Instruction Manual
for AC Generators

QAS108 PdS USA

PAGE

Instruction manual.....3

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ATLAS COPCO – PORTABLE AIR DIVISION
B-2630 AARTSELAAR BELGIUM

Congratulations on the purchase of your QAS108 AC generator. It is a solid, safe and reliable machine, built according to the latest technology. Follow the instructions in this booklet and we guarantee you years of troublefree operation. Please read the following instructions carefully before starting to use your machine.

While every effort has been made to ensure that the information in this manual is correct, Atlas Copco does not assume responsibility for possible errors. Atlas Copco reserves the right to make changes without prior notice.

CALIFORNIA
Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

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SAFETY PRECAUTIONS FOR GENERATORS QAS

Everyone who uses or maintains Atlas Copco equipment is expected to read the following safety precautions attentively and to act accordingly before installing, operating or repairing the generators.

The operator must employ safe working practices and observe all relevant local safety requirements.

The owner is responsible for maintaining the unit in a safe operating condition. Parts and accessories shall be replaced if unsuitable for safe operation.

Installation, operation, maintenance and repair shall only be carried out by authorized, competent personnel.

Any modification on the unit shall only be performed in agreement with and after written approval from Atlas Copco and under supervision of authorized, competent personnel.

If any statement in this book, especially with regard to safety, does not comply with local legislation, the stricter of the two shall apply.

Ignoring these safety precautions may result in injury or death of the operator and/or people in the vicinity.

In addition to normal safety rules which must be observed with generators, the following safety precautions listed hereafter are stressed.

INSTALLATION PRECAUTIONS

1. Generators shall be lifted only with adequate equipment in conformity with local safety rules. Loose or pivoting parts shall be securely fastened before lifting. It is forbidden to stay in the risk zone under a lifted load. Lifting acceleration and retardation shall be kept within safe limits.
2. The aspirated air shall be free from flammable or toxic fumes, e.g. paint solvents, that can lead to internal fire or explosion.
3. Generators shall be installed on an even, solid floor, in a clean location with sufficient ventilation. If the floor is not level or can vary in inclination, consult Atlas Copco. If the unit is installed on a trailer, immobilize the trailer and chock the wheels.
4. The engine exhaust is a lethal gas. Do not operate the unit in a confined, not-ventilated room.
5. Never remove or tamper with the safety devices, guards or insulations fitted on the machine.
6. The electrical connections shall correspond to the local codes. The machines shall be grounded and protected against short circuits by fuses or circuit breakers.
7. Damaged cables and insufficient tightening of connections may cause electric shocks. Replace damaged cables and make sure that all electric connections are securely tightened.

OPERATION PRECAUTIONS

1. Operate the unit as described in the Instruction book to ensure safe, efficient operation.
2. Never operate the generator in excess of its limits as indicated in the technical specifications and avoid long no-load sequences.
3. Use caution when operating the generator in a humid atmosphere. Excessive moisture causes deterioration of the generator insulation.
4. Never touch the power terminals during operation of the machine.
5. Keep all bodywork doors shut during operation. The doors may be opened for short periods only, e.g. to carry out routine checks. Wear ear protectors when opening a door.
6. People staying in environments or rooms where the sound pressure level reaches or exceeds 90 dB(A) shall wear ear protectors.
7. Periodically check that:
   a. All guards are in place and securely fastened.
   b. All hoses, cables and/or pipes inside the generator are in good condition, secure and not rubbing.
   c. There are no leaks.
   d. All fasteners are tight.
   e. All electrical wirings are secure and in good order.
8. Do not remove any of, or tamper with, the sound-damping material.
9. Whenever an abnormal condition arises, e.g. excessive vibration, noise, smell, etc., switch the circuit breakers to OFF and stop the engine. Correct the faulty condition before re-starting.
10. Never refill fuel while the machine is running. Keep fuel away from hot pipes. Never smoke while fuelling. Do not spill or leave fuel, oil, coolant or cleansing agent in or around the unit.
11. Keep flammable material away from the machine. If required, provide a spark arrestor to trap incendiary exhaust sparks.
12. Ground the generator as well as the load properly.
13. Check the electric cables regularly. Whenever damaged wires or dangerous conditions are observed, switch the circuit breakers to OFF and stop the engine. Replace the damaged wires or correct the dangerous condition before re-starting.
14. Avoid overloading the generator. The generator is provided with circuit breakers for overload protection. When a breaker has tripped, reduce the concerned load before re-starting.
15. If the generator is used as stand-by for the supply, it must not be operated without control system which automatically disconnects the generator from the supply when the supply is restored.
16. Never remove the cover of the output terminals during operation. Before connecting or disconnecting wires, switch off the load and the circuit breakers, stop the machine and make sure that the machine cannot be started inadvertently or there is any residual voltage on the power circuit.
17. Never connect the generator outlets to an installation which is also connected to a public supply.
18. Before connecting a load, switch off the corresponding circuit breaker, and check whether frequency, voltage, current and power factor comply with the ratings of the generator.
19. Running the generator at low load for long periods will reduce the lifetime of the engine.

MAINTENANCE PRECAUTIONS

1. Use only the correct tools for maintenance and repair work.
2. Use only genuine spare parts.
3. All maintenance work, other than routine attention, shall only be undertaken when the generator is stopped and when all loads are disconnected from the machine. Ensure that the machine cannot be started inadvertently.
4. Scrupulously observe cleanliness during maintenance and repair. Keep dirt away by covering the parts and exposed openings with a clean cloth, paper or tape.
5. Protect the air filter, electrical and regulating components, etc. to prevent moisture from entering them, e.g. when cleaning. Take care that moisture does not penetrate any component.
6. Never remove a filler cap of the cooling water system of a hot engine. Wait until the engine has sufficiently cooled down.
7. Never use flammable solvents or carbon tetrachloride for cleaning parts. Take safety precautions against toxic vapours of cleaning liquids.
8. Take precautions against fire. Handle fuel, oil and anti-freeze with care because they are inflammable substances. Do not smoke or approach with naked flame when handling such substances. Keep a fire-extinguisher in the vicinity.
9. Make sure that no tools, loose parts or rags are left in or on the generator. Never leave rags or loose clothing near the engine air intake.
10. Before clearing the generator for use after maintenance or overhaul, submit it to a testrun, check that the AC power performance is correct and that the control and shut-down devices function correctly.
11. When servicing batteries, always wear protecting clothing and glasses. The electrolyte is a sulphuric acid which can cause severe burns. When charging batteries, an explosive gas forms above the cells and escapes through the vents. Do not smoke near batteries being, or recently having been charged. Never break live circuits or battery terminals, because a spark usually occurs.
12. Make sure that all sound-damping material is in good condition. If damaged, replace it by genuine Atlas Copco material to prevent the sound pressure level from increasing.

LEADING PARTICULARS

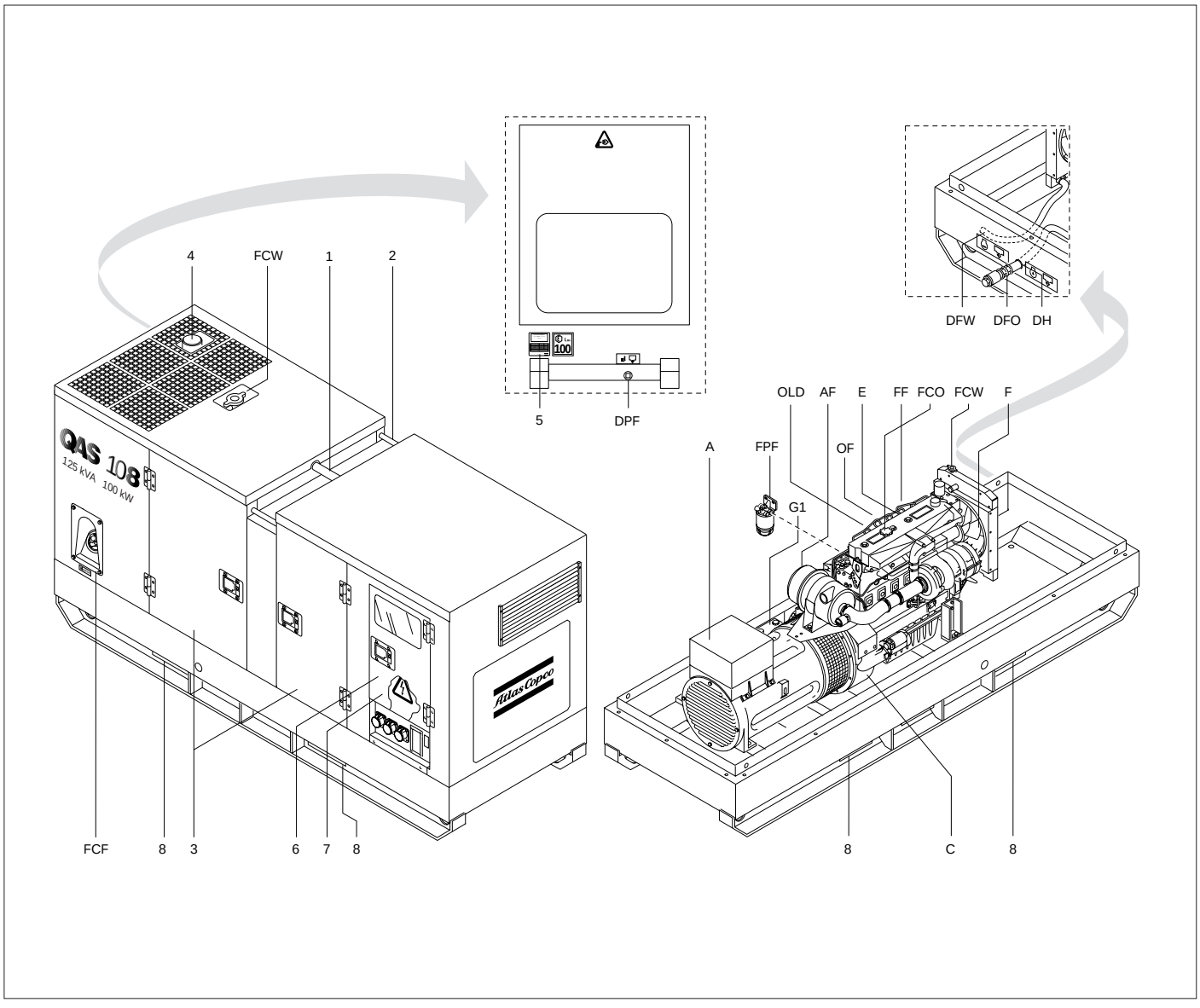
GENERAL DESCRIPTION

The QAS108 is an AC generator, built for continuous running at sites where no electricity is available.

The generator operates at 60 Hz, 120/240 V in 1 phase line-to-line mode, 120/208/240 V in 3 phase line-to-line lower voltage mode and 480 V in 3 phase line-to-line higher voltage mode. The rated output is 76.8 kVA in 1 phase operation and 124 kVA in 3 phase operation.

The QAS108 generator is driven by a water-cooled diesel engine, manufactured by PERKINS.

An overview of the main parts is given in the diagram below.



1	Lifting rod	A	Alternator	FCF	Filler cap fuel
2	Guiding rod	AF	Air filter	FCO	Filler cap engine oil
3	Side doors, access to engine and alternator	C	Coupling	FCW	Filler cap cooling water
4	Engine exhaust	DFO	Drain flexible engine oil	FF	Fuel filter
5	Data plate	DFW	Drain flexible cooling water	FPF	Fuel pre-filter
6	Side door, access to control and indicator panel	DH	Drain and access hole (in the frame)	G1	Battery
7	Output terminal board	DPF	Drain plug fuel	OF	Oil filter
8	Hole for forklift	E	Engine	OLD	Engine oil level dipstick
		F	Fan		

BODYWORK

The alternator, the engine, the cooling system, etc. are enclosed in a sound-insulated bodywork that can be opened by means of side doors (and service plates).

The recess in the roof has a lifting rod in the middle and a guiding rod at both sides.

NEVER USE THE GUIDING RODS TO LIFT THE GENERATOR.

To be able to lift the QAS108 by means of a forklift, rectangular holes are provided in the frame.

MARKINGS

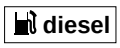
A brief description of all markings provided on the QAS108 is given hereafter.

Indicates that an electric voltage, dangerous to life, is present. Never touch the electric terminals during operation.

Indicates that the engine exhaust is a hot and harmful gas, which is toxic in case of inhalation. Always make sure that the unit is operated outside or in a well-ventilated room.

Indicates that these parts can become very hot during operation (eg. engine, cooler, etc.). Always make sure that these parts are cooled down before touching them.

Indicates that the guiding rods may not be used to lift the generator. Always use the lifting rod in the roof of the generator to lift it.



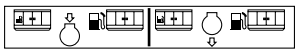
Indicates that the generator may be refueled with diesel fuel only.

Indicates the drain hole for the engine oil.

Indicates the drain hole for the coolant.

Indicates the drain plug for the engine fuel.

Indicates the lifting eye of the generator.



Indicates the 3-way valve.

