

**Optoelectronics, Inc.  
CD100Ô Multicounter  
Serial Interface Specification**

**Interface Version 1.1**

**March 15, 2000**

## **INTRODUCTION**

This document describes the serial interface of the CD100™ Multicounter, a hand-held frequency counter capable of measuring the frequency of VHF and UHF transmitters and other signal sources, as well as decoding CTCSS, DCS, DTMF, and LTR data. The CD100™ is also capable of storing up to 100 frequencies and corresponding decoded data. 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 CD100™.

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**OPTOELECTRONICS, INC.**  
**5821 N.E. 14th Avenue**  
**Fort Lauderdale, FL 33334**  
**Phone: (954) 771-2050**  
**FAX: (954) 771-2052**  
**<http://www.optoelectronics.com/>**

## ABOUT CI-5

The serial interface on the CD100™ 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.**

<b>DATA RATE</b>	9600 bps
<b>START BITS</b>	1
<b>DATA BITS</b>	8
<b>PARITY</b>	NONE
<b>STOP BITS</b>	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 the computer transmits a command, 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 CD100™ to a computer, a subminiature phone jack is provided on the top panel. An external interface converter box, such as the Optoelectronics Optolinx™, is required to connect the CD100™ 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 CD100™ accepts commands over the CI-5 interface when CI-5 COMMAND interface is selected from the front panel. In this section, all CI-5 command and response bytes are expressed in hexadecimal notation. The CD100™ recognizes 9 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 CD100™, which is fixed at 9A. Each device on the CI-5 bus must have its own unique address. The CD100™ will not process any command in which the RECEIVE ADDRESS is not 9A. However, the CD100™ 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 CD100™. 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 CD100™ will not process any command in which the TRANSMIT ADDRESS matches its own address, 9A.

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. CD100™ CI-5 Interface Command Summary.**

COMMAND	SUB-COMMAND	DESCRIPTION
03	-	Read Frequency
06	-	Write Mode
15	01	Read Squelch Status
7F	09	Read Identification
7F	20	Read Decode Measurement
7F	21	Write Decode Select
7F	22	Read Frequency Memory
7F	23	Read Decode Memory
7F	24	Clear Memory

## READ FREQUENCY

### Command:

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

### Example:

FE	FE	9A	E0	03	FD
----	----	----	----	----	----

### Response:

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

### Examples:

162.550000 MHz

FE	FE	E0	9A	03	00	00	55	62	01	FD
----	----	----	----	----	----	----	----	----	----	----

1045.725000 MHz

FE	FE	E0	9A	03	00	50	72	45	10	FD
----	----	----	----	----	----	----	----	----	----	----

Error

FE	FE	E0	9A	FA	FD
----	----	----	----	----	----

### Description:

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

The frequency data is in the form of 5 bytes, each consisting of 2 BCD digits. The order of the 10 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, 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:	TEST mode
01:	MEMORY mode
02:	CLEAR MEMORY mode
03:	INTERFACE mode
04:	RECEIVER mode
05:	APO mode
06:	FREQ DISPLAY mode

### Examples:

TEST mode

FE	FE	9A	E0	06	00	FD
----	----	----	----	----	----	----

CLEAR MEMORY mode

FE	FE	9A	E0	06	02	FD
----	----	----	----	----	----	----

### Response:

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

### Examples:

OK

FE	FE	E0	9A	FB	FD
----	----	----	----	----	----

Error

FE	FE	E0	9A	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 SQUELCH STATUS

### Command:

FE	FE	ra	ta	15	01	FD
----	----	----	----	----	----	----

### Example:

FE	FE	9A	E0	15	01	FD
----	----	----	----	----	----	----

### Response:

FE	FE	ta	ra	15	01	sd	FD
----	----	----	----	----	----	----	----

### Examples:

Squelch closed

FE	FE	E0	9A	15	01	00	FD
----	----	----	----	----	----	----	----

Squelch open

FE	FE	E0	9A	15	01	01	FD
----	----	----	----	----	----	----	----

Error

FE	FE	E0	9A	FA	FD
----	----	----	----	----	----

### Description:

This command instructs the unit to send the current squelch status.

The squelch status 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.

## READ IDENTIFICATION

### Command:

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

### Example:

FE	FE	9A	E0	7F	09	FD
----	----	----	----	----	----	----

### Response:

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

### Example:

CD100™, software version 1.3, interface version 1.1

FE	FE	E0	9A	7F	09	43	44	31	13	11	FD
----	----	----	----	----	----	----	----	----	----	----	----

### Error

FE	FE	E0	9A	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 DECODE MEASUREMENT

### Command:

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

### Example:

FE	FE	9A	E0	7F	20	FD
----	----	----	----	----	----	----

### Response:

FE	FE	ta	ra	7F	20	ds	decode data	FD
----	----	----	----	----	----	----	-------------	----

ds
----

 is a BCD value representing the selected decode measurement. BCD values are encoded as follows:

