This updated Xcel Energy Telecommunications Bulletin originally posted in March 2015 is offered as a guide to help you understand our application for "best practices" when installing/repairing a phone line at your gas meter.

Please share these guidelines with your technical personnel responsible for installing and maintaining communications equipment to better assure you can reliably meet compatibility requirements. We also urge customers using cell modems as their communications line to check with their service provider to determine configuration settings suggested for 'data' transmission.

We strive to keep up and work with evolving protocols as communications service providers continue to change over the years, but certain upgrades in technology negatively impact compatibility with our existing system, and outpace our ability to access your signal. In those cases, it is important to modify your telephone equipment and/or service to meet the compatibility requirement to avoid interruption or unnecessary Trip Charges that may occur if we must manually download usage due to inconsistent receipt of your data signal.

Why is our consistent receipt of measurement signal so important? The phone line (referred to as the "communication line" in our gas transportation rate schedules) installed and maintained by our gas transportation customers is a mandatory condition of gas transportation service. This allows us to receive and electronically post a customer's daily gas use so our Shippers can schedule and balance gas appropriately. It is also used by us for gas system reliability and billing activities.

TECHNICAL SPECIFICATIONS:

Technical specifications are attached for the Honeywell/Mercury Messenger Modem, our primary device to support gas transport measurement This document may provide your IT personnel with a better understanding of the communication between the Honeywell/Mercury device and our host measurement software. This information is printed with permission of our vendor of choice, Honeywell/Mercury, and can be copied if needed. Most of the material comes from the manufacturer's users' manuals and your technicians should be able to make informed decisions for providing a compatible/operational phone line.

For security and integrity of the gas measurement data, we cannot allow access to the Honeywell/Mercury devices. We suggest installing a Failsafe Station Protector, commonly known as a "biscuit", within 6 foot proximity of the gas meter. Once communication is established at this point, our device technicians will secure communications to the Honeywell/Mercury device. If a biscuit is installed, our device technicians will check for communications at this point and the Honeywell/Mercury device. The final result of the communications will always be at the biscuit, when available. Technical specifications and installation instructions are attached for the Failsafe Station Protector. If your technical personnel are interested in installing this for new installs and/or repairs, Xcel Energy will provide the biscuits at no cost. Please email BSOColorado@xcelenergy.com to request them.

Telephone Line Tips for Electronic Communications

Transport Service Gas Meters are fitted with Mercury Correctors. These correctors are analog instruments that have an analog Messenger Modem communicating to a host acquisition system by a standard telephone line (POTS Line). The integrity of the telephone line has a direct effect on successful communications with the host and the instrument. Many factors can affect the integrity of a telephone line; the list below is intended to assist you in making a decision on what type of telephone line to utilize for your Transportation gas meter instrument.

Best (Circuit Switched Data)

The use of a low cost analog line (1MB) provided by your local telephone company is the best choice for successful communication. This type of line is usually referred to as a POTS line by professions in the communications industry. Best results occur when a single POTS line is directed to each Transport gas meter.

Circuit switched technologies operate like land-line phones. Once the phone number is dialed and connection is made, you have a dedicated circuit from end to end. No one else can use it until you hang up.

Voice calls and dial-up calls are currently circuit switched. Check with your carrier for more information.

VoIP – Somewhat Successful

We continue to see more and more success with VoIP, but only if the following are met:

- Use of G.711 codec, uncompressed (64K but data)
- Packet size set to 20 ms
- Error Control is turned off (including multiple gateways)
- Maximum trans-coding cycles = 3 (more have worked, but incompatibility increases)
- Use your analog port for this phone line and keep the fax analog port separate
- Fire and Burglar alarm separate (absolutely no line sharing allowed here)
- Please consult with your phone system provider regarding these configurations as they relate to your service

Worked in the past, now obsolete

Do not use a single phone line to communicate with multiple meters. Instruments sharing lines can compete for the same dial tone at the same time causing communication failures. Also, sharing a line with smart faxes, elevator lines, fire alarms, credit card machines, entry machine

systems, and other modern dial up modems may cause interference during attempted Instrument calls, causing failures.

