

**TREADMILL BASE ELECTRONICS –
AC MOTORS
TECHNICAL CERTIFICATION TRAINING**

Field Engineering | 2010

LifeFitness
WHAT WE LIVE FOR

Course Objectives

- » Topics to be covered include:
 - ◆ Block diagrams of the various Commercial Treadmill systems with AC Motors
 - ◆ Major components identified
 - ◆ LF requirements (ie. Dedicated Line) defined
 - ◆ Common Issues/Trouble-shooting tips

Treadmill Models – Next Gen/Classic



SN# RT Front

Next Gen



SN# RT Front

Silver Bullet/ Artic Silver

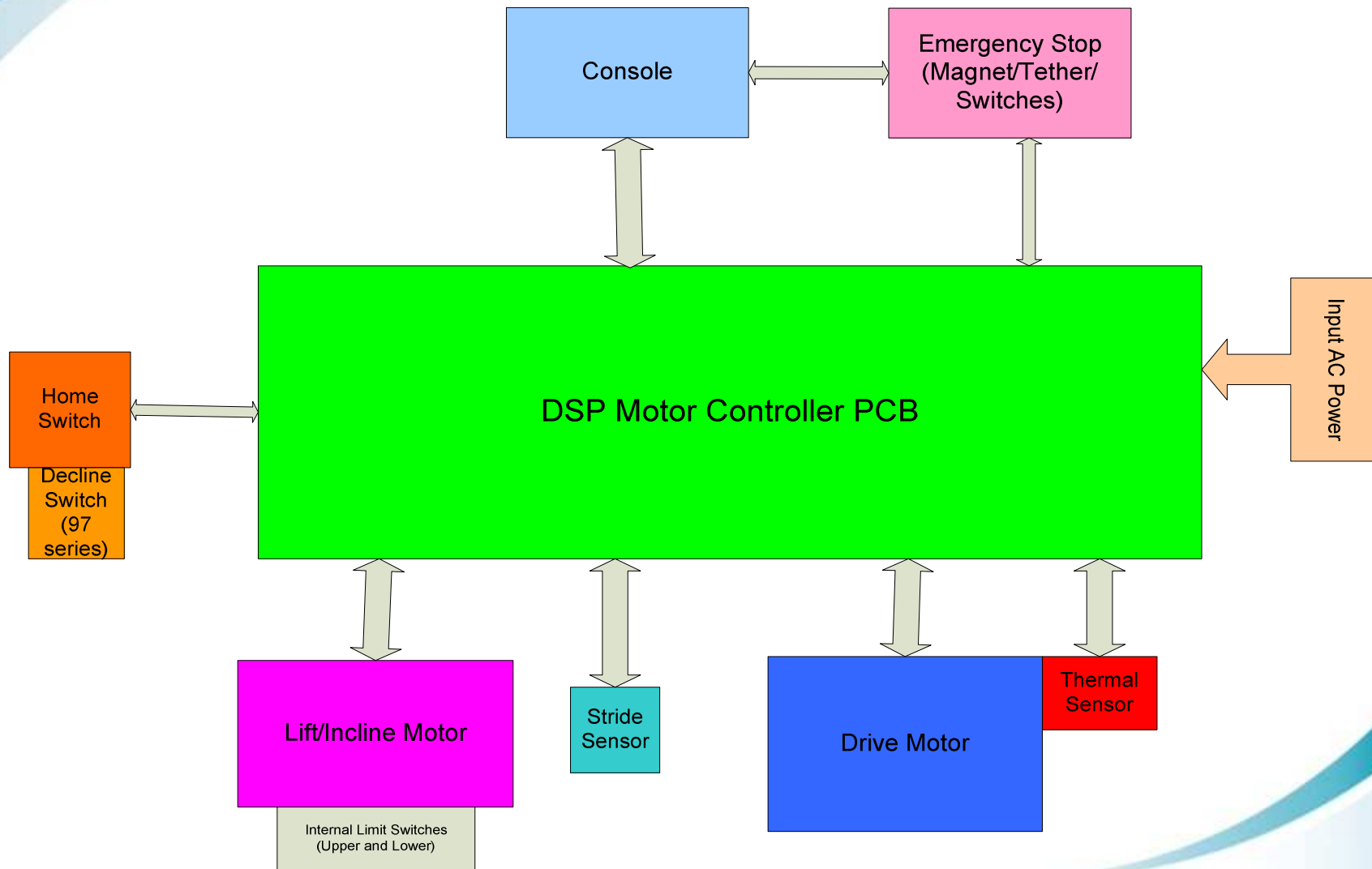
Treadmill Model - Elevation Series



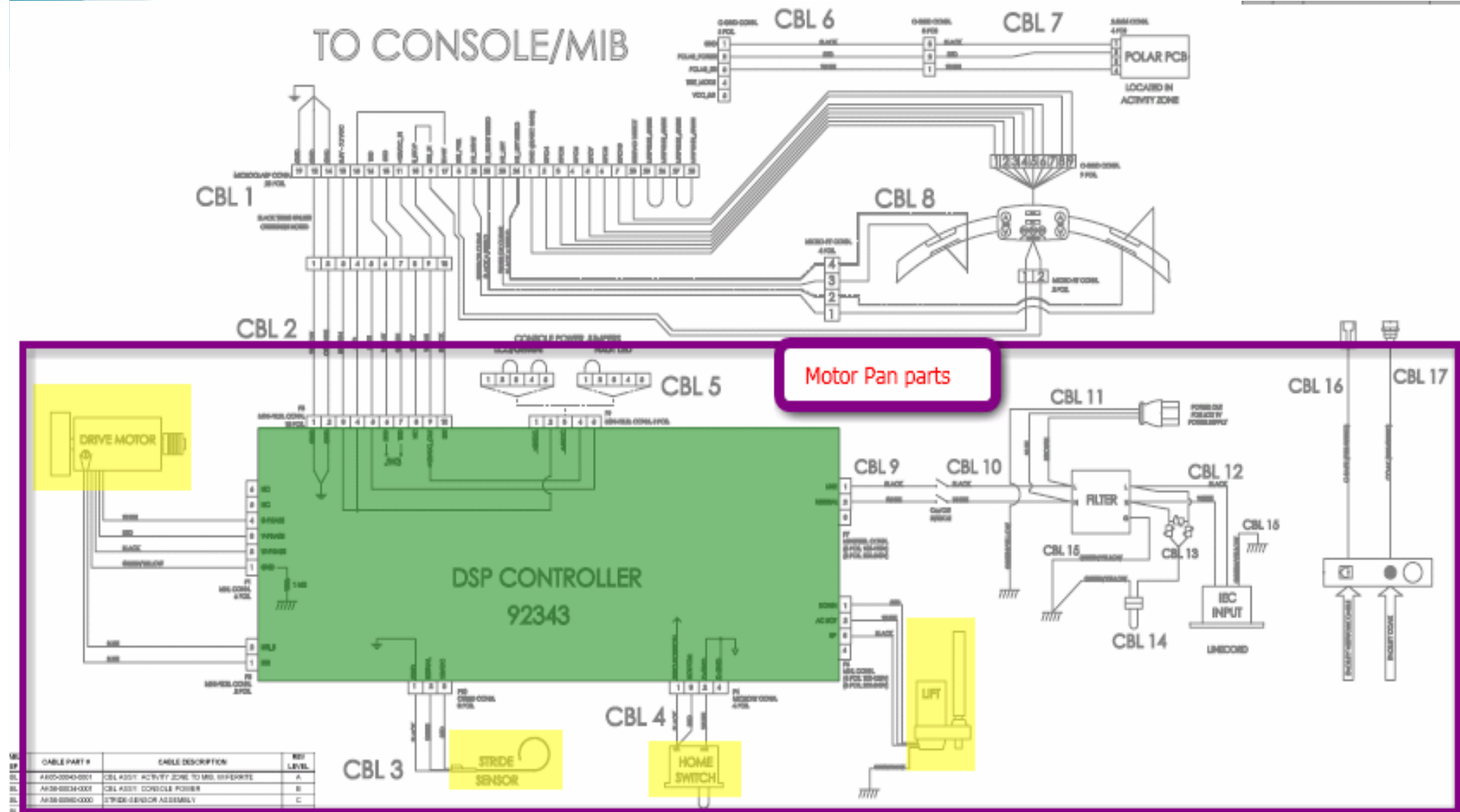
95T

Treadmill Block Diagrams

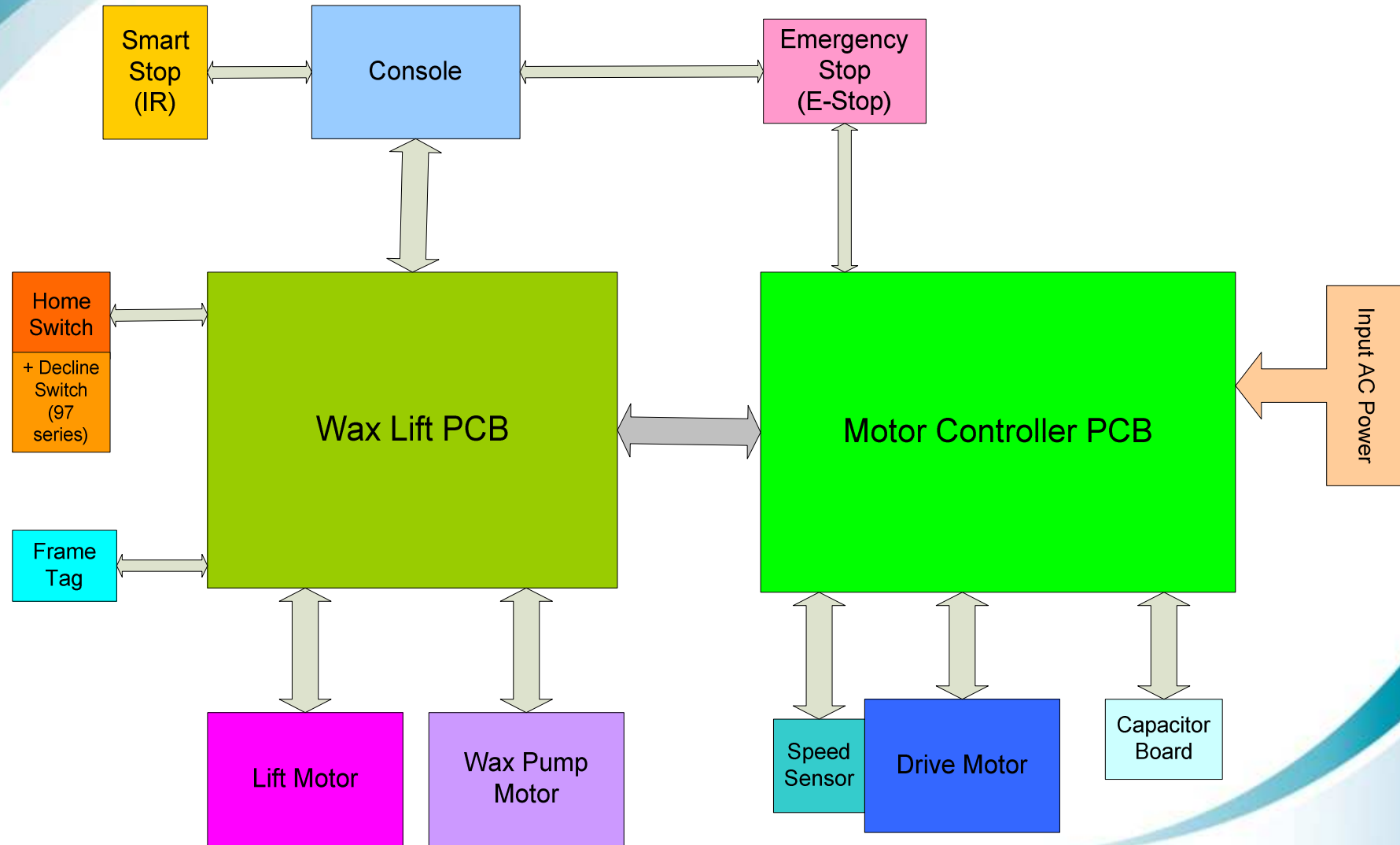
Classic/Elevation Treadmill – Block Diagram



