DB3001
HAND HELD MONITOR
USER'S MANUAL

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1. Introduction

The DB3001 Hand Held Monitor (HHM) is a device that allows the user to observe and alter data variables in the S3000, S3010 Processor board and S3040 Resolver Interface/PLS board. The HHM was designed as a troubleshooting aid and diagnostics tool, not as a hand held programming terminal. It does not allow the user to alter the applications program, but instead to observe and alter data variables used by the applications program.

1.1 S3010 Operations

When used in conjunction with the S3010 processor boards, the HHM provides the user with the following functions and features:

A. Access to the entire processor data space including all internal coils, contacts, timer/counter presets, real-world I/O points, and all other registers.

B. The above data variables can be displayed on any one of two 8-bit discrete LED data displays or on a 3-digit numerical display.

C. Selected counter/timer presets and other general registers may be altered by the operator via the HHM for control optimization as required.

d. Fault diagnostics information in the form of error codes is also available to the operator via the HHM. These faults include communications errors between the processor board and intelligent I/O boards (S3021, S3030, S3040, etc.) as well as internally detected non-fatal errors in the S3010 processor board.

1.2 S3040 Operations

When used in conjunction with the S3040 Resolver Interface/PLS, the HHM allows the user to perform the following functions:

A. Program all timing channel set points with two programming command formats:

- single-set point
- multi-set point

B. Set the Scale factor (number of divisions in one revolution).

C. Set the Offset (electrically zero the resolver).

D. Search (Read) pre-programmed set points displaying the status (on/off) of the set point and the location (in divisions) of the set point.

E. Read the current position (in divisions) of the resolver.

2. Description Of Features

The DB3001 Hand Held Monitor incorporates four displays for address, data and status information, a 41-key keypad, and two Interface ports to provide all the features necessary to interface with both the S3010 processor boards and S3040 Resolver Interface/PLS. A description of these features follows:

(Refer to the layout of the HHM, Figure 1.)

2.1 CHAN/ADDR Display (4 digit numerical)

A. S3010 Operations - Indicates the user entered address for both read and write operations. The value entered is either a 4-digit hex or 4-digit decimal value as selected by the user.

B. S3040 Operations - Indicates the user entered channel number for all operations. The value entered is a 2-digit octal value located in the two left most digits. The two right most digits are not used (blank).

2.2 DATA Display (3 digit numerical)

A. S3010 Operations - Indicates the numerical data respective to the operation performed (Read or Write). The data is either a 2-digit hex value located in the right most digits (left digit blank) or a 3-digit decimal value as selected by the user.

B. S3040 Operations - Indicates the current set point or angular position respective to the operation performed. The data is always a 3-digit decimal value.

2.3 Command Status Display (8-bit discrete LED)

A. READ - Illuminates when "READ" key is depressed and stays illuminated until a new command is entered. (Used only with S3010 operations.)

B. WRITE - Illuminates when "WRITE" key is depressed and stays illuminated until a new command is entered. (Used only with S3010 operations.)

C. STAT - Status of selected set point. Illuminates when set point is "ON" and extinguishes when set point is "OFF". (Used only with S3040 operations.)

D. DECIMAL - Illuminates when "MODE" key is depressed and stays illuminated until "MODE" key is depressed again. When on, decimal format numbering is used. When off, hex format numbering is used. (Used only with S3010 operations.)

E. F1 - Illuminates when "F1" key is depressed and stays illuminated until a new command is entered. (Used only with S3010 operations.)

F. F2 - Illuminates when "F2" key is depressed and stays illuminated until a new command is entered. (Used only with S3010 operations.)

G. F3 - Illuminates when "F3" key is depressed and stays illuminated until a new command is entered. (Used only with S3010 operations.)

H. F4 - Illuminates when "F4" key is depressed and stays illuminated until a new command is entered. (Used only with S3010 operations.)

In general, the above indicators simply provide the user with feedback as to which key was depressed and a reminder as to which operation is currently in process.

2.4 Data Display NO. 1 (8-bit discrete LED)

A. S3010 Operations - provides a binary display to allow the user to map a byte to and observe the operation of the individual bits within that byte. Updated once per S3010 scan thus providing essential "real-time" observation of data variable status.

B. S3040 Operations - not used (blank).

2.5 Data/Status Display NO. 2 (8-bit discrete LED)

A. S3010 Operations - functions identically to above display NO. 1 thus providing the user with two binary displays to map bit information to.

B. S3040 Operations - provides the user with command status information as follows:

1. SS - Illuminates when "SS" single-set point command key is depressed and remains illuminated until the single-set command is completed.

2. MS - Illuminates when "MS" multi-set point command key is depressed and remains illuminated until the multi-set command is completed.

3. START - Illuminates when "STRT" key is depressed and remains illuminated until next command is initiated.

4. STOP - Illuminates when "STOP" key is depressed and remains illuminated until next command is initiated.

5. ON - Illuminates when "ON" key is depressed and remains illuminated until next command is initiated.

6. OFF - Illuminates when "OFF" key is depressed and remains illuminated until next command is initiated. Also illuminates simultaneously with "SCALE" LED when "OFFSET" key is depressed and remains on until offset is entered or a new command is initiated.

7. SCALE - Illuminates when "DIV" Divisions per revolution key is depressed and remains on until scale factor is entered or until a new key is depressed. Also illuminates simultaneously when "OFF" key is depressed and remains on until offset is entered or a new command is initiated.

8. CHAN - Illuminates when "CH" Channel key is depressed and remains on until channel is entered or a new command is initiated.

2.6 Keypad

All commands are entered on a 41-key keypad. These keys include the S3010 command ([R] "read", [W] "write", [F1] through [F4], and [MODE]). The S3040 commands ([CH[, [SS], [MS], [STRT], [STOP], [ON], [OFF], [DIV], [OFFSET], [REC], [SET/CLR], AND [SRCH])general purpose commands ([ENTER], [CLR], [->], "backspace") and the Hex numerical keypad ([O] through [F]). See Sections 3 and Sections 4 for the definitions and use of these keys.

2.7 Interface Port

The Interface Port is a high-speed parallel port used to communicate between the HHM and S3010 or S3040. The port connects to an interface cable which consists of a 26-pin socket which connects to the HHM and a 25-pin male DB connector which connects to the S3010/ S3040 interface port. The Pinout of the interface cable is in Appendix B.

2.8 Data Output Port

The DATA Port makes available the information displayed on the discrete LED DISPLAYS NO. 1 AND NO. 2 to the user such that an oscilloscope can be used to view this information. See Appendix C for the Pinout of the DATA OUTPUT PORT as well as the Output boards available which can be used with this port.

