



RDP Customer Document

Technical Manual for the **E725 Serial Communication**

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This manual applies to units of mod status 7 ONWARDS



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of Conformity

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1 INTRODUCTION

The E725 is fitted with a serial port. This will be either RS232 or RS485 depending upon the options ordered. If it is RS232, one unit may be connected to each RS232 port on the host computer. For RS485, up to 256 unit may be connected via an RS232/485 converter to a single RS232 port on the host computer.

The communication interface between the E725 and the host computer has been designed to be very flexible and it is very simple to program the E725 using a terminal emulation program (e.g. Microsoft Windows 3.1™ Terminal Program). Alternatively a high-level programming language with ASCII based string functions (such as Visual Basic, Delphi, Pascal etc) could be used to develop data acquisition and control software.

RDP can supply RS232 or RS285 leads and converters. Please contact our sales department for additional information and pricing.

Note: The serial port communications control only supports comm. ports 1 to 4, so care must be taken when installing additional hardware to ensure that this criteria is met.

3 CONNECTION DETAILS

If you do not wish to make up your own lead, please contact RDP sales and we shall be happy to quote.

The connections depend upon whether the E725 is fitted with the optional RS485 protocol, or the standard RS232. Use sections 2.1 & 2.2 to establish if the unit is RS232 or RS485.

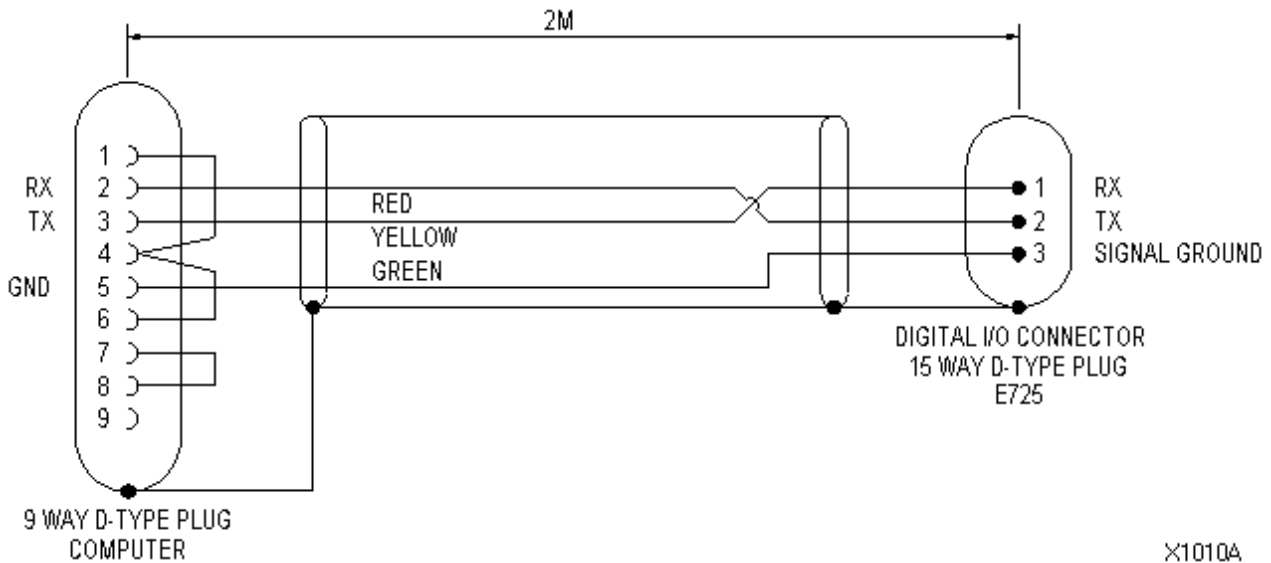
If the standard RS232 is fitted, only one unit may be connected to each RS232 port on the computer, as detailed in 3.1

If the optional RS485 is fitted, multiple units may be connected via an RS485/RS232 converter as detailed in 3.2.

