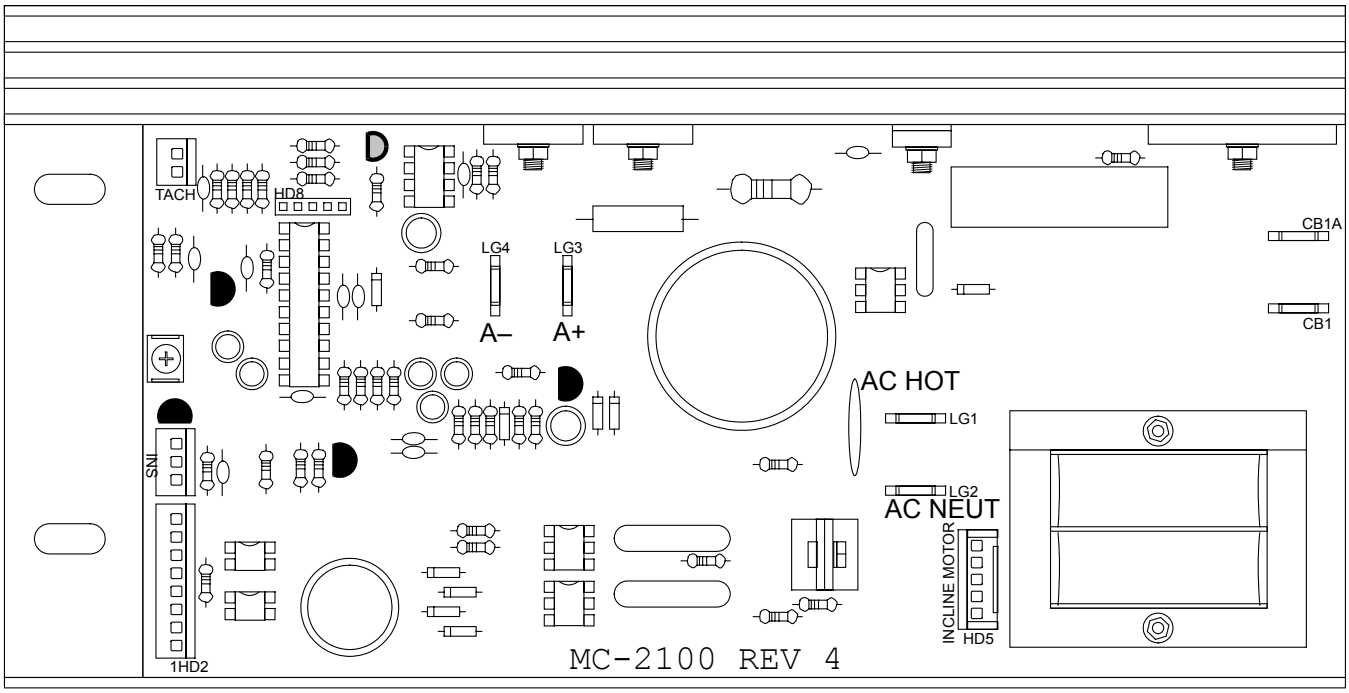

MC-2100/MC-2100E Motor Controller

The MC-2100 combines a PWM motor controller with a power board. It is designed to replace the combination of an MC-60 or MC-2000 with a PB-12i (or other) power board. The controller uses the same eight wire harness that has been used on Icon treadmills for the past several years. The wire colors and voltage signals are identical. A European version, the MC-2100E, functions identically, except the input voltage is 230 VAC 50 Hz. A specialized version of the MC-2100E, the MC-2100ENI, does not include any incline circuitry. Only the first four wires in the wire harness connect it to the console.

One difference between the MC-2100 and earlier controllers is that the on/off circuit breaker has its own connection directly on the board. On some MC-2100's, the switch will be hard-mounted directly on the circuit board. These controllers will mount directly to the belly pan. Other MC-2100's will have two spade connectors allowing the on/off circuit breaker to be mounted in another location. The switch is then connected to the controller with two jumper wires.

The MC-2100 has its own processor and software, which allows it to communicate with the console. This is done by a small digital signal carried by the GREEN tach wire. By entering calibration mode on the console, two alternate screens can be accessed which give information on the controller, including the status of the troubleshooting LED, motor voltage, and motor amperage. This greatly increases the amount of troubleshooting that can be done without removing the treadmill's motor hood.

Some MC-2100 controllers will have the transformer mounted on the circuit board as shown above. Other versions will have a larger transformer mounted directly to the treadmill frame with jumper wires connecting it to the controller. This allows a higher amp draw from consoles with many LEDs/LCDs. All MC-2100E controllers will have a separate transformer.

Controller Voltages

CB1, CB1A- These connections are for the two terminals of the on/off circuit breaker. The on/off breaker may be soldered directly onto the circuit board or attached by wires. When soldered, the incoming AC Hot wire (BLACK) will be routed through the thermal switch on the drive motor. When attached by wires, one wire will be routed through the thermal switch. 120 VAC will be measured across the open switch when power is applied. 0 VAC will be measured when the switch is closed. *NOTE: These connections are not present on the MC-2100E.*

LG1- Labeled AC HOT, this spade connector receives the incoming 120 VAC (BLACK) from the power cord (or BLUE from the thermal switch if the on/off circuit breaker is hardwired to the MC-2100). This voltage will be present whenever the treadmill is plugged in.

