KudosPro

App Note #4:

Genlock

Introduction

The KudosPro range of products all have the ability to perform full Genlocking. The product has a single reference input with loop-through. On a single channel version such as MC500 or MC1000, the Genlock feature is quite straight forward. Under normal conditions, a reference signal that is the same frame-rate are the output would be applied to the reference Input, and a fully Genlocked condition can be attained. However, on models that support multi-channel conversion channels (MC2000, SV2000, SV4000. LC2000, & LC4000), each individual channel maybe configured to be doing completely different video processes compared to other channels within the product. In particular, individual channels may be configured to have entirely different output frame-rates. Because there is only a single external reference available, this does constrain the Genlock options available. This document explains these constraints.

KudosPro products offer three states with regard to Genlock:

1. Locked to External Reference
2. Locked to Input
3. Free-running.

The KudosPro does offer the feature that an output can be locked to a reference standard that is a completely different frame-rate. In such circumstances, a fully 'Genlocked' state cannot be achieved. However, a locked state known as 'Clock-Locked' can be achieved.

Clocked-Locked condition - explanation:

In circumstances where a 'Genlocked' condition is enabled, but the output standard frame-rate and the reference standard frame-rate are different, then by definition, the output cannot be *Genlocked* to the reference. However, a 'Clock-Locked' state can be achieved.
Consider a condition where a 1080/24PsF output, is reference locked to a 625/50i reference signal.
If we consider 1 second duration of video: in this 1 second there are exactly 24 frames of *output* video. In this same 1 second duration, there are exactly 25 frames of *reference* video.

In a 'Clock-Locked' state, the 24 frames of the output will be *exactly* aligned in time with the 25 frames of the reference Input:
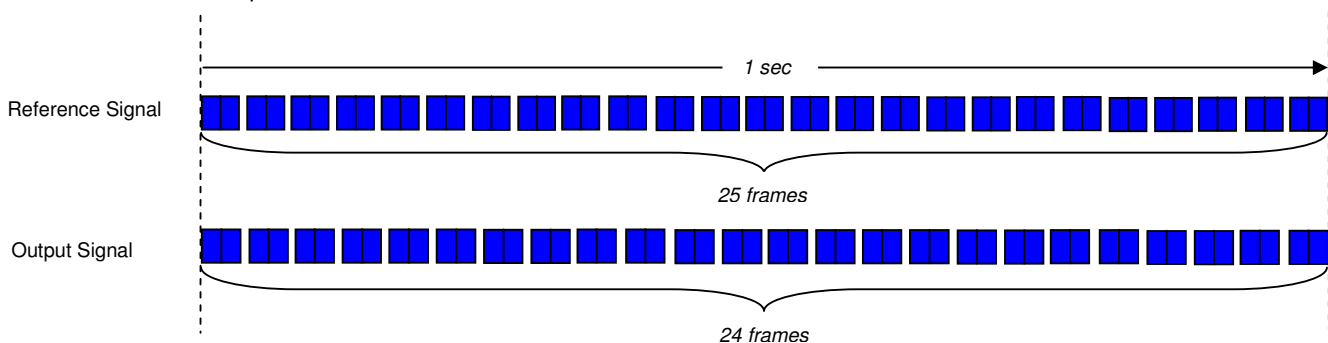

Figure 1: Clock-locked condition

The same conditions apply where, for example, a 525/59i output, is reference locked to a 625/50i reference signal. If we consider 1 second duration of video: in this 1 second there are exactly 29.97 frames of *output* video. In this same 1 second duration, there are exactly 25 frames of *reference* video.
In a 'Clock-Locked' state, the 29.97 frames of the output, will be *exactly* aligned in time with the 25 frames of the reference Input!

A 'Clock-locked' state can be achieved under any circumstances where the Reference and Output signals are of different frame-rates!

