

Title

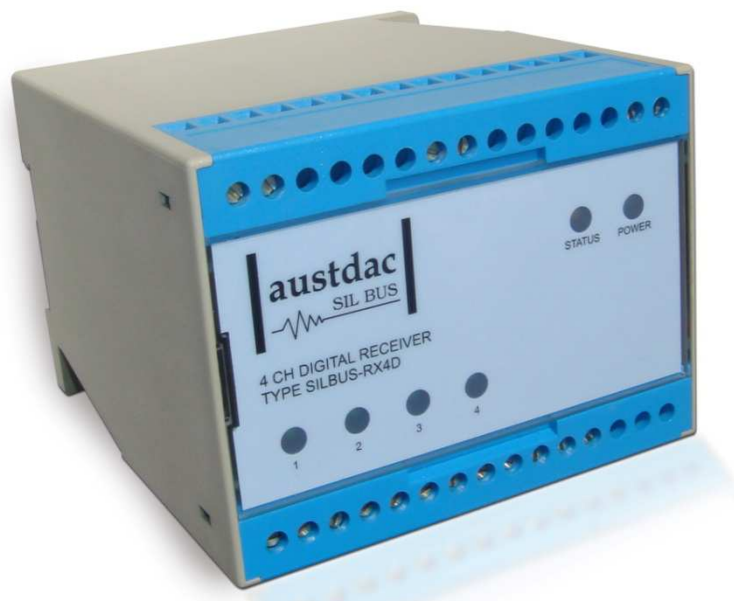
**4 CHANNEL DIGITAL
RECEIVER
TYPE SILBUS-RX4D
USER'S MANUAL**

Document Number

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Issue

04





REVISION CONTROL

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Austdac Pty Ltd

Unit 1 / 4 Packard Avenue
Castle Hill NSW 2154
Australia

PO Box 6486
Baulkham Hills Business Centre
NSW 2153
Australia

Phone: + 61 2 8851 5000
Fax: + 61 2 9899 2490
Website: www.austdac.com.au

Austdac Inc.

455 Lowries Run Rd,
Pittsburgh, PA 15237
USA

Phone: +1 888 254 9155
Fax: +1 412 635 0179

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1 GENERAL DESCRIPTION

The four channel digital receiver is part of a family of explosion protected DIN rail mounting modules that transmit to and receive from an Austdac SILBUS field bus network. The SILBUS-RX4D can receive from just a few through to many digital ON/OFF signal from a SILBUS network to control the four relay outputs directly or via complex multi-term logic functions. The digital receiver has four output relays controlled by up to six logic resolvers capable of implementing OR, AND, NOR, NAND, FLIP and S-AND logic functions. Each resolver has an independently configurable output ON and OFF delay filter to allow implementation of simple timer functions.

The four digital outputs are galvanically isolated from each other, from the power supply port and the SILBUS network port. This isolation allows the SILBUS-RX4D to provide many simple and highly effective solutions when used in installations involving intrinsically safe and non-intrinsically safe circuits.

The four channel digital receiver is available in two output contact power switching variants to cover all applications of the receiver. The two variants are the SILBUS-RX4D-L for low power switching applications and the SILBUS-RX4D-H for high power switching applications. See the specifications section for actual switching capacities. For the remainder of the manual the generic SILBUS-RX4D will be used instead of two individual types.

The receiver is housed within a DIN rail mounting enclosure measuring 100mm (W) x 75mm (H) x 110mm (D). The front panel is located between the two top of enclosure mounted terminal blocks to provide a clear view of the operation indicating LED's. Four LED's, one for each channel, are provided to indicate the status of each of the output relays. A further two LED's are provided to show power and SILBUS network status.

The SILBUS-RX4D can be quickly and simply configured using a laptop computer running Hyper Terminal and a small plug in programming adaptor. Each digital output can be independently programmed to any SILBUS channel address. Each digital input can also have it's de-bounce timer independently programmed between 500ms and 10s in 100ms increments.

2 FRONT PANEL LAYOUT

The four channel digital receiver front panel is located between the terminal blocks that form part of the enclosure. Located in the top right hand corner of the front panel are the STATUS and POWER indication LED's. The green power LED is illuminated whenever a 12 volt supply is connected to the receiver. The yellow status LED flashes at different rates to indicate the operational status of the receiver, see table 2 for more details.

On the lower left of the front panel are four green LED's labelled from one through to four, these LED's indicate the status of the four digital relay outputs. A LED is illuminated to indicate an on or active output and extinguished to indicate an off or inactive output.

The front panel is shown in photograph 1.

The front panel can be snapped out and removed by using a wide bladed flat screw driver to gain access to the configuration (console) port and programming switch. Photograph 2 below shows the front panel removed and the location of the console port and programming switch.



Photograph 1 SILBUS-RX4D front panel



Photograph 2 Access to console port and programming switch

The black four pin console port connector and the red programming switch are located behind the lower right corner of the front panel label.

3 THEORY OF OPERATION

3.1 LOGIC FUNCTIONS

The four channel digital receiver has been furnished with six configurable multi-term logic gates or logic resolvers, four of which drive the four general purpose relay outputs. These logic resolvers are typically used to implement conveyor 'OR' and 'AND' functions for emergency stop or remote isolation. The six basic logic functions are 'OR', 'AND', 'NAND', 'NOR', 'FLIP' and 'S-AND' while 'S-NAND' is possible by inverting the input terms. 'S-AND' and 'S-NAND' allow the two bit safety channels to be used as a single term in the logic resolver.

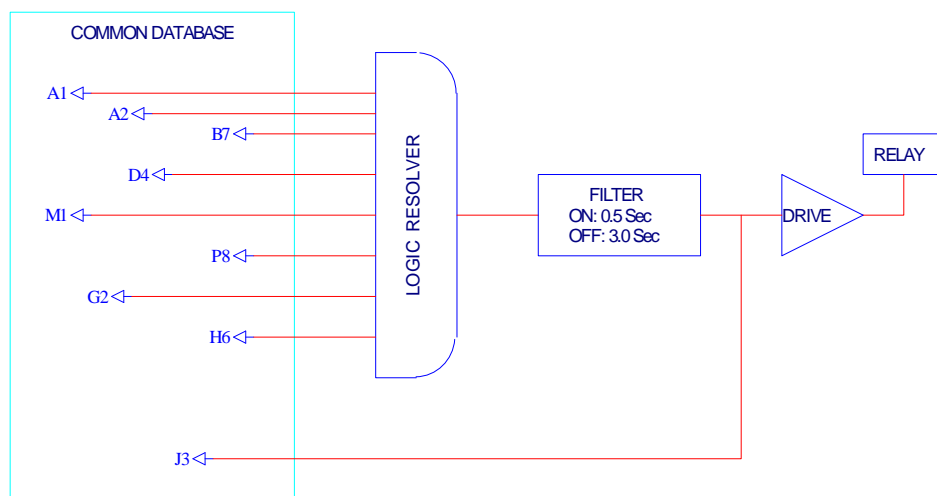


Figure 1 Multi-term logic function

Each logic resolver has a maximum number of input terms equal to the size of the connected SILBUS network or system database i.e. 128, 64, 32, 16 or 8. The input terms can be specified in any order and do not need to be sequential. Channels assigned for analink, fastlink, datalink or sync transmission should not be used as input terms of the logic functions, otherwise unpredictable results will be obtained.

