Bolton Electronics BE4 Beltweigher Instrument Version 4286

BE4 Beltweigher Specification (Version 4286)

Introduction

The BE4 Beltweigher is designed to weigh product delivered on a continuous belt using a load cell. It can work with or without a belt speed tacho. It works in metric units and provides the following information on its display at the press of a single key:-

- 1) Tonnes per hour
- 2) Belt speed in metres per minute
- 3) Total tonnes (ongoing tonnes counter with power failure storage)
- 4) Trip tonnes (tonnes since trip reset with power failure storage)

In addition to displaying information, the Beltweigher has the following outputs:-

- 1) Tonnes per hour analog signal (12 bits 0-10 Volt and 4-20 mA)
- 2) Serial RS232 or RS422 tonnes per hour and total tonnes
- 3) Variable rate impulse counter
- 4) Tonnes impulse counter
- 5) Setpoint (trip tonnes or tonnes per hour)
- 6) Remote display (optional)

In addition to these features, facilities are provided to set-up the Beltweigher for a particular installation. These include:-

- 1) Static tare and weight calibration
- 2) Belt calibration
- 3) Dynamic, or belt tare
- 4) Correction factor
- 5) Entering a setpoint

Description of display modes

A display mode may be selected by pressing the appropriate key. The key will light to confirm the selection. In the case of the Remote Display, the following modes may be cycled through by pulsing the Remote Display Select Input.

1) Tonnes per hour mode

Pressing key 1 causes the belt tonnes per hour delivery rate to be displayed. The value displayed is an average of readings taken over a minimum of 1 second. To increase the averaging time, a value other than 0 must be programmed into CAL-7 (TPH average time), (see calibration table). This value is in units of 0.1 seconds, therefore for a time of 3 second, CAL-7 (TPH average time) should be set to 20 (not 30 since a value of 0 corresponds to 1 second). If no value is available for display, e.g. the first averaging period after power-on, or exiting CAL mode etc. has not completed, dashes (i.e. ------) will be displayed. This indicates that the averaging process is taking place. Tonnes per hour to 1 decimal place is displayed. The display will show a negative value if the belt load is less than the load at the time of tareing.

2) Belt speed mode

Pressing key 2 causes the speed of the belt to be displayed in metres per minute. The value is continuously updated and is not averaged. Whole metres per minute are displayed, with no decimal point. See CAL-29 (Roller circumference) and CAL-38 (Belt Speed).

3) Total tonnes mode

Pressing key 3 causes the total delivery to be displayed. The value is continuously updated. Whole tonnes are displayed, with no decimal point. The counter will count down, and can go negative if the belt load is less than the load at the time of tareing. The total counter is held in a non-volatile memory so that the value is stored when the instrument is switched off. The counter can be zeroed by entering 3142 into CAL-43 (Counter reset). Note that this will also zero the trip tonnes counter.

4) Trip tonnes mode

Pressing key 4 causes the total delivery since the trip tonnes counter was zeroed to be displayed. The value is continuously updated. The counter will count down, and can go negative if the belt load is less than the load at the time of tareing. A choice of 3 display resolutions is available, allowing tonnes to displayed with 0, 1, or 2 decimal places. This feature is set by the value in CAL-41 (Trip tonnes counter resolution) (see calibration table). The counter may be zeroed, even if a different display mode is active, by pressing key 8. This does not effect the total tonnes counter. The trip counter is held in a non-volatile memory so that the value is stored when the instrument is switched off. The total tonnes zeroing method, described above, will also zero the trip counter.