KudosPro internal architecture

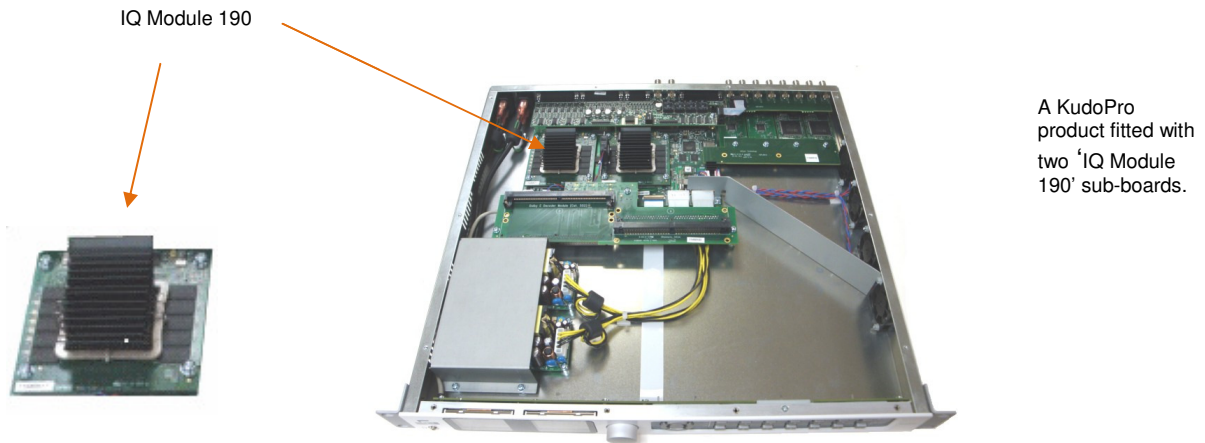The Genlocking function is performed by the 'IQP Module 190' sub-board:

IQ Module 190

A KudoPro
product fitted with
two 'IQ Module
190' sub-boards.

Figure 2: The 'IQ Module 190'.

Depending on the particular KudosPro model, either one or two 'IQP Module 190' maybe fitted:

SV

SV2000 models, fitted with one 'IQP Module 190' sub-board, can process two video channels simultaneously.

SV4000 models, fitted with two 'IQP Module 190' sub-boards, can process up to four video channels simultaneously.

LC

LC2000 models, fitted with one 'IQP Module 190' sub-board, can process two video channels simultaneously.

LC4000 models, fitted with two 'IQP Module 190' sub-boards, can process four video channels simultaneously.

MC

MC500 models, fitted with one 'IQP Module 190' sub-board, can process one video channel. Motion compensating conversion requires more processing power. The 'IQP Module 190' sub-board can only support one motion compensated video channel.

MC1000 models, fitted with one 'IQP Module 190' sub-board, can process one video channel. Motion compensating conversion requires more processing power. The 'IQP Module 190' sub-board can only support one motion compensated video channel.

MC2000 models, fitted with two 'IQP Module 190' sub-boards, can process two video channels. Motion compensating conversion requires more processing power. The IQP Module 190 can only support one motion compensated video channel. Hence, two channel motion compensating channels require two 'IQP Module 190' sub-boards.

With regard to Genlocking, it is important to understand the relationship between Genlocking and the 'IQP Module 190' sub-board. If we consider the linear models (SV & LC), each 'IQP Module 190' is configured to process two video channels independently of each other. However, it is a constraint of the 'IQP Module 190' sub-board that totally independent locking states of each video channel processed by it, cannot be configured. Whatever Genlock setting is configured applies to both Video Channels associated with a specific 'IQP Module 190'.

Genlock constraints by model

Genlock constraints only apply to multiple channel models:

SV2000:

SV2000 models, are fitted with one 'IQP Module 190' sub-board, and can process two video channels simultaneously.

Genlock: any configured state will apply to both video channels. The choices are:

1. Ref Lock
2. Ch1 input
3. Ch2 input
4. Free run

It should be considered that the video standard processed by Channel 1, may be completely different, with respect to frame-rate, to that processed by Channel 2. Under such conditions, if the Genlock state is configured, then it is not possible fully Genlock both video channels.

Example 1:

Consider an SV2000 that is setup to do the following process:

- Channel 1: 625/50i up-converting to 1080/50i
- Channel 2: 525/50i up-converting to 1080/59i
- A 1080/50i standard external reference is applied.
- The Genlock mode set is 'Ref Lock'.

