



LCD CONSOLES TECHNICAL CERTIFICATION TRAINING

Field Engineering | 2010

LifeFitness
WHAT WE LIVE FOR

Course Objectives

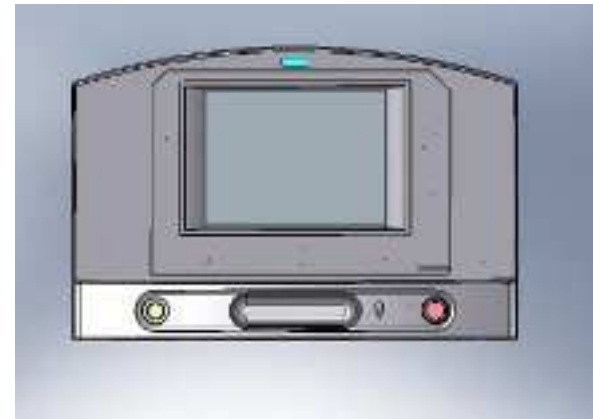
- » Life Fitness LCD Consoles – Hardware Overview
- » Core Features Highlight
- » Core Features = Core Diagnostics
- » Core Features – Review of Common Issues
- » Board Placement:
 - ♦ 12.1" Integrated LCD
 - ♦ 7" Inspire LCD (non-treadmill)
 - ♦ 15" Engage LCD (treadmill)
- » Replaceable Components
- » Value of LCD Consoles to Our Customers (End Users, Technicians)
- » Common Issues
- » Summary

Life Fitness LCD Consoles – Hardware Overview

- » Life Fitness currently uses three different types of console displays (all of which are PC/Laptop computer type displays):
 - ◆ 12.1" Integrated LCD
 - ◆ 7" Inspire LCD
 - ◆ 15" Engage LCD

Life Fitness LCD Consoles – Hardware Overview (cont.)

- » Pictures of PC/Laptop computer type LCD displays



12.1" LCD console. Methods of user input are via a touch screen and a keypad.

LF name: **Integrated 12.1-inch LCD**

Life Fitness LCD Consoles – Hardware Overview (cont.)

- » Pictures of PC/Laptop computer type LCD displays



7-inch LCD with a touch screen.
Above a 7-segment LED-based display. Sides and bottom: LED-backlit keypad

LF name: **Inspire**



Entire display is an LCD with a touch screen.

LF name: **Engage**

Life Fitness LCD Consoles – Hardware Overview (cont.)

- » In addition to a display and touch screen/keypad other electronic boards and sensors may be connected:
 - ◆ Telemetry heart rate board (usually found on non-treadmills)
 - ◆ Television tuner
 - ◆ iPod authentication chip
 - ◆ Interface (IF) boards used on 12.1" LCD consoles, a.k.a. Machine Interface Board (MIB) used on Elevation (Engage and Inspire) consoles
 - > Provide more than one type of functionality – discussed further in the presentation
 - ◆ FitLinxx modules and other devices connected to a CSAFE port
 - ◆ Motor controller
 - ◆ GBC
 - ◆ Alternator Control Board used with the 12.1" LCD consoles
- » **Functionality of the above modules can be verified in a console's respective diagnostics**

Core Features Highlight

» Core Features highlight

- ◆ Most often used by our customers are:
 - > Display
 - > Keypad (12.1" Integrated and the 7" Inspire)
 - > Touch panel (all LCDs)
 - > Heart rate telemetry
 - > Contact heart rate
 - > Speed/Incline (motor controller)
 - > Resistance adjustments (the generator brake controller and the generator, the alternator control board and the alternator, the consumer systems control board and the eddy current brake system)
 - > TV
 - > iPod
 - > Presets provided by means of networking (Fitlinxx / VIVO)
- ◆ Functionality of the above features is verifiable in diagnostics

Core Features = Core Diagnostics

- » This section will focus on some common sense / general diagnostics procedures. Details are provided in suitable service manuals and a separate presentation on diagnostics.
 - ♦ Diagnostics that will most often be executed are:
 - > Display
 - > Keypad (12.1" Integrated and the 7" Inspire)
 - > Touch panel (all LCDs)
 - > Heart rate telemetry
 - > Contact heart rate
 - > Speed/Incline (motor controller)
 - > Resistance adjustments (the generator brake controller and the generator, the alternator control board and the alternator, the consumer systems control board and the eddy current brake system)
 - > TV
 - > iPod

Core Features – Review of Common Issues

» **Display**

- » Device definition: A Liquid Crustal Display (LCD) used to give visual feedback to a user
- » Look for the following:
 - ♦ Mechanical issues
 - > Secured well after it has been replaced? (forgetting to tighten the screws after LCD panel was replaced)
 - > Cracked? (typically due to user's abuse)
 - ♦ Electrical issues
 - > Image displayed? (sometimes either a gray or a blank screen may be displayed if connection's to SBC loose)
 - > Image flipped? (an issue that happens with the 12.1" LCD display)
 - ♦ Software issues
 - > State transitions fast from one screen to another? (memory leaks may degrade performance of the system – they are difficult to catch)
 - > All of the on-screen buttons line up? (very rare, but it happens)

Note:

In reality the above SW issues are a manifestation of SBC issues, not the display itself.

Core Features – Review of Common Issues (cont.)

» **Keypad (12.1" Integrated and the 7" Inspire)**

- » Device definition: membrane switches arranged in a matrix connected to the InterFace Board (IF) or the Machine Interface Board (MIB).

Note:

IF is a term used when talking about the 12.1" integrated LCD console.

MIB is a term used when talking about the Elevation Series consoles.

- » Look for the following:

- ♦ Mechanical issues:
 - > Sticking keys
- ♦ Electrical issues:
 - > Oxidized connectors
- ♦ Software issues:
 - > Debouncing

Note:

Software will show in diagnostics that a key is stuck or that keys do not respond to key presses

Core Features – Review of Common Issues (cont.)

- » **Touch panel (all LCDs)**
- » Device definition: a resistive membrane interfacing with the SBC used to detect an on-screen finger position
- » Look for the following:
 - ♦ Mechanical issues:
 - > Possible cuts (user abuse)
 - > Air pocket created when applying a touch screen onto the LCD (was an issue on the 12.1" Integrated; solution: using a push pin poke a hole in either left or right UPPER corner of the display)
 - ♦ Electrical issues:
 - > Loose connection (after repair)
 - ♦ Software issues:
 - > Touch screen driver issues:
 - Debouncing time (slow response to key presses)
 - Activation of on-LCD buttons that should not be activated (was an issue on the 12.1" Integrated, fix implemented recently)

Core Features – Review of Common Issues (cont.)

» **Heart rate telemetry**

- » Device definition: a radio wave receiver that picks up heart rate signal from a telemetry chest strap
- » Look for the following:
 - ◆ Mechanical issues:
 - > Improperly attached (taped) sensors to the console's bezel (usually after a repair)
 - > Wrong orientation of the sensor, which is rotated 90 degrees (degrades electrical performance) – especially true with non-coded receivers
 - ◆ Electrical issues:
 - > See the last issue above (sensor rotated 90 degrees)
 - > Loose or no connection (check the cable)
 - > Cross talk (very common with bikes and non-coded receivers)
 - ◆ Software issues:
 - > None

Core Features – Review of Common Issues (cont.)