We ask that each Transport meter have its own analog phone line to ensure successful data transmission.

Digital Cellular (Packet Switched Circuit)

Cellular Voice/Data Modems are new technology for our Mercury instruments. Our Mercury instruments require connectivity at 2400 baud with the 'fax' port selected for proper data transmission. Different configurations outside of these settings could results in incompatible phone line issues. Please consult with your wireless provider on proper programming for data transmission.

While service providers may provide TCP/IP options, Xcel Energy cannot poll an IP address at this time.

While the technical requirements for a functional communication line may seem complicated, remember that the successful daily download of measurement to our information system is the critical foundation required for gas transportation services. It provides both shippers and PSCo with information necessary to gauge load, nomination, balancing, and ultimately billing data.

We continue to research connect-ability with new generation wireless digital communications. Testing continues with our vendors and we expect continued progress on the communications technology. We will notify shippers as soon as we complete, and can offer, a successful program with new technology.

tii network technologies
141Rodeo Drive
Edgewood, NY 11717
Toll Free 888.844.4720
www.tiinettech.com

tii 320/321/325/326
Totel® Failsafe TFS® Station Protectors
Rev E 9/4/13
ECN 13-204

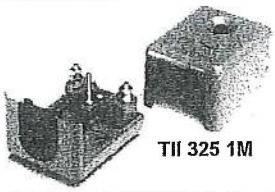
INSTALLATION NOTE

CAUTION: The Product shall be installed in a manner to comply with applicable national and local safety codes.

ATTENTION : Le produit doit être installè de manière à se conformer aux règlementations nationales et locales applicables en matière de sècuritè.

SAFETY: Verify no hazardous voltages exist on lines while making connections.

SÈCURITÈ : Vèrifiez qu` aucunes tensions dangereuses existent sur les lignes lors des connexions.



TII 325 1M

1. GENERAL

- The TII Totel Failsafe® TFS® Station Protectors consist of a mounting base, protector module, grommet, and fitted cover with nylon fastening nut.
- The plastic base is molded with two shallow rectangular wells, one above and one below the ground stud / binding post (Figure 1) and mounting holes designed to fit existing protector mounting holes when changing station protectors.
- The number of protectors that can be connected to various size copper-insulated ground wires is listed in Table A below.

TABLE A
Ground Wire Capacity

Wire Size (AWG)	No. of Primary Protectors
12	1 to 2
10	3 to 5
6	6 or more

- **National Electric Code Requirement.** The protector shall be installed per National Electric Code ANSI/NFPA 70, Article 800, Section C, and shall meet all applicable local safety codes.

2. INSTALLATION

Precautions

- Mount the station protector so as to minimize the possibility of dirt or moisture getting into the protector.
- Station protectors mounted side-by-side or end-to-end should be placed so covers can be easily removed. The cover is furnished with a nylon retention nut which secures the cover to the base (Figure 1). The cover is secured or removed by using a 3/8" terminal wrench.
- Where protection for multiple services is required, it is recommended that a protected building terminal in an interior terminal box be installed in place of station protectors.

Mounting

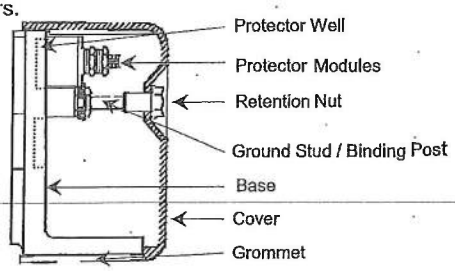


Figure 1

- Mount the station protector vertically on a flat surface using appropriate hardware (the length of the mounting screws should allow for 1/8" of length within the protector).
- The mounting holes are covered with a thin film of plastic, easily punched out, to maintain the environmental integrity of the protector (Figure 2).

