The CD42-R is covered under United States Patent.

**WARNING**

Any operation involving work on pipelines containing gases or liquids under pressure is potentially hazardous. It is necessary, therefore, to follow correct procedures in the use of this equipment to maintain a safe working environment.

No person should use this equipment unless fully aware of potential hazards of working with pressurized pipelines and trained in the procedures stated in this manual.

The purchaser of this equipment is responsible for the training and competence of operators and the manner in which it is used.

Contact CDI immediately should any difficulty arise in the use of this equipment.

**WARNING**

Always use caution when opening any CDI transmitter that has been in a pressurized environment.

It is possible for pressurized liquid or gas to leak into a transmitter and remain there even after the transmitter has been removed from the pipeline.

Always point the transmitter away from yourself or others when opening a cover or end cap.
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INTRODUCTION

The CD42-R is a land-based pipeline pig locating and tracking receiver that detects pulsing signals emitted by electromagnetic transmitters.

The transmitter signal strength is displayed on an LCD LED array which can be easily seen by an operator who is tracking moving pigs and/or locating a stationary or stuck pig.

COMPONENTS

The CD42-R system consists of a receiver unit, CD42-GP antenna, antenna cable, batteries, screwdriver, and carrying case. Systems may be ordered and shipped with or without a 22 Hz transmitter.
**Receiver Unit**

The CD42-R receiver records, processes, and stores up to 99 electromagnetic transmitter signal events. Processed signals are graphically displayed as wave forms on an LCD which can be adjusted for contrast and brightness. Receiver performance can be adjusted via menu-driven controls.

A special “screen blanking” feature shuts down the display after five minutes of inactivity to conserve battery consumption.

Input/output includes antenna connection, serial port, and printer port.

**Antenna**

The CD42-GP antenna is designed to reject magnet noise produced by movement through the earth’s magnetic field. This enables an operator to walk a pipeline at a normal pace while searching for transmitter signals.

Water-resistant construction means it can be submerged to a depth of several feet for occasional swamp or under-river operations.*

Though reception range is a function of transmitter power, the CD42-GP has been proven capable of receiving signals up to 50 ft [15 m] over open air, and 25 ft [7.6] from within a pipeline.

* Diver-held and skid-mounted subsea antennas are available for dedicated underwater applications. See pg. 44.
POWER

The CD42-R is powered by five (5) D-cell alkaline batteries. The batteries are located in the rear of the receiver. The CD42-R will operate for up to 40 hours on a change of batteries.

DETECTION METHODS

The CD42-R can track and locate any pig or inline inspection (ILI) tool equipped with a 22 Hz electromagnetic transmitter. Shown here are some of the 22 Hz transmitters manufactured by CDI*.

*For setup and operation of CDI Tx Series transmitters, consult the CD42 T-SERIES TRANSMITTER USER GUIDE (CDI Part # 89-09-0035-00)

*For setup and operation of ILI-MPS transmitters, consult the CD42-CD49 ILI-MPS SERIES TRANSMITTER USER GUIDE (CDI Part # 89-09-0045-00)
GETTING STARTED

Physical Checkout

Unpack the CD42-R receiver unit and other components and inspect for visible damage.

Batteries

Remove back cover with screwdriver (supplied).
Load batteries positive (+) side toward bottom of unit as shown.

Inspect back cover groove and gasket material for

- dents
- deformities
- ruptures
- nicks
- scratches
- dirt
- foreign objects

or anything else that might interfere with a proper seal.

Replace and secure back cover.
Attach Antenna

Attach cable to antenna and to CD42-R unit. Note keyed antenna cable ends to ensure proper orientation.

Make sure connectors are mated properly. Secure by tightening threaded collars.
Power ON

Press top two buttons simultaneously to turn system power ON.

The CD42-R is now ready to use, but you may wish to familiarize yourself with the various screens and advanced menu functions.

The Welcome Screen is first LCD screen you will see. It will display until one of the red control buttons is pressed.
LCD Menus

The Main Menu appears when the Welcome screen is bypassed. It is where most tracking and locating jobs are monitored. It is also where you access advanced CD42-R menu functions.

