2038

Technical Manual
and
Parts Catalog

INTRODUCTION

This publication is provided solely as a guide for individuals who have received METTLER TOLEDO Technical Training in servicing the METTLER TOLEDO product.

Information regarding METTLER TOLEDO Technical Training may be obtained by writing to:

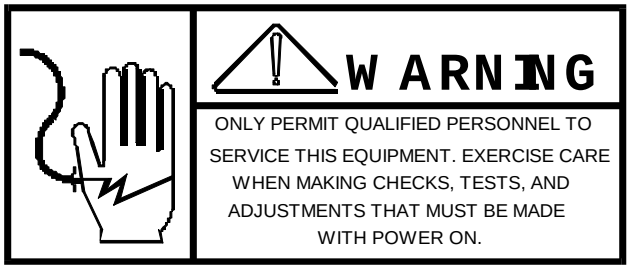
METTLER TOLEDO
Training Center
P.O. Box 1705
Columbus, Ohio 43216
(614) 438-4400

PRECAUTIONS

- **READ** this manual before operating or servicing this equipment.

- **ALWAYS REMOVE POWER** and wait at least 30 seconds **BEFORE** connecting or disconnecting any internal harnesses. Failure to observe these precautions may result in damage to, or destruction of the equipment.

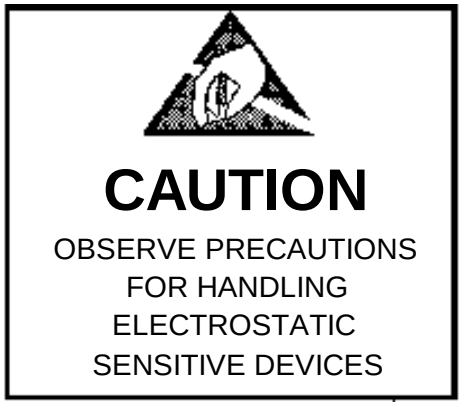
- **ALWAYS** take proper precautions when handling static sensitive devices.



- **DO NOT** connect or disconnect a load cell scale base to the equipment with power connected or damage will result.

- **SAVE** this manual for future reference.

- **DO NOT** allow untrained personnel to operate, clean, inspect, maintain, service, or tamper with this equipment.



- **ALWAYS DISCONNECT** this equipment from the power source before servicing.

- **CALL** METTLER TOLEDO for parts, information, and service.

CONTENTS

1. GENERAL DESCRIPTION

1.1 OVERVIEW

The Toledo Model 2038 is a battery operated high resolution bench scale It is designed for general purpose industrial or commercial environments, with an emphasis on easy operation and portability. The Model 2038 utilizes heavy duty metal construction for durability, and microprocessor based electronics incorporated in the patented high resolution Toledo DigiTOL Load Cell. The high resolution load cell provides maximum sensitivity and accuracy for either parts counting or straight weighing. The six key membrane keyboard uses graphic symbols to aid the operator.

Optional accessories available for the Model 2038 include an AC Wall Transformer kit, an adjustable height Stand Kit, and Stand Casters.

1.2 FEATURES

-- Battery operation allows maximum portability and easy setup.

-- Highly visible low power Liquid Crystal Display.

-- Sleep mode automatically shuts the electronics off and conserves battery power.

-- Keyboard setup and calibration miminizes installation time and expense.

-- Keyboard selectable sample reference.

-- Built-in RS232 data input and output allows connection to printer or host computer.

‘

-- Optional wall transformer can be used in place of batteries when AC power is available.

2. SYSTEM DESCRIPTION

2.1 INTERNAL FUNCTIONS

The Toledo Model 2038 consists of three major blocks. These are:

2.1.1 DIGITAL LOAD CELL -

The digital load cell used in the Model 2038 is the patented high resolution Toledo DigiTOL Load Cell. The digital load cell contains all the analog to digital circuitry and a microprocessor. The digital load cell processes and transmits weight data, controls scale functions, provides outut to a printer, accepts input commands from a host device, and stores softswitch settings.

2.1.2 DISPLAY PCB -

The display uses a low power custom liquid crystal display (LCD). Digits are 17.5 mm in height. In addition to displaying data, the Display PCB accepts input data from the keyboard for transmission to the digital load cell, regulates the optional wall transformer input power, and contains the solid state on/off switching circuitry.

2.1.3 POWER SUPPLY -

The standard power supply consists of six 1.5 volt alkaline D-cell batteries connected in series to supply 9 VDC. An optional wall transformer is also available which can be used in place of the batteries.

2.2 DISPLAY

The Model 2038 utilizes a low power custom liquid crystal display (LCD), with six seven-segment digits for data display, and special symbols indicating battery power, net/gross, weiight, zero, etc. A layout of the display and explanationof the symbols are shown in Figure l.

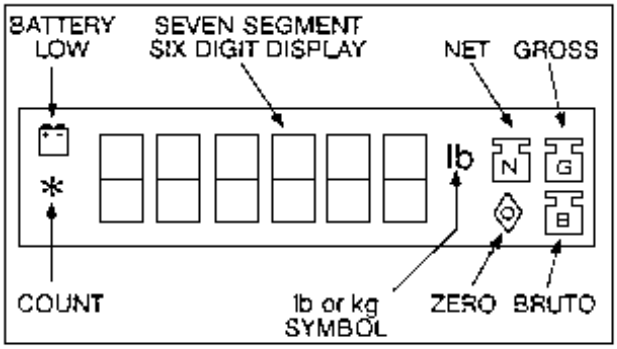


FIGURE 1

SYMBOL	DESCRIPTION
(BATTERY LOW)	– Indicates the battery voltage is below a minumum level for sustained scale operation.
✱ (COUNT)	– When steady, indicates calculated piece count is showing on the display. When blinking, indicates more pieces are required for sample reading.
lb or kg	– Indicates avoirdupois or metric mode in use.
(ZERO)	– The zero legend illuminates when the weight is within ±0.25 increments of zero.
N (NET)	– Indicates tare has been taken and the display is showing net weight.
G (GROSS)	– Indicates the scale is at zero and no tare has been taken.
B (BRUTO)	– International term for Gross. Used in place of the Gross symbol when Metric Mode (SSW-11), Tare Interlock (SSW-21), and Analog Verify (SSW-23) are enabled.

2.3 KEYBOARD

The keyboard used onthe Model 2038 is a six position membrane keyboard utilizing graphic symbols. An illustration of the keyboard is shown in Figure 2. Refer to Section 4.2.4 for descriptions of keys.

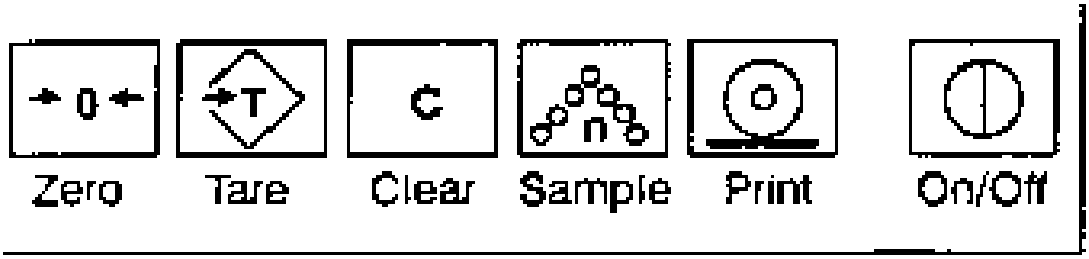


Figure 2

3. SPECIFICATIONS

3.1 ELECTRICAL

The Toledo Model 2038 uses six alkaline 1.5 VDC D-Cell batteries, connected in series to provide a nominal 9 VDC at 33 mA (increases to 48mA when the Remote Command Input feature is enabled), to power both the Digital Load Cell and the Display PCB. Only the 1.5 VDC alkaline D-Cells are recommended for use in the Model 2038. Rechargeable "ni-cad" batteries are not recommended due to the fact that they only are rated for 1.2 VDC when fully charged. The acceptable voltage range required is between 7.5 VDC to 12.0 VDC. The operation time with fully charged batteries is 200 - 250 hours. With Sleep Mode enabled, typical battery life is approximately 3 to 6 months.

When the battery amperage is not sufficient to allow sustained scale operation, a battery-low indicator will be visible in the upper left corner of the display, when Tare Interlock (SSW-21) is disabled. When the battery-low symbol is visible, replace the batteries with six new 1.5 VDC alkaline D-Cell batteries and discard the old batteries in a proper container.

When Tare Interlock (SSW-21) is enabled (legal-for-trade applications), the display will blank and the battery low indicator will illuminate when the voltage level is not sufficient to allow sustained scale operation. At this point, fresh batteries must be installed.

An optional wall transformer is also available to power the Model 2038 in place of the batteries. The wall transformer converts the AC input voltage to the transformer to a nominal 12 VDC output to the scale. The voltage requirement for use with the wall transformer is 120 VAC, 60 Hz. The Model 2038 automatically switches to the wall transformer when it is connected. The scale will operate on the transformer with or without batteries installed.

3.2 ENVIRONMENT

3.2.1 TEMPERATURE SENSITIVITY

Zero temperature coefficient is +/- 15PPM/C
Span temperature coefficient is +/- 8 PPM/C

3.2.2 OPERATING TEMPERATURE

The Toledo Model 2038 is designed to meet NBS HB-44 5000 d and 3000 d OIML requirements to operate in a temperature range between:
+14F (-10c) to 104F (+40C)
0 to 95% relative humidity, non-condensing.

3.2.3 APPLICATION

The Toledo Model 2038 is designed for general purpose, dry indoor industrial or commercial environments.

The Model 2038 is not designed for hose-down applications. Typical examples of mis-application of the scale include, but are not limited to:

- Immersions
- Hosedown
- Splashing liquids
- Corrosive Chemical Environments

3.2.4 HAZARDOUS AREAS

DO NOT USE the scale in locations classified hazardous by the National Electrical Code (NEC) because of combustible or explosive atmospheres.

3.3 PHYSICAL SPECIFICATIONS

3.3.1 DIMENSIONS AND SHIPPING WEIGHT

Dimensions

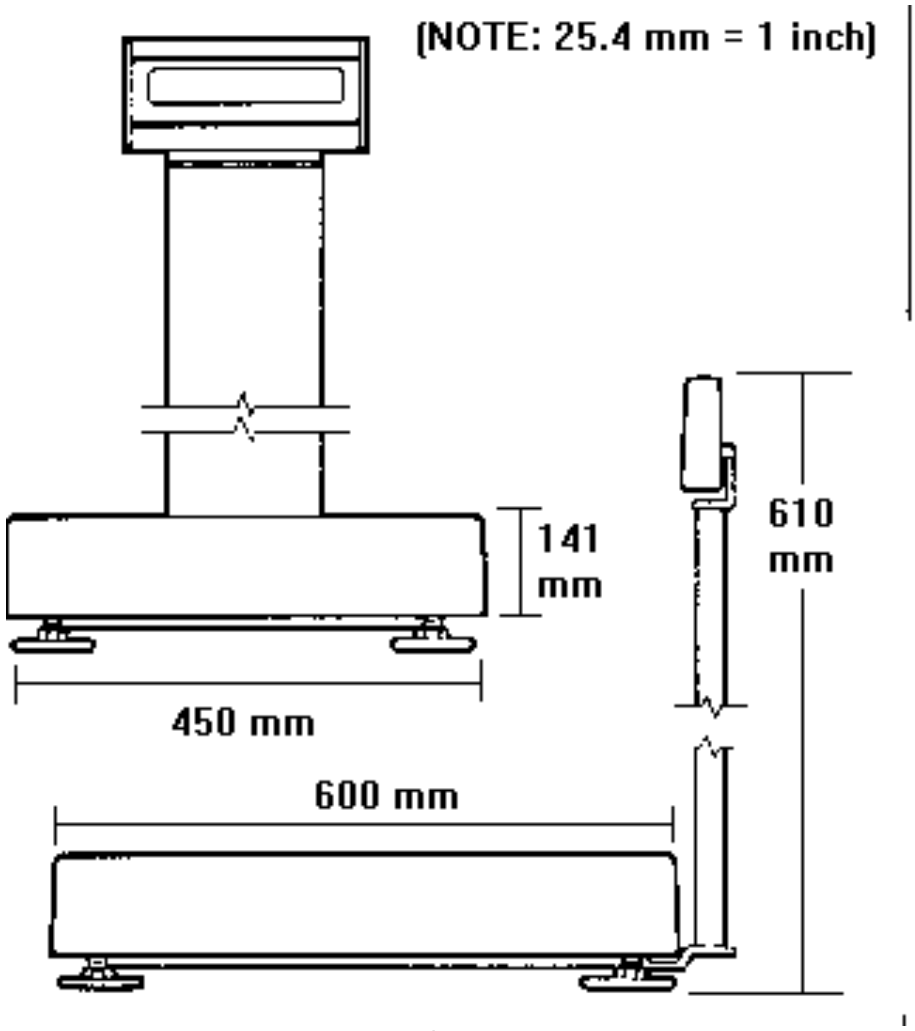


Figure 2A

Shipping Weight
Shipping weight w/column: 28kg (62lb)
(approximately)

3.3.2 CONSTRUCTION

Platter: Fabricated Steel, 14 Gauge
Base: Welded Steel
Connector Bracket: Cold roll steel
Column Support/End Caps: Die cast aluminum.

