



## RAPID CONTROLS

### Product Specification for CANbus to DeviceNet Transducer Gateway



The XG555 CANbus to DeviceNet Temposonics Gateway gathers position information from as many as four Temposonics CANBUS transducers, each with multiple magnets. This information is provided to a host over a DeviceNet interface. Setup information is stored on the local flash disk. The system is comprised of an embedded industrial computer, with a PC-104 stack providing hardware interfaces. The PC-104 stack includes the processor, a CANBUS interface, and a DeviceNet interface.

#### Features

- Up to eight channels of MTS Temposonics CANBUS position information
- Up to 15 magnets per transducer
- DeviceNet interface
- Full transducer resolution is provided
- Non-volatile flash storage of setup data
- Watchdog timer for reset upon software failure
- Convenient screw terminal connections

#### Specifications

- Eight channels of 24 bit magnetostrictive transducer measurement via CANbus using MTS protocol
- Device Net slave interface
- Intel 80386 processor
- Maximum 1 ms DeviceNet interface response time
- Linear interpolation of transducer linearization data
- 4Mbytes of non-volatile flash storage
- Power requirements: + 24V
- Enclosure is 14 x 10 in



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## General Operation

At power-on, transducer setup data is read from the local flash storage. Continuous interrogation of the transducers is started. The unit will now respond to requests for position information from the Device Net interface.

Transducer position information is acquired from each transducer and is updated into local memory continuously. The position information is returned to the host in 32-bit signed integer format on the device net interface. Values returned over the DeviceNet interface have the same resolution as the transducer. The position values of all magnets on a particular transducer are offset by a zero value independent to that transducer which is stored in flash. This value can be set through the DeviceNet interface. All positions returned from the control to the host via the DeviceNet will be offset by this value.

## Status

Basic status information is provided via the 2 by 16 character display. After the hardware has been initialized, the display will print a screen containing information about the transducers. The number of each transducer (1 through 8) is listed, followed by one of the following: “OK”, indicating the transducer is functioning properly; “MM”, indicating missing magnets; “NR”, indicating no response; and “--”, indicating that no transducer is setup.

Pressing the enter key while viewing this status screen takes you to the setup menu.

## Setup

Setup can be accomplished via a terminal attached to the RS232 serial port of the XG555, or by using the display and keypad integrated into the XG555 front panel.

### Front Panel Setup

The front panel keypad provides 4 keys as described in the following table.

Key	Function
ENT	Enter, select an option or store a value
ESC	Cancel an operation or move up in the menu
Up Arrow	Increment a number or selection
Down Arrow	Decrement a number or a selection

The setup menus can be accessed by pressing the enter key while viewing the transducer status screen. Navigate the setup options by using the arrows. Press enter to view a sub menu or edit a value. Press cancel to return to the parent submenu or to return to the transducer status screen if there is no parent submenu.

When editing a value, the arrow keys are used to change the value, cancel exits editing without keeping changes, and enter exits editing and keeps changes. You must select the “Save Setup” option to commit changes to permanent storage.

The front panel contrast can be adjusted by holding the down arrow while the XG555 starts. Release the button after the contrast adjustment screen is displayed. Press the up and down arrows to adjust contrast and press enter when finished.

To add a transducer, follow these steps:

1. Enter the transducer’s serial number.
2. Enter the number of magnets installed on the transducer.
3. Enable the transducer.
4. Select “Save Setup” from the first setup menu.

## Console

The device console is provided through a 9600-bps RS232 serial link. Interaction between an operator and the transducer bridge is through the COM1 RS232 connector. The console is used for several reasons. Error messages are output over the console, the console is used to add a new transducer, and the console is used to enter setup mode.

The following items are available in the top-level menu:

- Position
- Status
- Transducers
- Save Setup

The position submenu allows you to select a transducer. After selecting a transducer, a magnet number and an associated position are displayed. The arrow keys are used to select a different magnet.

The status submenu allows the selection of CANbus or DeviceNet status information. The CANbus status will be one of the following: Buss Off, TX or RX Error, Buffer Overrun, or Normal. The DeviceNet status will alternate between two displays. The first will identify the DeviceNet status as one of these: No Controller, Self Test, Standby, Operational, Recoverable Fault, or Unrecoverable Fault. The DeviceNet network status will be one of the following: Offline, Unconnected, Connected, or Comm Fault.

