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DBM 03

User's Manual

GB-4019 Rev.9 - July/98

DBM 03 - USER'S MANUAL

Rev.	Date	Description	Updated Pages
0	June/95	Initial Release	
1	22/June/95	Correct miscellaneous errors	52, 84, 111
2	6/July/95	Correct miscellaneous errors	7, 27, 28, 29, 33, 66, 68, 84, 86, 91
3	28/Sept/95	Correct miscellaneous errors	55, 73, 83, 94
4	24/Oct/95	Add facilities to change DBM01 with DBM03	52
5	6/May/96	Add reference to DBTALK program and pinouts of RS232/RS485 converter; correct OC, OV, VO commands; update personality card; add DBM-PS internal card jumpers; correct miscellaneous errors	7, 28, 33, 48, 49, 50, 51, 52, 63, 79, 80, 87, 90, 121
6	30/July/96	Add EMC paragraph; update motor connector pinout (Fig.1.13); correct soft start configuration (Fig.2.1, 2.2); update resolver wiring (Fig.2.3) according to EMC; correct miscellaneous errors	1, 3, 5, 8, 33, 35, 42, 44, 46, 61, 86
7	6/Feb/97	Add Section 6 (EMC); change par.1.6 (CE-marking); update all wiring figures according to EMC; add Appendix A (serial link multidrop); add Appendix B (Dbtalk communication program); update par.2.2.7 (personality card); correct miscellaneous errors	1, 2, 5, 6, 8, 13, 24, 27, 29, 30, 31, 34, 35, 38, 45, 46, 48, 49, 52, 56, 75, 82, 85, 88, 123, 124,125, 126, 127, 128, 129, 130, 131, 132, 133
8	23/May/97	Update standards with EN 61800-3, EMC product standard; correct fig.6.8 (EMC/Equipotential bonding); update 220Vac with 230Vac; correct tab.3.5 (IT/PC); correct the leakage current of EMC filters; correct miscellaneous errors	3, 5, 6, 8, 9, 11, 25, 37, 42, 43, 44, 48, 49, 52, 56, 57, 72, 75, 98, 99, 101, 105, 123, 125, 128, 129, 132, 133
9	6/July/98	Add Appendix C, D and E; add default values for keyboard setup; add reset to enable SE command; correct miscellaneous errors	2, 43, 48, 55, 83, 85, 94, 123, 125, 130, 134, 135, 136

Table of Contents

Introduction

This manual provides the necessary information for a proper installation and an effective use of DBM Digital Drives in the possible different configurations.

Its contents allow technicians to understand how the system works and to carry out installation procedures.

The safety instructions provided in this Manual are included to prevent injury to personnel (WARNINGS) or damage to equipment (CAUTIONS).

To emphasize the differences between new DBM 03 User's Manual and old DBM 01 User's Manual, a vertical line in the left margin of the text indicates new items.

Accident Protection

Keep to the general security rules for electrical equipment's. DBM-PS power supply is electrically connected to mains.

WARNING: High Voltage. L+ and L- pins and BUS BAR can have voltage ≥300Vdc even after switching off (capacitive voltage). Discharge Time Approx. 6 Minutes.

WARNING: High Voltage. The recovery resistor is connected to the Bus Bar’s and can have voltage ≥300Vdc.

WARNING: do not touch recovery resistor during operation to avoid scalds.

WARNING: when required for an emergency stop, opening motor phases must be preceded by disabling the axis. The delay time must be at least 30 ms.

WARNING: the drive should be located in an environment that is free from dust, corroding fumes and fluids. In condensing atmospheres, the cabinet must be provided with an anti-condensation device.

Tightening Torque

CAUTION: do not exceed the tightening torque of the table

Screw Thread	Tightening torque [Nm]	[lb in]
M3	1.00	8.85
M4	3.00	26.55
M5	6.00	53.10
M6	8.00	70.80
M8	20.0	177.0

SECTION 1 - DESCRIPTION

1.1 General Features

The modular DBM series drives offer digital speed loop and digital analog interfaces. They are suitable for use with 4-quadrant, brushless motors having sinusoidal back e.m.f. . Construction allows the use of the power amplifiers only, if required for easy CNC interface.

Hardware circuits are reduced by using Isolated Gate Bipolar Transistor (IGBT) components in the power section.

Control technique is sinusoidal.

The unique advantages of the digital technology (16/32 bit DSP based) are:

- Simplified installation through optimization of control parameters via software.
- No potentiometer adjustments.
- Autophasing.
- Easy adaptation to different applications: e.g. you may change the PI gain variables and choose between speed or torque control.
- Compact assembly: up to 3-axis control from a single module.
- Flexibility: up to 99 axes, 240A peak per axis.

1.2 Standard Features

- Three-phase full bridge with IGBT
- Current reference refresh time: 100 µs
- Phases refresh time: 300 µs
- R/D resolution automatically switched according to actual speed for optimum system performance (between 10 and 16 bit)
- Resolution of A/D converter: 12 bit or 14 bit (optional)
- 4 different velocity control structures to meet the most challenging requirements
- Digital low-pass filter on speed loop
- Over travel limit switches available (when Expansion is not present)
- Totally programmable control and interface parameters
- Current bandwidth (analog) > 1kHz
- Dead point: absent
- Speed ratio: 1:4000
- Static current gain 10^5 A/V
- Max operating temperature / humidity: 45 °C (113 °F) / 90%
- Derating for altitude > 1000 m (3333 feet): 1% per 100 m (333 feet)
- Storage temperature: -10 to +70 °C

1.3 Technical Data

DBM Module

Input voltage : 300Vdc, ±10%
Three-phase output voltage : 180V

DBM-PS Power Supply

Three-phase input voltage : 230Vac, ±10%, 50/60 Hz
Auxiliary power supply input voltage : 110Vac (optional) or 230Vac, ±10%, 50/60 Hz
Auxiliary input power : 55W for 3-axis module, 60W for fans pair
BUS BAR output voltage : 300Vdc

STANDARD MODULES

CODE	MODEL	TYPE	OUTPUT CURRENTS									Width	Weight
			AXIS 1			AXIS 2			AXIS 3			A	
			Rated (Arms)	Max (Arms)	Max (A)	Rated (Arms)	Max (Arms)	Max (A)	Rated (Arms)	Max (Arms)	Max (A)	(mm)	(Kg)
CG1210-03	DBM 1.5-1.5	DBM	1.5	3.5	5	1.5	3.5	5				90	9,5
CG1212-03	DBM 2.5-2.5	DBM	2.5	5.3	7.5	2.5	5.3	7.5				90	9,5
CG1200-03	DBM 05-05	DBM	5	10.6	15	5	10.6	15				90	9,5
CG1204-03	DBM 10-10	DBM	10	18	25	10	18	25				90	9,5
CG1207-03	DBM 15-15	DBM	15	32	45	15	32	45				90	9,5
CG1209-03	DBM 25-25	DBM	25	50	70	25	50	70				90	9,5
CG1319-03	DBM 1.5-1.5-1.5	DBM	1.5	3.5	5	1.5	3.5	5	1.5	3.5	5	90	10
CG1322-03	DBM 2.5-2.5-2.5	DBM	2.5	5.3	7.5	2.5	5.3	7.5	2.5	5.3	7.5	90	10
CG1300-03	DBM 05-05-05	DBM	5	10.6	15	5	10.6	15	5	10.6	15	90	10
CG1304-03	DBM 10-10-10	DBM	10	18	25	10	18	25	10	18	25	90	11
CG1308-03	DBM 15-15-15	DBM	15	32	45	15	32	45	15	32	45	90	11
CG1314-03	DBM 25-25-15	DBM	25	50	70	25	50	70	15	32	45	90	11
CG1727-03	DBM 05-50-05	DBM-L	5	10.6	15	50	100	140	5	10.6	15	180	15
CG1743-03	DBM 05-70-05	DBM-L	5	10.6	15	70	127	180	5	10.6	15	180	15
CG1708-03	DBM 10-50-10	DBM-L	10	18	25	50	100	140	10	18	25	180	15
CG1747-03	DBM 10-70-10	DBM-L	10	18	25	70	127	180	10	18	25	180	15
CG1734-03	DBM 15-50-15	DBM-L	15	32	45	50	100	140	15	32	45	180	15
CG1774-03	DBM 15-70-15	DBM-L	15	32	45	70	127	180	15	32	45	180	16
CG1716-03	DBM 25-50-15	DBM-L	25	50	70	50	100	140	15	32	45	180	16
CG1719-03	DBM 25-25-30	DBM-L	25	50	70	25	50	70	30	64	90	180	16

Note: we recommend to contact our Sales Locations or Service Centers for guidance on selection of drives not listed above (e.g. DBM05-10-15)

POWER SUPPLY

CODE	MODEL	INPUT AUXILIARY VOLTAGE	CURRENTS			WIDTH	WEIGHT
		Rated (V)	Output Rated (A)	Output Max (A)	Braking (A)	A (mm)	(Kg)
CG2000-03	DBM PS	230	100	300	100	60	8
CG2001-03	DBM PS/110 V	110	100	300	100	60	8
CG2002-03	DBM PS/150 A	230	100	300	150	60	8

EXPANSION MODULES

CODE	MODEL	Type	OUTPUT CURRENTS			WIDTH	WEIGHT
			Rated (Arms)	Max (Arms)	Max (A)	A (mm)	(Kg)
CG1002-03	EBM 50/140	EBM	50	100	140	90	10
CG1003-03	EBM 70/180	EBM	70	127	180	90	10
CG1004-03	EBM 70/240	EBM	70	170	240	90	10
CG1050-03	EBM 80/240	EBM-L	80	170	240	180	15

An external expansion module should be used for some configurations including an axis rated over 25A. This is due to thermal constrictions. Available expansion modules are shown in the lefthand table.

Note: to specify an expansion module, please replace the third axis rating number with an E, this ensures that the drive is configurated for use with an expansion module (e.g. DBM 25-10-E)

1.4 Interfaces

Digital

- Output for simulated encoder (optional)
- Serial Link RS485(1200-19200 Baud) full-duplex to manage:
  - Acceleration limits
  - Autophasing
  - Control parameters
  - Monitoring of internal parameters
  - Range of analog interface
  - System status
- Output for Drive OK axis 1, axis 2, axis 3 (TTL compatible)

On-Off (Optoisolated)

- Drive OK
- Drive Enable
- Motor OK
- Reference Enable

Analog

- Input velocity (see MR command)
- Resolver differential input signals
- Peak current limit input
- Output tachometer (see ET command)
- Max current, velocity reference, velocity error outputs (see ES, SO commands)

1.5 Protection

Module

- Auxiliary voltage out of tolerance
- BUS BAR overvoltage
- BUS BAR undervoltage
- Motor phase grounded
- Motor overtemperature
- Module overtemperature
- IT protection
- Abnormal resolver signal
- Short circuit on motor phases
- Non-coherent three-phase sequence
- Actual speed versus reference error

Power Supply

- Overtemperature
- Recovery unit not OK

1.6 CE-Marking

Starting from Jan/97, DBM03 drives have CE-marking according to Low Voltage Directive.
Starting from Apr/97 the CE-marking refers also to EMC Directive (see Section 6).
A Declaration of Conformity is available.

The Low Voltage Directive applies to all electrical equipment designed to use with a voltage rating of between 50 Vac and 1000 Vac and between 75 Vdc and 1500 Vdc.

The CE-marking states that the electrical equipment has been constructed in accordance with good engineering practice in safety matters in force in the European Community and it does not endanger the safety of persons, domestic animals or property when properly installed and maintained and used in applications for which it was made.

DBM 03 drives meet the following standard related to Low Voltage Directive:
CEI EN 60204-1 (1993)   par. 6.2.3, 20.3, 20.4

1.7 System Wiring

All of the analog and digital signal connectors, auxiliary power supplies and I/O interfaces are front-connected to the unit.

Connectors for auxiliary power supply are made via Molex type connectors. Motor power are connected via a Harting type connector, while I/O connectors use a Weildmuller type connector.

All other connectors are made via D-type connectors.

All signals are positive logic:
active = +15V
not active = 0V (or not connected)

1.8 DBM Configurations

Three configurations are possible for the module:

DBM-3A: 3-axis module (see Fig. 1.3)
DBM-2A: 2-axis module (see Fig. 1.4)
DBM-2E: 2-axis module with expansion (see Fig. 1.5)
DBM-L3A: 3-axis 180 mm module (see Fig. 1.6)
DBM-L2A: 2-axis 180 mm module (see Fig.1.7)

FIG. 1.1 - Inter module wiring

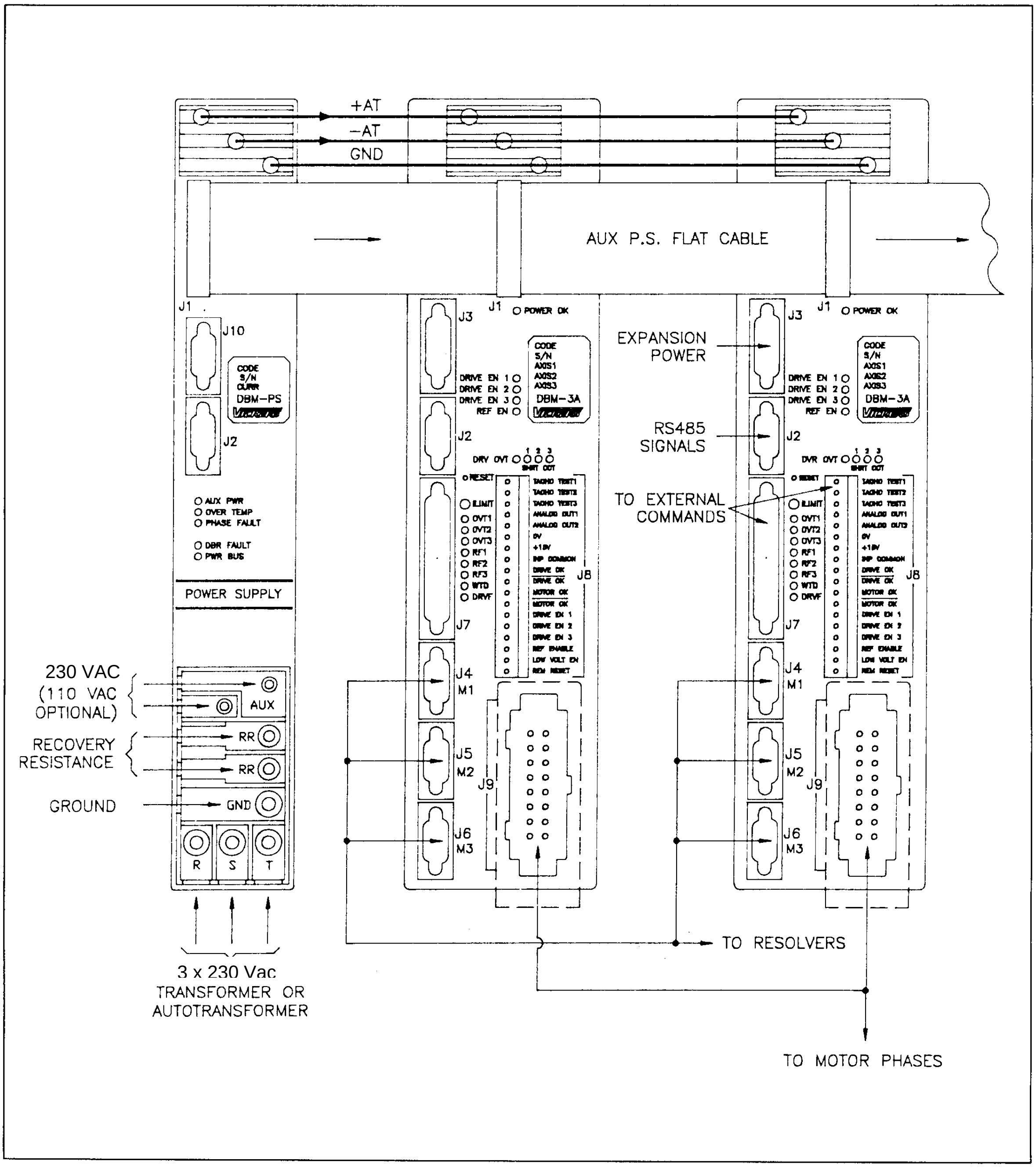
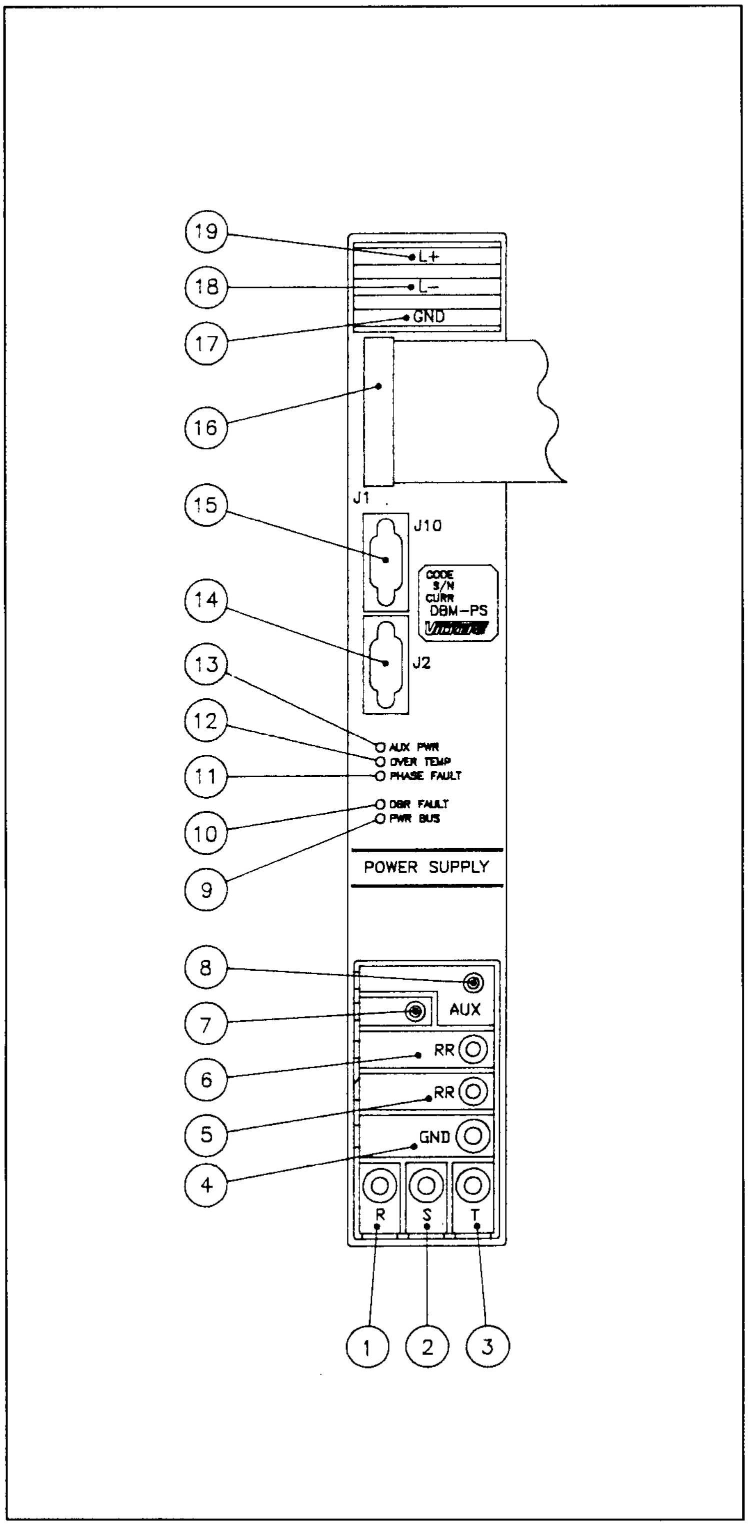


