



Profile Portable Energy Monitor Hardware Manual & User Guide

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Chapter 1

Profile Energy Logger

1.1 Introduction

Profile is a portable energy monitor with fully automatic measurement capabilities to provide the user with a quick, accurate method for recording and assessing energy consumption and demand in the work environment.

Profile can be set up manually but the unit is intended to be used mainly in fully automatic mode as this is the primary method of operation. Most users will only ever use it in this way but details for manual set up are included and functions are selectable using the associated ProPower software

Two models are available; one for LV and one model for LV & HV applications as follows:

Profile IV: 4 current ranges 0-6, 0-120, 0-500 and 0-2000Amps with CT ratio setting available. Power 50 W to MW.

Profile V: Current ranges as Profile IV plus HV with CT & VT ratio setting available. Power 50 W to GW.

1.2 Electrical safety

Profile is used for measuring electrical power on LIVE electrical circuits and it is therefore imperative that personnel using Profile are fully trained in electrical safety. All users must be fully aware of the dangers from electrical shock and it is entirely the users responsibility to ensure safe procedures at all times. To this end current measurements should only be made on insulated conductors.

1.3 Profile Overview

PROFILE is a sophisticated portable recording watt meter, it records up to 60,000 readings of electrical quantities, automatically selecting the correct ranges for current and voltage (Profile V). Profile measures Watts to Giga-Watts using isolated split core Rogowski coils to measure currents from a few % of 5 Amps up to 100% of 2000 Amps and more using the part current range. Voltage is measured via a standard mains plug meaning no live voltage connections are necessary (power & the voltage reference can be provided via a fused probes kit when no mains socket is available – for use by qualified personnel only).

1.4 Profile Measurability

PROFILE records measured values in non-volatile memory. It can be connected to a PC via the data cable provided, and survey data downloaded for analysis in spreadsheet or the ProPower software.

PROFILE displays kW, kVAr, Amps and kVA per phase, consumed and generated kWh, kVArh, and Voltage. There are also two re-settable nett kWh and kVArh registers.

When system coils are connected to meter CT output tails PROFILE IV & V accommodates CT ratios which can be set between 5:5 and 16,000:5. PROFILE V has auto-voltage ranging also and allows VT ratio setting from 1:1 and 999000:1.



1.5 Connectors and Controls

Current Coils and Pulse inputs connectors are identified on the rear panel.

Current Coil connector for the 3 split core Rogowski coils.

Pulse Input connector for two pulse inputs from volt free contacts or optical meter readers.

USB connector on unit side for set-up and download of records via ProPower software.

Display shows logging status, time and date, present readings (Fig 2) & set-up conditions.

Push Buttons;

Enter (↵) - to confirm a numeric entry, accept a function and to start a survey on site.

ESC (↔) to exit a menu or return to a previous one, or to quit a screen for further action.

Up (↑) scroll up through a menu display page, increment a number (e.g. CT ratio).

Down (↓) scroll down a menu display page, decrement a number (e.g. CT ratio)

Mains connection/measurement voltage can be 95 to 260 volts via connector in front panel.

1.6 To Start a Survey

- i. **Locate** the current feeder cables to be measured.
Note: cable colours, e.g. UK Pre-2006 - Red/Yellow/Blue, after harmonisation - Brown/Black/Grey
- ii. **Locate** a wall socket power source for Profile. **MUST** be from the same transformer supply as the cables in i above.
- iii. **Plug** the coils into connector labelled 'Inputs for Coils'.
- iv. **Connect** mains lead the Profile panel socket and then to a suitable supply voltage, wall socket or test block connector.

- v. **Place** current coils around the current feeder cables. Each coil must be installed on the correct phase cable and the correct way around (see arrow marking on each coil for direction of current flow).
- vi. **Verify** Profile LCD reads '30mins ••• .Autologg' or as appropriate for current Profile settings.
- vii. **Press** <enter> (↵) to start *autophasing*.
- viii. **See** '**Settling down ... please wait**'. on LCD display
Note: Button security operates 10 minutes after switch on so this message doesn't show if 10 minutes has elapsed. To de-activate security power Profile off and on again. Then press <enter> to re-start autophasing.
- ix. Profile will autophase if coils are the right way round, current is flowing and PF > 0.5. If Profile can't autophase, message '**Autophase not possible**' shows, and you must **phase by hand**. If you see '*phase by hand*', Profile has switched to FIXED phase (mains to Brown/Red coil). Press ESCAPE, select kW display and phase by hand to obtain correct kW on each phase.

N.B. reversed coils or reversed phase voltage can cause negative kW readings. The wiring polarity in the power supply to Profile is critical.

Chapter 2

Profile Measurement Displays

2.1 Measurement displays

Screens shown in Fig 2 are always available except during communications. At power on PROFILE shows the autologg screen in menu 1 (lower left).

From autologg screen:
UP(↑) to scroll up through menu
DOWN(↓) to scroll down menus
ENTER(↵) at 'See more pages' to view displays in other menus 2 and 3.

+ sign = reading is import or positive.

- sign = reading is export. or negative.

+/-KWh. is import/export can be reset using ProPower.

+/-Krh is import/export can be reset using ProPower.

KWh/Krh is net energy for kWh and kVARh, can be reset using enter (↵).

Pulses are direct counting of inputs. Scaling must be added manually after download of survey data.

See more pages on Menu 2 accesses status displays. (Press ESCAPE (↔) to return to previous menu

Fig 2

Menu 1	Menu 2
R= 74 Y= 70 B= 72 amps	Pulses, last per 591 36
R= 177 Y= 173 B= 172 kVA	Pulses, this per 610 46
R= 36 Y= 34 B= 12 kVAR	kWh 234.9 krh 38.6
R= 72 Y= 69 B= 71 kW	+krh 79.8 -krh 5.4
Date Time 19/03/95 11:4425	+kWh 15688.6 -kWh 2.4
30 Mins Autologg 19/03/95 11:4425	R= 239.8 Y= 239.9 B= 239.9 Volts
See more pages (9600 BAUD)	See more pages (9600 BAUD)

Autologg Variations:

- i) *Manual*: you are able to choose Automatic.
- ii) *Wait till*: logging will begin at specified time. You must use the ProPower software to set start time.
- iii) Not *30 mins*. The configured logging period is shown. Changeable through the ProPower software only.
- iv) It is advisable to specify a logging start time and use '*Wait till*' for intervals less than 10 minutes.

2.2 Other Operational Screen Messages

Profile uses this period to measure the circuit and set the correct ranges.

