

GENERAL SPECIFICATION

ELECTRICAL

GS EP ELE 135

Low voltage switchgear assembly
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1. Scope

This specification defines the minimum requirements for design, manufacture, inspection and testing of low voltage switchgear assembly. It is to be read in conjunction with the corresponding Project specification and/or data sheets.

The Manufacturer shall clearly identify in his technical offer any deviation to these specifications.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

Design and engineering shall conform as a minimum requirement to the current edition of the following in order of preference:

- Applicable laws and regulations of the country in which the system will be operated. In cases where no "local" regulations exist, then French laws and regulations shall be used
- Company Particular Specifications and data sheet (if any)
- Company General Specifications
- Applicable International Electrotechnical Commission (IEC) publications
- Applicable recognised standards and codes (e.g. UTE-NFC, BSI, VDE, etc.) where IEC publications have not yet been issued.

Any conflict or inconsistency between the above set of documents (standards, specification, codes and local regulation or laws) shall be raised to Company attention for resolution at tender stage.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
IEC 60044-1	Instrument transformers - Part 1: Current transformers
IEC 60050 (All parts)	International Electrotechnical Vocabulary - All parts
IEC 60068 (All parts)	Environmental testing - All parts
IEC 60073	Basic and safety principles for man-machine interface, marking and identification - Coding principles for indicators and actuators
IEC 60255 (All parts)	Electrical relays - All parts
IEC 60269 (All parts)	Low voltage fuses - All parts
IEC 60445	Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals, conductor terminations and conductors
IEC 60529	Degrees of protection provided by enclosures (IP code)

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Reference	Title
IEC 60664-1	Insulation coordination for equipment within low voltage systems - Part 1: principles, requirements and tests
IEC 60706-2	Maintainability of equipment - Part 2: Maintainability requirements and studies during the design and development phase
IEC 60947 (Parts 2; 3; 4-1)	Low voltage switchgear and controlgear - Parts 2; 3; 4-1
IEC 61000 (All parts)	Electromagnetic Compatibility (EMC) - All parts
IEC 61140	Protection against electrical shock - Common aspects for installation and equipment
IEC 61293	Marking of electrical equipment with ratings related to electrical supply - Safety requirements
IEC 61439 (Parts 1; 2)	Low-voltage switchgear and controlgear assemblies - Parts 1; 2
IEC 61641	Enclosed low-voltage switch gear and control gear assemblies - Guide for testing under conditions of arcing due to internal fault
IEC 61869 (Parts 1; 3)	Instrument transformers - Parts 1; 3
IEC 61892-3	Mobile and fixed offshore units - Electrical installations - Part 3: Equipment
IEC 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
IEC 62402	Obsolescence management - Application guide

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP ELE 001	Electrical design criteria
GS EP ELE 021	Electrical design criteria for floating units
GS EP TEC 007	Obsolescence and Lifetime Cycle Management

3. Service conditions

The low voltage switchgear assemblies shall be completely assembled and wired in free standing sheet steel cabinets suitable for operation as per **GS EP ELE 001** § 7.5.3 or **GS EP ELE 021** § 13.6.

For Low voltage switchgear assemblies installed in an offshore unit, special requirements of **IEC 61892-3** shall be applied.

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The equipment shall be suitable in all aspects for continuous operation at full load service.

The equipment shall be installed indoor, in accordance with environmental installation conditions given in the data sheet. Outdoor installation is not allowed.

The equipment shall be suitable for operation, without deleterious effect, with variations of voltage and frequency tolerances as follows:

- AC Voltage supply: $\pm 10\%$
- Frequency: $\pm 5\%$
- DC Voltage supply: $+10 / -15\%$.

4. Construction requirements

4.1 Degree of protection and Impact Strength

The minimum degree of protection against direct contact for the enclosure shall be at least IP31 and IP20 when any door (if any) is open ([IEC 60529](#))

When a withdrawable unit has been removed from the assembly, the live parts inside the fixed part shall be protected against touch with a degree at least IP20.

Access to live parts (such as incoming cable compartment, busbars...) with a degree of protection of less than IP20 shall only be possible by using tools ([IEC 61140](#)).

Impact strength shall be at minimum IK 08 as defined in the [IEC 62262](#).

4.2 Internal separation of assemblies ([IEC 61439-2 § 8.101](#))

For withdrawable switchgear, the separation shall be Form 4b.

For disconnectable type, the separation form shall be 2b minimum.

4.3 Functional units electrical connection type ([IEC 61439-2 § 8.5.101](#))

For withdrawable switchgear, the withdrawability shall be complete for the power connection as well as for the auxiliary connections (W.W.W.).

For disconnectable type, the connection type shall be D.D.F. minimum.

4.4 Electromagnetic Compatibility (EMC)

The Manufacturer shall ensure that effects of induced voltages, electromagnetic interference and "noise" are carefully considered, and means taken to prevent any miss-operation, erratic performance or failure due to these effects. Compliance with the [IEC 61000](#) (All parts) is mandatory.

The switchgear assembly shall be suitable for an environment A as defined in the [IEC 61439-1](#)

4.5 Structure

The low voltage switchgear assemblies shall be enclosed stationary type assemblies.

The switchgear assembly shall be entirely prefabricated and tested in factory.

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The switchgear assembly shall be arranged to form a single structure with a common bus-bar assembly.

The switchgear assembly shall have facilities for extension with panels of similar construction to the panels previously forming the end.

The switchgear assembly shall be complete with eyebolt/lifting eyes, etc., to facilitate installation

The switchgear assembly shall be self-ventilating.

When tropicalisation is required in the Data Sheet, Manufacturer shall indicate in his proposal the additional treatment performed.

The switchgear assembly and their components shall be of standard type and similar parts and components shall normally be interchangeable.

The number of module type shall be limited.

The switchgear assembly cubicles shall be at least self-extinguishable, free-standing, floor mounting, flush fronted construction.

Civil works guideline drawings shall be given to Civil works Contractors in due time with the minimum requirements for the switchgear assembly installation (holding bolts location, rails, etc.).

Unless otherwise specified, no key or locking device to open enclosure and doors is required. Only door handles shall be provided

Switchgear assembly shall be designed and constructed to facilitate inspection, site installation cleaning, repair and maintenance and to ensure absolute safety during operation, inspection and maintenance. All components shall be easily accessible. Maintainability of the equipment shall be as defined in the [IEC 60706-2](#).

It shall also be arranged in such a way that the operations mentioned in § 8.4.5 from [IEC 61439-2](#) shall be performed when it is in service and on live.

When marine class is required and unless otherwise specified, insulated handrails shall be provided at the front of each section of the switchboard assembly (and at the rear where rear access is specified) and all hinged equipment doors shall be fitted with door stays designed to retain the doors in the fully open position.

4.6 Internal Fault

The switchgear shall be type-tested under conditions of arcing in air due to an internal fault in accordance with the procedure described in [IEC 61641](#).

The switchgear shall fulfil under arcing conditions the criteria 1 to 7 as defined in [IEC 61641](#) § 8 for an internal arc up to the switchgear rated short-circuit current for duration of 0.3 s minimum.

4.7 Busbars

Busbars shall be installed in compartments separated from the switchgear and without transverse partitions at the level of each cell except at bus section(s). Insulating screens shall be installed between horizontal and vertical busbars. In event of internal fault, the damage shall be confined to that unit.

Bolted panels shall be provided to allow periodic checking of busbar mechanical fasteners.

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Accidental contact of people or tools with live parts shall be made impossible.

Main busbar shall be of the same cross-sectional area throughout the switchboard and made of hard drawn insulated copper. They shall be rated for the nominal current over the entire length of the assembly and shall not be rated lower than the incoming unit.

When the atmosphere is highly corrosive, busbars shall be protected with heat shrinkable sleeves, tinned copper or similar.

Busbars and connections shall be adequately sized, braced and supported to withstand the mechanical constraints and thermal effects resulting from the switchboard rated short circuit current.

Main busbar shall allow an easy expansion at its two extremities (holes already drilled).

4.8 Earthing

An earth busbar shall be provided along the full length of the switchgear assembly with terminals for connection of external protective conductors at each end.

Earthing busbar shall be made of hard drawn copper (minimum 35 mm²).

The terminals for external protective conductors shall be marked according to [IEC 60445](#).

All metallic non-current carrying parts of the switchgear assembly including hinged doors shall be bonded together and connected to the earth busbar.

Provisions shall be made, adjacent to the cable terminations, for earthing cable armour and screen to the earth busbar.

Each earthing circuit shall be identified by green/yellow strips.

4.9 Withdrawable part

Withdrawable parts shall have the following positions (module or switch):

- Connected (power and auxiliary contacts)
- Test facility: auxiliary circuits connected but power contacts disconnected in order to test the whole control and automation circuits without energising the load circuit
- Disconnected (isolated)
- Removed.

Each unit shall be withdrawable without using tools except for breaker above 630 A.

Withdrawable parts shall be effectively earthed until they are completely withdrawn with all power and control connections disconnected.

Withdrawable part shall be interlocked to prevent:

- Disconnection of part in service
- Closure of the switching device if the rack is not fully engaged in the service position
- Insertion with switching device closed.

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A mechanical foolproof system shall prevent insertion of a mobile part with a lower rating or a different design than normally assigned to the compartment.

All withdrawable units shall be lockable in the disconnected, test and removed position with padlock.

Half size modules are accepted for ratings up to 32 A.

4.10 Secondary wiring

Secondary wiring shall be stranded copper, self extinguishable, insulated with black or white PVC 1000 V grade with the following minimum cross-sections:

- 2.5 sq. mm for current circuits
- 1 sq. mm for voltage circuits
- 1 sq. mm for auxiliary wiring (control, signals, etc.)
- For electronic circuit wiring, Manufacturer standard shall be used
- When required by Project particular specification, wiring shall be halogen free.

All wiring for external connections and for analogue circuits shall be brought out to individual terminals on a readily accessible terminal block. Wires shall be terminated using compression type lugs, or crimp sleeves if spring terminals are not used.

Secondary wiring within the switchgear assembly shall be securely held in position (either loomed or run in trunking).

Identification shall refer to the related wiring diagram.

Flexible conductors shall be used for connections on door mounted equipment and shall be protected by flexible conduit where routed across hinged doors."

Wiring penetrations through compartment or cubicle sections shall be fitted with protecting strips or alternative means to prevent insulation damage.

Interconnection between sections separated for shipping shall be made with plug-in type connectors.

4.11 Instrument transformers

Current and voltage transformers shall be of dry insulation type (complete coating of thermosetting synthetic resin).

Instrument transformers shall be as per [IEC 61869-1](#).

The Manufacturer shall provide details on ratio, output, class and accuracy for all instrument transformers in his supply.

The secondary windings of instrument transformers shall be earthed at one point.

4.11.1 Voltage transformers

Voltage transformers shall be as per [IEC 61869-3](#).

Voltage transformers shall be of the encapsulated type.

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Three voltage transformers shall be provided with star connection and neutral earthed at the secondary.

They shall be disconnectable by live-fuse isolation and protected by adequate fuses situated at the primary and miniature circuit breakers at the secondary.

The secondary rated voltage shall be 100 V or 110 V as required in the data sheet.

Voltage transformers shall be designed with a rated voltage factor of 1.9 Un/8 hours.

Voltage transformers shall be designed with a primary rated voltage factor of 1.2 Un continuous.

Voltage transformer accuracy shall be:

- Class 1 for measurement
- Class 3P for protective relays.

4.11.2 Current transformers

Current transformers shall be as per [IEC 60044-1](#).

Current transformers accuracy shall be:

- Class 0.5 for measuring circuits when a high accuracy level is required (metering, regulation, power measuring)
- Class 1 for current measuring
- Class 5P for protective relays when required by the Manufacturer
- Class 10P for other cases (over current relay).

The secondary current rating for measuring CT shall be either 1A or 5A. However, where remote metering is required, the current rating shall be 1A.

Bridging terminals for current transformers shall be provided at the outgoing terminals where external connections are required.

Current transformers shall be rated to withstand the thermal and magnetic stresses resulting from the bus-bar rated fault level.

Magnetisation curves shall be provided for all protection CTs.

4.12 Metering, protection, control and indication

Metering, protection, control and indication shall be in accordance with the single line diagrams, typical protection diagrams and data sheet if any.

Each current and voltage transformer on the incomers and busbars will be equipped on the switchgear assembly with test/injection boxes.

All meters shall be mounted at a suitable height to allow for a correct reading. All scales shall be properly selected for the expected operating condition.

Meters and relays shall be capable of withstanding without damage the secondary currents associated with the switchgear rated fault current flowing in the primary of current transformers.

All indicating lamps shall be multi-LED type.

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All measuring relays and protection equipment shall be in accordance with the [IEC 60255](#) (All parts).

As a minimum, the following colour code shall be used (as per [IEC 60073](#) § 4.2.11 Table 2 col 1 Safety of persons or environment):

- Status:
- On / Closed : RED
- Off / Open : GREEN
- Fault / Trip: YELLOW
- Voltage presence: WHITE
- Push button:
- On / Close / Start: GREEN
- Off / Open / Stop: RED
- Emergency Stop RED (if any)
- Lamp test BLACK (if any)
- Reset BLUE (if any)

Interlock and intertrip circuits shall use hardwired auxiliary contacts and, unless otherwise specified, without interposing relays.

Selection and coordination of short circuit protective devices shall be such as to ensure maximum service Continuity.

