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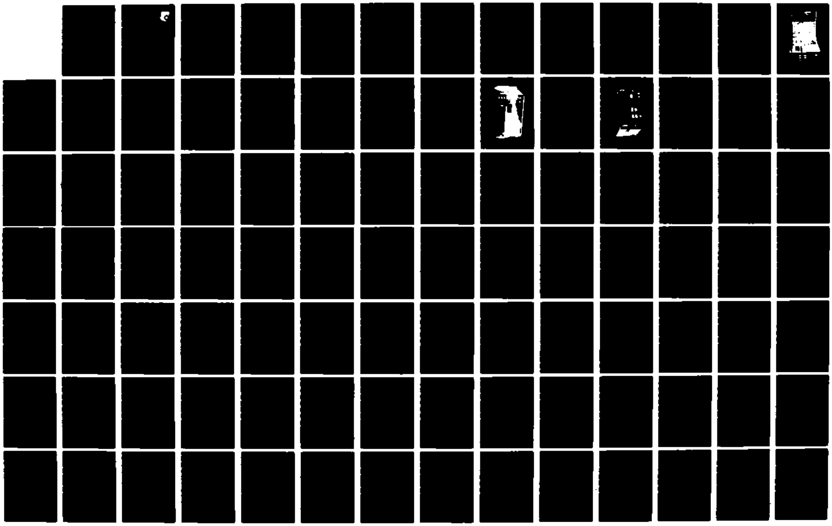

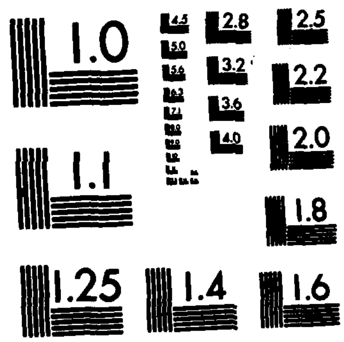

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PART II

THE REMOTE LINK UNIT: A DEMONSTRATION OF OPERATIONAL PERFORMANCE
Part II - User's Manual

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NOTICE

This technical report has been reviewed and is approved for publication.

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This report (Part II) is the User's Manual for the RLU Demonstration System and provides information on how to configure and operate the system. There are two accompanying reports: Part I summarizes the results of the program of implementation of the system, and Part III is the design manual describing the details of the hardware and software design.

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PREFACE

This document was prepared by the University of Houston, Houston, Texas, on Air Force Contract No. F33615-80-C-1095, entitled "The Remote Link Unit - A Demonstration of Operational Performance."

The work was administered under the direction of the Information Transfer Group, Information Processing Technology Branch, System Avionics Division of the Avionics Laboratory, under Project 2003, "Avionic System Design Technology," Task 08, "Multiplex and Information Transfer Technology," Work Unit 07, "Remote Link Unit Demonstration." The work was performed during the period 1 April 1980 to 31 December 1980 and this report was submitted in August 1981. The Air Force Project Engineer was Philip C. Goldman (AFWAL/AAAT-3).

The work is a continuation of a previous feasibility study entitled, "The Remote Link Unit: An Advanced Remote Terminal for MIL-STD-1553A." The results of this study are documented in a technical report entitled, "Remote Link Unit Functional Design: An Advanced Remote Terminal for MIL-STD-1553B," which was published as AFAL-TR-79-1176, AD-A080126. An add-on to this previous study resulted in a second technical report entitled, "The Remote Link Unit: Applications to the Design for Repair Methodology Program," published as AFWAL-TR-80-1033, AD-A086126.

This report summarizes the design, development, and testing accomplished under the contracted work. The Principal Investigator and Program Manager was Dr. Carlos J. Tavora. Drs. John Glover, Jr. and Miles A. Smither were Co-investigators. Dr. Tavora was responsible for the system architecture and modularization of the design. Dr. Glover supervised the design of the software for the Link Manager Simulator and the Link Module. He was assisted by Messrs. Hao-Cheng Hsia, William C. Law, and Parmanand Balsaver. Dr. Smither was assisted by Mr. Tzer-Tsan Lin in the design of the Interface Configuration Adapter. Mr. H. Mitchell Collins was in charge of the design of the Electronic Nameplate and the Nameplate Interface Controller.

This report is organized in three parts: Part I - Summary, Part II - User's Manual, and Part III - Design Manual. Part III is separated into two volumes: Volume 1 is the main body of the Design Manual, while Volume 2 contains the appendices.

This part is the User's Manual, which includes instructions for setup, connection, and operation of the Remote Link Unit Demonstration System (RLUDS). Also included are the test scripts used to exercise the system at the end-of-contract demonstration.

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LIST OF ACRONYMS

AC	Alternating Current
A/D	Analog to Digital
BCD	Binary Coded Decimal
CMOS	Complementary Metal Oxide Semiconductor
CPU	Central Processing Unit
CRT	Cathode Ray Tube
D/A	Digital to Analog
DC	Direct Current
DIP	Dual In-line Package
DMA	Direct Memory Access
EAROM	Electrically Alterable ROM
EEPROM	Electrically Erasable Programmable ROM
EPROM	Erasable Programmable ROM
FP	Front Panel
ICA	Interface Configuration Adapter
I/O	Input/Output
ISR	Interrupt Service Routine
LA	Link Address
LM	Link Module
LMG	Link Manager
LMP	LM Processor
LSB	Least Significant Bit
MP	Maintenance Port
MSB	Most Significant Bit
MUX	Multiplexer
NIC	Nameplate Interface Controller
NP	Nameplate
PCB	Printed Circuit Board
PIA	Peripheral Interface Adapter
PROM	Programmable Read Only Memory
RAM	Random Access Memory
RLU	Remote Link Unit
RLUDS	Remote Link Unit Demonstration System
RMW	Read-Modify-Write
ROM	Read Only Memory
RT	Remote Terminal
SIC	Subsystem Information Channel
SM	Shared Memory
SRU	Shop Replaceable Unit
TTL	Transistor-Transistor Logic
UFT	User File Table

SECTION 1

INTRODUCTION

The purpose of this manual is to provide a guide for the use and operation of the Remote Link Unit Demonstration System (RLUDS) without the details of the design of the system. The sections of this manual provide information on:

- inspection of the equipment to verify a correct physical configuration
- external cable connections
- procedures for operation

This manual provides all the details necessary for operation of the RLUDS, assuming the user is generally knowledgeable of the concept, purpose, and configuration of the RLU and its major components. Both background information and design details may be found in the Design Manual (Part III).

1.1 EQUIPMENT SUMMARY

There are several items of equipment which constitute the RLUDS. These items implement the many components of a Remote Link Unit (RLU) and the subsystems with which it communicates. The items delivered are:

LM Chassis - This is a demonstration version of the Link Module (LM) component of an RLU.

ICA Chassis - This is a demonstration version of two 4-channel groups of an Interface Configuration Adapter (ICA).

Subsystem Box - A se[illegible] sub[illegible]tem and a synchro subsystem are implemented in a single test box.

Electronic Nameplates - Two nameplates (NP) are included in the subsystem box. One is configured for the serial subsystem and one is configured for the synchro subsystem.

ICA Test Box - This box allows testing all of I/O capabilities of the ICA, except for serial and synchro I/O, which are tested using the serial and synchro subsystems.

LMG Simulator Software - An 800 bpi 9-track mag tape provides all of the software necessary to run the Link Manager (LMG) Simulator on a PDP-11 computer.

Cables and Connectors - All cables and connectors necessary to assemble the RLUDS and connect it to the PDP-11 are provided.

1.2 UNPACKING AND INSTALLATION

The RLUDS is packed in foam in two large shipping boxes. Remove all .ems from the boxes and verify that none are missing. Before connecting any cables, it is necessary to install the ICA chassis on top of the LM chassis. To do so, first remove the top cover from the LM chassis and the bottom cover from the ICA chassis. Next, as shown in Figure 1 , remove the two small pivot screws from the ICA chassis, align the ICA chassis with the LM chassis, and reinsert the two pivot screws. Connect the power cable at the rear of the LM chassis, and connect the double ribbon cable from the rear of the ICA chassis to the right edge connector on the ICA and Front Panel (FP) card in slot 1 of the LM. The ICA chassis should now swing down to rest just above the LM chassis.

Cabling instructions for interconnecting the components of the RLUDS are found in Section 2 (ICA), Section 3 (NP), Section 4 (LM), and Section 5 (subsystems). Instructions for installing the LMG simulator software on the PDP-11 and connecting the RLUDS to the PDP-11 are found in Section 6.

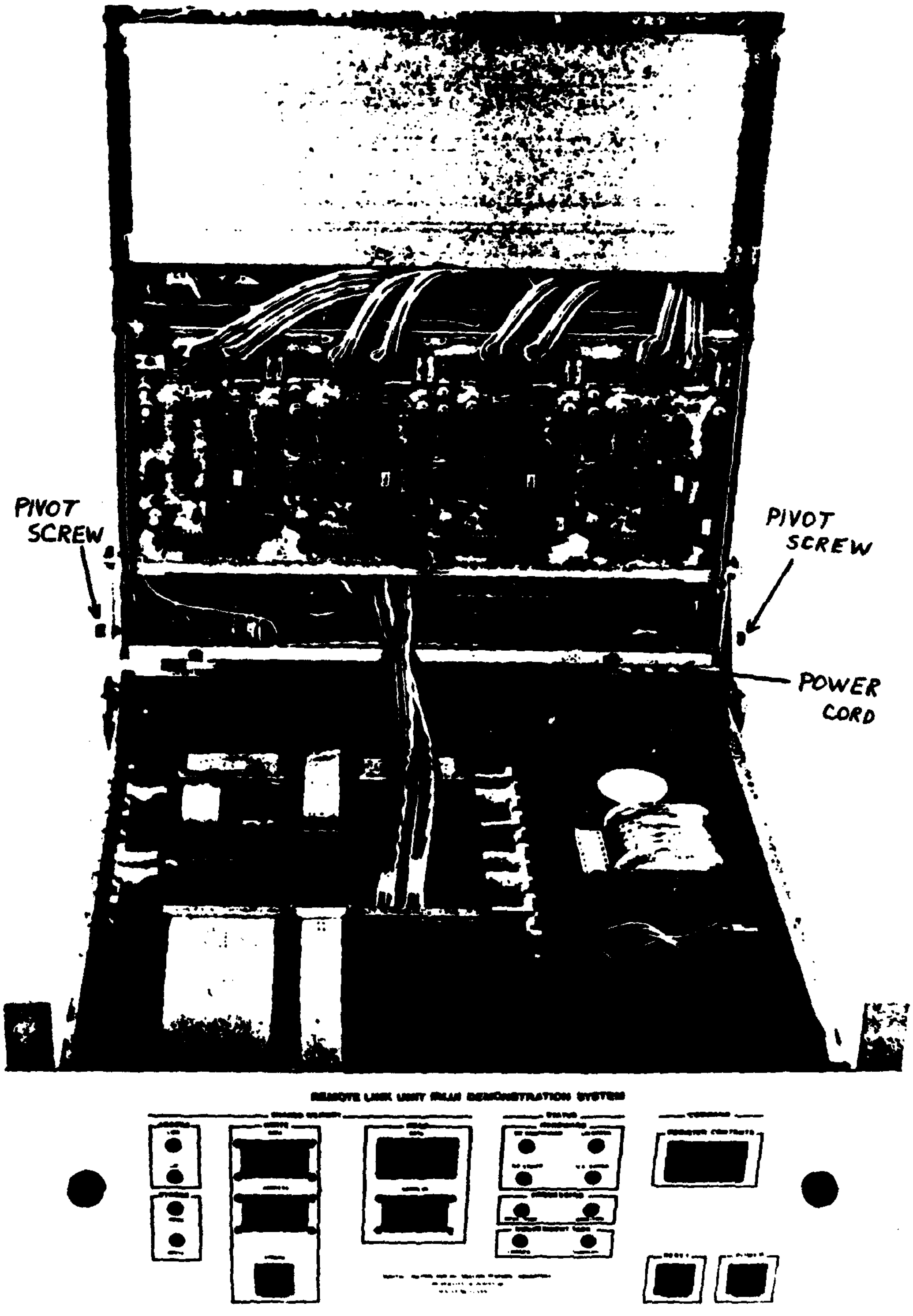


Figure 1 Connecting the ICA to the LM

SECTION 2

INTERFACE CONFIGURATION ADAPTOR

2.1 INSPECTION OF EQUIPMENT

Subassemblies and their Locations

The Interface Configuration Adaptor (ICA) is housed in a chassis mounted to the top of the Link Module (LM). The ICA circuitry is contained on 3 major subassemblies as follows:

1. Wire wrap board.
2. Signal I/O group A PCB.
3. Signal I/O group B PCB.

The wire wrap board contains the circuitry used to generate the AC and DC references used by the Signal I/O boards. This circuitry is shared by the two groups. Additionally the wire wrap board contains the logic to perform address decoding and configuration control and serial I/O functions for each of the two groups.

The wire wrap board is located at the front top of the ICA chassis.

The Signal I/O PCBs contain the circuitry used to perform analog/digital/analog conversions, the input signal processing (both analog and digital), and the output signal buffering.

Signal I/O group A PCB is located at the top rear of the ICA chassis. Signal I/O group B PCB is located at the bottom rear of the ICA chassis.

Internal Cable Connections

The ICA is connected to the LM through INTCBL 212 and INTCBL 2Ø2. INTCBL 212 is used for digital control/data signals between the ICA and the LM. INTCBL 2Ø2 is used for power distribution within the ICA and to bring power from the LM.

Cables within the ICA chassis are listed in Table 1 .

2.2 EXTERNAL CONNECTIONS

The ICA connects to the interfaced subsystem through CBLØ2. This cable connects at J4 on the rear panel of the ICA chassis. Cable CBLØ2 carries eight differential I/O lines (4 from/to group A and 4 from/to group B), signal return lines, the AC reference, and power (+/- 15 and +5 volt) to the subsystem.

2.3 OPERATION WITH THE LM

The ICA is completely controlled by the LM. There are no special hardware procedures to be followed in the use of the ICA. The LM provides initialization, configuration, and control signals to the ICA through INTCBL 212.

There are 22 LED lamps on the front panel of the ICA. These are used to indicate, in a condensed fashion, the state of the ICA. The following shows how the indicators for one of the two groups are arranged:

GROUP A

MODE	I/O	DIGITAL		ANALOG	
RESET *	INPUT *	PARALLEL *	MOMENTARY *	AC *	SYNCHRO *
TEST *	OUTPUT *	SERIAL *	FLAG *	DC *	

When the ICA is initialized by the LM the RESET lamp is on. The TEST lamp indicates that an ICA test mode has been selected by the LM. ANALOG DC, AC, or SYNCRO INPUT or OUTPUT is indicated by the appropriate lamp as are DIGITAL PARALLEL (either straight parallel or MOMENTARY) or SERIAL (either FLAG or refresh mode) INPUT or OUTPUT modes.

TABLE 1 ICA INTERNAL CABLES

INTCBL#	WW Board J#	SI/O#A J#
21Ø	J1	J1
22Ø	J3	J2
23Ø	J5	J3
24Ø	J7	J4
25Ø	J2	J5
26Ø	J4	J6
27Ø	J6	J7
28Ø	J8	J8

INTCBL#	WW Board J#	SI/O#B J#
211	J18	J1
221	J16	J2
231	J14	J3
241	J12	J4
251	J17	J5
261	J15	J6
271	J13	J7
281	J11	J8

SECTION 3

SUBSYSTEM INFORMATION CHANNEL

3.1 INSPECTION OF EQUIPMENT

The SIC consists of two main parts:

1) a Nameplate Interface Controller:

   - Resides in the LM in slot number 6,

   - Connected to the SIC bus connector J3 on the LM backpanel via cable INTCBL 3ØØ.