Gain

Gain indicates the current sensitivity level of the receiver to transmitter signals. Gain sensitivity adjustment is necessary to minimize environmental magnetic interference; for example, a motor vehicle operating in close range to the system.

Adjust gain by cycling buttons adjacent to + or − to increase or decrease gain.

If the surrounding environment is noisy, turn the gain down so that the ambient noise shown on the screen is no higher than the second row of “dots” across the lower part of the screen. If the Gain is turned down too low, the transmitter will not be located by the CD42-R receiver. If the Gain is turned up too high, the transmitter signal will be “hidden” in the noise.
By controlling system sensitivity, you can adapt the receiver performance to fit your surroundings and work habits.

Normally, a gain value of 5 is a good starting point. At gain level 5, the system can be operated while walking a line with little or no difficulty or the possibility of missing a transmitter signal. (At very high Gain settings, bumping or jarring the antenna may result in false data.)

Once receiver gain is set, gently bump the attached GP antenna. Doing so should produce a small but noticeable spike which will scroll slowly from right to left as shown here.

If no noticeable ripple appears after bumping the GP antenna a few times, then the cable connection should be checked. See pg. 27 for more GAIN examples.

**Help Menu**

Press the help button to receive brief information about Main Menu button functions. These buttons are “File”, “Setup”, “Record”, “Gain Up/Down” and “Help”.

A text screen will appear asking you which Main Menu button you would like help with. Pressing the button next to the Main Menu in question will explain that menu function.
Setup Menu

The Setup menu is where CD42-R system settings are verified and/or changed.

LCD CONTRAST - Adjust your display in digital increments to suit current viewing conditions.

METER - This adds an analog signal strength display to the waveform display.

LCD BACKLIGHT - Backlighting is the greatest single electrical drain on the receiver batteries. Because it is difficult to tell if backlighting is on or off under daylight conditions, a small bulb icon on the display “dashboard” indicates backlight status.

MORE - Select to continue setup options (see following page).
GETTING STARTED
CD42-R Pig Location and Tracking System

Setup Menu (cont.)

RECORD - Set recording options: Automatic or Manual

Automatic: Unit continuously monitors without an operator present. Recording starts and stops with each individual passage. This feature is useful when the unit must operate unattended.

Manual: Unit continuously monitors and records passages until halted. Recording continues until halted by operator. This can result in very large data files, but can be useful if and when it is desired to record something of interest that may or may not be a transmitter passage. It is also useful when operating in an extremely noisy magnetic environment.
Setup Menu (cont.)

Location ID: Miles, Kilometers, Numeric, or Not In Use.

Set for Miles or Kilometers if you plan on tracking by location along a pipeline (necessary if pig speed is to be calculated).

Set to Numeric if you want to assign a standard three-digit number to each recording (numbers will automatically advance with each passage, or can be manually set).

Set for Not In Use if you do not intend to track recordings by Location ID.
BEEP - A built-in loudspeaker emits a series of rapid audible tones when a pig recording is underway. When recording is finished, the frequency of “beeps” slows down.

FIX - Fix restores all default system settings. It is also a system and software reset to be used if and when operational problems are encountered. NOTE: Fix will also erase all recorded files, so do not use unless you are certain you no longer need these recordings.
BATT VOLTS - This feature measures and displays available battery voltage. It is recommended that this be checked before beginning a tracking or recording operation.

SET CLOCK - The CD42-R has an on-board real-time clock for date and time stamping of each pig passage. This information appears along with each displayed image.

For the date and time to have any real meaning, they must be correct at all times, therefore the system clock should be set to local time and date. (The system clock keeps time even when the unit continues to run even when the CD42-R unit is powered down, so it should not be necessary to re-set clock before each operation.)

BACK - Select to return to previous setup menu.

Screen Blanking

The CD42-R receiver display will “go blank” after five minutes of inactivity. This is to conserve battery consumption. Press any button to restore the display. (Doing so will not activate that button’s menu or control function unless it is pressed a second time.)

Note: display blanking will not interrupt a recording process. When a pig is detected, the unit will restore the screen display.
**Record Menu**

This is where pig passage recording is set up, started, and stopped.

**SET RECORD LOCATION** - When the Record menu is first selected, you are prompted to configure your position. Use the left/right arrow buttons to jump between units (miles, feet, kilometers, or meters).

