# Development of the Analogue Turntable SL-1200GAE

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## 1. Introduction

With the launch of the analogue turntable SL-1200GAE, which was the first time in six years, here I would like to express my thoughts on this occasion.

Many of you may know “SL-1200” - it may remind most people of the MK * analogue player for DJs. Indeed, the SL-1200 Series globally sold 3.5 million units from its launch of the first model in 1972 up until MK2 - MK6. It is also true that requests and comments by DJs were incorporated into the design from MK2 onwards, which in turn helped increase the sales with the popularity among DJs. However, allow me to add that, in our company this equipment was merely an analogue player and not one exclusive to DJs. It did not matter whether the equipment was for Hi-Fi or for DJs—the desire of listening to records with high-quality sound is the same.

With the revival of Technics in 2014, voices longing for an analogue player suddenly came to rise in the market, and many of us engineers were thinking “if it were possible….” Then one day directions were given by the top management to “work on a player,” and a few members including myself were called for the project. What kind of player with what level of performance should we make, and that in a short development period? After a multitude of discussions, we finally reached a conclusion: the SL-1200GAE.

What about the model number? Why SL-1200? Can’t it be simply a remade model of the former SL-1200? What would the inner design be? How about the outside design?

The discussions were endless, but SL-1200 was the model that kept Technics going until the end, and it made perfect sense to adopt SL-1200 for making the fresh start. However, a plain remake of SL-1200 would be too boring. This led us to decide to make the equipment achieve a performance equivalent to SP-10; in other words, we decided to make the new equipment look like SL-1200 from the outside, but remodel the inside anew with current technologies. To exaggerate, we worked on this aiming to re-define the reference of the direct-drive turntable. For the design, we did an aluminum hairline finish with some touches to new Technics amplifiers and network players, which revived in 2014, to give it a coolness in line with the times. Operation buttons were placed in the exact same places, taking into consideration the fans of the old SL-1200 to allow them to use the player with familiarity. The most important part, the inside, was created with persistent passion of the engineers involved, resulting in a completely different equipment from SL-1200 or SP-10 which was the origin of the direct-drive turntable. The details are described in the next page.

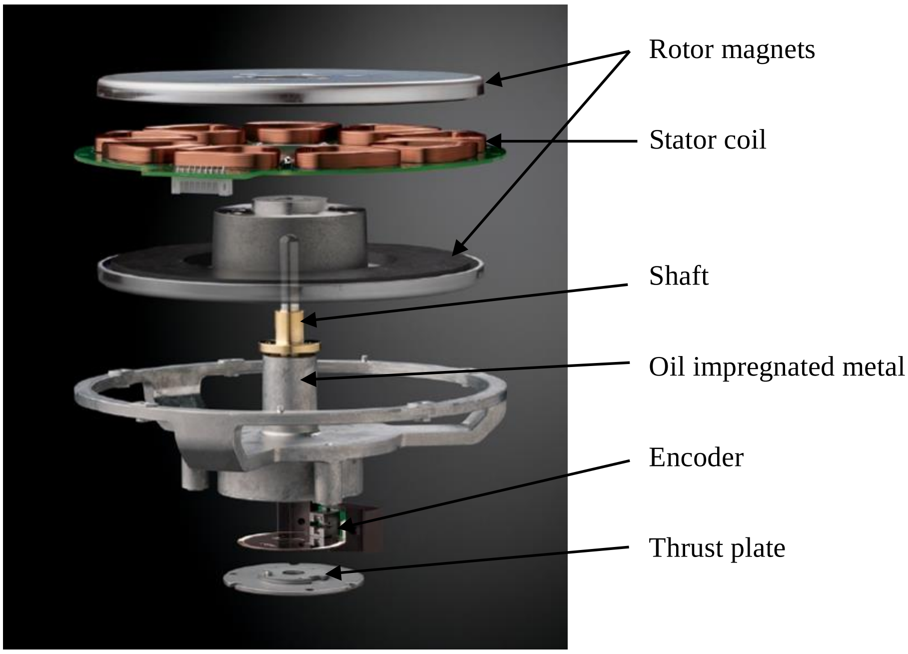
## 2. Development of SL-1200GAE

Here are the details on what we persistently worked on in developing SL-1200GAE. There are five main points: 1. Motor and control circuit; 2. Turntable (platter); 3. Tonearm; 4. Insulator; and 5. Chassis design.