Two Pair Wiring Scheme
Station Protector Housing
(Cover Removed)

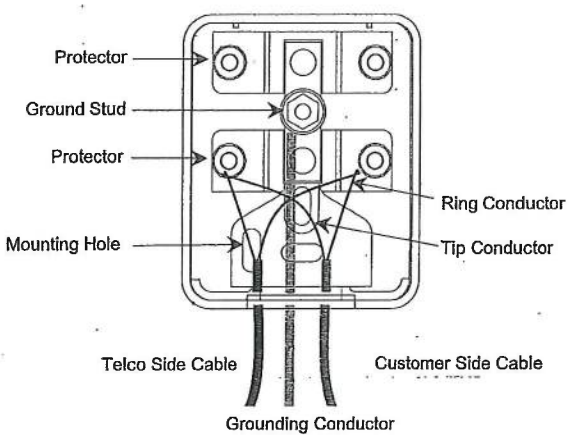


Figure 2

Wiring

- Insert the grounding conductor, the customer side cable and the telco side cable through the grommet located in the center of the base lip.
- Terminate one end of the grounding conductor (No. 6 AWG) on the ground stud / binding post and the other end to an appropriate ground source (Figure 3).
- Terminate the Telco Side cable in between the bottom set of washer and bottom nut of the appropriate stud (one conductor to Tip and one to Ring) and tighten down (Figure 3).
- Terminate the Customer Side Cable under the top set of washers and the top nut of the appropriate stud (one conductor to Tip and one to Ring) and tighten down (Figure 3).
- Loop back unused station wire conductors and coil around the station wire jacket or store in such a manner as to prevent them from coming in contact with protector terminals or bare wires.

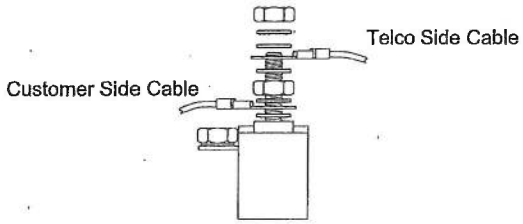
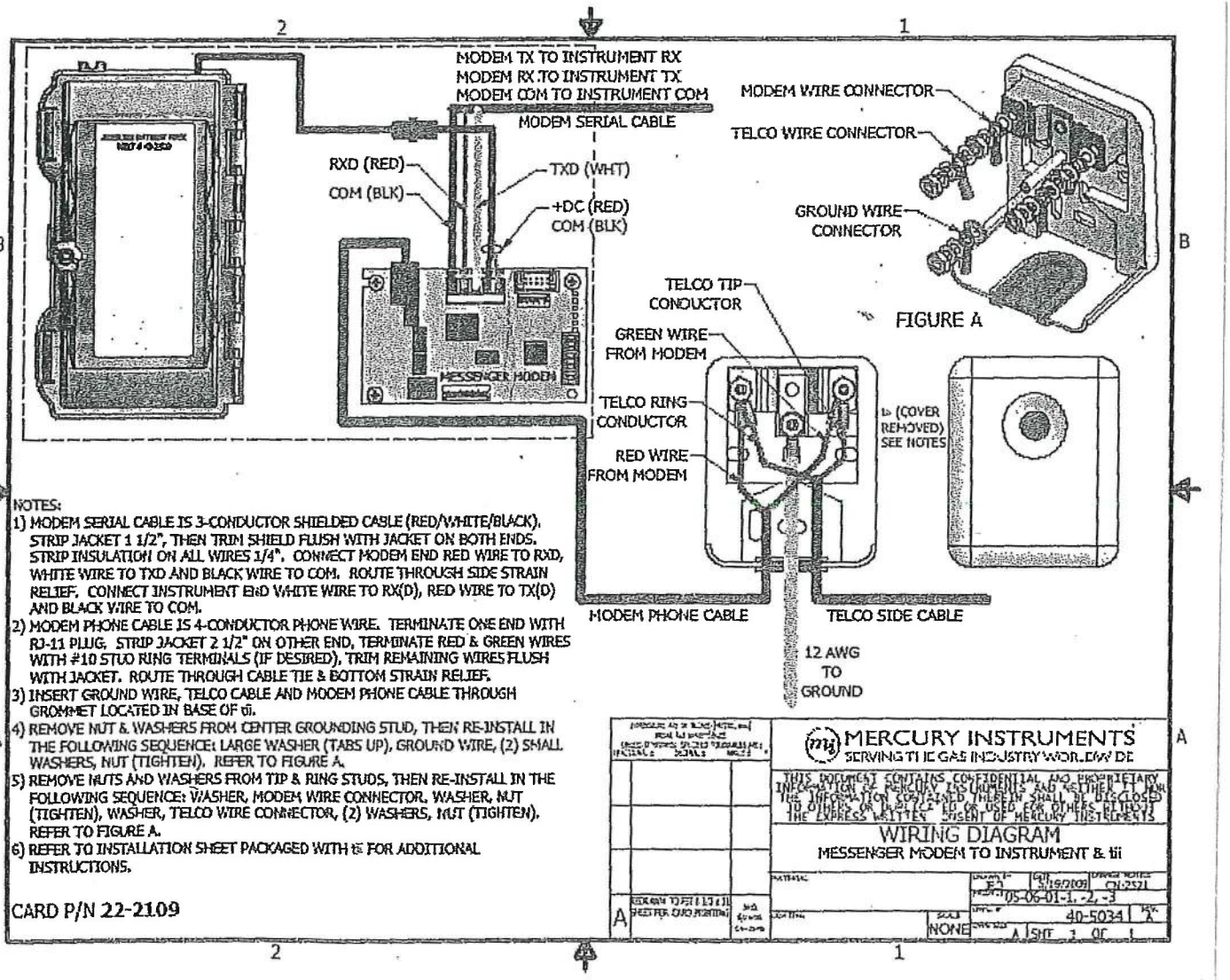


