

Technical Manual
**INTELLIGENT COMPUTER INTERFACE
& EXPANSION MODULE
TYPE 650 & 651**

Doc. Ref CD2030R

This manual applies to units of mod status 10 ONWARDS



Affirmed by Declaration
of Conformity

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1.0 INTRODUCTION

650 Interface Module

The 650 module acts as a digital indicator unit and is capable of addressing all channels in the system and displaying their data in volts.

The 650 module also provides a simple yet flexible interface between the analogue signals of the various 600 series amplifier modules, and a computer with a suitable RS232 port. The 650 module assumes that the analogue signals are calibrated as 0 to 10V or $\pm 10V$ over the range of the transducer, although it is possible to use it with lower outputs.

The configuration of the 650 involves telling the 650 a scaling factor (plus some other information) in order that it can calculate the digitised output in engineering units (e.g., mm, lbs, psi etc.)

The data from the 650 unit can be transferred in a number of ways.

- 1) The data from a single channel may be requested by the host computer, in which case the 650 will sample, then send the data for the requested channel.
- 2) The data from all enabled channels may be requested by the host computer in which case the 650 will sample all enabled channels in turn and send their data in a single delimited string.
- 3) The 650 may be programmed to send the data from all enabled channels at various times, intervals or upon specified transducer levels being reached.
- 4) The 650 may be programmed as above, except that the data may be stored in the internal memory of the 650 for downloading to the computer at a later date.

Data logging rates vary considerably with different baud rates, however, if data is logged to internal memory, sample rates of up to 100 scans of all enabled channels may be achieved. Therefore for higher speed logging, logging to memory is best. However, if it is essential to see the data in 'real time' then the manual contains information on calculating serial transmission rates.

651 expansion Module

The 651 is only present in systems that have more than 1 rack in the same case. If your system is housed in a 602, 603 or 604 housing, the 651 will not be present so you may ignore the remainder of this paragraph and any references to the 651. If your system is in a 605 housing or higher and has a 650, each rack except the one with the 650 in should have a 651 fitted. The 651(s) provide an interface between the 650 and other racks in a system. It does not require any user configuration, as it will have been factory set.

1.1 BEFORE POWERING-UP CHECK...

1	The supply voltage is correct to suit the 631/632 unit fitted and input range selected
2	The various plug-in modules are in the correct positions in the housing.
3	The input and output plugs are in the correct sockets. Note that on the housing back-plane all input sockets and all output sockets are of the same type.
4	Before connecting a transducer, ensure that the correct excitation voltage has been set. <u>Too high a voltage can destroy a transducer</u>
5	That each module has a unique address. (see section 3.12)

1.2 Information on Conformity to EC Directives.

This module is not CE marked because it is intended for use as a component of a larger system. RDP CE mark full modular 600 systems that includes a 60X housing and a 63X power supply where the system is fully populated with either 600 series amplifier/display modules or blank panels.

If the module is part of a full 600 system, refer to the system manual (CD2010) for CE certification.

If the module is not part of the full 600 system, it is the responsibility of the organization/individual producing the system to assess and/or test EMC compatibility.

2.0 USING THE 650 AS A DIGITAL INDICATOR

Refer to Fig.1 for front panel layout.

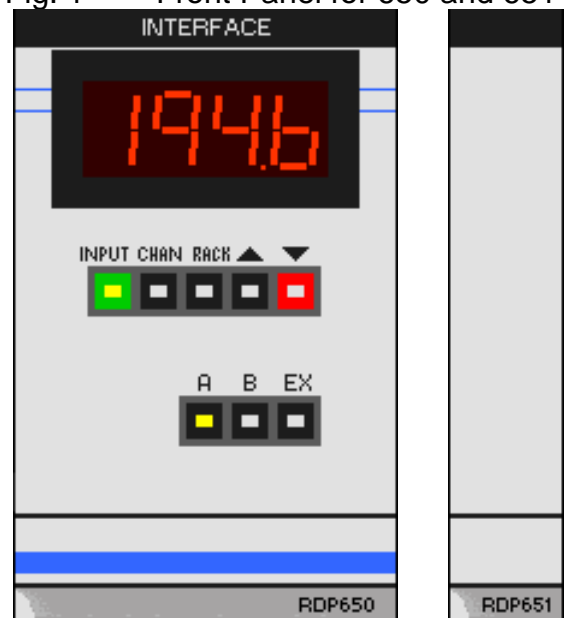
2.1 650 Controls

During data logging operations the 650 display ceases to display channel data. The display during data logging is detailed in later sections.

When the 650 is not logging data, the 650 will monitor the selected input signal and all the control push-buttons can be used to change the selected input signal (see below for further information). Otherwise the ▲ and ▼ can be used to control data acquisition (see section 7.0 for further information).

The control push-buttons are as follows:

Fig. 1 Front Panel for 650 and 651



Control Description

- INPUT** Displays the selected input signal.
- CHAN** Displays the selected module. The module is selected by the address set on the address switch of the input amplifier, not necessarily the position of the card in the system. If the selector does not select the expected channel, check that the address for the required amplifier module is correctly set.
- RACK** Displays the selected rack. This is only appropriate for systems containing more than one rack and having a 651 in the expansion racks. Rack 0 is the rack containing the 650 module.
- ▲ Used in conjunction with the CHAN and RACK push-buttons, increases the selected module and rack.
 - ▼ Used in conjunction with the CHAN and RACK push-buttons, decreases the selected module and rack.
 - A** Used in conjunction with the INPUT and displays channel A of the selected channel/rack.
 - B** Used in conjunction with the INPUT and displays channel B of the selected channel/rack.
-

EX Used in conjunction with the INPUT and displays the excitation voltage of the selected channel/rack.

For example, to change the selected channel from rack 0, channel 1a to rack 1 channel 2b do the following:-

Press the RACK button once and use the ▲ button to change from rack 0 to rack 1.
Press the CHAN button once and use the ▲ button to change from chan. 1 to chan. 2.
Press the INPUT button to tell the 650 to display the channel data in Volts.
Press the B button to select channel b of the selected channels. Note that not all amplifier modules have 2 channels.

2.2 What the 650 displays.

The 650 will display the output of the selected channel in volts. Even when the 650 has been given scaling values for a channel via its serial port, the data is still displayed in volts.

3.0 SERIAL INTERFACE CHOICE AND CONNECTIONS.

3.1 Deciding which serial interface type to use.

For a single 650 connected to a computer, use RS232 via the lead supplied. The factory defaults for the 650 are set to RS232. Using the standard 2m lead would mean that the baud rate could be as shown. The environment refers to the amount of electrical noise generated from other computers and machinery. Less is best!

