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■Cooling Fan Wiring Diagram PDF — Complete Generator Radiator Fan Electrical Connection Guide

Introduction

The cooling fan is an essential component of any diesel generator set's cooling system. It draws air through the radiator core to dissipate the heat generated by the engine during operation. While small generator sets typically use engine-driven (belt-driven) fans, larger generators and enclosed/containerized installations often use electrically driven radiator fans controlled by temperature sensors and the generator controller. The electrical wiring of these cooling fans — including the fan motors, relays, thermostats, and controller interface — must be correctly designed and installed to maintain the engine at its optimal operating temperature (typically 80–95°C for most diesel engines).

This comprehensive guide covers the complete wiring details for generator cooling fan systems. We cover both AC-powered and DC-powered electric cooling fans, thermostatic control circuits, variable-speed fan controllers, fan reversing (for radiator cleaning), and safety interlocks. Detailed pin assignments are provided for common fan controllers and temperature switches, along with compatible component tables, wiring specifications, and troubleshooting guidance. The guide is designed for generator service technicians, installation contractors, and facility maintenance personnel.

The cooling fan wiring system typically includes the fan motor(s), a relay or contactor for on/off control, a temperature switch or sensor to trigger operation, and integration with the generator controller for alarm and status reporting. More sophisticated systems use proportional controllers that adjust fan speed based on coolant temperature, improving fuel efficiency and reducing noise. The wiring must handle the high starting current of AC fan motors and protect against overcurrent, phase failure, and thermal overload.

Cooling Fan Wiring Connection Details

AC-Powered Radiator Fan (Single-Phase)

Most electric radiator fans in generator applications are AC-powered, ranging from 0.37 kW to 3.0 kW per fan, operating at 230 VAC single-phase.

Fan Motor Terminal	Function	Connection	Wire Size	Notes
L (Line)	Phase supply	From fan contactor NO output	2.5–4.0 mm^2	Via MCB, C-curve, 6–16 A
N (Neutral)	Neutral	Neutral busbar	2.5–4.0 mm^2	
E (Earth)	Protective ground	Ground busbar	2.5–4.0 mm^2	
T1	Speed tap (if 2-speed)	Contactor NO (high speed)	2.5 mm^2	Optional
T2	Speed tap (if 2-speed)	Contactor NO (low speed)	2.5 mm^2	Optional

Contactor Control Wiring:

- Contactor coil A1 → From temperature switch or controller output
- Contactor coil A2 → Neutral
- Contactor main poles L1 → Fan L (via MCB protection)
- Auxiliary contact NO → Controller input (fan run feedback)

AC-Powered Radiator Fan (Three-Phase)

Larger generators (>500 kVA) use 3-phase fan motors for higher airflow.

Fan Motor Terminal	Function	Connection	Wire Size	Notes
U (Phase A)	Motor winding	From contactor (L1)	4.0–10 mm²	Via thermal overload relay
V (Phase B)	Motor winding	From contactor (L2)	4.0–10 mm²	
W (Phase C)	Motor winding	From contactor (L3)	4.0–10 mm²	
PE	Protective ground	Ground busbar	4.0–10 mm²	
PTC (if fitted)	Thermal protection	Motor PTC → controller input	1.0 mm²	Overheat protection

3-Phase Fan Starter Wiring:

Component	Terminal A	Terminal B	Notes
MCCB (motor circuit breaker)	Main bus supply	Contactor input	Set at 1.15× motor FLA
Contactor (KM)	MCCB output	Overload relay input	AC-3 rated
Overload Relay (OL)	Contactor output	Motor terminals	Set at motor FLA
Control Fuse	Phase L1	Control circuit	2 A gG type
Temperature Switch (NC)	Control circuit L	Contactor coil A1	Opens when hot
Contactor Coil A2	Contactor coil	Neutral	

DC-Powered Cooling Fans

Some generator sets use DC fans (12 V or 24 V) for smaller radiators or auxiliary cooling.

