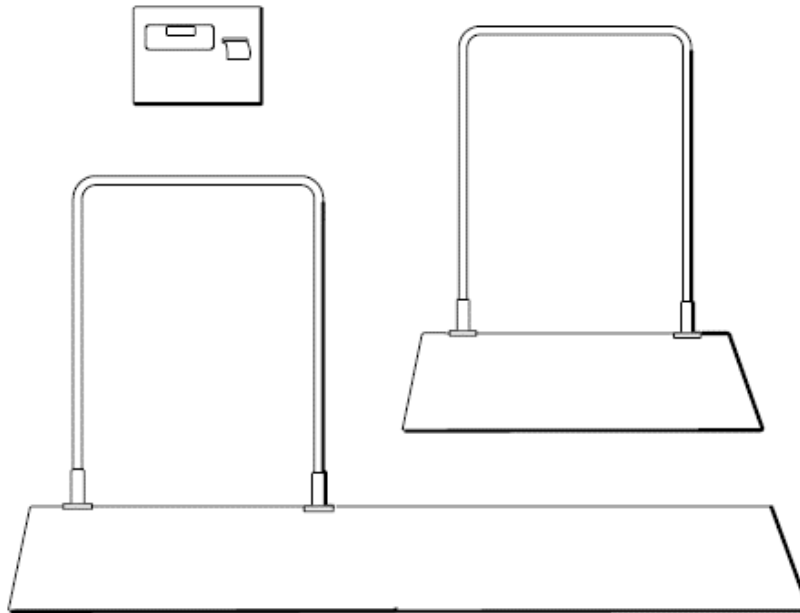# Welch Allyn Flush Mounted In-Floor Scales

Service Manual

Model 6102 Flush Mounted In-Floor Scale
Model 6154 Flush Mounted In-Floor Scale

WelchAllyn®

Advancing Frontline Care™

For information about any Welch Allyn product, contact your local Welch Allyn representative:
http://www.welchallyn.com/en/other/contact-us.html

Customer Support
Placing orders, checking on pricing, billing, or repairs
scale-tronix@welchallyn.com

1.800.535.6663, Option 2, 1, 5
9am - 5pm EST
Mon - Fri

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Warranty

Welch Allyn will warranty the weight scale to be free of defects in material and workmanship and to perform in accordance with manufacturer specifications for the period of one year from the date of retail purchase.

The warranty period shall start on the date of purchase. The date of purchase is: 1) the invoiced ship date if the device was purchased directly from Welch Allyn, 2) the date specified during product registration, 3) the date of purchase of the product from a Welch Allyn authorized distributor as documented from a receipt from said distributor.

This warranty does NOT cover damages caused by misuse or abuse, including but not limited to:
- Failure caused by unauthorized repairs or modifications
- Damage caused by shock or dropping during transportation
- Damage caused by improper use of the power supply
- Failure caused by improper operation not consistent with the instructions stated in the *Directions for use*

Should this device require maintenance (or replacement at our option) under warranty, contact your local Welch Allyn representative: http://www.welchallyn.com/en/other/contact-us.html

Scale setup

You can customize the scale to best suit your needs. Configurations that can be selected include the automatic shut-off time, weighing units, weight resolution, and more.

Enter custom setup mode

1. Make sure the scale is powered down.
2. Press and hold **ST** while pressing **ON**.
3. Once the scale powers up, press and release **ST** five times before the startup sequence completes. The scale displays **SEt-UP** and produces a series of four long beeps.

Set the options

Enter the custom setup as described.

Press **ST** to scroll through the custom setup options.

The options displayed with each press are as follows:

Note   Options indicated with an asterisk (*) require an additional press of **ST** to change the value.

Option displayed Feature

SOFt This option displays the software version of your scale.

dAtE This option displays the release date of the software. The format is MM/DD/YY.

SCALE This option displays the model number of the scale.

AutOFF* This displays the number of seconds before the scale turns off. The **Cont** value prevents the scale from turning off automatically.

AC con* This option causes the scale to remain on when plugged in to AC power.

rES This option allows you to change the resolution of weight. Pressing **ST** switches between the following options:

> 0.1 pounds / 0.05 kilograms
> 0.1 pounds / 0.1 kilograms
> 0.2 pounds / 0.1 kilograms
> 0.5 pounds / 0.2 kilograms
> 1 pound / 0.5 kilograms

UnitS* This option allows you to change the displayed weight unit.

Note: Do not change the scale units if you have purchased the kilogram-only option.

> ***KILOS**** This option allows the weight to display in kilograms.

> ***POUNDS**** This option allows the weight to display in pounds.

bEEPEr* This option determines the audible signal that occurs when a front panel button is pressed.

rECALL* This option allows you to turn **ON** or **OFF** the **RECALL** button functionality.

rS-232 Detailed instructions for this feature are available from Welch Allyn. Go to http://www.welchallyn.com/en/other/contact-us.html to find your local representative.

OutPut* This option displays the current data port output option. Detailed instructions for this feature are available from Welch Allyn. Go to http://www.welchallyn.com/en/other/contact-us.html to find your local representative.

> Set the value to **OFF** to disable the optional internal printer or the RS-232 port.

PrtUnt* This option determines whether pounds or kilograms are displayed on a printout.

> If the pounds and kilograms indicators are illuminated on the control panel, the printed output is determined by whichever unit is selected on the control panel.

> If the kilogram indicator is illuminated, it will only print in kilograms, regardless of the unit is selected on the control panel.

> If the pounds indicator is illuminated, it will only print in pounds, regardless of the unit is selected on the control panel.

PrtOPT* Press **RECALL** to choose between the following options:

> ***PnlPrt:*** The current weight is printed when **PRINT** is pressed on the control panel.

> ***AutPrt:*** The current weight is automatically printed when a weight reading occurs.

bAud* This option allows you to set the baud rate. Values are 1200, 2400, 4800, 9600, and 19200.

pArity* This option allows you to change the parity between the following options:

> Off: No parity, 8 data bits
> Odd: Odd parity, 7 data bits
> EuEn: Even parity, 7 data bits

StPbit* This option allows you to change the stop bits between the following options:

> 1 bit: One stop at the end of a word
> 2 bits: Two stops at the end of a word

rts.cts* This option allows you to turn **On** or **Off** the handshaking hardware for serial transmissions. The settings for rts.cts has to be "On" for printer and 'Off" for RS-232

Prtbtn* This option allows you to turn **On** or **Off** the front panel ***PRINT*** button.

rtEPrt* This option allows you to turn **On** or **Off** the enabling of printing from a remote location by connecting the receive line to the ground.

PC brd This option displays the model number of the printed circuit board. A second press of **ST** displays the revision of the printed circuit board.

SEt-UP This option is displayed when you have cycled through all the options. Press and hold **ON** to power down the scale.

Enter Advanced Service Mode

1. To enter the "service" mode start with the scale turned off.
2. Note the small "ST" logo (***"ST"***) located directly above the "**RE CALL**" pushbutton, and below the "**Zero**" pushbutton on the front panel of the readout.
3. This "***ST***" actually contains a small hidden pushbutton.
4. Next; press and hold this "***Zero***" pushbutton on the front panel while turning the power on with the "**ON**" pushbutton.
5. As soon as the scale turns on release the "***Zero***" pushbutton, then quickly press and release ***"ST"*** logo pushbutton 5 times.
6. The scale will display "***SERVICE***" and produce a series of four long beeps.
7. "Service" mode has now been entered.
8. Pressing the "***ST***" pushbutton will advance the display to the next item.
9. The scale will exit the service mode automatically after 3 minutes, or shut-off by pressing and holding the "**ON**" pushbutton for 3 or 4 seconds.
10. When the scale is turned back on, normal scale operation will resume.

1. **"A/D"**, and next window on display will show the raw A/D reading. As you press on the Platform the A/D reading will chance. The weight chance reading should be positive proportionally with the applied weight in pounds.
2. **"Test"**, and the next window will start displaying the display test, Number will show across from 0 to 9 and repeat w/ DP, from right side to left side.
3. **"Pr-OnS"** = Power on start-up, next display will show the number of times the "ON" pushbutton has been depressed.
4. **"Pr-rcl"** = Powered by Recall, next display will show the number of times the "RECALL" pushbutton has powered-up the scale (from an off state).
5. **"COUntS"** = Weighing Counts, next display will show the number of times a weight reading has been achieved.
6. **"rEcntS"** = Reweigh counts, next display will show the number of times "Reweigh" pushbutton has been depressed.
7. **"rECLLS"** = recalls, next display will show the number of times the "RECALL" pushbutton has been depressed.
8. **"OFFS"** = Turned Off, next display will show the number of times the scale has been turned off by holding the "ON" pushbutton down.
9. **"PrintS"** = Prints, next display will show the number of times the "Print" pushbutton has been depressed.
10. **"SEtUPS"** = set-up mode, next display will show the number of times the unit has entered into the set-up mode.
11. **"SEruES"** = service mode, next display will show the number of times the unit has entered into the service mode.
12. **"CALS"** = Cal mode, next display will show the number of times the unit has entered into the Cal mode.

Support services

If you have a problem with the device that you cannot resolve, call the Welch Allyn Technical Support Center nearest you for assistance. A representative will assist you in troubleshooting the problem and will make every effort to solve the problem over the phone, potentially avoiding an unnecessary return. Technical support is available 9am-5pm EST.

Welch Allyn offers the following technical support services:
- Telephone support
- Replacement service parts
- Product service

For information on any of these services, go to www.welchallyn.com/en/servicesupport.html.

Repairs

A Welch Allyn Service Center or Authorized Service Provider must perform all repairs on products under warranty unless you are a properly certified technician.

CAUTION Unauthorized repairs will void the product warranty.

Qualified service personnel or a Welch Allyn Service Center should repair products out of warranty.

If you are advised to return a product to Welch Allyn for repair or routine maintenance, schedule the repair with the service center nearest you.

Returning products

When returning a product to Welch Allyn for service, ensure that you have the following information:

- Product name, model number, and serial number. This information may be found on the product and serial number labels.
- A complete return shipping address.
- A contact name and phone number.
- Any special shipping instructions.
- A purchase-order number or credit-card number if the product is not covered by a warranty.
- A full description of the problem or service request.

1. Obtain an RMA number. Contact Welch Allyn and request.

Note Welch Allyn does not accept returned products without an RMA.

2. Ship the device to Welch Allyn, observing these packing guidelines:

Remove from the device the battery, all hoses, connectors, cables, sensors, power cords, and other ancillary products and equipment, except those items that might be associated with the problem.

Dispose of damaged or leaking batteries in an environmentally safe manner consistent with local regulations.

Note: To ensure safe receipt of your device by the service center and to expedite processing and return of the device to you, **thoroughly clean all residues from the device before you ship it to Welch Allyn**. For cleaning requirements, see the Cleaning instruction in the Directions for Use.

Welch Allyn thoroughly cleans all returned devices on receipt, but any device that cannot be adequately cleaned cannot be repaired.

3. Write the Welch Allyn RMA number with the Welch Allyn address on the outside of the shipping carton.

Warranty service

All repairs on products under warranty must be performed or approved by Welch Allyn.

Refer all warranty service to Welch Allyn Product Service or another authorized Welch Allyn Service Center.

Obtain a Return Material Authorization (RMA) number for all returns to Welch Allyn Product Service.

CAUTION Unauthorized repairs will void the product warranty.

Non-warranty service

Welch Allyn Product Service Centers and Authorized Service Providers support non-warranty repairs. Contact any Welch Allyn regional service center for pricing and service options.

Welch Allyn offers modular repair parts for sale to support non-warranty service. This service must be performed only by qualified end-user biomedical/clinical engineers.

Technical Description

Welch Allyn Scales utilize the latest developments in electronic scales and microcomputer technology to provide weighing scales engineered to be easy to use. This section describes the technical aspects of these scales.

Scale Technical Description

LOAD CELL TRANSDUCERS

The function of the load cell transducer is to convert the weight applied to the scale into an electrical signal for further processing and subsequent display by the readout. SCALE-TRONIX employs proprietary designed load cells in most of its scales to optimize performance and reliability.

The model 6102 utilizes a pair of "Double Ended Bending Beams" ("DEBBs"). It is constructed as a double bending beam with two strain gauges, forming a "half-bridge", mounted on each end of the beam, where the bending takes place in response to weight applied. The ends are interconnected to form the equivalent of a complete "Wheatstone bridge" configuration. Additional calibration and temperature compensating resistors are added in the DEBB's internal wiring.

The load cell transducer is "excited" (powered) by +5 volts dc from the readout's instrument board.

