RT-ANA

Analogue Interface for the RT3000

User Manual

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Table of Contents

Introduction

The RT-ANA unit is an interface converter that accepts CAN messages from the RT3000 and converts them to analogue voltages. The RT-ANA has up to 16 analogue output channels with a range of ±10V. The RT-ANA uses precision 16-bit DACs and precision op-amp drivers to ensure the highest levels of accuracy can be achieved.

The outputs are presented on 16 BNC connectors and on a 25-way D-type connector. Either output can be used and they are connected internally.

The configuration for the analogue outputs is performed in the RT3000; the RT-ANA decodes four, 8-byte CAN messages and turns them in to voltages. The only user configuration parameters are the CAN baud rate and the *fast-update* mode.

The RT-ANA includes galvanically isolated power supplies on the analogue side to ensure that there are no ground loops. This power supply is not intended to have large D.C. offsets between the earth and the analogue outputs since the EMC filters have a working voltage of 25V. The isolation is suitable for use in vehicles.

The RT-ANA has an indicator LED to show that it is receiving CAN messages and working correctly.

Scope of Delivery

Table 1, below, lists all the items that are delivered with each RT-ANA unit.

Table 1. Summary of the RT-ANA Components

Qty	Description
1	RT-ANA Unit
1	77C0002B Power Cable
1	14C0037A CAN Cable
1	Null Modem Serial Cable (for configuration)

Figure 1. RT-ANA Components

Specification

The technical specification of the RT-ANA unit is shown in Table 2, below.

Table 2. Technical Specification

Parameter	Specification
Input	CAN
Calculation Delay[1]	6.6ms (low latency mode), 16.6ms (fast-update mode)
Outputs	16 Analogue Channels
Output Rate	100 Hz (low latency mode), 1.6kHz (fast-update mode)
Output Range	±10V
Output Accuracy	1mV
Output Resolution	16-bits, 320mV
Power	3W, 9 – 18V d.c.
Operating Temperature	0 to 60°C
Relative Humidity	95%, non-condensing
Shock (Survival)	1000g, 5 ms half-sine

Note 1: Delays depend on the CAN bus, these figures assume a 1MBit/s CAN bus speed. Add an additional 1.8ms for a 500kBit/s CAN bus.

Warranty

Oxford Technical Solutions Limited warrants the RT3000 products to be free of defects in materials and workmanship, subject to the conditions set forth below, for a period of one year from the Date of Sale.

'Date of Sale' shall mean the date of the Oxford Technical Solutions Limited invoice issued on delivery of the product. The responsibility of Oxford Technical Solutions Limited in respect of this warranty is limited solely to product replacement or product repair at an authorised location only. Determination of replacement or repair will be made by Oxford Technical Solutions Limited personnel or by personnel expressly authorised by Oxford Technical Solutions Limited for this purpose.

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Functional Overview

The RT-ANA responds to four specific CAN-bus messages sent by the RT3000. Table 3, below, shows the default, factory configured identifiers used by the RT3000 and the RT-ANA.

Table 3. CAN Identifiers used by the RT3000 and RT-ANA

Identifer	Channels
610h	Channel 0 to 3
611h	Channel 4 to 7
612h	Channel 8 to 11
613h	Channel 12 to 15

The RT3000 encodes the desired voltage of each channel into these CAN messages. All the configuration for the channel data is performed by the RT3000, not the RT-ANA.

Status LED

The Status LED on the front panel gives some indication whether the RT-ANA is operating correctly or not. The following paragraphs describe the operation of the Status LED.

Power-Up. At Power-Up the LED is green but it quickly changes to red when the software in the RT-ANA boots. If the LED remains green after the power has been put on then the RT-ANA will not work correctly.

Waiting for CAN. The LED will remain red until 100 valid CAN messages have been decoded. CAN messages not intended for the RT-ANA will not count and will not change the LED state.

CAN Running. The LED will flash Orange/Off every 100 CAN messages (100 Orange then 100 Off). Since the RT3000 updates at 100Hz and there are 4 CAN messages per update, the LED will cycle with a frequency of 2Hz.

