



Ballantine Laboratories, Inc.

P/N 89-11341-1

Environmentalized X5 Attenuator Probe Kit

for

Model 9601M-AN/USM-413

AC Analog Voltmeter

1. SPECIFICATIONS

1.1 GENERAL DESCRIPTION

1.1.1 Part Number 89-11341-1 is an environmentalized passive X5 Attenuator Probe kit. It includes safety features per MIL-STD-454 and UL 1244. A triaxial BNC termination connector is incorporated for use with the Ballantine Model 9601M-AN/USM-413 environmentalized flight line AC Analog Voltmeter. The probe is fully compliant to Class II environmental requirements including operation over the temperature range from -40° to $+71^{\circ}\text{C}$. The probe is a direct replacement for Ballantine probe P/N 89-10348-1 described in the illustrated parts breakdown of U.S. Air Force T.O. 33A1-12-1083-1.

1.1.2 The 89-11341-1 probe provides high input impedance of 10 Megohms shunted by 24 pF for the Model 9601M voltmeter which has an input resistance of 2 Megohms shunted by 30 to 37 pF. The probe features a small body for use in compact circuits. The probe accepts a variety of accessory probe tips which screw into the probe body or press onto the sturdy low capacitance tip accessory. A flexible tip prod accessory permits attachment to test points having an 0.08 inch receptacle. A BNC adapter permits the probe tip to mate with standard female BNC connectors in a fully shielded manner.

1.1.3 The probe is fully modular with the probe head, the cable, and the termination each individually replaceable. No tools are required since the cable simply screws onto connectors in the probe head and termination.

1.1.4 A 45 inch (114 cm) environmentalized and strain relieved coaxial probe cable is used to provide a probe with 4 foot (122 cm) extended length. The probe is compensated to the voltmeter by means of a variable capacitor located in the termination. Access to this capacitor is provided by removing the soft plastic rain proofing fitting. Any small insulated screwdriver may be used to adjust the capacitor although a handy adjustment tool is provided with the probe kit.

1.2 ELECTRICAL SPECIFICATION

1.2.1 Applicability

The 89-11341-1 probe is specified for use with the Ballantine Model 9601M-AN/USM-413 AC Analog Voltmeter.

1.2.2 Probe Input Capacitance and Resistance

The probe input capacitance is measured at a frequency of 100 kHz or 1 MHz using a Tektronix Model 130 L.C. Meter. The voltmeter must be turned on and the probe connected to the input connector while making these measurements.

Input Shunt Capacitance:	19 to 24 pF
Input Resistance:	10 Megohms

1.2.3 Attenuation

X5 attenuation from DC to > 1 MHz.

1.2.4 Compensation Range

The probe may be frequency compensated when the input capacitance of the voltmeter is within the range of 30 to 37 pF. The probes may be transferred between voltmeters without recompensation when the input capacitance of the various voltmeters is set to 36 ± 1 pF.

1.2.5 Bandwidth

The probe will not deteriorate the bandwidth of the voltmeter to beyond 1 MHz. All Model 9601M-AN/USM-413 voltmeters will be within their frequency/accuracy specifications over the full environmental range when a properly compensated probe is used to couple the input signal.

1.2.6 Maximum Input Voltage

± 600 Volts (DC + AC peak) for normal operation.

± 1600 Volts (AC peak) maximum for intermittent overloads applied for no more than 10 seconds.

1.2.7 Environmental

Fully compliant with the Class II environmental specifications of the AN/USM-413 AC Voltmeter including:

Temperature

Storage	-55°C to +85°C
Operation	-40°C to +71°C

EMI, sand, dust, salt spray, shock, vibration, humidity, water resistance, altitude, etc.

2. OPERATING INSTRUCTIONS

- 2.1 Remove the probe from the shipping container and attach the ground lead by slipping it over the probe head and firmly seating it above the plastic finger guard. If required, shape the clamping fingers on the ground lead connector sleeve to snugly fit the probe head. Attach the desired probe tip by screwing it into the probe head body. Several probe tip accessories simply push onto the probe tip accessory which must be screwed into the probe head when the push-on probe tip accessories are to be used. To identify screw-on or push-on tip accessories, simply look into the hollow safety sleeve of the accessory and note that the push-on accessories have a hollow attachment fitting while the screw-on accessories have a solid fitting.

