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## FEATURES

- ASCII command support for all 1-Wire devices.
- Powered by RS232 handshake lines.
- Automatic power up and power down.
- Automatically provides smart strong-pull-up.
- 1000 feet, 100 devices per CAT-5 twisted net.
- Search, Family Search and Conditional Search.
- Block mode commands support all 1-Wire device functions.
- Supports Touch Memory File Structure for Dallas Semiconductor iButtons.
- ESD Protection more than 27kV (IEC801-2 Reference Model.) on the 1-Wire bus.
- Automatic CRC16 for TMEX files.
- ABS enclosure.
- Low Cost.



## DESCRIPTION

The HA7E is an RS232 to 1-Wire interface in a very small ABS enclosure designed to provide an ASCII command set for RS232 serial hosts that need to accommodate Dallas Semiconductor iButton and 1-Wire devices. The HA7E relieves the host of the burden of generating the time-critical 1-Wire communication waveforms while supporting all 1-Wire devices with simple ASCII commands that can be easily generated. The HA7E does all the hard work of interfacing 1-Wire networks.

Small size and very low power consumption as well automatic power-up and power-down features allow the HA7E to operate in low power and battery operated applications with no need for power control signals from the host device. The only interface signal required is the RS232 level TX, RX, RTS and DTR. When a serial ASCII command is sent the HA7E will wake-up, process the command, send the response and power down. The 1-Wire bus can be left in a powered up or a powered down state while the HA7E is powered down. While in power down mode the HA7E has a very low quiescent current requirement.

The HA7E can perform Search and Family search functions making it easy to acquire the unique 64 bit serial numbers of all connected devices. Many sensor devices require that extra power be delivered during periods of data conversions (DS1920 and DS1820 temperature sensors for example). The HA7E automatically provides the extra current these devices require with a built in smart strong-pull-up. Dallas Semiconductor iButtons which store data in TMEX Touch Memory File format can be read or written with simple ASCII commands. The HA7E will automatically generate and check the CRC16 error checks from Touch Memory File records. The HA7E supports analog, digital, and temperature 1-Wire devices and all Dallas Semiconductor iButtons.

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## Command List

- 'S'**    **SEARCH ROM:**  
Allows the HA7E to use a process of elimination to identify the 64-bit ROM codes of all slave devices on the bus.
- 's'**    **NEXT SEARCH ROM:**  
Identify the 64-bit ROM codes of the next device on the bus, must be preceded by "S" command.
- 'F'**    **FAMILY SEARCH:**  
Search command, except that only the device with a matching family code will participate in the search.
- 'f'**    **MORE FAMILY SEARCH:**  
Search command, next matching family code, must be preceded by "F" or "f" command.
- 'C'**    **CONDITIONAL SEARCH (ALARM SEARCH):**  
Search command, except that, only devices fulfilling a specific condition will participate in the search.
- 'A'**    **ADDRESS Select:**  
Selects a device on the 1-Wire bus with a matching 64-bit ROM code.
- 'Z'**    **WRITE ZERO BIT:**  
This command allows a single zero bit to be written on the bus.
- 'O'**    **WRITE/READ ONE BIT:**  
This command allows a single one bit to be read, or written on the bus, or a zero bit to be read.
- 'R'**    **1-WIRE RESET:**  
The Reset command generates a reset pulse on the 1-Wire bus.
- 'G'**    **READ PAGE:**  
Allows one page of data to be read from an iButton or 1-Wire memory device.
- 'g'**    **READ NEXT PAGE:**  
Read next page from an iButton or 1-Wire memory device, must be preceded by "G" or "g" command.
- 'L'**    **READ FILE RECORD:**  
Allows one TMEX™ file record of data to be read from an iButton or 1-Wire memory device.
- 'I'**    **READ NEXT FILE RECORD:**  
Read next TMEX™ file record, must be preceded by "L" or "I" command.
- 'U'**    **WRITE File RECORD AT PAGE, WITH CRC16:**  
Write to 1-Wire devices and iButtons in Touch Memory File Structure records.
- 'W'**    **WRITE BLOCK:**  
Similar to the write/read bit command on blocks of up to 32 bytes.
- 'M'**    **MATCH ROM COMMAND:**  
Sends a Reset and a Match ROM command for the currently selected device.
- 'P'**    **POWER DOWN THE 1-Wire Bus:**  
The 1-Wire bus and the HA7E will power down at the end of this command.

