MIILLE APPLIED RESEARCH CO., INC.

OMNII-COMM™
&
PROTOCOL CONVERTER™

USERS MANUAL

January 1, 2000

Also available on the Internet at
http://www.miille.com

PROPRIETARY NOTICE

Proprietary rights of MIILLE APPLIED RESEARCH CO., INC. are involved in this subject matter and all manufacturing, reproduction, use and sales rights pertaining to such subject matter are expressly reserved. It is submitted in confidence for a specified purpose and the recipient, by accepting this material, agrees that this material will not be used, copied or reproduced in whole or in part, nor its contents revealed in any manner or to any person except to meet the purpose for which it was delivered.

TABLE OF CONTENTS

USING THIS MANUAL

1.1. OVERVIEW

The MARC OMNII-COMM™ is a microprocessor-based multi-port communications module. The module is available as a single slot module for the Allen-Bradley PLC 5 or SLC 500, a single slot module for a Reliance Automate, and as a stand alone unit. The single slot PLC modules connect to the PLC backplane for +5V power only. The stand alone units are available with either a universal input AC supply or a 24VDC supply. Optional on-board leased line and dial-up modems can be added to the Omnii-Comm to provide extended communication capability for use over telephone lines, twisted pair and radio networks. Each port of the OMNII-COMM™ is uniquely configurable for protocol, communicaton parameters (baud rate, number of data bits, etc.) and for Master or Slave emulation. The configuration software runs on any standard PC. No PLC programming is required.

1.2 MANUAL'S PURPOSE

This manual tells how to install and operate the OMNII-COMM™. The manual covers the following areas:

- Hardware Specifications
- Installation of the OMNII-COMM™
- Functional Operation
- Configuration Information

The OMNII-COMM™ supports a wide variety of communication protocols and others are currently under development.

NOTE: WHEN THE NAME "OMNII-COMM" IS USED IN THIS MANUAL, IT CAN REFER TO THE 166-500, 166-201/202/203/206, AND THE 266-001/002. THE OMNII-COMM™ AND PROTOCOL CONVERTER™ BOTH BELONG TO THE "OMNII-COMM FAMILY" OF COMMUNICATION MODULES, THEREFORE THEY CAN OPERATE AND BE CONFIGURED THE SAME WAY. THE PROTOCOL CONVERTER™ IS COVERED UNDER THE NAME "OMNII-COMM" IN THIS MANUAL.

GENERAL DESCRIPTION

2.1 OBJECTIVES

This section discusses the various models of the OMNII-COMM™. After finishing this section the reader should:

- Understand and be able to identify the hardware components of the OMNII-COMM™.
- Understand the basic features and functions of the OMNII-COMM™.

2.2 MODELS

The following listed models are all members of the OMNII-COMM™ family.

166-500-XXX for the PLC-5 processor
166-201 for the SLC processor with Leased-Line modem
166-202 for the SLC processor with Dial-Up modem
166-203 for the SLC processor
166-206 for the SLC processor with 3rd RS-232 port
266-001-XXX Protocol Converter, stand-alone or 19”rack mounted, 24VDC
266-002-XXX Protocol Converter, stand-alone or 19”rack mounted, 120VAC

2.3 GENERAL FEATURES

An Omnii-Comm base module(166-500, 266-001/002) comes with Port 1 and Port 2 enabled for RS-232 or RS-422/485 communication. With optional add-on modules, the 166-500 and 266-001/002 can communicate using up to five ports at a time, where each port can use a different protocol. The Omnii-Comm for the SLC processors (166-20X) have a maximum of 3 ports.

2.4 OPTIONS

The customer can purchase optional add-on modules for the 166-500 and 266-001/002 versions of the Omnii-Comm. After the base module part number, for example a 166-500, there can be an options suffix (166-500-xxx). The part number 166-500-422, for example, indicates that a customer wishes to add an RS-422/485 driver/receiver to both Port 3 and Port 4, and add a 1200 baud Leased-Line modem module to the modem port. The options are as follows:

2.4 OPTIONS (Continued)

-1 RS-232 driver/receiver for P3 or P4
-2 RS-422/485 driver/receiver for P3 or P4
-3 2400 baud dial-up modem for P3, P4 or Modem port.
-4 1200 baud leased-line modem for Modem port
-5 14.4kbps dial-up modem for P3, P4 or Modem port
-6 RS-232 driver/receiver for the modem port on the 166-203
-7 RS-422/485 driver/receiver for the modem port on the 166-203

These add-on modules may be purchased and installed on the Omnii-Comm at any time.

2.5 SPECIFICATIONS

The Omnii-Comm cards (besides the 266-001/002) mount in the Allen-Bradley or Reliance PLC racks. The166-500 mounts in the 1771-I/O chassis, and the 166-201/202/203/206 mounts in the 1746-I/Ochassis. Both versions pull 5 volts from the chassis backplane. The 166-20X draws 100mA from the 1746-I/O chassis, while the 166-500 draws 1A from the 1771-I/O chassis. The Omnii-Comm is slot-independent in the chassis, and can be placed in any empty slot; the slot requires no configuration. The Omnii-Comm cannot communicate over the chassis backplane, and must communicate through the 9-pin serial ports or the modem ports.

CONFIGURATION PROGRAM

3.1 PROGRAMMING CONCEPTS

The fundamental areas of Omnii-Comm operation are as follows:

3.1.1 Configuration

The Omnii Config program lets the user build a configuration file. When this configuration file is saved, Omnii Config creates a .S19 file that the Omnii-Comm needs to run. Download this file to P1 of the Omnii-Comm using an RS-232 cable with a null-modem connected to a serial port on the Personal Computer. In order to receive a .S19 file, the Omnii-Comm needs to be in the setup mode; press the black button on the Omnii-Comm to put it into the setup mode. The active light should be on solid (not blinking) after pushing the black button. The .S19 program may be stored in temporary RAM or permanent EEPROM. Run the Omnii-Comm from RAM to test the preliminary program. For final operation, run the Omnii-Comm from EEPROM by transferring the .S19 program to EEPROM from RAM and making EEPROM active.

3.1.2 Port Selection

The 166-500 and 266-001/2 supports up to five ports. The 166-20X supports up to three ports. Each port can communicate using a different protocol, baud rate, etc. Remember to configure the ports on the PLC or related device with matching baud rate, protocol, error checking, etc. as the connecting port on the Omnii-Comm.

These ports can be hardware configured to use either RS-232 or RS-422/485 serial interface signal levels. Remember that RS-232 and RS-422 are for point-to-point full-duplex communications, and that RS-485 is used in half-duplex point-to-multipoint communications. Ports P1 and P2 require a certain jumper configuration (described in the Hardware chapter of this manual) while P3-P5 depend on the add-on board selected at purchase.

3.1.4 Polling Tables

Data is transferred through the various ports of the Omnii-Comm according to the Poll Tables. Each poll table tells the Omnii-Comm which port to read data from and which port to write data to -unless the Omnii-Comm emulates a slave device, in which case the poll table writes to an internal database set up to emulate a slave device. The poll table also specifies what addresses to be read/written, the amount of data to be read/written and an error location to place an error code if there is a problem with the poll instruction. There is only one read/write instruction per poll table, and a maximum of thirty

two poll tables. The maximum number of bytes the poll table can transfer depends on the two protocols used for that specific poll table.

If the Omnii-Comm is a master to two devices, the poll table will read from one port and write to another port. If the Omnii-Comm is a master to one device and a slave to another, the Omnii-Comm reads from the master port and writes the data to the database. This database will mirror the data in the device connected to the master port; any data change in the device the poll table reads from will change the data in the database and any write to the database thru the Omnii-Comm's slave port will update the data in the device the poll table reads from.

