FRS-3G-DUAL

Dual Frame Synchronizer for 3G/HD/SD-SDI

User manual

Rev. A (Preliminary)

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Revision history

Current revision of this document is the uppermost in the table below.

Rev.	Repl.	Date	Sign	Change description
A	-	20130829	TB	Initial version, preliminary

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1 Product description

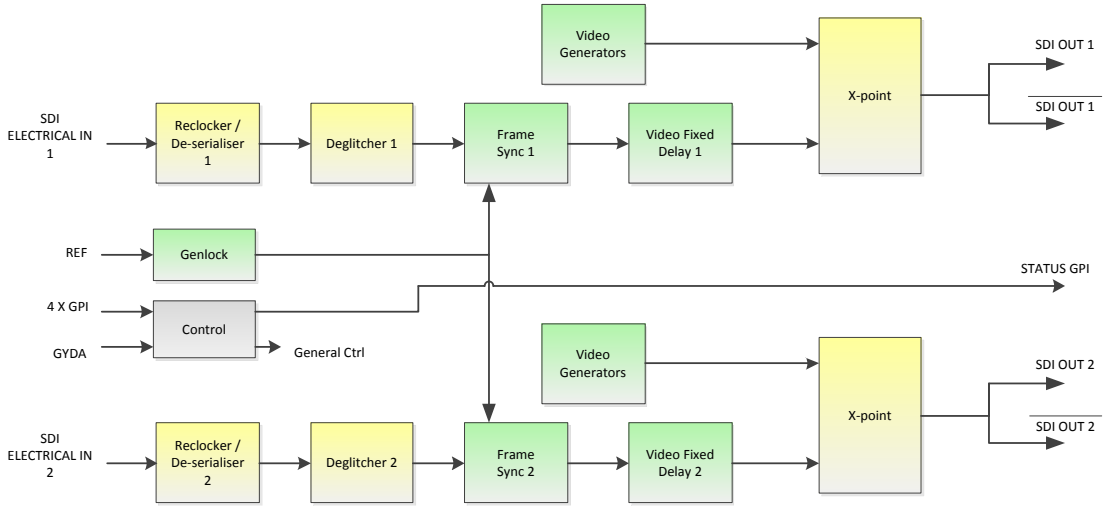


Figure 1: Simplified block diagram of the FRS-3G-DUAL card

1.1 The core functionality

The FRS-3G-DUAL is two 3G-HDSDI frame synchronizers on one Flashlink board. The two frame synchronizers share a common sync input, but are otherwise completely independent. They can handle all common SD, HD, and 3G level A video standards, and the two inputs need not have the same input frequencies or the same frame rates. Maximum video delay is eight frames.

The FRS-3G-DUAL comes in the standard Flashlink form factor and it is designed to be used with Multicon Gyda, the Nevion system controller. A subset of the configuration parameters can also be controlled by onboard switches, enabling stand-alone operation.

1.2 Secondary functionality

1.2.1 De-glitcher

The FRS-3G-DUAL comes with a built-in de-glitcher for continuous and seamless output. This will clean up line errors due to up-stream switching or other signal glitches. The output even remains error-free with change of input formats.

1.2.2 Input change-over with fallback to internal generators

The FRS-3G-DUAL comes with an electrical SDI input per frame synchronizer core. Sophisticated input selection logic can switch automatically between the physical input and one of the internal generators.

1.2.3 Multiple SDI outputs

The FRS-3G-DUAL comes with a total of 4 BNC SDI outputs. Each of the two frame synchronizer cores has one inverting and one non-inverting output.

1.2.4 EDH processing

The FRS-3G-DUAL always does EDH processing.

1.3 Product variants and how they differ

There are no lower-spec variants of the FRS-3G-DUAL. For frame synchronizers that only accept SD-SDI and/or HD-SDI input, see the FRS-SDI, FRS-HD-DMUX, and FRS-HD-XMUX4 product families. For prices, please contact Nevion or an authorized Nevion dealer.

2 How to get started

2.1 Power requirements

The absolute maximum power consumption for this module is 8.1 W. This figure varies considerably with the combination of video standards used. If the module will always be used with the same combination of input standards, the table below can be used to determine the actual maximum power consumption, and to determine how many modules can safely be used in one frame.

> Note that the module will draw all its power from +5 V. Check the +5 V rating of the power supply, generally it will be lower than the rating for the entire supply.

Table 1: Maximum power consumption as a function of video standards used

Input/output standard			
SD	HD 720p	HD 1080i	3G 1080p
7.35 W	7.35 W	7.35 W	8.10 W

2.2 Physical connections

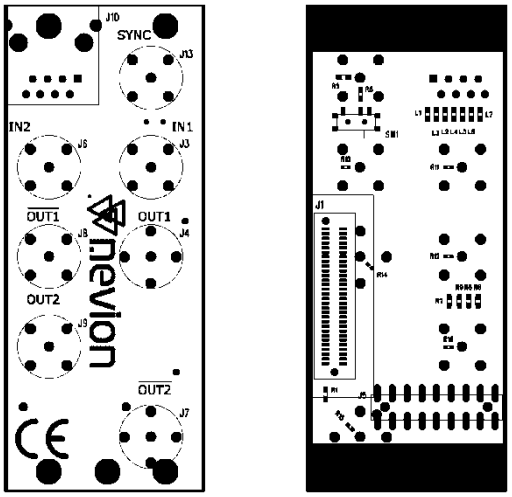


Figure 2: FRS-3G-DUAL-C1 backplane.
Connection side one the left, side towards the frame on the right

The backplane for the FRS-3G-DUAL is labeled FRS-3G-DUAL-C1. It is designed to be fitted in a Flashlink rack unit and to take up a single slot. The connection side will face outward on the back side of the Flashlink rack when mounted correctly. The table below is an overview of the connectors and their associated functions.

Function	Label	Connector type
3G/HD/SD-SDI input	IN1	BNC
3G/HD/SD-SDI output 1	OUT1	BNC
3G/HD/SD-SDI output 1 inverted	$\overline{\text{OUT1}}$	BNC
3G/HD/SD-SDI input 2	IN2	BNC
3G/HD/SD-SDI output 2	OUT2	BNC
3G/HD/SD-SDI output 2 inverted	$\overline{\text{OUT2}}$	

	OUT2	
Black & Burst/ tri-level frequency reference input	SYNC	BNC
GPI out	GPI/DATA	TP45, pin 1, 2, 3 (pin 8 = GND)
GPI in	GPI/DATA	TP45, pin 4, 5, 6, 7 (pin 8 = GND)

Table 2: Connector functions

Unused SDI inputs/outputs should be terminated with 75 Ohm.

2.2.1 Sync input

The main module features a slide switch to select between sync taken from the backplane input (switch position marked “BP”) and a frame-distributed sync (switch position marked “RACK”). At the time of writing this manual no frame-distributed sync is available, and the switch should be kept in the “BP” position.

The backplane also features a switch on the component side (the side facing into the frame). This is a switchable termination for the backplane sync input. By setting the slide switch in Figure 2 to the “ON” position, the sync input will be terminated to 75 Ohm. Generally, the sync inputs should be terminated if each sync input is fed from a separate output of a distribution amplifier. If one sync output is passively split and fed to several modules
(T-connectors) *one* module should be terminated while the others should be left unterminated.