2) an Electronic Nameplate:

   - Resides in the subsystem chassis,

   - Connected to the SIC bus connectors, J3, P3, on the subsystem panel via cable: INTCBL 6ØØ.

3.2 EXTERNAL CONNECTIONS

Connect the nameplate to the LM via the SIC bus cable CBLØ3. This cable is connected to the J3 connector on the LM back panel to the P3 connector on the panel of the subsystem to be used at this time. The SIC bus terminator T3 should be connected to the subsystem connector J3 directly below connector P3.

3.3 OPERATION WITH THE LM

The diagnostic switch on the nameplate should be in the nameplate position (i.e. in the position nearest the NP's LEDS).

The nameplate's LEDs display the following functions (in order starting with the LED nearest the edge of the NP and ending with the LED nearest the NP diagnostic switch):

1) NP Busy

2) This NP selected

3) SIC RESP/CMD bus line level (LED on = CMD)

4) SIC SERIAL DATA bus line level

5) Write memory program strobe

6) Erase memory strobe

7) SIC PRIORITY IN bus line level

8) NP diagnostic in progress

The following LMG commands may be used to communicate with the nameplate:

- NPINIT[1]
- PRGMLD
- XFRTBL:
  - A) NPDIR
  - B) NPCNFG
  - C) NPREC:
    - 1) RDREC
    - 2) WRTREC
    - 3) EOD
    - 4) BOD
    - 5) BACREC
    - 6) FWDREL
    - 7) ERAWRT.

These commands may be issued to the NP through the LMG Simulator. More details on these commands and the LMG Simulator are given in Section 6.

The three DIP switches in the U18 socket on the nameplate provide the option of selecting 8 different read/write memory blocks. For a given DIP switch setting, the nameplate can access only one 256 byte block (i.e. 16 performance records of 16 bytes each). Once this area is full, an operator may change the DIP switch setting to obtain an unwritten 256 byte block. Thus eight such blocks may be written before the read/write memory chip

[1]Note: NPINIT must be run first before any other commands may be issued.

(U17) must be removed and erased. The DIP switches are numbered 1, 2 and 3 and comprise an octal digit. Switch 3 is the most significant bit and switch 1 the least. The "on" position of the switch corresponds to a binary zero.

SECTION 4

LINK MODULE

4.1 INSPECTION OF EQUIPMENT

To gain access to inside the LM chassis, tilt back the ICA chassis which is mounted directly above the LM. Inside the LM are power supplies and a 10 slot card cage. Be sure all power supply connectors are firmly connected and all cards are firmly seated in their slots with their component side facing the front panel. There are 6 cards in the LM, and any card may be placed in any slot. However the recommended arrangement is as follows (slot 1 closest to front panel):

slot 1: ICA & FP card
slot 2: empty
slot 3: PROM card
slot 4: RAM card
slot 5: empty
slot 6: NIC card
slot 7: empty
slot 8: CPU card
slot 9: SM card
slot 10: empty

There are 7 internal cables which need to be connected to edge connectors on these 6 cards. Four of these cards have 3 edge connectors each for a total of 12. Thus there are 5 unused edge connectors.

1. The 2 cables from the front panel should be connected to the left 2 connectors on the ICA & FP card. The cable coming from the ICA connects to the right connector on the ICA & FP card.

2. The cable from the back panel NIC connector should be connected to the center connector on the NIC card. The other 2 connectors on the NIC card are unused.

3. The cable from the back panel CRT connector should be connected to the left connector on the CPU card. The other 2 connectors on the CPU card are unused.

4. The 2 cables from the back panel LMG connector should be connected to the left and right SM card connectors. The center SM card connector is unused.

Lastly, verify that the AUTO/MONITOR toggle switch on the back panel is in the AUTO position.

4.2 EXTERNAL CONNECTIONS

The LM chassis has 3 external connectors on the back panel. See Figure 2.

CABLE NAME	FUNCTION	CONNECTORS	REMARKS
CBLØ1	LM/LMG	P1	to J1 on LM
		J1 J2	to P1 & P2 on LMG-DR11C
CBLØ3	SIC	P3	to J3 on LM
		J3	to P3 on SS
CBLØ4	LM/CRT	P2	to J2 on LM
		P2	to J2 on CRT

CBLØ1 is a dual 40 conductor flat cable connecting the LMG-DR11C to the LM-SM. It has 2-40 pin socket connectors on one end and one 50 pin 'D' male connector on the other. Always connect CBLØ1 before turning the LM power on in order tc assure proper communication with the LMG.
CBLØ3 is a round cable connecting the NIC card to the NP's for the SS. It has a 15 pin 'D' male on one end and female on the other.

CBLØ4 is a round cable connecting the LM maintenance mode to a CRT via RS232C interface. It has a male 25 pin 'D' on each end.

Figure 2 LM Back Panel

4.3 FRONT PANEL OPERATION

The front panel is for monitoring and accessing the SM link between the LM and LMG. It additionally has some special status indicators and SM access strobes. If necessary, the front panel can be used in place of the LMG to issue commands and data transfers to the LM. This would be done by writing into appropriate SM locations just as the LMG would do. Four LED's to the extreme left side of the front panel are strobes indicating when the LMG or LM makes a read or a write access to SM. LM strobes are generated when the front panel accesses SM. The write data thumbwheel switches, write address thumbwheel switches, and write pushbutton work together to enter data into SM. These thumbwheel switches may be set at will, since the data is only written to the corresponding address when the write pushbutton is activated. This is different from the read data display and read address thumbwheel switches which are continuously monitored and updated. Thus read data display should change immediately with new settings of the read address thumbwheel switches. In this way contiguous areas of SM may be stepped through and examined. The status LED's and LMG command display are continuously updated. The RESET pushbutton causes a hardware system reset and the LM is reinitialized and starts over. This function should not normally be needed. Figure 3 shows the layout of the front panel.

There are 12 function commands to the LM which may also be issued via the front panel. This is done by writing the commands associated code into address FF using the front panel write data thumbwheel switches, write address thumbwheel switches, and write pushbutton. This command location is continuously displayed on the front panel LMG command display. (Note: all function commands are 8 bits with the MSB semaphore set to 1. Each

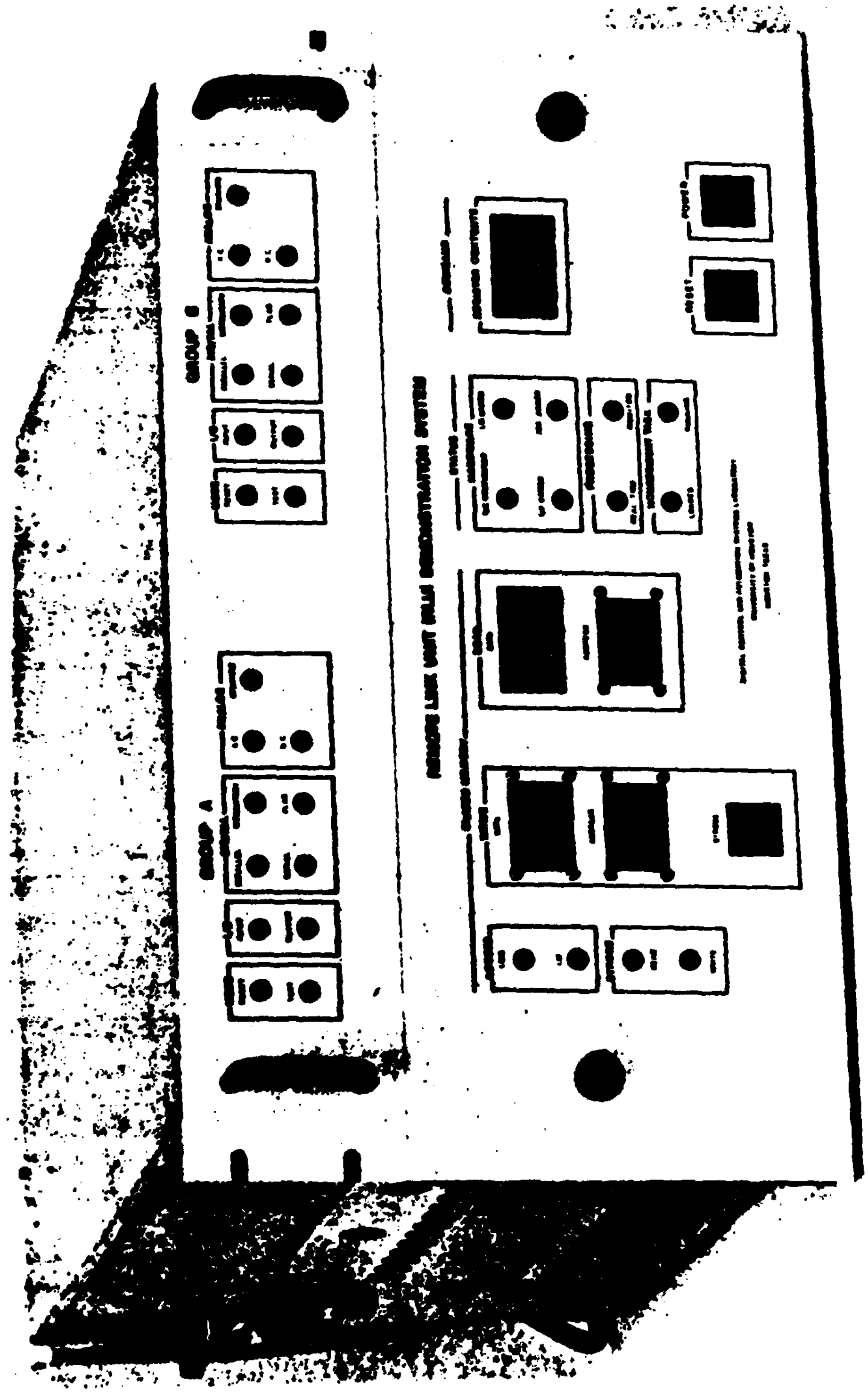


Figure 3 LM Front Panel

command code thus has the form 8X. This semaphore is immediately cleared by LM to acknowledge receipt and thus will always be displayed as ØX.) Table 2 lists the LM commands and Table 3 gives the possible status returns from each. Some commands require additional parameters which must be loaded into LMBUF before issuing the command. LMBUF is a 64 byte buffer in SM starting at location 8Ø. Table 4 gives the parameters.

The SM is 256 bytes organized as 4 groups of 64 bytes each. ØØ to 3F is IOBUFØ for data output to subsystem. 4Ø to 7F is IOBUF1 for data input from subsystem. 8Ø to BF is LMBUF for passing function command parameters. CØ to FF is for all commands, handshakes, and statuses. The layout of SM is shown in Table 5 . The SM is described in detail in Section 6.5.

4.4 OPERATION WITH PDP-11

The LM operates with the PDP-11 (LMG) independently of any front panel switches or settings. With all cables properly connected, you need only to be sure the external switch on the back panel is in the AUTO position and press front panel RESET to insure proper initialization. Three front panel LED's indicate when the LMG makes an access to SM, and whether it was a read or a write access.

Shared Memory Connections

1. INTCBL 1ØØ-J4 connected to P4 of LM shared memory card.

2. INTCBL 1ØØ-J2 connected to P2 of LM shared memory card.

TABLE 2 LM COMMANDS

PRGMLD	81	Load non-resident task.
RUN	82	Run non-resident task.
STOP	83	Stop non-resident task.
NPDIAG	84	Same as NPINIT
	85	Reserved
CANCEL	86	Cancel the previous cmd. that is pending.
XFRTBL	87	Transfer LM system tables to/from LMG.
STATUS	88	Clear input buffer request bit.
RESET	89	Resets CMDITR and ICA.
RESTRT	8A	Jump to power up restart location.
NPINIT	8B	Request NPHND to initialize NP's.
CONFIG	8C	Configure selected subsystem.
NOOP	8D	No operation.

TABLE 3 CMDITR STATUS RETURN CODES

Command	Status	Indication
General	+2	Command active.
	+1	Command received.
	Ø	Success
	-1	Invalid command.
	-2	Another command still in progress.
	-3	Command not implemented yet.
	-4	Command cancelled.
PRGMLD	-1Ø	# of bytes not from -1 to +61.
	-11	Existing non-resident task is not dormant.
	-12	TYPE not Ø or 1.
	-13	SOURCE not Ø or 1.
	-15	XFR or TRLR record with SOURCE=NP.
	-16	Invalid start address.
	-17	Invalid end address.
	-18	XFR record with no HDR record.
	-19	TRLR record with no XFR record.
	-2Ø	EXEC failure to REMOVE previous task
	-21	NP failure to upload task.
	-22	EXEC failure to INSTAL NP task.
	-23	Program checksum not zero.
	-24	EXEC failure to INSTAL LMG task.
RUN	-1Ø	A task is not installed.
	-11	The task is not dormant.
	-12	Task checksum not zero.
STOP	-1Ø	A task is not installed.
	-11	The task is dormant.
	-12	Failure to STOP after 5 sec.
NPDIAG	-	see NPINIT.
CANCEL	-	None
XFRTBL	-1Ø	Invalid table number.
	-11	To/from LM not Ø or 1.

TABLE 3 (CONTINUED) CMDITR STATUS RETURN CODES

Command	Status	Indication
	-12	# bytes not from 1 to 64.
	-13	Offset < Ø.
	-14	Attempt to write a read only table.
	-15	TIME: # bytes too large.
	-16	TIME: Offset too large.
	-17	NPREC: Function not Ø to 5.
	-18	NPREC: Invalid # bytes.
	-19	SICSTS: Table shows <1 # of NP's.
	-2Ø	SICSTS: Table shows >2Ø # of NP's.
	-21	NPHND error.
	-22	ICCNFG: ICAHND error GRP A.
	-23	ICCNFG: ICAHND error GRP B.
STATUS	-	None
RESET	-1Ø	ICAHND fail to reset ICA.
RESTRT	-	None
NPINIT	-1Ø	NPHND error.
CONFIG	-1Ø	SOURCE not Ø or 1 (LMG or NP).
	-11	GROUP not 1 or 2 (A or B).
	-12	ICAHND error.
	-13	NPHND error.
	-14	Invalid NP table.
NOOP	-	None

TABLE 4 LM COMMAND PARAMETERS

PRGMLD header record:	8Ø - FF
	81 - TYPE ØØ - I/O program Ø1 - DIAG program
	82 - SOURCE ØØ - LMG Ø1 - NP
PRGMLD transfer record:	8Ø - # bytes, Ø1 to 3D
	81 - starting load address, high byte
	82 - starting load address, low byte
	83 to BF - program bytes
PRGMLD trailer record:	8Ø - ØØ
	81 - program checksum
XFRTBL:	8Ø - table #, Ø1 to ØB
	81 - # bytes
	82 - offset into table
	83 - to/from ØØ - LM to LMG Ø1 - LMG to LM
	84 to BF - table loaded by LM or LMG depending on to/from byte
CONFIG:	8Ø - SOURCE ØØ - LMG Ø1 - NP
	81 - GROUP Ø1 - GRPA Ø2 - GRPB
	82 to 89 - configuration data if from LMG

TABLE 5 SHARED MEMORY

Symbolic Name	Address DEC	Address HEX								
LMFCMD	255	FF	S1	cmd #						
DXCMD	254	FE	X						IOB	REF
LMFSTS	253	FD	LMF cmd status							
DXSTS-S1	252	FC	RDY 1	REQ 1	FLG	X			REQ Ø	RDY Ø
-SØ	251	FB	X		WSC					
STSALR	25Ø	FA	S	X			LM	NP	ICA	LA
LMSTS-H	249	F9	X			HND	IMSK	SMHW	INIT	OPER
-L	248	F8	LM diagnosis							
NPSTS-H	247	F7	X							
-L	246	F6	HWE	CFC	NPP	INT	RCF	Ø	Ø	RST
ICASTS-H	245	F5	ICA status							
-L	244	F4	X							
LASTS	243	F3	LA status							
	242	F2	50 bytes spare							
HWTST	192	CØ	SM HW Test Byte							
	191	BF	64 bytes LMBUF							
LMBUF	128	8Ø								
	127	7F	64 bytes IOBUF 1							
IOBUF 1	64	4Ø								
	63	3F	64 bytes IOBUF Ø							
IOBUF Ø	Ø	ØØ								

SECTION 5

SUBSYSTEMS

5.1 INSPECTION OF EQUIPMENT

The subsystems are contained in two test boxes: the RLU test box and the ICA test box. The former contains the serial and synchro subsystems along with their nameplates, and the latter contains four different test set-ups for various ICA tests.