<19.2k baud	Nearly all environments
38.4k baud	Most environments
57600 baud	Some environments

If you require a longer lead, up to 15m can be used. It should be made from high quality twisted pair cable. Above 10m cable length, 57600 baud may be unreliable. For lead lengths greater than 15m use RS485.

For applications where there is more than one instrument connected to the network, RS485 should be used. If RS485 is used, a converter may be necessary to convert RS485 to RS232 in order to match the host computer's serial port. RDP sell such a device and as there are problems caused by software handshaking, we recommend that the device that we have specifically tested is used.

RS422 is not normally used.

3.2 Which connector to use on the rear of the 650.

The serial lead plugs into different connectors depending on the type of housing.	Housing Type	Connector	Connections A and B are internally connected, so either A or B may be used.
	602 (270mm wide)	4A or 4B	
	603 (360mm wide)	8A or 8B	
	604+ (483mm wide)	13A or 13B	

3.3 Connections & Solder Pad Setting for all supported serial protocols.

See sections 3.4 to 3.5 for connection diagrams

Connections for 650 end of serial lead & Solder Pad Selection				
<p>The serial connectors have different pin-outs depending upon the serial protocol used. Once you have decided upon the protocol, the 7 pin DIN connector should be wired as shown. Additionally, it may be necessary to change some solder ad links on the main 650 circuit board. The diagram below shows the locations of the solder pads. The factory configuration is RS232. REFER TO 650 REMOVAL INSTRUCTIONS under Fig. 2.</p>	PIN / Solder Pad	Serial Protocol		
		RS232	RS422	RS485
	Pin 1	TX	TX-A	TX/RX-A
	Pin 2		TX-B	TX/RX-B
	Pin 3	RX	RX-A	
	Pin 4		RX-B	
	Pin 5	Ground		
	Pin 6	Screen		
	Pin 7			
	SP5 link	A to D	A to C	A to C
SP6 link	A to D	A to C	A to C	
SP7 link	A to C	A to C	A to B	
SP8 link	A to D	A to C	A to B	
SP9 link	A to C	A to B	A to B	

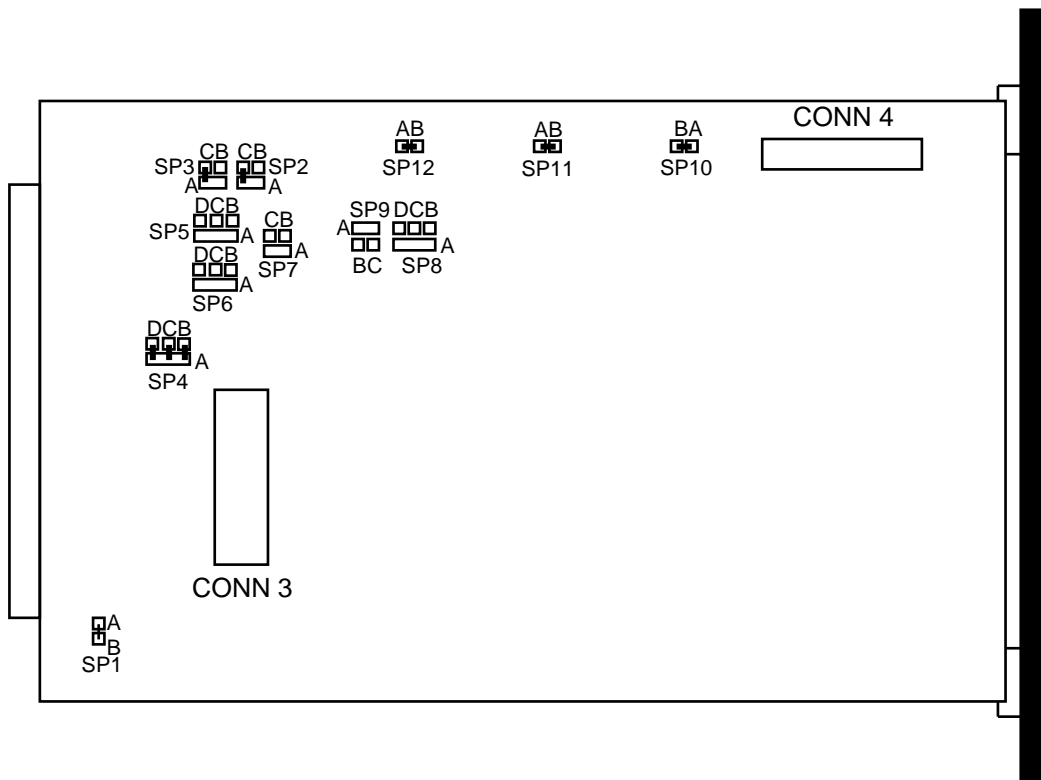
RS422 and RS485 also require line termination resistors detailed in the sections following.

Fig. 2 Location of Solder Pads for Serial Communication Selection

If the system has 651 modules fitted, care should be taken when removing the 650 as a ribbon cable connects the 650 and 651 modules.

To remove the 650, turn off power, undo the 4 screws on the front panel and withdraw unit. Anti-static precautions should be observed whilst handling the circuit board.

Note Solder pads SP1-4 and SP10-12 are for galvanic isolation and should not be changed.



3.4 RS232 Communication Summary & Connections

See section 3.3 for solder pad settings but note that default settings are for RS232 so changes may not be necessary.

Allows a single 650 to be connected to a PC using a good quality screened three-core cable. To simplify setting up and configuration, the 650 is configured in the factory for RS232 communication at 9600 baud and is supplied with a 2m RS232 serial interface lead.

3.5 RS422 Communication Summary & Connections

Due to the rarity of RS422 networks, they are not detailed here. Please contact RDP for information on connections.

3.6 RS485 Communication Summary & Connections

See section 3.3 for solder pad settings. NOTE, before changing solder pad links for RS485, connect using the RS232 lead and configure the software on the 650 for RS485 communications. See the section 5 and the SET COMMS instruction for details of how to do this.

Allows up to a maximum of two hundred and fifty six 650's to be connected to a single PC using a good quality dual pair cable (e.g. Belden 9841). If more than 32 units are used, or the network spreads over hundreds of metres, it may be necessary to use one or more line boosters.

To connect the RS485 network to the PC, a RS232 to RS485 converter will be required such as the Amplicon Model MA485F9 (see Figure 5 for connection details).