The output of the logic resolver is fed via a filter with independently variable on and off filter periods before being applied to the relay output. The on and off filter times can be independently configured from 100mS to hours in 100mS steps. The filter on and off times are used to stop intermittent signals from causing inadvertent trips and alarms. The filter on time ensures that the output from the logic resolver must be on for the 'on' filter period before the relay output will be asserted. The filter off time ensures that the output from the logic resolver must be off for the 'off' filter period before the relay output will be negated.

The timers can be used to implement simple timer related functions when delays are needed in system control sequences.

The filtered logic resolver output can be transmitted back onto the SILBUS network for use in further logic operations and to be read by the network channel generator or by a test unit

for indication purposes. Figure 1 shows the layout of one of the first four logic resolvers (1, 2, 3 and 4) that have the capability to drive an output relay. The SILBUS-RX4D has a further two logic resolvers (5 and 6) that do not have output relays but otherwise function identically. These two logic resolvers can be used to implement multi-term logic functions and then provide a single output that is feed back for use as an input term of one of the other logic resolvers. This is useful when combining safety channels and normal digital channels in the same logic function, as the S-AND function and the standard AND/OR functions can not be handled by the one logic resolver.

By combining logic and timer functions simple RS type latch functions can also be implemented by the SILBUS-RX4D. The logic resolver functions and outputs are only updated during the SILBUS SYNC pulse period at the end of each SILBUS scan period. System designers should take this and the associated delays into account when implementing and configuring the logic resolvers.

If the relay output is required to be operated from a single SILBUS channel then a single-term 'AND' or 'OR' logic function should be implemented.

The 'S-AND' safety function is used with safety channels and not only takes into account the status of the safety channel but also includes the quality or validity of the safety channel in the logic function. The 'S-AND' logic function can only accept safety channel input terms, the inclusion of standard digital channels as input terms will result in unpredictable outputs from the 'S-AND' logic function. The 'S-AND' logic function also needs to know the safety sync channel address, typically A1 as shown in figure 2. Safety and standard digital channels can be combined in logic operations by cascading logic resolvers as shown in the following figure.

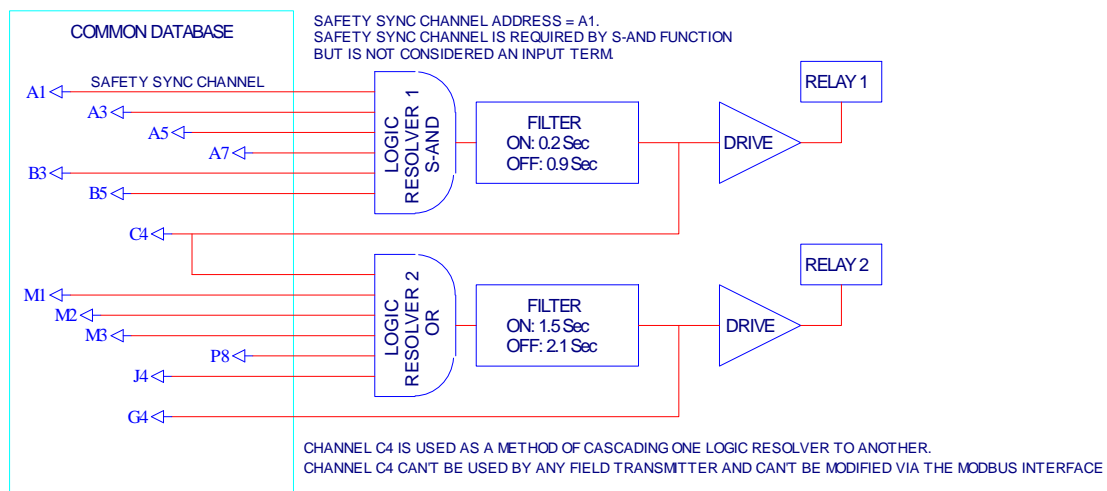


Figure 2 S-AND logic function and resolver cascading

When logic resolver outputs are fed back onto the SILBUS network for inclusion in subsequent logic resolvers the designer should ensure that these feedback channels are not modified by field devices or the channel generator.

The configuration and use of these logic resolvers is further explained in the configuration section of this manual.

3.2 THE FLIP FUNCTION

The FLIP logic function implements a D type flip flop with feedback to produce a toggling 'flip' function which is useful in implementing single way road block light systems. A schematic of the FLIP function is shown in the figure below.

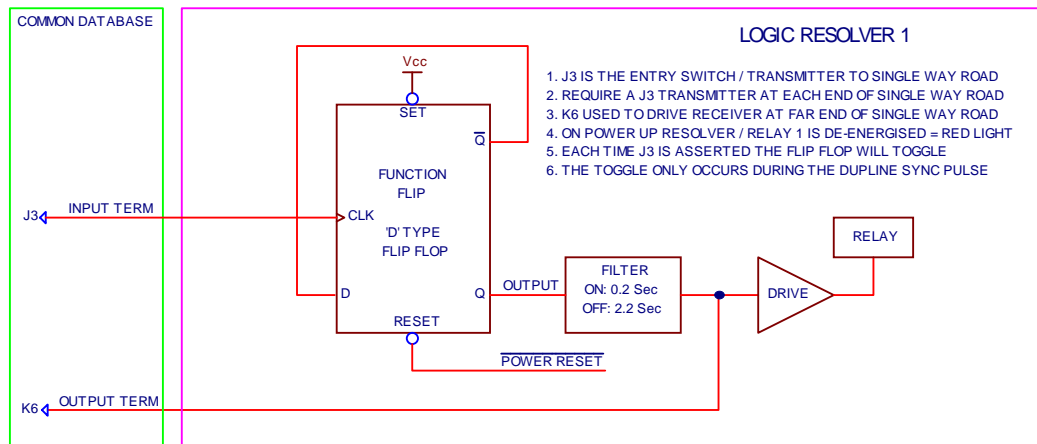


Figure 3 FLIP logic Function

The FLIP function occupies one logic resolver and has one configurable input term and one configurable output term. The FLIP function also uses the SILBUS-RX4D power on reset signal in its operation, this does not need to be configured it is automatically assigned when the FLIP function is selected.

During the SILBUS SYNC pulse period the FLIP function looks for the input term (J3) to be asserted (turned on) during the last SILBUS scan period and if so will toggle the 'D' type flip flop which results in the logic resolver output (K6) being changed to its opposite state i.e. if it was off it is now on or if it was on it is now off. The output relay can be used to drive a set of traffic lights to control the single way road. The output term is also sent back onto the SILBUS network so that a digital receiver with a single term AND function can be used to control the traffic lights at the remote end of single way road. A digital transmitter configured to J3 and located at either end of the single way road is used to control the block light system.

If the input term (J3) is held on or asserted over many SILBUS scan periods the flip flop of the FLIP function will not continue to toggle, the clock input to the 'D' type flip flop is edge sensitive and requires the input term to be negated and then asserted again before another toggle will take place.

The power on reset signal ensures that the 'D' type flip flop of the FLIP function comes up in a known state i.e. the output term is not on or asserted (green light). By combining other logic resolvers with the FLIP function more sophisticated control systems can be implemented.

3.3 OUTPUT RELAY SWITCHING POWER

The SILBUS-RX4D is available in two versions that have different relay contact switching capabilities. The SILBUS-RX4D-L variant for low power switching capabilities and the SILBUS-RX4D-H variant for high power and high voltage switching capabilities.

The table below shows the differences between the two models.

