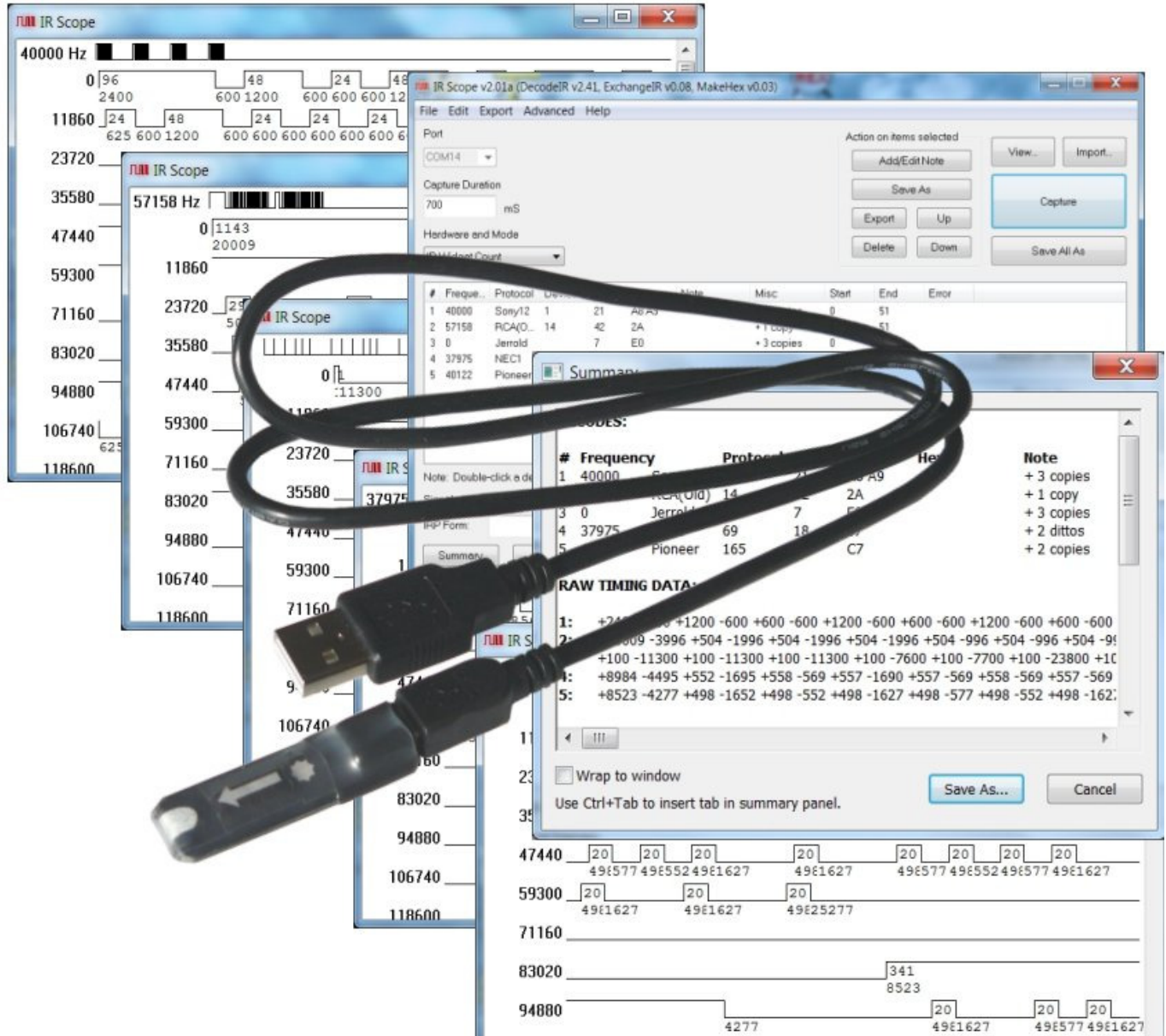


IR Widget & IRScope Operating Instructions

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1. INTRODUCTION The **IR Widget** and its companion Windows software, **IRScope**, is a tool for capturing, recording, and analyzing signals transmitted by infrared remote controls. Its fast optical sensor detects individual pulses of a remote's infrared LED to measure carrier frequency and ON/OFF times of carrier bursts with much greater accuracy and detail than possible with any other type of measurement instrument. Then **IRScope** uses its smart algorithms and broad data base to identify the signal protocol and provide a complete analysis. A graphic display similar to that of a digital storage oscilloscope provides a visual representation of the signal and shows precise timing details. Each recording can be from 1/2 to 15 seconds long, and can be zoomed in or out to an exact scale of from 1 to 1000 microseconds per pixel on your PC screen. The Widget can display an unlimited number of records simultaneously, and data can be saved or imported and exported in many different formats.

2. APPLICATION SOFTWARE A software bundle for **IRScope** (IRScope201a.zip) can be downloaded [here](#) , from which you can extract the following files:

- (1) IRScope.exe
- (2) DecodelR.dll
- (3) ExchangeIR.dll
- (4) MakeHex.dll
- (5) Features of IRScope version 2.pdf
- (6) DecodelR.html

Be sure and place items (1) through (4) in the same folder, any folder of your choice. Items (5) and (6) are not essential to operation of the **Widget** and can be discarded if you don't want to keep them. Item (5) is a good summary of the major features of **IRScope**, and also provides some useful information on drivers for the **Widget** and how to install them. Item (6) is an excellent reference on how protocols are decoded, and provides specifications for more than 100 of the most common infrared remote control protocols.

3. USB DRIVER A **Widget** requires the latest virtual COM port (VCP) driver available from FTDI Chip Ltd. Windows 7 may search and find the driver automatically, but if that doesn't work you can download it [here](#). If by chance you have an old **FTDI** driver installed in your PC (older than **2.04.06**) you must first uninstall it by using a utility called **CDM Uninstaller 1.4**, which you can download [here](#) as either a command line version or GUI version. The uninstaller download includes a brief **readme.html** file that explains how to use it.

