Analog Multitrack Recorders: A New Breed

By Greg Hanks

A new generation of analog machines, with greatly expanded features, has ensured their continued co-existence with digital machines.

DASH and Pro-Digi are at odds as digital standards, and the least expensive digital tape recorders still cost more than $75,000. These facts, in addition to the emergence of Dolby SR, have promoted the growth of a new generation of analog multitrack tape machines, providing greatly expanded functions compared to those of early hardware.

The evolution of the recorder can be compared to that of the automobile. The Model T performed the basic functions of starting, stopping and turning, but little attention was paid to the creature comforts of the operator.

Let's face it, the classic Ampex MM-1000 doesn't cut it anymore. Engineers demand more from modern analog multitrack machines. For example, in the area of transport, a contemporary machine must accommodate music recording, jingle production, video post-production and film scoring. These varied fields insist upon a transport that can:

1. Lock up quickly to SMPTE time code.
2. Easily accommodate 14-inch reels.
3. Accommodate 7-inch spot reels without transport oscillation.
4. Wind tape at speeds greater than 300ips.
5. Provide constant tension for both reels in all operating modes.

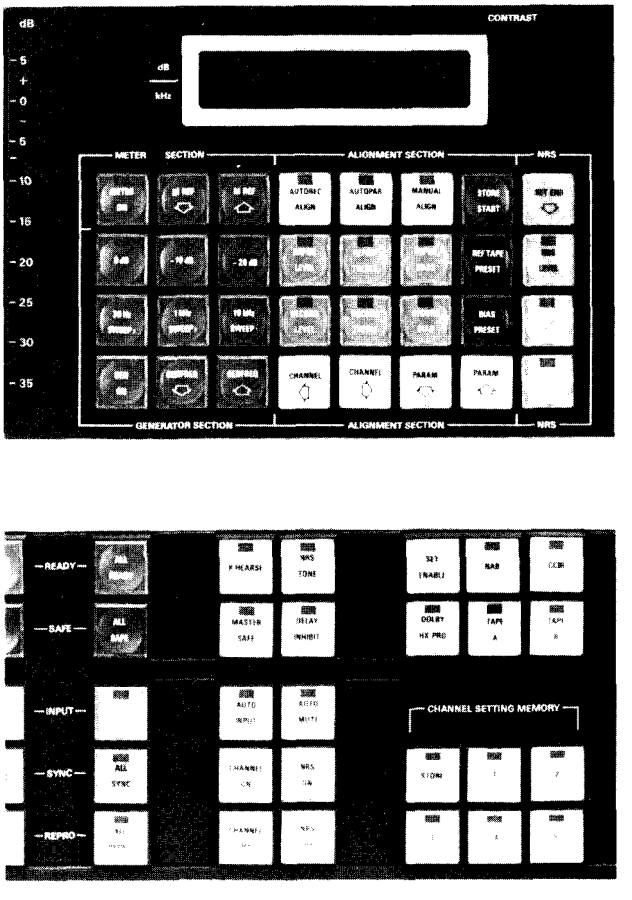

Photo 1. *Studer A820-24 master audio controls.*

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Table 1.

	Auto Alignment	Built-in Synchro-nization	Computer-controlled analog Audio electronics	Computer-controlled Transport	External Sync Input (Video House sync)	Hardened Head material	Jog Shuttle	Monitor parameters user program-mable	Noise reduction frame	Phase compen-sation
Tascam ATR-80	NO	OPT	NO	YES	OPT.	NO	YES	NO	NO	YES
Sony APR-24	NO	YES	YES	YES	YES	YES	YES	YES	NO	YES
Otari MRT-100A	YES	OPT.	YES	YES	OPT	YES	YES	NO	YES	YES
Studer A-820	YES	OPT	YES	YES	NO	YES	YES	YES	YES	YES
Studer A-827	NO	OPT	YES	YES	NO	YES	YES	YES	NO	YES

	Program-mable/ Assignable TC Channel	Reverse play	Serial Port	spot Erase	Storage of Alignment values	TC Reader	Trans-former I/O	Transport parameters user program-mable	VITC Reader	Wind Speed
Tascam ATR-80	note1	YES	OPT.	YES	NO	OPT	OPT	NO	NO	375 IPS
Sony APR-24	YES	YES	YES	YES	NO	YES	OPT.	NO	YES	475 IPS
Otari MRT-100A	YES	YES	YES/note 2	YES	NO	YES	OPT	NO	NO	472 IPS
Studer A-820	OPT	YES	OPT.	YES	OPT.	OPT.	OPT.	YES	NO	600 IPS
Studer A-827	OPT	YES	OPT	YES	OPT.	OPT.	OPT.	YES	NO	600 IPS

Notes 1 Tascam offers Sync-lock which locks a channel into sync repro at all times.
2 Otari offers either an RS-232/RS-422 port. Another serial port is optionally available.

photo *2. Studer A820-24 recorder and remote control.*

6. Be externally controlled by other intelligent devices, without compromising either the synchronizer interface or the remote control.

