





## Main

|                                    |                                                                                                                                 |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Range of product                   | Altivar Process ATV600                                                                                                          |
| Product or component type          | Variable speed drive                                                                                                            |
| Product specific application       | Process and utilities                                                                                                           |
| Device short name                  | ATV650                                                                                                                          |
| Variant                            | Standard version                                                                                                                |
| Product destination                | Synchronous motors<br>Synchronous motors                                                                                        |
| EMC filter                         | Integrated with 150 m conforming to EN/IEC 61800-3 category C3<br>Integrated with 50 m conforming to EN/IEC 61800-3 category C2 |
| IP degree of protection            | IP55 conforming to IEC 60529<br>IP55 conforming to IEC 61800-5-1                                                                |
| Type of cooling                    | Forced convection                                                                                                               |
| Supply frequency                   | 50...60 Hz - 5...5 %                                                                                                            |
| [Us] rated supply voltage          | 380...480 V - 15...10 %                                                                                                         |
| Motor power kW                     | 15 KW (heavy duty)<br>22 kW (normal duty)                                                                                       |
| Motor power hp                     | 20 Hp heavy duty<br>30 hp normal duty                                                                                           |
| Line current                       | 28.9 A at 480 V (normal duty)<br>27.7 A at 380 V (heavy duty)<br>24.4 A at 480 V (heavy duty)<br>39.6 A at 380 V (normal duty)  |
| Prospective line I <sub>sc</sub>   | 50 kA                                                                                                                           |
| Apparent power                     | 20.3 KVA at 480 V (heavy duty)<br>28.6 kVA at 480 V (normal duty)                                                               |
| Continuous output current          | 31.7 A at 4 kHz for heavy duty<br>46.3 A at 4 kHz for normal duty                                                               |
| Maximum transient current          | 47.6 A during 60 s (heavy duty)<br>50.9 A during 60 s (normal duty)                                                             |
| Asynchronous motor control profile | Optimized torque mode<br>Constant torque standard<br>Variable torque standard                                                   |
| Synchronous motor control profile  | Synchronous reluctance motor<br>Permanent magnet motor                                                                          |
| Output frequency                   | 0.0001...0.5 kHz                                                                                                                |
| Speed drive output frequency       | 0.1...599 Hz                                                                                                                    |
| Nominal switching frequency        | 4 kHz                                                                                                                           |
| Switching frequency                | 4...12 kHz with derating factor<br>2...12 kHz adjustable                                                                        |
| Safety function                    | STO (safe torque off) SIL 3                                                                                                     |
| Discrete input logic               | 16 preset speeds                                                                                                                |

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Communication port protocol | Modbus serial<br>Modbus TCP<br>Modbus TCP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Option card                 | Slot A: communication module, Profinet<br>Slot A: communication module, DeviceNet<br>Slot A: communication module, Modbus TCP/EtherNet/IP<br>Slot A: communication module, CANopen daisy chain RJ45<br>Slot A: communication module, CANopen SUB-D 9<br>Slot A: communication module, CANopen screw terminals<br>Slot A/slot B: digital and analog I/O extension module<br>Slot A/slot B: output relay extension module<br>Slot A: communication module, Ethernet IP/Modbus TCP/MD-Link<br>Communication module, BACnet MS/TP<br>Communication module, Ethernet Powerlink<br>Slot A: communication module, Profibus DP V1 |

