UES TECHNICAL MANUAL

INTERRUPT SERVICE ROUTINE

All serial link communication replies are handled by a software interrupt service routine IRQ. This routine is linked to the 6809 processor hardware interrupt line IRQ through the interrupt vector located in RAM at the address 00F5 hex. The interrupt is re-vectored to IRQ as part of the WARM-START routine following a powerup sequence or watchdog timeout. (Pressing the 4MS ABORT button re-vectors the interrupt to the standard 4MS service routine).

Since there are several serial links (all operating at 9600 baud) which may require servicing simultaneously, the routine is written in assembler code for speed of execution to ensure that no characters are lost. (The ISIS routine handles 12 links running at 9600 baud without character loss).

Each communication task (COMMS) enables its corresponding ACIA receive interrupts prior to every serial link command transmission.

When an interrupt request is received the processor stores all the register values on the stack, jumps to the IRQ routine via the IRQ vector. The routine polls each ACIA in turn to determine which links require servicing. Several links may be serviced for each interrupt event.

Due to different character handling requirements for the various modules and encoders the routine is split into 3 sections:

1. The first section handles all the RGO 6303-based modules (SMDM, BCRM and HSM) as well as the ASL M9000 unit.
   In operation the routine awaits the start character for that particular link (as specified in ROMSLINK) before storing subsequent characters in the link buffer, having first stripped off parity. The buffer pointer is incremented and the character count decremented by one for each character received. Termination of a message reply, either a carriage return CR being received or the character count reaching zero, is followed by the ACIA receive interrupt being disabled for that channel. Having serviced all module links the routine automatically passes on to the second section.

2. The second section handles the Ferranti encoders and is identical to the first in operation except that due to 8-bit data being received parity is not stripped off and the termination of the message reply is by character count not reception of a CR. Having serviced all encoder links the routine automatically passes on to the third section.

3. The third section, contained in the ethernet service routine IRQINTERRUPT, deals with the transmission and reception of characters to and from the ethernet link (see block# 325 on ethernet disk).

The IRQ service routine returns from the interrupt by executing the RTI instruction at the end of the IRQINTERRUPT routine, restoring all register values from the stack and resuming programme execution at the point from where it was interrupted.

DIAGNOSTIC SOFTWARE TOOLS

The following suite of diagnostic words provide easy access to specific areas within the Kernel, via the operator port, to assist in both commissioning and fault finding:

WHO displays the node name and message received by the Kernel from the ethernet port. Employed for checking that the message has been passed on by the network layer as well as diagnosing Kernel processing of that message.

M-LIST displays all 6 entries in the monitor-mode request list MON-LIST along with their request type (1 or 2).

S-LIST displays all 4 entries in the write-only status (immediate and delayed) request list STATREQ.

SEE All the fields in the PRESENTSTATUS table for the specified mechanism are displayed in a tabular form. Each parameter is displayed using its correct numerical base along with its field identification label.

.TIMEOUTS displays the number of resets and communication timeouts for all serial links in a tabular form, labelling each link with its corresponding module name. These values may also be transmitted across ethernet to the VAX System Computer by employing the health monitor status command, HMS200. A history may then be built up for each module, enabling suspect units to be weeded out of the system.

#SLINK requires the mechanism mnemonic number on the stack prior to executing this word. It displays the work space RAMSLINK for specified serial link. Employed when faults occur on serial link eg. #ERROR byte field can show framing, parity and overrun errors indicating wrong baud rates etc. See section on communication software.

#LINK requires the mechanism mnemonic number on the stack

(#LIST) prior to executing this word. It displays the serial communication receive buffer for specified link. See section on communication software.

.MECHS lists all the instrument's mechanism mnemonics along with each of their corresponding minimum and maxi parameter limits. Employed as an aide-memoire.

.SLINKS displays which serial links are faulty. This automatically occurs on powerup/reset of the 4MS but may be requested at any time through the operator's port.