DRAIN PLUGS AND FILLER CAPS

The drain holes for the engine oil, the coolant and the plug for the fuel, are located and labelled on the frame; the fuel drain plug at the front, the others at the service side.

The drain hole is used to guide external fueltank connections. Refer to “External fueltank connection”.

The filler cap for the engine coolant is accessible via an opening in the roof. The fuel filler cap is located in the side panel.

EXTERNAL FUELTANK CONNECTION

The external fueltank connection allows to bypass the internal fueltank and to connect an external fueltank to the unit.

When using an external fuel tank, make sure to connect the fuel supply line as well as the fuel return line. Always put both valves in the same position (either internal or external tank) and make sure that they are in the extreme (horizontal) position. Connections to fuellines ought to be air-tight to prevent air from entering the fuel system.

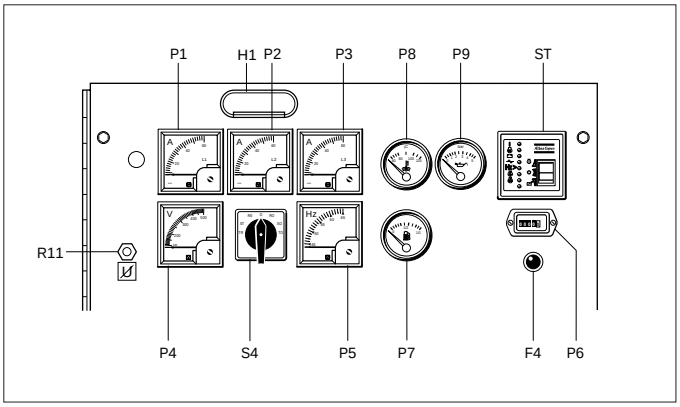
Indicates the fuel supply line from the tank to the engine.

Indicates the fuel return line from the engine to the tank.

Indicates the internal fueltank.

Indicates the external fueltank.

CONTROL AND INDICATOR PANEL



The control and indicator panel is located behind a door in the side panel. The hinged door is partly transparent and allows easy access to the parts mounted behind it. The panel light (H1) lights up as soon as the starter switch is turned into position ⏻ or the remote start/stop switch is put in position start, indicating that the fuel solenoid is energised.

Engine gauges

P6 .....Hourmeter

P7 .....Fuel level gauge

P8 .....Engine coolant temperature gauge

P9 .....Engine oil pressure gauge

Generator gauges

P1 .....Ammeter line L1

Indicates the outgoing current in the first phase (L1).

P2 .....Ammeter line L2

Indicates the outgoing current in the second phase (L2).

P3 .....Ammeter line L3

Indicates the outgoing current in the third phase (L3).

P4 .....Voltmeter

Indicates the voltage selected by means of voltage selector switch S4.

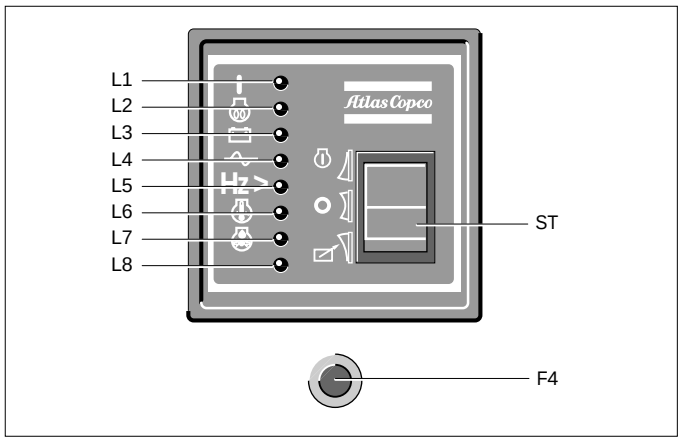
P5 .....Frequency meter

Indicates the frequency of the supply voltage.

S4 .....Voltmeter selector switch

Allows to measure the voltage between each of the phases and between each phase and the neutral. It also allows to switch off the voltmeter.

Engine controls and lamps



ST .....Starter switch

The starter switch is a three-position switch.

⏱ : used to select normal start and to disable remote start.

O : used to switch off the power supply from the battery or to reset after a shutdown due to a failure. The unit will not be able to start up.

⏲ : used to select remote start.

F4.....Fuse

The fuse activates when the current from the battery to the engine control circuit exceeds its setting.

L1.....Electrical system indicator

Lights up when the electrical system of the engine is energized.

L2.....Engine preheating system indicator

Lights up when the glow plugs in the engine, used to facilitate starting, are warming up. Extinguishes after approximately 10 seconds. Bypassing of the preheattime is allowed e.g. when starting a hot engine, but the preheat system remains active.

L3.....Alternator charging indicator

Goes out after starting, indicating that the alternator is charging. A failing alternator however will not shut the engine down.

L4.....AC shutdown indicator

Lights up when no AC input is present.

L5.....Overspeed shutdown indicator

Lights up when the engine's speed has exceeded 115 % of the nominal speed.

L6.....Engine coolant temperature fault indicator

Lights up when the high engine coolant temperature was the cause of shutdown.

L7.....Engine oil pressure fault indicator

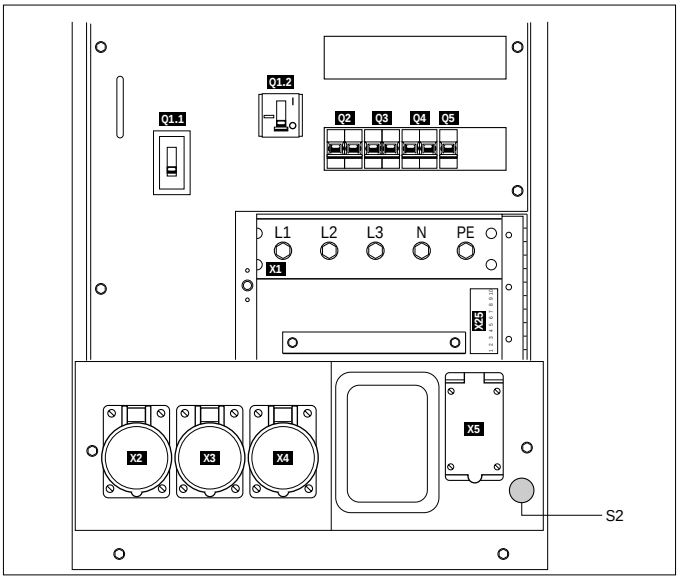
Lights up when the low engine oil pressure was the cause of shutdown.

L8.....Spare shutdown indicator

Can be used to wire an extra shutdown, e.g. for low fuel level in case a switch is incorporated in the fuel tank.

OUTPUT TERMINAL BOARD

The output terminal board is situated below the control and indicator panel.



Q2.....Circuit breaker

Interrupts phases L1 and L2 towards X2 when a short-circuit occurs at the load side or when the overcurrent protection (50 A) is activated. It must be reset manually after eliminating the problem.

Q3.....Circuit breaker

Interrupts phases L1 and L2 towards X3 when a short-circuit occurs at the load side or when the overcurrent protection (50 A) is activated. It must be reset manually after eliminating the problem.

Q4.....Circuit breaker

Interrupts phases L1 and L2 towards X4 when a short-circuit occurs at the load side or when the overcurrent protection (50 A) is activated. It must be reset manually after eliminating the problem.

Q5.....Circuit breaker

Interrupts phase L1 towards X5 when a short-circuit occurs at the load side or when the overcurrent protection (20 A) is activated. It must be reset manually after eliminating the problem.

X1 .....Main power supply

Terminals L1, L2, L3, N (= neutral) and PE (= grounding), hidden behind the control panel door and behind a small transparent door.

X2 .....Single phase outlet socket

Provides phases L1, L2 and N.

X3 .....Single phase outlet socket

Provides phases L1, L2 and N.

X4 .....Single phase outlet socket

Provides phases L1, L2 and N.

X5 .....Single phase outlet socket

Provides phase L1, N and PE.

R11 ...Output voltage adjust potentiometer

Allows to adjust the output voltage. R11 is located on the control and indicator panel.

S2 .....Emergency stop button

Push the button to stop the generator in case of an emergency. When the button is pressed, it must be unlocked, by turning it anti-clockwise, before the generator can be restarted.

TRIPPLE VOLTAGE WITH SWITCH (3V-SW)

The generator can run in three different modes:

– 1 phase
– 3 phase, lower voltage
– 3 phase, higher voltage

Depending on which mode the generator is running in, circuit breaker Q1.1 or Q1.2 will be operational.

Circuit breakers Q1.1 and Q1.2 cannot be switched on at the same time. This is prevented by means of the auxiliary voltage selection relays K11 and K12 (refer to the circuit diagram).

The selection between the three modes is done by means of S10.

S10 ...Output voltage selector switch

Allows to select a 3 phase high output voltage, a 3 phase low output voltage or a 1 phase low output voltage. Selector switch S10 is located on the alternator.

⚠ Changing the output voltage is only allowed after shutdown.

⚠ After changing the output voltage by means of the selection switch S10, adjust the output voltage by means of potentiometer R11 to the required value.

1 phase

When using this selection, the generator provides a 120/240 V output voltage.

Q1.1..Circuit breaker for low voltage

Interrupts the low voltage power supply towards X1 when a short-circuit occurs at the load side or when the overcurrent protection (320 A) is activated. It must be reset manually after eliminating the problem.

3 phase lower voltage

When using this selection, the generator provides a 120/208/240 V output voltage.

Q1.1..Circuit breaker for low voltage

Interrupts the low voltage power supply towards X1 when a short-circuit occurs at the load side or when the overcurrent protection (320 A) is activated. It must be reset manually after eliminating the problem.

3 phase higher voltage

When using this selection, the generator provides a 480 V output voltage.

Q1.2..Circuit breaker for high voltage

Interrupts the high voltage power supply towards X1 when a short-circuit occurs at the load side or when the overcurrent protection (145 A) is activated. It must be reset manually after eliminating the problem.

REMOTE START (RS)

"Remote start" allows to switch the unit on or off without using the control panel located on the unit. The start module of the control panel provides extra connections for the remote start/stop switch and the plant contactor (voltage free contact), both to be installed by the customer.

The plant contactor should be sized according to the load. The maximum current through the voltage free contact is 3A.

The remote start/stop switch Sx has to meet the following specifications: 12 V DC, 10 A.

Refer to the circuit diagram for the correct connection of the plant contactor and the remote start/stop switch.

A shunt trip coil will switch off Q1.1 or Q1.2 (depending on the mode the generator is running in) in case of an emergency stop or an earth fault.

OPERATING INSTRUCTIONS

In your own interest, always strictly observe all relevant safety instructions.

Do not operate the generator in excess of the limitations mentioned in the Technical Specifications.

Local rules concerning the setting up of low voltage power installations (below 1,000 V) must be respected when connecting site distribution panels, switch gear or loads to the generator.

At each start-up and at any time a new load is connected, the grounding of the generator must be verified. Grounding must be done by an existing, suitable grounding installation.

The generator is wired for a TN-system to IEC 364-3, i.e. one point in the power source directly grounded - in this case the neutral. The exposed conductive parts of the electric installation must be directly connected to the functional ground.

If operating the generator in another power system, e.g. an IT-system, other protective devices required for these types must be installed. In any case only a qualified electrician is authorized to remove the connection between the neutral (N) and ground terminals in the terminal box of the alternator.

INSTALLATION

- Place the generator on a horizontal, even and solid floor.
- Check that the engine exhaust is not directed towards people. If the generator is operated indoors, install an exhaust pipe of sufficient diameter to duct the engine exhaust towards the outside. Check for sufficient ventilation so that the cooling air is not recirculated. If necessary, consult Atlas Copco.
- Leave enough space for operation, inspection and maintenance (at least 1 meter at each side).
- Check that the inner grounding system is in compliance with the local legislation.
- Use soft water for the engine cooling system. If low temperatures are expected (close to 0 °C), the engine cooling system must be protected (refer to the Engine instruction book).
- Check the tightness of the bolts and nuts.

CONNECTING THE GENERATOR

Precautions for non-linear and sensitive loads

Non-linear loads draw currents with high contents in harmonics, causing distortion in the wave form of the voltage generated by the alternator.

The most common non-linear, 3-phase loads are thyristor/ rectifier-controlled loads, such as convertors supplying voltage to variable speed motors, uninterruptable power supplies and Telecom supplies. Gas-discharge lighting arranged in single-phase circuits generate high 3rd harmonics and risk for excessive neutral current.

Loads most sensitive to voltage distortion include incandescent lamps, discharge lamps, computers, X-ray equipment, audio amplifiers and elevators.

Consult Atlas Copco for measures against the adverse influence of non-linear loads.

Quality, minimum section and maximum length of cables

The cable connected to the terminal board of the generator must be selected in accordance with local legislation. The type of cable, its rated voltage and current carrying capacity are determined by installation conditions, stress and ambient temperature. For flexible wiring, rubber-sheathed, flexible core conductors must be used.