3.3.3 OVERLOADING

Corner Loading: 100% of full scale capacity
Safe Overload: 150% of full scale capacity

3.3.4 RESOLUTION

Displayed Resolution: 3000 (kg mode) or 5000 (avoirdupois mode)
Counting Resolution: 1 part in 200,000 internal for piece weight and total calculations.
Maximum Count: 999,999 pieces

3.4 CONFIGURATION

Factory Number	INDICATION	Load Cell Capacity
2038-0001	100 x 0.02 lb OR 60 x 0.02 kg	140 kg
2038-0002	250 x 0.05 lb OR 150 x 0.05 kg	300 kg

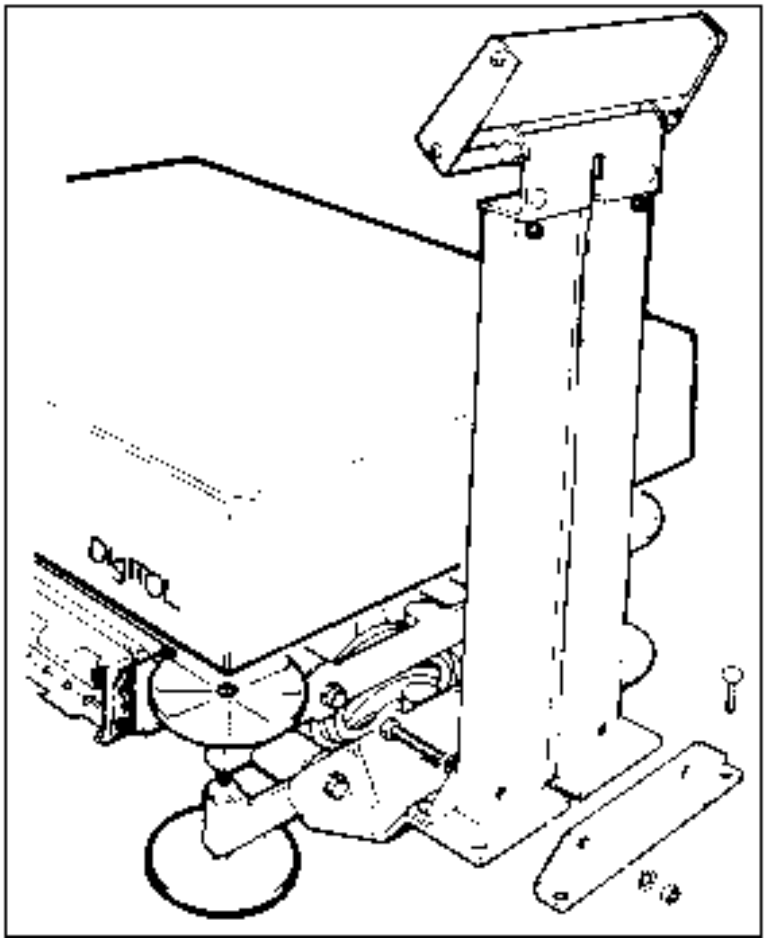
4. INSTALLATION INSTRUCTIONS

4.1 ASSEMBLY

4.1.1 Examine the shipping box for any signs of damage. IF DAMAGE IS FOUND, MAKE A CLAIM WITH THE CARRIER IMMEDIATELY.

4.1.2 Open the box and remove the top packing material. Remove the scale base, column and display from the box and place it on a stable flat level surface. Also remove the six 1.5 VDC alkaline D-Cell batteries from the carton and set aside until installation.

CAUTION! DO NOT LIFT THE SCALE BY THE UPPER FRAME, THE INDICATOR, OR COLUMN. LIFT THE SCALE USING THE LOWER FRAME ONLY.



4.1.3 The display is shipped from the factory mounted to the column and electrically connected to the base. The display column mounts in an upright position on the column support bracket (Refer to Figure 3). Loosen the hex screws on the outside angle bracket. Remove one of the hex screws and swivel the bracket outward. Place the column in between the brackets and route the cable into the slot in the column support. Swivel the bracket back in and replace the hex screw. Mount the column to the angle brackets using the hardware supplied in the envelope. First tighten the column hex screws, then tighten the bracket hex screws. Tuck any excess cable into the base cavity. The display can also be removed from the column and mounted directly to the tabletop or wall. (Refer to Figure 4).

Figure 3

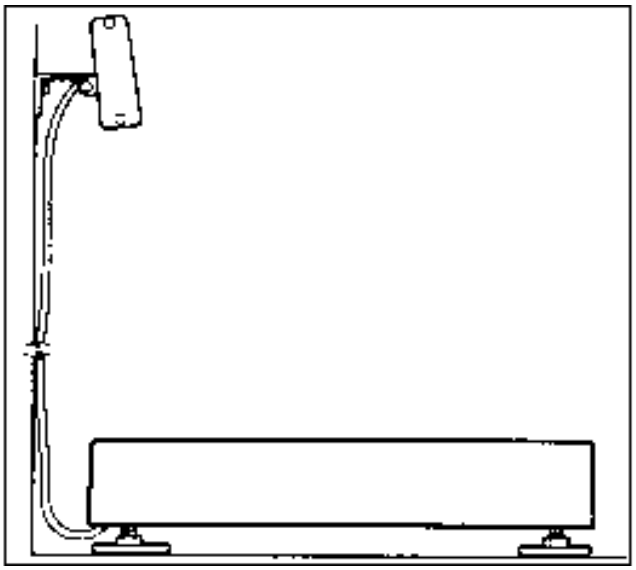
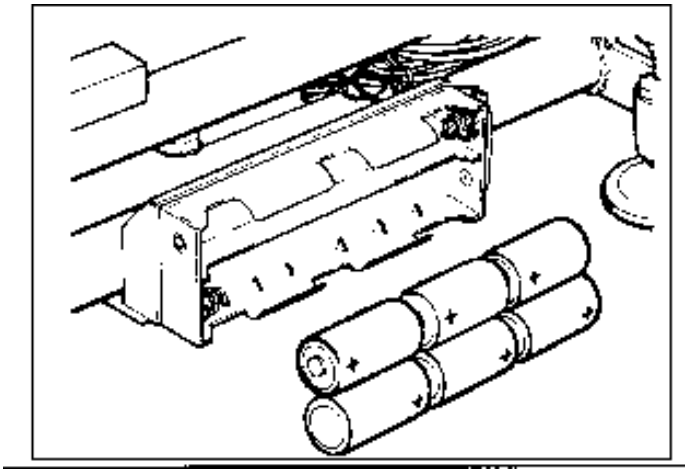
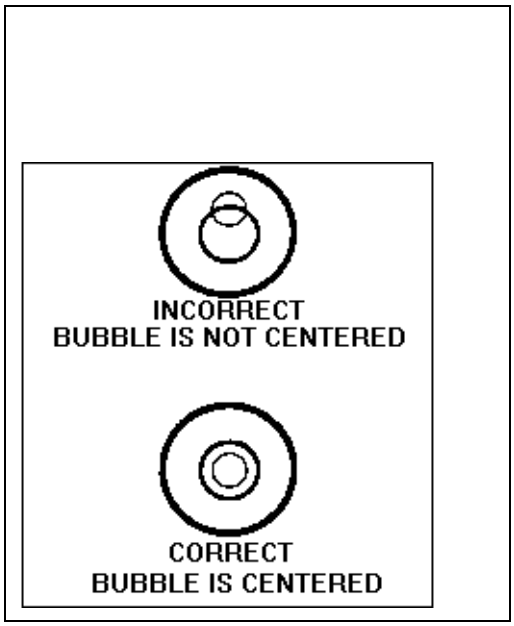


Figure 4



4.1.4 Remove the platter and install the six 1.5 VDC alkaline D-Cell batteries in the battery holder, orientating the positive/ negative terminals in the direction shown on the battery holder. (Figure 5)

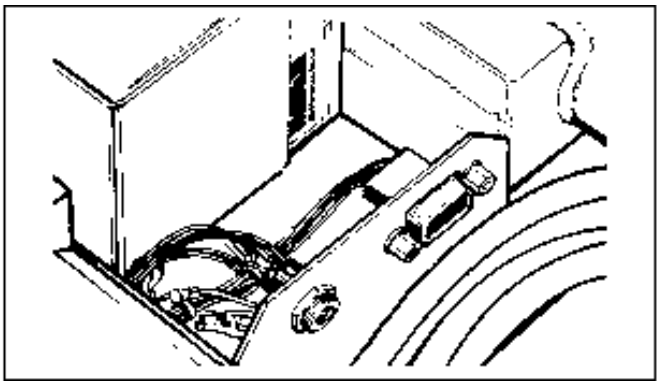
Figure 5



4.1.5 Level the scale by turning the adjustable feet on the bottom of the base in or out until a level condition is attained, and the scale does not rock. The scale is in a level condition when the level indicator on the top frame assembly is as shown in Figure 6.

Figure 6

4.1.6 Install the scale platter and press the “ON” button to apply power. If the display does not illuminate, check the batteries for proper installation.



4.1.7 If the optional wall transformer assembly is used, it is connected to the jack on the bottom of the base shown in Figure 7.

Figure 7

4.2 ACCESSING SETUP AND CALIBRATION MODE

The Model 2038 is calibrated at the factory per the specification listed on the equipment data plate, and functional programming is completed at the factory, allowing the unit to be operational right out of the box. The unit can be used for normal weighing and counting operations without changing any of the softswitch parameters, or the calibration. However, for commercial purposes (legal for trade), the unit must be calibrated using certified test weights. All operational changes and calibration can be performed using the scale keyboard.

Accessing the Setup Mode

1. Remove the top screw that secures the end cap on the right side of the display housing, and loosen the lower screw so the end cap can be rotated 180 degrees, allowing access to the inside of the enclosure (figure 8).

2. ` Press the white “ON/OFF” key (located on the lower right side of the display assembly) to turn the scale power ON. (Refer to Figure 2)

3. After the power-up sequence is completed, press and relaese the white pushbutton located on the end of the Display PCB (Figure 8). The scale will first display [10 0], indicating the start of the setup mode.