Figure 3



NOTES:

1) MODEM SERIAL CABLE IS 3-CONDUCTOR SHIELDED CABLE (RED/WHITE/BLACK). STRIP JACKET 1 1/2", THEN TRIM SHIELD FLUSH WITH JACKET ON BOTH ENDS. STRIP INSULATION ON ALL WIRES 1/4". CONNECT MODEM END RED WIRE TO RXD, WHITE WIRE TO TXD AND BLACK WIRE TO COM. ROUTE THROUGH SIDE STRAIN RELIEF. CONNECT INSTRUMENT END WHITE WIRE TO RX(D), RED WIRE TO TX(D) AND BLACK WIRE TO COM.
2) MODEM PHONE CABLE IS 4-CONDUCTOR PHONE WIRE. TERMINATE ONE END WITH RJ-11 PLUG. STRIP JACKET 2 1/2" ON OTHER END, TERMINATE RED & GREEN WIRES WITH #10 STUD RING TERMINALS (IF DESIRED), TRIM REMAINING WIRES FLUSH WITH JACKET. ROUTE THROUGH CABLE TIE & BOTTOM STRAIN RELIEF.
3) INSERT GROUND WIRE, TELCO CABLE AND MODEM PHONE CABLE THROUGH GROMMET LOCATED IN BASE OF ti.
4) REMOVE NUT & WASHERS FROM CENTER GROUNDING STUD, THEN RE-INSTALL IN THE FOLLOWING SEQUENCE: LARGE WASHER (TABS UP), GROUND WIRE, (2) SMALL WASHERS, NUT (TIGHTEN). REFER TO FIGURE A.
5) REMOVE NUTS AND WASHERS FROM TIP & RING STUDS, THEN RE-INSTALL IN THE FOLLOWING SEQUENCE: WASHER, MODEM WIRE CONNECTOR, WASHER, NUT (TIGHTEN), WASHER, TELCO WIRE CONNECTOR, (2) WASHERS, NUT (TIGHTEN). REFER TO FIGURE A.
6) REFER TO INSTALLATION SHEET PACKAGED WITH ti FOR ADDITIONAL INSTRUCTIONS.

