Digital Cinema Processor v1 - GUI design

for the JHD12864E, 3”x1.5”, 128x64 monochrome graphics LCD.

The graphical user interface for the Digital Cinema Processor v1 is simple and intuitive with only 11 pages, carefully designed to include all the user-selectable options and features while retaining quick response times for comfortable navigation.

1) The Home page (Fig. 1) displays important information such as master volume, the playback device selected by the user, the current format being decoded, the internal processing sample-rate, the number of processor channels in use and any post-processing algorithm, if applicable. This page is automatically loaded after the power-up sequence following which, all of the above-mentioned variables get updated in real-time.

Figure 1. The Home page.

2) The Main Settings page (Fig. 2) - This is the main menu of the GUI, that redirects to pages containing user-editable options / properties related to the different functions within the unit such as the Input Selection / Multiplexer, Decoding, Processing, the GUI system and User Storage.

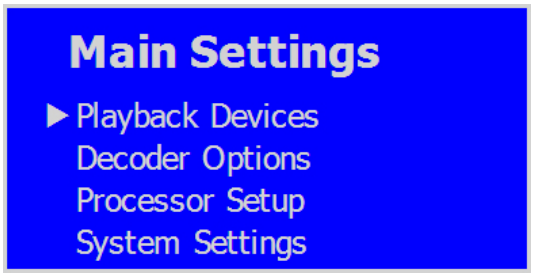

Figure 2. The Main Settings page.

3) The Playback Devices page (Fig. 3) is the page where the user specifies the kind of playback equipment connected to various inputs of the unit. Each device may be set to one of the four suboptions: BD/DVD, A/VCD, DAB/DVB and Game/PC. At times, the type of device selected also decides the default processing sample-rate used internally *e.g.* 192 kHz for BD/DVD and 176.4 kHz for A/VCD. There are no default sample-rates for the other types, as they are meant for digital audio / video braodcast receivers, set-top boxes, gaming consoles and computers.

Figure 3. The Playback Devices page.

4) The Decoder Options page(Fig. 4) lists the user-selectable parameters that pertain to the decoding / post-processing block within the unit, summarised in Table I.

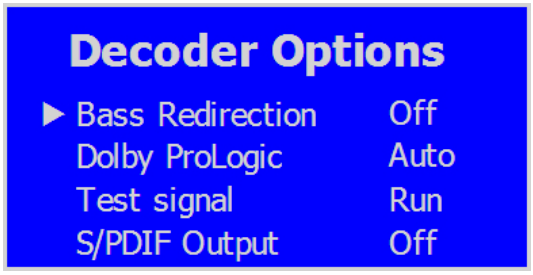

Figure 4. The Decoder Options page.

Table I
USER-SELECTABLE DECODING / POST-PROCESSING OPTIONS WITHIN THE UNIT.

Option	Suboption	Remarks
Bass Redirection	Off	No bass is redirected to the subwoofer.
	Mix	All channels are appropriately scaled and summed into the LFE, but no filters are applied to any of the channels.
	Filter	Scaling and summing are carried out as usual, followed by appropriate filters recommended by Dolby Labs.
Dolby ProLogic	Off	No ProLogic post-processing is applied to the incoming bitstream.
	On	Dolby ProLogic post-processing is forced onto the incoming bitstream, irrespective of format, channel layout or matrix-encoded status.
	Auto	Dolby ProLogic is applied only if the incoming bitstream is matrix (Lt Rt) encoded.
Test Signal	Run	Default values for the internal sample-rate and post-processing options are temporarily enforced while a pink-noise test signal is applied in the order L, R, C, LFE, Ls, Rs, with a 2s duration per channel. The cursor is automatically returned to the main option after completing the test sequence.
S/PDIF output	Off	The S/PDIF output is inactive.
	On	The S/PDIF output carries a 2-channel downmix of the decoded bitstream in the PCM format for recording / booth monitoring purposes.

5) The Processor Setup multi-page (Fig. 5) is where the user chooses the processor channel to be edited. This page also shows the speaker positions corresponding to all active channels, while inactive ones are indicated as “Off”. The frequency band identifier (Sub / Low / Mid / High) is also included for channels that use at least one crossover filter.

