TI-2100

Digital Indicator

Setup / Operation Manual

Revision 8.95P / August 18, 1994

Covering Versions 08.94 to 05.95

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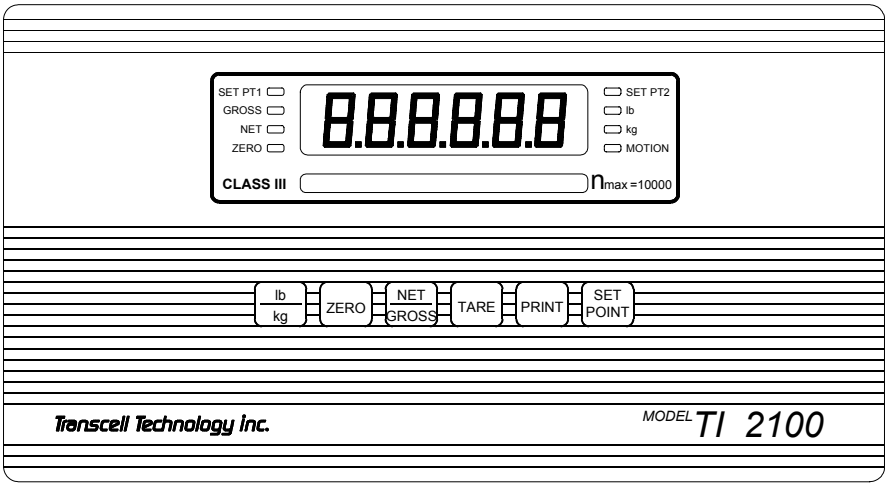
Introduction

The TI-2100 is a general purpose digital indicator, featuring NTEP certification for Class III at 10,000 divisions and two programmable set point outputs. The unit is housed in a NEMA 4X stainless steel enclosure for use in washdown environments, comes with a bright LED screen for easy readout of up to 50,000 display divisions, and supplies enough current for up to 8-350Ω load cells. The primary unit is the unit of the calibration test weight(s), and can be either lb or kg. The secondary unit is automatically set to the opposite unit. All setup parameters may be entered via the front panel keys, including calibration.

The TI-2100 uses full duplex RS-232 serial format for communication with many types of attached support equipment. The unit can transmit data on demand, or continuously in a popular data protocol to match a wide variety of printers, remote displays, or personal computers. Wiring diagrams to connect extra equipment will be found on page 2 of this manual.

The indicator's setup parameters are altered through the Setup menu while the serial communication parameters are altered through the User menu The configuration section of the manual, starting on page 2, explains how to use the five front panel keys to maneuver and save settings in both menus.



TI-2100 Front Panel

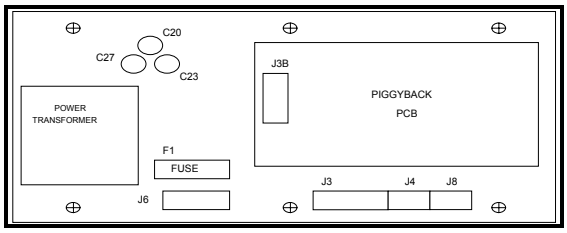
Keyboard Functions

lb / kg	ZERO	NET / GROSS	TARE	PRINT	SET POINT
Toggles between primary and secondary units if enabled in the Setup Menu.	When touched briefly, sets indicator to display "0" when in Gross mode, and within zero band range.	Toggles between Gross and Net weight display.	Used to zero a weight indication in Net mode.	Sends "Print" data to printer if weight is stable and not an overload.	Allows user to program set points while in Normal Operating Mode. See "Programming Set Points".

Installation and Wiring

OVERVIEW OF TI-2100 CIRCUIT BOARD

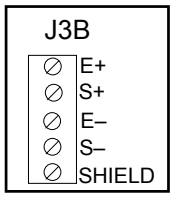
Shown at right is an overview of the TI-2100 Circuit Board showing the major landmarks as well as the terminal blocks used for the various inputs and outputs.



These consist of a Load Cell Feed (J3B), an AC Line Voltage feed (pre-wired) (J6), a Serial Communications Terminal (J4), and an I/O Terminal (J3). Terminal block J8 is not implemented at this time.

