BERTEC
DOMINATE YOUR FIELD

INSTRUMENTED TREADMILL

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USER MANUAL

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CE

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Should you have any questions concerning this Agreement, please write to:

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INTRODUCTION

Bertec's instrumented dual belt treadmills have been specifically designed for dynamic analysis of human locomotion. Through the use of strain gauge technology, innovative design, and quality manufacturing, Bertec's instrumented treadmills are well suited for locomotion applications in limited laboratory spaces. Each treadmill consists of a number of strain gauged load transducers and a built-in digital pre-amplifier for signal conditioning.

Each half of Bertec's dual belt treadmill incorporates an independent force plate measuring six load components – the three orthogonal components of the resultant force and the three components of the resultant moment in the same orthogonal coordinate system. The point of application of the force and the couple acting can be readily calculated from the measured force and moment components independently for each half of the treadmill.

Bertec treadmills use a state-of-the-art 16-bit digital technology for signal acquisition and conditioning. This technology makes the use of calibration matrices obsolete, since each half comes with the calibration matrix already digitally stored on it. External amplifiers available for use with the treadmills provide the user with three signal output alternatives: digital, analog, or dual digital/analog outputs. The digital signal output can be directly plugged into the standard USB port of a personal computer without the requirement of an additional PC card for analog-to-digital (A/D) signal conversion. This plug-and-play technology allows a simpler installation procedure in a minimum amount of time.

The analog signal output can be fed into an A/D board so that data can be collected using conventional techniques. Depending on the application, signal amplification can be performed for analog output using external amplifiers. External amplifiers are either fixed or adjustable gain (four and seven adjustable gain models available). These amplifiers enable the user to establish a trade-off between the measurement range and the resolution of the treadmills.

Bertec's dual belt treadmills can easily be incorporated with the commercially available motion analysis systems to be used in a fully equipped locomotion laboratory.

Optional accessories for the treadmill are available as add-on features. These accessories include an incline feature, which can be used to tilt the treadmill up to 15˚; instrumented handrails to measure test subjects' grip forces; safety harness attachment; and caster attachments to relocate the treadmill.

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TREADMILL BASICS

Locomotion analysis can provide significant information regarding the kinetics and kinematics of human motion. The necessity for proper foot placement decreases the efficiency of locomotion analysis using conventional, stationary force plates. Use of a dual belt instrumented treadmill eliminates the need for targeting the force plate to record valid ground reaction data and avoids the cumbersome process of multiple trials.

In addition to increased efficiency, the controllable belt speed allows testing a wide range of subjects ranging from the elderly population to sprinting athletes.

Optional attachments such as the incline feature, instrumented handrails, and harness support structure allow tests to be performed under a variety of conditions.

TREADMILL DESIGN

Bertec's dual belt treadmill consists of two treads running side by side. Each tread has a 6-component force plate underneath to measure loads exerted on the tread belts. Each tread is driven and controlled separately. The tread belt and force plate structure is constructed such that the forces generated by the tread belt and the tension from the driving timing belt are internal forces and do not affect the load measurement. Both halves of the treadmill sit on a rigid steel structure or a split mounting plate depending on the requested model. The handrails are attached to this structure or directly to the mounting plates.

The tread belts are adjusted and balanced in the factory. Do not change the adjustments without consulting Bertec Corporation first.

Technical specifications of the treadmill are supplied on a separate data sheet. This data sheet provides design parameters such as maximum load capacity, analog load scaling constants, and maximum belt speeds. Please review this data sheet before running the treadmill.

The standard width of the tread belt is 12". Upon customer specification it can be manufactured in the range 12"-16".

Bertec treadmills are calibrated and pre-assembled in the factory. Installation should be done by authorized Bertec personnel only.

Do not attempt to disassemble the treadmill - damage can occur to the transducer components or electronics. The Limited Warranty is void if the treadmill or any of the accessories are disassembled without the authorization of Bertec.

