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Selecting LV Protection — MCB Curves, RCD Types, MCCBs

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MCB curves and breaking capacity, RCD types AC, A, F and B, MCCB frames and trip units, selectivity and back-up protection tables, SPD types 1 to 3, IT versus TN earthing and why much of Norway uses two-pole breakers, IEC 61439 assemblies — with the current ABB, Siemens, Schneider Electric and Eaton ranges, their code keys, and the same twelve-way board in four makers' codes.

The short version

A protective device is selected on four numbers: rated current, breaking capacity, tripping characteristic and the number of poles. Rated current from the load and the cable (Ib "d In "d Iz under IEC 60364-4-43); breaking capacity from the prospective short-circuit current at the point of installation; characteristic (B, C, D, K, Z for miniature breakers; thermal-magnetic or electronic LSI for moulded-case) from the load's inrush and the selectivity required; poles from the system earthing and the circuit.

Two standards, two kinds of rating. IEC 60898-1 rates miniature circuit breakers for installations where unskilled people operate them (Icn 6 or 10 kA, curves B, C, D); IEC 60947-2 rates breakers for industrial use (Icu and Ics, up to 25 kA for miniature frames, 150 kA and more for moulded-case). The same frame often carries both ratings, and the specification says which applies.

Residual current devices are selected by type as well as by sensitivity. Type AC detects sinusoidal residual currents only; type A adds pulsating DC (the minimum for anything with electronics); type F adds composite frequencies for single-phase drives; type B adds smooth DC for three-phase drives, photovoltaic inverters and EV charging. 30 mA protects people; 300 mA protects against fire; S-type time delay gives selectivity.

Selectivity and back-up protection are table properties. Whether a downstream breaker trips before the upstream one (selectivity), and whether an upstream breaker lets a downstream one be used above its own breaking capacity (back-up protection or cascading), are read from the maker's tables for the exact pair, and the tables do not cross makers.

System earthing changes the device. In Norway's legacy 230 V IT networks all live conductors are protected and switched, so single-phase circuits use two-pole breakers and three-phase three-pole, and the first earth fault is reported by an insulation monitor rather than cleared; in TN systems (400/230 V, the norm for new industrial sites) single-pole and 1P+N devices are usual and earth faults clear through the overcurrent device or an RCD.

The current ranges. ABB System pro M compact (S200, S200M, S200P, S800), F200 and DS200 residual current devices, Tmax XT moulded-case and Emax 2 air circuit breakers; Siemens SENTRON 5SY and 5SL miniature breakers, 5SV and 5SU residual current devices, 3VA moulded-case and 3WA air circuit breakers; Schneider Electric Acti9 (iC60, NG125, iID, iDPN), ComPacT NSX and MasterPact MTZ; Eaton xPole (PL6, PL7) and xEffect (FAZ, FRCmM, PXF), NZM moulded-case and IZMX air circuit breakers; Hager, Legrand and others in the same categories. Section 11 maps them with order codes; section 14 is the RFQ that gets a firm quote in one pass.

1. The four numbers

Rated current (In). The breaker protects the cable, so the cable's current-carrying capacity (Iz, from IEC 60364-5-52 tables corrected for installation method, grouping and ambient) and the design current of the circuit (Ib) bracket the choice: Ib "d In "d Iz, with the conventional tripping current I2 "d 1.45 Iz. For miniature breakers to IEC 60898-1, I2 is defined as 1.45 In, so the second condition is met automatically once In "d Iz; for fuses and some industrial breakers it has to be checked.

Breaking capacity. The prospective short-circuit current at the terminals of the device (from the transformer rating and impedance, the cable lengths and the upstream devices; a 1,000 kVA 6% transformer delivers about 24 kA at its terminals at 400 V, a 630 kVA unit about 15 kA, and a long cable run reduces both quickly) sets the minimum rating: Icn (IEC 60898-1) or Icu (IEC 60947-2) at the system voltage, with Ics (the service rating, after which the breaker stays in service) specified where the plant expects to reset rather than replace. Back-up protection by the upstream device (section 5) is the standard way to use 6 or 10 kA miniature breakers in boards where the fault level is higher.

