



# CS1504 Data Communication Protocol

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**1. REVISION LEVEL**

This document reflects CS-1504 Protocol Revision Level 1.

**2. GLOSSARY OF TERMS**

Application Program	A software program in the Host computer that communicates between a user and a docked CS-1504 unit.
Bar Codes	The specialized bar code symbol data read by the CS-1504 that identifies specific information to the Host computer application program.
Command	A message sent from the Host computer software to a docked CS-1504 unit.
Command Termination Time	The defined length of time that the HOST_IN line needs to remain low in order for the CS-1504 to declare the current transmission as having been aborted.
Communications Drivers	Driver software for the CS-1504 in the Host. Handles all communications between the application program and a docked CS-1504 unit.
Counted string	A sequence of bytes prefixed by the length of the sequence.
CS-1504	A battery operated, laser scanner designed to scan, store and transmit bar codes.
CS-1504 Serial Number	A unique identifier for the CS-1504, 8 bytes in length.
DATA_READY	A hardware signal from the CS-1504 to the Host indicating that the CS-1504 has Bar Code data stored.
Delete Key	An alternate name for the Function Key.
Download	A transaction transferring data from the Host to the CS-1504.
Field	A sequence of characters, treated as a unit in a single counted string or a fixed length array in a message, prior to any counted string.
Function Key	A user operable control on the CS-1504 unit.
HOST_IN	A hardware signal from the Host to the CS-1504 that will wake up the CS-1504 if it is sleeping, implement the CS-1504 transmit flow control, and terminate the CS-1504 transmission.
Inter-character delay	A time delay inserted between characters of a message not including the time to send individual characters.
Interrogate	A transaction used to initiate communication with the CS-1504.
Cyclical Redundancy Check (CRC)	A number at the end of a message used to increase confidence that the message was correctly transmitted. Computed by applying a standard algorithm to the transmitted data on a byte by byte basis to compute a 16 bit value.
Message	A sequence of characters transmitted or received by the CS-1504.
Null	The hex byte 0x00. Used in this protocol in place of an ETX (hex byte 0x03) and located immediately prior to the CRC. Considered part of a message and marks the end of a sequence of counted strings.
Parameter	A value stored into or retrievable from the CS-1504 on command. A parameter value may influence the operation of the CS-1504 unit. The behavior, controllability, and accessibility of parameters are determined by Symbol Technologies, Inc.
Power Down	A very low power mode of the CS-1504 in which it is able to respond only to the user pushing the scan or function communication from a Host application when the unit is docked. Entered by explicit Host command or by a communication or scan session time-out.
Protocol version	A unique, single-byte number, corresponding to an implemented version of this document.

Response	A message sent from the CS-1504 to the Host computer after receiving a command.
RTC	Real Time Clock. A feature of the CS-1504 that maintains an accurate time value consisting of years, months, days, hours, minutes and seconds.
Scan Key	A user operable control on the CS-1504 unit.
Session	Period of operation of the CS-1504 commencing with an interrogate command and terminating with power down.
SW version	A unique, 8-character string assigned by Symbol Technologies, Inc to each software release.
System status	A single-byte status value defined by Symbol Technologies, Inc.
STX character	The hex byte 0x02. In this protocol, STX appears in the second byte of a message rather than the first
Transaction	A single operation, commanded by the Host computer software with the CS-1504 unit, including a command and a response message.
Upload	A transaction transferring data from the CS-1504 to the Host.
Serial Number	An 8-byte array.

### 3. COMMUNICATIONS CONTEXT

Communication takes place between the CS-1504 unit and Host computer software via a serial connection. The serial connection may directly connect to a Host computer's serial port or it may connect to a serial to USB conversion cable supplied by Symbol Technologies, Inc. In either case, the protocol specification in this document remains valid. Host computer software includes application programs and communications drivers needed for proper communication with the connected serial or USB cable. This document solely addresses the commands, responses, and the serial communications specification implemented by the CS-1504; the specification of the host driver and application are excluded.

Bar codes, scanned by the CS-1504, are uploaded to the application program. The user initiates an upload of bar codes by docking the CS-1504 unit and initiating the upload with the application program. To initiate communication with the CS-1504 unit, the driver software is expected to drive the HOST\_IN signal inactive for at least the Command Termination time. Subsequently, the driver software will put the HOST\_IN signal in an active state that will guarantee that the CS-1504 is ready to receive a command from the Host. The Host will send interrogate commands at no less than 200ms intervals. The first interrogate command correctly received by the CS-1504 will result in an audible signal and an OK status response to the Host, indicating that the communication session is open. The driver software will then initiate transactions. At the conclusion of the transactions (on reception of the power down command from the driver), the CS-1504 will in some manner indicate the close of the session and power down.

In the remainder of this document, the application program, the communications drivers and computer on which they run will be collectively referenced as the Host.

### 4. SUMMARY OF TRANSACTIONS

Each transaction initiated by the Host shall consist of a command message, including a command code, to the CS-1504 unit. After the CS-1504 is awake, in the absence of errors, the unit shall respond with a response message containing a status byte and any required data. Status may indicate that the rest of the required data is omitted. Following any detected error, the CS-1504 unit shall wait until the inter-character (plus character) time-out occurs, return the single error status byte, and await further commands. Only one transaction shall be processed at a time, and the CS-1504 unit shall not respond to a second transaction message before it has responded to the first. *Sending a transaction message when a response to another transaction is pending may result in a receive error at the Host, in the CS-1504 unit, or both and should be avoided.*

The interrogate command is provided for the Host to determine if the CS-1504 unit is receiving commands and to provide version information to the Host. This command shall be used initially to synchronize the interface.

The transaction set shall be as follows:

Source	Target	Command	Response <sup>1</sup>
Host	CS-1504	Clear bar codes	Status only
Host	CS-1504	Download Parameters	Status only, parameter number-status pairs
Host	CS-1504	Interrogate	Status, Protocol Version, System Status, Serial Number, Software Version
Host	CS-1504	Power down	Status only before power down
Host	CS-1504	Upload	Status, Serial Number, Bar codes
Host	CS-1504	Upload Parameters	Status, parameter number-value pairs

<sup>1</sup>Whenever a status byte containing an error is returned, the rest of the message shall be omitted. The CS-1504 unit shall then await further commands.

