Product Specification for XG555 DeviceNet Transducer Gateway

The XG555-SSI-DEV and XG555-R-DEV are gateway devices that interrogate sensors supporting SSI or Start/Stop protool sensors and makes that information available on a DeviceNet fieldbus network. The XG555 acts as a DeviceNet slave and outputs 64-bytes of data.

The XG555-SSI-DEV supports two or four SSI protocol magnetstrictive transducers, absolute encoders, or other SSI devices. The XG555-R-DEV supports Start/Stop protocol magnetostrictive transducers, with up to 16 magnets per sensor.

The XG555 is comprised of an embedded industrial computer, with a PC-104 stack providing hardware interfaces. The PC-104 stack includes the processor, one or optionally two 2-channel sensor interface cards, and a DeviceNet interface card.

Features

- Interrogates position from two or four sensors via SSI or Start/Stop interfaces
- Supports up to 16 magnets per sensor when used with Start/Stop output sensors
- Position values may be scaled before output
- DeviceNet slave interface
- Non-volatile flash storage of setup data
- Convenient screw terminal connections

Specifications

- Sensor interface compatible with RS-422 line levels
- Start/Stop sensors: 0.002 inch measurement resolution
- SSI sensors: resolution matches sensor resolution
- Device Net slave interface at 500 kbps
- Embedded x86 processor
- Internal non-volatile flash storage
- Power requirements: + 24VDC at < 500 milliamps
- Enclosure measures 9.5 x 4.1 x 3.5 in (L x W x D)

Available Models

Model	Max Sensors	Measurement Resolution	Sensor Type
XG555-R-DEV	2	0.002 inch	Start/Stop
XG555-R4-DEV	4	0.002 inch	Start/Stop
XG555-SSI-DEV	2	Determined by Sensor	SSI
XG555-SSI4-DEV	4	Determined by Sensor	SSI

Contents

1 General Operation

At power-on the DeviceNet and transducer interface boards are initialized and continuous interrogation of the transducers is started. The XG555 detects the number of sensor interface channels installed at this time. The unit will now respond to polled requests for position information from the Device Net interface. Transducer position information is acquired from each transducer and is updated into local memory continuously. DeviceNet status is displayed on the 3 Bicolor LEDS to the right of the DeviceNet connector.

1.1 Sixty Four magnet array

A 64 magnet array of positions is maintained by the XG555. The first 16 magnets (0 – 15) are from transducer one, the second 16 magnets (16-31) from Transducer 2, the third 16 magnets (32-47) are from transducer 3 and the fourth 16 magnets (48-63) from transducer 4. Any magnets or transducers not present will have values of 0. A value of zero can be used as a status indicator. Unless the second card option is installed magnets 32 through 63 are always 0.

Due to limitations of the SSI protocol, SSI sensors return a single value. Therefor, XG555-S models support a single magnet per sensor. The positions of the 15 unused magnets will always be 0.

Magnet array

Array (Command byte)	Transducer Number	Magnet Number
0	1	1
1	1	2
2	1	3
3	1	4
4	1	5
5	1	6
6	1	7
7	1	8
8	1	9
9	1	10
10	1	11
11	1	12
12	1	13
13	1	14
14	1	15
15	1	16
16	2	1
17	2	2
18	2	3
19	2	4
20	2	5
21	2	6
22	2	7
23	2	8
24	2	9
25	2	10
26	2	11
27	2	12
28	2	13
29	2	14
30	2	15
31	2	16
32 – 47	3	1-16
48 – 63	4	1-16

The magnet position data from this array can be viewed on the LCD screen and is returned to the host in 32-bit signed integer format on the DeviceNet interface. A single command byte is accepted from the Master and determines which 15 magnets of data and status is retuned to the Master in the 63 byte array.

2 LCD Display

A two line LCD display on the front of the XG555 allows the operator to view XG555 status and magnet positions. The status menus can be accessed by pressing the enter key while viewing the transducer status screen. Navigate the menus by using the arrows. Press enter to view a sub menu or edit a value. Press ESC to return to the parent submenu or to return to the transducer status screen if there is no parent submenu.

