

# BOYS TOWN NATIONAL RESEARCH HOSPITAL

## **SysRes**

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### **ABSTRACT**

SysRes is a program designed to measure a system response by performing synchronous averaging of the response to a wideband stimulus. This document is based on version 1.83 of the SysRes program.

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## Introduction

SysRes is short for System Response and was modeled after the SysID program ([www.sysid-labs.com](http://www.sysid-labs.com)). In addition to being able to do real-time simultaneous response measurements, SysRes can also do DPOAE averaging in the style of CUBeDIS. Both SysID and CUBeDIS were originally written by Jont Allen. SysRes is a highly portable program having been implemented on Windows, DOS, and Linux operating systems and in 5 different environments. The current version of SysRes supports high quality sound cards such as the 20-bit Pinnacle or Fiji from Turtle Beach/Voyetra and the CardDeluxe from Digital Audio Labs<sup>1</sup>. In addition, SysRes is capable of supporting more than one sound card in the Win32 environment (but not at the same time).

SysRes is a program of having many possible uses. With the correct configuration, SysRes can measure a response from just about any system. In particular, the program was written with the use of inner ear responses using a OAE probe microphone, such as the Etymotic ER-10C.

## Tutorial

SysRes is a command driven program, meaning all of the user input and program commands are given through the keyboard. This tutorial will give an overview of how to use SysRes and some of the common commands. Additional commands will be explained in detail in the Commands section.

Start SysRes by typing **sysres** on a Linux or DOS command line, or clicking the SysRes icon in Windows. When the program starts the configuration parameters are all set to their default values. More complex configurations will be introduced later, along with more complex uses for SysRes.

The most basic use of SysRes is to get a system response. For simplicity purposes, a loop-back configuration will be presented first. With a loop-back configuration, the soundcard output is connected to the soundcard input. Effectively all stimulus output is regained in the input, and the response will be the same as the stimulus. Once a loop back cable has been connected to the soundcard, start SysRes. A Turtle Beach Pro Series soundcard is being used in this example. Upon starting the program make sure SysRes properly found the soundcard. Issue the **di** command and the current soundcard and other information will be shown on the message portion of the screen.

Next, issue the **fn** command to compute a frequency response using the noise stimulus. As seen in Figure 1, a uniform frequency response is gathered from the stimulus since all of the stimulus is just fed back into the soundcard.

Another way at viewing the response is along a time and magnitude axis. To change the view issue the **tr** command and a different graph will appear. From the response that a loop back gathers, the time and magnitude axis gives a graph looking like a uniform line with a disturbance. Since it appears the only thing on this graph of importance is this disturbance, we are going to zoom into this portion of the graph. This is done by setting the *zoom time* values, **zt1** and **zt2** respectively. Since the portion of the graph we are interested in is on the left side set **zt2** to a value of 0.003 to zoom into the portion of the graph from 0 to 3msec. Issue the command **zt2=0.003** to set the value. Automatically the **zo** value is set to **1**, so all that is left is to redraw the graph by issuing the **tr** command again, and a screen like figure 2 will appear.

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<sup>1</sup> However, the CardDeluxe has not been implemented on the Linux versions since no driver or card information is available.

