Research and Development and Intellectual Property

Yamaha has adopted the corporate slogan of "Sharing Passion & Performance" and a corporate philosophy of "with our unique expertise and sensibilities, gained from our devotion to sound and music, we are committed to creating excitement and cultural inspiration together with people around the world." In addition, Yamaha has established a medium- to long-term management vision of becoming an indispensable, brilliantly individual company.

Guided by this slogan, philosophy, and vision, Yamaha has designated the technologies it has amassed in the fields of sound and music as core technologies in order to promote its business activities, and is conducting R&D activities with the aim of further advancing and extending these technologies. In addition, Yamaha is further sharpening its competitive edge by linking together its R&D strategies and intellectual property strategies.

Research and Development

Without being limited to sound itself, Yamaha is promoting R&D activities in a wide variety of technological fields that support the utilization of sound, from fundamental technologies to application methods. These fields include technologies related to materials and analysis, sensing, mechatronics, sound generation, signal processing, networks, and sensitivity evaluation.

In fiscal 2017, Yamaha identified sound, music, networks, and devices as focus areas. In particular, Yamaha endeavored to enhance its scientific understanding of what constitutes "good sound" and advanced R&D initiatives to actually apply "good sound" to its musical instruments and audio equipment design processes. In addition, Yamaha took initiatives to upgrade its various technologies, such as physical modeling, musical analysis, and singing voice synthesis, as well as to advance the development of high-quality sound transmission technology for the network generation and technology related to wireless connectivity.

Yamaha's R&D structure consists of two sections. The first section is the Research and Development Division, which is located within the Technology Unit. This section oversees the R&D functions for enhancing the Company's foundational elemental technologies and creating new businesses. The other section is the Technology Development Division, which handles the product development functions of each business division as well as subsidiaries.

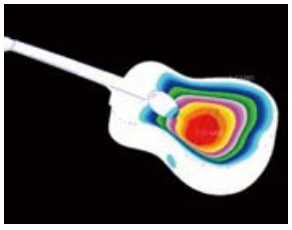
Technologies Accumulated through R&D

Guided by the expertise passed on from generation to generation and a sensitivity toward sound creation, Yamaha has accumulated a vast array of original technologies over its long history of manufacturing acoustic instruments. In the field of digital instruments and audio equipment, Yamaha has developed groundbreaking electronics technology. In recent years, Yamaha has expanded the scope of its technologies through the addition of new companies to the Group. By drawing on the strengths of these technologies and fusing them together, Yamaha has continued to provide new value that only it can create as well as new ways to enjoy and utilize sound and music.

(1) Technologies in the Musical Instruments Domain

In the musical instruments domain, Yamaha processes wood and metal materials in order to provide its customers with even more fulfilling sound and music. In addition, through the continued research of technologies related to the mechanisms of keyboard actions, sound generation and effects, as well as acoustics, the Company actively pursues good sound and superior performance.

YVN500S Artida™ violin with A.R.E.™ technology



Analysis of the vibrations of guitar surface

- Wood reforming technology A.R.E (Acoustic Resonance Enhancement): Yamaha's original wood reforming technology that ages wood in a short period of time
- Research on instrument structure; research and analysis on the vibrations and sounds that occur within acoustic instruments
- Sound source development: Development of FM sound generator, AWM sound generator, and physical model sound generator

DX7 Synthesizer

FM sound generator: A method for modulating the frequency of waveform and creating tone

SY77 Synthesizer

AWM sound generator: A method for creating tone by recorded sound of an instrument

VL1 Synthesizer

Physical model sound generator: A method that virtually creates an instrument's structure to make sound

(2) Technologies in the Audio Equipment Domain

In the audio equipment domain, Yamaha draws on the strengths of cutting-edge software and electronics technologies, centered primarily on digital signal processing and network technologies, using its expertise and know-how related to sound. Yamaha offers high-value-added products such as AV products and PA equipment as well as network devices.

- Fluid sound control technology, Twisted Flare Port™
- Virtual Circuitry Modeling (VCM) technology, RIVAGE™
- MusicCast® wireless transmission technology

TWISTED FLARE PORT

Preamplifiers with VCM technology used in RIVAGE™

(3) Technological Fusion and Creating More Value

Not only does Yamaha evolve the technologies it has cultivated over many years, the Company promotes the fusion of its technologies to offer new hybrid instruments as well as to innovate its existing products. At the same time, the Company is creating entirely new products in new businesses, thereby providing customers with both surprise and excitement.