In this scenario:

Channel 1 output = 1080/50i
Reference = 1080/50i
Genlock State = 'Genlock'

Channel 2 output = 1080/59i
Reference = 1080/50i
Genlock State = 'Clock-Locked'

Example 2:

Consider an SV2000 that is setup to do the following process:

- Channel 1: 625/50i up-converting to 1080/50i
- Channel 2: 525/50i up-converting to 1080/59i
- The Genlock mode set is 'Ch2 Lock'.

In this scenario,

Channel 1 output = 1080/50i
Reference = 525/59i
Genlock State = 'Clock-Locked'

Channel 2 output = 1080/59i
Reference = 525/59i

Genlock State = 'Genlock'

LC2000

LC2000 models, are fitted with one 'IQP Module 190' sub-board, and can process two video channels simultaneously.

Genlock: any configured state will apply to both video channels. The choices are:

1. Ref Lock
2. Ch1 input
3. Ch2 input
4. Free run

It should be considered that the video output standard of Channel 1 may be completely different, with respect to frame-rate, from the video standard processed on Channel 2. Under such conditions, if the Genlock state is configured, then it is not possible fully Genlock both video channels.

Example 1:

Consider an LC2000 that is setup to do the following process:

- Channel 1: 625/50i converting to 525/59i
- Channel 2: 525/59i converting to 625/50i
- A 525/59i standard external reference is applied.
- The Genlock mode set is 'Ref Lock'.

In this scenario:

Channel 1 output = 525/59i
Reference = 525/59i
Genlock State = 'Genlock'

Channel 2 output = 625/50i
Reference = 525/59i
Genlock State = 'Clock-locked'

Example 2:

Consider an LC2000 that is setup to do the following process:
- Channel 1: 625/50i converting to 525/59i
- Channel 2: 625/50i converting to 1080/50i
- The Genlock mode set is 'Ch1 lock'.

In this scenario:

Channel 1 output = 525/59i
Reference = 625/50i
Genlock State = 'Clock-Locked'

Channel 2 output = 1080/50i
Reference = 625/50i
Genlock State = 'Genlock'

SV4000

SV4000 models, fitted with two 'IQP Module 190' sub-boards, can process up to four video channels simultaneously.

Genlock:
Channels 1 & 2 are processed by the same 'IQP Module 190'. Any configured Genlock state will apply to both video channels (1 & 2).

Channels 3 & 4 are processed by the same 'IQP Module 190'. Any configured Genlock state will apply to both video channels (3 & 4).

However, the Genlock state of Channels 1 & 2 can be different to that configured for Channels 3 & 4:
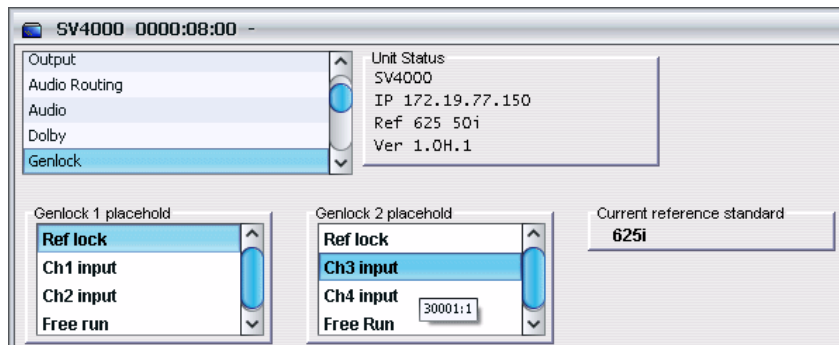

Figure 3: SV4000 Genlock configuration

Example 1

Consider an SV4000 configured in the following way:

- Channel 1 625/50i up-converting to 720/50P
- Channel 2 1080/59i cross converting to 720/59P
- Channel 3 625/50i up-converting to 1080/50i
- Channel 4 525/59i up-converting to 1080/59i
- A 625/50i external reference is applied.
- Genlock mode Ch 1 & Ch 2, set to 'Ref locked'
- Genlock mode Ch 3 & Ch 4, set to 'Ref locked'