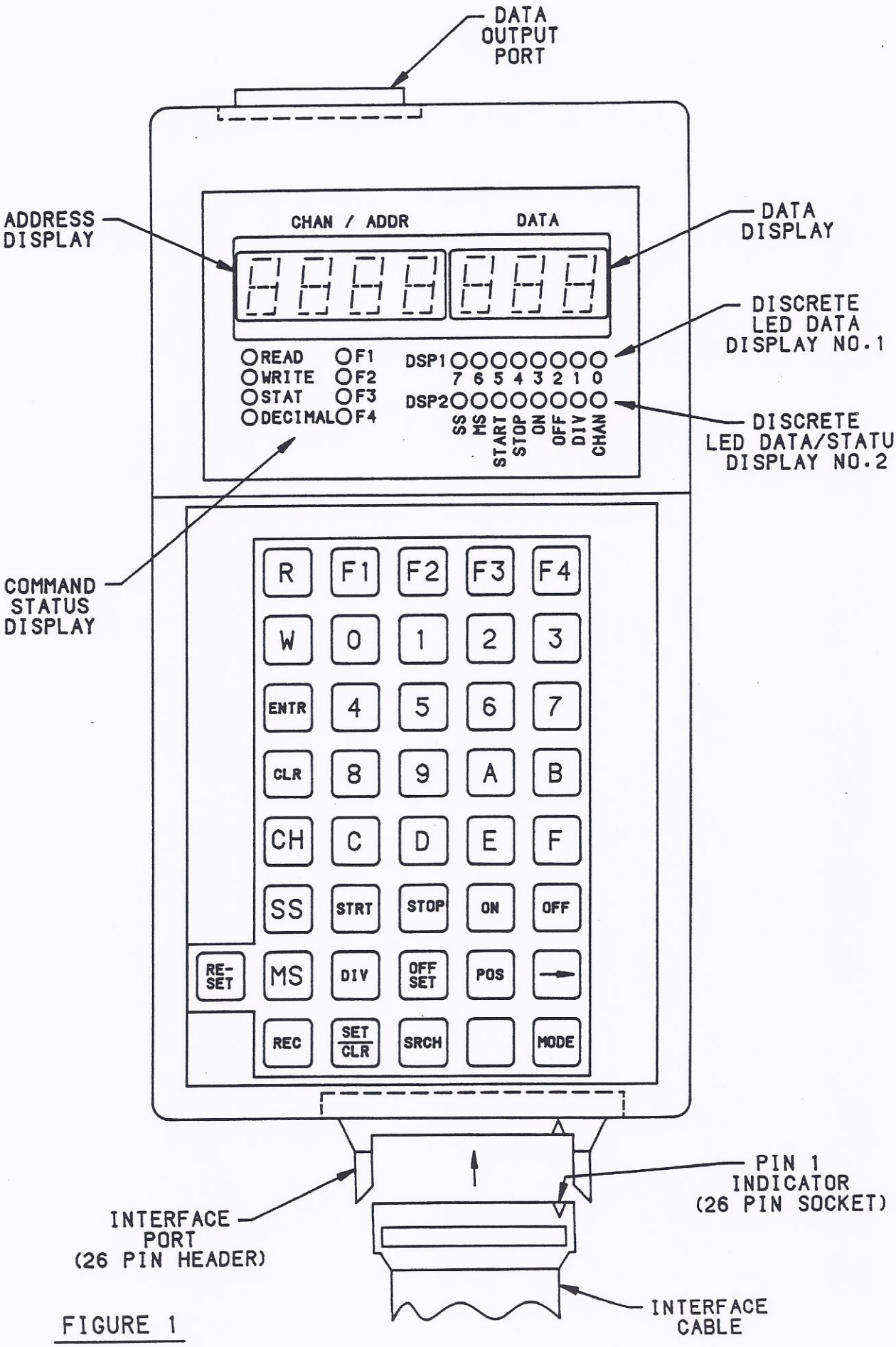

DATA OUTPUT PORT
ADDRESS DISPLAY
CHAN / ADDR
DATA
DATA DISPLAY
DISCRETE LED DATA DISPLAY NO.1
DISCRETE LED DATA/STATUS DISPLAY NO.2
READ
WRITE
STAT
DECIMAL
F1
F2
F3
F4
DSP1
7 6 5 4 3 2 1 0
DSP2
SS MS START STOP ON OFF DIV CHAN
COMMAND STATUS DISPLAY
R F1 F2 F3 F4
W 0 1 2 3
ENTR 4 5 6 7
CLR 8 9 A B
CH C D E F
SS STRT STOP ON OFF
RE-SET MS DIV OFF SET POS →
REC SET/CLR SRCH MODE
PIN 1 INDICATOR (26 PIN SOCKET)
INTERFACE PORT (26 PIN HEADER)
INTERFACE CABLE

FIGURE 1

3. S3010 Processor Board Hand Held Monitor Operations

The HHM allows the user to access to the entire data space of the S3010 processor board. This data space consists of the 256 bytes of RAM resident in the 8031/8032 microcontroller plus 2K bytes non-volatile memory (EEPROM) resident on the S3010. Refer to Figure 2 for the memory structure of the S3010 and below for a typical applications program memory map.

```
NAME        TYPE        LOC         HHM ACCESS ADDRESS

X000        BIT         00H         ; 20.0H RAM
X001        BIT         01H         ; 20.1H RAM
X002        BIT         02H         ; 20.2H RAM
 .           .           .
 .           .           .
TMG_CHK     BIT         2EH         ; 25.6H RAM
 .           .           .
 .           .           .
 .           .           .
ACC00       DATA        7FH         ; 7FH RAM
 .           .           .
 .           .           .
 .           .           .
PRST00      XDATA       45FEH       ; 5FEH EEPROM
```

3.1 Address Formats/Ranges - 256 Bytes RAM

The address formats and ranges allowed for the 256 bytes of RAM resident in the 8031/8032 are as follows: (See Appendix A, "Numbering Systems")

A. HEX formats/range:

Bit address = XX.X

- X — bit with byte (octal 0-7)
- XX — byte within which bit is located (hex 00-FFH)

Byte address = XX

- XX — byte location (hex 00-FFH)

B. Decimal Formats

Bit address = XXX.X

- X — bit within byte (octal 0-7)
- XXX — byte within which bit is located (decimal 000-255)

