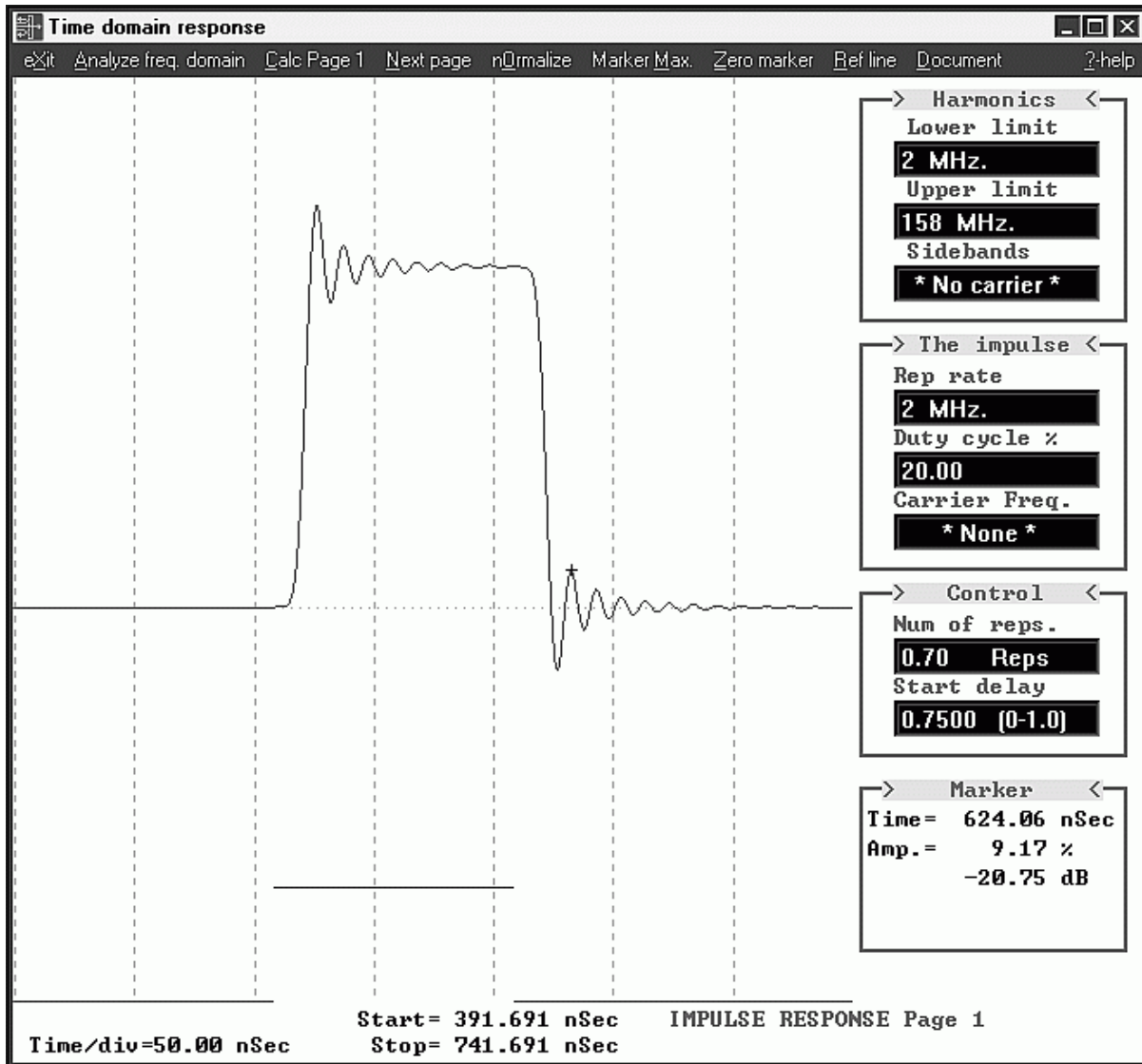


## Fourier Impulse response

This program calculates and displays the impulse or gated RF "carrier" response of a network by summing the amplitude and phase of each point of the spectrum represented by the impulse specified.



### > Harmonics <

Lower limit  
Upper limit

The edit boxes in the >Harmonics < area set the range for harmonics or sidebands of the impulse that will be included in the analysis. This should be ALL of the harmonics that are less than 60 dB down the attenuation skirts of the filter being evaluated. You must check this range and set the limits manually or transfer them from analysis. The range shown initially will be that of the repetition rate and up to the 600th harmonic (600 total frequency points) of a "spike". The values are adjusted to be exact harmonic or sideband frequencies.

NOTE: The total number of frequency points analyzed is adjusted by setting these frequency limits. The maximum is 600 points.

### > **The impulse** <

These three edit boxes describe the impulse itself.

#### **Rep rate (MHz.)**

The repetition rate defaults to 2 Mhz (for no particular reason except to provide some value for the display) and must be set.