» **Contact heart rate (LifePulse®)**

» Device definition: a Life Fitness-designed system that utilizes contact sensors to detect user's heart rate

» Look for the following:

- ◆ Mechanical issues:

Note:

Although, sensors are not mechanically connected to the console, the quality of their mechanical connection is very important for the overall system

- > Gaskets that are coming out (used to be an issue with Elevation Cross Trainers)

- > Too much or too little hand pressure, unstable grip, dirty sensors

- ◆ Electrical issues:

- > Loose or no connection (check the cable)

- > Dry skin

- > Too much lotion on skin / dirty connectors

- ◆ Software issues:

- > None

Core Features – Review of Common Issues (cont.)

- » **Speed and Incline (motor controller)**
- » Device definition: not a device, but a function provided by respective motors and controlled by the motor controller
- » Look for the following:
 - ◆ Mechanical issues:
 - > Not related to consoles
 - ◆ Electrical issues:
 - > Stuck key: a workout could start right away or the incline could go up after the power up.
 - > A stuck INCLINE DOWN key could cause the incline to reset to the minimum incline/level value while the machine is in workout – this behavior is dependent upon keypad mapping.
 - ◆ Software issues:
 - > Motor Controller would react to noise on the E-Stop circuitry by stopping the drive and incline motors. At the same time the console would continue displaying speed and incline – it would continue with its workout execution. This issue was noticed on the Achieve Consoles.

Core Features – Review of Common Issues (cont.)

- » **Resistance adjustments** (the generator brake controller and the generator, the alternator control board and the alternator)
- » Device definition: not a device, but function provided by either a generator or an alternator, controlled by either a Generator Brake Controller (GBC) or an Alternator Control Board (ACB)
- » Look for the following:
 - ◆ Mechanical issues:
 - > Not related to consoles.
 - ◆ Electrical issues:
 - > Connection problems could cause resistance increases/decreases – very analogous to the scenario from the previous slide.
 - ◆ Software issues:
 - > Any software issues would manifest themselves in the early development and/or when the non-treadmill product is reaching its maturity.

Core Features – Review of Common Issues (cont.)

- » **TV – Supported by a TV tuner board**
- » Device definition: the TV tuner allows to receive TV signals – it decodes sound and video
- » Look for the following:
 - ◆ Mechanical issues:
 - > Forgetting to torque the screws of the TV tuner to their proper values might cause them to rattle and fall off.
 - ◆ Electrical issues:
 - > Loose connections
 - Tuner-to-cable (forgetting to plug in the coax cable all the way)
 - ◆ Software issues:
 - > None.

Core Features – Review of Common Issues (cont.)

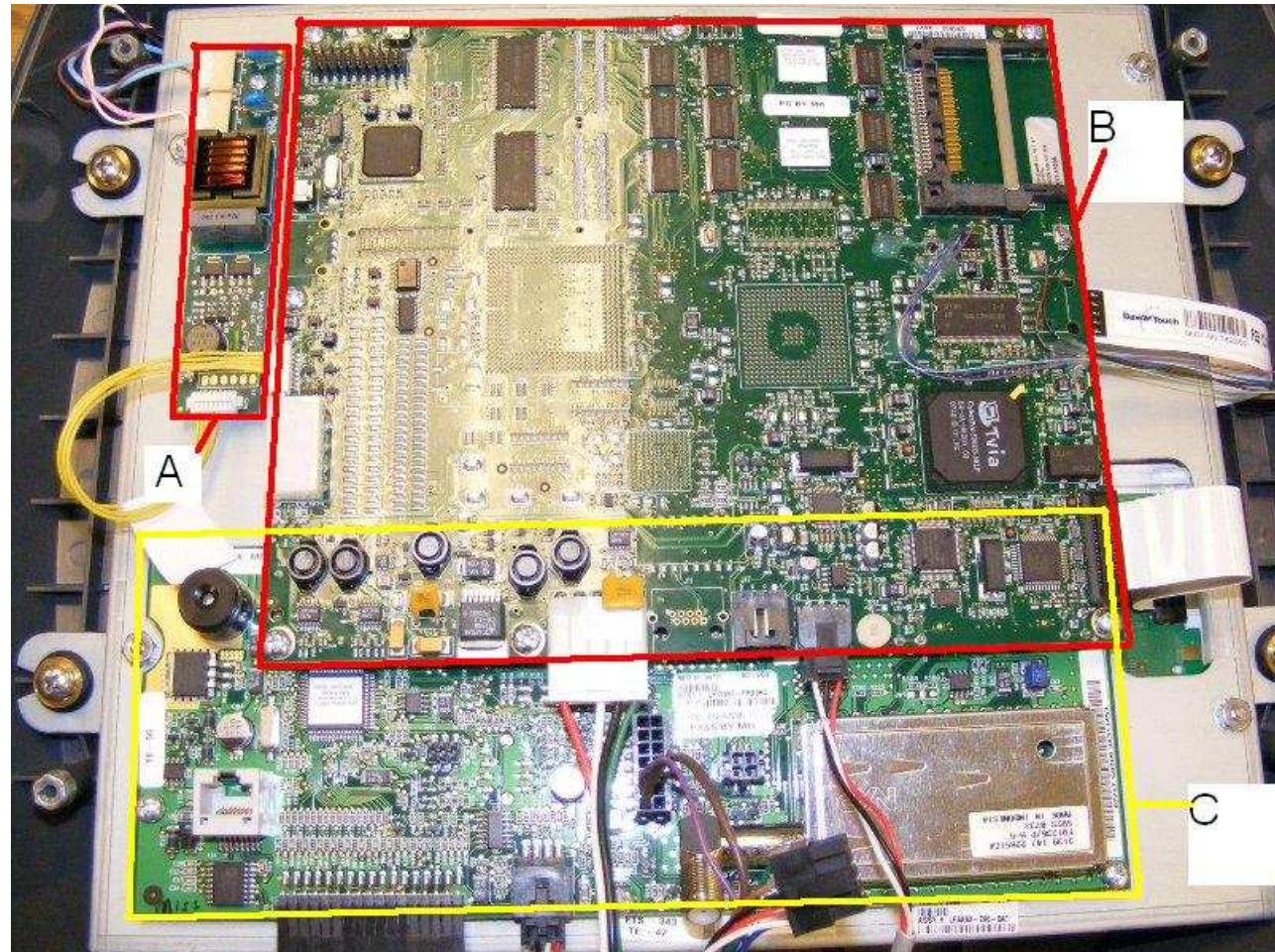
- » **iPod – Supported by an iPod Authentication Chip (a.k.a. iPod Co-processor)**
- » Device definition: unlocks iPod's functionality
- » Look for the following:
 - ◆ Mechanical issues:
 - > Loose screws that keep the board attached to the console's back plane.
 - ◆ Electrical issues:
 - > None.
 - ◆ Software issues:
 - > Caught early on in the development cycle. The issues were related to lack of protocol maturity.

Core Features – Review of Common Issues (cont.)

- » **Presets provided by means of networking (Fitlinxx / VIVO) – Supported by the CSAFE port**
- » Device definition: the CSAFE port allows for a serial communication with the FitLinxx or other exercise network
- » Look for the following:
 - ♦ Mechanical issues:
 - > Loose connector.
 - ♦ Electrical issues:
 - > Use a CSAFE loopback cable to verify Vout and to verify TX/RX operation provided by the console.
 - > Self-powered consoles would be held in reset by FitLinxx modules. Use **GK70-00002-0014** to resolve the problem. Description in: EC09020201N.
 - ♦ Software issues:
 - > None. LF consoles must be certified to work with FitLinxx network.