CARD P/N 22-2109

MERCURY INSTRUMENTS
SERVING THE GAS INDUSTRY WORLDWIDE

WIRING DIAGRAM
MESSENGER MODEM TO INSTRUMENT & ti

DRAWN BY	JEJ
DATE	5/19/2009
PROJECT	05-06-01-1, -2, -3
SCALE	NONE
DRAWING NO.	40-5034
REV.	A
SHT	1 OF 1

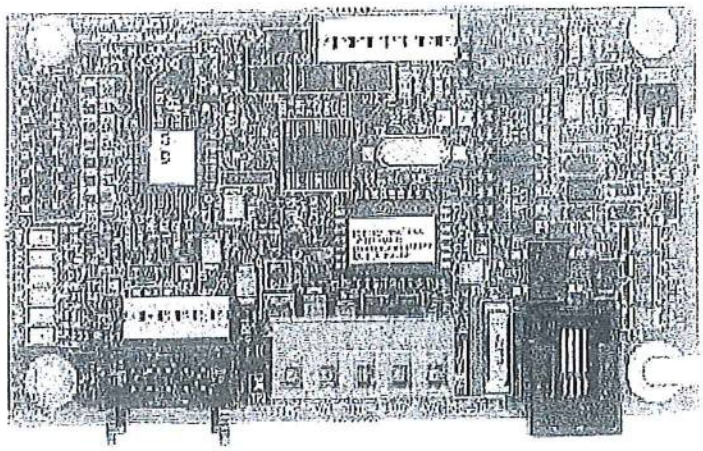
MERCURY INSTRUMENTS
SERVING THE GAS INDUSTRY WORLDWIDE

Messenger V4.0 Modem®

User Guide

V 2.06

January 2009



Single-Channel, 2400 Baud, Low-Power Modem

P 513.272.1111 3940 Virginia Avenue, Cincinnati, OH 45227 USA
F 513.272.0211 www.mercuryinstruments.com www.rmg.com

Appendix A

Basic Telephone Line Information

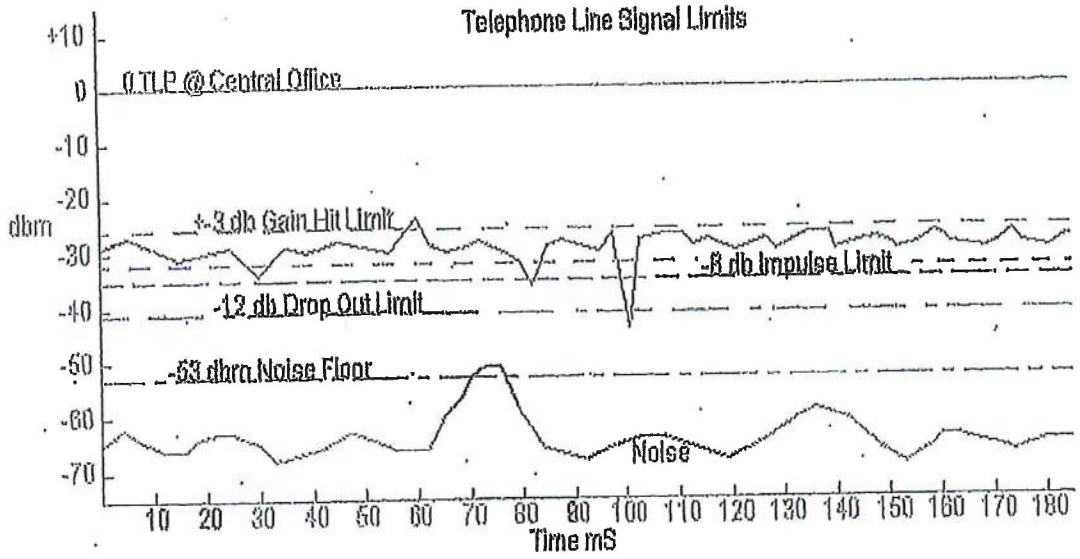
Messenger Modem®
Terminology:

◦ Hand set:	Telephone
◦ Data set:	Modem
◦ Central Office:	Telephone company switching office. All measurements are made with reference to the Central Office demarcation point.
◦ Signal:	Electrical activity on the loop containing information of interest.
◦ Noise:	Unwanted electrical activity on the loop.
◦ DTE:	Data Terminal Equipment.
◦ DCE:	Data Set Equipment.
◦ Subscriber:	Customer.
◦ Off Hook:	Connected to Central Office.
◦ On Hook:	Disconnected from telephone system.
◦ 3002 Channel:	Basic voice grade telephone service.
◦ Local Loop:	Two wire pair between the subscriber handset and Central Office.
◦ Demarcation:	Point where telephone company ownership ends and subscriber ownership begins.
◦ POTS:	Plain Old Telephone Service.
◦ Balanced Line:	Current on wire going out is equal and opposite to the current on the wire coming in.
◦ Originating set:	Modem set that makes the telephone call. Calling number.
◦ Destination set:	Modem set that answers the telephone call. Called number.
◦ DTMF:	Dual tone multifrequency. Keypad is a matrix with one tone for each column and row. When a key is pressed, both tones are put on the local loop.
◦ Receiver Off Hook Signal:	Fast pulsing signal indicating Off hook condition for more than 30 seconds.
◦ dbm:	Decibels with respect to one milliwatt. 10*log(power/.001)

Messenger Modem®
Typical Telephone Line Specs:

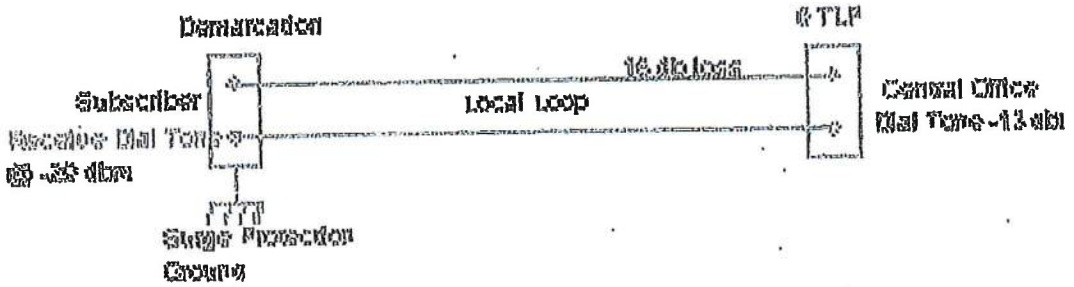
AC Impedance:	600 Ohms
Isolation from ground:	20 MΩ DC, 50 KΩ AC
Voltage at Site:	42.5 - 56.5 Volts DC
Loop Current:	20 - 140 mAmps
Max voice power:	0 dbm
Max data power:	-13 dbm
Local loop loss:	16 db +-4 db
Dial Tone:	350 & 440 Hz @ -13 dbm
Busy Tone:	480 & 620 Hz @ -24 dbm
Ring Signal:	20 Hz @ 100 Volts 2 sec on, 4 sec off
Bandwidth:	300 - 3000 Hz
Test Tone:	1004 Hz
Maximum Noise Level:	-57 dbm
Dropout:	Definition: Signal minus 12 db Limit: Three dropouts in thirty minutes.
Impulse Noise Limit:	Definition: Signal minus 6 db Limit: Fifteen impulses in 15 Minutes
Gain Hit:	Definition: Signal ± 3 db Limit: Eight gain hits in 15 Minutes

Messenger Modem®
Typical Telephone Line Specs:



Messenger Modem®
Typical Telephone System:

- The POTS system provides two wire service between the Central Office and a subscriber.
- The resistance of the copper wires between the two can vary from 400 ohms to 1750 ohms.
- The AC impedance of the loop is determined by the wire spacing and insulation properties and is fixed at 600 ohms.
- The Central Office provides -42.5 to -56.5 volts DC at the Central Office. This is nominally called -48 volts. The -48 volts is applied to the tip wire (red) and the common side is on the ring wire (green).
- The modem (Data Set) operates on current not voltage. This gives a balanced signal to the Central Office so that any noise that is picked up by the wires is canceled out.
- The modem is physically disconnected, by a relay, from the local loop when it is on hook. When the modem wants to dial or answer a ring, it closes the relay to connect to the local loop.
- The modem wiring connects to the POTS at the demarcation point where the telephone company provides a 600 volt surge protector and termination points for the subscriber's wiring.
- The surge protector is grounded at this point. The telephone system is a floating system. That is, neither line should ever be grounded by the subscriber. This would ground the entire telephone system and huge ground loops would result. The subscriber would have to pay for any damages to the telephone system.
- The power company and telephone company have entirely different power and ground systems. That's why modems are the point of failure. They connect the two systems together so any surge on either one is passed through to the other through the modem. Battery operated correctors add a third power and ground system.