Description of outputs

1) Tonnes per hour analog signal

The BE10410 provides a 0-10 Volts, and 4-20mA signal with a resolution of 12 bits representing the current tonnes per hour. The full scale range of the output may be set by programming CAL-37 (TPH output FSD) (see calibration table) with the full scale tonnes per hour value required to represent 20mA/10Volts. If the tonnes per hour value is zero or negative, the analog output will be at 4mA/0 Volts. If the tonnes per hour value equals or exceeds the setting in CAL-37, or if the Beltweigher is displaying a weighing or belt speed error, the analog output will be at 20mA/10 Volts

2) Serial RS232/422 tonnes per hour and total tonnes

The Beltweigher will transmit total tonnes and tonnes per hour every time a new tonnes per hour value is calculated *. See calibration table, CAL-7 (TPH average time). The values are transmitted in decimal ASCII, MSB first, and the string is of variable length depending on the magnitude of the values. Leading spaces and zeros are suppressed, but a leading minus ('-') will be appended for negative values. The order of transmission is total tonnes to 2 decimal places, a comma (',') separator, tonnes per hour to 1 decimal place, and finally a carriage return terminator. The serial format is 8 data bits, no parity, 1 stop bit, and baud rate defined by CAL-42 (Serial baud rate). Hardware handshake is provided. The data can be transmitted at the RS232 or RS422 standards. For RS232, ensure J4 is on pins 2-3, and use P4 for connections. For RS422, ensure J4 is on pins 1-2, and use P6 7, 8, 11, 12 for connections (see "**Pictorial View of BE10410 Beltweigher Interface**" at end of document).

* The Beltweigher cannot buffer data, therefore if the previous values have not been completely transmitted when new values become available, the new values will not be transmitted. This can happen if the Handshake Input slows the transmission rate down, or if a low baud rate is selected.

3) Variable rate impulse counter

A pulse is generated on this output at a rate depending on the value in CAL-36 (Variable counter rate) (see calibration table). It can be switched completely off, or can pulse 1, 10, or 100 times per tonne. It is intended to drive an electromechanical counter, or PLC etc. and is implemented using an open collector NPN Darlington, pulsed on for approximately 30mS. The maximum count rate is 10 pulses per second, and if this is not sufficient to cope with the delivery rate, the output is left permanently on.

NOTE: The counter output will stop pulsing if the tonnes per hour value goes negative. Furthermore, on tonnes per hour returning to a positive value, pulsing will be delayed until the total tonnes counter has reached the value it held immediately before tonnes per hour went negative. An exception to this is if a belt tare operation done. At the end of the belt tare, any negative hold off is cancelled, and the counter outputs will begin counting immediately the tonnes per hour value goes positive.

4) Tonnes impulse counter

A pulse is generated on this output for every tonne accumulated. It is intended to drive an electromechanical counter, or PLC etc. and is implemented using an open collector NPN Darlington, pulsed on for approximately 30mS. See NOTE above.

5) Setpoint

The Setpoint Output can operate either as a trip tonnes setpoint, or as a tonnes per hour setpoint. To select tonnes per hour mode, the Setpoint Mode Input should be ON. To select trip tonnes mode, leave the Setpoint Mode Input open circuit.

The Setpoint Output is off when the trip tonnes counter or tonnes per hour value, depending on the operating mode, is less than the programmed setpoint, and on when it is greater than the programmed setpoint. See 'Entering the setpoint', below, for instructions for programming in a setpoint.

6) Remote display

A 2 line by 16 character LCD remote display can be fitted to the Beltweigher as an optional extra. The remote display can show any of the 4 main display modes independently of the main display. The display modes are cycled through by pulsing the Remote Display Select Input.

Setting up

Before the unit can be used, several parameters must first be set up. Most of the following steps require the use of the CAL (calibrate) mode. It should be noted that the CAL key will only function if the CAL Mode Enable Input is ON. All CAL variables are entered in the same way, therefore an example follows for programming a typical CAL variable:-

A) Press the CAL key. The display should show the message 'CAL'. If the display blanks when the CAL key is pressed, this means that the CAL Mode Enable Input is not ON.

B) Enter a number through the keyboard. The acceptable range is 1 to 43 corresponding to CAL variables 1 to 43. In order to maintain compatibility with earlier products, several of these variables are not used.

C) Press the ENTER key. The display will show the value currently stored for the selected CAL variable. At this stage, the ENTER key may be pressed again and CAL mode will be terminated without changing the variable.

D) Enter a new value through the keyboard. As the first number key is pressed, the display will clear and show the value of the first key. The range of acceptable numbers is 0 to 32767, although the practical limit for a particular CAL variable will be much less.