2.2 Probe Grounding

- 2.2.1 A passive attenuator probe is a resistive divider at dc and low frequencies. It is a capacitive divider at high frequencies. The ground lead may form a significant part of the measuring circuit and may produce measurement errors due to resonances with the inductance of the ground lead. To avoid these problems and maintain measurement accuracy keep the ground lead short and use the BNC tip adapter whenever applicable.

2.3 Maximum Input Voltage

Do not exceed the specified ± 600 V (DC + AC peak) in normal operation.

CAUTION

Never exceed the ± 1600 V (AC peak) limit rating to avoid operator shock hazard or damage to the probe and voltmeter.

2.4 Before using the probe:

- a. Make certain that the voltmeter is properly calibrated and that the input shunt capacitance of the voltmeter is normalized to 36 ± 1 pF on all attenuator ranges (Verify with a Tektronix Model 130 L.C. meter and with voltmeter power turned ON).
- b. Be sure your probe is compensated. If uncertain check probe compensation by applying a 100 Hz and then a 1 MHz input signal of equal amplitude. The meter should read within $\pm 3\%$.

2.5 USING THE PROBE

- a. An attenuator probe reduces both the capacitive and resistive loading caused by the voltmeter. The probe isolates the voltmeter from the signal source, but reduces the effective sensitivity of the instrument by the attenuation factor of the probe. The Model 9601M-AN/USM-413 Voltmeter is calibrated with the probe so that its attenuation is automatically included in the attenuation range calibration.
- b. When using a probe to sample signals from a tuned, matched, or otherwise critical circuit, capacitive loading by the probe may cause erroneous readings. In these cases, it may be necessary to add capacity and resistance to the circuit under observation when the probe is not used. These values should equal that of the

probe impedance. This substitution will equalize loading and restore the operating characteristics of the circuit under observation to the same conditions when probe measurements were made.

NOTE

IMPORTANT: Before using the probe always be certain of its frequency compensation.

- c. An adjustable capacitor in the probe termination compensates for variations in probe parameters and voltmeter input capacitance. To insure accuracy, periodically check the probe compensation.

3. PROBE COMPENSATION

NOTE

Test equipment required is listed in Table 3-1.

TABLE 3-1. REQUIRED TEST EQUIPMENT

MODEL NO.	NOMENCLATURE	USE AND APPLICATION	MINIMUM SPECIFICATIONS
Fluke Model 5200 or Datron Model 4200	AC Voltage Calibrator	Supply calibrated AC input voltages for probe compen- sation	Constant amplitude sinusoidal output at 300 mV and 3 V at 100 Hz and 1 MHz
Tektronix Model 130 or equivalent	LC Meter	Determine input capacitance of the voltmeter input at J301	Measure capacitance from 10 to 50 pF within ± 1 pF when capacitance to be measured is shunted by a resistance equal to or greater than 1 Megohm
Model 9601M- AN/USM-413	Voltmeter, Electronic	AC Voltmeter re- quired for probe compensation	

NOTE

The following probe compensation procedure replaces paragraph 5-61 PROBE ALIGNMENT PROCEDURE in the Instruction Manual T.O. 33A1-12-1083-1.

- 3.1 Connect the probe termination to voltmeter input connector J301.
- 3.2 Grasp the termination body and unscrew the cable locking sleeve by turning it counterclockwise. It is permissible to turn the probe cable with the locking sleeve. Once the sleeve is unscrewed, remove the coax cable by pulling it gently away from the termination.

WARNING

Never force the probe connectors or component parts to avoid damage to the parts.

- 3.3 Remove the soft plastic rain protector sleeve from the termination by pushing it back over the exposed cable connector. The probe compensation capacitor is now accessible.
- 3.4 Re-install the probe cable in the termination by inserting the cable connector into the termination connector and turning the cable locking sleeve clockwise until the cable is firmly seated and is making good connection.

