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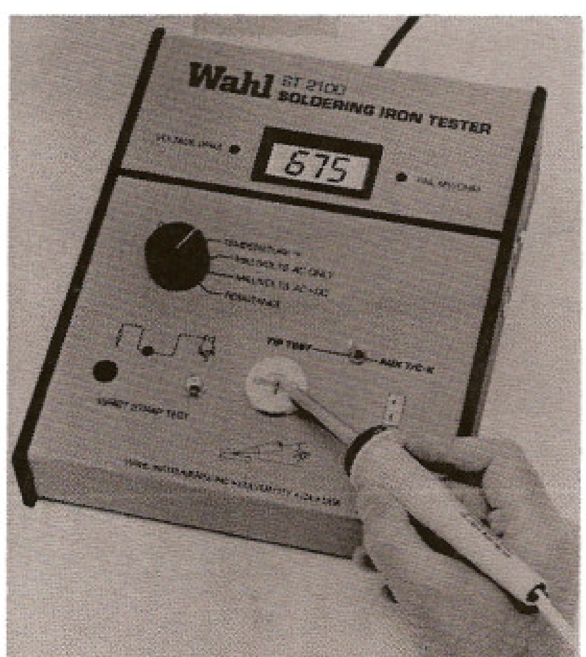
Wahl
INSTRUMENTS, INC.

ST-2100
Soldering Iron Tester
Instruction Manual

S/N ____________________ Date ____________



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UNPACKING

Use care in opening the carton containing the ST2100. Retain and store this carton and packing materials for use in returning the unit to Wahl for calibration to NIST standards and if necessary for use in returning the unit for repair.

LINE POWER

Each ST2100 is factory configured to accept line power of either 115 or 230 VAC (±10%) at 50 or 60 Hz. Verify that your instrument has the proper rating for the AC line voltage to be applied. This rating is shown adjacent to the power cord exit on the rear of the instrument.

CAUTION

The display bezel, side panels and line cable are made of thermoplastic resin. Be careful not to deform them by touching them with a soldering iron or other hot objects.

AC line output is always energized when power cord is connected to AC source.

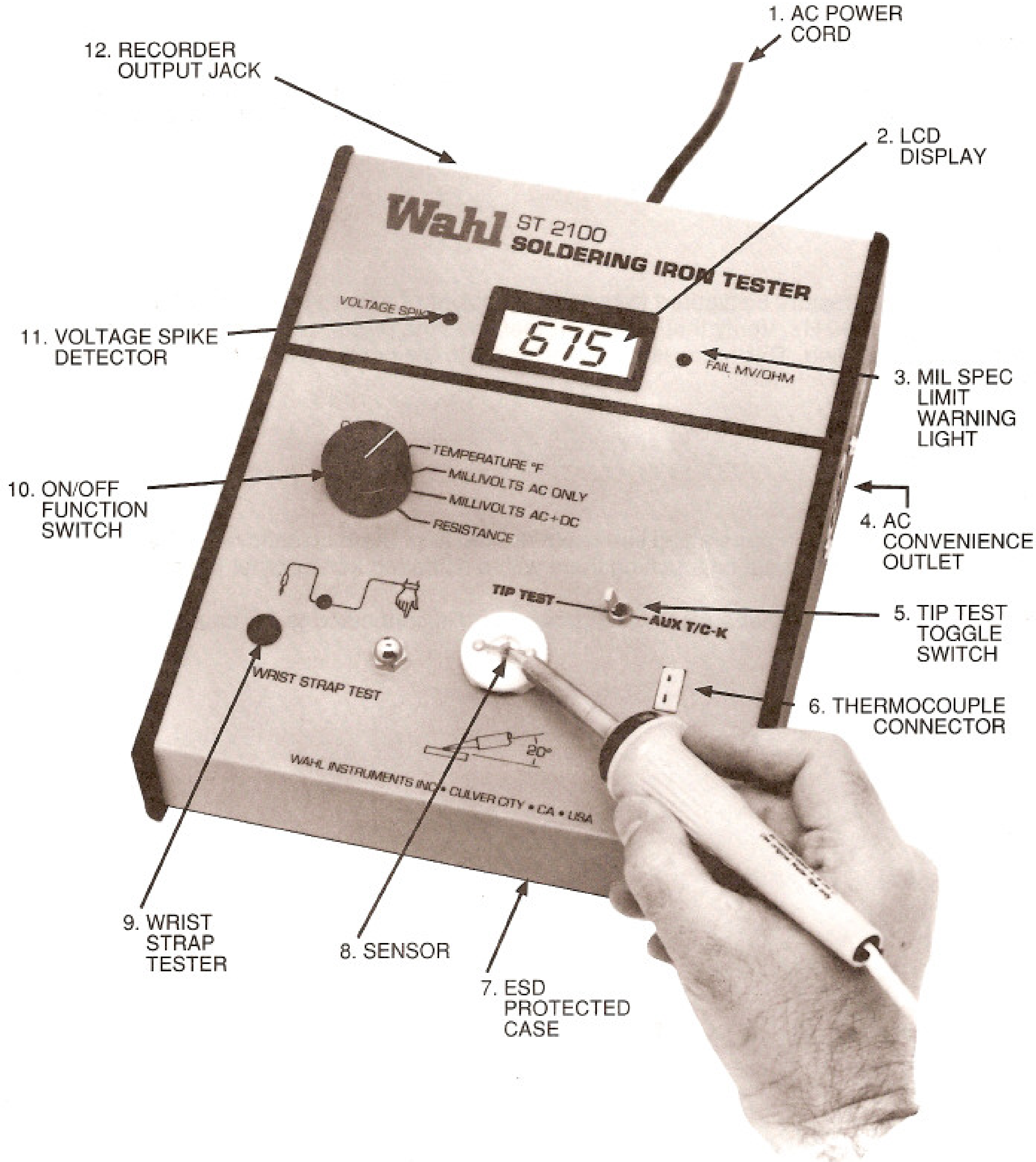

Figure 1-1. ST2100 Soldering Iron Mil Spec Tester

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SECTION I

1.0 INTRODUCTION

The Wahl Mil Spec Tester Model ST2100 is designed for testing the performance of hand-held soldering irons used in the production of electronic circuits for the U.S. military. See Figure 1 (facing page).

Standards have been established by U.S. Government specifications that limit the allowable tip voltage potential, tip to ground resistance and tip temperature variations of the soldering iron. See Table I, below.

The purpose of these standards is to prevent damage to sensitive electronic components by induced voltage or overheat and to assure high quality solder joints by controlled temperature at the tip.

TABLE I. MIL-STD-2000 REV. A TEST REQUIREMENTS

Equipment	Paragraph No.	Test	Spec Value
Soldering Irons	5.1.2.2	Tip Temp. (idling)	±10°F
	5.1.2.2	Tip-To-Ground Resistance	5.0 Ohms Max.
	5.1.2.2	Tip-To-Ground Voltage	2 mV RMS
Solder Pots	5.1.3	Solder Temperature	475-525°F
	5.1.3	Solder Stability	±10°F
Machine Soldering Systems	5.1.3	Solder Temperature	475-525°F

2.0 WAHL MIL SPEC TESTER ST2100

The Wahl ST2100 tester is easy to use since all tests are perfomed by touching the working tip of the soldering iron to the solder bead on the sensor. By rotating the function switch, all Mil Spec requirements are conveniently verified on the large digital display.

In addition, the sensor simulates a solder joint and provides the user with a means of matching the iron thermal capacity to the work. Sensors of different thermal load capacities are available from Wahl. An alternate wire-type sensor is available which provides the same functions (Paragraph 8.3.3).

FEATURES

- For use in soldering and desoldering operations.
- Tip potential AC or AC + DC RMS measurement from ground reference to soldering iron tip.
- Ohms measurement from ground reference to soldering iron tip.
- Wide range measurement of tip temperature, 50 - 1300°F (optional °C).
- Warning indicators for tip voltage and resistance.
- Independent wrist strap GO/NO GO test.
- Soldering iron voltage spike detection.
- Easy operation, three measurements from one sensor.
- Quick response, completely tests a soldering iron in 30 seconds or less.
- Auxiliary input for thermocouple probes.
- Measures pot-solder and machine solder resistance to ground, millivolt potential and temperature with supplied probe.

3.0 OPERATION OF PORTABLE MODEL ST2100 (FIG. 1)

To operate the tester refer to Figure 1 (page vi).

3.1 Connecting to AC Power

The ST2100 is a portable tester with the AC power cord coiled on hooks at the rear. It is used with 3-wire grounded soldering irons and is plugged into an AC receptacle with the identical ground wire as the irons to be tested.

3.2 Tip-Test/Auxiliary Input Switch

For soldering iron test, move toggle switch (5) to TIP TEST.

3.3 Function Selector and Power Switch

Turn the function switch (10) to TEMPERATURE. The function switch also acts as a power switch and the display will turn on and show ambient room temperature. If the selector is set for MILLIVOLTS or TIP RESISTANCE the display will indicate **1---** until the soldering iron tip is placed on the sensor bead.

3.4 Mil Spec Testing

To make Mil Spec tests, preheat the iron with the working tip installed to soldering temperature. Touch the heated tip to the solder bead at the center of the sensor (8). The same firm pressure is applied as in soldering. Apply a small amount of fresh solder as required.

When using a wire-type sensor (paragraph 9.2.6) place tip under the wire bridge, at the center, and lift up using light pressure. Wetting the contact area with solder provides better thermal conductivity.

Rotate the function switch to read TIP RESISTANCE OHMS, TIP MILLIVOLTS and TEMPERATURE. Read actual values on the display. If a voltage spike is present at the tip that exceeds 100 mV, the spike LED (11) will flash red during mV testing only.

If mV or Ohm measurements exceed specified values shown below the pass/fail indicator (3) to the right of the display will flash red.

Function	Condition
Tip Millivolts	2.0 mV or greater
Tip Resistance	2.0 ohms or greater*
Over Range (4)	When any of the functions exceed instrument limits.

In the Temperature Test mode, observe temperature values on the display. Most soldering irons will drop in temperature when first applied to the sensor (8), recover in about 5-10 seconds, and then idle within a temperature band width of a few degrees. Holding the iron on the sensor for 30 to 60 seconds will show the temperature performance of most irons.

Soldering irons with defective controls, or poor contact between tip and heater, or ones with course limit switches will cycle in excess of ±10°F (20°F band width) and should be removed from service. Some irons may drop too low in temperature for quality work and should be replaced.

* Mil Std 2000 Rev. A specification is 5 Ohms, max. However, if the measured tip resistance exceeds 2 Ohms the operator is cautioned to check the soldiring iron tip resistance more often as corrosion is indicated.

3.5 Voltage Spike Detector

The Voltage Spike Detection circuit detects transient voltages at the soldering iron tip during test. The voltage spike LED indicating light flashed RED for each occurrence of a voltage transient. Otherwise it is a steady state GREEN. The Voltage Spike Detector is operational in mV mode of test only.

These transient voltage spikes can result in damage to electronic circuitry being soldered/desoldered. If a voltage spike is detected look for these causes: (1) Intermittent faults with the soldering iron, (2) electrical equipment sharing the same power line or ground wire which can cause voltage spikes, like electric drills, welding machines, etc., (3) faulty ground connection. Older model irons with bi-metal temperature controls are known to generate voltage spikes of large magnitude.

3.6 Hook Up

Figure 2, below, shows several methods for connecting the ST2100 for production and inspection tests.