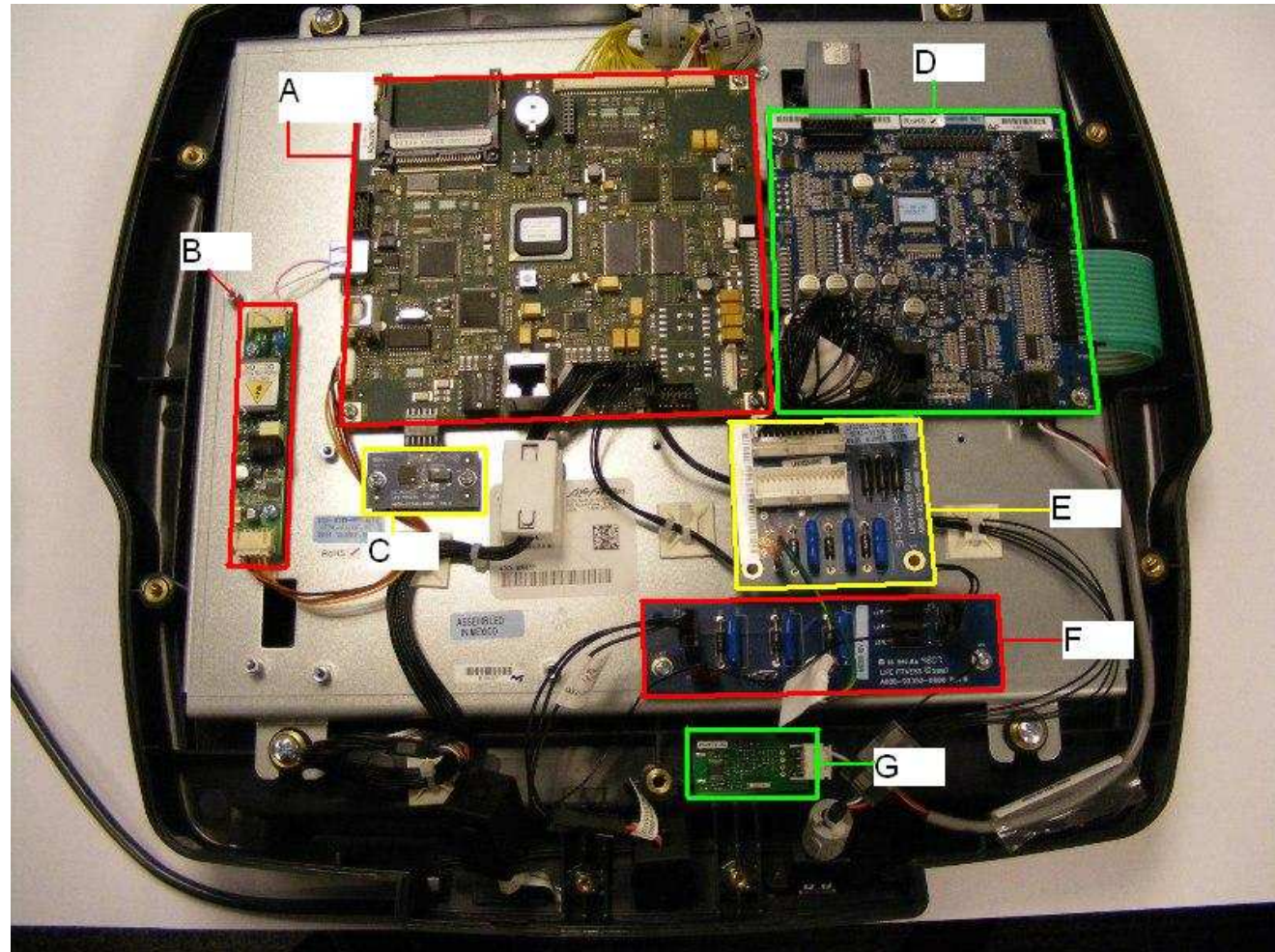
Board Placement: 12.1" Integrated LCD

- » A – Inverter
- » B – SBC
- » C – IF



Board Placement: 7" Inspire LCD (non-treadmill)

- » A – SBC
- » B – Inverter
- » C – iPod Authentication
- » D – MIB
- » E – LifePulse ESD
- » F – ESD Board
- » G – Polar Coded HR Receiver

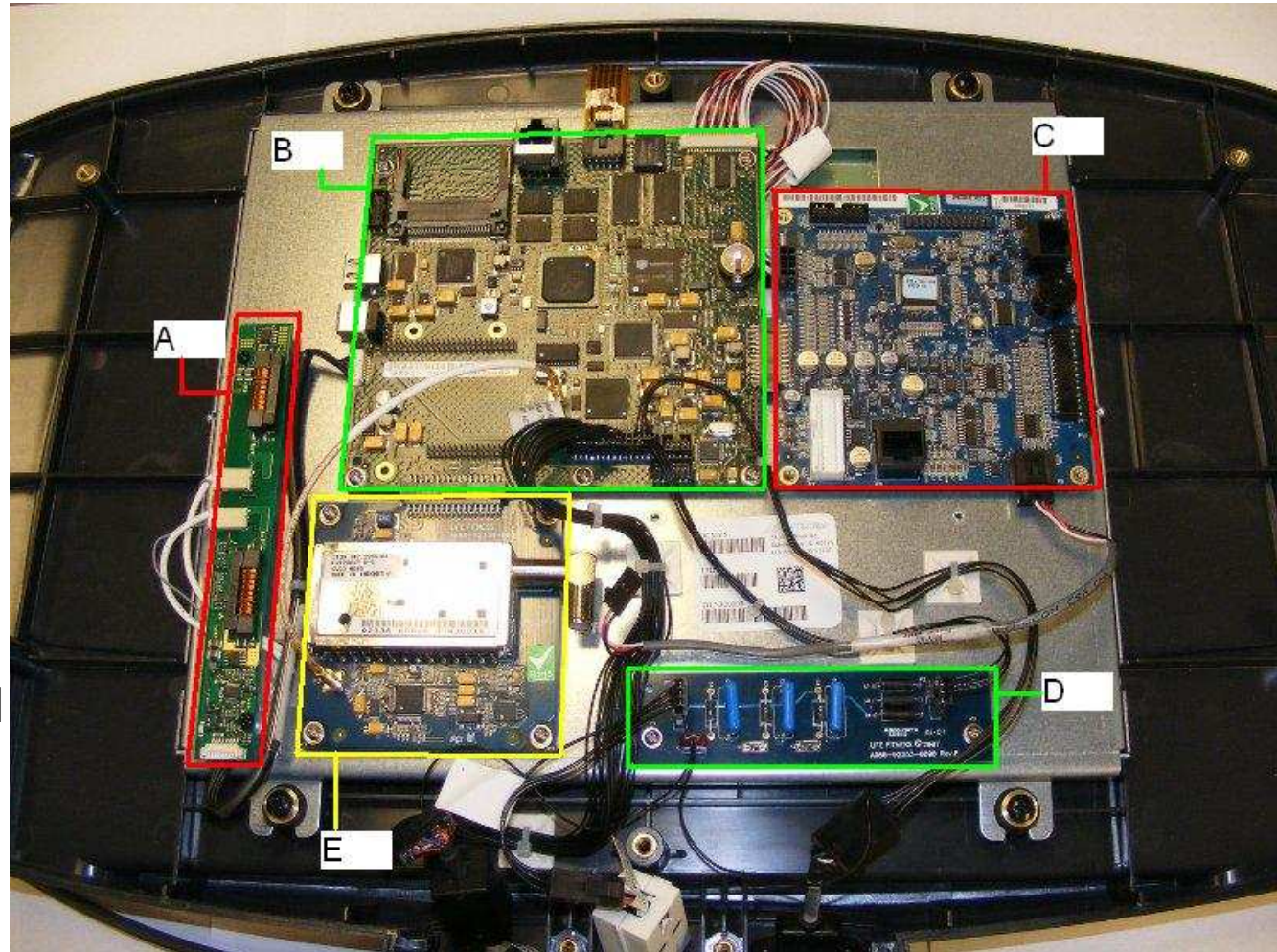


Board Placement: 15" Engage LCD with Analog Tuner

- » A – Inverter
- » B – SBC
- » C – MIB
- » D – ESD Board
- » E – Analog TV Tuner

