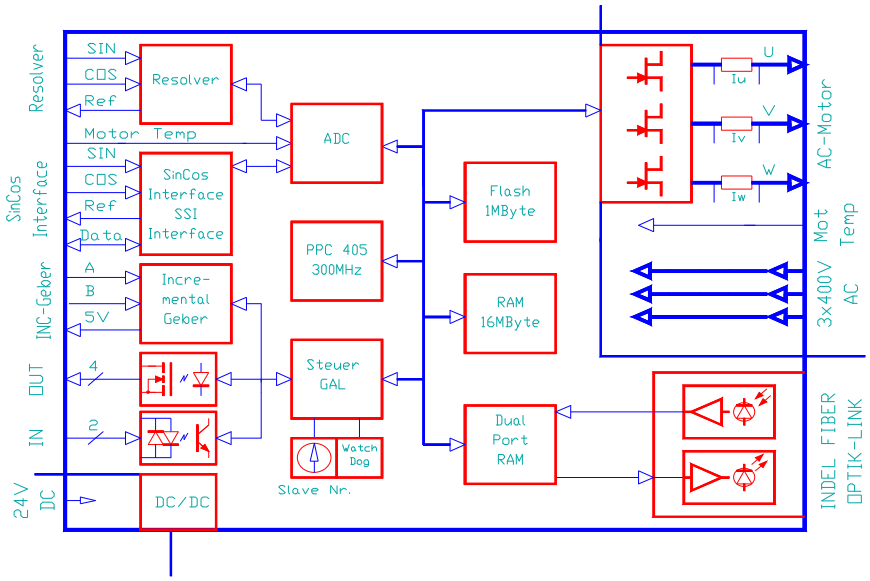
Motion Control

INFO-SAC2

Stand Alone Servo-controller 100% digital

High-precision and very fast positioning and control tasks are implemented using the Stand Alone Servo-controllers INFO-SAC2.
The servo-drive can work out customer specific applications.
As on all intelligent periphery boards, a PowerPC processor ensures adequate power. On the SAC Servo- controllers, all off-the-shelf three-phase synchronous and asynchronous motors can be operated, as well as specially developed asynchronous motors for servo-operation.
Three different PID parameter sets and 8 motor configurations are available to users. In addition, up to 6 parameters can be recorded.



Technical Data

Types
- 2.5A / 110 ... 400V AC
- 5A / 110 ... 400V AC
- 16A / 110 ... 400V AC
- 32A / 110 ... 400V AC
- 4A / 110 ... 230V AC
- Single phase or 3-phase power supply

Path curves
- S-curve
- ISO-code
- User-specific algorithmen

Measuring systems
- Resolver
- SinCos Interface
- Encoder
- SSI

Motors
- Synchronous three-phase motors
- Asynchronous three-phase motors
- Linear motors
- Standard motors

UL-Certificate
- Under examination

Order No. INFO-SAC2 610434900
Order No. INFO-SAC2x 610535200

Tel. ++41 44/956 20 00
Fax ++41 44/956 20 09

CH-8332 Russikon
Tüfiwis 26

Rev. 0807

INDEL AG INDUSTRIELLE ELEKTRONIK

Functions

Description

Controller types

Four variants of the INFO-SAC2 are available. In addition to the specified nominal current, the servo-controllers can be operated during 5s with the current I_{MAX5S}.

INFO-SAC2	2.5A	5A	16A	4A 230V
I_{NOM}	$2.5A_{RMS}$	$5A_{RMS}$	$16A_{RMS}$	$4A_{RMS}$
$I_{MAX\ 5s}$	$7.5A_{RMS}$	$15A_{RMS}$	$35A_{RMS}$	$12A_{RMS}$
Power Supply	3 x 110 ... 400VAC	3 x 110 ... 400VAC	3 x 110 ... 400VAC	3 x 110 ... 230VAC

Single-phase power supply is also possible.

Integration in the INFO-Link

The AC servo-controllers are systematically integrated in the INFO-Link. Analog interfaces and asynchronicities between the field bus master and the controller are eliminated. All parameters are read and written via the INFO-Link or via a serial connection using tools and are available throughout the network.

