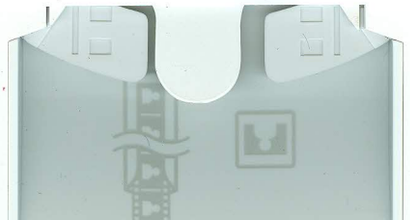
bpi Packing Tech Inc.
Lemo INTERmat
HTCC-13.5
ABB Drives (Parvex)

Section I – Control Interface

Section II – PARVEX Drives (ABB @ that time)



Catalogue/
Start-up Instructions

AXODYN®
Brushless DC Servo Drives with Permanent-Magnet Motors
4-Quadrant Operation

Series DSH(-S)..05

Publication No.
D ANT 4009 91 E

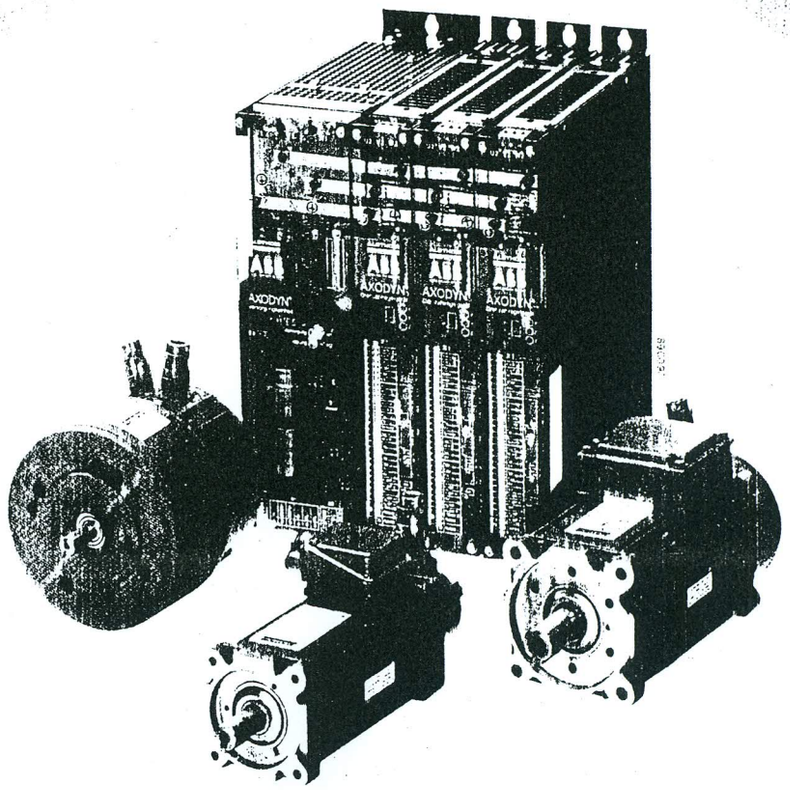


ABB
Servo drives
dynamic
accurate
reliable

Section II

ABB Drives

ABB

Catalogue/
Start-up Instructions

AXODYN®
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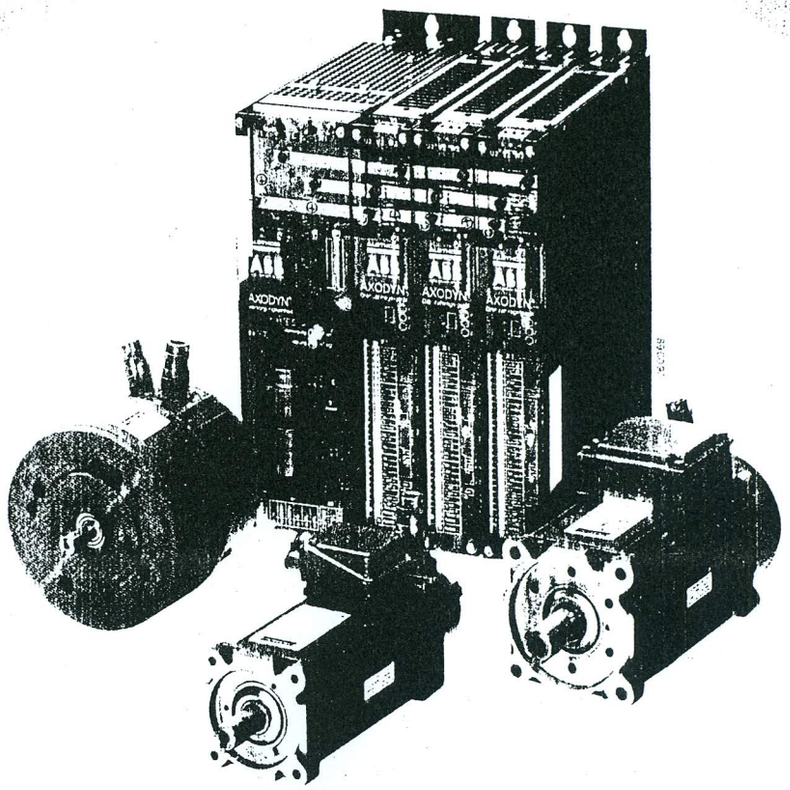


ABB
Servo drives
dynamic
accurate
reliable

Section II

ABB Drives

ABB

AXODYN® Brushless DC Servo Drives: The suitable speed regulators with matching permanent-magnet motors for demanding tasks in handling systems!

High degree of dependability, availability and reliability of the drive system:

- Brushless DC servo motors with permanent-magnet excitation requiring minimum maintenance; high degree of protection
- Stator windings of motors protected by thermal contacts (NC contacts)
- Output stage protected against overcurrent in the DC link or at the unit output
- Speed regulators equipped with various monitoring and signalling devices (displays/relay contact output)

Improved performance characteristics for industrial robots and handling systems:

- Increased load carrying capacity due to a favourable torque/motor weight ratio
- Shorter acceleration and deceleration times at higher travelling velocities ensured by drives with high rated speeds, constant torques over the entire speed setting range (no commutation limit, no reduced zero-speed torque) and pulse torques about 3 times higher than the rated torque
- High positioning accuracy at improved dynamic response achieved by drives with high resolution, wide speed setting range, smooth running even at low speeds and rotors with low mass moments of inertia
- Brushless DC motors with disc-rotor facilitate integration into the mechanical system (increased working space)

Easy assembly and start-up:

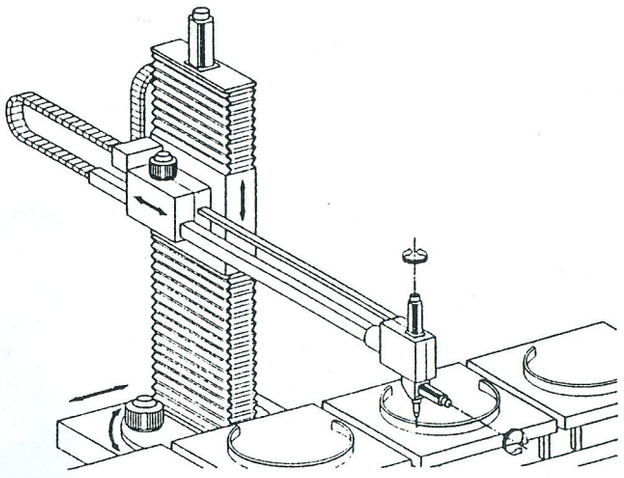
- Brushless DC servo motors with adjusted rotor position measuring device and brushless DC tacho-generator with evaluation electronics for speed feedback measurement
- Connections of rotor position measuring device to motor and speed regulator implemented via plugs
- Connection of control signals via plug-type terminals accessible from the front or via terminals for the power section
- Analog speed and current control loops
- Plug-in motor PCB (not provided for unit DSH-S 0305) for adaptation to motor and system-specific parameters
- 7-segment display unit for indication of status and fault signals

Applications

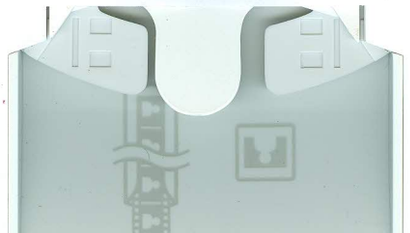
Feeding and positioning control systems meeting the high requirements of industrial robots, handling and transportation systems as well as of machine tools, transfer lines, printing and packing machines

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Application example:
Industrial robot for handling and processing tasks



AXODYN® Brushless DC Servo Drives: The suitable speed regulators with matching permanent-magnet motors for demanding tasks in handling systems!

High degree of dependability, availability and reliability of the drive system:

- Brushless DC servo motors with permanent-magnet excitation requiring minimum maintenance; high degree of protection
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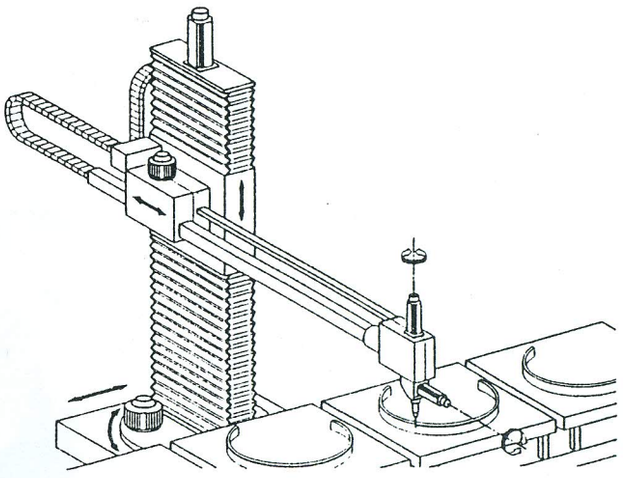
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Applications

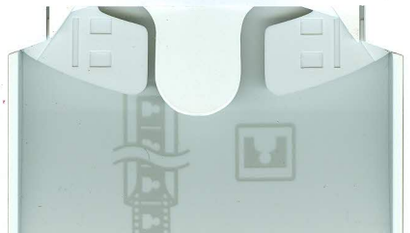
Feeding and positioning control systems meeting the high requirements of industrial robots, handling and transportation systems as well as of machine tools, transfer lines, printing and packing machines

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Application example:
Industrial robot for handling and processing tasks



1 Complete AXODYN® Brushless DC Servo Drive

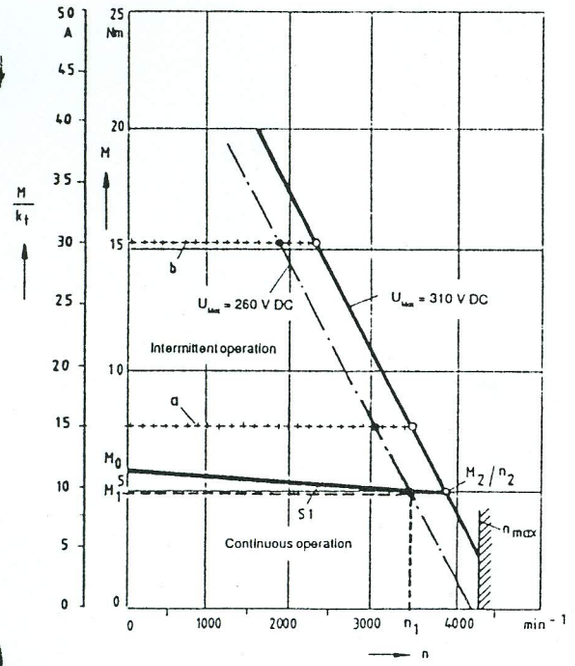


Figure 1./1 Speed/torque characteristic of a brushless DC servo drive system. Detailed information on request!

M_0 = Torque at zero-speed; permanently provided by the motor at low speeds and zero speed

M_1 = Continuous torque at n_1

M_2 = Continuous torque at n_2

n_1 = Speed at a motor voltage (U_{Mot}) of 260 V DC and for operation with $M = M_1$ (= supply undervoltage of 15 %)

n_2 = Speed at a motor voltage (U_{Mot}) of 310 V DC and for operation with $M = M_2$ (= rated supply voltage)

n_{max} = Max. permissible motor speed

Torque characteristics (a, b) of servo motor with I_N (a) or I_H (b) of speed regulator type DSH(-S) (only permissible for intermittent operation)

Note: M_1 and n_1 correspond with the **rated data** indicated on the motors' nameplates!

Table of motor/speed regulator combinations

Brushless DC servo motors Type	Matching speed regulator Type AXODYN®	Rated/dyn. high unit current I_N/I_H A	Continuous torque at zero speed M_0 Nm	Contin./ rated torque M_1 Nm	Contin. motor current I_1 A	Max. pulse torque M_{max} Nm	Max. pulse current I_{max} A	Speed at 260 V DC link voltage + rated torque M_1 n_1 ④ min^{-1}
LC 310TH	DSH-S 0305	3.5/10	0.9	0.8	2.5	3.0	9.3 ①	6000
LC 320TE	DSH-S 0305 *	3.5/10	1.7	1.5	3.4	4.4 ③	10.0 ②	4500
LC 420TL	DSH-S 0705 *	7.5/15	2.8	2.5	5.3	7.1	15.0 ②	3900
LC 430TJ	DSH-S 0705	7.5/15	3.6	3.2	5.9	8.2	15.0 ②	3400
LC 440TG	DSH-S 0705	7.5/15	4.5	4.0	6.9	8.7	15.0 ②	3350
LC 620TJ	DSH-S 1505 *	15/30	5.6	5.0	10.8	13.9	30.0 ②	3900
LC 620TJ	DSH 3005	30/60	5.6	5.0	10.8	19.0	38.0 ①	3900
LC 630TF	DSH-S 1505	15/30	9.1	8.1	15.0	16.2	30.0 ②	3550
LC 630TF	DSH 3005	30/60	9.1	8.1	15.0	28.0	47.5 ①	3550
LC 640TE	DSH-S 1505	15/30	12.3	9.2	15.0	18.4	30.0 ②	3000
LC 640TE	DSH 3005 *	30/60	12.3	11.0	18.3	35.0	53.0 ①	3000
LC 820TJ	DSH 3005	30/60	17.4	16.0	26.3	36.5 ③	60.0 ②	3000
LC 820TJ	DSH 4505	45/90	17.4	16.0	26.3	48.0	72.0 ①	3000
LC 830TG	DSH 3005	30/60	25.0	23.0	32.5	42.5 ③	60.0 ②	2600
LC 830TG	DSH 4505	45/90	25.0	23.0	32.5	60.0	77.0 ①	2600
LC 840TF	DSH 4505 *	45/90	33.0	30.0	37.2	70.0	79.0 ①	2200
GC 15TB	DSH-S 0705	7.5/15	5.0	4.4	7.5	8.8	15.0 ②	3200
GC 19TB	DSH-S 1505	15/30	11.0	9.1	15.0	18.2	30.0 ②	3150
GC 24 TB	DSH 3005	30/60	15.0	14.5	25.0	34.8 ③	60.0 ②	3100

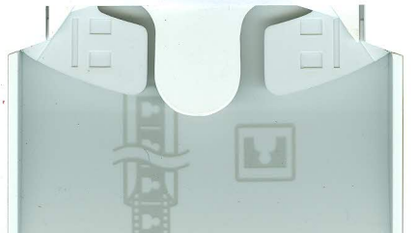
* As delivered by ABB, the regulator indicated is adapted to the associated motor (also refer to the table of components)!

① Max. pulse current permissible for the motor; **the associated regulator's dyn. high current (I_H) must be limited to this value.**

② Max. dyn. high current (I_H) of the associated regulator. The unit is capable of providing this current for a maximum period of 1 s, after which the current is limited to the adjusted rated value (I_N).

③ The motor torque is limited to the indicated value by the maximum unit current.