The transducer submenu allows configuration of each transducer entry. You can change the serial number of the transducer, the number of magnets, and whether the transducer is currently enabled.

Choosing save setup will save the current setup in permanent storage.

## Console Setup Mode

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 parallel or 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.

Setup presents a table showing the transducers that are currently being used by the system. The table lists the following items, from left to right:

- Whether the transducer is 'alive', or responding to position queries
- The serial number of the transducer
- The node id of the transducer
- The position id of the transducer
- The status id of the transducer
- The expected number of magnets on the transducer

The following actions are possible from the menu:

- **Add a transducer to the list** (not visible unless an opening exists)  
Prompts for information about a transducer to add to the list and tries to configure the transducer based on the input serial number. The operator should be prepared to enter the transducer's CANbus serial number, the number of magnets expected to be on the transducer, and the resolution returned by the transducer in inches.
- **Remove a transducer from the list** (not visible unless a transducer is defined)  
Removes a transducer from the list and stops interrogating the transducer for position information.
- **Load transducer information from the data files**  
Loads the saved transducer information into memory. This will "undo" changed made by the operator if they have not been saved.

- **Save transducer information to the data files**  
Saves the transducer information to the flash disk.
- **Display magnet positions**  
Prints the position of a selected magnet until 'Q' is pressed. Pressing +/- and 0-3 changes the selected magnet and transducer. '+' increments the selected magnet number; '-' will decrement the selected magnet number. '0' selects transducer 0, '1' selects transducer 1, and so on.
- **Quit**  
Exit setup mode and resume normal operation.

## DeviceNet

A second CANbus interface provides a DeviceNet interface to the transducer position information. 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 your PLC's DeviceNet scanner. Download the new configuration to the scanner. When you go on-line, the scanner should be exchanging data with the transducer gateway.

The slave provides a polled connection that consumes 1 byte and produces 63 bytes. The consumed byte is a command byte similar to the command byte used in the parallel connection. 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	Set Zero
Bit 7	Unused

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

Bytes 0-59	Position data for the requested transducer (0-14). The position data is returned as two's-complement 32-bit signed integers.
Bytes 60-61	Status data for the magnets on the requested transducer. Each bit of the status data corresponds to a magnet. For example bit 0 of byte 60 indicates the status of magnet 0 on transducer 0.
Byte 62	The consumed command byte.

The position data returned will contain position data for magnets on the following transducer if the requested transducer has less than 15 magnets, followed by the next transducer if space is still available, and so on. At most, 15 positions will be returned.

### Examples:

If your setup used 3 transducers with 6 magnets each and requested magnet 0; transducer 0 positions would be stored between bytes 0 and 23, transducer 1 positions would be stored between bytes 24 and 47, and transducer 2 positions for magnets 0 through 2 would be stored between bytes 48 and 59.

If you were to request transducer 1; transducer 1 positions would be stored between bytes 0 and 23, transducer 2 positions would be stored between bytes 24 and 47, and zeros would be stored between bytes 48 and 59 because only three transducer are used in the setup.

When bit 6 is not set, position and status data for the transducer requested in the command word are returned. In this case, the magnet number is ignored.

If bit 6 is set, the transducer specified in the command word is offset to the position of the magnet specified. If magnet 15 is specified, the offset of the transducer specified is set to zero. The command byte must change before the transducer will be zeroed again.

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

## Troubleshooting

### Transducer problems

No transducers respond after you have entered the correct setup information:

This can be caused by a lack of 24V power to the CAN bus measured at the CAN bus connector on the control, a bad CAN bus card in the control, a missing terminating resistor at the end of the trunk line, a bad cable or possibly a single bad transducer. If a bad transducer is suspected disconnect all of the transducers and reconnect them one at a time to see if they work individually. This could also be the case if wrong setup information is entered for all of the transducers.

A single transducer does not respond:

Check that the transducer has the right setup information entered and that the drop cable from the trunk to the transducer is ok. You may need to use the detect utility (see below). If so replace the transducer in question.

Missing magnets on one or more transducers:

Check and make sure the number of magnets on the transducer and the number entered in the XG555 match. Make sure all magnets have at least the manufacturer suggested buffer distance between them.

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 24 V, you may need to replace the transducer.

