9410

High Speed Junction Box for OEM Applications

Operators Manual

METTLER TOLEDO

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1.0 GENERAL DESCRIPTION

The Mettler-Toledo, Inc. Model 9410 High Speed Junction Box is intended for use with In-Motion Conveyor Weighing Systems utilizing strain gauge load cells. The 9410 performs high speed A/D conversion with filtering and outputs the weight data on demand to a host controller and display.

The Model 9410 display indicator is a digital indicator suitable for industrial use. It is designed to communicate digital information serially with the 9410 high speed junction box. The display receives and displays weight data and provides all required setup and calibration functions. A 7 digit vacuum florescent display will display lb and kg weight symbols. The desk and wall mount enclosure styles mean the display can be used in virtually any non-hazardous industrial environment. The dust-tight and splash-proof metal desk enclosure exceeds NEMA 12 requirements and meets European IP-65 standards. The wall-mount enclosure is stainless steel and meets the NEMA 4X requirements. Both enclosure styles are available for use in desk top, wall, or column mounting.

Features:

- Supports the use of 1, 2, or 4 load cell systems.
- Host Serial Port operating at RS422 four wire and three wire RS232 to 38.4k baud. Full control of the 9410 is through this port.
- Display for local calibration and functional control.
- Powered from a single 120VAC power source.
- Accommodates reduced excitation for hazardous area applications using the HAP module.
- Packaged in Stainless Steel Nema 4X type enclosures with cord grip connectors for cable entry.
- Power up zero capture selectable from 0, 2, 10, or 20% of scale capacity.
- Auto zero capture through a command from the Serial port to allow capturing 6, 14, 24, 54, or 104 minor increments at a time up to 0, 2, 10, or 20% of capacity.
- Digital filtering selectable through the display allowing adjustable corner frequencies from 10 HZ to 0.5 HZ.
- Digital shift adjust and calibration performed through the 9410 Display.
- The initial can range up to 80% of full scale with a span resolution of 100,000 minor increments.

2.0 SPECIFICATIONS

2.1 Electrical and Physical Specifications

2.1.1 Environment

The model 9410 and display will operate over a temperature range from -10 C (14 F) to 40 C (104 F) at 10 to 95% relative humidity, non-condensing. Zero temperature coefficient is 0.5 uV/degree C maximum per channel. Span temperature coefficient is 12 PPM/degree C maximum.

2.1.2 Power Requirements

The 9410 and Display operate at 120 VAC (+10%, -15%) 50/60 Hz. Power consumption is approximately 25VA.

The 9410 system requires a true earth ground for reliable operation. To test the quality of the earth ground, measure the AC voltage between neutral and ground at the AC outlet. If the neutral to ground voltage is greater than 0.3 VAC then the ground connection is inadequate and must be corrected before connecting the 9410.

The power line for the 9410 must not be shared with equipment that generates line noise (such as motors, relays, heaters, etc.). If adverse power conditions exist, a dedicated power circuit or power line conditioner may be required.

2.1.3 FCC Regulations

The 9410 meets or exceeds the FCC conducted and radiated emissions requirements.

2.1.4 RFI Specifications

The 9410 has been designed to greatly reduce susceptibility to Radio Frequency Interference if installed per the drawings supplied with the equipment.

2.1.5 Appearance and Dimensions

The 9410 junction box is packaged in a Stainless Steel Nema 4X enclosure. The enclosure is 2.64" deep, 12.00" wide, and 11.25" high. The unit weighs 5 lb.

Below are the general dimensions of the enclosure. Note the rear entry of the load cell cables that must be considered when mounting.

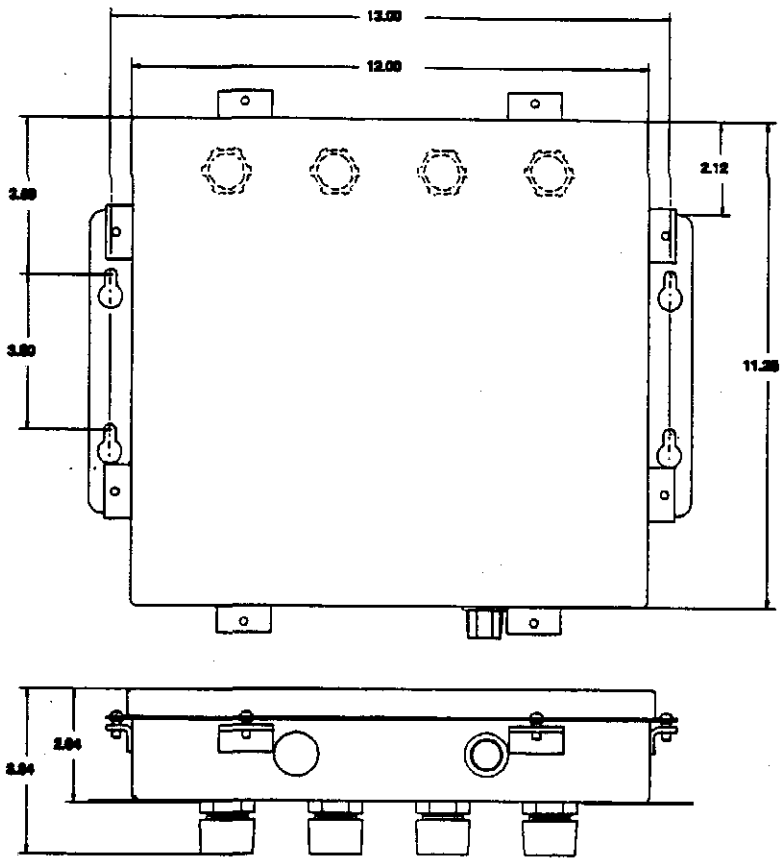


FIGURE 2.2

The model 9410 display desk version is charcoal black aluminum with a multi-color keyboard. The unit is 6.0" high, 6.3" deep and 9.5" wide. An additional 2" is required at the left end of the enclosure for cable attachments. This version of the 9410 display weighs approximately 5 pounds. The wall enclosure is brushed stainless steel with a multi-color keyboard. The enclosure is approximately 11" tall, 14.2" wide and 5.5" deep. An additional 2" is required at the bottom of the enclosure for cable attachments. This version of the 9410 display weighs approximately 14.8 pounds.

3.0 Installation and setup

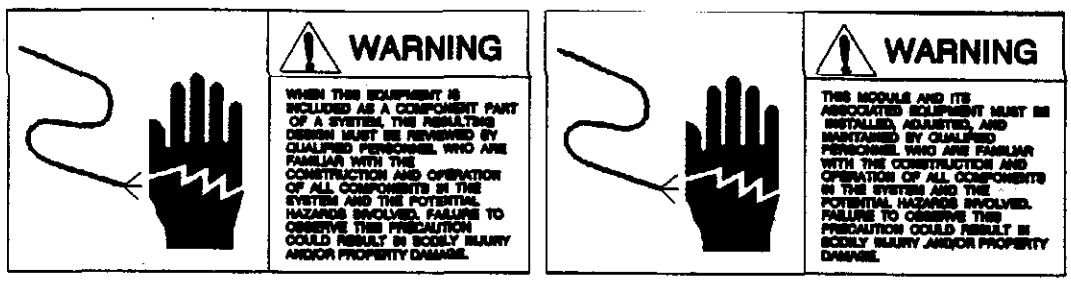
The following sections describe the hardware configuration and setup of the 9410.

