

## Data sheet for BT709IF Block

### Functional Description

The ITU-R BT.709 standardizes the format of high-definition television having 16:9 aspect ratio. The BT709IF block is a parallel interface which receives video data output from an HD Decoder. It then extracts the video and control signal information from this data stream.

The incoming data is in SMPTE 274M or SMPTE 296M format. The BT709IF block extracts the Y and C data from the data stream and outputs them on separate lines at the appropriate time. The output from BTIF is used by the subsequent stages of HD-Video processing.

In addition this block also generates color bars internally during operation in test mode.

### Features:

- Supports 16 bit input data coming at 74.25MHz
- Supports 8 bit input data coming at 148.5MHz
- Supports both EAV/SAV and sync modes
- Supports 720p (50Hz and 60Hz) and 1080p formats
- Color Bar mode support
- Internal HSYNC, VSYNC and BLANK signal Generation in EAV/SAV and color bar modes

### Block Diagram:

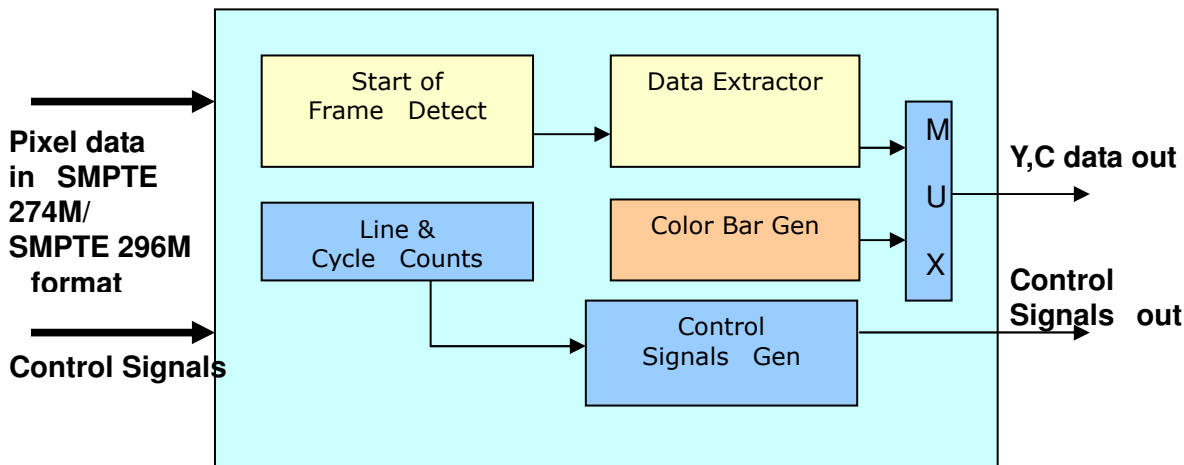


Figure 1: BT709IF Block Diagram

### Description:

The BT709IF block can accept video data in any one of the four formats

- 16 bit video data on Y and C lines, HSYNC, VSYNC and BLANK signals at 74.25Mhz
- 16 bit video data on Y and C lines, EAV/SAV signals on both Y and C lines at 74.25Mhz
- 8 bit video data on Y line, HSYNC, VSYNC and

BLANK signals at 148.5Mhz

- 8 bit video data on Y line, EAV/SAV embedded in Y line at 148.5Mhz

Also this module supports incoming data in 720p (50Hz and 60Hz) as well as 1080p formats.

Following is a brief description of the different blocks in BTIF.

**Start of Frame Detect** : This block is enabled only during normal mode of operation. It waits till the appropriate start of frame condition is achieved before the rest of the system is enabled.

**Line & Cycle Counters** : These counters are enabled by the output of *Start of Frame Detect* in normal mode and by the *rs\_color\_bar* signal during test mode

**Control Signals Gen** : This block uses the line and cycle counts and generates HSYNC,VSYNC,BLANK, HBLANK and, signals.

**Data Extract** : This block is enabled by the output of *Start of Frame Detect* . This block waits for the active data portion of the frame and then outputs the incoming data onto the Y and C lines

**Color Bar Generator** : This block is enabled during test mode. This block generates a constant color bar data during the active video portion of the frame. Based on the mode the output of either *Color Bar Generator* or *Data Extract* are output.

For both Normal and test mode, the internally generated **BLANK** signal acts as the data valid for active video data.