The first time you plug in your **Widget**, Windows' **New Hardware Wizard** will prompt you through the driver installation process in two phases. First a driver is installed for the **USB Serial Converter** function of the **Widget**. Following that, a driver is installed for the **USB Serial Port** function of the **Widget**. Windows 7 may do it all automatically. In case of problems you can verify whether your driver installation is working by opening **Device Manager** and expanding both the **Ports (COM & LPT)** list and the **Universal Serial Bus controllers** list. Watch the lists as you plug in the **Widget**. A new entry called **USB Serial Port (COMX)** (where "X" is the virtual COM port number assigned by Windows) should pop up at the end of the **Ports (COM & LPT)** list, and simultaneously a new entry called **USB Serial Converter** should pop up at the end of the **Universal Serial Bus controllers** list, as shown below in Figure 1.

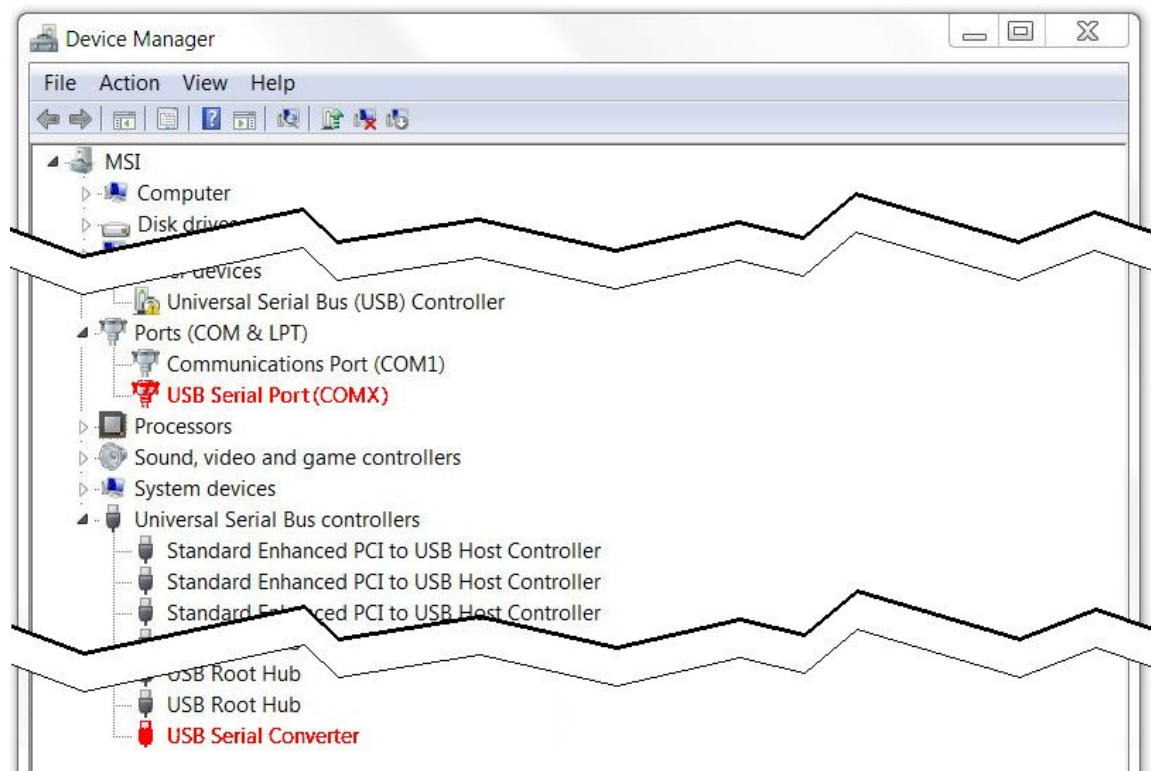


Figure 1. Device Manager Showing Typical Widget Device Recognition

4. THE MAIN WINDOW After plugging in your **Widget** and opening **IRScope** the main operating window will look something like Figure 2 below. It contains all of the **Widget** controls, and will remain on your screen as long as your recording session is active. The large blank area in the center is the decode area. It will list all the signals you capture, and also those you retrieve from previously saved records.

