

Tact-2150 XDM

Guide to Equal Loudness Compensation

Version 1.0

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1. Introduction

Tact-2150 XDM implements sophisticated user defined equal loudness compensation not found in any other power amplifier on the market. Equal loudness compensation can be used on its own or combined with Tact's room correction algorithm. When combined with the room correction algorithm it results in a room correction that is level dependent. We have named it DRCTM – Dynamic Room Correction.

Without the room correction feature, equal loudness compensation is applied to the input audio signal directly. When used with the room correction algorithm, input audio signal is first passed through the room correction and then through the equal loudness compensation algorithm.

Signal processing power built into 2150 XDM allows for instant switching from correction to no correction, and from equal loudness compensation to no equal loudness compensation. By using this exclusive Tact technology, real time listening tests can be performed and the effects of equal loudness compensation can be evaluated.

2. Equal Loudness Compensation without RCS

To perform and evaluate the effects of equal loudness compensation without the use of the room correction feature and to take full advantage of 2150 XDM processing power, 2150 XDM has to be connected to windows based personal computer (PC). Tact windows based GUI (graphics user interface) will allow you to view the full set of equal loudness curves as well as the frequency response of the equal loudness compensation filters.

Equal loudness compensation can be switched ON and OFF by turning DRC option ON and OFF accordingly. When DRC option is ON, 2150 XDM will engage equal loudness compensation. When DRC option is OFF, the eight dynamic (equal loudness) target curves are ignored. Effects of equal loudness compensation can be evaluated by performing a listening test with equal loudness compensation being turned ON and OFF.

To perform equal loudness compensation evaluation without the use of the room correction feature, we use one of the correction presets loaded with flat measurement and flat reference target curve. When the room correction process is applied to flat measurement data and flat target curve with DRC OFF, the result is the same as if BYPASS were engaged. When DRC is turned ON, the eight dynamic target curves are applied to bypass type correction with only equal loudness compensation applied to the input audio signal.

2.1 STEP 1

Step 1 clears measurement file 1 assigned to correction preset 1.

Connect 2150 XDM to PC. Open Tact-2150 XDM program and make sure that RS232 communication channel functions properly. Communication between 2150 XDM and PC is usually established automatically and the message “Connected to Tact-2150 X” will be displayed (1).

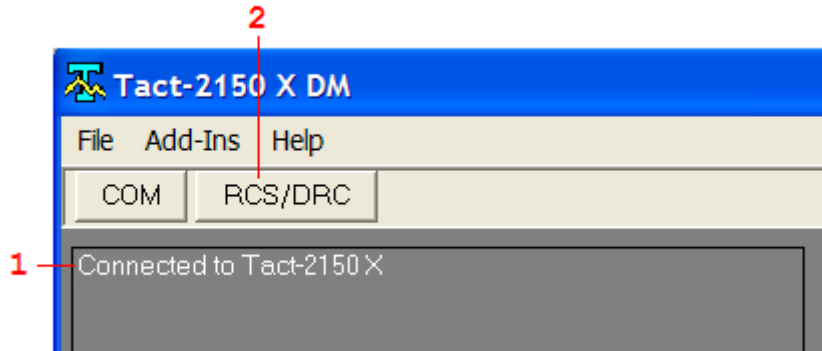


Fig. 1. Tact-2150 XDM opening window.

Click on the RCS/DRC (2) button to enter Tact-2150 XDM correction screen. In the correction screen and on the action panel select RCS/DRC Preset 1 (Fig. 2 option 1). When this option is executed, 2150 XDM will engage correction preset 1.

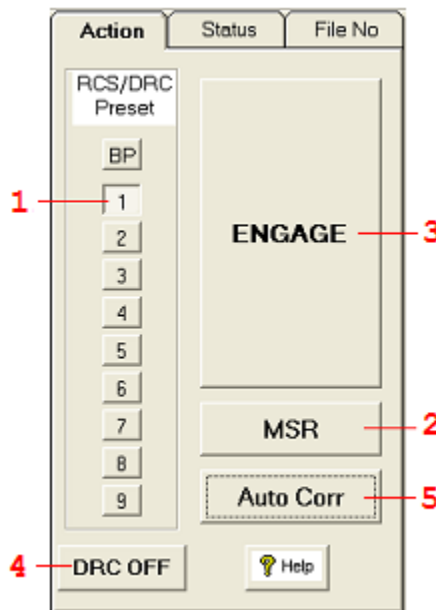


Fig. 2. Action panel.