RS485 Line Termination

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 650 in the network is terminated by linking solder pad SP5 A-B as well as SP5 A-C.

RS485 Network Biasing Resistors

In some instances, particularly in RS422/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, the network is allowed to float. So it may be required to add extra resistors to the RS232 to RS485 converter, so that the network is biased to about 1 to 2 volts when all transmitters are enabled (please refer to manufacturers instructions for further information).

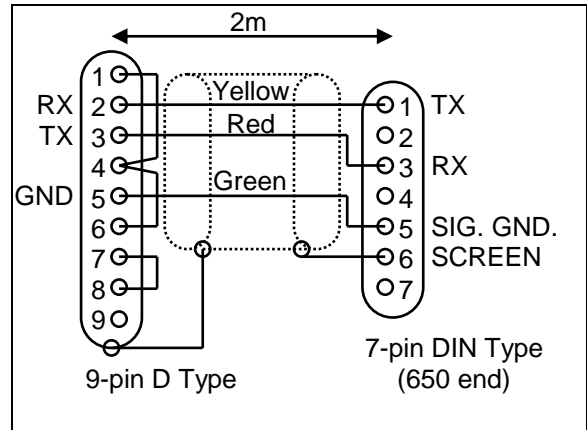
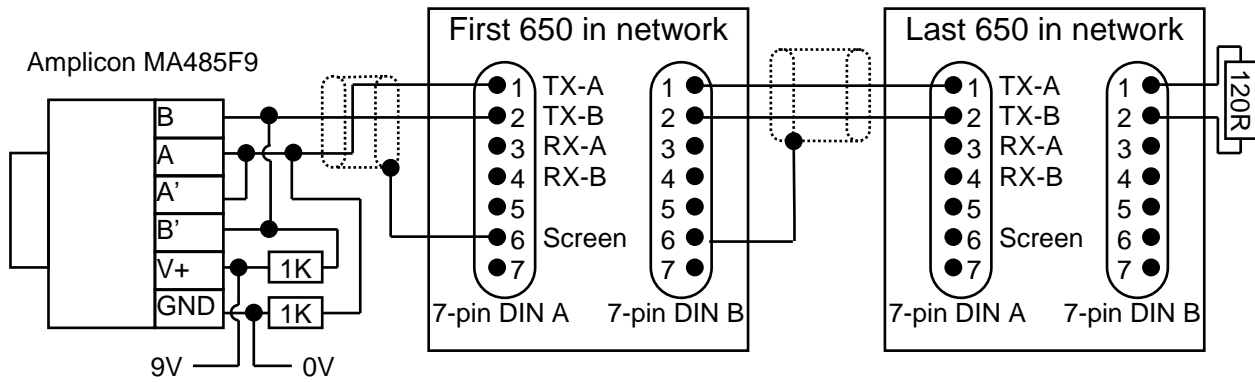


Fig. 3 Connections for RS232 lead.

The links between pins 1-4-6 and 7-8 at the computer end are essential due to the fact that the 650 uses software handshaking.

Fig. 4 Connections for a typical RS485 lead.



MA485 Jumper Positions	
Link	Description
J1 1-2 & J2 1-2	RS232 con. Wired as PC serial card
J3 1-2	RS485 local echo disabled

MA485 Switch Settings				
1	2	3	4	Description
x	x	x	ON	RS485 line termination on, termination resistor fitted
ON	ON	ON	x	RS485 transmit turnaround time = 512us

4.0 650 TO 651 CONNECTION DETAILS

This section is appropriate only to systems having more than one rack, and having a 650 in one rack, and having 651(s) on the other(s).

Each 651 connects is neighbour, or the 650 module via a ribbon cable. It is extremely unlikely that any changes or problems will be associated with the connection between the 650 and the 651(s)

The ribbon cable is connected to CONN3 of the 650.

It connects to CONN2 (marked IN) on the first 651. A subsequent 651 would connect between CONN3 (marked OUT) on the 651 to CONN2 (marked IN) on the next 651, and so on.

SW1 on the 651 sets the address of the sub-racks. The rack containing the 650 is rack 0. The first 651 should be set as 1 and so on.

If you require any further assistance regarding the 651 contact RDP.

5.0 SERIAL COMMUNICATIONS - CHOOSING THE BEST APPROACH

There are 3 approaches to communicating with the 650 module. The information below summarises these and will enable you to make the correct choice. It is necessary for you to decide how you want to use the product.

1 **M650 Configuration Software for Windows**

If you want to use the 650 as a stand-alone data logger (that is not connected to a pc) and you do not wish to become familiar with the instruction sets, you can use the Windows based M650ConfigurationSoftware.exe. This provides step-by-step instruction on configuring the 650 unit.

The program will have been supplied with your 650.

2 **Microsoft Excel Data Logger/Set-up Spreadsheets**

If you would like to get the data from your 650 directly into an Excel spreadsheet, then the set-up can also be done from the spreadsheet. Using this approach it is only necessary to configure the channels and then use the scan command to get data to the spreadsheet. From the spreadsheet, real time graphs can be set up, or any other of the functions of Excel used.

The Spreadsheet will have been supplied with your 650.

3 **Serial Terminal Emulation Program**

If you intend to use the 650 in conjunction with your own software, we suggest that you either configure the unit using the approach detailed in item 1 or that you use the terminal program within the M650ConfigurationSoftware.exe to send instructions directly to the 650 module from the keyboard. This approach is useful for gaining experience in the functions of the various commands.

A full summary of the commands and their syntax is contained within this manual.

6 **M650 CONFIGURATION SOFTWARE.EXE**

This M650 Configuration Software runs under Microsoft Windows environment and it has been designed primarily as a tool to assist in the configuration, calibration and programming of RDP's 650 Intelligent Computer Interface for the Microsoft Windows environment.

6.1 **Getting Started**

When the software is first started, a RDP copyright message will be displayed for a few seconds then you will be prompted to either create a New Configuration or Load Existing Configuration from the hard disk or go to the terminal program.

New Configuration

Click **[New Configuration]** if you are a new user or wish to create a new configuration then the software will guide you through creating a new configuration. Clicking **[Cancel]** at any time will exit the set-up wizard and save the new configuration file.

Load Existing Configuration

Will guide you through loading an existing configuration file off the hard disk. If you do not specify an existing configuration file then a new file will be automatically created with the default settings. Then the dialog box to Configure Communications will be displayed.

