MATELECT ISM INTERFACE UNIT

Type IU-1
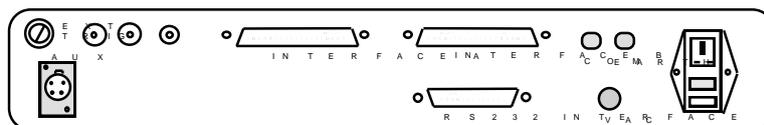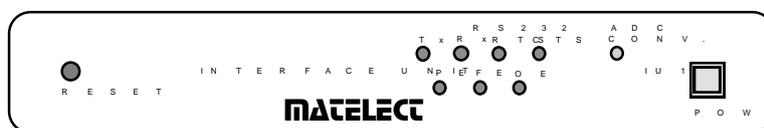
INSTRUCTION MANUAL

MATELECT ISM SYSTEM - COMPUTER CONTROL INTERFACE UNIT
TYPE IU-1

Thank you for your interest in our product, we hope that it will serve your needs and prove a reliable tool.

This product has been designed to the highest standard in both electronic and mechanical design, with careful attention to stability, reliability and electrical safety.

The ISM-5A has established itself as the most advanced EBIC amplifier and is routinely used in many prestigious laboratories throughout the world. The IU-1 interface unit permits control of the ISM-5A via a host IBM compatible personal computer.

Matelect manufacture the ISM system and have also built up considerable experience of the EBIC/EBIV techniques. Please contact us should you ever require further information or assistance.

IMPORTANT

Please read these instructions carefully before you use the instrument. Please pay particular attention to the section that follows on mains operation. For your reference please also read our terms and conditions of sale printed at the rear of this manual.

Please note that there are no user serviceable parts within the IU-1. Never attempt to open the instrument case as this will void any warranty. Please contact Matelect should you ever experience any difficulties.

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2. MAINS OPERATION

This section applies to all mains operated instruments
PLEASE READ BEFORE OPERATION

Before use, please make sure that the instrument's supply rating is correct for the location it will be used in. The IU-1 can be operated on both 110 and 220V supplies by appropriate selection on the input voltage switch (see page 8). Before shipment, your instrument will have been set for the commonly used voltage in your locality.

The instrument must be connected to the mains supply using an IEC mains lead terminated with the appropriate local mains plug. The unit is supplied with a suitable lead for this purpose.

The instrument is housed in a metal case for strength and electromagnetic screening purposes and therefore PLEASE ENSURE that the instrument is earthed to the mains earth via the IEC connector.

In addition to the fuse that may be present in the mains plug (e.g. UK versions), the IU-1 is fitted with two equipment fuses for protection. These fuses are located in the IEC input socket on the rear panel of the IU-1. Both fuses need to be functional if the equipment is to be operated.

The instrument fuses are rated at 500 milliampere and are of the 20mm "anti surge" type. Never replace these with fuses of a different type or rating as the instrument can be seriously damaged.

Ensure that the IU-1 does not come into contact with fluids or corrosive gases and that it is operated within the temperature range of 0 - 40°C.

3. CONTENTS

4. OVERVIEW:

The ISM system has been designed to allow the precise measurement of induced signals in semiconductor materials characterisation.

The ISM system is utilised in conjunction with the user's scanning electron microscope. Precise measurements of induced current and induced voltage are possible depending on the system configuration. In addition, the induced signal can be fed back into the SEM's cathode ray tube display so as to create an image of the specimen using that particular quantity.

The ISM system is mainly used for electron beam induced current studies (EBIC) although it is able to perform induced voltage (EBIV) work and various forms of cathodoluminescence measurements when using an appropriate detector.

A short applications note is reproduced at the end of this manual and acts as a brief introduction to the EBIC technique. Further advice on techniques and equipment can be obtained by contacting Matelect.

This manual applies to the IU-1 computer control interface unit. This connects via the cables supplied to the ISM-5 or ISM-5A.   Separate manuals deal with the ISM-5/5A unit and the ISMsoft data acquisition program for IBM PCs. The IU-1 permits the user to control the ISM-5A using a PC. It also allows the accurate recording of linescan data from an SEM (via the ISM-5A). This can then be subsequently transferred to the host PC.

The IU-1 communicates with the host PC via an RS232 serial link.   It is important to note that all communication is via ASCII character strings. Users can either choose to type these in directly using a terminal emulator or they can be incorporated into a suitable control program.

For users who do not wish to do their own programming, Matelect can supply the ISMsoft package which is a user friendly control, acquisition and display program for use with the IU-1 and ISM-5A. If you have this package, please refer to the accompanying manual for further details on its operation.

Linescan acquisition must be triggered from the SEM and an opto-coupled trigger unit is therefore incorporated into the IU-1. In units supplied from 1992 onwards, this trigger unit has been improved to cope with SEMs with low power X-scan outputs. Adjustment of the trigger to a particular point on the X-scan waveform can also be achieved.   Pre '92 units can be updated using the external trigger unit, type XSC-1, available from Matelect.

