If We Could Turn Back Timecode:

Finding a Way to Better Ancillary Data

Presented by Kelly Haydon and Benjamin Turkus
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No Time to Wait 3rd Annual Conference

10:26:20;18

What do Cher and Timecode have in Common?

1. They've been around forever
2. Their relevance is constantly questioned

The Timecode Problem

"...If [capturing timecode] were possible (and not super hard) to do in every instance, I probably would. I think the reason it isn't always captured is more the fact that it's a huge pain in the ass with our available tools." - Michael Angeletti, Stanford Media Preservation Lab

The Timecode Problem

- Most preservation container formats have not been developed to contain the totality of ancillary data from an analog signal (the AS-07 working group is progressing on this specification for the MXF container format).

- Proprietary capture software often does not interpret timecode as a stream which does not preserve the signals native discontinuity. Rather, software will only capture the first timecode stamp and either lay down a bogus continuous track or just capture the timecode of the first frame.

- Preservationists lack community-supported resources for capturing and understanding timecode.

Cher is so over it

What is Timecode Anyway?


01:04:24;36


01:04:24;37


01:04:24;38


01:04:24;39


01:04:24;40

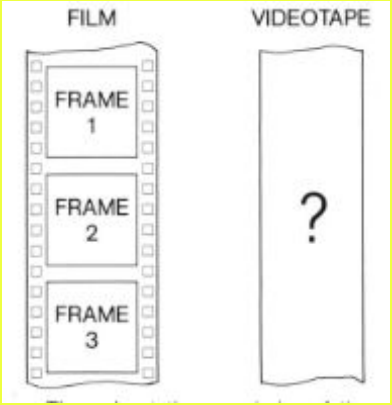
“Adopted in the 1960s by the Society of Motion Picture and Television Engineers, SMPTE timecode is an industry standard frame numbering system that assigns a specific number to each frame of video in hours, minutes, seconds, and frames format.” (The Professional Video Sourcebook, BH Photo/Video).

Brief Timecode Timeline

- 1956 - videotape is here, yay! But editors can't see the frame lines; the cut and splice method is adapted upon but imprecise and tedious.

- 1960s - electronic splicing systems are introduced but required the editor to search for a desired splice point and mark it with an electronic tone, also a tedious and imprecise process.

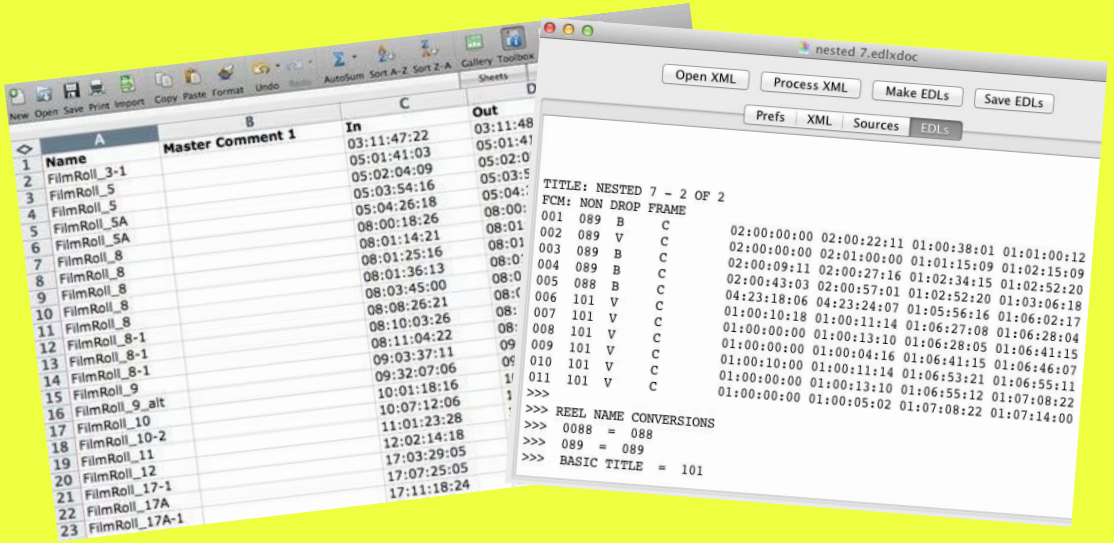
- 1967, EECO introduced the timecode synchronization system to the industry and in 1969, SMPTE/EBU standardized the timecode that we know today. Each frame of video has its own unique timecode and linear tape-to-tape editing is efficient AF.