④ For the speeds **attainable** at 310 V DC refer to the motor characteristics (upon request)



2 Brushless DC Motors of Series LC (with Extended Rotor) and Series GC (with Disc Rotor)

- Rotor with samarium-cobalt permanent magnets; extremely low mass moment of inertia
- Three-phase stator winding with excellent heat dissipation; voltage across 2 phases U_{Mot} = about 260 V DC
- Trapezoidal EMF ensures higher torques for the same rate of temperature rise and motor frame size
- Enclosure IP65 (series GC: IP44), insulation class F
- Vibration severity grade N
- Shaft extension run-out tolerance N (R upon request)
- Free choice of motor mounting position
- Paint coat: graphite-black, RAL 9011
- High torques over the entire speed setting range (no limitation by the commutation limit characteristic)
- Minimum maintenance due to the absence of commutator and carbon brushes
- Sensor system (RLG) consisting of rotor position measuring device (3 Hall sensors) and brushless DC tacho with integrated evaluation electronics; combined plug for sensor system (RLG)
- Motor connections implemented via plugs (types GC/LC 3...) or terminal box
- Motors also available with zero-speed holding brake; provision for attachment of an incremental encoder

2.1 Technical data of series LC motors (with extended rotor)

Characteristics (see "1 Complete AXODYN® ....")		Unit	Motor Type LC .... ③										
			310 TH	320 TE	420 TL	430 TJ	440 TG	620 TJ	630 TF	640 TE	820 TJ	830TG	840TF
Torque at zero-speed M_0	① ⑥	Nm	0.9	1.7	2.8	3.6	4.5	5.6	9.1	12.3	17.4	25.0	33.0
Continuous torque M_1	① ⑥	Nm	0.8	1.5	2.5	3.2	4	5	8.1	11	16	23	30
Speed n_1 (appr. value)	① ② ⑥	min⁻¹	6000	4500	3900	3400	3350	3900	3550	3000	3000	2600	2200
Max. permissible speed n_{max}		min⁻¹	7200	5500	5000	4500	4000	5000	4500	3600	3600	3100	3000
Motor current I_1	⑥	A	2.5	3.4	5.3	5.9	6.9	10.8	15	18.3	26.3	32,5	37.2
Winding resistance/inductance	④	Ω/mH	9.3/15.1	6.72/11.5	3.3/9.5	2.5/8.1	1.9/6.6	1.14/5.6	0.7/4.3	0.6/4.3	0.28/3.6	0.216/3.3	0.185/3.2
Pulse torque	⑥	Nm	3	5	9.5	12	15	19	28	35	48	60	70
Mech. time constant		ms	2.9	1.86	2.15	1.63	1.39	2.66	1.82	1.64	1.5	1.23	1.06
Moment of inertia		kg cm²	0.33	0.59	1.8	2.4	3.0	6.0	9.0	12.0	24.0	34.5	45.0
Torque constant	k_T	Nm/A	0.325	0.46	0.525	0.606	0.643	0.506	0.592	0.662	0.67	0.78	0.89
EMF const. per 1000 min⁻¹	④ k_E	V	34	48.4	55	63.5	67.3	53	62	69.3	70	81.6	93
Damping const. per 1000 min⁻¹	k_D	Nm	0.007	0.007	0.02	0.025	0.025	0.01	0.02	0.03	0.07	0.1	0.13

2.2 Technical data of series GC motors (with disc rotor)

Characteristics (see "1 Complete AXODYN® ....)		Unit	Motor Type ... ③		
			GC15 TB	GC19 TB	GC24 TB
Torque at zero-speed M_0	① ⑥	Nm	5	11	15
Continuous torque M_1	① ⑥	Nm	4.4	9.7	14.5
Speed n_1 (appr. value)	① ② ⑥	min⁻¹	3200	3150	3100
Max. permissible speed n_{max}		min⁻¹	4500	4000	4000
Motor current I_1	⑥	A	7.6	16	25
Winding resistance/inductance	④	Ω/mH	1.49/7	0.44/4	0.165/2.5
Pulse torque	⑥	Nm	18	40	60
Mech. time constant		ms	2.63	1.93	1.45
Moment of inertia		kg cm²	8.1	18.5	36
Torque constant	k_T	Nm/A	0.65	0.649	0.64
EMF constant per 1000 min⁻¹	④ K_E	V	71	68	67
Damping constant per 1000 min⁻¹	K_D	Nm	0.04	0.08	0.14

Motor Type	Data for zero-speed holding brakes at (20°C) 24 V ⎓ ±10 % (retrofitting not possible) ⑤			
	Mass moment of inertia	Holding torque	Power consumption	Weight (compl. brake)
LC 3..	0.07 kg cm²	1.5 Nm	9 W	0.19 kg
LC 4../GC 15	1.06 kg cm²	5 Nm	16 W	0.6 kg
LC 6../GC 19	3.63 kg cm²	12 Nm	18 W	1.1 kg
LC 8../GC 24	9.50 kg cm²	20 Nm	22 W	1.9 kg

Motors produced in France

① In the case of supply from pulse duration modulated (PDM) speed regulators

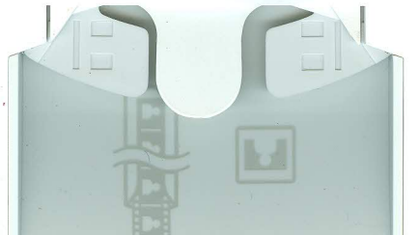
② Voltage across 2 phases appr. 260 V DC

③ Insulation class F, enclosure IP65 (series GC: IP44)

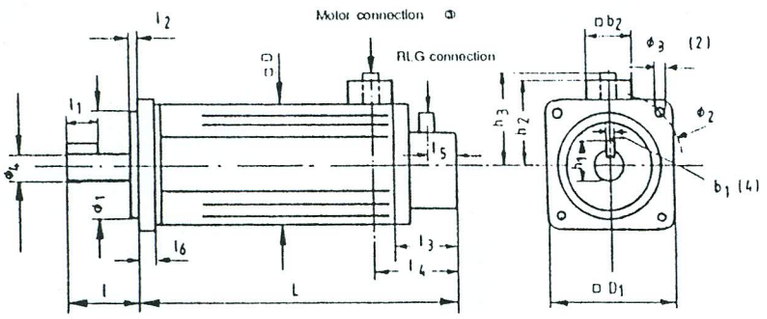
④ Values across 2 phases at 25°C
All data only apply if the components are fitted to sufficiently dimensioned cooling surfaces; reference (ambient) temperature 40°C

⑤ Not to be used as brake in normal operation; separate supply of 24 V DC required for release of the brake

⑥ **For the attainable drive data** refer to "Table of motor/speed regulator combinations" of chapter 1!



2.3 Dimensions of series LC motors



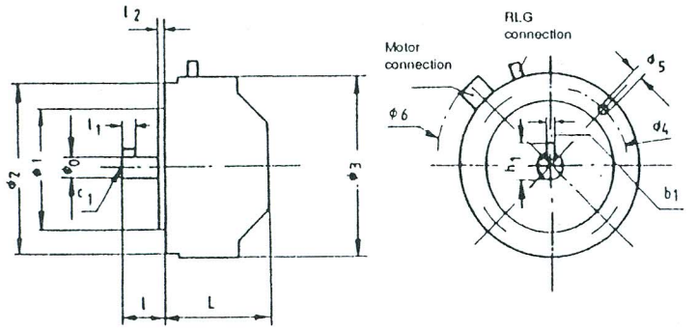
Motor Type	Appr. dimensions of motor/RLG connect. ③ Terminal box			Plug		
	b_2	h_2	l_3	l_4	h_3	l_5
LC 3....	- ③	- ③	- ③	99	90	29
LC 4....	66	85.5	75.5	103	116	25
LC 6....	98	101	76.5	105	140	35
LC 8....	97	121	76.5	112	156.5	35

Motor Type	Appr. dimensions (in mm) ①											Flange				Weight (in kg)	Holding brake
	ø1	□D	L	l	l_1	l_2	l_6	ø4	h_1 ⑤	b_1	c_1	Type ②	$□D_1$	ø2	ø3	without/ with br.	M_{Br} ⑧ (Nm)
LC 310 T	60j6	66	223	23 ± 0.4	- ④	2.6	9	11j6	- ④	-	-	F75TL	66	75	6	2/2.2	1.5
LC 320 T	60j6	66	262	23 ± 0.4	- ④	2.6	9	11j6	- ④	-	-	F75TL	66	75	6	2.5/2.7	1.5
LC 420 T	80j6	90	256	40 ± 0.4	30	3	18	19j6	21-0.14	6h9	M6x15 deep	F100TL	90	100	7	5/5.6	5
LC 430 T	80j6	90	282	40 ± 0.4	30	3	18	19j6	21-0.14	6h9	M6x15 deep	F100TL	90	100	7	5.7/6.3	5
LC 440 T	80j6	90	308	40 ± 0.4	30	3	18	19j6	21-0.14	6h9	M6x15 deep	F100TL	90	100	7	6.3/6.9	5
LC 620 T	110j6	115	280	50 ± 0.4	32	3.5	18	24j6	27-0.13	8h9	M8x20 deep	F130TL	115	130	10	8.6/9.7	12
LC 630 T	110j6	115	324	50 ± 0.4	32	3.5	18	24j6	27-0.13	8h9	M8x20 deep	F130TL	115	130	10	11.5/12.6	12
LC 640 T	110j6	115	367	50 ± 0.4	32	3.5	18	24j6	27-0.13	8h9	M8x20 deep	F130TL	115	130	10	14.4/15.5	12
LC 820 T	180j6	155	331	60 ± 0.5	32	4	17	28j6	31-0.22	8h9	M8x20 deep	F215TL	200	215	15	19/21	20
LC 830 T	180j6	155	381	60 ± 0.5	32	4	17	28j6	31-0.22	8h9	M8x20 deep	F215TL	200	215	15	25/27	20
LC 840 T	180j6	155	431	60 ± 0.5	32	4	17	28j6	31-0.22	8h9	M8x20 deep	F215TL	200	215	15	31/33	20

① Same dimensions apply for brushless DC servo motors with zero-speed holding brake
② F...TT = with threaded holes (upon request)
③ Types LC3.... with motor plug; types LC4..../LC6..../LC8.... with motor terminal box; motor types with plug upon request
④ Types LC3... without featherkey and keyway
⑤ Upper deviation 0 mm
⑧ Holding torque at 20°C

Note: It is possible to attach an incremental encoder on the second shaft extension; overall motor length including intermediate flange and encoder is appr. L + 90 mm (types LC3../4..) or L + 110 mm (types LC6../8.., including protective cover of encoder)

2.4 Dimensions of series GC motors

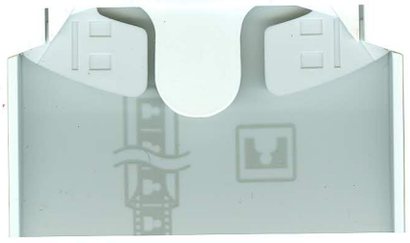


Motor Type	Appr. dimensions (in mm) - without holding brake											Flange				Wei. (in kg)	Holding brake M_{Br} ⑧
	ø 1	ø 3	ø 6	L ⑦	l	l_1	l_2	ø 0	h_1 ⑤	b_1	c_1	Type ⑥	ø 2	ø 4	ø 5		
GC 15	95j6	170	230	178	34	20	3	14g6	16-0.185	5h9	M4 x 15 deep	B14	165	115	M 8 x 12 deep	8.5	5
GC 19	130j6	211	360	183	50	32	3.5	24g6	27-0.22	8h9	M8 x 20 deep	B14	186	165	M 8 x 13 deep	12.5	12
GC 24	180j6	279	358	205	60	32	5	28g6	31-0.22	8h9	M8 x 20 deep	B14	242	215	M12 x 14 deep	21	20

⑤ Upper deviation 0 mm
⑥ Flange type B5 upon request
⑧ Holding torque at 20°C
⑦ L_{max} with zero-speed holding brake: 204 (GC 15)
254 (GC 19)
276 (GC 24)

Note: It is possible to attach an incremental encoder on the second shaft extension; dimensions upon request.

Subject to change!



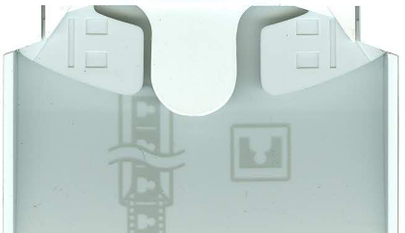
3 AXODYN® Speed Regulators of Series DSH(-S)..05 and Power Supply Units of Series DO *)

- The units' modular design permits application in single or multi-axis drives equipped with brushless DC servo motors with extended rotor or disc rotor
- 4-quadrant operation; internal ballast device absorbs surplus energy of the DC link
- All speed regulators have a common **power supply unit** of **series DO...** with power rectifier bridge, smoothing capacitors, electronics supply systems, monitoring devices, ballast circuits
- Series DSH(-S)..05 speed regulators are equipped with an 8-bit microprocessor taking over the following functions:
  - Evaluation of the signals provided by the rotor position measuring device (= RLG) for the control logic
  - Speed-dependent phase position adaptation (current/ EMF)
  - Monitoring and display of internal unit parameters (power section, electronics, temperature, RLG, n_{max}, I_{max} of unit, I_{max} of motor, I = f(t) monitor, resetting/ program interrupt, power supply unit)
- Components installed on soldering pins (on the front PCB in the case of DSH-S 0305 units) of the motor PCB for:
  - n_{max}
  - n_{fb} (standardized ±10 V)
  - R-C elements of speed controller
  - Internal current limitation
- Potentiometers for balancing the P component of the speed regulator, for fine adjustment of n_{max} (for SW1 and SW2) and offset voltage balancing
- Connections between series DO ... units and series DSH(-S)..05 units implemented via busbars; electronics supply and monitoring taken over by ribbon cable
- All signal inputs and outputs are designed as plug-type screw terminals
- Motor connection DSH-S 0705/1505: via screw terminals,
- Motor connection DSH-S 3005/4505: via screws on busbars

Connection of 220 V/3ph, 50/60 Hz supply voltage via autotransformer;
electronics section supplied with 220 V/1ph or 380 V, 50/60 Hz;
fan supply voltage of 220 V/1ph, 50/60 Hz in the case of units DO 5020, DO 10002, DSH 4505, DZ 2000

- Transistor output stage protected against overcurrent in the DC link and at the unit output
- Unipolar pulse duration modulation (PDM) for generation of a variable output voltage and the requisite current; control electronics and rotor position measuring system for accurate commutation to the presently effective motor stator windings
- Two reference differential inputs for a speed reference presetting of ±10 V (SW1/SW2 or n_1/n_2)
- Speed setting range > 1:10,000
- Full zero-speed torque at $n_{ref} = 0$, release of speed reference and torque through external contacts
- External current reduction through potentiometer, fixed resistor or analog signal (0 to +10 V); input of current reference from CNC system (10 V ≙ I_{max})
- Status and fault signals indicated by a 7-segment display; monitoring and indication of the signals X-Y-Z provided by the rotor position measuring device
- Interfaces:
  RLG signals
  Output stage blocking
  Monitor output signals for n and I (standardized: ±10 V)
  Signal output for collective fault signalling (relay)

*) Material produced in France



3.1 Technical data

General

- Type of construction — Modular design suitable for multi-axis drive systems
- Degree of protection — IP00 (intended for installation in cubicles)
- Scope of unit data

Coolant temperature	0°C ... +60°C
Max. ambient air temperature for nominal data (reference temperature)	+40°C
Storage temperature range	-20 ... +70°C
Altitude of site	h ≤ 1000 m above sea level
Relative air humidity	80 % bei 40°C (without condensation)
Reduction factors for	ϑ > 40°C: 2 %/K (up to max. 60°C) h > 1000 m: upon request

- Type of cooling: Convection cooling — For units DSH-S 0305/0705 and DO 5010
  Cooling by fan
  a) For units DSH-S 1505/DSH 3005: fan integrated in the unit and supplied internally with 24 V
  b) For units DO 5020/10002, DSH 4505, DZ 2000 } fan mounted to unit, external supply: 220 V/1ph, 50/60 Hz

General table of unit types

Type of AXODYN® unit	Power section supply Rated voltage $\frac{U_N}{V}$	Output data ② Rated continuous current $\frac{I_N}{A}$	Output data ② Dynamic high current $\frac{I_H}{A}$ ①	Power loss (appr. value) $\frac{P_V}{W}$	
Speed regulators					
DSH-S 0305	310 V DC	3.5	10	30	
DSH-S 0705		7.5	15	45	
DSH-S 1505 ③		15	30	90	
DSH 3005		30	60	200	
DSH 4505		45	90	290	
Power supply units					
DO 5010	220 V/3ph 50/60 Hz	50	150	80 ④	
DO 5020 ③		50	150	80 ④	
DO 10002 ③		100	200	150 ⑤	
Additional braking units					P_{max} (pulse)
DZ 0050	> 370 V DC	-	-	500	10 kW
DZ 2000 ③		-	-	2000	20 kW

Input current per phase = 0.82 x I_N for power supply units series DO

① Dyn. high current I_H with a max. operating time t = 1 s (from 0 to I_H) or 0.2 s (from I_N to I_H) and a time of recurrence of 3 s

② Refer to section "General data" in chapter 3.1

③ Provided with a fan (refer to section "General data" in chapter 3.1)

④ Without ballast device (P_N = 250 W)

⑤ Without ballast device (P_N = 1000 W)

3.2 Power supply units series DO

The number (n) of series DSH(-S) units, which can be connected to one common power supply unit, is limited by the power section and electronics supply of the power supply unit DO.

