Heathkit of the Month #118:
by Bob Eckweiler, AF6C

Heathkit

ELECTRONIC TEST EQUIPMENT

Heathkit Accessory Probes – Part I: Voltmeter Probes:

Introduction:

Heathkit's first two kits were the O-1 Oscilloscope and the V-1 Vacuum Tube Voltmeter (VTVM). Over the life of the Heathkit company many different versions of these two products were sold. To make these products more versatile Heath manufactured special purpose probes (or prods)[1] for use with their instruments. A quick count totaled 21 probes for use with their voltmeters (**Table I**) and 17 probes for their oscilloscopes. **Part I** will cover the probes associated with the VTVMs (and the later solid-state and digital meters.) In **Part II** the probes for oscilloscopes will be covered.

Three types of probes were sold in support of Heathkit voltmeters:

RF Probes: for measuring RF voltages at frequencies much higher than the AC section of the instrument will allow (>100 mc vs ~7.2 mc). These probes also provide a higher degree of shielding, eliminating extraneous signal pickup, unlike the provided unshielded AC cables of the early VTVMs. The first RF probe offered was the #309 probe, which was produced in three versions. **Figure 1** shows the #309-C that the author has been using for over 50 years now. It still works.

Figure 1: Heathkit #309-C RF Probe for all Heath VTVMs. Measures up to 30.V RF on up to 500 VDC (+ VRF).

Peak-to-Peak Probes: for measuring the peak-to-peak voltage of an AC signal.

High-voltage (HV) Probes: for measuring voltages up to 30 kV. Different models were manufactured based on the input impedance of the instrument it was to be used with.

Heathkit also sold two stand-alone HV probes with built-in meters that measured up to 40 kV: the IM-5210 (1975 – 1983) and later the IM-5215 (1984 – 1991). Both will be briefly discussed.

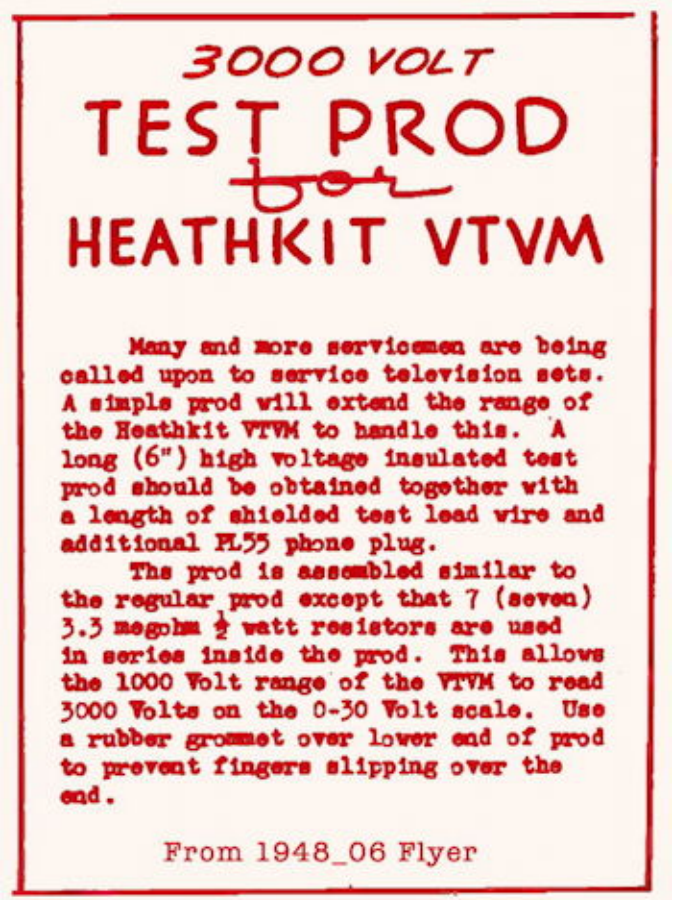
The Early Years:

Even before Heathkit began selling specialty probes for their test equipment, they were aware of the need. In an article in an early Heathkit flyer (June 1948) basic plans were given to build a probe that would allow your VTVM to measure to 3 kV [2] (**Figure 2**). About a half-year later Heathkit began advertising two probes that would work with "any" [3] of

Here is a link to the index of Heathkit of the Month (HotM) articles:

http://www.w6ze.org/Heathkit/Heathkit_Index.html

1. Notes begin on page 11



3000 VOLT
TEST PROD
for
HEATHKIT VTVM

Many and more servicemen are being called upon to service television sets. A simple prod will extend the range of the Heathkit VTVM to handle this. A long (6") high voltage insulated test prod should be obtained together with a length of shielded test lead wire and additional PL55 phone plug.

The prod is assembled similar to the regular prod except that 7 (seven) 3.3 megohm ½ watt resistors are used in series inside the prod. This allows the 1000 Volt range of the VTVM to read 3000 Volts on the 0-30 Volt scale. Use a rubber grommet over lower end of prod to prevent fingers slipping over the end.

From 1948_06 Flyer

Figure 2: Tech note in the June 1948 Heath flyer discussing how to build a simple probe to extend the V-1 VTVM to measure 3 kV.

their VTVMs; which at the time, were the V–1 and V–2. They are the #309 R.F. Probe and the #310 High Voltage Prod (**Figure 3**).

The #309 RF probe converts RF to a DC voltage to allow measuring RF rms voltage to over 100 mc. Though it was designed for use by the TV repairman, it turned out to be a necessity to amateurs adjusting their transmitters.