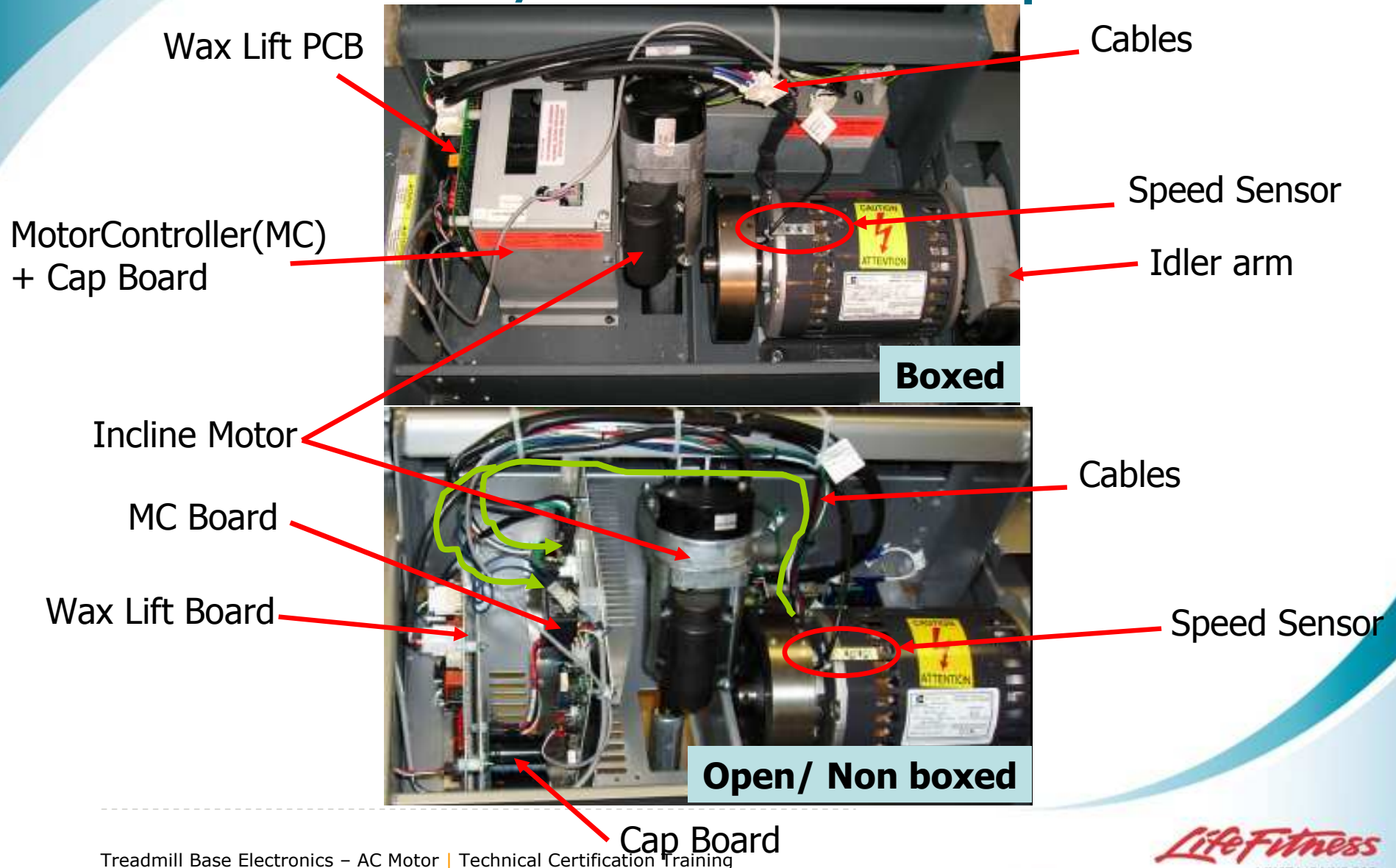
Wiring Diagram – Elevation Tread



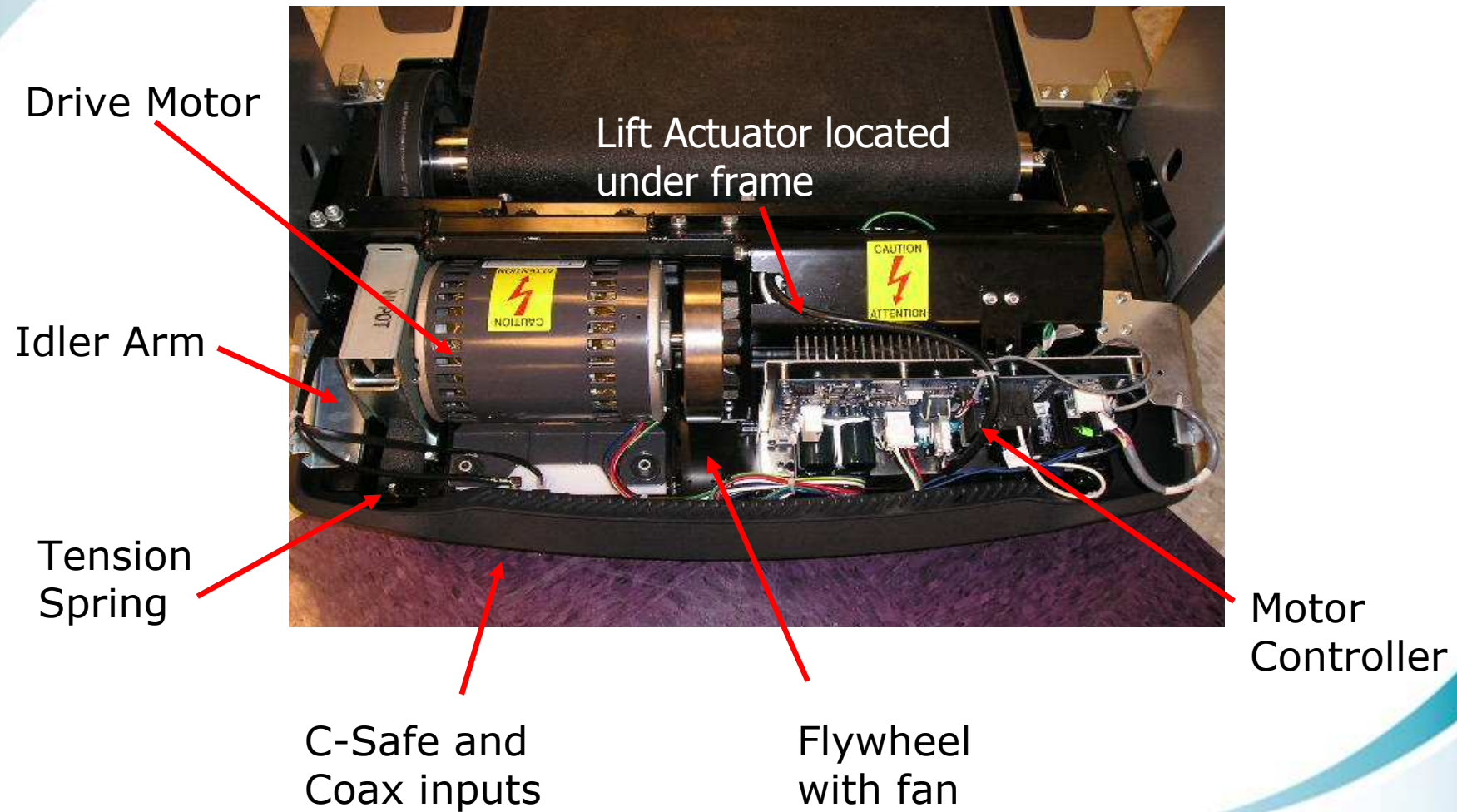
Next Gen Treadmill – Block Diagram



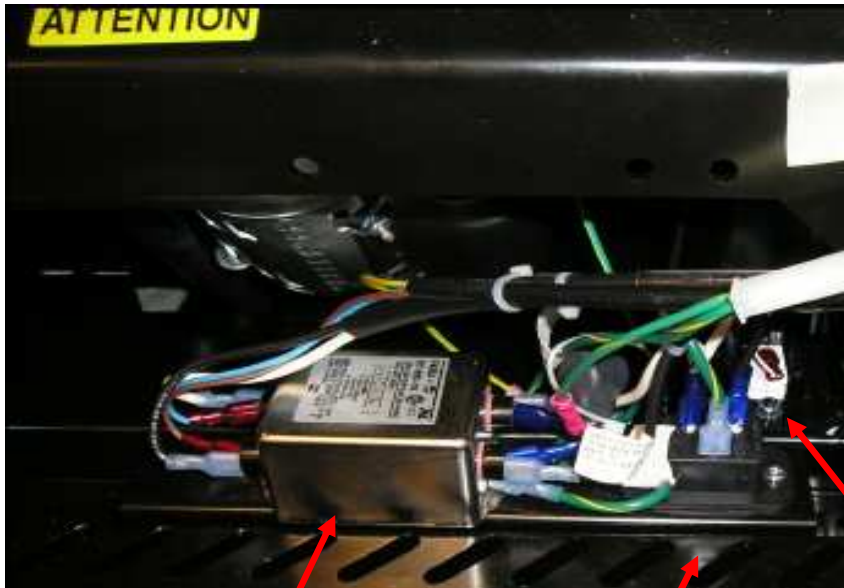
Next Gen/Classic - Motor Compartment



Elevation Series - Motor Pan

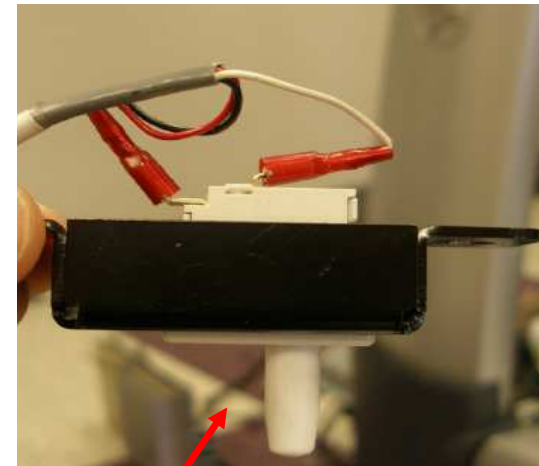


Elevation Series - Line Filter & Zero Switch



Line Filter purpose:
Block noise from
Tread to power cord.

IEC connector

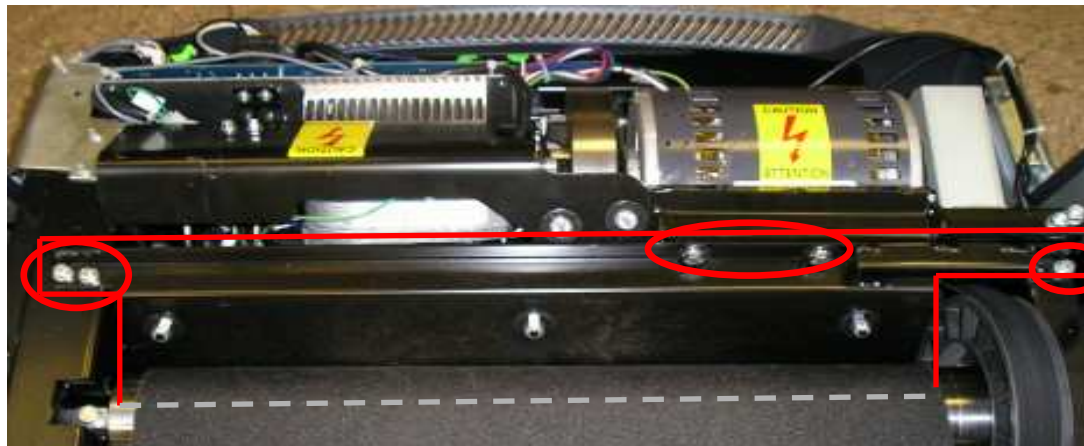


Zero/Home Switch

Elevation Series - Frame Supports



Support Bar is to be removed for Drive Motor replacement
(Remove 5 Hex and 2 Allen bolts)



Bar Tie is to be removed for Lift Actuator replacement
(Remove 5 bolts, and 3 nuts)

DO NOT REMOVE BOTH SUPPORT BAR and BAR TIE AT THE SAME TIME

Drive Motors

Drive Motors

- » Main Function is to drive the Treadmill Walking Belt.
- » AC Drive motors are available in 2 types:
 - ♦ AC Motor – Small/Thin boy, 2HP with Fan.
 - > Older Commercial Models
 - ♦ AC Motor – Big/Fat boy, 4 HP, no Fan.
 - > Newer Commercial Models.

Incline Motors (Lift Actuators)

Incline/Lift Motors

- » Incline motors are all AC motors.
- » Main Function is to drive the raise (or lower) the Treadmill Deck.
 - > Incline specified as a %.
 - > Ranges in the User Manuals.
 - > 97 Series Treadmills have a Negative Incline (Decline) – up to (-3%).
 - > Incline motors use the Home switch to determine starting position.
- » Incline motors have internal limit switches (top and bottom).
 - ♦ Internal limit switches are there for safety and should not activate.
 - ♦ With Internal limit activated, still allows activation in opposite direction – so Treadmill is still functional.

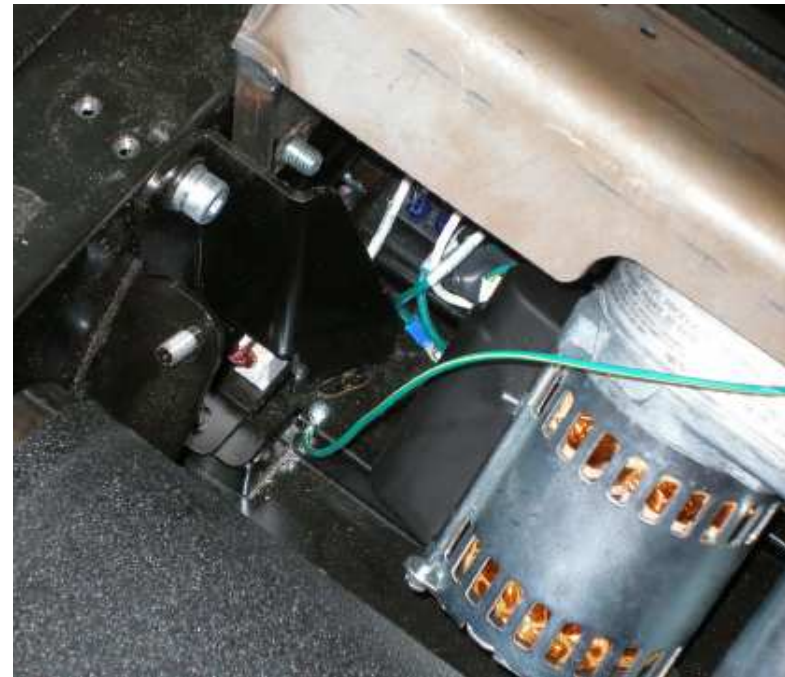
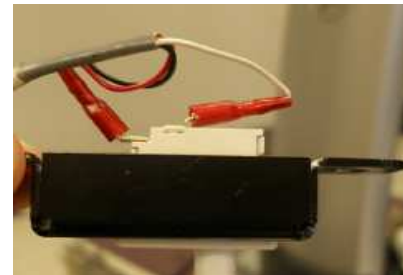