If the module will be used without a frequency reference the positions of these slide switches do not matter.

2.2.2 GPI outputs (alarms)

The FRS-3G-DUAL hardware module has three GPI output lines. The first one, GPIO 0, reflects the general status of the card, and thereby acts as an all-purpose alarm. GPIO 1 and GPOI 2 reflect the reclocker lock status of inputs 1 and 2, respectively. See Table 3 below for pin-out of the GPI lines.

2.2.3 GPI inputs

The FRS-3G-DUAL hardware module has four GPI inputs. No functions have yet been assigned to these input lines.

2.2.4 GPI pin-out

GPI name	Function	Pin #	Mode	Direction
GPIO 0, Status	General error status for the module. Will also activate at firmware loading, when the module is not processing video.	Pin 1	Inverted Open Collector (open is alarm)	Output
GPIO 1	Not assigned	Pin 2	Inverted Open Collector (open is alarm)	Output
GPIO 2	Not assigned	Pin 3		Output
GPI 0	Not assigned	Pin 4	TTL, 0V = active level	Input
GPI 1	Not assigned	Pin 5		Input
GPI 2	Not assigned	Pin 6		Input
GPI 3	Not assigned	Pin 7		Input
Ground	0 volt pin	Pin 8	0V.	

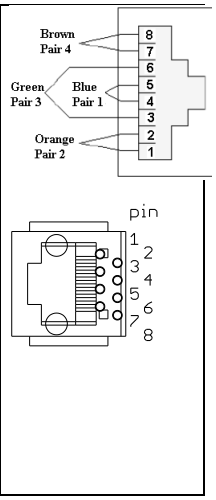


Table 3: The TP45 (8pin modular jack) in detail

2.3 What the LEDs mean

	Red LED	Orange LED	Green LED	No light
Card status	PTC fuse has been triggered or FPGA programming has failed	Module has not been programmed, or RESET and OVR DIPS are both on, or module is loading firmware.	Module is OK	Module has no power
IN1	Video signal absent.	Video signal present but card unable to lock VCXO	Video signal present and locked	Module has not been programmed
IN2	Video signal absent.	Video signal present but card unable to lock VCXO	Video signal present and locked	Module has not been programmed
Sync input status	Sync signal absent	Sync signal present but card unable to lock all VCXO	B&B or Tri-level sync in lock	Module has not been programmed

Table 4: LED states and what they mean

2.3.1 Exceptions/special conditions for the LEDS

The *locate* command will make all four LEDs blink on and off synchronously to quickly identify the module in a larger installation. The condition of the card is not otherwise affected by the command, only the appearance of the LEDs will change. The LEDs return to their normal states and functions after the special locate condition has timed out.

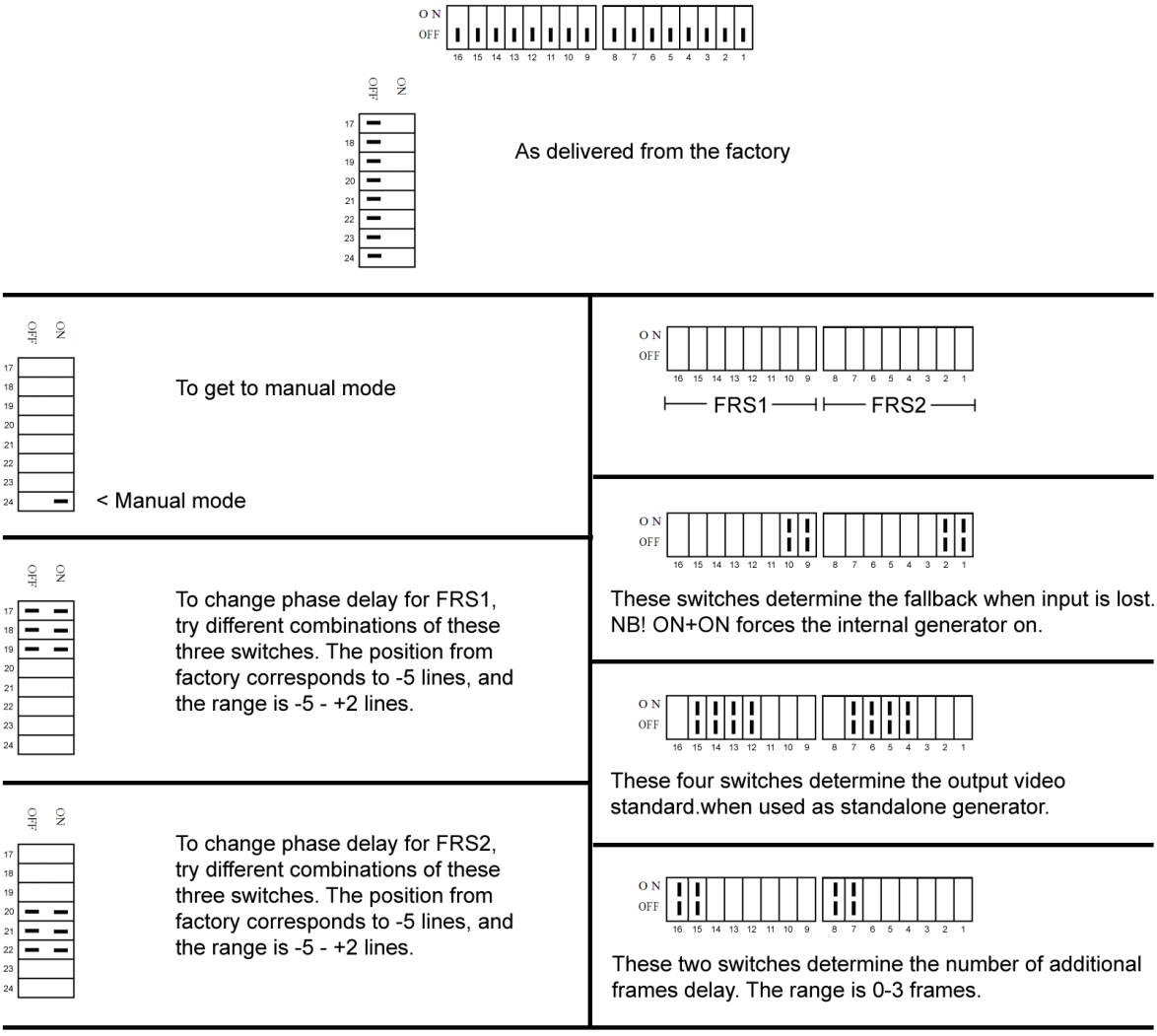
2.4 Selecting between Gyda mode or Manual mode

The board can be configured either manually or through the system controller *Multicon GYDA.* Since there's a limited number of switches available compared to the total number of settings available for the module, only a subset of the parameters can be adjusted when operating in manual mode. Generally, the parameters that cannot be directly controlled by the DIP switches will take their settings from the previous Multicon GYDA session. This means that for a specific manual setup it may be necessary to configure the module with a Multicon GYDA before switching to manual mode.

To reach manual mode, the lower DIP (labelled OVR) on the module must be switched to the "On" position (to the right) and the board must be re-booted. This isolates the board from Multicon GYDA control, but the module will still accept commands to retrieve its status, and also the commands necessary to initiate and perform firmware upgrades.

