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1 Overview

1.1 Introduction

FWCTRL is an application program to control in-car firmware which was developed completely in-house for YSS920B. Environment for sound creation can be established by using it with the evaluation board (EVB-EVE).

[Note] For details of firmware, refer to “YSS920B In-Car Firmware Manual.”

1.2 Operating Environment

This application operates on PC with parallel port.
OS: Windows2000/WindowsXP
Use this application on the account with administrative right.

1.3 File Configuration

This application handles the following files.

<table>
<thead>
<tr>
<th>Input file</th>
<th>Type</th>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Firmware</td>
<td>TOP.datEve</td>
<td>A firmware file for YSS920B. The firmware is downloaded to YSS920B when this application is started up.</td>
</tr>
<tr>
<td></td>
<td>Label File</td>
<td>TOP.lblEve</td>
<td>A file of which association between coefficient name and YSS920B is written.</td>
</tr>
<tr>
<td></td>
<td>INI File</td>
<td>FWCTRL.ini</td>
<td>Initial setting file. This file is read when this application is started up.</td>
</tr>
<tr>
<td></td>
<td>Virtual Sound Source File</td>
<td>**.psp</td>
<td>Virtual sound source file which is used in SFP module.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output file</th>
<th>Type</th>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Firmware</td>
<td>**.datEve</td>
<td>A firmware file for YSS920B. The firmware can be downloaded to YSS920B by using “EVBEVECTL.EXE”.</td>
</tr>
<tr>
<td></td>
<td>User Setting File</td>
<td>**.all.ini</td>
<td>A file to save the settings of all modules. When pushing the “SAVE” button on the screen, the file is written out. A file can be also read by pushing the “LOAD” button on the main screen.</td>
</tr>
<tr>
<td></td>
<td>User Setting File</td>
<td>**.module name.ini</td>
<td>A file to save the separate settings of each module. When pushing the “SAVE” button on each module screen, the file is written out. A file can be also read by pushing the “LOAD” button on each module screen.</td>
</tr>
</tbody>
</table>

1.4 Installation/Uninstallation Method

Copy the entire FWCTRL folder and others to the same folder.
Delete all the related file folders to uninstall it.
1.5 System Configuration

This application is executed while communicating with the evaluation board (EVB-EVE) through parallel port. Connecting input/output audio instrument to the evaluation board enables real-time sound creation. The system configuration is as follows.

1.6 Start-up/Stop

1.6.1 Start-up

The procedure to start up this application is as follows.

1. Double-click FWCTRL.exe in FWCTRL folder to start the application. (The application is started by reading FWCTRL.ini in FWCTRL folder).
2. Port Select dialog is displayed by starting this application. (See the Figure below).
   When multiple ports are displayed, select a port according to your environment and then push OK button.
   For start-up in second time or later, the setting is already stored, so push the OK button soon when no change is required.

1.6.2 End

The procedure to end this application is as follows.

1. Push “EXIT” button on the main screen or push × button on the upper right button.
2. A dialog that indicates end of the application is displayed, so push “OK” to end the application.

## 1.7 Module Configuration

The firmware is composed of 13 audio processing modules.

The channel configuration varies as follows according to the flow of audio processing.

- 2-channel (Lt/Rt) audio signal is input.
- The center channel (FC) and surround channel (S) is expanded in the MD module.
- The surround channel (S) is expanded to rear channel (RL/RR) in the RS module.
- The center channel (FC) is distributed to each channel (FL/FR/RL/RR).
- The subwoofer channel (SW) is created from the bass of each channel (FL/FR/FCL/RL/RR) in the BM module.
- 4.1 channel (FL/FR/RL/RR/SW) audio signal is output.

[Note] The following abbreviations are used in the manual.