Incline Actuator

» How does it function?

- ◆ Works off of an AC voltage either 120 VAC or 220 VAC
- ◆ Powered from the Wax Life Board or the DSP controller
- ◆ Relays determine the On/Off and Incline/Decline signals.
- ◆ Has fuses on the Controller for protection.
- ◆ Must find home or zero first.
- ◆ Incline determined by duration of the On-Time.
- ◆ Has internal limits or stops for Top and Bottom.
 - > These are Factory set
 - > No calibration required.
 - > IMPORTANT not to turn the lift screw or nut prior to installing.

Elevation Series - Lift Actuator

- » Remove **Bar Tie** to access ground cable to lift actuator or zero/home SW.
- » Prop the front frame with a 4x4 block to access mounting bolt securing lift actuator to lift frame. Then disconnect clevis pin securing top of the lift actuator to frame



Motor Controllers

Motor Controllers

- » This is the brains of the Treadmill Base.
- » Communicates with the Console.
- » Interfaces to the various Base components.
- » Controls and regulates the speed of the striding belt.
- » Many different Motor Controllers made at LF. Parts List identify the different part numbers and their cross-reference to newer DSP Motor Controllers.
- » New DSP (Digital Signal Processor) Motor Controllers can be used in AC Motor units using Fat Boy Motors.
- » DSP Motor Controllers are NOT backward compatible with Thin Boy AC motor and DC motors.
- » A DSP motor controller allows for speed control of the main drive motor without an external speed sensor (a chopper wheel and a phototransistor).

Motor Controllers (DSP)

- » Service Bulletin TR09120301R2 (Treadmill Motor Controller and DSP Selection) is available on Iftechsupport website.
- » Bulletin shows substituting motor controllers with newer DSP Controllers.