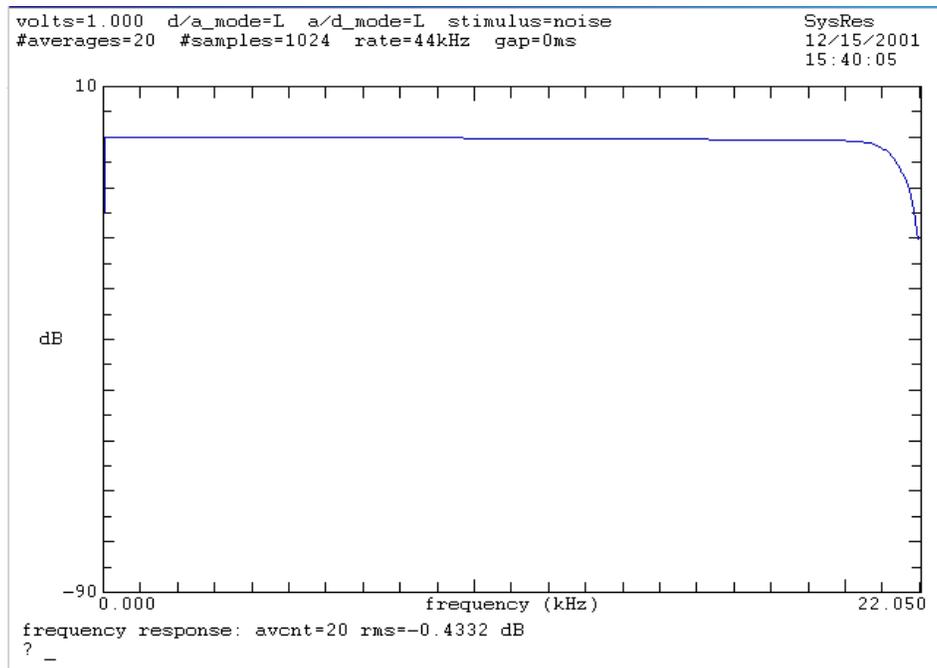


Figure 1

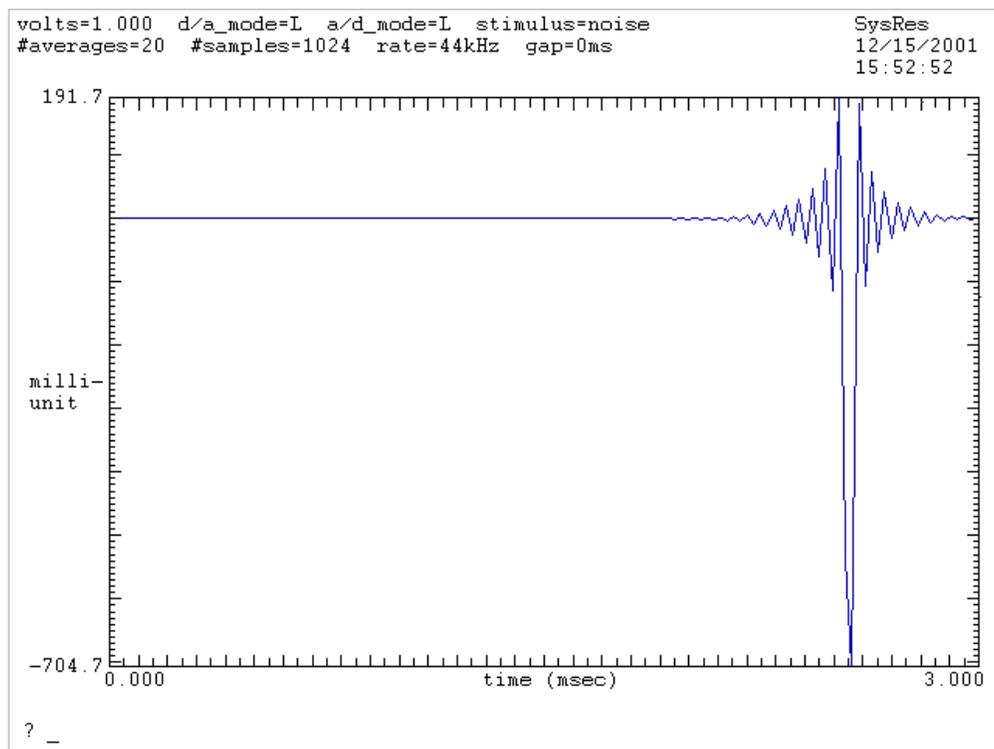


Figure 2

In order to zoom in closer to the disturbance in the graph set the **zt1** value to something like 0.002. To see the whole graph reset the **zo** value back to 0 by issuing the command **zo=1**, and redrawing the graph with the **tr** command.