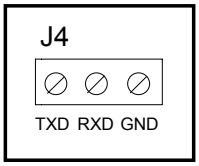
CONNECTING THE LOAD CELL OR JUNCTION BOX

Shown at right is a close-up of terminal block J5 which is the main load cell feed to the circuit board. To connect the load cell or junction box, simply make the appropriate connections to this terminal block. If the 4-20mA analog output option was ordered, there will be an additional two terminals labeled “Gnd” and “Out”.



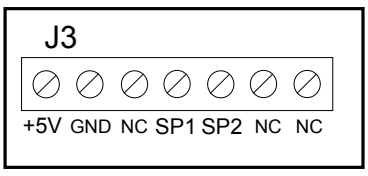
CONNECTING THE SERIAL COMMUNICATIONS CABLE

Shown at right is a close-up of terminal block J4 which is the Serial Communications Terminal. Make the appropriate connections between this terminal and the serial communications cable.



CONNECTING THE SET POINT OUTPUTS

Shown at right is a close-up of terminal block J3 which is the I/O Terminal. These digital outputs are TTL level compatible. A +5 VDC output is provided for connection to an I/O Module or photo relay. Make the appropriate connections between this terminal and the set point output cable.



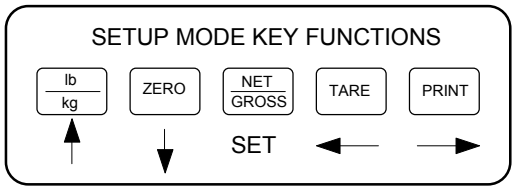
Configuration

The TI-2100 indicator includes two separate menus which contain all of the configurable parameters for the unit. The Setup menu, containing most of the indicator's functional setup parameters, consists of 15 separate menu selections, each with its own sub-menu of choices. The User menu, containing most of the indicator's serial communication parameters, consists of 6 separate menu selections, each also with its own sub-menu of choices.

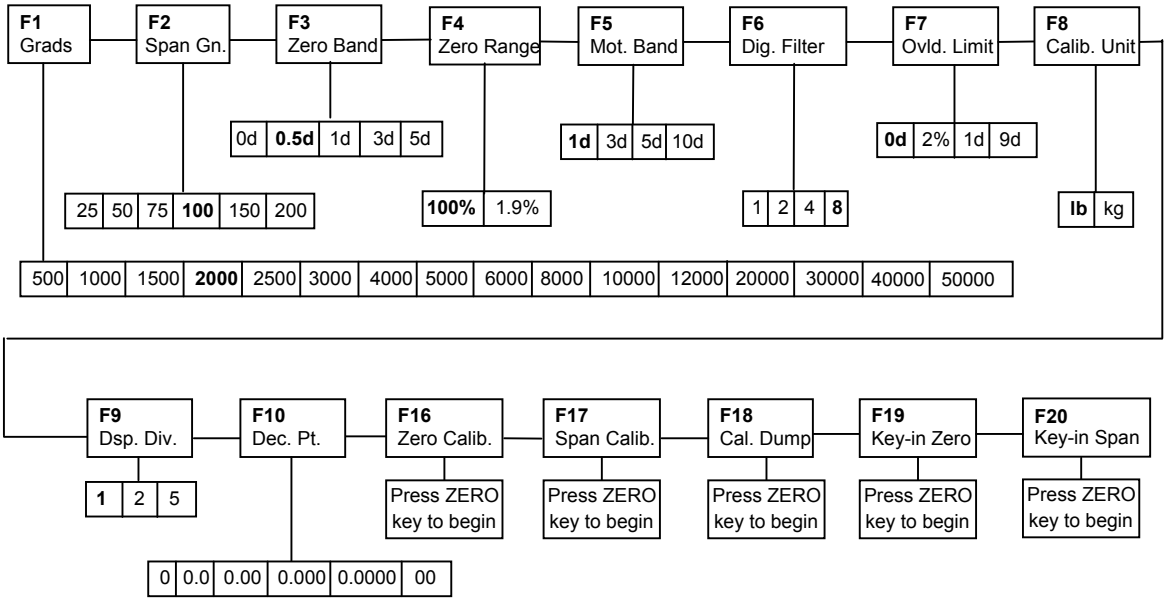
To set up the indicator, you must first enter the appropriate menu mode. Once there, four of the front panel keys become directional navigators to move around in the menus, and one key is used to save or SET the selections. Complete directions start below.