<table>
<thead>
<tr>
<th>Channel Name</th>
<th>Abbr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>Lt</td>
</tr>
<tr>
<td>Right</td>
<td>Rt</td>
</tr>
<tr>
<td>Front Left</td>
<td>FL</td>
</tr>
<tr>
<td>Front Right</td>
<td>FR</td>
</tr>
<tr>
<td>Center</td>
<td>FC</td>
</tr>
<tr>
<td>Center (Bass)</td>
<td>FCL</td>
</tr>
<tr>
<td>Rear Left</td>
<td>RL</td>
</tr>
<tr>
<td>Rear Right</td>
<td>RR</td>
</tr>
<tr>
<td>Subwoofer</td>
<td>SW</td>
</tr>
<tr>
<td>Surround</td>
<td>S</td>
</tr>
<tr>
<td>Left - Right</td>
<td>Lt–Rt</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Abbr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Range Control</td>
<td>DRC</td>
</tr>
<tr>
<td>Input VOLume</td>
<td>IVOL</td>
</tr>
<tr>
<td>Graphic EQualizer</td>
<td>GEQ</td>
</tr>
<tr>
<td>Input Delay</td>
<td>ID</td>
</tr>
<tr>
<td>Matrix Decoder</td>
<td>MD</td>
</tr>
<tr>
<td>Rear Spreader</td>
<td>RS</td>
</tr>
<tr>
<td>Sound Field Processor</td>
<td>SFP</td>
</tr>
<tr>
<td>Channel Distributor</td>
<td>CD</td>
</tr>
<tr>
<td>Bass Manager</td>
<td>BM</td>
</tr>
<tr>
<td>Parametric EQualizer</td>
<td>PEQ</td>
</tr>
<tr>
<td>Time Alignment</td>
<td>TA</td>
</tr>
<tr>
<td>VOLume control</td>
<td>VOL</td>
</tr>
<tr>
<td>Level Detector</td>
<td>LD</td>
</tr>
</tbody>
</table>
2 Main Screen

The main screen is composed of input selection, module icon, board control, window control, and file input/output function. When clicking a module icon, the setting screen (module screen) for each module opens.

2.1 Input Selection

The setting for input sources is controlled.

- **Input**
  - An input source is selected.
    - [Optical] ・・・・・・・・Designate “Optical” when the Optical input is used.
    - [Coaxial] ・・・・・・・・Designate “Coaxial” when the Coaxial input is used.
    - [Analog] ・・・・・・・・Designate “Analog” when the Analog input is used.

- **FS**
  - A sampling frequency for input signal is selected.
    - In the case of Optical / Coaxial input, one of 32kHz/44.1kHz/48kHz is selected.
    - In the case of analog input, only 44.1kHz can be designated.

2.2 Module Icon

When clicking an icon of DRC, IVOL, etc. (module icon), each module screen is opened. In addition, when checking “Disable” check box on upper part of the module icon, the audio processing for the module is not made. The input signal to the module is output as it is.

(It works with “Disable” check box on each module screen.)

2.3 Board Control

The setting of the evaluation board is made.

- **Initialize Board**
  - When pushed, evaluation board initialization, command code firmware and coefficient data firmware download are made. After that, the coefficient data firmware corresponding to the contents of this application setting is downloaded.

- **Default Setting**
  - When pushed, each setting of this application is returned to the initialization state (The setting state immediately after the application start-up)
  - After that, the coefficient data firmware corresponding to the initialization state is downloaded.

- **DAC VOL**
  - The DA output volume of CODEC can be adjusted.
2.4  Window Control

The control of the control screen can be made.

- Close all
  When pushed, all the module screens are closed.

- Cascade
  When pushed, module screens are arranged in the order of module icon.

2.5  File Input/Output Function

The file operations can be made.

- Load
  When pushed, the setting contents of the entire module are read from the user setting file (*.all.ini) and the corresponding coefficient data firmware is downloaded.

- Save
  When pushed, the setting contents of the entire module are written into the user setting file (*.all.ini).

- Export
  When pushed, the current downloaded command code firmware and coefficient data firmware are output as the firmware file (**.datEve) for YSS920B.
  The output file can be downloaded to YSS920B by using “EVBEVECTL.exe.”

2.6  Others

- Exit
  When pushed, the application is ended.
3 Module Screen

The common operations to each module are described here.

- Disable check box
  When checking “Disable” check box, audio processing of the corresponding module is not made.
  The input signal to the module is output as it is.
  (It works with “Disable” check box on the main screen.)

