

BROADCAST[®] ENGINEERING



**MTI Evaluates
the Top-of-the-line
Ampex VTR.**

Field report:

Ampex VPR-3

By Joseph Mahedy, chief engineer, Modern Telecommunications, New York

My first exposure to 1-inch helical VTRs came at a small UHF station about 12 years ago. Having worked on quad machines, I was very pessimistic, as were other engineers, of this mechanical toy they called a broadcast VTR. Many hours were spent in front of the VR-7900, tweaking its servos and TBC, hoping they would stay locked as it played back on the air. If someone had told me that one day I would see 1-inch as a broadcast standard, with full-color pictures from -1x play to +3x play speed, I would have laughed. In the 12 years since then, however, many advancements have been made in 1-inch technology and time base correctors.

Type-A format had many drawbacks, including non-compatibility with other manufacturers of 1-inch VTRs. Type B, which gives superior recordings, never caught on in the

United States, probably because of its segmented helical format. Finally, SMPTE Type C was adopted, and all manufacturers designed their VTRs according to that standard, creating compatibility. In the last four years, we have seen several generations of Type C, leading up to the VPR-3.

Looking deceptively like a videotape machine, the VPR-3 is actually a computer, disguised as a tape machine. The machine does not replace the VPR-2B, or the VPR-80; it does much more.

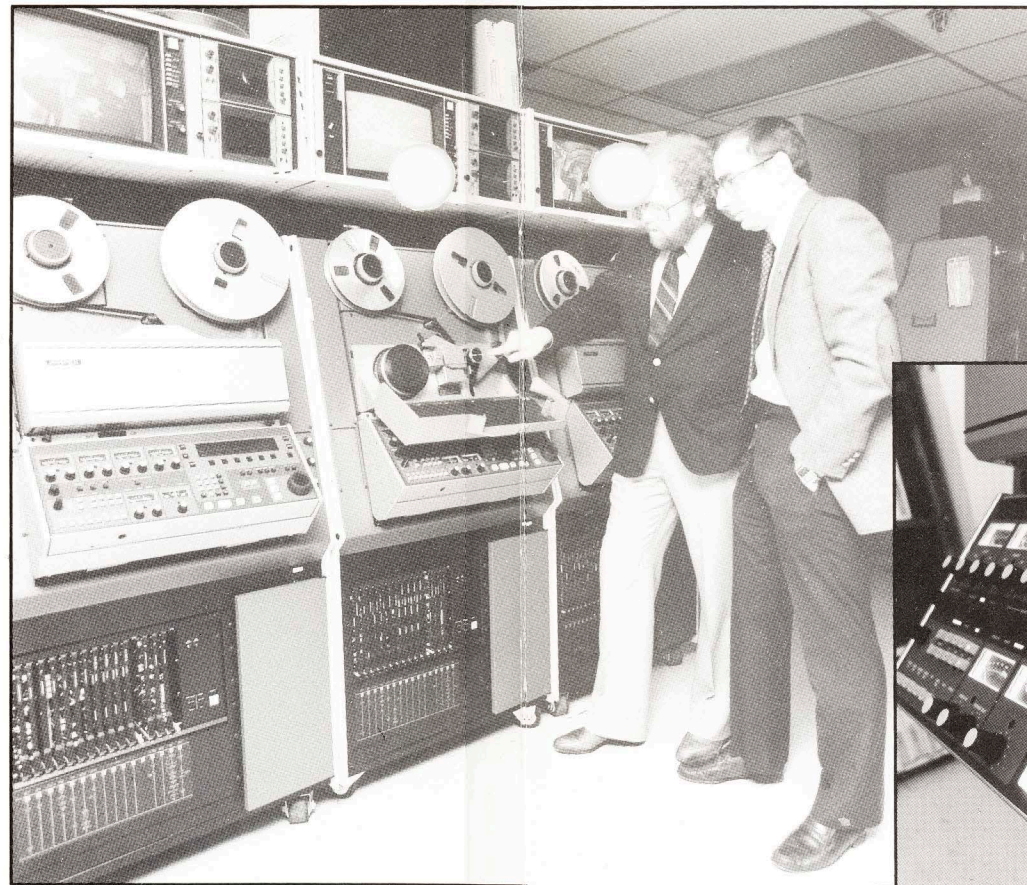
Unique features

The single most impressive feature of the VPR-3 is superior tape handling. We all know of problems in using spot reels on most 1-inch transports and the inability of most VTRs to handle 2- and 3-hour reels or not doing frame-by-frame editing for fear

of tape stretch or shredding. These problems are eliminated with the VPR-3.

