Ural (Урал) - Dnepr (Днепр) Electric Starters for Russian Motorcycles

Part II: Hitachi Starter-Generators

(See Also Part I: Electric Starter-Motors, Part III: Repair of Starter-Motors and Part IV: Adding a Starter-Motor)

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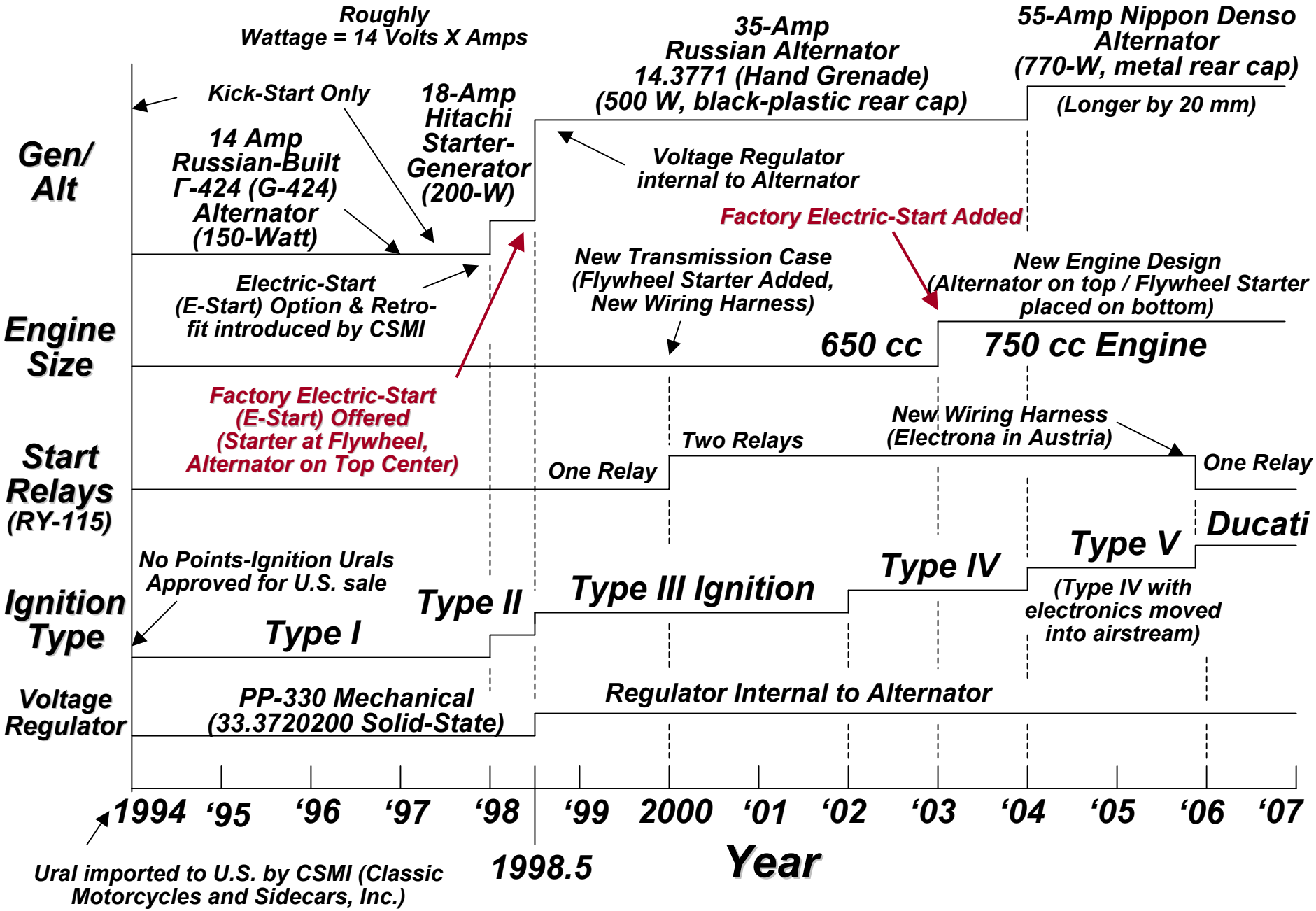
Electric-Start History

- *Ural Was Only Kick-Start When Introduced to the U.S. in 1994 thru 1997*
- *First Attempt at Electric-Start Replaced Original 14-Amp Generator with 18-Amp Hitachi Starter-Generator in 1998 (650 cc)*
  - *Operates thru Camshaft Gears, Instead of Flywheel Rim Gear*
    - *Original Engine Design Had No Flywheel Teeth*
  - *Always Engaged: No Bendix*
  - *Did Not Work Well and Was Discontinued Almost Immediately*
- *When It Dies, It Kills the Engine and Breaks the Timing Teeth*
- *True Electric-Start Introduced in 1998-1/2*
  - *Starter-Motor Required a Larger Battery and a 35-Amp Alternator (14.3771 Hand Grenade)*
  - *Alternator Powered by Cam Timing Gear*
  - *When Alternator "Freezes", Timing Gear Is Destroyed*

Even though the Hitachi Starter-Generator was added to Urals for a short period (1998 to 1998-1/2). Many older Urals utilized the retro-fit kit.