In the Action panel select **File No** tab and assign measurement file 1 to preset 1 (Fig. 3 option 1).

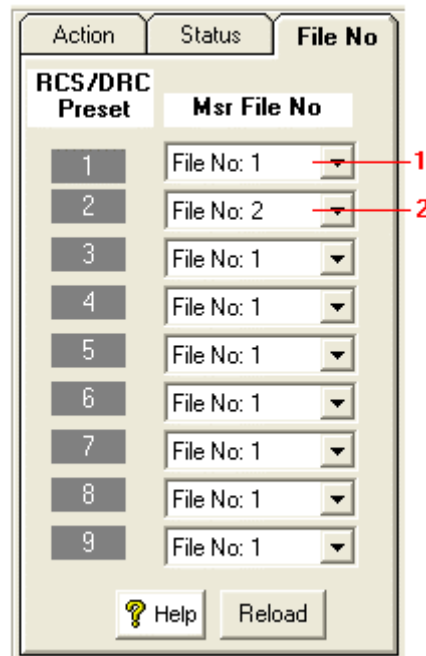


Fig. 3. Measurement file assignment to correction presets.

Click on MSR button (Fig. 2. option 2) to enter the measurement screen. In this case the measurement screen is entered not to perform any measurements but rather to clear measurement file 1.

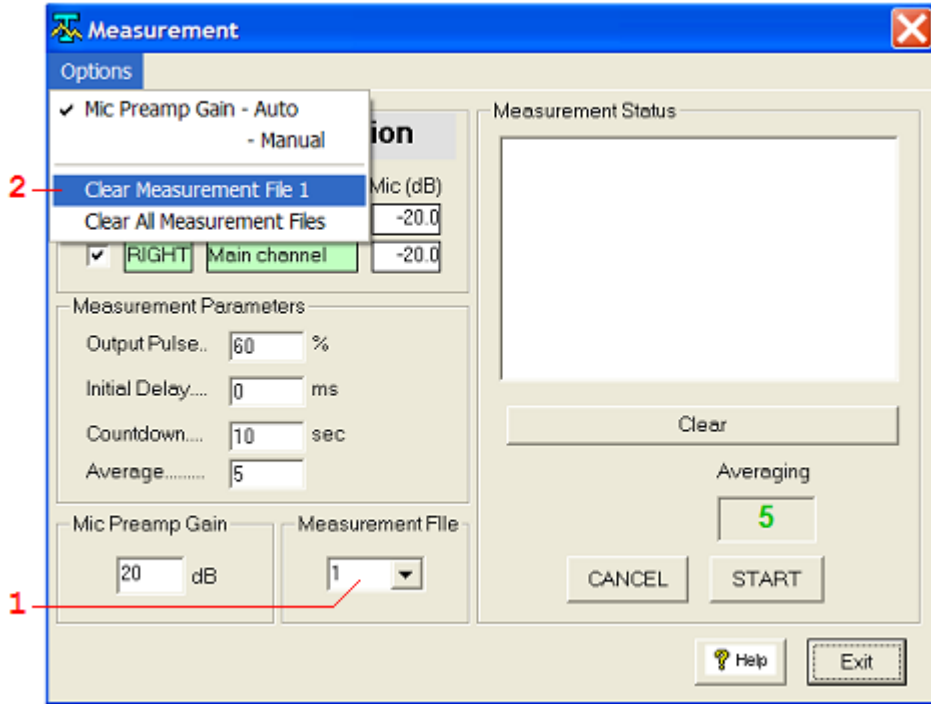


Fig. 4. Tact-2150 XDM measurement screen.

In the measurement screen select **Measurement File 1** (Fig. 4. option 1). In the **Options** menu select **Clear Measurement File 1** option (Fig. 4. option 2). This option will clear measurement data saved in the measurement file 1. When measurement file is cleared the frequency response for both channels is set to a flat line at 0 dB.

Click Exit button to go back to the correction screen.