Search-to-cue offers the operator the ability to store 100 cue points on a tape. This is especially useful in live sports, where you need multiple cue points. At MTI we have used this feature in lieu of a still store device, which stores 100 different still frames. Although it is not random access, the search-to-cue is fast, accurate and useful for a number of different needs.

The VTR features an SC/Hi meter that even inexperienced operators can



Author Mahedy demonstrates the VPR-3 tape-handling system to Phil Mancino, vice president of engineering, MTI.



A close-up view (right) of the menu display, soft keys and primary transport controls.

Along with this console configuration (right), the VPR-3 is available in a table-top format.

VIDEO AND SYNC	NTSC/PAL-M 525/60	PAL/SECAM 625/50
Bandwidth	Flat to 4.2 MHz \pm 0.5 dB -3 dB at 5.0 MHz	Flat to 5.0 MHz \pm 0.5 dB -3 dB at 6.0 MHz
S/N (Rhode & Schwarz unweighted with bandpass filter) using TBC-3	-46 dB peak-to-peak video to RMS noise on interchange basis	-43 dB peak-to-peak video to RMS noise on interchange basis
LF Linearity	2% blanking to white (maximum)	2% blanking to white (maximum)
Differential Gain	4% blanking to white (maximum)	4% blanking to white (maximum)
Differential Phase (40 IEEE units of subcarrier through TBC-3)	4° at 3.58 MHz off-tape (max)	4° at 4.43 MHz off-tape (max)
Chrominance/Luminance Delay	20 n sec (maximum)	25 n sec (maximum)
2T sin ² Pulse & Bar	1% K-factor maximum	1% K-factor maximum
Moire	-40 dB color bars 75% amplitude 3.58 MHz subcarrier	-36 dB color bars 75% amplitude 4.43 MHz subcarrier
GENERAL		
Record Time	190 minutes nominal; 9200 feet of tape on 14" reel	
Shuttle Time	less than 72 seconds for 60 minute tape, 3.6 minutes for a 3 hour tape	
Tape-Timer Accuracy (Control track updated)	\pm 0.1 Field with continuous control track	
Tape Speed	244 \pm 0.5 mm/sec 9.606 \pm 0.02 in/sec	239.8 \pm 0.5 mm/sec 9.44 \pm 0.02 in/sec
Video Writing Speed	1009 in/sec nominal	842 in/sec nominal
FM Carrier Frequencies	7.9 MHz blanking 10.0 MHz peak white	7.68 MHz blanking 8.9 MHz peak white
Audio Equalization	15 microseconds 3180 microseconds	15 microseconds
Lock-up time from Ready Mode	20 milliseconds	Lock-up time from Scanner Off 3 seconds

Selected manufacturer's specifications.

use. By centering the needle on the SC/Hi meter, virtually all H-shifts will be eliminated.

The audio system is designed specifically with the operator in mind. I/O ports for output processing make interfacing a noise-reduction or time-compression/expansion system as easy as plugging the external equipment into the ports. Also, full-stereo monitoring, an audio confidence head in record and the capability of mixing channels 1 and 2 at the output are included.

One engineering feature, *auto setup*, will automatically optimize three different tape stocks and store the data in memory. There is an auto tach phase and the capability to put artificial sync pulses on a non-sync recording. The operator may change almost any parameter via a menu. Diagnostics are planted to troubleshoot problems down to a component level.

Technical evaluation

Often when a newly purchased machine arrives, it is not working up

to specifications, or not working at all. Having recently received our fourth VPR-3, I can honestly say that all four worked out of the box. No repairs were made, nor any adjustments performed before the VTRs went on-line within hours after they had arrived.

On inspecting the machines, I found I could gain access quickly to virtually any area. I found high-quality parts throughout the machine on well-laid out printed circuit boards. Having several of the first production machines after ABC, I found the documentation, although preliminary, to be 95% complete, with only some parts lists incomplete.