In the RLU test box, the synchro subsystem consists of two synchros which are directly connected to connector J4 on the panel. Alongside are two dials which determine synchro angles.

The serial subsystem consists of a sending subsystem and a receiving subsystem, both of which are assembled on the wire wrap board on the base of the box. There are two cables, INTCBL 7ØØ and INTCBL 7Ø1, on the wire wrap board which are used to connect a particular subsystem to a particular ICA group. The following table summarizes these connections.

Connection	Cable INTCBL 7ØØ	Cable INTCBL 7Ø1
Sending to Gr. B and Receiving to Gr. A	28 to 12	29 to 13
Sending to Gr. A	28 to 13	Unused
Receiving to Gr. B	Unused	29 to 12

where 12,13,28 and 29 are 4 sockets on the wire wrap board.

Each subsystem in the RLU box has an accompanying nameplate along the sides of the box. For a description of their use please refer to Section 3.

The ICA test box consists of four test set-ups. All have separate external connections alongside them through connector J4. All internal connections are hardwired.

5.2 EXTERNAL CONNECTIONS

Each subsystem or test set-up has a female connector J4 alongside it. For connecting any set-up or subsystem to the ICA, connect the corresponding J4 on the subsystem box to J4 on the ICA box through cable CBLØ2.

5.3 OPERATION WITH LM

In the following, Reference switch (REFSW) selects between AC and DC inputs, mode switch (MODSW) selects between single ended and differential inputs, and control switch (CTLSW) selects between ON and OFF. Given below are the procedures for use of the subsystems in each of the I/O categories.

d.c. analog input -

1. Connect setup #1 on test box to ICA
2. Set REFSW to dc
3. Set MODSW to S.E. for single ended or DF for differential input
4. Set CTLSW to ON

a.c. analog input -

1. Same as d.c. input except set REFSW to ac

Synchro input -

1. Connect synchro subsystem to ICA

2. Turn dials A & B to set desired angles for Groups A & B respectively

Discrete input (sampled) -

1. Connect setup #1 to ICA

2. Set REFSW to dc, MODSW to S.E. or DF and CTLSW to ON

Momentary discrete input -

1. Connect setup #3 to ICA

2. Flip any of momentary contact switches SW1-SW8 to produce a binary 1 on the corresponding input. SW1 to SW4 correspond to channels 1 to 4 respectively, of ICA group A and SW5 to SW8 correspond to channels 1 to 4 respectively of ICA Group B.

Serial input (refresh mode) -

1. Connect serial subsystem to ICA

2. Connect sending subsystem to desired ICA group

3. Set MODSW to REFR; TX PARITY to desired parity

4. Select desired BCD values to be input, on the three sets of thumbwheel switches.

5. LED TX DATA LATCHED indicates parity error during input

Serial input (flag mode) -

1. Connect serial subsystem to ICA

2. Connect sending subsystem to desired ICA group

3. Set MODSW to FLAG; TX PARITY to desired parity

4. The RESET switch resets the sending subsystem and the STBSW allows the current BCD values set on the thumbwheels to be input. Nothing is input in FLAG mode until STBSW is flipped.

5. LED TX DATA LATCHED indicates parity error during input

d.c. analog output -

1. Connect setup #4 to ICA

2. Pins 1-1' to 4-4' have outputs from channels 1 to 4 respectively, for Group A. Pins 5-5' to 8-8' have outputs from channels 1 to 4 respectively, for Group B.

a.c. analog output -

Same as d.c.

Synchro output -

1. Connect synchro subsystem to ICA

2. Output angles are seen through movement of dials

Discrete output -

1. Connect setup #2 to ICA

2. LED's 1 to 4 show outputs of channels 1 to 4 respectively, of Group A and LED's 5 to 8 show outputs of channels 1 to 4 respectively, of Group B.

Serial output -

1. Connect serial subsystem to ICA

2. Connect the receiving subsystem to desired ICA group

3. Set RX PARITY to desired parity and notice parity errors on LED RX PARITY ERROR.

4. Notice output in BCD on the display.

SECTION 6

LMG SIMULATOR

6.1 INSTALLATION OF SOFTWARE

6.1.1 System Configuration Requirements

A DEC PDP-11/45 or PDP-11/70 computer running version 3.2 or later of the RSX-11M operating system is required to operate the LMG simulator. At least 800 blocks of disk space are required to load the software from mag tape and install it. 84K bytes of memory must be available to run the two tasks which comprise the LMG simulator. The mag tape must be a 9-track 800 bpi unit. In addition, two refreshed display CRT's are required for the user interface, at least one of which (CRT #2) must have a 24-line display. Finally, a DR11-C general purpose interface card is used for communication with the LM (see Section 6.2).

6.1.2 Installation from Mag Tape

The procedure described here should be performed by the System Manager of the computer installation, an individual well-versed in the operation of RSX-11M.

The software is delivered in DOS format on the mag tape. It will be copied to directory [77,1Ø]. Then a series of indirect command files are executed to compile and install the two LMG simulator tasks and the DR11-C driver. A transcript of the installation sequence is given in Figure 4 .

The DR11-C driver, which communicates with the Link Module through the DR11-C interface, is written with the DR11-C interrupt vector address assumed to be 35Ø and the CSR address assumed to be 16776Ø. If other addresses are to be used, edit VECADR and CSR in file SMTAB.MAC accordingly before giving the '@DRIVER' command in Figure 4 .

After completion of the installation sequence, subsequent opera-

```
>
>! RLUDS INSTALLATION PROCEDURE
>!
>
>TIM
08:28:18 15-DEC-80
>
>
>SET /UIC=[1,1]
>INS $F4P/TASK=...FOR
>PIP [77,10]*.*;*/DE
>SET /UIC=[77,10]
>FLX /RS=MM0:[*,*]*.*/DO
>
>
>@ASN
>ASN SY0:=GS0:
>ASN NL0:=GL0:
>ASN SY0:=GO0:
>ASN SY0:=GT0:
>@ <EOF>
>
>
>@USER
>MAC @MACBLD
>FOR @FORBLD
>TKB @TKBBLD
>@ <EOF>
>
>
>@DRIVER
>SET /UIC=[1,1]
>MAC @[77,10]SMDRVMAC
>TKB @[77,10]SMDRVTKB
>SET /UIC=[77,10]
>@ <EOF>
>
>
>TIM
08:45:56 15-DEC-80
>
>
>
```

Figure 4 RLUDS Software Installation Procedure tion of the LMG simulator does not require the expertise of the System Manager and is described in the sections which follow.

6.2 CONNECTION TO LM

The PDP-11 interfaces to the Link Module through a DR11-C interface card. The connection of the DR11-C to the LM is illustrated in Figure 5 .

(1) Cable CBLØ1-J1 connects to P1 of the DR11-C.

(2) Cable CBLØ1-J2 connects to P2 of the DR11-C.

(3) The other end of CBLØ-J1 and CBLØ1-J2 connect through P1 to J1 of the LM back panel.

6.3 OPERATION

6.3.1 Summary of Modules

The LMG simulator is comprised of two real-time tasks running under the RSX-11M operating system on the PDP-11 computer. The high level language FORTRAN IV is used whenever possible.

Figure 6 is a block diagram of the LMG simulation system. The Command Interpreter (CI) task runs on CRT #1 to interpret and execute commands. The Shared Memory Display task runs on CRT #2 to continually interpret and display the contents of the Shared Memory (SM) in an easy-to-read format.

There are three kinds of disk files. The Output Log File records all transactions during a simulation. The Output Command File records commands and parameters, when desired, for later use as an Input Command File. The commands and parameters can be input from CRT #1 or from a disk Input Command File.

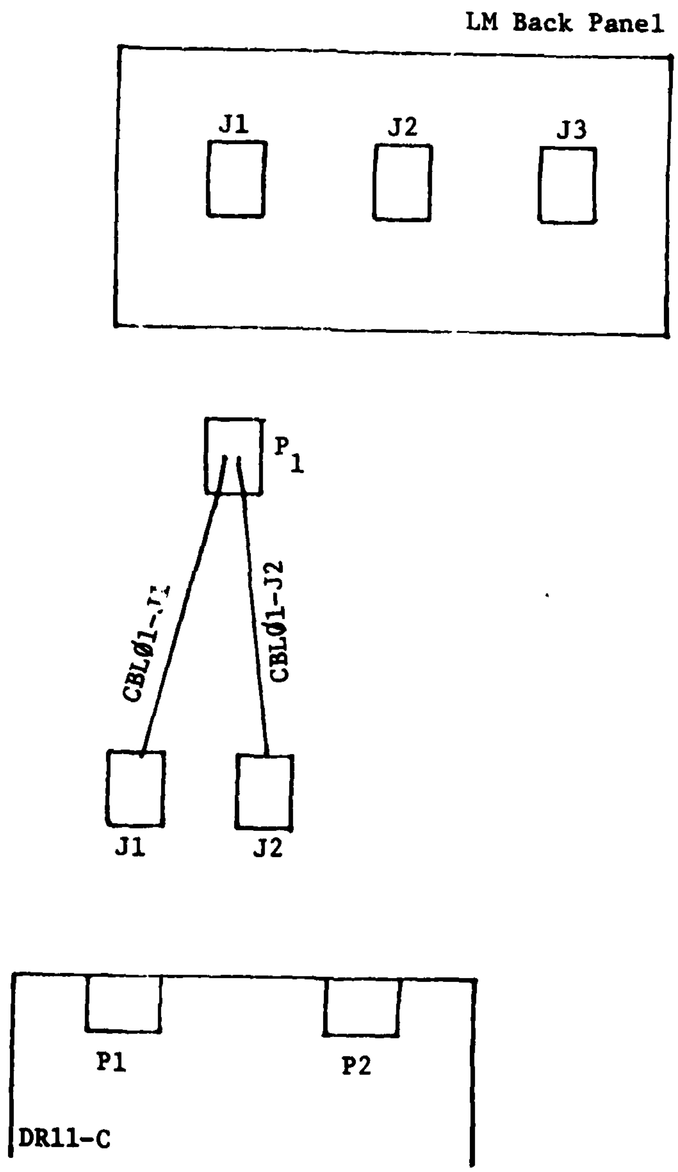


Figure 5 Connection of DR11-C and LM

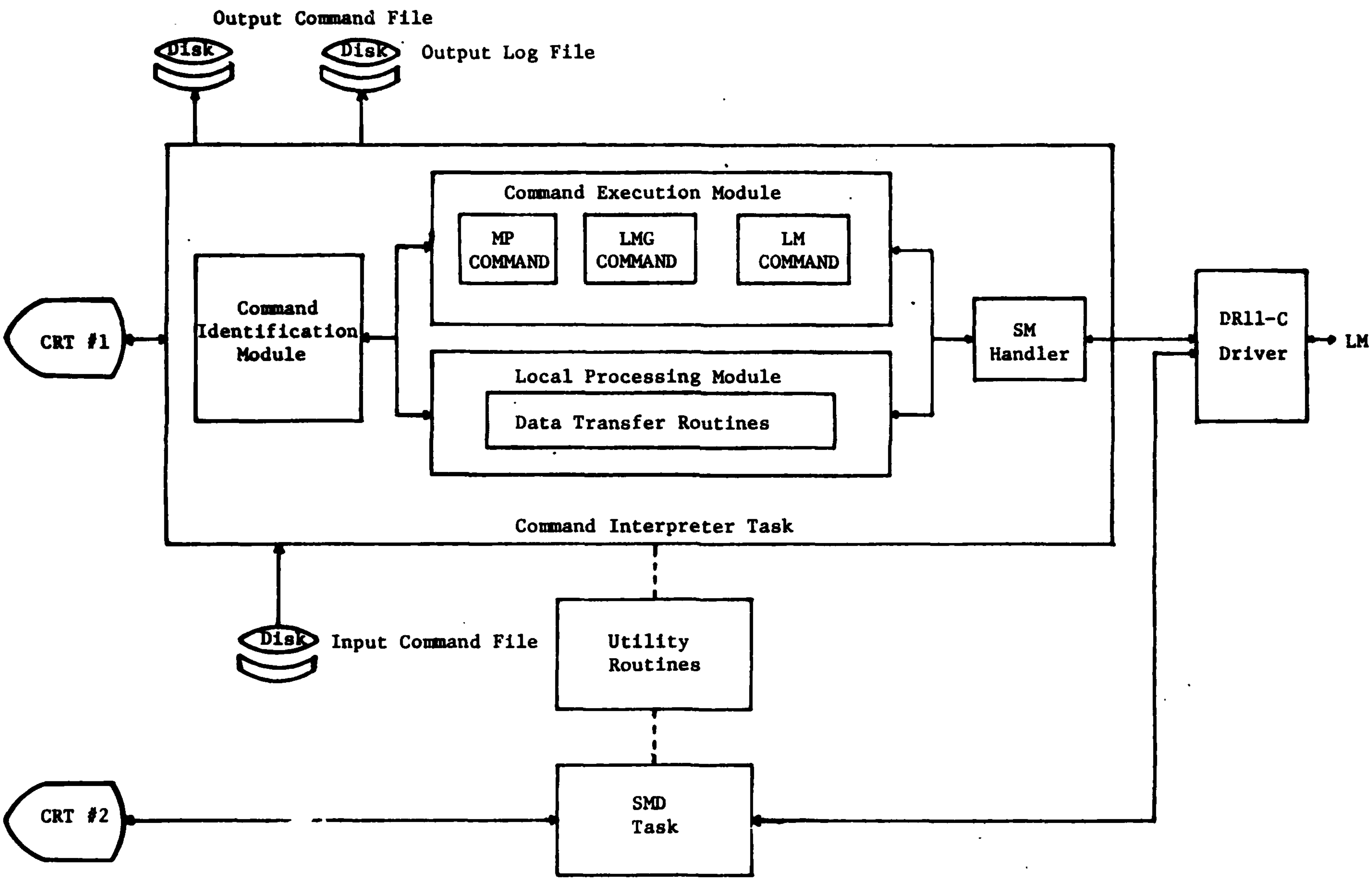


Figure 6 Block Diagram of LMG Simulator System

6.3.2 Initiating the Simulation

Before initiation of the simulation it is necessary to perform the setup procedures described in this manual for the ICA, nameplate, and link module. It is also assumed that the PDP-11 System Manager has installed the LMG simulation software as described in Section 6.1.

