

Optoelectronics, Inc.
M1Ô Handicounter
Serial Interface Specification

Interface Version 1.1

May 10, 2001

INTRODUCTION

This document describes the serial interface of the M1™ Handicounter, a miniature hand-held frequency counter capable of measuring the frequency of VHF and UHF transmitters and other signal sources. The M1™ is capable of automatically capturing and storing up to 100 frequencies. This frequency data can then be downloaded to a personal computer for logging and analysis.

This document was written to assist the programmer in developing computer software applications for the M1™.

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ABOUT CI-5

The serial interface on the M1™ conforms to the Icom CI-V interface standard. However, Optoelectronics has added enhancements in the form of additional commands and features. Optoelectronics has, therefore, modified the name of this new enhanced interface to CI-5.

The CI-5 interface is an asynchronous, half-duplex, Transistor-Transistor Logic (TTL) serial interface connected in a wire-OR (bussed) configuration. Several different devices can be connected to the bus simultaneously, and each device has its own unique address. Software developers who are unfamiliar with the CI-5 interface are strongly encouraged to obtain a copy of the *Icom Communication Interface - V Reference Manual* from Icom, Inc. for detailed information on the CI-V interface protocol. The communications parameters for the serial interface are listed in Table 1 below.

Table 1. Communications Parameters.

DATA RATE	9600 bps
START BITS	1
DATA BITS	8
PARITY	NONE
STOP BITS	1

One important thing to note about the CI-5 interface is that, as mentioned above, it is connected in a wire-OR configuration. This means that the transmit data signal and the receive data signal are connected together. Therefore, when a command is transmitted by the computer, it is automatically echoed back as received data, followed by the response to the command, if any. For example, if an 11-byte command is transmitted to a device on the bus, which returns a 6-byte response, the computer will receive a total of 17 bytes. This configuration allows devices on the bus to monitor their own transmissions in order to detect interface collisions. A collision occurs when two or more devices transmit simultaneously. If a collision occurs, the command must be re-transmitted.

To connect the M1™ to a personal computer, a subminiature (2.5 mm) phone jack is provided on the top panel. An external interface converter box, such as the Optoelectronics Optolinx™, is required to connect the M1™ to an RS-232C computer interface. Its purpose is to convert the CI-5 interface voltage levels to RS-232C levels compatible with most personal computers.

COMMAND REFERENCE

The M1™ accepts commands over the CI-5 interface. In this section, all CI-5 command and response bytes are expressed in hexadecimal notation. The M1™ recognizes 10 different commands, which are summarized in Table 2 below.

Following the command summary table is a detailed description of each of the commands, including examples illustrating their use. In the command descriptions, "ra" refers to the RECEIVE ADDRESS, and "ta" refers to the TRANSMIT ADDRESS.

The RECEIVE ADDRESS is the address of the M1™, which is fixed at 96. Each device on the CI-5 bus must have its own unique address. The M1™ will not process any command in which the RECEIVE ADDRESS is not 96. However, the M1™ will process commands with a RECEIVE ADDRESS of 00, but all command responses will be suppressed. A RECEIVE ADDRESS of 00 has special meaning. It provides a means for a device on the CI-5 bus to transmit a command to all other devices simultaneously. However, since several simultaneous responses would cause a collision, the responses are suppressed.

The TRANSMIT ADDRESS is the address of the device which is transmitting the command to the M1™. In most cases, this device is a personal computer executing application software, usually referred to as the CONTROLLER. The standard address for the CONTROLLER is E0, but any address can be used for the TRANSMIT ADDRESS. However, the TRANSMIT ADDRESS must be in the range 01 to EF. Also, the M1™ will not process any command in which the TRANSMIT ADDRESS matches its own address, 96.

It is important to remember that the values specified are not ASCII characters, but are bytes expressed in hexadecimal notation. For example, "FE" represents a single byte with a value of 0xFE (hexadecimal), or 254 (decimal). It does not represent the ASCII character "F" followed by the ASCII character "E", a two-byte sequence.

Table 2. M1™ CI-5 Interface Command Summary.