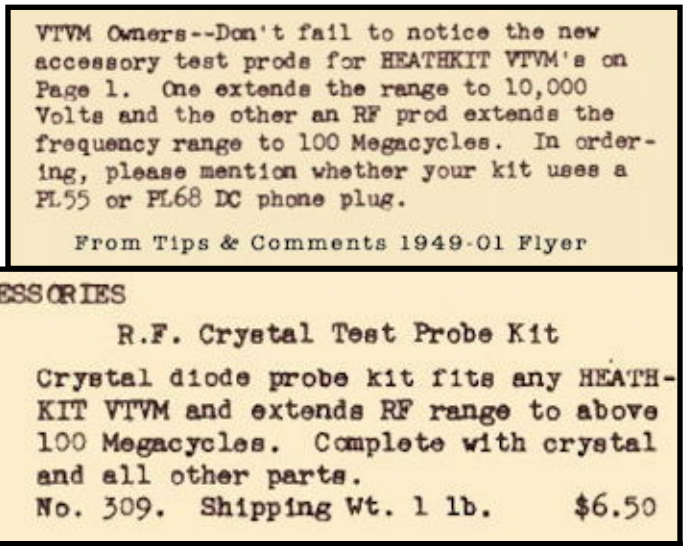
The #310 HV probe provides a 10:1 increase in voltage measurement allowing the 300 V and 1,000 volt ranges to measure 3 kV and 10 kV respectively. Equipment to measure high voltage was becoming a necessity to check the high voltage on the TV picture tube anode.

In mid 1950 the #310 was replaced with the #336, increasing the HV measurement capability to 30 kV as picture tubes got larger and used higher voltages.

Then, in the 1952 main catalog, a third probe, the #338 peak-to-peak probe, was added, though it only showed up on the order blank in my partial catalog. It also showed up in the Oct 1952 flyer at $6.50. When Heathkit released the V-7 it added a peak-to-peak voltage scale to the meter face and the peak-to-peak probe was discontinued shortly later.

A Polished Aluminum Probe Body:

In September of 1952 Heathkit announced their new kits for 1953. Included in the new kits was Heathkit's third generation signal



VTVM Owners--Don't fail to notice the new accessory test prods for HEATHKIT VTVM's on Page 1. One extends the range to 10,000 Volts and the other an RF prod extends the frequency range to 100 Megacycles. In ordering, please mention whether your kit uses a PL55 or PL68 DC phone plug.

From Tips & Comments 1949-01 Flyer

VTVM ACCESSORIES

10,000 Volt H.V. Test Prod Kit

Complete kit to assemble test probe which extends the range of any HEATHKIT VTVM to 3,000 and 10,000 Volts.
No. 310. Shipping Wt. 1 lb. $4.50

R.F. Crystal Test Probe Kit

Crystal diode probe kit fits any HEATHKIT VTVM and extends RF range to above 100 Megacycles. Complete with crystal and all other parts.
No. 309. Shipping Wt. 1 lb. $6.50

From 1949-01 Flyer

Figure 3: In January 1949 Heathkit introduced its first two probes, both designed for the V-1 & V-2 VTVMs.

tracer, the T-3. The RF probe that comes with the T-3 is built into a polished aluminum tube 3½" long by ⅞" in diameter with a conical red plastic end cap [4] threaded to take a probe tip, and a conical black plastic end cap [5] drilled for shielded cable and braid ground lead exit. An acetate insulator sleeve slides into the aluminum tube to prevent shorts. All the VTVM probes take the same aluminum tube part [6]. Starting in 1953 this probe body began being used on all probe kits except the heavily insulated high-voltage probes. **Figures 1** and **5** show this "red - aluminum - black" style probe body. Probes using this style continued to be manufactured into the 1990's, shortly before Heathkit stopped making electronic kits. Later kits that use this probe body style came with a decal sheet with decals for four of the probes, each marked with the Heathkit logo and the name of the probe. No part number is on the decal, but later units also came with the blue - white label that has the model number. The decals are labeled **"PEAK-TO-PEAK PROBE "; "R. F. PROBE"; "LOW CAPACITY PROBE"** and **"SCOPE DEMODULATOR PROBE".** Some decals have horizontal lines and others don't, depending on the print run. A photo of the decal sheet is shown at the end of the article **(Figure 12)**.

The VTVM RF Probes:

Typical VTVMs can measure AC voltages into the low MHz range. However, many VTVMs have unshielded leads that can add problems during measurements. An RF probe turns the RF signal into a DC voltage that can be read on the DC scale of the VTVM. The voltage read is the RMS value of the RF voltage being measured.

#309:

The early 1949 #309 RF probe uses a 6 inch long phenolic-like tube with a brass probe tip on one end. The other end of the tube has external threads that mate with the ring on an Amphenol 75-MC1F (432-1) microphone connector. Inside the tube sits a 0.02 µF 500 VDC blocking capacitor, a diode (1N34) [7] and a 4.7 MΩ resistor. A shielded cable leaves the connector along with a length of braided cable. The braided cable terminates in an alligator clip that grounds to the device under test, and the shielded cable ends in a ¼" phone plug that connects to the VTVM. The #309 is rated