PID parameter sets

The different PID parameter sets are freely available to the user. The parameter sets are simultaneously active, allowing load changes to be optimally accommodated. Example: PID parameter set 1 for upward stroke with load; parameter set 2 for downward stroke without load; parameter set 3 for stand-by with reduced current input. In addition to the PID parameters, it is possible to specify pilot controls (boosters) for velocity and acceleration.

Computing power

The PowerPC 405-300MHz performs the following taks at a clock rate of 12kHz:

- PID position controller, velocity control, active current control
- Power factor compensation
- Encoder correction (incremental transmitter)
- Limitation for: I_{MAX}, I_{2t}, controller, motor temperatures
- Logger of 6 freely selectable parameters such as rotary speed, active current, path error, target/actual velocities, etc.

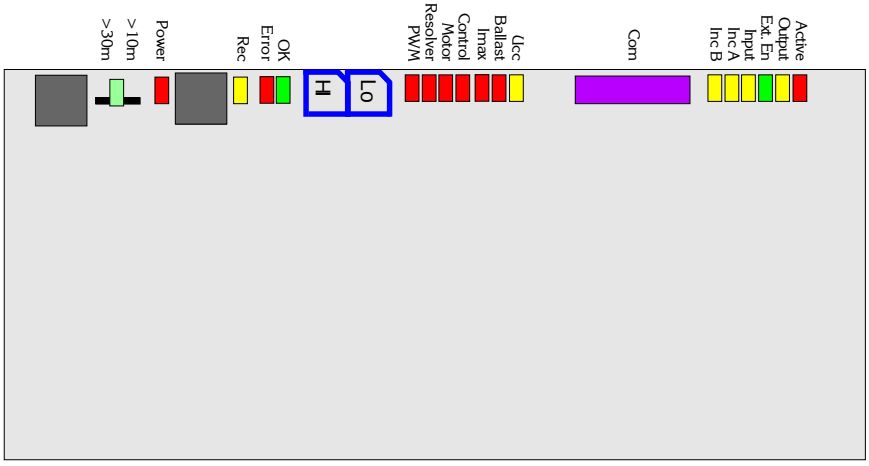
Position registration

- **SinCos Interface:** Up to 4096 periods per single turn, 16Bit resolution per periode
- **Hyperface:** Digital Interface
- **Encoder:** Up to 20'000 increments (4-quadrant interpolation) per turn
- **Resolver:** One or multipolar resolver, 16Bit resolution per resolver turn

Operational reliability

Various quantities of the AC servo-controller are continuously monitored in order to ensure maximum operational reliability. Short-circuit stoppages prevent shorts to motor or ground. In the individual phases, quick-action current cutouts protect the motor and the output stage. These become active when the drive is jammed or is stopped abruptly. The motor and the output stage are monitored for overtemperature. The motor temperature can be measured as required by means of a bimetal switch (digital) or via an NTC in the motor (voltage value).

Wiring



Adressing (blue)

S1,S2 (Y0,0X) (Adr.)	Axis (channel)	Incr. transmitter (channel)
00 ... 03	0 ... 3	
10 ... 13	4 ... 7	
...		
70 ... 73	28 ... 31	
80, 82	0, 2	1, 3
90, 92	4, 6	5, 7
...		
F0, F2	28, 30	29, 31

The incremental transmitter can be integrated directly into the control algorithm. If 0x80 is added to the current axis number (increase rotary switch Y0 by 8), the incremental transmitter will report on the next followig channel number.
In this connection, only even addresses are allowed for the controller so that the incremental transmitter will always come to lie on an odd address.

LEDs on receiver module

Power = +5V supply
Rec = INFO-Link receiver signal OK

LEDs

The functions of the other LEDs on the front panel are described starting on page 10.

Jumpers (light green)

The jumpers influence the light intensity of the transmitting LED and thereby the segment length of the fiberoptic cable to the next board.