SILBUS-RX4D SWITCHING POWERS		
PARAMETER	SILBUS-RX4D-L	SILBUS-RX4D-H
Pm	25W	100W
Pi	25W	100W
Um	25V	250V
Ui	25V	25V
Ii	1A	3A
Minimum switching voltage	1V	12V
Minimum switching current	10uA	250mA
Minimum switching power	10uW	3W
Contact material	Rhodium	Tungsten

Table 1 SILBUS-RX4D switching capabilities

The SILBUS-RX4D-H is only recommended for use where powers higher than 3 watts, voltages greater than 12V and currents greater than 250mA are being switched. The SILBUS-RX4D-H was specifically designed for use in the US market where 110V contactors are being switched directly by the SILBUS-RX4D-H.

The SILBUS-RX4D-H is not recommended for use in Australian installations where low touch potential regulations are in place. The SILBUS-RX4D-L is designed for use in a hazardous area where intrinsically safe circuits or extra low voltage control signals are being switched.

The SILBUS-RX4D-H can be used in Australian installations provided that the minimum switching requirements and touch potential issues are dealt with satisfactorily.

Operating the SILBUS-RX4D-H below the specified minimum switching requirements will result in intermittent and unreliable operation of the output relay contacts.

Similarly, operating the SILBUS-RX4D-L above its maximum switching capabilities will also result in unreliable operation of the output relay contacts and possibly result in welded or open-circuit contacts.

4 OPERATING INSTRUCTIONS

The four channel digital receiver does not require any operator action to operate once it has been installed within an IP54 host enclosure and configured correctly.

An understanding of the various flash sequences of the yellow status LED may be required to help in the trouble shooting and maintenance of the entire SILBUS network installation. The status LED provides information on the operational status of the receiver and the connected SILBUS network. This information includes correct microprocessor operation, health of connected SILBUS network, selection of an invalid SILBUS channel address and indication of software version number. The table below shows the various flash sequences and their meaning.

STATUS LED FLASH SEQUENCES		
FLASH SEQUENCE	NAME	MEANING
NONE – LED ON OR OFF CONTINUOUSLY	NO FLASH	INTERNAL MICROPROCESSOR FAULT OR NO POWER
OFF CONTINUOUSLY	NO FLASH	RECEIVER FUNCTIONING – NO SILBUS CONNECTED TO SILBUS PORT
1 SECOND ON 1 SECOND OFF	FAST FLASH	RECEIVER FUNCTIONING – HEALTHY SILBUS CONNECTED TO SILBUS PORT
LONG PERIOD OFF FOLLOWED BY 3 SHORT FLASHES	PAUSE – 3 SHORT FLASH	ONE OR MORE LOGIC TERMS HAVE BEEN ASSIGNED TO AN INVALID SILBUS CHANNEL ADDRESS I.E. P8 FOR A 64 CHANNEL SILBUS NETWORK
MAJOR REVISION FLASH SEQUENCE – PAUSE – MINOR REVISION FLASH SEQUENCE	SOFTWARE VERSION SEQUENCE	INDICATES THE SOFTWARE VERSION LEVEL OCCURS IMMEDIATELY AFTER POWER UP. SEE SOFTWARE REVISION SECTION OF THIS MANUAL FOR DETAILS

Table 2 Status LED flash sequence meanings

The console port power source selection switch SW1 must always be in the run position for correct operation of the receiver. The run position is with the small slide actuator pushed furthest away from the black four pin console connector X111.

The front panel has four green LED's numbered one to four that are illuminated whenever the associated relay is energised.

5 CONFIGURATION

The four channel digital receiver has several operational parameters that require configuration prior to use. All of these parameters can be viewed and changed via the console port. The console port consists of a small four pin connector and a two position slide switch behind the front panel label. Access to the console port can be gained by snapping out the front panel using a wide bladed flat screw driver in one of the slots between the front panel and terminal blocks.

To use the console port an Austdac MEAN1 interface, A to B USB cable and laptop computer running Hyper Terminal are required.

For more detail on the console port, MEAN1 interface and their use refer to Austdac document 53-018-12.

5.1 CONSOLE PORT OPERATION

The console port should be connected to a laptop running a terminal emulation program such as Hyper Terminal via the Austdac interface type MEAN1 and a USB cable as shown in the following photograph.



Photograph 3 Laptop connected to console port via MEAN1 interface

The SILBUS-RX4D certification places restrictions on what may be connected to the console port, the connection of an interface other than the Austdac MEAN1 to the console port will invalidate the certification of the receiver.

The terminal emulation program should be configured to 19200 baud, 8 data bits, one stop bit, no parity, no flow control and DEC VT100 terminal emulation.

Once communications have been established with the SILBUS-RX4D, it will display a screen of information that includes software version, software checksum, and a list of commands followed by the console port prompt.

The prompt includes an abbreviation of the receiver type number. **RX4D: :>**

Commands are invoked by entering the command name followed by any optional modifiers, keywords and the “ENTER” key. The enter key is shown in the following examples as a “↵” symbol.

5.2 HELP COMMAND

The HELP command prints a list of all available commands and shows the syntax for each command. Optional command modifiers are shown within [] while mandatory modifiers are shown within < >. An example of a screen output follows:

```
RX4D: :>HELP ↵
```



Software 1V04 0xCBF0 Configuration 0x049D SN:09041000

Commands:

```

-----
                ***** Level 1: Standard Menu *****

HELP           [1...7] Level of Help                               Display Help Menu
REPEAT         [LF] [Refresh rate in seconds]                     Repeat Previous Command
VER            Firmware Version and Checksum
STACK          Display Peak Stack Usage
SBMAP          Display SILBUS I/O Map
SBSTAT         Display SILBUS Status
SBGET          <A1-P8>                                           Display a SILBUS Channel State
SSYNC          [<SET> <Safety Sync Address>]                       Select safety sync address
LOGIC          <SET> <RELAY> <OFF | N/AND | N/OR | SAND | FLIP>   Select logic function
ADD            <SET> <RELAY> <Term | !Term | Term#>               Add terms to relay
DEL            <SET> <RELAY> <Term | !Term | Term#>               Delete terms from relay
SBOUT          <SET> <RELAY> <SILBUS Address>                       Select relay O/P address
ONFLT          [<SET> <RELAY> <On time in mS>]                     Set on filter time
OFFFLT         [<SET> <RELAY> <Off time in mS>]                    Set off filter time
DISP           [<RELAY> <Text | Map>]                               Display relay logic function
CFGUP          Upload Configuration Text
CFGDWN         Download Configuration Text
-----

```

RX4D::>_

5.3 REPEAT COMMAND

The REPEAT command is used after another command to continuously repeat that command. As an example the SBGET command can be executed followed by the REPEAT command to provide a continuously updating display of the selected SILBUS channel. The display will continue to update until any key is hit. The SILBUS-RX4D will respond by displaying the prompt.

RX4D::>SBGET D1 ↵
D1 = ON

RX4D::>REPEAT
D1 = OFF ↵

RX4D::>_

In the above example the “OFF” changed to an “ON” whenever SILBUS channel D1 was activated. In this mode the repeat command writes over the previously displayed information, if required, the repeat command can be made to refresh the information on a new line by entering LF (line feed) as part of the command invocation. The repeat command refreshes the display every one second by default. The refresh rate can be slowed by entering the refresh rate in seconds as part of the repeat command as shown in the following command:

RX4D::>REPEAT LF 5 ↵
D1 = OFF
D1 = OFF
D1 = ON



```
D1 = OFF
D1 = OFF
D1 = ON
D1 = OFF ←
```

```
RX4D::>_
```

As can be seen from the above example the repeat command refreshed the status of SILBUS channel D1 on a new line every five seconds. In the LF mode a record of the status of D1 can be viewed on the screen.