In this scenario:

Channel 1 output = 720/50P
Reference = 625/50i
Genlock State = 'Genlock'

Channel 2 output = 720/59P
Reference = 625/50i
Genlock State = 'Clock-locked'

Channel 3 output = 1080/50i
Reference = 625/50i
Genlock State = 'Genlock'

Channel 4 output = 1080/59i
Reference = 625/50i

Genlock State = 'Clock-locked'
Example 2

- Channel 1 625/50i up-converting to 720/50P
- Channel 2 1080/59i cross-converting to 720/59P
- Channel 3 625/50i up-converting to 1080/50i
- Channel 4 525/59i up-converting to 1080/59i
- A 625/50i external reference is applied.
- Genlock mode Ch 1 & Ch 2, set to 'Ref locked'
- Genlock mode Ch 3 & Ch 4, set to 'Ch4 input'

In this scenario:

Channel 1 output = 720/50P
Reference = 625/50i
Genlock State = 'Genlock'

Channel 2 output = 720/59P
Reference = 625/50i
Genlock State = 'Clock-locked'

Channel 3 output = 1080/50i
Reference = 525/59i
Genlock State = 'Clock-locked'

Channel 4 output = 1080/59i
Reference = 525/59i
Genlock State = 'Genlock'

LC4000

LC4000 models, fitted with two 'IQP Module 190' sub-boards, can process four video channels simultaneously.

Channels 1 & 2 are processed by the same 'IQP Module 190'. Any configured Genlock state will apply to both video channels.
Channels 3 & 4 are processed by the same 'IQP Module 190'. Any configured Genlock state will apply to both video channels.

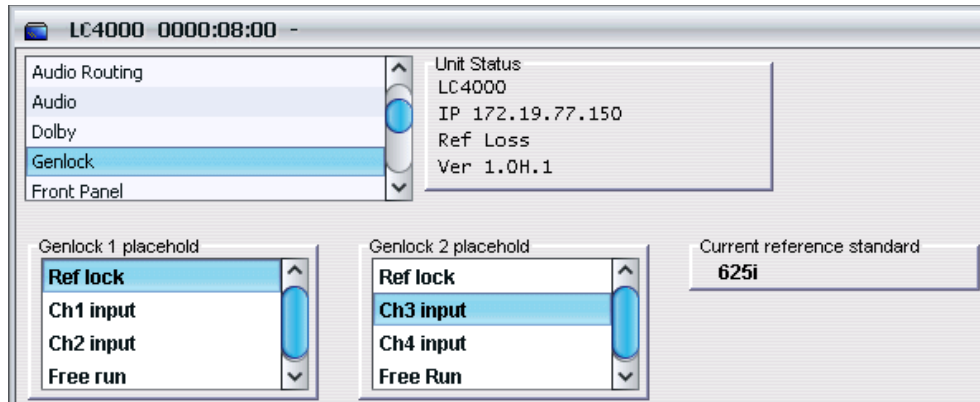However, the Genlock state of Channels 1 & 2 can be different to that configured for Channels 3 & 4:

Figure 4: LC4000 Genlock configuration

Example 1

Consider an LC4000 configured in the following way:

- Channel 1 625/50i up-converting to 720/50P
- Channel 2 720/50P converting to 720/59P
- Channel 3 525/59i up-converting to 1080/50i
- Channel 4 525/59i up-converting to 1080/59i
- A 625/50i external reference is applied.
- Genlock mode Ch 1 & Ch 2, set to 'Ref locked'
- Genlock mode Ch 3 & Ch 4, set to 'Ref locked'

In this scenario:

Channel 1 output = 720/50P
Reference = 625/50i
Genlock State = 'Genlock'

Channel 2 output = 720/59P
Reference = 625/50i
Genlock State = 'Clock-locked'

Channel 3 output = 1080/50i
Reference = 625/50i
Genlock State = 'Genlock'

