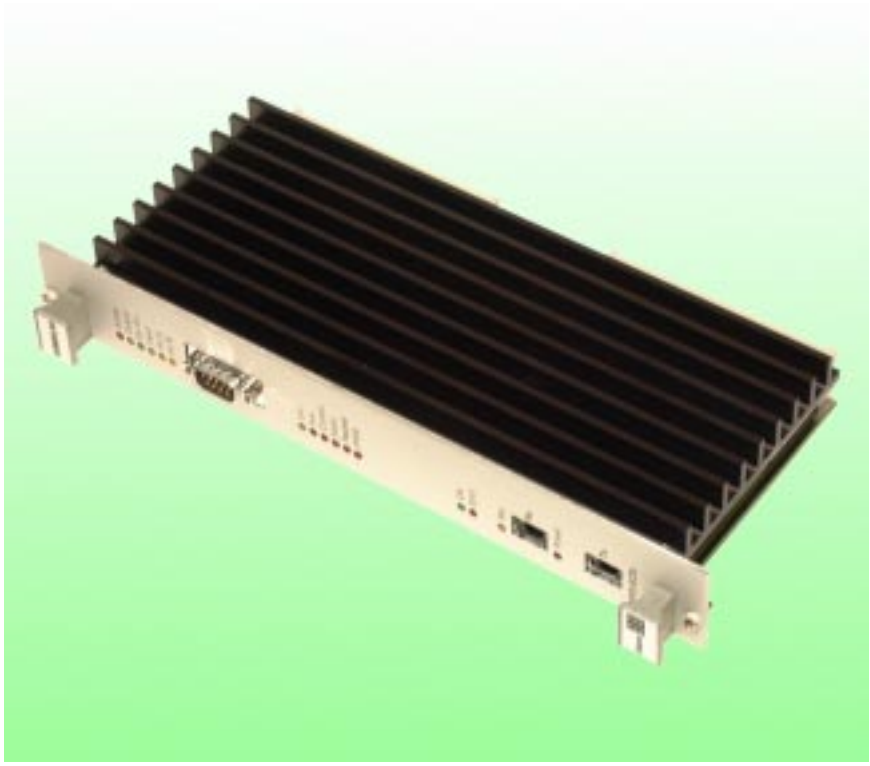
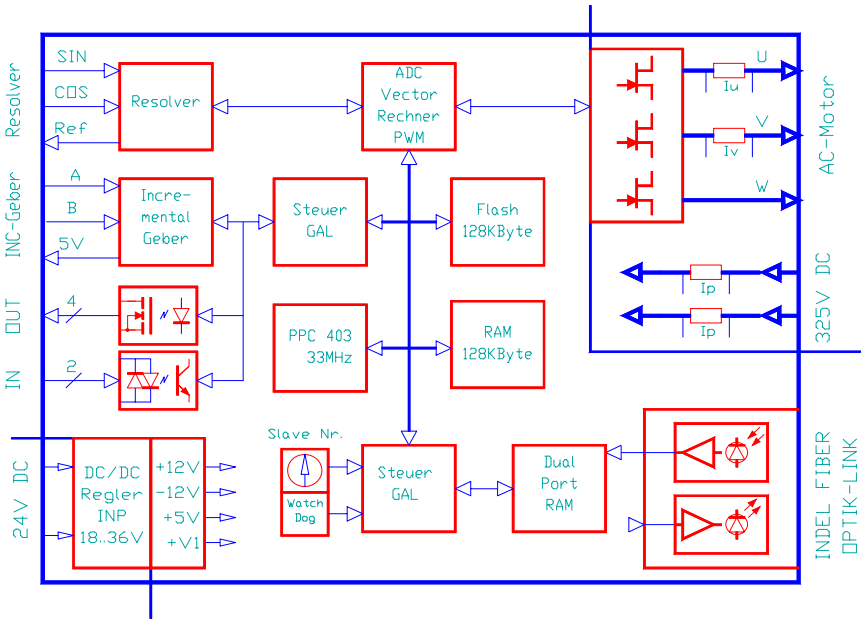
Motion Control

