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Cellular Network Interface – 2 (CNI2) Operating and Installation Guide

Version: 1.01
Issued: May 3, 2010

--Preliminary -- Not Released -- Preliminary -- Not Released -- Preliminary --

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Contents

Figures

REVISION HISTORY

Version 1.00 April 23, 2010

- Initial release of draft document.

Version 1.01 May 3, 2010

- Redefined section breaks.
- Redefined some text styles to allow automatic inclusion into the table of contents.
- Added figure titles to all illustrations and added a list of figures after the table of contents.
- Moved battery regulations statements and warnings to the beginning of the document.
- Added an auto-date field to the cover sheet.
- Refined and added to the section that deals with programming the unit.

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"Metretek" is a reference to a business that produced data logging and telemetry products between 1977 and 2008. Metretek was acquired by Mercury Instruments in 2008. The Metretek name appears in this document as a reference to legacy products and protocols, which are still in use today.

For additional information or questions regarding Mercury Instruments, please contact a Product Support Specialist or visit our website.

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SYMBOLS AND ICONS.

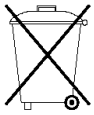
The following symbols may be found within the text of this document, or may be marked directly on the equipment.


Caution or Danger


Shock Hazard


Earth Ground Connection

Direct Current


Hazardous Waste Disposal


Denotes an information item


Denotes a user action item


Denotes an example line

Caution or Danger: Alerts the operator to special precautionary actions that may be required, or danger hazards that exist or have the potential to exist.

Shock Hazard: Alerts the operator to an electrical shock hazard condition that exists or could potentially exist.

Earth Terminal: Symbol that indicates earth ground. A copper rod buried in the ground is a common example of an earth ground connection, although these can take various forms. Reference your local electrical code regulations for detailed information.

Direct Current: Internationally recognized symbol that represents voltage in the form of direct current. A common example of a direct current (DC) source is an automotive car battery.

Hazardous Waste Disposal: Alerts the operator that the equipment or component thus labeled is not to be disposed of without special consideration to the hazardous waste that it contains. Compliance is necessary to ensure that national, state, and local community legal statutes are not violated.

Warning

This product contains a radio-frequency transmitter,
Motorola Model g24-L, FCC ID # IHDT56HQ1,
(GSM-Equipped CNI2)

The combined cable loss and antenna gain must not exceed +6.8 dBi (850 band), +1.9 dBi (900 band), +7.7 dBi (1800 band) or +2.2 dBi (1900 band). Total system output must not exceed 2.0W EIRP in the 1900 band in order to comply with the EIRP limit of 24.232.

The product must be installed in a manner that provides a minimum separation distance of 20cm (8") or more between the antenna and users and persons and must not be co-located or operate in conjunction with any other antenna or transmitter to satisfy exposure requirements.

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Warning

This product contains a radio-frequency transmitter,
Motorola Model c24, FCC ID # IHDT56JE1 ,
(CDMA-Equipped CNI2)

The combined cable loss and antenna gain must not exceed +5.3dBi (800 band). The combined cable loss and antenna gain must not exceed +4.2dBi and total system output must not exceed 2.0W EIRP in the PCS (1900) band in order to comply with the EIRP limit of 24.232(b).

The product must be installed in a manner that provides a minimum separation distance of 20cm (8") or more between the antenna and users and persons and must not be co-located or operate in conjunction with any other antenna or transmitter to satisfy exposure requirements.

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FCC Warning:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

IMPORTANT BATTERY INFORMATION

Caution

Disposal of lithium battery cells is strictly regulated in most areas as hazardous waste material. Consult your regional waste disposal authority to ensure full compliance with legal statutes when disposing of cells.

Warning

Transport of primary cell lithium batteries (even when fully discharged) of this type is strictly forbidden on passenger aircraft. Cargo shipment of batteries via UPS, FedEx, etc., requires special shipping containers, packing, and paperwork to be completed.

Domestic Requirements

Class-9 is a general class designation by the DOT and has specific packaging instructions. Lithium primary cells are 'Class-9' if they contain more than 5.0 grams of lithium. This is applicable to the lithium battery packs intended for use with the CNI2.

Specific requirements are applicable to Class-9 shippers:

Product handlers must be tested and certified. Packaging must meet Group II requirements and boxes must be tested by UN specification. Packaging must be clearly marked to indicate:

Lithium batteries, UN3090, PG II, Number of packages, Emergency phone number, Shipper certification.
MSDS information must also be included within the package.

Additional requirements may apply, or come into force in the future. Please confirm all requirements in advance with your shipper.

CNI2 OVERVIEW

The Honeywell CNI2 is a pulse accumulator (data logger) and serial data communications product with an integral cellular radio transceiver. Pulse signal inputs (dry contact) and alarm inputs can be supplied from an external electronic corrector or other measurement device. An index base option with both a mechanical index display and pulse switch output is available. Serial data communications with a corrector or similar instrument are also possible using either an RS-232 or RS-485 connection.

A variety of power options are also available. These include alkaline battery, lithium battery, or an external source such as solar or AC mains.

CNI2 FEATURES

- Numerous pulse counting inputs and alarm trigger inputs are supported.
- Optional meter index base enables direct mounting onto a gas meter.
- Several mounting options provide flexibility to mount to a wall, pipe, meter, etc.
- Cellular radio service options include conventional GSM and CDMA. Additional radio options are also available to service special market needs.
- The internal antenna feature conceals the nature of the wireless device. Where signal strength is a concern, external antenna options are also supported.
- Various power options are available, including alkaline battery, lithium battery, or connections for external sourced power. External power can be either AC mains or solar.
- The enclosure is field proven durable and UV resistant against weather effects.
- Over-the-air firmware update capability allows for new feature enhancements as they become available.

CERTIFICATIONS

- CSA Hazardous area certification, Class I, Div-2, Group-D
- PTCRB cellular network approvals
- FCC Part 15(B), 22, 24
- Measurement Canada Metrology
- Operational temperature range -22 to +158 F (-30 to +70 C)

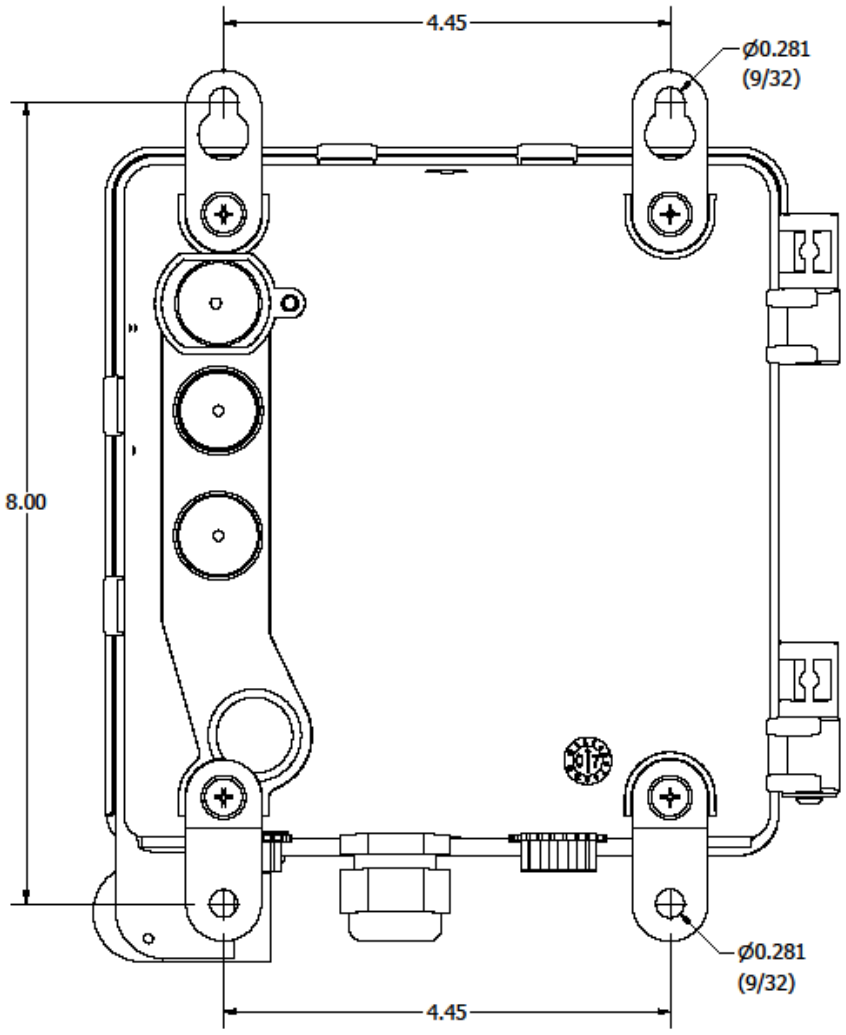
MECHANICAL ASSEMBLIES

INSTRUMENT MOUNTING OPTIONS

A number of options are available for convenient installation of the CNI2 product. These should be clearly specified at the time of order to ensure that the field technician has everything he or she needs to install the product.

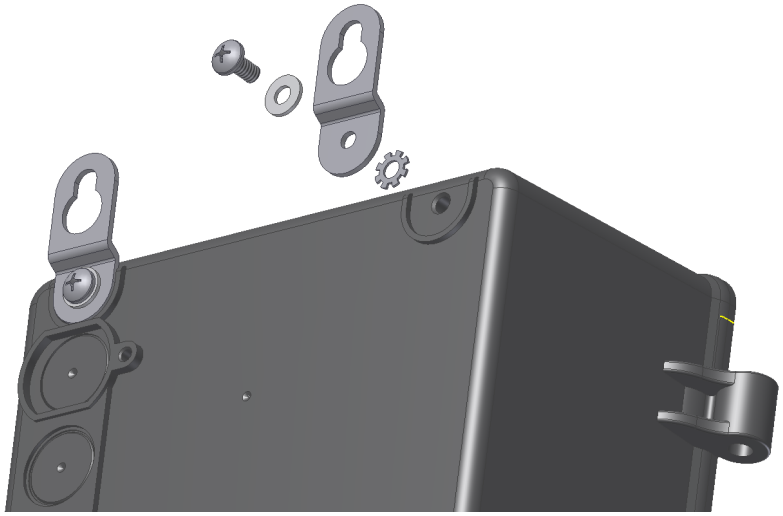
WALL MOUNTING

Where a flat wall surface is available, such as on the side of a building or shed, stainless steel "hangers" can be utilized. Illustrated below is the rear view of a CNI2, along with associated mounting dimensions.



Wall Mounting Tabs and Dimensions

Assembly sequence for the backside hangers is shown in the illustration below. The lock-washer contacts directly with the enclosure, then the hanger, the flat washer, and lastly the screw to secure. Tighten the screw until snug, but do not over-tighten.

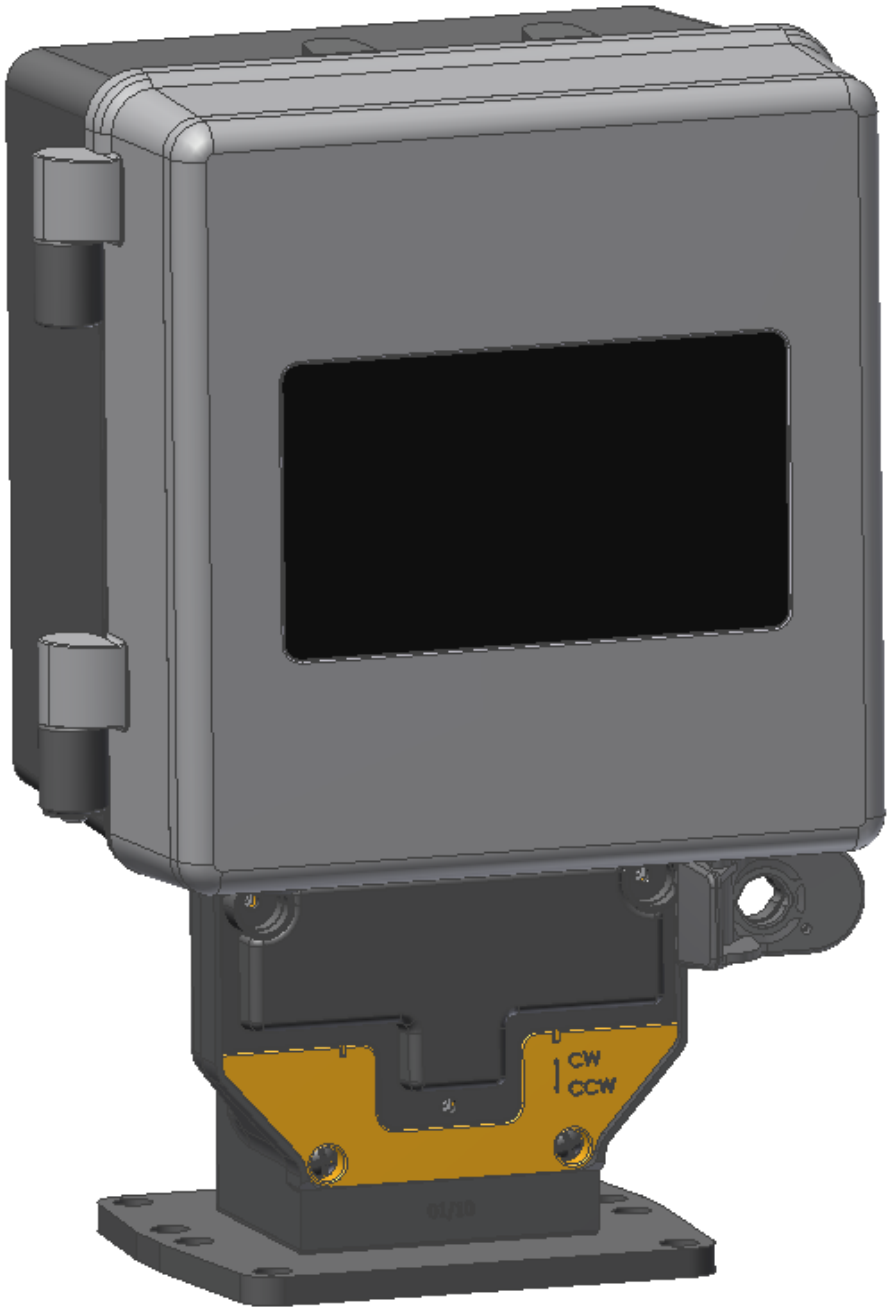


Wall Mount Hangers Assembly Sequence

METER INDEX BASE

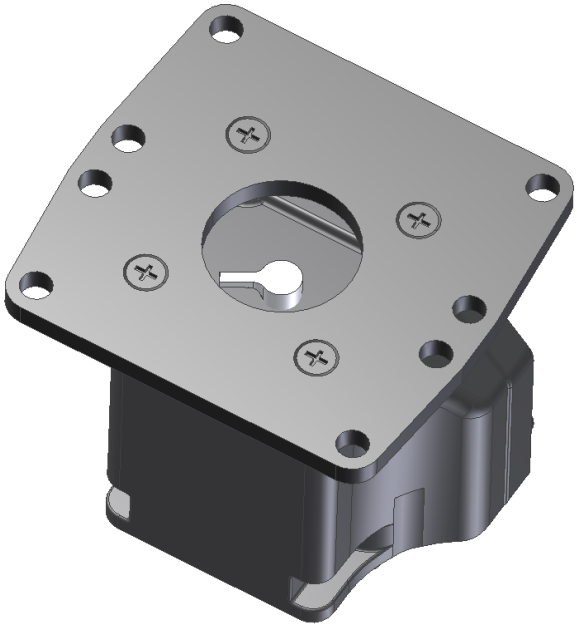
Where it is desired to have an index base mounted directly to a meter, the UMB (Universal Mounting Bracket) option is available. The advantages of this package are that the entire instrument can be mounted without any concerns about routing external meter pulse signal wires. Mounting of the UMB index base is possible on rotary, turbine, and diaphragm gas meters that have a rotating instrument drive output. This includes American, Rockwell, Romet, Roots, or Schlumberger meters.

The UMB housing may be rotated about the base plate so that the instrument and index will face in any of the four directions. Remove all four screws which attach the base plate to the bracket housing. Replace and tighten the four screws after you have repositioned the UMB housing.



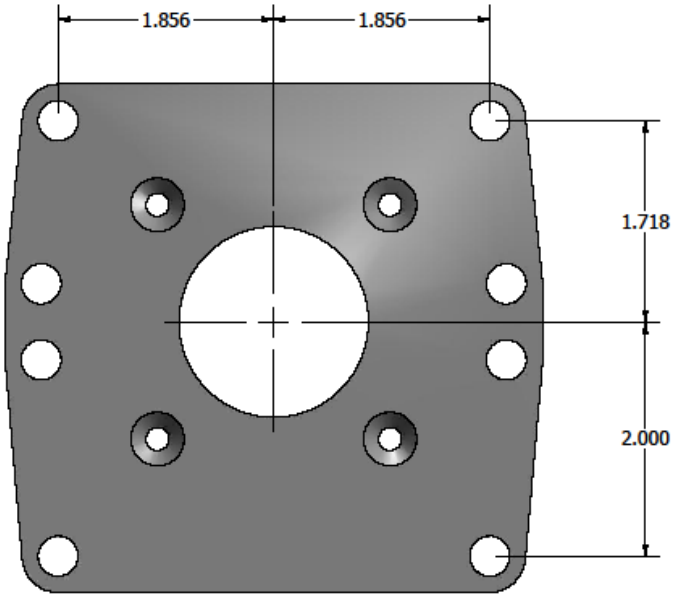
CNI2 with Universal Mounting Bracket (UMB)

The bottom side of the UMB meter index is seen below, along with the ‘wriggler’ mechanism.



Bottom View of the Universal Mounting Bracket (UMB)

The following illustration provides reference dimensions for the base plate.



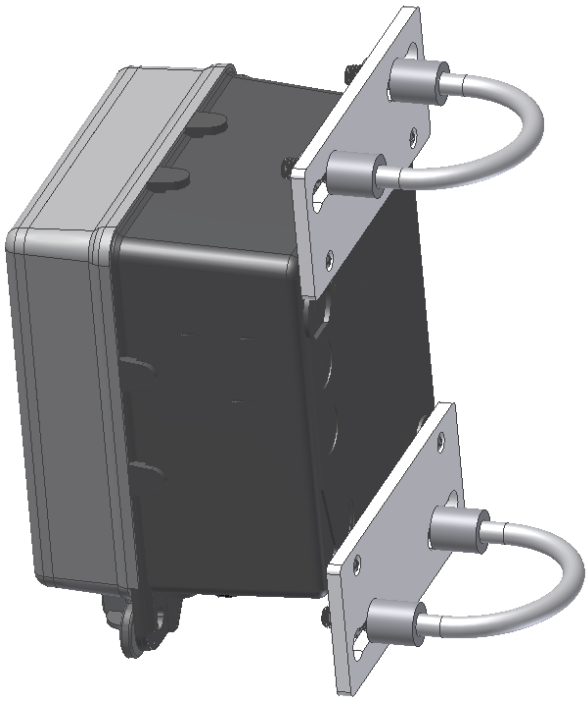
Universal Mounting Bracket (UMB) Hole Pattern

VERTICAL PIPE MOUNTING

Another mounting option available for the CNI2 is the pipe-mount. This adaptor will accept a 2 ⅜" (2.375") diameter galvanized pipe, and is secured in place with a pair of Allen-head set-screws.

Pipe Mounting using Collar

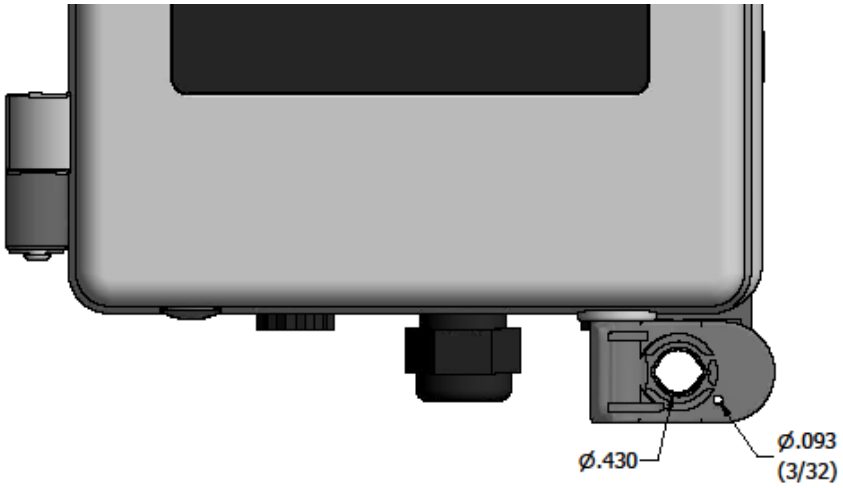
Illustrated below is a U-Bolt mounting option. This is optimized for metal pipe with an outside diameter of 2 ⅜" (2.375").



Pipe Mounting using U-Bolts

ENCLOSURE SEALING

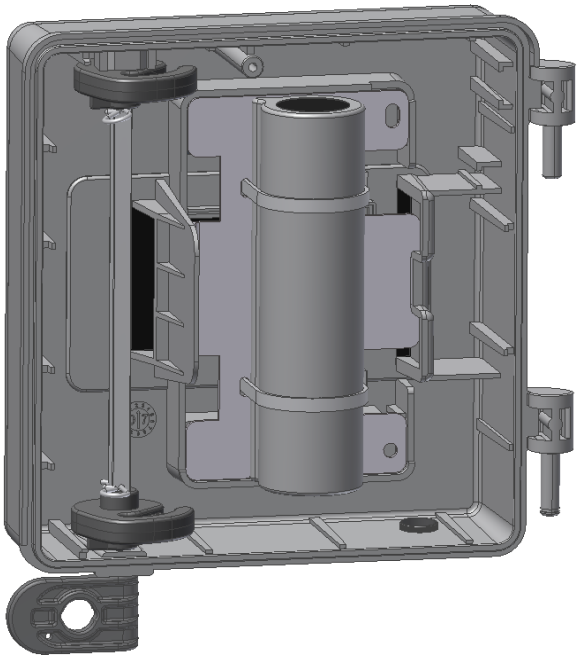
Sealing of the enclosure is readily accomplished using either a conventional lock through the larger hole or a security wire seal through the smaller hole.



Enclosure Sealing Options

INTERNAL BATTERY POWER OPTIONS

Several battery configurations are available to best serve the particular applications. Shown below is the dual-cell lithium power pack. This pack inserts onto the enclosure door with the right-side of the metal plate tilted inwards first, and then snapping secure on the left side. Removal is the opposite, and it is a simple matter of pressing outwards against the plastic lever.



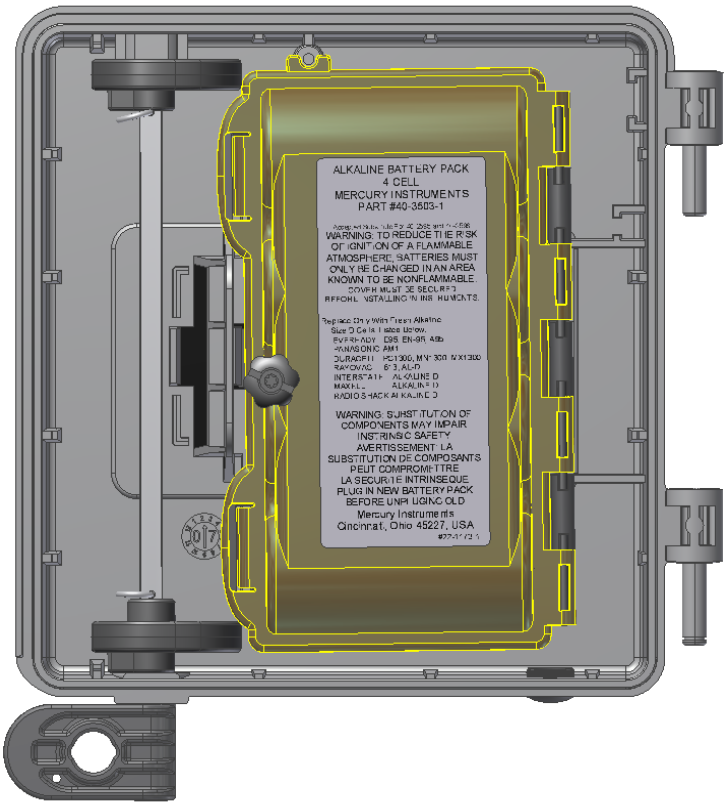
Lithium Battery Pack Mounting

A larger quad-cell lithium pack is also available for double the capacity of the dual cell type. Refer to the specifications section at the end of this manual for a comprehensive listing of battery pack options their part numbers.

Alkaline battery packs are available in either disposable form, or with a molded plastic housing that permits direct replacement of individual cells. The illustration below shows the plastic housing model mounted onto the enclosure door. Although the molded battery housing has a higher initial cost, it offers the advantage of replacement cell availability from numerous local suppliers.

NOTE

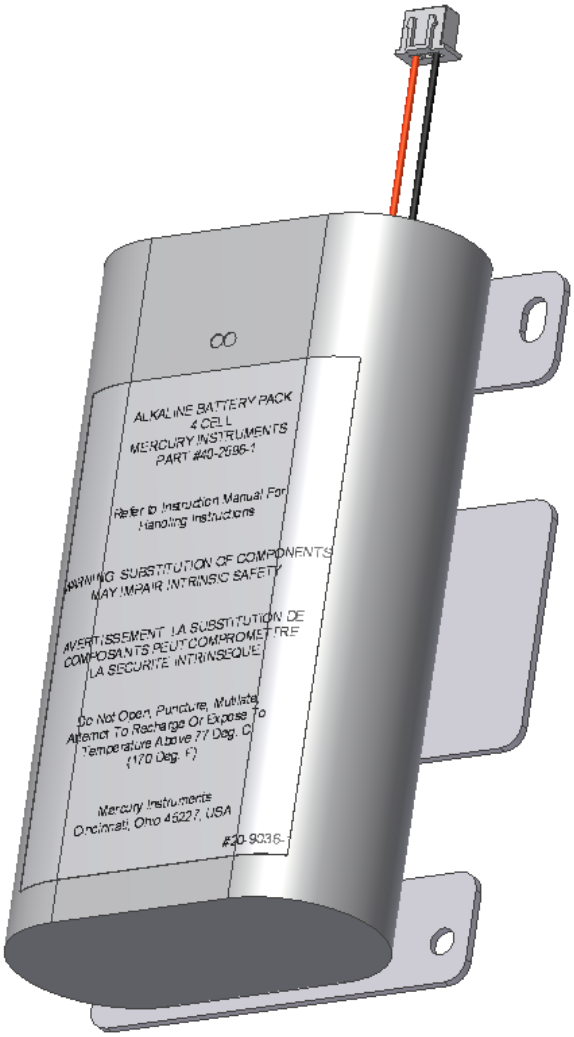
When replacing alkaline batteries, only use new fresh cells from the same supplier and having equivalent part numbers.



Alkaline Battery Pack Mounting

Alkaline cells are also available in a completely disposable package option. After the service life of the battery pack has expired, the user simply disposes of the entire assembly, including the metal bracket.

Refer to the specifications section of this manual, or the control drawing for a compiled listing of approved battery packs.



Disposable Alkaline Battery Pack

To avoid loss of system power to the CNI2 board during battery changes, it is recommended that the fresh batteries be connected to the available J1 or J2 connector before removal of the old battery pack. This is a hot swap method that is permitted for the brief period during which batteries are to be replaced.

IMPORTANT NOTE

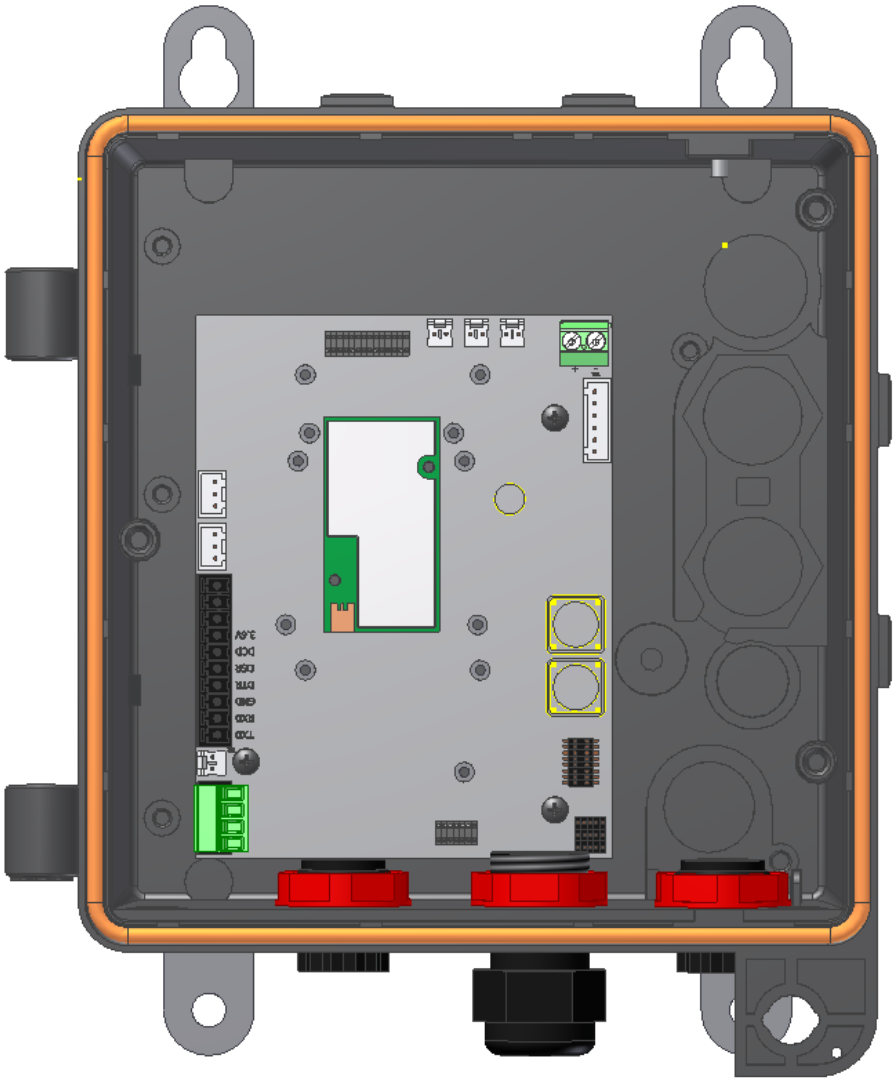
Physical space is not available within the enclosure to permit two battery packs to be permanently installed simultaneously. In addition, parallel battery packs would violate hazardous area safety approvals for this product.

INTERNAL CIRCUIT BOARDS

The following is a brief summary of the CNI2 internal circuit boards and various options. Specific details of each board or option are described in more detail later.

CNI2 Board

Illustrated below is the CNI2 board with the cellular radio in the center, and various connectors around the perimeter. This represents the most common model that is supplied with no accessory boards and no index base.

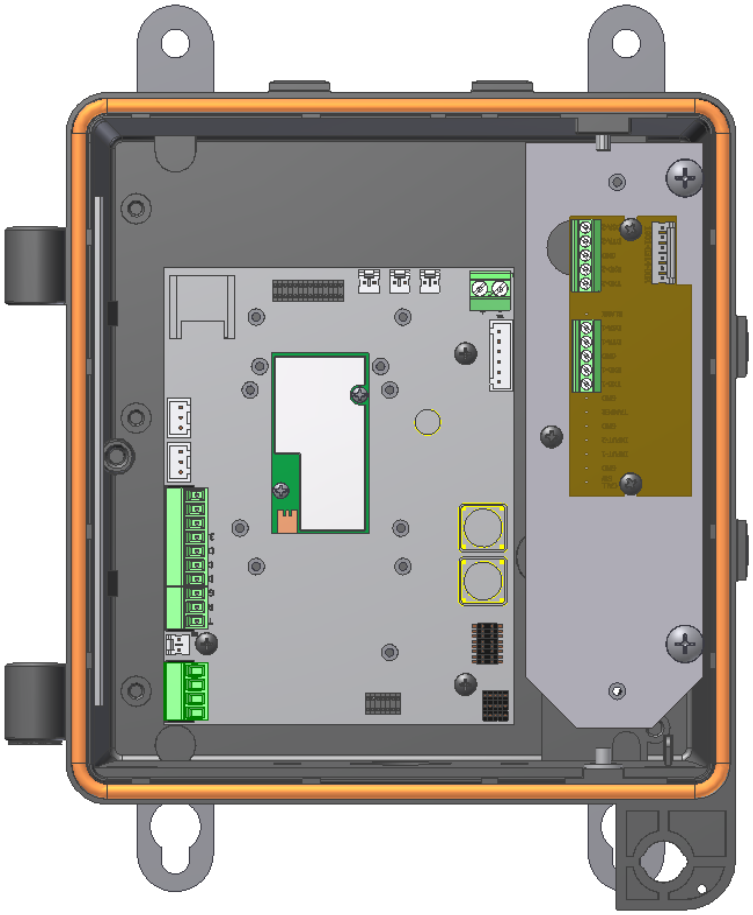


CNI2 Board Orientation

Serial Port Multiplexer Board

One of the accessory board options available is the serial port multiplexer. This enables the CNI2 serial data port to access two external devices (electronic correctors for example). Two terminal blocks provide the connection point for serial data cable.

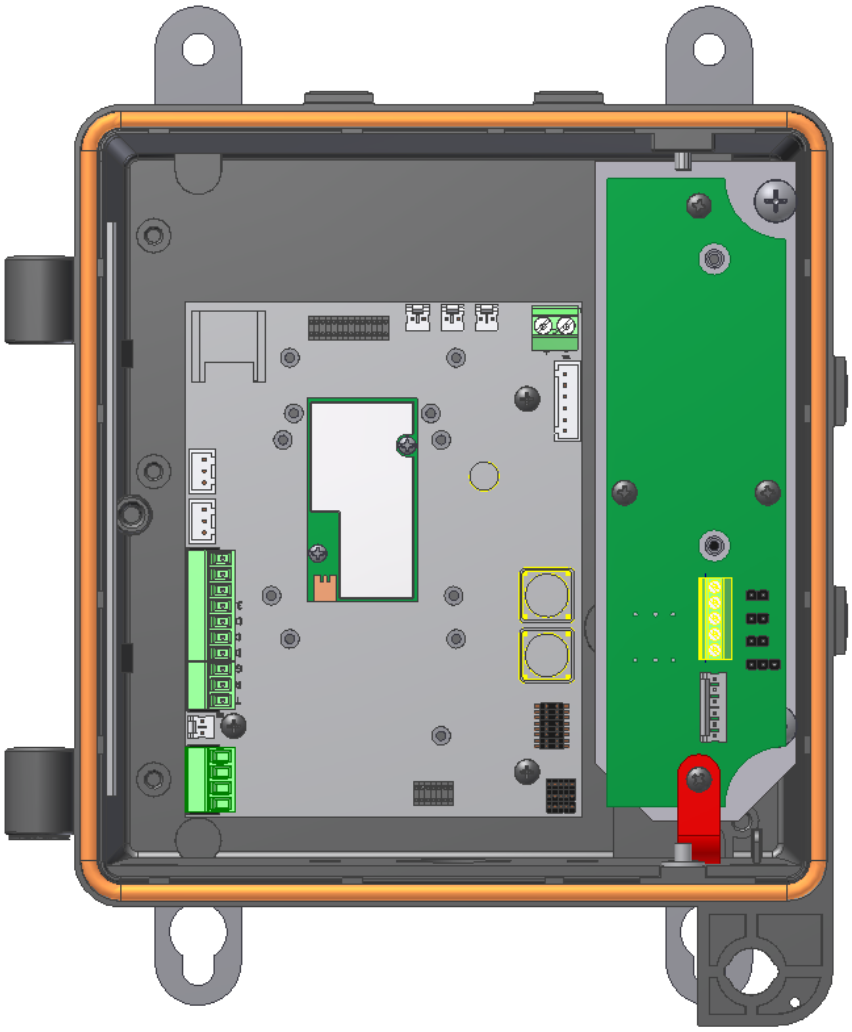
A metal base plate is included for the purpose of securing the board into position as seen in the illustration.



CNI2 Board and Multiplexer Board

RS-485 Serial Data Converter

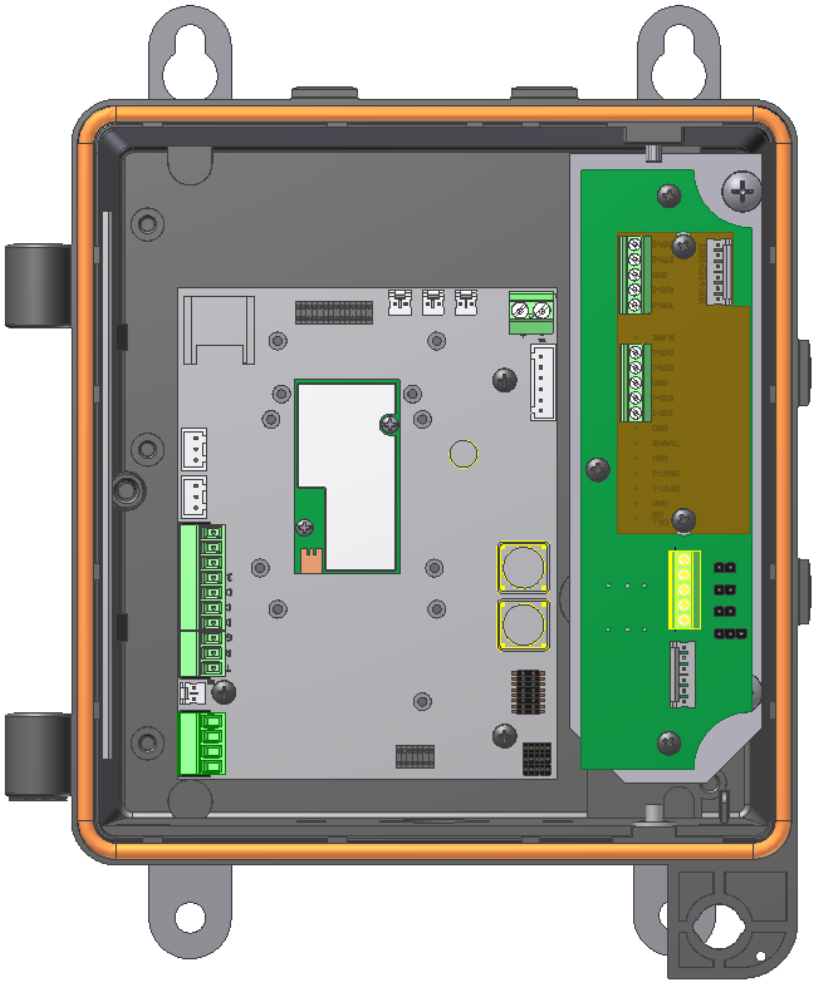
Another accessory option available is the RS-485 conversion board. RS-485 is somewhat similar to the RS-232 standard in that it is a wired transmission line for serial data exchange. The RS-485 standard offers several advantages over RS-232 in terms of cable length distance, noise immunity, multi-node drops, etc.



CNI2 Board and RS-485 Board

Serial Multiplexer & RS-485 Boards

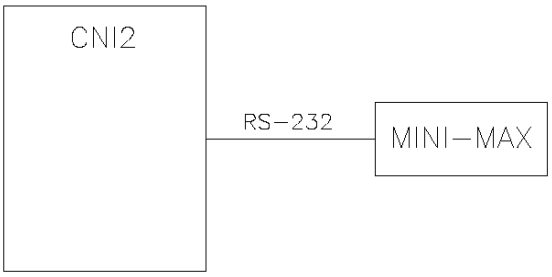
It is possible to support both the RS-232 serial data transfer and RS-485 transfer by switching channels with the multiplexer board. An example of where this might be of value is when there is a corrector that requires an RS-232 data link, and a pressure transducer that requires an RS-485 connection. Take note however that serial data exchange can take place only on a channel at a given time.



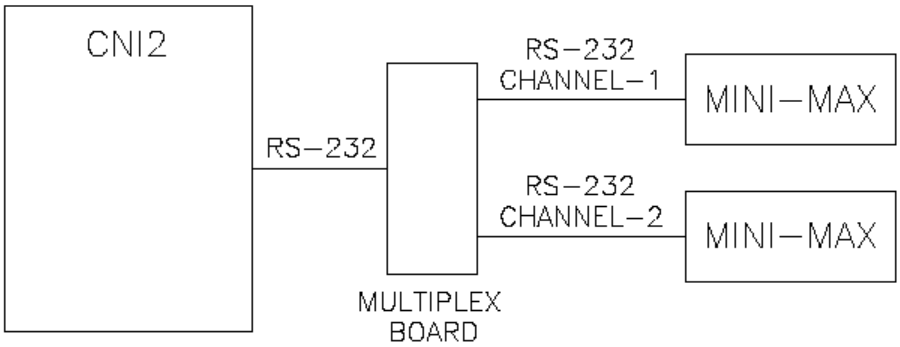
CNI2 Board with RS-485 Board and Multiplexer Board

Summary of Serial Data Connection Scenarios

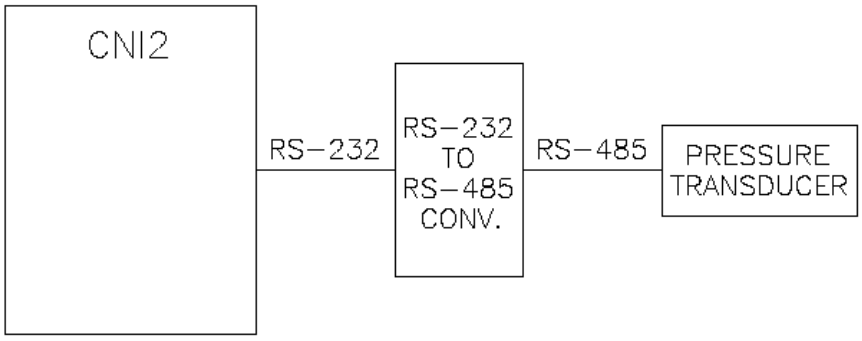
The simple block diagrams below provide an overview of serial data connection possibilities for the CNI2. For the sake of convenience, end devices are shown here as being a 'Mini-Max' corrector and a 'Pressure Transducer'. The Mini-Max has an RS-232 port and the Pressure Transducer has an RS-485 port.



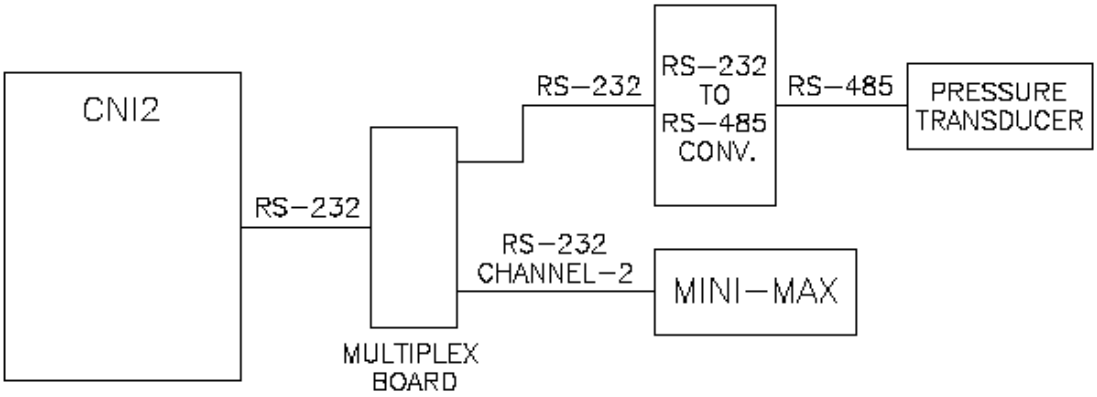
CNI2 with single RS-232 connection to external instrument



CNI2 with multiplexer board to support two serial data links



CNI2 with conversion board to interface to RS-485 capable instrument

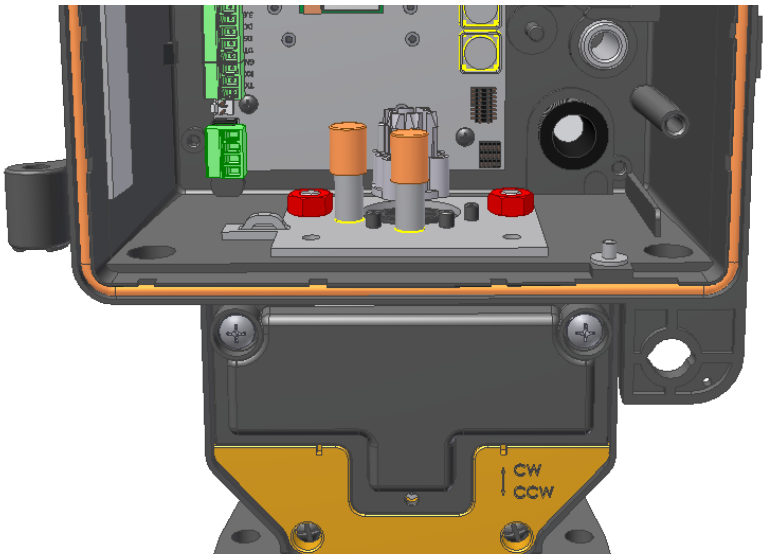


Configuration using both RS-232 & RS-485 options

CNI2 INDEX BASE

When the UMB index mount option is included with the instrument, a rotating magnet and several magnetic sensor switches will be present inside the enclosure as seen below. For convenience, wires from the sensor switches are pre-wired from the factory to the pulse counting input terminal block TB4. In the unlikely event that one of the two reed switches should fail, the redundant input channel will continue to register accurate counts.