Users who experience any difficulty in operation of the equipment are advised to contact Matelect at the address given at the beginning of this manual.

5. GENERAL DESCRIPTION

The IU-1 interface unit enables the user to control the ISM-5A from a host computer with an RS232 serial port.

The unit has within it, a Z80 microprocessor which interprets ASCII commands sent via the serial link, by either a dumb terminal or a purpose written program such as Matelect's ISMsoft. The microprocessor can control all the major front panel functions of the ISM-5A. The IU-1 also has an on-board fast 12 bit analogue to digital converter (ADC) which permits it to acquire linescan data and down load this via the RS232 link.

The unit resets itself on powering up, but a front panel reset switch is also provided. On reset, if the ISM-5A **REMOTE** switch is **ON**, all the ISM-5A front panel controls are disabled. Additionally the most sensitive head amplifier range, the minimum back-off current range and the maximum short circuit trigger are selected. Internal 12 bit digital to analogue converters (DACs) then take over from the 10 turn pots on the ISM-5A and are set at their midpoint values (this corresponds to code 2048- see command section)

Switching the **REMOTE** control to the **OFF** position on the ISM-5, or doing the same via the host computer, has a similar effect to resetting the unit, except that the DAC settings are not affected.

The IU-1 instruction set consists of over 70 commands, but the unit only responds to two commands when the system is not in **REMOTE** mode. These commands are **CCM** (Check Control Mode) and **OVL** (override **LOCAL** Mode). When the **OVL** command is issued via the host computer (from the keyboard or via a program), all the controls on the ISM, including the **REMOTE** switch, are disabled. The ISM is then controlled totally via the host PC and the IU-1. A return to **LOCAL** (manual) mode is only possible by sending the **ENL** (Enable Local mode) or by resetting the IU-1.

The three 4½ digit displays on the ISM-5A are updated 2 times per second. These slow conversions may cause the RS232 interface to produce a time out error at either the host computer end or at the IU-1 when an attempt is made to read their data. Users should therefore note that any programs that are written to control the IU-1 should take account of this and re-transmit the appropriate character string if no reply is received.

The IU-1 will ignore commands that are entered incorrectly. Interface time-outs are treated as incorrect commands. The unit will also ignore commands to read data points once the fast ADC circuit has begun data conversion.

On reset, the transmission buffer on the IU-1 may contain undefined characters so that the first command that causes the unit to give a reply may also cause an error to be detected by the host computer.

Please note that when the ICA-1 head amplifier is in use with the ISM-5A and also set to its most sensitive range (2nA full scale deflection), the back-off current range will be limited automatically to the lowest 2 ranges by circuitry in the ISM-5A unit. Appropriate tests can be included in any control program to alert the user that he is trying to set a back-off current when not allowed to do so.

The following sections describe the operation of the IU-1 in greater detail.

6. IU-1 Front Panel, - A Description.

Please refer to the diagrams of the front and back panel layouts (page 10)

- **1. Reset Switch:**
  This push button switch resets the IU-1 interface unit manually. The reset sequence takes about 3 seconds. During this period the IU-1 checks its internal memory. If a fault is discovered, the RS232 Error indicators will flash in sequence. When the reset process is completed the **RTS** indicator will light.

- **2. RS232 Indicators:**
  These LED lamps show the state of the RS232 lines used by the IU-1 to communicate with host computer. Outputs from the IU-1, i.e. **Tx** and **RTS** lines, are displayed by green LEDs. Inputs are shown by yellow LEDs and RS232 errors are indicated by red LEDs

- **3. ADC Conversion Indicator:**
  This is a green LED which lights whenever the 12 bit analogue to digital converter (**ADC**) in the IU-1 is selected.

- **4. Power On Indicator**: This is illuminated when the instrument is switched on by the mains switch incorporated in the chassis plug on the back panel.

7. IU-1 Rear panel, - A Description

Please see the diagrams of the front and back panel layouts on page 10

- **1. Mains switch and double fused chassis plug**
  Power requirement: 110/240V AC 50-60Hz.
  Two 20mm 500mA antisurge fuses are fitted in the chassis plug.
  Please read the caution on mains operation at the start of this manual.
  The mains connection to the IU-1 unit must be via an IEC cable,
  terminated with an EARTHED mains plug suitable for the country of use.
  The relevant input voltage is selected using control 2 (see below)

- **2. Voltage selector switch**
  This rotary selector switch enables the ISM-5A's mains supply to be set at
  either 240 or 110V. Ensure that the unit is not connected to the mains
  supply when changing the selector position.
  *INCORRECTLY SETTING THIS SWITCH, IS DANGEROUS AND WILL
  SERIOUSLY DAMAGE THE EQUIPMENT*

- **3. Earth and Common (COM) terminals.**
  The earth terminal is connected to the mains earth and the case of the
  instrument. The common (**COM**) terminal is connected to the
  circuit ground.