2.5 A very brief guide to Manual mode set-up

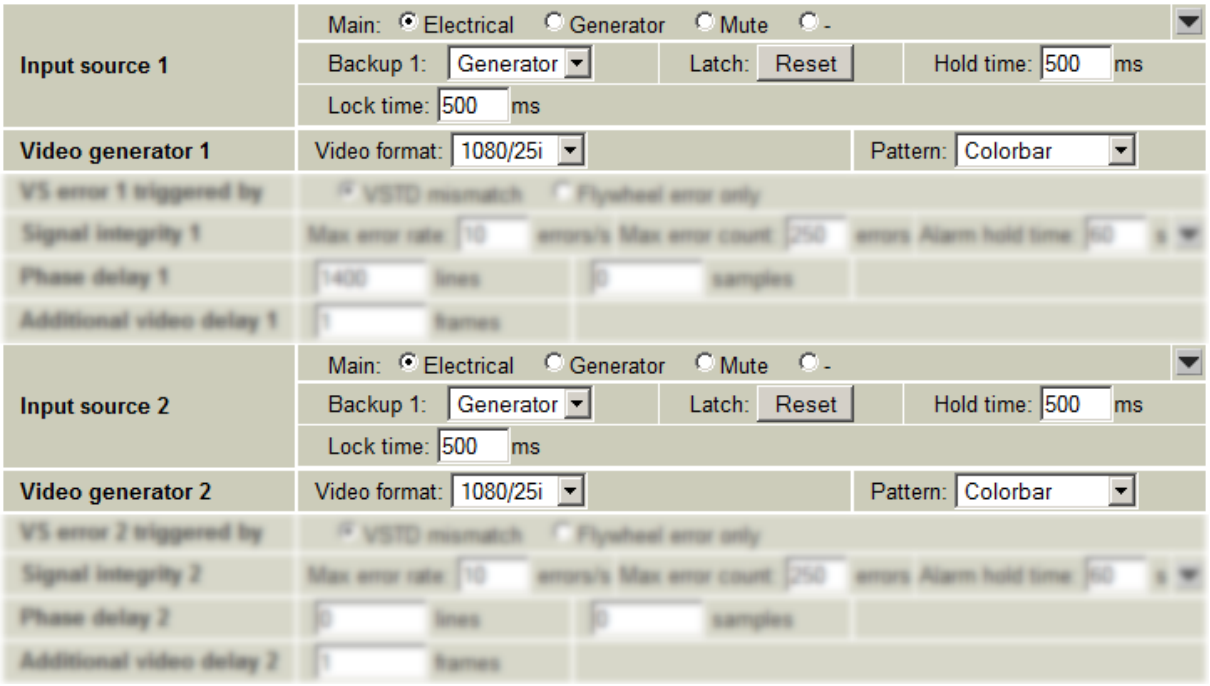
More details and possibilities are described in chapter 3.1, entitled 'Detailed control in manual mode'. This is just the bare minimum to get started and get a useful output in Manual mode:



2.6 A very brief guide to Gyda mode set-up

All of these settings are covered in much more detail in chapter 3.2. These are just the most important settings to get started:

Arguably the most important setting is where to take the input from. Since the module is only available with one single electrical BNC input per frame sync core, a good starting point would be to take the input from these BNCs:



What this means is that the electrical input will be chosen whenever a signal is present, and if a signal is not present, the output will frame freeze for 500 ms before resorting to an internal fallback generator. Here this generator is set to produce Colourbar.

2.7 How to get back to factory defaults?

To access the function that will reset the module and reload the factory default settings, the module must briefly be put into manual mode. The entire procedure is described in chapter 3.1.2.

3 Detailed control

3.1 Detailed control in manual mode

To reach manual mode, the lower DIP (labelled OVR) on the module must be switched to the “On” position (to the right) and the board must be re-booted. This isolates the board from Multicon GYDA control, but the module will still accept commands to retrieve its status, and also commands related to initiate and perform firmware upgrades.

The Manual Mode configuration controls are all found on the front side of the board. There are three sets of DIP switches, and the switches are numbered and labeled counter-clockwise from 1 to 24.

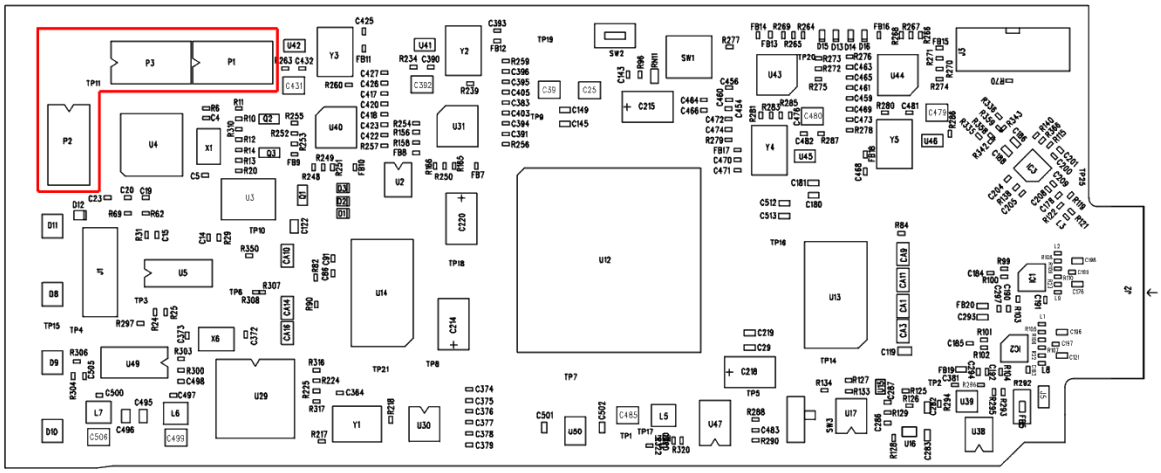


Figure 3: The figure shows a top view component printout of the board.

3.1.1 DIP switch functions

The two horizontally mounted DIP switch packages are here denoted DIP1-DIP16, counted from right to leftt. The vertically mounted DIP package is denoted with DIP17-DIP24, counted from top to bottom.

Switch	Function name	Function DIPs	Comment
1-2	Frame sync 2 input	DIP2 DIP1 OFF OFF Fallback to Colorbar OFF ON Fallback to Black ON OFF Fallback to Muted ON ON Module is generator	When the module is set as a standalone generator, the video standard can be selected on DIPs 3-6.
3-6	Frame sync 2 generator standard	DIP6 DIP5 DIP4 DIP3 VSTD OFF OFF OFF OFF 486/29i OFF OFF OFF ON 576/25i OFF OFF ON OFF 1080/24p OFF OFF ON ON 1080/25i OFF ON OFF OFF 1080/30i OFF ON OFF ON 1080/29i OFF ON ON OFF 1080/50p OFF ON ON ON 1080/60p ON OFF OFF OFF 1080/59p ON OFF OFF ON 720/24p ON OFF ON OFF 720/25p ON OFF ON ON 720/50p ON ON OFF OFF 720/60p ON ON OFF ON 720/59p ON ON ON OFF Reserved ON ON ON ON Reserved	
7-8	Frame sync 2 frame delay	DIP8 DIP7 FRAMES OFF OFF 0 OFF ON 1 ON OFF 2 ON ON 3	
9-10	Frame sync 1 input	DIP10 DIP9 OFF OFF Fallback to Colorbar OFF ON Fallback to Black ON OFF Fallback to Muted ON ON Module is generator	When the module is set as a standalone generator, the video standard can be selected on DIPs 11-14.
11-14	Frame sync 1 generator standard	DIP14 DIP13 DIP12 DIP11 VSTD OFF OFF OFF OFF 486/29i OFF OFF OFF ON 576/25i OFF OFF ON OFF 1080/24p OFF OFF ON ON 1080/25i OFF ON OFF OFF 1080/30i OFF ON OFF ON 1080/29i OFF ON ON OFF 1080/50p OFF ON ON ON 1080/60p ON OFF OFF OFF 1080/59p ON OFF OFF ON 720/24p ON OFF ON OFF 720/25p ON OFF ON ON 720/50p ON ON OFF OFF 720/60p ON ON OFF ON 720/59p ON ON ON OFF Reserved ON ON ON ON Reserved	
15-16	Frame sync 1 frame delay	DIP8 DIP7 FRAMES OFF OFF 0 OFF ON 1 ON OFF 2 ON ON 3	