Number n of series DSH(-S) units connected to one power supply unit of series DO

Type of unit	k	n
DO 5010	1	6
or		
DO 5020	0.75	7
or		
DO 10002	≤ 0.5	8

k = simultaneity factor

Ballast device integrated in the DO units

	DO 5010/5020	DO 10002
Resistance	24 Ω	13,6 Ω
P_N	250 W	1000 W
P_{max} (pulse)	5 kW	10 kW
Operating time		
without repetition	2 s	5 s
with repetition	0.1 s	0.2 s
c.d.f. (ED) at P_{max}	2 %	6 %

The average of the total power - resulting from conversion of the braking energy into heat - must not exceed the permissible rating P_N of the braking resistors. Observe evaluation of the thermal contact signal.

Additional braking units of series DZ available as optional equipment. The additional braking units series DZ serve for increasing the braking power of the connected DO units.

	DZ 0050	DZ 2000 ①
Resistance	2 x 22 Ω	4 x 22 Ω
P_N	500 W	2 kW
P_{max} (pulse)	10 kW	20 kW
Operating time		
without repetition	2 s	5 s
with repetition	0.1 s	0.2 s
c.d.f. (ED) at P_{max}	2 %	2 %

① With integrated additional capacitor

Planning advice

The power section of the power supply unit DO requires a supply voltage of 220 V/3ph, 50/60 Hz, with the supply system's neutral conductor to be connected to protective earth (PE). If galvanic **isolation** is desired or requested, an **isolating transformer** has to be used (in this case, the negative busbar of the power supply unit DO has to be connected to protective earth (PE) and the neutral of the transformer's secondary winding has to be left open)! Advice relating to special supply systems upon request!

Connection to the 380 V/3ph supply system via auto-transformer is illustrated in chapter 5.1 "Connection example".

For limitation of the starting current inrush in the case of transformer ratings above 7 kVA or direct connection to a 220 V supply system, 3 resistors - for instance 22 Ω/70 W - are required, which have to be short-circuited by a bypass contactor after switching-on has been completed.

Transformer ratings ②

a) Autotransformer U_{prim} 380 V/3ph

$P_{T1} = 0.6 \cdot 220\ V \cdot \Sigma I_{Mot.}$

$P_{T1} = 0.42 \cdot (1.42 \cdot 220\ V \cdot \Sigma I_{Mot})$

P_{T1} = nominal power of transformer

I_{Mot} = motor current

b) Isolating transformer

$P_{T1} = 1.42 \cdot 220\ V \cdot \Sigma I_{Mot.}$

P_{T1} = nominal power (rating) of transformer

I_{Mot} = motor current

Contactor rating for 380 V/3ph primary side of transformer

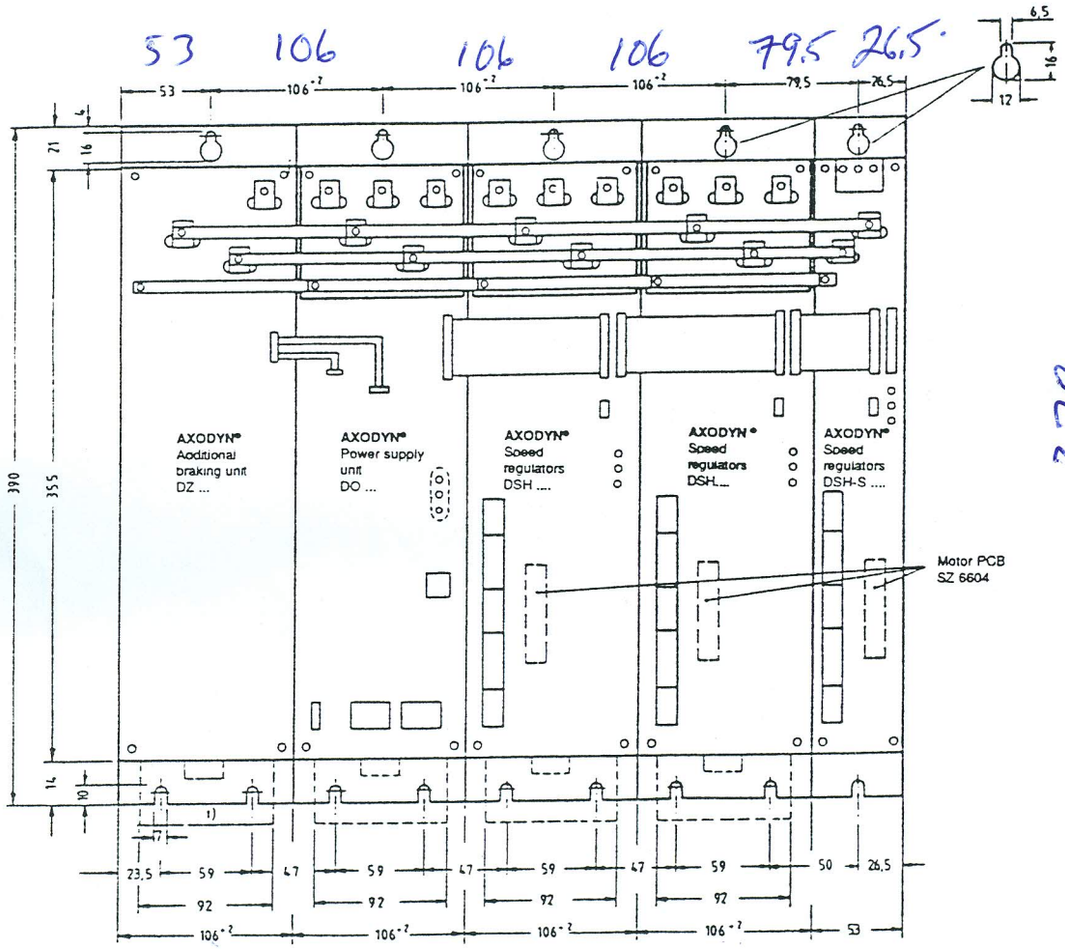
$$I_{Phase} = \frac{P_{T1}}{380\ V \sqrt{3}}$$

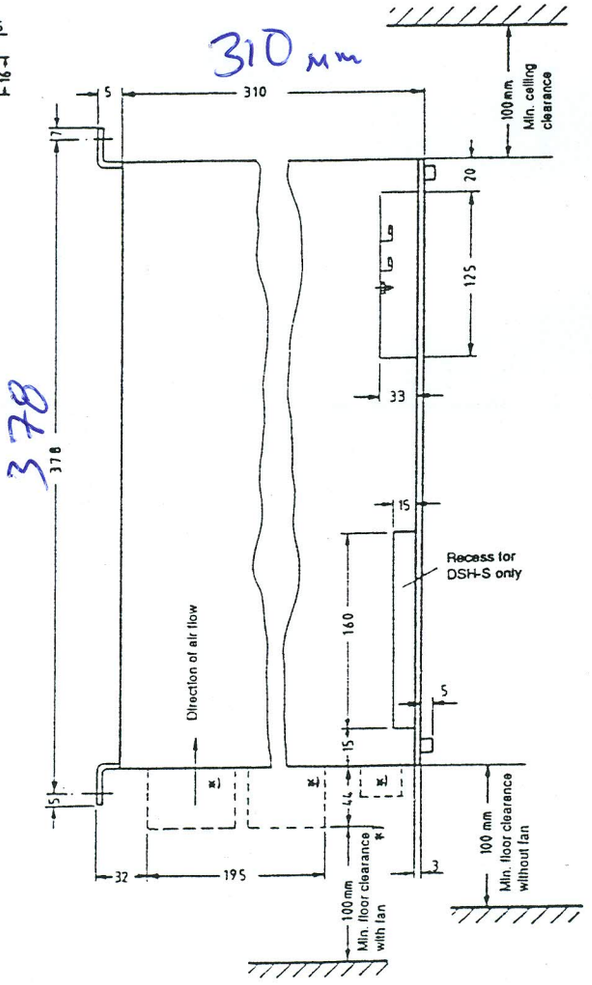
P_{T1} in VA

I_{Phase} in A

② For duty type S3 or mere 0 -> peak -> 0 operation, P_{T1} can be considerably reduced.

Dimensions in mm - Subject to change!



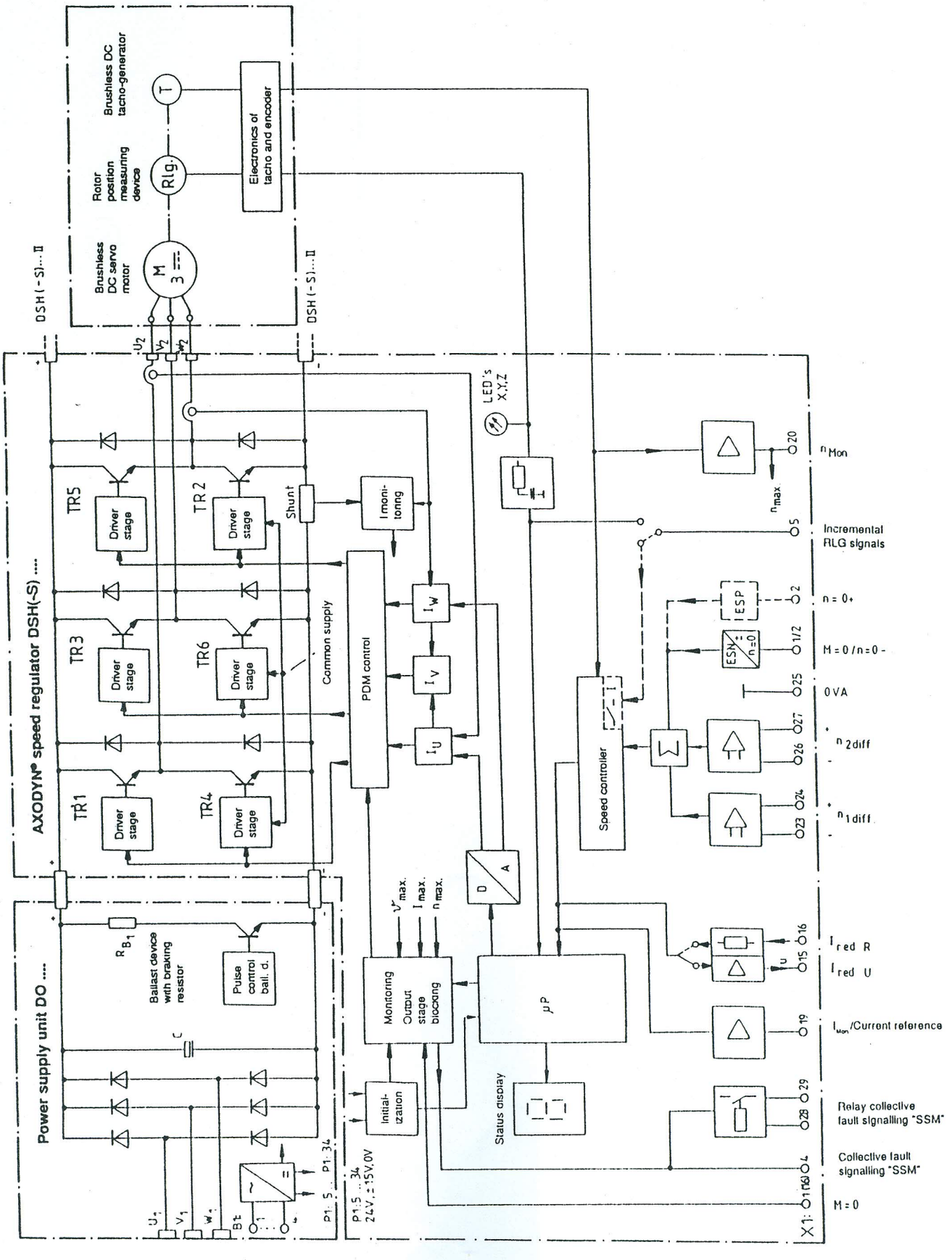


Type of unit	appr. weight (kg)
DO 5010	14
DO 5020	15
DO 10002	15
DSH-S 0305	4.5
DSH-S 0705	5
DSH-S 1505	6
DSH 3005	8
DSH 4505	11
DZ 0050	3.5
DZ 2000	6.5

x) For series DSH-S 1505, DSH 3005 the fan is integrated in the unit (refer to chapter 3.1 "Technical data")

Note: If used, the additional braking unit DZ must be arranged to the left of power supply unit DO.

