SSD
D R I V E S
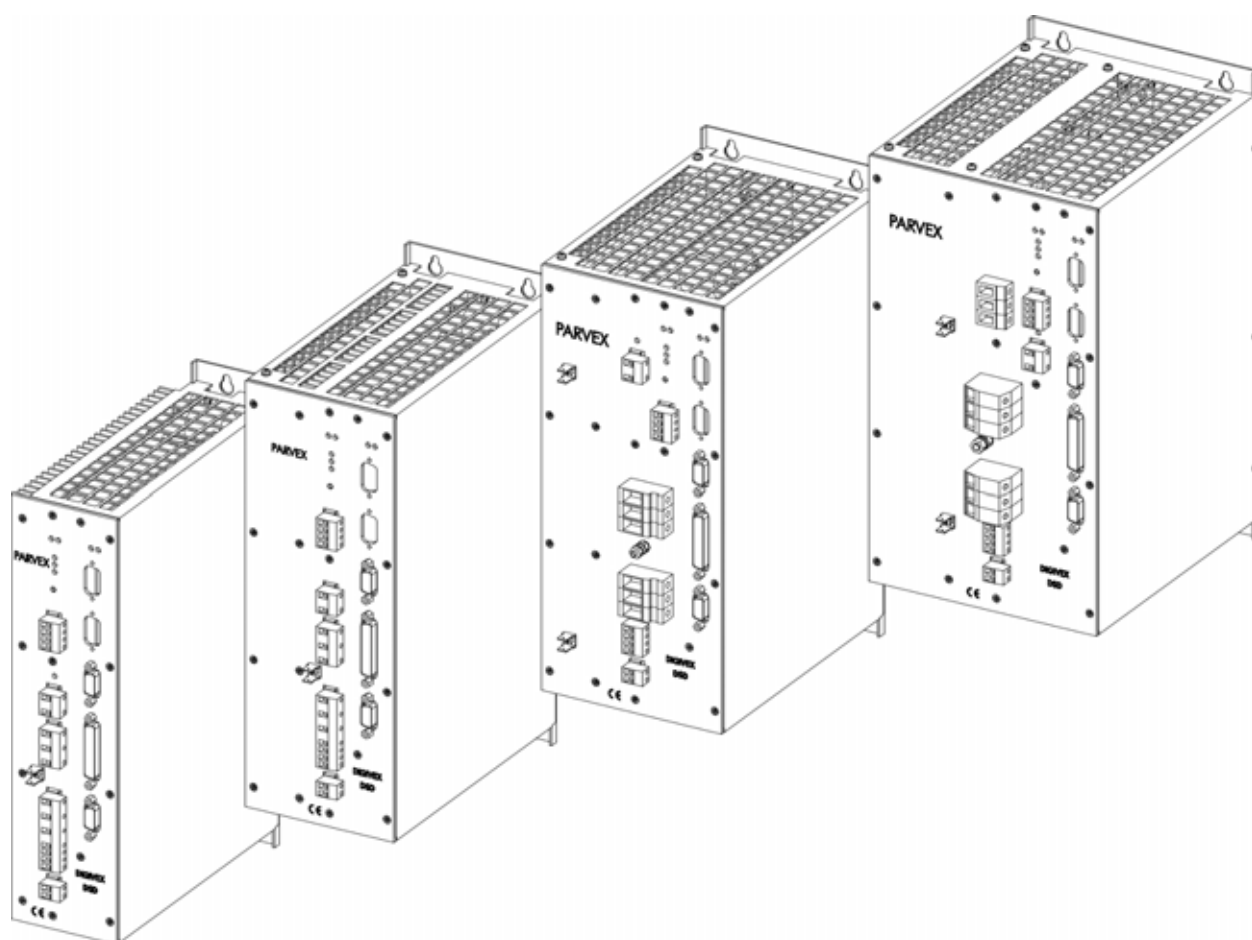
PARVEX

DIGIVEX Single Drive

DIGITAL SERVOAMPLIFIER

User and commissioning manual

PVD 3500 GB – 04/2004

PRODUCT RANGE

1 - « BRUSHLESS » SERVODRIVES

	TORQUE OR POWER RANGES	

- **BRUSHLESS SERVOMOTORS**, LOW INERTIA, WITH RESOLVER

  Very high torque/inertia ratio (high dynamic performance machinery):
  - $\Rightarrow$ NX -HX - HXA   1 to 320   N.m
  - $\Rightarrow$ NX - LX   0,45 to 64   N.m

  High rotor inertia for better inertia load matching:
  - $\Rightarrow$ HS - LS   3,3 to 31   N.m

  Varied geometrical choice :
  - $\Rightarrow$ short motors range HS - LS   3,3 to 31   N.m
  - $\Rightarrow$ or small diameter motors : HD, LD   9 to 100   N.m

  Voltages to suit different mains supplies :
  - $\Rightarrow$ 230V   three-phase for   «série L - NX»
  - $\Rightarrow$ 400V, 460V   three-phase for   «série H - NX»
- **"DIGIVEX Drive" DIGITAL SERVOAMPLIFIERS**
  - $\Rightarrow$ SINGLE-AXIS   DSD
  - $\Rightarrow$ COMPACT SINGLE-AXIS   DµD, DLD
  - $\Rightarrow$ POWER SINGLE-AXIS   DPD
  - $\Rightarrow$ MULTIPLE-AXIS   DMD
- "PARVEX Motion Explorer" ADJUSTING SOFTWARE

2 - SPINDLE DRIVES

- **SPINDLE SYNCHRONOUS MOTORS**
  - $\Rightarrow$ "HV" COMPACT SERIES
  - $\Rightarrow$ "HW" ELECTROSPINDLE,frameless, water-cooled motor   From 5 to 110 kW up to 60,000 rpm
- **"DIGIVEX" DIGITAL SERVOAMPLIFIERS**

3 - DC SERVODRIVES

- **"AXEM", "RS" SERIES SERVOMOTORS**   0.08 to 13 N.m
- **"RTS" SERVOAMPLIFIERS**
- **"RTE" SERVOAMPLIFIERS** for DC motors + resolver giving position measurement

4 - SPECIAL ADAPTATION SERVODRIVES

- **"EX" SERVOMOTORS** for explosive atmosphere
- "AXL" COMPACT SERIES SERVOREDUCERS   5 to 700 N.m

5 - POSITIONING SYSTEMS

- **Numerical Controls** « CYBER 4000 » 1 to 4 axes
- **"CYBER 2000"** NC   1 to 2 axes
- **VARIABLE SPEED DRIVE - POSITIONER**
  - $\Rightarrow$ SINGLE-AXIS   DSM
  - $\Rightarrow$ POWER SINGLE-AXIS   DPM
  - $\Rightarrow$ MULTIPLE-AXIS   DMM
- ADJUSTMENT AND PROGRAMMING SOFTWARE PARVEX Motion Explorer

CONTENTS

Characteristics and dimensions subject to change without notice.
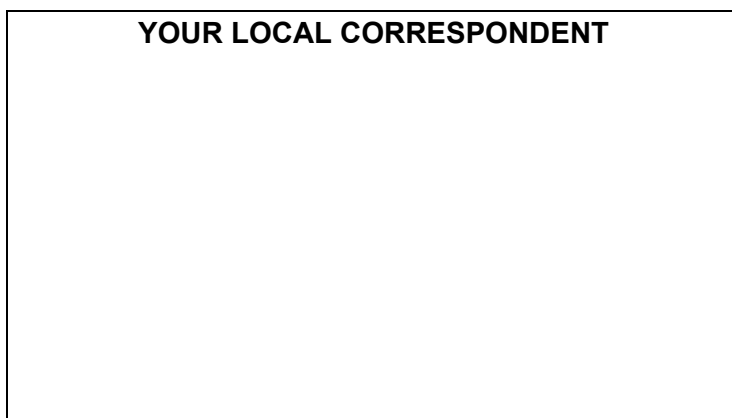
YOUR LOCAL CORRESPONDENT

SAFETY

Servodrives present two main types of hazard :

- **Electrical hazard**
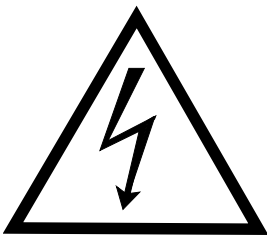
Servoamplifiers may contain non-insulated live AC or DC components. Users are advised to guard against access to live parts before installing the equipment.

Even after the electrical panel is de-energized, voltages may be present for more than a minute, until the power capacitors have had time to discharge.

Specific features of the installation need to be studied to prevent any accidental contact with live components :
- Connector lug protection ;
- Correctly fitted protection and earthing features ;
- Workplace insulation
  (enclosure insulation humidity, etc.).

General recommendations :
- Check the bonding circuit;
- Lock the electrical cabinets;
- Use standardised equipment.

- Mechanical hazard

Servomotors can accelerate in milliseconds. Moving parts must be screened off to prevent operators coming into contact with them. The working procedure must allow the operator to keep well clear of the danger area.

All assembly and commissioning work must be done by **qualified** personnel who are familiar with the safety regulations (e.g. VDE 0105 or accreditation C18510).

Upon delivery

All servoamplifiers are thoroughly inspected during manufacture and tested at length before shipment.

● Unpack the servoamplifier carefully and check it is in good condition.
● Also check that data on the manufacturer's plate comries with data on the order acknowledgement.

If equipment has been damaged during transport, the addressee must file a complaint with the carrier by recorded delivery mail within 24 hours.

Caution :

The packaging may contain essential documents or accessories, in particular :
● User Manual,
● Connectors.

Storage

Until installed, the servoamplifier must be stored in a dry place safe from sudden temperature changes so condensation cannot form.

Special instructions for setting up the equipment

	CAUTION
	For this equipment to work correctly and safely it must be transported, stored, installed and assembled in accordance with this manual and must receive thorough care and attention..
	Failure to comply with these safety instructions may lead to serious injury or damage.
	The cards contain components that are sensitive to electrostatic discharges. Before touching a card you must get rid of the static electricity on your body. The simplest way to do this is to touch a conductive object that is connected to earth (e.g. bare metal parts of equipment cabinets or earth pins of plugs).

1. GENERAL

1.1 Digital Servodrive

All of the drives comprise:

Brushless servomotors with permanent magnets, sine-wave e.m.f. and resolver-based position measurement (HX, HS, HD and LX, LS, LD range servomotors)
A box-type electronic control system including:
A power supply function for (depending on the model):

- *230 V single-phase mains supply,*
- *230 V three-phase mains supply,*
- *400 V three-phase mains supply.*

A control function corresponding to the servomotor (power and resolver) for spindle drive motor control.
This module also controls energy discharge via internal or external resistors (for some models).

Two connection options are available for these servomotors:

Terminal box + resolver connector.
Power connector + resolver connector.

1.2 General Characteristics

1.2.1 <u>Modules with 230 V single-phase power supply</u>

Input voltage: 230 V ±10% (see § 4.4.1)

TYPE	MAINS SUPPLY	CONTROLLABLE POWER	SINE PEAK PERMANENT CURRENT	PEAK MAXIMUM CURRENT	PARVEX PRODUCT NUMBER
DSD 2/4	*230 V – single-phase 50/60 Hz*	*375 W*	*2 A*	*4 A*	*DSD 13M02*
DSD 4/8	*230 V – single-phase 50/60 Hz*	*750 W*	*4 A*	*8 A*	*DSD 13M04*
DSD 7.5/15	*230 V – single-phase 50/60 Hz*	*1500 W*	*7.5 A*	*15 A*	*DSD 13M07*

1.2.2 Modules with 230 V three-phase power supply

Input voltage: 230 V ±10% (see § 4.4.1)

TYPE	MAINS SUPPLY	CONTROLLABLE POWER	SINE PEAK PERMANENT CURRENT	PEAK MAXIMUM CURRENT	PARVEX PRODUCT NUMBER
DSD 4/8	230 V – three-phase 50/60 Hz	750 W	4 A	8 A	DSD 13004
DSD 7.5/15	230 V – three-phase 50/60 Hz	1500 W	7.5 A	15 A	DSD 13007
DSD 15/30	230 V – three-phase 50/60 Hz	3000 W	15 A	30 A	DSD 13015
DSD 30/60	230 V – three-phase 50/60 Hz	6000W	30A	60A	DSD 13030
DSD 60/100	230 V – three-phase 50/60 Hz	12000W	60A	100A	DSD 13060

1.2.3 Modules with 400 V three-phase power supply

Input voltage: 400 V ±10% (see § 4.4.1)

TYPE	MAINS SUPPLY	CONTROLLABLE POWER	SINE PEAK PERMANENT CURRENT	PEAK MAXIMUM CURRENT	PARVEX PRODUCT NUMBER
DSD 2/4	400 V – three-phase 50/60 Hz	750 W	2 A	4 A	DSD 16002
DSD 4/8	400 V – three-phase 50/60 Hz	1500 W	4 A	8 A	DSD 16004
DSD 8/16	400 V – three-phase 50/60 Hz	3000 W	8 A	16 A	DSD 16008
DSD 16/32	400 V – three-phase 50/60 Hz	6000W	16A	32A	DSD 16016
DSD 32/64	400 V – three-phase 50/60 Hz	12000W	32A	64A	DSD 16032

1.3 Operating Principle

1.3.1 <u>Block diagram</u>

The block diagram shows two parts:
>A power supply section providing dc voltage to the power bridge and auxiliary power supplies (regulation, fans).
>one part for axis control and monitoring control.
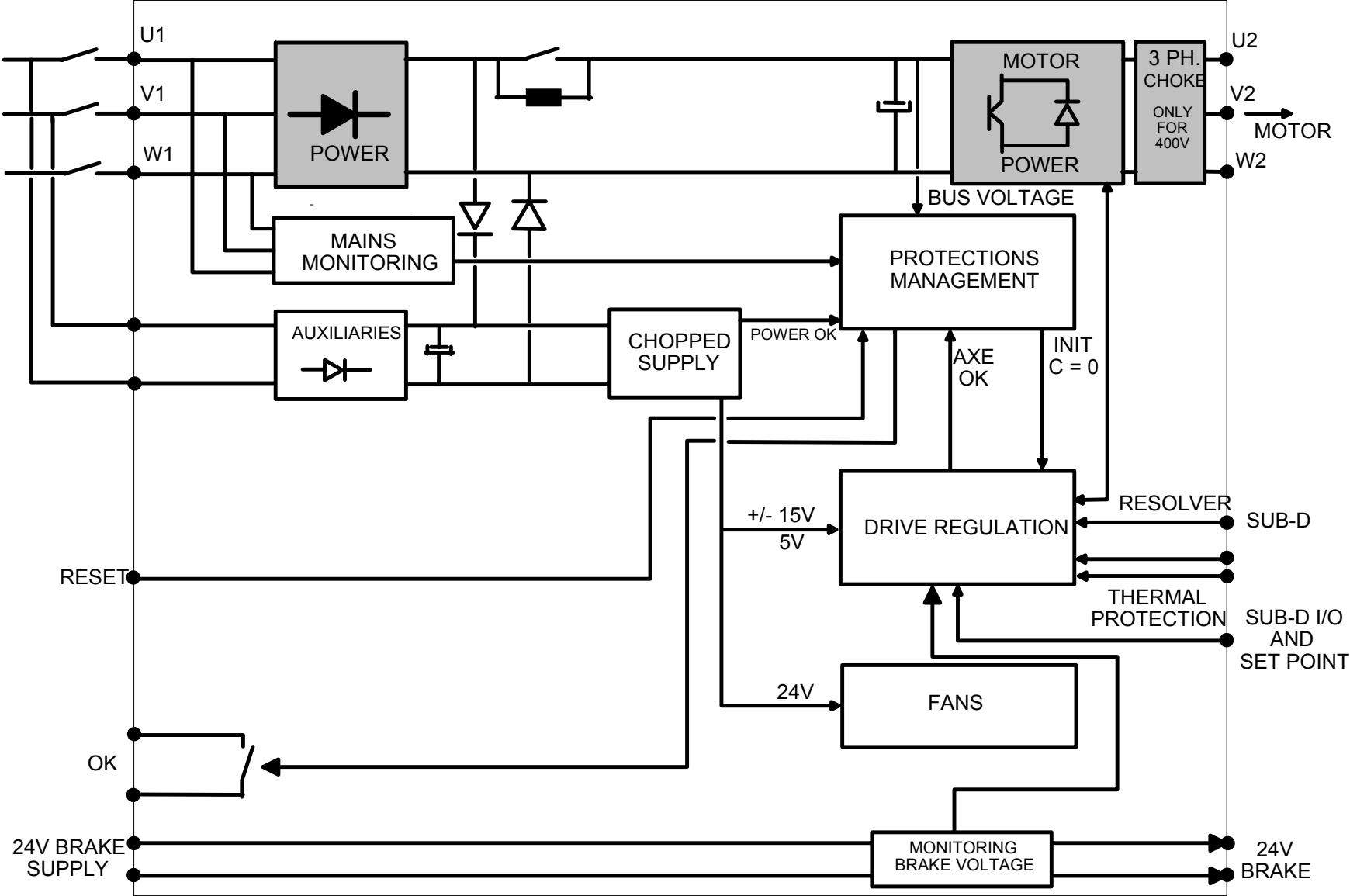
SYNODSDGB.D

1.3.2 Power supply functions

Receives the 230 V or 400 V mains supply through terminal block B3 and converts it into a 310 V or 550 V dc voltage.
Receives the 230 V or 400 V mains supply via terminal block B4 to generate the auxiliary supplies (±15 V, 5 V, 24 V) required for regulation.
May receive a 24 V supply via terminal block B1 for powering the motor brake.
Provides the interface to the automatic control via terminal block B5.
The power supply status is displayed by an array of 5 LEDs.
One LED indicates whether the auxiliary supply is present or not.

1.3.3 Servomotor control functions

1.3.3.1 Presentation

The DIGIVEX SINGLE DRIVE servo-amplifier is a 4-quadrant, transistor control module for controlling (brushless) synchronous motors with resolvers.

HX, HD, HS — LX, LS, LD spindle drive motors. See separate documentation.

The customized features of the motor-drive assembly and the servo-control parameters are entered :

either by using a PC with the DIGIVEX software (PME software DIGIVEX module), under Windows.
or by using the display and parameter setting hand held terminal.

These parameters are stored in two EEPROM memories.

one permanent store for DIGIVEX parameters.
one unpluggable store for application-specific parameters.

1.3.3.2 Functions and block diagram

See next page. The diagram shows the main drive functions and the setting parameters.
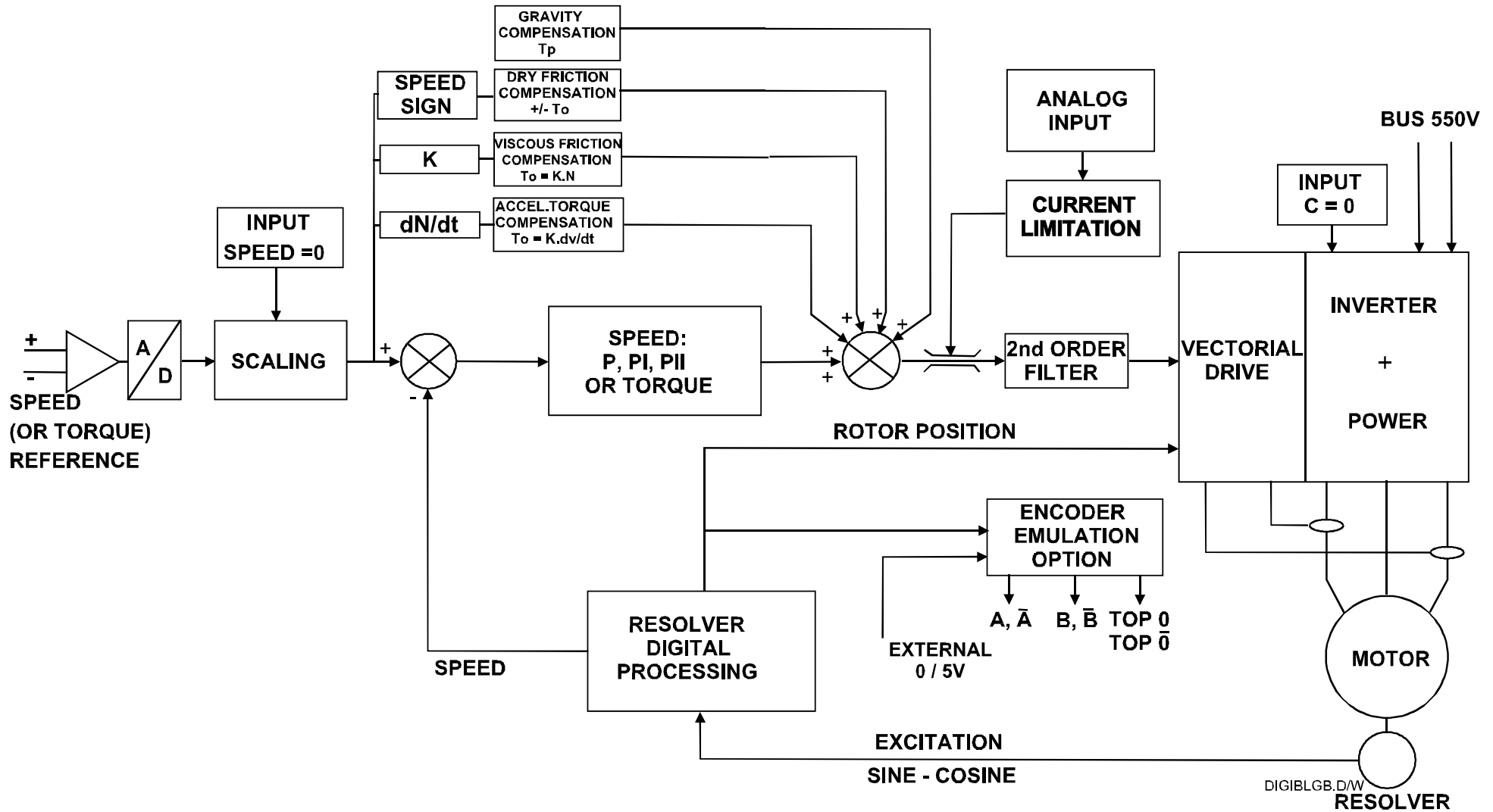
On the right of the diagram, the motor - resolver - power section.

Parameters can be set for:
⇒ the choice of motor, which dictates the drive rating.
⇒ the general characteristics of the resolver.

The choice of the motor - drive combination determines a number of parameters: current limitation, I^2 = f(t) protection, standard servo-control parameters.

Ahead of current control.
♦ Second order filter for reducing the effect of high-frequency resonance
♦ External reduction of current limitation

Resolver numerical processing (non parametric) and the optional encoder emulation function (number of points adjustable from 1 to 16384).

Choice of type of regulation: torque or speed.

En speed loop. Parameters can be set for :
⇒ maximum speed for the application (limited by the maximum motor speed).
⇒ scaling (1 V = N rpm).
⇒ choice of corrector type: proportional, proportional and integral, proportional and double integration.

Predictive actions associated with speed control.

These actions, acting outside the speed loop, directly affect torque. As they are external they have little effect on loop stability. However, they allow anticipated actions, without waiting for the speed loop reaction.

The predictive actions (or predictors) are:

Gravity: compensation for vertical masses.

Dry friction: a friction force value is fixed. The corresponding torque set point is applied, its sign being that of the speed set point.

Viscous friction: compensation for friction forces that are proportional to speed (hydraulic or electrical system drive).

Acceleration: changes in the speed set point (drift) are monitored and direct action is taken on the torque set point via a coefficient K, the inertia image.

The analog input speed reference (16 bits), non parametric.
On the left of the block diagram, the set of logic and analog inputs / outputs.

The parameter setting software is used:

for allocating some of these Inputs / Outputs.
for forcing them to a logic status. The inputs are then disconnected from the outside.

1.3.3.3 Forcing logic inputs

The software or console can be used to force a logic input to a particular value. Thus the software can be used with inputs N0+, N0-, C=0,
to "disconnect" them from the physical input.
to force them by software to 0 or 1.

1.3.3.4 Stimuli / oscilloscope functions

Certain functions integrated in the drive allow the speed set point to be excited: dc voltage, square (response at one scale), sine.

These stimuli can be activated by a PC or by the console. Their result is stored in the drive and can be displayed on the PC screen with the oscilloscope function (2 variables at most can be displayed simultaneously using the PME Digivex software).

1.3.3.5 logic outputs

1) Speed detection

The two outputs assigned OUT1 and OUT2 can detect four speed zones, depending on their logic status.

OUT1	OUT2	SPEED
1	1	Speed $\leq$ 48 rpm
0	1	Speed $\leq$ N1
1	0	Speed $\leq$ N2
0	0	Speed > N2

N1 and N2 are speeds that are programmed in the parameters.
N2 > N1
and N1 > 48 rpm

2) Speed reached and anchored

Selection and assignment with PME DIGIVEX PC software (pvd 3483) or terminal DTP001 (pvd 3491)

1.3.3.6 Brake action

The drive can be declared in the parameters with a brake function.

The 24 V brake supply (terminal block B1) is monitored by the drive.

> 24 V present: Axis under torque. Removal of limitation of 90% of rated motor current.
> 24 V absent: Axis at reduced torque with 90% of rated motor current.

The brake engage or release order is in no event given by the drive but by the external control. The control can monitor the drive outputs indicating zero speed to decide whether or not to apply the brake.

1.3.3.7 Monitoring reasons for stoppage

This monitoring may, through strategic choice, entail either stoppage or reduced performance for certain faults related to current.

Variables monitored :
> Mean drive current.
> Output current (short-circuit).
> Dissipater temperature.
> motor temperature.
> Ambient temperature.
> Overspeed.
> No resolver.
> Maximum and minimum dc bus voltages.
> Mains phase failure.
> Mains supply overvoltage.

1.3.3.8 General characteristics of the DIGIVEX SINGLE DRIVE

Power reduction with altitude	Above 1000 m, service power falls by 1% for every 100 m up to a maximum altitude of 4000 m
Operating temperature	Normal use: 0 - 40°C Above 40°C, service power fall by 20% for every 10°C up to a maximum temperature of 60°C.
relative humidity	85% (without condensation)
Storage temperature	-30°C to +85°C
Chopping frequency	8 kHz
Current bandwidth	to -3dB 600Hz
Speed bandwidth	Up to 300Hz
Minimum speed	Minimum speed 0.05 rpm or 1/30,000th of maximum speed
Maximum speed	Driven by DIGIVEX : 100,000 rpm
Speed static precision for load variation from 0 to In and for rated voltage of DIGIVEX SINGLE DRIVE	With digital set point (field bus): 0.1% With analog set point: 1% whatever the speed
Electrical protection	Electrical isolation of power bridge Mean current protection depending on drive rating Pulse current protection of drive and motor rms current protection of motor Protection against short circuits at bridge output
Mechanical protection	IP20 under IEC 529
Other monitoring	Motor temperature Drive temperature Resolver power supply Brake supply

1.4 Compliance with Standards

DIGIVEX Single Drive

The CE marking of the product is featured on the front panel (silk-screen printing).