3.1 RS232 Connection Details

A Single E725 can be connected to a computer using the RS232 communication link (see figure 1). Alternatively if your computer is fitted with more than one serial communication port then it would be possible to connect more than one E725 to the computer by connecting the first E725 to serial communications port 1 (COM1), a second E725 to serial communications port 2 (COM2) etc.

Figure 1 E725 to PC RS232 Communication Lead.



3.2 RS485 Connection Details

The factory fitted RS485 option allows a maximum of two hundred and fifty six E725s to be connected to a single RS232 serial communication port using a single twisted-pair cable. The other advantages of RS485 communication over the standard RS232 are higher baud rate, longer cable lengths (up to 1200 metres) and higher noise immunity.

It is generally recommended that a good quality twisted pair (e.g. Belden 9841) be used with characteristic impedance of 120R. If Belden 9841 cable cannot be used then any screened twisted-pair cable with characteristic impedance of 100 to 120R can be used but the maximum distance or communication baud rate may be reduced.

It is also recommended the instruments connected to the RS485 network be connected in series to minimise loading, data reflections and maintain data integrity.

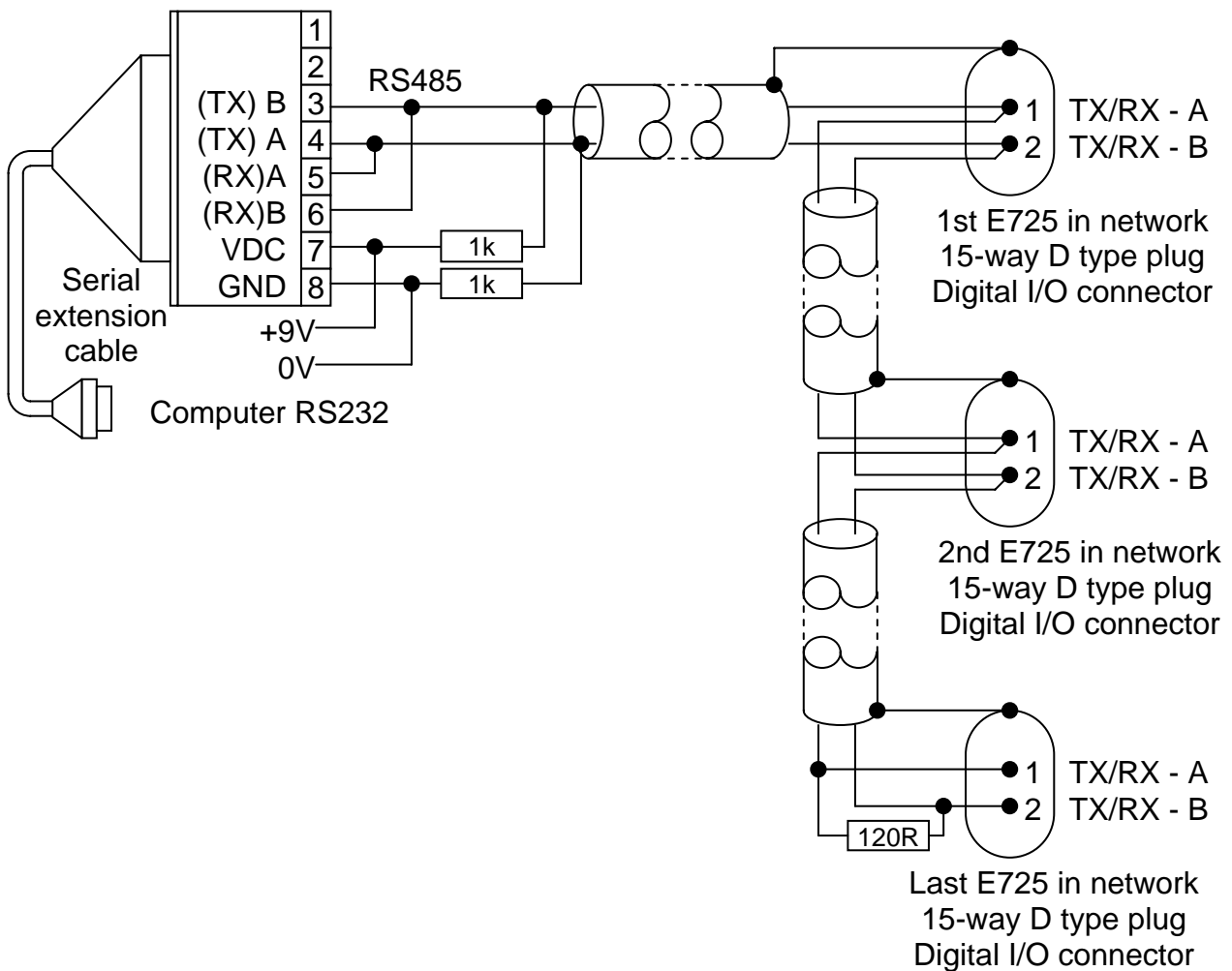
In RS485 applications, the two transmission lines must be properly terminated, and a single resistor across the receiver input pair on the Model 485F9 normally provides adequate termination at the computer end. It is important that the last E725 in the network is terminated by connecting a resistor across the two transmission lines (see figure 2).