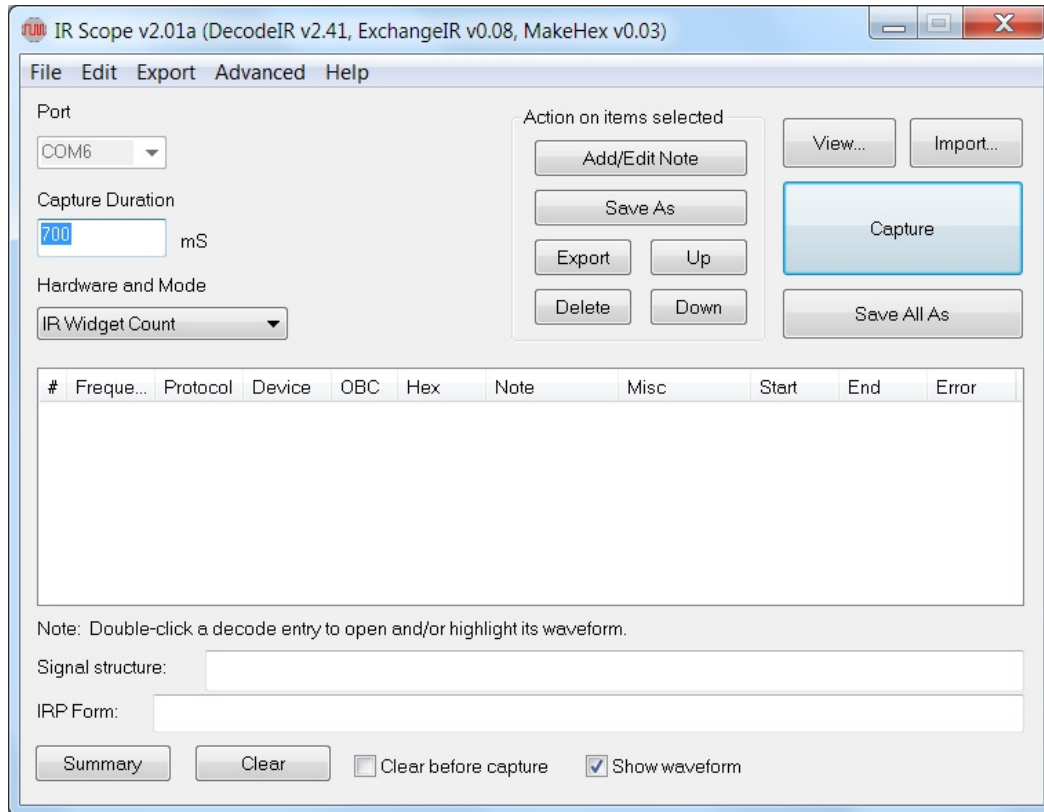


Figure 2. Default Main Window

The appearance may vary slightly depending on which **Windows** operating system you are using, as well as some of the configuration changes you may have made during your previous session. The registry has keys that preserve many configuration changes from one session to the next so you can save your preferences. To reset everything to default, run **Regedit** and delete the **IRScope** folder at **HKEY_CURRENT_USER / Software / UEIC**.

Port This must be set to the virtual COM port your **Widget** is connected to. There are two ways to set it, manual and automatic. If you drop down the **Advanced** tab menu and check the **AutoLocate Widget** option, then each time you open **IRScope** the computer will search through all the ports to find the **Widget**, and automatically select that port. It indicates this by greying out the **Port** box, as shown in Figure 2, and you can't change it. If you un-check the **AutoLocate Widget** option, then each time you open **IRScope** the **Port** box will be blue, letting you know that the port number selected may or may not be correct. If you get a port error message when you try to make a capture, you can drop down the list of COM ports and select the one that **Device Manager** says you are connected to.

Capture Duration Shows the total length of a recording in milliseconds, starting when the **Widget** detects the beginning of a signal from the remote. The entry in this box must be a whole number between **500** and **15000** (1/2 second to 15 seconds). The default value of **700 mS** is fine for capturing individual buttons, but will probably have to be increased for macros.

Hardware and Mode **ALWAYS leave this set on IR Widget Count.**

View button Used to select a previously saved file for viewing.

Import button Used to import **Pronto** and **UEI Learned** formats and also **Timing Lists** of the form displayed by the **Times Summary** of the **Learned Signals** tab of **IR.exe** or by the new **Summary** facility of this program. The **Pronto** import can handle both raw and pre-defined **Pronto** formats other than format 8000. Imported signals are displayed exactly as if they had been captured with the **Widget**.

Capture button Prepares the system to collect data. When you are all setup and ready to record a signal, point your remote at the window in the end of the **Widget**, click on **Capture**, and press a remote button to start transmitting. If you wait longer than five seconds before starting transmission the capture will abort with an error message. Otherwise, captured data will appear at the end of the **Capture Duration**. The default configuration is for the program to output an audible beep when you press **Capture** and again if it times out in five seconds. If you don't like the beeps, click on **Advanced** and check the **Suppress Beeps** option. A flashing white indicator in the **Widget** tells you when it detects infrared signals.

Decode area This area shows a list of all the signals you have captured. Most of the column headings are self-explanatory. If there is a **sub-device** its number appears following a decimal point in the **Device** column. Comments in the **Misc** column describe repetition characteristics of a signal. **No Repeat** means the signal consisted of only one full frame. **+N copies** means the signal consisted of the initial frame followed by **N** identical copies. **+N dittos** means the signal consisted of the initial frame followed by **N** ditto frames. These terms are defined as follows:

A "signal" is a message or command that causes a device to do something. A macro consists of two or more signals to the same or different devices.

Signals are made up of one or more "frames". Sometimes remotes are programmed to repeat frames a minimum number of times for redundant reliability. Sometimes frames are repeated as long as a button is held down.

Full frames often have an initial starting burst (usually distinctively long) and a final OFF time long enough to clearly indicate separation between frames. Within the frame are a series of bursts and spaces that encode address bits, data bits, etc.

Ditto frames consist of only a starting and ending burst. They are used primarily to indicate that a button is being held down.

For saving, exporting, or deleting a recording, moving it up or down in the list, adding notes, etc., select (highlight) the target decode entry by single-clicking anywhere on it. Deselect that one by selecting another one. Or deselect all of them by clicking in a blank area.

The **Start**, **End**, and **Error** columns are used mainly by Forum experts when debugging decoding problems, and so are not of much use to the typical user. My preference is to make better use of screen space by first sliding the right edge of the main window as far to the left as it will go, then sliding the right edge of the **Misc** column as far to the right as possible, out of sight. Illustrations throughout these instructions will appear that way.

Add/Edit Note Used to open a **Decode Note Editor** box for adding or modifying a comment in the **Note** column for a signal you have selected (highlighted) in the decode panel. Very handy for identifying the source of a signal, such as the brand and model of device controlled, remote used, button pressed, etc.

Save As Used to save a recording you have selected (highlighted) in the decode area. If you select more than one recording they will be joined approximately end-to-end and saved as a single file.

Save All As A faster and easier way to save the entire list of recordings in the decode area as a single file without having to first select them all individually.

