Russian Motorcycle Regulators
Part XXVIII-4: 33.3702
Solid-State Regulator for the Г-424 Alternator

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12-Volt Solid-State (Electronic) Regulator (33.3072) for the Г-424 11-Amp Alternator

- **Background**
  - Voltage Regulators Paired with Specific Generators/Alternators
  - Time-Line for Generators/Alternators/Regulators
  - Specs for the Г-424 Alternator
  - Г-424 Alternator Performance
  - Alternator / Regulator Application in Ural and Dnepr Wiring

- **What is the 33.3072 Regulator?**
  - External Voltage Regulator for the Г-424 11-Amp Alternator
  - Completely Solid-State (Electronic, Transistorized)
  - Replaced PP-330 Relay-Type (Mechanical) Regulator
  - Superceded by 35-Amp Alternator (14.3771) with Built-In Regulator

- **How Does It Work?**
  - Supplies Exciter Current to Vary Magnetic Field in Rotor Coil
  - Provides Constant Voltage Regardless of Rotor Speed
  - Regulates Alternator Output Voltage to 14-Volts

- **Replacement**
  - Widely Used in Lada (Russian) Vehicles
  - Replacements Purchased On-Line

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The electronic regulator (33.3072) was a welcome substitute for the vibration-sensitive PP-330 (electro-magnetic) mechanical regulator used in the Г-424 11-amp alternator.
## Types of Generators/Alternators for Ural (Урал) and Dnepr (Днепр)

<table>
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<tr>
<th>Generator/Alternator</th>
<th>Type</th>
<th>Vintage</th>
<th>Nominal Voltage</th>
<th>Current</th>
<th>Nominal Power</th>
<th>Regulator</th>
<th>Motorcycles</th>
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<tr>
<td>Г-11 (G-11)</td>
<td>DC Generator</td>
<td>1941-1951</td>
<td>6-Volt (7-Volt)</td>
<td>7-Amp</td>
<td>45-Watts</td>
<td>PP-1, PP-31 (1950)</td>
<td>Ural (IMZ): M-72</td>
</tr>
<tr>
<td>Г-11A (G-11A)</td>
<td>DC Generator</td>
<td>1952-1957</td>
<td>6-Volt (7-Volt)</td>
<td>7-Amp</td>
<td>45-Watts</td>
<td>PP-31 (1950)</td>
<td>Dnepr (KMZ): M-72, M-72M, M-61</td>
</tr>
<tr>
<td>Nippon Denso (P/N: IMZ-8.1037-18092)</td>
<td>Alternator (Built-in Rectifier &amp; Regulator)</td>
<td>2004-present</td>
<td>12-Volt (14-Volt)</td>
<td>55-Amp</td>
<td>770-Watts</td>
<td>Internal to Alternator (126000-0600)</td>
<td>IMZ 8.103, 8.103X, 8.123, 8.123X “750” Series</td>
</tr>
</tbody>
</table>

### Notes:
1. **Nomenclature:** The Cyrillic letter “Г” transliterates (Russian-to-Latin) to “G” or “L” or “T.” Thus we see Г-414 or G-414 or L-414 or T-414, all for the same part.
2. **Cannot use Alternator with discharged battery or without battery.**
Alternators have progressed in output voltage and power, from the Г-11 (G-11) generator of 6-Volts/45-Watts in 1941, the Г-11А in 1952, the Г-414 of 6-Volts/65-Watt in 1957, the Г-424 of 12-Volts/150-Watts in 1974, the 14.3771 of 12-Volts/500-Watts in 1998.5, to the present-day Nippon-Denso alternator of 12-Volts/770-Watts.

- 12-Volt / 11-Ampere / 150-Watt Alternator (a.k.a. 14-Amp)
- “Full-Time” (Continuous) Current Rating: 11-Amperes
- Alternator Г-424 Used on:
  - Ural: M-67, M-67.36, IMZ 8.103 “650cc” Series
  - Dnepr: MW-650, MW-650M, MT-10, MT-10.36, MT-11, MT-14, MT-16
- Used with Mechanical (PP-330) & Solid-State (33.3702) Regulators
- 3-Ø (three-phase), 12-Pole Stator Winding for Smooth Output Voltage
- Built-in Full-Wave Rectifier (MSF-2A)

The Г-424 alternator surfaced in 1974 on Ural’s M-67 and Dnepr’s MT-10, as Russian motorcycles migrated to 12-Volts.
The Г-424 alternator provides rated current (11-Amps) at 2,000 rpm of the crankshaft. Thus for urban driving (low-speed & traffic lights), the alternator was sufficient to supply the necessary charging current (prior to electric-start).
33.3702: Solid-State 12-Volt Regulator for the Г-424 Alternator

- Rated for 1.5-Amp Current from the Rotor (Exciter) Coil
- Used on Ural (Урал, IMZ): 650-cc 8.903, 8.923, 8.103
- Used on Dнепр (Днепр, KMZ): MT-10, -10.36, -11,-14, -16
- Standard Fitment on Last Years MT-11 Production
- Main Manufacturer: АО КЗАМЭ (АО KZAME, Russia, Kaluga)
- 6 Transistors
- No Adjustment Possible
- Board Covered with Thick Layer of Lacquer