Notes:

- » No LifePulse ESD
- » No Polar Coded HR Receiver



Board Placement: 15" Engage LCD with Digital Tuner

- » A – Digital Tuner
- » B – Signal In
- » C – Power In (12 Vdc) from the base
- » D – RS232 Reprogramming port

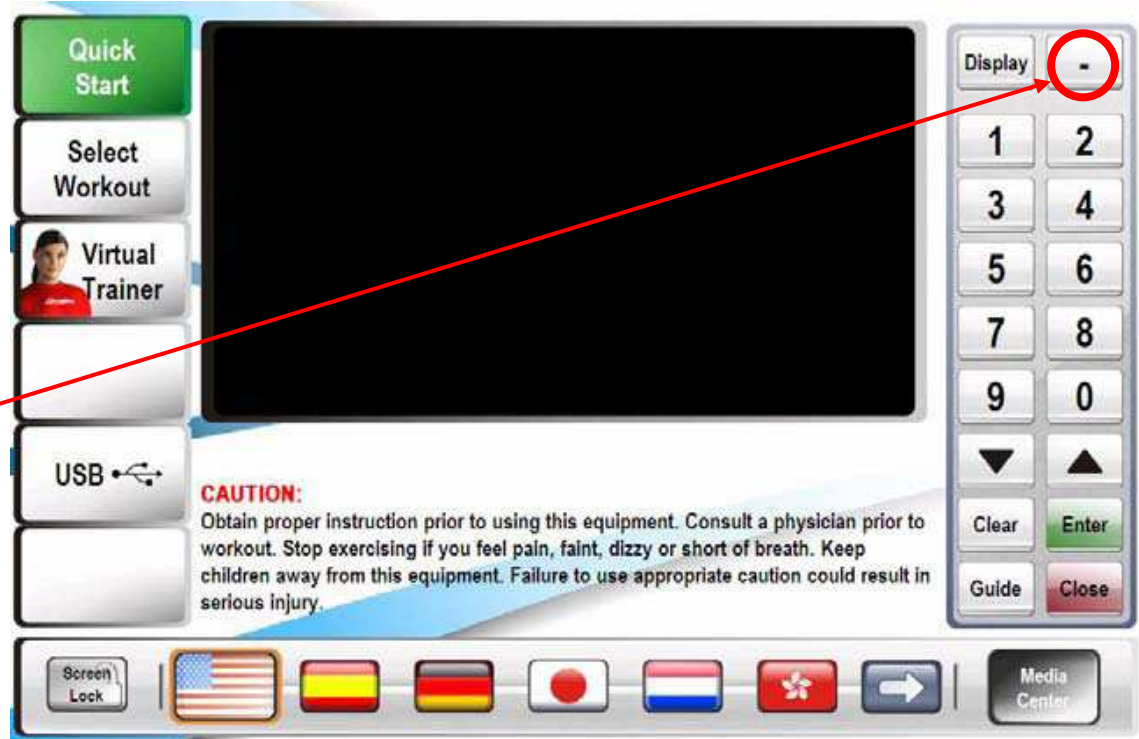
Notes:

- » No ESD Board
- » No LifePulse ESD
- » No Polar Coded HR Receiver



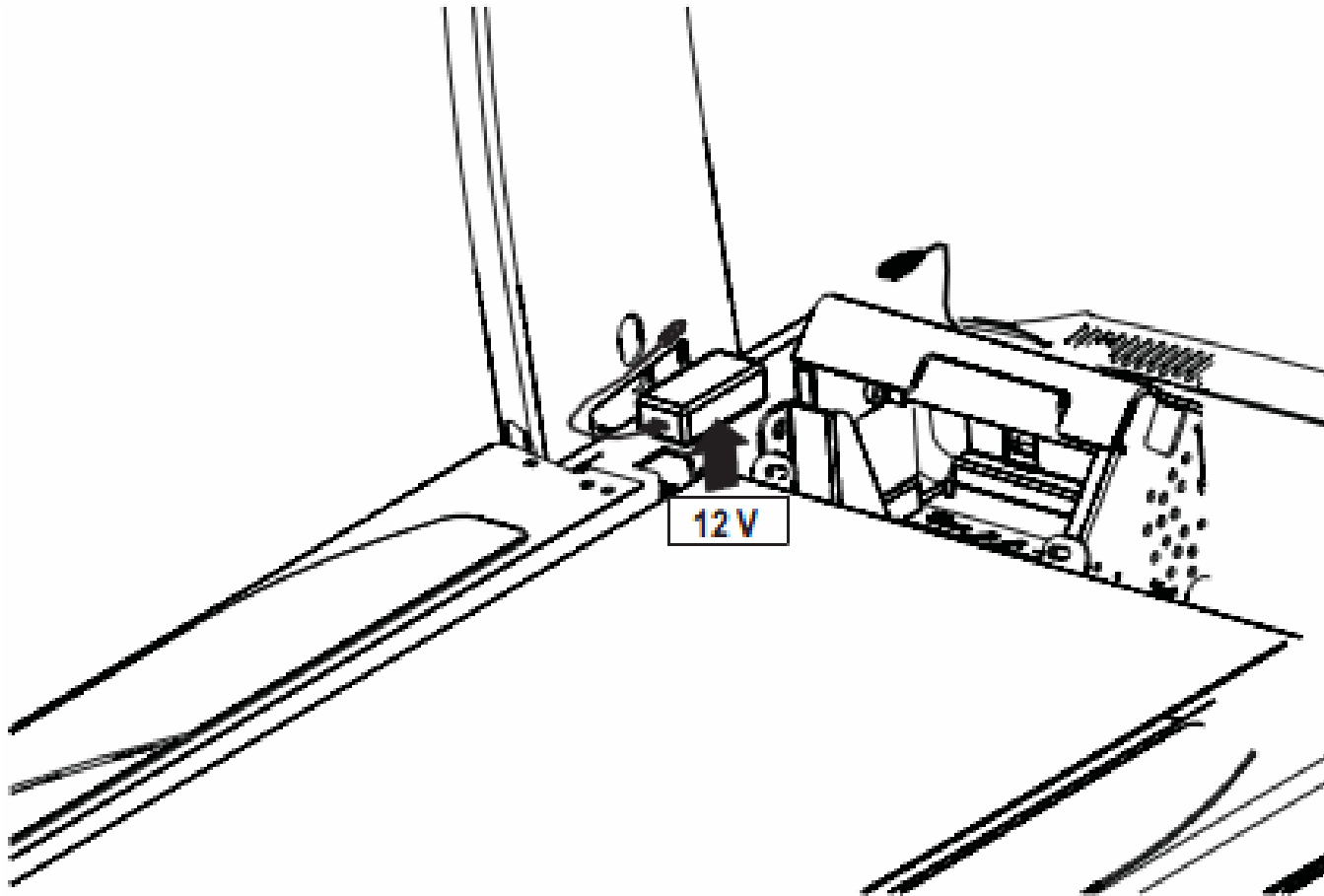
Digital TV Tuner

- » The US-Digital TV Tuner supports existing NTSC, QAM and FM radio reception and adds digital television capability ATSC in the Engage consoles.
- » A HYPHEN (-) key has been added to the channel keypad in order to support major-minor channel numbering (ie.11-2).
- » The Engage Console is powered by a single 12-volt DC power supply.
- » Extension power cable for the tuner is pre-wired in production (non-treadmills) or has to be assembled at the time of installation (treadmills).

