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A PROTOTYPE INTERFACE UNIT FOR MICROPROCESSOR-BASED LORAN-C RECEIVER

A command entry and display device designed to allow convenient operation of the Loran-C receiver-processor is described.

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I. INTRODUCTION

This paper documents an inexpensive data/command entry and display system being developed by the Ohio University Tri-University group. This system is designed to operate in place of a separate ASCII terminal. Also described is the software to interface this unit to the 6502-based navigation receiver currently under development at Ohio University.

II. HARDWARE IMPLEMENTATION

See Figure 1 for an overview of the command entry and display logic. In order to retain the use of some of the DEMON(TM) monitor facilities provided by the SuperJOLT(TM) microcomputer, an ASCII encoded keypad consisting of the decimal digits, decimal point, and nine letters has been designed as shown in Figure 2. A printed circuit board was prepared to produce the appropriate X-row Y-column code appropriate for each character (Figure 3). This X-Y code is input to a General Instruments AY-5-2376 keyboard encoder [1]. Figure 4 shows the encoder along with an NEC µ8212 octal latch, which stores the value of the pressed key until the microprocessor can poll the keyboard and read the data.

The latch holding the 7 bits of character data and a key-pressed strobe is made available to a 6530 Versatile Interface Adapter (VIA) on the J2 connector of the SuperJOLT microcomputer. Port A of the 6530 is configured as an input: lines 0 through 6 carry the ASCII value of the key, line 7 the key-pressed strobe which acts as a flag during the polling process to indicate that new data is present. Line 2 of the "B" port is set as an output line: after data has been read from the "A" port, line B2 is toggled to clear the latch so that new data can be read.

A Sony AVF-3250A 4-inch black-and-white monitor designed for 13 VDC operation was chosen for the display due to the ease with which it could be integrated into a standard avionics-size enclosure as shown in Figure 5. The monitor accepts standard NTSC composite video signals, requires 14 watts at 13 VDC and weighs approximately 1.9kg.

The VDM-1 Video Display Module [2] allows for the use of alphanumerics and graphic primitives in a 16x16 format along with a 256 x 256 coarse graphics mode and a 512 x 512 high resolution mode. This versatility allows for a variety of alphanumeric, graphic, or combined-mode displays. Such capabilities allow for receiver output to be displayed in CDI, HSI, or other analog data formats easily recognized and interpreted by the pilot.

III. SOFTWARE INTERFACE

A monitor routine is being written in 6502 assembly language to perform data input and output between the command/display unit and the