5.4 VERSION COMMAND

The VERSION command is used to display the serial number, abbreviated type number, software version and program memory checksum of the SILBUS-RX4D. The command can be invoked as shown in the following example:

```
RX4D::>VER ←
SN:09124321 RX4D 1V01 0XB12F
```

```
RX4D::>_
```

This command is useful when the user needs to know the software version or serial number. The program memory checksum is useful to confirm that a software update has completed successfully without any programming errors.

5.5 STACK COMMAND

The STACK command is provided to allow the technician to gauge the health of the SILBUS-RX4D microprocessor and its code by displaying the maximum usage of the program stack. The display is a peak value of the stack usage since the SILBUS-RX4D was powered up. The command can be invoked as shown in the example below:

```
RX4D::>STACK ←
Stack usage/size = 312/1024
Percentage Used = 30%
```

```
RX4D::>_
```

This command would typically only be used when requested by an Austdac software engineer.

5.6 SILBUS MAP COMMAND

The SILBUS map command allows the operator to obtain a snapshot of the SILBUS network to which the receiver is connected. The map shows all of the SILBUS channels available on the network. The map consists of a table with a heading of groups below which is displayed the channels using ones and zeros. Each group is shown vertically with 1 at the top and 8 at the bottom. A one indicates an ON channel and a zero indicates an OFF channel. An example of an SBMAP is shown below with channels A4, P7 and P8 on or active:

```
RX4D: :>SBMAP ↵  
ABCDEFGHIJKLMNPO  
0000000000000000  
0000000000000000  
0000000000000000  
1000000000000000  
0000000000000000  
0000000000000000  
0000000000000001  
0000000000000001
```

```
RX4D: :>_
```

The SBMAP command is particularly useful when used with the repeat command as this will display a continuously updated table.

5.7 SILBUS STATUS COMMAND

The SILBUS status command displays the number of SILBUS channels available on the connected SILBUS network, a SILBUS synchronisation pulse count and a SILBUS error count. This command is used to determine if the connected SILBUS network is functioning correctly and how many channels are available. The error count should typically be zero while the sync count should be incrementing. Once again the use of the repeat command will provide a dynamic updating display. An example of the SBSTAT command follows:

```
RX4D: :>SBSTAT ↵  
No. Chan = 128, Sync Count = 17807, Error Count = 0
```

```
RX4D: :>_
```

The error count will be non zero whenever the connected SILBUS network is out of specification. The error count can be non zero if the connected SILBUS network channel generator has its power supply cycled off and on. These error counts should be ignored.

5.8 SILBUS GET COMMAND

The SILBUS get command is used to display the status of one selected SILBUS channel only. If this command is used in conjunction with the repeat command a continuously updating display can be achieved. The command is invoked by entering the command name followed by the desired channel address as shown in the two examples below:

```
RX4D: :>SBGET M3 ↵  
M3 = OFF
```

```
RX4D: :>SBGET B7 ↵  
B7 = ON
```

```
RX4D: :>_
```

5.9 LOGIC COMMAND

This command is used to display and configure the logic function type of the matrices logic resolvers or output relays of the SILBUS-RX4D. The SILBUS-RX4D has six logic resolvers, matrices or relays but only the first four are fitted with actual output relays. The valid logic functions are OR, NOR, AND, NAND, FLIP, SAND and OFF. The current logic type of the output relays can be displayed by simply entering the command name as shown in the example below:

```
RX4D::>LOGIC ←  
Relay Matrix[1] is FLIP  
Relay Matrix[2] is AND  
Relay Matrix[3] is OR  
Relay Matrix[4] is OFF  
Relay Matrix[5] is SAND  
Relay Matrix[6] is FLIP
```

```
RX4D::>_
```

If the command name is entered with additional attributes the logic function can be configured to any of the valid logic types i.e. AND, NAND, FLIP, OFF, OR, NOR, SAND. An example of configuring relay 1 is shown below:

```
RX4D::>LOGIC SET 1 AND ←  
Matrix logic changed  
Relay Matrix[1] is AND  
Relay Matrix[2] is AND  
Relay Matrix[3] is OR  
Relay Matrix[4] is OFF  
Relay Matrix[5] is SAND  
Relay Matrix[6] is OFF
```

```
RX4D::>_
```

5.10 ADD COMMAND

This command is used to configure the specified logic resolver, matrix or output relay by allowing terms to be added to the logic function. The terms are in the form of valid SILBUS channel addresses and groups. Terms may also be inverted to allow negative logic to be used. The add command does not display current logic resolver configuration. See the DISP command for information on displaying the current configuration. Examples of adding terms to logic matrix 3 using the ADD command are shown below:

```
RX4D::>ADD SET 3 B1 ←  
Matrix terms added  
Relay Matrix[3] = B1
```

```
RX4D::>_
```

The first example shows the first term B1 being added to the matrix or resolver.

```
RX4D::>ADD SET 3 B2,B3 ←
```


Matrix terms added

Relay Matrix[3] = B1+B2+B3

RX4D::>_

The second example shows two terms B2 and B3, delimited by a comma, being added to the matrix or resolver. Valid delimiters are space, comma, plus and asterisk. The delimiters are not significant when entering terms i.e. + does not force an OR function and * does not force an AND function. The logic function is determined when using the LOGIC command. The + and * are allowed to increase readability.

However when the terms are being displayed after the ADD command has been invoked the + and * are significant i.e. + indicates an OR while an * indicates an AND function.

RX4D::>ADD SET 3 B4+!B5,B6+B7 ←

Matrix terms added

Relay Matrix[3] = B1+B2+B3+B4+!B5+B6+B7

RX4D::>_

The third example shows four terms B4, B5, B6 and B7 being added to the matrix or resolver. The B5 term is preceded by an exclamation mark to indicate inverted logic or a NOT. Therefore the logic function will be true only when B5 is inverted or negated.

RX4D::>ADD SET 3 C# ←

Matrix terms added

Relay Matrix[3] = B1+B2+B3+B4+!B5+B6+B7+C#

RX4D::>_

The last example shows what appears to be a single term but is in fact the entire SILBUS C group (eight terms). The SILBUS group is represented by the # character. The FLIP function can only have one term for its input.

5.11 DELETE COMMAND

This command is used to configure the specified logic resolver, matrix or output relay by allowing terms to be deleted from the logic function. The terms are in the form of valid SILBUS channel addresses and groups. The delete command does not display current logic resolver configuration. See the DISP command for information on displaying the current configuration. Examples of deleting terms from logic matrix 4 using the DEL command are shown below:

RX4D::>DEL SET 4 B7 ←

Matrix terms deleted

Relay Matrix[4] = C#*D#!E1*E2

RX4D::>_

The first example shows the term B7 being removed from the AND logic function of relay four. Note that SILBUS groups C and D and channel E1 still remain in the logic function.

RX4D::>DEL SET 4 C1 ←

Matrix terms deleted

Relay Matrix[4] = C2*C3*C4*C5*C6*C7*D#!E1*E2

RX4D::>_

The second example shows the term C1 being removed from the logic function. Note that the SILBUS-RX4D converted the group term C# into the remaining seven individual terms.

RX4D::>DEL SET 4 C2*C3+C4,C5,C6*C7*D# ←

Matrix terms deleted

Relay Matrix[4] = !E1*E2

RX4D::>_

The third example shows the entire D group and the remaining terms of the C group being removed from the logic function. Note the use of mixed delimiters.