3.1 Preliminary Inspection

Inspect the shipping container(s) and scale for loose or damaged parts. If any damage is found, immediately notify the freight carrier.

Open the enclosures and verify that all internal harnesses and components are securely fastened.

3.2 External Wiring Installation Recommendations



The following are general installation recommendations only, refer to the wiring diagrams supplied for detailed wiring(See Section 11.7).

1. 120 VAC, 60 Hertz or 230VAC, 50 Hertz, isolated, regulated power source to be furnished by others. Mettler Toledo recommends the use of a computer grade isolated transformer. The transformer shall be sized such that at least 50-70% of the VA rating will be drawn at minimum load.

2. Unless otherwise specified, all external wiring must be in steel conduit.

3. All external AC power and control lines must be in separate conduit from other external control and logic wiring.

4. All conduit shall enter the enclosure through insulated bushings.

5. Mettler Toledo recommends all wires and/or cables be tagged for future identification.

6. All electrical wiring to conform to appropriate national and local area electrical codes for this type of installation.

3.3 Preliminary Calculations

The scale system as supplied by Mettler Toledo is designed for use at a specific scale build. If another build is desired or the 9410 is being used with an existing system then the microvolts per increment must be calculated to verify that the scale build desired(increment size and total number of increments) is attainable with the scale base to be used.

3.3.1 Microvolts per Increment Calculation

Use the following formula to calculate microvolts per increment.

$$\text{Microvolt/increment} = \frac{I * V * O * 1000}{C * R}$$

I - Increment size desired: Increment size, scale capacity and load cell capacity must all be measured in the same weight units, lb or kg. If units are different then multiply kg units by 0.45359 to convert to lb units for the purposes of this calculation.

V - Excitation Voltage: Normal 9410 excitation voltage is 15 VDC. Hazardous area applications will have an excitation voltage of 5 VDC.

O - Load cell output rating in mV/V (millivolts per volt of excitation): The load cell output is normally marked on the load cell. Toledo load cells are typically 2 mV/V. Other types can range from 1 mV/V to 4.5 mV/V.

C - Load cell capacity as marked on the load cell.

R - Total number of load cells.

3.3.2 Total Increments Calculation

The total number of increments is calculated by dividing the desired scale capacity by the increment size.

3.3.3 Minimum Weigh Time Calculation

The minimum weigh time is the minimum amount of time a single product will be fully on the scale. The following will give the minimum weigh time in seconds.

$$\text{Min. Weigh Time} = \frac{(C - P) * 5}{F}$$

C - Conveyor length: Distance between the entrance photoeye and the exit photoeye of the weigh conveyor in inches.

P - Package length: The length of the longest package to be weighed on the scale in inches.

F - Conveyor speed: The speed the conveyor is conveying packages across the scale in feet per minute.

NOTE: Select the next lower value in .1 second increments for filter settle time selection.

3.3.4 Microvolt Build Table

The microvolt build in the 9410 is based on the Weigh Time(Filter Settle Time) selected in scale setup.

Minimum Weigh Time (Filter Settle Time)	Minimum microvolt per increment
less than .5 sec.	0.64
.5 - .8 sec.	0.38
greater than .8 sec.	0.29

The following example refers to a normal scale conveyor installation:

Scale Capacity	150 lb
Increment Size	.05 lb
Load Cell Capacity	250 lb
Number of Cells	4
Cell Output	2 mV/V
Excitation Voltage	15 VDC
Conveyor Speed	240 ft./min.
Conveyor Length	48 in.
Max. Package Length	30 in.

First, divide the scale capacity by the increment size to determine the total number of increments.

$$\frac{150 \text{ lb}}{0.05 \text{ lb}} = 3000 \text{ increments}$$

If this value is 10,000 or less, the capacity and increment size is acceptable. The 9410 will not allow total increments of greater than 10,000.

Next, use the formula from section 3.3.3 to calculate our expected minimum weigh time(filter settle time).

$$\frac{(48 \text{ in} - 30 \text{ in}) * 5}{240 \text{ ft/min}} = .375 \text{ seconds} = .3 \text{ seconds}$$

With the calculated minimum weigh time we can look in the microvolt build table and find the minimum microvolt per increment is 0.64.

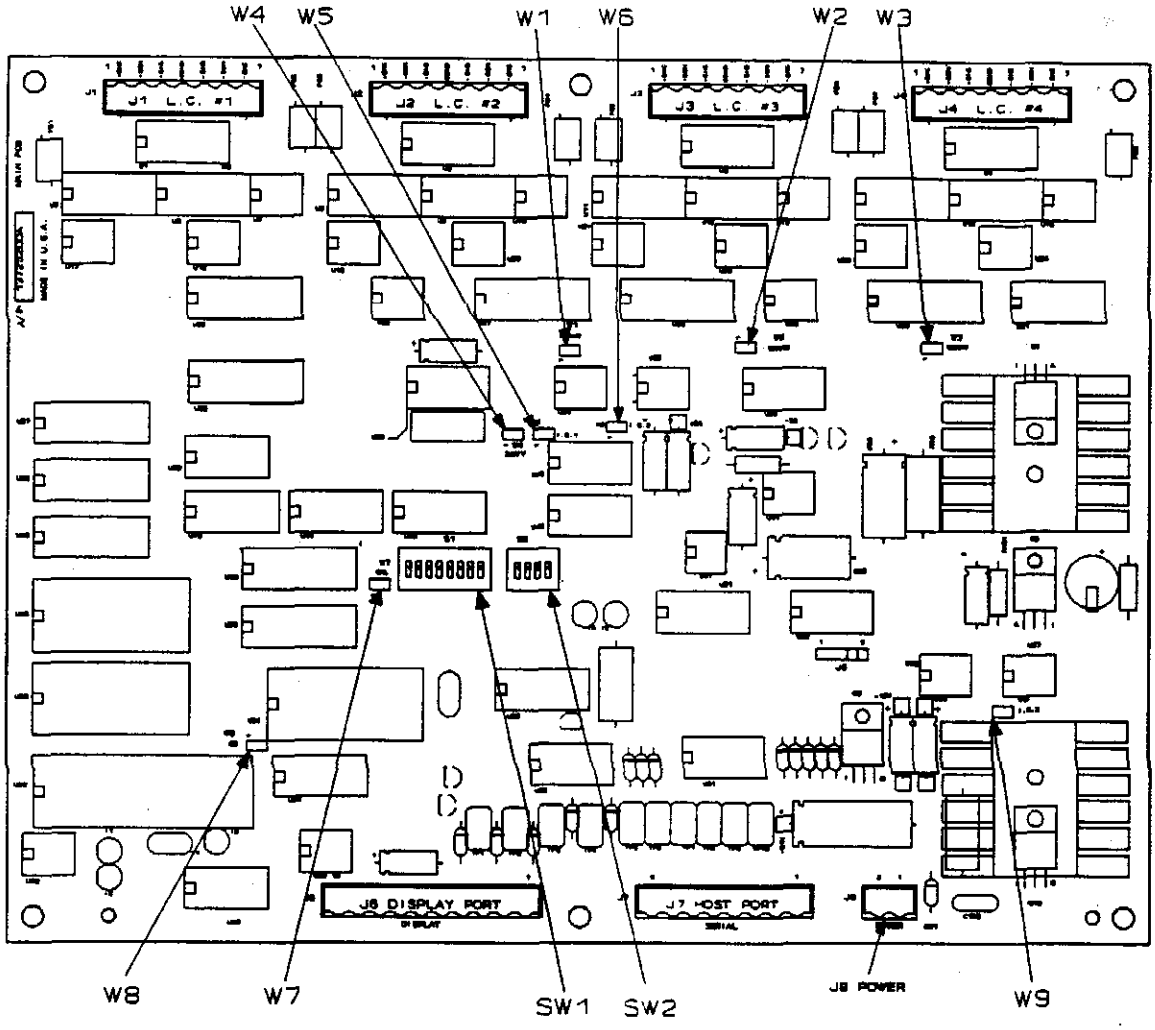
Next, use the formula in step 3.3.1 to calculate our microvolt per increment.