S3010 MEMORY STRUCTURE

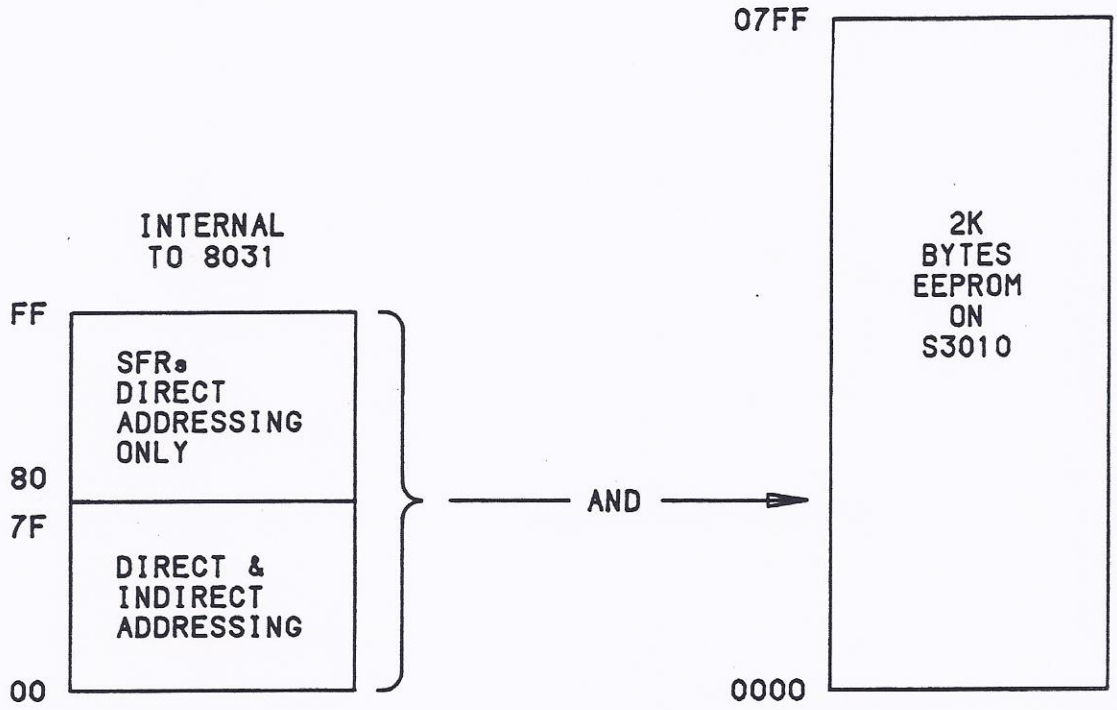


FIGURE 2a

S3010 (8031 BASED) DATA MEMORY

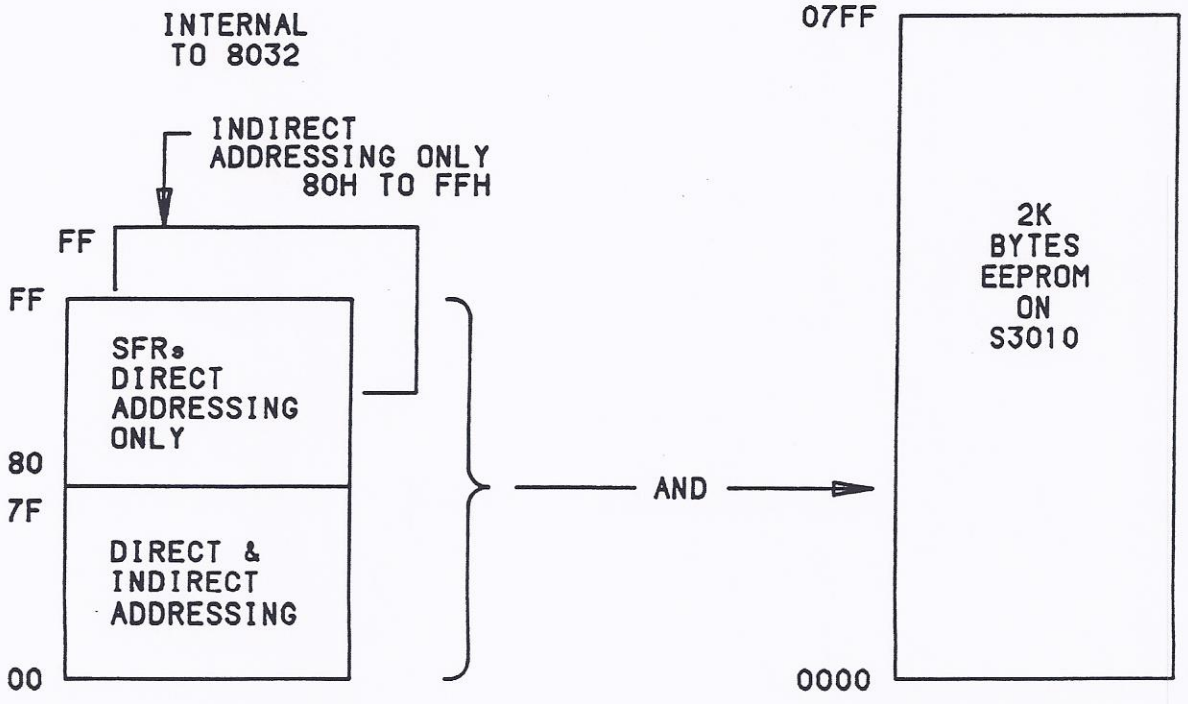


FIGURE 2b

S3010 (8032 BASED) DATA MEMORY

Byte address = XXX

byte location
(decimal 000-255)

3.2 Address Formats/Ranges - 2K EEPROM

The address formats and ranges allowed for the 2K bytes of non-volatile memory (EEPROM) are as follows:

A. HEX Format:

Byte address = XXX

byte location
(hex 000-7FFH)

B. Decimal Format

Byte Address = XXXX

byte location
(decimal 0000-2047)

The numerical format used (hex or decimal) is selected by the user via the "MODE" key (See Section 3.3-I).

3.3 Command Sets

The command set available to the user when interfacing to the S3010 are as follows:

A. [READ] [F1] (ADDR) - Read RAM location (ADDR=00-FFH) and display on Display NO. 1 (LED display). [Updated once per S3010 scan.]

B. [READ] [F2] (ADDR) - Read RAM location (ADDR=00-FFH) and display on Display NO. 2 (LED display). [Updated once per S3010 scan.]

C. [READ] [F3] (ADDR) - Read RAM location (ADDR=00-FFH) and display on DATA DISPLAY (Numerical display). [Updated once per S3010 scan.]

D. [READ] [F4] (ADDR) - Read EEPROM location (ADDR=000-7FFH) and display on DATA DISPLAY (Numerical display). [Read only once when command is entered.]

E. [WRITE] [F1] (ADDR) (DATA) - Write to RAM location (ADDR=00-FFH) the value (DATA=00-FFH).

F. [WRITE] [F2] (ADDR) (DATA) - Write to EEPROM location (ADDR=000-7FFH) the value (DATA=00-FFH).

NOTE: *Some applications programs will not allow certain memory locations to be altered by the user. If the user attempts to "write" to these locations, an ERROR04 will be displayed informing the user that this address is prohibited from alteration.*

G. [CLR] CLEAR - Clear or cancel current command. This command does not cancel previously initiated commands but only the current command in process of entry.

H. [ENTR] - Enter key used to complete a command in process or a particular step of a given command. (See command entry key sequences.)

I. [MODE] - Used to select the numerical format, Hex or Decimal. When first depressed, the "DECIMAL" LED is illuminated and the decimal format numbering system is used in both the address and DATA display fields. If depressed again, the "DECIMAL" LED is extinguished and the hex format numbering system is selected. The "MODE" key can be depressed as above as many times as desired thus allowing the user to conveniently switch between hex and decimal format.

J. [->] - Backspace key used to backspace address or data information if an incorrect number is entered. Used only when entering address or data on "READ" or "WRITE" commands.

As can be seen from the above command sets, the user has available four different "READ" commands and two different "WRITE" commands. Three bytes of information can be displayed simultaneously in DISPLAY NO. 1, DISPLAY NO. 2, and DATA DISPLAY. This information is updated once per S3010 scan thus the information is essentially "real-time". The information displayed in DISPLAY NO. 1 and DISPLAY NO. 2 is also mapped to the DATA OUTPUT PORT at the top of the HHM. This allows the user to observe the change of status of this data with an oscilloscope.

Once a [READ] [F1] or [READ] [F2] command is entered, the data displayed on DISPLAY NO. 1 and DISPLAY NO. 2 will continue to be displayed until a new [READ] [F1] or [READ] [F2] command is entered. Depressing any other key including [CLR] or incurring an error will not cancel these commands.

3.4 Using the Hand Held Monitor with the S3010

3.4.1 Connecting the Hand Held Monitor to the S3010

The HHM can be connected to the S3010 while power is on and the S3010 is running. To connect the HHM, perform the following steps:

A. Install 26 pin socket of Interface Cable in Interface port of HHM (26 pin header located at bottom of HHM) if not already installed. Be sure to align pin 1 of Interface Cable with pin 1 of Interface port. (See Figure 1 on Page 4.)

B. Connect 25 pin Male DB connector of Interface Cable to Interface port of S3010 by pressing connector evenly into Interface port.

C. The HHM will power up immediately upon connection to the S3010 and will come up in one of three states as follows:

1. ADDR/DATA DISPLAY all zeros, STATUS LED's all off. (Power up O.K.)

2. ADDR/DATA DISPLAY displaying "ERROR11" - "ERROR21" (Communications Error - Reset HHM.)

3. ADDR/DATA DISPLAY as well as STATUS LED's displaying erroneous data. (HHM did not power up correctly - Reset HHM.)

D. In all three cases above, always depress the [RESET] key after power up. This resets the HHM processor and re-initiates communications with the S3010. The ADDR/DATA DISPLAY should display all zeros while the STATUS LED's should all be off. DISPLAY NO. 2 may display erroneous data after reset, this is normal.