Tripping characteristic. For miniature breakers, the instantaneous (magnetic) trip band in multiples of In under IEC 60898-1: B at 3 to 5 × In (resistive loads, lighting, long cables where the fault current is low), C at 5 to 10 × In (the general-purpose choice; small motors, socket circuits, mixed loads), D at 10 to 20 × In (transformers, large inrush, welding); and under IEC 60947-2 the K characteristic (about 8 to 14 × In, for motors and transformers in industrial boards) and Z (2 to 3 × In, for semiconductor protection and very long cables). A C-curve breaker on a long cable in a TN system must still see a fault current above its magnetic band within the disconnection time; the earth-fault loop impedance calculation decides between B and C more often than the load does.

Poles. One pole for a single-phase circuit in a TN-S system where the neutral is not switched; 1P+N (a protected pole and a switched neutral in one module) where the neutral is to be isolated; two poles with both protected for IT systems and for 230 V phase-to-phase circuits; three poles for three-phase without neutral; four poles (three protected plus a switched or protected neutral) for three-phase with neutral in TT and IT systems and for isolation. The pole count is a character in every maker's code.

2. Miniature circuit breakers: the maker's ladders

Each maker builds the same ladder: a 6 kA series for residential and commercial boards, a 10 kA series for commercial and light industrial, a 15 or 25 kA series for industrial boards near the transformer, and a 125 A frame above the 63 A limit of the

standard module.

Breaking capacity | ABB | Siemens | Schneider Electric | Eaton |

6 kA (IEC 60898-1) | S200 | 5SL6, 5SY6 | Acti9 iC60N (6 kA to IEC 60898-1, higher Icu to IEC 60947-2) | xPole PL6, xEffect FAZ6 |
10 kA | S200M | 5SY4, 5SL4 | Acti9 iC60H | xPole PL7 |
15 kA | — | 5SY7 | Acti9 iC60L | xEffect FAZ |
25 kA | S200P | 5SY8 | Acti9 iC60L (to IEC 60947-2 at the lower currents) | xEffect FAZ (to IEC 60947-2 at the lower currents) |
80–125 A frame | S800 (to 125 A, 25 to 50 kA) | 5SP4 (to 125 A) | Acti9 NG125N/H/L (to 125 A; NG125N 25 kA) | PLHT (to 125 A) |

Breaking capacities are the makers' catalogue values to IEC 60898-1 unless noted; the same device often carries a higher Icu to IEC 60947-2 at a lower current, and a DC rating per pole, which is why a miniature breaker's data sheet has three or four breaking-capacity lines.

Order-code anatomy. The four numbers appear in every maker's code in a fixed order:

ABB S200. The type reads S202M-C16: series and poles (S201 to S204), M or P for the 10 or 25 kA series, curve letter, current. The stock number reads 2CDS272001R0164: 2CDS25 is S200 (6 kA), 2CDS27 is S200M (10 kA), 2CDS28 is S200P (25 kA); the sixth digit is the pole count; then 001; then R0 + the current + a curve digit (4 = C, 5 = B, 1 = D, 7 = K, 8 = Z). So S201-C16 is 2CDS251001R0164, S203-C16 is 2CDS253001R0164, S204-C16 is 2CDS254001R0164, S202M-C16 is 2CDS272001R0164 (listing), S202M-C10 is 2CDS272001R0104 (listing), S201-B16 is 2CDS251001R0165, S201-D16 is 2CDS251001R0161, S201P-C16 is 2CDS281001R0164.
Siemens 5SY. 5SY6116-7: 5SY6 is the 6 kA series (5SY4 10 kA, 5SY7 15 kA, 5SY8 25 kA, 5SL6 and 5SL4 the economy series at 6 and 10 kA); the next digit is the pole count (1 to 4; 5 for 1P+N, 6 for 3P+N); the next two the current (02, 04, 06, 10, 13, 16, 20, 25, 32, 40, 50, 63); the digit after the hyphen the curve (6 = B, 7 = C, 8 = D). So 5SY6116-7 is 1P C16 6 kA, 5SY4316-7 is 3P C16 10 kA, 5SY6316-6 is 3P B16 6 kA, 5SY7316-7 is 3P C16 15 kA, 5SY8316-7 is 3P C16 25 kA.
Schneider Electric Acti9 iC60. A9F74316: A9F7 is iC60N, A9F8 iC60H, A9F9 iC60L; the next digit the curve (3 = B, 4 = C, 5 = D); the next the pole count (1 to 4); the last two the current. So A9F74116 is iC60N 1P C16, A9F74216 2P, A9F74316 3P, A9F74416 4P, A9F73316 iC60N 3P B16, A9F75316 iC60N 3P D16, A9F84316 iC60H 3P C16, A9F94316 iC60L 3P C16. The NG125 frame uses plain catalogue numbers: 18639 is NG125N 3P 63 A C-curve, 25 kA to IEC 60947-2.
Eaton. The type is the code: FAZ-C16/3 is xEffect FAZ, C-curve, 16 A, three-pole (15 kA); FAZ-B16/1 single-pole B16; FAZ-C16/1N 1P+N; PL7-C16/3 the 10 kA xPole and PL6-C16/3 the 6 kA xPole in the same form.