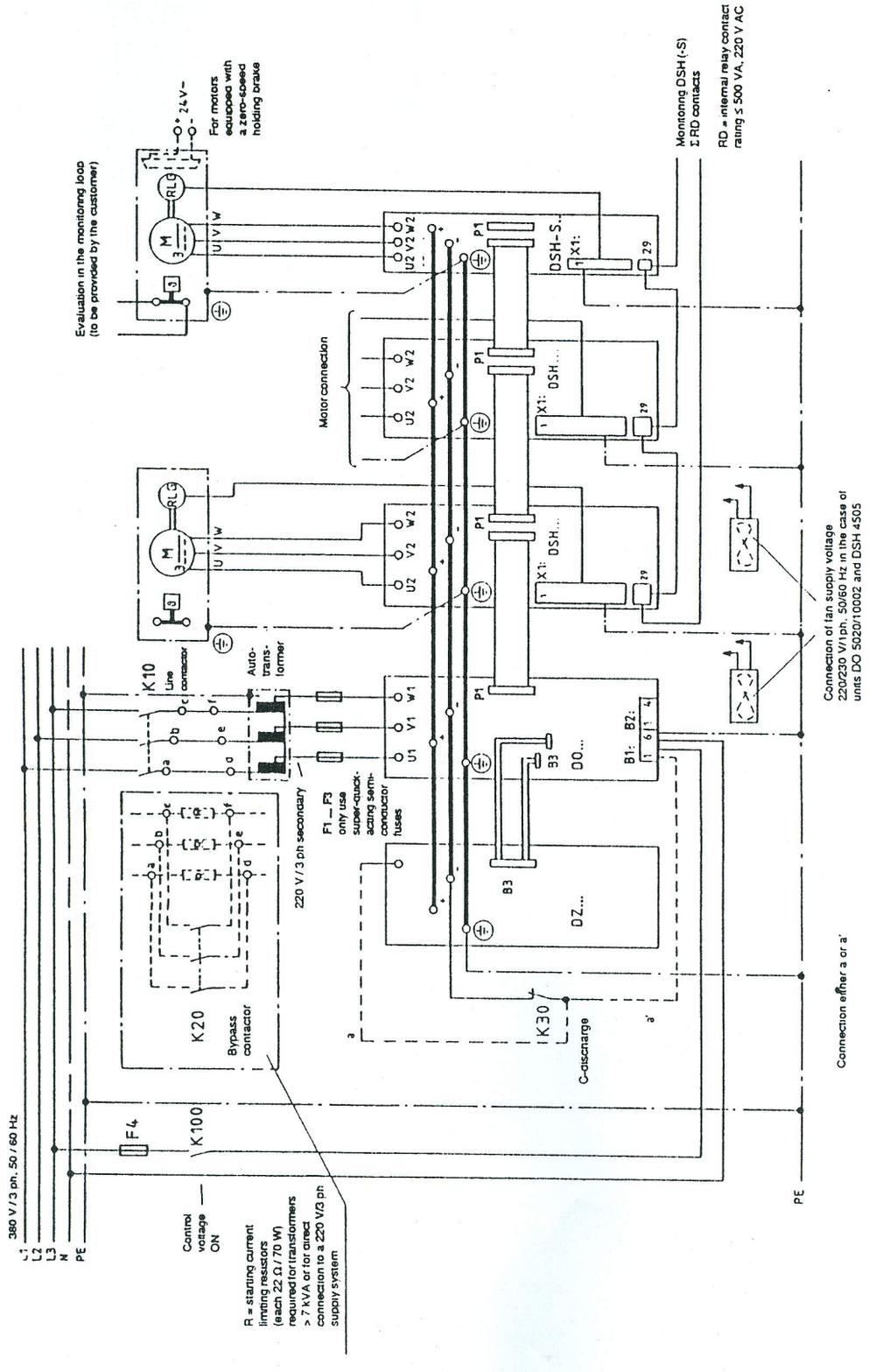
4 Block Diagram



5 Connections

5.1 Connection example

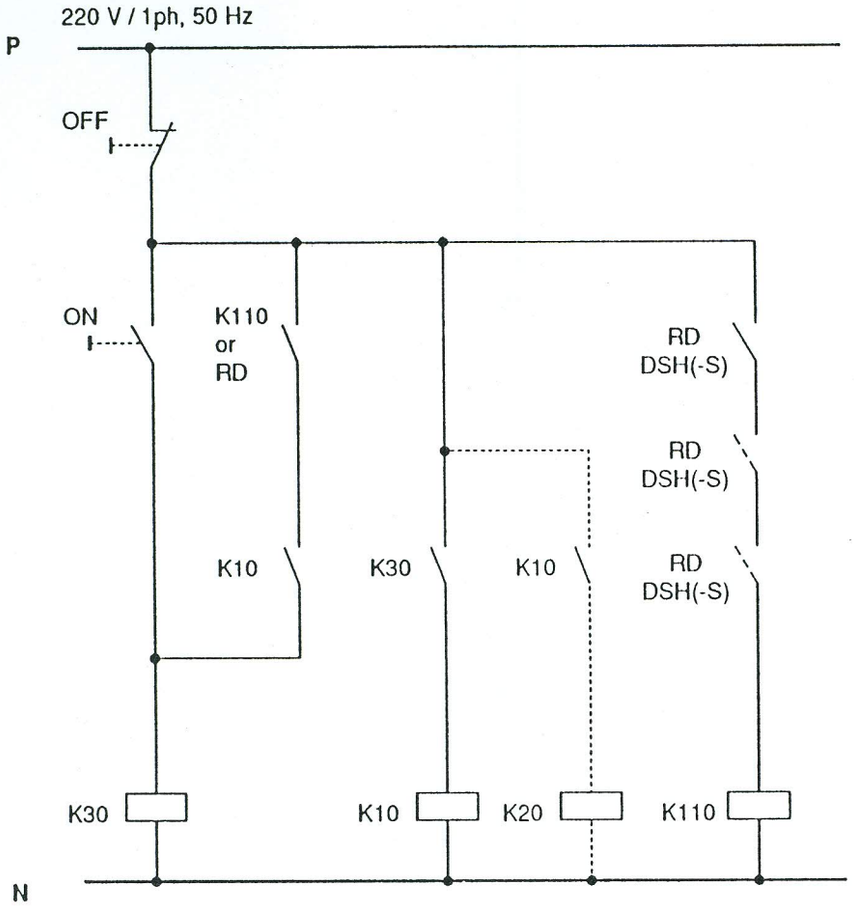
The illustrated connection example is just a recommendation how the units can be connected; it does not take into consideration individual application requirements!



Note: 1) If used, the additional braking unit DZ must be arranged to the left of power supply unit DO (unit interconnections!).

2) Different supply system conditions may require another type of transformer (transformer selection upon request).

Connection example for contactor control circuit



Switching devices

B 25 - 22 - 00

B 25 - 30 - 32 *)

K 22 E

*) Selection of line contactor determined by the power required

**) RD = internal relay contacts (≤ 500 VA, 220 V AC)

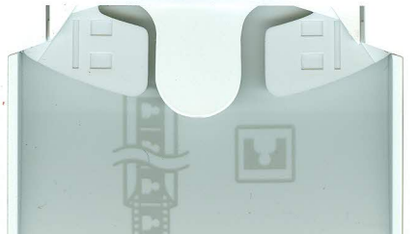
B25-22-00	B25-30-32 *)	B25-30-32 *)	K22E
Discharge contactor	Line contactor	By-pass contactor	Collective fault signalling loop **) e.g. in the case of several axes

Note: a) To relieve the contacts of K30, both main NC contacts (B25-22-00) can be connected in series.

b) Reconnection of the line contactor during DC link discharge is not permissible.

Discharge time depends on:
- the number of used speed regulators
- the drives' braking energy

Minimum discharge time ≥ 500 ms



5.1.1 Recommended conductor cross sections and fuses for power supply units DO

Recommended conductor cross sections

Unit	Terminals	Conductor cross sections	Remarks
DO 5010	U1,V1,W1, ⏚	3 x 10 mm², 1 x 6 mm²	3 phases + PE conductor
DO 5020	U1,V1,W1, ⏚	3 x 10 mm², 1 x 6 mm²	
DO 10002	U1,V1,W1, ⏚	3 x 25 mm², 1 x 10 mm²	
DO	B1	2.5 mm²	Multi-core
	B2	0.5 mm²	Multi-core

External super-quick-acting semiconductor fuses F1 ... F3

Power supply unit	Fuse data		
Type	$\frac{I_{eff}}{A}$	$\frac{I^2 t_A}{A^2s}$ ①	Type
DO 5010	63	2500	S00 üf 1/63 A/ 660 V
DO 5020	63	2500	S00 üf 1/63 A/ 660 V
DO 10002	125	14500	S00 üf 1/125 A/ 660 V

① For 660 V AC

② Fuse with an inside caliper of 80 mm, suitable for fuse bases GNT 7 030 028 R1
Only insert fuses of the indicated type (producer Jean Müller)!

5.1.2 Recommended conductor cross sections for speed regulators series DSH(-S)..05

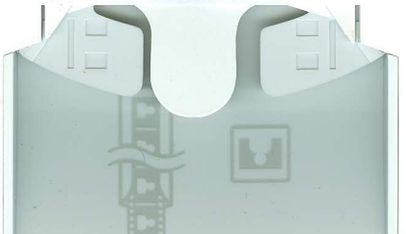
Unit	Terminals	Conductor cross sections		Remarks
DSH(-S)	X1:1 to 6	≥ 0.5 ≤ 1.5 mm²		Multi-core
	X1:15 to 21			Multi-core
	X1:22 to 27			Multi-core, shielded
	X1:7 to 14	4 x 2 x 0.25 ① ② or 4 x 2 x 0.5 ①		Shielded, twisted in pairs, connection of rotor position measuring device (RLG)
	X1:28 and 29	≥ 1.0 ≤ 1.5 mm²		Single or multi-core
		Conductor length up to 40 m	Conductor length 40 - 100 m	
DSH-S 0305	U2/V2/W2/⏚	4 x 1 mm² ③	4 x 1.5 mm² ③	Motor power terminals 3 main conductors + PE conductor
0705		4 x 1.5 mm² ③	4 x 2.5 mm² ③	
1505		4 x 1.5 mm² ③	4 x 4 mm² ③	
DSH 3005		4 x 6 mm² ③	4 x 10 mm² ③	
4505		4 x 10 mm² ③	4 x 16 mm² ③	

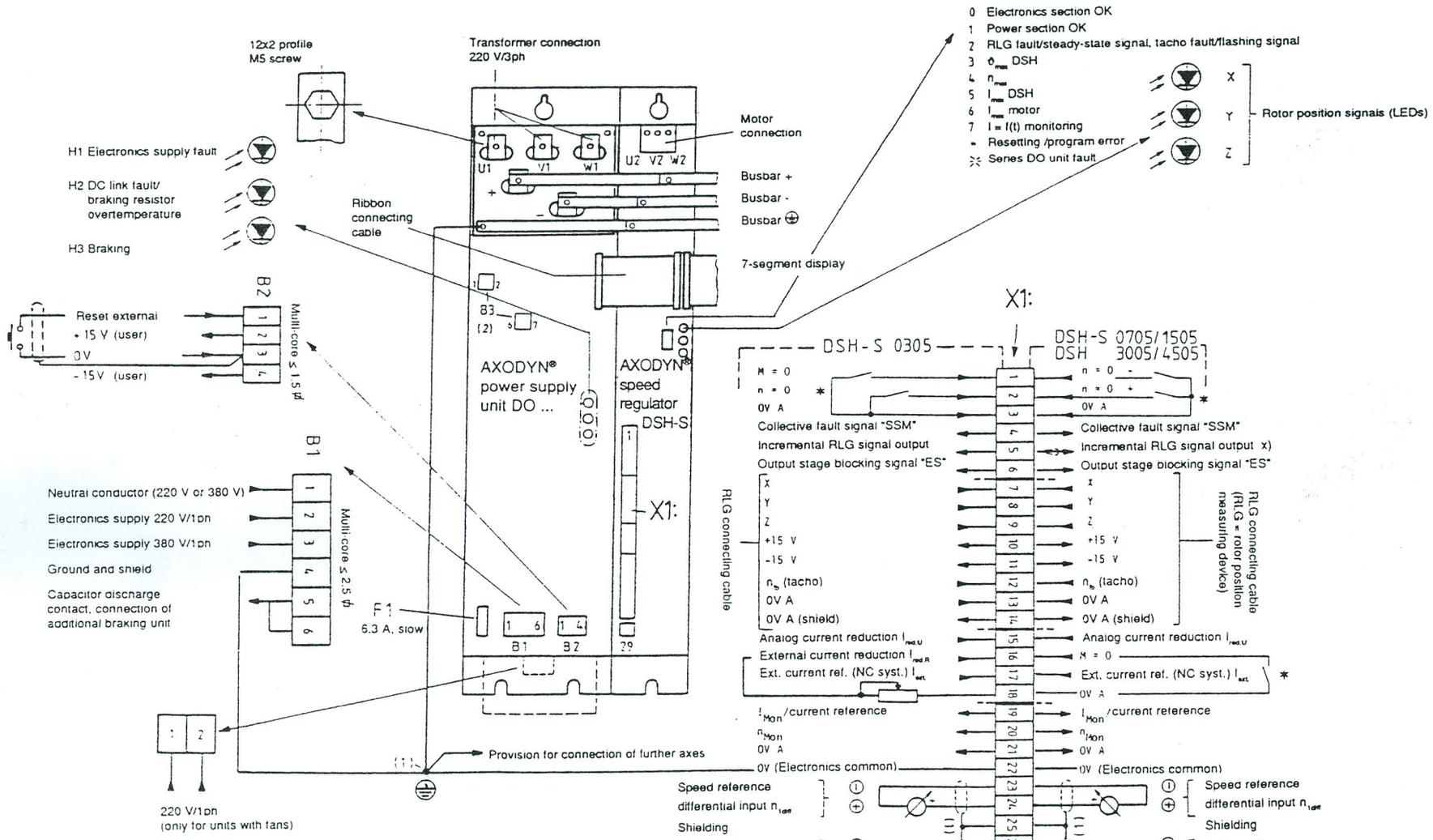
① For GC motors equipped with a brake, refer to chapter 5.3 "RLG cable"
If conductors twisted in pairs are used, the signals for tacho + and tacho 0V have to be transferred in the same core pair

② In the case of conductor lengths > 40 m, the 0V connections must have a minimum cross section of 0.5 mm², e.g. cable of 6x2x0.25

③ At the point where the connecting cable enters the terminal box (power plug, if any) of the motor, its cross section has to be such that it can be passed through the screwed conduit entry

Important: The length of the cable interconnecting the AXODYN® speed regulator of series DSH(-S) and the brushless servo motor of series GC/LC should not exceed a maximum of 100 m (please consult us in the case of longer distances)! Signal leads have to be laid separately from the other cables, if possible!





(1) The conductors connected to a neutral point should be as short as possible!

(2) For location of the terminals see unit front cover

x) With ST4: 1-2: I component suppression of speed controller with ST4: 2-3

* Drawn contact position: drive or direction of rotation blocked

5.2.2 Functions of terminals of AXODYN* speed regulators of series DSH(-S)..05

Terminals for motor connection (located at the top of the DSH(-S)..05 unit front)

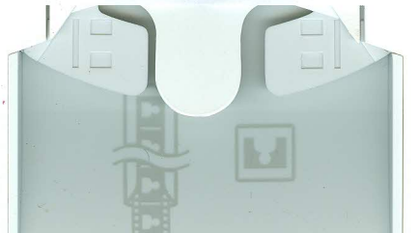
Terminal designation		Function
U2	Output	Power terminals for brushless DC servo motors of series LC and GC; rated motor voltage 260 V DC (across 2 phases)
V2	Output	
W2	Output	

Important: Observe correct sequence of phases U2/V2/W2;
also refer to the motor connection diagram!