Ural Starter / Generator / Alternator Timeline



18-Amp Hitachi Starter-Generator Identification

- Look at the Unit Located on Top, Center of Ural Engine
  - If It Has a Metal Rear Cover with a Louvered Grill, It's the 14-Amp Alternator
    - Has 3 Wires that Connect to a Terminal Block on Top
    - None of the 3 Wires Is Very Large
    - Urals: M-67, M-67.36, IMZ 8.103 Series (650 cc)
  - If It's Massive with a Fat Battery Wire, It's the Hitachi Starter-Generator
    - 98 Ural's Have a Starter-Generator Set
    - Should Have 'Hitachi' Label on the Side
    - Combined Starter and Generator in One Unit
    - Urals: IMZ 8.103 and 8.107 "650" Series
  - If It's Gray and Looks Like an Alternator (slots in the side) and Has a Black Plastic Cover on Back with a 10 mm Nut Terminal and 2 or 3 Wires, Plus a Plug-In Spade Connector, It's the 35-Amp Alternator
    - '98-1/2 and Later Ural's Have a Separate Starter and 35-Amp Alternator
    - None of the Wires Is Very Large
    - Automotive-Style Starter Hanging Off Left Side of Transmission
    - Urals: IMZ 8.103, 8.103X, 8.123, 8.123X "650 & 750" Series

14-Amp Alternator Г-424 (G-424) (P/N: 3701000) 1974-1998

18-Amp Hitachi Starter-Generator 1998-1998.5

35-Amp Russian Alternator (P/N: 14.3771-010) 1998.5-2004

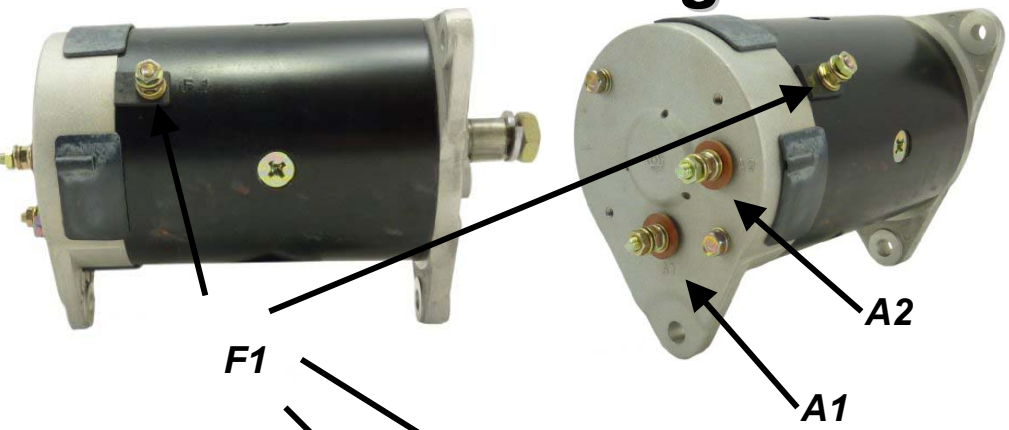
Hitachi Starter-Generator Retro-Fit Kit

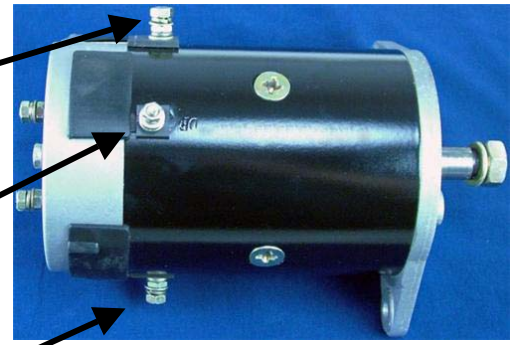
- Electric Starter-Generator Suitable for Most Urals Fitted with Alternators
- Unit Replaces the Alternator
- Combined Starter Motor and Generator
- Most Urals from Around 1998 Were Fitted with These Units in the USA and New Zealand
- Made by Hitachi Ltd, Tokyo, Very Reliable
- Starter-Generator: GSB107–04A, 12-Volt, 0.9 Hp