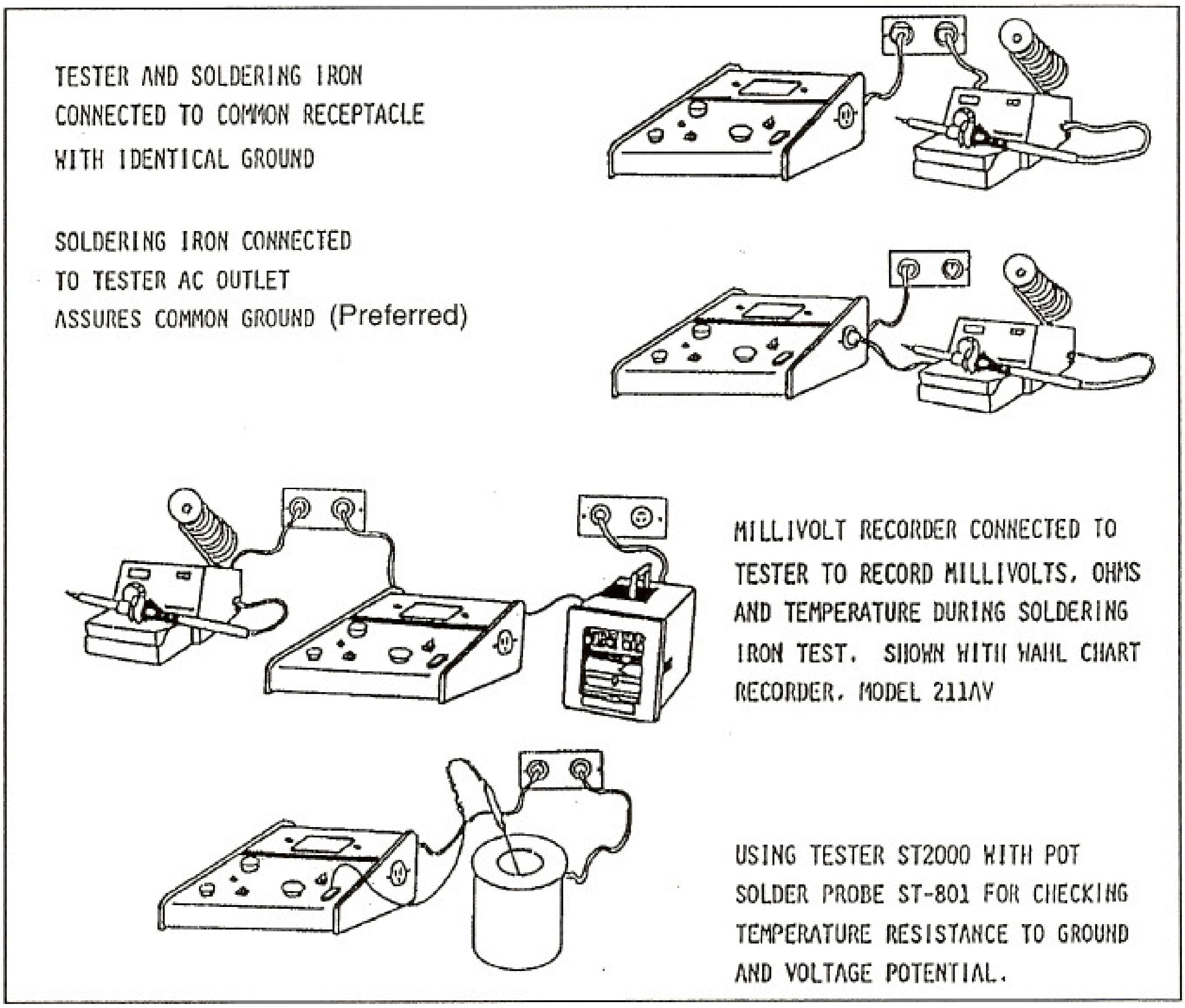


Figure 2. Tester Connection Methods

4.0 SAFETY FEATURES

4.1 ESD Protection

The ST2100 is designed for use in ESD protected areas. The case (7) is grounded and coated with chloride-free liquid anti-stat (Resque 2). The case has been tested for triboelectric effect during normal operation. It will neither generate a charge nor support a static electricity discharge.

The internal circuitry of the ST2100 is protected against static discharge that may be applied to the sensor during test of soldering irons or when the auxilliary thermocouple connector (6) is used.

4.2 Circuit Protection

The ST2100 was designed with concerns for operational safety, equipment protection and ease of operation. The ST2100 will withstand AC line voltages that may be inadvertantly touched to the sensor. This protection is accomplished by a combination of input clamping circuitry and wide-compliant circuitry capable of tolerating large voltage swings without damage.

4.3 Wrist Strap Test

Periodic testing of static control Wrist Straps is mandatory to provide an ESD safe working area. The ST2100 incorporates a GO/NO-GO method of verifying the integrity of wrist straps while being worn by the operator. Preset limits insure that the wrist strap minimum and maximum resistances are within safe limits for ESD protection.

5.0 ST2100 OUTPUTS

5.1 Recorder Output Jack

Monitoring of the Recorder Output Jack with a digital voltmeter permits higher resolution measurements than is presented by the ST2100 display.

Tip to ground resistance may be easily displayed to 0.01 Ohms and tip to ground voltage may be displayed to 0.01 mV by utilizing a 3-1/ 2 digit digital meter set to the 200mV range. High resolution temperature measurements of 0.1°F may also be obtained using this method.

Dynamic performance of tip measurement can be viewed on a strip chart recorder by using the analog output of the ST2100.

The output jack on the rear of the unit also permits recording data on soldering irons as part of quality audits and research. Output values are:

Tip Temperature:	1 mV/°F
Tip Resistance:	100 mV/Ohm
Tip Voltage:	100 mV/mV

5.2 AC Output Receptacle

An AC output receptacle is provided on the right side of the ST2100 for convenience. With the power cord plugged into an AC outlet, this receptacle is used for the soldering iron under test to assure a common ground between them. The AC receptacle is always energized when the power cord is plugged into an AC source. into an AC source.

6.0 DESOLDERING EQUIPMENT TEST

Circuits undergoing desoldering repair are exposed to the same potential sources of electrical and temperature damage as normal soldering. When checking desoldering tools, use the tester in the same manner as described above. When checking millivolt tip potential, operate the suction switch on the desolder tool and check for voltage spikes.

7.0 GENERAL PURPOSE USE — AUXILLIARY THERMOCOUPLE INPUT

7.1 Pot Solder MIL Spec Measurements

The ST2100 is also used to measure pot solder and machine solder temperature, voltage potential and ground resistance. Use the supplied Type -K thermocouple wire probe P/N 15134 or the optional Pot Solder Probe TC801P, each of which are trimmed to 1.0 Ohm resistance and compatible with the ST2100. Connect the probe to auxiliary output (6). Switch toggle (5) to auxiliary. Use function switch positions: Temperature, mV (AC) and Ohms. When measuring resistance in the auxiliary mode subtract the resistance of the probe from the display value.Do not use mV (AC + DC) because the thermocouple wire induces a small DC voltage which gives an erroneous reading.

The Wahl probes measure temperature, mV (AC) and Ohms without correction and the value is accurately shown by the display. Other Type K-probes may be used for Temperature and mV (AC) measurement, but the resistance will be in error.

The Voltage Spike test is also operational when testing in the accessory AUX T/C-K position of the TEMPERATURE SENSOR selector switch. This enables detection of transient voltage spikes in solder pots or wave solder machines.

7.2 Universal Temperature Calibrator

The ST2100 measures temperature of soldering irons using sensor WST-01 or WST-02. It also measures temperatures of solder baths, circuit boards, components and ambient air temperature by the use of Type K thermocouple probes shown in the Accessories section.

7.3 Imbedded Thermocouple in Soldering Iron Tip

A soldering iron with type-K thermocouple embedded in the tip can be measured using the auxilliary thermocouple connections. The tip temperature can be measured either from the embedded wire (AUX) or directly from the tip (TIP TEST).

Tip potential measured from the embedded thermocouple will be accurate on the AC (ONLY) function switch position. DC-mV position will be in error due to lead length resistance. Tip RESISTANCE measured from the embedded thermocouple will be in error due to lead resistance.

SECTION II
SPECIFICATIONS AND ACCESSORIES

8.0 GENERAL

The Wahl Instruments ST2100 Soldering Iron Tester provides the operator with a convenient, accurate method of measuring the tip temperature, tip to ground resistance and tip leakage potential in accordance with MIL-STD 2000. The ST2100 may be operated from the 120VAC line with the standard AC internal power supply. A convenient AC power outlet is provided to power the soldering iron under test.

8.1 Specifications (25±5°C)

8.1.1 Tip Temperature

Range:	50 to 1300°F (10 to 700°C)
Meter Accuracy:	±0.1% of reading ±1 digit
Resolution:	1 degree F or C (0.1°F or C)*
Sensor:	WST-02B heavy duty Bonnet Sensor included. Type K thermocouple with a solder bead thermal mass of 0.2 gram. (Optional WST-03 wire sensor.)

8.1.2 Tip Ohms to Ground

Range:	0-100 Ohms
Accuracy:	0-20 Ohms: ±0.1 Ohm, ±1 digit 20-100 Ohms: 0.5% ±0.1 Ohm, ±1 digit
Resolution:	0.1 Ohm (0.01 Ohm)*
Test Current:	10 mA, DC
LED Warning Indicator:	2.0 Ohms

8.1.3 Tip MV to Ground

Voltage Range:	0 to 30 mV true RMS AC + DC or AC only, switchable
Accuracy:	±0.1 mV, ±1 digit
Resolution:	0.1 mV (0.01mV)*
LED Warning Indicator:	2.0 mV

8.1.4 Digital Display

3-1/2 digit LCD with 0.5 inch character height with Limit Fail indicator

8.1.5 Output Jack

Temperature:	1.0 mV/degree of tip temperature
Resistance:	100 mV/Ohm tip resistance, 0-30 Ohms
Voltage:	100 mV/mV of tip Voltage, 0-20 mV
Protection:	Short Circuit and Over Voltage Protection

The Recorder Output Jack may be used with an external DVM to present higher resolution measurements of tip temperature, mV and Ohms. See Section 5.1.

*Utilizing the Recorder Output Jack and an external digital voltmeter.

8.1.6 Power

AC: 115 VAC(Optional 220 VAC), 50/60 Hz. 2 Watts, max. Internal power supply.

8.1.7 Auxiliary AC Outlet: An AC convenience outlet is provided to power the soldering iron under test.

8.1.8 Auxiliary TC connector: An Auxiliary type "K" thermocouple input connector is provided to allow interfacing with a variety of standard type "K" probes. Using Wahl Solder Pot Probe TC-801P electrical measurements may also be made, mV (AC) and ohms (subtract 1.0 Ohm from display reading).

8.1.9 Wrist Strap Tester: Function switch in W/S position. LED is Green for Acceptable Wrist Strap Resistance and RED for unacceptable values below 500K Ohms or above 10 Meg Ohms.

8.1.10 Voltage Spike Detector: Active during mV test. Spike LED flashes from green steady-state to Red for approx. one second for each 1 µs spike greater than 100 mV amplitude.

8.1.11 Environmental: Operational from 45 to 105°F Storage from -4 to 122°F.

8.1.12 Dimensions: 8.5"W x 10.5"D x 3.5"H

8.1.13 Weight: 3 lbs.

8.1.14 NBS/NIST Calibration: All ST2100 instruments are tested at Wahl using test equipment whose accuracy is traceable to NIST. Wahl provides NIST traceability test results at time of purchase and following recalibration at Wahl.

8.2 Calibration/Maintenance

All calibration adjustments and test points are easily accessible by removing the bottom of the unit.

8.3 Accessories

The following accessories are available optionally:

8.3.1 Sensors

The following sensors are interchangeable.

8.3.1 Sensors - Continued

WST-01 Bead Sensor, .01 gram, light duty
WST-02 Bead Sensor, .02 gram, standard
WST-02B Bead Sensor, with position stop, .02 gram, standard
WST-03 Wire Type Sensor, standard

8.3.2 Kits, Sensor Repair

WST-RT, Reusable Repair Tools for WST-02 sensors
WST-02KIT, Repair Kit for WST-02 Standard Sensor
WST-02BKIT, Repair Kit for WST-02B Bonnet Sensor
WST-03KIT, Repair Kit for WST-03 sensors (special tools not required).

8.3.3 Probes

TC801P Pot Solder probe for temperature, mV (AC) and Ohms testing.
TC-803 Miniature Tip surface probe.
TC-305 Air Probe for ambient air temperature and hot air guns.

8.3.4 Carrying Case

P/N WST-34, an ESD safe, soft carrying case is available which will hold the tester, spare sensors, spare probes and adapters.

SECTION III
OPERATING INSTRUCTIONS AND CALIBRATION

9.0 PRINCIPLES OF OPERATION

9.1 General

This section reviews soldering iron performance and test methods to achieve effective use of Mil Spec Tester ST2100.

9.2 Tip Temperature

9.2.1 Temperature Problems

By understanding how soldering irons can cause damage to integrated circuits and other electronic components and by knowing how to measure and control it, production line productivity can be improved.

The thermocouple sensor of the ST2100 is designed for the temperature measurement of soldering iron tips. The diameter of most soldering iron tips used in I.C. device assembly lines is less than 3mm.

For these applications use Wahl sensors WST-02 (Fig 1, page vi) , WST-02B (Fig. 3, page 3) or WST-03 (Fig 4. page 13). If the diameter is smaller than 1 or 2 mm, Model WST-01 is available for light duty.

As a point of reference, typical soldering iron tip temperatures vary from 480°F to 900°F while solder melts between 350°F and 600°F.

Most integrated circuit manufacturers specify a maximum temperature during soldering of 572°F held for 5 seconds or less. By increasing the tip temperature, it can increase device failure and decrease device MTBF.

Printed circuit board traces can also be damaged by high temprature causing them to lift away from the board material. The board material itself can be burned causing damage and unsightly brown burn areas.

Decreasing the tip temperature increases soldering time and can cause low quality solder joints. These low quality solder joints can have an undesirable appearance due to dullness and excessive solder build-up or may have cold solder joint characteristics such as high resistance and intermittent contact.