			Motor Controller Part #'s (Latest supercede)		DSP (GK58-00002-xxxx) PCB Kit Part #'s		DSP (AK65-00071-xxxx) PCB Kit Part #'s			
Model ID	Prefix	Models Affected	Low Volt(120V)	High Volt(230V)	Low Voltage (120V)	High Voltage (230V)	Low Voltage (120V)	High Voltage (230V)	JW3	JW10
95T	TTI	95T-XXXX-01	AK58-00153-0001	AK58-00153-0002	N/A	N/A	GK65-00002-0018	GK65-00002-0019	IN	N/A
	TTJ	95T-XXXX-02	AK60-00171-0000	AK60-00171-0001 AK60-00171-0003 (w/Ferrite)	N/A	N/A				
	ATT	95T-XXXX-03	AK60-00171-0000 AK60-00171-0002 (w/Ferrite)	AK60-00171-0001 AK60-00171-0003 (w/Ferrite)	N/A	N/A				
	TCT	95T-XXXX-05	N/A	N/A	GK58-00002-0118	GK58-00002-0120	AK65-00071-0000 AK58-00522-0000 (LED) AK58-00523-0000	AK65-00071-0002 AK58-00522-0000 (LED) AK58-00523-0000	IN	N/A
	TSS	95T-XXXX-07	N/A	N/A	GK58-00002-0118	GK58-00002-0120				
95T Elevatio n Series	TWT	95T-XXXXXX-01	N/A	N/A	N/A	N/A	AK65-00071-0000 AK58-00523-0000	AK65-00071-0001 AK58-00523-0000	OUT	OUT IN
		95T-XXXXXX-02	N/A	N/A	N/A	N/A				
	TET	95T-XXXXXX-03	N/A	N/A	N/A	N/A				

Motor Controllers (DSP cont.)

- » Service Bulletin TR09120301R2 describes how to order motor controllers.
- » Changing from the original (green) DSP controller to the new (blue) DSP controller: Remove the Stride Sensor (Isolation) board and cables to green DSP. Stride sensor connects directly to P10 of new DSP controller.
- » Service Bulletin describes the jumpers that the service technician needs to verify/set.
 - ♦ P9: different for LED or LCD console
 - ♦ JW10: identifies welded Elevation Treadmill frame
 - ♦ JW3: communication jumper (2 or 4 wire)

			Motor Controller Part #'s (Latest supercede)		DSP (GK58-00002-xxxx) PCB Kit Part #'s		DSP (AK65-00071-xxxx) PCB Kit Part #'s			
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95T	TTI	95T-XXXX-01	AK58-00153-0001	AK58-00153-0002	N/A	N/A	GK65-00002-0018	GK65-00002-0019	IN	N/A
	TTJ	95T-XXXX-02	AK60-00171-0000	AK60-00171-0001 AK60-00171-0003 (w/Ferrite)	N/A	N/A				
	ATT	95T-XXXX-03	AK60-00171-0000 AK60-00171-0002 (w/Ferrite)	AK60-00171-0001 AK60-00171-0003 (w/Ferrite)	N/A	N/A				
	TCT	95T-XXXX-05	N/A	N/A	GK58-00002-0118	GK58-00002-0120	AK65-00071-0000 AK58-00522-0000 (LED) AK58-00523-0000	AK65-00071-0002 AK58-00522-0000 (LED) AK58-00523-0000	IN	N/A
	TSS	95T-XXXX-07	N/A	N/A	GK58-00002-0118	GK58-00002-0120				
95T Elevation Series	TWT	95T-XXXXX-01	N/A	N/A	N/A	N/A	AK65-00071-0000 AK58-00523-0000	AK65-00071-0001 AK58-00523-0000	OUT	OUT
		95T-XXXXX-02	N/A	N/A	N/A	N/A				IN
	TET	95T-XXXXX-03	N/A	N/A	N/A	N/A				IN

Motor Controllers – DSP Retrofit Kits

- » Some Treadmills can convert from Older Motor Controllers (with Wax Lift Boards) to DSP Motor Controllers.
 - ♦ See “Motor Controller Selection” guide to determine units capable of this.
 - ♦ DSP Retrofit Kits have specific instructions that must be followed.
- » DSP Motor Controllers are more robust.
- » Switching to DSP MC's: The Capacitor PCB, Frame Tag board, Stride Sensor board and Speed Sensor on Motor (with cable) can all be removed. The Wax Lift Board however will be re-used.
- » Once a unit is converted to a DSP Motor Controller, it CANNOT be changed back.
- » 120VAC DSP Retrofit Kit = GK65-00002-0018
- » 230VAC DSP Retrofit Kit = GK65-00002-0019
- » DO NOT USE DSP RETROFIT KIT IF TREADMILL ALREADY HAS A DSP MOTOR CONTROLLER.

DSP Motor Controller - LED's

LED 1, 12V

LED 2, 8V

LED 3, TX Comm

LED 4, Lift (Up)

