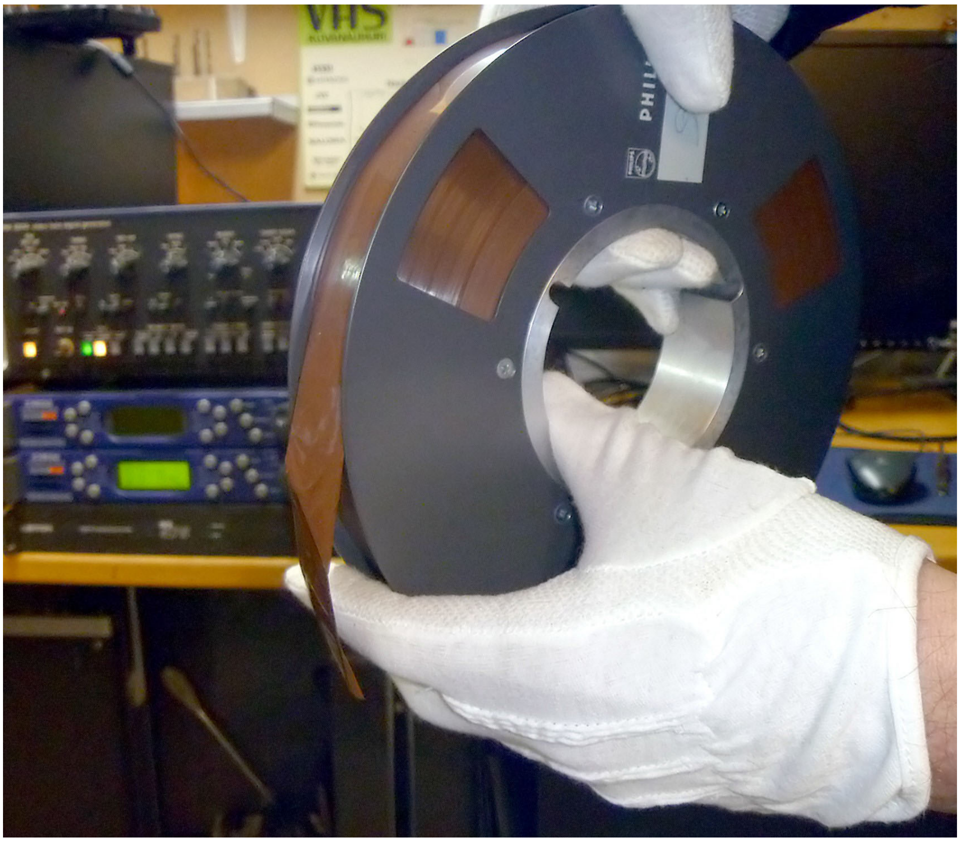

# Veteran video recorder revived and restored for digital transfer of video footage recorded 50 years ago

In October 2014, the ***Finnish National Opera*** commissioned DigiOmmel & Co. to investigate a batch of large video tape reels that had been stored in their archives for decades.

It turned out the ***FNO*** had used one of the earliest video tape recorders to document ballet rehearsals of their productions from mid-1960s to early 1970s. It is quite possible that these antiquated recordings haven't been seen by anyone for some 50 years.

After some intensive detective work, we identified the actual 1-inch tape video recorder employed by the ***FNO*** (out of several possibilities). Fortunately, we also managed to locate, almost certainly, the only surviving VTR unit of its kind in Finland. We were granted a loan of this VTR, as a kind courtesy of ***Vapriikki Museum Centre,*** Tampere.




***This video tape reel is taken out of the archives for the first time in about 50 years.***

Unlike all types of still and motion films, video tape recordings cannot be viewed or transferred by optical means, as the audio-visual information is stored in small changes of the magnetic field density on the tape invisible to the naked eye. Moreover, playing back video tapes require a high-precision transport mechanism capable of reading out closely-spaced, hair-thin strips of video signal tracks, laid diagonally across the tape.

The tapes in question, turned out to have been recorded on an open-reel VTR, made by the Philips Company, in 1964. Indeed, this is the very first domestic-purpose video tape recorder to emerge on the European market. What makes the model EL 3400 a home video is that it has a built-in television receiver and channel selector which enables the user to record an off-air television programme with sound while viewing another one.