9.2.2 Tip Temperature Measurement -- Solder Bead Sensor

Since many different types of soldering irons are used by industry, the Wahl tester ST2100 proivdes a fast, convenient way to measure most soldering iron tip temperatures with the working tip installed from 50 to 1300°F.

Switch the range selector switch of the ST2100 to TEMPERATURE and note that the normal room ambient temperature will be displayed (assuming that the sensor has been allowed to reach thermal equilibrium with the surrounding ambient). The display will indicate temperature with a resolution of 1°F or 1°C (optional).

With the thermocouple selector switch in TIP TEST position, touch the soldering iron tip to be tested to the solder bead of the sensor. The normal working area of the tip should be used and the tip should be placed on the cold solder bead sensor, allowing a few seconds for it to melt. A small amount of solder may be added as required. This is how the temperature of the tip is transmitted to the thermocouple sensor embedded in the solder. Continue to hold the same pressure as in soldering. Watch the display and observe the temperature readings for:

a. Temperature will rise as the tip heats and melts the solder bead on the sensor. Equilibrium will be reached in about 10-15 seonds.

b. Temperature stability. Most Mil-Spec irons are stable. After reaching equilibrium expect only a few degrees of temperature variations. Watch the display for the maximum and minimum temperatures of the soldering iron as it heats the sensor. Mil-STD-2000 allows ±10°F. Older designs or a faulty iron may have excessive temperature cycling due to a faulty control. The ST2100 will show this as you watch the display.

c. Temperature recording can be made using the output jack. A typical time-temperature history of a Mil-Spec soldering iron test is shown by Fig. 5, page 14.

9.2.3 Temperature Setting of Soldering Irons

The ST2100 displays temperature of the working surface of the tip. It may not agree with the indicated temperature of the soldering station or setting of the soldering iron control.

a. One reason may be the tip is oxidized and needs to be cleaned and re-tinned.

b. Another reason is the way the iron was calibrated. Frequently a special tip is installed by the manufacturer and is used for calibration which may be different from your working tip.

c. Another possibility is the ST2100 sensor needs to be cleaned and a new solder bead applied. See 13.0 and 14.0 for maintenance instructions.

9.2.3 Continued

Once you are satisfied that the tip and sensor are clean, reset the soldering station for the tip temperature you want. Make a note of the difference for future work at that station.

Note: It is not a requirement that the soldering station temperature control reading agree with the tip temperature measured. See Appendix A for Navy clarification of MIL-STD-2000, pages 40 and 41.

9.2.4 Replaceable Solder Bead Sensors

The replaceable temperature sensor P/N WST-02B, Figure 3, contains a high temperature Type K ribbon thermocouple (1), stainless steel support strap (2), solder bead (3), bonnet (4), and glass filled teflon body (5).

Type K thermocouple material is chosen for its high temperature stability, accuracy and long life in the soldering temperature range of 500 - 900°F. It is a good electrical conductor and therefore allows accurate measurements of tip voltage potential and tip to ground resistance.

The solder bead is important because it simulates a solder joint, provides excellent thermal transfer when melted by the iron and gives a good representation of effective working temperature of the tip. It reforms on cooling. Add new solder to the bead as necessary when the bead becomes dull. Best results occur when the bead is new and shiny. For fast response use only a small amount of solder.

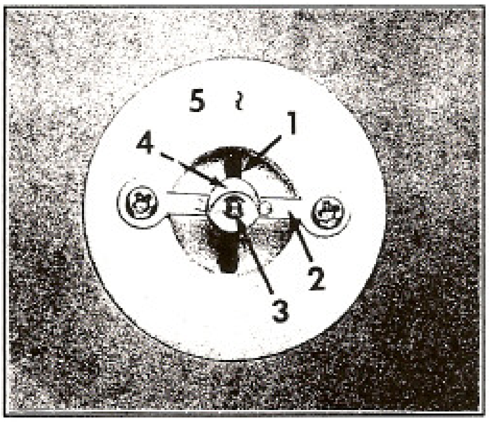
The bonnet (4) acts as a position stop for the tip. Since it measures each tip in the identical position the sensor gives repeatable readings with different operators. It also stabilizes the tip to prevent movement during measurement which can cause temperature fluctuations. A 20° angle gives a good position of the tip when placing it on the bead sensor.

The user may choose sensors to match the thermal capacity of the solder joint when rating soldering irons and tips best suited to the work.

The WST-02 sensor, (Fig. 1, page vi), is a heavy duty long-life sensor designed for everyday use for measuring idling temperatures and for rating the draw-down of irons in a working environment. The mass of its thermocouple element is only .02 gram. A light duty sensor, P/N WST-01, is available with a mass of .01 gram. Other sizes are available on request.

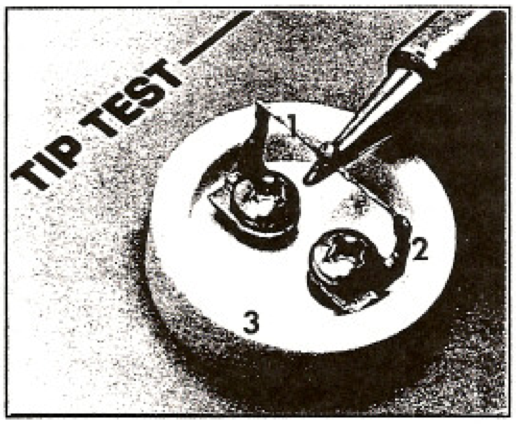
9.2.5 Repair Kits for Solder Bead Sensors WST-02 and -02B

Kits are available for field repair and replacement of thermocouple elements for these sensors. See paragraphs 8.2 and 14.0 (Sensor Repair Procedures).



1. Thermocouple Sensor
2. Support Strap
3. Solder Bead
4. Bonnet (tip stop)
5. Glass Filled Teflon Body.

Figure 3. WST-02B Sensor



1. Thermocouple Wire Sensor (welded in place)
2. Support Post
3. Glass Filled, Teflon Body

Figure 4. WST-03 Wire Sensor

9.2.6 Wire-Type Sensors

An alternate method of sensing tip temperature, tip potential and resistance is the wire-type sensor, Wahl Model WST-03, shown in Figure 4. It features a .02" dia. Type K thermocouple wire mounted in an inverted "V" between two posts. It is interchangeable on the ST2100.

The WST-03 has fast response, long life and is easy to clean. The wire sensor is useful where soldering iron tip geometry is not compatible with other sensors. The "angle of attack" is not critical and the contact area between tip and wire is always visible.

9.2.7 Repair Kit for Wire Sensor WST-03

A replaceable wire kit is available for field repair. See paragraph 8.2 and 14.0 (Sensor Repair Procedure).

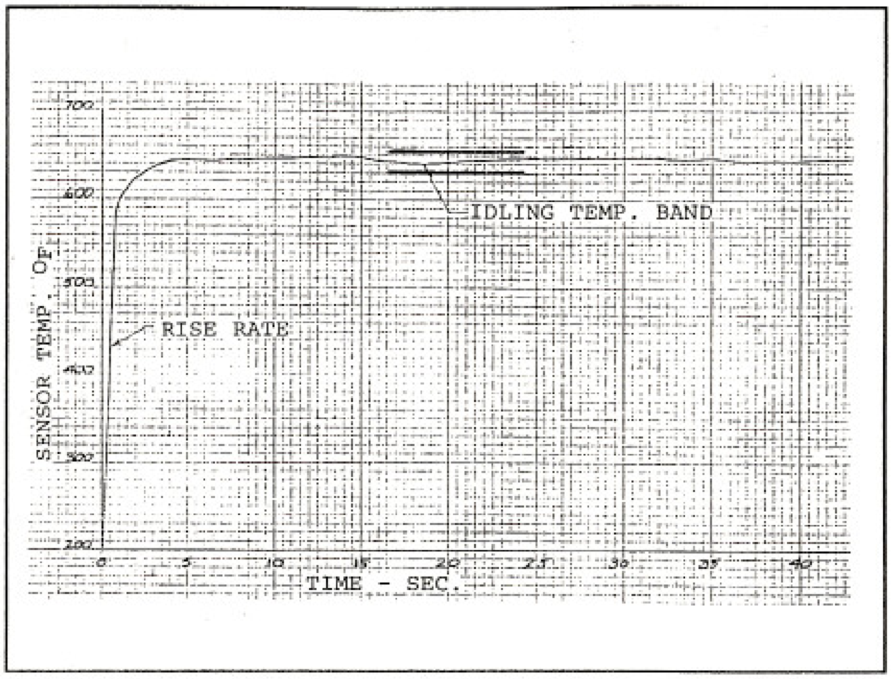


Figure 5. Typical Soldering Iron Tip Temperature Display

9.3 Ground Integrity

9.3.1 Soldering Iron Ground Circuit

For Mil-Spec soldering, only 3-wire grounded soldering irons are used. This is to provide a means of protecting electronic components from damage due to voltage potential at the solder joint for any reason.

The ground path on many soldering irons contains mechanical joints between replaceable tips, heater and the ground wire. These joints are subject to loosening, contamination and aging, all of which affect the ground integrity. Other designs have a direct ground connection to the tip which offers greater promise of reliability in spite of aging.

Ground integrity is improved by frequent disassembly and cleaning of irons.

9.3.2 Checking Tip Resistance to Ground

The ST2100 measures resistance when the Function Selector switch is set to RESISTANCE. If the resistance is less than 2 Ohms the pass/fail light (3) on the right side of the display will be green. When the resistance is equal to or greater than 2.0 ohms the pass/fail light will flash red. The actual value will be displayed on the LCD display within the 0-100 Ohm range.

MIL-STD-2000A specified 5 Ohms as the failing limit for tip to ground resistance. However, the PASS/FAIL indicator on the ST2100 will flash at 2 Ohms, warning the user that the soldering iron tip should be inspected for corrosion or faulty connection before the 5 Ohm limit is reached.

9.3.2 (Continued)

All resistance measurements are made with respect to the ground reference of the AC line cord (round pin of AC plug). Therefore, the ST2100 line cord ground wire must be connected to the ground reference as chosen by the user (either power ground or earth ground). If a ground reference is chosen other than the ground available via the AC outlet powering the soldering iron, then the ground reference of the ST2100 (round pin of the ST2100 power cord) must be connected to that ground to make tip resistance measurements.

The test current for ohms measurement is 10 milliamperes DC and the ST2100 will display resistance with a resolution of .1 Ohm. The operator should be aware that it is possible for circulating ground currents in the AC power distribution system to cause errors during ohms measurements. This will be evidenced by a difference in displayed ohms when the soldering iron power cord and ST2100 power cords are interchanged in their position of connection at the AC power outlet. The reason for this is that a ground current is flowing in the ground line and results in a voltage offset between the two adjacent outlets. In one orientation this offset voltage adds to the ST2100 voltage generated during ohms check and then subtracts if the orientation of the AC power cord connections is reversed. Therefore, as little as 10 millivolts of either polarity will cause a variance of the ST2100 digital display of ±1.0 Ohms as the scale factor is 1.0 Ohm per 10 millivolts of that voltage measured.

Should this phenomenon be seen, it would indicate that there is excessive ground current flowing (caused by a faulty piece of equipment connected to the AC line) or excessive resistance between AC outlets and should be resolved if highest accuracy measurements are to be made.

Methods of avoiding the errors due to differences in ground potential are: (a) use the AC outlet provided on the right side of the unit; (b) use a multiple AC outlet adaptor in which both the ST2100 and soldering iron under test are connected. This essentially connects the ground of the ST2100 and the soldering iron under test to a single point ground reference and thereby avoids the errors due to circulating ground currents.

9.3.3 Connections to Ground

The ground reference will usually be the same ground that the soldering iron is connected to with the third wire of its power cable. To test these irons, the ST2100 should be connected to the same AC line and preferably adjacent to the soldering iron connection at the AC line outlet. The most precise measurements will be made when the soldering iron power is connected to the auxiliary receptacle on the side of the ST2100 Soldering Iron tester.

The tip Ohms measurement will be most easily affected by an unsatisfactory ground connection of either the ST2100 or the soldering iron under test. Contact resistances of the AC power plug and receptacle combination can have a wide variability depending on the surface area of contact, pressure of the contact interface, and cleanliness. Many times the pressure clips in an AC receptacle are broken and no ground connection is available. This would indicate itself as an open circuit when tested with the ST2100 in Ohms test and would mean

9.3.3 (Continued)

either the ST2100 ground or the soldering iron ground is not functional at the AC outlet. When a tip Ohms measurement fails, the connections to the AC line should be investigated for intermittent contact.