To obtain a high quality measurement from Bertec treadmills they should be installed in a way that is suitable for the type of measurement to be performed. First of all, the floor and structure underneath should be prepared to be as rigid as possible in order to minimize any vibrations. Bertec instrumented treadmills are very sensitive devices. Therefore, they will pick up any vibration coming from the support structure. A second consideration is the flatness of the mounting surface. Uneven surfaces might cause the supporting structure to deform causing inaccurate measurements. Proper leveling and shimming should be done during installation.

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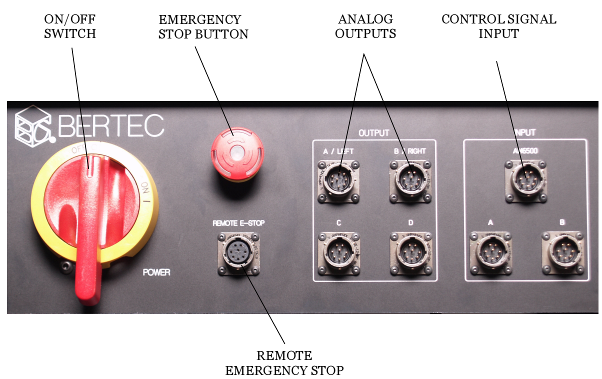
The treadmill can be installed on to the floor or into a pit so that the belt surfaces are flush with the floor. The height of the treadmill depends on whether it is fixed or inclining.

CONTROL ELECTRONICS

The control electronics are housed in a separate 19" rack with modular units. Each rack consists of a single power unit (***Power unit front panel***, below) and two (or three with the incline feature) control units (***Control Unit front panel***, next page). Each half of the treadmill (and the incline) is controlled by a single control unit. Due to control signal and power restrictions, the maximum distance from the treadmill motors to the electronics rack is about 3 m. Three cables run from the electronics rack to the amplifiers. They then continue on to the computer running the control and data acquisition software. These cables can be up to 30 m long. The control of the treadmill is carried out using an AM6500 USB amplifier. Load output from the treadmill can be either digital or analog (see *Amplifiers and Signal Converters* for available data acquisition units) depending on customer specification.

The electrical network used to supply power to the data acquisition systems and treadmill electronics rack should be properly grounded. Poor grounding is a common source of signal noise in electronic systems.

Cables can be a hazard for tripping. It is recommended that all cables be routed to prevent tripping. Alternatively, use masking tape, or some other non-permanent means, to hold the cables to the floor.



Front panel of the power unit in the treadmill control box

The power unit shown in the above figure houses the on/off switch, emergency stop button, connectors for analog outputs, and connectors for control signal inputs to the treadmill. The amplifiers for the analog load outputs are connected to the connectors labeled "A/LEFT" and "B/RIGHT". The AM6500 amplifier controlling the treadmill is connected to the connector labeled AM6500.

The red emergency stop button on the power unit can be used to bring the belts to a complete stop in case of an emergency. An additional emergency stop cable connected to the connector labeled "Remote E-Stop" is attached to the handrails of the treadmill so the test subject can also stop the treadmill if necessary.

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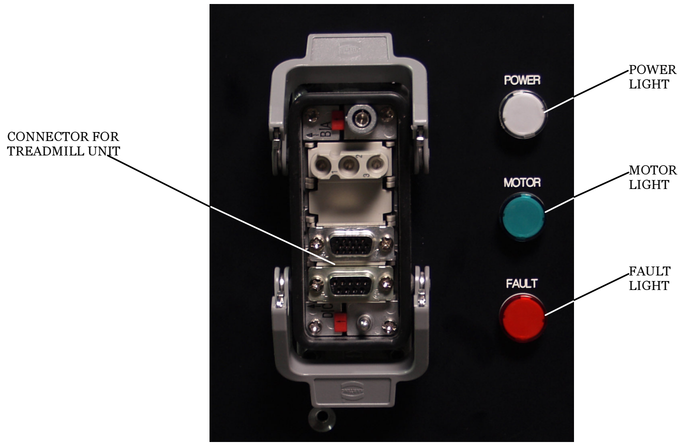

Front panel of the control unit.
Each half of the treadmill (and the incline option, if available) is controlled by a separate control unit.

