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An Automatic Transfer Switch (ATS) is an essential component in any standby generator system. It automatically transfers electrical load between the utility power source and a backup generator when the main power fails. The ATS wiring diagram is the blueprint that governs how the generator, utility ...

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■ATS Wiring Diagram PDF — Complete Guide for Generator Automatic Transfer Switch

Introduction

An Automatic Transfer Switch (ATS) is an essential component in any standby generator system. It automatically transfers electrical load between the utility power source and a backup generator when the main power fails. The ATS wiring diagram is the blueprint that governs how the generator, utility mains, controller, and load circuits interconnect to ensure seamless power transition. Understanding this wiring scheme is critical for electrical engineers, generator technicians, installation contractors, and facility maintenance personnel who need to commission, troubleshoot, or maintain generator power systems.

This comprehensive guide provides a detailed ATS wiring diagram with full pin assignments, connection specifications, compatible controller brands, and step-by-step wiring instructions. Whether you are installing a new ATS for a 100 kVA generator set or retrofitting an existing system, this article will serve as a definitive reference. We also provide a downloadable PDF version of the ATS wiring diagram for offline use, along with technical tables covering cable sizing, terminal identification, and safety interlocks.

The wiring configuration of an ATS involves three primary power paths: the normal (utility) source, the emergency (generator) source, and the load. The controller monitors the utility voltage and frequency, and when parameters fall outside preset thresholds, it signals the generator to start. Once the generator reaches nominal voltage and frequency (typically within 10–15 seconds), the ATS transfers the load from utility to generator. When utility power is restored and stable, the ATS transfers back and signals the generator to perform a cool-down run before shutting down.

ATS Wiring Connection Details

Main Power Circuit Connections

The ATS wiring diagram consists of several key circuit groups that must be wired correctly for reliable operation. The main power circuit handles the high-current path from utility and generator sources to the load. Proper conductor sizing, termination torque, and phase sequence are mandatory.

Utility Supply Side (Normal Source):

• L1 (Phase A) — Incoming from utility main breaker

• L2 (Phase B) — Incoming from utility main breaker

• L3 (Phase C) — Incoming from utility main breaker

• N — Neutral conductor from utility transformer

• PE — Protective earth ground

Generator Supply Side (Emergency Source):

• G1 (Phase A) — From generator output circuit breaker

• G2 (Phase B) — From generator output circuit breaker

• G3 (Phase C) — From generator output circuit breaker

• GN — Generator neutral (bonded or floating depending on system design)

• GE — Generator ground

Load Side (Output):

• LOAD L1 — Connected to facility main distribution panel
• LOAD L2 — Connected to facility main distribution panel
• LOAD L3 — Connected to facility main distribution panel
• LOAD N — Load neutral
• LOAD PE — Load ground

Control Circuit Wiring

The control wiring is typically low voltage (12 VDC or 24 VDC) and carries signals between the ATS controller and the generator set. These connections dictate when the generator starts, the transfer sequence, and any alarm or status reporting.

Termination	Signal	Description
1-2	Utility Sensing	3-phase voltage sensing from utility side
3-4	Generator Sensing	3-phase voltage sensing from generator side
5-6	Start Signal	Normally open contact to generator start circuit
7-8	Load Sense	Load current monitoring via CTs
9-10	Auxiliary Alarm	Common alarm dry contact output
11-12	Engine Run	Engine run confirmation input
13-14	Transfer Inhibit	Remote disable of automatic transfer

Interlocking and Safety Circuits

Mechanical and electrical interlock systems prevent simultaneous connection of utility and generator sources. The wiring must include:

• Mechanical Interlock: Physical barrier that prevents both contactors from closing simultaneously
• Electrical Interlock: Auxiliary contacts wired in series with the opposite contactor coil
• Under-Voltage Release: Coil that drops out when sensing voltage falls below threshold
• Shunt Trip: Remote trip input for emergency disconnection

ATS Pin Assignments

ATS Controller Pinout Table

Pin No.	Function	Wire Color	Voltage	Description
1	Utility L1 Sense	Black	230/400V AC	Voltage sensing phase A
2	Utility L2 Sense	Brown	230/400V AC	Voltage sensing phase B
3	Utility L3 Sense	Grey	230/400V AC	Voltage sensing phase C
4	Utility Neutral	Blue	—	Neutral reference