  The two terminals can be connected together or disconnected as
  appropriate to reduce noise pick-up. The common terminals of both
  the IU-1 and the ISM-5A should be connected together.

- **4. Interface A and Interface B chassis plugs.**
  The control and signal cables to the ISM-5A are connected here.
  Interface A on the IU-1 should be connected to the **Interface A** on the
  ISM-5A and the same for B.

- **5. RS232 Plug**
  The IU-1 communicates with the host computer via an RS232 cable
  connected to this point. The 25 way D connector is wired as follows.

  Pin 1   Tx transmitted data   (IU-1 output)
  Pin 2   Rx Received data   (IU-1 input)
  Pin 3   RTS Request to send (IU-1 output)
  Pin 4   CTS Clear to send   (IU-1 input)
  Pin 6   Not connected
  Pin 7   COM Signal ground

  The RS232 signals are opto-coupled in the IU-1 to avoid any possible earth

  loops with the host computer. The interface unit is factory set to operate at

9600 baud with EVEN parity, one stop bit and seven data bits.   The baud rate can be set to other values - please contact Matelect for further information. Please note that the RS232 COM pin is at the signal ground level with respect to the host computer and is not connected to the common (**COM**) or **EARTH** terminals on the rear of the IU-1.

- **6. Auxiliary Input Socket**

  This allows signals sources other than the output from the ISM-5A to be routed through the IU-1 and then to the host PC.
  The on-board ADC converts the **AUX**. analogue input to an accuracy of 12 bits and can be used to record linescan profiles from other signal sources such as back-scattered or secondary electron detectors.
  The input is not isolated and should be limited to ± 2 Volts with respect to the signal common. The signal common is connected to the common circuit point of the IU-1 circuitry.

  The AUX. socket also supplies ±15 volts at a maximum of 50mA. The pin-outs are shown below

  1. -15 Volts out
  2. Signal input
  3. Signal comm
 4. +15 Volts ou
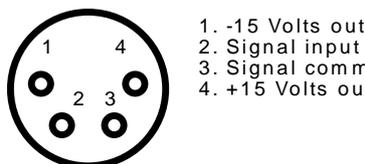
- **7. Trigger sockets and adjustment pot:**

  This is a collection of two connectors, a fuse and adjustable potentiometer.

  The fuse holder contains a 50mA, antisurge, 20mm fuse that protects the X-scan output of the SEM in the event of a fault condition.
  If the fuse blows then contact Matelect since this indicates a serious fault.

  The trigger input is fully floating to eliminate earth loop problems and circuit incompatibility. A suitable waveform is input into **BNC A**. The internal circuitry then processes this waveform to produce a clean, regular square wave which is used to trigger the IU-1 data acquisition.   This waveform can be observed via **BNC B** (using an oscilloscope) and the triggering position with respect to the input waveform can be adjusted using the pre-set potentiometer. The potentiometer is factory set to the mid point and should it be found necessary to adjust it, follow the instructions in section 9

  FUSE HOLDER   BNC A (in)   BNC B (out)   ADJUSTMENT POTENTIOMETE
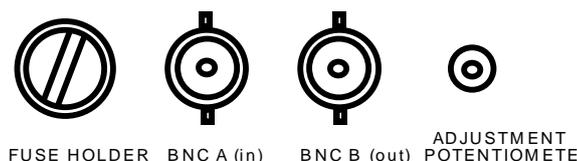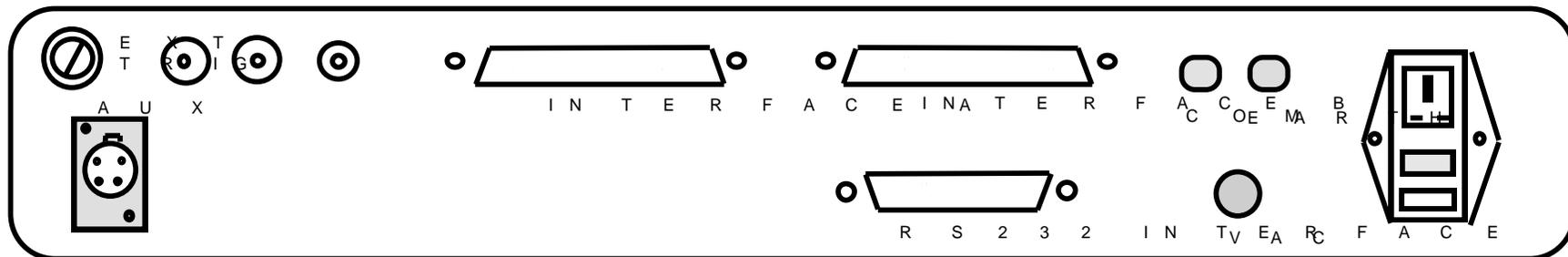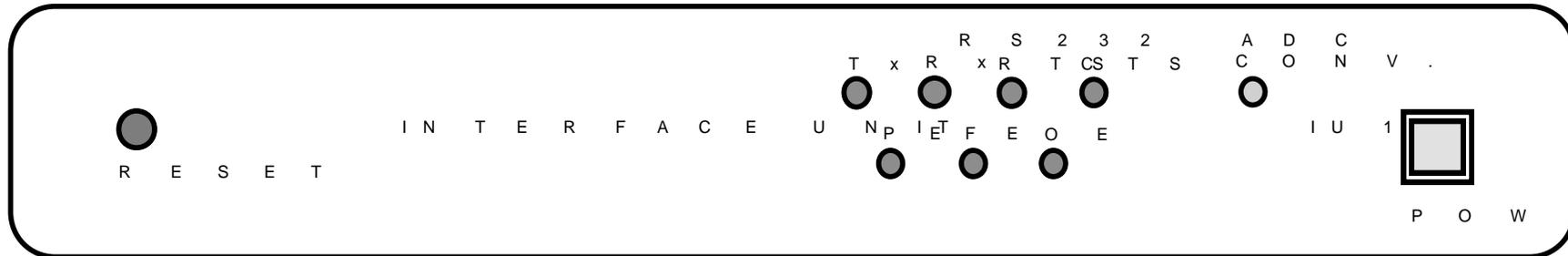
Front and Rear Panel Views of the IU-1