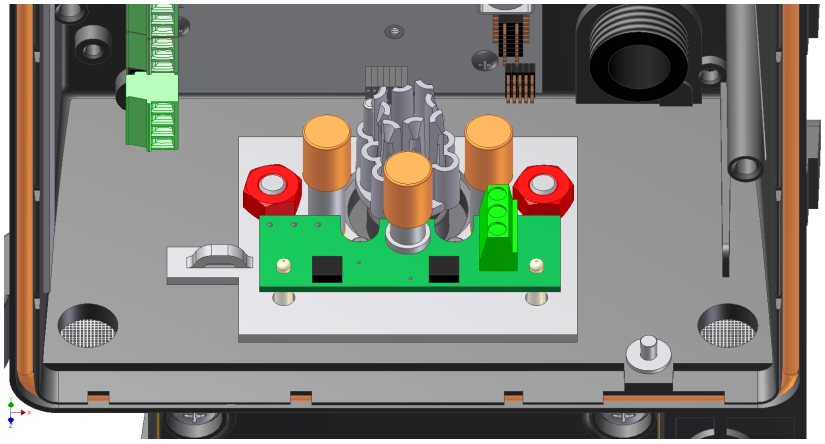
The illustration below shows the CNI2 with the rotary magnet and dual reed switches.



Index Base with Magnetic Switches

For the sake of clarity this illustration does not show the routing of wires from the sensor switches.

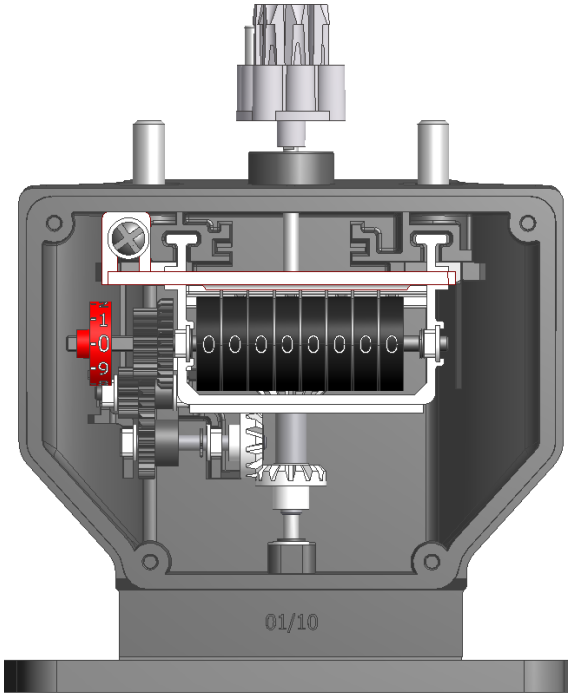
Another option is the Uncorrected Pulse Output board, as seen below. This provides an additional dry-signal pulse output that allows for connection to an external pulse counting instrument.



Pulse Output Board

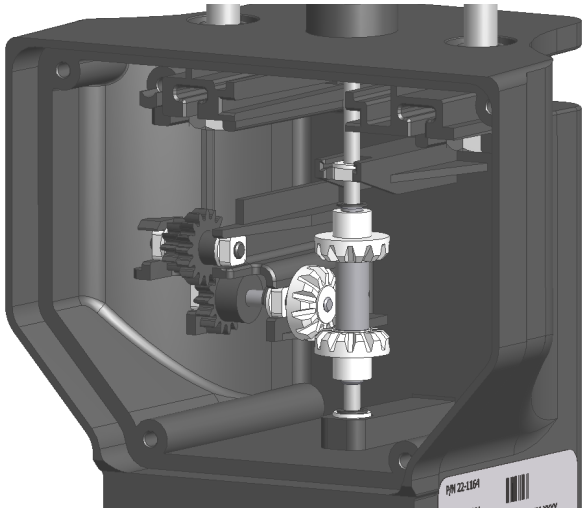
For the sake of clarity this illustration does not show the routing of wires from the sensor switches.

Illustrated below is the UMB index without the front covers or enclosure housing. To change the direction of rotation, it is first necessary to remove the odometer. This is accomplished by removal of the screw in the top left corner, after which the odometer pulls straight out.



Internal View of the Index Base

A small Allen wrench tool is included with the index. Loosen the set screws on the top and bottom miter gears and swap the gear that engages. Shift the gear set upwards for meters with CW rotation and down for meters with CCW rotation. See the gear detail drawing below. After the gears are securely set, check for good gear engagement that is neither too loose (causing gear skipping) or too tight (causing gear binding). Then reinstall the odometer.



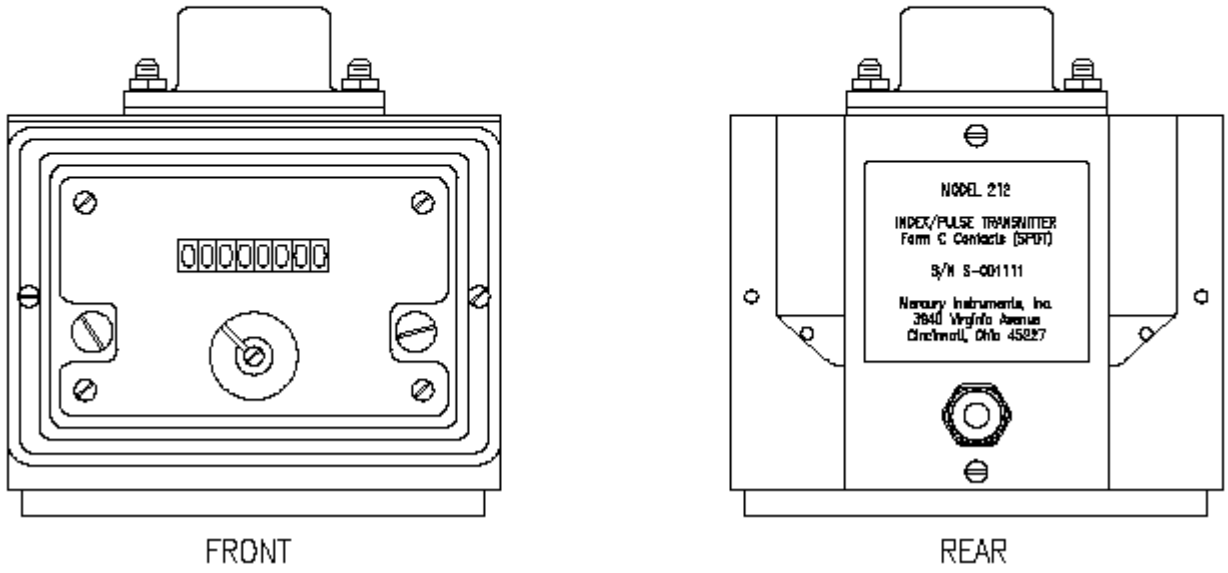
Rotation Gears within the Index Base

As a final note, it is also possible to change the number of digits visible on the mechanical odometer using horizontal sliding “windows”. Up to three digits can be masked-off from the right side, and/or up to three digits from the left side.

OPTIONAL REMOTE PULSE TRANSMITTER

Some applications may not be suitable for a direct mount index on the CNI2 enclosure, due to available space or other reasons. Where this is the case, Honeywell also offers a remote pulse transmitter with mechanical index display. Pulse switch wiring can then be routed into one of the cable fittings on the CNI2 enclosure.

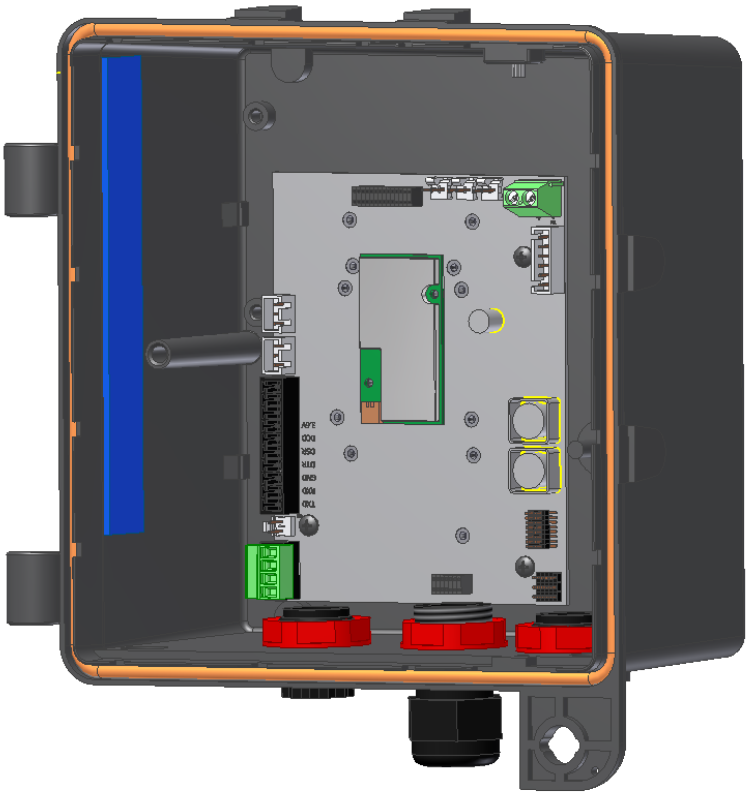
Contact a Honeywell Product Support Specialist for additional details and ordering options.



Remote Pulse Transmitter

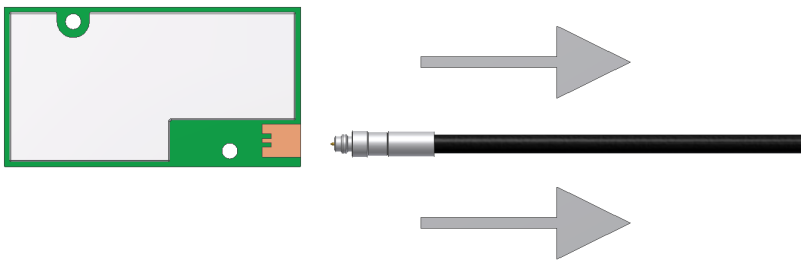
ANTENNA OPTIONS

For the majority of site installations the most convenient and cost effect choice are CNI2's with the internal cellular antenna as seen in the illustration below. This is a five inch length rectangular shaped circuit board (light blue color) that is mounted directly to the left inside wall of the enclosure. Connection to the radio is via a short coaxial cable with an 'MMCX' type connector on the end.



Location of the Internal Antenna

If it becomes necessary to disconnect the cable from the cellular radio, take care to firmly grasp the metal end of the MMCX connector housing and pull straight out. Never pull directly on the cable itself or bend the connector.



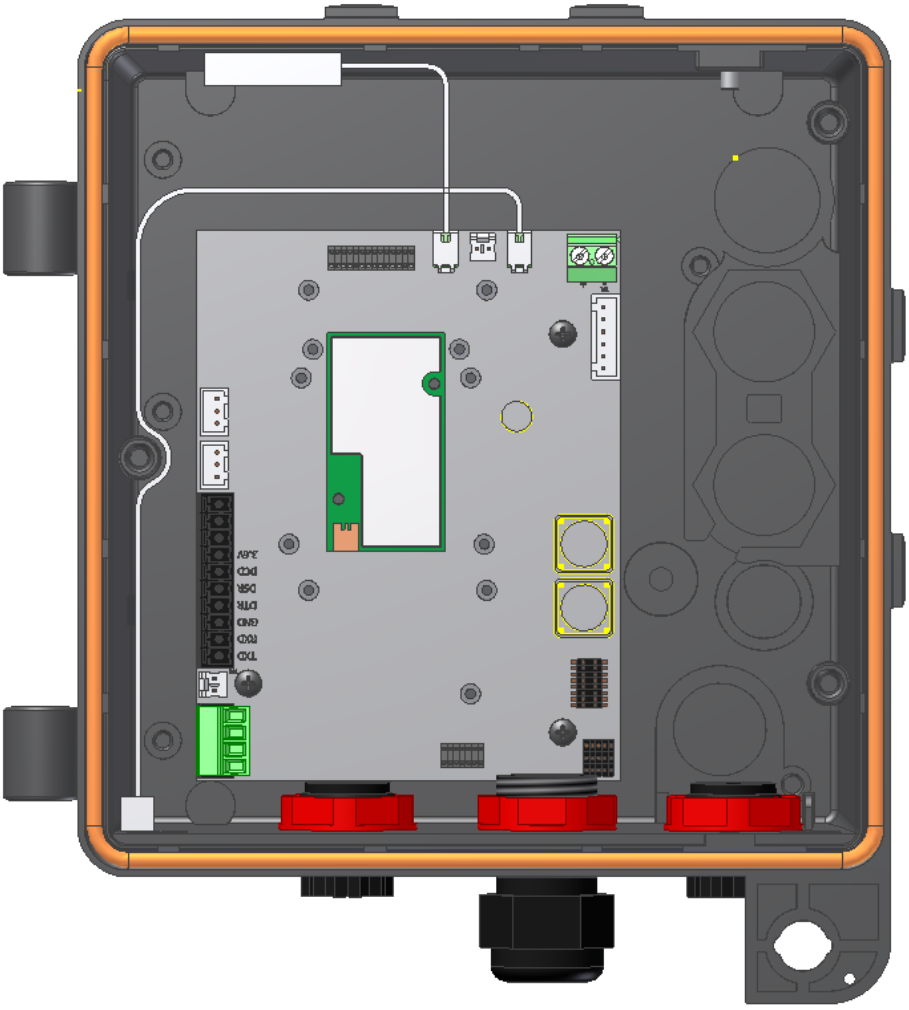
Antenna Connection to Radio Module

Where cellular signal reception is problematic, due to either terrain or proximity to cellular towers, it may be necessary to utilize an external antenna instead. This option is available in the form of a bulkhead N-Fitting (jack or female) mount as seen in the illustration. An external antenna can then be elevated as required and directionally pointed to the nearest cell tower.

Bottom View with External RF Connector

TAMPER DETECT & CALL SWITCH OPTIONS

The figure below illustrates where two magnetic detect switches have been added to the CNI2. At the bottom left corner is a seen a small white magnetic switch which has been wired into the J9 connector. This enables a field technician to swipe a hand-held magnet wand (part no. 20-7286) near bottom left side with in order to initiate a call. In cases where the CNI2 enclosure is sealed with a lock or wire seal, this form of call trigger is very convenient.



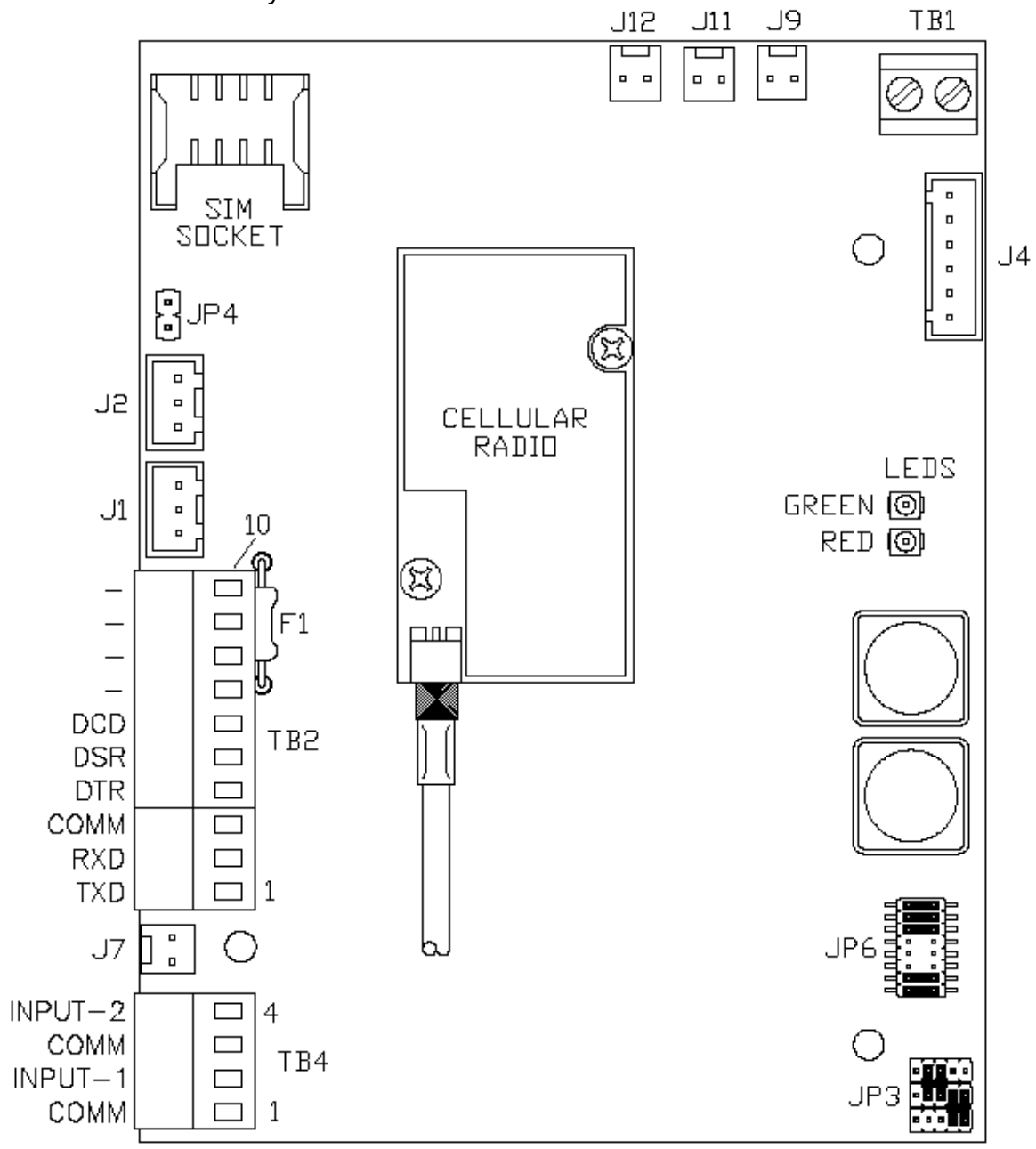
Location of the TAMPER and CALL Switches

The TAMPER switch is seen in the upper left-hand corner. Not shown is an actuating magnet attached to the door. When the door is opened the switch activates and can generate an immediate call into the central office, or the event will be reported on the next scheduled call.

ELECTRICAL ASSEMBLIES

CIRCUIT BOARD CONNECTORS & JUMPERS

This chapter identifies the locations of important components, connection points, and jumpers on the CNI2 and accessory boards.



CNI2 Circuit Board Layout

Cellular Radio Module

The cellular radio module is manufactured by Motorola and will be either a g24-L (GSM) or c24 (CDMA). It is possible to remove and install a new module in the event that the original module fails. Two small screws must be removed first, the radio pulled straight away from the board, and the nylon spacers retained for later use. This type of operation is best performed within an office setting, and even then only when absolutely necessary. The high density electrical connector on the radio is delicate and can easily be damaged unless great care is taken during insertion and removal.

SIM Card Socket

This connector holds the cellular radio SIM card for GSM-equipped models of the CNI2. SIM cards are not required for CDMA radios.

Reset Jumper JP4

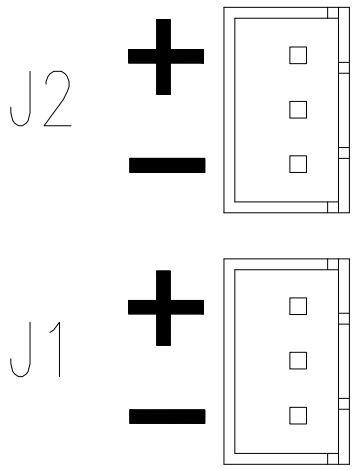
If it is necessary to perform a complete reset operation, use a small blade screwdriver or coin to short out the two pins of JP4.

⚠ Caution:

A reset will cause all pulse data to be lost and the unit's time-of-day to be reset. This will cause the CNI2 to call the data collection system to report a "Unit Reset" alarm. When possible, first place a call to download accumulated interval data to the central office prior to performing a reset.

Power Connectors J1 & J2

These connectors are intended for connection to power sources. Both connectors are identical in function, and allow for the hot-swap of batteries without the loss of power to the CNI2 board.



J1 and J2 Power Connectors

Terminal Block TB2

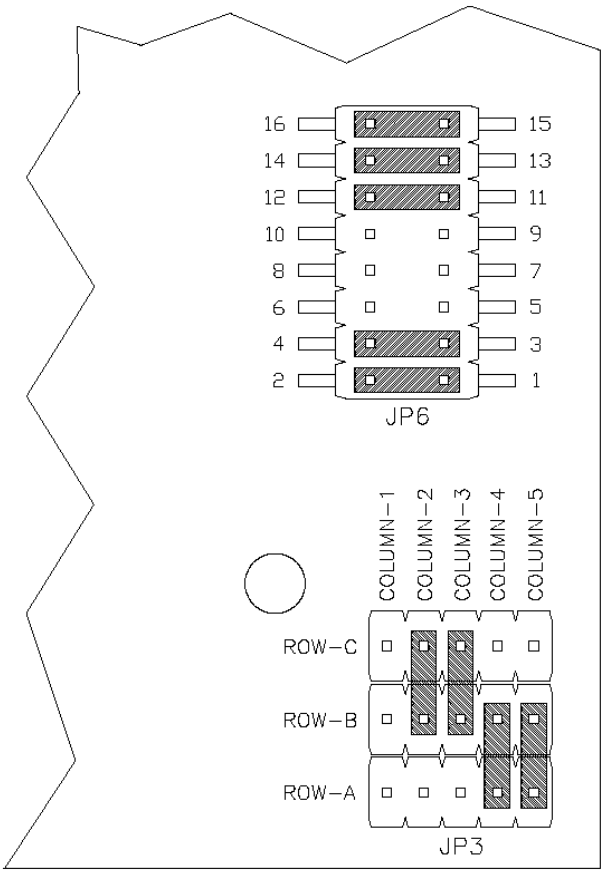
Terminal block TB2 provides for connection to the RS-232 serial port of the CNI2. This connector will be prewired at the factory whenever RS-485 adaptor or a RS-232 multiplexer board is installed. There is more information about the serial port later in this document.

Terminal Block TB4

Terminal block TB4 is the connection point for pulse-counting or alarm-sensing inputs. If an index base is provided with the CNI2 then this connector will be prewired at the factory.

JP3 & JP6 Jumper Settings

Factory default settings for JP3 and JP6 are illustrated below. Manipulation of these jumpers allows for special operating modes and test functions. Normally the default settings will not be altered unless under direct guidance from a Product Support Specialist or perhaps a customized retrofit kit supplied by Honeywell.



Configuration Jumpers

JP6	JUMPER OUT	JUMPER IN
1-2	Not used (storage for spare jumper)	Not used (storage for spare jumper)
3-4	Not used (storage for spare jumper)	Not used (storage for spare jumper)
5-6	***** Enables normal operation**	Enables factory test mode
7-8	Not used (storage for spare jumper)	Not used (storage for spare jumper)
9-10	***** Directs programming cable to Main Processor**	Directs programming cable to Auxilliary Processor
11-12	Disconnects on-board pull-ups for digital lines 1, 2, 3, 4, 5 and 8.	***** Connects on-board pull-ups for digital lines 1, 2, 3, 4, 5 and 8.**
13-14	Disconnects on-board pull-ups for analog input lines 1 thru 6.	***** Connects on-board pull-ups for analog input lines 1 thru 6.**
15-16	Disconnects on-board pull-ups for digital lines 6 and 7.	***** Connects on-board pull-ups for digital lines 6 and 7.**

***** = Recommended setting**

Jumper Block JP6 Settings

JP3	A-B	B-C
1	Not used (storage for spare jumper)	Not used (storage for spare jumper)
2	CNI2 wakes up on change in DTR serial input line	***** CNI2 wakes up on change in RXD serial input line**
3	+3.3V / 0V non-inverted RXD input on serial port.	***** ±5.5V inverted (RS-232) RXD input on serial port.**
4	***** Allows CNI2 to shut-down the on-board 3.6V regulator when not needed.**	Permanently enables the on-board 3.6V regulator. Normally only used for factory testing or special applications.
5	***** Allows CNI2 to shut-down the on-board 3.6V regulator when not needed.**	Permanently enables the on-board 3.6V regulator. Normally only used for factory testing or special applications.

***** = Recommended setting**

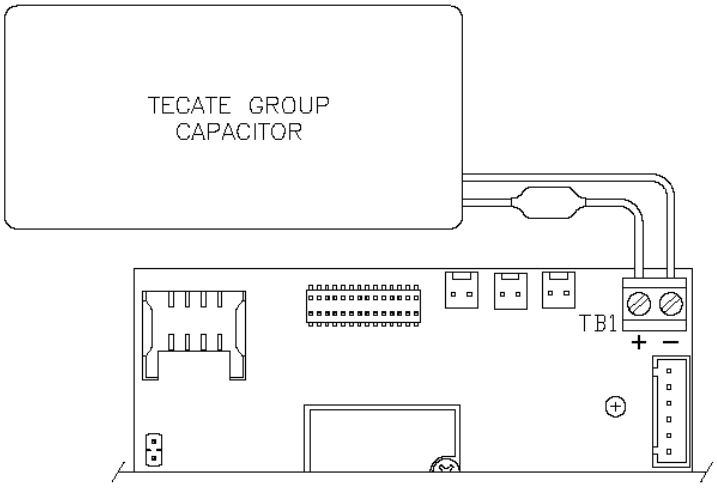
Jumper Block JP3 Settings

Connector J4

This connector provides direct access when performing a firmware download or configuration change when using the MP32 software and programming cable.

Terminal Block TB1

This terminal block is pre-wired to a high density reserve capacitor as illustrated below. Normally this connection will not be altered, unless under special circumstances and instructions from Honeywell.



Capacitor Connection to TB1 (prewired)

Connector J9

The default function of J9 is to serve as a CALL trigger input. Activation of this input will cause the CNI2 to immediately call the central office. Circuit connection is intended for a “dry” contact switch, meaning that it is a simple switch (or transistor) with no drive voltage. In most cases this will be pre-wired at the factory to a magnetic sense switch.

This line can also be configured as an additional alarm-sensing input, a pulse-counting input or as an output.

Connector J11

The default function of J11 is to serve as a power failure report input. This is useful for AC mains applications where the loss of power can be reported to the central office. Circuit connection is intended for a “dry” contact switch, meaning that it is a simple switch (or transistor) with no drive voltage.

This line can also be configured as an additional alarm-sensing input, a pulse-counting input or as an output.

Connector J12

The default function of J12 is to serve as a tamper detect input. If the TAMPER option is ordered then this alarm will trigger any time that the enclosure door has been opened. The CNI2 can be configured to place an immediate call to the central office when this occurs, or to simply report the event on the next scheduled call. Circuit connection is intended for a “dry” contact switch, meaning that it is a simple switch (or transistor) with no drive voltage.

This line can also be configured as an additional alarm-sensing input, a pulse-counting input or as an output.

Connector J7

There is no default function for J7. It can be configured as an additional alarm-sensing input, a pulse-counting input or as an output. Circuit connection is intended for a “dry” contact switch, meaning that it is a simple switch (or transistor) with no drive voltage.

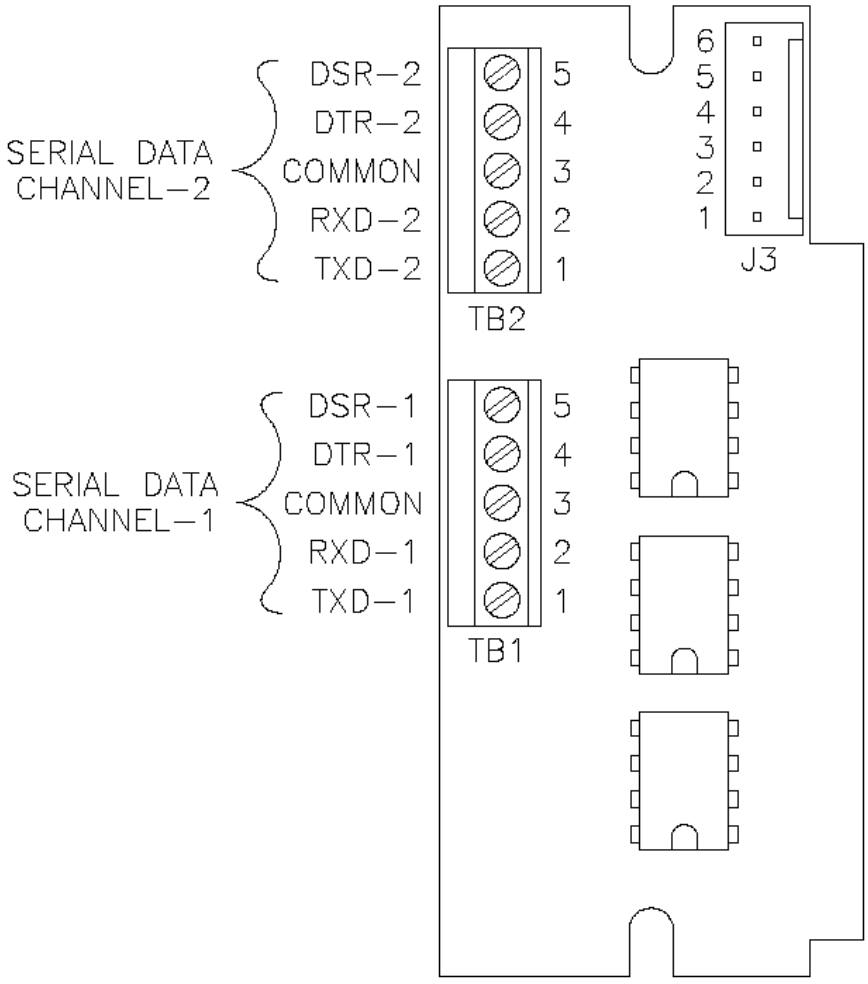
It can also be defined as a “Special Purpose Output” which allows the CNI2 to use this line to control some internal function. This is described in more detail later in this document under the heading “*Special Purpose Output*”.

RS-232 MULTIPLEXER BOARD

The RS-232 multiplexer is shown below. The connector J3 is pre-wired at the factory to the CNI2 board. When the RS-485 board is not included with the assembly then both serial ports are available for connection to external devices. An example might be two ECAT electronic correctors at a field site.

If the configuration has both the multiplexer board and the RS-485 as part of the system, then only terminal block TB2 is available for wiring to an external RS-232 device. TB1 will have been pre-wired to the RS-485 board, which has its' own connector for external wiring to an RS-485 compatible instrument.

Please note that the TXD line is a driven output, RXD is an input, DSR is a driven output, and DTR is used as a wakeup trigger. The following page describes the DTR function and wiring connection in more detail.

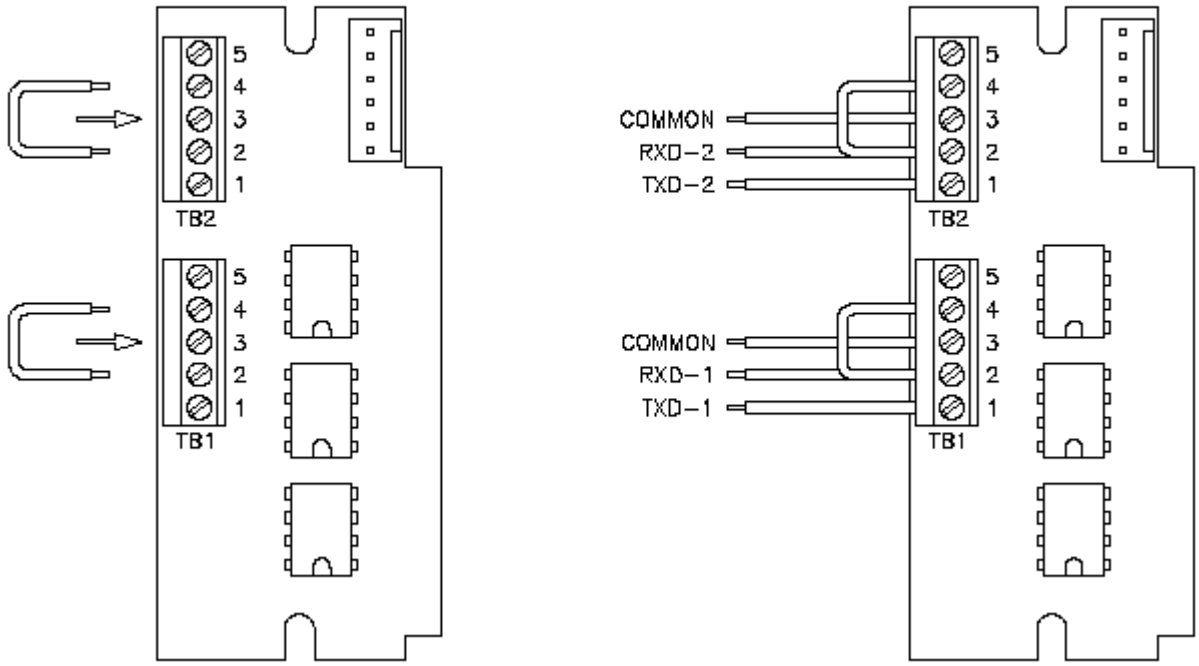


Serial RS-232 Multiplexer Board

In many cases the CNI2 is powered by a battery. It is necessary to minimize power consumption whenever possible. The multiplexer board is based upon opto-isolators that consume power when enabled. For this reason the multiplexer board is not powered except when in the process of active data exchange. This presents a problem in that the CNI2 will not be able to detect serial communications activity when the multiplexer board is powered down.

A simple method to resolve this is to wire the RXD signal coming from the external instrument in parallel with both the RXD line and DTR input line. The multiplexer board is able to detect serial data flow on the DTR line, even when in low power mode. This then enables the CNI2 board to wake from low power mode, drive the multiplexer board, and subsequently receive serial stream data.

The illustration below shows where the jumper wire is to be installed across the terminal block positions 2 & 4.



Wiring to the Serial RS-232 Multiplexer Board

NOTE

The addition of a jumper wire as seen above is only required on the multiplexer board itself. A jumper wire should not be installed directly on the terminal block of the CNI2 board.

RS-485 CONVERSION BOARD

The RS-485 conversion board is shown below. External wiring connections are accomplished using terminal block TB1. The number of connections will depend upon whether the link is half duplex or full duplex. Although the full duplex wiring method requires two additional wire conductors, it is typically simpler to deploy and service in the field.

JP1 - When installed this jumper places a 120 ohm termination load on the RX end. For most installations this jumper should be installed.

JP2 - When installed, this jumper places a 120 ohm termination load on the TX end. For most installations this jumper will not be installed.

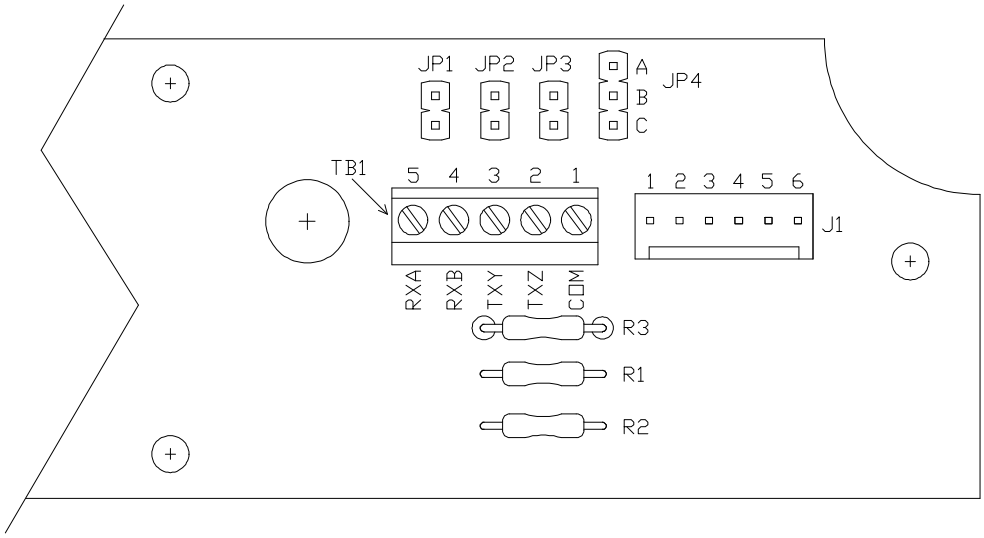
JP3 - When installed this jumper reduces the bandwidth of rise and fall transition edges of the transmit signal to minimize signal reflections (similar to echo's) on the cable. For most installations this jumper is not installed.

JP4 - Selects half duplex or full duplex mode. Position A+B is half duplex, and B+C is full duplex.

NOTE

If you are using half duplex operation you must select the "*RS-485 Half Duplex*" setting on the *Serial Port Settings* configuration screen.

Honeywell has a document available that further details the RS-485 theory of operation and how it applies to this particular board. A Product Support Specialist can provide a copy of this document in PDF format upon request.

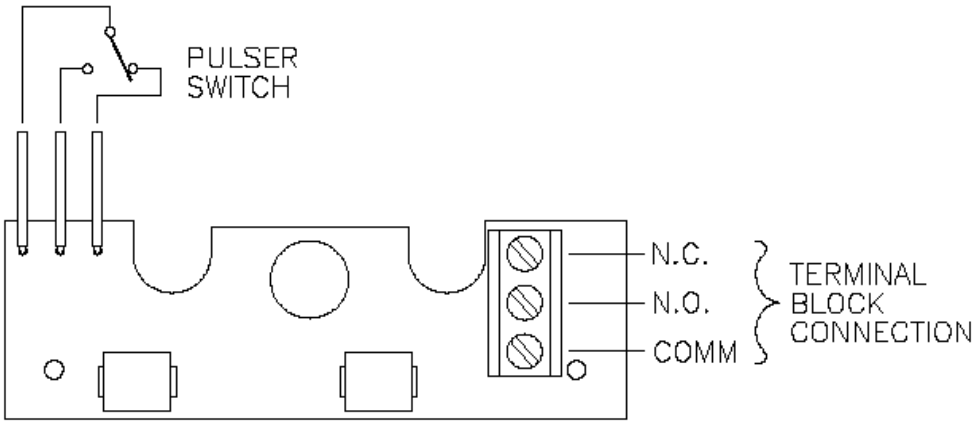


RS-485 Conversion Board Connectors

UNCORRECTED PULSE OUTPUT BOARD

This option provides a single Form-C dry contact switch output for connection to other devices outside of the CNI2. Counts are proportional to those recorded by the other sensor switches that wire into the CNI2. This board mounts onto the small metal plate in proximity to the rotating magnet head as seen earlier.

A three position terminal block provides the connection point for external wiring.



Uncorrected Pulse Output Board

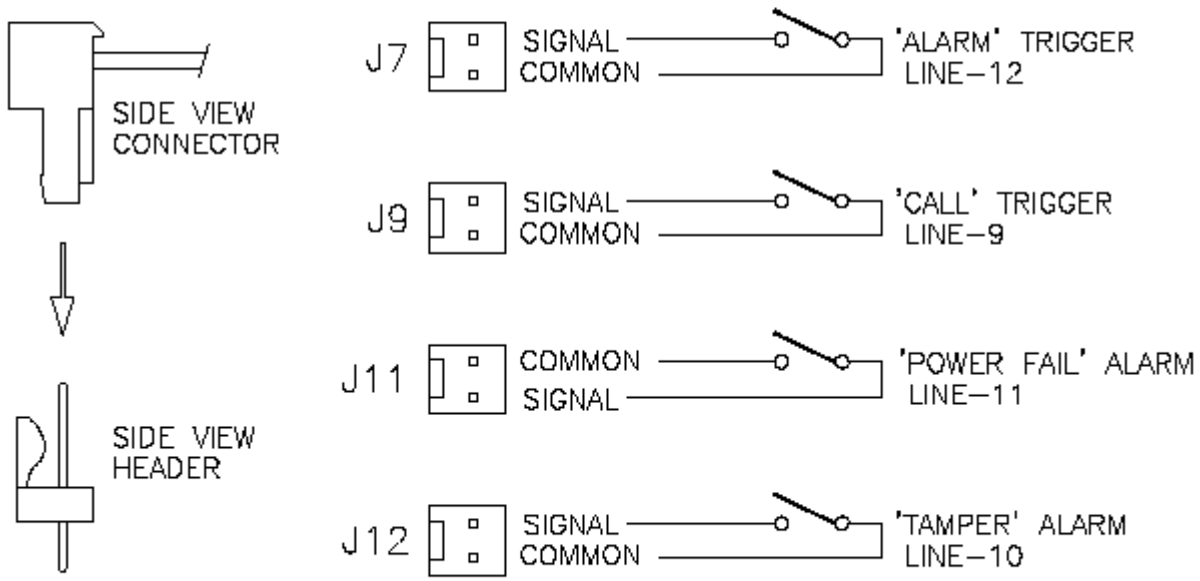
SIGNAL INPUTS & OUTPUTS

There are a total of six digital signals on the CNI2 board that can be used as alarms, status inputs, pulse-counting inputs or control outputs. A later portion of this chapter provides a technical discussion about how each input is processed.

Each signal has a “Line Number” associated with it as seen in the next figure. Knowing which line number correlates with which input signal is necessary when using the MP32 configuration software. In most applications these lines are preconfigured for the most common data logger applications, which would be a 2-channel pulse recorder with power supply control and monitoring. However any of the six signals can be reconfigured as necessary for the application.

Alarm Inputs

Any of the six signals can be used as alarms or status inputs. These can be configured in a number of ways. Two of these inputs are connected to the TB4 terminal block and the other four have their own connectors. If any input is configured as an alarm or status input then it cannot be used to count pulses.



Alarm Input Connectors

Note-1: The common or ground circuit connection at J11 is on the opposite pin when compared to the other three connectors.

Note-2: Mating connector type is available from AMP/Tyco Electronics under part number 641190-2.

Note-3: Some configurations of the CNI2 are pre-wired at the factory with a door-tamper detect switch at J12 and a magnetic call switch at J9.

The “CALL” input is usually connected to a magnetic switch located inside the unit. You can activate the switch by placing a strong magnet near this spot on the outside of the enclosure. Alternatively the switch can be a simple pushbutton switch located inside the unit or protruding from the wall of the enclosure. Or you can just momentarily short the J9 pins with a screwdriver or coin. This switch will cause the CNI2 to immediately call in to the central computer and report a “Call” or “Mag. Switch’ alarm.

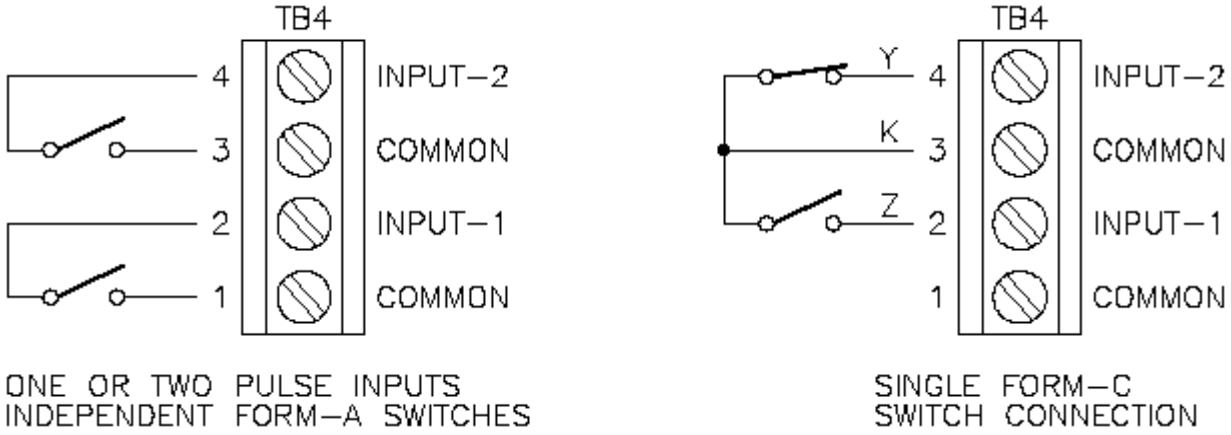
The “TAMPER” switch is often a magnetic switch mounted to the side of the enclosure and a magnet on the door. When the door is opened the magnet and switch separate and generate an alarm. This is often used to detect intrusion as well as record service events.

If you wish to use these inputs for any other purpose you can rename them in the data collection system. For instance you could rename the “Tamper” alarm as “Low Pressure” or “High Temperature”.

You can also combine the “Call” and “Tamper” inputs together as a Form-C (“KYZ”) pair, in which case the combination is reported as a “Call” alarm to the data collection system. A Form-C switch consists of one normally-open and one normally-closed switch. If at any time both are open or closed this is considered a failure and will be reported as a “Tamper” alarm.

The “Power Fail” input is usually used to detect the loss of ac mains power. When the alarm goes active this will be reported as an “AC-OFF” alarm. When it returns to an inactive state an “AC-ON” alarm will be reported. Again if you wish to use this input for any other purpose you can rename it in the data collection system.

In many standard configurations the J7 “Alarm” input can also be used as an alarm or pulse-counting input. This input is not reported to the system as any particular alarm but the CNI2 can still call in immediately if this input goes active or inactive. Usually if this line is programmed as an input it is used for pulse-counting rather than an alarm.



Alarm / Pulse Input Terminal Block TB4

The inputs on TB4 will be reported as “Alarm-1” and “Alarm-2” to the data collection system. Either can be Form-A (normally open) or Form-B (normally closed). Or they can be combined as a Form-C (“KYZ”) pair, in which case the combination is reported as “Alarm-1” to the data collection system. A Form-C switch consists of one normally-open and one normally-closed switch. If at any time both are open or closed this is considered a failure and will be reported as an “Alarm-2” alarm.

Pulse Counting Inputs

Any of the six signals can be used as pulse-counting inputs, but no more than four can be configured this way because that’s all the data collection system will accept. If any input is configured as a pulse-counting input then it cannot be used as an alarm or status input. Pulse-counting inputs can be either Form-A, Form-B or Form-C switches.

Outputs

Any of the six signals can be configured as outputs. These are low-level (+3.3V) logic signals with very low current (2 mA) capabilities. In many cases these signals will need additional amplification or conversion by external equipment.