2.2 STEP 2

In Step 2 we load reference and eight dynamic target curves and engage dynamic room correction. At the end of this step a listening test can be performed.

Form the **File** menu, select **Load Dynamic Target Group** (Fig. 5. option 1) option and load *Equal_Loudness_Minus_12dB_Ref.grp* dynamic target group file.

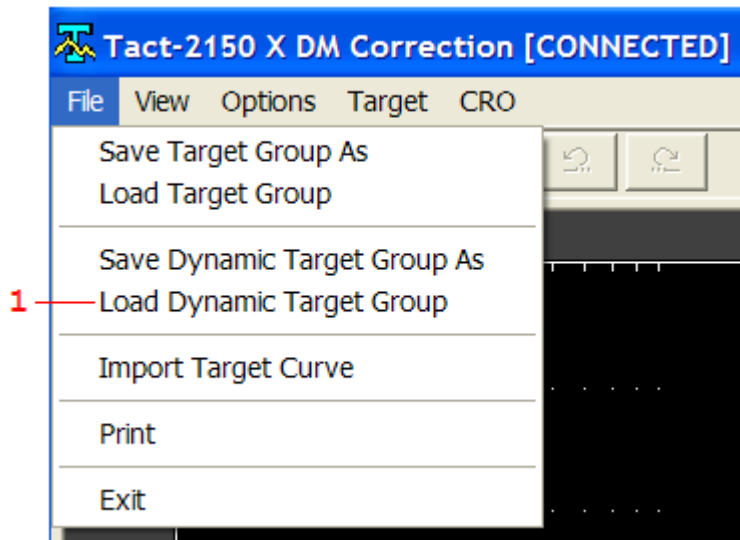


Fig. 5. File menu

Note that dynamic target curves (equal loudness curves) contained in the *Equal_Loudness_Minus_12dB_Ref.grp* group file are loaded in dynamic target curve buffers (Fig. 6. option 1) only and not in 2150 XDM internal memory. To display loaded dynamic target curves click on individual target button (1) or double click over (2) to toggle dynamic target curves ON and OFF.

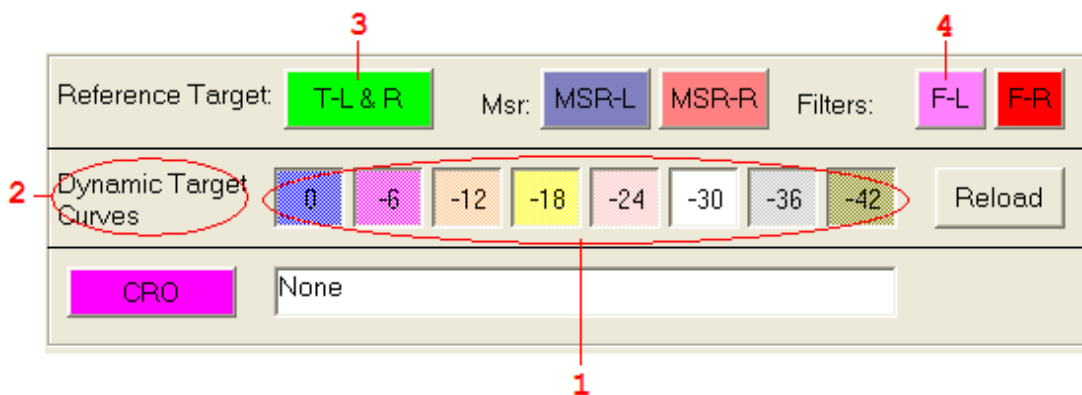


Fig. 6. Target curve panel.

Click on **T-L & R** button (Fig. 6. option 3) to display reference target curve. Place mouse pointer over (3) and then right mouse click to display target curve menu (Fig. 6).

