

## ► **Voice Coil Visits Panasonic** *By Mike Klasco*

**P**anasonic (Panasonic Electronic Device Co., Ltd.) is one of the largest speaker manufacturers in the world, producing over 125 million drivers per year.

The parent company is Matsushita Electric Industrial Co., Ltd., a leading electronic manufacturer founded in 1918, composed of over 600 companies, about 330,000 employees, and annual sales of approximately \$76 billion. They manufacture and market over 15,000 products under brands such as Panasonic and National. In the US and most of the world, since 2002, the name of Panasonic has been used as the company brand.

### **Panasonic Speaker History**

The speaker side of Panasonic is the Acoustics Products Business Unit. It is indicative of Matsushita's awareness of speakers as a critical component that their first use of the Panasonic name was for an audiophile speaker in 1957.

In consumer products, Panasonic's first home run in the US market was an AM-FM radio (tubes!), introduced in the early 1960s. FM was still at the fringes of the average consumer back then, and even the AM reception of that radio is not matched by the tuners of today. My father taught electronics at New York University at the time; he selected this product and got the schematics and told me (I was 13 at the time) that Panasonic was going to become a famous brand and that GE had met its match and then some.

The following year was the 1964 New York World's Fair featuring a large Panasonic display at the Japan Pavilion, which fueled my imagination about Japan. I never would have expected to be Panasonic's guest at their factories throughout Asia 43 years later.

### **Japan**

Panasonic's speaker operation headquarters, which they call the Acoustics Products Business Unit, is located in central Japan, in the town of Matsusaka, near the city of Nagoya, the center of Japan's third largest metropolitan region.

Products range from cellphone speakers to autosound

OEM drivers and active noise canceling systems for cars (you see these in some Japanese models), to home theater and aftermarket auto sound and professional speakers for commercial and concert sound.

Panasonic is, of course, TS16949, but perhaps more important, they follow the Japanese credo of 5S (6S sometimes—with the addition of "Safety"). The 5Ss are about doing the basics efficiently in an industrial environment. They provide a foundation on which to build other quality activities. They are:

1. Seiri (organization)—Separate out all the things that are not necessary and eliminate them or tidy them away.
2. Seiton (neatness)—Arrange the essential things in order so they can be quickly and easily accessed and put away.
3. Seiso (cleaning)—Keep machines and working environment clean.
4. Seiketsu (standardization)—Make cleaning and checking a routine practice; maintain a pleasant environment.
5. Shitsuke (discipline)—Standardize the previous four steps and constantly improve them.

A keiretsu is a set of companies with interlocking business relationships and shareholdings, often including a bank. It is a type of business group common in post WWII Japan, which contributed to the country's rapid recovery. Panasonic has direct and indirect affiliates as its team and world strategic partners.

Manufacturing style changes to reflect the thinking of the times. In the 1960s so much of Japan's production was cottage industries. Families built subassemblies in their homes and on Fridays brought their work to the assembly factories. Typically Friday was final assembly day at the factory, where the contract workers interfaced their subassemblies into the complete product—who better than the worker who stuffed the board to QC and troubleshoot their own work? The product then went through a final assembly QC and

then again when it reached the US operation.

In the late 1960s and early 70s I worked at Harvey Radio and Audio Exchange in NYC after school. All the Sherwood, Scott, and Fisher stuff was dead on arrival 20% of the time, yet the Kenwood, Sansui, and Pioneer receivers always worked. No wonder the Japanese products worked out of the box. They had 5000 miles of vibration testing and a final QC in the US by Japanese engineers, along with much more TLC (tender loving care) than the domestic products.

Panasonic's production personnel were predominately in-house, high stability, lifetime workers. JVC, on the other hand, used cottage industry workers taking their work-product to the final assembly factory on Fridays. Keep in mind this was over 40 years ago.

Not that all this is uniquely Japanese: At the same time IBM in upstate New York kept about 60% of its production in-house and shipped its seasonal work (40%) to sub-contractors such as Amphenol's Cadre assembly operations nearby.

Today Flextronics and similar operations serve the same function. Panasonic has evolved with a mix of large-scale production lines as well as a "cell" assembly operation in which one or two skilled workers build the entire speaker themselves.

As a certain engineer of Panasonic Japan pointed out, the days of huge production runs are over. Today there are many more very application-specific models and endless short runs of a few thousand units rather than the occasional runs of 10,000 to 50,000 popular models (such as for auto-sound OEM). Throughout Panasonic plants in Asia, the cell assembly program is being phased in where appropriate. Because the Japan operation houses not only manufacturing, but also R&D, comprehensive test facilities are located here. Aside from acoustic research, there is a comprehensive lab for in-house RoHS testing of materials.