Configuration

There are two configuration parameters that may need changing by the user before operation begins. These are the CAN baud rate (so it matches the RT3000 and the other devices on the bus) and the *fast-update* mode.

To configure the RT-ANA a serial terminal program is required. Windows comes with *HyperTerminal*, but other suitable programs can also be used.

Using the Null-Modem Serial Cable, connect the *Configuration* port of the RT-ANA to a serial port a PC. Run your serial terminal program and configure the settings as listed in Table 4, below.

Figure 2. RT-ANA Configuration Output at Start-up

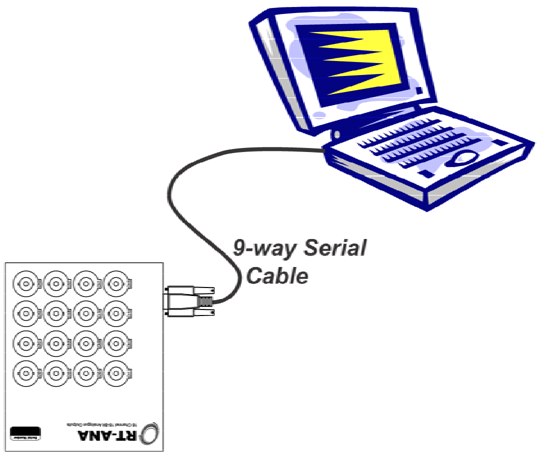
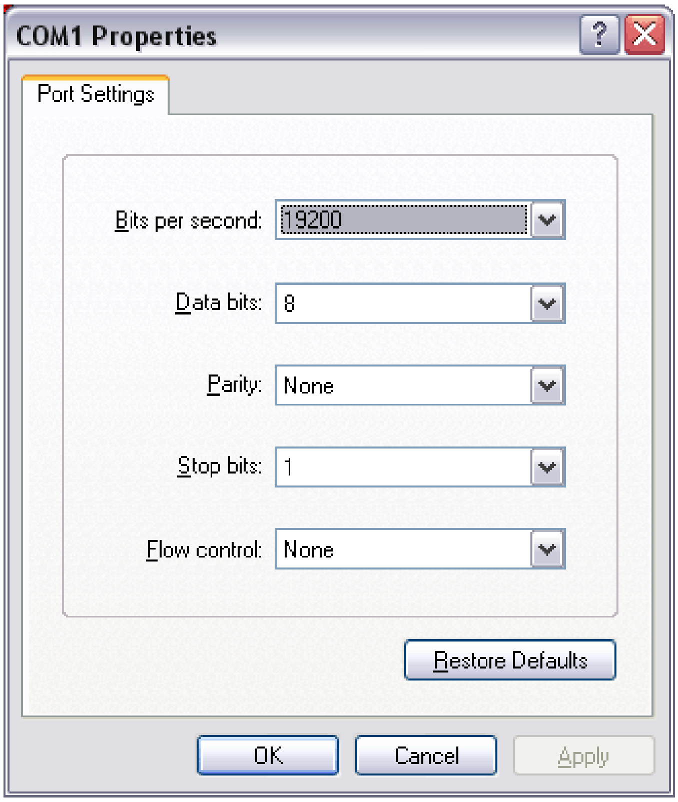