Unless otherwise specified the auxiliary voltage for control/relaying and signalling shall be generated by 110, 48 or 24 VDC battery charger units external to the LV switchgear assembly.

Polarity distribution shall be carried out via circuit breakers for each bus section and each bus tie and shall include two separate buses for signalling and control/relaying.

4.13 Cable terminations

Internal width dimension of cubicle's incoming/outgoing cable shall be suitable for the specified cable type (quantity, conductor size and dimension of cables to be connected) to make sure that connection will be performed easily and safely.

Terminals for external conductors shall be so arranged as to be accessible for mounting, wiring, maintenance and replacement.

For front access design, width of power cable compartment shall be minimum 400 mm.

For incomers and large power feeders:

- Distance between base plate and cable connection plates shall be at least 400 mm.
- Insulating screens shall be provided to separate Incomer cable phase's connection
- Terminals for more than one power cable core per phase shall have termination facilities arranged to avoid crossing of phase core.

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Termination of single core cables shall be through an insulating or non-magnetic plate.

All spare connections between the drawer and the cable compartment shall be terminated into spare terminals

Unless otherwise specified in the typical drawings, identification of terminals shall comply with [IEC 60445](#).

Terminals shall be identified in accordance with the wiring diagram. The lay out shall be logical and consistent.

Cable supports shall be provided to avoid undue strain on cable terminations.

Power and control cables shall be routed and terminated in separate cable trays.

Spring terminals are preferred.

Cables with voltage higher than 48 V shall be connected on segregated terminals, which are to be fitted with insulating screens and red warning labels

4.14 Neutral earthing system

For IT neutral earthing system, the neutral earthing impedance to limit the earth leakage fault to 150 mA shall be fitted with surge arresters in parallel and shall be provided on each transformer or generator incomer and installed within the switchgear assembly.

The equipment for earth fault detection and the related test facility shall be installed inside the switchgear assembly.

5. Switchgear

5.1 Particular characteristics for circuit breakers

Circuit breakers shall be in accordance with [IEC 60947-2](#).

Circuit breakers with electrical closing and opening devices shall have a manual and motor charged stored energy mechanism release.

Main breakers spring charging motors shall be 230V AC supplied.

Circuit breakers with automatic closing facility shall be provided with anti-pumping facilities.

Circuit breakers for incomers and the bus tie of a same switchgear assembly shall be identical.

Unless otherwise specified, circuit breakers for distribution feeders will be operated manually from the front of the switchgear assembly. In case of use of tripping coils, they shall be in energised to trip type unless otherwise specified by safety requirements.

Mechanical on/off push-buttons shall be padlockable.

5.2 Particular characteristics for Motor starters

Unless otherwise specified, motor starters shall consist of switch-disconnector-fuses and contactor.

Switch-disconnector and contactor shall have a limited number of different ratings with a minimum rating of 25 A.

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Switches, disconnectors, switch-disconnectors and fuse combination units shall be in accordance with [IEC 60947-3](#).

Fuses shall be in accordance with [IEC 60269](#) (All parts).

Contactors and motor-starters shall be in accordance with [IEC 60947-4-1](#).

Mechanical endurance for contactors shall not be less than 10,000,000 operations. Category for use shall correspond to conditions stipulated in [IEC 60947-4-1](#) and shall be AC 3.

Coordination between switching devices shall be at least type 2 as per [IEC 60947-4-1](#) § 8.2.5.

Whenever required by the data sheet, earth fault protection (51N) shall be achieved with a core balance type relay that gets a clear trip indication. Its reset shall be manual.

Stop/start pushbutton shall be installed on Company's request only.

5.2.1 Thermal overload protection

Thermal overload protection shall be performed as follows:

- Motors < 22 kW: Direct thermal protection
- Motors $\geq$ 22 kW: Three-pole thermal protection against single phase and overload operation supplied by three current transformers (1A) installed in the removable part to ensure interchangeability of racks equipped with contactor of the same rating
- Motors $\geq$ 110 kW: Digital protection relay may be used when required for following protections: 37-46-48-49-50-51-51LR-66-86
- Motors $\geq$ 200 kW: Digital protection relay able to treat PT100 may be used when required for following protections: 26T-37-46-48-49-50-51-51LR-66-86. Intrinsically safe relay may also be required in case of motor installed in a hazardous area.

Note: Undercurrent protection (37) shall be required only for pump drive motor starter.

5.2.2 Motor space heater

For motors rated 22 kW and above, a space heater shall be used. This space heater shall be automatically energised when motors are not in operation.

The supply shall be distributed from the 230 VAC auxiliary buses and controlled directly from each drawer.

If the motor is installed in a hazardous area, motor space heater shall be de-energized in case of gas detection (ESD) if it is not suitable for zone 1. In that case a de-energized coil could be installed on the auxiliary supply breaker in the switchgear.

5.3 Interface with the process control system

The required indications and alarm signals shall be as detailed in typical diagrams or in the particular specification and/or data sheet

Status signals shall be originated from volt free contacts.

Process information can be sent through a communication network if required by the data sheet.

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5.4 Miscellaneous

5.4.1 Labels

Switchboard assembly shall be marked as per [IEC 61293](#) requirements.

In addition to the IEC requirement the following information shall be indicated:

- Switchboard assembly type
- Year
- Number of sections
- Enclosure IP rating
- Rated operational voltage
- Frequency
- Control voltage
- Busbar ratings (main and secondary)
- Internal arc resistance rating (current and duration)
- Rated short-time withstand current: I_{cw} and duration
- Rated peak withstand current: I_{pk}.

Cubicles, compartments, withdrawable units, circuit breakers and components shall be identified by labels with circuit numbers. Cubicle label designations (at front and rear of panel, on the fixed and removable parts, at the main and auxiliaries cables terminations) shall be in accordance with the switchgear assembly single line diagram and associated data sheets.

Where voltage and current transformers are not readily accessible with the equipment energised, duplicate rating plates shall be fitted in an accessible location.

Mimic one-line diagram shall be provided on request, indicating the busbars, incomers, bus-ties and main feeders.

Nameplates shall bear all identification in accordance with the reference standards. Language used for labelling shall be stated in the data sheet.

Nameplates for cubicles, compartments, withdrawable units shall be laminated engraved plastic with black letters on a white background and shall be fixed by rivets or screws or on a dedicated support. Stuck labels are prohibited

Nameplate for circuit breakers and components shall be the Manufacturer standard.

Operating procedure when needed (interlocking keys for instance) and warning notices shall be installed at the nearest operating/danger point.

Warning labels shall be provided.

5.4.2 Special tools and accessories

Supply shall at minimum include:

- All necessary materials for fixing the cubicles to the floor (anchor bolts, etc.)

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- Portable earth fault leakage detection equipment
- Prefabricated testing link between drawer removed for maintenance purpose and its control connections inside the switchgear assembly.
- Handles, tools, and service trucks for operation and maintenance of the switchgear assembly.

5.4.3 Painting

Manufacturer standard painting shall be used unless otherwise specified.

5.4.4 Spares

Unless otherwise specified, it shall be planned for the future extension:

- 10% of equipped spare drawers inside switchgear assembly (one spare per module type/rating minimum except incomer and bus-tie).
- Provision of 20% free space in the cubicles for possible future equipment.
- For switchgears to be provided as part of a package such as turbo-generators, turbo-compressors:
 - If equivalent equipped spare feeders are already included in the main switchgears, no additional spare feeders may be required in the package switchgear subject to Company prior approval
 - Free space in the cubicles is not required for switchgear dedicated to the package.

5.4.5 Anti condensation space heater

When required in the data sheet, anti-condensation heater shall be provided in each cubicle. It shall be supplied from a dedicated source protected by an earth leakage circuit breaker. Its control shall be done automatically by means of a hygrostat.

5.4.6 Early smoke/fire detection

When required by the Project particular specification, an early detection system shall be provided and integrated into the switchgear assembly.

5.4.7 Infrared Monitoring

The Manufacturer shall indicate in his proposal the possibilities for infrared monitoring of connections in the switchgear assembly.

6. Interface with Electrical Control System (ECS) (Optional)

When specified, switchgear assembly may be connected to an Electrical Control System dedicated to control the general electrical system.

In this case a Programmable Logic Controller (PLC) or dedicated Remote Control Unit (RCU) from the Electrical Control System (ECS) may be installed within each switchgear assembly by the Manufacturer.

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The Manufacturer shall be responsible for the co-ordination with ECS Supplier to ensure the proper data transmission between the switchgear assembly and the ECS.

It shall be possible to isolate all incoming ECS controls for maintenance and manual operation.

7. Inspection and testing

7.1 General

All equipment covered by this specification shall be subject to inspection and testing by Company at Manufacturer works during manufacture. In certain cases these activities may extend to Manufacturer's Sub-Contractors.

Inspection and tests shall be performed in accordance with IEC standards.

Equipment shall be tested as per [IEC 60068](#) (All parts) for the defined environmental conditions as listed in the data-sheets.

The routine verifications and tests shall be performed in accordance with the [IEC 61439-1](#) and [IEC 61439-2](#).

7.2 Type tests

Type tests in accordance with the referenced standards shall have been carried out on Manufacturer's similar equipment and the type test certificates shall be provided with the quotation. When appropriate type test certificates do not exist, tests shall be made at the time of manufacture of the equipment to which this specification refers, subject to Company approval.

7.3 Factory acceptance tests

Unless otherwise specified, the following tests shall be performed during the Factory acceptance tests at the Manufacturer factory in the presence of Company representative.

- Visual inspection (appearance, painting, finish, welding, sheet metal, lifting ring, screwed and bolted connections (assembly, bus bar, connection) correct tightness, earthing connections, lining up of measuring apparatus, handling devices, remote control and signalling, labels)
- Dimension controls (terminals, busbar and wires, leakage path and insulation distance, fixation axis, overall dimensions, weight)
- Auxiliary device operation (e.g.: Insulation monitoring device, Automatic transfer device, Control and signalling circuits, etc.)
- Interchangeability of units
- Quality and quantity check for wearable parts and spare parts according to the specification concerned
- Control of protective devices by primary current injection corresponding to the protection setting values (Secondary injection is acceptable when the appropriate relevant certificates of CTs are provided)
- Measurement of insulation resistance

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- Dielectric test: Power-frequency voltage test on the main circuit during 1 minute based on the test voltages indicated in the [IEC 60664-1](#)
- Mechanical operation (interlocks and locks)
- Switchgear electrical operation test
- Minimum functional tests including: Start/stop, remote alarms, intertrip, automatic sequences if any, etc.
- Check for validation of the interface link with the ECS. The tests will be carried out in accordance with the tools and support (meeting, procedure and documentation) proposed by the ECS Manufacturer
- Participation in the Factory Acceptance Tests of the ECS in order to test all the protection and Measurement Management Units (MMU), and the specific functions (restarting, automatic transfer, load-shedding, etc.)
- When programmable relays or PLC's are provided, complete functional tests shall be carried out.

A test report of the acceptance tests shall be issued.

8. Design Life & Obsolescence ([IEC 62402](#))

Facilities are typically designed with an expected design life in the order of 25 years.

Obsolescence management shall be according to [GS EP TEC 007](#).

The Switchboard design shall therefore take into account the requirement that the equipment will most probably require to be upgraded during the design life of the facilities in particular for all the electronic based components. These requirements shall be incorporated from Basic Engineering stage.

The design will include provisions to allow an upgrade of the Switchboard to be performed with minimal disturbance to the power generation and distribution systems, fixed cabling infrastructure and infrastructure.

All hardware and software that may be developed by the Supplier further to the Switchboard delivery shall ensure full ascending compatibility to allow for easy replacement of equipment that became obsolete with limited reconfiguration.

At the Bid stage, the Switchboard Supplier shall detail his lifecycle management strategy focusing on product obsolescence, support options and further migration alternatives. The lifecycle/obsolescence management plan and associated cost shall be part of the Bid process evaluation.

The Switchboard Supplier shall complete an inventory of all provided equipment (hardware and software) matching to different lifecycles phases, including all Sub-Vendors equipment (e.g. servers, operator stations, switches, routers).

Switchboard **Supplier** shall guarantee that:

- Switchboard components (including software and hardware) shall remain in the "active products" range (i.e. supporting developments and releases) over a period of at least 10 years after the SAT

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- An announcement to Customer is provided 5 years prior the end of the commercial phase
- Switchboard components (including software and hardware) shall be fully supported and available over a period of at least 20 years after the SAT
- Maintenance services including availability of engineering services shall be available to support the Switchboard during the plant life time.

9. Documentation

All documents shall use the general terminology as defined in the [IEC 60050](#) (all parts).

Unless otherwise specified in project particular specification, Manufacturer shall at least provide the following documents:

	With the Bid	After Purchase Order
• List of clarifications/deviations from the Specifications	X	X
• Overall arrangement drawing	X	X
• Filled-up switchgear assembly data-sheets	X	X
• Heat loss data for each complete switchboard assembly	X	X
• Electrical power demand for the auxiliary power supplies	X	X
• Civil works drawings	X	X
• Transportation procedure		X
• Tropicalisation specification (if needed)	X	X
• One line diagram	X	
• Wiring diagram		X
• Schematic diagram		X
• Parts list for each component of the switchboard identifying the manufacturer, description, model no., type reference, rating and operating voltage		X
• Characteristic/operating curves for all protection devices		X
• Digital relay setting data sheet		X
• Maintenance and operation manuals		X
• Spare parts list		X
• List of Special tools for maintenance	X	X
• Detailed equipment information (technical documentation)	X	
• Copy of software and configuration of PLC/digital relays, etc.		X



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	With the Bid	After Purchase Order
• Type test reports	X	
• Routine verifications report		X
• FAT reports		X
• Obsolescence management dossier	X	X

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Appendix 1 LV typical diagrams for standard switchboards (not smart MCC)

The following typical diagrams are applicable to Standard LV switchboards, not equipped with smart MCC modules (electronic module equipped with serial link for remote control & monitoring to a supervision system).