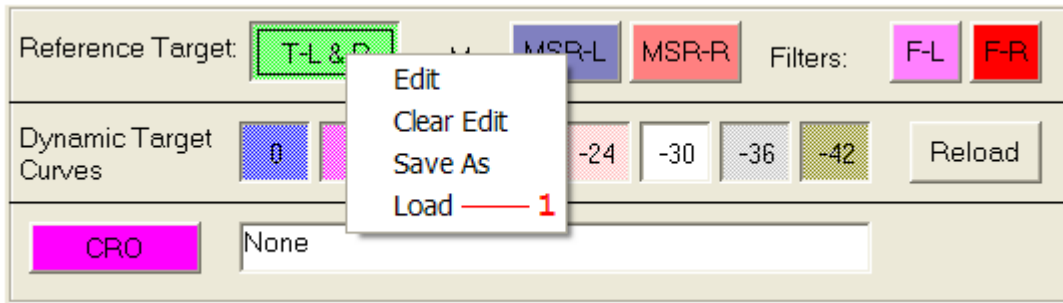


Fig. 7. Target curve menu.

Select **Load** option (Fig. 7.option 1) and load *Flat.cor* target curve. This target curve is a flat line at 0 dB. The correction screen with all loaded target curves are displayed in Fig. 8.

Curves labeled 1 through 8 are dynamic target curves.

1. 0 dB dynamic target curve
2. -6 dB
3. -12 dB
4. -18 dB
5. -24 dB
6. -30 dB
7. -36 dB
8. -42 dB dynamic target curve
9. Reference target curve.

By loading this set of dynamic target curves we assume that the listening level of -12 dB does not require equal loudness compensation. That is why we have chosen *Equal Loudness Minus 12dB Ref.grp* dynamic target curve group file. This file contains -12 dB dynamic target curve set to a straight line at 0 dB.

If for example -6 dB dynamic target curve is set to a straight line at 0 dB, and master level equals -6 dB, no loudness compensation will be applied to audio signal.

If for example 0 dB dynamic target curve is set to a straight line at 0 dB, and master level equals dB, no loudness compensation will be applied to audio signal.

If reference target curve is set to a straight line at 0 dB, no room correction will be applied to audio signal.

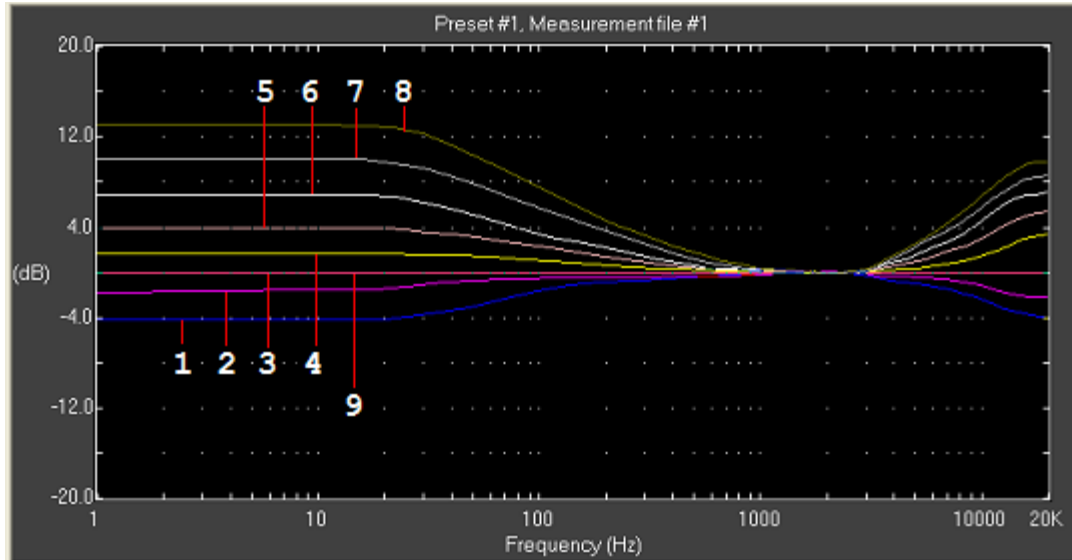


Fig. 8. Correction screen with all target curves loaded.

Note that in this case reference target curve is the same as -12 db (3) dynamic target curve.

Once the target curves are loaded, click on ENGAGE button (Fig. 2. option 3) to send them to 2150 XDM. As soon as all target curves are loaded, new correction based on this set of target curves will be calculated. Make sure that dynamic room correction is enabled. Button 4 in Fig. 2 (Action panel) has to display DRC ON.