$$\frac{.05 \text{ lb} * 15 \text{ VDC} * 2 \text{ mV/V} * 1000}{250 \text{ lb} * 4 \text{ load cells}} = 1.5 \ \mu\text{v per incr.}$$

This build is greater than .64, so it is acceptable.

3.4 Circuit Board Layout

The drawing below shows the location of all PCB jumpers, connectors, and switches on the 9410 Junction Box. The jumper definitions are on the following page.



Jumper Definitions:

W1 - Load Cell 2 Enable - Must be installed.

W2 - Load Cell 3 Enable - Must be installed.

W3 - Load Cell 4 Enable - Must be installed.

W4 - 3 mV/V Load Cell Output Enable - Remove for 2 mV/V load cell use. Install for 3 mV/V load cell use.

W5,W6 - Intrinsically Safe Compensation
These jumpers are to be used in conjunction with W9 for the Mettler Toledo HAP module. Remove for normal use. Install if the HAP module is connected.

W7 - Calibration Enable
This jumper allows access to the 9410 calibration by the 9410 display. Install to access calibration. Remove to not allow calibration. Must be removed for normal operation.

W8 - External ROM Enable - must be installed.

W9 - Reduced Excitation Enable
This jumper is used in conjunction with W5 and W6 for the Mettler Toledo HAP module. Remove for normal 15 Volt excitation. Install for reduced 5 Volt excitation.

LED Definitions:

I1 - Processor Running(should flicker constantly)

I2 - Display Interface Transmitting(Flashes with data)

I3 - Host Transmitting(Flashes with data)

I4 - Display Receiving(Flashes with data)

I5 - Host Receiving(Flashes with data)

Connector Definitions:

J1 - Load Cell 1 Connector

Pin 1 +Excitation
Pin 2 +Sense
Pin 3 +Signal
Pin 4 No connection
Pin 5 -Signal
Pin 6 -Sense
Pin 7 -Excitation

J2 - Load Cell 2 Connector See J1

J3 - Load Cell 3 Connector See J1

J4 - Load Cell 4 Connector See J1

J5 - Not Used

J6 - Display Port Connector

Pin 1 Shield(Chassis GND)
Pin 2 RS422 RB
Pin 3 RS422 RA
Pin 4 RS422 TB
Pin 5 RS422 TA
Pin 6 Common
Pin 7 20 mA TX+
Pin 8 20 mA TX- (Common)
Pin 9 20 mA RX+
Pin 10 20 mA RX-

NOTE: The 20 mA interface has the output active and the input passive.

J7 - Host Port Connector

Pin 1 Shield(Chassis GND)
Pin 2 RS422 RB
Pin 3 RS422 RA
Pin 4 RS422 TB
Pin 5 RS422 TA
Pin 6 Common
Pin 7 RS232 Rx
Pin 8 RS232 Tx

J8 - Power Supply connector

Pin 1 GND
Pin 2 +24 VDC

3.5 Load Cell Connection

The 9410 provides 15 volt excitation for up to four 350 ohm load cells(W5, W6, and W9 removed).

The 9410 can be used with 2 mV/V load cells (W4 removed) or 3mV/V load cells (W4 installed).

Connect the load cells to the 9410 in one of the configurations described in the following:

3.5.1 Single Load Cell System

When using the 9410 in a single load cell application the load cell should be wired to the J1 connector. The +SIGNAL lead must be connected to remaining load cell connectors(J2-4) +SIGNAL terminals and the -SIGNAL must be connected to the other load cell connectors -SIGNAL terminals.

3.5.2 Two Load Cell System

When using the 9410 in a two load cell application, Load cell 1 connects to J1 and to the + and - Signal terminals of J2. Load cell 2 connects to J3 and the + and - signal terminals of J4.

3.5.3 Four Load Cell System

When using the 9410 in a four load cell application Load Cell 1 must be connected to J1, Load Cell 2 must be connected to J2, Load Cell 3 must be connected to J3 and Load Cell 4 must be connected to J4.

NOTE: For maximum RFI immunity, <u>each</u> load cell cable must be routed through the provided RFI Toroids with four (4) turns of each cable wire per the method defined in the next section.

3.6 RFI Protection Measures

The sensitive analog electronics contained within this enclosure requires that any externally generated electrical noise be stopped before entering the enclosure.

An RFI Toroid ($1^1/_8$" dia. Ferrite Ring) must be placed on <u>each</u> cable going to and from the enclosure. Each load cell cable wire and the communications cable to the host must wrap around a Toroid with four (4) turns before connecting to the respective terminal strip. <u>DO NOT</u> wrap the shield wire around the Toroid. Instead, it must terminate directly to the chassis ground lug provided.

Wind the toroid as follows: (and refer to Figure 3.4)

1. Strip the cable jacket back four (8) inches from the end.

2. Wrap all wires (except the shield) through the toroid with at least four (4) complete turns. All wires may be wrapped together or individually as desired.

3. Connect the wire ends to the terminal strip.

4. Connect the shield wire directly to the ground lug on the enclosure. Keep the lead as short as possible. <u>DO NOT</u> pass the shield wire through the toroid.