E. If the DATA/ADDRESS DISPLAY displays an "ERROR11" - "ERROR21" after depressing [RESET], then the HHM cannot establish communications with the S3010. Verify the connections of the Interface Cable to both the HHM and the S3010 and try again. If the error persists, replace either the S3010, HHM, or Interface Cable until error is cleared.

F. If the HHM displays all zeros on the DATA/ADDRESS display after [RESET], then it is ready to receive and execute user commands as outlined in the following.

3.4.2 Read Data and Map to DISPLAY NO. 1/NO. 2 Key Sequence

To READ a byte of RAM and display on either DISPLAY NO. 1 or DISPLAY NO. 2, perform the following key sequence:

Step	User Action	Hand Held Monitor Response
1.	Depress [R] "READ"	ADDR/DATA displays are blanked. "READ" LED is illuminated.
2.	Depress[F1] or [F2] key	F1 LED or F2 LED is illuminated. The ADDR display will display the address entered in the previous [READ] [F1]/[F2] command. The DATA display will display "--". (If F1 is depressed, the data will be mapped to DISPLAY NO. 1. If F2 is depressed, the data will be mapped to DISPLAY NO. 2.)
3.	Enter Address of desired data starting with most significant digit and continuing to least significant digit.	Digits roll into ADDR display from right most digit (least siginificant digit). Remember in hex mode the largest address allowed is FFH and in decimal mode the larg- in hex mode the largest address allowed is 255.
4.	Depress [ENTER] key	If address is valid, the ADDR display will blink indicating the ADDR was entered. Leading zeros (higher significant digits) will be displayed as well. At this time, the data at the entered address will be displayed on the selected display (either DISPLAY NO. 1 or DISPLAY NO. 2). This data will be updated continuously until the [READ] [F1/F2] command is re-entered with a new address for the respective display. If the address was not valid (too large), "ERROR02" will be displayed indicating the address is not valid.

The [READ] [F1/F2] key sequence is now complete and the HHM is ready for the next command. If an error was incurred, the entire key sequence must be re-initiated by first depressing [CLR] and then starting with Step 1.

3.4.3 Read Data and Map to Data Display Key Sequence

To Read a byte of RAM and display in numerical format on the DATA display, perform the following key sequence:

Step	User Action	Hand Held Monitor Response
1.	Depress [R] "READ" key	ADDR/DATA Displays are blanked. "READ" LED is illuminated.
2.	Depress [F3] key	F3 LED is illuminated.
3.	Enter address of desired data starting with most significant digit and continuing to least significant digit.	Digits roll into ADDR display from right most digit (least siginificant). Remember in hex mode the largest address allowed is off and in decimal mode the largest address allowed is 255.
4.	Depress [ENTER] key	If address is valid, the ADDR display will blink indicating the ADDR was entered. Leading zeros (higher significant digits) of ADDR will be displayed as well. At this time, the data at the entered address will be displayed on the DATA display in the selected numerical format (hex mode if "DEC" LED is off, 3-digit decimal mode if "DEC" LED is on). To alter the numerical format simply depress the "MODE" key. This data will be updated continuously until a new command is initiated. If the address was not valid, "ERROR02" will be displayed on the ADDR/DATA display indicating the address is not valid (too large).

The HHM is now ready for a new command. If an error was incurred, the entire sequence must be re-initiated by first depressing the [CLR] key and then starting with Step 1.

3.4.4 Read EEPROM Key Sequence

To Read a byte in non-volatile EEPROM and display in numerical format on the DATA display, perform the key sequence below:

Step	User Action	Hand Held Monitor Response
1.	Depress [R] "READ" key	ADDR/DATA displays are blanked. "READ" LED is illuminated.
2.	Depress [F4] key	F4 LED is illuminated
3.	Enter address of desired data starting with most significant digit and	Digits roll into ADDR display from right most digit (least significant digit). Remember in hex mode the largest address allowed is 07FF and in decimal mode the

	contintuing to least significant digit.	largest address allowed is 2047.
4.	Depress [ENTR] key	If address is valid, the ADDR display will blink indicating the ADDR was entered. Leading zeros (higher significant digits) of ADDR will be displayed as well. At this time, the data at the entered address will be displayed in the selected numerical format (hex mode of "DEC" LED is off, 3-digit decimal mode if "DEC" LED is on). This data is only read once at the time the [ENTR] was depressed, it is not continuously updated. If the address was not valid, "ERROR02" will be displayed on the ADDR/DATA display indicating the address is not valid (too large).

The HHM is now ready for a new command. If an error was incurred, the entire sequence must be re-initiated by first depressing the [CLR] key and then starting with Step 1.

3.4.5 Write Data to RAM Key Sequence

To WRITE a byte to a RAM location, perform the following key sequence:

Step	User Action	Hand Held Monitor Response
1.	Depress [W] "WRITE" key	ADDR/DATA Displays are blanked. "WRITE" LED is illuminated.
2.	Depress [F1] key	F1 LED is illuminated.
3.	Enter address of location where data is to be written to, starting with most significant digit and continuing to least significant digit.	Digits roll into ADDR display from right most digit (least significant digit). Remember in hex mode, the largest address allowed is OFF and in decimal mode, the largest address allowed is 255.
4.	Depress [ENTR] key	If address is valid, the ADDR display will blink indicating the ADDR was entered. Leading zeros will be displayed as well. If the address is too large, an "ERROR02" will be displayed indicating as such.
5.	Enter data to be written to desired RAM location starting with most significant digit and continuing to least significant digit.	Digits roll into DATA display from right most digit (least significant digit). Remember in hex mode, the larges number allowed is off and in decimal mode, the largest number allowed is 255.
6.	Depress [ENTR] key	If the S3010 applications program allows write access to this RAM address, the DATA display will blink indicating the data was written to the entered address. This can be verified by using the [READ] [F3] function.

If the applications program does not allow write access to the entered address, an "ERROR04" will be displayed indicating this. The user can then not alter the data in this address.

If the data entered was not valid (too large) an "ERROR03" will be displayed.

The HHM is now ready for the next command. If an error was incurred, the entire sequence must be re-initiated by first depressing the [CLR] key and then starting with Step 1.

3.4.6 Write Data to EEPROM Key Sequence

To WRITE a byte to a non-volatile EEPROM data memory, perform the following key sequence:

Step	User Action	Hand Held Monitor Response
1.	Depress [W] "WRITE" key	ADDR/DATA displays are blanked. "WRITE" LED is illuminated.
2.	Depress [F2] key	F2 LED is illuminated
3.	Enter address of location where data is to be written to starting with most significant digit and continuing to least significant digit.	Digits roll into ADDR display from right most digit (least significant digit). Remember in hex mode, the largest address allowed is 07FF and in decimal mode, the largest address allowed is 2047.
4.	Depress [ENTR] key	If address is valid, the ADDR display will blink indicating the ADDR was entered. Leading zeros will be displayed as well. If the address is too large, an "ERROR02" will be displayed indicating this.
5.	Enter data to be written to desired EEPROM location starting with most significant digit and continuing to least significant digit.	Digits roll into DATA display from right most digit (least significant digit). Remember in hex mode, the largest number allowed is OFF and in decimal mode, the largest number allowed is 255.
6.	Depress [ENTR] key	If the S3010 applications program allows write access to this EEPROM address entered, the DATA display will blink indicating the data has been stored at this address. This can be verified by using the [READ] [F4] key sequence.