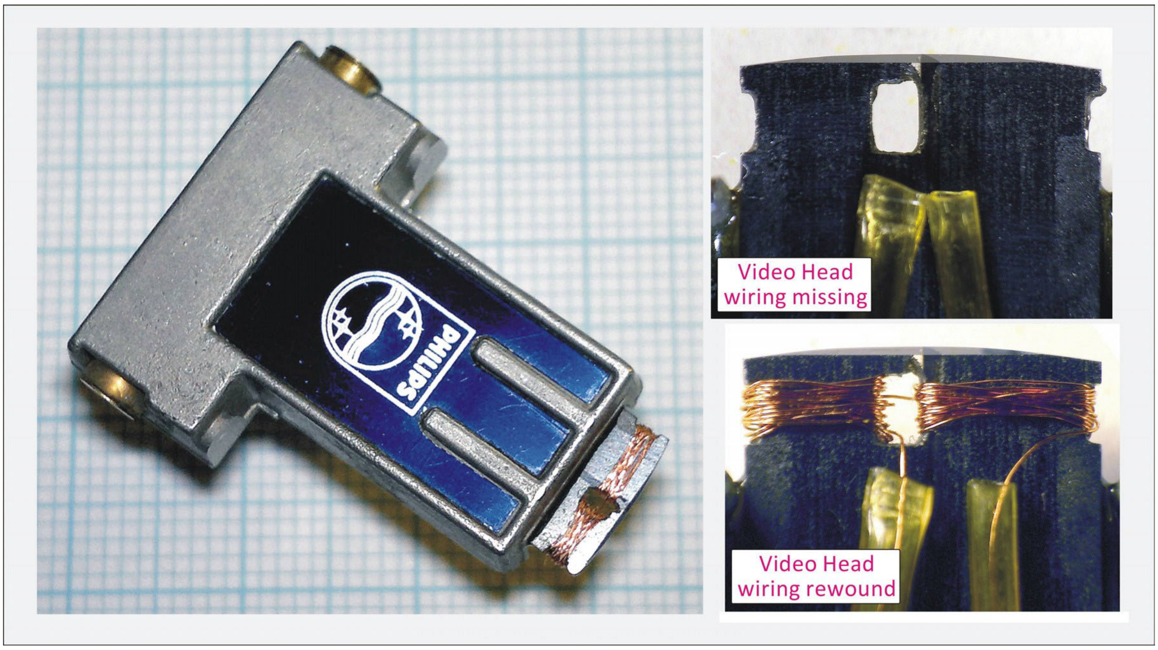
**Reviving the machine**

The EL 3400 weighs 45 kg and is bulky by any standards. It is built on a solid diecast chassis supporting powerful reel motors and a twin servo motor that turns a 15-centimeter scanner plate carrying a single video head. The scanner plate is sandwiched between two stationary cylinders and made to rotate at 3000 rpm in order to provide 50 video signal 'fields', or 25 frames per second.

In order to extract any kind of stable video image from a video tape, the head scanner mechanism has to follow video tracks with considerable precision. The linear tape speed is 19.05 cm per second. The tape is threaded to an omega-shaped wrap of 355-degrees around the video head cylinder/scanner combination.

As the head scanner rotates at 50 rpm, the tape signal readout requires a mechanism that can accurately trace the narrow (0.15 mm) signal tracks at an impressive 24 meters per second (85 km/h).