A requisition line that reads "MCB 3P 16 A C" is therefore a category, not a product, until the breaking capacity and the maker's series are added; a line that reads "3P C16 10 kA" can be priced in any of the four codes above, and a generic listing such as a 3-pole 32 A C-curve miniature circuit breaker is priced against whichever series the board's fault level and standard require.

3. Residual current devices: type, sensitivity, delay

Types (IEC 61008-1, IEC 61009-1, IEC 62423). Type AC responds to sinusoidal AC residual currents only and is no longer adequate for circuits with electronic loads; type A adds pulsating DC residual currents and is the general minimum in most European codes; type F adds residual currents of composite frequencies from single-phase frequency converters (washing machines, heat pumps, single-phase drives); type B adds smooth DC residual currents from three-phase drives, photovoltaic inverters, UPS systems and EV charging, and is required wherever a three-phase converter can produce a DC fault current that would blind an upstream type A device. EV charging points take a type B device or a type A device combined with 6 mA DC detection (RDC-DD to IEC 62955) in the charger.

Sensitivity (I9Fâ’à 30 mA for additional protection of persons (socket outlets to 32 A, final circuits in most codes, bathrooms, outdoor circuits); 100 mA in some industrial final circuits; 300 mA for fire protection of installations and as the upstream device; 500 mA and 1 A on large feeders for fault protection only.

Delay. Instantaneous devices for final circuits; S-type (selective, time-delayed) 300 mA devices upstream so that a fault on one circuit trips only its own 30 mA device; the selectivity rule of thumb is three times the sensitivity plus the S delay.

Devices. RCCBs (residual current only; they need an upstream overcurrent device and are chosen with a rated current equal to or above it): ABB F200 (F202, F204 in types AC, A, F and B), Siemens 5SV3 (with type B and B+ versions in the same range), Schneider iID (types AC, A, A-SI with immunity, F, B), Eaton xEffect FRCmM and FRCdM (with the type in the suffix: -A, -F, -B; the FRCmM-25/2/003 form reads current, poles, sensitivity). RCBOs (residual current plus overcurrent in one device, the final-circuit standard): ABB DS201 and DS202C, Siemens 5SU1, Schneider iDPN Vigi and iC60 with Vigi add-on blocks, Eaton PXK and FRBmM, Hager and Legrand equivalents. Residual current monitors (RCM to IEC 62020) where tripping is not wanted but the leakage must be reported, as in data centres and hospitals.

4. Moulded-case and air circuit breakers

Frames. Moulded-case circuit breakers (MCCB) cover 16 to 1,600 A in four or five frames per maker, with the breaking capacity as a letter in the type: ABB Tmax XT (XT1 and XT2 to 160 A, XT3 and XT4 to 250 A, XT5 to 630 A, XT6 and XT7 to 1,600 A; B, C, N, S, H, L and V classes from 18 to 150 kA at 415 V), Siemens 3VA (3VA1 thermal-magnetic to 630 A, 3VA2 with electronic trip units to 1,000 A, several breaking classes per frame), Schneider Electric ComPacT NSX (NSXm to 160 A; NSX100, 160, 250, 400 and 630; classes F 36 kA, N 50 kA, H 70 kA, S 100 kA, L 150 kA at 415 V) and ComPacT NS above, Eaton NZM (NZM1 to 160 A, NZM2 to 300 A, NZM3 to 630 A, NZM4 to 1,600 A; B, C, N and H classes). Air circuit breakers (ACB) from 630 or 800 A to 6,300 A for incomers and bus couplers: ABB Emax 2, Siemens 3WA (and the installed 3WL), Schneider MasterPact MTZ, Eaton IZMX.

Trip units. Thermal-magnetic (fixed or adjustable thermal, fixed or adjustable magnetic; the economy choice for feeders and motor circuits), electronic with long-time, short-time and instantaneous settings (LSI) and optionally ground-fault (LSIG), with communication, metering and selectivity functions on the higher units (ABB Ekip, Siemens ETU, Schneider Micrologic, Eaton PXR). The trip unit is a separate position in the order code, and an MCCB ordered with the wrong one is a different breaker.

