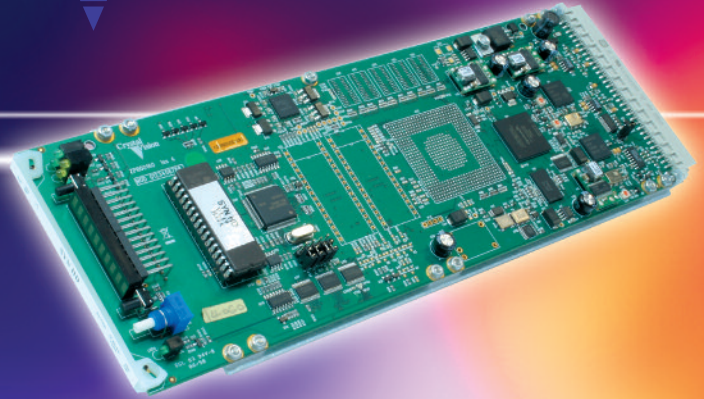# Crystal Vision

SYN HD
SYN HD-AFD

HD/SD synchronisers

You can use SYN HD and SYN HD-AFD to correct any timing problems – whether you need to synchronise your incoming video signals which are not locked to the local reference or to compensate for timing delays within your video system. The multi-functional SYN HD-AFD version can also be used to insert SMPTE 2016 AFD information to help downstream equipment automatically select the correct aspect ratio.

These two video synchronisers are ideal for broadcast engineers who need to bring untimed HD or SD video into their system. Primarily designed for applications without embedded audio, if the input and output frame rates are locked together then the synchronisers may be set to pass through embedded audio transparently. A TTL level pulse allows an audio delay to track the video delay through the synchronisers, making it easy to use them with separate audio.

There are two operational modes: synchroniser and delay line. Synchroniser mode is ideal for external sources that are not timed to station references such as satellite or remote contribution feeds. The boards take their timing from the external analogue reference and will automatically synchronise sources, fixing any incorrect frame rates plus any delays. Cross-locking means that an HD or SD input can be referenced to either HD tri-level syncs or SD Black and Burst – allowing the convenient use of any existing timing signals. You can easily compensate for mistimed sources elsewhere in your system by adjusting the output timing relative to the reference through an entire frame using horizontal and vertical settings. Should the reference be removed or the board powered without a connected reference, the synchronisers will free run at the previously received line rate.

With timing derived from the video input, delay mode is ideal for when the frame rate is correct but the source has been passed through equipment such as a chroma keyer, DVE or standards converter and therefore been delayed for a few lines. Allowing full adjustment of vertical and horizontal timing, the fixed delay can be set between 2us and one frame plus approximately 2us.

The boards offer the double benefits of both a frame synchroniser and line synchroniser. As a frame synchroniser they allow any timing difference, with storage for a whole frame ensuring that the output video is always valid with the sync information in the right place and also allowing you to output the video at a different rate to the input video, by being able to repeat the last frame if required. The line synchroniser advantages include a short minimum delay of 2us for a simpler system design and quick recovery of horizontal input timing which means that if you switch from one source to another in the active picture, the synchroniser will ensure that the picture below the switch is horizontally aligned even if it is shifted vertically, and will be correctly positioned in the next frame.

It's easy to avoid picture disturbances when you switch in the vertical blanking between two sources with different timings. To minimise loss of data and ensure the active picture is clean and in the right place, the synchronisers re-lock at three separate points: at the start of the nominal field or frame, after the switching point and before the start of the active field or frame.

Manual freeze allows the synchronisers to be used as a simple still store, with the type of freeze selected from frame, field 1 or field 2. Automatic freeze is available when input fails through loss of signal, and can be selected from blue screen, black screen, delay then blue or delay then black. Indication is given if the delay between the input video and external reference is shorter than the blanking period of the input video, while EDH and CRC information is regenerated and inserted into the output video.

