



GENERATOR BRAKE & GBC TECHNICAL CERTIFICATION TRAINING

Field Engineering | 2009

LifeFitness
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Course Objectives

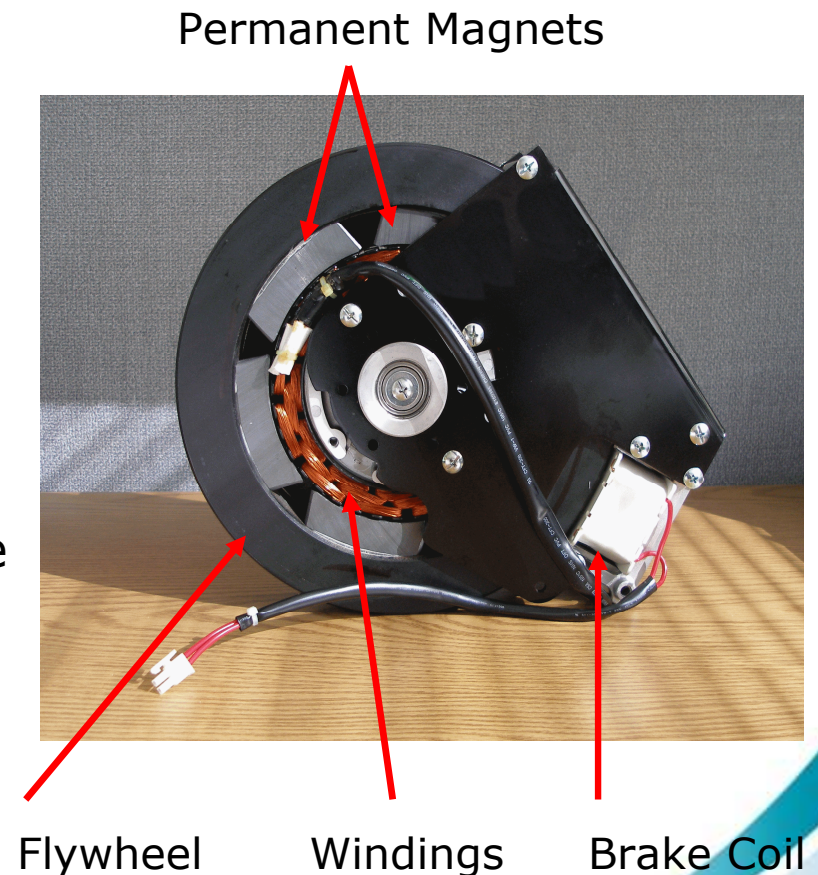
» Topics to be covered in this section:

- ◆ Generators
- ◆ Application in Life Fitness Products
- ◆ Generator Brake Control (GBC) board
- ◆ Generator Systems Common Issues

Generator System – Commercial Products

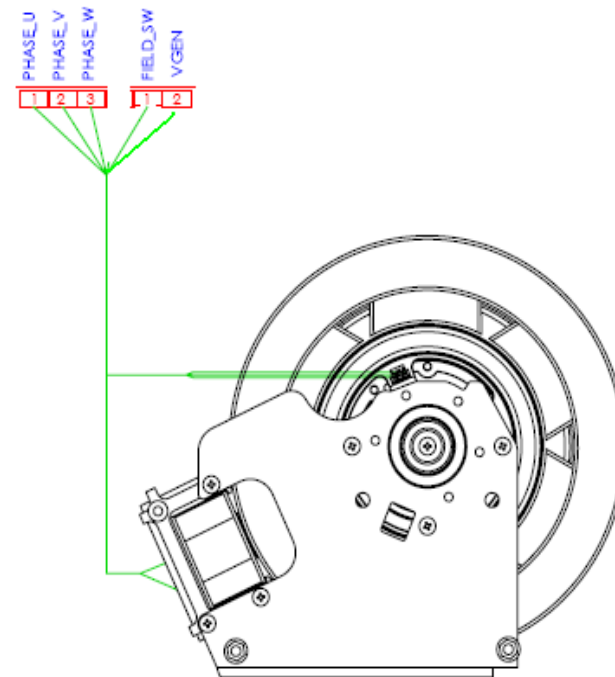
Generator/Brake Coil Assembly

- » Generator Assembly consists of the Flywheel with Permanent Magnets, coils in the middle, and a Brake Coil.
- » Magnets' (Flywheel) rotation produces an output voltage.
- » The current that flows through the brake coil (an electromagnet) creates a magnetic field and eddy currents, which in turn provides resistance to the flywheel of the generator (and user).



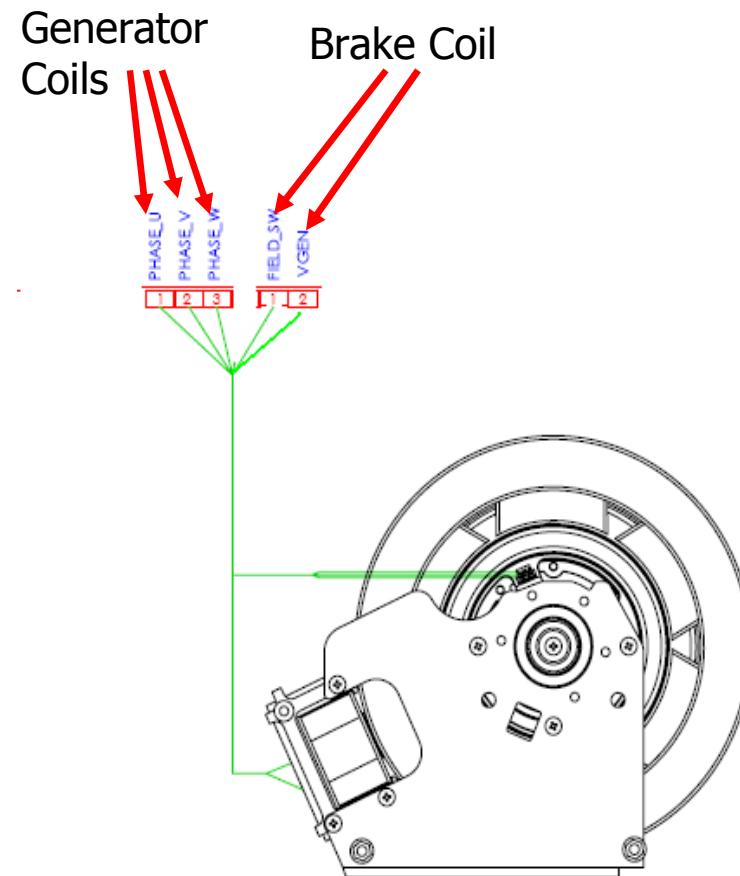
Generator & Brake Information

- » Output voltage is directly proportional to speed.
The Flywheel rotation will result in voltage being present at the Generator's output.
Use caution when working on a unit with flywheel spinning – as high voltage can be present.
- » Generator output voltage is 3 phase
- » Resistance to user is directly proportional to brake-coil current

