­

**CBT-350 remote protocol specification**

Author: Midtronics

Date: August 23, 2017

**Revision:** **1.02**

**Status: Initial Draft**

Table of Contents

[1 Overview 3](#_Toc490567085)

[1.1. Operating modes 3](#_Toc490567086)

[1.1.1. Remote mode 3](#_Toc490567087)

[1.2. Communication link setup 3](#_Toc490567088)

[1.2.1. Wired setup 3](#_Toc490567089)

[1.2.2. Wireless setup 3](#_Toc490567090)

[2 Packet structure 4](#_Toc490567091)

[2.1. Header 4](#_Toc490567092)

[2.2. Trailer 4](#_Toc490567093)

[2.3. DLE stuffing 4](#_Toc490567094)

[3 Communication sequence 5](#_Toc490567095)

[3.1. Handshaking responses 5](#_Toc490567096)

[3.2. Timing 5](#_Toc490567097)

[4 Packet descriptions 6](#_Toc490567098)

[4.1. General 6](#_Toc490567099)

[4.1.1. 0x0000 Get Tester info 6](#_Toc490567100)

[4.1.2. 0x00FB Tester Status 6](#_Toc490567101)

[4.2. Test 6](#_Toc490567102)

[4.2.1. 0x00FC Initiate Battery Test 6](#_Toc490567103)

[4.3. Battery settings 7](#_Toc490567104)

[4.3.1. 0x00FD Perform Battery test 7](#_Toc490567105)

[4.4. Battery Test results 7](#_Toc490567106)

[4.4.1. 0x00FE Battery Test Result Summary 7](#_Toc490567107)

[4.5. General request 8](#_Toc490567108)

[4.5.1. 0x00FF Packet request 8](#_Toc490567109)

[5 Automatic power on and shutdown 9](#_Toc490567110)

[6 Bluetooth select wireless device 9](#_Toc490567111)

[7 Appendix I: Packets content summary 10](#_Toc490567112)

[8 Appendix V: Change history 15](#_Toc490567113)

# Overview

This document describes the protocol which allows a master (Android Tablet or PC) to control the battery tester base (slave) using a serial communication link. This link normally would be over a Bluetooth radio connection, but other connections are possible.

## Operating modes

### Remote mode

When the tester operates in remote mode (slave) all settings for a battery test and the actual starting of the test will be done by the remote master (Android Tablet or PC). In remote mode the tester is locked for manual operations, except powering off.

## Communication link setup

### Wired setup

The tester can be connected to the remote master via a cable. When this is done the baud rate of the serial communication link is set to **115200**. The other settings are **8 bits, even parity, 1 stop bit and no flow control**.



Figure – Wired setup

### Wireless setup

When the tester is connected via the remote interface (Bluetooth) the communication link operates at a baud rate of 115200. The other settings are 8 bits, no parity, 1 stop bit and no flow control, the same as the wired link.



Figure – Wireless setup

# Packet structure

Except for the initialization sequence all data is transferred in byte-oriented packets. A packet contains a five-byte header (DLE, ID, and Size), followed by a variable number of data bytes, and followed by a three-byte trailer (Checksum, **DLE**, and **ETX**). The following figure shows the format of a packet:

|  |  |  |
| --- | --- | --- |
| **Byte Number** | **Byte Description** | **Notes** |
| 0 | Data Link Escape | ASCII DLE character (16 decimal) |
| 1 -2 | Packet ID | identifies the type of packet (See “Appendix I: Packets content”) |
| 3-4 | Size of Application Payload | number of bytes of packet data (bytes 5 to n-4) |
| 5 to n-4 | Application Payload | 0 to 255 bytes |
| n-3 | Checksum | Negative result of the sum of bytes 1 to n-4. |
| n-2 | Data Link Escape | ASCII DLE character (16 decimal) |
| n-1 | End of Text | ASCII ETX character (3 decimal) |

## Header

The packet always starts with a Data link escape (**DLE, value 0x10**). This DLE character is used to synchronize the start of a packet. After the DLE the ID is transmitted. The ID determines the use of the packet. See “Appendix I: Packets content” to look up the functionality per ID and the content of the packets. The last byte in the header, the size, indicates the total size of the data in number of bytes.

## Trailer

The checksum is an 8 bit value calculated by taking the negative result of the sum of bytes 1 to n-4. This means that when a packet is received the sum of all bytes (including the checksum) will always give an 8 bit value of 0xFF. After the checksum a DLE is transmitted for synchronization and an **ETX (0x03)** to end the packet transmission.