LOCAL Provides the ability to enter a single ethernet message (which may contain several instrument commands) via the operator port. It initially shuts the ethernet tasks down in an orderly fashion to prevent two sources of messages using the same internal buffer resources. The operator is prompted for the required message which is terminated by a carriage return, eg:

Enter Emsg : ABC101(1234)<cr>

The Kernel then processes the message in exactly the same way as for a message received-via the ethernet port. Finally the ethernet tasks are reactivated followed by a NET101 execution to flush the network software layer.
Under LOCAL operation status requests (immediate or delayed) will result in status replies being sent to the node who last sent a command via the ethernet port. It is therefore advised to omit all status requests when employing the LOCAL mode.
A shorthand version is available in the form | (pipe).

TRANSPARENT

requires the mechanism mnemonic number on the stack prior to executing this word. Any piggyback mechanism (see mechanism description) is first translated to its host before the SMDM protocol header is displayed, informing the operator which box# and motor# the specified mechanism is attached to. The commands required to enable the echo mode and to terminate the TRANSPARENT mode are also included:

a) Transparent to Smdm C Motor 2

To enable echo :UNSEAL
To return to 4MS :4MS

Additional mnemonic constants are defined to gain access to the barcode reader modules (GBCRM and HBCRM) and the ASL unit (M9000). Each TRANSPARENT displays its own specific protocol header, for the barcode reader case, the mnemonics of the mechanisms attached to each channel are listed:

b) Transparent to Bcrm G

1	2	3	4	5	6	7	8
-	FDB	BFA	BFB	DFK	RFA	RFB	-

To enable echo :UNSEAL
To return to 4MS: 4MS

c) Transparent to Bcrm R

1	2	3	4	5	6	7	8
GRB	GRR	XDB	XDR	-	MFS	-	-

To enable echo: UNSEAL
To return to 4MS :4MS

d) Transparent to M9000
To return to 4MS : A

The Kernel shuts down all status MAINTAIN, JOB and ethernet tasks in an orderly fashion, then revectors the interrupt routine and enables the serial link interrupt ready for transparent operation. This state is indicated by: **Application halted** being displayed when commands may now be entered via the operator terminal.

Refer to the corresponding manuals for description of the commands available for each module. On termination of transparent mode the interrupt routine is re-vectored and all the tasks are reactivated. Resumption of normal operation is indicated by the message: **Application restarted** appearing on the operator terminal.

All modules employing the 6303 processor card (SMDM, BCRM and HSM) must be correctly sealed up by the word '4MS' before returning to normal Kernel operation otherwise all subsequent communications with the module will result in continuous timeouts due to unexpected strings being received.

A shorthand version of **TRANSPARENT** is available in the form **TT**.

SEALED VOCABULARY WORDS

The use of the sealed vocabulary is to reduce typing errors accidentally crashing the 4MS system software. The following list of words are contained in the sealed vocabulary which is enabled on power up and are accessible through the operator's port:

All the mechanism mnemonics

M-LIST displays Monitor Mode List including types

S-LIST displays Status List

WHO displays Ethernet source and datagram

EMSG displays Ethernet datagram

SEE tabulates PRESENTSTATUS Table with labels

.SLINKS displays faulty serial links (if any)

.TIMEOUTS displays all serial link resets and timeouts

.MECHS displays all mechanisms with lower and upper limits

TRANSPARENT provides direct link to serial ports

TT short hand version

LOCAL permits direct entry of ethernet datagram

| short hand version

WARM-START restarts system following ABORT button

SIGN-ON logs on to NIU with NET200 message to itself

NET101 resets ethernet software then signs on to NIU

RES101 Shuts system down, reinitialises tables then restarts system

Barcode reader module

The Barcode Reader Module (BCRM) and its associated reader heads are designed to operate as a remote intelligent filter-slide reader to be directly attached to the instrument housing the filter-slide mechanism and be operated by an instrument controller, usually a 4MS system, via an RS422 serial communication link.

Each module, housed in a Schroff RF sealed box similar to the Stepper Motor Drive Module (SMDM), provides the facility of interfacing up to a maximum of 8 individual reader heads, although any number may be employed up to this limit. The module is able to determine how many heads are attached irrespective of whether or not a barcode is present or even incorrectly aligned under the reader head. All the heads may be read together sequentially or a specific head may be individually interrogated.