If the applications program does not allow write access to the entered address, an "ERROR04" will be displayed indicating this. The user can then not alter the data in this address.

If the data entered is not valid (too large) an "ERROR03" will be displayed.

The HHM is now ready for the next command. If an error was incurred, the entire sequence must be re-initiated by first depressing the [CLR] key and then starting with Step 1.

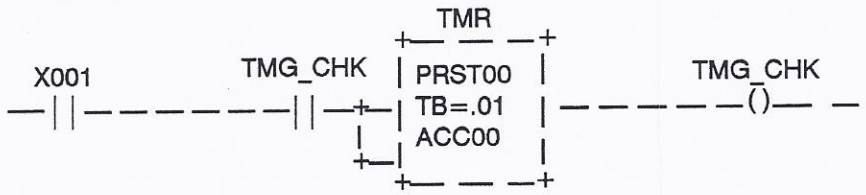
For all command sequences above, once the key sequence in process is completed, the next command key sequence can be initiated simply by starting at Step 1 of that command sequence. It is not necessary to depress the [CLR] key or perform any other action.

The [MODE] key can be used to alternate between hex and decimal formats at any point in the command key sequence except while numerical data is being entered.

3.4.7 Example Session

The following is an example of how to use the Hand Held Monitor to observe and modify data variables in a typical ladder diagram applications program.

The example rung is shown along with pertinent portions of the applications program memory map:



NAME	TYPE	LOC	HHM ACCESS ADDRESS
X000	BIT	00H	; 20.0H RAM
X001	FBIT	01H	; 20.1H RAM
X002	BIT	02H	; 20.2H RAM
.	.	.	
.	.	.	
.	.	.	
TMG_CHK	BIT	2EH	; 25.6H RAM
.	.	.	
.	.	.	
.	.	.	
ACC00	DATA	7FH	; 7FH RAM
.	.	.	
.	.	.	
.	.	.	
PRST00	XDATA	45FEH	; 5FEH EEPROM

The memory map above shows where the variables are mapped in the S3010 memory. Only the "NAME" column and HHM ACCESS ADDRESS columns contain pertinent information for the user. The "NAME" column contains the symbolic names of the variables used by the program. The "HHM ACCESS ADDRESS" column contains the addresses of the variables as used by the HHM. The "TYPE" and "LOC" columns specify the variable name type and location used by the program but are of little significance to the HHM user. The "H" appended to the address stands for Hex format. Thus the above addresses are all hex addresses.

The variable X001 used in the example rung is the location where the status of the physical input located in Slot 0, bit 1 is stored during the I/O scan. TMG_CHK is an internal bit (coil) used as the output of the timer. ACC00 is the name of the accumulator used by the time (byte location in RAM). PRST00 is the name of the preset used by the timer (byte location in EEPROM).

We can observe the status of all the variables associated with the example runs as follows:

A. First, map X001 to discrete LED DISPLAY NO. 1 using the following key sequence:

[R]	"Read"
[F1]	Map data to DISPLAY NO. 1
[2]	Address of byte where X001
[0]	is located
[ENTR]	

X001 is located at bit "1" of byte 20H, thus LED "1" of DISPLAY NO. 1 now indicates the status of X001. When the LED is "on", X001 is on (closed), when the LED is "off", X001 is off (open). Note that the status displayed is the status of the bit not the status of the contact (power flow).

B. Second, map bit TMG_CHK to discrete LED DISPLAY NO. 2:

[R]	"Read"
[F2]	Map data to DISPLAY NO. 2
[2]	Address of byte where TMG_CHK
[5]	is located
[ENTR]	

TMG_CHK is located in bit "6" of byte 25H, thus LED "6" of DISPLAY NO. 2 now indicates the status of the coil TMG_CHK. When LED "6" is "on", the bit (coil) TMG_CHK is on, when LED "6" is off, the TMG_CHK is off. In reference to the normally closed contact of TMG_CHK in the rung; when LED "6" is "on" the contact is "open". When LED "6" is "off" the contact is closed. Note that the Display indicates the status of the coil, not the power flow through the contact. Also note that the entire byte 25H is mapped to DISPLAY NO. 2, thus other bit variables located in byte 25H are displayed as well.

C. Third, display the value of the accumulator (ACC00) of the timer on the DATA display:

[R]	"Read"
[F3]	Map data to DATA (numerical) display
[7]	Address of ACC00
[F]	
[ENTR]	

The DATA display will now display in real time the value of the accumulator as it decrements down.

Up to this point the numbering system used has been hex. To observe the value in ACC00 in decimal mode, simply depress [MODE]. The "DECIMAL" LED should illuminate and the data in the DATA display will now be 3-digit decimal. The ADDR display as well will now be in decimal format.

D. Fourth, change the preset of the timer (PRST00) to 50 decimal. [The preset (PRST00) is located in EEPROM memory]:

[MODE]	Hex mode
[W]	"WRITE"
[F2]	To EEPROM address
[5]	
[F]	Address of PRST00
[E]	
[ENTR]	
[MODE]	Decimal mode ("DEC" LED on)
[5]	Data to be stored
[0]	at PRST00
[ENTR]	

The value 50 decimal has been stored at PRST00 (EEPROM address 5FEH - 1534 Decimal). This is now the new preset for the timer.

E. Finally, verify that the preset of the timer (PRST00) was actually modified in Step D by reading the data at PRST00:

[MODE]	Hex mode
[R]	"READ"
[F4]	Map EEPROM data to DATA display
[5]	
[F]	Address of PRST00
[E]	
[ENTR]	
[MODE]	Decimal mode

The value at PRST00 (32 Hex, 50 decimal) will be displayed on the DATA display. This is not updated continuously, but instead read only once when the [ENTR] key is depressed.

3.4.8 Troubleshooting with the Hand Held Monitor

Most S3010 applications programs contain fault diagnostics software which loads two bytes named FAULT and ERROR with error codes when a fault is detected. In general, the S3010 will stop program execution causing the "RUN" LED to extinguish and the "FAULT" LED to be illuminated on the Power Supply. The user can then connect the HHM to the S3010 and read the FAULT and ERROR bytes using the [READ] [F3] key sequence thus determining the nature of the fault. Refer to the specific applications program documentation for the addresses of FAULT and ERROR as well as the fault codes.

In more extreme cases, the S3010 will not be able to communicate with the HHM resulting in an "ERROR11" - "ERROR21" when the HHM is connected to the S3010. This implies a fatal error in the S3010 thus necessitating the replacement of the S3010.

The HHM can also be used as a general I/O troubleshooting aid to determine the integrity of the I/O hardware. When a specific I/O image byte is mapped to a display, that display should mirror identically the I/O status of the physical I/O board. By successively mapping the I/O image bytes to DISPLAY NO. 1 and DISPLAY NO. 2 using the [READ][F1] and [READ][F2] key sequences, the user can verify that the entire I/O structure is working correctly.

3.4.9 Error Codes

The following Error codes may be encountered when using the HHM with the S3010

ERROR01:	Invalid key depressed
ERROR02:	Address out of range (too large)
ERROR03:	Data out of range (too large)
ERROR04:	Write access denied current address

The following are communications errors:

ERROR11:	S3010 did not respond to command
ERROR12:	S3010 failed to read address
ERROR13:	S3010 failed to read data
ERROR14:	S3010 failed to send data
ERROR15:	S3010 failed to read acknowledge
ERROR16:	Erroneous communications request from S3010
ERROR17:	Communications time out (Data not sent from S3010)
ERROR21:	HHM failed to establish communications with S3010

4. S3040 Resolver Interface/PLS Hand Held Monitor Operations

The HHM allows the user to program the sixteen timing channels of the S3040 as well as set the scale factor and the position offset. In addition, the user can review the position and status of previously programmed set points in any one of the sixteen timing channels.