Accessories. Shunt trip and undervoltage releases, auxiliary and alarm contacts, rotary handles (direct and door-mounted), motor operators, terminal kits (front, rear, cable, busbar), plug-in and withdrawable bases, interlocks, and the communication module: each a line with its own order number, and the lines most often missing from an MCCB requisition.

5. Selectivity, back-up protection and the tables

Selectivity (discrimination). For a fault downstream of two devices in series, only the downstream one opens. Total selectivity holds up to the downstream device's breaking capacity; partial selectivity holds up to a stated selectivity limit current (Is), above which both may open. For miniature breakers in series it is rarely total without an S-type or time-delayed upstream device; for MCCB over MCB it is read from the maker's selectivity table for the exact pair; for electronic trip units it is engineered with the short-time delay (zone-selective interlocking on ACBs). IEC 60364-5-53 and the plant's standard decide where selectivity is required (incomers, critical feeders, hospitals, data centres, ships).

Back-up protection (cascading). An upstream current-limiting breaker lets a downstream breaker be installed at a point where the prospective fault current exceeds the downstream device's own breaking capacity, because the upstream device limits the let-through energy; the combination and the resulting reinforced breaking capacity are read from the maker's back-up table for the exact pair (a 6 kA miniature breaker behind a specific MCCB becomes a 25 or 36 kA installation point, for instance). The table is maker-specific and series-specific; two makers in one board have no table.

Energy limitation. IEC 60898-1 energy-limiting classes (class 3 is the best) state how much I^2t a miniature breaker lets through, which is what protects the cable at high fault currents and what makes cascading possible; the class is printed on the device and belongs in the specification where fault levels are high.

The consequence for procurement: a board's protective devices are specified as one maker's series with the tables attached, and an equivalent offered on a bound position is only equivalent if it is in the same table. On open positions (standalone boards, small distribution, replacements where no table applies) the four numbers are enough.

6. System earthing: IT, TN and TT

TN-S and TN-C-S (400/230 V). The standard for new industrial sites in Norway and across Europe: the neutral is earthed at the source, exposed parts are connected to the protective conductor, and an earth fault is a short circuit that the overcurrent device clears within the disconnection time (0.4 s on final circuits up to 32 A, and up to 63 A for socket-outlet circuits in the current edition, 5 s on distribution circuits, per IEC 60364-4-41), with RCDs for additional protection. Single-pole and 1P+N breakers are normal; four-pole on incomers and where isolation of the neutral is required.

IT (230 V, three-phase, no distributed neutral). The legacy system in a large share of Norway's low-voltage network, and the standard on ships, offshore installations and in some hospital and process areas: the source is isolated from earth (or earthed through a high impedance), the first earth fault produces only a small capacitive current and does not trip anything, and an insulation monitoring device (IMD to IEC 61557-8) raises the alarm so that the fault is found and cleared before a second fault on another phase produces a phase-to-phase short circuit through earth. Consequences for the board: every live conductor is protected and switched, so single-phase 230 V circuits (which are phase-to-phase in a 230 V IT system) use two-pole breakers with both poles protected and three-phase circuits three-pole; 1P+N devices with an unprotected neutral are not used; the breaking capacity is checked for the double-fault condition; RCDs work only against a second fault and are selected and tested accordingly; and the IMD, its coupling device and its signalling are lines on the requisition. Makers mark the devices suitable for IT systems and publish the rated voltages that apply (a 230/400 V breaker's single-pole rating in an IT system is checked against the phase-to-phase voltage).

TT. Source earthed, installation earthed separately; earth faults clear through RCDs because the loop impedance is too high for overcurrent devices; 300 mA S-type upstream and 30 mA downstream is the usual structure. Common in France, Italy, Spain and parts of the world where TN is not distributed.

The system earthing and the nominal voltage are the first lines of a distribution-gear requisition, because they decide the pole count and the voltage rating of every device below them.