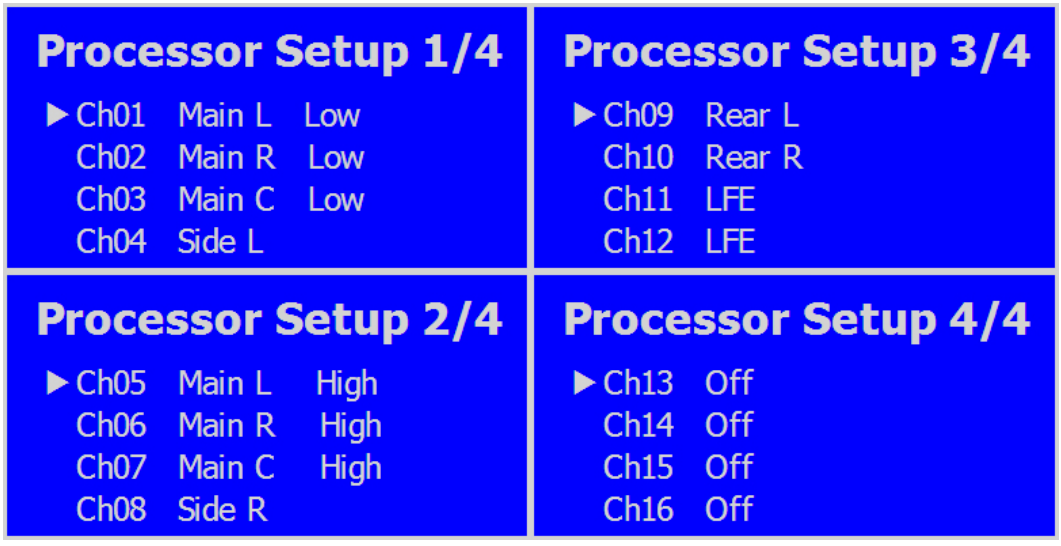

Figure 5. The Processor Setup multi-page for an LCR bi-amp setup (example).

6) The Edit Ch X multi-page (Fig. 6) carries user information about the X^{th} processing channel such as speaker position, status, channel linking, fader gain (prescaling), delay, frequency band identification and output polarity, detailed in Tables II and III. The "Crossover / EQ" option may be used to edit the various filters within the channel.

Figure 6. The Edit Ch X multi-page.

Table II
CHANNEL PROPERTIES FOR THE EDIT CH X (1/2) PAGE.

Option	Suboptions	Remarks
Position	Main L, Main R, Main C, Side L, Side R, Rear L, Rear R, LFE	Selects the speaker position for the processing channel. This information is also updated on the Processor Setup multi-page, as long as the channel status is set to 'On'. The Rear L / Rear R positions simply copy the Side L / Side R information, but may still use different gain / delay settings to obtain a more diffused and enveloping sound field.
Status	Off	The processing channel is deactivated (muted) and is indicated as 'Off' on the Processor Setup multi-page.
	On	The processing channel is activated (unmuted), along with relevant channel information being shown on the Processor Setup multi-page.
Link to:	Off	Channel linking is turned off and all properties of the current channel may be independently edited.
	Ch01-Ch08 or Ch09-Ch16	Properties of the current channel with the exception of Position, Status and Link become non-editable and are borrowed from the specified channel. This feature simplifies the setting up of multi-way / multi-channel speaker systems where multiple loudspeakers often share the same processing settings. **Hint:** Disabling the "Link to:" option (after having enabled it) allows modification of the copied channel properties.

Table III
CHANNEL PROPERTIES FOR THE EDIT CH X (2/2) PAGE.

Option	Suboptions	Remarks
Fade (-x dB)	Integer between -20 and 0.	The prescaling factor applied to the channel before any processing takes place. A correct value is necessary for a maintaining a proper gain structure that avoids saturation of later stages.
Delay (ms)	Float between 0.00 and 80.00	Time-alignment delay for the channel, often used while setting up subwoofers, multi-way or multichannel systems.
Polarity	Normal / Inverted	The output polarity for the channel, which is useful while setting up subwoofers and multi-way systems.
Freq. Band	Sub / Low / Mid / High	A frequency-based identifier, often used to link multi-way speaker channels. This property is displayed on the Processor Setup multi-page if the channel is active and uses at least one crossover filter.

7) The Edit Filter multi-page (Fig. 7) lists all the filters within a particular processing channel from where the user may select the one to be edited. The page also shows the "filter type" for each enabled filter while disabled ones are indicated as "Not used" or "Off". An "Error!" warning may occur whenever the coefficients for a filter exhibit overflow or lead to instability. However, filters with out of range coefficients, indicated by an "(R)", are automatically scaled by the system. The filter cutoff / centre frequency is also shown for every enabled filter.

