The Wireless

August 2026

The Garden City Amateur Radio Club

PO Box 482 • Garden City, MI 48135-9998

Next Meeting:
Tuesday, September 15, 2026
7:00pm
Garden City Presbyterian Church
1841 Middlebelt (just south of Ford)
Garden City, MI 48135

A free, weekly, live, Amateur Radio Technician Class Licensing course on Zoom will begin on Thursday, Sept 3, and will run through Thursday, October 15 (7 sessions). The three-hour sessions will start at 6:30 PM Eastern Time. These are the classes that we have been holding for years sponsored by the National Electronics Museum. Please share this with anyone you know that you think would be interested. Those wishing to sign up should email me at roland.anders@comcast.net.

KC8SBE takes down an antenna tower for relocation.

Photos courtesy KD8NFH

The Garden City Amateur Radio Club, it's officers and members extend our deepest condolences to Mark, N8WFX, on the recent loss of his mother.

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Mat-Matics # 133:
HP 5335A Universal Counter Purchase, Evaluation, and Upgrade

-Mat Breton, N8TW

Introduction

This article describes the purchase, inspection, upgrade, and testing of an HP 5335A universal counter. Although introduced in the early microprocessor-controlled era of Hewlett-Packard test equipment, the 5335A remains a capable precision frequency and time-interval counter. A well-optioned example is still quite useful on a modern amateur-radio or electronics workbench.

Purchase History

I purchased this unit at the 2022 Dayton Hamvention for $70 after my friend Steve Sageman, WQ8T, pointed it out. A tag on the instrument suggests that it was originally purchased by Westinghouse Electric Corp. as part of a U.S. Navy contract in the 1980s. After government or industrial service, it eventually moved into the surplus market and finally onto a Hamvention table.

Frequency Counter Basics

A frequency counter measures how many cycles of a repetitive signal occur during a precisely defined time interval, called the gate time. In simple terms, it is a very accurate timebase combined with a pulse counter. For example, if the counter opens its gate for exactly 1 second and counts 1,000 cycles, the input frequency is 1,000 Hz. The basic relationship is:

$$\text{Frequency} = \frac{\text{Number of cycles counted}}{\text{Gate time}}$$

Mat-Matics #133 cont'd:

How a Frequency Counter Works Internally

Signal conditioning: The input signal is amplified, shaped, and converted into clean digital pulses that the counter can reliably count.

Timebase and gate generator: A highly stable internal oscillator establishes the gate interval, such as 10 ms, 0.1 s, 1 s, or longer.

Pulse counting: While the gate is open, each input cycle increments the counter.

Display updates: When the gate closes, the instrument calculates and shows the frequency.

Time-Interval and Universal Counter Functions

A related instrument function is time-interval measurement. Instead of answering "how many cycles occurred per second?", a time-interval counter answers "how much time elapsed between event A and event B?" This is useful for pulse width, delay between pulses, rise-to-rise timing, and propagation-delay measurements.

A universal counter combines frequency measurement with these additional timing functions, including period, time interval, pulse width, frequency ratio, totalizing, and sometimes duty cycle. For amateur-radio work, that flexibility makes the instrument useful for checking oscillators, aligning equipment, verifying signal-generator accuracy, and comparing frequency references.

HP 5335A Overview

The HP 5335A was introduced around 1980 as a universal counter for frequency, period, time interval, ratio, totalize, and related measurements. According to the HP 5335A Operating and Service Manual, additional capabilities were available through plug-in options. The base instrument sold for approximately $5,775 in 1980.

The 5335A belonged to HP's broader 53xx counter family. Earlier instruments such as the 5300A measuring system used a modular mainframe-and-plugin approach, while models such as the 5328A integrated frequency, period, time-interval, and ratio measurements into a bench instrument. In that progression, the 5335A represented a later, higher-capability counter with microprocessor control, strong low-frequency resolution, optional expansion modules, and suitability for both bench and automated test use.

Technically, the HP 5335A reflected the transition period of test equipment around 1980: it combined classic counter architecture with microprocessor-based control, programmable functions, and HP-IB/GPIB-oriented system use. That made it attractive not just as a standalone bench instrument, but also as part of automated test setups. Its options included a DVM module, a C-channel microwave module, and expanded control features, which helped it cover a wide range of timing and frequency tasks.