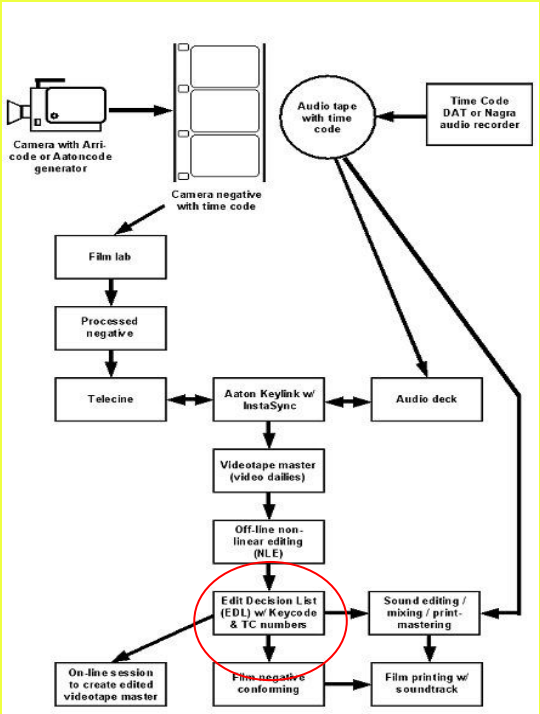


Source: "Time Code Basics," Anonymous, American Cinematographer; Mar 1983; 64, 3; ProQuest pg. 23

Brief Timecode Timeline

Timecode becomes an integral part of productions workflows recorded on both film and tape





Edit Decision Lists (logs timecode of correspond to the final cut).

Timecode in Production

Video production workflows often logged the reel number of the tape shot in a day's work.

Tape 1 - Start Timecode: 01:00:00;00
Tape 2 - Start Timecode: 02:00:00;00
Tape 3 - Start Timecode: 03:00:00;00

Characteristics of Timecode

Three characteristics to look out for when assessing your timecode*

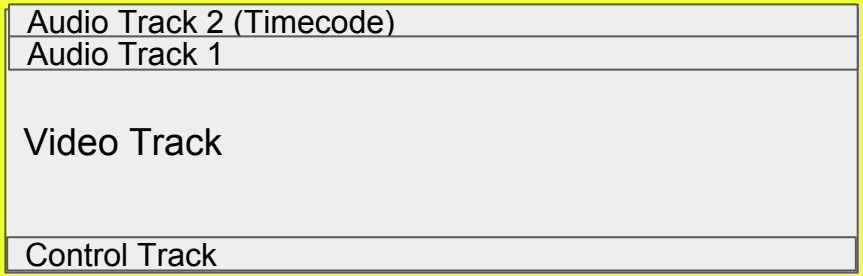
- Is it VITC or LTC timecode?
- Is it Drop Frame or Non Drop Frame?
- Is it Continuous or Discontinuous?

*DV Time (DV timecode captured via firewire) and DAT are not included in this timecode discussion.

Characteristics of Timecode: VITC & LTC

Longitudinal TimeCode (LTC)

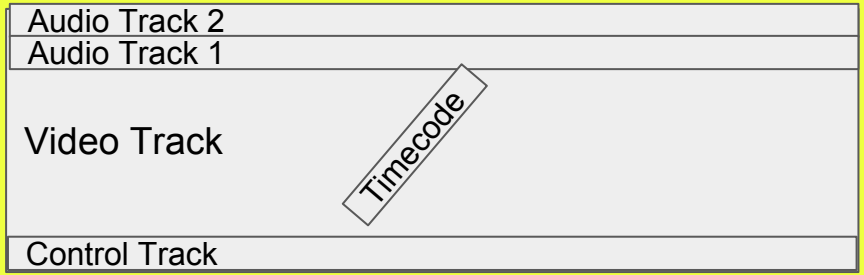
- The earlier of the two timecode types
- Usually (but not always) recorded on audio track 2.
- Prone to drift, read errors, and cannot be read at fast speeds.
- Listen to what ltc “sounds” like: https://www.youtube.com/watch?v=zjH0RFV206M



Source: “Time Code Basics,” Anonymous, American Cinematographer; Mar 1983; 64, 3; ProQuest pg. 23

Vertical Interval TimeCode (VITC)