FIG. 1.2 - DBM-PS Power Supply



Tab. 1.1 - DBM-PS Power Supply (See Fig. 1.2)

Pos.	Name	
1	R	"L1" phase, three-phase input voltage 230Vac
2	S	"L2" phase, three-phase input voltage 230Vac
3	T	"L3" phase, three-phase input voltage 230Vac
4	GND	Ground
5	RR	Recovery resistor
6	RR	Recovery resistor
7	AUX	Auxiliary power supply 230Vac (110Vac as option)
8	AUX	Auxiliary power supply 230Vac (110Vac as option)
9	Yellow LED PWR-BUS	BUS BAR voltage > 40Vdc
10	Red LED DBR FAULT	Recovery unit fault
11	N.C.	
12	Red LED OVER TEMP	Module overtemperature via PTC (threshold 80 °C)
13	Green LED AUX POWER	Auxiliary power supply OK
14	J2	RS485 output port to drives and power control fault
15	J10	RS485 input port
16	J1	Auxiliary power supply flat connector
17	GND	Ground
18	L-	BUS BAR -HV 300Vdc
19	L+	BUS BAR +HV 300Vdc

Tab. 1.2 - DBM-PS Power Supply - J1 Connector
Auxiliary Power Supply

Pos.	Name	
1		N.C. (Not connected)
2		N.C.
3		- 15Vdc referred to -HV (300Vdc)
4		+18Vdc referred to -HV (300Vdc)
5		150kHz square wave to high side drives
6		N.C.
7		+18Vdc referred to logic 0V
8		- 18Vdc referred to logic 0V
9		+8Vdc referred to logic 0V
10		+8Vdc referred to logic 0V
11		Logic 0V
12		Resolver 0V
13		10 kHz sinusoidal wave for resolver and synchronism (carrier)

Tab. 1.3 - DBM-PS Power Supply - J2 Connector
RS485 Port Signal and PWRS Control

Pos.	Name	
1		+ Rx (RS485 serial link)
2		N.C.
3		+ Tx (RS485 serial link)
4		PWRS fault 1 - power supply binary coded faults (level 1)
5		+ 5Vdc input referred to logic 0V
6		- Rx (RS485 serial link)
7		Logic 0V
8		- Tx (RS485 serial link)
9		PWRS fault 2 - power supply binary coded faults (level 2)

Note: Rx and Tx are the receiving and transmitting signals with reference to the drive. In the rest of the manual "RS485 serial link", referring to Rx and Tx, will not be specified anymore.

In case of fault, the type of fault is as follows:

J2/pos. 4	J2/pos. 9	
0	0	OK
0	1	DBR FAULT. Recovery fault
1	0	OVER TEMP. Overtemperature
1	1	PHASE FAULT.

Tab. 1.4 - DBM-PS Power Supply - J10 Connector
RS485 Port

Pos.	Name	
1		+Rx
2		N.C.
3		+Tx
4		N.C.
5		+5Vdc output referred to logic 0V for power supply
6		-Rx
7		Logic 0V
8		-Tx
9		N.C.

1.8A DBM-PS Internal Card Jumpers

JP1 closed (default) = connects a 120 Ω resistor between RX+ and RX-.
JP2 closed (default) = connects TX- of serial link to 0V via pull-down resistor
JP3 closed (default) = connects TX+ of serial link to +5V via pull-up resistor