If current is very/too low, Profile will tell you and ask if circuit is a CT secondary.

Settling down
please wait

When ranges are ascertained these two displays alternate, waiting for an operator decision and appropriate key press.

The autophase message shows only within the first 10 minutes after power up, so if you need to re-autophase after this period you must power Profile Off and On again to re-activate security.

Press up arrow(↑) to say YES

Press down arrow(↓) to say NO

Profile can only autophase if it is connected to a real/live circuit. Say YES if Profile is connected and ready to measure.

Do you want to
Autophase ?

Do you want to..?
↑ Yes ↓ No

Profile completes 7 steps to determine the phase from which the voltage reference is being taken (i.e. the phase supplying the wall power socket). This takes a few seconds only, so be patient.

Autophasing
Step 1

On completion of autophasing the appropriate display is shown to indicate autophase success or failure. For example;

OK - autophase OK, circuit conditions correct.

Red – wall socket same phase as its Red/Brown CT

Normal – phase rotation of circuit is RYB (BrBG)

OK Red normal

If phase is reversed, i.e. RBY (BrGB) Profile will tell you by including the word 'rev.' instead of 'normal' - Check coil installation.

Press ESCAPE(↔) to continue from this display.

If Profile cannot autophase for any reason the '*Auto phase not possible*' display will show and you must investigate the cause;

Press ESCAPE (↔) to continue.

Then check the following:

Is current flowing on all phases? Verify this by using kW display. Are values +ve?

Are CT's on the right way round? Check coil labelling. Are readings +ve?

Is the Line/Neutral wiring at wall socket correct? Errors here cause results similar to reversed coils.

After the autophase not possible message the LED screen gives the instruction to Phase by hand with the following effects.

Profile has asserted Red/Brown Phase by associating the Red/Brown coil with the wall socket voltage phase.

LCD shows '*Phase by hand*'.

Press ESCAPE (↔).

Check the circuit and the CT directions then carry out manual phasing using the kW display to ensure that CTs are on the correct circuit.

Please phase
By hand

If the coils are found to be wrongly fitted just correct the error or direction and re-autophase by using the enter (↵) key.

Chapter 3 Connecting to a PC

Profile has a Male Mini USB B connector on the right hand side of the case and a suitable data lead is supplied to connect to a USB port of your PC.

BEFORE connecting the Profile to your PC, the USB drivers must be installed. Drivers appropriate for your PC can be downloaded from <https://www.ftdichip.com/Drivers/VCP.htm>.

For detailed information on the Profile system software please refer to the appropriate software manual. Information on the ProPower 3 software package can be found at <https://www.newfound-energy.co.uk/propower-3-help/>

Whenever Profile communications are active normal displays are suspended and the Profile LCD screen changes to show that communications are in progress.

Communication In progress

Whilst this screen is displayed Profile sends instantaneous values to the system software for display and recording activity is suspended. Stored data is protected and the software can access all set-up and control functions. These conditions exist until the connection is terminated (the software is 'logged off').

3.1 General notes regarding Profile settings & software displays

Profile measures at 1200 times per second to calculate true power and derive other quantities.

The readings displayed on the LCD & software 'live' displays are from instantaneous samples but the stored data is integrated over the chosen interval period.

As this is the period used for tariff charging by UK electricity companies, there is no benefit to using interval times other than 30 mins except for special engineering applications, or if your local electricity supply company uses a different monitoring interval for billing purposes.

3.1.1 Logging Interval

Do NOT change the logging interval without understanding the effect on stored data and automatic logging.

Changing the logging interval re-schedules memory to the new interval and stored information will be re-timed thereby corrupting data.

Download all important data to your PC before changing the interval settings.

3.1.2 Automatic operation

This setting is self explanatory but is also discussed in the technical sections later in this manual. In most situations fully automatic operation should be used.

3.1.3 Manual ranging

Setting the Profile to Manual Ranging provides access to the Current and Voltage range settings.

In most cases setting the Profile to Manual Ranging is unnecessary.

Chapter 4 Data Analysis

4.1 Data file format

In general, analysis of Profile data should be done via the supplied ProPower software.

If necessary however, the downloaded data files can be analysed using any spreadsheet program.

Profile data files are in a simple text format with a column layout as follows.

Col. 1	Date & time (period ending)
Col. 2, 3, 4	average real power readings for the period for phase 1, 2, & 3.
Col. 5	average power factor for the circuit (multiplied by 100).
Col. 6, 7, 8	average reactive power for the circuit for phase 1, 2, & 3.
Col. 9, 10, 11	average voltages for the period (real plus synthetic values) for phase 1, 2 & 3
Col. 12, 13	the two counts for the pulse 1 and pulse 2 inputs if connected.
Col. 14	a remark indicating power data to be in kW or MW mode

This is the essential data required to describe all energy values from which other values can be derived.

kVA can be calculated from kW and kVAr. Amps can be calculated from kVA and voltage.

4.2 Deleting old records & Resetting Energy Counters

Always make sure you have saved all required data before using this function.

Profile retains all recordings (up to 4224 periods) until either the memory is full, when the oldest records are overwritten, or until the user decides to remove old readings. Because the use of memory is a function of the logging method and interval period there are various times during changes to these operations when Profile automatically deletes old readings:

- i) When setting a different Logging Interval.
- ii) When switching to Manual or 'Wait Till' logging
- iii) When the user wishes to zero the long term Energy counters (kWh/kVArh).

Manual deletion of old data can also be completed via the ProPower software.

Chapter 5 Connecting Profile for measurements

WARNING

Never connect the PROFILE inputs to physical voltages above 240 volts nominal, 268 volts RMS maximum. Connection to higher voltages such as 415 volts will cause destructive protection to operate and may destroy the instrument completely.

Current coils are fully insulated but should not be used on live conductors. The application of these coils is the users responsibility at all times.

Profile energy recorders are equipped with 6 measurement input channels as follows:-

Voltage: 1 input is provided and this is automatically connected each time Profile is plugged into a mains supply. This is convenient and safe and the operator does not have to access any other live voltage terminals.

Current: 3 inputs are provided and must only be accessed using the Rogowski coils supplied. These coil sets are available in different forms but all are of the split-core type allowing them to be installed easily and without interruption to the main feeder circuits. Rogowski coils are used because they are light and durable and specialised electronics within Profile ensure one set of coils is suitable for operation over a wide current range from a few 100 milliamps to 2000 Amps.

NEVER CONNECT ANY OTHER COIL OR DEVICE TO PROFILE CURRENT INPUTS.