- TransAcoustic™ Piano
- TransAcoustic™ Guitar
- Brass instrument silencing system, SILENT Brass™
- Flagship Speaker, NS-5000
- VOCALOID™
- *Omotenashi* Guide™

VOCALOID™

TransAcoustic™ Guitar, incorporating actuator to generate reverb and chorus effects

R&D Achievements

Motion Control Synthesis Engine

The Motion Control Synthesis Engine is a comprehensive tone generation system that combines two types of sound generators and three types of controllers, giving it the power to realize a dynamic and overwhelmingly expressive musical performance in a manner more fluid than conventional synthesizers. The engine combines the excellent sound reproduction of the Advanced Wave Memory™ 2 (AWM2) sound generator with the dynamic tonal expression of the newly developed FM-X frequency modulation sound generator. The engine also comes equipped with Motion Control, which continually shifts complex sound across a diverse control source.

Motion Control drastically changes sounds in line with the musician's performance and synchronizes these changes with the rhythm, thereby delivering a sound rich in expression. In addition, Motion Control is able to reflect the passion of the musician in the instrument through the color and motion of light that is emitted in response to changes in sound. This allows for an emotionally rich performance, almost as if the musician and the instrument were having a conversation. In these ways, the function generates truly high-dimensional sound.

The Motion Control Synthesis Engine was first applied to Yamaha's flagship synthesizer model, the MONTAGE™, which was launched in 2016. Going forward, Yamaha will further expand this technology, making it a key feature of its synthesizers.

NS-5000 Flagship Speaker

The NS-5000 is Yamaha's flagship speaker that brings together the latest speaker and analysis technologies. The speaker unit, which uses newly developed diaphragms, and the cabinet, which incorporates the latest R&D accomplishments, realize unlimited quietness and a clear sound, allowing for music to be clearly reproduced as is.

The newly developed diaphragms of the tweeter, mid-range, and woofer use ZYLON®—the world's strongest fiber with an ideal elastic modulus and a speed of sound that rivals beryllium. This allows the NS-5000 to reproduce extremely pleasant sounds with a high level of sophistication by realizing uniform tone quality across all frequency bands. Moreover, in order to control the unnecessary sound that is emitted from the back of the tweeter and mid-range units, the NS-5000 is equipped with a resonance suppression (R.S.) chamber, which has a flat frequency response that negates tube resonance without using a large amount of acoustic absorbent materials.

In these ways, the NS-5000 is able to achieve reproduction of even higher resolution.

As for the cabinet box sound, which is background noise that occurs when vibration is present, the NS-5000 controls even microscopic box sounds through the use of the latest finite element method (FEM) analysis that leverages the strengths of laser scan measurements.

Going forward, Yamaha plans on expanding its product lineup of speakers that utilize these technologies.

* ZYLON® is a registered trademark of Toyobo Co., Ltd. in Japan

Disklavier ENSPIRE + MusicCast—Connecting Musical Instruments with Audio Systems

Offering a new way to enjoy music at home through the integration of Disklavier ENSPIRE, a hybrid piano equipped with an automatic performance function, with the audio system MusicCast.

Through the integration of the world's most advanced piano, the Disklavier ENSPIRE, with Yamaha's high-fidelity MusicCast wireless audio system, customers can enjoy the sound and music of a real acoustic piano in any room of their house. This seamless integration allows customers to experience the sound of the Disklavier ENSPIRE piano directly in the room where it is located, or send the piano performance wirelessly to other areas of their home using the MusicCast mobile app.

Intellectual Property

The foundation that supports Yamaha's extensive business development is the technology and know-how that it has accumulated within the Group over many years of R&D activities. To support this technology and know-how and to accelerate the further accumulation of intellectual property rights, Yamaha has actively invested resources in its R&D activities. Moreover, with a primary goal of maintaining and improving the competitive edge of the technologies it possesses, Yamaha is expanding its activities to acquire, maintain, and utilize other related intellectual property rights.

Since its founding, Yamaha has sought to acquire its various patents and other intellectual property rights while simultaneously respecting the intellectual property rights held by third parties. More recently, the Company has taken steps to integrate its business, R&D, and intellectual property strategies by implementing a number of measures designed to maximize the contribution of its intellectual property on its business earnings.