9.3.4 Sources of Ground Circuit Errors

A wall receptacle containing a 3-wire ground circuit cannot be relied upon to provide a true earth ground and should be verified from time to time for these problems:

a) Wall receptacle ground connector open. If a test of the iron shows high resistance, change receptacles used for test to check for broken pressure clips.

b) Nearby electrical devices sharing the same ground may induce voltages on the ground line.

c) Ground connected to power station ground. Several volts of ground potential can be expected.

9.3.5 Other Ground Related Problems

The personnel ESD ground connections are not usually a common ground for soldering iron testing. They may contain a resistor network to bleed down ESD which destroys the ground reference; are too far removed from the iron to be a reliable connecting point; may not be the same ground network.

Grounds connected to water pipes are presumed to be earth ground. Some piping systems change from copper or galvanized steel to plastic and therefore are not reliable earth grounds.

Copper bar or water pipe earth grounds are not reliable in dry earth and may need to be continuously moistened with a brine solution.

Some soldering stations are planned so that the entire station shares one common ground. In the event of a high resistance measurement, check the ground connection of the iron at the receptacle.

9.3.6 Wrist Strap Measurements

When using the wrist strap at the work area insure that the ground wire is securely connected to an effective ground point. The wrist strap must be in contact with the skin of the wrist to be completely effective. Do not wear the wrist strap over garments.

9.4 Tip Voltage Potential

9.4.1 Soldering Iron Leakage Current and Insulation Impedance

Leakage current is available from the soldering tip via the insulation impedance between the tip and the AC voltage present at the heating element. Leakage current measurements taken from actual soldering irons show a range from 1 µA for new irons to in excess of 50 µA for older and more heavily used irons. This leakage current flows to the ground wire on grounded tip soldering irons and the resultant tip potential is a function of the leakage current and tip resistance to ground.

MIL-STD-2000 requires soldering irons to have three-wire cords and grounded tips with no more than 5 ohms, nor more than 2 millivolts RMS, when measured from tip to earth ground. DOD-HDBK-263 section 7.2.10 specifies tip resistance to ground to be 20 ohms or less and tip voltage to be less than 2 millivolts. Therefore, leakage current should not exceed 1000 µA RMS to meet the MIL-STD-2000 requirement or 100 µA to meet DOD-HDBK-263. If the heating element is powered directly from 110 VAC, the impedance from tip to the AC line should not be less than 1.5 megohm. Typical soldering irons tested by Wahl have insulation impedance readings from 2 megohms to 95 megohms.

9.4.2 Checking Tip Potential to Ground, AC or AC + DC Millivolts

AC mV - When the ST2100 function switch is rotated to the "MILLIVOLTS AC ONLY" position, the instrument will indicate the True RMS voltage as presented to the sensor by a soldering iron or other AC source of potential. All measurements are made with respect to the third wire (round pin in AC line plug) which connects to the ground of the AC power distribution.

The 2 mV warning indicator will flash red for any reading of 2.0 mV and above while the actual mV value is shown by the digital display from 0.0 to 20.0 mV True RMS of AC voltage.

If an oscilloscope is connected to the tip and the waveform viewed with respect to the soldering iron power ground, the basic frequency of the line power is seen but the waveform may or may not be uniform. In most cases the waveform will be distorted due to the effects of distributed capacitance throughout the soldering iron heater and sensor circuitry. In any case, the True RMS feature of the ST2100 will measure the power content of the available signal and display it as an engineering unit, RMS millivolts.

AC + DC Millivolts - When the selector switch is rotated to "MILLIVOLTS AC + DC", the total True RMS value of all DC and all AC voltage at the tip is measured and displayed.

Mil specs anticipate only AC voltage potential at the tip. However, Wahl has tested irons which show both AC and DC potential at the tip, either of which may be damaging to components.

9.4.3 Sources of Tip Voltage

a) The primary source of tip voltage is the 110 VAC 60 Hz line power supplied to the soldering iron heater and its temperature controller. Insulation breakdown is typically caused by the continuous high temperature operation which in time causes aging of insulation and circuit defects. For this reason it is advisable to perform frequent tests on each production iron after heating it to its working temperature.

b) Thermocouple EMF Effect

Most tips are made of copper which are steel clad and nickel plated. It is possible to experience a thermocouple EMF voltage at soldering temperatures between the nickel plating and dissimilar metals when working against a 2-ohm (spec limit) or higher tip-to-ground resistance. At 2 ohms to ground, Wahl has measured 2 mV in a circuit containing a 1 megohm, 5% resistor. (See Table II and test circuit, page 19.)

The potential between the Wahl sensor and the nickel plated tip is negligible, 1 μV at 630°F.

On a copper plate tested in accordance with suggested Mil Spec procedures the value is also negligible, 1.72 μV at 630°F.

9.4.4 Voltage Spike Detector

The voltage spike detector is operational in mV mode of test only and when the soldering iron tip is in contact with the tip sensor. Detection of a potentially damaging voltage spike is indicated by the VOLTAGE SPIKE indicator flashing from GREEN to RED. Each voltage spike transient detected will flash the indicator for approx. one second.

9.5 WRIST STRAP TEST

To test the wrist strap, connect the jack on the wrist strap cord to the jack provided in the area of the WRIST STRAP TEST on the ST2100. Set the Function Switch to the Wrist Strap position. Insure that the wrist strap is worn on the wrist of the operator and is in intimate contact with the skin. Touch the silver button, on the ST2100, with a finger. The WRIST STRAP INDICATOR light shall change from RED to GREEN. A RED indication indicates a faulty wrist strap. A GREEN indication indicates an acceptable wrist strap.

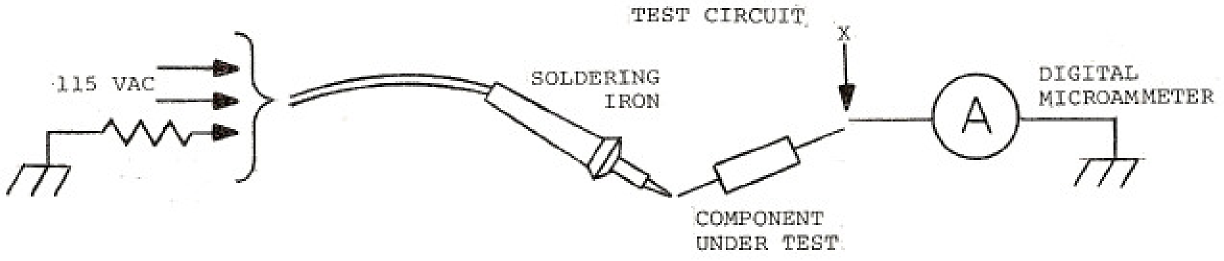
TABLE II

THERMOCOUPLE EFFECT

Thermocouple EMF effect from a nickel plated and tinned soldering iron tip. For test purposes the soldering iron was modified to have tip-to-ground resistance of 2.0 ohms for a consistent load. Test temperature 630°F.

Results With Iron at 630°F

Component Under Test	Material	Current	*Resultant Volts at "X"
Wahl Sensor + lead	Ni, 10% Chrome	7.6 μA	15.2 μV
Wahl Sensor - lead	Ni, 5% Al, Silicon	-5.2 μA	-10.4 μV
Wahl Sensor ± shorted		-4.0 μA	-.8 μV
10Ω, 1% Resistor	Cu & Tin Plate	1.5 μA	18.0 μV
562Ω, 1% Resistor	Cu & Tin Plate	.39 μA	219.0 μV
570Ω, 5% Resistor	Cu & Tin Plate	.68 μA	389.0 μV
33Ω, 5% Resistor	Cu & Tin Plate	.89 μA	31.2 μV
33Ω, 5% Resistor	Cu & Tin Plate	.89 μA	31.2 μV
Red Ammeter Clip Lead	Gold Plated Beryllium	.50μA	1.0 μV
Copper Test Plate	Cu	.87 μA	1.72 μV
2N4391 Drain (Source & Gate Shorted R_{DS} = 46Ω)	Gold Plated Kovar	-5.7 μA	-274 μV
1 meg, 5% Resistor	Cu & Tin Plate	-.002 μA	-2.0 mV
1 meg, 1% Resistor	Cu & Tin Plate	-.002 μA	-2.0 mV



*Computed by multiplying the current measured times the resistance of the component under test plus the 2 ohms. The potential at the soldering iron tip would equal the above current times the tip-to-ground resistance of 2 ohms.

10.0 DESIGN INFORMATION

10.1 Circuits

Figure 6 (page 22) is a simplified block diagram of the ST2100. There are six distinct measuring capabilities shown. During temperature measurement, the thermocouple characteristics of the type K sensor are used and the microvolt signals are amplified by the chopper stabilized amplifier, linearized, and converted to a digital display of engineering units in degrees. Degrees F is the standard output with °C output available as an option.

During the measurement of tip millivolts, the sensor is connected via the chopper amplifier to a true RMS-to-DC converter which scales its output to 10 millivolts per millivolt of true RMS input voltage. The tip millivolts are displayed in engineering units with a resolution of .1 millivolts RMS.

The ohms circuitry consists of a precision 10 ma DC current source and an ohms converter circuit to provide the scaling and offsets necessary to display the tip resistance to ground yet nulling out the resistance of the instrument and its power cable. Ohms are displayed in engineering units with a resolution of .1 ohm.

The analog to digital converter is a 12 bit dual slope converter which features auto zero drift nulling capability and excellent long term stability.

The display is a .50 inch, 3-1/2 digit, bright LCD display with non-multiplexed segments for minimum noise generation and best display stability. In addition, peripheral LED status indicators provide flashing go/no-go warnings at preset levels when tip voltage or tip ohms exceed default levels as defined by MIL-STD-2000.

The AC power inputs and sensor input are transient, static and surge protected for the utmost in damage immunity. The output jack buffer is also protected against shorts to ground and overvoltage inputs.

10.2 Construction

A rugged but lightweight design was selected for the ST2100 Tester. Its design was carefully considered from the standpoint of convenience and safety and for operation in ESD protected work areas.

The front operator panel is made of aluminum, as is the base and rear panel where the AC power cord enters the unit. These metal parts are connected to the power ground wire of the AC cord. The sides of the unit are made of high strength structural plastic foam with an outer painted finish. As an added precaution, the entire assembly has been treated with a cloride-free liquid anti-stat.

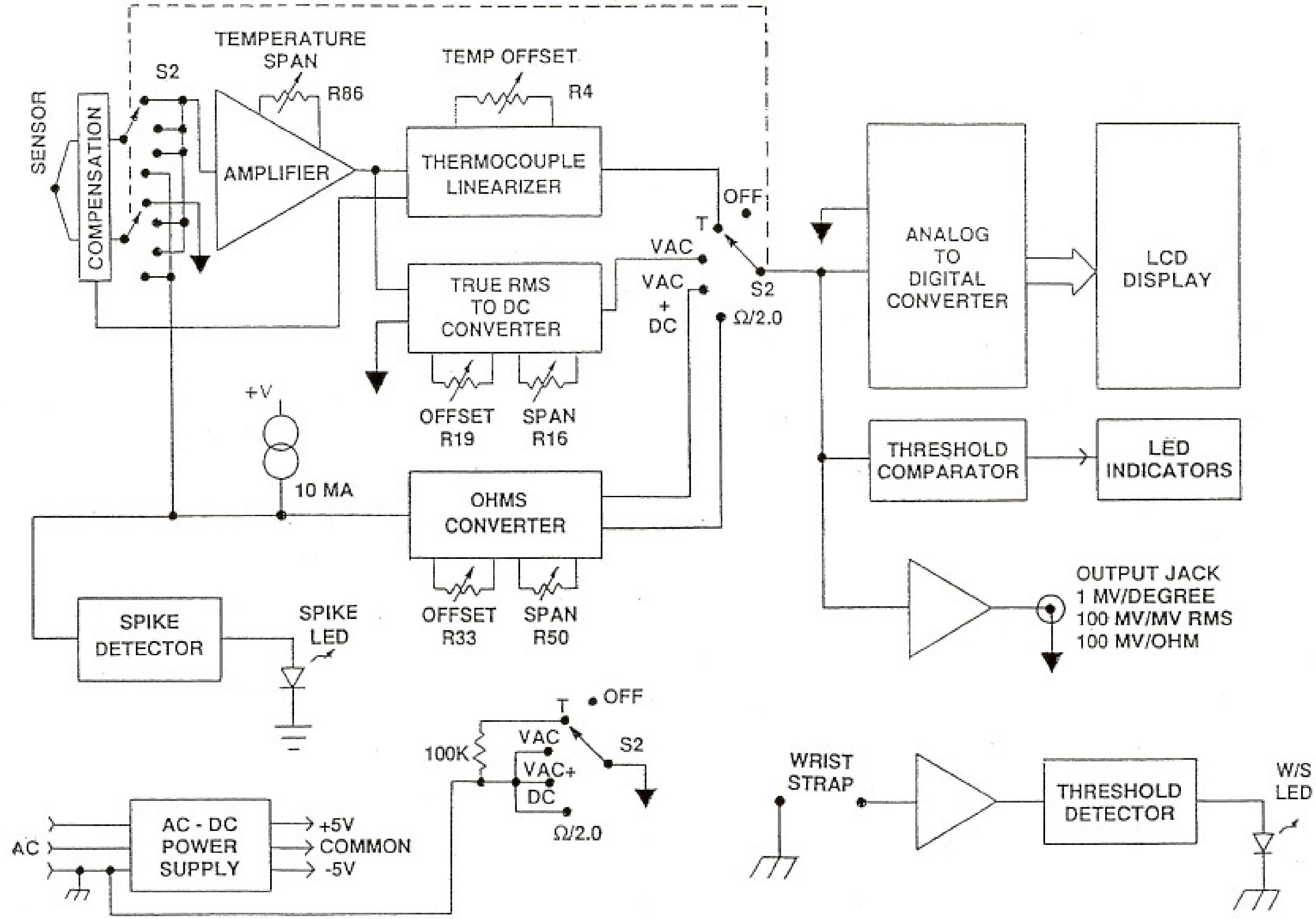


Figure 6. ST2100 Simplified System Diagram

SECTION IV
CALIBRATION

11.0 CALIBRATION PROCEDURE

11.1 Test Equipment Required

The ST2100 can be calibrated by using the following standard metrology calibration equipment or equivalent. Wahl Instruments, Inc., provides calibration services traceable to NIST standards.