RX4D::>DEL SET 4 E1 ←

Matrix terms deleted

Relay Matrix[4] = E2

RX4D::>_

The last example shows the inverted logic term E1 being removed from the logic function. Note that the exclamation mark is not entered when deleting inverted logic terms.

5.12 SBOU COMMAND

This command is used to display and configure the SILBUS channel addresses of the six logic resolver or matrix outputs. The current assigned relay output SILBUS channels can be displayed by simply entering the command name as shown in the example below:

RX4D::>SBOU ←

Relay Matrix[1] map to DISABLE

Relay Matrix[2] map to J3

Relay Matrix[3] map to K4

Relay Matrix[4] map to DISABLE

Relay Matrix[5] map to J5

Relay Matrix[6] map to J6

RX4D::>_

If the command name is entered with additional attributes the matrix output can be assigned a SILBUS channel address. Note that the matrix output SILBUS channel will be transmitted to the connected SILBUS network by the SILBUS-RX4D.

There is no restriction on the SILBUS addresses; they do not have to be in numerical order or from the same group. An example of configuring relay matrix 1 is shown below:

RX4D::>SBOU SET 1 K7 ←

Matrix mapping changed

Relay Matrix[1] map to K7

Relay Matrix[2] map to J3

Relay Matrix[3] map to K4

Relay Matrix[4] map to DISABLE

Relay Matrix[5] map to J5

Relay Matrix[6] map to J6

RX4D::>_

The above example shows the format of the command when the address is configured. The keyword “SET” is required to invoke a change; the number of the SILBUS-RX4D output is next, followed by the SILBUS channel address. If a SILBUS-RX4D output is not to be assigned a SILBUS channel address then the keyword “DISABLE” is used to stop the output from driving the local resolver database and the connected SILBUS network.

5.13 SSYNC COMMAND

This command is used to display and configure the safety sync channel address for those relay matrices that have been assigned a SAND logic function. The current assigned safety sync channel address can be displayed by simply entering the command name as shown in the example below:

```
RX4D::>SSYNC ←  
Relay Matrix[1] Safety Sync channel is DISABLE  
Relay Matrix[2] Safety Sync channel is DISABLE  
Relay Matrix[3] Safety Sync channel is DISABLE  
Relay Matrix[4] Safety Sync channel is DISABLE  
Relay Matrix[5] Safety Sync channel is A1  
Relay Matrix[6] Safety Sync channel is A3
```

RX4D::>_

If the command name is entered with additional attributes the safety sync address can be assigned a SILBUS channel address. The safety sync is generated by a safety receiver connected to the SILBUS network. Each SILBUS-RX4D relay matrix can be assigned an individual safety sync channel or they can be the same depending on which safety channel is associated with which safety receiver. As a general rule of thumb safety sync channels should be assigned channel addresses in the early part of a standard SILBUS network pulse train i.e. group A. An example of configuring relay matrix 1 is shown below:

```
RX4D::>SSYNC SET 1 A1 ←  
Matrix safety sync address changed  
Relay Matrix[1] Safety Sync channel is A1  
Relay Matrix[2] Safety Sync channel is DISABLE  
Relay Matrix[3] Safety Sync channel is DISABLE  
Relay Matrix[4] Safety Sync channel is DISABLE  
Relay Matrix[5] Safety Sync channel is A1  
Relay Matrix[6] Safety Sync channel is A3
```

RX4D::>_

The above example shows the format of the command when the safety sync address is configured. The keyword “SET” is required to invoke a change; the number of the SILBUS-RX4D relay matrix is next, followed by the SILBUS channel address of the safety sync. If a SILBUS-RX4D relay matrix does not use the SAND logic function then it should not be assigned a safety sync channel address. Use the keyword “DISABLE” to stop the

logic resolver from referencing what appears as a pulsing digital input that may result in an unpredictable logic output.

5.14 ONFLT COMMAND

This command is used to display and configure the on delay filter of the six relay matrices. These filters stop the output relays from picking up on noise and transients. The current assigned on delay filter can be displayed by simply entering the command name as shown in the example below:

```
RX4D::>ONFLT ↵  
Relay on filter times are:  
Relay[1] on time is 100mS  
Relay[2] on time is 100mS  
Relay[3] on time is 100mS  
Relay[4] on time is 100mS  
Relay[5] on time is 100mS  
Relay[6] on time is 100mS
```

```
RX4D::>_
```

If the command name is entered with additional attributes the on delay filter can be configured to a value suitable for the installation. The on delay filter can be set from 0mS to 20 seconds in 100mS increments. The time is entered in milliseconds. An example of configuring the on delay filter for relay matrix 1 is shown below:

```
TX4D::>ONFLT SET 1 1200 ↵  
Relay On time adjusted  
Relay on filter times are:  
Relay[1] on time is 1200mS  
Relay[2] on time is 100mS  
Relay[3] on time is 100mS  
Relay[4] on time is 100mS  
Relay[5] on time is 100mS  
Relay[6] on time is 100mS
```

```
RX4D::>_
```

The above example shows the format of the command when the on delay filter is configured. The keyword “SET” is required to invoke a change; the number of the SILBUS-RX4D relay matrix is next, followed by the new on delay filter value in milliseconds.

5.15 OFFFLT COMMAND

This command is used to display and configure the off delay filter of the six relay matrices. These filters stop the output relays from dropping out on noise and transients. The current assigned off delay filter can be displayed by simply entering the command name as shown in the example below:

```
TX4D::>OFFFLT ↵
```

```
Relay off filter times are:
Relay[1] off time is 100mS
Relay[2] off time is 100mS
Relay[3] off time is 100mS
Relay[4] off time is 100mS
Relay[5] off time is 100mS
Relay[6] off time is 100mS
```

RX4D::>_

If the command name is entered with additional attributes the off delay filter can be configured to a value suitable for the installation. The off delay filter can be set from 0mS to 20 seconds in 100mS increments. The time is entered in milliseconds. An example of configuring the off delay filter for relay matrix 2 is shown below:

```
RX4D::>ONFLT SET 2 900 ←
Relay off time adjusted
Relay off filter times are:
Relay[1] off time is 100mS
Relay[2] off time is 900mS
Relay[3] off time is 100mS
Relay[4] off time is 100mS
Relay[5] off time is 100mS
Relay[6] off time is 100mS
```

RX4D::>_

The above example shows the format of the command when the off delay filter is configured. The keyword “SET” is required to invoke a change; the number of the SILBUS-RX4D relay matrix is next, followed by the new off delay filter value in milliseconds.

5.16 DISPLAY COMMAND

The display command is used to provide a summary of the relay logic resolver configurations. The current relay matrix configurations can be displayed by simply entering the command name as shown in the example below:

```
RX4D::> DISP ←
# LOGIC O/P SS ONFLT OFFFLT TERMS
1 OFF -- -- 10000 1200 --
2 OR J3 -- 100 1000 D1+D2+D3
3 AND K1 -- 1100 100 B1*B4*B5*B6*B7
4 OFF -- -- 100 100 --
5 SAND K4 A1 100 100 B#*C#*D#*E1*E2
6 OFF -- -- 100 100 --
```

RX4D::>_

The above example shows all relays at the same time. The display can be reduced to one logic matrix by using additional attributes. Examples of altering the output format of the display command follow:

```

RX4D::> DISP 3 MAP ↵
Relay Matrix[3]
ABCDEFGHIJKLMNPO
x1xxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxx
x1xxxxxxxxxxxxxxxx
x1xxxxxxxxxxxxxxxx
x1xxxxxxxxxxxxxxxx
x1xxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxx
OR      K1      5
1100   --     100

```

RX4D::>_

The above example uses the MAP keyword to alter the display command output format to show the relay configuration in a GSW1 map layout. A don't care term is depicted by a small 'x' while a positive logic term is indicated by a '1' and an inverted or negative logic term is shown by a '0'.