8. Connections to the ISM and PC

The IU-1 is supplied with the following cables:
1. Interface A (IU-1) to Interface A (ISM)   37 way IDC D Connector to same
2. Interface B (IU-1) to Interface B (ISM)   37 way IDC D Connector to same
3. RS232 (IU-1) to RS232 (COM-1, PC)   25 way D connector to same
4. Trigger input (IU-1) to X scan (SEM)   BNC to same
5. Mains to IU-1 power in.   Mains plug to IEC plug
6. ISM COMmon to IU-1 COMmon solder terminated wire to same
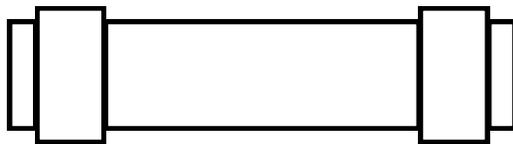
Interface A (IU-1) to Interface A (ISM)
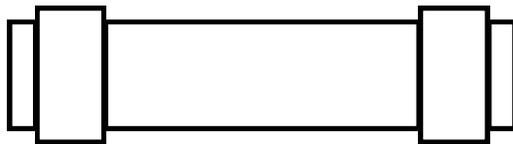
Interface B (IU-1) to Interface B (ISM)
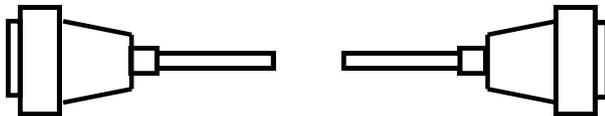
RS232 (IU-1) to COM-1 (PC)

Trigger (IU-1) to X-scan (SEM)
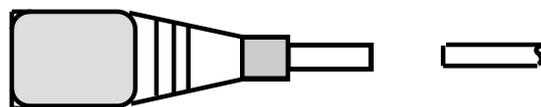
IEC Mains input (IU-1) to Local mains plug

IU-1 common to ISM common

The following diagram should be observed for connections between the IU-1 and the ISM-5A. Please ensure that all connectors are fully pushed home. Those that are provided with a locking mechanism, should be securely fastened. Do not allow the connectors or cables to be strained or placed under unnecessary stress.
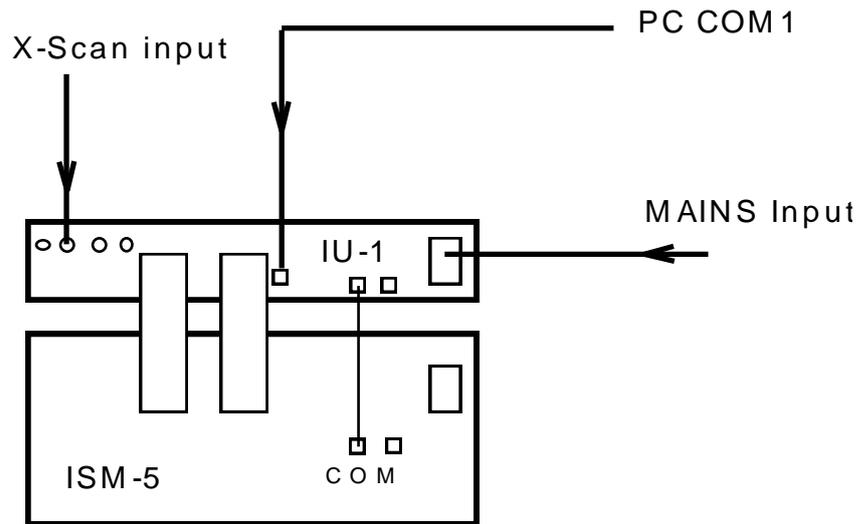
9. Setting Up The Trigger Unit