5	Generator L1 Sense	Black	230/400V AC	Generator voltage phase A
6	Generator L2 Sense	Brown	230/400V AC	Generator voltage phase B
7	Generator L3 Sense	Grey	230/400V AC	Generator voltage phase C
8	Generator Neutral	Blue	—	Generator neutral reference
9	Start Relay COM	—	—	Common for start output
10	Start Relay NO	Yellow	12/24V DC	Normally open start contact
11	Run Feedback +	Red	12/24V DC	Generator running signal input
12	Run Feedback —	Black	0V DC	Signal ground
13	Common Alarm NO	White	—	Normally open alarm relay
14	Common Alarm COM	White	—	Common alarm relay
15	Transfer Relay COM	—	—	Common for transfer coil
16	Transfer Relay NO	Orange	230/400V AC	Transfer command output
17	Retransfer Relay NO	Orange	230/400V AC	Return to utility output
18-20	Auxiliary Inputs	Various	12/24V DC	Configurable digital inputs

Terminal Block Connection Chart

Terminal Block	Connection	Torque (Nm)	Conductor Size (mm²)
TB1-1 to TB1-4	Utility power input	3.5–4.0	16–70
TB2-1 to TB2-4	Generator power input	3.5–4.0	16–70
TB3-1 to TB3-4	Load output	3.5–4.0	16–70
TB4-1 to TB4-4	Control signals (low voltage)	0.5–0.8	1.0–2.5
TB5-1 to TB5-3	Auxiliary contacts	0.5–0.8	1.0–2.5
TB6-1, TB6-2	Earth ground	4.0–6.0	25–95

Compatible ATS Controllers

The following table lists ATS controllers from leading manufacturers that are compatible with standard transfer switch wiring configurations. All controllers listed support the pin assignments detailed above with minor configuration adjustments.

Manufacturer	Model	Transfer Time	Rated Current	Features
SmartGen	HAT530N	3–5 s	16–3200 A	LCD display, programmable, RS485
SmartGen	HAT560	2–5 s	63–3200 A	Dual supply, auto/manual modes
DeepSea	DSE7210	2–5 s	Configurable	Remote monitoring, Modbus
DeepSea	DSE7310	2–5 s	Configurable	Load shedding, programmable I/O
ComAp	InteliATS ATC-100	3–6 s	Configurable	Web monitoring, Cloud connectivity
ComAp	InteliATS ATC-200	2–4 s	Configurable	Dual generator support
Woodward	EGCP-3	2–5 s	Configurable	Advanced load management

| Genset | GAC 510 | 3–7 s | 63–1600 A | Economical, reliable |

| Kohler | RXT Series | 3–5 s | 100–400 A | Integrated with Kohler generators |

| Caterpillar | EMCP 4.4 | 2–5 s | Configurable | Cat generator system integration |

ATS Connection Specifications Table

| Parameter | Specification | Notes |

|---|---|---|

| Rated Voltage | 400V / 230V (3-phase, 4-wire) | 50/60 Hz auto-sensing |

| Rated Current | 16 A to 3200 A | Depends on ATS frame size |

| Short-Circuit Rating | 50 kA RMS (for 1 second) | IEEE C37.41 compliant |

| Dielectric Withstand | 2500 V AC for 1 minute | Between live parts and ground |

| Operating Temperature | -20°C to +60°C | Derate above 50°C |

| Maximum Altitude | 2000 m | Derate 1% per 100 m above |

| Transfer Time | 2–6 seconds | Typical open transition |

| Contact Material | Silver-cadmium oxide / Silver-tin oxide | Arc-resistant alloy |

| Mechanical Life | 10,000 operations | Minimum |

| Electrical Life | 1,000 operations at full load | At rated current |

| Auxiliary Contact Rating | 5 A at 250 V AC | Dry contact output |

| Control Voltage | 12 VDC or 24 VDC | Internal power supply |

| Cable Entry | Top/Bottom via gland plate | IP42 minimum |

| Standards Compliance | IEC 60947-6-1, UL 1008, GB/T 14048.11 | — |

Download PDF — ATS Wiring Diagram

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Click the button above to download the complete ATS Wiring Diagram PDF. This downloadable reference includes:

- Full-sized A3 format wiring schematic in high resolution
- Color-coded phase conductors for easy identification
- Dimensioned connection terminal layouts
- Power circuit and control circuit separation diagram
- Standard cable sizing chart for 16 A to 3200 A ratings
- Installation checklist for field technicians
- Troubleshooting flowchart

The PDF is optimized for printing on A3 or A4 paper. Binary PDF file is approximately 2.4 MB and contains vector graphics that remain crisp at any zoom level. The diagram is compliant with IEC 60947-6-1 and UL 1008 ATS standards.

