

CATH-TECH

CORROSION CONTROL EQUIPMENT

Operation Manual for Hexcorder MM

CIPS/DCVG Survey Instrument



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Limited Warranty

All Cathodic Technology Limited (Cath-Tech) instruments and equipment are warranted against defects in materials, design or workmanship for a period of two years from date of sale. This warranty excludes damage due to misuse, abuse, tampering or acts of God such as fires, floods, wind damage, lightning etc.

We will repair or replace at our option any defective component, after examination in our manufacturing facility, if the fault is due to defective materials or labour, within two years of the purchase date. For warranty repair, a Returned Goods Authorization (RGA) must be obtained from Cathodic Technology Ltd prior to shipping the defective unit pre-paid to our location.

Note: *There is no warranty expressed or implied on batteries.*

Cath-Tech Policy

- Cath-Tech extends a two-year in use warranty on all units, which have been designed and/or manufactured by Cath-Tech staff.
- Cath-Tech reserves the right to make any changes in design or specification which it deems an improvement, with no liability to make the same changes on existing equipment.
- This warranty is in lieu of all other warranties or guaranties, expressed or implied, which might otherwise exist. The purchaser is relying only upon this guarantee and not upon any representations not herein expressed.
- Any material or equipment being returned to the factory must first have a Returned Goods Authorization (RGA) from Cath-Tech.

Welcome

Thank you for selecting the Hexcorder Millennium CIPS and DCVG survey instrument.

The Hexcorder utilizes GPS for synchronization with current interrupters and other data logging equipment. This ensures that everything happens at the same time no matter how far apart equipment is or how long it has been out in the field. GPS coordinates are logged for each reading and stored to memory.

Open and inspect your Hexcorder upon receipt. If any damage occurred during shipping, file a claim with the carrier immediately.

The Hexcorder comes complete with:

- Wire dispenser, either hip pack or back pack
- Hexcorder to wire dispenser cable (attached to back pack, in the box for hip pack)
- Battery charger
- 2 x Cu/CuSO₄ half cells
- 2 x half cell extension poles
- 2 x Hexcorder to half cell cables
- Spool of light survey wire
- Neck strap
- Carrying case
- RS-232 communication cable with USB adaptor
- Operation manual



Testing & Calibration

This instrument has been thoroughly tested at the factory to ensure it will perform correctly. A certificate of calibration is included. The calibration is traceable to the National Institute of Standards and Technology (NIST) or the National Research Council of Canada (NRC). The certificate of calibration is valid for one year from the date of issue. The Hexcorder requires re-calibration on a yearly basis; contact Cath-Tech for more information.

Charging the Battery

The battery is the latest generation of rechargeable nickel metal hydride type, (NiMH) rated for 450mAH. NiMH does not develop a memory. If looked after it will provide many years of service. Do not allow the battery to freeze, likewise do not store in a hot location.

It is recommended that you charge the battery for 24 hours upon receipt of the unit and prior to survey season. The nominal battery voltage is 7.2 volts and when charging may exhibit voltages as high as 8.4 volts. The battery is exhausted when the voltage drops to 6.5 volts.

GPS Engine

The standard GPS engine/antenna supplied with the Hexcorder is a 12 satellite WAAS enabled unit. It is capable of resolving position information with an accuracy of 3 metres if the WAAS differential correction is being received. Optional sub-meter GPS accuracy is available upon request.

The GPS engine is connected to the Hexcorder by a circular connector on the outside of the case.

Normally the GPS will lock within 5 minutes, however, if the GPS has been moved far from its last position, has not been used for a long period or if the signal is weak, it may take up to 10 minutes to lock.

If the GPS engine will not lock;

- Locate it in a position that has a good view of the sky in all directions, on the roof of a parked car is usually good
- Connect it to the Hexcorder
- Check in the main menu that G-GPS is on
- Leave it alone for 10 minutes or so
- Usually the GPS will lock in this situation



If the GPS loses lock while in survey mode, this is not usually a problem. The PPS (Pulse Per Second) signal will coast or free run and the ON/OFF measurements will still be accurate. Eventually, after some hours the PPS will start to slip and synchronization with other GPS devices in use such as a Smart Logger II or the current interrupters will be lost. This will normally take several hours and a short term loss of signal is not a problem. The GPS will typically regain lock long before the timing drift has any influence on the recorded data.

In the Test Menu there is an option to display information on the satellites from which the GPS antenna is receiving data, quality of data and other information. See section 5-Test for more information.

NOTE: The Hexcorder uses the exact date and time supplied by the GPS satellite system. This time is in UTC (Coordinated Universal Time). To convert to your local time, add or subtract the local time zone correction. All of the equipment uses UTC for synchronization; the equipment does not show local time.

Connections



Threading the Wire

From the spool, the wire passes through the plates of the lower tensioner. Then the wire is wound clockwise around the drum twice. Finally, it passes through the plates of the upper tensioner and out the side of the wire dispenser to be attached to the pipe at the test station.

Connect the lead from the bottom of the spool to the terminal at the base of the wire dispenser.

The wire has a fine coating/varnish on it that must be removed with sandpaper to make a good electrical connection.



Main Menu

To turn on the Hexcorder, press the upper yellow key on the keyboard. The main menu appears after the Hexcorder boots up.

To return to the Main Menu at any time, press the two yellow keys on the keyboard simultaneously.

- The first 3 lines are the various functions
- The next two lines indicate the date, time and GPS position if GPS is locked
- The last line indicates the firmware version, amount of memory used and battery voltage

```
CATH-TECH  HEXCORDER
1-survey 2-setup 3-export-data
4-change-time 5-test    OF-off
EM-erase-mem S-scope G-GPS on
TUE 11 JAN 11          15:14:24
4507.5514N 07942.9672W    04
26 III 11              00% 7.4V
```

If the GPS is off, the date and time displayed is that of the Hexcorder real time clock. If the GPS is ON but not locked, the position information will be blank until the GPS is locked.

OF-Off

To turn the unit off, press both yellow keys simultaneously to return to the main menu. Then press the ‘O’ and ‘F’ keys simultaneously. The screen will change to a shut down screen and the unit will turn off.

G-GPS

The ‘G’ key turns the GPS function on and off. GPS synchronized logging requires the GPS to be on and functioning. GPS can be turned off for high/low and non-interrupted modes. However, the timing of the readings is more accurate with the GPS on.

If a GPS synchronized survey is selected during setup, the Hexcorder will automatically turn the GPS on and over ride the ‘G’ key setting.

2 – Setup

Before a survey can be performed the Hexcorder must be configured for the type of survey to be done. Press 2 from the main menu to enter the setup procedure. The Hexcorder will display the last setup that was used for data logging.

- Press F to start a new file with the same parameters as previously used.
- Press A to exit without changing anything.
- Press C to continue with setup.

```
CIPS
GPS synchronized
00200ms off 00800ms on 100Mohm
60Hz    lat lon stored
manual
Memory 00% File 01

F-new-file    C-change A-accept
```

NOTE: After erasing the memory, the set up procedure must always be completed once to tell the Hexcorder how and when to record your data.

- File Number
- The Hexcorder automatically assigns a new file number if the setup is changed.
- Press A to accept and continue

```
File 01

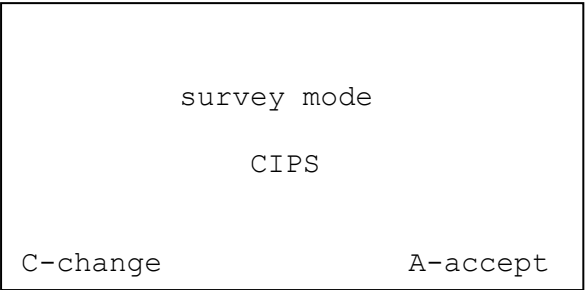
N-change-file-name

A-accept
```

Survey Mode

The Hexcorder is capable of performing four different types of surveys. CIPS measures the level of cathodic protection on a structure. DCVG detects flaws or holidays in the coating. The Hexcorder is capable of measuring both survey types at the same time. Additionally, it can be used as a stationary data logger with 4 channels.

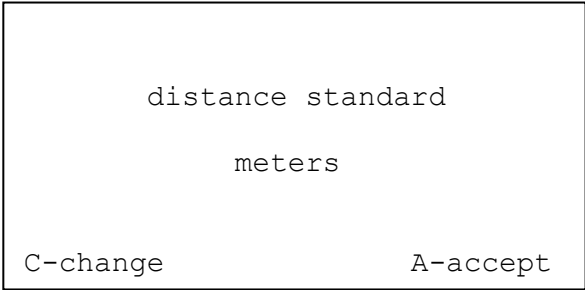
- CIPS - Close Interval Potential Survey
- Data Logger – uses the 15 pin D connector on the front of the Hexcorder, not GPS synchronized
- CIPS + DCVG combined
- DCVG - Direct Current Voltage Gradient only – no wire dispenser needed
- Press C to toggle between the options
- Press A to accept and continue



Distance Standard

This is only applicable for CIPS related surveys that have a trailing wire and chainage can be measured from it.