The three cables (motor power, motor control, and load transducer signal) from the treadmill are connected to the connecter shown as show above. When the control box is powered, the white **power light** on each control unit comes on. A lit green **motor light** shows that the motors are powered by the control unit while the software is running. The red **fault light** shows that control unit has shut down due to overload or some other error condition. The control software will display the appropriate error message.

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CONTROL SOFTWARE

The treadmill is entirely controlled using only two windows (***Control Panel window***, below and ***Settings Window***, next page). The Control Panel is broken into two main sections: Belt Control and Incline Control (Incline Control is not displayed if the incline feature is not available). Also available on the bottom of the Control Panel are the two stop buttons and the "Settings" button.

BELT CONTROL

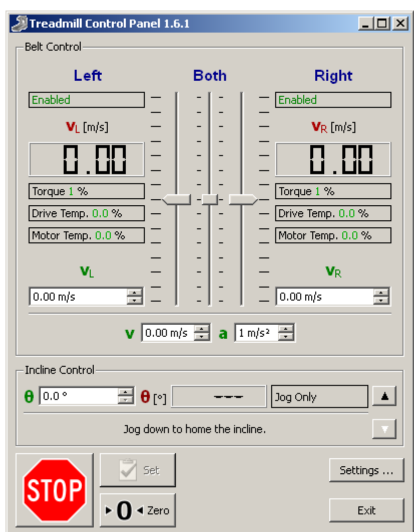
The Control Panel (***Control Panel window***, below) allows the user to direct the belt speed and acceleration.

The top left and right fields indicate if the treadmill is properly connected and ready to operate by displaying “Enabled”. If the fields do not display “Enabled”, then check the cable connections between the computer and the amplifiers, the amplifiers and the electronics, and the electronics and the treadmill.

The middle display fields – V_L, V_R, Torque, Drive Temp., and Motor Temp. – provide feedback from the treadmill. The user does not have access to these fields as they are for reference and diagnostic purposes only. These velocity fields (labeled in red) display the actual speed(s) the belts are moving as reported back by the treadmill.

The left and right sides of the treadmill can be controlled independently or jointly. The vertical slider bars allow for coarse control of the belt velocity. The individual velocity fields (labeled in green) allow for independent fine control. Below the independent velocity fields are the joint velocity and acceleration fields. These fields are used for fine control when running the treads together. For a description of the alternative control method see the section on *Settings*.

Changes to belt velocity and acceleration, independently or jointly run, can either take effect immediately or be delayed depending on the option checked in the Settings window. For more information about this feature, refer to the *Settings* section.



Control panel window for treadmill acceleration, velocity, and incline control

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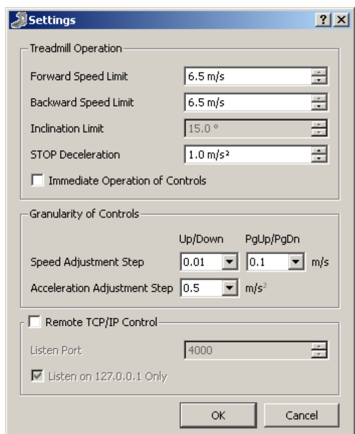
SETTINGS

The Settings window (***Settings Window***, below) is composed of three sections: Treadmill Operation, Granularity of Controls, and Remote Control. This window is available by clicking on the "Settings" button on the bottom right of the Control Panel.

The Treadmill Operation section allows the user to set maximum forward and backward velocities. For example, the Backward Speed Limit may be set to 0 m/s if you do not want the treadmill to run backward. The Inclination Limit is factory preset at 15˚ and can be lowered as necessary. The Stop Deceleration field allows the user to set the deceleration rate of used by the treadmill when the "Stop" button is clicked on the Control Panel. For more information on stopping the treadmill, see the *Stopping* section. By checking the box labeled Immediate Operation of Controls, the treadmill is enabled to immediately respond to any changes in velocity, acceleration, or inclination made while using the Control Panel. If the box is not checked, then changes to velocity, acceleration, and inclination may be made on the Control Panel, but they will not go into effect until the "Set" button at the bottom of the Control Panel is clicked. The "Set" button only becomes active if this box is checked. This allows the user to program multiple changes in the treadmill conditions and have them all go into effect at once.