ATS Installation and Commissioning Guide

Pre-Installation Checks

Before beginning ATS wiring installation, verify the following items are complete:

1. Site Survey Completed: Confirm the ATS enclosure location meets clearance requirements (minimum 600 mm front access, 150 mm top/bottom for ventilation), and the mounting surface is capable of supporting the ATS weight (typically 50–200 kg depending on rating).

2. Cable Routes Identified: Plan incoming utility cable path, generator cable path, and outgoing load cable path through the gland plate. Maintain minimum 300 mm separation between power cables (above 50 A) and control/low-voltage cables.

3. Grounding System Verified: Measure facility grounding electrode resistance — must be ≤10 ohms per IEEE 142 (Green Book). Install supplementary ground rods if necessary before proceeding.

4. Generator Controller Compatibility: Verify the ATS controller is compatible with the generator controller's start signal type (two-wire start, three-wire start, or Modbus). Confirm voltage sensing ranges match both utility mains and generator nominal outputs.

5. Protection Devices Installed: Confirm upstream MCCBs for both utility and generator inputs are installed and correctly rated. The utility breaker must be lockable in the OFF position for safe installation.

Step-by-Step ATS Wiring Installation

Step 1 — Mount ATS Enclosure:

• Mount the ATS panel on a rigid wall or support frame using M10 or M12 bolts

• Ensure the enclosure is level (use a spirit level on top edge)

• Ground the enclosure using a 25 mm² copper conductor to the facility ground grid

• Torque ground connection to 4.5 Nm minimum

Step 2 — Connect Utility Power Cables:

• Route utility cables through bottom gland plate (use separate gland for each cable)

• Connect L1 (black), L2 (brown), L3 (grey) to utility input terminals on the mains breaker

• Connect neutral (blue) to the neutral busbar

• Connect earth (green/yellow) to the ground busbar

• Torque power connections per the manufacturer's specifications (typically 3.5–6.0 Nm for 16–70 mm² conductors)

Step 3 — Connect Generator Power Cables:

• Route generator cables through bottom gland plate

• Connect L1, L2, L3 to generator input terminals on the generator breaker

• Connect neutral to the neutral busbar (verify neutral bonding configuration)

• Connect earth to the ground busbar

• Maintain correct phase rotation (use a phase rotation meter to verify before connecting load)

Step 4 — Connect Load Output Cables:

• Route load cables to the load output busbars

• Ensure load conductors are sized per the calculated full load current

• Verify the load neutral is connected to the correct terminal (switched or unswitched per system design)

Step 5 — Wire Control Circuits:

• Connect utility voltage sensing wires (L1, L2, L3, N) to ATS controller sensing terminals via 1 A fuses

• Connect generator voltage sensing wires (L1, L2, L3, N) to controller sensing terminals via 1 A fuses

• Wire start relay (NO output) to the generator controller remote start input terminals

• Wire run feedback from generator controller to ATS controller run feedback input

• Wire common alarm relay (NO/COM) to external alarm annunciator or BMS input

• Route all control wiring through separate cable ducts from power cables

Step 6 — Install Current Transformers:

• Install CTs around generator output cables (L1, L2, L3) — arrow on CT must point toward the load

• Connect CT secondary wires (S1 and S2) to the controller CT input terminals

• Short any unused CT secondary terminals to prevent open-circuit condition

Step 7 — Configuration and Testing:

• Apply control power (battery or DC supply) to the ATS controller

• Configure controller parameters: nominal voltage, frequency, under-voltage threshold (typically 80%), over-voltage threshold (110%), return voltage threshold (85%), start delay (3 seconds), transfer delay (5 seconds), return delay (120 seconds)

• Test in MANUAL mode: verify each contactor operates independently

• Test in AUTO mode: simulate mains failure by opening utility breaker

• Verify generator starts within configured time

• Verify ATS transfers to generator within configured time

• Verify generator stops after mains restoration and cool-down delay

ATS Wiring Best Practices

• Use torque wrenches: All power connections must be torqued to manufacturer specifications. Loose connections are the single most common cause of ATS failure.

• Label every wire: Use heat-shrink wire markers with unique identification numbers matching the wiring diagram.

• Maintain cable segregation: Keep power cables (≥50 A) separated from control cables by at least 300 mm.

• Install ferrite cores: On all control signal cables entering the enclosure to reduce EMI susceptibility.

• Use ferrules: On all stranded wires terminated in control terminal blocks to prevent strand breakout.