DIGIVEX Single Drive products have the CE marking under European Directive 89/336/EEC as amended by Directive 93/68/EEC on electromagnetic compatibility. This European Directive invokes the harmonized generic standards EN50081-2 of December 1993 (Electromagnetic compatibility - Emission generic standard - Industrial environment) and EN50082-2 of June 1995 (Electromagnetic compatibility - Immunity generic standard - Industrial environment). These two harmonized generic standards are based on the following reference standards:

EN 55011 of July 1991: Radiated and line conducted emissions.
ENV 50140 of August 1993 and ENV 50204: Immunity to radiated electromagnetic fields.
EN 61000-4-8 of February 1994: Power frequency magnetic fields.
EN 61000-4-2 of June 1995: Electrostatic discharge.
ENV 50141 of August 1993: Disturbances induced in cables.
EN 61000-4-4 of June 1995: Rapid transients.

Compliance with the reference standards above implies observance of the wiring instructions and diagrams provided in this documentation.

Incorporation in a machine

The design of this equipment allows it to be used in a machine subject to Directive 89/392/EEC (Machinery Directive), provided that its integration (or incorporation and/or assembly) is done in accordance with the rules of the art by the machine manufacturer and in accordance with the instructions of this booklet.

2. ENERGY DISSIPATION

The energy a module has to dissipate is broken down into:
Energy generated by braking.
Energy from rectifier and power bridge losses.

2.1 Braking Energy Dissipation

2.1.1 <u>Calculating the power to be dissipated in the braking resistor</u>

The permanent and pulse powers given in the preceding table are limited by the characteristics of the "braking" resistors.
When the application includes intensive cycles or long-duration decelerations, the mean power to be dissipated by each axis must be calculated.

$$P \text{ in Watts} = \frac{J}{2}\left(\frac{N}{9.55}\right)^2 .f$$

 J : Moment of inertia of the servomotor and the related load in kgm².
 N : Angular speed of motor shaft at start of braking, in rpm.
 f : repeat frequency of braking cycles in s^{-1}.

This formula is for the least favourable case. For a mechanism with substantial friction or with low reverse output, the power to be dissipated may be greatly reduced.
 .

The total power to be dissipated of all the drives must not exceed the permanent power admissible through the resistor. Durations and repetition must not exceed the values in table §2.1.3.

2.1.2 <u>Braking energy dissipation</u>

Braking energy is dissipated through a resistor mounted in the module. The resistor may be mounted externally for DSD 60/100-230 V three-phase and DSD 32/64 - 400 V three-phase models.

This recuperation is controlled from two thresholds measured on the bus voltage.

	Threshold Values	
	Braking resistor switched in	Braking resistor switched out
230 V single- or three-phase modules	380 V	370 V
400 V three-phase modules	710 V	690 V

2.1.3 <u>Braking capacity and module losses.</u>

230 V single-phase or three-phase modules.

		MODULE RATING					
		2/4	4/8	7.5/15	15/30	30/60	60/100
Resistor value	Ω	56	56	56	22	11	7
Maximum current	A	7	7	7	17	34	50
Pulse power	kW	2.2	2.2	2.2	6.0	12	18
Permanent power	W	60	60	60	250	500	700
Maximum non repetitive duration	s	1	1	1	2	2	2
Maximum repeat cycle duration	s	0.1	0.1	0.1	0.2	0.2	0.2
Repetition	%	2.7	2.7	2.7	4.3	4.3	4.3
Losses from modules (at maximum power)	W	15	25	50	100	200	400
Low level consumption	W	10	10	10	15	15	15

400 V three-phase modules.

		MODULE RATING				
		2/4	4/8	8/16	16/32	32/64
Resistor value	Ω	220	220	82	41	27
Maximum current	A	3	3	8.5	17	25
Pulse power	kW	2.2	2.2	6	12	18
Permanent power	W	60	60	250	500	700
Maximum non repetitive duration	s	1	1	2	2	2
Maximum repeat cycle duration	s	0.1	0.1	0.2	0.2	0.2
Repetition	%	2.7	2.7	4.3	4.3	4.3
Losses from modules (at maximum power)	W	30	50	100	200	400
Low level consumption	W	10	10	15	15	15

Definitions

Maximum current: maximum current controlled, the resistor switches in at 710 V or 375 V for certain modules, the controlled current is equal at most to 710 or 375 / resistor value.

Pulse power: maximum power dissipated by the resistor, this power can only be drawn for a short time and in compliance with a certain cycle.

Permanent power: mean power that can be dissipated on a permanent basis by the resistor.

Non repetitive maximum duration: maximum duration, in seconds, for which the pulse power can be required (starting from cold); the resistor must be allowed to cool down before braking again.

Repeat cycle maximum duration: maximum duration, in seconds, for which the pulse power can be required provided that this power is only present for a certain percentage of the total time (repetition).

Module losses: losses specific to the module, the value shown in the table is that obtained when the module is used at maximum power.

Low-level consumption: consumption of the low-level power supplies in Watts.

Specific case of 60/100 - 230 V three-phase and 32/64 -400 V three-phase modules.
These two modules can use an external resistor to dissipate braking energy. If this possibility is used, the characteristics obtained are those shown in the table below: with RE91001 resistor for the 32/64 module and RE91002 resistor for the 60/100 module

		MODULE RATING	
		32/64	60/100 Two resistors
Resistor value	Ω	27	6
Maximum current	A	26	62
Pulse power	kW	18	23
Permanent power	W	2000	2800
Maximum non repetitive duration	s	5	5
Maximum repeat cycle duration	s	0.5	0.5
Repetition	%	12	12

3. DIMENSIONS, ASSEMBLY, MASS, LABELLING, CODING

3.1 Dimensions, Assembly and Mass

See the following pages, drawing numbers - FELX 305463
- FELX 305464
- FELX 305541
- FELX 305568
- FELX 305540
- FELX 305567

PARVEX

DIGIVEX
DSD

VENTILATED DSD
8/16A 400V 3Ph AND
15/30A 230V 3Ph

DIMENSIONS

FELX 305464GB

313

7.2

109.5

69

20

5.5

Let 20mm minimum space

DO NOT OBSTRUCT THE FAN AIR INLET

Minimum space ventilation

Minimum space ventilation

80

300

40

328 over all

222 over all (without wiring)

Shield M4

Weight: 4,6 Kg

Est.: 27/10/97
Stamping: LR

Liste doc.:
Gre doc.: A3   English   N° feat 1   N° feat 1
Scale: 2/3

		Modif.
A	23/01/98	
B	AM:E98034	
C	AM:E98050	
D	AM:E99058	

DSD 30/60A
230V 3Ph

DIMENSIONS

PARVEX

FELX 305541GB

PARVEX

DSD 60/100A
230V 3Ph

DIMENSIONS

DSD 60/100

FELX 305568GB

Let 20mm minimum space
DO NOT OBSTRUCT THE FAN AIR INLET

Minimum space ventilation

313

168
120
23.5

7.2
120
5.5
23.5

5.5
6.2
10

300
80
40

328 over all

235 over all (without wiring)

Shield M5

Weight: 8,7 Kg

Liste doc.
Gre doc.   A3   English
Scale: 2/3

PARVEX

DIGIVEX DSD 16/32

ALIM. SUPPLY 400V/50Hz
3x400Vrms 50/60Hz

RECOVERY
OVERVOLT
PHASE
RESET

ENCODER
RS 232
INPUTS/OUTPUTS
RESOLVER

DO NOT OBSTRUCT THE FAN AIR INLET
Let 20mm minimum space

Minimum space ventilation
80
300
40
Minimum space ventilation

313
133
90
21
90
21
7.2
5.5
6.2
10
5.5

328 over all
222 over all (without wiring)
Weight: 5,5 Kg
Shield M4

PARVEX

DSD 16/32A
400V 3Ph

DIMENSIONS

Liste doc.
Gre doc.   A3   English
Scale: 2/3

FELX 305540GB

Est.:   17/12/97
Stamping: LR

		Modif.		
A	23/01/98	AM:E98032		
B		AM:E98050		
C		AM:E99058		
D				

3.2 Labelling and Coding

Physical identification by labels:

On DSD (Digivex Single Drive):
* One label plate fixed to the appliance as in the model below:

```
CONVERTISSEUR CA/CA        DSD13007
E: 3x230V   4,8A      S: 0-310V   î=7,5A
Fn: 50/60Hz   Classe 1    MADE IN FRANCE
```
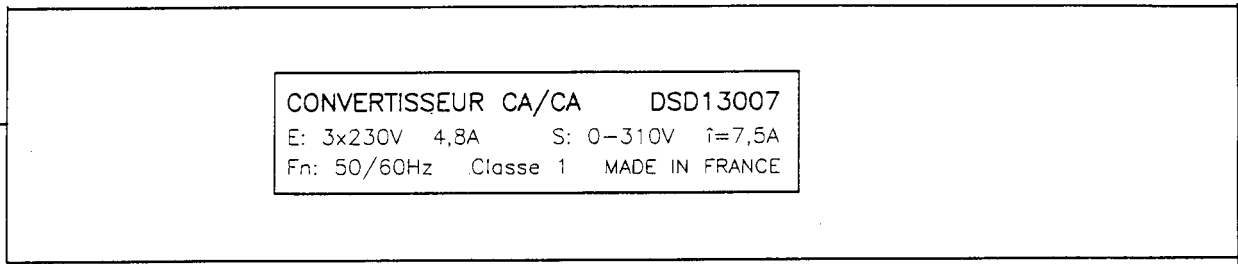
Meaning of label indications:
- AC/AC converter : Alternating current converter
- DSD - - - - - : Digivex Single Drive servo-amplifier code
- E : 3 X - - -V   --A : Input voltage and current
- fn : --/--Hz : Frequency
- S: 0- - - -V î=--Â : Output voltage and permanent output current (Amps. Peak)
- Classe - : Service class under standard NF EN60146, 1= permanent
- Serial number and date of manufacture

The customised parameters of the variable speed drive are memorised in the unpluggable EEPROM store. The parameters can be read by :

Digivex PC software
Hand help terminal (see following sections)

Codification

CODE	FUNCTION
DSD13M02	DIGIVEX Single Drive 230V single-phase 2/4 A
DSD13M04	DIGIVEX Single Drive 230V single-phase 4/8 A
DSD13M07	DIGIVEX Single Drive 230V single-phase 7.5/15 A
DSD13004	DIGIVEX Single Drive 230V three-phase 4/8 A
DSD13007	DIGIVEX Single Drive 230V three-phase 7.5/15 A
DSD13015	DIGIVEX Single Drive 230V three-phase 15/30 A
DSD13030	DIGIVEX Single Drive 230V three-phase 30/60 A
DSD13060	DIGIVEX Single Drive 230V three-phase 60/100 A
DSD16002	DIGIVEX Single Drive 400V three-phase 2/4 A
DSD16004	DIGIVEX Single Drive 400V three-phase 4/8 A
DSD16008	DIGIVEX Single Drive 400V three-phase 8/16 A
DSD16016	DIGIVEX Single Drive 400V three-phase 16/32 A
DSD16032	DIGIVEX Single Drive 400V three-phase 32/64 A

4. ELECTRICAL CONNECTIONS

4.1 General Wiring Requirements

4.1.1 Appliance handling

See the safety instructions given at the beginning of this manual. In particular, wait for all the front panel LEDs to go off completely before doing any work on the servo-amplifier or servomotor.

4.1.2 Electromagnetic compatibility

EARTHING

Comply with all local safety regulations concerning earthing.

Utilize a metal surface as an earth reference plane (e.g. cabinet wall or assembly grid). This conducting surface is termed the potential reference plate. All the equipment of an electrical drive system is connected up to this potential reference plate by a low impedance (or short distance) link. Ensure the connections provide good electrical conduction by scraping off any surface paint and using fan washers. The drive will then be earthed via a low impedance link between the potential reference plate and the earth screw at the back of the DIGIVEX SINGLE DRIVE. If this link exceeds 30 cm, a flat braid should be used instead of a conventional lead.

CONNECTIONS

Do not run low-level cables (resolver, inputs/outputs, NC or PC links) alongside what are termed power cables (power supply or motor). Do not run the power supply cable and the motor cables alongside one another otherwise mains filter attenuation will be lost. These cables should be spaced at least 10 cm apart and should never cross, or only at right-angles.

Except for the resolver signals, all low-level signals will be shielded with the shielding connected at both ends. At the DIGIVEX SINGLE DRIVE end, the shielding is made continuous by the Sub-D connector mechanism.

The motor cables are limited to the minimum functional length. The yellow and green motor cable lead must be connected to the box or front panel terminal block with the shortest possible link.

This usually means shielded motor cable is not required. Chokes may also be inserted into the motor phase leads.

MAINS FILTERING

The equipment complies with standard EN55011 with a filter on the power input with minimum 60 dB attenuation in the 150 kHz - 30 MHz range.

The mains filter must be mounted as close as possible to the potential reference plate between the mains and the DIGIVEX SINGLE DRIVE power supply. Use shielded cable (or run the cable in metal trunking).
Avoid running cables together, ahead of and after the filter.

Filters sometimes have high leakage currents. In this case, comply with the standard connection diagrams when fitting them.

OTHER MEASURES

Self-inducting components must be protected against interference: brakes, contactor or relay coils, fans, electro-magnets, etc.

4.1.3 <u>DIGIVEX SINGLE DRIVE Sub-D connectors</u>

In order to ensure the system is free from disturbances, it is essential for the rack to be properly connected to the earth plane of the electrical cabinet and for the covers of the Sub-D connectors to be EMI/RFI shielded (metal with shielding braid connection).
Make sure the Sub-D connectors and their covers are properly connected (lock screws fully tight).

<u>GROUND CONNECTION</u>

Fold the shielding braid over the cable sheath

Solder between the braid and the green and yellow lead.
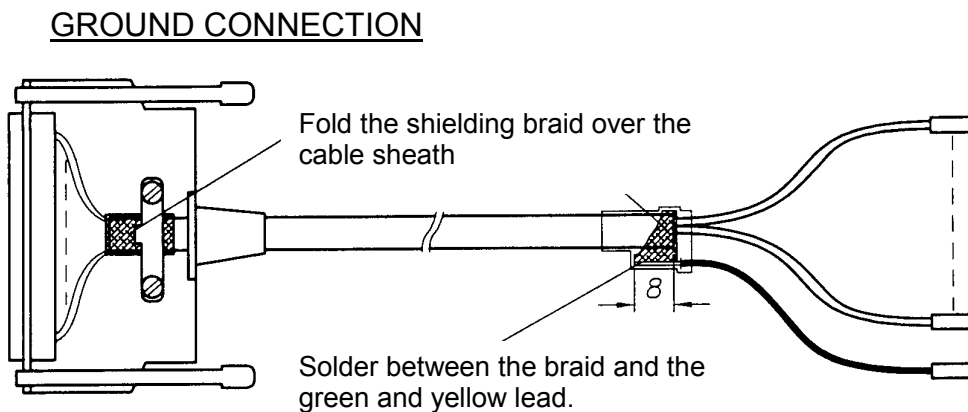
4.2 Standard Connection Diagram

See the drawings on the following pages
- FELX 305462
- FELX 305571
- FELX 305569
- FELX 305573
- FELX 305570
- FELX 305572

DSD THREE–PHASE

CONNECTING DIAGRAM

PARVEX

FELX 305462GB

SL : LINE SWITCH
KM1 : POWER CONTACTOR
F1 : LINE FUSES (gG)
F2 : AUXILIARY FUSES
AP* : SURGE SUPPRESSOR
FR : MAINS FILTER
At : OFF
MA : ON

Connections valid for:
DSD 2/4A, 4/8A and 8/16A 400V 3Ph
DSD 4/8A, 7,5/15A and 15/30A 230V 3Ph

Terminal block capacity
– B1 to B5 : max 2,5² multi–strand

Terminal block tightening torque
– B1 to B5 : max 0,5 Nm

* The power contactor coil KM1 should necessary have a surge suppressor AP connected.
** For 400V 3Ph version : shielding between filter and servoamplifier required only if appliance is not fitted in a closed cabinet.
To meet the requirements of standard EN 60204 an emergency stop safety block may be inserted in the energising circuit on electric equipment of machinery. It is then strongly recommended to use contactors that are adapted for auto-control and redundancy.

	ABB	TELEMECANIQUE
KM1	SERIE B	SERIE LC1
F2	2A 500V gG	

Fuse+ fault monitoring

Automatic control supply

KM1

SL : LINE SWITCH
KM1 : POWER CONTACTOR
F1 : LINE FUSES (gG)
F2 : AUXILIARY FUSES
AP* : SURGE SUPPRESSOR
FR : MAINS FILTER
At : OFF
MA : ON

Connections valid for:
DSD 2/4A, 4/8A et 7,5/15A 230V 1Ph

Terminal block capacity
- B1 to B5 : max 2,5² multi-strand

Terminal block tightening torque
- B1 to B5 : max 0,5 Nm

OK

DIGIVEX DSD

OTHER
DIGIVEX

F1

KM1

Thermal protection

Brake

+24V ext. brake

RESOLVER

FR

SL

L
N
PE

KM1

F2

* The power contactor coil KM1 should necessary have
a surge suppressor AP connected.

To meet the requirements of standard EN 60204 an emergency stop safety block
may be inserted in the energising circuit on electric equipment of machinery. It is
then strongly recommended to use contactors that are adapted for auto-control and
redundancy.

	ABB	TELEMECANIQUE
KM1	SERIE B	SERIE LC1
F2	2A 500V gG	

A	29/01/98		E	AM:E00003	Est.:	13/01/98
B	AM:E98044	Modif.	F	AM:E02093	Stamping:LR	
C	AM:E98149		G	AM:E04027		
D	AM:E99087					

ML | Modif.

CONNECTING DIAGRAM

PARVEX

DSD SINGLE-PHASE

Liste doc.				FELX 305571GB	N° leaf	1
Gre doc.	A3	English			1	1
Scale: /					N° leaf	1

SL : LINE SWITCH
KM1 : POWER CONTACTOR
F1 : LINE FUSES (gG)
F2 : AUXILIARY FUSES
AP* : SURGE SUPPRESSOR
FR : MAINS FILTER
At : OFF
MA : ON

Terminal block capacity
- B1, B2 (4,5,6,7), B4 and B5 : max 2,5² multi-strand
- B2 (1,2,3) and B3 : max 6² multi-strand
Terminal block tightening torque
- B1, B2 (4,5,6,7), B4 and B5 : max 0,5 Nm
- B2 (1,2,3) and B3 : max 1,8 Nm

* The power contactor coil KM1 should necessary have a surge suppressor AP connected.

To meet the requirements of standard EN 60204 an emergency stop safety block may be inserted in the energising circuit on electric equipment of machinery. It is then strongly recommended to use contactors that are adapted for auto-control and redundancy.

		ABB	TELEMECANIQUE
KM1		SERIE B	SERIE LC1
F2		2A 500V gG	

PARVEX

DSD 30/60A
230V 3Ph

CONNECTING DIAGRAM

				Liste doc.			FELX 305569GB	N° leaf	N° leaf
				Gre doc.	A3	English		1	1
				Scale: /					
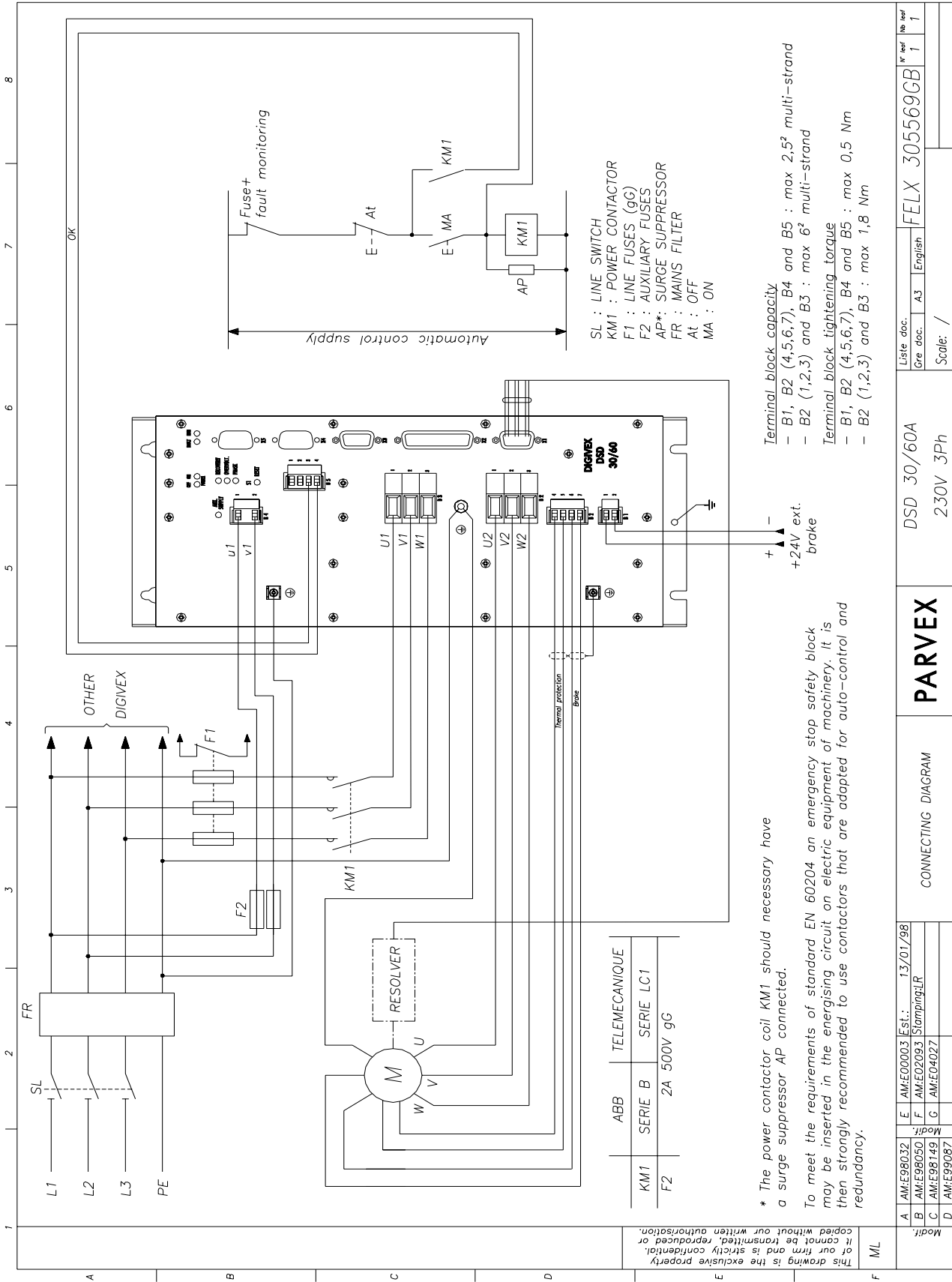
	Modif.				
A	AM:E98032	E	AM:E00003	Est.:	13/01/98
B	AM:E98050	F	AM:E02093	Stamping:LR	
C	AM:E98149	G	AM:E04027		
D	AM:E99087				

Modif.

