

SR-3

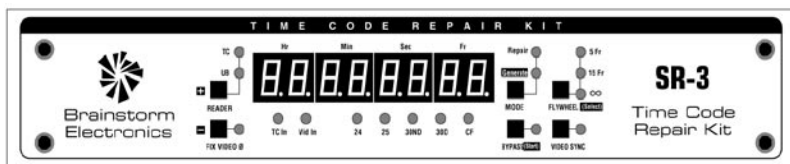
TIME CODE REPAIR KIT

Operation Manual

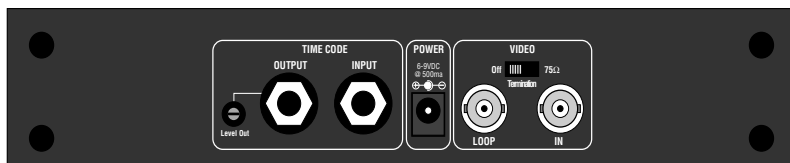
Manual written by Brainstorm Electronics, Inc.

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1. **Reader Switch:** Alternates between Time Code and User Bits.
In SET mode, increases the value of the selected parameter (+).
2. **Fix Video \emptyset Switch:** Time shifts the regenerated code to align it properly with the video reference.
In SET mode, decreases the value of the selected parameter (-).
3. **Reader display:** Reads Time Code or User Bits & indicates video phase.
4. **TC In LED:** Lights up when signal is present at the Time Code input jack.
5. **Video In LED:** Lights up when signal is present at the Video input jack.
6. **24/25/30ND/30D LED's:** In Repair & Bypass, indicate format of incoming code; in Generate mode indicate format of generated code.
7. **CF LED:** Indicates the color status of the incoming code.
8. **Mode Switch:** Selects the SR-3's operations mode: Repair / Generate.
9. **Bypass Switch:** In Repair mode, bypasses the regenerator;
In Generate mode, starts and stops the generator.
10. **Flywheel Switch:** In Repair mode, selects the flywheel time;
In Generate mode, selects the field to be edited.
11. **Video Sync Switch:** In Repair mode, locks the regenerator to ext video reference;
In Generate mode, locks the generator to video reference if available or pulls down rate if ext. video is not present (i.e. 29.97)



12. **Level Out:** Adjusts the TC output level from off to +12db.
Active in all modes: Repair, Generate and Bypass
13. **TC Output:** Regenerator output.
14. **TC Input:** Regenerator input
15. **Power:** 2.5mm jack. Requires 6 to 12 VDC with center pin positive.
16. **Termination switch:** turns on a 75 Ω video termination.
17. **Video Input & Loop:** BNC connectors for video reference.

Introduction

The SR-3 Time Code Repair Kit is a regenerator designed to repair bad time code. It's three main functions are to repair drop outs, reduce jitter and correct video phase. It also reads time code, identifies its format and analyzes its phase with video.

The SR-3 also generates all standard time code formats referenced to internal crystal or to external video.

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Setting up the SR-3

1. Connections

- ⇒ **Time Code Input:**
When repairing time code, connect your time code source (raw time code) to this jack.
- ⇒ **Time Code Output:**
This is the output of the generator in all modes (repair, generate and bypass). Connect this jack to your time code destination (reader, synchronizer, tape machine, ...).
- ⇒ **Video In & Loop:**
Connect composite sync or composite video to the "Video In" BNC connector. An additional BNC connector is provided for looping through as well as a switchable 75Ω termination.
- ⇒ **Power:**
The SR-3 requires 6 to 9VDC @ 500mA with center pin positive.

2. Wiring

- ⇒ **1/4" Jacks:**
Time code input and output jacks are RTS 1/4" jacks
Pins are: Tip = high, Ring = low, Sleeve = ground.

Since time code is bi-phase, a reversal of low & high wires would not cause a problem.

The SR-3 works with balanced and unbalanced equipment. When using unbalanced equipment with the SR-3, wire your cables as described in the diagrams below.

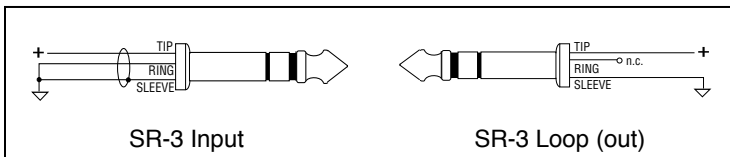


Figure 1. Proper unbalanced wiring diagrams

- ⇒ **BNC Connectors:**
Use standard 75Ω video cables.