INFO-ACSr



AC Motor Controller 100% Digital

Highly precise and very fast positioning and control tasks are implemented with the aid of the INFO-ACSr servo-controller. ACS servo-controllers have been systematically integrated in the INFO-Link, i.e. there are no analog interfaces or asynchronicities between the field bus master and the controller. As with all intelligent periphery boards, a PowerPC processor ensures sufficient power. Subordinated current, speed and position control is performed at a 12KHz clock rate by the AC servo, with the path curve, e.g. a trapezoid profile, being specified by the field bus master. Users have three different, simultaneously active PID parameter sets at their free disposal. In addition, up to 6 parameters can be recorded by means of a logger.



Technical Data

Sampling rate
- 12kHz (current, speed and position control)

End stage
- 2 types:
  1.1 kW or 2.7kW rated power

Incremental input
- RS422 signal
- Electrically isolated

Resolver input
- 12-Bit
- 4096 Inc/U

Processor
- PowerPC 403, 33/66MHz
- 128kByte RAM
- 128/512kByte Flash Eprom
- Vector computer for current transformation

2 outputs
- 24V/500mA, electrically isolated

4 inputs
- 3 inputs for use as required
- 5V, electrically isolated

5V power supply
- for incremental generator
- 200mA max.

Order No.	INFO-ACSr	96231-6A
Order No.	INFO-ACSr	96231-10A
Order No.	INFO-ACSr	96231-30A

Tel. ++41 1/956 20 00
Fax ++41 1/956 20 09

CH-8332 Russikon
Tüfiwis 26

Rev. 0005

INDEL AG
INDUSTRIELLE ELEKTRONIK

Functions

Description

Integration in INFO-Link

AC servo-controllers have been systematically integrated in the INFO-Link. This means that analog interfaces and asynchronicities between the field bus master and the controller are a thing of the past. All parameters can be read and written via the INFO-Link or via a serial connection using convenient tools (see controller manual INFO-ACSr). The servo-controller no longer requires any potentiometers or other trimming instruments.
PID parameters of trimmed axes can be loaded from a file to the non-volatile flash PROMs of the controller.

PID parameter sets

Users have three different PID parameter sets at their free disposal. The parameter sets are simultaneously active, allowing optimal responses to load changes; for 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 power consumption. In addition to the PID parameters, it is possible to specify input controls (boosters) for speed and acceleration.

Computing power

The PowerPC 403-33MHz performs the following tasks at a 12kHz clock rate:

- PID position controller
- Speed control
- Active current control
- Power-factor correction
- Measuring wheel correction (resolver)
- Limitation for: I_{MAX}, I_{2t}, controller temperature
- Logger of 6 freely selectable parameters such as shaft speed, active current, stroke error, target/actual speed, etc.

Measuring wheel

In addition to the resolver, an incremental encoder can be connected to the controller for measuring actual values and, depending on the application, can be directly integrated in the control algorithm or be used as an independent measured quantity.

Operational reliability

Different quantities of the AC servo controller are permanently monitored in order to ensure maximum operational reliability. Short circuit cutouts prevent motor or ground shorts. In the individual phases, fast overcurrent cutouts protect the end stage against destruction if the drive becomes jammed or is abruptly stopped.
If the end stage is excessively heated, a warning signal is indicated at the controller. If the end stage is overheated, it is automatically switched off.