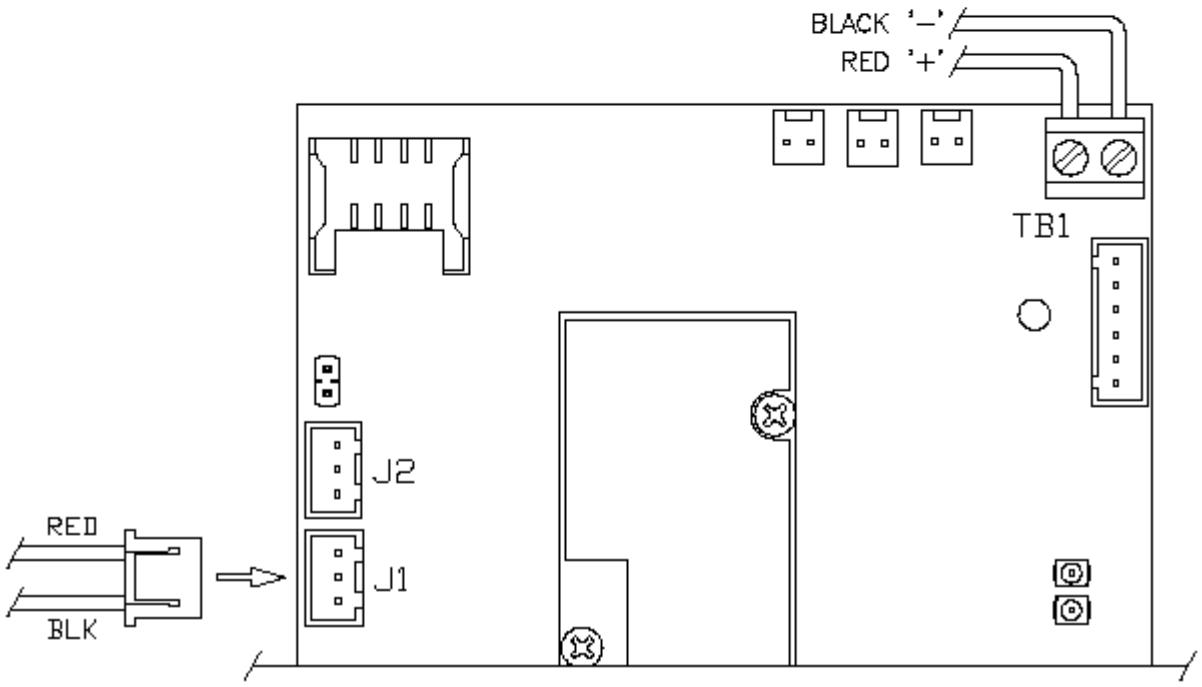
- *Output Under Host Control*: This configuration can be used to control external equipment from the central office, such as a warning light, an audio alarm or a pump. This is only supported when using the “Relay Settings” feature in the DC-2009® data collection system. The output is changed to the new setting only after a successful call.

- *Output Follows Input #”:* In this configuration the output follows any one of the inputs (“repeater”). This allows other external equipment to have access to the same pulse or alarm information that is being processed by the CNI2.

WARNING
An output has strict limitations with respect to voltage and current. See the specifications section to avoid damage to the CNI2 board.

POWER SUPPLY OPTIONS

Illustrated below is a portion of the CNI2 board. TB1 is prewired at the factory to a high density capacitor element to support peak load demands when operating the cellular radio. J1 and J2 are the power connectors for the CNI2. Additional details follow.



CNI2 Power Connections

Connectors J1 & J2 are electrically equivalent, and it does not matter which of the two is used for attachment to the power source. For a battery powered application it is recommended that the fresh pack be plugged into an available connector **first** before disconnecting the depleted pack.

Extending Battery Life

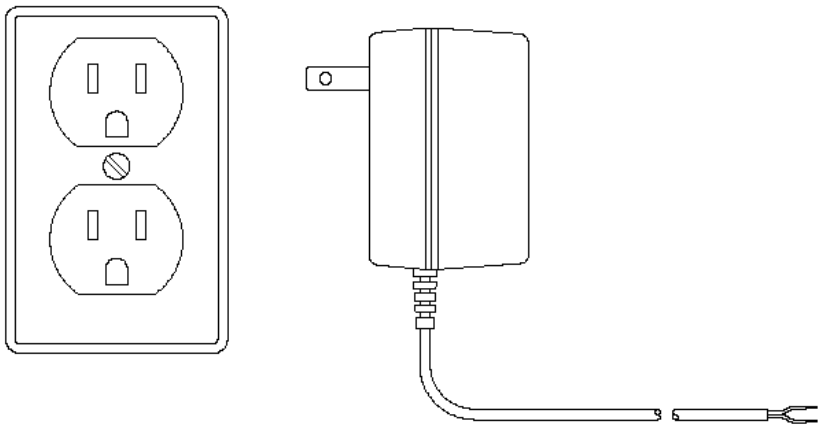
The CNI2 has been designed to provide long service life when operating from batteries. Total battery life is influenced by two factors in the CNI2; continuous background current and high current draw during cellular calls. The background current can be minimized to a certain extent by using fewer pulse input connections and using normally-open (Form-A) contacts for pulse and alarm sensing. High current draw depends on the number and duration of cellular calls made. This can be minimized by ensuring the CNI2 has strong cellular reception (which minimizes call retries) and by limiting the number of regular scheduled calls to the extent practical.

Low Battery Detection

The voltage level at which a low-battery condition is triggered can be changed using the MP32 programming software. Normally the programming template provided by Mercury will have a default value optimized for the application.

AC MAINS POWER CONFIGURATION

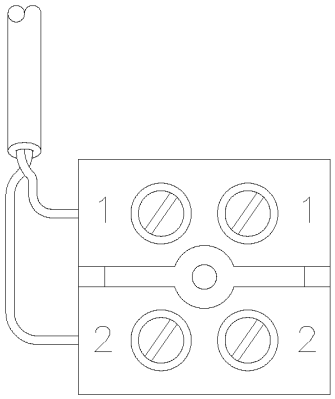
Where AC power is readily available, as is the case at some sites, then a power adaptor can be used to supply the necessary voltage. Requirements for the power adaptor are that it be capable of sourcing 1 ampere of current at 5.0 volts DC. For Class I, Div. 2 locations, this will require special consideration to ensure that the rules stipulated by NEC and equivalent Canadian wiring codes for hazardous locations are strictly adhered to.



AC Power Adapter

The output voltage from the power adaptor will be wired into a small terminal block as illustrated below. It may be necessary to check with a voltmeter which wire is positive and which is negative coming from the power adaptor.

Polarity of the terminal block connection will be apparent from the opposite end wire colors in that Red is positive and Black is negative. In the event that a reverse connection is made by accident, no harm will be caused to the electronics aside from the fact that the CNI2 will not power as expected.

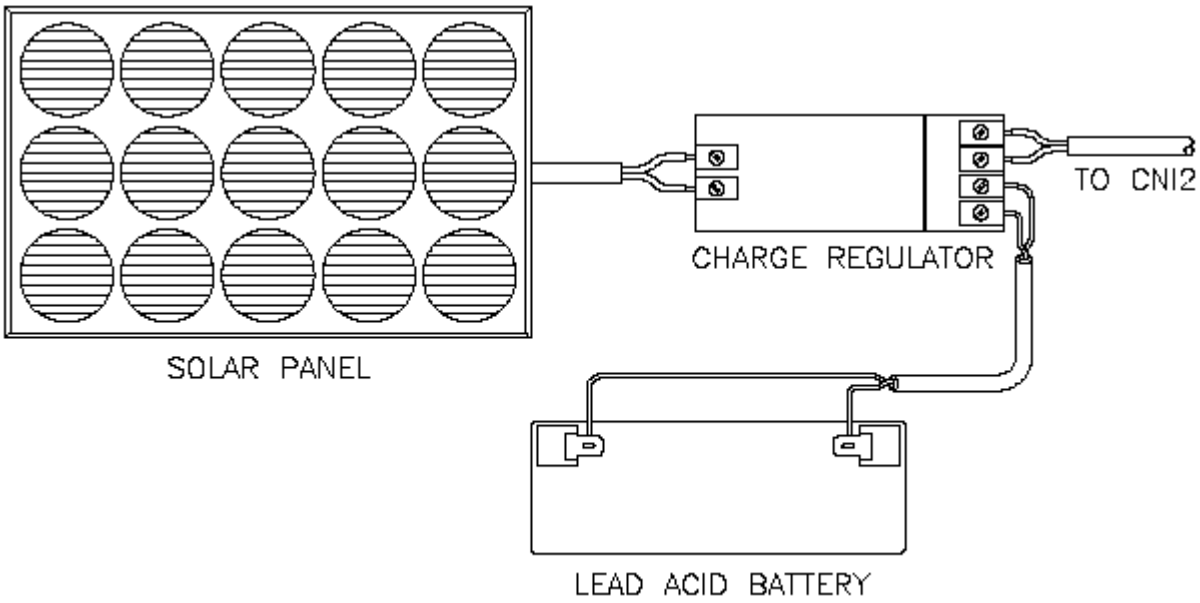


External Power Tie-In Block

A lithium or Alkaline battery pack can be connected to the vacant J1 / J2 power connector to supply continuous power in the event of AC mains failure. Lithium batteries have a longer ‘shelf-life’ as compared to alkaline batteries, and are normally regarded as the superior choice for long term backup applications.

SOLAR POWER CONFIGURATION

Solar power is also a possibility, although it will be necessary to also provide a voltage charge regulator and lead acid battery as seen in the illustration. Wiring to the terminal block illustrated previously will be the same as was the case for the AC mains application. The lead acid battery serves as the backup source during the evening and cloudy days. Correct sizing of the solar panel and lead acid battery are necessary for a given territorial region. Application notes are available from solar panel suppliers to assist in the process of sizing the panel and battery.



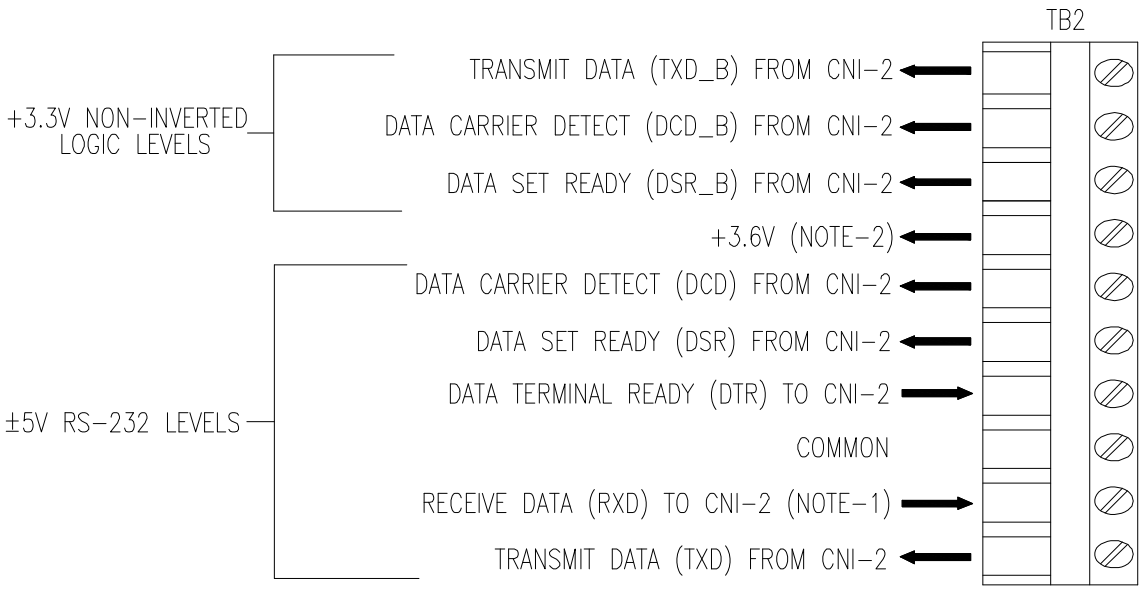
Typical Solar Power System

SERIAL PORT CONNECTIONS - TB2

In addition to processing alarms and pulse data, the CNI2 can act as a “transparent” modem. This allows the central computer to communicate directly with a device connected to the CNI2’s RS-232 serial port. Most applications for the CNI2 being used as a cellular modem will be with a Mercury corrector instrument. Other configurations are certainly possible as well, to support 3rd party instruments such as transducers, odorizers, etc.

The serial port consists of signals with traditional EIA (RS-232) levels of ±5V. Recommended cable length should not exceed 15 feet, and may need to be shorter at higher bit rates. All serial parameters are configurable using the MP32 configuration program.

There are also several non-inverted logic-level signals that are used to connect directly to other instruments that have a similar port. In most cases these signals will be prewired at the factory.

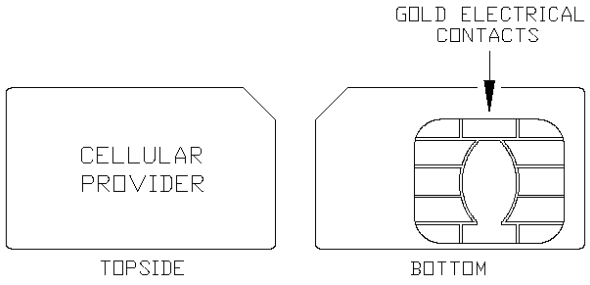


NOTE-1: RXD CAN BE CONFIGURED FOR +3.3 NON-INVERTED LOGIC LEVELS WITH JUMPER JP3-3.
NOTE-2: ONLY FOR USE WITH OTHER MERCURY EQUIPMENT.

Serial Port Terminal Block TB2

SIM SOCKET CONNECTION

CNI2 products that have a GSM cellular radio require a SIM card (Subscriber Identity Module) to be installed as shown in the illustration. The gold contacts face towards the connector, and the notched end must be positioned outwards as shown.

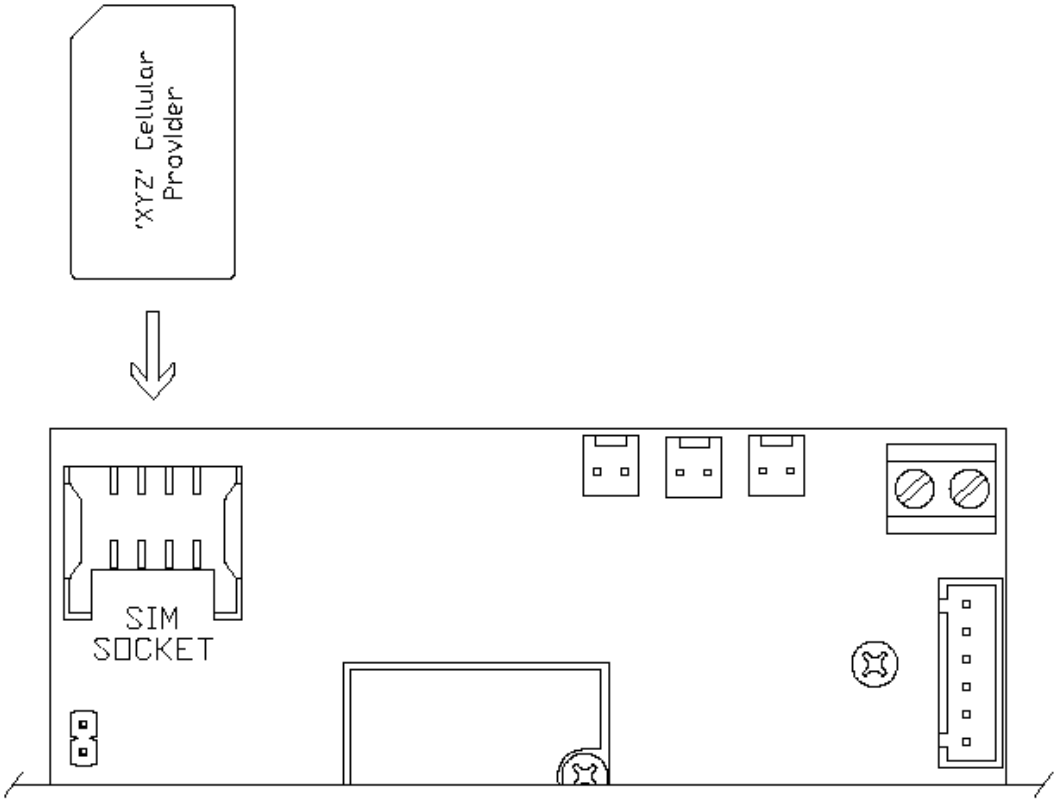


Typical SIM Card

If your CNI2 is equipped with a CDMA radio, then a SIM card is not required. A SIM card should not be installed into a CDMA configured CNI2.

⚠ WARNING - Explosion Hazard

Do not install or remove the SIM card while the circuit is live unless the area is known to be non-hazardous.



Installation of the SIM Card

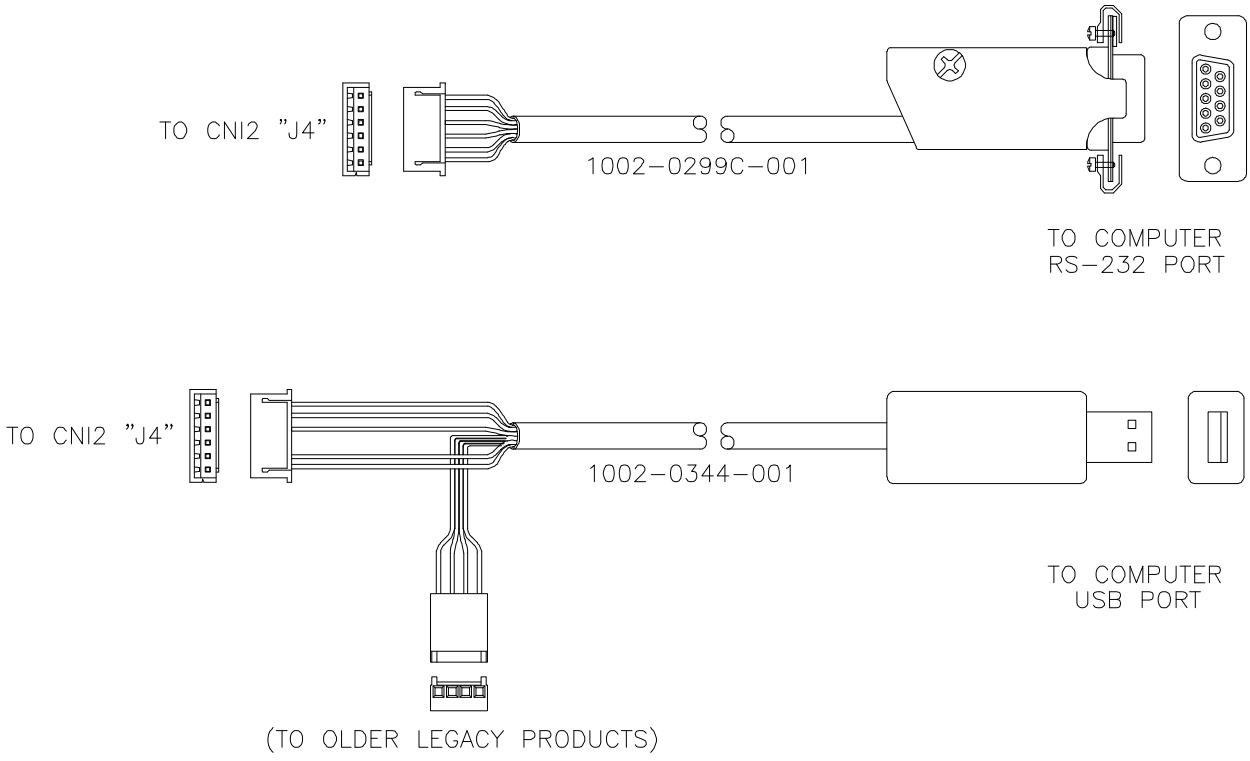
The otch on corner of SIM card faces away from the socket as illustrated above.

⚠ WARNING:

Never install or remove a SIM card when the CNI2 has power applied. There is some risk that the SIM card could be damaged if plugged / unplugged with power present.

PROGRAMMING INFORMATION

Each CNI2 must be programmed with information that relates to the cellular network, the type of data collection system that will be contacted, the type of inputs to process, etc. This is done with a Windows-based program called "MP32®" and a special programming cable as shown here.

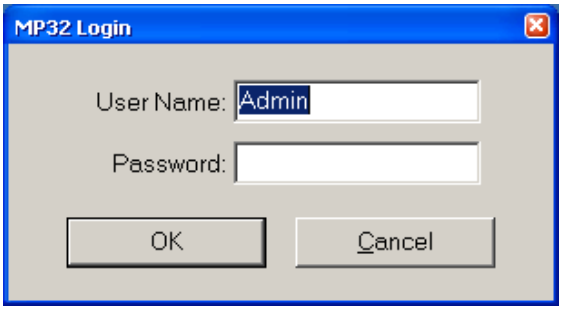


Serial and USB Programming Cables

STARTING THE MP32® CONFIGURATION PROGRAM

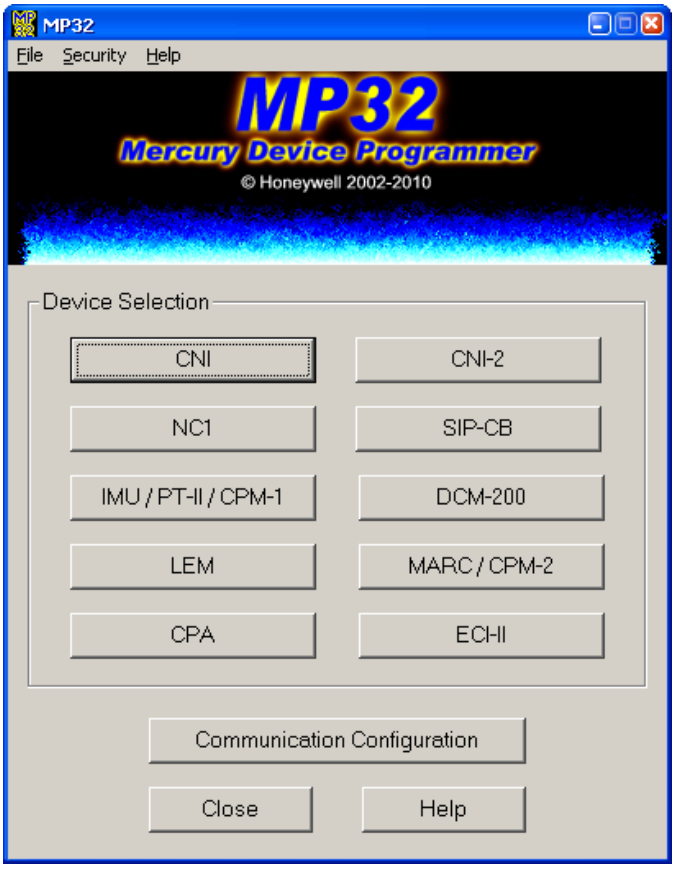
When the MP32® program is started a login screen appears. If the "DC-2009®" data collection system is also running on this system then you will need to enter an authorized user name and password that is valid for DC-2009®.

Otherwise if DC-2009® is not running on this system then use the default user name and password as is and select *OK*.



MP32® Login Screen

The next screen to appear will be the device selection screen.



MP32® Device Selection Screen

CONFIGURING THE PROGRAMMING PORT

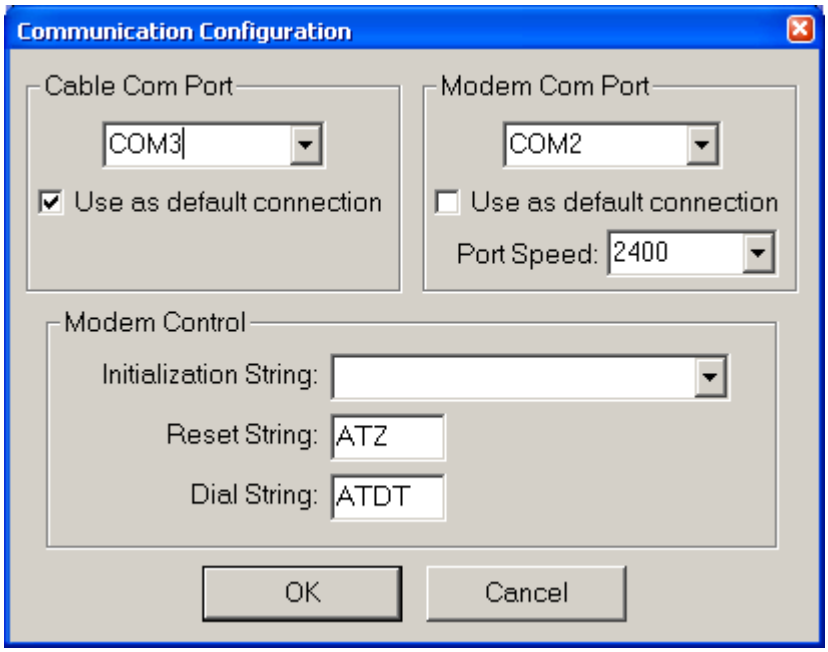
MP32® needs to know which COM port to use with the programming cable. Select the "*Communications Configuration"* button on the device selection screen.

When the USB programming cable is first plugged in, the system should detect it and load the necessary driver software. If you are having problems with this contact us and we can help. When the installation is complete the system will assign a new COM port to the cable, such as COM5. It may not be immediately apparent what COM number has been assigned to a USB device. To find this out (with the cable plugged in) go to:

Settings → Control Panel → System → Hardware → Device Manager → Ports

You should see your USB cable there and its assigned COM port. Each USB cable has a unique electronic serial number. The computer will remember this number. If one USB cable is unplugged and another one is installed, the system will not reuse the previous COM port number. Rather it will assign a new COM port number to it. For instance, if the previous cable was assigned COM5, then the new cable might become COM6.

If using the serial programming cable then the COM port is the physical COM port number that the cable is plugged in to, typically COM1 or COM2.

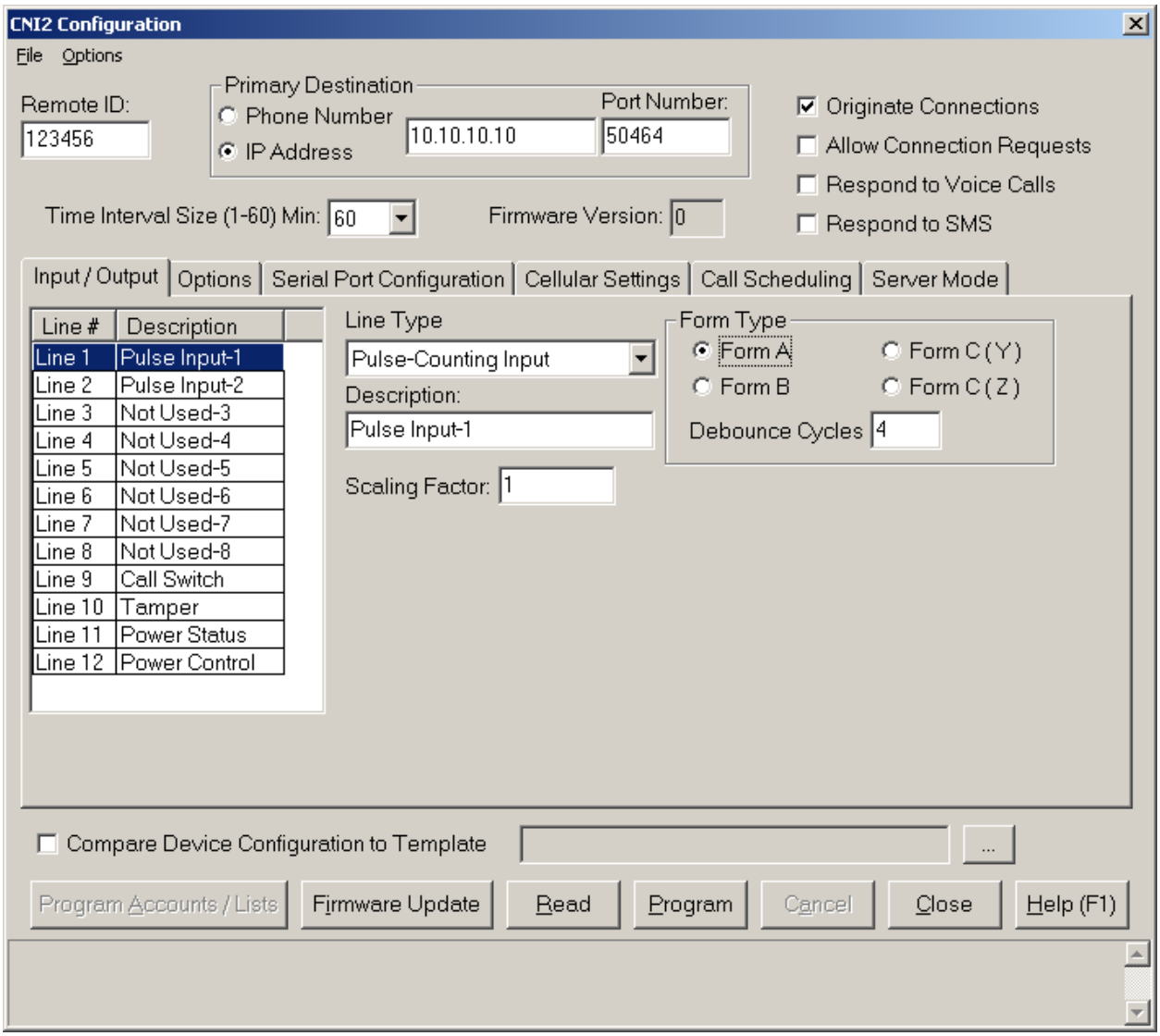


Programming Port Configuration Screen

Check the "*Use as default Connection*" under the *Cable COM Port* heading, select the appropriate COM port number and then select *OK*.

STARTING THE CNI2 PROGRAMMING APPLICATION

When the device selection screen reappears select the ***CNI2*** button. The following screen will appear. Some fields are filled in for demonstration purposes and may be different than those you will enter.



CNI2 Main Configuration Screen

MAIN SCREEN

Saving and Retrieving Configurations

A “configuration” is a set of parameters that will be programmed into the CNI2. It is also referred to as a “template”. Once you define a configuration it can be saved by using the *FILE* pull-down menu in the upper left-hand corner of the screen. A previously saved configuration can be opened in the same manner. This is useful if many units are to be programmed with similar information, such as all using the same destination IP addresses or cellular information.

To start a programming session either *OPEN* a previously saved template or manually enter all of the parameters. If you would like to work with the configuration that is already stored in the CNI2 you can perform a *READ* operation of the CNI2 with the programming cable installed and the unit powered up. The status of the operation is displayed on the bottom of the screen. The *CANCEL* button will terminate the session in the event there is no response or an error.

IMPORTANT NOTE
Reading the configuration from a CNI2 automatically resets the unit and clears all accumulated data.

Remote Unit ID (RUID)

Each CNI2 must have a unique six-digit ID number. This is required by the data collection system. Legal values are 000000-FFFFFF (hexadecimal notation). Sequential numbering is not required, nor is it necessary to use any of the hexadecimal digits ‘A, B, C, D, E, or F’. Typically if you do not specify the ID number prior to shipment then the CNI2 is shipped with an RUID that is the last six digits of the serial number located on the front label.

Primary Destination

CSD mode is similar to a dial-up connection on a wired phone line. CSD service is no longer offered by some cellular service providers. If the CNI2 is allowed to originate a CSD data call to another modem then it will need the phone number of that modem. Select the “*Phone Number*” button and enter up to 32 numeric digits. As with most cellular phones, it is usually necessary to enter the entire phone number, including area code, even if the call is local. For example in the U.S., a call to 555-1212 within area code 987 may have to be entered as 19875551212.

If the CNI2 is to communicate via the Internet then it will need the IP address and port number of the data collection server. Your computer systems administrator usually assigns these values. Select the “IP Address” button. Then enter the address of the server expressed in “dotted decimal format”, such as 198.32.67.101. The data collection server is usually assigned a default port number of 50466, but the system administrator can change this. Do not use port numbers below 1024.

The Primary Destination is used for scheduled calls, consumption-related alarms, page call-backs, low battery alarms, etc. Any hardware input that has been programmed as an alarm input can have its own unique destination. This will be discussed shortly.

Originate Calls

Check this box if the CNI2 is allowed to originate CSD or Internet connections. This allows the CNI2 to call in at regularly scheduled times or whenever an alarm condition occurs. When using the Internet for communications the CNI2 acts as a "client". It can only originate calls to the data collection system.

Allow Connection Requests

This setting allows the CNI2 to act as an Internet "server", allowing it to be contacted via the Internet. When this box is checked the *Server Mode configuration* screen is used to define specific server features.

IMPORTANT NOTE

The *Allow Connection Requests* feature requires the cellular radio to be powered up more frequently. This will have a great impact on battery life. A permanent power source such as solar or AC is recommended if you wish to use this option.

Respond to Voice Calls / Respond to SMS

"Paging" is a mechanism that causes the CNI2 to call back to the Primary Destination on demand. You can page the CNI2 by calling its cellular voice number or by sending it a text message using SMS, or short message service. Your cellular account may not offer voice or SMS service.

In addition to paging, if the CNI2 is configured for CSD mode then checking the "*Respond to Voice Calls*" box will allow the CNI2 to answer incoming CSD calls from the central office.

IMPORTANT NOTE

The *Respond to Voice Calls* / *Respond to SMS* options are NOT recommended for battery-powered operation. These options require the cellular radio to be powered up at all times, which will quickly drain the CNI2's batteries. A permanent power source such as solar or AC is recommended if you wish to use these options.

Time Interval Size

You can configure the CNI2 to count pulses from up to 6 sources. Pulses are counted over a specific time interval and the total for that period is saved as one record. It then starts the counting process over for the next time interval and this process continues indefinitely. The time interval can be 1, 2, 3, 5, 6, 10, 12, 15, 20, 30 or 60 minutes (anything evenly divisible into 60). A shorter time period allows you to observe small changes with more detail. But it also consumes storage space more quickly, causing the CNI2 to need to communicate with the data collection system more frequently so that older data is not lost. This can have an impact on both battery life and the cost of the cellular service.

The CNI2 has the capacity to save a total of 30,000 records before it starts to overwrite the oldest records. These are divided equally between all active pulse-counting channels. If only one channel is used for pulse-counting then all 30,000 record locations will be used for that

channel. If using a 10-minute interval it would take a little over 200 days to reach the end of the memory. If three channels are active then each channel is allocated 1/3 of the memory, or 10,000 records.

If some of the pulse / alarm inputs are not being used for pulse-counting then they should be programmed as alarm inputs even if they are not going to be used for alarms. This will cause the memory to be divided between only those channels that will be counting pulses.

The data collection system (DC-2009® or MV90®) must also be configured with the same interval size; otherwise the calls from the CNI2 will be rejected. Although the CNI2 can accept up to six channels of pulse information, DC-2009® or MV90® can only accept four.

Firmware Version

The firmware version number is reported any time the configuration is read from the CNI2 using the programming cable. This value cannot be altered.

Compare Device Configuration to Template

This feature is useful when programming many CNI2 devices with similar information. When the CNI2's configuration is read it is compared to a configuration file (a "template") of your choice. If there are any differences other than the unit's ID number, they will be displayed. You can manually enter the filename of the template or use the browse button to locate it on your system.

INPUT / OUTPUT CONFIGURATION

The CNI2 has six (6) digital lines that can serve as alarm sensing or pulse-counting inputs, or as outputs.

Four of the lines are available on four 2-pin MTA connectors J7, J9, J11 and J12, as shown earlier. These are normally used as alarm-sensing inputs and are often prewired for specific alarm triggers such as a magnetic TAMPER switch. However any of these can be configured as pulse-counting inputs.

Two other lines are available on the "TB4" terminal block. These are most often used as pulse-counting inputs but can also be configured as alarm-sensing inputs.

The inputs can be normally open (Form-A), normally closed (Form-B) or combined into a KYZ (Form-C) configuration. When using Form-C connections there are certain lines that can be grouped together.

An output can be used to control external equipment from the central office, such as a warning light, an audio alarm or a pump (remote control of this output is only available when using the DC-2009® data collection system). Or it can be configured as a "repeater", replicating any line that is configured as an input.

WARNING
An output has strict limitations with respect to voltage and current.
See the specifications section to avoid damage to the CNI2 board.

Alarm Input Parameters

An "alarm" is an event such as a switch closing or opening. The CNI2 reports the alarm condition to the data collection system (DC-2009® or MV90®) using standard descriptions as shown in this table:

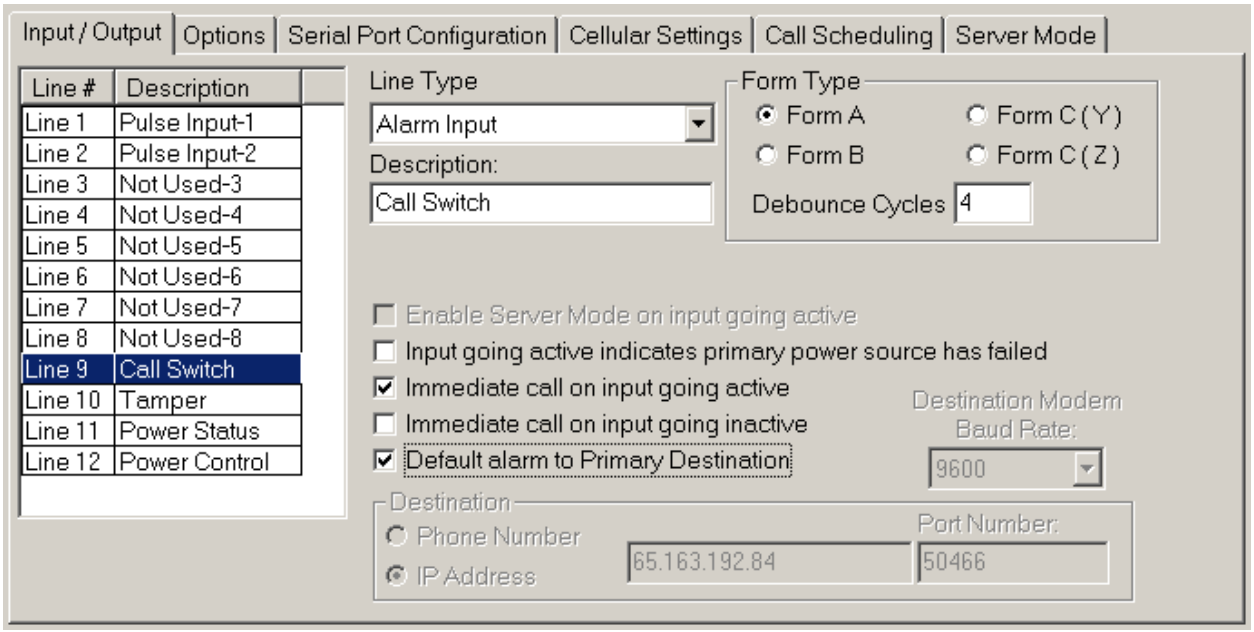
Line Designation	CNI2 Connector	Alarm Text Reported by DC2009
Line #1	TB4-1 & 2	"Alarm-1"
Line #2	TB4-3 & 4	"Alarm-2"
Line #3	-	-
Line #4	-	-
Line #5	-	-
Line #6	-	-
Line #7	-	-
Line #8	-	-
Line #9	J9	"Call" or "Mag"
Line #10	J12	"Tamper"
Line #11	J11	"AC-On" and "AC-Off"
Line #12	J7	No alarm description

Standard Alarm Descriptions

Any description can be changed in the data collection system. For instance if Line#10 is used for something other than the TAMPER switch it will still be reported to the data collection system as a TAMPER alarm. But you can change the alarm description at the central office to something like “Pump Failure” or “High Temperature” to more-accurately describe the event.

NOTE
Lines #3 thru #8 are only available using an optional expansion board which is not available at this time.

An example configuration for the internal “CALL” switch is shown here.



Configuration of an Alarm Input

Select “*Alarm Input*” from the “*Line Type*” pull-down list.

You can give this input a *Description* of 15 characters or less. This is for your records only and is not reported to the data collection system.

If the input is a normally-open switch then select *Form-A*. If the input is a normally-closed switch then select *Form-B*. If you are combining lines together to create a KYZ input, then select *Form-C (Y-normally open) or Form-C (Z-normally closed)*. If you select *Form-C* for one line then the next line will automatically be assigned as the other Form-C input and will inherit the partner’s settings. Allowed Form-C pairs are Lines-1&2, 9&10 and 11&12.

The “*Debounce*” setting, in combination with the “*Sample Rates*” setting on the OPTIONS screen determines how long the switch needs to be closed or open before being considered a “real” alarm event. Debouncing and sample rates are discussed in more detail later in this document.

The "*Immediate Call on Input Going Active*" will cause the CNI2 to call immediately into the central office when the alarm event is sensed.

The "*Immediate Call on Input Going Inactive*" will cause the CNI2 to call immediately into the central office when the alarm event ends.

If neither box is checked then the alarm event will be reported on the next scheduled call.

NOTE
Even if the "*immediate call*" boxes are checked the data collection system (DC-2009® or MV90®) has the ability to override them.

The "*Input Going Active Indicates Primary Power Source has Failed*" is usually used in systems that contain a primary power source (ac or solar) and also an emergency backup battery. This puts the CNI2 into a low-power conservation mode until the alarm event is over. During this time some features may not be available. For instance if the CNI2 is configured to respond to SMS pages, which requires that the radio be powered up and running all the time, this mode will be temporarily suspended and the radio will be powered down until the primary power has been restored.

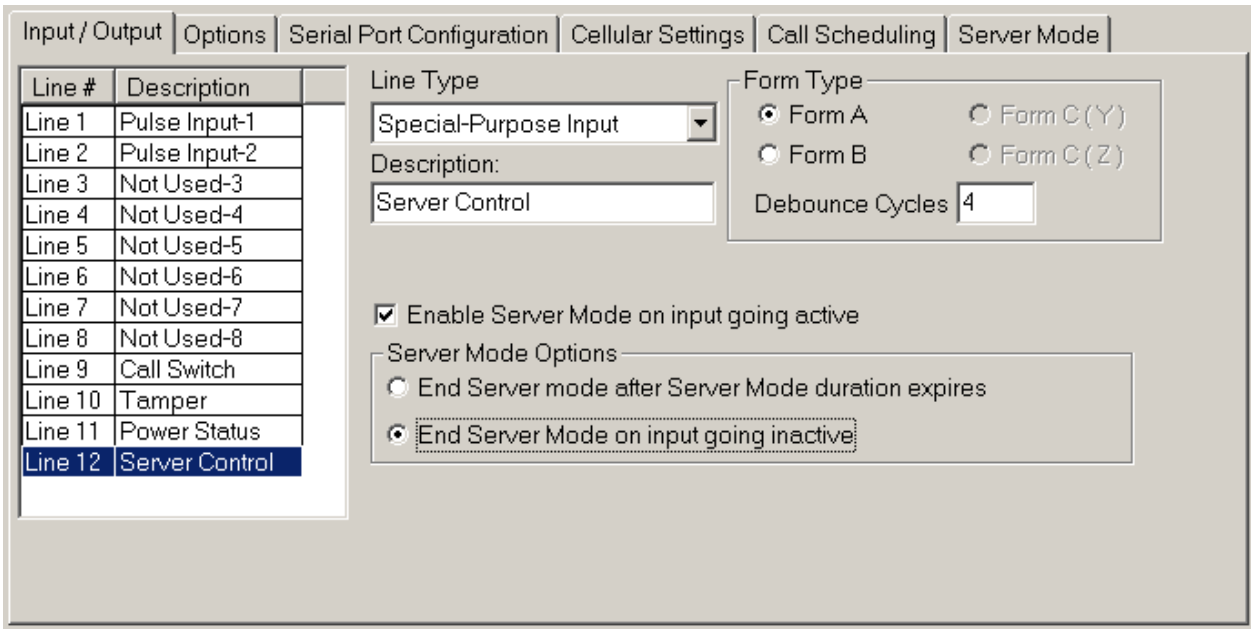
By checking the "*Default Alarm to Primary Destination*" box the CNI2 will call into the Primary destination phone number or IP address. Otherwise you can specify a unique destination for each alarm.

"Special Purpose" Input Parameters

An input can be configured to perform a predefined function that does not relate to alarm-sensing or pulse-counting. At this time there is only one function, and that is to start and / or end what is called "Server Mode". Server Mode allows the CNI2 to accept connection requests from the central office over the Internet.

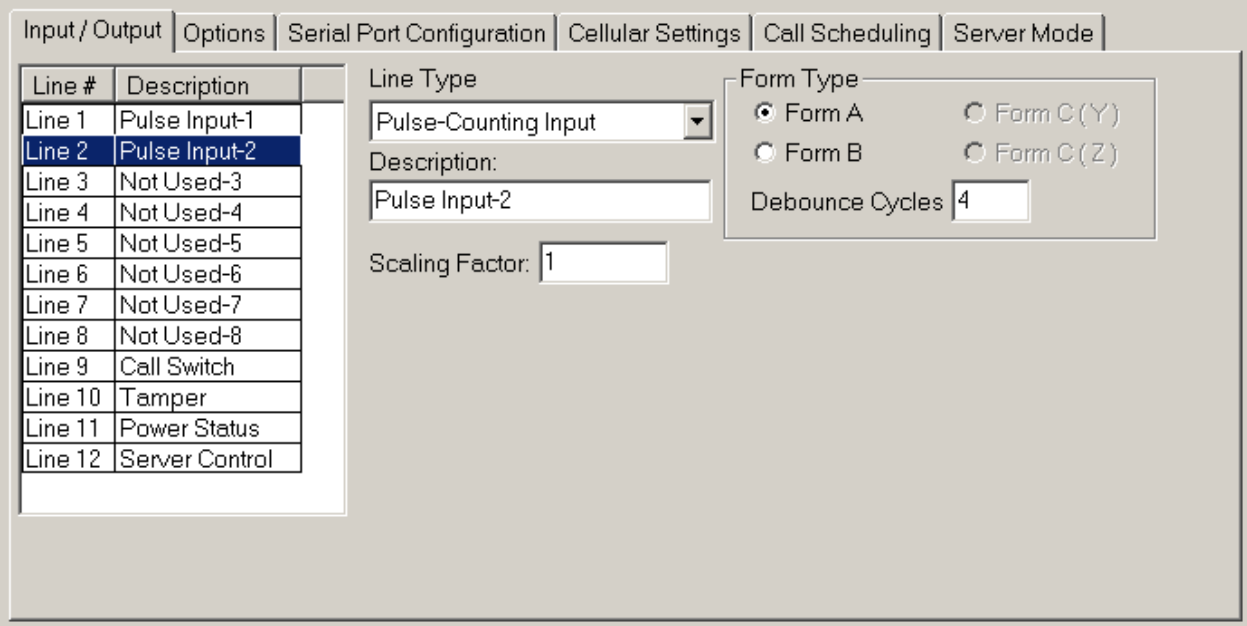
In many cases the CNI2 will only enter Server Mode for brief periods throughout the day. One way to make this happen is to configure one of the inputs as a Server Mode control line.