Terminal Program

This provides a facility to transmit typed instructions directly to the 650, and read the response. See terminal mode.

Network GuideLines (rules for successful serial communication)

To achieve successful and reliable serial communications, the following rules must be adhere to:

- a) The computer and all the instruments connected to the network must have the same communication protocol. If RS422/485 communication is being used then a suitable RS232 to RS422/485 converter must be used.
- b) The computer and all the instruments connected to the network must have the same baud rate selected.
- c) All the instruments must have identical command prefixes and delimiters (data and end of line separators). If the network has any E725 instruments connected then the command prefix must be '#'.
- d) Each instrument connected to the network must have a unique address.

Note All the instruments connected to the network must have the following communication parameters:

- a) The end of line characters must be CR/LF (see SET DELIMITERS).
- b) The software handshaking must be set on (see SET COMMS).

6.2 File Menu

Creating a New Configuration

Using the mouse click on the **F**ile menu, then click on **C**reate a **n**ew configuration file, then a series of dialog boxes will guide you through creating a new configuration by:

1) **Configure Communications**

Displays a dialog box to set the serial communication parameters on the computer. Note this does not program the communication settings of the instruments connected to the network.

2) **Add an Instrument to the Network**

Displays a dialog box to set the add an instrument to the configuration file. **Note** this option re-programs the instrument with current communication settings and the new instrument address.

3) **Modify 650 Configuration**

Displays a series of dialog boxes to modify the configuration. Initially a dialog box will be displayed listing all the configured instruments, select the required instrument and click **[OK]**.

Clicking **[Cancel]** at any time will exit the set-up wizard and save the new configuration file.

Open an existing configuration file

Using the mouse click on the **F**ile menu, then click on **O**pen existing configuration file, then a dialog box will be displayed allowing a 650 configuration file to be selected. **Note** the computers communication settings will be modified automatically.

Save configuration file

Using the mouse click on the **F**ile menu, then click on **S**ave configuration file, then a dialog box will be displayed allowing a file name to be entered.

Print Instrument Configuration

Using the mouse click on the **F**ile menu, then click on **P**rint Instrument Configuration, then a dialog box will be displayed listing all the configured instruments, select the required instrument and click **[OK]**.

Exit

Using the mouse click on the **F**ile menu, then click on **E**xit, to exit the M650 configuration software.

6.3 Edit Menu

Add Instrument to the Network

Using the mouse click on the **E**dit menu, then click on **A**dd Instrument to the Network, then a dialog box will be displayed allowing a new instrument to be configured. See on-line help for further information.

Delete Instrument Configuration

Using the mouse click on the **E**dit menu, then click on **D**elete Instrument Configuration, then a dialog box will be displayed listing all the configured instruments, select the required instrument and click **[OK]**.

Modify 650 Configuration

Using the mouse click on the **E**dit menu, then click on **M**odify **650 Configuration**, you will then be presented with a series of dialog boxes to modify the configuration. Initially a dialog box will be displayed listing all the configured instruments, select the required instrument and click **[OK]**. See on-line help for further information.

6.4 Comms Menu

Configure Communications

Using the mouse click on the **C**omms menu, then click on the **C**onfigure **C**ommunications menu and then you will be presented with a dialog box to set the following serial communication parameters on the computer. See on-line help for further information.

Note This does not program the communication settings of the instruments connected to the network.

If you are not sure about the communication settings of the instruments connected to the network then switch the instrument OFF and ON (POWER ON COMMS SUMMARY).

Scan Network for Connected Instruments

Using the mouse click on the **C**omms menu, then click on **S**can Network for Connected Instruments menu, then a dialog box will be displayed stating that NO INSTRUMENTS FOUND. Enter the address of the last instrument on the network and click [**S**can Network] to scan the network for any connected instruments, using the current comms configuration (see POWER ON COMMS SUMMARY). Any instruments found will be listed with the instrument address, instrument type and software version.

Program Instrument

Using the mouse click on the **C**omms menu, then click on **P**rogram **I**nstrument menu, then a dialog box will be displayed listing all the configured instruments, select the required instrument and click [**O**K].

Terminal Mode

Using the mouse click on the **C**omms menu, then click **T**erminal **M**ode, the terminal mode allows commands to be sent to the network. For example, type **#00 SYS** in the transmit window followed by the enter key will send the **SYS** command to the 650 (module address 00) and the response from the 650 will be displayed in the receive window. To clear either the transmit or receive windows position the mouse pointer over the appropriate clear button and click the left hand mouse button. To exit terminal mode click on the **T**erminal **M**ode menu option.

If any instruments have been configured then the following options will be displayed:

- a) Select a specific instrument (i.e. destination) for the Log and Scan commands.
- b) The Data Logging option (Log button), prompts for the name of the data output file before sending the **RUN** command to the selected instrument. From this point, any data received from the network will be saved in the specified file. Clicking the log button a second time will send the **END** command to the selected instrument and stop data logging. **Note** Exiting terminal mode will stop data logging.

- c) The Scan button sends the **SCAN** command to the selected instrument.

An alternative method of data logging is to use either the **RUN** or **SCAN** commands as follows:

- a) Use either the **RUN** or **SCAN** commands to acquire data.
- b) Position the mouse pointer at the start of the first data item.
- c) Press (and hold) the left hand mouse pointer, then move the mouse pointer to highlight all the required data.
- d) Press <Ctrl><C> to copy the data onto the clipboard.
- e) Open either MicroSoft Excel or Word and then press <Ctrl><V> to copy the data from the clipboard.

6.5 Timed Backup

Using the mouse click on the **Options** menu, then click on **Timed Backup**, you will be presented with a dialog box to enable/disable the automatic backup option and set the time interval in minutes between saves.

7 MICROSOFT EXCEL DATA LOGGER/SET-UP SPREADSHEETS

The details of the use of this facility are covered in a separate document, reference CD1425. The document is on the CD supplied with the 650.

Points of note are:

- 1 The configuration required is minimal. The required channels must be configured (using the set channel command) and then the settings save using the save command. It is not necessary to configure any of the data logging functions as they are not required
- 2 The Excel Spreadsheet has a command area into which the command is entered to instruct the 650 to send its data. The simplest command to use is the **SCAN** command, which instructs the 650 to send the data from all enabled channels, in ascending order of their channel number

8 SERIAL TERMINAL EMULATION PROGRAM

The terminal emulation program is available within the M650ConfigurationSoftware.exe. program supplied by RDP with the 650 unit. Its function is to turn your PC into a terminal emulator so that anything you type on the keyboard will be sent to the 650, and any response from the 650 will be sent to the monitor.

