Optoelectronics, Inc.
Scout™
Serial Interface Specification

Interface Version 1.1

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INTRODUCTION

This document describes the serial interface of the Scout™, a miniature hand-held frequency counter capable of measuring the frequency of VHF and UHF transmitters and other signal sources. The Scout™ has special features which make it invaluable for radio surveillance work. In particular, the Scout™ is capable of automatically capturing and storing up to 400 frequencies, along with the number of occurrences, or count, of each frequency. This frequency data can then be downloaded to a personal computer for logging and analysis. In addition, the Scout™ can be connected to a scanning receiver, such as the Realistic PRO-2006 or PRO-2005 receiver equipped with an OptoScan456™ board, to automatically tune the receiver to captured frequencies in real time. In this configuration, frequencies captured by the Scout™ can be monitored immediately.

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

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ABOUT CI-V

The serial interface on the Scout™ conforms to the Icom CI-V interface standard. The CI-V 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 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-V 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 eleven-byte command is transmitted to a device on the bus, which returns a six-byte response, the computer will receive a total of seventeen 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 Scout™ to a computer, a subminiature phone jack is provided on the top panel. An external interface converter box, such as the Optoelectronics model CX12 or Icom model CT-17, is required to connect the Scout™ to an RS-232C computer interface. Its purpose is to convert the CI-V interface voltage levels to RS-232C levels compatible with most personal computers.

CI-V ADDRESS JUMPER SETTINGS

There are two jumpers located on the Scout™ circuit board which are used to select the CI-V interface address. Four different addresses are available, making it possible for up to four Scout™ units to be connected to a CI-V interface bus. In order to communicate with the Scout™, the computer software must specify the address selected by the two jumpers. The CI-V address jumper settings are listed in Table 2 below. All addresses are specified in hexadecimal notation. The factory default setting, address 90, is shown in bold type.

Table 2. CI-V Address Jumper Settings.

U2 PIN 6	U2 PIN 7	ADDRESS
OPEN	**OPEN**	**90**
SHORT	OPEN	91
OPEN	SHORT	92
SHORT	SHORT	93

COMMAND REFERENCE

As mentioned earlier, the Scout™ conforms to the Icom CI-V interface standard. In this section, all CI-V command and response bytes are expressed in hexadecimal notation.

When NORMAL mode is selected, the Scout™ recognizes eight different commands. The commands, along with their corresponding responses, are summarized in Table 3 below. The Scout™ only responds to commands when NORMAL mode is selected (CAPTURE and RECALL switches both in the OFF position). In all other modes, the Scout™ automatically tunes a receiver connected to the CI-V interface, and, therefore, can accept no commands.

Following the 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 Scout™. The two address jumpers are used to select any address in the range 90 through 93. Each device on the CI-V bus must have its own unique address. The Scout™ will not process any command in which the RECEIVE ADDRESS does not match the address selected by the address jumpers. However, the Scout™ 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-V 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 Scout™. 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 Scout™ will not process any command in which the TRANSMIT ADDRESS matches its own address selected by the address jumpers.

Table 3. Scout™ CI-V Interface Command Summary.

COMMAND	SUB-COMMAND	DESCRIPTION
03	-	Read frequency.
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	23	Read count memory.
7F	24	Clear memory.

READ FREQUENCY

Command:

FE	FE	ra	ta	03	FD

Example:

FE	FE	90	E0	03	FD

Response:

FE	FE	ta	ra	03	frequency	FD

Examples:
162.550000 MHz

FE	FE	E0	90	03	00	00	55	62	01	FD

1045.725000 MHz

FE	FE	E0	90	03	00	50	72	45	10	FD

Error

FE	FE	E0	90	FA	FD

Description:
This command instructs the unit to send the current counter frequency measurement result. This command is only valid when NORMAL mode is selected.

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, the command is ignored, and the error response is returned. If NORMAL mode is not selected, the command is ignored, and no response is returned.

READ SIGNAL STRENGTH

Command:

FE	FE	ra	ta	15	02	FD

Example:

FE	FE	90	E0	15	02	FD

Response:

FE	FE	ta	ra	15	02	sd	FD

Examples:

0 bargraph segments

FE	FE	E0	90	15	02	00	00	FD

5 bargraph segments

FE	FE	E0	90	15	02	00	05	FD

16 bargraph segments

FE	FE	E0	90	15	02	00	16	FD

Error

FE	FE	E0	90	FA	FD

Description:
This command instructs the unit to send the current signal strength. This command is only valid when NORMAL mode is selected.

The signal strength data is in the form of two bytes, each consisting of two 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, the command is ignored, and the error response is returned. If NORMAL mode is not selected, the command is ignored, and no response is returned.