The second last line shows the logic function at the left, the output channel address in the centre and the number of terms in the logic function at the right.

The last line shows the on delay filter value at the left, the safety sync address in the centre and the off delay filter value at the right.

```

RX4D::> DISP 3 TEXT ↵
Relay Matrix[3] = B1*B4*B5*B6*B7

```

RX4D::>_

The above example uses the TEXT keyword to alter the display command output format to just show the resolver terms in Boolean format. The plus sign, asterisk and exclamation mark are significant in this display format.

The terms displayed in reverse text are currently asserted or true indicating that the AND logic resolver only needs B7 to become asserted and the logic resolver output will be true. This display format is extremely useful when used in conjunction with the repeat command to find which terms are asserted and which terms are negated and stopping the logic resolver output from becoming true and allowing the conveyor to start.

5.17 UPLOAD CONFIGURATION COMMAND

The upload configuration command is used to extract the configuration profile of the SILBUS-RX4D via the MEAN1 interface and record it in a file on a PC. Having an exact copy of the configuration is useful for record keeping and future cloning of new SILBUS-RX4D receivers for maintenance or system expansion. The upload is invoked by entering the command name without any attributes as shown in the example below.

```

RX4D::>CFGUP ↵
CFGDWN

```

```
S00300000FC
S1130000000001001022E008056000105000000CF
S11300108000000080000000800000008000000DC
S11300208000140008001E00090028000A000000D7
S113003080000000800000006492000011002ED9AE
S9030000FC
```

RX4D: :>_

The configuration is uploaded and displayed on the screen in Motorola S1-S9[®] HEX format. This data format includes headers and checksums to guard against errors and corruption of the data. The first line of the uploaded configuration is the keyword “CFGDWN” this does not form part of the data but is included to help with the configuration download process, see section 5.17 below for details.

To save the configuration to a file, open Notepad or a similar non-word processing editor, highlight the uploaded configuration as indicated below and copy to Notepad via the clipboard. The Notepad file should then be saved with a meaningful title that reflects the application e.g. RX4D_xxx.CFG. When highlighting the uploaded configuration, ensure that the invisible carriage returns (CR) at the end of all lines are included. Also ensure that the CFGDWN keyword is included.

RX4D: :>CFGUP ←

```
CFGDWN
S00300000FC
S11300000000001001022E008056000105000000CF
S11300108000000080000000800000008000000DC
S11300208000140008001E00090028000A000000D7
S113003080000000800000006492000011002ED9AE
S9030000FC
```

RX4D: :>_

The copy and paste method is used in this manual because it is the most universal method that works with all terminal emulation programs such as HyperTerminal[®]. Do not use an editor that introduces hidden formatting characters as a future download may not work with these characters in place. Many terminal emulation programs have automatic means to upload the configuration directly into a file; these are not described here as they differ from program to program but there is no restriction on using these features. Austdac is planning to release a complete tool to allow direct upload, download and editing of the configuration profile.

5.18 DOWNLOAD CONFIGURATION COMMAND

The download configuration command is used to take a previously saved configuration from a file and download it to the target SILBUS-RX4D receiver. This method of configuration ensures exact cloning during maintenance and system expansions. Communications with the target must first be established via the MEAN1 interface and a terminal emulation program such as Hyper Terminal[®]. The cursor should be left at the SILBUS-RX4D prompt as follows.

RX4D: :>_

Open the previously saved configuration file in Notepad or a similar non-word processing editor and highlight the configuration as shown below.

```

CFGDWN
S00300000FC
S1130000000001001022E008056000105000000CF
S11300108000000080000000800000008000000DC
S11300208000140008001E00090028000A000000D7
S113003080000000800000006492000011002ED9AE
S9030000FC
  
```

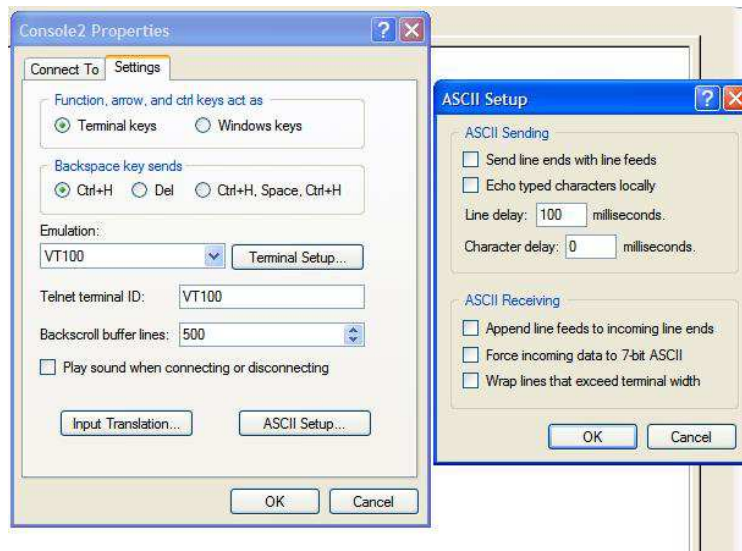
Copy and paste the configuration from Notepad to the RX4D:> prompt in Hyper Terminal as shown below. Note CTRL-V does not work in Hyper Terminal.

```

RX4D: :>CFGDWN
S00300000FC
S1130000000001001022E008056000105000000CF
S11300108000000080000000800000008000000DC
S11300208000140008001E00090028000A000000D7
S113003080000000800000006492000011002ED9AE
S9030000FC ↵
  
```

RX4D: :>_

The first line of the configuration contains the keyword “CFGDWN” which instructs the target to accept the data records. This “CFGDWN” keyword should have been copied from a previous upload and saved in the configuration file. Automatic file transmission features of the terminal emulation program may be used to download configuration files.



Photograph 4 Hyper Terminal delay setup

The terminal emulation program should be set up to allow a 100mS wait period after the carriage return at the end of each line during a download, this gives the target time to process the incoming data.

5.19 CONFIGURATION RECORDS

SILBUS-RX4D CONFIGURATION RECORD	
SILBUS NETWORK	
LOCATION	
CONFIGURATION CHECKSUM	
RESOLVER 1 LOGIC FUNCTION	
RESOLVER 1 NUMBER OF TERMS	
RESOLVER 1 OUT ADDRESS	
RESOLVER 1 ON FILTER TIME	
RESOLVER 1 OFF FILTER TIME	
RESOLVER 1 SAFETY SYNC ADDRESS	
RESOLVER 1 TERMS	
RESOLVER 2 LOGIC FUNCTION	
RESOLVER 2 NUMBER OF TERMS	
RESOLVER 2 OUT ADDRESS	
RESOLVER 2 ON FILTER TIME	
RESOLVER 2 OFF FILTER TIME	
RESOLVER 2 SAFETY SYNC ADDRESS	
RESOLVER 2 TERMS	
RESOLVER 3 LOGIC FUNCTION	
RESOLVER 3 NUMBER OF TERMS	
RESOLVER 3 OUT ADDRESS	
RESOLVER 3 ON FILTER TIME	
RESOLVER 3 OFF FILTER TIME	
RESOLVER 3 SAFETY SYNC ADDRESS	
RESOLVER 3 TERMS	
RESOLVER 4 LOGIC FUNCTION	
RESOLVER 4 NUMBER OF TERMS	
RESOLVER 4 OUT ADDRESS	
RESOLVER 4 ON FILTER TIME	
RESOLVER 4 OFF FILTER TIME	
RESOLVER 4 SAFETY SYNC ADDRESS	
RESOLVER 4 TERMS	
RESOLVER 5 LOGIC FUNCTION	
RESOLVER 5 NUMBER OF TERMS	
RESOLVER 5 OUT ADDRESS	
RESOLVER 5 ON FILTER TIME	
RESOLVER 5 OFF FILTER TIME	
RESOLVER 5 SAFETY SYNC ADDRESS	
RESOLVER 5 TERMS	
RESOLVER 6 LOGIC FUNCTION	
RESOLVER 6 NUMBER OF TERMS	
RESOLVER 6 OUT ADDRESS	
RESOLVER 6 ON FILTER TIME	
RESOLVER 6 OFF FILTER TIME	
RESOLVER 6 SAFETY SYNC ADDRESS	
RESOLVER 6 TERMS	

Table 3 SILBUS-RX4D Configuration record

The table above can be used to record the SILBUS-RX4D configuration.