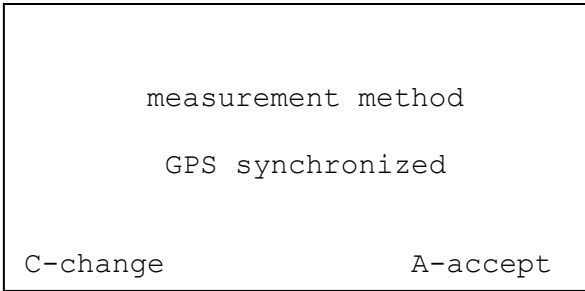
- The Hexcorder can measure chainage in feet or meters
- Press C to change between meters and feet
- Press A to accept and continue



Measurement Method

There are 3 measurement methods:

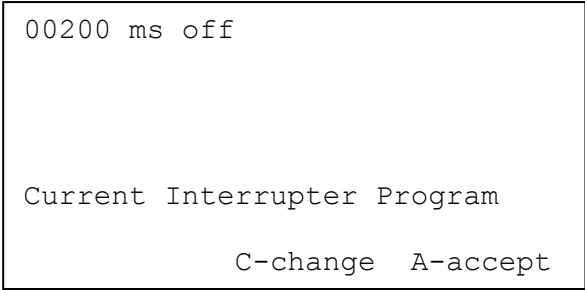
- Not Interrupted (logs once per cycle)
- High/Low (logs the highest and lowest value per cycle)
- GPS Synchronized (logs the readings at specific time points)
- Press C to toggle between modes
- Once set, press A to accept and continue



Program Interruption Cycle

In GPS synchronized and High/Low the same program as the current interrupters have must be entered into the Hexcorder to record at the correct time in the interruption cycle.

- Enter the rectifier OFF time in milliseconds.
- Press C then enter the OFF time numerically. Must enter 5 digits.
- Once set, press A to accept and continue.



- Press C to select the total current interruption cycle length in seconds.
- Cycle length = OFF Time + ON time
- Once set, press A to accept and continue

00200 ms off
01s cycle

Current Interrupter Program

C-change A-accept

Note: The programmed rectifier ON and OFF times must exactly match the rectifier ON and OFF times programmed in the current interrupters.

Instant OFF Measurement Delay

In GPS synchronized mode one can have increased survey accuracy by performing a delay, after the start of the ON/OFF time, before the ON/OFF potential is measured. When the cathodic protection is first turned on or off, there can be an inductance spike in the voltage due to the capacitance of the coating. A more accurate reading can be obtained by inserting a delay, instead of taking the reading right as the rectifiers turn off, wait 100ms, then take the reading. Inductive spikes can be seen on any waveforms taken, see section 6-Wave or S-Scope for more information.

- Press C to enter the delay time in milliseconds.
- The allowable delay time is dependent on the length of time that the rectifier is OFF.
- Once set, press A to accept and continue

00100 ms off

i-off measurement delay
10ms to 0150ms typical 0100ms

C-change A-accept

OFF Time Milliseconds	Recommended Delay before Measurement
200 Milliseconds	100 Milliseconds
300 Milliseconds	150 to 200 Milliseconds
400 Milliseconds	200 to 300 Milliseconds
500 Milliseconds	300 to 400 Milliseconds

Input Impedance

The Hexcorder has a selectable input impedance of either 10 Meg Ohms or 250 Meg Ohms.

- Press C to toggle between the two input impedances
- Once set, press A to accept and continue
- Use 250 Mohm for arid/dry conditions

input impedance

010 Mohm

C-change A-accept

Power System Frequency

The Hexcorder must be set to the local power system frequency to properly configure the AC filter.

- Press C to change between 50Hz and 60Hz
- North and Central America use a 60-hertz power system frequency.
- Europe and Asia use a 50-hertz power system frequency.
- Select the power system frequency for your area.

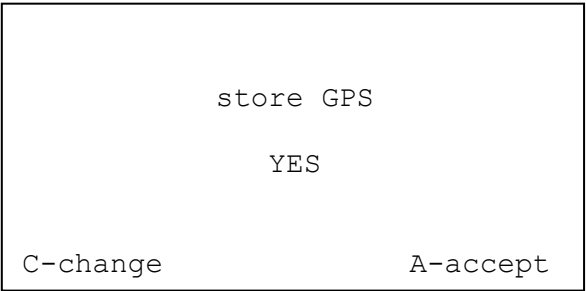
Power System Frequency

60Hz

C-change A-accept

Store GPS

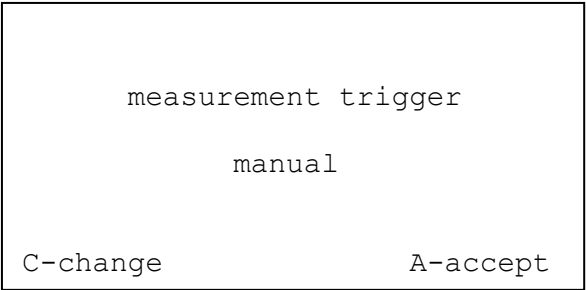
The Hexcorder can also store the GPS coordinates and information about the GPS signal by answering YES to the store GPS selection. The co-ordinates can be very useful to return to an exact location after the survey.



Measurement Trigger

Measurements can be taken manually or automatically based on time or distance. Manual should be the method of choice, this allows the surveyor to check that the reading is good before storing it. Using automatic can introduce many false readings into the data stream. In auto mode the Hexcorder takes the reading regardless of the pipe connection or the half cell contact to the ground.

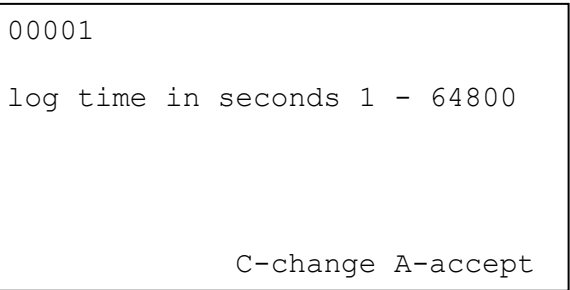
- Press C to toggle between manual and auto mode
- Press A to accept and continue



If auto is chosen, the Hexcorder next prompts for a trigger based on time or distance. If time is selected, the Hexcorder takes one reading every cycle time. If distance is selected, the distance desired between readings is asked. Input in meters or feet, whichever system was selected earlier. The Hexcorder can only take one set of readings per cycle, if the surveyor moves more than the specified distance in one cycle time, only one reading will be taken, not two. To stop taking readings, press the two yellow buttons to exit survey mode and return to the Main Menu.

Data Logger Settings

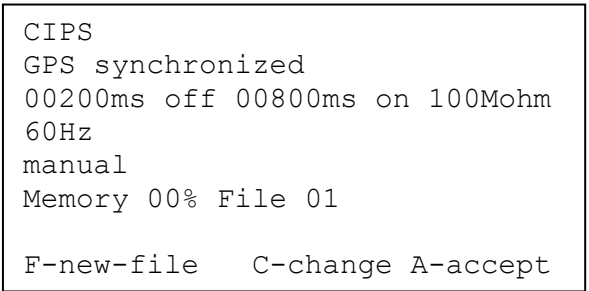
In Data Logger mode, the Hexcorder will prompt of the logging frequency. Then it will ask for the number of channels, 4 is the maximum.



Setup Screen

After setup is complete, the Hexcorder will return to the main setup screen

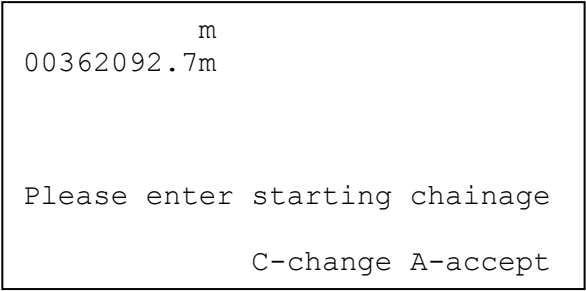
- Press C to cycle through the options again.
- Press F to change the file name
- Press A to accept and continue



Starting Chainage

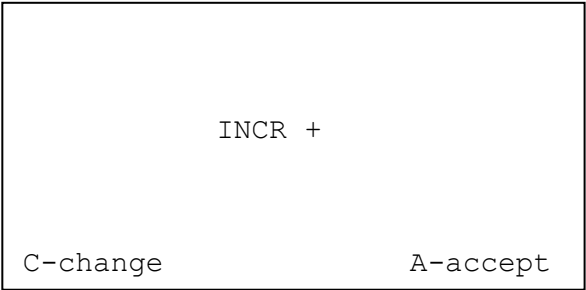
In a CIPS survey mode, the Hexcorder will ask for the starting chainage value. This can be set to 0, or a value from the pipeline can be used.