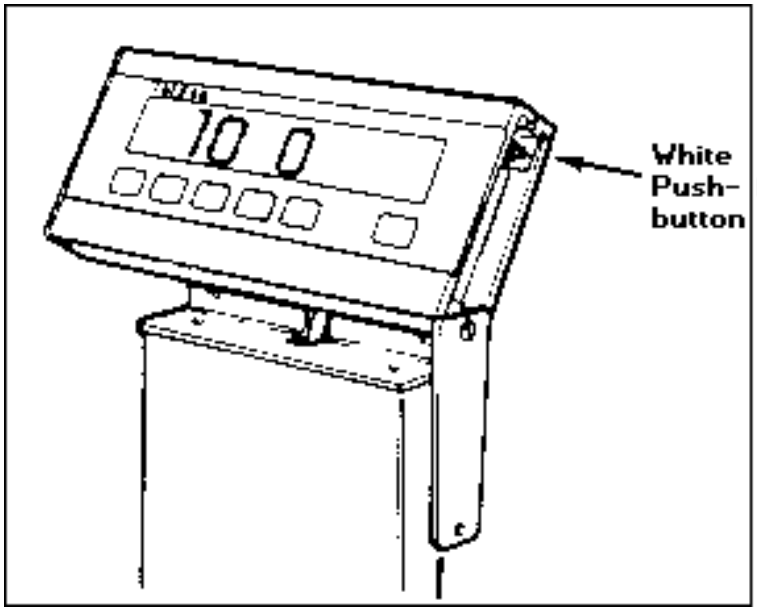
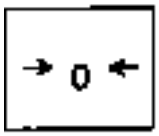
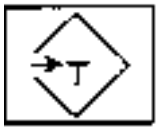
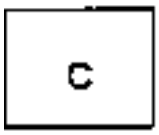
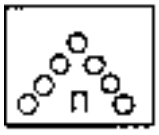
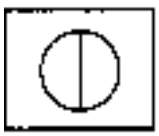


Figure 8

4. In addition to the normal mode functions of the keys, each key performs a different function when the scale is in the setup mode. The functions of the keys are as follows:

KEY		FUNCTION
 Zero	**Normal Mode:**	**Zero – pressing this key will return the scale to a gross zero condition if the weight is within +/- 2% of the scale capacity listed on the data plate.**
	Setup Mode:	**Used as a "cursor" key to backup to the previous softswitch.**
 Tare	**Normal Mode:**	**TARE – Used to tare the applied weight on the scale platter.**
	Setup Mode:	**Used to change the starus of the softswitch (on/off) or to toggle through a selection of softswitch options. When variable data is required, the Tare key advances the digit in each decade position from 0 to 9.**
 Clear	**Normal Mode:**	**CLEAR – clear tare weight or exit from counting mode.**
	Setup Mode:	**Abort setup and go to the end of setup mode softswitches.**
 Print	**Normal Mode:**	**PRINT – Used to initiate printing when a printer is connectd to the Model 2038.**
	Setup Mode:	**Allows entry of the displayed softswitch status and advances to the next soft switch.**
 Sample	**Normal Mode:**	**SAMPLE – Used in the counting mode.**
	Setup Mode:	**When entering variable data, Sample moves the control (blinking) digit from left to right one position at a time.**
 On/Off	**Normal Mode:**	**ON/OFF – Connects/disconnects power to the scale electronics.**
	Setup Mode:	**Not used.**

5. Following is a brief listing of the softswitches (SSW) for quick reference purposes. The default SSW settings and recommended settings for Legal-for-trade applications are also listed. For complete descriptions of each SSW, refer to Section 4.3.

Quick Reference Chart
(0=OFF, 1=ON)

SSW	DESCRIPTION	INITIAL DEFAULT SETTING	LEGAL FOR TRADE SETTING
10	**SCALE SETUP SECTION**		
11	Select KG or LB Mode	lb	
12	Capacity Select	Refer to Section 4.3	
13	Gravity Adjust	10000	
14	Filter Selection	1 (low)	
15	Sleep Mode	1	0
16	Tare Auto-Clear	0	1
20	**LEGAL-FOR-TRADE SECTION**		
21	Tare Interlock	0	1
22	Display Metric Comma	0	
23	Analog Verify Enable	0	
24	Expanded Weight Display	0	0
25	Calibration Mode	0	
30	**COUNTING SETUP SECTION**		
31	Parts Counting Mode Enable	1	
32	Auto Clear APW	1	
33	Minimum Sample Requirement Enable	0	
34	Select Fixed/Variable Sample	00 (Variable)	
40	**PRINTER OUTPUT SETUP**		
41	Printer Baud Rate	0 (9600)	
42	Checksum Enable	0	
43	Remote Input Enable	0	
50	**PRINT FORMAT SETUP**		
51	Single Line Print Enable	0	
52	Print Gross Weight	1	
53	Print Tare Weight	1	
54	Print Net Weight	1	
55	Print Double Width Net Wgt.	0	
56	Print APW	1	
57	Print Pieces	1	
58	Print Double Width Pieces	0	
99	**END OF SETUP MODE**		

4.3 SOFTSWITCH FUNCTIONS

When the setup mode is accessed, the first series of softswitches (SSW) will be displayed as [10 0]. The “10” indicates the first series of switches (11 through 16). Pressing the “TARE “ key will change the “0” (indicating an OFF condition), to a “1” (indicating an ON condition). When the “1” is diplayed, press the “PRINT” key to accept the displayed setting and advance to the first softswitch selection. If the “10 Series” of softswitches is to be by-passed, leave the display showing [10 0], then just press the “PRINT” key to advance to the “20 Series” of softswitches. Pressing the “PRINT” key without making changes will advance to the next selection and pressing the “ZERO” key will backup to the next previous selection.

There are five sections or series of softswitches inthe stup mode as follows:

10 = SCALE SETUP SOFTSWITCHES

20 = LEGAL FOR TRADE AND CALIBRATION SETUP SOFTSWITCHES

30 = COUNTING SETUP SOFTSWITCHES

40 = PRINTER OUTPUT SETUP SOFTSWITCHES

50 = PRINT FORMAT SETUP SOFTSWITCHES

Following is a lsit of the softswitch options and description of each softswitch:

Model 2038 Softswitch List

SSW	DESCRIPTION
10	**SCALE SETUP SOFTSWITCHES** 0 = Bypass Section 10 SSW 11-16 1 = Access Section 10 SSW 11-16
11	**AVOIRDUPOIS OR METRIC MODE** kg = Metric mode in use lb = Avoirdupois mode in use
12	**CAPACITY SELECT** Capacity selection - the Model 2038 is calibrated at the factory according to the capacity listed on the data plate and must not be changed. The capacity should be set as follows: 2038-0001 - 100 x .02lb or 60 x .02 kg 2038-0002 - 250 x .05lb or 150 x .05 kg
13	**GRAVITY ADJUST** 0 = Bypass Gravity Adjustment Parameters 1 = Access Gravity Adjustment Parameters (Refer to Gravity Adjustment section 4.5 of this manual)

14 FILTER SELECTION

Display Filtering - four selections are available (0, 1, 2, or 3). By enabling the filter, the scale is less susceptible to the effects of vibration. The scale response time is slowest when the highest filtering parameter (3) is selected. The response time is fastest when filtering is disabled (0). Press the “TARE” key to toggle through the selections, then press “PRINT” to accept the displayed setting.

0 = Filter Off
1 = Low Filter
2 = Medium Filter
3 = High Filter

15 SLEEP MODE

Select Sleep Mode Options. When enabled, power to the display and load cell will be disabled after the selected interval from the last time the scale was in use. The “1” setting will result in the longest battery life. Press the “TARE” key to toggle through the selections, then press “PRINT” to accept the displayed setting.

0 = Disable Sleep Mode
1 = Enable Sleep Mode after 1 minute
2 = Enable Sleep Mode after 2 minutes
5 = Enable Sleep Mode after 5 minutes

NOTE: LEGAL FOR TRADE APPLICATIONS MAY REQUIRE SLEEP MODE TO BE DISABLED.

16 TARE AUTO-CLEAR

0 = Disable Tare Auto-Clear - Tare must be cleared using the “CLEAR” key.
1 = Enable Tare Auto-Clear - Tare will clear when the gross weight is removed

20 LEGAL FOR TRADE SETUP SOFTSWITCHES

0 = Bypass Section 20 SSW 21-25
1 = Access Section 20 SSW 21-25

21 TARE INTERLOCK

0 = Disable Tare Interlock
1 = Enable Tare Interlock - TARE INTERLOCK MUST BE ENABLED IF THE SCALE IS TO BE USED FOR COMMERCIAL WEIGHING (legal for trade). The Tare Interlock mode requires all tare weight entries to be completed when the scale is inthe “gross” zero mode and allows the tare to be manually cleared only when the platter is empty.

22 SELECT METRIC COMMA OR DECIMAL POINT

0 = Display decimal point
1 = Display metric comma in place of decimal point

23 ANALOG VERIFICATION

0 = Disable Analog Verification
1 = Enable Analog Verification. This softswitch should be normally disabled, unless specified by local authorities.

24 EXPANDED DISPLAY

0 = Normal Display
1 = Expanded Display - Displays all minor increments. Used for test mode only. Set to “0” for normal use.

25 **CALIBRATION MODE**

0 = Bypass Calibration Mode
1 = Access Calibration Mode - Used to calibrate the scale with test weights. (Refer to Calibration Section 4.4 of this manual).

30 **COUNTING SETUP SOFTSWITCHES**

0 = Bypass Section 30 SSW 31-34
1 = Access Section 30 SSW 31-34

31 **PARTS COUNTING MODE**

0 = Disable Counting Mode
1 = Enable Counting Mode

32 **AUTO CLEAR AVERAGE PIECE WEIGHT**

0 = Disable Auto-Clear Average Piece Weight (APW). When disabled, APW will be retained in memory until manually cleared with the keyboard.
1 = Enable Auto-Clear Average Piece Weight. If enabled, calculated APW will automatically clear from memory when the scale is emptied.

33 **MINIMUM SAMPLE REQUIREMENT**

0 = No minimum sample weight requirement
1 = Set minimum sample weight for 0.1% for the scale's rated capacity. When sampling pieces, the scale will prompt the user to add pieces until the 0.1% minimum is ppplied to the scale.

34 **SELECT FIXED OR VARIABLE SAMPLE QUANTITY**

00 = Variable Sample Reference - Selecting 00 will allow the user to set the sample reference quantity for 5, 10, 20, 50, or 100 by pressing the "SAMPLE" key to toggle the selections.
05 = Set Fixed Sample Reference for 5
10 = Set Fixed Sample Reference for 10
20 = Set Fixed Sample Reference for 20

40 **PRINTER OUTPUT SETUP SOFTSWITCHES**

0 = Bypass Section 40 SSW 41-43
1 = Access Section 40 SSW 41-43

41 **PRINTER BAUD RATE**

0 = 9600 Baud
1 = 300 Baud

42 **CHECKSUM**

0 = Do not send checksum
1 = Send checksum

43 **REMOTE INPUT**

0 = Remote Inputis disabled
1 = Remote Input is enabled

50 **PRINT FORMAT SETUP SOFTSWITCHES**

0 = Bypass Section 50 SSW 51-58
1 = Access Section 50 SSW 51-58

51 **SINGLE OR MULTI-LINE PRINTING**

0 = Print/send data on multiple lines
1 = Print/send data on single line

Model 2038 Softswitch List (continued)

52 **PRINT GROSS WEIGHT**
0 = Do not print/send Gross Weight data
1 = Print/send Gross Weight data

53 **PRINT TARE WEIGHT**
0 = Do not print/send Tare Weight data
1 = Print/send Tare Weight data

54 **PRINT NET WEIGHT**
0 = Do not print/send Net Weight data
1 = Print/send Net Weight data

55 **PRINT DOUBLE WIDTH NET WEIGHT**
0 = Print Normal Width Net Weights
1 = Print Double Width New Weights

56 **PRINT APW**
0 = Do not print/send APW data
1 = Print/send APW data

57 **PRINT PIECES**
0 = Do not print/send

58 **PRINT DOUBLE WIDTH PIECES**
0 = Print Normal Width Number of Pieces
1 = Print Double Width Number of Pieces

99 **END OF SET UP MODE**
Press the setup pushbutton to return to normal run mode

After programming is complete, re-attach the right end cap, using the screws provided.