5. Tuck toroid and leads below cover area so it won't interfere with the cover.

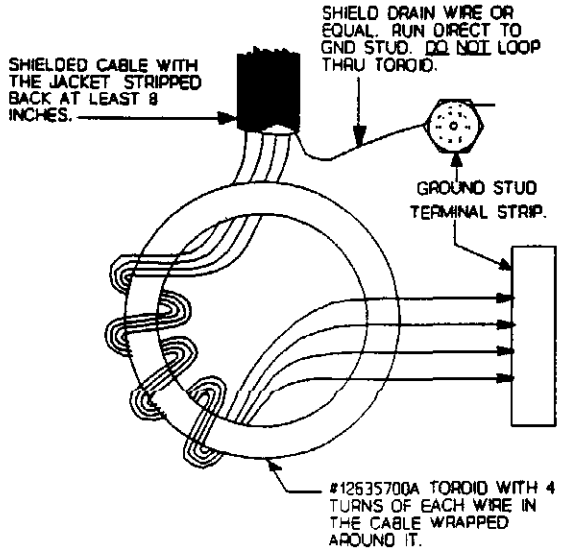


FIGURE 3.4

3.7 Communication/Power Cable

The wiring from J6 and J7 to the display are factory wired and J8 to the host must be made by the user.

3.8 Conduit

A female ½" NPT fitting is provided on the bottom of the 9410 enclosure opposite J7 and J8. The installer must provide metal conduit from the host to the 9410 enclosure for the cable. No other wires are allowed in this conduit.

3.9 Cover Closure

After all wiring has been made and the system calibrated, the desiccant (moisture absorbent material) and moisture indicator must be removed from the sealed bag and placed inside the enclosure. Apply 1 small bead of sealing compound (grease tube provided) around the gasket of the enclosure lid. Install the lid on the enclosure and tighten the screws until the cover gasket meets the mounting flange.

3.10 Data Interface

The 9410 has two ports for communications.

3.10.1 Display Port

The 9410 junction box display port operates at 9600 baud, 7 data bits, even parity. There are two modes of operation available:

1) A continuously updated weight display at 2 updates per second.

2) The weight display updated every time the controller requests a weight through the serial port so the weight displayed is the last requested by the controller.

The display mode is determined by DIP switch 1 in the 9410 as follows:

SW 6	SW 5	SW 4	Display Mode
OFF	OFF	OFF	No display connected
OFF	OFF	ON	Continuous display filter 1 major increments
OFF	ON	OFF	Continuous display filter 1 minor increments
OFF	ON	ON	Continuous display filter 1 internal counts
ON	OFF	OFF	Update as controller requests

The Port is selectable RS422(SW1-7 OFF) or 20 mA current loop(SW1-7 ON). The port must be selected for 20 mA current loop(SW1-7 ON).

The 9410 junction box connects to the display serial port 1. The port is labeled TB1 at the display PCB and must be configured for the 20 mA interface. This port connects to the 9410 using the 20mA interface. Jumper W2 must be set to 2-3 and jumper W3 to 2-3 for 20ma operation. The serial communication is 9600 baud, 7 bit, even parity. The wiring to the 9410 is as follows:

9410 J6		DISPLAY TB1
RXD+	9 ----------	4 TXD+
RXD-	10 ----------	3 TXD-
TXD+	7 ----------	2 RXD+
TXD-	8 ----------	5 RXD-

3.10.2 Host Port

This port is a real time controller interface using either RS232 or RS422(both are active at the same time). The scale acts as a slave and responds to requests by the controlling device. The data format is 7 data bits, even parity, and 1 stop bit. The baud rate is selectable on DIP switch 1 from 2400 to 38.4k baud as shown in the table below:

SW 1	2	Baud Rate
OFF	OFF	2400
OFF	ON	9600
ON	OFF	19200
ON	ON	38400

The serial port can be networked with other 9410's and the following table defines the mode and address of the 9410 as selected on DIP Switch 2: **NOTE:** The 9410 RS422 host port cannot be used as a multi drop port directly. If networking is desired external circuitry must be used.

SW 4	3	2	1	Address
OFF	OFF	OFF	OFF	Point to point
ON	OFF	OFF	OFF	Node address 1
OFF	ON	OFF	OFF	Node address 2
ON	ON	OFF	OFF	Node address 3
OFF	OFF	ON	OFF	Node address 4
ON	OFF	ON	OFF	Node address 5
OFF	ON	ON	OFF	Node address 6
ON	ON	ON	OFF	Node address 7
OFF	OFF	OFF	ON	Node address 8
ON	OFF	OFF	ON	Node address 9
OFF	ON	OFF	ON	Node address 10
ON	ON	OFF	ON	Node address 11
OFF	OFF	ON	ON	Node address 12
ON	OFF	ON	ON	Node address 13
OFF	ON	ON	ON	Node address 14
ON	ON	ON	ON	Node address 15

3.11 Display description

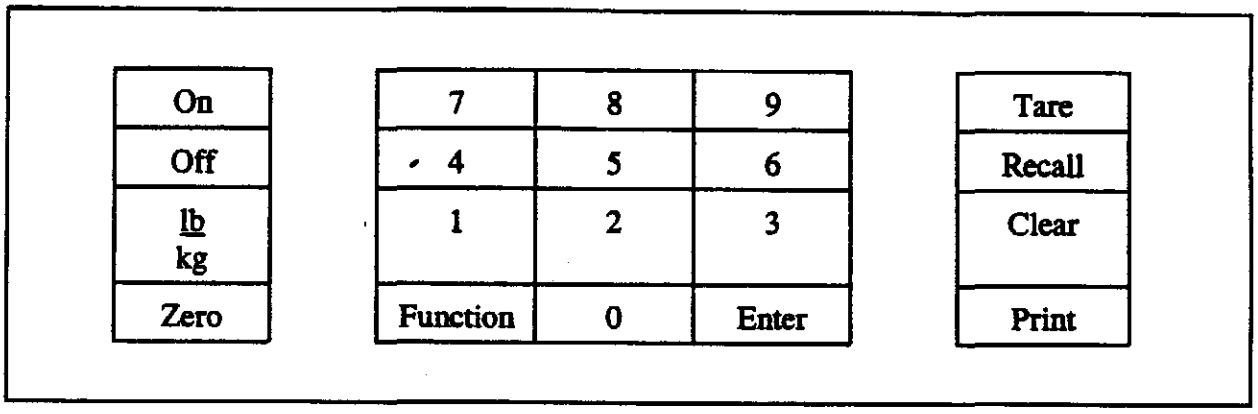
The display uses a custom designed vacuum florescent display. The display indicates up to six digits of weight and a decimal point or comma.

3.11.1 Status indication

The tilde is used to indicate a no motion condition of the current weight. The filled triangle is used to indicate center of zero. If the scale is performing an operation that requires time, the box in the right side of the display is display flashing to indicate a busy situation.