## Complementary

|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mounting mode                       | Wall mount                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Output voltage                      | $\leq$ power supply voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Permissible temporary current boost | 1.5 x I <sub>n</sub> during 60 s (heavy duty)<br>1.1 x I <sub>n</sub> during 60 s (normal duty)                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Motor slip compensation             | Automatic whatever the load<br>Not available in permanent magnet motor law<br>Adjustable<br>Automatic whatever the load                                                                                                                                                                                                                                                                                                                                                                                                      |
| Acceleration and deceleration ramps | Linear adjustable separately from 0.01...9999 s                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Braking to standstill               | By DC injection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Protection type                     | Safe torque off: motor<br>Motor phase break: motor<br>Thermal protection: drive<br>Safe torque off: drive<br>Overheating: drive<br>Overcurrent between output phases and earth: drive<br>Overload of output voltage: drive<br>Short-circuit protection: drive<br>Motor phase break: drive<br>Overvoltages on the DC bus: drive<br>Line supply overvoltage: drive<br>Line supply undervoltage: drive<br>Line supply phase loss: drive<br>Overspeed: drive<br>Break on the control circuit: drive<br>Thermal protection: motor |
| Frequency resolution                | Analog input: 0.012/50 Hz<br>Display unit: 0.1 Hz                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Electrical connection               | Line side: screw terminal 10...16 mm <sup>2</sup> /AWG 8...AWG 6<br>Motor: screw terminal 10...16 mm <sup>2</sup> /AWG 8...AWG 6<br>Control: removable screw terminals 0.5...1.5 mm <sup>2</sup> /AWG 20...AWG 16                                                                                                                                                                                                                                                                                                            |
| Connector type                      | RJ45 (on the remote graphic terminal) for Modbus serial<br>RJ45 (on the remote graphic terminal) for Ethernet/Modbus TCP                                                                                                                                                                                                                                                                                                                                                                                                     |
| Exchange mode                       | Half duplex, full duplex, autonegotiation Ethernet/Modbus TCP                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Number of addresses                 | 1...247 for Modbus serial                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Method of access                    | Slave Modbus TCP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Supply                              | Internal supply for reference potentiometer (1 to 10 kOhm): 10.5 V DC +/- 5 %, <10 mA, protection type: overload and short-circuit protection<br>Internal supply for digital inputs and STO: 24 V DC (21...27 V), <200 mA, protection type: overload and short-circuit protection<br>External supply for digital inputs: 24 V DC (19...30 V), <1.25 mA, protection type: overload and short-circuit protection                                                                                                               |
| Local signalling                    | 3 LEDs (dual colour) for embedded communication status<br>4 LEDs (dual colour) for communication module status<br>1 LED (red) for presence of voltage<br>3 LEDs for local diagnostic                                                                                                                                                                                                                                                                                                                                         |
| Width                               | 264 mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Height                              | 678 mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Depth                               | 299 mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|                                            |                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Net weight                                 | 20.6 kg                                                                                                                                                                                                                                                                                                                                                    |
| Analogue input number                      | 3                                                                                                                                                                                                                                                                                                                                                          |
| Analogue input type                        | AI1, AI2, AI3 software-configurable current: 0...20 mA/4...20 mA, impedance: 250 Ohm, resolution 12 bits<br>AI1, AI2, AI3 software-configurable voltage: 0...10 V DC, impedance: 30 kOhm, resolution 12 bits                                                                                                                                               |
| Discrete input number                      | 8                                                                                                                                                                                                                                                                                                                                                          |
| Discrete input type                        | DI5, DI6 programmable as pulse input: 0...30 kHz, 24 V DC ( $\leq 30$ V)<br>STOA, STOB safe torque off, 24 V DC ( $\leq 30$ V), impedance: $> 2.2$ kOhm<br>DI1...DI6 programmable, 24 V DC ( $\leq 30$ V), impedance: 3.5 kOhm                                                                                                                             |
| Input compatibility                        | DI5, DI6: discrete input level 1 PLC conforming to IEC 65A-68<br>STOA, STOB: discrete input level 1 PLC conforming to EN/IEC 61131-2<br>DI1...DI6: discrete input level 1 PLC conforming to EN/IEC 61131-2                                                                                                                                                 |
| Discrete input logic                       | Negative logic (sink) (DI1...DI6), $> 16$ V (state 0), $< 10$ V (state 1)<br>Positive logic (source) (DI5, DI6), $< 0.6$ V (state 0), $> 2.5$ V (state 1)<br>Positive logic (source) (STOA, STOB), $< 5$ V (state 0), $> 11$ V (state 1)<br>Positive logic (source) (DI1...DI6), $< 5$ V (state 0), $> 11$ V (state 1)                                     |
| Analogue output number                     | 2                                                                                                                                                                                                                                                                                                                                                          |
| Analogue output type                       | Software-configurable current AO1, AO2: 0...20 mA, resolution 10 bits<br>Software-configurable voltage AO1, AO2: 0...10 V DC impedance 470 Ohm, resolution 10 bits                                                                                                                                                                                         |
| Sampling duration                          | 5 Ms $\pm$ 1 ms (DI5, DI6) - discrete input<br>5 Ms $\pm$ 0.1 ms (AI1, AI2, AI3) - analog input<br>10 Ms $\pm$ 1 ms (AO1) - analog output<br>2 ms $\pm$ 0.5 ms (DI1...DI4) - discrete input                                                                                                                                                                |
| Accuracy                                   | $\pm 1$ % AO1, AO2 for a temperature variation 60 °C analog output<br>$\pm 0.6$ % AI1, AI2, AI3 for a temperature variation 60 °C analog input                                                                                                                                                                                                             |
| Linearity error                            | AO1, AO2: $\pm 0.2$ % for analog output<br>AI1, AI2, AI3: $\pm 0.15$ % of maximum value for analog input                                                                                                                                                                                                                                                   |
| Relay output number                        | 3                                                                                                                                                                                                                                                                                                                                                          |
| Relay output type                          | Configurable relay logic R2: sequence relay NO electrical durability 100000 cycles<br>Configurable relay logic R3: sequence relay NO electrical durability 100000 cycles<br>Configurable relay logic R1: fault relay NO/NC electrical durability 100000 cycles                                                                                             |
| Refresh time                               | Relay output (R1, R2, R3): 5 ms ( $\pm 0.5$ ms)                                                                                                                                                                                                                                                                                                            |
| Minimum switching current                  | Relay output R1, R2, R3: 5 mA at 24 V DC                                                                                                                                                                                                                                                                                                                   |
| Maximum switching current                  | Relay output R1, R2, R3 on resistive load, $\cos \phi = 1$ : 3 A at 30 V DC<br>Relay output R1, R2, R3 on inductive load, $\cos \phi = 0.4$ and L/R = 7 ms: 2 A at 250 V AC<br>Relay output R1, R2, R3 on inductive load, $\cos \phi = 0.4$ and L/R = 7 ms: 2 A at 30 V DC<br>Relay output R1, R2, R3 on resistive load, $\cos \phi = 1$ : 3 A at 250 V AC |
| Isolation                                  | Between power and control terminals                                                                                                                                                                                                                                                                                                                        |
| Variable speed drive application selection | Compressor centrifugal Building - HVAC                                                                                                                                                                                                                                                                                                                     |
| Motor power range AC-3                     | 15...25 kW at 380...440 V 3 phases                                                                                                                                                                                                                                                                                                                         |