4.4 CALIBRATION

If the Model 2038 is used in a commercial (legal-for-trade) application, it must be calibrated to the capacity specified on the equipment data plate using certified test weights. The calibration procedure is as follows:

NOTE: The capacity of the Model 2038 is selectable via softswitch #12 in the setup mode, and must be set according to the Factory Number Configuartion and Capacity listed on the equipment data plate, and as listed in Section 3.4 of this manual.

4.4.1 Press the setup mode pushbutton at the end of the Display PCB, as shown in Figure 8. The display will show [10 0]. Press the “PRINT” key to advance to the SSW Section 20 [20 0]. Press the “TARE” key to change the “0” to “1”, then press the “PRINT” key again. The display will show the first SSW in section 20, [21 0}. Press “PRINT” to enable the calibration mode. The display will show dashes [------], prompting the user to empty the scale platter. Empty the scale, then press the “PRINT” key. The display will count down from 15 to 00 while it waits for the filtered weight to settle.

4.4.2 When zero has been established, the display will show [0000lb] if in the avoirdupois mode, or [0000kg] if in the metric mode. The most significant digit will be flashing, prompting for the entry of the value of the test weight that will be used to calibrate the span. The test weight should be an amount close to the capacity of the scale. The minimum recommended test weight is 2/3 of scale capacity.

The value is entered from left to right. If the first flashing decade position is to be zero, press the ‘SAMPLE” key to toggle to the next decade. If a value other than zero is to be entered in this position, press the ‘TARE” key to toggle the selection of digits 1-9. When the required digit is

displayed, press the 'SAMPLE" key to move to the next decade position. When the complete variable test weight value is on the display, press the "PRINT" key to accept the displayed value (example: [0050lb].

4.4.3 The display will then show [l - l - l - l - l - l - xx], with xx = lb or kg depending on the weighing mode in use. Place the test weight(s) on the platter, then press the "PRINT" key. The display will count down from 15 while the scale waits for the filtered weight to settle.

4.4.4 When the span has been determined, the display will again show dashes [-----]. Remove the test weight(s) from the platter and press the "PRINT" key. The display will count down from 15. When calibration has been completed, the display will advance to the next softswitch section [30 0]. Press the "CLEAR" key to advance to the end of the setup mode, or continue in the setup mode in section 30-50. When [99] is displayed, indicating the end of the setup mode, press the white pushbutton at the end of the Display PCB to return to normal run mode.

4.4.5 Gravity Adjustment

The Toledo Model 2038 is calibrated at the point of manufacture to the capacity specified on the equipment data plate. If the scale is moved to another location, the factory calibration may require adjustment, due to the effect of gravity factors at the new location. the Gravity Factor is determined by geography (latitude) and distance above sea level (altitude). The probability is high that the gravity factor in your local area is different from the point of manufacture (Spartanburg, SC, USA). In this case some calibration adjustment may be required. If required, a gravity adjustment factor can be input into the scale as a calibration correction for your specific location.

NOTE: THIS CORRECTION FACTOR IS NOT REQUIRED IF THE UNIT HAS BEEN CALIBRATED USING CERTIFIED TEST WEIGHTS AT THE INSTALLAITON SITE OF THE UNIT. ONCE THE UNIT HAS BEEN CALIBRATED WITH TEST WEIGHTS AT A LOCATION OTHER THAN THE FACTORY, THE GRAVITY ADJUSTMENT FACTORS LISTED IN THIS MAUAL ARE NOT LONGER VALID.

The gravity adjustment feaature is intended for out-of-the-box use where test weights may not be available. The gravity adjustment feature must not be used if the scale has been purchased for commercial use (legal-for-trade). **IF THE SCALE IS INTENDED FOR COMMERCIAL USE, CALIBRATION AT THE INSTALLATION SITE WITH CERTIFIED TEST WEIGHTS IS REQUIRED.**

NOTE: THE GRAVITY ADJUSTMENT CAN ONLY BE USED ONE TIME. AFTER THE INITIAL ENTRY, FURTHER ENTRIES ARE INVALID. IF ADDITIONAL ADJUSTMENT IS REQUIRED, CALIBRATION WILL BE NECESSARY.

To use the gravity adjustment feature:

1. Enable softswitch (SSW) 13 by first displaying [10 0]. Press the "TARE" key once to change the "0" (off state) to a "1" (on state), then press the "PRINT" key until SSW-13 is displayed [13 0]. When SSW-13 is displayed, press the "TARE" key to change the "0" to "1", then press "PRINT", [13 1].

2. Refer to Appendix A, Section 9, for the Gravity Factors Table to locate the adjustment factor value for your specific location. If your specific locationis not listed, use Appendix B for the Alternate Gravity Factors Table to approximate a suitable gravity factor value, based on your location's longitude and altitude.

3. Input the five digit gravity adjustment factor using the "TARE" key to toggle values for the flashing digit on the display, and the "SAMPLE" key to advance through the four remaining decade positions until the complete gravity adjustment value is displayed.

4. Next, press the "PRINT" key to accept the displayed value. The scale will adjust the preprogrammed calibration parameters accordingly.

5. OPERATING INSTRUCTIONS

5.1 POWER-UP SEQUENCE

When power is first applied to the Model 2038 (by pressing the ON/OFF key on the right side of the keyboard), all of the display segments will be visible momentarily for display verification before displaying weight data. If the weight is less than +/- 2% fo the capacity, zero is captured. If the weight is outside of +/- 2% of zero, and tare interlock (SSW-21) is off, the weight is displayed with the zero cursor flashing to indicate zero must be captured. If tare interlock (SSW-21) is on, and the weight display is blanked while the zero cursor is flashing, recalibration may be required.

5.2 OPERATING SEQUENCES

5.2.1 NET WEIGHING

1.1 Place empty container on the scale platter.

1.2 Press the “TARE” key - the weight will change to show zero net weight and the net weight indicator will illuminate.

1.3 Add load to the scale platter. The net weight will be displayed.

1.4 If the scale is interfaced to a printer or other external device, the weight data can be transmitted from the scale at this time by pressing the “PRINT” key.

5.2.2 PARTS COUNTING

2.1 Place empty container or carton on the scale platter.

2.2 Press the “TARE” key - the weight will change to show zero net weight and the net weight indicator will illuminate.

2.3 Press the “SAMPLE” key to display the reference sample quantity. If the fixed sample mode is selected, the preprogrammed fixed reference sample quantity will be displayed. The display will show a flashing asterisk along with the selected reference sample quantitiy [* 5}. The flashing asterisk is a prompt to add the required pieces to the scale platter.

If the variable sample mode is selected in the setup procedure, the required sample reference quantity can be changed by pressing the”SAMPLE” key until the desired value is displayed. The desired sample reference quantity must be selected while the scale is at net or gross zero.

2.4 Place the required sample on the scale and press the “SAMPLE” key. If the minimum sample requirement has not been met, the display will prompt the operator to add additional pieces. The astreisk will change to a slashing “Plus” symbol(+). when sampling very small pieces, the scale may prompt the operator more than once to add more weight (pieces) in order to accurately calculate the average pieces weight of the item being counted.

2.5 When the minimum sample reference requirement has been met, the asterisk (or + symbol) will stop flashing and the count will be displayed shortly after the “SAMPLE” key has been pressed. Add additional pieces as required until the desired count is displayed.

2.6 If the scale is interfaced to a printer, the count and weight data can be transmitted from the scale at this time by pressing the “PRINT” key.

6. RS232 SERIAL INPUT/OUTPUT

The Mdel 2038 RS232 Serial Port is a bidirectional port that is capable of receiving certain ASC11 characters as well as transmitting scale weight/count data. The EIA specifications for maximum data cable length using RS232 communications is 50 feet.

6.1 DATA OUTPUT

Data output for the Model 2038 is at the TxD RS232 data line on pin 3, and pin 5 (ground), on the 9 pin D-sub connector. The character format is one start bit, seven data bits, one even parity bit, and one stop bit. The data bits are in the ASC11 format. The transmission rate is selectable to either 300 or 9600 baud.

Data output occurs when the scale is in a no-motion condition and the “PRINT” key is pressed. During setup mode, the format is selectable as either single or multiple line printing.

The Model 2038 can transmit any or all of its fields on a single line, which can be selected in the setup mode. The data will always be sent in the following order for a single line format:

Gross - Tare - Net - APW - Pieces

When the multiple line format is selected, the data will always be sent in the following order:

Gross
Tare
Net
APW
Pieces

The net weight and piece count can also have the “SO” character added to indicate expanded print.

Using the single line format, the transmitted data will be sent as follows:

SXT	<GROSS>	SP	<TARE>	SP	SO	<NET>	SP	SI

<APW>	SP	SO	<COUNT>	SI	CR	CKSM	LF

Using the multiple line format, the transmitted data will be sent as follows:

STX	<GROSS>	CR	CKSM

LF	<TARE>	CR	CKSM

LF	SO	<NET>	SI	CR	CKSM

LF	<APW>	CR	CKSM

LF	SO	<COUNT>	SI	CR	CKSM	LF

The brackets < > are printed around the data fields when tare interlock,analog verify and metric mode is enabled. The descriptions for the abbreviations used are as follows:

STX	Start of Text Character
SP	Space Character

<GROSS> If Gross Weight print is enabled, the six digit (including decimal point) gross weight is printed followed by “lb” or “kg”.
<TARE> If tare print is enabled, the six digit (including decimal point) tare weight is printed, followed by “kg” or “lb” and “TR”.
<NET> If net weight print is enabled, the six digit (including decimal point) net weight is printed, followed by “LB” or “KG” and “NET”.
<APW> If APW print is enabled, the eight digit (including decimal point) APW is printed, followed by “kg’ or “lb” and “APW”.
<COUNT> If count print is enabled, a one to six digit count is printed, followed by “PCS”.
CR Carriage Return Character.
CKSM Optional Checksum Character.
LF Line Feed Character.
SO Optional Shift Out Character for expanded print.
SI Optional Shift In Character to end expanded print.

6.2 DATA INPUT

The Model 2038 is capable of receiving remote commands for Print (P), zero scale (Z), Tare (T), and clear scale (C). The commands are input to the scale via the RxD data line on pin 2 of the 9 pin Dsub connector. The only command to which the Model 2038 will return a response is the “P” print command.

The baud rate of the data input must be the same as what has been selected for the date output in the setup mode, and the Remote Input Enable Softswitch 43 must be set on ON (1). The format of the input data must be one start bit, 7 data bits, one even parity bit, and one stop bit. **The Input commands must be an UPPERCASE ASC11 character.**

The commands that can be remotely input are as follows:

COMMAND	DESCRIPTION
Z	Zero the scale if within +/- 2% of capacity from zero, when scale is in a no-motion condition and at gross zero.
T	Tare the scale to net zero.
P	Print Command. Sends displayed data back to host.
C	Clear the scale. Functions the same as pressing the “CLEAR” key on the scale keyboard.

NOTE: <CR> IS NOT REQUIRED AFTER THE INPUT COMMAND FOR THE MODEL 2038, BUT MAY BE USED IF NEEDED.

6.3 PIN CONNECTIONS FOR RS232 PORT

The pin connections for the 9 pin D-sub female connector used for the RS232 port are as follows:

2 - RxD Receive
3 - TxD Transmit
5 - Signal Ground

7. CARE AND MAINTENANCE

Periodically, clean the keyboard and covers with a soft clean cloth that has been dampened with a mild window type cleaner or detergent. DO NOT USE ANY TYPE OF INDUSTRIAL SOLVENT OR CHEMICALS. DO NOT SPRAY CLEANER DIRECTLY ONTO THE UNIT. DO NOT HOSE DOWN.