Once units are selected, use the up/down arrow buttons to enter a numeric value.

For example, here the first recording position will be “Mile 0.”

Once your position is configured, press the “OK” button. The receiver is now ready to record. As many as 99 magnetic events may be recorded.

If you intend to record multiple passes in the same location and have set the CD42-R record mode to Automatic, nothing need be done while awaiting the next passage (see pg. 14). The unit will remain in a passive recording state until stopped.

If you are relocating the unit before the next recording, see next page.
Record Menu (cont.)

Here, the operator has relocated the unit exactly one mile down the pipeline so has set the mile value to “1.”

Note that the other units have changed accordingly (5,280 ft., 1.61 km, etc.)

This is important if you intend to calculate pig speed between stations (ref pg. 15).
**Files Menu**

Once passages are recorded, you can select and display them (if no passages have been recorded, the Files button will not activate).

STATUS INDICATORS - Useful for locating a specific file based on mile marker information or other easily identifiable locators.

Note that hours and minutes are displayed along with the date, but seconds are shown at the top of the display.

VIEW - Displays graphic waveform representation of a recording. You can scroll through the entire recording via Left and Right buttons.

ERASE - Select recording file(s) to be deleted. You will see one prompt to confirmation deletion. Selecting OK immediately and permanently erases recording.
Files Menu (cont.)

Here is a waveform view of a 43-second passage. Compare transmitter pulse and signal strength shown at transmitter approach, midpoint of passage, and as transmitter recedes.
Files Menu (cont.)

When finished viewing the waveform, the Back button will return you to the Files menu. (No data will be lost by switching between menus or by powering the CD42-R down. The only way to delete data is via Erase or Fix menu commands.)

FILE TAG and CALC PIG SPEED - The CD42-R can calculate pig speed when two files are tagged.
Files Menu (cont.)

Here is the speed calculation of a pig run between station 1 (Mile 0) and station 2 (Mile 1).

In this example from a different pig run, no pig speed calculation is provided. This is most likely because Location ID units and/or Record Location were not properly set (pgs. 15–17).
**Files Menu (cont.)**

PRINT - Your waveform files can be printed to any Epson® compatible dot matrix printer.

To print, remove the back cover (see pg. 7). Connect a standard printer cable to the 25-pin parallel port.

FILE IMAGE - Selecting a file to be printed is similar to the way you view a file, with the addition of an option to print either an individual waveform or a list of all file recordings.
If you have selected the FILE IMAGE option, the waveform as well as file date/time, Location ID, the gain setting, and the duration of the event.

There is also an area for the operator to record any notes that may apply to the File Image printout. When the File Image has completed printing, the CD42-R returns to the file list display, where another File may be selected for printing if so desired. Press the Back button to return to the File Submenu, and once more to return to the Main menu.

If printer is properly connected and online, it will print your waveform or file list. If not, you will see a “No Printer” error message. (If this is the case, check the printer connection.)
GETTING STARTED

Operational Checkout

Now that you have prepared your CD42-R receiver and antenna for operation and have a familiarity with the commands, you and the system are nearly ready to begin work.

It is recommended that you test your assembled system before conducting a field operation. Place activated transmitter* a few paces from and parallel to the antenna.

Here is a representation how a transmitter’s electromagnetic field is “seen” by the system:

*See pg. 6 for transmitter operation and specifications
As the transmitter generates electromagnetic pulses you should see a train of pulse waveforms moving from right to left as shown here.

If BEEP is enabled (pg. 16) you will hear audible tones that accompany pulsing.

If gain (see pg. 11) is set too high, pulse waves will appear “clipped.”

If gain is set too low, pulse waves will be barely visible and you may overlook an event.
OPERATION: TRACKING/LOCATING

Tracking a Moving Pig

“Leapfrogging”

Leapfrogging is a common method of determining the vicinity of a pipeline pig. This is done by setting up the CD42-R system at a point along a pipeline, recording a passage, and then moving the system a predetermined distance downline where the process is repeated.

Should an anticipated passage not occur, it is a simple matter of walking the system back to the last known passage location. This is done with the antenna kept parallel to the pipeline while the display is monitored for pulses.