Pulse: 2 inputs are provided on a dedicated socket which is compatible with a standard 5 pin DIN plug. These pulse inputs are suitable for use with isolated volt-free contacts and open collector devices using an external supply. A **suitable pulse adaptor** is available and connections made must be in accordance with the figures in this manual. See Chapter 8

5.1 Voltage input

Profile is provided with a mains lead with a standard UK 13 Amp mains plug. The only precautions are to ensure that the chosen power outlet is from the same supply as the system to be measured with no intervening transformer, and that it is wired with the correct polarity.

If the wall socket is supplied by a different distribution transformer the results will be wrong due to the unknown phase shifting properties of the transformer.

5.1.1 LV (Low voltage) 240/415v circuits

PROFILE should be powered by connecting the 13 Amp lead provided to a mains socket supplied from one of the three phases to be measured, it doesn't matter which phase as PROFILE will determine this during the setup autophase sequence.

5.1.1.1 Isolation.

For safety the earth pin of the PROFILE lead is not connected and PROFILE is isolated from the live and neutral voltage input pins, if the two wires in the socket are reversed there is no danger but the readings will be meaningless (a similar effect to reversing the current coils).

5.1.1.2 Faulty mains sockets.

Sometimes a socket is wired incorrectly. If you experience difficulties such as PROFILE complaining that auto phasing will not work, or negative kW values are present even when all appears OK. Check and test the socket.

5.1.2 HV (High Voltage) via voltage transformers, (Profile V in HV)

For HV systems a fused probes mains connection adaptor can be supplied for use by a suitably qualified person.

Alternatively a suitably qualified person could connect the live pin of the 13 Amp plug/socket to the Phase 1 110 volt secondary and the NEUTRAL pin to the Phase 2 (or common NEUTRAL) of the VT system.

For a suitably qualified person, a convenient method of connecting to a VT secondary source would be to make up an extension lead with a 13 Amp socket and approximately 2 metres of Brown/Black Test Cable with suitable terminations for your application.

5.2 Fitting Current Coils

5.2.1 Full current measurement on main conductors

The three Rogowski Coil current transformers must be fitted around the insulated conductors of the three phases to monitor. They must be put on the correct way round; there will usually be an arrow on the coil indicating the direction of current flow from source to load.

5.2.2 Five Amp secondary current

If you are measuring a 5 Amp secondary current you should be aware of potential problems. A correctly wired and fitted CT has its secondary connected such that the current flow is in the direction P1 to P2 and the corresponding secondary is S1 to S2.

5.2.2.1 Adjacent conductors

All clamp-on CT devices are sensitive to external fields from nearby cables particularly when measuring low level secondary currents. There are likely to be measurement accuracy problems for example, if an adjacent conductor is carrying a current which can be 100 times greater than the measured current. For best accuracy fit the coils at least 1 meter away from main power cables.

5.2.2.2 Small cables

With small conductor cores the large size of the Rogowski coils can cause the coils to be eccentric to the conductor. For best possible measuring accuracy use a concentric spacer to centralise each coil around the conductor. Best results will also be obtained if the conductor is perpendicular through the CT. Errors of up to 2% can be introduced by coil orientation differences but this should not normally concern general purpose energy monitoring applications.

Chapter 6 Automatic v Manual logging

Profile should almost always be used in the Automatic logging mode as this has been designed for the most common applications of Profile. In this mode current ranging and logging start is fully automatic.

However on occasions it can be desirable to carry out a survey of a particular set of conditions at a particular time of day or night, particularly if short time/logging intervals are used.

As memory allocation is treated differently in each mode it is necessary to protect from accidental changes between automatic & manual modes. Profile does this by making the manual settings available only via the system software with Profile connected to a PC.

This chapter details the operational requirements of different Profile settings.

6.1 Automatic logging.

Automatic logging is indicated on the main PC screen and also on the Profile LCD screen at power-on. The word *Autologg* tells you that automatic logging is activated.

In this mode logging commences immediately power is applied and the file remains open until the end of 6 logging intervals after power is removed, at which time the file is terminated and given its end time.

If a power failure or off time is less than 6 intervals then recorded data is appended to the existing file with the appropriate zero values recorded *in the gap*. A new file is opened when power is re-applied.

Memory is automatically switched to a cyclic mode so that oldest data is overwritten once memory is full and in theory it is never necessary to remove old data. However in practical terms memory should be cleared periodically to avoid the possibility that readings from a previous survey are not present during the file termination period and to reduce data search time.

6.1.1 Memory management in automatic

When Profile is logging and recording data to memory a decision has to be made as to when old data should be overwritten (and hence become irrecoverable). So in order to minimise the potential loss of data, Profile clears only one day at a time and this removal process is synchronised to midnight. At this time Profile deletes sufficient space for one more day's recording at the programmed time interval. This is important because it imposes limits on the interval times available in Automatic mode and you should NOT use intervals less than 10 minutes when switched to automatic.

In general switch to manual logging if interval is set to 5 minutes or less.

6.2 Switching to Manual Logging

Switching between automatic & manual logging is an operation that can be completed only with the Profile connected to your computer, through the ProPower software. Please consult your software documentation for details on the process involved.

Notes:

- i) Switching from automatic to manual logging or vice versa will wipe all data from the Profile's memory.
- ii) In manual logging mode the Profile uses memory in a different way; **under manual logging the Profile will stop recording when the memory is full** rather than wrapping around and overwriting the oldest data as it does in automatic logging mode.
- iii) it is important to set a logging start time when switching to manual logging mode.

When Profile is set to manual logging mode (and disconnected from the PC) the LCD will show the words *Manual* or *Wait Till*.

6.2.1 End of Manual logging

When Profile memory is full the manual logging terminates and the LCD screen shows this by displaying the word *finished* followed by the time and date.

6.2.2 Memory management in Manual logging

When Manual logging is asserted Memory is changed to be a one-shot process and is no longer cyclic. This is a precaution to ensure that records are not overwritten once empty space has been used. However the clearing of memory one day forward at midnight is still functional so be sure to have downloaded any existing important data from the Profile before implementing manual logging.

6.3 Selecting Logging Interval

The user can set logging interval periods to suit a number of applications in addition to its normal mode of *Autologg 30 mins*.

The logging interval can be changed only via the ProPower software.

Please be aware that when using the software to change the logging interval this will wipe the Profile's memory. Be sure to download any important data before changing Profile settings.