8. TROUBLESHOOTING

CAUTION! BEFORE CONNECTING/DISCONNECTING ANY INTERNAL ELECTRONIC COMPONENTS OR INTERCONNECTING WIRING BETWEEN ELECTRONIC EQUIPMENT ALWAYS REMOVE POWER AND WAIT AT LEAST THIRTY (30) SECONDS BEFORE ANY CONNECTIONS OR DISCONNECTIONS ARE MADE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN DAMAGE TO, OR DESTRUCTION OF, THE EQUIPMENT.

CAUTION

OBSERVE PRECAUTIONS FOR HANDLING ELECTRO STATIC SENSITIVE DEVICES

8.1 PROCEDURES

-- If operational difficulties are encountered, first obtain as much information as possible regarding the problem. Failures and malfunctions often may be traced to simple causes such as loose connections, low battery power, improper setup, etc.

-- If simple causes cannot be found, additional troubleshooting is best performed by substitution. A printed circuit board (PCB) or Digital Load Cell believed to be defective may be checked by replacing the suspect part with a known good part and then observing whether the problem is corrected.

-- To verify the problem was in the removed part, reinstall the original part and observe whether the problem returns. By doing this simple verification test, you will eliminate the possibility of having replaced a good part because of a loose or poor connection.

-- Consult Sexction 4.3 of this manual for proper programming. Do not automatically program a replacement PCB like the suspected faulty PCB. The original problem may have been caused by a programming error.

8.2 ERROR CODES

ERROR CODE	DESCRIPTION	CORRECTIVE MEASURES
E1	ROM ERROR	1. Remove power/wait 15 sec./ retry. 2. Check battery (or wall transformer) voltage/replace batteries/retry operation. 3. Replace Digital Load Cell.
E2	APPLICATION PROGRAM EEPROM ERROR	1. Remove power/wait 15 sec./retry. 2. Check battery (or wall transformer) voltage/replace batteries/retry operation. 3. Replace Digital Load Cell.
ERROR CODE	DESCRIPTION	CORRECTIVE MEASURES (CONTINUED)
E3	DLC NOVROM ERROR	1. Remove power/wait 15 sec./retry. 2. Check battery (or wall transformer)voltage/replace batteries/retry operation. 3. Perform Setup again. 4. Replace Digital Load Cell.
E8	DLC OUT OF RANGE	1. Check battery (or wall transformer) voltage/replace batteries/retry operation. 2. Check voltage to Load Cell. 3. Check for Mechanical Overload. 4. Replace Digital Load Cell.
E13	DLC EEPROM ERROR	1. Remove power/wait 15 sec./retry. 2. Check battery (or wall transformer) voltage/replace. 3. Replace Digital Load Cell.
E32	CALIBRATION ERROR OR BUILD ERROR	1. Recalibrate/Reconfigure SSW. 2. Replace Digital Load Cell.
AAAAAA	ANALOG VERIFY	Analog verify is on and active.
BLANK	BLANK DISPLAY	1. Check batteries/transformer. 2. If voltages are good, suspect faulty Display PCB.
DLC	Cal	1. Correction - Push white button on side (set up) power down and back up - this should get indicator going again.
E34	BAD ANALOG VERIFICATION CALCULATION	Recalibrate or replace cell.

8.3 VOLTAGE CHECKS

8.3.1 BATTERY VOLTAGE

Six 1.5 VDC D-cell alkaline batteries are required in the Model 2038 for proper operation (not: batteries are not required when using the wall transformer option). The six alkaline batteries are connected in series to provide a nominal 9 VDC at 33 mA (48 mA when Remote Command Input is enabled). Standard “flashlight” type batteries or rechargeable “nicad” batteries are not recommended for use in the Model 2038.

The acceptable voltage range for proper operation is between 7.5 VDC to 12.0 VDC. The "Battery-low" symbol will be visible on the display when the voltage of the batteries drops below the minimum level. When SSW-21 is ON (Tare Interlock), the display will blank and the battery low indicator will illuminate when the voltage is below the minimum requirement for sustained scale operation.

The actual voltage level of the batteries can be checked with a voltmeter between the battery terminals on the end of the battery holder.

8.3.2 WALL TRANSFORMER VOLTAGE

An optional wall transformer is available for the Model 2038 which converts standard 120 VAC/60 Hz input voltage to a nominal 12 VDC, at 500 mA, output to the scale. The unit will operate using the wall transformer with or without batteries installed in the unit, however discharged batteries should be removed from the scale. An internal switching circuit on the Display PCB automatically switches to the transformer when it is connected to the jack on the bottom of the scale base. This circuit works by switching to the higher voltage input to the scale, which normally will be the wall transformer. Not: the wall transformer does not charge the batteries.)

Low AC line voltage could cause the transformer voltage output to be lower than the battery voltage output. In this adverse condition, the switching circuit would then switch to battery input, providing batteries are installed and within the acceptable voltage range.

Altough the wall transformer output depends directly upon the AC line voltage it is connected to, typical output voltage to the scale will be between +12 VDC to +16 VDC. This voltage can be checked at the transformer jack on the scale base, or on the transformer output plug.

8.3.3 DISPLAY PCB VOLTAGES

Various input and output voltages can be checked at the Display PCB on PJ-1, located at the end of the PCB. Access to PJ-1 is gained by removing the top screw on the side of the display housing. The end cap can then be swiveled down, as shown in Figure 8. A Diagram of connector J-1 on the Display PCB is shown in Figure 9.

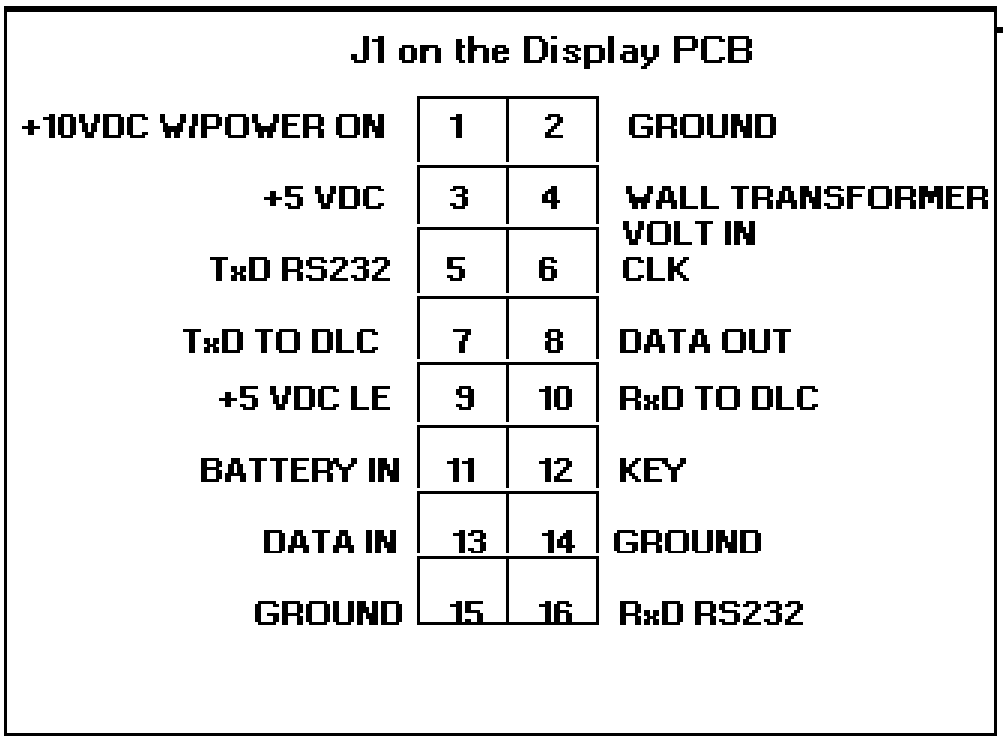


Figure 9

9. PARTS REPLACEMENT AND ADJUSTMENTS

9.1 KEYBOARD REPLACEMENT

The six position switch membrane keyboard is positioned in a slot on the front of the display housing, and is held in place by an adhesive backed overlay. First remove power to the unit by disconnecting the battery connector on the battery holder and/or unplugging the AC wall transformer if used.

To remove the keyboard and overlay, first disconnect the keyboard connector on the Display PCB. Peel the overlay from the display housing. The switch membrane can then be removed. Clean off any remaining adhesive on the housing by rubbing the adhesive into a “ball” with your finger. It can then be pulled off from the housing. Next, remove the spacer next to the tail access hole.

To install the new keyboard components, first position the switch membrane in the slot, and feed the tail through the hole at the end of the slot. Next, install the new spacer which is adhesive backed. Carefully position the overlay on the housing. when positioned correctly, apply pressure on the overlay with your fingers, especially on the edges to secure it to the housing. Do not use excessive pressure on the key positions.

9.2 DISPLAY PCB REPLACEMENT

The Display PCB is retained in slots on the top and bottom of the display housing. To remove the Display PCB, first remove power to the unit by disconnecting the battery connector at the end of the battery holder, and/or unplugging the wall transformer if used.

After power to the unit has been disconnected, remove both end caps from the display housing. Next unplug the Load Cell Harness at J1, the keyboard connector, and the Ground connector on the Display PCB. The Display PCB may now be slid out of the housing to the left (looking at the Display from the front). Reverse the previous steps to install the new Display PCB.

9.3 DIGITAL LOAD CELL REPLACEMENT

CAUTION: BEFORE CONNECTING OR DISCONNECTING THE LOAD CELL HARNESS, REMOVE POWER AND WAIT A MINIMUM OF 30 SECONDS. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN DAMAGE TO THE LOAD CELL.

The digital load cell is secured to the top and bottom frame by two hex head bolts on the 2038-0001, and by three hex head bolts on the 2038-0002. To replace the load cell follow these steps:

1. Remove the scale platter and remove power to the unit by disconnecting the battery connector on the battery holder, and/or unplugging the AC wall transformer. After waiting a minimum of 30 secoonds, disconnect the load cell harness from the load cell.

2. Loosen and remove the top load cell mounting bolts that secure the top frame to the load cell. Set the top frame and load cell spacer aside.

3. Remove the bottom load cell mounting bolts. The load cell assembly can now be removed from the lower base.

4. When reinstalling a digital load cell, reverse the preceeding steps. Be sure to lubricate the threads and the head of the hex bolts. Using a torque wrench, tighten the 2038-0001 bolts to 18 ft/lb. Use only Toledo Scale parts to replace damaged or lost bolts, nuts, or washers.

5. After replacing a load cell, the overload stop settings must be checked and adjusted (if needed). Refer to Section 4 for Overload Stop adjustments.

6. Before applying power to the indicator, first connect the load cell harness to the load cell connector. If the load cell assembly was replaced, calibration with test weights will be required. Refer to Section 4.4 calibration procedure.

9.4 OVERLOAD STOP ADJUSTMENTS

The overload stop gaps must be checked and reset if the top or bottom frame or load cell is replaced. Refer to Figure 11 for the location of the overload stops and Table A for the gap settings per Factory Number. To set the gaps, remove the platter and the four platter supports from the top frame. Apply sufficient weight to the top frame to approximately zero the scale. Loosen the jam nuts, then using the proper size gap guage in the gap, turn the set screw at each corner until a slight drag is felt. Tighten the jam nuts after adjustment and recheck the gap. Re-Install the platter supports and the platter, then check scale operation.