## Environment

|                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Insulation resistance                 | $> 1$ MOhm 500 V DC for 1 minute to earth                                                                                                                                                                                                                                                                                                                                                                                                  |
| Noise level                           | 53.7 dB conforming to 86/188/EEC                                                                                                                                                                                                                                                                                                                                                                                                           |
| Operating position                    | Vertical $\pm 10$ degree                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Maximum THDI                          | $< 48$ % from 80...100 % of load conforming to IEC 61000-3-12                                                                                                                                                                                                                                                                                                                                                                              |
| Electromagnetic compatibility         | Radiated radio-frequency electromagnetic field immunity test level 3 conforming to IEC 61000-4-3<br>Electrical fast transient/burst immunity test level 4 conforming to IEC 61000-4-4<br>1.2/50 $\mu$ s - 8/20 $\mu$ s surge immunity test level 3 conforming to IEC 61000-4-5<br>Conducted radio-frequency immunity test level 3 conforming to IEC 61000-4-6<br>Electrostatic discharge immunity test level 3 conforming to IEC 61000-4-2 |
| Pollution degree                      | 2 conforming to EN/IEC 61800-5-1                                                                                                                                                                                                                                                                                                                                                                                                           |
| Vibration resistance                  | 1 gn ( $f = 13...200$ Hz) conforming to IEC 60068-2-6<br>1.5 mm peak to peak ( $f = 2...13$ Hz) conforming to IEC 60068-2-6                                                                                                                                                                                                                                                                                                                |
| Shock resistance                      | 15 gn for 11 ms conforming to IEC 60068-2-27                                                                                                                                                                                                                                                                                                                                                                                               |
| Relative humidity                     | 5...95 % without condensation conforming to IEC 60068-2-3                                                                                                                                                                                                                                                                                                                                                                                  |
| Ambient air temperature for operation | 40...50 °C (with derating factor)<br>-15...40 °C (without derating)                                                                                                                                                                                                                                                                                                                                                                        |
| Ambient air temperature for storage   | -40...70 °C                                                                                                                                                                                                                                                                                                                                                                                                                                |

|                        |                                                                                                                                                                                                    |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Operating altitude     | 1000...4800 m with current derating 1 % per 100 m<br><= 1000 m without derating                                                                                                                    |
| Standards              | EN/IEC 61800-3<br>Environment 1 category C2 EN/IEC 61800-3<br>Environment 2 category C3 EN/IEC 61800-3<br>EN/IEC 61800-5-1<br>IEC 61000-3-12<br>IEC 60721-3<br>IEC 61508<br>IEC 13849-1<br>UL 508C |
| Product certifications | CSA<br>ATEX INERIS<br>Bureau Veritas<br>TÜV<br>UL<br>ABS<br>ATEX INERIS                                                                                                                            |
| Marking                | CE                                                                                                                                                                                                 |