In some instances, particularly in RS485 multi-drop operation, noise may be detected at the receiver. In the multi-drop configuration, there can be brief periods when no transmitter is enabled, which allows the network to float. So it is recommended that two extra resistors be added externally to the Model MA485F9, so that the network is biased to about 1 to 2 volts when all transmitters are disabled (see figure 2). For factory supplied leads, this will have been done.

The RS485 standard specifies that a maximum of 32 devices can be connected to a single driver. Therefore, if more than 32 E725's are to be connected to a network then it will be necessary to install RS485 repeaters at strategic points around the network. It may also be advantageous to use repeaters if the network is spread over a wide area.

Figure 2 RS485 Wiring Diagram

Magic RS232 to 485 converter (MA485F9)



4 ESTABLISHING SERIAL COMMUNICATIONS

4.1 IMPORTANT WARNING BEFORE SENDING COMMANDS

Some serial commands can affect the analogue output and limit relays. If the E725 is being used in a control application, carefully consider the implications of sending RS232 commands.

4.2 Serial Communications Protocol.

Refer also to sections 2 & 3.

Baud rate	The E725 baud rate is selectable. See section 2.2 for details of how to find the current setting. The default value is 9600
Parity	= NONE
Start bits	= 1
Stop bits	= 1
Number of data bits	= 8

4.3 Establishing RS232 Communications.

Please follow these steps in order to verify serial communication.

- a) Turn off both the E725 and the host device (PC, PLC etc)
- b) Connect the two devices using a lead wired as detailed in section 3.1.
- c) Turn on both the E725 and the host computer.
- d) Start a serial communications program on the host computer. It is strongly recommended that a terminal emulation program is used, rather than any high level software. We recommend Microsoft Terminal for windows 3.1, or a similar program.
- e) Configure the terminal software with the correct serial communications protocol and baud rate, as detailed in section 4.2.
- f) Type '#00 sys'* and press the enter key. The E725 should respond with a short line of identification text, including the unit part number and software version. If this happens, communication has been successfully established.

* This assumes that the module address is the default value of '00'

See section 7 for faultfinding information.

4.4 Establishing RS485 communications.

Note. The E725 units must have the optional factory fitted RS485 option. See sect 2.

- a) Turn off both the E725 and the host device (PC, PLC etc)
- b) Connect ONE of the E725 units to the communications lead, leaving all other sockets unconnected. Ensure that the RS232/485 converter is connected and turned on.
- c) Turn on both the E725 and the host computer.
- d) Start a serial communications program on the host computer. Initially a terminal emulation program should be used, rather than any high level software. We recommend Microsoft Terminal for windows 3.1, or a similar program.
- e) Configure the terminal software with the correct serial communications protocol, as detailed in section 4.2. The baud rate of the communications program should be set to that of the E725. See section 2.2 to find out the E725 baud rate setting.
- f) Send the following commands.