## DLE stuffing

If any byte in the Size, Packet Data, or Checksum fields is equal to DLE (value 0x10), then a second DLE is inserted immediately following the byte. **This extra DLE is not included in the size or checksum calculation**. This procedure allows the DLE character to be used to delimit the boundaries of a packet. The Packet ID with the same value as a DLE is not used.

# Communication sequence

## Handshaking responses

Unless otherwise noted in this document, a device that receives a data packet must send an ACK or NAK packet to the transmitting device to indicate whether the data packet was successfully received. Normally, the transmitting device does not send any additional packets until an ACK or NAK is received (this is sometimes referred to as a “stop and wait” or “blocking” protocol). The following table shows the format of an ACK/NAK packet:

|  |  |  |
| --- | --- | --- |
| **Byte Number** | **Byte Description** | **Notes** |
| 0 | Data Link Escape | ASCII DLE character (16 decimal) |
| 1 -2 | Packet ID | ASCII ACK/NAK character (6 or 21 decimal respectively)  (See “Appendix I: Packets content”) |
| 3-4 | Size of Packet Data | 2 |
| 5-6 | Packet Data | Packet ID of the acknowledged packet. |
| 7 | Checksum | Negative result of the sum of bytes 1 to 5. |
| 8 | Data Link Escape | ASCII DLE character (16 decimal) |
| 9 | End of Text | ASCII ETX (3 decimal) |

The ACK packet has a Packet ID equal to 6 decimal (the ASCII ACK character), while the NAK packet has a Packet ID equal to 21 decimal (the ASCII NAK character). Both ACK and NAK packets contain an 8-bit integer in their packet data to indicate the Packet ID of the acknowledged packet.

If an ACK packet is received, the data packet was received correctly and communication may continue. If a NAK packet is received, the data packet was not received correctly and should be sent again. NAKs are used only to indicate errors in the communications link, not errors in any higher-layer protocol.

When the slave receives a NAK it will try to send the data three additional times. When the last packet also receives a NAK the slave will disconnect and reset. After the reset the connection will not be active until the master sets up a new connection.

## Timing

When the first byte is received a time-out of 1 second 750 milliseconds is set. When there is no valid packet received within this time a NAK response is sent and the buffers are flushed.

When the slave doesn’t receive a NAK or ACK on a **transmitted packet within 5 seconds it will disconnect and reset**. After the reset the connection will not be active until the master sets up a new connection.

# Packet descriptions

This chapter describes the content of the packets per ID. The packet header and footer are now shown in this chapter, only the data.

When the tester is power cycled the default value will be set, regardless of the previous setting. When no default setting is specified the previous setting is maintained.

## General

### 0x0000 Get Tester info

This packet contains general information about the tester. The following table shows the data for this packet.

|  |  |  |
| --- | --- | --- |
| **Byte Number** | **Byte Description** | **Notes** |
| 0–3 | Serial number | Unused,0x00,0x00,0x00,0x00 |
| 4-10 | Tester name | ASCII,CBT-350 |
| 11-14 | Version | ASCII, 1.00 |
| 15-17 | Algorithm version | ASCII, unused |
| 18 | Build Number | ASCII, A |
| 19-21 | Communication Protocol Version | ASCII, 1.0 |

### 0x00FB Tester Status

This packet contains general information about the tester. The following table shows the data for this packet.

Tester->Tablet

| **Byte Number** | **Byte Description** | **Notes** |
| --- | --- | --- |
| 0 | Tester status | Bit 0: Ready  Bit 1: Busy  Bit 2: Finished  Bit 3-7: Unused |

## Test

### 0x00FC Initiate Battery Test

Begin battery test.

| **Byte Number** | **Byte Description** | **Notes** |
| --- | --- | --- |
| 0 | Battery Type | 1: Flooded (regular)  2: AGM  **3: EFB** |
| 1-2 | Battery rating CCA(MSB) | 500 CCA (0x01, 0XF4) |
| **3** | **Motorcycle/JIS ID(REF Number)** | **Motorcycle/JIS ID (#1, #2, #3….) (1, 2, 3….)**  **If value is 0XFF, it is non Motorcycle/JIS battery.** |
| **4** | **Algorithm ID** | 1. **Regular Flood** 2. **AGM** 3. **Below 100 CCA motorcycle.** 4. **Above 100 CCA motorcycle.** 5. **EFB** 6. **Panasonic 1** 7. **Panasonic 2** 8. **Panasonic 3** 9. **Customer Algorithm 1** 10. **Customer Algorithm 2** 11. **Customer Algorithm 3** |