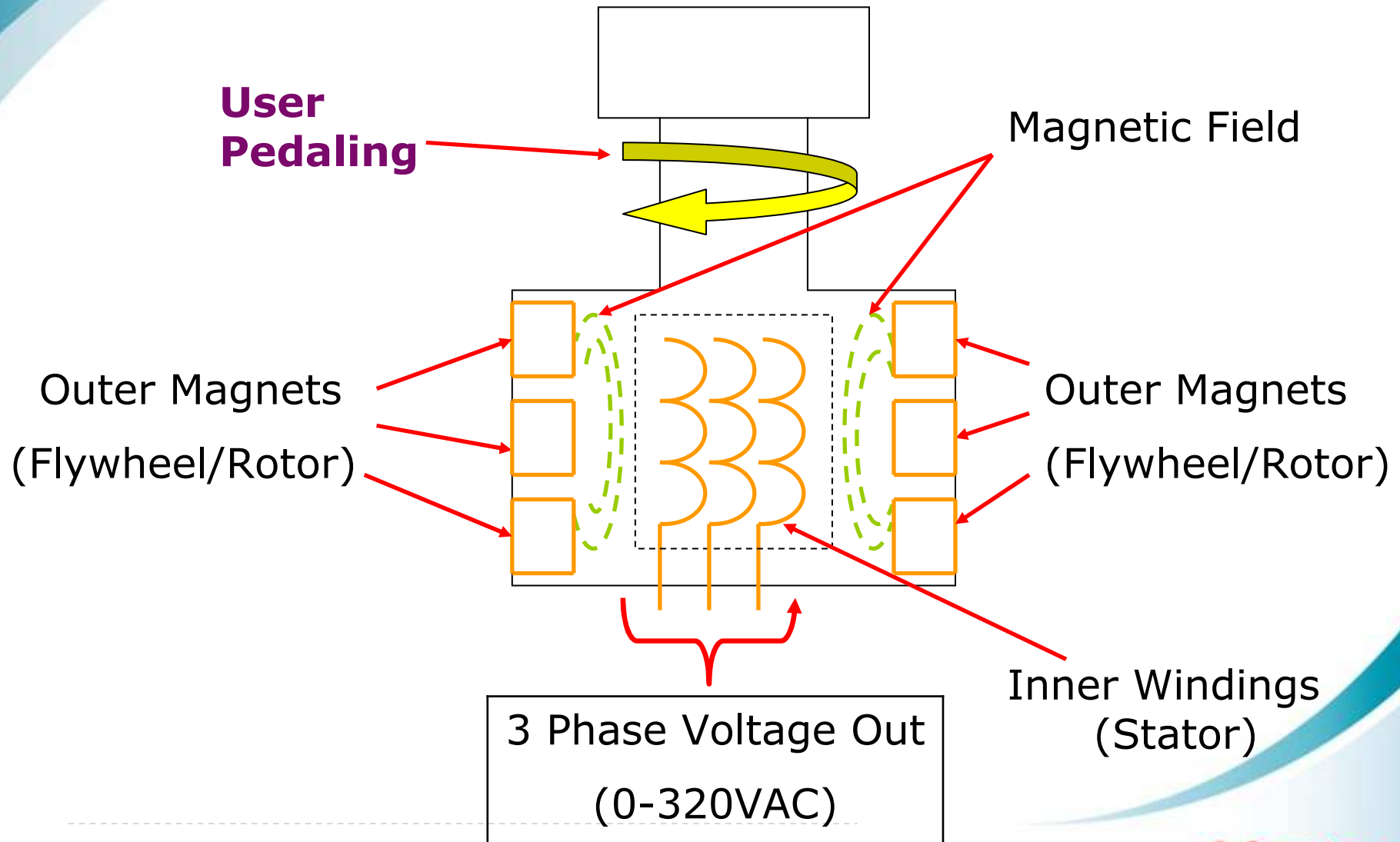


Generator & Brake Information

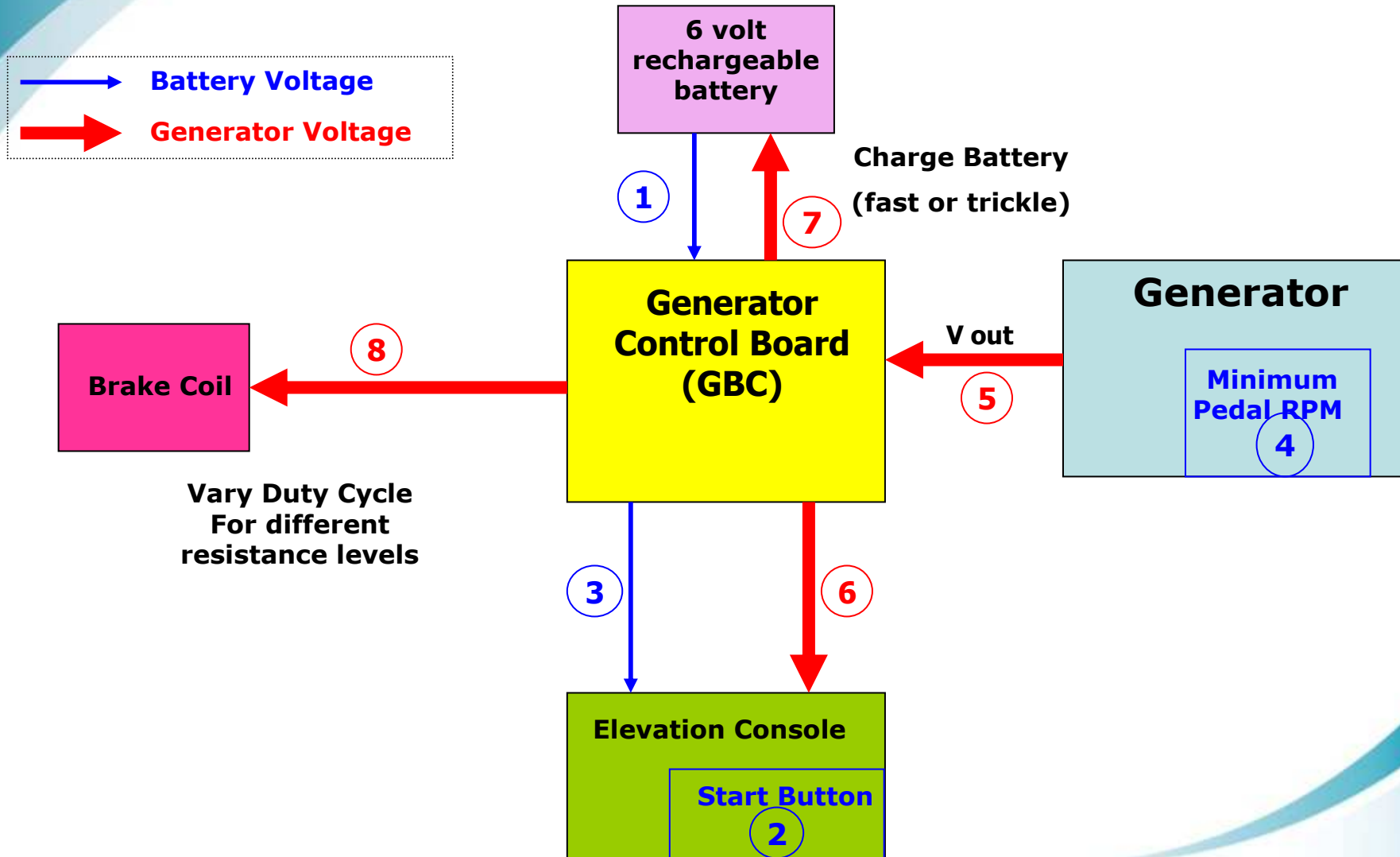
- » Test to verify the commercial Generators proper electrical operation:
 - ◆ Measure OHMS between each of the 3 wires (Generator Coils) with flywheel stable.
 - > 69.5 ohms +/- 10% at 27C
 - ◆ Measure OHMS between the two wires of the Brake coil.
 - > 12.1 ohms +/- 10% at 27C