As for the capstan and synchronization, the modern transport system needs to provide:

1. A closed-loop servo design for timing control of the capstan.
2. An external reference input for house sync.
3. Slew up starting, rather than being constantly on. (This is essential for controlled tape handling.)
4. Speed selections from 7½ips to 30ips.
5. Access to the reeling motor servos for fast-wind positioning under synchronizer control, without having to resort to forward/reverse toggling.
6. Access to tach pulses from both the counter roller and the capstan feedback system.
7. Direction sensing.
8. Transport mode tallies.

In the area of remote control, today's machines must provide:

1. Auto location. The auto-locater will have multiple addresses and the ability tc loop between them.
2. Capstan varispeed, allowing selection. adjustment and display.
3. Audio mode selection for all channels both individually and globally.
4. Control by either a console automation system or a synchronizer controller without having to have its own remote disabled.

Of course, all of these are in addition to providing the basic transport functions:

play, stop, edit, fast wind, reproduce, record and monitor-with particular attention to the following details.

- In play, the transport must move the tape across the heads at a constant velocity that conforms to industry standards. The height of the tape path must be consistent so that track positioning also conforms to industry standards. The reeling system must provide consistent tension for proper tape-to-head contact. The design must not deform the tape or cause undo wear on the heads and guides.
- In stop, the transport must provide sufficient tension to take up any slack in the tape path, and must also maintain tape-to-head contact to prevent "creep" in either direction.
- In the edit mode, the machine tension must be sufficiently "soft" for scrubbing.
- In fast wind, the machine must provide transfer from one reel to the other without damaging the oxide surface or either edge of the tape. It must also provide a correct and uniform height for consistent packing and pay-out during play. In addition, the wind tension must be uniform to eliminate both the trapping of air between windings, which results from too little tension, and hard-banding, which is a deformation of the tape caused by excessive tension.
- As for monitoring the record and reproduce processes, the bottom line is simply, "What do we hear?" While working, this is determined by the logic of the recorder/console system and how these two devices are interconnected. Traditionally, a generic monitor switching system provides for playback, sync playback and input. The logic controlling these switching functions is driven through the transport and audio operating modes-with the operator optional selections becoming more and more comprehensive.

Audio alignment

Just as a console with recallable level and equalization is attractive for its time economy, so it is with a machine that has resetable, storable operating parameters. Think about this. When you're aligning a 24-track and you have to change the operating level, speed and tape type, there are over 168 separate adjustments that must be made-assuming no sync repro EQ adjustment! If you get really fast at line-ups, only spending an average of 10 seconds-per-adjustment, it will still take 28 minutes to set up the machine-not counting the time it takes to change reels, load tape and so forth.

Naturally, there are ongoing demands for lower noise, better erasure, less hum, fewer switching artifacts, and better frequency, phase and transient response. The real changes in today's machines come in the area of adjustment, storage and global resetability. Most of the new machines can store the following settings:

1. Reproduce, sync and record levels.
2. NAB, AES or IEC EQ standards for reproduce, sync and record.
3. Low- and high-frequency reproduce and sync EQ for each speed.
4. High-frequency record EQ for each speed.
5. Bias settings for different tape types and different speeds.

Some less obvious parameters that are now addressable, if not programmable, include:

1. The ability to incorporate Dolby into the audio card frame, and switch it in/out from the channel.
2. Assignable time code channel, with EQ following track assignment. (Not all engineers stripe their masters on the same tracks. Assignable TC channels allows the user to adapt to all possible situations.)
3. "Wide-banding" of tracks for wind speed code reading. (Wide-banding is the deviation from standard operating EQ for the optimization of data capture-sacrificing low-end, flat frequency response and S/N.)
4. Mute/mute defeat during high speed winding.
5. Muting of audio (non-muting of TC track) for synchronization parking maneuvers. This saves on headphones, amps and ears.
6. Recording chain phase compensation to accommodate the included 90° of reproduce EQ.

