**Instromet**

**ENCAL 2000**
**CONTROL UNIT**

**INSTRUMENT INSTRUCTION MANUAL**

*In the design and construction of this equipment and instructions contained in this manual, due consideration has been given to safety requirements in respect of statutory industrial regulations.*

*Users are reminded that these regulations similarly apply to installation, operation and maintenance, safety being mainly dependent upon the skill of the operator and strict supervisory control.*

## CONTENTS                            Page No.

**SECTION 1**

## 1.0 INTRODUCTION

The ENCAL 2000 Control Unit (CU) is designed to provide the interface to the Model 2000 Process Gas Chromatograph (PGC).

The Control Unit provides the signal isolation necessary between the hazardous area and the safe area without the need for any additional safety barrier by using a fibre optical data communications link to the Process Gas Chromatograph.

The Control Unit enables the Process Gas Chromatograph to be interfaced to any personal computer with a windows environment for setting up the operation of the Process Gas Chromatograph.

The Control Unit gives local indication of the Gas data and status of the Process Gas Chromatograph, it also provided additional serial communication facilities and analogue 0/4-20 mA output signals.

All data is tested to ensure that they are within the designed operating limits, an alarm display records the time when alarms occur and clear.

A serial data printer output or a internal printer unit can be provided enabling reports to be printed at regular intervals.

Multiple serial outputs can be provided for interfacing to Gas Measurement Corrector systems using Modbus (ASCII) protocols.

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**SECTION 2**

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**2.0      GENERAL DESCRIPTION**

The Encal 2000 Control Unit (CU) comprises a standard size 19 inch rack which contains plug-in printed circuit boards connected to a mother board.

The Control Unit front panel contains a liquid crystal display, keyboard, display buttons and indicator LED's. The liquid crystal display (LCD) is a 4 line by 40 character type which is used to display the data entered and operating information. The keyboard is used to select the data to be entered into the Control Unit memory and select all of the displayed information, this can be accomplished by either using the **Ý** and **ẞ** keys to scroll through the display or by entering the individual location number of the required information to be displayed.

Input and output signals are connected to the Control Unit by D type connectors located at the rear of the unit and a optical connector (serial output) to interface with the Process Gas Chromatograph. The Control Unit is operated from a 24VDC supply.

The front and rear panel arrangement are shown in figures 1 and 2.

**2.1      CONTROL UNIT FACILITIES**

**2.1.1      MODE SWITCHES**

The manner of operation of the Control Unit is initiated by the setting of mode switches located on the back of the display circuit board.

The designation and function of the mode switches is as follows:-

| Switch No. | ON | OFF |
|---|---|---|
| 1 | Default to first display page after 30 seconds. | Remain on last displayed page |
| 2 | Comms board No 1 fitted. | Comms board No 1 not fitted. |
| 3 | Comms board No 2 fitted. | Comms board No 2 not fitted. |
| 4-6 | Not used | |
| 7[1] | Auto adj. of Retention times On | Auto adj. of Retention times Off |
| 8[2] | Remote Access Security On | Remote Access Security Off |
| 9[3] | Process Gas Chromatograph clock updated from CU clock On | Process Gas Chromatograph clock updated from CU clock Off |
| 10[3] | CU clock updated from Process Gas Chromatograph clock On | CU clock updated from Process Gas Chromatograph Clock Off |
| 11-12 | Do not use (changing SW12 will clear all programmed data) | |

Note (1)      See par. 2.9

Note (2)      See par. 2.8

Note (3)      See par. 2.4

## 2.2 FRONT PANEL

All of the controls necessary to operate the Control Unit are located on the front panel and provide the following functions:-

### 2.2.1 KEY SWITCH AND SECURITY SWITCHES

The key switch can be set to one of four positions which are identified as **DATA**, **EDIT**, **CAL** and **RUN**.

The **DATA** position is used to enter all of the operating data into the Control Unit memory. In the **DATA** mode the Control Unit serves only to request the data required to operate in the manner selected by the mode switch settings. The LCD display requests essential data by showing **??????** after the data symbol or optional data by showing **-----** after the symbol, if data has previously been entered then the value of that data will be displayed. The data to be entered is prompted by a flashing cursor. After data has been entered the **DATA** position of the key switch can be inhibited by a security switch.

With the key switch in the **CAL** position the analogue output signals of the Control Unit can be calibrated. Normal analysis functions continues in this mode. The **CAL** mode can be inhibited by a security switch.

Setting the key switch to the **EDIT** position allows only data which is identified by an * adjacent to the parameter symbol on the LCD display to be changed, the new value of data will be used when the key switch is turned to the **RUN** position. The edit facility can be inhibited by a security switch.

In the **RUN** mode the Control Unit operating data cannot be changed, the display can be used to show all of the analysis data as well as the data stored in memory by using the selector switches and keyboard.

When a key switch position is selected that is protected by a security switch in the on position then the Control Unit will ignore the key switch setting and continue in the run mode.

### 2.2.2 DATA DISPLAY FORMAT

The Control Unit uses a LCD display with a 4 lines of 40 characters presentation by which data and flow information is displayed. Each item of information having a unique location number which is shown on the display on the top line. The required information can be directly displayed by entering the location number on the keyboard or alternatively using the display scroll keys (**Ý,ß**) providing the key switch is in an allowable position.

The location number of all items is given in appendix 1.

```
           Parameter
Page Location No.          Stream Number    Time and Date


  Loc 1,0,01 ENERGY:ST1      25:25 20/03
   hs.dry = 7.71892      hi.dry = 7.12498
   hs.sat = 7.58901      hi.sat = 7.00507
   hs/Kg = 48.5897
```

## 2.2.3 KEYBOARD FUNCTIONS

The keyboard serves the purpose of selecting the information to be displayed and entering the numerical values of data.

## 2.2.3.1 KEYBOARD LAYOUT
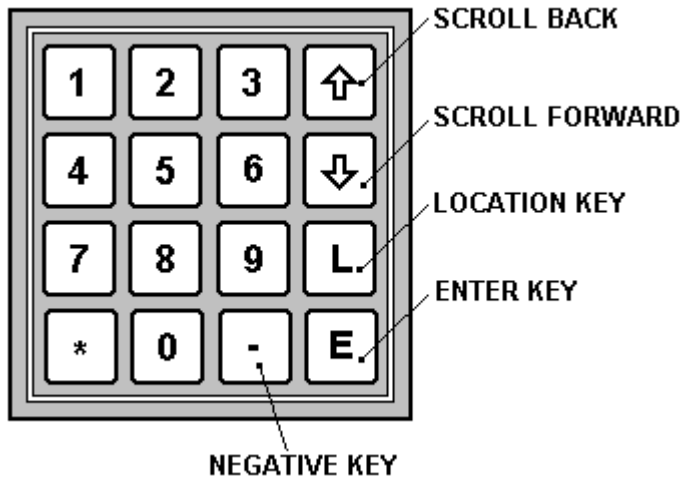


## 2.2.4 KEY FUNCTIONS

## 2.2.4.1 SCROLL FORWARD AND SCROLL BACK KEYS

These keys move the display cursor to the line of data before or after the present line, if the cursor is at the start or end of a page then the previous or next page of information will be displayed. The scroll keys (**Ý,ß**) can be used to advance the cursor from the start to the end. In the **DATA** mode the scroll keys allow the cursor to be advanced through all of the data. One press of the key advances or returns the cursor by one item when in the **RUN** mode.

In the data entry mode the **\*** key can be used as a scroll key to step forwards to locations requiring essential data jumping over other data and similarly the **-** key can be used as a scroll key to step forwards to locations requiring optional data jumping over other data.

## 2.2.4.2 ENTER AND LOCATION KEYS

The enter key **E** allows the value of data to be entered into the Control Unit memory. A location key **L** permits a location number to be entered which will recall that location to the display.

Where a value is to be entered in memory the procedure is to press the enter key, press the digit keys to the value required followed by a second press of the enter key.

To display a particular page of data the location key is pressed, then the location number is entered using the digit keys followed by pressing the enter key. The location number of all information is given in appendix 1.

**Note:** The Control Unit will respond only to valid location numbers, if an invalid number is used it is ignored e.g. requesting an edit location with the key switch in the run position.

### 2.2.4.3 NEGATIVE KEY

The negative key (**-**) is used to enter a negative value and to delete functions which are not required, e.g. Alarms, default values are deleted by the negative key.

### 2.2.5 FUNCTION SELECTOR SWITCHES

Below the LCD display are eight push-button switches which are only operational with the Control Unit in the **RUN** mode. Two of the switches are used for printer functions and two provide quick access to displayed information, the switches have the following functions:-

### 2.2.5.1 PROGRAMMED DATA

The **DATA** button enables the values of operating data stored in memory to be recalled and examined while the Control Unit is in the **RUN** mode. Data cannot be changed.

### 2.2.5.2 INFORMATION

Pressing the Information button immediately displays the first information page, using the scroll keys allows the other information pages to be viewed.

The first line of the first information page is printed as the user header information when the gas chromatagraph Calibration report is printed.

The data can be entered on the information pages in two ways.

**1**) By using the serial link connected to a computer. This uses software which is available on a disk. The data is typed on the computer keyboard and then sent to the Control Unit via the serial link, the Control Unit key switch must be set to the **DATA** position when using this method.

**2**) By using the Control Unit keyboard. The Control Unit key switch must be set to the **DATA** position when using this method. To enter data press the **INFORMATION** button to display the first page, uses the scroll keys to display the page to be modified. Press the enter key **E**, **EDITING** is shown in the top right-hand corner of the display and the cursor will now be at the location where the first character can be entered or changed. Use the decimal point and the negative keys to position the cursor to the position where a character is required or to be changed then use the scroll keys to step through the characters until the required one is shown. Move the cursor to the next position and scroll to the required character, repeat this procedure until all the information has been entered on the page then press the enter **E** key to store the information in memory.

### 2.2.5.3 PRINTER DATA

Pressing the Printer Data button allows the selection of either all of the displayed data or the pre-set data (programmed data) to be printed instantaneously. Use the scroll keys to select the requirement then press enter (**E**). The selected data will be bracketed by **[ ]** when it is being printed and **( )** when printing is pending. Press the button to return to the previous displayed function.

### 2.2.5.4 PRINTER RESET

Encal 2000 CU V3.0
ISM/01-04-2003

This is used to reset the printer after a printer fault such as a paper jam. Clear the cause of the fault before pressing.

**2.2.5.5    DISPLAY 1**
Pressing this button will display the following information:-
**Process Gas Chromatograph Status giving**:-
- The time in seconds into the current analysis
- The number of the stream being analysed
- The number of the next stream to be analysed
- The function being carried out in the TSC table
- The state and data being communicated between the Process Gas Chromatograph and Control Unit.
- Mode of operation

**Note:** The definitions of the symbols used for the TSC table are given in the ENCAL 2000 PGC Users Guide

**Process Gas Chromatograph Analysis data:-**
Using the keyboard scroll keys the following information is displayed:
- The heating values of the last gas analysis for Stream 1 and Stream 2
- The Wobbe index of the last gas analysis for Stream 1 and Stream 2
- The relative density of the last gas analysis for Stream 1 and Stream 2
- The normal density of the last gas analysis for Stream 1 and Stream 2
- The individual gas component concentrations for the last Stream analysis
- The non-measured component concentrations.
- The average heating values for the current hour for Stream 1 and Stream 2
- The average heating values for the previous hour for Stream 1 and Stream 2
- The average mol % $CO_2$ for the current hour for Stream 1 and Stream 2
- The average mol % $CO_2$ for the previous hour for Stream 1 and Stream 2
- The average normal density for the current hour for Stream 1 and Stream 2
- The average normal density for the previous hour for Stream 1 and Stream 2
- The average heating values for the current day for Stream 1 and Stream 2
- The average heating values for the previous day for Stream 1 and Stream 2
- The average mol % $CO_2$ for the current day for Stream 1 and Stream 2
- The average mol % $CO_2$ for the previous day for Stream 1 and Stream 2
- The average normal density for the current day for Stream 1 and Stream 2
- The average normal density for the previous day for Stream 1 and Stream 2
- The average heating values for the current month for Stream 1 and Stream 2
- The average heating values for the previous month for Stream 1 and Stream 2
- The average mol % $CO_2$ for the current month for Stream 1 and Stream 2
- The average mol % $CO_2$ for the previous month for Stream 1 and Stream 2
- The average normal density for the current month for Stream 1 and Stream 2
- The average normal density for the previous month for Stream 1 and Stream 2

### 2.2.5.6    DISPLAY 2
Pressing this button will display the following information:-

Process Gas Chromatograph Status (as for Display 1)giving:-
- The time in seconds into the current analysis
- The number of the stream being analysed
- The number of the next stream to be analysed
- The function being carried out in the TSC table
- The state and data being communicated between the Process Gas Chromatograph and Control Unit.
- Mode of operation

**Note:** The definitions of the symbols used for the TSC table are given in the ENCAL 2000 PGC Users Guide

Using the keyboard scroll keys the following detailed information for the last analysis is displayed:-
- The time and date of the start of the last analysis
- The time and date of the end of the last analysis
- The time and date of the last calibration
- The un-normalised sum
- The compressibility Zn
- For the gas components of C6+, Nitrogen, Methane, Carbon Dioxide, Ethane, Propane, i-Butane, n-Butane, neo-Pentane, i-Pentane and n-Pentane the following data is displayed:-
  1. Retention time in seconds
  2. Peak area
  3. Response factor
  4. Normalised concentration
  5. Energy contribution
  6. Relative density contribution

### 2.2.5.7    ALARM
Pressing the **ALARM** button operates the alarm and fault display facility. This facility records on the alarm pages of the  LCD display up to 24 alarm and fault conditions with the time and date that they occur and clear. The type of alarm or fault is identified by a code on the display, a list of codes is given in appendix 2 .