Hitachi GSB107-04A and Replacements

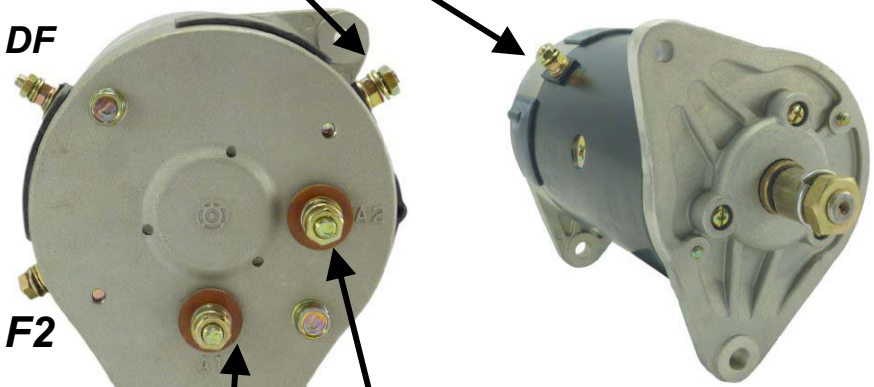
- *Used in 1998 Ural (650 cc) on Imported Models to U.S.*
- *Also Used in EZ-GO and CLUB CAR Golf Carts*
  - *250-400cc, 4-Stroke , 2-Cycle Gasoline Golf Cart Engines*
- *Original Part (blank or "A" version) No Longer Available*
- *Re-Use the Starter Gear*
- *Multiple Sources of Replacement Parts*
  - *Listed as Part #: GSB107-04A or 15421*
  - *Replaces: Club Car 1012316, E-Z-Go 16511G1*
  - *Specifications:*
    - *Voltage: 12-Volt*
    - *Charge Current: 18-Amps*
    - *Rotation: Reversible*
    - *Field Housing OD: 113.3mm / 4.461"*
    - *Overall Length: 230.3mm / 9.067"*
    - *Shaft OD: 17mm / 0.669"*
    - *Shaft Notes: Threaded With Keyway*
    - *5 Terminal Hook-Up (Metric)*
      - *Terminal 1 Size: M6-1.0*
      - *Terminal 2 Size: M5-0.8*
      - *Terminal 3 Size: M6-1.0*
      - *Terminal 4 Size: M6-1.0*
    - *Weight: 18.36 pounds*
- *Replaced by 35-Amp Alternator When Optional "True" Starter-Motor Added*

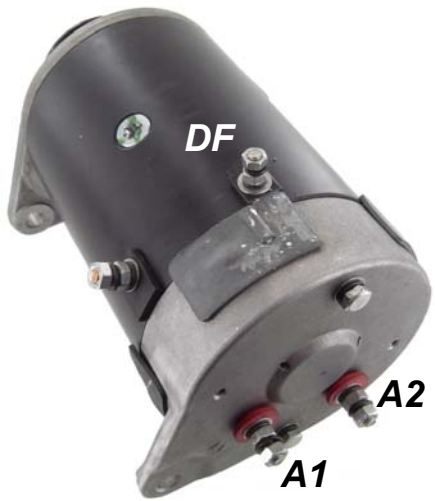
Hitachi 5-Terminal Starter-Generator Terminal Designations and Mounting Holes

