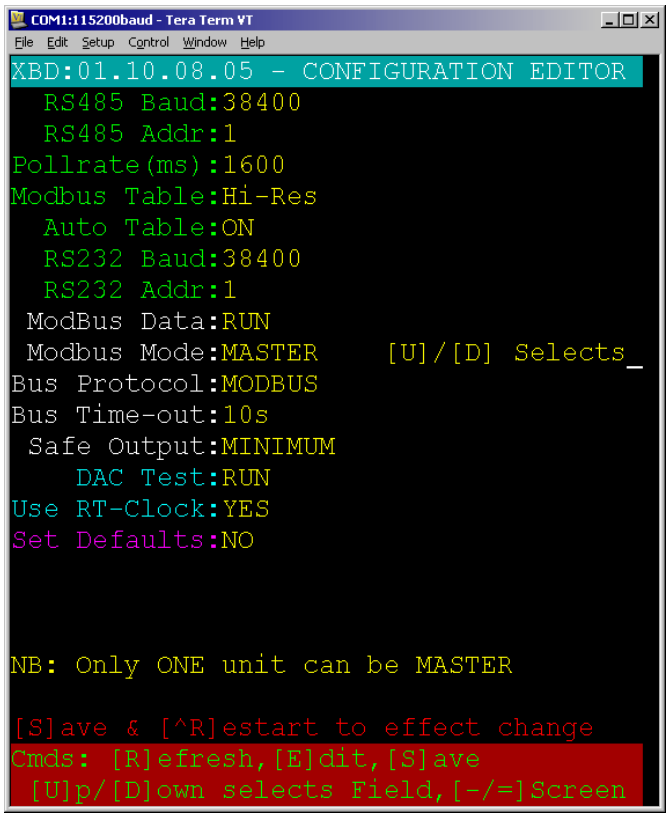
Configuration Editor

This is the entry screen and provides setting of the communications protocols and other global settings. DIL Switch settings override many of the configuration items on this screen; when they are in force, a warning message is posted should an attempt be made to edit an affected item.

Auto Table

ON/OFF: The ON setting allows the Master port to load the matching Modbus Table to that used by its slave. Whilst this can be a very useful feature, when the slave is physically remote, it will change the scaling parameters for the DAC Channel.

Figure 2 – Configuration Editor



Modbus Data

RUN/TEST: The TEST setting allows the insertion of test data, (The Register number), into the Slave's output. TEST is also asserted whilst Scaling/Editing of the DAC's limits and during DAC Test routines.

Modbus Mode

MASTER/SNOOP/SLAVE: Only one Master module may be present in the system, all others MUST be set to Snoop. SLAVE is a stand-alone operation with commands from a remote Master, (SCADA). When set to MASTER mode, the Master Port LED is normally ON and pulses OFF after a successful bus transaction. In SLAVE mode the LED pulses ON from a normally OFF condition. This allows an easy appraisal of the configuration in a system employing two or more XBD cards.

Bus Protocol

MODBUS/XBUS: The latter is a proprietary packet-based protocol. This is not available yet.

Bus Time-Out

This is the allowable period since receiving the last communication from the slave. This may be set from 10 to 1000 seconds and defaults to 10s.

Safe Output

MINIMUM/DISABLE/HOLD: Decide on the output level after a Bus Timeout has occurred. The MINIMUM level is the lowest current allowed by the DAC's range setting. DISABLE will disconnect the output altogether, ensuring no current is sunk. HOLD retains the last received value.

DAC Test

RUN/SAWTOOTH/SQUARE: The Sawtooth setting allows a triangular output waveform, encompassing the DAC's full span; to allow a viewable ramp, the DAC is increment by 100LSBs for each update.
The Square option switches alternately from minimum to maximum values and obeys the current Ramp-rate setting.

Use Real Time Clock

YES/NO: When used with our other products supporting a real-time clock, date/time data can be passed and is used by the on-board Event log and for future enhancements.

Factory Defaults

NO/YES: This option will restore the default settings upon saving.