If the program consists of multiple poll tables, any poll tables that write data to the database need to be done before any poll tables that write data to a connector. The order in which the poll tables are set up determines the order of registers within the database. For example, if poll table 1 writes two registers to the data base and poll table 2 writes three registers to the database, the third register in the database, as seen by the slave, is actually the first register written from poll table 2.

3.1.5 Modem Capabilities

The Omnii-Comm 166-500-XXX has the internal modem capability of two dial-up modems and one leased-line modem. If a leased-line modem is used, it is configured as the Modem port in the Connector section of the configuration program. In the configuration program, dial-up modems can be connected to Port 3, Port 4, or the Modem port. The Omnii-Comm 166-20X only has one modem option- either a leased line or a dial-up. The dial-up modems can autoanswer, but they cannot dial out.

3.2 COMMANDS

This section covers the commands and options of the **Omnii-Config** software. Type "config" to start the menu-driven program.

3.2.1 The FILE menu

NEW: This command tells the software to start a new configuration file.

OPEN: This brings up a list of previously saved files to open.

SAVE: This saves changes to the current file.

SAVE AS: This names the current file and saves it to the directory of choice.

ERASE: This erases the current file.

DISPLAY: This displays a summary of the configuration parameters for the current file.

PRINT: This prints a summary of the configuration parameters for the current file.

EXIT: This returns to DOS.

3.2.2 The EDIT menu

PROTOCOL MAINTENANCE

Add or delete protocols used by the configuration program from the current set before opening a configuration program; the protocols used in the program must be in the current set.

CONNECTOR SCREEN

The following is a list of command buttons for the Connector screen:

CHANNEL: This selects an internal UART channel for the processor to communicate with an enabled port. Each port requires a unique UART setting- no two ports can use the same UART. Port P1, port P2 and the modem port can be assigned UART1 CH A, UART1 CH B or HC11 UART. However, the HC11 UART only supports Configuration, A-B DF1 F/D or A-B DF1 H/D protocols. P3 must be UART2 CH A, and P4 must be UART2 CH B.

Port P1 is used for downloading the configuration file. It is automatically set up at power on if no configuration file is loaded, and is set to configuration when the black button is pushed. You may configure Port P1 for any protocol, but if it is an "extra" port, configuring it to "configuration" protocol allows the user to debug the application.

Remember that Ports 3 & 4 can be loaded with optional dial-up modem modules, as well as RS-232 or RS-422/485 line drivers.

PREVIOUS: This brings up the parameters for the previous port on the Connector Selection screen.

NEXT: This takes the user to the next port definition on the Connector Selection screen.

DISABLE: This disables the current port.

SAVE: This saves the current port configuration. Hit the save button each time a port is configured, otherwise, changes are not saved.

EXIT: This exits from the Connector Selection screen.

Besides the command buttons, there are several parameters that can be defined for each port. Not all of these options will be available for every protocol.

PROTOCOL: Select a protocol from the "Current Set" (in the "Protocol Maintenance" menu) to assign to a particular port.

RTS ON DELAY X10ms: The carrier signal will precede any transmissions by this number multiplied by 10ms. This is useful then connecting the Omnii-Comm to a radio, as this will "key-up" a radio in advance before the message is sent to the radio.

RTS OFF DELAY X10ms: The carrier signal will turn off after any transmissions according to this number multiplied by 10ms. This is useful for using the Omnii-Comm with a radio, as this will allow the complete message to be sent before the radio turns off.

ENABLE[ ] DIAL MODEM: If there is a dial-up modem module in Port 3, Port 4, or the "modem" port, this gives the option of assigning a "Hayes" compatible ASCII string to customize the auto-answer functions of the modem. Note: at this time, the dial-up modems come from the factory set to answer after one ring, and they do not support dial-out functions, i.e., they are for auto-answer applications.

ENABLE[ ] PROTOCOL: This will allow the Omnii-Comm to use special protocol specific functions when needed. See the on-line help file for specific protocol information.

MASTER or SLAVE: The Omnii-Comm has the option of being a master for most protocols, and a slave for some protocols. Click on the box to select a Master function. If the Omnii-Comm is configured as a slave, remember to assign a slave "RTU Address" for the Omnii-Comm in the "Header" menu.

ERROR CHECK BCC/CRC: Select a preferred error checking method by clicking on the selection box. Use CRC for the A-B DF1 protocols. See the "Help" file on the specific protocol for information regarding the error checking scheme for the particular protocol.

There can be several different options that appear on the Connector Selection screen depending on the protocol that is assigned to the current port. Please refer to the on-line help utility for the protocol of your choice to read a detailed explanation of these options.

The HEADER menu

The following is a list of parameters to be defined in the **Header** screen.

DATABASE PROTOCOL: If a connector on the Omnii-Comm is a slave, select the database protocol to match the slave protocol. See the on-line help file for the specific protocol for a detailed explanation of the database structure for that protocol.

RTU ADDRESS: This is the slave address of the Omnii-Comm's database as seen by a master unit. Set this to "0" if the Omnii-Comm will not be a slave.

OMNII-COMM ADDX: This is the Omnii-Comm address to the system when the Omnii-Comm will be a master unit. Make sure that the Omnii-Comm does not have the same address as some other unit in the system that it is polling.

POLL TIMER MUL: This number will be multiplied by (10ms)*(Repeat/Poll rate) in the "Poll Table" selection screen to setup the frequency of each poll table.

RADIO KEY ADDX: This is an address in a PLC that can be set to trigger a contact closing to key-up a radio. This is usually taken care of nowadays with the "RTS on delay" function. Set this to "0" if not needed.

ERROR TIME OUT: If there is an error with an Omnii-Comm poll, the Omnii-Comm will not attempt that poll again until after the number of seconds specified here.

The POLL TABLES menu

This section will define how the Omnii-Comm reads and writes data.

APPEND: This command adds a poll table.

DELETE: This command deletes the poll table specified in the poll table number box.

MOVE UP: This command moves the current poll table up in the order. For example, if poll table 4 is the current poll (in the box), clicking this button will switch poll table 4 with poll table 3.

MOVE DOWN: This command moves the current poll table down in the order. For example, if poll table 4 is the current poll (in the box), clicking this button will switch poll table 4 with poll table 5.

SYSTEM ERROR: This defines a global error location where the Omnii-Comm writes system error codes for errors that are not associated with specific poll talbes. The first byte (MSB) of the error code indicates the protocol of the communication link with the problem. The second byte (LSB) of the error code indicates the actual problem. See the error codes in the Error Message Definitions chapter.

REPEAT TIMER x 10ms: This number multiplied by (10ms)*(poll timer mul) sets the poll rate for each poll table. For example, if the Poll Timer Mul = 1, a value of 100 here executes the read/write operation of the poll table every (100)*(10ms)*(1) = 1 second, or 1000ms.

POLL TIME OUT x 10ms: This number, multiplied by 10ms, tells the Omnii-Comm how long to wait for a response from a slave unit before writing an error message and moving on to the next poll table.

POLL TABLE: This opens the "Table Selections" screen in order to define the read/write functions of poll tables.

Table Selections

When you enter the "Table Selections" screen, the Read, Write and Error buttons will appear. Read, Write and Error operations must be defined for each poll, and, if the write is to the database, the database must be configured also. Each button is described below:

R : A click on this button tells the software to define a read operation.

W : A click on this button tells the software to define a write operation. If the current poll writes data to the database, click on **W** and select Database as the Connector. Then click on "Save" and the "EXT" button will appear.

E : A click on this button opens the error operation to define the location for each poll table. See "System Error" above for more details on error codes.