During an individual barcode read, 3 actual readings are performed while the reader head remains stationary with respect to the barcode. A comparison then f ollows to generate a conf idence f actor ref lecting how well the 3 readings agree with each other. This method provides a useful insight into the ageing of components in addition to the accumulation of deposits on the actual barcodes themselves. This confidence factor is returned along with a code representing the best of the 3 readings obtained.

The barcodes are organised as a 7-bit binary code with an odd-parity bit located at the most significant bit position providing a total of 128 distinct codes. A label displaying the decimal equivalent of the binary code is positioned to the right of the least significant bit for easy identification. The barcodes themselves are fabricated from single-sided pcb and gold plated to improve their infra-red reflectivity.

See ER420 for a detailed description of the BCRM Module.

MECHANISM MNEMONICS

UES

4MS-#	Mnem	Function
0	CSL	Collimator select UES
1	CFC	Collimator focus
2	HSL	Hartmann select
3	EPS	Hartmann position
4	ESL	Echelle select
5	LTH	Low (31) echelle theta
6	LGM	Low (31) echelle gamma
7	ETH	High (79) echelle theta
8	EGM	High (79) echelle gamma
9	PSL	Prism select
A	PPS	Prism position
B	FFL	Flat-field LEDs
C	CSH	Camera (slow) shutter
D	PEM	Pinhole mask
E	CAD	Camera/detector identification
F	LDP	Dekker slide (Length, Dekker, Periscopes)
10	SWI	Slit width
11	SAN	Slit angle
12	SSH	Slit (fast) shutter
13	EXP	Exposure set
14	FMS	Focal modifier lens
15	ENC	Enclosure status
16	ITN	Instrument temperature now
17	ETS	Enclosure temperature set
18	ETC	Enclosure temperature control on/off

NAG

19	MFP	Main filter polarizer
1A	MFN	Main filter neutral density
1B	MFC	Main filter colour
1C	ASL	Autoguider slide
1D	AGX	Autoguider probe X-coordinate
1E	AGY	Autoguider probe Y-coordinate
IF	AGF	Autoguider probe focus
20	AFC	Autoguider filter colour (in CCD box)
21	CLP	Calibration lamps and shutters
22	CFN	Calibration light filter neutral density
23	CFC	Calibration light filter colour
24	IDS	Instrument doors status
25	CAC	Calibration auxiliary components NAG

SYSTEM

26	INS	Instrument overview, 1 bit/mechs
27	MON	Monitor mode
28	HMS	Health of serial links
29	ALL	Instrument status and stop
2A	RES	Reset 4MS
2B	NET	Reset network layer

OPERATIONS

100	STOP
101(n)	MOVE to n, n in "human" units
102	INITIALISE
180	READ BARCODE (NAG only)
182 (n)	MOVE to n, leave motor on (NAG only)
190 (p)	MOVE to p, p in encoder units (NAG only)
200	IMMEDIATE status request
201	DELAYED status request

Notes:

NAG has 3 different MOVE commands. The normal 101 is for use by observers, and leaves the motor on or off on arrival, as appropriate for that mechanism. The 182 and 190 are only for tests and hidden routines of the VAX; they always leave the motor on; the difference between them is that 190 expects its parameter in encoder units, whereas 182 expects human units as in 101.

The 102 command initialises to 'human' 0 for UES servo mechanisms; in NAG, all mechanisms initialise to the centre of the mechanisms range, then leave the motor as after a 101. For both UES and NAG, a mechanism MUST be initialised after a mechanism error has been recorded; other commands are rejected.

The 100 command, unlike in some other instruments, can act on some 'idle' mechanisms. This caters for such things as closing shutters, switching off motors and lamps. The guiding principle has been that a STOP should leave the mechanism in a safe state. ALL100 is a global panic-stop.

The standard diagnostic XXX SEE has been adapted slightly: the TARGET field is in 'human' units, the corresponding POSITION field in encoder units (for a 190, both are in encoder units). In 800 or 801 status returns the position parameter is in human units, except after a 190 (in this case, mechanism error 22 is reported in the same status return).