3.12 Keyboard description

The display contains a 4 by 5 matrix keyboard for operator interface. The keyboard is domed with tactile feel and embossed polycarbonate overlay with ridges to separate active key areas.



On/Off	-	Not used
lb/kg	-	Not used
Zero	-	The ZERO key is used to capture a new center of zero reference. This permits the operator to compensate for changes in zero caused by material buildup on the scale platform.
0 - 9	-	The numeric keys (digits 0 thru 9) are used to enter numeric values during setup.
Function	-	This permits entry to calibration mode when W7 is installed on the 9410 junction box PCB.
Enter	-	This terminates entries while in calibration mode.
Tare	-	Not used
Recall	-	Not used
Clear	-	This key permits clearing numeric entries and changing multiple selections in calibration mode.
Print	-	Not used

4.0 CALIBRATION

The 9410 is calibrated by use of the 9410 display. The 9410 jumper W7 allows entry into the calibration mode when required. A means of cold starting the 9410 is allowed by powering down the unit, installing W7, turning SW1-3 ON, and powering up the unit. This allows the user to power up the 9410 without using the stored calibration information.

The setup mode will be entered by pressing the FUNCTION key, if jumper W7 on the 9410 PCB is installed and W1 is installed on the display PCB; otherwise the display will stay in the weighing mode. Pressing the function key during setup will exit calibration code under most conditions. The programming procedure for the 9410 display is divided into six main groups. The number of steps in a group will vary depending upon which group is selected. The groups must be accessed to program each of the selections within the group by entering the group number (for example 30). All setup step numbers and group numbers are listed in the following "Quick reference chart" and also in the following section where the complete description of each setup step is given.

4.1 QUICK REFERENCE CHART

STEP NUMBER	DESCRIPTION
00	Shift adjustment group
01	Reset shift values to zero
02	Number of load cells
E SCL	Step 1 for digital shift adjustment
CELL 1	Step 2 for digital shift adjustment
CELL 2	Step 3 for digital shift adjustment
CELL 3	Step 4 for digital shift adjustment
CELL 4	Step 5 for digital shift adjustment
10	Calibration group
11	Calibration units
12	Increment size
13	Scale Capacity
14	Calibration procedure
20	Zero and span maintenance group
21	Zero adjustment
22	Span adjustment
23	Zero capture range at power up
24	Pushbutton zero range
25	Zero capture range
30	Filter 1 parameter maintenance group
31	Motion detection amount
32	Motion detection window
33	Settling time
40	Filter 2 parameter maintenance group
41	Motion detection amount
42	Motion detection window
43	Settling time
50	Filter 3 parameter maintenance group
51	Motion detection amount
52	Motion detection window
53	Settling time
60	Legal for trade group
61	Enable/disable legal for trade mode

4.2 Keyboard functions during setup

The following front panel keys perform the specified functions when in the programming mode unless other instructions are given for a particular step.

ENTER — Pressing this key will accept the displayed selection for a particular step and proceed to the next prompt.

ZERO — Depressing this key will enable the programmer to backup to the previous step.

CLEAR — Clears the display to permit re-entry of data or display valid selections if specified in the specific setup step.

1 — This key will enable or "turn ON" the displayed programming selection.

0 — This selection will disable or "turn OFF" the displayed programming selection.

2 THRU 9 These digits are used to select and program certain values in the 9410 display. These digits are also used to access the setup steps.

4.3 Programming setup steps

This section describes the programming and calibration of the 9410 display indicator. Described under each sample display are the possible selections and the effect these selections will have on the units's operation. After the setup jumper in the 9410 has been inserted and pressing the setup key on the 9410 display the indicator shows [- -]. At this point the operator has to key in the 2 digit group number.

[00] SHIFT ADJUSTMENT GROUP
Entering the digits 0 then 0 will access the shift adjustment group. The shift adjust group allows a digital shift adjustment to be performed on a multiple load cell system.

[01 0] RESET THE SHIFT ADJUSTMENT VALUES
Entering a 0 proceeds to the next step, entering a 1 resets the shift adjustment values to a default state.

[02 1] NUMBER OF LOAD CELLS
A number of 1, 2, or 4 may be entered. If a 1 is entered, the following steps in that group will be skipped.

[E SCL] The remaining steps allow compensation for differences in output from each of the load cells used in the scale structure. Shift adjust is calculated by taking a reading at empty scale and a reading for each load cell, with a load located as close as possible above the load cell. The number of steps required is the number of load cells (2 or 4) + 1. In this step the empty scale reading is taken. In the following steps, readings are taken with the load placed over each cell starting with cell 1.

After the required number of readings a calculation is performed and each load cell is trim adjusted. The precision of the result depends on the weight being used. It is desirable to have a test weight as close to scale capacity as possible but not to exceed the capacity of an individual loadcell (the dead load of the platform must be considered in the test weight selection).

Note: For a 2 load cell scale structure load cell 1 is to be wired into channel 1 and 2, load cell 2 into channel 3 and 4. It is sufficient to wire just the signal lines to duplicate the channels.

Press ENTER and the empty scale reading will be taken. When complete the display will proceed to the next step.

[CELL 1] PLACE THE TEST WEIGHT ABOVE LOAD CELL 1
Press ENTER when the load is placed above load cell 1. The indicator will take the reading and proceed to the next step.

[CELL 2] PLACE THE TEST WEIGHT ABOVE LOAD CELL 2
Press ENTER when the load is placed above load cell 2. The indicator will take the reading and proceed to the next step. If a 2 has been entered in step 2 the shift adjust is complete. The shift adjust values will be calculated and the following steps in this group will be skipped.

[CELL 3] PLACE THE TEST WEIGHT ABOVE LOAD CELL 3
Press ENTER when the load is placed above load cell 3. The indicator will take the reading and proceed to the next step.

[CELL 4] PLACE THE TEST WEIGHT ABOVE LOAD CELL 4
Press ENTER when the load is placed above load cell 4. The indicator will take the reading and shift adjust will be complete for a 4 load cell scale structure.

[10] CALIBRATION GROUP

Entering the digits 1 then 0 will access the calibration group. The display will begin with step 11 and proceed through step 14.

[11] CALIBRATION UNITS

The display shows the selected unit (kg or Lb). The clear key can be used to toggle the units. Pressing ENTER advances to the next step.

[12] INCREMENT SIZE AND DECIMAL POINT

The display shows the current increment size and decimal point position. If the displayed data is incorrect, press the CLEAR key until the desired decimal point and increment size combination is displayed. Press ENTER to advance to the next step.

[13] SCALE CAPACITY
[xxxxxx]

Enter the total scale capacity in the units selected in step 11. Refer to the data plate and technical manual of the scale base used to verify its capacity. Enter the desired capacity and press ENTER. Press the CLEAR key to clear the display if an error is made during entry. After pressing the ENTER key the display advances to the next step.