On the factory floor, to control consistency and attain high acoustic performance, Panasonic makes its own paper cones in a fully automatic and servo-controlled feedback system. It all starts with a conventional beater for fabrication and slurry production. After the beater operation, a holding tank is used with careful and even dispersion and servo control of the solids content of the slurry in the tank.

After cone pressing, each cone is automatically weighed (to a few decimal places!) and the solids content is optimized under servo-control to keep production weight, from cone to cone, in tolerance. Panasonic also fabricates its own poly cones—typically a high performance mix of high mica loading for increasing the Young's modulus and 5% graphite for good damping and low distortion. Precision single screw compounding of the poly and additives and regrind (which stabilizes and enhances the final mix) produces the final recipe as injection molding pellets.

Finally, the cones are gas injection-molded, which produces a super thin wall cross-section with some cones using integral stiffening fingers. There are quite a few advanced formulations including foamed poly, variable thickness

cones, and other sophisticated variants. The autosound OEM drivers are especially impressive.

Ultra-light assemblies using plastic frames were over-molded to the neo magnet assembly structure. The cones were also exceptionally light to enable high sensitivity and good dynamic range from the 12V rails that drive the head unit and amplifier in most OEM autosound systems. Also at the Matsusaka facility the Ramsa professional studio monitors, commercial sound, and concert sound speaker are produced for both Japan and export markets.

## Panasonic Taiwan Co. (PTW)

In 1962, Panasonic came to Taiwan, where it now, along with its subsidiaries, has over 4500 employees, including 600 engineers. From the first, speakers were made by Panasonic Taiwan, along with record players and radios.

The Japanese speaker companies Panasonic, Foster, and Pioneer taught Taiwan about speakers and speaker production techniques. If you were in China in the late 1980s or early 90s and wanted to build a speaker factory, you would go to Von Max for a Panasonic-style semiautomatic line.

These Taiwan companies included ex-Panasonic guys who set up their operations to provide Japanese type speaker production lines. Inon is another Taiwan supplier with Japanese style speaker production lines, now moved to Dong Guan, China.

When I visited Panasonic Taiwan, I was not surprised to see where Von Max got its inspiration for its semiautomatic lines. One attribute that Panasonic uses in production lines is the labyrinth baking sections which minimize taking the



PHOTO 1: Eiji Nakatani, Chief Engineer of Panasonic AVC Networks Company.

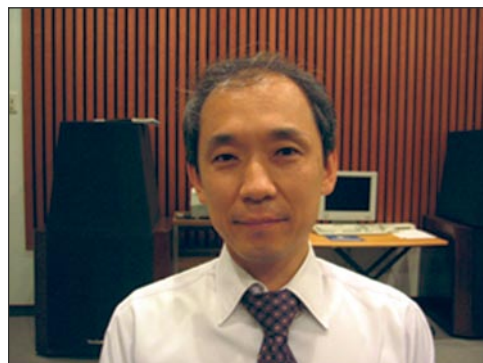


PHOTO 2: Shoji Tanaka, Staff Engineer of Panasonic AVC Networks Company.

product off the line to air dry—eliminating the handling and reducing the work in progress before QC testing. Of course, precision adhesive dispensers and other good practice is taken for granted here.

Panasonic focuses on incoming QC and tight process control rather than final QC—because at this point the damage has already been done! Other operations at Panasonic Taiwan range from remote control for consumer products such as for TVs to air conditioning units, auto-sound products including navigation systems, to a very sophisticated and precision automation building that fabricates multilayer circuit boards.

## China

I visited Panasonic's China operation with Tsuda-San and Katsube-San of Ferrotec (Ferrofluidics) and Jimmy Ying, my associate from Sea Galleon (the agents for Ferrotec, Du Pont Teijin, and a half dozen other high-tech products for speakers).

Panasonic's Xiamen operation is the focus of production and expansion for speakers. This operation is primarily managed as a satellite factory of Panasonic Taiwan. Costs are low, the work force relatively stable, and Xiamen is one of mainland China's large shipping ports. Panasonic has an excellent speaker factory in Tennessee for autosound OEM, but as the US automotive factories continually demand "cost down," Xiamen is Panasonic's fallback.

Xiamen is one of the more fascinating cities I have visited in China. It is located on the coast, facing Taiwan, which occupies several islands off the shore of Xiamen. In 1995-6, the Chinese conducted missile tests in the waters surrounding Taiwan, including the Taiwan Strait, the third in a series of confrontations. Now Taiwanese agricultural products are featured in Xiamen grocery stores, and EVA and other airlines will inaugurate regular flights between Xiamen and Taiwan.