The current crop of recorders use a higher bias frequency and a lower erase frequency than in the past. This means that the bias traps and the erase peaks can be of a much lower Q. A lower Q implies that there is less need for adjustment.

With the ability to adjust all of the previously mentioned features comes some concerns when changing cards. "Is this an even or an odd channel?" "What

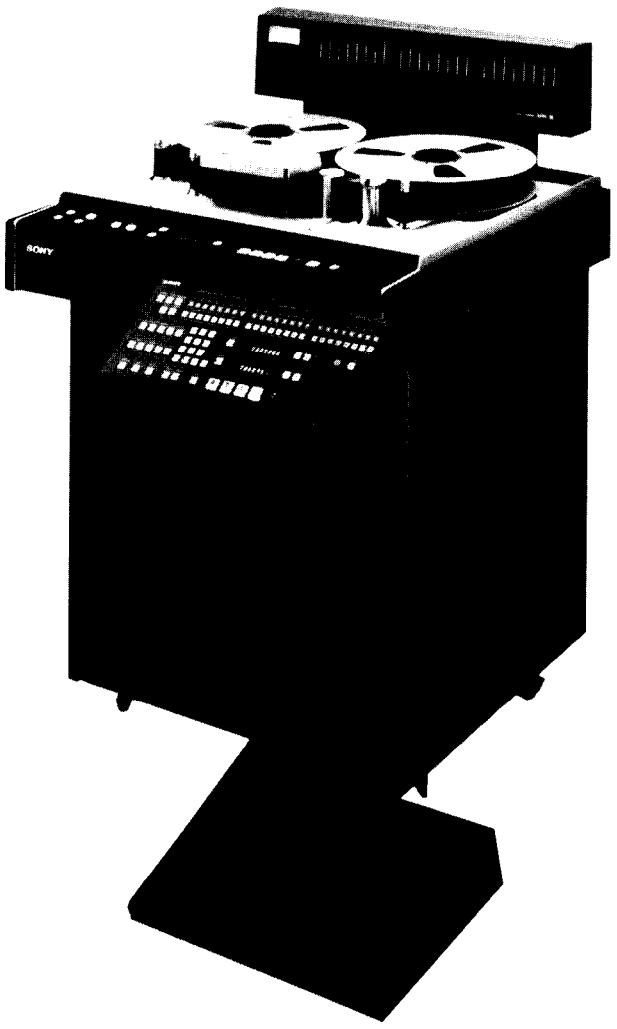

Photo 3. *Sonv* APR-24 *analog multitrack audio recorder*

do I have to do for the timing of the erase and bias switching?" Most modern nachines address such concerns automatically, but these questions need to be addressed at least once to ensure the nachines proper, initial configuration.

Current choices

The flagship machines of the following manufacturers are representative of this new breed. The single most significant Feature that differentiates them from machines of the past are their addressable alignment features. In alphabetical order, let's look at some of the offerings that are available.

Otari MTR-90/MTR-100A

Otari is currently manufacturing two professional 24-track recorders, the MTR-90 and MTR-lOOA. The MTR-100A sports the same pinchrollerless design as the MTR-90, with a substantial increase in available reeling and capstan motor torque. To minimize slippage, the capstan and tach rollers are made of a new material. All of this results in a much faster, more responsive transport, featuring a wind speed of 472ips and enhanced transition ballistics.

Built into the machine is amini-autolocator that is used for both tape footage counting and auto location, including three memory locations. The RS-422 ES-bus is used throughout the machine for both audio and transport remote control. This is implemented through an Otari "superset" of the ES-bus protocol under the local dialect provisions. Reverse play is available for back timing. The standard audio remote contains both the transport remote and a mini-locator.

The audio electronics are computer-controlled. The CPU performs automatic record alignment, while the reproduce setup is a "live-assist." The self-alignment computer allows any user-chosen frequencies for record level and EQ. There are four presets per tape speed, with three speed operation standard on all machines. The reproduce pre-amplifiers are located directly under the head assembly to keep the wiring lengths as short as possible. There are global settings that use a shuttle wheel as a controller. Phase compensation is performed automatically.

The heads employ a hard permalloy material to improve both frequency response and wear. When used at 3Oips, the asymmetrical head geometry is said to result in a -2dB response at 35Hz and a maximum response deviation of 1.6dB at 65Hz. Dolby HX-Pro is standard. Other options include:

1. EC-103 plug-in chase synchronizer and remote.
2. CB-120 full-featured autolocator with tachometer-based multiple memory.
3. CB-120B that employs time code.
4. Any of three different Dolby noise reduction frames, to accommodate either SR/A and SR cards, or the Cat. 22-type module.
5. Mixing console parallel interface for both transport and audio remote control.
6. Additional RS-232 and/or RS-422 serial I/O ports.
7. Audio interface through a multipin connector in addition to the standard XLR interface.