Establishing leapfrog points as close together as possible will minimize backtracking distance necessary to locate a stuck pig.
As the pig approaches, you should see a distinctive waveform similar to this.

(Remember to check gain and adjust as necessary.)

It is helpful to know the pipeline flow rate to allow enough time to traverse and set up to record the next passage. If the pig passes the next setup point before you arrive, you may end up spending more time locating a pig if and when it does become stuck.

For this reason, many operators deploy a second receiver downline. The CD42-R Dual Receiver Kit (see pg. 45) is offered as a more efficient way to perform a leapfrog operation.
TRACKING/LOCATING (cont.)

Locating a Stationary Pig

Locating a stuck pig in a pipeline is one of the most useful features of the CD42-R. The best way to minimize time spent searching for a stuck pig is to properly track the pig so that if and when it does become stuck, the length of pipeline to be explored is at a minimum.

If the last confirmed tracking location is known, all an operator need do to locate a stuck pig is back-track the pipeline until the receiver reads the signal.

To locate a stationary pig, move the system along the pipeline with the antenna held parallel to the pipeline.
As you approach the signal, the pulse waveforms will gradually increase.

(Remember to check gain and adjust as necessary.)

As you pass the immobilized pig, the signal strength will diminish and the waveforms will decrease.

Back-track again until the perceived maximum signal is received. At this point the CD42-R receiver is at its closest approach to the pig. This point on the pipeline can be marked for cutting or other remedial actions. (See next section, Pinpointing.)
Pinpointing a Stationary Pig

Once the approximate location of a stationary pig is known, a more precise method known as “pinpointing” can be used to further increase the location accuracy. To pinpoint, rotate the antenna perpendicular to the pipeline rather than parallel.

Here is a representation how a signal null is “seen” by the system when the antenna is rotated:
With the antenna in perpendicular rotation, look for the minimum ("null") signal rather than the signal peak.

As you move the antenna closer to the pig, the signal strength drops until reaching the null point of little or no signal, when the antenna is directly over the pig. Move the antenna back an inch or two, and the signal strength will rise. Move farther away and the signal will disappear altogether.

NOTE: Reception is severely limited when the antenna is held in perpendicular orientation. Therefore, null pinpointing is not a suitable method of random pig location.

Before pinpointing, you should first use tracking/locating procedures with antenna in parallel orientation (see previous pages) to determine the general vicinity of a pig.
COMMUNICATION

Connecting CD42-R to PC

The CD42-R receiver can communicate with your PC via standard RS-232C serial communications.

A standard RS-232C serial cable with a male 9-pin DB9 connector on the receiver end is required. (The other end will require either a 9-pin or 25-pin female connector, depending on your PC. A “null modem” type of cable is not necessary.)

Once the proper hardware connection has been made, it is necessary to run a terminal emulation program.*

The terminal emulator must be configured for 9600 baud, 1 stop bit, 8 data bits, and no parity (often referred to as 9600-N-8-1. For example, The PuTTY emulator settings should resemble this:

* As of this publication (2015) PuTTY, an open-source terminal emulator, serial console, and network file transfer application is readily accessible for free download. Other programs include Tera Term VT and HyperTerminal. CDI makes no specific recommendation regarding these or the many other programs available.
If using PuTTY, check the Serial button under Session options.

When the proper serial communications parameters are set, you should see a window like this:

NOTE: Your terminal emulator application may differ in appearance, command options, and performance from examples shown here.

If you do not see a prompt, press the CD42-R SETUP button to initialize communication.
The Receiver display will confirm a successful link with your PC:

While the CD42-R receiver is in normal operation, it continuously scans for the user to press the ENTER key on his keyboard. At this point, press your PC ENTER key one time and you should see this serial interface window.

This menu uses standard “highlight bar” selection, so simply pressing the “up arrow” and “down arrow” keys on your keyboard should allow you to highlight one of the four possible selections. If you do not receive the above menu after pressing ENTER, then you should first check your cabling and your communications configuration.