COMMAND	SUB-COMMAND	DESCRIPTION
03	-	Read frequency.
06	-	Write mode.
15	02	Read signal strength.
7F	09	Read identification
7F	20	Read gate setting.
7F	21	Write gate setting.
7F	22	Read frequency memory.
7F	24	Clear memory.
7F	25	Read range setting.
7F	26	Write range setting.

READ FREQUENCY

Command:

FE	FE	ra	ta	03	FD
----	----	----	----	----	----

Example:

FE	FE	96	E0	03	FD
----	----	----	----	----	----

Response:

FE	FE	ta	ra	03	frequency	FD
----	----	----	----	----	-----------	----

Examples:

162.5500000 MHz

FE	FE	E0	96	03	00	00	00	55	62	01	FD
----	----	----	----	----	----	----	----	----	----	----	----

1045.7250000 MHz

FE	FE	E0	96	03	00	00	50	72	45	10	FD
----	----	----	----	----	----	----	----	----	----	----	----

Error

FE	FE	E0	96	FA	FD
----	----	----	----	----	----

Description:

This command instructs the unit to send the current counter frequency measurement result.

The frequency data is in the form of 6 bytes, each consisting of 2 BCD digits. The order of the 12 BCD digits is as follows: 0.1 Hz digit, 0.01 Hz digit, 10 Hz digit, 1 Hz digit, 1 kHz digit, 100 Hz digit, 100 kHz digit, 10 kHz digit, 10 MHz digit, 1 MHz digit, 1 GHz digit, 100 MHz digit. See the examples shown above.

If the command length is incorrect, then the command is ignored, and the error response is returned.

WRITE MODE

Command:

FE	FE	ra	ta	06	ms	FD
----	----	----	----	----	----	----

ms

 is a BCD value representing the selected operating mode. BCD values are encoded as follows:

- 00: NORMAL mode
- 01: FILTER mode
- 02: CHANNEL mode
- 03: CAPTURE mode
- 04: RECALL mode

Examples:

NORMAL mode

FE	FE	96	E0	06	00	FD
----	----	----	----	----	----	----

CAPTURE mode

FE	FE	96	E0	06	03	FD
----	----	----	----	----	----	----

Response:

FE	FE	ta	ra	FB or FA	FD
----	----	----	----	----------	----

Examples:

OK

FE	FE	E0	96	FB	FD
----	----	----	----	----	----

Error

FE	FE	E0	96	FA	FD
----	----	----	----	----	----

Description:

This command selects the operating mode.

The mode select data is in the form of 1 byte, consisting of 2 BCD digits. See the examples shown above.

If the command length is incorrect, or if the mode select code is not valid, then the command is ignored, and the error response is returned.

READ SIGNAL STRENGTH

Command:

FE	FE	ra	ta	15	02	FD
----	----	----	----	----	----	----

Example:

FE	FE	96	E0	15	02	FD
----	----	----	----	----	----	----

Response:

FE	FE	ta	ra	15	02	sd	FD
----	----	----	----	----	----	----	----

Examples:

0 bargraph segments

FE	FE	E0	96	15	02	00	00	FD
----	----	----	----	----	----	----	----	----

5 bargraph segments

FE	FE	E0	96	15	02	00	05	FD
----	----	----	----	----	----	----	----	----

16 bargraph segments

FE	FE	E0	96	15	02	00	16	FD
----	----	----	----	----	----	----	----	----

Error

FE	FE	E0	96	FA	FD
----	----	----	----	----	----

Description:

This command instructs the unit to send the current signal strength.

The signal strength data is in the form of 2 bytes, each consisting of 2 BCD digits. The signal strength is reported as the number of bargraph segments active. The reported signal strength ranges from a minimum signal of 0 bargraph segments active to a maximum signal of 16 bargraph segments active. See the examples shown above.

If the command length is incorrect, then the command is ignored, and the error response is returned.