This kind of example can certainly be done using a different configuration. For example, a simple microphone and speaker to gather data from a certain environment, or even using a device like an OAE probe microphone, such as the Etymotic ER-10C.

In order to print a screen to either a file or a printer first make sure that the correct output is configured. Issue the **PN** command to get the current output. To print to a file, just set **PN** to a file name, for example **PN=output.prn** will create the file output.prn in the current working directory containing either a postscript or PCL image of the screen. To print to a printer, set **PN** to a printer name. Although, when running SysRes in a Linux environment, precede the printer name with an explanation point (!). Next, select the type of orientation to use by setting **PO** to either **0** for landscape (which is default), or **1** for portrait. Then select the file type to print to by setting the **PT** value to either **0** for postscript (which is default), or **1** for PCL. Finally, when the values have been set issue the **PS** command to print the screen.

## **Commands**

SysRes is a command driven program. All of the commands are an abbreviated form. When entering a command to set a value within the program, an equals sign [=] is needed directly after the command with no spaces. If no equals sign and new value is present, the current state of the value is shown, otherwise explicitly stated.

### **Configuration Commands**

The configuration commands allow the user to configure and set values that effect the stimulus and response.

- ad** – Set analog to digital (A/D) mode (input) to a corresponding channel. If no value is given, 0 is assumed and no input is set. [0=No input, 1=L 2=R 3=L&R 4=L/R 5=R/L] Default: just Left channel. (1)
- da** – Set digital to analog (D/A) mode (output) to a corresponding channel. If no value is given, 0 is assumed and no input is set. [0=No output, 1=L 2=R 3=L&R 4=L/R 5=R/L] . Default: just Left channel. (1)
- dc** – Set the DC component removed from response. [0=keep 1=remove]
- ia** – Input attenuation from the microphone or probe (in dB). Default: 0.0 (dB)
- na** – Set the number of averages for the stimulus, anywhere from 1 to 32000. Default is 20.
- ns** – Set the number of samples for the stimulus, anywhere from 64 to  $2^{20}$ . This number must be a power of 2. Default is 1024.
- oa** – Output attenuation to the speaker or probe (in dB). Default is 0.
- sk** – Number of repetitions to skip prior to averaging
- sr** – Set the sample rate to be used, default is 44 kHz. See specs for each card for acceptable sample rates.

### **Frequency Response Commands**

These commands handle initializing stimulus response computation.

- fc** – Measure frequency response using the chirp stimulus.
- fi** – Measure frequency response using the impulse stimulus.
- ft** – Measure frequency response using the tone stimulus.
- fp** – Measure frequency response using the tone-pair stimulus.
- fn** – Measure frequency response using the pseudo-random noise stimulus.
- fu** – Measure frequency response using a user defined stimulus by setting using an external file (preceded by an equals sign).
- fr** – Frequency response using the previously used stimulus, default is the chirp stimulus.
- nf** – Measure noise floor (normalized to stimulus).
- no** – Normalize to saved response (= filename) that was previously saved in a file.
- sa** – Measure spectral average by repeatedly measuring the system response.

## Plot Commands

These commands deal with the different implemented plot features .

