Review of **Installer**
Car Stereo Installation Software

By Dan Ferguson

Installer is a brand-new loudspeaker design program written by Dave Franklin of dB Audio. While you can use it for any application, it is clearly slanted toward the car stereo professional or amateur installer. *Installer* is compatible with Windows 95, 98, 98SE, ME, and XP.

Although there is nothing new under the sun—as a noted wise man once observed—the collection of features this program contains appears to be unique. And while this program is not written at the level of sophistication of some other well-known loudspeaker modeling programs, it is perhaps intended for a different-level user. The author's approach is to make the loudspeaker design process as simple and economical as possible for the car stereo installer. It provides all the tools necessary to design a complete system and then accurately measure the system's response with a sound level meter (SLM).

The program simplifies the manual frequency response measurement process, allowing you to obtain results similar to that obtained with a real-time analyzer. You can then plot those measurements superimposed on a predicted response so you can readily compare the two and make adjustments accordingly. This should appeal to those with limited test equipment in either car or home applications.

Installer is supplied on a CD as an .exe file along with a batch program, *Ride,* two .dll and two .ocx files, and several Word files containing diagrams and instructions. To use the program, you must first make a new file folder, C:\Installer, and then copy all the CD files into it. With the CD still in your PC drive, find the *Installer* folder using Windows Explorer, and double-click on *Ride1.bat*. When you do, *Ride* will register the .dll and .ocx files in your Windows registry. Make a shortcut to *Installer.exe* on your desktop, and you're ready to start using the program. Before you leave the *Installer* folder, though, you may want to print out the six pages of instructional documents that come with the program using either MS Word or WordPad.

PROGRAM OPERATION

You start the program by double-clicking on the Installer.exe file or your desktop shortcut, which takes you to the opening screen (**Fig. 1**). Clicking on the Enter button in the center of the screen then takes you to System Design, which consists of three tabs—Speaker Designer, Driver Parameter Calc, and Crossover Designer.

Speaker Designer (**Fig. 2**) is the starting point for designing closed and vented box woofer systems based on manufacturer's specifications. For a really quick calculation, you can simply enter the three principal T/S parameters (F_S, Q_{TS}, and V_{AS}), and the program will allow you to proceed immediately to the predicted response screen and start doing some "what if" box designs. There are spaces provided to record Q_{ES} and Q_{MS}, but they don't appear to be used by the program at this point. Before leaving this tab, however, you may want to take advantage of the rest of the features available here.

The next section on Speaker Designer calculates predicted sensitivity and power handling for multiple drivers connected in parallel (a note from the author warns that using series connections causes back emf distortion, so there is no provision made for that configuration). The number of drivers you enter here will be carried throughout the design process and applied to box volume calculations. To the right of this section, there are spaces provided to record X_{MAX} (defined as ½ of peak-to-peak displacement), BL

FIGURE 1: Opening screen.

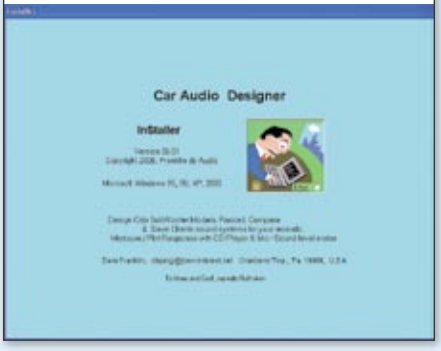
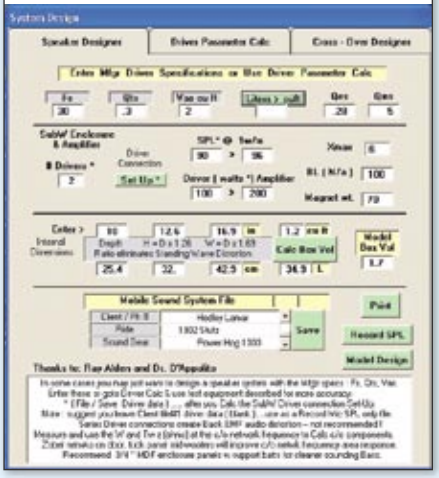


FIGURE 2: Speaker design screen.



rating, and magnet weight. Again, as far as I can determine, these parameters are used only as a record for qualitative driver comparisons.

Below the driver configuration section is a handy box calculator that calculates rectangular box volumes in cubic feet for any given set of dimensions in inches and the corresponding metric equivalents. It also provides the golden ratio for minimizing standing waves. A space is provided to the right of this section for you to enter a target box volume and keep it visible while you manipulate the box dimensions to fit your vehicle environment. While the box calculator feature clearly makes designing rectangular boxes a snap, the one drawback here is that many car speaker enclosures are not rectangular.

Finally, if you are a professional installer, this screen has a place to record some client data that will be displayed on the various printouts. After saving your entries, you may then print this screen for the customer for future reference. At this point, you're ready to proceed to the predicted response screen by selecting the Model Design button, which takes you to the Design/Plot Response screen (**Fig. 3**).