There are certain additional restrictions that must be observed when using short intervals;

Profile is a general purpose energy logger and therefore logging at short intervals requires thought as to its general operation. You should always use Manual logging with logging intervals below 10 mins (i.e. 5 min, 1 min etc).

On very short intervals (less than 1 minute) auto-ranging may not work as expected. For best results you should specify the range that the Profile should use with the manual range set-up facility.

Profile is a medium speed sampling logger with integration of the readings and therefore there is not much point to logging at very short intervals except for very special situations. Memory can be used very quickly and the files become very large.

Approximate logging times are given below.

<u>Period</u>	<u>Memory capacity</u>	<u>Channels</u>	<u>kW</u>	<u>KVAr</u>	<u>Volt</u>	<u>Pulse</u>
2 sec	2h.20m	11	3	3	3	2
10 sec	11h 43m	11	3	3	3	2
1 min	2d.19h	11	3	3	3	2
5 min	14 days	11	3	3	3	2
10 min	28 days	11	3	3	3	2
15 min	42days	11	3	3	3	2
30 min	84 days	11	3	3	3	2
60 min	168 days	11	3	3	3	2

Chapter 7 Site set up without a PC, more details.

When the PROFILE is first switched on it will show the Autologg screen discussed earlier. This means that PROFILE is working and logging the data it can measure. It is normally set to 30 minute logging and this is shown on the display. This log period can be set to other settings up to 1 hour but for security of data this can only be changed with the ProPower software on a computer.

At the point of power on, PROFILE may not be set correctly for your survey because:-

IF it is measuring a low current, Profile does not know if it should multiply that value by a CT ratio because it is a CT secondary circuit.

IF it is a Profile V and measuring a low voltage close to 110 volts it does not know if it should multiply that by a VT ratio and use the HV two wattmeter algorithm (Profile V only).

IF PROFILE has been pre set to work manually it doesn't know whether to cancel that and work with automatic controls.

PROFILE has not yet determined which voltage or current phases it is connected to.

7.1 First switch on at site

From any of the first seven displays press the enter (↵) key to initiate the auto set up (autophasing) routine. Autophasing is available only happen within the first ten minutes after power on to prevent later interference by unauthorised users. To regain this facility if more than ten minutes have elapsed since power on, simply power the Profile off and on again.

If tampering is possible the power supply source should be secured to prevent interference.

When the enter (↵) key is pressed, PROFILE may need answers as indicated below in order to configure the measurement set-up. In most cases however, Profile will be able to answer the questions automatically so you may never see the following seven steps:

IF PROFILE is set for "MANUAL CURRENT RANGING" you will be invited to enable current auto ranging.

IF PROFILE is set for "MANUAL VOLTAGE RANGING" you will be invited to enable auto ranging.

IF it is a PROFILE V and the voltage is near to 110 volts, on completion of the 'settling down' period you will be asked if the circuit is HV. If you say yes you will be able to edit the VT ratio to one of the available standard values. Use the (↑) and (↓) keys to raise or lower the VT ratio. Special values must be set using the ProPower software. Press enter (↵) to accept or press escape (↵) to quit the VT ratio edit page.

IF the largest phase current is less than 6 amps you are asked if the current is a CT secondary current. If you confirm that it is a CT secondary current you will have to edit or accept the existing CT ratio. Use the (↑) (↓) keys to raise or lower the setting and press enter (↵) to accept. Press escape (↵) when done.

IF PROFILE is set for manual logging you will be invited to use automatic logging. In automatic logging, records will always have the most recent data available, old data being cleared as memory is filled. For 'one shot recording' use manual logging.

IF PROFILE is connected to an LV system it will ask you if you want to autophase now. Autophasing allows you to use a voltage reference & power from any phase with PROFILE automatically assigning the measured and the two synthesised phase voltages for you.

If autophasing is requested and successful PROFILE will confirm the actual connections made (phase from which power is being supplied & phase rotation).

If autophase fails PROFILE will ask you to ***Phase by hand.***

7.2 Manual phasing details.

7.2.1 Manual phasing for LV situations.

You can phase manually at any time but you should normally let PROFILE perform the automatic routine first. If you do not let PROFILE autophase you must know exactly what you're doing otherwise results will be obtained that you may or may not understand and may be wrong. If you are forced to phase manually do the following:

PROFILE must either have just asked you to ***phase by hand*** or you must have set *Manual* operation via the ProPower software.

Profile must be set to POLYPHASE, FIXED association. If PROFILE has asked you to ***phase by hand*** it will have asserted this condition for you.

In **LV, poly phase, fixed association mode** PROFILE assumes it is receiving power from phase 1. If this really is the case just put the Rogowski Coils on to the three phases matching the phase and coil colours, ensuring correct orientation.

If you do not know which phase the voltage is from you must use the coils one at a time (starting with phase 1 - brown/red), the correct way round, to locate the current feeder that corresponds in phase to the forced allocation of phase 1 coil. Try to determine the correct phasing using the instantaneous real and reactive power displays. Repeat the procedure for the remaining phase coils in turn.

7.2.2 Some important considerations

Coils must be the right way round. If they're wrong you will never reach a correct configuration.

When the load is very small at start up and manual phasing is necessary be aware that some static loads can be capacitive and thereby produce -ve (negative) kVAr readings. This can be misleading because once normal load is applied it will probably be inductive and +ve readings will be obtained.

Use the kVAr displays to help your decision process, if these are small -ve values there could be small lighting or computer loads only.

ALWAYS ensure coils are installed with the correct current flow direction to avoid time wasting errors.

7.2.3 Manual phasing for HV two wattmeter situations (Profile V only)

Auto phasing is not relevant for HV as the two wattmeter method is used. Only Brown/Red and Grey/Blue coils are involved and the default voltage connection is Brown/Red to Black/Yellow. You can change this to Grey/Blue to Black/Yellow by using the Manual Voltage set up page the ProPower software.

The two coils must be the correct way round on the correct phases. If the phase rotation is reversed change the notional markings for Brown/Red and Grey/Blue as they apply to the equipment being measured.

Normally the Black/Yellow VT phase point is earthed and PROFILE uses this as the reference for the two wattmeter method. This is valid whatever earth connections exist as PROFILE does not assume any particular earth from the mains network.

Chapter 8 Pulse inputs, connections and use

PROFILE is equipped with two pulse inputs and each are essentially positive current or voltage pulse inputs, the quiescent state is open circuit. When a pulse of voltage or current is applied to the input PROFILE registers a pulse and on the trailing edge counts up a single count for that channel.