Command (replace nn ,X & Y!), then press <ENTER>	Help notes	Unit response*
#00 set user level,1,X	X= level 1 password, default = 1 (see E725 manual for further info) Assumes that module address is 00.	Nothing or "OK"
#00 set comms,nn,485,YY,on	Set nn to the desired module address. This should be unique and not '00'. Suggested value is 01 for the first unit, then 02 etc. Set YY to the baud rate that the E725 is currently set to. I.e. do not change it!	'OK'
#nn save	nn should match the address as set above	'OK'
#nn sys	nn should match the address as set above	'E725..." etc

* If the stated unit response is not received, there is a problem. Repeat the command sequence from the start. If this does not solve the problem, see section 7.

Fix a label to the E725 indicating its address. This will assist in system commissioning.

Once the first unit is working, test it in all sockets to ensure that all sockets are working. Use the #nn sys command to verify communication in each socket

- g) Disconnect the first unit and repeat steps b to f for all of the units giving each a unique non-zero address. It is not necessary to re-test all sockets.
- h) Connect all units to the network and test communications with each address.

If desired, the baud rate of each unit may now be changed, however, they must all be set to the same value. To change the baud rate, first establish communications with the units and then send the following to each of the units

Command Press <ENTER> after command	Help notes	Unit response
#nn set user level,1,X	Where X is the level 1 password	'OK'
#nn set comms,XX,485,YY,on	Where XX is the new module address and YY is the new baud rate, (e.g. 9600)	'OK'
#XX save	XX = new module address	'OK'

Baud rate changes do not take effect until the E725 has been reset. When all units have been re-programmed, turn them all off, then on. The new baud rate will now be set. Remember to change the baud rate of the host device before re-establishing communications.

5 SERIAL COMMUNICATION COMMANDS

Read section 4.1 for important information.

Commands to the E725 may be sent via a simple terminal emulation program or any programming language with ASCII based string functions (such as Visual Basic, Delphi, Pascal etc).

A unit will only respond if it receives '#' followed by 2 digits, corresponding to its address.

The E725 can only respond to serial communication during normal operation. In set-up mode communication is disabled.

5.1 Passwords / User level

In order to protect calibration parameters, several of communications commands require a password to be set before they will be accepted. The E725 has 3 levels of security; user level 1, 2 & 3. Some commands do not require a password. The password level for all commands is detailed by the command description. Once a password has been entered, it will remain valid until either it is cleared or returning the unit to run mode terminates set-up.

5.2 Quick Reference of runtime commands

The following table lists all the runtime commands that do not require a password.

Command	Description
SYS	Prints software version number.
GET ERROR	Prints error status
CLR ERROR	Clears error status.
RESET	Resets the E725.
RESET PEAKS	Clears the stored MAX, MIN and TIR values.
RESET LIMITS	Resets any latched limits.
CLR USER LEVEL	Clears the current user level (i.e. password).
ZERO	Calculates the tare reading (i.e. zeros the display)
CLR ZERO	Clears the tare reading.
DISPLAY INPUT	Displays the normal input signal
DISPLAY MAX	Displays the MAX input signal.
DISPLAY MIN	Display the MIN input signal.
DISPLAY TIR	Display the TIR input signal.
DISPLAY F1	Selects display function 1
DISPLAY F2	Selects display function 2
DISPLAY F3	Selects display function 3
DISPLAY F4	Selects display function 4
PRINT DATA	Prints the current display value.
GET DATA	Prints the current display value.
SCAN	Prints the current display value.
PRINT CAL	Prints the shunt cal. value (DC board) or the excitation voltage (AC board)

5.3 Example of a runtime command

For example, suppose we want to zero the display using serial communication on the E725 with address 00, then the following command must be sent:

#00 ZERO

5.4 Details of runtime commands

#nn SYS Password not required

Sending this command causes the E725 to return the current software version

#nn GET ERROR Password not required

Returns the number of lines of command received since the FIRST error occurred. CLR ERROR resets the counter. If no errors have occurred, the response string will state this.