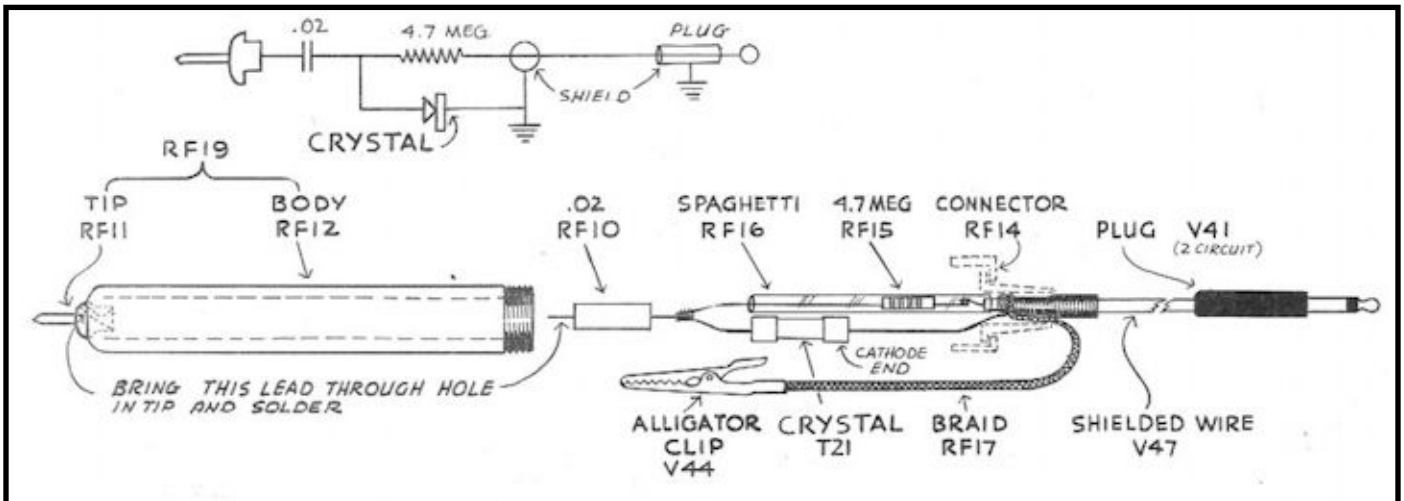


Figure 4: Schematic and assembly drawing of the early #309 probe using the early style probe housing. Part numbers are given in the old Heathkit part # scheme. See HOM #95, page 4 for brief details.

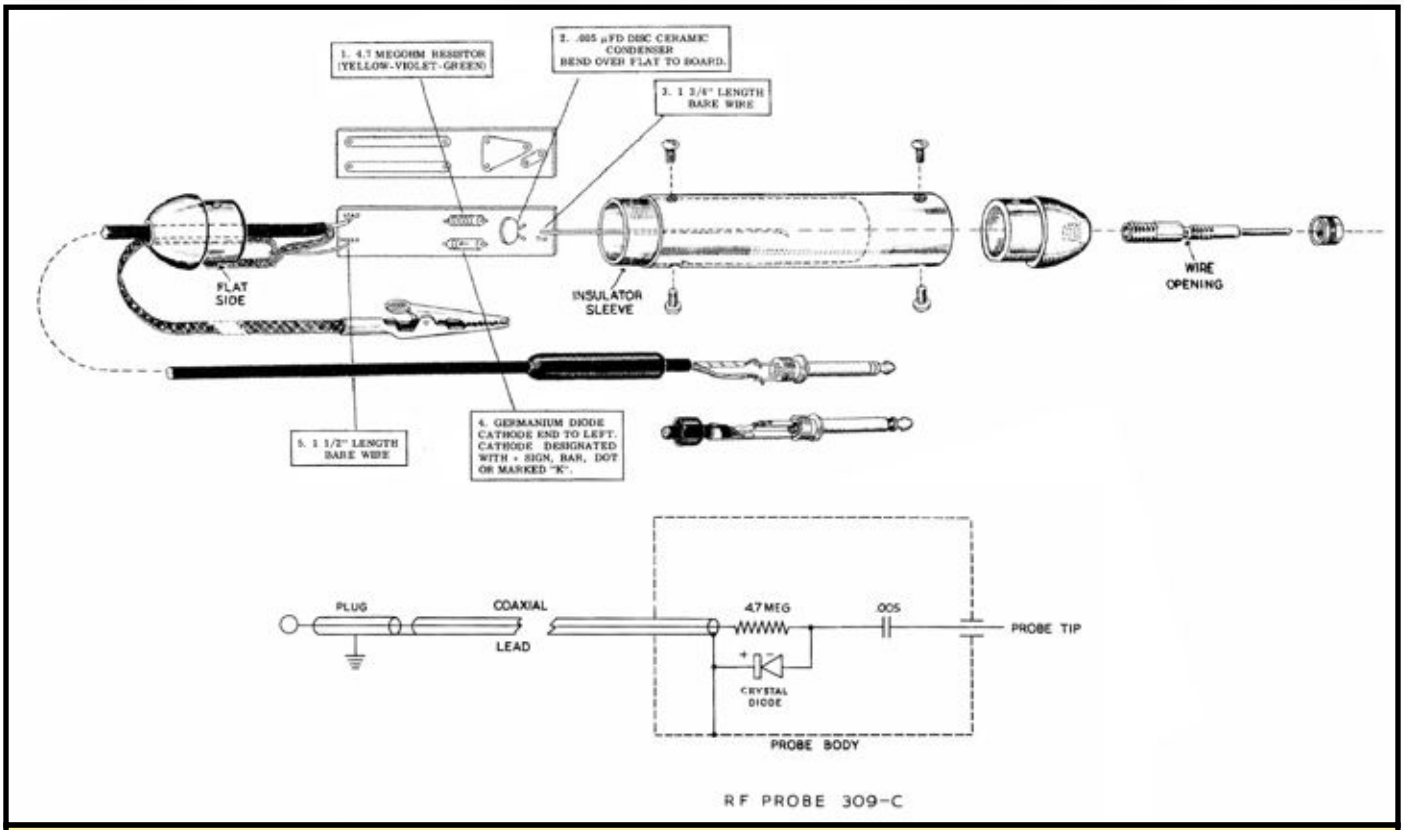


Figure 5: Schematic and assembly drawing of the #309C probe using the later "Red - Aluminum - Black "probe housing & PC board.

for 20 volts RF and 500 VDC. **Figure 4** shows the #309 circuit and assembly illustration.