RESPONSE PREDICTIONS

The Design/Plot Response feature plots predicted responses for box designs based on either the manufacturer's specifications or your measured T/S parameters (the latter of which is performed on the Driver Parameter Calc screen). You may then superimpose your measured in-car response on the predicted plots, a feature that may be unique to this program. I'll discuss both the parameter measurement and response measurement features a little later.

As stated earlier, if you enter the three principal T/S parameters at the top of initial screen and save the data, you can select the Model Design button and proceed to the Design/Plot Response screen. The T/S values will be transferred and displayed in the lower left box. You then click on the Calculate and Plot Model buttons and the predicted responses will be plotted for either of two selectable, optimized vented box alignments and a closed box with a Q_{CB} of 0.71 as the default setting.

On this screen, you can change alignment parameter values, experiment with them, and replot them successively with each new plot being assigned a one-up number. When the screen becomes obscured by too many iterations, you can wipe it clean by simply pressing the Clear button and then continue to experiment. I found this section both fun and quite simple to use. To leave this screen, click on "Compare Model" and the program takes you back to the opening screen where you may change your driver parameters or the number of drivers, resave the values, and start all over again.

While the manufacturer's T/S parameters are a good starting point, if you're like me, you'd rather complete your final design from measured T/S parameters, which you can perform using the Driver Parameter Calc tab (**Fig. 4**).

DRIVER PARAMETERS

Over the years, I have performed enough driver parameter measurements that I became tired of manually calculating them and eventually resorted to using

FIGURE 3: Design/Plot response screen.

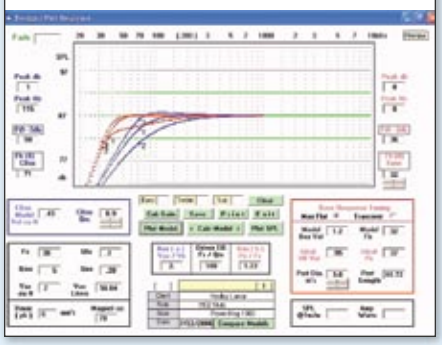
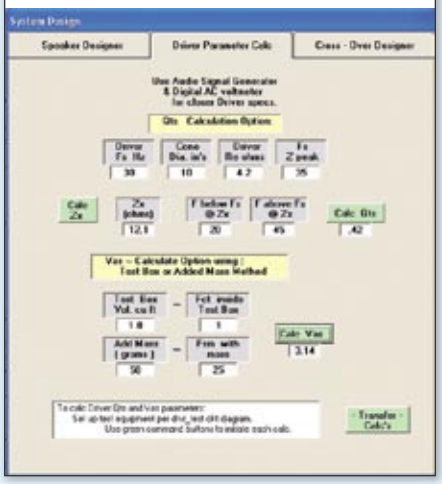


FIGURE 4: Driver Parameter Calc screen.



a spreadsheet. This implies that I had acquired the formulas and techniques from other texts (such as *Speaker Builder*) and had the PC skills to develop the spreadsheet. Someone who is less versed will be assisted greatly when performing T/S measurements using *Installer.* As before, it's simply a matter of filling in the blanks.

You start by measuring the free-air resonance (f_S), driver effective cone diameter, and voice coil DC resistance (R_E). *Installer* then calculates the impedance value at the -9dB (f_1 and f_2) points on either side of the impedance peak. After you take the measurements and record the frequencies, the program calculates Q_{ES}, Q_{MS}, and Q_{TS}. (Only Q_{TS} is visible on this screen.) When you select the Transfer Calcs button, all three variables will appear in their appropriate spaces on the Design/Plot Response screen.

Before you can leave the Driver Parameter Calc screen, you must complete the V_{AS} calculation using either the closed box or added mass method. After this final calculation, you may then transfer your values to the Design/Plot Response screen.

A word of caution here and a quibble about the T/S parameter calculation feature: Once you leave the Driver Parameter Calc screen, the values you just spent half an hour agonizing over will be erased, so be sure you print and save them. My quibble has to do with the fact that it is somewhat difficult to measure the lower –9dB frequency (f_1) point accurately. Many digital voltmeters will "blink" excessively at frequencies in the teens where typical values for f_1 are located.

Consequently, any text on T/S parameter measurement would be incomplete without emphasizing that the square root of (f_1*f_2) must be very close to the measured value of f_S for the measurement to be considered reliable. *Installer* will give an error message if the deviation is greater than 1Hz, but it doesn't display the actual value. In my opinion, 1Hz is too large a window because an accurate measurement will result in a value that is within 0.1 or 0.2Hz. Simply decreasing the error message threshold without displaying the value would cause problems, so it would be better if

the actual value were displayed.

Last, I must state before leaving this discussion that the author's instructions for making T/S parameter measurements using the constant current method are somewhat minimal. Perhaps the program bundle would be even more self-contained if more of these details were provided. Without them, you will need some supplemental know-how to get through all of this. Regardless, I liked the features on the Driver Parameter Calc screen very much due to their ease of use and plan to use it in the future instead of my old spreadsheet.