Commands

Edit

Allows the selected parameter to be changed.

Saving

When useful changes have been made to the configuration, they may be saved to non-volatile memory, for permanent usage.

Restart

A software restart is effected by ^R, (Ctrl+'R' keys).

Navigation

The [U]p/[D]own keys allow selection of a desired parameter. The pointer wraps from first to last and vice-versa.

Modbus Display/Editor Screen

By selecting the desired table on the “Configuration Editor”, from the in-built list, the desired table may be modified and saved to the default table, when it will be labelled as “CUSTOM”. Since each table contains 30 entries, the table is, (almost like a football match), displayed in two halves; the appropriate section is automatically displayed when entries are selected in that page.

The current values are displayed for each live channel, providing a useful debugging feature.

This screen allows a selection of the displayed Registers, Scale and Types.

Since the screens are always available, this screen can be employed to monitor locally all the Modbus channels.

DAC Selection

The “D#” column shows the assignment of the specific register’s data to the analogue output. This may be changed to the currently highlighted row and will be also updated on the Analogue Scaling/Editing screen.

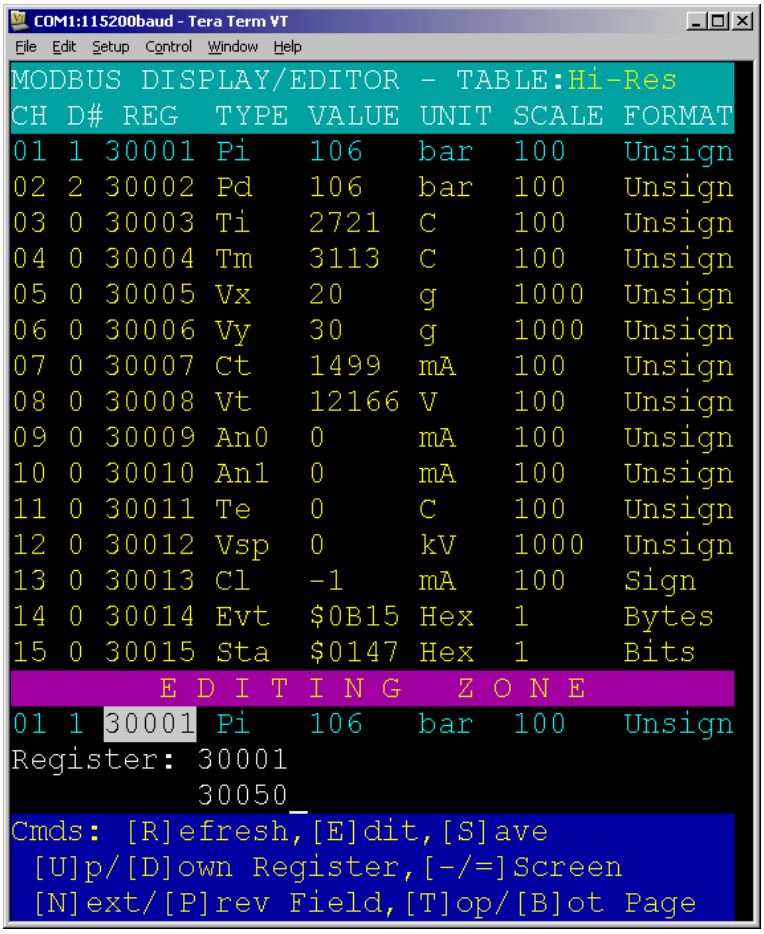


Figure 3 - Modbus Display/Editor Screen

Modbus Implementation

According to the publication, "MODBUS over serial line specification and implementation guide V1.02", page 13 of 44, (www.modbus.org), for new Modbus implementations, timeouts for high baud rates should adopt the following strategy:

> *For baud rates greater than 19200bps, fixed values for the 2 timers should be used: it is recommended to use a value of 750us for the inter-character time-out (t1.5) and a value of 1.750ms for inter-frame delay (t3.5).*

Whilst several higher baud rates are provided, it is prudent to poll at the slowest rate commensurate with matching the throughput of the down-hole transmission. A two-second-poll period is sufficient for most applications.