Note that CAL-1 and CAL-2 have the additional ability to 'learn' from the load cell input. This is achieved by pressing the CAL key at stage D) instead of entering a number through the keyboard.

A full list of CAL variables can be found at the end of this document.

1) Static Tare and weight calibration

Static tare is the process used to calibrate the weighing section of the Beltweigher. The belt must be stationery, completely empty, and preferably at normal running temperature. Set CAL-6 (Load cell signal averaging) to 0. This switches digital filtering off. Select CAL-1 (Zero counts) (A and B above) followed by the CAL key, followed by ENTER. This allows the Beltweigher to 'learn' the Static tare. Place a test weight (20kg or 30kg is recommended) immediately on top of the weigh roller, and select CAL-2 (Span counts) followed by the CAL key, followed by ENTER. This allows the Beltweigher to 'learn' the value of the test weight. Finally, select CAL-3 (Test weight) and set this to the value of the test weight in grammes (20000 for 20kg, 30000 for 30kg etc.). This allows the Beltweigher to relate the value from CAL-2 (Span counts) with real units of weight, and completes the weight calibration process. Note that during the 'learning' operation, the display will be live all the time the CAL key is pressed. It is good practise to press and hold the CAL key down and observe the display. The value should be reasonably steady. Release the key when the display appears stable.

2) Belt calibration

Belt calibration is the process used to calibrate the belt speed section and moving weight section of the Beltweigher. Note that the Beltweigher may be used with or without a tacho input. If it is to be used without a tacho, then the tacho input becomes a belt on/off input. If the input is ON, or not connected, the belt is considered to be running. If, however, the input is connected to zero Volts, the belt is considered to have stopped. The Beltweigher must know the speed of the belt, the length of the belt, the dynamic tare, i.e. the tare when running, the length of the segment of belt that is being weighed, the minimum acceptable delivery rate, and the correction factor to be applied to the weight readings.

Calibrating the belt speed

If the belt has a tacho fitted, CAL-38 (Belt speed) must be set to 0, and CAL-29 (Roller circumference) must be set to the distance covered by the belt for every tacho pulse in units of 0.1 millimetres, e.g. 319.2 should be entered as 3192. If only 1 tacho pulse is generated for every revolution of the pickup roller, this is the circumference of the roller.

If the belt does not have a tacho, CAL-38 (Belt speed) must be set to the speed of the belt in millimetres per second. This should be the normal running speed with a typical load, and at running temperature. CAL-29 (Roller circumference) is not used in this case.

To convert from metres per minute to millimetres per second multiply by 16.667. To convert from feet per minute to millimetres per second, multiply by 5.080.

Belt length learning

The belt should be empty, running at normal speed, and the CAL Mode Enable Input must be ON. Press key 5 with the Beltweigher in a display mode to select belt monitoring. The display should show zero and key 5 should light. If the display blanks, this is because the CAL Mode Enable Input is not ON. Wait for a distinguishing mark on the belt to pass e.g. a join, and press ENTER. The display will begin counting up. The belt should be allowed to run until the same mark on the belt comes around again, i.e. the belt has completed a full revolution. When this has happened, press ENTER again. Counting will stop, and the terminal count will be displayed. This number should be noted and ENTER pressed again to return to the previous display mode. The number should be programmed into CAL-32 (Belt length). The Beltweigher counts tacho pulses if a tacho is fitted, or units of 0.1 seconds if not.

3) Dynamic, or belt tare

Once the belt length has been programmed in using the procedure above, the dynamic tare can be taken. The belt should be empty, at normal running temperature, and running at a steady speed. Press key 0 to start. If the current tonnes per hour is less than the value programmed in CAL-40 (Max tonnes per hour), then the belt tare will begin. If it is greater, belt tare will not take place, the unit will display (--HI--) for 1 second, and return to its previous mode. This provides a safeguard against accidental belt tare when the belt is loaded, therefore, CAL-40 (Max tonnes per hour) should be less than the minimum normal tonnes per hour rate. Assuming the belt tare does start, the display will show the value of belt length programmed into CAL-32 (Belt length), and will count down to zero. If a tacho is fitted, tacho pulses are counted, if not, units of 0.1 seconds. When zero is reached, the belt tare value is automatically programmed into CAL-33 (Belt tare). The unit then returns to its previous mode.