- Press C to enter the starting chainage
- Below the entry line, the previous chainage is shown
- Once the chainage is entered, press the ENTER key
- Press A to accept and continue



Now the Hexcorder prompts for the increment to the chainage. The chainage can increase or decrease as the surveyor walks depending on the setting.

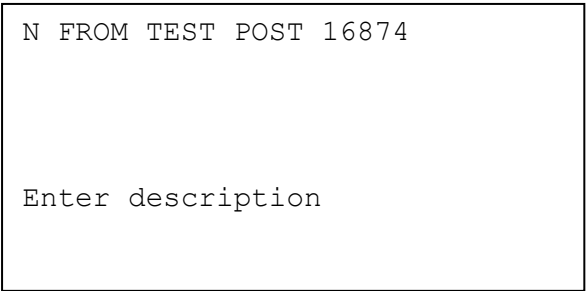
- Press C to toggle between + and –
- Press A to accept and continue



Description

The last step in the setup is to enter a description. The description will appear at the header of the file. Often the description is the starting point and direction the surveyor is heading.

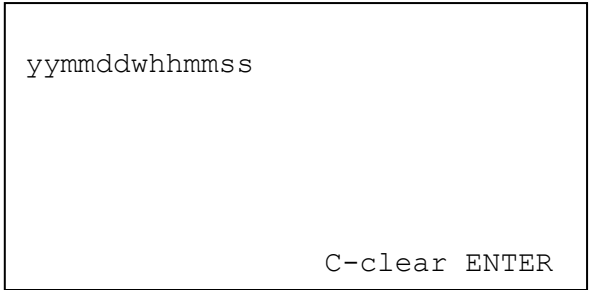
- Use the full keyboard to enter the description
- Press ENTER when finished
- Now the Hexcorder will return to the Main Menu



4 - Set Clock

The set time and date function is accessible from the main menu and sets the RTC (Real Time Clock) inside the Hexcorder. The RTC is normally only used in non GPS modes of operation, as the GPS system also provides the date and time. Press 4 to change or set the time and date.

- The time and date should be entered using the following format:
- yy = Last 2 digits of year
- mm = Month
- dd = Day of month
- w = Week day (Monday = 1, also used in GPS mode to display the day of the week)
- hh = Hour in 24 hour clock
- mm = Minutes
- ss = Seconds



1-Survey

After setup is complete, press 1 on the Main Menu to enter survey mode. If GPS synchronization is enabled, survey mode will not start until the GPS engine is connected and locked. A message will appear on the screen “Please wait for PPS from GPS”. Ensure that the GPS is connected and has a clear view of the sky. Also note that the GPS may take up to 10 minutes to lock. Once the GPS is locked, the main survey screen will appear.

To exit any survey mode at any time press and hold the two yellow RESET keys. This will stop the survey and return the user to the Main Menu.

CIPS Survey

- The following parameters are visible on the main survey screen:
- Pipe to soil voltage, mV, ON and OFF
- Record number
- Chainage
- Current Position; Latitude, Longitude & quality of signal
- Memory % used, altitude and PDOP (Position Dilution of Precision) from GPS.

	ON	OFF
Rect	1257mV	0924mV
Record# 00052		
Chainage 00000010.1		
4351.6000N 07943.5664W QU05		
Memory 01% 257.1m PDOP 1.9		

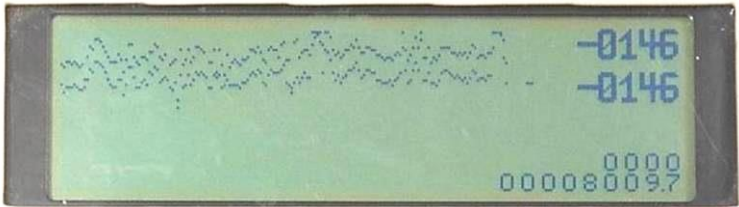
GPS information is only shown if the GPS synchronized option was selected in setup. If you have any issues with the GPS, turn to page 5 for more information on the GPS.

In manual mode, the surveyor presses the red button on the top of the half cell extension pole to take a reading. That reading is stored in the file and the record# increases. As the surveyor moves, the trailing wire spools out and the chainage increases. In order to take a reading one half cell must remain in contact with the ground. The Hexcorder will only take one reading per cycle no matter how many times the red button is pushed.

NOTE: The Hexcorder is focused on the many calculations required to take a reading. If the surveyor presses a key on the keypad, it can take the Hexcorder a few seconds to respond. The surveyor should press and hold the desired key until the Hexcorder responds.

Graph Mode

Pressing and holding G will change the display on the Hexcorder from a table to a graph. With graph mode it is possible to see the previous readings taken.



Before entering graph mode, the Hexcorder asks the user to select the graph range.

- 0mV to -2000mV will cover most common survey situations
- 0mV to -3500mV

select graph range	
1	0mV to -2000mV
2	0mV to -3500mV
3	5000mV to -5000mV


The graph itself shows the ON and OFF readings as two lines. On the right hand side there is the ON reading in mV, the OFF reading in mV. At the bottom right is the chainage.

In DCVG survey there is a third number under the ON and OFF readings, which is the gradient off. Graph mode works with both CIPS and CIPS & DCVG survey modes.

CIPS & DCVG Survey

When entering survey mode for CIPS & DCVG, the Hexcorder will prompt for the half cell offset. This is a value that can be entered to correct for any voltage difference between the two half cells being used. Initially, leave this at 0.

- Press A to accept and enter survey screen
- Place both half cells as close as possible on the ground and look at the DCVG reading
- If reading more than 5mV, press the two yellow keys to return to the Main Menu, then 1 to re-enter survey mode
- At the ½ cell offset screen press C to enter a value
- Press A to accept and return to the survey screen
- Check the gradient again, if still large, exit and enter and change the value or sign of the ½ cell offset
- This is a trial and error process

	ON	OFF
Rect	-1257.2mV	-0924.1mV
Grad	-001.2mV	-002.8mV
Record#	00052	
		
Chainage	00000010.1	
4351.6000N 07943.5664W		QU05
Memory	01% 257.1m	PDOP 1.9

-001.0
C-change
S-change-sign
1/2 cell offset
A-accept

In CIPS & DCVG mode, two half cells must be on the ground at all times. This can be one by one surveyor who pauses in place until the reading is complete or by utilizing Y-cables and two surveyors with 4 half cells. Contact Cath-Tech for more information.

As with CIPS mode, the surveyor presses the red button at the top of the half cell pole to take a reading.

DCVG Bar Graph

In DCVG survey there is a bar graph under the Record# line. This bar moves around just like the needle on an analogue DCVG instrument, allowing the surveyor to see the magnitude and direction of the voltage gradient.

The bar graph has some settings that can be changed. The scale of the bar can be changed by holding the following keys for 5 seconds;

Desired Scale	Hold Key
10-0-10 mV	1
50-0-50 mV	5
100-0-100 mV	0

When the Hexcorder acknowledges the change in scale, it will show the high value on the left side of the bar.

The action of the graph can also be changed. Holding Q will have the bar graph alternately display the gradient OFF and ON, similar to an analogue meter. Holding P will have the bar graph display the ON value minus the OFF value (calculated gradient) as a pulse. When the P setting is used, the numeric display shows the calculated gradient rather than the separate ON and OFF gradients.

DCVG Survey

DCVG only survey is very similar to CIPS & DCVG survey. No reading for the rectifier ON and OFF is taken and as there is no pipe connection wire, there is no chainage. The Hexcorder prompts for the ½ cell offset the same way.

	ON	OFF
Grad	-001.2mV	-002.8mV
Record#	00052	
4351.6000N	07943.5664W	QU05
Memory	01% 257.1m	PDOP 1.9

Data Logger

In Data Logger mode the Hexcorder shows the current readings of the channels. Readings are taken according to the programmed frequency.