### 2.1. Motor and control circuit

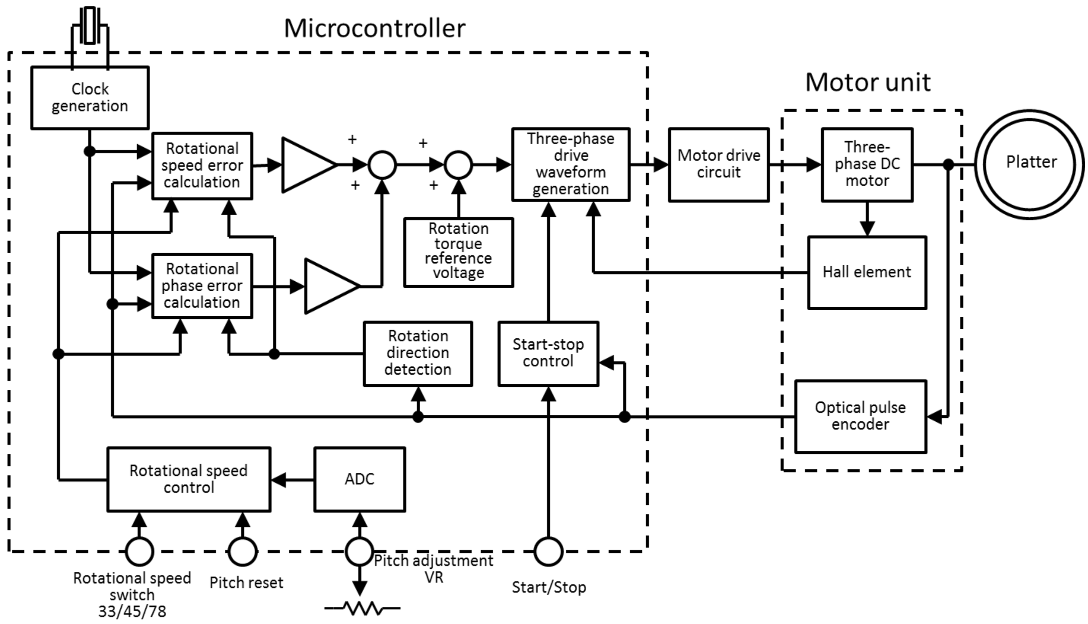
The motor is one of the parts we were most particular about. For formality purposes we call it the twin-rotor opposed three-phase brushless motor. Pompous as it may sound, the structure is one where a coreless stator coil is sandwiched between two sheets of rotor magnets.

In the old SL-1200, a stator coil with a core rotated with circumferentially opposed rotor magnets. While cogging is one of the faults of a direct drive (hereinafter abbreviated as “D.D.”) motor, cogging cannot be completely eliminated as long as there is a core (iron core). This may catch the attention of past D.D. owners and make them worry if their turntable was still OK, but in fact the servo system in the circuit reduces it to negligibly small. Many are concerned that slight noise to draw the servo system will cause impact, but they need not worry since the cartridge will not pick up the noise. Nonetheless, a completely novel approach was necessary to remove the bias of “D.D. = cogging.”




This is what led us to this new motor. By making the motor coreless (no iron core), the cause of cogging can be eliminated to the utmost limit. However, this also came with issues. Having no core means less magnetic force between the magnet and the coil, and results in losing torque. The twin-rotor magnet (ferrite) covers that problem. Placing them on the top and bottom of the stator core like a sandwich also serves the role of eliminating load to the thrust direction caused by the magnetic force. (We did not consider neodymium since it would not make sense to increase the magnetic force if it resulted in more leakage flux.) In addition, the inertial mass, or the weight of the part rotating simultaneously, also increases, yielding a maximum torque of 3.4 kg-cm. Given that the torque for the old SL-1200 was 1.5 kg-cm, this is actually more than double the value. Many of you might have thought that this would allow stably rotating a heavier turntable (platter). Obviously, a heavier platter would increase the inertial mass of the rotating system, and help stable rotation. Details on the platter are described in the later pages.

The stator coil and magnets were not the only items that were redesigned. A hall IC was used for detecting position, and an optical encoder was adopted for detecting rotational speed. The servo system using these sensors is the control circuit, the details of which is described later. Here is a schematic diagram of the control circuit.




While the old SL-1200 had an analogue control system using a custom IC, we replaced them all with microcomputer control. This system enables controlling with an accurate waveform by storing the motor drive waveforms necessary for rotation in the ROM and converting them to analogue waveform from digital data. An optical encoder is used to detect the speed, achieving speed detection with triple precision compared to the conventional type. We found that each wave of the encoder slits actually had different widths depending on the precision level of processing, and leaving it in such state caused errors when measuring the speed, ultimately affecting the wow and flutter performance.