[E SCL] INITIAL CALIBRATION

Press the ENTER key if the scale is empty for initial calibration. After the initial calibration the display will advance to the next step.

[14] TEST WEIGHT VALUE
[xxxxxx]

Enter the weight of the test weights to be used. A value as close to full capacity as possible should be used. The test weight value must agree with the increment size used on the scale. After the test weight value has been entered, press the ENTER key. Press the CLEAR key to clear the display if an error is made during entry. After pressing the ENTER key the display advances to the next step.

[ADD LD] SPAN CALIBRATION

Place test weights on the scale platform. After the test weights have been added to the scale, press the ENTER key. After span calibration has taken place the display will show [- -], that means programming for this group is complete and the indicator is ready to accept a new group number.

[20] ZERO AND SPAN MAINTENANCE GROUP

Entering the digits 2 then 0 will access the zero and span maintenance group. The display will begin with step 21 and proceed through step 25.

[21 0] ZERO ADJUSTMENT

This step adjusts calibrated zero without performing a complete scale calibration.

1 — This will select zero adjustment and [E SCL] will be displayed. Press the ENTER key if the scale is empty for initial calibration. After the zero adjustment the display will advance to the next step.

0 — No zero adjustment will be made.

[22] SPAN ADJUSTMENT

This step adjusts span without performing the complete calibration procedure again. When a span adjustment is made, the test weights must already be on the scale and the value of actual test weights must be known. The standard calibration must be completed to provide a reference point before attempting to use this feature.

1 — The span adjustment feature will be accessed. The actual amount of test weight must be entered using the numeric keyboard of the 9410 display. The increment size of the test weight must agree with the increment size of the scale. After the value has been entered, press the ENTER key and [Add Ld] will be displayed. Press the ENTER key to proceed with span adjustment.

0 — No span adjustment will be made.

[23 XX] ZERO CAPTURE AFTER POWER UP

This step programs the range for zero capture when power is applied to the 9410. Use the CLEAR key to select the correct range and press ENTER to accept it.

0 — Power up zero capture is disabled.

2 — Capture range is +- 2% of scale capacity.

10 — Capture range is +- 10% of scale capacity.

20 — Capture range is +- 20% of scale capacity.

[24 XX] PUSHBUTTON ZERO RANGE

This step programs the range (from the power up zero reference) for pushbutton zero and the host 'Z' and 'MZ' commands. Use the CLEAR key to select the correct range and press ENTER to accept it.

0 — Pushbutton/host zeroing is disabled.

2 — Pushbutton zero range is +- 2% of scale capacity.

10 — Pushbutton zero range is +- 10% of scale capacity.

20 — Pushbutton zero range is +- 20% of scale capacity.

[25 XX] ZERO CAPTURE RANGE

This step programs the average zero capture range for the take average zero command ('MZ') from the host. This value is the amount of minor weight increments (in 1/10 of a division) that can be zeroed off at any one time. Use the CLEAR key to select the allowable values and press ENTER to accept it. The allowable values are 6, 14, 24, 54, and 104 minor increments.

The display will return to [--], so that a new group can be entered and accessed.

[30] FILTER 1 PARAMETERS

Entering 3 and 0 will access filter 1 maintenance group. The display will begin with step 31 and proceed through step 33.

[31 xx] MOTION DETECTION READINGS

This step allows to program the number of successive scale readings which are not in motion to determine a no motion condition. The range of this number is 1 to 99.

The actual value will be shown in the display. Enter the desired value and press ENTER to accept it.

[32 xxx] MOTION DETECTION INCREMENTS

This step allows setting the weight deviation of any two successive readings to determine an in motion condition. The value is entered in 1/10th of increments. The maximum number to be entered is 250 representing 25 increments.

The actual value will be shown in the display. Enter the desired value and press ENTER to accept it.

[33 xx] SETTLING TIME FOR FILTER 1

This step allows to program the settle time for the digital filter 1. The settling time relates to a 3db corner frequency. Appendix B lists the settling times and the related frequencies. See Section 3.3.3 for selection of filter time.

The display will show the current selection. Enter the desired settle time and press ENTER to accept it. The range is 0.1 to 1.0 representing seconds. A value of 0.0 disables filter 1, so that unfiltered data directly from the A/D converter will be processed.

[40] FILTER 2 PARAMETERS

Entering 4 and 0 will access filter 2 maintenance group. The display will begin with step 41 and proceed through step 43.

[41 xx] MOTION DETECTION READINGS

This step allows to program the number of successive scale readings which are not in motion to determine a no motion condition. The range of this number is 1 to 99.

The actual value will be shown in the display. Enter the desired value and press ENTER to accept it.

[42 xxx] MOTION DETECTION INCREMENTS

This step allows setting the weight deviation of any two successive readings to determine an in motion condition. The value is entered in 1/10th of increments. The maximum number to be entered is 250 representing 25 increments.

The actual value will be shown in the display. Enter the desired value and press ENTER to accept it.

[43 xx] SETTLING TIME FOR FILTER 2

This step allows to program the settle time for the digital filter 2. The settling time relates to a 3db corner frequency. Appendix B lists the settling times and the related frequencies. See Section 3.3.3 for selection of filter time.

The display will show the current selection. Enter the desired settle time and press ENTER to accept it. The range is 0.1 to 1.0 representing seconds. A value of 0.0 disables filter 1, so that unfiltered data directly from the A/D converter will be processed.

[50] FILTER 3 PARAMETERS

Entering 3 and 0 will access filter 3 maintenance group. The display will begin with step 51 and proceed through step 53.

[51 xx] MOTION DETECTION READINGS

This step allows to program the number of successive scale readings which are not in motion to determine a no motion condition. The range of this number is 1 to 99.

The actual value will be shown in the display. Enter the desired value and press ENTER to accept it.

[52 xxx] MOTION DETECTION INCREMENTS

This step allows setting the weight deviation of any two successive readings to determine an in motion condition. The value is entered in 1/10th of increments. The maximum number to be entered is 250 representing 25 increments.

The actual value will be shown in the display. Enter the desired value and press ENTER to accept it.

[53 xx] SETTLING TIME FOR FILTER 3

This step allows to program the settle time for the digital filter 3. The settling time relates to a 3db corner frequency. Appendix B lists the settling times and the related frequencies. See Section 3.3.3 for selection of filter time.

The display will show the current selection. Enter the desired settle time and press ENTER to accept it. The range is 0.1 to 1.0 representing seconds. A value of 0.0 disables filter 1, so that unfiltered data directly from the A/D converter will be processed.

[60] LEGAL FOR TRADE PARAMETER

Legal for trade selection. The display advances to step 61.

[61 x] LEGAL FOR TRADE

If this flag is zero, the scale is set for a non legal for trade mode. If this flag is one, the scale is set up legal for trade. Legal for trade causes the system to send an under gross zero error ('E13'), if the weight goes below 5 increments under gross zero. The CLEAR key can be used to toggle this flag. The ENTER key accepts the selection.