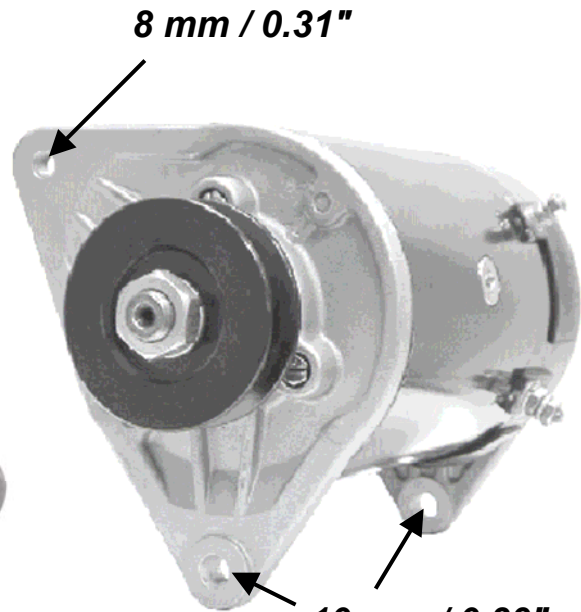




A = Armature
F = Field
DF = Dynamo Field

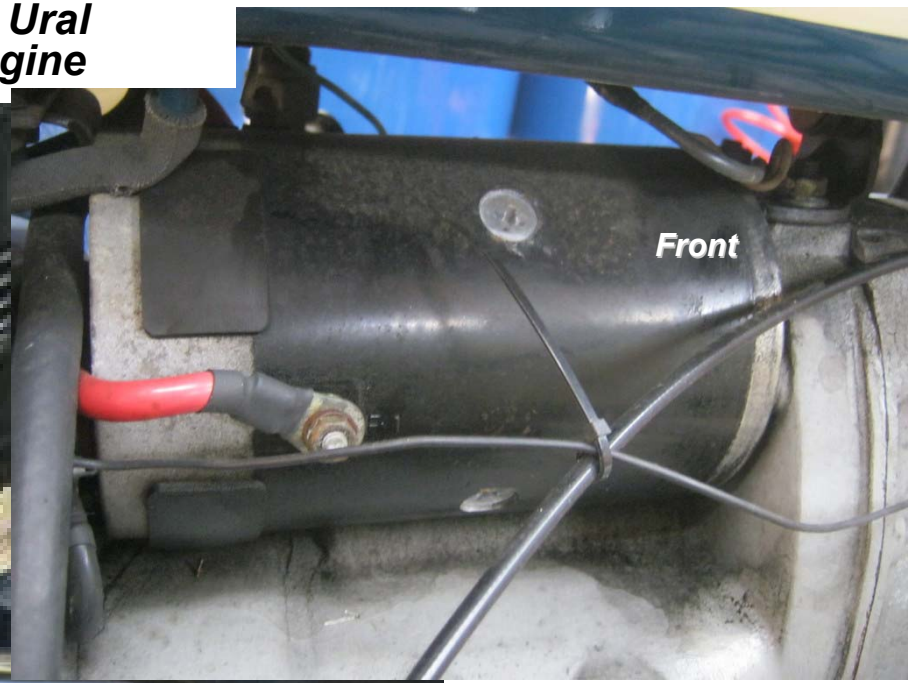


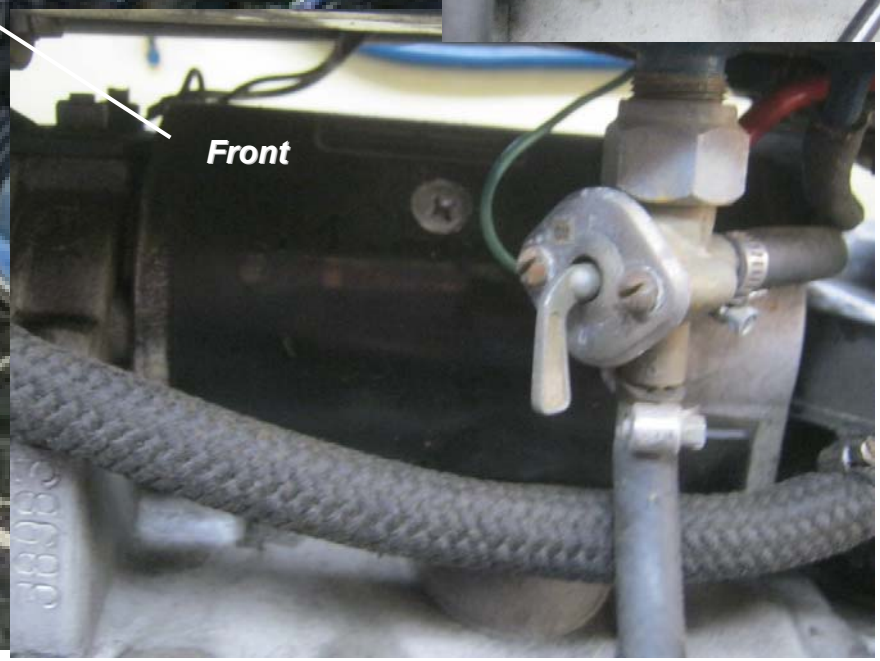




Mid-1998 Ural Deco with Hitachi Starter-Generator

- *Mid-'98 was the First of the Electric Starter for Ural*
- *Hitachi Generator in Close-Up Photo of the Engine*





General Guidance on the Use of 18-Amp Hitachi Starter-Generator Set (Genset)

(autos.dir.groups.yahoo.com)