Modes of Operation

The SR-3 has 2 modes of operation: Repair and Generate. The "Mode" switch to the right of the display toggles between the 2 modes and the 2 led's above the switch indicates which mode is currently selected.

Depending on the selected mode, some of the front panel buttons have different functions. The functions for the Generate mode are indicated in reversed lettering on the front panel. For example, the "Bypass" switch (in the Repair mode) becomes the "Start" switch in the Generate mode.

Repair Mode

In Repair mode, the SR-3 continuously regenerates the input time code, locked to either the source code or to external video, performing repairs in the process, specifically drop outs, jitter and video phase.

When the SR-3 is in the Repair mode, the "Repair" LED to the right of the display is on. If it is off, press the "Mode" switch to turn it on.

1. Reader display & Format LED's

The 8 digit display reads Time Code or User Bits. Use the "Reader" switch to the left of the display to select one or the other. The 2 LED's to the left of the display indicate which is currently selected (TC/UB).

The 5 LED's under the reader display give additional information on the input signal:

- TC In: This LED indicates that signal is present at the TC input jack
- Vid In: This LED indicates that valid video is present at the video input jack.

- 24/25/30ND/30D: Only one of these LED's is on at the same time. It indicates the format of the repaired code.
- CF: This LED indicates the color status of the incoming code. It is on if the color flag is set (bit 11); it is off if the flag is not set.

2. Flywheel Time

The Flywheel time is the time during which the SR-3 continues generating code after it has detected an input error, such as a drop out. If the error has not been resolved by the end of the flywheel time, the SR-3 stops.

During a drop out, the SR-3 generates code at the same rate it did just prior to the drop out. After the drop out, the SR-3 slowly resyncs to the incoming code. However, if after a drop out, the offset between the generator (SR-3) and the input code is greater than 1/4 frame (± 20 bits), the SR-3 stops regenerating and displays an error message (SLIP).

The SR-3 has 3 preset flywheel times: 5 Fr / 15 Fr / infinity.

Infinity (∞) is identical to "15fr" except that, if valid code does not reappear after 15 frames, the SR-3 disregards the input and continues generating time code at the same rate until the "Bypass (start)" switch is pressed. Once the SR-3 has switched to this mode and disregards the input, the "TC In" led goes off, even if input signal returns.

To change the flywheel time, press the "Flywheel" switch until the proper time is selected. Flywheel time cannot be changed while SR-3 is running.

3. Video Sync

What does it mean for time code to be in phase with video?

For time code to be synchronous with video, each word of time code must coincide with one frame of video; to be phased properly, the beginning of each word must coincide with the beginning of the video frame it describes.

Each word of time code is made up of 80 bits, numbered from 00 to 79 (see Figure 2 below). Time code is phased properly with video when the end of bit 79 of time code lines up with field 1 line 5 of video (F1L5), ± 1 line.

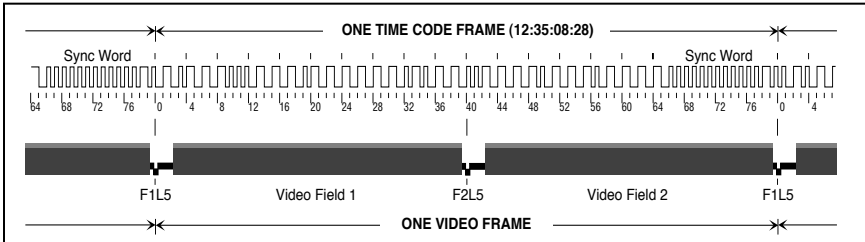


Figure 2. Proper alignment of time code and video

How can you check video phase with the SR-3 ?

You can monitor the sync between the incoming time code and the external video reference on the reader display. This feature is only available if "Video Sync" is on and if video is present:

Press and hold the "FixVideo 0" switch: the reader now shows which bit of the time code word lines up with video F1L5.

How to interpret the video phase display ?

With properly phased code, the display should read: "bit 79". In the 'real world' however, things are different and phase will often be slightly off. For example, if the display reads "bit 68" or "bit 07", the address track was possibly misaligned on the VCR and your synchronizer may show some slight sub-frame offset (i.e. 03,12, etc) when locked to code like this. So long as you are within a few bits of 79 and

the bit number stays the same, you should have no problems.