To place the unit in Setup mode:

1. Turn off power to the unit or unplug the indicator from its power source.
2. Carefully remove the back cover and locate the two-position DIP switch on the main PCB. The switch is located near the top edge of the board.
3. Slide switch # 1 to the **ON** position, then re-apply power.
4. The display shows "**F1**", indicating that the unit is in Setup mode. Shown at right are the directional and SET key assignments.



SETUP MENU CHART

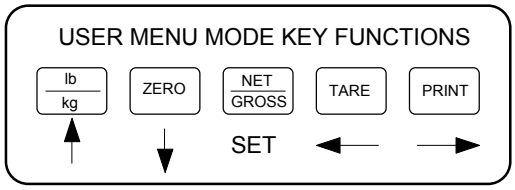


Notes on SETUP MENU CHART:

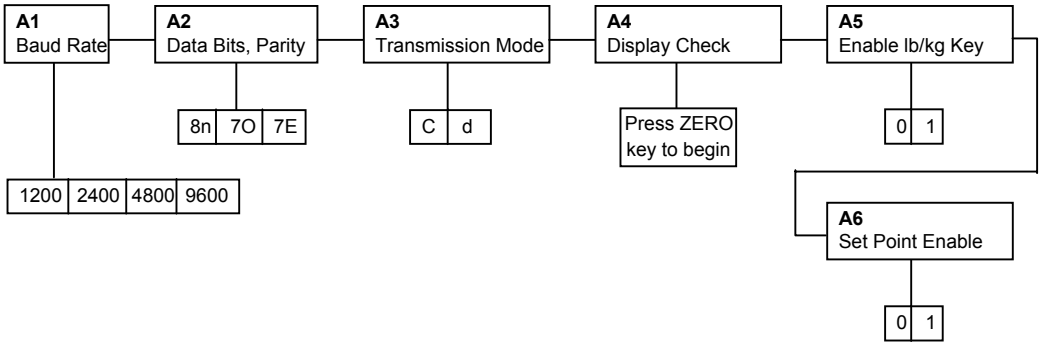
1. Functions **F11** to **F15** are reserved for future use and do not appear when toggling from **F10** to **F16**.
2. Detailed descriptions of the menu parameters begin on page 5 of this manual.

To place the unit in User menu mode:

1. Turn off power to the unit or unplug the indicator from its power source.
2. While holding down the **lb/kg** key, turn the power back on.
3. The display shows "**A1**", indicating that the unit is in User menu mode. Shown at right are the directional and SET key assignments.



USER MENU CHART



To place the unit back into the Normal Operating mode:

1. Turn off power to the unit or unplug the indicator from its power source.
2. If the unit was in Setup menu mode, toggle the DIP Switch back to its original position, and turn the indicator on. If the indicator was in User menu mode, just turn the indicator back on without pressing any keys.
3. The display will go through a digit check, then settle into Normal Operating mode.
4. All front panel keys will now return to their normal mode of operation.

Setup Menu Descriptions

NAME/CODE	DESCRIPTION	CODE/VALUE
F1 Graduations	Specifies number of full scale graduations. Value should be consistent with legal requirements and environmental limits on the useful system resolution.	500 1,000 1,500 2,000 2,500 3,000 4,000 5,000 6,000 8,000 10,000 12,000 20,000 30,000 40,000 50,000
F2 Span Gain	Span Gain is related to A/D integration time. The larger the span gain, the higher the external resolution, but the slower the update speed. See Appendix C for more information.	25 50 75 100 150 200
F3 Zero Track Band	Selects the range within which the scale will automatically zero. Note that the scale must be in standstill to automatically zero. Selections are in Display Divisions.	0d 0.5d 1d 3d 5d
F4 Zero Range	Selects the range within which the scale may be zeroed. Note that the indicator must be in standstill to zero the scale.	100% 1.9%
F5 Motion Band	Sets the level at which motion is detected by comparing the present display update with the previous one. If motion is not detected for two seconds or more, scale is in standstill and can process a Print or Zero command. Maximum value varies depending on local regulations.	1d 3d 5d 10d
F6 Digital Filter	Averages weight readings to produce higher accuracy. The higher the filter number, the greater the accuracy but the slower the response time. Choose 4 or 8 unless a very fast response is needed.	1 2 4 8
F7 Overload Limit	Selects the desired formula which determines the point at which the indicator shows overload ("□□□□"). All selections are based on the primary unit selected in F8. "FS" = Full scale in primary units.	FS FS + 2% FS + 1d FS + 9d
F8 Calib. Unit	Selects the primary base unit to be used in the calibration process. Also the default unit for normal operation. "1" = primary unit is lb. "2" = primary unit is in kg.	1 2
F9 Display Divisions	Determines the desired weight increments. Value should be consistent with legal requirements.	1 2 5
F10 Decimal Pt.	Determines location of the decimal point.	0 0.0 0.00 0.000 0.0000 00
F16 Zero Calibration	Places indicator into the zero calibration routine. Scrolling down with the **ZERO** key one level begins the procedure.	Press **ZERO** key to begin sequence