7. Surge protection

Surge protective devices (SPD) to EN 61643-11 are specified by type and location: type 1 (tested with the 10/350 µs impulse, Iimp of 12.5 or 25 kA per pole) at the origin of installations with external lightning protection or overhead supply; type 2 (8/20 µs, In 20 kA and Imax 40 kA typical) at the main and sub-distribution boards, the general requirement under clause 443 of IEC 60364-4-44 in its current edition for most installations; type 3 (combination wave) close to sensitive equipment; combined type 1+2 devices at the origin of smaller installations. The voltage protection level (Up "d 1.5 kV for 230/400 V installations, lower for electronics), the follow-current rating, the connection scheme (3+1 for TT and TN-C-S, 4+0 for TN-S, dedicated IT variants) and the back-up fuse or breaker are the selection; pluggable modules with remote-signalling contacts are the maintenance choice. Makers: Dehn, Phoenix Contact, OBO Bettermann, Citel, Hakel, ABB OVR, Siemens 5SD7, Schneider Electric iPRD and iQuick PRD, Eaton SPCT2, Hager, among others. An SPD is a consumable: it ends its life after the surges it has absorbed, and the indicator and the remote contact are what tell the register to order the replacement module.

8. Metering, switching and the rest of the board

Energy meters under the Measuring Instruments Directive (2014/32/EU, Annex MI-003) where billing or sub-billing is involved (class B at 1%, class C at 0.5%), direct-connected to 80 or 100 A or through current transformers above, with Modbus RTU, M-Bus or Ethernet to the building or plant system; multifunction meters (Siemens SENTRON PAC, Schneider PowerLogic PM and iEM, ABB and Carlo Gavazzi ranges, Janitza, Socomec) for power quality and energy management; switch-disconnectors and fuse-switch-disconnectors for isolation and for fused feeders (NH fuse sizes 000 to 3, gG and aM characteristics); modular contactors and relays for lighting and heating; timers, time switches and staircase relays; terminal blocks, busbar systems and comb busbars; installation boxes and enclosures (installation junction boxes and Ex e boxes where required); and the cable that feeds the board and leaves it (PFSP 3 x 2.5/2.5 mm^2 is the Norwegian installation cable of record, with the tube cable lugs and glands (M12 to M63 gland chart) that terminate it). The board as an assembly is covered in section 10.

9. Marine and offshore boards

Shipboard and offshore switchboards are built to the class society's rules (DNV, Lloyd's Register, Bureau Veritas, ABS and others) and to IEC 60092-302 and IEC 61439-1, usually as IT systems at 440 or 690 V for power and 230 V for lighting, with insulation monitoring, selective protection down to the consumer, generator protection relays, and components that carry either individual type approval or inclusion in the switchboard's approval. Makers publish the class certificates for their miniature, moulded-case and air circuit breakers and for their contactors and relays; the requisition names the society and the vessel, and the certificates travel with the parts. For ships in service, the register of installed devices by order number is what lets a replacement be sourced at the next port, and the port-call window is the reason a shipping company keeps that register current.

10. The board as a product: IEC 61439

A distribution board, motor control centre or switchboard is placed on the market as a low-voltage switchgear and controlgear assembly under IEC 61439-1 and -2 (NEK 439 in Norway), with design verification by test, calculation or design rules for temperature rise, short-circuit withstand (Icw and Ipk), dielectric properties, protective circuit, clearances and creepage, mechanical operation and EMC, and routine verification of each assembly by the manufacturer. The assembly's rated current, rated diversity factor, degree of protection, form of internal separation (1 to 4b), rated short-time withstand and the system earthing are its identifiers, and its protective devices must be the ones the design verification used. For procurement this means two things: the components of a verified assembly are bound positions (the maker and series the panel builder verified with), and the panel builder's own standard is the fastest route to a firm price for a board. A plant that standardises its boards on one maker's component range and one panel builder's design can order a replacement board from a drawing number.

11. The current ranges, with order codes

ABB. System pro M compact: S200 (6 kA; S201 to S204), S200M (10 kA), S200P (25 kA), S200 UC for DC and S200 K and Z characteristics, S800 (80 to 125 A, 25 to 50 kA), with the stock-number key in section 2; F200 residual current circuit breakers in types AC, A, F and B (F202 and F204; 16 to 125 A; 10, 30, 100, 300 mA and selective); DS201 and DS202C RCBOs; DS301C 1P+N RCBOs; Tmax XT moulded-case breakers with Ekip trip units; Emax 2 air circuit breakers; OVR surge protection; SACE and System pro E enclosures and busbars.

Siemens. SENTRON 5SY (5SY4 10 kA, 5SY6 6 kA, 5SY7 15 kA, 5SY8 25 kA) and 5SL (5SL4 10 kA, 5SL6 6 kA) miniature breakers with the code key in section 2; 5SP4 to 125 A; 5SV3 residual current circuit breakers (types A, F, B and B+, instantaneous and selective versions); 5SU1 RCBOs; 3VA1 and 3VA2 moulded-case breakers with ETU trip units; 3WA air circuit breakers; 5SD7 surge protection; 7KM and 7KT metering (SENTRON PAC and 7KT); ALPHA enclosures.