The control logic developed in these typical are guidelines which can be further developed or modified on specific projects.

The control voltage used in these schematics is 24 Vdc, however as per our **GS EP ELE 001** the control voltage can be as well 48 Vdc, and in specific applications or countries 110 Vdc.

These typical diagram sheets shall be modified as follow:

- Sheet 04: One line diagram

The use of PTA and PTB as auxiliaries voltage supply is only for small switchboard without ATS function. The normal practice will be supply from external sources.

- Sheet 05: One line control bus "A" and Sheet 06: One line control bus "B"

If some motors with space heater not suitable for zone 1 are installed in hazardous area, these two sheets shall be modified as followed:

Motor heating supply switches H3/H4 shall be replaced by breakers with a de-energized coil in order to de-energized motor's space heater in case of gas detection (ESD).

- Sheet 16: Typical motor DOL starter $P > 110$ kW type M3

Title shall be replaced by: Typical motor DOL starter $P \geq 110$ kW type M3

ANSI protection codes shall be modified as follow:

- 59 RMS shall be replaced by 49
- 51 shall be added.

A note shall be added: For Motors ≥ 200 kW, ANSI 26T protection shall be added.

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Appendix 1

LOW VOLTAGE SWITCHBOARD

TYPICAL DRAWING



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Contractor name:

GS EP ELE 135 Rev. 06 - Appendix 1

Doc type: SLD	Syst. / S-Syst:	Discipline: ELE	Electronic Filename:
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Company Ref:		Revision :	1	Scale:
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Contractor Ref:	Format: A4	Folio: 01/20
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LEGEND				
PROTECTION		EQUIPMENT	EQUIPMENT	
ANSI CODE	DESCRIPTION			
27	UNDERVOLTAGE RELAY	 AMMETER	 INDICATION LAMP (LED)	
37	UNDERCURRENT OR UNDERPOWER RELAY	 VOLTMETER	 VOLTAGE TRANSFORMER	
46	REVERSE PHASE OR PHASE BALANCE RELAY	 KILO WATT METER	 WITHDRAWABLE TYPE UNIT (ELEC. DISCONNECTION/ PLUG-IN CONTACTS)	
48	EXCESSIVE STARTING TIME	 POWER FACTOR METER	 MECHANICAL INTERLOCK	
49RMS	THERMAL OVERLOAD	 FREQUENCY METER	 SURGE ARRESTER	
50	INSTANTANEOUS OVERCURRENT OR RATE OF RISE RELAY	 KILOVAR METER	 FUSE	
50N	INSTANTANEOUS EARTH FAULT RISE EARTH FAULT RELAY	 CURRENT TRANSFORMER (CT)	 EARTH SWITCH	
51	OVERCURRENT RELAY, WITH TIME DELAY	 POWER TRANSFORMER,	 VOLTAGE TRANSDUCER	
51N	EARTH FAULT RELAY, WITH TIME DELAY	 CIRCUIT BREAKER	 NUMERICAL RELAY (COMBINED METERING & PROTECTION)	
51LR	LOCK ROTOR RELAY	 CONTACTOR	 MOTOR PROTECTION RELAY	
59	OVERVOLTAGE RELAY	 SWITCH	 HIGH IMPEDANCE	
59N	RESIDUAL OVERVOLTAGE RELAY	 CORE BALANCE CT. (CBCT)	 INSULATION MONITORING DEVICE	
63	SUDDEN PRESSURE RELAY		 ADAPTOR	
67N	DIRECTIONAL EARTH FAULT RELAY		 SOFT STARTER or VSD	
81	FREQUENCY RELAY			
86	LOCKOUT RELAY			
38	BEARING RTD			
49	STATOR RTD			
OT	TRANSFORMER OIL TEMPERATURE RELAY			
OL	TRANSFORMER LIQUID OR PRESSURE RELAY			
66	NOTCHING OR JOGGING DEVICE			
SYMBOL			GS EP ELE 135 Rev. 06	
			REV 1	SHEET 03