### 2.2.5.8    ALARM RESET
The **ALARM RESET** button enables the alarm display pages to be cleared, when cleared all locations show **---------**. As alarms or faults occur they are pushed into the first location thus ensuring that the latest entry is in the first alarm page on the top line.

The Alarm Reset also extinguishes the Accountable Alarm LED

**2.4      CLOCK**

A clock is built into the Control Unit which gives the time and date shown on the display and is used with the error, print and serial facilities to give accurate timing of events. The clock is set in the data mode using the keyboard.

Indication of the time is given at the top right-hand edge of the display in normal operation and access to the time and date is given by location **0.0.02** using the data push-button in the run mode.

The clock is powered by an internal lithium battery when the Control Unit power is removed, the battery will power the clock for 10 years with the Control Unit unpowered.

The clock setting in the ENCAL Control Unit can be achieved in a number of different ways depending upon the mode switches 9 and 10.

.

| clkCU>AN<br>*(MS 9)* | clkAN>CU<br>*(MS 10)* | Master Clock | Application |
|---|---|---|---|
| OFF | OFF | **None** | *No requirements for clock synchronisation. Both clocks (Control Unit and Process Gas Chromatograph) are not synchronised and are free running.* |
| ON[1] | OFF | **Control Unit** | *Control unit will synchronise Process Gas Chromatograph clock. This is used if the clock signal is written to the Control Unit via the MODBUS communication ports (e.g.: DSf-GC unit with DCF77 clock)* |
| OFF | ON[2] | **Process Gas Chromatograph** | *Process Gas Chromatograph will synchronise Control Unit clock. This is used if the clock signal is written to the Process Gas Chromatograph via RGC software using a PC (e.g.: PC with DCF-77 clock) (e.g.: In RGConfig.ini TG TIME-UPDATE = ON)* |
| ON | ON | **Not allowed** | *It is not recommended to use both mode switches 9 and 10 in the ON position because duplicate master clocks can conflict in the ENCAL 2000 System.* |

General remark:
The Statusflags On or Off on the CU display (programmed data) for the Mode-Switches 9 & 10 indicate the switch positions On or Off.

Note 1:
If Mode-Switch 9 (clkCU>AN) is in the ON position: The Process Gas Chromatograph clock will be synchronised to the CU clock every 1 minute interval (LOAD_TIME packet).

Note 2:
If Mode-Switch 10 (clkAN>CU) in in the ON position: The CU clock will be synchronised to the Process Gas Chromatograph clock every time the CU reads a valid STATUS packet from the Process Gas Chromatograph.

## 2.5     ANALOGUE OUTPUT SIGNALS

The Control Unit can be fitted with up to two optional output boards each board provides 3 analogue outputs of either 0-20 mA. or 4-20 mA.

The analogue output signals can be selected in the data entry mode to be proportional to items from the following list:-

**Dedicated Stream parameters available:**

| | |
|---|---|
| **Hs 1** | Superior heating value Stream 1 |
| **Hs 2** | Superior heating value Stream 2 |
| **Hi 1** | Inferior heating value Stream 1 |
| **Hi 2** | Inferior heating value Stream 2 |
| **Wob.s 1** | Wobbe index (superior) Stream 1 |
| **Wob.s 2** | Wobbe index (superior) Stream 2 |
| **rn 1** | Normal density Stream 1 |
| **rn 2** | Normal density Stream 2 |
| **CO2 1** | Carbon Dioxide Stream 1 |
| **CO2 2** | Carbon Dioxide Stream 2 |
| **N2 1** | Nitrogen from Stream 1 |
| **N2 2** | Nitrogen from Stream 2 |
| **d 1** | Relative density Stream 1 |
| **d 2** | Relative density Stream 2 |

**Stream parameters available from the last stream analysed:**

| | |
|---|---|
| **Hs** | Superior heating value from last stream analysed |
| **Hi** | Inferior heating value from last stream analysed |
| **Wob.s.** | Wobbe index (superior) from last stream analysed |
| **d** | Relative density from last stream analysed. |
| **rn** | Normal density from last stream analysed |
| **C6+** | Hexanes from last stream analysed. |
| **CO2** | Carbon Dioxide from last stream analysed |
| **N2** | Nitrogen from last stream analysed. |
| **Methane** | Methane from last stream analysed. |
| **Ethane** | Ethane from last stream analysed. |
| **Propane** | Propane from last stream analysed. |
| **i-Butan** | i-Butane from last stream analysed. |
| **n-Butan** | n-Butane from last stream analysed. |
| **neo-Pen** | Neo-Pentane from last stream analysed. |
| **i-Penta** | i-Pentane from last stream analysed. |
| **n-Penta** | n-Pentane from last stream analysed. |

All are current output signals of either 0 to 20mA. or 4mA. to 20mA.(this is selected by data entry location **0.0.04**. **Analogue O/P control** (0mA,4mA) and have an overrange capability of 24mA. The maximum load impedance that can be connected to an output to give 24mA. is 600Ω.

Associated with each output are two data entry locations, these are found on pages **0.0.05** to **0.0.08**.

|  |  |
|---|---|
| **O/Px** | selects the function of the output from the above list |
| **O/Px mn** | scales the min. output i.e. 0mA or 4mA. |
| **O/Px mx** | scales the max. output i.e. 20mA. |
|  | Where **x** is the output numbered. 1 to 6 |

The above scaling factors are entered in the same units as the output parameter for example, if the output has been selected to be superior heating value then **O/Px mn** and **O/Px mx** are entered in the units of  as programmed

The values entered for **O/Px mn** and **O/Px mx** must be within the operating range of the parameter selected.

## 2.6        GENERAL ALARM OUTPUT

The general alarm is the combination of the Fault, Accountable alarm and non-accountable alarm. Page **0.0.09** allows the selection of these alarms which can be set to ON or OFF.

The transistor output is operated when any of the selected alarm condition exists.

### 2.6.1        NON-ACCOUNTABLE ALARMS

If an internal printer is installed a non-accountable alarm is given when a printer defect or paper jam is detected. Indication is given by the illumination of the non-accountable alarm LED on the front panel and by showing the alarm identification and time on the alarm pages of the LCD display.

The transistor output is operated when an alarm condition exists.

### 2.6.2        ACCOUNTABLE ALARM INFORMATION

The Control Unit gives alarm indication when any of the following conditions occur:-

   **1)**   C6+ component concentration alarm
   **2)**   Nitrogen component concentration alarm
   **3)**   Methane component concentration alarm
   **4)**   Carbon dioxide component concentration alarm
   **5)**   Ethane component concentration alarm
   **6)**   Propane component concentration alarm
   **7)**   i-Butane component concentration alarm
   **8)**   n-Butane component concentration alarm
   **9)**   neo-Pentane component concentration alarm
   **10)**  i-Pentane component concentration alarm
   **11)**  n-Pentane component concentration alarm
   **12)**  neo-Pentane component concentration alarm
   **13)**  Unknown component alarm
   **14)**  Area alarm
   **15)**  Energy out of range alarm
   **16)**  Relative density out of range alarm
   **17)**  Calibrate has not occurred within a programmed time period.
   **18)**  Response factor difference alarm limits are exceeded (on calibration).
   **19)**  A communication alarm time-out between CU and PGC has occurred.

The alarm LED will remain (latched) on even if the alarm condition has cleared until the Alarm Reset button is pressed. The transistor output is operated only when an alarm condition exists.

### 2.6.3    FAULT

The Control Unit provides continuous self checking during operation. During data entry the data is checked to ensure sufficient  data has been entered in order that correct operation can be achieved. In normal operation the self checking routine tests the memory for data corruption, programme memory, random access memory, communications output, the key switch and the real time clock for correct operation. A watchdog circuit is also provided to detect failure of critical components such as the processor. When a fault occurs the fault LED is illuminated and the fault identification is shown on the alarm pages of the LCD display. The fault output is activated.

The fault alarm transistor output is operated if all of the following conditions occur:-

**1**)    The Control Unit detects insufficient data for normal operation to proceed.
**2**)    The Control Unit detects corruption of stored data.
**3**)    The Control Unit detects a PROM failure.
**4**)    The Control Unit detects a RAM failure.
**5**)    The Control Unit detects a keyswitch failure.
**6**)    The Control Unit detects a real time clock failure.
**7**)    The Control Unit detects a communications failure


### 2.6.4    RATING OF SWITCHED ALARM/FAULT OUTPUTS.

Transistor outputs (open collector)
Maximum continuous voltage                30Vdc.
Maximum continuous current                50mA.


### 2.7    GC CALIBRATION MODE

When the Process Gas Chromatagraph is in the calibration mode, this is indicated by the yellow LED on the Control Unit front panel.

The next listed Calibration Alarms can be activated by the Control Unit:
1.    If a calibration is not performed within the programmed calibration time interval (Cal. Time interval in hours Loc. 0,0,16,0) an accountable Calibration Alarm (Cal Alm) will be activated. If  zero (0) is programmed for Cal. Time interval this alarm function is disabled.
2.    If during a calibration cycle one or more Response Factor limits are exceeded (as programmed by RGC , Edit Alarm menu) a Response Factor Difference Alarm (RF Diff) will be activated. The RF difference alarm can be disabled by the RGC software if in the Edit Alarm menu the RF difference checkbox is not ticked. Remark: RF difference alarms are stream related.

Both the Cal.Alm and RF Diff alarms can activate a ModBus Calibration Alarm bit 6 at ModBus register 3046 depending on the programming of loc. **0.0.16.1** (if set to ON any calibration alarm will be signalized, if set to OFF this function is disabled).

### 2.8    DATA SECURITY IN THE PROCESS GAS CHROMATAGRAPH

The Process Gas Chromatagraph operating data (that can be entered by using the RGC software supplied with the Process Gas Chromatagraph), can be made secure i.e. write protected. The security mode switch 8 sets the security (Write protect) mode either ON or OFF. The position of the switch is indicated in display Page **0.0.00**. When the security mode is set to ON the only data that can be written into the gas chromatagraph is the Time and Date and the SST table parameters. If an attempt is made to write to any other data areas a warning message will be issued by the RGC software. When the Keyswitch is set to the EDIT position the security (write-protect) is overruled.

## 2.9 AUTOMATIC ADJUSTMENT OF RETENTION TIMES

Mode switch Number 7 allows the Adjustment of the retention times in the gas chromatagraph (for components detected in auto-peak mode only) to be either Automatic (ON) or Manual (OFF) . The setting of the mode switch is indicated on display location **0.0.01**. The Gas Chromatagraph operating instructions will give more details of this facility.

## 2.10 PRINTER FACILITY

The Control Unit can be selected to operate without a printer, or with an internal printer or an external printer. Location **5.0.00** is used to set the requirement.

If an external printer is selected then location **5.0.01** is used to set-up the serial data format which can be:-

7 or 8 data bits, parity none, parity odd or even and baud rates of 1200, 2400, 4800 or 9600 with or without CTS handshaking.

If the internal printer is selected the data format is automatically set.