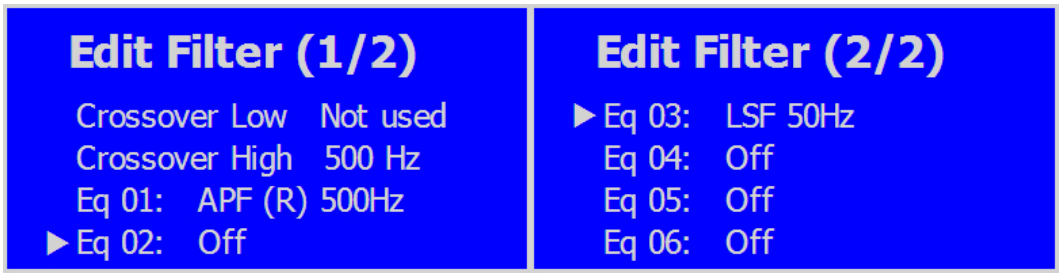

Figure 7. The Edit Filter multi-page for a woofer channel (example).

8) The Edit Crossover X / Edit EQ X pages (Fig. 8) accept parameters for the X^{th} crossover / EQ filter within a processing channel such as the filter type, gain, order, Q-factor and cutoff / centre frequency, as summarised in Tables IV and V. The edited filter is updated only after the user leaves this page, as the correct value of every parameter is necessary for filter calculation. Any unstable filters are automatically disabled by the system.

Figure 8. The Edit Crossover X and Edit EQ X pages.

Table IV
PARAMETERS FOR THE EDIT CROSSOVER X PAGE.

Option	Suboptions	Remarks
Filter	Off / High-pass / Low-pass	Sets the usage of the selected crossover filter as specified.
Type	Butterworth / Linkwitz-Riley	The filter type (Q-factor) that also affects the filter gain at the cutoff frequency *i.e.* -3dB for Butterworth and -6dB for Linkwitz-Riley.
Order	1 / 2 / 3 / 4	The order of the crossover filter.
Cutoff (Hz)	Integer between 20 and 20000	The cutoff frequency of the crossover filter.

Table V
PARAMETERS FOR THE EDIT EQ X PAGE.

Option	Suboptions	Remarks
Filter	Off / Low-Shelf / High-Shelf / PEQ / All-pass	Sets the usage of the selected EQ filter as specified. The All-Pass type maybe used for passband phase linearisation.
Gain (dB)	Integer between -20 and 20	The filter gain in all cases except All-Pass, in which case it is ignored.
Q-factor	Float between 0.10 and 10.00	The filter Q-factor in all cases. For shelving filters, $\frac{1}{Q} = \sqrt{(\sqrt{A} + \frac{1}{\sqrt{A}})(\frac{1}{S} - 1) + 2}$, where A and S denote the filter gain and the shelf slope respectively.
Freq (Hz)	Integer between 20 and 20000	The filter centre frequency in all cases except All-Pass, in which case it is the phase crossing (-180°) frequency.

9) The System Settings page (Fig. 9) contains options related to the GUI system and storage sections of the unit, explained in Table VI .

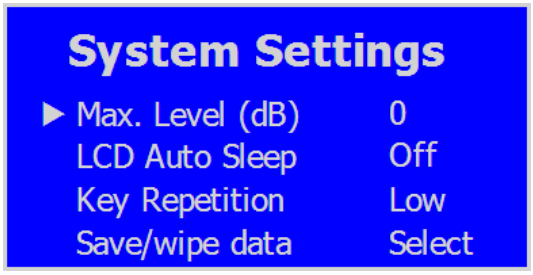

Figure 9. The System Settings page.

Table VI
USER-EDITABLE SYSTEM OPTIONS WITHIN THE UNIT.

Option	Suboptions	Remarks
Max. Level (dB)	0 to -9dB in -3dB steps	Sets the maximum user-fed master volume to the selected value. The feature becomes effective as soon as the current master volume falls below this limit.
LCD Auto Sleep	Off	The LCD backlight does not turn off on its own, and needs to be turned off by the user, if desired.
	On	The LCD backlight is automatically turned off whenever the Home Page is left idle for 1 minute and may be manually turned on by the user if desired. This setting has no effect on the functionality of the unit, and is not activated while Menu pages are being displayed.
Key Repetition	Low	Only 2 remote keys are processed in a second to obtain a very low bit error rate suitable for numeric entry etc.
	Med	Upto 4 remote keys are processed in a second allowing fast menu navigation as well as accurate data entry.
	High	The key repetition rate is increased to 10 per second.
Save/Wipe data	Select	No effect.
	Save	All user data is copied to the EEPROM after which the cursor automatically returns to the main option. The user data from the EEPROM is also loaded at the beginning of the next session.
	Wipe	Any user data within the RAM is cleared to load the default settings, after which the cursor is automatically returned to the main option. **Hint:** Immediately restarting the unit after the “wipe” operation enables recovery of accidentally deleted user data (if it exists within the EEPROM).