

Direct Drive



*Technics SL-1200 MkII
Timestep modified*

Dave Cawley of Timestep Electronics takes a close look at the Technics SL-1200 Direct Drive turntable.

Back in 1969 Matsushita released the National/Technics SP-10 MkI Direct Drive turntable, the world's first Direct Drive (ignoring some early Garrards etc). In those days for most people, a vinyl LP was the only source of stereo music. Everyone had a record player and a lot of them were auto-changers. The idler drive Garrard 401 was available to the wealthy but it rumbled, like so many idler drives.

The first SP-10 turntable (MkI) was basic and passed largely unnoticed in the UK. Then, three years later in 1972, Matsushita introduced the Technics SL-1200 MkI Direct Drive turntable. Featuring a

smaller motor than the SP-10, the SL-1200 was affordable and as an option came with a removable, one piece, cast SME tonearm mount.

In 1975 Technics followed this up by releasing a ground breaking update of the first SP-10, the invincible SP-10 MkII – the first to use a properly designed Quartz Lock system. This went on to dominate radio broadcast studios worldwide until the very end of vinyl broadcasting only a few years ago.

What made the SP-10 MkII special was cog free drive and a massive bearing. Toshikazu Yosumi senior engineer of the Matsushita Electric Industrial Co. Ltd, documented the Technics Quartz PLL drive in his white paper "Designing

of Quartz-Lock Turntable" This documents precisely why Technics turntables, above all others, have the pitch stability that other manufacturers strived for but failed to achieve.

In 1979 this Quartz PLL technology was applied to a lot of Technics turntables including the SL-1200 MkII – a new star was born. This turntable became popular with DJs in particular, being sturdy and easy to use. A mediocre arm, lightweight platter, on-board power supply and solid plinth lacking suspension kept it off hi-fi buyers lists though.

In 2006 Adam Smith of Hi-Fi World asked me if I could make an external PSU for the SL-1200,

something the American company KAB had been manufacturing for a few years. Since then the SL-1200 has risen in popularity with the hi-fi fraternity and has been reviewed in several incarnations.

Direct Drive looked more attractive when an SME arm replaced the original and more recently entirely new platters have been added to reduce coloration.

All the same, the main market was DJs and they had largely moved to CD. As a result, in 2010 Technics advised that due to low demand and a major tool breakage they would cease production of the SL-1200 for ever. Several companies, including Timestep, bought up Transit loads of new ones, so new SL-1200s in unopened boxes are still available.

MODELS AND MODS.

The SL-1200 is silver and the SL-1210 is black, but that is only in the UK. European units have 110/240V switchable power supplies but the USA is just 110V and Japan only 100V. This isn't a problem as an external PSU will fix this if you have bought a foreign unit.

The Direct Drive motor of the '1200 was almost identical to that of the SP-10 and was as near perfect and as cog free as it could be. Both listening tests and measurements show the SL-1200 to be superior on timing and pitch stability than almost any other turntable at any price.

Modifiers discovered how easy it was to change the power supply, the tonearm, the bearing and the platter, with new higher quality items. This improved sound quality greatly, lifting what was a budget DJ turntable into the realms of high fidelity.

About 200 used SL-1200s are for sale on eBay at any one time. From my experience buying them, they break down into three types.

There are the ones transported in a Transit for DJ use; these have led a hard life and are to be avoided.

Then there are ones that have been used in a bedroom and have plenty of life left.

Finally, there are the ones only used in a bedroom, but available in the original packing that had been kept safely in the attic by a fastidious owner. These are the best.

People will be buying and modifying SL-1200s for at least the next 50 years!

The MkII is by far the best model to buy as it comes with a lid and removable hinges; the MkV does not. Many people change the PSU and arm so any other variants and options are nullified by the modifications anyway. All versions can be modified to play at 78rpm by the installation of an extra PCB.

The rare ones are the gold plated special editions, and the rarest of them all is the MkIV that has 78rpm, a better arm and cables as standard. The Mark IV was only ever officially available in Japan and is 100V only – I have one in my collection!

CLONES

There are the SL-1200 clones of course. Audio Technica came out with the AT-PL120 that looked to all the world like an SL-1200. However, measurement showed its speed stability was poor. Worse still, I found inside a 1/4" thick plate of aluminium whose sole function was to make the unit heavier and feel more like a proper SL-1200.