For long distance and/or high baud rate applications, ensure BOTH ends are correctly terminated. XBD has a 120R termination evoked by closing Link LK5.

For lower baud rates, allow sufficient time for receipt of the complete response packet, before re-polling.

Event Log & Diagnostic

The XBD module has an integral event/error log, which records all major operations and fault conditions. The error messages are especially useful when debugging a Modbus connection. The XBD does not contain a real-time clock, but it can use the RTC of an attached slave. Figure 4 below, shows that the initial entry, [09], has been posted before date-time information has been gleaned from the slave.

Event Log

Up to 50 entries may be recorded, any more will displace those at the bottom of the log.
Navigation keys allow the log to be inspected, with quick means for traversing to the [F]irst, or [L]ast entry of the log.
For test purposes, the user can [M]ake dummy entries, to see the log filling. They are marked with a TST subsystem label to differentiate them from real events.

Log Clearing

Pressing the [C] key effects this. A new log entry records the action.

Diagnostics

Useful DAC states and system information are depicted to enable a quick appraisal of the card's integrity.

DAC1/2

These fields will indicate a DAC over-temperature, or open-circuit load.

XTO

This is the current state of the X-Bus timeout, which is set via the Configuration screen. If it drops to zero, the "Safe" DAC state is asserted.

CID

The field depicts the (almost) unique Card ID, in hexadecimal notation.

CPU

This is the CPU temperature, **NOT** the ambient.

MEM

These are the FLASH/SRAM resources on the CPU.

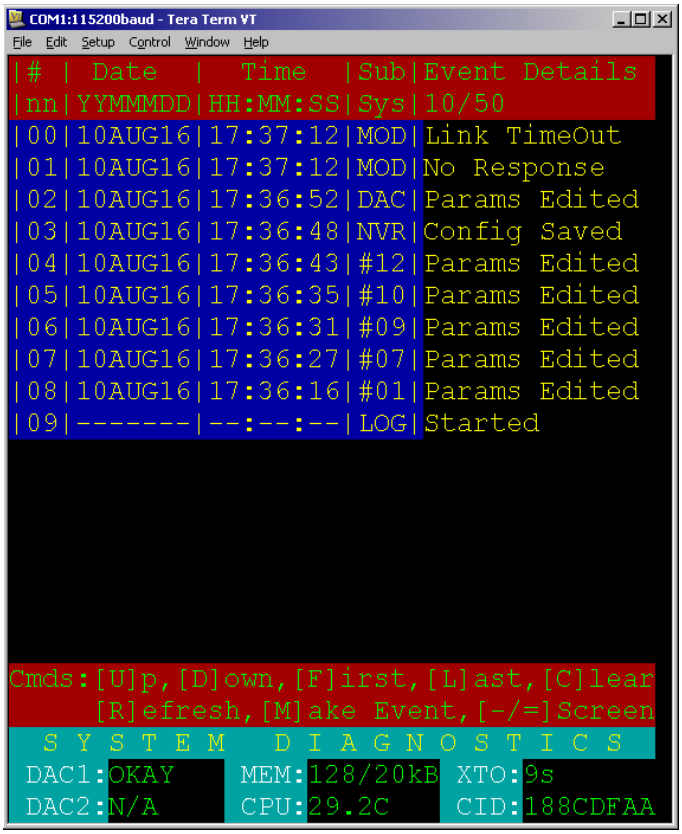
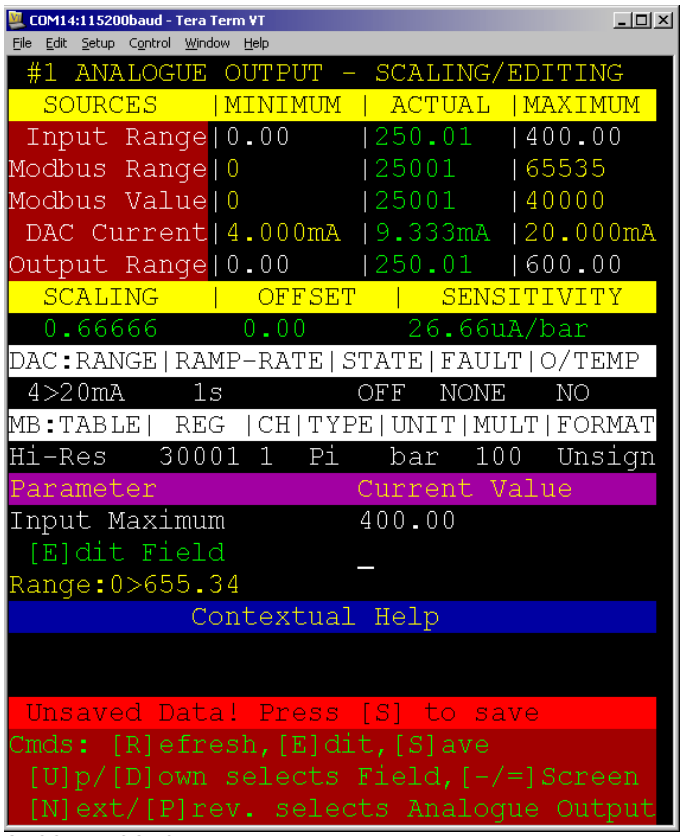