Segment length	Jumper position
0 ... 10m	no jumper
8 ... 30m	>10
20 ... 50m	>30

Specifications

Supply 24V DC

- Electrically isolated
- Operating voltage: 24V DC +10%, -5%
- Current consumption: 420mA @ 24V DC

Sampling rate

- Sampling rate: 8 ... 16kHz (current, velocity and position control)

Outputs Out 0,1

- Connector X15, Pin 3..8
- Outputs electrically isolated:
  V_{OFF}: 24V
  I_{ON}: 500mA

Inputs INP 0..3

- Electrically isolated:
- Input 0: 24V
- Input 1..3 without connection: 5V
- with 1.2kΩ series resistor: 24V

Increment inputs

- Incremental transmitter input with A,B tracks
- Interface: 5V / RS422
- max. count frequency: 2.5MHz

5V Supply

- Voltage: 5V; +10%
  max. current: 200mA
- Supply for additional incremental transmitter (no electric isolation from 24V board supply)

Mounting

W x D x H

- 2.5A 60 x 168 x 285 mm
- 5A 75 x 168 x 285 mm
- 16A 110 x 168 x 285 mm
- 32A

Intermediate circuit, brakes

- 155 ... 565V DC
- Brake-IGBT (X4)

RS232 interface (purple)

Communication with the controller is done either via the INFO-Link or via the RS232 interface with the aid of the program ACS-Show.

Specifications

Climatic conditions
Ambient temperature:

- Storage: -20...+80°C
- Operation: 0 ... +45°C
- Board temp. Operation: 0...+70 °C
- Relative air humidity no condensation: 80%
- Enclosure IP-20
- Pollution degree: 2 (EN 50178)

Supply 3x110...400V AC

- Operating voltage: 3 x 110 ... 400V ±10%
- 1-phase operation as option
- TT-supply and TN-supply with grounded star point

Motor

- All types of three-phase motors asynchronous und synchronous
- Minimum inductivity: 1mH
- Minimum resistance: 0.2Ω
- Max. motor voltage: 565V
- Max. line length: 20m
- Motor temperature monitoring: bimetal or KTY-84/110 (NTC) on connector X2: T+, T-
- Observe voltage resistance of winding

Resolver inputs

- 12 ... 16 Bit resolution
- 4Vrms sine, bridge connection
- 2Vrms Sin/Cos input

SinCos-Interface

- 1Vrms Sin/Cos Input
- max. 4096 periods / turn
- SSI-Interface: Hyperface, Bizz, Endat (on request)

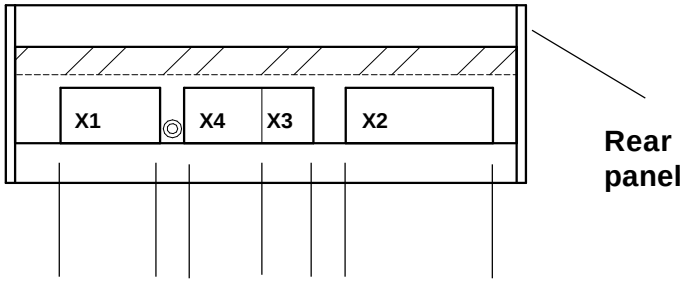
Output stage

- Loss power (I_{MAX}, without brake resistance)
  INFO-SAC2-2.5A: 55 W
  INFO-SAC2-5A: 100 W
  INFO-SAC2-16A: 280 W
- Short-circuit protection: Short to ground, short to phase
- Temperature monitor: Precision: ± 2°