#nn CLR ERROR Password not required

Causes the error counter to be reset.

#nn RESET Password not required

This causes the E725 to reset, which is equivalent to switching the E725 off and on. This command will clear any change sent to E725 since the last **SAVE** command.

#nn RESET PEAKS Password not required

This causes the E725 to reset the MAX, MIN and TIR values.

#nn RESET LIMITS Password not required

This causes the E725 to reset any latched limits.

#nn CLR USER LEVEL Password not required

Clears the current user level (password).

#nn ZERO Password not required

Same as pressing Zero from the front panel. See E725 manual for further info.

#nn CLR ZERO Password not required

Same as pressing Clear Zero from the front panel. See E725 manual for further info.

#nn DISPLAY INPUT Password not required

This command forces the E725 to display the normal (dynamic) input signal.

#nn DISPLAY MAX Password not required

This command forces the E725 to display the MAX input signal.

#nn DISPLAY MIN Password not required

This command forces the E725 to display the MIN input signal.

#nn DISPLAY TIR

Password not required

This command forces the E725 to display the TIR input signal.

#nn DISPLAY F1

Password not required

Only valid if dual channel option board is fitted or the customer has ordered the optional software function keys and it forces the E725 to display function 1 (i.e. input signal).

If the dual channel board is fitted then the display, limits and analogue output will track channel A.
--

#nn DISPLAY F2

Password not required

Only valid if dual channel option board is fitted or the customer has ordered the optional software function keys and it forces the E725 to display function 2.

If the dual channel board is fitted then the display, limits and analogue output will track channel B.
--

#nn DISPLAY F3

Password not required

Only valid if dual channel option board is fitted or the customer has ordered the optional software function keys and it forces the E725 to display function 3.

If the dual channel board is fitted then the display, limits and analogue output will track channel $(A+B)/2$.

#nn DISPLAY F4

Password not required

Only valid if dual channel option board is fitted or the customer has ordered the optional software function keys and it forces the E725 to display function 4.

If the dual channel board is fitted then the display, limits and analogue output will track channel $(A-B)$.

#nn PRINT DATA

Password not required

#nn GET DATA**#nn SCAN**

Note: the **GET DATA** and **SCAN** commands are only applicable to version 1.03 or higher.

All 3 commands do the same thing, the duplication is to provide compatibility with other RDP serial devices. They cause the current display value to be transmitted.

#nn PRINT CAL

Password not required

This command will either print the excitation voltage (ac input board only) or the shunt cal value (dc board only). The shunt cal value display will be the gross value (i.e. the local zero offset will not be subtracted from the reading so that the shunt cal value is constant regardless of the tare reading).

It is important to remember that the LIMITS, FAST MAX/MIN/TIR and analogue output will all change to reflect either the shunt cal value or excitation voltage.

5.5 Quick Reference of setup commands

Command	Description
CLR SETUP	Clears the current set-up in volatile memory
SAVE	Saves the current set-up to non-volatile memory.
SET USER LEVEL	Facilitates entry of the user level and password.
SET PASSWORDS	Facilitates changes to passwords for levels 1, 2 and 3.
SET COMMS	Programs the communication protocol and baud rate.
SET DATA LOGGING	Programs the data-logging mode of operation.
SET FRONT PANEL	Enables/Disables the front panel.
SET EXCITATION	Programs the excitation voltage for the DC input board.
SET GAIN	Programs the gain for the input board.
SET DP	Programs Full scale value with decimal places (I.e. cal point)
SET SCALING	Calibrates the input signal.
SET LINEARISATION	Programs straight-line linearisation.
SET POLYNOMIAL	Programs polynomial linearisation.
SET ENGINEERING OFFSET	Programs the engineering offset.
SET TARE POINT	Programs the tare point.
SET FILTER VALUE	Programs the filter value.
SET COUNTS	Programs the count facility
SET LIMIT	Programs the limits.