READOUT ELECTRONICS

The Welch Allyn second generation scales employ the model 23005 computer instrument board and the 22DSDP display board. NOTE: Different revision levels of these boards may be incorporated in your scale depending on its manufacturing date. Differences between these boards will be noted in the description where applicable.

Readout electronics consist of the following:

- Differential signal amplification.
- Additional amplification and signal filtering.
- Analog-to-Digital (A/D) converter and Clock circuit.
- Battery and support circuitry, voltage regulators, power supplies, etc.
- Microcomputer and support circuitry.
- Display board.
- Printer assembly.
- Printer interface board.

- Printer controller board.

DIFFERENTIAL SIGNAL AMPLIFICATION

The weight dependent output signal produced by the load cell transducers in the weighing frame is a "differential signal", meaning it is the voltage difference between the "+ Signal" and "- Signal" leads. Integrated circuit U4, an instrumentation amplifier, is used to interface to this differential signal and amplify it.

The output signal from the load cells is applied to the protection network consisting of diodes CR4/CR5/CR6/CR7. These diodes prevent destructive high voltages caused by static discharges from damaging U4. A high frequency filter, formed by L1/L2/C9, C10 couples the weight signal to the input of U4. In U4 the differential signal is amplified by a factor of 100, and converted to a "ground-referenced" voltage for further processing.

Capacitors C16/C17/C24 provide local bypassing of the power supplies used by instrumentation amplifier U4. Capacitor C18 furnished compensation of U4 by reducing amplification at higher frequencies.

ADDITIONAL AMPLIFICATION AND SIGNAL FILTERING

Components for an optional second gain stage may be added on the printed circuit board. If included, operational amplifier U5 is used to provide additional gain and signal filtering. U5, together with capacitors C14/C15 and resistors R17/R18, forms an active low-pass filter. These components help to remove fluctuations in the weight signal caused by movement of the patient on the scale. U5, like U4, is "chopper-stabilized" to correct internal offset and drift errors.

Resistors R24/R25 (optional) are used to increase gain; resistors R26/R27 (optional) are used to gain reduction. An additional low-pass filter stage furnished by resistor R34 and capacitor C23.

ANALOG-TO-DIGITAL (A/D) CONVERSION

Integrated circuit U6 is the analog-to-digital converter. Included on this integrated circuit are auto-zero functions, auto-polarity, and the digital and analog functions necessary to perform dual slope integration conversion to 20,000 counts (4-1/2 digits). The weight signal voltage is applied to the analog input (pin 10) of U6.

A reference voltage for the conversions is applied to pin 2 of U6. The reference voltage, nominally 1 Volt, is derived from the load cell transducer excitation voltage, by the divider network consisting of resistors R29, R30 and potentiometer P1. Adjusting p1 sets the "span" or weight calibration of the scale.

The system clock, applied at pin 22 of U6, is used to precisely time and control the phases of the dual slope conversion process. Refer to the converter time diagram when reading the following description.
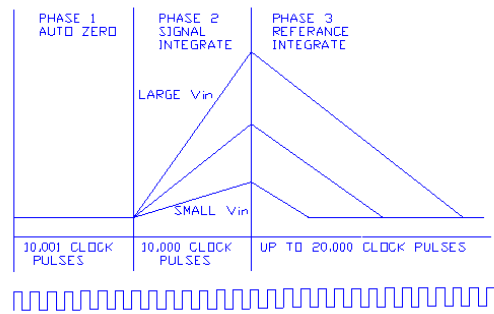
A/D CONVERTER TIMING DIAGRAM PHASE 1, AUTO ZERO

During auto zero, the errors in the analog components (offset voltages of buffers, comparators, etc.) will be automatically nulled out. This action is performed by internal logic that disconnects the input pins (9 & 10) from the applied analog signal, connects them to ground, then closes an internal feedback loop such that offset error information is stored in the "auto zero" capacitor, C21. Also during this phase, "reference capacitor" C22 is charged to the voltage present on "Vref" (pin 2 of U6).

PHASE 2, SIGNAL INTEGRATE

The input signal is reconnected and then integrated for exactly 10,000 clock pulses. On completion of the integration period, the voltage V is directly proportional to the input voltage, corresponding to the weight applied to the scale. Capacitor C20 is the integration capacitor, with resistor R32 setting the integration current. At the end of this phase the input signal polarity is determined.

PHASE 3, REF. INTEGRATE, SIGNAL DE-INTEGRATE

The input to the integrator is switched from the input signal to reference capacitor C22. Internal switches connect capacitor C22 to the integrator input so that its polarity is opposite that of the previously applied input signal. This causes the integrator to discharge back towards zero.   The number of clock pulses counted between the beginning of this cycle and the time when the integrator output passes through zero is a digital measure of the magnitude of the input signal. This count is stored in an internal latch on U6 for output to the microcomputer.

ZERO INTEGRATOR PHASE

One minor additional phase is included to insure that the integration capacitor C20 is fully discharged to zero volts. This typically lasts 100-200 counts.

CLOCK CIRCUIT

A clock is required for the A/D converter, integrated circuit U6.
23005 R01 board: Integrated circuit U2 is a dual timer circuit. One half (pins 8, 9, 12, and 13) is connected as a stable oscillator and used to generate a system clock for the A/D converter. Resistors R6, R7 and capacitor C2 set the clock frequency to approximately 150 KHZ.

23005 R02 board: A clock signal is generated internally in microcomputer U7 and appears on port pin "P1.0". The frequency is internally set by the microcomputer's software and is nominally 120 KHz.

POWER SWITCHING, VOLTAGE REGULATION AND SUPPORT CIRCUITRY

Depending upon their configuration, **WELCH ALLYN** second generation scales may contain disposable primary cells. (Note that some models may be specially ordered to utilize a different power supply than is normally provided; refer to the technical description that best matches the particular scale.) Additional circuitry is included to switch the battery supply, provide voltage regulation and detect low battery voltage conditions.

BATTERY SWITCHING

In order to conserve battery life, the battery supply is switched on and off as needed by the scale.

<u>Main board</u>: Transistor Q1 is a series switch which applies battery voltage to the remainder of the circuitry. Q1 is controlled by transistor Q2 which, in turn, is controlled by "watchdog timer" circuit U11.

To initiate power-on Q1 is turned on through momentary closure of membrane switch S9 ("**ON**") and diode CR10; diode CR13 is used to signal input pin "PB.7" of port expander U7 that the "**ON**" switch is pressed.

A secondary turn-on circuit occurs through diode CR12 and switch S3 ("**RE CALL**") to allow display of the previously stored weight if the scale is presently turned "off". The switch closure is also coupled through diode CR14 to signal input pin "PB.1" of port expander U7 that the "**RE CALL**" switch is pressed.

Once Q1 is on and voltage is applied to the circuit, watchdog timer U11 will keep transistor Q2 on through output line /WDO and resistor R5, subsequently keeping transistor Q1 energized. If no further action occurs, an internal timer contained within watchdog timer U11 will time-out after approximately 1.6 seconds and switch off Q2, causing Q1 to turn off and remove power from the scale's circuity.

Once energized and properly running, microcomputer U10 will keep resetting watchdog timer U11 by periodically pulsing U11's input line, labeled "WDI". Should the scale's operating program call for shut-off, or a hardware/software failure of microcomputer U10 occurs, the reset pluses to U11 will no longer occur and 1.6 seconds later U11 will time-out and cause the circuit power to switch off. The model 5102 has a jumper added at location J7; this causes U11 to reset U10 in the event of a hardware/software failure.

Resistors R1, R2, R3, R5 and R14 are included for proper circuit biasing. Capacitor C6 is used as an output filter.

VOLTAGE REGULATION

Voltage regulators VR1 and VR2 render regulated sources of +5 Volts DC for operation of the analog (VAA) and digital (VCC) circuits, respectively. Use of two separate +5V regulators helps to prevent noisy digital signals from entering the sensitive analog circuits. Capacitors C3 and C8 are used to insure regulator stability.

+9.5V/-7.5V SUPPLY

Integrated circuit U2 is used to convert +5 Volts DC to +9.5V and -7.5 Volts DC for use in the analog circuits. It contains an internal oscillator (operating at approximately 8 KHz) and a series of switches. During one half of the cycle capacitor C25 is connected between VAA and ground, charging C25 to VAA's potential of +5 Volts. During the other half cycle capacitor C25 is reconnected between the VAA and pin 8 (negative lead of C25 to VAA) so that its voltage adds to VAA and charges filter capacitor C26 to approximately twice VAA or 9.5 to 10 volts.

The remainder of U2 is used to generate a negative supply voltage. Capacitor C28 is connected between ground and the +9.5 Volt source on pin 8 during one half cycle of the internal oscillator. During the other half cycle it is reconnected between ground and pin 4 such that its negative lead is connected to pin 4. This produces a negative voltage. Diodes Cr8 and CR9 reduce the voltage slightly to obtain the desired -7.5 volts.

BATTERY MONITOR

Integrated circuit U3 is included to monitor the voltage of the battery and provide an indication to the scale's operator when battery replacement is required. Two states of weak battery operation are detected; "low-battery" (battery is usable but will soon need replacing" and "low-low battery" (battery is too weak to properly operate the scale.)

Pins 1, 2 and 3 of U3 are connected to a voltage divider network consisting of R8, R9 and R10, to form the "low-battery" detector. The output of this circuit (pin 1) is normally low when the battery is good and switches high when the battery is low. It is coupled to the busy signal of U6 (pin 21) through resistor R36 to the driver for the front panel "**LO BATT**" indicator. This causes the "**LO BATT**" indicator to flash when the battery is low.

The remaining half of U3, pins 5, 6 and 7, are connected to resistors R11, R12 and R13 to form the "low-low" battery" detector. The output on pin 7, which is normally "high" with a good battery, goes "low" when the battery is too weak to reliably operate the scale. This output is connected to an I/O pin on microcomputer U10 to signal the microcomputer the "low-low" battery has been recognized. The microcomputer U10 will process the "low-low" battery signal and cause "**bAttrY**" to appear on the scale's front panel display, in addition to the flashing "**LO BATT**" annunciator.

MICROCOMPUTER AND SUPPORT CIRCUITS

To attain various additional features such as automatic zero tare, pounds/kilograms conversion, weight lock-in, previous weight memory, etc., a microcomputer is employed to additionally process the data supplied by the A/D converter. This microcomputer system consists of U10, a microcomputer; U7, a peripheral port expander to furnish additional input/output lines; U9, a non-volatile memory which stores the previous weight reading; and U11 (23005 R02 only), a device to generate reset conditions for the microcomputer.

During operation of the scale the microcomputer continually receives the weight readings from the A/D converter. This data is received in a "multiplexed" format (one digit at a time) from the output of the A/D converter (microcomputer input lines P1.0 through P1.6). The microcomputer also continually scans the keyboard (using U7) looking for closed switches. If a key press is sensed, the microcomputer executes whatever action is called for in its program. After processing the A/D data, the microcomputer assembles it for viewing and transfers it to the front panel display.

U10 is a complete microcomputer, containing a software program stored in read-only memory, read/write memory for temporary storage of program variables, an arithmetic logic unit, input/output and other control lines, etc. Crystal XTAL1 and capacitors C29/C30 form the clock oscillator which controls the internal timing of the microcomputer.

PORT EXPANDER/KEYBOARD/BEEPER

Integrated circuit U7 is included to supplement the I/O (input/output) of the microcomputer system. U7 contains additional I/O lines (referred to as "ports"). Microcomputer U10 reads (from input lines) or writes (to output lines) data to U7 periodically by use of the data bus (lines DB0 through DB7) and the /RD and /WR lines.

The front panel keyboard is attached to some of U7's input port pins (PB.0 through PB.7, and PC.4). Resistor networks R42/R43 serve as "pull-ups" and keep the input pins at a "high" state (+5V) until a key switch is pressed; this pulls the respective input pin "low" (0V). The microcomputer will recognize this key press when it reads the input pins from U7 and if the key remains closed for number of milliseconds the microcomputer will execute that key's function.

A four position "DIP" (dual in-line package) switch, SW1, may be optionally included. It is connected to U7's "C" port, lines PC.0 through PC.3. It is used to select software contained in U7.

A small audio annunciator is driven by transistor Q3, which in turn is controlled by U7's output pin PA.7. The annunciator gives a short beep as audible recognition of a key being pressed. The length of the beep and its various sequences are controlled by U10's software. Additional output lines of U7 are used to control the driver for annunciator lamps on the display.

NON-VOLATILE MEMORY

The internal memory of microcomputer U10 does not retain data when the power is switched off. Because some features of the scale may require lasting data retention (such as last weight recall) integrated circuit U is included. This device, called an "electrically erasable programmable read only memory", or "EEPROM" will store selected information for periods of up to 100 years.