The Control Unit can be selected to print the following reports:-

**On demand:-**
**1**) All displayed data.
**2**) A list of all the programmed data.

**On timed intervals:-**
The interval time can be set to 5, 15 or 30 minutes, 1, 2, 3, 4, 8, 12 or 24 hours.
**1**) All displayed data.
**2**) A list of all the programmed data.

**Automatically printed reports of the following can also be selected:-**
**1**) When an alarm condition occurs, print the alarm data and optionally all displayed data
**2**) All programmed data at power on and after a power supply interrupt with the power on and off times.
**3**) All programmed data after the operation of the key switch with the time of the key switch operation.

**Automatically printed reports:-**

**1**)        At the end of each Analysis a summary report containing Stream analysed, Start time of Analysis, Value of Hs, Value of rn and Value of CO2.

**2**)        At each hour on the hour a report detailing the average values of valid analysis results during the previous hour for all gas components, Hs, wobbe.s and rn.

**3**)        At the contract hour at the start of each day a report detailing the average values of all hourly reports during the previous day for all gas components, Hs, wobbe.s and rn.

**4**)        At the contract hour on the first day of each month a report detailing the average values of all daily reports during the previous month for all gas components, Hs, wobbe.s and rn.

**5**)        At each calibration a calibration report containing Date and Time of Calibration, Calibration stream number, Certificate (reference), Last measured and % difference values for Hs, rn and CO2. A single line of 40 characters of user information can be added to the Calibration report header. This line of text is the first line of Information page No 1 and can be editted on user demand.

The printer operation is set in either the **EDIT** or **DATA** entry mode at locations **5.0.00** to **5.0.03**. Data is changed by moving the cursor to the required position using the scroll keys (**Ý,ß**) then pressing the enter (**E**) key followed by a scroll key until the required function is obtained followed by the enter (**E**) key to confirm the requirement.

## 2.11      SERIAL OUTPUTS  1 AND 2

The Control Unit is provided with two RS232 communication link without handshaking using Modbus ASCII as the data communication protocol. Both these outputs have the same data format. For full details of the data format and addresses see Appendix 4.

## 2.12      SERIAL OUTPUT 3

The Control Unit is provided with a RS232 communication link without handshaking using a data communication protocol in accordance with Gasunie Technical Standard OSC-01-E.  For full details of the data format and addresses see Appendix 5.

## 2.13      SERIAL OUTPUT TO RGC COMPUTER

The Control Unit is provided with a RS232 communication link without handshaking (SKT 9) using the RGC data communication protocol. This allows full operation of the ENCAL 2000 Remote Gas Chromatograph (RGC) through the Control Unit. See RGC users guide for operation.

## 2.14      CONTROL UNIT POWER SUPPLY

### 2.14.1      POWER SUPPLY  24V dc OPERATED VERSION
The nominal 24 Vdc supply is connected to a terminal block located on the rear panel. Adjacent to the terminal block is a fuse rated at 5A. The Control Unit will accept supply voltages in the range 21 Vdc. to 28 Vdc. at a peak current of 4A. when a printer is fitted in the Control Unit and an average current of 1A. without a printer.

## 2.15      REMOTE ANALYSER REVISION
It is possible to activate calibrations and/or testgas runs (stream 3) using The writable modbus registers 65000 and 65001. Writing 1 to modbus register 65000 will activate a CAL 1 cycle and writing 2 will activate a CAL 2 run. The number of CAL runs and CCK runs preceding depends on the programming of the Autocal sequence which is set in the ENCAL 2000 PGC. This can be changed using the RGC 2000 Software.

Writing a 1 to modbus register 65001 will activate stream 3 (which is normally used for a reference gas). This setting will overrule the normal analyser sequence as set in the SST table. The stream 3 can be deactivated by writing a "0" to register 65001.

Reading register 65000 or 65001 will result in either a "0" (if the register is not been written to or a written value to the register has not been –correctly- received) or a "1" if there ís written to the register and the message is received correctly.

**3.0      INSTALLATION**
**3.1      MECHANICAL**

      The outline chassis dimensions are given in figure 3 and provide for mounting in either a panel or standard rack. Under normal ambient conditions no special ventilation requirements are necessary. Where the Control Unit may be subject to high ambient temperatures- e.g. near heat producing apparatus or in direct strong sunlight. Adequate ventilation should be provided. The operating environment should be clean, dry and free from a corrosive atmosphere.

**3.2      SERIAL CONNECTION TO THE PROCESS GAS CHROMATOGRAPH**

      The Control Unit can be connected to the Process Gas Chromatograph using either:

1.   A direct core fibre optic cable (two 1 mm plastic fibres) for connecting the old style ENCAL 2000 Process Gas Chromatograph. Refer to paragraph 3.2.1. for connecting instructions.
     -or-
2.   The ENCAL 2000 RS232 Optical board. The RS232 Optical board is connected to the Control Unit using a 9-wire male D-type cable (1 to 1) from SKT 2 directly to PL1 of the RS232 Optical board. Refer to figure xxxx

**3.2.1      OPTICAL CABLE CONNECTING INSTRUCTIONS**

      The optical cable is terminated at the Control Unit end using Hewlett Packard HFBR-4503/4513 connectors and at the Process Gas Chromatograph end using HFBR-4501/4511 connectors. The maximum length of fibre optic cable should no exceed 30 metres of Hewlett Packard HFBR-RUD--- standard grade cable.

1)   Cut the cable to the required length and separate the two fibres at each end for approximately 5 cm. (2.in.).  Strip off  7mm. (0.3 in.) of the outer jacket.
2)   Place the crimp ring and connector over the end of the cable; the fibre should protrude about 3 mm. (0.1 in.) through the end of the connector.
    Carefully position the ring so that it is entirely over the end of the connector with the ring rim flush with the connector end. Crimp the ring in place with a crimp tool. Note fit the blue connector to the fibre end to be connected to the transmitter and the grey connector to the end connected to the receiver.
3)   The excess fibre protruding from the connector should be trimmed using a scalpel so that a minimum of  0.15 mm. (0.06 in.) extends from the connector.
4)   Use the Hewlett Packard polishing kit HFBR-4593 to polish the fibre ends
    by inserting the connector in the polishing fixture. Using a 600 grit abrasive paper on a smooth flat surface press down on the connector in the fixture and polish the fibre using a figure of eight movement until the fibre is flush with the connector end. Wipe the end of the fibre clean.
5)   Repeat the lapping procedure using  the 3 micron pink lapping film for about 25 strokes. The fibre end should be flat, clean and smooth.
6)   Insert the blue connector into the receiver connector and the grey connector into the transmitter connector of the Process Gas Chromatograph and similarly for the Remote Control Unit .

**3.3      ELECTRICAL**

**3.3.1      POWER SUPPLY 24Vdc OPERATED**

A power supply with a dc. voltage of between 21 V and 28 V is connected to the terminal block on the rear panel of the Control Unit ensuring that the polarity is as marked. Ensure that a 5A fuse is fitted in the fuse holder located above the terminal block.

**3.4      OUTPUT SIGNAL CONNECTIONS**

The output signal connections are via the 9 way 'D' type sockets on the rear panel and the connector pin designation is given in Appendix 3.

A typical connection to a alarm output is shown in fig.5.

**SECTION 4**

**4.0      INITIALISATION**

**4.1      GENERAL**

Before the Control Unit can be operated it is necessary to set the internal mode switches to the required positions in order that the required data and calibration can be carried out. After data entry and calibration the security switches can be set. (see figure 9 for the location of the switches.)

**4.1.1      ACCESS TO INTERNAL SWITCHES**

To gain access to the mode and security switches release the two cross drilled screws located at the top and bottom of the display panel and hinge back the panel to reveal the back of the display circuit board, the switches are located on the back of the display board. When setting the switches, care should be taken to minimise the handling of any circuit board within the Control Unit to avoid the possibility of any electrostatic damage to the integrated circuits.

**4.2      SETTING THE MODE SWITCHES**

Each mode switch is set by pushing the coloured slider to the position required. The functions are given below:-

| Switch No. | ON | OFF |
|---|---|---|
| **1** | Default to first display page after 30 seconds. | Remain on last displayed page |
| **2** | Comms board No 1 fitted. | Comms board No 1 not fitted. |
| **3** | Comms board No 2 fitted. | Comms board No 2 not fitted. |
| **4-6** | Not used | |
| **7**[1] | Auto adj. of Retention times On | Auto adj. of Retention times Off |
| **8**[2] | Remote Access Security On | Remote Access Security Off |
| **9**[3] | Process Gas Chromatograph clock updated from CU clock On | Process Gas Chromatograph clock updated from CU clock Off |
| **10**[3] | CU clock updated from Process Gas Chromatograph clock On | CU clock updated from Process Gas Chromatograph Clock Off |
| **11-12** | Do not use (changing SW12 will clear all programmed data) | |

Note (1)      See par. 2.9

Note (2)      See par. 2.8

Note (3)      See par. 2.4

## 4.3      RGC COMPUTER INPUT

The Control Unit serial port used for connection to the RGC computer uses a data transmission rate of 9600 baud. The computer must be set to 9600 baud  to operate with the Control Unit.

## 4.4      OPERATION

After initialisation of the mode switches the power to the Control Unit is switched on, the operating Data can then be entered into the Control Unit memory as given below.

### 4.4.1      DATA ENTRY

The first time the Control Unit is operated the operating data has to be entered. The Control Unit will prompt the operator for the data required for operation to the selected mode switch settings. The data falls into two categories,  data essential for the Control Unit to calculate flow and data which is optional and may or may not be entered depending on the operator requirements. The mode switch settings are displayed on the Configuration pages at locations **0.0.00** and **0.0.01** the configuration pages are also displayed in the **EDIT** and **RUN** modes

### 4.4.2      ESSENTIAL DATA

Essential data  is requested by the Control Unit by displaying after the parameter to be entered **??????**      Example: **pmax  = ??????**

### 4.4.3      OPTIONAL DATA

Optional data is prompted for by the display showing after the parameter to be entered  -------. If the choice is to use this parameter then the data is entered, if however this parameter function is not required then  the negative sign should be entered which notifies the Control Unit to ignore this parameter.

### 4.4.4      SETTING THE CLOCK

The clock is set at location **0.0.02** the procedure for entering the time parameters is the same as for other data, enter, value, enter. Only the last two digits of the year are set, one or two digits are entered for the month and day, e.g. March is entered as 3. The 24 hour clock is used for hours. The seconds are set to zero when the enter key (**E**) is pressed for the second time when the value of the minutes are set and the clock then starts running. Please refer to par. 2.4 for detailed clock setting options.

**4.5      PROCEDURE FOR ENTERING DATA**

Ensure that the Data security switch SW2 position 1 is set to the OFF position, Set the key switch to the **DATA** position, the Control Unit will show the first page of parameters for which data is require with a flashing cursor against the first parameter to be entered.

To enter the value press the enter key marked **E** followed by the value which will be shown on the display as the digits are pressed, if correct, press the **E** key again to enter the value in memory. Where the parameter requires a selection rather than a value to be entered then press the **E** key followed by a scroll key (**Ý,ß**) until the desired selection is shown then confirm by pressing the **E** key.

Then press the (**ß**) key to advance the cursor to then next parameter, continue this procedure until pressing the  key will not advance the cursor further when all of the data has been entered.  Pressing the  key allows the cursor to be stepped back to previous parameters which may be reviewed or changed using the same data entering procedure. To enter a negative (**-**) which deletes an optional parameter press **E** then **-** followed by **E**. To enter a negative value of temperature press **E** then **-** followed by the value, then **E**.

The Control Unit now has the data to operate and should now be calibrated. The calibration procedure is detailed in the CALIBRATION SECTION (section 5) of this manual. After calibration the security switches should be set.


**4.6      SETTING THE SECURITY SWITCHES.**

Switches are provided to give security of calibration data, editable data and operating data entered via the keyboard. Three switches  are provided, (Cal., Edit and Data) with a security switch in the ON position there is no access to change the data for that function, data can only be changed with the security switch in the OFF position.

The security switch identification is:-

Switch SW2

| Position | ON | OFF |
|---|---|---|
| **1** | Data secure | Data alterable |
| **2** | Edit secure | Edit alterable |
| **3** | Cal. secure | Calibration enabled. |

**Note:** If all three security switches are set to ON then the Control Unit will remain in the **RUN** mode regardless of the key switch setting.