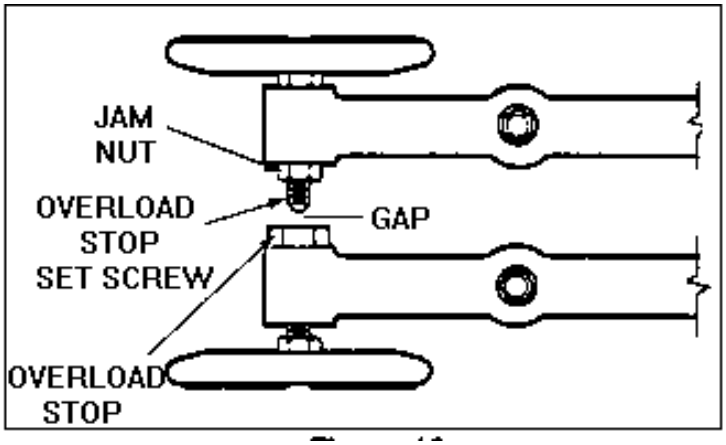


Figure 10

OVERLOAD STOP LOCATIONS

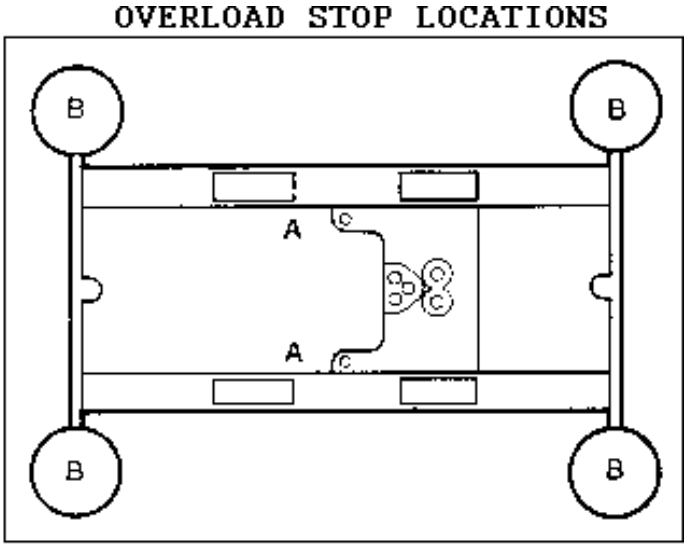


Figure 11

TABLE A

Position	2038-0001 Overload Gap In Inches	2038-0002 Overload Gap In Inches
A	0.036	0.043
B	0.198	0.247

9.4 SHIFT TEST

A shift test verifies that all sections of the scale platter weigh within tolerance. If the 2038 does not pass the shift test, verify overload stop settings before replacing the load cell. No adjustment for shift is possible.

Place test weights equal to one-half scale capacity sequentially at each of the positions A, B, C, and D, as shown in figure 12. Note the indicator reading at each position.

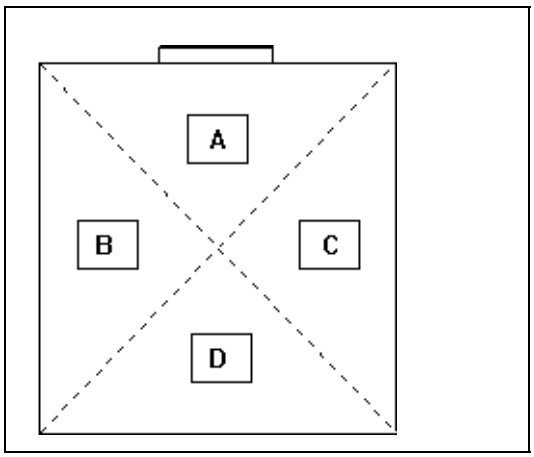


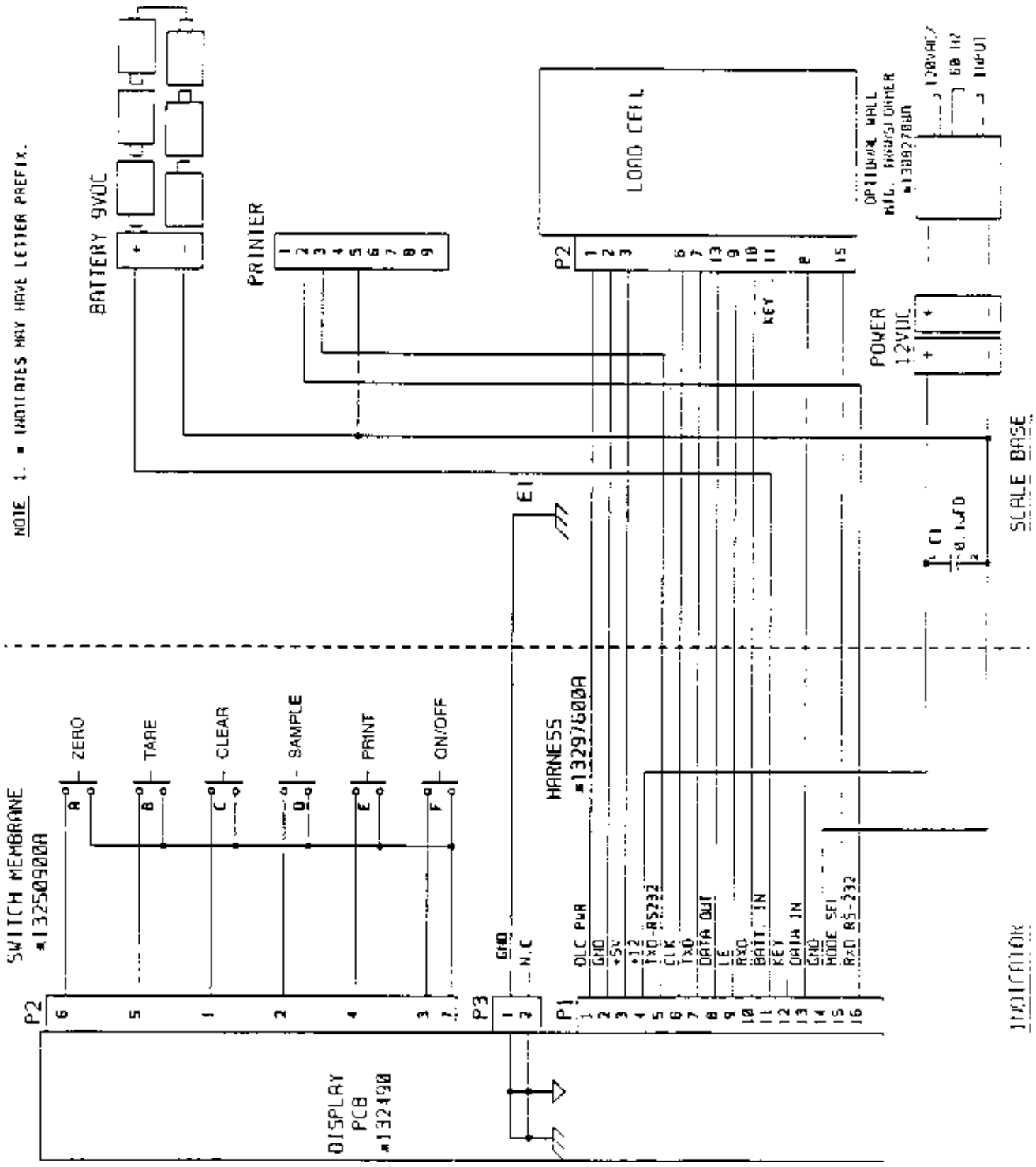
Figure 12

Positions A, B, C and D, are centered halfway between the center and the edges of the scale platter. The following table shows the tolerances in d (divisions) for the shift test.

TOLERANCE TABLE FOR SHIFT TEST

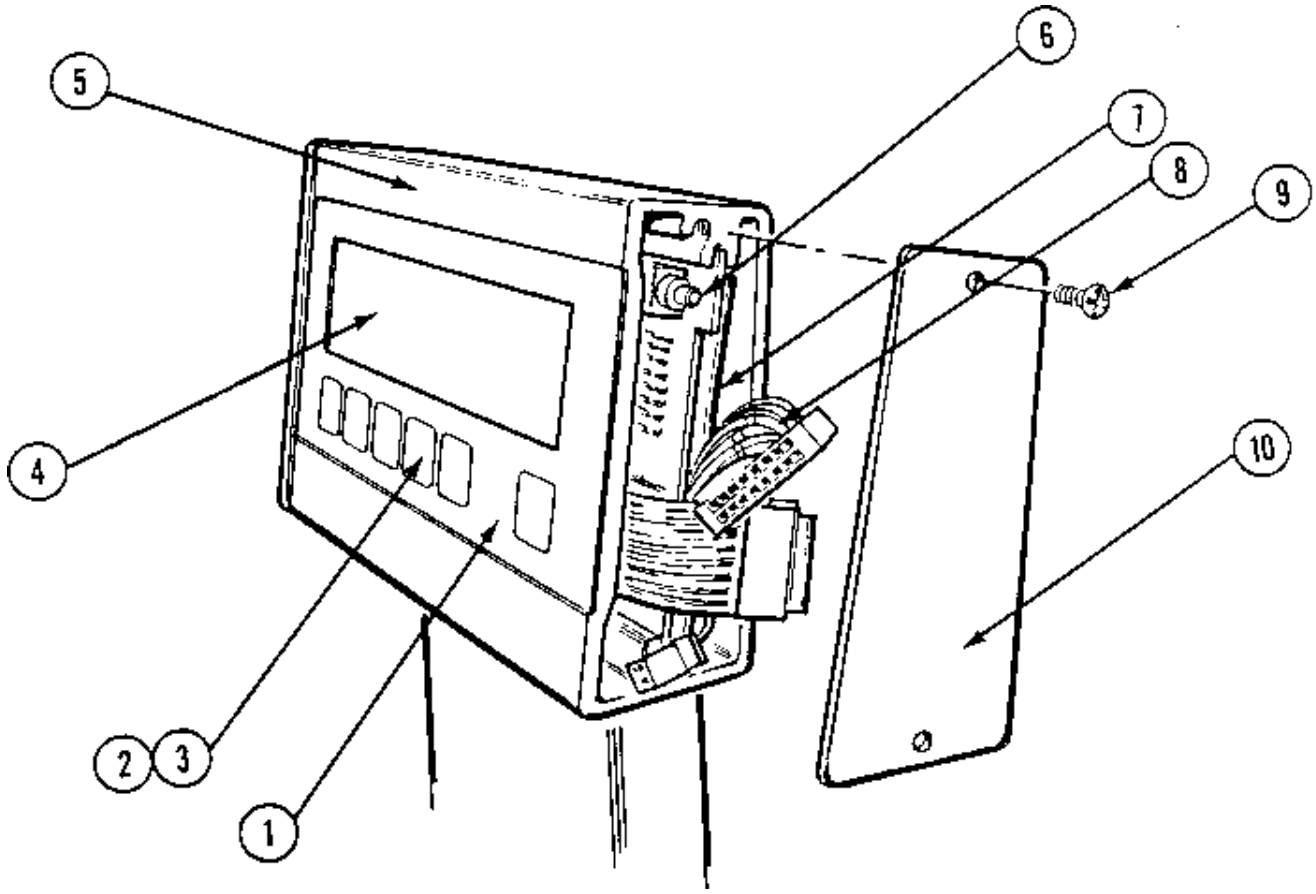
Scale Capacity	Test Weight	Acceptance (New Scale) Tolerance	Maintenance (In Service) Tolerance
5,000 d	2,500 d	+/- 1.5 d	**+/-** 3 d
3,000 d	1,500 d	+/- 1.0 d	+/- 2 d