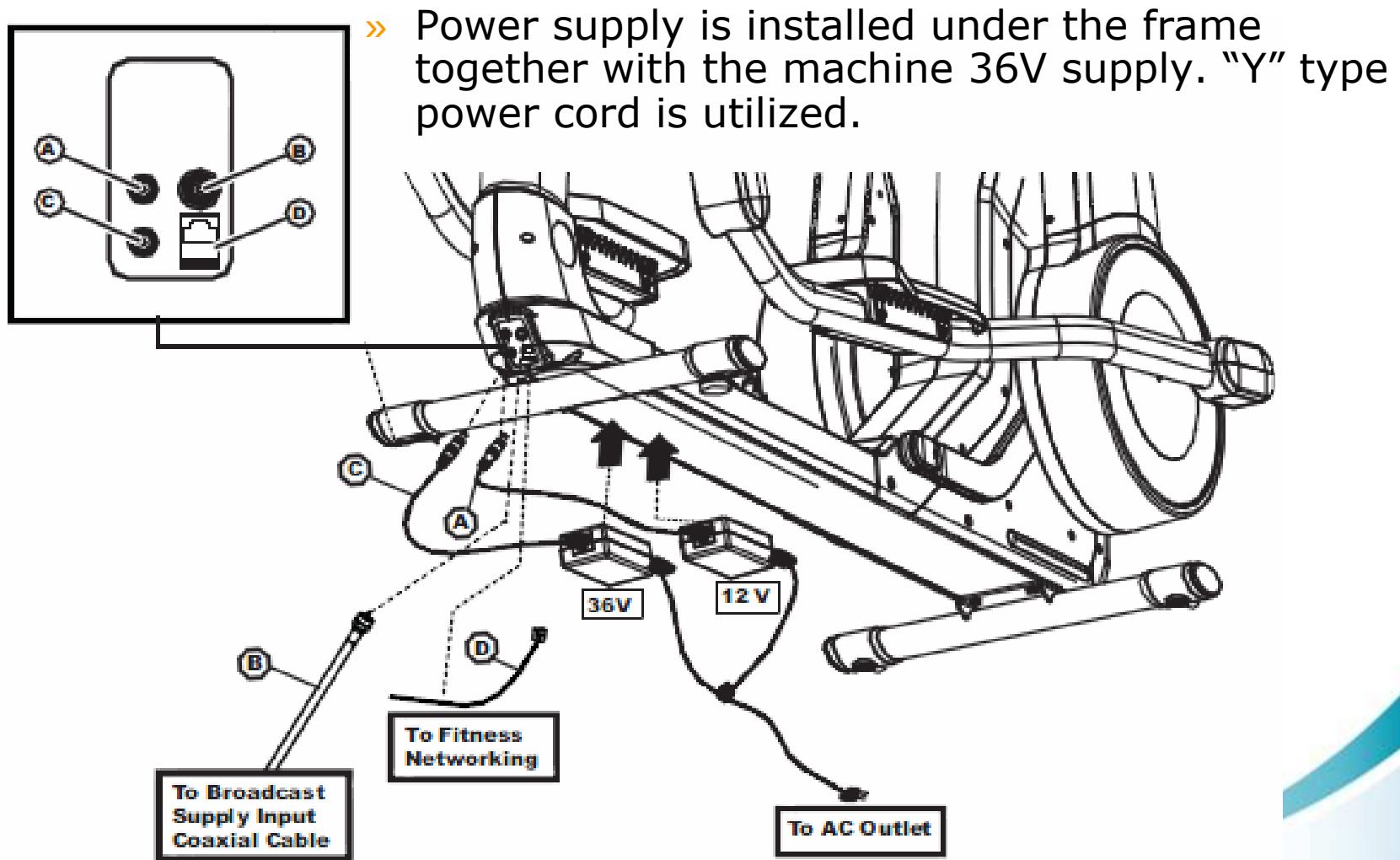


Power Supply Installation for DTV Tuner on a Treadmill

- » Power supply is installed near the left upright under the motor compartment cover.