FIG. 1.A - DBM-PS Card Jumpers

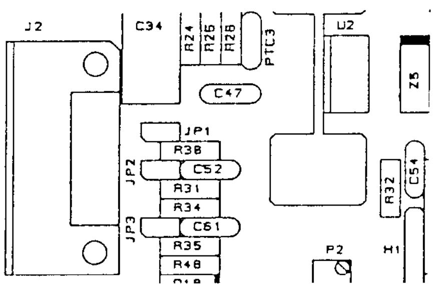


FIG. 1.3 - DBM 3-Axis Module

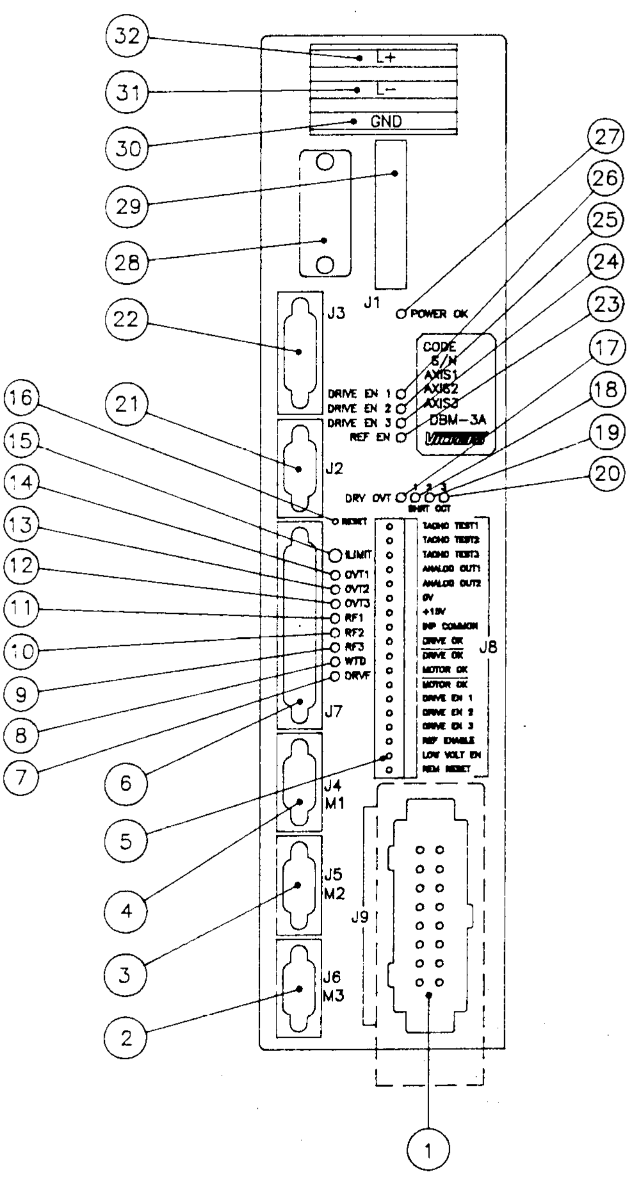


FIG. 1.4 - DBM 2-Axis Module

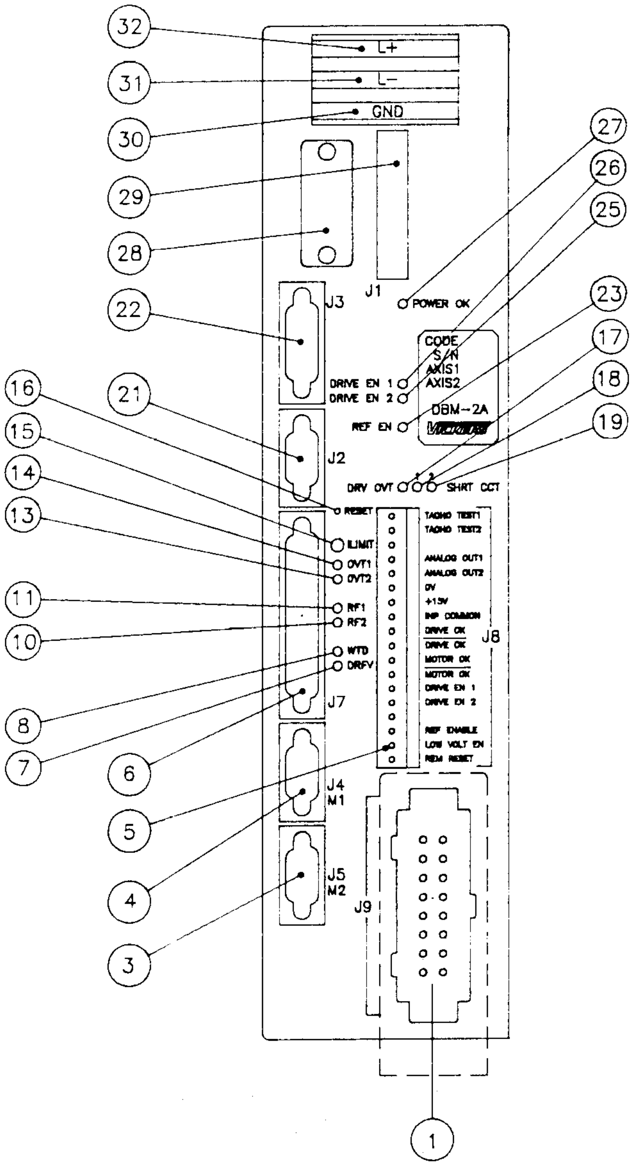


FIG. 1.5 - DBM 2-Axis and Expansion (optional) Module

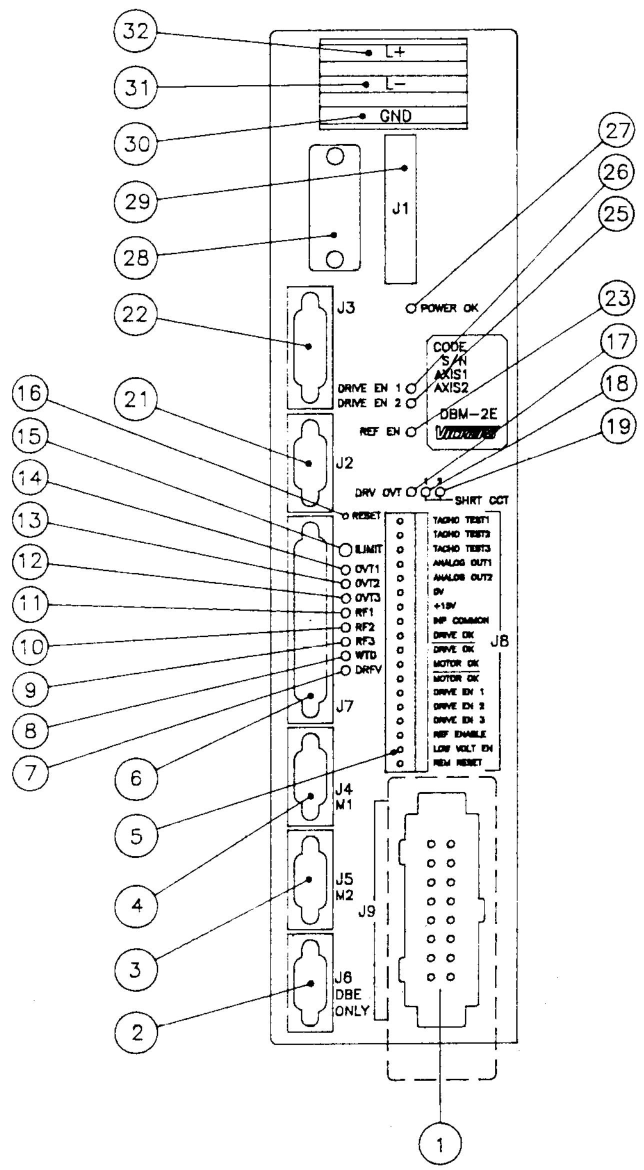


FIG. 1.6 - DBM-L (180 mm) 3-Axis Module

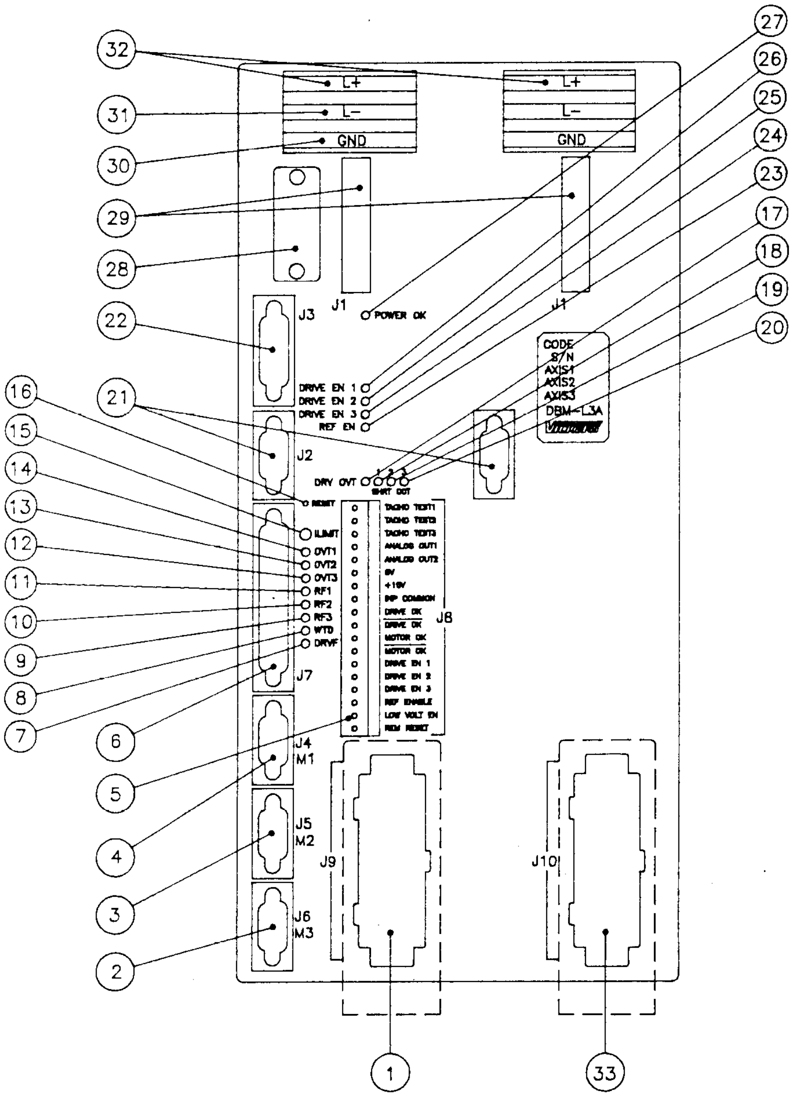


FIG. 1.7 - DBM-L (180 mm) 2-Axis Module

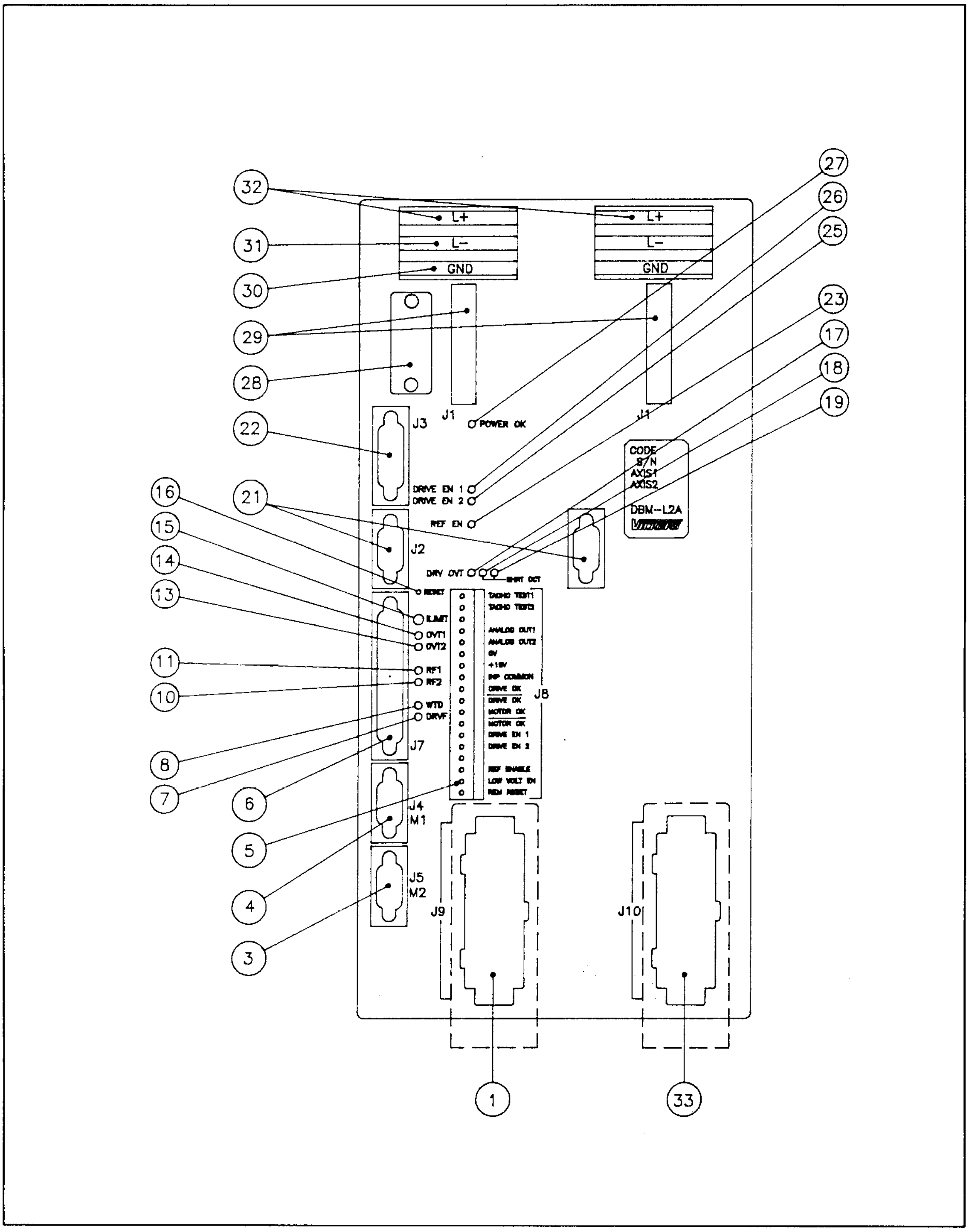
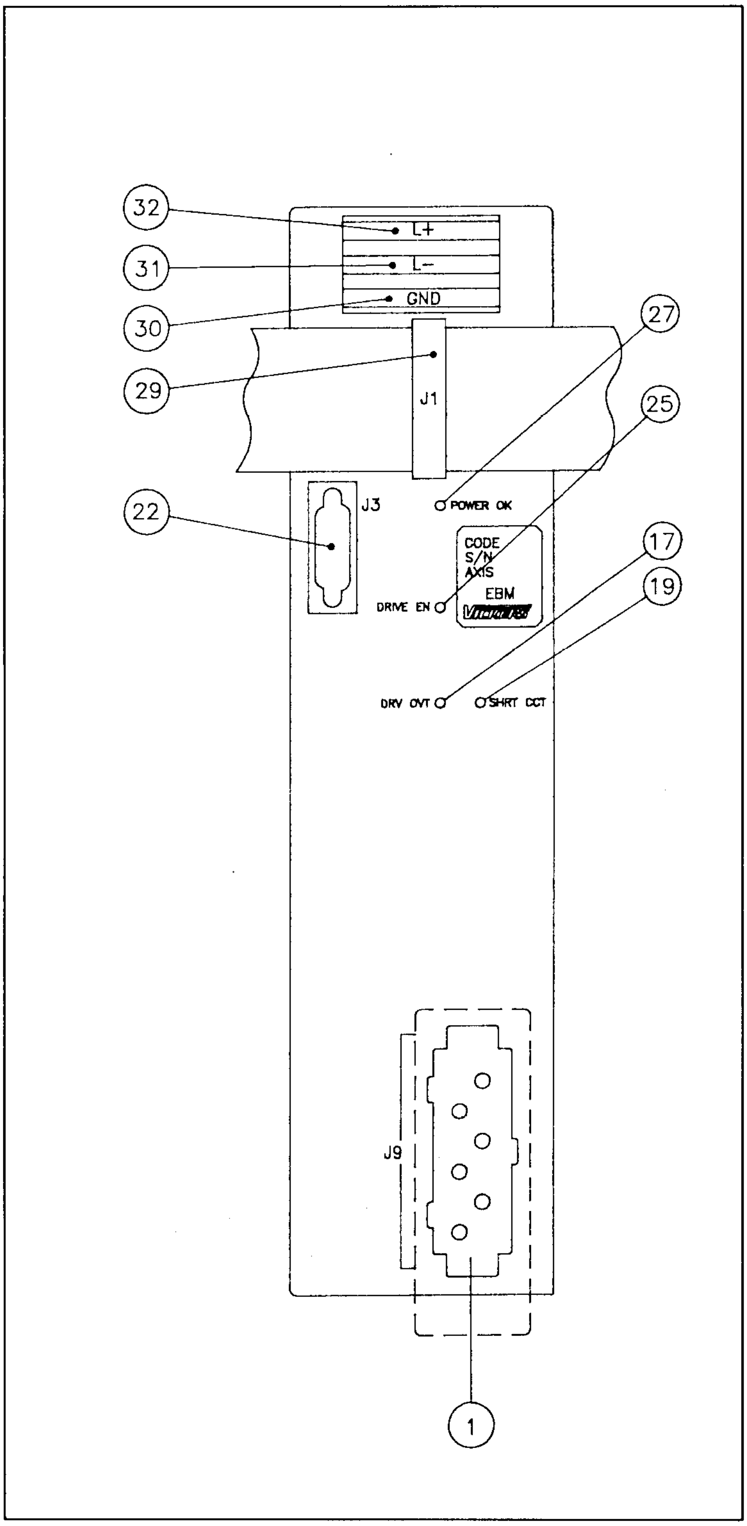


FIG. 1.8 - EBM Expansion Module (optional)



Tab. 1.5 - DBM Axis Module (See Fig. 1.3 to 1.8)

Pos.	Name	
1	J9	Motor phases (M1-M2-M3) connector
2	J6 M3	Resolver M3 connector
3	J5 M2	Resolver M2 connector
4	J4 M1	Resolver M1 connector
5	J8	I/O signals connector
6	J7	connector for analog references and simulated encoder output
7	Red LED DRFV	generic fault: the fault can correspond, according to the type, to a LED on the front end; if other red LED's are not on, out of the considered one, it is necessary to interrogate the drive via serial link to know the fault reason (see FA command)
8	Red LED WTD	Watch dog - signal; microprocessor circuit faults; this LED is on during reset
9	Red LED RF3	Resolver 3 fault - signal; resolver M3 fault, sin /cos signals interrupted, short circuit between signals or 10kHz carrier abnormal
10	Red LED RF2	Resolver 2 fault - signal; resolver M2 fault, sin /cos signals interrupted, short circuit between signals or 10kHz carrier abnormal
11	Red LED RF1	Resolver 1 fault - signal; resolver M1 fault, sin /cos signals interrupted, short circuit between signals or 10kHz carrier abnormal
12	Red LED OVT3	Motor M3 overtemperature
13	Red LED OVT2	Motor M2 overtemperature
14	Red LED OVT1	Motor M1 overtemperature
15	Trimmer ILIMIT	all axes peak current control (only for setup technicians); if current limit is required see IL, DL, AL commands
16	Push button RESET	digital control card reinitialization
17	Red LED DRV OVT	module overtemperature
18	Red LED SHRT CCT	short circuit on axis 1 (motor phases)
19	Red LED SHRT CCT	short circuit on axis 2 (motor phases)
20	Red LED SHRT CCT	short circuit on axis 3 (motor phases)
21	J2	RS485 input port and PWRS-fault signals connector
22	J3	Expansion connector for two axis module; on three axis module some pins of this connector are used as test points
23	Green LED REF EN	Reference enabled - signal: three - axis speed reference enable (see Tab. 1.12/ pos. 16)

24	Green LED DRIVE EN 1	Axis 1 enable (see also ON command)
25	Green LED DRIVE EN 2	Axis 2 enable (see also ON command)
26	Green LED DRIVE EN 3	Axis 3 enable (see also ON command)
27	Green LED POWER OK	Auxiliary power OK
28		Personality card: it contains drive setup in a non volatile memory
29	J1	Auxiliary power supply flat connector
30	GND	Ground
31	L-	BUS BAR -HV 300Vdc
32	L+	BUS BAR +HV 300Vdc
33	J10	Motor phases (M1-M2-M3) connector for DBM-L module

Tab. 1.6 - DBM Module, EBM Expansion - J1 Connector
Auxiliary Power Supply

Pos.	Name	
1		N.C.
2		N.C.
3		- 15Vdc referred to -HV (300Vdc)
4		+ 18Vdc referred to -HV (300Vdc)
5		150kHz square wave to high side drives
6		N.C.
7		+ 18Vdc referred to logic 0V
8		- 18Vdc referred to logic 0V
9		+ 8Vdc referred to logic 0V
10		+ 8Vdc referred to logic 0V
11		Logic 0V
12		Resolver 0V
13		10kHz sinusoidal wave for resolver and synchronism (carrier)

Tab. 1.7 - DBM Module - J2 Connector -
Power Supply Flat and RS485 Port Signals

Pos.	Name	
1		+Rx
2		N.C.
3		+Tx
4		PWRS fault 1 - power supply binary coded faults
5		+5Vdc output referred to logic 0V
6		-Rx
7		logic 0V
8		-Tx
9		PWRS fault 2 - power supply binary coded faults

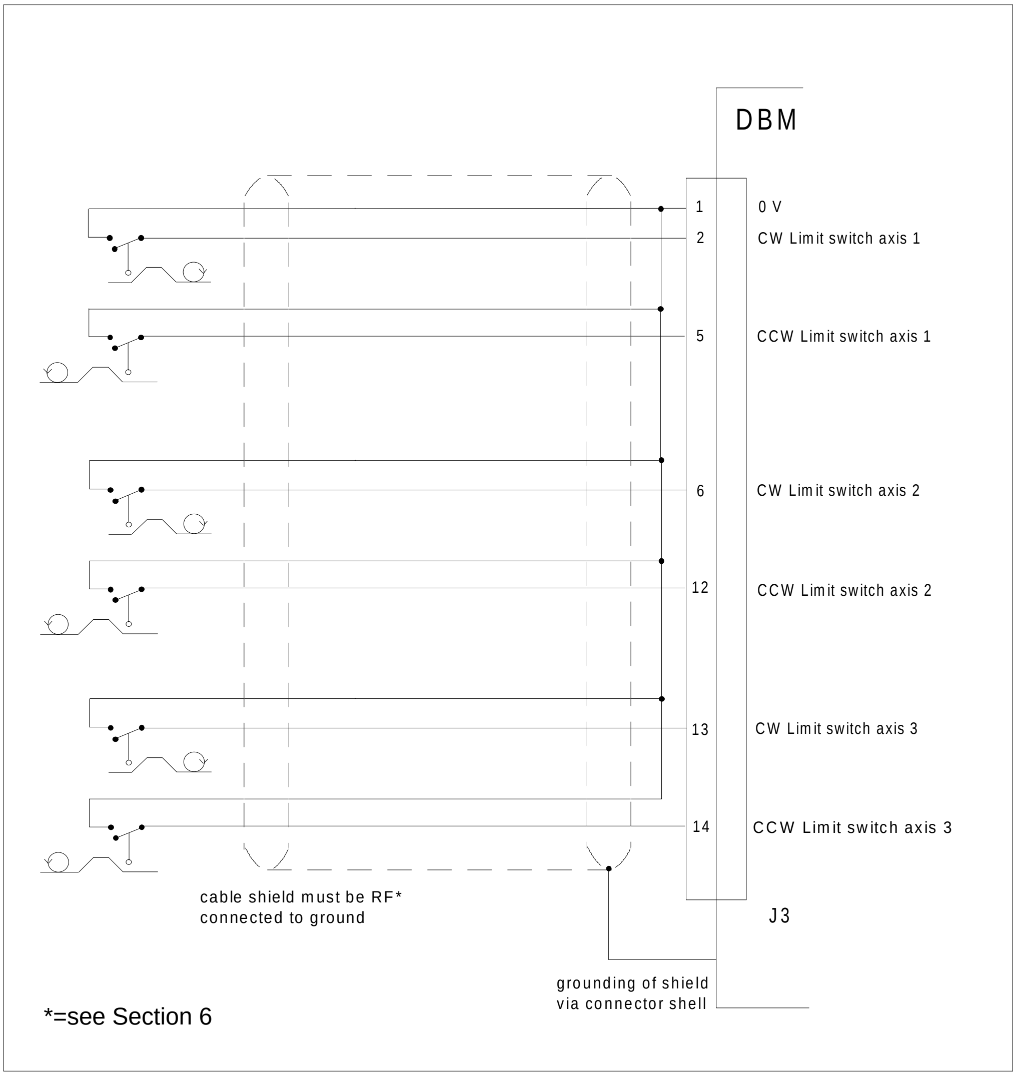
Note: In case of fault, the type of fault is as follows:

J2/pos. 4	J2/pos. 9	
0	0	OK
0	1	DBR FAULT. Recovery fault
1	0	OVER TEMP. Overtemperature
1	1	PHASE FAULT.

Tab. 1.8 - DBM Module - J3 Connector
Expansion Connection

Pos.	Name	
1		0V common
2		Auxiliary voltages referred to logic 0V not OK input signal
3		Phase U reference current output signal
4		Torque enabled output signal
5		Short circuit input signal
6		Overtemperature input signal
7		Expansion present input signal
8		Overtemperature output signal
9		N.C.
10		Phase V reference current, output signal
11		Overtemperature input signal
12		Non - coherent current input signal
13		BUS BAR fault input signal
14		Auxiliary voltages referred to - HV (300Vdc) not OK, input signal
15		N.C.

FIG. 1.9 - Limit Switches Wiring



Tab. 1.9 - DBM Module J3 Connector (when EBM Expansion is not present)
Limit Switches Connection (see Fig. 1.9)

The J3 connector allows, when the Expansion is not present, the availability of CW/CCW limit switches for each axis. With the input enabled (to 0V), the rotation is disabled in one direction and enabled in the other direction.
When the Expansion is present, the J3 connector is used for signal connection to the Expansion module.

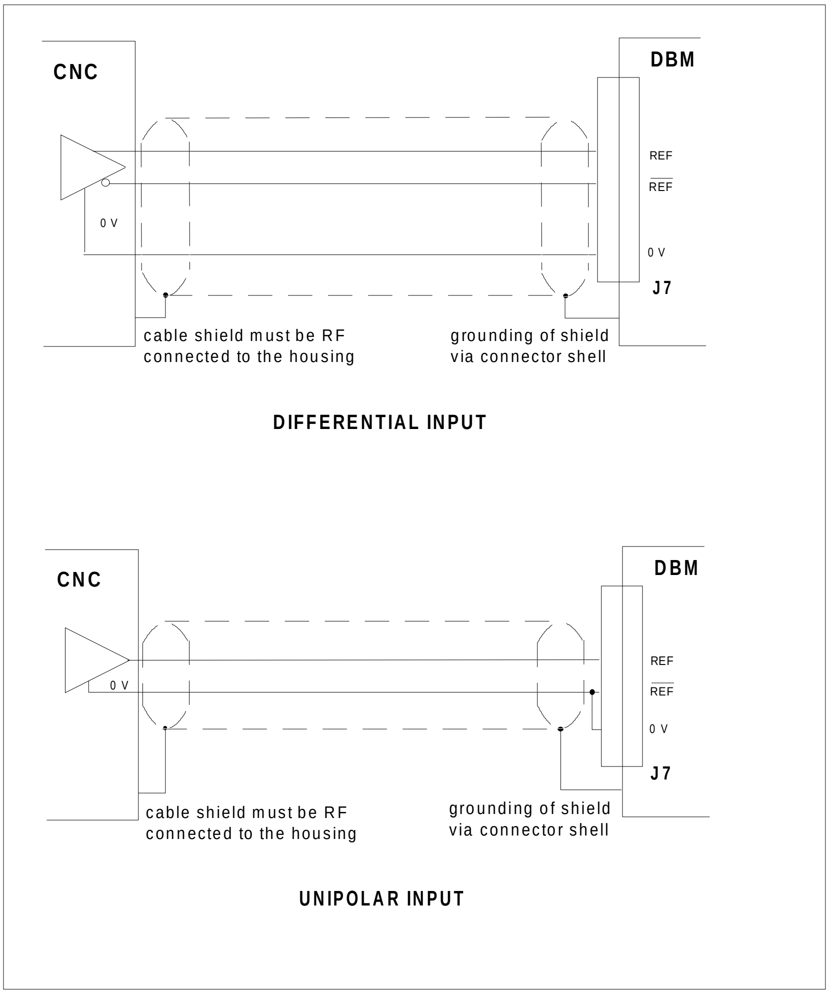
Pos.	Name	
1		0V common
2		CW limit switch, axis 1
3		N.C.
4		N.C.
5		CCW limit switch, axis 1
6		CW limit switch, axis 2
7		N.C.
8		N.C.
9		N.C.
10		N.C.
11		N.C.
12		CCW limit switch, axis 2
13		CW limit switch, axis 3
14		CCW limit switch, axis 3
15		0V common

Note: CW means clockwise rotation when viewed from shaft end, with default DI command.