LG2- Labeled AC NEUT, this spade connector is where the AC Common (WHITE) wire is attached from the power cord.

LG3- Labeled A+, this terminal is the positive connection for the RED drive motor wire. Voltage between this connection and LG4 will measure 0 VDC when the treadmill is at rest to approximately 100 VDC when the treadmill is running at full speed.

LG4- Labeled A-, this connection is for the BLACK drive motor wire. This is the negative terminal for the motor wires

HD2- This eight wire connection attaches the controller to the console. Each wire carries the following voltage signal:

BLACK- (Two wires) These are the ground wires for the console. All other voltages taken on the 8-wire harness are in reference to either of these wires. *Note: On the MC-2100SDI, the second Black wire (the one next to Violet) carries a very small pulsing voltage the console monitors to count the number of steps taken by the user.*

RED- This wire supplies the console with 9 VDC.

GREEN- This wire brings the speed sensor signal to the console. This is a pulsing 0, 5 VDC signal as the treadmill is running. When the treadmill is at rest, this voltage may measure either 0 VDC or 5 VDC.

BLUE- This wire carries the square wave speed control signal from the console to the power board. The duty cycle of this 5 VDC signal is used to set the speed of the treadmill. At the maximum duty cycle of 85% (meaning the 5 VDC is being sent 85% of the time and not being sent 15% of the time), approximately 4 VDC can be measured. At lower speeds, a lower voltage will be measured. *NOTE: Many digital multimeters have difficulty measuring this square wave signal. They may only show a maximum of 1.5 VDC when the treadmill is set to its maximum speed. What is important to see in this instance is that the voltage goes up as the treadmill speed is increased.*

ORANGE- This wire carries a 3.5–5 VDC signal to the power board to cause the power board to send 120 VAC to the incline motor to increase the incline setting of the treadmill. This voltage should only be present when the incline is being increased.

YELLOW- This wire carries a 3.5–5 VDC signal to the power board to cause the power board to send 120 VAC to the incline motor to decrease the incline setting of the treadmill. This voltage should only be present when the incline is being decreased.

VIOLET- This wire carries the incline sensor signal to the console This is a pulsing 0, 5 VDC signal as the incline is moving. When the incline is at rest, this voltage may measure either 0 VDC or 5 VDC.

HD5- This connection is for the incline motor wire harness. The RED (down) and BLACK (up) wires are separated by a WHITE (AC Common) wire. When an *Incline* button is pressed on the console, the controller receives the incline signal and sends 120 VAC to the incline motor to turn it in the appropriate direction.

TACH- This connection is for the reed switch wire. This allows the tach signal to be received by the controller and passed to the console wire harness, where it is sent up the GREEN wire. Voltage is a pulsing 5 VDC when the treadmill is running. When the treadmill is at rest, this voltage may be 0 VDC or 5 VDC, depending on the whether the magnet is closing the reed switch or not.

INS- This connection is for the incline sensor. While it will usually be a reed switch, an optic switch can also be connected. 5 VDC will be present across the open switch. Whenever the switch closes, 0 VDC will be measured. As the incline motor turns, this voltage will pulse on and off. The number of pulses is used by the console to determine how far it has changed the incline. When the incline is at rest, this voltage may measure 0 VDC or 5 VDC, depending on the position of the switch in relation to the magnet (or optic disk).

Troubleshooting LED

The MC-2100 has a single troubleshooting LED. Unlike earlier motor controllers, which had several LEDs monitoring different conditions, the MC-2100's LED can give multiple signals. Each LED state and its meaning is given below:

OFF- The controller is NOT receiving AC voltage

ON (Solid)- The controller is receiving AC voltage, but is not receiving a speed signal.

ON (Blinking rapidly)- The controller is receiving a PWM signal and is sending voltage to the drive motor (A+ and A-).

ON (Blinking on and off once per second)- The controller is operating near its current limit. This indicates the controller is working harder than it should to maintain treadmill speed. Check for friction problems between the board and belt, an over tightened belt, or check the roller bearings.

ON (Blinking VERY slowly, on one second, off one second)- The controller has entered its 'fold-back' mode. This means the controller is working as hard as it can to turn the drive motor without success. It then 'folds back,' or reduces, the voltage and amp draw of the drive motor to prevent overheating.

The state of the troubleshooting LED is also shown on the treadmill console when in calibration mode. To view this information, enter calibration mode by inserting the safety key while holding the *Stop* and *Speed* ▲ buttons. Release the buttons, and then press *Stop* four times to advance to level 5 of calibration mode. Press and hold the two *Speed* buttons for two seconds to display the alternate calibration screen. The Speed window will now display the status of the LED. This is given as a numerical value:

0- The controller is not running (idle state)

1- Controller is in the RESET state. The drive motor will not be running. *Equivalent to +12V lighting on the MC-60.*

2- The high voltage buss is charged.

4- The high voltage buss is charging.

6- The high voltage buss is charged and the unit is running. *Equivalent to SPD CNTL and SCR TRIG lighting on the MC-60.*

14- Current Limit is active. *Equivalent to CUR LIM lighting on the MC-60.*

30- Controller is in fold-back. To prevent overheating, if the controller remains near its current limit for an extended time, it will reduce, or 'fold back,' the amount of current allowed. The controller will return to normal operating levels once the high current condition is corrected.