In order to set up for the simulation, enter the following commands at CRT #1 and at CRT #2:

```
>HELLO [uic]
>PASSWORD?
>@[77,10]SETUP
```

where 'uic' is a privileged account assigned to you by the System Manager. The System Manager will also provide a password for the account. NOW enter 'RUN CMDINT' at CRT #1 to run the Command Interpreter task, and enter 'RUN SMD' at CRT #2 to run the Shared Memory Display task.

The remainder of this chapter describes the commands that can now be entered during the simulation. Appendix B gives a set of test scripts recommended for a user unfamiliar with the system.

At the completion of the simulation, to exit the program at each terminal, enter '@TERM' at either terminal, and log off the PDP-11 by entering 'BYE' at both terminals.

6.3.3 Tables of Commands and their Formats

There are three categories of commands: LMG command, LM function command, and maintenance port (MP) command. The LMG commands are listed in Table 6 . The LM function commands are listed in Table 7 . The MP commands are listed in Table 8 . For detailed information of each command please see 6.3.3.1 (LMG commands), 6.3.3.2 (LM function commands) and

TABLE 6 LMG COMMANDS

Command	Function
SMDIAG	Perform SM diagnostic function
LOCAL	Request data transfer application program to transfer data between the LMG and the subsystem

TABLE 7 LM FUNCTION COMMAND

Command	Function Within LM
NOOP	No operation
PRGMLD	Load non-resident task
RUN	Run non-resident task
STOP	Stop non-resident task
CONFIG	Configure selected subsystem
XFRTBL	Transfer LM system tables to/from LMG
CANCEL	Cancel the previous command that is pending
RESET	Reset CMDITR and ICA
RESTART	Jump to power up restart location
STATUS	Clear input buffer request bit and service request bit in flag mode
NPINIT	Request NP handler to initialize NP's
NPDIAG	Same as NPINIT

TABLE 8 MP COMMANDS

Command	Function
CRT	Input from CRT
DISK	Input from disk
CLOLF	Close log file
OPICF	Open input command file
CLICF	Close input command file
OPOCF	Open output command file
CLOCF	Close output command file
CREATE	Creating Output Command File
NOCRET	Stop creating output command file
STPERR	Stop on error
CNTERR	Continue on error
MPSTAT	Output Maintenance Port Status
REWIND	Rewind input command file
EXIT	Exit program
WRITE	Write data to SM
READ	Read data from SM
DUMP	Dump all of SM to the CRT
SETTIM	Set PDP-11 system time to LM

6.3.3.3 (MP commands).

6.3.3.1 LMG Commands

In this section, the function and format of each LMG command are described. The parameters are also described, if any.

(1) SMDIAG

SMDIAG runs the shared memory diagnostic program to diagnose the hardware shared memory.

Format

```
CMD>SMDIAG
```

(2) LOCAL

LOCAL requests a data transfer application program to perform data transfer between the LMG and the subsystem.

Format

```
CMD>LOCAL
SELECT ONE OF THE DATA TRANSFER ROUTINES:
REFIN    ALGIN    SYNIN    SINREF   SAMDIN   DINMOF
SEQIN    SINFLG   DINMOL
SEQOUT   ALGOUT   SYNOUT   DISOUT   SOUTA    SOUTB
SYNIO    SIO      CRTSIM
?
routinename
```

Parameter

taskfile
Specifies the name of local processing routine to be called. For available local processing routines please refer to Table 9 .

Example

```
CMD>LOCAL
SELECT ONE OF THE DATA TRANSFER ROUTINES:
REFIN    ALGIN    SYNIN    SINREF   SAMDIN   DINMOF
SEQIN    SINFLG   DINMOL
SEQOUT   ALGOUT   SYNOUT   DISOUT   SOUTA    SOUTB
SYNIO    SIO      CRTSIM
?
SIO
```

In this example, the SIO subroutine is called to execute data transfer.

TABLE 9 LOCAL PROCESSING ROUTINES

Routine	Function
REFIN	Just input refreshed data from subsystem once for the purpose of testing data transfer.
ALGIN	Inputs refreshed AC or DC voltages from subsystem and displays them.
SYNIN	Inputs refreshed synchro data, calculates and displays the angles set.
SINREF	Inputs refreshed serial data and displays on the CRT.
SAMDIN	Inputs refreshed discrete data, displays the threshold voltage and the binary bit pattern of discrete data.
DINMOF	Input refreshed discrete data and displays its binary bit pattern on the CRT.
SEQIN	Just input sequential data from subsystem once for the purpose of testing data transfer.
SINFLG	Inputs sequential serial data and displays on the CRT.
DINMOL	Inputs sequential discrete data and displays its binary bit pattern on the CRT.
SEQOUT	Just manually output sequential data from CRT to subsystem once for the purpose of testing data transfer.
ALGOUT	Sequentially outputs triangle wave amplitude to the subsystem.
SYNOUT	Sequentially outputs synchro data to the subsystem.
DISOUT	Sequentially outputs as discrete data a counter, which will increment at 1 sec intervals, to the subsystem.
SOUTA	Sequentially outputs as serial data a counter, which will increment at 1 sec intervals, to the subsystem connected to Group A.
SOUTB	As above, except Group B instead of Group A.
SYNIO	Inputs the refreshed input and output angles (already converted from synchro data) of the synchro subsystem and displays on the CRT.
SIO	Inputs the refreshed operation results from the subsystem and displays on the CRT.
CRTSIM	Simulate CRT to transfer ASCII character string to or from the LM.

6.3.3.2 LM Function Commands

In this section, the function and format of each LM function command are described. The parameters are also described, if any.

(1) NOOP

NOOP provides the LMG with a means of exercising the command handshake without causing anything to happen.

Format

CMD>NOOP

(2) PRGMLD

PRGMLD requests LM to down load a non-resident task from LMG or up load a non-resident task from NP.

Format

```
CMD>PRGMLD
DATA I/O(DIO)OR SUBSYSTEM DIAGNOSTIC (SSD)?  type
FROM LMG OR NP?  source
[FILENAME?  filespec]
```

Parameters

type
Specifies the type of non-resident task. Either data I/O conversion task or subsystem diagnostic task is allowed.

source
Specifies the source of the non-resident task: either from LMG down load or from NP up load.

filespec
Specifies the filename of the non-resident task. This parameter will be asked only when the source is LMG. The filetype .LX is automatically given and will override any filetype given by the user.

Examples

```
CMD>PRGMLD
DATA I/O (DIO) OR SUBSYSTEM DIAGNOSTIC (SSD)?  SSD
FROM LMG OR NP?  NP
```

In this example, subsystem diagnostic task will be up loaded from NP to LM.

```
CMD>PRGMLD
DATA I/O (DIO) OR SUBSYSTEM DIAGNOSTIC (SSD)?  DIO
FROM LMG OR NP?  LMG
FILENAME?  REFIN
```

In this example, data I/O task REFIN.LX will be down loaded from LMG to LM.

(3) RUN

RUN requests LM to run the non-resident task.

Format

```
CMD>RUN
```

(4) STOP

STOP requests LM to stop the non-resident task.

Format

```
CMD>STOP
```

(5) CONFIG

CONFIG requests LM to call the ICA handler to configure the selected subsystem from the LMG or NP.

Format

```
CMD>CONFIG
FROM LMG OR NP?  source
GROUP A OR B?  group
CONFIGURATION TYPE:
AINACS   AINACD   AINDCS   AINDCD
AOTACS   AOTACD   AOTDCS   AOTDCD
SINREF   SINFLG   SOUT     DOUT
DINRFS   DINRFD   DINMOF   DINMOL
SYNIN    SYNOUT
?  confitype
[THRESHOLD VOLTAGE (-9 TO 9)?  voltage]
```

Parameters

source
Specifies the source from which to configure the subsystem.

group
Specifies the group that will be configured.

conf1type
Specifies different configuration types. This parameter will be asked only when the source is LMG.

For configuration type, please refer to Table 10.

voltage
Specifies the threshold voltage to be used to configure the subsystem. This parameter will be asked only when the configuration types are DINRFS and DINRFD.

Example

```
CMD>CONFIG
FROM LMG OR NP?  LMG
GROUP A OR B?  A
CONFIGURATION TYPE:
AINACS   AINACD   AINDCS   AINDCD
AOTACS   AOTACD   AOTDCS   AOTDCD
SINREF   SINFLG   SOUT     DOUT
DINRFS   DINRFD   DINMOF   DINMOL
SYNIN    SYNOUT
?  DINRFS
THRESHOLD VOLTAGE?  -2.5
```

In this example, Group A is configured from LMG, with 'refreshed mode, single-ended discrete input' configuration type; the threshold voltage is -2.5v.

(6) XFRTBL

XFRTBL requests LM to transfer LM system tables to/from LMG.

Format

```
CMD>XFRTBL
TABLE NAME?  tablename
READ OR WRITE (R/W)?  tofrom
RECORD FUNCTION (Ø-5)
Ø:WRTREC    1:EOD
2:BOD       3:BACREC
4:FWDREC    5:ERAWRT
? recfunc
# OF BYTES?  numbytes
# OF RECORDS?  numrecs
ENTER HEXASC BYTES (1Ø BYTES/LINE)AS  XX,XX,...
hexascii
LEAP YEAR (Y/N)?  ansyear
MONTH:  month
HOUR:  hour
MINUTE:  minute
SECOND:  second
```

TABLE 10 ICA CONFIGURATION TYPES

Type	Indication
AINACS	Analog IN AC Single ended
AINACD	Analog IN AC Differential
AINDCS	Analog IN DC Single ended
AINDCD	Analog IN DC Differential
AOTACS	Analog OuT AC Single ended
AOTACD	Analog OuT AC Differential
AOTDCS	Analog OuT DC Single ended
AOTDCD	Analog OuT DC Differential
SINREF	Serial IN-REFresh mode
SINFLG	Serial IN-FLaG mode
SOUT	Serial OUT
DOUT	Discrete OUT
DINRFS	Discrete IN-ReFresh Single ended
DINRFD	Discrete IN-ReFresh Differential
DINMOF	Discrete IN-MOmentary Follow mode
DINMOL	Discrete IN-MOmentary Latch mode
SYNIN	SYNchro IN
SYNOUT	SYNchro OUT

Parameters

tablename
: Specifies the name of table to be transferred. Available tables are shown in Table 11.

tofrom
: Specifies to write the table to LM or read the table from LM. This parameter will be asked only for two tables: TIME and NPREC.

recfunc
: Specifies the record function that will be performed. This parameter will be asked only when the table to be transferred is NPREC and is to be written to LM. Available record functions are shown in Table 12 .

numbytes
: Specifies the number of bytes that will be written to the nameplate record. This will be asked only for the NPREC table that will be written to the LM.

numrecs
: Specifies the number of records that will be read from the nameplate record or be moved by the nameplate record pointer.

hexascii
: The hexadecimal ASCII data to be written to the nameplate record. Each byte is formed by two hexadecimal ASCII characters and separated by a comma or blank.

ansyear
: Specifies that this year is a leap year (Y) or not (N). This parameter will be asked only when the TIME table is written to LM.

month
: Specifies the month of the date. Only the first 3 letters are received. This parameter will be asked only when the TIME table is written to LM.

hour
: Specifies the hour of the date. This parameter will be asked only when the TIME table is written to LM.

minute
: Specifies the minute of the date. This parameter will be asked only when the TIME table is written to LM.

second
: Specifies the second of the date. This parameter will be asked only when the TIME table is written to LM.

TABLE 11 TABLES TRANSFERRED TO/FROM LMG

Table #	Name	Bytes	R/W	Remark
1	TSKSTS	12	RO	Task status
2	DLYTIM	12	RO	Delay time
3	STAADR	24	RO	Start address
4	RSTADR	24	RO	Restart address
5	PRGMHD	13	RO	Program header
6	TIME	5	RW	Time
7	SICSTS	5	RO	Subsystem information channel status
8	NPDIR	25	RO	Nameplate directory
9	NPCNFG	23	RO	Nameplate configuration
10	ICCNFG	14	RO	ICA configuration
11	NPREC	16	RW	Nameplate record

RO: can be read only by LMG.
RW: can be read or written by LMG.

For format of each table please refer to Appendix A.

TABLE 12 RECORD FUNCTIONS

Name	Function
WRTREC	WRITE RECORD
EOD	END OF DATA RECORD
BOD	BEGINNING OF DATA RECORD
BACREC	BACK RECORD
FWDREC	FORWARD RECORD
ERAWRT	ERASE RECORD

Examples

```
CMD>XFRTBL
TABLE NAME?  TIME
READ OR WRITE (R/W)?  W
LEAP YEAR (Y/N)?  N
MONTH:  JAN
HOUR:  1Ø
MINUTE:  3Ø
SECOND:  ØØ
```

In this example, the time of date will be set into the LM system.

```
CMD>XFRTBL
TABLE NAME?  PRGMHD
READ OR WRITE (R/W)?  R
```

In this example, the program header will be transferred from the LM. (For table format please refer to Appendix A).

```
CMD>XFRTBL
TABLE NAME?  NPREC
READ OR WRITE (R/W)?  W
RECORD FUNCTION (Ø-5)
Ø:WRTREC  1:EOD
2:BOD     3:BACREC
4:FWDREC  5:ERAWRT
? Ø
# OF BYTES WRITTEN TO RECORD (AT MOST 14)?  5
ENTER HEXASC BYTES (1Ø BYTES/LINE)AS  XX,XX,...
A1,A2,A3,B4,B5
```

In this example five HEXASCII bytes are written to the nameplate record that is pointed to by the nameplate pointer.

(7) CANCEL

CANCEL requests LM to stop the execution of the previous command already in progress.

Format

```
CMD>CANCEL
```

(8) RESET

RESET requests LM to reset the state of the CMDITR task and the ICA hardware.

Format

```
CMD>RESET
```

(9) RESTRT

RESTRT causes LM to jump to its power up restart location.

Format

CMD>RESTRT

(10) STATUS

STATUS clears the service request bit in status alert byte, and requests LM to clear the input buffer request bit in the data transfer handshake for sequential input.

Format

CMD>STATUS

(11) NPINIT

NPINIT requests NP handler to reset all the NP's, and causes each NP to run its internal diagnostic.

Format

CMD>NPINIT

Note

NPINIT command will return with two bytes. The format of the two bytes are the same as the last two bytes in SICSTS table.

(12) NPDIAG

NPDIAG does the same as NPINIT.

Format

CMD>NPDIAG

Note

NPDIAG command will return with two bytes. The format of the two bytes are the same as the last two bytes of SICSTS table.

6.3.3.3 MP Commands

In this section, the function and format of each MP command are described. The parameters are also described, if any.

(1) CRT

CRT directs that commands and parameters be input from the CRT.

Format

```
CMD>CRT
```

(2) DISK

DISK directs that commands and parameters be input from the disk.

Format

```
CMD>DISK
```

Note

The Input Command File should be opened before the DISK command is issued.

(3) CLOLF

CLOLF closes an old output log file and has an option to open a new one.