17-19	Frame sync 1 phase delay	DIP22 DIP21 DIP20 LINES OFF OFF OFF -5 OFF OFF ON -4 OFF ON OFF -3 OFF ON ON -2 ON OFF OFF -1 ON OFF ON 0 ON ON OFF 1 ON ON ON 2	
20-22	Frame sync 2 phase delay	DIP19 DIP18 DIP17 LINES OFF OFF OFF -5 OFF OFF ON -4 OFF ON OFF -3 OFF ON ON -2 ON OFF OFF -1 ON OFF ON 0 ON ON OFF 1 ON ON ON 2	
F-RESET	F-RESET	Off: Use values preset by MULTICON GYDA. On: RESET to factory defaults	This DIP is only read at power up. See chapter 3.1.2.
OVR	OVR	Off: MULTICON GYDA mode On: Manual mode	This DIP is only read at power up. OVR is short term for MULTICON GYDA override

Table 5: DIP SWITCH FUNCTIONS

3.1.2 Factory reset function

The factory reset puts the card back to its initial state, as it was delivered from the factory. These settings are just a starting condition for the board, and new settings applied by the user will still take effect and be stored.

> If a Multicon GYDA is controlling the frame in which the factory reset operation is performed, Multicon will see the re-insertion of the card in step 4 below as a hot-swap event, and it will try to write the previously stored settings back to the card. There are two ways to avoid this mechanism: The safest and easiest way is to keep the Multicon GYDA pulled out during the factory reset procedure. The next best thing is to select the Manual mode in step 3, which will effectively prevent the card from acknowledging the commands sent from Multicon in step 4. After ~30 seconds the Multicon settings will instead have been updated from the card settings (**some of which may now have been overridden by the DIP switches!**), and then the card can be unplugged once more, and returned to Gyda mode.

The factory reset is a four-step procedure:

1. Pull the main card out of the frame, and set the two DIPs labelled F-RESET and OVR to their On positions.
2. Re-insert the card into the frame. The Status LED will now be a permanent orange colour. No further waiting is needed after seeing the Status LED lit up orange.
3. Pull the card out of the frame again, and return the DIP F-RESET to its Off position, and set the OVR to the desired mode of operation.
4. Re-insert the card into the frame, and it should now boot as normal again. It is only at the end of this boot-up that the settings are actually reset, and to ensure that the new settings are stored properly it is important that the card is now kept powered for

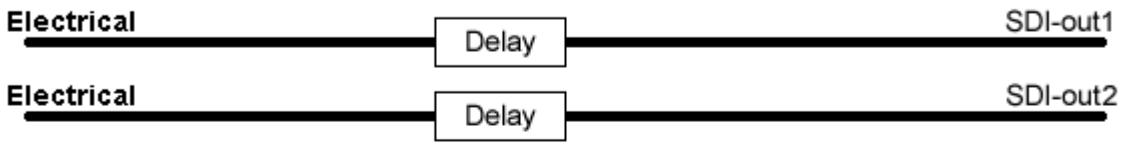
a few seconds after the Status LED has turned green. The card will start to operate as normal with the new settings right away.

3.2 Detailed control in Gyda mode

All functions of the card can be controlled through the Multicon GYDA control system. The Multicon GYDA has an information page and a configuration page.

3.2.1 Information page

FRS-3G-DUAL



Sync source	Blackburst						
Electrical input 1	Signal detected						
Reclocker 1	Locked						
Input source 1	Electrical						
Signal integrity 1	1080/25i		Error counter: 0			Reset	
			NO_EDH	VS	FF-CRC	AP-CRC	LOCK
	CCS	YCS	CCRC	YCRC	LNUM	SAV	EAV
Phase delay 1	0 ns				0 samples		
Additional video delay 1	1 frames						
Electrical input 2	Signal detected						
Reclocker 2	Locked						
Input source 2	Electrical						
Signal integrity 2	1080/25i		Error counter: 9779			Reset	
			NO_EDH	VS	FF-CRC	AP-CRC	LOCK
	CCS	YCS	CCRC	YCRC	LNUM	SAV	EAV
Phase delay 2	0 ns				0 samples		
Additional video delay 2	1 frames						
Voltage (1.2V)	1.19 V						
Voltage (1.2V)	1.19 V						
Voltage (1.5V)	1.49 V						
Voltage (5.0V)	4.90 V						

Figure 4: Multicon GYDA information page

The information page shows a dynamic block-diagram of the board and some additional informative text. The block diagram updates with the board status, showing input signal selected and signals missing (by red crosses over signal lines).

The information text below the dynamic block diagram lists information not easily conveyed in a graphical manner.

Sync source will indicate either *Blackburst* or *Tri-level* sync if a reference input has been detected, and *Loss of lock* if no reference has been detected.

Electrical input (1/2) will indicate either *Signal present* or *No signal*. *Signal present* merely means that a carrier has been detected, actual video content may or may not be present.

Reclocker (1/2) will indicate either *Locked* or *Loss of lock*. *Lock* means that the module has been able to recognize and lock to the video content.

Input source (1/2) will indicate either *Electrical*, *Generator*, or *Mute*. This is an indication of current input selection. If *Generator* or *Mute* is shown, it will either be because the selector has been forced to this selection by the user, or because they have been set as fallback for the electrical input, which is currently not present.

Signal integrity (1/2) is split in three sections. The first will indicate the present input video standard, and the second is an error counter that will count the number of frames with at least one countable error. The third section consists of the individual error bits as reported by the module. A red background color means that this error was detected, and counted. A green background color means that no error of this type was detected. A gray background color means that the user has decided to ignore this type of error.

Phase delay (1/2) displays a recalculation of the phase delay set by the user. The user can set the delay in video lines and/or video samples. The combined setting will be recalculated into nanoseconds and video samples *for the current video standard*. This can be used as a tool to match up the delays with other types of equipment with different input formats for the phase delay.

Additional video delay (1/2) is simply a reminder of the additional frame delay added by the user. This is usually used to add delay to match the processing time with that of other equipment.

3.2.2 Configuration page

The configuration page is shown over the next two pages. The different configuration parameters are explained in detail in the following sub-chapters. The order in which the settings are presented follows the order in the graphical user interface. Since there are two independent - but identical - sets of controls (for the two independent frame synchronizers), only the first set will be covered.