When the linescan data acquisition mode of the IU-1 has been invoked, it is necessary to initiate the analogue to digital conversion. This is performed by using an external trigger input. The input can be single shot or it can be derived from a waveform. The usual methodology is to use the X-scan signal from an SEM to trigger the acquisition. The period of the acquisition has to be set by the user. The period is either set using the interface commands such as **SAR** (see later) or via a purpose written driver program such as ISMsoft. ISMsoft also incorporates a configuration program (Matelect.cfg) which allows users to set different acquisition periods corresponding to the different scan periods available on their microscope. This is described in greater detail in the manual that accompanies ISMsoft.

The trigger unit is located within the IU-1 in models produced after mid 1992. On models produced before this, an optocoupler was utilised as the trigger. This requires at least 5mA of current from the triggering source in order to function reliably. The present design takes negligible current from the source and can therefore be used with low impedance outputs. An external unit (the XSC-1) can be supplied to upgrade old IU-1 units.

The trigger unit is fully floating and has no connection to the common of the IU-1. The outer of the X-scan input BNC forms the floating common. The trigger has been factory set to accept a pulse or waveform of up to 10 volts either side of the floating common. The trigger operates when the input signal crosses the value of the X-scan common. Thus if the X-scan common is zero volts, the trigger is set to operate when the value of the X-scan waveform crosses or reaches zero volts.

The trigger can be adjusted to operate at any point on the X-scan waveform. For example, if the waveform is not centred about signal common, it may be necessary to alter the triggering point to account for this.

A ten turn potentiometer (see rear panel description in section 7) provides this adjustment facility. It is located on the rear panel close to the X-scan input BNC. Immediately adjacent to it is a second BNC which permits the user to view (using an oscilloscope) the internal trigger signal.

To adjust the trigger point, users should connect the X-scan signal to the input BNC, whilst monitoring the waveform on a dual channel oscilloscope (use a BNC branch adapter for this purpose). The trigger output can be displayed on the second channel of the oscilloscope, thereby allowing a direct comparison of the two waveforms. By adjusting the position of the 10 ten potentiometer, the triggering position can be altered as required. The diagram overleaf, illustrates two examples of different trigger positions.

Users who wish to carry out this procedure but require further information, should contact Matelect.

Typical X-scan waveform (zero crossing)

V

A ———————————————————— see trace
t
see trace

V

B

Resultant trigger waveform when trigger point is set
to the zero cross-over point

V

C

Trigger waveform for cross-over below zero
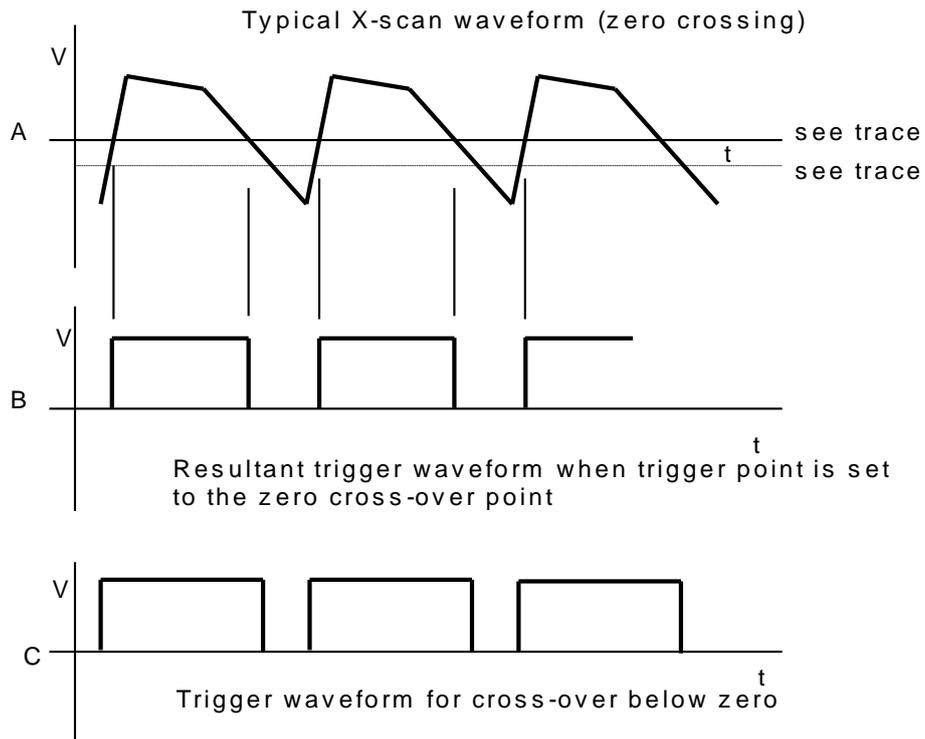
10. Interface Commands

The following list of commands is recognised by the IU-1 interface unit. They can be sent down the RS232 serial link from a host computer that either emulates a terminal, and hence outputs the relevant ASCII strings directly, or more usually, the commands can be built into a software program.