The next screen shot illustrates how Line-12 (connector J7) is used for this purpose. The *Line Type* is chosen to be "*Special Purpose Input*". The input is configured as a Form-A (normally open) input. When the "*Enable Server Mode on Input Going Active*" box is checked two more selections will appear. One selection will terminate the Server Mode after a user-defined time period (in the *Server Mode* configuration screen). The other selection will terminate the Server Mode when the input returns to the inactive (open) state.



Configuration of a “Special Purpose” Input

Pulse-Counting Input Parameters



Configuration of a Pulse Counting Input

Select "*Pulse-Counting Input*" from the "*Line Type*" pull-down list.

You can give this input a *Description* of 15 characters or less. This is for your records only and is not reported to the data collection system.

If the input is a normally-open switch then select *Form-A*. If the input is a normally-closed switch then select *Form-B*. If you are combining Lines-5 & 6 together to create a KYZ input, then select *Form-C (Y-normally open) or Form-C (Z-normally closed)*. If you select *Form-C* for one line then the next line will automatically be assigned as the other Form-C input and will inherit the partner's settings. Allowed Form-C pairs are Lines-1&2, 9&10 and 11&12.Line-5 settings.

The "*Debounce*" setting, in combination with the "Sample Rates" setting on the OPTIONS screen determines how long the switch needs to be closed or open before being considered a "real" pulse event. Debouncing and sample rates are discussed in more detail later in this document.

The "*Scaling Factor*" is not currently supported.

The CNI2 has the capacity to save a total of 30,000 pulse-counting records before it starts to overwrite the oldest records. These are divided equally between all active pulse-counting channels. If only one channel is used for pulse-counting then all 30,000 records will be used for that channel. If three pulse-counting channels are active then each channel is allocated 1/3 of the memory, or 10,000 records.

NOTE
If you do not require pulse-counting on a line then configure it as a Form-A alarm input so that all other pulse-counting inputs have access to as much storage space as possible.

The data collection system (DC-2009® or MV90®) must know how many pulse-counting channels are activated. The minimum is 1 and the maximum is 4.

When the data collection system receives the pulse records from the CNI2 it expects them to be in a specific order starting with the 1st input and ending with the last. The CNI2 does not have restrictions regarding the order in which you program the pulse-counting lines. You could program Line #1 and Line #2 as alarms and #9 and #10 as pulse-counters. To stay compliant with DC-2009 here is how the records are sent:

The very 1st line that is programmed for pulse counting is considered “Input-1”.
The next line that is programmed for pulse counting is considered “Input-2”.
The next line that is programmed for pulse counting is considered “Input-3”.
The next line that is programmed for pulse counting is considered “Input-4”.

Remember that a Form-C pair is treated as only one input.

Here’s an example:

Lines #1, 2, 9 and 10 are configured as alarm inputs and Lines #11 and #12 for pulse-counting. Line #11 is presented as “Input-1” to DC-2009 because it’s the 1st line programmed for pulse-counting. Line #12 is presented as “Input-2” because it’s the 2nd line programmed for pulse-counting.

Here’s another example involving a mixture of Form-C and Form-A settings:

Lines #1 and #2 are programmed for pulse-counting, Form-A operation. Lines #11 & #12 are configured for Form-C pulse counting. Line #1 is presented as “Input-1” to DC-2009 because it’s the 1st line programmed for pulse-counting. Line #2 is presented as “Input-2” because it’s the 2nd line programmed for pulse-counting. Lines #11/#12 are presented as “Input-3” because they are the 3rd set of lines programmed for pulse-counting.

Output Parameters

An output line can be configured three ways. You can give this input a *Description* of 15 characters or less. This is for your records only and is not reported to the data collection system.

Output Under Host Control

DC-2009® has the ability to control up to 3 output lines. These can be used to activate external equipment such as pumps or audible alarms.

These outputs are controlled using the *"Relay Information"* screen in DC-2009's *"Remote Unit Configuration"* program. This is discussed in an upcoming chapter.

Using the "Output-Under-Host-Control" feature, the outputs are not changed until the call has ended and declared a good call.

There are no restrictions on which digital signals can be programmed as outputs. But DC-2009 refers to Relay Numbers-1, 2 and 3. So here is how the CNI2 handles this:

The very 1st line that is programmed as a host-controlled output is considered "Relay-1".
The next line that is programmed as a host-controlled is considered "Relay-2".
The next line that is programmed as a host-controlled is considered "Relay-3".

NOTE
Whenever the CNI2 is powered up or reset, all outputs that have been configured for host control will be in an open-circuit condition until changed by DC-2009.

Output Follows Input

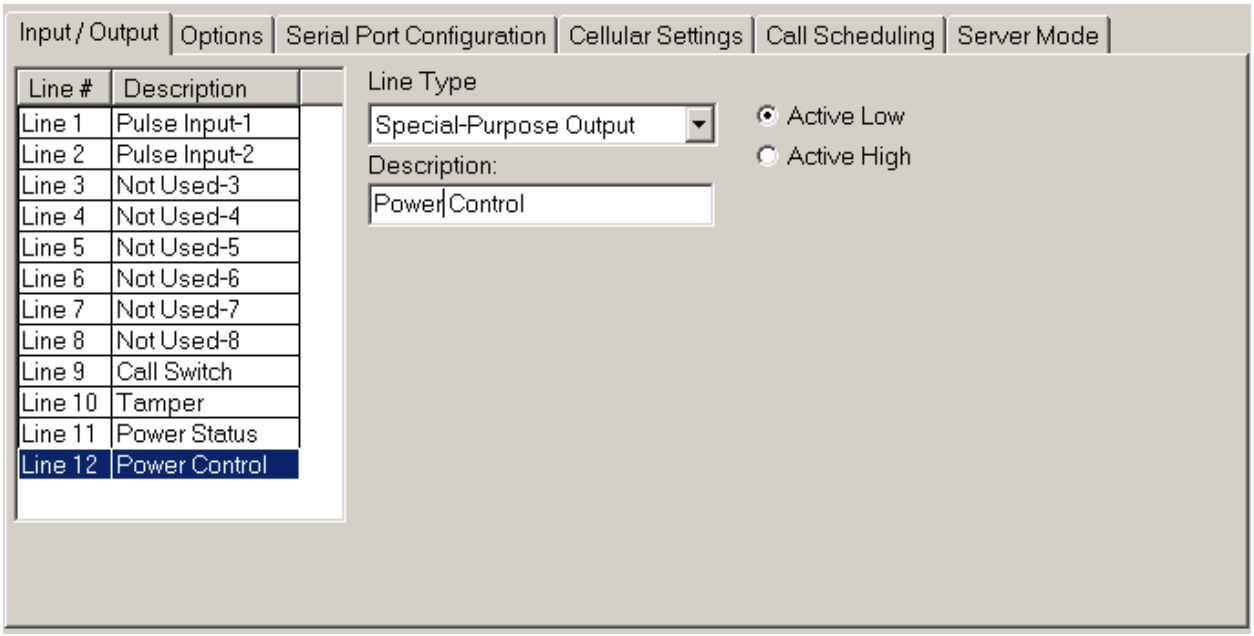
When a line is programmed as an alarm or pulse-counting input its state can be replicated on any one of the output lines, within the frequency limits of the CNI2. This allows other pulse-counting or alarm-sensing equipment to have access to the same information. For instance the CNI2 may be counting pulses and there may be another piece of equipment located nearby that needs to count these pulses too. The CNI2 can be programmed to transmit a replica of the input signal to this other piece of equipment.

To use this feature select the desired output line. Then from the selection list choose the *"Output Follows Input #x"* where "x" is one of the input lines. For instance you may want Input Line #1 to appear on Output Line #12. You would select Line #12 and then program is as *"Output Follows Input #1".*

There are some timing limitations when using this feature. This will be discussed shortly.

"Special Purpose" Output

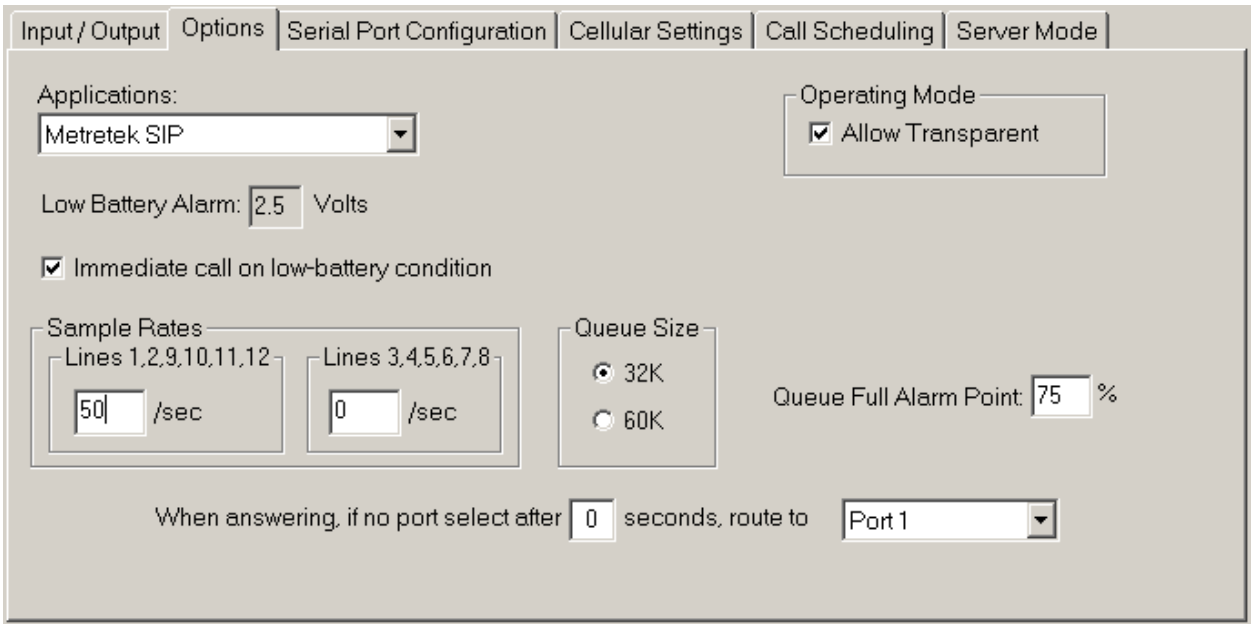
The CNI2 will use a "special purpose" output to control some operation within the unit assembly, such as turning a power supply on or off. At this time the "Special Purpose" output only applies to Line-12, which is the J7 connector. If a unit is shipped with a line programmed as a Special Purpose output, it should not be changed unless you understand the implications.



Configuration of a "Special Purpose" Output

As a "Special Purpose Output" the signal on the J7 connector will go active shortly before the cellular radio is powered up to make a call. It will return to the inactive state shortly after the cellular radio is powered down. The active state (3.3V or to 0V) is defined by the "*Active High*" or "*Active Low*" selections on this screen.

OPTIONS SCREEN



Options Screen

Applications Selection

The CNI2 has several modes of operation. It can serve as a data logger for pulse-counting and alarm sensing applications, a transparent modem to allow the host system to communicate with an external piece of equipment, or as a short-message-service (SMS) modem.

Metretek SIP

When the CNI2 calls into the data collection system (DC-2009® or MV90®) it will identify itself as a Metretek "SIP" data logger. In this mode the CNI2 serves as a data logger for pulse-counting and alarm sensing applications and uses the legacy Metretek communications protocol. The term "SIP" refers to a Metretek data logger called a Survey Instrument Point.

DC-2009® supports both CSD and IP (internet) communications with the CNI2. MV90®) only supports CSD connections (see next topic).

Metretek SIP via InvisiConnect

MV90® does not support internet connections with Metretek "SIP" devices. To accomplish this it is necessary to install another software product called "InvisiConnect®". InvisiConnect® acts as a modem emulator and a transparent "bridge" to the internet. In this case you should select "*Metretek SIP via InvisiConnect*" from the pull-down list.

The CNI2 contacts the InvisiConnect® server first. Data is then transferred between InvisiConnect® and the MV90® system as though the connection was occurring over a wired phone (CSD) connection.

Contact a Honeywell Product Support Specialist for additional details and ordering information for InvisiConnect®.

Metretek InvisiConnect
InvisiConnect® Server is a software application that acts as a modem emulator and a transparent "bridge" to the internet.

The CNI2 acts as an alarm-sensing unit as well as a transparent communications link between a device attached to its serial port and the host system that is connected to InvisiConnect® Server. The CNI2 does not support pulse-counting in this mode.

Contact a Honeywell Product Support Specialist for additional details about InvisiConnect®.

Mercury MINI-MAX or Mercury Pulse Accumulator

When the CNI2 calls into the data collection system (DC-2009® or MV90®) it will identify itself as a Mercury MINI-MAX or Mercury Pulse Accumulator. In this mode the CNI2 serves as a data logger for pulse-counting and alarm sensing applications and uses the legacy Mercury Instruments communications protocol.

DC-2009® supports both of these settings. MV90® can support either setting depending upon which options were purchased for MV90®. "*Mercury Pulse Accumulator*" is recommended because there is less data to transfer resulting in shorter calls. If "*Mercury MINI-MAX*" is selected the CNI2 will report values of 0 for any parameters relating to pressure or temperature measurements.

NOTE
At the present time the CNI2 does not fully support "*Mercury MINI-MAX*" or "*Mercury Pulse Accumulator*" modes of operation.
Contact a Honeywell Product Support Specialist for additional details.

Metretek SMS Modem

This mode is primarily used by the InvisiConnect® Server software. In a traditional wired modem setup the central computer can usually contact the remote device directly by dialing its phone number. On the Internet there are servers and clients. A server is usually a computer system that is always running and always "listening" for connection requests from clients. When you use your personal computer to access a website your PC is the client and the website is the server.

A client cannot be contacted directly via the Internet. In many cases the CNI2 acts as a client only. However the CNI2 can be "paged". The page then causes the CNI2 to call back immediately to the central office.

One method of paging is by Short Message Service, or SMS. SMS is often used to send short text messages between two cellular phones. In some cases a message can be sent from a computer using a traditional SMTP (email) server.

But there may be obstacles to sending an SMS. First, the computer running the data collection system may not have access to an SMTP server. Or if the computer is using a cellular modem to connect to the Internet it may not be able to send SMS messages without first terminating the Internet connection. Finally, for security reasons, some cellular providers only allow SMS messages to be exchanged between two mobile devices, and not between a mobile device and an SMTP server.

The *SMS Modem* is a special configuration of a CNI2. Its sole purpose is to allow the central computer to send mobile-to-mobile SMS messages via the cellular network without interfering with existing Internet connections or requiring an email server connection.

Transparent Modem

In this mode the CNI2 serves as a communications device only and does not count pulses or report alarms. It establishes a two-way connection between the central office and any serial device connected to one of its serial ports.

As a transparent modem a call can be triggered by an alarm event (CALL switch, TAMPER switch, etc.). However since it is not calling a known data collection system such as DC-2009® or MV90® it has no way to report the actual reason for the call.

Allow Transparent Mode

This checkbox only applies when the CNI2 is configured as a Metretek SIP, a Mercury MINI-MAX or Mercury Pulse Accumulator.

At the beginning of a call the CNI2 will attempt to communicate with the data collection system using the Metretek or Mercury protocol. If after a short period of time there is no recognizable response from the system, and if the "*Allow Transparent*" box is checked, the CNI2 will establish a transparent communications link between the device attached to its serial port and the host system.

Here's an example of how this might be used. Let's say the CNI2 is counting pulses from its UMB index and its serial port is connected to a digital camera. The CNI2 will normally call into DC-2009® or MV90® to report its UMB count information. The data collection system does not know that there is a camera at the site and wouldn't know how to communicate with it anyway.

Now another application program (not DC-2009® or MV90®) wants to capture an image of the site where the CNI2 is located. After the CNI2 connects and does not receive a recognizable Metretek or Mercury response it will establish a connection to the camera. At this point the application program can now communicate directly with the camera and will close the connection when finished.

On the *Cellular Settings* configuration screen (to be discussed shortly) is a setting called "*Session Timeout*". During transparent mode if there is no communications between the host system and the serial device for this period of time, the CNI2 will terminate the connection by itself. This period of time has a direct impact on battery life and should be kept as short as is reasonable for the application.

Also see the next discussion about port selection as this also affects the transparent mode of operation.

When Answering if No Port Select…….

This setting is used when the CNI2 is allowed to enter "transparent" mode. In this mode the CNI2 will establish a transparent communications link between the host system and the device attached to one of its serial ports (see previous discussions). This mode is only possible if (a) the CNI2 has been configured as a "*Transparent Modem*" or (b) the CNI2 is configured as a Metretek or Mercury data logger and the "*Allow Transparent*" box is checked.

The CNI2 has one on-board serial port (Port-1). This can be expanded to two ports using the Serial Port Multiplexer discussed earlier in this document. Future options will allow up to 7 additional ports to be added.

Each port is assigned a unique ID number using the *Serial Port Configuration* screen, to be discussed shortly. Port-1 is automatically assigned the RUID that is assigned to the entire CNI2. Port-2 and beyond are assigned unique ID numbers by you.

When the CNI2 receives an incoming connection request, or is paged to call back to the central office, it needs to know which serial port to select for the call. Once the connection with the host is established the CNI2 will wait a certain number of seconds (defined by you) for a special command to arrive from the host. This command has the format:

+-+PAxxxxxx<cr>

where "xxxxxx" is the ID of one of the serial ports and <cr> is a carriage return character. The "xxxxxx" must contain all six digits of the RUID including leading 0's.

If the ID number in the command is valid and that port is enabled (via the *Serial Port Configuration* screen), then CNI2 will return the following response:

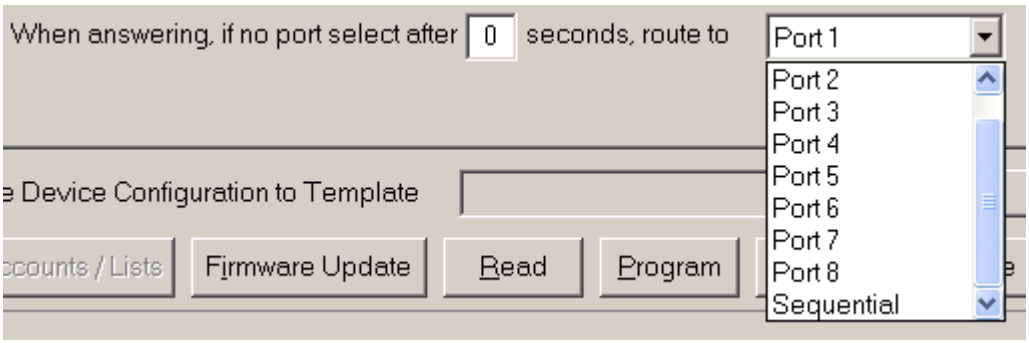
<cr><lf> CONNECTED TO PORT- xxxxxx<cr><lf>

where "xxxxxx" is the ID of the serial port, <lf> is a line feed character and <cr> is a carriage return character.

If the ID number in the command is not in the list, or if that particular port is not enabled (via the *Serial Port Configuration* screen), then the "*Route To*" port will be selected and the CNI2 will return the following response:

<cr><lf> INVALID PORT NUMBER OR PORT IS NOT ENABLED<cr><lf>

If the +-+PA command is not received within the specified time frame then the CNI2 will select a port based on the "*Route To*" setting.



"Route To" Port Selection in Transparent Mode

Port-1 is the on-board port (or the first channel of the Serial Port Multiplexer board). Port-2 is the second channel of the Serial Port Multiplexer board.

"*Sequential*" will cause the CNI2 to select the next enabled port with each call. For instance if Ports-1,2 and 3 are enabled then Port-1 will be selected on the first call, Port-2 on the next call, Port-3 on the third call and back to Port-1 on the next call.

With each call the CNI2 will send the following message to the host system:

<cr><lf> CONNECTED TO PORT- xxxxxx<cr><lf>

where "xxxxxx" is the ID of the serial port, <lf> is a line feed character and <cr> is a carriage return character.

Low Battery Alarm

When the batteries get low the CNI2 will start logging and reporting low-battery alarms to the data collection system. The voltage level is preset at the factory for most applications. If you check the "*Immediate Call on Low Battery Condition*" box the unit will immediately call in whenever the low battery point is reached. If this box is unchecked then the low battery condition will be reported on the next call.

NOTE
Even if the "*immediate call*" box is checked the data collection system (DC-2009® or MV90®) has the ability to override it.

The CNI2 will record the time of the day that the alarm event occurred and this time will be reported to the central office.

Queue Size

The CNI2 can count electrical pulses from up to siz sources although the data collection system (DC-2009® or MV90®) will only accept up to 4. Pulses are counted over a specific time interval and the total for that period is saved as one record. It then starts the counting process over for the next time interval and this process continues indefinitely. The place where this is stored is called the "queue".

The time interval can be anything evenly divisible into 60 minutes. A shorter time period allows you to observe small changes with more detail. But it also consumes memory more quickly, causing the CNI2 to need to communicate with the data collection system more frequently so that older data is not lost. This can have an impact on both battery life and the cost of the cellular service.

The CNI2 can save a total of 30,000 records before it starts to overwrite the oldest records. These are divided equally between all active pulse-counting channels. If only one channel is used for pulse-counting then all 30,000 record locations will be used for that channel. If using a 10-minute interval it would take a little over 200 days to reach the end of the memory. If three channels are active then each channel is allocated 1/3 of the memory, or 10,000 records.

Each record consumes 2 bytes of memory. For a queue size of 30,000 records select the "60K" size. For a smaller queue (16,000 records) select the "32K" size. The data collection system (DC-2009® or MV90®) has the ability to request the entire contents of the queue, so a smaller queue size will result in a shorter call, lower power consumption and lower cellular costs.

Queue Full Alarm

To prevent the loss of accumulated data the CNI2 will place an immediate call to the central office when the storage "queue" reaches a certain point. You can define this as any percentage between 1% and 100%. Default is 75%.

Sample Rates

The CNI2 does not inspect the state of the inputs 100% of the time; otherwise it wouldn't have time to perform any other functions. Rather the CNI2 briefly inspects ("*samples*") the condition of the lines one or more times each second. You can configure the CNI2 to take as few as one sample per second or as many as 50 samples per second. The 12 possible input/output lines are divided into two groups, each with its own sampling rate. Lines-1, 2, 9, 10, 11 and 12 are one group. Lines-3 thru 8 are in the other group.

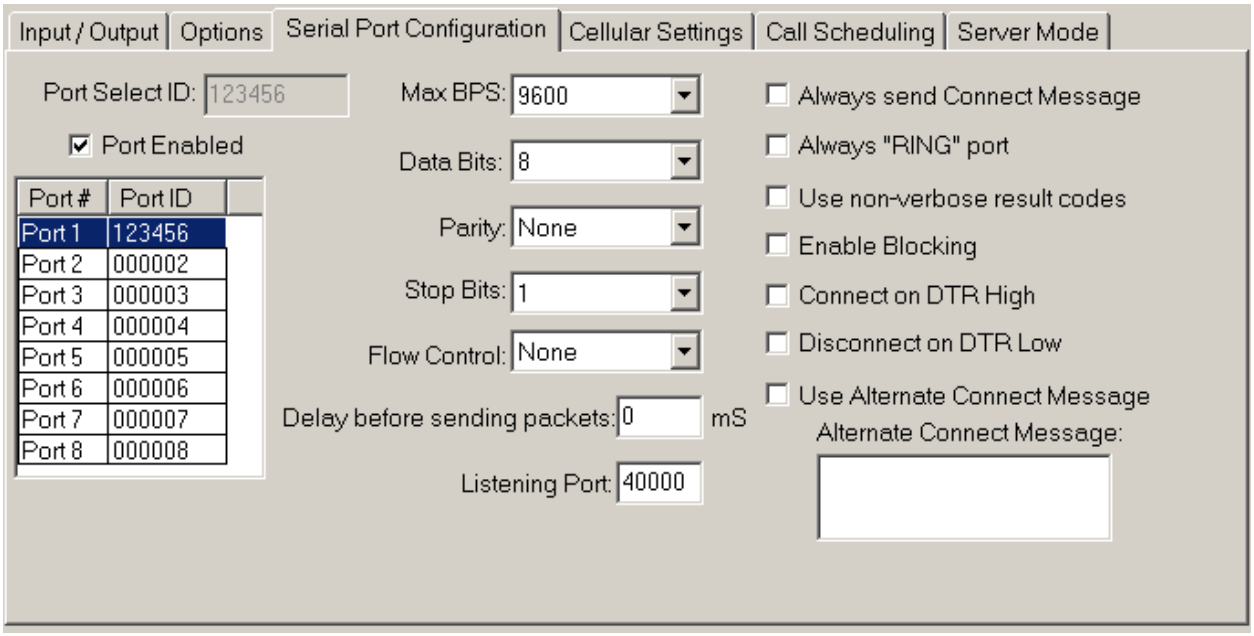
NOTE
Lines #3 thru #8 are only available using an optional expansion board which is not available at this time.

The sample rate is based on how quickly you expect the inputs to change. Faster sampling rates are used for quickly-changing inputs but results in higher power consumption. Too slow of a sampling rate can lead to errors.

Debouncing and sample rates are discussed in more detail later in this document.

SERIAL PORT CONFIGURATION SCREEN

Besides processing alarms and pulse data the CNI2 can act as a “transparent” modem. This allows the central computer to communicate directly with a device connected to the CNI2’s RS-232 serial port. An option board called the Dual Port Multiplexer allows a second port to be added. Future expansion boards will offer even more ports.



Serial Port Configuration Screen

Port Select ID

Each serial port must be assigned a unique *Port Select ID* number. The format follows that of the Primary RUID discussed earlier. Serial Port-1 is the physical port TB2 on the CNI2 board and is automatically set to the Primary RUID. Its Port Select ID is grayed out and cannot be changed.

Port Enable

Check the *Port Enabled* box to turn on a serial port. Ports must be enabled in ascending order starting with Port-1. For instance if Port-1 is enabled, and then you skip to Port-4 and enable it, this will automatically enable Ports-2 and 3 as well. Conversely if Ports 1 thru 4 are enabled and you disable Port-2, this will automatically disable Ports-3 and 4 as well.

Max BPS. Data Bits, Parity, Stop Bits

These parameters must match the settings of the device connected to each serial port.

Flow Control

There may be situations in which the device connected to the serial port is sending data at a volume that exceeds the CNI2's capacity to process it and pass it on to the central computer.

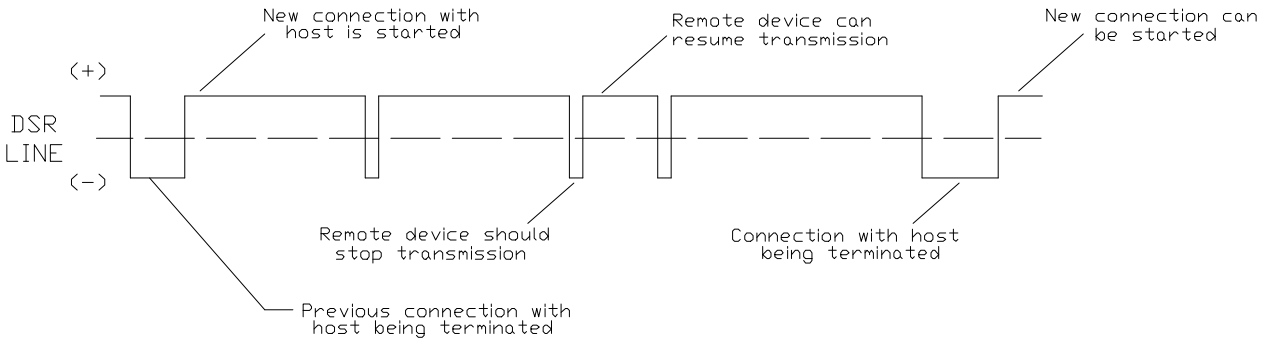
In packet mode the data from the serial device is assembled into a "packet", then sent on to the central computer. A packet cannot be larger than 1100 bytes and each packet's arrival at the central computer must be verified before another can be sent. Due to latency in the cellular networks and on the Internet each exchange may take several seconds to complete. During this time it may be necessary to stop the serial device from sending any more information. The actual packet size is adjustable using the "*Maximum Packet Size*" setting in the *Cellular Settings* configuration screen.

Some devices do not support any kind of handshaking and may have large messages to send. This is not usually a problem in CSD mode because each byte is immediately sent to the central computer. In packet mode when the user-defined packet size is reached it is sent to the server. Meanwhile the data that continues to be transmitted by the serial device is stored in memory. After the previous packet has been sent another is collected, packaged and sent. As each packet is delivered to the server there is that much more space is freed up for new data. However, it is possible for the serial device to eventually overrun the memory if the packets are slow to be delivered to the server. This may lead to the loss of data. One possible solution is to reduce the baud rate between the serial device and the CNI. This may give the CNI2 enough time to deliver packets and keep up with new data.

There are several methods commonly used to control the flow of data between serial devices, generally called "handshaking". The selections are *None*, *Hardware*, *Software or RS-485 Half Duplex*. Other selections are for other applications and should not be used.

Hardware Handshaking

Hardware handshaking uses additional signals on the hardware interface to stop and start the flow of data from the serial device. On the CNI2's terminal block is an output signal called DSR. This signal would normally be connected to the "CTS" (clear-to-send) input line on the serial device. Initially the DSR line will be positive. A positive voltage on this line indicates that the serial device may transmit data. When DSR goes negative, the serial device should halt its transmission. When the connection is terminated the DSR line will go negative for a brief moment and then go positive until the next connection.



Hardware Flow Control

Software Handshaking

Xon/Xoff handshaking (also called "software handshaking") uses two ASCII characters to stop and start the flow. The CNI2 will send an "Xoff" (19 decimal or 13 hex) to the serial device to stop the transmission, and an "Xon" (17 decimal or 11 hex) to resume transmission. Once an Xoff character is sent the serial device should halt its transmission. Also the DSR line will remain positive throughout the session. When the connection is terminated the DSR line will go negative for a brief moment and then go positive until the next connection.

No (None) Handshaking

If *NONE* is selected the DSR line will remain positive throughout the session. When the connection is terminated the DSR line will go negative for a brief moment and then go positive until the next connection. In CSD mode each byte of data from the serial device is immediately passed on to the central computer, and visa versa. In this case flow control is generally not needed and "*NONE*" can be selected as the flow control method.

In packet mode if the serial device never sends more than 1100 bytes in one message and must receive a response before sending another message, then the flow control can be set to "*NONE*".

RS-485 Half Duplex

Select this when using the optional RS485 conversion board and only when it is being used in half-duplex mode.

Delay before Sending Packets

In packet mode the data from the serial device is assembled into "packets" and sent on to the central computer. The maximum size of the packet is programmable and cannot exceed 1100 bytes. The data from the serial device is sent out whenever it exceeds the maximum packet size.

However some or all messages from the serial device may never exceed the maximum packet size. Therefore the CNI2 must have a way to determine when the serial device's message is complete and ready to send to the host. Some serial devices may terminate a message with a particular character like a carriage return or line feed. However for other devices these two characters may be meaningful data. Therefore searching for a particular terminating character may not work in all cases.

The CNI2 determines when a message is complete when there have been no characters received from the serial device for a certain period of time. This value can range from 1 to 65535 milliseconds and may have to be determined experimentally. A value that is too low may cause a message to be sent is several packets. Also, each packet contains the device's message along with some overhead information used for routing and error checking. Breaking a larger message down into several packets means more overhead and could affect the cost of the cellular service. Remember, the cost of packet service is usually based on the number of bytes exchanged in a month.

Choosing a value that is too high may cause the application program running on the central computer to abort or retry too often because it did not receive a response within an acceptable period of time.

Start with a value of 50 ms and fine-tune it from there.

Always Send CONNECT Message

The serial device connected to the CNI2 can request a call or answer an incoming call by issuing specific "AT" commands such as "ATD" (dial) or "ATA" (answer). When the connection with the central computer has been established the CNI2 will send a "CONNECT" message to the serial device to let it know that the connection has been established.

The CNI2 can also place a call on its own in response to an alarm condition or some other event. In these situations the CNI2 would not normally send a "CONNECT" message to the serial device. However some devices may require a "CONNECT" message before allowing further communications. By checking the *Always Send Connect Message* box the CNI2 will always send a "CONNECT" message every time it connects with the central computer, regardless of who originated the call.

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Always "RING" Port

In some applications the serial device connected to the CNI2 may have been programmed to automatically answer incoming calls. After the call is answered and a connection is established with the central computer a "CONNECT" message is usually sent to the serial device.

In other applications the serial device might control when incoming calls will be answered. The CNI2 will send a number of "RING" messages to the serial device and wait for the serial device to respond with an answer ("ATA") command. If this mode is required, check the *Always "RING" Port* checkbox. The CNI2 will send up to three "RING" messages to the remote device. If an "ATA" is received the CNI2 will respond with a "CONNECT" message. If no response is received the CNI2 will send a "CONNECT" message only if the *Always Send Connect Message* box has been checked.

Use Non-verbose Result Codes

For AT-compatible modems a "verbose" message is usually a readable text string such as "CONNECT" or "RING". A "terse", "numeric", or "non-verbose" message typically consists of one or two numeric digits, such as "2". The CNI2 defaults to verbose messages, but the remote device can change this by issuing an "ATV" or "ATV0" command. However some devices may simply expect non-verbose messages and will not issue any additional commands to make this happen. In this case check the *Use Non-verbose Result Codes* box.

Enable Blocking

This is used solely for InvisiConnect® applications and is not currently supported.

Use Alternate CONNECT Message

Usually the serial device requires some sort of notification when a connection has been established with the central computer. Often this message will be "CONNECT xxxx", where "xxxx" indicates the baud rate, such as "CONNECT 9600". The CNI2 defaults to this format, but

the serial device can change this to a simple “CONNECT” message by issuing an “ATX” command. However some serial devices may simply expect a simple “CONNECT” message and will not issue any additional commands to make this happen. In this case check the *Edit CONNECT Message* box.

You must specify the exact message in the *Connect Message* window. This includes non-readable (control) characters. Non-verbose responses are often one to two ASCII numbers followed by a carriage return character. Verbose messages are normally preceded and followed by a carriage return and line feed combination. Use the “Enter” key on your keyboard to insert a carriage return and line feed combination. To insert a single line feed character press and hold the ALT key while on the keyboard’s numeric keypad enter the digits 0 1 0. Then release the ALT key. To insert a single carriage return character press and hold the ALT key while on the keyboard’s numeric keypad enter the digits 0 1 3. Then release the ALT key. In either case you will not actually see the characters in the window, but you may see the cursor move to the next line.

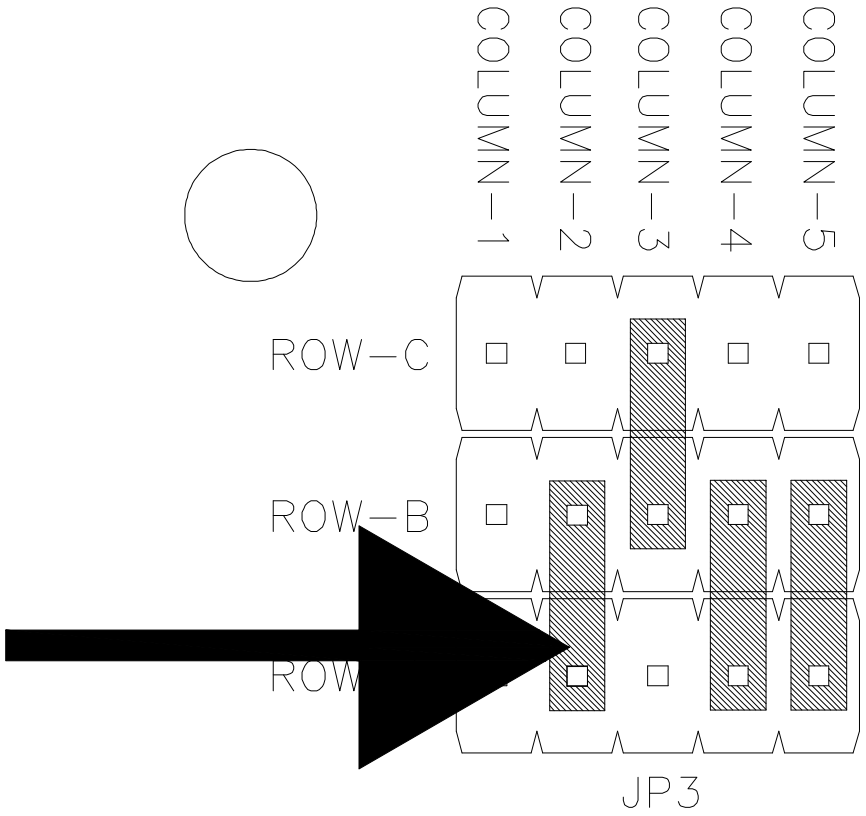
Connect on DTR High

Some serial devices may indicate a desire to place a call by simply activating a control line. On the CNI2’s TB2 terminal block is an input line called DTR. If the DTR input line on the communications terminal block goes positive, the CNI2 will wait 10 seconds for an “ATD” (dial) or “ATA” (answer) command from the device. If a command is received the CNI2 will start the call process. Otherwise a call will be placed after 10 seconds and the CNI2 will behave according to the *Always Send Connect Message* setting. If enabled a “CONNECT” message will be sent to the serial device once the connection with the central computer has been established. The call will end with a “NO CARRIER” message. If the connection cannot be established a “NO CARRIER” message is returned.

As discussed earlier two remote devices can be wired to the same CNI2 using the optional Serial Port Multiplexer board. Either remote device can raise the DTR line but the CNI2 will not be able to determine which device is actually asserting the line. If the wrong port is selected when this happens the CNI2 may not see the “ATD” command if the remote device issues one.

NOTE

When the CNI2 is in low-power “sleep” mode it can only detect that the DTR line has gone active if the JP3-2 jumper is in the “A-B” position. See the next illustration.



DTR Detection Jumper

Disconnect on DTR Low

Some serial devices may indicate a desire to terminate a call by simply deactivating a control line. On the CNI2's TB2 terminal block is an input line called DTR. If the DTR input line on the communications terminal block is positive when the call starts, and then goes negative while the call is in progress, the CNI2 will terminate the call.

As discussed earlier two remote devices can be wired to the same CNI2 using the optional Serial Port Multiplexer board. Either remote device can deactivate the DTR line but the CNI2 will not be able to determine which device is actually doing this. It might be possible that the call started by one device might be accidently terminated by the other device. In this case you might consider having the serial devices trigger an alarm input on the CNI2 rather than using the DTR line.

CELLULAR SETTINGS SCREEN

CDMA Service (Aeris, Verizon, Sprint)

CDMA is an abbreviation for **C**ode **D**ivision **M**ultiple **A**ccess communications. CDMA technology was originally developed for military applications but was eventually commercialized. This communications standard is widely used in North America and in some parts of Asia and South America.

Rather than dividing calls into time slots like GSM, CDMA allows all users to transmit at the same time. Each call is accompanied by a unique digital code that allows it to be differentiated from the rest. As an analogy suppose you are in a crowded room and many conversations are taking place at the same time. Your brain is able to distinguish the conversation you are having with your friend because it is able to focus on your friend's voice characteristics. As the room grows more crowded each person must talk louder and the size of the conversation "zone" grows smaller. You may have to move closer to your friend to keep the conversation going. Thus the number of conversations is limited by the overall interference and noise in the room.

A cellular account must be activated with a cellular service provider prior to placing a CNI2 into service. The service provider may ask the device type, which must be specified as the "CNI2 / CDMA24".

CDMA Packet (Internet) Service

Single carrier, radio transmission technology (1X or 1XRTT) packet service may have to be added to a standard voice plan, or may be a stand-alone service.

Packet service packages are generally priced by the number of bytes to be transferred rather than by the minute. Typically the smallest available package will be 1 megabyte (1 Mb) per month. The amount of data that the CNI2 will produce depends upon what sort of data is requested from the CNI2. The amount of information exchanged on each call may range from several hundred bytes to 10's of thousands of bytes. It may be necessary to test the system for several months and then adjust the cellular account for the best cost based on your needs.

The CNI2 requires full Internet access because the data collection software could be running on any server located anywhere in the world. Full access is usually assigned to customers who will be connecting a cellular modem to a personal computer.

One parameter that will be needed is the packet service connection command. In most cases the command will be *ATD#777* but you may want to check with your service provider.

CDMA Circuit Switched Data (CSD) Service

The service provider must support asynchronous circuit-switched data (CSD) exchange at the baud rate of the central computer's modem. Sometimes this capability may be included as part of a standard voice package or it may be an add-on feature at extra cost.

One consideration when ordering service is the frequency of calls to and from the CNI2. Each service provider offers different packages that may include a fixed number of minutes per month for a fixed price. However, when this number is exceeded, the cost per each additional minute

can be very high. There are also variations in the way "minutes" are measured. For example, a call lasting 1 minute 10 seconds may be considered to be a 2-minute call by some providers. It might be possible to purchase less expensive packages that have additional "weekend" or "evening" minutes, and then schedule the CNI2 to call in at those times. Some plans may offer the 1st minute free. This might be advantageous for short calls.

Another consideration when ordering service is the location of the CNI2 with respect to the service provider's network. It is best to describe where the units will be located and where they will be calling, otherwise you could be charged "roaming" or long-distance fees. Some providers offer free long distance or no roaming charges as part of their basic plans.

The final consideration is the direction of the calls. If the CNI2 is to originate calls, then the service must support "mobile-originate" service. If the unit is to receive calls, then "mobile-terminate" service is required.

The service provider may need the following information:

- Type of cellular service desired, which is *circuit-switched data (CSD)*.
- The device type, which must be specified as the "CNI2 / CDMA24".
- Data rate. This rate must match the speed of central computer's modem.
- Mobile-originate and/or mobile-terminate service.
- Number of minutes per month.
- Location of the CNI2and the location of central computer (to determine if "roaming" or long distance charges apply).
- The service provider will need to know the "MEID" number printed on the radio. This is printed on a label on the radio.

Over-the-Air-Activation (OTAA)

Unlike GSM, CDMA technology does not support the use of a SIM memory card (Subscriber Identity Module) to hold and transport account information. Therefore the account information must be downloaded into the cellular radio's own memory. For some carriers this is accomplished by dialing a special phone number to request "over-the-air-activation" (OTAA). The activation phone number is specific to the service provider and must be programmed into the CNI2.

The OTAA process does two things. After the first successful OTAA call a new phone number is programmed into the phone. This is the number that can be used to page the unit via a phone or data call, or via an SMS message. It also starts the account billing process. Second, a "preferred roaming list" (PRL) is downloaded into the phone. This instructs the radio which service provider(s) to search for and connect to.

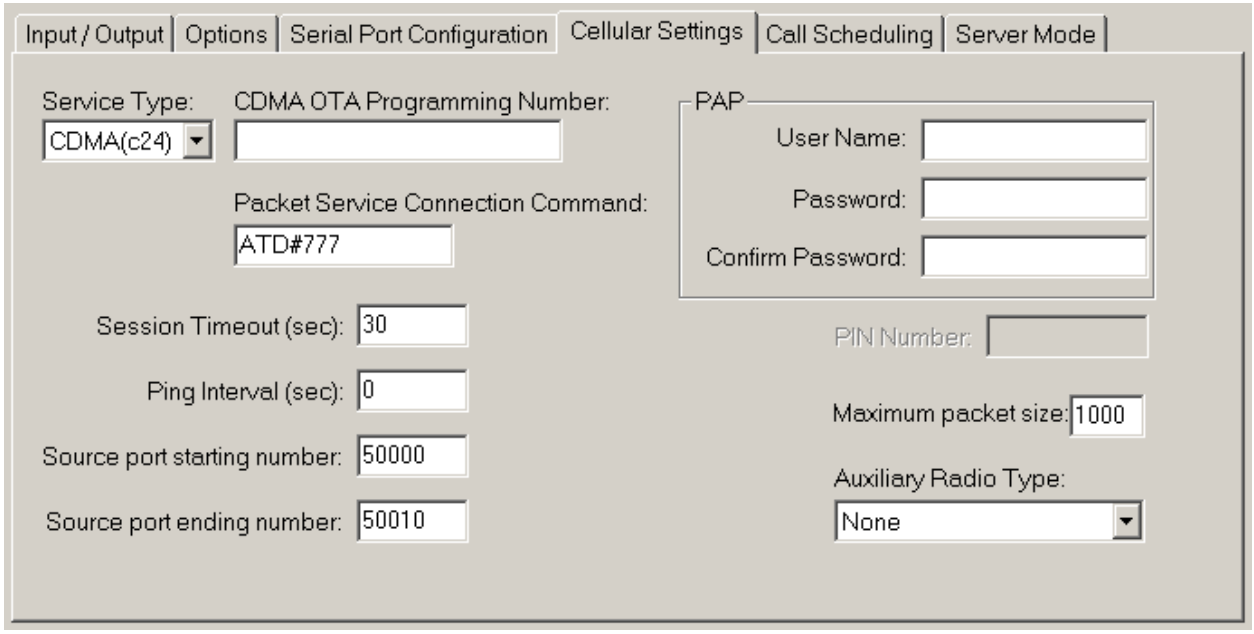
Over-the-air activation is attempted whenever the unit is reset. Another call will be attempted if the first one fails. After two unsuccessful attempts the CNI2 will go into an idle mode and will attempt another OTAA call every hour until one is successful. Until then the unit will not be able to call in to the data collection system.