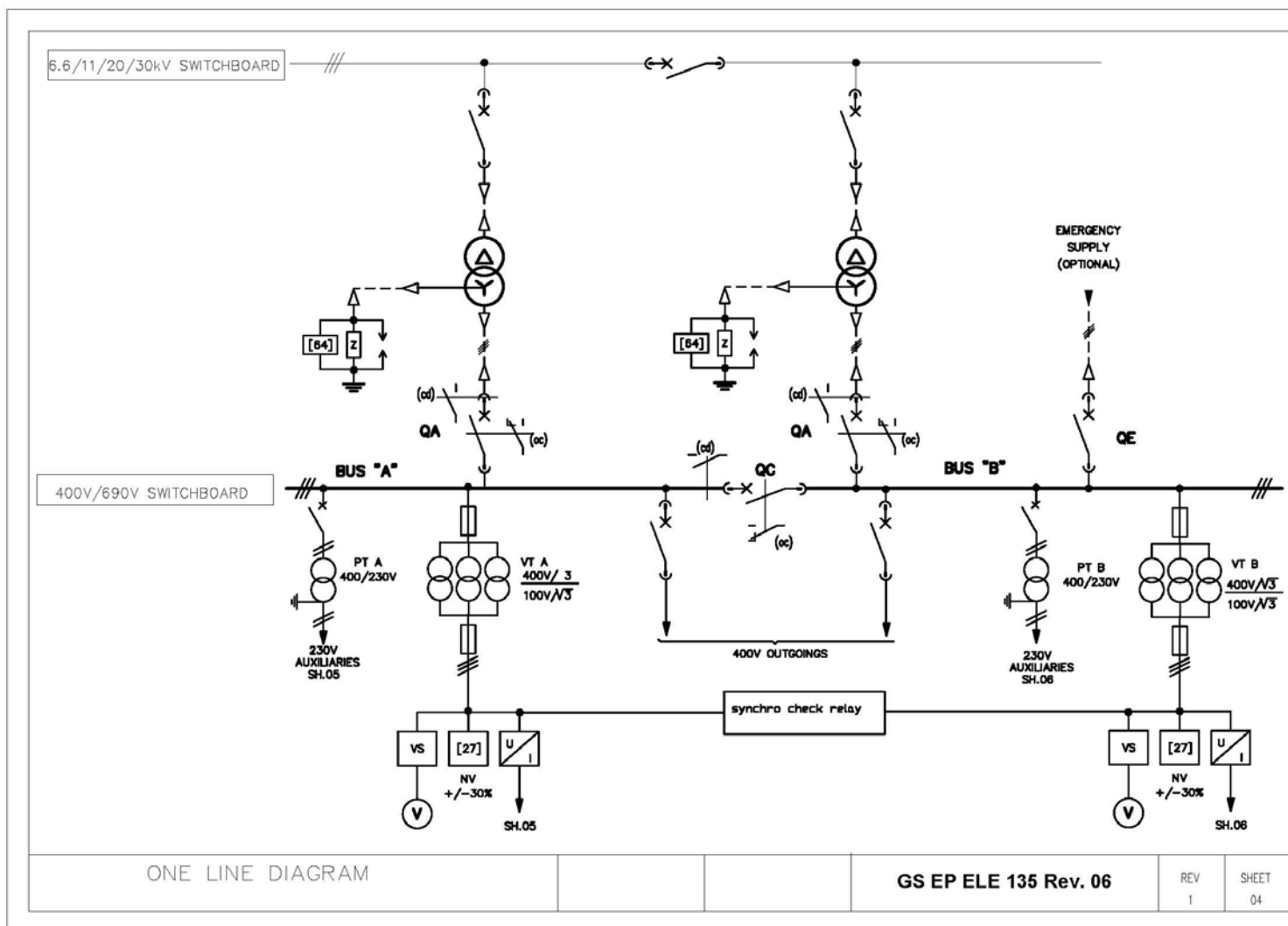
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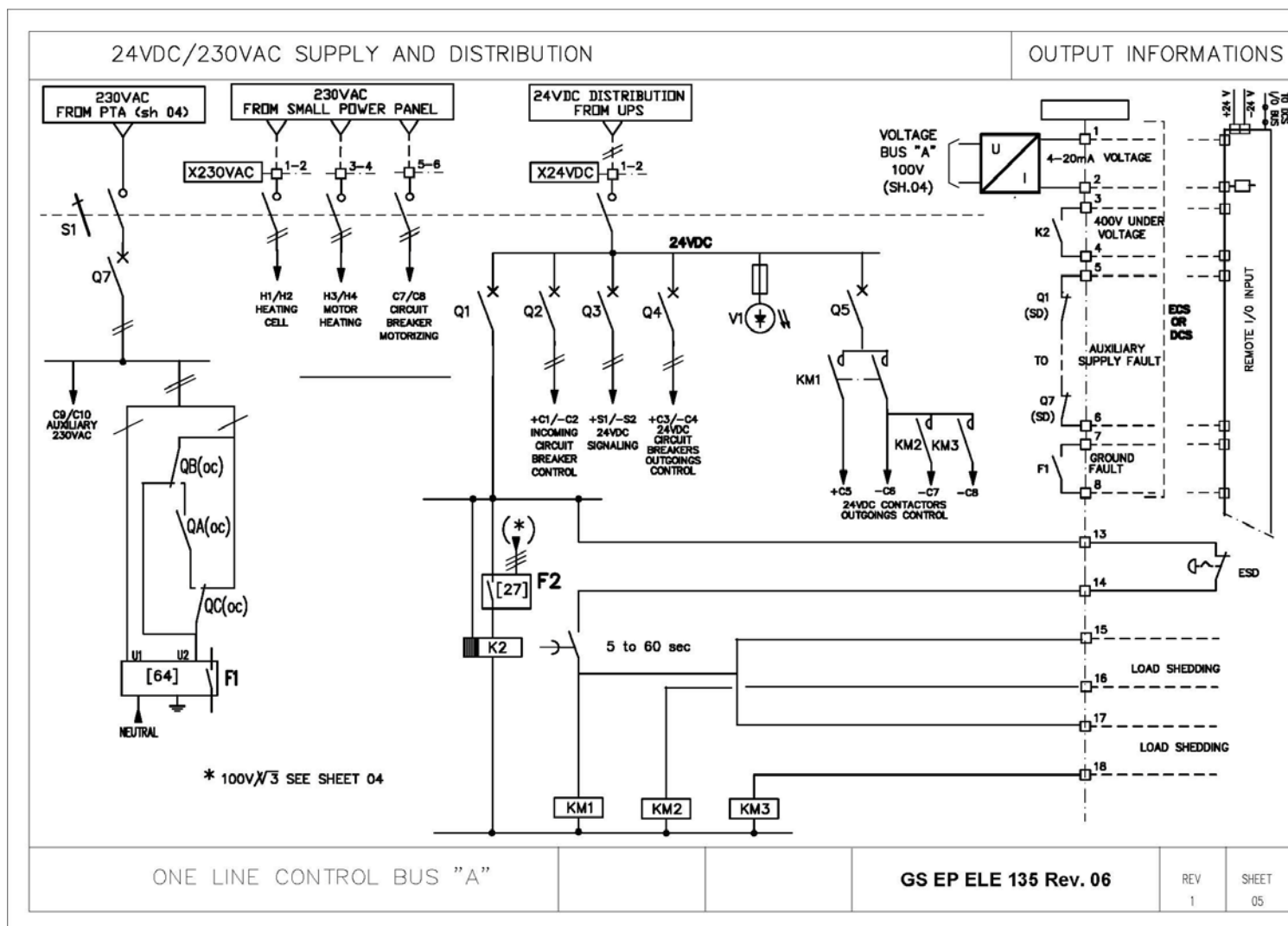
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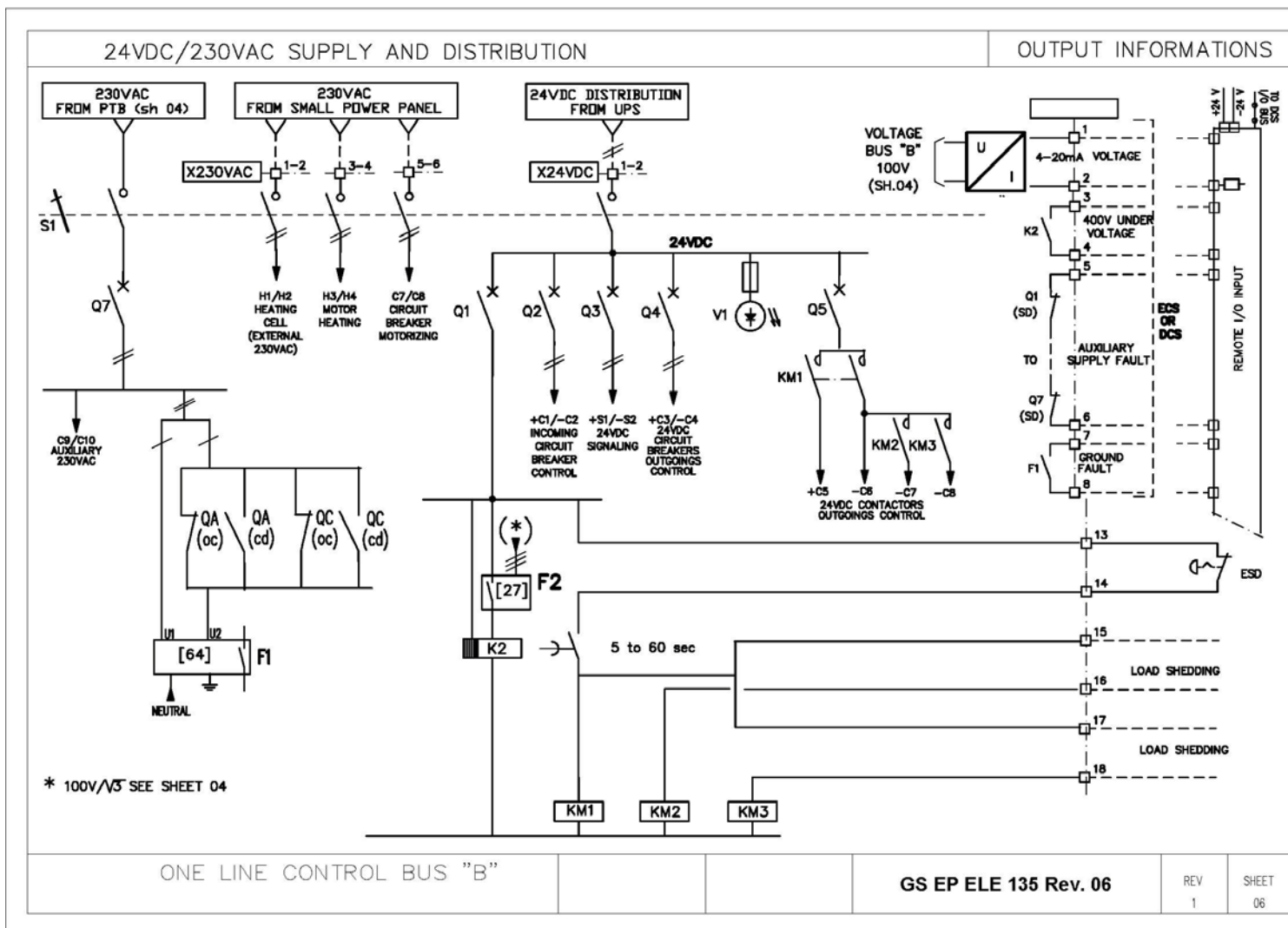
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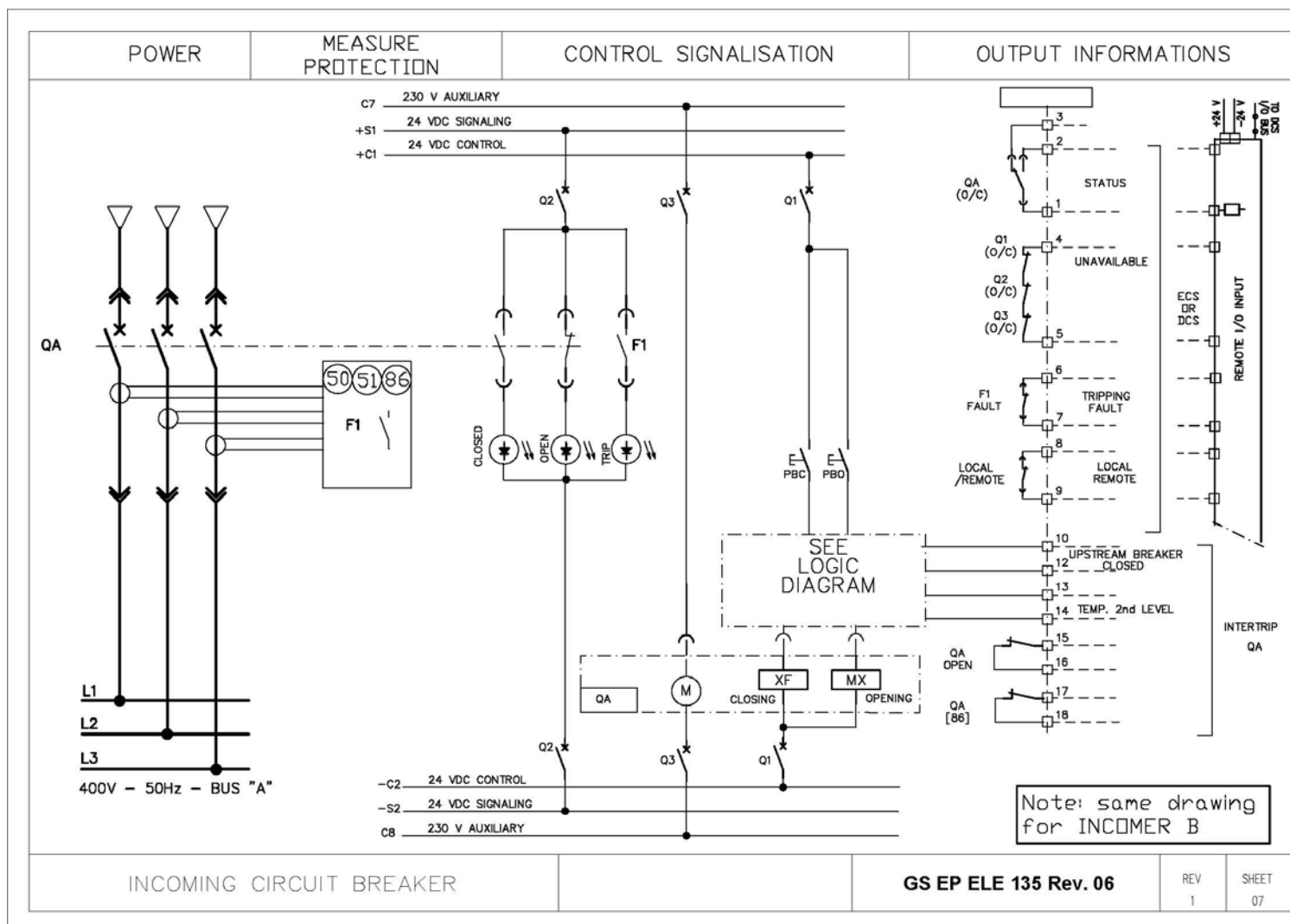
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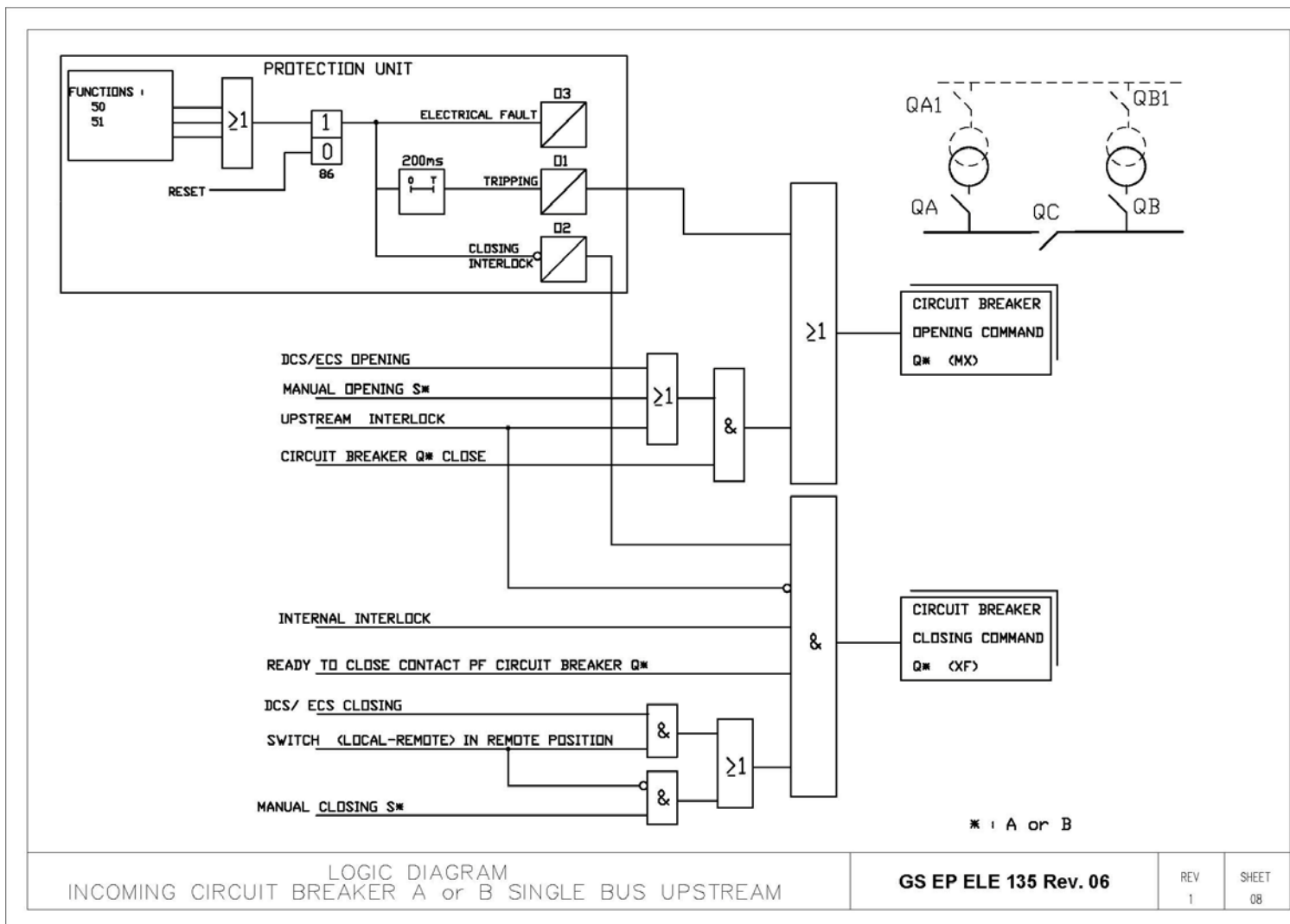
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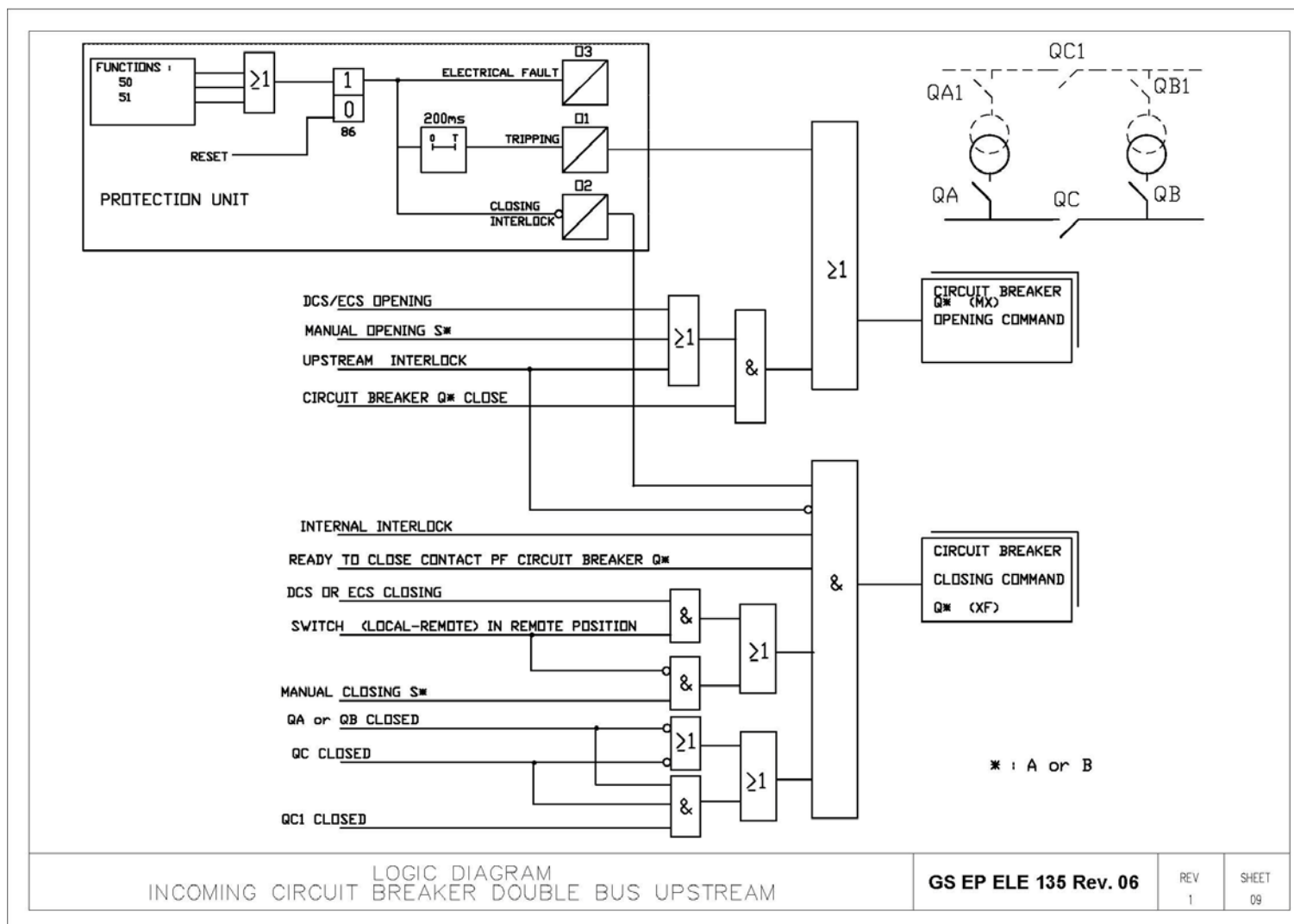
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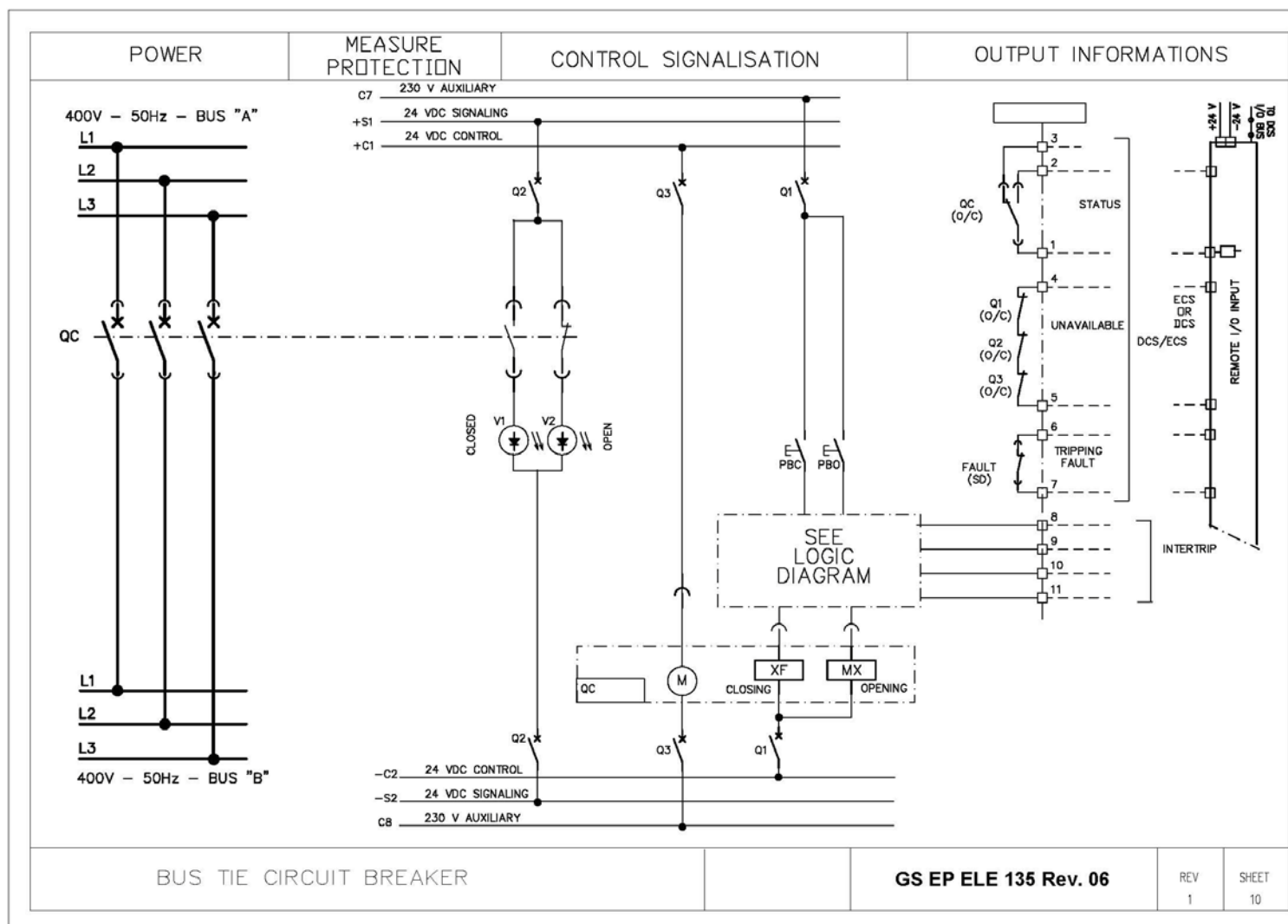
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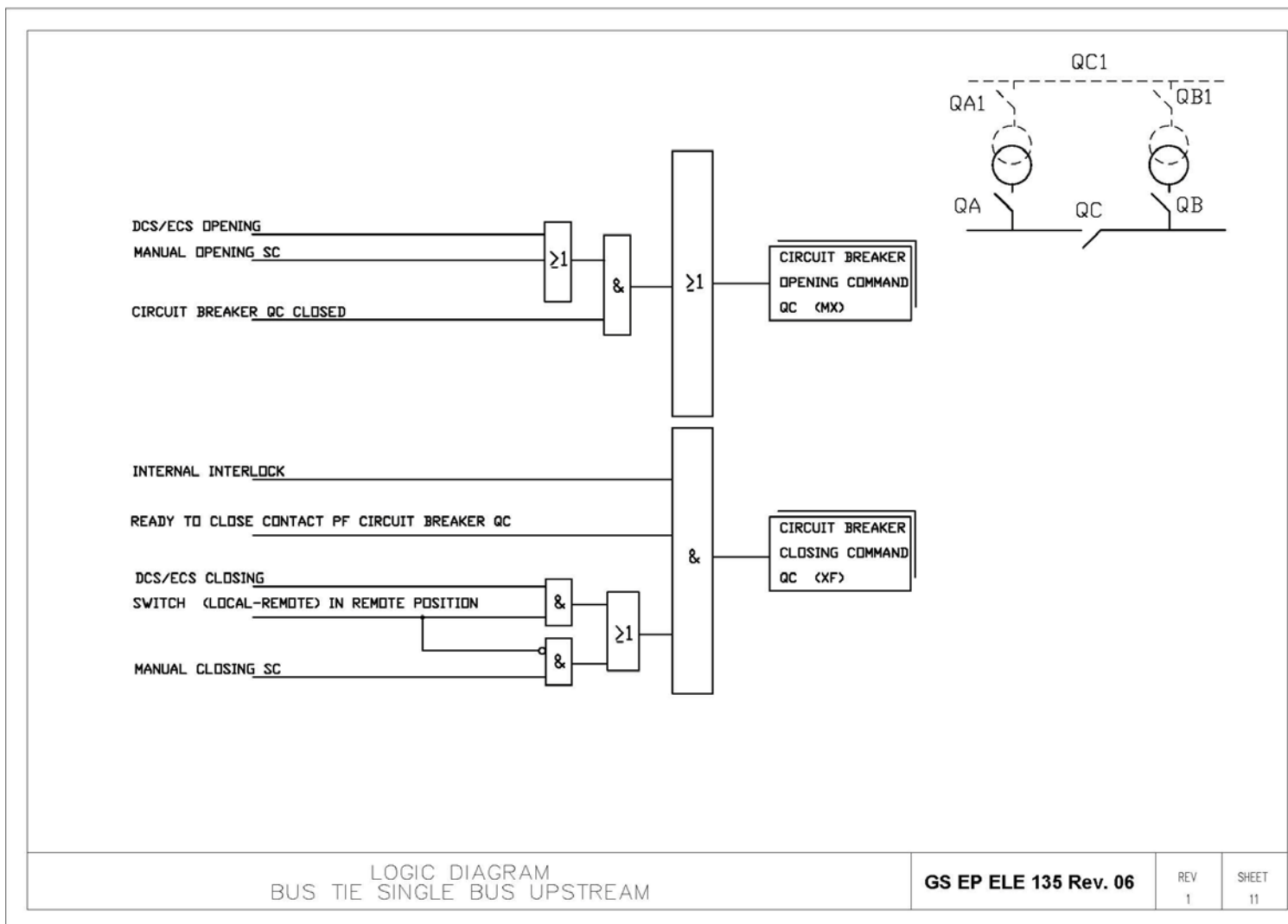
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11