- Load
  When pushed, the setting contents of each module is read from the user setting file (*.module name.ini) and the
  corresponding coefficient data firmware is downloaded.

- Save
  When pushed, the setting contents of each module are written into the user setting file (*.module name.ini).

- Close
  When pushed, a module screen is closed.
3.1 **DRC (Dynamic Range Control)**

The DRC module controls dynamic range compression and volume.

### 3.1.1 Module Screen

The figure below shows the module screen of Dynamic Range Control. The screen is composed of the characteristics display screen and six sliders for parameter adjustment. The setting of Ratio, Threshold, and Gain shift is reflected to the characteristics display screen on the left. On the other hand, Release time, Attack time, and Input Delay are not reflected to the characteristics display screen because they are parameters working for time direction.

![Dynamic Range Control Module Screen](image)

### 3.1.2 How to Set

The DRC function is set with the six parameters.

- **Ratio**
  - The slider sets the ratio of between input and output.
  - The dotted line of the characteristics display screen on the previous paragraph indicates that input is equal to the output, and the solid line indicates the input/output characteristics when DRC was applied.
  - The solid line has different slope from the red dashed line; “Ratio” determines the slope (amount of compression).
  - The range is from 0.1 to 1.0.

- **Threshold**
  - The slider sets the point to start the compression.
  - This means the slope change point indicated by the dashed line on the characteristics display screen.
  - The range is from -60 to 0dB.

- **Release time**
  - The slider sets time from a point of which the input becomes lower than Threshold to the cancellation of the compression.
  - The range is from 10 to 200ms.

- **Attack time**
  - The slider sets time from a point of which the input exceeds the Threshold to the start of the compression.
  - The range is from 1 to 32ms.

- **Gain shift**
  - The slider adjusts the entire volume.
  - The range is from -12 to +12dB.

- **Input Delay**
  - Delay is generated in the process for calculating compression rate from the input signal.
  - The slider gives delay for the calculated compression rate to the input signal.
  - The range is from 0 to 20ms.
3.1.3 Example of Operation

The horizontal axis of the characteristics display screen indicates the gain of input signal and the vertical axis indicates that of the output signal. When the characteristics are set so that it is overlapped with the dotted line, a signal with input=output is output. In the following example, the whole volume is gained up by +12dB by the Gain shift parameter. The characteristics lean significantly in the right side (the volume of the input signal is -20dB or over) of the Threshold (red dashed line).
### 3.2 IVOL (Input VOLume)

The IVOL adjusts the input gain. Reserve the head margin so that signal overflow may not occur by the processing of modules in the later stage.

#### 3.2.1 Module Screen

The figure below is the module screen of Input Volume. The screen is composed of a slider for controlling the input gain.

![Input Volume Control Screen](image.png)

#### 3.2.2 How to Set

Set the gain to 0dB when the module function is not used.

- **Gain Adjustment**
  
  The slider sets the input gain. The range is from -24 to 0dB.
3.3 GEQ (Graphic EQualizer)

GEQ indicates 10-band graphic equalizer. Each band is arranged at intervals of 1 octave.

3.3.1 Module Screen

The figure below is the module screen of Graphic Equalizer. The screen is composed of 10 sliders and the characteristics display screen. The frequency characteristics of the equalizer are displayed on the characteristics display screen.

![Graphic Equalizer Module Screen]

3.3.2 How to Set

Each band has the following center frequency:
31.5/63/125/250/500/1000/2000/4000/8000/16000Hz

When clicking each band slider, the selected band is highlighted on the characteristics display screen. And, the center frequency and gain are displayed on the lower left of the screen.

- **Gain Adjustment**
  - The gain is set by each band slider.
  - The range is from -12 to +12dB.

- **Flat button**
  - When pushing the “Flat” button, all the gain of each band is set to 0.
3.4 ID (Input Delay)

Delay up to 250ms in each channel is added to the input signal. Lip Synch which synchronizes image and voice in DVD playback etc can be realized by the delay.

3.4.1 Module Screen

The figure below is the module screen of Input Delay. The module is composed of sliders that adjust the delay time of Lt channel and Rt channel.