## 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 a Null modem 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 Gateways 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 "C:>" 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 a null 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 SAPPI.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 Sappi.exe" and press enter. The gateway should display a message "Receiving SAPPI.EXE".
3. Press the PGUP key. Select XMODEM protocol and enter "A:SAPPI.EXE"
4. The file will be transferred to the gateway. The letter 'T' is printed as a progress indicator. It will take a while to transfer the program.
5. When it is completed type "dir SAPPI.EXE" and you should see the correct file information regarding the SAPPI file. The file length may be slightly longer 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.

## Program Upgrades

A program upgrade can be accomplished by using the Transfer and Comm utilities, and copying the new program file or files to the flash disk. The following is a list of all files that must be on the flash disk for proper operation:

```
autoexec.bat
config.sys
contrast.cfg
dataa.cfg
datab.cfg
```

datac.cfg  
detect.exe  
mode.com  
transfer.exe  
remserv.exe  
sappi.exe

### **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 "DATAAC.CFG" contain the transducer information. They can be copied to a diskette for safekeeping.

Restoring data can be accomplished by simply copying the "DATA?.CFG" files back to the gateway unit's flash drive after setting up REMSERV/REMDISK or by using TRANSFER/COMM.

### **Detect Utility, Changing Transducer Serial Numbers, Node IDs or baud rates**

Transducer serial Numbers, Node Ids and Baud Rates can be detected and changed using the Detect utility provided on the flash disk of the transducer gateway. Connect to the gateway using the RS232 link and exit the gateway program by typing "SHELL" slowly (with a 1-second pause between letters). At the command prompt, type DETECT followed by enter. A list of detected slaves will be displayed. You can then press Escape to exit, or select a node to change. Cycle power to the gateway when finished. Note that an error may be displayed when changing the baud rate; this is normal.

## Hardware

The CANbus to DeviceNet Transducer Gateway is provided in a Hoffman type NEMA 12 metal enclosure with screw terminals for I/O connections and power. The enclosure is 10.375 by 11.75 inches without cables and is powered by 24 VDC. The enclosure contains a processor board with expansion facilities via PC104. The processor is a 40 MHz 80386 contained on a PC104 board. PC104 modules stacked on the baseboard provide additional capabilities. Connections to field I/O are made through a series of screw terminals along the edge. Connections are provided for a CRT, Keyboard and a serial connection. In normal use these are unconnected. For setup the serial channel can be used.

### Processor

33 MHz 80386 with 4 Mbytes of DRAM. ROM-DOS version 6.22 software is installed.

### PC 104 boards

#### CANbus interface modules

The Aim104 CAN module is an 8-bit PC/104 module providing a single channel, optically isolated CAN bus interface. In addition the board is fitted with an EEPROM for configuration information and an output port for driving three bicolor LED's. The AIM104 CAN modules are connected via ribbon cable to two SERT-DNET pluggable Device Net headers mounted to the front cover.

Connections made to the Can Bus transducer network and the Device Net are made via two 5-pin Device Net compatible screw terminals. CAN bus cabling should use the Trunk and Drop method with a 120-ohm termination resistor at the end of the trunk. The AIM104 CAN module provides termination at the controller end.

Two AIM104 CAN modules are installed in the system.

MTS Sensors CANbus:

Install links 1-A9,A7, and A6 and remove links A8 and A6 to establish I/O address of 120H

Install links 4 & 5 to provide line termination

I/O address of DeviceNet CANbus interface:

Install link 1-A9 and A7 and remove links A8, A6 and A5 to establish I/O address of 160H

Install links 4 & 5 to provide line termination

## **CANBus**

A CANbus interface provides the connection to the MTS transducers. The CANbus operates at 500 kbps.

### **CANBus Connections**

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

1. V- 24V power return
2. Can Low
3. Shield
4. Can High
5. V+ 24V power

### **CANBus Power**

The 24 VDC that powers the Gateway is brought to the CANBus transducers via the CANBus connector, V+ and V-, on the front panel. The transducers may be powered via this connector. If they are to be powered from another 24V source then connect the power supply - to the V- pin on the Gateway and leave the V+ pin unconnected.

### **CANBus Termination**

For proper operation the CANBus cable must be terminated with a 120 ohm resistor at each end of the cable. The XG555 provides CANBus interface termination on the CANBus interface board internally. An external termination resistor should **not** be added at the XG555 end of the CANBus network unless this termination is disabled. To disable the on-board termination, remove jumpers LK4 and LK5 from the CANBus interface board. A 120 ohm termination resistor should be added at the last transducer. This may be accomplished using a discrete resistor or with the MTS sensor termination connector on a transducer with dual connectors.