READ IDENTIFICATION

Command:

FE	FE	ra	ta	7F	09	FD
----	----	----	----	----	----	----

Example:

FE	FE	96	E0	7F	09	FD
----	----	----	----	----	----	----

Response:

FE	FE	ta	ra	7F	09	id	sv	iv	FD
----	----	----	----	----	----	----	----	----	----

Example:

M1™ A version, software version 2.0, interface version 1.1

FE	FE	E0	96	7F	09	4D	31	41	20	11	FD
----	----	----	----	----	----	----	----	----	----	----	----

M1™ B version, software version 2.0, interface version 1.1

FE	FE	E0	96	7F	09	4D	31	42	20	11	FD
----	----	----	----	----	----	----	----	----	----	----	----

Error

FE	FE	E0	96	FA	FD
----	----	----	----	----	----

Description:

This command instructs the unit to send the identification information.

The identification data is in the form of 5 bytes, each consisting of 2 digits. The first 6 digits uniquely identify the device. The next 2 BCD digits indicate the current software version. The last 2 BCD digits indicate the current interface version.

If the command length is incorrect, then the command is ignored, and the error response is returned.

READ GATE SETTING

Command:

FE	FE	ra	ta	7F	20	FD
----	----	----	----	----	----	----

Example:

FE	FE	96	E0	7F	20	FD
----	----	----	----	----	----	----

Response:

FE	FE	ta	ra	7F	20	gs	FD
----	----	----	----	----	----	----	----

gs

 is a BCD value representing the selected gate setting. BCD values are encoded as follows:

- 00: 10 kHz resolution gate setting
- 01: 1 kHz resolution gate setting
- 02: 100 Hz resolution gate setting
- 03: 10 Hz resolution gate setting
- 04: 1 Hz resolution gate setting
- 05: 0.1 Hz resolution gate setting

Examples:

10 kHz resolution

FE	FE	E0	96	7F	20	00	FD
----	----	----	----	----	----	----	----

100 Hz resolution

FE	FE	E0	96	7F	20	02	FD
----	----	----	----	----	----	----	----

Error

FE	FE	E0	96	FA	FD
----	----	----	----	----	----

Description:

This command instructs the unit to send the current gate setting.

The gate setting specifies the counter gate time, and, hence, the measurement resolution of the frequency counter. The gate setting data is in the form of 1 byte, consisting of 2 BCD digits. See the examples shown above.

If the command length is incorrect, then the command is ignored, and the error response is returned.

WRITE GATE SETTING

Command:

FE	FE	ra	ta	7F	21	gs	FD
----	----	----	----	----	----	----	----

gs

 is a BCD value representing the selected gate setting. BCD values are encoded as follows:

- 00: 10 kHz resolution gate setting
- 01: 1 kHz resolution gate setting
- 02: 100 Hz resolution gate setting
- 03: 10 Hz resolution gate setting
- 04: 1 Hz resolution gate setting
- 05: 0.1 Hz resolution gate setting

Examples:

1 kHz resolution

FE	FE	96	E0	7F	21	01	FD
----	----	----	----	----	----	----	----

10 Hz resolution

FE	FE	96	E0	7F	21	03	FD
----	----	----	----	----	----	----	----

Response:

FE	FE	ta	ra	FB or FA	FD
----	----	----	----	----------	----

Examples:

OK

FE	FE	E0	96	FB	FD
----	----	----	----	----	----

Error

FE	FE	E0	96	FA	FD
----	----	----	----	----	----

Description:

This command selects the gate setting.

The gate setting specifies the counter gate time, and, hence, the measurement resolution of the frequency counter. The gate setting data is in the form of 1 byte, consisting of 2 BCD digits. See the examples shown above. Note that when the Lo-Z prescaled count range setting is selected, only the first 4 gate settings are valid.

If the command length is incorrect, or if CAPTURE mode or RECALL mode is selected, or if the gate select code is not valid, then the command is ignored, and the error response is returned.

READ FREQUENCY MEMORY

Command:

FE	FE	ra	ta	7F	22	memory	FD
----	----	----	----	----	----	--------	----

Examples:

Memory location 0

FE	FE	96	E0	7F	22	00	00	FD
----	----	----	----	----	----	----	----	----

Memory location 63

FE	FE	96	E0	7F	22	00	63	FD
----	----	----	----	----	----	----	----	----

Memory location 99

FE	FE	96	E0	7F	22	00	99	FD
----	----	----	----	----	----	----	----	----

Response:

FE	FE	ta	ra	7F	22	frequency	FD
----	----	----	----	----	----	-----------	----

Examples:

162.550000 MHz

FE	FE	E0	96	7F	22	00	00	55	62	01	FD
----	----	----	----	----	----	----	----	----	----	----	----

1045.725000 MHz

FE	FE	E0	96	7F	22	00	50	72	45	10	FD
----	----	----	----	----	----	----	----	----	----	----	----

Error

FE	FE	E0	96	FA	FD
----	----	----	----	----	----

Description:

This command instructs the unit to send the frequency stored in the specified memory location.