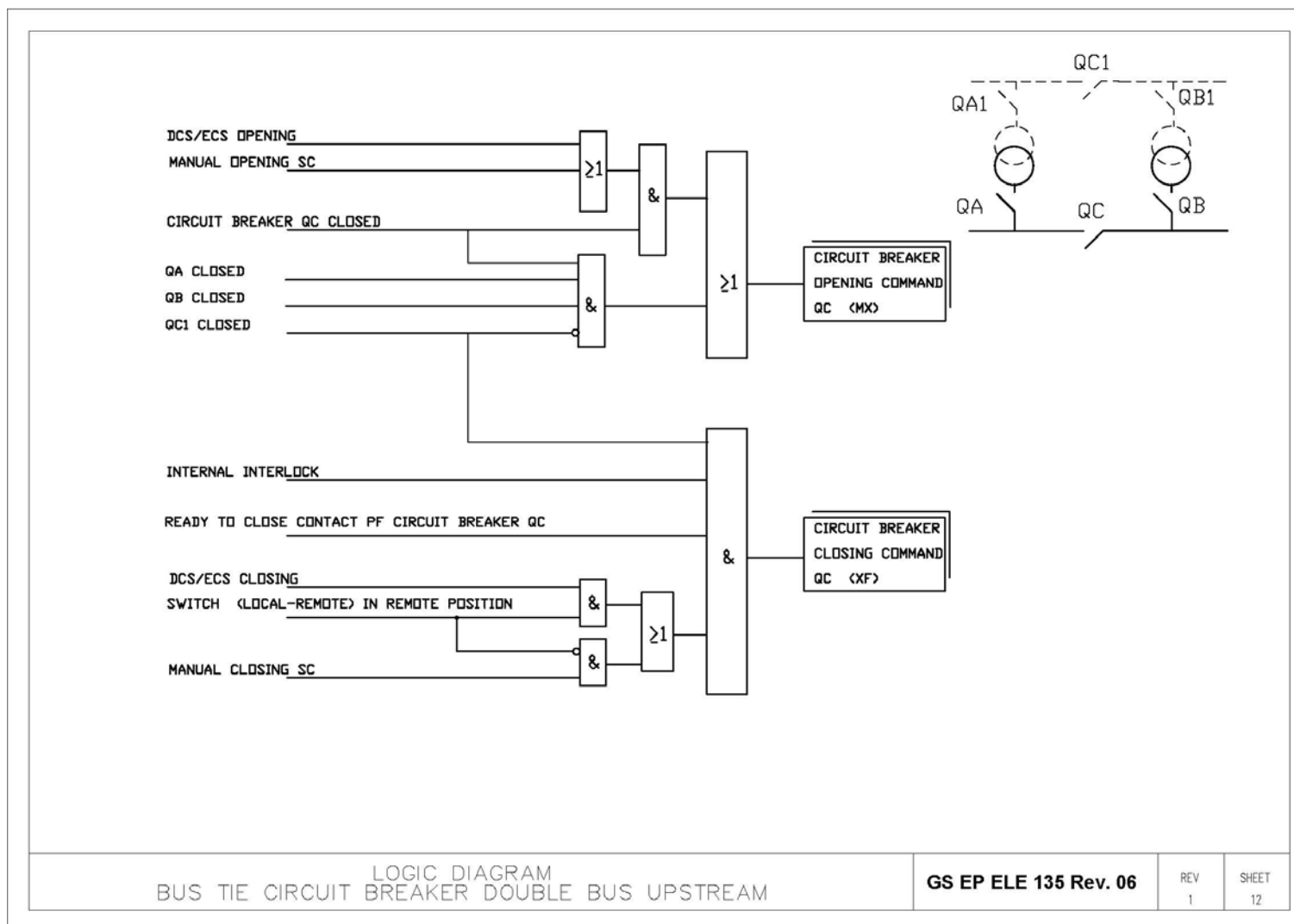
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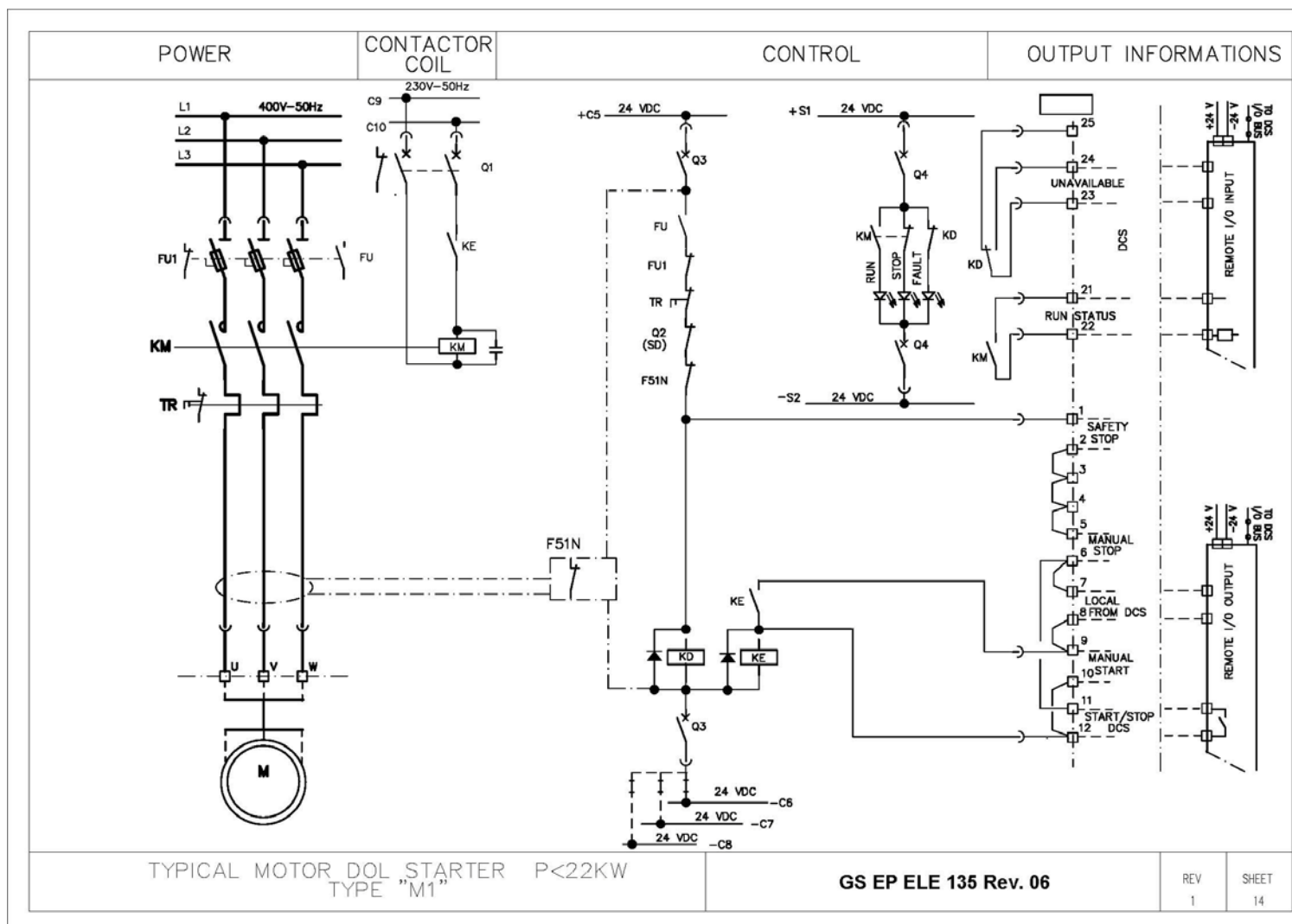
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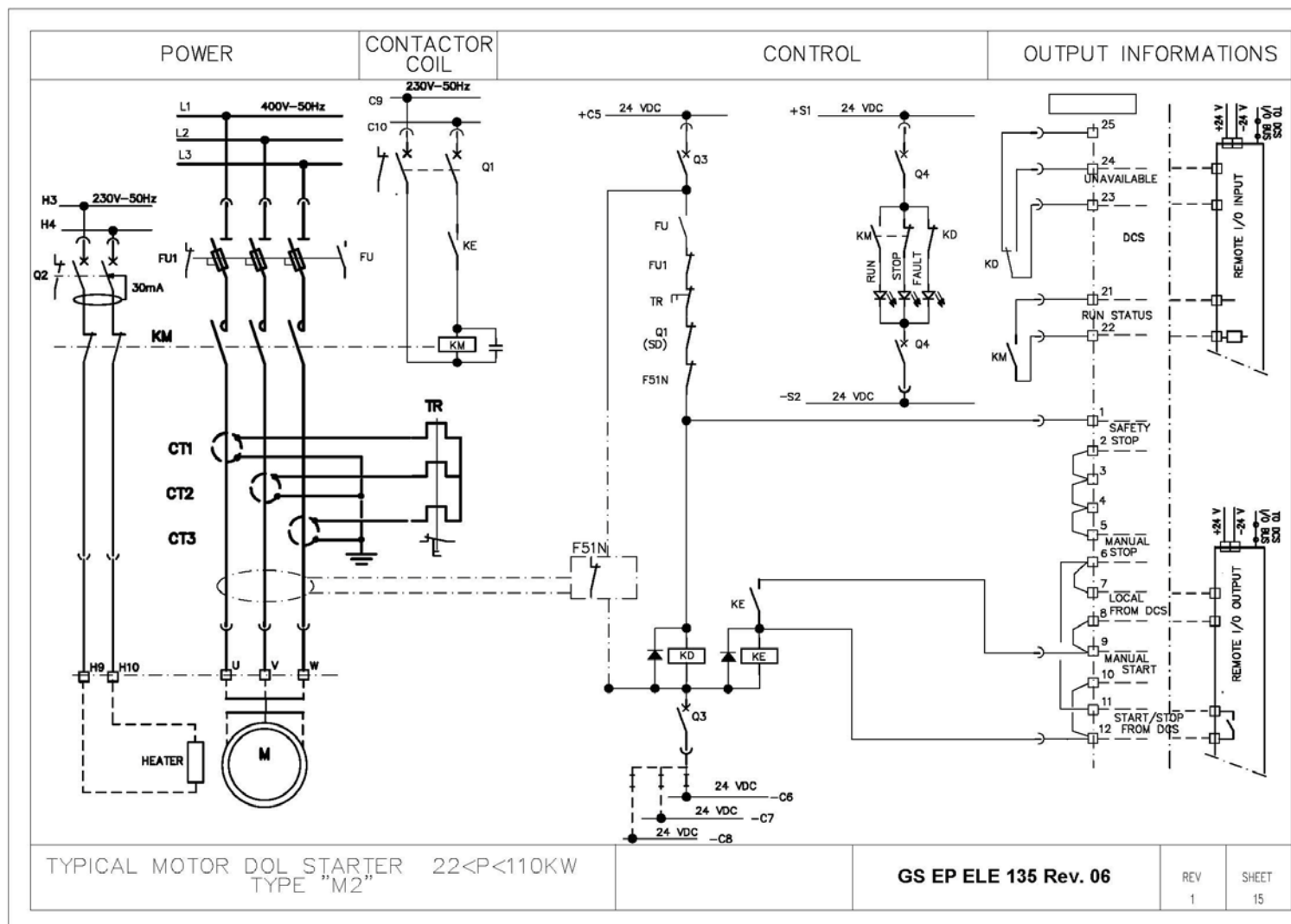
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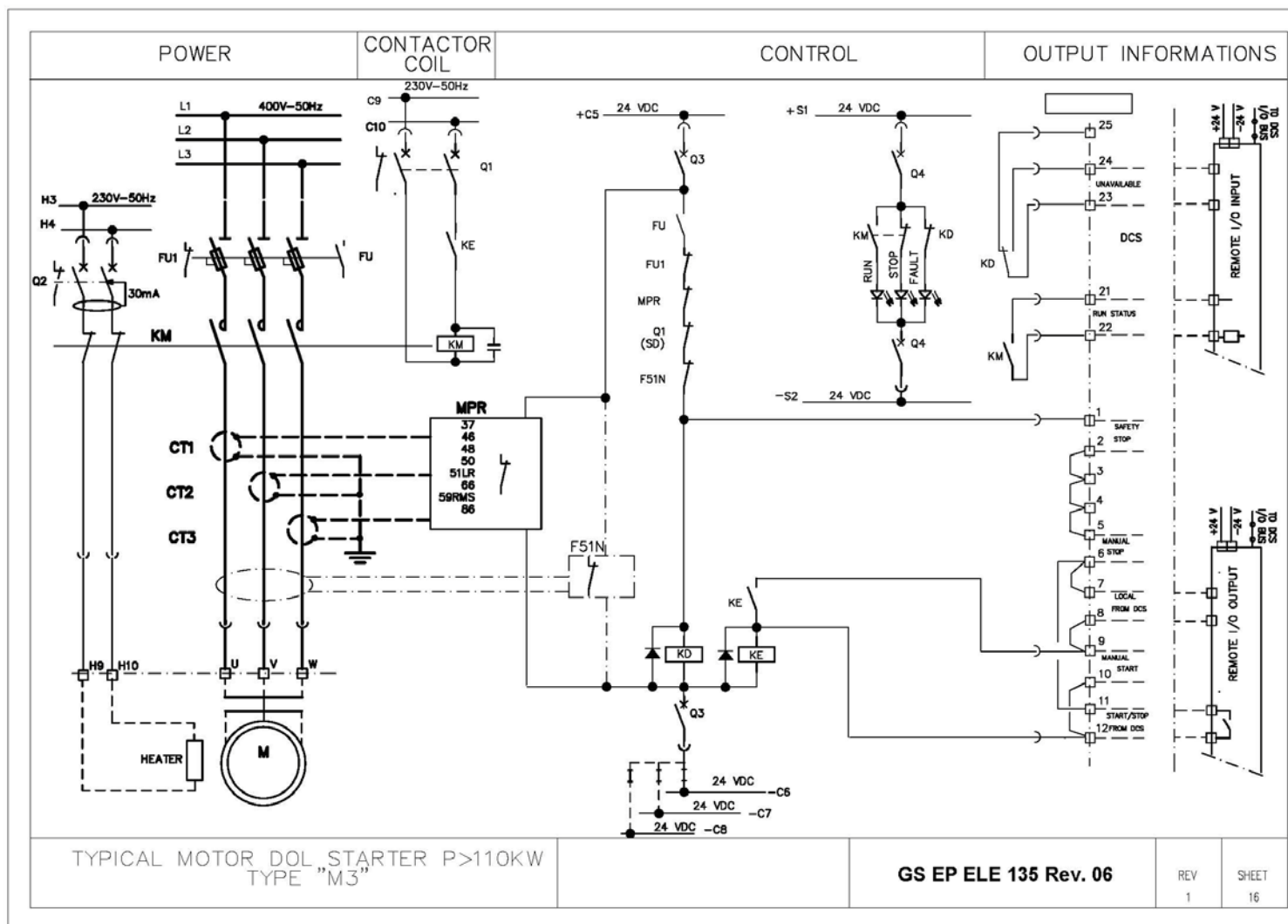
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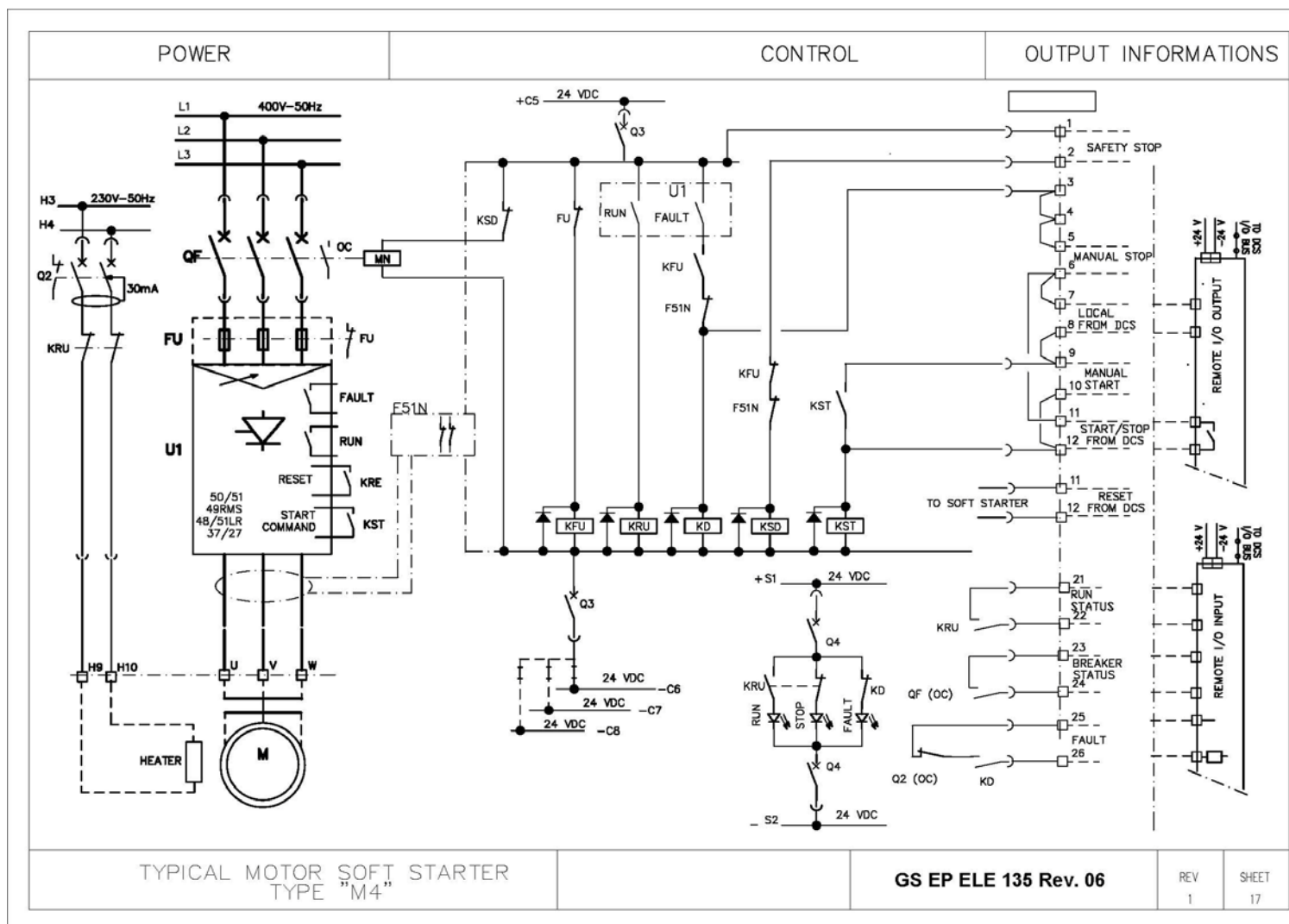
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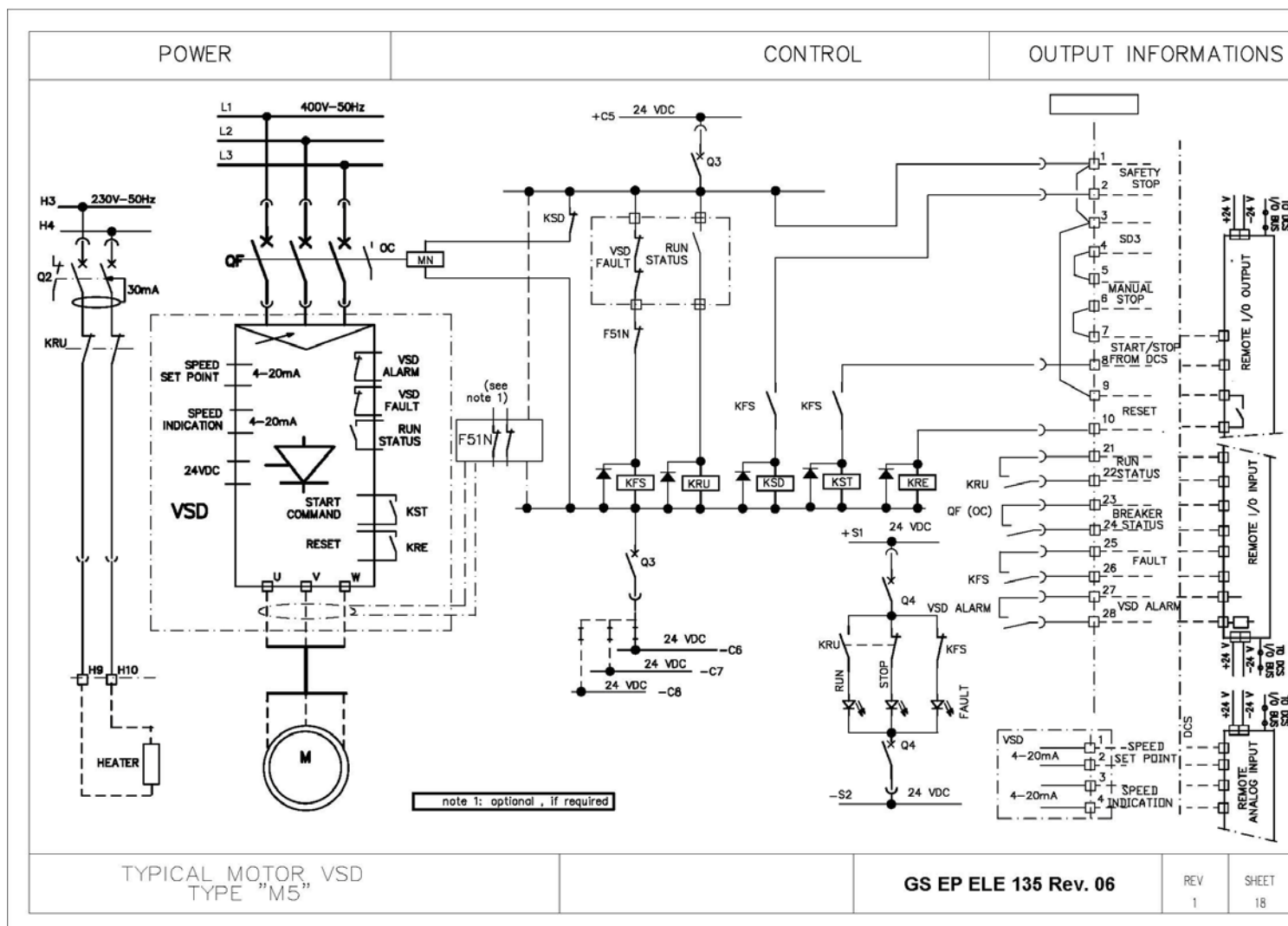
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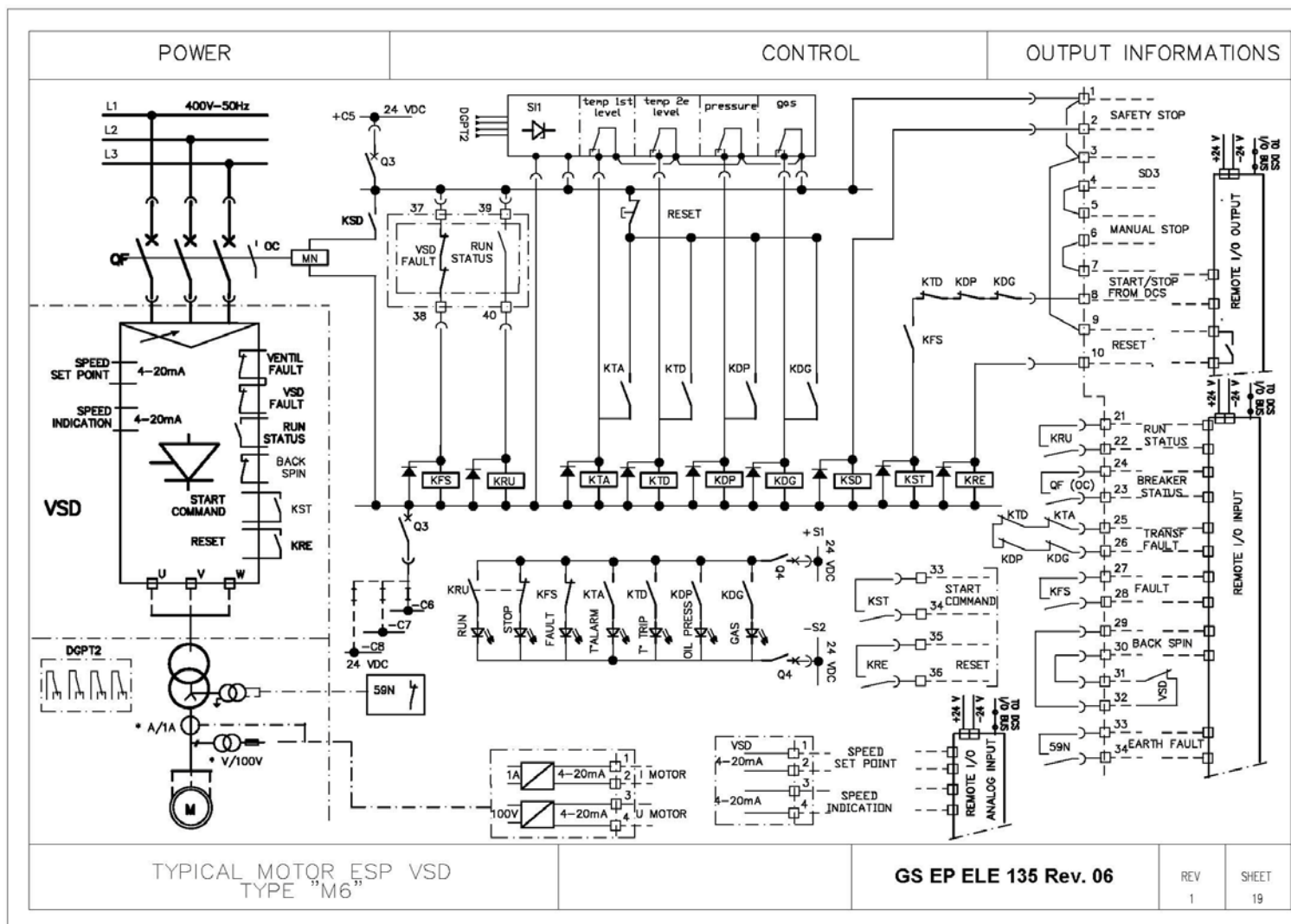
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TYPICAL MOTOR ESP VSD
TYPE "M6"