To access this software, run the M650ConfigurationSoftware.exe and from the menu select Terminal.

This allows you to see the response to each command and test any instructions that you may be planning to send.

Please note that characters are sent as you type them so if you make a mistake, you will have to press enter and allow the 650 to report an error, before starting the line again.

8.1 Establishing serial Communications

Before connecting the 650 system into any large networks, it is essential that you familiarise yourself with the operation of the unit on a simple one to one network with the host computer.

Connect the 650 to the host computer using the RS232 lead supplied.

Open the terminal program on the host PC.

Type '#00 sys' and then press ENTER

The unit should respond with an identification string, if it does, all is well, if not, check section 6.

9 650 SERIAL COMMANDS

The communication interface between the 650 and the host computer has been designed to be very flexible by using simple English commands. This makes it very simple to program the 650 using a terminal emulation program (see sections 8) 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 650 can be used on a RS422/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 must be terminated by a carriage-return. If the address of the command line does not match the programmed address of the 650 then the command will be ignored.

For example, suppose we want to set the real time clock on the 650 with address zero to 3pm, then the following command must be sent: -

#00 SET TIME,15:00:00

In this section, all the 650 commands will have the following format :-

#nn COMMAND,P1,P2

where **#nn** Please substitute **nn** with the address of the 650 module with 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.

9.1 650 commands – Quick Reference

All commands must be prefixed with '#nn ' where nn is the address of the 650 unit.

Command	Description
SYS	Prints the software version number.
CLR DATA	Clears all acquired data from the 650 memory.
CLR ERROR	Clears the error flag and counter.
CLR CHANNEL	Clears the specified channel to the default values.
CLR CHANNELS	Clears every channel to the default values.
CLR ALL CHANNELS	Clears every channel to the default values.
CLR PASSES	Clears passes one to eight to the default values.
CLR LOGSPEC	Clears the data logging parameters to the default values.
CLR ZERO	Clears tare readings to zero.
SET COMMS	Defines serial communication parameters.
SET DELIMITERS	Defines data separators.
SET DATE	Programs the real time clock (650ME1 unit only).
SET TIME	Programs the real time clock (650ME1 unit only).
SET CHANNEL	Defines channel set up parameters.
SET CHANNEL SCALING	Enables the specified channel, setting the scaling & format.
SET PASSES	Defines data acquisition rate and start/stop conditions.
SET HYSTERESIS	Defines the hysteresis for the start/stop conditions.
SET LOGSPEC	Defines the data logging parameters.
GET ERROR	Gets the error flag and counter.
GET CHANNEL	Reads the selected channel.
GET DATA	Reads the contents of the data buffer.
GET DATE	Reads the real time clock (650ME1 unit only).
GET TIME	Reads the real time clock (650ME1 unit only).
SAVE	Saves all the set up parameters to E ² PROM.
RESET	Causes the 650 to re-start.
ZERO	Zeros all channels having zeroscan enabled.
MEM SCAN	Scans all the enabled channels to memory.
SCAN	Executes a single scan of all the enabled channels, and transmits the data to the serial port.
RUN	Executes the programmed data acquisition parameters.
END	Terminates data acquisition.

9.2 Channel Address Entry Format

When a channel address is entered, it should be entered in the format rmmc where r is the rack number, mm is the 2 digit address for the amplifier module and c defined if the channel is channel a or b.

For example, to get the value of the channel in rack 0 (the one with the 650 in), module address 03 channel b, the command would be

```
#00 get channel,003b
```

9.3 650 Commands - Detailed Description

REMEMBER! All commands must be prefixed with '#nn ' where nn is the address of the 650 unit.

#nn SYS

Prints the software version number.

#nn CLR DATA

Sending this command causes all of the data stored in memory to be cleared. WARNING:- This command is effective immediately and once cleared, the data cannot be restored.

#nn CLR ERROR

Causes the error counter to be reset. The error counter stores the number of commands which have been received since the last **CLR ERROR** command and before an erroneous command.

#nn CLR CHANNELS

#nn CLR ALL CHANNELS

Both clear the set-up of all channels.

#nn CLR CHANNEL,Address

Clears the set-up of the specified channel. See 9.2 for format of *Address*.

#nn CLR PASSES

Clears passes one to eight to the programmed default values (see section 11.4). See SET PASS for details of PASS function

#nn CLR LOGSPEC

Clears the data logging parameters to the programmed default values (see section 11.4).

#nn CLR ZERO

This command will only affect channels with the tare facility enabled and it will set the tare reading for these channels to zero. See SET CHANNEL command for details of enabling tare facility.

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

Sets up the communications parameters for the 650.

Changing the Address and Mode will have an immediate effect on the 650 comms. The new baud rate will be set after the OK prompt has been transmitted to the computer. If the unit is switched off or the RESET command is sent, the changes will be lost unless they are saved in the E²PROM using the SAVE command.

- Address** Sets the module address of the 650. This only needs to be changed if a number of 650 units are connected to the same RS422 or RS485 network. Acceptable values are 00 to FF hexadecimal.
- Protocol** Sets the communications protocol for the 650. Acceptable values are 232, 422 or 485.
- BaudRate** Sets the communications baud rate of the 650. Acceptable values are 600, 1200, 2400, 4800, 9600, 19200, 38400 or 57600.
- HandShaking** Sets the response made by the 650 to a command. If **OFF** then the 650 does not make any response to commands otherwise if **ON** 650 will respond with OK<EOL1><EOL2> or ERROR<EOL1><EOL2> if the command was erroneous.

Where <EOL1><EOL2> are the current values set for DELIMITERS. See **SET DELIMITERS** command description.

For example, to set the 650 address to zero, RS232 communication at 9600 and software hand-shaking the command would be :-

#00 SET COMMS,00,232,9600,ON

#nn SET DELIMITERS,@DatSep1@DatSep2,@EOL1@EOL2

Sets the codes which separate the data and come at the end of each line of data. E.g.

DATETIME [DS1] [DS2] Data₁ [DS1] [DS2] Data_n [EOL1] [EOL2]

Where [DS1] [DS2] are data separators 1 and 2.
[EOL1] [EOL2] are end of line characters 1 and 2.

Codes for some common data separators and end of line characters are. Note, the DECIMAL values should be used & they do not print!