WARNING: If the bit number drifts, time code is not synchronous and may be useless for your application.

Locking the regenerator to external Video

When "Video Sync" is on, the SR-3 locks the regenerated code to the incoming video reference. This is recommended since video is a very stable reference.

- **DRIFT:** To avoid a drift between the input and the output time code, video sync is only possible if the source code is synchronous with video. Therefore if the incoming code is non-synchronous, the SR-3 indicates "DRIFT" in the display as a warning.

The SR-3 considers code non-synchronous if time code moves by more than 5 bits with respect to video F1L5.

- **VIDEO LOSS:** While "Video Sync" is on, if video is interrupted, the SR-3 stops and indicates "VID LOSS" in the display.

- **NO VIDEO:** When activating "Video Sync", if no video is present, the SR-3 indicates "NO VIDEO" for about one second and flashes the Video Sync LED.

Correcting Video Phase

When locked to video, if time code is out of phase, the SR-3 can shift the regenerated time code so it is in phase with the video reference (see page 4 - what does it mean to be in phase with video?).

To correct the video phase, both the "Video Sync" and the "FixVideo \emptyset " switches must be turned on.

NOTE: The "Fix Video \emptyset " switch can only be activated if the "Video Sync" switch is on and not while code is running.

Phase correction can only be accomplished if the rate (or frequency) of the incoming code is synchronous with video. As with "Video Sync" described above, if the source code drifts, the SR-3 indicates a "DRIFT" message in the display.

4. Regenerator Bypass

When bypass is engaged, the input signal is fed directly to the output without any bit correction or repair.

Manual Bypass

To manually activate the bypass mode, press the "Bypass" switch so that the LED is on.

Auto Bypass:

In the Repair mode, the SR-3 automatically switches to bypass whenever it detects non play speed code. This way, readable code is always present at the output, even during search and wind.

When the SR-3 switches to Bypass, the Reader displays the incoming code. However, the SR-3 is a play speed reader and if high speed code is running through the SR-3, the Reader won't display it. When play speed code reappears, the SR-3 switches back to repair and the Reader displays the regenerated code again.

5. Ramp-up time

When Video Sync is on, the SR-3 must wait for the tape transport to reach a stable speed before it can determine how the incoming code lines up with the video reference. Until this is established, the SR-3 cannot regenerate code. Therefore, the SR-3 stays in bypass until the end of a preset ramp-up time, then switches to Repair.

The SR-3 has 3 preset ramp-up times which are selected in conjunction with the Flywheel time:

FLYWHEEL TIME	RAMP UP TIME
5 Fr	5 fr
15 Fr	1.5 sec
∞	3 sec

Under most circumstances, the 5Fr setting should be used. The other settings should be used with slow transports.

Generate Mode

In the Generate mode, the SR-3 can generate all standard formats and frame rates, referenced to internal crystal or to external video.

To set the SR-3 to generate time code hit the "Mode" switch until the "Generate" LED is on.

Reader Display & Format LED's

In the Generate mode, the reader displays the output time code. It can read Time Code or User Bits. Use the "Reader" switch to select. TC or UB. The format LED's indicate which format is generated.

Starting the Generator

To start the generator, hit the "Start" button. To stop the generator, hit the "Start" button again. The Start LED is on solid when the generator is running and flashing when it is stopped.

Preset Start Time

The SR-3 always holds a preset in memory. This preset includes: Start Time, User Bits and Format.

Whenever you start the generator, it begins counting from the preset start time, no matter where you last stopped. To start from another number, you need to change the preset.

Changing the preset

To change the preset, hit the "Flywheel (Select)" switch. This brings you into the SET mode. - NOTE: You can only enter the SET mode when the generator is stopped.

While in the SET mode, the selected parameter blinks. You can scroll through the different parameters by tapping the "Flywheel (Select)" switch and adjust them by using the + and - buttons.

To exit the SET mode and store the new preset in memory, hit the “Start” button. This can be done at any time so you don’t have to scroll through all the parameters if you don’t need to edit them. After you exit the SET mode you can press the “Start” button again to start the generator.

Scrolling through the preset parameters

If the reader is on TC when entering the SET mode, you can edit the start time and the format; if it is on UB, you can edit the user bits.

Adjusting Start Time & Format:

Set the reader to TC and press the “Flywheel (Select)” button:

- The Start Time has 4 fields: Hours, Minutes, Seconds and Frames. Tap the “Flywheel (Select)” button to move from one field to the next and, using the + and - keys, adjust each one as needed.