Information needed to be stored to or retrieved from U is sent in serial form using the lines SCL (serial clock) and SDA (serial data). These are controlled by microcomputer U10. A data bit (a high or low level) is sent and received on SDA when the SCL line provides a pulse.

Resistors R54/R55 are provided as pull-ups on the SCL/SDA lines to insure the data and clock pulses are properly shaped. Capacitor C36 improves power supply bypassing.

RESET GENERATION

In order for microcomputer U10 to properly execute its software instructions it must be initialized to the start of the program when power is first turned on. Reset pin 9 of U10 will accomplish this when it is set "high".

Main board: A reset pulse of approximately 200 mS is automatically generated by "watchdog timer" U11 when the VCC level rises above 4.65 volts. If VCC is below 4.65 volts, the reset line stays "high", keeping the microcomputer U10 in an inactive state. The reset pulse is also connected to port expander U7.

DISPLAY BOARD

Presentation of the weight information is performed by the model 700027W display board. It incorporates LED (light-emitting diode) digits and annunciators to provide a clear, bright, easy-to-read display.

The weight value is displayed on six, 0.43" high common cathode digits. These are driven in a multiplexed fashion (one digit on at a time) by LED driver U1. U1 receives the digit display information from the microcomputer's parallel data bus (DB0-DB7) and automatically performs the multiplexing function. Resistor package RP1 sets the operating current level for the displays.

A variety of LED annunciator lamps are contained on the front panel to indicate "**POUNDS**", or "**KILOGRAMS**", "**PRIOR WEIGHT**", and "**LO BATT**". These annunciator lamps contain multiple LED's to provide an evenly illuminated surface. They are driven by integrated circuit U2. U2 receives the on/off information for the annunciators from microcomputer U10 via port expander circuit U7. Resistor packs RP2 and RP3 provide current limiting for the annunciators. Display boards 22DSP R01, 22DSP R02 and 22DSP R03 are all equivalent in operation with some minor changes in board layout to improve spacing. Some minor differences in connections to the terminals of the resistor networks were also made to improve spacing.

Printer General Description

Printer Setup

The optional printer assembly will normally be installed at the factory when your scale is produced and require no further attention during initial set-up.

Printer Option

On various model scales a digital paper tape printer can be supplied. The printer provides a convenient printed record of the weight. Space is provided on the tape printout to write in the patient's name or ID, Room number, and date. See the sample weight ticket printed below:

```
+------------------------------+
|  SCALE-TRONIX                |
|       MODEL 6102             |
|                              |
|  WEIGHT:  75.3 KILOGRAMS     |
|                              |
|                              |
|  ..........................  |
|  PATIENT           ROOM      |
|                              |
|                              |
|  ..........................  |
|  DATE              TIME      |
|                              |
+------------------------------+
```
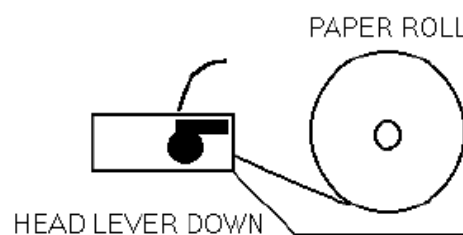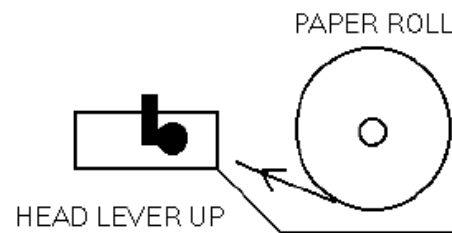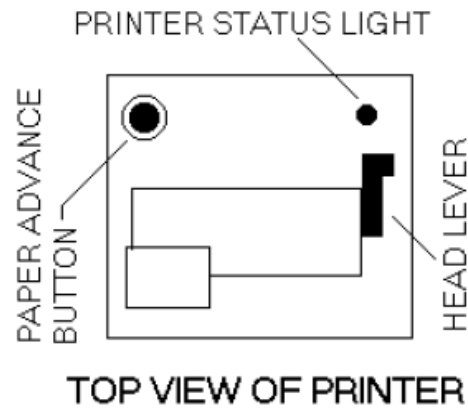
The printer will only print a valid weight. It will not print when the scale is reading "*0.0*" or is empty. It will print the prior weight if that feature is currently activated. Press the front panel "**PRINT**" pushbutton to activate the printer. A single beep should be heard, then the printer will power-up and begin printing. A series of four (4) short beeps signifies that an invalid print request was made (weight not displayed on scale or a weight ticket already being printed). One long beep signals an internal problem with the printer, such as an out of paper condition, open print head or disconnected cable.

Printing may occur after the patient has left the scale. To print the previous patient's weight, press the "**RE CALL**" pushbutton followed by the "**PRINT**" pushbutton. The "**PRIOR WEIGHT**" annunciator will flash, and the scale's readout will display the previous patient's weight for a short time while the printing continues. The scale will not automatically shut-off until the printing is completed.

Various set-up options are available for the printer. These include "auto" print (weight is printed automatically on display), print only in selected units regardless of front panel display, etc. See the section pertaining to "**SET-UP**" in your scale manual for further information

.
The printer is a modern thermal type using a specially coated paper. The paper should be 2¼" wide by approximately 1 7/8" in diameter. One roll of paper will produce about 500 weight tickets. No ink ribbons are required. Additional rolls of paper can be purchased at many stationary supply stores or directly from **Welch Allyn**.

Paper is loaded through a removable access door on most scale models. Be sure to install the paper as shown in the illustration.

PRINTER STATUS LIGHT

PAPER ADVANCE BUTTON

HEAD LEVER

TOP VIEW OF PRINTER

PAPER ROLL

HEAD LEVER UP

PAPER ROLL

HEAD LEVER DOWN

Printer Technical Description

This internal printer employs a thermal type print mechanism, which heats a specially coated paper to produce the resulting weight ticket. The use of a thermal printing mechanism eliminates the need for ribbons or ink cartridges, and provides quiet, maintenance-free operation. The total printing system consists of two assemblies:

1.) Printer mechanism assembly with stepper motor and thermal print head
2.) Printer interface board assembly

Printer Mechanism

The printer mechanism employs a thermal print head consisting of a horizontal row of 384 small heater resistors. The thermal print head also contains driver electronics that receive the formatted print data and control the 384 heater resistors.

When any of the heater resistors are momentarily energized (powered for about 3 milliseconds) it will produce a small rectangular black dot on the thermal paper. Each printed character composition is 10 dots wide by 24 dots high. The paper width allows a maximum of 24 characters per line, which includes spaces between characters and paper edge margins. Printed characters are formed as a series of horizontal lines. A stepper motor in the printer mechanism advances the paper after printing a horizontal line of dots, to print the next line of dots, or to advance the paper on blank lines. The printer mechanism also contains an optical paper sensor consisting of an infrared light emitting diode and matching phototransistor. Light from the diode is reflected off the surface of the paper and sensed by the phototransistor.

An optional switch is also included to sense when the thermal print head is in the open, paper loading position. The printer mechanism is serviced as a complete assembly and is generally not repairable.

Printer Interface Assembly

The printer interface assembly is used to control the printer mechanism. It contains all the circuitry needed to interface to the printer mechanism, scale's electronics, and battery/power supply. For technical explanation purposes it can be divided up into the following sections:

1.) Printer voltage regulation
2.) Microcontroller & support circuitry
3.) Interface to scale electronics
4.) Interface to thermal print head
5.) Interface to stepper motor
6.) Thermal print head temperature measurement
7.) Paper sensing and head position.
8.) Dip switch options

Printer Voltage Regulation

The printer mechanism and its electronics require a source of +5Vdc for operation. To increase battery life, the printer is only powered up when needed. Integrated circuit voltage regulator U201, an LTC1963, is
employed to regulate the varying battery voltage to a constant +5V dc.

Input voltage to U201 is applied at connector J201. U201's output voltage is set by the resistor divider R210 and R211. U201 has internal current limiting and reverse battery protection, and has a switchable output controlled by an on/off terminal. Capacitors C201, C202, C205, and C206 provide filtering and insure regulator stability. Additional capacitors C207 and C210 are included to provide distributed filtering.

A series transistor switch network consisting of Q202 and Q203 is used turn the U201 regulator on when printer operation is required. Transistor Q202 is turned on when the scale's instrument board powers up and the RXD raises to a "high"; it remains on the entire time that the scale is on. Transistor Q203 is turned on when the scale's instrument board sets the RTS line "high", it is activated only when printing is desired.

Resistors R204, R205, R206, and R207 bias Q202 and Q203. Capacitors C203 and C204 are included to form time delays to prevent the printer electronics from inadvertently turning on as the scale powers on or off. R209 is included to keep U201's on/off terminal at ground potential until switched on.

An additional circuit to turn the printer on is the manual paper advance switch S201. One set of S201's contacts is used to apply battery voltage to U201's on/off terminal through resistor R208. The other set of S201's contacts is connected to microcontroller U202 to indicate that a paper advance is requested. On the 500057-B printed circuit boards, R220 is included to provide additional pull-up bias.

Printer Microcontroller & Support Circuitry

Microcontroller U202 is included to perform all the data manipulation and timing required to make the printer mechanism work. It contains RAM (random access memory), a flash ROM (read only memory) with program software, I/O (input/output) ports, a UART (universal asynchronous receiver/transmitter) and the needed arithmetic logic, clock generating, and associated internal logic.

U202's internal software is loaded into the device through the ISP (in-circuit serial programming) port at J205 during manufacture.

A clock circuit for U202 is formed from crystal XTAL201 along with capacitors C208 and C209.

Reset supervisor U205 is provided to initialize microcontroller U202 on power up. U205 measures the circuit power supply and keeps U202's reset line high until the proper operating voltage has been reached. C212 determines the width of U205's reset pulse. R218 keeps U205's reset input biased high until pulled low for in circuit programming.

An 8-position dip switch assembly is attached to one port of U202 to allow operating options to be set.

D202, a bi-color (red/green) LED is used to indicate printer status. Internal software in U202 determines the operation of the LED. Resistor R212 sets the operating current for D202.

Printer Interface to Scale

The printer electronics are powered "on" when the scale's electronics set the "RTS" line high on J202. The "RXD" will have been set high prior to the RTS line. This gates on the series transistor network of Q202 and Q203, turning on voltage regulator U201.

Data to be printed is transmitted to the printer through J202's "TXD" line. Data is sent in ASCII serial format at 9600 baud. A data bit is about 104uS in length. Word length is 8 bits, no parity, at TTL levels (0 to 5V). Data is buffered by sections of U206, a Schmitt trigger inverter. Resistors R201 and R202 are included for protection and circuit bias. Printing begins once U202 receives a carriage return ("CR", ASCII 13) byte. While busy printing U202 will halt data transmission between the scale and printer by setting the "CTS" (clear to send) line of J202 high. The scale's electronics will recognize this and stop transmission until CTS goes low again. Diode D201, resistor R203 and sections of U206 are used to interface to the CTS line.

Printer Interface to Thermal Print Head

Microcontroller U202 takes the character print data (letter, number, etc.) from the scale and then converts it into the appropriate dot pattern to form letters and numbers on the paper. This is a complex process executed by U202's internal software. Dots that need to be printed on the paper are set to a "1" level; blank dots are set to a "0" level.

Once converted, the resulting dot data string is transmitted in serial format through the "DI" (data in) line as the "CLK" (serial clock) line is pulsed. Once all 384 bits (1 per dot) have been sent, the "/LAT" (latch) line is pulsed to load the data into the thermal print head. The process is similar to manipulating a digital logic shift register. The thermal print head contains the appropriate logic interface and current drivers to operate the heater resistors.

Because of the current required per dot (about 35mA) only a limited number of dots can be energized at one time to avoid overloading the scale's power supply. This is accomplished by dividing the thermal head's heater resistors into segments by use of the STB1, STB2, STB3, and STB4 (strobe 1, strobe 2, etc.) lines.

Note that STB2 and STB3 are joined together to divide the heater resistors into three, 128 heater resistor segments. U202 also controls the maximum number of heater resistors energized by assemblies using limiting the number of "on" dots in the dot data string sent to the thermal head.

With the dot data now loaded into the thermal print head, microcontroller U202 controls the length of time the heater resistors are on, typically around 3-4 mS, to form the dot image on the paper. Microcontroller U202 calculates this based on the temperature of the thermal print head, which is measured by a thermistor embedded in the head. U202 will pulse mosfet transistor Q201 to provide power for the heater resistors to match the interval required. This is repeated as necessary with the various STB sections until all the required dots on a single line are formed.

Resistors contained in RN201 provide pull-up bias on the various logic interface lines to insure a fast transition.