Users who do not wish to write their own programs can use the ISMsoft control and acquisition program, available from Matelect.

Command	Control Mode	Head-amp Mode	Output	Description
BCI	Remote	Current	–	Back-off current in.
BCO	Remote	X	–	Back-off current out. Back-off current test out
BCT	Remote	X	–	Back-off current test in.
BVI	Remote	Current	–	Bias voltage in.
BVO	Remote	X	–	Bias voltage out. Bias voltage test out
BVT	Remote	X	–	Bias voltage test in; reset short-circuit trigger.
CAB	Remote	X	ABn	Check analog output bias DAC setting. n=0 to 4095
CAG	Remote	X	AGn	Check analog gain setting AG0 = x0.1 AG5 = x5 AG1 = x0.2 AG6 = x10 AG2 = x0.5 AG7 = x20 AG3 = x1 AG8 = x50 AG4 = x2 AG9 = x100
CAN	Remote	X	ANn	Check fast ADC datapoint buffer size. n=0 to 8192.
CAR	Remote	X	ARn	Check fast ADC recording rate. n=15 to 255. rate = 153,600/n points/sec.
CBC	Remote	X	BCc	Check back-off current status. BCI = Back-off current in. BCO = Back-off current out BCT = Back off current test in.
CBV	Remote	X	BVc	Check bias voltage status. BVI = Bias voltage in. BVO =Bias voltage out BVT = Bias voltage test in.
CCC	Remote	X	CCn	Check back-off current COARSE DAC setting. n=0 to 4095.
CCF	Remote	X	CFn	Check back-off current FINE DAC setting. n=0 to 4095
CCM	X	X	c	Check control mode status. L = Local (manual) mode. R = Remote control mode. S = Short-circuit mode. E = Control mode conflict.

Command	Control Mode	Head-amp Mode	Output	Description
CCR	Remote	X	CRn	Check back-off current RANGE CR0 = 100nA CR4 = 1mA CR1 = 1uA CR5 = 2mA CR2 = 10uA CR6 = 20mA CR3 = 100uA
CEA	Remote	X	EAn	Check fast ADC input status. EA1 = Head-amplifier output. EA2 = Control unit output.
CFR	Remote	X	FRn	Check filter range. FR0 = reserved FR3 = 1kHz FR1 = 10Hz FR4 = 10kHz FR2 = 100Hz FR5 = Out
CHM	Remote	X	c, Cn	Check head-amplifier mode. B = Beam current mode. V = Voltage mode. Cn = Current mode. C0 = bc off and bv off. C1 = bc on. C2 = bv on C3 = bc on and bv on C4 = bct on. C5 = bvt on. C6 = bct on and bvt on. C7 = bc on and bvt on. C8 = bv on and bct on. bc = Back-off current. bv = Bias voltage. bct = bc test. bvt = bv test.
CII	Remote	X	In	Check invert switch status. IO = normal I1 = invert
CSR	Remote	X	SRn	Check signal output RANGE Mode : **Current** **Voltage** SR0 = 2mA 10v SR1 = 200uA 10v SR2 = 20uA 10v SR3 = 2uA 2v SR4 = 200nA 200mV SR5 = 20nA 20mV SR6 = 2nA 2mV
CST	Remote	X	STn	Check short-circuit trigger RANGE. STO = 10mA ST3 = 0.5mA ST1 = 5mA ST4 = 0.1mA ST2 = 1mA
CUG	Remote	X	UGn	Check uncalibrated gain status. n = 0 to 15. Gain = x1 to x2.5
CVC	Remote	X	CVn	Check bias voltage COARSE DAC setting. n=0 to 4095.
CVF	Remote	X	CFn	Check bias voltage FINE DAC setting. n=0 to 4095
DABn	Remote	X	–	Decrement analog output bias DAC setting by n . n=0 to 9999
DAGn	Remote	X	–	Decrement analog gain setting by n.
DCCn	Remote	X	–	Decrement back-off current COARSE DAC setting by n.