#### **Duty cycle %**

The duty cycle is the ratio of "on" to "off" time of the pulse expressed as a percentage of on time and may be set to any value from .1% to 99.5% (for example, a square wave would be a 50% duty cycle). Any value less than .1% will be considered an infinitely short "spike".

#### **Carrier Freq.**

The "carrier" is the CW frequency that will be "gated" when using the "Gated RF Pulse" mode. Because it is not possible to gate an RF signal on for the zero time interval represented by a "spike" (zero duty cycle), this option will only be available when the duty cycle is set to some finite value. The upper and lower harmonic limits are set up so that the carrier frequency must be BETWEEN them. Normal use is to first set the duty cycle, then set the carrier frequency to within the passband of the filter under evaluation. If any sidebands fall in the stopband area of the filter, the sideband upper and lower limit frequencies may be set using the <Ctrl F1> and <Ctrl F2> keys from within the graphic display from analysis. These limits should be set up last.

### > **Control** <

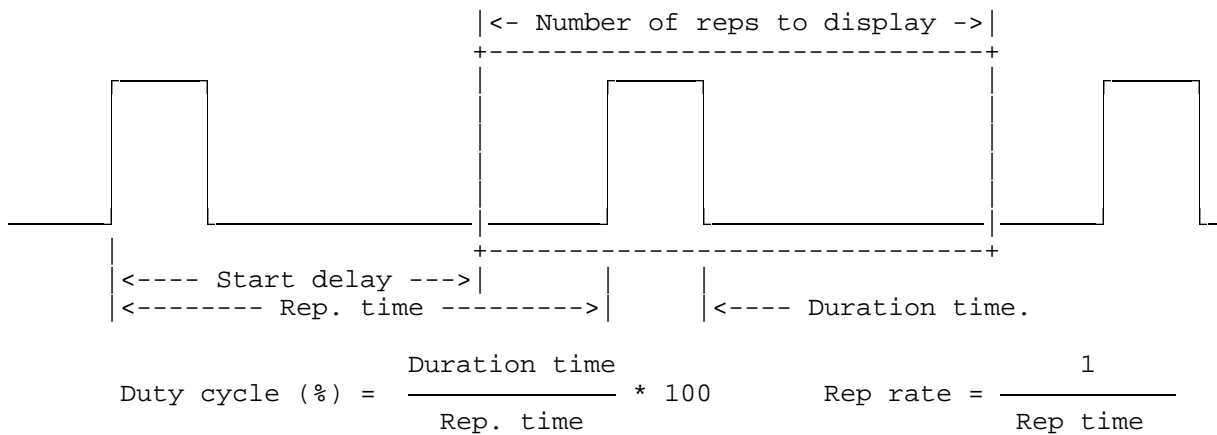
#### **Number of reps**

The number of "reps" to display adjusts the "time base" of the simulated oscilloscope displaying the response. Units are impulse time periods. The actual scale factors are determined automatically (1.0 impulse time is usually good "spike" evaluation, but fractional times, like 1.5 or .3 can be used also). For example, An impulse with a "rep. rate" of 1 MHz. shown on a 1.5 "rep. time" scale will cover 1.5 Microseconds of time.

In order to properly display impulse response, it is vital that enough points in time be calculated to reproduce each cycle of ringing or carrier with adequate resolution. To do this, a check is made to see that at least 20 points will be calculated for each cycle of the Fc or Fo of the filter analyzed (this is usually very close to the "ringing frequency" of the filter). If this requirement is not met, the program will automatically switch to an *"Envelope display"* mode. In this case, segmented vertical lines represent all the possible voltage levels that exist during the time interval represented by the lines horizontal position. The EXTREME ENDS of each segmented line will form an outline of the envelope. Ignore the sometimes amusing patterns this will generate paying attention only to the extreme top and bottom of the "envelope".

#### **Start delay (0-1.0)**

This will allow the starting time of the display to be set forward in time to a point just before the beginning of an impulse relative to the previous one. This time is automatically adjusted when the number of reps to display is set. The setting will be approximately correct to center the impulse within the number of delay times selected. The approximate group delay of the filter is also added to this number after the analysis is concluded. If you select zero delay time, the group delay is not added.



## Top menu items

### Analyze freq domain

The Analyze option will allow the necessary harmonic or sideband range to be determined conveniently. Note: The <Ctrl F1> and <Ctrl F2> keys or transfer menu in the graphic analysis display may be used to set this range. When a range limit is set, the program will automatically adjust the frequency to the nearest harmonic of the repetition rate or sideband frequency.

### Calc Page 1

To display the response select this option. The impulse response will be drawn graphically.

**NOTE:** To abort a very slow calculation press and hold the [Back] ("~") key.

The vertical scale of the display is uncalibrated and relative. Before the display exceeds the scale limit, the scale factor will be changed and the entire response quickly redrawn. In the event the display is too small, it will be redrawn to fill the scale after the calculation is complete. Scale factor changes will be obvious. At all times, the digital readout of % of maximum amplitude will remain accurate.