3.4.2 How to Set

Set the delay time of each channel to 0ms when the module function is not used.

* Delay time
  The sliders set the delay time of Lt channel and Rt channel.
  The range is from 0 to 250ms.
3.5 MD (Matrix Decoder)

The MD makes the Matrix Decoding of 2-channel voice and expands the center channel (FC) and the surround-sound channel (S).

Our proprietary decoding method is used in the MD module. The method has the following features.

- To the movie source, the directional emphasis circuit acts on the input which was Matrix-Encoded, and the sense of sound movement and the positioning of spoken lines can be realized.
- Also to the music source which was not Matrix-Encoded, realistic sense can be obtained without destroying the stereophonic sense.

3.5.1 Module Screen

The figure below is the module screen of Matrix Decoder.

![Matrix Decoder Module Screen](image)

3.5.2 How to Set

Only “Disable” check box is an operable parameter for user.
3.6 RS (Rear Spreader)

The surround channel (S) is expanded to the rear 2-channel (RL/RR). Effects using delay and feedback can be applied. (Example: comb filter etc.)

3.6.1 Module Screen

The figure below is the module screen of Rear Spreader. The module is composed of the setting display screen, parameter setting sliders, and checkboxes.

3.6.2 How to Set

Here only describes parameters on the left side of the module screen. Parameters on the right side of the screen make the same operation as that of the left side.

- **Total mix**
  
  The slider sets the total amount of mix in the case of mixing the surround channel (S) and Lt–Rt channel to Rear Left channel (RL).
  
  The range is from -100 to 100%.

- **Lt–Rt mix**
  
  The slider sets the rate of Lt-Rt in the case of mixing the surround channel (S) and Lt–Rt channel to Rear Left channel (RL).
  
  The range is from -100 to 100%.
  
  The mix rate of $\text{①}$ is “setting value of Total mix” $\times$ “setting value of Lt–Rt mix.”
  
  The mix rate of $\text{②}$ is “setting values of Total mix” $\times$ “100% - |setting value of Lt–Rt mix|.”

- **delay mix**
  
  The slider sets the mix rate from the delay path to Rear Left channel (RL).
  
  The range is from -100 to 100%.
  
  The mix rate of $\text{③}$ “setting value of delay mix.”
  
  The mix rate of $\text{④}$ “setting value of 100% - |delay mix|.”
• delay feedback
  The slider sets the value of ⑤ that is the mix rate of the feedback path.
  The range is from -99 to 99%.

• delay time
  The slider sets the amount of delay of ⑥.
  The range is from 0 to 50ms.

• invert S to RL mix
  Check the box when mixing the surround channel(S) to Rear Left channel (RL) in inverted phase.
  When checked, plus and minus of the mix rate of ⑤ is inverted.
3.7 SFP (Sound Field Processor)

The SFP module enables reproduction of various sound fields in the vehicle interior. (For example: Church, Hall, Movie Theater, etc.)

Front channel (FL/FR) and Center channel (FC) are mixed with Presence sound field. The sound field effect to dialog/vocal can be optimized by changing the mix ratio in the Front channel and Center channel.

The surround channel (S) and Lt–Rt channel are mixed with Surround sound field. Different effects can be set to the anterior and posterior sound field by the two sound fields: Presence sound field and Surround sound field.

3.7.1 Module Screen

The figure below is the module screen of the Sound Field Processor. The module screen is composed of the setting display screen, virtual sound source file selection browse, and sliders for parameter settings.

3.7.2 How to Set

- **Presence Phantom Source**
  It designates the virtual sound source file of Presence sound field.
  The file can be designated by either way as described below.
  1. Write path and file name of the virtual sound field file into the edit box.
     The file path is designated by the absolute path or relative path from the folder which started up this application.
  2. Push "Browse" button to open the file selection dialog and designate the virtual sound source file.

  [Note] SFP module operates by reading the virtual sound source file we provided.
  The virtual sound source includes information about sound field. (Church, Hall, Movie Theater, etc.)

- **Surround Phantom Source**
  It designates the virtual sound field of Surround sound field.
  The way to designate a file is the same as that of Presence Phantom Source.