After the first successful call an OTAA call is then performed every 7 days. The reason for this is that cellular service providers often make arrangements with other providers to carry calls in areas where their own equipment and towers do not exist. These agreements allow the call to

be forwarded at no additional charge. The preferred roaming list says that it is acceptable to connect with these carriers. However at some point your service provider may install new equipment in these areas and the contract with the partner may be terminated. In this new situation roaming fees will be added to each call if the radio is allowed to connect to the other carriers. This is why it is important to periodically update the PRL.

For service providers that do not support "over-the-air-activation" the radios must be preprogrammed at our factory prior to shipment.

Go to the Cellular Settings screen and select "*CDMA*" as the *Service Type*.



CDMA Cellular Configuration Screen

OTAA Programming Number

In some cases after purchasing CDMA service the radio must dial a special phone number to be activated and to have account information downloaded into the phone's memory. This phone number is specific to the carrier and must be entered into the "*OTAA Programming Number*".

For instance for Verizon the number is usually *228,,,,,1; (*228 followed by five (5) commas, then a "1" followed by a semicolon).

NOTE
If your CDMA service provider does not support OTAA programming then leave this field blank.

Packet Service Connection Command

This command is issued to the cellular radio to request a packet (Internet) connection. For most CDMA service providers the phrase "*ATD#777*" will work, and this is the default setting for the CNI2 in CDMA mode.

If you are having problems connecting, this could be the problem. Contact your service provider for more information.

Session Timeout

If there is no communications between the CNI2 and the data collection system for this many seconds then the CNI2 will terminate the connection. Recommended value is 30 seconds.

Ping Interval

Not used in this application.

Source Port Starting / Ending Numbers

This only applies to packet (Internet) connections.

DC-2009® and InvisiConnect® act as an Internet servers on your computer and thus must be allowed access to the outside world. Most corporate computer systems use firewall technology to prevent unauthorized and potentially damaging access from outside sources. To minimize potential invasion DC-2009® or InvisiConnect® and the CNI2 exchange private information using the 64-bit data encryption standard (DES64). If this exchange fails, the connection is terminated by both sides.

When the CNI2 calls in it assigns itself what is known as a "*source port*" number. To further enhance security the CNI2 can be assigned only one or a specific range of source port numbers that the firewall will allow through.

Valid source port numbers are 40000 – 65535. The CNI2 will use a new number with each call. For example for a range of 50000 – 50010, the first call will use 50000, the 2nd call 50001, and so on. When 50010 has been used the next port number will roll back to 50000.

PAP User Name and Password

As an added security measure some cellular service providers require Password Authentication Protocol, or PAP, to gain access to their Internet service. The radio must present a user name and a password that was assigned when the cellular service was purchased. The user name or password can be any combination of printable characters, including spaces, such as "Bob Smith" or "1234". The total number of characters for both the user name and password cannot exceed 48 characters. Often the cellular provider has a specific format for the username and password, so you will need to obtain that information from them.

The password is hidden on this screen for added security. You must enter the password twice to verify that it was entered correctly.

NOTE
If PAP is not required then both the user name and password fields must be blank, otherwise the connection may be refused.

Maximum Packet Size

The setting has no affect in CSD mode. In packet (IP) mode the data from the serial device is assembled into "packets" and sent on to the central computer. The maximum packet size is 1100 bytes. Depending upon cellular network congestion and the quality of the radio connection, it may help to reduce the packet size. The larger the packet, the more chance there is for errors. Several smaller packets may have a better chance of arriving intact than a single large one. As each packet arrives at the central computer, it is checked for errors. If a packet arrives with errors, the computer will request retransmissions until it arrives intact or until a maximum number of retries have occurred. This can introduce significant delays and may increase the cost of the cellular service. Remember, the cost of packet service is based on the number of bytes exchanged in a month. Excessive retries may cause your maximum plan limit to be exceeded.

If you notice excessive retries, or if the connection between the CNI2 and the central computer terminates early or often, this may be the cause.

Auxiliary Radio Type

Not currently supported.

GSM Service (AT&T, T-Mobile, Rogers)

GSM is an abbreviation for **G**lobal **S**ystem for **M**obile communications. This communications standard is widely used throughout Europe, Africa, Asia and parts of North and South America. Messages are digitized into packets and sent in brief bursts during allocated time slots using a variation of TDMA (Time Division Multiple Access) techniques. Up to 8 cellular phones can thus share the same frequency band, which in turn permits the system to support more users with existing equipment. Efficient utilization of spectrum is an important consideration for service providers since there is only a limited bandwidth space that has been allocated to cellular phone service.

Most GSM systems throughout the world operate on either the 900 MHz or 1800 MHz communications bands. In North America most GSM systems operate on the 850 and 1900 MHz bands.

GSM Packet (Internet) Service

Some GSM service providers may not offer all forms of data transfer. General packet radio service (GPRS) may have to be added to a standard voice plan, or may be a stand-alone service.

GPRS packages are generally priced by the number of bytes to be transferred rather than by the minute. Typically the smallest available package will be 1 megabyte (1 Mb) per month. The amount of data that the CNI2 will produce depends upon what sort of data is requested from it. The amount of information exchanged on each call may range from several hundred bytes to 10's of thousands of bytes. It may be necessary to test the system for several months and then adjust the cellular account for the best cost based on your needs.

In order to connect to the Internet, the cellular service provider has its own computer equipment called a "gateway" server, aptly named, as it is their gateway to the Internet. The server will have an "APN" (access point name), usually in the form of a domain name such as "internetaccess.providername.com" or something as simply as "proxy". Contact your service provider for this information. This APN will be needed when configuring the CNI2.

Service providers may have several different gateways to choose from, depending upon the type of service required. "Web phones" (cellular phones that support Internet access) are generally assigned to a gateway that only connects to WAP services (wireless application protocol). The CNI2 requires full Internet access because the data collection software could be running on any server located anywhere in the world. Full access gateways are usually assigned to customers who will be connecting a cellular modem to a personal computer.

Another parameter that will be needed is the packet service connection command. In most cases the command will be *ATD*99#* but you may want to check with your service provider.

A cellular account must be activated with a cellular service provider prior to placing a CNI2 into service. The service provider may ask the device type, which must be specified as the "CNI2 / GSM24".

GSM Circuit Switched Data (CSD) Service

For CSD service the GSM service provider must support asynchronous circuit-switched data (CSD) exchange at 4800 or 9600 baud. The baud rate must match the baud rate of the central computer's modem. Sometimes this capability may be included as part of a standard voice package or it may be an add-on feature at extra cost.

One consideration when ordering service is the frequency of calls to and from the CNI2. Each service provider offers different packages that may include a fixed number of minutes per month for a fixed price. However, when this number is exceeded, the cost per each additional minute can be very high. There are also variations in the way "minutes" are measured. For example, a call lasting 1 minute 10 seconds may be considered to be a 2-minute call by some providers. It might be possible to purchase less expensive packages that have additional "weekend" or "evening" minutes, and then schedule the CNI2 to call in at those times. Some plans may offer the 1st minute free. This might be advantageous for short calls.

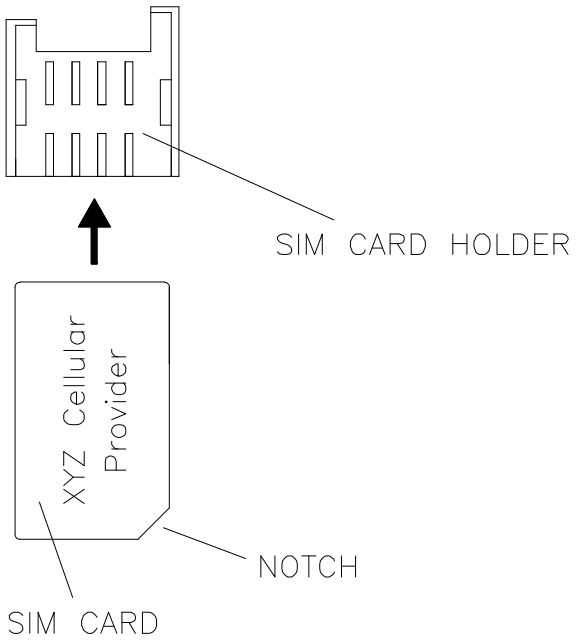
Another consideration when ordering service is the location of the CNI2 with respect to the service provider's network. It is best to describe where the units will be located and where they will be calling, otherwise you could be charged "roaming" or long-distance fees. Some providers offer free long distance or no roaming charges as part of their basic plans.

The final consideration is the direction of the calls. If the CNI2 is to originate calls, then the service must support "mobile-originate" service. If the unit is to receive calls, then "mobile-terminate" service is required.

The service provider will need the following information:

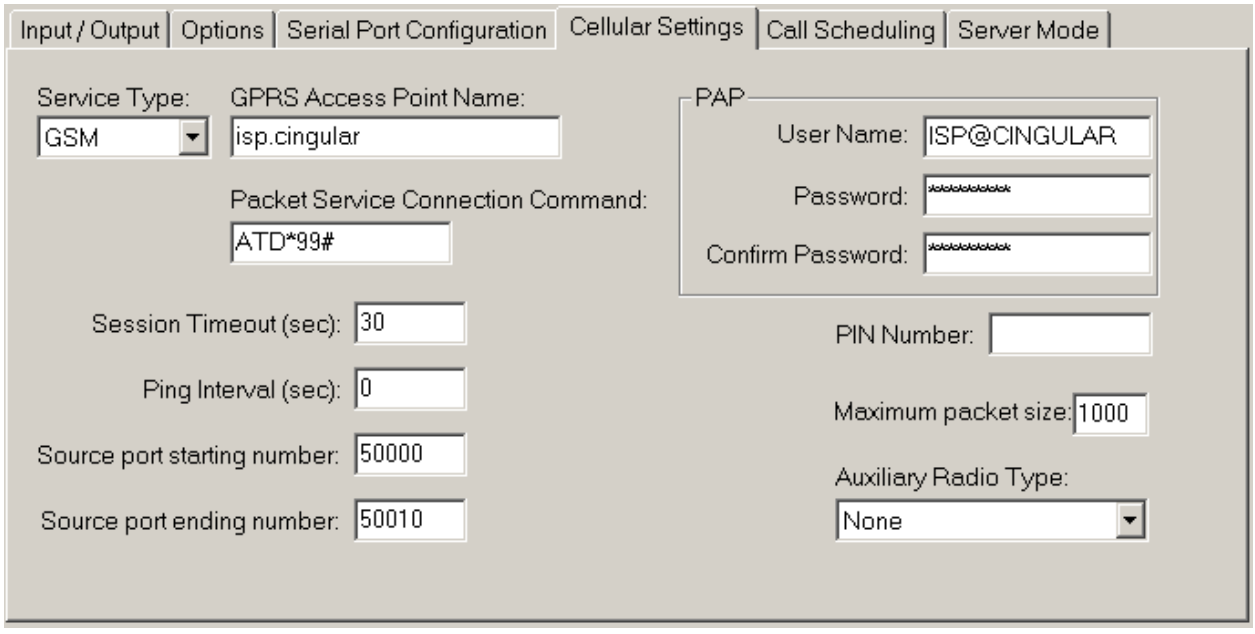
- Type of cellular service desired, which is *circuit-switched data (CSD)*.
- The device type, which must be specified as the "CNI2 / GSM24".
- Data mode is to support 4800 or 9600-baud operation. This rate must match the speed of central computer's modem.
- Mobile-originate and/or mobile-terminate service.
- Number of minutes per month.
- Location of the CNI2 and the location of central computer (to determine if "roaming" or long distance charges apply).
- The service provider may need to know the "IMEI" number printed on the radio.

Installation of the SIM Card



Installation of the SIM Card

Go to the Cellular Settings screen and select "*GSM*" as the *Service Type*.



GSM Cellular Configuration Screen

GPRS Access Point Name

If the CNI2 will be making an Internet connection the cellular service provider will need to provide an Internet APN (access point name). In order to connect to the Internet, the provider has its own computer equipment called a "gateway" server. The server will usually have an APN in the form of a domain name, such as "myserviceprovider.com" or a generic name such as "proxy". Contact your service provider for this information.

Packet Service Connection Command

This command is issued to the cellular radio to request a packet (Internet) connection. For most GSM cellular service providers the phrase "*ATD*99#"* will work, and this is the default setting for the CNI2 in GSM mode.

If you are having problems connecting, this could be the problem. Contact your service provider for more information.

Session Timeout

If there is no communications between the CNI2 and the data collection system for this many seconds then the CNI2 will terminate the connection. Recommended value is 30 seconds.

Ping Interval

Not used in this application.

Source Port Starting / Ending Numbers

This only applies to packet (Internet) connections.

DC-2009® and InvisiConnect® act as an Internet servers on your computer and thus must be allowed access to the outside world. Most corporate computer systems use firewall technology to prevent unauthorized and potentially damaging access from outside sources. To minimize potential invasion DC-2009® or InvisiConnect® and the CNI2 exchange private information using the 64-bit data encryption standard. If this exchange fails, the connection is terminated by both sides.

When the CNI2 calls in it assigns itself what is known as a "*source port*" number. To further enhance security the CNI2 can be assigned only one or a specific range of source port numbers that the firewall will allow through.

Valid source port numbers are 40000 – 65535. The CNI2 will use a new number with each call. For example for a range of 50000 – 50010, the first call will use 50000, the 2nd call 50001, and so on. When 50010 has been used the next port number will roll back to 50000.

PAP User Name and Password

As an added security measure some cellular service providers require Password Authentication Protocol, or PAP, to gain access to their Internet service. The radio must present a user name and a password that was assigned when the cellular service was purchased. The user name or

password can be any combination of printable characters, including spaces, such as “Bob Smith” or “1234”. The total number of characters for both the user name and password cannot exceed 48 characters. Often the cellular provider has a specific format for the username and password, so you will need to obtain that information from them.

The password is hidden on this screen for added security. You must enter the password twice to verify that it was entered correctly.

NOTE
If PAP is not required then both the user name and password fields must be blank, otherwise the connection may be refused.

PIN Number

GSM cellular radios require a memory card called a SIM card (Subscriber Identity Module). This is issued when the cellular service is purchased. A SIM holds information about the account so that certain services are made available to the customer such as Internet access. A SIM card can be moved to a different phone or radio, and the account information moves with it. Though convenient, this may encourage someone to steal the SIM card, insert it into his or her own cellular phone and make hundreds of hours of calls that will be billed to you or your company.

A personal identification number (PIN) is an extra security measure to prevent unauthorized use of a SIM card. The PIN number can range from 1 to 8 numeric digits long and can be assigned by the cellular service provider when the card is activated.

NOTE
If a PIN number is not required then the PIN number field must be blank.

Maximum Packet Size

The setting has no affect in CSD mode. In packet (IP) mode the data from the serial device is assembled into “packets” and sent on to the central computer. The maximum packet size is 1100 bytes. Depending upon cellular network congestion and the quality of the radio connection, it may help to reduce the packet size. The larger the packet, the more chance there is for errors. Several smaller packets may have a better chance of arriving intact than a single large one. As each packet arrives at the central computer, it is checked for errors. If a packet arrives with errors, the computer will request retransmissions until it arrives intact or until a maximum number of retries have occurred. This can introduce significant delays and may increase the cost of the cellular service. Remember, the cost of packet service is based on the number of bytes exchanged in a month. Excessive retries may cause your maximum plan limit to be exceeded.

If you notice excessive retries, or if the connection between the CNI2 and the central computer terminates early or often, this may be the cause.

Auxiliary Radio Type

Not currently supported.

iDENService (Nextel, Harmony)

iDEN is an abbreviation for **I**ntegrated **D**igital **E**nhanced **N**etwork. This communications standard was developed by Motorola and provides its users the benefits of a trunked radio and a cellular telephone. Up to six communication channels share a 25 kHz space. iDEN operates on either the 800 MHz or 900MHz bands and is based on time division multiple access (TDMA) and GSM architectures. It supports circuit-switched data (CSD) and packet (Internet) communications, as well as voice and two-way radio services.

Like GSM radios an iDEN radio requires a memory card called a SIM card (Subscriber Identity Module). When "iDEN" is selected as the *Service Type* most parameters are the same as for GSM. Refer to the previous section for information.

One parameter that is not required is the Internet APN (access point name), so this field is disabled (grayed out).

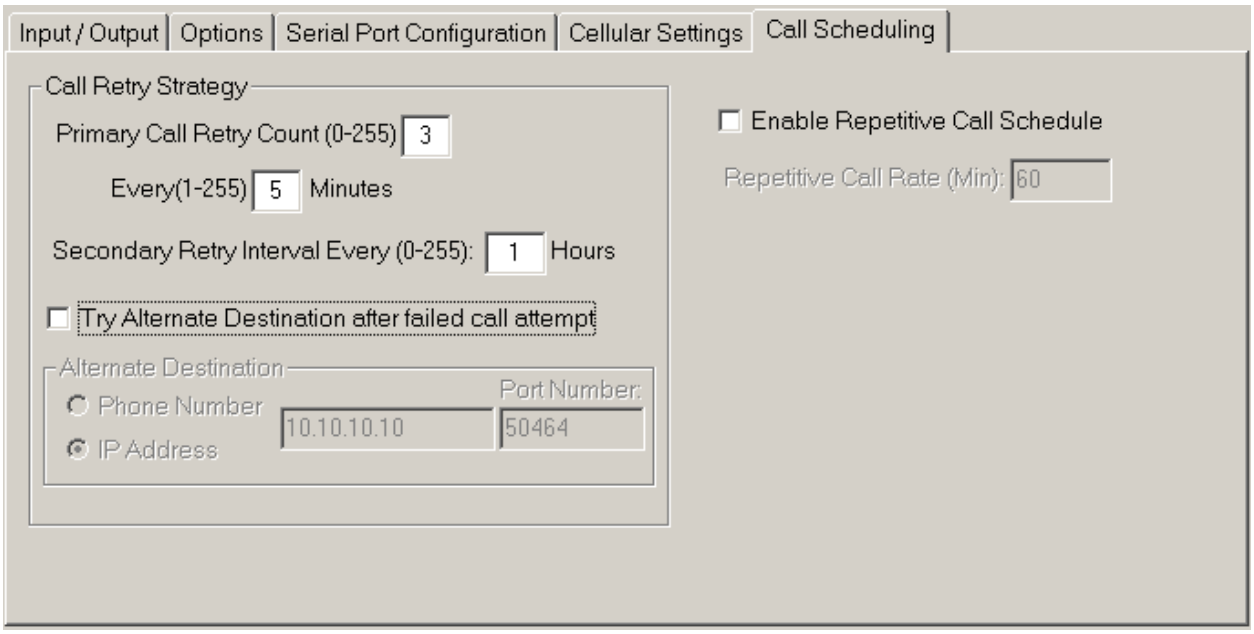
You can leave the Packet Service Connection Command field blank.

NOTE
Due to the availability of iDEN radios support for iDEN service will not be offered after 2010 and may be discontinued earlier.

HSPAService

HSPA (High Speed Packet Access) is not yet supported by the CNI2. If this selection is made the CNI2 will display an error code of "15" until another selection is made.

CALL SCHEDULING SCREEN



Call Scheduling Screen

Call Retry Strategy

If the CNI2 attempts a call and the call is unsuccessful for any reason, it can try the call again at a later time. It can also be told to retry the call to a different computer or not retry the call at all.

If many CNI2s are installed and programmed to call the same system around the same time then it is likely that a few of the calls may fail due to network congestion, or the data collection system may not be configured to accept that many calls at once. To reduce the chance of retries it is best to spread the call schedule out among all of the units.

An overly-aggressive retry strategy will reduce battery life.

Primary Call Retry Count

This is the number of times that the CNI2 will try to repeat a call at the *Primary Call Retry Interval* rate, which is a value between 1 and 255 minutes. Once a call is successful the retry strategy is cancelled. But if the *Primary Retry Count* is exhausted then subsequent calls will be attempted at the *Secondary Call Retry Interval*.

If the *Primary Retry Count* value is specified as 0 then no primary retry attempts are made and the CNI2 will go immediately to the *Secondary interval.*

Primary Call Retry Interval

This is the number of minutes to wait between each Primary retry attempt. The range is from 1 to 255 minutes.

Secondary Call Retry Interval

After the *Primary Call Retry Count* has expired, or if it was set to 0 to begin with, the *Secondary Call Retry Interval* defines the number of hours between each additional attempt, up to 255 maximum. There is no limit to the number of times the CNI2 will attempt a call at this rate. Once a call is successful the retry strategy is cancelled.

If the secondary interval is specified as 0 then no further attempts will be made to retry the call.

To completely disable the retry strategy, set both the *Primary Retry Count* and the *Secondary Retry Interval* to zero (0).

Disabling the retry strategy is not recommended for most applications. Each time the CNI2 contacts DC-2009® or MV90® it is given a new time to call back. If a call fails and the unit is not allowed to retry the call, it will never receive a new call-back time and therefore will not have a reason to call back again unless an alarm situation forces a new call.

If you do disable the retry strategy you may want to consider using the *Repetitive Call Schedule* feature. With this enabled the unit will have another reason to call in at a later time.

Try Alternate Destination

If the CNI2 attempts a call and the call is unsuccessful for any reason, it can immediately retry the call to a different destination. If this 2nd call also fails then the CNI2 will follow the normal retry strategy described earlier. Each new retry will start with a call to the primary destination followed by a call to the alternate destination if the call to the primary destination fails.

This feature is useful when there are several data collection systems sharing the same database and the primary system is overwhelmed with other calls or is down for maintenance or some other reason.

Even if the retry strategy is disabled, if the *Try Alternate Destination* is checked, the CNI2 will still try one call to the alternate destination if the call to the primary destination fails.

Enable Repetitive Call Schedule

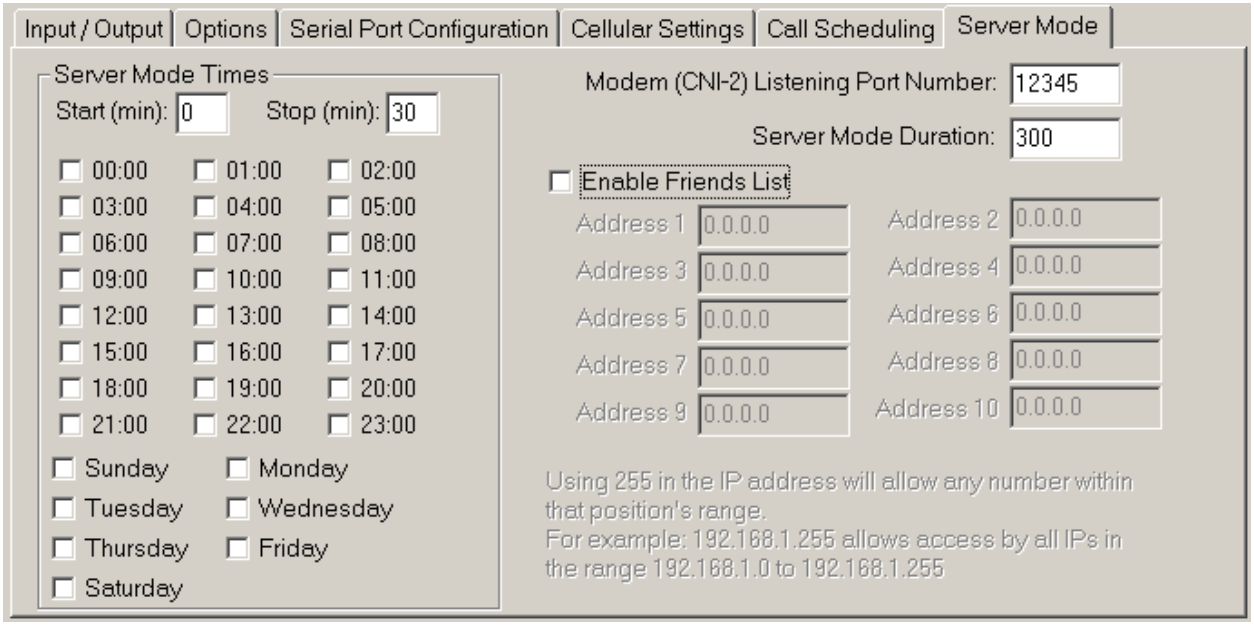
In some applications you might want the CNI2 to call in at regular intervals. Check the box and enter the time period in minutes. This schedule will be followed as soon as the unit is reset or reprogrammed. For instance if the unit is to call in every 24 hours enter a value of 1440 minutes.

SERVER MODE SCREEN

On the Internet there are “servers” and “clients”. A server is usually a computer system that is always running and always “listening” for connection requests from clients. When you use your personal computer to access a website your PC is the client and the website is the server.

A client cannot be contacted directly via the Internet. In many cases, for security reasons and for battery life reasons, the CNI2 acts as a client only.

However the CNI2 can act as a server and accept connection requests from the outside world. It can do this on a full-time basis or at specific times during specific days of the week.



Server Mode Screen

NOTE
At the present time Server Mode is not supported.

PROGRAMMING THE CNI2

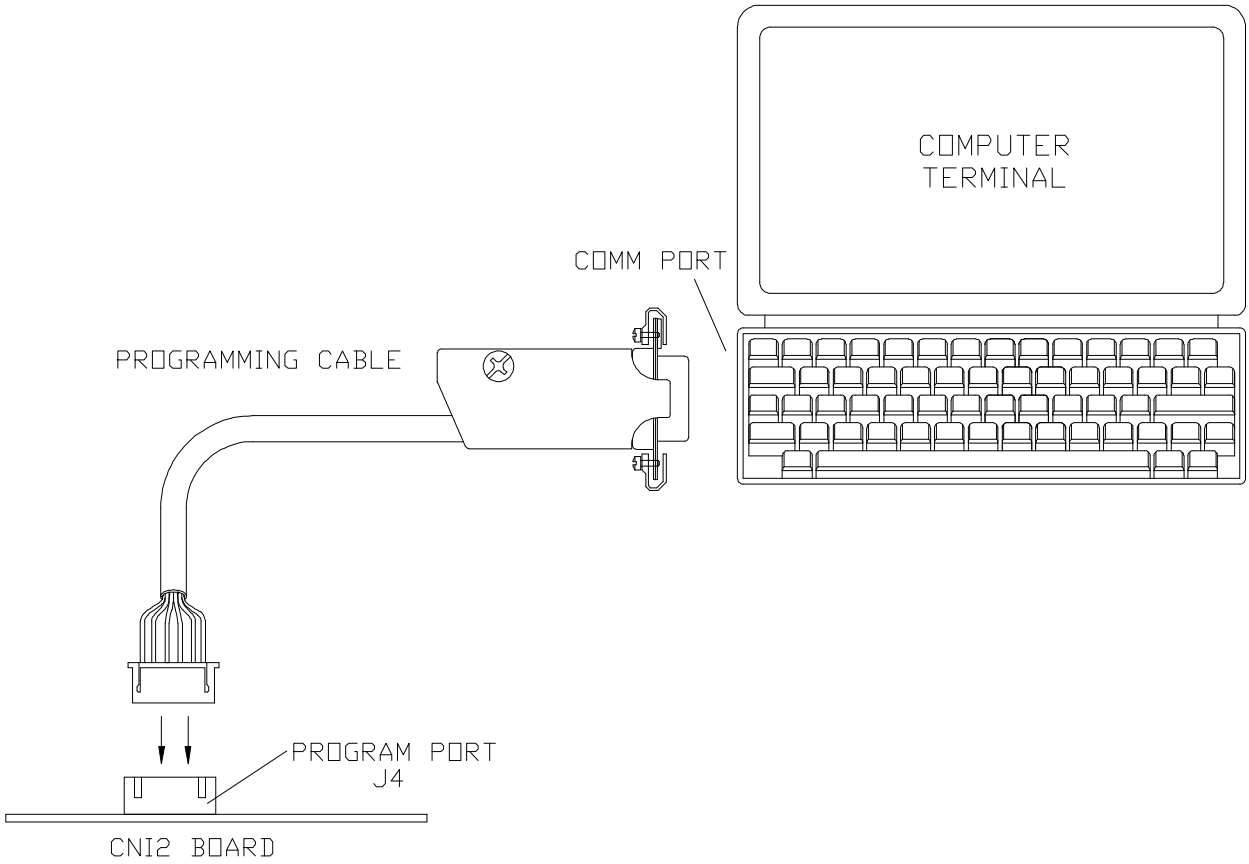
Loading a Configuration with the Programming Cable

IMPORTANT NOTE
Programming the configuration into a CNI2 automatically resets the unit and clears all accumulated data.

1) Make sure the proper COM port is selected (see the beginning of this chapter).

2) Attach the 9-pin end of the programming cable (Figure 4-1) to an available serial communications port on the computer, such as COM1, or if the cable is a USB type (Figure 4-2), then simply attach it to your USB port.

3) Attach the opposite end of the interface cable to the 6-position connector (J4) on the CNI2 board. The connector is keyed and can only insert in one direction.



Attaching the Programming Cable

4) Select the *PROGRAM* button to start programming the CNI2. Status messages will appear in the lower left-hand corner of the screen and should end with an “Operation Successful” message. If an error occurs check your cable and serial port settings.

During programming the RED and GREEN LEDs may light as data is being transferred between the CNI2 and MP32®.

5) When programming has completed, unplug the cable from the CNI2 board. The CNI2 is now ready to be put into service.

OVER-THE-AIR (OTA) PROGRAMMING

What is Over-the-Air Programming?

The CNI2's configuration and/or its operating program (called "firmware") can be changed once the unit is installed in the field. This is called over-the-air (OTA) programming. At the present time this feature is only supported when using the DC-2009® data collection system and then only in Internet (IP) mode. MV90® does not support OTA changes and DC-2009® does not support OTA in CSD mode.

NOTE

The remote unit ID (RUID) and Service Type (GSM or CDMA) cannot be changed over-the-air. These can only be changed using a programming cable.

WARNING

In some case and in some countries (Canada for example) a metering device is not allowed to have its program or configuration changed over-the-air.

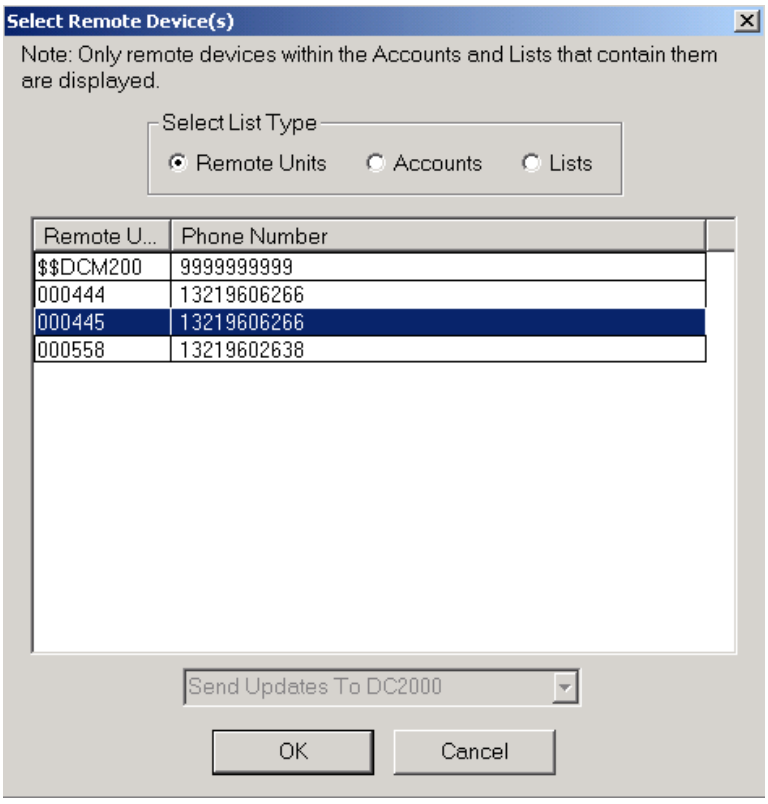
Over-the-Air Configuration Changes

IMPORTANT

It is extremely important that all configuration parameters be correct, especially those related to the cellular network.
Otherwise the CNI2 may not be able to contact the central office again.
This will require an on-site visit to correct the problem.

Both MP32® and DC-2009® must be running on the same system at the same time. The *PROGRAM ACCOUNTS / LISTS* button on the bottom of the main MP32 screen will be enabled only when both programs are running.

Set up all configuration items as you would for any CNI2. Then select the *PROGRAM ACCOUNTS / LISTS* button on the bottom of the main MP32 screen. The following screen will appear.



OTA Device Selection Screen

Since the remote unit ID (RUID) cannot be changed over-the-air it is possible to change the configuration for 1000's of devices in one simple operation using the *Accounts* or *Lists* selections, or simply one at a time using the *Remote Units* selection. Then highlight the desired units.

When the *OK* button is selected the configuration information is saved in DC-2009's database. This new configuration will be loaded into each CNI2 the next time it calls in. If for any reason the configuration update cannot be completed due to a network problem or a data error the original configuration will remain in effect until the new one can be transmitted.

Over-the-Air "Firmware" Changes

The CNI2's operating software, also called "firmware", can be changed over-the-air. Both MP32® and DC-2009® must be running on the same system at the same time.

1. Select the *FIRMWARE UPDATE* button on the bottom of the main MP32 screen.

2. We will provide a software file that contains the new firmware code. Enter the filename into the *Firmware Filename* box or use the browse button to locate it on the disk drive.

WARNING
It is extremely important to select the correct firmware file.
Otherwise the CNI2 may not be able to contact the central computer again.
This will require an on-site visit to correct the problem.

3. Select the *SEND FIRMWARE UPDATE TO DC-2009* button. This button will be enabled only when both MP32® and DC-2009® must be running on the same system at the same time.

4. See the previous screen shot. It is possible to change the firmware for 1000's of devices in one simple operation using the *Accounts* or *Lists* selections, or simply one at a time using the *Remote Units* selection. Then highlight the desired units.

5. When the *OK* button is selected the firmware information is saved in DC-2009's database. This new firmware will be loaded into each CNI2 the next time it calls in.

If for any reason the firmware update cannot be completed due to a network problem or a data error the old firmware will remain in effect until the new one can be transmitted.

RECOMMENDATION

Try an over-the-air firmware update on a CNI2 that is located in your office first!
If you've selected the wrong file you will be able to correct it before sending it to units that are located in the field.

LED STATUS INDICATORS

CALL PROGRESS AND STATUS

Here is a typical sequence from the time the CNI2 is powered up to the time it completes its first call. The **green** LED is mostly used to indicate the status of the radio and the network whereas the **red** LED indicates the progress of the call. After a reset all future calls start at Step-3.

1. Upon power-up or reset both LEDs turn on for 10-20 seconds:
2. The **red** LED will turn off.
3. The **green** LED will start flashing once per second.
4. The radio is powered up and initialized for communications. If this is successful the **green** LED's flash rate will double.
5. When adequate signal is detected and the radio registers with the network the **green** LED's flash rate will double again if the signal strength is less than 3 bars or will triple for signal strength of 3 bars or more.
6. The unit will start a call sequence.
7. While the **green** LED continues to flash the **red** LED will begin flashing once per second.
8. When the unit has established a data connection to the network the **red** LED's flash rate will double.
9. When the unit has gained access to the internet (packet mode only) the **red** LED's flash rate will double again.
10. When the unit establishes a connection with the data collection system (DC-2009® or MV90®) both LEDs will light solidly at half intensity. The **red** LED's intensity will increase and decrease (flicker) during the time that the CNI2 is communicating with the host.
11. Once the call has completed both LEDs will return to flashing rapidly.
12. The **red** LED's flash rate will reduce as the data and network connections are terminated.
13. At the end of a successful call both LEDs will light solidly for 3 seconds. If the call was unsuccessful an error code will be displayed twice. A call will be attempted again later using the retry strategy defined by you. See the next section for a list of error codes.
14. The **red** LED turns off.
15. The **green** LED returns to the slowest flash rate as the radio is being powered down.
16. Both LEDs are turned off when the unit enters its "sleep" mode.

NOTE

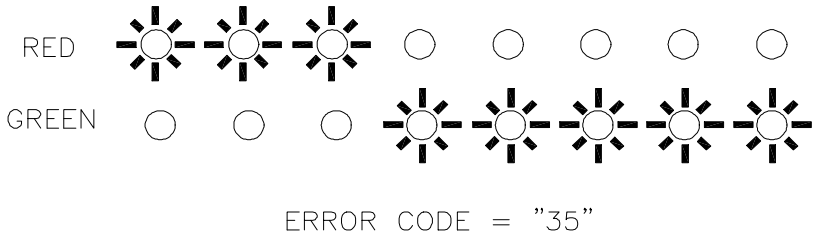
15 minutes after the unit is powered-up or reset the LEDs will no longer display the call progress. This is done to conserve power.

However if a new call is triggered by the magnetic CALL switch or the TAMPER switch the LEDs will be reactivated for another 15 minutes.

ERROR CODES

The two LEDs on the CNI2 board are used to indicate call progress and call status. They are also used to display error codes.

In the event of an error the LEDs will be flashed in a pattern that represents a 2-digit number. The **red** LED represents the first digit while the **green** LED the second digit. For instance, for an error code of "35", the **red** LED will flash 3 times and then the **green** LED will flash 5 times. An error code is displayed several times to allow the user to observe the pattern.



Example of Error Code "35" Display

Error codes are listed on the next few pages.

The last 30 error codes are saved in the CNI2's memory and are reported to the data collection system with each call, but only if calling into DC-2009® or InvisiConnect®. MV90® will not accept this information.

NOTE

15 minutes after the unit is powered-up or reset the LEDs will no longer display error codes. This is done to conserve power. Errors that do occur will still be logged in memory and reported to the data collection system.

However if a new call is triggered by the magnetic CALL switch or the TAMPER switch then new error codes will be displayed for another 15 minutes.

CODE	DESCRIPTION
11	The radio rejected the PIN number that is sometimes required for GSM SIM cards. The PIN number that was programmed into the CNI2 may not be needed or may be incorrect. If a PIN number is not required then it should be left blank.
12	The radio will not register with the cellular network. This could be caused by poor signal strength in the area where the unit is located, or possibly a defective SIM card for GSM units. Otherwise this may be caused by a defective radio or antenna, or a CDMA radio that has not been provisioned correctly.
13	No detectable signal from the cellular network. This could be caused by poor signal strength in the area where the unit is located. Otherwise this may be caused by a defective radio or antenna.
14	The connection was unexpectedly terminated by the cellular network. This is not necessarily a hardware problem. Frequent errors may point to marginal signal strength or interference in the area where the unit is located.
15	The selected "Service Type" in MP32® is not currently supported. The choices for the CNI2 are either GSM or CDMA.
16	The radio did not respond properly when reset. This is not necessarily a hardware problem. This can be caused by a nearly depleted battery. It can also occur if a connection is unexpectedly terminated, which may leave the radio in an unpredictable state. It may take one or two resets to recover from this. Otherwise continuous errors indicate a problem with the radio.
17	The CDMA radio has not been activated by the cellular service provider. This error may occur prior to the first over-the-air-activation (OTAA) call. If the error continues then (a) the OTAA phone number entered in MP32® is wrong (b) the carrier does not support OTAA and the radio must be manually activated or (c) the cellular account is provisioned incorrectly.
18	The radio initialized properly but does not respond to commands. This can be caused by a nearly depleted battery. Otherwise the radio or the GSM SIM card may be defective.
19	The radio does not respond properly to a change in baud rate. This may be a problem with the radio or possible the CNI2 board.

LED Error Codes 11 thru 19

CODE	DESCRIPTION
21	The CNI2 cannot make a connection in CSD mode. This could be caused if the service provider does not support CSD connections or if the modem that is being called is not connecting.
22	The GSM SIM card is defective or cannot be read. Try another SIM card. A SIM card is a memory device and can be damaged by static discharge. If another SIM card also fails then this indicates an electrical problem with the radio or the CNI2 board.
23	The radio does not respond properly to an echo-off command. This is a problem with the radio.
24	The radio cannot be initialized. This can be caused by a nearly depleted battery. Otherwise the radio or GSM SIM card may be defective.
25	The radio did not return a proper response to a command. This is a problem with the radio or perhaps the GSM SIM card.
26	Packet (Internet) service is not available. This is a problem with the network or with the way the cellular account has been set up.
27	The radio does not respond properly to an SMS command. This is a problem with the radio.
28	The over-the-air-activation (OTAA) call failed (CDMA units only)
29	Not used
30	Logic supply Vcc is less than 2.8V during light-load conditions. This is generally caused by a nearly depleted battery.
31	Logic supply Vcc is less than 2.8V during heavy-load conditions (radio powered up). This is generally caused by a nearly depleted battery or a power source that cannot supply the current required by the radio.
32	The output of the radio's regulator circuit is less than 3.4V.
33	There is a data retention problem with the non-volatile EEPROM memory device.
34	The board has not been calibrated.
35	Problem reading voltages and temperature (A/D converter problem)
36	Not used
37	Not used
38	There is no primary phone number to dial or no primary IP address to connect to. Check the configuration.
39	There is a communications problem with the non-volatile EEPROM memory device.

LED Error Codes 21 thru 39

CODE	DESCRIPTION
41	TCP/IP variables could not be initialized. This is generally a firmware problem.
42	Could not establish a point-to-point (PPP) connection with network. This might be caused by the cellular account not being setup for Internet service. It could also be caused by an incorrect PAP username or password, or an incorrect APN for GSM service.
43	Could not establish a TCP/IP connection to the destination server. This might be caused by the cellular account not being setup for Internet service. It could also be caused by an incorrect PAP username or password.
44	Error sending data to the destination server. This is usually caused by an unexpected termination of a connection due to network problems or poor signal conditions.
45	Error receiving data from the destination server. This is usually caused by an unexpected termination of a connection due to network problems or poor signal conditions.
46	Unexpected command from the data collection system. This might indicate a problem with the way the CNI2 is setup in the data collection system.
47	Not used
48	Not used
49	Not used
51	Unexpected response from the data collection system. This might indicate a problem with the way the CNI2 is setup in the data collection system.
52	The memory address specified in a memory write command from the host system (the data collection system) is illegal. This might indicate a problem with the way the CNI2 is setup in the data collection system.
53	Unexpected message received from the data collection system to terminate the connection. This can be caused by network problems or poor signal conditions.
54	Message from the data collection system was too large. This might indicate a problem with the way the CNI2 is setup in the data collection system.
55	Over-the-air configuration update command contained a memory address outside of the configuration memory area.
56	Unrecognized command from the data collection system or an inappropriate combination of commands was received. This might indicate a problem with the way the CNI2 is setup in the data collection system.
57	Not used.
58	Message from the data collection system had an incorrect CRC value. This is usually caused by an unexpected termination of a connection due to network problems or poor signal conditions.
59	Not used

LED Error Codes 41 thru 59

CODE	DESCRIPTION
61	Not used
62	Not used
63	Not used
64	Not used
65	Not used
66	Not used
67	Not used
68	Not used
69	Not used
71	Configuration memory has not been programmed or is corrupt. Attempt to reload the configuration. This could be caused by a nearly-depleted battery. Otherwise the FLASH memory in the processor is defective.
72	There is a data retention or communications problem with the non-volatile EEPROM memory device.
73	Could not write into FLASH memory. This is a problem with the processor.
74	Over-the-air firmware download was aborted. This is usually a network-related problem or problems with the the data collection system data collection system.
75	The watchdog timer expired and generated a reset. This could be caused by defective firmware but might also be caused by a defective crystal.
76	Not used
77	Not used
78	Not used
79	Not used

LED Error Codes 61 thru 79

LEDS AFTER OVER-THE-AIR REPROGRAMMING

If a new operating program (“firmware”) is successfully downloaded over-the-air the call will complete as normal. Then the LEDs will rapidly flash in an alternating pattern for anywhere between 10 – 30 seconds as the CNI2 reprograms itself. At the end of the operation the CNI2 will return to “sleep” mode and both LEDs will turn off.

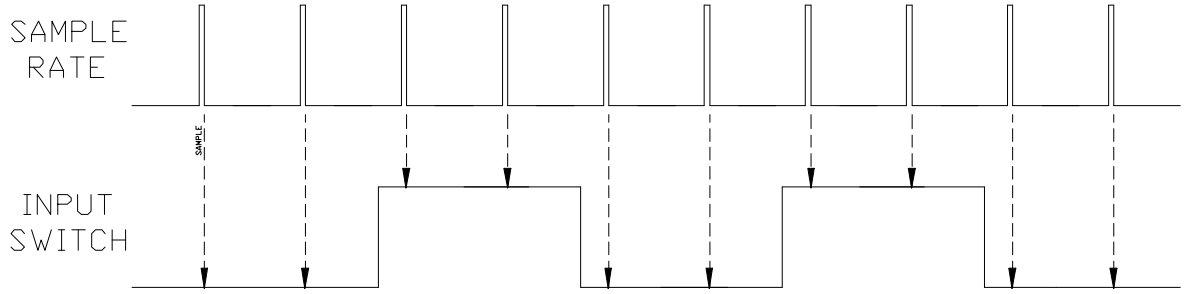
TECHNICAL INFORMATION

"SAMPLE RATE" EXPLAINED

The CNI2 does not inspect the state of the inputs 100% of the time; otherwise it wouldn't have time to perform any other functions. Rather the CNI2 briefly inspects ("*samples*") the condition of the lines one or more times each second. You can configure the CNI2 to take as few as one sample per second or as many as 50 samples per second. The 12 lines are divided into two groups, each with its own sampling rate. Lines-1, 2, 9, 10, 11 and 12 are one group. Lines-3 thru 8 are in the other group.

NOTE
Lines #3 thru #8 are only available using an optional expansion board which is not available at this time.

The sample rate is based on how quickly you expect the inputs to change. Faster sampling rates are used for quickly-changing inputs but results in higher power consumption. Too slow of a sampling rate can lead to errors.