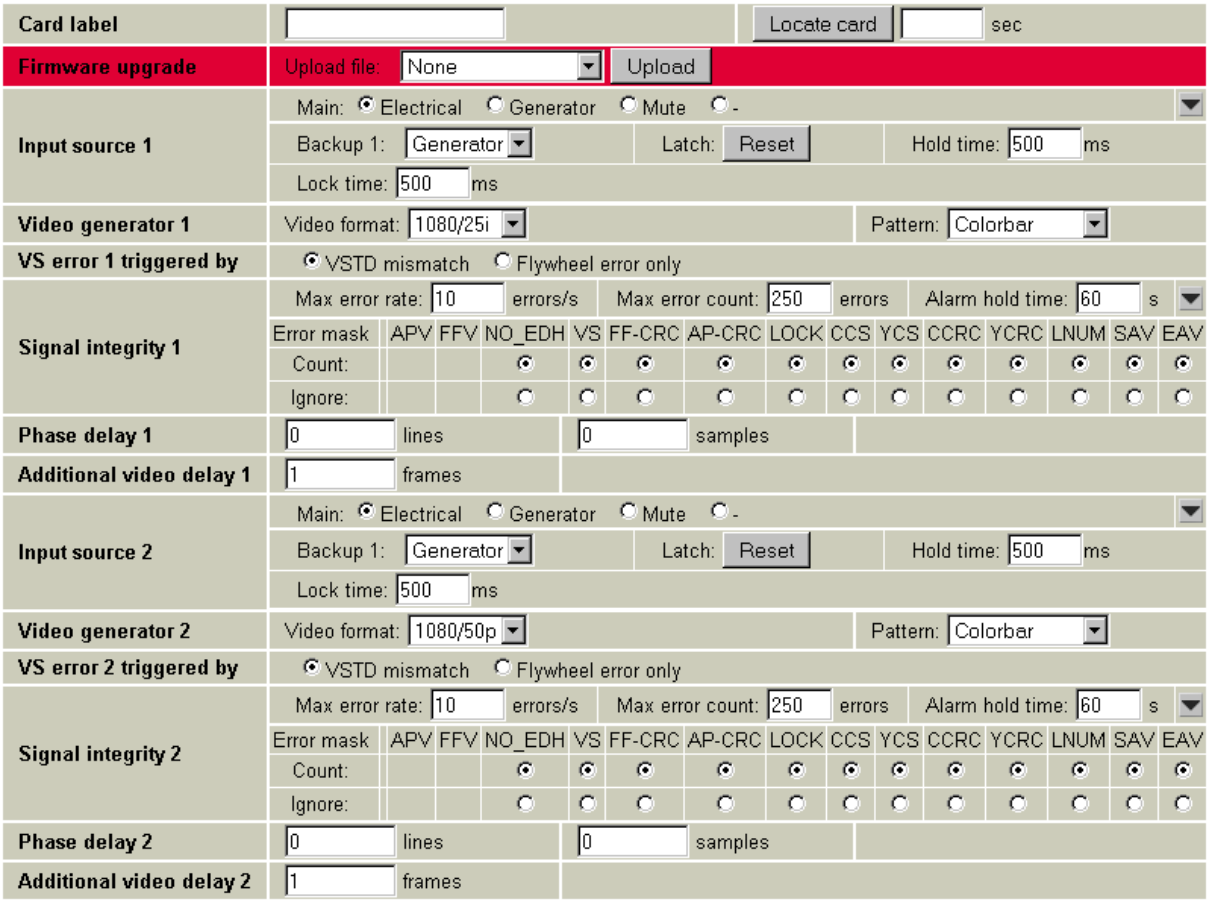


Figure 5 Multicon Gyda configuration page

3.2.3 Input selection

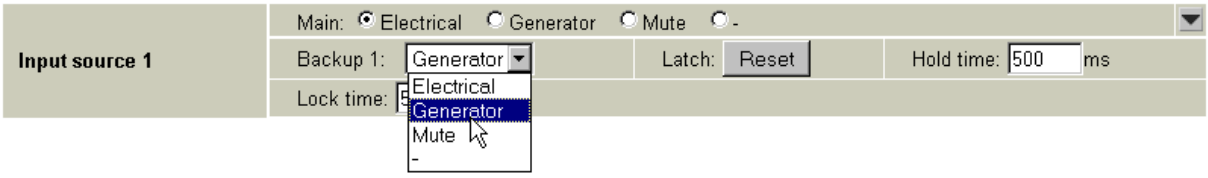


Figure 6: Multicon GYDA view of generator selected as fallback for electrical input

Each half of the FRS-3G-DUAL has one electrical input, in addition to a number of internal generators that conceptually can be thought of as alternative inputs.

The input is selected by specifying two *priorities*, referred to as *Main* and *Backup1*. The module will always start by looking at the input selected as *Main*. This input will be selected as long as it is present. If the module is not able to lock to this input for *Hold time*, the module will go to the next priority, *Backup1*, if that exists. If '-' has been selected as *Backup1*, this means that no fallback exists, and the module will stay in *Main* forever, even if the *Main* signal disappears, and the output will be frozen until *Main* reappears. If the module is in *Backup1* and the *Main* signal reappears, it will have to be continuously present for *Lock time* before the module will again select the *Main* source.

This may look like a very complex to do the input selection, and in some ways that is correct. When there is only one physical input the number of useful combinations is rather small:

Electrical → '-'	Video output will freeze for as long as the electrical input is missing. No fallback. If at any time the input is again locked for a duration of *Lock time*, the module will again un-freeze the picture.
Electrical → Mute	Video will freeze for *Hold time* after the electrical input disappears, then the output will be muted, i.e. the output drivers are turned off. If at any time the input is again locked for a duration of *Lock time*, the module will again select the electrical input and turn the output drivers back on.
Electrical → Generator	Video will freeze for *Hold time* after the electrical input disappears, then the output will switch to an internal generator. The generator pattern (*Black* or *Color bar*) is selected in the *Video generator* block, but the video format will always be the same as last seen by the module. If at any time the input is again locked for a duration of Lock time, the module will again switch from generator to the electrical input.
Generator → '-'	This forces the output to use one of the internal generators. Both the pattern (*Black* or *Color bar*) and the video format are selected in the *Video generator* block.
Mute → '-'	This forces the output to *Mute*, i.e. the output drivers are turned off.

Combinations like Generator → Mute will be reduced to Generator → '-' in the reply from the module, because the internal generators are always present, and hence the *Backup1* setting is irrelevant. Likewise Electrical → Electrical will be reduced to Electrical → '-' , because it doesn't make sense to have an input as its own fallback.