Command	Control Mode	Head-amp Mode	Output	Description
DCFn	Remote	X	–	Decrement back-off current FINE DAC setting by n.
DFRn	Remote	X	–	Decrement filter range by n.
DUGn	Remote	X	–	Decrement uncalibrated gain setting by n
DVCn	Remote	X	–	Decrement bias voltage COARSE DAC setting by n
DVFn	Remote	X	–	Decrement bias voltage FINE DAC setting by n
EA1	Remote	X	–	Set fast input to head amplifier output.
EA2	Remote	X	–	Set fast ADC output to control unit output.
ENL	Remote	X	–	Enable local (manual) mode; reset switches and ranges to initialisation state. DAC settings not affected.
G	Remote	X	–	Start fast ADC conversions. Conversions are aborted if buffer is not initialised or if a short-circuit occurs.
IABn	Remote	X	–	Increment analog output bias DAC settings by n . n=0 to 9999.
IAGn	Remote	X	–	Increment analog gain setting by n.
ICCn	Remote	X	–	Increment back-off current COARSE DAC setting by n.
ICFn	Remote	X	–	Increment back-off current FINE DAC setting by n.
IFRn	Remote	X	–	Increment filter range by n.
IUGn	Remote	X	–	Increment uncalibrated gain setting by n.
IVCn	Remote	X	–	Increment bias voltage COARSE DAC setting by n.
IVFn	Remote	X	–	Increment bias voltage FINE DAC setting by n.
OVL	X	X	–	Override local (manual) mode; set remote control mode.
RANn	Remote	X	d	Read fast ADC datapoint n . n limit set by SANn.
				Command ignored if ADC is in the process of converting. (for example: d = +1.9990nA)
RBC	Remote	X	d	Read back-off current meter.
RBV	Remote	X	d	Read bias voltage meter.
RSO	Remote	X	d	Read signal output meter.
RST	Remote	X	–	Reset short-circuit trigger.
SABn	Remote	X	–	Set analog output bias DAC setting to n . n=0 to 4095.
SAGn	Remote	X	–	Set analog gain setting to n. n=0 to 9. (see CAG).
SANn	Remote	X	–	Set number of fast ADC data to be stored to n . n=0 to 8192.
SARn	Remote	X	–	Set fast ADC conversion rate divisor to n . n=15 to 255. rate = 153,600/n points/sec.

Command	Control Mode	Head-amp Mode	Output	Description
SBM	Remote	X	–	Set BEAM mode; reset CURRENT or VOLTAGE mode.
SCCn	Remote	X	–	Set back-off current COARSE DAC setting to n . n=0 to 4095
SCFn	Remote	X	–	Set back-off current FINE DAC setting to n . n =0 to 4095
SCM	Remote	X	–	Set CURRENT mode; reset BEAM or VOLTAGE mode.
SCRn	Remote	X	–	Set back-off current RANGE setting to n . n=0 to 6 (See CCR)
SFRn	Remoet	X	–	Set filter range setting to n. (See CFR).
SI1	Remote	X	–	Set INVERT switch in.
SIO	Remote	X	–	Set INVERT switch out.
SSRn	Remote	X	–	Set signal output RANGE setting to n . n=0 to 6 (See CSR).
SSTn	Remote	X	–	Set short-circuit trigger RANGE setting to n . n=0 to 4. (See CST).
SUGn	Remote	X	–	Set uncalibrated gain setting to n .n=0 to 15 (See CUG).
SVCn	Remote	X	–	Set bias voltage COARSE DAC setting to n . n=0 to 4095.
SVFn	Remote	X	–	Set bias voltage FINE DAC setting to n . n=0 to 4095.
SVM	Remote	X	–	Set voltage mode; reset BEAM or CURRENT mode.

Additional Commands for Version 1.4 (22 Mar 1989)

Command	Control Mode	Head-amp Mode	Output	Description
CAS	Remote/ Partial	X	ASn	Check ADC slow rate code Points/s Points/s AS0 = 1 S8 = 32 AS1 = 2 S9 = 40 AS2 = 4 AS10 = 64 AS3 = 5 AS11 = 80 AS4 = 8 AS12 = 128 AS5 = 10 AS13 = 160 AS6 = 16 AS14 = 320 AS7 = 20 AS15 = 640 AS16 = Slow rate disabled
CVN	Remote/ Partial	X	-	Check version number. Displays command program version number.
EA3	Remote/ Partial	X	-	Set fast ADC input to Auxiliary socket.
ENP	Remote	X	-	Enable Partial REMOTE mode to be executed: Allows the folling commands All check Commands, e.g. CHN, CCM and the following: EAn, G,RANn, RAR, RBC, RBV, RSO, RST, SANn,SARn,SASn and SATn. CCM gives gives 'P' as the reply when ENP is executed.
RAR	Remote/ Partial	X	-	Read all ADC raw data. Sends back the number of data the signal output range code, the unscaled ADC data and a terminating message.
			AN0002	Two data points.
			CSR6	Current or beam mode, range 6.
			0001	(CSR becomes VSR in voltage mode)
			0009	
			END	Terminating message
SASn	Remote/ Partial	X	-	Set ADC slow rate code. n=0 to 15 (see CAS). CAR gives 'AR240' after SASn is executed n=16 is set when SARn is used
SATn	Remote/ Partial	X	-	Set ADC external trigger. n=0 positive edge trigger. n=1 negative edge trigger.
SLFn	Remote		-	Set linefeed character. n=0 no linefeed. n=1 linefeed sent after carriage return.