• Leave service loops: Allow 150–200 mm of spare cable length for each conductor to facilitate future maintenance.

• Apply anti-oxidation compound: On aluminum conductor terminations to prevent galvanic corrosion.

• Document as-built conditions: Photograph the completed wiring before closing the enclosure for future reference.

15 Frequently Asked Questions About ATS Wiring

1. What is the difference between open transition and closed transition ATS wiring?

Open transition wiring includes a break-before-make sequence where the load briefly disconnects from both sources during transfer (typically 50–200 ms). Closed transition wiring uses a make-before-break sequence that requires paralleling the generator with the utility for a short period. Closed transition systems need additional synchronizing controls and are more complex to wire.

2. Can I use the same neutral conductor for both utility and generator?

In most countries, the neutral conductor must be switched along with the phases to comply with grounding regulations. A 4-pole ATS switches all live conductors including neutral. A 3-pole ATS does not switch neutral, which is acceptable only when utility and generator neutrals are bonded at the same point.

3. What wire gauge is required for ATS control wiring?

Control wiring in ATS systems typically uses 1.0 mm² to 2.5 mm² (14–18 AWG) stranded copper wire for 12/24 VDC signals. For voltage sensing lines to the controller, use 1.5 mm² to 2.5 mm² (14–16 AWG) rated for 600 V minimum insulation.

4. How do I wire the start signal from the ATS to the generator?

Connect the normally open (NO) start relay contact from the ATS controller (pins 9-10) to the generator's remote start input terminals. When utility voltage drops below the set threshold, the relay closes, completing the circuit to initiate generator cranking. Use twisted pair shielded cable for noise immunity.

5. Why does my ATS fail to transfer back to utility?

Common causes include: (a) utility sensing voltage still below return threshold, (b) return-to-utility timer still counting down, (c) mechanical interlock jammed, (d) transfer coil burnt out, or (e) auxiliary limit switch misaligned. Check voltage at sensing terminals with a multimeter before troubleshooting further.

6. What is the recommended cable segregation between power and control wiring?

Maintain a minimum physical separation of 300 mm between power cables (≥50 A) and control signal cables to prevent electromagnetic interference (EMI). If crossing is unavoidable, use a 90° crossing angle. Install ferrite cores on control cables in high-interference environments.

7. Do I need a separate battery charger for the ATS controller?

Most ATS controllers include an internal battery charger that maintains the starting batteries at float voltage. However, if the ATS is located far from the generator, a dedicated battery charger with temperature compensation is recommended to ensure reliable controller operation during prolonged outages.

8. How should I ground the ATS enclosure?

Connect the enclosure to the facility grounding electrode system using a minimum 25 mm² copper conductor (or as per local code). The ground conductor must be continuous with no splices between the ATS and the main ground bus. Verify ground resistance is ≤10 ohms using a ground resistance tester.

9. Can multiple generators share one ATS?

Standard single-source ATS units cannot accept multiple generator inputs. For multiple generator installations, use either a synchronizing panel with a common bus and single ATS, or a paralleling switchgear system with multiple ATS units serving separate loads.

10. What protection devices should be installed upstream of the ATS?

An upstream molded case circuit breaker (MCCB) or fused disconnect switch must be installed on the utility side for overcurrent and short-circuit protection. The breaker rating should match the ATS frame size. Generator side protection is typically provided by the generator's output circuit breaker.

11. How do I configure the voltage sensing parameters?

Most ATS controllers have programmable voltage thresholds for: under-voltage (typically 80% of nominal), over-voltage (110% of nominal), under-frequency (90% of nominal), and return threshold with hysteresis (typically 85–90% of nominal with 5% dead band). Refer to the controller manual for specific programming procedures.

12. What is the purpose of the engine run feedback wire?

The run feedback wire (pins 11-12 on most controllers) confirms that the generator has started and is producing voltage. This signal prevents the ATS from attempting to transfer to a generator that has failed to start or is not producing acceptable power quality.

13. Can I wire the ATS for single-phase 230V operation?

Yes, most ATS controllers can be configured for single-phase operation. Connect the active conductor to the L1 sensing terminal and neutral to the corresponding neutral terminal. Configure the controller software for single-phase mode and disable phase loss alarms for L2 and L3.

14. What maintenance is required for ATS wiring connections?

Inspect and re-torque all power connections annually using a calibrated torque wrench. Loose connections are the leading cause of ATS failure. Check for signs of overheating (discolored insulation, melted terminals) using thermal imaging during full-load operation. Replace any burned or pitted contacts immediately.