MEASUREMENTS

The next feature of *Installer*, and perhaps its best, is the in-car, frequency response and plotting function. In my opinion, the author has pulled out all the stops to minimize the drudgery and make the manual measurement as accurate and meaningful as possible. He starts by providing calibration data for two popular, inexpensive sound-level meters—the Tenma 72-860 and the Radio Shack 33-2055. The signal source is a set of 1/3 octave warble tones from *Stereophile* Test CD3.

Figure 5 shows the layout of the Record/Plot Response screen. It is important to understand that you must fill all of these data spaces or the program will not proceed to the response plot. If a space is not used you must enter "0" as a minimum. You start here by entering the calibration data for your particular SPL meter, and after you save it, the program automatically copies it into future response measurement screens. Now you can begin to take measurements.

As you step through the warble tones, simply fill in the data form provided by the author and then transfer the numbers to the spaces in this screen. Be sure to note the position of the tone controls on your car head unit, especially if you're using non-flat settings. When you have completely filled out the screen, hit the Save button and you're ready to see the plot by selecting the Plot button. **Figure 6** shows some hypothetical curve results.

Each measured response dataset is assigned a one-up number as it is saved and can be recalled and plotted superimposed on other measured responses or predicted model curves or any combination. Multiple measured response plots are displayed in different colors for clarity. It sure would have been nice to have had all this during those years I was trying to make SPL measurements on a shoestring budget.

The last tab on the System Design screen is a passive two-way crossover calculator (**Fig. 7**). To get started, you enter the target crossover frequency followed by the measured impedance of the woofer and tweeter at the crossover frequency. You then enter woofer voice coil DC resistance and inductance (either measured or from manufacturer's specifications), and the program will calculate the Zobel network values.

After selecting the Calculate Network button, the program calculates five different crossovers: 1st order, 2nd order Linkwitz-Riley in flat, boosted, and cut lower mid versions, and 2nd order woofer with 3rd order tweeter. Discussion of the merits of these different approaches is beyond the scope of this article. Suffice to say that passive crossover design is a difficult and complex topic, but the value of including it here is that you can use the features of this program to calculate initial component values, measure the actual response, and eventually get your crossover dialed in.

SUMMARY

Installer is a very handy little program with an overall "theme" that appears to be very similar to my personal philosophy of doing more with less. I do think its main appeal will, in fact, be to car audio installers, because the file formats and mathematical models employed are somewhat geared to that venue. That said, the manual plotting features are, in my opinion, uniquely useful for anyone who chooses to measure their system response on a limited budget. Finally, even if you have a more sophisticated modeling program, this one is a time saver for doing "quick and dirty" what-if design iterations. The superimposed successive response plots let you clearly see the effect of tweaking variables and will aid you in homing in on the optimum alignment. In other words, this thing's going in my toolbox. *aX*

Dan Ferguson *has a BS and MS in mechanical engineering from Clemson University with a specialty in automatic controls. After serving as an aircraft maintenance officer in Vietnam, he has been employed in the petrochemical and paper industries for over 30 years in various engineering and management positions. For the past 23 years, he has been employed by Kimberly-Clark and is currently a plant maintenance consultant. Dan has written several books on auto sound and a number of articles for* ***Audio Amateur****. He and his wife of 39 years now reside in Appleton, Wis.*

FIGURE 5: Record/Plot Response screen.

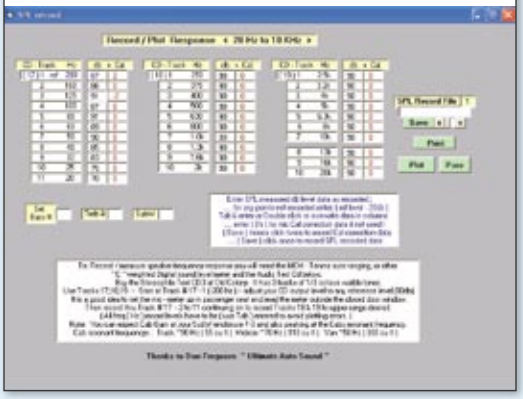


FIGURE 6: Example Superimposed plots.

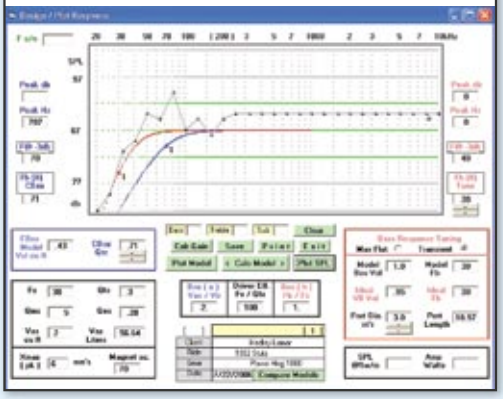


FIGURE 7: Crossover Designer screen.