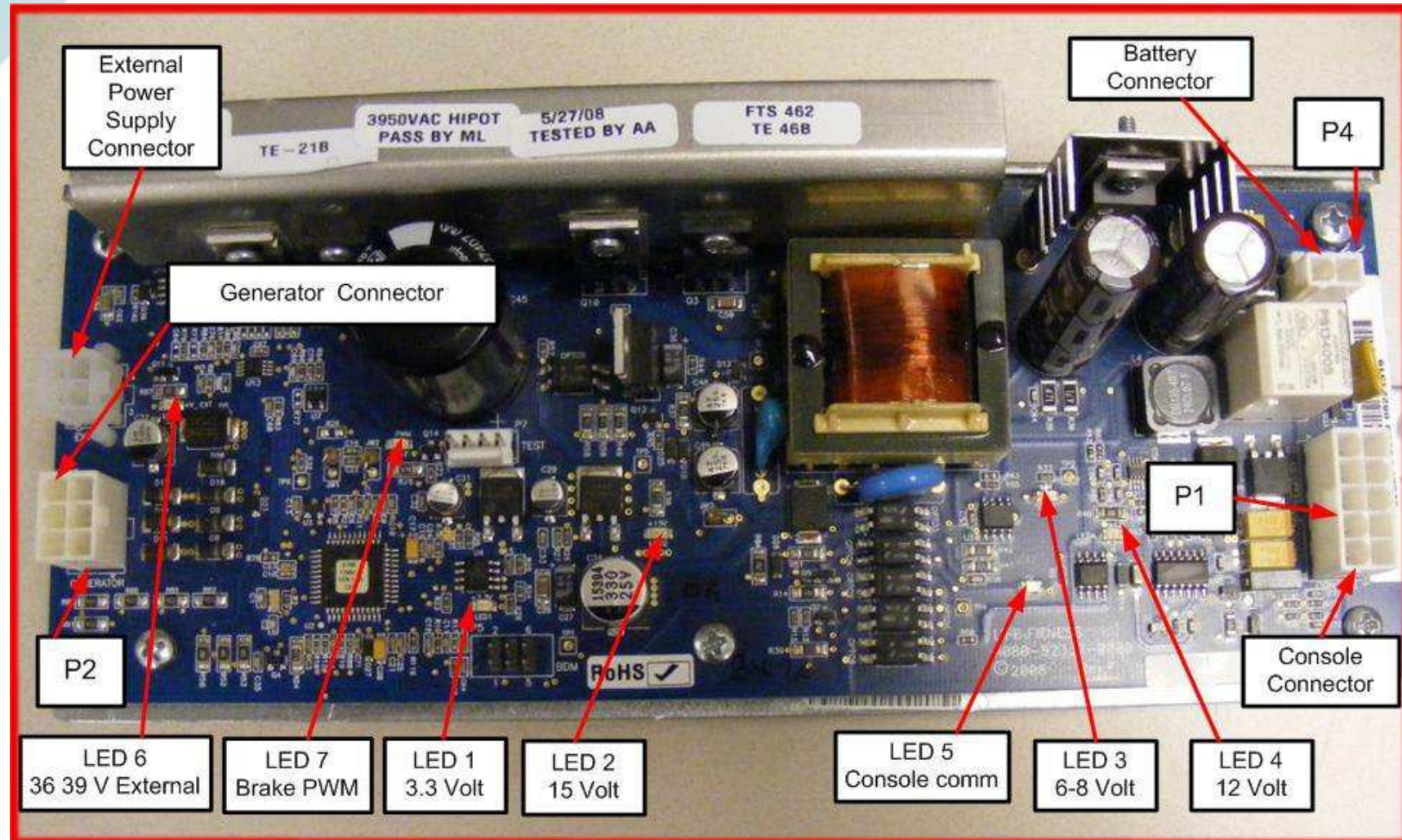
GENERATOR: Electric POWER



Voltage Diagram *Self Powered Products*



Generator/Brake Control (GBC) PCB



GBC PCB Functions

- » The GBC (Generator-Brake Controller) converts the 3-Phase AC Voltage from the Generator into different DC voltages for the various control systems.
- » Serial communication from the Console to the GBC controls a circuit, which adjusts (by changing duty cycle) the current applied to the brake coil, which in turn adjusts the resistance to the user.

The CONSOLE and the GBC are in a Master-Slave configuration: the GBC does not send any packets unless requested to do so by the console.

GBC PCB Functions (cont.)

- » The RPM of the Generator is determined by detecting the frequency from the W phase of the Generator's output voltage.
- » The GBC controls the charging of the Battery. It will either Fast-charge or Trickle-charge based on user RPM and resistance/wattage level.

Added Function of GBC AK66-00100-0005



- » Allow users to totally power the 15" (Engage) LCD console using only user's energy generated during their workout.
- » The Hybrid feature is enabled by default.