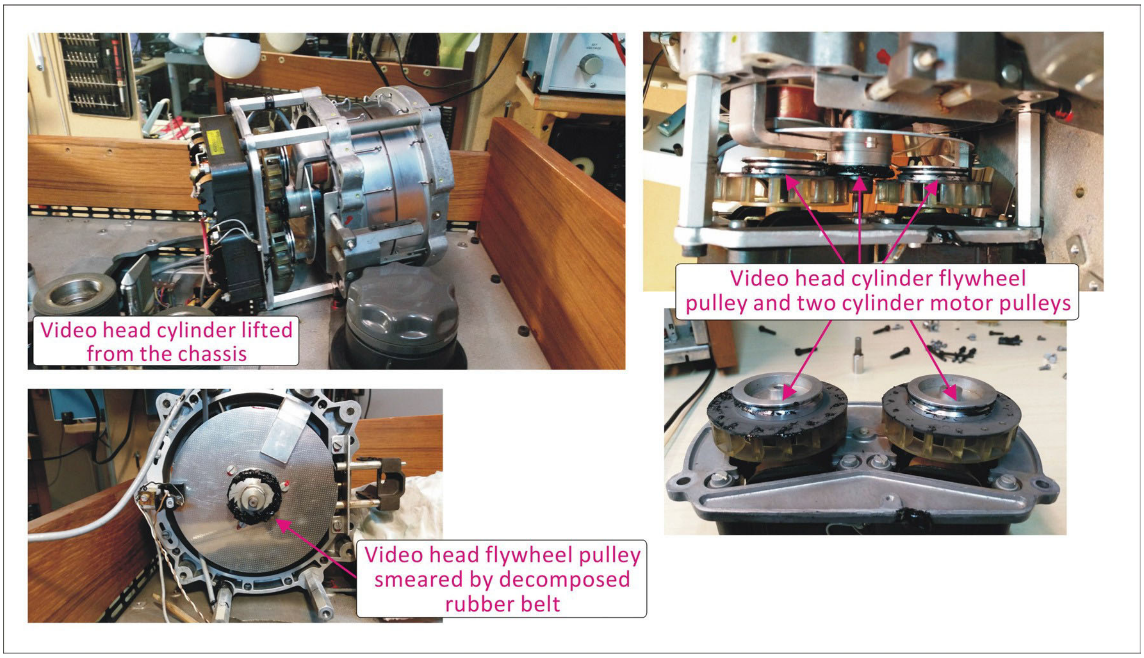
The EL 3400 employs vacuum-tube amplifier and servo motor circuits. The audio and control signal recording and playback circuits are built with the early Germanium-alloy transistor technology, however.




*The EL 3400 video head coil was rewound.*

This veteran VTR needed a complete overhaul before it could be worked at all. It appeared to have lain in state of dereliction possibly for decades. The replaceable (!) video head unit had its coil inexplicably stripped off altogether, making it necessary to be rewound in order make any use of the machine.

The cylinder flywheel carrying the video head appeared to have no means of rotation; its transmission belt had turned into a sticky black paste spattered all over inside the machine.




*Mechanical restoration of the EL 3400.*

**Reviving the tapes**
Once we had restored the machine to a fully functional state, it was time for some test runs. The **FNO** had used two types of tape formulations. The earlier one (light brown) had a significantly reduced tape signal, but posed no other difficulties in the playback.

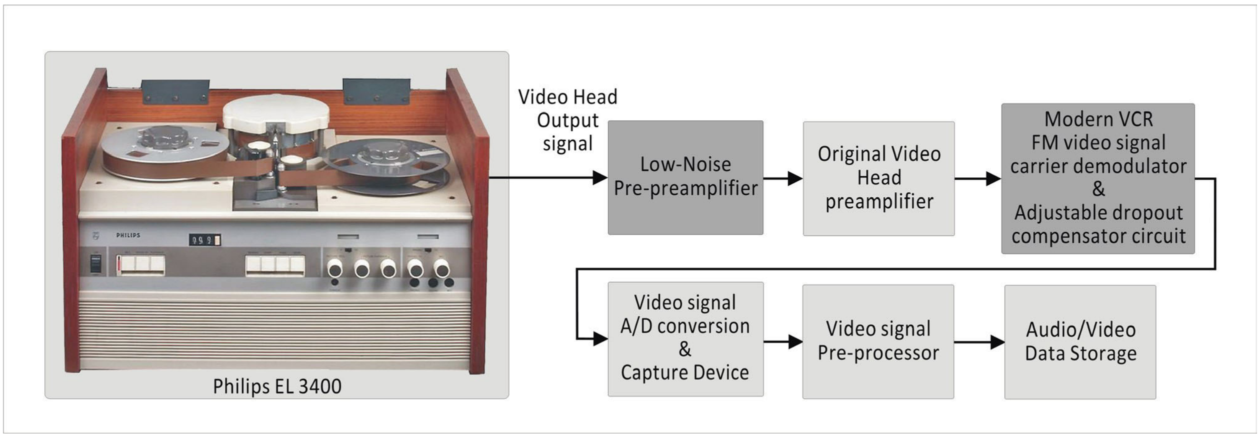
The tapes with darker formulation, however, suffered from so-called sticky-shed syndrome. The sss tapes could only be played for half a minute before the video head tip was clogged by tape debris. The head clog causes a severe loss of the tape signal, and total disappearance of the video image.