If cabling and configuration are correct, then verify that the batteries in the CD42-R are functioning, and that the power is turned on. If you still have problems, please contact CDI (see pg. 46 for contact information).
**View/Transfer File Data**

Use the View/Transfer File Data command to permanently store a set of recording image data to your PC. The image data is output in a platform independent manner called “comma delimited text” or “comma separated values” (CSV). CSV files are very generic and versatile and may be operated upon by a great many computer programs.

Spreadsheet programs such as Microsoft Excel are capable of directly reading these CSV files and rendering them back into the original graphical data.

To select the View/Transfer File Data menu option, move the black highlight bar using the up and down arrow keys so that it is highlighted black and press ENTER.

The display will then show the total number of recorded files in the CD42-R memory. This window indicates four log files (recordings) stored in memory.
Use UP/DOWN, HOME, END, BACK and ENTER keys to select the recording that you are interested in. Once you have the appropriate file highlighted with the menu bar, press the ENTER key. You will then be prompted to open a recording.

Opening a log file on your local computer allows the data that is about to be dumped from the CD42-R memory to be captured and permanently stored on your PC.

Once selected, the Capture Text option will ask you to provide a filename for the data about to be stored. Providing an extension of .CSV will identify this text for spreadsheet.

Once the capture file has been named and opened by the terminal program, simply press ENTER on your keyboard again. The CD42-R will “dump” the data to the screen as it writes to the capture file, which will also be written into the capture file.
A typical data dump of comma-separated values will resemble this:

Once the dump has completed, the capture file must be closed. This prevents everything else that you do with the CD42-R during the session from being logged to disk. Choose Stop to close the capture flag.
Now that you have successfully stored the image of a given pig passage, you may open it directly from within a spreadsheet program (which is why you provided a .csv extension).

You may use spreadsheet charting functions to manipulate the data in any way that you wish. You may also overlap recordings, join recordings together, or anything else that you can think of doing with a spreadsheet program. Here is a line graph created in Microsoft Excel.

**Dump File Dates/Times**

The Dump File Dates/Times menu option works similarly to the View/Transfer Data File option but only the number of the recording in memory, the date, the time and the mile marker position are dumped to the capture file. (This data may also be manipulated with standard spreadsheet programs.)


**View Transmitter Signal**

This option allows you to view receiver coil input signals in real time via PC terminal emulation. This has limited use in the real world, but is occasionally useful for testing purposes.

To see the real-time waveform display, simply highlight the View Transmitter Signal menu item and press ENTER. The CD42-R will prompt you with “Vertical display of antenna input. Press ENTER to start, any key quits.”

![Waveform Image]

**NOTE:** Once you begin viewing the waveform, pressing any key will quit the operation. No other prompting will occur.

Note that the transmitter pulses are displayed vertically instead of horizontally (as with the CD42-R LCD). This is because of serial interface limitations. The image will scroll from the bottom to top.
Version/Statistic Info

The Version/Statistic Info menu selection displays current CD42-R system information.

- CDI contact information
- Firmware version and compilation data
- Equipment Owner text (also displayed on the opening screen at system boot)
- Card Number (serial number of the electronics circuit board)
- Chassis Number (serial number of the hardware chassis)
- Current battery voltage as measured by the system.
- Current amount of memory used by all recordings in memory

TROUBLESHOOTING

If your CD42-R fails to operate after following all battery installation, configuration, and connection procedures, it will be necessary to contact CDI at 1-800-580-4234 or 918-258-6068 for product support.

REMOVING FROM SERVICE

**WARNING:**
Always remove batteries before placing the unit into storage. Failure to do so may result in damage and may void warranty.
APPENDIX A: OPTIONAL EQUIPMENT

The standard CD42-R receiver kit includes receiver, antenna and antenna strap, 6-ft [1.8 m] antenna cable, Pelican™ case, screwdriver, batteries, and a CD42 T-series 22 Hz transmitter.

In addition, CDI also offers this optional equipment to expand the capability of your system. Contact your CDI distributor for more information.