Tab. 1.10 - DBM Module - J4 - J5 - J6 Connectors
Resolvers

Pos.	Name	
1	cos	Differential cos signal non-inverted input
2	$\overline{cos}$	Differential cos signal inverted input
3	Shield	Internally connected to 0V common
4	sin	Differential cos signal non-inverted input
5	$\overline{sin}$	Differential cos signal inverted input
6	PTC	Motor PTC input
7	0V	0V common. Special for 10kHz carrier
8	PTC	Motor PTC input
9	V ref	20 Vpp/ 10kHz sinusoidal output signal for supplying primary resolver winding (carrier)

FIG. 1.10 - Speed Reference Wiring



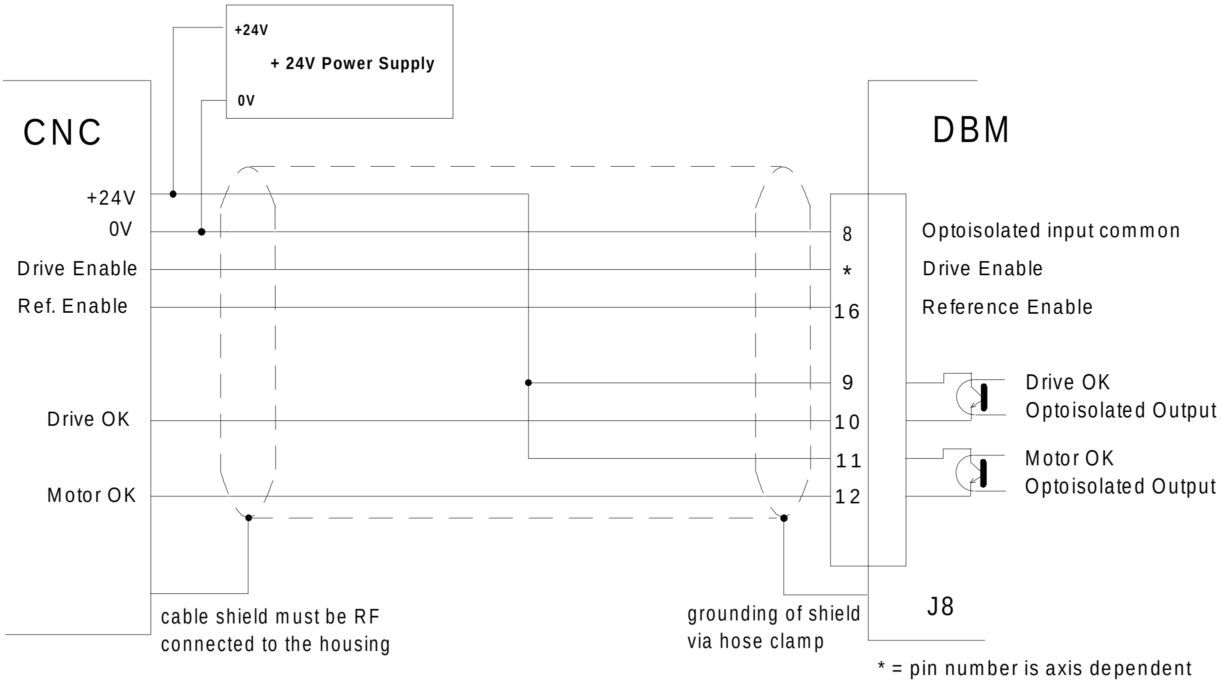
Tab. 1.11 - DBM Module - J7 Connector
Analog Inputs and Simulated Encoder Outputs

Pos.	Name	
1		Logic 0V (it can be used as common for analog output supplies ±15V)
2	$\overline{A1}$	encoder output: inverted phase A - motor 1
3	$\overline{B1}$	encoder output: inverted phase B - motor 1
4	$\overline{C1}$	encoder output: inverted phase C - motor 1
5	$\overline{A2}$	encoder output: inverted phase A - motor 2
6	$\overline{B2}$	encoder output: inverted phase B - motor 2
7	$\overline{C2}$	encoder output: inverted phase C - motor 2
8	$\overline{A3}$	encoder output: inverted phase A - motor 3
9	$\overline{B3}$	encoder output: inverted phase B - motor 3
10	$\overline{C3}$	encoder output: inverted phase C - motor 3
11	TP2	Testing point 2
12	ILIMIT3	Analog input I limit axis 3, referred to analog 0V 0V = zero current +10V (or not connected) = max current
13	ILIMIT2	Analog input I limit axis 2, referred to analog 0V (0 to +10V)
14	ILIMIT1	Analog input I limit axis 1, referred to analog 0V (0 to +10V)
15		Shield. Internally connected to 0V
16	$\overline{REF3}$	Differential inverting analog input for the speed reference signal (or torque ref. signal, see TC command) axis 3, max range ±10V (see MR command). See Fig. 1.10.
17	$\overline{REF2}$	Differential inverting analog input for the speed reference signal (or torque ref. signal, see TC command) axis 2, max range ±10V (see MR command). See Fig. 1.10.
18	$\overline{REF1}$	Differential inverting analog input for the speed reference signal (or torque ref. signal, see TC command) axis 1, max range ±10V (see MR command). See Fig. 1.10.
19		+15Vdc output (I max = 30mA)
20	A1	encoder output: phase A - motor 1
21	B1	encoder output: phase B - motor 1
22	C1	encoder output: phase C - motor 1
23	A2	encoder output: phase A - motor 2
24	B2	encoder output: phase B - motor 2
25	C2	encoder output: phase C - motor 2
26	A3	encoder output: phase A - motor 3
27	B3	encoder output: phase B - motor 3
28	C3	encoder output: phase C - motor 3

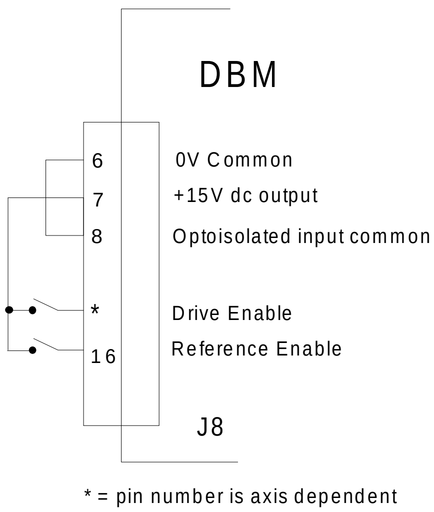
29	TP1	Testing point 1
30		Shield. Internally connected to 0V
31	DRIVE OK 1	Drive OK output, axis 1. Imax=5mA. 0V=not OK +5V=OK
32	DRIVE OK 2	Drive OK output, axis 2. Imax=5mA. 0V=not OK +5V=OK
33	DRIVE OK 3	Drive OK output, axis 3. Imax=5mA. 0V=not OK +5V=OK
34	REF3	Differential non-inverting analog input for the speed reference signal (or torque ref. signal, see TC command) axis 3, max range ±10V (see MR command). See Fig. 1.10.
35	REF2	Differential non-inverting analog input for the speed reference signal (or torque ref. signal, see TC command) axis 2, max range ±10V (see MR command). See Fig. 1.10.
36	REF1	Differential non-inverting analog input for the speed reference signal (or torque ref. signal, see TC command) axis 1, max range ±10V (see MR command). See Fig. 1.10.
37		- 15Vdc output (I max = 30mA)

REMARK: in DBM 01 version positions 31, 32 and 33 were assigned to differential inverting I Limit analog inputs. If this option was used, to change DBM 01 with DBM 03 it is necessary to properly specify <u>differential</u> analog I Limit input in the order (CG5502 code).

FIG. 1.11- Input/Output Wiring



+ 24V POWER SUPPLY



+ 15V INTERNAL SUPPLY
(for drive test)

Tab. 1.12 - DBM Module J8 Connector
I/O Commands and Signals

Pos.	Name	
1	TACHO TEST 1	tachometer analog output, axis 1. Range: see ET command
2	TACHO TEST 2	tachometer analog output, axis 2. Range: see ET command
3	TACHO TEST 3	tachometer analog output, axis 3. Range: see ET command
4	ANALOG OUT 1	analog output 1. Max current, velocity reference or velocity error outputs. See ES and SO commands.
5	ANALOG OUT 2	analog output 2. Max current, velocity reference or velocity error outputs. See ES and SO commands.
6	0V	0V common
7	+15V	+15Vdc output (Imax = 30mA)
8	OPTO 0V	Optoisolated 0V
9	DRIVE OK	Collector of Drive OK optoisolator
10	$\overline{\text{DRIVE OK}}$	Emitter of Drive OK optoisolator
11	MOTOR OK	Collector of Motor OK optoisolator
12	$\overline{\text{MOTOR OK}}$	Emitter of Motor OK optoisolator
13	DRIVE EN1	Drive enable 1: optoisolated input for axis 1 torque enable. See Fig. 1.11.
14	DRIVE EN2	Drive enable 2: optoisolated input for axis 2 torque enable. See Fig. 1.11.
15	DRIVE EN3	Drive enable 3: optoisolated input for axis 3 torque enable. See Fig. 1.11.
16	REF EN	Reference enable: optoisolated input for the confirmation of the common reference to the three axis (REF EN not active means no speed reference or zero torque)
17		N.C.
18	REM RESET	Remote reset: optoisolated input for logic section reset, equivalent to push button on the front panel

Tab. 1.13 - EBM Expansion (optional) - J3 Connector
(See Fig. 1.8)

Pos.	Name	
1		0V common
2		Auxiliary voltages referred to logic 0V not OK output signal
3		Phase U reference current input signal
4		Torque enabled input signal
5		Short circuit output signal
6		Overtemperature output signal
7		Expansion present input signal
8		Overtemperature input signal
9		NC
10		Phase V reference current, input signal
11		Overtemperature output signal
12		Non - coherent current output signal
13		BUS BAR fault output signal
14		Auxiliary voltages referred to +HV (300Vdc) not OK output signal
15		N.C.

Tab. 1.14 - Input/Output Characteristics

Optoisolated inputs Drive enable 1,2,3 Reference enable Remote reset	z in =1.2 kΩ I nom = 10 mA Imax = 20 mA Vmin = 15Vdc Vmax = 25V
Optoisolated outputs Drive OK Motor OK	z out = 1.2 kΩ I max = 20 mA Vnom < 25 Vdc
Analog tacho outputs 1,2,3	z out = 100 Ω I max = 5 mA Range: see ET command Gain error = ±10% over production spread Max linearity error: ±2% over full range
Analog outputs Analog Out1 Analog Out2	z out = 100 Ω I max = 10 mA Range: see ES command Full scale = ±10V
Velocity reference inputs 1,2,3	z in > 20 kΩ Range = see MR command Vmax = 12 V
Drive OK outputs 1, 2, 3	TTL compatible Fan-out = 5 LS-loads I max = 5 mA
Simulated Encoder differential output	z out = 100 Ω Full scale = 7V (differential)

FIG. 1.12 - Motor Phases Wiring (only one axis shown)

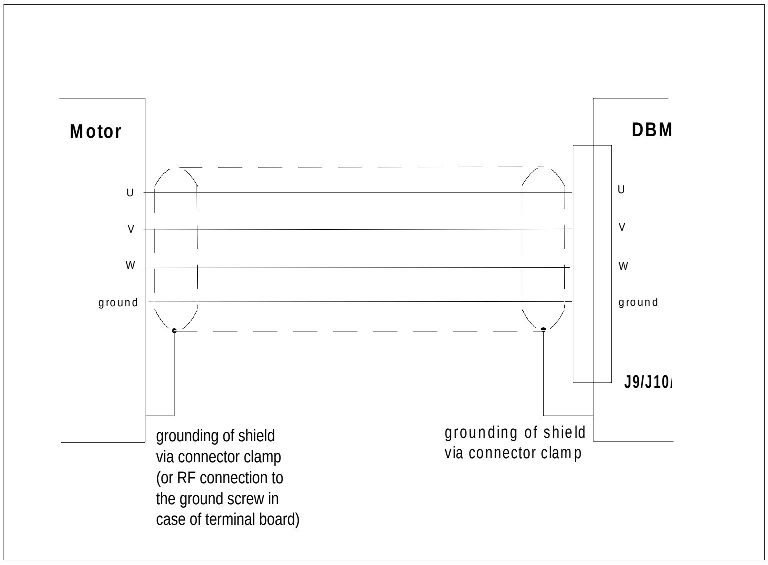
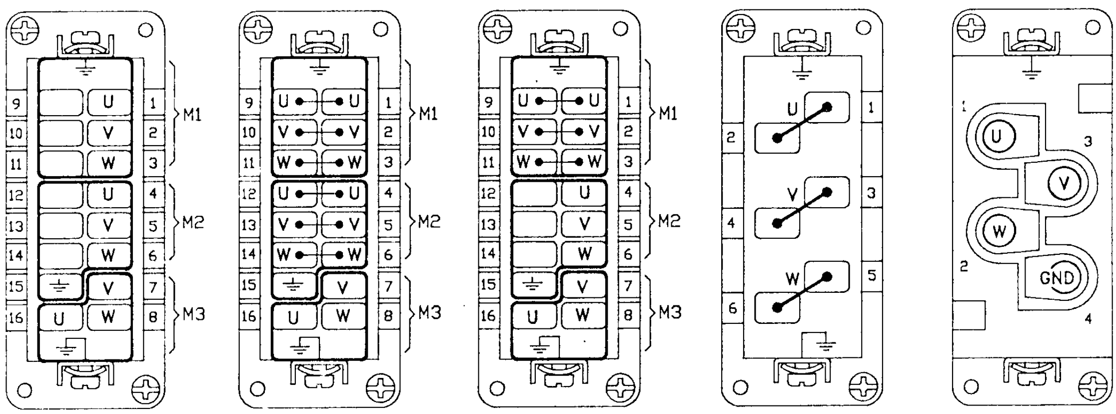


FIG. 1.13A DBM03 Module. J9 Connector. Motor Power (wiring side)

The configuration of this connector depends on the different combinations of sizes .
Notes: M1 always corresponds to the more powerful axis. M3 must not be connected in 2 axis configuration.



M1	M2	M3
5/15	5/15	5/15
10/25	5/15	5/15
10/25	10/25	10/25
10/25	10/25	5/15
15/45	10/25	10/25
15/45	5/15	5/15
15/45	15/45	15/45
15/45	15/45	5/15
15/45	15/45	10/25
15/45	10/25	5/15
5/15	5/15	
10/25	5/15	
15/45	5/15	
10/25	10/25	
15/45	10/25	
15/45	15/45	

M1	M2	M3
25/70	25/70	5/15
25/70	25/70	10/25
25/70	25/70	15/45
25/70	25/70	

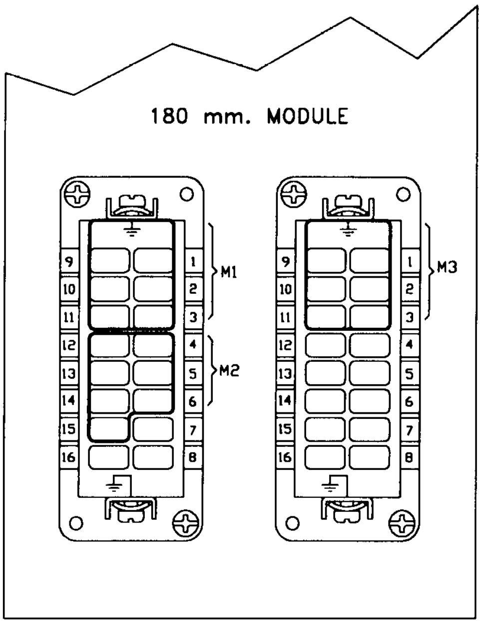
M1	M2	M3
25/70	5/15	5/15
25/70	10/25	10/25
25/70	15/45	15/45
25/70	10/25	5/15
25/70	15/45	5/15
25/70	15/45	10/25
25/70	5/15	
25/70	10/25	
25/70	15/45	

50/140
70/180

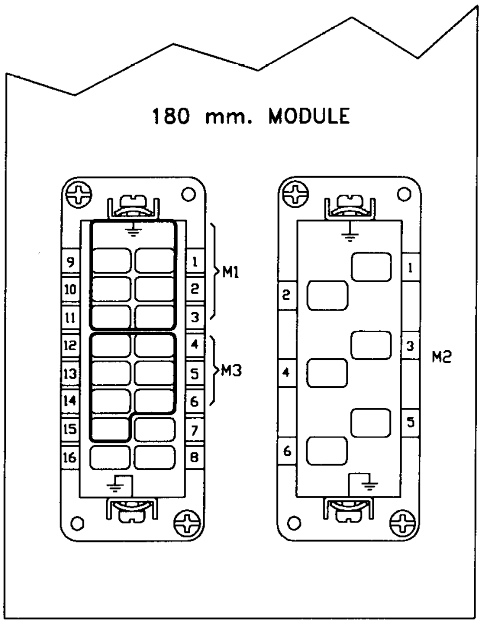
80/240

FIG. 1.13B DBM03-L (180 mm) Module. J9 and J10 connectors. Motor Power (wiring side)

The configuration of these connectors depend on the different combinations of sizes .
Notes: M2 always corresponds to the more powerful axis. M3 must not be connected in 2 axis configuration. For U-V-W positions see Fig. 1.13A.