The status submenu allows the selection of transducer or DeviceNet status information. After the hardware has been initialized, the display will enter the magnet position display screen.

2.1 Magnet Position display

The magnet position screen displays 2 magnets of position information from the 64 magnet array. The magnet number displayed can be incremented using the UP key or decremented using the DN key. The number shown is the decimal value from the transducer and magnet shown. A value of zero indicates no magnet or possibly no transducer. The following table shows examples of the screen.

First two magnets on transducer 1

Transducer	Magnet Number	Scaled position value
X1	1	7210
X1	2	14000

Transition from transducer 1 (Magnet 16 is not present) to Transducer 2 Magnet 1

Transducer	Magnet Number	Scaled position value
X1	16	0
X2	1	6333

2.2 Transducer Status Screen

The XDCR status screen shows information about the number of magnets found on each of the transducers. The number of each transducer (1 through 4) is listed on the first line. Directly beneath the transducer number is a value indicating the number of detected magnets on that transducer. A value of zero indicates that no transducer is connected or no magnets are on the transducer

Xdcr Status Screen

X1	X2	X3	X4	XDCR #
15	1	0	0	Magnets

2.3 Device Net Status Screen

The DeviceNet network status will be indicate one of the following: Offline, Unconnected, Connected, or Comm Fault.

3 Conversion Speed

The model XG555 allows 5 milliseconds per magnet for each conversion. When interrogating a Start/Stop sensor, the XG555 will automatically and continuously determines how many magnets are present, up to a maximum of 16. The sensors are interrogated in parallel so the maximum time for a complete update of each transducer is independent of the other transducers.

The time for conversion of a complete set of magnets on a single transducer will be a minimum of 5 * (number of magnets + 1) milliseconds. A transducer with 4 magnets would require at least 5 * 5 = 25 milliseconds. The minimum conversion time for a sensor with 16 magnets would be 16 * 5 = 80 milliseconds.

4 Scaling

Basic measurement resolution of the XG555-R is approximately 0.002 inches and is determined by the transducer Gradient and the 56 MHz oscillator. The XG555 maintains a separate scale value for each transducer, which can be used to scale the value returned to an even resolution, compensating for the gradient. A Scale value can be entered for each transducer using the console menu and then stored on the Solid State disk. The scale can be used to compensate for varying gradients and create units. A gradient value does not need to be entered, just a scale to compensate for the gradient.

Magnet values displayed and returned over the DeviceNet interface are equal to:

(Magnet distance from head in inches * 56 * Gradient) * Scale

Calculating a scale to correct for the gradient (XG555-R)

Scale = (((1/desired resolution)/500) / 56)) / Gradient
Scale for 0.002 inch resolution = 8.92857142857 / Gradient

Example 1: No scaling (Scale = 1.0)
Gradient = 9 microseconds per inch
Scale = 1.0
magnet is 10.0 inches from the head of the transducer
value = 9 * 56 * 10 * 1.0 = 5040

Example 2: Scaled to exactly 0.002 inches per count
Gradient = 8.995 microseconds per inch
Scale = ((1 / 0.002) / 56) / 8.995
Scale = 8.92857142857 / 8.995 = 0.99261494481
magnet is 10.0 inches from the head of the transducer
value = 8.995 * 56 * 10 * 0.99261494481 = 5000

5 DeviceNet

A DeviceNet Slave interface provides magnet position information from the 64 magnet array to a DeviceNet master. An EDS file is provided with the unit. The DeviceNet interface defaults to 500 kbps, node 63. This setup can be changed using RSNetworx for DeviceNet or another DeviceNet configuration tool.

To configure the gateway within RSNetworx, first use the EDS Wizard to add the .EDS file supplied with the gateway. The gateway should be detected correctly during the next scan of the network. After the gateway has been detected, add the gateway to the scan list of the Master's DeviceNet scanner. Download the new configuration to the scanner. Once the two units are on-line, the scanner should be exchanging data with the transducer gateway.