Weigh length and minimum delivery rate

The Beltweigher needs to know the length of the section of belt that the load cell is weighing. If the rollers are equidistant, this is simply the distance between adjacent rollers. Measure the distance between the centre of the weigh roller, and one of the adjacent rollers and enter it into CAL-31 (Weigh length). This should be entered in units of 0.1 millimetres, e.g. 1000.0 millimetres should be entered as 10000.

The belt delivery rate must be greater than, (or less than if tonnes per hour is negative) the value in CAL-34 (Minimum kg per hour) for weight to be recorded. This location should therefore be programmed with a value below the minimum normal running rate. This feature prevents extraneous readings from appearing when the belt is running empty.

4) Correction factor

Even if all the above CAL variables are correctly setup, the Beltweigher output may be in error. This can be due to a variety of reasons, including the angle of the belt, the stiffness of the belt material, etc. To compensate for this, CAL-39 (Correction factor) is provided. Set the Correction factor to 1000 (no correction), and CAL-41 (Trip tonnes counter resolution) to 2 (for 2 decimal places). Select trip tonnes counter mode (key 4) and when the belt is running and empty, press key 8 to zero the trip tonnes counter. Pass a batch of material of known weight along the belt and note the final reading on the display (note that the reading is tonnes to 2 decimal places). CAL-39 (Correction factor) should be set to:-

CAL-39 (Correction factor) = (True weight * 1000) / Displayed weight

Perform the above test again to confirm, or fine tune the Correction factor.

5) Entering the setpoint

The setpoint is compared with the trip tonnes counter or the current tonnes per hour value, depending on the Setpoint Select Input, to determine the state of the Setpoint Output. It may be programmed when the unit is in a display mode, and CAL-8 (Setpoint programming enable) is NOT zero, by pressing key 7. The current value will be displayed, and if only the ENTER key is pressed, it will remain unchanged. This is provided for checking. A new setpoint may be entered at this stage in tonnes with 1 decimal place, i.e. in hundreds of kilogrammes. When the ENTER key is pressed, the new value is stored, and the unit reverts to the previous mode. Note that the setpoint value is stored in CAL-35 (Setpoint), but CAL mode is not normally used to change it.

Calibration table

This is a full list of the calibration or CAL variables used by the Beltweigher. Note that CAL mode can only be entered if the CAL Mode Enable Input is ON. Instructions for viewing or entering a CAL variable are given under the 'Setting up' section, above.

CAL 1 Zero counts
CAL 2 Span counts
CAL 3 Test weight

The section 'Static tare and weight calibration' (above) describes the use of CAL-1, CAL-2, and CAL-3.

CAL 4 and 5 Not used

CAL 6 Load cell signal averaging

This value is used by the Beltweigher to control the load cell signal digital filtering. Typical values are 0, 1, or 2 depending on installation. Set to 0 initially.

CAL 7 Tonnes per hour averaging time

This is the tonnes per hour averaging time in units of 0.1 seconds, e.g. 1.5 seconds is entered as 15. Note that 10 (1 second) is internally added to this value, and therefore 1 second is the minimum averaging time.

CAL 8 Setpoint programming enable

If this is zero, the setpoint CANNOT be programmed from the keyboard as described in 'Entering the setpoint' (above). To enable programming, 1 (or anything other than 0) must be entered.

CAL 9 to CAL 28 Not used

CAL 29 Roller circumference

The distance between tacho sensor impulses. If the impulses are from a roller, and there is only 1 pulse per revolution, this setting becomes the roller circumference. The value entered in units of 0.1 millimetres, e.g. 123.0 millimetres is entered as 1230. The maximum value is 932 millimetres.

CAL 30 Initial display mode

This is the display mode used after power-up, i.e. for tonnes per hour, enter 1, for belt speed enter 2, for total tonnes enter 3, and for trip tonnes enter 4. Out of range values default to 1

CAL 31 Weigh length

This is the distance between the weigh roller and its adjacent roller. It is entered in units of 0.1 millimetres, e.g. 1000.0 millimetres is entered as 10000.