Format

```
CMD>CLOLF
DO YOU WANT TO OPEN A NEW LOG FILE?  (Y/N)  answer
OPEN OUTPUT LOG FILE
ENTER FILE NAME
filename
$$$$ OUTPUT LOG FILE filename.LOG IS OPENED $$$$
ENTER IDENTIFICATION
identi
```

Parameters

answer
Replies to the question with Y or N.

filename
Specifies the file name of the output log file. The file type .LOG is automatically given and will override any filetype given by the user. This parameter will be asked only when the answer of first question is Y(yes).

identi
Specifies the identification of this demonstration. This parameter will be asked only when the answer of the first question is Y(yes).

Example

```
CMD>CLOLF
DO YOU WANT TO OPEN A NEW LOG FILE? (Y/N)  Y
OPEN OUTPUT LOG FILE
ENTER FILENAME
SAM
$$$$ OUTPUT LOG FILE SAM.LOG IS OPENED $$$$
ENTER IDENTIFICATION
TEST DATA TRANSFER COMMANDS
```

In this example, a new output log file SAM.LOG is opened to record the output of the testing of data transfer commands.

(4) OPICF

OPICF opens an input command file.

Format

```
CMD>OPICF
ENTER FILENAME
filename
```

Parameter

filename
: Specifies the file name of input command file. The filetype .COM is automatically given and will override any filetype given by the user.

Example

```
CMD>OPICF
ENTER FILENAME
TRY
```

In this example, TRY.COM File is opened as an input command file.

Note

It is not permissible to open two input command files concurrently.

(5) CLICF

CLICF closes the input command file.

Format

```
CMD>CLICF
```

(6) OPOCF

OPOCF opens an output command file.

Format

```
CMD>OPOCF
ENTER FILENAME
filename
```

Parameter

filename
Specifies the file name of the output command file. The filetype .COM is automatically given and will override any filetype given by the user.

Example

```
CMD>OPOCF
ENTER FILENAME
TRY.CMD
```

In this example, TRY.COM is opened as an output command file. Note that the filetype given by the user is .CMD, but overridden by .COM.

Note

It is not permissible to open two output command files concurrently.

(7) CLOCF

CLOCF closes the output command file.

Format

```
CMD>CLOCF
```

(8) CREATE

CREATE puts the system into the creating mode. All the commands and parameters will be recorded into a disk file (output command file).

Format

```
CMD>CREATE
```

Note

An Output Command File should be opened before the CREATE command is issued.

(9) NOCRET

NOCRET puts the system into the non-creating mode.

Format

CMD>NOCRET

Note

In non-creating mode, commands and parameters will not be recorded into the disk file, even though the output command file is opened.

(10) STPERR

STPERR causes disk input mode execution to stop if an error occurs.

Format

CMD>STPERR

Note

This command is used only for disk input mode. CRT input mode always stops on error.

(11) CNTERR

CNTERR causes disk input mode execution to continue, even if an error occurs.

Format

CMD>CNTERR

Note

This command is used only for disk input mode. Stop-on-error condition will override the CNTERR command in CRT input mode.

(12) MPSTAT

MPSTAT shows the maintenance port status.

Format

CMD>MPSTAT

Note

The maintenance port status includes the files opened, stop-on-error or continue-on-error condition, creating (output command file) mode or non-creating mode, CRT input mode or DISK input mode.

(13) REWIND

REWIND rewinds the input command file to the top of the file.

Format

```
CMD>REWIND
```

Note

An input command file should be opened before the REWIND command is issued.

(14) EXIT

EXIT stops the program and closes all opened files.

Format

```
CMD>EXIT
```

(15) WRITE

WRITE writes data to certain locations of SM.

Format

```
CMD>WRITE
STARTING ADDRESS (Ø-255)?  startaddress
# OF BYTES?  numbytes
ENTER HEXASC BYTES (1Ø BYTES/LINE)AS  XX,XX,...
hexascii
```

Parameters

startaddress
Specifies the starting address of the data to be modified.

numbytes
Specifies the number of data bytes to be modified.

hexascii
The hexadecimal ASCII data to be written to the SM. Each byte is formed by two hexadecimal ASCII characters and separated by a comma or blank.

Example

```
CMD>WRITE
STARTING ADDRESS (Ø-255)? 64
# OF BYTES?  2
ENTER HEXASC BYTES (1Ø BYTES/LINE)AS  XX,XX,...
5E,4A
```

In this example, the data in SM addresses 64 and 65 will be 5E (hex) and 4A (hex), respectively.

Notes

It is not allowed to write data beyond the address range Ø-255.

(16) READ

READ reads data from consecutive locations of SM and displays on CRT.

Format

```
CMD>READ
STARTING ADDRESS (Ø-255)?  startaddress
# OF BYTES?  numbytes
```

Parameters

startaddress
Specifies the starting address of the data to be read.

numbytes
Specifies the number of data to be read.

Example

```
CMD>READ
STARTING ADDRESS (Ø-255)?  Ø
# OF BYTES?  1Ø
```

In this example, the data in SM address from Ø to 1Ø will be displayed on CRT.

Note

It is not allowed to read data beyond the address range Ø-255.

(17) DUMP

DUMP displays all data in SM on the CRT.

Format

```
CMD>DUMP
```

(18) SETTIM

SETTIM gets the PDP-11 system time and sends it to LM.

Format

CMD>SETTIM

6.4 LM FUNCTION COMMAND STATUS RETURN CODES

The LM function command status return codes are shown in Table 13 .

6.5 SHARED MEMORY

A summary of shared memory is shown in Table 14 . Detailed descriptions of each area in SM are given in the sections that follow.

6.5.1 Interpretation of Significant SM Locations

(1) LMFCMD - LM function command

S1:	semaphore	1:	given
		∅:	received

CMD#:

1 - PRGMLD
2 - RUN
3 - STOP
4 - NPDIAG
5 - reserved
6 - CANCEL
7 - XFRTBL
8 - STATUS
9 - RESET
1∅ - RESTRT
11 - NPINIT
12 - CONFIG
13 - NOOP

(2) DXCMD - Data transfer command

REF:	refreshed buffer indicator	∅:	sequential mode
		1:	refreshed mode
IOB:	I/O buffer #	∅:	output buffer (IOBUF ∅)
		1:	input buffer (IOBUF 1)

(3) LMFSTS - LM function status

Refer to 6.4, table of LM function status return codes.

TABLE 13 LM FUNCTION COMMAND STATUS RETURN CODES

Command	Status	Indication
General	+2	Command active.
	+1	Command received.
	Ø	Success
	-1	Invalid command.
	-2	Another command still in progress.
	-3	Command not implemented yet.
	-4	Command cancelled.
PRGMLD	-1Ø	# of bytes not from -1 to +61.
	-11	Existing non-resident task is not dormant.
	-12	TYPE not Ø or 1.
	-13	SOURCE not Ø or 1.
	-15	XFR or TRLR record with SOURCE=NP.
	-16	Invalid start address.
	-17	Invalid end address.
	-18	XFR record with no HDR record.
	-19	TRLR record with no XFR record.
	-2Ø	EXEC failure to REMOVE previous task.
	-21	NP failure to upload task.
	-22	EXEC failure to INSTAL NP task.
	-23	Program checksum not zero.
	-24	EXEC failure to INSTAL LMG task.
RUN	-1Ø	A task is not installed.
	-11	The task is not dormant.
	-12	Task checksum not zero.
STOP	-1Ø	A task is not installed.
	-11	The task is dormant.
	-12	Failure to STOP after 5 sec.
NPDIAG	-	see NPINIT.
CANCEL	-	None
XFRTBL	-1Ø	Invalid table number.
	-11	To/from LM not Ø or 1.

TABLE 13 (CONTINUED) LM FUNCTION COMMAND STATUS RETURN CODES

Command	Status	Indication
	-12	# bytes not from 1 to 64.
	-13	Offset < Ø.
	-14	Attempt to write a read only table.
	-15	TIME: # bytes too large.
	-16	TIME: Offset too large.
	-17	NPREC: Function not Ø to 5.
	-18	NPREC: Invalid # bytes.
	-19	SICSTS: Table shows <1 # of NP's.
	-2Ø	SICSTS: Table shows >2Ø # of NP's.
	-21	NPHND error.
	-22	ICCNFG: ICAHND error GRP A.
	-23	ICCNFG: ICAHND error GRP B.
STATUS	-	None
RESET	-1Ø	ICAHND fail to reset ICA.
RESTRT	-	None
NPINIT	-1Ø	NPHND error.
CONFIG	-1Ø	SOURCE not Ø or 1 (LMG or NP).
	-11	GROUP not 1 or 2 (A or B).
	-12	ICAHND error.
	-13	NPHND error.
	-14	Invalid NP table.
NOOP	-	None

TABLE 14 SHARED MEMORY

Symbolic Name	Address DEC	Address HEX	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
LMFCMD	255	FF	S1	cmd #						
DXCMD	254	FE	X						IOB	REF
LMFSTS	253	FD	LMF cmd status							
DXSTS-S1	252	FC	RDY 1	REQ 1	FLG	X			REQ Ø	RDY Ø
-SØ	251	FB	X		WSC					
STSALR	25Ø	FA	S	X			LM	NP	ICA	LA
LMSTS-H	249	F9	X			HND	IMSK	SMHW	INIT	OPER
-L	248	F8	LM diagnosis							
NPSTS-H	247	F7	X							
-L	246	F6	HWE	CFC	NPP	INT	RCF	Ø	Ø	RST
ICASTS-H	245	F5	ICA status							
-L	244	F4	X							
LASTS	243	F3	LA status							
	242	F2	50 bytes spare							
HWTST	192	CØ	SM HW Test Byte							
	191	BF	64 bytes LMBUF							
LMBUF	128	8Ø								
	127	7F	64 bytes IOBUF 1							
IOBUF 1	64	4Ø								
	63	3F	64 bytes IOBUF Ø							
IOBUF Ø	Ø	ØØ								

(4) DXSTS - Data transfer status

a. DXSTS - S1

RDYØ: IOBUF Ø ready bit

REQØ: IOBUF Ø request bit

FLG : subsystem down flag

REQ1: IOBUF 1 request bit

RDY1: IOBUF 1 ready bit

b. DXSTS - SØ

WSC: word (byte) subcount

(5) STSALR - status alert

S: asynchronous service request bit (Flag mode)
LM: LM status alert bit
NP: NP status alert bit
ICA: ICA status alert bit
LA: LA status alert bit

(6) LMSTS - LM status

a. LMSTS-H

OPER: LM diagnostic error

INIT: cleared by RESET command

SMHW: shared memory hardware is not present

IMSK: interrupt mask

HND: cleared by shared memory handler

b. LMSTS-L

Written by resident or non-resident task relating to LM diagnostic.

1 is written by non-resident task SMDIAG.

(7) NPSTS - Nameplate status

a. NPSTS-H

Not used.

b. NPSTS-L

RST: SIC reset state

RCF: SIC maintenance record is full.

INT: SIC has been initialized.

NPP: at least one NP is present.

CFC: SIC configuration changed since initialization.

HWE: SIC hardware failure.

(8) ICASTS - ICA status

a. ICASTS-H

Status	Indication
ØØ	Success
FF	Invalid ICA function
FE	Group not configured
FD	Parity error during serial input
FC	Invalid configuration
FB	No data received during serial input
FA	Parity error during serial output
F9	Data not transmitted during serial output
F8	Synchro-out configuration, but request input
F7	Synchro-in configuration, but request output
F6	Analog-out configuration, but request input
F5	Analog-in configuration, but request output
F4	Discrete-out configuration, but request input
F3	Discrete-in configuration, but request output
F2	Serial-out configuration, but request input
F1	Serial-in configuration, but request output

b. ICASTS-L

Not used.

(9) LA status - Data I/O Task Status

Status	Indication
ϕ2	Running
ϕ3	Stopped
ϕD	Stopped - S1 byte error
ϕB	Stopped - ICA not configured
ϕA	Stopped - ICA error
ϕ5	Stopped - invalid synchro voltages(don't sum to ϕ)
ϕ6	Stopped - invalid synchro voltage (wrong value of 'A')

Status	Indication
A5	Same as ϕ5, but error not written into NP
A6	Same as ϕ6, but error not written into NP
ϕ7	Stopped - parity error on serial input
A7	Same as ϕ7, but error not written into NP
ϕ8	Stopped - parity error on serial output
A8	Same as ϕ8, but error not written into NP
ϕ9	Stopped - data not transmitted on serial output
A9	Same as ϕ9, but error not written into NP

(10) HWTST - Hardware test

This location is tested by SMHND for presence of hardware card. The tested byte is A5.

(11) LMBUF - LM function buffer

For transferring parameters and data for the LM function command.

(12) IOBUF 1 - Input/Output Buffer 1

Used as input buffer for single-buffered transfers in RLUDS.

(13) IOBUF ϕ - Input/Output Buffer ϕ

Used as output buffer for single-buffered transfers in RLUDS.

APPENDIX A - DETAILED DESCRIPTIONS OF LM TABLES

The detailed descriptions of the tables transferred to/from the LM with the XFRTBL command are given in this appendix. The name, size, function and format are described for each table.

(1) TSKSTS-12 bytes, 1 byte/task, indicating READY state

Task Number	b7	bØ	Task Name
Task #Ø		X	UPDATE
#1		X	ICAHND
#2		X	SICHND
#3		X	SMHND
#4		X	CMDITR
#5		X	NRTSK
#6		X	
#7		X	
#8		X	
#9		X	
#1Ø		X	
#11		X	

b7 = Ø - task not ready
1 - task ready

b6 - bØ not used

(2) DLYTIM-12 bytes, 1 byte/task, indicating delay time.

Task Number	b7	b6–bØ
Task #Ø		
Task #1		
Task #2		
Task #3		
Task #4		
Task #5		
Task #6		
Task #7		
Task #8		
Task #9		
Task #1Ø		
Task #11		

b7 = Ø delay count in 10 ms
     1 delay count in 1 sec

b6-bØ delay count

(3) STAADR-24 bytes, 2 bytes/task, indicating start address.

Task #Ø	start address H L
#1	
#2	
#3	
#4	
#5	
#6	
#7	
#8	
#9	
#1Ø	
#11	

(4) RSTADR-24 bytes, 2 bytes/task, indicating restart address.

The format is the same as STAADR.

(5) PRGMHD-13 bytes, indicating the program header of the loaded non-resident task.

program name
start address H L
last address +1 H L
initial stack pointer H L
checksum

(6) TIME-5 bytes, indicating BCD date and time of day.

Day of the Year (1-366)
hours
minutes
seconds

(7) SICSTS-5 bytes, indicating subsystem information channel status

NIC status
# of NP's
1st NP ID
1st NP diagnostic results

NIC status

ϕ	ϕ	ϕ	ϕ	ϕ	PWR	CKE	RST

PWR: SIC is disconnected or SIC power not present

CKE: SIC system clock failure

RST: SIC in reset state

NP diagnostic result bytes

H:	DGC	ROME	ϕ	RECE	ϕ	RAME	TIME	ϕ

DGC: Diagnostic completed

ROME: ROM data errors

RECE: Write records in error

RAME: RAM errors

TIME: Timer errors

L:	ROM4	ROM3	ROM2	ROM1	Free Record

Free Record: Number of write memory records still available at time of diagnostic.

(8) NPDIR - 25 bytes, Directory of NP.