Printer Interface to Stepper Motor

The printer mechanism contains a stepper motor to advance the paper during printing and paper feed. The stepper motor is driven by a separate IC designed for that purpose, U203, and is connected to lines OUT1, OUT2, OUT3, and OUT4. The stepper motor requires various combinations of high and low logic signals from U203 in order to rotate.

U202's operating software generates these combinations. A section of Schmitt trigger inverter U206 is used to enable U203 and insure the stepper motor is off while the microcontroller is reset.

To provide manual paper advance for paper loading, switch S201 is included. One section of S201 is used to turn on regulator U201 and provide circuit power; the other section is connected to microcontroller to U202 to request a paper advance. U202 will then provide the correct signals to U203 to operate the stepper motor and advance the paper.

Printer Thermal Print Head Temperature Measurement

The temperature of the thermal print is measured to determine the correct "on" timing of the heater resistors.
An NTC thermistor is embedded in the thermal print head and changes its resistance based on the print head's temperature. U204, a 10 bit (1 part in 1024) A/D (analog to digital) converter is included to measure the voltage developed by the divider formed of R217 and the thermistor connected at "TM".

U204 converts the thermistor voltage from an analog value to a digital number, and passes it to microcomputer U202.

Assemblies employing the 500057-A printed circuit board: The converted temperature value is passed to microcontroller U202 in I2C serial format via use of data (SDA) and clock (SCL) lines. Resistor R219 and capacitor C211 provide filtering of the temperature signal. Resistors contained in RN201 provide pull-up bias for the SDA and SCL lines.

Assemblies employing the 500057-B printed circuit board: The converted temperature value is passed to microcontroller U202 in SPI serial format via use of data (Dout) and clock (CLK) lines. When U204's chip selects (/CS) line is pulled low by U202 the conversion process begins. Capacitor C211 provides filtering of the temperature signal.

Resistors contained in RN201, along with resistor R220, provide pull-up bias for the Dout, CLK, and /CS lines.

Printer Paper Sensing and Head Position

The printer mechanism contains an optical paper sensor consisting of an infrared diode emitter and a complimentary phototransistor. Light from the infrared emitter reflects off the paper and is detected by the phototransistor at connector J207. Microcontroller U202 uses this signal to determine the presence or absence of paper and take action accordingly. The infrared emitter is pulsed on by U202 to conserve battery and emitter life.

One section of U206 is used to process the detected signal before application to U202. Resistor R214 sets the operating current of the emitter. Resistor R215 provides the phototransistor load.

A snap action switch is incorporated within the printer mechanism to determine whether the thermal print head is open for paper insertion or closed for printing. Resistor R206 is included for circuit protection. A

section of S202 parallels this switch so that mechanisms not equipped with this switch will operate properly.

Printer Dip Switch Options

An 8-position dip switch is included to allow troubleshooting and some adjustments to operating parameters. Note that the settings below may vary slightly depending on the current software revision.

For normal default operation all switches should be "OFF". Use a fine tip ballpoint pen to actuate the switches as follows:

S202-1: Puts printer in test mode. When "ON" and the paper advance switch is pressed, the printer will display the software version, date, and other dip switch options. If the paper advance is held long enough the printer will produce a variety of printable characters. When S202-1 is "OFF" paper advance operation is normal.

S202-2: Sets maximum number of simultaneous dots to be printed. With S202-2 "OFF" the maximum number of dots is 12. With S202-2 "ON" the maximum number of dots is 30. While increasing the maximum number of simultaneous dots produces faster print speeds, it also increases power consumption and reduces battery life. S202–2 "ON" should only be used with scales that have rechargeable battery packs.

S202-3 & S202-4: Increases resistor heater on time to improve printing contrast. May need to be adjusted depending on paper type. Adjustment as follows

S202-3 "OFF" & S202-4 "OFF" : 100%
S202-3 "OFF" & S202-4 "ON" : 115%
S202-3 "ON" & S202-4 "OFF" : 133%
S202-3 "ON" & S202-4 "ON" : 150%

Note that increasing the on time will slow the printing slightly and decrease battery life. Setting should be at the minimum consistent with good print results.

S202-5: Bypasses head temperature sensor circuitry and provides fixed resistor heater pulse width. Used for troubleshooting only.

S202-6 & S202-7: Not used

S202-8: Bypasses thermal head position switch. Used for printer mechanisms without head position switch or for troubleshooting.

Maintenance of Scales

Routinely perform the following preventive maintenance to keep your scale in working order.

1. Check the calibration annually or as required.
2. Inspect the scale for cracks or loose mounting hardware. Replace or repair as necessary.
3. Visually inspect the scale enclosure for damage or loose or missing hardware. Replace or repair as necessary.
4. If equipped, inspect the AC line cord for abrasions or other signs of wear if equipped.
5. Do not expose the scale to excessive water or moisture.
6. Do not store the scale where heavy objects can be placed on it.
7. Replace the batteries annually or as required.
8. Do not service or perform maintenance while the scale is in use with a patient.

Change the printer paper

1. Use a screwdriver to loosen the screw on the battery access door and remove the printer access door.

2. Remove the spindle containing the empty printer paper roll from the printer paper well.

3. Replace the printer paper roll in the spindle. Make sure the new printer paper is advancing from the bottom of the roll.

4. Lift the green knob to lift the print head lever.
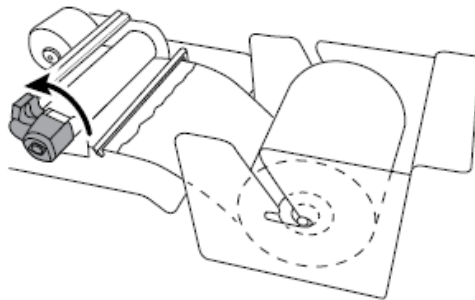
5. Insert the paper through the paper guide slot, and make sure it goes under and around the black roller bar.
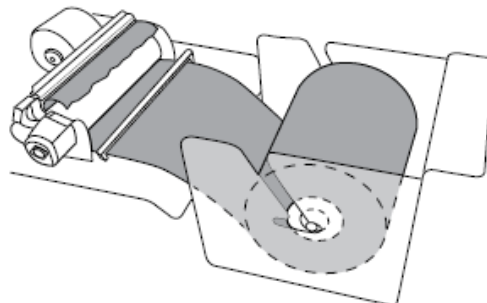
6. Pull the paper under the print head lever and push the green knob down to push the print head lever down.
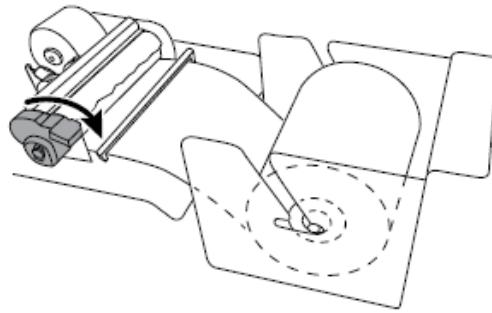
7. Press **PAPER ADVANCE** to move the paper through the printer.

8. Install the printer access door, and advance the new paper through the slot on the door.

9. Install the screw on the printer access door

Note: Never pull or force paper through the printer mechanism with the head lever in the "down" (or closed) position. Never insert any object besides paper into the printer head assembly. Damage to the print head can occur.

If problems occur with the printer, check the condition of the printer status light located on the printer assembly. Press the paper advance switch to power up the printer and activate the lamp.

Battery replacement

1. Using a #1 Phillips screwdriver, remove the screw on each corner of the readout's top panel and remove the top panel.
2. Remove the battery in the battery holder by removing the tape that holds the battery in place.
3. Disconnect the battery from the board and discard the battery per local regulations.
4. Connect the new battery to the board and place in the holder, re-apply the holding tape.
5. Re-attach the top panel.

Calibration of Scale

Your scale has been carefully calibrated at the factory. This calibration involves matching and tuning of the load cells and readout electronics. The scale calibration should be checked annually. Only use calibrated, certified scale test weights for this purpose. Traction or physical therapy weights are **NOT** acceptable since their actual weight can often be in error as much as +/-10%. Calibration weights may be purchased from **WELCH ALLYN** or a local scale dealer. An alternative to calibration weights is the weight comparison method. This requires a known accurate, calibrated scale. A fixed weight is "weighed" on the calibrated scale then the same weight is placed on the scale for comparison.

TEST CALIBRATION WEIGHTS ARE AVAILABLE FROM WELCH ALLYN.

THREE (3) 25 KILOGRAM TEST WEIGHTS ARE RECOMMENDED.

ORDER PART NO. 20021W. (25 KG TEST WEIGHTS)

Large changes in calibration often indicate a damaged load cell or faulty readout component. It is generally recommended that if calibration is necessary for your scale it should be returned to the factory. Calibration procedure follows for those situations where it is not desirable. Calibration should not be attempted by those not having the proper tools or knowledge of electronic systems and their attendant shock hazards.

Calibration Procedure

Enter the "calibration mode" by following **exactly** the procedure outlined below:

1. Verify serial number labels on Readout Assembly, & Base Assembly match.
2. Be sure scale is off.
3. Press and hold in the "**RE WEIGH**" pushbutton.
4. While pressing the "**RE WEIGH**" pushbutton, press and release the "**ON**" pushbutton.
5. NOTE: The "**ST**" pushbutton is a special hidden programming and test pushbutton located under the **WELCH ALLYN** logo ("**ST**") on the left side of the front panel between the "**ZERO**" and "**RE CALL**" pushbuttons. After the scale displays the test pattern of "**888888**" release the "**RE WEIGH"** button and press the "**ST**" pushbutton five (5) times. This will cause the readout to enter the calibration mode. The display will indicate "**CAL**".
6. Press the "**ST**" pushbutton once more; the display will indicate "**A/D**". This indicates the start of the "raw" analog-to-digital converter data being inputted to the microprocessor.
7. Press the "**ST**" pushbutton one more time. The number displayed is now the raw analog to digital data.
8. The automatic turn-off timer has also been programmed for an extended "on" period to give you time to calibrate the scale. This time period is three minutes. The scale may be turned off before this time period by simply pressing and holding the "**ON**" pushbutton. Hold it in for several seconds until the power shuts off. If additional time is needed to complete the calibration procedure, press the "**ON**" pushbutton briefly. This will reset the timer for an additional three minutes.

The readout is displaying a number, which represents the zero offset value of the platform and load cell transducers, in tenths of pounds (0.1 pound). Note and record this value. (Even though your scale may be "kilograms only" in operation, pounds are used internally because of their finer resolution.) Units conversion is as follows:

  1.0 kilogram = 2.2 (2.2046) pounds
  5.0 kilograms = 11.0 (11.0231) pounds
10.0 kilograms = 22.0 (22.0462) pounds
25.0 kilograms = 55.1 (55.1156) pounds
50.0 kilograms = 110.2 (110.231) pounds
100 kilograms = 220.4 (220.462) pounds

Add the specified test weight to the platform. Note the new number displayed. Subtract the original zero offset value from this new number to obtain the scale's displayed value of the calibration weight.

NOTE: Early versions of the software did not display the decimal point in the A/D calibration mode, i.e.: 11.7 pounds is displayed as "117".

Example: The zero offset value is "11.7" (representing 11.7 pounds). Adding the specified three 25 kilogram test weights (equivalent to 165.3 pounds) to the platform produces a reading of "177.1"   The difference is 177.1-11.7=165.4 (equivalent to 165.4 pounds). This would indicate the calibration is 0.1 pound "high".

Using the specified three 25 kilogram test weights, a difference of 165.3 +/-0.1 pound should be obtained. If necessary, adjust potentiometer P1 (span adj.) on the instrument board until the correct value is obtained. Remove the test weight and recheck the zero offset value. Note that adjusting P1 may also alter the zero offset value. Repeat the process as necessary to obtain the correct difference.

Now you may turn the scale off by pressing the "**ON**" pushbutton and holding it in for a few seconds. That will force it to turn off. You may also wait for it to time out and turn off by itself.

Dis-assembly of Scales

Required Tools:

- 5/32" Allen wrench
- 1/8" Allen wrench
- 5/16" socket
- 9 mm socket
- 11 mm socket
- 3/8" socket

- 1/2" socket
- Phillip screwdriver
- Small slotted screwdriver
- Small Philips screwdriver

- 5 mm nut-driver
- ½" wrench
- ¼" Ratchet driver with extension

Power down the scale and remove any A/C power

CAUTION: **Do not apply extra force to the base of the scales. The load cell capacity can overload and cause damage to the load cells.**

Note: Whenever the scale is opened for repair purposes a Calibration must be performed. Reassembling is reversal of these instructions.