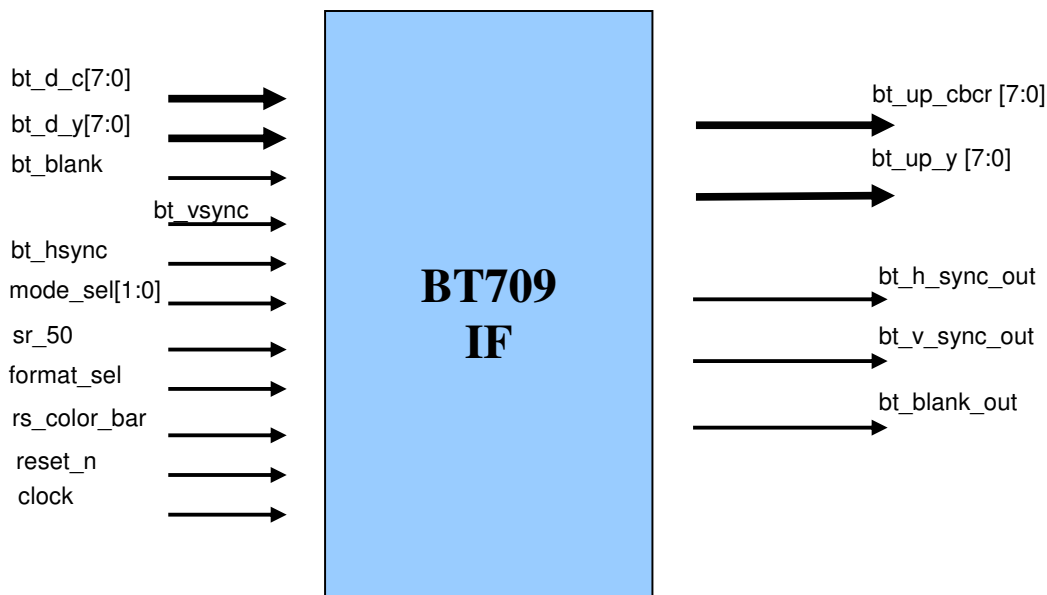
**Operational Frequency** : The entire system operates at a frequency of 148.5 MHz with incoming data at either 74.25MHz or 148.5MHz

**Signal definition table:**

<b>Signal</b>	<b>Direction</b>	<b>Description</b>
clock	IN	The BT709IF system is a single clock system and all I/Os and internal blocks are synchronous with it.
reset_n	IN	This signal resets the system whenever it is disabled and all counters, registers are sets to starting point.
rs_color_bar	IN	Enables the color bar (Test mode) operation. The incoming data stream and sync pulses are ignored 1'b1 : Configures the system in Test mode, incoming data is ignored 1'b0 : Configures the system in normal mode
format_sel	IN	This signal indicates whether the input data is in 720p/1080p format 1'b0 : 720p (50 Hz or 60Hz ) format 1'b1 : 1080p format
sr_50	IN	When the format selected is 720 p, this signal allows to choose between sample rates 50 Hz and 60Hz 1'b1 – Sample rate 50Hz 1'b0 – Sample rate 60Hz
mode_sel	IN	This 2 bit signal indicates the mode of the incoming data stream 2'b00: 16 bit BT data on Y and C lines along with hsync,vsync Incoming data rate is 74.25MHz 2'b01: 16 bit BT data on Y and C lines along with EAV/SAV on both Incoming data rate is 74.25MHz 2'b10: 8 bit BT data on Y line along with hsync,vsync Incoming data rate is 148.5MHz 2'b11: 8 bit BT data on Y line along with embedded EAV/SAV on Y Incoming data rate is 148.5MHz
bt_hsync	IN	This port represents the Hsync pulse used during SYNC mode of operation
bt_vsync	IN	This port represents the Vsync pulse used during SYNC mode of operation

<b>Signal</b>	<b>Direction</b>	<b>Description</b>
bt_blank	IN	This port represents the Blanking signal used during SYNC mode of operation. The value of this port is high only during the active video portion
bt_d_y	IN	This 8-bit port carries the luma data when the incoming data rate is 74.25MHz It carries the multiplexed YCbCr data when incoming data rate is 148.5MHz
bt_d_c	IN	This 8-bit port carries alternate Cb and Cr when the incoming data rate is 74.25MHz When incoming data rate is 148.5MHz, this port is unused.
bt_h_sync_out	OUT	The hsync pulse output from BT709IF.
bt_v_sync_out	OUT	The vsync pulse output from BT709IF.
bt_blank_out	OUT	The blank pulse output from BT709IF. This port also acts as data valid for active video data.
bt_up_y	OUT	This 8-bit port contains the output Luminance data during active video
bt_up_cbc	OUT	This 8-bit port outputs alternate Cb and Cr data during active video

**The BTIF Schematic symbol:**



**Performance:**

<b>Device</b>	<b>Slice Count</b>	<b>Frequency</b>
Virtex-4	425	168.77MHz

**Verification:**

The BTIF module has been verified with following approaches:

- Data generated through behavioral models for the BT709 drivers.
- Color Bar mode configuration
- All the configuration modes were tested till post par level

**Deliverables:**

- Verilog RTL source code
- Test benches
- Behavioral models of the BT709 drivers