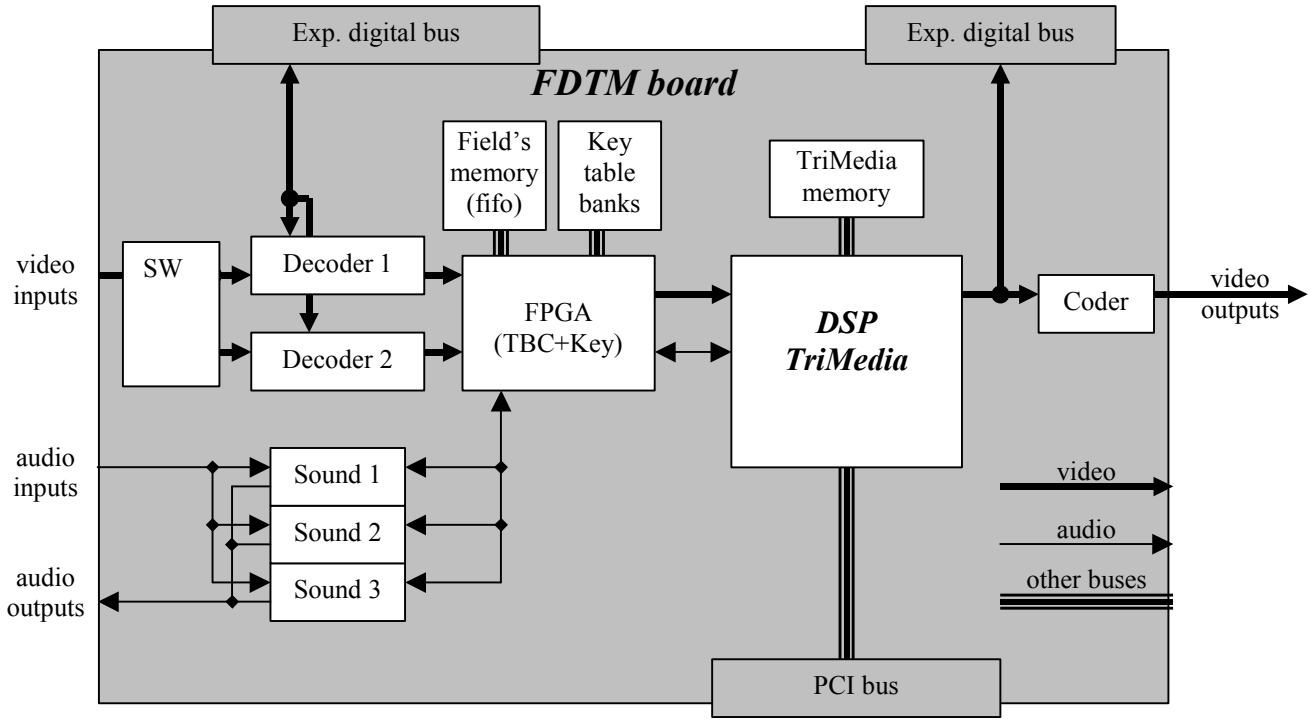
FDTM – family of TriMedia processor based Video-Audio In/Out boards (FD200, FD300…)

The Main purpose of the FDTM hardware solution is to provide hi-quality input and output of SD video and audio streams with additional digital processing, independent of a concrete application.

A typical board configuration includes the following functional modules:

- Input video switcher/selector module
- Analog Video Decoders
- Time-base corrector modules
- Embedded chromakey modules
- Digital expansion buses
- Multi channel audio In/Out module
- DSP module based on Trimedia processor
- Analog Video Encoder

Below you can see a diagram of the FD300 board architecture.



Input video switcher/selector module enables us to select any of the video inputs to any video decoders without reconnections of cables (like expensive matrix switcher). The passive breakout box has some limitations of using different kind of signals simultaneously (they can use same wires), but the active breakout box does not have such limitations.