Variants

Three variants of the INFO-ACSr are available. The 6 and 10A versions differ by matched measurement resistances: (phase currents)

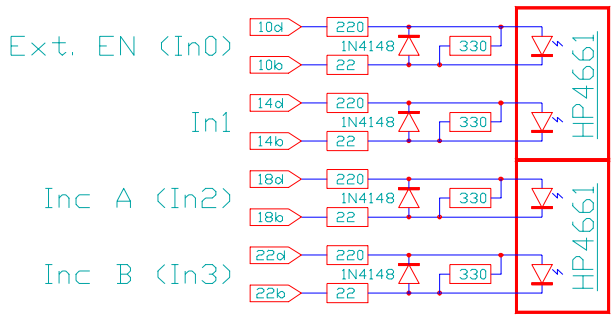
INFO-ACSr	-6A	-10A	-30A
P_{MOT}	1.1kW	1.1kW	2.7kW
I_{NENN}	$3A_{RMS}$	$3A_{RMS}$	$6A_{RMS}$
I_{MAX5S}	$6A_{RMS}$	$10A_{RMS}$	$20A_{RMS}$
U_{CC}	325V	325V	325V

Interfaces

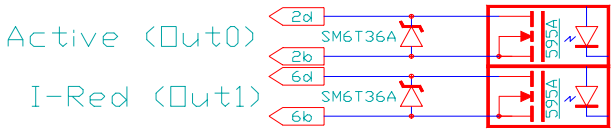
RS232 Interface

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



Outputs



Connection

RS232 interface

The RS232 interface serves as a direct connection of the INFO-ACSr to the PC.

Encoder, inputs

The inputs are designed for 5V.
If the inputs are operated with 24V, a series resistor of 1.2kΩ is necessary.

The incremental encoder is connected to the inputs 2, 3. Track A is connected to input 2; Track B to input 3. The power supply to the encoder is provided by the INFO-ACSr: 5V or 24V. Instead of an incremental encoder, it is also possible to connect limit switches.
Input 0 is reserved for external controller enable. This input can be included in the EMERGENCY stop circuit.
Input 1 is freely available to the programmer.

Outputs

The two outputs are reserved for "motor control active" and "current reduction active".

Resolver

The actual position of the motor, measured by the resolver, is available at the outputs A, B, and NM (connector1 32d ... 32z) as an incremental encoder value. The signal is freely available to the user. A, B, NM are TTL signals. (74HC14; per signal two outputs in parallel)

Supply of incremental encoder

The DC/DC converter on the board also supplies +5V to the encoder. This eliminates the need for a special power supply for the encoder (not electrically isolated from the 24V supply).

Specifications

Power supply
- Electrically isolated
- Operating voltage: +18 ... 34V
- Powe consumption: 380mA @ 24V

Climatic conditions
- Ambient temperature:
  Warehouse: -20...+80°C
  Operation: 0 ... +45°C
- Board temperature:
  Operation: 0...+70 °C
- Relative air humidity
  No condensation: 80%

Motor
- Minimum inductance: 1mH
- Minimum resistance: 0.9Ω
- Max. motor voltage: 325V
- Max. line length: 20m

Resolver inputs
- Resolution: 4096 inc/r
  (12-bit counter)
- 4Vrms sine, bridge circuit
- 2Vrms sin/cos input
- Incremental shaft encoder output:
  The resolver signal is additionally processed as an incremental signal:
  Level: 5V
  A, B tracks, zero pulse

Intermediate circuit
- INFO-ACSr operate with an external 325V DC intermediate circuit.
  (see INFO-AC1r, -AC3r)

End stage
- IGBT end stage; 3 phases, 600V
- Short-circuit protection:
  Ground short, phase short
- Temp. monitoring:
  Precision: ± 2°
- Dissipation power (I_{RATED})
  INFO-ACSr-6A (I_{RATED}=3A): 25W
  INFO-ACSr-10A (I_{RATED}=3A): 25W
  INFO-ACSr-30A (I_{RATED}=6A): 40W