Field	Demonstration System Values (Hex)
NP ID	81 = Serial NP, 82=Synchro NP
Directory Code	DC
Size of Directory (bytes)	00 19 = $(25)_{10}$
Entry #1 ID Code	CF = Subsystem Configuration Table
Entry #1 Starting Address	
Entry #1 Size in Bytes	
Entry #2 ID Code	C0 = Subsystem Data Conversion Program
Entry #2 Starting Address	
Entry #2 Size	
Entry #3 ID	D1 = Subsystem Diagnostic
Entry #3 Starting Address	
Entry #3 Size in Bytes	
Entry #4 ID	DA = Write Memory Data Storage
Entry #4 Starting Address	
Entry #4 Size in Bytes	
Directory checksum	

(9) NPCNFG-23 bytes, subsystem configuration table in nameplate.

	Field	Demonstration System Values (Hex)
	Configuration Code	CF
	Size of Table	ØØ 17=(23)$_{1Ø}$
	Number of ICA Group	Ø2
8 bytes	Group 1 Configuration Bytes	
8 bytes	Group 2 Configuration Bytes	
	Number of NP's Present	Ø1
	1st NP	81=serial, 82=synchro
	Checksum	

(10) ICCNFG-14 bytes, 7 bytes/Group, ICA configuration table in ICA.

Group A	Group A Topology
	high level
	low level
	threshold
	word count
	clock rate
Group B	Group B Topology
	high level
	low level
	threshold
	word count
	clock rate

Topology Bytes

	Bit 7	6	5	4	3	2	1	ϕ
H	A/D	AC/DC	RI/V	DVRN	DVRP	INM2	INM1	INMϕ

A/D: 1 = Analog
ϕ = Digital

AC/DC: 1 = AC
ϕ = DC

RI/V	DVRN	DVRP	
ϕ	ϕ	ϕ	no source enabled
1	ϕ	ϕ	current source
ϕ	ϕ	1	voltage source, single-ended
ϕ	1	1	voltage source, differential

INM2	INM1	INM0	
ϕ	1	1	single-ended
1	1	1	differential

	Bit 7	6	5	4	3	2	1	ϕ
L	Serial Out	Serial In	Synch Out	Synch In	Unused	FLG/REF	Out Enable	L/F

Bit 7-4 at most one is set. If both bit 4 and 5 are set, it is in reset state.

Bit 3 Unused

Bit 2 Refreshed or flag mode for serial input

Bit 1 Output enable

Bit ϕ Latch or refreshed mode for discrete input

(11) NPREC - 16 bytes/record. Nameplate maintenance record

Bit 7

RCV	Record ID Code
Number of Valid Bytes	
Julian Day	
Time Hours	
Time Minutes	
Record Data 8 bytes Maximum	
Record Checksum	
Record Terminator	

RCV = Record Valid Bit,

If cleared (=Ø), the NP wrote this record correctly. When requesting a record to be written, this bit should be cleared.

Record ID Codes:

3Ø = Subsystem repaired, or determined to be working correctly.

3A = Subsystem Failure Detected

31 = Subsystem Calibration Results

32 = Subsystem Diagnostic Results

Record Data:

Data Codes and formats left up to the user.

APPENDIX B

TEST SCRIPTS FOR THE

REMOTE LINK UNIT DEMONSTRATION SYSTEM

The tests are organized into 5 groups:

- Group I: Initialization
- Group R: RLU Tests
- Group A: ICA Tests
- Group N: SIC Tests
- Group T: Termination

The Group I tests must be run first and Group T last. Groups R, A, and N may be conducted in any order.

The tests assume that all software has already been properly installed onto the computer, as described in Section 6 of this User's Manual.

When performing the tests at the CRT, all keyboard entries prescribed are terminated by the 'RETURN' key. The 'control-Z' entry prescribed is obtained by holding the 'CTRL' key down and then depressing the 'Z' key.

I. SCRIPT	✔	RESULTS/ REMARKS
The following steps must be performed to initialize the RLUDS and prepare for performing the RLU, ICA, and NP tests. I.1 CRT #1 (console) setup a) Verify that the LM is properly connected to the PDP-11 through the DR11C interface, as described in this User's Manual. b) Enter 'HELLO [uic]' at CRT #1, entering the proper password when it is requested. The uic and password must be obtained from the PDP-11 System Manager. c) Enter '@[77,1ϕ]SETUP' to set up for the demonstration. d) Enter 'RUN CMDINT' to begin execution of the LMG command interpreter task. e) The command interpreter will begin by asking a few questions: 1. First, it asks for information regarding the terminal type. Respond according to the type of CRT being used. 2. Then it asks whether the user wants a FULL, BRIEF, or NO transcript on the CRT of the operations being performed by the LMG. For the purposes of these tests, respond '1' for BRIEF. 3. Then it asks: DO YOU WANT A LOG FILE? A log file, if chosen, would be used to record all transactions performed on a disk file for later printing. For the purposes of these tests, respond 'NO'. f) Verify that the CRT has prompted 'CMD>' and is thus ready to receive commands. I.2 CRT #2 setup (optional) a) Enter 'HELLO [uic]' at CRT #2, entering the proper password when it is requested. b) Enter '@[77,1ϕ]SETUP' to set up for the demonstration. c) Enter 'RUN SMD' to begin execution of the shared memory task. d) SMD will begin by asking some questions:		

I. SCRIPT	✔	RESULTS/ REMARKS
1. First, it asks for information regarding the terminal type. Respond according to the type of CRT being used. 2. Then it asks for the update rate in seconds for refreshing the display of the shared memory contents. The suggested rate is 1 second. e) SMD will then begin the refreshed display. Observe that characters typed at the keyboard have the following effects: 1. 'R' restarts the display by asking for a new update rate. 2. Any other character merely erases the screen and then continues the display anew. I.3 Initialization of RLU a) Return to CRT #1 and enter '@INIT' to initialize the RLU. b) When the prompt CMD> is given, the RLU is ready for any of the remaining tests to be executed from CRT #1.		

R. SCRIPT - RLU TESTS	✔	RESULTS/ REMARKS
Initialization tests I.1 to I.3 must be performed before beginning the tests that follow. R.1 Test of the Synchro Subsystem a) With no subsystem or nameplate connected to the LM, observe that the 'SIC configured' light on the LM front panel is off. b) Enter '@R1A' on the console to attempt operation with the subsystem. c) Observe that failure code -1∅ is reported on the CRT. d) As illustrated in FigureB-1, connect the LM to the Synchro Subsystem and its nameplate. e) Observe that the 'SIC configured' light on the LM front panel is now on. f) Enter '@R1A' on the console once again. g) Control the angle of input synchro B and observe the changes in output synchro A and the angles reported on the console by the LMG. Verify that the synchro program is operating properly. h) Disrupt the synchro input data and observe that the synchro program will stop execution. Observe that this condition is detected and reported by the LMG. i) Enter '@R1B' on the console to read the subsystem nameplate and identify the cause of the failure. j) Correct the failure introduced in the input synchro and enter @R1C on the console to restart the data I/O task in the LM and the local processing task in the LMG. Verify that the synchro program resumes normal operation. k) Enter 'control-Z' on the console to end the test. R.2 Test of the Serial Subsystem a) With no subsystem or nameplate connected to the LM, observe that the 'SIC configured' light on the LM front panel is off. b) Enter '@R2A' on the console to attempt operation with the subsystem.		

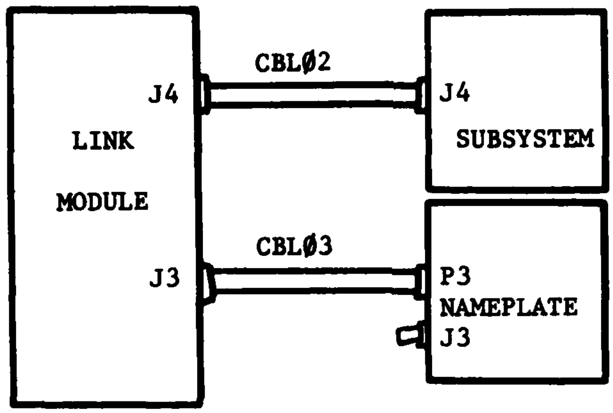


Figure B-1 Set-up for RLU Tests

R.	SCRIPT	✔	RESULTS/ REMARKS
c)	Observe that failure code -1ø is reported on the CRT.		
d)	As illustrated in Figure B-1, connect the LM to the Serial Subsystem and its nameplate.		
e)	Observe that the 'SIC configured' light on the LM front panel comes on.		
f)	Enter '@R2A' on the console once again.		
g)	Set two numbers on the left and right thumbwheel switches and select an operation on the middle thumbwheel switch (=ø for addition, ≠ø for multiplication). Depress the STROBE switch on the serial subsystem and observe that the operation requested has been performed by the LM's data I/O task and has been displayed on the serial output display. Observe also that the entire operation has been reported to the local processing task in the LMG and displayed on the console. Repeat this test for several operations.		
h)	Set TX PARITY switch on subsystem to ODD and push the flag switch again. Observe that the data I/O task stops running and that the condition is detected and reported by the LMG.		
i)	Enter '@R2B' on the console to read the subsystem nameplate and identify the cause of the failure.		
j)	Return TX PARITY to EVEN.		
k)	Enter '@R2C' on the console to restart the data I/O task in the LM and the local processing task in the LMG. Verify that the serial program resumes normal operation.		
ℓ)	Set RX PARITY switch on subsystem to ODD and depress the STROBE switch. Observe that the data I/O task stops running and that the condition is detected and reported by the LMG.		
m)	Enter '@R2B' on the console to read the subsystem nameplate and identify the cause of failure.		
n)	Return RX PARITY switch to EVEN.		
o)	Enter '@R2C' on the console to restart the data I/O task in the LM and the local processing task in the LMG. Verify that the serial subsystem resumes normal operation.		

R. SCRIPT	✓	RESULTS/ REMARKS
p) Enter 'control-Z' at the console to end the test.		
R.3 Retrieval of Serial Subsystem Information		
This test will show the organization of subsystem information stored in a nameplate. This information includes parameters used to configure the signal interface and run the Data I/O task.		
a) Enter 'X' (transfer table command). The CRT will respond with a request for a table name.		
b) Enter 'NPDIR' (nameplate directory). Observe that a directory describing the information stored in the nameplate is displayed on the screen.		
c) Enter 'X'. The CRT will request a table name.		
d) Enter 'NPCNFG' (interface configuration). Observe that the configuration parameters for the serial subsystem are displayed on the screen.		
e) Enter 'X'. The CRT will request a table name.		
f) Enter 'PRGMHD' (program header). All parameters which are required to run the data conversion program for the serial subsystem demonstration will be displayed on the screen.		
g) Enter 'X'. The CRT will request a table name.		
h) Enter 'NPREC' (maintenance records). The console will request a read or write selection.		
i) Enter 'W' (write). The console will request selection of a write command.		
j) Enter '2' (beginning of data).		
k) Enter 'X'. The CRT will request a table name.		
ℓ) Enter 'NPREC' (nameplate records). The console will prompt for selection of read or write operation.		
m) Enter 'R' (read). The console will prompt for the number of records to be read.		
n) Enter '3'. The first three records in the nameplate maintenance files will be displayed on the screen.		
o) Disconnect the subsystem cables at the end of this test.		

A. SCRIPT - ICA TEST SCRIPTS	✓	RESULTS/ REMARKS
Initialization tests I.1 to I.3 must be performed before beginning the tests that follow. Refer to Figure B-2 for **each** test set-up.		
A.1 d-c analog input		
These tests will verify the acquisition of analog d-c signals through the ICA.		
a) Test set-up: the LM to Test Panel #1.		
b) Set REFSW=dc, CTLSW=OFF and MODSW=se.		
c) Enter '@A1A' on the console for <u>single-ended source</u> test.		
d) Set CTLSW=ON.		
e) Observe the test results on the CRT screen and compare with expected values in Table B-1, column se.		
f) Enter 'control-Z' on the console to end the test.		
g) Set CTLSW=OFF and MODSW=df.		
h) Enter '@A1B' on the console for the <u>differential source</u> test.		
i) Set CTLSW=ON.		
j) Observe the test result on the CRT screen and compare with expected values in Table B-1, column df.		
k) Enter 'control-Z' on the console to end the test.		
A.2 a-c analog input		
This test will verify the acquisition of analog a-c signals (synchronous 400 Hz) through the ICA.		
a) Test set-up: connect the LM to Test Panel #1.		
b) Set REFSW=ac, CTLSW=OFF and MODSW=se.		
c) Enter '@A2A' on the console for the <u>single-ended source</u> test.		
d) Set CTLSW=ON		
e) Observe the test results on the CRT screen and compare with expected values (volts peak) in Table B-1.		
f) Enter 'control-Z' on the console to end the test.		

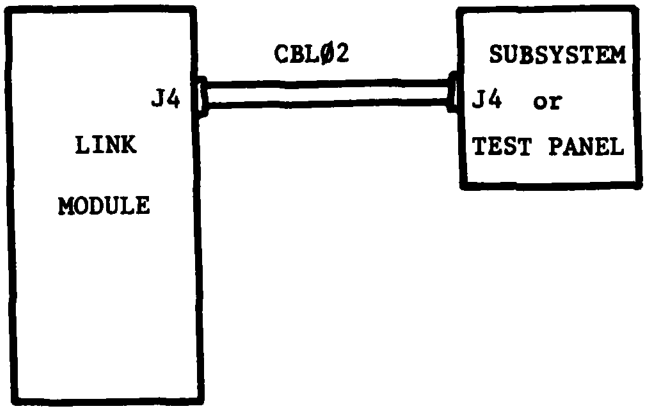


Figure B-2 Set-up for ICA Tests

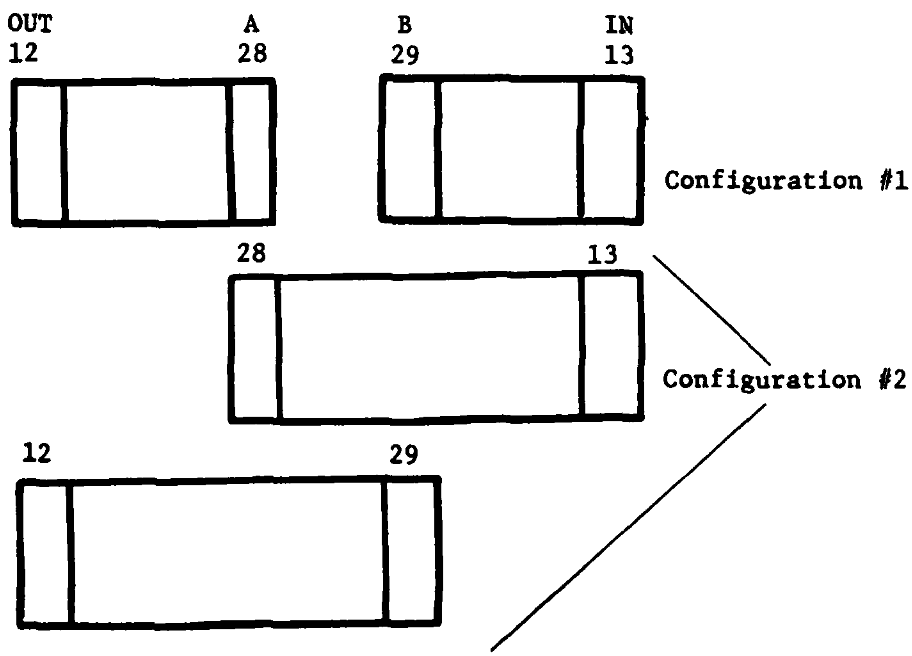


Figure B-3 Serial Subsystem Internal Cable Connections

TABLE B-1 ANALOG INPUT

channel	dc (volts)^{se} ac (volts peak)	dc (volts)^{df} ac (volts peak)
1	8.0	7.1
2	6.8	4.8
3	5.9	2.9
4	4.8	0.8
5	3.9	-1.2
6	2.9	-3.2
7	1.9	-5.1
8	0.9	-7.2

Note:

1. Voltages measured are within ± .1 v.

A. SCRIPT	✔	RESULTS/ REMARKS
g) Set CTLSW=OFF and MODSW=df		
h) Enter '@A2B' on the console for the differential source test.		
i) Set CTLSW=ON.		
j) Observe the test results on the CRT screen and compare with the expected values (volts peak) in Table B-1.		
k) Enter 'control-Z' on the console to end the test.		
A.3 Synchro input		
This test will verify the acquisition of synchro data through the ICA.		
a) Test set-up: connect the LM to the Synchro Subsystem.		
b) Enter '@A3' on the console.		
c) Set the angle of each synchro to a desired value.		
d) Observe the test result on the CRT screen and compare with the angles set in step c. Repeat c) and d) as desired.		
e) Enter 'control-Z' on the console to end the test.		
A.4 Discrete input (sampled)		
This test will verify the acquisition of parallel digital data through the ICA.		
a) Test set-up: connect the LM to Test Panel #1.		
b) Set REFSW=dc, CTLSW=ON and MODSW=se.		
c) Enter '@A4A' on the console to download the data I/O task.		
d) Enter '@A4B' for the single-ended source test.		
e) Twice in response to the prompt, enter a threshold value from Table B-2, column se.		
f) Observe the results on the CRT and compare with the expected results in Table B-2.		
g) Enter 'control-Z' on the console to end the test.		