5.1 DeviceNet Data

The slave provides a polled connection that consumes 1 byte and produces 63 bytes. The consumed byte is a command byte controlling the data returned. The bits of the command byte are as follows:

Bits 0-3	Magnet number (0-15) (LSB is bit 0)
Bits 4-5	Transducer number (0-3) (LSB is bit 4)
Bit 6-7	Not Used

The data produced by the slave contains position and status data for 15 magnets, and returns the command byte for feedback purposes. The production data is as follows:

Bytes 0-59	Position data for the requested magnets. The position data is returned as twos-compliment 32-bit signed integers.
Bytes 60-61	Status data for the requested magnets. Each bit of the status data corresponds to a magnet. For example bit 0 of byte 60 indicates the status of the first requested magnet.
Byte 62	The consumed command byte.

The position data returned will contain position data for 15 magnets, selected by the command byte and mapped over the entire array of 4 * 16 magnets.

The command byte mirrored in Byte 62 can be used to determine when the data has been updated. The following sequence can be used:

1. Output new command byte
2. Wait for byte 62 to equal the sent command byte
3. Read data
4. Return to step 1

The following tables are examples of magnet data in the 63 byte DeviceNet array with different command byte settings. There are many other possible command byte settings.

Command Byte	Transducer Number	Magnet	DeviceNet Array Posn
0	1	1	0
0	1	2	4
0	1	3	8
0	1	4	12
0	1	5	16
0	1	6	20
0	1	7	24
0	1	8	28
0	1	9	32
0	1	10	36
0	1	11	40
0	1	12	44
0	1	13	48
0	1	14	52
0	1	15	56

command Byte	Transducer Number	Magnet	DeviceNet Array Posn
8	1	9	0
8	1	10	4
8	1	11	8
8	1	12	12
8	1	5	16
8	1	6	20
8	1	7	24
8	1	8	28
8	1	9	32
8	1	10	36
8	1	11	40
8	1	12	44
8	1	13	48
8	1	14	52
8	1	15	56

6 Console

Interaction between an operator and the transducer bridge is provided through the device console, a 9600-bps, no parity, one stop bit RS232 serial link using the COMM connector. The device console can be used to view real time error messages, to enter setup values or to load new firmware.

6.1 Viewing real time error messages

In certain instances the firmware will print informational messages on the console. Having a dumb terminal or PC in terminal mode hooked to the console port will allow the technician to observe these messages and perhaps gain insight into problems. Contact the factory for information on these messages.

6.2 Entering Setup values via the Console

Setup can be accomplished with a terminal or computer connected to the COMM serial connector. If the operator desires to enter the 'Setup Mode' the operator should type three characters rapidly at 9600 baud until the control acknowledges with a setup menu. The control is then in the 'Setup Mode'. While in setup mode, the transducer will continue to be interrogated and output over the Device Net interfaces will continue. However, the timing of responses is no longer guaranteed; user input may cause the host unit to become busy while waiting for input. Setup values are stored in non-volatile flash memory.

The setup menu shows the transducers that are currently being used by the system. The table lists the number of magnets found on each transducer. Any settings changed must be saved before they take effect, using the *Save transducer information to the data files* menu item.

The following actions are possible from the menu:

- **Enter a Scale value for each sensor**
  Allows entry of a scale value which is applied to the data before it is displayed locally or returned on DeviceNet
- **Load transducer setup information from the data files**
  Returns the setup values to the values stored on the flash disk
- **Save transducer setup information to the data files**
  Saves the transducer setup data to the flash disk.
- **Quit**
  Exit setup mode and resume normal operation.

The console setup menu:

Start/Stop Transducer DeviceNet Gateway
Copyright(c) 1999-2006 Rapid Controls Inc.

Xdcr 0: 10 magnets
Xdcr 1: 2 magnets
Xdcr 2: 0 magnets
Xdcr 3: 0 magnets

1 - Edit Xdcr 1 Scale 1.000000
2 - Edit Xdcr 2 Scale 1.000000
3 - Edit Xdcr 3 Scale 1.000000
4 - Edit Xdcr 4 Scale 1.000000
L - Load transducer information from the data files
S - Save transducer information to the data files
Q - Quit, Return to normal operation

Choose one:

7 Troubleshooting

7.1 XG555 does nothing once power is applied

A Rapid Controls cable ASSY A10753 connected to a PC with terminal program active or a jumper cable such as the one provided by Rapid Controls must be installed on the COMM connector. Minimum connections are 6-4 and 7-8.