- VITC is integrated into the video track of the tape which resolves a number of problems found with LTC
- Provides indexing resolution down to the video field; this means VITC timecode can be read at all speeds the video is played back at
- Frees up the 2nd audio channel for recording



NOTE: Track configurations can vary by format. Images are non-format specific examples

Characteristics of Timecode: NDF & DF (it's an NTSC thing)

- Drop Frame [DF] and Non-Drop Frame [NDF] are distinguished by the colon or semi-colon present before the frame count:

  Drop Frame: HH:MM:SS;FR (01:01:01;01)
  Non Drop Frame: HH:MM:SS:FR (01:01:01:02)

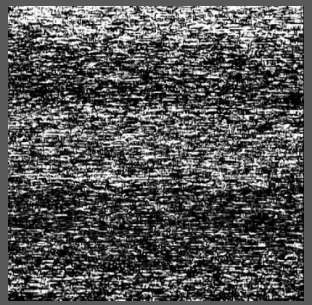
- Simply two different ways of labeling a frame. Drop Frame timecode accommodates the 29.97fps framerate of color, introduced after the 30fps was already established for monochrome.
- "When an American TV frame-rate video production must be edited to actual clock time, Non Drop Frame timecode must be used. If staying in time with an actual clock is not important, especially on short video productions like commercials, the bastard 29.97 fps Drop Frame timecode is often used." - Shawn Amaro, "How to Use Drop Frame or Non-Drop Frame."

Source: "SMPTE EBU", Phill Rees:
https://drive.google.com/drive/folders/1fTTe27RhP1G_v-C8Acd_9L_ltBrg1xls

Characteristics of Timecode: Continuous & Discontinuous

- Continuous timecode is an unbroken clocking moving forward from the first frame to the last.

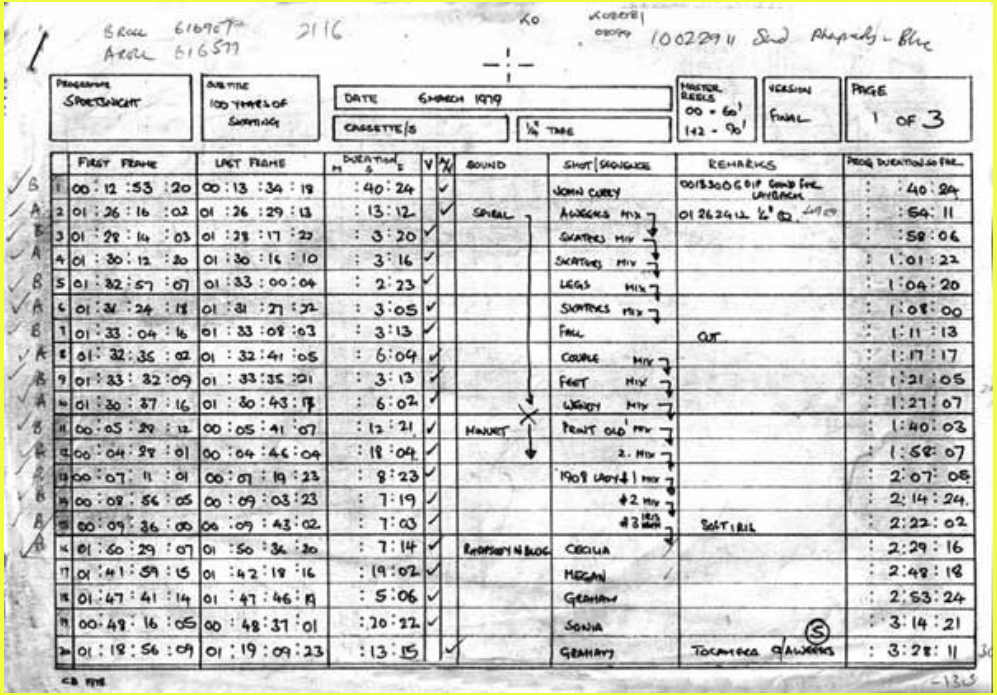
- Discontinuous timecode occurs when a recording abruptly stops and starts again. Discontinuous timecode is common in recordings not made within strict broadcast workflows: video art, independent media, home movies



So why should archivists care about Timecode?