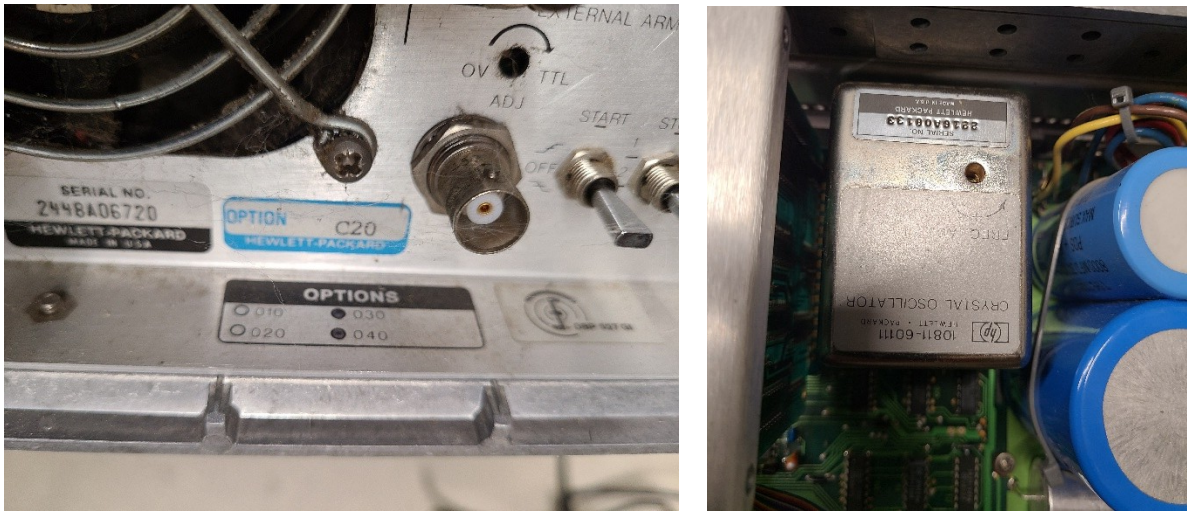
The standard instrument has two 150 MHz inputs with oscilloscope-style controls, including selectable 1 MΩ or 50 Ω input impedance, AC/DC coupling, and adjustable trigger levels. Channel A is normally used for direct frequency measurements. Channel B is primarily used with Channel A for timing measurements, such as time interval, ratio, or event-to-event measurements, rather than as a second independent frequency input. The instrument also supports arithmetic functions such as offset, scaling, and normalization, allowing readings to be displayed as relative frequency, parts per million, or other derived values. One useful feature is its ability to maintain good low-frequency resolution by using reciprocal or period-based measurement techniques, avoiding the long gate times required by simpler direct-counting instruments when measuring very slow signals.

Mat-Matics #133cont'd:

Installed Options

This unit came with all four major options installed. Option C10 was probably added after the original purchase. Options C30 and C40 were marked as factory-installed. Option C20 had an additional official sticker, indicating that the optional module was installed before shipment or as part of an authorized configuration.

- C10: High-stability double-oven timebase, specified at approximately 5×10^{-10} per day ($1,100)
- C20: 4-digit DC digital voltmeter module ($825)
- C30: 1.3 GHz C-channel module ($1,015)
- C40: Expanded GPIB Control ($950)



Option Stickers Left, C10 Timebase "Extra" on Right

Service Bulletins and Firmware

I located three HP service bulletins relevant to this counter and reviewed them before making any changes.

- **Option C10 rear-input interaction:** If the C10 special rear-input configuration is installed and the rear inputs are not terminated in 50 Ω, a parasitic step-filter effect can reduce sensitivity between approximately 82 MHz and 152 MHz when using the front-panel A/B inputs. My unit has the C10 option but does not have the rear-input configuration, so this bulletin does not apply.
- **C-channel diode upgrade:** During production, HP implemented an improved detection diode in the C-channel module. My unit already has this upgrade, so no change was required.
- **Power-supply relay upgrade:** The power-supply relay may overheat during continuous operation. Since I do not plan to operate the counter continuously, and the bulletin recommends replacement only on failure, I chose not to implement this change.

The instrument already had firmware version 1.1 installed. That avoided the need to decide whether to upgrade from the original version 1.0 firmware. One caution is that some C-channel modules were built with different prescaling factors, so firmware and C-channel compatibility should be verified before changing ROM versions.

Mat-Matics #133 cont'd:

Modifications

I considered several practical modifications: extending the front-panel gate range, quieting the fan, and investigating the possibility of extending the Channel C maximum frequency. The completed modification described here is the front -panel gate-range change.