CH1	-0857mV	CH2	-0943mV
CH3	-0258mV	CH4	-0016mV
Record#	00052		
Mon 08 Aug 11		19:52	09
Memory	01%		

Comments / Quick Menu

The Quick Menu allows the user to enter comments into the data stream on the fly. To access from any survey screen, press and hold the white MENU button. This menu is pre-programmed with many common items and places found on a right of way, simply press the corresponding letter and the comment will be saved in the data. The quick menu can be changed in the 5-Test section. If the comment to be added is not on the standard list, press 1 to enter custom text. Any comments/text will appear in the downloaded data in the far right column. The Scope function can also be accessed from this menu.

A-ANODE	B-----	C-----
D-----	E-END	F-FENCE
G-----	H-HYDRO	I-----
J-----	K-----	L-----
M-MP	N-XING	O-WATER
P-POWER	Q-----	R-ROAD
S-STREAM	T-TP	V-VALVE
1-text	2-scope	

S-Scope

The Scope function can be accessed from the Main Menu or on the fly during a survey by pressing S. During survey, it may be necessary to hold the S key down for a few seconds until the Hexcorder is able to respond. Scope or waveform files can be useful to detect mis-firing current interrupters, AC from overhead power lines, telluric activity and other foreign influences.

S-SCOPE will capture and store 2,000 readings per second for the duration of the interruption cycle, as configured in the S-SETUP menu. If you are using a 1 second interruption cycle then the Hexcorder will record and store 2,000 readings in each file. If however your interruption cycle is 4 seconds, 1 second OFF and 3 seconds ON for instance, the Hexcorder will record and store 8,000 readings in each file.

The GPS (if used) must be locked for the S-SCOPE function to operate

- When the S-SCOPE is invoked, after a short delay, the following screen will appear:

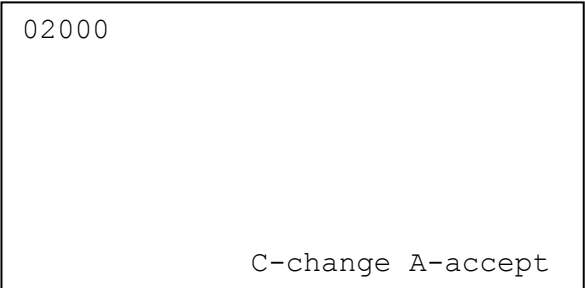


The first screen displays the first 100mS period following the start of the interruption cycle. This also, will normally be the start of the OFF period. Subsequent screens can be viewed, (100mS each), by pressing the arrow keys (V for left and B for right) to move back and forth through the waveform, the screen number is displayed on the right.

The voltage range in mV of the vertical axis is displayed in the right corners of the screen. This will normally be preset to +10000mV and –10000mV at the factory, but may be adjusted as required, see below. This will not affect the data to be stored in memory, but will allow the waveform to be sized appropriately for viewing. The maximum input range for the waveform function –s +/- 40,000mV. If the input voltage is larger than this, clipping may occur.

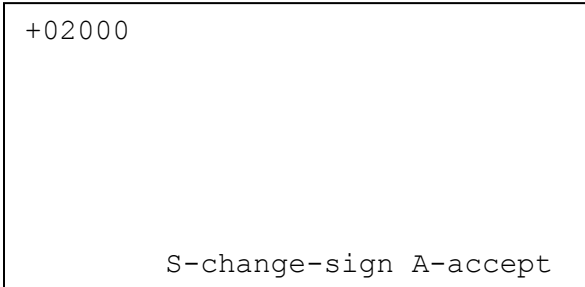
Press the ‘S’ key to change the display voltage range, and a new screen will appear:

- Display Voltage Range
- Press C to change the upper limit and enter a 5 digit number representing the upper voltage limit of the graph in mV.
- Press A to accept the setting and continue.



The next screen allows the polarity of the limit to be changed

- Press “S” to change the polarity
- Press A to accept the setting and continue
- The next two screens allow the lower limit to be changed in a similar way

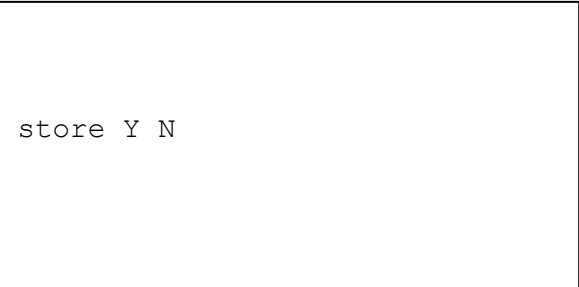


The previous waveform will now be displayed according to the new upper and lower limits.

Storing a Waveform

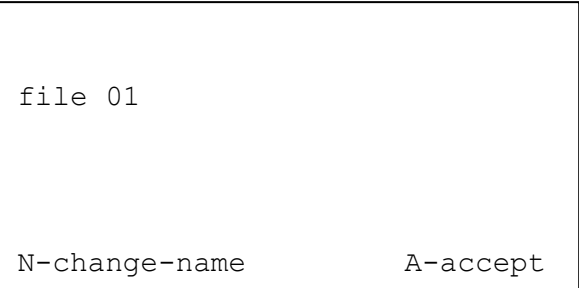
Press ENTER to store the waveform. The Hexcorder will ask to confirm storage of the waveform.

- Press “N” to discard the waveform and return to the Main Menu or press “Y” to continue



Now it will ask to confirm the file number.

- Press “N” to change the file number.
- Press “A” to accept and continue



Finally enter a description of the waveform, which will be stored with the data.

To complete the storage of the waveform data press “ENTER”.

The waveform will now be stored in memory and you will be returned to the Main Menu.

3 - Export Data

The data stored in the Hexcorder must be exported to a computer on a regular basis. Typically this is done once per day. After the data is downloaded and secured, the memory should be erased to ensure there is ample space available for the next day’s data.

S-set-up	D-directory
survey file	F-single G-all
wave file	W-single E-all
A-all	H-hex-dump

In order to extract the data from the Hexcorder, it needs to be connected to a computer with an RS232 serial port. USB to RS232 adapters are available. A terminal emulation program must be installed on the computer, e.g. Windows HyperTerminal, Mirror or equivalent. Set up for 38400, N,8,1 with no handshaking.

HyperTerminal is included in Windows 95 to XP. For Windows Vista, 7 and other operating systems go to www.hyperterminal.com and down load a copy of HyperTerminal or search on the internet for a terminal emulator. HyperTerminal 5.0 is the free version that was included in Windows XP and can often be found for downloading from various sites. In Windows XP HyperTerminal is found in Programs → Accessories → Communications.

Turn on the computer and Hexcorder. Connect the Hexcorder to the computer using the supplied DB9 straight through cable and start HyperTerminal. If needed, an RS-232 to USB adapter is included with the Hexcorder.

Configure HyperTerminal

When HyperTerminal is opened, it will prompt for a connection name. Enter ‘Hexcorder’ then change the port connection to:

- Direct to COM 1 or whichever COM port your computer uses.

Then click on ‘OK’. A New Box will appear where you can change the configuration of the COM port.

- | | |
|----------------|-------|
| • Baud Rate | 38400 |
| • Data Bits | 8 |
| • Stop Bits | 1 |
| • Parity | NONE |
| • Flow Control | NONE |

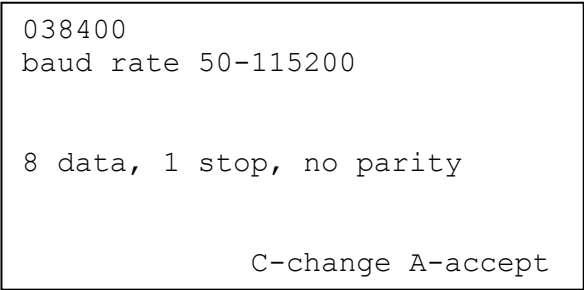
If you need to check or change the settings later on, in HyperTerminal, go to Call → Disconnect, then go to File → Properties. This shows your connection port. Click the ‘Configure...’ button below the port to access the full configuration.

S-Set-up

Baud Rate

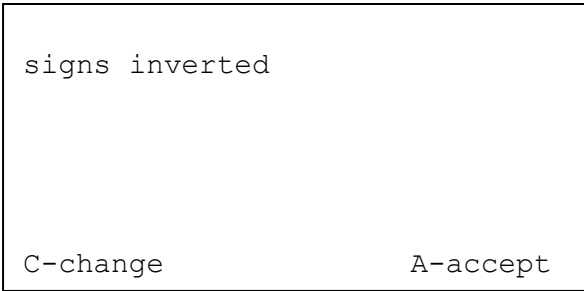
The baud rate can be set at any speed between 50 and 115200 bits per second; common settings are 1,200, 2,400, 4,800, 9,600, 19,200 and 38,400. The default baud rate is 38,400 which is recommended.