- **feedback delay**
  It sets delay time of Presence sound field feedback path.
  The range is from 0 to 500ms.
• liveness
The slider sets liveness. The liveness is a parameter to determine the attenuation characteristics of the reflected sound. The bigger value makes live sound field with a lot of reflected sound, and on the contrary, the smaller value makes dead sound field with a little reflected sound.

- initial delay
This is a parameter to control time from the direct sound to the start of reflected sound. The shorter time makes a sound field as if the sound source becomes closer to the wall surface; and on the contrary, the longer time makes a sound field as if the sound source is away from the wall surface.

- room size
This is a parameter to control sense of spread of space. The bigger value makes wider space (room), and on the contrary, the smaller value makes narrower space. The room size acts as multiple parameter to the time interval of the reflected sound level. When the sound repeats reflection, the time interval of the reflected sound becomes longer as a hall becomes wider.

The SFP module operates according to the signal flow described in the next page. The coefficient data firmware indicated in dotted line is changed by the operation of this application.

• Pre LPF Fc
The slider sets the cut-off frequency of Pre LPF. (Common to Presence sound field and Surround sound field)
The range is from 20 to 20000Hz.

• delay LPF Fc
The slider sets the cut-off frequency of delay LPF. The range is from 20 to 20000Hz.
- FL/FR to PF
  The slider sets the mix rate from Front channel (FL/FR) to Presence sound field.
  The range is from 0 to 100%.

- FC to PF
  The slider sets the mix rate from Center channel (FC) to Presence sound field.
  The range is from 0 to 100%.

- feedback to PF
  The slider sets the mix rate from feed back signal to Presence sound field.
  The range is from 0 to 99%.

- PF to FL/FR
  The slider sets the mix rate from Presence sound field to Front channel (FL/FR).
  The range is from 0 to 100%.

- PF to RL/RR
  The slider sets the mix rate from Presence sound field to Rear channel (RL/RR).
  The range is from 0 to 100%.

- S to SF
  The slider sets the mix rate from S channel to Surround sound field.
  The range is from 0 to 100%.

- Lt–Rt to SF
  The slider sets the mix rate from Lt–Rt channel to Surround sound field.
  The range is from 0 to 100%.

- SF to FL/FR
  The slider sets the mix rate from Surround sound field to Front channel (FL/FR).
  The range is from 0 to 100%.

- SF to RL/RR
  The slider sets the mix rate from Surround sound field to Rear channel (RL/RR).
  The range is from 0 to 100%.
3.8 CD (Channel Distributor)

The Parametric Equalizer (PEQ), LPF, and HPF can be applied to Center channel (FC). And, the Center channel (FC) is distributed to Front channel (FL/FR) and Rear channel (RL/RR). In addition, CD can apply the delay adjustment to Front channel (FL/FR) and distribute it to Rear channel (RL/RR).

3.8.1 Module Screen

The module is composed of Delay/Front mix screen, Rear mix screen, and PEQ/HPF/LPF screen. Display screen can be selected with the upper left tab on the module screen.

3.8.1.1 Delay/Front Mix Screen and Rear Mix Screen

The figure below shows Delay/Front mix screen and Rear mix screen. The screen is composed of the setting display screen and slider for setting mix rate and delay time. The slider numbered corresponds to the number on the settings display screen, respectively. (Example: when the slider ① is operated, the operation is reflected to the parameter ① on the setting display screen.)
3.8.1.2 PEQ/HPF/LPF Screen

The figure below is the PEQ/HPF/LPF screen. The screen is composed of characteristics display screen and sliders for the setting of equalizer and filter characteristics. In the PEQ/HPF/LPF screen, characteristics of PEQ, HPF, and LPF can be set.