Figure 4 – Example Event Log & Diagnostic Screen

Scaling & Editing

Figure 5 - Scaling & Editing Screen



Input Range

Minimum

This is the Zero-scale setting of the source transducer.
NB: An unsigned Modbus integer format will automatically zero this value.

Actual

This is the live reading and provides a useful debugging feature.

Maximum

This is the Full-scale setting of the source transducer.

Modbus Range

This system is based on integer, 16-bit wide, data registers. However, these may be signed, or unsigned. This value has a profound effect on the resolution and should be chosen carefully.

Signed Integer

This allows positive and negative values to be conveyed, in the range of –32768 to +32767.

Unsigned Integer

This format only uses positive numbers, ranging from 0 to 65535.

Modbus Value

This is the value of the source value multiplied by the scaling factor, in this case x100.

DAC Output Current

This displays the DAC range extents and the current, live value.

Output Range

To accommodate legacy equipment, especially where access to the destination scaling is denied, a mapping can be made to preserve the scaling. However, this will not give optimal resolution.

Conversion Factors

A mapping must be made between the source and output ranges. The following fields display the scaling and offset values that are in force.

Scaling

This is the mapping between the 16-bit Modbus register value and DAC output.

Offset

This is the applied offset.

Sensitivity

This display is a figure of merit for the conversion settings; the highest value is best.

DAC Status

Output Range

One of four ranges may be selected; Disabled, 4>20mA, 0>20mA and 0>24mA.

Ramp-Rate

This is the time taken for the analogue output to ramp from either 0 to 100%, or 100 to 0%. Any change in output will be subjected to the same slope. Rates are selectable from 10uS, (disabled), to 10s, in decade increments.
Step-change levels can cause severe problems to attached plant, e.g. motors, therefore this parameter should be set appropriately.

State

Shows whether, or not, the Analogue Output DAC is enabled.

Fault

This state is also indicated via the on-board red DAC Fault LED; it indicates an open-circuit load, or a burden value that is too high for the available source voltage.

Over Temperature

This is an indication of the DAC's core temperature exceeding 150°C. In practice, this should only occur for ambient temperatures exceeding the card's rating, or an external fault back-feeding a voltage in excess of 24volts.
The DAC output will be disabled after a period determined by the Bus Timeout value. After another elapsed timeout, it will be re-enabled, to cycle ad-nauseum, potentially reducing the DAC's temperature and allowing the unit to restore should the load fault clear.