After the Frames field, tapping the “Flywheel (Select)” button one more time moves you to the Format.

- While setting the format, the LED corresponding to the selected format is blinking. The standard formats are: 24, 25, 30ND, 30D. Tap the + or - button repeatedly until the desired format LED blinks.

Pressing the “Flywheel (Select)” button again moves you out of the SET mode and stores the new preset in memory

Adjusting User Bits:

Set the reader to UB and press the “Flywheel (Select)” button:

- Each digit of the User Bits is adjusted separately. Tap the “Flywheel (Select)” button to move from one digit to the next and, using the + and - keys, adjust each one as needed.

After the eighth digit, hitting the “Flywheel (Select)” button again moves you out of the SET mode and stores the new preset in memory.

NOTE: When starting the generator, the display automatically switches back to TC.

Frame Rates & Clock Sources

The SR-3 can generate time code at all standard frame rates, locked to its internal crystal or to external video.

To lock to external video, turn the "Video Sync" switch on and connect your video reference to the rear panel BNC connector.

If the "Video Sync" switch is on and no video is present, the "Video Sync" LED blinks and the SR-3 generates code at a rate .1% slower. This pull-down corresponds to the difference between regular SMPTE rate (30 f/s) and the NTSC Color rate (29.97 f/s).

The following table shows the different frame rates and clock sources:

VIDEO SYNC	EXT VIDEO	SELECTED FORMAT	FRAME RATE	CLOCK SOURCE
Off	n/a	30ND	30	Internal Xtal
		30DF	30	Internal Xtal
		25	25	Internal Xtal
		24	24	Internal Xtal
On	None	30ND	29.97	Internal Xtal
		30DF	29.97	Internal Xtal
		25	24.97	Internal Xtal
		24	23.97	Internal Xtal
On	NTSC	30ND	29.97	Ext. Video
		30DF	29.97	Ext. Video
		25	No Output *	N/A
		24	23.97	Ext. Video
On	PAL	30ND	No Output **	N/A
		30DF	No Output **	N/A
		25	25	Ext. Video
		24	No Output **	N/A
* with message "NOT PAL" in display				
** with message "NOT NTSC" in display				

Output Level & Waveform

Output level

The output level is always adjustable, in repair, generate or even bypass, with the rear panel pot (located next to the output jack). It is adjustable from full off to +12db. This adjusted level remains constant regardless of input level fluctuations.

Output Waveform

SMPTE & EBU Specs

Per SMPTE and EBU specifications, rise time limiting is used to minimize crosstalk from time code into audio. A longer rise time removes more high frequency components from its waveform. SMPTE specs call for a $25\mu\text{s}$ rise time; EBU for $50\mu\text{s}$. A third waveform is available from the SR-3: square wave ($1\mu\text{s}$ rise time)

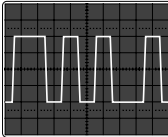


Figure 3.
 $25\mu\text{s}$ rise time
SMPTE specs

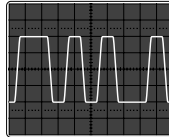


Figure 4.
 $50\mu\text{s}$ rise time
EBU specs

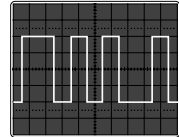


Figure 5.
 $1\mu\text{s}$ rise time
Square wave

SR-3 Output waveform (rise time)

- In Bypass, the rise time is set at approximately $2\mu\text{s}$. This way, high speed code can go through without being filtered.
- In Repair and Generate, the output rise time is set at $25\mu\text{s}$.

Application Notes

Recording the repaired time code

One way to deal with bad code is to restripe on a new track, running the damaged code through the SR-3 and recording its output. This is the simplest solution, but it requires an empty track and takes a little time.

In this situation, set the Flywheel Time to 15 frames and, if the original code is synchronous with video, turn "Video Sync" on, and "Fix Video \emptyset " if necessary.

Repairing "on the fly"

If you don't have an empty track or the time to re-stripe your tape with repaired code, you can insert the SR-3 at the output of your time code track and repair "on the fly".

For example, if the time code on your master tape machine is marginal and your synchronizer loses lock once in a while, connect the output of your tape machine into the SR-3 and feed the output of the SR-3 into your synchronizer. In this set up the synchronizer no longer reads the raw time code off the tape machine but the repaired code off the SR-3. The SR-3 automatically switches to bypass in wind or search so you always have valid code at the output of the SR-3.