EXT : This is for the database configuration if the Omnii-Comm is to be a slave. To get this button to appear, follow the instructions above concerning the "**W**" button. Click on the **EXT** button to set up the database. See the on-line help file to find detailed information on how to set up the database for a specific protocol. Remember, if some polls build a database and other poll write to a port, the database-building polls must be first.

3.2.3 CONTROL Menu

Clicking on the **Control** menu opens the "Omnii-Talk" screen to download the configuration file to the Omnii-Comm.

OMNIITALK Program

The "Omnii-Talk" opens with the Help menu on the screen; to view this screen again, hit the F1 key at any time. The function of the program is to manage the configuration of the Omnii-Comm - download the configuration file, select RAM/EEPROM, move file to EEPROM, restart the Omnii-Comm, etcetera.

Note- OmniiTalk establishes a contact with a monitor program in the Omnii-Comm that allows the user to examine and change memory and perform numerous software moitoring functions. Typing random keys could create random problems: in the worst case, altering the restart or interrupt vectors could result in the Omnii-Comm failing completely.

The Omnii-Comm needs to be in the configuration mode in order to receive the .S19 file. Press the black button to put the Omnii-Comm in this mode. The commands are described as follows:

F2 = Stop Polls This command takes the Omnii-Comm out of the run mode. This only works if P1 was configured with the configuration

protocol. This function is only needed to break into a running Omnii-Comm- the black button stops the Omnii-Comm too.

F3 = Send File to RAM This sends the .S19 file to the Omnii-Comm's RAM so the program may be tested. Once the Omnii-Comm loses power, this file is lost.

F4 = Restart Polls This command puts the Omnii-Comm in the run mode; the Omnii-Comm either starts polling or sends an error message to the screen if there is a configuration error.

F5 = Move RAM to EEPROM This transfers the file in RAM to EEPROM. If the Omnii-Comm loses power, the configuration file will not be lost. As soon as power is turned back on the Omnii-Comm will start to run again.

F6 = Change Port This lets the user select which port on the Personal Computer to use to download the configuration file from. This program supports comm ports 1 through 4.

F7 = Make RAM Active This command activates RAM. The configuration file in the active memory runs the Omnii-Comm. The Omnii-Comm either runs off of the configuration file in RAM or the one in EEPROM.

F8 = Make EEPROM Active This command makes the file in EEPROM the operative program for the Omnii-Comm.

F9 = Copy Configuration to File Pulls the current .S19 file out of RAM and writes it to a user selectable file name. Note: the Omnii-Config program cannot edit this file.

F10 = Save changes, exit to DOS Saves any port settings made and exits to DOS.

ALT F1 = Advanced Functions This describes the Advanced Functions screen. These functions are used for debugging purposes.

ALT F2 = Save OmniiComm state to file This saves the entire memory of the Omnii-comm, which can be E-mailed to MARC to help resolve extreme problems.

ALT F3 = Clear Terminal Buffer This command clears the program buffer so saving to a file will not include characters previously typed.

ALT F4 = Write Terminal Buffer to Disk This writes any previously displayed memory to a file on the disk.

ALT F5 = Save Port Configuration This saves the current port settings- COM port, IRQ line, baud rate, number of data bits, number of stop bits, and parity.

ALT F6 = Transmit ASCII File This sends an ASCII file to the Omnii-Comm.

ALT F7 = Port Configuration Changes This lets the user select the port settings- COM port, IRQ line, baud rate, number of data bits, number of stop bits, and parity.

ALT F8 = Shell to DOS Commands This opens a temporary DOS prompt.

ALT F9 = Show Port Configurations This displays the port settings.

ALT F10 = Exit to DOS This exits the Omnitalk program without saving the current port settings.

3.2.4 HELP Menu

The help menu contains useful information about general configuration procedures as well as protocol specific details. The help file should contain information about the protocols that are in the “Current Set” of the “Protocol Maintenance” menu.

SOFTWARE TUTORIAL

4.1 GENERAL INFORMATION

The biggest obstacle to a working system is software configuration errors. The fundamental needs for the Omnii-Comm are:

- Configuration header with module address, etc.
- Communication and protocol assignments for each port being used
- Poll tables to direct read/write operations
- Error word locations for diagnostic purposes.

4.2 BEFORE STARTING

Before attempting to run the configuration program, select the addresses and communication parameters of the various PLCs and related devices for the system in which to install the Omnii-Comm. A checklist for each device in the system should verify the following: RTU address or addresses (such as processor and station), protocol, baud rate, data bits, stop bits, parity, duplex type. Make sure that an Omnii-Comm port is configured to match its compatible port of the device that it communicates with.

4.3 PROGRAMMING TUTORIAL

New users should demonstrate the Omnii-Comm with one of the following tutorials. The first configuration consist of one poll table uses the read and write functions of the Omnii-Comm as a master to read a word of data from an Allen-Bradley PLC and write the data back to the PLC. The second tutorial utilizes the internal database allowing the Omnii-Comm to emulate a Modbus slave device.

The equipment used in this demonstration is a PLC5 (with a RS-232 port), a 166-500 Omnii-Comm base module, a personal computer, a 9-pin serial RS-232 cable with a null-modem to connect Port 1 of the Omnii-Comm to a serial port on the P.C., a cable (M.A.R.C. cable #127-073-12) to connect the PLC5 to Port 2 of the Omnii-Comm, and PLC-5 software. Set the communication parameters for the PLC5 serial port to:

After completing this tutorial program, the Omnii-Comm will:

Use Port 2 to read 2 bytes from N9:10 of PLC-5
Use Port 2 to write the same 2 bytes previously read to N9:11 of PLC-5
Write any global error codes to N9:12 of PLC-5
Write any poll table error codes to N9:13 of PLC-5

Example 1

- 9600 baud
- 8 data bits
- 1 stop bit
- no parity
- CRC error checking
- DF-1 Full Duplex

Connect the cable between the PLC5 and Port 2 of the Omnii-Comm, and connect the serial cable with the null-modem from a serial port on your P.C. to Port 1 of the Omnii-Comm. Press the black config button to put the Omnii-Comm in the configuration mode. The ACTIVE light should be on continuously and the Omnii-Comm awaits a configuration file.

***Step 1*:** Go to the directory or disk containing the **Omnii-Config** software and type "**config**" to start the configuration program.

Step 2: Go to the **Edit** menu and click on **Protocol Maintenance**. Make sure that A-B DF-1 F/D is in the current set, then click on **Exit/Save**.

***Step 3*:** Go to the **Edit** menu and click on **Connector**. The P1 connector screen appears. Since this tutorial does not use connector P1, click on **Save** to save the default settings. Click on **Next** to screens to the Port 2 configuration, then click on **Enable** to activate the parameter selection. Then click on the ↓ by the **Channel** options and choose **UART 1 Chan A** for Port 2. This UART lets the microprocessor communicate with the port. Each port requires a unique UART setting- no two ports can use the same UART. The communication parameters- the baud rate, number of data bits, number of stop bits, and the parity- should be set to match that of channel 0 on the Allen-Bradley PLC. Click on the ↓ by the **Protocol** selections and choose **A-B DF-1 F/D** since the Omnii-Comm will be using a full-duplex link with the PLC5. Go to the options section and select **Master** since the Omnii-Comm will poll the PLC5. P1 and P2 are now configured for this example program; click on **Save** and then **Exit**.
Step 4: Go to the **Edit** menu and select **Header**. For this application, leave these values in thier default mode. Click on the **Ok to Save** button.