7.2 Transducer problems

No transducers respond:

This can be caused by an improperly addressed PC4_TEMPO board, incorrect connections, a bad transducer, no magnets on the transducer or a lack of 24V power to the transducers. Check the connections and the power supply. If a scope is available check the interrogate and Gate pulses.

Error in position information:

If the readings are occasionally in error it could be a noise problem caused by bad solenoids or motor drive cables, etc. If the readings are always in error check the transducer cabling and power supply. If the power supply at the transducer is 24V, the transducer may need to be replaced.

7.3 DeviceNet

There are three status LED's located to the right of the DeviceNet connector. The right most LED indicates DeviceNet connection status.

Solid Green indicates a good DeviceNet connection.
Blinking Red indicates no DeviceNet connection.

8 Remote File Operations

Communication with the gateway console is accomplished via the gateway COMM port at 9600 bps, no parity, 8 data bits, and one stop bit, using a terminal emulator program on a host PC. Rapid Controls provides a terminal emulator, COMM.EXE. Programs such as ProComm and Windows HyperTerminal may also be used. Connect Rapid Controls A10753 cable between the Gateway COMM port and the Host PC serial port.

Programs and data on the transducer bridge flash drive can be accessed from a remote host using the utility programs COMM.EXE and TRANSFER.EXE. The TRANSFER program runs on the transducer bridge, and acts as an XMODEM server of the flash drive. The XMODEM function of the COMM program is a simple communications program that allows the flash disk to be access as a virtual drive on the host computer.

Once you have the terminal emulator running on the host PC and connected to the Gateway you can interrupt the gateway program by typing “SHELL”. Note that “shell” must be typed slowly enough not to activate the menu: 1 character every second. If the setup menu is displayed, press ‘Q’ and attempt again.

Once you have exited the transducer gateway program, you will see the DOS prompt of the Gateway. You can then send or receive files from the Gateway. To download files to the gateway type: “TRANSFER /R *filename*” and press enter. You will see the message “Receiving *filename*”. Activate the XMODEM upload function of the terminal emulator (For COMM and ProComm press the PGUP key and select XMODEM, For HyperTerminal select the Transfer pull down menu). Once the XMODEM function has started you will see transfer status information printed while the file is transferred. When it is finished Type “DIR *filename*” to insure that the file has been transferred correctly. Once the transfer is complete power cycle the XG555.

Example:

These instructions assume you have Rapid Controls A10753 cable between the gateway and the host pc and that the gateway is running it's normal program. It also assumes you have a floppy with XG555.EXE on it.

1. Start Comm on your host computer.
1. Exit the gateways main program by typing "SHELL" one character per second. You will see the "C:>" prompt. If you see the transducer maintenance screen press “Q” and start over.
2. Type "Transfer XG555.exe" and press enter. The gateway should display a message “Receiving XG555.EXE”.
3. Press the PGUP key. Select XMODEM protocol and enter “XG555.EXE”
4. The file will be transferred to the gateway. The letter ‘T’ is printed as a progress indicator. It will take a few moments to transfer the program.
5. When it is completed type “dir XG555.EXE” and you should see the correct file information regarding the new file. The file length may be slightly larger as the transfer program pads up to the nearest 256 bytes of length.
6. Reboot the gateway and it will have the new program on it.

9 Backup and Restore

Configuration data stored on the gateway unit can be saved elsewhere in case of data loss. The files “DATAA.CFG”, “DATAB.CFG”, and “DATAC.CFG” contain the transducer information. They can be copied to a PC for safekeeping.

Restoring data can be accomplished by simply copying the “DATA?.CFG” files back to the gateway unit’s flash drive by using TRANSFER/COMM.

10 PC 104 boards

10.1 Processor

A embedded x86 processor with internal flash drive.

10.2 DeviceNet interface

A single ARCOM CAN module is installed in the system and functions as the DeviceNet interface.

I/O address of DeviceNet interface:
Install link 1-A9, A7, A6 and remove links A8, A5 to establish I/O address of 120H
Install link IRQ5
Remove links 4 & 5.