Null (nothing)	= 00	Carriage-Return	= 13
TAB	= 09	Line-Feed	= 10
Space	= 32	COMMA	= 44
Semicolon	= 59		

For example, to configure the 650 output file to be compatible with MicroSoft Excel (i.e. data separator = TAB and the end of line characters are carriage-return, line-feed) the command would be: - **#00 SET DELIMITERS,@09@00,@13@10**

#nn SET DATE,DD/MM/YYYY

(Only available with 650ME1 unit)

Sets the date on the internal real time clock. The format must be as shown above, for example to program the date 1st. February, 2000 the command would be :-

#00 SET DATE,01/02/2000

#nn SET TIME,HH:MM:SS

(Only available with 650ME1 unit)

Sets the time on the internal real time clock. The time is based on the twenty four hour clock and the format must be as shown above, for example to program the time 3.54pm the command would be :-

#00 SET TIME,15:54:00

#nn SET CHANNEL,Address,Enabled,TareFacility,Scaling,Offset,TarePoint,Format
OR

#nn SET CHANNEL SCALING,Address,Scaling,Offset

This command sets up the logging values for the specified channel. One must be specified for each channel, which needs to be logged. At least one **MUST** be specified in order for logging to work. SET CHANNEL SCALING is just an abbreviated form of SET CHANNEL. Using SET CHANNEL SCALING automatically enabled the channel and sets the format.

NOTE, BOTH OF THESE COMMANDS AUTOMATICALLY CLEAR ALL LOGGED DATA IN THE MEMORY OF THE 650.

Address Is the address of the channel to be set up, format is abbc where a is the rack number, bb is the module address and c is channel a or b. For example, to address module 3, channel a in the rack fitted with the 650 the address would be 003a.

Enabled This turns a channel on or off. If **ON** a channel will be logged, if **OFF** the channel will be ignored.

TareFacility This enables the tare facility (see **TarePoint**). If **ON** the channel will respond to the **ZERO** and **CLR ZERO** commands, if **OFF** these commands will be ignored by this channel.

Scaling The 650 assumes that the full scale of an input channel is 10V and if the scaling factor were 1, the channel would be stored in Volts. The value entered here is the multiplier required to convert the ±10V input signal into engineering units. In summary, the calculation for the scaling factor is:

$$\text{Scaling Factor} = \frac{\text{Full Scale Value (Engineering Units)}}{\text{Full Scale Value (Volts)}}$$

The input to the 650 can be monitored by selecting the required channel from the front panel (see Using the 650 in monitor mode).

Offset This is the zero offset one wishes to apply to the stored data. For example, if one wished to store 0 to 10mm instead of ± 5 mm the offset value would be 5. The best accuracy is achieved by scaling all bipolar channels as ± 10 V and applying the offset (if required) with this parameter.

TarePoint If the channel is enabled for the tare facility then this value is used to derive the tare reading when a ZERO is sent to the 650. The tare reading is calculated as follows:

$$\text{Tare Reading} = \text{ADC Reading} \times \text{Scaling} + \text{Offset} - \text{Tare Point}$$

Format A two digit number (LT). L=leading digits, T=trailing digits. This sets the number of digits stored. For example 23 would result in a number with 2 digits before the decimal point and three digits after. (eg 12.345). The maximum number of digits is eight. (i.e. L+T must be 8 or less however more than 5 digits will exceed the resolution of the A to D converter.)

For example, if channel 001A has a ± 25 mm LVDT, calibrated ± 10 V for ± 25 mm which one wishes to store as 0 to 50.000, with the tare facility enabled and a tare point of zero, the command would be: -

#nn SET CHANNEL,001A,ON,ON,2.5,25,0,23

or

#nn SET CHANNEL SCALING,001A,2.5,0 to set just the scaling and tare.

#nn SET PASS,PassNumber,Interval,Function,StartCondition,StopCondition

This function sets up the logging rate and start/stop conditions for a data logging step or PASS. A PASS is one of the eight data logging stages which can be defined and allows the operator to define different data logging rates etc. within one test.

For example, one may wish to acquire data very rapidly at the start of a test but less rapidly as the test continues. One of the ways of doing this is to specify a number of PASSES each with progressively slower data capture rates.

Alternatively one may wish to vary the data capture rate according to the value of one of the channels. This can be achieved by assigning PASSES which start and stop based on the value of one or more channels. Several examples of test applications are available in this manual.

All passes are executed in turn starting with pass 1 and ending with the pass with the highest number. A new pass cannot start until the stop condition for the previous pass has been met.

PassNumber This defines a pass number and the order in which the pass will be processed. The 650 will log at the values defined in PASS 1 first and then continue to PASS 2 etc., if more passes are defined. A subsequent pass cannot start until the stop condition of the previous pass has been met and the start condition of the subsequent pass has been met. Acceptable values are 1 to 8.

Interval This defines the time period between scans. A scan is a single capture of all of the enabled channels in the system. For example, if twelve channels are enabled, a scan will involve twelve channel readings. Acceptable values are 0.01 to 59999 seconds.

Function If you require a constant time between scans, set this value to 0. Any other value entered will change the scan period by the specified percentage for each pass (see formulae below), thus enabling logarithmic data logging rates.

Where $t_{(x+1)} = t_{(x)} + ft_{(x)}$
 $t_{(x+1)}$ = Next time interval between scans.
 $t_{(x)}$ = Current time interval between scans.
f = Fixed multiplier, expressed as a percentage.

Exmple, a positive number will cause the scan interval to increase (i.e. the logging rate gets slower) and a negative number will cause the scan interval to decrease (i.e. the logging rate gets faster). However, if this function is not required then enter 0. We suggest that you simulate the effect of the multiplier in a spreadsheet to see the effect on the logging interval.

StartCondition Defines the scan start condition. Summary of start conditions as follows:

IMM,,,, (the commas are essential)
Logging starts immediately if it is pass 1, or as soon as soon as the previous pass has finished if it is not pass 1

BUTTON,,,, (the commas are essential)
The pass starts as soon as the front panel ▲ button is pressed.

DELAY,Number_Of_Seconds,, (the commas are essential)
The pass starts after the specified delay of 0.01 to 59999 seconds.

LEVEL,Value,Channel,Condition,
Logging starts when the *value* of the *channel* meets *condition*. See 9.2 for details of channel number entry

Conditions are: H Channel level is higher than Value.
L Channel level is lower than Value.
LH Channel level rises through Value.
HL Channel level falls through Value.

Also, see **SET HYSTERESIS**

TIME,Time,Date,, (The commas are essential)
The pass starts at the specified time and date. This function is only available on the 650ME1 unit.