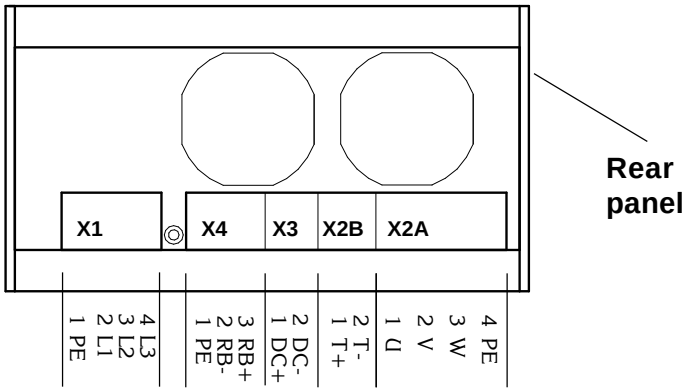
Connector Allocations

Casing bottom

INFO-SAC2 2.5 / 5A



INFO-SAC2 16A



Connector assignment

Casing bottom

INFO-SAC2 2.5 / 5A

X1
Line

1	I	PE
2	I	L1
3	I	L2
4	I	L3

X4
Brake resistance

1	O	PE
2	O	RB-
3	O	RB+

X3
DC voltage link Ucc

1	O	DC+
2	O	DC-

X2
Motor

1	I	T-
2	O	U
3	O	V
4	O	W
5	I	T+
6	O	PE

INFO-SAC2 16A

X1
Line

1	I	PE
2	I	L1
3	I	L2
4	I	L3

X4
Brake resistance

1	O	PE
2	O	RB-
3	O	RB+

X3
DC voltage link Ucc

1	O	DC+
2	O	DC-

X2B
Temp-Switch

1	I	T-
2	I	T+

X2A
Motor

1	I	U
2	I	V
3	I	W
4	I	PE

Connections

Board supply

For the board supply, a 3-phase rectifier without electrolytic capacitor is sufficient. To avoid trouble, however, we recommend an electrolytic capacitor of 4'700 ... 10'000µF.
The rack must be provided with a power line filter, immediately after entry of the power supply.

Screening lines

The signals of the resolver are extremely susceptible to interference; therefore the resolver must be installed with a twisted-pair and screened cable.

The incremental transmitter and the serial interface as well as the motor cables must always be connected with screened lines!

Bonding

Always connect all screens at both ends. To avoid undesirable discharge currents through the screening, it may be necessary to provide a binding conductor, especially with large distances or different supplies.

Screen bar

The control cabinet must be provided with a screen bar to which all screened cables are connected.
Metallic connectors with all-round contacting of the screen are also suitable for cable entries.

Brake resistor

INFO-SAC2-2.5A	min. 60 Ω
INFO-SAC2-5A	min. 30 Ω
INFO-SAC2-16A	min. 15 Ω

Tel. ++41 44/956 20 00
Fax ++41 44/956 20 09

CH-8332 Russikon
Tüfiwis 26

INDEL AG
INDUSTRIELLE ELEKTRONIK

Connections

Connectors

Interruptions in the resolver and motor cables at the cabinet entries etc. should be implemented using metallic connectors and not terminal connections.

Motor temperature switch

Open = Motor overtemperature
connector X2, Pin T+, T-
Closed = Ok

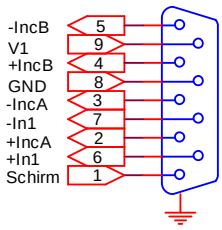
Connections

Casing top

X15
Power Supply
Logic

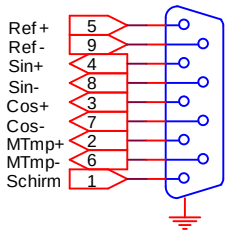
1	I	24V
2	I	0V
3	I	+En
4	I	-En
5	O	+O
6	O	-O
7	O	+Ac
8	O	-Ac

X12
Encoder
D-Sub 9-pol
(female)

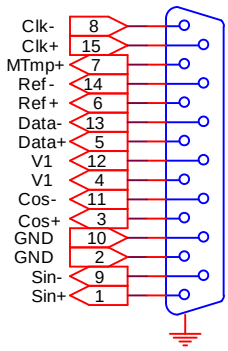


V1: 5V

X13
Resolver
D-Sub 9-pol
(female)

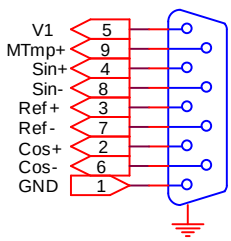


X14A
SinCos Interface
D-Sub 15-pol
(female)