## **DeviceNet**

### **DeviceNet Connections**

The DeviceNet interface connections are made on a 5 pin removable screw terminal on the front 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)

### **DeviceNet Power**

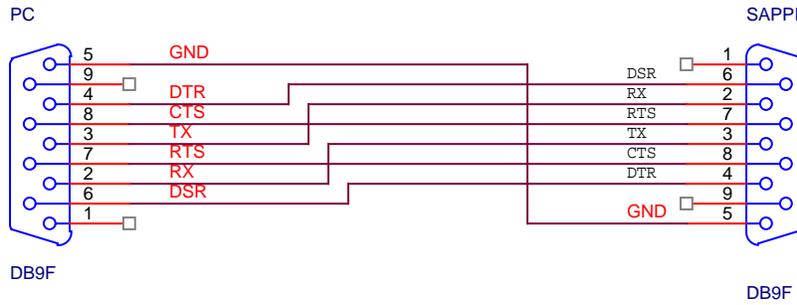
15 to 24VDC power must be supplied to the DeviceNet connector for the DeviceNet communications to operate. The power must be connected to the 5 pin screw terminal. In normal operation this is a separate supply from the CANBus transducer supply.

### **DeviceNet Termination**

For proper operation the DeviceNet cable must be terminated with a 120 ohm resistor at each end of the cable. The XG555 provides DeviceNet interface termination on the DeviceNet interface board. An external termination resistor should not be added at the XG555 end of the DeviceNet network. If the transducer bridge is not the last DeviceNet node on the cable and termination is provided elsewhere, you will have to disable the termination on the transducer bridge. To disable the on-board termination, remove jumpers LK4 and LK5 from the DeviceNet interface board.