#309-B:

In late 1953 the #309 was repackaged into the #309-B using the "red - aluminum - black" style probe-housing discussed previously. Components mount on a small phenolic board where holes are used as tie points. Leads are passed through a hole, twisted, soldered together and then trimmed to ¼" and bent over to hold the connection in place. Circuit-wise, the only change is the value of the capacitor which decreased to 0.01 μF 500 VDC. The diode may have changed too (likely to the Hughes HD2257), as the #309-B is rated for 30 volts RF and 500 VDC.

#309-C:

The 309-C is identical to the 309-B with the exception that the small phenolic board was replaced with a printed circuit board that held the components. Also, the blocking capacitor value was decreased further to 0.005 μF. Comparing a manual dated 9/4/64 and one dated 7/29/66 the diode used in the 309-C changed from a Hughes HD2257 (56-4) to a 1N191 (56-26). The HD2257 is marked with three bands; red - green - violet and the 1N191 is marked with three bands; brown - white - brown. The #309–C is rated for 30V RF and 500V DC. **Figure 5** shows the #309-C circuit and assembly illustration.

A factory assembled #309-C became available late in production as the #309W-C.

Through its existence, the #309 probe series was specified, in available manuals, as "over 100 [MHz]". However, many of the catalog ads state "up to 250 [MHz]" for each of the three models in the series.

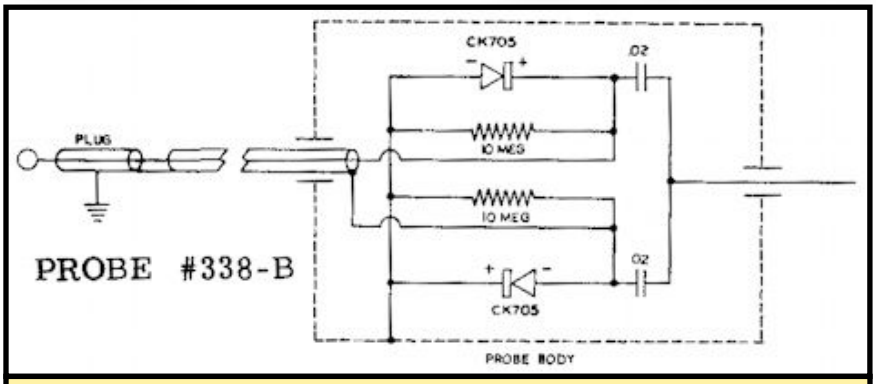


Figure 6: Schematic of the #338 series Peak-to-Peak Probes.

The #309 series output is a negative [8] DC voltage equal to the RMS voltage of the RF signal being measured. Be sure the FUNCTION switch is in the **DC−** position.

PK-3:

The PK-3 replaced the #309-C RF probe in early 1970. It offers the capability to measure higher RF levels and RF atop higher DC levels. It is spec'd at up to 90 volts of RF and a maximum of 1000 V (DC + RF). This is accomplished by using three 1N191 crystal diodes in series. While this allows higher measurement capability, it introduces some errors when measuring low RF voltages. The kit has the option to use a single diode and limit the RF capability to 30 V. Again the blocking capacitor has been further reduced to 1000 pF (0.001 µF).

The PKW−3, a factory wired model of the PK−3, was also available from Heath.

PK-3A:

The PK-3 was upgraded to the PK-3A around mid-1979 in response to the numerous new FET meters (both digital and analog) that Heathkit was selling. Most of these have a 10 MΩ input impedance. The PK-3A could be built for use with meters having either input impedance. If built for 11 MΩ it is identical to the PK-3 except for diode polarity. If built for 10 MΩ the internal resistor changes from 4.7 MΩ to 3.9 MΩ; at the same time the phone plug at the end of the cable is replaced with a dual banana plug to mate with the new meters. The PK-3A also has the option to use a single diode for measuring more sensitive RF voltages. While all the other RF probes produce a negative DC output, including the PK-3, the PK-3A produces a positive voltage, so if you are using the 11 MΩ PK-3A with a VTVM be sure the FUNCTION switch is in the **DC+** position.

The PKW-3A, a factory wired model of the PK-3A, was also available from Heathkit. It was sold alongside the PK-3A until

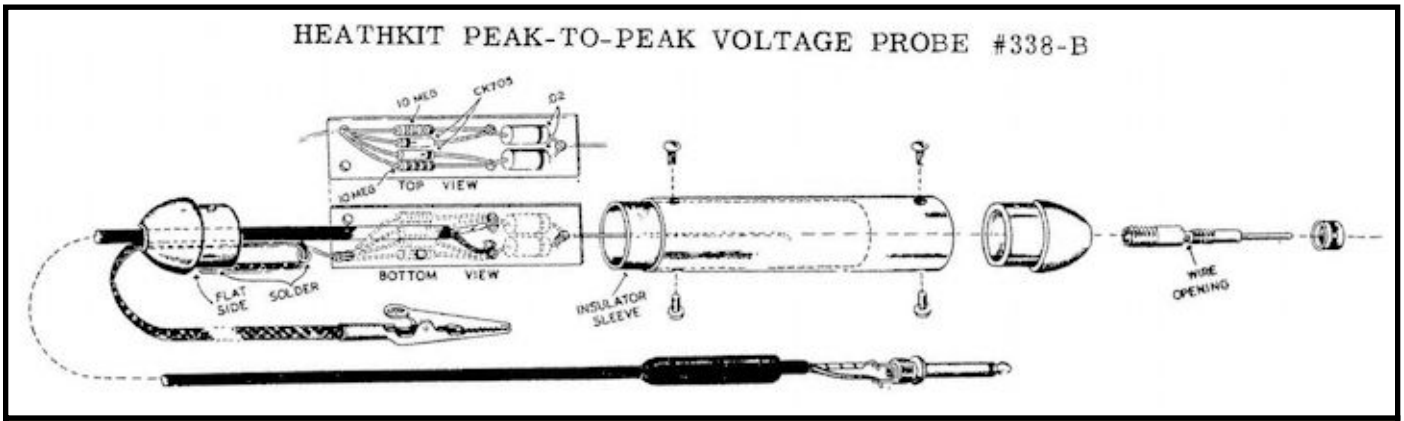


Figure 7: Assembly drawing of the #388-B probe using the later probe housing. Note phenolic board with brass rivets in holes for mounting components.

mid-1981. The kit version continued to be sold until late in 1987.