The analysis program will cut the 360 degrees total phase shift generated by a second order all-pass equalizer into two segments of + and - 180 degrees. The transition is made right at the point of maximum group delay. Because of this transition, the spectrum represented by an analysis run on a network containing an all-pass section may not be correct.

### Therefore:

```
*****
**                                NOTICE !                                **
**          DO NOT ATTEMPT TO DISPLAY THE IMPULSE RESPONSE OF          **
**        ANY NETWORK CONTAINING AN ALL-PASS GROUP DELAY EQUALIZER.        **
**          THE RESULTS YOU GET MAY or MAY NOT BE CORRECT !          **
*****
```

After the display has been drawn, the marker will appear at the point of maximum amplitude of the display. The marker is a small "+" and will first appear on the highest point of the display. The marker has a set of commands that allow it to be calibrated and moved around the display as needed.

## Marker options

The marker is a small yellow "+" mark that may be moved left or right by the keyboard arrow keys or by the use of your mouse. Press the left button and the marker will jump to the mouse cursor. Simply hold the left button and drag the marker left or right, that is forward or backward in time. When using the arrow keys, holding the <Shift> key down at the same time will speed up the motion.

### Next page

Requests the program to continue calculating and displaying the impulse response beginning at the time the present display ends.

If it is desired to continue the display beyond the end time displayed, to see each cycle of ringing for example, the **Next page** instruction can be used along with the **Zero marker** feature to display as many repetitions as desired and still measure settling time or risetime.

Each screen drawn is a "page". For example: if you requested that 1 impulse time be displayed and the program switched to the "*Envelope display*" mode, you could reduce the rep times displayed and recalculate page 1 until the "*Envelope mode*" no longer shows. Let's say you reduced it down to .25 impulse times. You will then have to "**Next page**" 4 times ending up on "page" 4 to see one impulse time period.

**NOTE:** If the marker RELATIVE warning is showing when the "Calc Page 1" command is given, the offset will then be "FIXED" at the marker time showing.

### NormaLize

When this option is picked, the point at the marker is forced to be the 100% amplitude point causing the digital "% of amp.=" display to change to 100%. All other points will then read relative to this point. The 100% point is initially set to the point of maximum amplitude.

### Marker Max

Moves the marker quickly back to the point of maximum amplitude. (Where it started).

### Zero marker

The Zero marker effects the "time =" display and can be in one of three possible states:

OFF - When zero offset is off, the "time =" will be displaying the absolute time at the marker and will change as the marker is moved. The offset is off until you turn it on.

Marker **RELATIVE** means zero offset is on, the "time =" displayed will be the time from the point where it was "zeroed". This allows the time displayed in the digital readout to be set to zero at any point desired making the time display read out the time between two points. The time display can be rezeroed at any time the offset is not "**FIXED**". To "zero" the offset, simply press the "Z" key. The "time =" readout will change to 0. When the marker is moved, the display will read out how far you have moved it in units of time.

+ **reference FIXED** + When the offset is fixed, it acts just like it does when it is not fixed, except that the offset can no longer be set to zero. Toggling the (Z)-Zero marker on and off will cause the "time =" display to alternate between absolute time, and the time from where the offset was "zeroed". The offset will become fixed when: marker **RELATIVE** is showing, AND the calc Page 1 command is given.

**Ref . line**

A dotted reference line will be seen running across the display that indicates the point of maximum settling to the marker readout. The vertical position of this line is determined by one of three methods:

**Start of imp.** - The level of the reference line is sampled at the instant of the leading edge of the input impulse. If the repetition rate is set such that the ringing from the previous impulse continues into the next the reference line will fall in the wrong place. If this happens simply reduce the repetition rate.

**Zero** - The reference line indicates zero volts at all times.

**Average** -An average voltage is calculated from all the calculated points in time. The reference line is positioned at this level.

**Document**

Response plots may be documented directly to the printer or to a PCX graphics file. The graphics file will be fourier.pcx.

**eXit.**

Leave the impulse response module and close the window.

**Envelope display distortion**  
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In the event there is not enough resolution to display a complete cycle of ringing or an accurate rise or fall of a waveform the envelope display mode will be used. This mode uses vertical lines to simulate all the voltage levels that would exist during the interval of time represented by its horizontal position on the screen. When displaying gated RF pulses, this sometimes will cause the envelope to be distorted. When this happens a warning message will be displayed:



This is caused by a bad combination of the displayed number of Rep times and the Rep rate chosen. The situation can be overcome by changing either of these parameters. Often rather drastic changes may be necessary. The combination must be chosen to either cause the envelope mode to go off or to compress the envelopes into a smaller horizontal area of the screen to make each vertical line longer representing a longer time interval. These two options are total opposite extremes and are achieved by changing either or both of the two parameters in opposite directions.