- **Frequency Characteristics Display**
  Select the contents of characteristics display screen by the “View” drop-down list.
  - PEQ
    3-band PEQ frequency characteristic is displayed.
  - HPF
    HPF frequency characteristic is displayed.
  - LPF
    LPF frequency characteristic is displayed.
  - PEQ + HPF
    Frequency characteristic of the path through 3-band PEQ and HPF is displayed.
  - PEQ + LPF
    Frequency characteristic of the path through 3-band PEQ and LPF is displayed.
3.8.2 How to Set

3.8.2.1 How to Set Delay/Front Mix Screen

- **FL/FR mix**
  Set the mix rate from Front Left channel (FL) to Front Left channel (FL) with the left slider.
  Set the mix rate from Front Right channel (FR) to Front Right channel (FR) with the right slider.
  Each setting range is from 0 to 100%.

- **FC(H) mix**
  The Center channel (FC) of which sound quality was adjusted by PEQ and HPF is mixed with Front channel (FL/FR).
  Set the mix rate to Front Left channel (FL) with the left slider.
  Set the mix rate to Front Right channel (FR) with the right slider.
  Each setting range is from 0 to 100%.

- **FL/FR delay**
  Delay can be given when mixing Front channel (FL/FR) with Rear channel (RL/RR).
  Set the delay time of Front Left channel (FL) with the left slider.
  Set the delay time of Front Right channel (FR) with the right slider.
  Each setting range is from 0 to 40ms.

- **FC(H/L) delay**
  Delay can be given when mixing Center channel (FC) with Rear channel (RL/RR).
  Set the delay time to the path through PEQ and HPF with the left slider.
  Set the delay time of Front Right channel (FR) with the right slider.
  The range of FC(H) delay is from 0 to 40ms. The range of FC(L) delay is from 0 to 120ms.

3.8.2.2 How to Set Rear Mix Screen

- **RL/RR mix**
  Set the mix rate from Rear Left channel (RL) to Rear Left channel (FL) with the left slider.
  Set the mix rate from Rear Right channel (RR) to Rear Right channel (RR) with the right slider.
  Each range is from 0 to 100%.

- **FL/FR mix**
  Set the mix rate from Front Left channel (FL) to Rear Left channel (FL) with the left slider.
  Set the mix rate from Front Right channel (FR) to Rear Right channel (RR) with the right slider.
  Each range is from 0 to 100%.

- **FC(H) mix**
  The Center channel (FC) of which sound quality and delay was adjusted by PEQ and HPF is mixed with Rear channel (RL/RR).
  Set the mix rate to Rear Left channel (RL) with the left slider.
  Set the mix rate to Rear Right channel (RR) with the right slider.
  Each range is from 0 to 100%.

- **FC(L) mix**
  The Center channel (FC) of which sound quality and delay was adjusted by PEQ and HPF is mixed with Rear channel (RL/RR).
  Set the mix rate to Rear Left channel (RL) with the left slider.
  Set the mix rate to Rear Right channel (RR) with the right slider.
  Each range is from 0 to 100%.
3.8.2.3 How to Set PEQ/HPF/LPF Screen

- **Fc**
  Fc is a center frequency of each band of PEQ.
  In a band for low frequency (left side of module screen), the range is from 20 to 20000Hz.
  In other bands, the range is from 500 to 20000Hz.

- **Gain**
  Gain indicates a value in a center frequency of each band of PEQ.
  The range is from -12 to +12dB.

- **Q**
  Q is a parameter to determine a band width of Equalizer characteristics.
  The bigger Q, the band width becomes narrower Q, and the smaller Q, the band width becomes wider.
  The range is from 0.5 to 5.0.

- **Flat**
  Gain of all the bands is set to 0dB by pushing the “Flat” button.

- **HPF Fc**
  The slider sets the cut-off frequency of HPF.
  The range is flat (no-filtering) and from 50 to 20000Hz.

- **LPF Fc**
  The slider sets the cut-off frequency of LPF.
  The range is from 20 to 20000Hz.
3.9 **BM (Bass Manager)**

The BM extracts bass from five channels (FL/FC/FR/RL/RR) and creates SubWoofer channel (SW). And, the BM can return bass to each speaker again. In addition, a function to inhibit resonance in vehicle interior is implemented. The BM is used to make an optimal bass distribution (bass management) in accordance with user’s playback environment (speaker configuration).

### 3.9.1 Module Screen

The figure below is the module screen of Bass Manager. The screen is composed of setting/characteristic display, sliders for parameter setting, and check boxes.