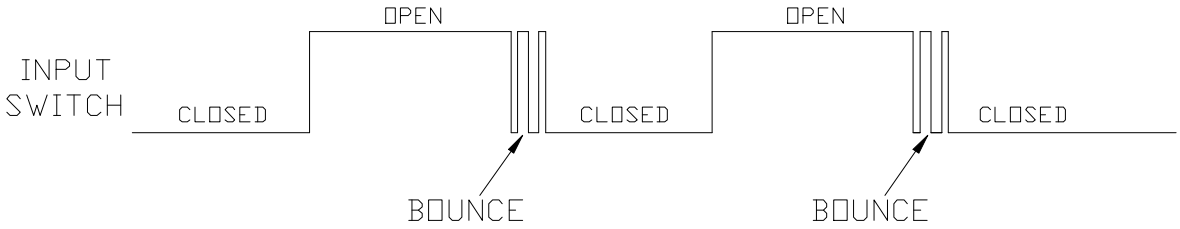


Example of Timed Sampling

"DEBOUNCE" EXPLAINED

What is Switch "Bounce"?

If you strike a hard surface with a stick it is likely to bounce a few times before coming to rest. The same is true for most mechanical switches. As the contacts come together they may "bounce" (open and close a few times), then finally settle in the closed position. This "bouncing" may be falsely interpreted as several events rather than just one. If the CNI2 is counting pulses from this switch it might interpret the bounce as two or three pulses rather than just one. Electronic switches such as transistors do not have this problem.



Example of Switch Bounce

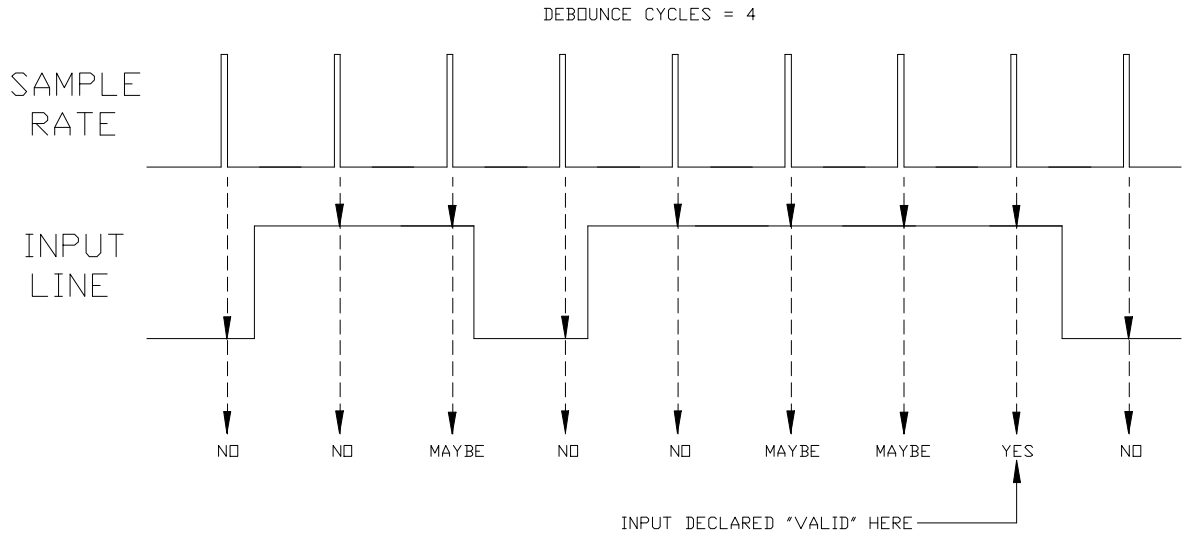
What is "Debouncing"?

The process of "debouncing" requires the switch be in the same state over a specific number of samples to be considered "valid". Therefore the *DEBOUNCE CYCLES* and *SAMPLE RATE* are interrelated. If the input line changes states within this period of time the event is ignored and the debouncing process starts over.

See the next illustration. Suppose an alarm input is sampled 10 times a second and the debounce cycles are set for 4. This means that the input has to be in the same state for 4 consecutive samples (0.4 seconds) to be considered "valid". If it changes even once during this time the entire process starts over. As seen in the illustration the first and second transitions were ignored because they did not stay in that same state for 4 samples. However the third transition was considered to be a "real" event.

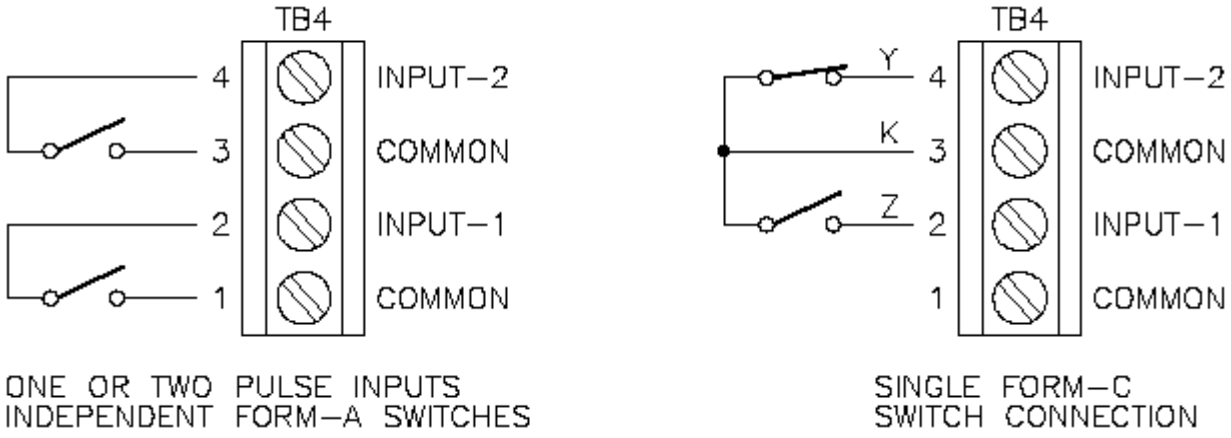
Setting the *DEBOUNCE CYCLES* to 1 will result in the fastest recognition of a change in the switch. As soon as it changes from one state to another it is considered "valid". But this may also lead to inaccurate results if the switch bounces a lot. This setting is normally used with non-mechanical switches such as transistors because they do not exhibit bounce problems.

The debounce cycle count can be as high as 255. The equation is (debounce ÷ sample rate) seconds. For instance if the sample rate is set to 25 and the debounce is 2, then the input condition will be recognized in (2 ÷ 25) seconds, or 0.08 seconds (80 mS). As an alarm input this means that the signal must be in the active (on) state for at least 80 mS to be considered a real alarm. As a pulse counting input the signal must be in the active (on) state for at least 80 mS and in the inactive (off) state for another 80 mS to be considered a real pulse. This total period of 160 mS translates into a maximum pulse rate of 6.25 pulses per second.



Example of Debouncing Process

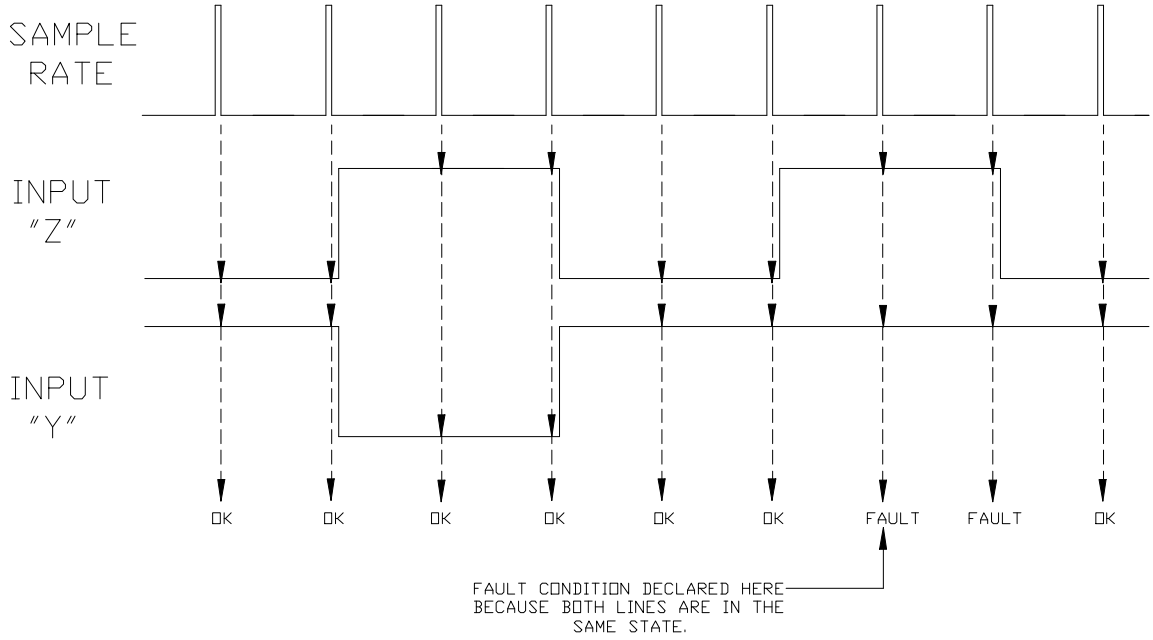
FORM-C OPERATION



Typical Form-A and Form-C (KYZ) Connections

A Form-C (KYZ) switch is often used so that a defective switch or associated wiring can be detected. In the illustration alarm sensing or pulse counting is performed on the “INPUT-1” connection only. “INPUT-2” is used for fault detection.

The switches should never be open or closed at the same time. If so the CNI2 will report an alarm condition. The next figure shows how a KYZ fault is detected.

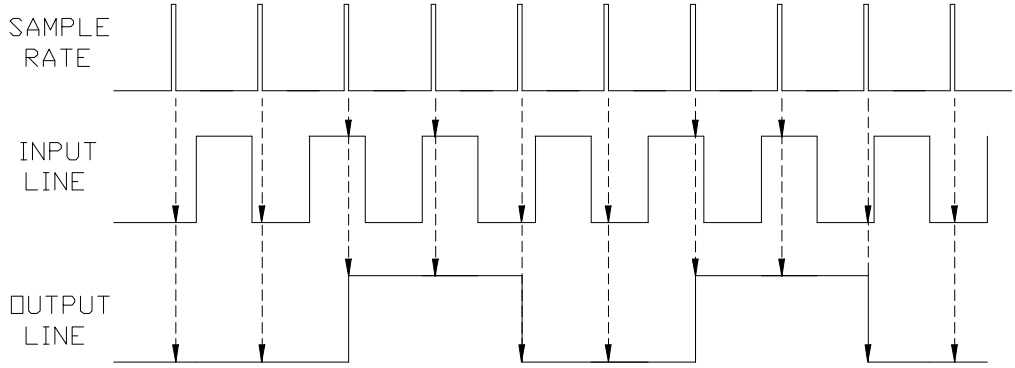


Example of Detection of a Form-C Fault

USING THE OUTPUT

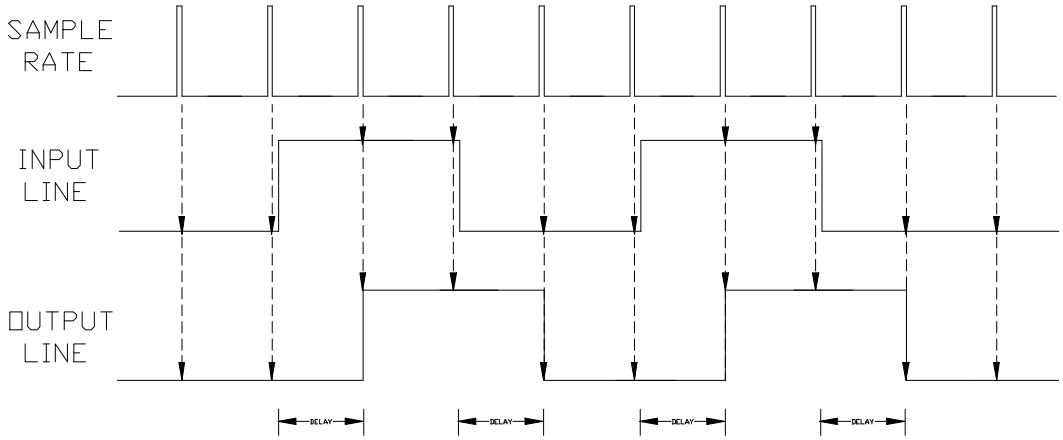
The output line can be configured to replicate (follow) any of the input lines. This allows other pulse-counting or alarm-sensing equipment to have access to the same signals. For instance the CNI2 may be counting pulses on Line-2 and another piece of equipment located nearby may need to count these pulses too.

There are some limitations that you should be aware of. The processor samples each input line at a rate defined by the *SAMPLE RATE*. It then sets the output line to the same state with each pass. Input signals that change faster than the sample rate may not be accurately reproduced as illustrated here.



Accuracy Errors Using the “Output-Follows-Input” Feature

Also, when an input signal changes state there could be a delay of up to one sample period before the output matches that state, as illustrated here.



Delay Errors Using “Output-Follows-Input” Feature

AT MODEM EMULATION MODE

For this discussion the symbol **<cr>** indicates an ASCII control character called “carriage return” and is represented by a single value (byte) of 13 decimal or 0D hex.

For this discussion the symbol **<lf>** indicates an ASCII control character called “line feed” and is represented by a single value (byte) of 10 decimal or 0A hex.

NOTE
If the CNI2 will respond to AT modem commands in ALL modes of operation.

If you have a serial device attached to the CNI2’s serial port it is likely that the device is expecting to communicate with an AT-compatible modem. The acronym “AT” means “attention”. AT modem commands always start with the ASCII characters “AT” or ”at” followed by other characters that define specific operations. The final character of a command string is always a carriage return (<cr>).

Upon completion of a command the modem sends back a response in one of two formats, either “terse” or “verbose”. Terse messages (also called “non-verbose” or “numeric”) are often one to two ASCII numbers followed by a <cr>. Verbose messages are readable ASCII messages preceded and followed by a <cr><lf> combination. For example when an incoming call is detected the verbose message will be “<cr><lf>RING<cr><lf>” whereas the terse version is simply “2<cr>”.

These are the typical responses that the CNI will return to the remote device:

Terse Response (Note-1)	**Verbose Response (Note-2)**	**DESCRIPTION**
0	OK	Accepted, no error
1	CONNECT	Connected with remote modem
2	RING	Incoming call
3	NO CARRIER	Connection with remote modem is lost
4	ERROR	Command error

Note-1: Terse (non-verbose) responses always followed by one carriage return <cr>.

Note-2: Verbose responses always preceded and followed by one carriage return <cr> and one line feed <lf>.

Typical CNI2 “AT” Responses

The remote device may issue commands that were important to the original modem but not to the CNI2. In these cases the CNI2 will return a standard response such as “OK” to these commands. Other commands are meaningful and the CNI2 will act upon them. The following is a list of these commands. The CNI2 defaults to certain settings until programmed otherwise.

ATV (response type) Command

ATV, ATV0: This instructs the CNI2 to return “terse” (non-verbose or numeric) result codes

starting with this command.

ATV1 (default): This instructs the CNI2 to return "verbose" result codes starting with this command. This is the default setting

NOTE:
An ATV command will override the *Use Non-verbose Result Codes* setting that was programmed by MP32.

ATE (echo) Command
An AT modem can be instructed to immediately return every character it receives. This is called "echoing". The "ATE" command controls this function. The default is echo OFF.

ATE, ATE0 (default): This instructs the CNI2 to disable echoing starting with the next command.

ATE1: This instructs the CNI2 to enable echoing starting with the next command.

ATH (hangup) Command
ATH, ATH0: Once a connection has been established this instructs the CNI2 to terminate the connection with the central computer. The normal response to this is "NO CARRIER". If a connection does not exist then the normal response will be "OK".

ATZ (reset) Command
ATZ, ATZ0: Once a connection has been established this command instructs the CNI2 to terminate the connection with the central computer. The normal response to this is "NO CARRIER". If a connection does not exist then the normal response will be "OK".

ATA (answer) Command
ATA: This instructs the CNI2 to answer an incoming call and establish a connection with the central computer. The normal response is a "CONNECT" message if a connection is established or "NO CARRIER" if one could not be established. The CONNECT message can be modified using MP32.

ATD (dial) Command
ATDxxxx, ATDPxxxx, ATDTxxxx: This instructs the CNI2 to establish a connection to the central computer. The "xxxx" portion of this command is the phone number or IP address of the central office. For "ATD" commands with no phone number included, the CNI2 will use the primary destination phone number or IP address that was programmed by MP32.

The normal response is a "CONNECT" message if a connection is established or "NO CARRIER" if one could not be established. The CONNECT message can be modified using MP32.

For CSD calls the "xxxx" portion of the ATD command is the destination phone number followed by a <cr>. Example ATD3215551212<cr> will dial the number 555-12212 in area code 321.

For IP mode the "xxxx" portion of the ATD command is *IP address/Port Number* <cr>. For example ATD192.34.165.29/23267 will connect to IP address 192.34.165.29 on Port #23267.

NOTE
If the CNI2 detects a decimal point (.) or a forward slash (/) in the dial string it will assume this is an IP address and Port #, and not a standard phone number.

+++ (escape) Command

Once the CNI2 has established a connection with the central computer it can no longer respond to AT commands. However AT modems are always looking for an "escape" sequence, which is "+++" preceded and followed by 1 second of quiet time. This will return the CNI2 to command mode and the unit will respond with an "OK" message.

Following this the CNI2 will wait 5 seconds to receive an "ATH" (hangup) command from the device. If the command is received, or 5 seconds elapse, the CNI2 will terminate the connection with the central computer and will return a "NO CARRIER" message to the remote device.

AT Command Chaining

"AT" commands can be grouped together into one string. For example, the command "ATE0V1" commands the CNI2 to turn off echoing and return verbose responses. However "ATA", "ATH" or "ATD" commands should be sent separately or should be the last command in a chain.

AT+ICLK? (time and date) Command

NOTE
This command is only supported when the CNI2 is configured as an InvisiConnect® device.

This command will return the present time and data information to the serial device. InvisiConnect™ provides the time to the CNI with every call if that feature has been enabled.

If the CNI does not have a valid time, or if it is in need of an updated time from InvisiConnect®, an "ERROR" message will be returned to the remote device. Otherwise the response will be formatted as follows, including delimiters such as quotation marks (“), forward slash (/) and colon (:):

<cr><lf>+ICLK: "yy/MM/dd,hh:mm:ss±zz"<cr><lf>

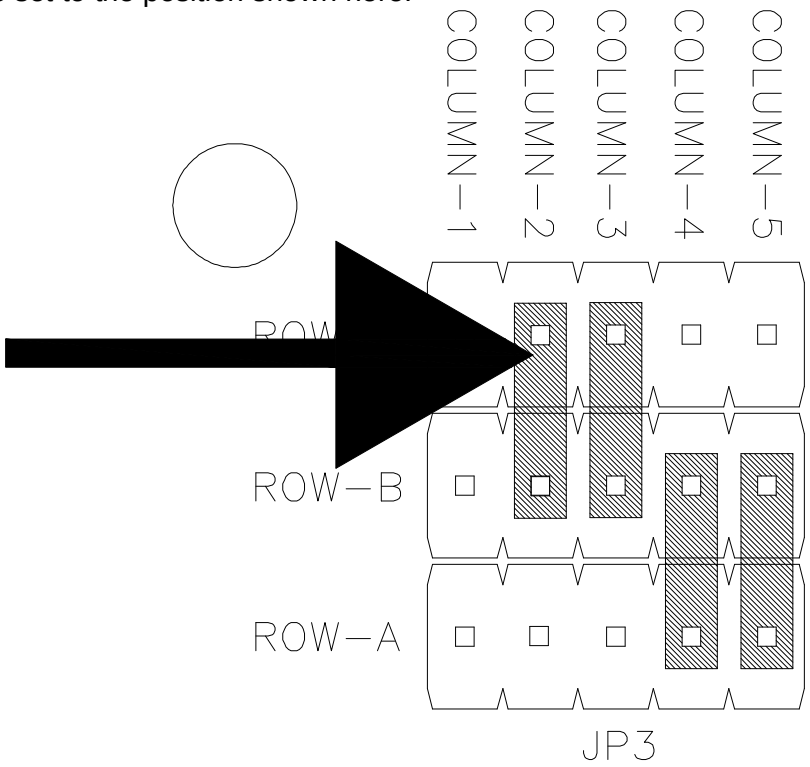
where:

yy = 2-digit year [00-99], as in 2000-2099]
MM = 2-digit month [01-12]
dd = 2-digit day of month [00-31]
hh = 2-digit hour [00-23]
mm = 2-digit minute [00-59]
ss = 2-digit seconds [00-59]
± = "+" or "-"
zz = time zone offset from GMT in ¼ hour increments [-48 to +48]

The time represents the time on the InvisiConnect® computer. If the CNI2 is in a different time zone then the "zz" offset can be used to calculate a correct local time.

Response to AT Commands while in SLEEP Mode

In low-power sleep mode the CNI2 shuts down its serial port components in order to conserve power. However the CNI2 can still detect activity on the received data line (RXD) or the DTR line. A jumper on JP3 selects which line to respond to. To detect incoming AT commands the jumper should be set to the position shown here.



Received Data (RXD) Detection Jumper

NOTE

While in sleep mode the CNI2 will not be able to interpret the very first character that arrives. It is common practice for any serial device to send the same command more than once until it receives a valid response.
The CNI2 should correctly interpret the second command that arrives.

DC-2009 DATA COLLECTION SOFTWARE SETUP

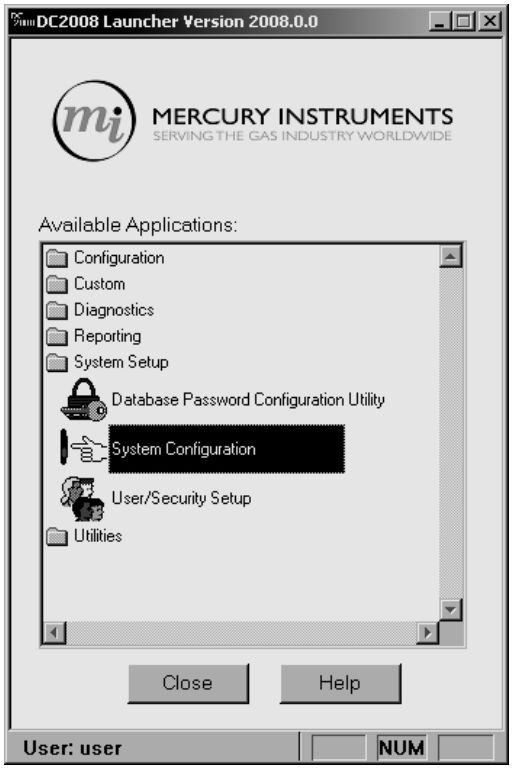
INTRODUCTION

This chapter introduces the fundamental data collection setup parameters needed to start the communications process with the CNI2. It does not address reports or database management. Additional training is available from Honeywell, as well as hands-on training options.

SETTING UP THE SIP SERVER FOR PACKET (INTERNET) CONNECTIONS

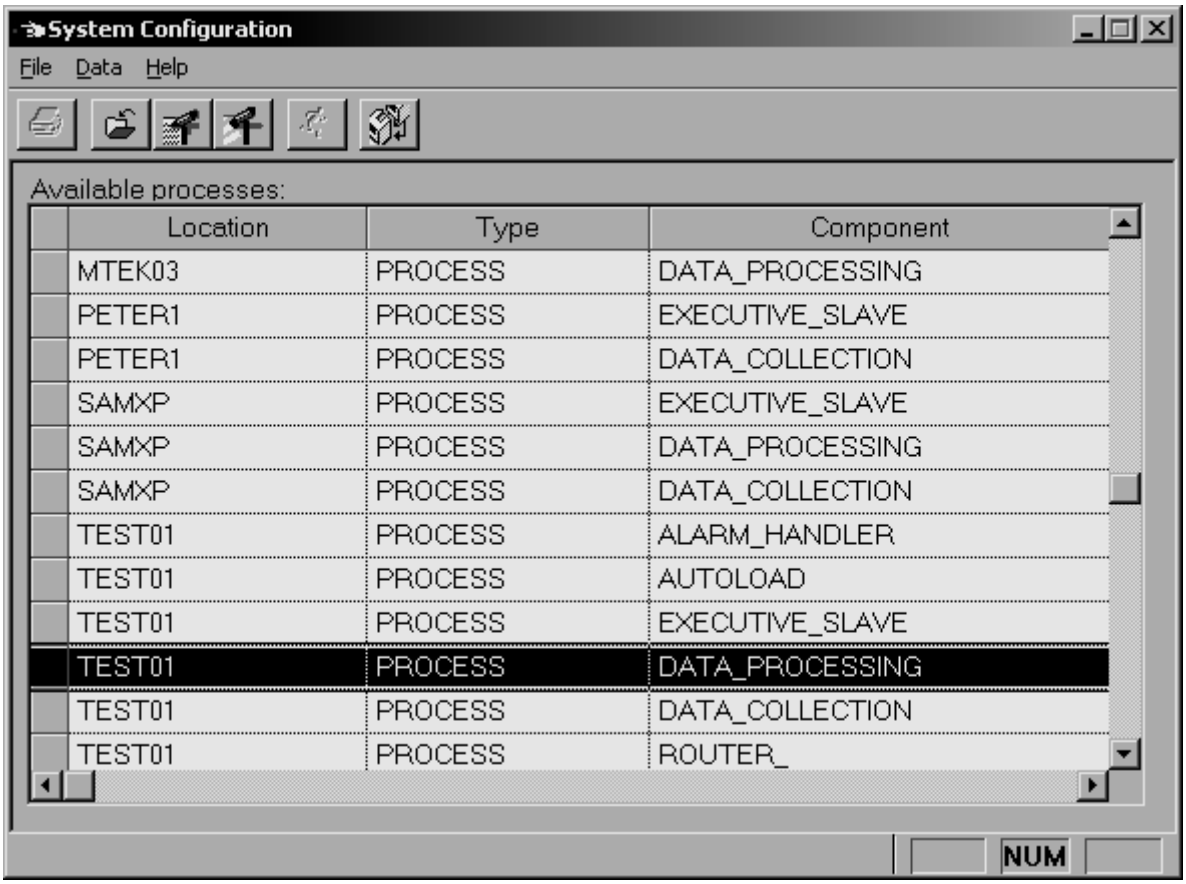
For Packet (Internet) connections the SIP server acts as an Internet server on your computer and thus must be allowed access to the outside world. An Internet address and port number must be assigned to the SIP server, and these numbers must be programmed into each CNI2. Your computer systems' administrator usually assigns the address and port number.

Start the DC-2009 Applications Launcher and select "System Configuration".



Starting the DC-2009 System Configuration

On the next screen select the Data Collection process. There may be more than one to choose from depending upon the way DC-2009 has been configured.

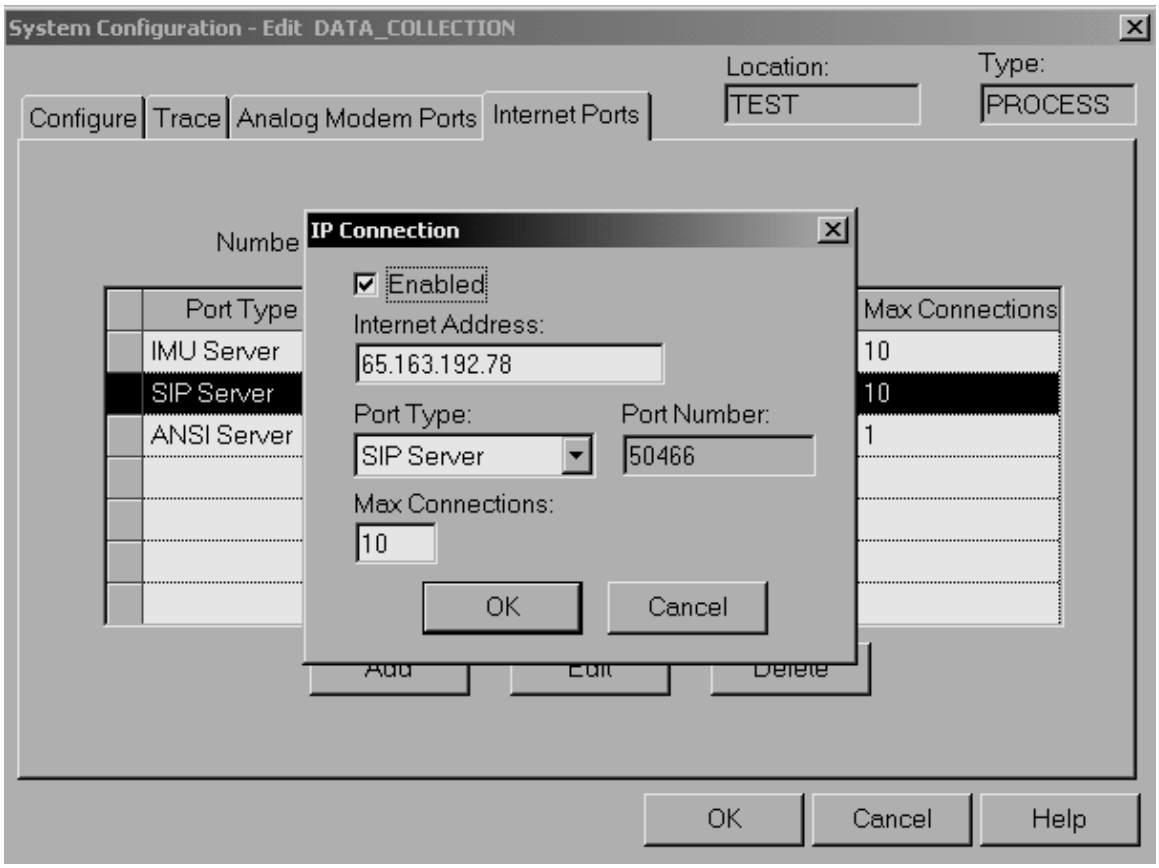


Changing the Data Collection Configuration

On the next screen select the “Internet Ports” tab and select the “Add” button near the bottom of the screen. A smaller selection window will appear. Place a checkmark in the “Enabled” checkbox. Select “SIP Server” for the port type. The port number will be filled in automatically, and must match the port number that was programmed into the CNI2. The default is 50466. If a different port number is being used then hold down the CTRL key on the keyboard, point to the Port Number box and double click on the port number box. Then enter a new port number.

Enter the Internet address that was assigned to DC-2009 and programmed into the CNI2. Your computer systems’ administrator usually assigns this address.

DC-2009 has a number of Internet servers for various products. A maximum of 255 connections are allowed at the same time for all servers. For instance if there are already 200 connections allocated for other products, you can only open another 55 connections for the SIP server. If you have 50 devices in the field and only 10 connections allocated, then only 10 devices will be allowed to connect at any one time. The devices can be scheduled to call in at different times during the day to resolve this. The choice of how many to assign depends upon the capabilities of the data collection computer.



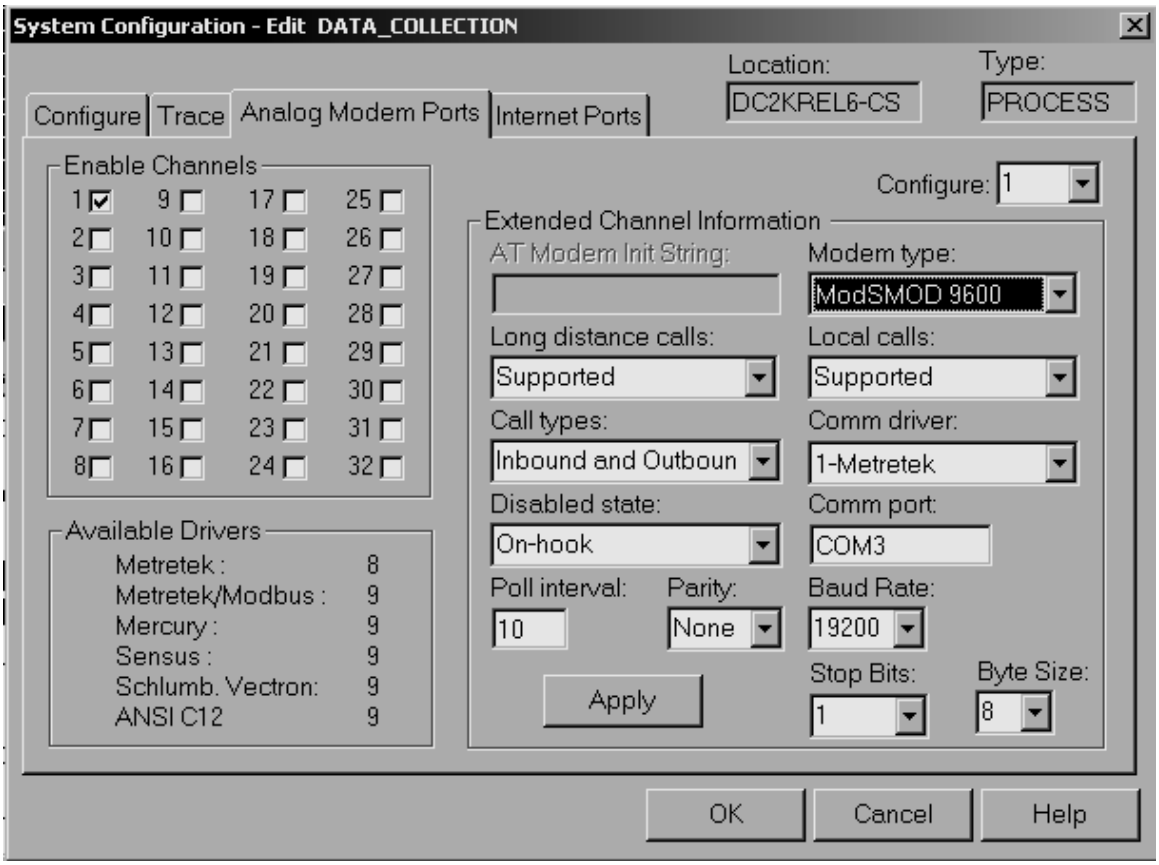
Configuring the SIP Server

SETTING UP DC-2009 FOR CSD CONNECTIONS

CSD connections are basically the same as two modems communicating over wired phone lines. Start the DC-2009 Applications Launcher and select “System Configuration”. On the next screen select the Data Collection process.

On the next screen select the “Analog Modem Ports” tab. Some cellular providers that support CSD calls do not support bit rates below 9600 bps, and the GSM version of the CNI2 does not support anything below 4800 bps. Therefore you will need at least one 9600 bps MODSMOD modem card in the Mercury MODSMOD chassis.

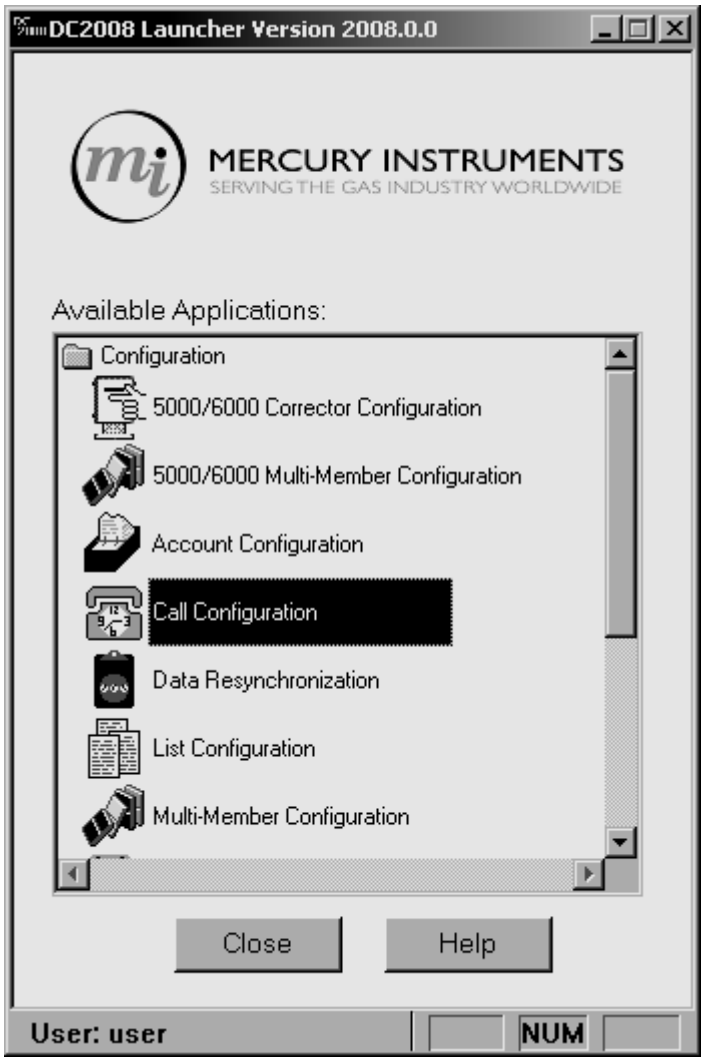
In the example shown below we have configured DC-2009 for a 9600 bps MODSMOD card on Channel-1 using a METRETEK software driver. The baud rate selection box near the bottom of the screen is the bit rate between the computer and the MODSMOD card, not between the MODSMOD and the CNI2. This rate is determined by a set of jumpers on the MODSMOD card. 19200 bps is the recommended setting.



Configuring DC-2009 for CSD Connections

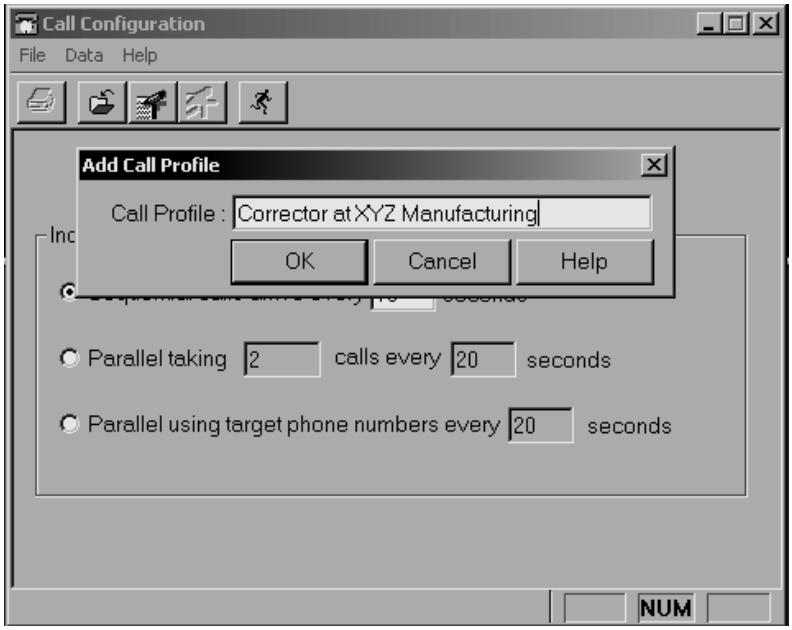
SETTING UP A CALL SCHEDULE

When the CNI2's are in service you may want them to call in at regular intervals, say once an hour or once a day. You can define a call schedule for one CNI2, or a group of them by selecting "Call Configuration" from the Applications Launcher.



Configuring a Call Schedule

On the next screen select the “Add” button and enter in a text name for the profile.



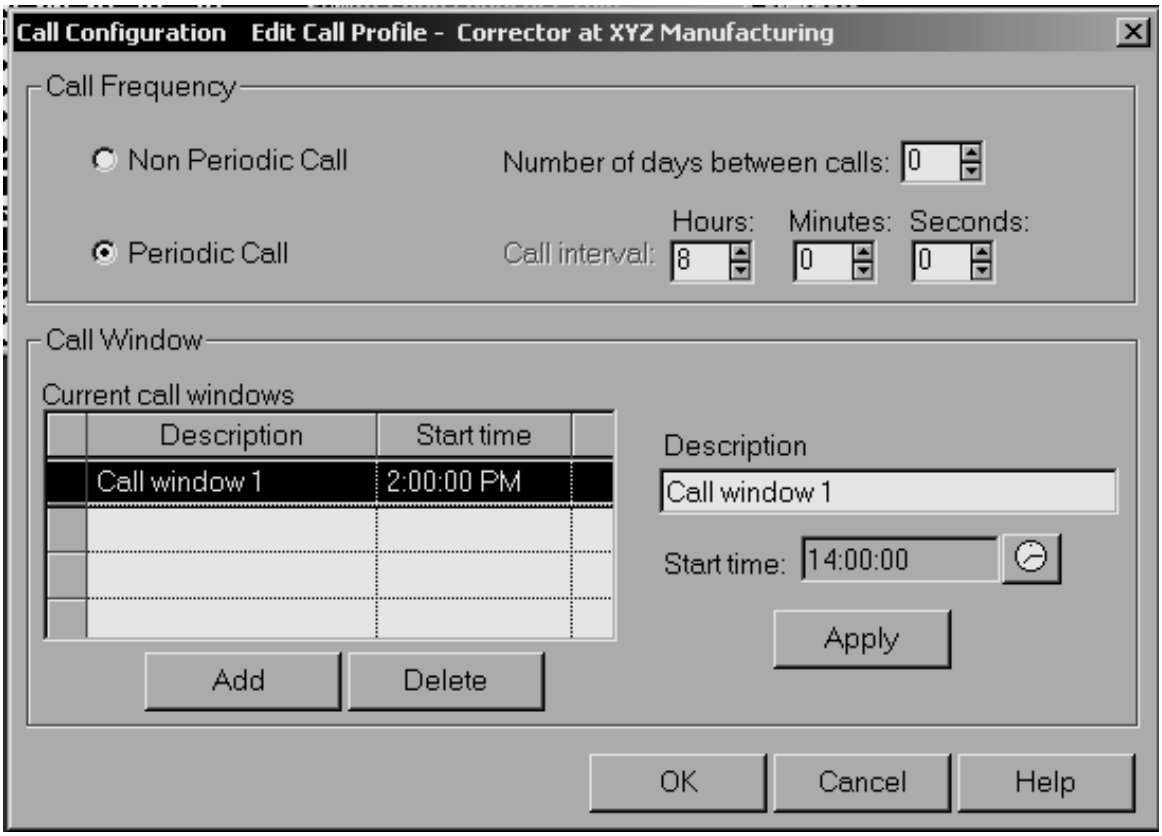
Defining a Call Profile Name

On the final screen you can define the rate at which the devices should call in. In the following figure, the CNI2 will call in at regular 8-hour intervals starting at 14:00:00. This is a Periodic schedule. The CNI2 must make at least one call into the system in order to obtain the first call schedule. Thereafter each time the unit calls in DC-2009 will instruct the CNI2 to call again in 8 hours.

⚠ NOTE:
An aggressive call schedule will reduce battery life of CNI2 products that run entirely on battery power.

You can also use the Non-Periodic Call mode to define unusual call profiles. For instance you may want the CNI2 to call in at 8:00 and 12:00 each day. A Mercury Product Support Specialist can provide assistance in defining these special profiles.

Select the Apply button to make the changes permanent.



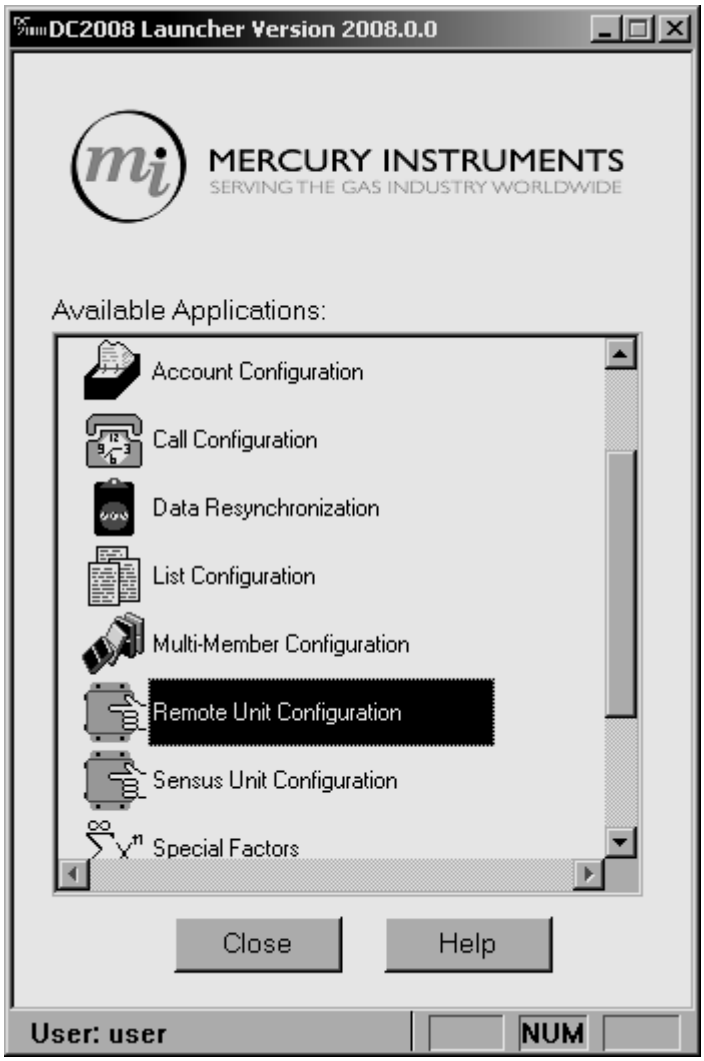
Defining a Call Profile

DEFINING THE CNI2 – MANUAL MODE

Now that you've defined how DC-2009 will communicate with a CNI2 you must define the CNI2 itself. Information in DC-2009 must correlate with the configuration of the CNI2. The number of data (pulse) inputs and the pulse-counting interval sizes must match exactly.