- cs** – Clear screen; this will clear the plotted data.
- crn** – This command will set the upper right-hand corner of the screen to a specified string. “SysRes” is the default string. When set to “\$fn” the most recently read data file name will be displayed.
- dr** – Dynamic range; This sets the dB range on the graph. Upper limit is 10 (dB) and the lower limit changes depending on the value given. For example, giving a value of 50 sets the upper limit to 10 (dB) and lower limit to -40 (dB). Default value is 100 (dBmax = 10 dBmin = -90). (See **vr**).
- dm** – Delay axis maximum (ms). When **shd** (show delay) value is set to 1, the delay data is shown upon a frequency response or a replot command. The **dm** command will set the upper value shown on the graph data. Default is set to 4 (ms).
- dn** – Delay axis range (ms). Like the **dm** command, the delay data will only shown if the **shd** (show delay) value is set to 1. The **dn** command will allow the user to set the lower value in respect to what the **dm** (delay maximum) value is set to, the range of the graph data. Default is set to 5 (ms).
- do** – Delay offset removed (ms). This command will allow the user to better synchronize the input and output by setting an approximate delay caused by the sound card. Default is set to 0 (ms).
- eml** – Extra message lines. This command will enable the user to see more then one line of messages underneath the graph data. When one or more extra lines in indicated it will condense the graph data up respectively. This parameter is incremented automatically when needed. Default is zero.
- pl** – Toggle frequency domain scale from log to linear and vice versa. Default is set to a linear scale.
- pm** – Set the upper bound (maximum) of the phase axis (cycles). Default is set to 2.
- pn** – Set the range and lower bound of the phase axis (cycles). Default is set to 4.
- po** – Phase offset removed (cycles). This command will set the offset of the phase when graphed. Default is 0.
- pr** – Plot response versus frequency. This is the default setting for the graph. This will also re-plot the current data on the graph in regard to any of the plot settings that have been changed. However, only the most recent data will be re-plotted.
- ps** – Plot stimulus versus frequency. Allows the user to plot the behavior of the stimulus relative to the response on the same graph. This command will also replot the current plot data to represent the current plot settings.
- shd** – Show delay mode. Allows the user to view the delay graphed data when the value is 1, although the graph will not show until a frequency response has been issued. Default is set to 0. **shd** will override **shp** when both are set to 1.
- shp** – Show phase mode. Allows the user to view the phase graphed data when this value is 1, although the graph will not show until a frequency response has been issued. Default is set to 0. When both **shp** and **shd** are turned on (set to 1), **shd** will override **shp**.
- tr** – Plot response versus time. Shows the frequency response data as time on the x-axis.
- ts** – Plot stimulus versus time. Show the stimulus data as time on the x-axis.
- td** – Specifies the direction of the ticks on the graph. 0 is inward and 1 is outward. Default is 0.
- te** – Plot reverse-time-energy vs time for frequency response data.
- vr** – Voltage reference (dBV). Set the upper value of the dB axis. The lower value is set in respect to what the allowed range is with the **dr** command. Default value is 10.
- SR** – SPL reference (dBSPL). This also sets the upper value of the dB axis, when it is in SPL mode. (See **vr**).
- zf1** – Zoom frequency 1. This and the following command allows the user to zoom into a certain portion of the frequency axis by setting the lower and upper value of frequency in hertz. If invalid values are set, like if **zf2** is bigger then **zf1**, then the min and max values along the axis are displayed. Once a user sets either **zf1** or **zf2**, **zo** becomes 1.

- zf2** – Zoom frequency 2. Likewise with **zf1**, this command allows a user to set the upper value of the frequency axis to zoom in Hertz. To show the zoomed graph once both **zf1** and **zf2** have been set, just issue the **pr** command to view the zoomed graph.
- zt1** – Zoom time 1. This and the following command allows a user to zoom into a certain portion of the time axis by setting the lower and upper value of time in seconds.
- zt2** – Zoom time 2. Likewise with **zt1**, this command allows a user to set the upper value of the time axis to zoom in seconds.
- zo** – Zoom on/off (toggle). Default is off. When one of the zoom commands are set, **zo** gets set to on.

## File commands

These commands deal with the file reading and writing capabilities of SysRes. All of the commands deal with files in the current working directory, issue the command **cd** to set or view the current directory.