## 4.7        PRINTER UNIT

### 4.7.1        LOADING THE ROLL OF PAPER

Open the front panel by releasing the two knurled screws and hinge the panel downwards. remove the old roll of paper by pulling the rewind handle on the left hand side then pulling the paper from the drum. Remove the spindle from the paper holder, put the new roll onto the spindle with the paper flowing from the top of the roll as shown in figure 12. Clip the spindle into the holder and feed the paper into the bottom of the print mechanism. Press the paper feed button on the front of the printer to advance the paper through the mechanism until the paper comes through the slot in the front of the printer. Pull sufficient paper through to enable it to be inserted into the lower slot and onto the rewind drum, secure the paper with the rewind handle. Refit the front panel.

The paper specification is 57 mm. wide with a roll diameter of 50 mm. and a core diameter of 12.5 mm.

### 4.7.2        REPLACING THE INK CASSETTE

Remove the paper from the printer, see above section.

Remove the two front panel retaining knurled screws completely and separate the outer panel from the printer to reveal the ink cassette.

Remove the used cassette by pressing on the left hand side where marked, which will cause the right-hand side to lift away from the printer mechanism, carefully lift out the cassette.

Push a new cassette into the mechanism the left-hand end first and then push down the right-hand end making sure it clicks into place. if it does not fit easily into place at the right-hand end, turn the small knob on the cassette in the direction marked until it locates.

Refit the paper.

Use ink cassette Epson part No. ERC-09

**SECTION 5**

**5.0      CALIBRATION**

**5.1      OUTPUT SIGNAL CALIBRATION**

**5.1.1      TEST EQUIPMENT**

The calibration procedure given in this section requires the use of the following test equipment:-

**1)**      Digital voltmeter 0 to 4 V dc. range (measurement error less than 0.01% of range).

**2)**      Standard resistor $100\Omega \pm 0.01\Omega$

Connect the test equipment to the Control Unit as shown in figure 6, set the calibration security switch to the off position, turn the key switch to the **CAL** position, the CAL LED will flash.

**5.1.2      OUTPUT SIGNAL CALIBRATION PROCEDURE**

The analogue output signals are calibrated with the key switch set in the calibrate position. The range and zero potentiometers are located on the front edge of the output circuit boards and calibration is carried out in a similar manner for all outputs, see figure 8.

The Control Unit has six analogue outputs, output signals 1 to 3 are from the output board in chassis position 59 and output signals 4 to 6 are from the output board in chassis position 55. The output calibration potentiometers are identified as Z(0mA) and G(20mA). Both output circuit boards are identical except for the link settings as detailed in paragraph 7.3 and figure 8.

The Control Unit generates the calibration signals and no input signal generators are required. The output current is measured by connecting a $100\Omega$ standard resistor across the output being calibrated with a voltmeter across the resistor.

When the key switch is turned to the **CAL** position the LCD display will show the first input to be calibrated, press the scroll key (**ß**) until the Analogue Output page is displayed, locations **2.0.00** or **2.0.01**

An example of the display is given below:-

**Page Location No.**                    **Parameter being calibrated**

```
Loc 2,0,02 Analogue O/P Cal (4-20mA)
O/P1= Normal    O/P1  = 12.345 mA
O/P2=   Set 4    O/P2  =   4.000 mA
O/P3=   Set 20   O/P3  = 20.000 mA
```

**Set output to this value**

### 5.1.3    CALIBRATION PROCEDURE

 a) Set the cursor against the output to be calibrated, press the enter key (E) press a scroll key until **set 4** is shown then press the enter key.

 b) Adjust the Z potentiometer to give an output of  4mA±0.01mA.

 c) Set the cursor against the output to be calibrated, press the enter key (E) press a scroll key until **set 20** is shown then press the enter key.

 d) Adjust the gain potentiometer G until the output is 20mA±0.01mA.

 e) Repeat a) to d) above until the output is within the required limits.

 f) Set the cursor against the output to be calibrated, press the enter key (E) press a scroll key until **normal** is shown then press the enter key.

The output is now calibrated and operational.

If an output range of 0-20 mA. is selected during data entry at location **0.0.04.0** an identical procedure is used.

**6.0      MAINTENANCE**

No routine servicing is required to ensure continuous operation, however should a system failure occur during operation, then the most likely cause of malfunction is that of a requirement not being fully or correctly implemented. If a fault occurs, the cause should be determined in a logical and systematic manner and a guide is given below.

**6.1      INITIAL CHECKS**

1)    Check that the power supply is of the correct type and value.
2)    Check the fuse and that the power supply polarity is correct.
3)    Ensure that all input and output connections to the plugs and sockets at the rear of the Control Unit are satisfactory and the plugs are engaged firmly and in the correct sockets.
4)    Ensure that all of the data entered via the keyboard is correct and that all of the calibration data has been entered and is correct.
5)    Switch off the power to the Control Unit and open the front panel and check that all of the circuit boards are fully engaged in their sockets and are positioned in the correct location.
6)    Carry out a visual inspection of all wires and cables for obvious loose or broken connections.

**6.2      COMPONENT REPLACEMENT**

The remedial action for the failures indicated in the following table will entail in the majority of cases replacement of one or more printed circuit boards. The location of the boards is shown in figure 10. The fault finding list below should be used in conjunction with the alarm and fault codes given in appendix 2.

| | **FAILURE** | **ACTION** |
|---|---|---|
| **1** | Analogue output are inoperative | Replace the output board. |
| **2** | Display indicates FAULT 1 | Insufficient data, re-enter or check all data is entered |
| **3** | Display indicates FAULT 2 | Data corruption, change Micro/memory board. |
| **4** | Display indicates FAULT 3 | Defective RAM, change Micro/memory board. |
| **5** | Display indicates FAULT 4 | Defective PROM, change Micro/memory board. |
| **6** | Display indicates FAULT 8 | Replace key switch. |
| **7** | Display indicates FAULT 9 | Defective real time clock, replace Micro/memory board. |
| **8** | Display indicates FAULT 11 | Comms2 board No.1 is defective |
| **9** | Display indicates FAULT 12 | Comms2 board No.1 is defective |
| **10** | Display indicates FAULT 13 | Comms2 board No.2 is defective |
| **11** | Display indicates FAULT 14 | Comms2 board No.2 is defective |

## SECTION 7

**7.1 REPLACEMENT PARTS**

The following replacement parts are available for maintenance purposes :

| Description | Part No. |
|---|---|
| Micro/memory Board | 700-3-118B |
| Output Board | 700-1-009D |
| DC/DC Converter Board | 210-2-009 |
| Display Board | 740-2-016 |
| Comms 2 Board | 700-3-093 |

When replacement boards are fitted it may be necessary to change the link positions, the following tables show the link functions on the circuit boards where changes may require to be made. All other boards do not have user changeable links.

**7.2 MICRO/MEMORY BOARD LINK SETTINGS**
**CHASSIS POSITION 75**

| LINK FITTED | 2, 5, 6 and 9 |
|---|---|
| LINKS NOT FITTED | 1, 4, 6, 7, 8, 10, 11, 12, 13, 14 and 15 |

See figure 11 for the location of the links.

**Note: If the plastic fibre connection on the backpanel is used link 3 should be fitted instead of link 5.**

**7.3 OUTPUT BOARD LINK SETTINGS**
**CHASSIS POSITIONS 55 AND 59**

| LINK FITTED = X LINK NOT FITTED = O | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| OUTPUT BOARD IN CHASSIS POSITION 55 | O | X | O | O |
| OUTPUT BOARD IN CHASSIS POSITION 59 | X | O | O | O |
| LINKS 5, 6, AND 7 HAVE NO CUSTOMER OPTION AND ARE FITTED | | | | |
| LINK 8 HAS NO CUSTOMER OPTION AND IS NOT FITTED | | | | |
| LINKS 9, 10 AND 11 HAVE NO CUSTOMER OPTION AND ARE FITTED IN POSITION A | | | | |

See figure 8 for the location of the links.

**7.4 COMMS 2 BOARD LINK SETTINGS**

**Note:-** The two Comms 2 boards fitted in the Controller are the same except that the link setting are different, therefore the positions should not be changed without the link settings being set as given in the following tables:-

**CHASSIS POSITIONS 67   (SERIAL COMMS 2 SKT 4 AND PRINTER SKT11)**

| LINK IDENTIFICATION . LINK FITTED = X LINK NOT FITTED = O | J | K | A | B | Y | Z |
|---|---|---|---|---|---|---|
| SERIAL OUTPUT 2 MODBUS ASCII RS485 | X | O | | | | |
| SERIAL OUTPUT 2 MODBUS ASCII RS232 | O | X | | | | |
| PRINTER INTERNAL | | | X | O | | |
| PRINTER EXTERNAL RS232 WITHOUT HANDSHAKING | | | O | X | X | O |
| PRINTER EXTERNAL RS232 WITH HANDSHAKING | | | O | X | O | X |
| LINKS C, G, L, V, X, HH AND KK HAVE NO CUSTOMER OPTION AND ARE FITTED | | | | | | |
| LINKS D, E, F, H, M, N,  P, Q, R, S, T, U, W, AA,  BB, CC, DD, EE, FF, GG, JJ, LL AND MM HAVE NO CUSTOMER OPTION AND ARE  NOT FITTED | | | | | | |

**CHASSIS POSITIONS 71   (SERIAL COMMS 1 SKT 3 AND OSC-01-E SKT 10)**

| LINK IDENTIFICATION . LINK FITTED = X LINK NOT FITTED = O | J | K |
|---|---|---|
| SERIAL OUTPUT 1 MODBUS ASCII RS485 | X | O |
| SERIAL OUTPUT 1 MODBUS ASCII RS232 | O | X |
| FIT LINKS B, C, F, L, P, U, X, Y, AA and HH HAVE NO CUSTOMER OPTION AND ARE FITTED | | |
| LINKS A, D, E, G, H, M, N,Q, R, S, T, V, W, Z, BB, CC, DD, EE, FF, JJ, KK,     LL and MM. HAVE NO CUSTOMER OPTION AND ARE  NOT FITTED | | |

See figure 7 for the location of the links.

## APPENDIX 1

## PARAMETER LOCATION IDENTIFICATION CONFIGURATION of ENCAL 2000 CONTROL UNIT

| Location | Symbol | Function | |
|---|---|---|---|
| 0,0,00,0 | timeout | On or Off | Display returns to Status page=On |
| 0,0,00,1 | board 1 | On or Off | Comms board No. 1 fitted=On |
| 0,0,00,2 | board 2 | On or Off | Comms board No. 2 fitted=On |
| 0,0,00,3 | Anlgue 1 | On or Off | Analogue output board No. 1 fitted=On |
| 0,0,00,4 | Anlgue 2 | On or Off | Analogue output board No. 2 fitted=On |
| 0,0,00,5 | Securty | On or Off | Security Access Mode switch 8 On or Off |
| 0,0,01,0 | Autoadj | On or Off | Auto adjustment of retention times mode switch 7 On or Off |
| 0,0,01,1 | ClkCU>AN | On or Off | Process Gas Chromatograph Clock updated from CU clock mode Switch 9 On or Off |
| 0,0,01,2 | ClkAN>CU | On or Off | CU Clock updated from Process Gas Chromatograph clock mode Switch 10 On or Off |

## DATA ENTRY

| Location | Symbol | Parameter Description |
|---|---|---|
| 0,0,02,0 | Year | Set Clock Year |
| 0,0,02,1 | Month | Set Clock Month |
| 0,0,02,2 | Day | Set Clock Day |
| 0,0,02,3 | Hour | Set Clock Hour |
| 0,0,02,4 | Minute | Set Clock Minute |
| 0,0,02,5 | Day 1-7 | Set Day of the week (Sunday = 1) |

## Miscellaneous

| Location | Symbol | Parameter Description |
|---|---|---|
| 0,0,03,0 | SN | Station or Serial Number |
| 0,0,03,1 | Dens. air | Density of air at base conditions |
| 0,0,03,2 | ctrct hr | Start of Day Hour (used for AVG calculations) |

## Analogue O/P Control

| Location | Symbol | Parameter Description |
|---|---|---|
| 0,0,04,0 | 0mA,4mA | Analogue o/p  0-20mA or 4-20mA |