NOTE

Be certain that the voltmeter input capacitance is equalized to ± 1 pF for all ranges before compensating your probe. Measure at J301 using a Tektronix Model 130 LC Meter. The probe will compensate for J301 input capacitances over the range of 30 to 37 pF. To provide interchangeability of probes between voltmeters, the voltmeter input capacitance should be adjusted to 37 pF ± 1 pF on all ranges. Please see the revised voltmeter ATTENUATOR ADJUSTMENT procedure of paragraph 4.3 of this manual which replaces paragraph 5-60 of Instruction Manual T.O. 33A1-1083-1.

- 3.5 Set the voltmeter RANGE switch to the 500 mV position.
- 3.6 Apply sufficient 100 Hz sinewave signal to the probe tip to exactly produce a 300 mV reading on the voltmeter scale.
- 3.7 Change the probe input frequency to 1 MHz while maintaining exactly the same rms amplitude applied at 100 Hz in step 3.6.
- 3.8 Adjust the probe compensating capacitor in the probe termination until the meter again indicates exactly 300 mV. Use an insulated screwdriver to make the adjustment (an insulated adjustment screwdriver is supplied with each probe kit).
- 3.9 Repeat step 3.6 for the 100 Hz input while holding input signal amplitude constant ($\pm 0.25\%$). Be sure that the 100 Hz meter indication is precisely at 300 mV or repeat steps 3.6 to 3.9.
- 3.10 Apply a 1 kHz input signal of equal amplitude ($\pm 0.25\%$) and observe that the voltmeter indication is within the limits of 297 to 303 mV.
- 3.11 Remove the probe cable by carefully unscrewing the cable locking sleeve and gently pulling the cable from the termination.
- 3.12 Re-install the soft plastic rain protector over the termination. Make sure it is completely seated.
- 3.13 Re-install the cable in the termination by inserting the cable connector into the termination connector and turning the cable locking sleeve clockwise until the cable is firmly seated and is making good connection.

4. REVISED CALIBRATION FOR VOLTMETER 9601M-AN/USM-413

- 4.1 The 89-11341-1 probe is sufficiently stable to permit interchangeability between voltmeters when the input capacitance at J301 of the several voltmeters is equalized.
- 4.2 To equalize (standardize) the input capacitance at J301 of the voltmeters, delete paragraph 5-60 ATTENUATOR ADJUSTMENT in T.O. 33A1-12-1083-1 and substitute the following calibration procedure.
- 4.3 ATTENUATOR ADJUSTMENT

NOTE

The following adjustments are made with the voltmeter assembly removed from the case, but the resulting meter measurements are read with the voltmeter assembly re-installed in the case for shielding. Alternatively, a spare voltmeter case, if available and expendable, may be drilled with access holes for the adjustments.

- a. This procedure is used to set A1C4 the 5, 50, and 500 volt Range Adjustment trimmer; A1C8 the Input Capacitance Adjustment for the 5, 50, and 500 mV ranges; and A1C3 the Input Capacitance Adjustment for the 5, 50, and 500 volt ranges.
- b. Set the voltmeter RANGE switch to 500 mV. Set the voltmeter POWER switch to ON.
- c. Zero the capacitance meter and connect the ground clip to the circuit ground at AC OUTPUT connector J301. Connect to the inside concentric ring using a triaxial mating connector or by manually holding a wire prod to this inner connector sleeve.
- d. Connect the active input of the capacitance meter to the female center connector of triaxial input connector J301.
- e. Adjust A1C8 until the capacitance meter reads 37 ± 1 pF. Record the exact reading. Be certain the tuning slug of A1C8 is seated and does not extend so far out of the capacitor that it interferes with or touches the case. If the adjustment cannot be reduced to 37 pF, it is permissible to entirely remove the tuning slug from A1C8 or to redress the position of input coupling capacitor A1C303 and input circuit wiring to reduce stray capacitance to ground.
- f. Disconnect the capacitance meter.
- g. Set the voltmeter RANGE to 5 V. Apply a 100 Hz signal to J301 to produce a 3 volt scale deflection on the voltmeter.
- h. Change the signal frequency to 1 MHz. Adjust A1C4 to obtain the same scale deflection obtained in the previous step f with the voltmeter assembly installed in the case. Check that the same meter scale deflection ($\pm 2\%$) is obtained at signal frequencies of 100 kHz, 10 kHz, and 1 kHz. Maintain constant input amplitude and use a short (6 inch) low capacitance coupling cable from the AC Voltage Calibrator.
- i. Disconnect the AC Voltage Calibrator.
- j. Reconnect the capacitance meter as described above in steps c and d.