Specified Torque Values

Part Number	Description	Torque Specification	Tool	Bit Type
48611	SCW, 6-32 X 1/4" PHMS SEMS, NICKEL	8.7 +/- 2.2 in-lb.	200016	#2 Phillips bit
40408	BHSCS 10-32 X 3/8 18-8 STAINLESS STEEL	31.7 +/- 7.9 in-lb.	200069	1/8" Hex Bit
106137-7	NUT 6-32 LOCKING HEX	10.2 +/- 2.6 in-lb.	200014	8 mm Socket
HST-308	1/4-20 KEPS LOCK NUT, 18-8	75.2 +/- 18.8 in-lb.	200025	7/16" Socket
106137-2	NUT 8-32 LOCKING HEX	5.1 +/- 1.3 in-lb.	200074	9 mm Socket
130215	SCW, NO 09 PHILLPS RECESS, SOUTHCO	2.5 +/- 0.6 in-lb.	200074	#2 Phillips bit
48115	SCW, 6-32 X 1/2" PHIL PAN HD, NICKEL	8.7 +/- 2.2 in-lb.	200016	#2 Phillips bit
130208	SCW, 2-56 X 3/16" PHIL PAN HD	2.5 +/- 0.6 in-lb.	200074	#2 Phillips bit
160231	JACK SCREWS FOR DB9	4.7 +/- 1.2 in-lb.	200023	5/16"Socket

Note: The specified torque values are +/-5% of the torque specification. It is 1/5 of the actual specification of +/-25%. The narrower specification is listed in this work instruction to account for the torque driver tolerance.

Readout Disassembling Guide:

Flush-mount Readout:

1. Disconnect the AAF Connector to the Base from the Readout Assy	
2. **Cover Panel Disassembly:** Use a #1 Phillip screwdriver to remove the screw on the readout's cover	

Standard Readout:

1. Disconnect the AAF Connector to the Base from the Readout Assy	
2. **Cover Panel Disassembly:** Use a 1/8" Allen wrench to remove the screws on the cover	

Standard Readout Power Disassembly

1. **Power Option Disassembly:** Use a 1/8" Allen wrench to remove the two screws on the wall mount bracket	

2. Disconnect the power plug	
3. Use a #1 Phillip screwdriver to remove the clamp's screw	
4. Use a 1/8" Allen wrench to remove the screws on the A/C power assembly panel	

5. Use a #1 Phillip screwdriver to remove the two screws on the IEC power plug Disconnect the wires	
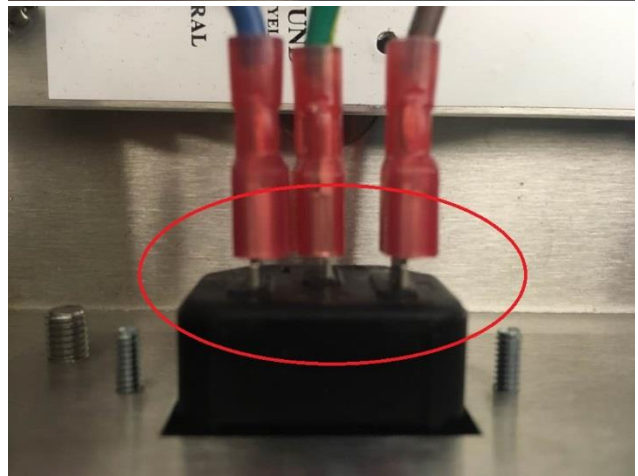
RS-232 Port Disassembly

1. **RS-232 Port Disassembly only:** Use a 5/16" socket to remove screws on the RS-232 access door	

2. Use a 5 mm nutdriver to remove the two nuts on the RS-232 data port	

Printer Disassembly

1. Printer Disassembly only: Use a #1 Phillip screwdriver to remove the screws on the printer board	

2. Disconnect J208, J204, J207, J206, J203	
3. Use a 5/16" socket to remove the nuts on the printer mechanism assembly's four screws	

4. Use a #1 Phillip screwdriver to remove the printer access door's screw	

Readout Disassembly

1. Use a Phillip screwdriver to remove the screws on the AAF cable connector assembly	
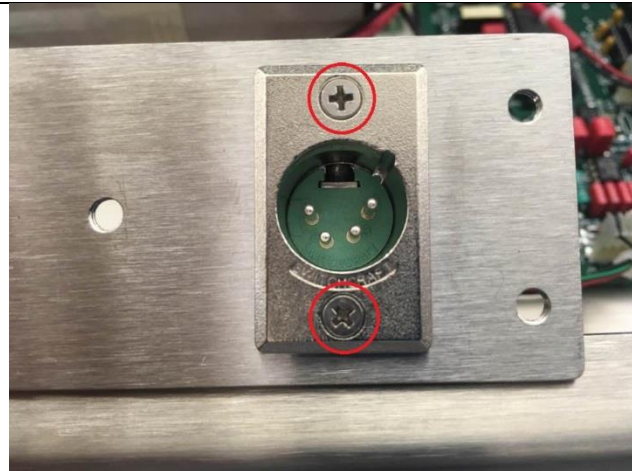
2. Use a small slotted screwdriver to remove wired connectors	
3. Disconnect J6	
4. Disconnect J4	
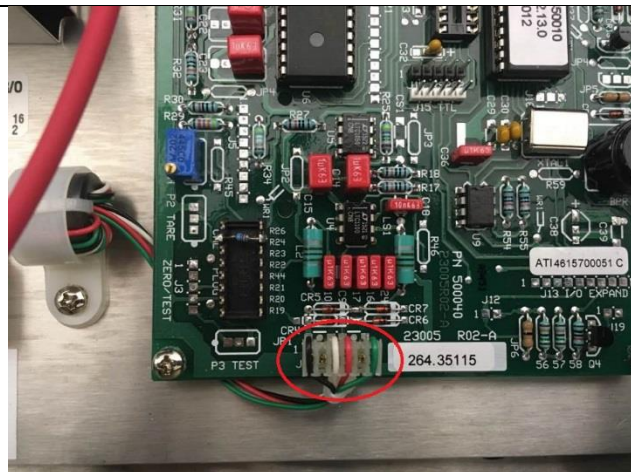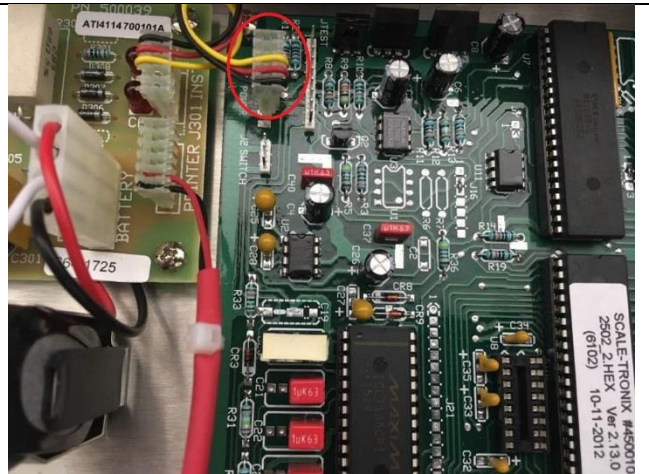
5. Disconnect J1	
6. Disconnect J15	
7. Use a #1 Phillip screwdriver to remove the board's screws	
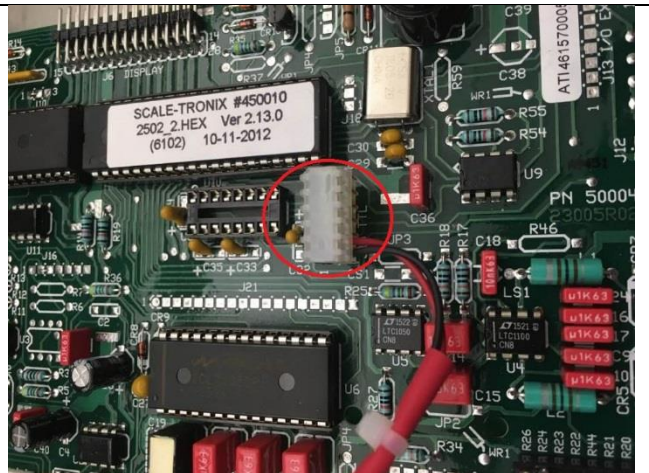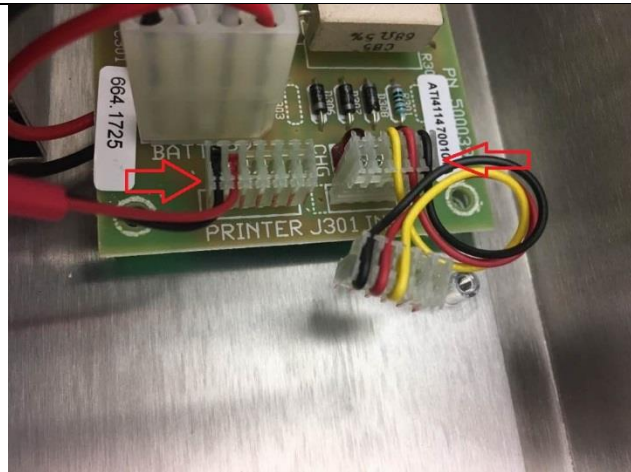
8. Disconnect J301	
9. Use a #1 Phillip screwdriver to remove the battery board's five screws	
10. Use a slotted screwdriver to loosen the two screws of the blue plug to remove the wires	

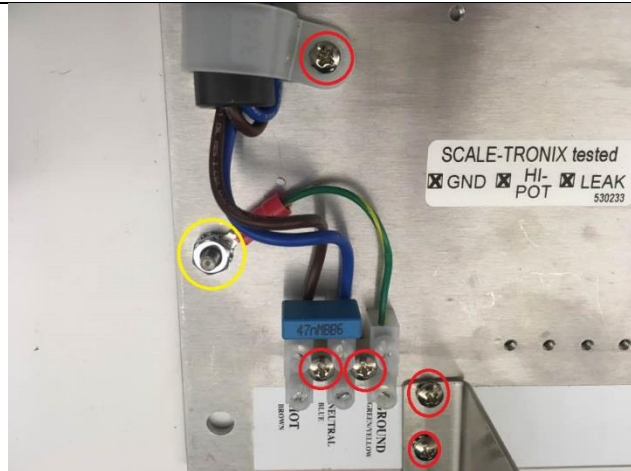|	
11. Peel the tape and remove the battery	
12. Disconnect the wire harness	
13. Use a #1 Phillip screwdriver to remove the three screws on the battery holder	
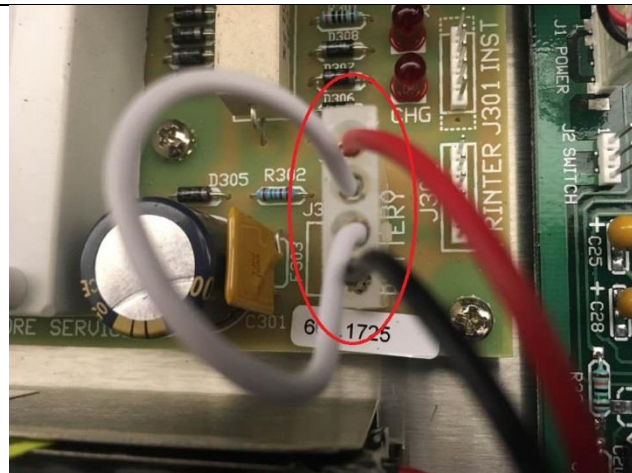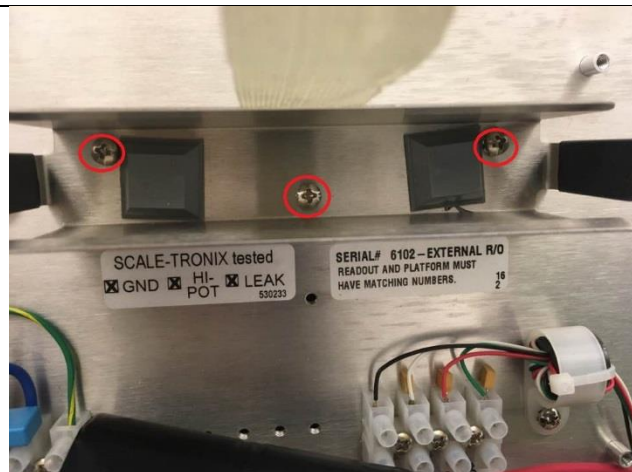
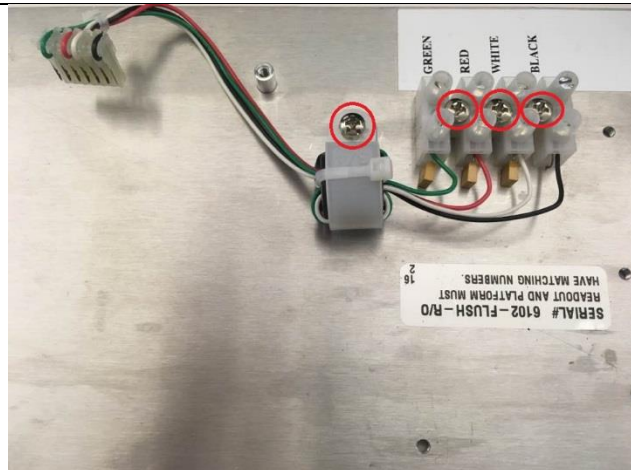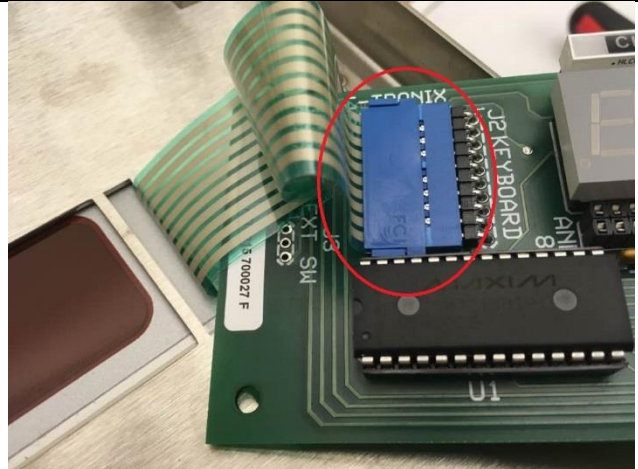|	
14. Use a 11 mm socket to remove the nuts on the assembly	
15. Use a #1 Phillip screwdriver to remove the five screws Use a 9 mm socket to remove the nut	
16. Use a #1 Phillip screwdriver to remove four screws on the block	