The CS-1504 unit will process all commands, except upload and power down, before responding to the Host. For power down, any signal and the actual power down shall occur after the response is completed since no further communication can take place in that session. For upload, the fetching of bar codes may take place concurrently with the response due to the exceptionally long response message. *[Note: This ordering is motivated by the need for the CS-1504 unit to be ready to accept commands following each response message, except after processing the power down command.]*

**5. MESSAGE SUMMARY**

Command messages from the Host shall contain a command number, an STX character, a sequence of counted (variable length) strings, and two CRC bytes. Normal response messages from the CS-1504 unit shall consist of a status byte, an STX character, command-specific fixed-length fields, a sequence of counted strings, and two CRC bytes. If the status byte indicates an error, then the remainder of the response message is omitted. The last counted string in a sequence shall be null (zero length).

**6. COMMUNICATION CHARACTERISTICS**

The character framing shall be 8 data bits, 1 stop bit, and odd parity. The default baud rate shall be 9600. The maximum length of any command message shall be 70 bytes while the maximum length of any response message shall be 6144 bytes (6 KB). Messages shall be transmitted starting with the command/status byte and ending with the CRC. Each byte shall be transmitted from LSB to MSB.

**6.1 Hardware Flow Control**

A hardware flow control mechanism exists on the CS-1504 that allows the Host serial connection to pause or terminate the flow of information from the CS-1504 to the Host. The pin used is the HOST\_IN line. During all normal, unthrottled, communications sessions, the Host holds the HOST\_IN line high. In either of the cases below, the CS-1504 will delay powering down until at least the maximum response time after the HOST\_IN line returns to a high state to allow the Host to send any needed commands.

If the host wishes to suspend CS-1504 transmission, it may lower the state of the HOST\_IN line for less than the Command Termination time. Subsequent raising of that line will allow the CS-1504 to continue its transmission. The Host may lower and raise that line at its discretion as many times as it wishes during the transmission session as long as no individual lowering of the line exceeds the Command Termination time.

If the host wishes to terminate CS-1504 transmission and initialize a CS-1504 communications session, it may lower the state of the HOST\_IN line for greater than the Command Termination time. Subsequent raising of that line is required for the Host to begin sending its next command. Because this initializes the communications session, the only command that the CS-1504 will respond to will be the Interrogate Command until a new communications session is established.

**6.2 CS-1504 DATA\_READY**

The CS-1504 indicates that it has barcode data to send the host by raising its DATA\_READY line. When there is no data left in the CS-1504 to send to the Host, the CS-1504 will lower its DATA\_READY line. The DATA\_READY line will also be low when the CS-1504 is not connected and when the CS-1504 is connected and sleeping.

By careful monitoring of the DATA\_READY line by the Host, the Host can determine when a CS-1504 with data to send is connected to it. The Host may initiate a session and upload the information from the CS-1504. Similarly, the Host may choose to toggle the HOST\_IN line to wake up the CS-1504 and request its barcode data in a polling mode of operation. This mode is not recommended as it will adversely affect battery life of the CS-1504 as it will constantly wake up to indicate to the Host its current status.

**7. TIMEOUT CONSTRAINTS**

The CS-1504 unit shall apply the following timing constraints:

Name	Constraint	Description
‘Sleep’ to ‘Wake-up’	<200ms	Host will wait 200ms between interrogate commands to the CS-1504
Session Time-out	< 20 sec (default)	Last command to CS-1504 timeout*
Command time	> 5 ms	End of response message to beginning of next command message
Response time	> 5 ms, < 2 sec	End of command message to beginning of response message
Command Termination time	> 1 sec	Terminates any interrupted CS-1504 communication and leaves the CS-1504 in a receptive state.
Inter-character delay	> 0 ms, < 20 ms	Last bit of character to first bit of next character

- \*Notes:
1. A docked CS-1504 unit can be ‘awakened’ by either a push of the scan or function key or by toggling the HOST\_IN signal from the Host. Once ‘awakened’ the CS-1504 unit will remain awake awaiting communication from the Host. With each new Host command that is sent, the CS-1504 unit will extend its period of ‘awake’ time so that the current transaction can be completed.
  2. When a docked CS-1504 unit is ‘awakened’ by either a push of the scan or function key or by toggling the HOST\_IN signal from the Host, the unit will provide some external feedback to indicate to the user that the unit is ready for communication.
  3. Once the CS-1504 is ready for communication, it will remain ‘awake’ until either a power down command is received from the Host or the ‘awake time’ expires. If a power down command is received from the Host, the CS-1504 unit will externally indicate that the communication session completed and then power down. If no power down command is received and the ‘awake time’ expires, the CS-1504 unit will signal an unsuccessful completion of the communication session. Then the unit will power down.
  4. Sometimes random RS232 activity may ‘awaken’ a docked CS-1504 unit. In this case, the CS-1504 unit will remain awake (default time = 20sec), awaiting valid communication from the Host. If there has been no valid communication from the Host at the end of the ‘awake time’ and no push of the scan or function key, the CS-1504 unit will power down with no indication to the user. It is important to note here that if this random RS232 activity is recurrent, then this will adversely affect the battery life of the CS-1504, as it will continuously wake up and consume battery power in response to this spurious indication.

**8. TRANSACTION, MESSAGE, AND FIELD FORMATS**

The first transaction in each session shall be the interrogate transaction because this transaction contains version numbers that may be required for proper interpretation of the remaining transactions and to increase confidence that Host and CS-1504 communications are synchronized. Both the CS-1504 unit and Host shall ignore all characters and errors until receipt of a valid interrogate command has been confirmed.

**8.1 Transaction Format**

All transactions shall consist of the following message exchange:

<b>Host</b>	<b>CS-1504</b>
Command	
	Response

**8.2 Message Format**

All command messages shall start with a command number that determines the interpretation of both command and response. All responses shall start with a status byte that determines whether or not the defined response follows the status byte. All messages shall contain the STX character following the command or status byte. The end of every message, except an error response, shall be two CRC bytes.