LED 5, Lift ON

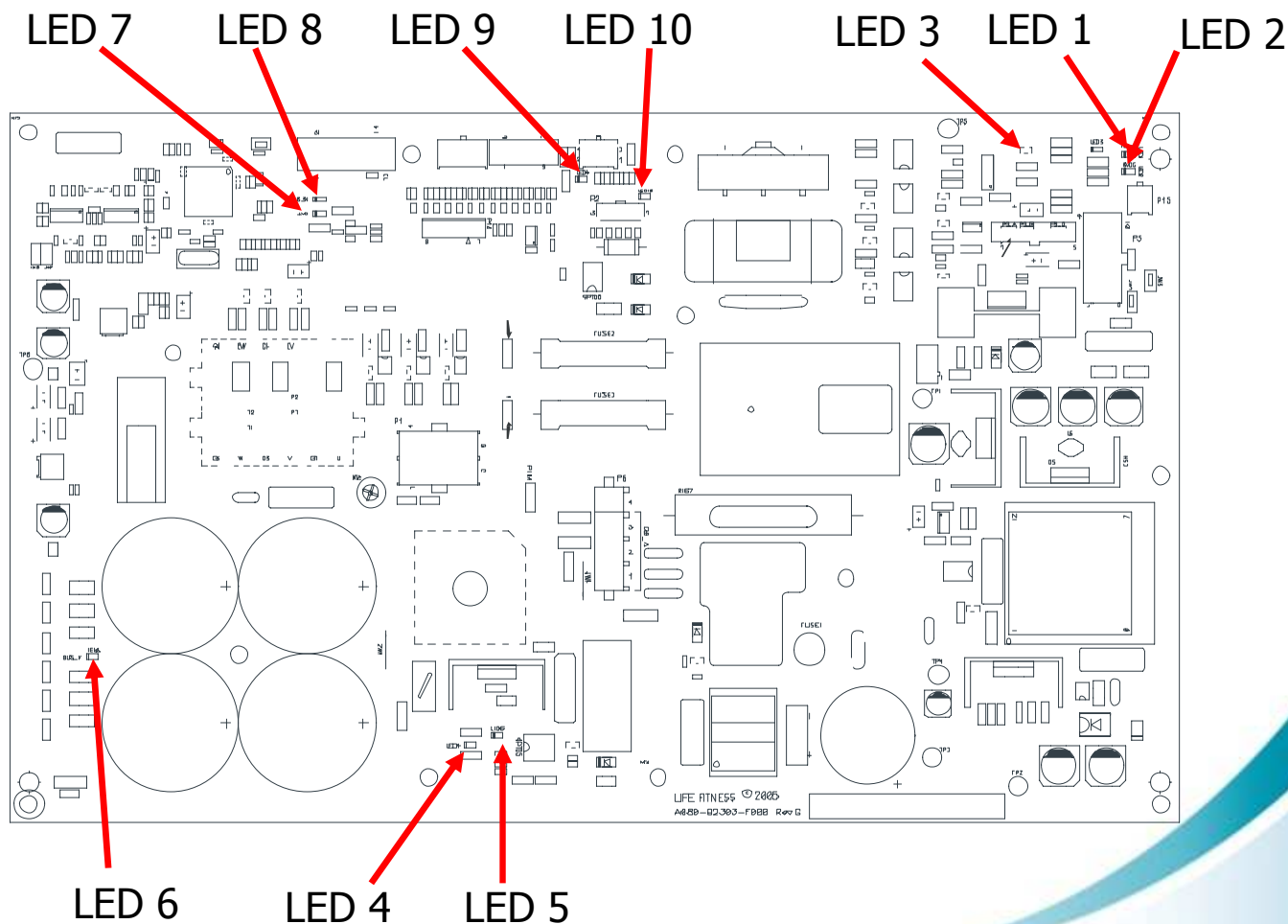
LED 6, V bus

LED 7, +15Vdc

LED 8, 3.3Vdc

LED 9, 0 position

LED 10, Bottom
position



Meaning of the DSP MCB LED's

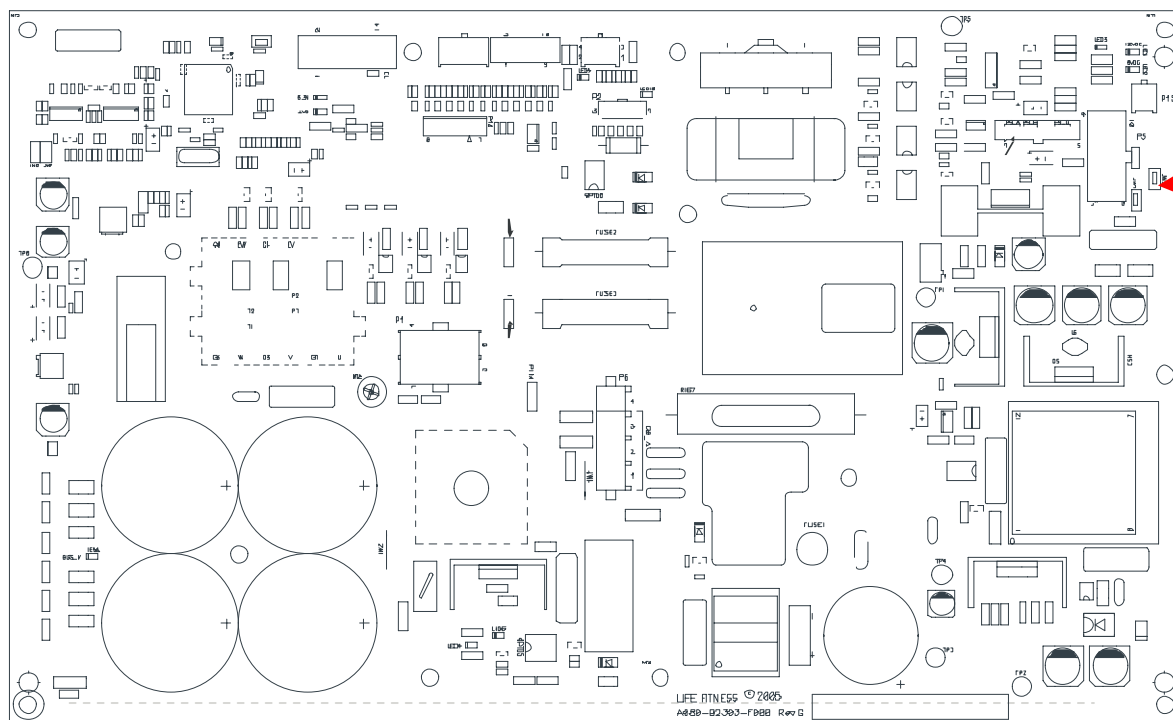
LED name	Designated as	How to use in troubleshooting
LED 1	12 V	Always ON if powered
LED 2	8 V	Always ON if powered
LED 3	TX Comm	LED constantly ON, but dimmer, then boot code issue. NORMALLY blinking = comm OK.
LED 4	Lift (Up)	Lift mechanism moving up
LED 5	Lift ON	Lift sys. powered up (functional)
LED 6	V Bus	WARNING: ON if system HOT! DON'T remove the controller unless OFF!
LED 7	+15 V	Driver voltage. If OFF, when power applied to the board, then replace the MC.
LED 8	3.3V	Power to DSP uC. If OFF, when power applied to the board, then replace the MC.
LED 9	0 position	ON if 0% incline activated
LED 10	Negative pos.	ON if bottom position activated

DSP Motor Controller – JW3 jumper

JW3 jumper: This jumper determines 2 wire vs. single wire communication between Console and MC.

This Shorting Jumper must be OUT for Elevation Treadmills Only. It is IN (shorting) for all other applications.

If this jumper is incorrectly configured, the Motor Controller will not communicate to the Console and various Errors will result.



JW3 Jumper
OUT: Elevation
In: Others

DSP Motor Controller - Jumper's

JW10
(P17 pin 2 and 4)

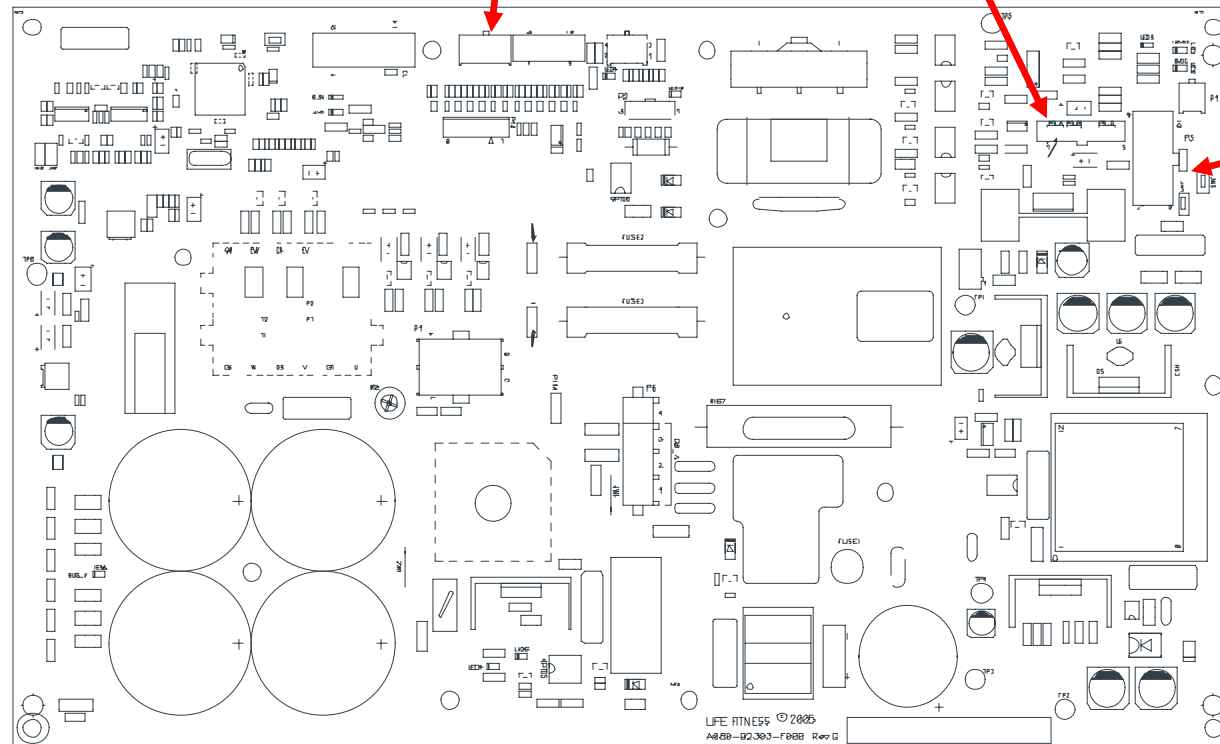
P9

JW3

JW3: Comm Jumper
OUT for Elevation
series.

P9: Power Supply
Jumper cable. Part
number based on
console used.
(see "Motor
Controller Selection"
Chart).

JW10: IN for
Welded frame
only.



DSP Motor Controller – Data Stored

Depending upon a specific model of a treadmill the following can be stored in the EEPROM of the motor controller:

- » Configuration settings (see Managers and Manufacturers Configuration menu's)
- » Accumulated statistics (see Information/System Statistics)
- » Product serial number (see Information/Software Version) - this is the number on the base sticker
- » Main Motor Info (stored by m/c and viewable in the console via the Information/Main Motor Info)
- » Incline usage statistics (available via Information/Lift Motor Info)
- » Maintenance logs (viewable via Information/Maintenance Info)
- » Belt Wear logs (viewable via Information/Belt-Deck Info)

Other Boards (Older systems)

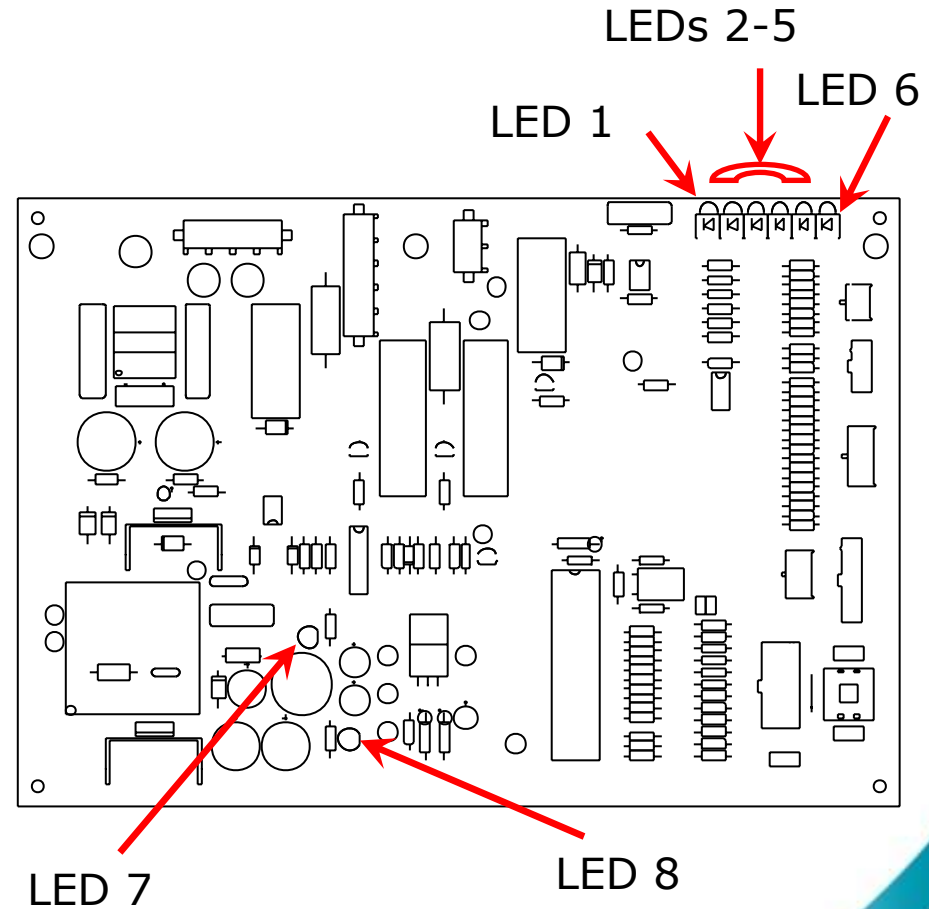
Wax Lift Board (WLB)

- » Used on older LF Treadmills
- » Functions:
 - ♦ To control the Incline/Lift actuator and the wax pump (model specific).
 - ♦ AC input is received and DC voltage created for Console power.
- » Capable of working with DSP Motor Controllers with Retrofit Kits are used.