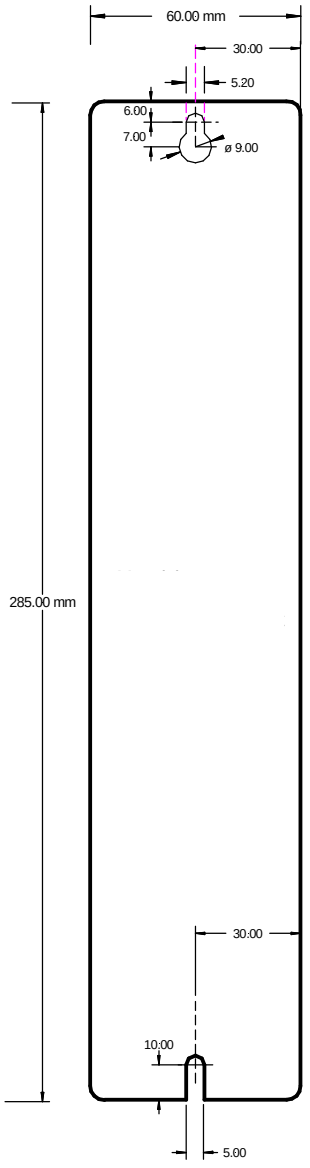


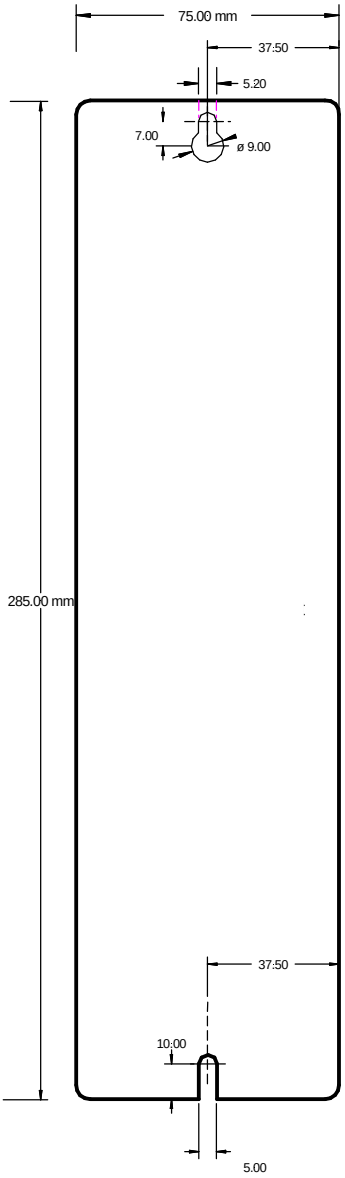
V1: 5V

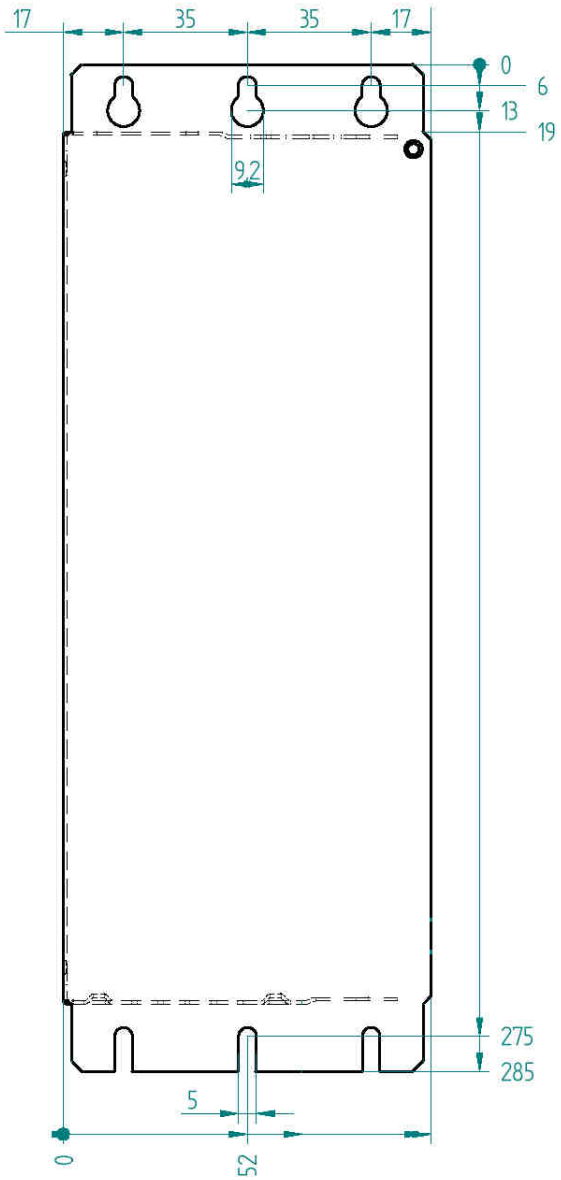
X14B
SinCos Interface
D-Sub 9-pol
(female)