- k. Adjust A1C3 to provide a capacitance meter indication to be equal to the capacitance reading recorded in step e.
- l. If the meter has not been in its case, mount it firmly in the case and turn POWER switch ON.
- m. Set the voltmeter RANGE switch to 5 mV and measure the input capacitance at J301. It must be 37 ± 1 pF.
- n. Set the voltmeter RANGE switch successively to 50 mV, 500 mV, 5 V, 50 V, and 500 V and check that the input capacitance remains constant within $\pm 1/2$ pF.

MAINTENANCE

5. REPAIR AND MAINTENANCE

WARNING

Only qualified personnel should perform the following maintenance. Unless qualified, do not perform any servicing except the compensation instructions detailed in Section 3.

- 5.1 Although the 89-11341-1 Probe is rugged and will withstand flightline usage, they may be damaged by careless handling.
- a. Do not kink the cable.
 - b. Do not strain, or roughly pull the cable.
 - c. Do not squeeze or otherwise compress the cable.
 - d. Avoid extreme heat and cold, or submersion in water.
 - e. Avoid excessive voltages.
- 5.2 Always store the probe in the voltmeter cover. Keep the probe tip accessories and ground leads with the probe.
- 5.3 The 89-11341-1 Probe is modular. Replacement parts and cables are available from Ballantine Laboratories, Inc. The replaceable parts list in Section 6 provides part numbers and descriptions for replaceable parts.
- 5.3.1 Repair of the probe has been made easy by use of modular construction. The probe tip head can be removed from the cable by unscrewing the black plastic retainer which acts as primary strain relief for the cable. Once this retainer is unscrewed, move it back over the probe cable and expose the metal parts of the cable connector. Grasp the probe tip and cable connector and gently pull to separate the cable from the probe tip assembly.

CAUTION

Always disconnect the probe from any voltage source and the voltmeter before separating the probe parts to avoid personnel shock hazard.

WARNING

Never disengage the probe cable connectors by grasping the cable rather than the connector itself to avoid damaging the probe cable.

- 5.3.2 The Termination Assembly may be disconnected from the probe cable in a manner similar to the separation of the cable from the probe tip assembly. See paragraphs 3.2 and 3.3.

5.4 PROBE ASSEMBLY REPLACEMENT

The probe cable is replaceable. Simply disconnect the probe head assembly and termination assembly from the defective cable and replace with a new cable assembly. Only a 45 inch (114 cm) replacement cable is provided for the 89-11341-1 probe.

5.5 REMOVING THE COVER FROM THE TERMINATION ASSEMBLY

5.5.1 Proceed as if removing the modular cable from the Termination Assembly as indicated in paragraph 5.3.1. Once the cable has been separated, simply slide the soft plastic cover over the exposed cable connector on the Termination Assembly until the cover is fully free. Reconnect the probe cable connector and retaining clamp. See paragraph 3.3.

5.5.2 To replace the cover, detach the cable, slide the cover back over the Termination Assembly and reconnect the cable.

5.6 REPLACING THE PROBE TIP

5.6.1 To replace the probe tip grasp it firmly with your fingers and unscrew the small tip assembly from the probe body.

5.6.2 To install the probe tip, screw it into the probe and make it finger tight.

5.6.3 Several of the probe tip accessories push onto the probe tip assembly. Other tip accessories screw into the probe without requiring the probe tip accessory. See paragraph 2.1 and 4.8.

5.7 ATTACHING GROUND ASSEMBLIES

5.7.1 The probe ground assemblies may be attached by sliding their rings over the probe tip and firmly over the hidden metal collar on the probe tip assembly. The ground lead assembly may be removed by grasping the plastic ring and pulling it axially over the tip away from the probe tip assembly.