10.3 Start/Stop interface modules

At least one and optionally two Rapid Controls PC4-TEMPO-R boards must be installed. This module provides the hardware interface to the transducers. Connections are made to the transducers via two (Optionally 4) 5-pin Phoenix type screw terminals. The boards should be addressed as 150H and optionally 158H for the second board.

10.4 Start/Stop configuration

Two P4-tempo interface boards are used to interface to four transducers. The boards must be addressed as 150H (Board 1) and 158H (Board 2).

PC4-Tempo dipswitch settings

Board #	Bd Address	S1	S2	S3	S4	S5	S6	S7	S8
1	150H	ON	OFF	ON	OFF	ON	OFF	ON	ON
2	158H	OFF	OFF	ON	OFF	ON	OFF	ON	ON

Data read from the transducers is placed in the DeviceNet array starting with Board 1 transducer 1, magnet 1 through board 2 transducer 2, magnet 16. Any of the 64 magnet values are continuously updated even though the DeviceNet host may not be looking at them specifically.

11 End panel Connections

11.1 Start/Stop Connections

The Start/Stop interface connections are made on a 5 pin removable screw terminal on the end panel of the Gateway. There is a connector for each transducer and it is numbered from left to right as follows:

1. Transducer Gate+
2. Transducer Gate -
3. Transducer Interrogate +
4. Transducer Interrogate -
5. Transducer DC common

11.2 Transducer Power

The transducers are electrically isolated from the Gateway power supply. They may be powered via any appropriate power supply but the power supply common must be connected to pin 5 of at least one of the Start/Stop connectors. The 24V that powers the Gateway may be used but it must be connected external to the Gateway.

12 DeviceNet

12.1 DeviceNet Connections

The DeviceNet interface connections are made on a 5 pin removable screw terminal on the end panel of the Gateway. The connector is numbered from left to right as follows:

1. V- DeviceNet input power return
2. Can Low
3. Shield
4. Can High
5. V+ DeviceNet input power (15 to 24 VDC from host)

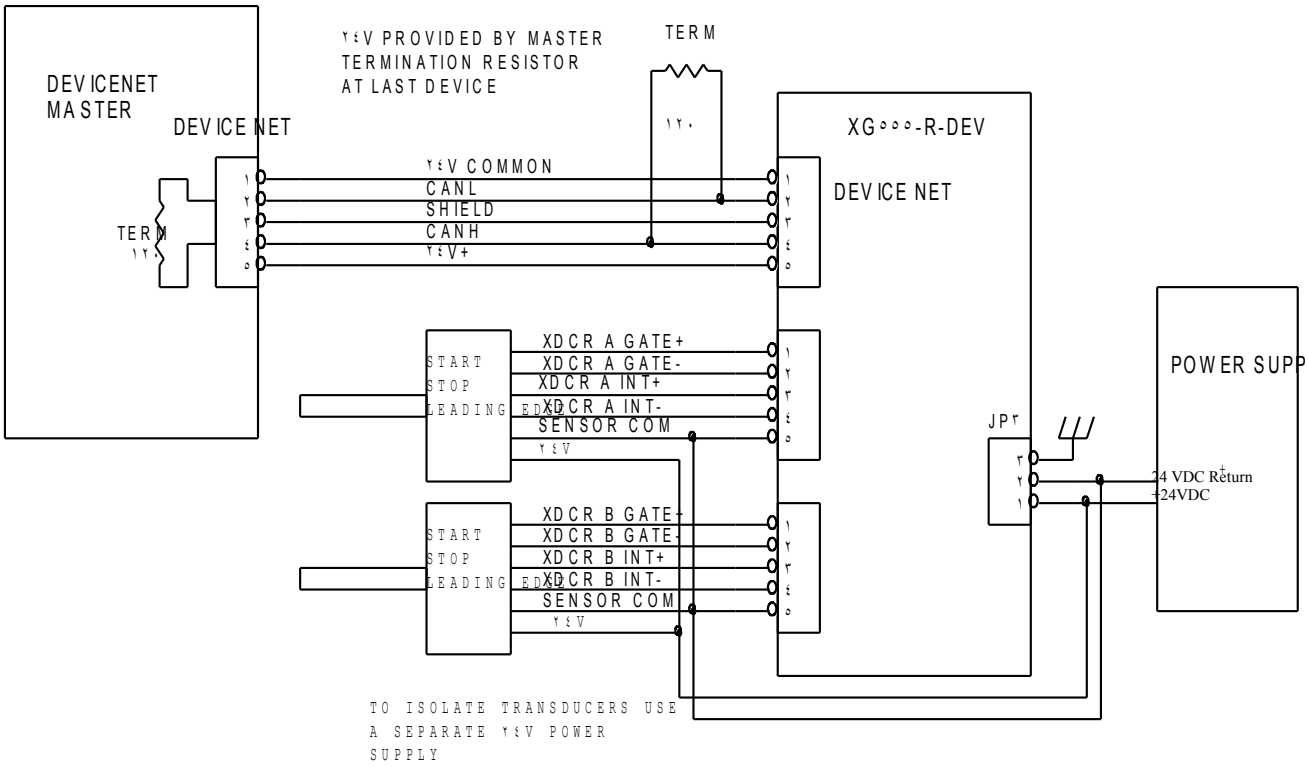
12.2 DeviceNet Power

15 to 24VDC power must be supplied to the DeviceNet connector for the DeviceNet communications to operate. The power must be connected to the 5 pin screw terminal. In normal operation this should be a separate supply from the XG555 and transducer supply.

12.3 DeviceNet Termination

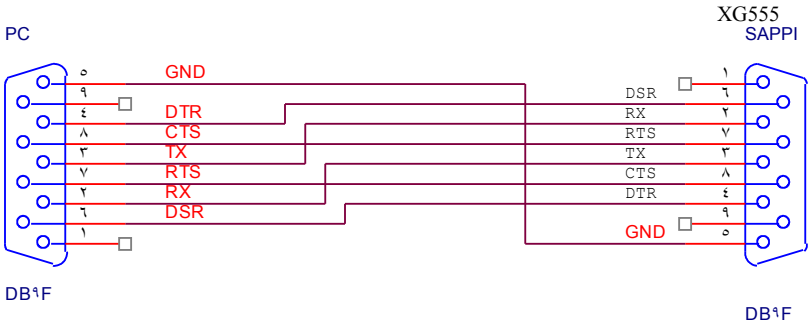
For proper operation the DeviceNet cable must be terminated with a 120 ohm resistor at each end of the cable. The XG555 does not provide internal DeviceNet interface termination. An external termination resistor should be added at the XG555 end of the DeviceNet network if the transducer bridge is the last DeviceNet node on the cable and termination is not provided elsewhere.

13 Typical Installation



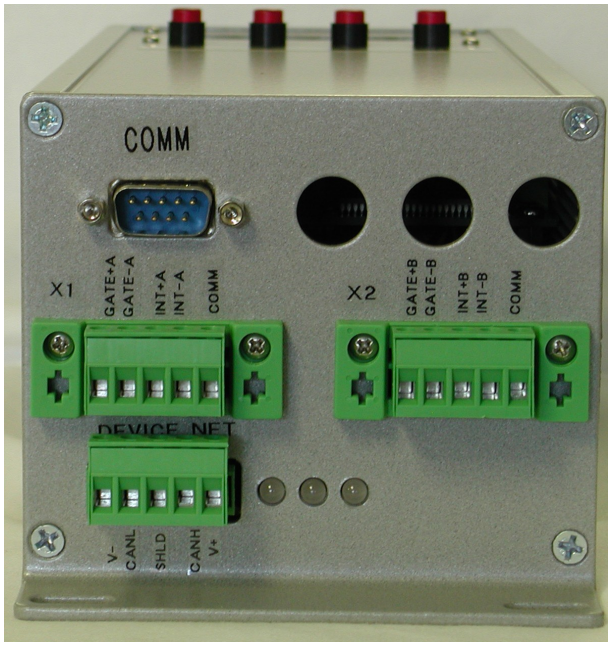
14 Console Serial Interface Cable Pinout

The serial cable for use with TRANSFER/COMM is as follows:



15 End Panels

Lower Panel



Upper Panel

16 Dimensions