10. SCHEMATIC DIAGRAM



11. REPLACEMENT PARTS

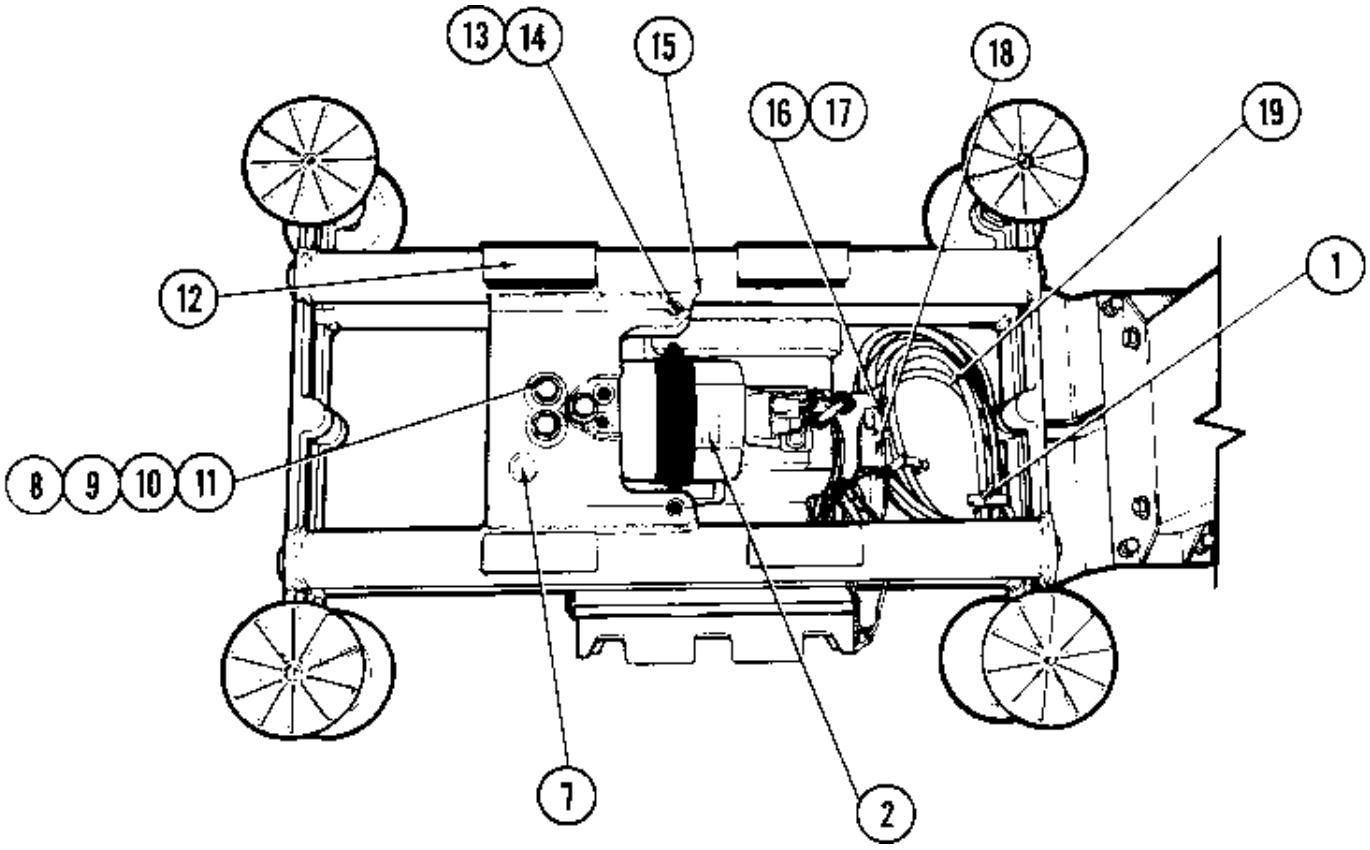
DISPLAY HOUSING

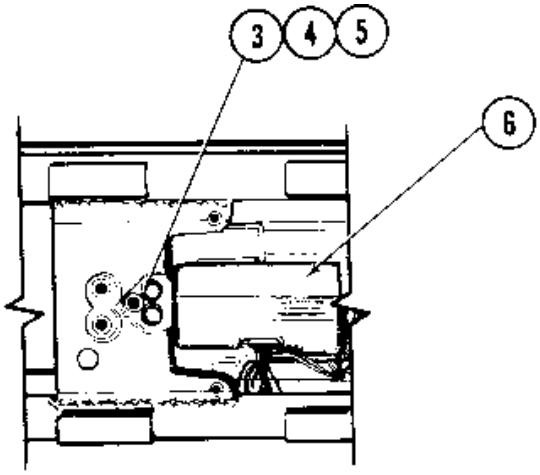


REF	PART NUMBER	DESCRIPTION	QTY
1	13250800A	KEYBOARD OVERLAY	1
2	A13250900A	KEYBOARD SWITCH MEMBRANE, 1 X 6 (N.S.)	1
3	13298400A	SPACER, SWITCH MEMBRANE LAYER (N.S.)	1
4	13250700A	LENS, DISPLAY	1
5	1325000A	HOUSING, DISPLAY	1
6	A13249000A	PCB ASSEMBLY, DISPLAY	1
7	13368100A	INSULATOR, PCB	1
8	C13297600A	HARNESS ASSEMBLY, INTERCONNECT	1
9	R0387200A	SCREW, 8 - 32 X 3/8” TRUSS	4
10	13250400A	END CAP	2

N.S. = NOT SHOWN

2038 BASE LOAD CELL



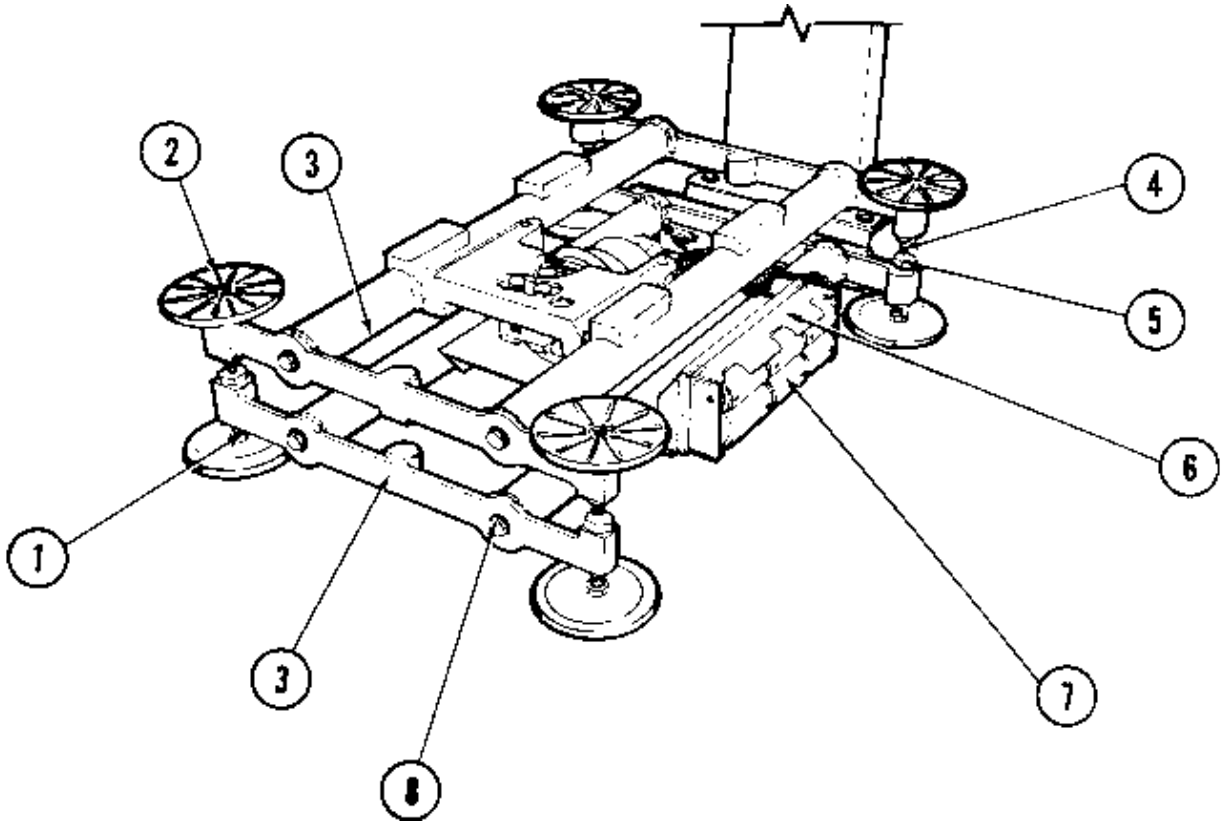


2038-0001 140 KG.
LOAD CELL

2038 BASE LOAD CELL

REF	PART NUMBER	DESCRIPTION	QTY
1	13342900A	WIRE CLIP, SNAP IN	2
2	A13068200A	LOAD CELL, GP/SS/300 KG DIGITAL 2038-0002 (SEE NOTE FOR -0001)	1
3	13299300A	SPACER, 140 KG L/C (2038-0001)	2
4	R0390900A	WASHER, FLAT .344 ID, CS (2038-0001)	4
5	R0392200A	SCREW, CAP 5/16-18 X 1.25 (2038-0001)	4
6	B13258900A	LOAD CELL, GP/140 KG DIGITAL 2038-0001 ONLY	1
7	10268900A	LEVEL BUBBLE	1
8	R0389600A	NUT, HEX 3/8-24 CS (2038-0002)	6
9	R0389800A	WASHER, FLAT .406 ID/CS (2038-0002)	6
10	R0390200A	SCREW, HEX 3/8-24 X 2 CS (2038-0002)	6
11	13299400A	SPACER, 300 KG L/C (2038-0002)	2
12	13253900A	PLATTER PAD,CENTER	4
13	A13305500A	SETSCREW, INSIDE	2
14	009131050	NUT	2
15	A123299000A	OVERLOAD STOP,INSIDE	2
16	10856800A	SCREWLOCK ASSEMBLY	1
17	11867000A	CONNECTOR,DE-9 FEMALE 9 PIN	1
18	13271700A	CONNECTOR, JACK, WALL TRANSFORMER	1
19	C13297600A	INTERCONNECT HARNESS ASSEMBLY	1