Please contact the factory at 800-421-2853 for details.

The following calibration equipment is required:

(1) A DC millivolt source to simulate type K thermocouple characteristics. Wahl Model C65-4 or equivalent is suggested.

(2) Decade Resistance Box 0 to 200.0 ohms with .1 ohm resolution.

(3) Digital Voltmeter with DC volts and true RMS measurement capability to 2 volts with a resolution of .01 MV DC or RMS. Suggest Solartron 7061 or Hewlett-Packard HP3458A.

(4) A low level AC sine wave generator with variable signal levels and frequencies from 50 to 60 HZ. The generator should have the capability to have its output synchronized to the applied line frequency.

11.2 Analog to Digital Converter Calibration

Remove the bottom plate of the ST2100 by removing four screws. This will expose the circuitry and calibration potentiometers. Connect a clip lead jumper from TP2 to to TP3.

Connect a DC mV source to the tip sensor banana posts with (+) to post marked with (+) and (-) of the mV source to the remaining banana post nearest the board edge. Set the mV source for approximately 23 mV DC.

Connect the calibrating DVM with (+) to TP5 and (-) to TP3. Switch ST2100 to TEMP and make a fine adjustment to the DC mV source for a 1000 mV reading at the calibrating DVM.

11.2 Continued

Calibrate the ST2100 analog-to-digital converter so that it conforms to the externally connected calibrating DVM over a range of 100 to 1300 millivolts between TP5 and TP3. R28 is the adjustment for the A/D. Adjust R28 with 1000.0 millivolts input and take care to insure that R28 is in the center of its adjustment by rotating R28 back and forth and noting where the least significant digit switches from 9-0-1 as the display changes from 999-1000-1001.

The linearity of the ST2100 A/D should correspond to within ±1 counts of the readings on the calibrating DVM as the input is varied from 100 to 1300 millivolts.

11.3 Ohms Calibration

The external calibrating DVM should remain connected to TP3 and TP5 as discussed in paragraph 11.2 and the selector switch of the ST2100 should be at the OHMS position.

The preferred leads used to connect the decade box to the ST2100 should be at least AWG#22 or larger with a banana plug on one lead and an alligator clip on the other lead as shown in Figure 8, page 26. These leads must be measured for ohms so the calibration can be altered accordingly.

Use an external ohms measuring instrument and perform a four wire ohms measurement on the decade box with its leads attached while the decade box is set to 0.00 ohms. The reading obtained must be added to all future decade box readings for proper calibration. For example, if the leads measure .2 ohms, the proper calibration when the decade box is set at 0.00 or 50.00 ohms will be 0.20 and 50.20 ohms respectively.

Starting with a decade box setting of 0.00 ohms, connect one side to the ST2100 tip sensor and the other to the power ground adjacent to the ST2100 power plug on the AC strip similar to the connection shown in Figure 8.

NOTE

For best results, solder a resistor lead to the solder bead of the tip sensor and attach the alligator clip to it. The ST2100 line cord should have its round ground pin as clean as possible to insure a good low ohms connection to the AC outlet. The AC outlet female receptacle should also be clean as it forms the other half of the connection. A good contact cleaner may be necessary along with some abrasive action to arrive at a connection that does not vary more than ±.1 ohms with mild tugging movement of the AC line cord. This will also be true for the decade box connection to the ground socket of the AC outlet.

Also, be sure to use adjacent AC outlets for the ST2100 line cord and the decade box connections to avoid errors due to resistance in the ground connections or circulating ground currents from other equipment. (See paragraph 9.3.2 for further explanation.)

11.3 Continued

With the connections as described above, set the decade box for 0.00 ohms and adjust R33 for a ST2100 reading equal to the value of lead resistance found earlier in the four wire measurement. Again, use the calibrating DVM at TP3 and TP5 to make the best adjustment as the resolution will be better. For example, the test current is 10 milliamperes. If the lead resistance is .2 ohms, 2.0 millivolts will be displayed at the calibrating DVM but the ST2100 will display 0.2 ohms. Therefore, the added digit of resolution at TP3 and TP5 allows for a more precise adjustment to be made.

Next, adjust the decade box to 50.0 ohms and adjust R50 for a reading on the ST2100 of 50.0 plus the lead resistance. If the lead resistance was .2 ohms, the calibrating DVM should read 502.0 millivolts and the ST2100 display would indicate 50.2 ohms.

Repeat the 0.0 and 50.0 Ohm settings and adjust R33 and R50 respectively for the best calibration.

11.4 Temperature — Span and Offset Adjustment

The external calibrating DVM should remain connected to TP3 and TP5 as discussed in paragraph 11.2.

Refer to Figure 7. Connect an external temperature calibrator as shown with the (+) lead to the banana post closest to the display and the (-) lead to the remaining banana post. The connection must be made with type K thermocouple wire or type K compensation wire. Allow at least five minutes for the connections to dissipate any increased temperature due to handling as the connections were made.

With the ST2100 selector switch at Temperature, adjust the external Temperature calibrator for a room ambient input of 75-77 degrees F using a type K calibration. Adjust R4 for a ST2100 display reading to agree with the calibration source input. Use the external calibrating DVM with its increased resolution (± .1 millivolts or better) to more precisely adjust R4.

Next, adjust the temperature calibrator for an input of 1300°F adjust R86 for an exact 1300 reading on the ST2100 display.

Repeat paragraph 11.3 as necessary until both the adjustments at R4 and R86 are satisfactory. When properly calibrated, the ST2100 will display the correct temperature from 75°F to 1300°F with an error band of ±1 degree F or C.

NOTE: When setting an output signal from a mV source for calibration, use Reference Table III, page 30, to correlate mV to temperature per IPTS-68 standard. Tolerance of Type K thermocouples in the 500-800°F range is ±3/4 percent between 530°F and 2300°F.

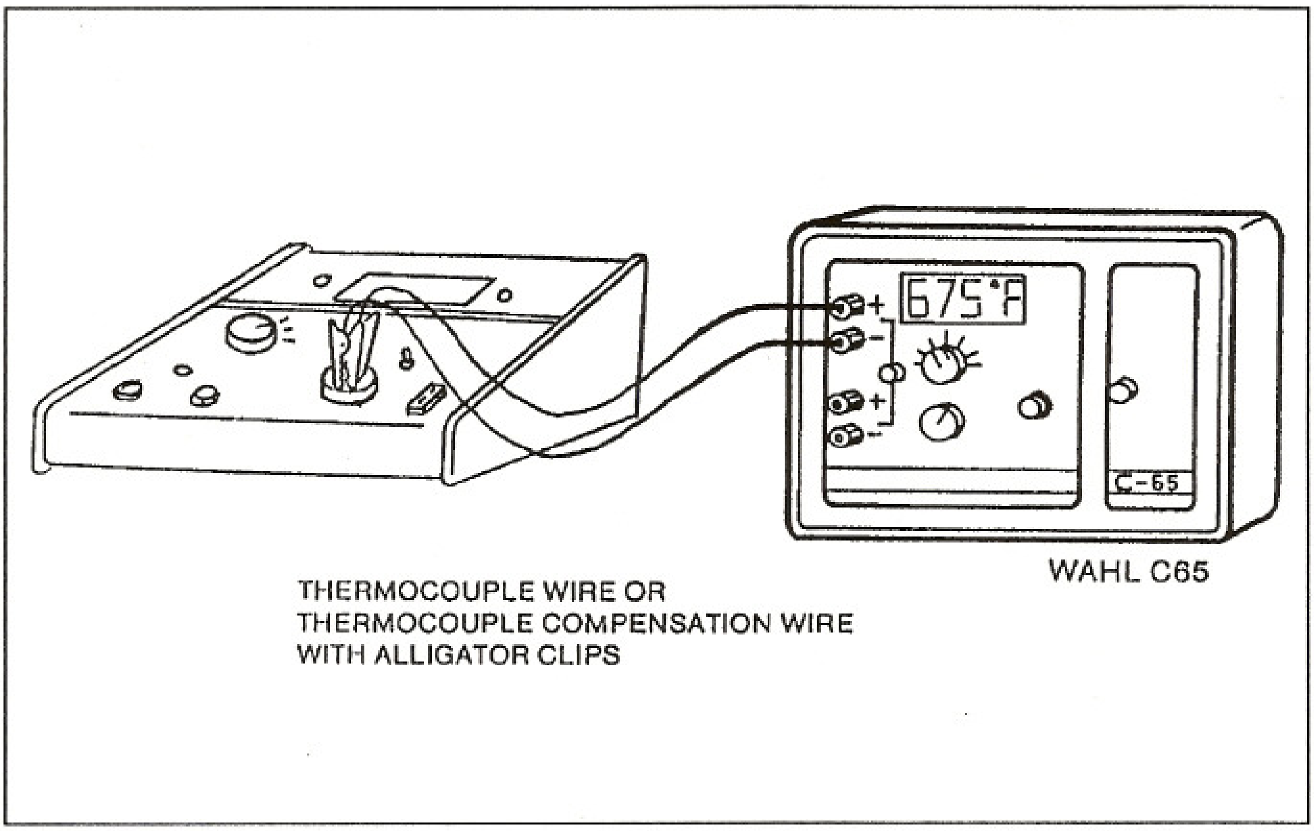


Figure 7. Temperature Calibration

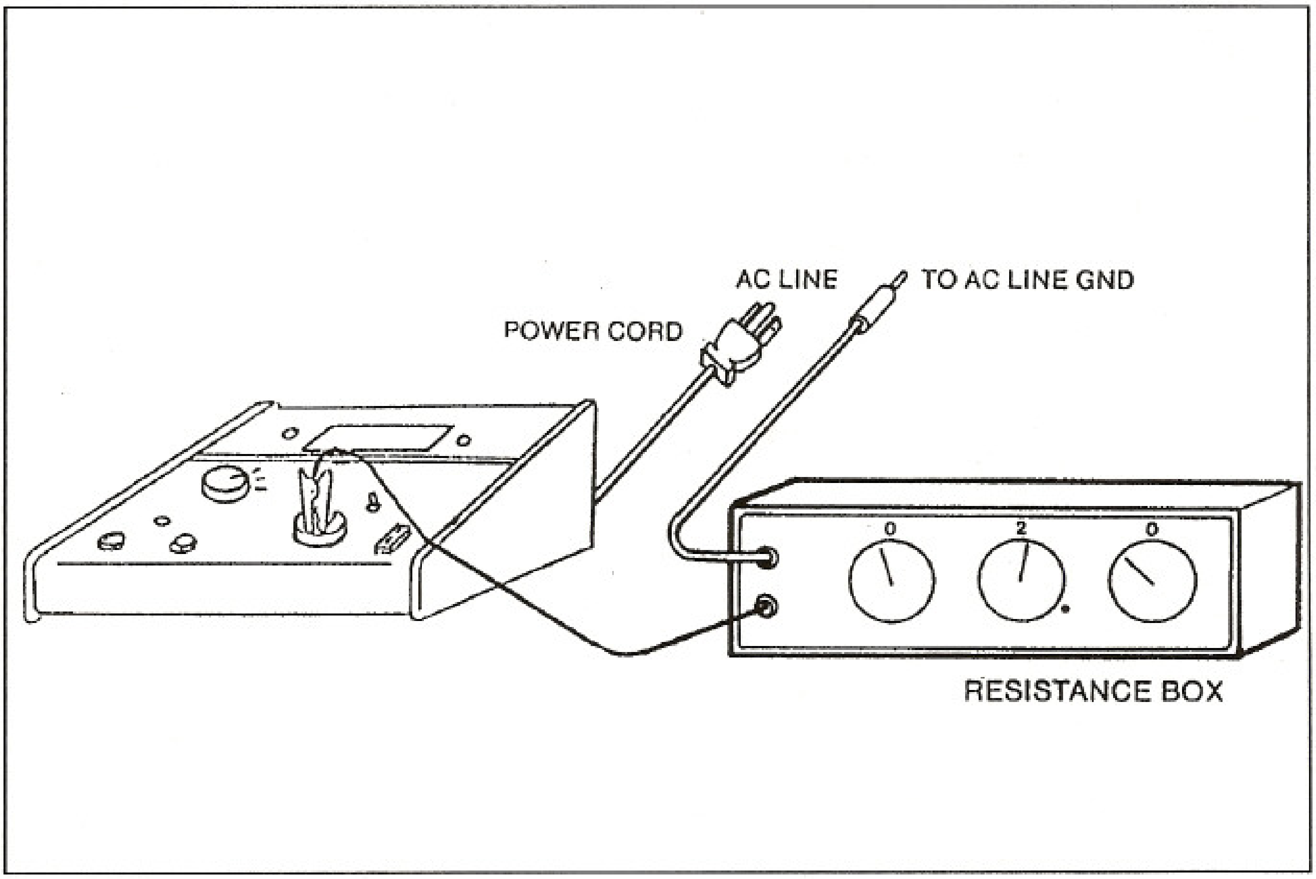


Figure 8. Ohms Calibration

11.5 Test Fail LED

For all MV and Ohm readings below 2.0, the ST2100 "FAIL mV/Ohm" LED will indicate green. The ST2100 will flash a red Fail mV/Ohm LED when the tip OHMS or tip MILLIVOLTS reads 2.0 or greater. This LED will also blink for open inputs during MV and OHMS.