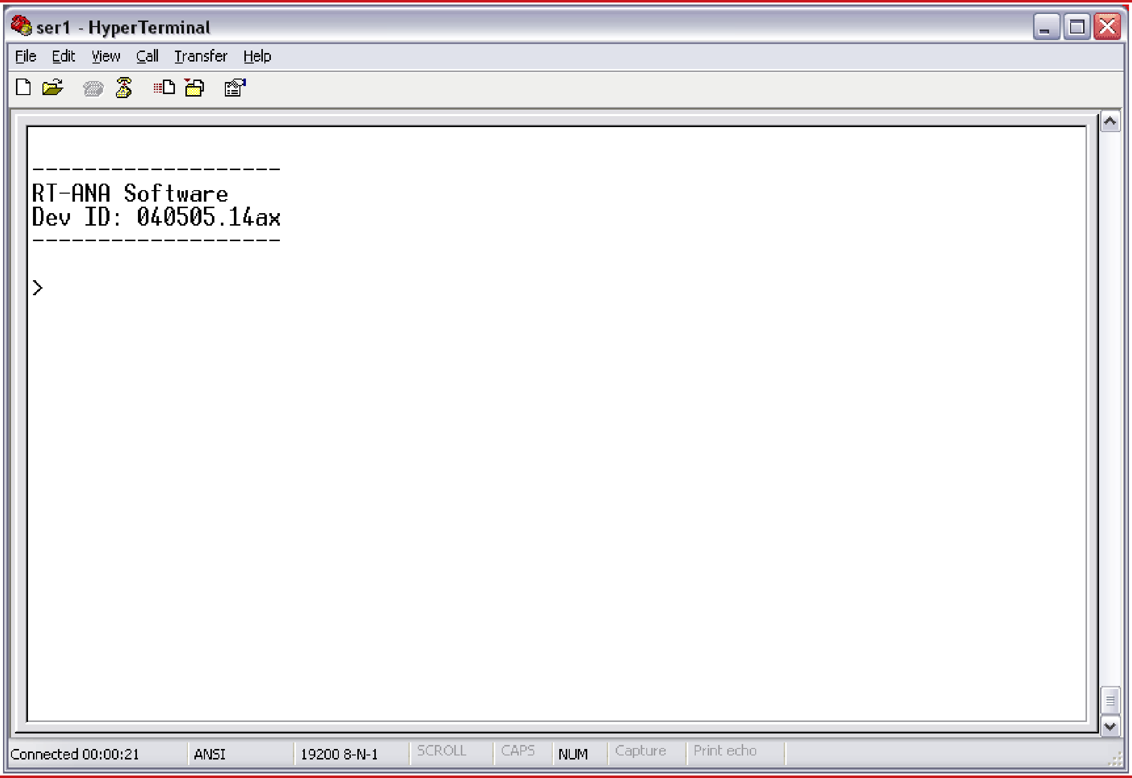
Table 4. Serial Terminal Settings

Parameter	Specification	Example from Hyperterminal
Baud Rate	19200	
Data Bits	8	
Parity	None	
Stop Bits	1	
Flow Control	None	



Apply power to the RT-ANA, the terminal will respond as shown in Figure 3, below.

Figure 3. RT-ANA Configuration Output at Start-up



At Start-up the *Dev Id* is the version of software running in the RT-ANA unit. This may be required when contacting Oxford Technical Solutions for support.

The user commands that the RT-ANA responds to are listed in Table 5, below.

Table 5. RT-ANA Commands

Command	Function
CONFIG	Lists the configuration of the RT-ANA.
CANBAUD	Sets the CAN Baud rate in KBit/s.
FASTUPDATES	Sets *fast-updates* on or off.
SAVECONFIG	Saves the configuration to non-volatile memory.

Command Syntax

The syntax for each of the commands is listed below. Note that the commands are case-sensitive; upper case is required or the RT-ANA will not accept the command. Some commands will not all take effect until next power-on. All commands need to be saved to non-volatile memory using the SAVECONFIG command or they will be forgotten when the power is removed.

CONFIG command. The CONFIG command is used to list the settings in the RT-ANA box. The command will list all the configurations, not just the ones for the user. Do not change any configurations apart from the ones described here.

Syntax

```
CONFIG
```

Example Response

```
Config Version Valid: 60785645
CRC:                   EEA0489
CANBAUD 1000
CANID 0 610
CANID 1 611
CANID 2 612
CANID 3 613
DACCAL 0 4 61867
DACCAL 1 -21 61832
DACCAL 2 -15 61874
DACCAL 3 -15 61881
DACCAL 4 -3 61853
DACCAL 5 -4 61863
DACCAL 6 220 61345
DACCAL 7 -1 61870
DACCAL 8 -4 61870
DACCAL 9 1622 65501
DACCAL 10 -12 61881
DACCAL 11 0 61867
DACCAL 12 16 61846
DACCAL 13 -4 61877
DACCAL 14 -6 61846
DACCAL 15 -15 61881
FASTUPDATES OFF
```

CANBAUD command. The CANBAUD command is used to change the baud rate settings of the RT-ANA. This setting does not become active until the RT-ANA is next powered on.