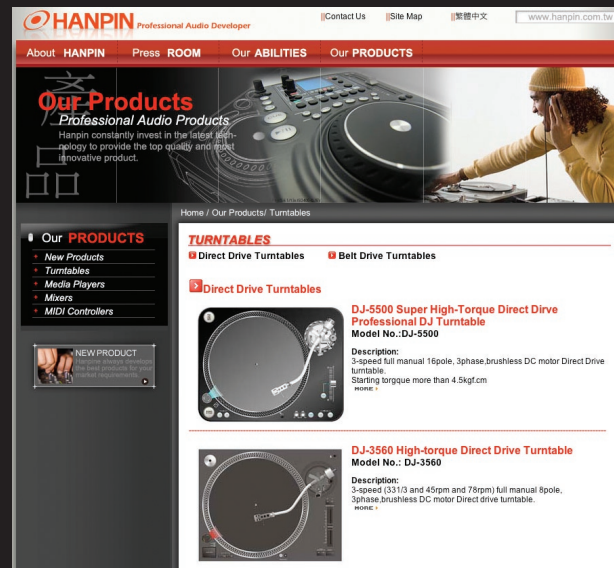
Then there are clones made by Hanpin in Taiwan that appear under a dozen or so different labels. Hanpin make the DJ-5500 that looks identical to models from Stanton, Reelap and



Audio Technica.

The motor is potentially superior but the real problem is that the bearing is poor and is an integral part of the PCB, so not easily replaceable; in fact not replaceable at all! Without putting the main chassis on a vertical mill it isn't possible to change the arm either. But why bother when the Technics SL-1200 is in such plentiful supply and is so easily modifiable?

Nearly 45 years after its introduction the Technics SL-1200 is now being elevated into a world beating state of the art turntable,



Direct Drives are made today by Hanpin of Taiwan, mostly for OEM supply to brand names.

but not by Technics who produced a wonderful design but never understood how to realise its full potential.

Part II of this article will examine control systems of Direct Drive turntables.

A Reelap Direct Drive. It is identical in design to Hanpin DJ-5500 and is likely made by Hanpin.



Quartz control

Last month Dave Cawley of Timestep Electronics looked at the workings of the famed Technics SL-1200 turntable in his history of Direct Drive decks. In Part Two here, he explains why Japanese quartz lock technology ushered in a new era for manufacturers and listeners.

Hundreds of Direct Drive turntables were produced by the Japanese during the 1970s and 80s. The market was so huge that although more complex than their belt drive counterparts, the Direct Drive motor was actually cheaper to mass produce.

JVC and others made a motor, bearing and PCB in one small unit that could simply be fitted into any plinth. It was complete, only requiring a base of some sort, a platter and a few switches/controls. They made so many they are still available new on eBay right now. Even the mighty linear tracking Revox B795 used a Direct Drive PCB motor.

Early Direct Drive – and that

includes almost every Technics without the MkII suffix – were relatively simple devices that often clogged and hunted with bad speed control. The technology was in its infancy and price was the main driving force.

Speed setting was often by a pair of pots on the plinth and these are now often noisy and worn. They might not have rumbled, but speed stability of these early Direct Drives wasn't anywhere near the post-1979 models. As an example, the mighty Technics SL-110 with its wonderful wooden plinth and white arm marking drawings was often fitted with a SME 3009 but it didn't have great speed stability.

All these early turntables had two speed pots – 33 and 45rpm – and strobe markings for both 50

and 60Hz. That's because there was no absolute speed stability and the rotating turntable platter had to be compared to the frequency of the AC mains supply,

In 1979 everything changed as Technics and many others adopted 'Quartz PLL' (Quartz Phase Locked Loop) as pioneered by Toshikazu Yosumi in his seminal white paper 'Designing of Quartz-Lock Turntable'. In practice he used a normal stability crystal, divided down to the same speed as the 190 or so sensor points around the platter. The two signals are then compared in a complex phase locked loop, in a two stage process. A 'speed loop' got the platter up and running quickly at almost the correct speed. It was followed by

an accurate phase comparator that maintains absolute phase lock and hence arguably the most accurate speed control possible.

Some critics say this speed control produces hunting and liken it to an almost stop-go digital speed control. Nothing could be further from the truth.

The three coils on the motor are driven with a sine wave of varying amplitude as determined by the phase comparator. The output of the phase comparator is an analogue signal and that is passed into a low pass loop filter before being applied to the motor drive electronics.

If a very tiny correction is needed, that is exactly what it gives. A tiny smooth change, no big step changes at all. It is possible to monitor the loop control voltage whilst playing a record in real time. The correction is very small but perfect.