Dimensions







Tiefe = 168mm

INFO-SAC2 2.5A
INFO-SAC2 4A/230V

INFO-SAC2 5A

INFO-SAC2 16A

Wiring

RS232 interface

The RS232 interface serves as direct connection of the controllers to the PC.

Incremental transmitter, external zero pulse

Inputs 1..3 are sized for 5V. Input 0 is sized for 24V. This input is reserved for external controller enable and can be included in the EMERGENCY stop circuit.

If the inputs 1...3 are operated with 24V, a series resistor of 1.2kΩ is necessary. Input 1 is reserved for an external zero pulse. The incremental transmitter is connected to the inputs 2,3. Trak A is connected to input 2; Trak B to input 3. The supply of the transmitter is provided by the INFO-SAC. Instead of the incremental transmitter, it is also possible to connect limit switches.

Outputs

The two outputs are reserved for "Motor control active" and "Current reduction active".

Supply of the incremental transmitter

The DC/DC converter on the board also supplies +5V to the incremental transmitter. A special power supply for the transmitter therefore is unnecessary (not electrically isolated from the 24V supply).

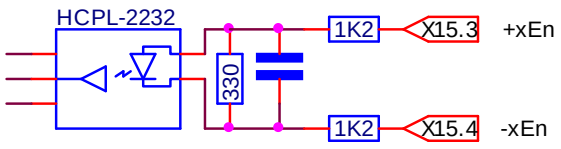
Interfaces

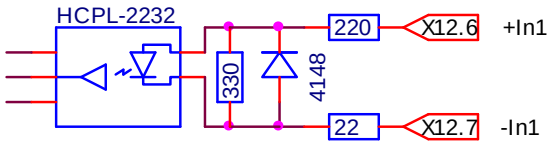
RS232 interface

RS 232 Stecker INFO-ACSr		Kabel	9-Pol-Stecker PC, Laptop
Pin-5 GND		Schirm	Pin-5
Pin-2 Rx	Eingang	←	Pin-3
Pin-3 Tx	Ausgang	→	Pin-2
Pin-6 DSR	Eingang	←	Pin-4
Pin-4 DTR	Ausgang	→	Pin-6

Inputs

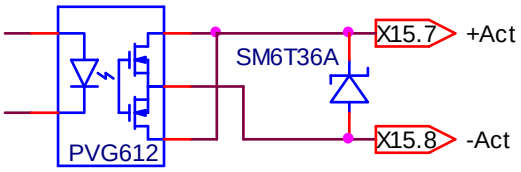
- Extern Enable (In0)
- Zero mark (In1)
- Inc A (In2)
- Inc B (In3)





Outputs

- Active (Out 0)
- I-reduced (Out 1)



Installation

Cooling

All INFO-SAC2 controllers are provided with a built-in fan. Despite this, an additional fan must be installed inside the cabinet to dissipate the exhaust heat.

Between the individual SAC controllers, observe a clearance of at least 1cm.

The fan is operated at a temperature of 37.5°C with 25% power, at 50°C 100%.

Motor temperature

The motor temperature can be measured as required by a bimetal switch (T-switch) or using an NTC (MTemp).

Sensor leads in the motor cables
If the leads of the bimetal switch are located in the motor cables, these must be wired to connectors X2 (X2B).

Sensor leads in the resolver cable
If the leads of the bimetal switch or of the NTC are located in the resolver cable, these must be wired to connector X13/X14. (insulation class!)

Filter

The 24V supply must be provided with a filter, as well as the 3 x 400V AC to connector X1. The optimal filter may have to be determined by a measurement for line-bound emission, as the radiated interference depend, among other things, on the motor cable length.