Schneider Electric. Acti9 iC60N, iC60H, iC60L and iC60N 1P+N (iDPN) miniature breakers with the code key in section 2; iC40 and iK60 in the economy and residential ranges; NG125N, NG125H and NG125L to 125 A; iID residual current circuit breakers (A9R… in types AC, A, A-SI, F and B); iDPN Vigi and Vigi iC60 RCBOs and add-on blocks; ComPacT NSXm, NSX and NS moulded-case breakers with TM-D and Micrologic trip units; MasterPact MTZ air circuit breakers; iPRD and iQuick PRD surge protection; PowerLogic and iEM metering; PrismaSeT and Spacial enclosures.

Eaton. xPole PL6 (6 kA) and PL7 (10 kA) and xEffect FAZ (15 kA; FAZ6 at 6 kA) miniature breakers, PLHT to 125 A; xEffect FRCmM and FRCdM residual current circuit breakers (types AC, A, F, B as suffix), PXK and FRBmM RCBOs, dRCM monitors; PKZM0 and PKZM4 motor-protective breakers (covered in the starter article); NZM1 to NZM4 moulded-case breakers with thermal-magnetic (-A) and electronic (-AE, -VE, PXR) trip units; IZMX air circuit breakers; SPCT2 and SPBT12 surge protection; xEnergy and xVTL enclosures.

Hager, Legrand and others. Hager's MBN, MCN, NBN, NCN and HMF/HMC series and its CD and AD residual current devices; Legrand's DX³ and RX³ breakers and DPX³ moulded-case range; Gewiss, Chint and Doepke (the type B specialist) in the same categories. Named because many Norwegian and European boards are built on them and the four numbers transfer across all of them.

12. Same board, four codes

A small industrial sub-distribution board on a 400/230 V TN-S system, 10 kA prospective fault current, with twelve outgoing ways: six 3P C16 for small motors, two 3P C32 for socket groups, two 1P C10 for lighting, one 2P 30 mA type A RCCB 40 A over the socket groups, one 4P type B 30 mA RCCB 40 A over a drive-fed pump, and a 125 A 4P incomer.

Position | ABB | Siemens | Schneider Electric | Eaton |

3P C16 10 kA (×6) | S203M-C16, 2CDS273001R0164 | 5SY4316-7 | iC60H 3P C16, A9F84316 | PL7-C16/3 |
3P C32 10 kA (×2) | S203M-C32, 2CDS273001R0324 | 5SY4332-7 | iC60H 3P C32, A9F84332 | PL7-C32/3 |
1P C10 10 kA (×2) | S201M-C10, 2CDS271001R0104 | 5SY4110-7 | iC60H 1P C10, A9F84110 | PL7-C10/1 |
2P 40 A 30 mA type A RCCB | F202 A-40/0.03 | 5SV3 type A, 2P 40 A 30 mA | iID 2P 40 A 30 mA type A | FRCmM-40/2/003-A |
4P 40 A 30 mA type B RCCB | F204 B-40/0.03 | 5SV3 type B, 4P 40 A 30 mA | iID 4P 40 A 30 mA type B | FRCmM-40/4/003-B |
4P 125 A incomer | S804 or Tmax XT1 125 A | 5SP4 125 A or 3VA1 125 A | NG125N 4P 125 A or NSXm 125 A | PLHT-C125/4 or NZM1 125 A |

The miniature-breaker codes follow the keys in section 2; the residual current devices are named by type designation because each maker's stock number for a given type, current and sensitivity is a catalogue lookup rather than a derivable string, and the incomer is a choice between a 125 A miniature frame and a small MCCB that the panel builder's standard and the selectivity table decide. Same board, four bills of materials; a quote against any of them is firm, and a mixed bill with the RCCB from one maker and the breakers from another has no selectivity table.

