



The Compact Cassette revolutionised portable audio and mainstreamed for nearly 40 years (Image credit: Thegreenj, CC BY-SA 3.0).

FEATURE - PART 3

# (R)evolution of Portable Audio: Tape goes 'compact'

*Billions of them were made, they'd fly to the moon, frustrate home computer users and launch the original mix-tape. Darren Yates looks back at the rough-and-tumble story of the audio-cassette.*

**Right:** The Sony Elcaset had potential but arrived five years too late (Image credit: Akakage1962 & Retired electrician, CC BY 3.0).

**Below:** The Commodore 'Datasette' stored programs from the PET, VIC-20 and 64 computers on cassette (Image credit: Public Domain).

Dutch engineer Lou Ottens isn't a household name – but he should be. Reel-to-reel tape recorders were fast becoming commodity items by the early-1960s and while the transistor had been responsible for new portable designs, the tape system itself still required the dexterity of a surgeon, as users navigated lacing the tape around pinch-rollers, guides and heads. Efforts to encase the tape reels into a simple snap-load cartridge system weren't new. However, it would eventually take two technology giants playing 'hardball' to get Ottens' new technology its place in history.



## Musical chairs

Work on an audio-cassette began back in the 1950s, with the huge Radio Corporation of America (RCA) releasing the 'Sound Tape Cartridge' in 1958. However, despite its clear convenience over reel-to-reel tape, the format disappeared six years later. Suggested reasons for its failure vary, but RCA's slowness to release pre-recorded music tapes and domestic players is often cited.

Meanwhile in Europe, German maker Grundig was the 'market goliath' in tape recorders and in 1961, reportedly partnered with Dutch giant Philips to create an audio-cassette. The problem for Grundig was Philips also had its Belgian team (including engineer Lou Ottens) working on an

alternate design. Ottens' 'Pocket Recorder' design eventually won out, leaving Grundig's joint-effort out in the cold. Despite Philips' offer to Grundig to join its 'Pocket Recorder' group, Grundig was having none of it and instead, released the rival music-focused 'DC-International' cassette with fellow-German maker Telefunken in 1965. However, it failed to catch on and by 1968, it was gone.

RCA and Grundig essentially missed the bus – RCA missed its first-to-market opportunity and Grundig was just too late. Philips, with Ottens' renamed 'Compact Cassette', won the market, but a high-stakes battle with Japanese heavyweight Sony would ultimately see Philips win a hollow victory.



## The 1963 Berlin IFA Exhibition

Some 28 years after AEG demonstrated its 'Magnetophon' reel-to-reel tape recorder at the Berlin Radio Show (see APC last month), Philips arrived with its 'Pocket Recorder' in August 1963. The reception was reportedly muted, though it's suggested Japanese manufacturers at the show were impressed. As RCA was finding out (and tech brands still learn years later), creating a global media format on your own is a hard slog. Still, Philips no doubt had hopes for its cassette format becoming a stream of ever-flowing royalties from other hardware makers – but it knew if it was to win the market, it needed the fast-growing Japanese makers on-board, starting with Sony.

This time, however, Grundig got to Sony first. The Sony team weighed up the Pocket Recorder and DC-International proposals, but chose the smaller Philips unit. Philips may now have anticipated an 'easy win' and came at Sony with a 25-yen (seven US cents in 1965) per-unit-sold royalty contract. Sony's response was effectively 'yeah, nah', expecting Philips to go away and 'sharpen the pencil'. Philips obliged soon afterwards, but dropped the royalty a whopping 75 percent to just 6-yen per unit.

Sony must have sensed the tide was turning in its favour, for it now demanded Philips either drop its royalties completely, or Sony would choose Grundig. For Philips, this must have come as a shock – either it now caved in to Sony and forgot the royalties, or, it stuck to its guns and fought a united Sony-Grundig front for the cassette market. In the end, Philips dropped the royalties, but ensured Sony didn't get exclusive rights.

As for Grundig, it lost out in the middle of the Sony-Philips battle – by 1966, Japanese manufacturers were churning out cassettes and recorders by the bushel and the following year, the recently-renamed 'Compact Cassette' had won. However, the Sony fight had cost Philips all hope of royalties.

When the dust settled, the real winner to emerge was Sony.

## Fly me to the moon

Meanwhile, Sony continued with its healthy business of making and selling tape recorders and cassettes. One of those recorders was a 1968 design that could be operated in one hand. NASA saw it



**Above:** The Nakamichi Dragon, arguably the ultimate cassette deck, will cost you beyond \$5,000 today (Image credit: Bbadgett, CC BY-SA 4.0).

and thought it could be a great way for Apollo astronauts to record mission log notes. The result was the Sony TC-50, the first 'notetaker' cassette recorder, hitching a ride on every mission, beginning with Apollo 7 and orbiting the moon on Apollo 10. In a twist, it's likely the Apollo missions also invented the mix-tape, with each astronaut carrying tapes with their favourite music.