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## Search ROM Command

### 'S' SEARCH ROM

**Form:** "S" (a single character command)

When a system is initially brought up, the host application might not know the number of devices on the 1-Wire bus or their 64-bit ROM codes. The Search ROM command allows the HA7E to use a process of elimination to identify the 64-bit ROM codes of all slave devices on the bus. The Search ROM process is the repetition of a simple 3-step routine: read a bit, read the complement of the bit, then write the desired value of that bit. The HA7E performs this simple, 3-step routine on each bit of the ROM. After one complete pass, the HA7E knows the contents of the ROM in one device. The 64 bit ROM code is then reported as an 8-byte ASCII hexadecimal string. Additional passes may identify the remaining number of devices and their ROM codes. The HA7E Search ROM command will find the ROM codes of one (the first in search order) slave device on the bus. The host application can remember this ROM code for future references to this slave device with the "A" address command. See Chapter 5 of the Book of DS19xx iButton Standards from Dallas Semiconductor for a comprehensive discussion of the search ROM function.

The Search ROM command selects the 1-Wire device that corresponds to the ROM code sent to the host last as a response. Devices may also be selected with the "A" (address), "M" (match ROM) or "F" (family search) commands. Once selected all commands will operate on the selected device until another device is selected.

**Example:** Read the ROM codes of the first slave device on the bus.

<u>Command</u>	<u>Response</u>
S	7F0000000836A410<CR>

### 's' NEXT SEARCH ROM

**Form:** "s" (a single character command)

The Next Search ROM command must be used after the first search to find additional ROM codes. This command can only be used after a "S" or "s" command for valid response. This command can be sent repetitively until all 1-Wire device ROM codes are found.

The Next Search ROM command selects the 1-Wire device that corresponds to the ROM code sent to the host last as a response. Devices may also be selected with the "A" (address), "M" (match ROM) or "F" (family search) commands. Once selected all commands will operate on the selected device until another device is selected.

**Example:** Read the ROM codes of the all slave device on the bus.

<u>Command</u>	<u>Response</u>
S	7F0000000836A410<CR>
s	A00000000B14E710<CR>
s	800000000AE6A012<CR>
s	EA0000000AE5AF12<CR>
s	<CR> (no more devices)

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## Family Search Command

'F' FAMILY SEARCH

'f' NEXT FAMILY SEARCH

**Form: Fc** Where "F" is the command directive and "c" is the family code.

Family search speeds the process of selecting a specific device on the 1-Wire bus if the user knows the family code. In a network of many devices the user may wish to read, for example, the temperatures of all the DS1820 based sensors. The family search command "F10" can be used to locate the first sensor, the temperature can be read with the "W" command. Subsequent temperature sensors can be selected with the "f" command and read with the "W" command until all temperatures have been taken (indicated by a CR only response or a ROM code with a different family code response).

The Family Search command selects the 1-Wire device that corresponds to the ROM code sent to the host last as a response. Devices may also be selected with the "A" (address) or "S" (search) commands. Once selected all commands will operate on the selected device until another device is selected.

**Example:** Search for all DS1820/DS1920 temperature sensor devices on the bus, family code 10 and read the temperature data with the "W" command.

**Note:** After the first selection of a device with the desired family code, subsequent searches must be made with the "f" command until a <CR> only is returned indicating that all have been found.

<u>Command</u>	<u>Response</u>
F10 (family search)	7F0000000836A410<CR>
W0144<CR> (convert command)	44<CR>
(WAIT 350 MILLISEC. FOR CONVERSION TO COMPLETE)	
M (match ROM command)	7F0000000836A410<CR>
W0ABEFFFFFFFFFFFFFFFFFFFF<CR>	BE28000000FFFF274B72 <CR>
f (next family search)	BD0000001D323910<CR>
(WAIT 350 MILLISEC. FOR CONVERSION TO COMPLETE)	
M (match ROM command)	BD0000001D323910<CR>
W0ABEFFFFFFFFFFFFFFFFFFFF<CR>	BE28000000FFFF274B72 <CR>
f (next family search)	<CR> (no more DS1820/DS1920s)

Note: It can be seen from this example that the host does not need to maintain the ROM codes of the devices in the network in order to acquire data and communicate with them. This example uses the family search command to select the DS1820/DS1920 devices and the "W" command to acquire the temperature data.