Terminals of DC voltage supply system (located at the top of the DSH(-S)..05 unit front)

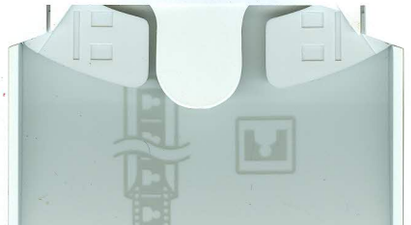
Terminal designation		Function
+	Input/output	See power terminals (busbars) of the DC link of the power supply unit DO
–	Input/output	
⏚	-	

For electronics supply and axis interlocking,
see functions of terminals of series DO power supply unit



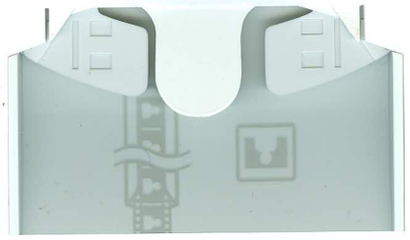
a) Terminal strip X1 for unit DSH-S 0305

Terminal No.	Terminal Designation		Function
X1:1	M = 0	Input	External torque release if contact is closed; if the contact between X1:1 and X1:3 (0VA) is open, the output stage is blocked and torque M = 0
X1:2	n = 0	Input	External release of speed references n_1 and n_2 (SW1/SW2) if the contact is closed; if contact between X1:2 and X1:3 (0VA) is open, speed reference "0" is preset internally, i.e. n = 0
X1:3	0V	-	0VA reference for analog electronics voltages
X1:4	SSM	Output	Collective fault signalling; signal output connected in parallel with the position of relay RD "Collective fault signalling"; max. load rating of open-collector circuit is 10 mA: Low (0)-signal ≙ relay RD closed (axis ready for operation) High (1)-signal ≙ relay RD open (collective fault signal)
X1:5	INKR.	Output	Incremental RLG-signals; HIGH-signals with a duration of 4 µs initiated by each signal level change of RLG tracks X-Y-Z; number of HIGH-signals per rotation = 6 x p (p = number of motor poles); 24 V open-collector circuit, 10 kΩ, max load rating 20 mA
X1:6	ES	Output	"Output stage blocked" signal at M = 0 (see X1:1) or in the case of a collective fault signalling initiated through a HIGH-signal; 24 V open-collector circuit, 10 kΩ, max load rating 20 mA
X1:7	X	Input	} Tracks X/Y/Z of rotor position measuring device (RLG) (logic signals 0/+15 V corresponding with the rotor position)
X1:8	Y	Input	
X1:9	Z	Input	
X1:10	+15 V	Output	+15 V supply of rotor position measuring device (RLG)
X1:11	-15 V	Output	-15 V supply of rotor position measuring device (RLG)
X1:12	n_{ist}	Input	Analog tacho feedback n_{ist} (from brushless DC tacho-generator)
X1:13	0V	-	0VA
X1:14	Schirm	-	0VA (terminal for connection of the RLG cable shield)
X1:15	$I_{red.U}$	Input	Analog current reduction (I_{redU}) through external voltage } + 10 V ≙ appr. 100 % I_H ; + 5 V ≙ appr. 50 % I_H
X1:16	$I_{red.R}$	Input	External current reduction (I_{redR}) through fixed resistor or potentiometer (see start-up instructions)
X1:17	$I_{ext.}$	Input	External current reference presetting ("NC system input"): 0 to ±10 V
X1:18	0V	-	0VA reference for analog electronics voltages
X1:19	$I_{Mon.}$	Output	a) Current reference monitor I_{Mon}; standardized ±10 V ≙ ±I_H, rating 3 mA b) Current reference output for 2nd speed regulator (common speed regulator for two drives); plug ST1 plugged in ≙ inverted output signal
X1:20	$n_{Mon.}$	Output	Speed feedback monitor n_{Mon}; about ±10 V ≙ ±n_{max} corresponding with the selected adjustment; 47 Ω amplifier output, max. rating 3 mA
X1:21	0V	-	0VA reference for analog electronics voltages
X1:22	0V	-	0VA electronics common connected to "Neutral point"
X1:23	n_{1diff-}	Input	Speed reference differential input -n_{1diff} (max. -10 V)
X1:24	n_{1diff+}	Input	Speed reference differential input +n_{1diff} (max. +10 V)
X1:25	0V		0VA (for connection of reference lines shields)
X1:26	n_{2diff-}	Input	Speed reference differential input -n_{2diff} (max. -10 V)
X1:27	n_{2diff+}	Input	Speed reference differential input +n_{2diff} (max. +10 V)
X1:28	Relais	Output	} Relay contact RD for "Collective fault signalling" (NO contact, isolated); max. rating 500 VA, 220 V AC; open contact indicates fault in the DSH(-S) or DO unit
X1:29	Relais	Output	



b) Terminal strip X1 for units DSH-S 0705/1505 and DSH 3005/4505

Terminal No.	Designation		Function
X1:1	n = 0 ⊖	Input	Limit switch function; closed contact ≙ release of direction of rotation, motor shaft rotating in anti-clockwise direction (with view to the drive end)
X1:2	n = 0 ⊕	Input	Limit switch function; closed contact ≙ release of direction of rotation, motor shaft rotating in clockwise direction (with view to the drive end)
X1:3	0V	-	0VA reference for analog electronics voltages
X1:4	SSM	Output	Collective fault signalling; signal output connected in parallel with the position of relay RD "Collective fault signalling"; max. load rating of open-collector circuit is 10 mA: Low (0)-signal ≙ relay RD closed (axis ready for operation) High (1)-signal ≙ relay RD open (collective fault signal)
X1:5	INKR	Output	a) Incremental RLG-signals with plug ST4 in position 1-2; HIGH-signals with a duration of 4 µs initiated by each signal level change of RLG tracks X-Y-Z; number of HIGH-signals per rotation = 6 x p (p = number of motor poles); 24 V open-collector circuit, 10 kΩ, max load rating 20 mA
		Input	b) Suppression of the speed controller's I component with plug ST4 in position 2-3 and with a LOW-signal being present
X1:6	ES	Output	"Output stage blocked" signal at M = 0 (see X1:1) or in the case of a collective fault signalling initiated through a HIGH-signal; 24 V open-collector circuit, 10 kΩ, max load rating 20 mA
X1:7	X	Input	} Tracks X/Y/Z of rotor position measuring device (RLG) (logic signals 0/+15 V corresponding with the rotor position)
X1:8	Y	Input	
X1:9	Z	Input	
X1:10	+15 V	Output	+15 V supply of rotor position measuring device (RLG)
X1:11	-15 V	Output	-15 V supply of rotor position measuring device (RLG)
X1:12	n_{ist}	Input	Analog tacho feedback n_{fb} (from brushless DC tacho-generator)
X1:13	0V	-	0VA
X1:14	Schirm	-	0VA (terminal for connection of the RLG cable shield)
X1:15	I_{redU}	Input	Analog current reduction (I_{redU}) through external voltage } + 10 V ≙ appr. 100 % I_H ; + 5 V ≙ appr. 50 % I_H
X1:16	M = 0	Input	External torque release if contact is closed; if the contact between X1:16 and X1:18 (0VA) is open, the output stage is blocked and torque M = 0
X1:17	I_{ext}	Input	External current reference presetting ("NC system input") 0 to ±10 V
X1:18	0V	-	0VA reference for analog electronics voltages
X1:19	$I_{Mon.}$	Output	a) Current reference monitor I_{Mon}; standardized ±10 V ≙ ±I_H, rating 3 mA b) Current reference output for 2nd speed regulator (common speed regulator for two drives); plug ST1 plugged in ≙ inverted output signal
X1:20	$n_{Mon.}$	Output	Speed feedback monitor n_{Mon}; about ±10 V ≙ ±n_{max} corresponding with the selected adjustment; 47 Ω amplifier output, max. rating 3 mA
X1:21	0V	-	0VA reference for analog electronics voltages
X1:22	0V	-	0VA electronics common connected to "Neutral point"
X1:23	n_{1diff-}	Input	Speed reference differential input -n_{1diff} (max. -10 V)
X1:24	n_{1diff+}	Input	Speed reference differential input +n_{1diff} (max. +10 V)
X1:25	0V		0VA (for connection of reference lines shields)
X1:26	n_{2diff-}	Input	Speed reference differential input -n_{2diff} (max. -10 V)
X1:27	n_{2diff+}	Input	Speed reference differential input +n_{2diff} (max. +10 V)
X1:28	Relais	Output	} Relay contact RD for "Collective fault signalling" (NO contact, isolated); max. rating 500 VA, 220 V AC or 24 V DC, 2 A; open contact indicates fault in the DSH(-S) or DO unit
X1:29	Relais	Output	



b) Terminal strip X1 for units DSH-S 0705/1505 and DSH 3005/4505

Terminal No.	Designation		Function
X1:1	n = 0 ⊖	Input	Limit switch function; closed contact ≙ release of direction of rotation, motor shaft rotating in anti-clockwise direction (with view to the drive end)
X1:2	n = 0 ⊕	Input	Limit switch function; closed contact ≙ release of direction of rotation, motor shaft rotating in clockwise direction (with view to the drive end)
X1:3	0V	-	0VA reference for analog electronics voltages
X1:4	SSM	Output	Collective fault signalling; signal output connected in parallel with the position of relay RD "Collective fault signalling"; max. load rating of open-collector circuit is 10 mA: Low (0)-signal ≙ relay RD closed (axis ready for operation) High (1)-signal ≙ relay RD open (collective fault signal)
X1:5	INKR	Output Input	a) Incremental RLG-signals with plug ST4 in position 1-2; HIGH-signals with a duration of 4 µs initiated by each signal level change of RLG tracks X-Y-Z; number of HIGH-signals per rotation = 6 x p (p = number of motor poles); 24 V open-collector circuit, 10 kΩ, max load rating 20 mA b) Suppression of the speed controller's I component with plug ST4 in position 2-3 and with a LOW-signal being present
X1:6	ES	Output	"Output stage blocked" signal at M = 0 (see X1:1) or in the case of a collective fault signalling initiated through a HIGH-signal; 24 V open-collector circuit, 10 kΩ, max load rating 20 mA
X1:7	X	Input	} Tracks X/Y/Z of rotor position measuring device (RLG) (logic signals 0/+15 V corresponding with the rotor position)
X1:8	Y	Input	
X1:9	Z	Input	
X1:10	+15 V	Output	+15 V supply of rotor position measuring device (RLG)
X1:11	-15 V	Output	-15 V supply of rotor position measuring device (RLG)
X1:12	n_{ist}	Input	Analog tacho feedback n_{fb} (from brushless DC tacho-generator)
X1:13	0V	-	0VA
X1:14	Schirm	-	0VA (terminal for connection of the RLG cable shield)
X1:15	I_{redU}	Input	Analog current reduction (I_{redU}) through external voltage } + 10 V ≙ appr. 100 % I_H ; + 5 V ≙ appr. 50 % I_H
X1:16	M = 0	Input	External torque release if contact is closed; if the contact between X1:16 and X1:18 (0VA) is open, the output stage is blocked and torque M = 0
X1:17	I_{ext}	Input	External current reference presetting ("NC system input") 0 to ±10 V
X1:18	0V	-	0VA reference for analog electronics voltages
X1:19	I_{Mon}	Output	a) Current reference monitor I_{Mon}; standardized ±10 V ≙ ±I_H, rating 3 mA b) Current reference output for 2nd speed regulator (common speed regulator for two drives); plug ST1 plugged in ≙ inverted output signal
X1:20	n_{Mon}	Output	Speed feedback monitor n_{Mon}; about ±10 V ≙ ±n_{max} corresponding with the selected adjustment; 47 Ω amplifier output, max. rating 3 mA
X1:21	0V	-	0VA reference for analog electronics voltages
X1:22	0V	-	0VA electronics common connected to "Neutral point"
X1:23	n_{1diff-}	Input	Speed reference differential input -n_{1diff} (max. -10 V)
X1:24	n_{1diff+}	Input	Speed reference differential input +n_{1diff} (max. +10 V)
X1:25	0V		0VA (for connection of reference lines shields)
X1:26	n_{2diff-}	Input	Speed reference differential input -n_{2diff} (max. -10 V)
X1:27	n_{2diff+}	Input	Speed reference differential input +n_{2diff} (max. +10 V)
X1:28	Relais	Output	} Relay contact RD for "Collective fault signalling" (NO contact, isolated); max. rating 500 VA, 220 V AC or 24 V DC, 2 A; open contact indicates fault in the DSH(-S) or DO unit
X1:29	Relais	Output	



5.2.3 Functions of terminals of power supply units of series DO

Power terminals (located at the top of the DO unit front)

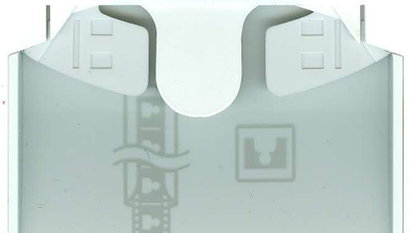
Terminal designation		Function
U1	Input	Three-phase connections 220 V/3ph, 50/60 Hz in accordance with the connection examples, permissible voltage fluctuations: +10 % / -15 %
V1	Input	
W1	Input	
+	Output	DC voltage connection + (busbar) for AXODYN® speed regulators of series DSH(-S)..05 (rated DC link voltage 310 V DC)
–	Output	DC voltage connection – (busbar) for AXODYN® speed regulators of series DSH(-S)..05 (rated DC link voltage 310 V DC)
⏚	-	Earth busbar for connection of PE and AXODYN®speed regulators of series DSH(-S) ..05 **Important:** Take connection example into consideration!

Electronics supply, axis interlocking

Ribbon cable provided with multiple plugs at both ends interconnecting power supply unit of type DO... and AXODYN® speed regulators of series DSH(-S)..05 take over the ±15 V, +24 V supply and axis interlocking (plug base P1)

Terminal strip B1

Terminal designation		Function
B1:1 B1:2	Input Input	220 V/1ph, 50/60 Hz electronics supply (500 VA power consumption; internal fuse F_1: 6.3 A/250 V, slow); B1:1 for neutral conductor
or		
B1:1 B1:3	Input Input	380 V/1ph, 50/60 Hz electronics supply (500 VA power consumption; internal fuse F1: 6.3 A/250 V, slow); **Important:** Do not connect electronics supply via the line contactor but directly ! (see connection example)
B1:4	-	Earth and shield of electronics supply **Note:** To be connected - via short lines - with the earth busbar and ⏚ of the electronics common of unit DSH(-S)..05 (terminal X1:22), and to be earthed at one point!
B1:5 DC voltage connecting busbar	Output	Connection of the NC contact (only use DC contactor!) for discharge of the DC link's capacitor after the drive has been switched off (see connection example) ⓘ **Important:** For units with 6 terminals the NC contact is connected between B1:5 (or B1:6) and the DC voltage connecting busbar –; B1:5 and B1:6 are interconnected internally. If the additional braking unit DZ 0050 (for units DO 5010 / DO 5020) or DZ 0100 (for units DO 10002) is used, the NC contact for capacitor discharge can only be connected at terminal R_B (CP) and the DC voltage connecting busbar – of the additional braking unit. In addition, signal inputs/outputs of B3 as well as power terminals +/–/ ⏚ on DO and DZ units have to be interconnected.



Terminal strip B2

Terminal designation		Function
B2:1	Input	Fault acknowledgement/reset through external electronics contact provided between B2:1 and B2:3 in the case of collective fault signalling including signal storage Reset only permissible as short-time pulse **Note:** Same function as pushbutton S1 located on the power supply unit DO. If an external contact is used, it must be connected to shielded lines. **Important:** Reclosing of the line contactor is only possible after fault acknowledgement. Any fault in the power supply unit DO causes blocking of all axes.
B2:3	-	0VA from electronics power pack
B2:2	Output	+15 V, stabilized; max. load rating 10 mA, internal resistance 470 Ω; for customer use
B2:4	Output	–15 V, stabilized; max. load rating 10 mA, internal resistance 470 Ω; for customer use

Connection of fan (if any)
The terminals for connecting the 220 V/1ph, 50/60 Hz supply voltage are located at the unit bottom.