Connecting the load

Site distribution panel

If outlet sockets are required, they must be mounted on a site distribution panel supplied from the terminal board of the generator and in compliance with local regulations for power installations on building sites.

Protection

For safety reasons, it is necessary to provide an isolating switch or circuit breaker in each load circuit. Local legislation may impose the use of isolating devices which can be locked.

- Check whether frequency, voltage and current comply with the ratings of the generator.
- Provide for the load cable, without excessive length, and lay it out in a safe way without forming coils.
- Open the door of the control and indicator panel and the transparent door in front of the terminal board X1.
- Provide the wire ends with cable lugs suited for the cable terminals.
- Loosen the cable clamp and push the wire ends of the load cable through the orifice and clamp.
- Connect the wires to the proper terminals (L1, L2, L3, N and PE) of X1 and tighten the bolts securely.
- Tighten the cable clamp.
- Close the transparent door in front of X1.

BEFORE STARTING

- With the generator standing level, check the engine oil level and top up if necessary. The oil level must be near to, but not exceed the high mark on the engine oil level dipstick.
- Check the coolant level in the expansion tank of the engine cooling system. The water level must be near to the FULL mark. Add coolant if necessary.
- Drain any water and sediment from the fuel pre-filter. Check the fuel level and top up if necessary. It is recommended to fill the tank after the day's operation to prevent watervapour in a nearly empty tank from condensing.
- Check the vacuum indicator of the air filter. If the red part shows completely, replace or clean the filter element.
- Press the vacuator valve of the air filter to remove dust.
- Check the generator for leakage, tightness of wire terminals, etc. Correct if necessary.
- Check that circuit breakers Q1.1 and Q1.2 are switched off.
- Check that fuse F4 is set and that the emergency stop is in the OUT position.
- Check that the load is switched off.
- Check the correct position of the voltage selector switch (S10) on the alternator.

STARTING

To start up the unit locally, without using the remote start/stop switch, proceed as follows:

- Put the starter switch in position ⏱. The unit starts a preheating cycle which takes 12 seconds.
- After the preheating period, the unit will start. The starting attempt will take maximum 12 seconds. If the unit does not start immediately, it will perform another two starting attempts.
- Check that the warning lamps on the control and indicator panel are out. Refer to "Control and indicator panel" for component locations.
- Run the engine for approximately 5 minutes to warm up. Check the engine oil pressure (P9) and the cooling water temperature (P8).
- Check the voltmeter P4 (with voltmeter selector switch S4 in different positions) and the frequencymeter P5.
- Switch on circuit breaker Q1.1 or Q1.2 (depending on the mode the generator is running in).
- Switch on the load and check the ammeters P1, P2 and P3, voltmeter P4 (voltmeter selector switch in different positions) and frequencymeter P5.

To start up the unit from a remote location using the remote start/stop switch, proceed as follows:

– Put the starter switch in position ⊿ .
– Switch on circuit breaker Q1.1 or Q1.2 (depending on the mode the generator is running in).
– Put the remote start/stop switch in position start. The unit starts a preheating cycle which takes 12 seconds.
– After the preheating period, the unit will start. The starting attempt will take maximum 12 seconds. If the unit does not start immediately, it will perform another two starting attempts.
– Approximately 15 seconds after starting (stabilisation time for the generator), the timer relay closes the voltage free contact and the plant contactor is energised (if installed).
– Check that the warning lamps on the control and indicator panel are out. Refer to “Control and indicator panel” for component locations.
– Check the voltmeter P4 (with voltmeter selector switch S4 in different positions) and the frequencymeter P5.
– Switch on the load and check the ammeters P1, P2 and P3, voltmeter P4 (voltmeter selector switch in different positions) and frequencymeter P5.

DURING OPERATION

Following points should be carried out regularly:

– Check the engine gauges and the lamps for normal readings.

⚠ Avoid letting the engine run out of fuel. If this occurs, priming may be required for starting.

– Check for leakage of oil, fuel or cooling water.
– Avoid long low-load periods. In this case, an output drop and higher oil consumption of the engine could occur.
– Check, by means of the generator gauges, that the voltage between the phases is identical and that the rated current per phase is not exceeded.
– When single-phase loads are connected to the generator output terminals, keep all loads well-balanced (in 3 phase output voltage mode).

If circuit breaker Q1.1 or Q1.2 (depending on the mode the generator is running in) has tripped during operation, switch off the load and stop the generator. Check and, if necessary, decrease the load.

The generator’s side doors may only remain opened for short periods during operation, to carry out checks for example.

STOPPING

To stop the unit when the starter switch is in position ⏻ , proceed as follows:

– Switch off the load.
– Switch off circuit breakers Q1.1 and Q1.2.
– Let the engine run for about 5 minutes.
– Stop the engine by putting the starter switch in position O.

To stop the unit when the starter switch is in position ⊿ , proceed as follows:

– Switch off the load.
– Let the engine run for about 5 minutes.
– Stop the engine by putting the remote start/stop switch in position stop or by putting the starter switch in position O.

⚠ Lock the side doors and the door of the indicators and control panel to avoid unauthorized access.

MAINTENANCE

⚠ Before carrying out any maintenance activity, check that the start switch is in position O and that no electrical power is present on the terminals.

MAINTENANCE SCHEDULE	Daily	Initial	Small	Normal	Yearly
		50 hours	*250 hours*	*500 hours*	*2000 hours*

SERVICE PAK	–	With unit	2912 4264 05	2912 4265 06	2912 4266 07
For the most important subassemblies, Atlas Copco has developed service kits that contain all wear parts. These service kits offer you the benefits of genuine parts, save on administration costs and are offered at reduced price, compared to the loose components. Refer to page 63 for more information on the contents of the service kits.					
Coolant level	Check	Check	Check	Check	Check
Tension and condition of drive belt(s)		Check	Check	Check	Replace
Radiator and intercooler fins		Check/Clean	Check/Clean	Check/Clean	Check/Clean
Fuel pre-filter/Water separator	Check/Drain	Check/Drain	Check/Drain	Check/Drain	Check/Drain
Fuel filter element		Replace	Replace	Replace	Replace
Fuel injectors					Check
Oil level in sump	Check	Check	Check	Check	Check
Oil pressure on gauge	Check	Check	Check	Check	Check
Lubrication oil		Change	Change	Change	Change
Oil filter(s)		Replace	Replace	Replace	Replace
Air cleaner and dust bowl		Clean	Clean	Clean	Clean
Air filter element (1)			Clean	Replace	Replace
Safety cartridge					Replace
Valve clearance		Check/adjust	Check/adjust	Check/adjust	Check/adjust
Oil, fuel and water leaks		Check	Check	Check	Check
Mechanical links (e.g. fuel solenoid link)			Grease	Grease	Grease
Level battery electrolyte (2)		Check	Check	Check	Check
Condition of vibration dampers		Check	Check	Check	Check
Alternator insulation resistance (*)		Measure	Measure	Measure	Measure
Tightness of nuts and bolts		Check			Check
Door hinges and locks		Grease			Grease
Fixation of hoses, cables and pipes				Check	Check
Inspection by Atlas Copco Service technician					⚠

(1) More frequently when operating in a dusty environment. Evacuate dust from the airfilter valve daily.

(2) A Service Bulletin (ASB) dealing elaborately with batteries and due care is available on request.

ENGINE MAINTENANCE

Refer to the engine's operator manual for full maintenance, including instructions for changing the oil and cooling water and replacing the fuel, oil and air filters.

(*) MEASURING THE ALTERNATOR INSULATION RESISTANCE

A 500-V megger is required to measure the alternator insulation resistance.

If the N-terminal is connected to the grounding system, it must be disconnected from the ground terminal. Disconnect the AVR.

Connect the megger between the ground terminal PE and terminal L1 and generate a voltage of 500 V. The scale must indicate a resistance of at least 5 MΩ.

Refer to the alternator operating and maintenance instructions for more details.

STORAGE OF THE GENERATOR

STORAGE

- Store the generator in a dry, frost-free room which is well ventilated.
- Run the engine regularly, e.g. once a week, until it is warmed up. If this is impossible, extra precautions must be taken:
  - Consult the engine's operator manual.
  - Remove the battery. Store it in a dry, frost-free room. Keep the battery clean and its terminals lightly covered with petroleum jelly. Recharge the battery regularly.
  - Clean the generator and protect all electrical components against moisture.
  - Place silica gel bags, VCI paper (Volatile Corrosion Inhibitor) or another drying agent inside the generator and close the doors.
  - Stick sheets of VCI paper with adhesive tape on the bodywork to close off all openings.
  - Enclose the generator, except the bottom, with a plastic bag.

PREPARING FOR OPERATION AFTER STORAGE

Before operating the generator again, remove the wrapping, VCI paper and silicagel bags and check the generator thoroughly (go through the checklist "Before starting").

- Consult the engine's operator manual.
- Check that the insulation resistance of the generator exceeds 5 MΩ.
- Replace the fuel filter and fill the fuel tank. Vent the fuel system.
- Reinstall and connect the battery, if necessary after being recharged.
- Submit the generator to a test run.

CHECKS AND TROUBLE SHOOTING

Never perform a test run with connected power cables. Never touch an electrical connector without a voltage check.

When a failure occurs, always report what you experienced before, during and after the failure. Information with regard to the load (type, size, power factor, etc.), vibrations, exhaust gas colour, insulation check, odors, output voltage, leaks and damaged parts, ambient temperature, daily and normal maintenance and altitude might be helpful to quickly locate the problem. Also report any information regarding the humidity and location of the generator (eg. close to sea).

ALTERNATOR TROUBLE SHOOTING

Symptom	*Possible cause*	*Corrective action*
Alternator does not excite.	Blown fuse. Insufficient residual voltage. No residual voltage.	Replace fuse. Increase the speed by 15 %. For an Instant apply on the + and – terminals of the electronic regulator a 12 V battery voltage with a 30 Ω resistor in series respecting the polarities.
After being excited alternator does not excite.	Connections are interrupted.	Check connection cables as per attached drawings.
Low voltage at no load.	Voltage potentiometer out of setting. Intervention of protection. Winding failure.	Reset voltage. Check rpm. Check windings.
High voltage at no load.	Voltage potentiometer out of setting. Failed regulator.	Reset voltage. Substitute regulator.
Lower than rated voltage at load.	Voltage potentiometer out of setting. Intervention by protection. Failed regulator. Rotating bridge failure.	Reset voltage potentiometer. Current too high, power factor lower than 0.8; speed lower than 4% of rated speed. Substitute regulator. Check diodes, disconnect cables.
Higher than rated voltage at load.	Voltage potentiometer out of setting. Failed regulator.	Reset voltage potentiometer. Substitute regulator.
Unstable voltage.	Speed variation in engine. Regulator out of setting.	Check regularity of rotation. Regulate stability of regulator by acting on "STABILITY" potentiometer.

ENGINE TROUBLE SHOOTING

The table below gives an overview of the possible engine problems and their possible causes.

The starter motor turns the engine too slowly

- Battery capacity too low.
- Bad electrical connection.
- Fault in starter motor.
- Wrong grade of lubricating oil.

The engine does not start or is difficult to start

- Starter motor turns engine too slowly.
- Fuel tank empty.
- Fault in fuel control solenoid.
- Restriction in a fuel pipe.
- Fault in fuel lift pump.
- Dirty fuel filter element.
- Air in fuel system.
- Fault in atomisers.
- Cold start system used incorrectly.
- Fault in cold start system.
- Restriction in fuel tank vent.
- Wrong type or grade of fuel used.
- Restriction in exhaust pipe.

Not enough power

- Restriction in a fuel pipe.
- Fault in fuel lift pump.
- Dirty fuel filter element.
- Restriction in air filter/cleaner or induction system.
- Air in fuel system.
- Fault in atomisers or atomisers of an incorrect type.
- Restriction in fuel tank vent.
- Wrong type or grade of fuel used.
- Restricted movement of engine speed control.
- Restriction in exhaust pipe.
- Engine temperature is too high.
- Engine temperature is too low.

Misfire

- Restriction in a fuel pipe.
- Fault in fuel lift pump.
- Dirty fuel filter element.
- Air in fuel system.
- Fault in atomisers or atomisers of an incorrect type.
- Fault in cold start system.
- Engine temperature is too high.
- Incorrect valve tip clearances.

The pressure of the lubricating oil is too low

- Wrong grade of lubricating oil.
- Not enough lubricating oil in sump.
- Defective gauge.
- Dirty lubricating oil filter element.

High fuel consumption

- Restriction in air filter/cleaner or induction system.
- Fault in atomisers or atomisers of an incorrect type.
- Fault in cold start system.
- Wrong type or grade of fuel used.
- Restricted movement of engine speed control.
- Restriction in exhaust pipe.
- Engine temperature is too low.
- Incorrect valve tip clearances.

Black exhaust smoke

- Restriction in air filter/cleaner or induction system.
- Fault in atomisers or atomisers of an incorrect type.
- Fault in cold start system.
- Wrong type or grade of fuel used.
- Restriction in exhaust pipe.
- Engine temperature is too low.
- Incorrect valve tip clearances.
- Engine overload.