The history is particularly interesting. Xiamen (also known as Amoy) was the first port used by Europeans in the 1540s. After the treaty of Nanjing in 1842 following the Opium War with Britain, Xiamen was one of the ports of trade opened to Western nations, in particular for the export of tea. In the late 1800s the smaller island had European consulates, banks, and businesses. The Westerners were eventually pushed out in the late 1930s during WWII.

Xiamen University is another unique attraction, founded in 1921 by Tan Kah Kee, an overseas Chinese millionaire who made his fortune with rubber in Malaysia. The architecture is a cross between European and Chinese public buildings.

Xiamen consists of two islands, the smaller named Gulangyu, considered an important cultural resource. All manufacturing (as well as private vehicles) has been moved over to Xiamen Island and to the peninsula. The larger island and peninsula are connected by a bridge. You can reach Gulangyu by ferry.

Most of the smaller island's architecture is of European construction from the late 1880s to the early 1900s with

Chinese accents. The ambience is a cross between Venice and the European Bund in Shanghai.

Street vendors sell old Victrolas (record players with a large acoustic horn for a speaker), ancient typewriters, and similar paraphernalia from the era—at very fair prices. In some ways Xiamen cultural legitimacy is undermined by their poor locally made beer (but there is always Tsingtao!). But aside from beer tasting, I was reminded by Jimmy that I was in Xiamen to see Panasonic's big factory on Xiamen Island.

We stayed at a classic 1980s era Chinese hotel that was one of the original "Friendship Hotels"—essentially a guest house of the local government, but now a public five-star hotel and resort. If you did not get a chance to travel to China in the 1980s, you missed the "Friendship" handling of foreigners—such as FEC (Foreign Exchange Currency) which was two times the cost of local currency for the same value. You could only shop in "Friendship" retail stores for export goods and stay in Friendship Hotels. Of course, all that is ancient history now, but the hotel layout was a classic Friendship Hotel and brought back memories of my first trips to China.

## Home Theater Developments

While in Japan I auditioned Panasonic's new Twin Center four tower surround system. The familiar Panasonic brand adorns its plasma flat-screen product line, and one of the big Panasonic sub-brands for stereo in the US in the 1980s was Technics. But in the US Technics is known best by professionals such as musicians for Technics keyboards, and DJs for Technics turntables and related prosumer products. Technics means industrial technological arts.

Now Panasonic plans on reinforcing its audio product line with an innovative and high technology home theater sound system under the Panasonic name, perhaps as part of its Viera A/V product lineup. My part in this is small; last year at a ferrofluid technology conference I suggested applications for magnetic fluids beyond just tweeters, including midrange and even satellite woofers in home theater speaker systems.

Panasonic was developing its Twin Center sound system; the key driver was the ultra-low distortion and



PHOTO 3: THE THS1212ELS speaker.

smooth-sounding midrange driver. The company gave it a try, and made it work. Specifically, the application was for ferrofluid in this midrange for enhanced Q, smoother response, and minimized distortion.

How this midrange driver is used is also innovative—instead of a center channel above or below the screen, the center sound is virtual—and reflected off the flat panel TV screen. This is not a compromise to get rid of the center channel: a significantly stronger and more credible sound image results.

An uncanny impression is that the voices are coming directly from the images on the screen and are especially realistic when a performer is talking and walking across the screen—a truly superior and immediately apparent center-channel solution. My guess is this is due to the vertical offset of the center channel. I have never been comfortable with the horizontal configuration of woofers and tweeters or horizontal “mtm” configurations in center channels.

The midrange response is 800Hz to 3kHz and has a deep drawn back chamber, high mica content cone with graphite damping compounded into the material. No in-band edge resonance is visible on the response curves, nor are such resonances audible, just absolute clarity in voice and music, as well as lack of power compression effects when cranked up due to the ferrofluid stabilizing operating temperatures on impedance.

There are quite a few other innovations and significant engineering refinements in this product, from the front radiating super sonic (100kHz) tweeter, to decoupling the woofer and midrange from the enclosure for reduced vibration transmission into the baffle, and even tweaks such as oxygen-free wire and bi-wiring. The projected price of the complete audio system, with receiver and four tower speakers, is about \$3000 retail, about the top-end of what the big retail chains can handle.

While I only visited Panasonic's Japanese, Taiwanese, and Xiamen China factories, Panasonic has speaker production in 13 factories in 10 counties.

I would like to thank my friends at Panasonic and also at Ferrotec for the opportunity to visit Panasonic's operations in Asia. Panasonic is one of those multi-ton elephants that somehow don't get noticed and is rarely visited by the press. I appreciate the chance to satisfy my curiosity and then be able to talk about it here. *VC*

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