M1	M2	M3
25/70	25/70	25/70



M1	M2	M3
5/15	50/140	5/15
5/15	70/180	5/15
10/25	50/140	5/15
10/25	70/180	5/15
10/25	50/140	10/25
10/25	70/180	10/25
15/45	50/140	5/15
15/45	70/180	5/15
15/45	50/140	10/25
15/45	70/180	10/25
15/45	50/140	15/45
15/45	70/180	15/45
25/70	50/140	5/15
25/70	70/180	5/15
25/70	50/140	10/25
25/70	70/180	10/25
25/70	50/140	15/45
5/15	50/140	
5/15	70/180	
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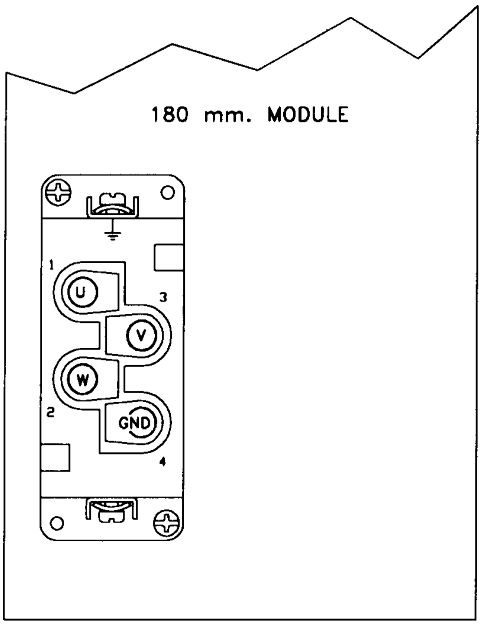
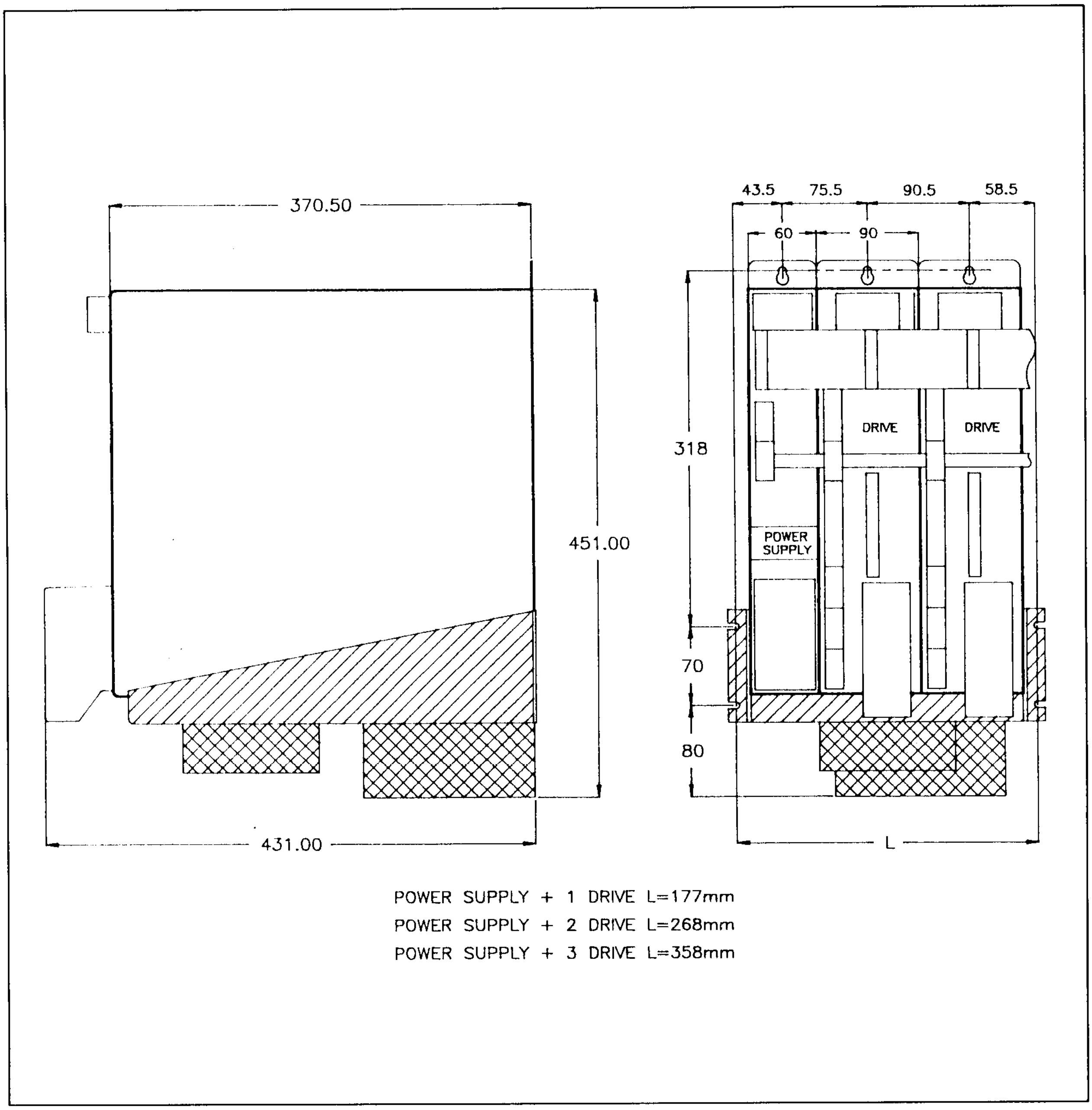
15/45	50/140	
15/45	70/180	
25/70	50/140	
25/70	70/180	



EBM	80/240

1.9 Dimensions
FIG. 1.14 - Dimensions (in mm).

Note: for DBM-L modules (180 mm), dimensions are the same as two side by side standard modules



1.10 Fans

The ventilation is provided by fans mounted under the modules. The size and the number of fans are according to the system configuration.

Fan input voltage is 230 Vac (or 110 Vac optional). The input power is 60 W for each pair of fans.

CAUTION: a free circulation must be guaranteed for the air flow.

TAB. 1.15 - FANS.

MODEL	INPUT VOLTAGE (V~)	PAIR OF FANS	CONFIGURATION
DBM F2	230	1	DBM-PS + 1 DBM
DBM F3	230	1	DBM-PS + 2 DBM
DBM F4	230	2	DBM-PS + 3 DBM
DBM F5	230	3	DBM-PS + 4 DBM
DBM F2 (110V)	110	1	DBM-PS + 1 DBM
DBM F3 (110V)	110	1	DBM-PS + 2 DBM
DBM F4 (110V)	110	2	DBM-PS + 3 DBM
DBM F5 (110V)	110	3	DBM-PS + 4 DBM

Note: to size the fans a DBM-L (180 mm) module counts as two DBM modules.

Example: DBM-PS, one DBM module and one DBM-L (180 mm) module, requires a DBM F4 fan type.

1.11 Recovery Circuit

The recovery circuit is formed by a switching regulator, a recovery transistor and a recovery resistance. While braking the motor returns energy which cannot be sent to the line since the rectifier circuit is not regenerative. Returned energy tends to increase the BUS BAR DC voltage. When HV reaches 375V the switching regulator brings the recovery transistor into conduction, thus connecting the recovery resistance in parallel with filter capacitors. The recovery resistance is formed by enameled wire fixed resistor(s).

If the recovery resistance works for intervals shorter than the time necessary to reach thermal equilibrium, the resistor can temporarily handle power levels up to 10 times the nominal power rating of the resistor (short time overload).

If not specifically requested, systems are provided with standard 3.9 Ω, 370W recovery resistor.
An oversized Power Supply with three 8.2 Ω, 370 W (parallel configuration) is available.

WARNING: an unusual application with motor driven by the load, a large portion of the time, could result in overheating of the recovery resistor.
An unusual application with motor driven by high inertial load from high velocity in very short deceleration time could result in the explosion of the input capacitor.
It is suggested contacting our Customer Service.

WARNING: do not touch recovery resistor during operation to avoid scalds.
Ventilated enclosures containing dynamic braking resistors shall provide a degree of protection of at least IP22 (according to EN 60204-1, par. 13.3).

1.12 Standard Configurations

The modules are available in almost all combinations in the multiple version (see Fig.1.13A and 1.13B).
We recommend to contact our Sales Locations or Service Centers for guidance on correct selection of drives.