TABLE B-2 DISCRETE INPUT

Threshold Voltage se	Bit Pattern	Threshold Voltage df
8.5	Ø Ø Ø Ø Ø Ø Ø Ø	8.0
7.5	Ø Ø Ø Ø Ø Ø Ø 1	6.0
6.5	Ø Ø Ø Ø Ø Ø 1 1	4.0
5.5	Ø Ø Ø Ø Ø 1 1 1	2.0
4.5	Ø Ø Ø Ø 1 1 1 1	0.0
3.5	Ø Ø Ø 1 1 1 1 1	-2.0
2.5	Ø Ø 1 1 1 1 1 1	-4.0
1.5	Ø 1 1 1 1 1 1 1	-6.0
0.5	1 1 1 1 1 1 1 1	-8.0

A. SCRIPT	✔	RESULTS/ REMARKS

h) Repeat d)-g) for each threshold in Table B-2, column se.

i) Set MODSW=df.

j) Enter '@A4C' on the console for the differential source test.

k) Twice in response to the prompt, enter a threshold value from Table B-2, column df.

ℓ) Observe the results on the CRT and compare with the expected results in Table B-2.

m) Enter 'control-Z' on the console to end the test.

n) Repeat j)-m) for each threshold in Table B-2, column df.

A.5 Momentary discrete input

This test will verify the acquisition of parallel digital data associated with the momentary closure of contacts.

a) Test set-up: connect the LM to Test Panel #4.

b) Enter '@A5A' on the console for the latched mode test.

c) Depress a switch (or switches) on the test panel.

d) Observe detection of the switch closure on the CRT. Repeat c) and d) as desired.

e) Enter 'control-Z' on the console to end the test.

f) Enter '@A5B' on the console for the follow mode test.

g) Depress a switch (or switches) on the test panel.

h) Observe detection of the switch closure on the CRT. Repeat g) and h) as desired.

i) Enter 'control-Z' on the console to end the test.

A.6 Serial input (Group B)

This test will verify the acquisition of serial digital data through ICA, Group B.

a) Test set-up: connect the LM to the Serial Subsystem.

A. SCRIPT	✓	RESULTS/ REMARKS
b) Verify that the two small ribbon cables inside the ICA chassis are as indicated in FigureB-3 ,configuration #1. c) Set MODSW=REFR and TX PARITY=EVEN. d) Enter '@A6A' on the console for the <u>refresh mode</u> test. e) Set a number on each of the three thumbwheel switches on the test panel. f) Observe the test results on the CRT screen and compare with the value set on the switches. Repeat e) and f) as desired. g) Enter 'control-Z' on the console to end the test. h) Set MODSW=FLAG. i) Enter '@A6B' on the console for the <u>flag mode</u> test. j) Set a number on each of the three thumbwheel switches and depress the STROBE switch. k) Observe the results on the CRT screen and compare with the value set on the switches. Repeat j) and k) as desired. ℓ) Enter 'control-Z' on the console to end the test. A.7 Serial input (Group A) This test will verify the acquisition of serial digital data through ICA, Group A. a) Test set-up: connect the LM to the Serial Subsystem. b) Rearrange the two small ribbon cables inside the ICA chassis to be as shown in Figure B-3,configuration #2. c) Set MODSW=REFR and TX PARITY=EVEN. d) Enter '@A7A' on the console for the <u>refresh mode</u> test. e) Set a number on each of the three thumbwheel switches on the test panel. f) Observe the test results on the CRT screen and compare with the value set on the switches. Repeat e) and f) as desired. g) Enter 'control-Z' on the console to end the test.		

A. SCRIPT	✓	RESULTS/ REMARKS
h) Set MODSW=FLAG.		
i) Enter '@A7B' on the console for the <u>flag mode</u> test.		
j) Set a number on each of the three thumbwheel switches and depress the STROBE switch.		
k) Observe the results on the CRT screen and compare with the value set on the switches. Repeat j) and k).		
ℓ) Enter 'control-Z' on the console to end the test.		
m) Return the two small ribbon cables to the configuration shown in Figure B-3, configuration #1.		
A.8 d-c analog output		
This test will verify the generation of analog d-c signals by the ICA.		
a) Test set-up: connect the LM to Test Panel #2.		
b) Enter '@A8A' on the console for the <u>single-ended</u> test.		
c) Monitor the output of each ICA channel and compare the output values with the expected results in Table B-3.		
d) Enter 'control-Z' on the console to end the test.		
e) Enter '@A8B' on the console for the <u>differential</u> test.		
f) Monitor the output of each ICA channel and compare the output values with the expected results in Table B-3.		
g) Enter 'control-Z' on the console to end the test.		
A.9 a-c analog output		
This test will verify the generation of analog a-c signals by the ICA.		
a) Test set-up: connect the LM to Test Panel #2.		
b) Enter '@A9A' on the console for the <u>single-ended</u> test.		
c) Monitor the output of each ICA channel and verify that a sine wave is being generated between channel 1 of the scope and ground. Compare the peak amplitudes with the		

TABLE B-3 ANALOG OUTPUT

channel	dc (volts) ac (volts peak)
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8

Notes:

1. Results are within ±.1 v.
2. Single-ended voltages are measured between (+) and ground terminals.
3. Differential voltages are measured between (+) and (-) terminals.

DO NOT GROUND THE (-) TERMINAL.

A. SCRIPT	✔	RESULTS/ REMARKS
expected results in Table B-3.		
d) Enter 'control-Z' on the console to end the test.		
e) Enter '@A9B' on the console for the differential test.		
f) Monitor the output of each ICA channel and verify that a sine wave is being generated between channel 1 and channel 2 of the scope. Compare the peak amplitudes with the expected results in Table B-3.		
g) Enter 'control-Z' on the console to end the test.		
A.10 Synchro output		
This test will verify the generation of synchro signals by the ICA.		
a) Test set-up: connect the LM to the Synchro Subsystem.		
b) Enter '@A1Ø' on the console.		
c) When requested, enter on the console the desired output angles.		
d) Observe the angles displayed on the CRT and verify that the synchros are positioned at the correct angles. Repeat c) and d) as desired.		
e) Enter 'control-Z' on the console to end the test.		
A.11 Discrete output		
This test will verify the output of parallel digital data by the ICA.		
a) Test set-up: connect the LM to Test Panel #3.		
b) Enter '@A11' on the console.		
c) Observe the output LED's corresponding to each bit. The system will output the contents of a counter which is incremented at 1 second intervals.		
d) Enter 'R' on the console, as desired, to zero the counter.		
e) Enter 'control-Z' on the console to end the test.		

A. SCRIPT	✔	RESULTS/ REMARKS
A.12 Serial output This test will verify the transmission of serial data by the ICA. a) Test set-up: connect the LM to the Serial Subsystem. b) Verify that the two small ribbon cables inside the ICA chassis are as shown in Figure B-3, configuration #1. c) Set RX PARITY switch on subsystem to EVEN. d) Enter '@A12A' on the console for the Group A test. e) Observe the LED display. The system will output to the display a counter which is incremented at 1 second intervals. f) Enter 'control-Z' on the console to end the test. g) Rearrange the two small ribbon cables to be as shown in Figure B-3, configuration #2. h) Enter 'A12B' on the console for the Group B test. i) Observe the LED display. The system will output to the display a counter which is incremented at 1 second intervals. j) Set RX PARITY switch on subsystem to ODD. Observe that the LM reports 'subsystem down' to the LMG. k) Return RX PARITY to EVEN. ℓ) Enter '@A12B' on the console once again. m) Observe that the system is again operating correctly. n) Enter 'control-Z' on the console to end the test. o) Return the two small ribbon cables to the configuration shown in Figure B-3, configuration #1.		

N. **SCRIPT** - SIC TESTS	✔	RESULTS/ REMARKS

The SIC tests will establish the operational performance of all components of the Subsystem Information Channel (SIC). The components to be tested include the nameplate interface controller, the subsystem information channel bus and two electronic nameplates. Test scripts I.1, I.2, and I.3 should have been run and the LMG CRT should have the prompt:

CMD>

displayed before preceding with these test scripts.

N.1 SIC Test Setup
(Refer to Figure B-4)

a) Disconnect the SIC cable Ø3 from the back of the LM if it is connected. Observe that the SIC CONFIGURED LED on the LM front panel is not lighted.

b) Connect the SIC bus terminator, 3, to the J3 connector of the synchro subsystem's nameplate.

c) Connect one of the SIC cables numbered Ø3 to P3 of the synchro nameplate and to J3 of the serial nameplate.

d) Connect the other SIC cable Ø3 between P3 of the serial nameplate and J3 on the back of the LM.

Observe:

As soon as the nameplates are connected to the LM the SIC CONFIGURED LED lights.

e) To the CRT prompt:

CMD>

enter:

@SIC (CR)

when the CRT displays:

SUBSYSTEM INFORMATION CHANNEL TEST

ENTER COMMAND AND DATA AS XX,XX,XXXX,XX...

proceed to the following tests.

On the following tests an interpreter program will accept instructions in a format similar to the SIC commands and will

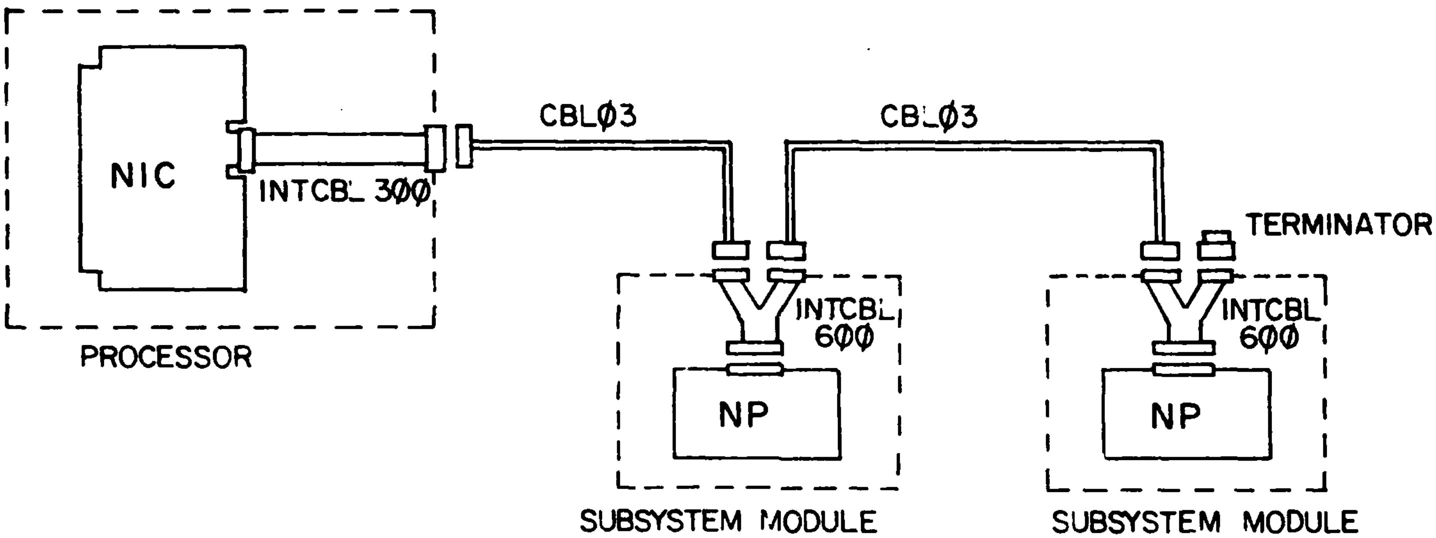


Figure B-4 SIC Bus Connections

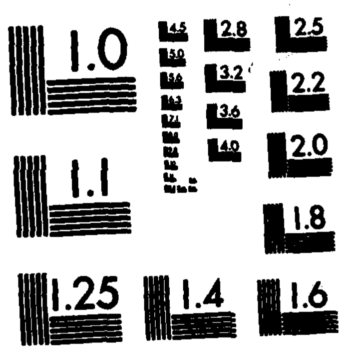
AD-A124 620 THE REMOTE LINK UNIT: A DEMONSTRATION OF OPERATIONAL PERFORMANCE PART II..(U) HOUSTON UNIV TX DEPT OF ELECTRICAL ENGINEERING C J TAVORA ET AL. AUG 81 2/2

UNCLASSIFIED AFWAL-TR-81-1131-PT-2 F33615-80-C-1095 F/G 17/2 NL

END

FILMED

DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

N. SCRIPT	✓	RESULTS/ REMARKS

display the response from the nameplate as a sequence of bytes in hexadecimal notation that conforms with the formats described in Table B-4. Note that the first byte of the response is always the nameplate status byte (Figure B-5). Upon the occurrence of an error the second byte of the response will be the error diagnostic byte (Figure B-6). The definition of the nameplate's display LEDs is shown in Table B-5.

In these scripts the symbol: (CR) at the end of each command is used to designate the carriage return key.

N.2 Sequential Addressing/Address Assignment Test

This test will demonstrate the capability of the SIC to address existing electronic nameplate sequentially. This test will also demonstrate the capability of the SIC to assign an arbitrary 8-bit address to each nameplate.

a) Select the Serial NP

Enter:

ø1 (CR) (Select Level Zero NP Command)

Observe:

- response is:

øø FF (FF = NP default address)

- LED #2 of the serial NP (see Table B-5) is on indicating that NP is selected.

b) Assign Serial NP the Address: ø1

Enter:

ø5,ø1 (CR) (Assign NP Address Command)

Observe response:

øø ø1 (ø1 = newly assigned NP address)

c) Select the Synchro NP

Enter:

ø2 (CR) (Select next NP command)

Observe:

- response:

2ø FF ("Last NP" status bit set)

- LED #2 of Synchro NP is on indicating the Synchro NP is selected.