The 2.0 level is digitally determined and not adjustable.

11.6 Calibration of Tip Millivolts Circuitry (See Figure 11-3.)

NOTE

> The ST2100 measures TRMS voltage of AC or AC + DC voltages to 30 KHZ bandwidth. Many TRMS voltmeters have a restricted bandwidth and are AC coupled such that DC is not measured. Verify that the meter you intend to use has the necessary capability for true RMS in both AC and AC + DC up to 30 KHZ or beyond.

The thermocouple-based sensor must be installed at the TIP TEST area for this calibration. Connect the ST2100, reference TRMS voltmeter, and signal source as shown in Figure 9. A 2 ohm load is recommended to insure the impedance is near the maximum allowed for the soldering iron.

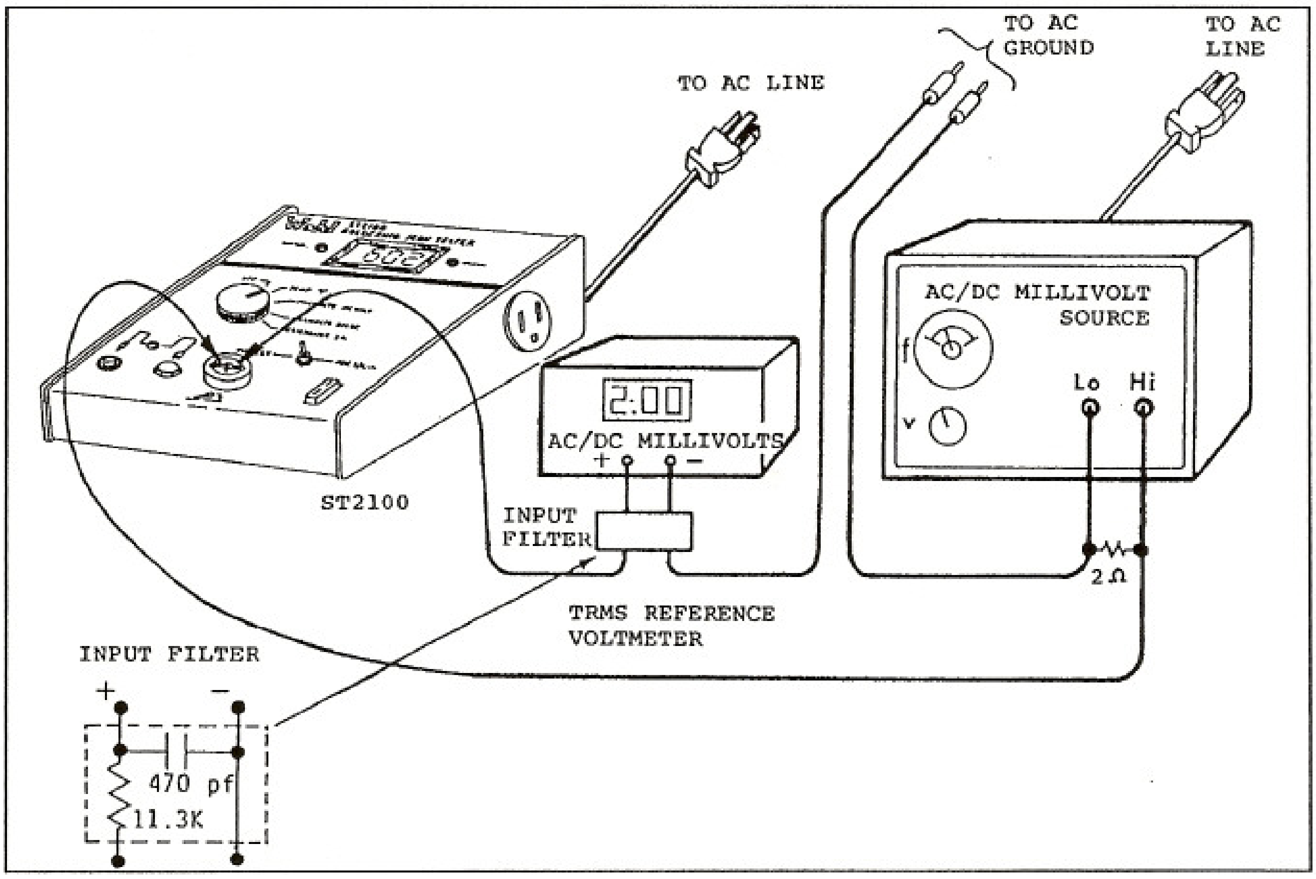


Figure 9. Millivolts Calibration

11.6 Continued

The TRMS voltmeter should have its bandwidth limited to that of the ST2100 to insure that the voltmeter does not respond to a spectrum of frequencies that the ST2100 cannot respond to. For a 30 KHZ bandwidth, use an 11.3 K Ohm resistor in series with the HI input and then a shunt 470 pf capacitor from the HI terminal to LO. This will provide the same frequency characteristics to the TRMS voltmeter as the ST2100 has, i.e., a 30 KHZ bandwidth.

The AC millivolt source should be set to 60 HZ (or 50 HZ) and synchronized to the line frequency for best results. If this is not done, there will be beat frequencies developed with the powerline ambient background 60 Hz AC such that the output from the RMS to DC converter will be varying, which will give the display the appearance of being unstable. If the 60 HZ (or 50 HZ) output connot be synchronized to the line, then the alternative is to set the input frequency to 300 HZ and proceed with the calibration.

The AC voltmeter should be connected as shown with the HI lead connected to the TIP SENSOR (the resistor lead that was soldered in for OHMS test can be used here also) and the LO lead connected to the power ground next to the AC power cable of the ST2100. Turn the ST2100 selector switch to AC mV.

With the millivolt signal source power switch off, note the AC reference voltmeter reading (call it V1) and zero out any ambient voltage that the ST2100 is sensing by adjusting R19 for a ST2100 display reading of 0.0 mV.

Next, turn on the power to the AC millivolt generator and adjust its output for 20 mV RMS plus V1 reading from above. The AC reference voltmeter should read 2.0 mV + V1. Now adjust R16 for a ST2100 display of 20 mV RMS.

Next turn off the power to the AC millivolts source and touch up R19 as necessary for a 0.0 display reading on the ST2100. Repeat the R16 and R19 adjustments as necessary for an accurate calibration.

11.7 Verification of DC Calibration

The ST2100 displays the TRMS of the sum total of AC +DC voltages presented to the sensor with respect to power ground. There is no separate adjustment for AC and DC inputs as the RMS-to-DC converter is the same for all AC or AC + DC measurements and was calibrated with AC millivolts in 11.6.

With an input of DC millivolts, a different calibrating source is usually required which can be a cause of errors in the calibration. It should also be remembered that in the AC + DC position, the ST2100 will also convert and display any background AC that may have been picked up. Therefore, due to the very low level signal magnitudes involved, extreme care is needed to make accurate and repeatable measurements.

11.7 Continued

Apply the DC millivolts directly to the ST2100 sensor with the (+) lead to the sensor and the (-) lead to the same ground point used in step 11.4 to terminate the AC millivolts "Lo" output. The filter input to the reference voltmeter should be maintained to insure that the reference voltmeter and ST2100 will view the spectrum of inputs with the same bandwidth.

Turn the ST2100 selector switch to mV AC + DC position. Set the DC millivolt source to 0.0 millivolts. The ST2100 should read 0.0 millivolts to within its specification as listed on pages 7-8 of this manual. Insert other DC millivolt settings within the 0-30 mV range and verify that the ST2100 reads these inputs within the accuracy stated in the specification.

11.8 Temperature Calibration of Sensor

Wahl calibrates production sensors against a Wahl-Standard Sensor. Using a constant temperature soldering station, Met-Cal Model STSS-001, as a transfer standard, production sensors are compared to the Wahl Standard at 650°F. Production sensors are passed at ±5°F compared to the standard.

11.9 Calibration Check of Spike Detector

Connect a source of 100 mV ±1% pulses, with a pulse width of 1 micro-second or greater, between the tip sensor and power ground. Turn the Function Selector Switch to Tip mV. Set the repetition rate for "single shot" or one every 2 seconds. The Spike LED should be green when no spikes are presented but flash red for approximately 1 sec. when a spike is presented. There is no adjustment.

11.10 Wrist Strap Circuit Check

Set the Function switch to the Wrist Strap Test position. Connect a one megohm resistance between the "Wrist Strap" test points. These connections should be made with banana plugs and alligator clips and NOT held with the hand as stray parallel resistances will effect the readings. The Wrist Strap Indicator should be GREEN. Connect a 450K Ohm resistance across the Wrist Strap test points. The Wrist Strap Indicator should be RED. Connect an 11 meg ohm resistance across the Wrist Strap test points. The Wrist Strap Indicator should be RED. There is no field adjustment for the Wrist Strap circuitry.

TABLE III. Type-K Thermocouple

REFERENCE TABLE — mV vs Temperature

TYPE K Nickel-Chromium Vs. Nickel-Aluminum (Chromel-Alumel)						
CAL TEMP. / ROOM TEMP.	0 °F	200 °F	400 °F	600 °F	800 °F	990 °F
60 °F	-1.311	3.200	7.695	12.235	16.904	21.395
61 °F	-1.334	3.177	7.672	12.212	16.881	21.372
62 °F	-1.356	3.155	7.650	12.190	16.859	21.350
63 °F	-1.378	3.133	7.628	12.168	16.837	21.328
64 °F	-1.401	3.110	7.605	12.145	16.814	21.305
65 °F	-1.423	3.088	7.583	12.123	16.792	21.283
66 °F	-1.445	3.066	7.561	12.101	16.770	21.261
67 °F	-1.468	3.043	7.538	12.078	16.747	21.238
68 °F	-1.490	3.021	7.516	12.056	16.725	21.216
69 °F	-1.513	2.998	7.493	12.033	16.702	21.193
70 °F	-1.535	2.976	7.471	12.011	16.680	21.171
71 °F	-1.557	2.954	7.449	11.989	16.658	21.149
72 °F	-1.580	2.931	7.426	11.966	16.635	21.126
73 °F	-1.602	2.909	7.404	11.944	16.613	21.104
74 °F	-1.625	2.886	7.381	11.921	16.590	21.081
75 °F	-1.647	2.864	7.359	11.899	16.568	21.059
76 °F	-1.670	2.841	7.336	11.876	16.545	21.036
77 °F	-1.692	2.819	7.314	11.854	16.523	21.014
78 °F	-1.715	2.796	7.291	11.831	16.500	20.991
79 °F	-1.737	2.774	7.269	11.809	16.478	20.969
80 °F	-1.760	2.751	7.246	11.786	16.455	20.946
81 °F	-1.782	2.729	7.224	11.764	16.433	20.924
82 °F	-1.805	2.706	7.201	11.741	16.410	20.901
83 °F	-1.827	2.684	7.179	11.719	16.388	20.879
84 °F	-1.850	2.661	7.156	11.696	16.365	20.856
85 °F	-1.873	2.638	7.133	11.673	16.342	20.833
86 °F	-1.895	2.616	7.111	11.651	16.320	20.811
87 °F	-1.918	2.593	7.088	11.628	16.297	20.788
88 °F	-1.940	2.571	7.066	11.606	16.275	20.766
89 °F	-1.963	2.548	7.043	11.583	16.252	20.743
90 °F	-1.986	2.525	7.020	11.560	16.229	20.720

12.0 TROUBLESHOOTING

When trouble occurs, it will usually center around three main areas.