- Press C to change the setting
- If in doubt set the baud rate to 038400 as shown above
- Press A to accept the setting and continue



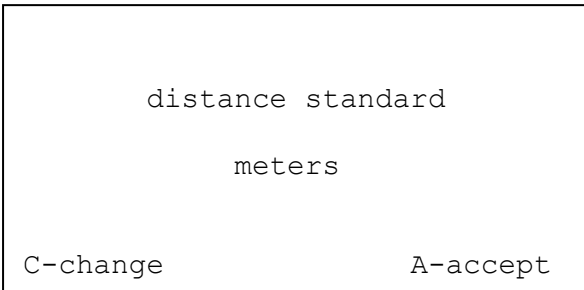
Sign Convention

- Press C to toggle the polarity of the data output
- Signs inverted reverses the polarity of the data output
- Signs normal does not reverse the polarity of the data output
- Press A to accept and continue



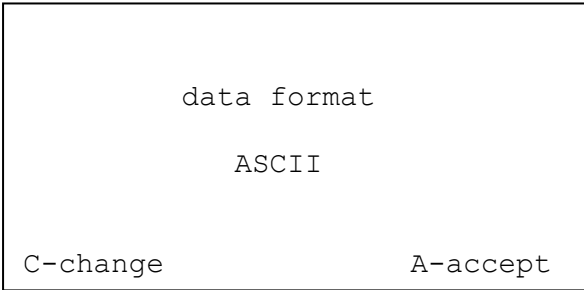
Distance Standard

- Press C to change between feet and meters
- The Hexcorder can convert between metric and imperial distance as the data is output
- Press A to accept and continue



Data Format

- Press C to change between ASCII and ProActive
- ASCII is plain text
- ProActive is a proprietary database format, do not use unless the data will be directly imported into ProActive
- Pres A to accept and return to the Export Data Menu

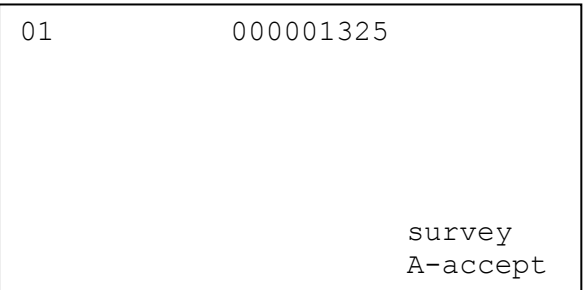


D-Directory

Note: At this stage, communication with your PC can be confirmed by pressing the D key. This will display the file directory on the Hexcorder *and* send it via RS232 to the PC. If HyperTerminal is working correctly, the directory information should appear on the computer screen.

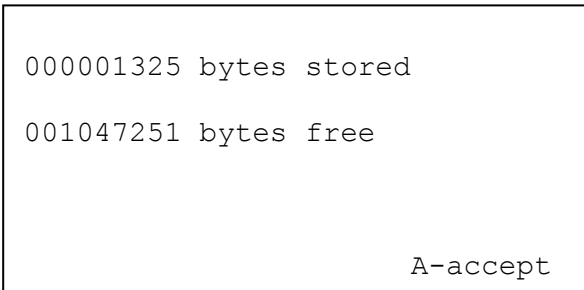
File Directory

- This screen lists your files by number and lists the number of bytes of data in each file
- Press A to Accept and continue to a similar screen with details of the wave files stored
- Press A again to accept and continue



Memory Information

- This screen indicates the number of bytes of memory used in data storage and the number of bytes available for data storage
- Press A to accept and return to the Main Export Data Menu



Exporting Data

To capture the data in the PC, it is necessary to open a capture file in HyperTerminal. Go to Transfer → Capture Text and select the location and name for the file on the computer. The file extension should be .txt or .csv to ensure the computer recognizes the file type.

On the Hexcorder single files can be downloaded or all files together. To download a single file, press F for a survey file or W for a wave form. The next screen will prompt you for the file name. Press C to cycle through the available files and A to start that file downloading.

```
S-set-up      D-directory
survey file F-single G-all
wave file W-single E-all
A-all H-hex-dump
```

To download a group of files, press G for survey files or E for wave form files. These will create one large text file divided into sections by the file header information (serial number, GPS location, description, etc).

As the information is downloading, the Hexcorder will display ‘Please Wait’. Once the download is complete and the Hexcorder has returned to the Export Data screen, the file in HyperTerminal needs to be closed. Go to Transfer → Capture Text → Stop.

To return to the Hexcorder Main Menu, press the two yellow keys simultaneously.

EM- Erase Memory Function

Occasionally it will be necessary to erase the memory to remove old data from the Hexcorder. When the erase memory function is used, the data is removed from memory and unrecoverable. Please make sure your data is backed up on another device before erasing the memory.

- The Hexcorder requires confirmation before it erases the memory
- If you are sure that you wish to erase the memory press ‘Y’
- If you do not wish to erase the memory press “N” to exit without erasing

```
are you sure ? Y N
```

After erasing the memory, the full setup must be verified prior to commencing the next survey, see the section for 2-Setup.

5 - Test

To enter the Test Menu press 5 from the Main Menu.

- There are 8 tests and/or settings that can be accessed;
- Initialize GPS
- Keyboard function
- Memory integrity
- Eprom (processor)
- Quick Menu
- Alarms

```
I-initialize GPS
K-keyboard M-memory E-eprom
Q-quick-menu A-alarm P-sync
001048576 bytes      Serial #
26 III 11           S-satellites
```

- Sync
- Satellite information

To return to the Main Menu at any time, press the two yellow RESET keys simultaneously.

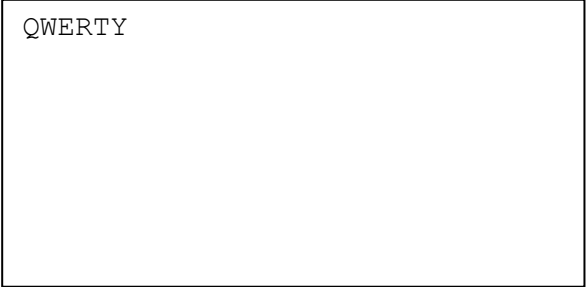
I – Initialize GPS

If the GPS characters are garbled on the Hexcorder screen or the GPS refuses to lock, it can be re-initialized with this option.

K – Keyboard Test

Press K to invoke the keyboard test

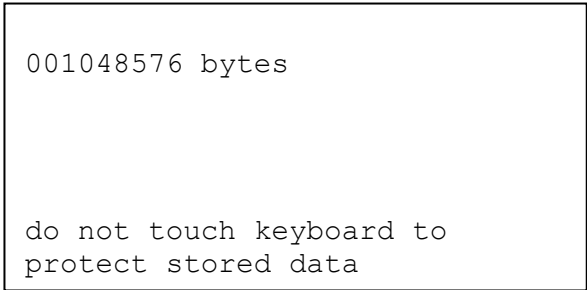
- While at the keyboard test screen, each key pressed on the keyboard, will be echoed to the LCD.
- Press each key in turn and check that it appears on the LCD.
- Any key that does not appear is defective and the Smart Logger II should be retuned for service.



M - Memory Test

This tests the integrity of the CMOS non-volatile RAM memory. Do not touch the keyboard during this test as the memory is being fully tested and any interruption could result in loss of data.

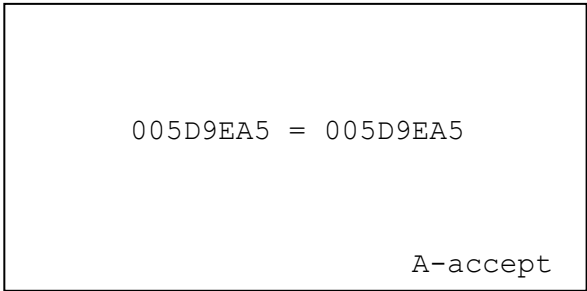
At the end of the memory test, the Hexcorder will display the number of Good bytes of memory. This value should match the memory size you purchased.



E - EPROM Test

The EPROM, which contains the operating program, can also be tested; press E for EPROM test and the following screen appears:

The Hexadecimal values must exactly match, if not then the EPROM is damaged and the unit should be returned for repairs.



Q-Quick Menu

The Quick Menu is pre-programmed with some standard comments that can be quickly added to the data during survey.