Modbus Register Display

Modbus Table

This entry is set on the main Configuration page.

Register

This is the Modbus Register number.

Indexed Channel

This setting vectors the source, from one of the 30 Modbus Table Registers, to the Analogue Output.

Parameter Type

This value is shown for indication only, but may be modified on the Modbus Table.

Units

The value is shown for indication only, but may be modified on the Modbus Table. It is used to make the "Sensitivity" display more meaningful.

Multiplier

The value may be modified on the Modbus Table Editor.

Modbus Integer Data Types

In Modbus parlance there is either signed, or unsigned. However, we have additionally defined a few more, which allow better handling and display in our applications.

The defined formats and their respective meanings are:

- UNUSED Unused/Disabled
- SIGN Signed
- UNSIGN Unsigned
- NUMBER Unsigned, but displayed differently (legacy)
- BITFIELD 16 separate Bits/Flags
- BYTES Two Bytes, each containing a different parameter

Editing

The following fields may be edited and are selected by the [U]p/[D]own keys. The controls wrap the last item around to the first and vice-versa.

- Modbus Table Index
- Input Minimum
- Input Maximum
- Output Minimum
- Output Maximum
- DAC Current Range
- Ramp-Rate 0>100%

Modbus fields must be changed using the Modbus Display/Editor screen except the DAC channel assignment, which can be set here and via the Modbus screen. This is the parameter that links the two screens and a change from either will update the other.

Register Mapping Considerations

This module offers two distinct methods of mapping, one is via the on-board DIL switch and the other by the VT100 screens.

DIL Switch Assignment

DIL Switch, S1, must have one or more of Poles 1 to 5 in the ON, (Closed) position. Registers are selected via a binary count; please consult Table 2 - DIL Switch Assignment.
This is a simple, but very crude method, which blindly impresses the selected channel's Modbus 16-bit data onto the 16-bit DAC's output.
To give an example, let's say we use a pressure channel, with 0 to 400bar range. With an unsigned integer Modbus data format, we have a maximum data value of 40,000, with a Modbus scaling factor of 100. When this is directly impressed on the Analogue Output DAC, its full-range value will be 65535/40000, which is 655.35bar; but how would you know that? Knowledge of the Modbus Table entries is mandatory, but this still doesn't convey the usage, i.e. Full and Zero-scale values.

VT100 Scaling/Editor Screen

To operate in this mode, the DIL Switch, S1, must have **all** Poles 1 to 5 in the OFF, (Open) position (Software Configuration).

Empirical DAC Calibration

This screen displays the values in engineering units and allows the actual value to be forced to specific levels.