- *Don't Use the Hitachi Starter-Generator Set on Ural/Dnepr Motors!*
  - *–Isn't a True Starter Geared to the Flywheel*
    - *Geared to the Camshaft, It Requires Tremendous Effort and Juice to Turn Over the Motor, at the Expense of the Battery*
  - *–Installation Problems Involving Insufficient Gear Lash and Ruining Front Bearings*
    - *Mounting Holes in the Front Plate Must Be "Ovaled" to Allow Rotation of the Starter-Generator for Gear Backlash Adjustment*
  - *–Inertial Mass of Starter/Generator Is More than Timing Gears Can Handle*
    - *Starter-Generator Couples in at Timing Gears*
    - *You'll Wipe Them Out in about 5,000 kM (3,000 miles)*
  - *–The Stress Load the Genset Places on the Crank and Crank Bearings Is Also Bad*
    - *Thrust Bearing Will Go before 10,000 kM (15,000 miles), Assuming the Crankshaft Does Not Break First*
  - *–Genset (Motor-Generator Set) Does Not Really Begin to Charge until about 2500 RPM*
    - *Most Rigs Spend 80% of Their Time Running Under This Speed*
    - *You'll End-Up Charging Your Battery Once a Week*
  - *–Starter Genset Does Not Have Enough Oomph to Spool-Over a Good Motor*
    - *Except on a Full Charge – Once*
    - *Most Folks Use Starter as Kick-Assist to Overcome TDC Compression*
    - *Before Using the Electric-Starter, Push Down on Kick-Start Pedal One Split-Second before Pressing the Starter Button*
- *Very Few Reported Failures of the Hitachi Unit over 5 years*

All-in-all, the Hitachi Starter-Generator Set (Genset) was a good idea, but turned out to be bad in reality. Avoid it.

Electric-Assisted Starter Concept

- Hitachi Starter-Generator Set (Genset) Is a Simple Unit
  - DC motor with an Extra Set of Brushes on the Commutator for Charging Service
  - Starting Circuit Is Energized Only When the Starter Button Is Depressed, and the Generator Circuit Is Operating the Rest of the Time
  - The Hitachi Unit Charges at 18-Amps maximum
    - Doesn't Start Charging until Engine Rotating at Nearly 1,500 rpm
    - Even When Working Fine, Only Marginally Charges the Battery
- Hitachi System Uses the Cam Gear (Timing/Cam) to Turn the Crankshaft
  - Poor Mechanical Advantage with Starter Geared Off the Cam Gears
  - Requires Lots of Energy to Start
- Solution for Battery Running Down with Hitachi Starter-Generator
  - Use the Kick-Starter to Overcome TDC Compression One Split-Second before Pushing the Starter-Button
  - Since It Is Recommended to Prime the Engine with One Kick with the Kill-Switch in the "No-Run" Position, Kicking It a Second Time with the Kill-Switch in the "Run" Position Is Not a Bother
  - Nothing Awkward about Pushing the Starter-Button, Since the Right Hand Is Already on the Throttle and the Starter Button Is Right under the Thumb
- Many Folks Use the Russian method of Starting
  - Stand on the Ground and Use Right Foot to Kick-Down, While Keeping the Right Hand on the Throttle
  - Works much better

Most early electric-start owners rely on the electric-assist technique.

Hitachi Starter-Generator Alignment and Support

- Hitachi Starter-Generator Unit Has to Be Installed, Lined-Up and Maintained Correctly to Insure that It Doesn't Rip Itself Apart
  - Oval Mounting Holes on the Hitachi unit Allow a Bit of Play for Lash Adjustment
  - If Lash Is Not Right, the Shaft Will Be Off-Center and Will Wobble Enough to Eventually Destroy Itself
  - On Some Bikes the Lash Adjustment Hole Must Be Elongated with a Rat-Tail to Achieve the Proper Lash adjustment
  - Once a Bike Is Broken-In, There Should Be Little Need for an Electric Starter
    - A Properly Adjusted Bike Will Kick-Start in One or Two Kicks
- Hitachi Starter-Generator Support
  - Unit Is Heavy and Very Long
  - For Long Life under Vibration, Some Kind of Strap around the Back Side Is Needed to Pick Up Some of the Weight and Dampen Vibrations
- Removing the Hitachi Starter-Generator
  - Note: Not Secured from Front under Timing Gear Casing
  - Unhook the Electrical Terminals
  - Remove the Air Breather and Battery
  - Unscrew Two Smallest Bolts on Back of Hitachi Unit
    - After Several Turns They Will Come Loose
    - Slide them Out
    - They Are the Length of the Starter
  - There Are One or Two Big Brass Screws (Phillips head) on the Cylindrical Section
    - Remove Screws and Slide the Entire Black Casing Backwards
    - There Are a Pair of Hex-Head Bolts (allen-type) within the Casing
    - Remove the Bolts
    - Starter-Generator Comes Out Easily