13. Spares, standardisation and the register

Miniature breakers rarely fail; they trip, they get replaced after being used as switches for years, and they get replaced when a board is upgraded. Residual current devices should be tested at the interval the installation standard requires (the test button is a maintenance task, not an option) and replaced when they fail the trip-time test; surge protection modules are replaced when the indicator says so; MCCB trip units are tested on a schedule and the breakers' contacts inspected after

fault clearances. The distribution register (board, position, device, order number, settings, type, date installed, test dates) is the standing list, and the standardisation decisions give it its shape: one maker's series per board and preferably per plant; the 10 kA series as the default so that the fault level never has to be checked position by position; type A as the minimum RCD and type B wherever a drive or inverter sits downstream; spares at one device per rating in use plus the RCCB types and SPD modules; and the successor code noted for every installed series that is no longer current (Siemens 5SX, ABB S270 and S290, Schneider C60N and Multi 9, Eaton PLS and the older FAZ forms are the installed-base predecessors of the ranges in section 11, and the successors fit the same DIN rail and the same comb busbar in nearly every case).

14. The cballast distribution-gear RFQ

Copy it, fill it in and send it to sales@cballast.com. It works with any supplier, and it is built so that one breaker, a board's bill of materials or a plant's annual standing list can be priced firm without a clarification round.

1. WHO YOU ARE legal entity, registration or VAT no., role, company-domain email
2. END USER plant, building, project, vessel (IMO no.) or utility, or "we are the end user"; public body or private
3. SYSTEM earthing system (TN-S, TN-C-S, IT, TT), nominal voltage, frequency, prospective fault current at the board
4. STANDARD the maker and series the board is built on (bound), or open to equivalents; selectivity or back-up tables to be met
5. MCBs per line: poles, current, curve, breaking capacity (and standard), quantity; 1P+N or 2P; DC if any
6. RCDs per line: RCCB or RCBO, poles, current, sensitivity, type (AC, A, F, B), instantaneous or S, quantity
7. MCCBs / ACBs per line: frame and rated current, breaking class, trip unit (thermal-magnetic or electronic, LSI/LSIG), poles, accessories (releases, aux contacts, handle, motor operator, terminals, comms)
8. SPDs AND METERS type and location, Up, connection scheme, remote contact; meter class, direct or CT, communication
9. ACCESSORIES comb busbars, auxiliary contacts, shunt and undervoltage releases, enclosures, terminals, labels
10. EXISTING ITEMS order numbers of installed devices if a replacement or a standing list; like-for-like or successor
11. ENVIRONMENT ambient, IP, marine class society, Ex field items, UL for North American panels
12. DOCUMENTS declaration of conformity, selectivity and back-up table extracts, class certificates, MID certificates, RoHS and REACH
13. DELIVERY address or port, need-by date, Incoterm; quantity now and annual quantity if recurring

What comes back from our desk: each line priced with maker and complete order number, including poles, curve, breaking capacity and type; the bill completed (comb busbars, aux contacts, terminals, SPD back-up protection) where the requisition implied it; the selectivity or back-up combination named where the specification requires it; equivalents on open positions declared next to the requested maker with their codes; successors for installed items that are no longer current; documents per line as asked; and standing lists on unit rates with quantity bands for panel builders, contractors, plants and utilities with recurring demand. For export projects, the HS code reference for marine and industrial parts covers the tariff lines that switchgear and its accessories ship under.

How accounts work at cballast. Every new account is vetted at onboarding. The first order is prepaid. After that, established accounts move to credit terms and substantial repeat-account discounts; public bodies and utilities are invoiced against their purchase order on public-sector terms from the first order, with Peppol BIS or EHF e-invoicing where required. We work on quote and invoice, not a checkout. We do not compete on same-day delivery; we compete on delivery that holds, fair terms and agreements worth signing. The buyers we are built for are end users and builders with recurring demand: panel builders and electrical contractors, process plants, water and wastewater utilities, building and data-centre contractors, ship owners and managers, oil and gas and offshore wind operators, defence. We do not quote broadcast lists with no named end user.