WLB (Wax Lift PCB) - LED's

» Service LEDs

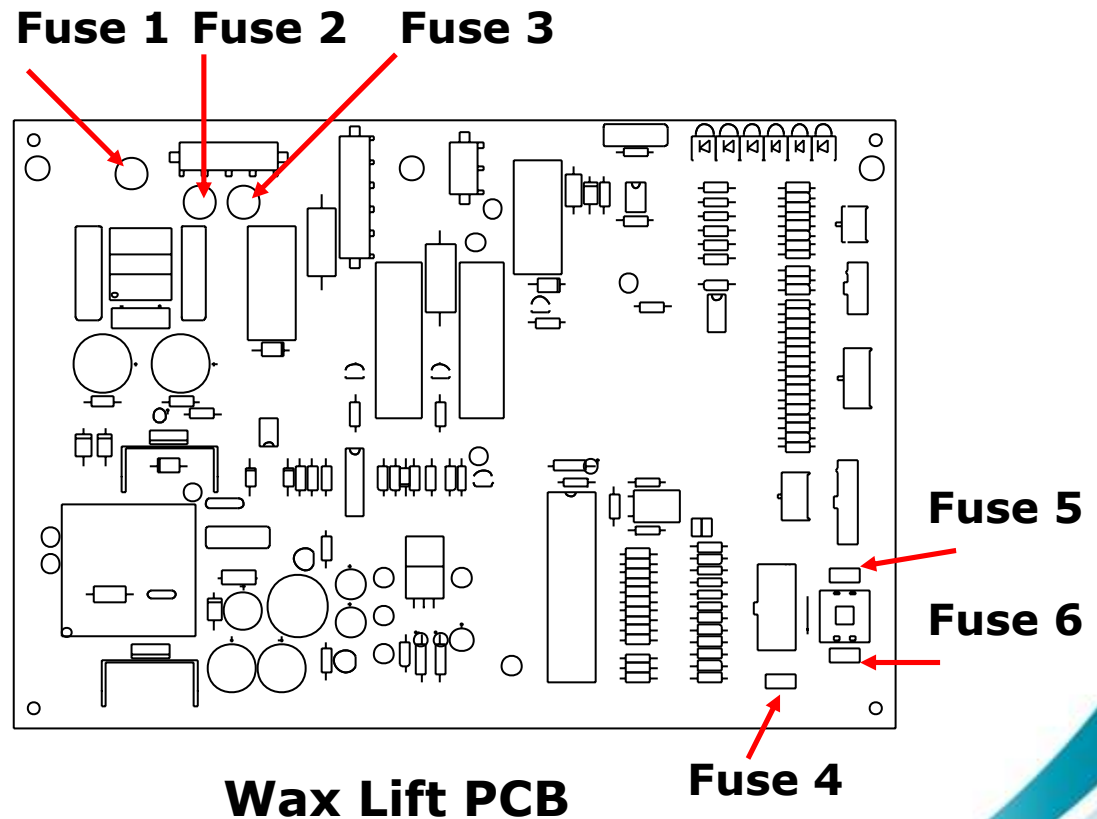
- LED 1 - Communications
- LED 2 - Incline
- LED 3 - Decline
- LED 4 - Home Switch on the 95Ti/93T. Negative Switch 97Ti
- LED 5 - Home 97Ti
- LED 6 - Communications
- LED 7 - Green indicates 12V output is ON
- LED 8 - Red indicates 8V output is ON



Wax Lift PCB

WLB - Fuses and Function

- » **Fuse 1**
2 Amp 120 VAC for low voltage power supply.
- » **Fuse 2 & 3**
4 Amp 120 VAC for Wax Pump and Lift Motor.
- » **Fuse 4**
0.5 Amp 12 VDC Emergency Stop Magnet. P/N 17-3-933
- » **Fuse 5**
1 Amp 8 VDC Console, Smart Stop, C-safe. P/N 17-3-934
- » **Fuse 6**
1 Amp 8VDC Console



Capacitor (Cap) Board

- » Used on older LF Treadmills
- » Function:
 - ♦ To rectify an Alternating Current sine wave to a DC Voltage Source.
 - ♦ This DC Source is used to drive the AC motor through a control circuit.
- » Connects to Motor Controllers (non-DSP).
- » DSP Motor Controllers do not require the external Capacitor Boards as they are incorporated into the DSP Circuit.

Frame Tag Board

- » Used on older LF Treadmills
- » Main function is to store and collect data.
- » Connects to the Wax Lift Board.
- » DSP Motor Controllers do not require the external Frame Tag Boards as they are incorporated into the DSP Circuit.

User Detect Devices

Stride Sensor

- » Used to detect user's presence on Treadmill
- » Allows the Treadmill to stop the belt if a user steps off the unit prior to a workout being completed
- » Connects to a Stride Sensor Board or directly to the DSP Motor Controller
 - ♦ Stride Sensor (Isolation) Boards are required for Green DSP Boards (GK58-00002-xxxx).
 - ♦ Blue DSP Boards (AK65-00071-xxxx) do NOT need Stride Sensor Boards.
 - ♦ If converting from Green DSP to Blue DSP Boards, remove Stride Sensor Board and connect Stride Sensor cable directly to connector P10 of the Blue DSP Board.
- » Stride sensor device is located under the deck and deflects with every step of the user.
When it deflects, the Board detects this and sends information to the Console

Smart Stop

- » Used to detect user's presence on Treadmill
- » Allows the Treadmill to stop the belt if a user steps off the unit prior to a workout being completed
- » Located in the Activity Zone area
- » Connects directly to the Console
- » Uses Infra Red (IR) technology
- » User must not be too close to the sensor
- » User must not wear black t-shirt
- » Treadmills with Smart Stop sensors must NOT have a mirror behind it.
 - ♦ A mirror in front of Smart Stop can fake out the sensor into thinking a user is on the unit
 - ♦ In this case, the Treadmill will not stop even when use exits the unit

Dedicated Line Definition

“Dedicated Line” Definition

- » All Commercial Treadmills require a Dedicated Line
- » Both Hot and Neutral MUST be dedicated (not just Hot) for Single Phase source (Domestic)
- » User Manuals call for this requirement and Clubs must meet this for proper operation
- » Failures such as “treadmill belt stops prematurely”, “breaker trips”, or “belt slows down” can result if Dedicated Line requirements are not met.

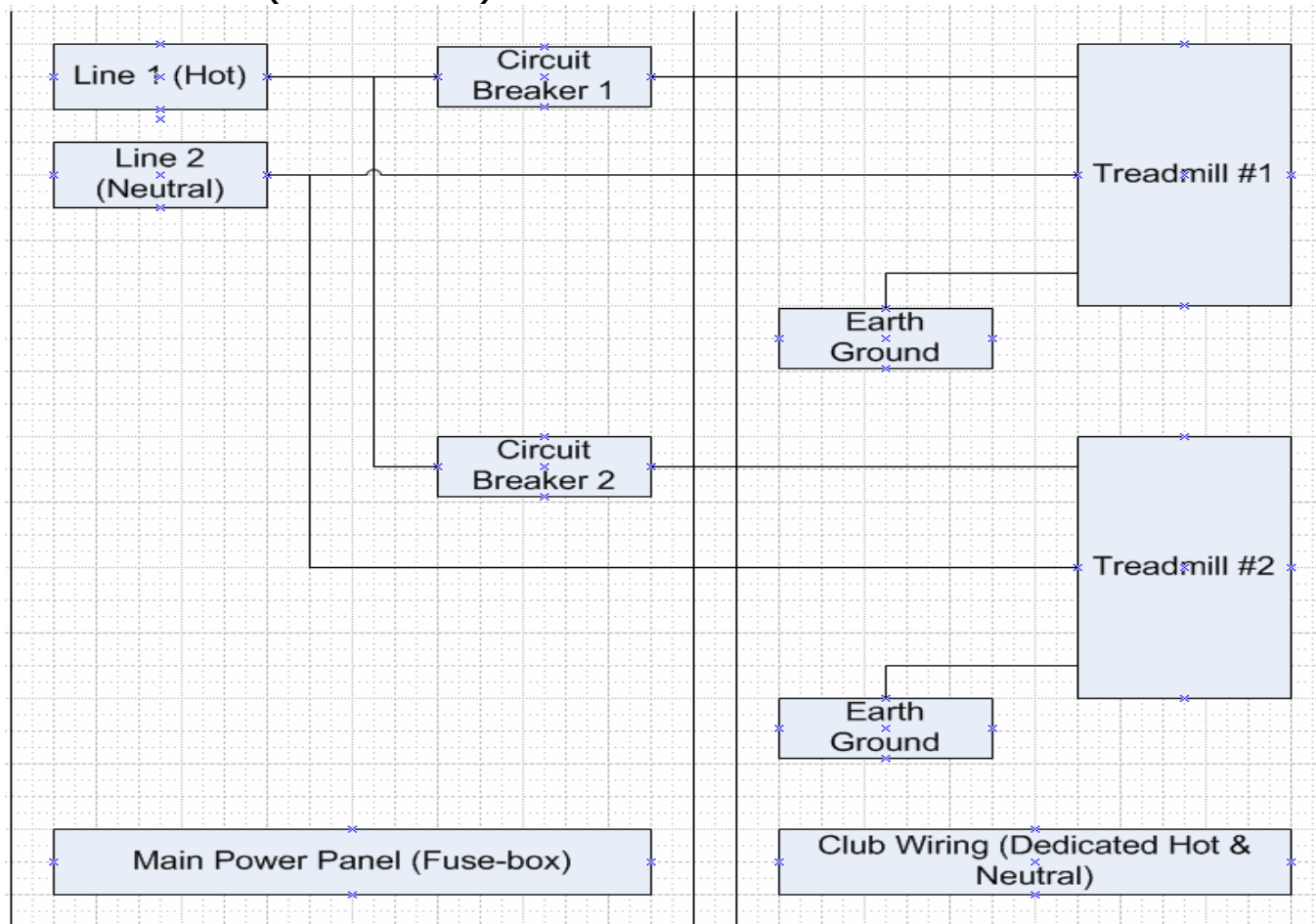
ELECTRICAL POWER REQUIREMENTS

The Life Fitness Treadmill requires a dedicated* line according to the electrical configurations listed in the chart below.