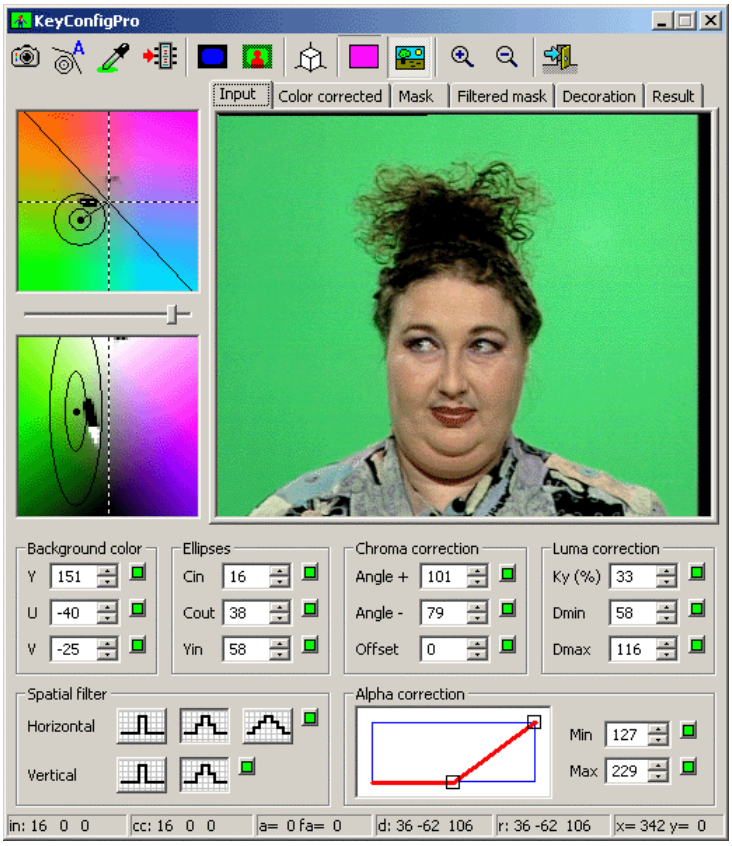
Analog Video Decoders provide accurate decoding of most video signals – (Composite, Y/C, YUV, RGB, PAL, NTSC, SECAM) to standard digital parallel video signal (CCIR 656). Tuning of the most typical parameters of video signals is available. Below you can see an example of the software dialog for input selection and tuning.

Also, digital input/output of the video data stream through the **Digital Expansion bus** is available (SDI option, DVI converter etc.). These connectors can be used for cascading the FDTM boards for additional image processing or they can be used for connection of different optional hardware modules.

Time-base corrector modules provide full-frame buffering and synchronization for two onboard channels of digital video. We are able to use any un-genlocked video sources for providing drop-free switching, mixing and so on.

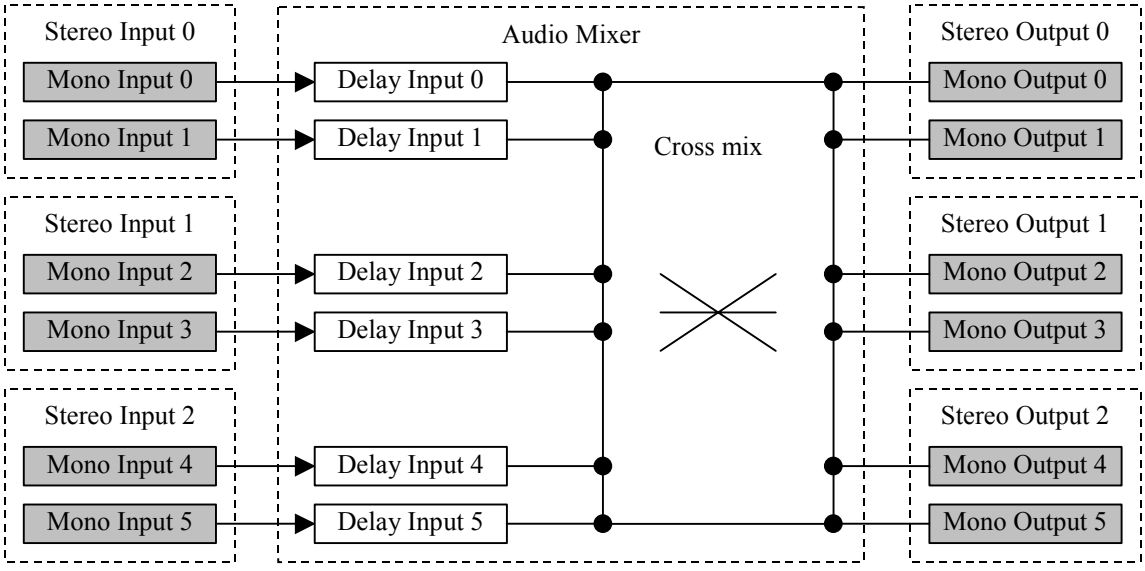
Embedded chroma-key modules provide real-time matte (alpha-mask) generation for any of 2 digital video channels. But only one channel with mask can be streamed to TriMedia in real-time with drop-free switching of the source channel. We are able to stream two full D1 video without alpha-mask from both channels. It means we can stream to the host computer one full D1 video with alpha-mask and switch between two channels in real-time. Our chroma-key engine, based on an original algorithm, is specially developed as a low-budget solution with reduced requirements for background, lights, camera etc. It allows for a wide range of possibilities with many different levels of video equipment for an affordable result.