Export Used to export decoded signals. The format depends on the selection in **Export Mode** under the **Export** drop-down menu, and can be either **Pronto**, **UEI Learned**, or **Lintronic** (a format used by the Beoworld community). The **Pronto** export is in the raw **Pronto** format, but can be generated from either the signal data or from its decode, as required. Exports are appended to a file called **ExportedUEI.txt**, **ExportedPronto.txt** or **ExportedLintronic.txt**, as appropriate, and the file is created if it does not exist. By default these files are created in the folder containing **IRScope.exe** but this can be changed with the **Set Export Output Folder** selection in the **File** drop-down menu.

Up, Down, and Delete Used to change the order of items in the decode area, or delete them entirely. Deleting a decode entry automatically deletes its waveform display.

Signal structure Shows additional information about a signal that is selected in the decode area.

IRP Form Presents a signal in **IRP** form when it is selected in the **Decode Panel**. The **IRP** representation is made independently of the decode operation, so an **IRP** form can sometimes be determined for signals that cannot be decoded by **DecodeIR**, and vice versa.

Summary Opens a **Summary** display box like the one shown in Figure 3.

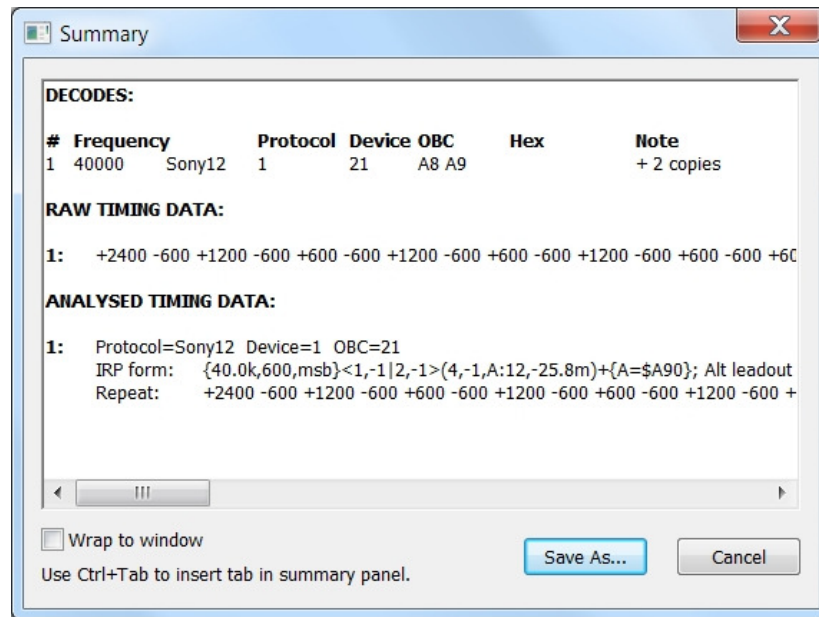


Figure 3. Summary Display

In addition to decoded parameters, the **Summary** display includes two forms of timing for a signal, the raw timings as used in the waveform display, and analyzed timings in which repeats have been identified and timings averaged over supposedly identical bursts. To see all timing data, either scroll horizontally with the slider at the bottom or check the **Wrap to window** box and scroll vertically with the slider at the right. The **Summary** display can be saved in either Rich Text Format (.rtf) or as a plain text file (.txt).

Clear Clears all entries in the decode area and their corresponding waveform displays. Does not delete any saved files.

Clear before capture Check this box to automatically clear the previous decode data and waveform each time you click the capture button in preparation for collecting new data.

Show waveform Checked by default, provides a **Waveform Display** of each new captured signal.

Menu Bar Right below the title bar of the main window is a menu bar with five drop-down menus, **File**, **Edit**, **Export**, **Advanced**, and **Help**. There are so many sophisticated features within these menus that rather than try to explain them all here I suggest you experiment with them to learn your needs and preferences.

5. THE WAVEFORM DISPLAY The main purpose of **IRScope** is to capture enough information about a signal transmitted from a remote control to identify it completely and display it graphically. When you click on the **Capture** button the PC sends a signal to the **Widget** to start looking. If the **Widget** sees a remote signal it starts transmitting data to the PC every 0.1 millisecond, telling it how many infrared carrier pulses it has seen and when the carrier is turned on and off. At the end of the **Capture Duration** the PC sends another signal to the **Widget** to stop looking.

Almost instantaneously, **IRScope** processes the data and displays the results two ways. First, its analysis and identification of the recording appears in the decode area of the main window. Second, a **waveform display** of the recording pops up in the upper left corner of your screen. Those two items define what was captured, and remain linked together (even if you close the **waveform display**), until the decode entry is deleted. For an example we will use a recording captured from a **Sony** remote by pointing it at the **Widget**, clicking on **Capture**, the tapping the **POWER** button on the remote.

Figure 4 shows the resulting **waveform display**, and Figure 5 shows the corresponding decode entry that appears in the main window. Even if **IRScope** is unable to identify an unknown protocol its waveform will be displayed.