GBC Compatibility

- » The GBC Assembly AK66-00100-0005 is a drop in replacement for the AK66-00100-0002.
- » The GBC software and update instructions are available on www.lftechsupport.com

Assembly Number	AK66-00100-0002	AK66-00100-0005
GBC Software Version	1.3 K70F-12602-0000	2.0 * K70B-12629-0000
GBC Board Number	92337	92363

* The GBC 2.0 Software is not compatible with the GBC Assembly AK66-00100-0002

GBC Identification



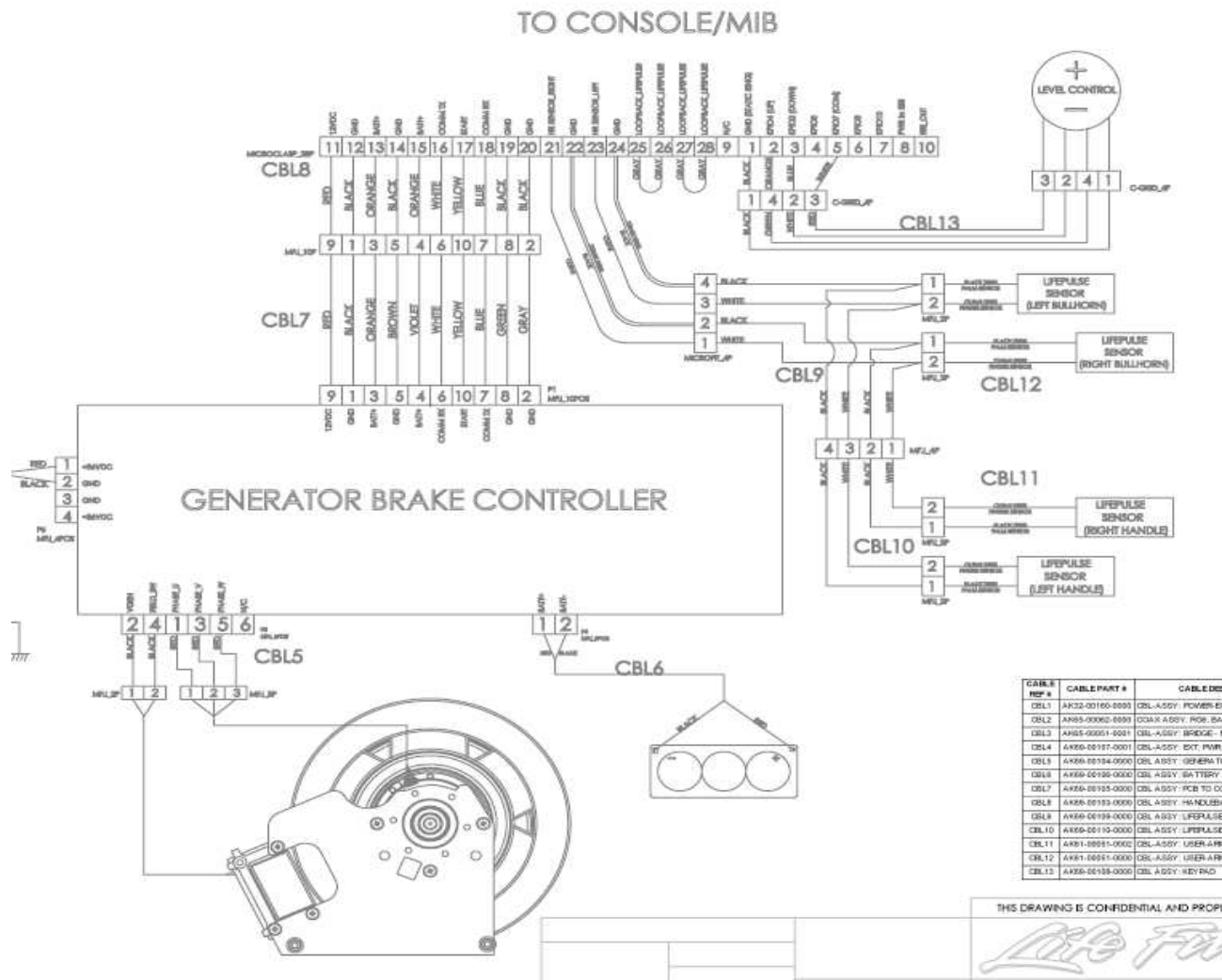
The latest GBC assembly is part # **AK66-00100-0005.**

Cluster number	Example (picture above)	Meaning	Notes
1	92337	Board number	Controlled by engineering
2	F000D	First two characters: board revision, next two characters: place holder, last character: software version	In this case: •Board revision: F0 •Place holder: 00 •Software version: D
3	08407701	Date of manufacture and serial number for the week: •first two numbers: year •next two numbers: week of the year •remaining four numbers: serial number for the week	In this case: •Year: 08 •Week: 40 •Serial number for the week: 7701

GBC Diagnostics – LED State

LED #	Description	Function: Action to by service	Normal State
LED1	+3.3V/local voltage	GBC local microprocessor & control If LED1 is off: replace GBC	ON
LED2	+15V	GBC local brake driver voltage If LED2 is off: replace GBC	ON
LED3	+6V	Charging/System Voltage If LED3 is off: replace GBC	ON
LED4	+12V	+12V is for backlight on E/I consoles, unused on Gemini If LED4 is off: replace GBC	ON
LED5	Tx to Console	Serial Transmit from GBC to Console If LED5 is off: 1). Failed console cable connection 2). Failed console	BLINKING
LED6 (If Present)	+36V ext. power	Power from external power supply present If LED6 is off, could be: 1). External power supply not connected or powered 2). Failed external power supply	ON
LED7 (If Present)	PWM	Brake PWM present when connected to Console If LED7 is off, could be: 1). Console is in "Pause" (no failure) 2). Console Resistance level set to "0" (no failure) 3). Failed flyback power supply (if LED1, 2, 3, 4, 5 also off) 4). Failed +3.3V supply (replace GBC) 5). Failed +15 V supply (replace GBC) 6). Brake control circuit failure (replace GBC) 7). Console failure	ON with Varying Brightness

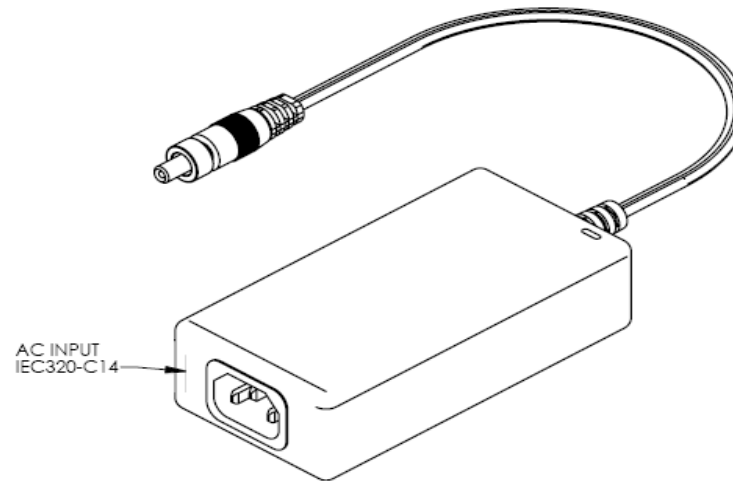
Generator system block diagram



Alternator vs. Generator systems

Alternator Systems	Generator systems
Reed Switch/Magnet required (for Field Kick)	No Reed switch/magnet required.
AC Tap wire from Alternator used for RPM	RPM determined on GBC. No additional wire from Generator.
Load Resistor to create resistance.	Brake Coil to create resistance.
Battery always charged with same voltage.	Fast-Charge and Trickle-Charge voltages on GBC.
Dual Stage Drive system	Single Stage Drive System

External Power Supply – 36 or 39 VDC



External 36 or 39 VDC Power supply for Elevation Series products.