5.0 HOST COMMUNICATION

The host communication is a set of messages which give the host control of the scale at weighing time.

There 2 protocols:

- point to point connection (RS232 or RS422)
- multi drop connection (RS232 or RS422) following ANSI X3.28

  NOTE: The 9410 RS422 host port cannot be used as a multi drop port directly. If networking is desired external circuitry must be used.

Dip switch 2 for the node address selects the protocol. The protocol determines how data is exchanged and defines recovery procedures for faulty transmissions. The data to be exchanged is independent of the protocol. This port is a real time host interface. The scale acts as a slave and services requests from the host. The command set allows full control of the scale. Operational problems will be flagged in an "ERROR" message.

5.1 Protocol for point to point connection

The protocol is the same as the network protocol except the log-on phase and log-off phase are not required.

5.2 Protocol for network operation

The protocol is based on ANSI X3.28 subcategory E3. This standard describes the different phases during communication and recovery techniques for timeout, faulty transmissions etc. The data to be transmitted is all printable ASCII characters to not interfere with control characters. A block check character is used as a longitudinal checksum. It is calculated as an exclusive 'OR' of the transmission, including the command, data, ETX (excluding STX).

The three different phases of communication are:

- 1) log-on phase
- 2) data exchange phase
- 3) log-off phase

During phase 1 the host sends ENQ preceded by the node ID to address the designated scale. The scale answers with an ACK to confirm it is logged on. During phase 2 the host issues a request in the form:

STX|Command|Data|ETX|BCC

At this point the scale answers with ACK if the request does not involve any return data. Or it answers with:

STX|Command|Data|ETX|BCC

During phase 3 the host sends an EOT which is a global command. Every scale has to log-off and shut off its drivers.

Example 1:

Host:	**Scale:**
01ENQ -->	
	<--ACK
STX...BCC-->	
	<--ACK
EOT -->	

Example 2:

Host:	**Scale:**
01ENQ -->	
	<--ACK
STX...BCC-->	
	<--STX...BCC
ACK-->	
	<--ACK
EOT -->	

A complete discussion of X3.28 is beyond the scope of this document. See the ANSI specification.

5.3 Host commands and data formats

The field for application data consists of 2 fields, a command field and a data field of variable length depending on the command.

5.3.1 General host commands

These commands can be used in weighing mode. They are the status and reset commands. The error command is not really a command, because it is generated by the scale in return to a host request in case an error condition exists.

5.3.1.1 Status request

This command is used to check the error status of the 9410 at any time.

Format: <STX>S<ETX>BCC <= 4 byte message)

Answer: <STX>Xee<ETX>BCC < 6 byte message)

X - 'B' for busy
'E' for error
ee - 2 digit error code

NOTE: Error codes are outlined in Appendix A

5.3.1.2 Error messages

An error message may be returned by the scale in response to a request.

Format: <STX>Exx<ETX>BCC < 6 byte message)

xx - 2 digit error number.

NOTE: Error codes are outlined in Appendix A

5.3.1.3 Reset scale

This command resets the microprocessor, it performs a cold start and a confidence test. The results of the confidence test can be obtained by the status request command.

Format: <STX>R<ETX>BCC <= 4 byte message)

Answer: <ACK>

NOTE: Reset time is about 10 seconds. During reset time the scale will process only a status request.

5.3.1.4 Upload parameters

This command loads setup information from the scale into the host.

Format: <STX>U<ETX>BCC <== (4 byte message)

Answer: <STX>Ua...a<ETX>BCC <== (119 bytes)
U = Upload command

a...a - Data Field:

Initial counts	7 bytes
Span counts	7 bytes
Scale capacity	6 bytes
Digital increment	5 bytes
DAC 1 constant	4 bytes
DAC 2 constant	4 bytes
DAC 3 constant	4 bytes
DAC 4 constant	4 bytes
Settle time filter 1	4 bytes
Pole number filter 1	1 byte
Settle time filter 2	4 bytes
Pole number filter 2	1 byte
Settle time filter 3	4 bytes
Pole number filter 3	1 byte
Lb/kg mode	1 byte
Zero range in %	2 bytes
Power up zero range	2 bytes
Zero Capture Range (1/10 of d)	3 bytes
Motion count (filter 1)	2 bytes
Motion window1 (1/10 of d)	3 bytes
Motion count (filter 2)	2 bytes
Motion window2 (1/10 of d)	3 bytes
Motion count (filter 3)	2 bytes
Motion window3 (1/10 of d)	3 bytes
Analog verification value	6 bytes
Decimal point character	1 byte
Conversion frequency	1 byte
Decimation count	3 bytes
State calibration switch	1 byte see note
Dip switch setting S1 Hi	1 byte '0'-'F'
Dip switch setting S1 Lo	1 byte '0'-'F'
State spare 3 inputs	1 byte '0'-'7'
Dip switch setting S2	1 byte '0'-'F'
HSJB version	24 bytes
Legal for trade flag	1 byte ('Y/N')

NOTE: Calibration mode will be flagged as '1'.

5.3.2 Host commands for weighing operation

5.3.2.1 Send weight data

This command requests weight data from the scale in minors, majors or counts. If the scale is not ready to operate upon weight request an error message will be returned. The display will be updated with this weight if it is set to update as controller requests.

Format: <STX>Wxn<ETX>BCC <== (6 byte message)

Answer: <STX>Wxnsddddddddm<ETX>BCC <== (14 byte message)

Where W is the weight request command. Where m is the motion byte.

Where x is a specified for the mode of the data output.
- x = 1 equals data output in majors.
- x = 2 equals data output in minors.
- x = 3 equals data output in counts.

Where n determines the filter output.
- n = 0 equals all 3 filter outputs.
- n = 1 equals output filter 1.
- n = 2 equals output filter 2.
- n = 3 equals output filter 3.

Where s is the bit coded scale status:

7	6	5	4	3	2	1	0
							----- reserved
						----- reserved	
					----- reserved		
				----- zero flag (1 = zero)			
			----- reserved				
		----- reserved					
	----- always 1						
----- parity							

Where ddddddd is a 7 byte data field right justified with decimal point. It is followed by the motion byte. A no motion condition is represented by 'N' and motion by 'M'. If all filter outputs are requested the weight field is 24 bytes long representing the filter outputs 1-3 with filter output 1 following the status byte.

5.3.2.2 Zero scale command

This command forces the scale to zero if the scale is within the valid zero range and in a no motion condition.

Format: <STX>Z<ETX>BCC <== (4 byte message)

Answer: <ACK>. This command initiates the zeroing process.

5.3.2.3 Begin average weighment

This requests the 9410 to begin (after the filter time has been reached) averaging the filtered weight data.

Format: <STX>MB<ETX>BCC <== (5 byte message)

Answer: <ACK>.