The table lists all the set-up commands that require a password. The relevant password is listed on the far right hand side of the page next to the command. For example, SET COMMS requires User Level 3.

The communication interface between the E725 and the host computer has been designed to be very flexible by using simple English commands. This makes it very simple to program the E725 using a terminal emulation program or alternatively any high-level programming language with ASCII based string functions (such as Visual Basic, Delphi, Pascal etc) can be used to develop data acquisition and control software.

Since the E725 can be used on a RS485 network, all units expect to be sent a two digit hexadecimal address before any command, this address must be preceded by # and the command line does not match the programmed address of the E725 then the command will be ignored.

The E725 can only respond to serial communication during normal operation (i.e. pressing a front panel key, applying a digital input or if the instrument is in the set-up menu disables serial communication).

For example, suppose we want to zero the display using serial communication on the E725 with address 00, then the following command must be sent : -

#00 ZERO

In this section, all the E725 commands will have the following format : -

#nn COMMAND,P1,P2

where **#nn** Please substitute nn with the address of the E725 instrument which you wish to communicate.

COMMAND The command to be sent.

,P1,P2 Optional command line parameters.

It is important to remember that all instructions sent to the 650 must be terminated with a carriage-return line-feed sequence.

The E725 can also be configured for software handshaking, so that the E725 will respond with either: -

OK If a valid command that does not request data (e.g. **ZERO**) has been received.

ERROR If the E725 does not recognise the command or the necessary password has not been set.

Data String If the host computer requests data (e.g. **Print Data**).

All responses from the E725 are terminated with a carriage-return, line feed (ASCII characters 13, 10) sequence.

If the E725 does not receive a character after serial communication has been requested (i.e. the '#' character has been received) then the E725 will time out, erasing all received data and resuming normal operation.

5.6 Example of a setup command

Command	Comments
#00 SET USER LEVEL , 1 , 1	Sets the user level to 1, using the default password for level 1, which is 1! Note that '#00' indicates a unit having address '00'
#00 SET COMMS,01,232,19200,on	Sets the communications parameter to address 01, RS232, 19200 baud and handshaking on.
#01 SAVE	Saves the new settings. (Note change in address!)
#01 RESET	Note that the new baud rate is not active until after the unit has been reset. Change host settings!

5.7 Serial Communication Commands

#nn CLR SETUP User Level 1, 2 or 3

Clears all set-up parameters for the current user level, INCLUDING CALIBRATION.

#nn SAVE User Level 1, 2 or 3

This command saves all of the settings to non-volatile memory. Until this command is used, all settings will be lost if the power is switched off or the unit is reset.

#nn SET USER LEVEL,*L,P*

User level & password required

The E725 has 3 levels of security; user levels 1, 2 & 3. Each of the user levels has a separate password. In order to change settings, first check the user level required, then enter it here if you are authorised. Level 3 is the highest level (giving access to levels 1, 2 and 3). The default password for level 3 access is 3.

L defines the user level you wish to enter

P defines the password for the user level

For example, to enable access to the calibration and limits menu, send the command: -

Example: - #00 SET USER LEVEL, 2, 2

#nn SET PASSWORDS,*P1,P2,P3*

User Level 3

This commands re-programs the three passwords, which are used to access the various E725 set-up facilities

Where *P1* is the password used for the limits menu (User Level 1).

P2 is the password used for the calibration menu (User Level 2).

P3 is the password used for the Configuration Set-up Menu (User Level 3).

#nn SET COMMS,*Address,Protocol,BaudRate,HandShaking*

User Level 1

Note: In version 1.04 this command was moved from user level 3 to user level 1.