Step 5: Go to the **Edit** menu. and click on **Poll Tables.** Since we will only do one read and write operation in this example, we will only need one poll table. Go to the **Poll Timer 10ms** section and enter a polling rate value which will be multiplied by 10ms; if you enter 100 here, the Omnii-Comm will perform the read and write functions every 100*10ms = 1 sec. Choose 100 for now.

Click on **Poll Table** to set up the poll table parameters. Click on **R** to define what the Omnii-Comm reads. Click on the ↓ next to the **Connector** selections, and select **P2** so the Omnii-Comm will read from the PLC5. Choose the location within the PLC as follows: PLC Type = PLC5, Command = PLC5 Read, PLC DH+ Addr = 0 (this option only applies if the PLC is on the Data Highway), LP = 0 (this only applies to a PLC5/250), File Type = PLC5 Integer, File Number = 9, Starting Element = 10, # Bytes = 2. Click on **Save.**

Then, click on **W** to write the data previously read. Click on the ↓ by **Connector** and choose **P2** in order to write the data to the PLC5. Set up the following parameters to write the data to this location within the PLC5: PLC Type = PLC5, Command = PLC5 Write, DH+ Addr = 0, LP = 0, File Type = PLC5 Integer, File Number = 9, Starting Element = 11, # Bytes = 2. Make sure the number of bytes read equals the number of bytes written. Click on **Save.**

Next, click on **E** to set up the parameters that determine the location to write the poll table's error code. Click on the ↓ by **Connector** and choose **P2** to write this error code to the PLC5. Define the location within the PLC5 as follows : PLC Type = PLC5, Command = PLC5 Write, DH+ Addr = 0, LP = 0, File Type = PLC5 Integer, File Number = 9, Starting Element = 12, # Bytes = 2. Click on **Save**, then **Exit**. The poll table is now complete.

Now click on **System Error** to define a global error location where the Omnii-Comm can write an error code in case a general error occurs. An error code is 2 bytes long; the high byte tells which protocol originated the error, and the low byte is the error itself. A list of error codes is in chapter 7 under System Error Message Definitions. Now click on the ↓ by the **Connector** selections and choose **P2** so the Omnii-Comm will write this error code to the PLC5. Now select the location within the PLC5 as follows: PLC type = PLC5, Command = PLC5 Write, PLC DH+ Addr = 0, LP = 0, File Type = PLC5 Integer, File Number = 9, Starting Element = 12, # Bytes = 2. Then click on **Save**, **Exit** and Exit once more to return to the main screen.

Step 6*:* Go to **Save As** in the **File** menu and save the program as a unique name. Then click on **Control**, this opens the Omnii Talk program.

CAUTION: Before downloading the configuration to the Omnii-Comm:

A) press the black configuration mode button.

B) connect a 9-pin RS-232 serial cable with a null-modem.

Step 7: The Omniitalk screen appears in the help mode. Hit F7 to make the RAM active and then hit F3 to send the configuration file to RAM. After the file is sent, hit F4 to start the Omnii-Comm.

Step 8: With the PLC-5 software, enter a value in N9:10. This value should appear in N9:11 about one second later due to the Poll Timer Value in the poll table. If there was an error, the error code will appear in N9:12 and N9:13.

Step 9: For a real application, hit F5 to move the configuration file from RAM to EEPROM and then hit F8 to make EEPROM active; this puts the file into the non-volatile EEPROM memory so that the configuration will stay in memory even when the Omnii-Comm is turned off.

This simple configuration will gives a good idea about how the Omnii-Comm can be configured. Display the file or obtain a printout of the configured parameters with the **Display** or **Print** options under the **File** menu in the Omnii-Config program.

Example 2

This next example sets up the Omnii-Comm as a Modbus slave.

After completing this tutorial, the Omnii-Comm will:
Use P1 to read two bytes from N9:0.
Write two bytes to the Modbus database as a holding register.
Use P2 to emulate a Modbus slave port supporting one holding register.

The equipment used in this demonstration is a PLC5 (with a RS-232 port), a 166-500 Omnii-Comm base module, a personal computer, a 9-pin serial RS-232 cable with a null-modem to connect Port 1 of the Omnii-Comm to a serial port on the P.C., a cable (M.A.R.C. cable #127-073-12) to connect the PLC5 to Port 2 of the Omnii-Comm, PLC-5 software, a Modbus master device and a 9-pin serial RS-232 cable with a null-modem to connect P2 of the Omnii-Comm to the serial port of the Modbus device. Set the communication parameters for the PLC5 serial port to:

- 9600 baud
- 8 data bits

- 1 stop bit
- no parity
- CRC error checking
- DF-1 Full Duplex

Step 1: Click on **File** and select **New** from the list to open a new file.

Step 2: Click on **Protocol Maintenance** in the **Edit** section and add **Modbus** and **A-B DF1 F/D** to the current set; the current set list holds a maximum of five different protocols.

Step 3: Select **Connector** from the **Edit** menu to configure the connectors. The first screen is for connector P1; click on the ↓ by the **Protocol** selections and choose **A-B DF-1 F/D** as the protocol. Next, setup the baud rate, number of data bits, number of stop bits, and the parity to match that of channel 0 on the Allen-Bradley PLC. Check the box beside Master (the Omnii-Comm will be a master to the Allen-Bradley PLC). Leave the box next to BCC blank in order to select CRC error checking (CRC is a more thorough and reliable error checking algorithm). Then click on the ↓ by the **Channel** options and choose **UART 1 Chan A** for Port 2. This UART lets the microprocessor communicate with the port. Each port requires a unique UART setting- no two ports can use the same UART. Now, click on **Save** and then **Next**- this opens the screen for connector P2. Click on Enable and select Modbus as the protocol. Select the baud rate, number of data bits, number of stop bits, and the parity required by the Modbus master device. Leave the box next to Master blank- this configures P2 as a slave. Select ASCII or RTU depending on the version on the Modbus master device. Click on **Save** before exiting the screen.

Step 4: Click on **Header** in the **Edit** menu. Select Modbus as the Database Protocol since the slave connector P2 accesses the database. Set the RTU address to the address the Modbus master device will use to send the Omnii-Comm messages. Leave the other values in their default state. Click on **Ok to Save**.

Step 5: Go into the **Poll Tables** section in the **Edit** menu. Since we will only do one read and write operation in this example, we will only need one poll table. Go to the **Poll Timer 10ms** section and enter a polling rate value which will be multiplied by 10ms; if you enter 100 here, the Omnii-Comm will perform the read and write functions every 100*10ms = 1 sec. Choose 100 for now.

Click on **Poll Table** to set up the poll table parameters. If the program consists of multiple poll tables, any poll tables that write data to the database need to be done before any poll tables that write data to a connector. The word next to Poll

Table 1 tells which portion of the poll is currently shown. Click on the **R** to view the read section. Select the PLC Type, Command and File Type. Since P1 of the Omnii-Comm is connected directly to Channel 0 of the PLC, the PLC DH+ address is inapplicable and the LP only applies to a PLC 5/250. Now, read from File Number 9, Starting Element 10 and 2 Bytes Expected and click on Save (always click on save after making a change before clicking on **W** or **E** or **Ext** to update the write, error or extension part of the poll - otherwise, the change will not be saved).

Click on **W** and select Database as the connector, this tells the Omnii-Comm where to write the data. Click on Save and then **Ext**. This extension table sets up the database. The order in which the poll tables are set up determines the order of registers within the database. For example, if poll table 1 writes two holding registers to the data base and poll table 2 writes three holding registers to the database, the third holding register in the database is the first holding register of poll table 2. After, setting up the database extension, click on **Save**.