Plug base B3

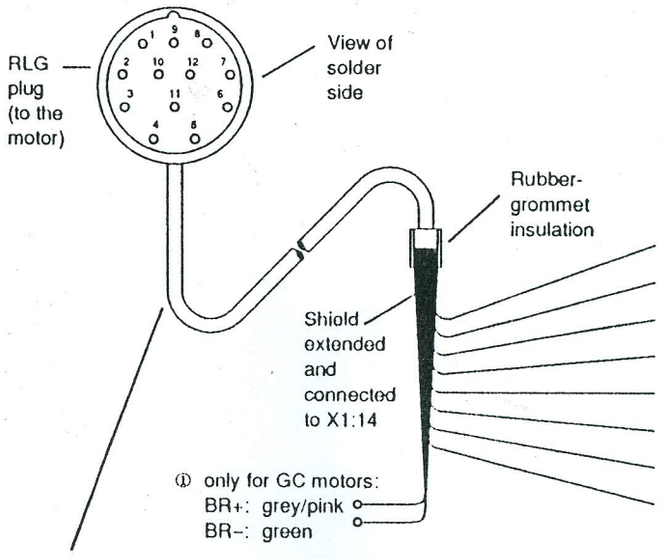
Designation		Function
B3: 1-2	Input	Synchronization of braking chopper (additional braking unit)
B3: 6-7	Input	Thermal contact, NO contact

For location of B3 see unit front cover

5.3 Motor and RLG (= rotor position measuring device) plugs

5.3.1 RLG connecting cable

Pin	Core/colour	Signal
1	yellow	–15 V
2	red/blue	0V
3	-	-
4	red	+15 V
5	brown	TA +
6	white	TA-0V
7	-	-
8	blue	RLG Z
9	grey	RLG Y
10	black	RLG X
11	grey/pink	BR + ①
12	green	BR – ①



X1:	Core/colour	Signal
7	black	X
8	grey	Y
9	blue	Z
10	red	+15 V
11	yellow	–15 V
12	brown	n_{fb}
13	white	TA-0V
14	red/blue	0V

Type: Paarflex CY
shielded, twisted in pairs
colours acc. to DIN 47100

4 x 2 x 0.25 (8-core) ②
or
4 x 2 x 0.5 (8-core) ②
or
6 x 2 x 0.25 (12-core) ③

② for LC motors and GC motors without BR

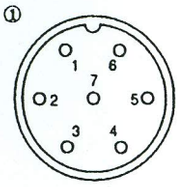
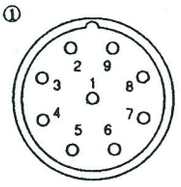
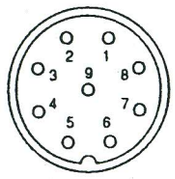
③ for GC motors with BR

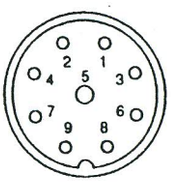
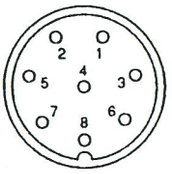
RLG = Rotor position measuring device
TA = Tacho
BR = Brake

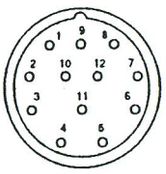


5.3.2 Assignment of pins and terminals of motor and RLG (rotor position measuring device)

Please observe the connection diagrams supplied along with the motor! View: Solder side of plug. Pin base (male) mounted to the motor

Motor type	Motor plug
GC 15 GC 19 GC 24	①  1 = Phase U 2 = Phase V 3 = Phase W 4 = Neutral (only for service) 5 = Ground 6 = } Thermal 7 = } switch *)
LC 310 LC 320	①  1 = – 2 = Phase U 3 = Phase V 4 = Phase W 5 = Ground 6 = Brake + 7 = Brake – 8 = } Thermal 9 = } switch *)
LC 420 LC 430 LC 440	 1 = Phase U 2 = Phase V 3 = Phase W 4 = Neutral (only for service) 5 = Ground 6 = Brake+ 7 = Brake – 8 = } Thermal 9 = } switch *)

Motor type	Motor plug
LC 620 LC 630 LC 640	 1 = Phase U 2 = Phase V 3 = Phase W 4 = Neutral (only for service) 5 = Ground 6 = Brake + 7 = Brake – 8 = } Thermal 9 = } switch *)
LC 820 LC 830 LC 840	 1 = Phase U 2 = Phase V 3 = Phase W 4 = Brake + 5 = Ground 6 = Brake – 7 = } Thermal 8 = } switch *)

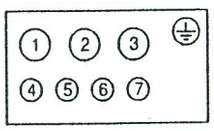
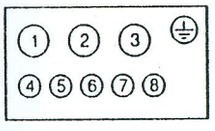
Motor type	RLG plug
GC.. LC...	 1 = –15 V 2 = 0V 3 = - 4 = +15 V 5 = Tacho + 6 = Tacho 0V 7 = - 8 = RLG Z 9 = RLG Y 10 = RLG X 11 = Brake + ② 12 = Brake – ② ② only for GC motors, for LC motors not connected

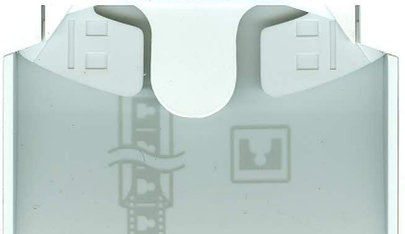
① **Important:** From 1987, the motor plug has been modified; it is thus advisible to check assignment of the plug pins against the connection diagram supplied along with the motor !

*) **Note:** The stator winding of the brushless DC servo motors is eqipped with a thermal switch (NC contact):

Threshold temperature:	155°C ±5°C
Resetting temperature:	98°C min. to 146°C max.
Max. voltage:	250 V, 50 Hz
Switching current:	10 A DC (6.3 A AC)

Power terminals for motors with terminal box (RLG plug see at upper right)

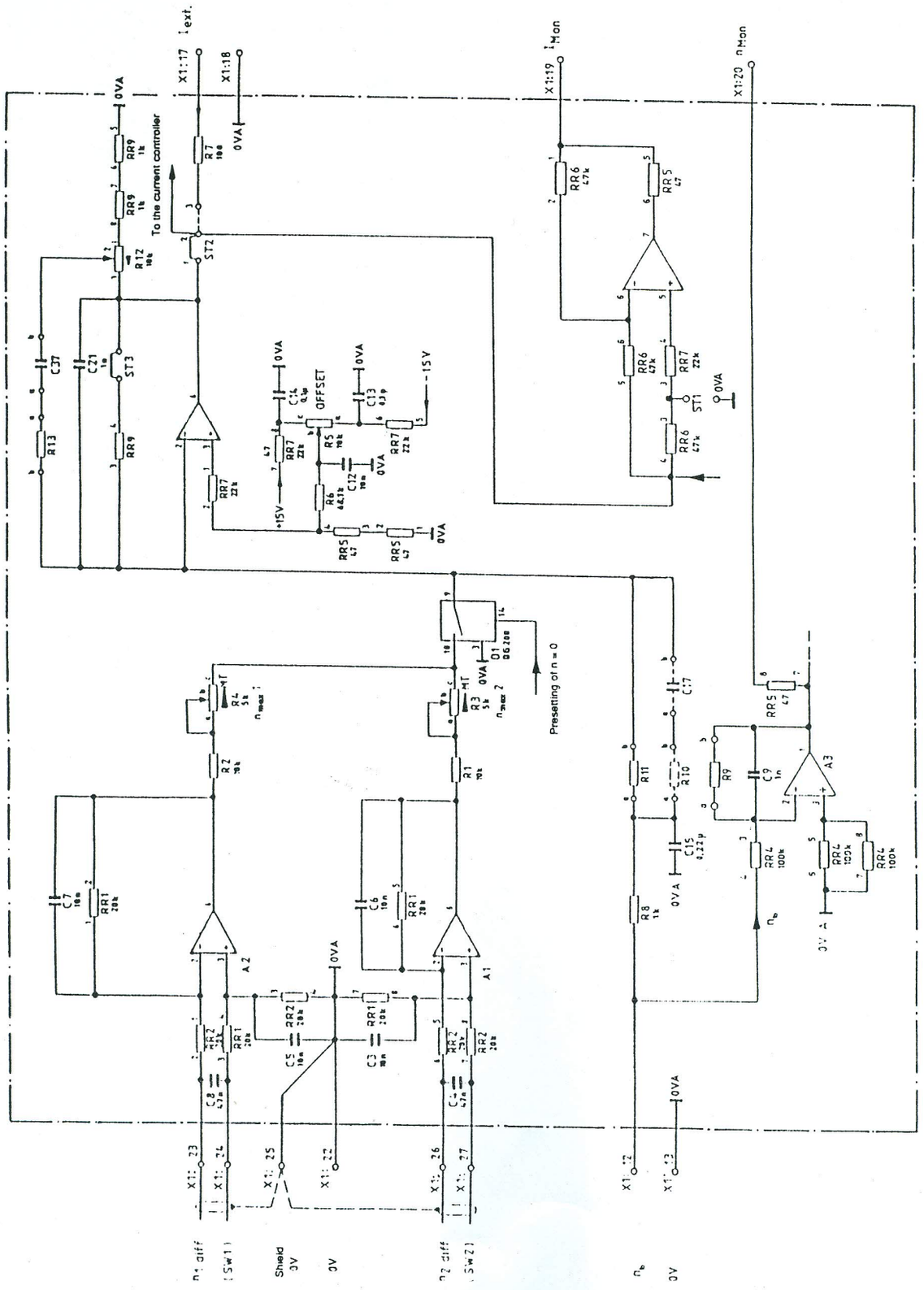
LC 4..	LC 620/630/640/LC8..
 1 = Phase U 2 = Phase V 3 = Phase W 4 = Brake + 5 = Brake – 6 = } Thermal 7 = } switch *)	 1 = Phase U 2 = Phase V 3 = Phase W 4 = Brake + 5 = Brake – 6 = – 7 = } Thermal 8 = } switch *)



6 Start-up

6.1 R-C elements of speed controller for DSH-S 0305

6.1.1 Schematic diagram of speed controller (installed on controller PCB SR 6606)



6.1.2 Description of the most essential components of speed regulator DSH-S 0305

Designation	Function	Location
R13, C37	Adaptation of the speed controller's PI component	SR 6606
R10, C17	D component of the speed controller	SR 6606
R9	Response threshold for the n_{max} monitoring function implemented via separate speed feedback output (n_{Mon})	SR 6606
R11	Speed feedback adaptation	SR 6606
R16	Current limitation dyn. high current ≤ I_H	SR 6606
R36	Adjustment of the DC link's I_{max} monitor	SD 6604
R58	Adjustment of current limit I = f (t)	SD 6604
R59	Adjustment of time constant I = f (t)	SD 6604
R68	Speed-dependent current/voltage adaptation	SD 6604
Pot R4/R3	Fine adjustment of n_{max1} / n_{max2} for input n_{1diff} / n_{2diff}	SR 6606
Pot R12	Adjustment of dyn. gain V_P	SR 6606
Pot R5	Offset voltage balancing	SR 6606
Plug ST1	Negated output of current reference I_{Mon} (X1:19) for 2nd regulator with the plug plugged in	SR 6606
Plug ST2	Position 1-2: current reference from speed controller (≙ as delivered by ABB) Position 2-3: current reference from external current reference input X1:17	SR 6606
Plug ST3	Reduction of the speed controller's gain to 1/10; as delivered by ABB, ST3 is plugged in to avoid uncontrolled motor acceleration without any speed feedback signal being present **Important:** After initial start-up, ST3 has to be removed or plugged onto one pin only!	SR 6606

For arrangement of the type ST plugs refer to chapter 6.2.3.

SR 6606 = controller PCB (front board) for DSH-S 0305

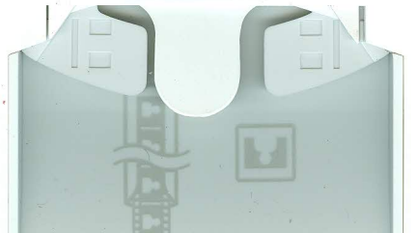
SD 6604 = pulse control PCB (behind front board; accessible after the right side panel for DSH-S 0305 has been removed)

6.1.3 Table of components for DSH-S 0305

Motor type	Mounting place								
	R13	C37	R9	R11	R16	R36	R58	R59	R68
LC 310 TH	15	220	120	10	10	-	56	1000	6.8
LC 320 TE *)	15	220	100	10	12	-	33	820	4.7

Note:
- Refer to the table of motor/speed regulator combinations given in chapter 1 "Complete AXODYN®..." (page 3)
- Values given in kΩ (R) or nF (C), if not otherwise indicated
  0 ≙ jumper
  - ≙ mounting place not used
  Empty spaces ≙ indication of values upon request
- By all means check whether the right components and all requisite components have been installed! Subject to change.

*) As delivered by ABB, the speed regulator is already adapted to suit the associated motor identified in this table, i.e. provided with recommended basic components.
For different speed regulator/motor combinations the components have to be changed (see table).



6.4 Monitoring and indication of status and fault signals

6.4.1 Monitoring and indication of status and fault signals - AXODYN® speed regulators of series DSH(-S)..05

The microprocessor monitors various unit functions and issues - on the 7-segment display - specific codes indicating the ready-for-operation status or faults of the unit to ensure fast and simple diagnosis.