A listening test can be performed at this point to evaluate the effect of equal loudness compensation. To perform the listening test, select one of your favorite tracks and by switching DRC option (Fig. 2. option 4) ON and OFF evaluate the effect of the selected equal loudness curves.

It is important to understand that the equal loudness curves supplied with the Tact-2150 XDM software are not a definition of what they should be. They are just one possible example and a good starting point for creating your own equal loudness curves. Each equal loudness curve can be modified to fit your particular listening needs. Equal loudness curve modification should produce a new set of target curves with different slopes and different separation between them. However, all target curves should merge to the same level (0 dB) around 2000 Hz.

2.3 Equal Loudness Filter Response

Tact-2150 XDM calculates a new correction filter for every master level change of 0.1 dB. In this case, correction filter response is equivalent to the equal loudness curve response for that particular master level.

To load correction filter response click on **F-L** button (Fig. 6. option 4) and then right mouse click to display **Load Filter** menu option. Click on **Load Filter** option to upload correction filter response.

Fig. 9 shows correction filter response (4) for master level set to -33.6 dB. 2150 XDM calculates this response by interpolating a target curve between -30 dB (2) and -36 dB (3) dynamic target curves (equal loudness curves). Note that reference target curve is set to a flat line at 0 dB (1).

In this example, we can see from the graph that audio frequencies around 2000 Hz are not affected by the equal loudness compensation. However, frequencies at around 100 Hz are given a gain of more than 4 dB. The same holds for frequencies around 8000 Hz. The gain added to audio signal at these frequencies compensates for the human loss of sensitivity at these frequencies at this particular listening level.

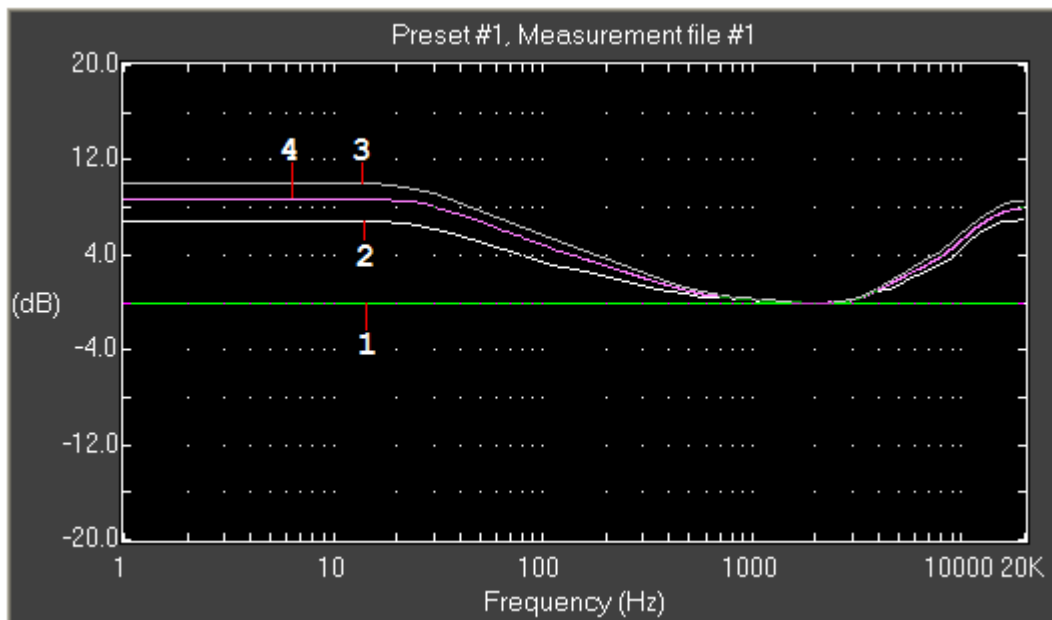


Fig. 9. Equal loudness filter response for master level set at -33.6 dB

Fig. 10 shows correction filter response (4) for master level set to -20.7 dB. 2150 XDM calculates this response by interpolating a target curve between -18 dB (2) and -24 dB (3) dynamic target curves (equal loudness curves).

In this example as in the previous one, frequencies around 2000 Hz are not affected by the equal loudness compensation. Since the master level is increased the amount of equal loudness compensation is reduced. Signals with frequencies around 100 Hz and 8000 Hz have a gain of around 2 dB.