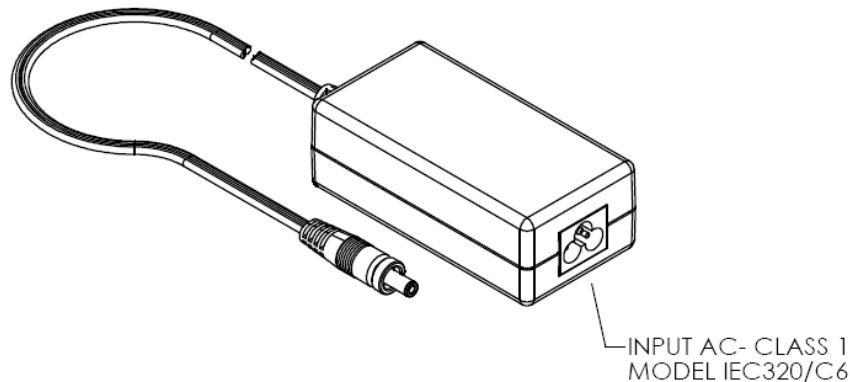
Engage Console: Required.

Achieve and Inspire consoles: Optional.

Allows a Level 0. (2.1mm plug).

Recommended for facilities where RPM's are consistently below 50RPM or where the workout time is less than following ratio: 7 minutes workout for 3 minutes console drain (Console ON but no pedaling).

External Power Supply – 12VDC



17" Attachable LCD TV power supply: 12VDC, 2.5mm plug

Caution: This jack is similar in size to the 36VDC jack. Plug power supplies into LF products before plugging into the wall outlet – possible damage to TV's if this is not done.

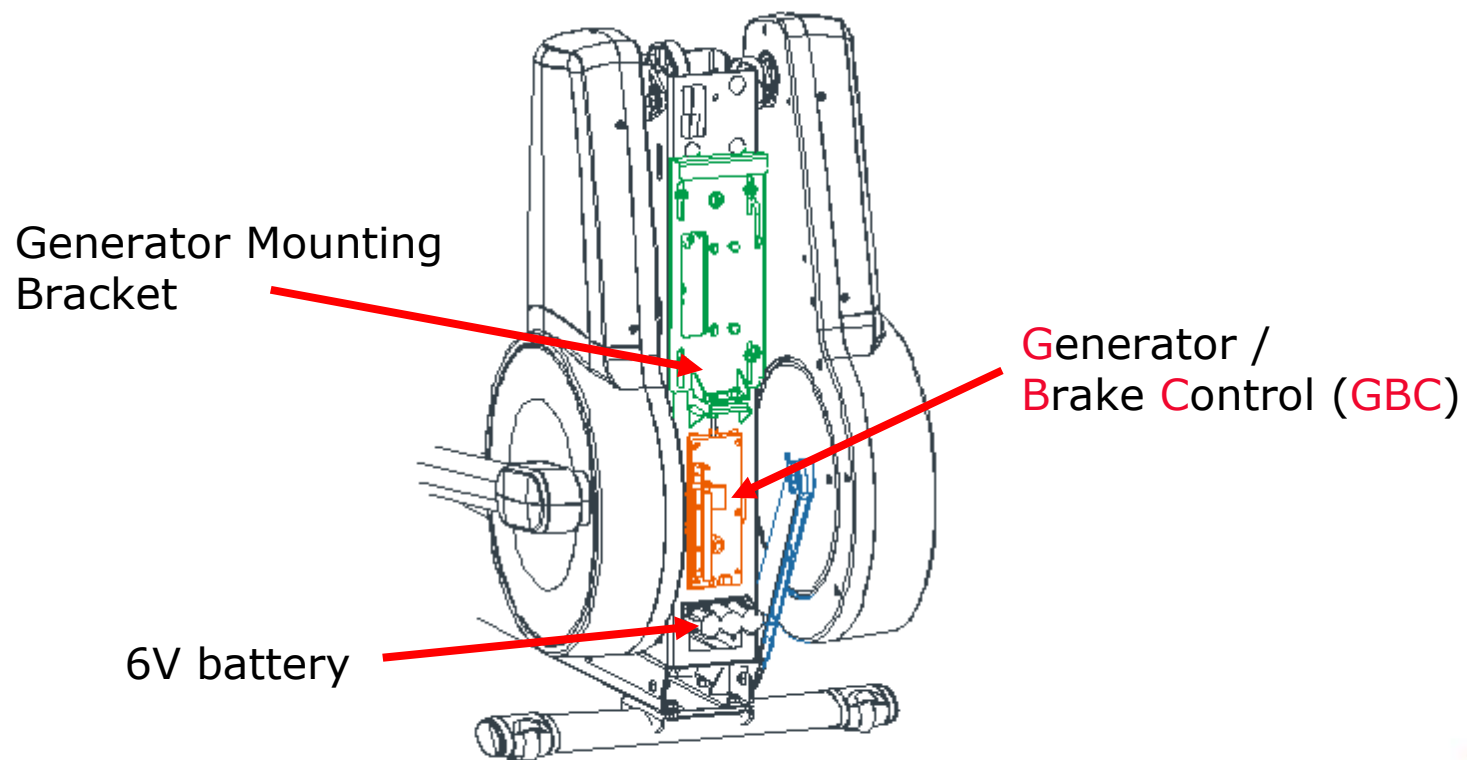
GENERATOR IN ELEVATION SERIES CROSS TRAINERS