TABLE B-4 NAMEPLATE COMMANDS

COMMAND		RESPONSE	
Instruction	Data	Status	Data
1. Select level ∅ NP	N/A	NP status	NP address
2. Select next NP	N/A	NP status	Newly selected NP address
3. Select NP by address	NP address	NP status	NP address
4. Deselect NP	N/A	NP status	NP address
5. Assign NP address	Address to be assigned	NP status	NP address
6. Read selected NP's address	N/A	NP status	NP address
7. Read selected NP's memory	Number of memory bytes wanted (∅=256) starting memory address	NP status	Number of memory bytes, starting memory address, memory data
8. Write enable/ disable	Enable/disable flag (Enable=1)	NP status	NP address
9. Write memory data	Number of data bytes, starting memory address, Data to be written	NP status	Starting memory address
10. Next available address to be written	N/A	NP status	Address of next available write memory record
11. Erase read/ write memory	N/A	NP status	NP address
12. Run NP diagnostic	N/A	NP status	NP address
13. Read NP diagnostic results	N/A	NP status	Diagnostic results
14. Abort selected NP	N/A	NP status	NP address

b7	b6	b5	b4	b3	b2	b1	bØ
CER	NPB	LNP	WRE	DLA	WED	DT1	DTØ

CER: Command error
NPB: NP is busy
LNP: This NP is the last NP on the SIC bus
WRE: Error occurred on last write
DLA: Deselect acknowledge
WED: Write enabled/disabled flag (enabled=1)
DT1, DTØ: Indicated type of data in response as follows:

CER	DT1	DTØ	Response Data
Ø	Ø	Ø	Nameplate Address
Ø	Ø	1	Diagnostic Results
Ø	1	Ø	Memory Address Only
Ø	1	1	Memory Address and Memory Data
1	X	X	Error Diagnostic Byte

NOTE: A one in the associated bit position indicates condition is true.

Figure B-5 Nameplate Status Byte

b7	b6	b5	b4	b3	b2	b1	bØ
INC	INA	INW	CER	INS	Ø	Ø	Ø

INC: Invalid command
INA: Invalid memory address (either starting or ending address)
INW: Invalid write (erase) request, write not enabled
CER: Communication error
INS: Another NP requested while this NP is still selected

NOTE: A one in the associated bit position indicates the condition is true

Figure B-6 Error Diagnostic Byte

TABLE B-5 NP STATUS DISPLAY

LED NUMBER*	STATUS DISPLAYED
1	NP is busy
2	This NP is selected
3	SIC RESP/CMD bus line level (CMD=on)
4	SIC SERIAL DATA bus line level
5	EPROM write strobe
6	EPROM simulated erase strobe
7	SIC PRIORITY IN bus line level (High=on)
8	NP Diagnostic is executing

*LED #1 is the LED closest to the edge of the nameplate board.

N.	SCRIPT	✓	RESULTS/ REMARKS

d) Assign Synchro NP the Address: ϕ2

Enter:

ϕ5,ϕ2 (CR) (Assign NP Address Command)

Observe the response:

2ϕ ϕ2

e) Deselect the NPs

Enter:

ϕ4(CR) (Deselect command)

Observe:

- response:

28 ϕ2 ("Deselect Acknowledge" status bit set)

- LED #2 on both NPs are off

N.3 Random Addressing Test

This test will demonstrate the capability of the SIC to randomly select nameplates using the address previously assigned.

a) Select the Synchro NP (Address: ϕ2)

Enter:

ϕ3,ϕ2 (CR) (Select NP by Address Command)

Observe:

- response:

2ϕ ϕ2

- Led #2 of the Synchro NP is on

b) Deselect the Synchro NP

Enter:

ϕ4 (CR) (Deselect NP command)

Observe:

- response:

28 ϕ2

- LED #2 of Synchro NP is off

N.	SCRIPT	✔	RESULTS/ REMARKS

c) Select the Serial NP (Address: ϕ1)

Enter:

ϕ3,ϕ1 (CR) (Select NP by Address Command)

Observe:

- response:

ϕϕ ϕ1

- LED #2 of the Serial NP is on

N.4 Retrieval of the Nameplate Directory Test

This test will demonstrate the capability of the SIC to retrieve the directory of each nameplate.

a) Read Directory of Serial NP

Enter:

ϕ7,19,5ϕ2ϕ(CR) (Read memory command)

Observe the response:

ϕ3 19 5ϕ2ϕ

81 DC ϕϕ 19 CF 5ϕ 4ϕ ϕϕ 17 Cϕ 5ϕ 6ϕ ϕ6 ϕϕ D1 56
70 ϕ2 ϕϕ DA 7ϕ ϕϕ ϕ1 ϕϕ BA

The format of this directory is given in Figure B-7. Note that this NP ID = 81 which indicates this NP is the serial NP.

b) Read Directory of Synchro NP

1) Deselect NPs

Enter:

ϕ4 (CR) (Deselect Command)

Observe the response:

ϕ8 ϕ1

2) Select the Synchro NP

Enter:

ϕ3,ϕ2(CR) (Select NP by Address Command)

Observe:

- response:

2ϕ ϕ2

- LED #2 of the Synchro NP is on

	Hex Values in Directory:
NP ID	81 = Serial, 82 = Synchro
Directory Code	DC
Size of Directory (bytes)	ØØ 19
Subsystem Configuration Table Code	CF
Configuration Table Starting Address	5Ø 4Ø
Configuration Table Size (bytes)	ØØ 17
Data Conversion Program Code	CØ
Data Program Starting Address	5Ø 6Ø
Data Program Size (bytes)	Ø6 ØØ
Diagnostic Program Code	D1
Diagnostic Program Starting Address	56 7Ø
Diagnostic Program Size (bytes)	Ø2 ØØ
Read/Write Memory Data Code	DA
Read/Write Starting Address	7Ø ØØ
Read/Write Size (bytes)	Ø1 ØØ
Directory Checksum	

Figure B-7 Nameplate Directory

N.	SCRIPT	✓	RESULTS/ REMARKS

3) Read Directory of Synchro NP

Enter:

ϕ7,19,5ϕ2ϕ(CR) (Read memory command)

Observe response:

23 19 5ϕ2ϕ

82 DC ϕϕ 19 CF 5ϕ 4ϕ ϕϕ 17 Cϕ 5ϕ 6ϕ ϕ6 ϕϕ D1 56
7ϕ ϕ2 ϕϕ DA 7ϕ ϕϕ ϕ1 ϕϕ B9

Note that this NP ID = 82, the ID of the Synchro NP.

N.5 NP Read/Write Tests

This test will demonstrate the ability of reading and writing into the read/write memory area of an electronic nameplate. This test will also demonstrate the protection against errors resulting from trying to write on protected memory or read from non-existing memory. The memory map of an electronic nameplate is given in Figure B-8 .

a) Attempt Read from Non-Existing Memory

Enter:

ϕ7,ϕϕ,6ϕϕϕ(CR) (Read memory address: 6ϕϕϕ-6ϕFF)

Observe response:

Aϕ 4ϕ (Error status with "invalid address" bit set in the error diagnostic byte)

b) Write into Read/Write Memory

1) Read All of Read/Write Memory Area First

Enter:

ϕ7,ϕϕ,7ϕϕϕ(CR) (Read memory command)

Observe response:

23 ϕϕ 7ϕϕϕ

XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
.
.
.

where each XX is a hexadecimal byte and each line on the CRT represents one 16 byte record area. The records containing all FF are unwritten as of now. The first 16 byte line

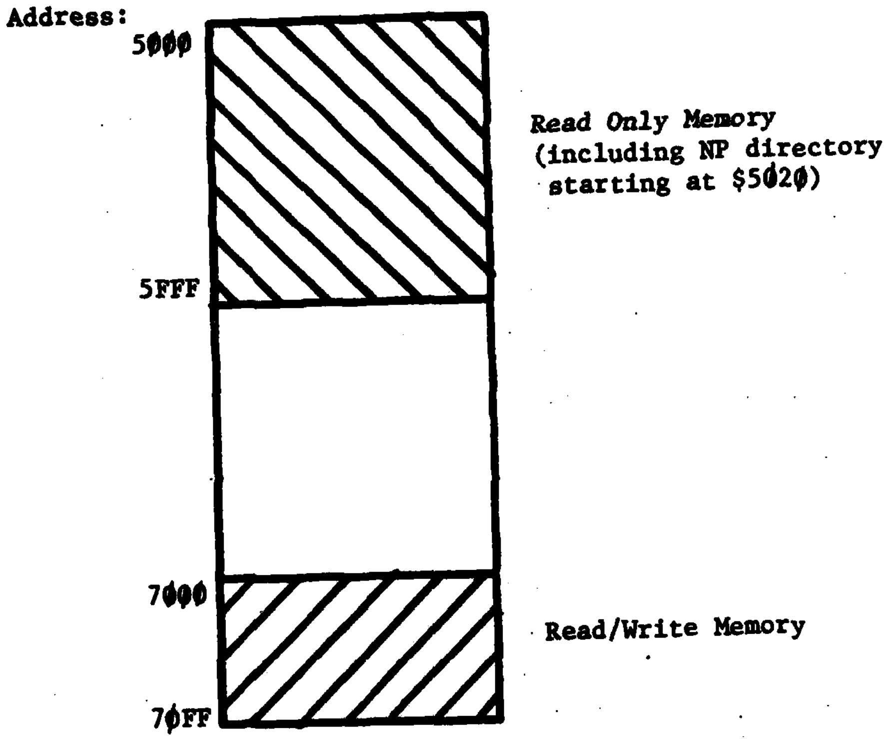


Figure B-8 Nameplate Memory Map

N. SCRIPT	✔	RESULTS/ REMARKS

corresponds to the record with starting address: 7ØØØ; the next line is record with starting address: 7Ø1Ø; etc.

Observe the address of the 1st unwritten record.

2) Enable Write to this NP

Enter:

Ø8,Ø1 (CR) (Write enable/disable command)

Observe response:

24 Ø2 ("Write enabled" status bit set)

3) Obtain the Address of the Next Available Record

Enter:

ØA(CR) (Next record address command)

Observe response:

26 XXXX

where XXXX = record address in range: 7ØØØ-7ØFØ. If XXXX= ØØØØ, read/write area is full, replace EPROM with an erased one. The address XXXX should be the address observed above.

4) Write Data into NP

Note: Upon entering this command's (CR) the synchro NP's LED #1 and #5 will pulse indicating the NP is writing data. However this pulse is fairly fast so one should be watching as the (CR) key is depressed.

Enter:

Ø9,ØE,XXXX,Ø1,Ø2,Ø3,Ø4,Ø5,Ø6,Ø7,Ø8,Ø9,ØA,ØB,ØC,ØD,ØE (CR)

where XXXX = address from above next address response.

Observe LED #1 and #5 pulse on then off.

Observe response:

26 XXXX

5) Read All of the Read/Write Memory to Verify Data was Written.

Enter:

Ø7,ØØ,7ØØØ(CR) (Read memory command)

N.	SCRIPT	✓	RESULTS/ REMARKS

Observe response:

27 ØØ 7ØØØ

XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
:

Note that the data was written in the record specified by XXXX as described above.

c) Attempt to Write into Read Only Memory (Address: 5Ø2Ø)

Enter:

Ø9,Ø1,5Ø2Ø,22(CR) (Write data command)

Observe response:

A4 4Ø

indicating an invalid address for writing data but not for reading since this area is the NP directory read in a preceding test.

d) Attempt to Write into Read/Write *Memory* when Writing is Disabled

1) Disable Write

Enter:

Ø8,ØØ(CR) (Write enable/disable command)

Observe response:

2Ø Ø2 ("Write enabled" status bit is cleared)

2) Obtain the Next Available Record Address

Enter:

ØA(CR) (Next record address command)

Observe response:

22 XXXX

where XXXX is the record address.

3) Attempt to Write Data

Enter:

Ø9,Ø2,XXXX,11,22(CR) (Write data command)

Observe response:

AØ 2Ø ("invalid write" bit set in error diagnostic byte)

N. SCRIPT	✓	RESULTS/ REMARKS

N.6 Nameplate Diagnostic Test

This test will verify the execution of the nameplate diagnostic and the retrieval of the results of this test. Each nameplate is equipped with a diagnostic program that exercises the nameplate internal architecture to establish its operational status.

a) Run NP's Diagnostic

Note: Upon entering this command's (CR), the synchro NP's LED #1 and #8 will pulse. One should be watching them as the carriage return key is depressed.

Enter:

ØC (CR) (run NP diagnostic command)

Observe:

- response:

  2Ø Ø2

- LED #1 and #8 pulse on then off indicating the diagnostic program is running.

b) Read Diagnostic Results

Enter:

ØD (CR) (Read diagnostic results command)

Observe response:

21 8ØØX (see figure B-9)

where X = number of records not yet written (Ø-F)

c) Run Diagnostic on Bad Read/Write Area

If the read/write EPROM in the synchro NP is the one delivered from U of H, set the dip switches on the nameplate to OFF, OFF, OFF (top to bottom). This enables a read/write area which contains at least one record with an invalid checksum.

1) Run NP Diagnostics

Enter:

ØC (CR) (Run NP diagnostic command)

Observe:

- response:
  2Ø Ø2
- LED #1 and #8 pulse on then off.

First Result Byte

b7	b6	b5	b4	b3	b2	b1	bØ
DCG	ROME	Ø	RECE	Ø	RAME	TIME	Ø

DGC: Diagnostic completed
ROME: ROM data errors
RECE: Read/Write records in error
RAME: RAM errors
TIME: Timer errors

Second Result Byte

b7	b6	b5	b4	b3	b2	b1	bØ
ROM4	ROM3	ROM2	ROM1	FR	EE	REC	

ROM4: ROM number 4, address $(58ØØ\text{-}5FFF)_{16}$, data errors
ROM3: ROM number 3, address $(5ØØØ\text{-}57FF)_{16}$, data errors
ROM2: ROM number 2, address $(48ØØ\text{-}4FFF)_{16}$, data errors
ROM1: ROM number 1, address $(4ØØØ\text{-}47FF)_{16}$, data errors
FREE REC: Number of read/write records still available

NOTE: A one in the associated bit position indicates the condition is true.

Figure B-9 NP Diagnostic Result Data Bytes

N.	SCRIPT	✔	RESULTS/ REMARKS

2) Read Diagnostic Results

Enter:

ØD (CR) (Read diagnostic result command)

Observe response:

21 9ØØX

where bit 4 of the first result byte indicates some record data is in error.

N.7 SIC Test Termination

a) Enter:

X (CR)

Observe response:

SIC TEST STOPPED

CMD>

b) Disconnect NPs from LM

T. SCRIPT - TERMINATION	✓	RESULTS/ REMARKS
T.1 Terminating at CRT #1 a) Enter 'EXIT' at CRT #1 to exit the command interpreter. b) Enter ' BYE ' to log off the computer. **T.2 Terminating at CRT #2** a) Enter 'control-Z' to exit the shared memory display. b) Enter '@TERM'. c) Enter 'BYE' to log off the computer.		

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