Grounding

The casing of the INFO-SAC board is grounded. Take care to ensure that the casing is connected to the mounting plate so that good conduction exists. (EMC and heat dissipation). As the resolver is mounted directly onto the motor, this motor transmitter combination must must always be grounded, as otherwise the transmitter electronics will be exposed to interference.

Further documentation

See also INDEL wiring guidelines and INDEL design guidelines.

UL Directive

Motor overload protection

An external overload protection for the motor must be provided.

To protect the motor against termal overload, a temperature sensor that measures the motor temperature can be connected to the servo-drive.

Only UL-approbated wires for 75°C must be used.

UL-fuse and Sicherungen and conductor cross-section

The servo-drive needs a fuse in the power line. Only UL-approbated fuses and fuse holder must be uses. Tripping characteristic "H" or K5 must be used.

Servo-drive	Lead fuse *A*	conductor cross-section *mm²*	*AWG*
SAC-2.5A	5	1	17
SAC-5A	10	1	17
SAC-16A	25	6	9

Supplier of UL-approbated lead-fuses.

- FS Ferraz Shawmut
- Cooper Bussmann Inc.

Break resistor

The break resistor must have a protection agains thermal overload.

Function of the LEDs on the Front Panel

LEDs

Motor control active (Out 0)

Requires external enable (Ext En, INP-0). Output stage ON, motor energized and with current and positioning control on Active or Simulation.
In the event of an error, the controller will quit the active state.

Active

Current reduction mode active (Out 1)

In this operation mode, the controller limits the maximum current to I_{red}.

Output

External controller enable (INPUT 0)

Interlocks output stage by hardware function, i.e. the controller cannot be switched to active without external enable.
INP-0 can be included in the emergency off circuit.

Ext. En

Free input (INPUT 1)

Free 5V input. (See software manual)

Input

Incremental transmitter track A (INPUT 2)

Allocated as standard as incremental transmitter input A (additional encoder). 5V input, or RS 422 interface.

Inc A

Incremental transmitter track B (INPUT 3)

Allocated as standard as incremental transmitter input B (for the additional encoder). 5V input, for RS 422 interface.

IncB

Emergency system

In the emergency system, Flash-PROM burning is supported. To enable the controller to start in the emergency system, you must plug a short-circuit connector onto the serial interface (front panel).

Connections:	Signals	Pin
	RxD, TxD	2, 3
	DSR, DTR	6, 4

Once the controller has been started up, the short-circuit connector can be removed and the serial cable to the PC can be connected again.

OK **Error**

LEDs

Function of the LEDs on the Front Panel

Controller status

Blink code

The LEDs indicate by lighting, fast or slow blinking the status of different functions of the controller. For the following sketch, the following applies:

E = Error; Delete Error from Software: Deactive, Active
W = Warning

Please use the program "ACS-Show" as additional help in verifying the error.

 same rhythm as OK-LED on controller

 approx. 3 times per second

 approx. 1.5 times per second

U_{cc}

Intermediate circuit voltage (565 VDC)

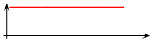
(see also modulation, PWM-LED)

 = E Intermediate circuit voltage lower 20V ($U_{CC\ MIN}$)

 = E Intermediate circuit voltage higher 800V ($U_{CC\ MAX}$)

 = E Phase error, see below

 = W Intermediate circuit voltage lower 500V ($U_{CC\ OK}$)

 = Intermediate circuit voltage 501 ... 799V

Ballast

Ballast resistance

Dimming = Ballast resistance is switched on-off (PWM output)

Ballast + U_{cc}

 = E Discharge does not work: U_{CC} does not become smaller although ballast resistance is on.
(U_{CC} blinks with same frequency as ballast LED)

Causes:
- No ballast resistance connected
- Extraneous supply through parallel-connected controllers (U_{CC} bridged)

Ballast + U_{cc}

Phase error

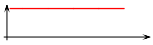
 = E A phase has failed.

Function of the LEDs on the Front Panel

LEDs

Motor current

- I_{MAX}

 = E I_{2t} exceeded ($I_{2t} \geq 120\%$)

 = E Motor overloaded or blocked (excessive load with excessive starting current).