ML

Fuse + fault monitoring

OK

Automatic control supply

E – At

E MA

KM1

AP

KM1

SL : LINE SWITCH
KM1 : POWER CONTACTOR
F1 : LINE FUSES (gG)
F2 : AUXILIARY FUSES
AP* : SURGE SUPPRESSOR
FR : MAINS FILTER
At : OFF
MA : ON

Terminal block capacity
– B1, B2 (4,5,6,7), B4 and B5 : max 2,5² multi-strand
– B6 : max 4² multi-strand
– B2 (1,2,3) and B3 : max 10² multi-strand

Terminal block tightening torque
– B1, B2 (4,5,6,7), B4 and B5 : max 0,5 Nm
– B6 : max 0,8 Nm
– B2 (1,2,3) and B3 : max 1,8 Nm

DIGIVEX
DSD
60/100

R ext.
R int. **

** : where the optional ext. resistor is fitted,
remove the int. resistor link.

Optional ext. resistor
2,8 Kw : 2xRE 91002

u1 v1

U1 V1 W1

U2 V2 W2

Thermal protection

Brake

+ –
+24V ext.
brake

OTHER
DIGIVEX

F1

F2

KM1

FR

SL

L1
L2
L3
PE

RESOLVER

M
U
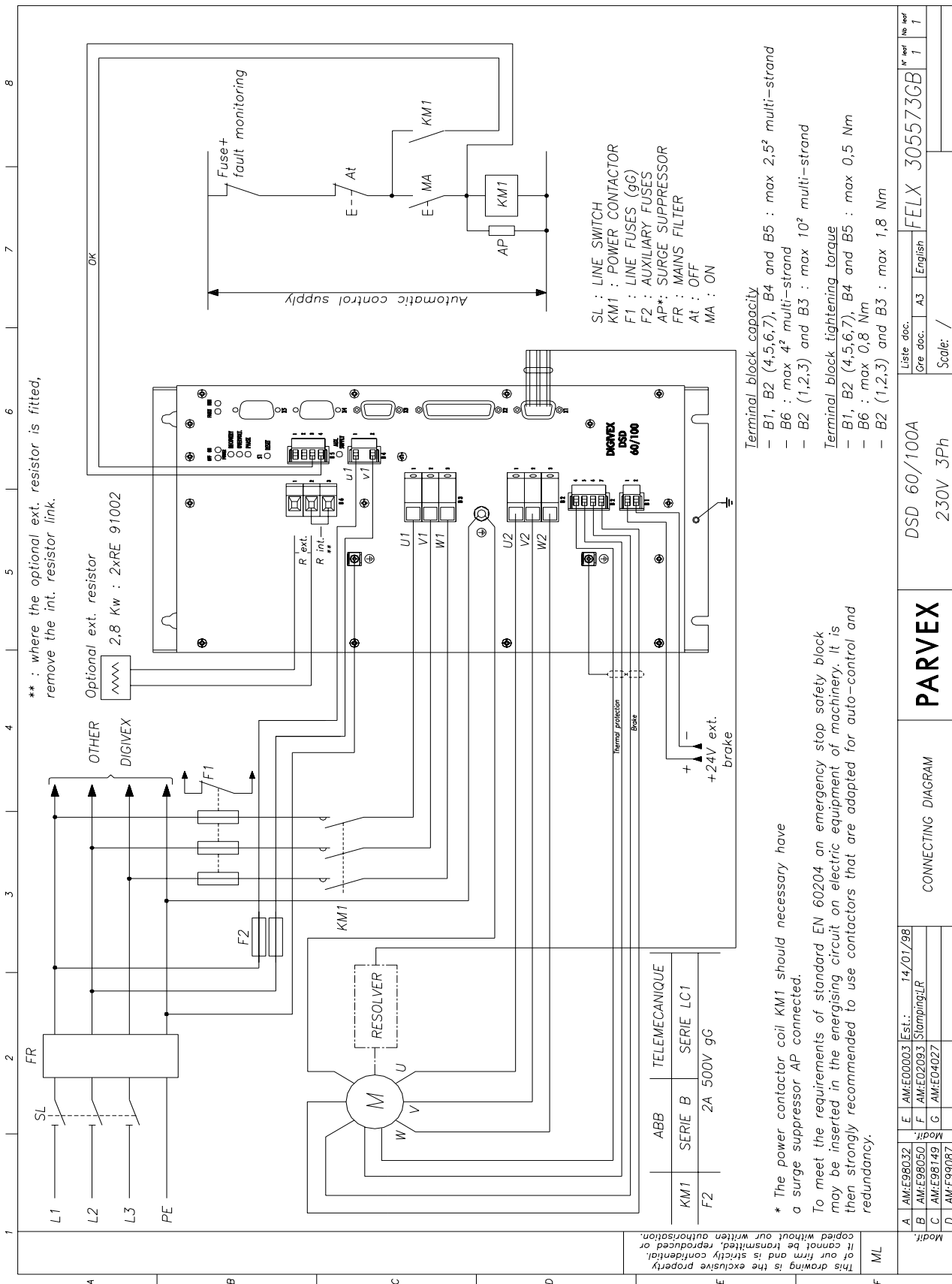V
W

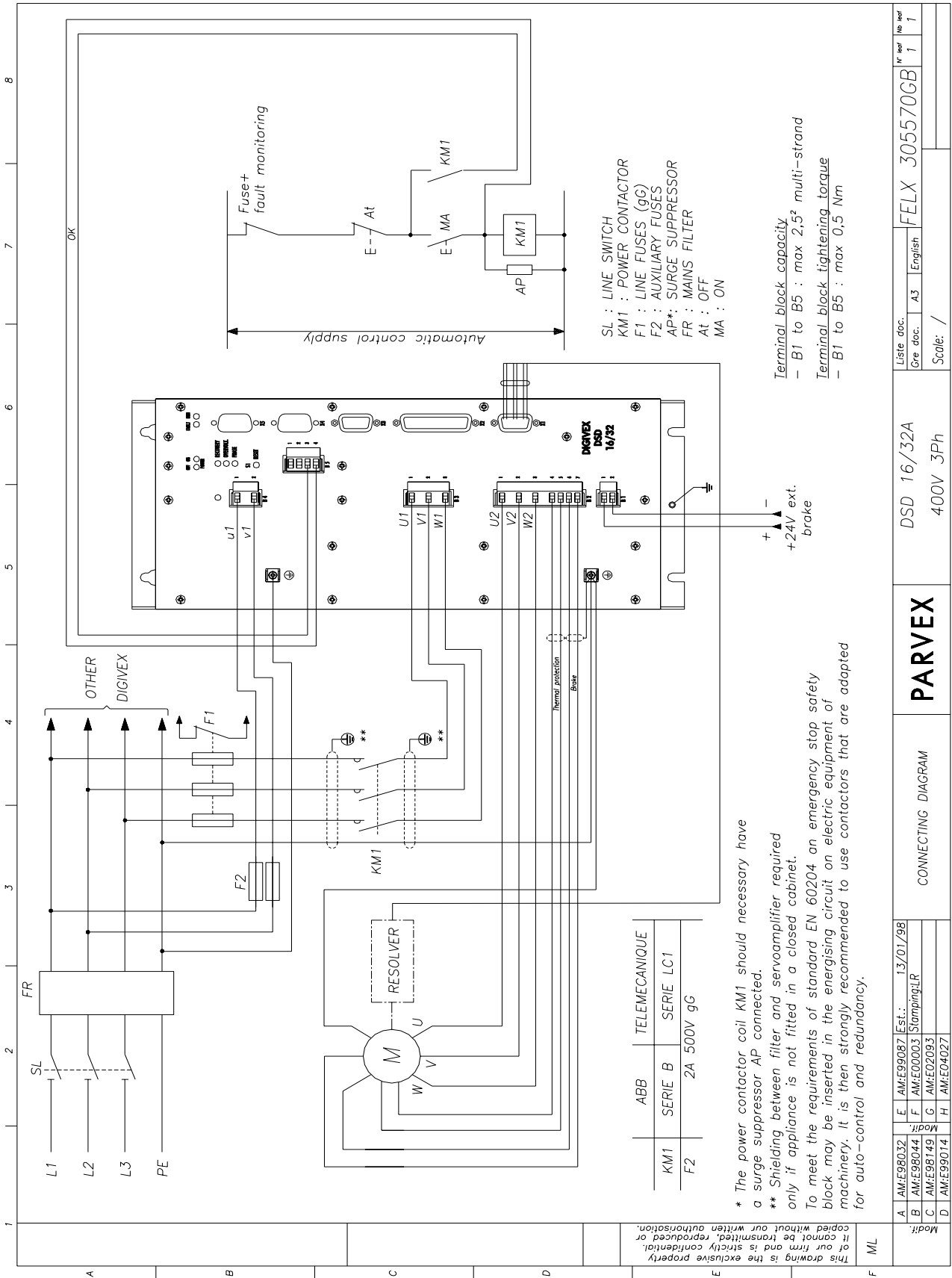|	ABB	TELEMECANIQUE
KM1	SERIE B	SERIE LC1
F2	2A 500V gG	

* The power contactor coil KM1 should necessary have
a surge suppressor AP connected.

To meet the requirements of standard EN 60204 an emergency stop safety block
may be inserted in the energising circuit on electric equipment of machinery. It is
then strongly recommended to use contactors that are adapted for auto-control and
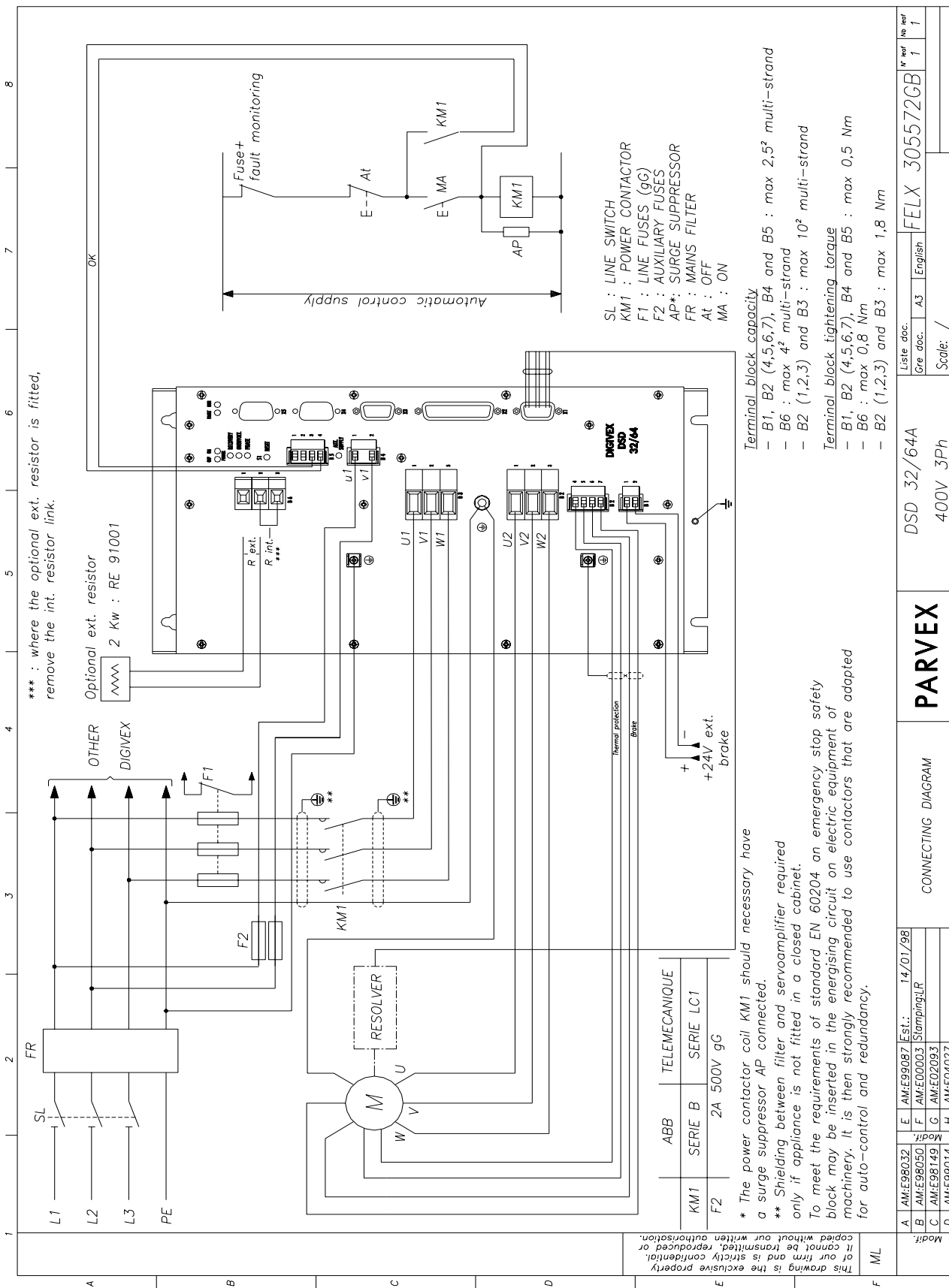redundancy.

PARVEX

DSD 60/100A
230V 3Ph

CONNECTING DIAGRAM

Liste doc.		
Gre doc.	A3	English
Scale: /		

FELX 305573GB 1 1
N° leaf 1 Nb. leaf 1

	Est.:	14/01/98
E	AM:E00003	Stamping:LR
F	AM:E02093	
G	AM:E04027	
A	AM:E98032	
B	AM:E98050	Modif.
C	AM:E98149	
D	AM:E99087	

Modif.

ML

CONNECTING DIAGRAM

PARVEX

DSD 32/64A

400V 3Ph

4.2.1 <u>Surge Suppressor</u>

- KM1:   Power Contactor
- AP: Surge Suppressor

The power contactor coil KM1 should **necessary** have a surge suppressor AP connected in order not to destroy prematurely the internal relay contact of the drive. This module should be use whether the power contactor supply is AC or DC.

The relay manufacturers (Telemecanique: LC1 series, ABB: B series,…) provide surge suppressors fitted relays wether the power contactor supply is AC or DC for various voltages (RC module, Diode+Zener Diode, Varistor,…).

4.3 Front Panel, Description of Terminal Blocks and Sub-D Connector

All the input/outputs required for operation are arranged on the front panel in the form of:
- B1 supply terminal block.
- B2 motor terminal blocks (in 1 or 2 parts depending on rating).
- B3 power supply terminal block.
- B4 auxiliary power supply terminal block.
- B5 terminal block for automatic control connection.
- B6 terminal block for external resistor connection on DSD 32/64 and DSD 60/100 ratings.
- X1 RESOLVER connector.
- X2 INPUTS / OUTPUTS connector.
- X3 RS232 connector.
- X4 ENCODER connector (option).

The motor earth is to be connected to the Faston lug located below the rack. The Sub-D connectors used must be metal-plated (or metallic) and ensure the shielding is continuous right to the metal earth of the rack.

See the following pages for diagrams
- 230 V single-phase DSD 2/4A, 4/8A, 7.5/15A
- 230 V three-phase DSD 4/8A, 7.5/15A
- 230 V three-phase DSD 15/30A
- 230 V three-phase DSD 30/60A
- 230 V three-phase DSD 60/100A
- 400 V three-phase DSD 2/4A, 4/8A,
- 400 V three-phase DSD 8/16A
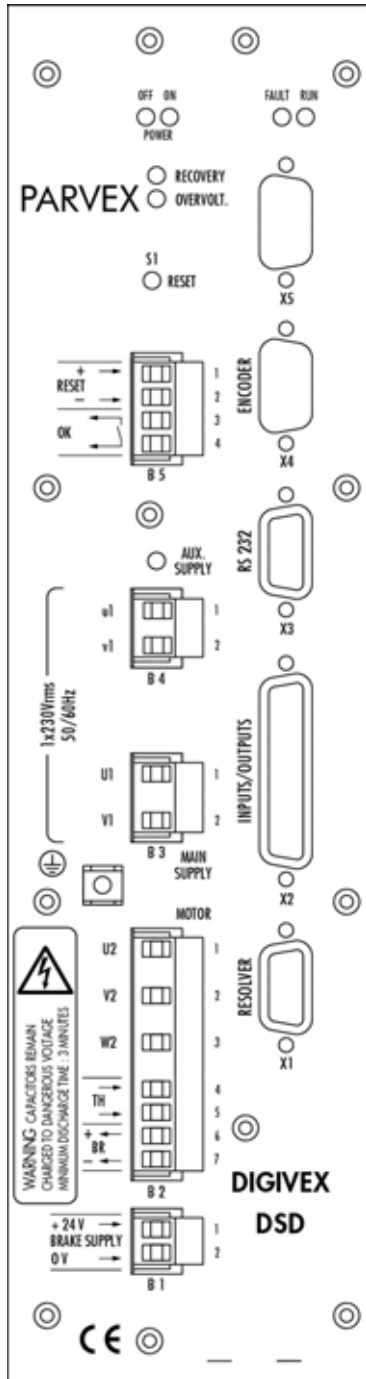- 400 V three-phase DSD 16/32A
- 400 V three-phase DSD 32/64A

230V Single-phase 2/4A, 4/8A, 7,5/15A

230V Three-phases 4/8A 7,5/15A

230V Three-phases 15/30A.
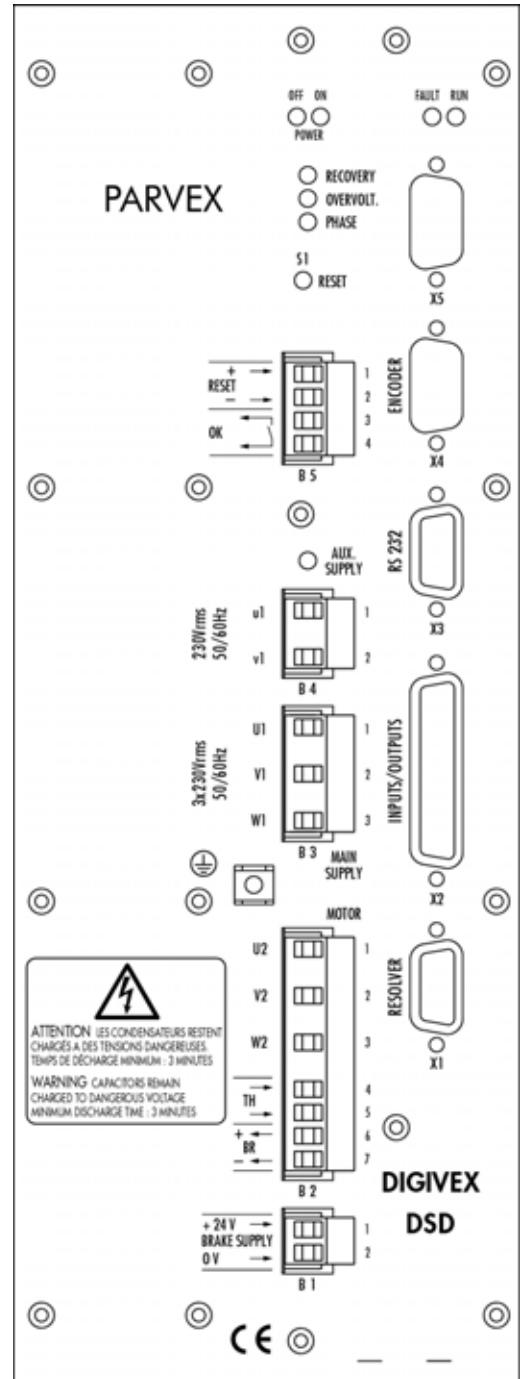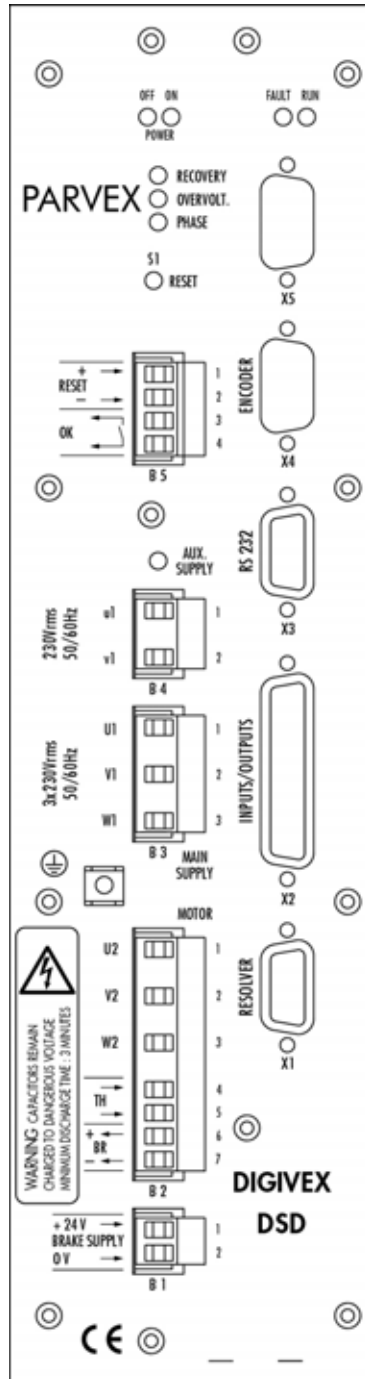
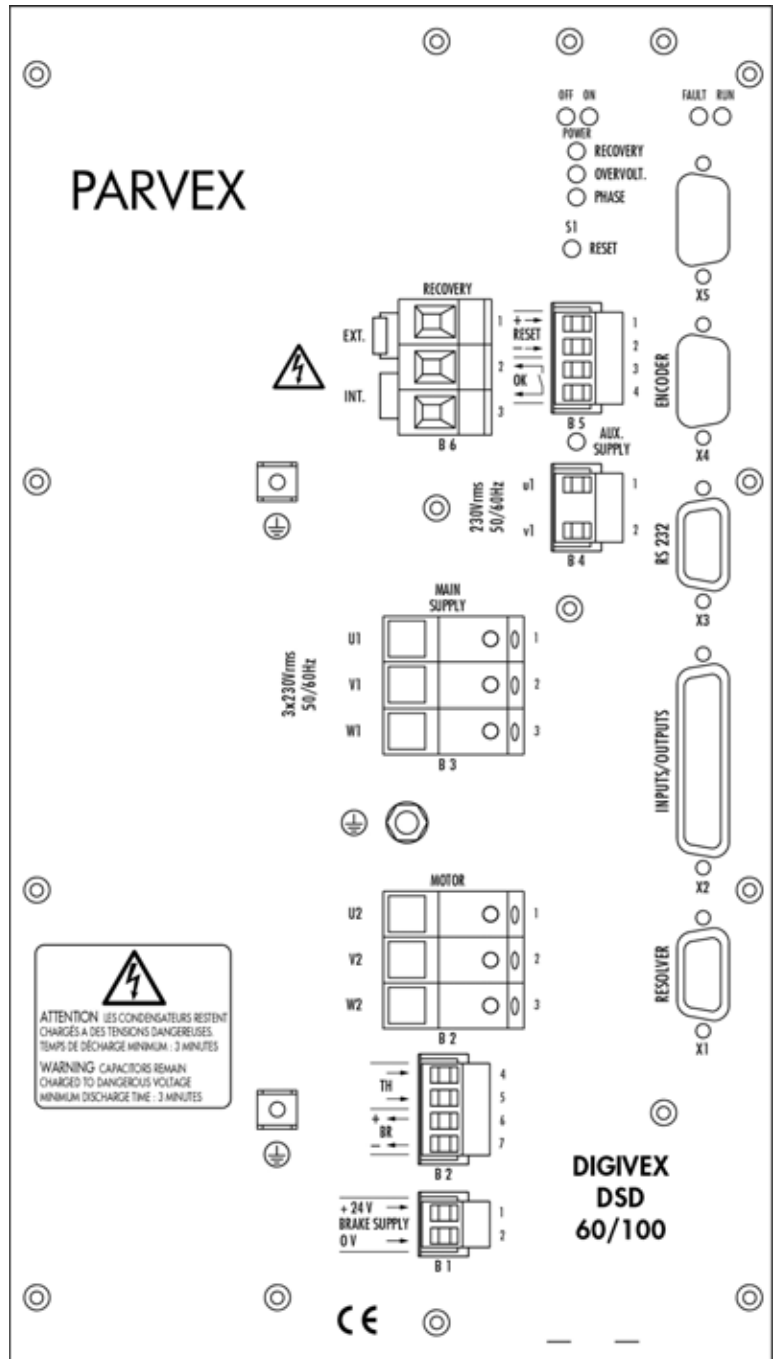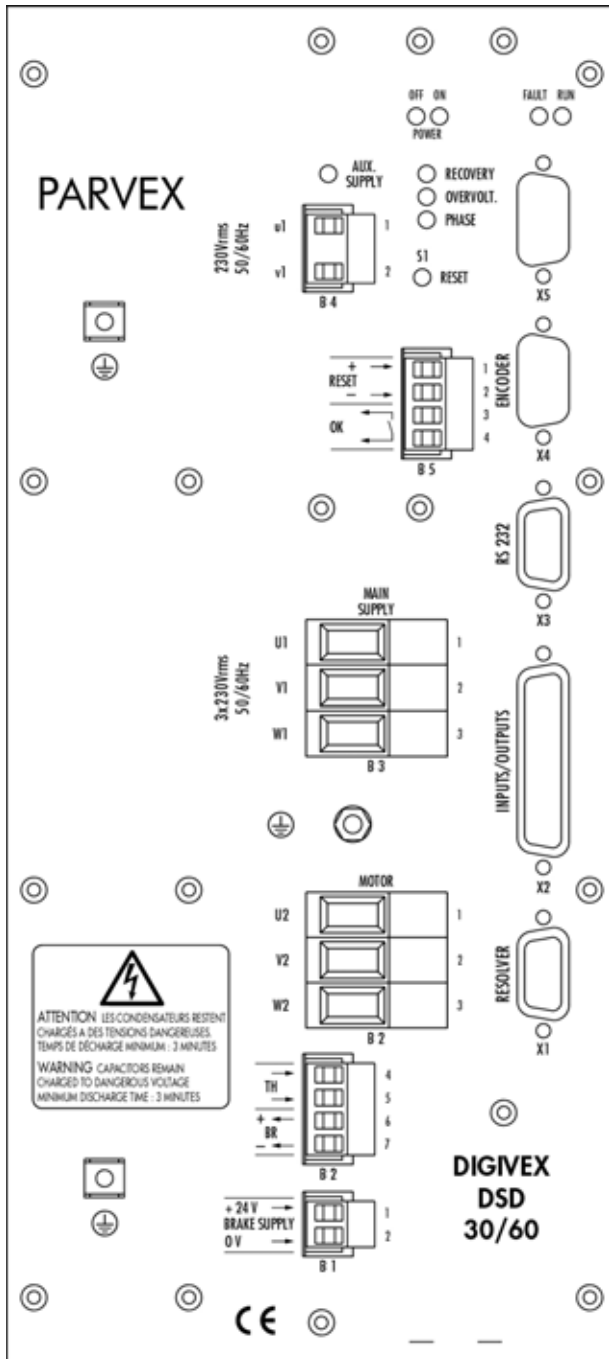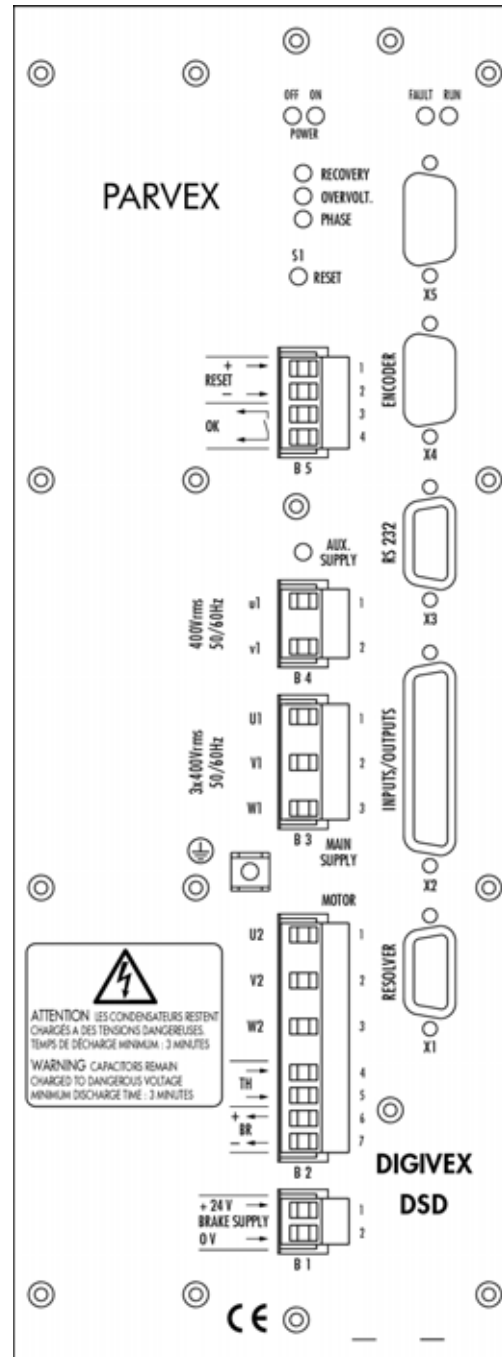230V Three-phases 30/60A   230V Three-phases 60/100A

400V Three-phases 2/4A, 4/8A　　　　　　　400V Three-phases 8/16A
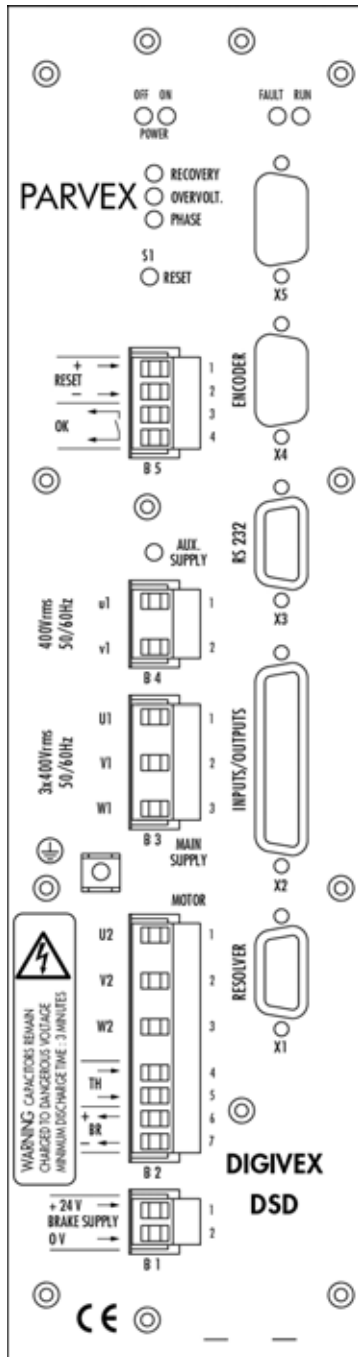
400V Three-phases 16/32A