SYN HD-AFD can be used either as a synchroniser with SMPTE 2016 AFD functionality or purely as an AFD inserter to allow a following down converter to output the Standard Definition with an appropriate aspect ratio. HD programmes are often made of a mixture of true High Definition sources and SD sources that have been up converted and have black pillars at the sides. SYN HD-AFD can embed one of 16 AFD codes into the output video for the down converter to read, with the code describing which areas of the screen contain a picture and which areas are black 'padding'.
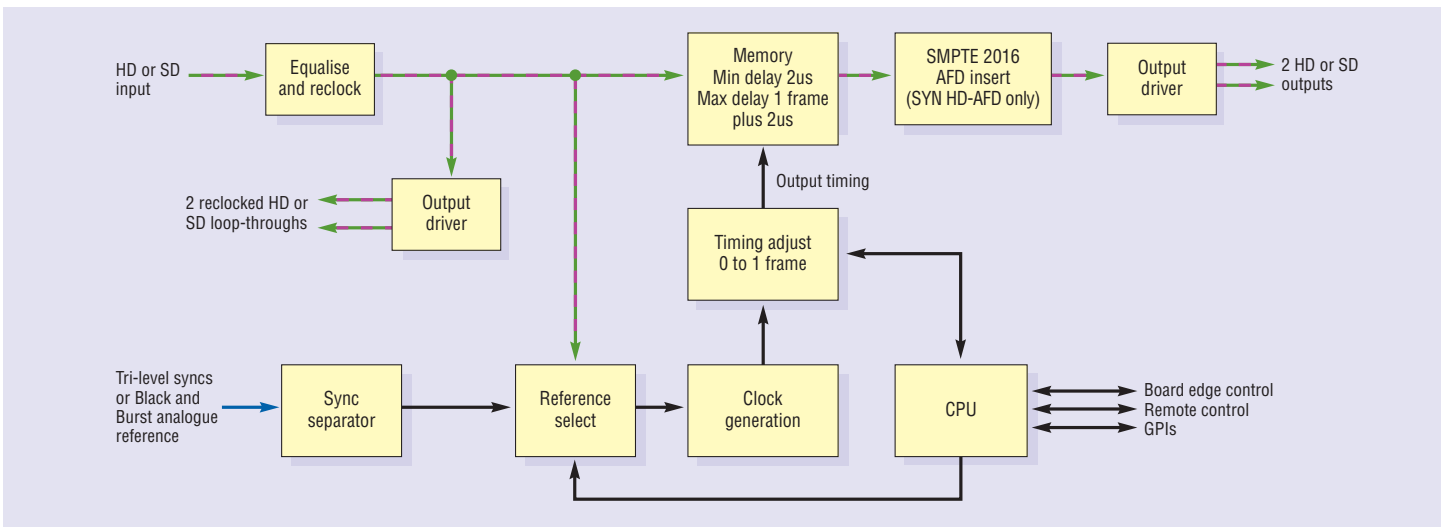
SYN HD and SYN HD-AFD fit in the standard Crystal Vision frames and are used with the RM34 frame rear module to provide two HD or SD outputs and two reclocked input loop-throughs. The flexible control options include board edge switches, an active front panel on the frame, a remote control panel, SNMP and the Statesman PC software. GPIs can also be used, and are particularly useful on the SYN HD-AFD as they allow an automation system to easily control the insertion of any AFD code by recalling one of 16 presets, which can inform SYN HD-AFD when to change the AFD code.

All versions:

- Video synchroniser which works with both HD and SD, in two versions
- Ideal for correcting any timing problems: use it to either synchronise incoming video signals or compensate for timing delays within video system
- Excellent range of synchronising features – combines advantages of both frame synchroniser and line synchroniser
- Allows any timing difference: synchronises sources between 0 and one frame
- Avoids picture disturbances when switching between two mistimed sources in vertical blanking by re-locking three times
- Quick recovery of horizontal input timing allows you to switch in the active picture
- Get a simpler system design with short minimum delay of 2us
- Use any existing timing signals with cross-locking: HD or SD source can be referenced to either HD tri-level syncs or SD Black and Burst
- Compensate for mistimed sources elsewhere in the system with full vertical and horizontal timing adjustment (0-1 frame)
- Use it as a simple still store with manual freeze
- Choose what happens on input failure, with selectable blue, black or freeze
- Easy to use with external audio, thanks to audio follow output control
- Use it with embedded audio sources when output locked to input
- Includes EDH and CRC regeneration
- Space-saving: 100mm x 266mm module allows 12 SYN HD and SYN HD-AFD in 2U (24 in 4U, six in 1U and two in desk top box)
- Flexible control, including SNMP and PC software