Setup Menu Descriptions / Continued

NAME/CODE	DESCRIPTION	CODE/VALUE
F17 Span Calibration	Places indicator into the span calibration routine. Scrolling down with the **ZERO** key one level begins the procedure.	Press **ZERO** key to begin sequence
F18 Dump Calibration	Actuates the function which allows user to view both the zero and span calibration value. The values displayed in this function are valid only after Calibration (F16 & F17) has been successfully completed. Scrolling down with the **ZERO** key one level begins the procedure.	Press **ZERO** key to begin sequence
F19 Key-in Zero	Allows user to key-in known zero calibration value in case of memory loss in the field. Scrolling down with the **ZERO** key one level begins the procedure.	Press **ZERO** key to begin sequence
F20 Key-in Span	Allows user to key-in known span calibration value in case of memory loss in the field. Scrolling down with the **ZERO** key one level begins the procedure.	Press **ZERO** key to begin sequence

User Menu Descriptions

NAME/CODE	DESCRIPTION	CODE/VALUE
A1 Baud Rate	Selects the baud rate for data transmission through the serial port.	1200 2400 4800 9600
A2 Data Bits and Parity	Selects the number of data bits and parity of serial transmission. "8n" = 8 data bits with no parity bit "7O" = 7 data bits with odd parity bit "7E" = 7 data bits with even parity bit	8n 7O 7E
A3 Mode of Serial Transmission	Selects when data will be sent out of the serial port to a printer or computer: "C" = Continuous mode; send data continuously "d" = Demand mode; send data when a PRINT command is issued from the printer, computer, or indicator.	C d
A4 Display Check	Actuates the function which illuminates all digit segments, decimal points, and LCD annunciators in a test sequence. Pressing the **ZERO** key to scroll down one level begins the test sequence.	Press **ZERO** key to begin sequence
A5 Disable the lb/kg Key	Allows the lb/kg key to be disabled so that an operator cannot accidentally press the key and change the displayed units. "0" = Disable the lb/kg key "1" = Enable the lb/kg key	0 1
A6 Set Point Enable	Allows the set point outputs to be enabled or disabled. See “Set Point Timing & Level Diagrams” for more information. "0" = Disable the set points "1" = Enable the set points	0 1

Calibration

The indicator is calibrated by following the procedures embedded in F16 (Zero) and F17 (Span) of the Setup Menu. Each procedure enters a value into the indicator's non-volatile memory; F16 the **zero** value (deadweight) and F17 the **span** value (test weight). The minimum test weight that can be used is 1% of full scale capacity. After the two calibration procedures are executed successfully, the user should record both calibration values, which can be viewed by entering the F17 "dump" procedure.

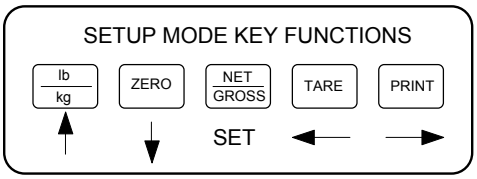
In the unlikely event that either value is lost while in the field, the setup menu makes provisions for re-entering these values via F19 and F20, thus eliminating the need for re-calibration with test weights.