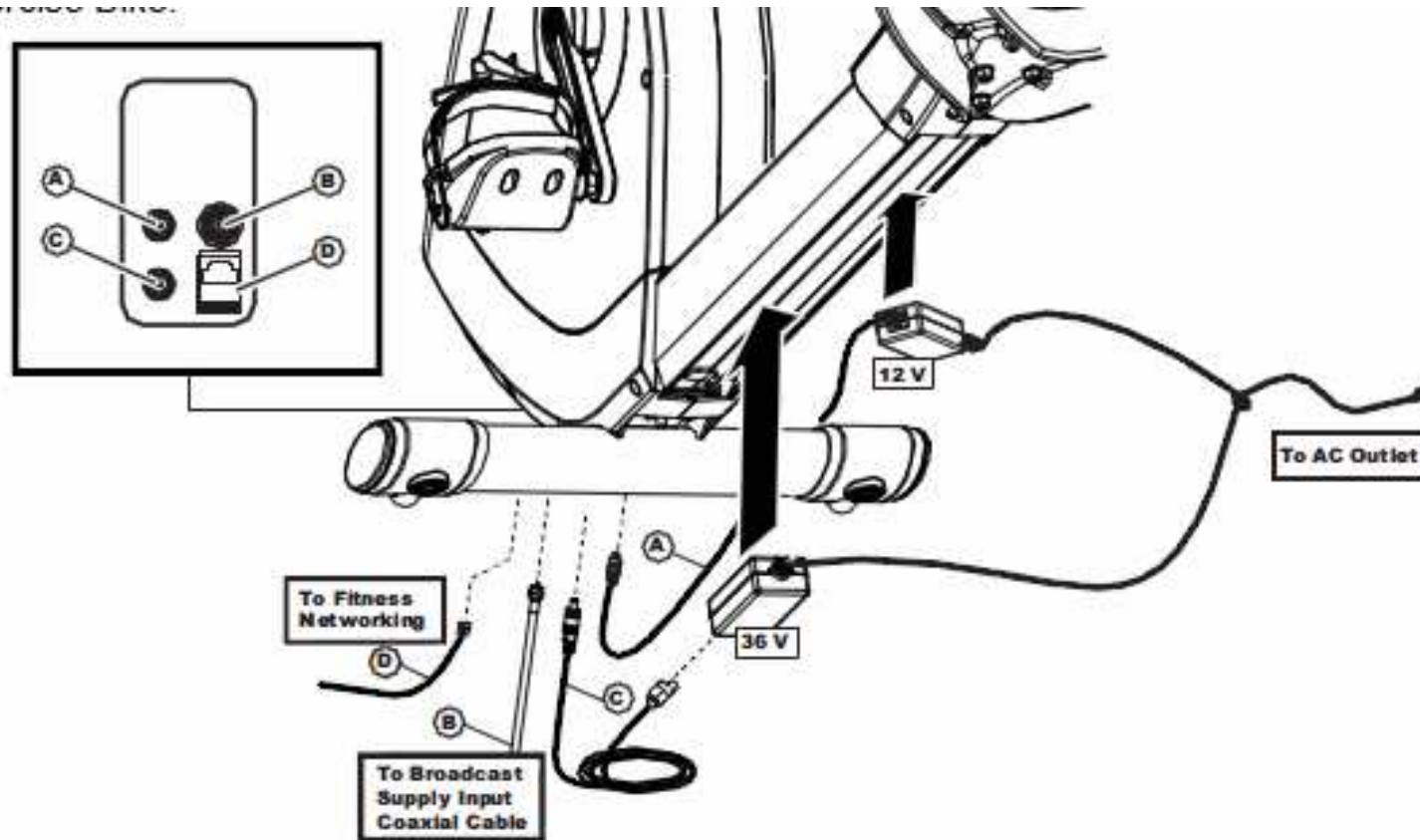


Power Supply Installation for DTV Tuner on a Cross-trainer

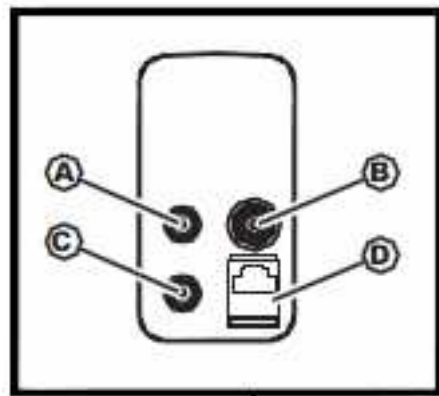


Power Supply Installation for DTV Tuner on a Recumbent Bike

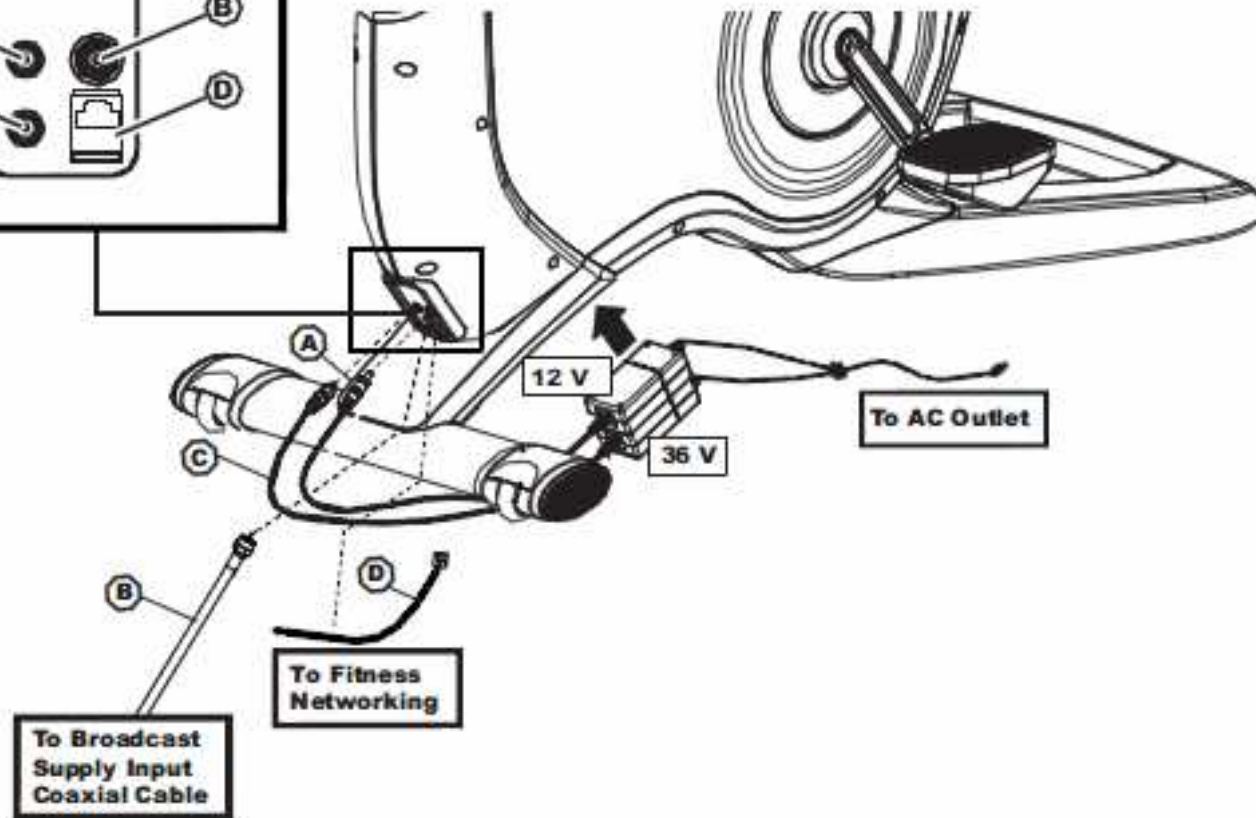
- » Power supply is installed under the frame together with the machine 36V supply. “Y” type power cord is utilized.



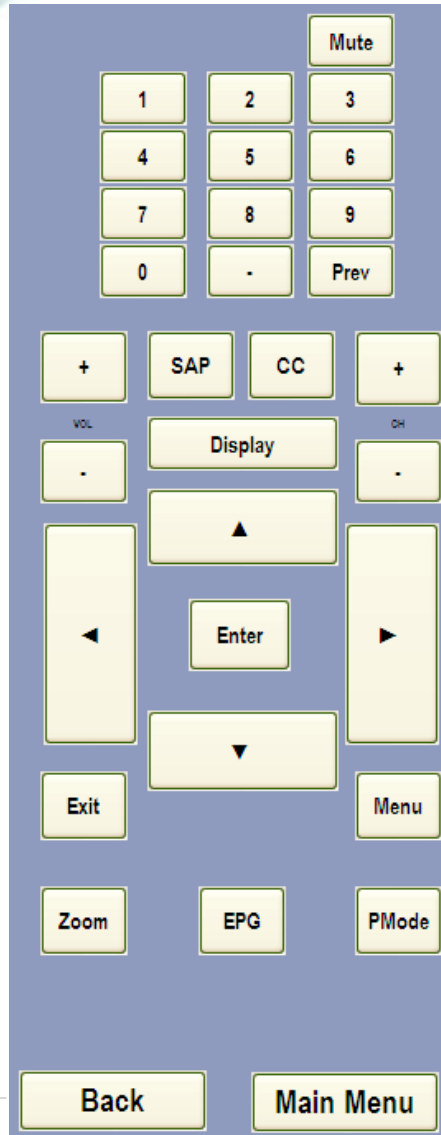
Power Supply Installation for DTV Tuner on an Upright Bike



» Power supply is installed under the frame together with the machine 36V supply. "Y" type power cord is utilized.