You can see some examples on illustrative pictures.



The sample of software dialog represents typical set of parameters for chroma-key. Different model of actors and background colors can be implemented in hardware, on this sample you can see simplified ellipsoid model for determine colors areas for keying. Chroma- and Luma correction also implemented in hardware for eliminate blue-spill and other color artifacts. Some additional filtering can be provided for matte (alpha-mask) image for smoothing ages and reduce noise (horizontal, vertical and time-based). Resulted levels of alpha-mask can be also adjusted. Input video image can be cropped to eliminate some boundaries or not proper background colors.

Multi channel audio In/Out module provides standard 16 bit/48 KHz digital audio processing for 6 mono (or 3 stereo) audio channels. General features include programmable delay for each channel and cross-mixing between all channels with independent volume.



Every mono input *Mono Input N* and mono output *Mono Output N* have hardware regulator (controller) of volume and switch (mute). Moreover, the pairs of inputs *Mono Input 2 + Mono Input 3* and *Mono Input 4 + Mono Input 5* have their own switches of extra gain for 20dB (mic mode).
The *Cross Mix* module represents a connection of each input with every output. Its own volume and its own transfer audio switch (mixing) is set for every connection of ***i*** input with ***j*** output. The value of audio delay is set for each input individually within the range from 0 to 999 milliseconds.
From the point of view of operation system the FDTM board represents tree standard WAVE-devices, namely three WaveIn devices (to input audio) and three WaveOut devices (to output), every device operates with its stereo channel. The audio from PC incoming to the first WaveOut is added to *Stereo Output 0*. Therefore, audio from the second WaveOut device feeds *Stereo Output 1*, from the third one - *Stereo Output 2*. Unlike the clear connection of output audio devices, the WaveIn devices can input audio from any stereo input.

DSP module based on Trimedia processor provide overall control of image and audio processing and host interaction. Also some portions of video and audio processing are implemented in TriMedia software. TriMedia receives a stream of packed video data from FPGA and outputs the video data stream to the output coder:

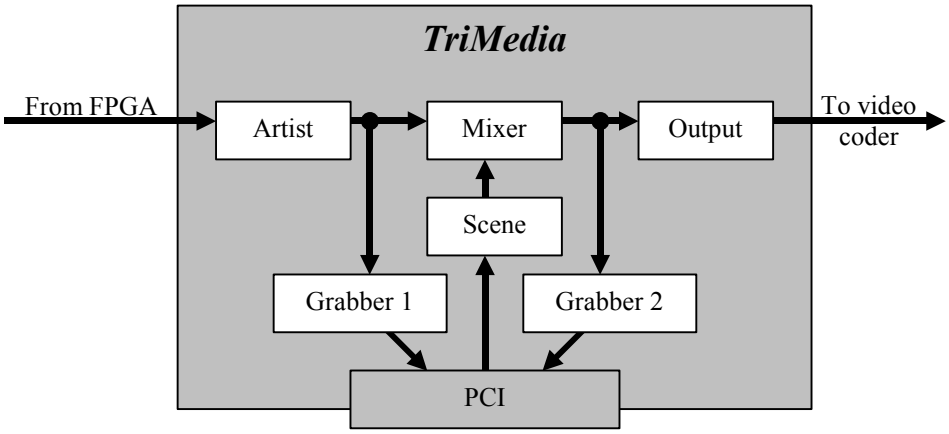


Figure 3. Internal structure of TriMedia video streams

TriMedia internal software contains several software objects: Artist, Mixer, Output, Scene, Grabber 1, and Grabber 2.