Connector Allocations

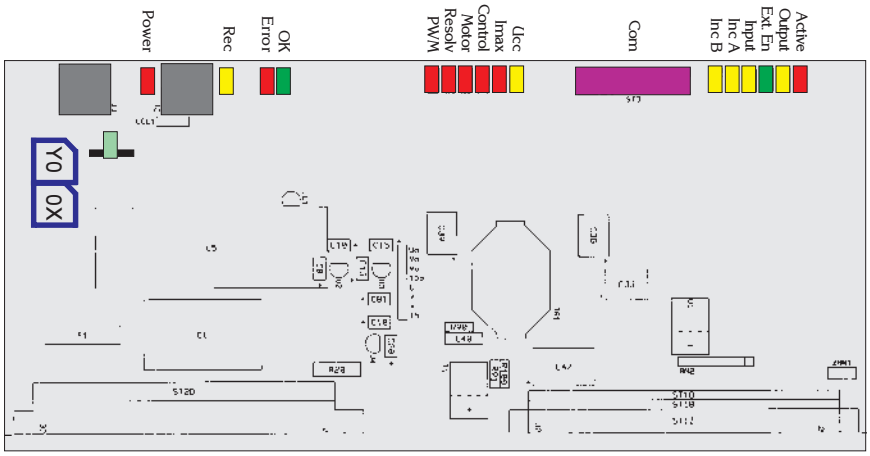
Connector 1
angled
DIN 41612, Type F-48
2,8mm pins

	d		b		z	
2	O	+ Active	O	- Active	I	+ 24 V
4	O	+ 24 V	O	0 V	I	0 V
6	O	+ I-Red	O	- I-Red		Shield
8	O	+ 24 V	O	0 V		Shield
10	I	+ Ext. EN	I	- Ext. EN		Shield
12	O	+ 24 V	O	0 V		Shield
14	I	+ In 1	I	- In 1		Shield
16	O	+ 24 V	O	0 V		Shield
18	I	+ INC A	I	- INC A		Shield
20	O	+ 24 V	O	0 V		Shield
22	I	+ INC B	I	- INC B		Shield
24	O	+ 5 V	O	+ 5 V		Shield
26	I	+ Cos	I	- Cos		Shield
28	I	+ Sin	I	- Sin		Shield
30	O	+ Ref	O	- Ref		Shield
32	O	+ A	O	+ B	O	+ NM

Connector 2
angled
DIN 41612, Type H-15
6,3mm pins

	d		z	
4			I	+ 325 V
6	I	+ 325 V		
8			I	+ 325 V
10	O	U		
12			O	U
14	O	V		
16			O	V
18	O	W		
20			O	W
22	I	- 325 V		
24			I	- 325 V
26	I	- 325 V		
28			I	T.-Switch
30	0	T.-Switch		
32			O	Ground

Assembly



Addressing (blue)

S1,S2 (Y0,0X) (Adr.)	Axis (channel)	Incremental encoder (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 encoder can be directly integrated in the control algorithm. When 0x80 is added to the current axis number (increase rotary switch Y0 by 8), the encoder will address the next channel number.
In this connection, only even addresses are allowed for the controller so that the encoder 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 on page 7 and the following pages.

Jumpers (light green)

The jumpers influence the light intensity of the emitting LED and thereby the segment length of the fiber cable up to the next board.

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

Specifications

Sampling rate

- Sampling rate: 12kHz (current, speed and position control)

Outputs Out 0,1

- Outputs electrically isolated:
  V_{OFF}: 48V
  I_{ON}: 500mA

Inputs INP 0..3

- Electrically isolated:
- without connection: 5V
- with 1.2kΩ series resistor: 24V

Incremental inputs

- Incremental input with A,B tracks
- Interface: 5V / RS422
- max. counting frequency: 2.5MHz (12-bit counter)

5V supply

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

Installation

- Connector DIN 41612, Type F-48, Type H-15
- Installation in 19" chassis
- Dimensions: (LxWxH)
  96231-6A: 105 x 234 x 25 mm
  96231-10A: 105 x 234 x 25 mm
  96231-30A: 105 x 234 x 35 mm

RS232 interface (violet)

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

Connections

Board power supply

For the board power supply, a 3-phase rectifier without electrolytic capacitor is sufficient. But to prevent interference, a electrolytic capacitor of 4'700 ... 10'000µF is recommended.
The rack must be provided with a line filter just after the entry of the power supply.