The Settings window
This allows setting the treadmill's functional limits as well as the increment change for velocity and acceleration used in the Control Panel.

The Granularity of Controls section allows the user to adjust the increments by which the velocity and acceleration on the Control Panel move. The Speed Adjustment has two adjustments: fine (left pull-down) and coarse (right pull-down) in m/s. The Acceleration Adjustment only has one adjustment in m/s^2.

These adjustments are useful in that the treadmill control software has an alternative control feature. While on the Control Panel, hitting the "Tab" key on the keyboard highlights the velocity and acceleration fields and moves through those fields. The user can then use the Up and Down Arrow keys and the Page-Up and Page-Down keys on the keyboard to adjust speeds and acceleration without using the mouse or manually entering numbers. The Page-Up and Page-Down keys allow for coarse control, set in increments of tenths of m/s for velocity. The Up and Down Arrow keys allow for fine control, set in hundredths of m/s for velocity. The amount of change that each key hit corresponds to is controlled by the Granularity of Controls.

The final feature of the Settings window is under the Remote Control section. This section is used for remote control of the treadmill via a network. For further details, please contact Bertec directly.

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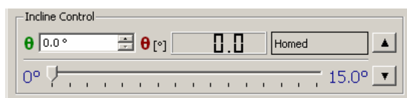
INCLINE CONTROL

The incline feature is an available option; treadmills do not come standard with this feature. For those treadmills without the incline feature, then this section will not be displayed in the Control Panel.

When the control software is first started, the incline feature is not fully activated. This is indicated by the text “Jog Only” displayed in the Incline field of the Incline Control portion of the Control Panel (see the ***Control Panel window*** figure). In order to fully activate the incline feature, the user must manually calibrate, or home, the zero position of the incline. To home the incline, click and hold down the down arrow in the Incline Control section until the treadmill is completely down (the treadmill will make an audible “thump” noise when it is down). Once it is completely down, the treadmill will automatically take this as its zero position. The **θ** degree indicator (labeled in red) and the horizontal degree slider bar now become active, and the Incline field will display “Homed” (see ***Incline Control and Drive Status***, below). The incline feature is now completely active, and the **θ** degree selector (labeled in green) or slider bar may be used to change the slope of the treadmill. The degree indicator displays feedback from the treadmill indicating the actual degree of incline. If you wish to limit the maximum incline angle, refer to the Settings section.



The Incline Control and Drive Status section.
This is only available with a completely activated treadmill with the incline feature.

STOPPING

In addition to the two manual emergency stop buttons, the control software provides two stop buttons. These are the buttons to be used during normal operating conditions. The “►O◄ Zero” button slows the treadmill to a stop using the current acceleration specified by the user in the acceleration field of the Belt Control section of the Control Panel. The “Stop” button slows the treadmill to a stop using the deceleration preset in the Stop Deceleration field of the Settings window. These two stop buttons always take immediate effect regardless of the status of the “Immediate Operation of Controls” box in the Settings window.

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DATA ACQUISITION AND LOAD CALCULATIONS

All Bertec products use a novel 16-bit digital technology for signal acquisition and conditioning. The output signal of the load transducers are already digitized and conditioned in the treadmill force plates by using state-of-the-art electronics developed by Bertec Corporation. With this new technology, the output signal has a very high signal-to-noise ratio, which means increased sensitivity and accuracy for the force plates. In addition, the digital technology makes the use of calibration matrices obsolete, since each plate comes with the calibration matrix already digitally stored on it. Depending on the configuration, the system provides the user with a digital, analog, or dual digital/analog output.

The digital output of the system is always in the form of calibrated data in their respective units selected by the user (N and N•m, or lb and lb•in). The analog output requires an additional scaling depending on the external amplification used in data acquisition.

ANALOG DATA ACQUISITION

The output of the treadmill force plate is in the form of a 16-bit digital signal. External digital-to-analog (D/A) converters are used in order to obtain an analog output to be used in conventional data acquisition systems. The D/A converters are also analog amplifiers with either a unity (6501 series) or adjustable gain (6504 and 6800 series) setting (for a detailed description of amplifiers please refer to Amplifiers and Signal Converters). The pin configuration for the 15-pin analog output is given the ***General Specifications*** section.