400V Three-phases 32/64A
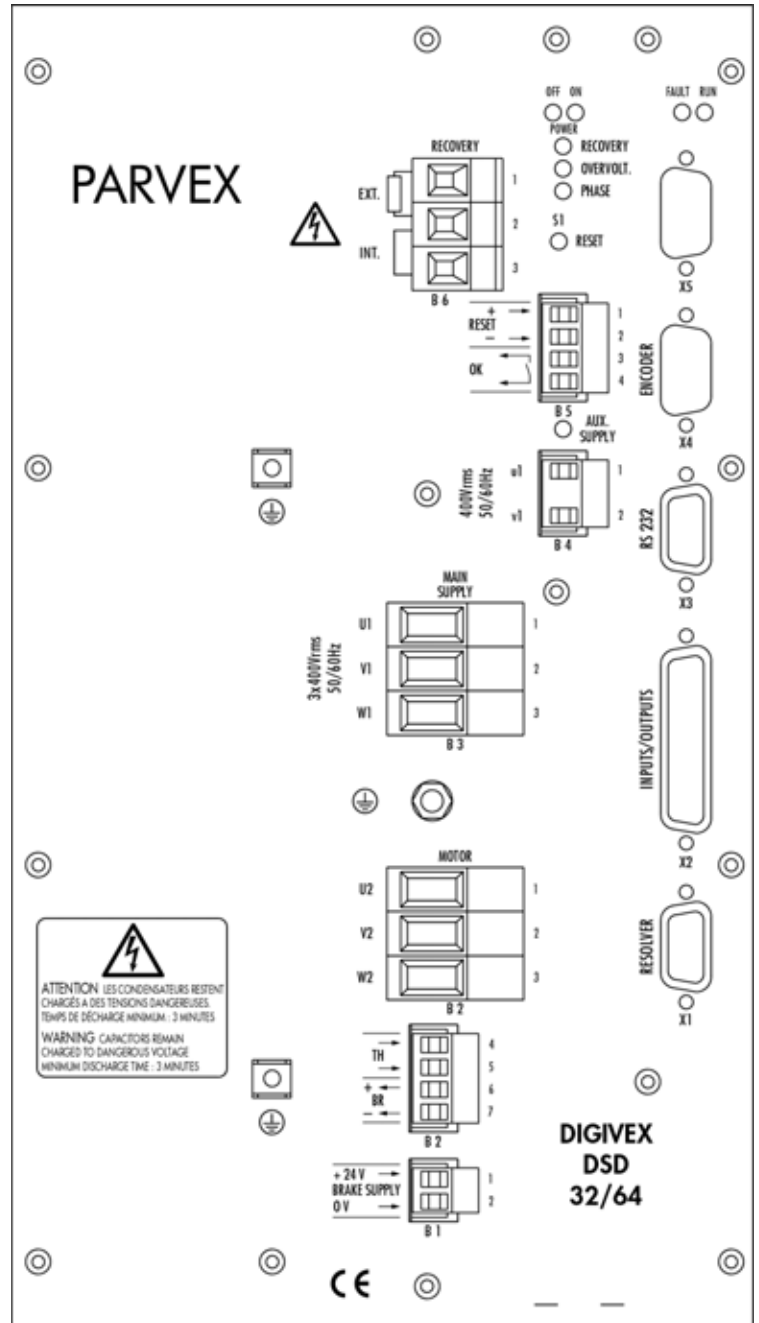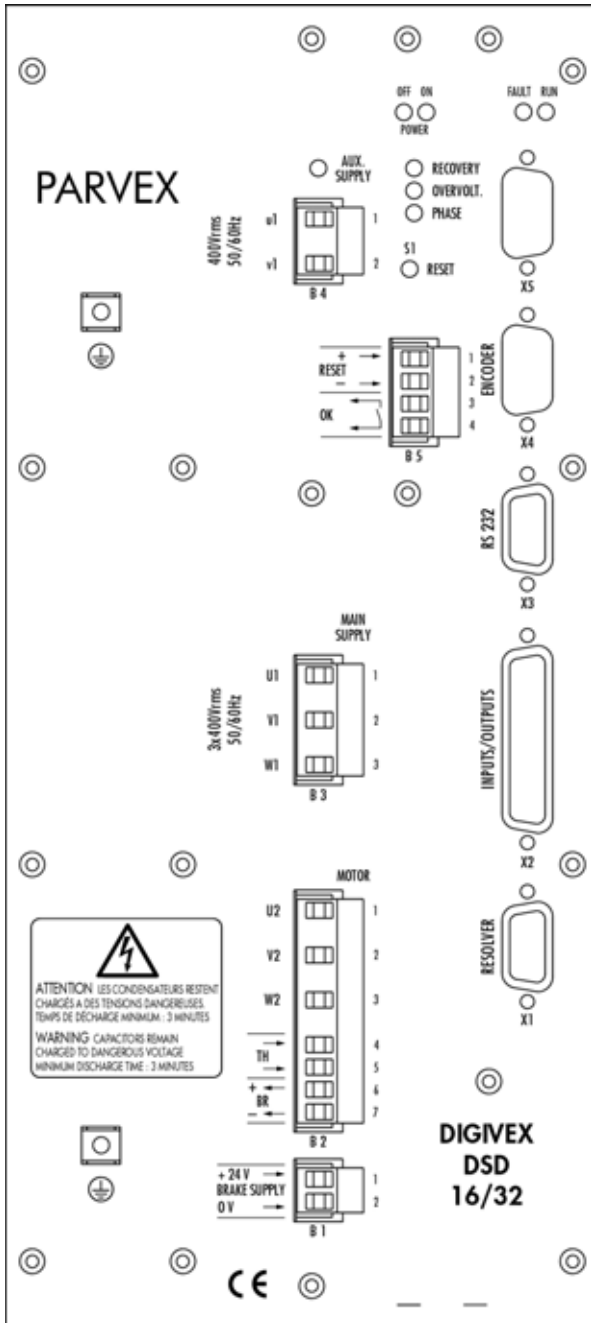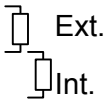
4.3.1 Terminal blocks B1, B2, B3, B4, B5, B6

Description of module terminal blocks: **230V single-phase 2/4, 4/8, 7.5/15A**
230V three-phase 15/30A
400V three-phase 2/4, 4/8, 8/16A
400V three-phase 16/32A

ITEM REF.	TERMINAL	Front Panel Marking	FUNCTION	TERMINAL BLOCK TYPE	TERMINAL CAPACITY
B1/1	+24V	BRAKE	24V input for brake supply	Unpluggable screw-type	Min 0,2 mm² Max 2,5 mm² flexible and rigid lead
B1/2	0V	SUPPLY			
B2/1	U2			screw-type	
B2/2	V2	MOTOR	Motor connection		
B2/3	W2				Min 0.2 mm² Max 2,5 mm² flexible and rigid lead
B2/4	TH	TH	Motor thermal protection	Unpluggable	
B2/5	TH				
B2/6	+	BR	Motor brake		
B2/7	-				
B3/1	U1	MAIN	Mains connection *For single-phase mains only B3/1 and B3/2 are to be connected*	Unpluggable screw-type	Min 0,2 mm² Max 2,5 mm² flexible and rigid lead
B3/2	V1				
B3/3	W1	SUPPLY			
B4/1	u1	AUX.	Low-level supply	Unpluggable screw-type	Min 2,5 mm² flexible and rigid lead
B4/2	v1	SUPPLY			
B5/1	+	RESET	Logic input RESET	Unpluggable screw-type	Min 0,2 mm² Max 2,5 mm² flexible and rigid lead
B5/2	-				
B5/3		OK	OK contact (regulation and power OK)		
B5/4					

Description of module terminal blocks*:* 230V three-phase 30/60A
230V three-phase 60/100A
400V three-phase 32/64A

ITEM REF.	TERMINAL	Front Panel Marking	FUNCTION	TERMINAL BLOCK TYPE	TERMINAL CAPACITY
B1/1 B1/2	+24V 0V	BRAKE SUPPLY	24V input for brake supply	Unpluggable screw-type	Min 0,2 mm² Max 2,5 mm² flexible and rigid lead
B2/1 B2/2 B2/3	U2 V2 W2	MOTOR	Motor connection	No unpluggable screw-type	<u>30/60 and 32/64</u> Min 0,2 mm² Max flexible lead 6 mm² <u>60/100</u> Min 0,5 mm² Max flexible lead 10 mm²
B2/4 B2/5	TH TH	TH	Motor thermal protection	Unpluggable screw-type	Min 0,2 mm² Max 2,5 mm² flexible and rigid lead
B2/6 B2/7	+ -	BR	Motor brake		
B3/1 B3/2 B3/3	U1 V1 W1 ⏚	MAIN SUPPLY	Mains connection *For single-phase mains only B3/1 and B3/2 are to be connected* *Earth*	No unpluggable screw-type	<u>30/60 and 32/64</u> Min 0,2 mm² Max flexible lead 6 mm² <u>60/100</u> Min 0,5 mm² Max flexible lead 10 mm²
B4/1 B4/2	v1 u1	AUX. SUPPLY	Low-level supply	Unpluggable screw-type	Min 0,2 mm² Max 2,5 mm² flexible and rigid lead
B5/1 B5/2	+ -	RESET	*Logic input RESET*	Unpluggable screw-type	Min 0,2 mm² Max 2,5 mm² flexible and rigid lead
B5/3 B5/4		OK	OK contact		
B6/1 B6/2 B6/3	Ext. Int.	RECOVERY	Internal / external resistor connection	No unpluggable screw-type	<u>32/64 and 60/100</u> Min 0,2 mm² Max flexible lead 4 mm²

4.3.2 Sub-D connectors X1, X2, X3, X4, X5

4.3.2.1 Sub-D connector table

Connectors with metal-plated or metallic covers.

ITEM REF.	CONNECTOR TYPE (cable end)	FUNCTION	MAX. CONDUCTOR CROSS-SECTION
X1 RESOLVER	9-pin plug for soldering	Resolver link	max. 0.5 mm² on soldering barrel
X2 INPUTS/ OUTPUTS	25-pin plug for soldering	Logic and analog inputs / output	max. 0.5 mm² on soldering barrel
X3 RS232	9-pin plug for soldering	PC or programming terminal link	max. 0.5 mm² on soldering barrel
X4 ENCODER	9-pin socket for soldering	Encoder emulation output (option)	max. 0.5 mm² on soldering barrel
X5	9-pin socket for soldering	CAN bus (option) or SSI encoder	max. 0.5 mm² on soldering barrel

See §8 (options) for X4 and X5 connectors.

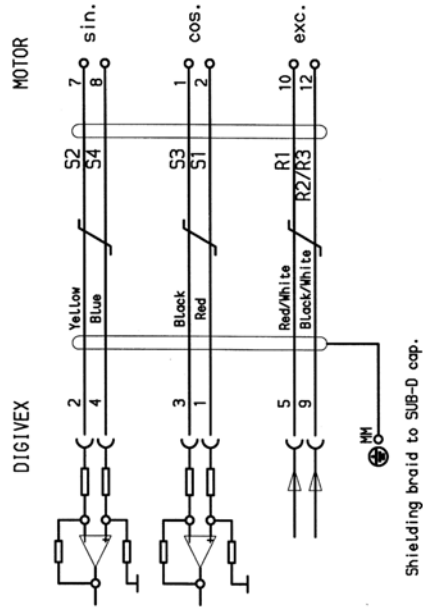### 4.3.2.2 Sub-D connector X1:"Resolver"

Digivex end connections, Sub-D 9 pin connector item ref. X1 "RESOLVER".
Maximum conductor cross-section: 0.5 mm²

CONTACT	TYPE	FUNCTION
1	Input	Cosine S1
2	Input	Sine S2
3	Input	Cosine S3
4	Input	Sine S4
5	Output	Excitation R1
6		
7		
8		
9	Output	0V Excite R2/3

RESOLVER CABLE
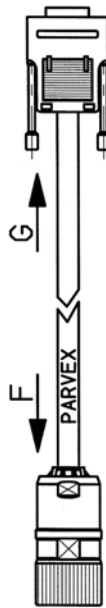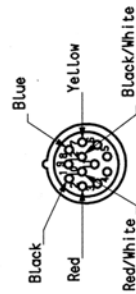
4.3.2.3 Sub-D connector X2: Inputs / Outputs

Maximum conductor cross-section : 0.5 mm²

CONTACT	TYPE	FUNCTION	CHARACTERISTICS
1	EA1 +	Speed or current set point ±10V, **+** point	Analog conversion: 15 bits + sign Differential input
14	EA1 -	Speed or current set point ±10V, **-** point	
2	EA2 +	Analog input ±10V, **+** point	Analog conversion: 9 bits + sign Differential input
15	EA2 -	Analog input ±10V, **-** point Input assigned to external current limitation. +/-10V = max. current	
3	SA1	Analog output ±10V, **+** point **ANA1**	Analog conversion: 7 bits + sign Max. voltage = 10V
16	0V	0V of analog output Output assigned to speed measurement 10V = maximum speed	Max. current = 3 mA Protected against short circuits.
4	SA2	Analog output ±10V, **+** point **ANA2**	Analog conversion: 7 bits + sign Max. voltage = 10V
17	0V	0V of analog output Output assigned to current measurement 10V = maximum current	Max. current = 3 mA Protected against short circuits.
9	EL1 +	SPEED RANGE	Type-2, optocoupled 24V logic inputs to IEC 1131-2.
21	EL1 -	Speed range choice	
10	EL2 +	CW: enables clockwise rotation if input is active (level 1)	(see characteristics on following pages)
22	EL2 -		
11	EL3 +	CCW: enables counter-clockwise rotation if input is active (level 1)	These inputs must have a 24V supply to have level 1.
23	EL3 -		

EA = analog input, **EL =** logic input, **SA =** analog output, **SL =** logic output

"Inputs / Outputs" Sub-D connector (continued)

CONTACT	TYPE	FUNCTION	CHARACTERISTICS
12 24	EL4 + EL4 -	Torque : enables torque if input is at 1	Type 2 logic input under IEC 1131-2 5
6 18	SL1 0V Logic	Drive OK	Max. 50 mA, optocoupled PNP 24V output
7 19	SL2 0V Logic	OUT1 speed detection	Max. 50 mA, optocoupled PNP 24V output
8 20	SL3 0V Logic	OUT2 speed detection	Max. 50 mA, optocoupled PNP 24V output
13 25	+24V Logic 0V Logic	Power supply available for logic inputs / outputs	Max. 50 mA through R=22 Ω

EA = analog input, **EL =** logic input, **SA =** analog output, **SL =** logic output
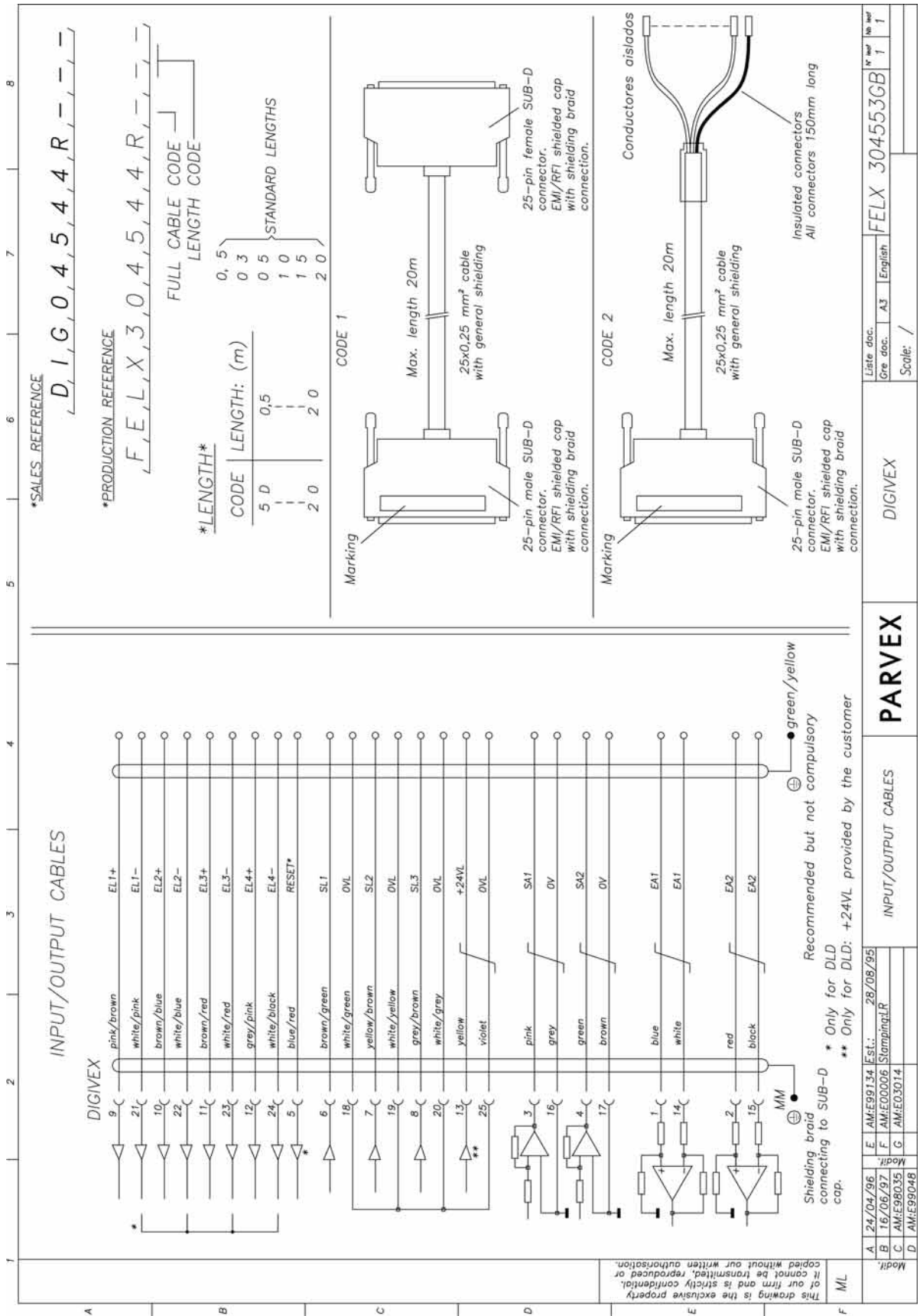
4.3.2.4 <u>Sub-D connector X3: RS232</u>

Maximum conductor cross-section: 0.5 mm²
Serial link configuration :

- ♦ 9600 bauds
- ♦ 8 data bits
- ♦ 1 start bit, 1 stop bit
- ♦ no parity
- ♦ no electrical isolation
- ♦ use an extension cable of 5 m maximum

DIGIVEX INTERNAL LINKS	DIGIVEX 9-PIN SUB-D CONNECTOR		PC	PC 9-PIN SUB-D CONNECTOR
	1		DCD	1
	2	TD (TXD)	RD (RXD)	2
	3	RD (RXD)	TD (TXD)	3
	4		DTR	4
	5	0V	0V	5
	6		DSR	6
	7		RTS	7
	8		CTS	8
	9	5V / 50mA	For programming console	9 [*]

[*] May be connected without danger to DIGIVEX pin 9.

This input is for linking with a computer (PC) for parameter loading and setting via the DIGIVEX PC software. It is also used with the hand help terminal to change those parameters.

4.4 Connection Details

4.4.1 Mains supply characteristics

230 V single-phase or three-phase modules

PARAMETER	VALUE
Frequency	48 - 62 Hz
Minimum voltage	100 V rms
Maximum voltage	253V rms
Rated voltage	230V +/- 10%
Dc voltage achieved	140 - 340V

400 V single-phase or three-phase modules

PARAMETER	VALUE
Frequency	48 - 62 Hz
Minimum voltage	280V rms
Maximum voltage	480V rms
Rated voltage	400V +/- 10%
Dc voltage achieved	380 - 670V

An auto-transformer is required for 480 V rms ±10%.

An external mains filter is necessary for compliance with the requirements on electromagnetic compatibility.

Braking energy is dissipated across the resistor.

Mains monitoring:
>   No phase (Except single-phase).
>   Overvoltage.

4.4.2 Power component dimensions

one single drive

Applicable to components ahead of the DIGIVEX SINGLE SUPPLY (fuses, cables, contactors, etc.), these dimensions are dependent on:
>   Permanent current $\hat{I}_0$ (sine wave peak) at slow motor speed, as given in the characteristics.
>   Electrical power of mains supply $\cong 1.1$ U rms $\hat{I}_0$

$$\text{Irms mains} = \frac{P}{\text{Urms}\sqrt{3}}$$

Parameters for determining power components

INPUT POWER FOR 230V SINGLE-PHASE MAINS kW	MODULE STANDARD $\hat{I}_0$ VALUE Â	LINE CURRENT for mains Urms = 230 V SINGLE-PHASE A rms	FUSE RATING Type gG	MAINS FILTER
0.5	2	2	2	FR01006
1	4	4	4	
2	7.5	8	8	FR01010

INPUT POWER FOR 230V THREE-PHASE MAINS kW	MODULE STANDARD $\hat{I}_0$ VALUE Â	LINE CURRENT for mains Urms = 230 V THREE-PHASE A rms	FUSE RATING Type gG	MAINS FILTER
1	4	2.5	4	
2	7.5	5	6	FR03016
4	15	10	10	
8	30	20	20	FR03036
16	60	40	40	

INPUT POWER FOR 400V THREE-PHASE MAINS kW	MODULE STANDARD $\hat{I}_0$ VALUE Â	LINE CURRENT for mains Urms = 400 V THREE-PHASE A rms	FUSE RATING Type gG	MAINS FILTER
1	2	1.3	2	
2	4	2.5	4	FR03016
3,5	8	5	6	
7	16	10	10	
14	32	20	20	FR03036

several drives in parallel

MAINS INPUT POWER 400 V kW	$\Sigma \hat{I}_0$ Â	LINE CURRENT for mains Urms = 400 V A eff.	FUSE RATING Type gG	MAINS FILTER
4.4	10	6.5	10	FR03016
6.6	15	9.5	16	
13.2	30	19	32	FR03036
24.2	55	36	50/63	

The cable cross-section and contactor rating must be selected accordingly.

4.4.3 <u>Auxiliary power supply</u>

The power supplies required for regulation (+/- 15 V, 5 V, 24 V) are drawn from an intermediate dc voltage which may be obtained:

either from a single-phase supply from the mains, drawn between two phases ahead of the main contactor (terminal block B4 input).

or from a separate single-phase (230 V or 400 V) supply connected to terminal block B4. In this case, the supply must be isolated from the mains by a transformer (secondary 230 V or 400 V +/- 10% 100VA).

or from an intermediate power voltage, through diodes (B4 not connected). With this arrangement (not recommended), power failure leads to the loss of low-level supplies and, in particular, the pulses generated by the "encoder emulation" option.

Clarification:

1) *Connection of the auxiliary power source is not **compulsory** because it is fed internally by the direct bus. Connection proves necessary if we want to save the position and the state through the encoder output (emulation) when for safety reasons, the mains power is turned off.*

2) *If the auxiliary power source is used, it is **essential** for it to be connected to the same phases (2 out of 3 for three-phase) as the mains power supply (see recommended diagram – see chapter 4.2), to avoid damage to the appliance.*
If this is not possible, this auxiliary power source can possibly originate from another circuit, but it must, imperatively, be isolated from the system using a transformer whose secondary will not be earthed. The voltage of the transformer secondary must be identical to the mains voltage (230V for mono appliances or three-phase 230V or 400V for three-phase 400V appliances).

4.4.4 <u>External braking resistor connection</u>

This feature applies to 60/100 - 230 V three-phase and 32/64 - 400 V three-phase supplies only.

<u>Use with internal resistor:</u>   short-circuit B6/2 and B6/3 with a 4 mm^2 isolated cable. B6/1 is not connected.

<u>Use the external resistor:</u>   connect the external resistor between B6/1 and B6/2. The B6/3 terminal is not connected.

Maximum current in cable:
With RE 91001 (2000 W): 26 A for the 32/64 A, 400 V three-phase module.
With RE 91002 (4500 W): 31 or 62 A (see page 21) for the 60/100 A, 230 V three-phase module.

Cable type: unshielded, cross-section 2.5 mm^2 for 2000 W, 4 mm^2 for 4500 W.

Maximum recommended distance: 10 m.
Resistor end: Connection via terminal block via packing gland PG 16, for cable diameters between 10 mm and 14 mm.

4.4.5 <u>Terminal block B1: brake supply</u>

This terminal block may receive 24 V supply voltage for the brake mounted on the motor. It is supplied at the motor terminal block B2.

Regulated / filtered 24 V ±10% voltage. Protection against overvoltage by 26 Joule varistor, this protection is effective from 30 V.

CAUTION: Do not use the 24 V available at X2 for this function.

4.4.6 <u>Earth connection (front panel Faston tab)</u>
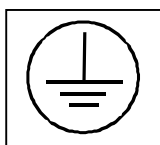
Chassis earth:

For compliance with the standards in force, the lead cross-section must normally be identical to that of the mains connection and at least 16mm².

4.5 Connecting Servomotors

4.5.1 <u>Power cable definition</u>

The motor / drive power connection cables will have as a minimum:

- 3 isolated conductors connected to phases U2, V2, W2. Cross-sections as in the table on the next page. The presence of chokes internal to the DIGIVEX means there is no need for shielding of the three power conductors.
- 1 earth conductor (green and yellow).
- 2 twisted and shielded pairs for connection of the motor thermal protection. Cross-section in the order of 1mm².
- 2 twisted and shielded pairs for connection of the holding brake (if present). Cross-section in the order of 1mm².
- 1 "shielding continuity" conductor (green/orange) to be connected to the servoamplifier earth ⏚

Power cable cross-section

The cable cross-sections given in the table below take account of:

The rated drive current.
The motor / drive distance, service voltage loss = RI.
The ambient temperature, cable Joule losses = RI².
the standardized increase in cable sections.

The cable section to be used is given in the table below

Distance ➜	0m	50m	100m
DIGIVEX Rating	Cable cross-section in mm²		
2/4 and 4/8	0.5		1
7.5/15 and 8/16	1		2.5
16/32 and 15/30	2.5		6*
32/64 and 30/60	6		10*
60/100	10		16*

* cross-section incompatible with power terminal blocks see §4.3.1. Provide an intermediate terminal block nearby.

Connection by connector

The power connection by connector is available as an option. The removable part of the connector (plug) can be supplied on request.