 = W I_{2t} exceeded, motor current is limited to I_{nom} (I_{2t} = 100 ... 119%)

 = W I_{MAX} reached; if the controller is operated in the current limiting mode, this warning is displayed when I_{red} is reached.

Temperature output stage

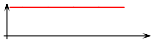
- Control

 = E Output stage overheated (from 80°C)

 = W Output stage hot (from 75° C)

Motor: Temperature, short circuit

- Motor

 = E Motor short circuit, or output stage defective

 = E Motor temperature switch tripped for over 10s

 = W Motor temperature switch tripped

Resolver, SinCos

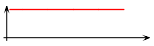
- Resolver

 = E Resolver connection defective or incorrect. This error also occurs when the rotor is turning while the axis is switched to active.

 = E Maximum mechanical rotary speed exceeded

PWM

Modulation

 = E Current offset too high (Test before Active)
Auto Commutation is necessary

 = E Current measurement range exceeded

 = W PWM 100% modulation reached (poss. U_{CC} too low?)

If the motor is operated with high rpm, the PWM-LED will start to blink. U_{CC} is fully modulated, i.e. the full int. circuit voltage is present at the motor. This is an allowable operating condition. With high power (current) and high rpm, the intermediate circuit voltage will drop and the U_{CC} LED and the PWM LED will start to blink. In this state, the controller is allowed to be in continuous operation. Only when the controller exceeds the maximum allowable path error (increment, entrainment error) is the loading limit reached and the controller switches to Error.

Important!
If the maximum rpm cannot be reached because path errors, entrainment errors occur while the U_{CC} LED is blinking, check the following causes:

- Inadequate power of supply mains (400V). Inadequately sized or too high-ohmic isolating transformer. Observe line length and cross-section of the supply line.
- Overloaded motor.

Remedy:
- Increase intermediate circuit voltage with additional transformer windings Observe max. U_{CC} = 720V!
- If several controllers exist distribute them among different phases.
- Possibly apply additional power pack (INFO-ACPr).

Function of the LEDs on the Front Panel

LEDs

CPU-OK, controller active

Controller deactive, OFF, CPU ok

Controller active, ON, CPU ok

OK

Errors

= E Software error, CPU on Trap

= E Externer Enable missing.

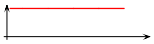
Error

Wrong control parameters

= E After the controller is switched on (not Active), the Control LED together with Error LED indicate unplausible or missing **control** parameters. With the factory-set parameters, this status display appears.

Error + Control

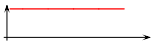
Wrong motor parameters



= E After the controller is switched on (not Active) the Motor LED together with Error LED indicates unplausible or missing **motor** parameters. With the factory-set parameters, this status display appears.

Error + Motor

RAM errorr



= E If this error message appears, the controller must be subjected to a hardware overhaul. Please contact Indel AG.

Error + U_{cc}

Notes on Safety

Terms

In the following text, the term "Module" refers to the servo controller and the associated power components as well as control components which have an operating voltage of over 50V AC.

Specialist personnel

Only qualified specialst personnel are allowed to carry out work such as handling, installation, start-up and maintenance.

Documentation

Before installation and start-up, please read the present documentation. Incorrect handling of the Modules may lead to personal injury or property damage. Always observe the technical data and the information provided on the connection conditions.

ESD

The Modules contain electrostatically endangered components which might be damanged by improper treatment. Discharge your body before touching the Modules. Avoid contact with highly insulating materials (synthetic fibers, plastic film, etc.). Place the Modules on a conductive base.

Live components

During operation, keep all covers and cabinet doors closed. If you touch live components, you may risk death or serious injuries or property damage.
Never disconnect the electrical connections of the Modules while they are energized and never withdraw rack boards from the rack while they are energized. In the worst case, this may cause electric arcs, injuring persons and damaging contacts.

Deactivation

Control and power connections may be live even if a motor is not turning. After the operating voltage has been switched off, residual voltages may remain present during several minutes. Measure the intermediate circuit voltage and wait until the voltage has dropped below 50V.

Inquiries

These notes on safety do not claim to be complete. Should you have any inquiries, please call us. (Phone +41 1 956 20 00)