DC Fan Terminal	Function	Connection	Wire Size	Notes
Fan Positive (+)	Power input	From controller aux output or relay	2.5–4.0 mm²	10–15 A fuse
Fan Negative (–)	Ground	Battery negative / chassis ground	2.5–4.0 mm²	
PWM Input (if variable)	Speed control	Controller PWM output	1.0 mm²	0–5 V or 0–100% duty
Tach Output (if fitted)	Speed feedback	Controller digital input	1.0 mm²	RPM monitoring

Temperature Switch and Sensor Wiring

Capillary Thermostat (On/Off):

Terminal	Function	Normal State	Operating Temp
COM	Common	—	—
NC	Normally closed	Closed (fan OFF)	Below setpoint
NO	Normally open	Open (fan OFF)	Below setpoint

At setpoint (typically 85–95°C), NC opens and NO closes.

PT100/NTC Temperature Sensor (Proportional Control):

Terminal	Function	Connection	Sensor Type
Red	Sensor +	Controller resistance input (+)	PT100
White	Sensor –	Controller resistance input (–)	PT100
Screen	Shield	Controller ground	—

Cooling Fan Pin Assignments

Generator Controller Fan Control Interface

Controller Pin	Function	Signal Type	Connection	Notes
Aux Output (Programmable)	Fan Relay Coil +	Digital Output	Fan contactor/relay coil	Configurable as "Fan"
Config Input	Fan Run Feedback	Digital Input	Contactor auxiliary NO	Confirms fan running
Analogue Input	Coolant Temperature	4–20 mA or resistance	Coolant temp sensor	Continuous monitoring
Config Input (NC)	High Temperature Alarm	Digital Input	95°C NC switch	Pre-shutdown warning
Config Input (NC)	Over-Temperature Shutdown	Digital Input	105°C NC switch	Emergency stop

Cooling Fan Relay — Typical Wiring

Relay Terminal	Function	Connection	Cable Size
85	Coil (–)	Controller fan output (sink)	1.5 mm²
86	Coil (+)	DC supply + (fused)	1.5 mm²
30	COM	DC supply + (fused)	4.0 mm²
87	NO	Fan motor + (if DC) or contactor coil (if AC)	4.0 mm²
87a	NC	Not used	—

Compatible Cooling Fan Controllers and Components

Component	Manufacturer	Type	Voltage	Current	Features
FAN-1D	SmartGen	Fan controller	12/24 VDC	10 A	Programmable on/off temp
FAN-AC-2	SmartGen	AC fan controller	230 VAC	2.2 kW	Soft start, variable speed
DSE Fan Module	DeepSea	CAN bus I/O	12/24 VDC	15 A	Integrated with DSE controller
InteliFan	ComAp	PWM controller	24 VDC	20 A	Variable speed, Modbus
CM-FAN-01	Woodward	Fan control relay	24 VDC	10 A	Simple on/off
TS-85/95	Various	Capillary thermostat	N/A	16 A@250V	NC at 85°C, NO at 95°C

PTC-01	Various	PTC thermistor	N/A	N/A	Motor winding temp
FLR-D-3X	Finder	Ice cube relay	12/24 V	16 A	General purpose fan relay
3RH2	Siemens	Contactor	230 V coil	9 A (AC-3)	AC fan motor switching
K1-25	Telemecanique	Contactor	24 V coil	25 A (AC-3)	Larger fan motors
VLT HCC	Danfoss	Variable frequency drive	3×400 V	0.37–7.5 kW	Variable speed fan control