4.1 S3040 Data Formats/Ranges

The data formats and ranges used with particular S3040 functions are as follows:

A. CHANNEL ADDRESSES - Channels are addressed using octal format. Thus, the first eight channels are accessed using the numbers 00-07. The second group of eight channels are accessed using 10-17.

B. SCALE FACTOR - The scale factor is represented in decimal format. The maximum scale factor allowed is 512. The minimum scale factor allowed is 001.

C. OFFSET - The offset is represented in decimal format. The maximum offset allowed is one division less then the scale factor. The minimum offset allowed is 000.

D. SET POINTS - The data format used to enter the set points is decimal. In general, set point information is in the range of 000 to one less then the scale factor being used.

4.2 Command Sets

The command sets available to the user when interfacing to the S3040 are as follows:

A. [DIV] (data)-	Scale factor set command. Scale factor equals the number of divisions per revolution of resolver. For 360^{O} per revolution, set the scale factor = 360. (data = scale factor = 001 up to 512)
B. [OFFSET] (data)-	Electrical offset added to absolute zero of resolver. Allows the user to redefine the Zero of the resolver without physically moving shaft of resolver. (data = 000 to scale factor minus one)
C. [CH] (Addr)-	Select the channel to modify or search. (Addr = 00-07 or 10-17)
D. [SS][STRT](POS1)- [STOP](POS2) [SET/CLR]	Program the current channel with one set point starting at position 1 and stopping at position 2. SET/CLR is used to program the set point on or off.
E. [MS][STRT](POS1)- [ON](DIV1) [OFF](DIV2)	Program the current channel with continuous duty cycle set points of on divisions equal to DIV1 and OFF divisions equal to DIV2 starting with the 1st ON set point at POS1. Used to program a channel as a clock pulse generator, etc.
F. [SRCH]-	Searches the current channel and displays the position and status of the starting and ending points of all set points within the channel.
G. [POS]-	Displays the current position of the resolver. This is not updated continuously but instead only once when [POS] key is depressed.
H. [CLR]-	Clear or cancel current command in process. This command does not cancel previously initiated commands but only the current command in process of entry.
I. [REC]-	Record or store key which is used to actually complete the set point program command. Once all set point parameters are entered when using [SS] and [MS], the [REC] key is depressed causing the S3040 to actually perform the set point program function.
J. [ENTR]-	Enter key used to complete a command in process in a particular step of a given command. (See command entry descriptions.)

K. [->]- Backspace key used to backspace, address, or data information if an incorrect number is entered. Used only when entering address or data in "[SS]" or "[MS]" commands.

Note that with all the commands above, the current channel being modified or searched is displayed in the two left most digits of the ADDR display. The two right most digits of the ADDR display are not used (blank). All set point, scale factor, offset, and position information is displayed in the DATA display. Status information relative to the S3040 HHM operations appears in DISPLAY NO. 2 as well as the Status display.

4.3 Using the Hand Held Monitor with the S3040

4.3.1 Connecting the Hand Held Monitor to the S3040

The HHM can be connected to the S3040 while power is on and the S3040 is running. To connect the HHM to the S3040, perform the following steps:

A. Install 26 pin socket of Interface Cable in Interface port of HHM (26 pin header located at bottom of HHM) if not already installed. Be sure to align pin 1 of Interface Cable with pin 1 of Interface port. (See Figure 1 on page 4).

B. Connect 25 pin Male DB connector of Interface Cable to Interface port (J1) of S3040 by pressing connector evenly into Interface port.

C. The HHM will power up immediately upon connection to the S3040 and will come up in one of three states as follows:

1. Zeros in two left most digits of ADDR display, two right most digits of ADDR display blank, or all zeros in DATA display.

2. ADDR/DATA DISPLAY displaying "ERROR20" - "ERROR26" (Communications Error - Reset HHM.)

3. ADDR/DATA DISPLAY as well as status LED's displaying erroneous data. (HHM did not power up correctly - Reset HHM.)

D. In all three cases above, always depress the [RESET] key after power up. This resets the HHM processor and re-initiates communications with the S3040. The ADDR/DATA DISPLAY should display as in case no. 1 above while the STATUS LED's should all be off after depressing [RESET]. Both DISPLAY NO. 1 and DISPLAY NO.2 should be blank.

E. If the DATA/ADDRESS DISPLAY displays an "ERROR20" - "ERROR26" after depressing [RESET], then the HHM cannot establish communications with the S3040. Verify the connections of the Interface Cable or both the HHM and the S3040 and try again. If the error persists replace either the S3040, HHM, or Interface Cable until error is cleared.

F. If no error is displayed on the DATA/ADDRESS display after [RESET], then it is ready to receive and execute user commands as outlined in the following.

4.3.2 Setting the Scale Factor

To set the desired scale factor, perform the following key sequence:

Step	User Action	Hand Held Monitor Response
1.	Depress [DIV] key	"SCALE" LED is illuminated. DATA display displays the current scale factor used.
2.	Enter new scale factor starting with most significant and continuing to least significant digit.	DATA display flashes while digits roll into display from right most digit. Remember the largest scale factor allowed is 512.
3.	Depress [ENTR] key	DATA display stops flashing and displays the new scale factor. The new scale factor is stored in the S3040 at this time.

CAUTION!!

Changing the scale factor after timing channels have been previously programmed will result in invalid set points within these channels. It is recommended that all timing channels be pre-programmed after setting the scale factor.

The user can observe the scale factor without changing it by simply depressing the [DIV] key and observing the scale factor on the DATA display. The user can then depress another command key or depress [CLR] to continue without modifying the scale factor. The scale factor is changed only after the [ENTR] key is depressed in Step 3 above.

4.3.3 Setting the Offset

To move the resolver zero position electrically to a new location perform the following steps:

Step	User Action	Hand Held Monitor Response
1.	Locate machine at mechanical zero position.	----------
2.	Depress [OFFSET] key	"OFF" and "DIV" LED's illuminate. Current OFFSET is displayed on the DATA display.
3.	Depress [0] key	DATA display flashes with least significant digit equal to zero.
4.	Depress [ENTR] key	DATA display flashes with zeros in all digits while offset is changed in S3040 memory. (Offset change takes approximately 13 seconds to perform.) DATA display stops flashing once offset operation is complete.

The above steps reset the Offset to zero thus allowing the new Offset to be located at the correct position.

NOTE: *While the offset change is being implemented and the display is flashing, all new key entries are ignored by the HHM. Therefore, wait until the Offset programming is complete before continuing to enter new commands.*

5.	Depress [POS] key	DATA display displays the current position of the resolver shaft. This will be the value entered for the Offset. Remember this value for the next few steps.
6.	Depress [OFFSET] key	DATA display displays 000.
7.	Enter the position displayed in Step 5 above starting with the most significant digit and continuing to the least significant digit.	DATA display flashes while digits roll into display from right most digit.
8.	Depress [ENTR] key	DATA display flashes with value entered in Step 7 above while Offset is changed in S3040 memory. DATA display stops flashing once Offset operation is complete.

The OFFSET is now set and the S3040 position display should read "0". The user can observe the Offset without changing it by depressing the [OFFSET] key and observing the Offset on the DATA display. Then simply depress another command key or depress [CLR] to continue without modifying the Offset.