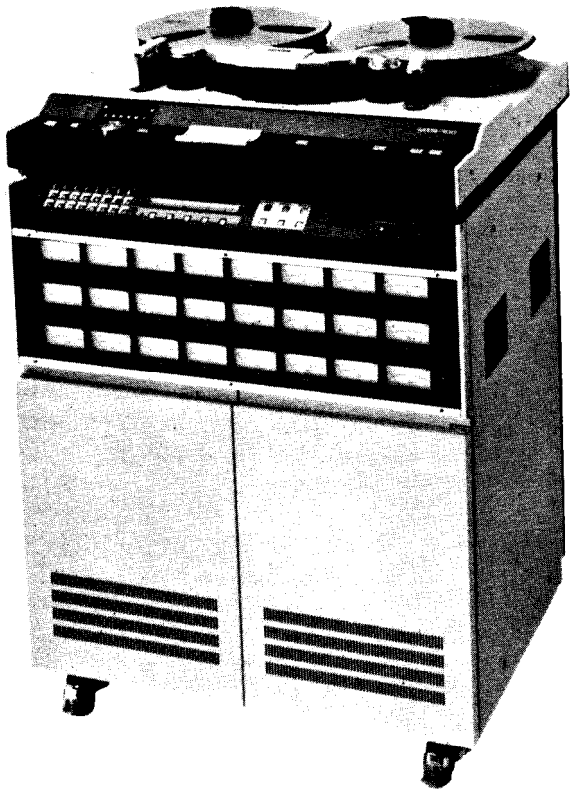

Photo 4. *Otari MTR100A analoq multitruck recorder.*

Sony APR-24

The APR-24 is Sony's version of the contemporary analog machine. The transport is microprocessor-based, with provisions for communication with both intelligent controllers and standard remotes. The key features of the machine include:

1. A remote unit providing audio, transport, locator and synchronizer control in a single unit requiring only one connecting cable.
2. Built-in synchronization that can address any of the 24 tracks. The selected channel's EQ automatically incorporates wide-banding. The synchronizer can read LTC or VITC in various formats, as well as resolve to time code, tone and video. The tape timer reads out in either "tach time" or SMPTE address time. When the transport is in the stop mode, any external time code being fed to the machine appears in the counter window. Provisions for house sync are standard.
3. Wind-speed code handling. While in fast wind the synchronizer outputs "burst" time code, which is not simply a bi-phase clock at wind-speed, but rather a continuous address that is updated twice a second and output at play clock-speed.
4. Digitally controlled analog electronics, with three non-volatile memories per-speed. The alignments can be globally or individually addressed using either ± keys or the jog/shuttle wheel.
5. SMPTE-based insert editing management, with five data storage registers.
6. Amorphous heads, providing improved response and long head life.

As of this writing, the serial port interface protocol and the parallel interface for the record and play status lines have not been implemented, but are said to be due shortly.

Studer A820/A827

Studer is currently manufacturing two machines. The recently introduced A827 offers the same transport as the A820, with simpler audio electronics, alignment systems and metering. Where the A820 has full auto-alignment, the A827 offers digital control of analog electronics

without analysis and signal generation capabilities. The transports for both models include 14-inch reel capacity; fully programmable 600ips wind-speed; all soft keys; 40 user-programmable transport functions and a library of programmed functions; and varispeed indication in ips, semitones and percentages.

Both machines are predominantly computer-controlled. The variables under processor control are basic transport operation; auto location; audio metering; audio alignment; operational key assignment; and in/out punch timing.