Patents

To differentiate itself from its competitors, gain a business advantage, ensure greater flexibility, and enable licensing to third parties, Yamaha has formulated patent strategies tailored to its operations in specific business segments. These strategies include establishing target technical fields for patent acquisition, such as core technologies, new businesses, and new technologies, and building a strong patent portfolio by identifying and focusing on its core competencies. From the standpoint of asset optimization, Yamaha annually assesses its full portfolio of patents held within and outside of Japan, evaluating patent rights in terms of present application and future potential, and ultimately retaining only those rights deemed most advantageous. As of March 31, 2017, the Yamaha Group owned a total of approximately 4,700 patents and utility models in Japan. Outside of Japan, the Group also held a total of roughly 4,400 patents, mainly in the United States, Europe, and China. Going forward, Yamaha is working to increase the number of patents held in China in particular.

Designs

Yamaha views design as a critical element in setting its products apart from other offerings in the market, and consequently makes every effort to properly safeguard and utilize these assets. In recent years, Yamaha has taken bolder steps to acquire design rights in China to protect itself against counterfeit products. As of March 31, 2017, the Yamaha Group held a total of approximately 1,100 design rights, roughly 380 in Japan and 730 overseas.

Copyrights

In addition to industrial property rights, such as patents, designs, and trademarks, the Yamaha Group produces numerous copyright-protected works, primarily in the fields of sound and music. Music-related copyrights are of particular importance to Yamaha in terms of its overall intellectual property policy. The Company takes steps to ensure their proper management and use, including undertaking legal action when necessary.

Brands

Yamaha has taken numerous initiatives to maintain and enhance the value of the Yamaha brand. In 1986, the Company established regulations for brand management, and also set up a Companywide brand management committee to maintain and improve brand value by ensuring the effective use of the Yamaha brand. Furthermore, as part of the Company's efforts to secure brand rights, a wide range of trademarks related to the Yamaha brand are being acquired in nearly every country worldwide, with additional efforts including precise preliminary surveys and acquisition of rights for sub-brand products and services.

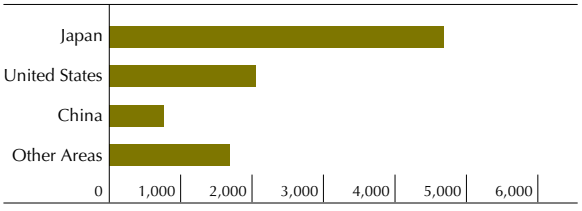
Anti-Counterfeiting Measures

In recent years, the number of cases of unauthorized third parties manufacturing and selling products under the Yamaha brand or reproducing counterfeit Yamaha product designs has been increasing. Using government agencies and various legal means, Yamaha has vigorously combated cases of counterfeiting with growing success. Going forward, Yamaha plans to adopt a more aggressive legal approach, including litigation against infringers, to preserve the Yamaha brand value and the value of its businesses as well as to maintain consumer trust in the Yamaha brand.

Intellectual Property Management Systems

As part of the corporate body, the Intellectual Property Division oversees the integrated management of all intellectual property held by the Yamaha Group. In addition, members of the Intellectual Property Division are assigned to each business and R&D division, where they ensure that the Company's intellectual property strategy is integrated within its business and R&D strategies. The Intellectual Property Division also works in close communication with each business division to promote Yamaha's intellectual property strategy from both Companywide and business domain perspectives.

Patents Owned by Yamaha (As of March 31, 2017)



Yamaha's Intellectual Property Receives High Appraisal Globally

2016 TOP 100 GLOBAL INNOVATORS Clarivate Analytics

Clarivate Analytics Selects Yamaha as Top 100 Global Innovator

In January 2017, Yamaha received a 2016 Top 100 Global Innovators Award from the global business data provider Clarivate Analytics (based in Philadelphia), formerly the Intellectual Property & Science business of Thomson Reuters. The award, which began in 2011, recognizes the world's top 100 innovators for invention excellence by analyzing intellectual property trends based on proprietary patent metrics owned by Clarivate Analytics.

Award recipients are selected based on four criteria derived from data on patent volume, patent registration rates, globalization, and impact of patents based on how often they are subsequently cited.

This is the fourth time for Yamaha to be selected, after being selected for the first time in 2011 and again in 2014 and 2015. Yamaha received high praise for the global scope of its patent rights acquisition activities, which factored in greatly to the Company receiving this award.