## Analogue O/P Control

| Location | Symbol | Parameter Description |
|---|---|---|
| 0,0,05,0 | O/P 1 | Selects function of Analog O/P 1 from list |
| 0,0,05,2 | O/P 1mn | Min Value for O/P 1 ie 0,4mA= this value |
| 0,0,05,4 | O/P 1mx | Max Value for O/P1 ie 20mA= this value |
| 0,0,05,1 | O/P 2 | Selects function of Analog O/P2 from list |
| 0,0,05,3 | O/P 2mn | Min Value for O/P 2 ie 0,4mA= this value |
| 0,0,05,5 | O/P 2mx | Max Value for O/P2 ie 20mA= this value |

## Analogue O/P Control

| Location | Symbol | Parameter Description |
|---|---|---|
| 0,0,06,0 | O/P 3 | Selects function of Analog O/P 3 from list |
| 0,0,06,2 | O/P 3mn | Min Value for O/P 3 ie 0,4mA= this value |
| 0,0,06,4 | O/P 3mx | Max Value for O/P3 ie 20mA= this value |

**Analogue O/P Control**

| | | | |
|---|---|---|---|
| 0,0,07,1 | O/P 4 | | Selects function of Analog O/P 4 from list |
| 0,0,07,3 | O/P 4mn | | Min Value for O/P 4 ie 0,4mA= this value |
| 0,0,07,5 | O/P 4mx | | Max Value for O/P4 ie 20mA= this value |
| 0,0,07,0 | O/P 5 | | Selects function of Analogue O/P 5 from list |
| 0,0,07,2 | O/P 5mn | | Min Value for O/P 5 ie 0,4mA= this value |
| 0,0,07,4 | O/P 5mx | | Max Value for O/P5 ie 20mA= this value |

**Analogue O/P Control**

| | | | |
|---|---|---|---|
| 0,0,08,1 | O/P 6 | | Selects function of Analogue O/P 6 from list |
| 0,0,08,3 | O/P 6mn | | Min Value for O/P 6 ie 0,4mA= this value |
| 0,0,08,5 | O/P 6mx | | Max Value for O/P6 ie 20mA= this value |

**General Alarm Output**

| | | | |
|---|---|---|---|
| 0,0,09,0 | Fault | ON or OFF | Fault operates general alarm output |
| 0,0,09,1 | ac. Alm | ON or OFF | Accountable alarm operates general alarm output |
| 0,0,09,2 | n.ac Alm | ON or OFF | Non-accountable alarm operates general alarm output |

**Information**

0,0,10      120 characters of information

**Information**

0,0,12      120 characters of information

**Information**

0,0,14      120 characters of information

**Cal. Config**

| | | | |
|---|---|---|---|
| 0,0,16,0 | Cal time | | Calibrate alarm time interval in hours |
| 0,0,16,1 | MB C.alm | ON or OFF | MobBus register 3046 (bit 6) calibration alarm ON = enabled, OFF = disabled |

**Unit Type (Heating value)**

0,0,17,0   Units      kWh/m3, MJ/m3, kCal/m3 or kJ/m3

**DISPLAYED PARAMETERS**

| Location | Symbol | Parameter Description |
|---|---|---|

**DISPLAY 1**
**STATUS**

| | | |
|---|---|---|
| 1,0,00,0 | Time | Time in second into the current analysis |
| 1,0,00,1 | Stream | The number of the stream currently being analysed |
| 1,0,00,2 | Next | The next analysis operation |
| 1,0,00,3 | TSC | The function being carried out in the TSC table |
| 1,0,00,4 | State | The state of the data being communicated between the Process Gas Chromatograph and the Control Unit |
| 1,0,00,5 | Mode | The mode of operation |

**ENERGY :ST 1**

| | | |
|---|---|---|
| 1,0,01,0 | Hs. | Superior heating value Stream 1 |
| 1,0,01,1 | Hi. | Inferior heating value Stream 1 |

**ENERGY :ST 2**

| | | |
|---|---|---|
| 1,0,02,0 | Hs. | Superior heating value Stream 2 |
| 1,0,02,1 | Hi. | Inferior heating value Stream 2 |

**WOBBE :ST 1**

| | | |
|---|---|---|
| 1,0,03,0 | Wobbe.s | Superior wobbe value Stream 1 |
| 1,0,03,1 | Wobbe.i | Inferior wobbe value Stream 1 |

**WOBBE :ST 2**

| | | |
|---|---|---|
| 1,0,04,0 | Wobbe.s | Superior wobbe value Stream 2 |
| 1,0,04,1 | Wobbe.i | Inferior wobbe value Stream 2 |

**DENSITY :ST 1**

| | | |
|---|---|---|
| 1,0,05,0 | d | Relative density value Stream 1 |
| 1,0,05,1 | rn | Normal density value Stream 1 |

**DENSITY :ST 2**

| | | |
|---|---|---|
| 1,0,06,0 | d | Relative density value Stream 2 |
| 1,0,06,1 | rn | Normal density value Stream 2 |

Note :    On all of the following pages the Current Stream Number will be indicated on the top Line as    **:ST X**          where X= Stream Number

**CONC.:ST X**

| | | |
|---|---|---|
| 1,0,07,0 | C6+ | Normalized concentration of C6+ components |
| 1,0,07,1 | N2 | Normalized concentration of nitrogen |
| 1,0,07,2 | Methane | Normalized concentration of methane |

**CONC.:ST X**

| | | |
|---|---|---|
| 1,0,08,0 | CO2 | Normalized concentration of carbon dioxide |
| 1,0,08,1 | Ethane | Normalized concentration of ethane |
| 1,0,08,2 | Propane | Normalized concentration of propane |

**CONC.:ST X**

| | | |
|---|---|---|
| 1,0,09,0 | i-Butne | Normalized concentration of i-butane |
| 1,0,09,1 | n-Butne | Normalized concentration of n-butane |
| 1,0,09,2 | neo-Pen | Normalized concentration of neo-pentane |

**CONC.:ST X**

| | | |
|---|---|---|
| 1,0,10,0 | i-Pent | Normalized concentration of i-pentane |
| 1,0,10,1 | n-Pent | Normalized concentration of n-pentane |

**NON-MEASURED :ST X**

| | | |
|---|---|---|
| 1,0,11,0 | H2 | Non-measured percentage of hydrogen |
| 1,0,11,1 | Helium | Non-measured percentage of helium |
| 1,0,11,2 | Oxygen | Non-measured percentage of oxygen |

**NON-MEASURED :ST X**

| | | |
|---|---|---|
| 1,0,12,0 | CO | Non-measured percentage of carbon monoxide |

**AVG.CUR.HR :ST 1**

| | | |
|---|---|---|
| 1,0,13,0 | CO2 | Average value of Mol % CO2 Stream 1 in current hour |
| 1,0,13,1 | rn | Average value of rn in Stream 1 current hour |
| 1,0,13,2 | Hs | Average value of Hs in Stream 1 current hour |

**AVG.CUR.HR :ST 2**

| | | |
|---|---|---|
| 1,0,14,0 | CO2 | Average value of Mol % CO2 Stream 2 in current hour |
| 1,0,14,1 | rn | Average value of rn Stream 2 in current hour |
| 1,0,14,2 | Hs | Average value of Hs Stream 2 in current hour |

**AVG.LST.HR :ST 1**

| | | |
|---|---|---|
| 1,0,15,0 | CO2 | Average value of Mol % CO2 Stream 1 in previous hour |
| 1,0,15,1 | rn | Average value of rn in Stream 1 previous hour |
| 1,0,15,2 | Hs | Average value of Hs in Stream 1 previous hour |

**AVG.LST.HR :ST 2**

| | | |
|---|---|---|
| 1,0,16,0 | CO2 | Average value of Mol % CO2 Stream 2 in previous hour |
| 1,0,16,1 | rn | Average value of rn Stream 2 in previous hour |
| 1,0,16,2 | Hs | Average value of Hs Stream 2 in previous hour |

**AVG.CUR.DAY :ST 1**

| | | |
|---|---|---|
| 1,0,17,0 | CO2 | Average value of Mol % CO2 Stream 1 in current day |
| 1,0,17,1 | rn | Average value of rn in Stream 1 current day |
| 1,0,17,2 | Hs | Average value of Hs in Stream 1 current day |

**AVG.CUR.DAY :ST 2**

| | | |
|---|---|---|
| 1,0,18,0 | CO2 | Average value of Mol % CO2 Stream 2 in current day |
| 1,0,18,1 | rn | Average value of rn Stream 2 in current day |
| 1,0,18,2 | Hs | Average value of Hs Stream 2 in current day |

**AVG.LST.DAY :ST 1**
1,0,19,0   CO2          Average value of Mol % $CO_2$ Stream 1 in previous day
1,0,19,1   rn           Average value of rn in Stream 1 previous day
1,0,19,2   Hs           Average value of Hs in Stream 1 previous day

**AVG.LST.DAY :ST 2**
1,0,20,0   CO2          Average value of Mol % $CO_2$ Stream 2 in previous day
1,0,20,1   rn           Average value of rn Stream 2 in previous day
1,0,20,2   Hs           Average value of Hs Stream 2 in previous day

**AVG.CUR.MON :ST 1**
1,0,21,0   CO2          Average value of Mol % $CO_2$ Stream 1 in current month
1,0,21,1   rn           Average value of rn in Stream 1 current month
1,0,21,2   Hs           Average value of Hs in Stream 1 current month

**AVG.CUR.MON :ST 2**
1,0,22,0   CO2          Average value of Mol % $CO_2$ Stream 2 in current month
1,0,22,1   rn           Average value of rn Stream 2 in current month
1,0,22,2   Hs           Average value of Hs Stream 2 in current month

**AVG.LST.MON :ST 1**
1,0,23,0   CO2          Average value of Mol % $CO_2$ Stream 1 in previous month
1,0,23,1   rn           Average value of rn in Stream 1 previous month
1,0,23,2   Hs           Average value of Hs in Stream 1 previous month

**AVG.LST.MON :ST 2**
1,0,24,0   CO2          Average value of Mol % $CO_2$ Stream 2 in previous month
1,0,24,1   rn           Average value of rn Stream 2 in previous month
1,0,24,2   Hs           Average value of Hs Stream 2 in previous month

**DISPLAY 2**
**STATUS**
| | | |
|---|---|---|
| 1,0,25,0 | Time | Time in second into the current analysis |
| 1,0,25,1 | Stream | The number of the stream currently being analysed |
| 1,0,25,2 | Next | The next analysis operation |
| 1,0,25,3 | TSC | The function being carried out in the TSC table |
| 1,0,25,4 | State | The state of the data being communicated between the Process Gas Chromatograph and the Control Unit |
| 1,0,25,5 | Mode | The mode of operation |

**STATUS :ST X**
| | | |
|---|---|---|
| 1,0,26,0 | Str Date | Start of last analysis date |
| 1,0,26,1 | Str Time | Start of last analysis time |
| 1,0,26,2 | End Date | End of last analysis date |
| 1,0,26,3 | End Time | End of last analysis time |
| 1,0,26,4 | Cal Date | Last calibration gas analysis date |
| 1,0,26,5 | Cal Time | Last calibration gas analysis time |

**DETAILS :ST X**
| | | |
|---|---|---|
| 1,0,27,0 | Unnor. Sum | Unnormalised sum |
| 1,0,27,1 | Z | Gas compressibility factor |

**C6+ :ST X**
| | | |
|---|---|---|
| 1,0,28,0 | Time | Retention time for C6+ components |
| 1,0,28,1 | Area | Peak area of C6+ |
| 1,0,28,2 | RF | Response factor for C6+ |
| 1,0,28,3 | Conc | Concentration of C6+ components |
| 1,0,28,4 | Energy | Superior energy content of C6+ |
| 1,0,28,5 | Density | Density of C6+ |

**NITROGEN :ST X**
| | | |
|---|---|---|
| 1,0,29,0 | Time | Retention time for Nitrogen components |
| 1,0,29,1 | Area | Peak area of Nitrogen |
| 1,0,29,2 | RF | Response factor for Nitrogen |
| 1,0,29,3 | Conc | Concentration of Nitrogen components |
| 1,0,29,4 | Energy | Superior energy content of Nitrogen |
| 1,0,29,5 | Density | Density of Nitrogen |

**METHANE :ST X**
| | | |
|---|---|---|
| 1,0,30,0 | Time | Retention time for Methane components |
| 1,0,30,1 | Area | Peak area of Methane |
| 1,0,30,2 | RF | Response factor for Methane |
| 1,0,30,3 | Conc | Concentration of Methane components |
| 1,0,30,4 | Energy | Superior energy content of Methane |
| 1,0,30,5 | Density | Density of Methane |