Click on **E** to set up the parameters that determine the location to write the poll table's error code. Click on the ↓ by **Connector** and choose **P2** to write this error code to the PLC5. Define the location within the PLC5 as follows : PLC Type = PLC5, Command = PLC5 Write, DH+ Addr = 0, LP = 0, File Type = PLC5 Integer, File Number = 9, Starting Element = 12, # Bytes = 2. Click on **Save**, then **Exit**. The poll table is now complete.

Now, click on **System Error** to define a global error location where the Omnii-Comm can write an error code in case a general error occurs. An error code is 2 bytes long; the high byte tells which protocol originated the error, and the low byte is the error itself. A list of error codes is in chapter 7 under System Error Message Definitions. Now click on the ↓ by the **Connector** selections and choose **P2** so the Omnii-Comm will write this error code to the PLC5. Now select the location within the PLC5 as follows: PLC type = PLC5, Command = PLC5 Write, PLC DH+ Addr = 0, LP = 0, File Type = PLC5 Integer, File Number = 9, Starting Element = 12, # Bytes = 2. Then click on **Save**, **Exit** and Exit once more to return to the main screen.

Step 5: Click on **Save As** in the **File** menu and enter a name. Exit the Omnii configuration program by clicking on Exit in the File menu.

CAUTION: Before you download the configuration to the Omnii-Comm, make sure that you:

A) have pressed the small black configuration mode button.

B) have a 9-pin RS-232 serial cable with a null-modem connected properly.

Step 6: Go to the download program by exiting the Omnii-Config program. At the DOS prompt in the same directory, type CT and hit enter. This program sends the file created by Omnii-Config to the Omnii-Comm.

Step 7: With your PLC-5 software, enter a value in N9:10. This value should appear in N9:11 about one second later due to the Poll Timer Value in the poll table. If there was an error, look in N9:12 and N9:13 for the error codes.

Step 8: Now go to the download program and select **Transfer to EEPROM**, then select **EEPROM Active** to transfer the configuration to the non-volatile EEPROM memory so that the configuration will stay in memory even when the Omnii-Comm is turned off.

HARDWARE

5.1 OBJECTIVES

This section describes the hardware on the Omnii-Comm with which the user may need to be familiar.

5.2 HARDWARE

5.2.1 Hardware Options

The Omnii-Comm as a protocol converter allows multiple devices, speaking different protocols, to communicate. Here is a list of the different models:

A) Allen-Bradley 1771 rack mounted Omnii-Comm
- 166-500-XXX

B) Allen-Bradley 1746 rack mounted Omnii-Comm
- 166-201 Omnii-Comm with FSK modem
- 166-202 Omnii-Comm with dial-up modem
- 166-203 Omnii-Comm
- 166-206 Omnii-Comm with additional RS-232 port

C) Stand alone Omnii-Comm
- 266-001-XXX requires 24 VDC power
- 266-002-XXX requires 120 VAC power

D) Allen-Bradley 1746 and 1771 rack mounted modems
- 166-100 2400 baud dial-up modem for 1746 rack
- 166-101 1200 baud FSK modem for 1746 rack
- 166-010 2400 baud dial-up modem for 1771 rack
- 166-010-144 14.4K baud dial-up modem for 1771 rack
- 137-001 1200 baud FSK modem for 1771 rack
- X could be:
  - -1 RS-232 driver/receiver for P3 or P4
  - -2 RS-422/485 driver/receiver for P3 or P4
  - -3 2400 baud dial-up modem for P3, P4 or Modem.
  - -4 1200 baud leased line modem for the modem port.
  - -5 14.4K baud dial-up Modem for the modem port.
  - -6 RS-232 driver/receiver for the modem port.
  - -7 RS-422/485 driver/receiver for the modem port.

5.2.2 Diagnostic Lights

The diagnostic LEDs on the Omnii-Comm include the Transmit and Receive indicators for each port, an Active/On Line(heartbeat) and Error light. Some common LED scenarios are listed below.

Active/On Line LED is solid: There is no configuration loaded or active.

Active/On Line LED flashes: There is a configuration loaded, and the unit is attempting to run as configured.

Error LED flashes: There is a system error or poll table error; check the error locations for error codes.

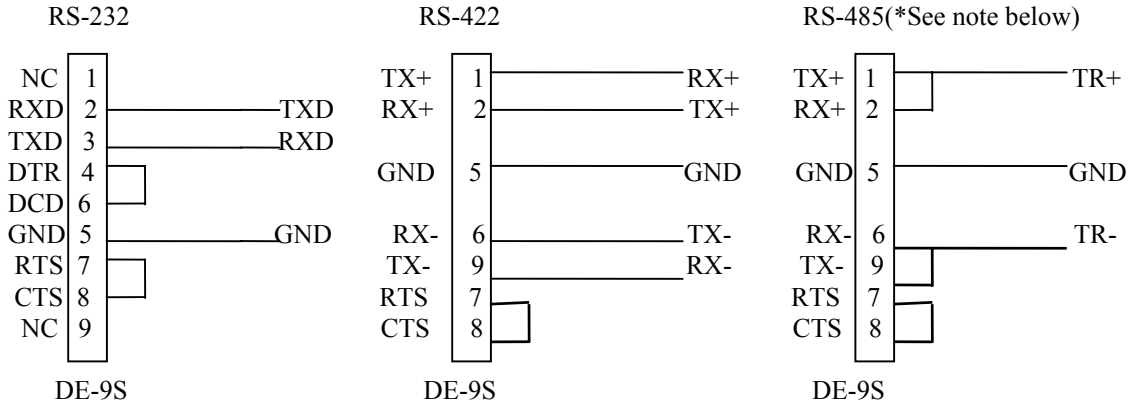
TX LED flashes: The Omnii-Comm is transmitting a message from the specified port.

RX LED flashes: The Omnii-Comm is receiving a message on the specified port.

These LEDs help determine connection errors and minor configuration errors. For example, if the Omnii-Comm TX light flashes and the RX light for the same port does not, the cable for that port is bad or the other device is not responding to the Omnii-Comm. Also see "Omnii-Comm Troubleshooting Tips" on page 27.

5.2.3 CONNECTOR PINOUTS

Typical pinouts for the Omnii-Comm:



*NOTE: When using RS-485 on Port 3 or Port 4 of the 166-500 or 266-001/002, jumper pin 8 to pins 6 & 9. Do not connect pin 7.

See the "MARC Standard Cable Assemblies" booklet for more cable information.

5.3 JUMPER SETTINGS

The following are user configurable jumpers.

5.3.1 166-500 & 266-001/002 Jumper Settings

PORT 1 AND PORT 2 SIGNAL LEVEL CONFIGURATION(RS-232 IS DEFAULT)

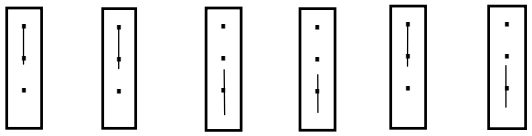
	Port 1	Port2
166-500	JP1	JP2
266-00X	JP2	JP1

FOR RS-232	FOR RS-422	FOR RS-485
JUMPER PINS	JUMPER PINS	JUMPER PINS
4-6	3-5	1-3
5-7	2-4	2-4
8-10	9-10	9-11
13-14	12-14	12-14

5.3.2 166-500 & 266-001/002 MEMORY CHIP JUMPERS

For 28 pin RAM and EPROM chips, set the jumpers as follows:

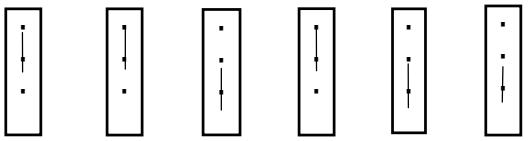
166-500 MEMORY CHIP JUMPERS



J16 J6 J17 J14 J5 J2

For a 32 pin EPROM, reverse J5.