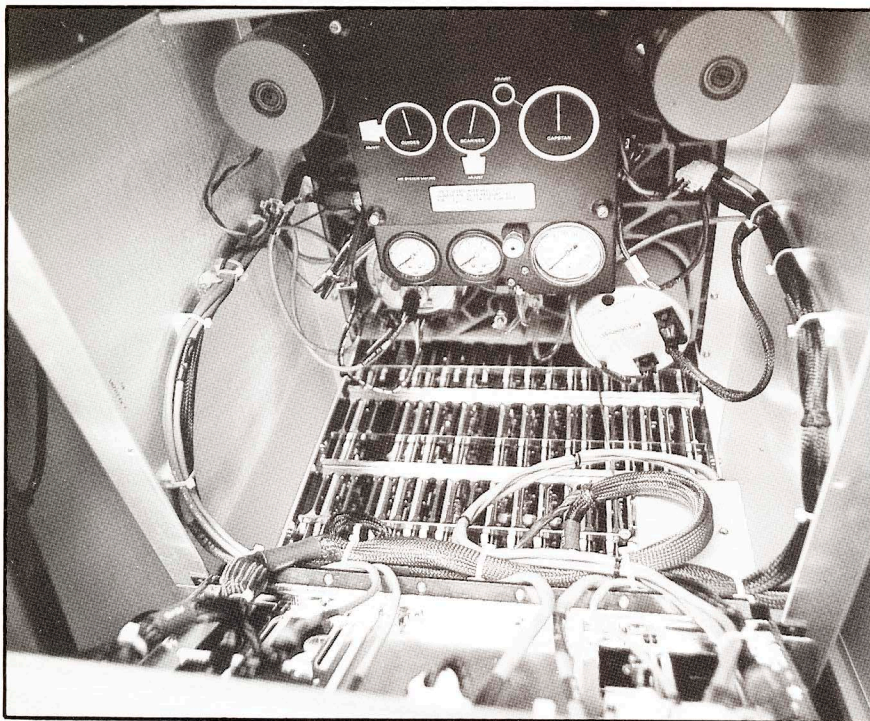
Elimination of most of the mechanical assemblies makes the transport less prone to failure and should drastically reduce preventative maintenance costs.

The video input stages have clamping, a selectable low-pass filter (for users with RF problems) and an input cable equalizer to peak up input signals that suffer from high-frequency roll-off. This is handy for

any facility. Also included is a calibration pulse to aid proper adjustment of input and demod levels.

The most significant evaluation performed was trying to fool the tape handling system into destroying a tape. The battle was lost. Any reel size can be loaded and the transport will handle it without fear of tape stretch or run-off. Several air guides on the transport eliminate friction, which causes the tape to stretch. A vacuum capstan replaces pinch rollers to give accurate control of the tape in any mode of operation. The continuous use of the capstan permits a coupling servo to monitor both tension-arm positions and adjust the capstan acceleration in conjunction with the reel servos.

The heart of the VPR-3 is the control system. There are two Z-80 microprocessors; one for system control, the second for I/O functions. A third Z-80 is used on an optional time code reader/generator card. We have experienced no problems with the micros.



Access to circuitry and components is possible from the back of the machine.

TBC. I think Ampex should have offered somewhat better than an 8-bit, 3x subcarrier unit. The TBC-3 seems to be an updated TBC-28 with some extra features.

The signal system, as a whole, is very similar to earlier VPR designs, so your engineers should feel right at home, although there will be data buses almost anywhere you look.

The software is the brains of the machine. Ampex has recently released version 2.0 software to eliminate some minor bugs in version 1.1. Also changed was a software command for audio muting. In the earlier software, in all modes except normal play speed, audio would be muted, making it impossible to use a time compression/expansion system. This has been corrected in version 2.0, which seems to be trouble free.

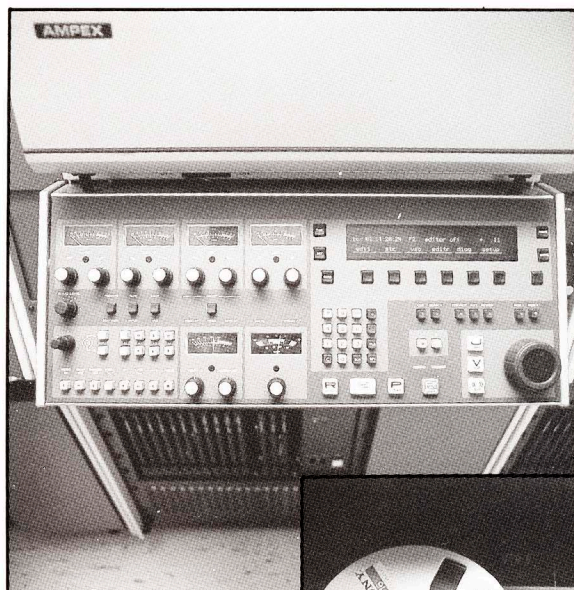
Operational evaluation

Most of the operator's interface is done through a menu and six soft keys. The soft keys are used to create dialogue with the computer in the VPR-3 in order to do a number of varied operations. From the menu,