Time. The required time HH:MM:SS

Date. The required date DD/MM/YYYY.

If the date parameter is not entered, the pass will start at the time entered on the current date. In order to log at the same time every day, set multiple iterations and do not define a date.

StopCondition Defines the scan stop condition. Summary of stop conditions as follows:

BUTTON,,, (the commas are essential)

The pass stops as soon as the front panel ▼ button is pressed.

DURATION,Number_Of_Seconds,, (the commas are essential)

The pass stops after the specified duration of 0.01 to 59999 seconds.

BURST,Number_of_scans,, (the commas are essential)

The pass stops after the specified number of scans.

LEVEL,Value,Channel,Condition

Logging stops when the *value* of the *channel* meets *condition*. See 9.2 for details of channel number entry

Conditions are: H Channel level is higher than Value.

L Channel level is lower than Value.

LH Channel level rises through Value.

HL Channel level falls through Value.

Also, see **SET HYSTERESIS**

#nn SET HYSTERESIS, *Value*

This command sets the amount of hysteresis that is applied to the following start/stop conditions:

- i) Waiting for the input signal to pass through a pre-defined set point (high to low transition).
- ii) Waiting for the input signal to pass through a pre-defined set point (low to high transition).

Value Is the global amount of hysteresis applied to the set points in engineering units.

#nn SET LOGSPEC,*Passes,Iterations,Clock,Duration,Medium,Format,Serial,Auto*

This command sets up the data logging parameters, and the command line parameters are as follows :-

- Passes** Enter the number of passes (log stages) you have defined.
- Iterations** Enter the number of times you want the whole test to repeat (between 1 and 99). A test is from the beginning of pass1 to the end of the last pass. If you enter 0, the test will repeat infinitely or until interrupted.
- Clock** Defines if the data is time and date stamped. For the 650ME1 acceptable values are ON or OFF but for the 650 this must be off as the 650 does not have a real time clock.
- Duration** If set to **ON** the elapsed time since the last new pass or iteration began will be logged in seconds. If set to **OFF**, the elapsed time will not be logged.
- Medium** If set to **COMM** the data will be logged directly to the serial communications port in either the ASCII, hexadecimal or binary format as specified by the **Format** parameter. If set to **MEMORY** then the data will be logged to internal memory which can be later dumped to the host computer in the specified format.
- Format** This specifies the format for the data and is normally set to **ASCII** but could be **BIN** or **HEX**
- Serial** If set to **ON**, the 650 will respond to serial transmissions during logging. Logging can therefore be interrupted.
If set to **OFF** the unit will ignore all communications on the network. This facility is of most use when the 650 units are on a network. All of the 650 units will evaluate an instruction on the port to check the address of the unit to which the instruction is directed. It is possible that the time taken to evaluate an instruction may interfere with logging. Therefore, in this situation it is better to instruct the 650 to ignore the communications ports whilst it is logging.
The down side is that once the serial communications are turned off, it is not possible to interrupt a logging run via the serial port. For RS232 systems with a single 650, it is better to leave the serial port turned **ON**.
- Auto** If set to **ON**, the 650 will automatically go to RUN mode when it is switched on. Logging will start once the **StartCondition** for **PASS 1** is met (see **SET PASS**). This is useful when the 650 is to be used without a computer connected. If this is set to **OFF**, a computer will be required to send a **RUN** command before data can be captured.

#nn GET ERROR

The unit returns either the number of command lines it had received before the erroneous line and after the last **CLR ERROR** command or OK if no errors have occurred.

This facility allows a number of lines of command to be sent in a block and then error checked afterwards.

The **GET ERROR** command only returns the line number on which the FIRST error occurred. Also please ensure that the **CLR ERROR** command is used before the set up lines are re-sent.

#nn GET CHANNEL,*Address*

This request causes the 650 to return the current data value of the specified channel. See 9.2 for address format

#nn GET DATA

This instructs the 650 to down-load the data in memory to the serial communications port. The data separators and end of line codes will be as defined in the **SET DELIMITERS** command, please see **SET LOGSPEC,*Format*** for a detailed description of the data transmitted.

#nn GET DATE

(Only available on 650ME1)

The unit returns the current date followed by the defined end of line codes. Format is DD/MM/YYYY.

#nn GET TIME

(Only available on 650ME1)

The unit returns the current time followed by the defined end of line codes. Format is HH:MM:SS.

#nn SAVE

The 650 has a volatile and a non-volatile memory area. When logging, commands from the volatile memory area are used. The SAVE command writes the commands and settings from the volatile memory area to the non-volatile (EEPROM) area.

On start-up or after a RESET command, valued from the EEPROM are loaded into volatile memory.

#nn RESET

Completely resets the 650 (the same as turning off, then on). Volatile memory is overwritten by settings from EEPROM.

#nn ZERO

This causes all of the channels with the *TareFacility* enabled to be compared against the programmed *TarePoint* to calculate a tare reading for each channel. The tare reading is calculated as follows :-

$$\text{Tare Reading} = \text{ADC Reading} \times \text{Scaling} + \text{Offset} - \text{Tare Point}$$

#nn MEM SCAN

This command causes a single scan of all the enabled channels, the data is stored in memory and it can be retrieved at a later date using the **GET DATA** command.

Note This is a global command (i.e. all 650's connected to the network respond to the command and **nn** must be sent not the 650 module address.

#nn SCAN

This command causes a single scan of all the enabled channels, the data is transmitted immediately to the serial communication port in the specified data transmission format.

#nn RUN

This causes the 650 to go into RUN mode which means that it is waiting for the Start condition of PASS 1 to be met before logging actually starts. If the **Auto** is set to **ON**, the 650 will automatically go to RUN mode when it is powered up.

If the following have not been set up correctly, the RUN command will result in an ERROR.

- A) At least one channel must be configured.
- B) At least one PASS must be set. (see default values).
- C) The LOGSPEC command must be sent. (see default values).

The display shows 'S 1' as the 650 waits for the start condition for PASS 1 and the 'P 1' as PASS 1 is performed. It then shows 'S 2', if and as it waits for the start condition of PASS 2 and then 'P 2' as PASS 2 is performed etc.

Following the completion of the test, the unit will return to monitor mode.

#nn END

The end command causes the unit to leave RUN mode and go to monitor mode. This is useful if one wishes to terminate a test earlier than planned. Also, a unit which is configured with the **Auto ON**, must be sent this command before the unit will go to monitor mode and control can be regained.