Figure 8: #336 30 kV HV Probe. This probe mounts in a red and black plastic body that Heathkit used for all their HV Probes (Part # 476-2) with the exception of the early #310.

The VTVM Peak-to-Peak Probes:
The AC scale on a VTVM usually reads RMS voltage and assumes the AC signal is a sine wave. The #338 series of probes reads the actual peak-to-peak voltage being measured. For a sine wave this would be 2.83 or $(2\sqrt{2})$ times the RMS value.

#338:
The #338 probe was introduced in 1952. It is built into the same phenolic-like tube as the early #309 probe. Little can be found on the original #338, but it appears the circuit stayed the same, or very close, between the three models.

#338-B:
The #338-B was introduced in late 1953. Like the 309-B it appeared in the red - aluminum - black style probe-housing. The components mount to a phenolic board in a similar fashion to the #309 B (See **Figures 6** and **7**.)

#338-C:
The 338-C was introduced with little fanfare along with the #309-C in the fall of 1955. The only change is that the phenolic board that holds the components was replaced with a printed circuit board.

The #338-C was the last of the peak-to-peak probes. Starting with the V-7 VTVM in 1953 Heathkit added a Peak-to-Peak scale on its meter face. The scale corresponding to the 15 V RMS range reads 0 - 42.4 peak-to-peak volts. (Though the actual scale terminates short of full-scale at 40), and the corresponding 50 V RMS scale reads 0 - 141.2 peak-to-peak volts. (Though the actual scale terminates short of full scale at 140). These scales are only accurate when measuring peak-to-peak voltages of sine waves. Heathkit continued selling the #338-C until around 1960, but never advertised a factory assembled unit.

The VTVM High Voltage Probes:
With the possible exception of the early #310 probe, all the high-voltage probes use the same probe body (476-2); a red housing with a black handle and a brass probe-tip; the end of the handle has male threads to mate with an

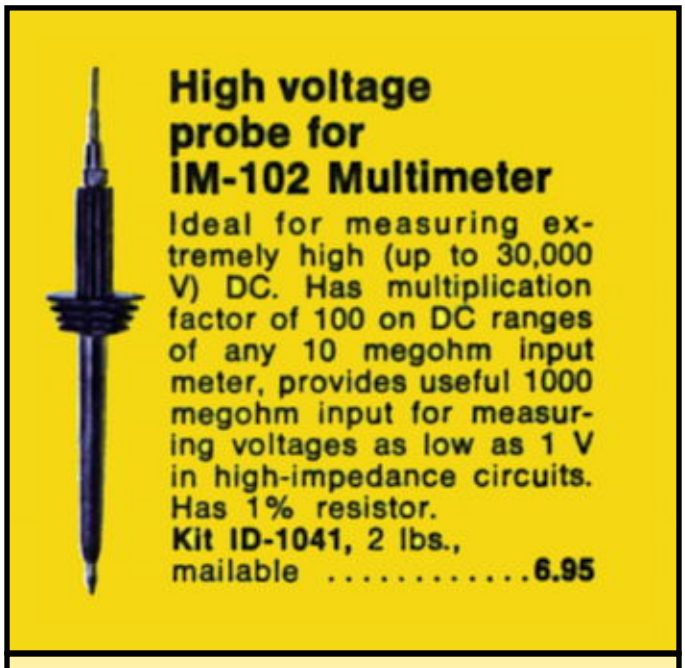


Figure 9: The ID-1041 HV Probe was designed for the IM-102 DVM with its 10 MΩ impedance.

Amphenol 75-MC1F connector. The significant difference between the models is the value of the high-voltage resistor installed in the probe housing. Also, some of the later probes have different connectors at the far end of their cable to mate with different types of later style meters. The internal resistor value used with each probe is given in the heading; none of the resistors dissipate more than 1 watt.

#310: (R = 100 MΩ)
The #310 10,000 volt HV Probe is for use on 11 MΩ input VTVMs. It uses a probe housing with an old, unknown part #. The probe divides the measured voltage by ten. It uses a 100 MΩ HV resistor. Early VTVMs have a 1,000 volt range that can be used with the probe to measure 0 - 10,000 volts. One can also measure 0 - 3,000 volts on the meter's 300 volt range. Later VTVMs have a 1,500 V range but should only be used up to 1,000 on the scale, to measure 0 - 10,000 V. Use the 500 volt range to measure 0 - to 5,000 V. You should never try to measure more than 10,000 volts. Since it is used with an 11 MΩ meter the total resistance for x10 is 110 MΩ. The probe internal resistor is 100 MΩ, and the internal VTVM resistance is 10 MΩ summing to give the required 110 MΩ.

#336: (R = 1090 MΩ Part # 2-47)
The #336 30,000 volt HV Probe replaced the #310 in 1950. It is also for use with 11 MΩ VTVMs. It was the first to use the 476-2 probe housing. It divides the measured voltage by 100. Since it is used with an 11 MΩ meter the total resistance for x100 is 1100 MΩ. The probe internal resistor is 1090 MΩ and the internal VTVM resistance is 10 MΩ summing to give the required 1100 MΩ. The resistor is a BEMAN – MP-6, 1090 MΩ 2%, Ceramic, 6 Watt Resistor [9].

A factory assembled version, #336-W, was available starting around late 1961.