Blue or white exhaust smoke

- Wrong grade of lubricating oil.
- Fault in cold start system.
- Engine temperature is too low.

The engine knocks

- Fault in fuel lift pump.
- Fault in atomisers or atomisers of an incorrect type.
- Fault in cold start system.
- Wrong type or grade of fuel used.
- Engine temperature is too high.
- Incorrect valve tip clearances.

The engine runs erratically

- Fault in fuel control.
- Restriction in a fuel pipe.
- Fault in fuel lift pump.
- Dirty fuel filter element.
- Restriction in air filter/cleaner or induction system.
- Air in fuel system.
- Fault in atomisers or atomisers of an incorrect type.
- Fault in cold start system.
- Restriction in fuel tank vent.
- Restricted movement of engine speed control.
- Engine temperature is too high.
- Incorrect valve tip clearances.

Vibration

- Fault in atomisers or atomisers of an incorrect type.
- Restricted movement of engine speed control.
- Engine temperature is too high.
- Fan damaged.
- Fault in engine mounting or flywheel housing.

The pressure of the lubricating oil is too high

– Wrong grade of lubricating oil.
– Defective gauge.

The engine temperature is too high

– Restriction in air filter/cleaner or induction system.
– Fault in atomisers or atomisers of an incorrect type.
– Fault in cold start system.
– Restriction in exhaust pipe.
– Fan damaged.
– Too much lubricating oil in sump.
– Restriction in air or water passages of radiator.
– Insufficient coolant in system.

Crankcase pressure

– Restriction in breather pipe.
– Vacuum pipe leaks or fault in exhauster.

Bad compression

– Restriction in air filter/cleaner or induction system.
– Incorrect valve tip clearances.

The engine starts and stops

– Dirty fuel filter element.
– Restriction in air filter/cleaner or induction system.
– Air in fuel system.

The engine shuts down after approximately 15 seconds

– Bad connection towards oil pressure switch/coolant temperature switch.
– DIP switch on back of module wrong positioned.

OPTIONS AVAILABLE FOR QAS108 UNITS

OVERVIEW OF THE ELECTRICAL OPTIONS

The following “electrical” options are available for the QAS108 unit:

– single frequency with electronic speed control (SF).

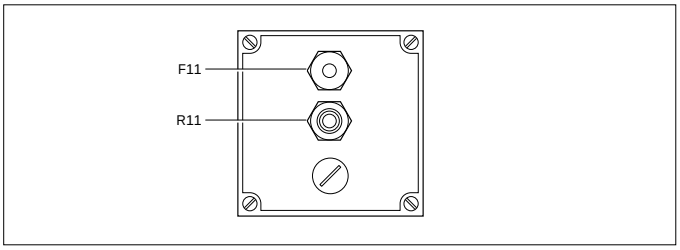
The engine control circuit diagrams and the power circuit diagrams for the standard QAS108 unit, for the units with options and for the units with combined options are:

Unit	*Power circuit*	*Engine control circuit*
QAS108 PdS USA 3V-SW RS (Standard)	9822 0888 45	9822 0888 28
QAS108 PdS USA 3V-SW RS SF	9822 0888 45	9822 0888 28

DESCRIPTION OF THE ELECTRICAL OPTIONS

Single frequency with electronic speed control (SF)

The “Single frequency” option provides an electronic speed controller which makes sure that the output frequency of the generator is 60 Hz with an accuracy of 0.25 % at constant load.



F11 ...Fuse

Interrupts the power supply towards the speed or frequency controller.

R11 ...Supply voltage adjust potentiometer

Allows to adjust the output voltage.

TECHNICAL SPECIFICATIONS

READINGS ON GAUGES

Gauge	*Reading*	*Unit*	*Unit*
Ammeter L1 (P1)	Below max. rating	A	A
Ammeter L2 (P2)	Below max. rating	A	A
Ammeter L3 (P3)	Below max. rating	A	A
Voltmeter (P4)	Depends upon selector switch	V	V
Frequencymeter (P5)	Between 62.5 and 60	Hz	Hz
Hourmeter (P6)	Adding up	h	h
Fuel level (P7)	Above 0	Fuel tank full	Fuel tank full
Engine temperature (P8)	Below 221 °F or 105 °C	°F	°C
Engine oil pressure (P9)	Below max. rating	psi	bar

SETTINGS OF SWITCHES

Switch	*Function*	*Activates at*	*Activates at*
Engine oil pressure	Shut-down	7.25 psi	0.5 bar
Engine coolant temperature	Shut-down	221 °F	105 °C

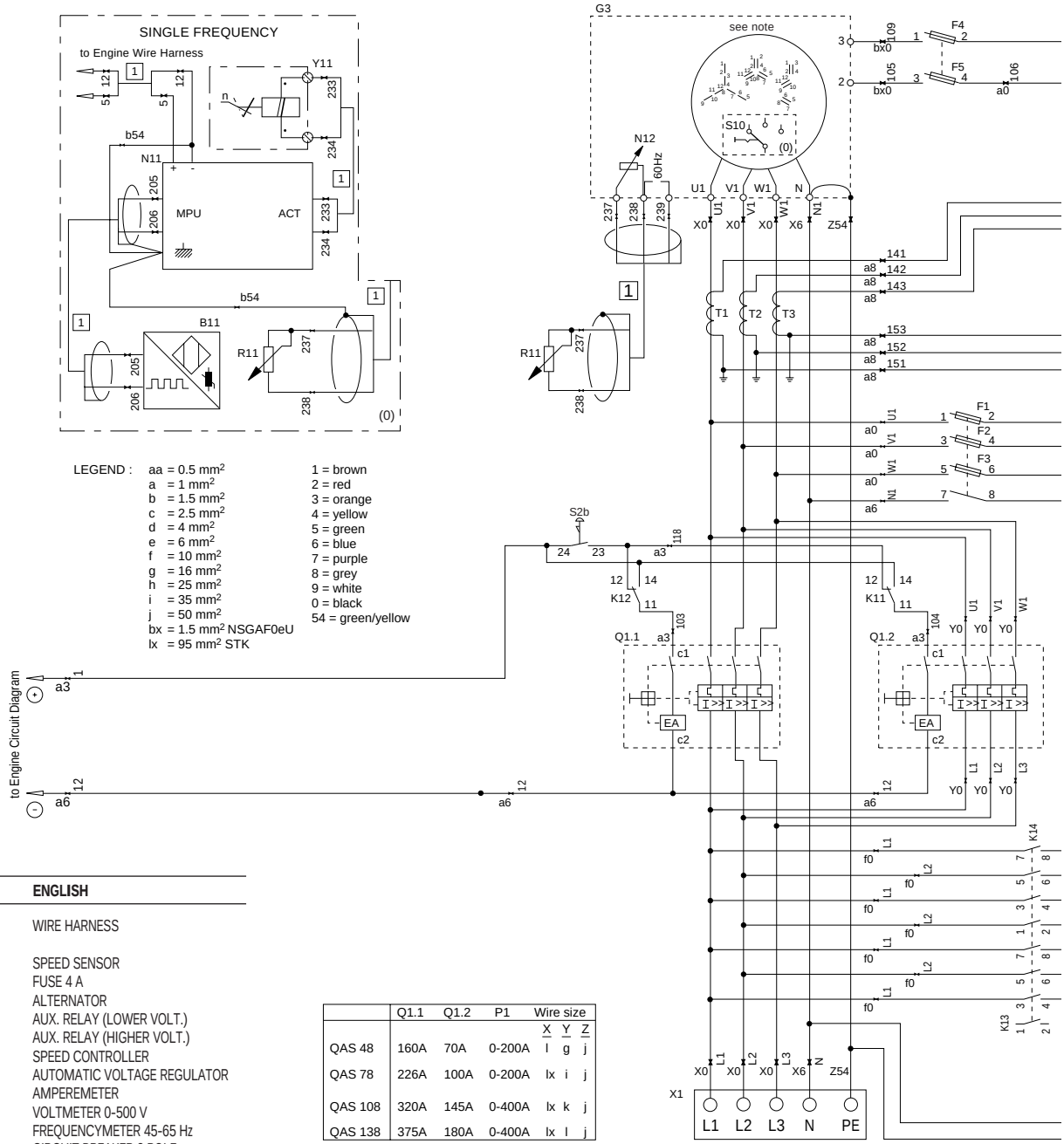
SPECIFICATIONS OF THE ENGINE/ALTERNATOR/UNIT

Reference values	Absolute air inlet pressure	14.5 psi	1 bar
	Air inlet temperature	80.6 °F	27 °C
	Relative air humidity	60 %	60 %
	Generator load	Continuous	Continuous
Limitations without derating	Maximum ambient temperature	104 °F	40 °C
	Maximum altitude	3281 ft	1000 m
	Maximum relative air humidity	85 %	85 %
	Minimum starting temperature	- 0.4 °F	-18 °C
Engine	Type PERKINS	1006-60T	1006-60T
	Rated net output	143.5 hp	107 kW
	Load speed	1800 rpm	1800 rpm
	Electrical system	12 V	12 V
	Battery	12 V / 66 Ah	12 V / 66 Ah
	Oil circuit capacity	4.2 gal	16 l
	Cooling circuit capacity	7.4 gal	28 l
	Fuel tank capacity	81.9 gal	310 l
	Fuse F4	10 A	10 A
	Fuel consumption at full load/no load	6.3/1 gal/h	23.8/3.8 l/h
	Maximum run time with fuel tank	11 h	11 h
Alternator	Type	ECN 34 LC-4	ECN 34 LC-4
	Rated net output	156 kVA	156 kVA
	Voltage 1ph. line-to-line	240 V	240 V
	Voltage 3ph. line-to-line, lower voltage	208/240 V	208/240 V
	Voltage 3ph. line-to-line	480 V	480 V
	Frequency	60 Hz	60 Hz
	Speed	1800 rpm	1800 rpm
	Power factor (3 phase/1 phase)	0.8/1.0	0.8/1.0
	Number of wires	12	12
	Insulation armature winding, class	H	H
	Insulation field winding, class	H	H
	Setting of Q1.1	320 A	320 A
	Setting of Q1.2	145 A	145 A
	Setting of circuit breaker Q2	50 A	50 A
	Setting of circuit breaker Q3	50 A	50 A
	Setting of circuit breaker Q4	50 A	50 A
	Setting of circuit breaker Q5	20 A	20 A
	Fuses F1, F2 and F3 for voltmeter selector switch	4 A	4 A
Unit	Dimensions (L x W x H)	122.5 x 44.5 x 59.3 in	3112 x 1131 x 1507 mm
	Weight net mass	4393.8 lb	1993 kg
	Weight wet mass	5011.1 lb	2273 kg

Circuit diagrams
Schémas de circuits
Esquema de conexiones

CIRCUIT DIAGRAM
SCHEMA DE CIRCUIT
DIAGRAMA DE CIRCUITOS

9822 0888 45
Applicable for QAS108 PdS USA 3V-SW RS, 3V-SW RS SF



LEGEND :

aa = 0.5 mm²		1 = brown
a = 1 mm²		2 = red
b = 1.5 mm²		3 = orange
c = 2.5 mm²		4 = yellow
d = 4 mm²		5 = green
e = 6 mm²		6 = blue
f = 10 mm²		7 = purple
g = 16 mm²		8 = grey
h = 25 mm²		9 = white
i = 35 mm²		0 = black
j = 50 mm²		54 = green/yellow
bx = 1.5 mm² NSGAF0eU		
lx = 95 mm² STK		