To calibrate the zero point using the F16 zero calibration procedure:

1. If the unit is not in the Setup mode, enter the Setup mode as follows: Remove power to the unit and carefully remove the back cover. Locate the two-position DIP switch on the main PCB, located near the top edge, and slide switch # 1 to the **ON** position. When power is re-applied, "**F 1**" shows on the display. Allow a 20 minute warm-up period for the load cell(s) and indicator to become thermally stable.
2. While in the Setup mode, scroll to "**F 16**", then scroll down once using the **ZERO** key to enter zero calibration menu.
3. The display will momentarily show "**C 0**" followed by a value. After making sure that there are no test weights on the platform, press **ZERO** to zero the value, then press the **NET/GROSS** key to save the zero point value.
4. The display will show "**EndC0**" momentarily, then revert back up to F16. At this time, proceed to the F17 span calibration to complete indicator calibration.

To calibrate the span using the F17 span calibration procedure:

1. While in the Setup mode, scroll to "**F 17**", then scroll down once using the **ZERO** key to enter zero calibration menu.
2. The display will momentarily show "**C 1**" for the span calibration, followed by a value with one flashing digit. This value will be zero with the Decimal Point parameter selected in F10. Place the test weight on the weighing mechanism.
3. Use the four directional keys (shown at right) to adjust the displayed value to the actual test weight value. Increase the flashing digit by pressing the **lb/kg** key. Decrease the flashing digit by pressing the **ZERO** key. The position of the flashing digit may be changed by pressing the **PRINT** key or the **TARE** key.



4. After setting the exact value, press the **NET/GROSS** key to save the value.
5. If the calibration was successful, the display will show "**EndC1**" momentarily, then revert back up to F17. At this time it is suggested that the calibration values be recorded for future use (see next page).
6. If the calibration was *not* successful, one of the error messages below will appear. Take the indicated action to correct the problem, then perform a new calibration.

"**Err0**" - The calibration test weight or the adjusted keyed-in weight is larger than the full capacity of the scale. Change the calibration test weight or check the input data.

"**Err1**" - The calibration test weight or the adjust keyed-in weight is smaller than 10% of the full capacity of the scale. Change the calibration test weight or check the input data.

"**Err2**" - The internal resolution of the scale is not high enough to accept the calibration value. Select a larger parameter for the Span Gain (F2).

To record the calibration values using the F18 Dump Procedure:

Note: The values displayed in this procedure are valid only after a successful calibration has been performed using F16 and F17.

1. If the unit is not in the Setup mode, enter the Setup mode as follows: Remove power to the unit and carefully remove the back cover. Locate the two-position DIP switch on the main PCB, located near the top edge, and slide switch # 1 to the **ON** position. When power is re-applied, "**F 1**" shows on the display.
2. While in the Setup mode, scroll to "**F 18**", then scroll down once using the **ZERO** key to enter dump calibration menu.
3. The display will momentarily show "**CAL 0**" followed by a value. This value is the **zero calibration value** and should be recorded in the table below. Press any key to continue.
4. The display will momentarily show "**CAL 1**" followed by another value. This value is the **span calibration value** and should also be recorded in the table below. Press any key to return to upper level (F18).

TI-2100 INDICATOR	ZERO CALIBRATION VALUE	SPAN CALIBRATION VALUE
S/N:		

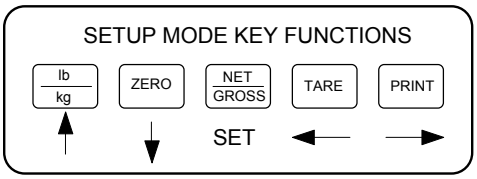
TI-2100 Calibration Value Table

To key-in the zero calibration value using the F19 Key-in Procedure:

Note: This procedure is intended for emergency use only in the case of non-volatile memory loss. A valid zero calibration value, obtained from a successful F16 calibration procedure, must be used.

1. If the unit is not in the Setup mode, enter the Setup mode as follows: Turn the power off to the unit. On the back cover, move the Setup / Calibration Switch to opposite position. When power is re-applied, "**F 1**" shows on the display.
2. While in the Setup mode, scroll to "**F 19**", then scroll down once using the **ZERO** key.

3. The display will momentarily show "**CAL 0**", followed by a flashing zero. Use the four directional keys (shown at right) to adjust the displayed value to the zero calibration value.