17. Use a #1 Phillips screwdriver to remove the four screws on the display board	
18. Disconnect blue-ribbon cable	
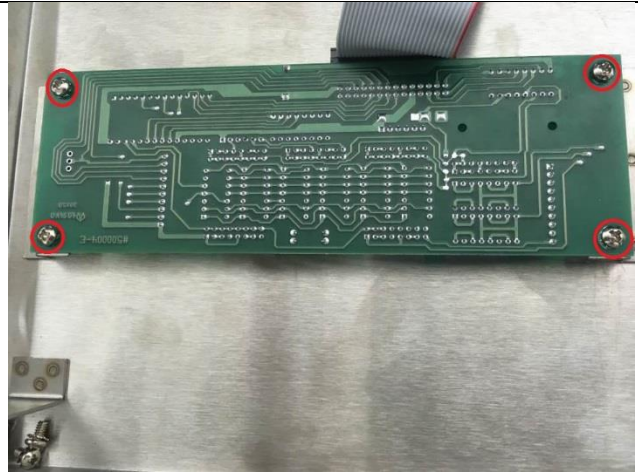
Base Disassembling Guide:

Top Plate Disassembling

1. **6102 and 6102D Top Plate Disassembly only:** Use a 1/8" Allen wrench to remove the screws on the top plate	

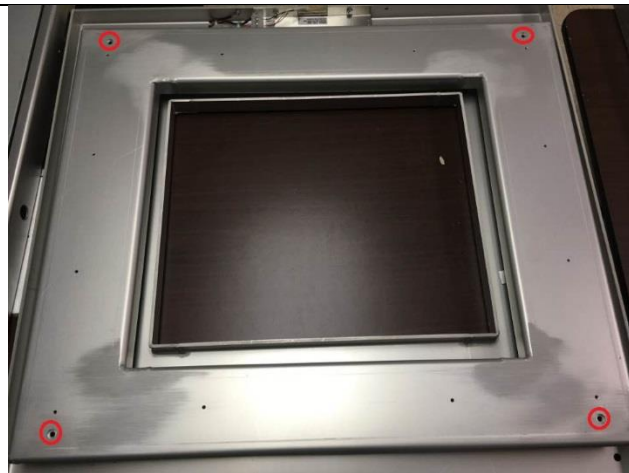|	
1. **6154 Top Plate Disassembly only:** Use a 1/8" Allen wrench to remove the screws on the top plate	

Base Disassembly

1. Disconnect the AAF Connector from the Base to the Readout Assy	
2. **6102, 6102D, 6154 Base Disassembly only:** 0Use a 5/32" Allen wrench to remove screws on the cover	

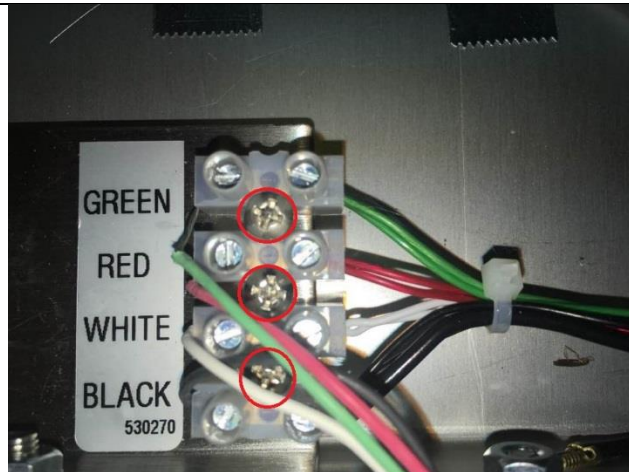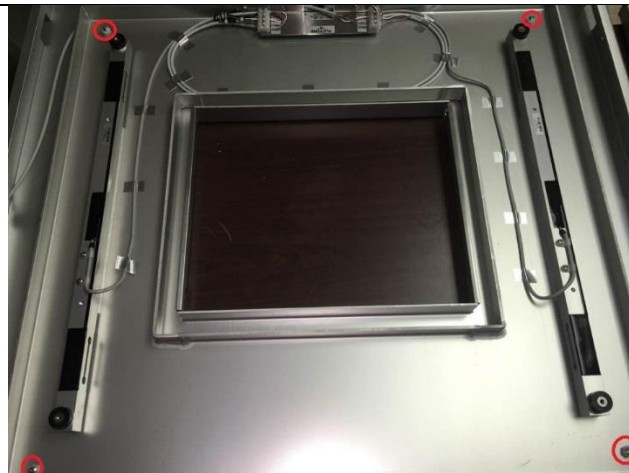|	
3. Using a #1 Phillip screwdriver, remove the three screws. Remove the terminal block from the platform	
4. Using a 3/8" socket, remove the nut on the black cable with loop	
5. Using a 3/8" socket, remove the two nuts on the platform's screws	

|	
6. Use a #1 Phillip screwdriver to remove the screws on the terminal block NOTE: Remove the tape or cable clamps that hold the load beam and the cable in place to the weldment	
7. Use a 1/2" socket to remove the nuts on the scale's base CAUTION: Do not apply extra force to the base of the scale. The load beam capacity can overload and cause damage to the load beams.	
8. Use a 1/8" Allen wrench to remove screws under each load beam to remove the load beams and spacers	
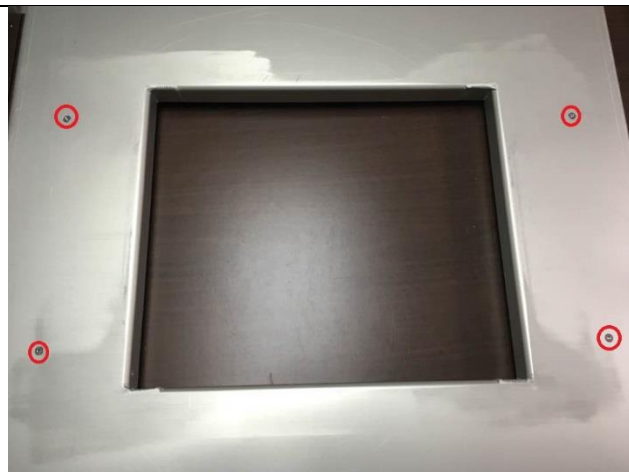
Troubleshooting

Scale Troubleshooting

The internal microcomputer contained in the readout constantly monitors the scale's operation and uses the display to indicate error conditions when they arise. An explanation of these messages is given below:

    a. "**bAttrY**": Indicates the battery has become depleted to the point that it can no longer operate the scale. Replace the battery to continue operation.

    b. "**O-LOAd**": Shows that the scale platform's weighing capacity has been exceeded. Refer to the inside front cover specifications for maximum capacity.

    c. "**CAbLE**": Displays that the transducer signal is well in excess of its maximum value. This is usually caused by the transducer cable being disconnected. Check the cable connection between the readout and the weighing platform.

    d. "**E-FAIL**", "**r-FAIL**": Shows that a memory failure has occurred in the internal microcomputer's memory. Requires service of the scale.

The following simplified trouble shooting procedures are recommended for identifying defective system components. Certain corrective measures are provided.   More complicated servicing should only be performed by the factory or authorized service facilities. Most problems can be solved over the telephone. Problems requiring factory service are usually handled quickly and the scale is on its way back. Call first to discuss the problem.

Printer Troubleshooting

The following simplified trouble shooting procedures are recommended for identifying defective system components. Certain corrective measures are provided.

1.) NO PRINT, FOUR SHORT BEEPS

This indicates a print request was made when a valid weight is not present. The patient's weight must be currently displayed on the scale's readout before the printer will function, or alternately, the "**PRIOR WEIGHT**" can be printed if the "**PRINT**" button is pressed immediately after pressing the "**RECALL**" button.

A second reason for this problem is if the print button is pressed while a ticket is currently printing. If this occurs simply wait for the current ticket to complete printing before requesting another by pressing the "**PRINT**" button.

2.) NO PRINT, ONE LONG BEEP

This indicates the printer did not respond to the scale's request for printing. This can be caused by the printer being out of paper or the printer head switch being in the "UP" (open) position.

Observe the printer status lamp, LED D202, on the printer interface board; it should light immediately when the print button is pressed. If the lamp flashes "red" Check that the printer interface board has all cables connected and that the data cable is connected to the scale's data port connector.

3.) PRINTER RUNS BUT RESULT IS BLANK OR FAINT

This is generally indicative of a problem with the paper used for printing. This printer uses "thermal" type printing paper; using ordinary plain paper will not produce a printed result. Also, note that since thermal printing paper is coated on one side only, inserting the paper upside-down will result in a blank weight ticket.

There are differences between the sensitivities of various thermal type papers, which can result in variations of print contrast.

4.) PRINTED RESULT DISTORTED, PAPER ADVANCE NOT WORKING PROPERLY, EDGE OF PAPER TICKET WRINKLED OR TORN

Compressed printing may be caused by the paper not advancing properly. Press the paper advance switch and check that the paper feeds smoothly. Inspect the printer mechanism and look for small bits of paper or other debris on the paper drive roller. Check that nothing is interfering with the movement of the paper or paper roll. Check that the paper roll is the correct maximum diameter of 1 7/8" (about 47mm).
If problems are noted with the paper advance or if the edge of the weight ticket is wrinkled or torn, examine the paper for correct loading. Check that the paper roll is properly installed and is not dragging or rubbing due to interference.

5.) SECTION OF PRINT OUT MISSING

If a small section of printed output is missing, activate the print head lever, remove the paper, and look at the print head for small bits of loose paper or other debris. Blow gently in the print head to dislodge any foreign matter. If the problem continues it may indicate a defective thermal print head. If a large continuous section of the printed output is missing, it likely indicates a problem with one of the strobe (STB) signals between the printer and interface board. This can be caused by a defective thermal print head, printer head cable, or interface board. The appropriate STB line can be identified as follows:

STB1: Controls left 1/3 printed area
STB2 & STB3: Controls center 1/3 printed area
STB4: Controls right 1/3 printed area

6.) LOW BATTERY LIGHT FLASHES DURING PRINTING

This is caused by a battery that is becoming weak. The large amount of power demanded by the printer taxes the battery more than regular weighing use of the scale. Some occasional flashing while printing is acceptable. Replace battery when possible.

7.) PRINTER STATUS LIGHT FLASHES RED

The printer status lamp will change color from green to red if a problem is detected. It will also flash a predetermined number of times to indicate the cause of the malfunction. The flashing sequence is described below:

One flash: Needs paper. If paper is ok, then check connector J207.

Two flashes: Printer head is open. Close printer head. If problem continues check cable at J208. Check the printer head switch.

Three flashes: Indicates head temperature is outside of acceptable range. Check head cables J203 & J204. Check thermistor resistance; it should measure approximately 30k ohms at room temperature.

<u>Four flashes</u>: Indicates interface board has internal problems with its microcontroller. Replace interface board.