Legacy timecode (or “time code”) is a tool for:

- Restoring, finishing, or rebuilding film and video works based on existing edit decision lists (either paper based or software generated)
- Identify the placement of a camera roll in an array of tapes (tape 1, tape 2, tape 3, etc.)
- Contextualizing the support documentation found in a collection (and raising the research value of that documentaion)
- Finding important/interesting material amid large quantities of media based on available documentation



1979 edit decision list for a production recorded on Umatic tape (VTOldboys.com)

Timecode: The Original Trash Fire

Capturing Timecode: A New Bare Minimum?

< $1,000

What are the issues regarding timecode? Source recordings may have multiple timecodes: vertical interval timecode (VITC), linear timecode (LTC), and more. Some are present on purpose, others by accident; some may have good integrity and continuity, others may be discontinuous. Any or all of these timecodes may provide forensic help for future researchers. A legacy timecode may be keyed to old documents like tape logs, may provide clues about the older source tapes that were assembled to create the video program you are now preserving, and may (as with footage of NASA space vehicle launches) represent elapsed time that can be correlated to other data streams. In many cases, this is data you do not want to lose.

Carl Fleischauer, AMIA-L, 2014

https://lsv.uky.edu/scripts/wa.exe?A2=ind1402&L=AMIA-L&D=0&P=218059

When Timecode Makes U Wanna Scream

- LTC does not match VITC
- LTC is DF and VITC is NDF.
- LTC is inconsistent or garbled.
- User bit code if present is inconsistent.
- VITC changes line assignment or drops out completely in a single tape.
- Time code in the picture [BITC] does not match LTC or VITC.

David Crosthwait, AMIA-L, 2014

https://lsv.uky.edu/scripts/wa.exe?A2=ind1402&L=AMIA-L&D=0&P=224872

The Problem of Timecode Revisited

The challenges of transmitting, through a digitization set up, the different types of timecode, messy or not, that could be recorded onto a tape

The work-in-progress discussion of how best to store these different types of timecode within a digital video file

- **The complexities of timecode as recorded onto different video formats (what's possible; what's common; what's rare)**
- **The complexities of choosing the right decks and connections to capture**
- **Capture card differences/issues**
- **File format compatibility with all of this nonsense**

Matroska, timecode, and side data

VBI (Vertical Blanking Interval) and ANC (Ancillary Data)

- Timecodes (LTC, VITC, ATC)
- Captions(North American CEA-608, CEA-708, European and Australian WSS/Teletext, Japanese ARIB B37)
- Recording Information
- Bar and pan/scan data
- Camera acquisition dynamic metadata
- Audio Metadata
- Film Transfer and Video Production Information

DID	SDID	Used Where	Application
41h	05h	S2016-3	AFD and Bar Data
41h	06h	S2016-4	Pan-Scan Data
41h	07h	S2010	ANSI/SCTE 104 messages
41h	08h	S2031	DVB/SCTE VBI data
60h	60h	S12M-2	Ancillary Time Code
61h	01h	S334-1	EIA 708B Data mapping into VANC space
61h	02h	S334-1	EIA 608 Data mapping into VANC space

Thomas Edwards, “RTP Payload for SMPTE ST 291 Ancillary Data,” https://datatracker.ietf.org/meeting/92/materials/slides-92-payload-2

Decklink Duo 2 Drama

Counting Time

In FFmpeg/vrecord, we can now:

1. **store a correct first frame timecode stamp within our files; and**
2. **store vrecord-produced sidecar txts that will log all of the analog timecode values, continuous or not, as we wait for the larger Matroska side data advancement**

avdevice/decklink_dec: capture timecode to metadata when requested

Browse files

```
If the user provides a valid timecode_format look for timecode of that
format in the capture and if found store it on the video avstream's
metadata.

Slightly modified by Marton Balint to capture per-frame timecode as well.

Signed-off-by: Marton Balint <cus@passwd.hu>
```

master (#1)