Before starting to collect data, make sure that the cables from the treadmill to the control electronics, from the control electronics to the amplifiers, and from the amplifiers to the computer are properly connected. The force plates reach thermal stability in about 5 minutes. Therefore, always allow the equipment to warm up at least for 5 minutes before collecting data.

AUTO ZERO

All <u>analog</u> amplifiers are equipped with an "*Auto Zero*" button. This button allows zeroing offset loads up to full scale. This functionality can be used to remove tare weight placed onto the treadmill as part of the measurement protocol. When the amplifier is first turned on, of the two green lights next to the *auto zero* button, only the bottom one will be on, confirming that the amplifier is powered. This indicates that zero has not been set yet. Simply press and release the *auto zero* button in order to zero the bridges on the amplifier. When zero is set, both lights next to the *auto zero* button will be on.

For the 6800 series amplifiers, the *auto zero* button is next to the power switch on the front panel. For the 65XX series amplifiers it is located next to the 15-pin output connector.

Note that auto zeroing sets all channels to near zero. True zeroing should be done by software at the time of data collection by subtracting a baseline reading from the collected data.

The analog data acquisition procedure can be summarized as follows:

- Check all the cables, and make sure that they are properly connected.
- Turn on the amplifiers, and allow the system to warm up at least for 5 minutes.

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- For the 6504 and 6800 series amplifiers, set a proper gain value for the data channels using the gain switch.
- Press the auto zero button to remove any load offset from the signals.
- Using the control software, set the speeds for the right and left sides of the treadmill.
- Collect analog data using software. Remember to remove a baseline reading from the signals in order to set the signal mean values to true zero.

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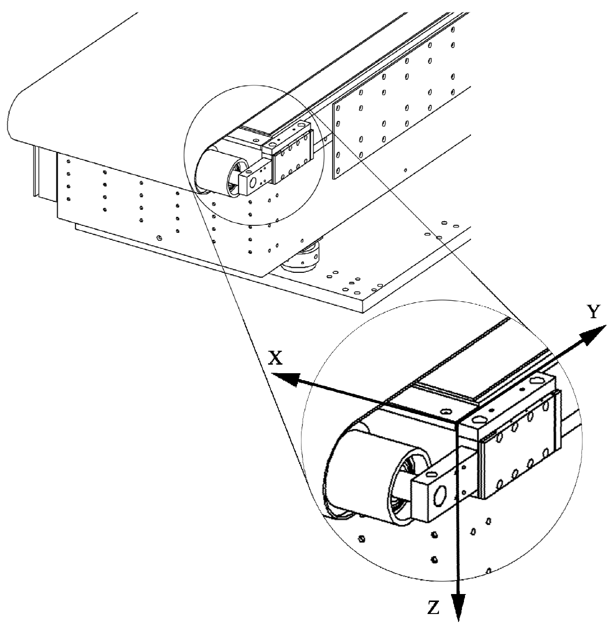
CALCULATING LOAD VALUES

Each force plate is calibrated individually and the calibration matrix is stored digitally in the force plate. Therefore, the analog output from the amplifier provides full-scale calibrated output (±5 V) per rated load range of the attached force plate. The voltage output of each channel is a scaled form of the load in the units of N and N•m for the forces and moments respectively. The scale factor for each channel for a gain of unity is given in the product data sheet supplied with the transducer. The force and moment values are calculated by multiplying the signal values with corresponding scale factors, as given in the following equation:

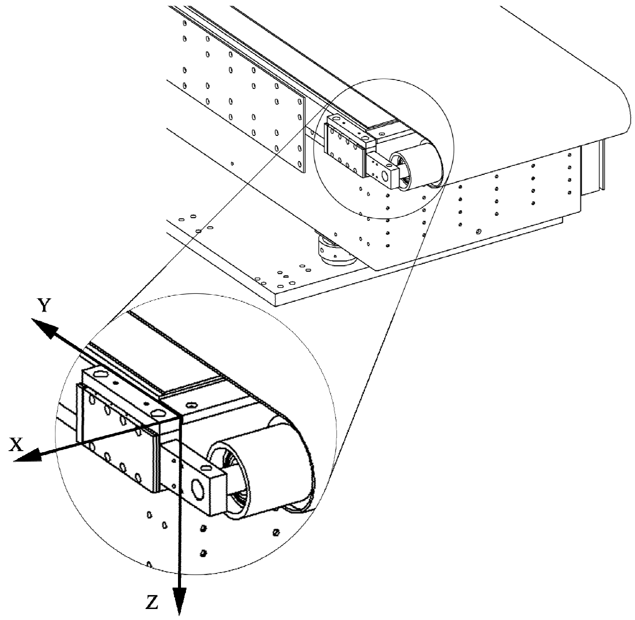
$$
\begin{aligned}
F_x &= C_1 \cdot S_1 \\
F_y &= C_2 \cdot S_2 \\
F_z &= C_3 \cdot S_3 \\
M_x &= C_4 \cdot S_4 \\
M_y &= C_5 \cdot S_5 \\
M_z &= C_6 \cdot S_6
\end{aligned}
$$

Force and signal scale factors

where, F's and M's are the force and moment components in the force transducer coordinate system (***Figure 6***), and S's are the output signals corresponding to the channels indicated by their subscripts, in volts, divided by the respective channel gain. The origin of the coordinate system is centered at the inner corner of the outer back roller support block of the corresponding (right or left) treadmill half (***Figure 6*** and ***Figure 7***). The standard coordinate system is such that the positive y-direction points forward; x-axis is to the left when looking in the y-axis direction; and the z-axis is defined downwards by the right hand rule.



Coordinate system for load measurements, right half of treadmill
The center of the coordinate system is at the inner corner of the arm block with y-axis forward, x-axis to the left (pointing inwards looking from behind), and z-axis downward.



Coordinate system for the left half of the treadmill
The y-axis is forward, the x-axis is to the left (outwards, looking from behind), and the z-axis is downward.

CALCULATION OF THE POINT OF APPLICATION OF FORCE AND COUPLE

A load system acting on a treadmill belt can be completely described by the six load components (i.e. the three force and three moment components) calculated from the ***Force and signal scale factors*** equation. Alternatively, the same information can be given as the three force components, the point of application of the force vector (x_p, y_p), and a couple (sometimes also referred as "torque" or "free moment") acting on the force plate. The point of application of the force and the couple are calculated from the force and moment components as:

$$x_p = \frac{-h \cdot F_x - M_y}{F_z}$$

$$y_p = \frac{h \cdot F_y + M_x}{F_z}$$

$$T_z = M_z - x_p \cdot F_y + y_p \cdot F_x$$

Force and Couple equation

Where x_p and y_p are the coordinates of the point of application for the force (i.e. center of pressure) on the treadmill belt; h is the height difference of the belt surface from the x-y plane of the coordinate system (see the ***Coordinate system*** figures) and T_z is the couple acting on the force plate. The height h can be taken as 15 mm (0.58").

LOAD COMPUTATION EXAMPLE

Consider a case where the external amplifier gain is set to 10 (note that the gain value is always the same for all of the six channels). If, at an instant in time, the amplifier voltage outputs for the six channels are:

CHANNEL	OUTPUT, V
1	-1.450
2	2.235
3	4.765
4	3.095
5	-0.575
6	-1.016

Then, by dividing each output by the corresponding gain, the output signal values to be used in the ***Force and signal scale factors*** equation are obtained:

S_1 = -1.450/10 = -0.145 V

S_2 = 2.235/10 = 0.2235 V

S_3 = 4.765/10 = 0.4765 V

S_4 = 3.095/10 = 0.3095 V

S_5 = -0.575/10 = -0.0575 V

S_6 = -1.016/10 = -0.1016 V

Let us use hypothetical scale factors, in N/V and N•m/V [*]:

C_1 = 1000 N/V

C_2 = 1000 N/V

C_3 = 1500 N/V

C_4 = 300 N•m/V

C_5 = 300 N•m/V

C_6 = 250 N•m/V

Then from the ***Force and signal scale factors*** equation:

F_x = 1000 • (-0.145) = -145.0 N

F_y = 1000 • (0.2235) = 223.5 N

F_z = 1500 • (0.4765) = 714.8 N

M_x = 300 • (0.3095) = 92.9 N•m

[*] Note that if the results are needed in English Units, an alternative to converting them at the end of calculations is to convert the scale factors to English Units by converting the first three factors from N/V to lb/V, and the last three factors from N•m/V to ft•lb/V. This can be done by multiplying the first three scale factors by 0.2248 lb/N, and last three scale factors by 0.7376 (ft•lb)/(N•m).

M_y = 300 • (-0.0575) = -17.3 N•m

M_z = 250 • (-0.1016) = 25.4 N•m

To calculate the point of application of the force, the ***Force and Couple equation*** is used. With h=0.015 m the coordinates of the Center of Pressure on the belt will be:

$$x_p = \frac{(-0.015)\cdot(-145.0)+17.3}{714.8} = 0.027\ \mathrm{m}$$

$$y_p = \frac{(-0.015)\cdot(223.5)+92.9}{714.8} = 0.125\ \mathrm{m}$$

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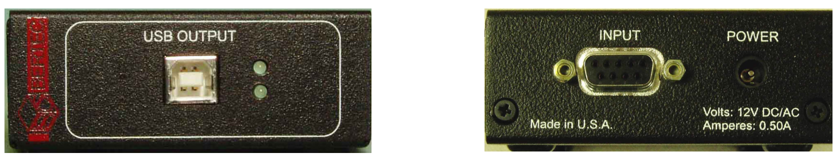
AMPLIFIERS AND SIGNAL CONVERTERS

Signal conditioning and amplification for the treadmill force plates are provided by means of external amplifiers. Each force plate has an internal digital preamplifier, which digitizes the analog signal from the transducer strain gauges, and conditions it through oversampling, preliminary amplification, and filtering. The calibration matrix of the force plate is digitally stored on the preamplifier so that the output is already calibrated data having the units of Newtons and Newton-meters. The output of the force plate is a 16-bit digital signal using RS-485 format.

AM6500 DIGITAL SIGNAL CONVERTER

The AM6500 series external converter is used to control the motion of the treadmill belts. It can also be used to collect data through the USB port of the computer. The input-output connections for the AM6500 module are shown in the figure below. The output is a standard B-type USB connector. Next to the connector are two LED lights. The lower light is on when the unit is powered, and the upper light comes on if the unit is connected to the USB port of the computer. The input to the module is via a 9-pin D-Sub connector located at the back of the unit located next to the power input. When they are used with treadmills, no external power source is needed.



AM6500 Digital Signal Converter connections

AM6501/AM6504 ANALOG AMPLIFIER

The **AM65XX** series external analog amplifiers are utilized to convert the digital output of the treadmill force plates to an analog signal using a **fixed** or **variable** gain value. The number of gain values is indicated by the suffix XX in the model identifier (i.e. 6501 – unity gain, 6504 – gain of four, etc.). These amplifiers also provide an *auto zero* button to remove tare load offset. When they are used with treadmills no external power source is needed.

The input and output connections to the AM65XX modules are shown in the figure below. The pin assignments for the analog output channels are shown in the ***General Specification*** section. The output voltage range for all channels is ±5V. Shorting pins 9 and 10 on the 15-pin output connector has the same effect as pushing the *autozero* button.

AM65XX series connections

The lower light is on when the unit is powered. A blinking LED indicates that the unit is not connected to a treadmill force plate. If the LED is blinking, check all the cable connections to the treadmill.