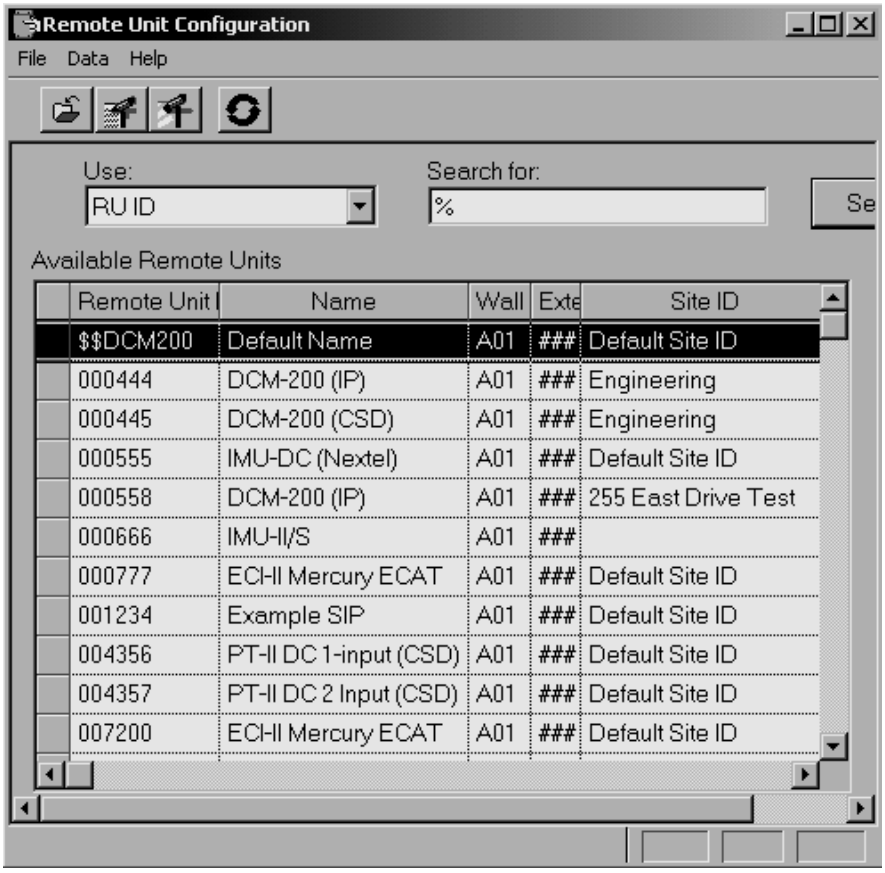
There are two methods that can be used. The one that will be discussed first allows you to manually define each CNI2. Later we will describe how this can be done automatically each time a new CNI2 calls in for the first time.

Start the DC-2009 Applications Launcher and select the 'Remote Unit Configuration' application as shown next.



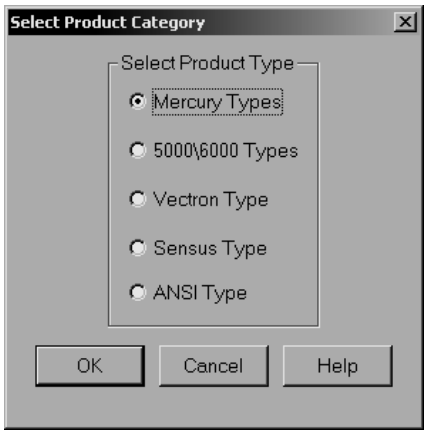
Starting the CNI2 Configuration Process

The next screen will appear. It is not necessary to select a device that's already been defined, simply select the ADD icon 

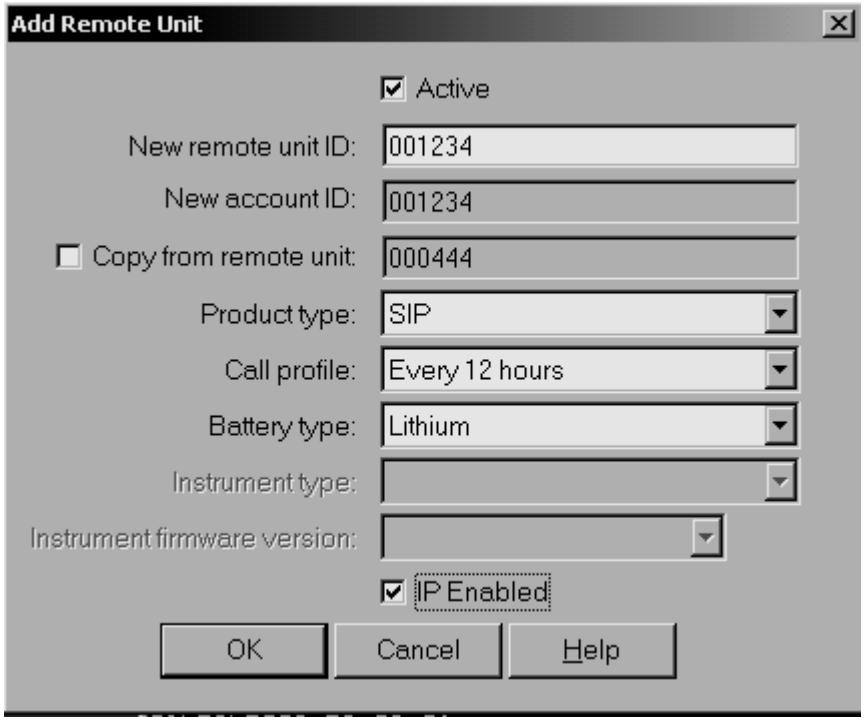


Remote Unit Selection Screen

On the next screen select "Mercury Types" and OK.



Device Type Selection Screen



Add Remote Unit Screen

Check the “Active” box to allow this device to be added to the list of all active devices.

For devices that will be communicating over the Internet check the “IP Enabled” box. For CSD devices leave this unchecked.

Enter the New Remote unit ID (RUID) that was assigned and programmed into the CNI2 using MP32.

Select “SIP” as the product type. Select the Call Profile that is desired.

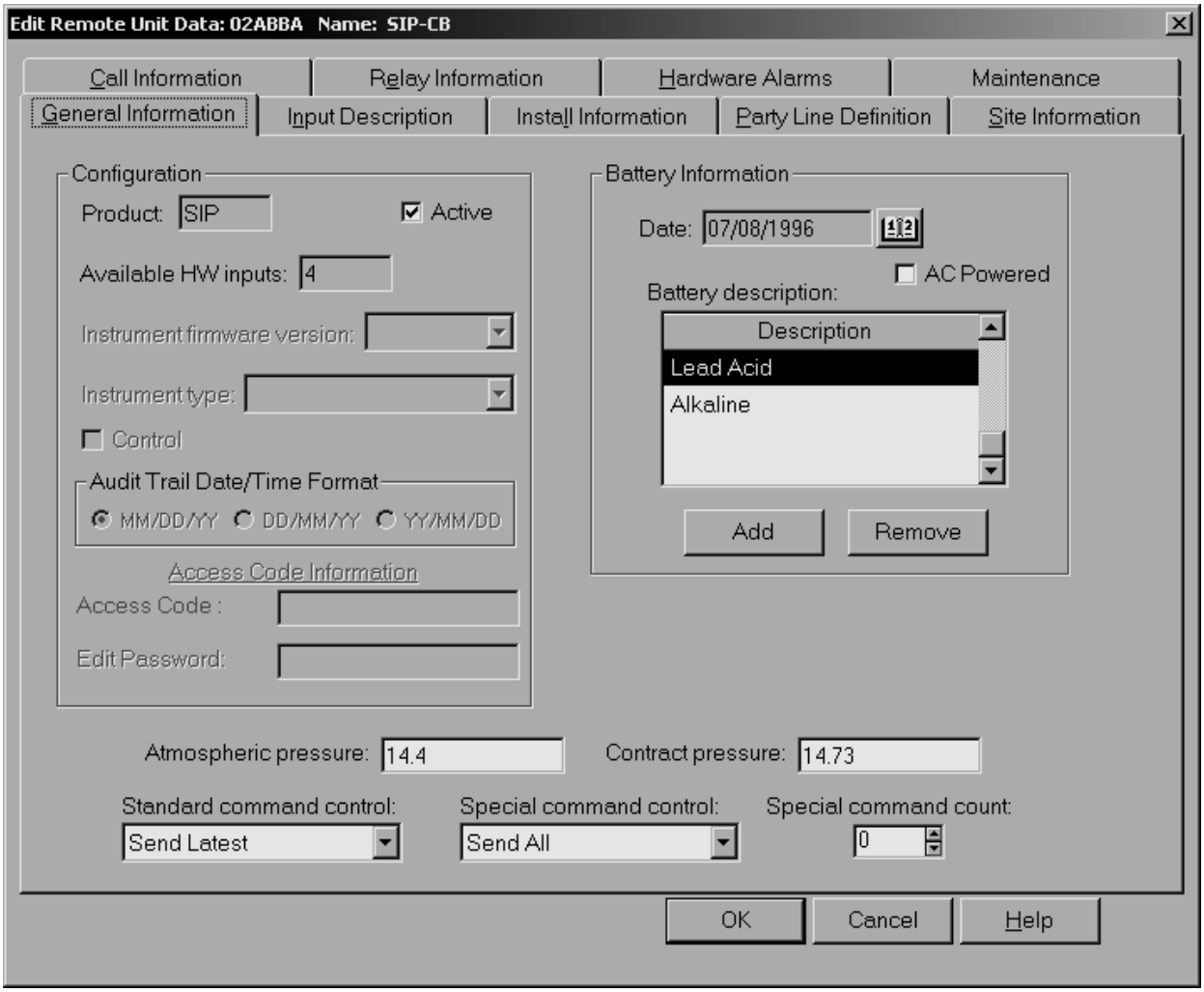
Battery Type is simply for record keeping and does not alter the operation in any way.

Select OK when finished.

The “Copy From Remote Unit” feature allows you to define other CNI2’s with similar characteristics to one that’s already defined. For instance suppose you define a new unit with an RUID of 001234. Now you need to define 49 other units but the only difference will be the RUID of each unit. Simply check the “Copy From Remote Unit” box and enter 001234 as the template. Then enter the new RUID in the New Remote unit ID box and select OK. All other parameters will be copied from the original template.

CONFIGURING THE CNI2

The figure below illustrates one of the nine 'tabs' that can be accessed once a remote unit is defined. This screen will appear immediately after you've defined a new unit, or if you select a unit from the list that appears in the Remote Unit Configuration screen. Some of the fields like Battery Description are not critical and are primarily for record keeping. For instance, if a unit calls in to report a low-battery condition, it might be handy to know what type of battery to bring with you when you visit the site.

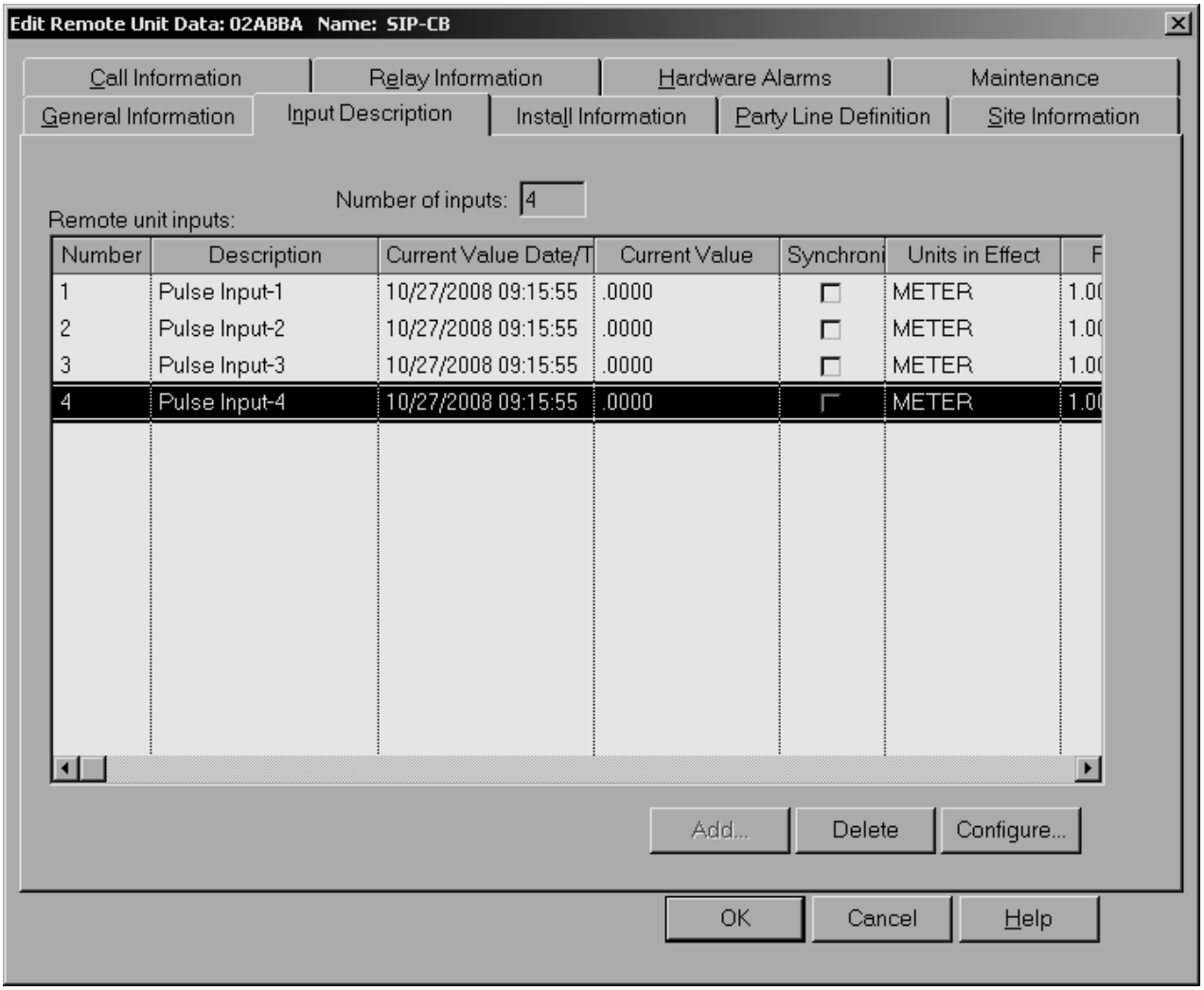


Remote Unit Configuration General Information Screen

With each call DC-2009 will ask the CNI2 for any data records that were accumulated since the last time it called in. This is referred to as a Send Latest operation and is the preferred method. A Send All operation instructs the CNI2 to send the entire contents of its memory from the oldest to the newest record. This method results in a long duration call and the most data sent, both of which can result in higher cellular service costs and reduced battery life.

CONFIGURING THE CNI2'S PULSE-COUNTING INPUTS

Now select the Input Description tab. The following screen will appear.



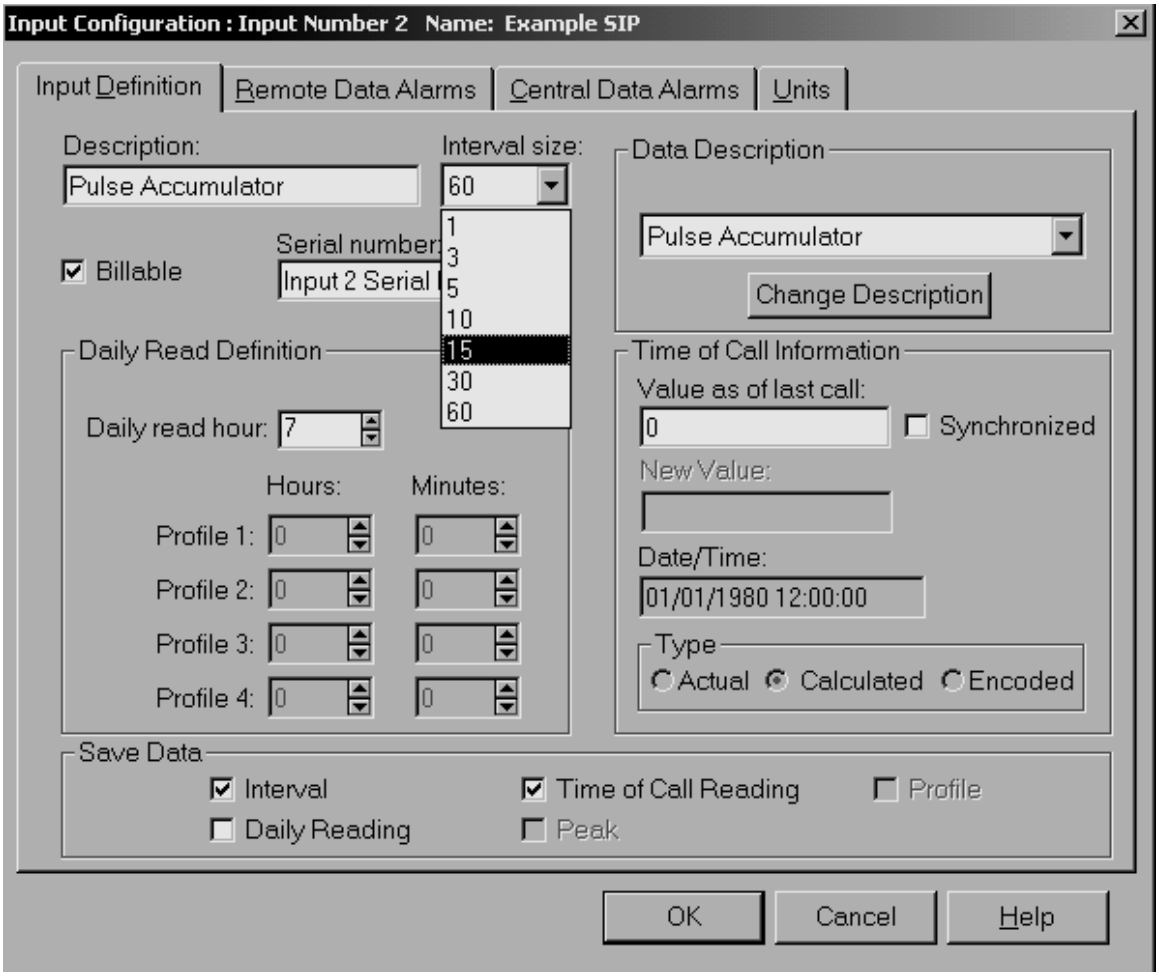
Device Configuration Screen

It is important to select the correct number of data (pulse-counting) inputs and the time interval for counting pulse data, both of which were programmed into the CNI2.

As mentioned earlier, a CNI2 can use its inputs for either pulse-counting or alarm sensing. If a combination is used then DC-2009 must be told how many channels are being used for pulse-counting.

In DC-2009 you must match the number of pulse-counting inputs to that of the CNI2's. This is done by deleting inputs from the screen. However you can only delete inputs starting at the last input and working your way up.

Next you must define the pulse-counting interval, which applies to all channels that are configured for pulse-counting. Highlight one of the remaining channels on the screen and select the CONFIGURE button (or simply double-click on the selected channel). The following screen will appear.

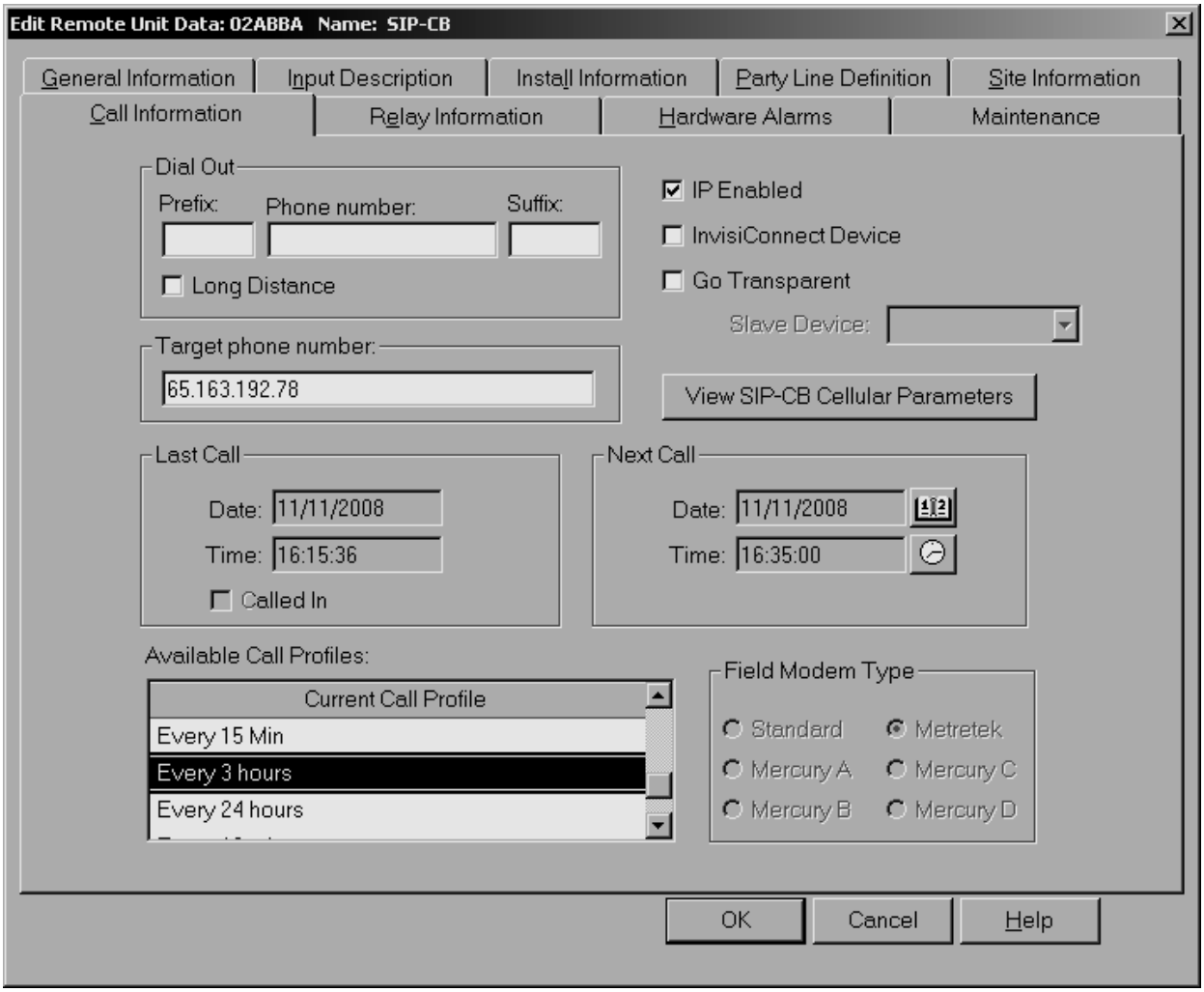


Data Input Configuration Screen

Select the Input Definition tab. Here you can match the time interval to that which was programmed into the CNI2. This will apply to all pulse-counting channels. You can also change the description of each channel and select which type of data to save. Contact a Product Service Specialist if you need additional help with other selections on this screen.

CONFIGURING THE CNI2'S CALL INFORMATION

Go back to the device configuration screen and select the Call Information tab. Proper configuration of the call information fields are essential to ensure that data will be collected and available for processing when expected. If the CNI2 is programmed to originate calls only then it will not be possible to initiate outbound calls since the cellular radio is not powered to receive incoming calls.



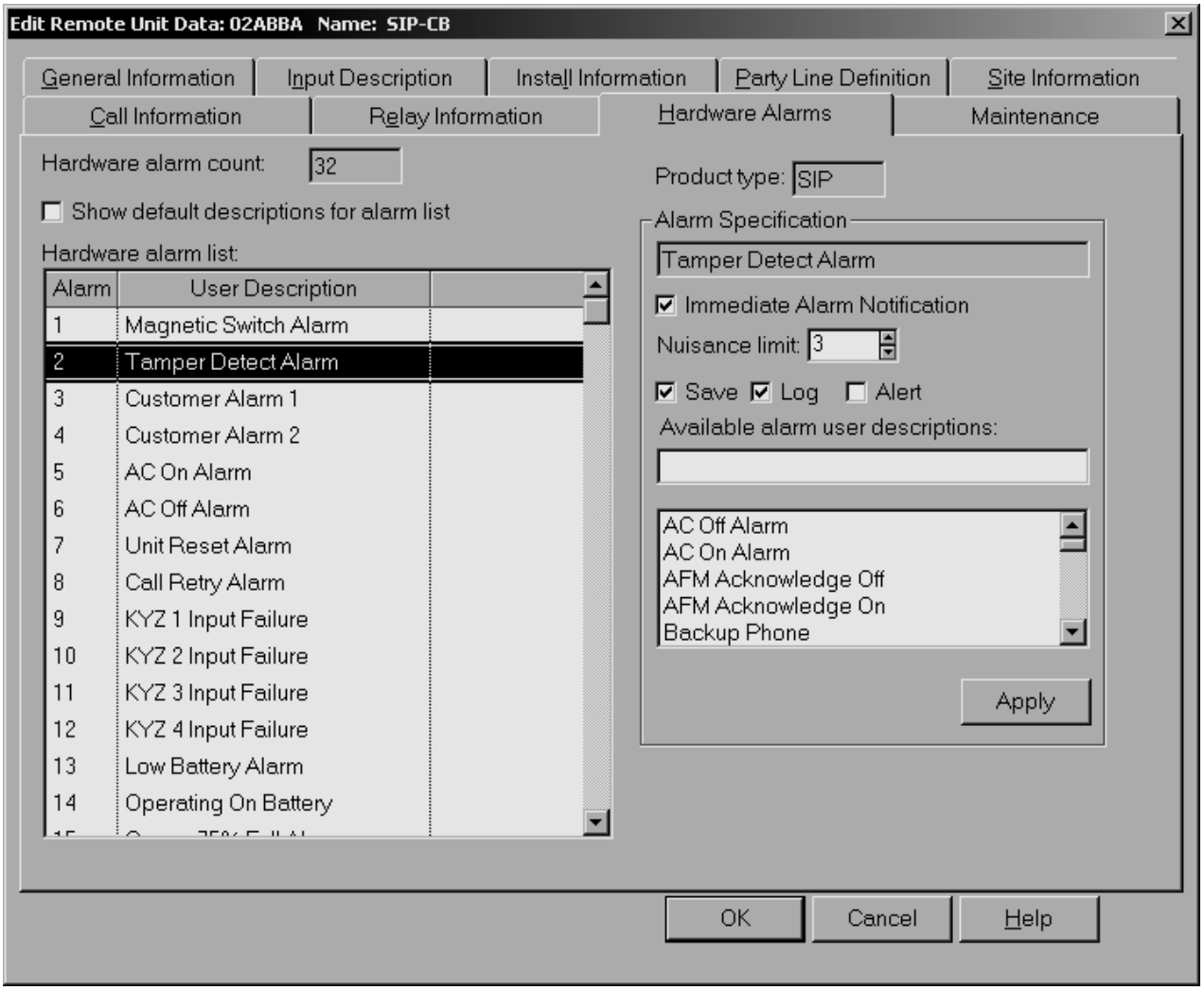
Call Information Screen

The Dial Out phone number is what DC-2009 will use to call the CNI2. This might be used for a direct CSD call ("mobile-terminate") or it may be used to "page" the unit, which will cause the unit to call back to the system. In either case this is usually the mobile phone number that was assigned to the cellular account. This field is automatically loaded whenever the CNI2 calls in to report a UNIT RESET alarm.

The Target Phone Number is for record keeping only and does not affect the operation of DC-2009. This is the phone number or IP address that was programmed into the CNI2 and is what the CNI2 uses when placing a CSD call or making an Internet connection.

CONFIGURING THE CNI2'S ALARMS

Go back to the device configuration screen and select the Hardware Alarms tab.



Hardware Alarm Configuration Screen

As discussed earlier, the CNI2 is capable of reporting a number of alarm conditions from external equipment and internal conditions. The CNI2 can be configured to call immediately when an alarm condition occurs or to simply report it on the next call. This screen allows you to configure how alarms are reported to DC-2009 by the CNI2 and by DC-2009 to you. It also allows you to change the verbal description of each alarm. For instance the generic "Customer Alarm-2" description might be changed to "Smoke Detector Alarm".

Even if the CNI2 is configured to call immediately when an alarm occurs, in some cases DC-2009 can override this and simply have the alarm reported on the next scheduled call. For any alarm that requires an immediate call check the Immediate Alarm Notification box. Some alarms cannot be overridden because they are too important to ignore, such as a unit reset alarm. Make sure you have also programmed the CNI2 to place an immediate call for these alarms.

The Nuisance Limit can be used to disable calls due to a repeating alarm condition. As an example, say the CNI2 is scheduled to call in every 12 hours. One of the alarm inputs comes from a pressure sensor which has become defective. Until the sensor is repaired the CNI2 will keep calling in every couple of minutes to report a the pressure alarm. This is especially undesirable for battery-operated units because each call consumes power. But if you set the Nuisance Limit to 3 then DC-2009 will instruct the CNI2 to stop calling in after the third report of the same alarm. Later, when the CNI2 calls in at its regularly-scheduled time (12 hours later), the Nuisance Limit will be reset and the unit will again be allowed to report the alarm up to 3 times until the next scheduled call.

The SAVE checkbox allows the alarm condition to be recorded in the database. The LOG checkbox allows the alarm to be reported to the computer's printer or screen. The ALERT checkbox will activate the printer's audio alarm if a printer is used.

For each alarm be sure to select the APPLY button after you make any changes.

Note: Changes made to any alarm configuration will not go into effect until the next communication with the CNI2.

Here is a general list of the alarms supported by the CNI2. You can change the description of each alarm to more accurately describe its purpose. For instance "Customer Alarm 1" could be changed to "High Pressure".

Most electrical switches have only two contacts and are either normally-open (Form-A) or normally-closed (Form-B). A third configuration, Form-C, contains two switches, one of each type.

Customer Alarm-1
If Line #1 has been configured as a Form-A or Form-B alarm input the alarm will be reported as a "Customer Alarm-1" alarm.

If the combination of Line #1 & #2 has been configured as a Form-C alarm, then the alarm condition itself will be reported as a "Customer Alarm-1" alarm. If a switch failure is detected, the failure is reported as a "Customer Alarm-2" alarm.

Customer Alarm-2
If Line #2 has been configured as a Form-A or Form-B alarm input the alarm will be reported as a "Customer Alarm-2" alarm.

If the combination of Line #1 & #2 has been configured as a Form-C alarm then see the discussion for the Customer Alarm-1 alarm.

Magnetic or "CALL" Switch Alarm
If Line #9 has been configured as a Form-A or Form-B alarm input the alarm will be reported as a MAGNETIC SWITCH or CALL SWITCH alarm.

If the combination of Line #9 & #10 has been configured as a Form-C alarm, then the alarm condition itself will be reported as a MAGNETIC SWITCH or CALL SWITCH alarm. If a switch failure is detected, the failure is reported as a TAMPER alarm.

TAMPER Detect Alarm
If Line #10 has been configured as a Form-A or Form-B alarm input the alarm will be reported as a TAMPER alarm.

If the combination of Line #9 & #10 has been configured as a Form-C alarm then see the discussion for the Magnetic or "CALL" Switch alarm.

AC-OFF Alarm
If Line #11 has been configured as a Form-A or Form-B alarm input an active alarm will be reported as an AC-OFF alarm.

AC-ON Alarm
If Line #11 has been configured as a Form-A or Form-B alarm input an inactive alarm will be reported as an AC-ON alarm.

Unit Reset Alarm
Reports if the CNI2 has been reset. A reset can be caused by the following conditions:

1 - The JP4 reset pins are shorted together.

2 - The board's configuration memory or operating code has been changed or read using the programming cable.

3 - The battery is nearly exhausted and can no longer support the current required by the board.

Call Retry Alarm
If a previous call attempt failed then this alarm will be reported on the next successful call. Numerous Call Retry alarms may be an indication of network problems or that the unit is located in a marginal reception area. It may also happen if too many units are programmed to call the data collection system at the same time.

Queue Full Alarm
If pulse data is not collected often enough there is a chance that the oldest data may be lost due to insufficient memory. This memory is referred to as the "queue" and the CNI2 will call in to report a "Queue Full" alarm when a certain percentage of the queue contains new records. Default value is 75% but can be changed using MP32.

Clock Resync Alarm
The CNI2's time-of-day clock is updated each time it calls in to the data collection system. A Clock Resync alarm is reported if the CNI2's clock has been corrected by more than ±20 seconds, and will be reported on the next call. Be aware that there will always be a Clock Resync alarm reported on the next call after a unit reset call, and this is normal.

Frequent Clock Resync alarms may indicate one of the following problems:

1 - The CNI2 cannot properly keep time due to a timekeeping hardware fault.

2 - The time given to the CNI2 is taken from the computer's time-of-day clock. This alarm may indicate that the computer's clock is inaccurate (slow, fast or has been changed since the last call, such as a daylight savings time (DST) change).

3 - If the CNI2 is programmed to call more than one computer, and the computers' clocks are different by more than 20 seconds, this will result in Clock Resync alarms.

4 - During packet (Internet) connections DC-2009 prepares the message containing the new time-of-day and sends it to the CNI2. If a packet does not arrive after a certain amount of time, the same packet is retransmitted. This will be repeated several more times before the connection is terminated. If it takes over 20 seconds to deliver the packet, then the time in the message will be 20 seconds older than the CNI2's current time.

Remote Daily Volume Low Input-1,2,3,4
These alarms occur if the daily volume use is below the limits for pulse inputs 1, 2, 3 and 4, respectively.

Remote Daily Volume High Input-1,2,3,4
These alarms occur if the daily volume use is above the limits for pulse inputs 1, 2, 3 and 4, respectively.

Remote TTI Consumption Low Input-1,2,3,4
These alarms occur if the interval volume use is below the limits for pulse inputs 1, 2, 3 and 4, respectively.

Remote TTI Consumption High Input-1,2,3,4
These alarms occur if the interval volume use is above the limits for pulse inputs 1, 2, 3 and 4, respectively.

Low Battery Alarm
This alarm indicates that the battery pack in the CNI2 needs to be replaced as soon as possible. The voltage level at which the alarm will occur is programmed using MP32. The battery should be changed as soon as possible to continue uninterrupted service.

Note About Batteries

Battery voltage level drops in cold weather. If the unit is located in cold climates you may receive occasional low-battery alarms as the temperature drops. As the unit warms up during the day the voltage may return to acceptable levels. However, any low-battery alarm should be taken seriously and the battery should be replaced soon. If the battery gets too low the unit may no longer be able to make calls and may not be able to save its' pulse data.

DEFINING THE CNI2 – AUTOMATIC MODE

Manually defining a large deployment of CNI2's in larger systems can be tedious. In many cases the only difference between all of these units will be their remote unit ID (RUID) numbers. As long as all other parameters are the same there is a way to automate this process.

First, go to the Remote Unit Selection Screen and locate a template called "$CNI2". Select this for editing to define all of the parameters that you will need for your CNI2's.

If you look at the General Information tab on the Remote Unit Configuration screen you will see a checkbox called "Active". As long as this box is checked any new CNI2 that calls in for the very first time will be automatically added to the system under the RUID number that was programmed into the unit. If the "Active" box is not checked then the call will be rejected unless you manually add the unit to the system.

STARTING DC-2009

Once all CNI2's have been defined you can start DC-2009. For CSD connections the appropriate modem channels will be initialized. For packet (Internet) connections the SIP server will be started and will begin listening on the number of channels that were selected.

DC-2009 is a powerful and highly-configurable application program. There are many features not discussed here. A Mercury Product Support Specialist can provide more information and training options.

OBTAINING THE CNI2'S CELLULAR PHONE NUMBER

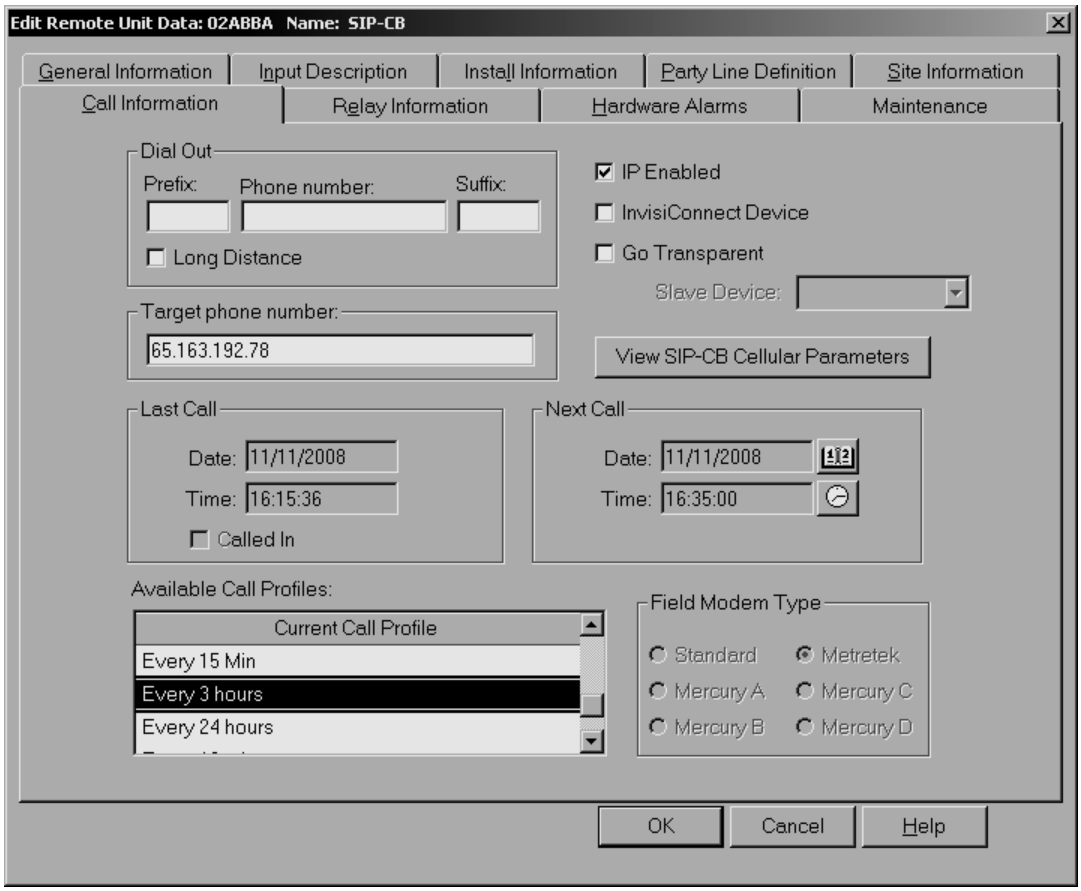
Whenever a CNI2 calls in to report a UNIT RESET alarm DC-2009 will ask for its Mobile Directory Number (MDN), which is usually the phone number that was assigned to the cellular account. DC-2009 saves this number in the database and also places it in the Call Information tab on the Remote Unit Configuration screen. It appears as the Dial-Out number.

For this feature to work the mobile phone number must be stored on the SIM card. There are usually three or four memory slots reserved for this, one for voice (which is usually considered the primary mobile number), another for a data number (usually used for "mobile-terminate" CSD service) and a third for a FAX number. The CNI2 will report the 1st mobile number stored on the SIM card. If you are using the phone number for paging purposes then this should be the voice number. If you wish to make mobile-terminate CSD calls then this should be the data number. Confirm with your cellular service provider to make sure the right number is stored on the SIM card.

OBTAINING THE CNI2'S HARDWARE STATUS AND CELLULAR INFORMATION

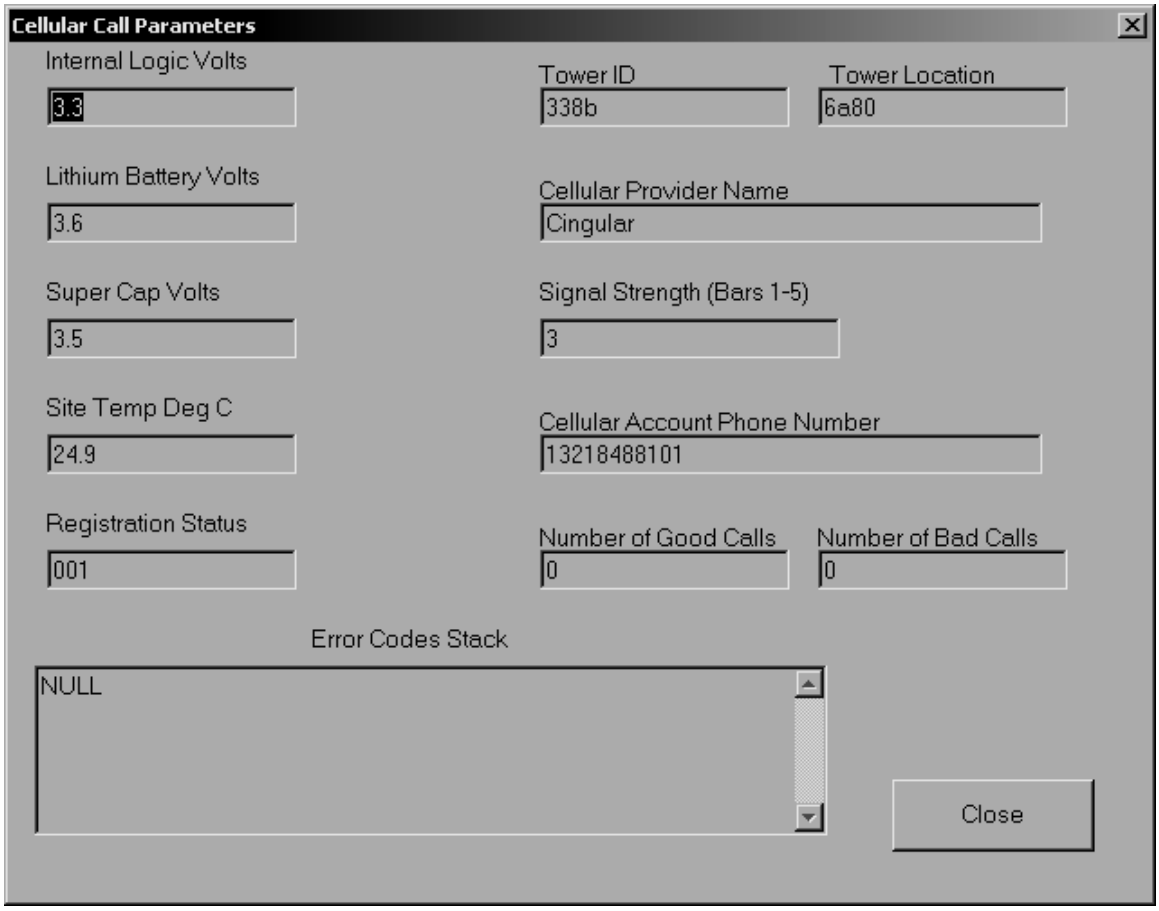
Each time the CNI2 communicates with DC-2009 it starts the communications process by sending a short message containing information about alarms, status, its time-of-day and other pertinent information.

In packet (Internet) mode, the CNI2 also sends additional information about cellular status, battery voltage, error codes, etc. In DC-2009 you can view this information from the Call Information screen. Select the View CNI2 Cellular Parameters button on the right-hand side of the screen.



Viewing the Cellular and Hardware Status

The following information screen will appear.

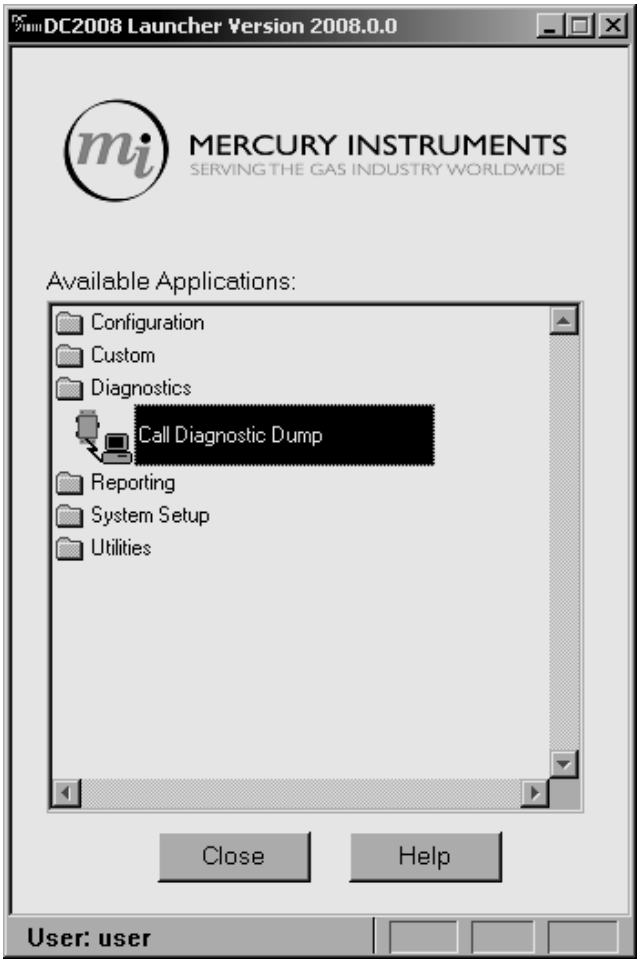


Cellular and Hardware Status Screen

The Error Code Stack is a list of the most recent 30 errors that were detected and displayed on the LEDs. The most recent code appears first. Besides pointing out hardware problems certain other codes might explain why calls are failing and have to be retried. For instance you might see codes relating to loss of signal or network registration, both of which might indicate that the unit is in a marginal reception area.

The Registration Status number will be ‘001’ for registration on the “home” network or ‘005’ for registration on a roaming network.