Additional features on SYN HD-AFD:

- Helps downstream equipment to automatically select the correct aspect ratio: can insert SMPTE 2016 AFD data into the output video
- Makes it easy to use an automation system to control the insertion of AFD codes, with 16 presets allowing the appropriate AFD code to be recalled by GPI

Block Diagram

HD or SD input → **Equalise and reclock** → **Memory** Min delay 2us Max delay 1 frame plus 2us → **SMPTE 2016 AFD insert (SYN HD-AFD only)** → **Output driver** → 2 HD or SD outputs

Output driver → 2 reclocked HD or SD loop-throughs

Output timing

Timing adjust 0 to 1 frame

Tri-level syncs or Black and Burst analogue reference → **Sync separator** → **Reference select** → **Clock generation** → **CPU** → Board edge control / Remote control / GPIs

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SPECIFICATION

MECHANICAL
Standard Crystal Vision modules 266mm x 100mm
Weight: 185g
Power consumption: 4 Watts

VIDEO INPUT
One HD or SD input with reclocking 270Mb/s or 1.5Gb/s serial compliant to EBU 3267-E, SMPTE 259M and SMPTE 292M
HD cable equalisation up to 140m with Belden 1694A or equivalent (approx. 100m with Belden 8281). SD cable equalisation >250m Belden 8281 or equivalent
The video formats supported are 625, 525, 720p50, 720p59.94, 720p60, 1035i59.94, 1035i60, 1080i50, 1080i59.94 and 1080i60
Input return loss: -15dB for 50MHz to 1.5GHz
Auto 50/59.94/60Hz and video format selection
May contain embedded audio when input and output frequencies are locked

VIDEO OUTPUTS
Two HD or SD retimed outputs using RM34 frame rear module
Two equalised and reclocked input loop-throughs
Serial output: 270Mb/s or 1.5Gb/s serial compliant to EBU 3267-E, SMPTE 259M and SMPTE 292M. Output follows the input format

ANALOGUE REFERENCE
Tri-level syncs or analogue Black and Burst or video

HD or SD source can use either type of reference
When cross-locking it is necessary for both the video input and reference to share the same frame rate
Amplitude of syncs 150mV to 600mV
Link on PCB selects 75 ohm termination or high impedance

TIMING ADJUSTMENTS
In synchroniser mode SYN HD/SYN HD-AFD takes its timing from the analogue external reference and will automatically synchronise sources between 0 and one frame. Should the reference be removed it will free run at the previously received line rate
In delay mode timing is derived from the HD or SD input
The timing can be fully adjusted using horizontal and vertical settings. Increasing the vertical setting will delay the output relative to the reference in increments of one line. Increasing the horizontal setting will increase this delay in increments of approx. 74ns for SD and 13.5ns for HD. The maximum setting of both controls will provide a delay of one frame plus approx. 2us
SYN HD/SYN HD-AFD synchronises at three separate points within each field or frame: at the start of the nominal field/frame, just after the switching point and before the start of the active field/frame

DELAY THROUGH BOARD
2us min – 1 frame plus approx. 2us max

FREEZE FUNCTIONS
Manual freeze allows SYN HD/SYN HD-AFD to be used as a simple still store. Selecting single field output can counteract any flicker caused by the interlacing of the two fields on a picture with significant movement. Either field can be selected. The single field is output only when the picture is frozen. Automatic freeze is available when input fails through loss of signal. The user can specify to show the whole frame in which failure happened, field 1 or 2 of the last frame or alternatively a black or blue screen (with or without an initial delay)

ACTIVE FORMAT DESCRIPTION (SYN HD-AFD ONLY)
SYN HD-AFD will insert SMPTE 2016 AFD data into the output video to allow downstream equipment to automatically select the appropriate aspect ratio
One of 16 AFD codes can be embedded, with the code describing which areas of the screen contain a picture and which areas are black 'padding'
The 16 codes are 0: Undefined, 1: Reserved, 2: 16:9 top, 3: 14:9 top, 4: >16:9, 5: Reserved, 6: Reserved, 7: Reserved, 8: Full Frame (as coded frame), 9: 4:3 image, 10: 16:9 image, 11: 14:9 image centred, 12: Reserved for future use, 13: 4:3 with shoot and protect 14:9 centre, 14: 16:9 with shoot and protect 14:9 centre and 15: 16:9 with shoot and protect 4:3 centre
The AFD code is contained in an ANC data packet, which is carried in the active portion

of a specified line in the vertical blanking
When inserting SMPTE 2016 data the inserter will blank any incoming SMPTE 2016 data