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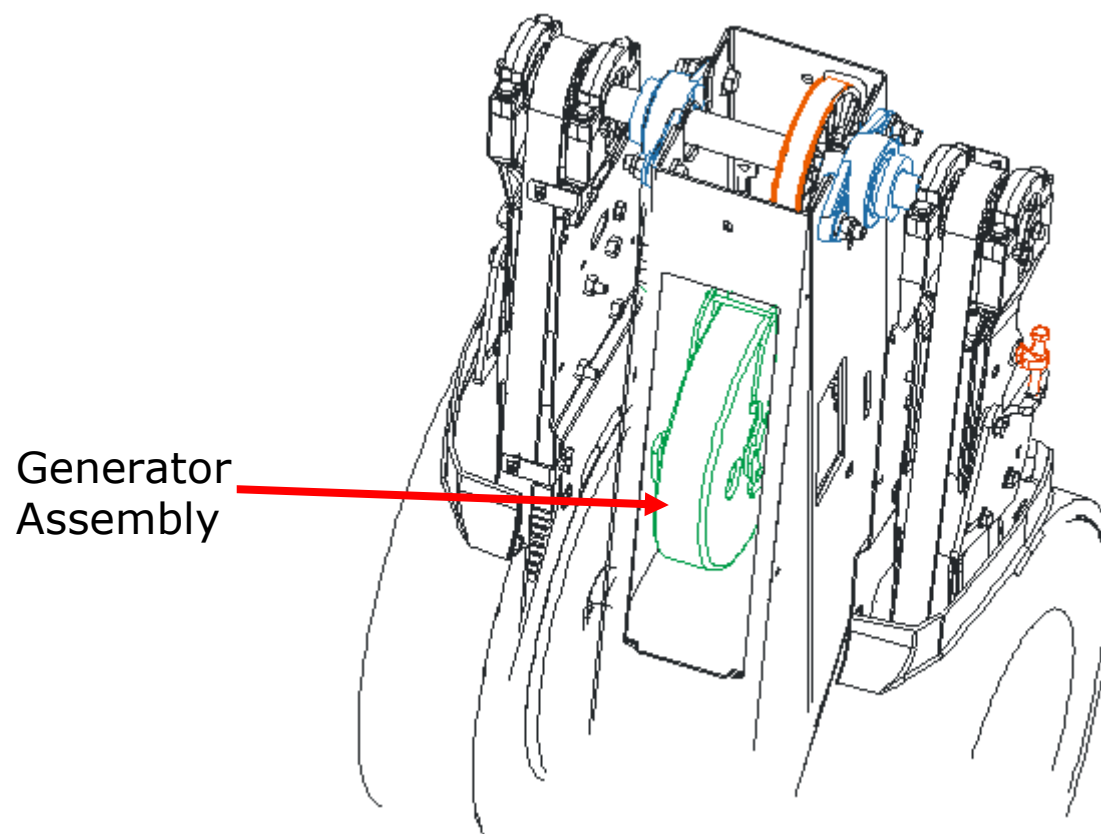
95X Cross Trainer