* Screen Selection to display
  
  The display contents of setting/characteristics are selected by the “View” drop-down list.
  
  Select a screen from the following five screens.
  
  - **Mix Image screen**
    
    The screen displays mix rate and delay time.
  
  - **Front cross screen**
    
    The cross characteristics between Front channel (FL/FR) and Center Channel (FC) is displayed.
  
  - **Rear cross screen**
    
    The cross characteristics of Rear channel (RL/RR) is displayed.
  
  - **LPF + Resonance BPF screen**
    
    The frequency characteristics of a path that goes through LPF for SW and through BPF for Resonance damping are displayed.
  
  - **Resonance BPF screen**
    
    The frequency characteristic of BPF for Resonance damping is displayed.
3.9.2 How to Set

BM module operates according to the following signal flow. Coefficient data firmware indicated in dotted line is changed by the operation of this application.
3.9.2.1  Bass Management

- **front to LPF**
  The slider sets a mix rate from front channel (FL/FR) to LPF for bass extraction.
  The range is from 0 to 100%.

- **rear to LPF**
  The slider sets a mix rate from rear channel (RL/RR) to LPF for bass extraction.
  The range is from 0 to 100%.

- **FCLow to LPF**
  The slider sets a mix rate from center channel (FC) to LPF for bass extraction.
  The range is from 0 to 100%.

- **LPF to SW**
  The slider sets a rate of bass output. The setting value is applied to all the channels.
  The range is from 0 to 100%.

- **SW to front**
  The slider sets a mix rate used when bass is returned to front channel (FL/FR).
  The range is from 0 to 100%.

- **SW to rear**
  The slider sets a mix rate used when bass is returning to rear channel (RL/RR).
  The range is from 0 to 100%.

- **Output SW**
  The SW sets the presences of SubWoofer channel (SW) output.
  When checked, bass is output to the SubWoofer channel (SW).
  When unchecked, 0 is output.

- **Front HPF Fc**
  The slider sets a cut-off frequency of HPF for front channel (FL/FR).
  This is used for removing bass from the front channel (FL/FR).
  The range is flat (no-filtering) and from 50 to 300Hz.

- **Rear HPF Fc**
  The slider sets a cut-off frequency of HPF for rear channel (RL/RR).
  This is used for removing bass from the rear channel (RL/RR).
  The range is flat (no-filtering) and from 50 to 300Hz.

- **SW LPF Fc**
  The slider sets a cut-off frequency of LPF for bass extraction.
  Bass is extracted by applying LPF to signal which was made by mixing each channel.
  The range is from 20 to 300Hz.

3.9.2.2  Resonance Damping

“Resonance damping” function is implemented for inhibiting resonance in vehicle interior.
Occurrence of the resonance is inhibited by removing resonance frequency component from the original signal.

- **BPF Fc, BPF Q**
  BPF Fc indicates center frequency of the band-pass filter and BPF Q indicates band width of the band-pass filter.
  Set the BPF Fc and BPF Q so that resonance frequency component is picked out.
  The range of BPF Fc is from 20 to 150Hz. The rage of BPF Q is from 0.5 to 5.0.

- **delay**
  The slider gives delay to a signal picked out with the band-pass filter and matches the phase of it to the original signal.
  The range is 0 to 50ms.

- **Effect mix**
  The polarity of a signal which was delayed and adjusted is inverted and the resultant signal is mixed with the original signal.
  The slider sets a mix rate of this mixing.
  (For example, when the slider is set to 50%, a signal multiplied by -0.5 is mixed with the original signal.)
  The range is from 0 to 100%.
3.10 PEQ (Parametric Equalizer)

3-band parametric equalizer (PEQ) is for Front channel (FL/FR), Rear-Left channel (RL), Rear-Right channel (RR), and SubWoofer channel (SW).

3.10.1 Module Screen

The figure below is the module screen of Parametric Equalizer. The module is composed of channel selection tab, each channel characteristic display, and PEQ setting for 3-band. The frequency characteristic of PEQ is displayed on the display.