READ IDENTIFICATION

Command:

FE	FE	ra	ta	7F	09	FD

Example:

FE	FE	90	E0	7F	09	FD

Response:

FE	FE	ta	ra	7F	09	id	sv	iv	FD

Example:

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FE	FE	E0	90	7F	09	53	43	54	20	11	FD

Error

FE	FE	E0	90	FA	FD

Description:

This command instructs the unit to send the identification information. This command is only valid when NORMAL mode is selected.

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

If the command length is incorrect, the command is ignored, and the error response is returned. If NORMAL mode is not selected, the command is ignored, and no response is returned.

READ GATE SETTING

Command:

FE	FE	ra	ta	7F	20	FD

Example:

FE	FE	90	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 time
        01:      1 kHz resolution gate time
        02:      100 Hz resolution gate time
        03:      10 Hz resolution gate time

Examples:

10 kHz resolution

FE	FE	E0	90	7F	20	00	FD

100 Hz resolution

FE	FE	E0	90	7F	20	02	FD

Error

FE	FE	E0	90	FA	FD

Description:
This command instructs the unit to send the current gate setting. This command is only valid when NORMAL mode is selected.

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

If the command length is incorrect, the command is ignored, and the error response is returned. If NORMAL mode is not selected, the command is ignored, and no 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 time
- 01: 1 kHz resolution gate time
- 02: 100 Hz resolution gate time
- 03: 10 Hz resolution gate time

Examples:

1 kHz resolution

FE	FE	90	E0	7F	21	01	FD

10 Hz resolution

FE	FE	90	E0	7F	21	03	FD

Response:

FE	FE	ta	ra	FB or FA	FD

Examples:

OK

FE	FE	E0	90	FB	FD

Error

FE	FE	E0	90	FA	FD

Description:

This command selects the gate setting. This command is only valid when NORMAL mode is selected.

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

If the command length is incorrect, the command is ignored, and the error response is returned. If NORMAL mode is not selected, the command is ignored, and no response is returned.

READ FREQUENCY MEMORY

Command:

FE	FE	ra	ta	7F	22	memory	FD

Examples:

Memory location 0

FE	FE	90	E0	7F	22	00	00	FD

Memory location 19

FE	FE	90	E0	7F	22	00	19	FD

Memory location 247

FE	FE	90	E0	7F	22	02	47	FD

Memory location 399

FE	FE	90	E0	7F	22	03	99	FD

Response:

FE	FE	ta	ra	7F	22	frequency	FD

Examples:

162.550000 MHz

FE	FE	E0	90	7F	22	00	00	55	62	01	FD

1045.725000 MHz

FE	FE	E0	90	7F	22	00	50	72	45	10	FD

Error

FE	FE	E0	90	FA	FD

Description:
This command instructs the unit to send the frequency stored in the specified memory location. This command is only valid when NORMAL mode is selected.

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 399. 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 399, the command is ignored, and the error response is returned. If NORMAL mode is not selected, the command is ignored, and no response is returned.

READ COUNT MEMORY

Command:

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

Examples:

Memory location 0

| FE | FE | 90 | E0 | 7F | 23 | 00 | 00 | FD |

Memory location 19

| FE | FE | 90 | E0 | 7F | 23 | 00 | 19 | FD |

Memory location 247

| FE | FE | 90 | E0 | 7F | 23 | 02 | 47 | FD |

Memory location 399

| FE | FE | 90 | E0 | 7F | 23 | 03 | 99 | FD |

Response:

| FE | FE | ta | ra | 7F | 23 | count | FD |

Examples:

37 occurrences

| FE | FE | E0 | 90 | 7F | 23 | 00 | 37 | FD |

214 occurrences

| FE | FE | E0 | 90 | 7F | 23 | 02 | 14 | FD |

Error

| FE | FE | E0 | 90 | FA | FD |

Description:

This command instructs the unit to send the number of occurrences of the frequency stored in the specified memory location. This command is only valid when NORMAL mode is selected.

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 399. The count data is in the form of two bytes, each consisting of two BCD digits. The count will be in the range 0 to 255. See the examples shown above.

If the command length is incorrect, or if the specified memory location is not in the range 0 to 399, the command is ignored, and the error response is returned. If NORMAL mode is not selected, the command is ignored, and no response is returned.

CLEAR MEMORY

Command:

FE	FE	ra	ta	7F	24	FD

Example:

FE	FE	90	E0	7F	24	FD

Response:

FE	FE	ta	ra	FB or FA	FD

Example:
OK

FE	FE	E0	90	FB	FD

Error

FE	FE	E0	90	FA	FD

Description:
This command clears all frequency and count memory locations. This command is only valid when NORMAL mode is selected.

Once this command is executed, all frequency and count memory bytes are set to zero. The Scout™ can then begin to capture 400 new frequencies. This command has the same effect as turning the unit off and back on.

If the command length is incorrect, the command is ignored, and the error response is returned. If NORMAL mode is not selected, the command is ignored, and no response is returned.