CAL 32 Belt length

This is programmed with the value found in the 'Belt length learning' section (above).

CAL 33 Belt tare

This is automatically programmed with the Belt tare value at the end of a belt tare operation. See 'Dynamic, or belt tare' (above).

CAL 34 Minimum kg per hour

This is the minimum delivery rate in kilogrammes per hour that the belt must pass before the Beltweigher will record weight.

CAL 35 Setpoint

This is the setpoint in units of 0.1 tonnes and is normally programmed directly, see 'Entering the setpoint' (above).

CAL 36 Variable counter rate

This defines the count rate of the variable rate impulse counter. Active values are: 0 (counter off), 1 (100 pulses per tonne), 2 (10 pulses per tonne), or 3 (1 pulse per tonne). Any other value will switch the counter off. See 'Variable rate counter' (above).

CAL 37 TPH output FSD

This is the full scale deflection value for the 'Tonnes per hour analog signal' (above). Special cases are 0 which forces 0 Volts/4mA output, and 1 which forces 10 Volts/20mA output. These are provided for calibrating the interface. For normal operation, this should be programmed with the full scale deflection tonnes per hour value.

CAL 38 Belt speed

The Belt speed in millimetres per second see 'Calibrating the belt speed' (above). Must be 0 for tacho operation. Maximum value 16666, corresponding to 1000 Metres per minute.

CAL 39 Correction factor

The calibrated load is multiplied by this factor and then divided by 1000. For no correction factor, enter 1000. See 'Correction factor', (above).

CAL 40 Max tonnes per hour

The tonnes per hour rate must be lower than this value for belt tare to work see 'Dynamic, or belt tare', (above).

CAL 41 Trip tonnes counter resolution

If this is zero, the trip tonnes counter will count with no decimal places, i.e. in units of 1 tonne. If it is 1, it will count with 1 decimal place, i.e. in units of 100kg. If it is 2 or more, it will count with 2 decimal places, i.e. in units of 10kg.

CAL 42 Serial baud rate

This CAL variable defines the serial output baud rate, and can be set as follows:-

0 - 9600
1 - 4800
2 - 2400
3 - 1200
4 - 600
5 - 300
6 - 150
7 - 110

All other values are undefined. If the baud rate is changed, the instrument must be powered off, and on again before the new settings will take effect.

CAL 43 Counter reset

This is not a CAL variable at all. It is a special method used to clear the non-volatile total tonnes and trip tonnes counters. Enter the value 3142 to clear the counters- no other value has any effect.

Beltweigher Specifications

Belt

Max. belt speed:- 16666 mm/sec or 1000 m/min or 3280 ft/min

Max. tacho pulse rate:- 200 pulses/sec

Note. If either of the above is exceeded, the display will show '-FAST-' and weight recording will stop.

Min. tacho pulse rate:- 1 pulse/sec

If the pulse rate is below this, the belt is considered to have stopped.

Max. tacho roller circumference:- 932.0 mm or 36.6 inches

weight

Resolution:- CAL-3 (Test weight) grammes / CAL-2 (Span count)

Max. load cell capacity:- 125kg @ 1000 m/min belt speed,
250kg @ 500 m/min belt speed etc.

Max. test weight:- 30kg

Max. delivery rate:- 3600 tonnes per hour

Max. weight display capacity:- 65535 tonnes

Inputs and outputs

P1 AC Power to BE4 Instrument (OLD TYPE AC UNITS ONLY)

P2 Data I/O to BE4 Instrument (24VDC SUPPLY TO BE4)

P3 General I/O

NOTE:- an input is ON if there is a short between the 2 input terminals, and OFF if the terminals are open.