3.2.4 Video generator

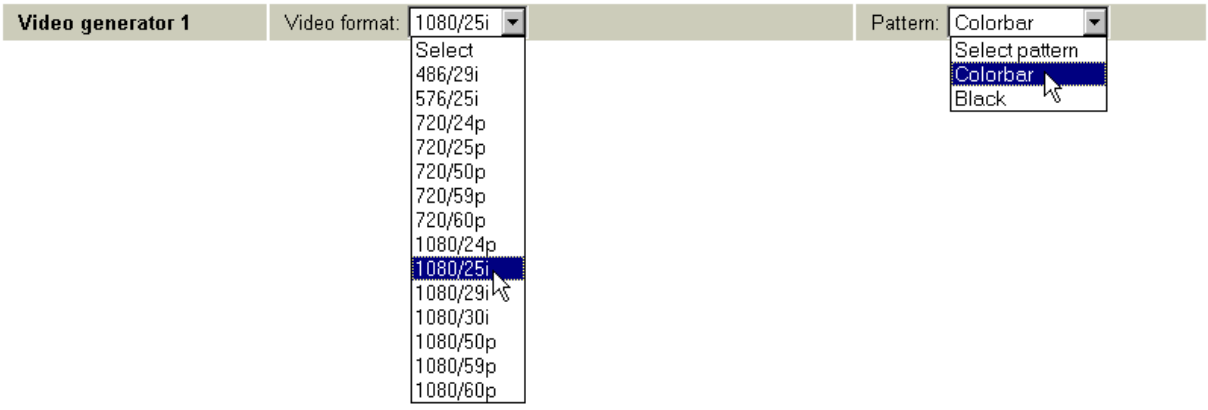


Figure 7: Multicon GYDA view of video generator and the possible selections therein

The video generator block work in conjunction with the input selector, and together they decide how the module behaves when the input signal is lost. See the previous chapter.

Note that the Video format selection only comes into play when the module is used as a standalone generator. In normal operation the video format will be taken from the last legal input seen by the module.

3.2.5 VS error triggered by …

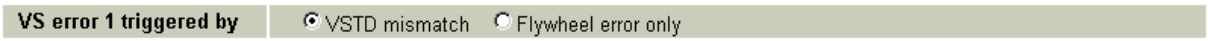


Figure 8: Multicon Gyda view of the VS error bit functionality selector

This must be seen in relation to both the Video generator block and the *Signal integrity* block (next chapter). In the *Signal integrity* block there's an error bit called *VS*, i.e. *Video Standard error*. Normally this error bit would only be asserted when the internal flywheel of the reclocker is locked, but to an unknown video standard. When *VSTD error* is selected in *Video error triggered by*, the *Video standard* setting in the Video generator block will also act as an *Expected video standard*. Whenever the *Expected video standard* does not match the incoming video standard (as reported in the *Signal integrity* block, the *VS* error bit will be asserted. The *VS* error bit can then make the error counter in the *Signal integrity* block act as a video standard alarm.

3.2.6 Signal integrity

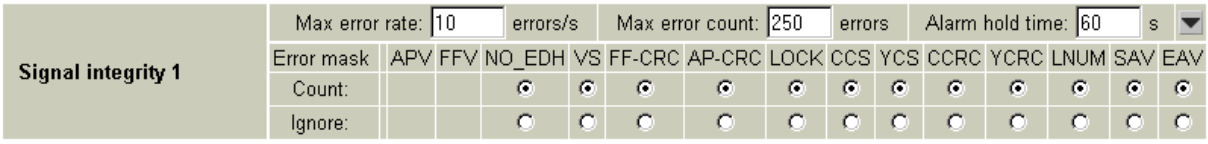


Figure 9: Multicon Gyda view of the signal integrity block, all error bits set to count

In this block a number of standard video error bits can be set to be either counted or ignored. The counter will count frames wit at least one error. Multiple errors in the same frame will only be counted once, but the actual errors as reported from the module can be seen on the module's info page (see description in chapter 3.2.1).

3.2.7 Phase delay

This is arguably the core of the frame synchronizer. By setting the Phase delay in video lines and video samples, the phase of the output can be adjusted relative to an incoming sync reference. Negative delays will force start-of-frame for the output to come slightly earlier than the reference (compensating for reference propagation time or pre-compensating for a cable length on the output). Of course, for negative phase delays approaching one frame, it may be more practical to imagine it as a smaller positive delay. For practical purposes one can consider the phase delay block to be a delay line that automatically adjusts itself between 0-1 frame to keep a constant phase between itself and the reference. If a reference signal is not available, the delay in lines and samples will simply be added to the frame delay in Additional video delay, and the two delays together will act as a single constant delay line.

Figure 10: Multicon Gyda view of the delay settings

3.2.8 Additional frames delay

As mentioned the phase delay will effectively be a 0-1 frame variable delay line when a reference is present. The Additional video delay setting will then add entire frames to this delay, and for practical purposes an additional delay of N frames is equivalent to saying that the phase delay will vary between N and (N+1) frames. The Additional delay setting is useful to compensate for processing delays in other equipment (notably Dolby E processors, if audio is split from video and embedded again at a later stage). Maximum

frame delay is 7 frames, which means that maximum total delay is 7-8 frames with reference present.

4 More about the frame synchronizer

The frame synchronizer consists of a few important parts that deserve further explanation:

4.1 De-glitcher

The de-glitcher corrects timing errors within a single video line. The de-glitcher has a 2048 samples buffer. When the first signal is present, we call it the “initial phase signal”, data is taken from the centre of this buffer. If the timing reference of the video signal changes, when for instance a new source being switched into the signal path, the timing errors occurring by this change will be corrected if the new timing reference is within +/-1024 samples of the “initial phase signal”. This also goes for all consecutive timing references.

If a signal is more than +/-1024 samples off relative to the “initial phase signal”, the output will repeat the last frame, refill the 2048 samples buffer and take out data from the centre of the buffer. This new signal is now considered the “initial phase signal”. Audio will fade out when a frame repeat is being done, and fade in at the new frame.

Hence, it produces an error free video output without frame wrapping when the video input comes from a router with synchronous input video signals that all lies within +/-1024 samples of each other.

> The de-glitcher output is always seamless. When a signal is repeated the audio is faded out. It fades in at the new frame.

4.2 Frame synchronizer

The frame synchronizer consists of a frame store buffer and some control logic. The frame store buffer can store up to 8 full 3GHD frames. Data is fetched from this buffer according to the user specified delays. The control logic sets the frame synchronizer into different modes dependent on the presence of a sync input.

4.2.1 Frame sync mode

If a sync input (BlackBurst or Tri-level) is present, the frame synchronizer will have an output signal that has a delay relative to the sync reference. As covered in chapter 3.2.7, two parameters can be used to control this delay: *Phase delay* and *Additional frame delay*.

Let us first focus on the *phase delay*, also called *output phase delay*. This parameter can be positive or negative, and determines the relationship between the video output and the sync input signal. This parameter really adds a delay on an internal sync signal, isync[1]. The output is always synchronous and in phase with isync, see Figure 11.