Both machines have separate TC cards that can be physically plugged into any channel, providing a high-speed reader and code re-shaper. There are no global alignment controls on the A820, but they are included on the A827. The A820 provides a bar graph meter display, reading either peak or VU, and also either full range or "zoom mode" metering. In the zoom mode, the full scale display represents a 2.5dB level change. Both machines will accommodate Dolby noise reduction, Alignment is performed in the same manner as the Otari, with a "live assist" in playback and a fully automated record alignment. The A820 auto-aligns

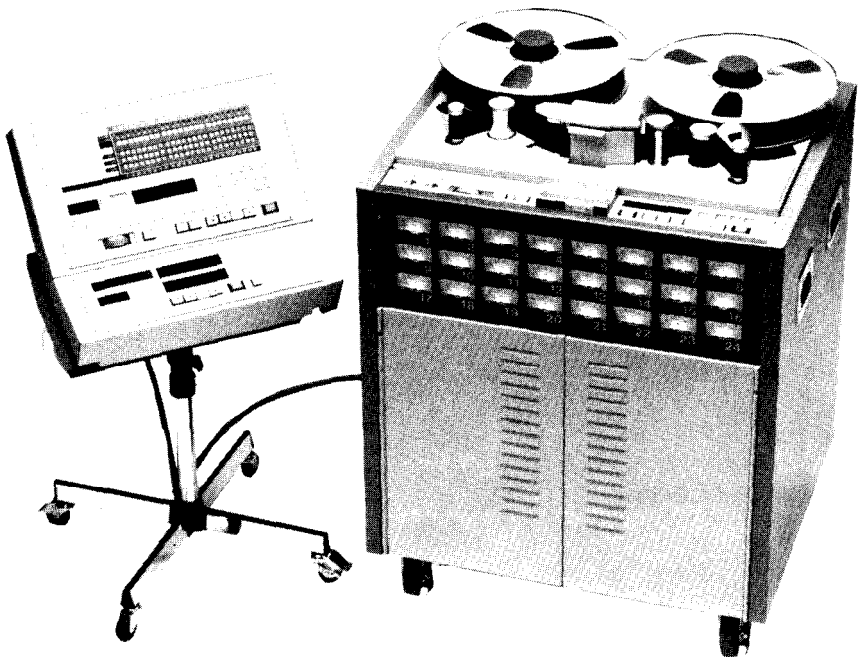

Photo 5. *Tascam ATR-80 analog multitrack recorder.*

any included noise reduction. Studer provides an optional serial to parallel audio remote interface for console-audio status switching.

Amorphous heads are used on both machines, with the reproduce pre-amps located under the head block. Erase current and tape tension are both set by head block jumpers. Dolby HX is standard with both machines.

The autolocator is interfaced serially, has 24 memories and is built into the transport remote. Reverse play is available and is selected as a two-button function. Secondary counters are available and programmable. The A827 remote has VU metering with peak indication and a status indicator for each channel. Spot erase is also included. Optional features include:

1. "Skimming? (Unique to the A820, skimming is a process used to reduce print through to tolerable levels on old tapes that have been archived for years. The erase head is turned off and the bias is activated at a very low level-just enough to have the overall effect of reducing the frequencies around 1OkHz by 3dB.
2. A fully implemented serial protocol through which all transport and audio functions are controlled and access to the audio alignment and transport parameter registers. (These data are also available optionally as FSK information that can be stored directly to tape through a load/unload routine.)
3. TLS 4000 synchronizer system.
4. An input/output transformer kit.

Tascam ATR-80

Tascam now offers a full-featured, 2-inch 24-track machine. The ATR-80 transport is fast, with a 380ips wind speed and a 200ms capstan lock time. The machine is multiprocessor-based, relying on separate microprocessors for the transport, the remote control/auto-locator, and the reeling motor and capstan servo. There is also a 4-bit processor on each channel for punch-in and punch-out timing, enabling the machine to provide seamless and gapless punches at any standard operating speed, as well as when the machine is in varispeed or under synchronizer control.

Audio alignment is handled in the classic analog fashion using pots and caps. The main area of digital control is in the bias timings and the transport functions. The spot erase function is unique in that when in this mode, the play lamp flashes and the tape moves at one of three speeds (1⅞ips, 1⅞ips or 3¾ips). Spot erasure can be performed in either forward **or reverse play.**

The sync-lock feature can assign any one of the 24 tracks to be the sync head, and is jumper/switch programmable on the I/O card. This feature is only for operation as a time code channel (without making that channel wideband). Other switchable card-level features include an IEC/NAB equalization selection and an input impedance of 600/1KΩ.

The globally selectable options include balanced/unbalanced output; +4 or +lO output level; 320/250nW/m operating level; and running speed for spot erase.

Also included is a serial interface port for linking the machine to an external computer, a sync board for accommodating house sync (either through video or 60Hz tone) and an input/output transformer kit.

Taken together, the above machines are representative of the new breed. Only time will tell whether or not they are part of the last generation of analog tape recorders. But given the cost of high quality digital recorders, the new analog machines have their appeal, adding refine. ment to proven technology.

RE/P