SETTING THE PROPER FLYWHEEL TIME: In this set up (repairing "on the fly"), after you stop the master tape machine, the synchronizer will continue seeing time code until the SR-3 stops. If your synchronizer does not read tallies but only time code, there will be a delay between the time you stop the master machine and the time the synchronizer stops the slave machine.

If you set the flywheel time to 5 frames, this delay will be virtually unnoticeable. Set the flywheel time to 15 frames only if you don't mind the 1/2 second delay or if you have a time code error that requires 15 frames flywheel time to be repaired.

Infinity flywheel time

Infinity flywheel time is helpful when you need to add new time code after the original code has stopped.

It is also helpful if the original code has become so corrupted and useless that you need to replace it and you only want to use the original code to give the SR-3 a starting number.

If you need to stay in sync with the source code, do not use infinity unless the source code is synchronous with video. Set to infinity, the SR-3 disregards the time code input after 15 frames of bad code and, from that point, a drift would most likely occur between the source time code (input) and the regenerated time code (output). However, if the SR-3 stays locked to video and the source code is synchronous, no drift will occur.

When repairing synchronous code, always turn on “Video Sync”

One of the problems the SR-3 can help reduce is jitter. Whenever the source time code is synchronous with video, you should feed the video reference into the SR-3 and activate “VideoSync”. Video is a much more stable clock than time code and helps reduce jitter substantially.

Appendix A: Eight Digit Display

The eight digit display is mainly used to read Time Code and User Bits. In repair mode, it reads the input signal; in generate mode, the output. It is also used for the following:

Software version number

When the SR-3 is first turned on, the reader displays the software version number for a few seconds.

Error Messages

Error descriptions appear in the display as soon as they are detected - (see appendix D pg. 16)

Video Phase

While pressing and holding the "FixVideo ø" button, the reader indicates which bit of the time code word lines up with video Field 1 Line 5 ("V" drive). This feature is only available when "Video Sync" is on - (see Video Sync pg. 5).

Appendix B: Longitudinal bit assignment

There is one time code word for each frame. Each word of longitudinal time code (LTC) is divided into 80 equal segments called bits, numbered 0 to 79. These bits are mainly grouped by four into Binary Coded Decimal words to form decimal numbers (0 to 9). Twenty six of these bits are assigned to the Time Address information (frames, seconds, minutes and hours); thirty two are assigned to the Binary Group information (user bits); sixteen are used for sync (sync word) and the remaining six are used for flags or are still unassigned.

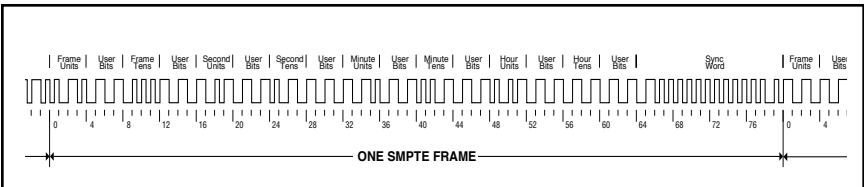


Figure 6. SMPTE Word
Address: 05:38:14:29 - User Bits: 00000000 - drop & color flags set

SMPTE time code has 30 frames per second and EBU has 25. Both time codes have 80 bits per word. All bits are identical, except for some of the flags that are different (bits 10, 27 & 59) - see Figures 7 & 8 below.