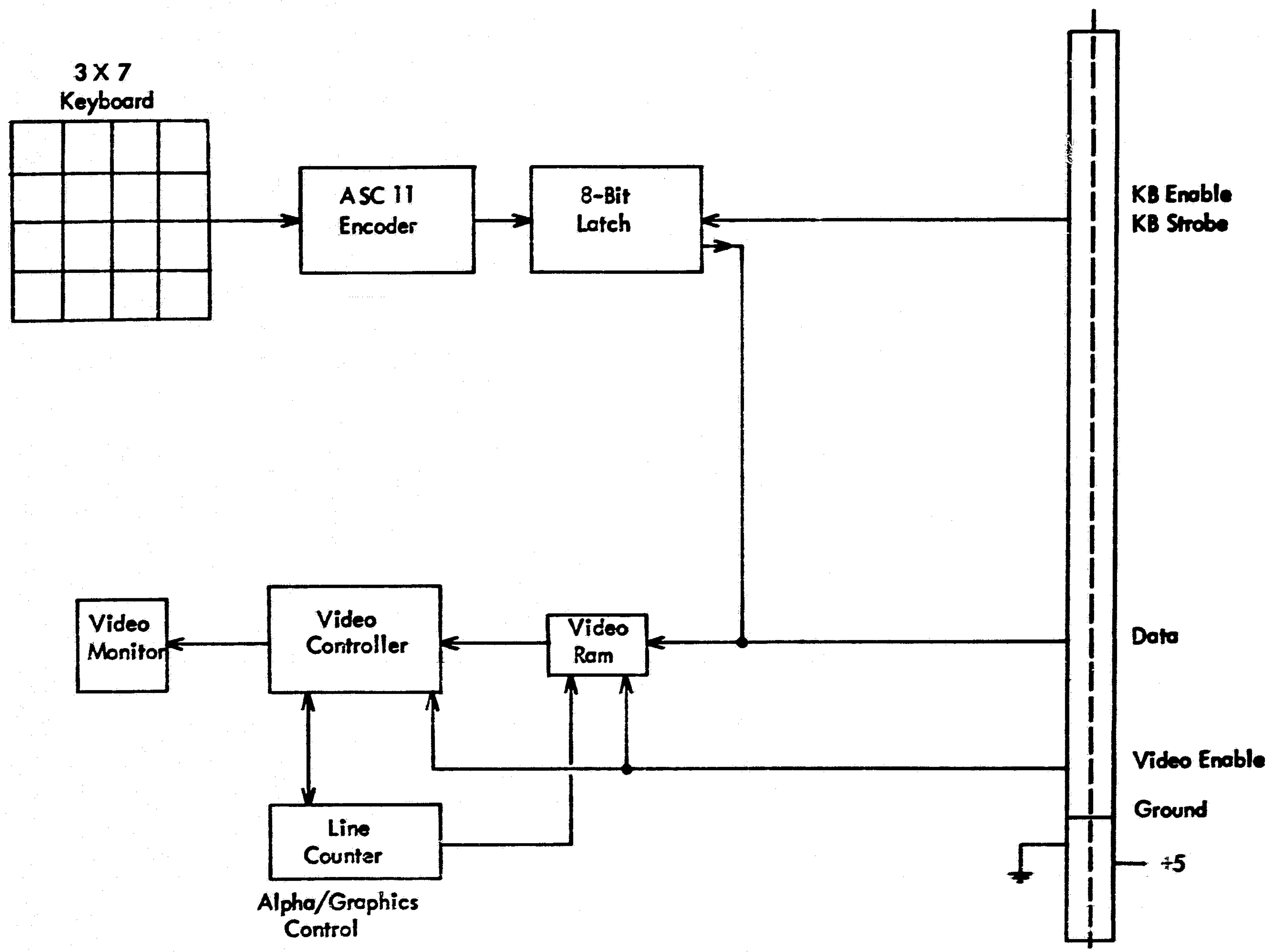

Figure 1. LORAN-C CONTROL/DISPLAY

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7	8	9
4	5	6
1	2	3
.	0	D
BSP	ENT	SKIP
CNCL	SC	NAV
PWR	SW	AW

Figure 2. Proposed ASCII Keypad Layout.

CONNECT → / TO OBTAIN		X_0	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Y_0	NORMAL	NUL	DLE	-	Ø	;	l	o	9
	SHIFT	NUL	DLE	=	NUL	+	L	O	)
	CONTROL	NUL	DLE	NUL	NUL	NUL	FF	SI	NUL
Y_1	NORMAL	SOH	K	FS	:	/	k	i	8
	SHIFT	SOH	[	FS	*	?	K	I	(
	CONTROL	SOH	VT	FS	NUL	NUL	VT	HT	NUL
Y_2	NORMAL	STX	L	GS	p	.	j	u	7
	SHIFT	STX	\	GS	P	>	J	U	'
	CONTROL	STX	FF	GS	DLE	NUL	LF	NAK	NUL
Y_3	NORMAL	ETX	N	RS	_	,	h	y	6
	SHIFT	ETX	^	RS	DEL	<	H	Y	&
	CONTROL	ETX	SO	RS	US	NUL	BS	EM	NUL
Y_4	NORMAL	EOT	M	US	@	m	g	t	5
	SHIFT	EOT	]	US	`	M	G	T	%
	CONTROL	EOT	CR	US	NUL	CR	BEL	DC_4	NUL
Y_5	NORMAL	ENQ	NAK	<	BS	n	f	r	4
	SHIFT	ENQ	NAK	<	BS	N	F	R	$
	CONTROL	ENQ	NAK	NUL	BS	SO	ACK	DC_2	NUL
Y_6	NORMAL	ACK	SYN	>	[	b	d	e	3
	SHIFT	ACK	SYN	>	{	B	D	E	#
	CONTROL	ACK	SYN	NUL	ESC	STX	EOT	ENQ	NUL
Y_7	NORMAL	BEL	ETB	,	]	v	s	w	2
	SHIFT	BEL	ETB	,	}	V	S	W	"
	CONTROL	BEL	ETB	NUL	GS	SYN	DC_3	ETB	NUL
Y_8	NORMAL	DC1	CAN	SP	CR	c	a	q	1
	SHIFT	DC1	CAN	SP	CR	C	A	Q	!
	CONTROL	DC1	CAN	SP	CR	ETX	SOH	DC1	NUL
Y_9	NORMAL	P	EM	.	LF	x	FF	HT	^
	SHIFT	@	EM	.	LF	X	FF	HT	~
	CONTROL	DLE	EM	NUL	LF	CAN	FF	HT	RS
Y_{10}	NORMAL	O	SUB	_	DEL	z	ESC	VT	\
	SHIFT	_	SUB	_	DEL	Z	ESC	VT	:
	CONTROL	SI	SUB	US	DEL	SUB	ESC	VT	FS