## How the Compact Cassette improved

Despite all this, however, the original 1960s' Compact Cassette wasn't well-suited to music – it was originally meant for voice-recording. In simple terms, early Compact Cassette recorders were better than analog AM radio, but not as good as an analog FM receiver.

Even by 1960, it was understood that high-fidelity audio needed tape that was as wide as possible, running as fast as commercially viable. Music tapes in the 1960s (including the popular American

'8-track' system) delivered two-channel 'stereo' sound on 6.35mm (¼-inch)-wide tape with a play speed of 9.5cm/second (3.75-inch). The Compact Cassette tape, however, was just 3.175mm (1/8-inch) wide, had a play speed of 4.75cm/second (1.875-inch) and single-channel only. With half the width, tape hiss (affecting 'signal to noise ratio' or SNR) was much more noticeable and at half the speed, the frequency response was considerably lower. But with these specs baked into the Compact Cassette standard, what could be done?

It became a technological battle on multiple fronts. The first cassettes used Ferric-Oxide particles on PVC plastic tape, but in 1968, the U.S. chemical giant DuPont commercialised Chromium-Dioxide (CrO<sub>2</sub>) and the big German tape maker BASF created the first 'chrome' cassettes in 1970. These moderately improved SNR and frequency response.



**Below:** Grundig's DC-International cassette was a brief competitor during the mid-1960s (Image credit: Ulrich Miemietz, CC BY-SA 3.0).

**Below:** Compact cassettes featured in 1970s' home computers, including the Commodore PET (Image credit: Parrot of Doom, CC BY-SA 4.0).





**Above:** The shoebox-style Philips EL3300 was the very first Compact Cassette recorder (Image credit: Erkaha, CC BY-SA 4.0).

**Noise Reduction – Dolby and dbx**

The second step was electronic. Today, Dolby Atmos is a multi-channel audio processing system developed by Dolby Laboratories, found in everything from cinemas to phones. But back in 1965, Dolby Labs was just Ray Dolby, an electrical engineering graduate from Stanford and Cambridge universities, who created a technology that would soon tackle the background-hiss problem.

Dolby figured out that our perception of background noise occurs in the higher frequencies, rather than the lower ones. So, he split the higher-frequency sounds into a separate stream or ‘band’ and electronically-increased the audio level of those frequencies during recording onto tape.

During playback, he just did the reverse – he reduced those frequencies by the same amount, effectively returning the audio to its original levels. However, the difference was that on playback, the background hiss was also reduced by that same amount (this hiss wasn’t increased or ‘amplified’ during recording because it is a function of the tape, not the audio signal). The result was a reduction in background noise by as much as 10dB (a bit over 3x) – and Dolby ‘B’ Noise Reduction was born.

But Dolby wasn’t the only option. A more complex system known as ‘dbx’ was invented in 1971 by engineer David Blackmer. Whereas Dolby split the audio spectrum into different bands, dbx applied the ‘companding’ (compression-expanding) process to the whole audio spectrum. At its peak, dbx-encoded cassettes could achieve a near-Compact Disc SNR approaching 90dB. However, Dolby-B-recorded tapes were still listen-able without a proper decoder, whereas dbx tapes weren’t – this helped Dolby-B become the more-popular commercial choice amongst record labels.

**Below:** The Swiss-made Revox B215 rivalled the Nakamichi Dragon for audio quality (Image credit: Public Domain).



**Above:** The 1958 RCA Sound Tape Cartridge was the first serious attempt at an audio-cassette (Image credit: Public Domain).

**The cassette ‘deck’**

Nevertheless, this was all still just technology in 1971. Late-1960s’ cassette recorders were predominantly ‘shoebox’ style units, like the original single-channel Philips EL-3300. The Advent 201 became the first stereo cassette ‘deck’ to offer Dolby noise reduction and CrO2 tape support, glimpsing the Compact Cassette’s future potential for high-fidelity audio.

In 1973, Japanese brand TEAC launched the A450 as the first reel-to-reel rival. It came with Dolby and CrO2 support, improved frequency response and lower ‘wow and flutter’ than the Advent. Because cassettes had a mechanical-drive system, any variation in tape speed could be heard as either long drawn-out ‘wow’ or fast, short ‘flutter’ changes in the audio pitch. While the Advent 201 achieved a decent ‘W&F’ figure of 0.15 percent, the tank-like A450 dropped this to just 0.07 percent, unheard of in cassettes in 1973.