Parts ID



Parts ID Tower Area



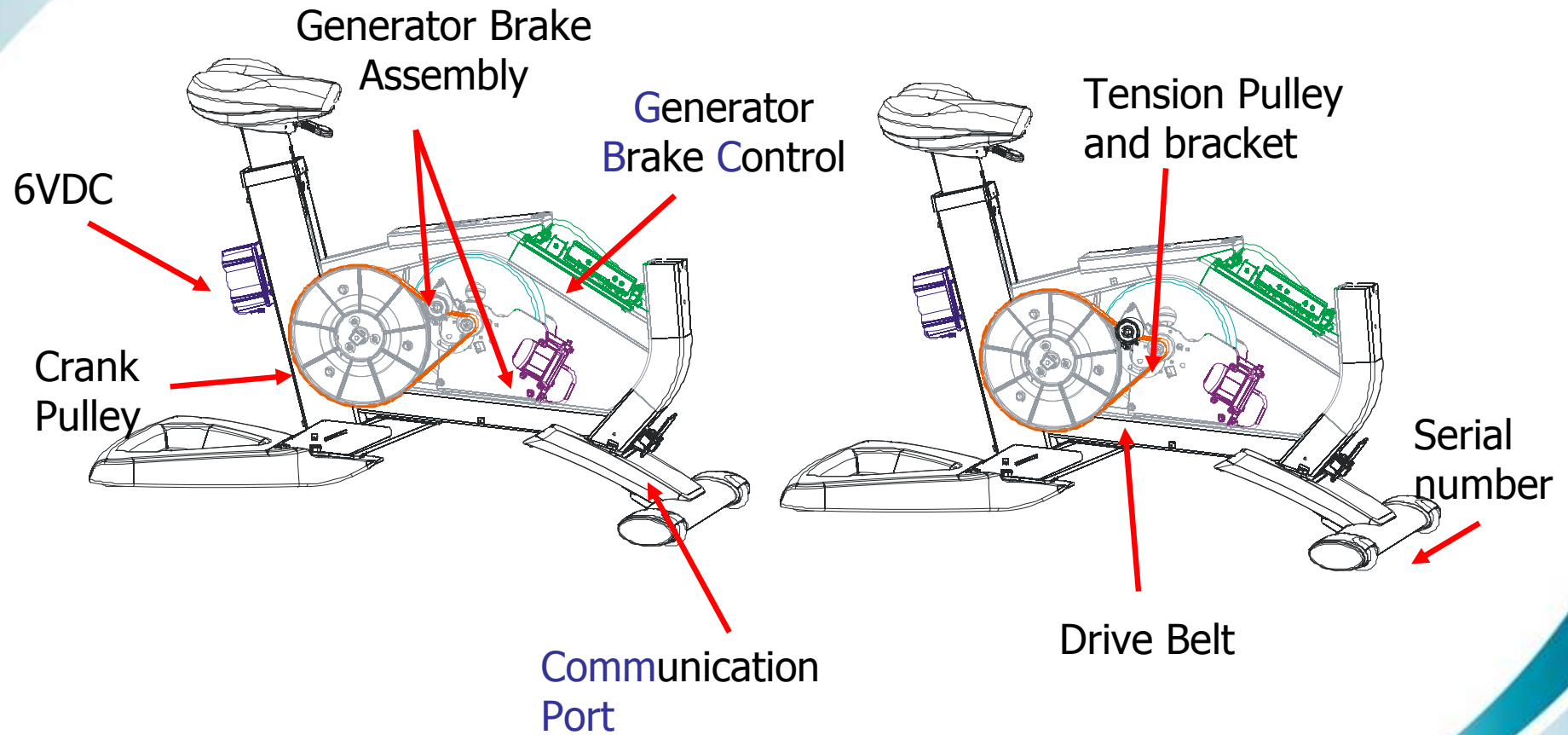
GENERATORS IN ELEVATION SERIES BIKES

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Elevation Series

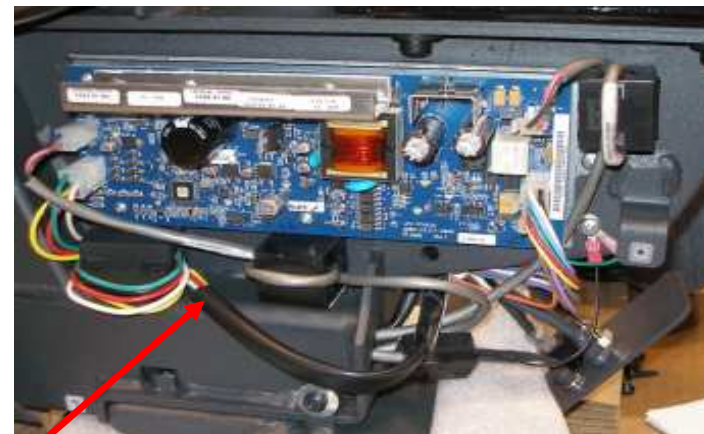
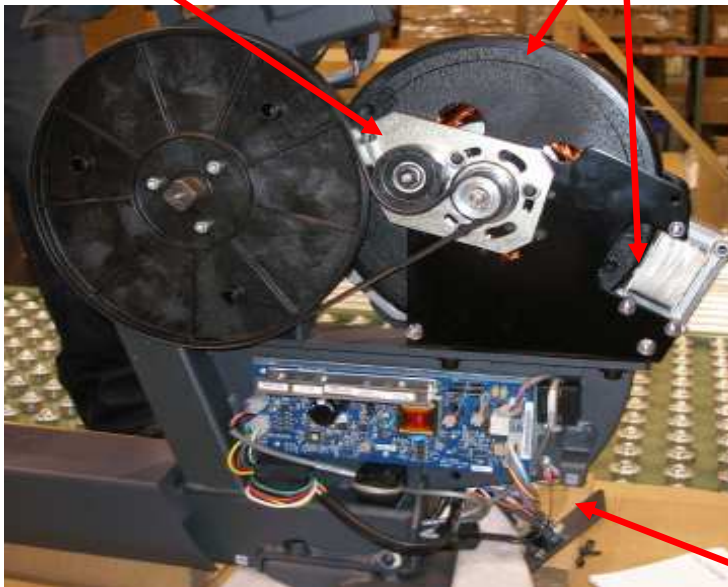


Upright Elevation



Recumbent Right Side

Generator Brake Assembly
Tension Pulley Bracket

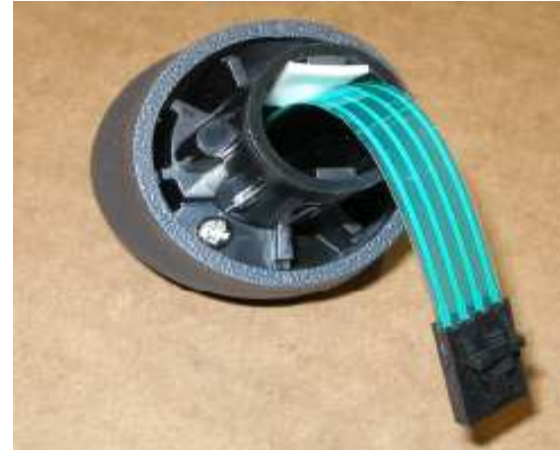


Generator Brake Control

Comm Port

Level Thumb Control

- » The Level control switch (pictured) allows the user to adjust their level from the end of the handle on the Recumbent Bike.
- » On the Upright Bike, the level control switch is in the middle of the handle (different setup).
- » On the Cross Trainer (Elliptical), this switch is located on the top of the stationary handle (bull-horn).

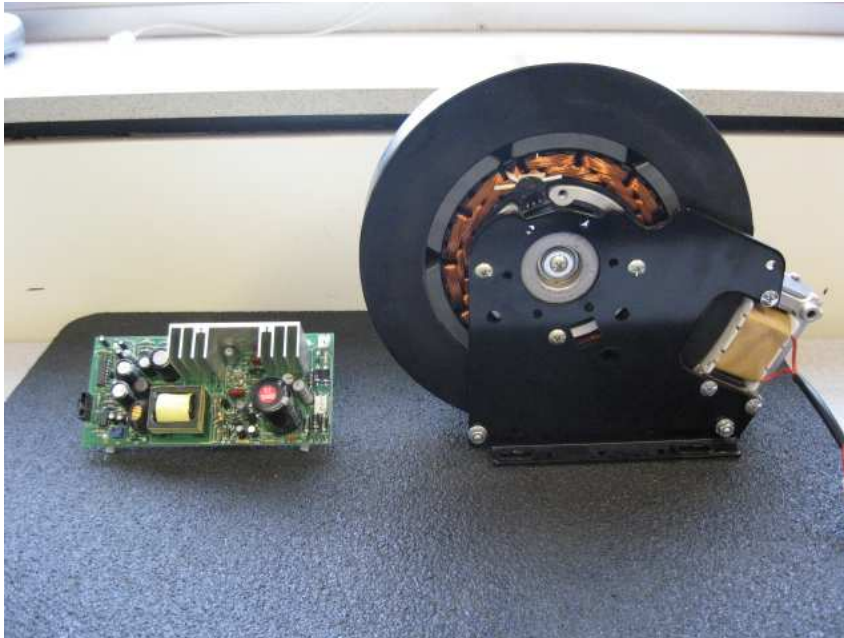


Consumer Models – Generator Systems

Generator system operation

- » Three part control system
 - ◆ Console
 - ◆ Generator/ electromagnetic eddy current brake
 - ◆ Generator control board
- » Resistance is actively controlled by console.
- » Current in electromagnetic coil is controlled based on desired level and pedal RPM.
- » Power output curve is speed dependant based but is controlled by software.

Generator Brake System

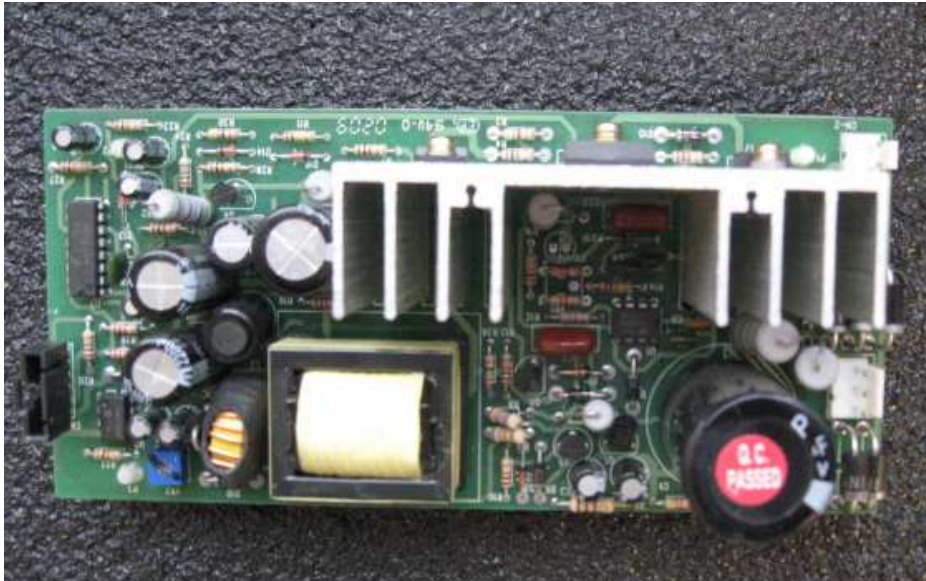


- » Electrical cables are also part of the system
- » C3/R3 only with Generators. Not available on Cross Trainers.