Replacements for Hitachi GSB107-04A

Mfgr Part #: 1541-8
OEM Part #: GSB107-04
Vendor ID: 1372671884
Price: $145.00
Brand: Caltric
(www.amazon.com)

15421N
List Price: $169.99
(www.nationsstarteralternator.com)
or
Part #: 3101501HI
Price: $179.95
(store.alternatorparts.com)

ID #: 261019012685
US $160.00
(www.ebay.co.uk)
or
Price: $160.00
(www.cncelectrical.com)

Price: $138.00
(www.helmarparts.com)

Replaces Hitachi GSB107-04A
ID #: 270896043368
List Price: $142.65
(www.ebay.com)

Part #: 15421N
OEM Part #: GSB107-04A
List Price:$178.31
(www.amazon.com)

Part #: GHI0001
List: $175.00
(www.mfgsupply.com)

Starter Generator Ez-Go Golf Cart Club Car GSB107-04
List Price: $178.31
(ezgogolfcartprices.giftsite2013.info)

The gear (pinion) must be salvaged from the original starter-generator.

Replacements for Hitachi GSB107-04A (cont.)

Replaces: Hitachi GSB107-04A
List Price: $142.65
(stores.channeladvisor.com)

DYNASTARTER
Replaces Hitachi GSB 107-04A
Part #: 113144
List Price: £140.00 (inc. VAT)
(www.startermotor-alternator-store.co.uk)

Replaces Hitachi GSB107-04A
List Price:$185.61
(www.amazon.com)
or
GSB107-04A
MPN: 3008369E
List Price: $142.68
(www.pricegrabber.com)

Replaces Hitachi GSB107-04A
MES15421N
MES (MOTORCYCLE ELECTRIC SUPPLIERS)
List Price: $119.95
(www.psep.biz)
or
AHGHI0001
AEP (ARROWHEAD ELECTRICAL PRODUCTS)
List Price: $101.14

Part #: 1521
Replaces Hitachi GSB107-04A
Vendor ID: 350525228981
(www.ebay.com)

MEG107-N
Replaces Hitachi GSB-107-04A
(www.mesmotorcycle.com)

A replacement starter-generator is easily found on the Internet.

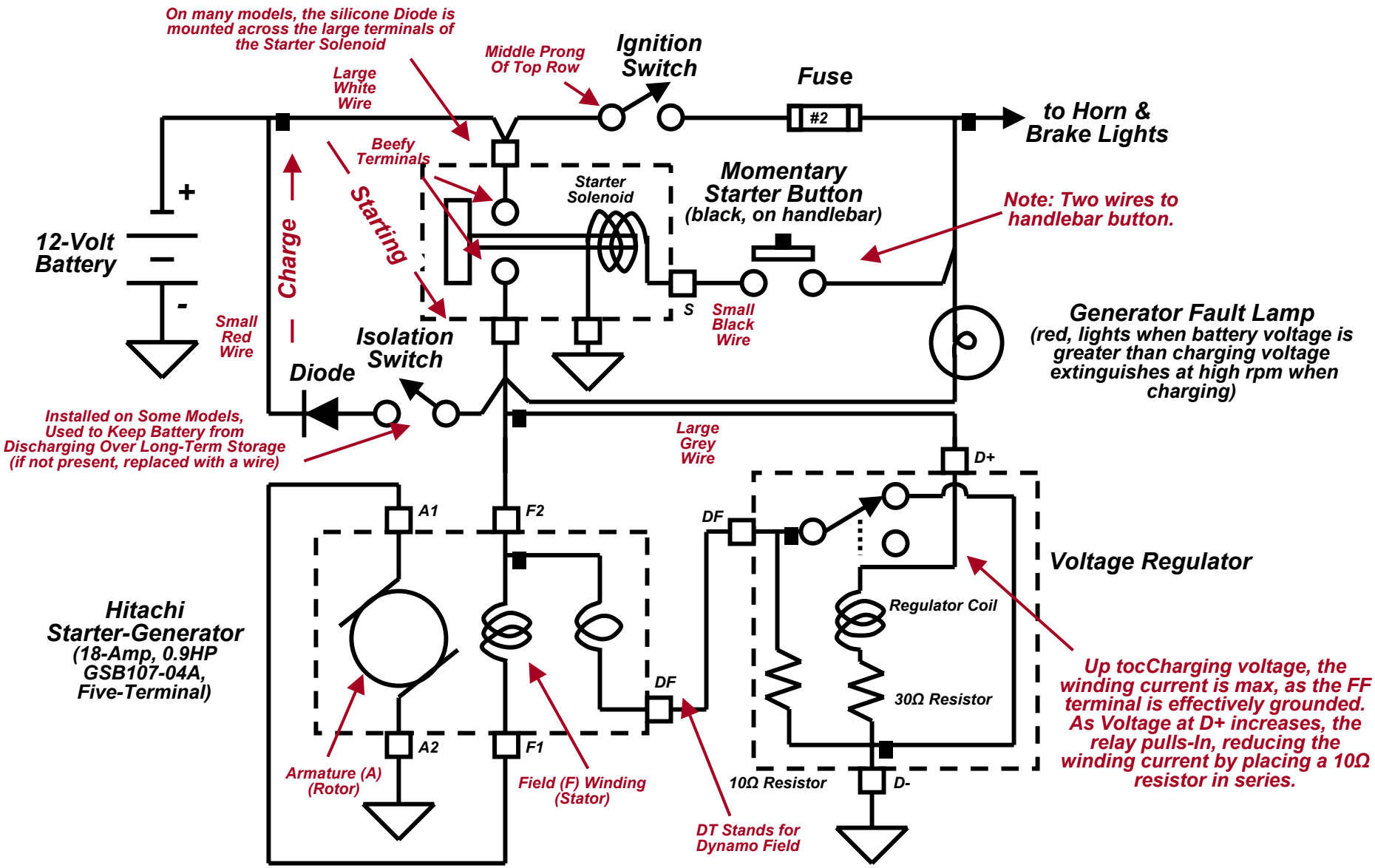
Replacements for Hitachi GSB107-04A (cont.)