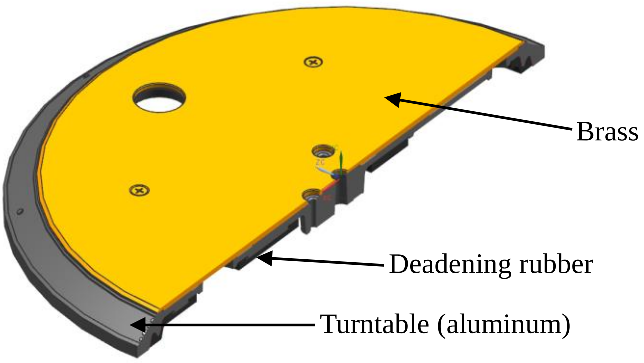
Therefore, in this new system, the width of the every encoder slit is measured for each motor, the values are recorded as data for correction, and adjusts the speed when controlling the rotation. By making adjustments to the waveform data of sine waves that control the rotation and the encoder, we succeeded in yielding a more accurate rotation precision.

### 2.2. Turntable (Platter)

The turntable (platter) has a three-layered structure of brass, aluminum die cast, and deadening rubber. Various metals were attached together to improve the damping factor. The effect is obvious when one hits the platter. Eliminating unnecessary vibration from the platter where the record is directed placed was one point we focused on to faithfully reproduce the original sounds of a record. Additionally, we used brass with high specific gravity to increase the inertial mass.

Weight balance is also important for better rotation stability. Think of adjusting the wheel balance when replacing car tires. If the weight balance is lost, the center of gravity of rotation swings and cannot give stable rotation. A heavier platter may lead to great impact if it has slight unbalance.

To address this, we developed a platter balance adjuster with the cooperation by a manufacturer of machines to adjust the wheel balance of Shinkansen (bullet train). Each platter that is marketed goes through balance adjustment and a “balance adjustment complete” label is attached to each one.

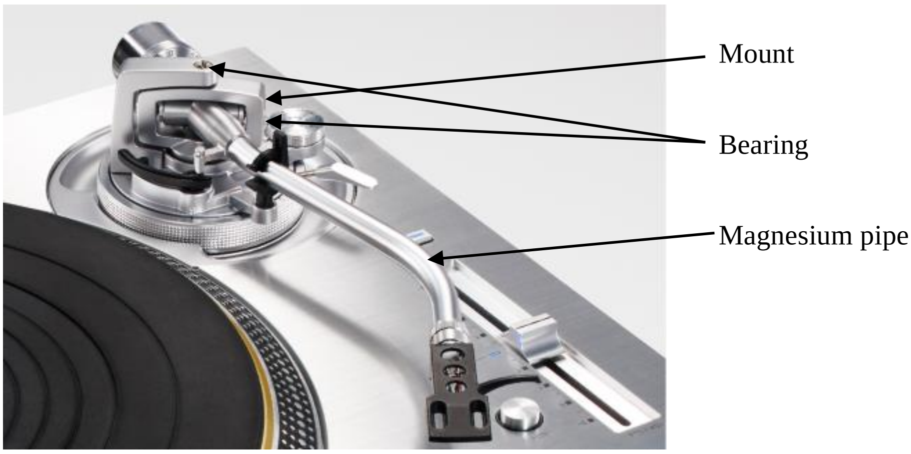



## 2.3. Tonearm

The traditional gimbal suspension is used for the tonearm. However, we did add some new points, including the arm pipe, which we changed to a magnesium pipe for its low specific gravity and high stiffness. Magnesium is difficult to process, but we were able to achieve processing through cold-drawing. This significantly improved the reproduction of sound field space.

Another point is the bearing. While the component had been used since the 1970’s, none on the market was optimal at that time, so we developed it in-house. This time, however, we succeeded in improving the initial motion sensitivity of the arm to 5 mg by using a bearing where hard balls were set in an ultra precision cutting worked cup.

Furthermore, the mount part supporting the gimbal suspension was overlayed for higher stiffness to hinder external vibration.

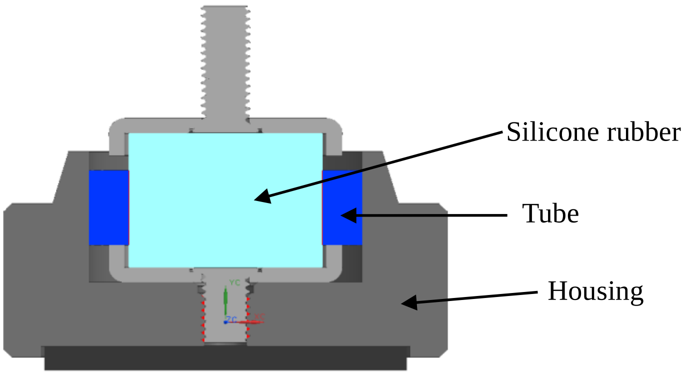


### 2.4. Insulator

The insulator cuts the vibration from outside. Particularly, vibration from the speakers cause howling, which can also spoil sound quality. The change in the chassis weight due to the new design also led us to develop an insulator with suitable properties.