The fields in the normal 800 status return are:

command errors
mechanism errors
position (updated actual position, in human units)
barcode (or special, often 0)
datum switch (including a copy of the NAG hardware busy bit)

ERRORS

Command errors

0 mechanism OK
1 mechanism busy
2 parameter out of range
3 invalid parameter
4 invalid format
5 monitor mode list full
6 invalid function
7 interlocked (not implemented)
8 command cancelled

Mechanism errors

0 mechanism OK
1 mechanism timeout
2 communications link timeout
3 error in temperature control unit communications
4 mechanism has not been initialised
5 cable connected to wrong SECU module (not implemented)
6 invalid data returned from serial link
7 illegal command received by SECU
8 action on mechanism was aborted
9 barcode read was unreliable
A barcode read - head absent
B barcode read - parity error
C mechanism busy (request to read barcode of moving mechanism)
E position check has found an error
10 current limit - initialisation required
11 limit switch activated
14 alarm switch activated
20 NAG mechanism does not settle after a move
21 not all lamps requested have in fact struck
22 WARNING target field is in encoder units
23 diffuser in undefined position
24 darkslide in undefined position
>80 multiple errors, TEMPFLAG codes 0Red with 80hex

Tempflags

1 invalid-data
2 ctimeout
4 illegal command
8 moving
10 limit switch
20 alarm switch
40 current limit (UES)
80 tams-err (UES): TAMSON unit communication error
80 settling (NAG): mechanism has arrived; checking it stays put

n.b. Summary pages like this one and the next exist for all UES and NAG mechanisms. See the Quick Reference Guide.

ECHELLE TILT (THETA)

LTH 5
HTH 7

DRAWING## (UCL) 11 Sec 3 of Assemblies

MNEMONIC LTH HTH

PERMITTED OPS. 100 101 102 200 201

SECU ECHELLE

BCRM CHANNEL N.A.

TARGET 0 - 20000 micron

STEPS (=Position) 0 - 20000

DATUM SWITCHES 4 (limit switch active)

SWITCH LIM-1

ENCODER Mitutoyo linear; see Assemblies, p 9
MOTOR Oriel Motormike

NOTES: These motions are non-linear. The VAX converts angles into microns of encoder displacement.

MAIN FILTER WHEELS

MFP 19
MFN 1A
MFC 13

DRAWING## A000-A007 in A&G-box || PRINTED CIRCUIT PLAN
B000-B002 Cn,Ln,Mn printed ccts

(n=1,2,3)

MNEMONIC MFP (Polariser) MFN (ND) MFC (Colour)

PERMITTED OPS. 100 101 102 180 182 190 200 201

		MFP	MFN	MFC
NAG unit	1	1	2	
hardware adrs	DD00	DD08	DD10	
BCRM CHANNEL	1	2	3	

TARGET 1 - 11 (1 = Clear, with return beam to TV)

STEPS (=position) 200 by 300 to 3200

DATUM SWITCHES Not fitted (and the switch bits at the hardware addresses are used for other purposes)

80hex: mechanism busy

SWITCH# N.A.

ENCODER Tekel 63.5 mm: TK492.S.1800.5.S
MOTOR Escap 34HL11-224E20418 with P4214-017,6:1

NOTES:
Filters are permanently fitted in cells which are manually exchangeable; barcodes identify them.

Drives cannot cope if the wheels are-TOO much out of balance; if so, redistribute filters, try to balance the 'hole' at 12/1. Each drive comprises 3 circuit cards: C(ode), L(ogic), M(otor); these are numbered 1, 2, 3 for MFP, MFN, MFC respectively; see PRINTED CIRCUIT PLAN in NAG Electronics manual

Contacts

The following persons might be able to help you or point the way whenever you need the latest information on the UES and Nasmyth A&G 4MS svstem:

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Document history

DATE	VERSION	STATUS & CHANGES
Jan 1993	1.0	Plain ASCII; preliminary; for circulation and comments
Nov 1993	1.1	Final for Day-1 system; LaTeX