List of power cables, power connectors, and equipped cables for H or L series motors

MOTOR	Cable cross-section (mm²)	Power Cable	Power Plug (1)	Equipped Cable
HX200-HX300-HX400	0,5	6537P0019	220065R1610	220049R49..
LX200-LX300-LX400 **HS-HD-HX600/HS800**	1	6537P0009	220065R1610	220049R42..
LS-LD-LX600/LS800	2,5	6537P0010	220065R1611	220049R43..
HD-HX-HV800 **LD-LX-LV800**	2,5	6537P0010	220065R3611	220049R48..
HS900 **LS900**	6	6537P0011	220065R3610	220049R45..
HD-HV900 **LD-LV900**	10	6537P0012	220065R3610	220049R46..
HXA-HVA **All HW et LV**	16	6537P0013	220065R3610	220049R47..
HD-HV1000 **LD-LV1000**	25	6537P0014		

Length 5 m / 10 m / 15 m / 25 m / 50 m. Add the length in metres to the cable product number.

(1) Straight power plug with crimp-fit contact.

4.5.2 <u>Guidelines for the use of long cables</u>

The inductors and, where necessary, the resistors are to be fitted between the DIGIVEX Single Drive (as close as possible to the drive) and the motor when used with long cable lengths.
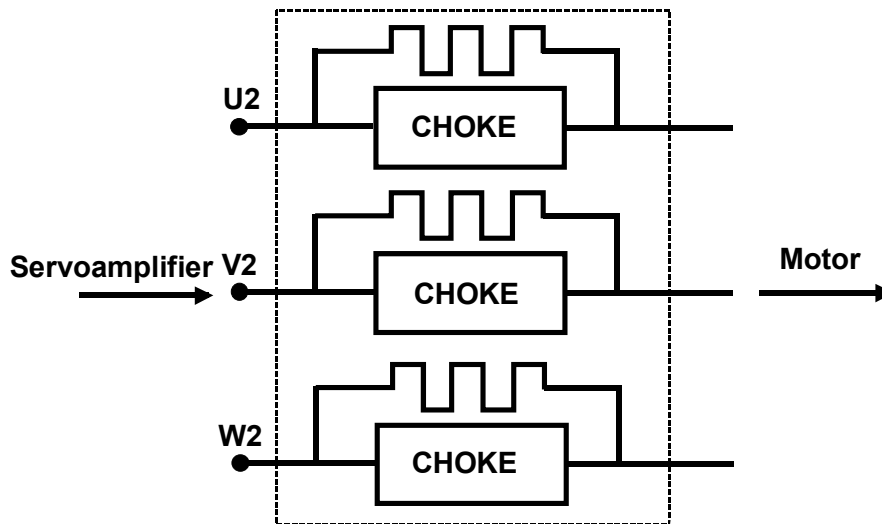
<u>References of inductors</u>

Cable length (L)	Normal	L ≤ 20 m	20 < L < 30 m	30 ≤ L < 70 m	70 ≤ L < 100 m
	Shielded	L ≤ 15 m	15 < L < 20 m	20 ≤ L < 50 m	50 ≤ L < 70 m
2/4 – 4/8		-	DSF02	DSF02	Not recommended
7,5/15 – 8/16		-	-	DSF02	SF02032 + resistor
15/30 to 32/64		-	-	SF02025	SF02025
60/100		-	-	SF02026	SF02026

(leftmost label spanning rows: DIGIVEX Single Drive)

- DSF02: three inductances of 50 mH damped by resistors to rise on rail DIN
- For lengthes superior to 100 m, consult us.
- Damping resistor to be used with SF02032 :RE 40008 470 Ω 25 W

The use of self dampers for shorter distances can be envisaged to reduce parasite reception, caused by capacitive coupling with power cables.

DSD THREE-PHASE

DSF02

PARVEX

CONNECTING DIAGRAM

FELX 306613GB

SL : LINE SWITCH
KM1 : POWER CONTACTOR
F1 : LINE FUSES (gG)
F2 : AUXILIARY FUSES
AP* : SURGE SUPPRESSOR
FR : MAINS FILTER
At : OFF
MA : ON

Connections valid for:
DSD 2/4A, 4/8A and 8/16A 400V 3Ph
DSD 4/8A and 7,5/15A 230V 3Ph

Terminal block capacity
– B1 to B5 : max 2,5² multi-strand

Terminal block tightening torque
– B1 to B5 : max 0,5 Nm

* The power contactor coil KM1 should necessary have a surge suppressor AP connected.
** For 400V 3Ph version : shielding between filter and servoamplifier required only if appliance is not fitted in a closed cabinet.

To meet the requirements of standard EN 60204 an emergency stop safety block may be inserted in the energising circuit on electric equipment of machinery. It is then strongly recommended to use contactors that are adapted for auto-control and redundancy.

Connection cable between DSD and DSF02
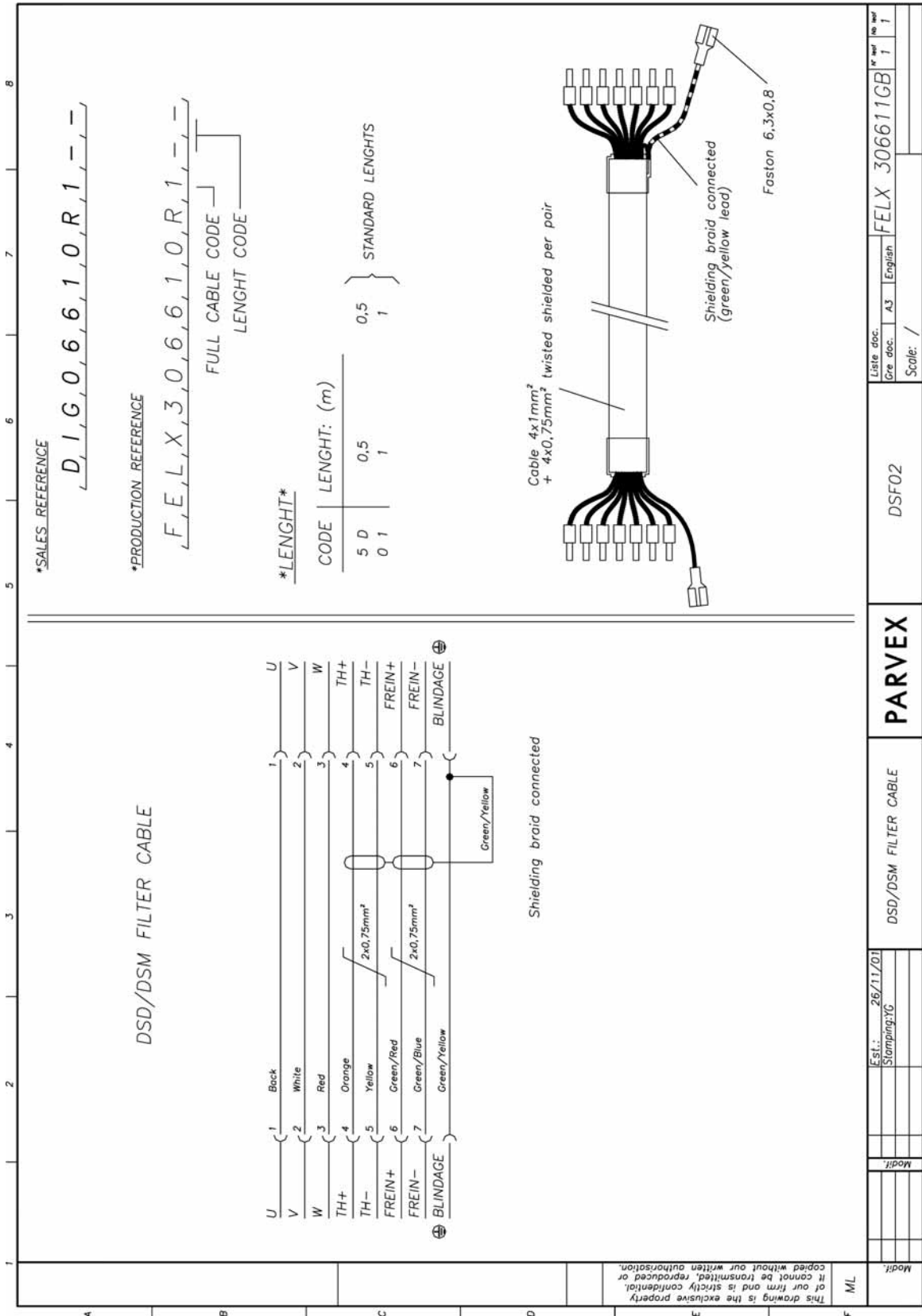
4.5.3 Motor end connection

Power connection

There are two possibilities for connection:

> Terminal block + resolver connector.
> Power connector + resolver connector.

Terminal block connection

For the terminal block, the clamping nuts and washer come in a bag
Take care when fitting the lugs not to loosen the connecting leads between the motor and the terminal block.

The power connection lugs are to be inserted between the striated washer and the flat washer.
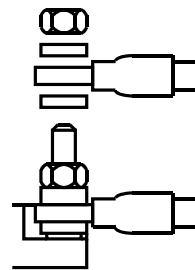
Digpl3.D

Motor direction of rotation: by wiring as recommended, a positive set point applied to the drive entails clockwise rotation (viewed from the power shaft end).
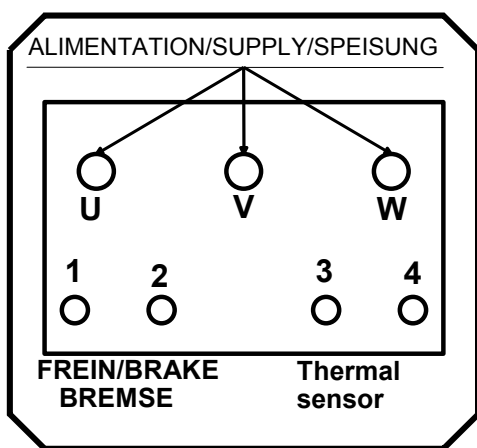
U Phase U

V Phase V

W Phase W

1 Optional brake +24 V   cable $\geq$ 1mm²

2 Optional brake   0 V

3 Thermal sensor   cable $\geq$ 1mm²

4 Thermal sensor

ALIMENTATION/SUPPLY/SPEISUNG

U   V   W

1   2   3   4

FREIN/BRAKE BREMSE   Thermal sensor
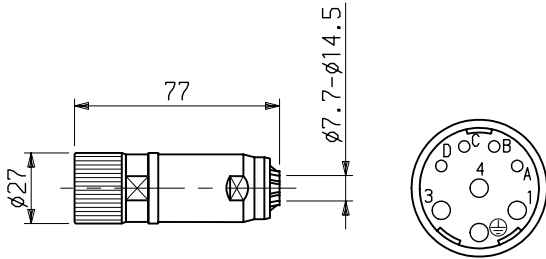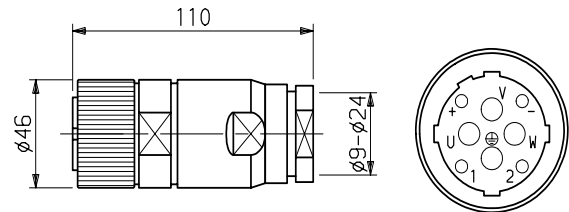
PLUG 220065R1610/1611   PLUG 220065R3610/3611

CABLE CROSS-SECTION FOR PLUGS

PLUG 220065R1610 : power & earth: 0.14 - 1.5 mm². Brake & thermal: 0.14 - 1 mm²
PLUG 220065R1611 : power & earth: 0.75 - 2.5 mm². Brake & thermal: 0.14 - 1 mm²
PLUG 220065R3611 : power & earth: 1.5 - 4 mm². Brake & thermal: 1 - 2.5 mm²
PLUG 220065R3610 : power & earth: 6 - 16 mm². Brake & thermal: 1 - 2.5 mm²

FUNCTION	PLUG PINS		CABLE COLOR
	220065R1610/R1611	220065R3610/R3611	
BRAKE +	A	**+**	Green/Red
BRAKE **-**	B	**-**	Green/Bblue
THERMAL PROTECTION	C	1	Orange
THERMAL PROTECTION	D	2	Yellow
EARTH	2	⏚	Green/Yellow
U$_2$	1	U	Black
V$_2$	4	V	White
W$_2$	3	W	Red
Shielding to be connected to the earth at the servoamplifier end ⏚	-	-	Green/Orange

Holding brake connection

Brushless motors can be equipped with a specially sized brake to maintain the axis immobilized. If 24 V ±10% dc voltage is applied across the brake terminals, the brake disc is free and the motor can rotate.

The 24 V dc supply used for brake control must be regulated and filtered. It is to be connected to terminal block B1. The brake is to be connected to terminals B2/6 and B2/7.

Thermal protection connection

The two terminals of the thermal sensor located in the motor terminal box are to be connected to B2/4 and B2/5.

Motor fan connection

Some motors can be supplied in the fan-cooled version.

Motor fan characteristics:

Supply voltage: 400 V or 230 V three-phase 50/60 Hz.
Power consumption: 45 W
Connection by connector (plug 220056P0200 supplied on request).
When connecting, check the direction of fan rotation and that air actually flows.
The direction of circulation is shown in the dimension drawings.

Connector removable plug

Viewed from F
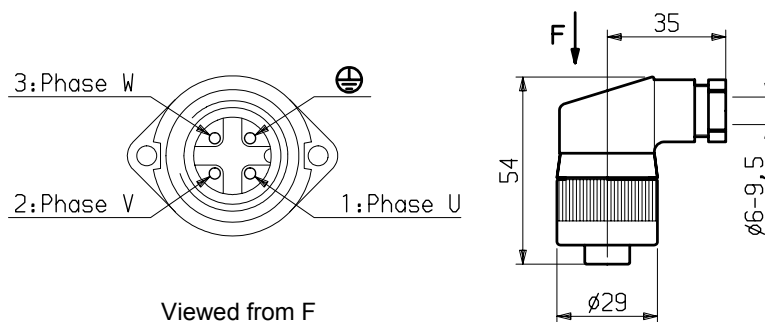
Digpl7.T/dm8.H

4.5.4 <u>Resolver connection</u>

The resolver is a high-precision sensor (±10 angular minutes as standard) which must be wired carefully:

        routed separately from the power cables.

        twisted pairs (sine, cosine, excite) with general shielding. The general shielding must be connected to the metal-plated Sub-D connector cover. Do not connect the shielding at the motor end.

Parvex S.A. can supply this cable in either of two forms:

        Separate cable, in this case wire as in the drawing below.

        Cable fitted with Sub-D plug at the drive end and connector at motor end. This solution is **highly recommended** as the cable is ready for use.

Maximum distance between the resolver and the DIGIVEX SINGLE DRIVE: 200 m (Please ask about greater distances).

Maximum permissible cross-section:

        by the Sub-D connector: 0.5mm².

        by the connector removable plug: 0.14 - 1 mm² (solder- or crimp-fit contacts)

<div align="center">

RESOLVER CONNECTOR REMOVABLE PLUG (motor end connector)
220065R4621 (solder-fit contacts - standard)
220065R1621 (crimp-fit contacts)

</div>

<div align="center">Viewed from F</div>
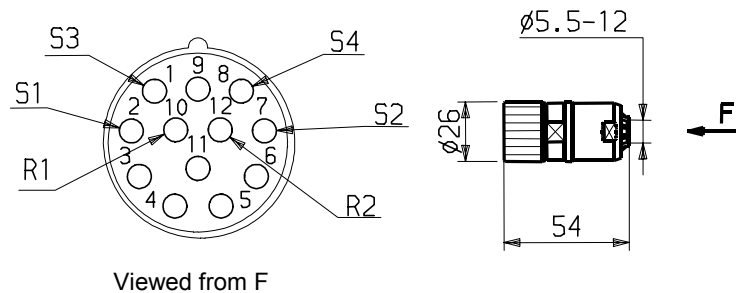
<div align="center">Dm7.H</div>

For XD motors :
Connect by Sub-D connector under rear cover (cable routed through special cable gland).

Please ask for details.

4.5.5 <u>Automatic control Input / Output connection</u>

See functions and characteristics of these inputs / outputs in Section 5.
> Terminal block B5: linked to the main contactor control (OK contacts potential-free).
> Sub-D X2: RS232 link with PC: use a standard 9-pin - RS232 cable - extension.
> Sub-D X2 and X4: use the cable as in drawing FELX 304553 (see § 4.3.2.3).

4.6 Accessories and Tools

4.6.1 <u>Input mains filter:</u>

Dimensions as in drawings FELX 304967 and FELX 305603 (see following pages).

4.6.2 <u>Inductors for long cables</u>

> Between motor and drive. See § 4.5.2 for choice. See FELX 302983 for dimensions (following pages).

4.6.3 <u>External braking resistor</u>

> See drawing FELX 4045237 (next page).

4.6.4 <u>Cables</u>

> Plain cables.
> > ♦ *Resolver cable: 6537P0001*
> > ♦ *Input / Output cable : CB 08304*
> > ♦ *Emulation cable: CB 08307*
> Complete cables (equipped with connectors and/or Sub-D connectors).
> > ♦ *Resolver cable: 220049R61-- (-- = length in metres) 5m/10m/15m/25m/50m.*
> > ♦ *Input / Output cable: FELX 304544R--- (code 1 or 2 and length in metres 3m/5m/10m/15m/20m).*
> > ♦ *Encoder emulation cable: FELX 304546R1--(-- = length in metres) 3m/5m/10m/15m/20m.*
> For the RS232 cable (Sub-D X3), see commercially available cables with 9-pin Sub-D extension.
> Power cable (supplied unequipped or equipped with connector plug).
> See § 4.5.3. connection by connector.

Position	Text	Identification number		Weight
	DIGIVEX	*FELX 404537GB P1*		
	EXTERNAL RESISTOR			

packing gland

4 fastening holes ø6,5

205

(L-110)

L

25

= 136 =

170

Standard N°	Power (W)	R (Ω)	L (mm)
RE 91001	*2000*	*27*	*620*
RE 91002	*4500*	*12*	*1195*

Connection in IP55 sealed terminal box with packing gland.
Weight (kg) : 1 + 9,2L(m)

RE 90020

11

50

4 ø8 holes

98

120

30

222

Pair of wall consoles
Weight : 0,9kG

RECOMMENDATION:
These resistors must be used horizontally, fixed to the ground
or to wall consoles, with nothing liable to impede natural convection.

Service		Drawing	*26/07/95*	*JP*	Stamping					Order of execution		*ML*

Modifications	A	AM:E98026 – 20/02/98 – VR				Scale	Replacing

1

Separate nomenclature of Nbe dif.

Separate nomenclature of same Nbr

PARVEX

DIGIVEX

EXTERNAL RESISTOR

SIZE: A4

Family

LEAF N° 1 Nb 1

FELX 404537GB

MAINS FILTER 3 ph

OUTLINE DIMENSIONS

Uin : 440 Vac 50/60Hz
Ta : 40°C
Norm : EN 133200

* permissible section

121
66
17
34 (3)

135
M6
LOAD
LINE
A
B
115
6.5
151

Pos.	Standard Nr	Current	Dimensions A	B	* Section	Weight
1	FR 03016	16A	241	201	4mm²	3Kg
2	FR 03036	36A	251	201	10mm²	3Kg
3	FR 03064	64A	308	231	25mm²	4Kg

Dimensions in mm

Standard Nr	Max. leakage current (50/60Hz) in mA three-phase operation	unbalanced operation (start-up)
FR 03016	10	30
FR 03036	3	200
FR 03064	3	170

Position | Text | Identification number | Weight
MAINS FILTER 3 ph
OUTLINE DIMENSIONS
FELX 304967GB P.

PARVEX

MAINS FILTER 3 ph
OUTLINE DIMENSIONS

Service	Drawing	26/06/96	LR	Stamping
A	AM:E97016	22/01/97 – LR	D	AM:E98056 – 12/05/98 – VR
B	AM:E97162	20/11/97 – VR	E	AM:E98175 – 09/11/98 – VR
C	AM:E98035	11/03/98 – VR		

Order of execution
Replacing
Separate nomenclature of Nbe dif.
Separate nomenclature of same Nbr
Scale
Family
SIZE A3
LEAF N: 1 N°: 1 Nb: 1
ML
FELX 304967GB

MAINS FILTER 1Ph
OUTLINE DIMENSIONS

FELX 305603GB

PARVEX
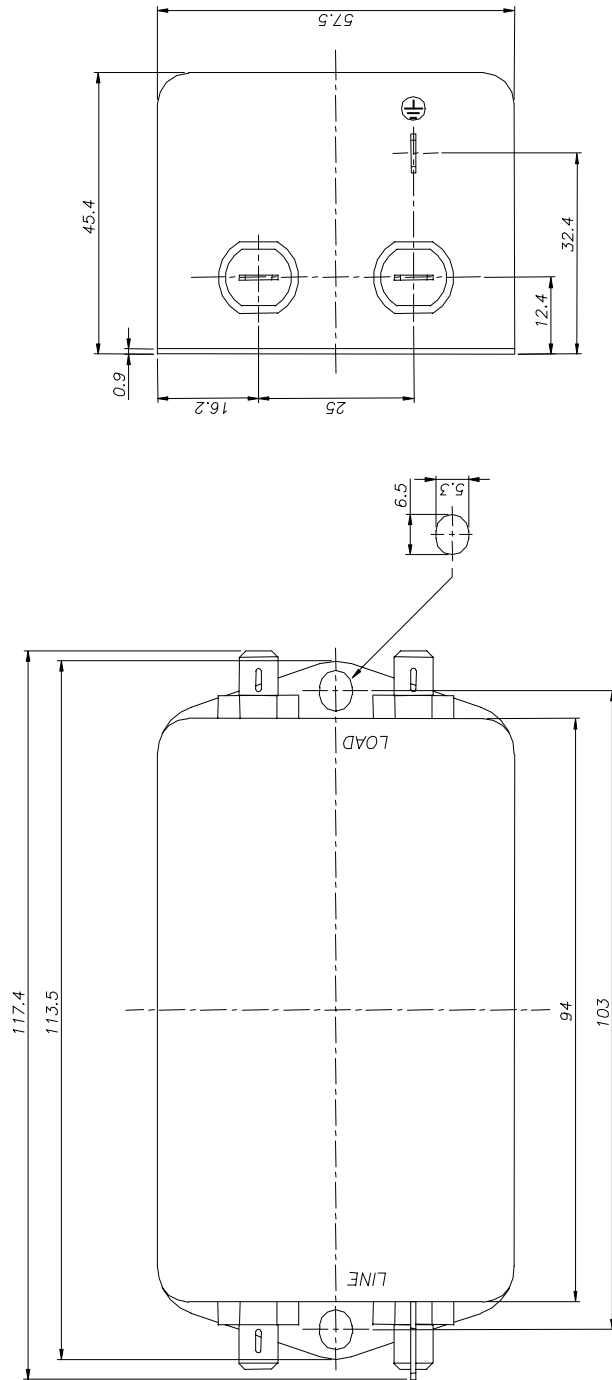
Uin : 110/250Vac 50/60Hz
T : 40°C
Norm : IEC950

CONNECTION FASTON TAB 6,3x0,8

Pos.	Standard Nr	Current	Max. leakage current (50/60Hz) in mA	Weight
1	FR 01006	6A	3	0,420Kg

DIMENSIONS IN mm

MAINS FILTER 1Ph
OUTLINE DIMENSIONS

Uin : 110/250Vac 50/60Hz
T : 40°C
Norm : IEC950

CONNECTION FASTON TAB 6,3x0,8

PARVEX

Pos.	Standard Nr	Current	Max. leakage current (50/60Hz) in mA	Weight
1	FR 01016	16A	3	1Kg

DIMENSIONS IN mm

THREE PHASE CHOKE — DIMENSIONS

Connection area , Dia M

The dimensions are in mm

TERMINAL BLOCK CONNECTION

No Standard	Ct nom.	Choke nom.	Dimensions A	B	C	H	H#	Fixing axb	D	connection area	M	Weight
SF 02025	26A	850uH	150	95	110	/	135	112x80	6	# 6mm2	/	4,5kg
SF 02026	65A	340uH	175	95	95	165	180	53x68	6,5	16x16	6,5	9Kg
SF 02027	118A	190uH	290	116	135	210	/	230x100	8	20x20	9	13Kg
SF 02028	17A	1,3mH	160	95	/	/	115	112x71	6	# 6mm2	/	4,2Kg
SF 02029	91A	245uH	220	135	160	160	/	166x114	6	20x20	9	15Kg
SF 02030	170A	130uH	235	120	165	240	/	185x100	9	25x28	11	19Kg
SF 02032	7,5A	400uH	132	75	85	/	103	94x55	6x10	# 4mm2	/	1,9Kg

PARVEX

THREE PHASE CHOKE
DIMENSIONS

Position — Text: THREE PHASE CHOKE / DIMENSIONS
Identification number: FELX 302983GB

FELX 302983GB

Service	Modifications	Drawing	
A	17/12/92 – AJOUT SF 02032	Drawing	05/02/91
B	24/02/97 – MISE A JOUR		
C	AM:E98035 – 11/03/98 – VR		