To maintain good EMC immunity no voltage source is provided for the pulse transmitter and this must be provide from external sources. An accessory is available which allows battery powered operation from volt free or low current drain optical transmitters.

8.1. Performance and specification of the pulse inputs.

The inputs are scanned every 1.6 ms and a new state of On or Off must be steady for five consecutive scans to be valid. This means that when any input bouncing has stopped the new pulse On or Off state must last at least 9.6 ms to be recognised. Bouncing has the effect of reducing the maximum rate that can be correctly counted.

The pulse counting performance is high and should deal with any practical situation but beware of pulse count saturation. (see paragraph 8.5).

An optional Pulse Adaptor accessory is available for direct connection of pulse inputs.

Each pulse input consists electrically of a 390 ohm resistor in series with the anode of a photodiode that has its cathode grounded to PROFILE ground with the following limits

Absolute maximum current input	(+) 60 mA.
Minimum current input	(+) 5mA
Accidental reverse polarity input is protected to	(-) 1 Amp.

8.2 The 5 way stereo DIN connections.

PROFILE pulse input is equipped with a 5 way 180 degree type DIN socket.

Pin identification is:-

pin 1	pulse input 1
pin 4	not connected
pin 2	pulse input 2
pin 5	PROFILE ground.
pin 3	Internal connection only.

8.3 Connecting volt free contacts.

The connections needed for volt free contacts are shown below.

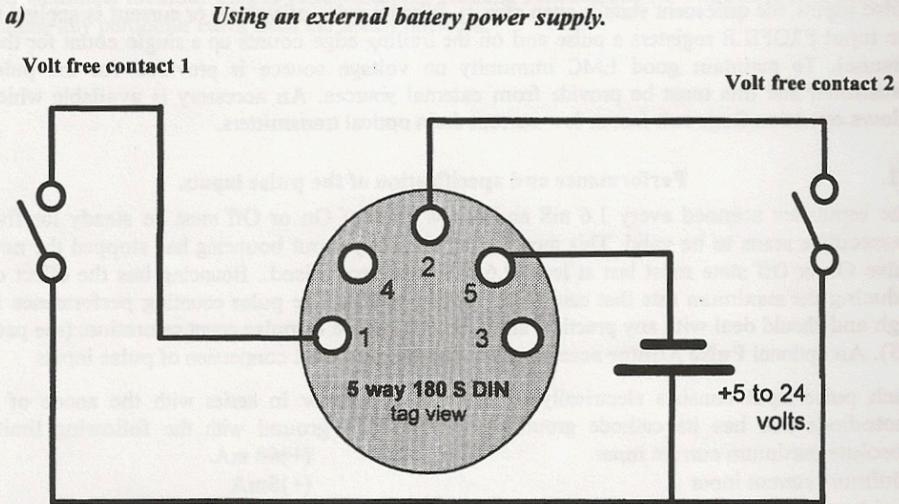


Fig 8

8.4 Connecting Open Collector Transistors

9.4 Connecting open collector transistors.

Volt free transistor 1
open collector

Volt free transistor 2
open collector.

Fig 9

8.5 Pulse records and firmware.

Pulses from the two channels are counted over each data integration period starting at zero up to a maximum count of 4095 per period. If more than 4095 pulses are counted in the period the recorded count will saturate at 4095. Saturation is not normally a problem even on hourly records. However a shorter interval like 15 minutes or even 5 minutes may be better to avoid count saturation for devices with a high pulsing rate. At five minutes interval the PROFILE can record average pulse rates of up to 13.5 per second without saturation.

To avoid translation errors due to incorrect meter scaling factors the pulse data is not scaled. It does not matter what the pulse value is, PROFILE will only record the number of pulses. The pulse count data can be easily converted to engineering units after downloading to a computer.

Chapter 9 Profile LCD displays, Advanced settings

9.1 Advanced information displays (Menu 3)

Menu 3 is available by pressing return (↵) at the 'See more pages' display of Menu 2. From menu 3 press escape (↵) once to return to Menu 2 or twice for Menu 1.

Displays in Menu 3 are as follows:

EDSL Ser no 1234
V5.06 PROFILE IV

EDSL is the Profile EDSL manufacturing product code
Ser no is the unique unit serial number,
V5.06 is the firmware version. Upgrades are obtainable.
PROFILE IV signifies the model number and hence the capability and specification of the unit.

One Vcon poly ph
Fixed red nor

One Vcon one voltage is used (standard for Profile).
poly ph poly-phase as opposed to single .
Fixed phasing is manual. Autophase has failed or was set by user.

floating applies only when the autophasing is OK

red nor phase association is for red normal (**always the case for fixed**).

If floating you may see e.g. **floating yel rev** this means auto-phasing at set up found yellow coil on the same phase as the voltage and phase rotation was reversed to your choice of coil placements.

LV A
Full 1 500amp A

The third display shows the ranges set or chosen by Profile:

LV: Low Voltage (240/415) supply systems with automatic voltage ranging.

Full: Full current mode as opposed to part for CT secondary currents.

1: Coil set number 1 is configured as the set in use*.

500 amp: PROFILE is using the 500 Amp range (other ranges are 2000 and 120amps, plus the part current range of 6 amps).

A: at the end of the line means that current is also working in Automatic mode

*PROFILE is normally supplied with one set of coils which are set up, calibrated, and selected to be Set 1, but it can also store calibration constants for up to four more coil sets/CT devices which must be labelled I through 5.

If you use more than one coil /CT set, the correct one must be chosen to ensure the right calibration numbers are in use, and accurate measurements are made.

9.2 Profile LCD panel, advanced messages and control.

In most cases advanced set up will be done via the ProPower software because there is a specific task to perform. However, if Profile is preset to manual current ranging it is possible to select the coil set, current range or CT ratio with the Profile panel and LCD using the status displays of menu 3.

These functions are deliberately hidden from view to minimise the risk of accidental changes but can be accessed by pressing Enter (↵) at the last display shown in the previous section of this manual.

There is a discussion on different coil sets above and with this display showing it is possible to select different coil sets and hence calibration constants for use by

Profile.	
CT set:	1
make set:	1

From this display use the raise (↑) and lower (↓) keys to select a new coil set number that will be indicated on the lower line.

With the correct coil set number showing press return (↵) to see the allocated set in line 1 change to the new number. If you change your mind and do not want to change press escape (↵). In either case you will now see the next display:

Select part/full	
full current ope	

This shows Profile operating on **full currents** indicated by the word **full** in line 2. Press the (↓) key and line 2 will show **part**. Press return (↵) to accept the one you want and/or escape (↵) for no change. If **part** is selected, the display will change to show:

CT ratio	5	:5
New ratio	5	:5

Use the (↑) and (↓) keys to set a new ratio within the range 5:5 to 16,000:5 amps. Large changes can be made by holding the key pressed. The rate of

change will speed up to make large changes or return to slow if the key is released.