Figure 3. Code Assignment Chart - AY-5-2376 Keyboard Encoder

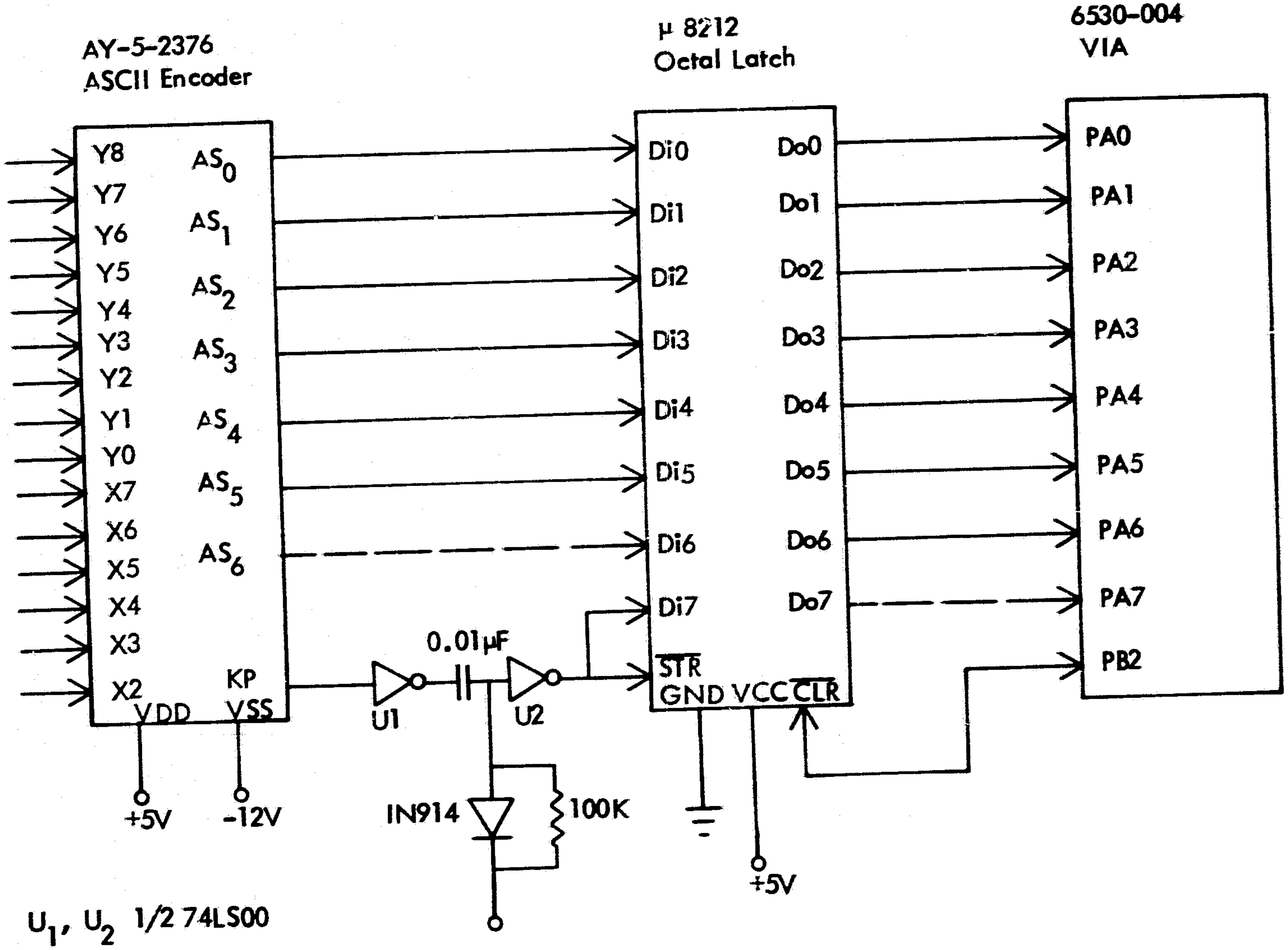

Figure 4. ASCII Keyboard Encoder Using AY-5-2376.