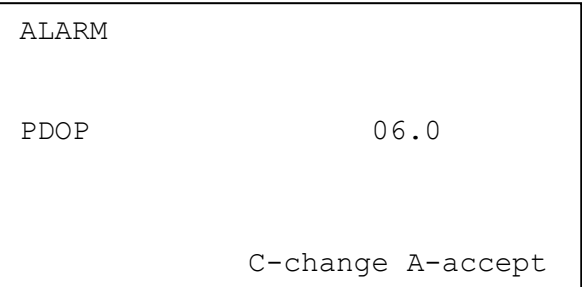
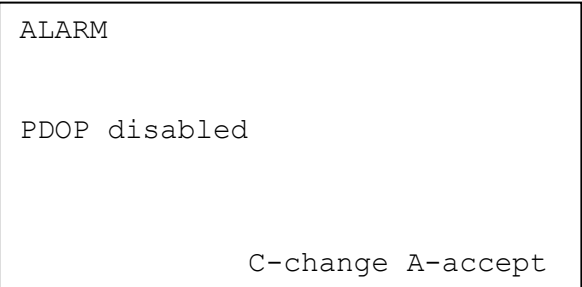
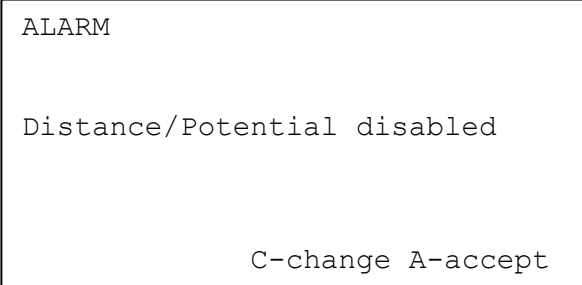
- To navigate, hold down MENU + B to move right, MENU + V to move left
- Type over whatever is to be replaced
- Maximum of 7 characters
- Hold down MENU + 0 to restore default settings

A-ANODE	B-----	C-----
D-----	E-END	F-FENCE
G-----	H-HYDRO	I-----
J-----	K-----	L-----
M-MP	N-XING	O-WATER
P-POWER	Q-----	R-ROAD
S-STREAM	T-TP	V-VALVE
<-MENUV MENUB-> MENU0-default		

A-Alarm

The Hexcorder has some alarm functions that can be activated or disabled.

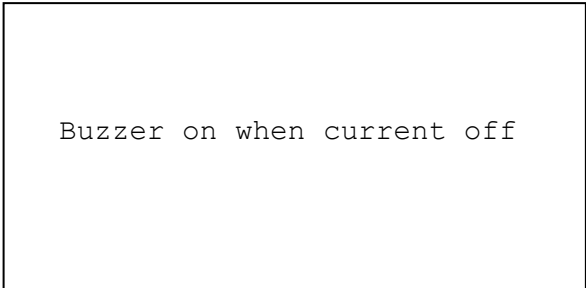
- Distance & Potential
 - Beeps and flashes “Check Wire” if chainage does not increment OR potential changes more that 50% from last reading
 - Press C to enable or disable
 - Press A to accept and continue
-
- PDOP alarm
 - Beeps when the PDOP falls below a set value
 - PDOP is a measure of GPS signal accuracy
 - Good PDOP is <3
 - Recommended setting for alarm is 6
-
- Press C to enable the PDOP alarm
 - The next screen allows the user to change the PDOP alarm value
 - Press C, then enter the desired value
 - Press A to accept and continue



P-Sync

This function can be used to verify synchronization between the Hexcorder and current interrupters

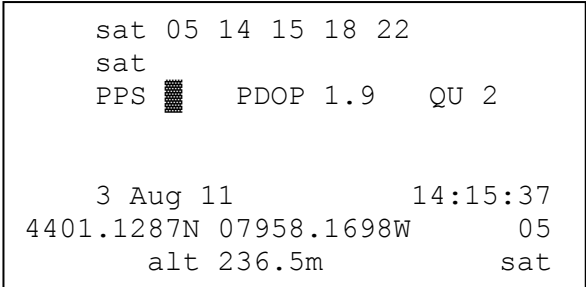
- Hexcorder beeps during programmed OFF cycle
- User can observe rectifier meters to see if rectifier responds at the same timing



S – Satellites Test

The satellite screen is displayed which provides information about the GPS satellites being received and other information.

- The screen lists the satellites received by satellite number
- PPS presence: (Pulse Per Second), is indicated by a flashing square box character on the screen, between PPS and PDOP
- PDOP.: (Position Dilution Of Precision) value
- QU: quality of the satellite signal
- UTC. date and time, the position (Latitude Longitude & Altitude)
- Number of satellites being received



GPS Datum

The GPS Datum is the information set the GPS uses to interpret location information. Over the years, there have been many different datum’s used by different countries or areas of the world. Changing the datum affects the latitude and longitude values only, not the timing signal or the date/time the unit uses.

To change the datum used by the Hexcorder, use the RS232 cable to connect the Hexcorder to a computer and start up HyperTerminal. For more information on connecting to the computer, see section 3-Export Data.

Turn the Hexcorder on and enter 5-Test. On the computer screen, the word ‘test’ should appear. Now press T & S together, the computer shows ‘hidden’. Now press 2, the computer shows ‘GPS’. This has connected the computer directly to the GPS antenna. Data will start to appear, this is the raw output from the GPS system;

```
$GPGGA,161014,4351.5635,N,07942.8229,W,0,00,,,M,,M,,*43
$GPGGA,161015,4351.5635,N,07942.8229,W,0,00,,,M,,M,,*42
$GPGGA,161016,4351.5635,N,07942.8229,W,0,00,,,M,,M,,*41
```

By default the datum is set to World Geodetic System 1984, datum #100. To change to another datum enter the following command on the computer:

```
$PGRMC,,,## [ctrl]+M [ctrl]+J
```

The GPS engine should respond with:

```
$PGRMC,,,##
```

For example, to change to datum 84, South America 1969 the command is \$PGRMC,,,84 [ctrl]+M [ctrl]+J and the GPS engine responds with \$PGRMC,,,84. Now the GPS continues to send out a string of data, note that the latitude and longitude have changed.

```
$GPGGA,161021,4351.5756,N,07942.7812,W,0,00,,,M,,M,,*4C
$GPGGA,161022,4351.5756,N,07942.7812,W,0,00,,,M,,M,,*4F
$GPGGA,161023,4351.5756,N,07942.7812,W,0,00,,,M,,M,,*4E
$GPGGA,161024,4351.5756,N,07942.7812,W,0,00,,,M,,M,,*49
```

The new datum has been stored and will continue to be used until the user follows this procedure again to change it.

To check which datum the Hexcorder is using, enter the \$PGRMCE [ctrl]+M [ctrl]+J command on the computer. The GPS will respond with the datum number.

When finished with the datum information, press the two yellow reset keys on the Hexcorder to return to the Main Menu and close HyperTerminal.