Press **enter** (↵) key to effect the change or press (↔) key to leave the setting unchanged.

If full current ranging is selected you will be allowed to change the full current range as follows:

Range = 1000amps
Select 1000amps

Choose the range you want with the raise (↑) and lower (↓) and press enter (↵). After selecting the current range or CT ratio you will see the voltage and current range display again to verify settings are correct.

LV	A
full 1 1000 amp	A

From this display press escape (↔) twice to return to the Profile main autologg display to start the survey. This completes the configuration of Profile at site using the internal LCD and push buttons.

Chapter 10 More information about Auto-ranging

10.1 Current auto ranging.

Some of the choices the user makes affect the operation of the current auto ranger, these are as follows:

AUTO/MANUAL Ranging: the ranging selection chosen.

PART/FULL CURRENT: configuration made via Profile set up.

IF Automatic/Manual selection for current ranging is set to **manual** the current auto ranger cannot function, the **range will remain fixed** as selected by the user even if the input current becomes too large or too small for measurement on the selected range. No damage will result but over-range results will be distorted or lost.

IF the automatic current ranger is switched to auto then the current range will automatically slide to the best range available for the incoming current.

PROFILE IV and V are equipped with ranges for 2000, 500, 120, and 6 Amps.

<u>From Range</u>	<u>Condition</u>	<u>Switches to range</u>
2000	$I_m < 450$	500
500	$I_m > 490$	2000
500	$I_m < 90$	120
120	$I_m > 115$	500
120	$(I_m < 6)$ AND ("setup given")	6
6	$(I_m > 6)$ OR ("setup not given")	120

In the above, ' I_m ' is the largest RMS current of the three phases measured on the existing range and before multiplying by the CT ratio. These are not critical/absolute figures but are included for information.

From the above, the auto ranger will select an appropriate range for the service if one is available. The auto ranger does not drop down a range as early as possible because some hysteresis is required to prevent range hunting as the load fluctuates. The 'set up' permission mentioned is discussed below. The current auto ranger acts once every 16 seconds to prevent undue disturbance to measurements and for a brief period during range switching readings may be erratic but this is 'smoothed out' by the normal integration periods.

10.2 Voltage auto ranging. (Profile V only)

Three choices affect the voltage auto range facility. Profile V can measure HV circuits using the 110 volt secondary of a voltage transformer and on this so called 'HV range' the VT ratio will be applied to voltage and power measurements. The voltage auto ranger can, if it is present and enabled, automatically select between HV (3-wire) and LV (4-wire) measurement by measuring the voltage connected to the Profile.

Important Note: The User should be aware that a LV (4-wire) circuit with less than 145 volts phase to neutral requires the voltage auto ranger to be switched off to prevent automatic assertion of 2 Wattmeter operation.

Apart from the initial choice of PROFILE (IV or V), two other controls affect the voltage. These choices are:

- a) Voltage ranging auto/manual selection.
- b) Set up choices.

If the PROFILE is type IV the range will always be LV.

If the PROFILE is type V and you select manual voltage ranging then the automatic voltage ranger can not work and will remain fixed in the way it has been set. At auto set-up time you will be asked if the circuit is HV with voltages coming from a VT, if the user answers Yes the voltage ranger will be free to select the HV range when it 'sees' an HV circuit (110 volts) or LV range (4-wire) if it sees a 220/240 volt circuit.

The conditions of operation are as follows:

<u>From Range</u>	<u>Condition</u>	<u>Switches to Range</u>
LV	(V < 132) AND (HV selected)	HV
HV	(V > 140) OR (HV not selected)	LV

Where V is the RMS voltage measured at the power socket before applying VT ratio.

The changeover figures are selected not to coincide with any normal operational condition and the offset in the switch levels gives hysteresis which together with a time delay of 16 seconds ensures that the PROFILE should not hunt between the voltage ranges.

10.3 The effect of set up choices on auto ranging.

a) Current (Profile IV & V)

PROFILE is normally set to be fully automatic but there are some things which still have to be decided.

When Profile finds it is measuring a current of less than 6 amps it cannot determine whether the current is full current or if it is the secondary current from a CT. When you operate the set up programme from the LCD controls you will be asked what choice should be made.

If you choose that current will be from a CT secondary, Profile can still measure a large current of more than 6 amps but the decision will affect readings of 6 amps or below. Whatever decision is made at auto set up time if Profile encounters a current too large to be a CT secondary current it will automatically select the best range for the current flowing. If you have answered "Yes" to the CT secondary question, small currents under 6 amps will be measured by the special 6 amp range and will be multiplied by the C'I' ratio set into Profile.

If the CT ratio is set to 5:5 amps it will always be safe to answer "Yes" to the CT secondary question and readings will be stored as measured because 5:5 is a multiplier of 1.

If however you want your data to read directly in whole current engineering units you must set in the correct CT ratio for part current applications.

With a non CT secondary current that is below 6 amps and a CT ratio of other than 5:5 you will get apparently false readings because they are always multiplied by the CT ratio held in Profile memory.

b) Voltage (Profile V only)

The set up programme asks if the voltage is from a VT secondary. If the answer is 'Yes' and the **voltage is below 132 volts** and **auto voltage ranging is on**, Profile will switch to the 110 volt input range, assume that the circuit is a three wire HV circuit and that the voltages are line to line delta voltages reduced by the VT ratio. If you wish to measure a circuit that has a voltage below 150 volts that represents the line to neutral voltage then you should answer "No" to the VT secondary question or switch off the auto voltage ranger all together.

Answering "yes" to the VT secondary question makes a fundamental difference to how PROFILE deals with the circuit but only if the voltage measured is lower than 132 volts.

10.4 Power measurement principles and phasing

10.4.1 Two and three wattmeter connections

The PROFILE design is based upon the assumption that the instrument will be used to measure Watts, VARs, Amps, VA, and Volts on three phase or single phase electrical circuits operating at 50 Hz ac.

Two types of three phase circuit are covered. Four wire circuits which have a neutral wire and three wire circuits which have no neutral wire. Profile is also designed on the assumption that HV circuits are always three wire with nominally symmetrical voltages in magnitude and phase and always have potential transformers with secondary voltages line to line of around 110 Volts or 100 Volts. The PROFILE also assumes that LV circuits are always 4-wire and always have line to neutral voltages that are nominally symmetrical in phase and magnitude and between 100 volts and 240 Volts nominal.