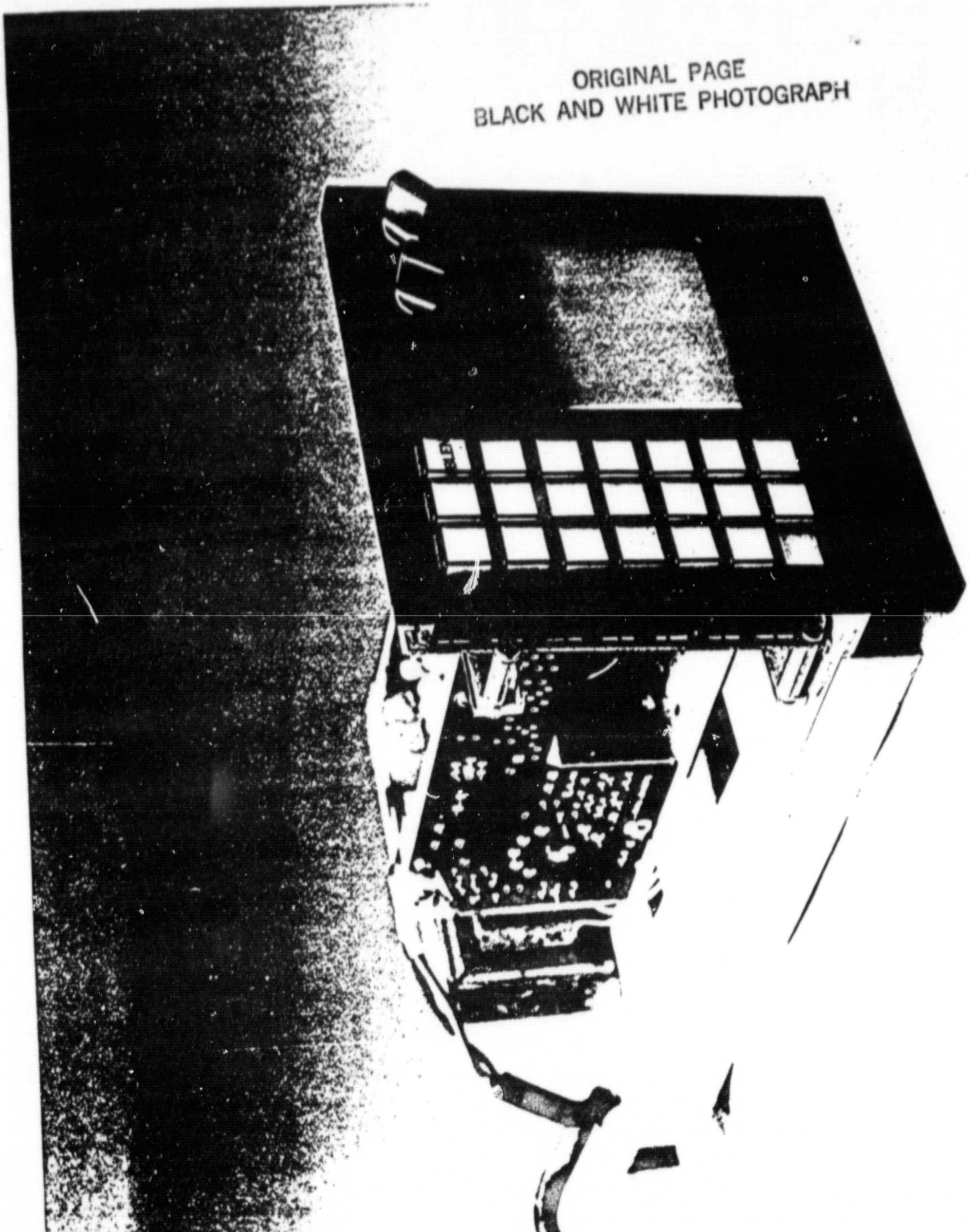

Figure 5. Proposed Display Unit.

SuperJOLT microcomputer. The DEMON(TM) monitor routines can provide all services necessary for system initialization and data input; however, it also requires a full communications terminal and does not offer the range of display formats offered by the VDM graphics unit. The attendant reduction in size and weight coupled with the ease of operation made possible by tailoring the monitor to a specific application make the development of a custom software interface highly desirable.