Screened lines

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

The incremental encoder and the serial interfaces as well as the motor cables must always be connected through screened lines!

Potential equalization

Always install all screens on both sides. To prevent undesirable leakage currents via the screening, it may be necessary to provide a potential equalization line, especially in case of long distances or different power supplies.

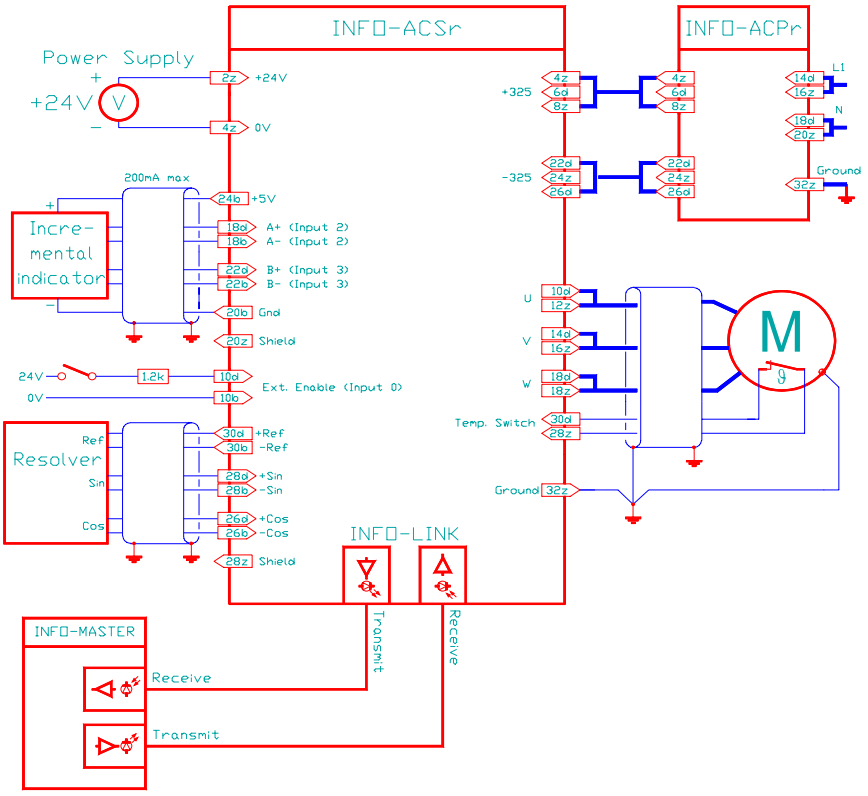
Screening bar

A screening bar must be provided inside the rack on which all screened cables must be placed.
Metallic connectors with circumferential contacting of the screen are also suitable for cable entries.

Plug-in connections

Interruptions in the resolver and motor cables at entries into cabinets etc. should be made by metallic plug-in connections and not by clamp terminal connections.