Output of any of the fault signals listed below will have the following consequences:

- Indication of the specific fault
- Output stage blocking (zero current presetting)
- Speed controller blocking
- Opening of the collective fault signalling contact (RD), which may actuate the main contactor (depending on the plant conditions)

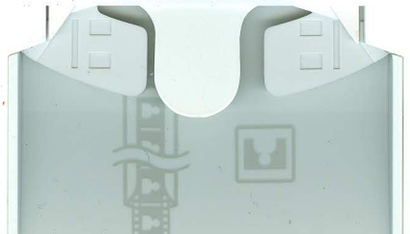
The fault signals can be acknowledged/reset by:

- Disconnection and reconnection

or

- Initiating command RESET via pushbutton S1 or by short-time closing of an external electronics contact (momentary-contact switch) between B2:1 and B2:3 of the associated power supply unit of series DO

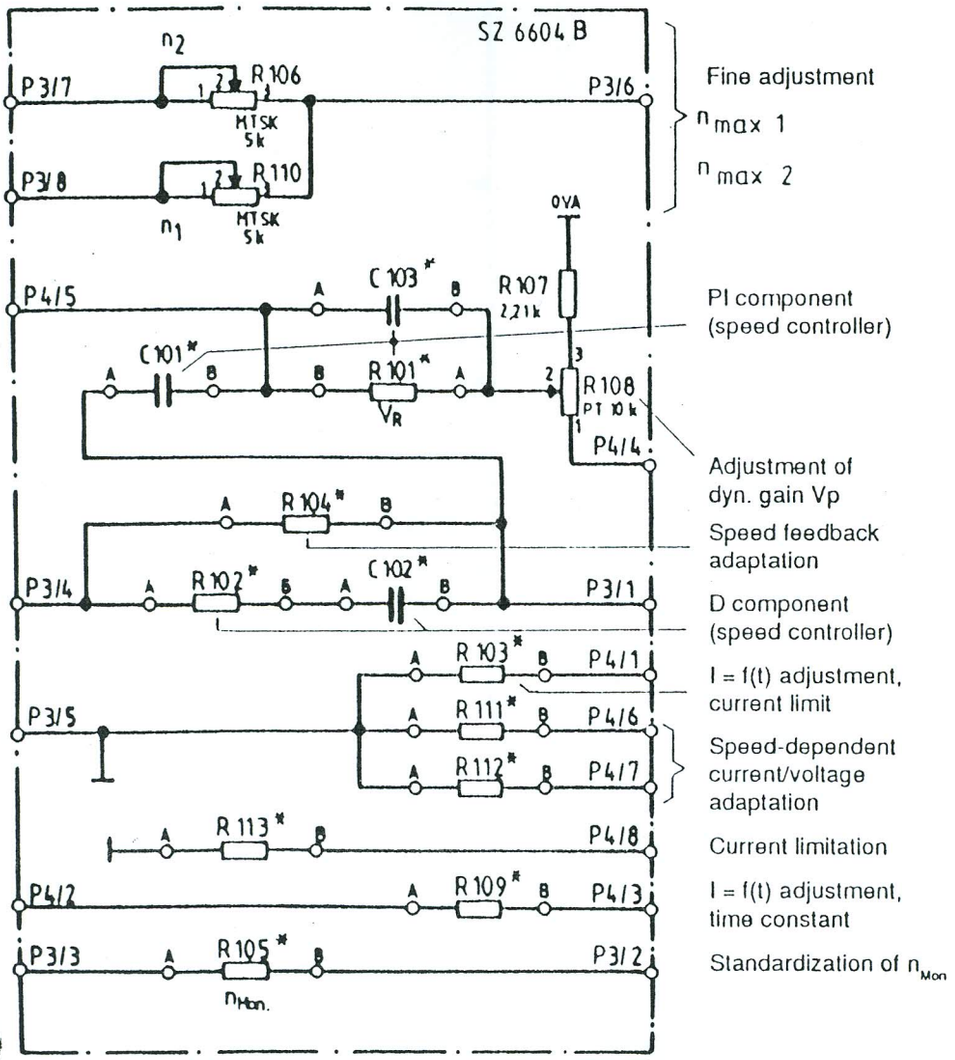
Code of the 7-segment display	Short description	Function
0	Electronics section OK	±15 V electronics supply available; signal appears upon switching-on (without power section supply); electronics voltage < 12 V ≙ output stage blocking
1	Power section OK	Speed regulator ready for operation; signal appears if both electronics and power section are connected to their supply system
2 static	RLG fault	Monitoring of the rotor position indicating signals X, Y, Z; signal appears in the case of signal interferences (spurious peaks, signal dropouts or missing track signal)
2 blinking	Tacho signal fault	Monitoring of the tacho feedback signal; signal appears in the case of signal interferences (spurious peaks, increased tacho ripple, signal dropouts or missing tacho signal, tacho failure)
3	ϑ max DSH(-S)	Max. permissible temperature of transistor bridge heat sink exceeded
4	n_{max}	Max. permissible speed has been exceeded by more than 20 %
5	I_{max} DSH(-S)	Signal initiated by the current measuring device located in the DC link for detection of internal faults as well as of an earth fault in one of the motor phases
6	I_{max} Motor	Signal appears if the max. permissible unit output current has been exceeded or in the case of a short-circuit in the motor phases, a short-circuit to frame or an earth fault
7	I = f (t)	Time-related monitoring of the dyn. high current I_H during acceleration (1 s from 0 to I_H or 0.2 s from I_N to I_H)
•	RESET/ program fault	Display of a point upon actuation of RESET or in the case of a microprocessor program error or microprocessor defect
☐	DO unit fault	Any fault in the power or electronics section supply system causes the display segments to go dark

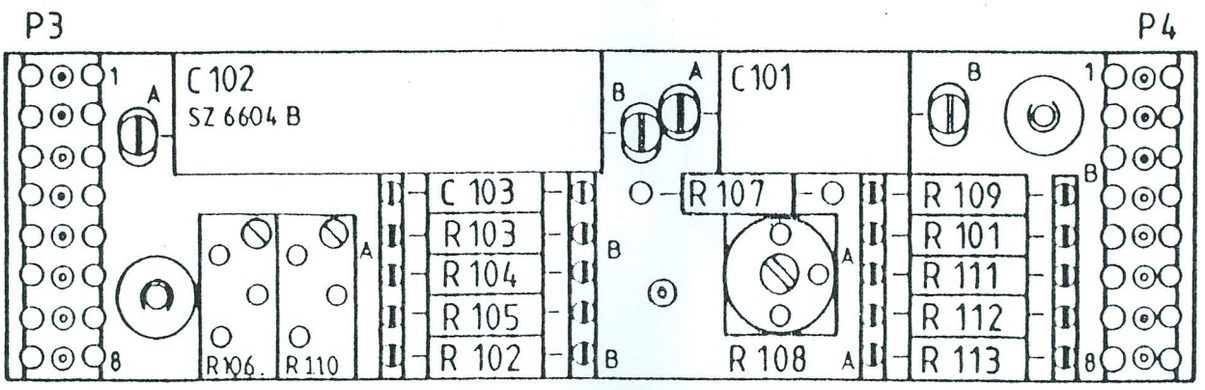


6.2 RC elements of speed controller for DSH-S 0705/1505 and DSH 3005/4505

Motor PCB type SZ 6604B is provided with the designations relating to the motor type to match and the associated speed regulator;
Example: LC 620 TJ at the motor PCB top, 15/30 (A) at the motor PCB bottom.

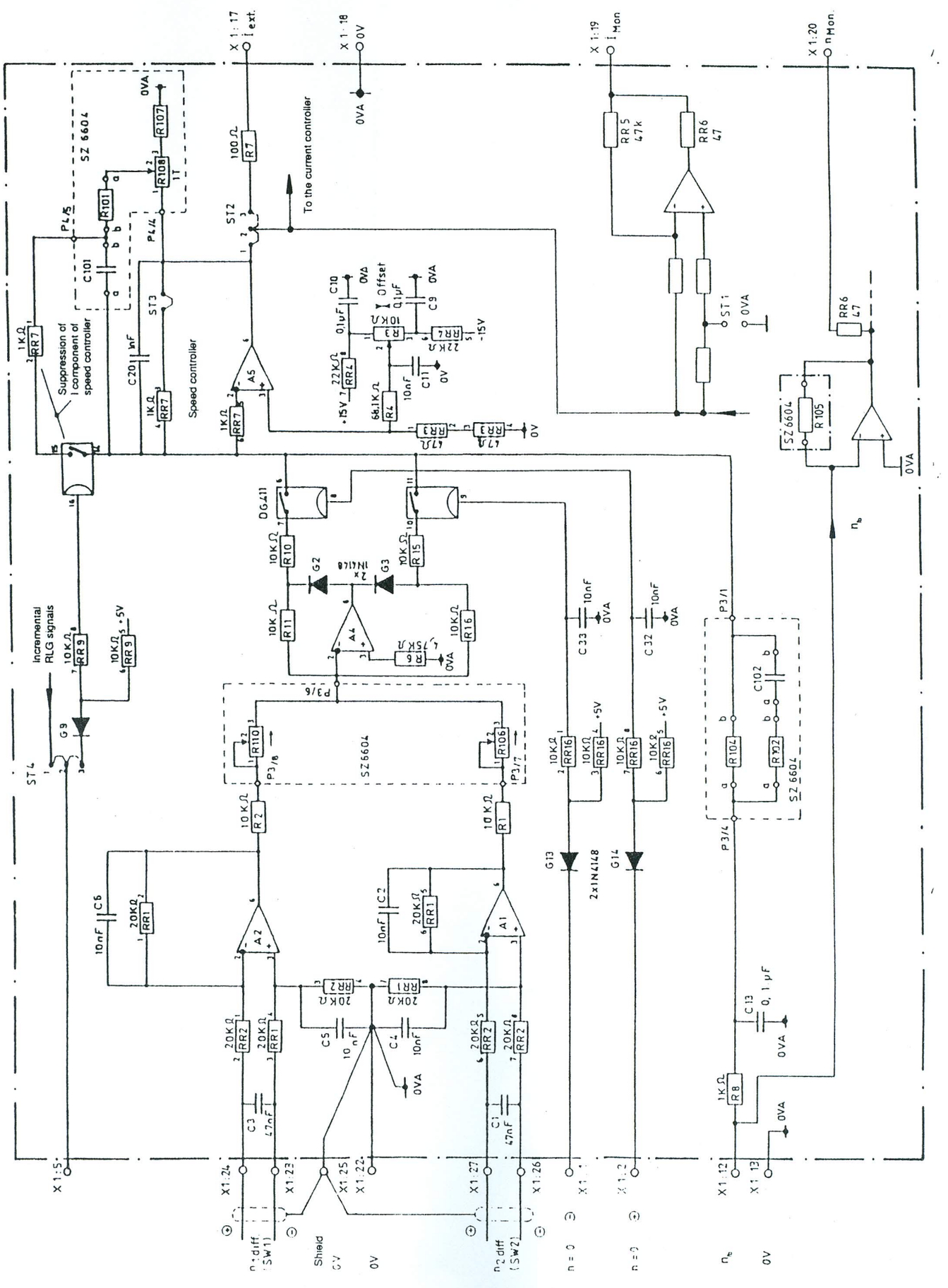
6.2.1 Component layout plan of motor PCB type SZ 6604B **)





*) Values see table of components chapter 6.2.4
**) As delivered by ABB from 06/92

Schematic diagram of speed controller with motor PCB type SZ 6604 *) for units DSH-S 0705/1505 and DSH 3005/4505



*) Modified PCB type SZ 6604B, as delivered by ABB from 06/92: C103 connected in parallel to R101

6.2.2 Description of the most essential components of speed regulators DSH-S 0705/1505 and DSH 3005/4505

Designation	Function	DSH-S 0705/1505 Location	DSH 3005/4505 Location
R101, C101	Adaptation of the speed controller's PI component	SZ 6604 B	SZ 6604 B
R102, C102	D component of the speed controller	SZ 6604 B	SZ 6604 B
C103	Smoothing of P component	SZ 6604 B	SZ 6604 B
R105	Response threshold for the n_{max} monitoring function implemented via separate speed feedback output (n_{Mon})	SZ 6604 B	SZ 6604 B
R104	Speed feedback adaptation	SZ 6604 B	SZ 6604 B
R113	Current limitation dyn. high current $\leq I_H$	SZ 6604 B	SZ 6604 B
R103	I = f (t) adjustment of current limit	SZ 6604 B	SZ 6604 B
R109	I = f (t) adjustment of time constant	SZ 6604 B	SZ 6604 B
R111, R112	Speed-dependent current/voltage adaptation	SZ 6604 B	SZ 6604 B
Pot R106/110	Fine adjustment of n_{max1}/n_{max2} for input n_{1diff}/n_{2diff}	SZ 6604 B	SZ 6604 B
Pot R108	Adjustment of dyn. gain V_P	SZ 6604 B	SZ 6604 B
Pot R3 / R1	Offset voltage balancing	SR 6607	SR 6610
Plug ST1	Negated output of current reference I_{Mon} (X1:19) for 2nd regulator with the plug plugged in	SR 6607	SR 6610
Plug ST2	Position 1-2: current reference from speed controller (≙ as delivered by ABB) Position 2-3: current reference from external current reference input X1:17	SR 6607	SR 6610
Plug ST3	Reduction of the speed controller's amplification to 1/10; as delivered by ABB, ST3 is plugged in to avoid uncontrolled motor acceleration without any speed feedback signal being present **Important:** After initial start-up, ST3 has to be removed or plugged onto one pin only!	SR 6607	SR 6610
Plug ST4	Position 1-2: output of incremental encoder signals to X1:5 (see chapter 5.2.2 b) (≙ as delivered by ABB) Position 2-3: suppression of I component of speed controller upon application of a 0-signal at X1:5 (see chapter 5.2.2 b)	SR 6607	SR 6610

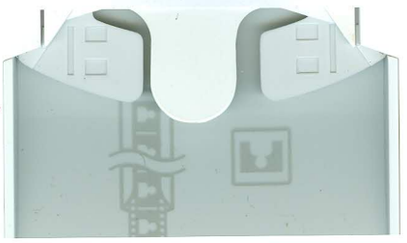
For arrangement of the ST plugs refer to chapter 6.2.3.

SR 6610 = controller PCB (front board) for units DSH 3005/4505

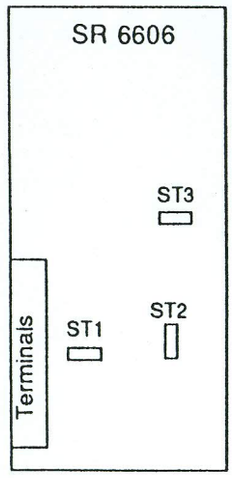
SR 6607 = controller PCB (front board) for units DSH 0705/1505

SR 6605 = pulse control PCB (behind front board; accessible after the right side panel has been removed) for units DSH 0705/1505

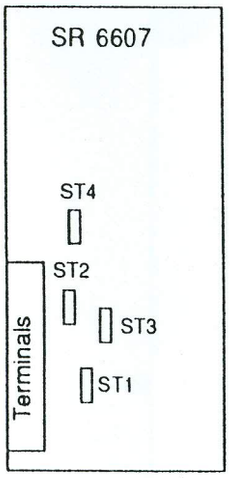
SZ 6604**B** = plug-type motor PCB for units DSH 0705/1505 and DSH 3005/4505 (as delivered by ABB from 06/92; SZ 6604 without C103)



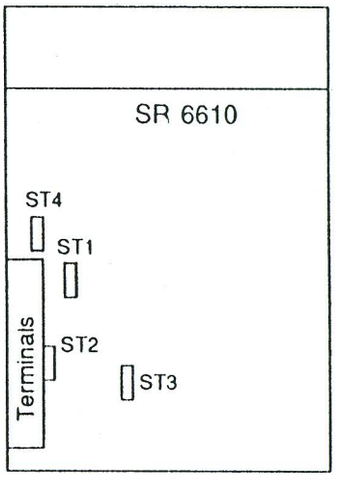
6.2.3 Arrangement of plugs for AXODYN® series DSH(-S) units



DSH-S 0305



DSH-S 0705/1505



DSH 3005/4505

6.2.4 Table of components of motor PCB type SZ 6604B for units DSH-S 0705/1505 and DSH 3005/4504

Motor type	Regulator type	Mounting place R101	C101	C103	R105	R104	R113	R103	R109	R111	R112
LC 310 TH	DSH-S 0705	15	220		120	10.0	5.6	2.2	1500	6.8	0
LC 320 TE	DSH-S 0705	15	220		120	10.0	8.2	3.9	1200	5.6	0
LC 420 TL	DSH-S 0705	27	680	47	120	8.2	-	15	1000	6.8	0
LC 430 TJ *	DSH-S 0705	33	680	33	100	10.0	-	22	820	4.7	0
LC 440 TG	DSH-S 0705	33	680	47	100	10.0	-	100	680	4.7	0
LC 620 TJ *	DSH-S 1505	56	220	6.8	120	8.2	-	15	1000	6.8	0
LC 620 TJ	DSH 3005	18	1000	47	120	8.2	5.6	2.2	150	6.8	0
LC 630 TF	DSH-S 1505	100	150	10	100	12.0	-	-	560	5.6	0
LC 630 TF	DSH 3005	27	680	22	100	10.0	12.0	4.7	1000	5.6	0
LC 640 TE	DSH-S 1505	56	330	22	120	8.2	-	-	560	4.7	0
LC 640 TE *	DSH 3005	33	470	22	120	8.2	27.0	8.2	820	3.9	0
LC 820 TJ	DSH 3005	68	330	10	120	8.2	-	39.0	680	3.9	0
LC 820 TJ	DSH 4505	47	470	22	120	8.2	12.0	7.5	820	3.9	0
LC 830 TG	DSH 3005	47	680	22	120	6.8	-	-	470	3.3	0
LC 830 TG	DSH 4505	68	330	10	120	6.8	18.0	15.0	680	3.3	0
LC 840 TF *	DSH 4505	39	470	47	120	7.5	22.0	27.0	560	2.7	0
GC 15 TB	DSH-S 0705	68	100		120	8.2	-	-	560	4.7	0
GC 19 TB	DSH-S 1505	68	100		120	8.2	-	-	560	4.7	0
GC 19 TB	DSH 3005	68	100		120	8.2	-	5.6	1500	7.5	0
GC 24 TB	DSH 3005	68	100		120	8.2	-	27.0	680	7.5	0
GC 24 TB	DSH 4505	68	100		120	8.2	-	6.8	1200	7.5	0

Note: - Refer to the table of motor/speed regulator combinations given in chapter 1. "Complete AXODYN®..." (page 3)

- Values given in kΩ (R) or nF (C), if not otherwise indicated
  0 ≙ jumper
  - ≙ mounting place not used
  Empty spaces ≙ Indication of values upon request

- By all means check whether the right components and all requisite components have been installed! Subject to change.