4.3.4 Channel Number Entry

To select a new channel number, perform the following steps:

Step	User Action	Hand Held Monitor Response
1.	Depress [CH] key	"CHAN" LED illuminates
2.	Enter new channel number starting with most significant digit, then least significant digit.	CHAN display flashes while digits roll into display from 2nd digit from left. Remember, the range allowed for channel numbers is 00-07 and 10-17.
3.	Depress [ENTR] key	CHAN display stops flashing. "CHAN" LED extinguishes indicating the new channel number is entered.

Notes: *(1) The channel number can be changed at any time (even once the [SS] or [MS] commands have been initiated) except while other data is being entered (display flashing).*

(2) All operations (SS, MS, SRCH) are performed against the current channel number displayed in the CHAN display.

(3) If an error occurs while entering the Channel number, depress [CLR] and start over at Step 1.

4.3.5 Single Set Point Programming Key Sequence

To program a single set point in current channel, perform the following steps:

Step	User Action	Hand Held Monitor Response
1.	Depress [SS] key	"SS" LED illuminates.
2.	Depress [STRT] key	"START" LED illuminates. DATA display displays current starting position.
3.	Enter the starting position of the set point starting with the most significant digit and continuing to the least significant digit.	DATA display flashes while digits roll into display from right most digit. Remember, the largest position allowed equals the scale factor minus one.
4.	Depress [ENTR] key	DATA display stops flashing and displays the starting position. "START" LED extinguishes.
5.	Depress [STOP] key	"STOP" LED illuminates, DATA display displays current stopping position.
6.	Enter the ending position of the set point starting with the most significant digit and continuing to the least significant digit.	DATA display flashes while digits roll into display from right most digit. Remember, the largest position allowed equals the scale factor minus one.
7.	Depress [ENTR] key	DATA display stops flashing and displays the ending position. "STOP" LED extinguishes.
8.	Depress [SET/CLR] key until the "STAT" LED displays the desired status of the set point.	Depressing [SET/CLR] toggles the "STAT" LED from off to on or on to off depending on the previous state of "STAT". To program a set point as "on", depress [SET/CLR] until the "STAT" LED is "on". To program a set point as "OFF", depress [SET/CLR] until the "STAT" LED is "OFF".
9.	Depress [REC] key	Both the CHAN and DATA displays blink and the "SS" LED extinguishes. At this time the timing channel in the S3040 is programmed with the START and STOP parameters.

Notes: *(1)* *The [SS] command only programs the channel between the "START" and "STOP" positions using the state of the "STAT" LED. It does not affect any previously programmed set points within the channel outside of the START/STOP positions. This does allow the user to program more than one set point in the channel, however, caution should be used to assure that no additional undesired set points are in the channel.*

(2) *Any channel can be cleared using the [SS] command by making sure "STAT" is off and entering [START] = 000 and [STOP] = 000 (START = STOP position). By programming the channel with START = STOP, the entire channel is programmed as off.*

4.3.6 Multiple Set Point Programming Key Sequence

To program a channel with multiple set points (continuous pulses) of a specified on and off duration, perform the following steps:

Step	User Action	Hand Held Monitor Response
1.	Depress [MS] key	"MS" LED illuminates.
2.	Depress [STRT] key. (If the starting position is to be "000", skip this step as well as Steps 3 and 4.)	"START" LED illuminates. DATA display displays current starting position.
3.	Enter the position to the first "on" duration starting with the most significant digit and continuing to the least significant digit.	DATA display flashes while digits roll into display from right most digit. The largest start position allowed equals the scale factor minus one.
4.	Depress [ENTR] key	DATA display stops flashing and displays the starting position. "START" LED extinguishes.
5.	Depress [ON] key	"ON" LED illuminates. DATA display displays current "ON" duration.
6.	Enter the number of divisions each pulse is to be on.	DATA display flashes while digits roll into display from right. The largest on duration allowed is 255. The smallest duration is 001.
7.	Depress [ENTR] key	DATA display stops flashing and displays "ON" duration. "ON" LED extinguishes.
8.	Depress [OFF] key	OFF LED illuminates. DATA display displays current OFF duration.
9.	Enter the number of divisions each pulse is to be off.	DATA display flashes while digits roll into display from right. The largest off duration allowed is 255. The smallest duration is 001.
10.	Depress [ENTR] key	DATA display stops flashing and displays "OFF" duration. "OFF" LED extinguishes.
11.	Depress [REC] key	Both the CHAN AND DATA displays blink and the "MS" LED extinguishes. At this point, the timing channel in the S3040 is programmed.

Notes: *(1) The [MS] command programs the entire channel, writing over any existing previously programmed set points.*

(2) If an error occurs while entering parameters of the "MS" command, depress [CLR] and start over at Step 1.

4.3.7 Searching (Recalling) A Timing Channel

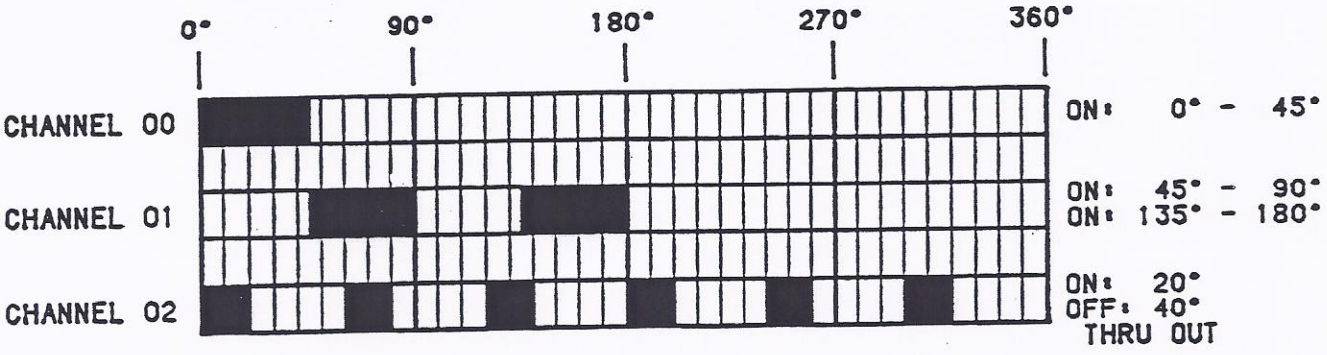
To view the position and status of set points in the current channel, perform the following steps:

Step	User Action	Hand Held Monitor Response
1.	Depress [SRCH] key	The starting or ending position of the next set point is displayed in the DATA display. The "STAT" LED displays the status of this position. If the "STAT" LED is "ON", this position is the start of the next set point. If the "STAT" LED is "OFF", this position is the end of the current set point. If the display displayed "--" and the "STAT" LED is "OFF", the channel is cleared. If the display reads "--" and "STAT" is "ON" the channel is programmed all on.
2.	Depress SRCH] key	Continuing to depress the [SRCH] key displays the starting and ending position of all set points within the channel.

4.3.8 Example Session

The following is an example session to set-up an S3040 using the Hand Held Monitor.

Given the timing sequence chart below, go through the steps necessary to program the S3040 timing Channels:



A. First, set the scale factor equal to 360 (360^{o} per revolution) as follows:

[DIV]	Divisions per revolution key
[3]	
[6]	SCALE FACTOR equals 360
[0]	
[ENTR]	

The scale factor is now set to 360

B. Second, assuming the shaft of the resolver is located at the desired zero position, set the offset:

[OFFSET]	
[0]	
[0]	Reset Offset
[0]	
[ENTR]	
[POS]	Read angular position of resolver (assume, for this example, it read "245").
[OFFSET]	
[2]	OFFSET equals absolute
[4]	position of resolver when
[5]	located at desired zero
[ENTR]	position.