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## Conditional (Alarm) SEARCH Command

'C'    **CONDITIONAL SEARCH (ALARM SEARCH)**    'c'    **NEXT CONDITIONAL SEARCH**

**Form: C**                    (a single character command)

**Form: c**                    (a single character command)

The Conditional Search ROM command operates similarly to the Search command except that only those devices fulfilling a specific (device dependent) condition will participate in the search. This is a very powerful functional aspect of 1-Wire devices. This capability provides for very fast and efficient polling of the 1-Wire bus for devices that have activity of interest. See the individual device specifications from Dallas Semiconductor for details on the conditional search capability of a specific 1-Wire device.

The Conditional Search ROM command selects the 1-Wire device that corresponds to the ROM code sent to the host last as a response. Devices may also be selected with the "A" (address), "S" (search), "F" (family search) and "M" (match ROM ) commands. Once selected all commands will operate on the selected device until another device is selected.

**Example:** Search for all slave devices on the bus fulfilling the respective conditions for conditional search

Note: each 1-Wire device family may or may not support conditional search, see the individual device specifications for details.

<u>Command</u>	<u>Response</u>
C	7F0000000836A410<CR>
c	0600000001C8BE12<CR>
c	<CR> (no more devices with alarms)

In the above example a D1820/DS1920 (family code 10) had an alarm condition and a DS2407 (family code 12) had an alarm condition pending. No other devices had alarms pending. See the individual device specifications for details on conditional (alarm) search capabilities.

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## ADDRESS Select Command

### 'A' ADDRESS Select

**Form:** `Aa<CR>` Where "A" is the command directive and "a" is the ADDRESS.

The Address command is used to select a device on the 1-Wire bus. Once a device has been selected subsequent commands can operate on it without the need to select it again. The HA7E will remember the ROM code of a selected device and automatically use it when necessary to re-address the selected device without the users need to re-send the ROM code. ROM codes are determined with the "S" search, "M" match ROM and "F" family search commands.

The Address command selects the 1-Wire device that corresponds to the ROM code in the command. Devices may also be selected with the "F" (family search), "S" (search) or "M" (match ROM) commands. Once selected all commands will operate on the selected device until another device is selected.

**Example:** Select the DS2407 with a ROM code of "0600000001C8BE12", then read the channel info byte with the "W" command.

<u>Command</u>	<u>Response</u>
A0600000001C8BE12<CR>	0600000001C8BE12<CR>
W04F5FFFFFFF<CR>	F5FFFA6<CR>

The channel info byte is A6, the last byte. (See the DS2407 specification from Dallas Semiconductor.)

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## MATCH ROM Command

**'M'**     **Reset device and send the Match ROM command for the current device.**

**Form:** "M"     (a single character command)

The Match ROM command is used to reset and re-select the current device on the 1-Wire bus. Once a device has been selected subsequent commands can operate on it without the need to select it again. The HA7E will remember the ROM code of a selected device and automatically use it when necessary to re-address the selected device without the users need to re-send the ROM code. ROM codes are determined with the "S" search, "M" match ROM and "F" family search commands.

The Match ROM command resets and selects the current 1-Wire device and responds with the ROM code of that device. Devices may also be selected with the "F" (family search), "S" (search) or "M" (match ROM) commands. Once selected all commands will operate on the selected device until another device is selected.

**Example:** Reset and re-select the DS2407 currently addressed then read the channel info byte with the "W" command.

<u>Command</u>	<u>Response</u>
M	060000001C8BE12<CR>
W04F5FFFFFFF<CR>	F5FFFA6<CR>

The channel info byte is A6, the last byte. (See the DS2407 specification from Dallas Semiconductor.)

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## WRITE-ONE /READ BIT Command

### 'O' WRITE-ONE/READ BIT and 'Z' WRITE-ZERO BIT COMMANDS

**Form:** "O" or "Z" (single character commands)

The bit write/read command is the lowest level 1-Wire command. This command allows a single bit, either zero (0) or one (1) to be read from the bus or a (1) to be written to the bus. This function is provided to allow direct manipulation of 1-Wire devices and is not normally required.

On a 1-Wire bus the bus master (HA7E) writes a one (1) by setting the bus voltage low for a short time (See Chapter 1 of the Book of DS19xx iButton Standards from Dallas Semiconductor for details). A bus master writes a zero (0) by setting the bus voltage low for a longer time. When a slave device needs to communicate a one (1) bit it simply does nothing during the bus master write of a one (1) time slot. When a slave device needs to communicate a zero (0) bit it holds the bus master write one (1) time slot low for the longer time indicative of a zero (0) time slot. This allows the slave device to communicate both zero and one bits without the need to drive the bus. The 1-Wire bus master does the bus driving. A slave device only needs to hold the bus low during time slots that it wishes to communicate a zero (0) bit value. The only condition under which the slave drives the bus is during reset presence.