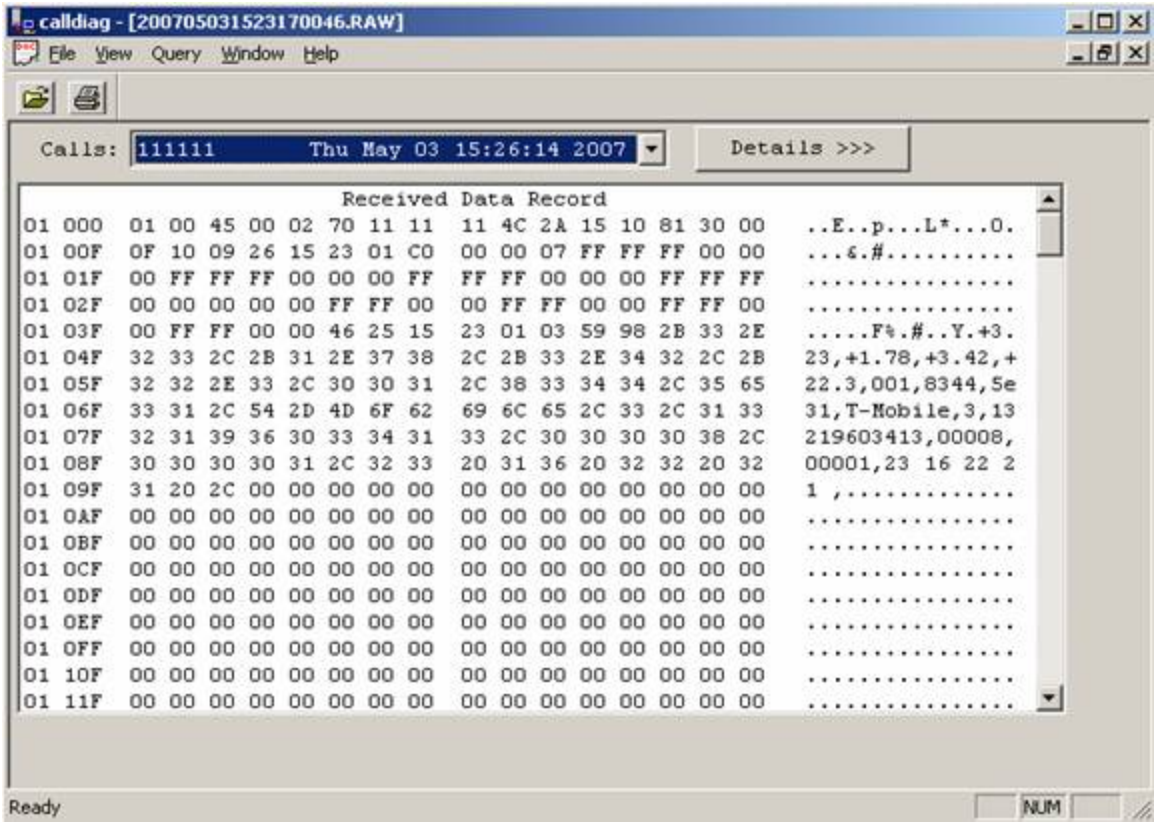
Earlier versions of the data collection software (DC-2000) do not process the CNI2's additional information but it can be viewed using a utility called Call Diagnostic Dump.



Starting the Call Diagnostic Dump Utility

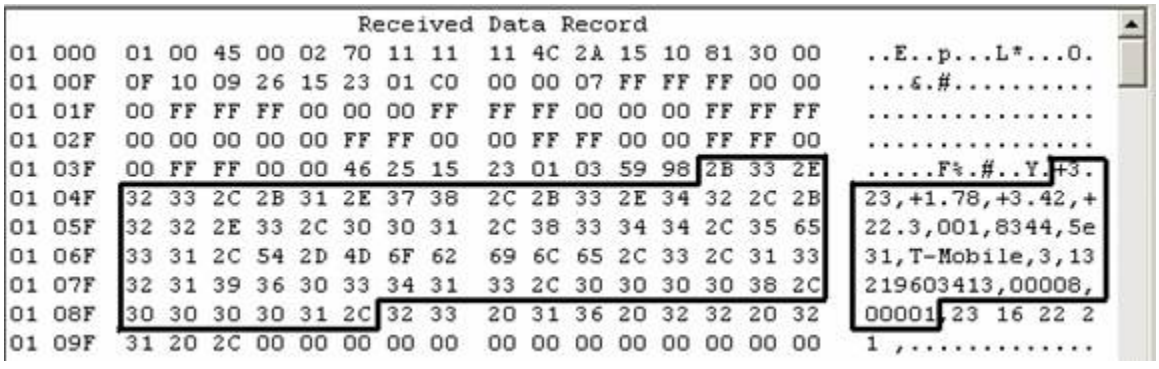
When DC-2009 processes the CNI2's information it creates a file called a "raw file". This is usually stored in the Data Processing folder and is usually in a sub folder called "Output". Each file has an extension of ".raw". The filename itself is a conglomeration of the date, time and a sequence number. It does not contain the unit's ID number, so finding the right file is somewhat difficult. But the Diagnostic Dump utility does have a way to select only raw files that are associated with a particular RUID.

In the next figure we show how a raw file is displayed. You will see that the unit's RUID number appears at the top of the screen along with the time of the call.



Using the Call Diagnostic Dump Utility

The screen is formatted to show the data in both hexadecimal and ASCII format. Most of the information on the ASCII side of the screen is readable and contains information about the CNI2's power condition and cellular status. This portion of the message is highlighted in the next figure.



Status and Cellular Information on the Call Dump Screen

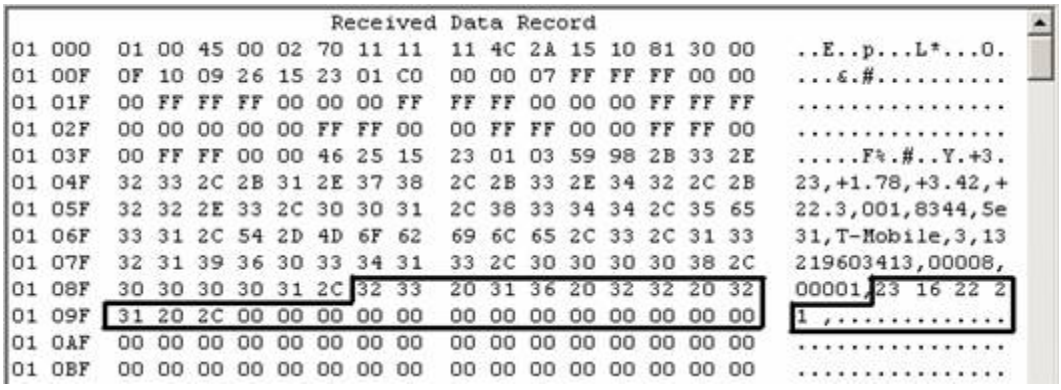
Here is how the information is formatted in the order it appears, including the comma (,) that separates each item:

Parameter Item	Example
Internal logic supply voltage (volts)	+3.23,
Loaded battery voltage (volts)	+1.78,
Radio power voltage (volts)	+3.42,
Temperature at site (ºC) (± 2ºC)	+22.3,
Cellular registration status: 001 = registered on home network, 005 = registered on roaming network	001,
Cellular tower location (4-digit hex)	8344,
Cellular tower ID number (4-digit hex)	5e31,
Cellular provider's name	T-Mobile,
Signal strength at time of call (in terms of "bars" (1 – 5)	3,
Cellular mobile directory number (phone number assigned to account) (Note-1)	13213946414,
Number of successful calls since reset	00008
Number of unsuccessful calls since reset	00001

Cellular Information Fields

Note: The phone number may include characters such as international dialing prefixes.
Status and Cellular Information

Following the power and cellular status is a list of the most recent errors that were detected and displayed on the LEDs. Each code is separated by a space and the list ends with a comma (,). The most recent code appears first. There can be up to 30 codes listed.



Previous Error Codes on the Call Dump Screen

Besides pointing out hardware problems, certain other codes might explain why calls are failing and have to be retried. For instance, you might see codes relating to loss of signal or network registration, both of which might indicate that the unit is in a marginal reception area.

The entire string of power, cellular and error status ends with a 0 (null). This portion of the raw file could be processed as a comma-delimited file by a spreadsheet program. But beware that the length of the data preceding this information is variable, so this information block may not always start at the same location with each call.

MAINTENANCE

BATTERY REPLACEMENT

Life of the battery pack is dependent on several factors such as the number of calls made per day or month, the number of inputs attached, etc. Some users may prefer to wait for a low battery alarm to be reported before sending a person the field to replace the pack. Others may prefer to replace the battery pack on a fixed schedule, regardless of the remaining battery capacity. This approach has several trade-offs, which include higher reliability and less down time but at the extra expense of purchasing batteries more often. There could potentially be lower labor costs for the field technician if he or she is also servicing other nearby equipment.

Replacement of internal battery packs is quick and convenient by pressing left-wards on the large plastic tab and pulling the pack out. Take care to not lose grip of the battery pack while disconnecting the power connector from the CNI2 board. Battery replacement intervals will vary depending on frequency of calls and the battery type (lithium vs. alkaline).

CLEANING AND CHEMICAL COMPATIBILITY LIST

Acceptable cleaning and degreasing agents for the external surface of the CNI2 enclosure: Mineral Spirits, Isopropyl Alcohol, mild soap and water, VM&P Naptha, Fantastik, Windex, Joy dishwashing soap, Top Job, Mr. Clean, Formula 409.

MAINTENANCE CHECKLIST

A regular program of performing inspection and maintenance on a CNI2 when in the field offers the following benefits:

a) Longer total service life of the product
b) More reliability, less downtime
c) Decreased risk of potential hazards caused by deteriorating wires, etc.

Each user will have their own internal policies for maintenance / inspection of equipment, which includes regulators, turbine meters, pipelines, and electrical equipment to name just a few. Some of these policies and schedules are dictated by statutory requirements that must be met, and some are based on internal corporate experience where the benefits of regular maintenance have become apparent.

Physical inspection of the equipment is also necessary, with the following list provided as a starting point:

1) Check the condition and integrity of the cables leading into the CNI2. Long term exposure to the elements may cause the cable jacket to become brittle. Physical damage from lawn equipment or similar equipment is not uncommon. Maintaining the cable in good condition will enhance the reliability and safety of the system.

2) Check for evidence of tampering, vandalism, or unintended impact damage. If someone has attempted to tamper with the unit, there may be evidence of screwdriver pry marks on the door of the enclosure. Such a unit should be serviced immediately, since the

water ingress resistance of the CNI2 will have been compromised, which reduces the overall safety and reliability levels.

3) If the enclosure is opened for service reasons, check for any evidence of moisture accumulation, mold, or cable corrosion. Inspect the enclosure gasket for evidence of small cracks, which would indicate that it should be replaced. It is normal however that a gasket will have a slight indent mark due to the compression from the lid. Insects will normally not be an issue so long as the cable glands were properly tightened during the initial install. Performing this periodic service step increases potential service life, reliability, and maintains hazardous area safety.

4) Where the CNI2 has the external antenna connection option, this should be inspected for corrosion. Normally it is best policy to completely seal the connector area with a suitable sealant.

5) Cleaning / decontamination of the enclosure's exterior is normally not necessary, except to address obvious issues such as a bird or hornet nests atop the unit. If it is desired to clean the surface for better label visibility, then a cloth heavily dampened with water or aspray cleaner such as Clorox Formula 409 will work.

 WARNING – Explosion Hazard

The plastic enclosure's surfaces are potential sources for static charge accumulation when rubbed with a dry cloth. This could result in static discharge, which would then lead to hazardous gas ignition / explosion.

Always use a damp cloth when cleaning the outside surface of a CNI2 enclosure.

Additional service is normally not required, unless it becomes necessary to swap out a CNI2 or diagnose problems. Precautionary guidelines when using multi-meters and other diagnostic equipment while inside a potential hazardous gas environment apply here.

 WARNING – Explosion Hazard

Do not make or break connections while the circuit is alive unless you are in an area known to be non-hazardous. This includes both field wiring connections and battery pack replacement.

If there are any operational problems directly related to the electronics of the CNI2, then it is often times more convenient to swap the unit out with a spare and then later make a determination in the repair shop as to whether it should be returned to Honeywell for service.

ESD HANDLING PRECAUTIONS

Any electronics device contains components sensitive to ESD (electrostatic discharge). For example people experience up to 35kV ESD, typically while walking on a carpet in low humidity environments. In the same manner many electronic components can be damaged by less than 1000 volts of ESD. For this reason you must observe the following handling precautions when servicing this equipment:

1) Always wear a conductive wrist strap.
2) Eliminate static generators (plastics, Styrofoam, and so on) in the work area.
3) Remove nylon or polyester jackets, roll up long sleeves, and remove or tie back loose hanging neckties, jewelry, and long hair.
4) Store and transport all static sensitive components in ESD protective containers.
5) Disconnect all power from the unit before ESD sensitive components are removed or inserted, unless noted.
6) Use a static safeguarded workstation, which can be set up by using an anti-static kit (Motorola part number 0180386A82). This kit includes a writes strap, two ground cords, a static control tablemat, and a static control floor mat. The Motorola part number for a replacement wrist strap that connects to the tablemat is 4280385A59.
7) When anti-static facilities are unavailable, use the following technique to minimize the chance of damaging the equipment:
8) Let the static sensitive component rest on a conductive surface when you are not holding it.
9) When setting down or picking up the static sensitive component, make skin contact with a conductive work surface first and maintain this contact while handling the component.
10) If possible, maintain relative humidity of 70-75% in development labs and service shops. Less humidity is more conducive towards static charge buildup and subsequent discharge.

CONTROL DRAWINGS - HAZARDOUS AREA

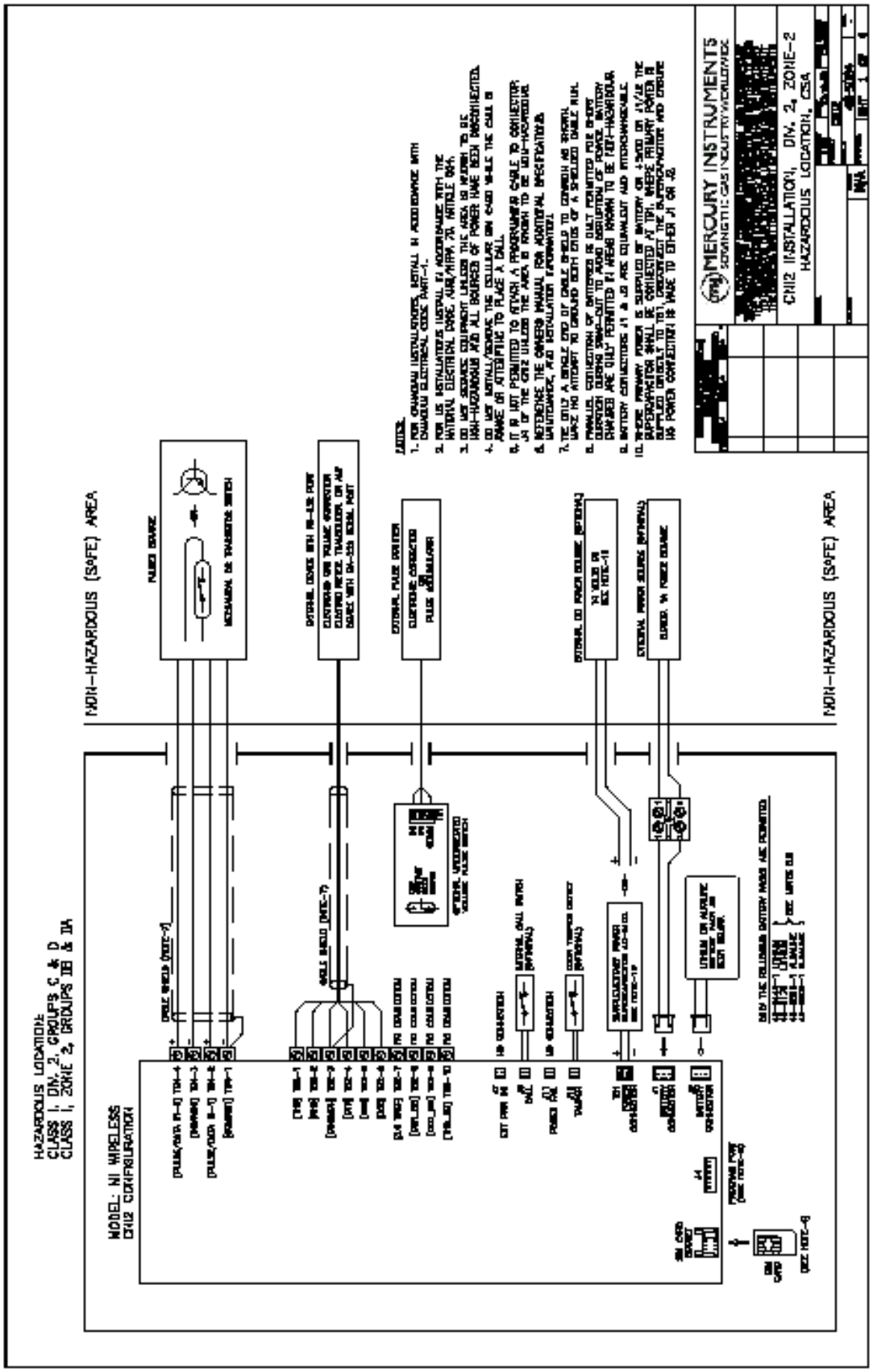
HAZARDOUS AREA CLASSIFICATION (NORTH AMERICAN CLASS I, DIVISION 2)

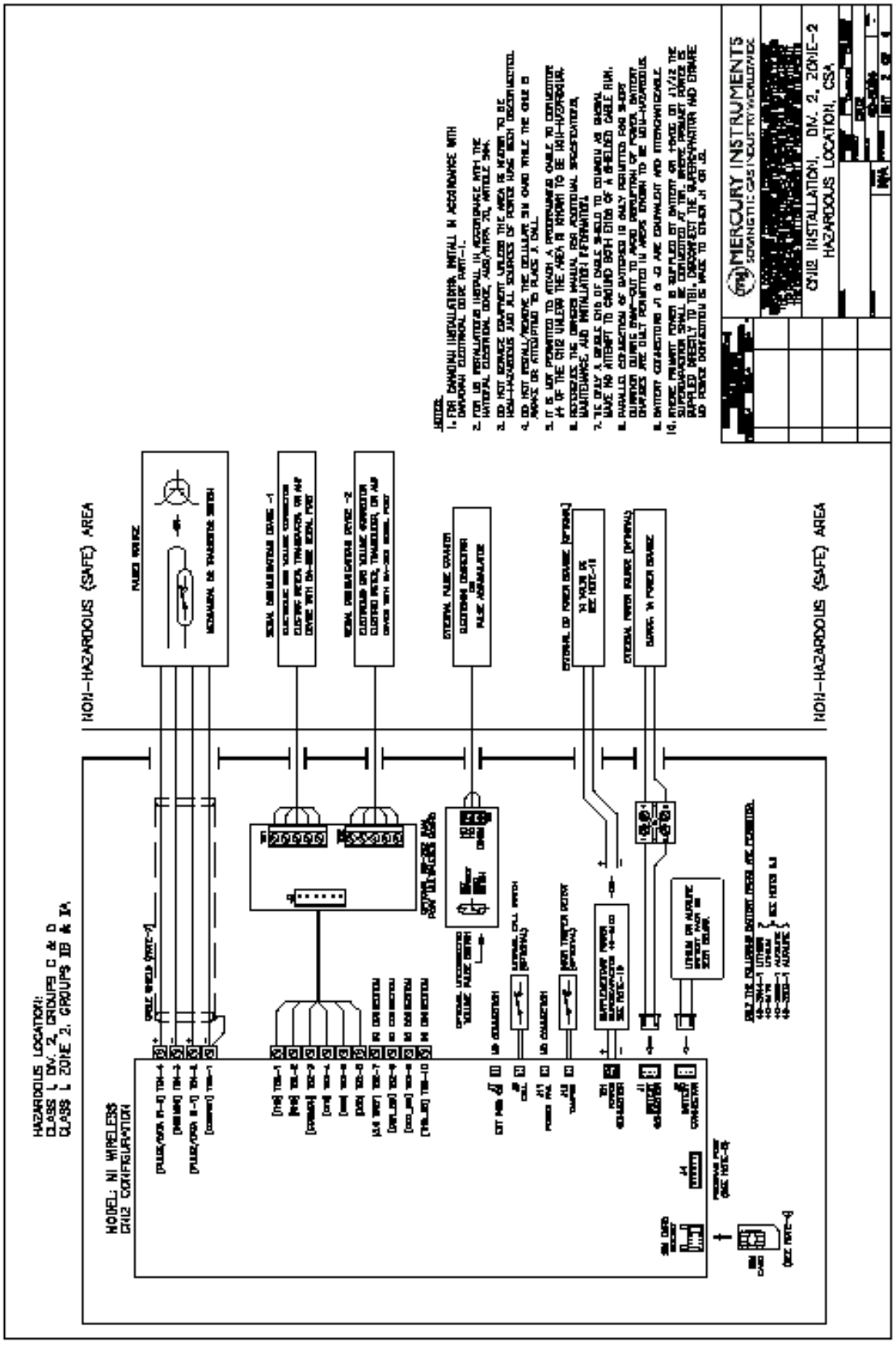
The CNI2 is approved for use in hazardous gas environments, Class I, Division 2, Group-D (methane, propane, butane), temperature class T4. Equivalent ratings as defined by the NEC / NFPA70 article 501 are Class I, Zone 2, Group IIA. Prior to installing equipment, always confirm the safety ratings are appropriate by checking the label affixed to the product.

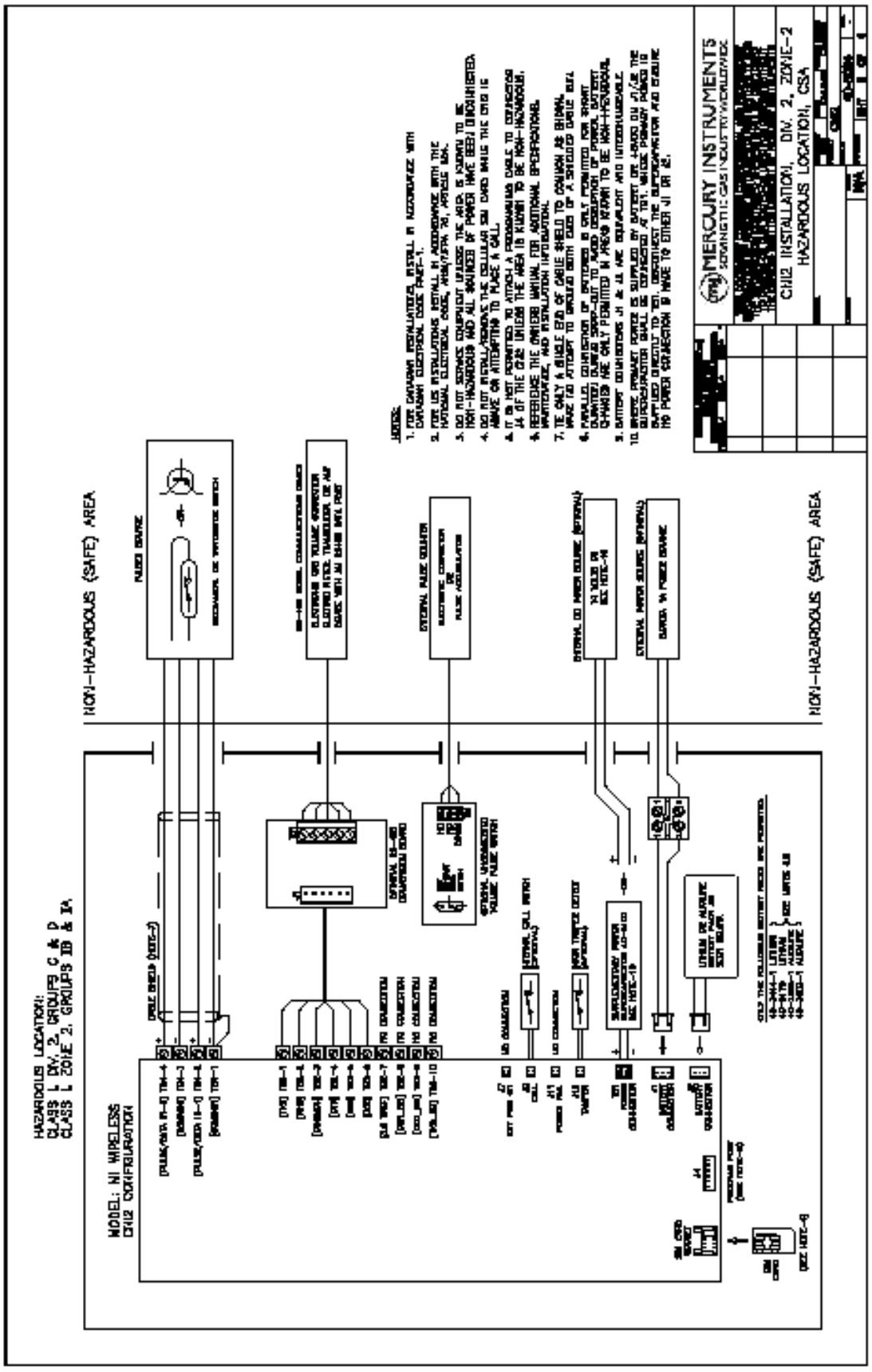
The NEC / NFPA-70 text provides important guidance for proper electrical wiring methods, grounding, safety area classifications etc. Articles 500-505 are of particular relevance to hazardous gas environments.

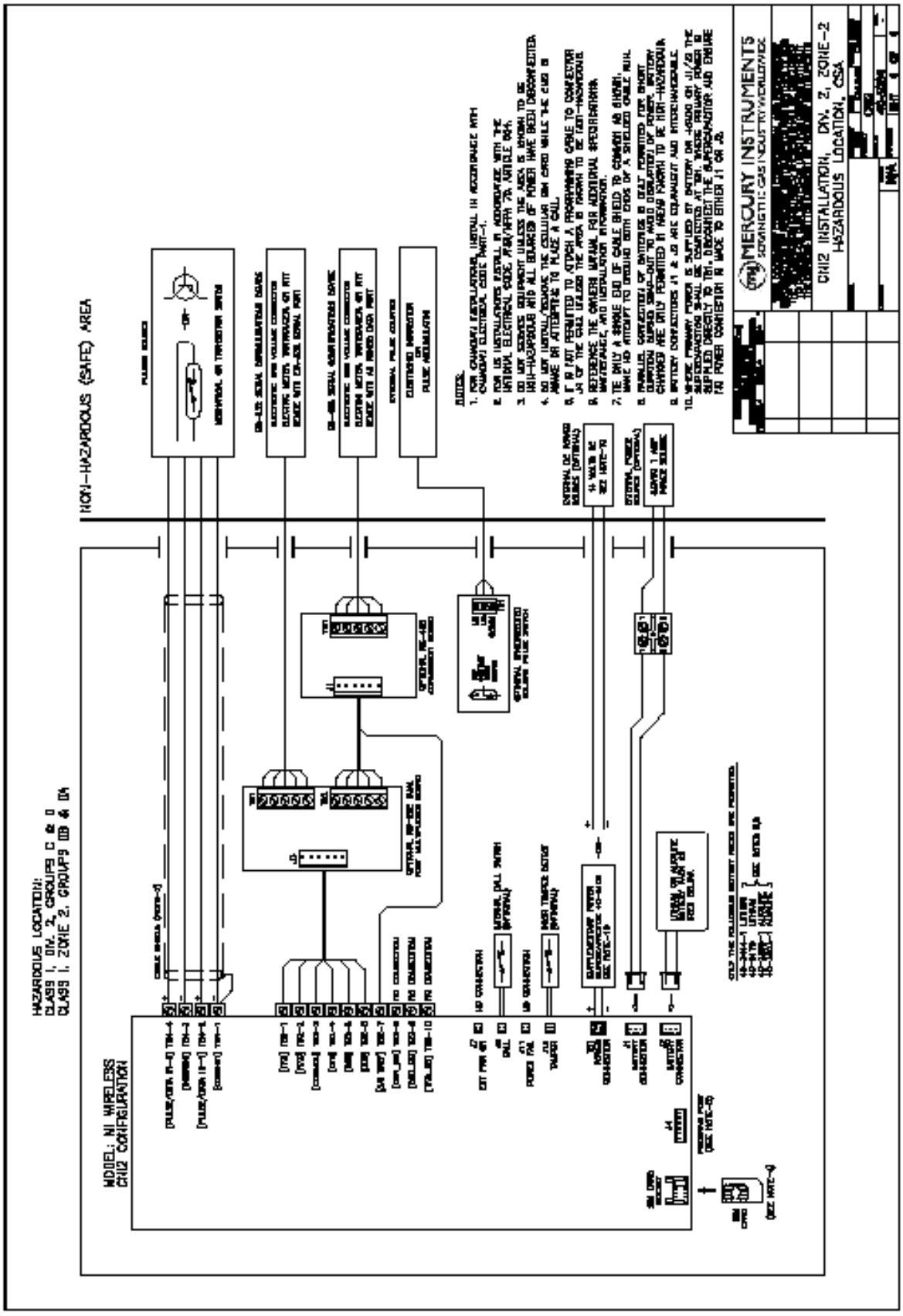
Control drawing 40-5084 defines the exact parameters related to all permissible inputs, outputs, battery options, and site information. This drawing is also available in electronic PDF format free of charge upon request. Contact your local Product Support Specialist for assistance.

NOTE: The hazardous ratings label affixed to the product should be relied upon as being the most reliable source of information concerning approved ratings. This manual and similar texts or brochures may be updated periodically to reflect new product improvements or additional certifications that have been obtained.


HAZARDOUS LOCATION:
CLASS I, DIV. 2, GROUPS C & D
CLASS I, ZONE 2, GROUPS IIB & IIA
MODEL: NI WIRELESS
CNI2 CONFIGURATION
NON-HAZARDOUS (SAFE) AREA
NON-HAZARDOUS (SAFE) AREA
MERCURY INSTRUMENTS
CNI2 INSTALLATION, DIV. 2, ZONE-2
HAZARDOUS LOCATION, CSA


MERCURY INSTRUMENTS
CNI2 INSTALLATION, DIV. 2, ZONE-2
HAZARDOUS LOCATION, CSA
NOTES:
HAZARDOUS LOCATION:
CLASS I, DIV. 2, GROUPS C & D
CLASS I ZONE 2, GROUPS IIB & IIA
NON-HAZARDOUS (SAFE) AREA
MODEL: NI WIRELESS
CNI2 CONFIGURATION


HAZARDOUS LOCATION:
CLASS I, DIV. 2, GROUPS C & D
CLASS I, ZONE 2, GROUPS IIB & IIA
MODEL: NI WIRELESS
CNI2 CONFIGURATION
NON-HAZARDOUS (SAFE) AREA
NON-HAZARDOUS (SAFE) AREA
NOTES:
MERCURY INSTRUMENTS
CNI2 INSTALLATION, DIV. 2, ZONE-2
HAZARDOUS LOCATION, CSA


NON-HAZARDOUS (SAFE) AREA
HAZARDOUS LOCATION:
CLASS I, DIV. 2, GROUPS C & D
CLASS I, ZONE 2, GROUPS IIB & IIA
MODEL: NI WIRELESS
CNI2 CONFIGURATION
MERCURY INSTRUMENTS
CNI2 INSTALLATION, DIV. 2, ZONE-2
HAZARDOUS LOCATION, cSA

SPECIFICATIONS

CERTIFICATIONS

- Measurement Canada (metrology) --- (pending)
- CSA: Class I, Div 2, Group-D Hazardous Gas Areas --- (pending)
- FCC CFR 47 Part 15 (B) and ICES 003 --- (pending)
- FCC Parts 22, 24 IHDT56HQ1 (G24-L) and IHDP56JE1 (C24)
- PTCRB for the GSM network

MECHANICAL

Operational Temperature range
-22 °F to 158 °F (-30 °C to 70 °C)

Terminal Block Screws
Use a slotted screwdriver having a blade width of 0.140" or 9/64" typical.

Environmental Ratings
Enclosure is equivalent in protection to NEMA 3R, suitable for indoor or outdoor use, providing a degree of protection against solid foreign objects, and to provide a degree of protection with respect to harmful effects due to ingress of rain, sleet, snow or formation of ice on the enclosure. Fiberglass reinforced polycarbonate enclosure is resistant to the effects of long term UV exposure.

Enclosure Mounting
Various mounting options are available, including flat wall, pipe clamps, or direct meter mount. Contact a Mercury Product Support Specialist to discuss your application and the most appropriate solution.

Mounting Direction
To maintain integrity of the enclosure protection rating, the enclosure must be mounted in a vertical configuration.

Humidity Range
Operational range of 5 - 95% R.H. If the product is to be retained in storage for any length of time, it is recommended that the humidity range be maintained between 10 - 70% R.H., non-condensing.

Cable Glands
A maximum of three cable glands can be populated onto the enclosure. The actual number of supplied glands will vary depending on the configuration ordered and whether the CNI2 is supplied with or without an index.

Weight of CNI2 with Wall Mount Option: (w/o batteries)
2.4 pounds

Weight of CNI2 with Meter Mount Option: (w/o batteries)
3.4 pounds

Battery Pack Shipping Weight

40-5170	0.6 Pounds	(dual cell lithium, disposable)
40-3444-1	1.0 Pounds	(quad cell lithium, disposable)
40-3503-1	0.4 Pounds	(quad cell Alkaline molded plastic housing without cells)
40-3503-1	1.6 Pounds	(quad cell Alkaline molded plastic housing with cells)
40-2596-1	1.4 Pounds	(quad cell Alkaline disposable)

SPECIAL CONDITIONS OF USE FOR HAZARDOUS GAS LOCATIONS:

Under certain extreme circumstances, the non-metallic parts incorporated in the enclosure of this equipment may generate an ignition-capable level of electrostatic charge. The equipment shall not be installed in a location where the external conditions are conducive to the build-up of electrostatic charge on such surfaces. Additionally, the equipment shall only be cleaned with a damp cloth.

If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.

ELECTRICAL - POWER

Battery Voltage: (without load applied)
Lithium = 6.9 Volts, Alkaline = 6.0 Volts

Approved Battery Pack Assemblies

40-5170	Dual cell lithium, disposable configuration.
40-3444-1	Quad cell lithium, disposable configuration.
40-3503-1	Quad cell alkaline molded plastic assembly (replaceable cells).
40-2596-1	Quad cell alkaline disposable configuration.

Battery Life
Highly dependent upon number of pulse counting inputs, cellular call durations, and the number of calls made per day or month. Due to the number of potential variables, this is difficult to predict for all circumstances. Mercury can provide reference information that details a single "typical" site and the expected life based on this example case.

⚠ CAUTION:
Disposal of lithium battery cells is strictly regulated in most areas as hazardous waste material. Consult your regional waste disposal authority to ensure full compliance with legal statutes when disposing of cells.

⚠ WARNING:
Transport of primary cell lithium batteries (even when fully discharged) is strictly forbidden on passenger aircraft. Cargo shipment of batteries via UPS, FedEx, etc., requires approved shipping containers, packing methods, MSDS information, and other paperwork to be included.

Current Requirements during Transmission

GSM: During transmission the average current is 300 mA but peak currents can be as high as 2.0 amps for a duration of 0.5 milliseconds every 4.5 milliseconds.

iDEN: During transmission the average current is 250 mA but peak currents can be as high as 1.2 amps for a duration of 15 milliseconds every 90 milliseconds.

CDMA: During transmission the maximum current draw is 800 mA.

Sleep current (data logger mode, no communications option boards)
< 350 µA.

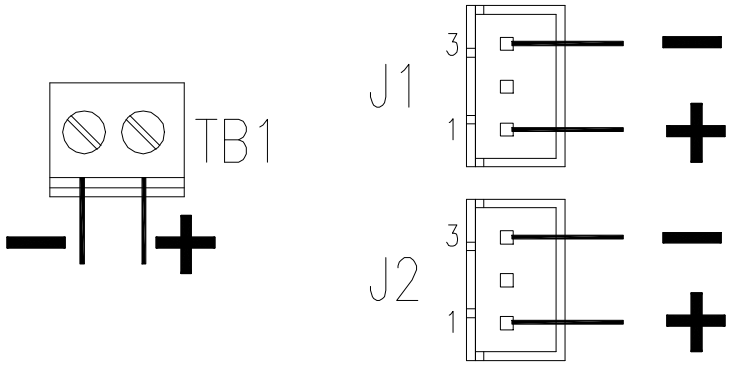
Sleep current (transparent modem mode, no communications option boards)
< 300 µA.

Boost Capacitor
Connects to the TB1 terminal block and assists the battery pack during peak current events, usually during radio transmission.

Low-Voltage Detector
Measured at the TB1, J1 and J2 power connectors, which ever has the highest voltage. A user-selectable alarm point in the range of 0.1 – 28 Vdc can be used to report low-voltage situations.

Power Input #3 (TB1) Connector Type
Screw terminal, 5.08 mm (0.2") spacing. 90º entry. 14-26 AWG (0.14 – 1.5 mm) wire size. Maximum torque is 0.6 Nm (5.3 lbs.-in). See next illustration for polarity.

Power Input #1 & #2 (J1 and J2) Connector Type
3-pin JST B3B-XH-A. Recommended mating connector is JST XHP-3 connector housing with two SXH-001T-P0.6 female contacts. See next illustration for polarity.



Power Input Connector Polarities

ELECTRICAL - GENERAL

Pulse Count Retention Memory
32k bytes or 60K bytes (user-selectable)

Flash Program Memory
116k bytes. Holds operating system and configuration values.

Static RAM Memory
8k bytes.

Clocks
Main frequency: 15.360 MHz
Time keeping frequency: 32.768 kHz
"Sleep" frequency: 200 kHz nominal (internal oscillator), bursting to 15 Mhz during input sample periods in data logger mode.

Logic Supply Voltage
3.3V nominal. This supply is also available on Expansion Port #1 (J8) and Expansion Port #2 (J3) but is intended to be used as a reference and not as a power source.

Auxiliary Supply Voltage
3.6V, 1.5A max. Normally only used to power the cellular and is normally under the control of the processor. This supply is also available on Expansion Port #2 (J3), the serial port terminal block (TB2) and the middle pins of the J1 and J2 power input connectors. These connections are current-limited with a replaceable 250 mA fuse (Littelfuse 251-250 or equivalent).

ELECTRICAL – DIGITAL OUTPUTS

Number of outputs
Six outputs are available if not being used as inputs.

Output Configuration
Push-pull, +3.3V, 2 mA max. Programmable as normally low or normally high.

Source resistance
100Ω

Operating Modes
Up to three outputs can be changed remotely using DC-2009® data collection system.

Any output can be configured to follow an input.

Some outputs can be configured to be used by the CNI2 to control external power sources.

J7, J9, J11, J12 Connector Type
2-Pin MTA with 2.54 mm (0.1") spacing. Recommended mating connector is AMP 641190-2.

TB4 Connector Type
Socket: RIA Connect Type 343, 4-position, Part number P/N 313431-04
Plug-in Terminal Block: RIA Connect Type 339, 4-position, Part number P/N 313391-04

Recommended Output Cable
Alpha 6300/4, Belden 9534, or equivalent having less than 100pF/ft capacitance. This cable type is 24awg, shielded, and has a PVC jacket. Terminate only one end of the cable shield to signal common or ground. Maximum cable length run should not exceed 1000 feet. Other cable types or gauges can be also be used as long as careful consideration is given to suitable wiring practices and performance.

ELECTRICAL – DIGITAL INPUTS

Number of inputs
Six inputs are available if not being used as outputs.

Input Configuration
Form-A or Form-B (independently configurable). Two inputs can be paired for Form-C operation.

Input rate (sampling mode)
10 Hz maximum

Minimum input pulse width (sampling mode)
25 mS.

Sample rate (sampling mode)
1 – 50 samples per second (applies to all 6 inputs). Sample rate is user-selectable. A value of 0 selects edge-detection mode.

Debounce Count (sampling mode)
Number of samples needed to declare an input valid. This is user-selectable and each input is independently configurable. For instance if the sample rate is 4 samples per second, and the debounce value is set to 20, then the signal must be in the same state for 20 consecutive samples to be declared valid, which would be for a period of 5 seconds. Debounce values are ignored in edge-detection mode.

Input rate (edge-detection mode)
TBD Hz maximum

Minimum pulse width (edge-detection mode)
TBD mS.

Wetting current per input
33 µA nominal.

Wetting voltage
+3.3V nominal.

Input resistance
100Ω

J7, J9, J11, J12 Connector Type
2-Pin MTA with 2.54 mm (0.1") spacing. Recommended mating connector is AMP 641190-2.

Recommended Input Cable
Alpha 6300/4, Belden 9534, or equivalent having less than 100pF/ft capacitance. This cable type is 24awg, shielded, and has a PVC jacket. Terminate only one end of the cable shield to signal common or ground. Maximum cable length run should not exceed 1000 feet. Other cable types or gauges can be also be used as long as careful consideration is given to suitable wiring practices and performance.

ELECTRICAL – SERIAL PORT (TB2)

Number of input lines
Two (2), RXD receive data and DTR handshake

Input levels
DTR: ±15V max.
RXD: ±15V max (JP3-3 in B-C position) or +3.3V/0V max JP3-3 in A-B position)

Number of output lines
Three (3) with EIA / RS-232 levels: TXD transmit data, DCD and DSR handshakes

Three (3) with non-inverted logic levels: TXD_B transmit data DCD_B and DSR_B handshakes

Output levels
±5.5V max for EIA / RS-232 signals.
+3.3V / 0V max for logic-level signals.

Bit rate
300 to 115200 (user-selectable)

TB2 Connector Type (RXD, TXD, GND)
Socket: RIA Connect Type 343, 3-position, Part number P/N 313431-03
Plug-in Terminal Block: RIA Connect Type 339, 3-position, Part number P/N 313391-03

TB2 Connector Type (all other signals)
Socket: RIA Connect Type 343, 7-position, Part number P/N 313431-07
Plug-in Terminal Block: RIA Connect Type 339, 7-position, Part number P/N 313391-07

FUNCTIONAL

Modes of Operation

- Metretek “SIP” Pulse Accumulator, 1 – 4 channels
- Mercury Instruments “Mini-Max” (pulse accumulation only) or “PA” (Pulse Accumulator)
- Simple transparent modem (CSD or IP)
- SMS Modem

Cellular Network Communications Options (varies with model)

- CSD Mobile Terminate
- CSD Mobile Originate
- TCP/IP Client
- TCP/IP Server

Paging Mechanisms

- Short message service (SMS)
- Voice call.

Status Indicators

- Two LEDs, red and green. Various patterns displayed to indicate connection status, cellular network status and error codes.

Firmware and Configuration Programming

- Via connector J4 using a USB or RS-232 Programming cable and MP32 software.
- Over-the-air reprogramming via DC-2009® data collection system and MP32 software
- Via RS-232 port using Master Link software (future option)

CELLULAR RADIO AND ANTENNA INFORMATION

GSM24
Motorola Model g24-L Quad-Band GSM GPRS, FCC ID# IHDT56HQ1

CDMA24
Motorola Model c24 Dual-Band CDMA 1XRTT, FCC ID# IHDP56JE1

iDen270
Motorola Model iO270 Dual-Band iDEN, FCC ID# AZ489FT7011

Receive Frequencies

GSM, CDMA	824-849 MHz
GSM	880-915 MHz
GSM	1805-1880 MHz
GSM, CDMA	1930-1990 MHz
iDEN270 (iDEN 800)	851-870 MHz
iDEN270 (iDEN 900)	935-941 MHz

Transmit Frequencies

GSM, CDMA	869-894 MHz
GSM	880-915 MHz
GSM	1710-1785 MHz
GSM, CDMA	1850-1910 MHz
iDEN270 (iDEN 800)	806-825 MHz
iDEN270 (iDEN 900)	896-902 MHz

Antenna Connector
MMCX Jack (female), 50 ohm impedance, (GSM24, CDMA24, HSPA24)
U.FL Jack (male), 50 ohm impedance, (iDEN270)

Antenna (internal quad-band) (GSM24, CDMA24)
824 – 894, 890 – 960, 1710 – 1880, 1850 – 1990 MHz

Antenna (internal quad-band) (iDEN270)
824 – 894, 890 – 960, 1710 – 1880, 1850 – 1990 MHz

ASCII CHART

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	00	Null	32	20	Space	64	40	@	96	60	`
1	01	Start of heading	33	21	!	65	41	A	97	61	a
2	02	Start of text	34	22	"	66	42	B	98	62	b
3	03	End of text	35	23	#	67	43	C	99	63	c
4	04	End of transmit	36	24	$	68	44	D	100	64	d
5	05	Enquiry	37	25	%	69	45	E	101	65	e
6	06	Acknowledge	38	26	&	70	46	F	102	66	f
7	07	Audible bell	39	27	'	71	47	G	103	67	g
8	08	Backspace	40	28	(	72	48	H	104	68	h
9	09	Horizontal tab	41	29	)	73	49	I	105	69	i
10	0A	Line feed	42	2A	*	74	4A	J	106	6A	j
11	0B	Vertical tab	43	2B	+	75	4B	K	107	6B	k
12	0C	Form feed	44	2C	,	76	4C	L	108	6C	l
13	0D	Carriage return	45	2D	-	77	4D	M	109	6D	m
14	0E	Shift out	46	2E	.	78	4E	N	110	6E	n
15	0F	Shift in	47	2F	/	79	4F	O	111	6F	o
16	10	Data link escape	48	30	0	80	50	P	112	70	p
17	11	Device control 1	49	31	1	81	51	Q	113	71	q
18	12	Device control 2	50	32	2	82	52	R	114	72	r
19	13	Device control 3	51	33	3	83	53	S	115	73	s
20	14	Device control 4	52	34	4	84	54	T	116	74	t
21	15	Neg. acknowledge	53	35	5	85	55	U	117	75	u
22	16	Synchronous idle	54	36	6	86	56	V	118	76	v
23	17	End trans. block	55	37	7	87	57	W	119	77	w
24	18	Cancel	56	38	8	88	58	X	120	78	x
25	19	End of medium	57	39	9	89	59	Y	121	79	y
26	1A	Substitution	58	3A	:	90	5A	Z	122	7A	z
27	1B	Escape	59	3B	;	91	5B	[	123	7B	{
28	1C	File separator	60	3C	<	92	5C	\	124	7C	|
29	1D	Group separator	61	3D	=	93	5D	]	125	7D	}
30	1E	Record separator	62	3E	>	94	5E	^	126	7E	~
31	1F	Unit separator	63	3F	?	95	5F	_	127	7F	□

ASCII Conversion Chart