5.3.2.4 Send average weight

This command requests average weight last initiated by an 'MB' command in minors, majors or counts. If the scale is not ready to operate upon an average weight request an error message will be returned. The display will be updated with this weight if it is set to update as controller requests.

Format: <STX>MExn<ETX>BCC <== (7 byte message)

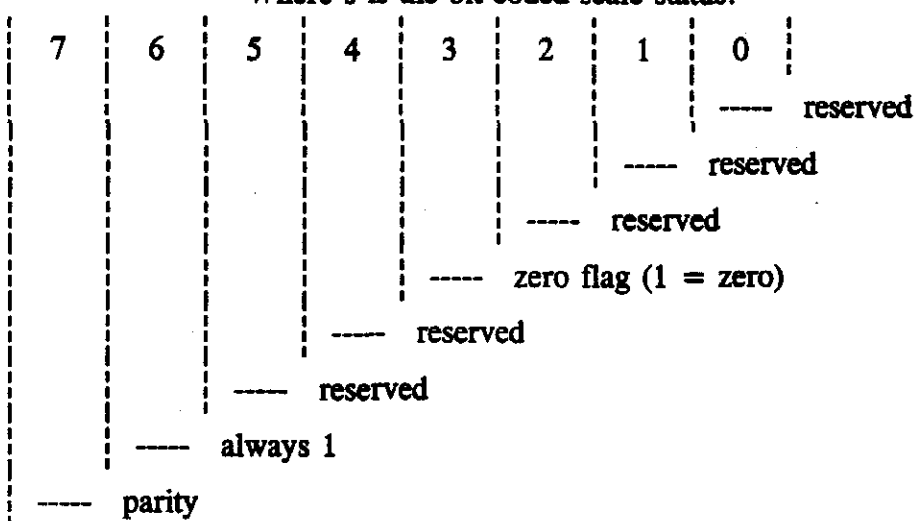
Answer: <STX>MExnsddddddddm<ETX>BCC <== (15 byte message)

Where "ME" is the weight request command.
Where m is the motion byte(always "N").

Where x is a specified for the mode of the data output.
- x = 1 equals data output in majors.
- x = 2 equals data output in minors.
- x = 3 equals data output in counts.

Where n determines the filter output.
- n = 0 equals all 3 filter outputs.
- n = 1 equals output filter 1.
- n = 2 equals output filter 2.
- n = 3 equals output filter 3.

Where s is the bit coded scale status:



Where ddddddd is a 7 byte data field right justified with decimal point. If all filter outputs are requested the weight field is 24 bytes long representing the filter outputs 1-3 with filter output 1 following the status byte.

5.3.2.5 Zero scale with average command

This command forces the scale to zero using the current averaged weight started by an 'MB' command if the scale is within a valid zero range(pushbutton zero range and the zero capture range). The selected filter settle time must be exceeded or zeroing will not occur.

Format: <STX>MZ<ETX>BCC <== (5 byte message)

Answer: <ACK>.

6.0 OPERATING INSTRUCTIONS

The 9410 is designed to be an indicator with the weighing features controlled by a host. The display is used for all calibration and allows pushbutton zero. It is the responsibility of the host to initiate a weighing cycle, terminate a weighing cycle, and allow auto zero maintenance.

At power up the 9410 goes through initialization and does a power up zero. Initialization can take up to 10 seconds. During this time the 9410 will not respond to host requests. The display will show the software number [901925], the version [L 00], and will go through display verification.

The 9410 has the capability of having three separate digital filters operating for use with products of different weighing times. This allows a weighment of as short as 100 milliseconds using the lightest (0.1) filter for a long item or for longer than 1 second to take a weighment, the heaviest (1.0) filter may be used for a short item. The host can request the filtered weight that is best for the weighment time. In addition to the filters the 9410 averages the filtered weights during the weighment when the "MB" and "MExn" are used.

A typical weighing cycle starts with the item to be weighed entering the scale. When the package is completely on the scale the host sends a begin average weighment command ("MB"). The 9410 waits the filter settle time and begins gathering weight data. When the item is ready to exit the scale the host sends a send average weight command ("MExn"). This command terminates the weight gathering, calculates an average weight from the data gathered and sends the requested weight to the host. The 9410 will send an error if the weigh time is less than the filter time. The 9410 can only store weight data for an 8 second period of time, after 8 seconds the host can request the average weight but only gets the first 8 seconds of the time period.

Auto zero maintenance is provided by the host sending a begin average weighment command ("MB") while the scale is empty and sending a zero scale with average command ("MZ") while the scale is still empty. The 9410 will attempt an auto zero maintenance on the average weight calculated. The weight must be within the zero capture range and the total pushbutton zero range.

The display can be updated in two manners. The first, continuous, sends the current filter 1 weight to the display 2 times a second. In the continuous mode no date is sent between the time a begin average weighment command is sent and a send average or a zero scale with average command is sent to terminate the average weighment cycle. The second type, update on host request, is sent to the display when the host requests weight data with a send weight data ("Wxn") or send average weight data ("WExn") command. The weight sent to the display is the same weight data sent to the host.

7.0 APPENDIX A, ERROR CODES

The following error codes are generated in the 9410 and sent to the controller and display. They are useful in determining a specific problem in system.

'00': No error condition.
'01': Unrecognized command.
'02': Access denied (Calibration jumper not in place).
'03': Invalid data.
'04': Can not process command at this time.

Scale error messages during weighing operation:

'11': Scale outside zero range for analog verify.
'12': Scale overcapacity.
'13': Scale is under zero.
'14': Scale outside zeroing range.
'15': Can not process command due to motion.
'16': Can not process command due to insufficient weight readings.

Scale error messages during calibration:

'51': Out of range for shift adjust.
'52': Not enough resolution for selected scale build.
'53': Calibration command not in sequence.

Error messages as the result of a hardware failure:

'70': Time out ,A/D defect.
'71': Analog verification error.
'72': EPROM memory failure.
'73': RAM memory failure.
'74': EEPROM checksum error (invalid parameters).

Error messages generated by the display:
'98': No weight data available from scale.
'99': Communication error (typically wiring problem).

NOTE: Hardware errors are reported with the highest precedence, if multiple error conditions exist.

Error '74' is reset by storing parameters after calibration.

Error '71' is reset with initial calibration.

8.0 APPENDIX B, FILTER SETTLE TABLE

Settling time for 1 part in 20000	3db frequency	filter type
0.1 s	8.00 Hz	4 pole
0.2 s	6.00 Hz	4 pole
0.3 s	4.50 Hz	4 pole
0.4 s	3.65 Hz	4 pole
0.5 s	3.00 Hz	4 pole
0.6 s	2.50 Hz	4 pole
0.7 s	2.20 Hz	4 pole
0.8 s	1.95 Hz	4 pole
0.9 s	1.73 Hz	4 pole
1.0 s	1.55 Hz	4 pole