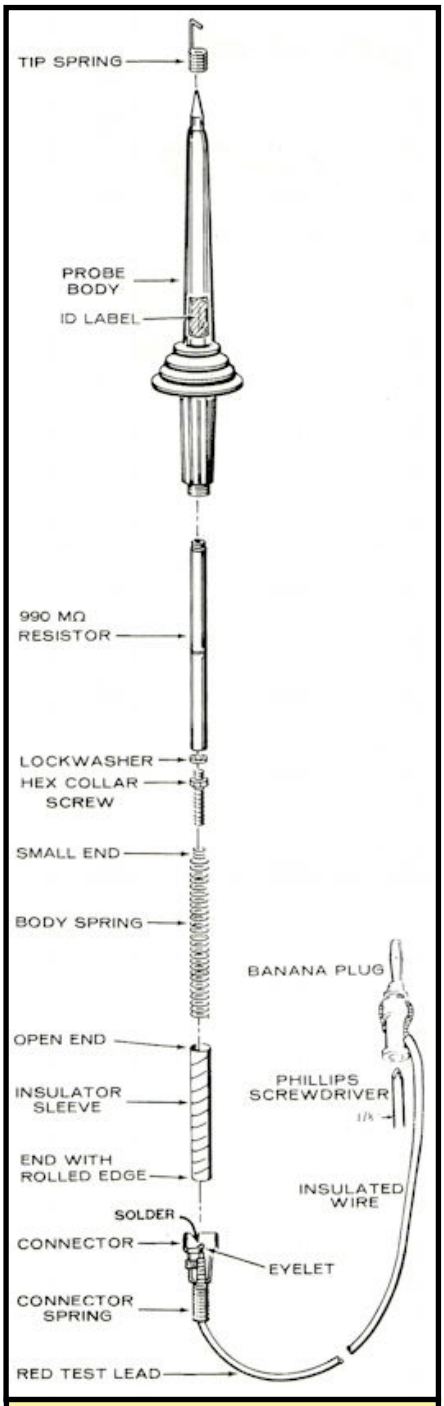


Figure 10: Assembly drawing of the IMA-100-10 and its banana plug output connection.

ID-1041: (R = 990 MΩ 1%, Part # 2-307)
From 1972 to 1975 the ID-1041 30,000 volt HV Probe was built specifically for the IM-102 Digital Multimeter (**Figure 9**). It divides the input voltage by 100 and works with any later FET meter with a 10 MΩ input impedance. Since it is used with the 10 MΩ IM-102, the total resistance for x100 is 1000 MΩ. The probe internal resistor is 990 MΩ, and the internal meter resistance is 10 MΩ, summing to give the required 1000 MΩ. No manual was available but it is believed the output connection is via banana plugs. A factory assembled option was not available.

IMA-100-10: (R = 990 MΩ, Part # 2-307)
In 1975 Heathkit refreshed their com-

plete lineup of HV probes using the model designation IMA. Designed to support 10 MΩ FET meters that Heath was adding to their voltmeter line, the IMA-100-10 replaced the ID-1041. Output is a single heavy red wire with a banana plug for connecting to the FET or digital meter. No ground cable is supplied as the one supplied with the meter is expected to be used.

A factory assembled SMA-100-10 was sold from mid-1983 through 1986.

IMA-100-11: (R = 1090 MΩ Part # 2-47)
This unit replaced the #336 probe. They are virtually identical. The output cable is terminated in a phone plug, a ground lead with attached alligator clip provides the ground path. The SMA-100-11, a factory assembled version, was sold from 1975 through 1980.

IMA-1000-1: (R = 999 MΩ Part # 2-344)
In 1975, along with the two other 30 kV IMA HV probes, Heathkit released the IMA-1000-1 which divides the measured voltage by 1000. It is designed to be used with devices that have an input impedance of 1 MΩ such as the IM-1212 DVM. It can also be used to view high voltages on an oscilloscope, many of which have a 1-MΩ input impedance. Since it is used with a 1 MΩ input device, the total resistance for x1000 is 1000 MΩ. The probe internal resistor is 999 MΩ and the internal resistance of the measuring device is 1 MΩ summing to give the required 1000 MΩ. A factory assembled option was not available.

Stand Alone HV Probes:
This is a good point to mention that Heath also offered two 40 kV HV probes, the IM-5210 (Circa late 1975 – 1983) and the IM-5215 (Circa 1983 – 1986) These probes have a meter built into their handle. The meter is 50 µA and the resistor is 800 MΩ, 2% (2-331).

Heathkit Probes for VTVMs and DVMs		
#	Part #	Description
1	#309	11 MΩ RF
2	#309-B	11 MΩ RF [a]
3	#309-C	11 MΩ RF [a]
4	#309W-C	11 MΩ RF [a] [c]
5	#310	11 MΩ HV 10 kV x10
6	#336	11 MΩ HV 30 kV x100 [b]
7	#336-W	11 MΩ HV 30 kV x100 [b] [c]
8	#338	11 MΩ Peak-to-Peak
9	#338B	11 MΩ Peak-to-Peak [a]
10	#338C	11 MΩ Peak-to-Peak [a]
11	ID-1041	10 MΩ HV 30 kV x100 [b]
12	IMA-100-10	10 MΩ HV 30 kV x100 [b]
13	SMA-100-10	10 MΩ HV 30 kV x100 [b] [c]
14	IMA-100-11	11 MΩ HV 30 kV x100 [b]
15	SMA-100-11	11 MΩ HV 30 kV x100 [b] [c]
16	IMA-1000-1	1 MΩ HV 30 kV x1000 [b]
17	PK-3	11 MΩ RF [a]
18	PKW-3	11 MΩ RF [a] [c]
19	PK-3A	11 MΩ RF [a]
20	PKW-3A	11 MΩ RF [a] [c]
21	PKW-4	11 MΩ Replacement cable [c]
	[a] "red - aluminum - black" probe body style	
	[b] "Red & Black" HV probe body (476-2)	
	[c] Factory assembled probe	

TABLE I

IM-5210:
The IM-5210 features a switch that shorts out the sensitive meter when not in use. This tends to protect the meter movement from swinging wildly if jarred during transport.

