Tonochi's Audio Room – Supplemental Information

MEASUREMENT INSTRUMENTS

2019/03/06

Tonochi's Measurement Instruments

DMM (digital Multi-Meter)

SANWA PC710 (bought for approx. 19,000 JPY in Feb. 2014)

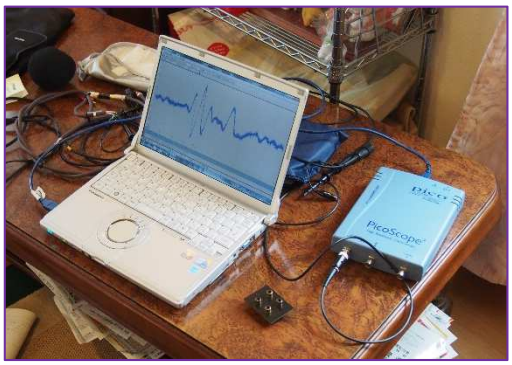
DMM to be used together with PC. I always use it stand alone like a circuit tester. It can be used for audio because its frequency range is 15Hz-50kHz (However, I used the digital oscilloscope to measure audio signals). I also use it as a thermometer with the thermo couple included in its accessories.

The photo was taken just after I bought it. I still keep it in this container box. The original container box is the best container since the accessories can be stored neatly along with the DMM itself. But I leave it on a desk while I am building an amplifier or things like that, because the DMM is often needed.

I like it because of its high usability. The PC710 can display two data at the same time. For example, it can display voltage and frequency at a time. My previous DMM, SOAR 3430, didn't have this feature. I like this feature particularly.

Digital Oscilloscope

Pico Technology PicoScope 4262 (bought for 84,000 JPY in May 2012)



10MS/s,16bit Digital oscilloscope to used together with PC. The main body consists of ADC and DAC only. Data processing, display and user interface are dependent on PC. It also offers additional features like FFT, voltmeter, frequency counter, signal generator, etc. The PC app can be downloaded from the website of Pico Technology for free of charge.

I use this oscilloscope for measurements of signal voltages instead of the DMM. This is because, with the DMM, the error increases as the frequency goes up, and with the oscilloscope, you can observe waveforms during the measurement.

The built-in signal generator has useful features such as frequency sweeping and mixing of multiple signals, but I seldom use it, because the maximum frequency is only 20kHz. However, it can generate super low frequencies, and even DC. I use it when I need frequencies of 10Hz or lower.

I used to have ADC-216, which was a Pico Technology too, before I bought PicoScope 4262. I liked Pico products because easy-to-understand tutorials and application notes were offered by the company. I guess the company's main users are amateurs. I didn't hesitate to buy the 4262, when the ADC-216 was broken.

When I bought the ADC-216, the PC oscilloscope was the only option, because stand-alone digital oscilloscopes were so expensive. However, they are inexpensive these days. Even a 100MHz oscilloscope is priced 40,000 JPY (as of Feb. 2018). The stand-alone type is easier to use, since it takes some time to get the PC oscilloscope ready for measurement. Please be aware, however, resolution of 16 bits or higher is necessary for precise voltage measurement and FFT analysis. Be careful of the resolution when you buy a cheap oscilloscope. The resolutions of most cheap oscilloscopes are not high enough.

Analog Oscilloscope

Kikusui Electronics COS5100 (bought for approx. 200,000 JPY in 1981)

2-ch, 100MHz oscilloscope with delay sweep feature. I've been using it since my college days. It still works, though I've never had it calibrated. It can be used for observing waveforms, but the voltage and frequency can't be read precisely.

This oscilloscope is useful in some situations. I always use it in *hiire-shiki* (the first power-on of a newly built amplifier). The analog oscilloscope is more useful than PicoScope to find a defect like oscillation. And, the maximum input voltage of PicoScope 4262 is 200V even with the 10:1 probe, so I use COS5100 to check tube amplifiers.

Oscillator

KENWOOD AG-203D (bought in 1999. It was a used one. I forgot its price)

Inexpensive low distortion oscillator that generates sine and square waves. The frequency range is 10Hz-1MHz.

This seems to be an oscillator for amateurs. Though it is called a low distortion oscillator, its distortion ratio is 0.01%. I measured the distortion ratio, and the result is nearly 0.01% as the catalog says. You can't use it for measurements of super low distortion (less than 0.01%). But I wouldn't like replace this oscillator, because I don't regard THD as an important index.

Unfortunately, the bottom end of the frequency range (10Hz) is too high. In order to check the stability of the amplifier, the bottom end must be 1Hz. Amplifiers with low stability tend to oscillate in the super low region (or the super high region).