Front-Panel Gate-Range Change

One interesting detail is that the gate timing circuit uses a monostable multivibrator, also known as a one-shot. This circuit produces a controlled timing pulse whose duration is set primarily by an RC time constant.

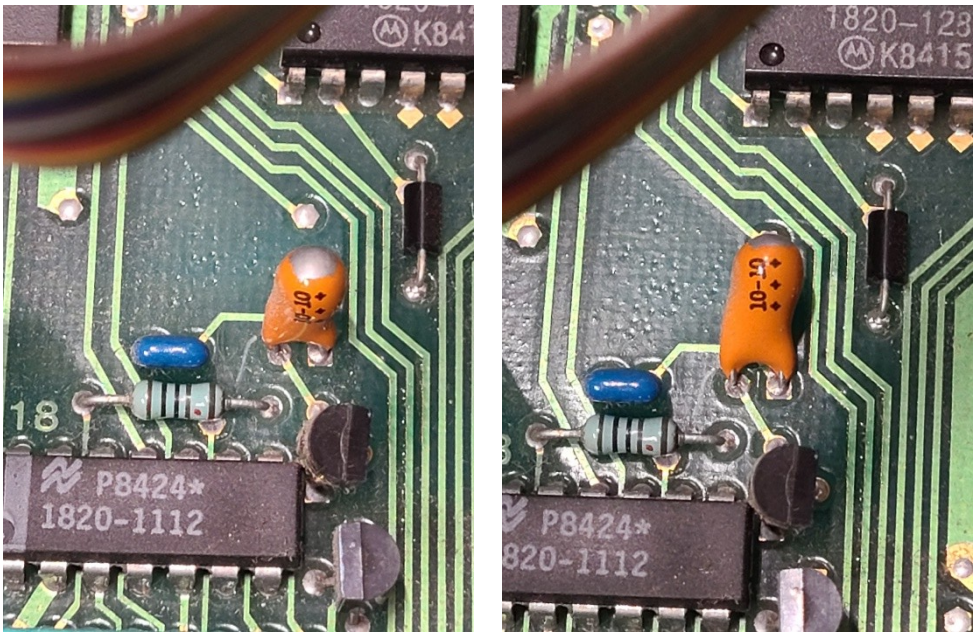
Why Gate Time Matters

Longer gate time → more accurate, more digits, slower update

Shorter gate time → faster update, less resolution

Changing the one-shot timing interval can be done by increasing either the timing resistance or the timing capacitance. Increasing either value increases the RC time constant and therefore lengthens the gate interval. In this case, changing the capacitor is the simpler modification.

Change A4C36 from 10 µF/10 V to 22 µF/10 V. The exact maximum gate time depends on component tolerances and capacitor leakage current, so the final value may vary slightly from unit to unit.



Original and New Capacitors

This change increases the "Gate Mode NORM" range from approximately 20 ms–4 s to roughly 50 ms–12 s, allowing up to 12 displayed digits instead of the original maximum of 10.

After testing, I installed a 22 µF/10 V tantalum capacitor, which produced a maximum gate time of about 12.5 seconds.

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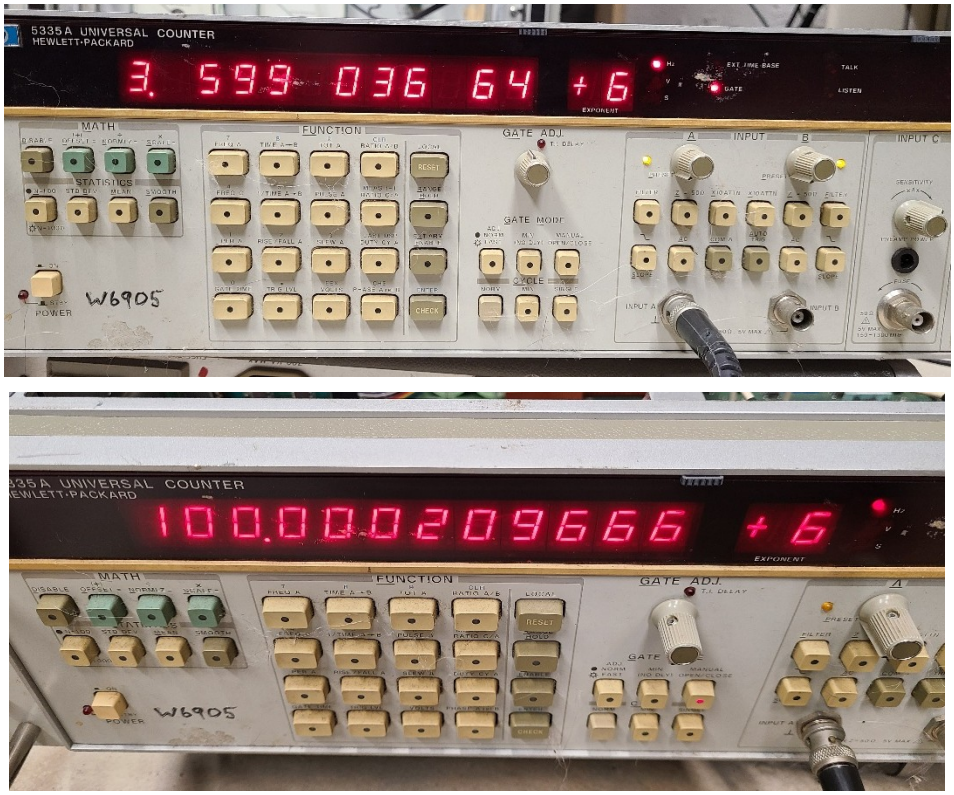