Order of execution — Replacing
Separate nomenclature of Nbe dft.
Separate nomenclature of same Nbr
Family — LEAF N° 1 — Nb 1
SIZE A3
ML
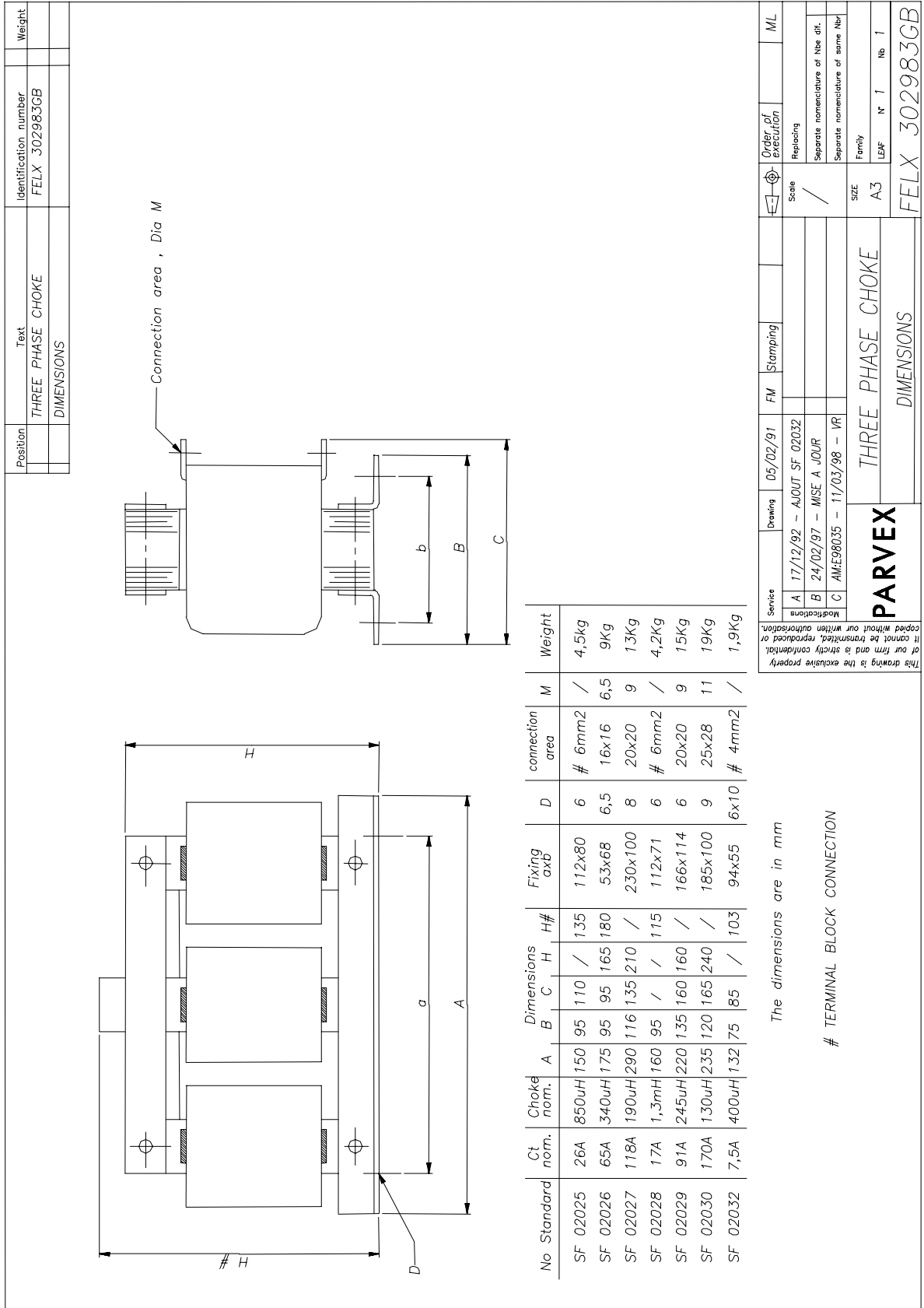
5. AUTOMATIC CONTROL INPUT / OUTPUT FUNCTIONS AND CHARACTERISTICS

5.1 Input / Output Characteristics

Logic inputs

24 V dc optocoupled inputs (isolation voltage 100 V)
type 2 inputs under IEC 1131-2
these inputs may be connected directly to PNP type outputs (no external load resistor required)
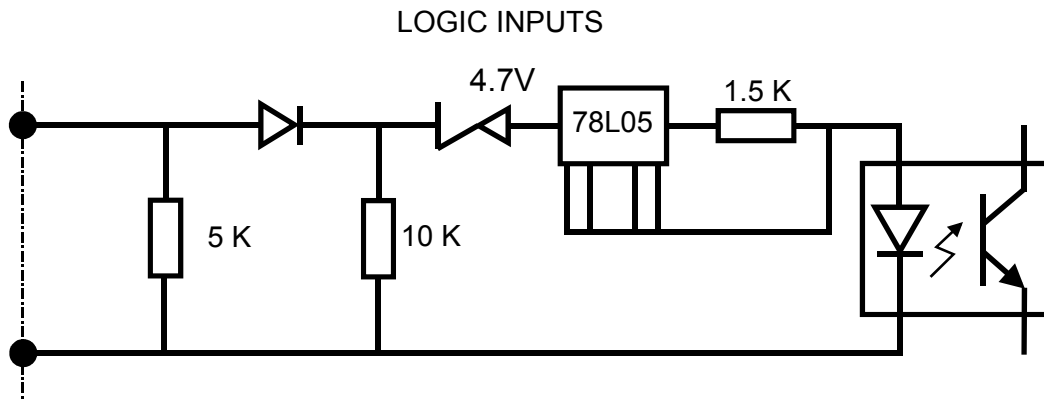
LOGIC INPUTS

	MINI	TYPICAL	MAXI
Level 0 input voltage	-	0V	5V
Level 1 input voltage	11V	24V	30V
Level 0 input current	-	0mA	2mA
Level 1 input current	7mA	13mA	15mA
Ton response time (0 to 1)	-	1 ms	-
Toff response time (1 to 0)	-	1 ms	-

Logic outputs

The outputs are supplied by a 24 V internal supply (isolated 24 V and 0 V and common at terminal 25 and 13 (24 V)). An external 24 V supply must not be connected to the outputs. The three 0V of the outputs and terminal 25 are connected :

Max output current (level 1) : 50 mA
Residual current (level 0) : Negligible
Response time : 1 ms
Voltage drop for I = 50 mA : 2 V

Opto-isolated output (opto-mos), PNP type, the load being for connection to the 0V logic (i.e. between the two contacts allocated to this output).
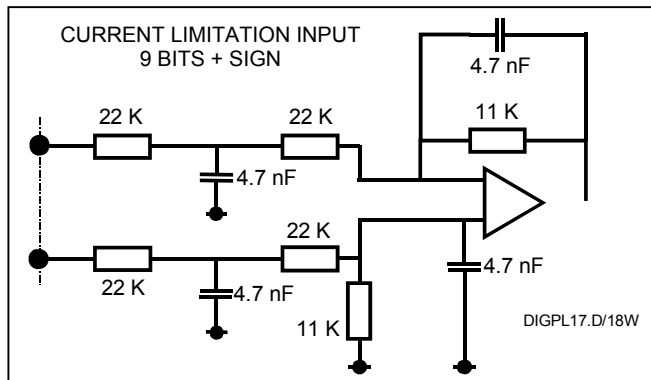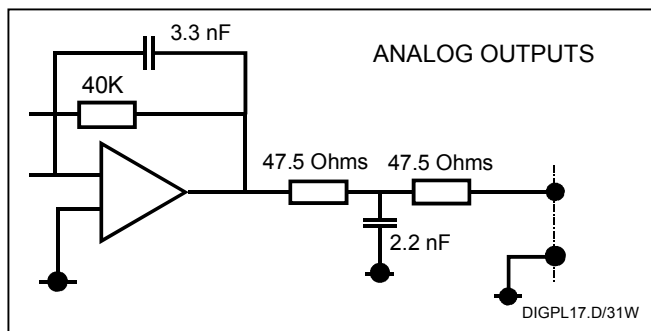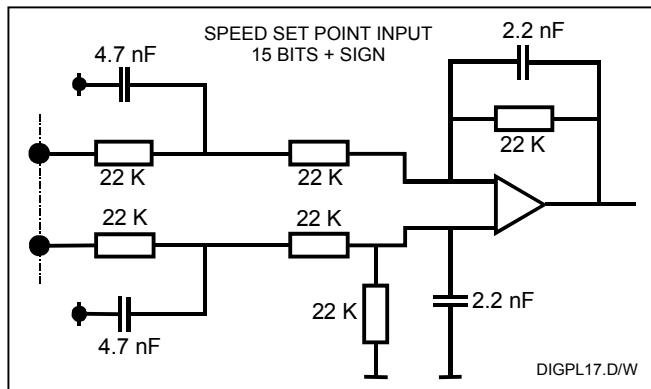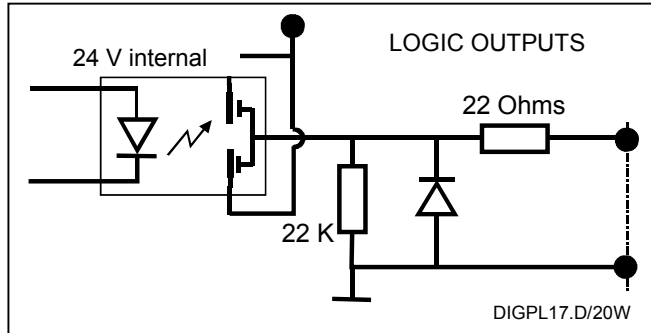
5.2 RESET and Contactor Control

- B5/1   **Reset +**
- B5/2   **Reset -**

A 24 V leading edge applied to B5/1 compared with B5/2 reinitializes the system after power supply or drive failure.
Notice that the system can also be reset by the "reset" button on the front panel or by switching the power supply off completely (power and auxiliaries).
This control has no effect during normal operation. The system must be "reset" after any active fault.

- B5/3 – B5/4 :   **Contact OK**
                    Cut-out power : max voltage 250 Vac, max 1A.
This contact is closed if:

    the power supply is present.
    the drive, low-level and power, indicate no faults.
    the power bus voltage is present.

This contact authorizes the main contactor to self-hold
        the green "POWER ON" LED is on

ATTENTION: Opening the OK contact must cause the main contactor to open with a maximum delay of 100 ms.

Main contactor control

Opening the OK relay causes the main contactor to open. The OK relay opens under the following circumstances:

    No phase.
    Recovery fault.
    Maximum power bus voltage.
    Minimum power bus voltage.
    Drive fault.
    Auxiliary supply fault.
    Maximum mains voltage.

5.3 Initilialization Sequence

After auxiliary power has built up: (approx. 300 ms)

To	$\Leftarrow$ Mains supply present
To + Tc	$\Rightarrow$ capacity precharging internal relay closes and relay "OK"
To + Tc + 500 ms	$\Rightarrow$ INIT. signal

The INIT. (initialization) signal releases the drive.

DSD 230V SINGLE-PHASE

DSD	2/4	4/8	7,5/15
Tc(ms)	150	300	400

DSD 230V THREE-PHASE

DSD	4/8	7,5/15	15/30	30/60	60/100
Tc(ms)	150	150	300	450	600

DSD 400V THREE-PHASE

DSD	2/4	4/8	8/16	16/32	32/64
Tc(ms)	150	150	300	450	600

The "OK" relay closes when the minimum bus voltage transits. Maximum time 100 ms.

5.4 Stop Sequence

5.4.1 <u>Normal stoppage</u>

Normal stoppage is achieved by deliberately opening the main contactor.

To	$\Leftarrow$ contactor opened
To + 10ms	$\Rightarrow$ "POWER OFF" LED comes on
To + 20ms	$\Rightarrow$ OK contact on terminal block B5 opens
To + 20ms + delay	$\Rightarrow$ "DRIVE OK" output of connector X2 goes to 0 after bus discharge
	The discharge time depends on the activity of the drive during this phase.
	The motor continues to be controlled until the output trips. "POWER ON" LED goes off,

5.4.2 <u>Stoppage subsequent to mains supply or braking fault</u>

To	$\Leftarrow$ Fault detected.
To + 20ms	$\Rightarrow$ OK contact of terminal block B5 opens and fault type at power supply end displayed.
	The external plc must then open the main contactor at the latest 100 ms after the OK relay opens.
	Let Tr be the contactor opening delay.
To + 20ms +Tr+delay	$\Rightarrow$ "DRIVE OK" output of X2 socket goes to 0 after bus discharge.
	The discharge time depends on the activity of the drive during this phase.
	The motor continues to be controlled until the output trips. "POWER ON" LED goes off,

5.4.3 <u>Stoppage subsequent to motor drive fault</u>

To	$\Leftarrow$ Fault detected
To + 10ms	$\Rightarrow$ The "FAULT" LED comes on and the "DRIVE OK" output of the X2 socket goes to 0. The motor is no longer controlled.
To + 20ms	$\Rightarrow$ The OK contact of terminal block B5 opens.
	The external automatic control must open the main contactor at the latest 100 ms after "OK" opens.
	After the main contactor opens "POWER OFF" lights up.
To + 20ms + delay	$\Rightarrow$ "POWER ON" LED goes off,

N.B. A mains failure entails the bus dc voltage discharge command two seconds after.

<div style="border: 1px solid black; padding: 20px;">

6. SERVO-CONTROL PARAMETER FUNCTION AND SETTING

</div>

6.1 Servocontrol Parameter Functions

6.1.1 List of parameters

Choice of regulation type:

      Speed   Proportional: P
          $\Rightarrow$ Proportional integral: PI
          $\Rightarrow$ Proportional double integral: PI^2
      Current regulation

In all cases :	**Minimum value**	**Maximum value**
Filtering frequency	20 Hz	800 Hz
Offset	- 1% V max.	+ 1% V max.
Current limitation	0 A	I pulse - drive

For speed regulation (P, PI, PI²)

Maximum speed	100 rpm/min	100 000 rpm /min
Speed for 1 V	10 rpm /min	20 000 rpm /min
Proportional gain	I pulse - drive /156	I pulse - drive x 210
Integration stop	0,1 Hz 1	50 Hz
Speed 1 and Speed 2	48 rpm /min $<$ Speed 1 $<$ Speed 2 $<$ Max speed	
Predictors (gravity, dry or dynamic friction, acceleration).		

6.1.2 Regulation selection: current, proportional, PI, PI²

Current regulation

Choosing "current" means current can be controlled directly (therefore the motor torque through the torque coefficient Kt). This then gives 10 V = pulse peak current of the drive selected beforehand.

In this mode, PI/PI^2 settings and predictors are neutralized. The only functions operative are:

      Current limitation (often reduced below the permanent drive current, so as not to trip in mean or rms values.

      The second order low pass filter (filtering frequency), for reducing the effect of any resonance.

Choosing P

The drive is used in a speed loop with purely proportional gain. This gain is the ratio between the output current and the speed error. It is expressed in mA / rpm.
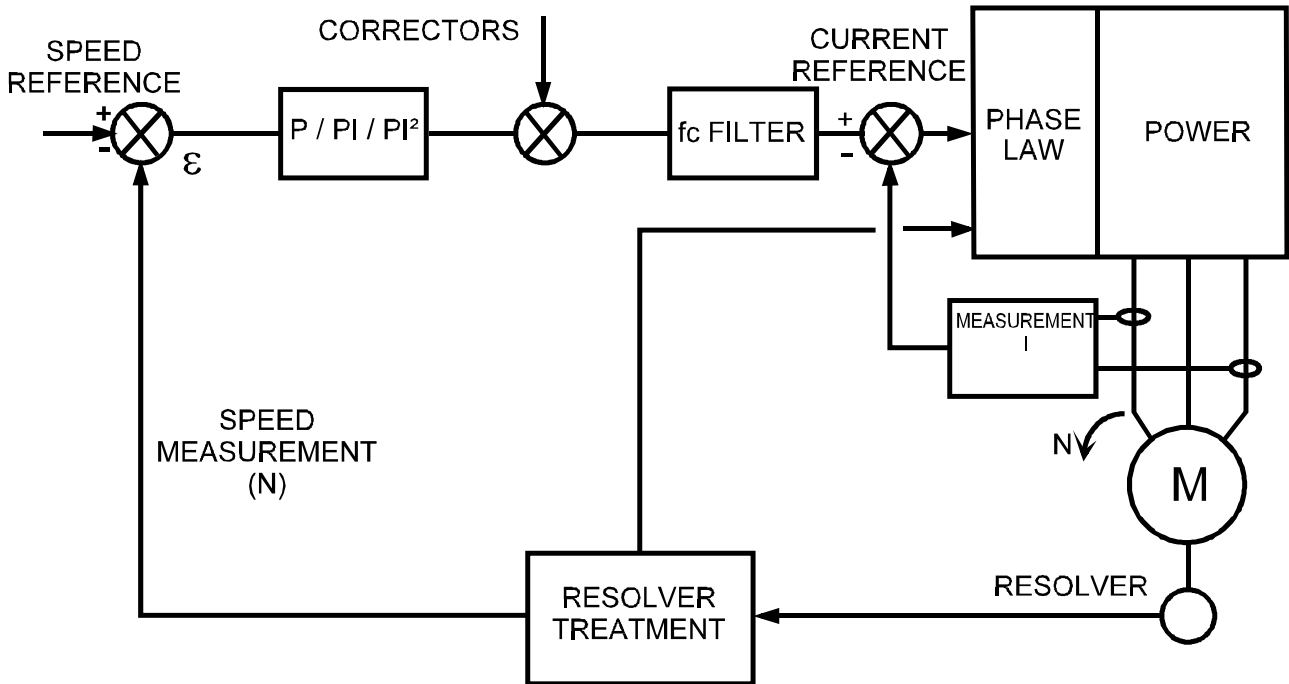
For the same current I, if the gain increases, the error ε is reduced, the rapidity of the system increases as does its bandwidth.

An increase in gain may lead to instability because of the other components in the loop (resonances, second order filter).

The use of proportional action P alone has the drawback of giving zero rigidity because there is no integration ahead of the current section.
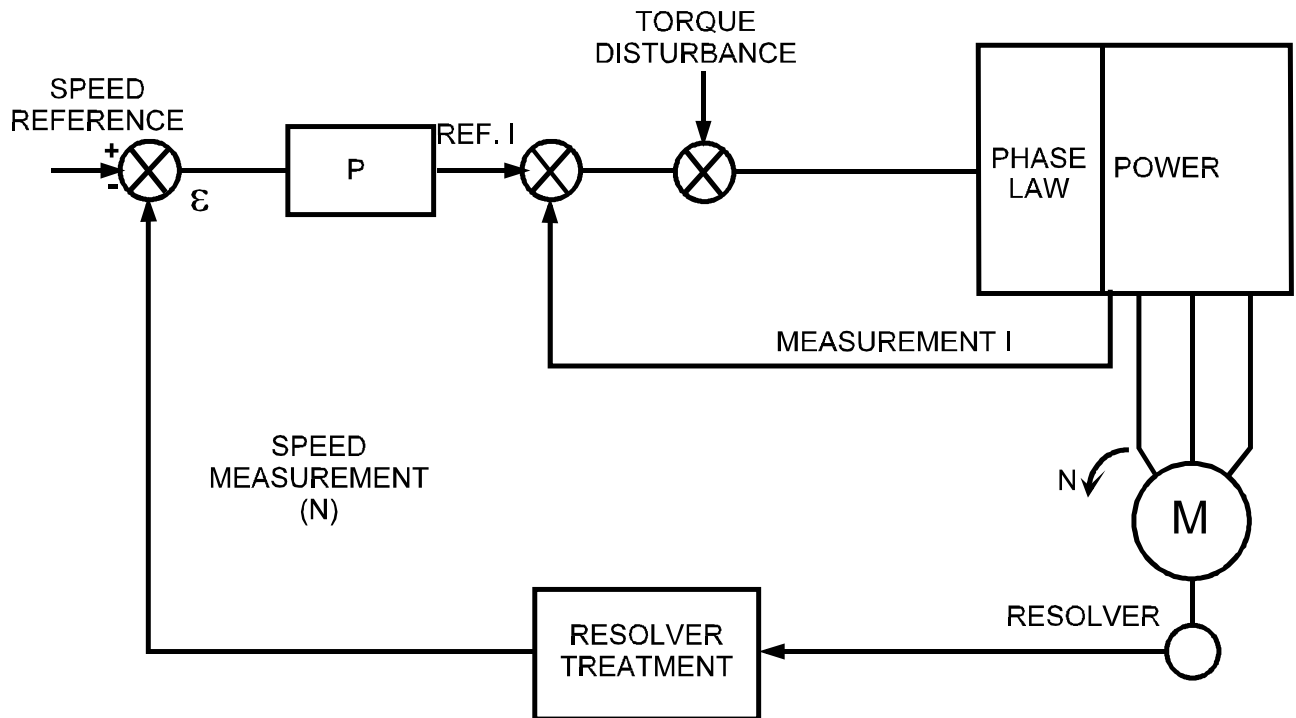
Choosing PI (proportional and integral action)

Compared with P action alone, PI provides the following two modifications:

> The gain (open loop) at zero frequency is infinite. If there is a torque surge, there will be an angular discrepancy of the motor shaft compared with the state at rest. This angle will be proportional to the torque applied and there will not be any permanent speed drift. The system can be said to be "rigid". This rigidity is strictly proportional to the integration stop frequency.

> The proportional gain P sets the bandwidth f_0 (system rapidity). The integral action entails -90° phase shift, which creates instability. This phase shift is not troublesome at low frequencies, but may make the system unstable at higher frequencies. It is therefore best to adjust the "integral stop frequency" correctly (0.2 - 0.3 times the bandwidth f_0).

Choosing PI^2 action (proportional and double integration)

Compared with P action alone, PI^2 provides the following two modifications:

Rigidity when stopped is infinite. When motor torque surges and after a transient period, the motor shaft returns to the position it was in at rest (there is no longer any permanent position discrepancy).

The double integral action entails a -180° phase shift at low frequencies. Poor adjustment of the integral stop frequency may entail instability in the system. Restrict to 0.1 to 0.2 times the bandwidth f_0.

6.1.3 <u>Integration stoppage</u>

See the previous paragraph for the function of this parameter. Below is its definition after the Bode graphs only (gain / frequency and phase / frequency).

Dipl17.D/34.W
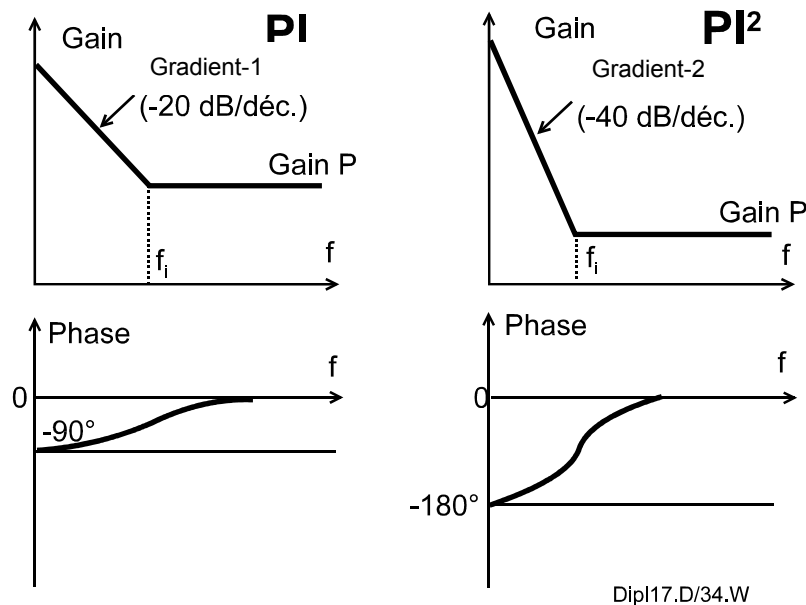
6.1.4 <u>Speed scaling</u>

The choice of motor - drive assembly determines a maximum possible speed. The "Maximum" speed parameter can be used to reduce this maximum speed for the application. This parameter is external to the speed loop and modifying it does not modify gain.
The "Speed for 1 Volt" parameter determines the speed "gradient" (e.g. maximum speed can be obtained for 10 V, 9 V or 7 V, depending on the positioning control).

6.1.5 <u>Filtering frequency</u>

Resonance phenomenon

Many systems have one or more resonance frequencies related most of the time to mechanical phenomena: inertia or mass, associated with the rigidity of the mechanical components (belts, screws, reducing gear, frames, etc.).

In a zone of reduced frequency around the resonance frequency, there occur:
   Marked variations in loop gain.
   Marked variations in the closed loop phase.
This leads to instabilities or "squeaking", with more or less violent oscillation.

Second order filter

This phenomenon cannot be dealth with by P/PI/PI^2 adjustment. If the resonance cannot be dealt with mechanically, the frequencies concerned must be eliminated. This is the function of the second order low pass filter.

Diggb17.D/pl35.W
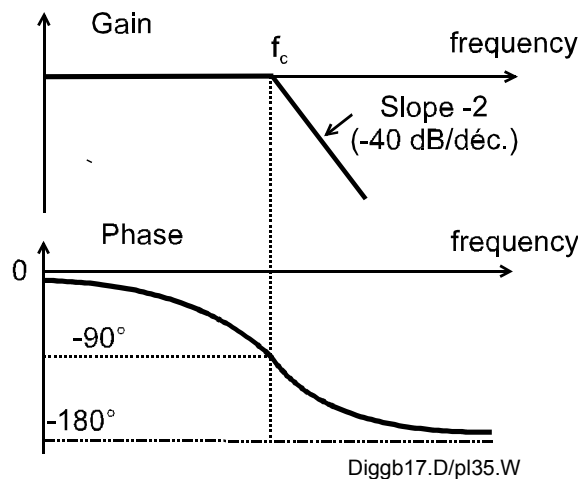
6.1.6 <u>Predictors</u>

Purpose of predictors

Four physical phenomena:

   Vertical mass.
   Dry friction
   Friction proportional to speed.
   Acceleration.

Are direct and calculable causes of modification of motor torque.

The purpose of the predictors is, by calculation, to act directly on the current set point, without recourse to the speed loop and without waiting for the speed error produced by these phenomena (see block diagram).

The principle of predictor setting and work is to minimize the current set point part from the P, PI, PI^2 branch and therefore to reduce the speed error.

As these predictors are outside the speed loop (which must be adjusted first), they do not affect stability. They provide an appreciable improvement on response time.

The acceleration predictor improves stability and allows gain to be increased in any position loop superimposed on the speed loop.

However, it should be noticed that many speed servocontrols do not require the use of these predictors.

General characteristics of each predictor

Mass or gravity compensation (vertical axis)

The current value, in amps, required by the motor to move the mass at constant speed (average between up and down) is introduced directly into the parameter.

Dry or "static" friction

The friction force is fixed, whatever the speed. Its direction is opposed to motion, the sign therefore depends on the speed set point sign.

In this case too, the values are entered directly in amps, for the required motor current to overcome friction.

The "threshold" expressed in rpm defines a speed "band" within which this compensation is zero.
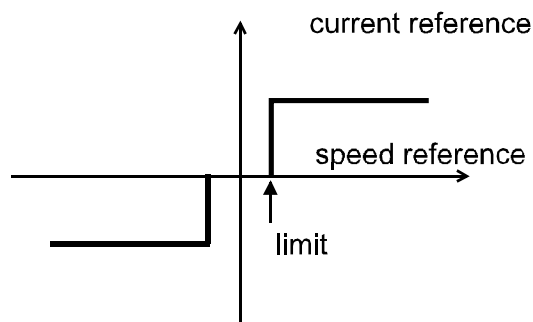
Dipl17gb.D/pl36.W

The threshold is of the order of 1/1000th of maximum speed. This zone allows torque oscillation to be reduced during rapid and repeated changes of the speed sign. This is the case, in particular, at rest when there is a position loop.

"Dynamic" friction compensation

Friction proportional to speed, encountered on some mechanical components using fluids.

Value to enter: coefficient in amps / rpm.

Acceleration prediction

Depending on the total inertia (load and motor rotor) and on the desired acceleration, the torque necessary is equal to: $C = \Sigma J \cdot d\omega / dt$.

The set point is monitored therefore in order to send a set point that is proportional to inertia (fixed) and to acceleration to the current control. This is one of the limits of the system; there is no point in having a variation in the speed set point that is greater than the maximum possible acceleration of the motor, given by $d\omega / dt$ = peak torque $/ \Sigma J$. Acceleration prediction is only useful if there is a ramp on the speed reference.

The parameter used is t_{pr}, prediction time, in milliseconds; t_{pr} can vary between:

0 ms (no prediction)
t = td, start up time from 0 to maximum speed, with full drive current. There is then 100% correction.