Syntax

```
CANBAUD <RATE>
```

Valid values for *<RATE>* are listed in Table 6, below.

Table 6. RT-ANA CAN Baud Rate Options

<RATE>	Baud Rate
1000	1 MBit/s
500	500 kBit/s
250	250 kBit/s
200	200 kBit/s

Note: Other values will be accepted, but are not guaranteed to work correctly.

FASTUPDATES command. The FASTUPDATES command is used to turn the *fast-updates* mode on and off.

Syntax

```
FASTUPDATES <STATE>
```

Valid values for *<STATE>* are listed in Table 7, below.

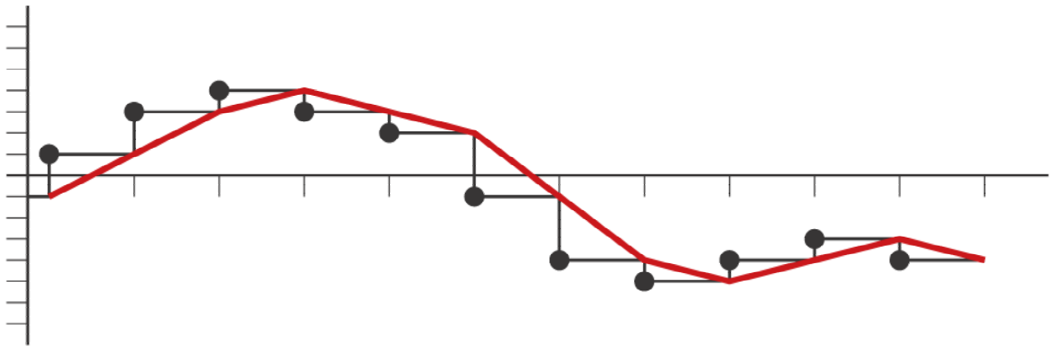
Table 7. RT-ANA *fast-update* states

<STATE>	*Fast-update* state
ON	Fast updates are on
OFF	Fast updates are off

When fast updates are off the RT-ANA behaves as expected for an analogue output system. The 100Hz outputs are written directly to the DACs as quickly as possible. This results in the lowest output latency.

In *fast-update* mode the output to the DACs is smoothed. Linear interpolation is used to ensure that the new value at the DACs is reached at the end of the 100Hz cycle. Figure 4, below, compares the outputs using the normal DAC update and *fast*-update mode.

Figure 4. Fast-Update mode



In *fast-update* mode the output is delayed by one extra cycle (extra 10ms), but then the DACs are updated at 1600Hz. This can allow for better timing between systems; although the delay is longer, it is known more accurately. If a system samples the low-latency RT-ANA output at 100Hz then the timing is only known to 10ms. If it samples the fast-update RT-ANA output then it knows the timing to 0.6ms. For some applications the improved timing is more critical than the additional delay.

An alternative is to use the low-latency mode and then have the acquisition system over-sample the signal from the RT3000. For example, if the RT3000 is sampled at 1kHz and the samples are filtered using a suitable reconstruction filter then the fast-update mode is not needed and the low latency output can be used without any reduction in performance. (Note that the fast-update mode is a form of reconstruction filter. It is impossible to make a reconstruction filter work in real-time without a delay. But it is possible to use a reconstruction filter on the data post-mission in the acquisition software.)

SAVECONFIG command. The SAVECONFIG command is required to save the configuration to non-volatile memory. The SAVECONFIG command takes a few seconds to run; it is essential that power is not removed during the SAVECONFIG command.