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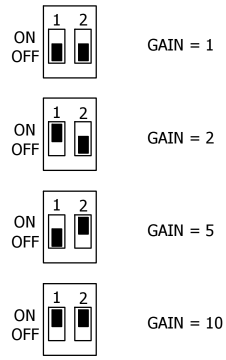
The AM6504 has two additional dipswitches on the top surface to set the gain for the output signal. Each switch has an ON/OFF setting. The gains corresponding to each setting are given below:



Gain switch settings for the AM6504

AM6800 DUAL OUTPUT, ADJUSTABLE GAIN AMPLIFIER

The **AM6800** amplifier, shown below, incorporates both analog and digital outputs into one unit. The gain of the analog output is user selectable, and has 7 different settings (1, 2, 5, 10, 20, 50, 100). A single gain selection switch is provided for all 6 output channels. A three-digit LED display on the front panel shows the current gain setting. The channel signal indicators show the polarity of the analog output for the six force plate channels. The *auto zero* button is utilized to remove tare load offset from each channel output. The mains power input is a universal input with the range 100-240 V, 50-60 Hz. The digital output is a USB signal.

If the unit is not connected to a treadmill force plate, the digital display will read "**PLA**". After the force plate is properly connected to the unit, when the amplifier is turned on, the display will briefly (about 0.5 sec.) show the message "**CAL**", which indicates that the amplifier has successfully recognized the force plate. Finally, the gain setting will display on the digital readout. The pin assignments for the analog output channels are shown in the ***General Specification*** section.

A 19" rack mounting adaptor for AM6800 is available upon request from Bertec Corporation.

AM6800 amplifier

On the front panel of the AM6800 amplifier, the two lights between the auto zero button and power switch, the bottom one comes on when the unit is switched on, and the top light is lit after the auto zero button is pressed.

The input and output to the unit is through 9-pin and 15-pin female D-Sub connectors respectively.

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GENERAL SPECIFICATIONS

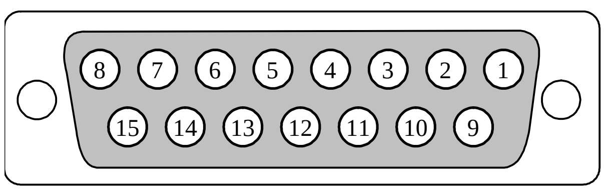
The AM65XX series and AM6800 amplifiers provide a ±5 V full-scale calibrated analog output per rated load range for each of the six force plate channels. For example, if the force plate has a ±10 kN load range for the Fz channel, then for a gain of unity, the –5.00 V output corresponds to –10 kN, and +5.00 V stands for +10 kN (i.e. a sensitivity of 0.5 mV/N). The analog gain used in data acquisition represents a trade-off between maximum load range and force plate sensitivity. If the same force plate above is used with an amplifier gain of 5, then the load range will be limited to ±2 kN. This means the plate now has an increased sensitivity of 2.5 mV/N. The analog load scale factors for specific force plates, given on the product data sheet supplied with the force plate, are specified for a gain of one.

The analog output signals are filtered so that they have a standard bandwidth of 500 Hz. The actual analog gain ratios are applied to the digital signal with an accuracy of 99.997%.

The *auto zero* button removes the signal offset and sets the analog output signal within ±5 mV. This feature can be used to increase the useful measurement range of the force plate by shifting the signal baseline. Note that *auto zero* might not set the mean value of the signal to true zero. Therefore, an additional offset removal through software is suggested.

The digital input to all external amplifiers and signal converters is a female 9-pin D-Sub connector, whereas the analog output is in the form of a female 15-pin D-Sub connector with the pin assignments shown below. Shorting pins 9 and 10 has the same effect as pushing the autozero button on the AM6501 and AM6800.

The output range for each channel is ±5V.



CH1 : Pin 3
CH2 : Pin 4
CH3 : Pin 5
CH4 : Pin 6
CH5 : Pin 7
CH6 : Pin 8
GRND : Pin 10
Autozero: Pin 9

Pin configuration for the standard analog 15-pin connector

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CUSTOMER SUPPORT

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Suggestions or comments about Bertec products are always welcomed.

DOCUMENT REVISION HISTORY

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09/14/2009	1.00	Initial Revision	Todd Wilson
08/04/2010	1.01	Treadmill diagram updated	Todd Wilson
04/15/2011	1.02	Equation updated	Todd Wilson
10/03/2011	1.03	Treadmill diagram updated	Todd Wilson

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