In my opinion this tiny, accurate, smooth and necessary correction is less audible than the relentless hysteresis of a belt drive where the tension on the belt can be constantly changing. Put simply, a properly designed quartz lock turntable provides unrivalled pitch stability and less cogging and variance in the drive system than either DC or AC belt drive systems.

What about stylus drag? Yosumi said in his paper: "There is gossip about influence being given to sound quality by a jogging motion of the DD motor which is caused by fortissimos of the record".

Yosumi had set up a turntable with two identical tonearms, each arm playing a different part of the record. One tonearm's output was carefully monitored on low modulation parts of the record whilst the second tonearm with a much heavier vertical tracking force was playing a high modulation passage.

The result was not what is widely quoted on the internet. In fact he said: "There is no remarkable difference between quartz lock turntable and conventional speed turntable".

However, there was a small and measurable difference and he was, after all, comparing against another Technics. As he said, it was not remarkable, but it was present.

Maybe it would have been more definitive if he had compared the quartz lock against a belt drive. It would be good to repeat the experiment, however Yosumi had special records made for this and they are no longer available.

He concluded the advantages of quartz lock were:

- (1) Becomes stronger against external disturbing load torque, meaning stylus pressure.
- (2) Attains better rotational accuracy (+/- 20ppm).
- (3) Improves the rotational stability (temperature and time-lapse variation).
- (4) Braking performance by means of the bi-directional servo.

But does flutter and stylus drag really matter? Hisao Sakai in the AES publication, June 1970, entitled "Perceptibility of Wow and Flutter" concluded that: "The threshold of perceptibility was smallest for piano music at 0.14%". But subsequent letters suggested that the figure depended on the weighting used.

Bruel & Kjaer presented a paper to the AES in 1977 entitled "Audible Effects of Mechanical Resonance in Turntables" that concentrated on wow and flutter. They concluded: "In this paper we have pointed out that traditional specifications like rumble, wow and flutter and required tracking force are both unreliable and inadequate".

They went on to say: "Our investigations tell us that here is an area which at present has rather poor correlation between the measurement methods available and the impact on sound quality".

So where does this leave us? Well all the Technics quartz lock turntables share a feature that not all other manufacturers' similar turntables and none of the older Direct Drive have – that is not only a speed lock but also an absolute phase lock.

A simple if none too reliable test for this, is to run any Direct Drive turntable and look at the strobe, then slowly put your finger on the edge of the platter. You will find that on all Technics MkIIIs the strobe will stay locked but the strobe lines will retard just a little. It will still be locked though.

When you take the load off they will recover to their original position. This is a very tough test and turntables such as the Trio L-07D will fail. However the L-07D does not actually claim 100% phase lock in its sales literature.

All this becomes important when you consider the essential elements of music replay. Pitch stability is very important to many listeners. Sustained piano notes are a big point in question and for me the relentless rhythms generated with crystal controlled synthesisers are disturbed

by any wow or stylus drag.

In his conclusion Yosumi wrote: "The audible point was very close to the best turntables".

But below audibility is the sense or feeling that something is not quite right. If this 'sense' was only 10dB down then some listeners would be able to distinguish clearly between belt drive, Direct Drive and Direct Drive quartz-lock turntables.

GOLDEN DAYS

The golden days of quartz lock Technics turntables seem a long way away now, and the age of ordinary Direct Drives has faded into the sunset – probably where they belong.

In my experience only the Technics MkII series and upmarket JVC turntables are really pitch stable. The L-07D, Nakamichi TX1000 and many quite recent low-torque Direct Drive turntables have for me failed the synthesiser electro-pop music test. Many more feel the same about their inability to handle piano.

As we have seen, a Direct Drive needs quartz lock to get real pitch stability and even then many do not achieve it. So if your turntable is not quartz locked or doesn't achieve phase lock, then it's time to upgrade to a Technics MkII turntable of some sort.

Although I am personally obsessive about pitch stability and flutter, others are not and for them a high mass turntable with ultra low mechanical resonance and a massive platter might sound better. As they say, your mileage might vary.

In summary, my experience has taught me that you cannot measure everything. We are tantalisingly close but not yet close enough.

Maybe with a little knowledge, vanishingly low flutter measurements and the finger test we can live happily ever after.

Or we can just play safe with almost any Technics quartz-lock turntable.

JVC and others made a motor, bearing and PCB in one small unit that could simply be fitted into any plinth. All it needed to make a Direct Drive deck was a base, platter and a few controls.