IM-5215:
Little information on the IM-5215 could be found on the web. It appears to be lacking

the switch but otherwise is similar in appearance.

A Replacement VTVM Probe – PKW-4:

Many of the early Heathkit VTVMs use three test leads. A black "common" cable with a black banana plug on one end and an alligator clip on the other; a red "AC-OHMS" cable with a red banana plug on one end and a red test prod on the other; a shielded black cable with a ¼" phone plug on one end and a black test prod, with a series 1 MΩ resistor at its tip, on the other end. Should they be lost or damaged they could readily be fixed by easily obtainable parts at the time. These VTVMs can be recognized as they have two banana jacks and a phone jack on their front panel.

However, later VTVMs use a *"new slim all-purpose probe"* that has a phone plug on one end with two cables leaving the plug. One cable is a black "common" test lead terminating with an alligator clip, and the other is a shielded cable terminating in a special prod that contains a flippable switch that selects either "**AC – OHMS**" or "**DC**". This switch switches in the 1 MΩ resistor that is located near the tip of the prod when "DC" is selected. Should this test probe be lost or broken, a replacement would be hard to find or even make. Realizing this, Heath, between 1978 and 1986, offered a fully assembled replacement probe assembly. When introduced, the PKW-4 sold for $8.95; later, before it was discontinued in late 1986 the price had risen to $19.95.

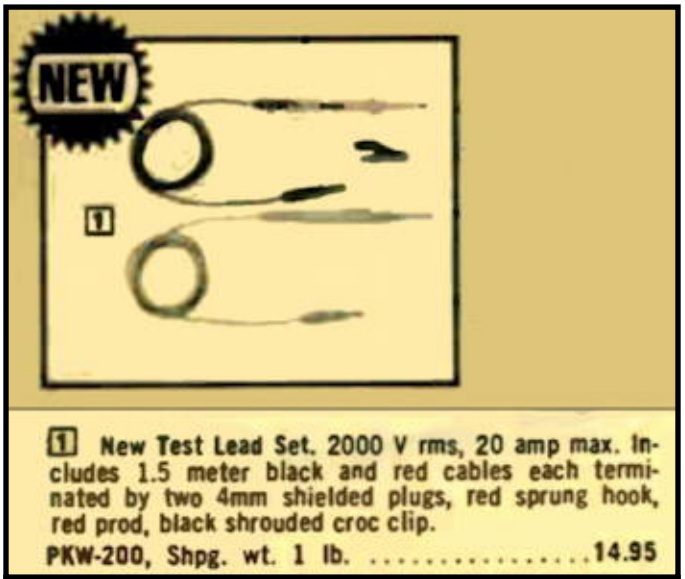


Figure 11: Introductory ad for the PKW-200 from the Fall 1980 Heathkit Catalog #850 page 56

PKW-200 Versatile Test Lead Set:

Little can be found on the PKW-200 other than a short description in a few catalogs. It is basically two unshielded 2000V 20 amp, 1.5 meter (about 5 feet) test leads, one red and one black, with a "4mm shielded plug" [11] Note: 11 on each end. Included are a red prod, a red sprung hook [12] and a black shrouded crocodile clip. Each appear to be designed to mate with the 4mm plug so you can have different ends on the test leads. No suggested use for this product was mentioned in any of the ads. It would work well with an appropriate analog or digital multimeter to measure voltage; the 20 amp lead capability means it can also be used with an appropriate multimeter to measure high current. The PKW-200 was first listed in the Fall 1980 #850 catalog at $14.95. In 1981 the price was increased by a dollar It remained at $15.95 until the 1983-84 winter catalog where it was shown, but instead of a price *"no longer available"* was printed.

Safety First:

When measuring High Voltage be sure to:

- Never measure voltages higher than the rating of the probe.
- Be sure the proper ground lead is connected.
- Be sure the probe is connected to the meter.
- When possible, make the connection using the probe sprung hook with the voltage off.

Then turn the power on to measure. After measuring, turn the power off. Discharge any HV capacitors prior to removing the probe.

Conclusion:

The VTVM probes give users extra versatility making measurements. A Heathkit VTVM is still a useful instrument to have on your bench. It is rugged and the only two parts you're ever likely to destroy by misuse are the 6AL5 rectifier tube and the 9.1 ohm resistor [10] in the ohms divider chain. The 6AL5 can be damaged by measuring a high AC voltage with the range switch in one of the low voltage settings, and the resistor can be damaged trying to measure voltage with the FUNCTION switch in OHMS position. Both components are readily available and easy to replace. Probably the most common damage to these meters is caused by not checking the battery often. I remove the batteries when I'm not expecting to use the meter within a month. The meters also are marked with a label with Battery Installation Date, battery manufacturer, and a box to check noting "batteries removed.

In a future article the probes Heathkit sold for their oscilloscopes will be covered. **Table II** shows the basic model numbers for the various Heathkit probes that are being covered.

BASIC TEST PROBE MODELS	
PROBES FOR OSCILLOSCOPES	**PROBES FOR VOLTMETERS**
Model #	**Model #**
337	309, -B, -C
342	310
P-150	336
P-250-2	338, -B, -C
P-350-2	ID-1040
PK-1	IM-5210 All-in-one
PKW-104	IM-5215 All-in-one
PKW-105	IMA-100-10
PKW-2	IMA-100-11
PS-150	IMA1000-1
	PK-3, -3A
	PKW-4
MISCELLANEOUS PROBES	
Model #	
PKW-200	

TABLE II

Ramblings:

I was looking for something short to write on as my external workload has gotten hectic. I recently picked up a box of electronic "junk". In it were a couple of Heathkit probes, along with an old Hammarlund FS-135-C 100 kc frequency standard (circa 1948 - 1955). The two Heathkit probes are model PK-1. On one the tip is broken off, but I should be able to find a replacement. They are in the "red - aluminum - black" style. These work with some of the older vacuum tube oscilloscopes.