The sss is thought to occur due to polymer breakdown of the plastic film layer that insulates the binder layer, consisting of the actual signal-carrying ferromagnetic particles. Polymer ruptures expose the binder layer instigating a gradually developing hydrolysis. In other words, the binder layer starts to absorb water molecules from the air.

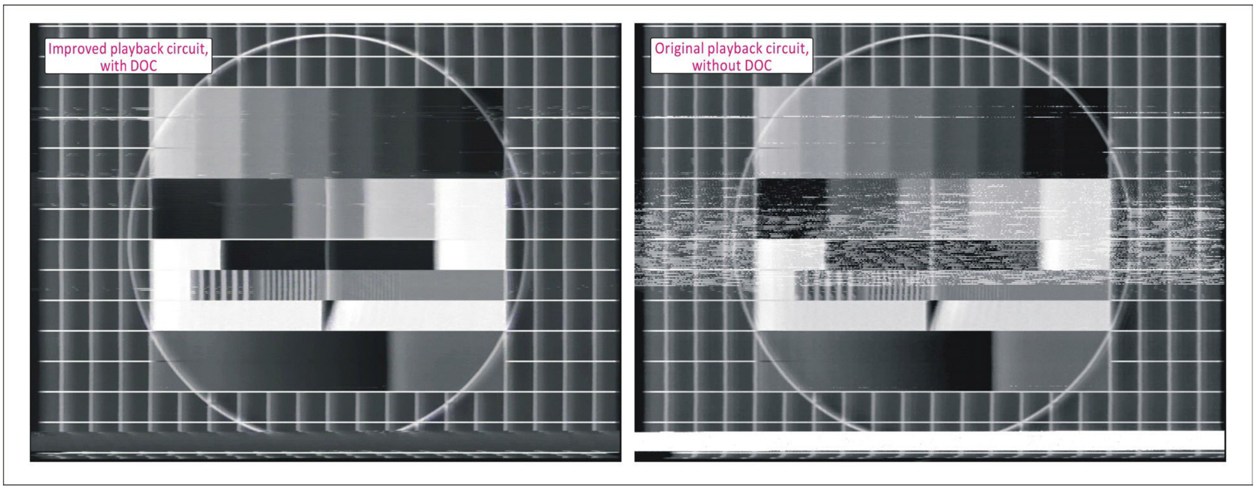
At playback, the increased humidity within the binder triggers a sudden rise of friction between the tape and fast-moving video head tip. The friction heats the tape surface resulting in local binder surface erosion (melt-down) and consequent transfer of the binder matter onto the video head tip. When this happens, head clogs suddenly reducing the tape signal below all usability.

Before these sss video tapes were rendered playable and transferable, we had to perform extensive dehumidification, or drying runs for several days.

**Circuit Modifications**
The reduced tape RF signal, made it necessary to install a video head pre-preamplifier to normalise the playback video signal. Also, we expected an occurrence of high number of short but visually disturbing dropouts, or momentary tape signal losses manifesting as bright white streaks in the playback video image.




***Modified video tape signal playback/transfer setup.***




*Captured frame from video output signal with (left) and without (right) added dropout compensation circuit.*

The dropout problem was addressed by routing the 'raw' RF tape signal from the EL 3400 to a modern VCR electronics, with an improved FM video demodulator and adjustable dropout compensator. These modifications stabilised the tape signal significantly and provided a more viewable and archiveable versions of these tapes, dating back to almost 50 years.

*Leo Backman/DigiOmmel & Co.*