1.13 Block Diagrams

FIG. 1.15 - Power Supply, block diagram

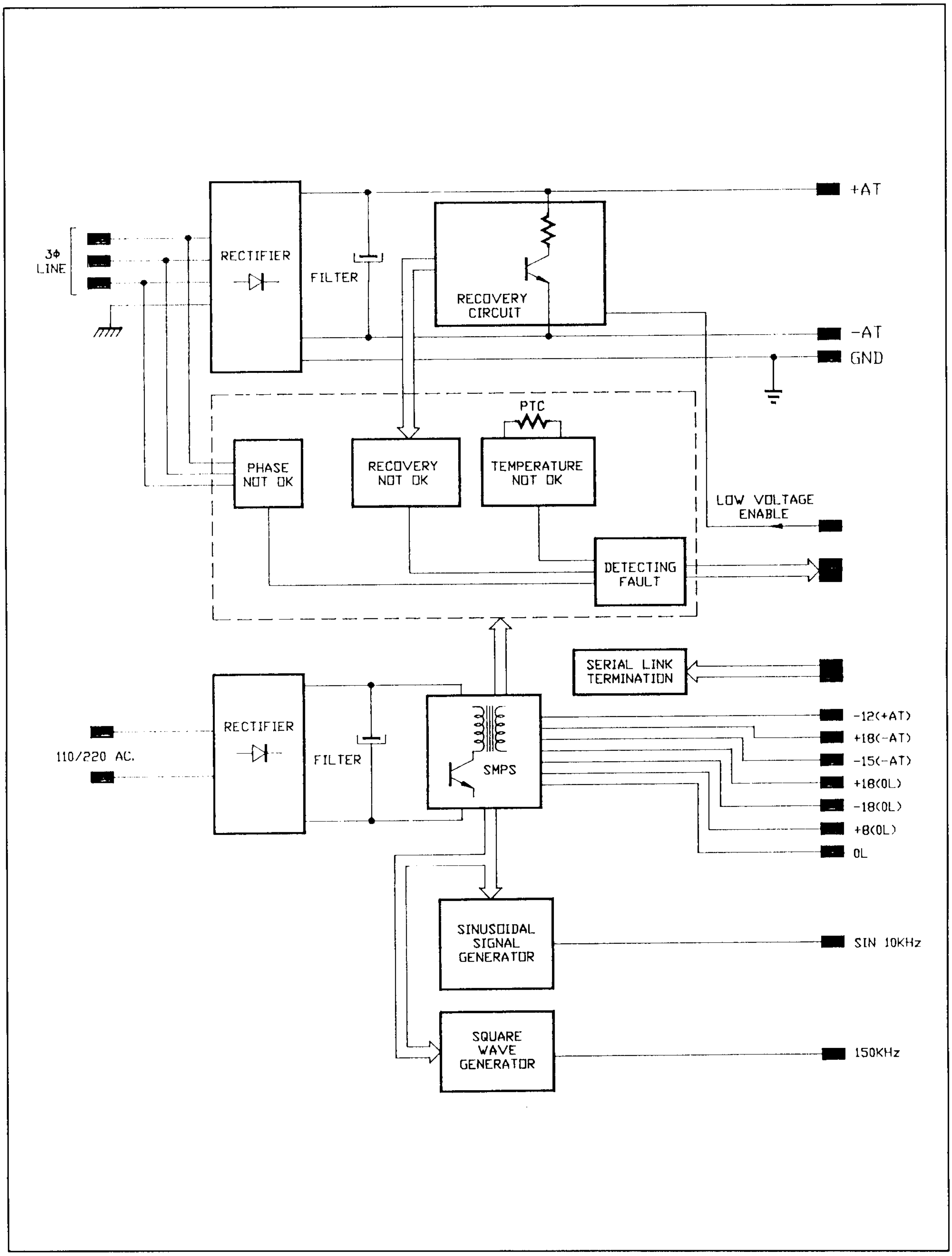


FIG. 1.16 - Digital Section, block diagram

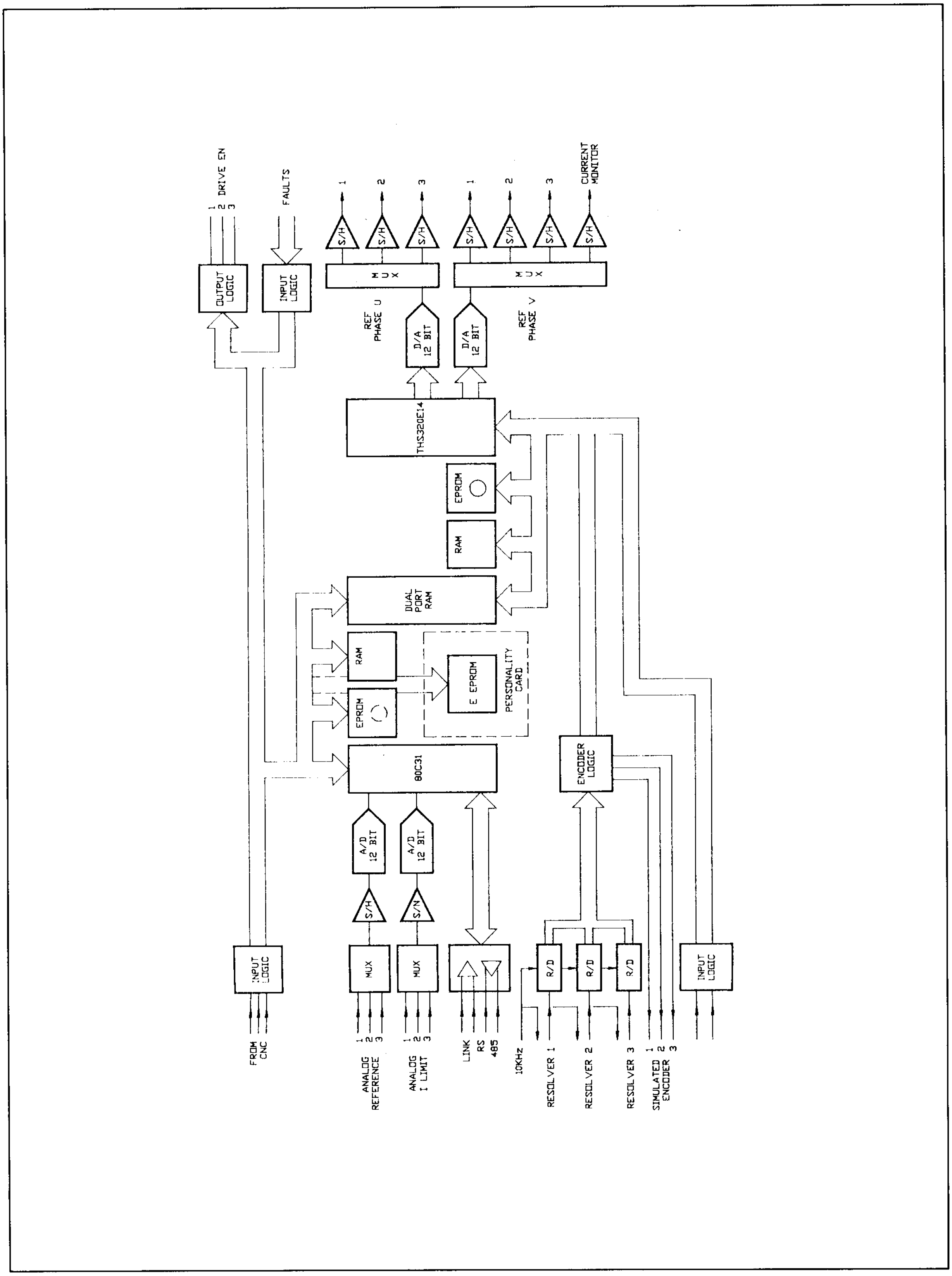


FIG. 1.17 - Analog Section, block diagram

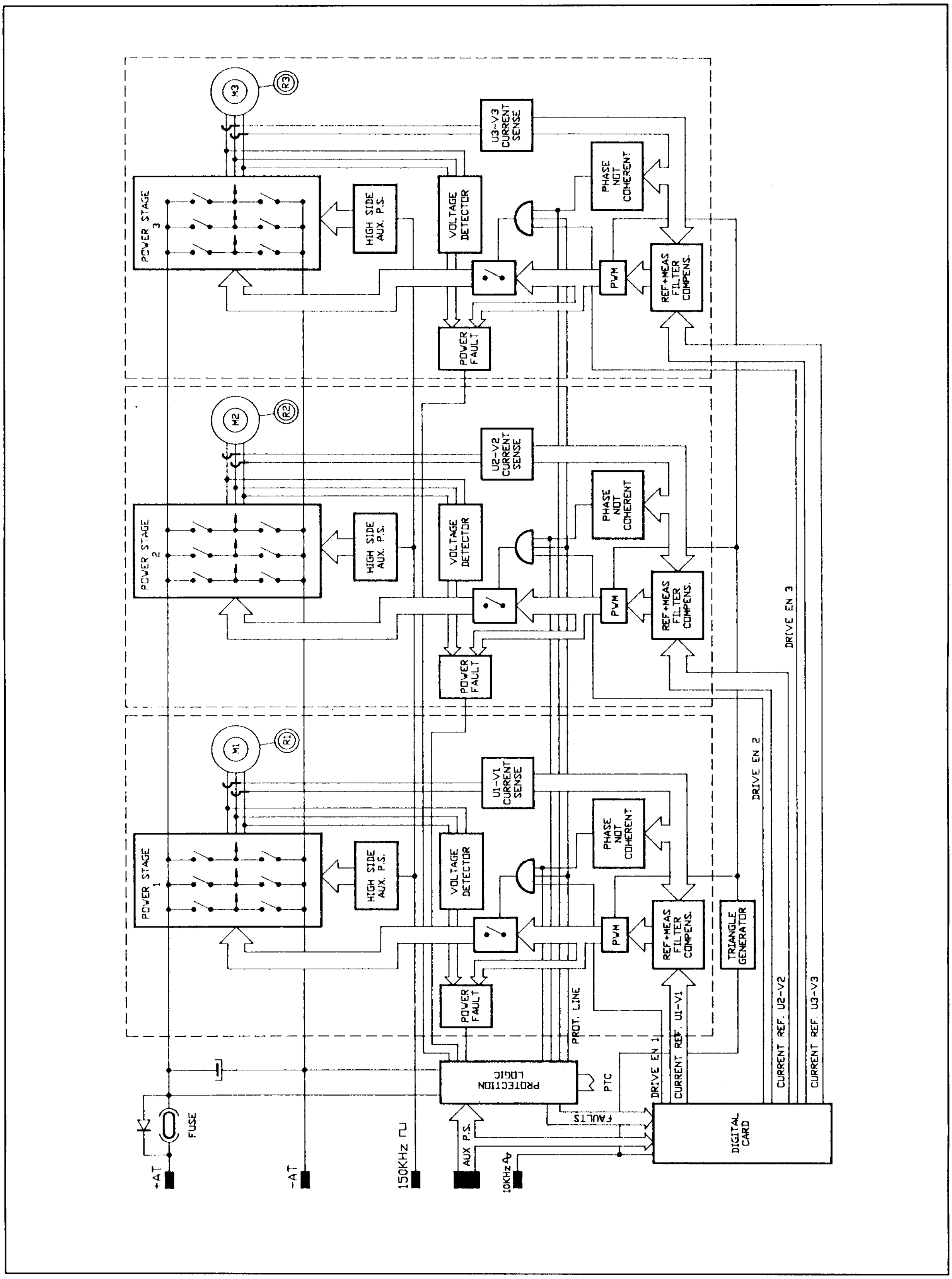
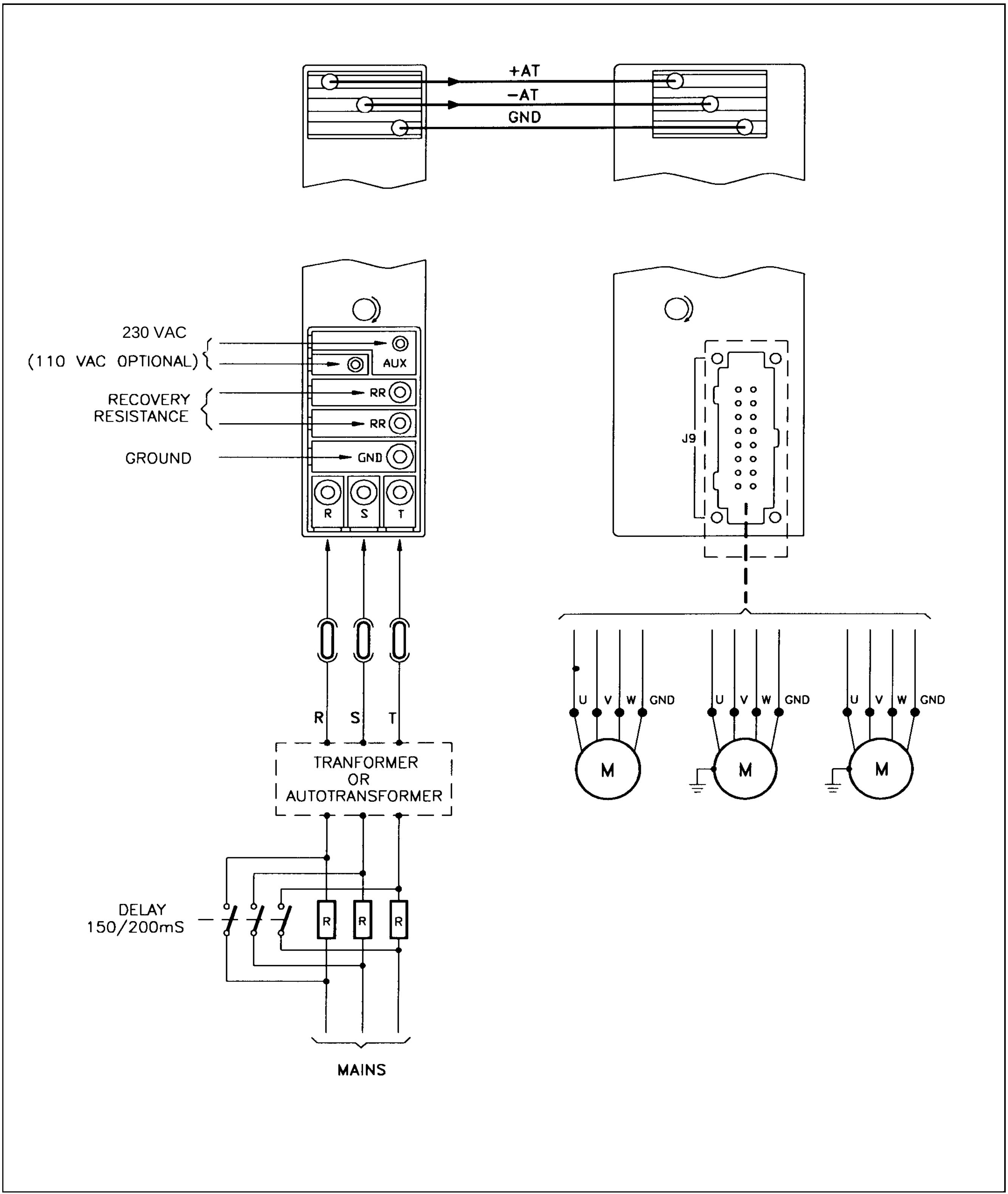


Fig. 2.1 - Transformer Connections



Section 2 - Installation

2.1 Wiring

This section provides the necessary information to properly wiring the digital brushless system.

1. Mains connections via transformer or autotransformer.
2. Resolver and motor power wiring.
3. Signals wiring.
4. Other wiring.

2.1.1 Mains Connections via Transformer or Autotransformer

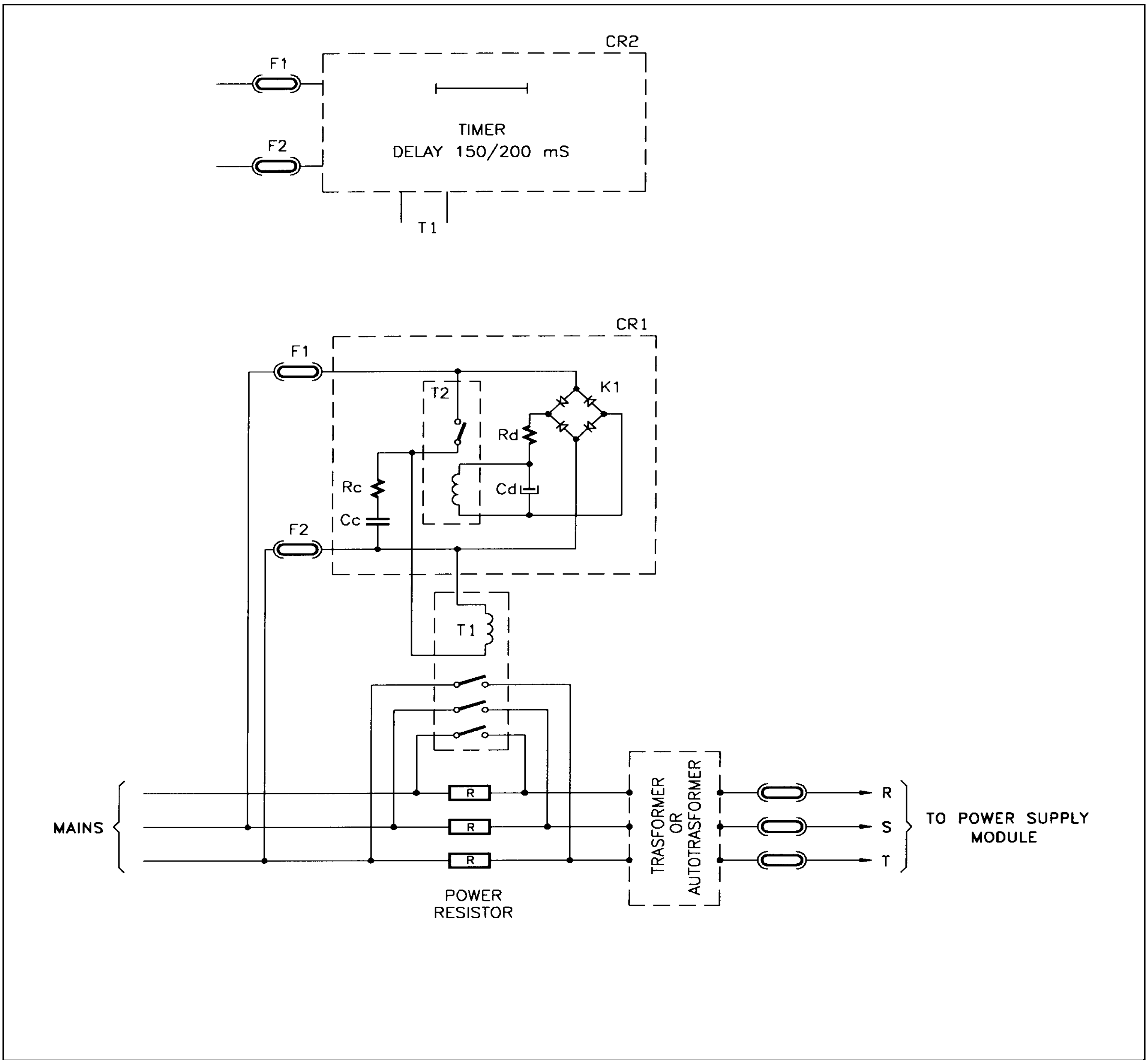
Figure 2.1 shows the electric diagram for transformer or autotransformer connection (from three-phase mains voltage to 230V). See Appendix D for a correct sizing.

If a transformer is used it is recommended to set the - HV to the ground, the secondary neutral remaining floating. It is recommended to use star primary winding and delta secondary winding.

If an autotrasformer is used, the -AT must not be connected to the ground.

REMARK: the auxiliary supply must be independent from the power supply, if the fault information (see FA command) is to be retained in case of a mains failure.

Fig. 2.2 - Soft Start



2.1.2 Soft Start

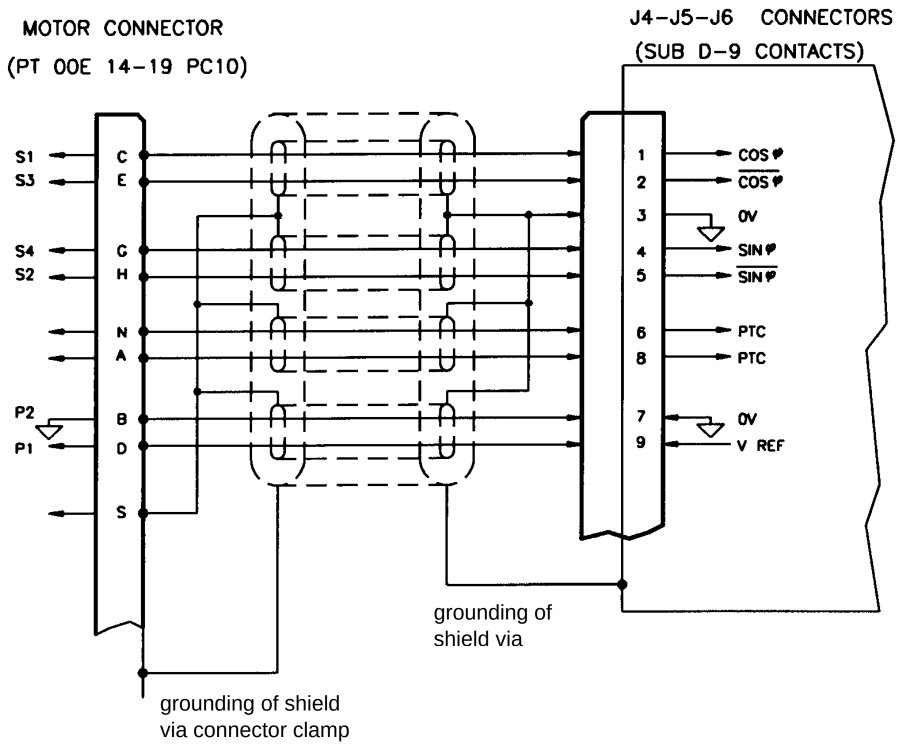
Figure 2.2 shows a current limit circuit for a standard configuration (1 Power Supply and 3 modules): it is not strictly necessary for the system operation, though it is recommended to limit the current through R-S-T phases on power up, as filter capacitors at power supply input are uncharged and can require very high instantaneous current.

The three limit resistors must be short-circuited after 150 to 200 ms. They must be of high energy type (to charge/uncharge capacitors) and must be rated 10 to 20 Ω, 100W.

The delay can be achieved by a timer (CR2 in Fig. 2.2) or by the circuit marked CR1 in Fig. 2.2. In this case the component list is as follows:

Cc	: capacitor 0.1 μF, 250V
Cd	: electrolytic capacitor 20 μF, 250V
F1, F2	: fuse 315 mA,- 250V
K1	: bridge rectifier 1A, 400V
Rc	: resistor 22 Ω, 5 W
Rd	: resistor 10 kΩ, 5 W
T2	: relay SPST 5A, 220V, coil 110 V, 10 kΩ

FIG. 2.3 - Resolver Wiring



RESOLVER CABLE		MOTOR CONNECTOR
OUTPUT	SIGNAL	PIN
S1	COS	C
S2	$\overline{\text{SIN}}$	H
S3	$\overline{\text{COS}}$	E
S4	SIN	G
P1	Vref	D
P2	0V	B
SHIELD		S
PTC		A
PTC		N

2.1.3 Resolver Wiring

Each DBM module can be connected up to 3 resolvers via the following connectors:

J4 M1 : axis 1 resolver
J5 M2 : axis 2 resolver
J6 M3 : axis 3 resolver

A cable with 4 pair, each pair twisted and individually shielded with an independent overall shield is recommended. 22 AWG (0.38mm^2) to 20 AWG (0.6 mm^2) can be used.

Resolver cables must be separated from power cables by a distance of 30cm (12 inches) by using a independent duct (conduit). It is recommended to avoid intermediary connections for resolver cables.

Figure 2.3 shows the wiring lay-out of the resolver with differential output.

2.1.3 Motor Power Wiring

There are seven different motor power connections, depending on module configuration (See Fig. 1.12 and 1.13).

REMARK: motor power cables must be shielded.

2.1.5 Signals Wiring

All the enable signals and OK signals must be connected.

REMARK: it is suggested to connect the isolated output "DRIVE OK" to a remote control switch so that, if a fault occurs, the power supply is disconnected to avoid system damages.

2.1.5.1 Simulated Encoder Signals Wiring

Encoder signals cable must be shielded. For lengths in excess of 5 m (16 ft.) the cable must have 3 pairs, each pair twisted.

REMARK: in noisy environments it is suggested to connect a 220 ÷ 680 Ω resistor between A and $\overline{A}$, B and $\overline{B}$, C and $\overline{C}$ at the receiver input.

2.1.6 Serial Link Wiring

CAUTION: the serial link must be shielded and must be separated from the power cable through the use of independent duct (conduit).

2.1.7 Serial Link Connection

REMARK: for the first installation it is strongly recommended to use either the optional keypad or the DBTALK communication program.

2.1.7.1 Keypad

The keypad is an optional accessory product which can be used for drive setup and monitoring. It must be connected to J10 connector.
If problems occur when attempting to communicate, the keypad is most likely set incorrectly.
To start the setup procedure press <CTRL>, then <CR>. For each parameter the current setting is displayed, together with a question asking if you want to change it.
The correct setting is:

BAUD = 9600
WORD = 8D+E+1 STOP
BLOCK MODE
SINGLE LINE MODE
FLASHING OFF
KEY REPEAT ON SLOW

Be sure to save at the end of the procedure by pressing <Y> when the display shows: "Make changes permanent Y/N".

2.1.7.2 DBTALK Communication Program

See Appendix B.

2.1.8 Other Wiring

- the braking resistor
- the flat cable for auxiliary supplies
- the keyboard (or PC)
- all the analog references

2.2 Installation

2.2.1 Starting Sequence

- Connect 230 Vac (or 110 Vac) single phase power supply.
- Multimodule configuration only. Disconnect the first module from the serial link and assign basic address to the second module and so on for the next modules (all the modules from factory being usually configured with address 1,2,3 if 3-axis or with address 1,2 if 2-axis).

Example of basic address assignment for the 2nd module, the first module being triple-axis:

FROM KEYBOARD (see Chapter 3 for a detailed description of commands)

1 SA 4 <CR>	Assign basic address 4 to the second module (its primary axis)
4 SV <CR>	Save the address configuration

Note: a module programmed as "address 4" will automatically assign for the other axes the following addresses, i.e. 5 - 6 (if triple-axis) or 5 (if double-axis); and so on for the next basic addresses.

• Check if NP (pole number), MV (max velocity) and MR (max reference) parameters are OK for the application.

• Make a hardware reset via button on drive or via positive logic on pin 18 of J8 connector (software reset via FA command being useless for digital control card reinitialization).

• Connect 230Vac three phase power supply.

WARNING: HIGH VOLTAGE - DISCHARGE TIME APPROX. 6 MINUTES.

2.2.2 "Keyboard" or "Opto" Priority

On the personality card there is a jumper (G2) (See Fig. 2.4) which gives priority to keyboard or to opto to execute "Drive Enable" command. " Drive Enable" opto isolated signals are connected to J8/ pos.13, 14, 15.

G2 opened (position 2-3) = keyboard priority = the keyboard (or the device connected to the serial link) is the master, i.e. it allows to enable or disable motor current, whereas the optocouplers can only disable (protection); they can enable after resetting only.