- lf** – Log messages. When this command is set to 1, a log file is created in the current working directory called `sysres.log`. This will log all of the messages, and will stop logging the messages once **lf** is set back to 0. If there already is a file called `sysres.log` in the current working directory all logged messages will be concatenated to the end of the file.
- ra** – Read ASCII data file from current working directory. If no file name is given, **SYSRES** will try to read from the file `sysres.txt`. Don't know what this command is used for.
- rc** – Read configuration file. This command will read the file `sysres.cfg` within the same directory if present. The configuration file is created by the **wc** command.
- rd** – Read data file (MATLAB). If no file name is given, **SYSRES** will try to read the file `sysres.mat` within the current directory.
- rl** – Read list of commands from file. Must supply a file name that has a `.lst` extension in the current working directory. For more information on how to create a command list file consult the command list section of this manual.
- rs** – Read stimulus file. This command will read a MATLAB file (`.mat` extension) that contains stimulus data. File name must be given must be in the current working directory.
- sv** – Sample value for 1 volt (in stimulus files). Don't know what this command is used for.
- wa** – Write ASCII data file. Will write ASCII data in the file `sysres.txt` of the current working directory.
- wc** – Write configuration. This will save the current configuration settings to the file `sysres.cfg` in the current working directory.
- wd** – Write data file in MATLAB format (`.mat` extension). If no file name is given, then the file `sysres.mat` will be written in the current working directory.
- wh** – Write help file. This command will write all of the help information (like the command **h**) to the file `help.txt`.
- ws** – Write stimulus file. This command will write a stimulus file in the MATLAB format in the current working directory by specifying a file name.

## Printer commands

- PL** – Printer label. Default is “\$vn”, which displays the SysRes version number.
- PN** – Printer name. This will set the printing destination or command upon the **PS** command. Default is set to `sysres.prn`. For example, to set SysRes to print directly to the printer when running in Linux set the printer name to `!lpr`.
- PO** – Print orientation. This will change the printing orientation 0=Landscape 1=Portrait
- PS** – Print screen. This command will print the screen in either PostScript or PCL format to the specified printer name (**PN**), or to a specified file with the equals sign. For example, to print the screen to a file, and to name that file `screen.prn`, give SysRes the command **PS=screen.prn**.

**PT** – Printer type. Allows a user to change the file type from either PostScript or PCL. Default type is PostScript.

### **DPOAE commands**

These commands describe and control a DPOAE experiment.

- avm** – average weighting mode (0=uniform, 1=RMS, 2=MS)
- ca** – calibrate (specify buffer size)
- cach** – DP calibration channel (0 or 1)
- ct** – calibration tones (specify frequency in Hz)
- cn** – specify calibrate buffer size (samples)
- dp** – display distortion product ( $2 * F_1 - F_2$ ) vs time  
" = display one short-term spectrum
- dpbw** – DP envelope bandwidth (Hz)
- dpch**– DP analysis channel (0 or 1)
- dpdp**– display  $3 * F_1 - 2 * F_2$  component also (0=NO, 1=YES)
- dpef** – DP exponential fit type (0, 1 or 2)
- dpen**– DP envelope size (power of 2, 0=STFT)
- dpfc** – DP fit complex (0=NO, 1=YES)
- dpft** – DP filter type (0=24dB, 1=Blackman, 2=Gaussian)
- dpno**– set DP noise display (0=off, 1=on)
- dpon**– set DP order number [-1= $2 * F_1 - F_2$ ]
- dpsb** – DP noise sidebands (% of DP frequency)
- dpst** – Copy the DP stimulus to the response buffer, as if it were measured.
- dptl** – DP initial time-constant (sec) [0.1]
- om** – offset for DP envelope analysis (msec)
- os** – offset for DP envelope analysis (samples)
- rjm** – reject mode (0=none, 1=DPN)
- rjn** – maximum number of rejects
- rjt** – reject threshold (dB SPL)

### **Stimulus commands**

- a1** – Attenuation of tone 1 (dB)
- a2** – Attenuation of tone 2 (dB)
- a3** – Attenuation of tone 3 (dB)
- bd** – Beginning duration (msec) specifies silence before stimulus onset.
- dbms1** – Growth rate of tone 1 (dB per msec) for stimulus with exponential ramps.
- dbms2** – Growth rate of tone 2 (dB per msec) for stimulus with exponential ramps.
- dbms3** – Growth rate of tone 3 (dB per msec) for stimulus with exponential ramps.
- ed** – End duration (msec) specifies silence after stimulus termination.
- f1** – Frequency of the first tone (kHz). Default is 1000.