**CO2 :ST X**

| | | |
|---|---|---|
| 1,0,31,0 | Time | Retention time for Carbon dioxide components |
| 1,0,31,1 | Area | Peak area of Carbon dioxide |
| 1,0,31,2 | RF | Response factor for Carbon dioxide |
| 1,0,31,3 | Conc | Concentration of Carbon dioxide components |
| 1,0,31,4 | Energy | Superior energy content of Carbon dioxide |
| 1,0,31,5 | Density | Density of Carbon dioxide |

**ETHANE :ST X**

| | | |
|---|---|---|
| 1,0,32,0 | Time | Retention time for Ethane components |
| 1,0,32,1 | Area | Peak area of Ethane |
| 1,0,32,2 | RF | Response factor for Ethane |
| 1,0,32,3 | Conc | Concentration of Ethane components |
| 1,0,32,4 | Energy | Superior energy content of Ethane |
| 1,0,32,5 | Density | Density of Ethane |

**PROPANE :ST X**

| | | |
|---|---|---|
| 1,0,33,0 | Time | Retention time for Propane components |
| 1,0,33,1 | Area | Peak area of Propane |
| 1,0,33,2 | RF | Response factor for Propane |
| 1,0,33,3 | Conc | Concentration of Propane components |
| 1,0,33,4 | Energy | Superior energy content of Propane |
| 1,0,33,5 | Density | Density of Propane |

**I-BUTANE :ST X**

| | | |
|---|---|---|
| 1,0,34,0 | Time | Retention time for i-Butane components |
| 1,0,34,1 | Area | Peak area of i-Butane |
| 1,0,34,2 | RF | Response factor for i-Butane |
| 1,0,34,3 | Conc | Concentration of i-Butane components |
| 1,0,34,4 | Energy | Superior energy content of i-Butane |
| 1,0,34,5 | Density | Density of i-Butane |

**N-BUTANE :ST X**

| | | |
|---|---|---|
| 1,0,35,0 | Time | Retention time for n-Butane components |
| 1,0,35,1 | Area | Peak area of n-Butane |
| 1,0,35,2 | RF | Response factor for n-Butane |
| 1,0,35,3 | Conc | Concentration of n-Butane components |
| 1,0,35,4 | Energy | Superior energy content of n-Butane |
| 1,0,35,5 | Density | Density of n-Butane |

**NEO-PENTANE :ST X**

| | | |
|---|---|---|
| 1,0,36,0 | Time | Retention time for neo-Pentane components |
| 1,0,36,1 | Area | Peak area of neo-Pentane |
| 1,0,36,2 | RF | Response factor for neo-Pentane |
| 1,0,36,3 | Conc | Concentration of neo-Pentane components |
| 1,0,36,4 | Energy | Superior energy content of neo-Pentane |
| 1,0,36,5 | Density | Density of neo-Pentane |

**I-PENTANE :ST X**

| Location | Symbol | Parameter Description |
|---|---|---|
| 1,0,37,0 | Time | Retention time for i-Pentane components |
| 1,0,37,1 | Area | Peak area of i-Pentane |
| 1,0,37,2 | RF | Response factor for i-Pentane |
| 1,0,37,3 | Conc | Concentration of i-Pentane components |
| 1,0,37,4 | Energy | Superior energy content of i-Pentane |
| 1,0,37,5 | Density | Density of i-Pentane |

**N-PENTANE :ST X**

| Location | Symbol | Parameter Description |
|---|---|---|
| 1,0,38,0 | Time | Retention time for n-Pentane components |
| 1,0,38,1 | Area | Peak area of n-Pentane |
| 1,0,38,2 | RF | Response factor for n-Pentane |
| 1,0,38,3 | Conc | Concentration of n-Pentane components |
| 1,0,38,4 | Energy | Superior energy content of n-Pentane |
| 1,0,38,5 | Density | Density of n-Pentane |

**CALIBRATION DATA**

**Location Symbol      Parameter Description**
**Analogue O/P Calibration**

| Location | Symbol | Parameter Description |
|---|---|---|
| 2,0,00,0 | O/P1 | normal, set 4mA or set 20mA |
| 2,0,00,1 | O/P2 | normal, set 4mA or set 20mA |
| 2,0,00,2 | O/P3 | normal, set 4mA or set 20mA |
| 2,0,01,0 | O/P4 | normal, set 4mA or set 20mA |
| 2,0,01,1 | O/P5 | normal, set 4mA or set 20mA |
| 2,0,01,2 | O/P6 | normal, set 4mA or set 20mA |

**PRINTER DATA**

| Location | | Parameter Description |
|---|---|---|

**Printer Type**

5,0,00,0   Printer = Int, Ext or Off   Internal, External or Off

**If External**

| 5,0,01,0 | Baud | 9600, 4800, 2400, 1200 |
| 5,0,01,1 | Data | 7 or 8 data bits |
| 5,0,01,2 | Parity | None, Odd or Even |
| 5,0,01,3 | Cts | OFF or needed |

**Internal or external printer**

| 5,0,02,0 | Interval | Print interval |
| 5,0,02,1 | Start | Start print time |
| 5,0,02,2 | Last | Last print time |
| 5,0,02,3 | Next | Next print time |

**Printer Functions**

| 5,0,03,0 | P-Keysw | Print on Keyswitch Operation On/Off |
| 5,0,03,1 | P-Pwr on | Print on Power On On/Off |
| 5,0,03,2 | P-Alarm | Print on Alarm On/Off |
| 5,0,03,3 | P-Disp | Print all Display Parameters on Alarm On/Off |

**Communications Port osc-01-e**

| 5,0,04,0 | Baud | 9600, 4800, 2400, 1200 |
| 5,0,04,1 | Data | 7 or 8 data bits |
| 5,0,04,2 | Parity | None, Odd or Even |

**Communications Port  Modbus 1**

| 5,0,05,0 | Baud | 9600, 4800, 2400, 1200 |
| 5,0,05,1 | Data | 7 or 8 data bits |
| 5,0,05,2 | Parity | None, Odd or Even |
| 5,0,05.3 | MB id | Control Unit identification number for serial communication |

**Communications Port  Modbus 2**

| 5,0,06,0 | Baud | 9600, 4800, 2400, 1200 |
| 5,0,06,1 | Data | 7 or 8 data bits |
| 5,0,06,2 | Parity | None, Odd or Even |
| 5,0,06.3 | MB id | Control Unit identification number for serial communication |

**ALARM AND FAULT CODES**

The alarm and fault codes shown on the display when the alarm pages are selected

The first eight digits define the code for any alarm or fault condition which exists and identifies the condition and state of the contributing parameter.

Digit 1 will be either an **N, C** or **F** identifying an NON-ACCOUNTABLE ALARM, ACCOUNTABLE ALARM or FAULT condition. (if a fault occurs digits 1 to 5 spell FAULT)

Digit 2 will be either a blank space or letter **A**.

Digits 3, 4 and 5 give the parameter code or are letters ULT.

Digit 6 is a blank space.

Digits 7 and 8 are either **Hi**, **Lo** or numbers **1** to **12**

**PARAMETER SYMBOLS FOR NON-ACCOUNTABLE ALARMS (N)**
**N PRINT**  Defective printer or paper jam

**PARAMETER SYMBOLS FOR ACCOUNTABLE ALARMS (C)**

| | |
|---|---|
| **C6+** | C6+ component concentration alarm |
| **N2** | Nitrogen component concentration alarm |
| **Methan** | Methane component concentration alarm |
| **CO2** | Carbon dioxide component concentration alarm |
| **Ethane** | Ethane component concentration alarm |
| **Propan** | Propane component concentration alarm |
| **i Butan** | i-Butane component concentration alarm |
| **n Butan** | n-Butane component concentration alarm |
| **neo Pen** | neo-Pentane component concentration alarm |
| **I Pentn** | i-Pentane component concentration alarm |
| **n Pentn** | n-Pentane component concentration alarm |
| **Unknown** | Unknown component alarm |
| **Area** | Area alarm |
| **Energy** | Energy out of range |
| **SG** | SG or relative density out of range |
| **G Comms** | Communication to Process Gas Chromatograph has failed |
| **Cal Alm** | Calibrate time period exceeded |
| **RF diff** | RF difference limits exceeded during calibration |

**FAULT CODES**

When an operational fault occurs the display indicates **FAULT** followed by the numbers **1** to **14** identifying the cause of the fault, the time of the fault is given if the failure allows the Control Unit to continue operating.

**FAULT 1**        Insufficient data has been entered to allow normal operation to proceed.

**FAULT 2**        The data stored in memory has been corrupted.

**FAULT 3**        The RAM memory is defective.

**FAULT 4**        The PROM programme memory is defective..

**FAULT 8**        The keyswitch is defective.

**FAULT 9**        A defect has occurred in the real time clock circuit.

**FAULT 11**      The  Comms 2 communications board No.1 is defective.

**FAULT 12**      The  Comms 2 communications board No.1 is defective.

**FAULT 13**      The  Comms 2 communications board No.2 is defective.

**FAULT 14**      The  Comms 2 communications board No.2 is defective.

# CONNECTOR PIN IDENTIFICATION FOR INPUT AND OUTPUT SIGNALS

| SOCKET No SKT 2 | SERIAL COMMS. PORT TO PGC 2000 |
|---|---|
| **D type Pin No.** | **FUNCTION** |
| 1 | power supply +24 VDC (for fibre module) |
| 2 | RS232 RxD |
| 3 | RS232 TxD |
| 4 | not to be used |
| 5 | RS232 Common 0V |
| 6 | not to be used |
| 7 | not to be used |
| 8 | not to be used |
| 9 | not to be used |

| SOCKET No SKT 3 | RS232 MODBUS ASCII COMMS. PORT No.1 |
|---|---|
| **D type Pin No.** | **FUNCTION** |
| 1 | Latch input |
| 2 | No.1 RS232 RxD |
| 3 | No.1 RS232 TxD |
| 4 | not to be used |
| 5 | RS232 Common 0V |
| 6 | not to be used |
| 7 | No.1 RS232 RTS |
| 8 | No.1 RS232 CTS |
| 9 | not to be used |

| SOCKET No SKT 4 | RS232 MODBUS ASCII COMMS. PORT No.2 |
|---|---|
| **D type Pin No.** | **FUNCTION** |
| 1 | Latch input |
| 2 | No.2 RS232 RxD |
| 3 | No.2 RS232 TxD |
| 4 | not to be used |
| 5 | RS232 Common 0V |
| 6 | not to be used |
| 7 | No.2 RS232 RTS |
| 8 | No.2 RS232 CTS |
| 9 | not to be used |

| SOCKET No SKT 5 | OUTPUT ALARM SIGNALS |
|---|---|
| **D type Pin No.** | **FUNCTION** |
| 1 | Fault |
| 2 | Non-accountable Alarm |
| 3 | not to be used |
| 4 | Power Supply 0V |
| 5 | Power Supply +24V |
| 6 | Accountable Alarm |
| 7 | General Alarm |
| 8 | not to be used |
| 9 | not to be used |