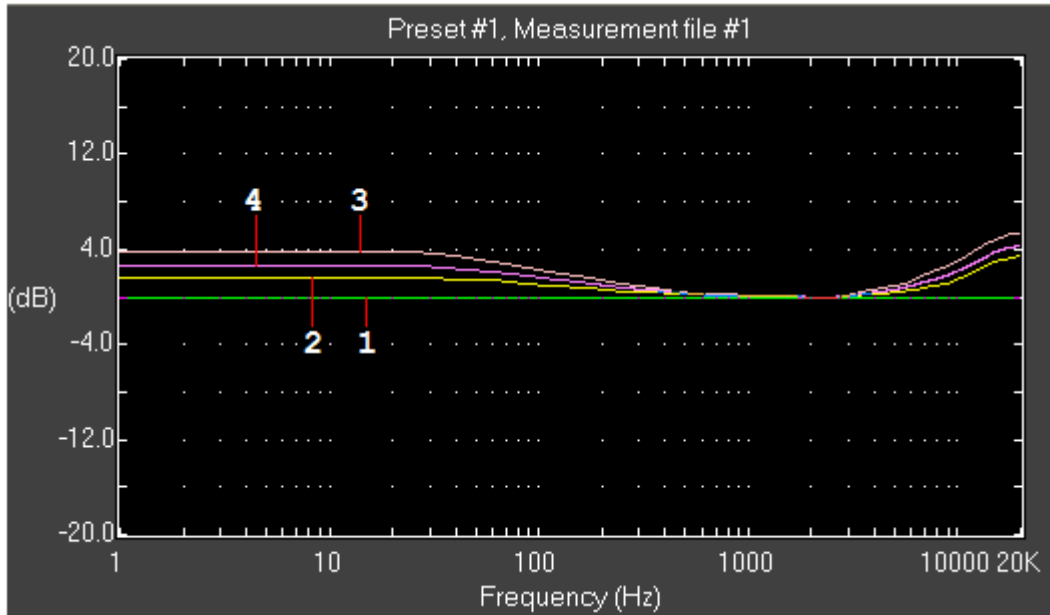


Fig. 10. Equal loudness filter response for master level set at -20.7 dB

These two examples are just two samples of the equal loudness compensation at master level set to -33.6 and -20.7 dB. Equal loudness curve can be uploaded for any master level setting. Uploaded correction filter can give a good indication of what audible change can be expected when equal loudness compensation is turned ON and OFF.

In this section we have used cleared measurement file with both channels set to flat response and a flat reference target curve. Dynamic room correction applied to these conditions produces correction filters that are equivalent to equal loudness compensation.

3.0 Equal Loudness Compensation and RCS

Section 2.0 has outlined 2150 XDM basic principles of equal loudness compensation without the use of either room response measurement or room correction feature.

To take full advantage of 2150 XDM signal processing power, it is strongly recommended to use equal loudness compensation together with the room correction feature. In this way, equal loudness compensation is applied to the left and right channels, which are balanced throughout the entire audio frequency range.

To use equal loudness compensation combined with the room correction feature and to compare it to the previous case, implement the following steps:

1. Place 2150 XDM into bypass mode and perform room response measurement. Make sure that measurement data is saved in measurement file #2. Measurement file #1 was used in the previous section for preset 1.
2. Place 2150 XDM into correction preset 2 and turn DRC option OFF (Fig. 2 option 4). Make sure that measurement file 2 is assigned to preset 2 (Fig.3 option 2). Select proper target curve. Click on ENGAGE button and perform a listening test to verify that room correction algorithm performs.
3. Turn DRC option ON. Load *Equal Loudness Minus 12dB Ref.grp* target file and click on ENGAGE button (Fig. 2 option 3) to load target curves into 2150 XDM internal memory. As soon as engage operation is executed, 2150 XDM will calculate a new set of filters based on measurement data saved in the measurement file 2 and based on reference and dynamic target curves.

At this point a listening test can be performed to evaluate the combined effect of room correction and equal loudness compensation.

With DRC option turned ON, 2150 XDM calculates a new set of correction filters for every master level change of 0.1 dB.