The auto set-up is remarkable and saves much engineering time by allowing the operator to set up bias levels easily. By selecting auto set-up mode on the menu, the VTR automatically goes into a sequence to optimize record currents, bias currents, equalization and predistortion for all three audio channels. It then adjusts video record bias for peak RF. You can see what is happening during the optimization mode by looking at a bar graph on the menu display. I had my audio engineer check all the levels that the computer had set. He found that all parameters were correct and accurate. Memory in the computer allows storing and recalling any one of three different tape stock parameters, so the optimization procedure does not have to occur. Of course, at any time you can manually optimize the machine as well.

The auto-scan tracking (AST) system on the VPR-3 is practically the same as the one on the VPR-28 at first glance, but some improvements have been made. A high-frequency tach on the vacuum capstan sends a reference to the AST servo to give faster lock up than on the older machine. Additionally, electronics in the TBC will give locked pictures in shuttle mode (50x play speed). The AST system and TBC work very well from -1x to +3x play speed.

I am disappointed in what Ampex decided to use as the TBC. The TBC works very well, but with the most sophisticated 1-inch VTR in existence today, they did little in the way of the



(Above) The operator's control panel of the VPR-3.



(Right) A close-up of the vacuum capstan area.

you can select sub-menus, depending on your choice of edit, varispeed, search-to-cue, diagnostics or set up. It is very difficult at first to remember where all the software switches are, but the more it's used, the simpler it becomes. The menu gives the operator all pertinent information needed to do a specific task, whether it is search-to-cue, tape time or time code, varispeed percentages of real time speed, selection of color frame, and so on. To be competent on the machine, you must know and understand the menu.

The operator's panel is well-laid out and can be conveniently positioned at an angle or practically flat. On it, the audio system controls are planned for the operator. Separate record and playback audio levels include a unit/variable switch. Audio has full stereo capabilities and any combination of monitoring methods can be accomplished.

There are separate video input and demod level controls on the front panel, along with a *calibration pulse enable* to set the levels. Also located on the panel is an SC/H meter, which aids in setting VTR for proper SC/H phase.

A numeric key pad is used to enter edit numbers into the menu and may also be used for time code calculations. Below the menu display are standard edit and preview switches, and below that are normal machine controls.

The VPR-3 has two serial remote ports to communicate to external controllers. In MTI's configuration, port 1 interfaces to an ISC editing system, while port 2 is used to control another VPR-3, in an *editec* mode. It is useful to have the control panel of the record machine controlling the playback machine as well.

Having worked with all types of C-format machines, I find the VPR-3 is the easiest to thread. The first few times it was difficult, because there is no threading diagram on the machine. The take-up reel can be either A-wind or B-wind, depending on the polarity of a jumper, located near the lower right of the take-up reel.

On the TBC, the video, black and chroma phase adjustments use control knobs, but the H phase and sub-carrier phase are still screwdriver adjustments. Control knobs for the two functions would save a good deal of time.

A problem I have with the VPR-3 is not being able to see E/E easily. For E/E mode through the machine, you must shut down the scanner. I find this to be a hindrance, and it is a condition I hope they correct in the future.

Edit interfacing and RS-422 serial remote

Although ABC had several ISC editing systems married to the VPR-3s for the '84 winter Olympics, MTI was the first teleproduction house with a VPR-3 editing system. Chuck Heuer, director of engineering at MTI, did the actual interfacing.

"At a physical level, interfacing is simple (RS-422)," Heuer said. "At a language level, there were a few hitches. Ampex's continuing evolution of software, a later revision than ABC's, had become slightly incompatible with the ISC editing software. ISC quickly modified its program to run with the new revision of VPR-3 software so there would be good communication."