The "O" command is both a write bit and read bit command. When the bus master is writing bits both "O" and "Z" commands apply. When the bus master is reading bits only the "O" command applies. When reading a bit the response to a "O" command may be either "0" or "1" depending on whether or not the slave device holds the bus low to indicate a "0" bit.

The block command "W" performs this same function on blocks of data.

**Example:** Write a zero "0" on the bus.

<u>Command</u>	<u>Response</u>
(write a 0 bit) Z	0<CR>
(write a 1 bit) O	1<CR>
(read a 1 bit) O	1<CR>
(read a 0 bit) O	0<CR>



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## RESET Command

'R' 1-WIRE RESET.

**Form:** "R" (a single character command)

The Reset command generates a reset pulse and determines if any slave devices are on the 1-Wire bus.

**Example:** Reset the 1-Wire bus and determine if any slave devices are present.

<u>Command</u>	<u>Response</u>
(no checksum) R	<CR>

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## READ PAGE Command

**'G' READ PAGE. and 'g' Read NEXT PAGE Command.**

**Form: Gp** Where "G" is the command directive and "p" is the page number.

The Read Pages command allows one page of data to be read from an iButton or 1-Wire memory device. No assumptions are made about the nature of the contents of the page. See the "L" (read file record) command for details on how to read Touch Memory File (TMEX™) records.

**Example:** Read two pages of data starting at page 0F from the DS1996 with ROM code EF0000003B7890C.

<u>Command</u>	<u>Response</u>
AEF0000003B7890C<CR>	AEF0000003B7890C <CR>
G0F	<u>Response</u> (this is page 0F)
	1D2E0001142E0001142E0001132E0001112E0001132E0001122E00011210CA42<CR>
g	<u>Response</u> (page 10)
	1D2E00010E2E00010D2E0001102E00010F2E00010F2E0001102F00010D11A299<CR>
g	<u>Response</u> (page 11)
	1D2E00010D2E00010E2E00010F2E00010D2F0001122F0001122F00011312BBD0<CR>

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## READ FILE RECORD Command

'L' READ FILE RECORD and 'I' READ NEXT FILE RECORD

**Form:** Lp Where "L" is the command directive and "p" is the page number.

The Read File Record command allows one TMEX™ file record to be read from an iButton or 1-Wire memory device. CRC16 is checked on the record and if the record is not a valid Touch Memory File record an error code (BEL, 07) is generated. The byte count, continuation code and CRC16 bytes are stripped from the file record before it is sent. See Chapter 7 of the Book of DS19xx iButton Standards from Dallas Semiconductor for a comprehensive discussion of the Touch Memory File Structure.

**Example:** Read two records of a file starting at page 0F from the DS1996 with ROM code EF0000003B7890C. Then read the next record of the file after these two.

Command \_\_\_\_\_ Response

AEF0000003B7890C<CR>

<CR>

L0F Response (this is pages 0F)

2E0001142E0001142E0001132E0001112E0001132E0001122E000112<CR>

I Response (page 10)

2E0001102E00010F2E0001112F00010F2E00010E2E0001102E00010E<CR>

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## WRITE File RECORD Command

### 'U' WRITE File RECORD AT PAGE WITH CRC16.

Form: **Up{data}<CR>**

Where [I] is the write record directive, **p** is the page number of the record to be written, **data** is a 0 to 28 byte hex string representing the data to write into the selected page. See Chapter 7 of the Book of DS19xx iButton Standards from Dallas Semiconductor for a comprehensive discussion of the Touch Memory File Structure.

The "U" command will always write 28 bytes of data even if the user provides less than 28 bytes. The application may require that the user write all 28 bytes each time. This command will automatically set the continuation pointer to the next page, this limits the use to files that have contiguous records.

The HA7E can only write to 1-Wire devices and iButtons in Touch Memory File Structure records. However, the user can directly communicate with any 1-Wire device or iButton using the block write/read commands; "W". The block commands support all device functions.

**Example:** Write the record "HA7 is Easy To USE" into the file that contains page 21 (hex) of the DS1996 with ROM code EF00000003B7890C.