Messenger Modem®
Typical Modem Session:

- Corrector originated call. (Voltages, currents and power levels are measured here at the subscriber demarcation.)
- 1. Corrector wakes up and determines a call needs to be made. (Time or Alarm.)
- 2. Corrector sends a wake up to modem.
- 3. Corrector sends ATDT to modem. (AT=Attention, D=dial, T=use tones)
- 4. Modem closes its relay seizing the local loop.
- 5. Connected modem draws at least 20 milliamps DC.
- 6. Central Office sees current draw and connects local loop to switching system.
- 7. Central Office sends 350 Hz and 440 Hz dial tone to local loop at -13 dbm.
- 8. Modem detects dial tone and sends telephone number using DTMF tones.
- 9. Central Office turns off dial tone when it sees the first DTMF signal.
- 10. Central Office switching system routes call to the destination set by switching in trunk lines through other offices to the destination Central Office.
- 11. Destination Central Office looks to see if the destination set local loop is in use.
    - a) If in use, it signals the Originating Central Office which sends a 480 Hz & 620 Hz busy tone to the originating modem. The normal busy is 1/2 second on, 1/2 second off. The corrector modem will disconnect from the loop, terminating the session.
    - b) If not in use, the destination Central Office applies a 90 - 110 volt AC 20 Hz ring signal to the local loop. Two seconds on. Four seconds off. The originating Central Office sends a ring tone to the corrector modem. If the destination set does not go off hook within 30 seconds, the corrector modem will disconnect from the loop, terminating the session.
- 12. The destination modem counts ring signals to answer the call (usually three). Then seizes the loop and draws at least 20 milliamps DC.
- 13. The destination Central Office signals the originating Central Office that the connection has been made.
- 14. The originating Central Office stops sending the ring signal.

Messenger Modem®
Typical Modem Session:
(Cont.)

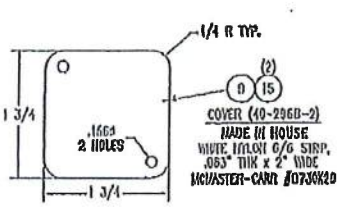
- 15. Both modems have to be quiet for 1.2 seconds while the Central Offices talk to each other to start the billing.
- 16. After the delay, the originating modem sends a signal which the destination modem responds to. They negotiate and if they can communicate, they send a connect message out their respective serial ports. This switches them from the command mode to the data mode.
- 17. The communication session begins and the data is transferred.
- 18. When a session is done (successfully or unsuccessfully) the corrector tells the modem to go on hook. (+++ATH0, +++=switch back to command mode, AT=attention, H0=hangup)
- 19. The modem opens the relay and stops drawing current from the loop.
- 20. The Central Office detects this and tells the other offices to terminate the connection.
- 21 The Central Office disconnects the local loop and completes the billing process. The Originating modem can not redial while this takes place. (0.8 seconds)