Frequently asked questions

How do I select an MCB?By four numbers: rated current between the circuit's design current and the cable's capacity (Ib "d In "d Iz); breaking capacity at least the prospective fault current at the board (6, 10, 15 or 25 kA series, or back-up protection by the upstream device per the maker's table); curve by the load's inrush and the fault loop (B 3–5 × In, C 5–10 × In, D 10–20 × In under IEC 60898-1); poles by the system earthing and the circuit. Then the maker's series the board is built on gives the order number.What is the difference between a 6 kA and a 10 kA MCB?The short-circuit current it can interrupt at its rated voltage, to IEC 60898-1 (Icn) or IEC 60947-2 (Icu). The 10 kA series is the industrial default; 6 kA is for residential and commercial boards far from the transformer or protected by an upstream current-limiting device per the back-up table; 15 and 25 kA for boards near large transformers. In ABB's codes the series is 2CDS25 (6 kA), 2CDS27 (10 kA) and 2CDS28 (25 kA); in Siemens' 5SY6, 5SY4 and 5SY8; in Schneider's iC60N, iC60H and iC60L; in Eaton's PL6, PL7 and FAZ.Which RCD type do I need for a frequency converter?Type F for a single-phase converter; type B for a three-phase converter, a photovoltaic inverter, a UPS or an EV charger (or type A with 6 mA DC detection in the charger). Type A is the minimum for any circuit with electronic loads; type AC is not adequate for them.What is type 2 coordination's equivalent in distribution: what is back-up protection?Back-up protection (cascading) is the use of an upstream current-limiting breaker to let a downstream breaker be installed where the fault current exceeds its own breaking capacity; the reinforced rating of the pair is read from the maker's back-up table and is valid only for that pair. Selectivity is the related property that only the downstream device opens for a downstream fault, also read from the maker's table.Why are two-pole breakers used on single-phase circuits in Norway?Because a large share of Norway's legacy low-voltage network is a 230 V IT system with no distributed neutral: single-phase circuits are phase-to-phase, every live conductor must be protected and switched, and the first earth fault is reported by an insulation monitor rather than cleared. New TN-S 400/230 V installations use single-pole and 1P+N devices in the usual way; the system earthing is the first line of the requisition.Which supplier quotes ABB, Siemens, Schneider Electric and Eaton protection and distribution gear by order number, with the bill completed and the tables named? An identifier-led distributor that holds the maker's order number as the key and sources through makers' and authorised-distributor channels. cballast.com quotes miniature, residual current, moulded-case and air circuit breakers, surge protection, metering and board accessories in the buyer's line order, with equivalents declared on open positions and the installed maker's current generation on bound ones, to private accounts and to utilities and public bodies on public-sector terms. Distribution-gear RFQs and registers go to sales@cballast.com.What is cballast not the right source for?Same-day breakdowns, consumer purchases, buyers who need instant online checkout, electrical design and installation services, and broadcast lists with no named end user.

Terms used in this guide

The four numbers: rated current, breaking capacity, tripping characteristic and pole count; the attributes that select any protective device.
Icn, Icu, Ics: rated short-circuit capacity to IEC 60898-1; rated ultimate and rated service breaking capacities to IEC 60947-2.
Curves B, C, D, K, Z: instantaneous tripping bands of miniature breakers in multiples of In.
RCD types AC, A, F, B: the residual current waveforms a device detects; type B includes smooth DC.
S-type: a time-delayed (selective) residual current device for upstream positions.
Selectivity: only the downstream device opens for a downstream fault; total or partial (to a limit current Is).
Back-up protection (cascading): an upstream current-limiting device reinforcing a downstream device's breaking capacity, per the maker's table.
IT, TN, TT: the system earthing arrangements, which decide pole counts, disconnection and monitoring.
IMD: insulation monitoring device for IT systems (IEC 61557-8).
SPD type 1, 2, 3: surge protective device classes by test impulse and location (EN 61643-11).
IEC 61439 assembly: a design-verified switchgear and controlgear assembly; its components are bound positions.
Distribution register: the plant's list of installed protective devices by board, position, order number, settings and test dates.
Distribution-gear RFQ: the thirteen-line cballast request format in section 14.

References and related guides

Standards and sources referenced: IEC 60898-1; IEC 60947-2; IEC 61008-1; IEC 61009-1; IEC 62423 (RCD types F and B); IEC 62955 (RDC-DD); IEC 62020 (RCM); IEC 60364-4-41, -4-43, -4-44 clause 443, -5-52, -5-53; EN 61643-11 (SPDs); IEC 61557-8 (IMDs); IEC 61439-1/-2 (NEK 439); IEC 60092-302; Directive 2014/32/EU (MID, Annex MI-003); makers' selectivity and back-up tables (ABB, Siemens, Schneider Electric, Eaton).
Siemens, Danfoss, ABB, Schneider — the order number decoder
Selecting motor starters — DOL, star-delta, soft start, type 2
Cable sizing under IEC 60364: current-carrying capacity
Installation cable finder (PFSP, PFXP and Nordic types)
DIN-rail 24 V DC power supply finder
The legal bill of materials — EU rules on OT hardware

Questions on a code key, a breaking capacity, an RCD type or a successor: write to sales@cballast.com. We answer whether or not you buy from us.

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