Each message consists of one of the following formats:

**Command:**

Command	STX	Sequence of strings	CRC
---------	-----	---------------------	-----

**Response—Good:**

Status (OK)	STX	Fixed length data (optional)	Sequence of strings	CRC
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**Response—Error:**

Status (error)
----------------

**8.3 Common Field Contents**

**8.3.1 Command Byte Content**

The command byte shall be one of the following numbers. All other values shall result in an error.

Command	Command Byte
Interrogate	1
Clear bar codes	2
Download Parameters	3
Special	4
Power down	5
Upload CS-1504 bar code data	7
Upload Parameters	8
Set Time	9
Get Time	10

**8.3.2 Status Byte Content**

Status shall be a single-byte field in each response. Error codes shall be as follows:

Code (decimal)	Error
0	Never to be used
5	Unsupported command number
6	No error encountered, OK or ACK
7	Command CRC error
8	Received character error
9	General error
255	Never to be used
Unused numbers	Reserved by Symbol Technologies

A Host receiving a valid response (status=6) shall assume that the command was received and executed. *[Not all error values are reportable to the Host.]* Conversely, an error response shall be assumed to indicate that an error was encountered in receiving the command message and that the command was not executed. Any other response or no response at all shall imply that the command was not correctly received.

**8.3.3 Sequence of Strings Format**

A sequence of strings shall consist of one or more counted strings of bytes, the last of which is null. Each counted string shall consist of a sequence of bytes preceded by the number of bytes (not including the length byte). Each byte of a string may be any value in the range [0,255]<sub>dec</sub>; lengths in the range [251-255]<sub>dec</sub> are reserved. *[The shortest such sequence is the null string, a single byte containing a zero count; since the count is zero, no data bytes follow in the string.]* The ordering of multi-byte strings shall be in left to right order as written.

Example of an 8 byte counted string – ‘12345678’:  
 [08 31 32 33 34 35 36 37 38]<sub>Hex</sub>

Count	String (Hex)
08	31 32 33 34 35 36 37 38

**8.3.4 CRC Content**

The CRC shall be computed by applying the algorithm found in the appendix of this document. The algorithm will operate on the bytes in the message, including the command or status field, STX byte, and sequence of strings and produce a 16 bit CRC. The operation will not include the CRC bytes themselves.

**8.3.5 System Status Byte**

The system status byte is a byte whose value and meaning are defined by Symbol Technologies, Inc.

Status (decimal)	Meaning
00	System OK
22	Low Battery

**8.3.6 CS-1504 Parameters**

See CS-1504 parameter document for a list of currently available CS-1504 parameters and their possible values.



**8.4 Transaction Specific Formats**

See Figure 1-CS-1504 Commands & Responses for a summary of the CS-1504 commands and response formats.

**8.4.1 Interrogate Transaction**

The interrogate transaction must be the first transaction in each communication session. *[Note: This is required because the response contains version information that may be required to interpret the remaining commands and because restriction to a single command increases confidence that communications have been initiated.]*

**8.4.1.1 Interrogate Command**

The interrogate command requests a response from the CS-1504 unit indicating that it is operational. The CS-1504 may not correctly receive the interrogate command sent from the Host. Erroneous data received or a response time-out prior to a confirmed interrogate shall be ignored by both the CS-1504 unit and Host. The Host shall wait *[200ms minimum]* and send the command message again, until a correct response is received.

cmd	STX	null	CRC
1	2	0	HH LL

**8.4.1.2 Interrogate Response**

When the CS-1504 unit correctly receives the interrogate command, it shall provide the required external feedback signal before the response is sent. The interrogate response shall be sent to the Host, reporting the communication status, the protocol version, the system status, and the CS-1504 unit software version. Once an interrogate response is confirmed, the Host shall respond in the defined manner. See the glossary for definitions and lengths of the fields in the interrogate response.

status	STX	Fixed	Fixed	fixed	Null	CRC
6	2	Protocol Version	System Status	Serial Number	SW Version	0 HH LL

**8.4.2 Clear Bar Codes Transaction**

The clear bar codes command shall request the CS-1504 unit to clear all stored bar codes from its memory.

**8.4.2.1 Clear Bar Codes Command**

The clear bar codes command message shall request clearing of all bar codes in the CS-1504 unit.

cmd	STX	Null	CRC
2	2	0	HH LL

**8.4.2.2 Clear Bar Codes Response**

The clear bar codes response message shall report execution of the command.

status	STX	Null	CRC
6	2	0	HH LL

**8.4.3 Download Parameters Transaction**

The download parameters transaction shall provide new values to the CS-1504 unit for specified parameters. *[Refer to the Appendix for a specific example of this transaction.]* Timing of the effectivity of a parameter change is parameter dependent. Some parameter values, such as: Xmit Code Id (16), Max Code Length (21), Min Code Length (22), Max Barcode Length (34), and Store Real Time Clock (35), **can only be changed when there are no stored bar codes** in the CS-1504 unit.

8.4.3.1 Download Parameters Command

The download parameters command shall request download of parameter data to the CS-1504 unit.

cmd	STX	Cstring(s)	null	CRC
3	2	Parameter Download String	0	HH LL

A parameter download string shall consist of one or more counted strings, one for each parameter to be changed. Each string shall consist of a parameter number byte and one or more parameter value bytes. The number of parameters in this message shall not cause the maximum message length (70 bytes) for the command to be exceeded. Symbol Technologies, Inc shall define parameter numbers and values.

Example of a parameter download string to enable Code39 (param #31) and set the communication awake time (param #32) to 40sec:

[02 1F 01 02 20 02]<sub>Hex</sub>

Parameter Download String

Count	String (Hex)	Count	String (Hex)
02	1F 01	02	20 02
	Param #31 Value = 1(Enable)		Param #32 Value = 2 x 20sec

8.4.3.2 Download Parameters Response

The download parameters response message shall contain status, the STX byte, a parameter response string consisting of a sequence of counted strings terminated in a null, and the CRC. Each counted string shall contain three bytes: the length (2), the parameter number, and a status value (non-zero implies the parameter value was successfully stored). This return should always be checked to ensure that the data was stored as intended.