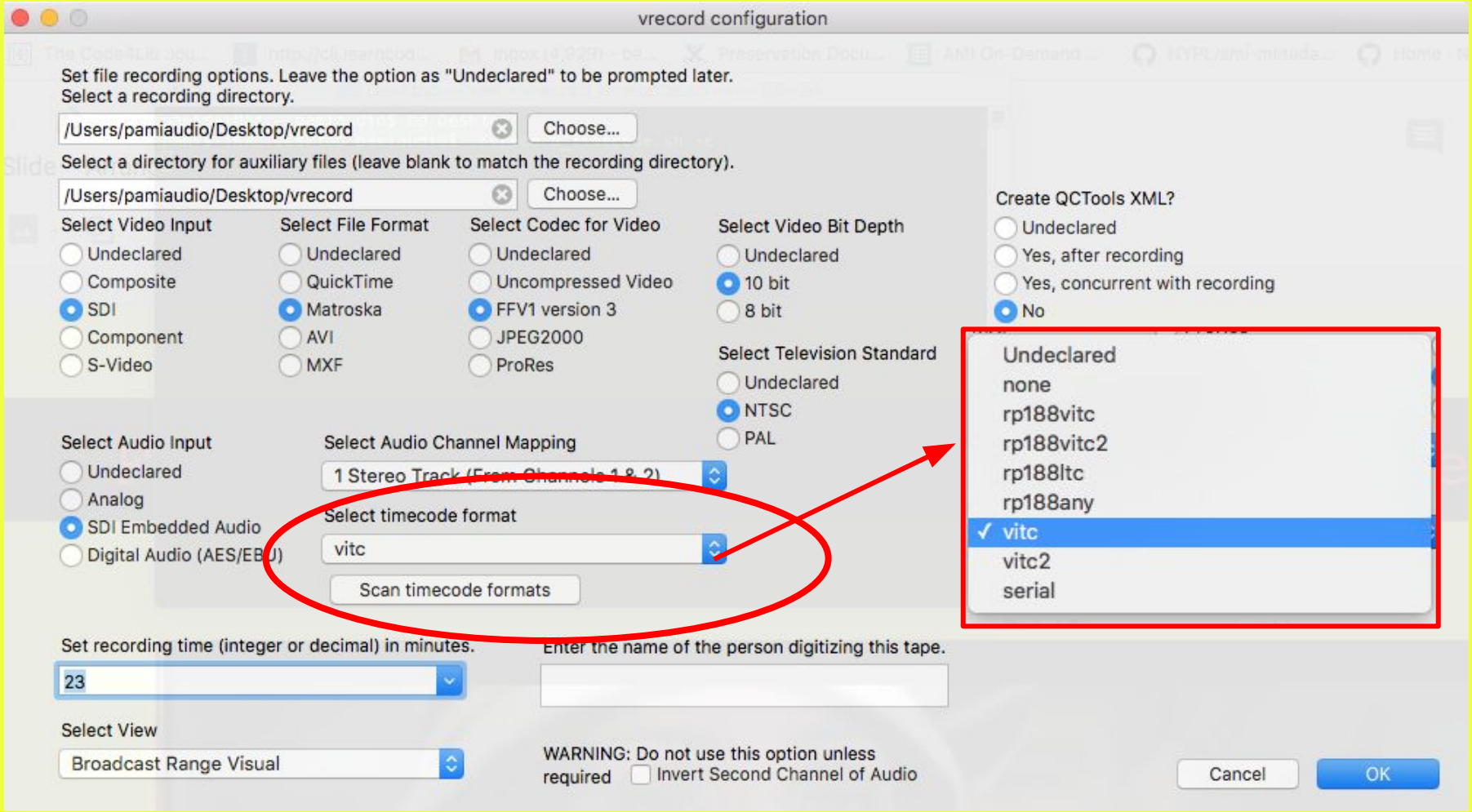
Jon Morley authored and **cus** committed on May 31 — 1 parent fb480a1 — commit 0946c0ec177dc48ef0677f890aa42d95e667c417

ANTI-STATIC

BETACAM SP

Chris Isaak "Let Me Down Easy"
Reprise Records

Cher "Song For the Lonely"
Cher "Living Proof" Press Kit 2002
Warner Bros. Records