All outputs are NPN open collector Darlingtons

terminals 11 & 12	Setpoint Mode Input (ON for Tonnes/Hr, OFF for Trip Tonnes)
terminals 9 & 10	Remote Display Select Input (Pulse ON to cycle mode)
terminals 7 & 8	CAL Mode Enable Input (ON to enable CAL mode)
terminals 5 & 6	Tonnes Impulse Counter Output (6 is +24 Volts)
terminals 3 & 4	Setpoint Output (6 is +24 Volts)
terminals 1 & 2	Variable Rate Impulse Counter Output (2 is +24 Volts)

P4 Port 1 (RS232)

terminal 1	0 Volts
terminal 2	Handshake Input
terminal 3	Serial Data Output (Tonnes/hour & total tonnes)

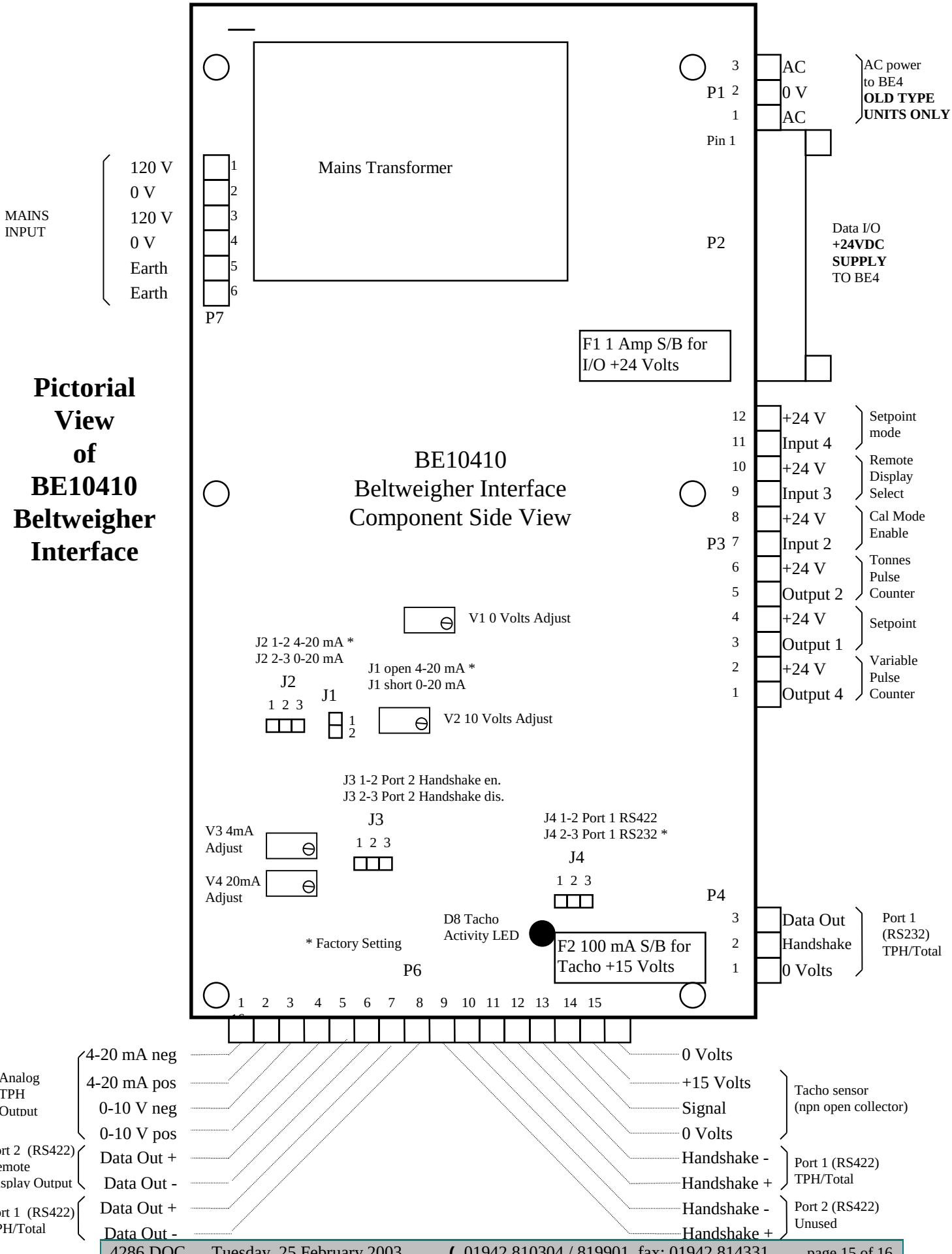
P6 Analog, RS422, and Tacho Interface

terminal 1	4-20 mA current return (negative)
terminal 2	4-20 mA current source (positive)
terminal 3	0-10 Volts negative
terminal 4	0-10 Volts positive
terminal 5	Port 2 RS422 +Serial Data Output (data output to remote display)
terminal 6	Port 2 RS422 -Serial Data Output (data output to remote display)
terminal 7	Port 1 RS422 +Serial Data Output (Tonnes/hour & total tonnes)
terminal 8	Port 1 RS422 -Serial Data Output (Tonnes/hour & total tonnes)
terminal 9	Port 2 RS422 +Handshake (unused)
terminal 10	Port 2 RS422 -Handshake (unused)