Replaces OEM Hitachi GSB107-04A
Brand: URQS
Part #: 15421
List Price: $142.65
Vendor ID: 281091219975
(www.ebay.com)
or
Replaces Hitachi GSB107-04A
Part #: 15421
List Price: $142.65
Vendor ID: 1372671505
(www.amazon.com)
or
Replaces Hitachi GSB107-04A
Part #: 15421
List Price: $142.65
(www.pricegrabber.com)

Replaces Hitachi GSB107-04
Part #: G107
List Price: $152.95
(electricmotorserviceonline.com)

Starter-Generator, Black
Part #: GSB107-04A
ID #: 221053947641
List Price:US $100.00
(www.ebay.com)

18-Amp Hitachi Starter-Generator



Notes for Hitachi Starter-Generator Schematic

- *Genset (Generator Set) Is a Simple Unit*
  - *DC Motor with an Extra Set of Brushes on the Commutator for Charging Service*
  - *Starting Circuit Is Energized Only When Starter Button Is Depressed*
  - *Generator Circuit Is Operating the Rest of the Time*
  - *Only Way to Connect the Battery Positive to F2 on the Generator Is thru Starter Solenoid Contacts, Which Closes When the Starter Button Is Pressed*
- *High-Current Silicone Rectifier Diode Isolates Starter from Charger Circuit*
  - *Capable of Handling 20+ Amps (with 0.7-Voltage Drop Across Terminals!)*
  - *Isolates the Two Functions of Hitachi Unit: Starting and Charging*
    - *Used on Starter-Generator Systems as "One-Way" Check Valve for the Charging System*
    - *Diode Lets Current Flow from F2 to Charge the Battery, but Prevents Current Flow Back to F2, So That the Generator Doesn't Act Like a Motor When Power Is Removed from Ignition Circuit*
- *Isolation Switch- Mounted under the Seat*
  - *Installed to Prevent Battery from Discharging Back thru the Diode in Reverse Direction*
    - *No Diode Is Perfect; There Is a Very Small Reverse Leakage Current Which Can Allow the Battery to Discharge thru the Starter-Generator Over a Prolonged Period (months)*
    - *To Prevent This Very Slow Discharge, the Isolation Switch Would Be Opened during Long-Term Storage to Ensure No Discharge Path for the Battery*
    - *If Switch Isn't Closed during Normal Operation, There Would Be No Path for Charging the Battery*
      - *Riding with Switch "Off" Will Result in Discharging the Battery*
  - *Isolation Switch Can Be Used to Test to See If the Bike Is Charging*
    - *Flip the Switch while Riding, to Take the Battery Out of the Loop, and the Engine Dies If the Charging System Is Toasted*

Notes for Hitachi Starter-Generator Schematic (cont.)