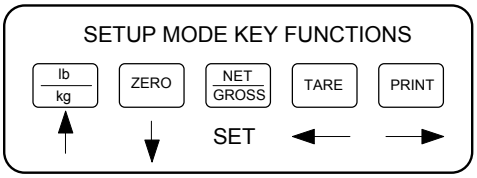


4. After setting the exact value, press the **NET/GROSS** key to save the value.
5. The display will show "**E CAL 0**" momentarily, then revert back up to F19.

To key-in the span calibration value using the F20 Key-in Procedure:

Note: This procedure is intended for emergency use only in the case of non-volatile memory loss. A valid span calibration value, obtained from a successful F17 calibration procedure, must be used.

1. If the unit is not in the Setup mode, enter the Setup mode as follows: Remove power to the unit and carefully remove the back cover. Locate the two-position DIP switch on the main PCB, located near the top edge, and slide switch # 1 to the **ON** position. When power is re-applied, "**F 1**" shows on the display.
2. While in the Setup mode, scroll to "**F 20**", then scroll down once using the **ZERO** key.
3. The display will momentarily show "**CAL 1**", followed by a flashing zero. Use the four directional keys (shown at right) to adjust the displayed value to the span calibration value.



4. After setting the exact value, press the **NET/GROSS** key to save the value.
5. The display will show "**E CAL 1**" momentarily, then revert back up to F20.

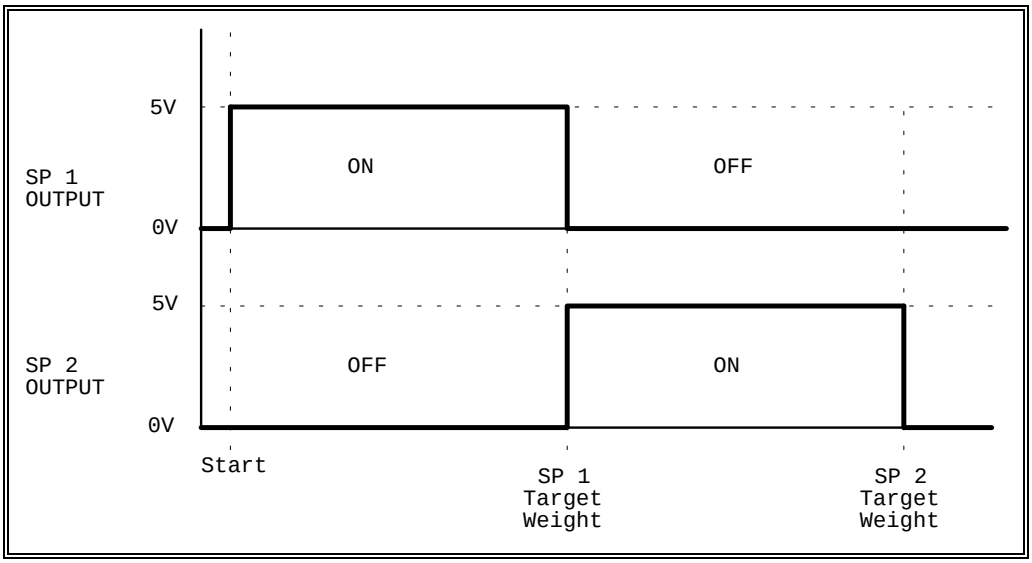
To place the unit back into the Normal Operating mode:

1. While still in Setup mode, slide DIP switch #1 back to its original position.
2. The display will go through a digit check, then settle into Normal Operating mode.
3. All front panel keys will now return to their normal mode of operation.

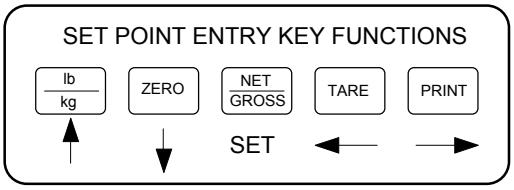
Set Point Timing and Level Diagram

Shown below is the set point timing and level diagram. An important point to understand is that Set Point 2 *must* come after Set Point 1. To activate the cycle, press the **TARE** key while in normal operating mode.

As shown, the levels are +5V TTL level compatible. An external photo-isolated solid state relay or I/O Module is highly recommended for interfacing to large inductive loads.