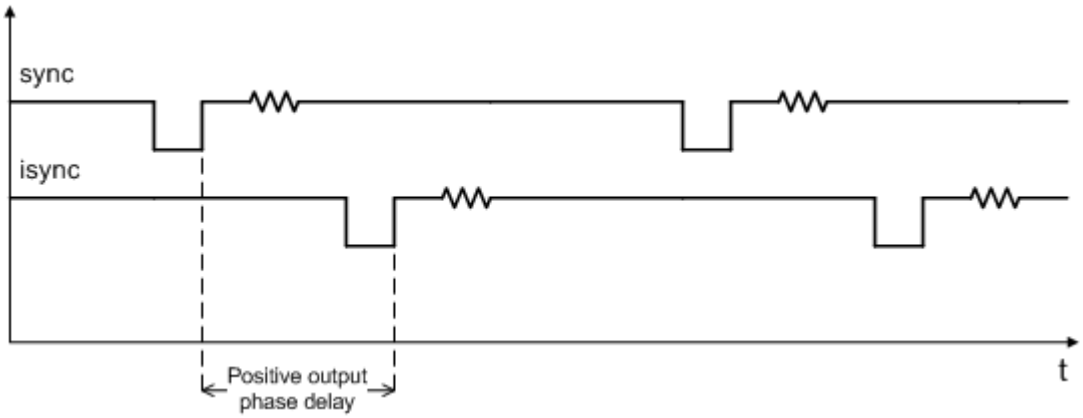


Figure 11: Positive phase delay

[1] Note that *isync* is not a physical entity, but a term used in this context to explain the delay process and the use of the configurable parameters related to this process.

Figure 11 show how the sync signal and the isync signal would look on an oscilloscope, if converted to analogue signals. The delay of isync can be given in lines, and samples. The delay can be negative, see Figure 12.

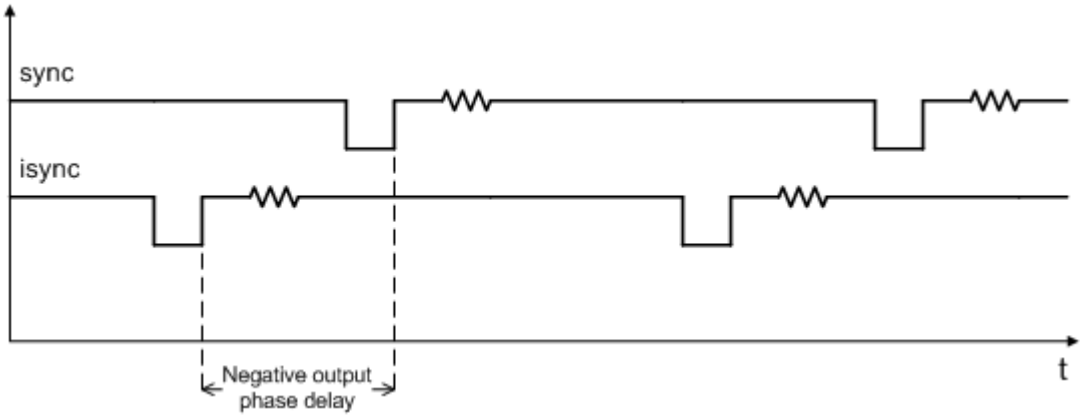


Figure 12: Negative phase delay

It is not possible to specify a more negative phase delay than -1 frame, or more positive phase delay than +1 frame. Doing so would be pointless, as the distance between two start-of-frame pulses for the sync reference must by definition be 1 frame, and the delay will wrap around. A phase delay of 1 frame + N lines would be completely equivalent to a phase delay of just N lines. The same applies to a phase delay of -1 frame + (-N lines), it would be equivalent to just –N lines.

Strictly speaking, it would suffice to allow the phase delay to be within the interval -1/2 frame to +1/2 frame (or just 0 frames to 1 frame, or even -1 frame to 0 frames); every possible phase delay could be specified this way. But people like to think of these things in different ways, and the *phase delay* can thus be specified in the entire interval -1 frame to +1 frame.

In addition to the *phase delay,* the user may specify *Additional frame delay*. If the input signal doesn't have the exact same frequency as the sync reference, the phase between the input and the reference will vary continuously, and hence the delay must also vary over time. When the *Additional frame delay* is set to N frames, the delay through the card will be somewhere between N and (N+1) frames, and vary over time unless the sync and SDI input have the same frequency.

Here's what happens when an external error event occurs:

If video input disappears

Given that a stable sync input exists: If the SDI input disappears, the output picture will freeze for *Hold time* and then go to one of the internal video generators (depending on the module's configuration).

If video input reappears

Given stable sync input, the video will reappear after the module has had stable lock to the video input for a duration of *Lock time*.

If sync input disappears

Given that stable SDI input exists: If the sync signal disappears, the card will revert to *frame delay mode*, see Chapter 4.2.2.

NOTE: This will result in a frame roll as the delay changes.

If sync input reappears

Given that a stable SDI input exists: If the sync reference reappears the delay logic will change back to *frame sync mode*. Hence the internal clock will be locked to the sync signal and the delay will change again.

NOTE: This will result in a frame roll as the delay changes.

If both signals disappears

The picture will first freeze for *Hold time* and then go to one of the internal video generators (depending on the module's configuration). The output is now referenced to the local clock source. This clock will however be kept within 1 ppm of the last sync source seen by the module.

4.2.2 Frame delay mode

In this mode a sync signal is not present. The phase delay will be set relative to the SDI-input. In effect this will create a delay line with length equal to the sum of the phase delay and the additional frame delay, and the output frequency will be locked to the input frequence.

Here's what happens when an external error event occurs:

If video signal disappears

The picture will first freeze for *Hold time* and then go to one of the internal video generators (depending on the module's configuration). The output is now referenced to the local clock source. This clock will however be kept within 1 ppm of the last video input seen by the module.

If video signal reappears

If the input video signal reappears, the video will reappear on the output *Lock time* after the input has stabilized. The delay will be set to the same as before input was lost.

NOTE: This may cause a frame roll.

If a sync input appears

Given that a stable SDI input exists: If a sync signal appears the delay mode will change to *frame sync mode*, see Chapter 4.2.1. Hence the internal clock will be locked to the sync signal and the delay will change.

NOTE: This will result in a frame roll as the delay changes.

Appendix A RS422 commands

A.1 FLP4.0 required commands

Block	Blk#	Commands	Example	Response	Control
-	-	?	?	*product name*\ SW rev *n.m*\ FW rev *r.s*\ protocol ver 4.0\	***Hello* command**. *Note 1: No other commands will be available until the card has received this hello.* *Note 2: This command will also enable checksums.* *Note 3: Cards are designed to be hot-swappable. To sync with the start of a new command, the cards will wait for a <lf> character before looking for a valid command.*
conf	0	-	conf 0	*too long to list*	**Configuration settings** Retrieves the card's configurable settings. Each addressable block is represented by a single line. Dynamic status *may* be included in response, but is usually reported in *info* only.
-	-	info	info	*too long to list*	**Dynamic status info** Blocks with static settings only will usually not be included, see *conf* above.
-	-	chk off	chk off	ok	**Checksum off** If issued twice in succession, this command will disable checksums. Note: Responses will still have the checksums appended. *NOTE1: ? command turns the checksum back on*
-	-	locate on <seconds> locate off	locate on 3 locate off	ok	**Card locator** This command will cause all the LEDs to flash for a user specified number of seconds. If omitted, the value <seconds> will be set to a default of 120 seconds. The flashing can be terminated at any time with *locate off*.
-	-	address	address	address <address>	**Card address** This command will check and update the card's current rack and slot address, which is normally only done at start-up.
-	-	filename	filename frs3gdual-0-123.ffw filename frs3gdual-0-112.mfw	<name>'.'<extension>	**Firmware upgrades** The <name> part must match the card's hardware and include a revision number, and the extension must be either 'ffw' for FPGA firmware or 'mfw' for microcontroller firmware.
-	-	fin	fin	ok	**Finalize** Finalize the programming of the microcontroller. See description of the uC bootloader (separate document).

misc	0	-	NOT AVAILABLE BY COMMAND. ONLY FOUND in Conf 0	prog | fin ' ' | ovr	**Misc info** *prog* if the card is freshly programmed by the bootloader and the program is still un-finalized. *fin* is the normal condition. *ovr* if DIP-switch 16 is set to the ON position and the card is under DIP-switch control. Note 1: The info part of misc has additional functionality when locate is used: *locating <remaining seconds>*. This enables a visible countdown clock in Multicon GYDA, but is not a required part of FLP400.