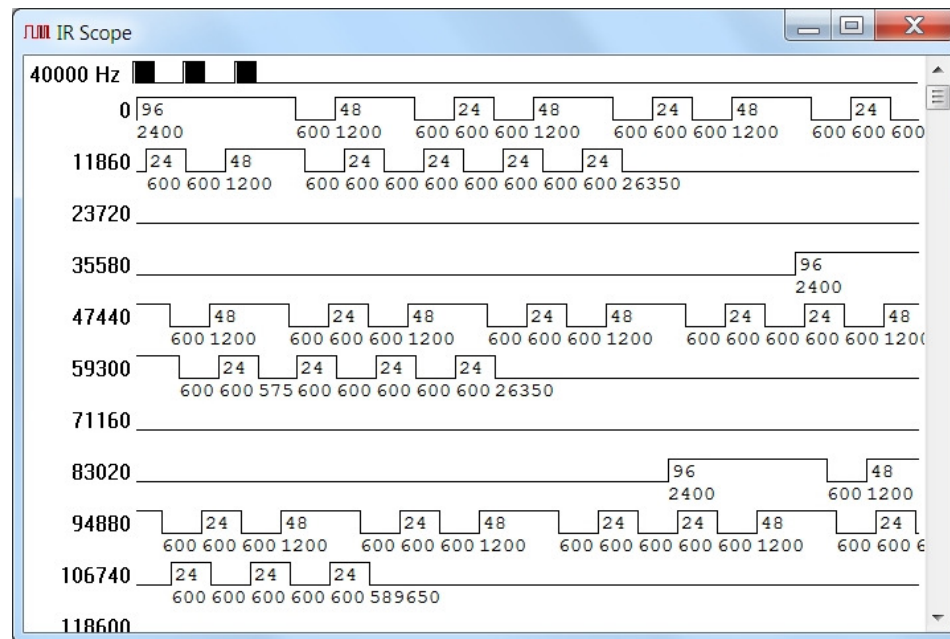


Figure 4. Waveform Display for Sony POWER Button

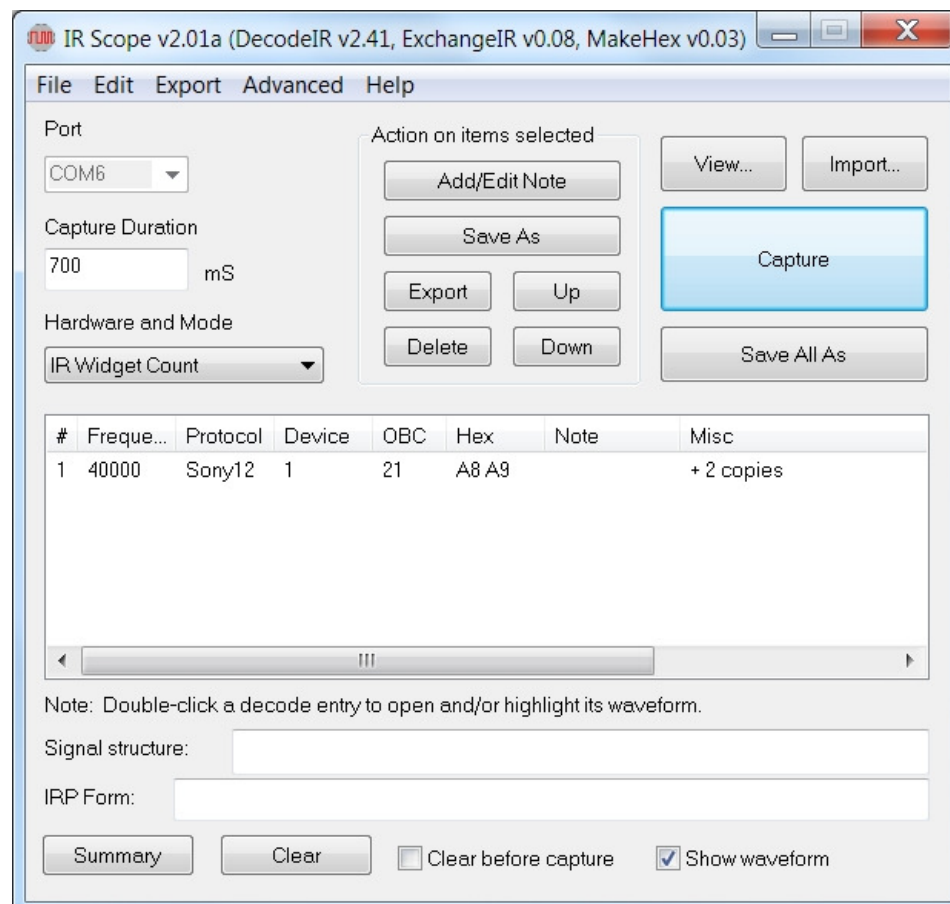
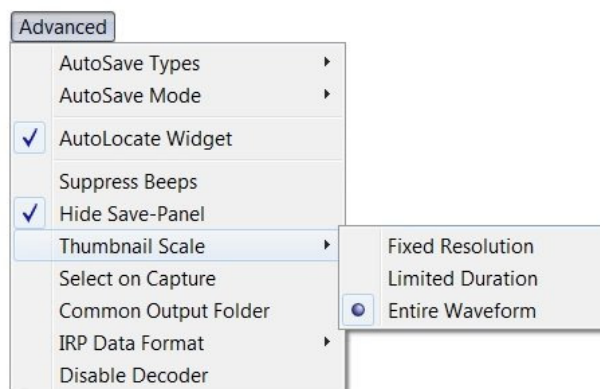


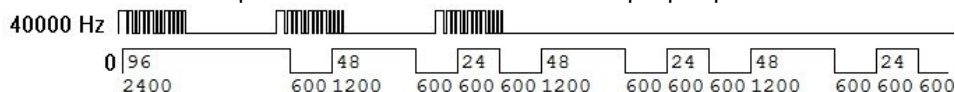
Figure 5. Decode Analysis for Sony POWER Button

In Figure 4 the first line of the waveform display shows the carrier frequency, followed by a one-line thumbnail sketch of the captured signal that provides an overview of your recording. Our example was shot with the default selection of **Thumbnail Scale**, which is **Entire Waveform**. That means the thumbnail shows everything that was recorded, from the beginning of the first signal to the end of the **Capture Duration** period 700 milliseconds later.