22 Hz Transmitters

22 Hz InLine Inspection (ILI) Transmitters
OPTIONAL EQUIPMENT (cont.)

Dual Receiver Kit for efficient leapfrogging

20 ft [6 m] Cable

Subsea General Purpose Antenna, skid-based, w/cable

Subsea General Purpose Antenna, w/200 ft [61 m] Cable
### APPENDIX B: SYSTEM SPECIFICATIONS

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
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<tr>
<td>Detection Type:</td>
<td>Non-Intrusive Electromagnetic</td>
</tr>
<tr>
<td>Applications:</td>
<td>Tracking and/or Locating</td>
</tr>
<tr>
<td>Deployment:</td>
<td>Land (subsurface antennas for water recording available)</td>
</tr>
<tr>
<td>Sensor:</td>
<td>Wire-wound Antenna</td>
</tr>
<tr>
<td>Detection Direction:</td>
<td>Bi-Directional</td>
</tr>
<tr>
<td>Devices Detected:</td>
<td>Electromagnetic Transmitters (Standard CD42 Family)</td>
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<tr>
<td>Detection Speed:</td>
<td>0.01 meter/sec to 20 meter/sec</td>
</tr>
<tr>
<td>Visual Indicator:</td>
<td>LCD</td>
</tr>
<tr>
<td>Audible Indicator:</td>
<td>Loudspeaker</td>
</tr>
<tr>
<td>Power Source:</td>
<td>D-Cell (5) Alkaline Batteries</td>
</tr>
<tr>
<td>Battery Life:</td>
<td>40 hours</td>
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<tr>
<td>Controls:</td>
<td>Configuration and Operation by Menu Pushbutton</td>
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</table>
APPENDIX C: WARRANTY, CARE, & MAINTENANCE

Warranty

All equipment sold by Control Devices, Incorporated (CDI) is warranted for a period of one (1) year from the date of shipment to Purchaser, providing the instrument or equipment has not been modified, abused, or used for purposes which it was not designed for.

Batteries, probes, leads, magnets, and other consumables subject to wear are not covered by this warranty. CDI will repair or replace faulty equipment during the warranty period when the cause is a defect arising from faulty design, materials or workmanship.

Making a Warranty Claim

Equipment being considered for warranty repair, or a representative sample thereof, must be returned to CDI at the Purchaser’s expense. The equipment must be accompanied by the Purchaser’s written order* describing the defect(s) and authorizing CDI to invoice the Purchaser for any charges not covered by the warranty.

Upon receipt of the equipment and Purchase Order, CDI will examine the equipment and make a determination of the nature and cause of the defect. If the defect is not covered by the warranty, CDI will quote to Purchaser the cost for replacement or repair equipment, and will not proceed until Purchaser delivers a written acceptance of the quotation.

During the one year warranty, CDI will bear the cost to return units repaired under the warranty back to the Purchaser’s domestic premises. CDI will return units to foreign countries at Purchaser’s expense.

* Contact CDI at 1-800-580-4234, ext 143 for CDI RMA Form FM-03-0089
Care and Maintenance

Equipment designed by CDI is protected against the environment in which it is intended to operate. Much of the equipment is designed for prolonged use in the field without any special maintenance other than routine battery replacements. It is the Purchaser’s responsibility to insure that proper precautions are taken during installation and operation so that weather seals are in place, routine maintenance occurs, etc. Failure to perform these operations nullifies this warranty.

CDI equipment should only be operated by qualified personnel who are familiar with any and all manuals and procedures for said equipment’s operation.

Service and Repairs

Cost for repairs not covered by the warranty or carried out after the warranty period has expired will be charged at the current hourly or set service rate, plus the cost of materials, upon approval by Purchaser.

Equipment for repair must be sent at the Purchaser’s expense and be accompanied by the Purchaser’s written order describing the defect and authorizing CDI to invoice the Purchaser for labor, materials and return delivery cost.

No service or repair will be undertaken until an approved written order is received from the Purchaser.

Operating equipment while in a damaged condition nullifies this warranty.
ABOUT CDI

CDI is a family-owned and operated business located in Broken Arrow, Oklahoma, just 12 miles from downtown Tulsa. Incorporated in 1982, CDI has proudly been manufacturing products in the United States for more than 32 years. CDI currently employs 45 people in the areas of electronics and mechanical design, software and firmware programming, electronics manufacture, machining, and more.

All CDI products are designed and built completely in-house utilizing an on-premises machine shop boasting six fully-automated CNC machines as well as full-time electronics assembly personnel.