The "Drive Enable" and "Reference Enable" opto-isolated signals must be driven at +15V.

Such a procedure, should be followed during installation and drive test.

G2 closed (position 1-2) =opto priority =the optocouplers are the master and the keyboard can only be used for parameters setup.

Note: "Drive Enable" priority is different from the use of the analog or digital reference.
You can choose an analog or digital reference by "AR" (Analog) or "DR" (Digital) commands, and save. The drives are supplied set to digital reference "DR".

2.2.3 Autophasing

Note: it is possible to limit the current in autophasing via IL command.

• Check that the motor is free to rotate in both directions.
• Check that no fault condition occurs (red DRVF leds off).
•The jumper G2 on the personality card must be opened.
• Check that all module axes have analog drive enable on via positive logic and digital drive enable off.
• Send the password command for the module.
• Send the autophasing command for every axis of the module and save.

Example for a double module with axis 4 and axis 5:

FROM KEYBOARD

4 PW91 <CR>	Enter the password for 2nd module (primary axis = 4)
PASSWORD ON	The correct answer is displayed
<CR>	Only for optional keyboard.
4 AP <CR>	Allow axis 4 autophasing.
AUTOPHASING IN PROGRESS	
AXIS PHASED	
5 AP <CR>	Allow axis 5 autophasing.
AUTOPHASING IN PROGRESS	
AXIS PHASED	
4 SV <CR>	Save module 4 phasing.

- Repeat the password and autophasing procedures for subsequent modules (if applicable).
- Make a hardware reset via button on drive or via positive logic on pin 18 of J8 connector.

2.2.4 Wiring Checks

After phasing each axis, it is possible to check the wiring by rotating the motor via its digital reference.

- Enable analog Drive Enable and Reference Enable via positive logic.
- Check that G2 is in position 2-3, for keyboard priority.
- Send to every axis the ON command (to enable digital Drive Enable) , the VE command (for CW slow rotation), the VE- command (for CCW slow rotation), the OF command (to disable the digital Drive Enable).

Example of checking axis 5 rotation:

FROM KEYBOARD

5 ON <CR>	Enable digital Drive Enable for axis 5
O	Drive Enable led will be on
5 VE 50 <CR>	Set CW rotation at 50 rpm
5 VE-50 <CR>	Set CCW rotation at 50 rpm
5 OF <CR>	Disable digital Drive Enable for axis 5
O	Drive Enable led will be off

2.2.5 CNC Priority

With CNC, the following procedures must be followed. This way the CNC is the master and the keyboard is the slave, as follows:

- Parameters managed by CNC: Drive Enable, Reference Enable, Speed References
- Parameters managed by keyboard (or PC): all dynamic parameters (acceleration, KI, KP, etc.), Status and Fault.

2.2.5.1 Setting of Analog References

To set the modules to use the analog references from the CNC, it is necessary to enter the password, to send the AR command to every axis and to save. ST command can be entered to check if the commands have been accepted.

Note that:
- AR command can be sent via global address (∗).
- If there are two or more modules, PW (password) and SV (save) commands can be sent to each module (not only to each axis).

Example of enabling all the analog references for two modules with axes 1,2,3 and 4,5:

FROM KEYBOARD

1 PW91 <CR>	Enter the password for 1st module (primary axis= 1)
PASSWORD ON	The correct answer is displayed
4 PW91 <CR>	Enter the password for 2nd module (primary axis = 4)
PASSWORD ON	The correct answer is displayed
* AR <CR>	Enable analog reference for all axes
1 SV <CR>	Save the configuration for 1st module
4 SV <CR>	Save the configuration for 2nd module
1 ST <CR>	Ask the status for axis 1
A1 ST___ E___ I_0___	Axis 1 status is displayed. Check the 0 in the 2nd bit after I (bit i)
...	Repeat ST command and check other axes

2.2.5.2 Drive Enable with CNC Priority

To give the priority for enabling and disabling the drive from the CNC, it is necessary to pull out the personality card from the module, install G2 jumper in position 1-2 (closed) and to pull in the card.

REMARK: if there are more than one module, do not swap the personality cards, this will swap the module data.

2.2.6 Velocity Offset

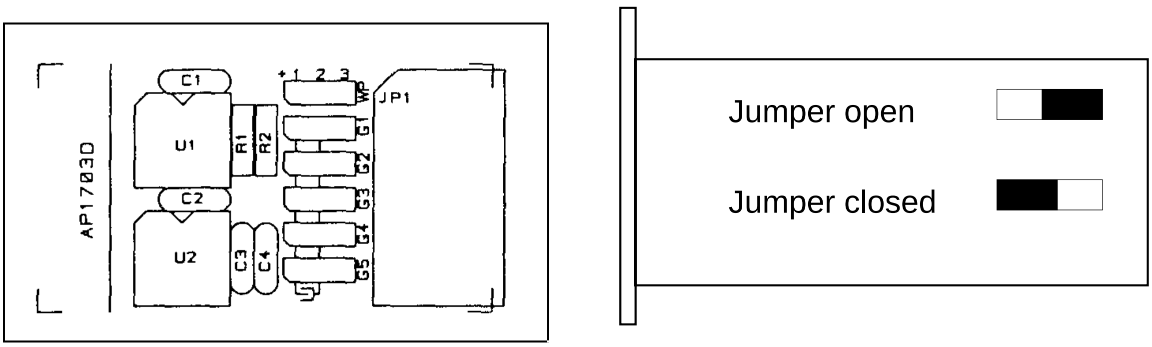
If it is necessary you can adjust the <u>analog</u> velocity offset by providing 0 analog speed reference and setting VO command for an automatic adjustment. A fine adjustment can be done with successive steps via OV command.
REMARK: the adjustment of the <u>digital</u> velocity offset must not be used to adjust the analog velocity offset and it is reserved to <u>setup technicians</u>. It can be made by providing 0 digital speed reference (VE=0) and setting OC command. The opto Drive Enable must be high.

2.2.7 Personality Card Jumpers

WP (default: open): if closed, the EEPROM is write protected and SV command disabled
G1 (default: open) : if closed, connects TX- of serial link to 0V via pull-down resistor
G2 : if closed, gives priority to "opto" , if open gives priority to "keyboard"
G3 (default: open) : if closed, set 9600 Baud rate and basic address 1
G4 (default: open) : if closed, connects TX+ of serial link to 5V via pull-up resistor
G5 (default: open) : if closed, connects a 120 Ω resistor between RX+ and RX- of serial link

CAUTION: it is recommended to close the WP jumper at the end of installation and setup.

Fig. 2.4 - Personality Card



REMARK: personality card of DBM 03 has a software different from DBM 01 personality card.
To change DBM 01 with DBM 03:
1. *Switch on DBM 03 with 230V mono-phase and replace the personality card with the old DBM 01 personality card with G2 and G3 jumpers closed*
2. *Reset the drive with reset button on front panel*
3. *Wait 30 sec*
4. *Switch off the drive*
5. *Restore G2 and G3 as before the removal*

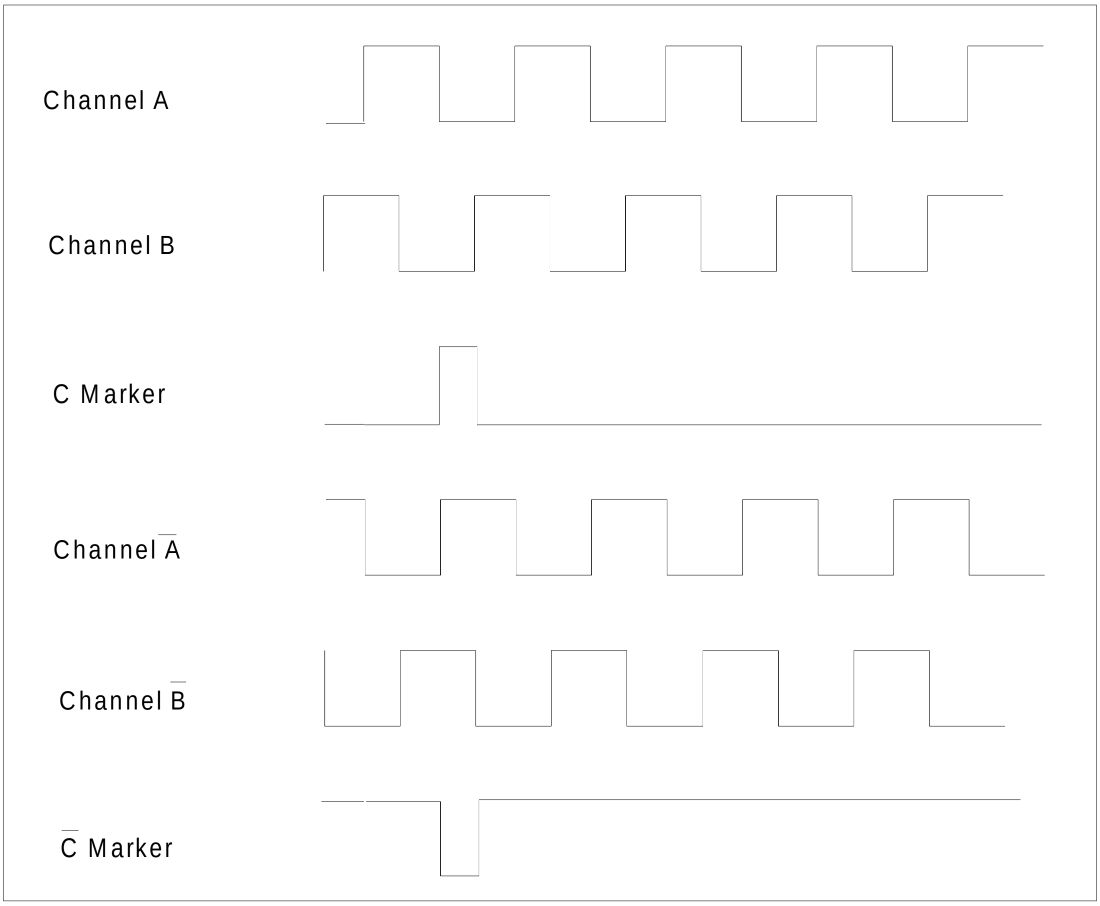
The personality card is now set to DBM 03 format. New parameters are: 1SO=1; 2SO=2; CU=128; CV=128; DF=0; ES=16; ET=80; PW=91, RN=RX=12; PR=3 and VS=0 for 2 pole resolver; PR=1 and VS=1 for 6 pole resolver; SE=1024 (if applicable).
Note: - if the number of pulses per revolution has to be different from 1024, SE parameter must be properly specified in the order
- after this setting the personality card cannot be used with DBM 01.
- with G2 and G3 closed DBM 03 does not work. The situation is as follows:
G2 open, G3 closed = keyboard priority, 9600 Baud, base address 1, password ON.
G2 and G3 closed = opto priority, reading of DBM 01 parameters (AC, AL/DL, AR/DR, BR, DE, IL, IT, KI, KP, MR, MV, NP, OC, PC, RS, SA), password OFF.

2.2.8 Resolver to Encoder (optional)

For position sensing a resolver to encoder option (simulated encoder) is available.
Encoder signals are 7V, 100 Ω impedance, as follows:

- 2 channels of square wave output with a resolution from 128 to 1024 pulses per electrical revolution. Channel B leads channel A by 90° for clockwise rotation when viewed from shaft end.
- 1 marker pulse per electrical revolution (i.e. 1∗ 3 = 3 marker pulses per mechanical revolution with a 6 pole resolver).
- complementary outputs $\overline{A}$, $\overline{B}$ and $\overline{C}$.

FIG. 2.5 - Simulated Encoder (CW rotation when viewed from shaft end)



2.2.8.1 Setup for the Number of Steps/Revolution

From DBM 03 version the number of steps/electrical revolution of simulated encoder can be set via software (see SE commands).

REMARK: the maximum number of pulses per electrical revolution depends on the R/D resolution. See Tab.2.1.

The width of C marker can be A (360°), A/2 (180°) or A/4 (90°); it must be specified in the order. This parameter does not depend on the software commands.

Note: to obtain the resolution per mechanical revolution it is necessary to multiply the pole pairs by the electrical resolution.

Example: if a FAS T motor with 6 pole resolver is used, 1024 pulses per electrical revolution mean 1024 ∗ 3 = 3072 pulses per mechanical revolution.

2.2.8.2 R/D Resolution

From DBM 03 version the resolution of Resolver to Digital converter will automatically be switched according to actual speed for optimum system performance between minimum (see RN command) and maximum resolution (see RX command).

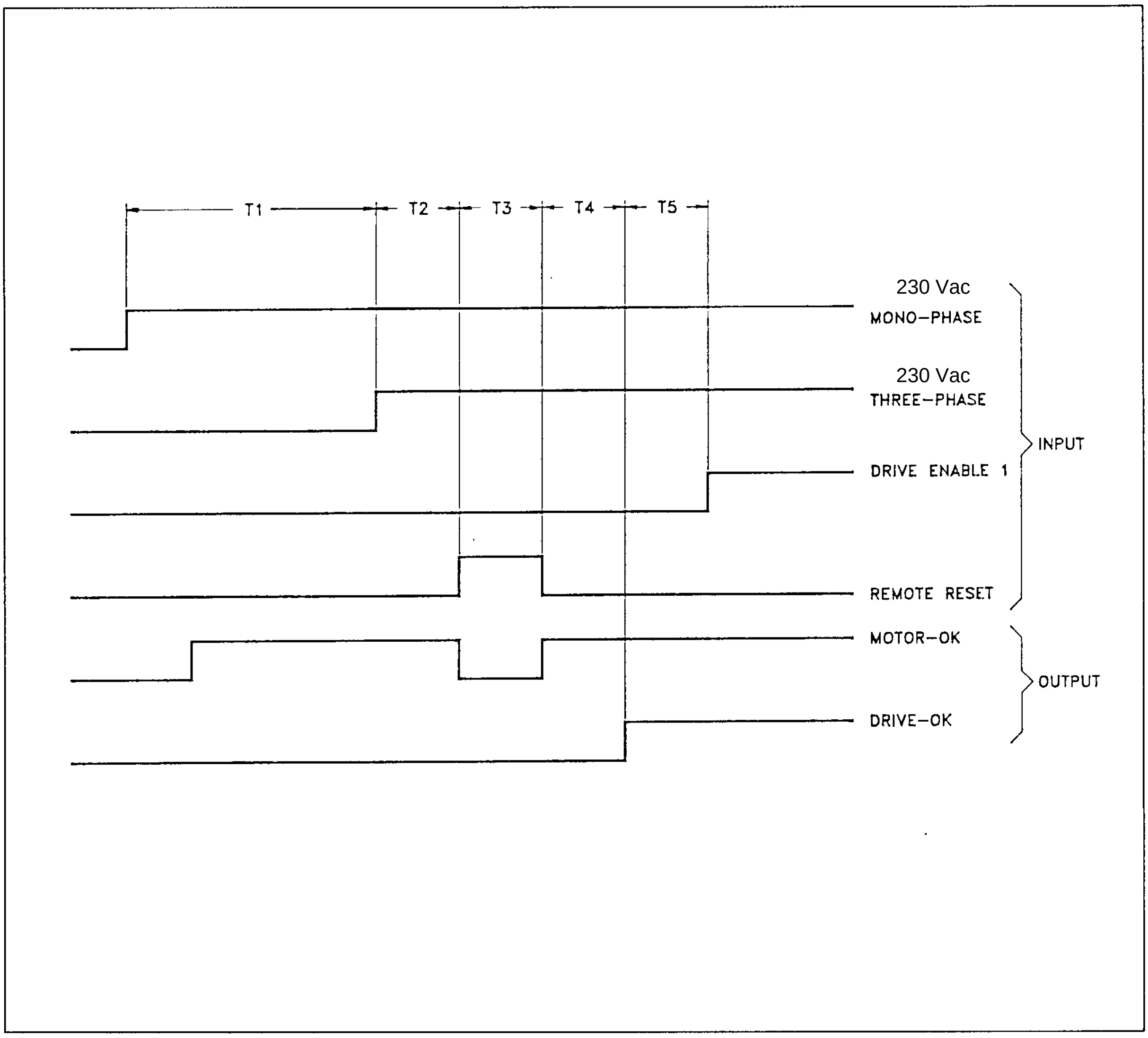
The speed range of R/D resolution is included in the following table.

Tab. 2.1 - Max speed and max ppr versus R/D resolution

	Resolution (bit)			
	10	**12**	**14**	**16**
Max number of pulses per electrical revolution	256	1024	4096	16384
Max speed with 2 pole resolver (rpm)	24000	12000	3510	877
Max speed with 6 pole resolver (rpm)	8000	4600	1170	292
Max speed with 8 pole resolver (rpm)	6000	3510	877	219

FIG. 2.6 - Starting Sequence, Timing Chart

Note: T1 = 8 to 10 s, T2 ≥ 1 s, T3 ≥ 20 ms, T4 ≈ 3 s, T5 ≥ 0.5 s.



2.3 Operation

After system wiring and installation, it is possible to start the system according to the sequence shown in figure 2.6.

Action	Effect
• Connect 230Vac single phase power supply (or 110Vac optional)	• Digital and diagnostics circuits are fed - Green LED on DBM PS, AUX PWR = ON - Opto output MOTOR OK is enabled
• Connect 230Vac three phase power supply	• 300V Bus Bars are fed - Yellow LED on DBM PS, PWR BUS = ON - Green LED on DBM, POWER OK = ON
• Reset protections by pushing the RESET button on front panel or by sending a 20ms pulse to REM RESET opto input	• Possible faults are reset - After 3s the opto output DRIVE OK is enabled
• Enable analog Drive Enable for each axis and Reference Enable via positive logic	• Green LED's on DBM, DRIVE EN = ON and REF EN = ON

WARNING: HIGH VOLTAGE - DISCHARGE TIME APPROX. 6 MINUTES.