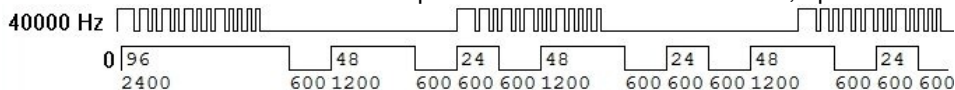
To select a different format for the thumbnail display, drop down the **Advanced** tab of the main window. There are three choices available.



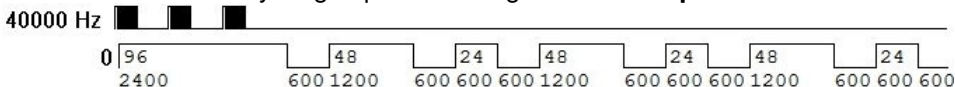
Fixed Resolution shows captured data at a resolution of 400 μ S per pixel:



Limited Duration shows as much of the captured data as will fit on the line, up to a maximum of 300mS:

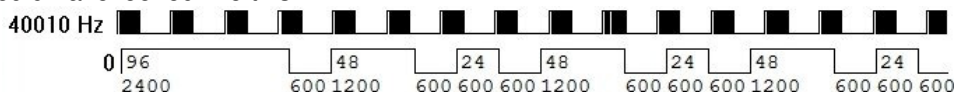


Entire Waveform shows everything captured during the entire **Capture Duration** time:



It's not necessary to capture new samples after changing the thumbnail scale. All waveform displays are immediately updated as soon as a different thumbnail scale is selected.

Sony12 protocol specifies transmitting a frame about twenty times per second as long as the button is held down, but in no case less than three times even for a brief press of the button. In our example the button was just tapped lightly, but If it had been held down steadily the **Misc** column of the decode entry would have said **+14 copies**, and the thumbnail would have looked like this:



The chart in Figure 4 depicts the demodulated carrier, drawn to a precise scale of 20 μ S per pixel. Waveform timing starts on the second line at time **0** (the moment the remote began transmitting), and increases from left to right across successive rows as you move down the screen. Numbers down the left side (**11860, 23720, 35580, 47440**, etc.) show the time in μ S at that point in the waveform. Raised portions of the waveform are periods when the carrier is turned ON, and lower (baseline) portions are periods when it is turned OFF. Numbers beneath the baseline (**2400, 600, 1200, 600**, etc.) are carrier ON and OFF times in μ S, and numbers above the baseline within the raised portions (**96, 48, 24, 48**, etc.) are the number of carrier cycles (infrared pulses) that were counted by the **Widget** during those ON bursts.

Each time you capture a record a new waveform is displayed, always in the upper left area of the screen at default size, stacked on top of those previously recorded, and a new decode line is added in numerical order in the decode area of the window. If the recording is of a macro it will be shown as a single waveform display with the actual time of separation between commands. But each command of a macro will be listed separately in the main window so it can be decoded individually.

You can drag waveforms anywhere on your screen to look at several of them at the same time, or you can use the convenient **Waveform Selection Tool** (described below) to look at them one at a time. The size, location, and scale of each waveform display can be individually adjusted with the mouse, but the changes will remain in effect only during the current session and cannot be saved with the waveforms.

6. THE WAVEFORM SELECTION TOOL This is without doubt one of the handiest features of **IRScope**. It enables you to collect an unlimited number of recordings and have instant access to the waveform of any one of them with a click of the mouse. The "Note" below the main window says it all: **"Double-click a decode entry to open and/or highlight its waveform"**

Suppose you have collected six records, all listed in the decode area in the order you captured them, with waveforms stacked on top of each other on your screen so that all you can see is record #6 on top of the stack. If you wanted to examine, for example, record #3 you simply double-click on that decode entry in the main window and instantly that waveform display is brought to the top of the stack and highlighted in red.

You don't even have to leave the waveforms stacked on your screen to use the selection tool. You can get them all out of the way by **CLOSING** them, as long as you **DO NOT** delete anything in the decode list of the main window. When you double-click an entry the waveform will be reopened automatically and highlighted for you.

The selection tool works similarly with macro waveforms. Instead of having to tediously scroll through a macro waveform display containing a bunch of commands to get to the one you want to examine, just double-click on its decode entry in the main window. If the macro waveform is already opened it will instantly scroll to that command, without changing size or position, and highlight only that portion so there's no mistake where it starts and ends. If the macro waveform is closed it will reopen automatically and scroll to the highlighted command.

7. SAVING AND RETRIEVING CAPTURED DATA It is strongly suggested that you form the habit of naming and saving important files promptly. When collecting a lot of data it's easy to get carried away and lose track of which records are which. Every capture event, whether it be for an individual signal or a macro, produces a temporary file containing all of the numerical data sent from the **Wizard** and used to generate the graphic **Waveform Display**. This data can be saved under a filename of your own choosing, or under a default filename automatically generated by **IRScope**, and consisting of the letters **IR** followed by a 14-character date/time code in the format: [YYYY] [MM] [DD] [HH] [MM] [SS]. Example: **IR20131225140621**. NOTE: This is the date/time you are saving the file, not the date/time the recording was collected.

**If you save a file using the same name as one that is already saved,
the new file will replace the old file without any warning.**

Saved files have an extension of **.ict**, but they are in text format and you can look at them with any text editor.