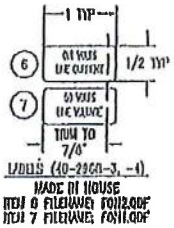
Appendix B

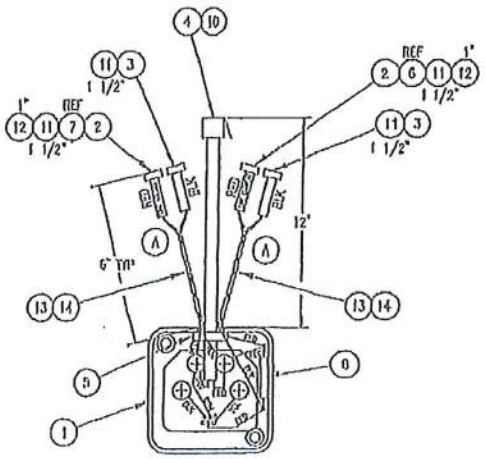
Basic Telephone Line Troubleshooting

Messenger Modem®
Telephone Line Test Adapter
p/n 40-2968

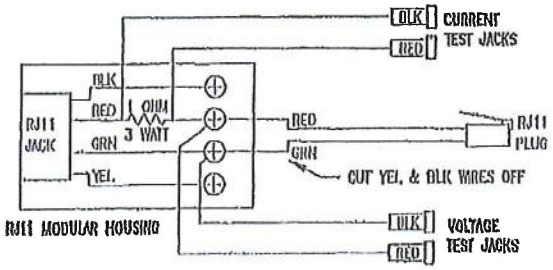
Since modem operation can be adversely affected by improper phone line voltages, use the Telephone Line Test Adapter (shown below) and the procedure on the next page to determine the voltages for a POTS (analog) phone connection.







ITEM	REQ	PART NO	DESCRIPTION
1	1	40-2212	JACK, MODIFIED TELEPHONE
2	2	40-1740	JACK, RED TIP
3	2	40-1741	JACK, BLACK TIP
4	1	40-2324	PLUG, 4 POSITION MODULAR LINE
5	1	20-3027	CABLE TIE
6	1	40-2968-3	LABEL, 0,1 VOLTS LINE CURRENT
7	1	40-2968-4	LABEL, 50 VOLTS LINE VOLTAGE
8	1	40-1739	RESISTOR, 1 OHM, 3 WATT, ±1%
9	1	40-2960-2	COVER, MODIFIED TELEPHONE JACK
10	12"	40-2323	CABLE, MODULAR TELEPHONE
11	6"	40-1103	TUBING, BLACK HEAT SHRINK
12	2"	40-2339	TUBING, CLEAR HEAT SHRINK
13	A/R	40-1310	WIRE, 22 AWG, RED
14	A/R	40-1314	WIRE, 22 AWG, BLACK
15	2	80-1302	SCREW, DD #8-32 x 5/16



Messenger Modem®
Telephone Line Troubleshooting

- 1. Plug line tester into RJ-11 jack on modem
- 2. Plug telephone line into line tester
- 3. Set multimeter to read 200 DC Volts.
- 4. Plug into jacks marked voltage on line tester. Red to red, black to black.
- 5. Voltage (on-hook) should read 46 to 52 volts.
- 6. Cause the modem to go off hook. The Central Office will give you a dial tone. This will last for 30 seconds before it gives you an off hook error tone. Try to complete the test within the 30 seconds.
- 7. The meter should read 5 to 7 Volts.
- 8. Disconnect the meter.
- 9. Set multimeter to read 2 DC Volts.
- 10. Plug into jacks marked current on line tester. Red to red, black to black.
- 11. If the modem is on hook, cause the modem to go off hook.
- 12. The meter should read .023 to .035 Volts. Equates to 23 to 35 mA.
- 13. If current is high, put in attenuator and adjust current into range.
- 14. If current or voltage is low, call telephone service provider.
- 15. Disconnect the meter.

Messenger Modem®
Additional Information

- If the current is too high, an attenuator can be put in the line to keep from overdriving the modem. If the current is too low, the telephone company will have to give you a different cable pair or add an amplifier to the line. The same is true for voltage. If the meter reading is really erratic, then there is a lot of noise present on the line and a telephone technician should do a 1004 Hz attenuation distortion test.
- There are different types of service available for the POTS.
- A 3002 basic line can have no conditioning, C2, C4 or C5 conditioning. Each one provides a better grade of service at a higher cost.
- The C2 conditioned line is all you should ever need. The best thing is that they have to actually test the line to make sure that you are getting a good connection. You will see them go through several pairs on a cable to give you a good one. They would have just given you any old pair for an unconditioned line. The signal quality can change dramatically based on weather and the age of the cable and if it is going over microwave radio to get to the answer central office.
- Another type of is D1 conditioning. This is a naturally high quality circuit that has little noise or distortion and can support up to 9600 Baud without any changes.