1. Bad soldering irons which act erratically or bad connection to the AC line.
2. High contact resistance connection to ground of either ST2100 or the soldering iron.
3. A faulty ST2100.

12.1 PROBLEMS WITH TEMPERATURE MEASUREMENTS

Wahl test technicians have extensive experience with making temperature measurements and offer the following hints when temperature readings seem incorrect.

1. Add a bit of fresh solder to the soldering iron tip to insure a good thermal connection via "wet" solder.
2. Apply steady and firm (but not heavy) pressure to the sensor.
3. If readings are very high or "1---" shows on the display, it may indicate an open ST-01 or ST-02 sensor. Replace and try again. If still high, soldering iron may be in runaway mode or there is an internal fault in the ST2100. Re-calibrate. If not possible, return to factory.

12.2 PROBLEMS WITH MILLIVOLTS MEASUREMENTS

If measurements are in doubt, connect a clip lead from the ST2100 sensor to ground at the AC line. The display should indicate from 0.0 to 0.2 mV max for a "zero" input.

If there is more than this, the ST2100 may need recalibration or repair. Try reconnecting the ST2100 AC cord at the AC line and try again. The contact resistance of the ground connection at the AC line is not a major factor, but if it is over 100 ohms, erratic readings may appear. Switch to "OHMS" and measure the ohms of the soldering iron back to the AC line. If more than the 2 or 20 ohms allowed, there may be a problem with the ground in the soldering iron or the AC line receptacle.

Other problems:

1. Cycling readings -- up, down, up, down, etc. This may be due to actual cycling of the soldering iron control.
2. Large differences between hot and cold soldering iron millivolt readings. This could indicate a bad heater or control circuit. Veryify with another iron of similar design.

12.3 PROBLEMS WITH OHMS MEASUREMENT

The contact resistance from the soldering iron power cord to the AC line and the contact resistance from ST2100 power cord to AC line will cause most of the indicated error in this measurement assuming the soldering iron itself is under 2.0 ohms.

PROBLEMS AND THINGS TO CHECK:

1. High or erratic readings -- remove the AC line cord and reconnect for both the soldering iron and ST2100 and try again. If still high, connect the soldering iron to the AC power receptacle on the ST2100 and measure again. If still high, connect a clip lead from the ST2100 sensor to ground and verify that there is resistance of no more than 0.2 ohm.

   If the clip lead test is fine but the soldering iron test was high, it points to the soldering iron as the problem.

2. Display always reads "1---". Replace the ST2100 sensor and try again with a soldering iron or clip lead from ST2100 sensor to ground. If the display still reads open, check the ground where the ST2100 line cord is plugged in. Sometimes the AC receptacle ground clips break and a ground connection is not available even though AC power is available to the ST2100.

   Move to another AC outlet and repeat the above tests. If the ground has been verified and the ST2100 sensor has been replaced but the over range indication of "1---" still exists, return the ST2100 to the factory for diagnosis and recalibration.

12.4 PROBLEMS WITH WRIST STRAP TEST

If a wrist strap under test indicated a failure, the indication could be caused by the following:

1. Problem: Wrist strap cable connector not connected to ST2100 correctly.

   Corrective Action: Insert the wrist strap cable connector into the appropriate connector provided on the ST2100. The connector is located below the Function Switch.

2. Problem: Parallel resistance path.

   Corrective Action: The operator may be touching another conductive material. Insure that the operators free hand is not in contact with any other object.

3. Problem: Defective Wrist Strap

   Corrective Action: Replace Wrist Strap

4. Problem: Wrist Strap is worn over clothing.

   Corrective Action: Wrist Straps must be in contact with the skin. Wear the Wrist Strap under clothing, against the skin.