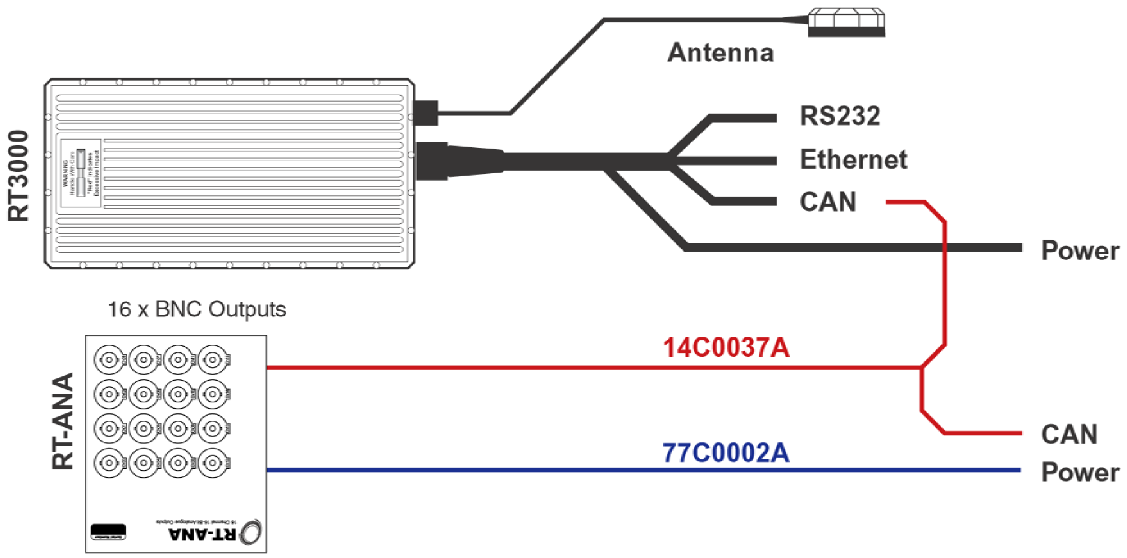
Syntax

```
SAVECONFIG
```

Connections

The RT-ANA should be connected to the RT3000 CAN bus as shown in Figure 5, below.

Figure 5. RT-ANA Connections to RT3000



The pin assignments for the connectors on the RT-ANA are given in the following tables.

Figure 6. RT-ANA Front Panel Connectors

Table 8. Power Connector Pin Assignments

Pin	Cable Colour	Description
1	Brown	Power Supply 9–18 V d.c.
2	White	Not Connected
3	Blue	Ground
4	Black	Not Connected

Connector type: Hirschmann ELST 412 PG9. Also known as an E-serial M12 plug.

Table 9. CAN Bus Pin Assignments

Pin	Description
2	CAN– (CAN Low)
3	Ground
6	Ground
7	CAN+ (CAN High)

Notes: Other Pins not connected. There is no CAN bus termination resistor inside the RT-ANA. The CAN bus must have *at least* one 120R resistor between CAN– and CAN+.
Connector type: 9-way D-type, male.

Table 10. Configuration RS232 Pin Assignments

Pin	Description
2	Data Receive
3	Data Transmit
6	Ground

Notes: Other Pins not connected. Use a standard Null-Modem serial lead to connect to a PC.
Connector type: 9-way D-type, male.

Table 11. Analogue Outputs (25-way)

Pin	Description
1	Analogue Ground
2	Channel 0
3	Channel 1
4	Analogue Ground
5	Channel 2
6	Channel 3
7	Analogue Ground
8	Channel 4
9	Channel 5
10	Analogue Ground
11	Channel 6
12	Channel 7
13	Analogue Ground
14	Channel 8
15	Analogue Ground
16	Channel 9
17	Channel 10
18	Analogue Ground
19	Channel 11
20	Channel 12
21	Analogue Ground
22	Channel 13
23	Channel 14
24	Analogue Ground
25	Channel 15

Connector type: 25-way D-type, male.

Revision History

Table 12. Revision History

Revision	Comments
040510	Initial Version