Earth Datum’s

- 0 ADINDAN - Ethiopia, Mali, Senegal, Sudan

1 AFGOOYE - Somalia

2 AIN EL ABD 1970 - Bahrain Island, Saudi Arabia

3 ANNA 1 ASTRO 1965 - Cocos Island

4 ARC 1950 - Botswana, Lesotho, Malawi, Swaziland, Zaire, Zambia, Zimbabwe

5 ARC 1960 - Kenya, Tanzania

6 ASCENSION ISLAND 1958 - Ascension Island

7 ASTRO BEACON .E. - Iwo Jima Island
- 8 AUSTRALIAN GEODETIC 1966 - Australia, Tasmania Island

9 AUSTRALIAN GEODETIC 1984 - Australia, Tasmania Island

10 ASTRO DOS 71/4 - St. Helena Island

11 ASTRONOMIC STATION 1952 - Marcus Island

12 ASTRO B4 SOROL ATOLL - Tern Island

13 BELLEVUE (IGN) - Efate and Erromango Islands

14 BERMUDA 1957 - Bermuda Islands

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15 BOGOTA OBSERVATORY - Colombia	61 NORTH AMERICAN 1927 - Mean Value (CONUS)
16 CAMPO INCHAUSPE - Argentina	62 NORTH AMERICAN 1927 - Cuba
17 CANTON ASTRO 1966 - Phoenix Islands	63 NORTH AMERICAN 1927 - Greenland (Hayes Peninsula)
18 CAPE CANAVERAL - Florida, Bahama Islands	64 NORTH AMERICAN 1927 - Mexico
19 CAPE - South Africa	65 NORTH AMERICAN 1927 - San Salvador Island
20 CARTHAGE - Tunisia	66 NORTH AMERICAN 1983 - Alaska, Canada, Central America, CONUS, Mexico
21 CHATHAM 1971 - Chatham Island (New Zealand)	67 NAPARIMA, BWI - Trinidad and Tobago
22 CHUA ASTRO - Paraguay	68 NAHRWAN - Masirah Island (Oman)
23 CORREGO ALEGRE - Brazil	69 NAHRWAN - Saudi Arabia
24 DJAKARTA (BATAVIA) - Sumatra Island (Indonesia)	70 NAHRWAN - United Arab Emirates
25 DOS 1968 - Gizo Island (New Georgia Islands)	71 OBSERVATORIO 1966 - Corvo and Flores Islands (Azores)
26 EASTER ISLAND 1967 - Easter Island	72 OLD EGYPTIAN - Egypt
27 EUROPEAN 1950 - Austria, Belgium, Denmark, Finland, France, Germany, Gibraltar, Greece, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland	73 OLD HAWAIIAN - Mean Value
28 EUROPEAN 1979 - Austria, Finland, Netherlands, Norway, Spain, Sweden, Switzerland	74 OMAN - Oman
29 FINLAND HAYFORD 1910 - Finland	75 PICO DE LAS NIEVES - Canary Islands
30 GANDAJIKA BASE - Republic of Maldives	76 PITCAIRN ASTRO 1967 - Pitcairn Island
31 GEODETIC DATUM 1949 - New Zealand	77 PUERTO RICO - Puerto Rico, Virgin Islands
32 ORDNANCE SURVEY OF GREAT BRITAIN 1936 - England, Isle of Man, Scotland, Shetland Islands, Wales	78 QATAR NATIONAL - Qatar
33 GUAM 1963 - Guam Island	79 QORNOQ - South Greenland
34 GUX 1 ASTRO - Guadalcanal Island	80 REUNION - Mascarene Island
35 HJORSEY 1955 - Iceland	81 ROME 1940 - Sardinia Island
36 HONG KONG 1963 - Hong Kong	82 RT 90 - Sweden
37 INDIAN - Bangladesh, India, Nepal	83 PROVISIONAL SOUTH AMERICAN 1956 - Bolivia, Chile, Colombia, Ecuador, Guyana, Peru, Venezuela
38 INDIAN - Thailand, Vietnam	84 SOUTH AMERICAN 1969 - Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Venezuela, Trinidad and Tobago
39 IRELAND 1965 - Ireland	85 SOUTH ASIA - Singapore
40 ISTS O73 ASTRO 1969 - Diego Garcia	86 PROVISIONAL SOUTH CHILEAN 1963 - South Chile
41 JOHNSTON ISLAND 1961 - Johnston Island	87 SANTO (DOS) - Espirito Santo Island
42 KANDAWALA - Sri Lanka	88 SAO BRAZ - Sao Miguel, Santa Maria Islands (Azores)
43 KERGUELEN ISLAND - Kerguelen Island	89 SAPPER HILL 1943 - East Falkland Island
44 KERTAU 1948 - West Malaysia, Singapore	90 SCHWARZECK - Namibia
45 L.C. 5 ASTRO - Cayman Brac Island	91 SOUTHEAST BASE - Porto Santo and Madeira Islands
46 LIBERIA 1964 - Liberia	92 SOUTHWEST BASE - Faial, Graciosa, Pico, Sao Jorge, and Terceira Islands (Azores)
47 LUZON - Mindanao Island	93 TIMBALAI 1948 - Brunei and East Malaysia (Sarawak and Sabah)
48 LUZON - Phillippines (excluding Mindanao Island)	94 TOKYO - Japan, Korea, Okinawa
49 MAHE 1971 - Mahe Island	95 TRISTAN ASTRO 1968 - Tristan da Cunha
50 MARCO ASTRO - Salvage Islands	96 User defined earth datum
51 MASSAWA - Eritrea (Ethiopia)	97 VITI LEVU 1916 - Viti Levu Island (Fiji Islands)
52 MERCHICH - Morocco	98 WAKE-ENIWETOK 1960 - Marshall Islands
53 MIDWAY ASTRO 1961 - Midway Island	99 WORLD GEODETIC SYSTEM 1972
54 MINNA - Nigeria	100 WORLD GEODETIC SYSTEM 1984
55 NORTH AMERICAN 1927 - Alaska	101 ZANDERIJ - Surinam
56 NORTH AMERICAN 1927 - Bahamas (excluding San Salvador Island)	102 CH-1903 - Switzerland
57 NORTH AMERICAN 1927 - Central America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua)	103 Hu - Tzu - Shan
58 NORTH AMERICAN 1927 - Canal Zone	104 Indonesia 74
59 NORTH AMERICAN 1927 - Canada (including Newfoundland Island)	105 Austria
60 NORTH AMERICAN 1927 - Caribbean (Barbados, Caicos Islands, Cuba, Dominican Republic, Grand Cayman, Jamaica, Leeward Islands, Turks Islands)	106 Potsdam
	107 Taiwan - modified Hu-Tzu-Shan
	108 GDA - Geocentric Datum of Australia
	109 Dutch

Survey Techniques

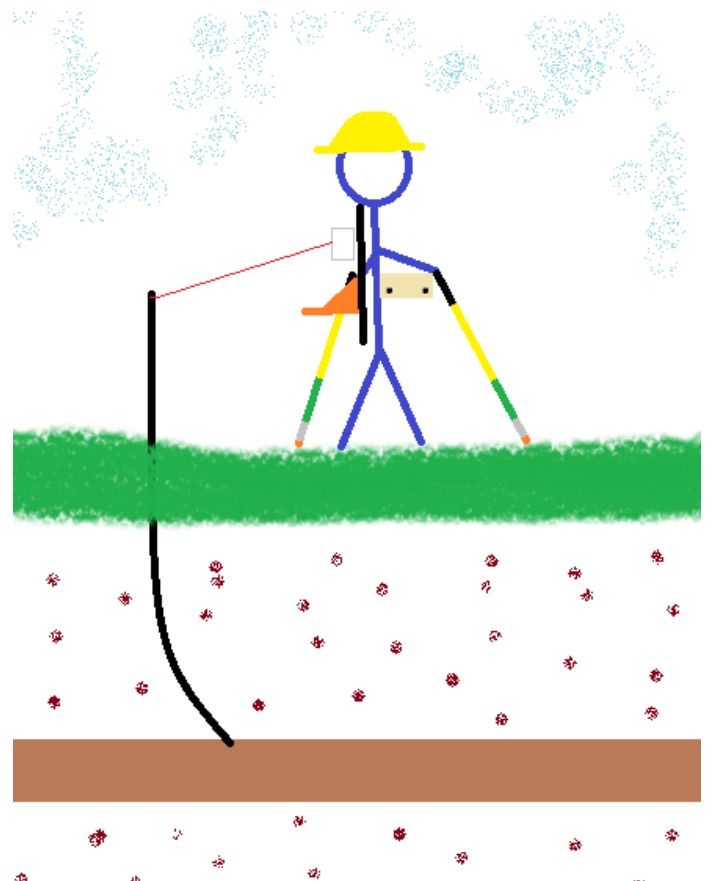
The Hexcorder is designed and built to perform above ground assessment of cathodic protection and coating integrity for buried metallic structures. Used correctly it can provide an indication of areas that are more likely to corrode or do not meet industry accepted criteria for protection. A background in corrosion or a training course from Cath-Tech is highly recommended prior to surveying for the first time.

The Hexcorder is supplied with all the parts and accessories necessary to start surveying. If an interrupted CIPS or a DCVG survey is to be done, the current interrupters need to be installed in the rectifiers prior to starting.

CIPS

Turn on the Hexcorder and program it for the survey as described earlier in the manual. Clean off the end of the light survey wire with some emery paper and connect it to the pipe at a convenient test station. Fill the half cells with distilled water then insert the half cells into the poles. Remove the plastic caps from the half cells so the ceramic tip makes contact with the soil. Hook the Hexcorder onto the neck strap and connect the half cell poles and wire dispenser. From the Main Menu press 1 for survey to enter survey mode.

The surveyor should use both half-cell sticks and keep one half-cell in contact with the soil at all times to minimize delay while the half cell stabilizes. In areas where the soil is dry, it may be necessary to wet the soil to reduce half-cell to soil contact resistance.



A close interval survey is best accomplished at a comfortable walking speed. Most surveyors prefer a 1 second cycle whereby the rectifier is turned OFF for 200 to 300 milliseconds every second. The one-second cycle will yield a stored reading approximately every two metres at a comfortable walking speed.