The article took a lot longer to finish than I had thought, so with that and our editor rushing due to an impending trip, I missed last month's RF deadline. Thus you are reading this a month late. However, I have extra time to start on the next article.

Speaking of publishing this article in "RF", Let me comment that "RF" is the newsletter of the Orange County Amateur Radio Club, that is celebrating its 90th anniversary this September. They are allowing me to post my articles on the website after they appear in the newsletter. So let me give recognition to our current club members who have also sup-

ported these articles by acting as rotating editors for the newsletter and/or passing along Heathkit paraphernalia.

In alphabetical order:

Steve Belasco - N1BKB
Tom Cowart - W6ETC
Frank Doting - W6NKU
Tim Goeppinger- N6GP
Nicholas Haban - AF6CF (darn near stole my call!)
Ken Konechy - W6HHC (Club webmaster emeritus)
Tim Millard - N6TMT
Corey Miller - KE6YHX (Current Editing Manager)
Ron Mudry - W6WG
Tony Scalpi - N2VAJ
Jim Schultz - AF6N
Dan Violette - KI6X (New Club Webmaster)

73, from AF6C

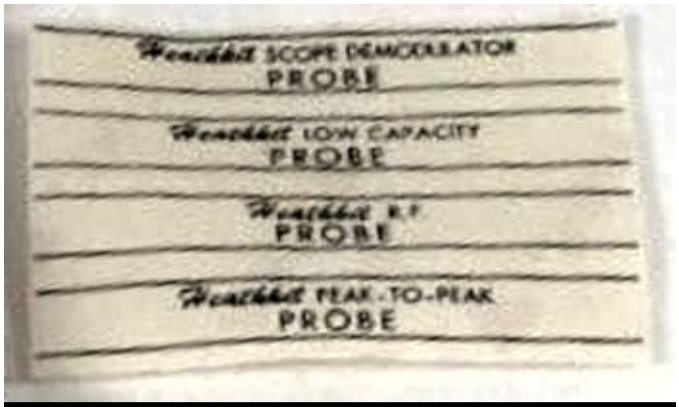


Figure 12: The decal sheet, (Part # 390-13) provided with later probes using the red - aluminum - black probe body.

Remember if you are getting rid of any old Heathkit Manuals or Catalogs, please pass them along for my research.

*This article is copyright 2023, and originally appeared in the September issue of '**RF**', the newsletter of the Orange County Amateur Radio Club - W6ZE.*

Thanks - AF6C

Notes:

1. In the early years Heathkit used the word "prod" instead of "probe" Both are correct, and both are still used today.
2. The V-1 has 5 voltage ranges: 3V, 30V, 100V, 300V, 1000V
   The V-2 through the V-5A have 6 voltage ranges: 3V, 10V, 30V, 100V, 300V, 1000V
   The V-6 and above have 7 voltage ranges: 1.5V, 5V, 15V, 50V, 150V, 500V, 1500V
3. While the Heath VTVM ranges sometimes changed with a new model, the voltage range divider resistors aways added up to 10 Meg Ω internally with an additional 1 Meg Ω resistor in the probe tip when measuring DC. The resulting 11 Meg Ω means the probs will work with all the meters.
4. Part # 459-M2 (459-2) red probe tip end (tapped).
5. Part # 459-M3 (459-3) black probe tip end (not tapped)
6. Part # 476-8 (0.035 wall thickness), drilled 4 places. Other aluminum tubes, with different part numbers, machined for a slide switch, adjustable capacitor access etc. are used with the various scope and other probes.
7. The use of the 1N34 crystal diode (56-1) was stated in many of the ads at the time. The 1N48 and CK705 are also listed under (56-1). Other diodes were used throughout the life of the #309 series, including the Hughes HD2257 (56-4) and the 1N191 (56-26)
8. Negative output was selected because the diode presented less capacitance with the cathode to ground.
9. A tthe time this was written this resistor is still available at: https://www.electronicsurplus.com/beman-mp-6-1090meg-2-resistor-ceramic-1090meg-ohm
10. The value of this resistor varied in different VTVMs. However it was in the range of 8 – 10Ω.
11. A "4mm shielded plug" is evidently a banana plug, though I wonder if they meant insulated instead of shielded. This test lead set may have come from Europe.
12. A sprung hook is a spring loaded hook on the probe tip that may be clipped onto a terminal. wire or other point in a circuit, usually before applying power so the measurement may be made hands free and eliminate the damaged should a hand-held test probe slip and short something out.

Notes for HotM #118 (VTVM Probes) 9/2023 rev. A

REVISION NOTES:

A (Oct 18, 2023):
Page 3: Additional text added to end of paragraph "A Polished Aluminum Probe Body":

Later kits that use this probe body style came with a decal sheet with decals for four of the probes, each marked with the Heathkit logo and the name of the probe. No part number is on the decal, but later units also came with the blue - white label that has the model number. The decals are labeled **"PEAK-TO-PEAK PROBE "; "R. F. PROBE"; "LOW CAPACITY PROBE"** and **"SCOPE DEMODULATOR PROBE".** Some decals have horizontal lines and others don't, depending on the print run. A photo of the decal sheet is shown at the end of the article **(Figure 12)**.

Page 9: Paragraph added:
"PKW-200 Versatile Test Lead Set":

This paragraph originally appeared in **Part II** of the article. It was moved to **Part I** since it related more to VTVMs and meters than oscilloscopes.

Page 11: Figure 12 added:
Figure 12 shows a photo of the decal sheet.