Dummy Load for LINE Output

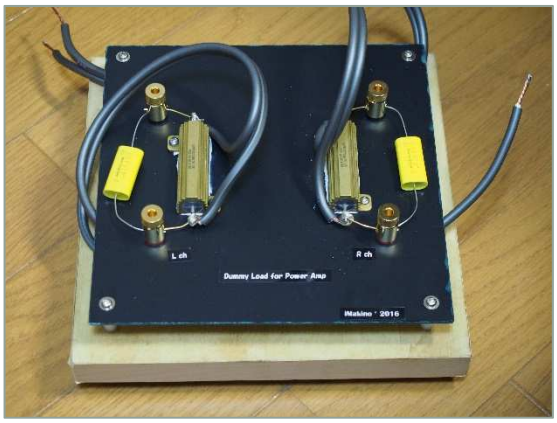
Dummy load connected to the LINE output of DUT (device under test). It's also used for the output of a phono equalizer amplifier (EQ OUT). I usually call it "**dummy load cable**."

It is composed of a 0.5m long balanced cable (Belden 8412), an RCA plug (Canare F-10 without the metal cover) at the DUT end, and a metal oxide film resistor 1W, 22kohm (KOA MOS1C223J) at the other end. This resistor is inexpensive one, though, the rating (1W) is enough to keep noises low.

To make it easy to connect the probes of a measurement instrument, the resistors are soldered on stand-off terminals fixed to a Bakelite board. The probe can be connected to the stand-off terminals.

Two dummy load cables are assembled and bound up so that the two channels can be measured at a time.

Dummy Load for Power Amplifier



This dummy load is used for measurements of a power amplifier. It is my original work. I usually call it "**dummy load board**."

Two 50W, 8 ohm, non-inductive, wire-wound resistors (Vishay (formerly Dale) NH05008R00FE02) are mounted on a matt black aluminum board. For easy connections of instrument's probes and capacitors, biding posts are mounted too. It is fixed on 21mm thick wooden board for easy handling.

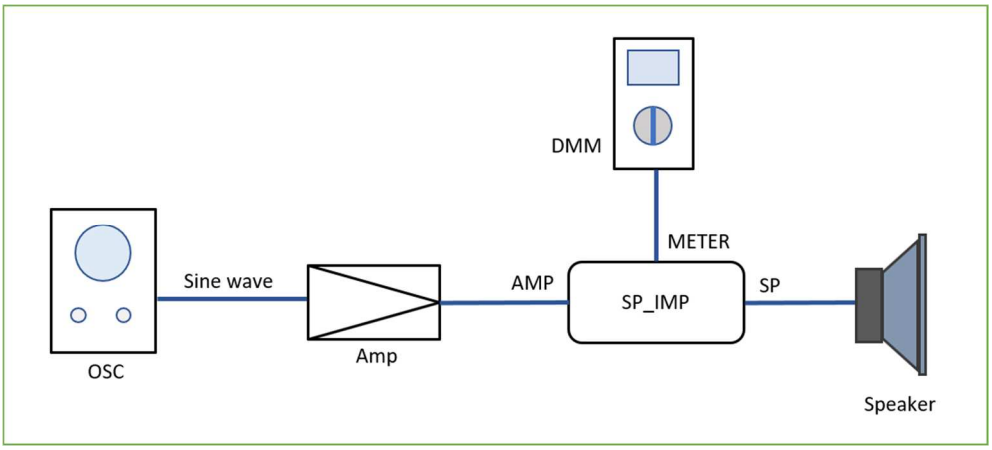
Silicon grease is applied between the resistors and the aluminum board to lower the heat resistance. Though the rating of the resistors is 50W, this dummy load endures for a short period of time if the power is 100W or so.

0.5m long speaker cables (Audio Technica AT6S27) are soldered to the resistors for connection to the power amplifier.

Speaker Impedance Measurement Device

This device (SP_IMP) is a self-made device used for measurement of the voice coil impedance of the loudspeakers. It is used together with an oscillator, a power amplifier and a voltage meter (DMM).

SP_IMP has three pairs of terminals and is connected as shown in the figure below.

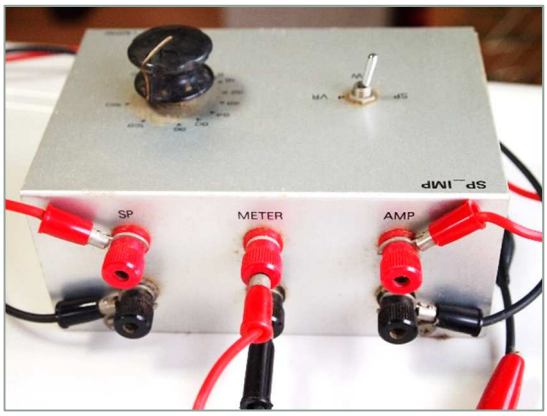


SP_IMP has a switch (SW). It selects one of two modes: SP and VR.
When SW selects SP, the load of the amplifier is the speaker. When SW selects VR, the load is the built-in variable resistor.

The value of the VR is adjusted by rotating the knob.

The voltage across the load appears at the METER terminals. The DMM shows it.

For the measurement procedure, read the “Supplemental Information - Measurement Methods.”