6 TERMINATIONS AND CONNECTIONS

All connections to the four channel digital receiver are via cage-clamp terminals around the perimeter and near the front of the DIN rail mounting enclosure, these terminals can accommodate up to 4mm² conductors. There are 16 possible connections to the receiver; these are shown in the following tables and diagrams:

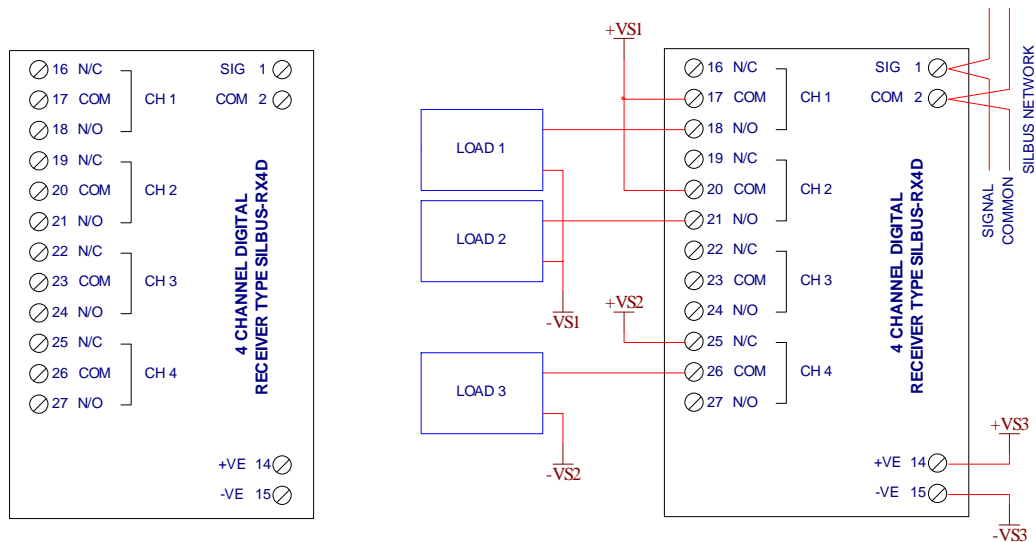


Figure 4 SIBUS-RX4D Connection diagram

6.1 RELAY OUTPUT PORTS

Each digital output is provided with three terminals for the connection of field wiring to the changeover or form C output contacts. Each output contact is capable of switching a maximum voltage of 250 volts, a maximum current of 3 amperes and a maximum power of 100 watts.

RELAY OUTPUT TERMINATIONS			
OUTPUT	TERMINAL	INDICATION LED	DESCRIPTION
CH1	16	1	CH1 NORMALLY CLOSED CONTACT
	17		CH1 CHANGEOVER CONTACT
	18		CH1 NORMALLY OPEN CONTACT
CH2	19	2	CH2 NORMALLY CLOSED CONTACT
	20		CH2 CHANGEOVER CONTACT
	21		CH2 NORMALLY OPEN CONTACT
CH3	22	3	CH3 NORMALLY CLOSED CONTACT
	23		CH3 CHANGEOVER CONTACT
	24		CH3 NORMALLY OPEN CONTACT
CH4	25	4	CH4 NORMALLY CLOSED CONTACT
	26		CH4 CHANGEOVER CONTACT
	27		CH4 NORMALLY OPEN CONTACT

Table 4 Relay output termination details

Each digital output is galvanically isolated from the other outputs and the remainder of the receiver circuitry and ports; this allows the SIBUS-RX4D to be used in a variety of special ways that include connecting non-intrinsically safe signals to the digital outputs while the receiver is connected to both intrinsically safe SIBUS networks and power supplies.

6.2 POWER INPUT PORT

The four channel digital receiver operates from a nominal 12 volt DC supply. The power supply operating range is from 7.5 volts through to 12.6 volts. The SILBUS-RX4D consumes less than 62mA from the power supply. The table below shows the power input port connection details.

POWER INPUT PORT TERMINATIONS		
TERMINAL	DESIGNATION	DESCRIPTION
14	+VE 12V	POWER SUPPLY +VE INPUT
15	-VE 12V	POWER SUPPLY -VE OR COMMON INPUT

Table 5 Power input port termination details

6.3 SILBUS NETWORK PORT

The SILBUS network port provides a means for the receiver to be connected to a SILBUS network. Any connections to a SILBUS field bus network pair should be of a multi-drop nature with spur lengths kept to a minimum. This will minimize any reflections and therefore communications errors in the SILBUS network.

SILBUS NETWORK PORT TERMINATIONS		
TERMINAL	DESIGNATION	DESCRIPTION
1	SIG	SILBUS NETWORK SIGNAL
2	COM	SILBUS NETWORK COMMON

Table 6 SILBUS network port termination details

The table above shows the SILBUS network port connections.

7 CERTIFICATION

The four channel digital receiver type SILBUS-RX4D has been awarded IECEx certification under IECEx TSA 07.0002X, Ex ia I, as part of the Dupline / SILBUS system.

The certification requires that the SILBUS-RX4D be mounted within a host enclosure that provides a minimum ingress protection of IP54 (IP55 for Queensland Australia).

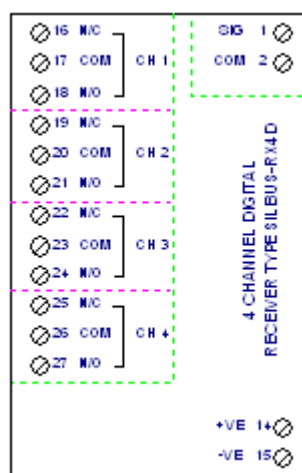


Figure 5 SILBUS-RX4D segregation and isolation levels

Because of the segregation and isolation between the various ports of the SILBUS-RX4D it may be used in three different installation configurations that offer considerable flexibility in

its application when dealing with intrinsically safe and non-intrinsically safe circuits. As shown in the figure 5 the three major port areas are segregated from each other to IEC60079-11 375 volts as indicated by the green dotted lines. The four digital output channels are further segregated from each other to IEC 60079-11 30 volts as indicated by the magenta dotted lines.

The digital output terminals, the SILBUS network terminals and the power port terminals are all separated from each other by more than 50mm. The individual digital output channel terminals are separated from each other by more than 6mm.