266-001/002 MEMORY CHIP JUMPERS



J9 J10 J11 J12 J13 J17

For a 32 pin EPROM, reverse J12.

5.3.3 166-500 & 266-001/002 RESET BUTTON

The small black button by Port 1 can either be used to reset the Omnii-Comm, or put it in programming mode for configuration.

166-500 RESET/CONFIG BUTTON

J1 Configuration J1 Reset

266-001/002 RESET/CONFIG BUTTON

J7 Configuration J7 Reset

5.3.4 166-201/202/203/206 JUMPER SETTINGS

The following jumper settings apply to the 166-201/202/203/206 versions of the Omnii-Comm:

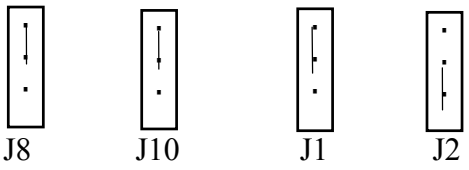
PORT 1 AND PORT 2 SIGNAL LEVEL CONFIGURATION(RS-232 IS DEFAULT)

Use J1 for Port 1 and J2 for Port 2 on the 166-201/202/203/206

FOR RS-232	FOR RS-422	FOR RS-485
JUMPER PINS	JUMPER PINS	JUMPER PINS
3-4	2-4	1-2
7-8	6-8	5-6
10-12	9-10	9-10

5.3.5 166-201/202/203/206 MEMORY CHIP JUMPERS

For 28 pin RAM and EPROM chips, jumpers will be set as follows:



For a 32 pin EPROM, reverse J1.

5.3.6 166-201/202/203/206 RESET/CONFIG BUTTON

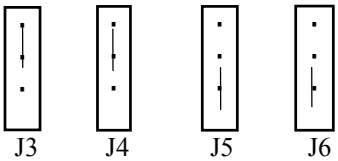
The small black button by Port 1 can either be used to reset the Omnii-Comm, or put it in programming mode for configuration.

5.3.7 Modem Functions

The following jumpers apply when "Omniiserial Port 3" on the 166-500 or "Omniiserial U10" on the 266-001/002 is loaded with a modem module. They also apply for the 166-201 and 166-202.

LEASED LINE MODEM SETTINGS:

For 266-001/002 For 166-500

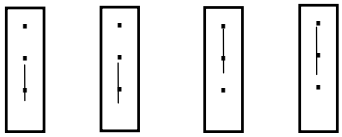


For 166-201

DIAL-UP MODEM SETTINGS:

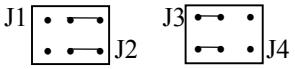
— J2 — J4 — J10 — J12

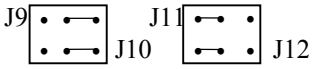
For 266-001/002 For 166-500



For the 166-202

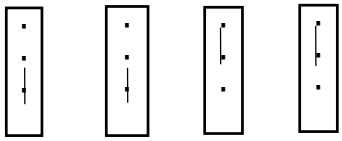
-6 RS232 ADD ON BOARD SETTINGS:





For 266-001/2-XX6
install a jumper on J8

For 166-500-6XX
install a jumper on J13



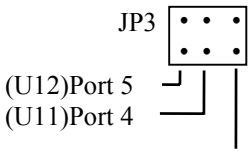
For the 166-206
install a jumper on J11

DIAL-UP MODEM SPEAKER

Jumpered = enabled
Open = disabled

For 266-001/002 For 166-500

DIAL-UP MODEM SPEAKER SELECTION
For 266-001/001 and 166-500



(U10)Port 3 ——

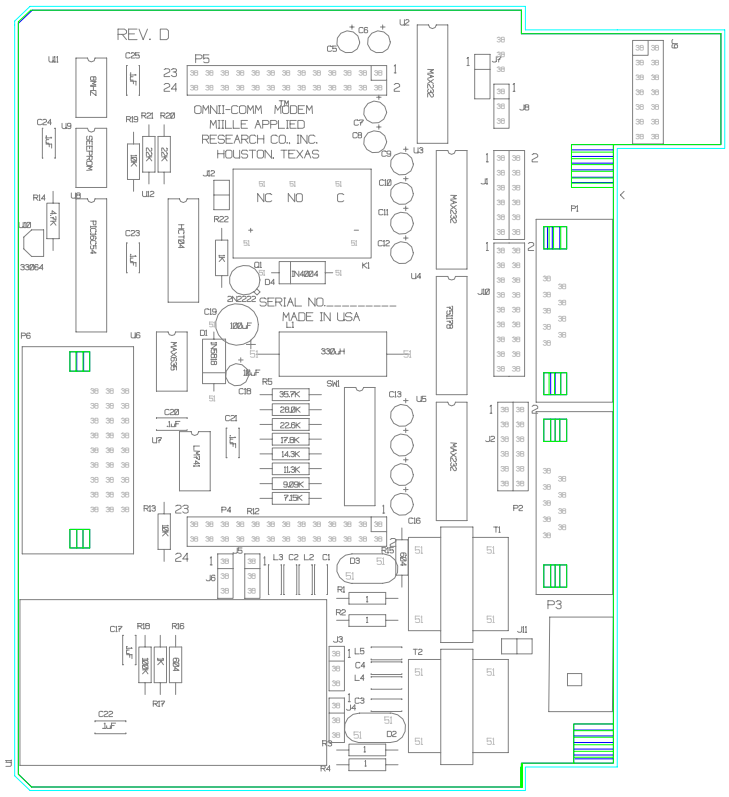
Note: Speaker is not available on the 166-201/202/203/206