Status	STX	cstring(s)	null	CRC
6	2	Parameter Response String	0	HH LL

Example of a parameter response string indicating volume (param #2) and communication awake time (param #32) were changed:

[02 02 01 02 20 01]<sub>Hex</sub>

Parameter Response String

Count	String (Hex)	Count	String (Hex)
02	02 01	02	20 01
	Param #2 Value Changed		Param #32 Value Changed

8.4.4 Set Defaults Transaction

The set defaults transaction shall cause all the user parameter values to be set to their default values. In addition, all stored bar codes will be cleared from the CS-1504 memory.

8.4.4.1 Set Defaults Command

The set defaults command is:

cmd	STX	Len	Dflt	null	CRC
4	2	1	1	0	HH LL

8.4.4.2 Set Defaults Response

The set defaults response shall report execution of the command.

cmd	STX	Len	Dflt	Done	null	CRC
6	2	2	1	1	0	HH LL

**8.4.5 Power Down Transaction**

The last transaction in any host application should be the power down transaction. The power down transaction shall direct the CS-1504 unit to end the communication session and enter power down mode until the next scan, function or HOST\_IN activation. The CS-1504 unit shall send the response message, initiate an external signal, and enter power down mode.

8.4.5.1 Power Down Command

The power down command is:

Cmd	STX	null	CRC
5	2	0	HH LL

8.4.5.2 Power Down Response

The CS-1504 unit sends a power down response to report command received before the external signal and before it powers down.

Status	STX	null	CRC
6	2	0	HH LL

**8.4.6 Upload Transaction**

The upload transaction shall upload CS-1504 data including User-Id and the scanned bar codes. *[Refer to the Appendix for a specific example of this transaction.]*

8.4.6.1 Upload Command

cmd	STX	null	CRC
7	2	0	HH LL

8.4.6.2 Upload Response

*[The upload response message may be very long due to the presence of a variable number of bar codes stored in the unit.]*

Status	STX	Fixed	Cstring	Cstring	Cstring	null	CRC
6	2	Serial Number	C <sub>1</sub>	C <sub>2</sub>	•••	C <sub>n</sub>	0 HH LL

The upload response shall include the following data:

- Serial Number (8 bytes, most significant byte first)
- Bar codes, each in an individual counted string, with a count followed by encrypted string contents.
- A null counted string

C<sub>i</sub> is a bar code string. The first byte of each bar code counted string shall be the length of the code excluding the length byte. The information in the remaining bytes is encrypted and not relevant to the understanding of this document or implementation of the serial protocol.

**8.4.7 Upload Parameters Transaction**

The upload parameters transaction shall permit the Host to read the values of specified parameters. *[Refer to the Appendix for a specific example of this transaction.]*

8.4.7.1 Upload Parameters Command

The upload parameters command shall contain a list of the parameter numbers to be read, in the form of a single counted string followed by a null counted string.

Cmd	STX	cstring(s)	Null	CRC
8	2	Parameter list string	0	HH LL

Example of a parameter list string requesting the values of volume (param #2) and Code128 enable/disable (param #8) parameters:

02 02 08

Parameter List String

02	02	08
Count	Param #2	Param #8

8.4.7.2 Upload Parameters Response.

The upload parameters response message shall contain one counted parameter data string for each parameter number in the command. The counted parameter data string shall contain the string length, the parameter number, and the parameter value. The parameter value shall be omitted in the event that the parameter is undefined or otherwise unavailable.

Status	STX	Cstring(s)	null	CRC
6	2	Parameter Data Strings	0	HH LL

Example of parameter data strings giving the values of volume (param #2) = High and Code128 enable/disable (param #8) = Enabled:

02 02 03 02 08 01

Parameter Data String<sub>1</sub>

02	02	03
Count	Param #2	Value = High (3)

Parameter Data String<sub>2</sub>

02	08	01
Count	Param #8	Value = Enabled (1)

**8.4.8 Set Time Transaction**

The set time transaction shall provide new values to the CS-1504 unit's RTC.

**8.4.8.1 Set Time Command**

The set time command shall send a time to the CS-1504 unit in the following format.

cmd	STX	Cstring(s)	null	CRC
9	2	Set Time String	0	HH LL

A Set Time String shall consist of one counted string whose contents include the single byte values to be set for each of the seconds, minutes, hours, days, months and years values. The valid ranges of these values are as follows.

Unit	Unit / Range(decimal)
Seconds	0-59
Minutes	0-59
Hours	0-23
Days	1-31
Months	1 - 12
Years	0 - 99

Example of a set time string to set the time to 10/25/00 9:12:35 PM  
 [06 23 0C 15 19 0A 00] Hex

Set Time String:

Count*	byte	Byte	byte	byte	byte	byte
06	23	0C	15	19	0A	00
	35 seconds	12 minutes	21 hours or 9:00 PM	25 <sup>th</sup> day	10 <sup>th</sup> month	Year = 2000

\*The **Count** value in this string **must be 06**.

**8.4.8.2 Set Time Response**

The set time response message shall contain status, the STX byte, and a set time response counted string consisting of the byte values set for seconds, minutes, hours, days, months and years terminated in a null, and the CRC.

Status	STX	Cstring(s)	null	CRC
6	2	Set Time Response String	0	HH LL

Example of a set time response string indicating that the previous set time command was executed properly:  
 [06 23 0C 15 19 0A 00] Hex

Set Time Response String:

Count	byte	Byte	byte	byte	byte	byte
06	23	0C	15	19	0A	00
	35 seconds	12 minutes	21 hours or 9:00 PM	25 <sup>th</sup> day	10 <sup>th</sup> month	Year = 2000

**8.4.8.3 Set Time Error Handling**

Each entry in the Set Time command string, including the count, will be verified to be within the unit range.

Note that the count value must be 06. If any of the values for seconds, minutes, hours, days, months or years is outside the unit's range, the Set Time command will be ignored and the value in the response string for that unit will contain 0xFF. If the count in the Set Time command string is not 06, the command will be ignored, and the response string will contain a count of 01 followed by 0xFF.

Example of a set time command string with illegal values for seconds and months.