### Packing Units

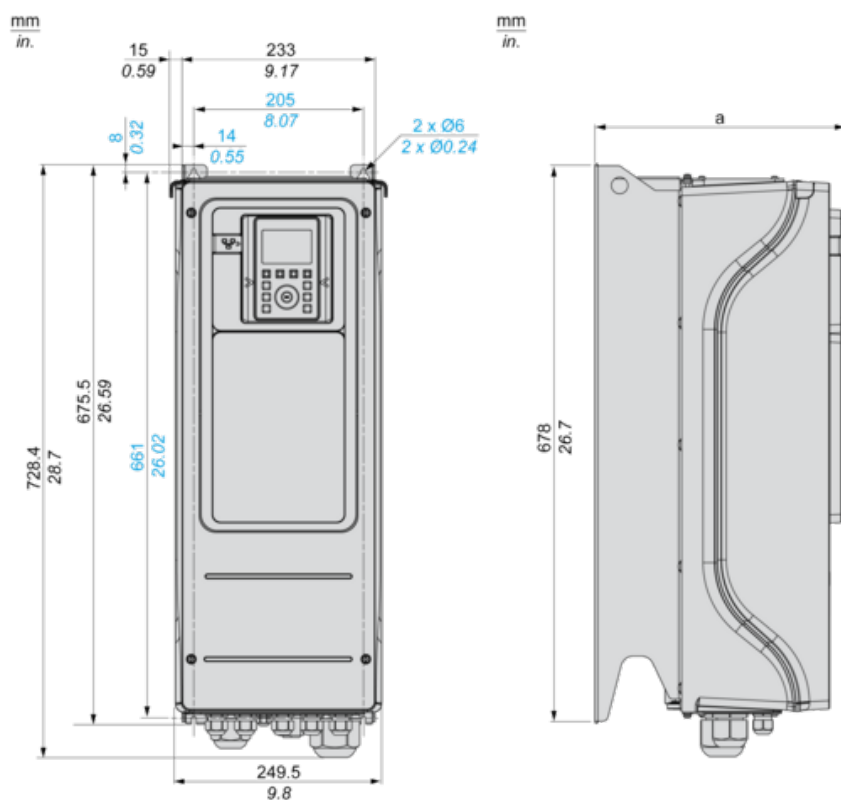
|                  |           |
|------------------|-----------|
| Package 1 Weight | 23.000 kg |
| Package 1 Height | 4.200 dm  |
| Package 1 width  | 2.800 dm  |
| Package 1 Length | 8.000 dm  |

### Offer Sustainability

|                            |                                                                                                                                                                                      |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sustainable offer status   | Green Premium product                                                                                                                                                                |
| REACH Regulation           |  <a href="#">REACH Declaration</a>                                                                  |
| EU RoHS Directive          | Pro-active compliance (Product out of EU RoHS legal scope)  <a href="#">EU RoHS Declaration</a> |
| Mercury free               | Yes                                                                                                                                                                                  |
| RoHS exemption information |  <a href="#">Yes</a>                                                                              |
| China RoHS Regulation      |  <a href="#">China RoHS Declaration</a>                                                           |
| Environmental Disclosure   |  <a href="#">Product Environmental Profile</a>                                                    |
| Circularity Profile        |  <a href="#">End Of Life Information</a>                                                          |
| WEEE                       | The product must be disposed on European Union markets following specific waste collection and never end up in rubbish bins                                                          |
| Upgradeability             |  <a href="#">Upgraded Components Available</a>                                                    |

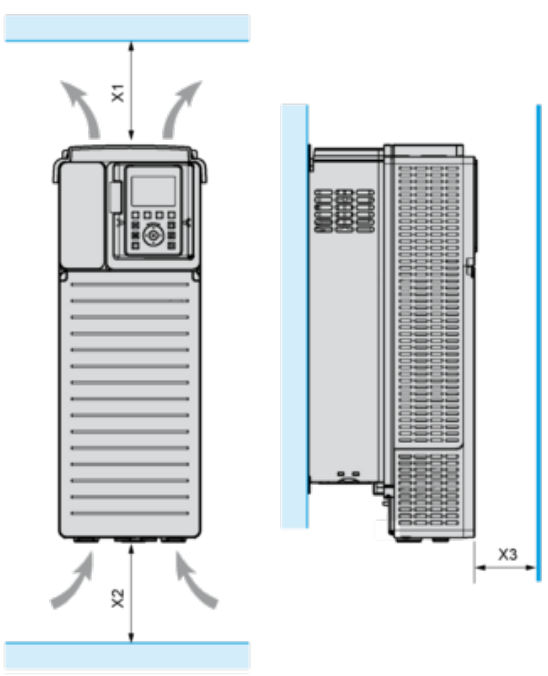
## Dimensions

### Front and Left Views



(a) = 299 mm (11.8 in.)