Encal 2000 CU V3.0
ISM/01-04-2003

| SOCKET No SKT 6 | ANALOGUE OUTPUT SIGNALS |
| D type Pin No. | FUNCTION |
| 1 | Analogue Output No. 6 |
| 2 | Analogue Output No. 4 |
| 3 | Analogue Output No. 2 |
| 4 | Power Supply 0V |
| 5 | Power Supply +24V |
| 6 | Analogue Output No. 5 |
| 7 | Analogue Output No. 3 |
| 8 | Analogue Output No. 1 |
| 9 | not to be used |

| SOCKET No SKT 7 | OUTPUT ALARM SIGNALS |
| D type Pin No. | FUNCTION |
| 1 | Fault |
| 2 | Non-accountable Alarm |
| 3 | not to be used |
| 4 | Power Supply 0V |
| 5 | Power Supply +24V |
| 6 | Accountable Alarm |
| 7 | General Alarm |
| 8 | not to be used |
| 9 | not to be used |

| SOCKET No SKT 9 | RGC COMMS. PORT (TO RGC PC) |
| D type Pin No. | FUNCTION |
| 1 | not to be used |
| 2 | RS232 RxD  RGC |
| 3 | RS232 TxD  RGC |
| 4 | not to be used |
| 5 | RS232 0V Common |
| 6 | not to be used |
| 7 | not to be used |
| 8 | not to be used |
| 9 | not to be used |

| SOCKET No SKT 10 | SERIAL OSC-01-E GASUNIE PROTOCOL PORT |
| D type Pin No. | FUNCTION |
| 1 | not to be used |
| 2 | RS232 RxD  OSC |
| 3 | RS232 RxD  OSC |
| 4 | not to be used |
| 5 | RS232 0V Common |
| 6 | not to be used |
| 7 | not to be used |
| 8 | not to be used |
| 9 | not to be used |

| SOCKET No SKT 11 | SERIAL PRINTER PORT |

| D type Pin No. | FUNCTION |
|---|---|
| 1 | TTL Printer CTS |
| 2 | RS232 Printer RxD |
| 3 | RS232 Printer TxD |
| 4 | not to be used |
| 5 | RS232 0V Common |
| 6 | TTL Printer TxD |
| 7 | not to be used |
| 8 | RS232 Printer CTS |
| 9 | not to be used |

| SOCKET No SKT 14 | NO FUNCTION |
|---|---|
| D type Pin No. | FUNCTION |
| 1 | not to be used |
| 2 | not to be used |
| 3 | not to be used |
| 4 | Power Supply 0V |
| 5 | Power Supply +24V |
| 6 | not to be used |
| 7 | not to be used |
| 8 | not to be used |
| 9 | not to be used |

| SOCKET No SKT 15 | NO FUNCTION |
|---|---|
| D type Pin No. | FUNCTION |
| 1 | not to be used |
| 2 | not to be used |
| 3 | not to be used |
| 4 | Power Supply 0V |
| 5 | Power Supply +24V |
| 6 | not to be used |
| 7 | not to be used |
| 8 | not to be used |
| 9 | not to be used |

## POWER SUPPLY TERMINALS

| 24V | 24 Vdc positive power supply terminal |
|---|---|
| E | Earth connection terminal to signal cable screens |
| 0V | Power supply 0V negative terminal |
| ⏚ | Chassis Earth connection screw |

# APPENDIX 4

**MODBUS COMMUNICATION PORTS No.1 AND No. 2  SERIAL OUTPUT**

The Controller is provided with a two RS232 communication link without handshaking using a ASCII Modbus data communication protocol

## A4.1     COMMUNICATIONS  PACKET DEFINITIONS

**1)** Read requests
   **:KK03ssssnnnnLL<CRLF>**

**2)** Write requests
   :**KK10ssssnnnnbb<DATA>LL<CRLF>**

**Where:**
**a) :** (colon) is an ASCII colon character , all characters before this are ignored except <CRLF>

**b) KK** is the Control Unit identification number this must be set to the identification number of the model ENCAL 2000 Control Unit

**c) 03**hex is the Modbus code "Read multiple registers"

**d) 10**hex is the Modbus code "Preset multiple registers"

**e) ssss** is the start address in the range 0000 to FFFF (0 to 63535 decimal). This corresponds to the 5 digit Control Unit locations, see APPENDIX 1

**f) nnnn** is the number of registers in the range 0001 to 001F (1 to 31 decimal)

**g) bb** is the number of bytes to be transferred In this Control Unit this will always be **nnnn** multiplied by 8.

**h) LL** is the LRC a checksum formed by adding the bytes represented by each pair of hex. digits and then subtracting the result from 0 , modulo 256

**i) <DATA>** data nnnn items 16 ASCII characters (8 bytes) each

**j) <CRLF>** Carriage return ,line feed in ASCII i.e. 0DH and 0AH

## A4.2     CONTROL UNIT COMMUNICATION RESPONSES
The Control Unit response to the above packets is as follows:-

**i)** Valid Read Requests:
   **:KK03bb<DATA>LL<CRLF**
   all definitions as above

**ii)** Valid Write Requests:
   **:KK10ssssnnnnLL<CRLF>**
   all definitions as above

**iii)** Invalid Read Requests
   **:KK83ccLL<CRLF>**
   all definitions as above except **cc** which is an error code this can be:

**1)**      01 The message function received is not an allowable action, it is allowable to read (03hex) all addresses in the range 0-FFFFH (0-65535) and it is allowable to write (10hex) to addresses in the range FFFB (65531) to FFFFH (65535) in the ENCAL 2000 Control Unit. This code will be returned if the ENCAL 2000 Control Unit is in the data entry mode.

**2)**      04 The ENCAL 2000 Control Unit that was addressed has failed to respond. i.e. The ENCAL 2000 Control Unit was not powered.

**iv)** Invalid Write Requests
**:KK90ccLL<CRLF>**
all definitions as above .

**v)** Nothing
No reply will be received if either the request contains less than 17 characters, or a request packet that does not contain valid hex characters is received or the checksum is invalid.

## A4.3     DATA FORMAT

When a valid **READ** request is received or a valid **WRITE** transmitted then the data format will be in the form of 8 bytes (64 BIT) per register ,represented as 16 ASCII hex digits with the following data format:

**i)** Floating point IEEE 64 bit double precision (double float ) value MSB first
**ii)** Integer 64 bit binary (double long) value MSB first.
**iii)** Strings sent as integers see Paragraph A4.6
**iv)** Date and time sent as a specially defined String

## A4.4     REGISTERS THAT CAN BE WRITTEN

Data that can be written into the ENCAL 2000 Control Unit is a s follows:-.

**Time and Date**

Location 65535 (FFFFhex)          Time and Date(Format as follows)

8byte string converted into 16 ASCII bytes as with all numbers where the year number is the LSB

|       |          |                |                    |
|-------|----------|----------------|--------------------|
| i)    | Year     | <=99           |                    |
| ii)   | Month    | >=1 and <=12   |                    |
| iii)  | Day      | >=1 and <=31   |                    |
| iv)   | Hour     | <=23           | where 0 = midnight |
| v)    | Min.     | <=59           |                    |
| vi)   | Sec.     | <=59           |                    |
| vii)  | Week Day | <=7            | where 1 = Sunday   |
| vii)  | Spare not used. |         |                    |

**Remote revision**

It is possible to activate calibrations and/or testgas runs (stream 3) using The writable modbus registers 65000 and 65001. Writing 1 to modbus register 65000 will activate a CAL 1 cycle and writing 2 will activate a CAL 2 run. The number of CAL runs and CCK runs preceding depends on the programming of the Autocal sequence which is set in the ENCAL 2000 PGC. This can be changed using the RGC 2000 Software.

Writing a 1 to modbus register 65001 will activate stream 3 (which is normally used for a reference gas). This setting will overrule the normal analyser sequence as set in the SST table. The stream 3 can be deactivated by writing a "0" to register 65001

## A4.5 REGISTER ADDRESSES THAT CAN BE READ

The ENCAL 2000 Control Unit location numbers may very easily be translated into register addresses for communication purposes. For Data entry and Display variables the 5 digit location number is used see APPENDIX 1. with leading zeros removed

Address 65535 FFFFhex has a special function .When read it returns the machine configuration i.e. the mode switch settings. The last 12 bits show the mode switch settings i.e. bit set = ON and not set = OFF. however only switches used are shown.

Edit pages that start 3 are not available via the communication port . Any attempt to read from unused addresses will result in -1.0E+38 being returned.

Error pages those addresses starting with a 6 have a format as follows, It is a contiguous block of 24 20-register messages corresponding to the maximum 24 Error locations **6.0.00.0** to **6.0.47.9** each message consists of one of each of the following 20 items.

### i) Error code: CONTROL UNIT

| | |
|---|---|
| 0000 | No error |
| 0001 | Internal error or Fault 1 |
| 0002 | Fault 2 |
| 0003 | Fault 3 |
| 0004 | Fault 4 |
| 0008 | Fault 8 |
| 0009 | Fault 9 |
| 0011 | Fault 11 |
| 0012 | Fault 12 |
| 0013 | Fault 13 |
| 0014 | Fault 14 |
| 0100 | Unknown alarm |
| 0101 | Area alarm |
| 0102 | Energy alarm |
| 0103 | SG or Relative Density alarm |
| 0105 | Oven Temperature alarm |
| 0106 | C6+ component alarm |
| 0107 | Nitrogen component alarm |
| 0108 | methane component alarm |
| 0109 | CO2 component alarm |
| 0110 | ethane component alarm |
| 0111 | propane component alarm |
| 0112 | i-butane component alarm |
| 0113 | n-butane component alarm |
| 0114 | neo pentane component alarm |
| 0115 | i-pentane component alarm |
| 0116 | n-pentane component alarm |
| 0117 | Process Gas Chromatograph Comms alarm |
| 0118 | Calibration alarm (Cal. Interval Time) |
| 0119 | Calibration RF Difference Alarm |

**ii)        Error ON date**

This is always 16 bytes in the following format:

    **a)**        0000000000
    **b)**        Year No 0 to 99
    **c)**        Month No 1 to 12
    **d)**        Day No 1 to 31

If the error code is 0 then all the above will be 0

**iii)        Error ON time**

This is always 16 bytes in the following format

    **a)**        0000000000
    **b)**        Hour No 0 to 23
    **c)**        Minute No 0 to 59
    **d)**        00

If the error code is 0 then all the above will be 0

**iv)        Error OFF date**

This is always 16 bytes in the following format:

    **a)**        0000000000
    **b)**        Year No 0 to 99
    **c)**        Month No 1 to 12
    **d)**        Day No 1 to 31

If the error code is 0 or the error is still present then all the above will be 0

**v)        Error OFF time**

This is always 16 bytes in the following format:

    **a)**        0000000000
    **b)**        Hour No 0 to 23
    **c)**        Minute No 0 to 59
    **d)**        00

If the error code is 0 or the error is still present then all the above will be 0

**vi)**        zero
  to
**xx)**        zero

## A4.6    DISPLAY STRING INTERGER VALUES

As previously stated in Paragraph A4.3 items shown on the ENCAL 2000 Control Unit display in string form cannot be transmitted in that form and are transmitted as integer numbers  the following is a list of the display strings with the corresponding integer code and function .The integer must be transmitted as a 64 bit number as previously stated.

### CODES FOR ENCAL 2000 Control Unit CONTROL UNIT DATA
### Code      Variable

| 00000 | Mode switch 1 | 1= ON   0=OFF |
|---|---|---|
| 00001 | Mode switch 2 | 1= ON   0=OFF |
| 00002 | Mode switch 3 | 1= ON   0=OFF |
| 00003 | Analogue output board1 | 1= ON   0=OFF |
| 00004 | Analogue output board2 | 1= ON   0=OFF |
| 00005 | Mode Switch 8 | 1= ON   0=OFF |
| 00010 | Mode Switch 7 | 1= ON   0=OFF |
| 00011 | Mode Switch 9 | 1= ON   0=OFF |
| 00012 | Mode Switch 10 | 1= ON   0=OFF |

| 00040 | Analogue outputs | 0=0-20mA, 1=4-20mA. |
|---|---|---|

| 00050 | Analogue output 1 |
|---|---|
| 00053 | Analogue output 2 |
| 00060 | Analogue output 3 |
| 00070 | Analogue output 4 |
| 00073 | Analogue output 5 |
| 00080 | Analogue output 6 |

| 0=OFF, | 11= Rel. Dens | 22= CO2 2 |
|---|---|---|
| 1=methane | 12= CO2 | 23= N2 1 |
| 2=ethane | 13= Hs | 24= N2 2 |
| 3= propane | 14= Hi | 25= d 1 |
| 4= i-butane | 15= Wobbe.s | 26= d 2 |
| 5= n-butane | 16=.rn | 27= rn 1 |
| 6= neo-pentane | 17= Hs 1 | 28= rn 2 |
| 7= i-pentane | 18= Hs 2 | 29= Wobbe.s 1 |
| 8= n-pentane | 19= Hi 1 | 30= Wobbe.s 2 |
| 9= C6+ | 20= Hi 2 | |
| 10= nitrogen | 21= CO2 1 | |

| 00090 | General alarm  Fault | 1=ON   0=OFF |
|---|---|---|
| 00091 | General alarm  Accountable alarm | 1=ON   0=OFF |
| 00092 | General alarm  Non-accountable alarm | 1=ON   0=OFF |

| 50000 | Printer | 0= None, 1=Internal, 2= External |
|---|---|---|
| 50010 | Printer baud rate | 0=1200, 1=2400, 2=4800, 3=9600 |
| 50011 | Printer bits | 0=7 bits, 1=8 bits |
| 50012 | Printer parity | 0=None, 1=Even, 2=Odd |

| 50020 | Print interval | HH:MM integer value in minutes |
|---|---|---|
| 50021 | Print start time | HH:MM integer value in minutes |
| 50022 | Last print time | HH:MM integer value in minutes |
| 50023 | Next print time | HH:MM integer value in minutes |

| 50030 | Print on keyswitch operation | 0=OFF | 1=ON |
| 50031 | Print on power on | 0=OFF | 1=ON |
| 50032 | Print on Error | 0=OFF | 1=ON |
| 50033 | Print error and display data | 0=OFF | 1=ON |

| 50040 | OSC-01-E Serial 1 baud rate | 0=1200, 1=2400, 2=4800, 3=9600 |
| 50041 | OSC-01-E Serial 1 bits | 0=7 bits, 1=8 bits |
| 50042 | OSC-01-E Serial 1 parity | 0=None, 1=Even, 2=Odd |

| 50050 | Modbus 1 Serial 2 baud rate | 0=1200, 1=2400, 2=4800, 3=9600 |
| 50051 | Modbus 1 Serial 2 bits | 0=7 bits, 1=8 bits |
| 50052 | Modbus 1 Serial 2 parity | 0=None, 1=Even, 2=Odd |

| 50060 | Modbus 2 Serial 2 baud rate | 0=1200, 1=2400, 2=4800, 3=9600 |
| 50061 | Modbus 2 Serial 2 bits | 0=7 bits, 1=8 bits |
| 50062 | Modbus 2 Serial 2 parity | 0=None, 1=Even, 2=Odd |