5.7.2 The ground assembly should be loose enough to rotate on the probe tip collar; but sufficiently tight to make a good electrical ground connection and be retained in use. To control the tightness of it, gently adjust the ground assembly split sleeve by holding with your fingers and squeezing it against the work bench surface until the desired fit is achieved.

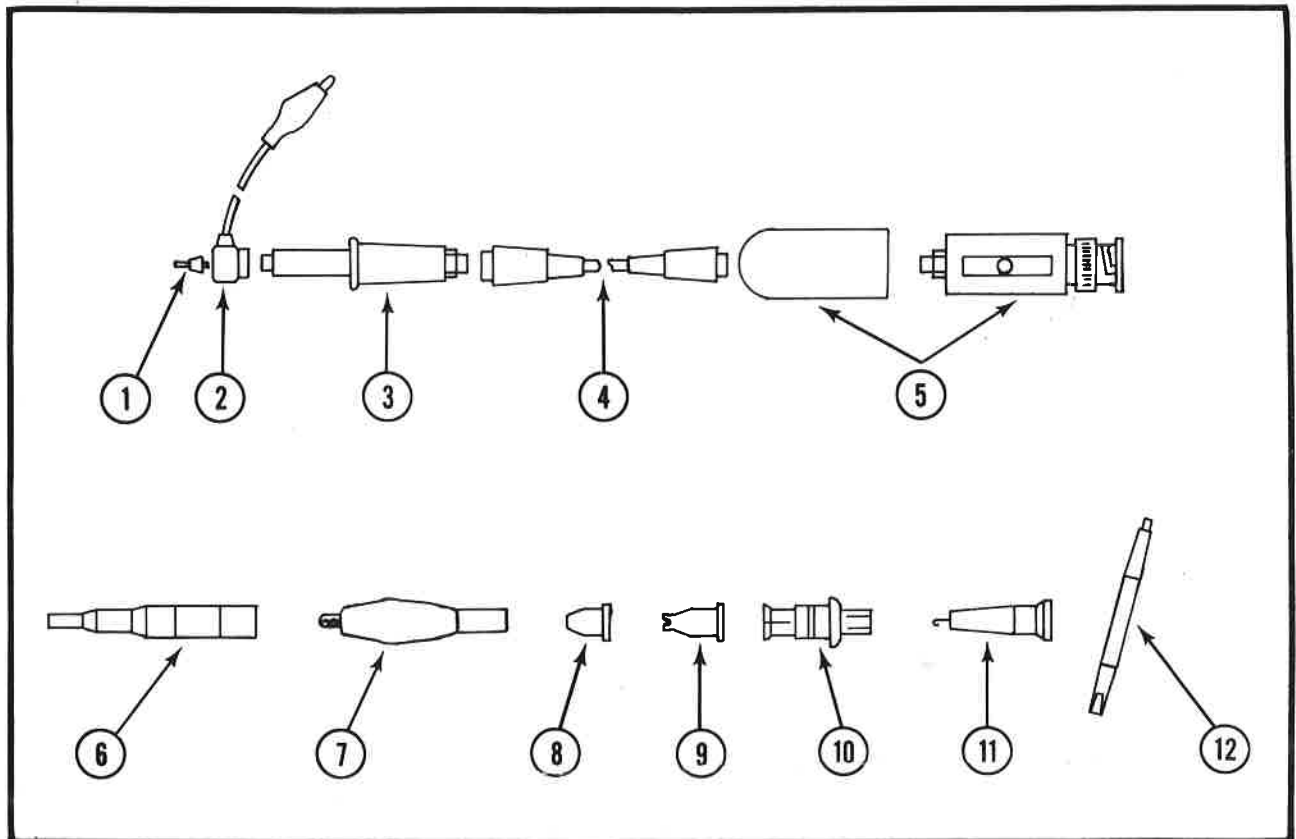
5.8 MOUNTING PROBE TIP ACCESSORIES

5.8.1 Probe tip accessories which push on are pushed over the probe tip shank. Insulating tips are retained by the exposed metal surface at the tip of the shank while conductor tips are retained by pushing their female spring connector onto the probe tip.