6.2 Inputting Parameters

Customisation parameters for the motor-drive unit are introduced at start up using a PC under Windows via the Digivex PC software (see brochure PVD 3483 DIGIVEX P.C SOFTWARE).

They may be read and in part altered via the display/parameter setting terminal.

The characterization is safeguarded in an EEPROM store mounted on a plug-in sub-print. This store can therefore be transferred from one drive to another of the same calibre.

Transfer of data from this EEPROM to a servoamplifier of different rating generates a fault. The parameters stored in the EEPROM are retained.

Customization unit reference : SZ6608
With a short circuit on J_O for spindle motors
With an open circuit on J_O for axis motors
Label :
Motor name
Speed reference value
Adjustment number.

6.3 Setting with Digivex PC Software

6.3.1 Outline

```
┌─────────────────────────────────────────┐
│     SELECT MOTOR/DRIVE COMBINATION       │
└─────────────────────────────────────────┘
                    │
┌─────────────────────────────────────────┐
│        SELECT TYPE OF REGULATION         │
│   CURRENT              SPEED (P/PI/PI≤)   │
└─────────────────────────────────────────┘
        │                       │
┌──────────────────┐   ┌─────────────────────┐
│ CURRENT LIMITATION,│  │  POSSIBLE SETTINGS   │
│ SECOND ORDER       │  │ Max. Speed, Current  │
│ FILTER, fc         │  │ limitation,          │
│                    │  │ Speed for 1 Volt     │
└──────────────────┘   └─────────────────────┘
        │                       │
┌──────────────────┐   ┌─────────────────────┐
│   NO PREDICTOR     │  │ FILTER fc & PROPORTIONAL│
│                    │  │ GAIN P ADJUSTMENT    │
│                    │  │ (suppress resonance) │
└──────────────────┘   └─────────────────────┘
                               │
                    ┌─────────────────────┐
                    │    ENTER PI OR PI≤    │
                    │ Set integral stop     │
                    │ frequency             │
                    └─────────────────────┘
                               │
                    ┌─────────────────────┐
                    │ GRAVITY AND DRY FRICTION│
                    │     PREDICTORS       │
                    └─────────────────────┘
                               │
                    ┌─────────────────────┐
                    │ DYNAMIC FRICTION AND │
                    │ ACCELERATION PREDICTORS│
                    └─────────────────────┘
```

6.3.2 <u>Parameter setting tools</u>

Without PC software or hand help terminal

There is no access to any setting modifications. The two variables usually assigned to the two analog outputs can be displayed only on a standard oscilloscope:

- ♦ Number 1 output: speed measurement.
- ♦ Number 2 output: current set point.

With the hand help terminal, without PC software

If the system allows complete access (level 2), the hand help terminal provides access to the servo-control parameters (regulation type, gain, etc.). They can be displayed in two ways:

- ♦ Either by direct read-off from the LCD screen of:
  - ▪ Input set point
  - ▪ Current set point
  - ▪ Bus voltage
  - ▪ Temperature
  - ▪ Speed measurement

- ♦ Or by assigning two of five internal variables:
  - ▪ Input set point in rpm
  - ▪ Speed measurement in rpm
  - ▪ Current set point in Amps
  - ▪ Bus voltage in Volts
  - ▪ Position in degrees
  to the two analog outputs, and using an external oscilloscope.

If at level 1, it is possible only to modify the gain already in place (ratio 0.7 to 1.4), speed for a set point of 10V (±10% unless already at maximum speed) and offset (±1%).

With the Digivex PC software

Three tools are accessible:

- ♦ Speed set point generation (fixed, scale, sine wave) with adjustable amplitude, frequency and mean value.
- ♦ Oscilloscope function, for displaying and recording the response curves of any two of the accessible internal variables.
- ♦ Adjustment procedure which allows, using the two functions above ("parameter" window open) to make adjustments (except predictors) from the response at one scale.

Accessible internal variables (via Digivex PC software or hand help terminal)
The following internal variables may be selected:

DIGIVEX DRIVE SOFTWARE BLOCK
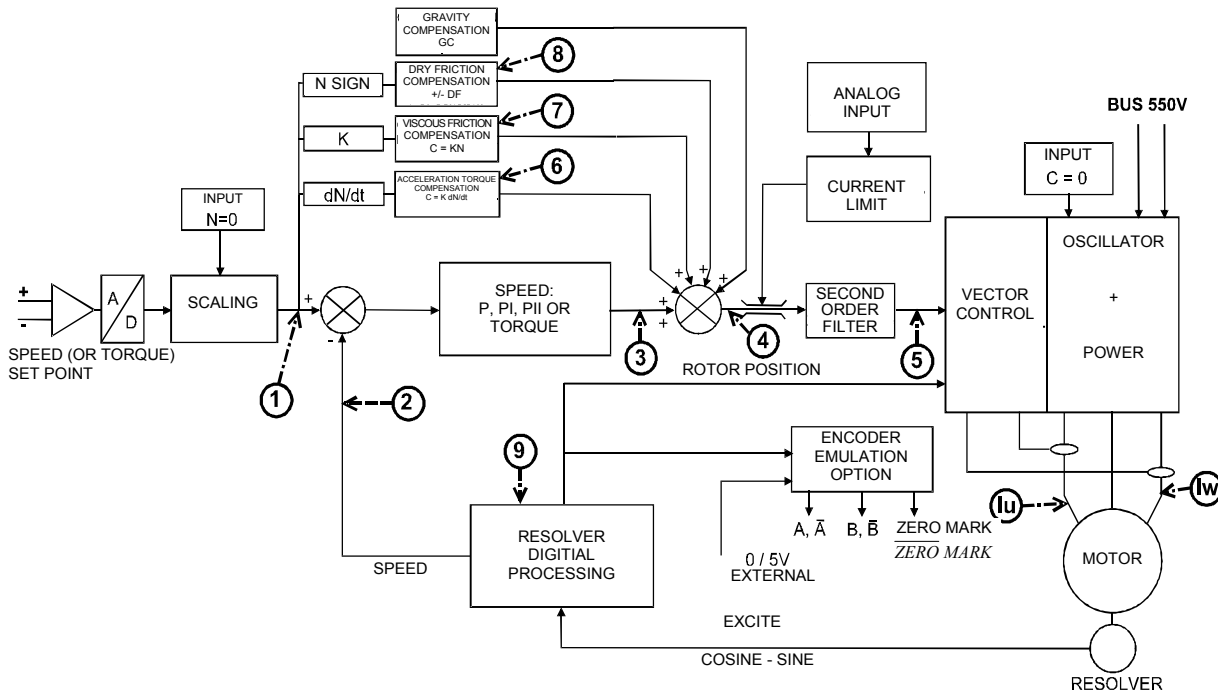
Digbl1.Ds4/W

Reference

- ♦ 1   Input set point in rpm
- ♦ 2   Speed measurement in rpm
- ♦ 3   P, PI, PI^2 output in Amps
- ♦ 4   Sum in Amps
- ♦ 5   Current set point in Amps
- ♦ 6   Acceleration in ms
- ♦ 7   Viscous friction in Amps
- ♦ 8   Dry friction in Amps
- ♦ 9   Position in degrees
- ♦ Iu   Phase current U in Amps
- ♦ Iw   Phase current W in Amps

The two selected variables may be chosen :

either in interactive mode, by positioning on the points of the diagram the "2 probe tips" available
or from the list proposed in the "TOOLS - OSCILLOSCOPE" table. Access via the name of the variables. This is valid for the variables: the eleven above plus the following :

- ♦ Temperature in degrees centigrade
- ♦ Bus voltage in Volts
- ♦ I Active current in Amps
- ♦ I Reactive current in Amps
- ♦ Id current in Amps
- ♦ Iq current in Amps
- ♦ Ud voltage in Volts
- ♦ Uq voltage in Volts
- ♦ Auxiliary input in Volts
- ♦ Low frequency generation

It should be noticed that these variables can be assigned to the two analog outputs, which means a separate oscilloscope can be used.

6.3.3 Parameter access conditions with Digivex PC software

Access level

Level 1, always accessible, can be used to modify:

- ♦ Proportional gain in the limited proportions (0.7 to 1.4).
- ♦ Speed for a set point of 10V (±10%, unless already at maximum speed).
- ♦ Offset adjustment (±1%).

It can also be used for measuring all the parameters.

Level 2, accessible by entering a code, this level can be used to modify all the parameters required for the application.

These levels are valid whether "on line" or "off line" with the PC software or with the hand help terminal.

Working "off line"

If access can be gained to level 2 and the PC software is being used, complete parameter files can be prepared "off line": motor choice, servo-control parameters, work on inputs and outputs, etc. This is data processing work on files (File Menu, Open, Save as, etc.).

Working "on line" (access to level 2)

In this mode, there is an RS232 serial link connection between the PC and its software and the Digivex Single Drive drive.

To go "on line"

♦ Check, via File + serial link Set-up, that the PC set-up is compatible with the drive (9600 bauds / 8 data bits / no parity / 1 stop bit).
♦ Call up "Connect".

To go back "off line"

♦ Call up "Disconnect".

When going "on line" all the parameters in the drive are copied to the PC. Any parameter modified by the PC will be copied in the drive.

The "on line" mode has the following particularities:

Parameters concerning the resolver cannot be modified.
Servo-control parameters can only be modified by the + or - keys, the numerical values cannot be keyed in directly.
To send a complete parameter file via the serial link (first time loading, copying from one drive to another).
Torque is set to zero (T = 0) via the software at the time of transfer and stays there. It must then be set to software "1" or on the "connector" (see Digivex PC software instructions PVD 3483F).
The drive checks compatibility with the drive rating. It may then refuse the file.

6.3.4 Entering parameters via Digivex PC software

See Digivex PC software instructions PVD 3483 F:

Choice of rating
Choice of motor (standard or special)
Choice of resolver
Entering servo-control parameters (global transfer)
Assigning inputs / outputs and variables
Use of the oscilloscope function
Two parameters set : "extended parameter set" option

6.3.5 Setting loop parameters for speed regulation

This can be done by using the "Setting Assistant" menu or directly with the stimuli and oscilloscope.

Speed for 1 V and maximum speed
The maximum possible speed is set when the motor - drive choice is made.

It can be reduced only here :

> Choose a "dc" stimulus of, say, 1 volt.
> By "drive status" (in the COMMANDS menu) or by the oscilloscope function, check the value obtained for the "speed measurement in rpm" variable.

Proportional gain adjustment

Initial status

> Switch to proportional gain P alone.
> Filtering frequency fc to maximum (800 Hz) and low gain.
> System ready to run, no predictor.

Proportional gain and filter frequency are adjusted simultaneously. If, by increasing proportional gain, the system starts to resonate, the resonance must be eliminated by reducing the filter frequency, then increasing P, etc. until a compromise is found.

Maximum recommended for P.

There is a maximum advisable proportional gain, depending on the drive rating, and corresponding to maximum current oscillation.

RATING	P In mA/ rpm
2/4	35
4/8	75
7,5/15 ou 8/16	150
15/30 ou 16/32	300
30/60 ou 32/64	600
60/100	1200

N.B. This gain may be exceeded under certain circumstances. Please ask for details.

Generate a speed set point scale (0.5 to 1 V).

Use the oscilloscope function to display
> Channel 1 $\Rightarrow$ the input set point
> Channel 2 $\Rightarrow$ the speed measurement
> Trigger on channel 1 at 1 or 2 percent of N max, leading edge.

Increase gain P

The stimulus is excited on line. The response is collected at one scale of speed set point.

There are three possibilities :

Non oscillating response

Dipl43gb.D/W
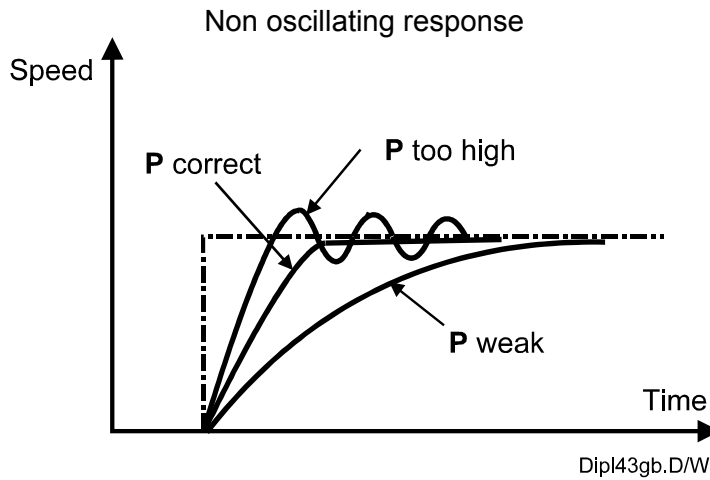
A response must be obtained without overshooting and oscillation. For example, increase gain until oscillations gradually appear, then reduce it by 20 to 30%.

If the maximum value shown in the table is reached with P gain, without reducing the filtering frequency, then:

Stop increasing P
Reduce the filtering frequency until the limit of oscillation

Filtering frequency setting

Oscillations may appear on the response obtained above (even when speed is increasing).

Response with pseudo-oscillation

Dipl43gb.D/44.W
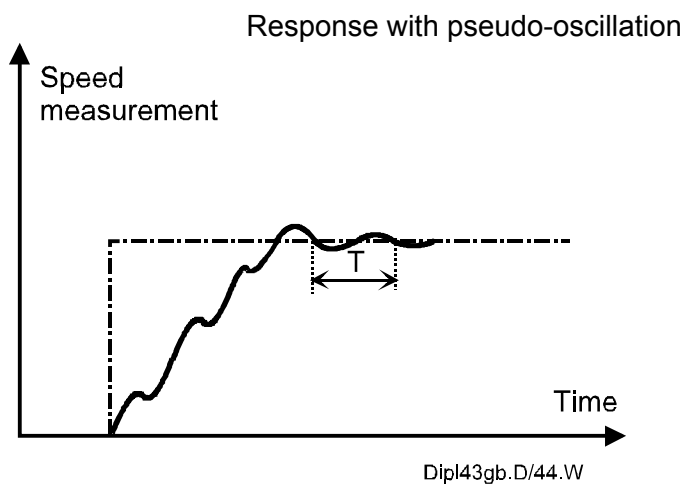
This gives frequency resonance (probably mechanical origin) fr = 1/T, greater than 100 Hz.

Then reduce the filtering frequency until the oscillation disappears almost completely. If that cannot be done, the maximum gain is reached.

If possible, gain can be increased again until a response is obtained without oscillation. Oscillation may reappear. Reduce the filtering frequency a little more.

Notice that it is essentially P and filtering frequency that determine the bandwidth.

If the resonance frequency is too low, adjust the filter frequency to a high value.

PI/PI2 - integral stop frequency setting

Initial status

P gain alone. P and filtering frequency setting completed.
Integration stop frequency = 0.
Still no integration.
System ready to run.

♦ Select PI or PI².
♦ Use the same stimulus as before (index analysis).
♦ "On line", increase the integration stop frequency until overshoot is obtained in the order of:

▪ 25 - 30% in PI
▪ 15 - 20% in PI²

Without oscillation.

If the frequency is too high, fairly low frequency oscillations occur (< 50 Hz). Frequency must then be reduced (never readjust P gain).

Dipl43gb.D/45W

Dipl43gb.D/46W
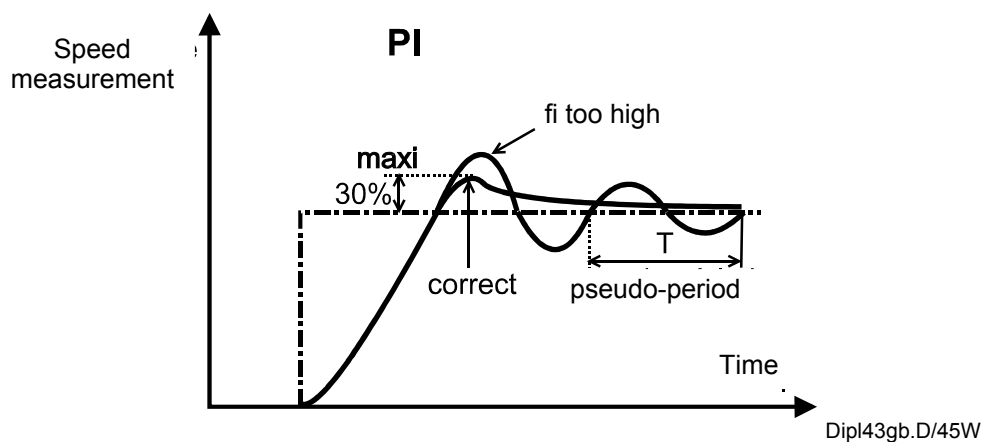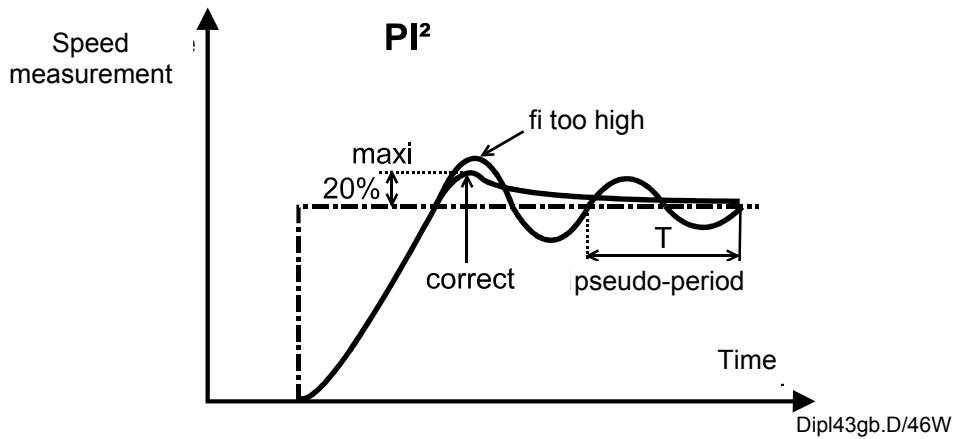
Do not change PI to PI^2 without setting the integral frequency to 0.

6.3.6 <u>Setting predictors</u>

Initial conditions

All loop parameters (P, integral and filtering frequency, max. speed, current limitation) are set (without predictors).
The system is ready to run.

Setting the Gravity and Static Friction predictors

Notice that the gravity factor is zero for a horizontal axis.

Take a square stimulus, offset = 0, peak to peak value = 3 to 5% of maximum speed in rpm, frequency 0.2 to 1 Hz.
Display on the oscilloscope function:

- ♦ The input set point,
- ♦ The current set point.
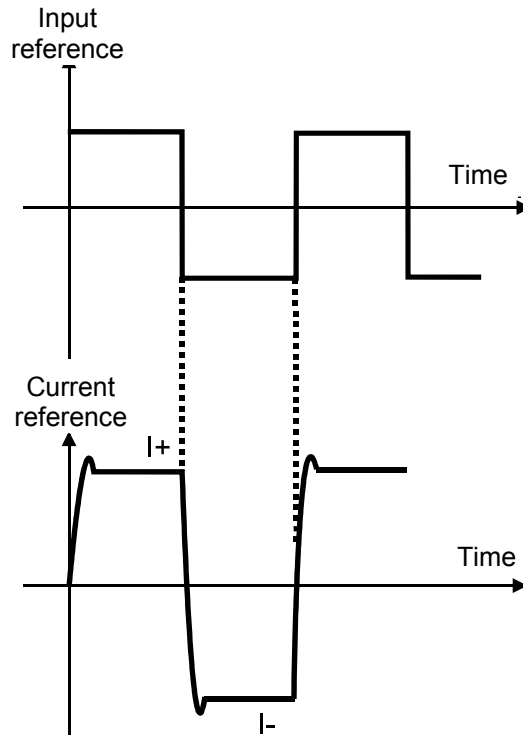
Diggb43.D/47W

N.B. I+ and I- are to be taken with their sign. In general I- is negative.
In principle:

Gravity = $\dfrac{I_+ + I_-}{2}$ in Amps (horizontal motion, gravity = 0).

Static friction = $\dfrac{I_+ - I_-}{2}$ in Amps.

Enter these values into the parameters.
Enter the threshold value (e.g. threshold = max. speed / 1000).
After introducing the values, the result obtained can be checked with the same stimulus.
Check the input set point on one channel and the P, PI, PI^2 output on the other channel.
This should give a result close to:
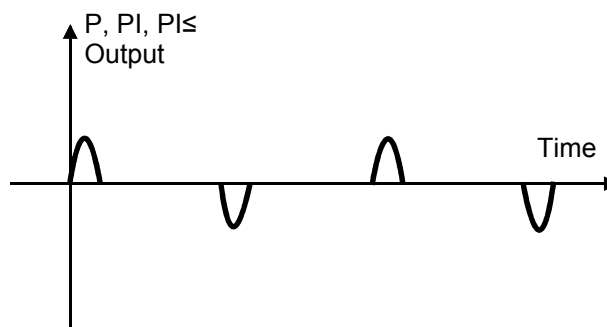
Dipl43gb.D/49W

Setting the dynamic friction and acceleration parameters. (It is assumed that the dry friction and gravity predictors have been set).

Use a sine stimulus, offset 0, peak to peak value 10 to 20% of maximum speed, frequency 0.2 to 1 Hz.
Use the oscilloscope function to display:

♦ The input set point on one channel.
♦ P, PI, PI² output on the other channel.

Acceleration predictor setting. Increase the predictor until P, PI, PI^2 output is minimized. Too high a value increases P, PI, PI^2 with a phase change

DIGPL43.DW9.W
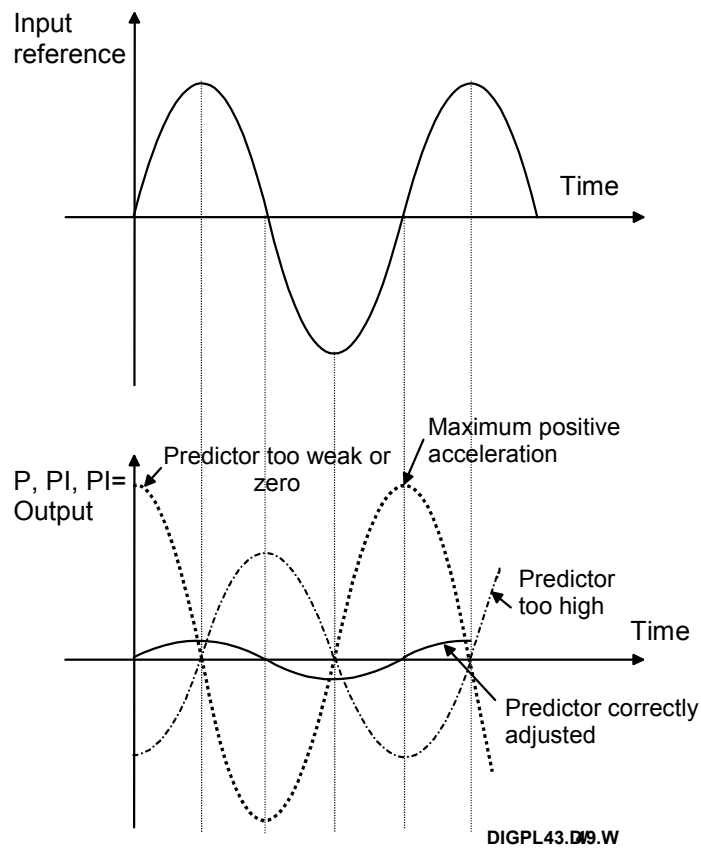
Very marked difference between optimum setting and no predictor

The correct setting corresponds to minimum amplitude P, PI, PI^2 output. The predictor must allow the P, PI, PI^2 output to be reduced in a ratio of at least 5 to 10.

Remember that the value of t_{pr} (prediction time) (in ms) is close to td (start up time) with:

$$td = \frac{(\text{Load inertia} + \text{motor inertia}) . \omega \max}{\text{Max torque}}$$

td is the acceleration time from 0 to maximum speed with maximum torque,
td in seconds, inertia in kgm^2, max. ω in rd/s, torque in Nm

Setting the dynamic friction predictor. Once all the other predictors have been adjusted, increase the dynamic predictor to minimize the P, PI, PI² output signal.

When the setting is correct, this output should be minimum and in phase with the input set point.

DIGPL43.D/50.W
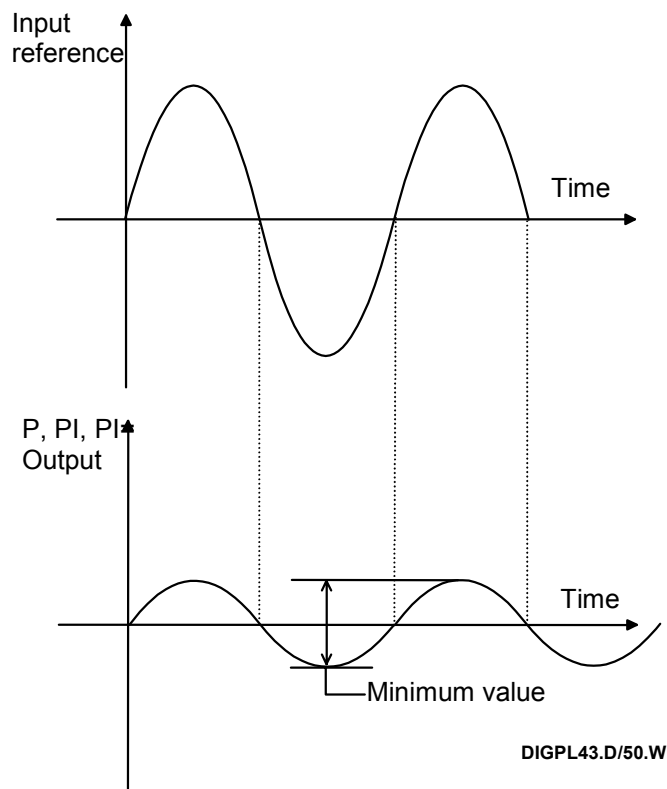
6.3.7 <u>Setting current regulation parameters</u>

If the "current" option has been chosen, the only adjustments needed are:

> Current limitation; take care in this type of application that it does not trip with mean or rms current monitoring. Current limitation is often equal to permanent current.
> Second order filter frequency. This can only be done with the "superior" regulation loop giving the current set point.

6.3.8 <u>Other characterization parameters</u>

Logic and analog inputs / outputs

Access either via the menus (CONTROLS + FORCED INPUTS) or (CONTROLS + OUTPUT ASSIGNMENT), or in interactive mode by clicking on I/O on the left of the block diagram. This makes it possible:

> To assign one of the internal variables to each of the two 10 V analog outputs.
> To force the logic inputs to 0 or 1.

The logic inputs / outputs are assigned permanently.

Encoder emulation option

> Choice of number of marks between 1 and 16384 per turn (off line).
> Validating by teaching of zero mark position (on line).