There are four tasks currently envisioned for the interface monitor. They consist of:

1. Selecting the mode of operation; for example, direct-route or multi-waypoint navigation.

2. Provide user prompts for the data input needed for the specified mode of operation.

3. Provide data conversion from a user-oriented format to a microprocessor-oriented one.

4. Select the display mode of the processor output.

Tasks 1 and 2 are fairly obvious and no further elaboration will be given here. Data format conversion is required because the current versions of the time-difference to latitude-longitude and area navigation routines require information such as waypoint location to be given in a particular 32-bit floating-point format as used by the Advanced Micro Devices Am9511A arithmetic processor [3]. This format is illustrated in Figure 6. The format conversion typically consists of stripping the ASCII zone bits and performing a BCD-to-binary conversion and then "floating" the 8-bit integer number into the 32-bit format. This data format change is greatly simplified by the arithmetic facilities of the Am9511A: software multiply-and-add routines are replaced by presenting data to the math chip and giving it the appropriate operation codes. This decrease in the size of the interfacing software and attendant improvements in program legibility make software maintenance much easier, especially in terms of code optimization for faster execution as well as increased memory resources to allow for more sophisicated I/O routines.

Perhaps the most significant difference between the interface monitor and the terminal monitor is that the former cannot be interrupt driven. The processor's principal function is monitoring the LORAN-C pulse train and deriving time-differences from them to drive the navigation routines. An interrupt to service something as irrelevant to the pulse tracking and TD measurements as a change of display formats would force the receiver to retrack the pulse trains, reducing the total time the processor is devoting to actual navigation duties. As an extension of the data display currently used in the prototype receiver, the keyboard will be polled as part of the general

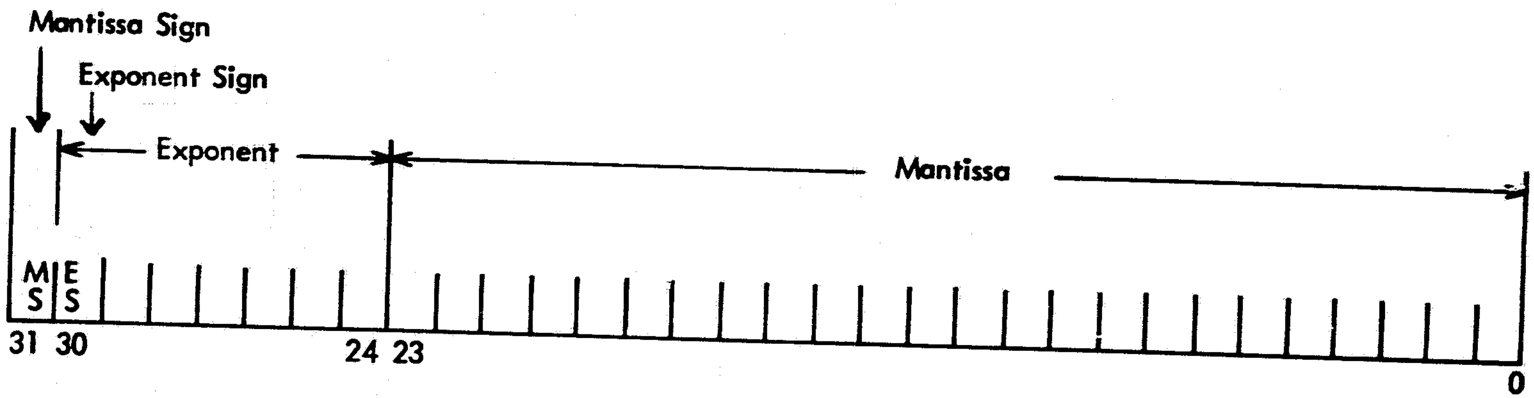

Figure 6. AM9511A 32-Bit Floating-Point Format.

housekeeping software. The information from the keypad is stored until the processor has the opportunity to implement the command.

IV. SUMMARY

An ASCII keypad with a CRT display capable of alphanumeric and graphics-mode operation is being developed to provide specialized data entry and display for the Ohio University LORAN-C receiver/processor. This unit is being developed to replace conventional communications terminals so as to simplify receiver operations to a level typical of current avionics systems.

V. REFERENCES

[1] KBD-5 Keyboard and ASCII Encoder, Southwest Technical Products, San Antonio, Texas, 1978

[2] VDM-1 Video Display Module, Microcomputer Products Co.,Columbus, Ohio, 1980

[3] Am9511A MOS/LSI Arithmetic Processor, Advanced Micro Devices, Sunnyvale, California, 1979