Additional Notes: for Version 1.4 (22 Mar 1989)

1. Partial Remote Mode

The Partial REMOTE mode allows the user to operate the manual controls on the main unit. However, the interface unit can only read the front panel meters and the internal , 12-bit ADC. It cannot read the positions of the front panel range switches. This means that although the correct digit will be returned, the units and the decimal points may not correspond to those of the ranges being used.

It should also be noted that the back-off current and bias voltage meters incorporate two levels of autoranging.

Thus in the Partial mode RBC will return:

Autorange Level	Digits
0	1.9999
1	19.999
2	199.99

The back-off current ranges are as follows:

Range	Autorange Level		
	0	1	2
0	1.9999nA	19.999nA	199.99nA
1	19.999nA	199.99nA	1.9999uA
2	199.99nA	1.9999uA	19.999uA
3	1.9999uA	19.999uA	199.99uA
4	19.999uA	199.99uA	1.9999mA
5	199.99uA	1.9999mA	19.999mA
6	1.9999mA	19.999mA	199.99mA

2. Changes In SAR Command.

The SARn command is now limited to values of n from 24 to 255. The maximum conversion rate is therefore 6400 points per second. The SASn command may be easier to use.

3. Changes In CHM Command

In the event of a short-circuit being detected, the CHM command will return 'S'.

Messages and data from the interface unit are now sent with only a Carriage Return character by default. If a Linefeed character is also required, please use the SLF1 command in the Remote mode.

11. Specifications

GENERAL   IU-1 interface unit for computer control of ISM-5A and linescan acquisition

POWER: 220-240V and 110-120V AC input, 50 or 60 Hz line frequency

MAINS INPUT: Via Earthed IEC connector

LINE FUSE: Two 20mm 500mA antisurge fuses fitted to rear IEC connector

OUTPUTS/INPUTS Twin outputs to ISM-5A
RS232 serial link
BNC X-scan input, max. ±10V input, 1 MOhm input impedance
Input protected by replaceable 50mA fuse.
BNC trigger test output
Auxiliary socket with ±15V output 50mA max.
and extra A-D conversion input (internally clamped to ±2 V)

RS232 LINK   Supports Tx, Rx, RTS, CTS, and COM, 9600 baud (internally variable), even parity, 1 stop bit.

COMMANDS   Instruction set of over 70 commands

ADC   12 bit A-D with maximum conversion rate of 6400 per second
Selectable to either ISM input signal or auxiliary input

DIMENSIONS   471 x 103 x 262 mm

MECHANICAL   Cast aluminium frame with pressed aluminium alloy panels finished in standard RAL powder coat.

MASS   10Kg

SEALING   To IP20

STANDARD   Constructed in accordance with CEI/IEC 1010-1 1990

Warranty, and service information

The following text is an extract from our standard conditions of sale. It covers the terms of warranty and liability only. Please refer to the full text, supplied upon delivery of the goods or contact Matelect Limited.

Extract 6. WARRANTY

Items sold by the company are warranted only as stated below.

Subject to the exceptions and upon the conditions specified below, the company agrees to correct, whether by repair or, at it's election, by replacement, any defect of materials or workmanship which develops within twelve months after delivery of the instrument to it's original purchaser by the company or by any authorised representative provided that investigation and factory inspection by the company discloses that such defect developed under normal and proper use (unless covered by a separate agreement or guarantee written by the company).

The exceptions and conditions mentioned above are the following.

a). The company makes no warranty concerning components and accessories not manufactured by it. however, in the event of the failure of such components or accessory, the company will give reasonable assistance to the purchaser in obtaining from the respective manufacturer whatever adjustment is reasonable in the light of the manufacturer's own warranty.

b). The company shall be released from all obligations under it's warranty in the event of repairs or modifications being made by persons other than it's own or authorised service personnel unless such repairs by others are made with the written consent of the company or unless such repairs are minor or merely the installation of a new Matelect component.

c). The warranty is only valid providing that the terms of payment in clause 4 are strictly adhered to.

d). No product may be returned except with the company's permission in writing. After receiving factory authorisation, goods requiring repair or replacement should be sent prepaid to the factory in the original container properly packed accompanied by a Return Goods Authorisation, purchase order or letter stating as completely as possible the defects and the condition under which it occurred.

Extract 8. CONDITIONS PARAMOUNT

The company expressly disclaims any liability of whatsoever nature and in any circumstances whatsoever, to it's customers, dealers or agents, except as stated in the forgoing terms and conditions.

Extract 9. These terms and conditions of sale may be amended or altered at any time the company feel it necessary to do so.

REPAIR AND RECALIBRATION:

Matelect Limited can repair and/or recalibrate instruments manufactured by it, after the warranty period has expired. If this service is required then please contact Matelect and we will be pleased to provide a quotation for the work necesary.