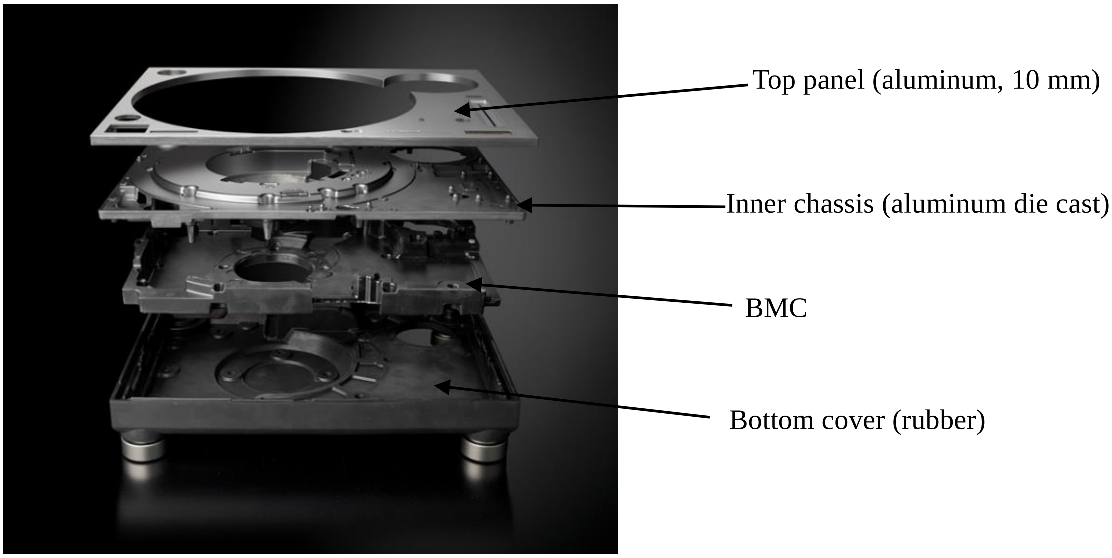
The structure of the conventional insulator was a combination of a spring and rubber. However, combining two components with different properties would result in damping factors creating peaks in two different frequencies. We figured it was best to use a single material for the structure in order to attain an even characteristic.

We then directed our attention to silicone rubber, which is widely applied as anti-vibration material. After creating a number of prototypes with various types of materials and repeating sound quality reviews, we came to the present structure. This enabled a larger howling margin than the conventional product.




### 2.5. Chassis design

The chassis has a four-layer structure of the top panel, inner chassis (aluminum die cast), BMC (bulk mold compound), and bottom cover (rubber). A 10 mm-thick aluminum plate with hairline processing was used for the top panel. Most of the components were fixed inside the inner chassis. In addition, the high stiff structure could be realized by the combination of BMC and bottom cover.



## 3. In conclusion

With the popularization of digital audio, music has recently become something that can be enjoyed ever so easily and simply. The broader lineup of high resolution audio has also allowed us to enjoy music with better sound quality.

In such environment, many may question the point in pursuing analogue audio now—something that stands on the very opposite. However, we believe that such era and environment is the exact reason why we should value analogue audio.

Taking a record out from its jacket and placing it on the turntable. Placing the stylus on the record with somewhat nervous fingertips. Only can we listen to the music after this ritualistic operation. There is no remote controller, nor is there a function to fast-forward or rewind. Inconvenient as it may be, there is a moment of slowly giving full attention to music. Records have warmth and depth of expression that digital audio does not. You may be too busy with hectic everyday lives to spend much time indulging in music, but I would recommend digging a record out from the closet and listening to it once in a while.

It would be our honor to produce that fulfilling moment with our turntable.

Last but not least, I would like to convey my gratitude to my superiors, component manufacturers, and cooperating companies who assisted us in developing this turntable.

About the author

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Joined Matsushita Electric Co., Ltd. (current Panasonic Corporation) in 1977.

Engaged in development of various products including analogue players, CD players, electronic musical instruments, karaoke systems, photo frames, and stereo systems before taking the current position.

Current position: Development Department 4, Home Entertainment Development Center, Corporate Engineering Division, Appliances Company, Panasonic Corporation