* One individual branch circuit for each treadmill per NEC article 210-21 (b) (1) and 210-23 (or other appropriate, country specific electrical compliance guidelines). The hot, neutral and ground wires must each be routed independently (not looped or tied to other circuits.)”.

“Dedicated Line” Definition (cont.)

- » Wiring diagram example of Dedicated Line requirement for 2 Treadmills (Domestic).



“Dedicated Line” Definition (cont.)

- » The Circuit Breaker and wiring amperage rating must meet or be the closest higher rating than the Life Fitness Treadmill rating per the chart (see Electrical Power Requirements section of the Operational Manual).
- » Below is the chart from the 95T Operation Manual.
- » For Domestic Treadmills, this would be a 20A Dedicated line (Commercial products).

Supply Voltage (VAC)	Frequency (Hz)	Rated Current (Amps)
100	50 / 60	18
120	50 / 60	18
200	50 / 60	9
220	50 / 60	9
230	50 / 60	9
240+	50 / 60	9

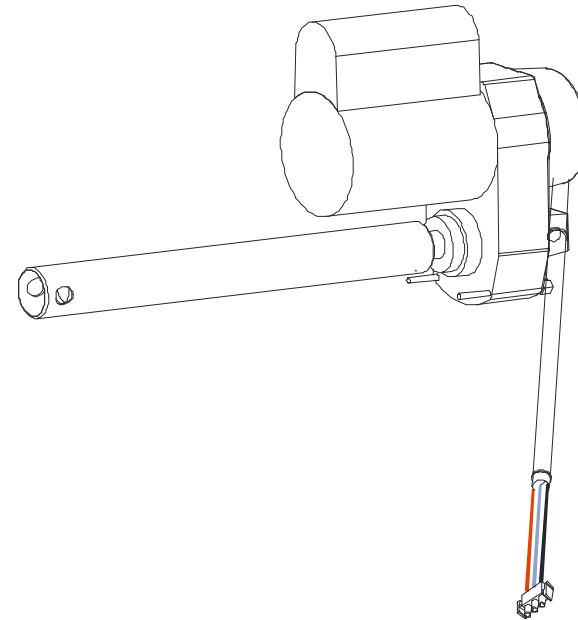
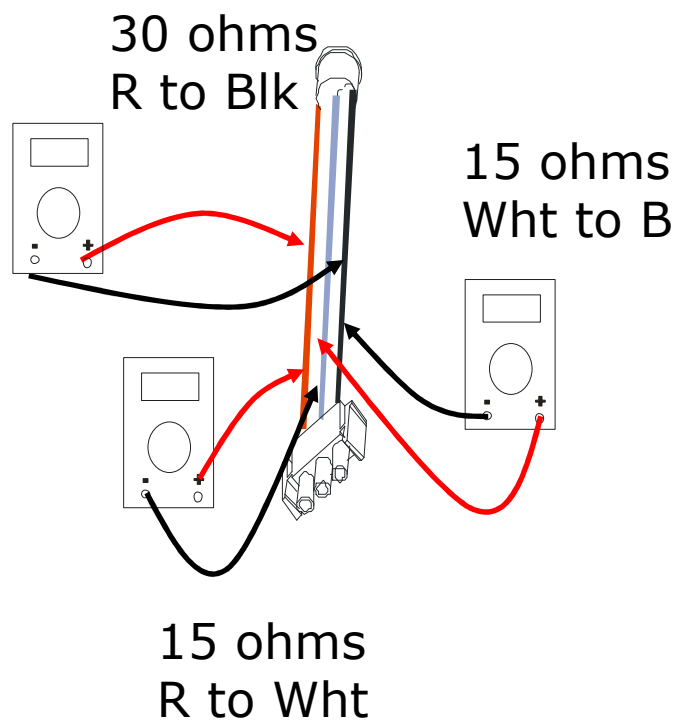
Console

Console

- » Main function is to interface with the user
- » Communicates with the Lower Boards (Motor Controllers and Wax Lift Boards)
- » Stores repair history data
- » Diagnostic routines to assist in trouble-shooting are covered in detail in Diagnostic Module of training
- » Console specific details covered in Console Module section of training.

Service Information & Troubleshooting

Testing an Incline Actuator



Troubleshooting Tips

- » General Tip: Check all cables and connectors prior to replacing any Electronic parts (Circuit Boards, motors, etc.).
 - ◆ Cables can be pinched, damaged
 - ◆ Connectors can have broken/bent pins, pins pushing out the back of the housing, etc.

Common Issues - Commercial

Power issues – check Club/Building Wiring

» 3 possible error messages due to building power issues:

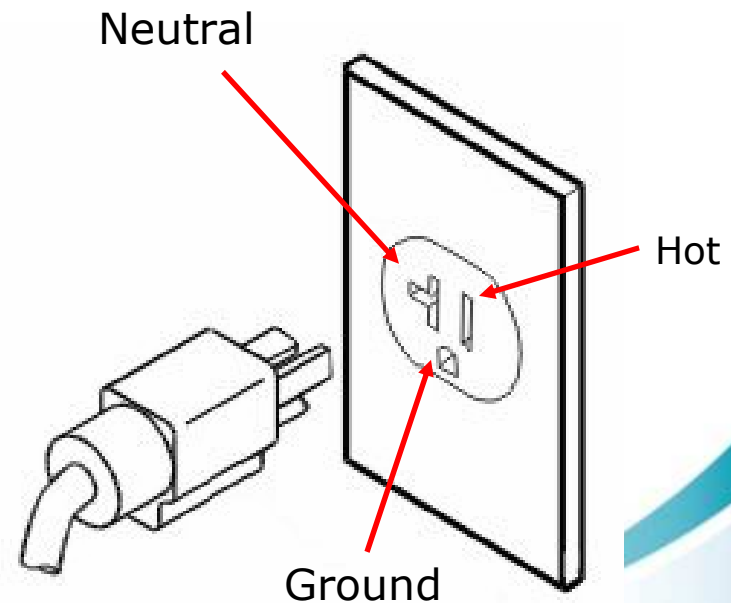
- ◆ System Initializing
- ◆ Power up reset
- ◆ Unit speed slows

» Proper Wiring Measurements

- ◆ Hot to Neutral = 120 VAC
- ◆ Hot to Ground = 120 VAC
- ◆ Neutral to Ground < 2 VAC
- ◆ if more you have a ground issue

» Must have Dedicated Lines per definition.

Wiring Codes	USA	International
Neutral	White	Blue
Hot	Black	Brown
Ground	Green	Green & Yellow



Treadmill - No Power

» Questions to ask

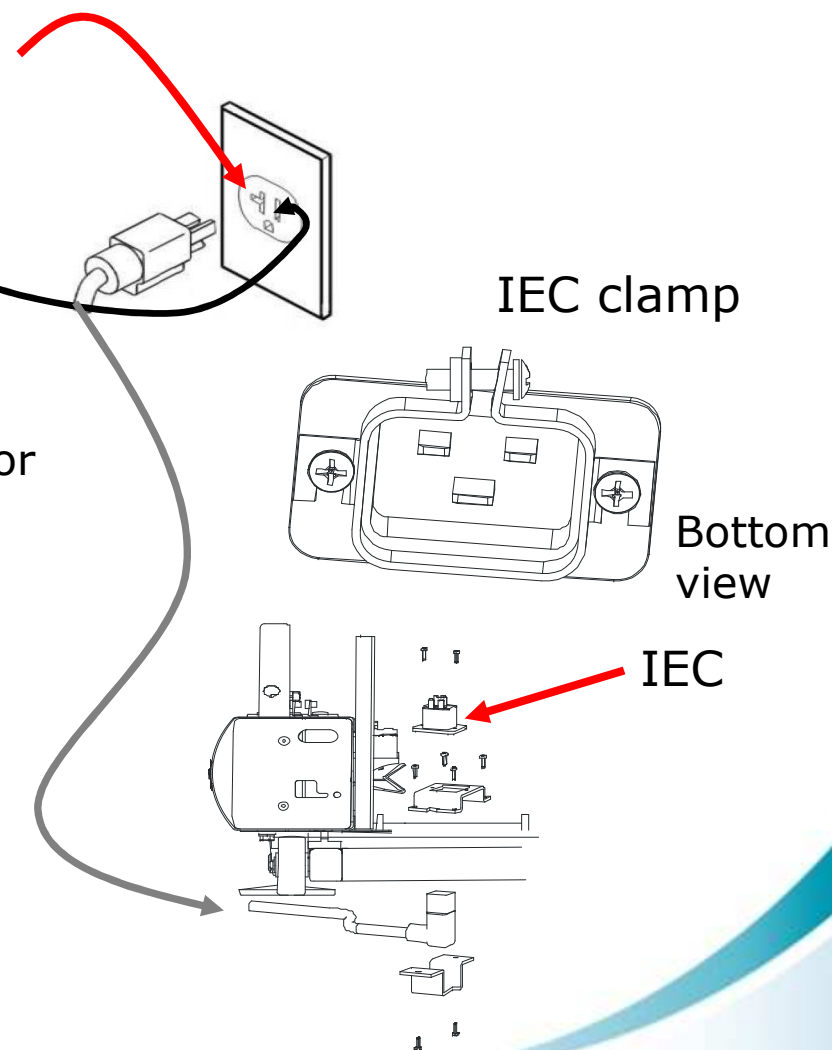
- ◆ What is the voltage at the wall outlet? 120VAC or 220VAC?
- ◆ Has the Line Cord been inspected and is properly seated in wall outlet and in the IEC connector (on Treadmill).
- ◆ Is IEC clamp secure
- ◆ Is IEC cracked on the inside of unit
- ◆ Are the LED's ON for the Wax Lift or Motor Control Board?