- Channel Selection
  The channel selection tab on the upper left of the display can select a channel to adjust PEQ characteristics. The selection is made from Front channel (FL/FR), Rear Left channel (RL), Rear Right channel (RR), and SubWoofer channel (SW).

3.10.2 How to Set

- \( F_c \)
  \( F_c \) is a center frequency of each band of PEQ. In a band for low frequency (left side of module screen), the range is from 20 to 20000Hz. In other bands, the range is from 500 to 20000Hz. As for SubWoofer channel (SW), the range is from 20 to 20000Hz for all the three bands.

- Gain
  Gain indicates a value in a center frequency of each band of PEQ. The range is from -12 to +12dB.

- \( Q \)
  \( Q \) is a parameter to determine a band width of Equalizer characteristics. The bigger \( Q \), the band width becomes narrower, and the smaller \( Q \), the band width becomes wider. The range is from 0.5 to 5.0.

- Flat
  All the gain of channel that is being set currently is set to 0dB by pushing the “Flat” button.
3.11 TA (Time Alignment)

Arrival time of sound is adjusted by giving delay to each channel.

3.11.1 Module Screen

The figure below is the module screen of Time Alignment. The module is composed of the setting display screen and the sliders for setting delay time of each channel.

3.11.2 How to Set

When the module function is not used, set delay time of each channel to 0ms.

- Delay time
  Set delay time of each channel.
  The range is from 0 to 30ms.
3.12 VOL (VOLUME control)

Adjustment of master volume, balance and offset can be made.

3.12.1 Module Screen

The figure below is the module screen of Volume control. The display is composed of the settings of master volume, balance of Front/Rear and Left/Right, and Offset.

3.12.2 How to Set

When the module function is not used, set the master volume/Offset to 0dB and set the balance to Neutral.

- **Volume**
  - Set a value of the master volume to whole channels.
  - The range is from -100dB to +30dB.

- **Balance**
  - Set the volume balance of Front/Rear and Left/Right.
  - The adjustment result is displayed in dB value.
  - The range is -∞dB and from -98 to 0dB.

- **Offset**
  - Set an Offset value with respect to the output level of Front (Front channel), Rear (Rear channel), SW (Subwoofer channel).
  - The range is from -10 to +10dB.

3.12.3 Upper Limit of Volume Adjustment

The upper limit of volume adjustment in VOL module is +36dB.

When a total of master volume, balance, and Offset exceeded +36dB, a signal adjusted to +36dB is output.
3.13  LD (Level Detector)

The signal level of each channel is displayed.

3.13.1  Module Screen

The figure below is the module screen of Level Detector. The signal level is displayed in 6dB step.

3.13.2  How to Set

When opening the module screen, automatically operation for the display is made. No operation is required on the display.
4 Precautions for Use

1. Since this evaluation board is controlled by PC through the parallel port, Allophone may occur due to the restriction of communication speed when changing coefficient. In order to inhibit the unpreventable allophone as little as possible, the application makes operation so that input signal is directly output while coefficient is changed. Therefore, voice without audio effect is instantaneously output. This operation is made only when the slow communication speed caused by the parallel port is used. So, such allophone does not occur when controlling the application in sufficient communication speed from a microprocessor which was directly connected, and the above operation is not required.

2. In some case, initialization operation from PC to the parallel port is made for approximately 2 minutes from the start-up. Depending on your PC environment, when this application was started up before this initialization operation is terminated, normal sound may not be generated. And, the same phenomenon may occur when PC is in standby state or was returned from the pause state. Note the following points.
   - Connect PC and Evaluation Board before the power-up. And, do not plug/unplug cables during operation.
   - When normal sound cannot be obtained because of the above cause, please restart the application or initialize the board with “Main Screen” → “Initialize Board.”

   This restriction is the peculiar matter for the board control from PC through the parallel port.

3. Allophone due to an overflow may occur when amplifying the signal by each audio processing. Lower the signal amplitude by IVOL module and prevent the overflow.

4. In some case, discontinuous sound may occur due to dynamic change of the delay time.

5. Delay of one sample time is generated even if setting delay time of 0ms.

6. This application and “EVBEVECTL.exe” cannot be started up at the same time.