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

Part XI-1: Hitachi Starter-Generators

(See Also Part XI: Electric Starters Evolution, and Part XI-2: Repair of Electric Starters)

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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

**Year**

- 1994
- 1995
- 1996
- 1997
- 1998
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007

**Engine Size**

- 650 cc
- 750 cc Engine

**Gen/Alt**

- Kick-Start Only
- 14 Amp Russian-Built Г-424 (G-424) Alternator (150-Watt)
- 18-Amp Hitachi Starter-Generator (200-W)
- Voltage Regulator internal to Alternator
- New Transmission Case (Flywheel Starter Added, New Wiring Harness)
- 55-Amp Nippon Denso Alternator (770-W, metal rear cap)

**Start Relays (RY-115)**

- One Relay
- Two Relays

**Ignition Type**

- Type I
- Type II
- Type III Ignition
- Type IV
- Type V

**Voltage Regulator**

- PP-330 Mechanical (33.3720200 Solid-State)
- Regulator Internal to Alternator

**Ural imported to U.S. by CSMI (Classic Motorcycles and Sidecars, Inc.)**

- 1994
- 1995
- 1996
- 1997
- 1998
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007

**Roughly Wattage = 14 Volts X Amps**

- 14 Amp Russian-Built Г-424 (G-424) Alternator (150-Watt)
- 35-Amp Russian Alternator 14.3771 (Hand Grenade) (500 W, black-plastic rear cap)
- 35-Amp Alternator 14.3771 (Hand Grenade) (500 W, black-plastic rear cap) (Longer by 20 mm)

**Voltage Regulator**

- Internal to Alternator

**Factories**

- Ducati
- Factory Electric-Start Added
- New Engine Design (Alternator on top / Flywheel Starter placed on bottom)

**Current Details**

- 55-Amp Nippon Denso Alternator (770-W, metal rear cap)

- New Wiring Harness (Electrona in Austria)

- Electric-Start (E-Start) Option & Retrofit introduced by CSMI

- Voltage Regulator internal to Alternator

- One Relay

- Two Relays

- One Relay

- One Relay

- No Points-Ignition Urals Approved for U.S. sale

- Type I

- Type II

- Type III Ignition

- Type IV

- Type V

- Type IV with electronics moved into airstream

- No Points-Ignition Urals Approved for U.S. sale
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

18-Amp Starter-Generator
Voltage Regulator
Starter Solenoid

UA-ES-RK
Electric Start Retro-fit Kit
Electric Starter Parts List, Installation Instructions, and Drawings
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

A1, A2, F1, F2, DF

8 mm / 0.31"
10 mm / 0.39"
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 “Oval” 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

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

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

Part #: 15421N
OEM Part #: GSB107-04A
List Price: $169.99
(www.nationsstarteralternator.com)
or
Part #: 3101501HI
Price: $179.95
(store.alternatorparts.com)

Price: $138.00
(www.helmarparts.com)

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

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

Starter Generator Ez-Go Golf Cart Club Car GSB107-04
List Price: $178.31
(ezgogolfcartprices.gifsite2013.info)

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

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

12-Volt Battery

Small Red Wire

Diode

Beefy Terminals

Starter Solenoid

Momentary Starter Button (black, on handlebar)

Fuse

DF

10Ω Resistor

D-

30Ω Resistor

Regulator Coil

Voltage Regulator

Up to charging voltage, the winding current is max, as the FF terminal is effectively grounded. As voltage at D+ increases, the relay pulls-in, reducing the winding current by placing a 10Ω resistor in series.

Hitachi Starter-Generator (18-Amp, 0.9HP GSB107-04A, Five-Terminal)

Installed on some models, used to keep battery from discharging over long-term storage (if not present, replaced with a wire).

On many models, the silicone Diode is mounted across the large terminals of the Starter Solenoid.

Generated Fault Lamp (red, lights when battery voltage is greater than charging voltage; extinguishes at high rpm when charging).

Note: Two wires to handlebar button.

DT stands for Dynamo Field.
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
• 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

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