The specified memory location data is in the form of two bytes, each consisting of two BCD digits. The specified memory location must be in the range 0 to 99. The frequency data is in the form of five bytes, each consisting of two BCD digits. The order of the ten BCD digits is as follows: 10 Hz digit, 1 Hz digit, 1 kHz digit, 100 Hz digit, 100 kHz digit, 10 kHz digit, 10 MHz digit, 1 MHz digit, 1 GHz digit, 100 MHz digit. See the examples shown above.

If the command length is incorrect, or if the specified memory location is not in the range 0 to 99, then the command is ignored, and the error response is returned.

CLEAR MEMORY

Command:

FE	FE	ra	ta	7F	24	FD
----	----	----	----	----	----	----

Example:

FE	FE	96	E0	7F	24	FD
----	----	----	----	----	----	----

Response:

FE	FE	ta	ra	FB or FA	FD
----	----	----	----	----------	----

Example:

OK

FE	FE	E0	96	FB	FD
----	----	----	----	----	----

Error

FE	FE	E0	96	FA	FD
----	----	----	----	----	----

Description:

This command clears all frequency memory locations.

Once this command is executed, all frequency memory locations are set to zero. The M1™ can then begin to capture 100 new frequencies. This command has the same effect as turning the unit on while holding down the MODE switch.

If the command length is incorrect, then the command is ignored, and the error response is returned.

READ RANGE SETTING

Command:

FE	FE	ra	ta	7F	25	FD
----	----	----	----	----	----	----

Example:

FE	FE	96	E0	7F	25	FD
----	----	----	----	----	----	----

Response:

FE	FE	ta	ra	7F	25	rs	FD
----	----	----	----	----	----	----	----

rs

 is a BCD value representing the selected range setting. BCD values are encoded as follows:

- 00: Hi-Z direct count range setting
- 01: Lo-Z direct count range setting
- 02: Lo-Z prescaled count range setting

Examples:

10 kHz resolution

FE	FE	E0	96	7F	25	00	FD
----	----	----	----	----	----	----	----

100 Hz resolution

FE	FE	E0	96	7F	25	02	FD
----	----	----	----	----	----	----	----

Error

FE	FE	E0	96	FA	FD
----	----	----	----	----	----

Description:

This command instructs the unit to send the current range setting.

The range setting specifies the counter input impedance and direct/prescale count mode. The range setting data is in the form of 1 byte, consisting of 2 BCD digits. See the examples shown above.

If the command length is incorrect, then the command is ignored, and the error response is returned.

WRITE RANGE SETTING

Command:

FE	FE	ra	ta	7F	26	RS	FD
----	----	----	----	----	----	----	----

RS is a BCD value representing the selected range setting. BCD values are encoded as follows:

- 00: Hi-Z direct count range setting
- 01: Lo-Z direct count range setting
- 02: Lo-Z prescaled count range setting

Examples:

Hi-Z direct count range

FE	FE	96	E0	7F	26	00	FD
----	----	----	----	----	----	----	----

Lo-Z prescaled count range

FE	FE	96	E0	7F	26	02	FD
----	----	----	----	----	----	----	----

Response:

FE	FE	ta	ra	FB or FA	FD
----	----	----	----	----------	----

Examples:

OK

FE	FE	E0	96	FB	FD
----	----	----	----	----	----

Error

FE	FE	E0	96	FA	FD
----	----	----	----	----	----

Description:

This command selects the range setting.

The range setting specifies the counter input impedance and direct/prescale count mode. The range setting data is in the form of 1 byte, consisting of 2 BCD digits. See the examples shown above.

If the command length is incorrect, or if RECALL mode is selected, or if the range select code is not valid, then the command is ignored, and the error response is returned.

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