[06 60 30 08 10 20 00]<sub>Hex</sub>

Example of a set time response string indicating that the previous set time command had illegal values for seconds and months and was not executed:

[06 FF 30 08 10 FF 00] <sub>Hex</sub>

Set Time Response String:

Count	Byte	Byte	byte	byte	byte	byte
06	FF	30	08	10	FF	00
	Error	48 minutes	8 hours or 8:00 AM	16 <sup>th</sup> day	Error	Year = 2000

Example of a set time command string with an illegal count value.

[08 60 30 08 10 20 00 02 77]<sub>Hex</sub>

Example of a set time response string indicating that the previous set time command had an illegal count value and was not executed:

[01 FF] <sub>Hex</sub>

Set Time Response String:

Count	Byte
01	FF
	Error

**8.4.9 Get Time Transaction**

8.4.9.1 Get Time Command

Get Time command requests a response from the CS-1504 unit. This response will indicate the present time on the RTC (real time clock)

cmd	STX	null	CRC
10	2	0	HH LL

8.4.9.2 Get Time Response

When the CS-1504 unit correctly receives the get time command the get time response message will be reported to the host. The Get Time Response string is defined to be the same format as the previously defined Set Time Response string.

Status	STX	Cstring(s)	null	CRC
6	2	Get Time Response String	0	HH LL

Example of a get time response string indicating the current time:  
 [06 23 0C 15 19 0A 00] Hex

Get Time Response string:

Count	Byte	Byte	byte	byte	Byte	byte
06	23	0C	15	19	0A	00
	35 seconds	12 minutes	21 hours or 9:00 PM	25 <sup>th</sup> day	10 <sup>th</sup> month	Year = 2000

This indicates that the current time is 10/25/00 9:12:35 PM.

8.4.9.3 Get Time Error Response

When a low voltage condition is detected on the RTC, the integrity of the clock information is no longer guaranteed. This condition will be indicated by setting the seconds field in the get time response string to 0xFF. The remaining bytes will contain the values as read from the clock.

Example of a get time response string indicating a low voltage condition on the RTC has occurred:  
 [06 FF 0C 15 19 0A 00] Hex

Get Time Response string:

Count	Byte	Byte	byte	byte	Byte	byte
06	FF	0C	15	19	0A	00
	Low Voltage	12 minutes	21 hours or 9:00 PM	25 <sup>th</sup> day	10 <sup>th</sup> month	Year = 2000

9. APPENDIX

9.1 Command Summary

Figure 1-CS-1504 Commands & Responses

**Interrogate Command**

01	02	00	CRC
----	----	----	-----

Response - Good

06	02	Protocol Version	System Status	Serial Number (8 bytes)	SW Version (8 bytes)	00	CRC
----	----	------------------	---------------	-------------------------	----------------------	----	-----

**Upload Parameters Command**

08	02	Parameter List String	00	CRC
----	----	-----------------------	----	-----

Parameter List String

Count	Param Numbers*
N	P <sub>1</sub> P <sub>2</sub> ... P <sub>n</sub>

\*List of parameter numbers whose values are to be uploaded

Response - Good

06	02	Parameter Data Strings	00	CRC
----	----	------------------------	----	-----

Parameter Data Strings

Count	Param#	Data	...	Count	Param#	Data
N	P <sub>1</sub>	Data <sub>1</sub> Data <sub>2</sub> ..... Data <sub>n-1</sub>	...	2	P <sub>n</sub>	Data

**Download Parameters Command**

03	02	Parameter Download String	00	CRC
----	----	---------------------------	----	-----

Parameter Download String

Count	Param#	Parameter Data	...	Count	Param#	Parameter Data
N	P <sub>1</sub>	Data <sub>1</sub> Data <sub>2</sub> ..... Data <sub>n-1</sub>	...	2	P <sub>n</sub>	Data <sub>1</sub>

Response - Good

06	02	Parameter Response String	00	CRC
----	----	---------------------------	----	-----

Parameter Response String

Count	Param#	Response	...	Count	Param#	Response
2	P <sub>1</sub>	1=successful download 0=unsuccessful download	...	2	P <sub>n</sub>	1=successful download 0=unsuccessful download

**Upload Bar Codes Command**

07	02	00	CRC
----	----	----	-----

Response -

06	02	Serial Number (8 bytes)	Bar Code String <sub>1</sub>	Bar Code String <sub>2</sub>	...	Bar Code String <sub>n</sub>	00	CRC
----	----	-------------------------	------------------------------	------------------------------	-----	------------------------------	----	-----

Bar Code String<sub>i</sub>

Length	Encrypted Bar Code Data
N	Data <sub>1</sub> Data <sub>2</sub> ... Data <sub>n-1</sub>

**Clear Bar Codes Command**

02	02	00	CRC
----	----	----	-----

Response - Good

06	02	00	CRC
----	----	----	-----

**Set Time Command**

9	2	6	SS	MM	HH	DD	MM	YY	0	CRC
---	---	---	----	----	----	----	----	----	---	-----

Response - Good

6	2	6	SS	MM	HH	DD	MM	YY	0	CRC
---	---	---	----	----	----	----	----	----	---	-----

**Power Down Command**

05	02	00	CRC
----	----	----	-----

Response - Good

06	02	00	CRC
----	----	----	-----

**Get Time Command**

10	2	0	CRC
----	---	---	-----

Response - Good

6	2	6	SS	MM	HH	DD	MM	YY	0	CRC
---	---	---	----	----	----	----	----	----	---	-----

**Set Defaults Command**

04	02	01	01	00	CRC
----	----	----	----	----	-----

Response - Good

06	02	02	01	01	00	CRC
----	----	----	----	----	----	-----

**Error Response:**

Status
--------

5 = Invalid command number      7 = Command CRC error  
 8 = Received character error      9 = General error



**Sample CS-1504 Data:**

Serial Number: ABCDEFGH  
 Software Version: NBRIKAAA  
 Protocol Version: 1  
 System Status: 0  
 Serial Number: [02 FA CE 06 19 62]<sub>Hex</sub>  
 Encrypted Bar Codes: D12345  
 D@ABCDEFGH  
 A0123456512  
 A12345670  
 A1234567890128