10 CONFIGURING THE 650 FOR RS422 OR RS485.

ONCE RS232 COMMUNICATIONS HAVE BEEN SUCCESSFULLY ESTABLISHED, it is necessary to change the 650 to the required new protocol. Using RS232, an instruction line must be sent, for which you will need to know the current baud rate (see section 6.1) and the new address of the 650 unit.

Run the RDP terminal program (see section 8)

If there is an existing network containing other 650 units, the address of the new unit should be the next available address, and the baud rate to the baud rate of the existing network.

If there is no existing network, the address of the unit should be changed to 01, and the baud rate set to the existing value (it can be changed later if required).

To change the communications settings send the command

#00 SET COMMS,XX,YYY,ZZZ,ON then press enter

Where XX is the new module address and

And YYY is the communication protocol (either 422 or 485)

And ZZZ is the required baud rate, either 600,1200,2400,4800,9600,19200, 38400 or 57600

The unit should respond with OK

Then send

#nn SAVE then press enter

where nn is the new address as set above.

The unit should respond with OK.

The unit can now be configured with the appropriate connections and solder pad settings (see section 3.3) and connected into the network.

11 SERIAL COMMUNICATION PROBLEMS

Check the baud rate. Check that the serial lead is connected to the correct socket on the 600 system. Check that the address you are using is correct. Failing this, please follow the diagnostics routines detailed below. Change the solder pad connections back to the RS232 settings (see section 3.3). Connect the 2m RS232 lead supplied by RDP between the 650 and the host computer. See section 3.2 for details of the correct socket to use on the 650 system. Run the terminal program supplied by RDP.

MOST COMMUNICATION PROBLEMS ARE CAUSED BY INCORRECT CONNECTIONS. CHECK THESE AND THEN CHECK AGAIN.

Type the command **#00 sys**, then press ENTER. An ID string should be returned. If it is, communications are successful. If not proceed to 11.1.

11.1 Establishing 650 Communication Settings (Display during Start-up)

In order for communications to be successful, both the computer and the 650 must have the same communication settings. To find out the settings of the 650, turn it off, then on again and write down the display sequence. It runs as follows: -

- a) Instrument Identification (e.g. 650).
- b) Software Version Number (e.g. 1.06)
- c) Summary of the current COMMS settings in the format 'XX.Y.Z' for five seconds.
Where XX = Module Address (a 2 digit number, e.g. 00)

Y = Communication Mode:	0 = RS232	1 = RS422	2 = RS485
Z = Baud Rate:	0 = 600	1 = 1200	2 = 2400
	3 = 4800	4 = 9600	5 = 19200
	6 = 38400	7 = 57600	

Check that the address of the 650. Type the command **#nn sys** (then press ENTER) where nn is the address to which the 650 is set. If the ID string is not sent proceed to 6.2

11.2 Matching the 650 Baud Rate to the Computer Baud Rate

Establish the 650 baud rate as detailed in section 6.1. In the terminal program settings, change the baud rate to the same value as the 650 unit. Type the command **#nn sys** (then press ENTER) where nn is the address to which the 650 is set. If the ID string is not sent proceed to 11.3

11.3 Resetting Serial Comms to Factory Values (POWER-ON RESET)

You can set the 650 back to default values as follows; turn the unit off then hold the ▲ and ▼ keys and turn the unit on. The settings will be as follows:

Address = 00
Communications mode = RS232
Baud rate = 9600

Note that these settings are volatile, if the unit is turned off, the settings will revert to the values saved. Re-try the communications with these settings. Full default values are detailed in 11.4. If this fails, again check the connections. Otherwise, contact your supplier.

11.4 650 Default Software Settings (after power on reset)

Unless specified otherwise, the 650 will have the following settings when supplied. To return a unit to these settings one must perform a **POWER ON RESET**. For details of how this is done refer to section 6.

Serial Communication Settings (COMMS)

Command which would set default values:

```
#00 SET COMMS,00,232,9600,ON  
i.e. Module Address = 00  
Protocol = 232  
Baud Rate = 9600  
Hand-Shaking = ON
```

Data Separators

Command which would set default values:

```
#00 SET DELIMITERS,@09@00,@13@10
```

i.e. Data Separator 1	= @09 (Tab)
Data Separator 2	= @00 (Null)
End Of Line 1	= @13 (Carriage-Return)
End Of Line 2	= @10 (Line-Feed)

Data Logging Specification

Command which would set default values:

#00 SET LOGSPEC,1,1,OFF,OFF,COMM,ASCII,ON,OFF

i.e. Number of Passes	= 1
Number of Iterations	= 1
Log Real Time Clock	= OFF
Log Test Duration	= OFF
Logging Medium	= COMM
Data Transmission	= ASCII
Format	
Serial Reception	= ON
Autoexec	= OFF

Test Pass Specification

Command which would set default values:

#00 SET PASS,1,1,0,IMM,,,BURST,1,,

i.e. Pass Number	= 1
Scan Interval	= 1
Function	= 0
Start Condition	= IMM
Stop Condition	= BURST,1

12 GENERAL SPECIFICATION

General

Display	±10.000 LED for data & selected channel reference to simplify cal and set-up. Display is also used to display the logging status (see RUN command, section 7.2 for further information).
Sample Rate	1 Hz
Linearity	±0.005 % FS
System Accuracy	±0.03% FS
Temperature	Zero 0.002% FS/°C typical
Coefficient	Gain 0.005% FS/°C typical
Input Signal	±10v for ±10.000 display
Supply	±15v (+125mA, -2.6mA)
Channels	164
Dimensions	Height 133.35 mm (3U), Width 81.28 mm (16HP)
Controls	Input, channel and rack selection
Operating temperature	0 to 60°C

Serial Communication

Standards	RS232, RS422 and RS485
Protocol	1 start, 8 data and 1 stop bit, no parity.
Baud Rates	600, 1200, 2400, 4800, 9600, 19200, 38400, 57600.
Line Termination	120 (RS422, RS485 communication only).
650 Addressing	00 - FF Hex (RS422, RS485 communication only).
Maximum Cable Length	15m (RS232). 1200m (RS422, RS485).
Transient Suppression	Standard.

Galvanic Isolation Optional.

Analogue to Digital Converter

ADC 16 bit analogue to digital converter calibrated to read ± 10.25 volts full scale and with a typical conversion time of $17\mu\text{S}$.

Data Storage (max)

650	10240 channel readings.	Time and date stamping count as
650 ME1	65530 channel readings.	2 channel readings