1. The "**Artist**" object receives video data from FPGA and stores them in the TriMedia memory.
2. The "**Scene**" object reads video data from PC memory to its buffers.
3. The "**Mixer**" object inquires the addresses of memory buffers with corresponding fields of the artist and scene and mixes the image to its memory, which later sends to the "**Output**" object for displaying. Up to 3 layers of images and 2 layers of mask can be mixed in real-time.
4. All operation of video data mixing is synchronized by the "**Output**" object, which receives interrupts from the video decoder.
5. Two "**Grabber**" objects are realized in TriMedia: the first grabber is to input video data to PC from input, and the second grabber – from mixer output.

Analog Video Encoder forms analog video signal in CVBS format (composite video signal), S-Video or YCrCb/RGB/YCrCb+Sync/RGB+Sync (component video signals). The coder can receive source digital video data from DSP TriMedia or an other devices via digital bus (656 bus). Also, output signal can be genlocked to any analog input, selected to one of decoders. NTSC, PAL and SECAM standards are supported. As additional options it possible to output analog key signal simultaneously with video signal.

FDTM Board Technical Specification

Output Video Formats:
Full D1 resolution, full motion, full color analog or 4:2:2 digital video
NTSC, PAL or SECAM software selectable
NTSC: 720x480 at 29.97 fps
PAL, SECAM: 720x576 at 25 fps

Video Inputs:
Composite (BNC): up to **6** (1.0 Vp-p, 75 Ohm)
S-Video (4-pin mini-DIN): up to **3** (Y: 1.0 Vp-p, 75 Ohm; C: 0.286 or 0.3 Vp-p at burst level, 75 Ohm)
Component RGB (BNC): up to **3** (R/G/B: 1.0 Vp-p, 75 Ohm) with Int. or Ext. sync
Component YUV (BNC): up to **3** (Y: 1.0 Vp-p, 75 Ohm; U/V: 0.7 Vp-p, 75 Ohm) with Int. or Ext. sync
SDI (BNC): (SMPTE 259M-C, 270 Mbps) - *optional*
The maximum possible number of inputs is shown, some are mutually exclusive
All Inputs are software selectable except certain RGB/YUV ext. sync selections
Real time switching is available between any **2** of these inputs

Video Outputs:
Composite (BNC) (1.0 Vp-p, 75 Ohm),
S-Video (4-pin mini-DIN) (Y: 1.0 Vp-p, 75 Ohm; C: 0.286 or 0.3 Vp-p at burst level, 75 Ohm),
Component RGB (BNC) (R/G/B: 1.0 Vp-p, 75 Ohm) with Int. or Ext. sync,
Component YUV (BNC) (Y: 1.0 Vp-p, 75 Ohm; U/V: 0.7 Vp-p, 75 Ohm) with Int. or Ext. sync,
SDI (BNC) (SMPTE 259M-C, 270 Mbps) - *optional*
Outputs are software selectable, only certain combinations are available simultaneously

Audio Input/Output:
Inputs microphone- or line-level analog or SPDIF digital mono or stereo audio (Up to 6 analog stereo channels)
Outputs stereo line-level analog or SPDIF digital audio with programmable delay for proper A/V synchronization
Optional Breakout support balanced Audio In/Out (XLR).

Time Base Correction:
Individual Time Base Correction for each selected video input allows for real time switching between **2** asynchronous analog/digital video sources without loss of a single frame

Genlock:
Master video output (analog and/or digital) can be genlocked to an external reference video signal (*optional*)

FDTM SDK Concept

FDTM SDK is intended for development of applications that use FDTM (FD300) boards for video input/output, video mixing, color-keying, controlling board's audio mixer etc.

FDTM SDK consists of the following parts:
- Executable modules and services
- Include header and C-files with definition of constants and objects/interfaces identifiers
- Documentation – description of FDTM board, objects and interfaces

Program modules of FDTM SDK are COM-objects that are installed and registered in the system as a part of drivers and applications of FDTM board. The COM technology is used for calling FDTM objects.

It is recommended to create projects using Microsoft Visual Studio version 6.0 or higher, with the use of ATL library. COM initialization will be inserted to an ATL project automatically. Besides, ATL library provides a set of functions and classes that significantly facilitate development of COM-projects (for example, CComPtr class – “smart pointer” that automatically counts object reference counter).

There are several *PropertyPages* in the FDTM objects intended for setting the FDTM boards parameters. All of them are of the same size and can be used simultaneously.

More detailed description of FDTM SDK is available as separate set of documents by order from our web site or nearest office.