Miscellaneous choices

> Choice of processing strategy for monitoring of mean or rms currents: current reduction or power opening (see § 6.2.2.1 and Digivex PC software instructions - PVD 3483F).
> Choice of brake use strategy: current reduction or not in the event of brake closure (see Digivex PC software instructions - PVD 3483F).
> Choice of user strategy for thermal protection of motor (with or without thermal protection).

7. COMMISSIONING - SERVO-CONTROL PARAMETER SETTING - DETECTING REASONS FOR STOPPAGE

7.1 Start-up Sequence

7.1.1 Preliminary checks

Wiring check

Power and auxiliary connections to Digivex Single Drive.
Reset wiring.
External 24 V supply for brake.
Check the resolver connections.
- ♦ Motor end
- ♦ DIGIVEX Single Drive end

Check the power, brake and thermal connections.
- ♦ Motor end
- ♦ DIGIVEX Single Drive end

Supply type check

Power: 50/60 Hz, 230 V single or three-phase, 400 V three-phase depending on model.
Auxiliaries: single-phase 50/60 Hz, 230 V or 400 V depending on model.
Brake supply: 24 V dc ±10% (including oscillation).

Caution: Before doing any work on the system, make sure the power bus is at 0 V. Wait at least three minutes after the motors have come to a complete stop before starting work. **Wait until all the LEDs have gone out.**

7.1.2 Commissioning with Digivex PC software or the hand help terminal

Remove terminal block B5 from the DIGIVEX SINGLE DRIVE so as not to supply power. This inhibits the self-hold of the main contactor.
Connect the PC via the RS232 serial link.
Energize the auxiliary parts (low levels) alone; this is possible only if the single-phase auxiliary supply is taken ahead of the main contactor. The "POWER OFF" LED of the Digivex Single Drive supply comes on.
Use the PC (Connect menu) to come "on line". If this connection is not made:
- ♦ Check the serial link set-up is compatible.
- ♦ Check the serial link cable.

Once "on line" all the parameters in the Digivex Single Drive can be read.

Check with the PC or console that there are no faults (menu CONTROLS + INCIDENT). If there is no access for modification (level 1), read the parameters in the drive and check they conform with the problem: motor type, maximum speed, etc.

Check the CW/CCN/T input status.

If there is access to the change (level 2) set up the drive. This can be done "off line" in a file and then transferred or modified "on line".

♦ Choice of motor.
♦ Choice of servo-control parameters (without the power part, their validity cannot be checked).
♦ Ancillary checks: validate brakes, analog outputs, safety strategy, etc...

Refit terminal block B5 (OK relay).

Use the software to force the drive to zero torque.

Turn on the power. Normally the "POWER on" LED lights.

Remove the "zero torque" lock by software or by hardware contact (set "T=0" input to 24 V), the drive releases the brake (if the motor is fitted with one and if a brake has been declared by software).

Using the stimuli (PC software or console) or the setting assistant (PC) carry out the system setting.

♦ "dc" stimuli (square with peak-to-peak = 0). Check max. N.
♦ "Square" stimuli or setting procedure for adjusting servo-control parameters.
♦ Digivex PC software for setting the predictors if necessary.

Check the driven mechanism can operate freely.

7.1.3 **Commissioning with the hand help terminal**

The general procedure is the same as before.

The hand help terminal is reserved for systems that have already been programmed.

either by the PC software
or by transferring the parameters from one drive to another using the PC software or hand help terminal.
or by physically transferring the EEPROM store containing the customized parameters of the application.

7.2 Detecting Reasons for Stoppage

7.2.1 <u>LED display - power supply function</u>

LED	COLOR	FUNCTION
POWER ON	Green	Power on, with no fault in the supply or in the drive control.
POWER OFF	Red	Auxiliary supply on. No power supply (either because of a fault, or by switching off).
RECOVERY	Red	Either, if temporarily on, normal switch in of recovery resistor. Or, if permanently on, recovery fault: - resistor short-circuited (valid only for external resistors).
OVER VOLT	Red	Flashing: mains supply overvoltage 480V or 255V Fixed: bus overvoltage 750 VDC or 400VDC
PHASE	Red	No mains power phase.
AUX. SUPPLY	Green	Indicates auxiliary supply is on.

In normal operation, the LED status is as follows:

POWER ON	Green
POWER OFF	Off
RECOVERY	Off
OVER VOLT	Off
PHASE	Off
AUX. SUPPLY	Green

N.B : The Power ON and Power OFF LEDs may come on simultaneously when the power supply is cut out : mains disconnected and intermediate supply greater than minimum voltage (200V for 400Vac models and 100V for 230Vac models).

7.2.2 <u>Fault display - drive function</u>

Incidents with drive operation can be displayed in two ways.

- **On the drive front panel** through the "RUN" and "FAULT" LEDs

RUN (Green)	FAULT (Red)	MEANING
✿		Microprocessor fonction correct. Normal state.
✿	cl	Fault. Operation continues with reduced performance.
✿	✿	Fault with power down.
	✿	CPU fault with power down
		RUN and FAULT LEDs off. No power supply.

✿ : LED on
CI : LED flashing

For RS232 serial link

- ♦ Either by the PME-DIGI software, which specifies in uncoded language, the problem and advice for correcting it.
- ♦ Or via the hand help terminal.

7.2.2.1 <u>Fault processing</u>

Two cases arise:

- **Faults with the "FAULT" LED on**

These faults entail:

- ♦ Main contactor opens and system powers down.
- ♦ Initial fault code is stored in the drive.

- **Faults with "FAULT" LED flashing**

These faults entail:

♦ Motor current is reduced
♦ Status is stored in drive.
♦ No action on DIGIVEX SINGLE DRIVE OK relay.

These cases arise:

♦ For excessive Digivex dissipater temperature.
♦ For excessive mean drive current or excessive rms motor current, if the drive parameter setting allows operation to continue. The choice of continuing operation with reduced current or stopping is made by the "current protection" strategy in the "servo-control" window of the parameter setting software.

7.2.2.2 <u>Current monitoring</u>

Mean drive current

Each drive is characterized by two currents:
For example for a 15/30 Digivex Single Drive:

permanent permissible current 15 A (peak value of sine wave).
maximum pulse current 30 A, permissible for a limited time (0.3 to 1 seconds).

In order to prevent the drive from overheating, the mean current [I = f(t)] after 2 second filtering, with the permanent permissible current. There is then a choice between two strategies:

Strategy 1: Fault, with the power supply OK relay and main contactor opening eventually.
Strategy 2: Permanent current reduction of drive to 90% of permanent permissible current. The "FAULT" LED flashes.

Motor rms current

To prevent the motor thermal tripping by the thermal sensor, the drive monitors the rms current [I^2 = f(t)].

The rms current is compared with the permanent permissible current at slow rotation by the motor $\hat{I}_0$ (after first order filtering of 20 second time constant). This data, which is characteristic of the motor, is known to the drive when the choice of motor - drive is made.

As before there is a choice between two strategies:

♦ Strategy 1: Fault.
♦ Strategy 2: Drive pulse current reduced to 0.9 Î0 of motor current. The "FAULT" LED flashes.

Drive output current

There are two forms of monitoring:

♦ Short-circuit protection: monitoring of current drift.
♦ Excessive output current (maximum current). Check whether the current as measured exceeds the drive pulse current by 30%..

In both cases, a fault is tripped and the OK relay opens.

7.2.2.3 Temperature monitoring

DIGIVEX SINGLE DRIVE dissipater temperature

♦ If the temperature is less than 70°C at the dissipater, nothing happens.
♦ From 70° to 94°C, there is a fall in pulse current that the drive can deliver (the "FAULT" LED flashes slowly).
♦ At 95°C the fault is tripped.

Servo-motor winding temperature

Each motor has a thermal sensor. When customizing the drive, this sensor can be taken into account or ignored. If it is taken into account (usual case), excessive motor temperature causes a fault.

Ambient temperature

This is measured between the electronic boards and operations are stopped when it exceeds 60°C.

7.2.2.4 Other monitoring

No resolver
Resolver fault or wiring fault.

Overspeed
Speed > 1.15 times the maximum motor - drive setting.

These two cases entail a fault with:
Red "FAULT" LED comes on.

7.2.2.5 Summary table of faults and fault finding

✿ : LED on, **E**=LED off, **RF**=rapid flashing, **SF**=slow flashing

RUN LED (Green)	FAULT LED (Red)	PC SOFTWARE FAULT-FINDING	PROGRAMMING CONSOLE FAULT-FINDING	COMMENTS
✿	✿	Max. drive current reached	Overcurrent	
✿	✿	dI/dT fault	Short circuit	Output or earth short circuit
✿	✿	Excessive mean current	I average fault	Too much current asked of drive
✿	✿	Excessive rms current	I RMS fault	Too much current asked of drive. Cycle too demanding.
✿	✿	Excessive motor temperature	Motor overtemp.	Cycle too demanding or no motor fan cooling
✿	✿	Excessive dissipater temperature	Fin overtemp.	
✿	✿	Excessive ambient temperature	Ambient overtemp.	Fan cooling stopped or excessive cabinet temperature
✿	✿	Resolver fault	Resolver fault	Problem with resolver or wiring
✿	✿	Excessive speed	Overspeed	Speed reference > 10 V or speed parameter setting error
E	✿	CPU fault	CPU fault	
☼	☼	Bus overvoltage	Bus overvoltage	Regenerative braking impossible. Disconnected from mains supply.
☼	☼	Customization card fault	EEPROM fault	Customization card incompatible with drive rating or drive type
☼	☼	Drive-spindle definition	SPINDLE BIT DEF.	Control type (drive-spindle) incompatible with customization cardSZ6608B
☼	☼	Motor not connected	MOTOR Disconnect	Motor wrongly connected
E	E	Liaison impossible		No power supply

RUN LED (Green)	FAULT LED (Red)	PC SOFTWARE FAULT-FINDING	PROGRAMMING CONSOLE FAULT-FINDING	COMMENTS
✿	**RF**	Excessive mean current OR		Current reduction. I mean > drive rating
✿	**RF**	Excessive rms Current		Current reduction. Drive RMS current > Îo motor
✿	**SF**	Excessive dissipater temperature		Max. current reduced depending on temperature

7.2.2.6 Corrective actions

The incidents that may arise (from wiring errors or mishandling) are as follows:
Resolver fault
  ♦ Check the resolver connection.
Overcurrent
  ♦ poor motor connection (motor phase missing)
  ♦ programmed motor does not correspond to connected motor
Overspeed
  ♦ Nmax. incorrectly set
  ♦ Accidental transition to torque regulation
Motor fails to run and remains without torque
  ♦ System is set to zero torque (hardware or software input T=0). The torque has been forced to zero during a global transfer. Reset system torque (see software or console instructions).
  ♦ The motor is not connected.
Motor fails to run, but torque present
  ♦ CW and CCW inputs set to zero (hardware or software). Check with software or hand help terminal.

7.2.2.7 7-segment display (SS 6611 mounted)

Function: to provide information on DIGIVEX status discriminating between faults. Format: placed in the upper part of the DIGIVEX.
Description :

Display	Description
0	Drive live, no power present
1	Drive OK, power present
2	Resolver fault
3	Excessive ambient temperature or dissipater temperature
3 Flashing	Excessive dissipater temperature / current reduction
4	Excessive speed
5	Maximum supply current
6	Maximum drive current reached or di/dt fault
7	Excessive mean current or excessive rms current
7 Flashing	Excessive mean current or excessive rms current: Reduction
8	Bus overvoltage
9	Excessive motor temperature
A	Drive/spindle definition fault
F	Drive rating incompatible with CUSTOMIZATION
. (dot)	CPU fault
- (dash)	Unlisted fault

8. OPTIONS

8.1 Possible associations

Maximum of two options possible		Integrated encoder SC6631	7-segment display SS6611	Indexing function SH6601	Speed output card SV6601	SSI SC6637	SERCOS SP6605
Integrated encoder	SC6631		X	X			
7-segment display	SS6611	X			X		
Indexing function	SH6601	X					
Speed output card	SV6601		X				
SSI	SC6637						
SERCOS	SP6605						

Association examples: Integrated encoder   +   7-segment display
                                                         OR
                                      Integrated encoder   +   Indexing function

8.2 Encoder Emulation (SC6631 board)

The resolver is above all a position sensor. It is used to measure the position of the rotor relative to the stator.

An optional board, placed inside the Digivex Single Drive, is used to convert the signal from the resolver into a series of pulses that are identical to those from an incremental encoder : A, B, 0 and their complements.

8.2.1 Programming resolution and zero mark position

This is done with the DIGIVEX PC software or the hand help terminal.

The parameter setting is called up:

> Either in graphic mode (double-click on the encoder emulation).
> Or via the menus: parameters + options.
> Or via the hand help terminal keyboard.

Resolution

Adjustable between 1 and 16384, either by +/- keys, or be entering the number directly (OFF LINE only).

Zero Mark Setting

Setting by teaching, with the PC working "on line".

When the operator judges the position is suitable, he confirms by acknowledging the zero mark.

8.2.2 Electrical characteristics

The electrical output interface meets standard RS422 for differential serial links. The circuit used is a "LINE DRIVER" of the MC 26 LS 31 D type. The electrical characteristics are therefore closely related to the use of this component.

Voltage supply

The encoder emulation boards are electrically isolated between the output stage through three optocouplers, needing to be powered by an external +5V ±10%, 100 mA source, as for all incremental encoders.

In no case can this power supply, which is intended only for electrical isolation, be used to keep position information from the resolver in the event of failure of the drive's low-level power supply.

Short-circuit capability

A single output may be short-circuited at 0 V at any given time

Signal form

Signal levels:

U high $\geq$ 2.5V for I high $\geq$ -20mA
U low $\leq$ 0.5V for I low $\leq$ 20mA

CHANNEL A

CHANNEL $\overline{A}$

CHANNEL B

ZERO SIGNAL

Dipl44gb.D/51W
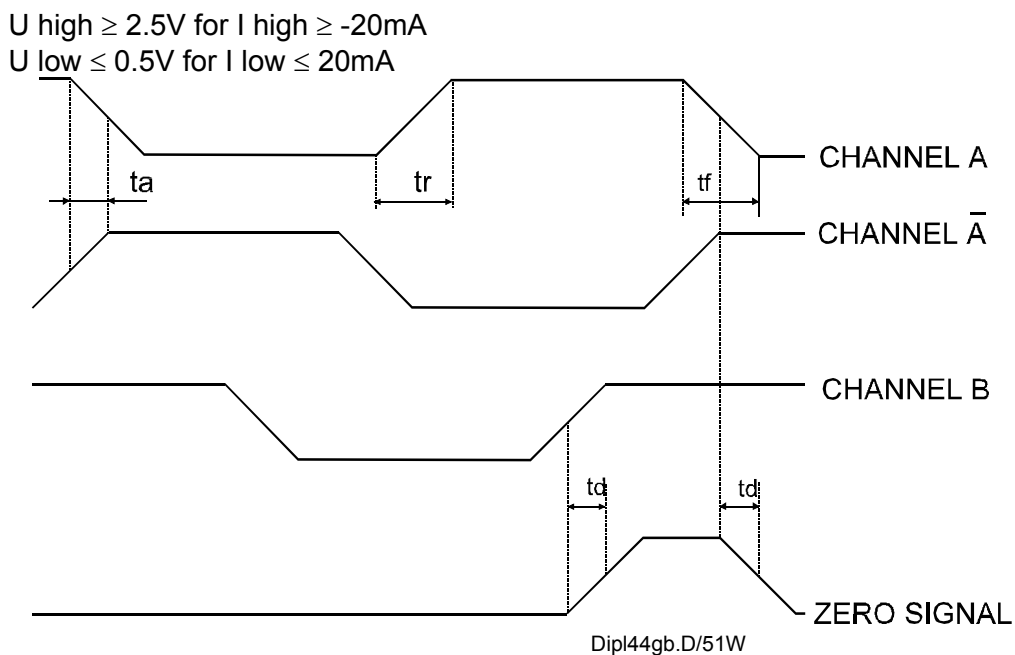
Switching time:

Rise or fall time defined from 10% to 90% of the magnitude in question, without cable and without load.

tr = tf = 45ns (typical value)

Time delay between direct and complemented channels

Time delay defined at 50% of magnitudes in question without cable and without load.

$$-6ns \leq ta \leq 6ns \text{ (maximum)}$$

Time delay between channels A, B and the zero mark

Time delay defined at 50% of magnitudes in question without cable and without load.

$$-6ns \leq td \leq 6ns \text{ (maximum)}$$
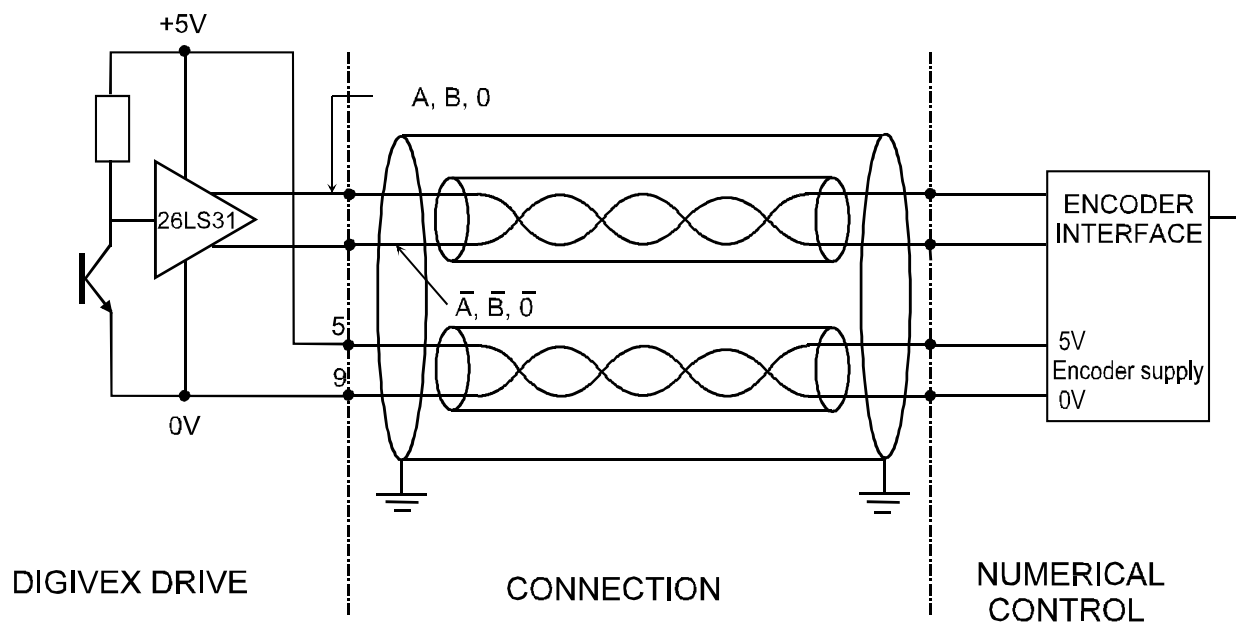
8.2.3 <u>Sub-D connector X4: encoder emulation option</u>

Sub-D 9-pin plug, "Encoder". Maximum conductor cross-section: 0.5 mm².

CONTACT	TYPE	FUNCTION
1	.	
2	Output	Top $\overline{0}$
3	Output	$\overline{A}$
4	Output	$\overline{B}$
5	Input	5V
6	Output	Top 0
7	Output	A
8	Output	B
9	Input	0V

8.2.4 <u>Encoder emulation cable</u>

Cable formed from three twisted pairs of 0.14 mm^2, of one twisted pair of 0.5 mm^2 for 5 V supply and general shielding.

Cable reference recommend by PARVEX, 6537P0016.

Cables equipped with Sub-D connectors can be supplied, see drawing FELX 304554.

ENCODER EMULATOR CABLE

*SALES REFERENCE

D I G 0 4 5 4 6 R _ _ _

*PRODUCTION REFERENCE

F E L X 3 0 4 5 4 6 R _ _ _

FULL CABLE CODE
LENGTH CODE

LENGHT

CODE	LENGHT: (m)
0 3	0 3
2 0	2 0

	STANDARD LENGHTS
0 3	
0 5	
1 0	
1 5	
2 0	

CODE 1

Marking

9-pin female SUB-D connector
EMI/RFI shielded cap with
shielding braid connection

Max. lenght 20m

Cable-3 twisted pairs 2x0,14mm² + 1 twisted
pair 2x0,50mm² with general shielding

9-pin male SUB-D connector
EMI/RFI shielded cap with
shielding braid connection

CODE 2

Marking

9-pin female SUB-D connector
EMI/RFI shielded cap with
shielding braid connection

Max. lenght 20m

Cable-3 twisted pairs 2x0,14mm² + 1 twisted
pair 2x0,5mm² with general shielding

Shielding braid attached
(green/yellow lead)
All conductors 150mm long

ENCODER EMULATOR CABLE

DIGIVEX

A   7   brown
Ā   3   green   } 2x0,14mm²
B   8   grey
B̄   4   pink   } 2x0,14mm²
Z   6   red
Z̄   2   black   } 2x0,14mm²
+5V* 5   blue
0V   9   white   } 2x0,5mm²
MM

Shielding braid connected
to SUB-D cap

* Not connected for DLD

7   A
3   Ā
8   B
4   B̄
6   Z
2   Z̄
5   encoder +5V*
9   encoder 0V
R1: MM
R2: green/yellow

R1: Shielding braid connected
    to SUB-D cap.
R2: Recommended but
    not compulsory

A	12/06/97			
B		AM:E98035		
C		AM:E98132		
D		AM:E99024		
E	AM:E00006	Est.:		29/08/95

Stamping:LR

Modif.

ENCODER EMULATOR CABLE

DIGIVEX

PARVEX

Liste doc.
Gre doc.   A3   English
Scale: /

FELX 304554GB

DIGIVEX SERVO-AMPLIFIER

Reference	Description
DPS0612	12 kW power supply
DPS0625	25 kW power supply
DPS0615	15 kW power supply with return to mains
SF_02040	Three-phase choke for 15 kW mains supply
DRA3165V23	+6U rack 3 slots, fan, reduced (4/8)
DRA3165V43	+6U rack 3 slots
DRA3165R23	+ 6U rack 3 slots, with external recovery
DRA3168V23	+ 6U rack 19" 6 slots, fan, reduced (4/8)
DRA3168V63	+ 6U rack 19" 6 slots
DRA3168R43	+ 6U rack 6 slots with external recovery
RE_91001	2000 W 27 ohm external resistor
RE_91002	4500 W 12 ohm external resistor
RE_91020	Pair or wall consoles for resistors
TL_83085	6U 11E stopper
DXD06001	Digivex 1/2 single module
DXD06002	Digivex 4/4 single module
DXD06004	Digivex 4/8 single module
DXD06008	Digivex 8/16 single module
DXD06016	Digivex 16/32 double module
DXD06032	Digivex 32/64 single module
DSD13M02	Digivex Single Drive 230V 2/4 1 phase
DSD13M04	Digivex Single Drive 230V 4/8 1 phase
DSD13M07	Digivex Single Drive 230V 7,5/15 Three-phase
DSD13004	Digivex Single Drive 230V 4/8
DSD13007	Digivex Single Drive 230V 7.5/15
DSD13015	Digivex Single Drive 230V 15/30
DSD13030	Digivex Single Drive 230V 30/60
SDS13060	Digivex Single Drive 230V 60/100
DSD16002	Digivex Single Drive 400V 2/4
DSD16004	Digivex Single Drive 400V 4/8
DSD16008	Digivex Single Drive 400V 8/16
DSD16002	Digivex Single Drive 400V 2/4
DSD16004	Digivex Single Drive 400V 4/8
DSD16008	Digivex Single Drive 400V 8/16
DSD16016	Digivex Single Drive 400V 16/32
DSD16032	Digivex Single Drive 400V 32/64
DSD16016	Digivex Single Drive 400V 16/32
DSD16032	Digivex Single Drive 400V 32/64
DPD16050	Digivex Power Drive 50/80
DPD16100	Digivex Power Drive 100/120
DPD16150	Digivex Power Drive 150

Reference	Description
SC_6631	Encoder emulation
SC_6637-1	Simplified SSI encoder card
SC_6637-2	SSI encoder card
DTP001	Programming and parameter setting console
FR_03016	16 A filter (Digivex 12 kW)
FR_03036	36 A filter (Digivex 25 kW and 50/80)
FR_03064	64 A filter (Digivex 100/120)
PVD3464x	Digivex Multiple Drive manual D, E, F, GB
PVD3500x	Digivex Single Drive manual
PVD3484x	Digivex Power Drive manual D, E, F, GB
PVD3488x	SSI D, F board manual
x = D German, E Spanish, F French, GB English	
	Software Parvex Motion Explorer
PMED	Pack1 : Software PME + clé Digivex
PMEDC	Pack2 : Software PME + clé Digivex et Cyber
PMEREL	Mise à jour logiciel PME (sans clé)
PVD3494x	PME manual (base) D,E,F,GB
PVD3483x	Digivex manual D,E,F,GB
PVD3495x	Cyber manual D,E,F,GB

PLUGS AND CABLES FOR DIGIVEX AND HX, HS, HD

Reference	Description
DXDK1	Set of 3 Sub-D connectors for Digivex
DXDK2	Set of 4 Sub-D connectors for Digivex + encoder emulation
CB_08304	I/O cable by metre for Digivex drive
FELX304544R205	Equipped I/O cable (1 Sub-D) for Digivex drive length 5 m (1)
FELX304544R105	Equipped I/O cable (2 Sub-D) for Digivex drive length 5 m (1)
6537P0016	Encoder emulation cable for Digivex drive
FELX304546R105	Equipped encoder emulation cable (2 Sub-D) for Digivex length 5 m (1)
220065R4621	Motor end resolver cable
6537P0001	Resolver cable by metre
220049R6105	Equipped resolver cable (motor plugs & Sub-D) length 5m (1)
For motors HX3	
220065R1610	Size 1 power plug
6537P0019	0.5 mm^2 power cable by metre
220049R4905	Equipped power cable - length 5m (1)
For motors HX4, HX6, HS6, HD6, HD6, HS8 and Io < 14 A.	
220065R1610	Size 1 power plug
6537P0009	1 mm^2 power cable by metre
220049R4205	Equipped power cable - length 5m (1)
For motors HS820EQ (Io > 14 A)	
220065R1611	Size 1 power plug
6537P0010	2.5 mm^2 power cable by metre
220049R4305	Equipped power cable - length 5m (1)
For motors HD8, HS9	
220065R3611	Size 3 power plug
6537P0010	2.5 mm^2 power cable by metre
220049R4805	Equipped power cable - length 5m (1)
For motors HD9 and Io < 60 A	
220065R3610	Size 3 power plug
6537P0011	6 mm^2 power cable by metre
220049R4505	Equipped power cable - length 5m (1)
For motors H....and Io > 60 A	
220065R3610	Size 3 power plug
6537P0012	10 mm^2 power cable by metre
220049R4605	Equipped power cable - length 5m (1)