The 33.3702 regulator is readily available from various Ural / Dnepr “parts suppliers” on the Internet.
How the 33.3702 Voltage Regulator Works

- Alternator Output Voltage Created by Magnetic (exciter) Field Rotating (rotor) within Stationary (three-phase stator) Winding
- Current is Supplied thru Carbon Brushes to Rotor Shaft Slip-Rings via Voltage Regulator
- Stronger Magnetic Field or Higher Rotor Speed Yields Higher Output Voltage
- Regulator Maintains Constant Output Voltage by Modulating Exciter Rotor Current

Operation:
- Turn-On (engine not running): Exciter Winding Energized with Ignition Switch On
  - Current flowing in Rotor Coil, Pre-Excitation of the Alternator, before Obtaining Necessary Speed of Rotor
  - Fault Indicator Lamp Indicates Regulator Supplying Current to Rotor (Exciter)
  - If Engine Not Running and Lamp Not Lit: Defective Red “Fault” Lamp “or” Defective Alternator “or” Defective Voltage Regulator
- After Engine Starts: With rpm’s, Alternator then Supplies Exciter Current thru Six Diode Rectifiers, Extinguishing the Red “Fault Light”
  - If “Fault” Lamp Continues to Light, May Be Caused by Broken Connection “or” Defective Alternator
- Normal Run: Regulator’s Output Transistor Provides Variable Path for Rotor Exciter Current to Maintain Constant Output Voltage

Voltage Settings: 13.5 -to- 14.5-Volts
- Measure Battery Voltage with Engine Running
- With Increasing Speed, Voltage Should Slowly Rise to Maximum of 14.5-V, and Must Not Exceed for Further Increases in Speed
- If Voltage Increases Beyond 15-Volts: Immediately Turn-Off Engine Regulator Is Either Broken or Error in Wiring

The voltage regulator provides a constant 14-Volt output, regardless of the crankshaft or rotor speed or load current.
33.3072 Voltage Regulator Application

With one end of the Ё-424’s Rotor grounded, the regulator must be connected between the battery and the other end of the rotor.

Voltage Regulator has no adjustments

Rectifier Diodes to convert generated AC to battery DC

The electronic (33.3072) regulator varies the current in the rotor coil (terminal Ё) to maintain a constant output voltage at the “+” terminal.

12-Volt Battery

Ignition Switch

15-Amp

Regulator modulates exciter current to control the magnetic field

(not used with 33.3072, used with PP-330)

Master Switch (not used with Electric-Start)

Red “Fault” Light

With one end of the Ё-424’s Rotor grounded, the regulator must be connected between the battery and the other end of the rotor.

Voltage Regulator has no adjustments

Rectifier Diodes to convert generated AC to battery DC

The electronic (33.3072) regulator varies the current in the rotor coil (terminal Ё) to maintain a constant output voltage at the “+” terminal.
Voltage Regulator Types

• Grounded Regulator or a Grounded Field Regulator?
  – Grounded Regulator Works by Controlling the Amount of Grounding (−) the Alternator Windings Are Permitted thru the Regulator
  – Grounded Field Regulator Works by Controlling the Amount of Battery Voltage (+) Applied to the Alternator Windings thru the Regulator

• 33.3072 Voltage Regulator Is Grounded Field Regulator
  – Magnetic Field Generated by Rotating Exciter Field
  – One End of Rotor Field Grounded
  – Intensity of Magnetic Field Dependent on Exciter Voltage

The 33.3072 voltage regulator is a grounded-field regulator.
Dnepr (Днепр) MT-10 and MT-10.36 using 33.3702 Regulator

1. Turn Signal
2. Flasher
3. Battery (2X 3MT-6)
4. Oil Pressure Switch
5. Neutral Switch
6. Oil Switch
7. Horn Button
8. Breaker (PM-302/PM-302A)
9. Master Switch
10. Foot Brake Light Switch
11. Brake
12. Ignition Coil (B204)
13. Breaker
14. Oil Pressure Light
15. Control Panel
16. Generator
17. Breaker
18. Foot Brake
19. Oil Pressure Switch
20. Horn
21. Breaker
22. Regulator (33.3702)
23. Battery
24. Generator
25. Breaker
26. Foot Brake
27. Oil Pressure Switch
28. Control Panel
29. Oil Pressure Switch
30. Generator
31. Battery
Dнепр (Днепр) MT-11, MT-14 and MT-16
(showing replacement of PP-330 Regulator with the Solid-State 33.3702)

Older Models:
PP-330 (Relay-Type)

Battery Regulator (33.3702)

Oil Pressure Switch

Neutral Switch

Master Switch

Brake

Regulator

Ignition Coil (B204)

Alternator (Г-424)