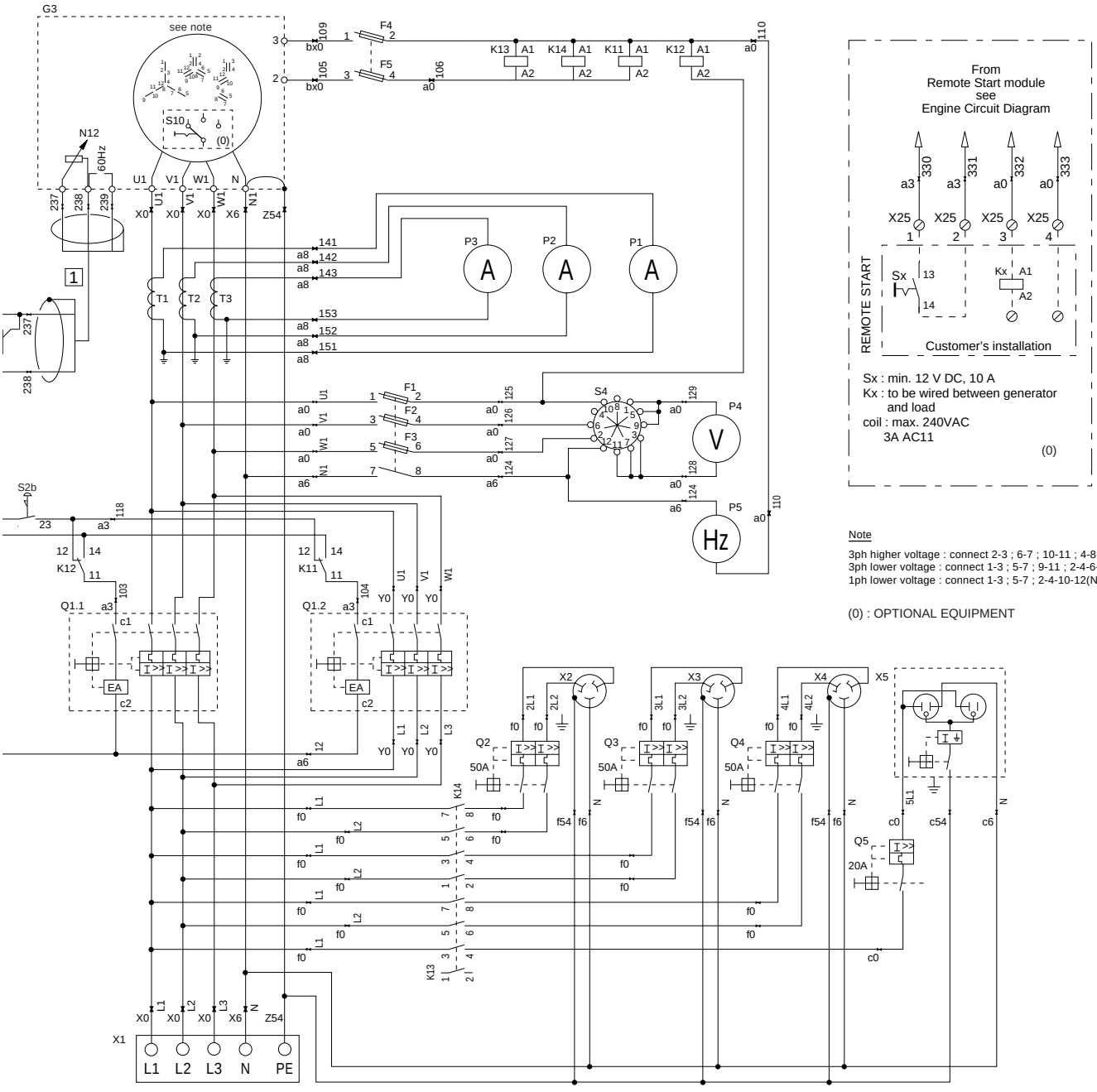
	ENGLISH
1	WIRE HARNESS
B11	SPEED SENSOR
F1-5	FUSE 4 A
G3	ALTERNATOR
K11	AUX. RELAY (LOWER VOLT.)
K12	AUX. RELAY (HIGHER VOLT.)
N11	SPEED CONTROLLER
N12	AUTOMATIC VOLTAGE REGULATOR
P1-3	AMPEREMETER
P4	VOLTMETER 0-500 V
P5	FREQUENCYMETER 45-65 Hz
Q1.1	CIRCUIT BREAKER 3 POLE
Q1.2	CIRCUIT BREAKER 3 POLE
R11	SUPPLY VOLTAGE ADJUST
R16	SPEED ADJUST (60 HZ ONLY)
R17-18	SPEED OFFSET (60 HZ ONLY)
S2b	EMERGENCY STOP
S4	VOLTAGE CHANGE-OVER SWITCH
S10	SUPPLY VOLTAGE SWITCH
S11	SELECTOR SWITCH 50/60 HZ
T1-3	CURRENT TRANSFORMER
X1	TERMINAL BOARD
X25	TERMINAL STRIP
Y11	ACTUATOR

	Q1.1	Q1.2	P1	Wire size X	Y	Z
QAS 48	160A	70A	0-200A	l	g	j
QAS 78	226A	100A	0-200A	lx	i	j
QAS 108	320A	145A	0-400A	lx	k	j
QAS 138	375A	180A	0-400A	lx	l	j

Sx	REMOTE START/STOP
Kx	CONTACTOR GENERATOR READY (by voltage free contact, 15 s. delayed)

CIRCUIT DIAGRAM
SCHEMA DE CIRCUIT
DIAGRAMA DE CIRCUITOS

9822 0888 45



Note

3ph higher voltage : connect 2-3 ; 6-7 ; 10-11 ; 4-8-12 (N)
3ph lower voltage : connect 1-3 ; 5-7 ; 9-11 ; 2-4-6-8-10-12 (N)
1ph lower voltage : connect 1-3 ; 5-7 ; 2-4-10-12(N) ; 6-8-9-11

(0) : OPTIONAL EQUIPMENT

CIRCUIT DIAGRAM
SCHEMA DE CIRCUIT
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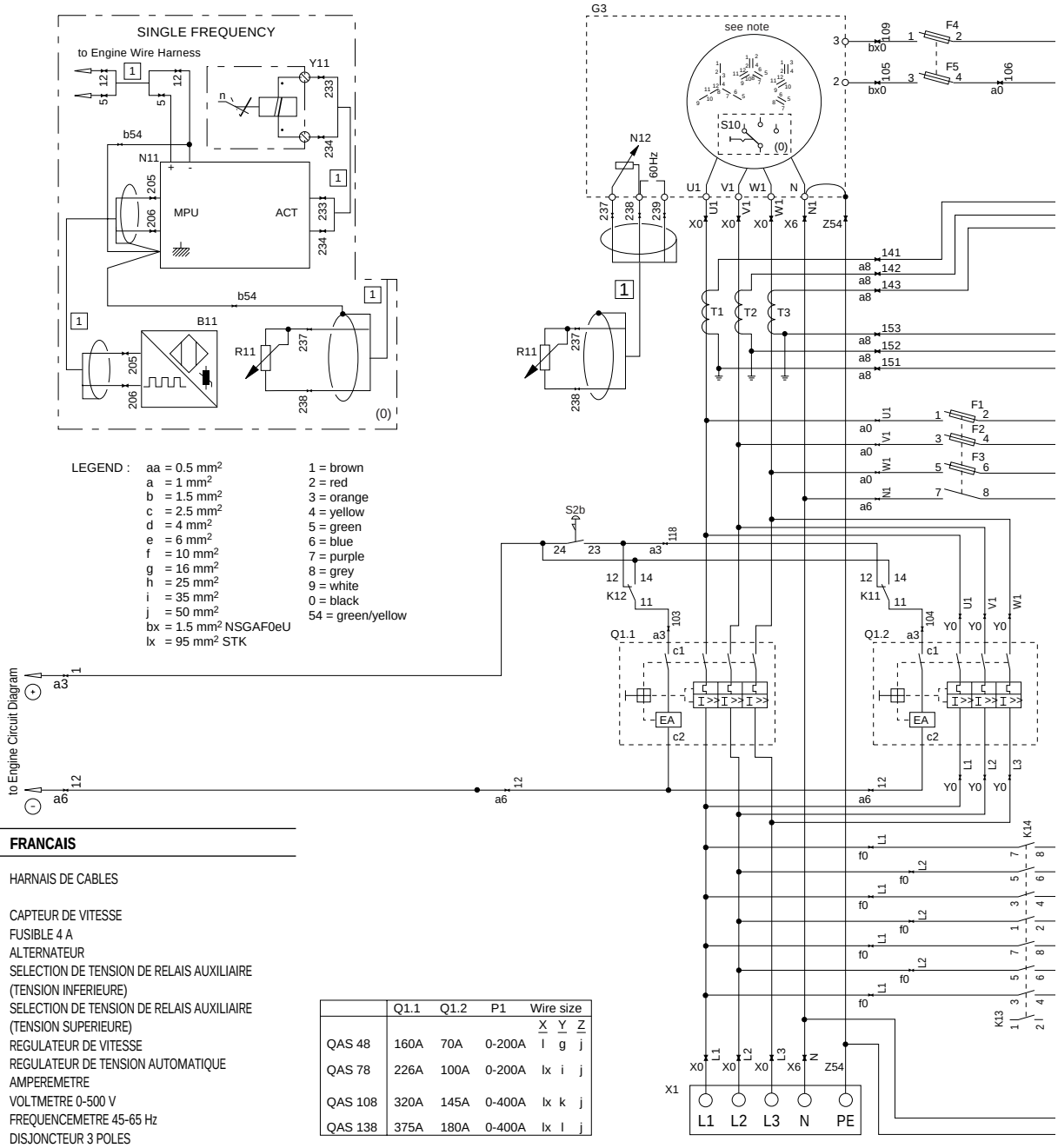
Applicable for QAS108 PdS USA 3V-SW RS, 3V-SW RS SF



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bx	= 1.5 mm² NSGAF0eU		
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	Q1.1	Q1.2	P1	Wire size		
				X	Y	Z
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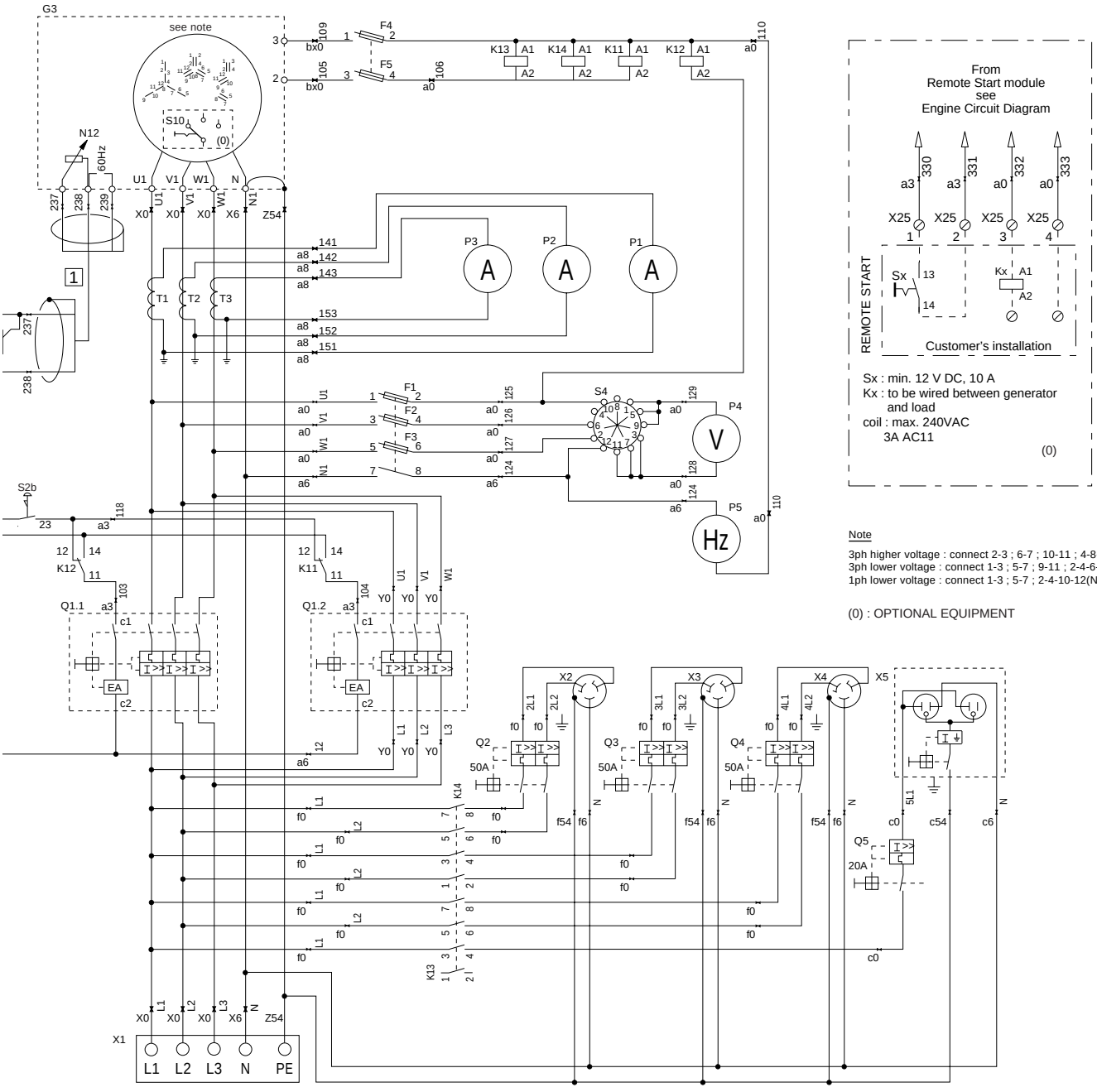
QAS 138	375A	180A	0-400A	lx	l	j

FRANCAIS

1	HARNAIS DE CABLES
B11	CAPTEUR DE VITESSE
F1-2	FUSIBLE 4 A
G3	ALTERNATEUR
K11	SELECTION DE TENSION DE RELAIS AUXILIAIRE (TENSION INFERIEURE)
K12	SELECTION DE TENSION DE RELAIS AUXILIAIRE (TENSION SUPERIEURE)
N11	REGULATEUR DE VITESSE
N12	REGULATEUR DE TENSION AUTOMATIQUE
P1-3	AMPEREMETRE
P4	VOLTMETRE 0-500 V
P5	FREQUENCEMETRE 45-65 Hz
Q1.1	DISJONCTEUR 3 POLES
Q1.2	DISJONCTEUR 3 POLES
R11	POTENTIOMETRE DE REGLAGE DE LA TENSION D'ALIMENTATION
R16	REGULATION DE VITESSE (60 HZ UNIQUEMENT)
R17-18	DECALAGE DE VITESSE (60 HZ UNIQUEMENT)
S2b	ARRET D'URGENCE
S4	SELECTEUR DE VOLTMETRE
S10	SELECTEUR DE TENSION DE SORTIE
S11	SELECTEUR DE FREQUENCE 50/60 HZ
T1-3	TRANSFORMATEUR DE COURANT
X1	TABLETTE A BORNES
X25	BARRETTE DE RACCORDEMENT
Y11	ACTUATEUR
Sx	INTERRUPTEUR DE DEMARRAGE/ARRET A DISTANCE
Kx	CONTACTEUR D'INSTALLATION (avec contact exempt de potentiel, retard de 15 sec.)