- *Voltage Regulator*
  - *Mechanical Voltage Regulator Is Set Close to 16V*
  - *Voltage Regulator "Watches" the Voltage at D+, Which Should Be the Same as That Applied to Battery*
  - *It Now Changes the Short-Circuit between the D+ and DF Terminals into a Resistance (10Ω Resistor)*
  - *This Effectively Controls the Field Current (whose source is now the output from the D+ terminal, and not the charge warning lamp) and Thus Regulates the Output Voltage of the Alternator*
  - *A Set of Contact Points Is Placed in Series with the Field Coil Circuit and All Field Coil Current Passes thru Them*
  - *If These Points Were to Open, Current Would No Longer Pass thru the Points, but Travel thru a Resistance to Ground and Then thru the Ground Conductor Back to the Ground Brush of the Generator*
  - *The DF or "Dynamo Field" Terminal Connects to the Ungrounded End of the Alternator Field Winding, and Is an Input to the Alternator*
  - *The Current Supplied to the DF Terminal Determines the Strength of the Magnetic Field that Penetrates the Output Windings, and Thus Controls the Alternator's Output*
  - *The D- Terminal Is Connected to the Alternator Frame, and Is the Ground Return for the Voltage Regulator*
  - *The Other End of the Field Winding Is Also Connected to Ground at That Point*
- *Handlebar Start Button*
  - *Regular Starter Circuit Grounds a Connection at the Handlebar for Electric-Start*
  - *The Hitachi Unit Has a Hot Wire Running In and Another Wire Coming Back Out That Is Connected to the Push-Button Switch*

Notes for Hitachi Starter-Generator Schematic (cont.)

- *Generator Fault Light*
  - *Engine Must Rotate over 1400 to 1500 rpm to See the Generator Light Extinguish*
  - *When Motorcycle Is First Started, There Is No Output from the Alternator at Either the B+ or D+ Terminals*
  - *The Voltage Regulator, Sensing No Output, Attempts to Command Maximum Field Current*
    - *Resistance of the Field Winding Is Not Large*
  - *There Is +12 Volts on One Side of the Charge Warning Lamp*
  - *The Other Side of the Lamp Is Grounded thru the Alternator Field Winding*
  - *Current Thus Flows thru the Lamp, Lighting It*
  - *This Same Current, However, Also Flows thru the Alternator Field Winding, Producing a Magnetic Field*
    - *This Magnetic Field Is What the Alternator Needs to Start Up*
  - *The Alternator Now Begins to Develop Identical Voltages at the D+ and B+ Terminals*
  - *The D+ Terminal Is Connected to One End of the Charge Warning Lamp, While the Other End of the Lamp Is Connected to the Battery via the Ignition Switch*
  - *Since the B+ Terminal Is Hard-Wired to the Battery*
  - *Since Both the D+ and B+ Diodes Are Fed from the Same Set of Windings in the Alternator, No voltage Difference Can Exist between These Two Points, the Warning Lamp Goes Out*

18 Amp Hitachi Starter-Generator

- Some Folks Replaced Hitachi Starter-Generator with Russian 35-Amp Alternator
  - Installed 35-Amp Alternator at Center Top of Engine Off the Timing Gear
  - Results: No More Electric-Start
    - Must Remove Starter Relay Located on the Right Side of the Frame
- Adjustable Voltage Regulator
  - Generator Does Not Put Out at Idle
  - On Right Side of Motorcycle, Just below Seat Level thru Right Plastic Cover
  - Left Side of Motorcycle Also Has a Cover, Which Is Much Easier to Remove and It Covers the Starter Relay
    - Right Cover Hard to Remove Because It Has A Sidecar Support Going thru It
  - Adjusting the Regulator to Put Out 13.5V to 14.5V Extinguishes the Generator Fault Light on the Dashboard
  - Once Adjust, the Fault Light Will Go Off at about 8 to 10 mph, Which Is Normal for the System
  - Ensure All Connections Are Clean
- Solenoid
  - Solenoid Is Mounted on Left side of Rear Fender Where It Meets the Battery Box Area
- To Check the DF Portion of the System, It Is Necessary to Determine if the D+ Output Can Produce Enough Current to Drive the Alternator to Full Output
  - To Do This, Short the D+ and DF Terminals on the Relay Board
  - This Will Provide Maximum Field Current to the Alternator Can Supply (not the battery)
  - If This Test Puts the Light Out, Then the Alternator Is Good, and the Trouble Is Elsewhere
  - If It Doesn't, Then the Alternator Is Almost Certainly Bad

Hitachi Motor-Generator Replacement Brushes

- Brushes and Brush Holder Fit Hitachi GSB107-04A Starter-Generator
  - Hitachi Part #: GSB107-1310
  - Dimensions
    - Length: 26 mm (1.024”)
    - Width: 13.5 mm (0.531”)
    - Height: 5.5 mm (0.217”)
    - Lead Length: 40 mm (1.575”)
  - Two Positive and Two Negative Brushes

Brush Holder

Hitachi GSB107-04A replacement brushes are available from multiple sources via the Internet.