However, that year, a well-respected but lesser-known Japanese audio company effectively said to TEAC ‘hold my beer’. That company was Nakamichi. Born in 1948, Nakamichi was making cassette decks for brands including Harman-Kardon by 1970, but in 1973, it began selling new decks under its own name. The first two models – the 700 and 1000 –

combined Dolby and CrO2 support with a raft of new features, but added a new dimension. Nakamichi developed a new playback head, the electromechanical device that read the audio signal from the tape. Its key feature was a head gap (over which tape passes) much smaller than previously possible at just 0.7-micron (0.0007mm). This smaller gap delivered a much-improved frequency response and for the first time, the Compact Cassette could capture the audio spectrum right up to 20kHz. Move over, reel-to-reel.

**One last hurrah: the Sony Elcaset**

By 1967, the Compact Cassette had seen off RCA’s Sound Tape Cartridge and the Grundig-Telefunken DC-International cassette. So, it still seems odd Sony would have a dash at the cassette market itself nine years later.

The Sony ‘Elcaset’ (L or Large-Cassette) was technically very good, albeit similar to the old RCA system, with twice the tape width and speed of the Compact Cassette. However, despite Sony’s quality engineering, the Elcaset market barely lasted three years.

So what made Sony do it? There’s no doubt by 1971, the Compact Cassette was struggling to improve audio quality. Dolby-B noise reduction improved the SNR aspect but couldn’t solve the wider magnetic and mechanical issues. Sony wanted a cassette system to rival reel-to-reel and built Elcaset for the job. Unfortunately, creating a new cassette system isn’t something you did quickly and its likely Sony hit the ‘go’ button near to Nakamichi launching the Model 1000. By the time the Elcaset arrived, Nakamichi had the Compact Cassette largely knocked into shape and Sony was left with a

proprietary design about five years too late.

Still, it wasn't all bad for Sony – the Elcaset might have expired by 1979, but the Japanese giant was about to embark on a new brand that would enter technology folklore.

### The Sony Walkman

While Nakamichi focussed heavily on Hi-Fi, Sony was already known for portability, producing a number of portable recorders during the 1970s. This culminated in the legendary TC-D5 in 1979. In fact, the TC-D5 was so good, it was manufactured in various models for nearly 25 years and used by radio and TV journalists around the world.

One of its first users was Sony founder Masaru Ibuka, who favoured it as a travelling companion. However, whilst it delivered near-studio quality in a portable, the TC-D5 was comparatively heavy and deputy president Norio Ohga was tasked to come up with a stereo headphone-playback-only version of Sony's recent TCM-100B 'Pressman' notetaker.

Combining new electronics with the Pressman's sturdy tape mechanism, the result was the iconic TPS-L2 hitting Japanese store shelves in July 1979, just four months after the concept was sketched. Sony hoped to sell 5,000 a month – it sold 30,000-plus in the first two and the 'Walkman' was born. They appeared in music



**Above:** The Sony TC-D5 is still mentioned in hushed tones by tape enthusiasts (Image credit: KnowledgeIsImportant, CC BY-SA 4.0).

videos, movies, rewrote pop culture and still do today – the TPS-L2 recently found a new generation of fans through Marvel's *Guardians of the Galaxy* movie franchise and now, the going rate for a working TPS-L2 is typically \$1,000, minimum.

### Home computer storage

By the mid-1970s, the cassette wasn't just for storing music, but also computer code. The 'home computer' revolution started by the Commodore PET and Tandy TRS-80 in 1977 took advantage of audio cassettes as cheap data storage devices. In fact, cassette tape served as the storage medium-of-choice for many home computers, including the ZX Spectrum, Amstrad CPC464, the Commodore VIC-20 and 64 into

the 1980s. In 1982, the Commodore 64 delivered its first floppy disk drive, saving home-coders who'd wait nervously for programs to slowly load from a tape.

### A revolution in sound

In a way, the Compact Cassette is just another chapter in the broader story of technology. It began as something of an oddity, but kicked along by engineers and companies over 20 years, it became a global phenomenon. That it thrived as a consumer technology for 30 years is testament to how forward-thinking the Compact Cassette was when it arrived in 1963. Three cheers, Lou Ottens!

But when you consider the size of cassette decks compared with the cassette itself, it's the Sony Walkman that took the cassette to its ultimate conclusion. The Walkman didn't make the cassette portable – it made using the cassette portable. It mightn't have rivalled a Nakamichi Dragon for audio quality, but when it came to sitting on a crowded bus for two hours, nothing beat pulling out your Walkman and entering your own little world.

### Another 'new' revolution beckons

Technology is never invented or created in isolation – in any technology genre, you almost always find a popular technology on the slide, one that's in its heyday and another coming to take its place. Even in the 1970s' heyday of the Compact Cassette, its successor was well on the way. Next time, we go back to the mid-1970s and re-trace the story of two technology antagonists joining forces to launch a new revolution that's still with us today. ■



**Above:** The Sony Walkman TPS-L2, as recommended by guardians throughout the galaxy (Image credit: Binarysequence, CC BY-SA 4.0).



**Above:** The 1970s' range of TEAC reel-to-reel recorders is still legendary today (Image credit: Rybkovich, CC BY-SA 4.0).