## A4.7      SERIAL COMMUNICATION ADDRESSES

The following Tables numbers 1 to 3 contain lists of data that is normally read from either of the available MODBUS communication ports by other equipment , for example 793-SC Station Controllers or a DSf-GC Unit. This data is presented in the format stated for each address and is the same as the data that is available either on the display or via the other communication options.

ENCAL 2000 CU COMMUNICATION LOCATIONS

Table 1 Component codes and Status information

| Addr. | Function | Code | Number Format |
|-------|----------|------|---------------|
| 3001 | Component code for C6+ | 108 | unsigned 16 bit integer |
| 3002 | Component code for N2 | 114 | unsigned 16 bit integer |
| 3003 | Component code for Methane | 100 | unsigned 16 bit integer |
| 3004 | Component code for CO2 | 117 | unsigned 16 bit integer |
| 3005 | Component code for Ethane | 101 | unsigned 16 bit integer |
| 3006 | Component code for Propane | 102 | unsigned 16 bit integer |
| 3007 | Component code for i-Butane | 103 | unsigned 16 bit integer |
| 3008 | Component code for n-Butane | 104 | unsigned 16 bit integer |
| 3009 | Component code for neo-pentane | 107 | unsigned 16 bit integer |
| 3010 | Component code for i-pentane | 105 | unsigned 16 bit integer |
| 3011 | Component code for n-pentane | 106 | unsigned 16 bit integer |
| 3012 | Component code for H2 | 112 | unsigned 16 bit integer |
| 3013 | Component code for Helium | 113 | unsigned 16 bit integer |
| 3014 | Component code for Oxygen | 116 | unsigned 16 bit integer |
| 3015 | Component code for CO | 115 | unsigned 16 bit integer |
| 3016 | Component code for H2O | 144 | unsigned 16 bit integer |
| 3017 | Component code for Argon | 146 | unsigned 16 bit integer |
| 3034 | GC Stream Number | 1, 2 or 3 | unsigned 16 bit integer |
| 3046 | GC Status register 1 (See Table 2 for details) | 0 = OK | unsigned 16 bit integer |
| 3047 | GC status register 2 (See Table 2 for details) | 0 = OK | unsigned 16 bit integer |
| 3059 | Analysis/Calibration | 1=Analysis 0=Calibration | unsigned 16 bit integer |
| 3062 | Process Gas Chromatograph State | 0=Idle 1=Analysing 2=Calibrating | unsigned 16 bit integer |
| 3067 | Control Unit Keyswitch Status | 1=DATA 2=RUN 3=EDIT 4=CAL | unsigned 16 bit integer |
| 3093 | Energy Units | 0=KWh/m3 1=KJ/m3 2=KCal/m3 3=MJ/m3 | unsigned 16 bit integer |

| Addr. | Function | Code | Number Format |
|---|---|---|---|
| 3100 | CAL stream nr. | 1 = CAL 1<br>2 = CAL 2 | unsigned 16 bit integer |
| 3101 | Current stream nr. | 0 to 23<br>(See table 4<br>for details) | unsigned 16 bit integer |
| 3102 | Next stream nr. | 0 to 23<br>(See table 4<br>for details) | unsigned 16 bit integer |

Table 2 Alarm Status definitions

| 3046 STATUS WORD No 1 | | 3047 Status WORD No 2 | |
|---|---|---|---|
| LSB | Function | LSB | Function |
| 1 | Unknown peak Alarm | 1 | C6+ Component Alarm |
| 2 | Area alarm | 2 | N2 Component Alarm |
| 3 | Energy Alarm | 3 | Methane Component Alarm |
| 4 | Rel. dens Alarm | 4 | CO2 Component Alarm |
| 5 | Concentration Alarm | 5 | Ethane Component Alarm |
| 6 | Calibrate Alarm (see par.2.7) | 6 | Propane Component Alarm |
| 7 | | 7 | i-Butane Component Alarm |
| 8 | | 8 | n-Butane Component Alarm |
| 9 | | 9 | neo-Pentane Component Alarm |
| 10 | | 10 | i-Pentane Component Alarm |
| 11 | | 11 | n-Pentane Component Alarm |
| 12 | | 12 | |
| 13 | | 13 | |
| 14 | CU Fault | 14 | |
| 15 | Comms to Process Gas<br>Chromatograph Alarm | 15 | |
| 16 | Reserved | 16 | |

Table 3 Gas Analysis results

| Address | Function | Number Format |
|---|---|---|
| 7001 | Mol % C6+ | IEEE 32 bit Float |
| 7002 | Mol % N2 | IEEE 32 bit Float |
| 7003 | Mol % Methane | IEEE 32 bit Float |
| 7004 | Mol % CO2 | IEEE 32 bit Float |
| 7005 | Mol % Ethane | IEEE 32 bit Float |
| 7006 | Mol % Propane | IEEE 32 bit Float |
| 7007 | Mol % i-Butane | IEEE 32 bit Float |
| 7008 | Mol % n-Butane | IEEE 32 bit Float |
| 7009 | Mol % neo-Pentane | IEEE 32 bit Float |
| 7010 | Mol % i-Pentane | IEEE 32 bit Float |
| 7011 | Mol % n-Pentane | IEEE 32 bit Float |
| 7012 | Mol % H2 | IEEE 32 bit Float |
| 7013 | Mol % Helium | IEEE 32 bit Float |
| 7014 | Mol % Oxygen | IEEE 32 bit Float |
| 7015 | Mol % CO | IEEE 32 bit Float |
| 7016 | Mol % Water Vapour | IEEE 32 bit Float |
| 7017 | Mol % Argon | IEEE 32 bit Float |
| 7033 | Superior Heating Value (Dry) | IEEE 32 bit Float |
| 7034 | Superior Heating Value (Sat) | IEEE 32 bit Float |
| 7035 | Relative Density | IEEE 32 bit Float |
| 7036 | Z factor | IEEE 32 bit Float |
| 7037 | Wobbe index (Superior) | IEEE 32 bit Float |
| 7038 | Un-normalised sum | IEEE 32 bit Float |
| 7087 | Inferior Heating Value (Dry) | IEEE 32 bit Float |
| 7088 | Inferior Heating Value (Sat) | IEEE 32 bit Float |
| 7089 | Wobbe index (Inferior) | IEEE 32 bit Float |
| 7090 | Density Kg/m3 | IEEE 32 bit Float |
| 7095 | Response factor C6+ | IEEE 32 bit Float |
| 7096 | Response factor N2 | IEEE 32 bit Float |
| 7097 | Response factor Methane | IEEE 32 bit Float |
| 7098 | Response factor CO2 | IEEE 32 bit Float |
| 7099 | Response factor Ethane | IEEE 32 bit Float |
| 7100 | Response factor Propane | IEEE 32 bit Float |
| 7101 | Response factor i-Butane | IEEE 32 bit Float |
| 7102 | Response factor n-Butane | IEEE 32 bit Float |
| 7103 | Response factor neo-Pentane | IEEE 32 bit Float |
| 7104 | Response factor i-Pentane | IEEE 32 bit Float |
| 7105 | Response factor n-Pentane | IEEE 32 bit Float |
| 7095 | Rf C6+ | IEEE 32 bit Float |
| 7096 | Rf N2 | IEEE 32 bit Float |
| 7097 | Rf Methane | IEEE 32 bit Float |
| 7098 | Rf CO2 | IEEE 32 bit Float |
| 7099 | Rf Ethane | IEEE 32 bit Float |
| 7100 | Rf Propane | IEEE 32 bit Float |
| 7101 | Rf I-Butan | IEEE 32 bit Float |
| 7102 | Rf N-Butan | IEEE 32 bit Float |

| | | |
|---|---|---|
| 7103 | Rf Neo-But | IEEE 32 bit Float |
| 7104 | Rf I-Penta | IEEE 32 bit Float |
| 7105 | Rf N-Penta | IEEE 32 bit Float |
| 7500 | CO2 Soll | IEEE 32 bit Float |
| 7501 | CO2 Ist | IEEE 32 bit Float |
| 7502 | CO2 abw | IEEE 32 bit Float |
| 7503 | rn soll | IEEE 32 bit Float |
| 7504 | rn ist | IEEE 32 bit Float |
| 7505 | rn abw | IEEE 32 bit Float |
| 7506 | Hs Soll | IEEE 32 bit Float |
| 7507 | Hs Ist | IEEE 32 bit Float |
| 7508 | Hs abw | IEEE 32 bit Float |
| 7509 | d soll | IEEE 32 bit Float |
| 7510 | d ist | IEEE 32 bit Float |
| 7511 | d abw | IEEE 32 bit Float |
| 7520 | CO2 soll | IEEE 32 bit Float |
| 7521 | CO2 ist | IEEE 32 bit Float |
| 7522 | C6 soll | IEEE 32 bit Float |
| 7523 | C6 ist | IEEE 32 bit Float |
| 7524 | N2 soll | IEEE 32 bit Float |
| 7525 | N2 ist | IEEE 32 bit Float |
| 7526 | CH4 soll | IEEE 32 bit Float |
| 7527 | CH4 ist | IEEE 32 bit Float |
| 7528 | C2H6 soll | IEEE 32 bit Float |
| 7529 | C2H6 ist | IEEE 32 bit Float |
| 7530 | C3H8 soll | IEEE 32 bit Float |
| 7531 | C3H8 ist | IEEE 32 bit Float |
| 7532 | i-C4H10 soll | IEEE 32 bit Float |
| 7533 | i-C4H10 ist | IEEE 32 bit Float |
| 7534 | n-C4H10 soll | IEEE 32 bit Float |
| 7535 | n-C4H10 ist | IEEE 32 bit Float |
| 7536 | Neo-C5H12 soll | IEEE 32 bit Float |
| 7537 | Neo-C5H12 ist | IEEE 32 bit Float |
| 7538 | i-C5H12 soll | IEEE 32 bit Float |
| 7539 | i-C5H12 ist | IEEE 32 bit Float |
| 7540 | n-C5H12 soll | IEEE 32 bit Float |
| 7541 | n-C5H12 ist | IEEE 32 bit Float |

Table 4  (Register 3101 and 3102)

| Code | Function |
|---|---|
| 0 | CAL1 |
| 1 | CCK 1 |
| 2 | Stream 1 |
| 3 | Stream 2 |
| 4 | Stream 3 |
| 5 | Stream 4 |
| 6 | Stream 5 |
| 7 | Stream 6 |
| 8 | Stream 7 |
| 9 | Stream 8 |
| 10 | CAL 2 |
| 11 | CCK2 |
| 12 | CAL 3 |
| 13 | CCK 3 |
| 14 | SST-END |
| 15 | SST-None Selected |
| 16 | Stream 9 |
| 17 | Stream10 |
| 18 | Stream11 |
| 19 | Stream12 |
| 20 | Stream13 |
| 21 | Stream14 |
| 22 | Stream15 |
| 23 | Stream16 |