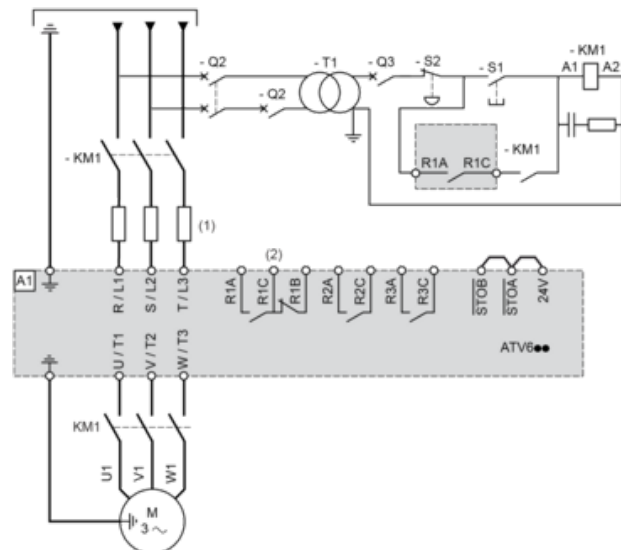
Clearances



| X1                  | X2                  | X3                 |
|---------------------|---------------------|--------------------|
| ≥ 100 mm (3.94 in.) | ≥ 100 mm (3.94 in.) | ≥ 10 mm (0.39 in.) |

## Three-Phase Power Supply with Upstream Breaking via Line Contactor

Connection diagrams conforming to standards EN 954-1 category 1 and IEC/EN 61508 capacity SIL1, stopping category 0 in accordance with standard IEC/EN 60204-1



(1) Line choke if used

(2) Use relay R1 set to operating state Fault to switch Off the product once an error is detected.

A1 : Drive

KM1 : Line Contactor

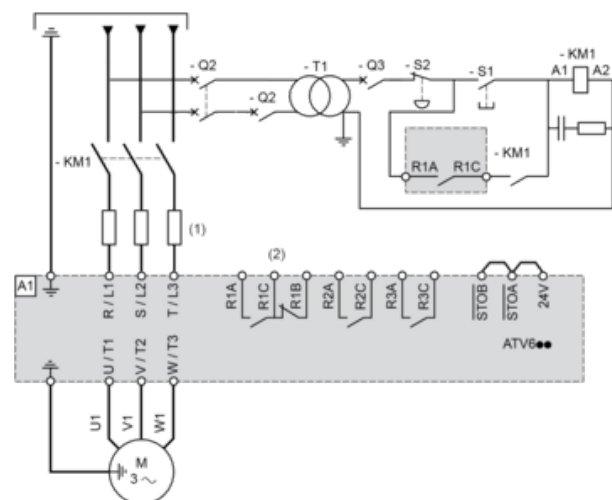
Q2, Q3 : Circuit breakers

S1, S2 : Pushbuttons

T1 : Transformer for control part

## Three-Phase Power Supply with Downstream Breaking via Contactor

Connection diagrams conforming to standards EN 954-1 category 1 and IEC/EN 61508 capacity SIL1, stopping category 0 in accordance with standard IEC/EN 60204-1