General



Generator Control Board



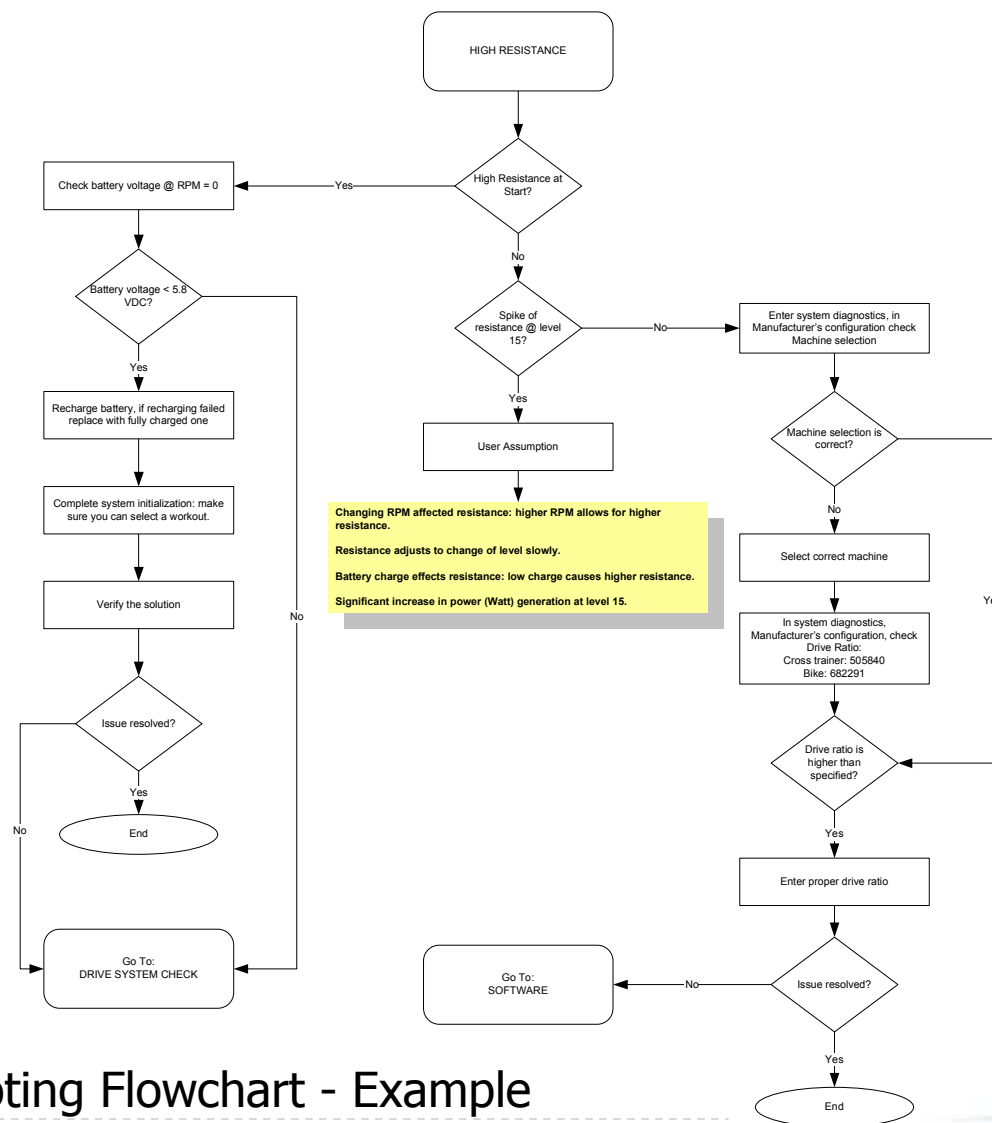
- » Passive Board – no processor
- » Takes output from Generator and creates 12 VDC power supply to Console
- » Uses a 0 to 5 VDC input from Console to determine proper PWM output control for the Brake coil
- » Creates pulsed output signal for speed input into Console

Generator Systems – Common Issues

Common Issues

- » Will not power up
- » Become difficult to pedal
- » No resistance
- » Variable resistance
- » No change in resistance
- » Sudden, sustained drop in resistance
- » Undershooting the target resistance

EC09042001R3 - Elevation Series Resistance Related Issues



Trouble Shooting Flowchart - Example

System is difficult to pedal - Battery

» **Problem description:**

- » On self-powered units, equipped with the Inspire (7" LCD) console, frequent Console activation (waking up) not followed by a long enough workout will discharge the battery.
- » Result is the "difficult to pedal" situation due to high battery charge current being required for a discharged battery.

» **Problem mitigation:**

- » Recommend a 7 minute workout (above 50RPM) at minimum for every 3 minutes that the Console is ON without pedaling.
- » Other option is to leave the 36V external power supply plugged in the unit for a duration of 20 minutes or more to recharge the 6V battery.
- » For situations that continue to operate the Console without a workout, it is recommended to permanently use a 36VDC external power supply.

System has no resistance - GBC

» **Problem description:**

- » Product does not change any of the resistance levels.

» **Root Cause:**

- » The issue was isolated to the over-temperature and over-current management circuitry.
- » This problem occurs on revision "D" and assembly revision "F6" GBC board.

» **Problem mitigation:**

- » Replace the GBC with a later assembly revision AK66-00100-0002 "G7," or "H0".
- » Order AK66-00100-0005 or latest version.

Variable resistance - GBC

» **Problem description:**

Resistance levels increase in the unit unexpectedly.

Root Cause:

- » The Over Voltage prevention feature in the software.
If the user is pedaling at high RPM's (mostly in low levels), the Generator can reach higher output voltages, and cause the unit to try and protect itself.
As a result the software will start increasing the load until the user slows down and the voltage level comes back to normal.
This is per design and not a failure.

» **Problem mitigation:**

- » Replace the GBC with a later assembly revision "H0". It will have software code "F" : Board assembly number "H000F"
- » Order AK66-00100-0005.

Applications draining Batteries. Recommendation...

- » At some Facilities (rehab, elderly, etc.) where Users pedal very slowly (less than 50RPM), it is recommended that those units be used with External Power supplies. Self Powered units will have challenges with batteries failing due to not having enough battery charge time during workouts.
- » Recommend a minimum of a 7 minute workout above 50RPM for every 3 minutes that the console is powered by the battery (i.e. no pedaling).

Questions





THANK YOU!

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