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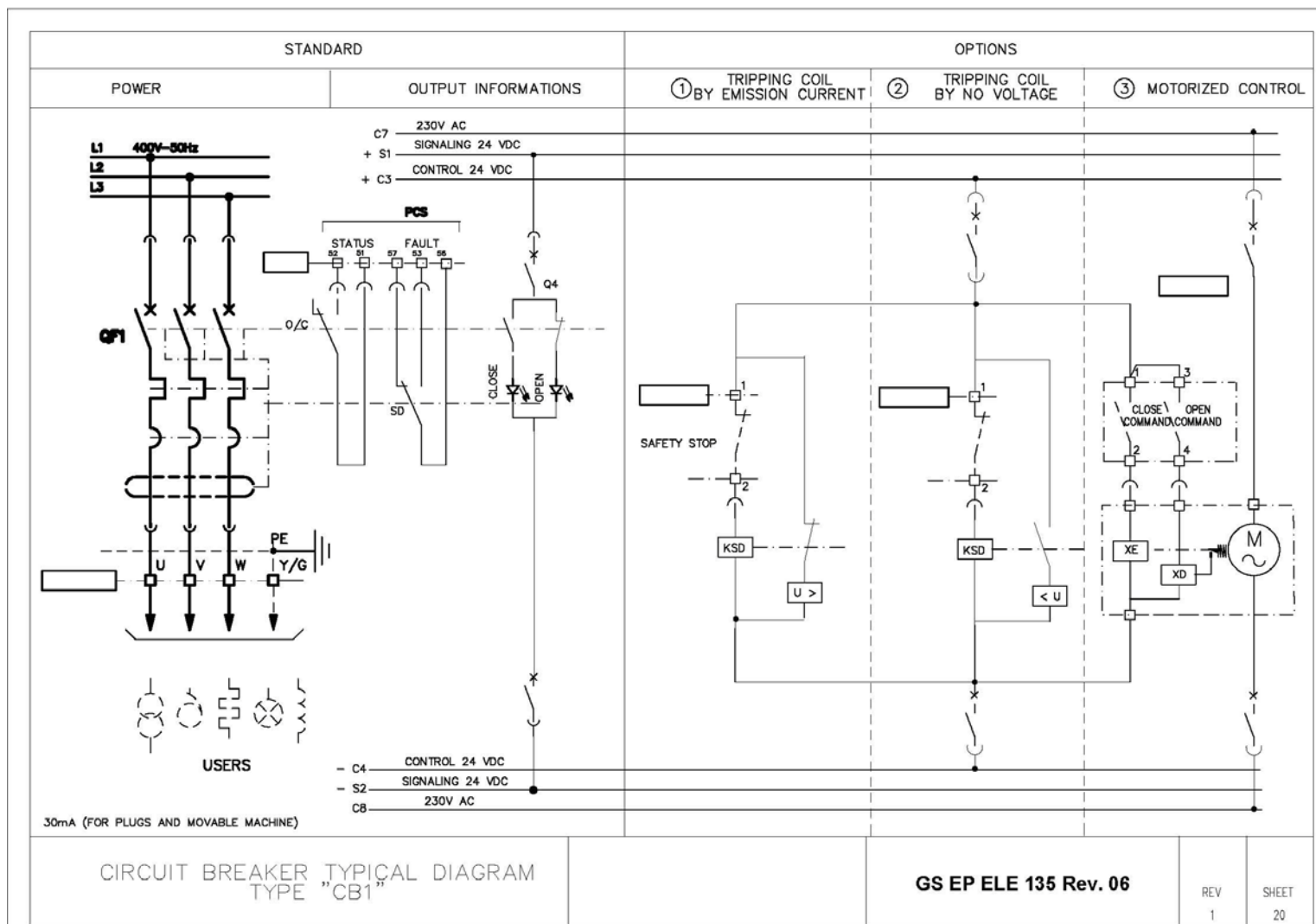
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Appendix 2 Data Sheet