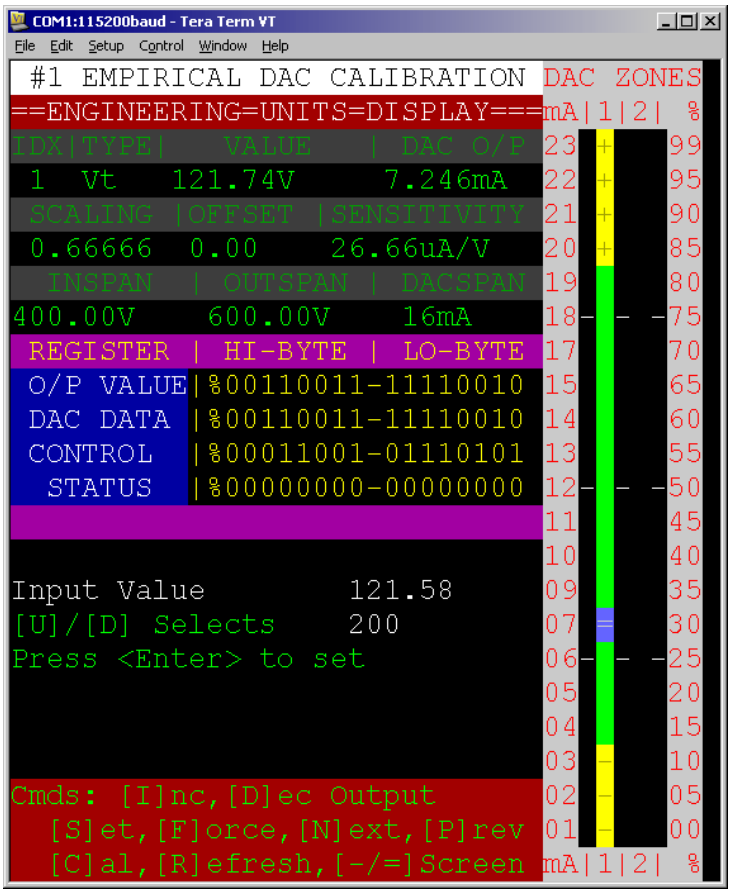


Figure 6 - DAC Calibration

DAC Register

This binary representational display shows the inner workings of the DAC and therefore allows integrity checking and testing of the same. The bottom three rows are read-back from the isolated DAC; the top shows the developed actual value to be sent to the DAC. In normal operation the first and second rows should be identical. The DAC's register values won't be much use without reference to the relevant data-sheet, but the control bits will change when the ramp-rate and DAC range are adjusted.

Commands

[I]nc & [D]ec

These two commands allow the output to be nudged up and down respectively.
Initially the step is a LSB, but after 10 steps in any consecutive direction, the step is magnified by a factor of 10. This magnification effect continues until the direction is reversed. The values at either end of the valid input range may be reached fairly rapidly.

[F]orce

The allows the user to force the value to either the lower or higher input limits, or to an arbitrarily set value.

[Q]uit

Any forcing of the Input Value disconnects the DAC from the Modbus input stream. After forcing, (or nudging), is completed, the stream may be reconnected by pressing the now visible [Q]uit key. This changeover is effected by temporarily switching the "Modbus Data" flag, from the Configuration screen.

[S]et & [C]al

These commands have not been implemented.

Appendix

Signal Converters

The following list of third party, validated signal converters is presented to help integrate our products. These are used in-house on a daily basis. Most USB items are based on either the Prolific PL-2303, or FTDI FT232R devices.

TTL<>RS232

B&B Electronics
TTL Converter – non-isolated
Port powered; TTL Male DB9; RS232 Female DB9
5V Version - Model: 232LPTTL
1-off $49
http://www.bb-elec.com/bb-elec/literature/232LPTTL-3406ds.pdf

3V3 Version - Model: 232LPTTL33
1-off $49
http://www.bb-elec.com/bb-elec/literature/232LPTTL-3406ds.pdf

RS232<>USB

Prolific Technology Inc
Prolific PL-2303
USB powered; Male DB9
Caveat: No driver for Vista-64
http://www.prolific.com.tw

1-off £13.99 ex VAT
http://www.startech.com/item/ICUSB232-USB-to-RS232-DB9-Serial-Adapter-Cable-Male-to-Male-Serial-Adapter-USB-to-Serial.aspx
1-off £12.82 ex VAT
http://www.saverstore.com/product/20003270/Startech-ICUSB232-USB-to-RS-232-DB9-Serial-Adapter

RS485<>USB

Soarland & Hexin
http://www.hexin-technology.com/USB_2.0_To_RS-485_Converter-Product-255.html
Model: HXSP-2108F
Prolific PL-2303
USB powered; Male DB9
Useful Female DB9 to screw terminal adapter
Caveat: No driver for Vista-64; Remove 120R termination
NB: Echo is OFF

1-off £15.16
http://www.sourcingmap.com/usb-rs485-rs485-serial-adapter-converter-p-43362.html

RS485<>USB

Future Technology Devices International
Model: USB-RS485-WE-1800-BT
FTDI FT232R
USB powered; cable, wire-ends
NB: Echo is OFF

1-off £21.50

http://apple.clickandbuild.com/cnb/shop/ftdichip?op=catalogue-products-null&prodCategoryID=91&title=USB-RS485+Cable