C. Third, program CHANNEL 00 using the [SS] single set command:

[CH]	
[0]	
[0]	Select Channel 00
[ENTR]	
[SS]	
[STRT]	
[0]	Start of set point = 000^{o}
[ENTR]	
[STOP]	
[4]	End of set point = 45^{o}
[5]	
[ENTR]	
[SET/CLR]	Turn "STAT" LED "ON"
[REC]	

Channel 00 is now programmed with a set point which turns "on" at 000 and turns "off" at 45^{o}.

D. Fourth, program CHANNEL01 also using the [SS] command

[CH]	
[0]	
[1]	Select Channel 01
[ENTR]	
[SS]	Clear Channel 01
[REC]	
[SS]	
[STRT]	
[4]	Start of 1st set point = 45^{o}
[5]	
[ENTR]	
[STOP]	
[9]	
[0]	End of set point = 90^{o}

[ENTR]
[SET/CLR] Program 1st set point "on"
[REC]

[SS]
[STRT]
[1] Start of 2nd set point = 135°
[3]
[5]
[ENTR]
[STOP]
[1]
[8] End of 2nd set point - 180°
[0]
[ENTR]
[SET/CLR] Program 2nd set point "on"
[REC]

Channel 01 is now programmed with one set point on from 45° to 90° and a second set point on from 135° to 180°.

E. Fifth, program Channel 02 using the [MS] multi-set point command:

[CH]
[0]
[2] Select Channel 02
[ENTR]

[MS]
[STRT]
[0] Start of 1st "on" duration = 000°
[ENTR]
[ON]
[2] Pulse "on" duration = 20°
[0]
[ENTR]
[OFF]
[4] Pulse "off" duration = 40°
[0]
[ENTR]
[REC] Program set points in Channel 02

Channel 02 is now programmed with a pulse train such that each pulse is "on" for 20° and "off" for 40°.

F. Finally, review the channels programmed above using the [SRCH] key.

[CH]
[0]
[0] Select Channel 00
[ENTR]

[SRCH] POS = 000, STAT LED "on"
[SRCH] POS = 045, STAT LED "off"
[SRCH] POS = 000, STAT LED "on"

.
.

[CH]
[0]
[1] Select Channel 01
[ENTR]

[SRCH] POS = 045, STAT LED "on"
[SRCH] POS = 090, STAT LED "off"
[SRCH] POS = 135, STAT LED "on"
[SRCH] POS = 100, STAT LED "off"
[SRCH] POS = 045, STAT LED "on"

.
.
ETC.

4.3.9 Error Codes

The following error codes may be encountered when using the HHM with the S3040:

ERROR01	Invalid key depressed
ERROR03	Data not valid (out of range)

The following are communications errors:

ERROR20	S3040/HHM buffer fail (initialization)
ERROR21	S3040 failed to read buffer (transmit)
ERROR22	S3040 failed to write acknowledge to HHM
ERROR23	Data integrity error
ERROR24	S3040/HHM buffer (RDY-IN/OUT) fail during transmit cycle.
ERROR25	S3040 failed to transmit data (time out)
ERROR26	S3040/HHM buffer (RYD-IN/OUT) fail during receive cycle.

APPENDIX A
NUMBERING SYSTEMS

The numbering systems encountered when using the HHM are:

Binary (base 2), Octal (base 8), Decimal (base 10), and Hex (base 16). What follows is a brief outline on these different bases.

A.1 BINARY

The binary number system uses only two discrete digits, 0 and 1, to represent all numerical quantities, thus the term binary or base two. The weight of each position in an 8-bit binary number is shown below:

	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	POWER
Weight	128	64	32	16	8	4	2	1	VALUE
	1	1	0	1	0	0	1	1	BINARY NUMBER

Thus, in decimal, the above binary number equals:

least significant bit:	(1x1)	= 1
	+(1x2)	= 2
	+(0x4)	= 0
	+(0x8)	= 0
	+(1x16)	= 16
	+(0x32)	= 0
	+(1x64)	= 64
most significant bit:	+(1x128)	= 128
	sum	= 211

Therefore 11010011 Binary = 211 decimal

A.2 OCTAL

The octal number system uses eight discrete digits to represent all numerical quantities. These are:

0
1
2
3
4
5
6
7

The weight of each position in 5-digit octal number is:

	8^4	8^3	8^2	8^1	8^0	POWER
Weight	4096	512	64	8	1	VALUE
	2	5	3	7	1	OCTAL NUMBER

Thus, in Decimal, the above octal number equals:

least significant digit:

(1x1)	=	1
+(7x8)	=	56
+(3x64)	=	192
+(5x512)	=	2,560
+(2x4096)	=	8,192
sum	=	11,001

Therefore 25,371 = 11,001 decimal

A.3 HEX

The hex numbering system uses sixteen discrete digits to represent all numerical quantities. These are:

HEX		DECIMAL
0	=	0
1	=	1
2	=	2
3	=	3
4	=	4
5	=	5
6	=	6
7	=	7
8	=	8
9	=	9
A	=	10
B	=	11
C	=	12
D	=	13
E	=	14
F	=	15

The weight of each position in a 4-digit hex number is:

	16^3	16^2	16^1	16^0	POWER
Weight	4096	256	16	1	VALUE
	7	F	C	3	HEX NUMBER

Thus, in Decimal, the above hex number equals:

least significant digit:	(3x1)	=	3
	+[C(12)x16]	=	192
	+[F(15)x256]	=	3,840
most significant digit:	+[7x4096]	=	28,672
		sum =	32,707

Therefore, 7FC3 hex = 32,707 decimal.

APPENDIX B:
INTERFACE PORT

B.1 **PINOUT** (Standard 25 pin DB connector)

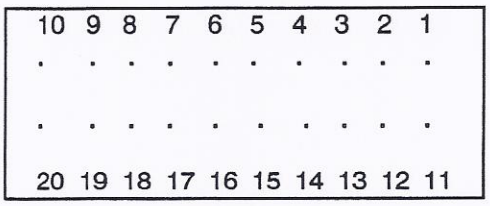
1 - Ground
2 - I/O SEL
3 - RD'
4 - NC
5 - GROUND
6 - NC
7 - NC
8 - D7
9 - GROUND
10 - D4
11 - D2
12 - D0
13 - GROUND
14 - +V
15 - WR'
16 - NC
17 - HAND HELD MONITOR RD7
18 - NC
19 - AB2
20 - NC
21 - D6
22 - D5
23 - D3
24 - D1
25 - +V

NC = No Connection

APPENDIX C:
DATA OUTPUT PORT

C.1 **PINOUT** (20 PIN SOCKET)

1 - GROUND
2 - LED 0 DISPLAY 2
3 - LED 1 DISPLAY 2
4 - LED 2 DISPLAY 2
5 - LED 3 DISPLAY 2
6 - LED 4 DISPLAY 2
7 - LED 5 DISPLAY 2
8 - LED 6 DISPLAY 2
9 - LED 7 DISPLAY 2
10 - VCC (+5VDC)
11 - GROUND
12 - LED 0 DISPLAY 1
13 - LED 1 DISPLAY 1
14 - LED 2 DISPLAY 1
15 - LED 3 DISPLAY 1
16 - LED 4 DISPLAY 1
17 - LED 5 DISPLAY 1
18 - LED 6 DISPLAY 1
19 - LED 7 DISPLAY 1
20 - VCC (+5VDC)



DATA OUTPUT PORT
(looking into Port)