A.2 Normal control blocks

Block	Blk#	Commands	Example	Response	Control
ceq	0-1	-	ceq 1	cd | ncd	Cable equalizer for electrical input. No control; only used to report *carrier detect* or *no carrier detect.*
cho	0-1	pri <k> | pri <k> <l> | pri <k> <l> <m> latch reset t1 <hold_time> t2 <lock_time>	cho 0 pri 0 cho 1 pri 0 1 cho 0 latch reset cho 0 t1 1000 cho 0 t2 1000	size 4 pri *k,l,m* t1 <hold time> t2 <lock time>	**Video input select** ***pri*:** a prioritized list of inputs, used when change-over is automatic. The list can have 1 or 2 entries, or *levels*. 0 = from electrical input 1 = internal video generator 2 = mute 3 = none The module will always respond with 2 levels, filling in 3=none for the levels not used. ***t1* and *t2*:** change-over doesn't happen immediately, as a precaution against glitches and unstable signals. The timers t1 and t2 let the user decide how long (in ms) we will cling on to a missing input before we consider it gone and move on to the next pri level, and how long an input with a higher priority should be present before we consider it repaired and switch back, respectively.
dly	0-1	<lines>lines <samples>sps	dly 1 1lines - 30sps	'phase' <lines> lines <samples> sps	**Video phase** Sets the output phase relative to the sync reference. If lines != 0 the resulting phase will vary with incoming video standard. In info this block reports back the current delay in nanoseconds and converted to samples only.
dly	2-3	<frames>frms	dly 0 2frms	'tgt' <frames> frms	**Additional frame delay** This sets the additional video delay of the card.
gpi	0-1	act | inact	gpi 1 act gpi 1 inact		**VS error triggered by** inact: Flywheel error only act: VS error bit also set if

					incoming vstd doesn't match vgen vstd.
pwr	0-3	-	pwr 0	<nom_voltage>Vnom <voltage>V	**Power monitoring** The nominal voltages are listet with the measured voltages. For this product the following voltages are measured: 0: 1.2Vnom 1: 1.2Vnom 2: 1.2Vnom 3: 5.0Vnom
rcl	0-1	-	rcl 0	lock | lol	**Reclocker** No control, only used to report *lock status.*
sync	0	-	sync 0	'lol' | ('lock' ('trilvl' | 'bb' | 'sdi'))	Frequency reference for video output. Status only, no commands available.
vgen	0-1	cbar | black video <lns>/<rate><scan>	vgen 0 cbar vgen 0 video 1080/24p	video <lns>/<rate><scan> (cbar | black)	**Internal video generator.** The video generator will be activated in two different ways: If selected as a fallback option the generator will generate the selected pattern when the other input(s) are missing, and then use the video settings from the last external source present. It can also be selected as the main input in cho 0-1, in which case its own video settings will also be used.
vmon	0-1	msk <16b_mask> reset	vmon 0 msk 0xFFF vmon 0 reset	msk <12b_mask>	**Video monitoring.** Error counting. The count itself is reported in info. Errors can be masked off and not counted; this is the purpose of the mask. The counter itself is 12b and will wrap around, but can also be reset by issuing *reset*.

Appendix B Specifications

Electrical SDI inputs

Connectors	75 Ohm BNC
Equalization	Automatic; >300m @270Mbps w/Belden 8281, with BER < 10E-12 >100m @1485Mbps w/Belden 1694A, with BER < 10E-12
Input Return loss	>15dB, 5MHz -1.5GHz
Jitter tolerance	SD limit: 10Hz-1kHz: >1 UI 10kHz – 5MHz: >0.2 UI HD limit: 10Hz-100kHz: >1 UI 100kHz–10MHz: >0.2 UI

Electrical Sync input

Connector	75 Ohm BNC
Format	Black & Burst, Tri-level
Input Return loss	>35dB @ < 10MHz, 30dB @ < 30MHz
Termination	Selectable internal or external 75 Ohm termination

Electrical SDI outputs

Number of outputs	4
Connectors	75 Ohm BNC
Output Return loss	>15dB, 5MHz -1.5GHz
Output signal level	800mV +/- 10%
Output signal rise / fall time	SD limit: [0.4ns – 1.5ns]; <0.5ns rise/fall var.
20% - 80%	HD limit: < 270ps, <100ps rise/fall var.
Amplitude overshoot	<10%
Output timing jitter	SD: <0.2 UI HD: <1 UI
Output alignment jitter	SD: <0.15 UI HD: <0.15 UI

Supported standards

SD, 270 Mbps	SMPTE 259M
HD, 1485 Mbps	SMPTE 274M, SMPTE 291M, SMPTE 292M, SMPTE 296M
3G, 2970 Mbps	SMPTE 291M, SMPTE 424M, SMPTE 425M
Video switch point definition and sync	SMPTE RP168 (tri-level), SMPTE 170m, ITU-R. BT.470
AES	AES3-1996
EDH	Compliant to SMPTE-RP165

Power consumption (+5 VDC)

Maximum power, at 50°C	8.1 W [2]

[2] Actual power consumption varies with the video standards used. Please see the complete table under Power requirements, chapter 2.1.

Appendix C General environmental requirements for Nevion equipment

1. The equipment will meet the guaranteed performance specification under the following environmental conditions:
   - Operating room temperature range: 0°C to 45°C
   - Operating relative humidity range: <90% (non-condensing)

2. The equipment will operate without damage under the following environmental conditions:
   - Temperature range: -10°C to 55°C
   - Relative humidity range: <95% (non-condensing)

Appendix D Materials declaration and recycling information

D.1 Materials declaration

For product sold into China after 1st March 2007, we comply with the “Administrative Measure on the Control of Pollution by Electronic Information Products”. In the first stage of this legislation, content of six hazardous materials has to be declared. The table below shows the required information.

組成名稱 Part Name	Toxic or hazardous substances and elements					
	鉛 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr(VI))	多溴联苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
FRS-3G-DUAL	O	O	O	O	O	O

O: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.

X: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T11363-2006.

This is indicated by the product marking:

D.2 Recycling information

Nevion provides assistance to customers and recyclers through our web site http://www.nevion.com/. Please contact Nevion’s Customer Support for assistance with recycling if this site does not show the information you require.

Where it is not possible to return the product to Nevion or its agents for recycling, the following general information may be of assistance:

- Before attempting disassembly, ensure the product is completely disconnected from power and signal connections.
- All major parts are marked or labeled to show their material content.
- Depending on the date of manufacture, this product may contain lead in solder.
- Some circuit boards may contain battery-backed memory devices.

Product Warranty

The warranty terms and conditions for the product(s) covered by this manual follow the General Sales Conditions by Nevion, which are available on the company web site:

www.nevion.com