This command sets up the communications parameters for the E725.

Address Sets the module address of the E725. This only needs to be changed if a number of E725 instruments are connected to the same RS485 network. Acceptable values are 00 to FF hexadecimal.

Protocol Sets the comms protocol for the E725. Acceptable values are 232 or 485.

BaudRate Sets the communications baud rate of the E725. Acceptable values are 600, 1200, 2400, 4800, 9600, 19200, 38400 or 57600.

HandShaking Sets the response made by the E725 to a command. If **OFF** then the E725 does not make any response to commands otherwise if **ON** the E725 will respond with OK or ERROR if the command was erroneous.

Changes to the baud rate are not effective until the E725 has been reset.

For example, to set the E725 address to zero, RS232 communication at 9600 and software hand-shaking the command would be: - **#nn SET COMMS, 00, 232, 9600, ON**

#nn SET DATA LOGGING ,*Mode*

User Level 1

Notes: This command is only applicable to Version 1.03, or higher. In version 1.04 this command was moved from user level 3 to user level 1.

The data logging command controls the flow of display data to the serial port. When off, data is only sent when requested by an appropriate command. In any of its 3 different modes, data is sent as detailed below.

- Mode* = *OFF* Disables data logging function.
Note that data streaming continues between setting the user level and sending the 'off' command.
- Mode* = *HOLD* The displayed value is sent each time the digital HOLD input is pulsed. See the instrument manual for details of Digital Inputs. Display flashes whilst HOLD is applied.
The maximum frequency at which the HOLD pin can be pulsed is 40Hz but the serial port should be monitored to ensure that the last piece of serial data has been transmitted before the next HOLD pulse is applied.
- Mode* = *DISPLAY* The displayed value is sent each time display updates (4/sec approx.)
- Mode* = *CONT* Data is sent as fast as possible. The transmission rate depends upon limit settings, filter value and calibration method but particularly baud rate. At 57600 baud, between 70 and 120 readings per sec (nom) is possible, at 9600 baud this will reduce to 50 to 60 readings (nom).
NOTE: - The speed of limit and MAX/MIN response will be reduced.

Example:- **#00 SET DATA LOGGING,DISPLAY** causes the display data to be transmitted each time the display updates.

#nn SET FRONT PANEL ,*Mode*

User Level 3

Note: This command is only applicable to Version 1.03, or higher.

Mode = ON or OFF. Turns front panel keys on or off

#nn SET EXCITATION ,*Value*

User Level 3

This command is used to set the excitation voltage. Acceptable values are 1, 3, 5 or 10. Disconnect the transducer before changing this as excessive voltage could destroy the transducer. Measure the excitation with a voltmeter before connecting the transducer.

#nn SET GAIN ,*Value*

User Level 3

This command is used to set the gain of the input board. Acceptable values are 1, 2, 3, 4, 5, 6, 7, or 8. See the E725 manual for details.

#nn SET Counts, *Count*

User Level 1

Note: This command is only applicable to Version 1.06, or higher.

So, if you had a $\pm 12.5\text{mm}$ LVDT connected and you wanted to display 0 to 25.00mm you might typically do as follows, using an E725 that has address 00 and user level 2 password = 2

Send

```
#00 SET USER LEVEL,2,2
```

```
#00 SET DP,2,12.5,1 [This will clear any previous calibration]
```

Move the transducer until the display shows 0 (approx) A-D counts

Move the transducer to the position which represents full scale (eg 12.5mm) and note the A-D counts, this should be between about 26000 and 55000 if the GAIN value is correct. For this example, we will assume that this value is 50000.

Calculate the scaling factor M (in this case $12.5/50000 = 0.00025$)

As we want a unipolar display (0 to 25mm) the scaling offset (C) = 12.5

The commands sent to an E725 that has address 00 and user level 2 password = 2 would be

```
#00 SET SCALING,0.00025,2.5
```

```
#00 SAVE
```

The display would now be calibrated.