SPL Meter

Phonic PAA3 (bought for 43,000 JPY in Apr. 2016)

Hand-held 31-band real time spectrum analyzer (RTA) with a built-in microphone. This enables quick measurements of acoustics of the loudspeakers and the room. I hear it is a product for professional audio technicians, though, it is also suitable for amateurs because of its reasonable price. If you install the PAA3 app in PC, you can control PAA3 from PC, view the measurement data and save them on PC. Test signals (WAV files of sine waves, pink noise, etc.) are also included in the CD that comes with this product.

At first, I intended to utilize every feature of PAA3, but now I use PAA3 as a simple SPL (sound pressure level) meter. It is a hand-held type (compact, light and battery-powered), so it is suitable for quick measurements. I put it on the audio rack (AR-416) so that I can use it quickly anytime.

Microphone for Frequency Domain Measurements

Dayton Audio UMM-6 (bought for 16,302 JPY in Jun. 2017)

Microphone with calibration data. The preamplifier and ADC are embedded. The output is USB so it can be directly connected to PC. I use this microphone in combination with a measurement app Room EQ Wizard (REW) and USB DAC (KORG DS-DAC-10). I use this combination for measurements of frequency response.

I use a cheap tripod for a camera as a microphone stand. Its price is less than 1,000 yen. But it is very useful, since it's so compact it can be stored even in a small drawer. Needless to say, it can be used for photo shoots too.
A microphone holder comes with UMM-6, but I don't use it. Instead, I use the mic holder with suspension (Audio Technica AT8410a), in order to prevent vibration from coming from the floor to the mic (suspensions like this is not dramatically effective, though, it's better than nothing). An adapting screw (Tomoca CAMERE-SHURE, priced 190 yen) is used to attach the mic holder to the tripod.

This accessory carrying case is handy

UMM-6 attached to the tripod

Adaptor

Microphone for Time Domain Measurements

Behringer ECM8000 (bought for 6,458 JPY in Feb. 2018)

The sampling frequency of UMM-6 is too low (48kHz) to observe waveforms. At least 192kHz is necessary to observe waveforms in the full audio band. For that purpose, I bought another microphone. Behringer ECM8000 is the cheapest microphone for measurement, but it's enough for me, since I don't need very precise data.

Unlike UMM-6, ECM8000 needs a mic amp and phantom power. I looked for a used mic amp, but couldn't find a good one. So I bought a new audio interface. I use it as a mic amp.

As with UMM-6, I use the mic holder, Audio Technica AT8410a, to attached the mic to the tripod for camera. The mic cable is CLASSIC PRO MIX015GR.

Audio Interface for PC (Mic Amp)

TASCAM US-1X2-CU (bought for 8,834 JPY in Mar. 2019)

At first, I bought Focusrite Scarlett Solo G2 a year earlier. But it was noisy. I don't know the reason. I don't like to spend much time for troubleshooting. I bought US-1X2-CU to replace it.

I didn't know that TASCAM produces the counterpart of Scarlett Solo, when I bought it. The price is almost the same too. If I had known US-1X2-CU before I bought Scarlett Solo, I would've chosen US-1X2-CU in a heartbeat.

I used to use TASCAM DR-1 for live recording. I was satisfied with its performance, quality and usability. I had been thinking using a TASCAM once again.

Setting up US-1X"-CU is easy with its app "Settings Panel".

In the standalone mode (unplugged from PC), it can be used as a mic amp. With the microphone and the oscilloscope, it is used mainly for time domain measurements like observing and recoding waveforms.

Analog Tester

Sanwa SP-18D (I forgot when and how much I bought it for)

I thought an along tester was sometimes useful, and bought this. I remember I bought it at a nearby DIY shop, but forgot the details.

I don't use it often. I sometimes use it for checking cables and batteries.

It has a protect cover. The leads can be housed when the cover is closed. The cover also functions as the stand as shown in the photo.

Storage of the Instruments

Unlike the title of this website, I don't have an audio room, and I'm not allowed to leave instruments in the room. Though I use my study room as a laboratory, I'd like it to be a comfortable study at other times. So, I put away the instruments and tools normally. I put them away so neatly that I can get them ready quickly when I need them.

I have the spaces for the instruments.

The instruments for acoustic measurement are put on the lowest tier of the audio rack.
Other instruments are put in a cabinet with wheels attached, which is stored in the closet of the study usually. When I draw it out of the closet, the study turns into the lab at once.

I use the digital oscilloscope in both the study and the living room, so I store it in an old shoulder bag along with its accessories and other small goods like shorting RCA plugs, the dummy load cable and the line cable. I usually stored this bag in the cabinet mentioned above.

Instrument cabinet

If a carrying case is included in the instrument's accessories, it is useful for storage. If not, the original container box is the second best. The instrument and its accessories can be neatly packed.

Shoulder bag

Acoustic measurement instruments

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NOBODY Audio
Tonochi's Audio Room - Supplemental Information