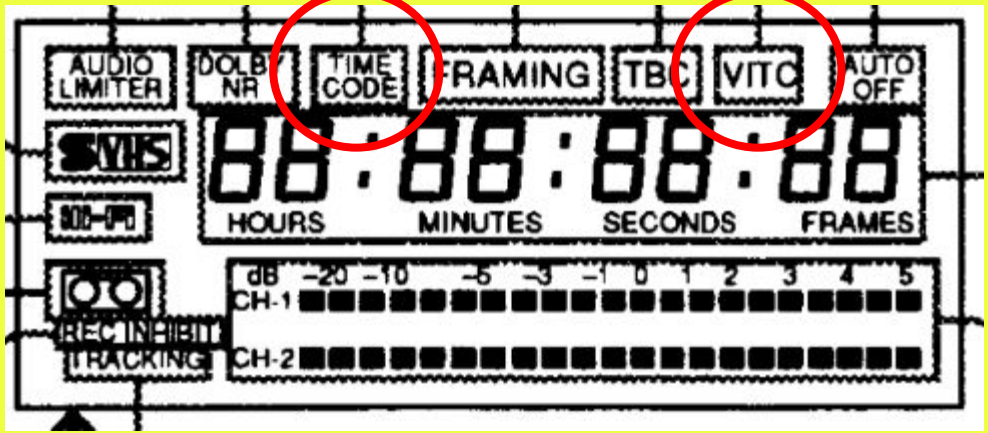

vrecord configuration
Set file recording options. Leave the option as "Undeclared" to be prompted later.
Select a recording directory.
/Users/pamiaudio/Desktop/vrecord
Choose...
Select a directory for auxiliary files (leave blank to match the recording directory).
/Users/pamiaudio/Desktop/vrecord
Choose...
Select Video Input
Undeclared
Composite
SDI
Component
S-Video
Select File Format
Undeclared
QuickTime
Matroska
AVI
MXF
Select Codec for Video
Undeclared
Uncompressed Video
FFV1 version 3
JPEG2000
ProRes
Select Video Bit Depth
Undeclared
10 bit
8 bit
Create QCTools XML?
Undeclared
Yes, after recording
Yes, concurrent with recording
No
Select Television Standard
Undeclared
NTSC
PAL
Select Audio Input
Undeclared
Analog
SDI Embedded Audio
Digital Audio (AES/EBU)
Select Audio Channel Mapping
1 Stereo Track (From Channels 1 & 2)
Select timecode format
vitc
Scan timecode formats
Undeclared
none
rp188vitc
rp188vitc2
rp188ltc
rp188any
vitc
vitc2
serial
Set recording time (integer or decimal) in minutes.
23
Enter the name of the person digitizing this tape.
Select View
Broadcast Range Visual
WARNING: Do not use this option unless required
Invert Second Channel of Audio
Cancel
OK

Format	SMPTE LTC	SMPTE VITC	Capture Recommendation	Additional Considerations
EIAJ-1 & EIAJ-2	✗	✗	n/a	
U-matiC	✓	✗	Serial (RS-422) LTC audio as audio	Mostly late generation VTRs (VO and BVU series) with timecode generator/readers; some aftermarket modifications; LTC on audio or address track
1” Type C	✓	✓	Serial (RS-422)/LTC audio as audio	LTC (audio CH3) most common
S-VHS	✓	✓	Serial (RS-422) LTC audio as audio	No separate address track for LTC; typically CH2
Betamax	✗	✗	n/a	
Betacam Family	✓	✓	SDI	
Video8 Hi8	✗	✗	n/a	No SMPTE timecode, but Sony RCTC (rewritable consumer timecode)

Trust your machines (but read your manuals)

Built-in Time Code Generator/Reader

The generation and reading of SMPTE format VITC and LTC and user bits comes as standard in the BVW-D75. LTC can be automatically recorded on the dedicated time code track and VITC recorded in the Vertical blanking interval of the video signal. Time code or user bit settings can be easily executed using the push buttons located on the control panel. User bit settings can be pre-set and stored in non-volatile memory. External/internal time code, REGEN/PRESET, or REC-RUN/FREE-RUN selections are available.



2. Plug-in Time Code Generator/Reader (BKU-905)
   The BKU-905 enables the recording and reading of SMPTE LTC and user bits on the address track of the tape. The BKU-905 consists of a plug-in TC Board (TC-42) and Time Code Control Panel.