8.) PRINTED PAPER TICKET TEARS POORLY, UNEVENLY

Inspect the tear bar mounted in the enclosure top cover for signs of damage (missing teeth, cracks, missing fasteners, etc.).

9.) Weight Reading not Accurate

This can commonly be caused by a mechanical obstruction of the weighing platform. Check that the platform is not touching some foreign object so that it is restricted in its' downward movement. Also check that the connecting cable is firmly plugged into the instrument circuit board (marked "J4 LOAD CELL").

10.) Weight Reading takes Excessive Time to Display

If the platform is in motion, the scale will wait for it to settle before displaying the weight. This can be caused by excessive patient motion.

Also check that the connecting cable is firmly plugged into the readout cabinet. Examine the weighing platform that it is not rubbing against a foreign object.

11.) Reading does not change when weight applied

Check that the weight platform is plugged into the readout. The platform cable, connector or load cell transducer may be defective. The load cell transducer's resistance can be checked with an ohmmeter after unplugging from the readout. The proper resistance values are listed below:

12.) Non-functional Key(s)

Check the front panel keyboard for visible signs of damage (punctures, dents, etc.). Check that keyboard tail with connector is properly inserted into the display board.
If a particular function does not work (example" no kilogram units) check if that particular function is turned off in the "**SET-UP**" mode.

13.) Scale Displays: "E-FAIL" OR "r-FAIL"

This indicates a failure of the internal microcomputer's memory during the start-up self-test. "**E-FAIL**" indicates a failure of the microcomputer's eprom memory during the checksum test. "**r-FAIL**" shows a failure of the random access memory. Both conditions require replacement of the microcomputer.
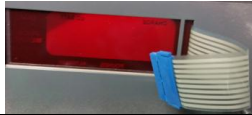
14.) Scale Displays "CAbLE" OR "O-LOAd"

This indicates the scale's internal microcomputer has received a signal in excess of its expected value. "**O-LOAd**" indicates the weight signal is larger than the maximum value assigned to that particular model (see specifications on inside front cover). If the weight value is within the specified range, this indicates a damaged transducer or defective instrument board.

The "**CAbLE**" display indicates a signal outside the range of the internal A/D converter has been applied. This is most likely caused by a damaged or disconnected transducer cable. On those scales with a mast, check the connection to the weighing platform at its base. Also check the internal connection of the four wire cable to the "J1 LOAD CELL" connector.
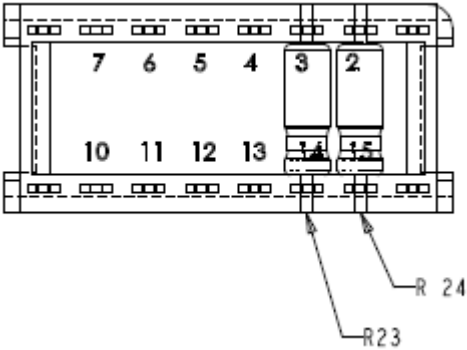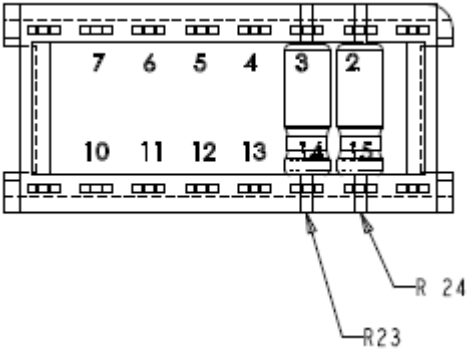
Symptom and Solutions

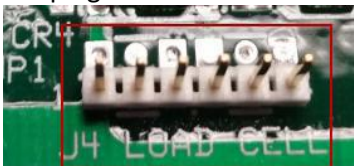| Symptom	Possible Cause	Corrective Action
No Power/No Display/Shuts off	No A/C Power	Does the display have a charge light? **Surface Mount:** **If no** check the A/C Power Cord to make sure the scale is plugged in **Flush Mount** **If no** check the breaker to the readout box, **make sure the breaker is turned on**
	AC Power Supply and Charger PC Board	Check the PWR Lamp to see if "on" if not, check the fuses on the Power Supply Board. If the fuses are blown replace fuse. If not, replace the Power Supply Board.
	Display Cable	Check the pins in the cable to make sure the Display cable is properly aligned and seated
	Front Panel Switch Assembly	Visually inspect the front panel, to determine if any switches are indented concaved, nicked, battered, beat up, poked, jabbed, bruised, crushed or cracked. If so replace the front panel switch assembly. If the switch assembly looks good press on the U6, U7 and U10 IC chips to make sure they are fully seated. **Test switch assembly.** Unplug the switch connector from J2 on the Display board and short pins 1 and 10 together for one second to turn scale on

Symptom	Possible Cause	Corrective Action
		If Scale turns on replace the switch assembly. Follow the below instructions to replace the switch assembly. 1. Remove front panel switch assembly, by removing the two Screws on top of front panel with 1/8" Allen Key. 2. Check to make sure the Black and Red battery cable is connected to J1 Power. Unhook J1 Power from the main board. 3. Unplug the J4 Load Cell Connectors from the Main Board. 4. Remove 4 Philips head screws to pull back the display board and remove the blue ribbon cable from J2 of Display. 5. Peel off the front panel switch assembly from the front side of the faceplate
	Display Board/Mainboard	1. Main Board: Check the U6, U7, and U10, IC Chips to make sure they are fully seated in IC Sockets.

Symptom	Possible Cause	Corrective Action
		2. Test for +5 Volts across pins 1 and 8 of JTest connector, for VR1, after pressing the "On" button. 3. Test for +5 volts on VR2 Regulator Pin 3 for the Voltage to Microprocessor and the Display Board. If no + 5 Volts, replace regulators, VR1, or VR2. 4. Check U10 chip across pins 20 to Pin 18 (2.31V), across Pin 20 to Pin 19 (2.33V) +/ − 0.1 Volts 5. Check the crystal chip to ensure it is operational and functional. If one of the pins is at 0 or 5 volts, then the scale will not turn on. Replace the Board if necessary.
Bubble on the front of the display	Front panel switch assembly – cable not pulling through the slot properly 	Install new front panel switch assembly. Pull flex cable straight so face plate is smooth.
Faint Battery Light	Crystal	1. Test for +5 volts on VR2 Regulator Pin 3 for the Voltage to Microprocessor and the Display Board. If no + 5 Volts, replace regulators, VR1, or VR2. 2. Check U10 chip across pins 20 to Pin 18 (2.31V), across Pin 20 to Pin 19 (2.33V) +/ − 0.1 Volts. 3. Check the crystal chip to ensure it is operational and functional. If one of the pins is at 0 or 5 volts, then the scale will not turn on. Replace the Board if necessary.
No Weight Change Scale Only Reads "0.0"	Cable Assembly	**Test Cable:** 1. Remove front panel and unplug the J4 Load Cell Connector 2. Turn scale on IF Scale displays **"Cable"** or **"O-Load"** Replace the MAST Cable **IF** Scale display remains at **"0.0"**

Symptom	Possible Cause	Corrective Action
		1. Test with DC Volt Meter across pins 1 and pin 7 of JTest • Voltage .985 or +/- .01 and stable 2. Test mV reading from **Pin 1** of **JTEST** to pin 10 of U6 approximately 100 lbs is 100 mV
	C21, C22 and U6 on the Main Board	IF the above test of pins 1 and pin 7 have the 100 mv reading then the components to check are C21, C22 and U6. Replace C21, C22 and U6 or Replace the main board
-------------	A/D Readings are unstable	Removing the top plate, the load cells will be visible 1. Enter into **"Cal Mode"** from the front panel 2. Press and hold the Reweigh button 3. Turn the Scale on 4. Release the Reweigh button immediately 5. Immediately go to the **ST l**ogo and press 5 X 6. Display should say "**CAL**" 7. Press **ST** Logo two more times to display A/D Readings Note: A/D reading without a load. Look for a low stable weight reading less than 10 lbs and that is not drifting or unstable. Unplug each load cell and connect one at a time to see if your display becomes unstable. This will tell you which load cell needs to be replaced

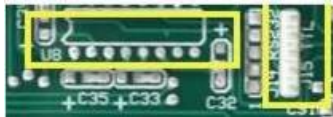| Symptom	Possible Cause	Corrective Action
	Load Cell/Calibration	(OHM out Load Cells) See Calibration procedure the Service Manual
Inaccurate Weight Readings with the 4 Corner Test being stable and consistent	Mechanical Hang-up on Platform Assembly	**4 corner platform test using 25KG or 50lb certified weight** 1. Apply weight evenly on the center of the scale. Press "**REWEIGH**" two times and record your weight reading each time. 2. Remove weight from center and apply weight on each 4 corners one at a time and Press "**REWEIGH**" two times and record weight reading each time. **Examine your corner readings** Plot all readings and they should be within +/ - 0.4 lb./.2 kg from center reading. The corner that is different from the other 3 and center is the problem area. Look for debris causing a hang-up or replace the load-cell.
Inaccurate Weight Readings with the 4 Corner Test "Not" stable	Bad Load Cell	Removing the top plate, the load cells will be visible 1. Enter into **"Cal Mode"** from the front panel 2. Press and hold the Reweigh button 3. Turn the Scale on 4. Release the Reweigh button immediately 5. Immediately go to the **ST l**ogo and press 5 X 6. Display should say "**CAL**" 7. Press **ST** Logo two more times to display A/D Readings Note: A/D reading without a load. Look for a low stable weight reading less than 10 lbs and that is not drifting or unstable. Unplug each load cell and connect one at a time to see if your display becomes unstable. This will tell you which load cell needs to be replaced

Symptom	Possible Cause	Corrective Action
	Cal Chip	Check Gain Resistor R24 on the Cal Chip, Replace Cal chip if necessary. ASSEMBLY MATERIAL / LOCATION / RESISTOR VALUE 255029 / R24 / 3.4K 1% 1/8W 255006 / R24 / 23.7K 1% 1/8W
Only displays Scale Model #	Bad A/D Chip	**U10 Microprocessor not communicating U6** Check to make sure the U6 and U10 are seated all the way. Replace the Main Board if necessary.
Weight Remains the same	Memory Chip or Microprocessor	U9 and EM1033 or Microprocessor – Replace the Main Board
Unable to Calibrate	Cold Solder on the Calibration Plug	Check Gain Resistor R24 on the Cal Chip, Replace Cal chip if necessary. ASSEMBLY MATERIAL / LOCATION / RESISTOR VALUE 255029 / R24 / 3.4K 1% 1/8W 255006 / R24 / 23.7K 1% 1/8W
Out of Calibration	Needs Calibration	Calibrate the Scale

Symptom	Possible Cause	Corrective Action
Weight readings are off		
Display says "Cable or O-Load" Flashes or Beeps	Cable or A/D over range	**Try to Zero first:** 1. Remove Front Panel - Top of Faceplate (need 1/8" Allen key) 2. Check the green, white, black and red cable to make sure that it is connected to the J4 Load Cell 6 pin connector 3. Gently press all the chips on the Display board to make sure they are seated **Test Electronics** 1. Unplug J4 Load Cell connector 2. Short the two center pins 3 and 4 3. **IF** the electronic display goes to 0.0 this verifies that the electronics are working as expected. The problem is external. Check the continuity of the cable. IF cable is open replace cable. 4. Ohm out pins 1 and 6 of J4 connector. The reading should be approximately 270 – 290 Ohm to be stable. If outside of this range test the Load cells and replace as necessary. 5. Ohm out pins 3 and 4. The reading should be approximately 250 Ohm's. If outside of this range test the Load cells and replace as necessary.
Turn scale on and display does not go to 0.0; and/or readings are off	Low + 5 Vdc, or Bad A/D Chip U6	1. Main Board Check the U6, U7, and U10, IC Chips to make sure they are fully seated in IC Sockets, and U6 is not getting hot to the touch.

Symptom	Possible Cause	Corrective Action
		  2. **With J4, pins 3 and 4 shorted together;** Test for +5 Volts DC across pins 1 and 8 of JTest, 9 pin connector, for Vaa power supply, after pressing the "On" button for a second If + 5 Vdc, is not ± 0.05 V of 5 V, and stable, then replace VR1 regulator. If +5 Vdc is within ± 0.05 of 5V and stable. Then proceed to next step; Go into "Cal Mode" by; 3. Turn off the scale – Hold "Reweigh" down while turning scale "On." Release "Reweigh." 4. Immediately press and release ST button 5 times quickly. The display should show "Cal" with four long beeps. 5. Press ST button one more time to display "A/D." 6. Press ST button once more to display raw A/D reading. 7. If stable A/D reading, press on platform and watch display for linear reading 10, 20, 30, 40, etc. up to 100. If missing numbers like 1, 2, 3, 4 etc… then replace U6 A/D chip or Main Board. 8. If unstable A/D reading (maybe Load Cell or PC Board issue), go back to earlier step "Mechanical Hang-up on Platform Assembly" out procedure.
All the numbers are not lighting up (Missing Segments of the Numbers)	LED	**Remove the Display Board** (see directions above) 1. Gently, lift a working 7 Segment LED chip with a flat head screw driver and exchange with a non-working LED chip. 2. IF the trouble follows the LED chip replace the chip 3. IF the trouble stays in the socket replace the display board.