- 00: CTCSS decode
- 01: DCS decode
- 02: DTMF decode
- 03: LTR decode

### Examples:

CTCSS decode, 103.5 Hz, CTCSS active

FE	FE	E0	9A	7F	20	00	10	35	01	FD
----	----	----	----	----	----	----	----	----	----	----

DCS decode, 732, DCS inactive

FE	FE	E0	9A	7F	20	01	07	32	00	FD
----	----	----	----	----	----	----	----	----	----	----

DTMF decode, "A"

FE	FE	E0	9A	7F	20	02	10	FD
----	----	----	----	----	----	----	----	----

DTMF decode, DTMF buffer empty

FE	FE	E0	9A	7F	20	02	99	FD
----	----	----	----	----	----	----	----	----

LTR decode, AREA = 1, GOTO = 11, HOME = 03, ID = 176, FREE = 08, LTR active

FE	FE	E0	9A	7F	20	03	01	11	03	01	76	08	01	FD
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Error

FE	FE	E0	9A	FA	FD
----	----	----	----	----	----

### Description:

This command instructs the unit to send the current decode measurement.

The decode select is in the form of 1 byte, consisting of 2 BCD digits, and specifies the type of decode measurement data returned. The decode data is in the form of from 1 to 7 bytes, each 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 DECODE SELECT

### Command:

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

ds
----

 is a BCD value representing the selected decode measurement. BCD values are encoded as follows:

- 00: CTCSS decode
- 01: DCS decode
- 02: DTMF decode
- 03: LTR decode

### Examples:

DCS decode

FE	FE	9A	E0	7F	21	01	FD
----	----	----	----	----	----	----	----

LTR decode

FE	FE	9A	E0	7F	21	03	FD
----	----	----	----	----	----	----	----

### Response:

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

### Examples:

OK

FE	FE	E0	9A	FB	FD
----	----	----	----	----	----

Error

FE	FE	E0	9A	FA	FD
----	----	----	----	----	----

### Description:

This command selects the decode measurement.

The decode select code 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 decode 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	9A	E0	7F	22	00	00	FD
----	----	----	----	----	----	----	----	----

Memory location 63

FE	FE	9A	E0	7F	22	00	63	FD
----	----	----	----	----	----	----	----	----

Memory location 99

FE	FE	9A	E0	7F	22	00	99	FD
----	----	----	----	----	----	----	----	----

### Response:

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

### Examples:

162.550000 MHz

FE	FE	E0	9A	7F	22	00	00	55	62	01	FD
----	----	----	----	----	----	----	----	----	----	----	----

1045.725000 MHz

FE	FE	E0	9A	7F	22	00	50	72	45	10	FD
----	----	----	----	----	----	----	----	----	----	----	----

Error

FE	FE	E0	9A	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.

## READ DECODE MEMORY

### Command:

FE	FE	ra	ta	7F	23	memory	FD
----	----	----	----	----	----	--------	----

### Examples:

Memory location 0

FE	FE	9A	E0	7F	23	00	00	FD
----	----	----	----	----	----	----	----	----

Memory location 99

FE	FE	9A	E0	7F	23	00	99	FD
----	----	----	----	----	----	----	----	----

### Response:

FE	FE	ta	ra	7F	23	ds	decode data	FD
----	----	----	----	----	----	----	-------------	----

ds
----

 is a BCD value representing the selected decode measurement. BCD values are encoded as follows:

- 00: CTCSS decode
- 01: DCS decode
- 02: DTMF decode
- 03: LTR decode

### Examples:

CTCSS decode, 103.5 Hz

FE	FE	E0	9A	7F	23	00	10	35	FD
----	----	----	----	----	----	----	----	----	----

DCS decode, 732

FE	FE	E0	9A	7F	23	01	07	32	FD
----	----	----	----	----	----	----	----	----	----

DTMF decode, "0123\*#C"

FE	FE	E0	9A	7F	23	02	00	01	02	03	14	15	12	16	16	16	FD
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

LTR decode, AREA = 1, GOTO = 11, HOME = 03, ID = 176, FREE = 08

FE	FE	E0	9A	7F	23	03	01	11	03	01	76	08	FD
----	----	----	----	----	----	----	----	----	----	----	----	----	----

Error

FE	FE	E0	9A	FA	FD
----	----	----	----	----	----

### Description:

This command instructs the unit to send the decode measurement 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 decode select is in the form of 1 byte, consisting of 2 BCD digits, and specifies the type of decode measurement data returned. The decode data is in the form of from 2 to 10 bytes, each consisting of 2 BCD digits. 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	9A	E0	7F	24	FD
----	----	----	----	----	----	----

### Response:

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

### Example:

OK

FE	FE	E0	9A	FB	FD
----	----	----	----	----	----

Error

FE	FE	E0	9A	FA	FD
----	----	----	----	----	----

### Description:

This command clears all frequency and decode memory locations.

Once this command is executed, all memory locations are set to zero. This command has the same effect as clearing the memory from the front panel.

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

**OPTOELECTRONICS, INC.**  
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