These segregations and separations combine to allow the following installation configurations (see Austdac drawing 120-251-19 for more detail):

- Configuration 1 – Installation within the hazardous area with connection of only intrinsically safe circuits.
- Configuration 2 – Installation within the safe area with connection of an intrinsically safe SILBUS network. Powered from an intrinsically safe power supply located in the safe area. Connection of non-intrinsically safe digital outputs.

Careful attention should be paid to the segregation of wiring in all of these configurations as incorrectly segregated wiring could negate the segregation and safety of the receiver.

7.1 INSTALLATION CONFIGURATION 1

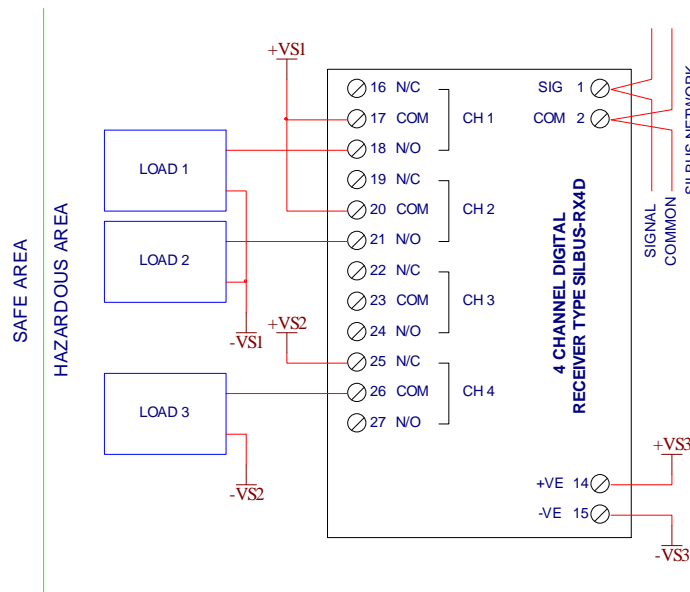


Figure 6 Installation configuration 1

This configuration allows the four channel digital receiver to be located wholly within the hazardous area and the connection of intrinsically safe circuits to its various ports. The digital outputs can drive four loads powered from the same intrinsically safe source or drive four loads powered from different intrinsically safe sources because of the segregation between the four digital input channels. For the same reason the power supply port can be driven from the same source as the digital outputs or from an entirely different intrinsically safe source without the need for an assessment of voltage or current addition.

As always, careful attention should be paid to the segregation of wiring in this configuration as incorrectly segregated wiring could negate the segregation and safety of the receiver.

7.2 INSTALLATION CONFIGURATION 2

This configuration allows the four channel digital receiver to be located wholly within the safe area, the connection of an intrinsically safe SILBUS network, be powered from an intrinsically safe power supply and the connection of non-intrinsically safe digital outputs. This configuration is possible because of the segregation and isolation between the SILBUS network port and the remainder of the receiver.

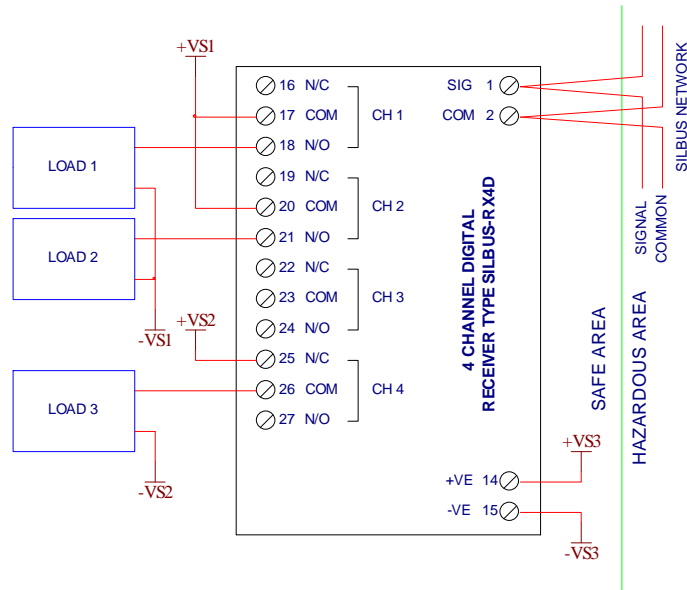


Figure 7 Installation configuration 2

This configuration allows an intrinsically safe SILBUS network to be interfaced with non-intrinsically safe digital outputs. This is particularly useful in the controlling of tripper drives in underground conveyor installations. This configuration eliminates the need for certified barriers or interposing relays.

Obviously the segregation of the intrinsically safe SILBUS network and power supply port is of paramount importance in this configuration. Incorrectly segregated SILBUS network wiring could negate the segregation and safety of the receiver and the entire SILBUS network installation.

8 SOFTWARE REVISION AND DISPLAY

The software version of the four channel digital receiver type SILBUS-RX4D will vary as its functionality is improved at the request of our customers. The software version is given in two parts, the major revision level and the minor revision level and is written in the following format:

VERSION M.mm where M represents the major revision level and mm represents the minor revision level. E.g. VER 1.12

The software version can be determined by using the console port or by watching the yellow status LED immediately after power up. The software version will be indicated by a sequence of longer flashes for the major revision level, a long pause to indicate the decimal point and a further sequence of shorter flashes representing the minor revision level.

Therefore software version 1.12 would be represented by the sequence “one longer flash, a long pause, followed by 12 shorter flashes”.

9 SPECIFICATIONS

Name	4 Channel Digital Receiver
Type (high power switching contacts)	SILBUS-RX4D-H
Type (low power switching contacts)	SILBUS-RX4D-L
Number of digital logic resolvers with relay outputs	4
Number of digital logic resolvers	6 (2 without output relays)
Resolver logic functions	OR AND NOR NAND SAND FLIP
Digital output timer filter range	500ms to 10s in 100ms steps
Digital output format.....	One voltage free form C (SPDT) contact per output
SILBUS-RX4D-H maximum output switching voltage.....	120 VDC or 250 VAC
SILBUS-RX4D-H maximum output switching current	3A
SILBUS-RX4D-H maximum output switching power	100W
SILBUS-RX4D-H minimum output switching power	3W
SILBUS-RX4D-H minimum output switching voltage	12V
SILBUS-RX4D-H minimum output switching current	250mA
SILBUS-RX4D-H contact material.....	Tungsten
SILBUS-RX4D-L maximum output switching voltage	25 VDC or AC
SILBUS-RX4D-L maximum output switching current.....	1A
SILBUS-RX4D-L maximum output switching power	25W
SILBUS-RX4D-L minimum output switching power	10uW
SILBUS-RX4D-L minimum output switching voltage	1V
SILBUS-RX4D-L minimum output switching current.....	10uA
SILBUS-RX4D-L contact material	Rhodium
Console port configuration	19200 baud, 8 data, 1 stop, No parity
Terminations	Cage clamp 4mm ² maximum
Size.....	100mm (W) x 75mm (H) x 110mm (D)
Mass	600g
Fixing	TS35 DIN rail or screw mount M4 on 85mm x 61mm centres
Ingress protection	IP20
Enclosure material	Polycarbonate (30%GV) UL 94 V-1
Enclosure colour	RAL 7032 Grey
Terminal material	Polycarbonate UL 94 V-2
Terminal block colour.....	Blue
Operating temperature range.....	0°C to 40°C
Storage temperature range	-20°C to 80°C
Operating relative humidity range	10% to 90% Non condensing
Power supply operating voltage range	7.5 to 12.6VDC
Power supply current consumption	6mA plus 14mA per energised relay maximum

Note: SILBUS-RX4D-H requires a minimum load for operation see section 3.3.