Programming Set Points



NOTE: Use Net weight values when programming batch type set points.

1. While in normal operating mode, press the **SET POINT** key once. The display shows "**SP 1**" briefly then the current Set Point 1 value with one digit flashing. Additionally, the SP 1 annunciator will be lit.
2. Use the directional arrows shown above to change this value. Press **NET/GROSS** to save and proceed to Set Point 2.
3. The display briefly shows "**SP 2**", then shows the current Set Point 2 value with one digit flashing . Additionally, the SP 2 annunciator will be lit.
4. Use the directional arrows shown above to change this value, if necessary. **NOTE:** This value *must* be greater than SP 1 to be valid. If this value if less than SP 1 or equal to ZERO, then it will be disabled.
5. Press **NET/GROSS** to save this value and return to Normal Operating mode.

APPENDIX A: Specifications

ANALOG SPECIFICATIONS

Full Scale Input Signal	0.2 mV/V min to 3.0 mV/V max
Input Impedance	na
Internal Resolution	Up to 230,000 internal counts
Display Resolution	50,000 dd
Measurement Rate	Up to 30 meas/sec
System Linearity	0.01% of full scale
Calibration Method	Software Calibration, with long term storage in EEPROM
Excitation Voltage	+10VDC, 8 x 350Ω load cells
Display Filtering	Selectable via front panel service menu

DIGITAL SPECIFICATIONS

Microcomputer	Intel 80C32	
	Program Memory:	32K x 8, external to μC
	SRAM:	8K x 8, external to μC
	EEPROM:	64 x 16, external to μC
Digital Filtering	Software selectable	

SERIAL COMMUNICATIONS

Printer Port	Full Duplex, 1200, 2400, 4800, 9600 Baud 8 data bits, no parity 7 data bits, odd parity 7 data bits, even parity

OPERATOR INTERFACE

Display	0.6" 7-segment, LED, 6-Digit
Additional Symbols	Set Pt 1, Gross, Net, Zero, Set Pt 2, lb, kg, Motion
Keyboard	6-key flat membrane panel

POWER

AC Adapter	120VAC , 50/60 Hz
Power Consumption	na

ENVIRONMENTAL

Operating Temperature	32º to 104º F (0° to +40° C)
Storage Temperature	-13º to 158º F (-25° to +70° C)

MECHANICAL

Overall Dimensions	6" x 10.5" x 3" w/o stand
Weight	9 LB (4.1 kg)
Enclosure Classification	NEMA 4X

APPENDIX B: Serial Data Format

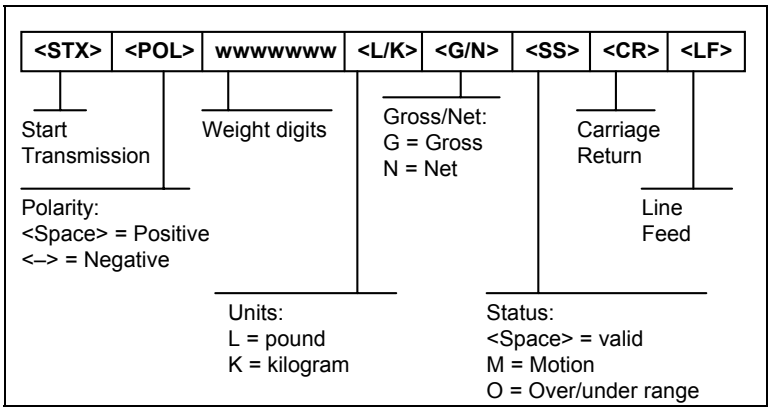
OVERVIEW

The TI-2100 is equipped with a full duplex ASCII compatible RS-232 serial communications terminal which may be wired to any type of serial output connector. The serial data format is compatible with most printers, scoreboards, and other remote devices.

As shown in the SETUP MENU CHART, the terminal may be configured for Continuous or Demand data transmission.