Cooling Fan Connection Specifications

Parameter	DC Fan (12 V)	DC Fan (24 V)	AC Fan (1-ph)	AC Fan (3-ph)
Voltage Rating	12 VDC	24 VDC	230 VAC	400 VAC, 3-phase
Power Range	50–300 W	50–500 W	0.37–3.0 kW	0.75–7.5 kW
Current Range	4–25 A	2–20 A	2–13 A	1.5–15 A (per phase)
Starting Current	1.5–2.0× rated	1.5–2.0× rated	5–7× rated	6–8× rated
Airflow	1000–4000 CFM	1000–5000 CFM	3000–15000 CFM	5000–30000 CFM
Operating Temp	-30°C to +70°C	-30°C to +70°C	-20°C to +60°C	-20°C to +60°C
IP Rating	IP54–IP67	IP54–IP67	IP44–IP55	IP44–IP55
Duty Cycle	Continuous (S1)	Continuous (S1)	Continuous (S1)	Continuous (S1)
Cable Size	2.5–4.0 mm^2	2.5 mm^2	2.5–4.0 mm^2	4.0–10 mm^2
Fuse/Breaker	15–30 A blade	10–25 A blade	6–16 A C-curve MCB	2.5–16 A C-curve MCB
Contactor/Relay	30 A min.	25 A min.	12 A AC-3	Motor-rated AC-3
Fan Diameter	300–500 mm	300–600 mm	500–1000 mm	800–1400 mm
Max Fan Speed	2500–3500 RPM	2500–3500 RPM	1400–2800 RPM	900–1500 RPM
Temperature Setpoint	85–90°C ON	85–90°C ON	85–95°C ON	85–95°C ON
Temperature Hysteresis	5–10°C	5–10°C	5–10°C	5–10°C

Cooling Fan Control Logic and Operation

Standard On/Off Fan Control Sequence

1. Engine Cold (<70°C): Fan OFF — Engine warms up quickly for optimal efficiency
2. Engine Normal Operation (70–85°C): Fan OFF — Radiator natural convection sufficient
3. Engine Warming (85–92°C): Fan ON (low speed if 2-speed) — Maintain temperature
4. Engine Hot (92–98°C): Fan ON (high speed if 2-speed) — Maximum cooling
5. Engine Overheat (>105°C): Alarm + possible shutdown — Critical protection

2-Speed Fan Control (Optional)

Two-speed fans provide improved temperature regulation and reduced noise.

Condition	Temperature	Fan Speed	Control Method
Normal	<85°C	Off	—
Moderate	85–92°C	Low speed	Star connection (3-ph) or series resistor
High	>92°C	High speed	Delta connection (3-ph) or direct
High temp persists	>95°C	High + alarm	Warning to controller

Variable Speed (PWM) Fan Control

For DC fans with PWM capability, the controller varies fan speed proportionally with coolant temperature.

Coolant Temperature	PWM Duty Cycle	Fan Speed	Airflow %
<75°C	0%	Off	0%
75–85°C	20–50%	Low	20–50%
85–92°C	50–80%	Medium	50–80%
92–100°C	80–100%	High	80–100%
>100°C	100%	Full	100% + alarm

Fan Reversing Control (for Radiator Cleaning)

Some installations include a fan reverse function to blow debris out of the radiator core.

Operation	Direction	Duration	Control
Normal cooling	Forward (pull air through rad)	Continuous	Standard
Cleaning cycle	Reverse (push air out through rad)	10–30 seconds	Manual or automatic timer
Restore cooling	Forward	Auto after cleaning cycle	Reversing contactor control

Fan Reversing Wiring (AC Single-Phase):

A reversing contactor arrangement swaps the capacitor connection for single-phase motors (or any two phases for 3-phase motors).

Contactor KM1 (Forward)	Contactor KM2 (Reverse)	Result
L1 → Motor U	L1 → Motor V	Phase swap for reverse
L2 → Motor V	L2 → Motor U	
N → Motor N	N → Motor N	

Download PDF — Cooling Fan Wiring Diagram

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Click the button above to download the complete Cooling Fan Wiring Diagram PDF. This comprehensive reference includes:

- AC single-phase cooling fan wiring diagram with thermostat control
- AC three-phase cooling fan wiring with contactor and thermal overload protection
- DC cooling fan wiring with relay control and PWM speed regulation
- Dual-fan wiring diagram for paralleled or redundant fan arrangements
- Two-speed fan motor wiring (Dahlander connection for 3-phase)
- Fan reversing wiring for radiator cleaning cycles
- Temperature sensor wiring (PT100, NTC, capillary thermostat)
- Generator controller fan control interface (SmartGen, DeepSea, ComAp)
- Variable-speed fan drive (VFD) wiring for proportional cooling
- Manual fan override circuit for maintenance
- Fan run-hour monitoring and maintenance reminder wiring
- Cable sizing table for fan motor circuits
- Fan thermal protection wiring (PTC thermistor, klixon)
- Alarm integration for fan failure and over-temperature

The PDF is 2.4 MB, vector graphics, A3 format, suitable for field printing and zoom-friendly for on-screen viewing. Includes both single-fan and multi-fan system configurations.

15 Frequently Asked Questions About Cooling Fan Wiring

1. What is the correct temperature setpoint for the cooling fan thermostat?

The standard fan-on temperature for most diesel generator engines is 85–92°C (engine coolant temperature). The fan-off temperature (hysteresis) should be approximately 5–10°C lower, typically 75–82°C. These values ensure the engine operates in its optimal temperature range (85–95°C) for thermal efficiency and emission control. Verify with the specific engine manufacturer's specification, as some engines (e.g., newer Tier 4 engines) may have higher optimal temperatures.

2. Can I wire two cooling fans in parallel from a single relay?

Yes, two fans can be connected in parallel from a single relay or contactor provided the total current does not exceed the relay/contactor's rated contact capacity. Each fan should have its own individual circuit breaker (MCB) or fuse. Wire: Relays NO terminal → Split to Fan 1 MCB and Fan 2 MCB → Each MCB to its respective fan. Ensure the supply cable is sized for the total current of both fans.

3. What size MCB should I use for a 1.5 kW, 230 V single-phase fan motor?

For a 1.5 kW fan at 230 V (FLA ≈ 6.5 A): Use a C-curve MCB rated at 10 A. The C-curve characteristic (5–10× In) accommodates the motor's starting current surge (5–7× FLA). The MCB protects the cable, not the motor — thermal overload protection for the motor must be provided separately via the overload relay or motor protection relay.

4. How do I wire a temperature sensor for proportional fan control?

For proportional (variable speed) fan control, the coolant temperature sensor provides a continuous signal (4–20 mA or resistance) to the fan controller. The controller then adjusts fan speed proportionally via a VFD (for AC fans) or PWM output (for DC fans). Wire the sensor to the controller's analogue input and configure input scaling: e.g., at 4 mA = 40°C (fan off), 20 mA = 100°C (fan at full speed). The controller map temperature to PWM duty cycle or VFD frequency.

5. Why does my cooling fan stay on even after the generator stops?

Possible causes: (a) Temperature switch is stuck closed (failed short), (b) Controller is still in cool-down mode — many generator controllers run the fan for 5–10 minutes after the engine stops to dissipate residual heat, (c) Fan control relay contacts are welded (failed closed), (d) Over-temperature condition has locked the fan in continuous run mode. Check the controller display for active status, and verify temperature switch opens when coolant temperature drops below setpoint.

6. What is the difference between a piston-type and disc-type thermostat for fan control?

A piston-type thermostat (wax-element) uses a wax-filled piston that expands at a specific temperature to push a switch mechanism. It is slower responding but more robust. A disc-type thermostat (bimetallic) uses a bimetallic disc that snaps at the setpoint temperature. It responds faster but has a shorter mechanical life. For generator applications, the robust and reliable capillary-type thermostat (bulb and capillary tube) is most common for radiator fan control.

7. Can I connect a PTC thermistor directly to the generator controller?

Most generator controllers (SmartGen, DeepSea, ComAp) support direct connection of PTC thermistors to the resistance temperature inputs. Connect the PTC across the controller's resistance input terminals. The controller provides a small bias current and measures the voltage drop to determine temperature. Configure the controller for the specific PTC characteristics in the configuration software.