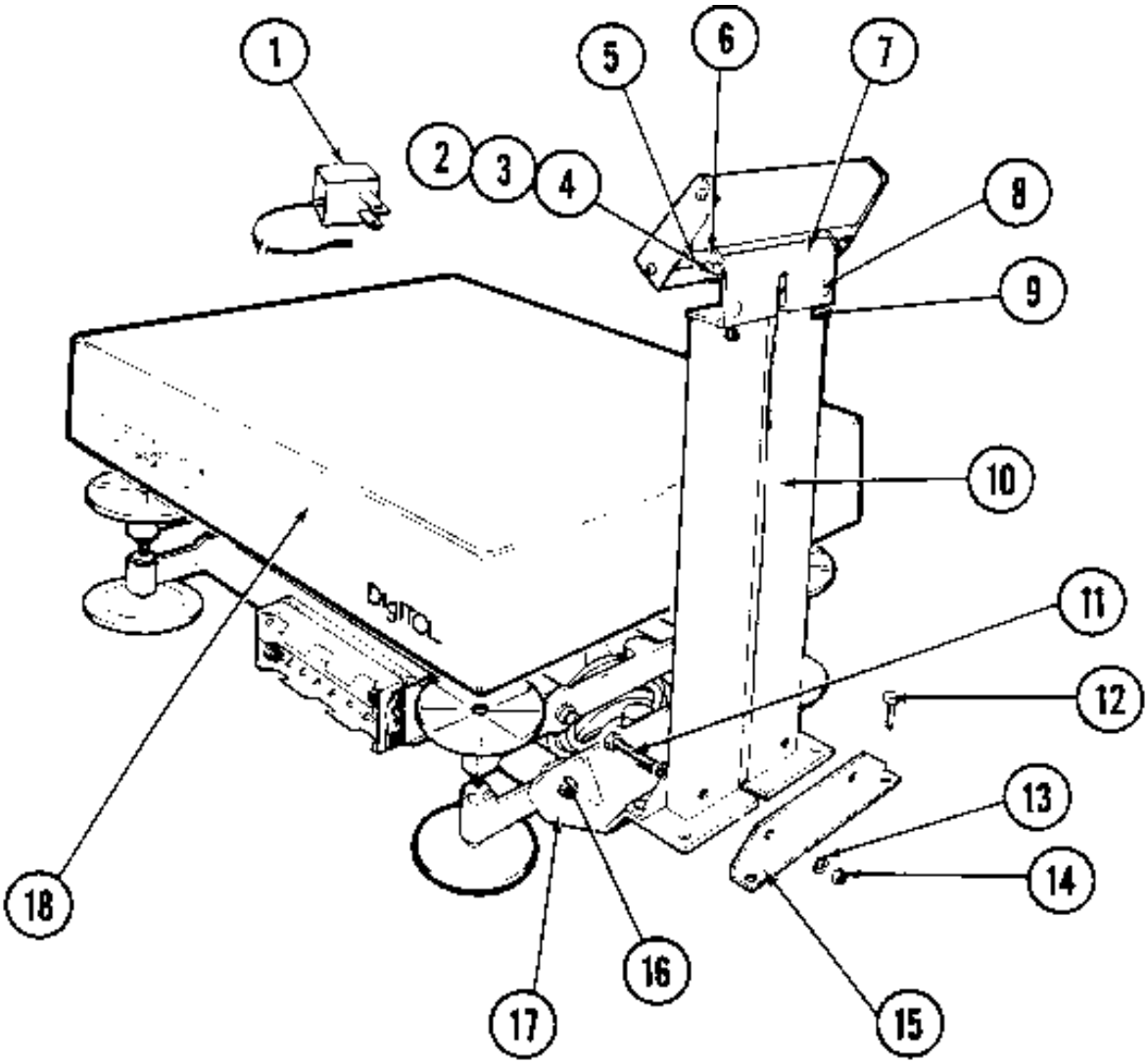
2038 BASE FRAME



REF	PART NUMBER	DESCRIPTION	QTY
1	009131050	NUT, 3/8-24 CS	12
2	A13254100A	FOOT/PLATTER PAD	8
3	13071700A	FRAME	2
4	13258600A	SETSCREW, OUTSIDE	4
5	13257800A	OVERLOAD STOP,OUTSIDE	4
6	13257500A	BATTRY HOLDER	1
*7	13293700A	BATTERY, 1.5VDC ALKALINE	6
8	R0392700A	SCREW, CAP 3/8-16 X 1/2	6

* Expendable Item - Not covered by standard product warranty.

2038 EXTERIOR



REF	PART NUMBER	DESCRIPTION	QTY

1	13082700A	WALL TRANSFORMER, 120VAC/12VDC	1
2	13250500A	SHOULDER SCREW 10-32	2
3	R0387300A	SPRINT WASHER, .265 I.D.	2
4	13249900A	PIVOT WASHER,NEOPRENE	2
5	R0387200A	SCREW,8-32 X 3/8” TRUSS	2
6	13250600A	BRACKET,PIVOT ANGLE	2
7	13250100A	INDICATOR SUPPORT	1
8	R0391100A	HOLE PLUG, BLACK 5/16”	2
9	R0354400A	SCREW, CAP 10-32 X 1”	2
10	13250200A	COLUMN, INDICATOR MOUNTING	1
11	R0394600A	SCREW, CAP 1/4-20 X 1-3/4”	2
12	R0275900A	SCREW, CAP 1/4-20 X 3/4”	4
13	R0394500A	WASHER, SPLIT LOCK 1/4”	6
14	R0394400A	NUT, HEX 1/4-20	6
15	13253500A	ANGLE, COLUMN MOUNTING	2
16	R0276200A	SCREW, CAP 3/8 - 16 X 1	2
17	1333300A	BRACKET, COLUMN MOUNTING	1
18	13254800A	PLATTER	1

OPTIONAL ACCESSORIES

PART NUMBER	DESCRIPTION	FACTORY NUMBER
13304500A	ADJUSTABLE HEIGHT STAND	0924-0036
13330400A	CASTERS FOR STAND KOP	0924-0019
13304400A	WALL MOUNT TRANSFORMER KOP	0901-0266

12. APPENDICES

12.1 APPENDIX

GRAVITY ADJUSTMENT TABLE FOR SPECIFIC LOCATIONS

The five-digit factors listed below are provided for calibration adjustment on the Model 2038. Refer to Section 4.5 to determine if this feature applies to your situation and/or for details regarding procedure.

WORLD CITIES (Listed alphabetically)

Amsterdam Netherlands	0.9984
Athens Greece	0.9997
Auckland New Zealand	0.9997
Bangkok Thailand	1.0013
Beijing PRC	0.9996
Bogota Colombia	1.0025
Bombay India	1.0011
Bridgetown Barbados	1.0014
Brussels Belgium	0.9985
Bucharest Romania	0.9991
Budapest Hungary	0.9989
Buenos Aires Argentina	0.9999
Cairo Egypt	1.0003
Cartacas Venezuela	1.0015
Cologne West Germany	0.9985
Colombo Sri Lanka	1.0016
Copenhagen Denmark	0.9980
Dublin Ireland	0.9982
Frankfurt West Germany	0.9986
Gibraltar	0.9998
Guayaquil Ecuador	1.0016
Hamburg West Germany	0.9983
Hamilton Bermuda	NR
Helsinki Finland	0.9977
Istanbul Turkey	0.9994
Jakarta Indonesia	1.0016
Jiddah Saudi Arabia	1.0012
Johannesburg South Africa	1.0012
Kingston Jamaica	1.0011
Kuala Lumpur Malaysia	1.0016
London England	0.9985
Lyon France	0.9990
Madrid Spain	0.9997
Managua Nicaragua	1.0014
Marseille France	0.9992
Manila Philippines	1.0013
Melbourne Australia	0.9997
Mexico City Mexico	1.0018
Milan Italy	0.9990
Montevideo Uruguay	NR
Moscow USSR	0.9990
Munich West Germany	0.9989
Naples Italy	0.9994
Nassau Bahamas	1.0007
New Delhi India	1.0006
Oslo Norway	0.9977
Pago Pago American Samoa	1.0014
Panama City Panama	1.0015
Paris France	0.9987
Port of Spain Trinidad	1.0015
Prague Czechoslovakia	0.9986
Reykjavik Iceland	0.9974
Rio De Janeiro Brazil	1.0008
Rome Italy	0.9993
Rosario Argentina	NR
San Jose Costa Rica	1.0015
San Juan Puerto Rico	1.0011
San Salvador El Salvador	1.0013
Santiago Chile	1.0002
Santo Domingo DR	1.0011
Sao Paulo Brazil	1.0010
Seoul Korea	0.9997
Shanghai PRC	NR
Singapore	1.0016
Stockholm Sweden	0.9978
Sydney Australia	NR
Taipei Taiwan	1.0007
Tangier Morocco	0.9998
Tegucigalpa Honduras	1.0013
Tel Aviv Jaffa Israel	1.0002
Tokyo Japan	NR
Victoria Hong Kong	1.0009
Vienna Austria	0.9988
Warsaw Poland	0.9984
Yokahama Japan	0.9999
Zurich Switzerland	0.9990

NR - No Adjustment Required

U.S.A. (States Listed Alphabetically)

Alabama	1.0002
Alaska	0.9976
Phoenix AZ	NR
Tucson AZ	1.0004
Arkansas	NR
Los Angeles CA	NR
Sacramento CA	0.9996
San Diego CA	NR
San Francisco CA	0.9997
Colorado	NR
Connecticut	0.9994
Delaware	0.9995
Washington DC	0.9996
Miami FL	1.0004
Orlando FL	1.0007
Georgia	1.0002
Hawaii	1.0010
Idaho	0.9994
Illinois	0.9995
Indiana	0.9995
Iowa	0.9994
Kansas	0.9996
Kentucky	0.9997
Louisiana	1.0003
Maine	0.9991
Maryland	0.9995
Massachusetts	0.9993
Michigan	0.9993
Duluth MN	0.9989
Minneapolis MN	0.9991
Mississippi	1.0002
Missouri	0.9997
Montana	0.9997
Nebraska	0.9995
Nevada	NR
New Hampshire	0.9992
New Jersey	0.9994
New Mexico	1.0005
New York	0.9992
North Carolina	NR
North Dakota	0.9989
Ohio	0.9995
Oklahoma	NR
Oregon	0.9990
Pennsylvania	0.9995
Rhode Island	0.9993
South Carolina	NR
South Dakota	0.9993
Tennessee	NR
Dallas TX	NR
Houston TX	1.0004
Utah	0.9998
Virginia	0.9995
West Virginia	0.9995
Washington	0.9988
Wisconsin	0.9992
Wyoming	0.9998

CANADA (Cities Listed Alphabetically)

Calgary	0.9998
Edmonton	0.9984
Halifax	0.9990
Montreal	0.9990
Quebec City	0.9989
Saskatoon	0.9985
Sydney	0.9989
Toronto	0.9992
Vancouver	0.9986
Windsor	0.9993
Winnepeg	0.9986

NR - No Adjustment Required

12.2 APPENDIX

ALTERNATE GRAVITY FACTORS TABLE FOR LATITUDE/ALTITUDE

For locations not listed in Appendix A, use the following table to determine the gravity adjustment factor based on the specific location's longitude and altitude. Refer to Section 4.5 for details on using this adjustment factor.

Gravity Table for Feet/Meters of Altitude and Degrees Latitude
Valid Only for Scales Calibrated at Spartanburg, SC, USA

Degrees Latitude	Altitude above sea level in meters						
	0 to 650	650 to 1300	1300 to 1950	1950 to 2600	2600 to 3250	3250 to 3900	3900 to 4550
	Altitude above sea level in feet						
	0 to 2132	2132 to 4264	4264 to 6393	6396 to 8528	8528 to 10660	10660 to 12792	12792 to 14924
0.0 TO 12.9	1.0016	1.0018	1.0020	1.0022	1.0024	1.0026	1.0028
12.9 TO 18.4	1.0014	1.0016	1.0018	1.0021	1.0022	1.0024	1.0026
18.4 TO 22.8	1.0011	1.0013	1.0015	1.0017	1.0017	1.0021	1.0023
22.8 TO 26.6	1.0008	1.0010	1.0012	1.0014	1.0016	1.0019	1.0021
26.6 TO 30.0	1.0006	1.0008	1.0010	1.0012	1.0014	1.0016	1.0018
30.0 TO 33.2	1.0003	1.0005	1.0007	1.0009	1.0011	1.0013	1.0015
33.2 TO 36.3	N/A	1.0002	1.0004	1.0006	1.0009	1.0011	1.0013
36.3 TO 39.2	0.9998	N/A	1.0002	1.0004	1.0006	1.0008	1.0010
39.2 TO 42.1	0.9995	0.9997	N/A	N/A	1.0003	1.0005	1.0007
42.1 TO 45.0	0.9992	0.9994	0.9997	N/A	N/A	1.0003	1.0005
45.0 TO 47.8	0.9990	0.9992	0.9994	0.9996	0.9998	N/A	1.0002
47.8 TO 50.8	0.9987	0.9989	0.9991	0.9993	0.9995	0.9997	N/A
50.8 TO 53.7	0.9985	0.9987	0.9989	0.9991	0.9993	0.9995	0.9997
53.7 TO 56.8	0.9982	0.9984	0.9986	0.9988	0.9990	0.9992	0.9994
56.8 TO 60.0	0.9979	0.9981	0.9983	0.9985	0.9987	0.9989	0.9991
60.0 TO 63.4	0.9977	0.9979	0.9981	0.9983	0.9985	0.9987	0.9989
63.4 TO 67.2	0.9974	0.9976	0.9978	0.9980	0.9982	0.9984	0.9986
67.2 TO 71.6	0.9971	0.9973	0.9975	0.9977	0.9980	0.9982	0.9984
71.6 TO 77.1	0.9969	0.9971	0.9973	0.9975	0.9977	0.9979	0.9981
77.1 TO 90.0	0.9966	0.9968	0.9970	0.9972	0.9974	0.9976	0.9978

N/A - No Adjustment Required