» Possible Causes

- ◆ Clamp not holding line cord
- ◆ Bad wall outlet wiring
- ◆ Bad connection from plug to outlet

» Possible Fixes

- ◆ Install line cord kit to secure
- ◆ Replace Faulty IEC connector (**International Electro-technical Commission**)
- ◆ Repair/Rewire wall outlet



Treadmill - No Power

» Models

- ♦ Wax Lift Board units

» Questions

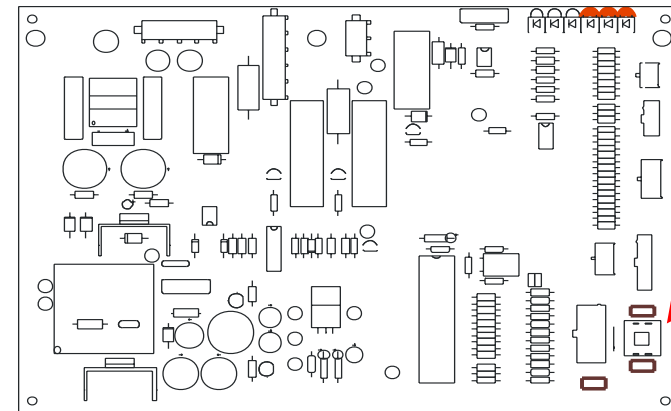
- ♦ Some LED's are "ON"
- ♦ NO 8 VDC at pin 1 & pin 3 on the main wire harness?

» Possible reasons

- ♦ Fuse 5 is open
- ♦ Fuse 6 is open

» Possible Cause

- ♦ Fuse 5 open: inspect for water damage in Smart Stop compartment, replace faulty Smart Stop and fuse.
- ♦ Fuse 6 open: visual water or sweat damage on console board, replace faulty console and fuse.



6	1
7	2
8	3
9	4
10	5

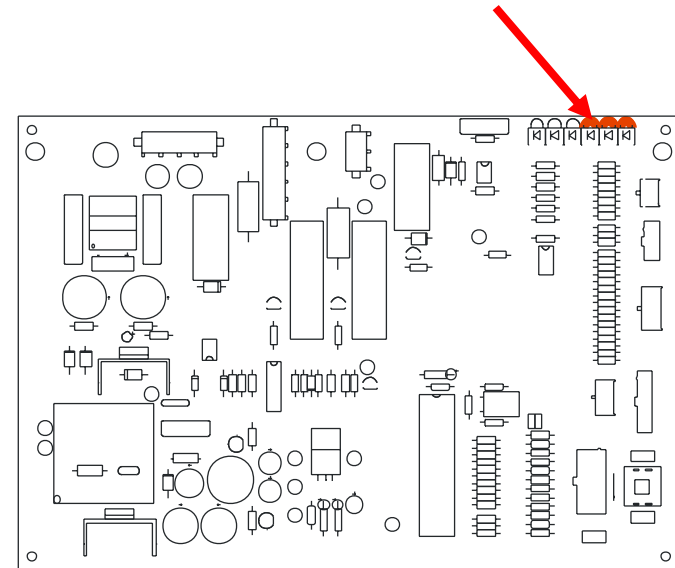
Treadmill will not Incline

» Questions

- ◆ Does it state "**Please Wait**"
- ◆ Does the Home switch appear to be depressed by frame
- ◆ Does the Wax Life Board (if present) have LED #4 "ON" or "OFF" (Home switch)?

» Possible Solutions / Steps to Take

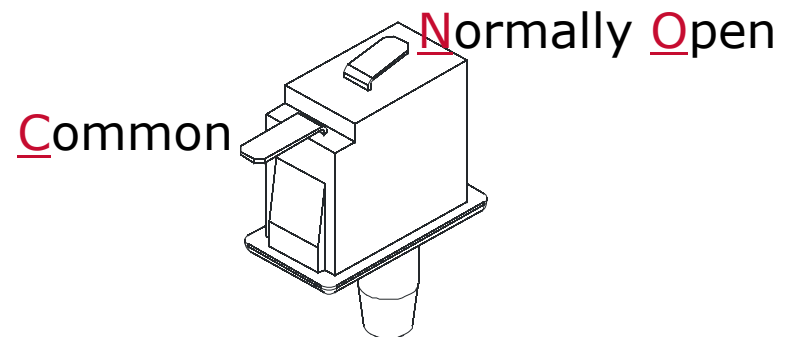
- ◆ Enter Diagnostic Incline automatic "**IA**" mode.
 - > Treadmill should see home.
- ◆ Check/change switch or cable to Home switch
- ◆ Treadmill is not seeing itself at Home or Zero – will not operate incline unless it does.



Treadmill will not Incline (cont.)

» Diagnostics Test?

- ◆ Incline Automatic (IA) in Diagnostics does not see itself at "0", but the Incline Manual "IM" test can operate the Lift Motor fine

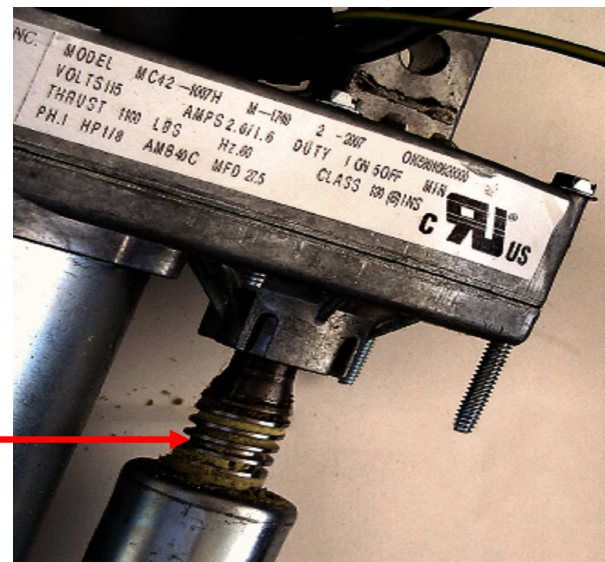


» Possible Solutions

- ◆ Debris between frame weldment
- ◆ Bad Home/zero switch
- ◆ Bad Home/zero switch cable
- ◆ Bad Lift actuator
- ◆ Open Fuse on Wax Lift Board

» Fix

- ◆ Remove debris
- ◆ Replace Faulty component as needed



“Notify Maintenance, Motor Controller Error”

» Model

- ◆ Next Gen, Arctic/Silver Bullet with waxer's

» Questions

- ◆ Have you performed the “Systems Comm Test” in Diagnostics?
- ◆ Have you checked the Belt and Deck?

» Possible Causes

- ◆ Worn Belt and deck
- ◆ Unit is not getting wax due to clamp not released
- ◆ Unit is out of wax
- ◆ Wax pump is faulty

» Fix

- ◆ Replace faulty components

“Notify Maintenance, Wax bag empty”

» Model

- ◆ Silver Bullet, Midline

» Question

- ◆ Has customer replaced wax bag
- ◆ Does unit allow you to reset wax counts?

» Possible Causes

- ◆ Unit is out of wax
- ◆ Software revision is below 2.3 Mid-line and 5.0 Silver/Arctic and unit will not accept maintenance repair to replace wax bag

» Probable Solutions

- ◆ Replace wax bags
- ◆ Update software revision using the correct widget box

“Motor Comm Bad”

» Model

- ◆ Next Gen, Arctic/Silver Bullet, Classic, Elevation

» Possible Causes

- ◆ Bad connection between Motor Controller or Wax Lift Board and Console
- ◆ Is JW3 installed on the DSP Motor Controller for Elevation Series?
- ◆ Is JW3 removed for non-Elevation Series Treadmills?
- ◆ Verify power present at Wax Lift Board via service LED's
- ◆ Is the console wire pinched between motor controller and Console?

» Fixes

- ◆ Re-seat cable or replace faulty cable
- ◆ Replace line cord or line filter
- ◆ Swap wax lift board to a functioning unit. If problem remains, replace Wax Lift Board
- ◆ Correct JW3 jumper on DSP Motor Controller

“Immobilized by Manager”

- » User error, customer accidentally locks up console
 - ◆ Use same sequence to unlock:
 - > Stop/Stop/Stop/Speed-down/Speed-down/Speed-down
 - ◆ This is a toggle to turn ON and OFF the Immobilization.
- » Damaged main wire harness

“Replace Emergency Stop SW”

- » Activity Zone magnet location
 - ♦ Move magnet to front of bracket
- » Damaged cable
- » Bad Console MIB (Machine Interface) Board

“Please Pedal” on Elevation Series

- » Elevation Treadmill could display this.
- » Check for JW3 jumper on DSP to be properly configured
 - ♦ JW3 must be OUT for Elevation
- » Damaged cable
 - ♦ (Communication lines broken between Console and DSP Motor Controller)

Summary – Treadmill Base Electronics

- ◆ How do you find the motor controller part numbers for Life Fitness Treadmills?
- ◆ Why would you see a “Please Pedal” message on an Elevation Series Treadmill?
- ◆ What would happen if a Commercial Treadmill is powered with a line that is not Dedicated?
- ◆ Should the Motor Controller be changed first for failures?

Questions





THANK YOU!

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