EDH AND CRC
EDH/CRC insertion to SMPTE RP165 and SMPTE 292M

AUDIO FOLLOW OUTPUT
TTL output on GPI
Pulse length shows delay through store
Can provide control signal for audio delay systems

GPI INPUT LEVELS
Active: pull to ground, pulled up to +5V through 10 kohm

GPI OUTPUT LEVELS
Electrically: Open drain transistors 30V, 270 ohm current limit resistors. Pulled up to +5V through 6800 ohm

GPI INPUTS
SYN HD: Three GPI inputs can recall one of eight presets
SYN HD-AFD: Four GPI inputs can recall one of 16 presets. GPIs can be used to control the insertion of any of the 16 AFD codes by recalling a preset

GPI OUTPUTS
Two GPI outputs
Audio follow pulse
Reference disconnected or missing

LED INDICATION OF:
SD/HD input or input not present
Power supplies okay
External reference present
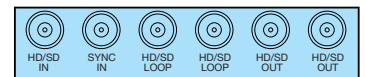Short delay

LOCAL CONTROL
Intuitive board edge interface with two select buttons, shaft encoder and ten character alphanumeric display
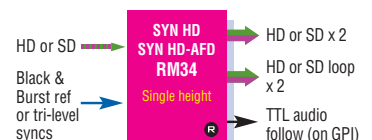
REMOTE CONTROL
RS422/485
19200 baud, 8 bits, 1 stop no parity
Control from frame active panel and remote panel
Statesman allows control from any PC on a network
SNMP monitoring and control available as a frame option

ORDERING INFORMATION

SYN HD	HD/SD video synchroniser
SYN HD-AFD	HD/SD video synchroniser with AFD insertion
Indigo 4	4U frame with passive front panel for up to 24 Crystal Vision modules
Indigo 4SE	4U frame with passive front panel fitted with Statesman CPU for up to 24 Crystal Vision modules
Indigo 2	2U frame with passive front panel for up to 12 Crystal Vision modules
Indigo 2AE	2U frame with active front panel for up to 12 Crystal Vision modules
Indigo 2SE	2U frame with passive front panel fitted with Statesman CPU for up to 12 Crystal Vision modules
Indigo 1	1U frame with passive front panel for up to six Crystal Vision modules. Power supply redundancy available with Indigo 1-DP
Indigo 1AE	1U frame with active front panel for up to six Crystal Vision modules. Power supply redundancy available with Indigo 1AE-DP
Indigo 1SE	1U frame with passive front panel fitted with Statesman CPU for up to six Crystal Vision modules. Power supply redundancy available with Indigo 1SE-DP
Indigo DT	Desk top box with passive front panel for up to two Crystal Vision modules
Indigo DTAE	Desk top box with active front panel for up to two Crystal Vision modules
Indigo DTSE	Desk top box with passive front panel fitted with Statesman CPU for up to two Crystal Vision modules
RM34	Single slot frame rear module. Allows maximum number of boards in frame (24 in 4U, 12 in 2U, six in 1U, two in desk top box). Gives access to one HD or SD input, two HD or SD outputs and two HD or SD reclocked input loop-throughs
REMIND	19" remote control panel
REMIND-E	19" Ethernet remote control panel
Statesman	PC Control System
SNMP	SNMP monitoring and control

RM34 connectors: HD/SD IN, SYNC IN, HD/SD LOOP, HD/SD LOOP, HD/SD OUT, HD/SD OUT

RM34

HD or SD → **SYN HD / SYN HD-AFD RM34** Single height → HD or SD x 2
Black & Burst ref or tri-level syncs → HD or SD loop x 2 / TTL audio follow (on GPI)

Performance and features are subject to change. Figures given are typical measured values. SYNHD1110