<u>Command</u>	<u>Response</u>
AEF00000003B7890C<CR>	<CR>
I21484137206973204561737920544F20555345<CR>	<CR>

**p**=21, the page number of the file record to write to.

**data**, data ,484137206973204561737920544F20555345 = "HA7 is Easy To USE" in ASCII hex.

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## WRITE/READ BLOCK Commands

'W'

Form: **W***b*{*data*}<CR>

Where **b** is byte count to write and **data** is the block to write onto the 1-Wire bus (1-32) bytes.

The write/read block commands are very similar to the write/read bit command. The block commands performs the bit write/read functions on blocks of data up to 32 bytes long.

The block write/read commands are the most powerful of the 1-Wire commands provided by the HA7E. These commands allow blocks of data, either zeros (0) or ones (1) to be written or read on the bus. This function is provided to allow direct manipulation of 1-Wire devices and can provide interface to all 1-Wire device functions.

On a 1-Wire bus the bus master (HA7E) writes a one (1) by setting the bus voltage low for a short time (See Chapter 1 of the Book of DS19xx iButton Standards from Dallas Semiconductor for details). A bus master writes a zero (0) by setting the bus voltage low for a longer time. When a slave device needs to communicate a one (1) bit it simply does nothing during the bus master write of a one (1) time slot. When a slave device needs to communicate a zero (0) bit it holds the bus master write one (1) time slot low for the longer time indicative of a zero (0) time slot. This allows the slave device to communicate both zero and one bits without the need to drive the bus. The 1-Wire bus master does the bus driving. A slave device only needs to hold the bus low during time slots that it wishes to communicate a zero (0) bit value.

The "W commands is both a write-block and read-block command. The bus master always writes, even when reading. The bus master writes 1 time-slots whenever it wishes to write a 1 bit or when it wishes to read a bit from a selected slave. When reading a bit the response to a write 1 time-slot may be either "0" or "1" depending on whether or not the slave device holds the bus low to indicate a "0" bit. The block write/read commands will send up to 32 bytes of 8-bits each onto the 1-Wire bus and record the slave response and send it back as a command response. This is a very powerful and efficient technique for communicating with 1-Wire slaves.

**Example:** Select the DS2407 with ROM code 2400000007377212, issue the Channel Access command and read the Channel Info Byte which contains the input latches, output latches and sensed levels of the two I/O lines PIOA, PIOB.

<u>Command</u>	<u>Response</u>
A2400000007377212<CR> W04F5CFFFFFF<CR>	2400000007377212<CR> F5CFFF47 <CR>

Note: 4 bytes were written and 4 bytes were read. The last byte written FF is a read byte corresponding to the reading of the Channel Info Byte in the DS2407. See the DS2407 specification from Dallas Semiconductor for more details on the operation of the DS2407.

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## POWER DOWN Command

'P' 1-WIRE POWER DOWN.

**Form:** "P" (a single character command)

The Power Down command will cause the 1-Wire bus voltage to be reduced to 0 volts.

<u>Command</u>	<u>Response</u>
(no checksum) P	<CR>

### RJ-11 PINOUT

RJ11 PIN	SIGNAL	DESCRIPTION
1	No connection	No connection
2	No connection	No connection
3	1–Wire Input/Output Pin	Microlan™ network I/O
4	1–Wire Ground Pin	Microlan™ ground
5	No connection	No connection
6	No connection	No connection

### DB9 PINOUT

SIGNAL 9–PIN	CONNECTOR	RS232/RS485/TTL DB9 Signal	DESCRIPTION FUNCTION
NC	1	NC	No connection
TXD	2	Transmit Data/TXRX+/TX	output
RXD	3	Receive Data/TXRX-/RX	input
DTR	4	PWRIN1	input power( DTR diode blocked)
RTS	7	PWRIN2	input power ( RTS diode blocked)
GND	5	Ground	(reference)
NC	6	NC	No connection
NC	8	NC	No connection
NC	9	NC	No connection

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
Supply Voltage	$V_{CC}$	6	-	16.5	Volts
Supply Current (during command)	$I_s$	2	3	4	mA
Strong Pullup Short Circuit current	$I_{sc}$	-	-	35	mA
Supply Current (quiescent)	$I_q$	60	100	400	MicroAmp.
1-Wire devices		-	-	100	devices
CAT-5 Cable length		0	-	1000	feet
Communications	9600 Baud 8 Bits no parity 1 stop bit				