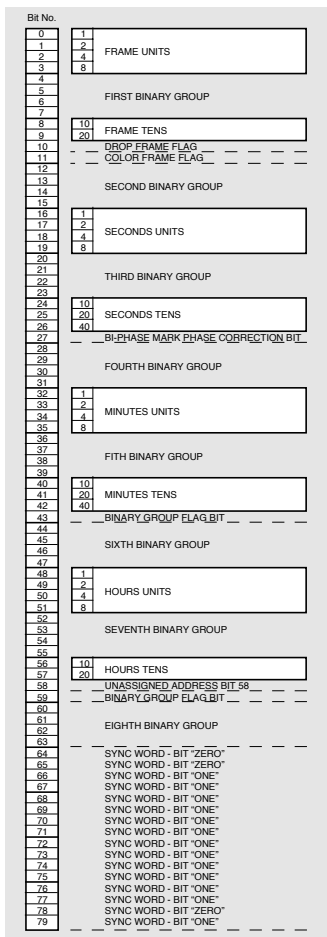


Figure 7. SMPTE longitudinal bit assignment

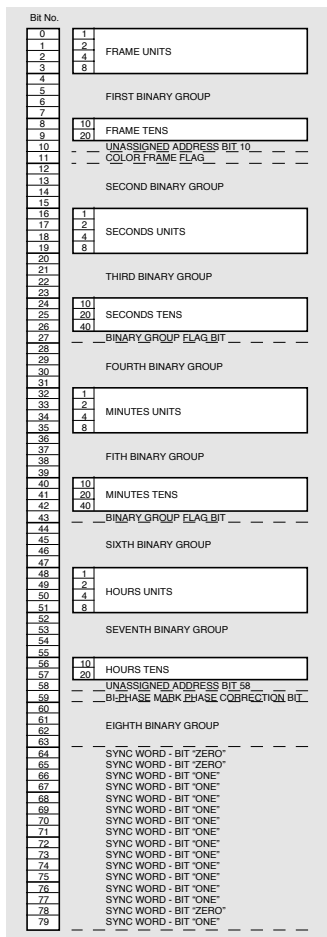


Figure 8. EBU longitudinal bit assignment

Appendix C: Error Messages

Repair Mode:

NO VIDEO	Video is not present and "Video Sync" is on.
DRIFT	Input code is not synchronous with video reference and "Video Sync" is on.
VID LOSS	External video reference has been interrupted and "Video Sync" is on.
SLIP	After a drop out, offset between input code and regenerator (SR-3) is greater than 1/4 frame.

Generate Mode:

NOT PAL	Video reference is NTSC while SR-3 is set to generate 25 f/s code with "Video Sync" turned on.
NOT NTSC	Video reference is PAL while SR-3 is set to generate 30 f/s code with "Video Sync" turned on.

Specifications

Input Signal:

SMPTE/EBU Longitudinal Time Code

8 Digit Display:

Reads time code & user bits

Digit height: .36"

Front Panel LED indicators:

Format: 24/25/30D/30ND/Color

TC In: indicates signal present

Video ø: indicates valid video reference at video input

Connectors:

1/4" RTS Jack (2): time code input & output

BNC: Video In & loop

2.5mm jack: Power (center pin hot)

TC Output Level:

Adjustable (rear panel pot):

full off to +12dbU balanced; to +6dbU unbalanced.

Termination switch:

75Ω to ground - for video reference

Power:

6 - 9 VDC @ 500 ma

Dimensions:

8 1/2" x 5" x 1 5/8"

Other Brainstorm Products

SR-15+ Time Code Distriplalyzer

Combines 3 units in a single space 19" chassis: a time code analyzer, a 1x5 Time code distributor (w/reshaping on all 5 outputs) and a pilot tone stripper. The analyzer identifies time code format, detects errors and monitors video sync and color field alignment. A comprehensive report can be sent to a printer or computer via the parallel and RS-232 ports.

SA-1 Time Code Analyzer

Same analyzer as the one found in the SR-15+, in a small portable package (same as the SR-3). It operates on an external 6VDC supply and can be used with a battery pack.

SR-26 Dual Time Code Distributor / Reshaper

Cleans up time code and distributes it through 6 individually buffered outputs. Can be used as 2 separate units: 1x4 (master) + 1x2 (slave) or as a single 1x6 unit - Same reshaping circuitry as the SR-1 with individual output level controls & switchable output rise times.

SR-1 Time Code Reshaper

Cleans up unreadable code by eliminating distortions and level fluctuations. Low input threshold (better than -30db) - Reshapes in fast forward and rewind modes - Balanced or unbalanced input and output - Adjustable output level - Switchable output rise time (SMPT/E/EBU/square wave).

SR-2 Frame rate counter

Same unit as the SR-1 with a 4 digit counter that reads the incoming time code's frame rate. Ideal to identify the code's format and verify it's stability - Very accurate counter (4 updates per second) also shows potential problems such as wow and flutter or jitter.

TB-4 Communicator System (wireless talkback remote)

A high-performance infrared remote that allows the producer to activate the console's talkback from anywhere in the control room - 4 switchable talkback functions - Rechargeable transmitter - No aiming necessary - Easy to install - Includes transmitter and receiver.

For more information on these products, contact your Brainstorm Electronics dealer.

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