* As delivered by ABB, the speed regulator is already adapted to suit the associated motor identified in this table, i.e. provided with recommended basic components. For different speed regulator/motor combinations the components have to be changed (see table).

6.3 Start-up instructions

6.3.1 General Important Instructions

These start-up instructions apply for AXODYN® speed regulators of series DSH..05 and DSH-S..05 used together with power supply units of series DO... and brushless DC servo motors of series GC and LC.

Protect these units against inadmissible loading.

When touching or holding the unit, avoid bending of components and/or changing of the insulating distances.

Avoid touching of electronic components (static discharge may cause damage or destruction) and contacts. Observe the relevant information labels.

Start-up should be carried out observing the given sequence of operations. Signal voltages are to be measured using a moving-coil instrument with a minimum internal resistance of 10 kilohms/V.

When working on live units, adhere to the applicable safety instructions (e.g. VBG 4). Check whether the VDE specifications listed on the rear flap of this catalogue have been met.

6.3.2 Start-up Instructions

☐ General checks to be performed on the brushless DC servo motor equipped with permanent-magnet rotor

- Screwed connections
- Connections of motor and RLG plug (also refer to chapter 5.3.2 "Assignment of pins and terminals of ..."
- Readiness for operation: brake, locking device, gearing, oil, etc.

☐ Checks and adjustments to be performed on the de-energized unit, e.g. mains fuses removed

- Check power supply unit of series DO and AXODYN® speed regulators of series DSH(-S)..05 for possible damage suffered during transportation or assembly.
- Check whether the components of controller PCB SR 6606 (for DSH-S 0305) and of motor PCBs SZ 6604 B (for DSH-S 0705/1505 and DSH 3005/4505) are in accordance with associated motor types; if necessary, modify and supplement it (for the components of controller PCB SR 6606 or motor PCB SZ 6604 B see chapters 6.1 and 6.2). Replug motor PCB for units DSH-S 0705/1505 and DSH 3005/4505 and fasten it by using a knurled-head screw (this check also serves for assuring that the motor PCB has been mounted properly).
- As delivered by ABB, each speed regulator of series DSH(-S) is already provided with recommended basic components to match a specific motor (see relevant tables). For different speed regulator/motor combinations the equipment has to be changed!
- Check power terminals, electronics supply system, contactor control circuit, etc. by referring to the connection example (ref. to chapter 5.1) as well as to the information on the assignment of pins and terminals (ref. to chapter 5.2) given for series DO/DSH(-S) units (also refer to tables 5.1.1 and 5.1.2 "Recommended conductor cross sections").

  Important: Observe earthing instructions for terminal B1:4 of series DO unit! Connect the motor's earth conductor (refer to the table "Assignments of pins and terminals of motor ...") to the common earth. Provide the by-pass contactor connected to three resistors required in the case of transformer ratings above 7 kVA or direct connection to a 220 V/3ph supply system.

- Check connections of the shielded RLG line, of the control leads, etc. at terminal strip X1, refer to "Arrangement and functions of terminals" in chapter 5.2.

  Important: The functions assigned to the terminals of terminal strip X1 are in some cases different for units DSH-S 0305, DSH-S 0705/1505 and 3005/4505 (refer to chapters 5.2.1 and 5.2.2).

- For presetting a reference during start-up, connect a potentiometer (appr. 10 kilohms) with potentiometer wiper to X1:24 (n_{diff+}) of DSH(-S) unit as well as to B2:2 (+15 V) and B2:4 (-15 V) of series DO unit, and implement connection between X1:23 and X1:25. In this case, disconnect references preset by a superordinated control system (CNC, NC).

  Note: Check positions of plugs ST2, ST3 and ST4 (only for units DSH-S 0705/1505 and 3005/4505); refer to the schematic diagrams of speed controller and the description of the components (functions) in chapters 6.1 and 6.2.

- External electronics contacts are required for:

  DSH-S 0305:

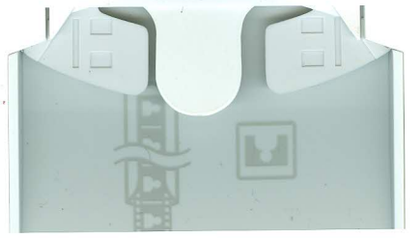
X1:1	Torque release with the contact between X1:1 and X1:3 closed
X1:2	Release of speed references n_1 and n_2 with the contact between X1:2 and X1:3 closed

  DSH-S 0705/1505, DSH 3005/4505:

X1:1 and X1:2	Release of direction of rotation (refer to 5.2.2 b)
X1:16	Torque release with the contact between X1:16 and X1:18 closed

- Provide potentiometer/fixed-value resistor for the requisite current reduction or an analog voltage for current reduction determined by the motor used or the plant requirements, refer to chapters 5.2.2 a/b and 6.3.3.

  Important: Integrate relay contact outputs RD for "Collective fault signalling" into the monitoring loop!



☐ Functional checks and optimization

Important: By all means plug in plug ST3 for start-up. Do not perform any modifications on the equipment when the unit is energized.
Provide switches for switching OFF or initiating EMERGENCY STOP!

- Check readiness for operation of the electronics supply
  - Only connect electronics supply with separate feeder

  7-segment display: Code 0 ≙ electronics supply connected; RLG plugs plugged onto motor and speed regulator. For other codes displayed refer to 6.4.1
  LED display: X/Y/Z rotor position indicating signals (depending on rotor position) ①
  Fan: For units DSH-S 1505 and DSH 3005 internal 24 V fans are used

- Check readiness for operation of the power supply
  - For torque release open external contact between terminals: X1:1 and X1:3 (DSH-S 0305)
    X1:16 and X1:18 (DSH-S 0705/1505 a. DSH 3005/4505)
  - For speed reference release open external contacts between terminals: X1:2 and X1:3 (DSH-S 0305)
    X1:1/X1:2 and X1:3 (DSH-S 0705/1505 and DSH 3005/4505)
    X1:1 n = 0 ⊖
    X1:2 n = 0 ⊕
    } Limit switch function for release of direction of rotation (refer to 5.2.2 b)
  - Set external reference potentiometer to centre position (n_{ref} = 0)
  - Switch on power section supply system (energize line contactor)
  - Following this, the DC link voltage is built up and the internal relay contacts RD (≙ no collective fault signals) of the series DSH(-S) units pick up

    7-segment LED display: Code 1 = power and electronics sections' supply voltage available
  - Close external contact for torque release, which starts operation of the output stage

- Short-time rotation of motor and offset voltage balancing
  - Close external contacts for speed reference presetting
  - If a small speed reference is preset, the motor starts rotating

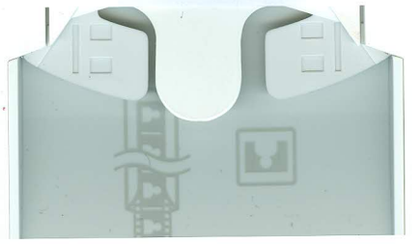
    Important: Observe distances to be travelled by the axes!

    Note: If a positive reference is preset at differential amplifier input n_{1diff} or n_{2diff}, the motor rotates in clockwise direction - with view to the drive shaft extension. For reversing the direction of rotation, the speed reference polarities have to be exchanged; the motor's sequence of phases U/V/W must not be changed!
  - Open external contacts for speed reference release and M = 0, and pull off plug ST3, i.e. open bridge
  - Bridge reference inputs n_{1diff} and n_{2diff} with the voltage supply disconnected
  - Reconnect voltage supply and close contacts for n = 0 and M = 0
  - Adjust zero speed of motor by using potentiometer R5 (DSH-S 0305) or R3 (DSH-S 0705/1505 and DSH 3005/4505) (offset voltage balancing)
  - Open bridges installed for reference inputs $n_{1diff.}$ and $n_{2diff.}$

- Speed balancing
  - Connect voltmeter to the reference potentiometer and preset a reference of 0 V.
  - Close external contact for n = 0 and increase reference to 10 V ≙ n_1
  - Adjust motor speed to the desired value (e.g. speed n_1) by using one of the potentiometers R3/R4 or R106/R110. Check speed on the motor!
  - Switch drive off

① Sequence of signals when motor shaft is turning in clockwise direction: X → XY → Y → YZ → Z → ZX → X etc.
Sequence of signals when motor shaft is turning in anti-clockwise direction: Z → ZY → Y → YX → X → XZ → Z etc.

Any deviations in the signal sequence indicate an electronics fault or a defect of the rotor measuring device.



- Speed controller optimization

  - For speed controller optimization preset the reference voltage corresponding to n_1 as jump function, with the tacho voltage being observed via an oscilloscope triggered by a reference signal applied to the reference input.
  - For components required for speed controller optimization refer to "Description of the most essential components of speed regulator(s) ..." in chapters 6.1 and 6.2.
  - Optimization sequence:

    a) Adjust proportional gain (R13 or R101) - with the capacitor (I component) bridged - by means of an R decade; observe position of potentiometer R12 and R108!

    b) Adjust integral-action component (C37 or C101) by means of a C decade; for operation with a higher-level control system the I component can be dispensed with (solder in jumper)

    c) Adjust derivative-action component, if slight speed overshooting is not permissible and cannot be suppressed through the PI action (R10, C17 or R102, C102)

  For any questions concerning speed controller optimization please contact our Sales Offices.
  RC decade type GG 0101 can be ordered from ABB.

6.3.3 External current reduction

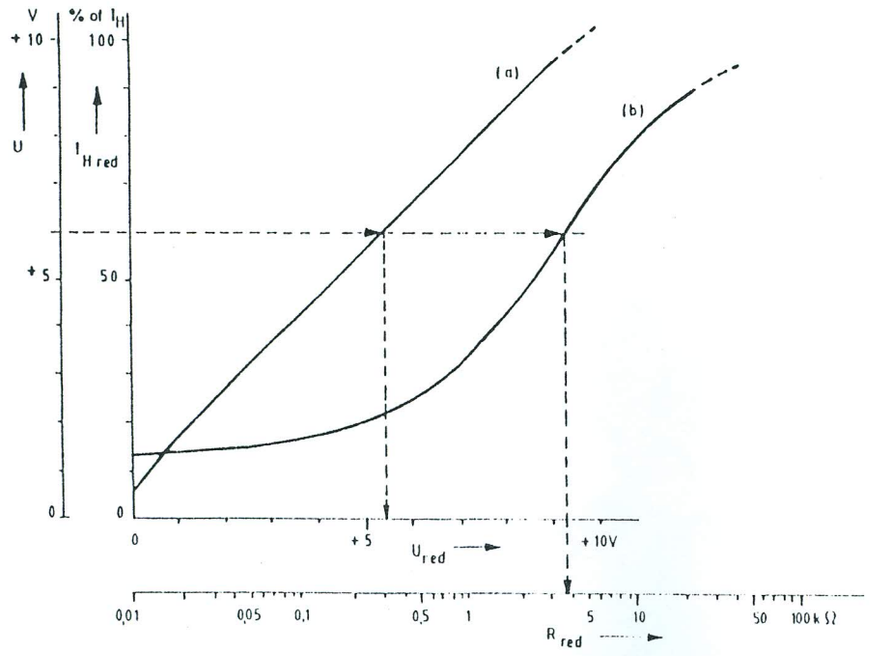
The dyn. high current I_H adjusted on the speed regulator series DSH(-S) (as delivered by ABB) in accordance with chapter 3.1 "Technical data" corresponds with a proportional DC voltage $U \leq \pm 10$ V at output I_{Mon} (X1:19). For external high current reduction I_{Hred} in dependence on the selected drive and the plant requirements, two alternative methods are possible:

a) Analog current reduction

Through application of a positive DC voltage $U_{red} \leq +10$ V at terminals X1:15 to X1:18 (0 V) the dyn. high current can be reduced to the desired value I_{Hred} in accordance with the characteristic (a) given below.

b) Current reduction by means of a resistor or potentiometer

Installation of an external resistor or potentiometer between terminals X1:16 to X1:18 (only for unit DSH-S 0305) also causes the dyn. high current to be reduced from I_H to the desired value I_{Hred} - in accordance with the characteristic (b) given below.
For units DSH-S 0705/1505 and DSH 3005/4505 the reduction of I_H is carried out by soldering in a resistor at mounting place R113 of motor PCB type SZ 6604B in accordance with the characteristic (b) given below.





6.4.2 Monitoring and indication of status and fault signals - power supply units of series DO

The power supply units of series DO comprise - among other functions - the supply systems of electronics section (±15 V, +24 V) and power section (310 V DC) for all axes connected as well as their monitoring logic.

Any fault in the power supply unit of series DO will cause interlocking of all axes connected and "Collective fault signal" output by relay contact (RD) on the connected series DSH(-S) units.

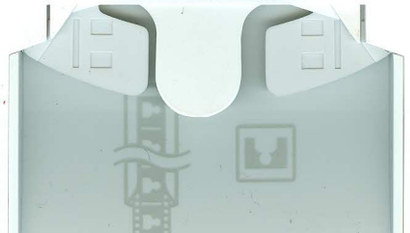
The following functions are monitored, with the correct status or any fault being indicated by LEDs and through relay contact output:

LED display (on series DO unit)	Function	Consequences	Output of collective fault signal RD on series DSH(-S)..05 unit (X1:28/29) ①
H1 red	Electronics voltage too low (< +15 V)	Upon violation of the voltage limit values, the fault signals storage is set	X
H2 red	DC link voltage (output) } < 260 V ② / > 390 V ③	Upon violation of the voltage limit values, the fault signals storage is set **Note:** For applications for which undervoltage monitoring is not required or not permitted, diode G21 (V21) has to be removed from the solder points on the unit's front board SA 6604.	X
H2 red	Overtemperature Ballast device Additional braking device	Collective fault signal output via relay RD to the speed regulators upon opening of the thermal contact, which monitors the ballast resistors installed on the series DO/DZ units **Note:** Faults can only be acknowledged/ reset after the thermal contact has closed!	X
H3 red	Ballast circuit active		—

① Fault acknowledgement/resetting through actuation of pushbutton S1 (series DO unit) or via an external electronics contact (momentary-contact switch) installed between B2:1 and B2:3 (see functions of terminals of series DO power supply unit)

② Over- and undervoltage monitoring is active when plug ST3 (on series DO unit) is plugged in; no undervoltage monitoring takes place when plug ST3 (on series DO unit) is removed

③ Plug ST1 (on series DO unit) in position 1-2: continuous operation of ballast device (LED H3 lights permanently; risk of overloading!)
in position 2-3: pulse operation of ballast device



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