CIRCUIT DIAGRAM
SCHEMA DE CIRCUIT
DIAGRAMA DE CIRCUITOS

9822 0888 45



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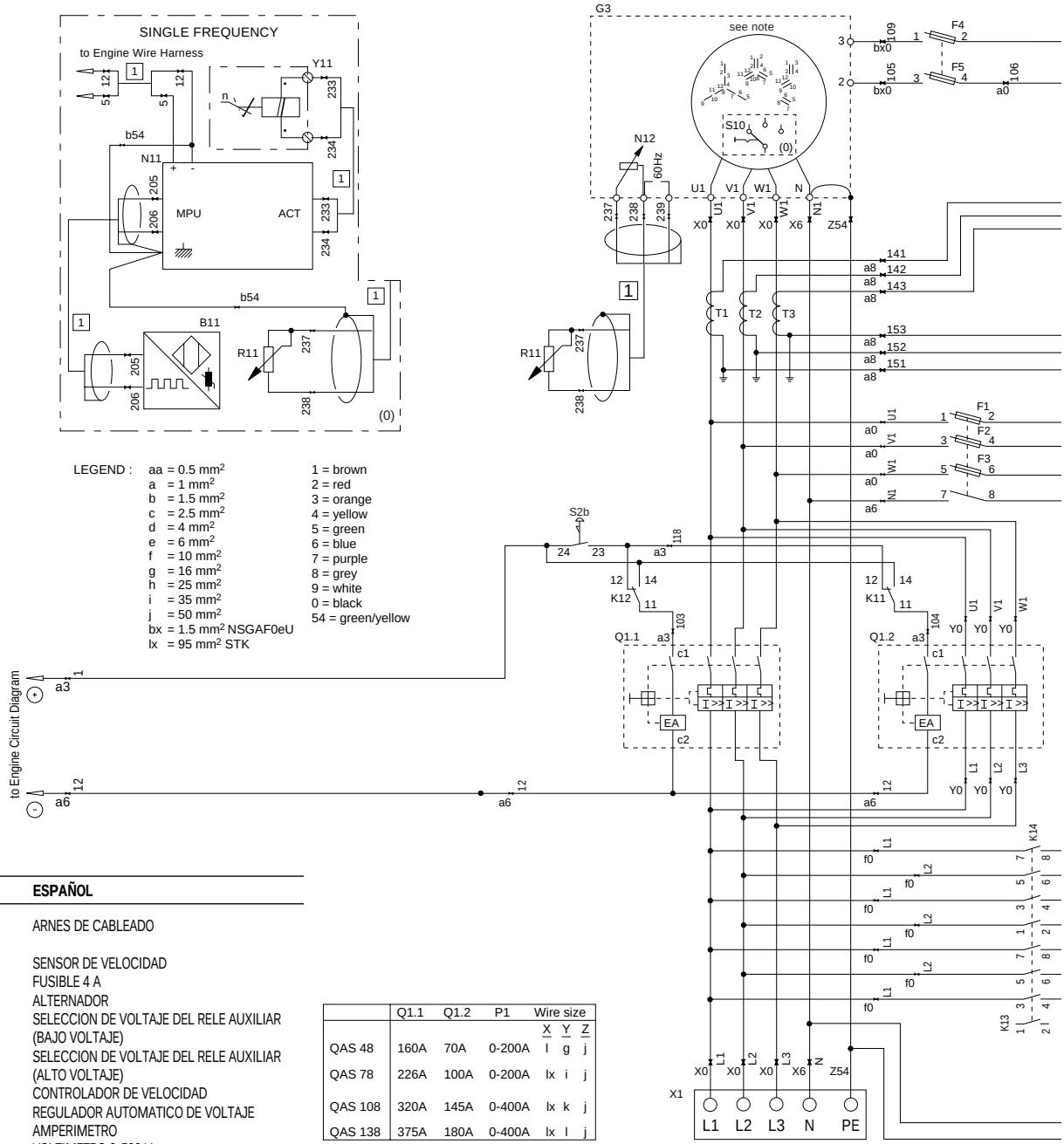

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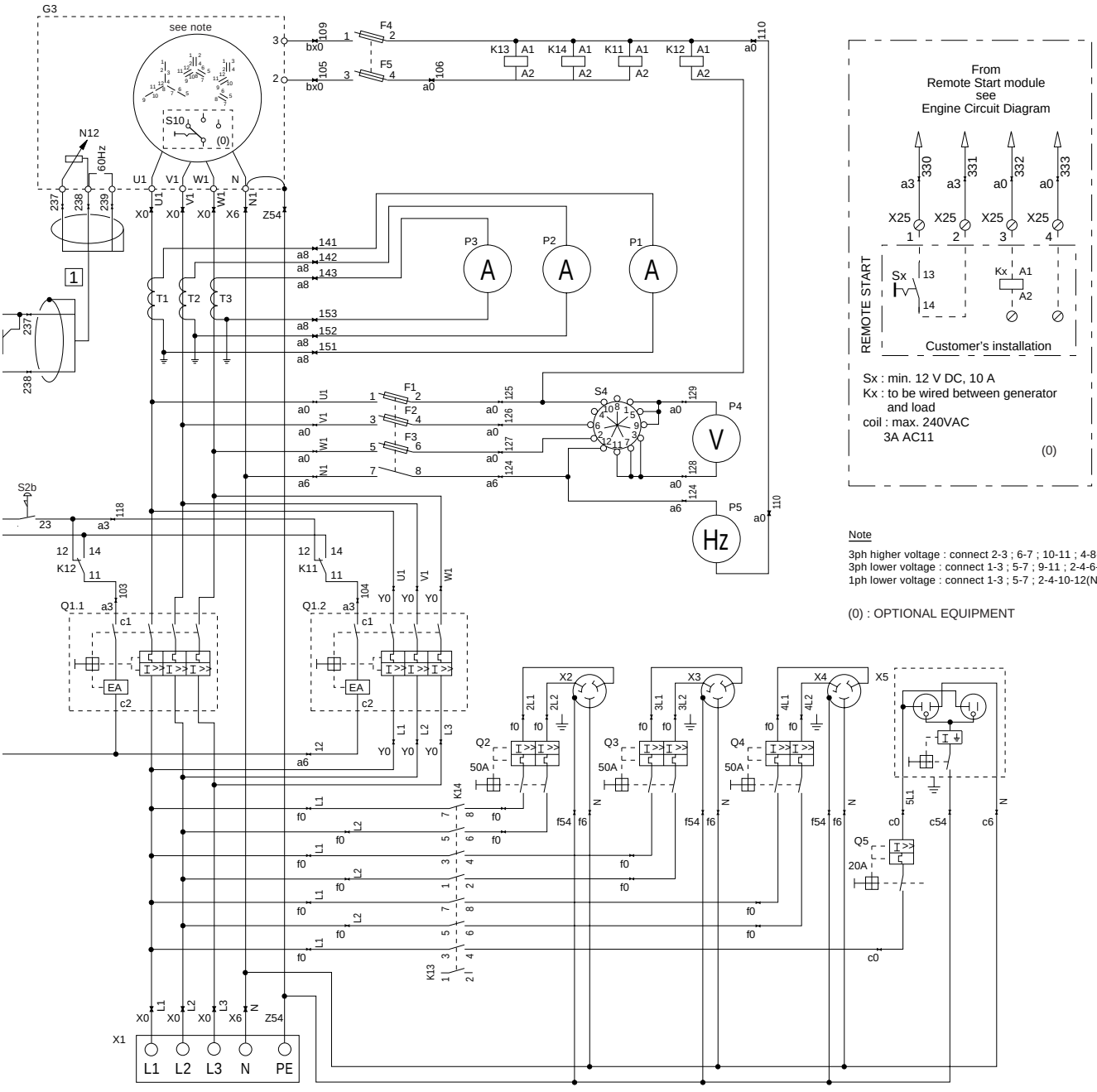
QAS 138	375A	180A	0-400A	lx	l	j

	ESPAÑOL
1	ARNES DE CABLEADO
B11	SENSOR DE VELOCIDAD
F1-2	FUSIBLE 4 A
G3	ALTERNADOR
K11	SELECCION DE VOLTAJE DEL RELE AUXILIAR (BAJO VOLTAJE)
K12	SELECCION DE VOLTAJE DEL RELE AUXILIAR (ALTO VOLTAJE)
N11	CONTROLADOR DE VELOCIDAD
N12	REGULADOR AUTOMATICO DE VOLTAJE
P1-3	AMPERIMETRO
P4	VOLTIMETRO 0-500 V
P5	FRECUENCIMETRO 45-65 Hz
Q1.1	DISYUNTOR 3-POLAR
Q1.2	DISYUNTOR 3-POLAR
R11	POTENCIOMETRO DE AJUSTE DEL VOLTAJE DE ALIMENTACION
R16	AJUSTE DE VELOCIDAD (SOLO 60 HZ)
R17-18	COMPENSACION DE VELOCIDAD (SOLO 60 HZ)
S2b	PARADA DE EMERGENCIA
S4	SELECTOR DE VOLTIMETRO
S10	UNISELECTOR DE VOLTAJE DE SALIDA
S11	CONMUTADOR SELECTOR 50/60 HZ
T1-3	TRANSFORMADOR DE CORRIENTE
X1	CUADRO DE BORNAS
X25	BLOQUE DE TERMINALES
Y11	ACTUADOR
Sx	INTERRUPTOR REMOTO DE ARRANQUE/PARADA
Kx	CONTACTOR PARA INSTALACION (con contacto sin voltaje, retardo de 15 sec.)

CIRCUIT DIAGRAM
SCHEMA DE CIRCUIT
DIAGRAMA DE CIRCUITOS

9822 0888 45



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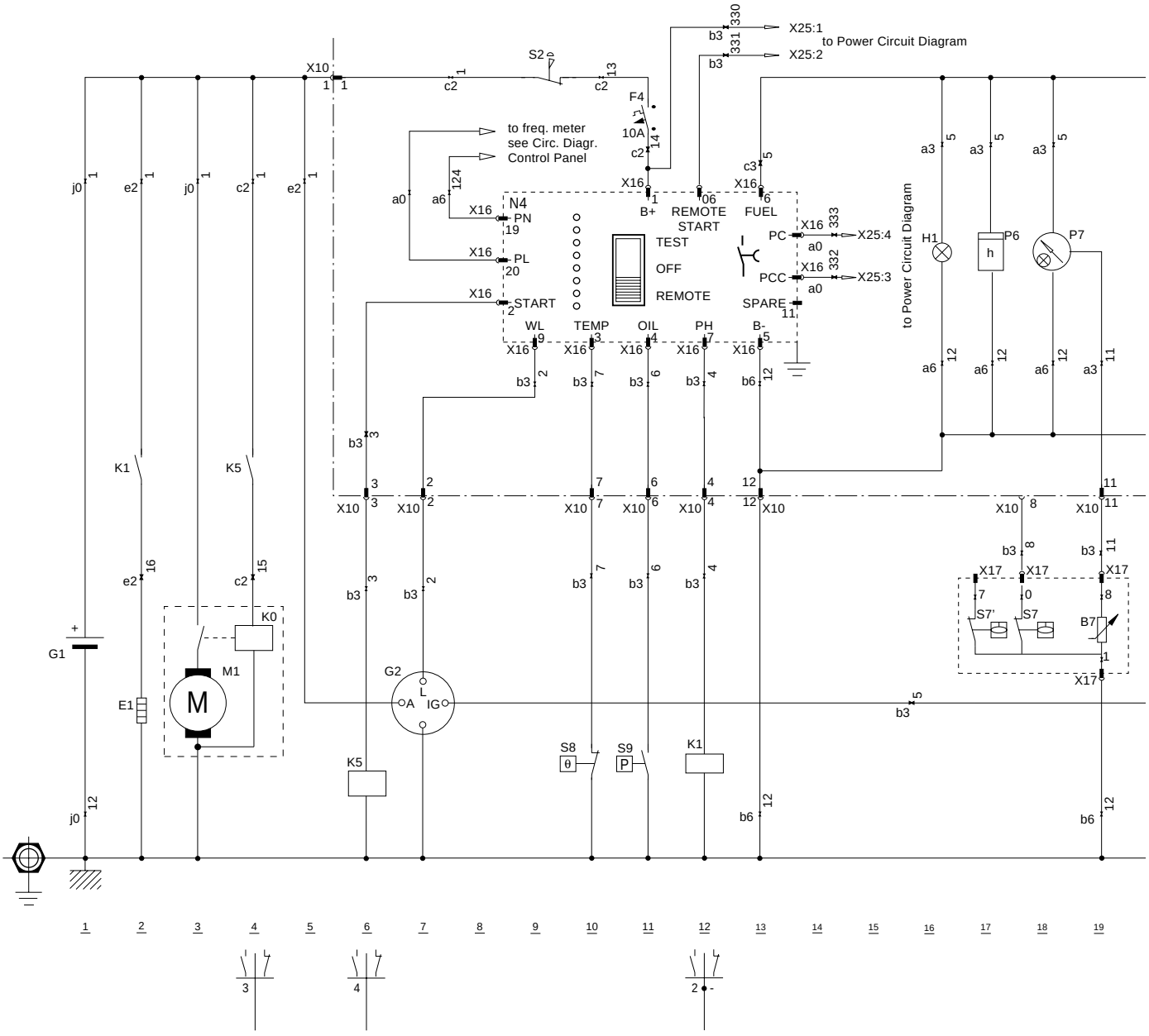
CIRCUIT DIAGRAM
SCHEMA DE CIRCUIT
DIAGRAMA DE CIRCUITOS