In 3 wire systems the assumption is that it is always possible to measure VA Watts and VARs with one less wattmeter (and coils/CTs) than the number of wires in the circuit being measured. This is because a reference for voltage must be taken and that reference can always be chosen to be the potential of one of the wires. If one of the wires is chosen to be the reference potential it has zero potential with respect to itself and hence zero power associated with it, therefore its current is irrelevant and it does not need a CT/coil or a wattmeter.

The sum of the real energy amounts measured in each wattmeter will always represent the total amount of power flowing through the circuit. However the division of the amounts measured in each phase or wattmeter is only with respect to the reference wire and may be meaningless before it is added to the other wattmeter. The amount of power in each wattmeter can be used to reconstruct a vector diagram of the current in the circuit so the values for each wattmeter are recorded separately and the user has to add them together externally to obtain useful data.

Unfortunately although VA and kVA are used extensively in electrical engineering the units do not actually mean anything. This is because the answer depends upon the voltage reference point chosen and since that reference point is arbitrary the value of VA is arbitrary and therefore meaningless. To remove this difficulty VA can be expressed with respect to the reference level chosen. In other words the total VA in the circuit can be expressed as the sum of the VA readings from each wattmeter with respect to the reference phase.

When a 3-wire circuit is said to have a load of so many VA on each phase the underlying assumption is that the VA has been measured with respect to an

imaginary neutral that is in the voltage plane centre of the three voltages. One should bear in mind that the reference voltage is non-existent and the VA measurements are a largely irrelevant construction. This difficulty seems to be removed in the case of 4-wire circuits because one assumes that the neutral, being earthed somewhere, is rather like earth and therefore not arbitrary.

10.4.2 Star and delta VT secondary connections (Profile V only)

The VT secondary wiring may be such that three VT are wired as a star with an earthed centre point or two or three VT wired in delta. The PROFILE assumes that the nominal VT secondary voltage line to line (between corners of the phasor diagram) is 110 Volts. If the nominal secondary voltage is different to 110 Volts you will have to adjust the primary VT ratio setting to compensate.

e.g. if the VT ratio is 13,800/100 Volts you must convert this to 15,180/110 (by multiplying 13,800 by 110/100) in order to set the primary HV voltage.

Please also note the following:

i) the secondary voltage (line to line) must be in the range > 93 Volts to < 130 Volts rms. in order to power PROFILE correctly.

ii) PROFILE voltage inputs are differential and isolated from ground so it is not critical how the VT secondary are connected as long as the line to line voltage is nominally 110 Volts.

iii) VT secondary are normally wired with two VT Brown/Red & Black/Yellow, and Grey/Blue & Black/Yellow where the two Yellow ends are connected together to ground. PROFILE is connected with its neutral input to Black/Yellow and live input to Brown/Red. If VT are wired in star configuration ignore the centre connection and connect the **neutral** input pin of the Profile to the Black/Yellow point and the **live** input connection to the Brown/Red voltage point.

iv) If the power system uses phase nomenclature other than Brown/Black/Grey (Red/Yellow/Blue) (e.g. R S T) make a note of the relationship.

10.4.3 Power measurement algorithm.

PROFILE measures the voltage and currents 24 times each mains cycle of nominal 20mS duration. Scanning of the voltage and current measurement is synchronised to mains and phase locked to the zero crossing point of the connected voltage. Real power is measured by digitally integrating the product of each scan's instantaneous voltage and current values and in the case of

autophasing the relative association of phase voltages and currents is changed in software.

Reactive power is measured by the same method as real power and kVA is measured by taking the square root of the sum of the squares of the real and reactive measurements. Voltage is found by calculating the true RMS value of voltage once every two seconds and current is derived by dividing kVA by voltage. Thus it can be seen that the primary measurements are real and reactive power with other parameters being calculated from that data. Each wattmeter (phase) is calibrated for each voltage and current range separately with range and phase specific magnitude adjustments in firmware. Separate calibration constants are applied to the snapshot voltage measurements.

10.4.4 Harmonic power measurement.

The PROFILE wattmeter are able to respond to the harmonic power elements up to the 9th harmonic and measure the effect that they have upon real and reactive power up to about 1 KHz. Although there may be significant amounts of current above the 9th harmonic the actual power levels are usually trivial. **For best accuracy when measuring chopped waveforms always measure the power on the supply side.**

Chapter 11 More details about PROFILE output data.

Profile data can be downloaded using the ProPower software. Please refer to the software manual for more information.

The format of Profile data is described below.

11.1 Tabulation of data in files.

PROFILE data files are set out as a series of columns with a column for each data item. A block of rows contains all the readings for a day separated by blank lines and a date message before the next day's data. At the beginning of the ? each file the point name is also given if used. Each data item is represented in plain ASCII text.

Column 1	Time at the end of the period to which the data relates.
Column 2	kW or MW for phase 1
Column 3	kW or MW for phase 2.
Column 4	kW or MW for phase 3
Column 5	Power factor for the three phases together multiplied by 100
Column 6	kVAr or MVA for phase 1
Column 7	kVAr or MVA for phase 2
Column 8	kVAr or MVA. for phase 3
Column 9	Voltage for phase 1
Column 10	Voltage for phase 2 (identical to phase 1 if not measured)
Column 11	Voltage for phase 3 (identical to phase 1 if not measured)
Column 12	Pulse count for channel 1
Column 13	Pulse count for channel 2
Column 14	The power units (kW or MW) in plain text

Chapter 12 Features and Specification of the PROFILE.

The PROFILE is a hand held poly phase portable energy monitor that can record energy profiles of LV circuits and also in HV circuits (Profile V only) for up to nearly 6 months. The instrument measures the electrical real, reactive and apparent energy, voltage, and current on single or poly phase LV circuits (Profile IV), or LV and HV circuits (PROFILE V). The PROFILE also reads and stores the number of pulses on two pulse input channels.

The PROFILE has enough internal memory to store all the channels of data for 4,224 periods in a ? last in first out (LIFO) ? battery backed memory file. The recordings can be uploaded to a text file using the ProPower software which also provides comprehensive analysis facilities.

12.1 Features and Specifications

Simple to use, low user skill level requirement, automatic set up programme, automatic configuration, ranging and logging controls.

Installation may require qualified personnel depending on location.

Flexible Rogowski Coil type CTs for current interface. Simple 13 Amp power plug connection for voltage sensing.