**Interrogate Command** (Sent from the Host)

01 02 00 HH LL

**Sample Interrogate Response** (Sent from the CS-1504 unit)

[06 02 31 00 41 42 43 44 45 46 47 48 4E 42 52 49 4B 41 41 41 00 HH LL]<sub>Hex</sub>

06	02	31	00	41 42 43 44 45 46 47 48	4E 42 52 49 4B 41 41 41	00	HH LL
Status	Stx	Prot Ver: (Hex) '1'	System Status	Serial Number: (Hex) 'ABCDEFGH'	Software Version: (Hex) 'NBRIKAAA'	Nul	CRC (Hex)

**Command to Upload Bar Codes** (Sent from the Host)

07 02 00 HH LL

**Sample Upload Response** (Sent from the CS-1504)

[06 02 02 FA CE 06 19 62 42 42 06 44 31 32 33 34 35 09 44 40 41 42 43 44 45 46 47  
 0B 41 30 31 32 33 34 35 36 35 31 32 09 41 31 32 33 34 35 36 37 30  
 0E 41 31 32 33 34 35 36 37 38 39 30 31 32 38 00 HH LL]<sub>Hex</sub>

06	02	02 FA CE 06 19 62 42 42
Status	Stx	Serial Number: (Hex) 02 FA CE 06 19 62 42 42

Counted String 1

06	44 31 32 33 34 35
Length	Encrypted Bar Code Data: (Hex) 44 31 32 33 34 35

Counted String 2

09	44 40 41 42 43 44 45 46 47
Length	Encrypted Bar Code Data: (Hex) 44 40 41 42 43 44 45 46 47

Counted String 3

0B	41 30 31 32 33 34 35 36 35 31 32
Length	Encrypted Bar Code Data: (Hex) 41 30 31 32 33 34 35 36 35 31 32

Counted String 4

09	41 31 32 33 34 35 36 37 30
Length	Encrypted Bar Code Data: (Hex) 41 31 32 33 34 35 36 37 30

Counted String 5

0E	41 31 32 33 34 35 36 37 38 39 30 31 32 38
Length	Encrypted Bar Code Data: (Hex) 41 31 32 33 34 35 36 37 38 39 30 31 32 38

00	HH LL
Nul	CRC

**Power Down** (Sent from the Host)

05 02 00 HH LL

**Power Down Response** (Sent from the CS-1504)

06 02 00 HH LL

**9.3 SAMPLE TRANSACTION - Upload CS-1504 Parameter Values to a Host**

**Sample CS-1504 Data:**

Serial Number: SAMPLE01  
 Software Version: NBRIKAAA  
 Protocol Version: 1  
 System Status: 0

**Sample CS-1504 Parameter Values:**

Volume: High (Parameter #2)  
 AutoClear: On (Parameter #15)  
 Delete Enable: Delete Enabled/Clear All Enabled (Parameter #33)

**Interrogate Command** (Sent from the Host)

01 02 00 HH LL

**Sample Interrogate Response** (Sent from the CS-1504)

[06 02 31 00 53 41 4D 50 4C 45 20 20 4E 42 52 49 4B 41 41 41 00 HH LL]<sub>Hex</sub>

06	02	31	00	53 41 4D 50 4C 45 30 31	4E 42 52 49 4B 41 41 41	00	HH LL
Status	Stx	Prot Ver: (Hex) '1'	System Status	Serial Number: (Hex) 'SAMPLE01'	Software Version: (Hex) 'NBRIKAAA'	Nul	CRC (Hex)

**Command to Upload CS-1504 Parameters** (Sent from the Host)

[08 02 03 02 0F 21 00 HH LL]<sub>Hex</sub>

08	02	[03 02 0F 21] <sub>Hex</sub>	00	24
Upload Cmand	Stx	String of the 3 parameter numbers: 2,15,33	Nul	CRC (Hex)

**Sample Response to Upload CS-1504 Parameters Command** (Sent from the CS-1504)

[06 02 02 02 01 02 0F 01 02 21 03 00 HH LL]<sub>Hex</sub>

06	02
Status	Stx

Counted String 1 -

02	02	01
Length	Parameter #2 - Volume	Value - On

Counted String 2 -

02	0F	01
Length	Parameter #15 - Auto Clear	Value - On

Counted String 3 -

02	21 (Hex)	03
Length	Parameter #33 - Delete Enable	Value - Delete Enabled / Clear All Enabled

00	HH LL
Nul	CRC (Hex)

**Power Down** (Sent from the Host)

05 02 00 HH LL

**Power Down Response** (Sent from the CS-1504)

06 02 00 HH LL

**9.4 SAMPLE TRANSACTION - Download Parameter Values From Host to the CS-1504**

**Note:** Some parameter values, such as: Xmit Code Id (16), Max Code Length (21), Min Code Length (22), Max Barcode Length (34), and Store Real Time Clock (35), **can only be changed when there are no stored bar codes** in the CS-1504 unit.

**Sample CS-1504 Data:**

Serial Number: ABCDEFGH  
 Software Version: NBRIKAAA  
 Protocol Version: 1  
 System Status: 0

**Sample CS-1504 Parameter Values to be Set:**

Volume: Low (Parameter #2)  
 Reject Redundant Bar Code: Off (Parameter #4)

**Interrogate Command** (Sent from the Host)

01 02 00 HH LL

**Sample Interrogate Response** (Sent from the CS-1504)

[06 02 31 00 41 42 43 44 45 46 47 48 4E 42 52 49 4B 41 41 41 00 HH LL]<sub>Hex</sub>

06	02	31	00	41 42 43 44 45 46 47 48	4E 42 52 49 4B 41 41 41	00	HH LL
Status	Stx	Prot Ver: (Hex) '1'	System Status	Serial Number: (Hex) 'ABCDEFGH'	Software Version: (Hex) 'NBRIKAAA'	Nul	CRC (Hex)