## Battery settings

### 0x00FD Perform Battery test

This packet can be requested for the battery test parameters with one command.

|  |  |  |
| --- | --- | --- |
| **Byte Number** | **Byte Description** | **Notes** |
| 0 | Start one or more of the battery test | 0X00, perform battery test |

## Battery Test results

### 0x00FE Battery Test Result Summary

This packet contains the results of the battery test.

| **Byte Number** | **Byte Description** | **Notes** |
| --- | --- | --- |
| 0 | Battery Result | GOOD BATTERY --0  GOOD RECHARGE --1  CHARGE & RETEST --2  REPLACE BATTERY --3  BAD CELL-REPLACE --4 |
| 1-2 | Battery measure voltage(MSB) V | 1250(0x04, 0XE2) |
| 3-4 | Battery measure CCA(MSB) | 500CCA(0x01, 0XF4) |
| 5 | SOH Value | 0-255 |
| 6 | SOC Value | 0-100 |

## General request

### 0x00FF Packet request

To receive any packet from the slave, this packet must be sent. Send the requested packet ID as data with a request packet.

When a packet is requested that the slave cannot send (See ‘Appendix I: Packets content summary’) the slave will simply acknowledge the packet upon successful receive. It will not send any packet back.

|  |  |  |
| --- | --- | --- |
| **Byte Number** | **Byte Description** | **Notes** |
| 0 | Packet request | Packet ID |

# Automatic power on and shutdown

The BT-POD shall power on from the battery under test when the voltage is nominally greater than 1V and less than 26V and then power off when disconnected from battery under test.

# Bluetooth select wireless device

1. Tool should be turned on
2. Tablet will scan for available base units using discovery command.
3. Base units will respond to discovery command.
4. Wait for Bluetooth devices to respond with their MAC address and ID string CBT-350~~##########, where ######### is the base serial number~~
5. Tablet will initiate connection
6. Wait for the connection
7. Now you can send data to and from the Bluetooth devices
8. If there are more than 2 base units the tablet will ask user to select base by serial number.