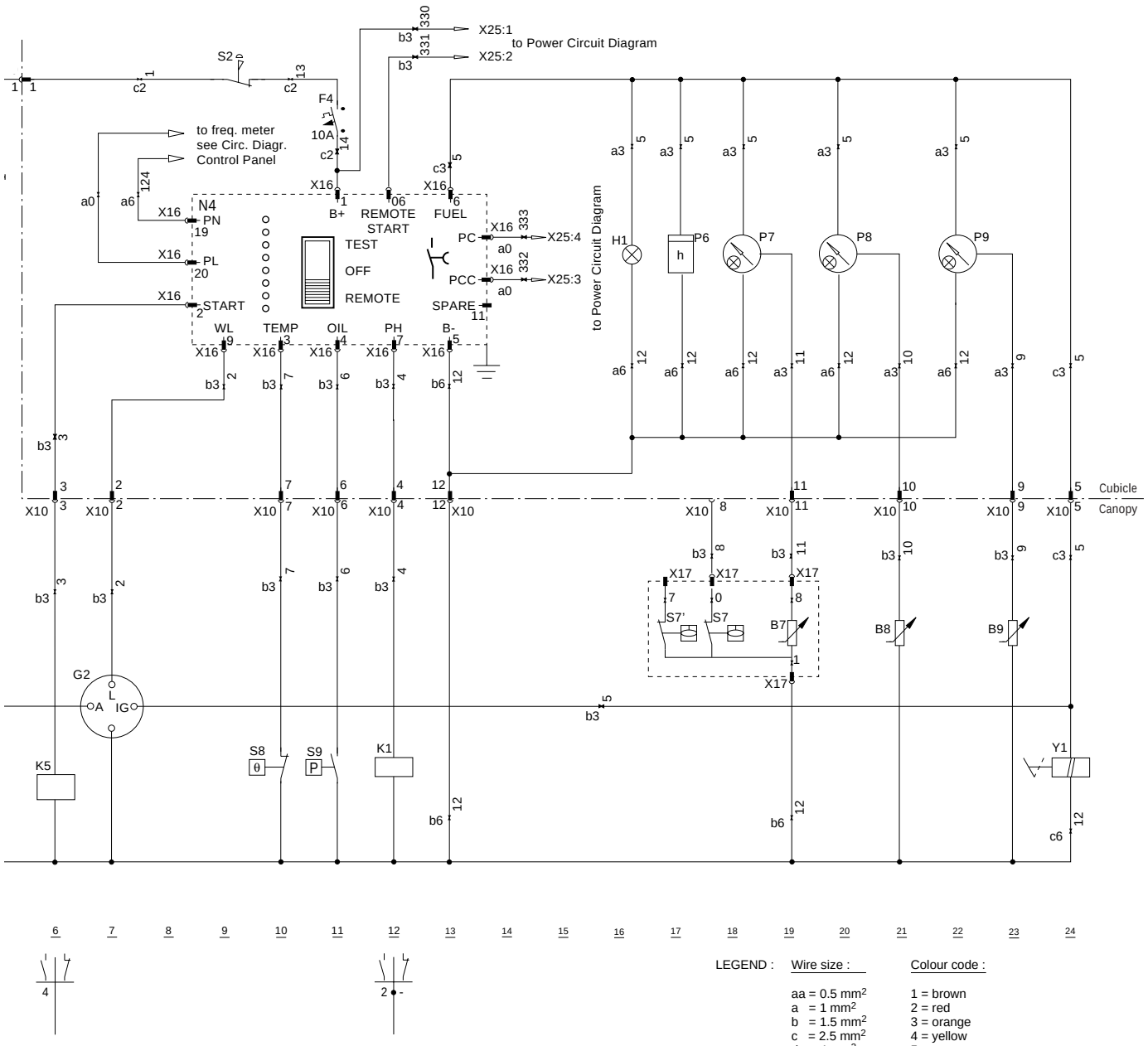
9822 0888 28
Applicable for QAS108 PdS USA 3V-SW RS, 3V-SW RS SF



	ENGLISH				
B7	FUEL LEVEL SENSOR	K1	PREHEAT RELAY	S7	LOW FUEL LEVEL SWITCH
B8	COOLANT TEMPERATURE SENSOR	K5	STARTER RELAY	S7'	LOW FUEL LEVEL SWITCH, WARNING
B9	OIL PRESSURE SENSOR	M1	STARTER MOTOR	S8	COOLANT HIGH TEMPERATURE SWITCH
E1	PREHEAT RESISTOR	N4	CONTROL MODULE	S9	ENGINE OIL LOW PRESSURE SWITCH
F4	FUSE	P6	HOURMETER	X10	12-POLE CONNECTOR
G1	BATTERY 12 V	P7	FUEL LEVEL GAUGE	X16	MODULE CONNECTOR
G2	CHARGING GENERATOR	P8	COOLANT TEMPERATURE GAUGE	X17	FUEL LEVEL UNIT CONNECTOR
H1	PANEL LIGHT	P9	OIL PRESSURE GAUGE	Y1	FUEL STOP SOLENOID
K0	STARTER SOLENOID	S2	EMERGENCY STOP BUTTON		

CIRCUIT DIAGRAM
SCHEMA DE CIRCUIT
DIAGRAMA DE CIRCUITOS

9822 0888 28



LEGEND :

Wire size :	Colour code :
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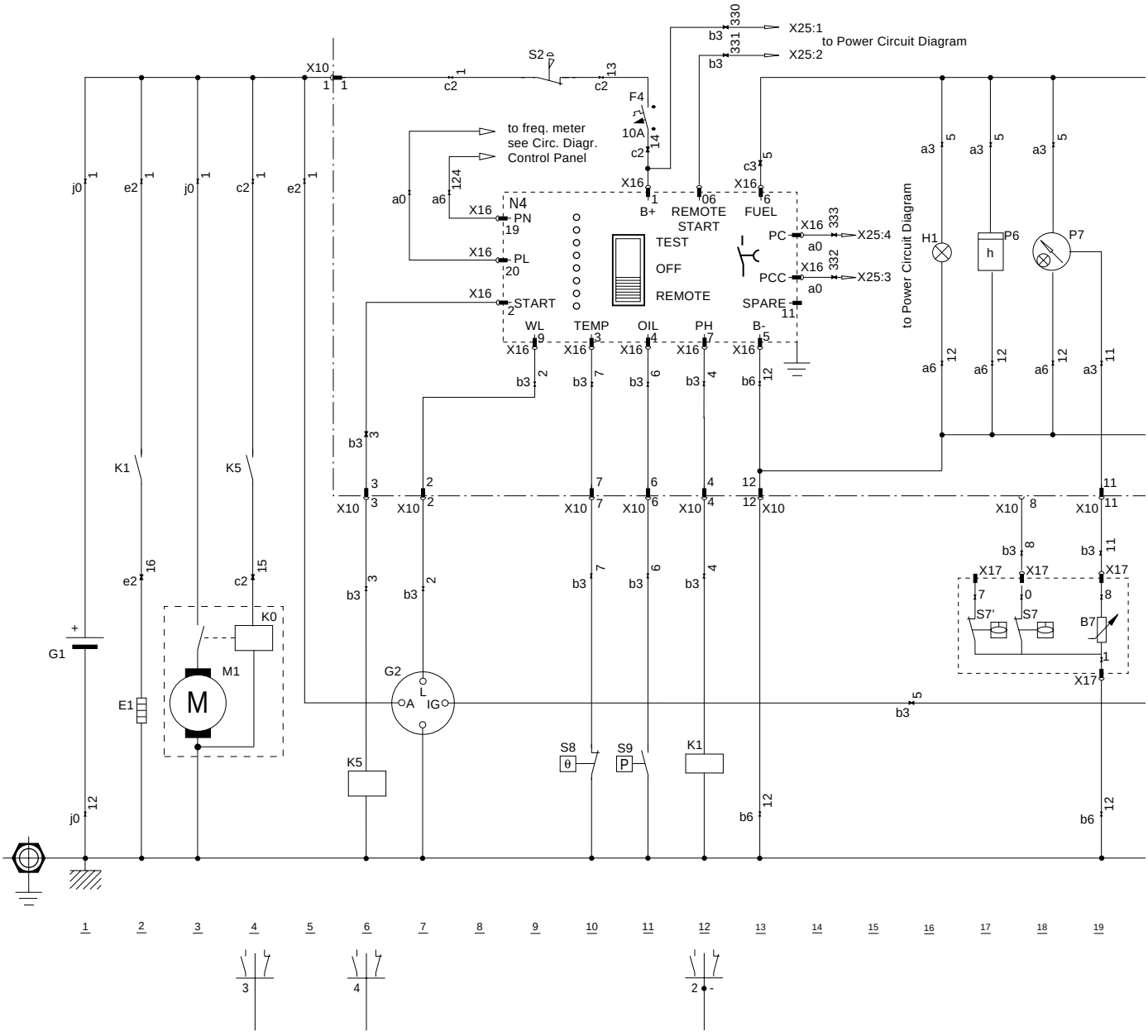
g = 16 mm²	8 = grey
h = 25 mm²	9 = white
i = 35 mm²	0 = black
j = 50 mm²	

CIRCUIT DIAGRAM
SCHEMA DE CIRCUIT
DIAGRAMA DE CIRCUITOS

9822 0888 28
Applicable for QAS108 PdS USA 3V-SW RS, 3V-SW RS SF



	FRANCAIS				
B7	CAPTEUR, NIVEAU DE CARBURANT	K5	RELAIS DE DEMARREUR	S7'	INTERRUPTEUR NIVEAU DE CARBURANT
B8	CAPTEUR, TEMPERATURE EAU DE	M1	DEMARREUR		BAS, AVERTISSEMENT
	REFROIDISSEMENT	N4	MODULE DE COMMANDE	S8	THERMOSTAT, BASSE TEMPERATURE
B9	CAPTEUR, PRESSION D'HUILE	P6	COMPTEUR D'HEURES		EAU DE REFROIDISSEMENT
E1	RESISTANCE DE PRECHAUFFAGE	P7	INDICATEUR DE NIVEAU DE CARBURANT	S9	INTERRUPTEUR BASSE PRESSION
F4	FUSIBLE	P8	INDICATEUR DE TEMP., EAU DE		D'HUILE MOTEUR
G1	BATTERIE 12 V		REFROIDISSEMENT	X10	CONNECTEUR 12 BROCHES
G2	ALTERNATEUR, CHARGE	P9	INDICATEUR, PRESSION D'HUILE	X16	CONNECTEUR DE MODULE
H1	ECLAIRAGE PANNEAU	S2	BOUTON ARRET D'URGENCE	X17	CONNECTEUR DE MODULEDE NIVEAU
K0	SOLENOIDE DU DEMARREUR	S7	INTERRUPTEUR NIVEAU DE CARBURANT		DE CARBURANT
K1	RELAIS DE PRECHAUFFAGE		BAS	Y1	SOLENOIDE D'ARRET DE CARBURANT