Digital Tuner Setup



» Virtual remote control is available in the Consoles Diagnostics:

- ♦ Go to Diagnostics (System Options – Main Menu)
- ♦ Select Configuration
- ♦ Select Media Center
- ♦ TV Setup

» To setup the digital tuner, follow the instructions in the Console Operation Manual.

- ♦ Reference: **Addendum: Engage™ Consoles with Digital TV Tuner (M051-00K88-A001).**

Board Functions (all LCD consoles)

- » It's good to know board functionality when trying to diagnose a problem. The below descriptions highlight console's PCBs functions.
- » SBC
 - ◆ Single Board Computer (different ones for the Engage and Inspire consoles, and totally different for the Integrated LCD consoles)
 - > Runs the Windows CE Operating System
 - > Runs the main application and its threads
 - > Processes TV's Audio/Video (15" Engage and 12.1" Integrated consoles)
 - > Processes touch screen presses
 - > Allows for iPod functionality (iPod authentication chip connected to it)
 - > Sound processing and interface
 - > Processes messages from the MIB (on the Engage and Inspire) and the IF (the Integrated LCD)
 - > Controls LCD brightness and the LCD itself
 - > On the 12.1" Integrated LCD series the SBC calculates LifePulse® heart rate

Board Functions (all LCD consoles, cont.)

» MIB and IF

- ◆ Machine Interface Board: different ones for the Engage and Inspire consoles; the Interface Board: used with the Integrated LCD consoles only
 - > In general this board does processing of signals where operating system's latencies are unacceptable
 - > Decodes hardware keys input (from the Activity Zone, and the on-console keys)
 - > MIB of the Elevation series consoles: calculates heart rate for both the LifePulse® and the telemetry
 - > IF of the Integrated LCD series consoles: DOES NOT compute LifePulse® heart rate, however it computes telemetry heart rate.
 - > Handles the E-Stop
 - > Controls the single-tone speaker
 - > Drives the LED data display and under-the-key LEDs (7" Inspire console)
 - > Sends IR commands to the attachable TV
 - > Controls power to the console
 - > Provides independent serial communication for: CSAFE, the base unit, and the SBC

Board Functions (all LCD consoles, cont.)

» iPod Authentication

- ◆ Implemented as a separate board in the 7" Inspire console and as part of the TV tuner board in the 15" Engage console
 - > Allows for full iPod functionality (pulling a play list, making a selection of the desired song or video, using iPod as a workout results storage device)
 - > Communicates with an SBC
 - > Functionality unlocked using a proprietary Apple protocol

» Inverter

- ◆ Used in all LCD consoles EXCEPT the latest 7" Integrated console, which uses an LED backlight
 - > The inverter produces very high voltage in the range of 1200VAC to illuminate the display using a Cold Cathode Fluorescent Light
 - > Controlled by the SBC

Board Functions (all LCD consoles, cont.)

» LifePulse® ESD

- ◆ Used in Elevation non-treadmill consoles 7- and 15-inch
 - > Protects the contact heart rate circuitry against damage due to electrostatic discharge

» ESD Board

- ◆ Used in all of the Elevation consoles
 - > Protects the MIB against damage due to electrostatic discharge

Board Functions (all LCD consoles, cont.)

» Polar Coded HR Receiver

- ◆ Used with all Elevation consoles (note: all of LF consoles are currently specified to use the coded receivers, however it will take some time before stock of consoles equipped with non-coded receivers get depleted)
 - > Developed by Polar
 - > The coded board has a limited sensitivity range upon powerup up to 2/3 of its original range of one meter (three feet). The range is extended back to one meter (three feet) after a heart rate signal was detected – as a result users wearing the telemetry chest strap have to get closer to the receiver to have their chest straps detected by the receiver.

Board Functions (all LCD consoles, cont.)

» TV Tuner

◆ NTSC and PAL Tuners

- > In case of the Engage console the iPod Authentication Chip (a.k.a. Co-processor) is mounted on the tuner board
- > The NTSC tuner supports the following standards:
 - NTSC-M
 - PAL-M
 - PAL-N
- > The PAL tuner supports the following standards:
 - PAL-B/G
 - PAL-I
 - PAL-D/K
 - SECAM-D/K
 - SECAM-L
- > Digital TV support

» 7-Segment Data Display (Inspire console)

◆ Used with the 7" Inspire consoles

- > Controlled by the MIB
- > Display organized in three clusters of 4/3/4

Replaceable Components

- » For an exact list see the respective Parts Lists
- » In general you can replace:
 - ◆ PCBs
 - ◆ Cables
 - ◆ Plastics
 - ◆ Display components
 - ◆ Some other hardware (examples: tape used to secure a Polar heart rate telemetry board, cable assembly of the USB, Elevation series' option panel – see below)



Value of LCD Consoles to Our Customers (End Users)

- » Our customers paid for the product that provides excellent quality of service in the following realms:
 - ♦ **Entertainment** (of the end user)
 - ♦ **Motivation** (of the end user)
 - ♦ **Raising brand awareness** (to the end user and a prospective customer of the club)
- » Make sure that after conducting the repair, the above aspects work as desired.
- » For troubleshooting guidance use Core Features – Review of Common Issues section of this presentation

Value of LCD Consoles to Our Customers (End Users, cont.)

- » **Entertainment** (some diagnostic states can be used to exercise the below functionality, but **always run a test that simulates user's experience**)
 - ◆ TV
 - ◆ iPod/iPhone
 - ◆ USB Audio
 - ◆ FM radio

Value of LCD Consoles to Our Customers (End Users, cont.)

- » **Motivation** (no diagnostics available, functionality to be proven out by running a workout)
 - ◆ Virtual Trainer
 - ◆ Custom workouts on USB
 - ◆ A large workout selection
 - ◆ Workout landscapes
 - ◆ Zoom feature
 - > Time
 - > Incline
 - > Speed
- » **Raising Club's Brand Awareness** (no diagnostics available, functionality to be proven out by booting up the console and making sure that the below aspects are present)
 - ◆ Scrolling custom message
 - ◆ Promo channel
 - ◆ Custom logo

Value of LCD Consoles to Our Customers (Technicians)

- » More efficient diagnostics
 - ◆ Get the problem resolved quickly and accurately
- » The Graphical User Interface (GUI) allows for a bird's eye view of many diagnostic parameters

Common Issues

- » Life Fitness 12.1" Integrated LCD consoles
 - ◆ Reprogramming
 - > Challenge in getting Compact Flash (CF) Cards that work with our system (the CF cards must be based on the Toshiba controller)
 - > Possible software mismatch between the SBC and the MIB – Life Fitness Engineering to issue a suitable compatibility matrix bulletin
 - ◆ Inverted picture, which is perfectly clear
 - > Check connections of the SBC-to-LCD cable
 - ◆ Telemetry receiver falls off inside the console
 - > Make sure that after repair the receiver is properly attached

Common Issues

- » Life Fitness Elevation series consoles (15" Engage and 7" Inspire)
 - ♦ Headphone jack nut issue: the nut would vibrate off (see picture)

Note:

See next page for a macro picture of the headphone jack nut.