Interface to a PC via the USB serial data line using the supplied cable.

Capability to up-load recorded data to a text file for use in a PC spreadsheet program or the associated ProPower software.

High accuracy hardware, battery backed real-time clock to time and date stamp the survey records.

One coil set handles all current ranges from 2000 Amps down to milliamps. No range switches, all range switching is done electronically by the system.

PROFILE V measures HV circuits as well as LV and chooses the voltage range automatically. Current and voltage auto rangers make sure the current and voltage are measured correctly.

Double insulated to meet the toughest electrical safety requirements.

CT ratios (Profile IV & V) can be changed over a very wide range, 5:5A to 16,000:5 Amps.

VT ratio (Profile V) is selectable over the primary voltage range 110:110V to 999000:110V.

Physical features

The PROFILE can be transported in the small carry case supplied complete with its coils, power and computer leads and instruction documentation. The PROFILE main module is a hand held unit of approx. 195 mm x 99 mm x 40 mm weighing approx. 600 grams. The panel of the PROFILE has a membrane switch pad with just four push buttons and a clear high contrast LCD display of 16 characters by two lines.

Configuration

Most configuration can be done from the Profile's four push buttons and LCD display. Advanced manual set up is achieved by using the associated ProPower software.

Technology

8 bit microcontroller with fast (1200 Hz) scanning measurements of voltage and current. The split core CTs are of the Rogowski coil type. The instrument 'steals' about 3 VA to cover its internal power supply needs. Memory and clocks are fully battery backed and a floating USB RS232 connection is provided for the computer interface. Voltage input is isolated from the rest of the instrument. Software is written in a combination of Motorola assembler code and a proprietary high level language system called PMSL.

Connections

The connection for voltage measurement and power is made via a standard power plug and socket.

The current transformers (Rogowski coils) plug in via a 6 way bayonet style DIN socket.

A Male Mini USB B connector is provided for connection to a computer with the supplied cable.

Pulse inputs can be connected using the optional Pulse Adaptor, or via a user made connection using the simple circuit described within this manual.

Voltage Ranges

Range 0	95 to 280 Volts when used in LV configuration. (Profile IV & V)
Range 1	95 to 130 Volts when used in HV configuration (Profile V only)

Current Ranges

Range 1	0 to 120 Amps.
Range 2	0 to 500 Amps.
Range 3	0 to 2000 Amps.
Range partial	0 to 6 Amps.

Rogowski current probes

These are easy for a non skilled operator to fit in a few seconds without power disconnection.

Standard coils have an internal diameter of approx 65mm. Coils with a larger ID can be supplied on request.

Each coil should be looped around the conductor only once and secured into the integrated socket/holder to complete the circuit.

The Rogowski Current coils are fully insulated but should not be used on live conductors (e.g. bus bars). The application of these coils is the users responsibility at all times.

The metal conductor inside the coil is floating electrically but this is not a limitation. With best practice calibration and use the coils are able to deliver 1% accuracy over an extended inter calibration period of up to two years.

Pulse Inputs

Two pulse inputs can be counted simultaneously. Pulses are either voltage or current from open collector devices or volt-free contacts using the optional **Pulse Input Adaptor** accessory available from NewFound Energy Ltd to provide a suitable isolated power source.

Power accuracy

This is better than +/- 2% of reading above 25% of range including coil/CT errors.

Reactive and Apparent power, Voltage and current measurements.

The instrument measures and records the reactive power flow and direction within the same limits as real power. Reactive power measurements are made with the same accuracy as real power for sine waves. Reactive harmonics degrade the reactive accuracy slightly.

PROFILE measures the voltage using a true rms. method from one cycle per two seconds. This limited voltage measurement is not associated with the power algorithms. Current is calculated by inference by finding the kVA value from the real and reactive power values after Pythagoras and then dividing by the voltage. The power measurements are more accurate than the product of the derived current and voltage measurements. KVA and Amps are provided for display only to conserve memory and these can be easily calculated from recorded data.

Internal clocks

The instrument is provided with a high accuracy clock sub-system, with a battery driven quartz crystal clock with ten year shelf life. The crystal clock is accurate to 30 seconds per month.

Memory systems

The user's configuration is preserved indefinitely in an EEPROM memory and partly in a battery backed RAM with ten year battery life. The instrument program is on a ROM. (Read Only Memory) and this is exchangeable so that software upgrades can be accommodated in a safe reliable way that ensures good software quality control. The historic data is kept in the battery backed RAM.

Memory records and length

Each period the PROFILE stores three kW average readings (one per phase), three reactive kVAr readings (one per phase) and three voltage (only one is measured), plus the count from two pulse channels up to a maximum of 4096 counts on each channel, plus the time and date of the period end.

The PROFILE can store data for 4224 periods before ending or overwriting data.

<u>Period</u>	<u>Memory capacity</u>	<u>Channels</u>	<u>kW</u>	<u>KVAr</u>	<u>Volt</u>	<u>Pulse</u>
2 seconds	2h.20m	11	3	3	3	2
10 seconds	1h 43m	11	3	3	3	2
1 minute	2d.19h	11	3	3	3	2
5 minutes	14 days	11	3	3	3	2
10 minutes	28 days	11	3	3	3	2
15 minutes	42days	11	3	3	3	2
30 minutes	84 days	11	3	3	3	2
60 minutes	168 days	11	3	3	3	2

Run diagnostics

A LCD display which shows the time and logging status during normal operation provides evidence of continued correct working. The user can step through several pages of survey information to confirm system operation.

Standards

The mechanical and electrical specifications conform to the relevant BS/IEC. Electrical safety is intended to comply with IEC 1010. The voltage inputs are fused and over volt protected and the whole instrument is double insulated.

EMC performance

The instrument has been found to work without fault in the harshest environments. RFI emissions are within the limits set down.

Shelf life

10 years designed life for battery and electrolytic condensers, the battery is only guaranteed for one year.

Guarantee

Please see your sales document and contract but the standard is 1 year back to base repair.

Reliability

At present a field proven M.T.T.F. figures with an instrument using the same technology of better than ten years. Rogowski coils are subject to wear and tear and are limited life components.

The specification of the Profile Portable Energy recorder is subject to change without prior notice. The details, guides, & specification in this document reflect the capabilities at the time of writing.

NewFound Energy Ltd cannot be held responsible for incorrect or inaccurate data recordings caused by incorrect use or installation of the Profile.

Any customer requiring further guidance in the use of Profile should contact their supplier.

END

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