PUSH TO TALK RELAY

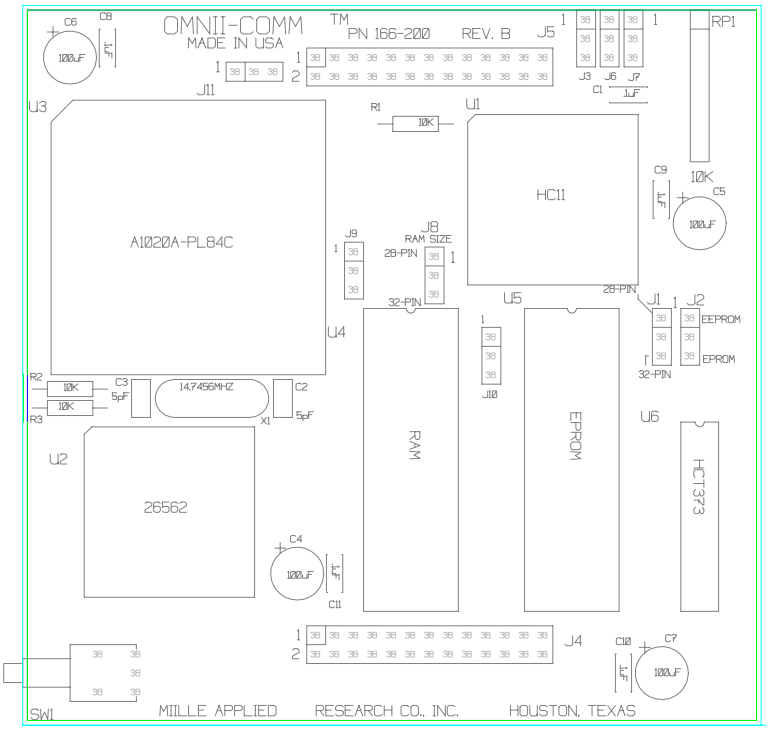
J16  For 266-001/002

J8  For 166-500

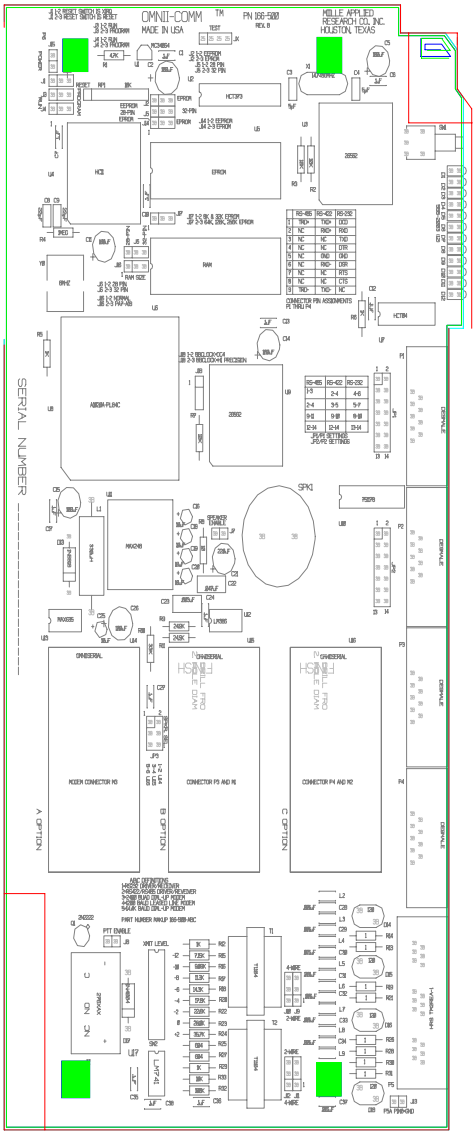
J12  For 166-201

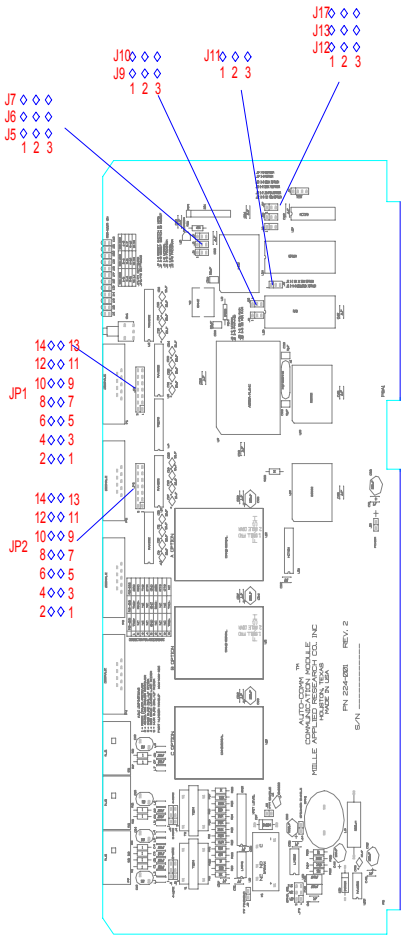


LAYER 3 (GROUND)



LAYER 3 (GROUND)


OMNII-COMM
MADE IN USA
MILLE APPLIED RESEARCH CO., INC.
HOUSTON, TEXAS
SERIAL NUMBER
A OPTION
B OPTION
C OPTION
CONNECTOR P5 AND P6
CONNECTOR P4 AND P2
PTT ENABLE
XMIT LEVEL

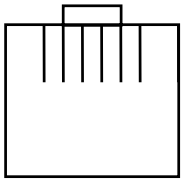

J17
J13
J12
1 2 3
J10
J9
1 2 3
J11
1 2 3
J7
J6
J5
1 2 3
14 13
12 11
JP1
10 9
8 7
6 5
4 3
2 1
14 13
12 11
JP2
10 9
8 7
6 5
4 3
2 1

OMNII-COMM LEASED LINE MODEM FUNCTIONS

The Omnii-Comm lease-line modems operate the same for all of the different versions.

6.1 LEASED LINE CONNECTIONS

An RJ-11 connector is used for connection to the phone line. Use the RJ-11 connector at the bottom of the 166-201, or the very last RJ-11 connector on the 166-500 or the 266-001/002. A standard modular phone line connector can be used. The Omnii-Comm's RJ-11 leased-line pinout is shown below.



1 2 3 4 5 6
RJ11 connector pinout

In this view, the mating end of the connector is facing upward, and the locking tab is at the rear of the connector.

1 Push To Talk output(remember to install jumper)
2 RX+ (Yellow)
3 TX+ (Green)
4 TX- (Red)
5 RX- (Black)
6 Push To Talk common

Use the Push To Talk signal to "key-up" a radio that accepts an FSK modem input. The signal is a relay contact output that is enabled when the RTS signal goes high, and the modem is ready to transmit. The relay close time can be changed by altering the RTS on/off delays in the "Connector" menu of the configuration program.

For a 4-wire leased-line connection, reverse the transmit and receive wires so that the transmit output of one modem enters the receive input of another modem. One possible connection is as follows:

Modem A		Modem B
Yellow	-	Green
Green	-	Yellow
Red	-	Black
Black	-	Red

For a 2-wire leased-line connection, you will need to jumper the RX+ to TX+, and RX- to TX-, then connect these pairs to the same combination on another modem. The connection scheme is shown below:

Modem A		Modem B
Yellow, Green	-	Yellow, Green
Red, Black	-	Red, Black

6.2 LEASED-LINE TRANSMIT LEVEL SELECTION

The transmit level is selected by setting an 8-position "DIP" switch: SW1 on the 166-201, and SW2 on the 166-500 and 266-001/002. For standard output levels, only one switch position should be on at a time. Lower output levels can be obtained by turning on more than one switch at a time. The following list shows the output level that will be obtained by setting one particular switch at a time.

Switch Position	Output
1	+2 dB
2	0 dB
3	-2 dB
4	-4 dB
5	-6 dB
6	-8 dB
7	-10 dB
8	-12 dB

6.3 LEASED-LINE MODEM MODE SELECTION

The modem is located on a plug-in module in the Omnii-Comm. On the 166-201 the module is located at the bottom of the card, on the 166-500 the module is located in the Omniiserial Port 3 position, and on the 266-001/002 the module is located in the Omniiserial U10 position. There will be a 7 or 8 position "DIP" switch either on the top or bottom of the plug-in module that you will use to select the operating mode of the modem. The factory default is Bell 202 Full Duplex.

1	2	3	4	5	6	7	8	MODEM OPERATING MODE
X	X	1	1	1	1	1	X	Bell 103 Originate, 300 bps, full duplex
X	X	1	1	1	1	0	X	Bell 103 Answer, 300 bps, full duplex
X	X	1	1	1	0	1	X	Bell 202 1200 bps, half duplex
X	X	1	1	1	0	0	X	Bell 202 1200 bps, half duplex with equalizer
X	X	1	1	0	1	1	X	CCITT V.21 Originate, 300 bps, full duplex
X	X	1	1	0	1	0	X	CCITT V.21 Answer, 300 bps, full duplex
X	X	1	1	0	0	1	X	CCITT V.23 Mode 2, 1200 bps, half duplex
X	X	1	1	0	0	0	X	CCITT V.23 Mode 2, 1200 bps, half duplex with equalizer
X	X	1	0	1	1	1	X	CCITT V.23 Mode 1, 600 bps, half duplex
X	X	1	0	0	1	1	X	CCITT V.23 Mode 1, 600 bps, half duplex with soft turn off
X	X	1	0	0	0	1	X	CCITT V.23 Mode 2, 1200 bps, half duplex with soft turn off
X	X	1	0	0	0	0	X	CCITT V.23 Mode 2, 1200 bps, half duplex with eq. & soft turn off
X	X	0	1	1	0	1	X	Bell 202, 1200 bps, full duplex
X	X	0	1	1	0	0	X	Bell 202, 1200 bps, full duplex with equalizer
X	X	0	1	0	0	1	X	CCITT V.23 Mode 2, 1200 bps, full duplex
X	X	0	1	0	0	0	X	CCITT V.23 Mode 2, 1200 bps, full duplex with equalizer
X	X	0	0	1	1	1	X	CCITT V.23 Mode 1, 600 bps, full duplex

X = Not Used, 0 = Switch Off, 1 = Switch On

6.4 RTS ON/OFF DELAYS

RTS on and off delays are configured in the “MODEM” section of the “Connector” configuration menu, as well as the serial ports of the devices to which other leased-line modems are connected. Many times PLCs will not communicate with the Omnii-Comm unless there is a sufficient RTS on/off delay configured in the Omnii-Comm and the PLCs. Make sure that the “on” delay of the Omnii-Comm is greater than the “off” delay of other devices in the system, and vice versa.