**Sample Command to Download CS-1504 Parameters** (Sent from the Host)

[03 02 02 02 01 02 04 00 00 HH LL]<sub>Hex</sub>

03	02
Dnload Cmnd	Stx

Counted String 1 -

02	02	01
Length	Parameter #2 – Volume	Value – Low

Counted String 2 -

02	04	00
Length	Parameter #4 – Red Check	Value – Off

00	HH LL
Nul	CRC (Hex)

**Sample Response to Download CS-1504 Parameters Command** (Sent from the CS-1504)

06 02 02 02 01 02 04 01 02 00 HH LL

06	02
Status	Stx

Counted String 1 -

02	02	01
Length	Parameter #2 – Volume	Successful Download

Counted String 2 -

02	04	01
Length	Parameter #4 – Red Check	Successful Download

00	HH LL
Nul	CRC

**Power Down** (Sent from the Host)

05 02 00 HH LL

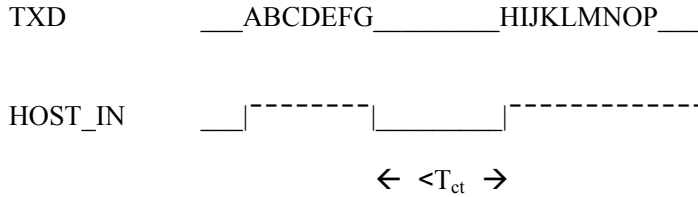
**Power Down Response** (Sent from the CS-1504)

06 02 00 HH LL

**9.5 SAMPLE TRANSACTION – Hardware Flow Control Used to Suspend a Transmission.**

This example assumes that the Host device wishes to throttle the CS-1504 communications temporarily. When the HOST\_IN line is dropped, the CS-1504 will suspend transmission until the line is raised again provided the line is low for less than the Command Termination time ( $T_{ct}$ ).

Message to send: ABCDEFGHIJKLMNOP

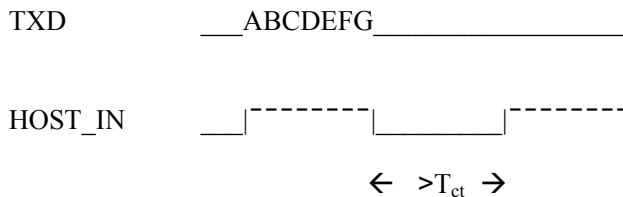


(Forgive the crude graphics...)

**9.6 SAMPLE TRANSACTION – Hardware Flow Control Used to Terminate a Transmission.**

This example assumes that the Host device wishes to abort the current CS-1504 transmission. When the HOST\_IN line is dropped for greater than the Command Termination time ( $T_{ct}$ ), the CS-1504 will abort the current transmission and initialize its communications. The only command the CS-1504 will subsequently respond to is the Interrogate Command until a communications session is re-established.

Message to send: ABCDEFGHIJKLMNOP



(Forgive the crude graphics...)

## 9.6 The CS-1504 CRC Calculation Algorithm

This 'C' code segment and data table illustrates how the CRC is calculated for the CS-1504.

```
typedef unsigned int  WORD;
typedef unsigned char BYTE;
typedef union
{
    WORD w;
    struct
    {
        BYTE lo, hi;
    } b;
} BYTEWORD;

WORD ComputeCRC16(char *msg, int len)
{
    BYTEWORD chksum;
    unsigned char *msgchk;

    chksum.w = 0xFFFF;
    msgchk = (unsigned char *) msg;

    while (len--)
    {
        chksum.w = chksum.b.hi ^ (ccittrev_tbl[chksum.b.lo ^ *msgchk++]);
    }

    chksum.w = ~chksum.w;
    return(chksum.w);
}
```

```
static const WORD ccittrev_tbl[] =
{
    0x0000, 0xC0C1, 0xC181, 0x0140, 0xC301, 0x03C0, 0x0280, 0xC241,
    0xC601, 0x06C0, 0x0780, 0xC741, 0x0500, 0xC5C1, 0xC481, 0x0440,
    0xCC01, 0x0CC0, 0x0D80, 0xCD41, 0x0F00, 0xCFC1, 0xCE81, 0x0E40,
    0x0A00, 0xCAC1, 0xCB81, 0x0B40, 0xC901, 0x09C0, 0x0880, 0xC841,
    0xD801, 0x18C0, 0x1980, 0xD941, 0x1B00, 0xDBC1, 0xDA81, 0x1A40,
    0x1E00, 0xDEC1, 0xDF81, 0x1F40, 0xDD01, 0x1DC0, 0x1C80, 0xDC41,
    0x1400, 0xD4C1, 0xD581, 0x1540, 0xD701, 0x17C0, 0x1680, 0xD641,
    0xD201, 0x12C0, 0x1380, 0xD341, 0x1100, 0xD1C1, 0xD081, 0x1040,
    0xF001, 0x30C0, 0x3180, 0xF141, 0x3300, 0xF3C1, 0xF281, 0x3240,
    0x3600, 0xF6C1, 0xF781, 0x3740, 0xF501, 0x35C0, 0x3480, 0xF441,
    0x3C00, 0xFCC1, 0xFD81, 0x3D40, 0xFF01, 0x3FC0, 0x3E80, 0xFE41,
    0xFA01, 0x3AC0, 0x3B80, 0xFB41, 0x3900, 0xF9C1, 0xF881, 0x3840,
    0x2800, 0xE8C1, 0xE981, 0x2940, 0xEB01, 0x2BC0, 0x2A80, 0xEA41,
    0xEE01, 0x2EC0, 0x2F80, 0xEF41, 0x2D00, 0xEDC1, 0xEC81, 0x2C40,
    0xE401, 0x24C0, 0x2580, 0xE541, 0x2700, 0xE7C1, 0xE681, 0x2640,
    0x2200, 0xE2C1, 0xE381, 0x2340, 0xE101, 0x21C0, 0x2080, 0xE041,
    0xA001, 0x60C0, 0x6180, 0xA141, 0x6300, 0xA3C1, 0xA281, 0x6240,
    0x6600, 0xA6C1, 0xA781, 0x6740, 0xA501, 0x65C0, 0x6480, 0xA441,
    0x6C00, 0xACC1, 0xAD81, 0x6D40, 0xAF01, 0x6FC0, 0x6E80, 0xAE41,
    0xAA01, 0x6AC0, 0x6B80, 0xAB41, 0x6900, 0xA9C1, 0xA881, 0x6840,
    0x7800, 0xB8C1, 0xB981, 0x7940, 0xBB01, 0x7BC0, 0x7A80, 0xBA41,
    0xBE01, 0x7EC0, 0x7F80, 0xBF41, 0x7D00, 0xBDC1, 0xBC81, 0x7C40,
    0xB401, 0x74C0, 0x7580, 0xB541, 0x7700, 0xB7C1, 0xB681, 0x7640,
    0x7200, 0xB2C1, 0xB381, 0x7340, 0xB101, 0x71C0, 0x7080, 0xB041,
    0x5000, 0x90C1, 0x9181, 0x5140, 0x9301, 0x53C0, 0x5280, 0x9241,
    0x9601, 0x56C0, 0x5780, 0x9741, 0x5500, 0x95C1, 0x9481, 0x5440,
    0x9C01, 0x5CC0, 0x5D80, 0x9D41, 0x5F00, 0x9FC1, 0x9E81, 0x5E40,
    0x5A00, 0x9AC1, 0x9B81, 0x5B40, 0x9901, 0x99C0, 0x5880, 0x9841,
    0x8801, 0x48C0, 0x4980, 0x8941, 0x4B00, 0x8BC1, 0x8A81, 0x4A40,
    0x4E00, 0x8EC1, 0x8F81, 0x4F40, 0x8D01, 0x4DC0, 0x4C80, 0x8C41,
    0x4400, 0x84C1, 0x8581, 0x4540, 0x8701, 0x47C0, 0x4680, 0x8641,
    0x8201, 0x42C0, 0x4380, 0x8341, 0x4100, 0x81C1, 0x8081, 0x4040
};
```