8. My fan motor won't start but hums loudly. What's wrong?

This is a classic symptom of a failed start capacitor (single-phase motors) or a single-phasing condition (three-phase motors). For single-phase: check the start capacitor with a capacitance meter — replace if value is >10% off nominal. Check the centrifugal start switch — it should be closed at rest and open when running. For three-phase: check all three phases at the motor terminals — if one phase is missing, check fuses, contactor, and wiring connections.

9. How do I wire a fan failure alarm to the generator controller?

Install a current sensing relay on one phase of the fan motor supply. When the fan is running (current present), the relay output closes. Wire the relay's NO contact to the controller's configurable digital input. Configure the input as "Fan Running" with a time delay of 5–10 seconds to accommodate starting surge. If the fan fails (current drops to zero with fan commanded ON), the controller generates a "Fan Failure" alarm.

10. Do I need separate cooling for the radiator fan motor in enclosed generator sets?

Fan motors are typically air-cooled by the air they move, so a dedicated cooling fan for the fan motor is not required. However, in enclosed/containerized installations, the ambient temperature around the motor can be 10–20°C above outside ambient due to engine heat. Ensure the fan motor is rated for the expected maximum ambient temperature. For extreme conditions, specify a motor with higher thermal class insulation (Class F or H).

11. What is the correct wiring for a dual-voltage fan motor (230/400V)?

A dual-voltage fan motor has nine terminals (typically numbered U1, V1, W1, U2, V2, W2, and three links). For low voltage (230 V, delta connection): Connect supply L1, L2, L3 to U1, V1, W1 respectively; link U2-W1, V2-U1, W2-V1. For high voltage (400 V, star connection): Connect supply L1, L2, L3 to U1, V1, W1; link U2-V2-W2 together. The wiring diagram is typically shown on the motor nameplate.

12. Can I use a thermostatic switch instead of a controller-based fan control?

Yes, a capillary thermostatic switch can directly control the fan contactor without the generator controller. The thermostat bulb is mounted in the coolant stream (engine water outlet or radiator top tank), and its switch contacts (rated for motor load) directly energize the fan contactor coil. This is a simpler and highly reliable approach but lacks monitoring and variable speed capability.

13. How do I protect the fan motor from lightning-induced surges?

Install surge protection devices (SPDs) at the fan motor's distribution board: Class 2 SPD (type 2) for AC fan circuits or a DC surge suppressor for DC fan circuits. Connect the SPD between each phase and ground (for AC) or across the DC supply lines (for DC). This is particularly important for outdoor or rooftop radiator installations susceptible to lightning transients.

14. What maintenance is required for cooling fan electrical connections?

Annual maintenance: (a) Inspect and re-torque all power connections at the contactor, overload relay, and motor terminals, (b) Clean contactor contacts (if accessible) and check for pitting, (c) Check motor winding insulation resistance (minimum 5 MΩ at 500 VDC), (d) Verify overload relay setting matches motor nameplate FLA, (e) Test temperature switch operation by applying heat (heat gun or hot water method), (f) Clean fan blades and motor cooling fins, (g) Check fan rotation direction against the arrow on the fan shroud.

15. Why does my fan run continuously even when the engine coolant is cold?

If the fan runs continuously regardless of temperature: (a) Temperature switch is stuck in the closed position (failed), (b) Controller fan output is incorrectly configured — check if the controller is erroneously holding the fan relay ON, (c) Contactor or relay coil is shorted (permanently energized), (d) Wiring error — fan power supply bypasses the control circuit. As an immediate workaround, disconnect the fan power until the cause is identified. Check the temperature switch with an ohmmeter: cold switch should read OL (open circuit for NO type) or 0 Ω (NC type used opposite).

Cooling Fan Wiring Installation Guidelines

Fan Motor Protection Circuitry

Proper protection of the fan motor is essential for long service life. The following protection devices should be wired in sequence:

1. Motor Circuit Breaker (MCB): Install a dedicated MCB for each fan motor. Trip characteristic: C-curve for standard motors (5-10× In) to accommodate the 5-7× starting current. Rating: 1.15-1.25× motor full load amperes (FLA). The MCB provides both overload and short-circuit protection for the cable.