5.8.2 Removal of the push-on probe tip accessories is accomplished by gently pulling them away from the probe tip assembly.

5.8.3 Several of the probe accessories screw onto the probe body like the probe tip. This permits the screw-on accessories to be retained on the probe head assembly when a pulling force is applied. This applies to the small alligator tip accessory. Remove the probe tip accessory when mounting the screw-on tip accessories. See paragraph 2.1.

SECTION 6
REPLACEABLE PARTS



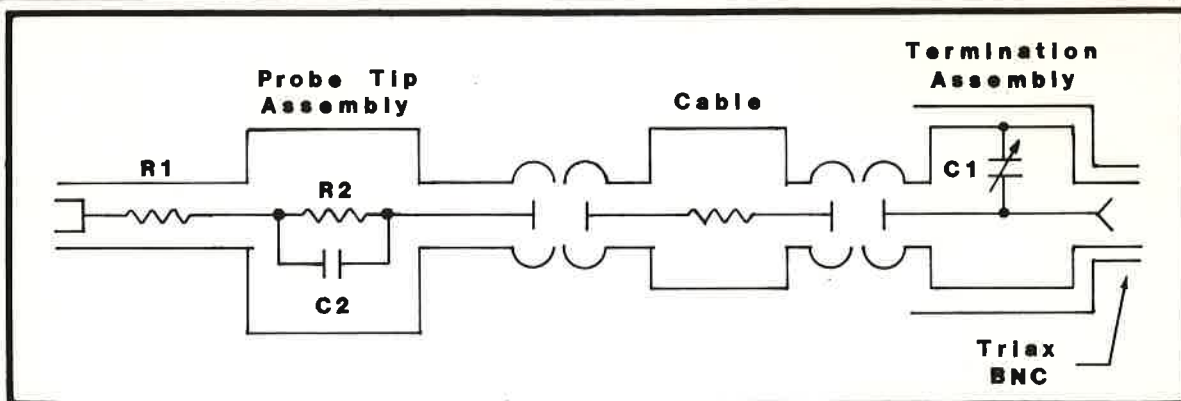
P/N 89-11431-1
REPLACEABLE PARTS LIST

INDEX NO.	BALLANTINE P/N	DESCRIPTION	VENDOR CODE	SUPPLIED ACCESSORY
1	85-10128-1	Probe Tip (Screw-On)	50423	2
2		Ground Lead with Alligator Clip	50423	
	85-10129-1	3½ inches (9 cm)	50423	
	85-10130-1	6 inches (15 cm)	50423	
	85-10131-1	12 inches (30 cm)	50423	1
3	85-10294-1	Probe Head Assy. X5 for 9601M	50423	1
4	89-11389-1	Cable Assy. Environmentalized 45 inches (114 cm)	50423	1

P/N 89-11431-1
REPLACEABLE PARTS LIST -- Cont'd

INDEX NO.	BALLANTINE P/N	DESCRIPTION	VENDOR CODE	SUPPLIED ACCESSORY
5	85-10293-1	Termination, Triax BNC for 9601M	50423	1
6	85-10168-1	Spring Tip Adapter (Screw-On) 0.08 in.	50423	1
7	85-10148-1	Alligator Probe Tip Adapter (Screw-On)	50423	1
8	85-10145-1	Sleeve Tip, Insulating	50423	1
9	85-10146-1	Sleeve, IC Adapter	50423	1
10	85-10147-1	BNC Adapter (Push-On)	50423	1
11	85-10225-1	Hook Tip Adapter (Push-On)	50423	1
12	85-10149-1	Adjustment Tool, Insulated	50423	1
	89-11390-1	<u>Probe Accessory Kit</u>	50423	

1 each 0.08" Spring Tip; 1 each Probe Tip; 1 each BNC Adapter; 1 each 12" Ground Lead; 1 each Alligator Tip Adapter; 1 each Hook Tip; 1 each IC Adapter; 1 each Adjustment Tool; 1 each Hook Tip Adapter



Notes:

1. Electrical Components in Probe Tip Assembly and Termination Assembly are not replaceable parts.
2. C1 is Compensation Adjustment.

89-11341-1 Probe Schematic