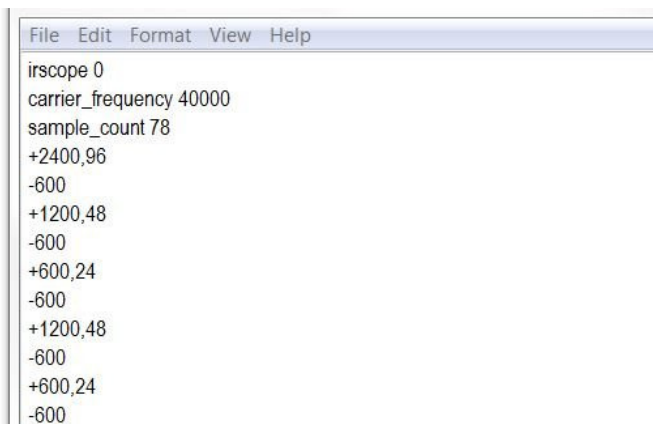
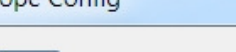
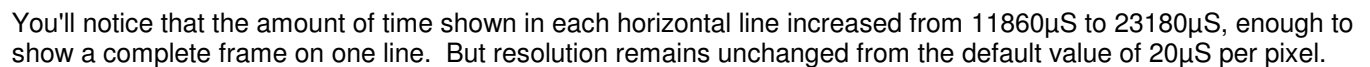


Figure 6. Portion of a Typical .ict File

Figure 6 shows the initial portion of a typical **.ict** file that has been opened with Notepad. A number preceded by a "+" symbol is a carrier burst ON time in microseconds, and a number immediately following a comma is the number of carrier cycles in that burst. A number preceded by a "-" symbol is an OFF time in microseconds between carrier bursts. As you can see, there's enough information in the **.ict** file to completely reproduce the recording.

8. CHANGING THE APPEARANCE OF A WAVEFORM DISPLAY IRScope allows you to manipulate the appearance of waveform displays in many ways, for taking measurements, making comparisons, etc. Probably the change that is most useful is to vary the waveform resolution to see more or less detail. It's fast and easy. To illustrate, I'll start with Figure 4 as an example. Here's the start of what that waveform looks like as captured.



IR Scope Config

20 microseconds per pixel

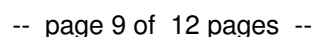
☒ Show elapsed time


☒ Show pulse times


☒ Show pulse counts


OK Cancel


The numbers showing ON and OFF times and carrier pulse counts are still there, but they are too jammed together to be readable. Unchecking those three boxes in IRScope Config will turn off the numbers for a clearer picture.



38072 Hz 

26685 
557 1690 557 570 556 1696 552 1696 556 1696

35580 
552 569 557 1696 530 596 552 1696 530 596

44475 
530 570 557 1690 557 570 556 570 557 569 552 1696

The timing diagram shows the following signals over 10 clock cycles:

- Clock:** A periodic square wave with a period of 10 clock cycles.
- Enable:** A square wave that is high for the first 5 clock cycles and low for the next 5 clock cycles.
- Data:** A 4-bit output signal that changes at the rising edge of the clock. The data values are: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

0 1 1 1 1 1 1

11200 11300 11300 7700 7700 650100

71160

A horizontal number line is shown. At the left end is a vertical line labeled '0'. To the right of '0' is a tick mark labeled '100'. Further to the right is another tick mark labeled '11200'. Below the number line, there is a label '593' positioned between the '100' and '11200' marks.

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9. WORKING WITH MACROS Capturing a macro is not much different from capturing an individual command. The main thing to remember is to set the **Capture Duration** to a value greater than the macro duration. You can just set the duration to a very long time, or estimate the duration by using the **Widget's** flashing white LED.

The measurement of carrier frequency shown in the decode entry is not quite as accurate when the captured signal is part of a macro rather than an individual signal. So if you need the best measurement of this parameter possible, try to capture a sample of that signal alone.

Remember to use the Waveform Selection Tool to zip instantly to different parts of a macro recording for examination. Don't waste time scrolling. You can save one or several commands of a macro as one file by selecting them in the **Decode Panel** and using the **Save As** button. But to save the entire macro as one file you don't have to select them one at a time. Just use the **Save All As** button instead.

10. TAKING MEASUREMENTS DIRECTLY FROM A WAVEFORM. Since waveforms are drawn to exact scale, you can take some timing measurements with a simple ruler directly from the screen. For example, suppose you wanted to know the time from the beginning of the first frame in Figure 7 to the beginning of the second frame. Notice that each line represents 11,860 μ S of time and is 6.7 inches in length. The total time from 0 to the start of the second frame includes the time for three complete lines (3 x 11,860 = 35,580 μ S) plus a portion of the fourth line (11,860 x (5.6/6.7) = 9,913 μ S), for a total of 45,493 μ S. In consideration of accuracy limitations the total should be rounded off to three significant figures, or 45.5mS.

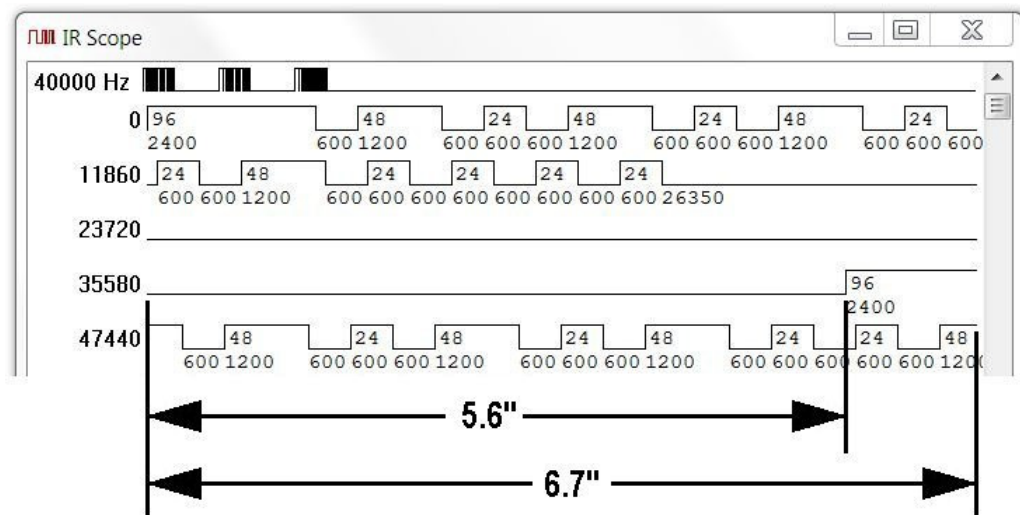


Figure 7. Measuring the Time From One Frame to the Next

An even faster and easier way to find this time is to adjust the width of the waveform display until the point of interest lies at the start of a line.