Connection Example



Connection example

Motor temperatur switch

open = Motor over temperatur
close = Ok

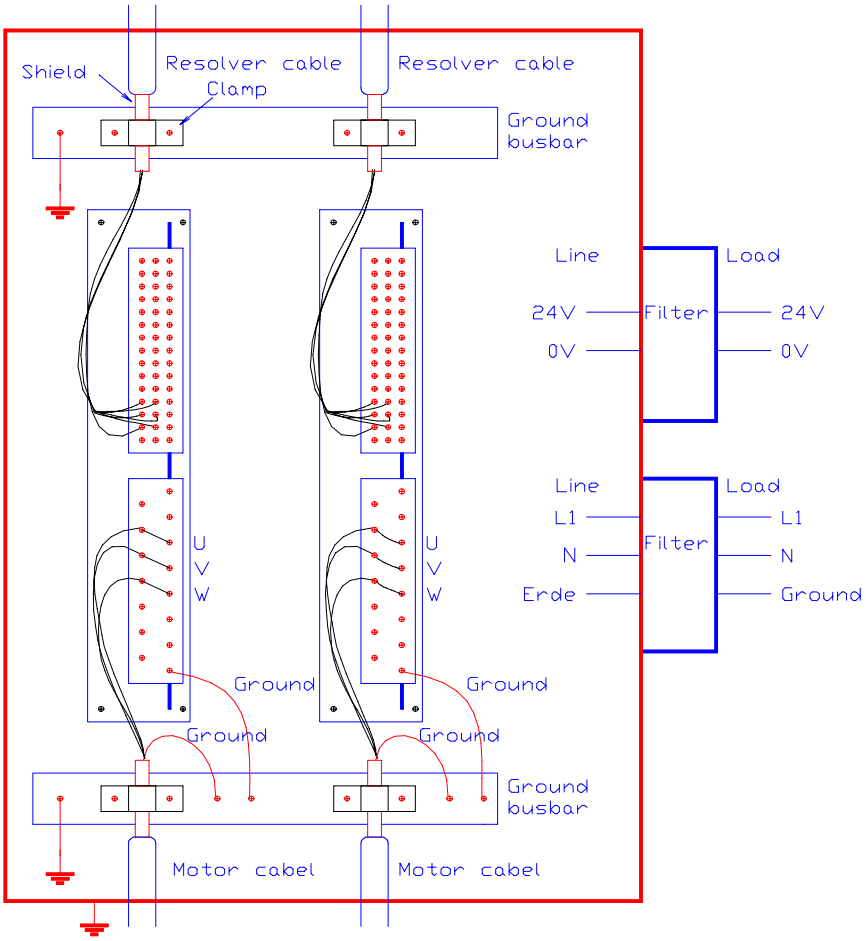
Inputs & outputs

The additional inputs and outputs:

External enable (Inp0)	Free input (Inp1)
Incremental encoder track A (Inp2)	Incremental encoder track B (Inp3)
Controller active (Out 0)	Current reduction active (Out 1)

are only allowed to be wired inside the rack. If the cabling length exceeds 1m, the inputs and outputs must also be installed with screening.

Grounding



Grounding of INFO-ACSr

Connections

Filter

The 24V power supply must be provided with a filter directly at the entry into the rack.
This is also true for the 230V of the power section for the intermediate circuit.
The optimal filter may have to be determined by a measurement for line-bound emission, as the radiated interference depends, among other factors, on the motor cable length.

Grounding

The INFO-ACSr board is grounded at the front panel. Take care to ensure that the rack housing is connected in a conductive way with the control cabinet. As the resolver is mounted directly on the motor, it is essential to ground also this motor-resolver combination, as otherwise the motor current will interfere with the resolver electronics.

Screening plate

If the Stand Alone Master (INFO-SAM) is installed together with controllers of the INFO-ACSr series in the same rack, a screening plate must be interposed between the master and the controller. In addition, the manufacturer recommends a minimum clearance of 5 ... 10cm between the master and INFO boards carrying high voltage. Possibly provide empty space.

See also Indel Wiring guidelines and Indel design guidelines.

LEDs

Function of LEDs on front panel

Inputs & outputs

Active

Motor control active (Out 0)

Requires external enable (Ext En, INP-0). End stage ON, motor energized and 4k-Pos control on Active or Simulation.
In the event of an error, the controller exits the active state.

Output

Current reduction active mode (Out 1)

In this mode, the controller limits the maximum current to I_{red}.
Out-1 of 4k-Pos-Job = 1

Ext. En

External controller enable (INPUT 0)

Interlocks the end stage by a hardware function, i.e. the controller cannot be activated without external enable.
INP-0 can be included in the emergency stop circuit. Without connection: 5V input, with 1.2kΩ series resistor connected: 24V input.