## 9.7 Various CS-1504 Usage Scenarios

The following usage scenarios are presented as examples of how the CS-1504 may interact with a Host application to provide various modes of operation.

### 9.7.1 Auto-Upload on CS-1504 Connection.

This scenario postulates that a CS-1504 has been operated in untethered mode and stored up one or more items to be sent to the host. Furthermore, it does not matter whether the CS-1504 is awake or asleep when the connection is made. Additionally, we will assume that the Host driver is already running.

Because the Host driver is running, the HOST\_IN line is high. This will cause the CS-1504 to awaken if it is asleep. The awakened CS-1504, aware of the newly raised HOST\_IN line will raise its DATA\_READY line to the Host indicating that the CS-1504 has data to send to the Host. The Host side driver software upon detection of a recently raised DATA\_READY line can now initiate a communications session with the CS-1504 with an Interrogate command. Subsequent successful communications can result in the Host sending an Upload command and retrieving the data from the CS-1504. Thus the Host driver, without any further user intervention, can automatically retrieve the stored data in the CS-1504. The Host driver may then issue a Power Down command to the CS-1504 to put it to sleep, or the CS-1504 will sleep automatically after the Session Time has expired. It is highly recommended that the Host send the Power Down command when it ends communications with the CS-1504 in order to maximize battery life.

### 9.7.2 Auto-Upload in Tethered Mode.

This scenario postulates that an already connected CS-1504 has awoken and stored a piece of data that the host would wish to retrieve in a timely manner. It further presumes that the Host driver is already up and running and that the HOST\_IN line is being held high. It is immaterial whether or not the CS-1504 has 1 or more pieces of data to send, the procedure is the same.

After storing the data to send to the Host, the CS-1504 will remain awake for the balance of the Session Time. It is at this point that the CS-1504, noting that it has data to send, will raise its DATA\_READY line to the Host. The Host side driver software upon detection of a recently raised DATA\_READY line can now initiate a communications session with the CS-1504 with an Interrogate command. Subsequent successful communications can result in the Host sending an Upload command and retrieving the data from the CS-1504. Thus the Host driver, without any further user intervention, can automatically retrieve the stored data in the CS-1504. The Host driver may then issue a Power Down command to the CS-1504 to put it to sleep, or the CS-1504 will sleep automatically after the Session Time has expired. It is highly recommended that the Host send the Power Down command when it ends communications with the CS-1504 in order to maximize battery life.



### 9.7.3 Tethered Mode Upload by Host Command.

In this scenario, the situation is that the CS-1504 is attached to the Host and sleeping, and the Host driver is running with the HOST\_IN line held high. The CS-1504 may or may not have data stored. In order to be in this state, it is assumed that the Host driver software does not always perform an automatic upload after the CS-1504 stores a piece of data. Finally, it is also assumed that there exists some manual mechanism for the user to initiate an upload of CS-1504 data via an externally generated Host application program.

The scenario begins with the User initiating the manual upload procedure via the Host application program. In order for the Host to initialize communications with the CS-1504, the Host driver will drop the HOST\_IN line for greater than the Command Termination time. The subsequent raising of this line will result in the CS-1504 being awakened. If the CS-1504 has data for the Host, the CS-1504 will raise its DATA\_READY line. The Host side driver software upon detection of a recently raised DATA\_READY line can now initiate a communications session with the CS-1504 with an Interrogate command. Subsequent successful communications can result in the Host sending an Upload command and retrieving the data from the CS-1504. The Host driver may then issue a Power Down command to the CS-1504 to put it to sleep, or the CS-1504 will sleep automatically after the Session Time has expired. It is highly recommended that the Host send the Power Down command when it ends communications with the CS-1504 in order to maximize battery life.

### 9.7.4 Initialization of Communications by Host Command.

Usually, communications between the CS-1504 and the Host driver will take place in a lock-step manner. The Host will initiate all communications and the CS-1504 will send any required response only once. This should prevent almost all manner of spurious and extraneous data transfers. Should the current communications situation become confused, the Host has the ability to initialize the communications channel with the CS-1504. This mechanism is implemented with the HOST\_IN line and the Command Termination time out.

Whenever the host wishes to initialize communications with the CS-1504, it will lower the HOST\_IN line for a period in excess of the Command Termination time. If the CS-1504 is in the middle of transmitting a response to the host and the HOST\_IN line is removed for more than the Command Termination time, then the current transmission is aborted. When the HOST\_IN line is subsequently raised, the CS-1504 will be ready to begin a new communications session and will be expecting to receive an interrogate command in order to continue. This will be true for all cases including when the CS-1504 was awake and transmitting, when the CS-1504 was awake and not transmitting, and when the CS-1504 was asleep.