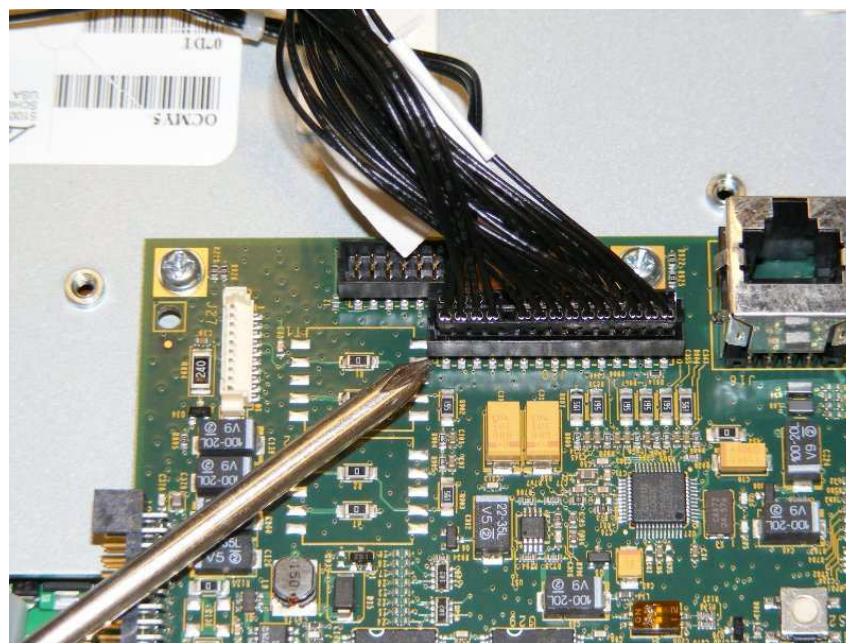
Common Issues (cont.)

- » Life Fitness Elevation series consoles (15" Engage and 7" Inspire)
 - ♦ Headphone jack nut issue: the nut would vibrate off (see picture, macro)



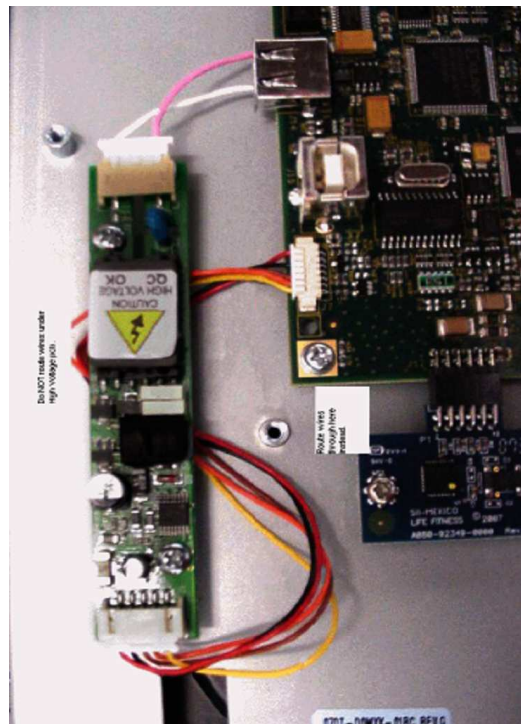
Common Issues (cont.)

- » Life Fitness Elevation series consoles (15" Engage and 7" Inspire)
 - ♦ Not connecting all of the ground connections to the console
 - ♦ Some of the connectors are really tight fit – exercise caution when removing them – never pull on just one wire, wiggle the connector out, don't just pull (see the picture below)



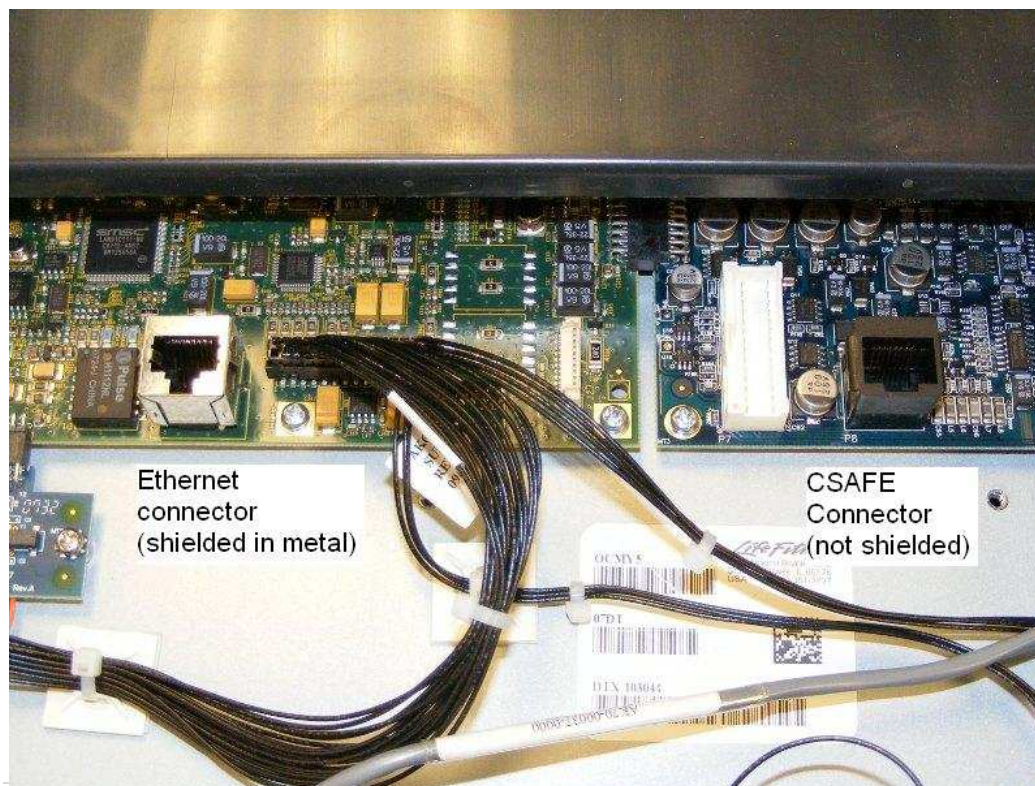
Common Issues (cont.)

- » Life Fitness Elevation series consoles (15" Engage and 7" Inspire)
 - ♦ Running cables/wires under the high voltage inverter (see picture)



Common Issues (cont.)

- » Life Fitness Elevation series consoles (15" Engage and 7" Inspire)
 - ♦ Plugging in a CSAFE device into an Ethernet port, both are of the RJ45 format (usually 7" Inspire consoles, because both connectors are readily visible)



Common Issues (cont.)

- » Life Fitness Elevation series consoles (15" Engage and 7" Inspire)
 - ◆ Life Fitness logo rubs off from the console's bezel (*at the time of this writing picture not available*)
 - ◆ People have a tendency to literally hang on the consoles thus they rub off the Life Fitness logo; also, if the console is not securely attached it will fall off
 - ◆ Coded Polar telemetry heart rate receiver initially limited range (not an issue, but a design limitation)

Summary

- » In this presentation we had discussed the following subjects:
 - ◆ We introduced Life Fitness' LCD consoles
 - ◆ We discussed the core features of the consoles and general diagnostics thereof
 - ◆ We had shown where the PCBs are located in the consoles
 - ◆ We named groups of replaceable components
 - ◆ We discussed value that the Life Fitness LCD consoles offer to our customers and technicians
 - ◆ We had discussed common issues related to the LCD consoles

Questions





THANK YOU!

LifeFitness
WHAT WE LIVE FOR