Channel 2 output = 1080/59i
Reference = 625/50i

Genlock State = 'Clock-locked'
Example 2

- Channel 1 625/50i up-converting to 720/50P
- Channel 2 720/50P converting to 720/59P
- Channel 3 525/59i up-converting to 1080/50i
- Channel 4 625/50i up-converting to 1080/59i
- A 625/50i external reference is applied.
- Genlock mode Ch 1 & Ch 2, set to 'Ref locked'
- Genlock mode Ch 3 & Ch 4, set to 'Ch3 input'

In this scenario:

Channel 1 output = 720/50P
Reference = 625/50i
Genlock State = 'Genlock'

Channel 2 output = 720/59P
Reference = 625/50i
Genlock State = 'Clock-locked'

Channel 3 output = 1080/50i
Reference = 525/59i
Genlock State = 'Clock-locked'

Channel 4 output = 1080/59i
Reference = 525/59i
Genlock State = 'Genlock'

MC2000

MC2000 models are fitted with two 'IQP Module 190' sub-boards, can process two video channels simultaneously.

Each 'IQP Module 190' sub-board will process a single Video channel.

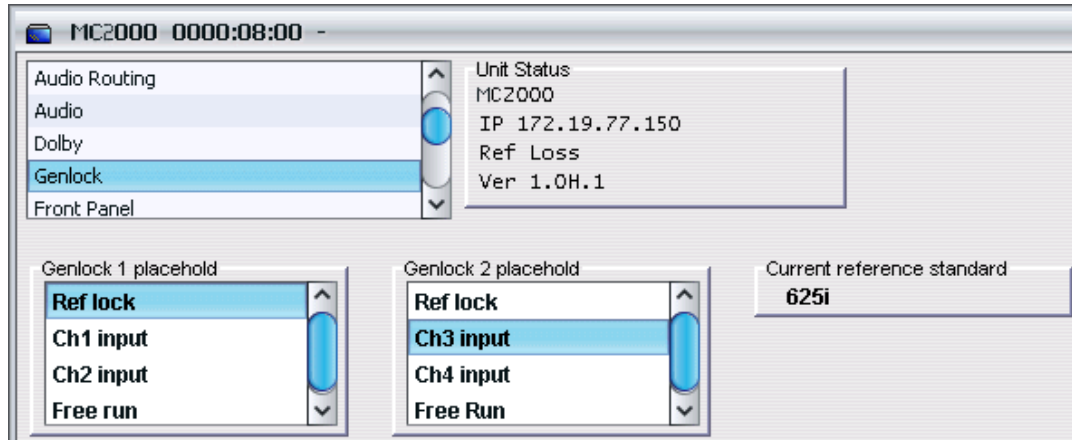The Genlock state of Channel 1 can be different to that configured for Channels 2:

Figure 5: MC2000 Genlock configuration

Example 1

Consider an MC2000 that is setup to do the following process:

- Channel 1: 625/50i converting to 525/59i
- Channel 2: 525/59i converting to 625/50i
- A 525/59i standard external reference is applied.
- The Genlock mode Ch 1 set is 'Ref Lock'.
- The Genlock mode Ch 1 set is 'Ref Lock'.
-

In this scenario:

Channel 1 output = 525/59i
Reference = 525/59i
Genlock State = 'Genlock'

Channel 2 output = 625/50i
Reference = 525/59i
Genlock State = 'Clock-locked'

Example 2

Consider an MC2000 that is setup to do the following process:

- Channel 1: 525/59i converting to 625/50i
- Channel 2: 525/59i up-converting to 1080/59i
- A 625/50i standard external reference is applied.
- The Genlock mode Ch 1 set is 'Ref Lock'.
- The Genlock mode Ch 1 set is 'Ch 2 input'.

In this scenario:

Channel 1 output = 625/50i
Reference = 625/50i
Genlock State = 'Genlock'

Channel 2 output = 1080/59i
Reference = 525/59i
Genlock State = 'Genlock'

Composite output.

On models fitted with Composite Encoders, the composite output will follow the Genlock state of the Video Channel that the Composite Output is derived from. Note that the Genlock state will be 'Line-locked', and not 'Subcarrier Locked'.