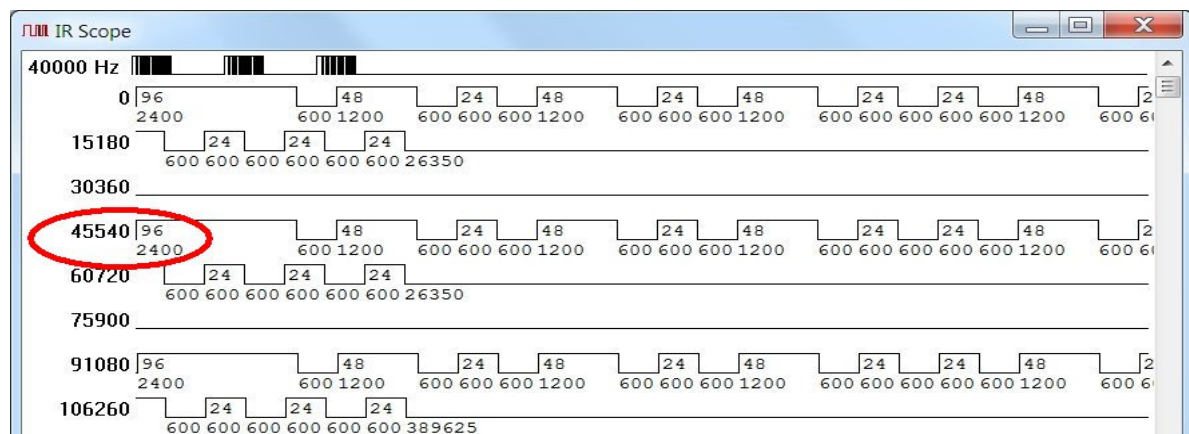


Figure 8. Display Width Adjusted to Start of Frames

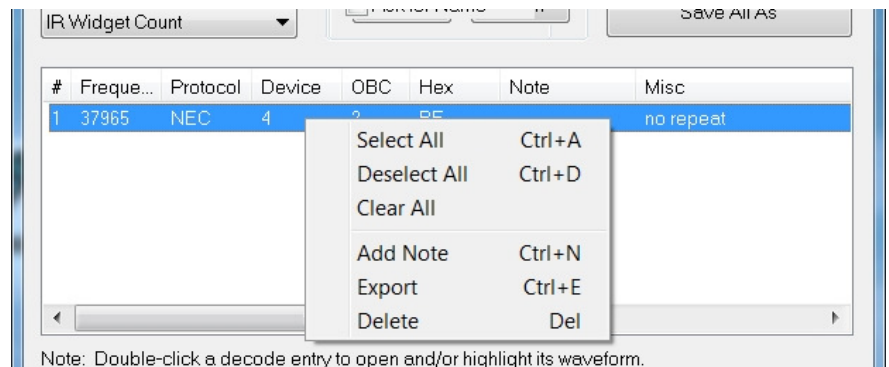
In Figure 8, the waveform has been expanded until the **2400µS** lead-in burst of the second frame lies exactly at the beginning of the fourth line. Since the fourth line starts at **45540µS**, that is the time from start of frame #1 ("**0**") to start of frame #2. Notice how closely this value agrees with the previous measurement made with a ruler. You can also see that the third frame starts at **91080µS**, which is exactly $2 \times 45540\mu\text{S}$.

You can use this same method to find the time between any two points "A" and "B" on the waveform. Adjust the display width to find the time from "**0**" to the first point "A". Then adjust the width to find the time from "**0**" to the second point "B". The difference between these two values is the time from "A" to "B".

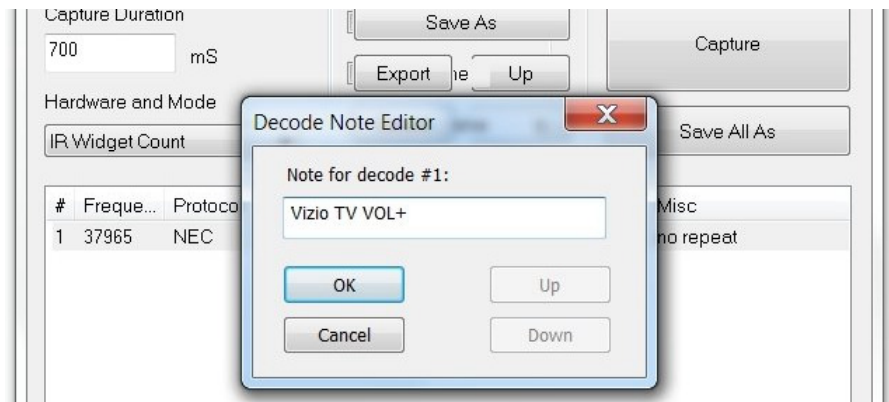
11. ADDING NOTES TO YOUR DATA The

The decode entry identifies the button alright, but "NEC1 Device 4 OBC 2 Hex BF" is not very descriptive when you're searching for a recording maybe a day or more after you captured it. You can add descriptive information to a saved waveform easily.

Right-click on a selected entry in the decode area to drop down a menu, then Click on **Add Note** to open the **Decode Note Editor** window.



Type your note in the box. The note can be as long as you want, but for practical reasons it is recommended you limit it to a dozen or so characters if you want to be able to read it in the limited width of the **Note** column in the decode area.



If all of your note is not visible you can make the **Note** column wider by sliding the left or right margins.