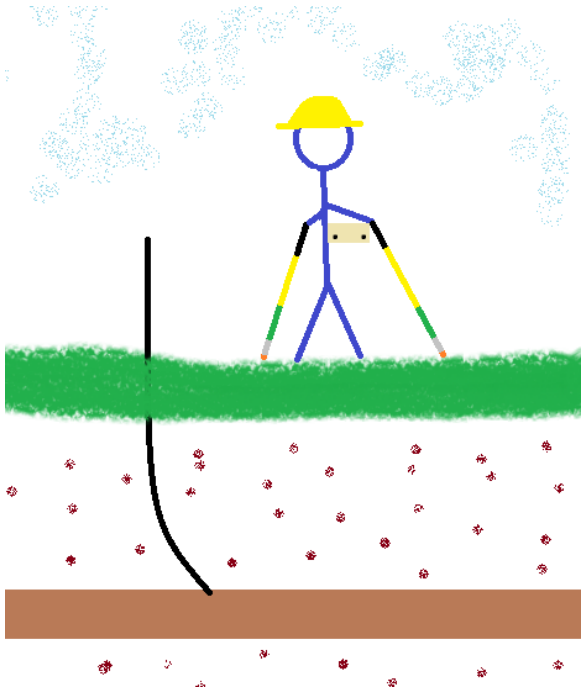
To take and store a reading, observe the potential on the Hexcorder display then when you have a valid pipe-to-soil potential press one of the buttons on the half-cell stick sharply. Make sure that the half-cell stays firmly in contact with the soil until the Hexcorder beeps indicating the reading is stored. When using a 1 second cycle the pipe-to-soil potential can only be updated once per second. The Hexcorder reads the rectifier OFF potential first then the rectifier ON potential. These values along with the chainage and GPS coordinates are written to the display every second and stored to memory.

DCVG

DCVG works by measuring the voltage change between two half cells placed on the ground. To undertake a DCVG survey typically, a minimum potential swing of 300-500 mV between the rectifier ON and OFF is sought and the current source output of the rectifiers is adjusted accordingly. The application of a pulsed current enables coating defects to be distinguished from potential differences between the half-cells.

The difference between 'on' and 'off' potentials is recorded at the test point nearest the survey start point, and all other test points encountered.

The surveyor walks on top of the pipeline with both half cells. When both half cells are in firm contact with the soil a reading can be taken. If one half cell is in the air, the reading is no good. The half cells can be oriented to the pipe with two methods; lateral and longitudinal. For a lateral DCVG survey, one half cell is kept over the pipe and the other is approximately 2m to the side. A longitudinal survey has both half cells lined up on the pipe approximately 2m apart. With a longitudinal survey, the surveyor can leap-frog the half cells as they walk.

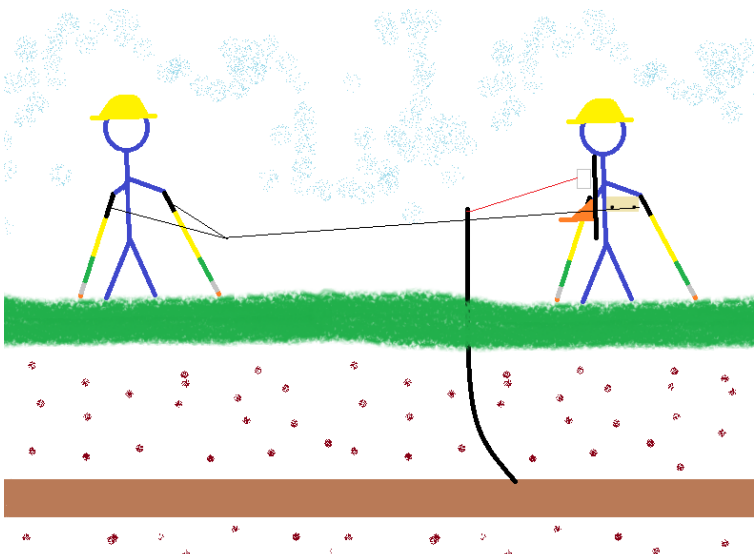


As a defect is approached a noticeable fluctuation is observed on the voltmeter at a rate similar to the interruption cycle. The amplitude of the fluctuation increases as the defect is approached and adjustment of voltmeter sensitivity is made as necessary. The swing on the voltmeter is directional, providing the probes are maintained in similar orientation parallel to the pipeline.

Thus, the defect is centered by detailed manoeuvre around the epicentre and the size of the defect estimated by considering signal strength at the defect, difference between 'on' and 'off' potential at adjacent test point and the distance from those points.

Combined CIPS & DCVG

Combining CIPS and DCVG allows the surveyor to gather data on both the cathodic protection and the coating integrity in one survey. This allows for accurate data correlation after the survey. Combined CIPS & DCVG can be performed by one surveyor or with the assistance of a second surveyor. A combined survey requires a pipe connection for the CIPS reading and two half cells on the soil to capture the gradient between them. Utilizing Y-cables can allow two surveyors to perform a combined survey and walk at a normal pace.



Replacement Parts / Accessories

CTL-101

Hip pack wire dispenser

- Does not include cables or survey wire



CTL-131

Half cell extension pole

- Does not include half cell



CTL-103

Counter wheel & axle



CTL-133

Half cell pole replacement switch

- Includes handle assembly



CTL-104

Wire tensioner



CTL-135

Cap for half cell pole switch



CTL-115

4 Point strap for Hexcorder



CTL-136

Cu CuSO4 half cell with cone tip



CTL-116

Strap for Hip Pack



CTL-141

Small spool wire for hip pack



CTL-121

Backpack wire dispenser

- Complete with cable to Hexcorder
- Does not include survey wire



CTL-142

Case small spools (16)



CTL-122

Wire chainage for backpack



CTL-143

Empty small spool



CTL-145
Large spool wire for backpack



CTL-214
Data logging cable for Hex



CTL-146
Case large spools (4)



CTL-215
Y cable set



CTL-147
Empty Large Spool



CTL-235
7V charger Hex, SL, CI-25 & 50



CTL-207
Cable Hex to backpack, 4 wire



CTL-236
12VDC to 7V cigar charger Hex & SL



CTL-208
Cable Hex to hip pack, 4 wire



CTL-252
RS232 cable Hex



CTL-211
Cable Hex to half cell pole, pair



CTL-258
USB to serial port adapter



CTL-212
Short Y cable



CTL-310
GPS 18X, short lead

- Hexcorder



CTL-213
Long Y cable



CTL-514
QWERTY keypad assembly for Hexcorder



CTL-516
LCD display for
Hexcorder & Smart
Logger



CTL-563
Pin extractor



CTL-530
7.2V battery for Hex
& SL



CTL-564
Alligator clips pack
10



CTL-560
Pin for Hex cables



CTL-626
Circuit board Hex
active AC filter



CTL-561
Socket for Hex
cables



CTL-628
Circuit board Hex
Millenium



CTL-562
Amp connectors for
Hex cables



Troubleshooting

Issue	Possible Solution
Unit won’t turn on	Dead battery, plug in to AC power
Unit reads very low ON/OFF values	Check all connections <ul style="list-style-type: none">• Half cell pole cables• Wire dispenser cable• Wire spool to wire dispenser• Survey wire to test post• Caps removed from half cells• DI water in half cells
Unit won’t take readings	<ul style="list-style-type: none">• Switch half cell poles (bad switch)• Switch half cell cables (broken cable)• Check for manual survey mode• Memory may be full
Readings are very scattered	<ul style="list-style-type: none">• Soil conditions, if dry place half cells on green weeds for better contact• Check calibration of half cells
GPS won’t lock	<ul style="list-style-type: none">• Ensure good view of sky, no trees/buildings/etc• Check GPS is plugged in correctly
Chainage isn’t increasing	<ul style="list-style-type: none">• Broken survey wire• Broken wire dispenser cable
Unit won’t respond when in survey mode	<ul style="list-style-type: none">• Press and hold the key for 5 seconds

Export Data Issues

Problem	Cause	Solution
Can’t find HyperTerminal	Not installed	Download from hyperterminal.com or Google
		Copy hypertrm.exe and hyperterm.dll from another computer
No RS-232 port	Use USB to RS-232 adapter	Install drivers
No data received by HyperTerminal	Wrong cable	Must be DB9 straight through, not null modem
	Wrong COM port	COM port selected in HyperTerminal must be port in use
	Not on line	Check HyperTerminal menu Call → Connect
	Flow control wrong	Must be set to NONE
HyperTerminal properties locked	Not offline	Check HyperTerminal menu Call → Disconnect
Garbled data received by HyperTerminal	Settings wrong	Baud rate same as Hexcorder (38,400 bps recommended) 8 data bits 1 stop bit
	ProActive data format	Go to Export Data then Setup and change the data format to ASCII
Data not stored in file	Capture Text not enabled	Check HyperTerminal menu Transfer → Capture Text



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