Symptom	Possible Cause	Corrective Action
Letters or Numbers across the Display	IC Chips may be loose	U1 on the Display Board – Reseat the IC chip (U1) on display or replace Display board
Beeping and Buzzing	Bad Chip	Check U7 Chip seating or replace the Main Board

Flooding	Water Damage	1. Turn off power
		    a. Recommend replacing water damaged parts. Failure to replace may cause additional problems with corrosion in the future.
		2. **Replacement Parts** Load Cells, Load Mounts and Terminal Block must be ordered
		    a. If you have extra length on the platform cable, cut it back approximately 12" if not replace Platform Cable.
		3. Recalibrate once the new parts are installed.
		
		Please Note: If the flood water is removed within a few hours. The load cells can be dried in warm 110 Degrees Temperature. However, load cells can continue to corrode. Our recommendation is to replace.

Above the Class A Leakage Current	Leakage Current	Unplug the Platform prior to doing any leakage testing. Readings should be less than 10 micro amp leakage.
Paper Jam	Paper being torn off incorrectly	Must lift paper straight down or up at a slight angle, and do not pull out or to left or right side of paper slot (opening in door for paper).
Not printing, Paper not coming out of printer	Too much paper is curled up inside on roller	Have to remove paper from roller and redress paper in roller of printer mechanism.
	Orientation	In-Floor Scales Only – Re-orient the Printer door for Tearing of thermal paper.

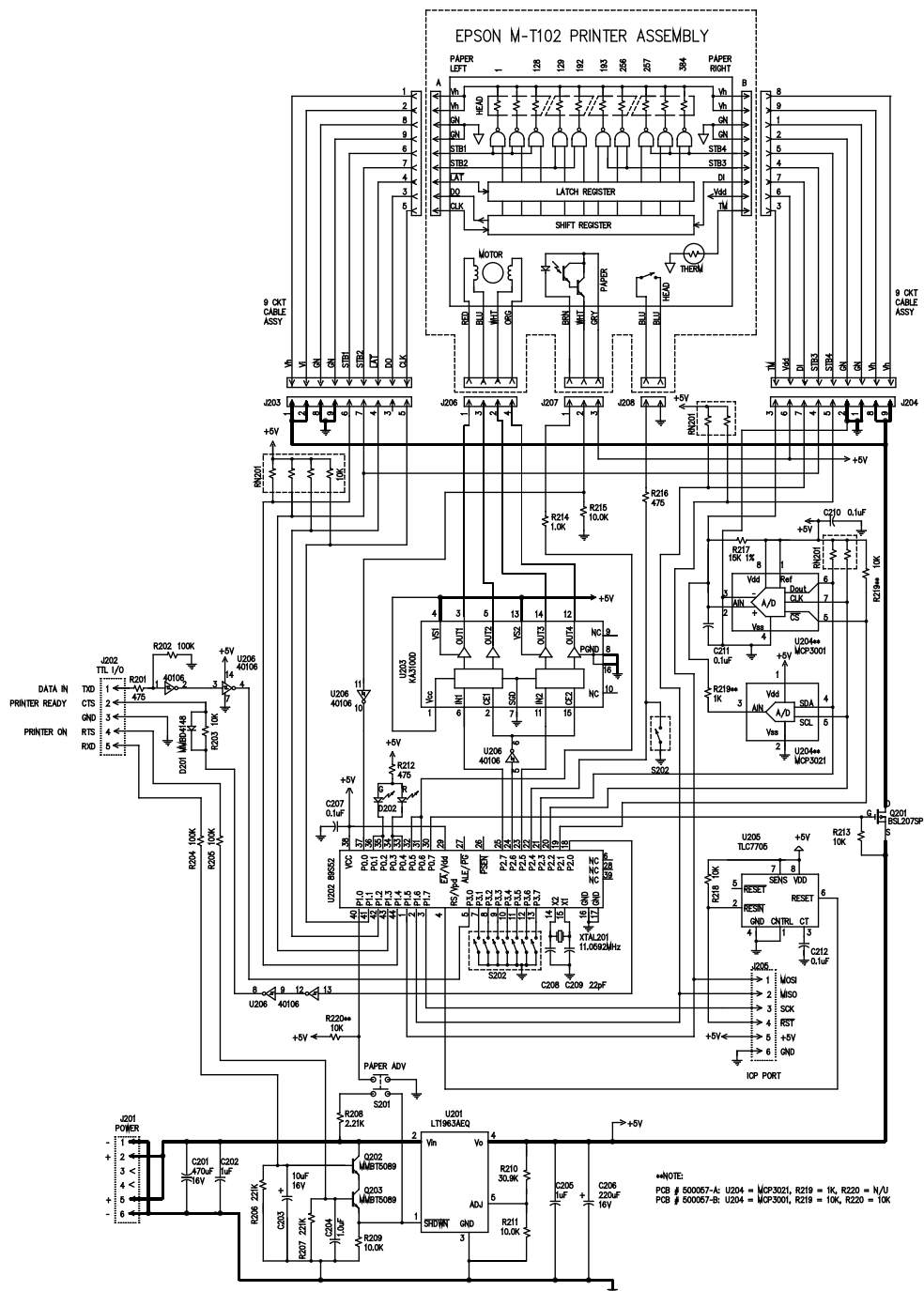| Symptom	Possible Cause	Corrective Action
	Installation of thermal paper	Paper may be installed upside down. Thermal paper is critical to the operation, and need to have the chemical treated side of paper facing print head.
Pink strip on paper	Almost out of paper	Time to change the thermal paper
Not operating/four long beeps	Yellow Data Cable	Open Front Panel, Locate Yellow Data Cable from side of printer to Main PCB J15 TTL port. Check the cable connection to J15, 5pin header to make sure it is correctly plugged into the J15 port, Red wire w/ white strip should be on Pin 1 of J15 TTL port (5 pin connector on the main board), and green wire with white stripe should be on pin 5 of J15 TTL port.
	U8 RS232 Chip	If U8 has the RS232 chip in socket, then remove the U8 IC Chip from IC socket for printer to operate.
Not operating	Weight on Display & No Print	**Note:** Printer will not print 0.0 lb/kg weight reading. When the "Print" button is depressed do you hear a beep or see a Data lamp light up on Display for a moment? If no, printer is shut off and needs to be activated in "Set-Up" mode, see manual. If yes, open printer door and view printer status light. See Printer section in this service manual.
One Flash	No Paper	Add/Install Thermal Paper.
Two Flashes	Print Lever not down	Close the print Lever, unit will not operate with lever up.
Three Flashes	Printer head temperature is out of operational range	Check cables J203, J204 from Printer PC Board to printer mechanism, see section in the service manual.
Four Flashes	Indicates printer PCB has trouble	Replace Printer PC Controller Board, which has failed.
Print is faint	Low Battery Pack, Low Batteries	Replace rechargeable battery pack
	Printer Mechanism	Replace Printer Mechanism

Repair Parts List

Material #	Description
039393W	SCALE, TOP 6154
846239	ROUGH IN FRAME 6154 SURFACE MNT
846238	ROUGH IN FRAME 6102 SURFACE MNT
846107	ROUGH IN FRAME 35 X 54
20067W	LOADCELL, DEBB II 6102
23709	PAPER, THERMAL 2" FOR PRINTER
030110W	DOOR, PRINTER PAPER WITH TEAR
039394W	DECK, 6154 PLATFORM TOP
030102W	CABINET, READOUT
039395W	CABINET, FLUSH READOUT
096102W	HANDRAIL BRACKET KIT 6102
096154W	HANDRAIL BRACKET KIT 6154
61022	Handrail (Model 6102/6154)
20110	BUMPER RUBBER GRAY
133086	LOADMOUNT 3/8" X 1" WITH 3/8"
630159	MOUNTING PLATE ASSY
22316	BOLT, 1/4-20 X 3/4" GRADE 8
25066	BOLT. 1/4-20 X 1" HEX HEAD, SS
HST-308	1/4-20 KEPS LOCK NUT, 18-8
40517	CORD POWER
50408	CABLE, INTERIOR R/O POWER
50509	1/8 THICK EAR SPACER 3/4" X 3/4"
61201	Data Cable (Readout to Platform) 6154-S
412246	Data Cable (Readout to Platform) 6154-F
120024	TERMINAL BLOCK, 3 PIN
120032	TERMINAL BLOCK, 4 POSITION
133110	MOUNT METAL LOAD
030158W	BRACKET HANDRAIL L SUPPORT 6102
030161W	TOP, 6102 SCALE
030162W	DECK TOP 6102 (S/N 1001 & ABOVE)
030164W	BRACKET, TERMINAL STRIP
750053	CABLE, GROUND
270022	IEC APPLIANCE INLET C14
360007	BATTERY PACK 7.2V
400039	LOAD BEAM WING BACK 135LB - 6154
412246	WIRE HARNESS FM TO SCALE
450006-KIT	FIRMWARE KIT 5152,6102,6154 V2.13.5

450010-KIT	FIRMWARE KIT 6102D,6154 V2.11.0
600041	BRACKET, HANDRAIL SUPPORT
630158	PRINTER SUB ASSEMBLY
630234	FLUSH MOUNT COVER ASSY
720024	SWITCH ASSY LB/KG W/RS232
720025	SWITCH ASSY KG ONLY W/RS232
750056	HARNESS PRINTER POWER RED
750057	HARNESS PRINTER DATA YELLOW FOR 6102
750088	CABLE, GRD PUSH-ON 18AWG 4"
750089	CABLE, BLUE PUSH-ON 18AWG 4"
750090	CABLE, BROWN PUSH-ON 18AWG 4"
846112	ADD ON AFTER PURCHASE PRINTER, 6102/6154
030105W	PLATE, MOUNTING COMPONENT
030106W	BATTERY HOLDER
030114W	BRACKET, WALL MOUNTING
030159W	BRACKET HANDRAIL 6102 6154
090076W	SRV KIT PLATFORM HARDWARE 6154
255006-KIT	CALIBRATION PLUG KIT 5152
255008-KIT	CALIBRATION PLUG KIT 6102
255031W	PLUG CALIBRATION 6154
620037W	COVER W/RS232 CUT OUT
700027W	PCB DISPLAY ASSEMBLY
700051W	MAIN PCBA (No Cal & Firmware Chips)
700101W	PC BOARD 7.2V POWER SUPPLY ASSY
700119W	JUNCTION Bd 5202 6202 VG
710031W	HARNESS, RS-232 DATA
710039W	HARNESS, INTERIOR LOADCELL
710040W	HARNESS, INTERIOR GROUND
710041W	HARNESS, INTERIOR POWER
750102A	CABLE, 6154 JUNCTION BD TO BLK
AP-113	TERMINAL BLOCK
ELD-1032	LAMP LED HLCP-B100
EM1037	DISPLAY CABLE/28PIN 15"
412314	ASSY 700051 MAIN PCBA, 6102, STD
412315	ASSY 700051 MAIN PCBA, 6102, KG
412362	ASSY 700051 MAIN PCBA, 6102, STD, PRT
412363	ASSY 700051 MAIN PCBA, 6102, KG, PRT
412364	ASSY 700051 MAIN PCBA, 6154, STD
412365	ASSY 700051 MAIN PCBA, 6154, KG
412366	ASSY 700051 MAIN PCBA, 6154, STD, PRT

412367   ASSY 700051 MAIN PCBA, 6154, KG, PRT

Schematics & Part Diagrams

EPSON PRINTER INTERFACE

10/23/2008

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500057-B
EPPRT102

M-T102A PRINTER MECHANISM

EPPRT102 PRINTER INTERFACE

TO BATTERY/
POWER SUPPLY

TO SCALE
TTL DATA PORT (J15)
RED/WHITE TO PIN 1

700051C / 700027F
11/17/15

SCALE-TRONIX
22DSDP Rev E
500004-E

J2 KEYBOARD

ANN1
R1
R2
ANN2
ANN3
ANN4
ANN5

RP4

700027 F

ANN8

ANN7
ANN6

RP2
RP1
RP3

U1

JP1

J1

28
14

15
1

U2