Another hitch Heuer found was a definite time delay between when the command was given by the external controller to when it was actually completed. For example, using an external editor, the machine cannot make an edit of less than four frames. This is because of the time it takes for the command to pass through the two Z-80s to actually complete the command. Heuer explained, "The editor in the VPR-3, in fact, can do single field editing, but this cannot be done by the ISC editor at this time. While it is possible to avoid this 4-frame problem by sending the machine an out time as

a deferred event, this is a trade-off introducing other operational problems to the editorial operation." According to Heuer, the parallel port on the VPR-3 is limited and provides only the basic machine controls. Otherwise, the RS-422 ports on the machine do work well communicating serially.

It should be noted that LEDs on the control board indicate whether serial data is present.

Pros and cons

A list of various features shows how the engineering and operational staff at MTI votes for the VPR-3.

Engineering Pros

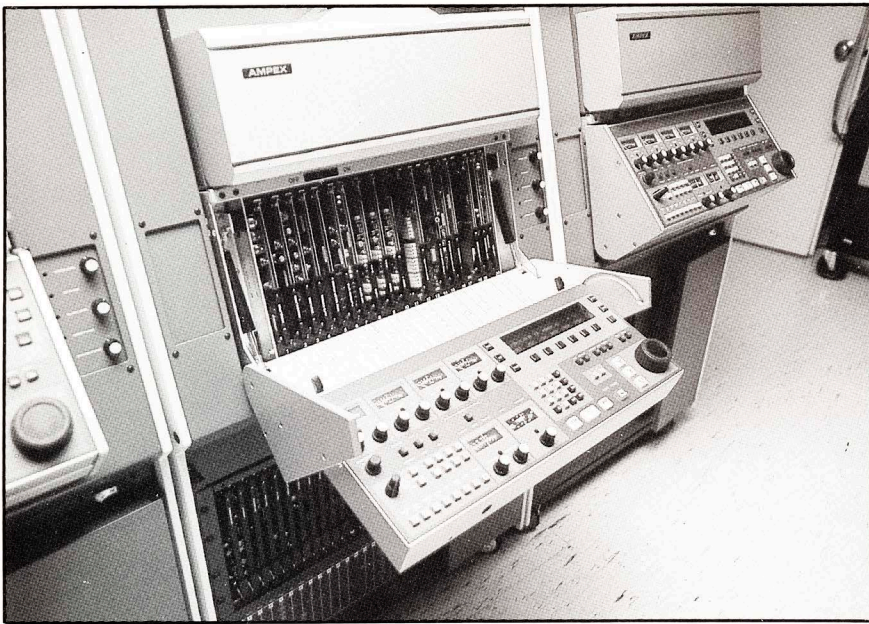
- Very few mechanical parts, reducing replacement part costs and preventive maintenance costs.
- Diagnostics make troubleshooting easier and faster.
- Software can be easily upgraded.

Operational Pros

- Tape handling is best.
- Ability to control the variables in the machine, via the menu.
- Very fast search-to-cue.
- Improved monitoring.
- Excellent audio system.
- Under external computer control with the ISC system, the ability to use job and slo-mo eliminate the need for VITC.



From the ISC editing controller, MTI's Bob Lefcovich handles four VPR-3 machines.



The control panel folds down for easy access to circuitry.

Engineering Cons

- Engineers will need digital background to troubleshoot some of the circuitry.
- Limited parallel interface.
- TBC shortcomings.

Operational Cons

- Very difficult to learn at first.

- Several functions not easy to access.
- Shuttle speed is inhumanly fast.
- E/E is not easily accomplished.
- Machine should have separate unity/variable switches instead of one master.
- When the VPR is in shuttle, operators wearing a tie or scarf

have the real danger that it can get caught in the reel.

Conclusion

I have just touched the surface of the VPR-3. There are many subtle improvements in the design of the machine that you will have to see for yourself. The Ampex VPR-3 passes its published specifications with flying colors. We at MTI feel the VPR-3 outperforms any 1-inch videotape recorder on the market today. The designers should be very proud of the product for its unique engineering and operational designs.

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In essence, these field reports are prepared by the industry *for* the industry. Manufacturer's support is limited to providing loan equipment and to aiding the author, if support is requested in some area.

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For more information on the Ampex VPR-3, contact Ampex Corporation, 401 Broadway, Redwood City, CA 94063.

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