Before and After Displayed Resolution of the Maximum Manual Gate Times

In later production versions, HP appears to have replaced some of the earlier tantalum capacitors with alternative capacitor types, likely to improve long-term reliability.

Calibration and Performance Testing

Since the counter passed operational testing, the only adjustment I made was a slight trim of the precision oven oscillator. No other calibration changes were required. Note that the internal oscillator will only be used if my atomic clock is unavailable for some reason, as I slave all my frequency-related test equipment to my clock.

Performance testing: I connected a signal generator to the counter and locked the signal generator reference to a GPS-disciplined oscillator (GPSDO) for high accuracy. I then compared measurements with the counter using its internal reference and with the signal generator reference synchronized to the counter. Input C was tested up to 1 GHz, limited by the available precision frequency sources I had.

I also tested the input voltage sensitivity of Channels A, B, and C, and all three inputs passed.

Summary

For $70, I acquired a capable precision universal counter that now integrates well with the rest of my test equipment. After inspection, testing, calibration, and a useful gate-range upgrade, the HP 5335A is ready for regular bench use where it will operate as my primary universal frequency counter.

Cert is a volunteer-based program that allows members to assist with disasters or emergency situations when first responders are overwhelmed.

Join WESTLAND'S CERT COMMUNITY EMERGENCY RESPONSE TEAM

Who Can Apply:

- Anyone who is over the age of 18 and resides in Wayne County
- No prior criminal history (background check is required)
- No prior CERT experience is needed

What will I learn:

- Many aspects of emergency and disaster response
- Light search and rescue
- Fire safety
- Team building skills
- First aid (stop the bleed and CPR / AED training)
- Disaster psychology and disaster preparedness

What will I do as a CERT member?

- Assist with community events (parades, festivals, open houses)
- Help with weather situations or missing persons
- Emergency lifesaving skills, training and drills
- Provide critical support in disasters, until first responders arrive
- Help with public safety

Why should I join CERT?

- Gain life-saving skills
- Support your family and community during disasters
- Volunteer with Westland Fire, Police, and Emergency Services
- Build friendships and connections
- Learn important team-building skills

JOIN

Website: www.cityofwestland.com : Search 'CERT' for details, video, and application

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Westland Community Emergency Response Team (Cert)

What is Cert?

Cert is a volunteer based program that allows members to assist with disasters or emergency situations when first responders are overwhelmed.

Who Can Join Westland Cert?

- Any one who is over the age of 18 and resides in Wayne County
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How can I join?

Website: www.cityofwestland.com : Search 'CERT' for details, video, and application

Westland CERT
Community Emergency Response Team

Interested in helping your community during an emergency?
Leave your details below and a member will reach out to you

Full Name _____

Email Address _____

Phone Number _____

I am interested in learning more about:

- ☐ Basic First Aid and Triage
- ☐ Search and Rescue and Operations
- ☐ Disaster Preparedness
- ☐ Radio Communications
- ☐ Community Event Volunteering

Best Time to Reach You:

- ☐ Morning 9 am - 11 am
- ☐ Afternoon 12pm - 2pm
- ☐ Evening 4pm - 6pm

Thank you for your interest in the Westland CERT Team!