Full Range of Functions

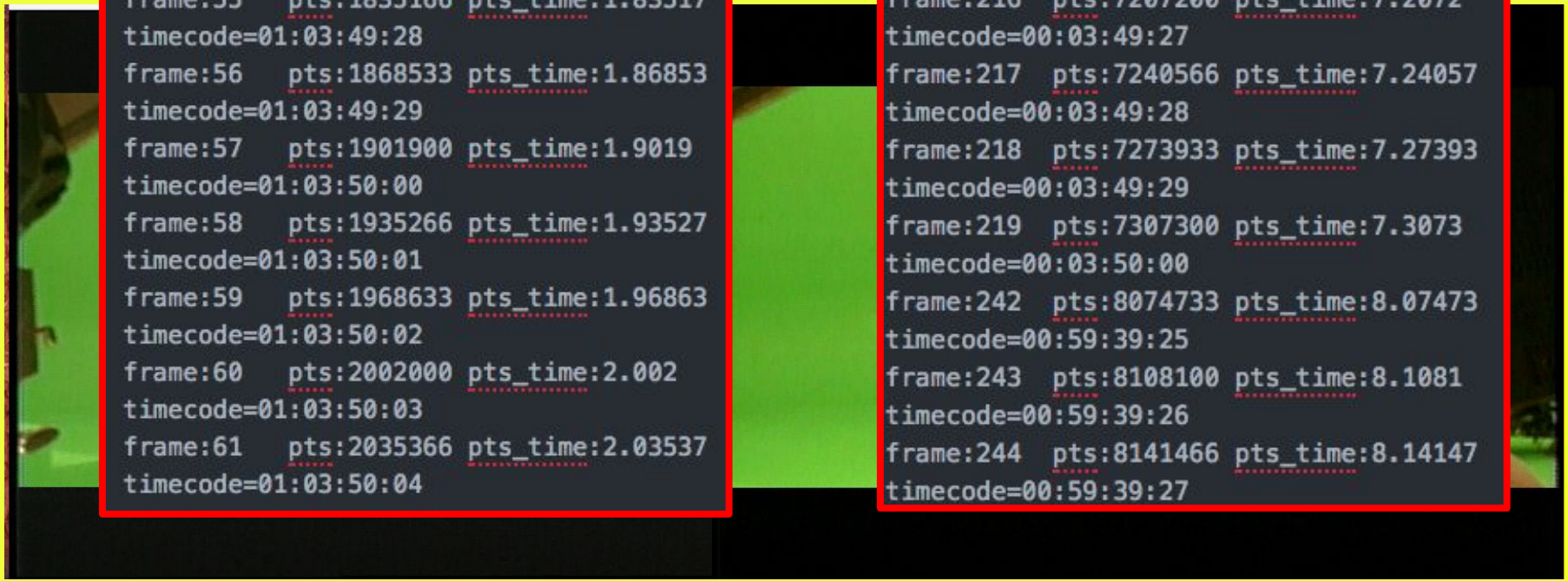
Built-in time code generator (SVO-5800/5800P only) and reader

The built-in time code generator and reader allow the unit to record (SVO-5800/5800P only) and read time codes (LTC [1], VITC [2]) or user bits simultaneously with the video and audio signals.

Sony Service Manuals for BVU-950, SVO-5800, and BVW-D75

Puzzling Over the Permutations

The New Discontinuity (w/ vrecord)



```
frame:55    pts:1835166 pts_time:1.83517
timecode=01:03:49:28
frame:56    pts:1868533 pts_time:1.86853
timecode=01:03:49:29
frame:57    pts:1901900 pts_time:1.9019
timecode=01:03:50:00
frame:58    pts:1935266 pts_time:1.93527
timecode=01:03:50:01
frame:59    pts:1968633 pts_time:1.96863
timecode=01:03:50:02
frame:60    pts:2002000 pts_time:2.002
timecode=01:03:50:03
frame:61    pts:2035366 pts_time:2.03537
timecode=01:03:50:04
```

```
frame:216   pts:7207200 pts_time:7.2072
timecode=00:03:49:27
frame:217   pts:7240566 pts_time:7.24057
timecode=00:03:49:28
frame:218   pts:7273933 pts_time:7.27393
timecode=00:03:49:29
frame:219   pts:7307300 pts_time:7.3073
timecode=00:03:50:00
frame:242   pts:8074733 pts_time:8.07473
timecode=00:59:39:25
frame:243   pts:8108100 pts_time:8.1081
timecode=00:59:39:26
frame:244   pts:8141466 pts_time:8.14147
timecode=00:59:39:27
```

Time After Timecode? If Only!

- MKV side data (for timecode/s and lots of other stuff)
- FFmpeg & decklink ability to read multiple timecodes
- Format-by-format decision tree, with recommendations for diff scenarios (a.k.a. how to set yourself up for success)
- Rethinking workflows and digitization racks
- Automated audio LTC conversion (some tools out there)
- User Bits (super fun, not discussed at all in this prez)
- More vrecord testing and tweaking