Flasher

Horn

Horn Button

Breaker points

Turn Signal

Flasher installation schematic for Dnepr MT-11, MT-14, and MT-16

Older Models: PP-330 (Relay-Type)
Alternator and Voltage Regulator Testing

- **Ignition Off**
  - Measure DC Voltage between Alternator Terminal and Ground
  - Voltage Should Be about 12-to-12.5-Volts
    - If Less than 12-Volts: Battery Needs to be Charged
    - Voltage Below 11-Volts: Indicates Weak or Dead Battery
- **Ignition On, Lights On**
  - Warning: Do Not Increase Engine Speed if Voltage Rises beyond 16-Volts, as This Will Damage Motorcycle Electrics
  - If Regulator is Functioning Properly: 13.5- to- 14.5-Volts
- **Increase Engine Speed from Idle**
  - Voltage Should Rise to about 14-Volts (ideally 14.4-Volts)
  - If Voltage Remains Normal, 13.5 -to- 14.5-Volts; All Is Well!
  - If Voltage immediately Heads towards 15-Volts, Alternator is Good, but Regulator is Broken
  - If Voltage Surpasses 15-Volts with an Increase in Speed and Drops in Voltage when Speed is Decreased, Alternator is Good and Regulator is Broken
  - If Voltage Does Not Rise with Increased Engine Speed; Alternator is Bad, Regulator Most Likely Good

Both the alternator and voltage regulator may be checked on the motorcycle. As the engine speed is increased the output voltage should increase slightly, but regulated to less than 15-Volts.
Repair of Voltage Regulator and Alternator

- Faulty 33.3702 Regulator
  - Check Terminals of Regulator for Tightness and Corrosion

- Fault Alternator
  - Check All Terminals: Bad Contacts Almost Always the Cause. Clean with Fine Emery Cloth.
  - If Contacts Already Shiny: Remove Block of Carbon Graphite Brushes and Inspect Brushes and Slip-Rings

- Inspect Two Copper Slip-Rings
  - Rings Should Be Flat, Smooth, Shiny Surface, with Possible Darkening on Brush Tracks
  - Clean Tracks: Rub Each Track with Rag or Felt Pad Soaked with Solvent / Acetone
  - Warning: Do Not Clean Slip-Rings with Abrasive! Do Not Use Sandpaper or File! Any abrasive Will Make Scratches on Surface of Soft Copper Tracks. Scratches Will Work on Graphite Brushes Like an Emery Wheel.

- Check Integrity of Rotor Coil
  - Check Rotor Coil Circuit thru Carbon Brushes: Should Be 1-to-5 Ohms
  - If Tracks Clean and Ohmmeter Reads High: Coil is Open
  - If Rotor Coil Shows Very Little Resistance (less than two ohms): Coil is Short-Circuited

A faulty alternator can be repaired, but if the electronic regulator dies it’s best to replace.
Repair of Alternator (cont.)

• Inspect Graphite Carbon Brushes
  – Measure Brush Length: If Less than 1/16” (4 mm): Replace
  – Without Chips and Breaks
  – Working Surface Must Be Smooth and Polished
  – Smoothly Push Brushes into Spring-Loaded Nests: No Resistance

• Check Resistance of Three-Piece Stator Windings
  – Remove from Terminals and Check Resistance between Each Winding
  – Each Winding Should Be about Same Small Value
Migration from Mechanical (PP-330) to Electronic (33.3702) Regulator on Dnepr’s MT-11 and MT-16

Diagram is useful when unmarked wires are removed from unmarked terminals!

'+' (output) goes to the battery
'W' (field) goes to the regulator
'~' is not used. Used only with the old electromechanical regulators (PP-330).
Terminal Marking (Replacing PP-330 with 33.3702)

- Three Unmarked Terminals On Г-424 Alternator (11-Amp)
  - '+' 12-Volt (output) to the Battery
  - 'Ш' (field) from Regulator
  - '~' not used with 33.3072 Electronic Regulator (used only with older electro-mechanical regulator PP-330)

<table>
<thead>
<tr>
<th>Alternator Function</th>
<th>Regulator Designation</th>
<th>PP-330 (RR-330) (Mechanical)</th>
<th>33.3702 (Solid-State)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;+&quot; Battery or Alternator</td>
<td>D+</td>
<td>В3 (BZ)</td>
<td>+</td>
</tr>
<tr>
<td>Rotor Excitation (shunt)</td>
<td>DF</td>
<td>Ш (W)</td>
<td>Ш (W)</td>
</tr>
<tr>
<td>&quot;-&quot; Ground (mass)</td>
<td>B-</td>
<td>Body of Regulator</td>
<td>Body of Regulator</td>
</tr>
<tr>
<td>Mid-Point of Alternator</td>
<td>no</td>
<td>~</td>
<td>Absent</td>
</tr>
<tr>
<td>&quot;Fault&quot; Lamp Control</td>
<td>no</td>
<td>ЛК (LC)</td>
<td>ЛК (LC)</td>
</tr>
</tbody>
</table>

Electro-magnetic (mechanical) regulators have traditionally used the terms D+ (battery and alternator), DF (control voltage to rotor) and B- (ground).