#nn SET LINEARISATION, $CP_0, M_0, C_0, CP_1, M_1, C_1 \dots, CP_n, M_n, C_n$ User Level 2

This command is used to set the transducers calibration data, so that the transducer is linearised using the straight-line method.

CP_0 First calibration break point

M_0 First scaling constant

C_0 First offset constant

This option cannot not be used if either the fast limit or the fast MAX / MIN / TIR board is fitted and the maximum number of break point is eleven.

#nn SET POLYNOMIAL, C_n, \dots, C_1, C_0 User Level 2

This command is used to set the transducers calibration data, so that the transducer is linearised using a polynomial.

Note This option cannot not be used if either the fast limit or the fast MAX / MIN / TIR board is fitted and the maximum number of coefficients is 16 (i.e. $n = 15$).
--

#nn SET ENGINEERING OFFSET, *value* User Level 2

Used to set the engineering offset and tare point to the entered value.

#nn SET TARE POINT, *value* User Level 2

This command is used to set the tare point to the entered value.

#nn SET FILTER VALUE, *value*

User Level 1

Note: In version 1.03 this command was moved from user level 3 to user level 1.

This command is used to set the filter value. Acceptable values are 1 to 9.

#nn SET LIMIT, *Limit, Operation, Mode, Set-Point, Deviation, Hysteresis, Latched* User Level 1

This command is used to configure the limit. The command line parameters are:

Limit Defines the limit to be configured. Acceptable values are L1, L2, L3 and L4.
Operation Defines the operation of the limit. Acceptable values are OFF, HI, LO and DEVIATION.
Mode Defines the signal that the limit is to be compared against, Acceptable values are GROSS, NETT, TARE, MAX, MIN and TIR.
Set Point Defines the limits set point.
Deviation Defines the limits deviation value.
Hysteresis Defines the limits hysteresis value.
S
Latched Defines whether the limit is working is latched or unlatched mode. Acceptable values are LATCHED or UNLATCHED.

6 USING THE E725 WITH WINDOWS TERMINAL

The E725 has been fully tested with Microsoft Windows® Terminal program on Windows 3.1 and 3.11 for Work Groups and Windows 95. It will probably work with other versions also. Remember to configure the communication settings.

Assuming that you have connected the E725 to your computer using the appropriate lead (turn both units OFF before connecting or disconnecting), you are now ready to communicate with the E725.

To test communications, type:

#00 SYS and press the enter key. (Assuming the E725 address is 00)

The E725 should respond, probably with its type and version number.

This verifies that you have full communications with the E725. If not, check the settings, communication for the correct serial communications settings.

6.1 Windows Terminal Settings.

Settings, Terminal Preferences: - (Local Echo = ON), (CR > CR/LF = outbound)

Settings, Communications: - 8 data, no Parity, 1 Stop, Flow = Xon/Xoff. Baud as required.

Remember to save the terminal settings otherwise they will be lost.

7 FAULTFINDING.

7.1 Communications problems.

- 1) Check that the terminal emulation program on the host PC is configured to send both 'Carriage Return' and 'Line Feed' when the enter key is pressed. The E725 will not respond otherwise.
Carriage return = ASCII code 13, sometimes entered as /013 or ^m
Line feed = ASCII code 10, sometimes entered as /010 or ^j
- 2) Check that the setting for the COM port on the host computer is the actual port that the E725 is connected to.
- 3) Check the communications settings.
- 4) The most common reason for communications failure is incorrect connections in the serial lead. If after the above have been re-checked there is still no communication, double check the serial lead connections, then check again for good measure!

Before you contact RDP, ensure that you have tested communications as detailed above. We are unable to assist unless it can be shown that the communications problems are not as a result of programming errors in applications software. Testing communications on a terminal program is essential.

7.2 Commands not being actioned.

Remember that many commands require the correct user level (password) to be set and many are volatile until the SAVE command is sent.