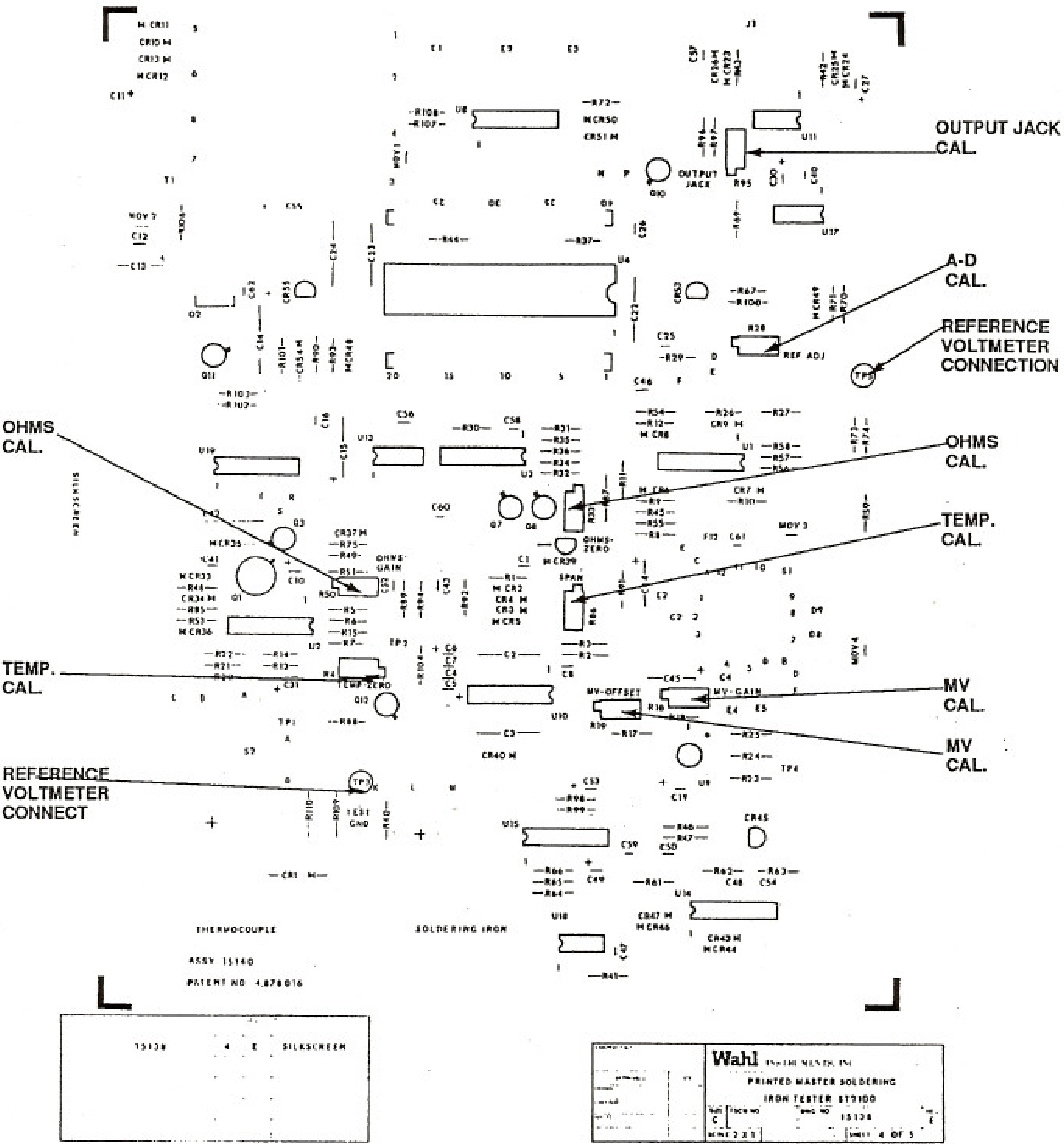


Figure 10. Components Layout Diagram

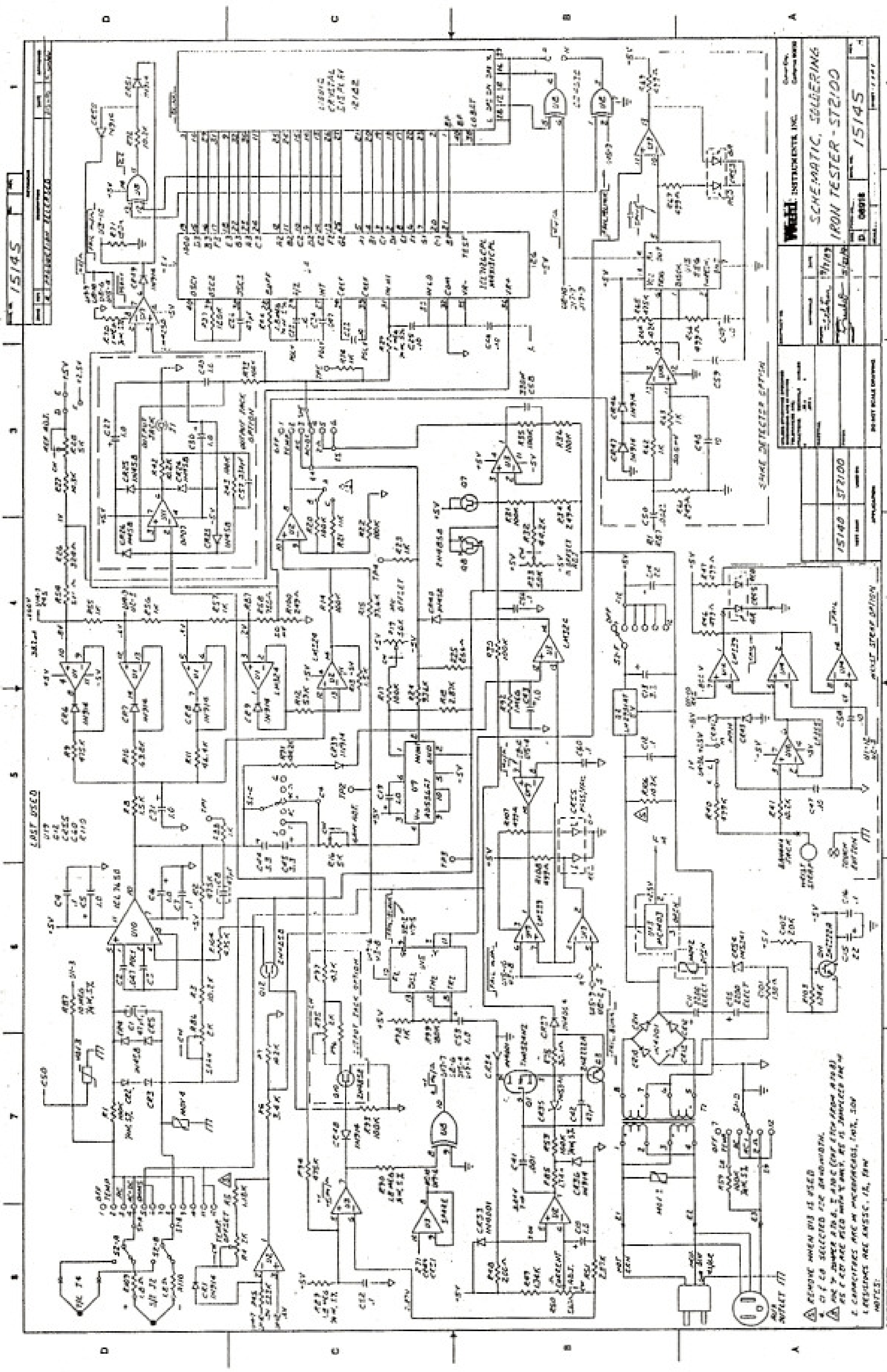


Figure 11. Schematic Diagram

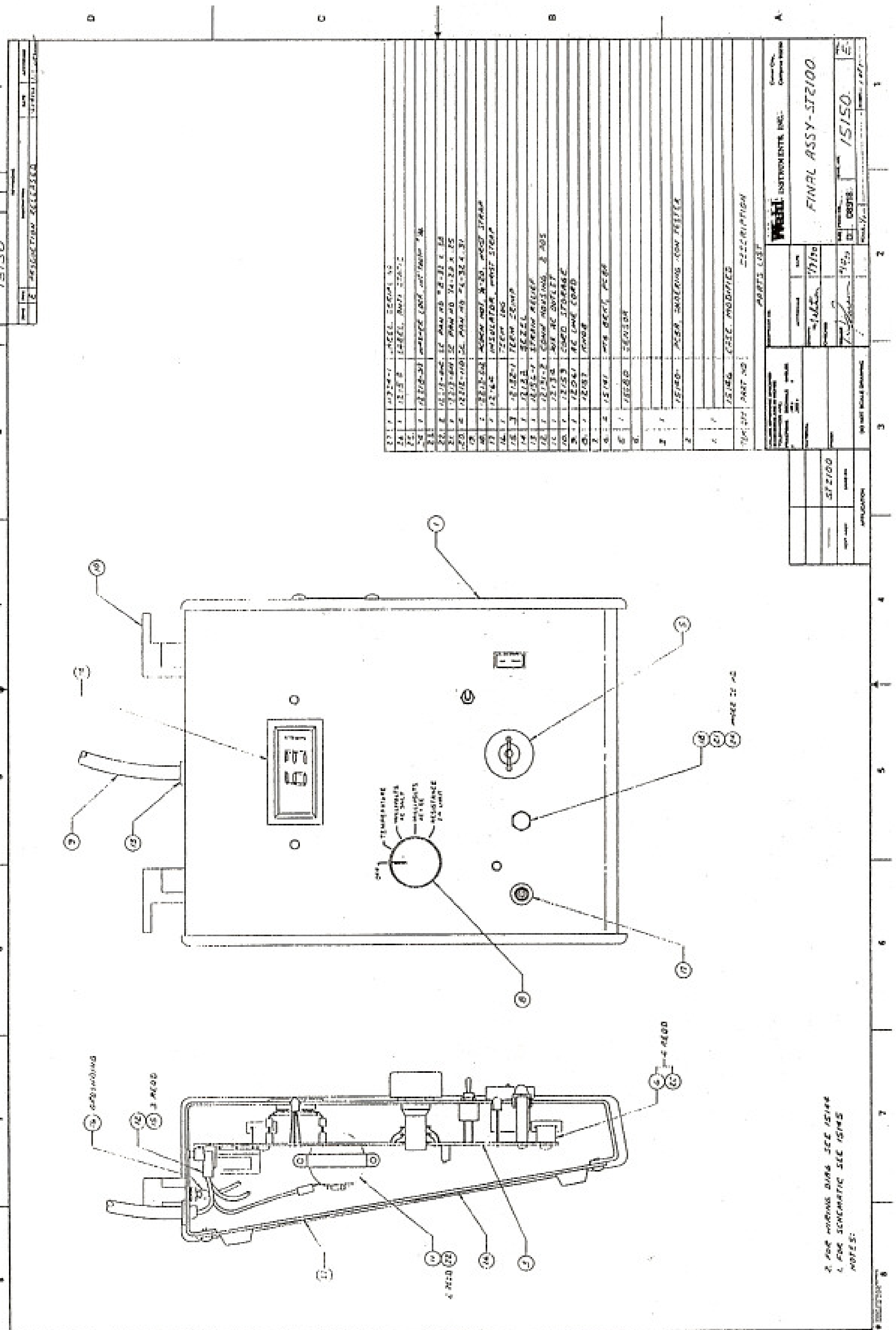


Figure 12. Assembly Drawing

13.0 DO's AND DON'TS, TIP TEMPERATURE MEASUREMENTS AND SENSOR MAINTENANCE

To obtain accurate tip temperature measurements and to obtain long sensor life here are some recommendations and maintenance instructions.

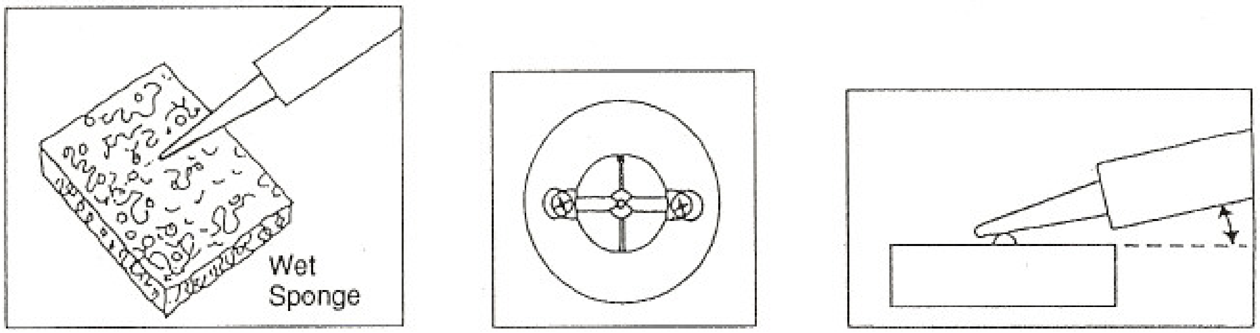
13.1 DO:

1. Clean the working tip prior to testing. (Fig. 13, page 37)
2. Touch the soldering iron tip gently to the sensor. Heavy pressure won't provide faster or more accurate readings.
3. Apply fresh solder to the sensor for the test. A fresh solder bead gives accurate temperature readings. An oxidized hard bead does not provide good heat transfer. Make sure the solder is rated to the temperature of the tip. We recommend S/N 63/44 QQ-S-571.
4. Clean the sensor band regularly. Remove the crystallized bead with a heated soldering iron and replace it. (Fig. 15)
5. Test the tip at about the same angle (approximately 20°) each time — the Bonnet Sensor will assure this. (Fig. 13)
6. Read the instruction manual thoroughly prior to making your first measurement. Spare manuals are available from Wahl. Order part number STM-20.

13.2 DON'T:

1. Apply heavy pressure to the sensor. This shortens sensor life. (Fig. 14, page 37).
2. Test tips that are dirty or corroded.
3. Allow solder or flux to build up on the sensor.
4. Perform tests without following proper grounding instructions. Refer to paragraphs 3.1, 9.3.

Remember Wahl is here to serve you. If you have any problems or questions, call Wahl on our toll-free hot line: 1-800-421-2853.

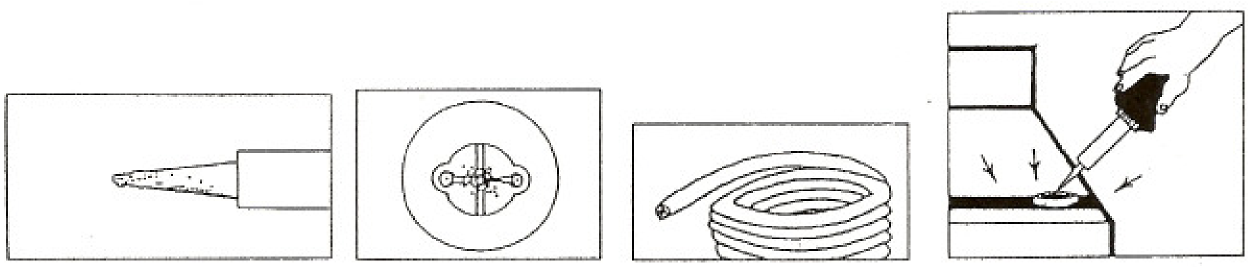


Clean tip

Clean sensor -- fresh bead

Proper angle, 10° - 30°
1/8" from tip
light - medium pressure

Figure 13. Achieving Accurate Test Readings



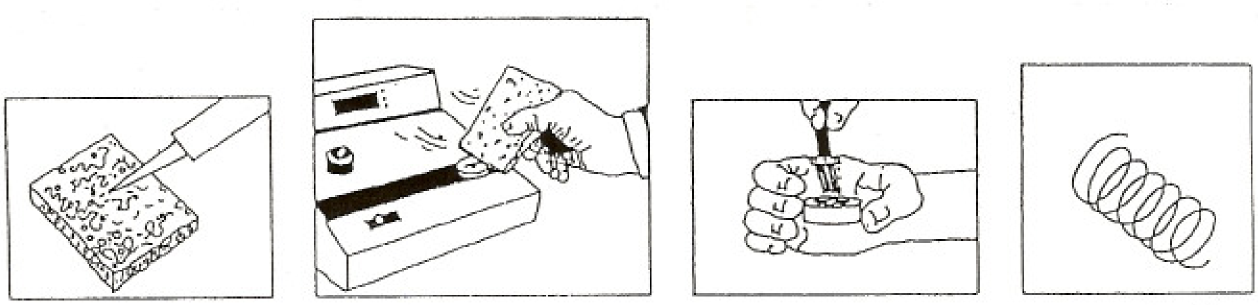
Don't use dirty tips

Don't use crystalized sensor bead

Don't use large diameter resin core solder

Don't use heavy pressure on sensor

Figure 14. Poor Test Practices



Clean tip with wet sponge

Clean off old bead. Heat with hot iron. Wipe with wet sponge.

Clean out flux. Remove sensor. Use solvent.

Apply fresh solder .030" dia. per SN63/44 QQ-S-571

Figure 15. Sensor Maintenance

14.0 REPAIR OF SENSORS

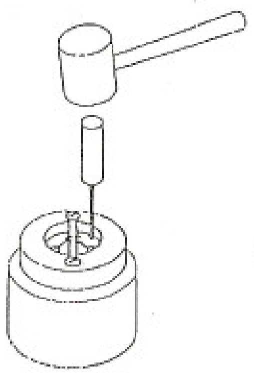
Sensors for the ST2100 are very sturdy and will give long life if not subjected to excessive force during use.

Except for P/N WST-01 (light duty) all sensors are repairable in the field by installing new bands and wires.

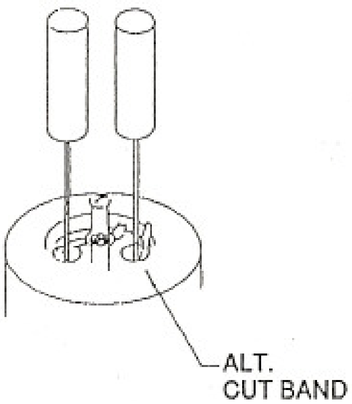
Or, they may be returned to the factory for repair.

14.1 WST-02, 02B Replacement of Bands.

1. Remove two screws from bottom end of sensor, then turn over and remove two screws from top of sensor.
2. Place sensor in holder per Step A and B. Insert plug removal tool in sensor strap and hold and strike with small hammer until plug falls out of sensor. Alt. Cut bands for clearance of removal tool.
3. Repeat for other end of strap.
4. Remove old sensor strap.

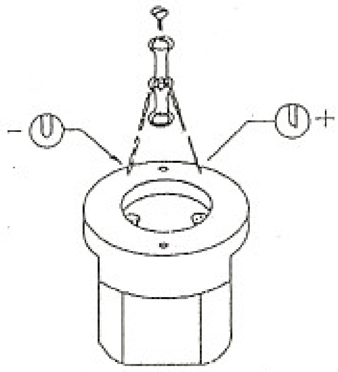


Step A

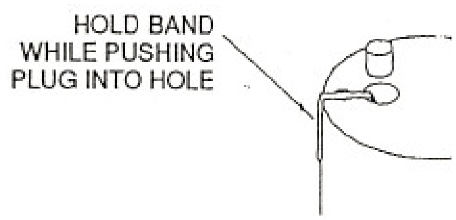


Step B

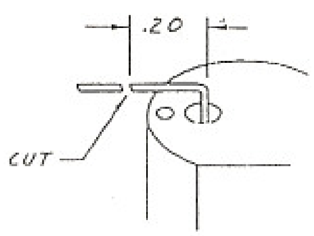
5. Insert new strap per Step C and fasten with 2 screws. Arrow point must face direction shown. Note, plus (+) lead location is stamped on bottom of housing.
6. Step D, bend bands over edge of housing. Hold firmly against side while pushing plastic plug to bottom of hole.
7. Step F, cut excess lead then push cut lead into screw hole and install two screws.



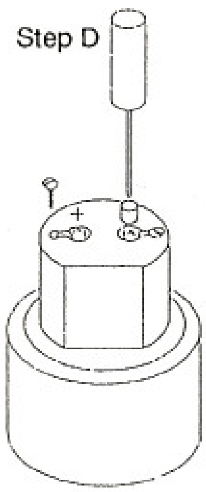
Step C



Step D



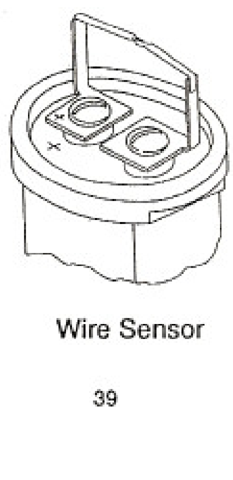
Step E



Step F

14.2 WST-03 Replacement of Wire

1. Remove the two screws that secure the Wire Mounting Posts.
2. Note the orientation of the Wire Mounting Posts.
3. Remove the Wire Mounting Posts and Wire Sensing element.
4. Install the replacement element with the same orientation as the one removed. The Wire Mounting Post marked with a "+" is to be positioned nearest to the "+" identification on the sensor body. See drawing below.
5. Carefully tighten the screws taking care not to damage the Wire Element. It may be necessary to hold the Posts with pliers to prevent movement when tightening screws.



Wire Sensor