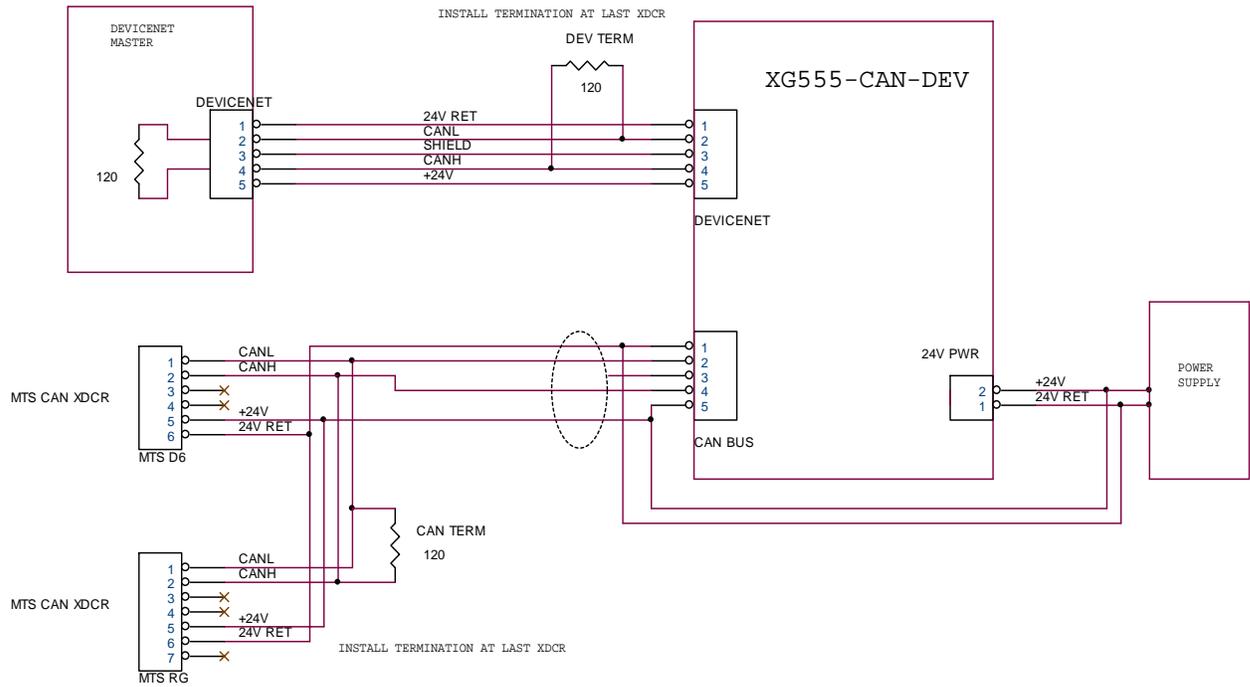
## Serial Interface Cable Pinout

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

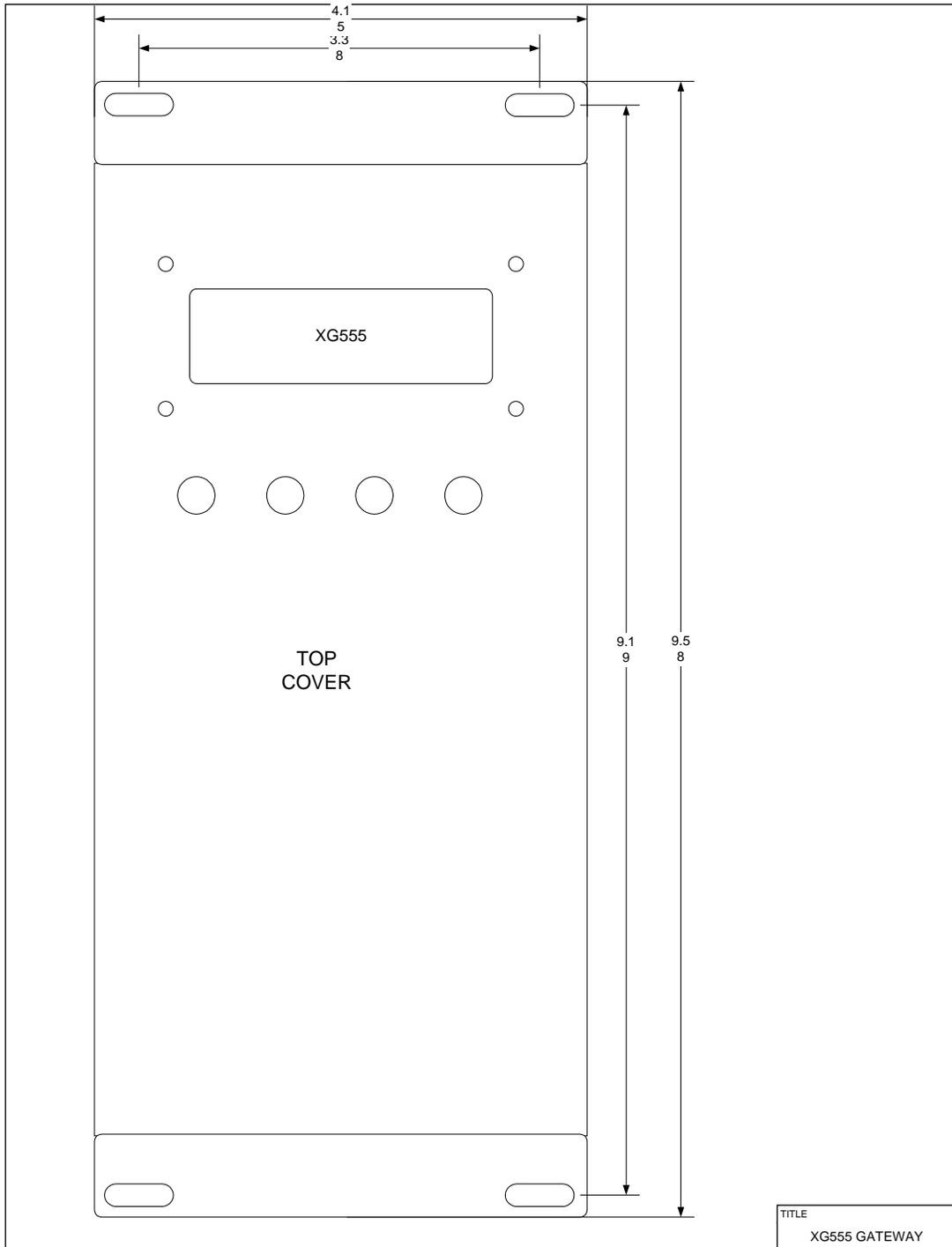


## Rear Panel:





### Typical Installation



**Dimensions**