Input

Free input (INPUT 1)

Free 5V input, can be read in 4k-Pos job. (See software manual)

Inc A

Encoder track A (INPUT 2)

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

Inc B

Encoder track B (INPUT 3)

Allocated as standard as encoder input B (for additional measuring wheel).
5V input, for RS 422 interface.

OK **Error**

Emergency system

In the emergency system, flash PROM burning is supported. In order to start the controller in the emergency system, a short-circuit termination must be connected to 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 termination can be removed and the serial cable to the PC can be reconnected.

Function of LEDs on front panel

LEDs

Flashing code

By continuous lighting, fast or slow flashing, the LEDs indicate the status of various controller funtions. The following applies for the sketches below:

E = Error
W = Warning

Please use the program "ACS-Show" as an additional aid to verify errors. See also "Manual for AC-Servo Controllers".

Same rhythm as OK-LED on controller

approx. 3 times per second

approx. 1.5 times per second

Controller status

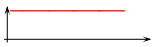
Intermediate circuit voltage (325 VDC)

(see also Modulation)

= E Intermediate circuit voltage lower than 20V

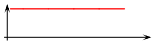
= E Intermediate circuit voltage higher than 385V

= W Intermediate circuit voltage lower than 260V


= Intermediate circuit voltage 261 ... 384V (optimal mode)

U_{CC}

Motor current


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

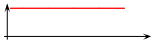
= E Motor overloaded or blocked (excessive load in case of excessive starting current).

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

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

I_{MAX}

Temperature end stage


= E End stage overheated (from (80°C)

= W End stage hot (from 75° C)

= W End stage warm (from 60° C)

Control

LEDs

Function of LEDs on front panel

Motor

Motor: temperature, short circuit

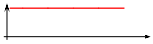
= E Motor short circuit, or end stage defective

= E Motor temperature switch activated more than 10s

= W Motor temperature switch activated

Resolver

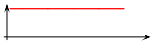
Resolver

 = E Resolver connection defective or not correct.
This error will also occur when the rotor is turning while the axis is switched active.

= E Maximum mechanical rotary speed exceeded

PWM

Modulation

 = E Current offset too high (Test before Active)

= E Current measurement range exceeded

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

If the motor is operated at high rpm, the PWM-LED starts to flash. U_{CC} is fully modulated, i.e. the full intermediate circuit voltage is applied to 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 flash. In this condition, the controller is not allowed to be in permanent operation.
The loading limit is reached only when the controller exceeds the maximum allowable path error (increment, trailing error), and the controller switches to Error.

Important!

If the maximum rpm cannot be reached because path errors, trailing errors occur while the U_{CC}-LED is flashing, the following causes must be checked:

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

Funktion der LEDs auf der Frontplatte

LEDs

Remedy:

- Increase the intermediate circuit voltage by adding windings to the transformer Observe max. U_{CC}=385V!
- In the presence of several controllers, split them up among different phases.
- Possibly apply an additional power supply unit (INFO-ACPr).

CPU-OK, controller active

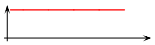
OK

Controller deactive, OFF, CPU ok

Controller active, ON, CPU ok

Errors

Error



= E Software error, CPU on Trap

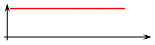
Incorrect control parameters

Error + Control

= E After switching on the controller (not Active), the Control-LED together with the Error-LED show implausible or missing **Control** parameters. With the factory-set parameters, this status display will appear.

Incorrect motor parameters

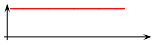
Error + Motor



= E After switching on the controller (not Active), the Motor-LED together with the Error-LED show implausible or missing **Motor** parameters. With the factory-set parameters, this status display will appear.

RAM error

Error + U_{CC}



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

Tel. ++41 1/956 20 00
Fax ++41 1/956 20 09

CH-8332 Russikon
Tüfiwis 26