2. Overload Relay: Wire a thermal overload relay after the contactor for motor overload protection. Set the overload relay to the motor's nameplate FLA. Use Class 10 trip characteristic for fan motors (fast response — trips within 10 seconds at 7.2× FLA). Manual reset mode is recommended so the fan does not auto-restart after an overload trip.

3. Phase Failure Relay (3-phase fans only): Install a phase failure/phase sequence relay on the supply side of the fan contactor. This relay monitors all three phases and prevents the motor from starting if a phase is missing or the phase sequence is incorrect. Single-phasing is the most common cause of three-phase motor failure.

4. PTC Thermistor Protection (optional): Wire the motor's built-in PTC thermistor (if fitted) to a PTC protection relay. This provides direct motor winding temperature protection independent of the overload relay. Set the relay to trip at the PTC's nominal response temperature (typically 130-150°C for Class F insulation).

Variable Frequency Drive (VFD) Wiring for Fan Control

For installations requiring proportional cooling control, a VFD provides the best solution with energy savings of 30-60% compared to on/off control.

VFD Wiring for Cooling Fan:

VFD Terminal	Function	Connection	Cable Size	Notes
R/L1	AC supply phase	From MCB (3-phase input)	Per VFD rating	Use line reactor for long cables
S/L2	AC supply phase	From MCB	Per VFD rating	
T/L3	AC supply phase	From MCB	Per VFD rating	
U/T1	Motor phase A	To motor U terminal	Per motor rating	Shielded VFD cable recommended
V/T2	Motor phase B	To motor V terminal	Per motor rating	
W/T3	Motor phase C	To motor W terminal	Per motor rating	
PE	Ground	Ground busbar	Same as line	
+10V	Speed reference supply	Controller analogue output	1.0 mm^2	0-10V reference
AI1	Speed reference input	From generator controller	1.0 mm^2 shielded	0-10V or 4-20mA
GND	Analogue ground	Controller analogue ground	1.0 mm^2	
DO1	Run status output	Controller digital input	1.0 mm^2	VFD running confirm
DI1	Start/Stop input	Controller digital output	1.0 mm^2	Run command to VFD

VFD Control Parameter Settings for Fan Applications:

- Acceleration time: 10-20 seconds (to reduce mechanical stress on fan blades)
- Deceleration time: 15-30 seconds (to prevent belt slip on belt-driven fans)
- Minimum frequency: 15-20 Hz (minimum speed before resonance band)
- Maximum frequency: 50 Hz (or 60 Hz depending on motor rating)
- Skip frequency bands: Configure to skip any frequencies where the fan assembly resonates mechanically (typically 25-35 Hz)
- Motor overload protection: Enable I^2t protection and set for the motor's rated FLA
- Auto restart: Disable for fan applications (safety) — use manual restart after fault

Multi-Fan Wiring for Large Radiators

For radiators requiring multiple fans (typically for generators >500 kVA), the fans can be wired in various configurations:

1. Sequential Staging (Recommended): Fans 1 and 2 are controlled independently. Fan 1 starts at 85°C. If temperature continues rising to 90°C, Fan 2 starts. This provides improved temperature regulation, reduced starting current surge, and partial backup if one fan fails.

2. Simultaneous Start (Simple): Both fans start and stop simultaneously from a single temperature switch. Simpler wiring but higher starting current and less temperature control granularity. No redundancy.

3. Alternating Duty (Reliability): The controller alternates which fan starts first on each cycle to equalize run hours. Requires separate contactor control for each fan and a controller capable of alternating relay logic.

Multi-Fan Staging Wiring (Component Wires):

• Temperature switch 1 (85°C NO) → Contactor KM1 coil → Fan 1 motor

• Temperature switch 2 (92°C NO) → Contactor KM2 coil → Fan 2 motor

• Controller fan status output 1 → Fan 1 running lamp

• Controller fan status output 2 → Fan 2 running lamp

• Total current protection: Individual MCB per fan (not shared)

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