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DATA SHEET	N°
Project:	
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Rev. Date						
Written						
Verified						
Approved						

Item N°	Description	Default values as per GS EP ELE 135 / IEC recommendation	Données Spécifiques au projet / Particular project Datas	Données Fournisseur / Supplier Datas
1	Général / General			
2	Repère de l'équipement / Equipment identification			
3	Langue / Language: Etiquetage / Labelling			
4	Langue / Language: Affichage sécurité / Safety notices			
5	Conditions générales d'installation / Installation conditions			
6	Lieu d'implantation / Place of installation:			
7	Onshore / Off Shore			
8	Salle ventilée / Ventilated Climatisée / Air conditioned room			
9	Salle surpressée / Pressurised room			
10	Altitude	< 2000 m		
11	Environnement corrosif / Corrosive atmosphere			
12	Présence H ₂ S / H ₂ S presence			
13	Vibrations , chocs, Risque sismique / heavy vibrations , shocks, earthquakes			
14	Température ambiante/Ambiant air temperature:			
15	Normale /Normal		°C +/- °C	
16	Maximale /Maximum	40 °C	°C	
17	Hygrométrie relative / Relative humidity:			
18	à T° maximale / at Maximum T°	50 % à/at 40 °C	% à/at °C	
19	Maximale à T° / Maximum at T°	90 % à/at 20 °C	à/at °C	
20	Mise en place / Installed :			
21	Contre un mur/against wall Sol béton/Concrete floor Caniveau/Cable Duct Châssis/Frame			
22	Accessibilité pour maintenance/Maintenance accessibility (Avant/Front only)			
23	Caractéristiques du réseau électrique / Electrical Network Characteristics			
24	Fréquence assignée / Rated Frequency	50 Hz +/- 5 %	Hz +/- %	
25	Tension nominale du réseau / Network nominal Voltage	V +/- 10 %	V +/- %	
26	Courant de court circuit / Short circuit current (Icp)		kA	
27	Régime de neutre / Earthing System	IT		
28	Neutre Distribué / Distributed neutral	No		
29	Présences harmoniques/ Harmonics levels	5 % THD	% THD	
30	Surtensions transitoires / Transient overvoltages		kV	