terminal 11	Port 1 RS422 +Handshake (Tonnes/hour & total tonnes)
terminal 12	Port 1 RS422 -Handshake (Tonnes/hour & total tonnes)
terminal 13	0 Volts to Tacho Sensor
terminal 14	Signal from Tacho Sensor (must be npn open collector type)
terminal 15	+15 Volts @100 mA MAX supply to Tacho Sensor
terminal 16	0 Volts

P7 Mains Input

NOTE: for 240 Volt operation, link terminals 2 & 3. For 110 Volt operation, link terminals 1 & 3, and terminals 2 & 4. Connect neutral to terminal 4, and live to terminal 1. Ensure a good earth connection is wired to terminal 5 or 6.

Pictorial View of BE10410 Beltweigher Interface

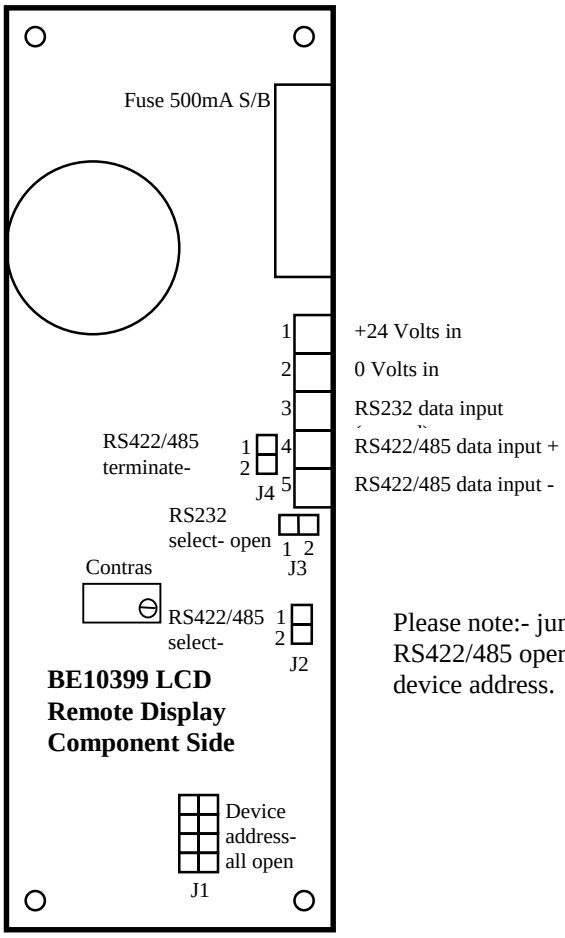


Connection Detail for Optional Remote Display

When the remote display is to be used, it should be connected to the interface board (BE10410) as follows:-

terminal 1	+24 Volts-	connect to +24 Volts	P3, (2, 4, 6, 8, 10, or 12)
terminal 2	0 Volts-	connect to 0 Volts	P6, 16
terminal 3	N/C		
terminal 4	+data-	connect to Port 2 +data	P6, 5
terminal 5	-data-	connect to Port 2 -data	P6, 6

Pictorial View of BE10399 Remote LCD Display



Please note:- jumpers set for RS422/485 operation, and no device address.