OMNII-COMM TROUBLE SHOOTING TIPS

PROBLEMS & SOLUTIONS

1. Problem - The Omnii-Comm does not respond with the OmniiComm prompt when the return key is pressed in OmniiTalk.

Solution- The cable from the P.C. to Omnii-Comm Port 1 is not a null modem cable or thesmall black reset button on the Omnii-Comm was not pressed before the download attempt. It may help to cycle power on the Omnii-Comm and attempt downloading again. Make sure that RAM is active.

2. Problem - A "Start Poll" command is issued and the Active/On Line LED will not flash and the Error LED turns on.

Solution - There is a **fatal** configuration error in the Omnii-Comm configuration file. Make sure that the following are consistent between the Omnii-Comm and the devices it communicates with: error checking(CRC, BCC), baud rate, data bits, stop bits, parity, protocol, signal specification(RS-232, RS-422/485), etc. Make sure that the configuration program is saved correctly before downloading. Check error locations for error codes.

3. Problem - The Omnii-Comm starts to poll, but immediately turns on the Error LED, and there is no further polling activity from a port for up to 30 seconds, then another poll attempt is made and the same thing happens again.

Solution - There is a **minor** configuration error in the configuration file, or possibly a minor hardware problem such as a bad cable. Make sure that the configuration program is saved correctly. Make sure to use the correct cable, and that the cable is installed properly. Check to see if the Omnii-Comm and other devices in the system have valid addresses, and that there are no address conflicts. Check error locations for error codes.

4. Problem - The Omnii-Comm seems (by watching the TXD and RXD LEDs on the Omnii-Comm) to transmit a message to another device, but the other device does not respond back, or it responds with a message that the Omnii-Comm does not understand.

Solution - Similar solutions as to Number 3 above. This usually indicates a cable problem or an addressing problem. Also make sure that baud rates, signal specifications(RS-232, RS-422/485), etc, are the same between the Omnii-Comm and the devices to which it is connected. Make sure to issue valid commands to the Omnii-Comm and to other devices in the system. Check error locations for error codes.

SYSTEM ERROR MESSAGE DEFINITIONS

7.1 OBJECTIVES

This section describes the error codes encountered in the Omnii-Comm.

7.2 GENERAL INFORMATION

Error codes are stored as Hexadecimal words in the error locations defined in the configuration program(poll table & system error locations). If the error code originates from the Omnii-Comm, the high byte of the error word indicates the **PROTOCOL** of the communication link that has an error, and the low byte indicates the **SPECIFIC ERROR** that is occurring. If an error is being reported by a device that is connected to the Omnii-Comm, the high byte will have its most significant bit set and the error code returned from the device will be placed in the low byte. **Example**: Error code 0BF5 indicates that there is an error with Modbus communication, and there is no response from the remote unit within the configured timeout period.

7.3 ERROR CODES

PROTOCOL NUMBERS	
09	Modem
0B	Modbus
0C	Allen-Bradley DF1 Full-Duplex
0D	Square D
0E	MARC protocol
0F	Control Applications
10	Debug for SCI port
11	Reliance
12	Allen-Bradley DF1 Half-Duplex
13	Omron
14	3720 ACM
15	American Dynamics 2150
16	Dukane
17	Caterpillar
18	Dynalco TM 5000
19	Dynalco TEC 9000
1A	Tejas
1B	Conitel 2020

TABLE INITIALIZATION ERRORS	
10	illegal mode in header table
11	too many poll tables
12	illegal RTU type in poll table
13	illegal PLC type in poll address
14	different RTU types in poll table
15	wrong protocol selected
16	illegal RTU count
17	too many points configured
18	invalid info in poll table
19	data table byte count
1A	error in RAM check
1B	invalid port number
1C	error in database
1D	set CMD buffer full
1E	Gate Array Version
1F	attempt to write across 2 PLCs

1C GE Lighting
1D Modbus Report by Exception
1E Danload 6000
20 ASCII
21 Controlotron
22 Tennessee Gas
23 Data Aire
24 Liebert
25 CDC 44-560
26 Multi Port Monitor
27 Sutron
28 SCI CSNET
29 Sullair
2A Brite
2B Amocans

SPURIOUS INTERRUPT ERRORS

20	SPI
21	pulse accum input edge
22	pulse accum overflow
23	timer overflow
24	timer output compare 4
25	timer output compare 3
26	timer output compare 2
27	timer output compare 1
28	timer input capture 3
29	timer input capture 2
2A	timer input capture 1
2B	real time clock
2C	XIRQ
2D	illegal opcode
2E	COP fail
2F	COP clock fail

OMNII-COMM SYSTEM ERRORS

F0	stack error in TASKER
F1	illegal command to BLDCMD
F2	transmitter buffer full
F3	transmitter pointer queue full
F4	insufficient data returned from poll
F5	no response from remote within timeout
F6	unable to send - no CTS from port
F7	invalid state found in PTSTATE
F8	error in RTU message
F9	bad address in BLDCMD
FA	bad pointer in OUTQUE
FB	CA download error
FC	Modbus command queue full
FD	Conitel MCD State Error
FE	Bad Pointer (RWE PTR, PCB, etc.)

PORT/DRIVER INITIALIZATION ERRORS

30 illegal port
31 illegal protocol
32 error in SIO configuration file
33 wrong port or connector
34 no protocol defined for port
35 Illegal Parsing Instruction
36 Protocol Extension Table
37 Data size is not 2/4 bytes/element

MODEM ERRORS

40 invalid response from modem
41 insufficient data in modem response
42 Modem type not recognized
43 Init string invalid or too long

DRIVER I/O ERRORS

70 SIO parity, overrun, or framing error
71 CRC error code
72 received byte error count
73 receive buffer overrun
74 transmitter buffer overflow
75 illegal control code in received data
76 illegal char. in received message
77 illegal PLC address in received message
78 error in receiver state byte
79 error in xmitter state byte
7A error in timer state byte
7B error in received data
7C Square D link not established
7D Illegal command
7E Bad data returned

7F No data to return

FLOATING POINT ERRORS

81 floating point overflow error

81 floating point underflow error

85 division by 0 error

86 number too large or small to convert to integer

87 tried to take the square root of a negative number

88 Tangent of 90 degrees attempted

89 LOG or LN of negative number or 0

8A Arc Cosine not implemented

8B Arc Sine not implemented

8C floating point format error in ASCFLT

Miscellaneous Errors

50 Watchdog timer disabled

51 Error in timeout program

52 Caterpillar auto init failure

53 Error in state byte

54 Bad data or XD erect command flag or data

55 Queue empty

56 Post process procedure error