- f2** – Frequency of the second tone (kHz). Default is 1200.
- f3** – Frequency of the third tone (kHz). Default is 0 (indicating none).
- l1** – Level of tone 1 (dB SPL)
- l2** – Level of tone 2 (dB SPL)
- l3** – Level of tone 3 (dB SPL)
- od** – Ramp onset duration (msec)...don't know that this does.
- rt** – Ramp type (0=None, 1=Linear, 2=Cosine, 3=Blackman)...not sure what this does.
- st** – Stimulus type: [0=chirp, 1=impulse, 2=zero, 3=tone, 4=tone pair 5=noise, 6=user defined, 7=masking]  
Default: (0) chirp.
- vo** – Volts (stimulus amplitude). Default is 1.

### **Masking commands**

These parameters describe the stimulus for a forward masking experiment.

- ma1** – masker attenuation (dB)
- ma2** – probe attenuation (dB)
- mf1** – masker frequency (Hz)
- mf2** – probe frequency (Hz)
- mmd**– masker duration (msec)
- mmr**– masker ramp time (msec)
- mms** – masker start time (msec)
- mpd** – probe duration (msec)
- mpg** – probe gap time (msec)
- ms** – initialize forward masking stimulus
- mtd** – timing pulse duration (msec)
- mtv** – timing pulse amplitude (volts)

### **Other commands**

- be** – Beep, plays a system sound.
- bp** – Band-pass filter (from F1 to F2)
- cd** – Get or set the current directory. Default is where the program executes from.
- co** – Comment. This command will insert one line of text in the portion above the plot data and below the information data.
- dbg** – Debug mode, causes commands read from a list file to be displayed on the command line (as if they were typed) before they are executed (0=off, 1=on).
- di** – SIO device information. This command will display the current sound card information and allow a user to change sound cards if applicable. For example, if there are two sound cards installed, to allow SysRes to work with the second sound card issue the command di=2.
- et** – Elapsed time. Displays the amount of time in seconds that has elapsed since the start of the program.
- ga** – Gap between stimulus repetitions (sec)
- go** – Average and show time-domain response
- ls** – List file names of the current working directory in the message portion.

- sm** – Sensitivity of microphone (V/Pa)
- ow** – Overwrite existing data files without prompting (0=no, 1=yes).
- pa** – Pause (with optional message after =).
- pg** – Pregap before I/O (sec)
- q** – Quit
- sl** – Sleep for N seconds
- to** – Time-out pause after N seconds
- vn** – Displays the version number of SysRes.

### **Command Lists**

SysRes has a scripting capability to run list files that contain commands instead of having to type them in every time. This feature can be used to do repeated frequency responses, calculations, or configurations. A command list file is a regular text file that ends with the .lst extension. Each command is on one line and comments can be inserted by starting a line with a semi-colon (;). When starting the SysRes program from a command line, if a command list filename has been issued along with SysRes, SysRes will begin to execute the command list once the program starts. For example, issuing the command `sysres command.lst` SysRes will start running the command list `command.lst` instead of having to issue the command **rl=command.lst**.

It is also useful to insert pause (**pa**) commands to a list. This gives the user the opportunity to pause a list that is being executed to record or view graph data. In addition, a comment can be inserted to show up on the message portion of SysRes by setting **pa** to that string. For example, to pause the list to record data on an external source include the line **pa=record data** at the point of the list, and when the list is executed it will pause at that point and 'record data' will appear in the message portion.