15. How long does a typical ATS installation take?

A standard ATS installation by a qualified electrical contractor typically takes 4–8 hours for the mechanical mounting and power wiring, plus 2–4 hours for control wiring, programming, and commissioning testing. Complex systems with remote monitoring or multiple generators may require 2–3 days.

16. What is the difference between a bypass isolation ATS and a standard ATS?

A bypass isolation ATS includes a separate manual bypass switch that allows the load to be powered directly from the utility or generator source while the main ATS mechanism is isolated for maintenance or repair. Standard ATS units must be de-energized and disconnected from both sources for service, which requires the load to be manually re-powered through external means. Bypass isolation ATS units are recommended for critical facilities (hospitals, data centers) that cannot tolerate downtime for ATS maintenance.

17. How do I calculate the required ATS current rating for my generator?

The ATS must be rated for at least 115% of the generator's continuous rated current. For a 500 kVA generator at 400 V: I = 500,000 / (400 × √3) = 722 A. Minimum ATS rating = 722 × 1.15 = 830 A. Standard available ratings: 800 A or 1000 A. Always round up to the next standard rating. For motor loads or non-linear loads (UPS, VFDs), consider a higher service factor (1.25×).

ATS Wiring Troubleshooting Guide

Common ATS Wiring Problems and Solutions

Problem: Generator starts but ATS does not transfer to generator

Check: Generator voltage is present at ATS sensing terminals (pins 5-8). Verify generator has reached nominal voltage (+10% / -10%). Confirm the controller's transfer delay timer has expired. Check the transfer relay output (pins 15-16) — it should close after timing out. Verify the ATS contactor coil circuit is complete and the mechanical interlock with the mains contactor is properly disengaged.

Problem: ATS cycles back and forth between sources repeatedly

Check: Return-to-utility voltage threshold is set too close to the actual utility voltage. Increase the deadband between transfer-out and return voltage thresholds (add 5% minimum hysteresis). Also verify the return delay timer is set appropriately (minimum 120 seconds). Check for loose sensing wire connections that cause intermittent voltage readings.

Problem: ATS contactor chatters or buzzes loudly

Check: Contactor coil voltage is too low (below 85% of rated). This is typically caused by voltage drop in the control circuit wiring. Measure the coil voltage under load — if below the pick-up threshold, increase wire gauge or use a separate control transformer from both utility and generator sources. Another cause: mechanical interlock binding — verify the interlock bar moves freely.

Problem: Generator does not start when utility fails

Check: Start signal relay is closing (measure continuity across pins 9-10 when utility fails). Verify the generator controller is in AUTO mode. Check the engine run feedback circuit — if the controller receives a false "engine running" signal, it may not initiate cranking. Verify battery disconnect switch is closed and starting batteries have sufficient charge.

Problem: Short circuit or earth fault during transfer operation

This is a dangerous situation requiring immediate attention. Lock out and tag out both sources. Inspect the ATS contactor main poles for arc tracking or carbon deposits between phases. Verify the neutral conductor connections are correct (for 4-pole ATS, ensure neutral contacts are make-before-break to prevent floating neutral). Test insulation resistance between all phases and phase-to-ground (minimum 10 MΩ at 500V). Replace any damaged components before returning to service.

ATS Preventive Maintenance Checklist

Monthly:

• Visually inspect ATS enclosure for moisture, dust, or insect ingress

• Listen for unusual contactor noise during operation

• Verify controller display shows correct voltage readings for both sources

• Test the emergency stop circuit

Quarterly:

• Simulate mains failure test (open utility supply breaker)

• Observe full transfer and retransfer sequence

• Check and record transfer and retransfer times

• Tighten all accessible power connections (powered-down condition)
• Clean enclosure ventilation filters

Annually:
• Thermal imaging scan of all connections under full load
• Inspect and clean main contacts (pitted or worn contacts require replacement)
• Verify torque on all power connections using calibrated torque wrench
• Perform insulation resistance test on all power circuits
• Test all protection functions (under-voltage, over-voltage, phase loss)
• Update controller firmware if applicable
• Review and document all alarm logs

Related Downloads

• [Generator Control Panel Wiring Diagram]() — Complete wiring schematic for generator control panels
• [AMF Panel Wiring Diagram PDF]() — Automatic mains failure panel wiring guide
• [DeepSea Controller Wiring Diagram]() — DSE controller pin assignments and wiring
• [Standard Cable Sizing Chart for Generators]() — Cable cross-section selection guide
• [Generator Installation Checklist PDF]() — Pre-commissioning verification document

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