# Appendix I: Packets content summary

| **ID**  **(hexadecimal)** | **Packet type** | **Description** | **Master to slave** | **Slave to master** |
| --- | --- | --- | --- | --- |
| 0x0000 |  |  |  |  |
| 0x0001 |  |  |  |  |
| 0x0002 |  |  |  |  |
| 0x0003 |  |  |  |  |
| 0x0004 |  |  |  |  |
| 0x0005 |  |  |  |  |
| 0x0006 |  |  |  |  |
| 0x0007 |  |  |  |  |
| 0x0008 |  |  |  |  |
| 0x0009 |  |  |  |  |
| 0x000A |  |  |  |  |
| 0x000B |  |  |  |  |
| 0x000C |  |  |  |  |
| 0x000D |  |  |  |  |
| 0x000E |  |  |  |  |
| 0x000F |  |  |  |  |
| 0x0010 |  |  |  |  |
| 0x0011 |  |  |  |  |
| 0x0012 |  |  |  |  |
| 0x0013 |  |  |  |  |
| 0x0014 |  |  |  |  |
| 0x0015 |  |  |  |  |
| 0x0016 |  |  |  |  |
| 0x0017 |  |  |  |  |
| 0x0018 |  |  |  |  |
| 0x0019 |  |  |  |  |
| 0x001A |  |  |  |  |
| 0x001B |  |  |  |  |
| 0x001C |  |  |  |  |
| 0x001D |  |  |  |  |
| 0x001E |  |  |  |  |
| 0x001F |  |  |  |  |
| 0x0020 |  |  |  |  |
| 0x0021 |  |  |  |  |
| 0x0022 |  |  |  |  |
| 0x0023 |  |  |  |  |
| 0x0024 |  |  |  |  |
| 0x0025 |  |  |  |  |
| 0x0026 |  |  |  |  |
| 0x0027 |  |  |  |  |
| 0x0028 |  |  |  |  |
| 0x0029 |  |  |  |  |
| 0x002A |  |  |  |  |
| 0x002B |  |  |  |  |
| 0x002C |  |  |  |  |
| 0x002D |  |  |  |  |
| 0x002E |  |  |  |  |
| 0x002F |  |  |  |  |
| 0x0030 |  |  |  |  |
| 0x0031 |  |  |  |  |
| 0x0032 |  |  |  |  |
| 0x0033 |  |  |  |  |
| 0x0034 |  |  |  |  |
| 0x0035 |  |  |  |  |
| 0x0036 |  |  |  |  |
| 0x0037 |  |  |  |  |
| 0x0038 |  |  |  |  |
| 0x0039 |  |  |  |  |
| 0x003A |  |  |  |  |
| 0x003B |  |  |  |  |
| 0x003C |  |  |  |  |
| 0x003D |  |  |  |  |
| 0x003E |  |  |  |  |
| 0x003F |  |  |  |  |
| 0x0040 |  |  |  |  |
| 0x0041 |  |  |  |  |
| 0x0042 |  |  |  |  |
| 0x0043 |  |  |  |  |
| 0x0044 |  |  |  |  |
| 0x0045 |  |  |  |  |
| 0x0046 |  |  |  |  |
| 0x0047 |  |  |  |  |
| 0x0048 |  |  |  |  |
| 0x0049 |  |  |  |  |
| 0x004A |  |  |  |  |
| 0x004B |  |  |  |  |
| 0x004C |  |  |  |  |
| 0x004D |  |  |  |  |
| 0x004E |  |  |  |  |
| 0x004F |  |  |  |  |
| 0x0050 |  |  |  |  |
| 0x0051 |  |  |  |  |
| 0x0052 |  |  |  |  |
| 0x0053 |  |  |  |  |
| 0x0054 |  |  |  |  |
| 0x0055 |  |  |  |  |
| 0x0056 |  |  |  |  |
| 0x0057 |  |  |  |  |
| 0x0058 |  |  |  |  |
| 0x0059 |  |  |  |  |
| 0x005A |  |  |  |  |
| 0x005B |  |  |  |  |
| 0x005C |  |  |  |  |
| 0x005D |  |  |  |  |
| 0x005E |  |  |  |  |
| 0x005F |  |  |  |  |
| 0x0060 |  |  |  |  |
| 0x0061 |  |  |  |  |
| 0x0062 |  |  |  |  |
| 0x0063 |  |  |  |  |
| 0x0064 |  |  |  |  |
| 0x0065 |  |  |  |  |
| 0x0066 |  |  |  |  |
| 0x0067 |  |  |  |  |
| 0x0068 |  |  |  |  |
| 0x0069 |  |  |  |  |
| 0x006A |  |  |  |  |
| 0x006B |  |  |  |  |
| 0x006C |  |  |  |  |
| 0x006D |  |  |  |  |
| 0x006E |  |  |  |  |
| 0x006F |  |  |  |  |
| 0x0070 |  |  |  |  |
| 0x0071 |  |  |  |  |
| 0x0072 |  |  |  |  |
| 0x0073 |  |  |  |  |
| 0x0074 |  |  |  |  |
| 0x0075 |  |  |  |  |
| 0x0076 |  |  |  |  |
| 0x0077 |  |  |  |  |
| 0x0078 |  |  |  |  |
| 0x0079 |  |  |  |  |
| 0x007A |  |  |  |  |
| 0x007B |  |  |  |  |
| 0x007C |  |  |  |  |
| 0x007D |  |  |  |  |
| 0x007E |  |  |  |  |
| 0x007F |  |  |  |  |
| 0x0080 |  |  |  |  |
| 0x0081 |  |  |  |  |
| 0x0082 |  |  |  |  |