CONTINUOUS MODE SERIAL TRANSMISSION

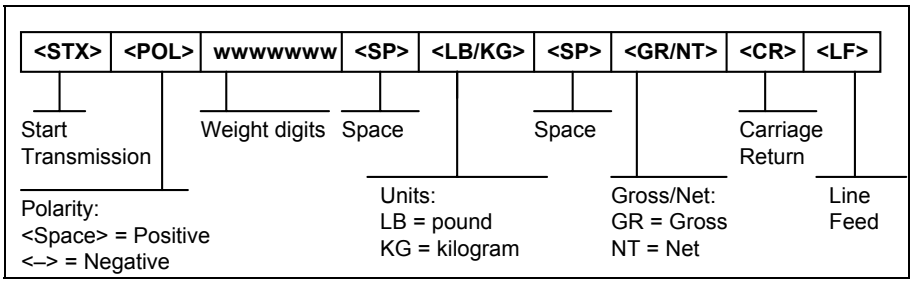
This mode is used primarily to interface to computers, scoreboards, and other remote devices requiring constant data updating. This transmission occurs at the end of each display update.



Continuous Mode Serial Data Format

DEMAND MODE SERIAL TRANSMISSION

Primarily designed to interface to printers, this format makes use of the **PRINT** key present on the TI-2100 front panel. The indicator will respond with the following data provided it is not in motion, over-loaded, or under zero, in which case the unit does not respond.



Demand Mode Serial Data Format

The unit also responds to the following commands issued from an external controlling device:

"P"	Print
"C"	Convert Units - same as pressing **lb/kg** key
"Z"	Zero the present weight indication - same as pressing the **ZERO** key
"T"	Tare the present weight indication - same as pressing the **TARE** key
"N"	Change to Net mode
"G"	Change to Gross mode

APPENDIX C: Determining Proper Span Gain

The Span Gain parameter specified in F2 of the Setup Menu is directly related to the A/D integration time. Therefore, the lower the number, the higher the measurements per second. Disregarding digital filter length, a span gain of **25** produces about 25 to 30 measurements per second, while a span gain of **200** produces only about 3 or 4 measurements per second.

There are two steps to determining the proper span gain value to use in the Setup Menu for F2. The first involves looking up a value in the table below, saving that value, then calibrating the system.

If the first step does not yield a successful calibration, then the second step allows the technician to view the actual internal count to determine the proper value for the span gain and check the system for linearity.

To determine the initial value for span gain in the setup menu:

1. Determine the number of desired external graduations and choose the corresponding value under the number closest to your full scale input range in millivolts.
2. Enter the Setup Menu and save this number for the Span Gain parameter in F2.
3. Perform a system calibration. If the calibration proves unsuccessful, or you wish to view the internal count, proceed to the next set of instructions.

To view the internal count during the calibration procedure:

1. Enter the zero calibration menu (F16) and follow steps 1 to 3, ***but do not save the zero point.***
2. After pressing **ZERO** to zero the offset, you may place the test weight(s) on the weighing mechanism.
3. The displayed count is the internal count. At full scale, the displayed count should be a minimum of 2 times the desired external graduations. However, for maximum stability, a factor of 5:1 or higher is recommended.
4. If the displayed count is large enough, remove the test weight(s), re-zero the indicator if necessary, and proceed with the calibration. If the displayed number is *not* large enough, increase the Span Gain to the next highest choice in the Setup Menu and re-calibrate.

# of External Grads	Full Scale Input Range (mV/V)							
	0.25	**0.50**	**0.75**	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**
500	25	25	25	25	25	25	25	25
1000	50	25	25	25	25	25	25	25
1500	50	25	25	25	25	25	25	25
2000	75	50	25	25	25	25	25	25
2500	100	50	50	25	25	25	25	25
3000	100	50	50	25	25	25	25	25
4000	150	75	50	50	25	25	25	25
5000	200	100	75	50	50	50	25	25
6000	200	100	75	50	50	50	50	25
8000	–	150	100	75	50	50	50	50
10000	–	200	150	100	75	75	50	50
12000	–	200	150	100	75	75	75	50
20000	–	–	–	200	150	150	100	100
30000	–	–	–	–	200	200	150	150

Recommended Minimum (5:1) Span Gain Table

APPENDIX D: Interfacing to Remote Display Unit

If interfacing to a Remote Display Unit, the following serial communication parameters must be used:

Baud Rate (A1):	2400
Data Bits & Parity (A2):	8 Data Bits, No Parity
Trans. Mode (A3):	Continuous