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31	<u>Caractéristiques Techniques / Technical Datas</u>			
32	Connexion des unités fonctionnelles / Electrical connections of functional units Fixe / Fixed = F Déconnectable / Disconnectable = D Débrochable / Withdrawable = W			
33	Circuit arrivées principales / Main incoming circuits	W		
34	Circuit départ principal / Main outgoing circuits	W		
35	Circuits auxiliaires / Auxiliary circuits	W		
36	Forme de séparation / Separation form (IEC 61439-2)	4b		
37	Degré IP / Degree of protection	IP 31 minimum	IP	IP
38	Tropicalisation / Tropicalisation			
39	Résistance mécanique / Impact Strength	IK08 (5 joules) minimum	IK	IK
40	Degré de pollution / Pollution degree (IEC 61439-1)	Degree 3		
41	Raccordement / Connection:			
42	Puissance / Power (Avant/Front – Arrière/Rear)			
43	Contrôle commande / Signal control (Avant/Front – Arrière/Rear)			
44	Passage des câbles / Cable entry (Bas/Bottom – Haut/Top)	Bottom		
45	Connexion sur ECS / ECS connection (fil à fil/hardwire – liaison série/serial link)			
46	Bus duct (Haut/Top – Bas/Bottom)			
47	<u>Caractéristiques électriques / Electrical characteristics:</u>			
48	Tension assignée d'emploi / Rated Operating Voltage U _e		V	
49	Tension assignée d'isolement / Rated Insulated Voltage U _i		V	
50	Courant assigné / Rated Current I _n		A	
51	Courant assigné de court circuit conditionnel / Rated conditional short circuit current I _{cc}		kA	
52	Valeur de crête du courant assigné admissible / Rated peak withstand current I _{pk}		kA	
53	Courant assigné de courte durée admissible / Rated short time withstand current I _{cw}		kA r.m.s. / 1 s	
54	Calibre Jeu de barres principal / Main busbar rating		A	
55	Cuivre / Copper – Isolé / Insulated – Nu / Bare – étamé / tinned - etc.	Insulated copper		
56	Calibre jeu de barres de distribution / Distribution busbar rating		A	
57	Cuivre / Copper – Isolé / Insulated – Nu / Bare – étamé / tinned - etc.	Insulated copper		
58	Section du collecteur de terre / Earthing bar cross section	35 mm² minimum	mm²	

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59	Tension des auxiliaires / Auxiliary voltage:			
60	Commande / Control	DC +10 /- 15 %	V +/- %	
61	Signalisation / Signalling	DC +10 /- 15 %	V +/- %	
62	Moteur de réarmement / Spring charging motor	230 V +/- 10 %	V +/- %	
63	Réchauffage moteur / Motor heater	230 V 1ph +/- 10 %	V 1ph +/- %	
64	Résistance anti condensation / space heater	230 V 1ph +/- 10 %	V 1ph +/- %	
65	Contrôleur d'isolement / Insulation monitoring device	Yes		
66	Limitation du courant de défaut à fréquence nominale / Earth fault limitation at rated frequency	150 mA @ 50Hz		
67	Parasurtenseur / Surge arrester	Yes		KV—/—kA
68	Dispositif de recherche de défaut d'isolement / Insulation fault localisation device.	Yes portable		
69	Autres caractéristiques / Other Characteristics:			
70	Extension futures / Future extension (Gauche/Left - Droite/Right)	Yes both		
71	Fermure des portes / Doors locking:			
72	Poignée / Handle	Yes		
73	Serrures / Key	No		
74	Peinture / Painting	Supplier standard		
75	Couleur / Color (RAL)			
76	Etiquettes / Labels:			
77	Dilophane / Traffolyte- Inox / Stainless steel			
78	Fixation / Fixation	Rivets or screws		
79	Détection incendie / Early smoke-fire detection			
80	Surveillance infrarouge / Infrared monitoring			
81	Résistance anticondensation / Space heater			
82	Cablage interne avec des câbles sans halogène / Halogen free secondary wiring			
83	Automatismes intégrés au tableau (API, etc.) / Automatism included inside the assembly (PLC, etc.)			
84	Synoptique simplifié sur tableau / Mimic one line diagram on switchgear			
85	Visserie / Screw Bolts Nuts (Zinguée bichromatée/Zinc bichromate - Inox 316/Stainless steel 316)			
86	Chariot de manutention / Service truck	Yes		
88	Essais/Tests (IEC 61439)			
89	Réception usine / Factory acceptance tests	Yes		
90	Essais individuel / Routine tests (IEC 61439-2 §11)	Yes		
91	Autres essais / Other tests			

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92	Réception communication avec ECS / ECS communication tests			
93	Usine ECS ou tableau / ECS or switchgear factory			
94	<u>Dimension de l'armoire / Cubicle Size</u>			
95	Longueur / Width			mm
96	Profondeur / Depth			mm
97	Hauteur / Height			mm
98	Poids / Weight			kg
99	Dégagements nécessaires / clearance (Avant - Arrière - Au-dessus/Front - Rear - Top)			mm
100	<u>Liste des fabricants / Component manufacturer list</u>			
101	Disjoncteur / Circuit breaker			
102	Contacteur / Contactor			
103	Fusibles / Fuses			
104	Appareil de mesure / Metering apparatus			
105	Relais auxiliaire / Auxiliary relay			
106	Relais de protection / Protection relay			
107	Automate programmable / PLC			
108				
109				
110				
111				
112				

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1	Unité d'arrivée / Incoming unit : Selon schéma type / As per typical			
2	Directe / Direct on busbar			
3	Disjoncteur / Circuit breaker	Yes		
4	Bobine de déclenchement / tripping coil	Yes		
5	Bobine de fermeture / Closing coil	Yes		
6	Moteur de rearmement / Spring charging motor	Yes		
7	Interrupteur / Switch			
8	Inter-fusible / Fused-Switch			
9	Raccordements / Connections			
10	Câbles / Cables gaine à barres / Busduct	Cables		
11	Cuivre / Copper Aluminium /aluminium –	Copper		
12	Unipolaire / Single core Multipolaire / multicore	Single core		
13	Section / Cross section		mm²	
14	Nbre de cable par phase / Cable number by phase		mm²	
15	Protection / Protection Code ANSI	50-51-86		
16	Contrôle / Control			
17	Boutons-poussoirs / Push buttons (Ouvert - Fermé / Open -Closed)	Open - Closed		
18	Commutateur / Switch (Local – Distance / Local - Remote)	Local – Remote		
19	Signalisation / Indicating lights (Ouvert – Fermé - Défaut/Open – Closed -Trip)	Open – Closed - Trip		
20	Interdéclenchement / Intertrip – Interverrouillage /Interlock	Yes		
21	Mesures / Meters			
22	Ampèremètre / Ammeter	Yes		
23	Voltmètre / Voltmeter	Yes		
24	Facteur de puissance / Power factor meter			
25	Fréquencemètre / Frequency meter			
26	Wattmètre / Wattmeter – Varmètre / VAR meter			
27	Compteur d'énergie / Watt / VAR hour meter			
28	Module numérique mesures & Comptage Meter and counter digital module			

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29	Standard de communication / Communication standard			
30	Transformateur de tension / Voltage transformer			
31	Nombre par phase / Number by phase	1 / Phase		
32	Tension secondaire / Secondary voltage	100 V or 110 V		
33	Transformateur de Courant / Current transformer			
34	Nombre par cellule / Number	1 / Phase minimum		
35	Classe / Class			

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Item N°	Description	Default values as per GS EP ELE 135	Données Spécifiques au projet / Particular project Datas	Données Fournisseur/Supplier Data
1	Unité du couplage/Bus tie unit : Selon schéma type / As per typical			
2	Disjoncteur / Circuit breaker	Yes		
3	Bobine de déclenchement / tripping coil	Yes		
4	Bobine de fermeture / Closing coil	Yes		
5	Moteur de rearmement / Spring charging motor	Yes		
6	Interrupteur / Switch			
7	Remontée de barres / Bus riser (Déconnectable / Disconnectable)			
8	Protection / Protection Code ANSI	25 as minimum		
9	Contrôle / Control			
10	Boutons-poussoirs / Push buttons (Ouvert - Fermé / Open - Closed)	Open - Closed		
11	Commutateur / Switch (Local - Distance / Local - Remote)	Local - Remote		
12	Signalisation / Indicating lights (Ouvert - Fermé - Défaut/Open - Closed - Trip)	Open - Closed - Trip		
13	Mesures / Meters			
14	Voltmètre / Voltmeter			
15	Fréquencemètre / Frequency meter			
16	Module numérique mesures & Comptage Meter and counter digital module			
17	Standard de communication / Communication standard			
18	Transformateur de tension / Voltage transformer			
19	Nombre par cellule / Number	2/Phases		
20	Tension secondaire / Secondary voltage	100 V or 110 V		
21	Transformateur de Courant / Current transformer			
22	Nombre par cellule / Number	1/Phase		
23	Classe / Class			

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DATA SHEET	N°
Project:	
DS EP ELE 135 Rev. 03 10/2012	Low voltage switchgear

Item N°	Description	Default values as per GS EP ELE 135	Données Spécifiques au projet / Particular project Datas	Données Fournisseur/Supplier Data
1	Jeu de barres / Busbar Selon schéma type / As per typical			
2				
3	Contrôle / Control			
4	Commutateur / Switch	yes		
5	Signalisation / Indicating lights	yes		
6	Mesures / Meters			
7	Ampèremètre / Ammeter			
8	Voltmètre / Voltmeter	Yes		
9	Fréquencemètre / Frequency meter			
10	Module numérique mesures & Comptage Meter and counter digital module			
11	Standard de communication / Communication standard			
12	Transformateur de tension / Voltage transformer			
13	Nombre par cellule / Number	2 / Phases		
14	Tension secondaire / Secondary voltage	100 V or 110 V		
15	Transformateur de Courant / Current transformer			
16	Nombre par cellule / Number			
17	Classe / Class			

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Project:	
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Item N°	Description	Default values as per GS EP ELE 135		Données Spécifiques au projet / Particular project Data		Données Fournisseur / Supplier Data		
1	Départ Moteur / Motor Feeder: Selon schéma type / As per typical							
2	Type de Coordination / Coordination type (IEC 60947-4-1)	Type 2 minimum						
3	Catégorie d'emploi / Duty (IEC 60947-4-1)	AC3						
4	Relais thermique / Thermal overload relay							
5	Direct jusqu'à / Direct until	< 22 kW		<	kW			
6	Par 3 TC pour / By 3 CT's for	≥ 22 kW		>	kW			
7	Protection différentielle / Earth fault protection							
8	Relais numérique pour / Digital relay for			≥110 kW		>	kW	
9	Protection / Protection Code ANSI			37-46-49 or 49T- 50-51-51LR-66-86				
10	Contrôle / Control							
11	Réarmement / Reset (Intérieur / Inside – Extérieur / External)			Inside				
12	Boutons-poussoirs / Push buttons (Marche- Arrêt / Start - Stop)			No				
13	Commutateur / Switch (Local – Distance / Local - remote)			No				
14	Compteur horaire / Hour meter							
15	Signalisation / Indicating lights			Closed – Open - Fault				
16	Interface vers DCS / DCS interface							
17	Etat / Status			Run status				
18	Indisponible / Unavailable			Yes				
19	Défaut / Fault							
20	Commande / Command			Start / stop				
21	Calibre et type des appareils de coupure Rating and type of breaking devices		Plage Puissance Power range		Calibre Rating	Disjoncteur Circuit Breaker	Thermique Thermal range	Nombre de module/ Cubicle size
22				kW	A			
23				kW	A			
24				kW	A			
25				kW	A			
26				kW	A			
27				kW	A			
28				kW	A			
29				kW	A			
30				kW	A			
31				kW	A			
32				kW	A			
33				kW	A			

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DATA SHEET	N°
Project:	
DS EP ELE 135 Rev. 03 10/2012	Low voltage switchgear

Item N°	Description	Default values as per GS EP ELE 135		Données Spécifiques au projet / Particular project Datas		Données Fournisseur / Supplier Data	
1	Départ Distribution / Distribution feeder: Selon schéma type / As per typical						
2	Protection / Protection Code ANSI	49-51					
3	Contrôle / Control						
4	Réarmement / Reset (Intérieur / Inside – Extérieur / External)						
5	Boutons-poussoirs / Push buttons (Marche- Arrêt / Start - Stop)	Yes					
6	Commutateur / Switch (Local – Distance / Local - remote)	No					
7	Signalisation / Indicating lights	Closed – Open - Fault					
8	Interdéclenchement / Intertrip – Interverrouillage / Interlock						
9	Transformateur de Courant / Current transformer						
10	Nombre par cellule / Number	1 / Phase minimum					
11	Classe / Class						
12	Tore/Ring core type1/Feeder						
13	Calibre et type des appareils de coupure/ Rating and type of breaking devices	Plage Puissance: Power range		Calibre Rating	Disjoncteur Circuit Breaker	Thermique Thermal range	Nombre de module/ Cubicle size
14			kVA	A			
15			kVA	A			
16			kVA	A			
17			kVA	A			
18			kVA	A			
19			kVA	A			
20			kVA	A			
21			kVA	A			
22			kVA	A			