| 0x0083 |  |  |  |  |
| 0x0084 |  |  |  |  |
| 0x0085 |  |  |  |  |
| 0x0086 |  |  |  |  |
| 0x0087 |  |  |  |  |
| 0x0088 |  |  |  |  |
| 0x0089 |  |  |  |  |
| 0x008A |  |  |  |  |
| 0x008B |  |  |  |  |
| 0x008C |  |  |  |  |
| 0x008D |  |  |  |  |
| 0x008E |  |  |  |  |
| 0x008F |  |  |  |  |
| 0x0090 |  |  |  |  |
| 0x0091 |  |  |  |  |
| 0x0092 |  |  |  |  |
| 0x0093 |  |  |  |  |
| 0x0094 |  |  |  |  |
| 0x0095 |  |  |  |  |
| 0x0096 |  |  |  |  |
| 0x0097 |  |  |  |  |
| 0x0098 |  |  |  |  |
| 0x0099 |  |  |  |  |
| 0x009A |  |  |  |  |
| 0x009B |  |  |  |  |
| 0x009C |  |  |  |  |
| 0x009D |  |  |  |  |
| 0x009E |  |  |  |  |
| 0x009F |  |  |  |  |
| 0x00A0 |  |  |  |  |
| 0x00A1 |  |  |  |  |
| 0x00A2 |  |  |  |  |
| 0x00A3 |  |  |  |  |
| 0x00A4 |  |  |  |  |
| 0x00A5 |  |  |  |  |
| 0x00A6 |  |  |  |  |
| 0x00A7 |  |  |  |  |
| 0x00A8 |  |  |  |  |
| 0x00A9 |  |  |  |  |
| 0x00AA |  |  |  |  |
| 0x00AB |  |  |  |  |
| 0x00AC |  |  |  |  |
| 0x00AD |  |  |  |  |
| 0x00AE |  |  |  |  |
| 0x00AF |  |  |  |  |
| 0x00B0 |  |  |  |  |
| 0x00B1 |  |  |  |  |
| 0x00B2 |  |  |  |  |
| 0x00B3 |  |  |  |  |
| 0x00B4 |  |  |  |  |
| 0x00B5 |  |  |  |  |
| 0x00B6 |  |  |  |  |
| 0x00B7 |  |  |  |  |
| 0x00B8 |  |  |  |  |
| 0x00B9 |  |  |  |  |
| 0x00BA |  |  |  |  |
| 0x00BB |  |  |  |  |
| 0x00BC |  |  |  |  |
| 0x00BD |  |  |  |  |
| 0x00BE |  |  |  |  |
| 0x00BF |  |  |  |  |
| 0x00C0 |  |  |  |  |
| 0x00C1 |  |  |  |  |
| 0x00C2 |  |  |  |  |
| 0x00C3 |  |  |  |  |
| 0x00C4 |  |  |  |  |
| 0x00C5 |  |  |  |  |
| 0x00C6 |  |  |  |  |
| 0x00C7 |  |  |  |  |
| 0x00C8 |  |  |  |  |
| 0x00C9 |  |  |  |  |
| 0x00CA |  |  |  |  |
| 0x00CB |  |  |  |  |
| 0x00CC |  |  |  |  |
| 0x00CD |  |  |  |  |
| 0x00CE |  |  |  |  |
| 0x00CF |  |  |  |  |
| 0x00D0 |  |  |  |  |
| 0x00D1 |  |  |  |  |
| 0x00D2 |  |  |  |  |
| 0x00D3 |  |  |  |  |
| 0x00D4 |  |  |  |  |
| 0x00D5 |  |  |  |  |
| 0x00D6 |  |  |  |  |
| 0x00D7 |  |  |  |  |
| 0x00D8 |  |  |  |  |
| 0x00D9 |  |  |  |  |
| 0x00DA |  |  |  |  |
| 0x00DB |  |  |  |  |
| 0x00DC |  |  |  |  |
| 0x00DD |  |  |  |  |
| 0x00DE |  |  |  |  |
| 0x00DF |  |  |  |  |
| 0x00E0 |  |  |  |  |
| 0x00E1 |  |  |  |  |
| 0x00E2 |  |  |  |  |
| 0x00E3 |  |  |  |  |
| 0x00E4 |  |  |  |  |
| 0x00E5 |  |  |  |  |
| 0x00E6 |  |  |  |  |
| 0x00E7 |  |  |  |  |
| 0x00E8 |  |  |  |  |
| 0x00E9 |  |  |  |  |
| 0x00EA |  |  |  |  |
| 0x00EB |  |  |  |  |
| 0x00EC |  |  |  |  |
| 0x00ED |  |  |  |  |
| 0x00EF |  |  |  |  |
| 0x00F0 |  |  |  |  |
| 0x00F1 |  |  |  |  |
| 0x00F2 |  |  |  |  |
| 0x00F3 |  |  |  |  |
| 0x00F4 |  |  |  |  |
| 0x00F5 |  |  |  |  |
| 0x00F6 |  |  |  |  |
| 0x00F7 |  |  |  |  |
| 0x00F8 |  |  |  |  |
| 0x00F9 |  |  |  |  |
| 0x00FA |  |  |  |  |
| 0x00FB |  |  |  |  |
| 0x00FC | Initial battery |  |  |  |
| 0x00FD | Perform battery test |  |  |  |
| 0x00FE | Return battery result |  |  |  |
| 0x00FF | Packet request | See section 4.12.1 | X |  |

# Appendix V: Change history

| **Date** | **Rev** | **Description** | **By** |
| --- | --- | --- | --- |
| 8/4/16 | 1.00 | * Initial Draft | King |
| 08/14/17 | 1.01 | * Add Motorcycle support | King |
| 08/21/17 |  | * Add SOH, SOC output | King |