CIRCUIT DIAGRAM
SCHEMA DE CIRCUIT
DIAGRAMA DE CIRCUITOS

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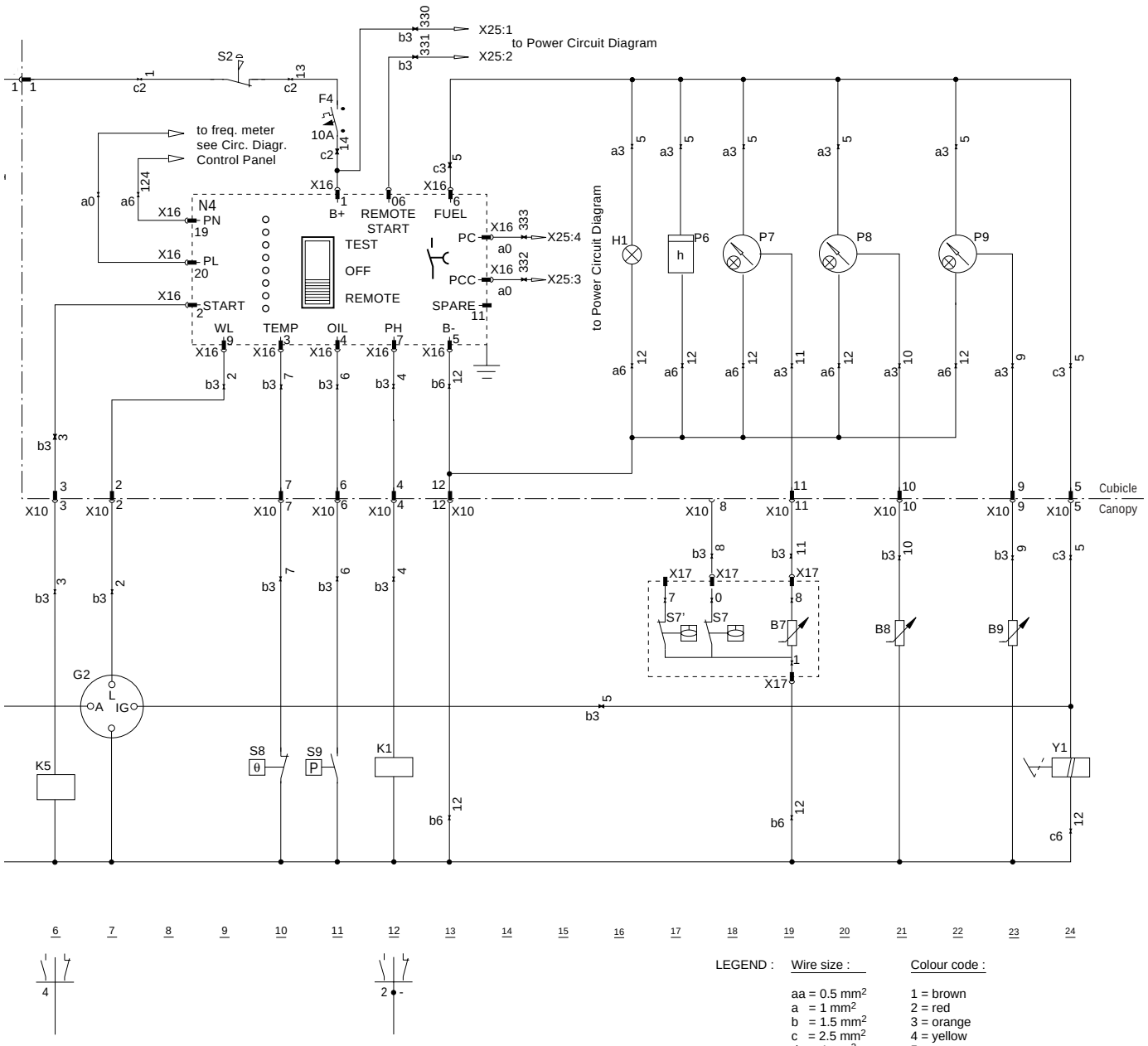

LEGEND :

Wire size :	Colour code :
aa = 0.5 mm²	1 = brown
a = 1 mm²	2 = red
b = 1.5 mm²	3 = orange
c = 2.5 mm²	4 = yellow
d = 4 mm²	5 = green
e = 6 mm²	6 = blue
f = 10 mm²	7 = purple
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CIRCUIT DIAGRAM
SCHEMA DE CIRCUIT
DIAGRAMA DE CIRCUITOS

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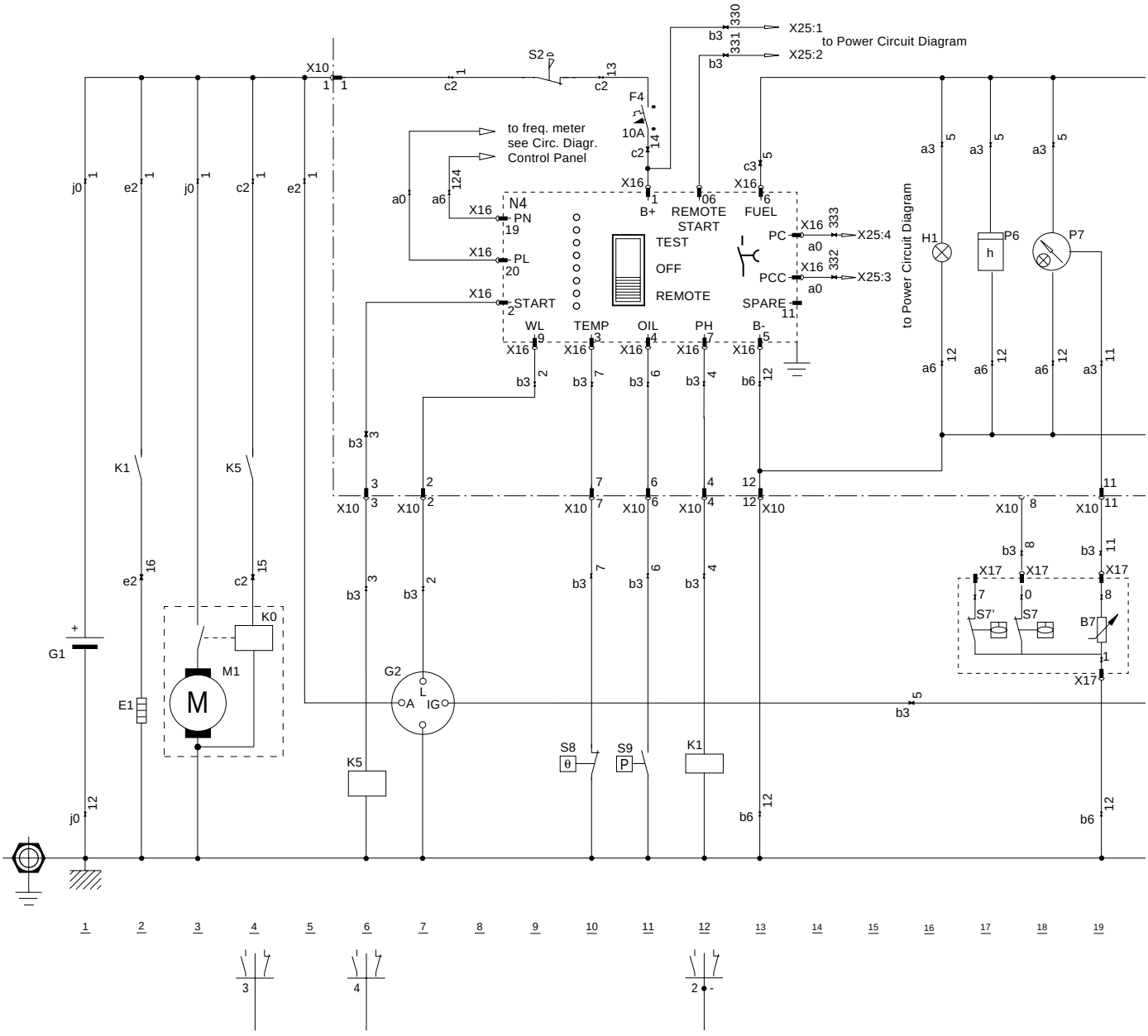

	ESPAÑOL				
B7	SENSOR DEL NIVEL DE COMBUSTIBLE	M1	MOTOR DE ARRANQUE	S7'	INTERRUPTOR BAJO NIVEL DE COMBUSTIBLE, AVISO
B8	SENSOR DE TEMPERATURA DEL REFRIGERANTE	N4	MODULO DE CONTROL	S8	INTERRUPTOR ALTA TEMPERATURA DE REFRIGERANTE
B9	SENSOR DE PRESION DE ACEITE	P6	CUENTAHORAS	S9	INTERRUPTOR BAJA PRESION ACEITE DEL MOTOR
E1	RESISTENCIA DE PRECALENTAMIENTO	P7	INDICADOR DEL NIVEL DE COMBUSTIBLE	X10	CONECTOR 12-POLAR
F4	FUSIBLE	P8	INDICADOR DE TEMPERATURA DEL REFRIGERANTE	X16	CONECTOR DE MODULO
G1	BATERIA 12 V	P9	INDICADOR DE LA PRESION DE ACEITE	X17	CONECTOR UNIDAD NIVEL DE COMBUSTIBLE
G2	GENERADOR DE CARGA	S2	BOTON DE PARADA DE EMERGENCIA	Y1	SOLENOIDE DE DETENCION DEL COMBUSTIBLE
H1	LUZ DE PANEL	S7	INTERRUPTOR BAJO NIVEL DE COMBUSTIBLE		
K0	SOLENOIDE DE ARRANQUE				
K1	RELE, SISTEMA DE PRECALENTAMIENTO				
K5	RELE ARRANCADOR				

CIRCUIT DIAGRAM
SCHEMA DE CIRCUIT
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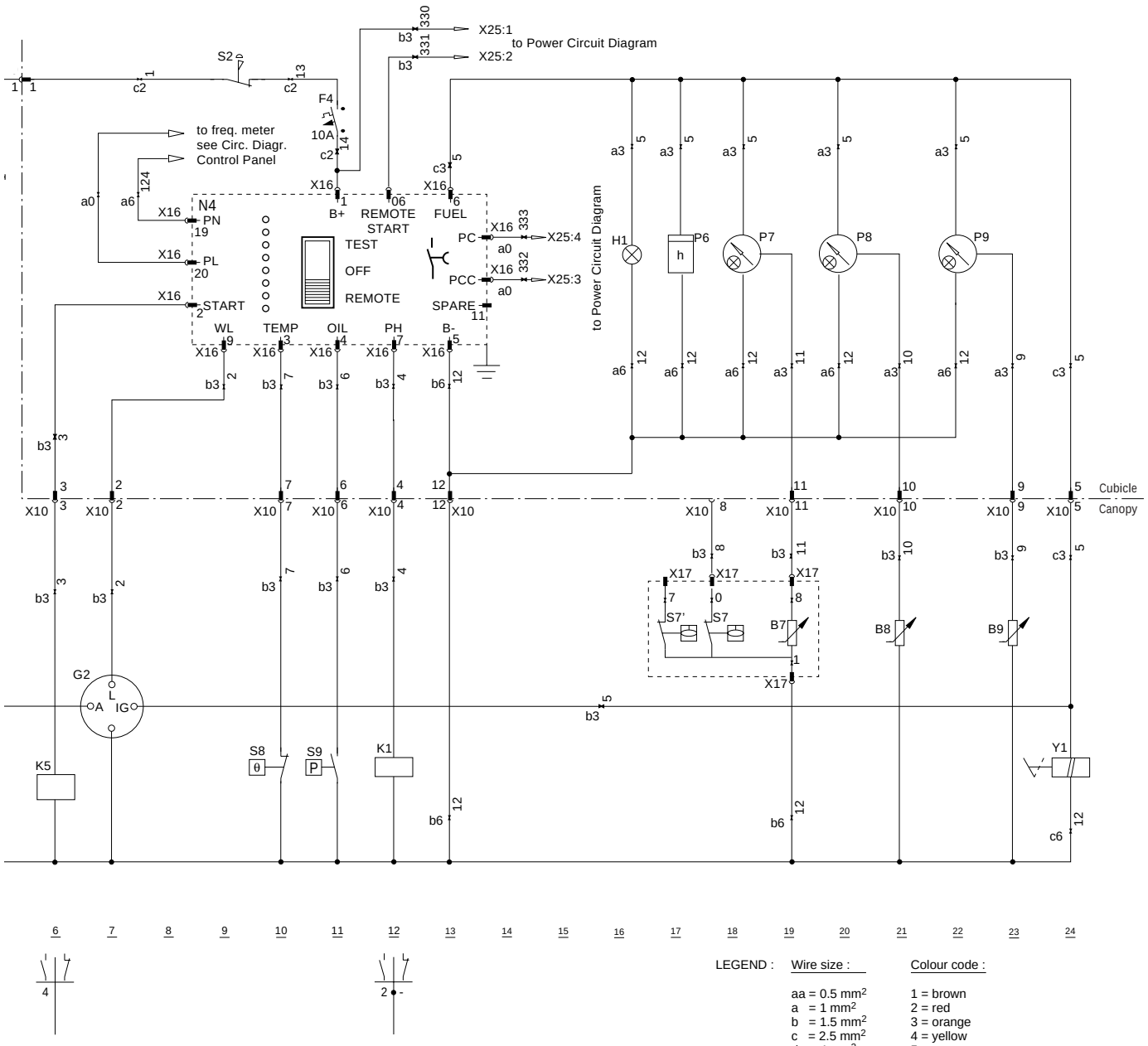

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