(1) Line choke if used

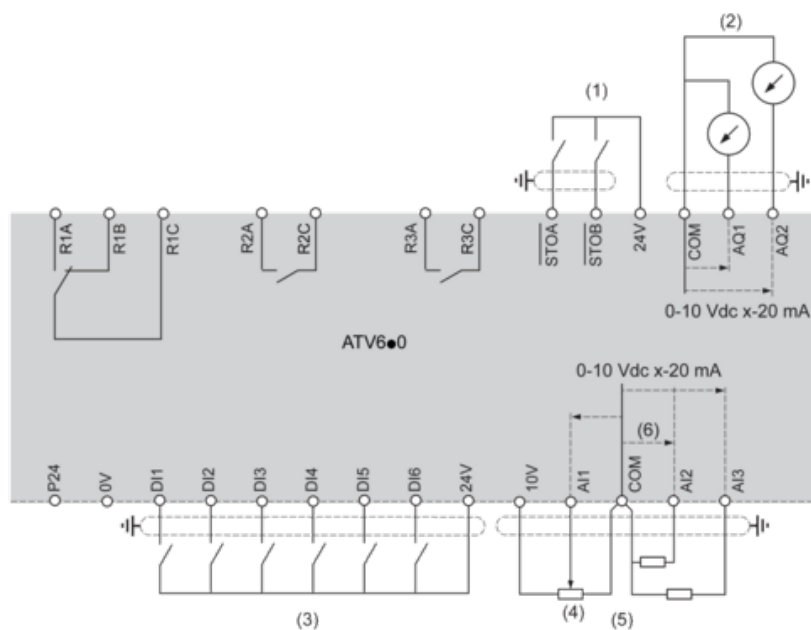
(2) Use relay R1 set to operating state Fault to switch Off the product once an error is detected.

A1 : Drive

KM1 : Contactor



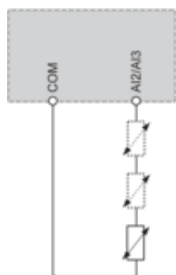
## Control Block Wiring Diagram



- (1) Safe Torque Off  
 (2) Analog Output  
 (3) Digital Input  
 (4) Reference potentiometer  
 (5) Analog Input  
 R1A, R1B, R1C : Fault relay  
 R2A, R2C : Sequence relay  
 R3A, R3C : Sequence relay

## Sensor Connection

It is possible to connect either 1 or 3 sensors on terminals AI2 or AI3.

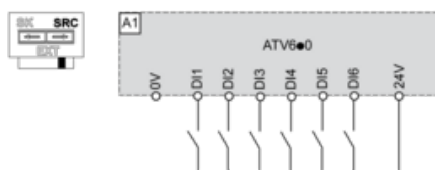


## Sink / Source Switch Configuration

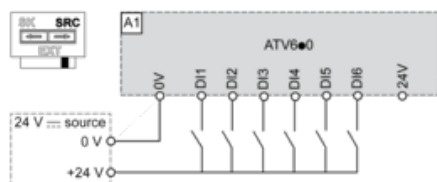
The switch is used to adapt the operation of the logic inputs to the technology of the programmable controller outputs.

- Set the switch to Source (factory setting) if using PLC outputs with PNP transistors.
- Set the switch to Ext if using PLC outputs with NPN transistors.

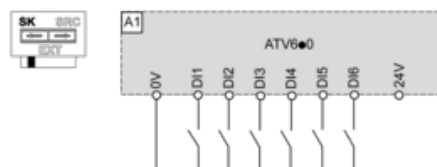
## Switch Set to SRC (Source) Position Using the Output Power Supply for the Digital Inputs



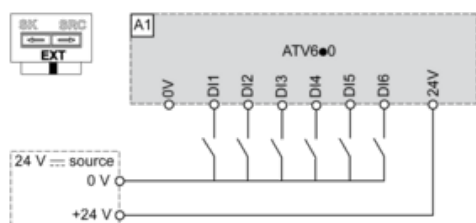
### Switch Set to SRC (Source) Position and Use of an External Power Supply for the DIs



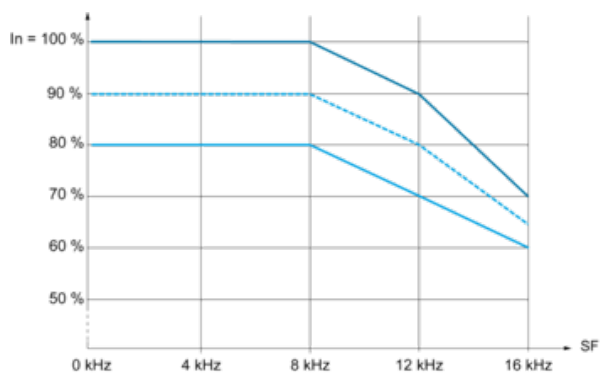
### Switch Set to SK (Sink) Position Using the Output Power Supply for the Digital Inputs



### Switch Set to EXT Position Using an External Power Supply for the DIs



### Derating Curves



— 40 °C (104 °F)

- - - 45 °C (113 °F)

— 50 °C (122 °F)

$I_n$  : Nominal Drive Current

SF : Switching Frequency