SECTION 3 - COMMANDS AND PROTECTIONS

3.1 General Features

For serial communication, according to standard RS485, DBM drives are connected in parallel (multidrop) and in "slave" configuration, whereas the CNC, the PC or the keyboard are in "master" configuration.

This is because the protocol is configured so that the drives are able to communicate only if inquired by the master, to avoid contentions on the line. As a consequence, all the commands have been configured individually (single axis questioned), except those for which an answer is not foreseen; therefore all the drives can be reached simultaneously.

There are 3 kinds of command:

- **status monitoring**

Monitor commands on the status of the drive, which displays axis configuration and eventual faults.

- **data monitoring**

Monitor commands for displaying memorized motion parameters (e.g. I limit=100%, etc.).

- **data (command) input**

Execute commands for setting and changing parameters (e.g. speed, pole number, acceleration, deceleration, etc.).

Remark: if a mistake has been made while digitizing, it is possible to reset the command by pressing <CR> (<CARRIAGE RETURN>).

The commands are in ASCII format:

1 bit-start
8 bit-data
1 bit-parity even
1 bit-stop

Serial communication speed can vary from 1200 to 19200 Baud.

Command syntax is as follows:

status monitoring: ■ address COMMAND
data monitoring: ■ address COMMAND
data input: ■ address COMMAND data
command input: ■ address COMMAND

Remark: press <CR> after each command string if the optional keyboard is used.

- **Address:** there are three kinds of address:

Axis: it is a number from 1 to 9 (max. number of axes in a system); it identifies the axis selected for data monitoring / input.

Module: the "module" (or "basic") address is referred to the possibility to get the execution of the command either addressing the chosen axis (axis) or any axis inside the module (module). This last possibility is valid for all axes within a module common commands (e.g. temperature).

Global: it is also possible to globally address all axes (global address) using the <*> in place of the address number.

- **Command:** it consists of two letters (e.g. AC, AE, etc.).

- **Datum:** it can be composed by a max. of 4 figures or 3 figures and the <-> symbol. The <+> symbol is optional. Any data without a symbol is considered as positive.

3.2 Commands

All commands available for system management can be used to monitor and execute every datum.

To monitor, it is sufficient to enter the address and the command; to execute, the address, the command and the datum must be typed.

Tab. 3.1 List of Commands

Symbol	Command
AC	Acceleration
AD	Axis disabled
AE	Axis enabled
AL	Analog limit
AP	Autophasing
AR	Analog reference
AS	Address show
BR	Baud rate
CP	Current position
CU	Current U offset
CV	Current V offset
DE	Deceleration
DF	Digital velocity reference filter
DI	Direction
DL	Digital limit
DR	Digital reference
ES	Extra parameter for spare output
ET	Extra parameter for Tacho output
EV	Error velocity
FA	Fault
IL	I Limit
IT	IT protection
KI	Integral gain
KP	Proportional gain
MR	Max reference

Symbol	Command
MV	Max velocity
NP	Number of poles
OC	Velocity Fine offset
OF	Off
ON	On
OV	Offset Display
PC	Peak current
PR	Motor poles to resolver poles ratio
PW	Password
RE	A/D resolution
RN	Minimum of R/D resolution
RS	Resolver shaft
RX	Maximum of R/D resolution
SA	Set Address
SE	Simulated encoder
SO	Spare output
SR	Show Release
ST	Status
SV	Save
TC	Torque Control
VC	Velocity Control
VE	Velocity
VO	Velocity Offset
VS	Velocity structure

3.2.1 Command: AC - Acceleration

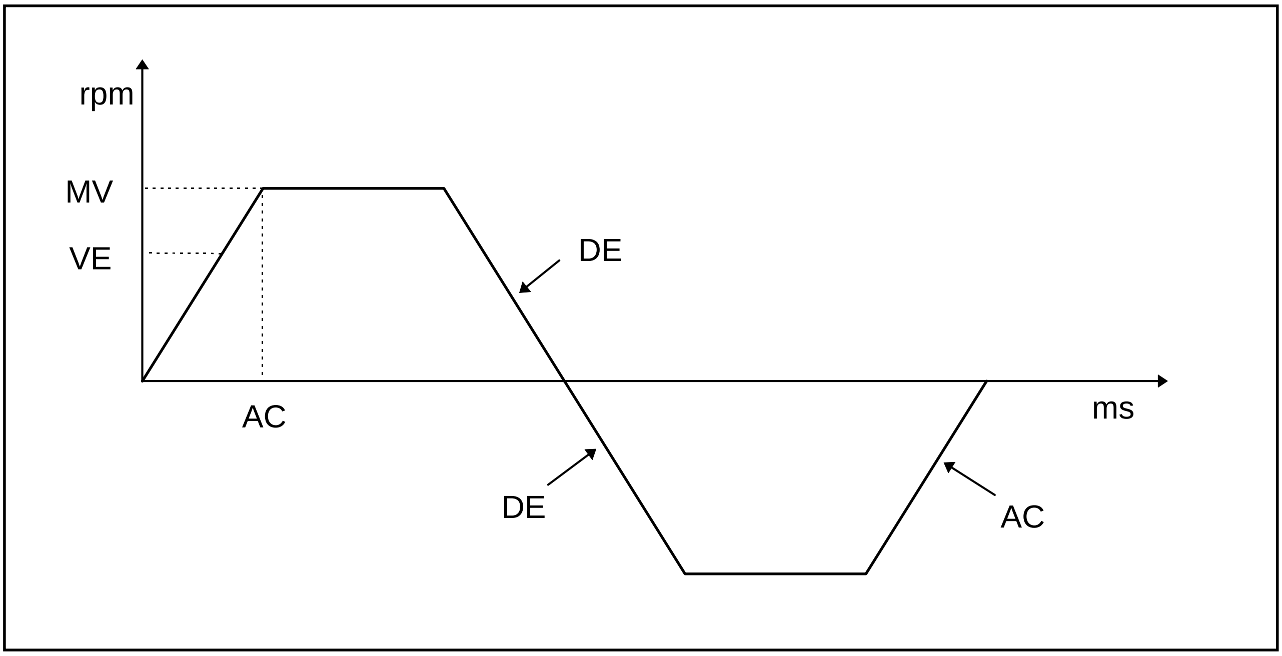
Function:	it allows to set an acceleration ramp. Whatever the input reference (analog or digital), the system will follow it, but accelerations will never be faster than those set by this command. It can be useful when the drive is connected to rather simple position controllers (e.g. max, 0, -max), with an application requiring progressive accelerations.
Syntax:	data monitoring: ■ address AC <CR> data input: ■ address AC n <CR>
Address type:	axis
Unit of measure:	n = ms
Range:	10 to 999 or 0
Default:	0 (disabled)
Password:	no
(∗) addressing:	yes
Opposite to:	-
See also:	DE

Examples:

■ 1 AC 100 <CR>: it sets an acceleration ramp = 100ms for axis1.

■ 2 AC <CR>: it questions axis 2 about the acceleration ramp. In case no one has been set, the answer is: "A2 ACC. TIME = ms 0".

FIG. 3.1 - Acceleration/Deceleration



3.2.2 Command: AD - Axis Disabled

Function:	AD command makes the logic section ignore an axis and the relatives faults. It is useful with DBM 2-axis: if the third axis were not disabled, the logic would reveal resolver fault and motor overtemperature, preventing the drive from running.
Syntax:	data monitoring: ■ address AD <CR> data input: ■ address AD n <CR>
Address type:	axis
Unit of measure:	n = axis number
Range:	1 to 99
Default:	-
Password:	yes
(∗) addressing:	no
Opposite to:	AE
See also:	AE

Note: the axis disabled holds his address, which can be interrogated via FA command.

REMARK: AD and AE commands must be set only when the motor is standstill

Examples:

- ■ 1 AD 3 <CR>: it disables the 3rd axis of a module, whose first address is 1.
- ■ 4 AD 6 <CR>: it disables the 3rd axis of a module, whose first address is 4.
- ■ 1 AD <CR>: "1 AXIS DISABLED 3" will be displayed if the 3rd axis is disabled. "1 AXIS DISABLED 1 3" will be displayed if the 1st and 3rd axis is disabled.

3.2.3 Command: AE - Axis Enabled

Function:	the AE command enables an axis and relative faults.
Syntax:	data monitoring: ■ address AE <CR> data input: ■ address AE n <CR>
Address type:	axis
Unit of measure:	n = axis number
Range:	1 to 99
Default:	-
Password:	yes
(∗) addressing:	no
Opposite to:	AD
See also:	AD

Examples:

- ■ 1 AE 3 <CR>: it enables the 3rd axis of a module, whose first address is 1.
- ■ 4 AE 6 <CR>: it enables the 3rd axis of a module, whose first address is 4.
- ■ 1 AE <CR>: "1 AXIS ENABLED 3" will be displayed if the 3rd axis is enabled. "1 AXIS ENABLED 1 3" will be displayed if the 1st and 3rd axis is enabled.

3.2.4 Command: AL - Analog Limit

Function:	it informs the controller that I limit reference to be considered is analog (see J7 connector).
Syntax:	command input: ■ address AL <CR>
Address type:	axis
Unit of measure:	-
Range:	-
Default:	digital I Limit
Password:	yes
(∗) addressing:	yes
Opposite to:	DL
See also:	DL, IL, ST

Examples:

■ 1 AL <CR>: Sets the analog I limit for axis 1. The display is cleared. After this command a current limit can be set via J7 connector, pos. 14 and 33 (range 0 to 10V). The status can be interrogated via ST command.

REMARK: DBM 03 has the "Analog I limit" as standard.

3.2.5 Command: AP - Autophasing

Function:	AP command allows resolver auto-phasing. As in this phase the motor can rotate for a revolution fraction, it is opportune to make sure it is free to rotate to avoid risk of friction, which could compromise phasing accuracy. So, motor must be disconnected from load.
Syntax:	command input: ■ address AP <CR>
Address type:	axis
Unit of measure:	-
Range:	-
Default:	non-phased axes
Password:	yes
(∗) addressing:	no
Opposite to:	-
See also:	ON, OF

Note: To execute AP, all module axes must have optoisolated Drive Enable signals "on" and digital ones "off" (see paragraph 2.2.3) via OF command. To execute AP, it is necessary that the "G2" jumper on the personality card is in position 2-3 (open), which means priority from the keyboard (see paragraph 2.2.2.).

Examples:

■ 1 AP <CR>: it allows axis 1 auto-phasing. During such operation (a few seconds) "AUTOPHASING IN PROGRESS" will be displayed; when auto-phasing is successfully carried out "AXIS PHASED" will be displayed, otherwise "ERROR IN AUTOPHASING" will be shown. If digital Drive Enable is enabled (ON) (see above) the message "WARNING DRIVE EN. CLOSED" will appear. The auto-phasing is not allowed if a fault is on. This case, the message displayed will be "ERROR: FAULT STATUS".

3.2.6 Command: AR - Analog Reference

Function:	AR command allows enabling analog (speed or torque) reference. pins, ignoring VE command given from keyboard.
Syntax:	command input: ■ address AR <CR>
Address type:	axis
Unit of measure:	-
Range:	-
Default:	digital reference
Password:	yes
(∗) addressing:	yes
Opposite to:	DR
See also:	DR

Note: the status can be interrogated via ST command (bit I).

3.2.7 Command: AS - Address Show

Function:	it allows display of the basic address of a module, if unknown. To avoid simultaneous answers on the line from more than one module, it is necessary that serial flat J2 is connected only between power supply and the questioned module. It is different from SA command, which is used to change basic address.
Syntax:	data monitoring: ■ ∗ AS <CR>
Address type:	-
Unit of measure:	-
Range:	-
Default:	-
Password:	no
(∗) addressing:	compulsory
Opposite to:	-
See also:	SA

Examples:

■ ∗ AS <CR>: if the "base" address for such a module is 1, the answer will be "ADDRESS MODULE 1".

3.2.8 Command: BR - Baud Rate

Function:	it allows to change transmission speed of the serial link.
Syntax:	data monitoring: ■ address BR <CR> data input: ■ address BR n <CR>
Address type:	module
Unit of measure:	n = Baud
Range:	1200, 2400, 4800, 9600, 19200
Default:	9600
Password:	yes
(*) addressing:	yes
Opposite to:	-
See also:	-

Note: To modify the Baud Rate alsoat keyboard side, it is necessary to type <Control> and after <CR>. Type <Y> to change Baud Rate and after <CR>.

3.2.9 Command: CP - Current Position

Function:	it allows to know the position relative to electric revolution of the resolver at start-up. It is used when the application requires to know the absolute position.
Syntax:	data monitoring: ■ address CP <CR>
Address type:	axis
Unit of measure:	-
Range:	0 to 4096
Default:	-
Password:	no
(*) addressing:	no
Opposite to:	-
See also:	-

Examples:

■ 2 CP <CR>: Interrogates axis 2 about the current position. If the starting position is 4006, the answer will be : "A02 CURRENT POSITION = 4006".

3.2.10 Command: CU - Current U offset <u>(only for setup technicians)</u>

Function:	it allows to set the offset of U phase current
Syntax:	data monitoring: ■ address CU <CR> data input: ■ address CU n <CR>
Address type:	axis
Unit of measure:	
Range:	0 to 255
Default:	-
Password:	no
(∗) addressing:	no
Opposite to:	-
See also:	CV

Note: the CU command must be executed with digital Drive Enable disabled (via OF command) and the opto Drive Enable enabled.

Examples:

■ 2 CU <CR>: Interrogates axis 2 about the offset of the U current. If U current offset is 128, the answer will be : "A02 CURRENT U OFFSET = 128".

CAUTION: do not change CU parameter. A wrong set of CU increases torque ripple.

3.2.11 Command: CV - Current V offset <u>(only for setup technicians)</u>

Function:	it allows to set the offset of V phase current
Syntax:	data monitoring: ■ address CV <CR> data input: ■ address CV n <CR>
Address type:	axis
Unit of measure:	
Range:	0 to 255
Default:	-
Password:	no
(∗) addressing:	no
Opposite to:	-
See also:	CU

Note: the CV command must be executed with digital Drive Enable disabled (via OF command) and the opto Drive Enable enabled.

Examples:

■ 1 CV <CR>: Interrogates axis 1 about the offset of the V current. If V current offset is 128, the answer will be : "A01 CURRENT V OFFSET = 128".

CAUTION: do not change CV parameter. A wrong set of CU increases torque ripple.

3.2.12 Command: DE - Deceleration

Function:	it allows to set a deceleration ramp. Whatever the input reference (analog or digital), the system will follow it, but deceleration's will never be faster than those set by this command. It can be useful when the drive is connected to a rather simple position controller (e.g. max,0,-max), with an application requiring progressive deceleration's (see Fig. 3.1).
Syntax:	data monitoring: ■ address DE <CR> data input: ■ address DE n <CR>
Address type:	axis
Unit of measure:	n = ms
Range:	10 to 999 or 0
Default:	0 (disabled)
Password:	no
(∗) addressing:	yes
Opposite to:	-
See also:	AC

Examples:

■ 1 DE 100 <CR>: it sets a deceleration ramp = 100 ms for axis 1.

■ 1 DE <CR>: it questions axis 1 about the deceleration ramp. In case no one has been set, the answer is: "A01 DECEL. TIME = ms 0"

3.2.13 Command: DF - Digital Filter

Function:	it allows to set a low-pass digital filter. The filter reduces high frequency noise and resonance's When the Velocity Structure command is VS=0 or VS=1, the velocity reference is filtered. When the Velocity Structure command is VS=2 or VS=3, the velocity error is filtered. The value DF=0 switches the filter OFF
Syntax:	data monitoring: ■ address DF <CR> data input: ■ address DF n <CR>
Address type:	axis
Unit of measure:	-
Range:	0 to 255. The filter bandwidth is: $f\,[Hz] = \{\ln[1/(1-DF/512)]\}/(2\pi * 300\ 10^{-6})$
Default:	0 (disabled)
Password:	yes
(∗) addressing:	no
Opposite to:	-
See also:	VS

Note: the DF command must be executed with digital Drive Enable disabled (via OF command) and the opto Drive Enable enabled.

Examples:

■ 2 DF 165 <CR>: sets the filter bandwidth to 206 Hz for axis 2.

■ 2 DF <CR>: Interrogates axis 2 about the reference filter on the velocity reference. The answer will be : "A02 DIG.FIL. REF. PAR. = 165".

Tab. 3.2 - Filter Bandwidth

DF	Frequency	DF	Frequency	DF	Frequency	DF	Frequency
1	1 Hz	65	72 Hz	130	155 Hz	195	254 Hz
5	5 Hz	70	77 Hz	135	162 Hz	200	262 Hz
10	10 Hz	75	84 Hz	140	169 Hz	205	271 Hz
15	15 Hz	80	90 Hz	145	176 Hz	210	280 Hz
20	21 Hz	85	96 Hz	150	183 Hz	215	288 Hz
25	26 Hz	90	102 Hz	155	191 Hz	220	297 Hz
30	32 Hz	95	108 Hz	160	198 Hz	225	307 Hz
35	37 Hz	100	115 Hz	165	206 Hz	230	316 Hz
40	43 Hz	105	121 Hz	170	214 Hz	235	325 Hz
45	48 Hz	110	128 Hz	175	221 Hz	240	335 Hz
50	54 Hz	115	134 Hz	180	229 Hz	245	345 Hz
55	60 Hz	120	141 Hz	185	237 Hz	250	355 Hz
60	66 Hz	125	148 Hz	190	246 Hz	255	366 Hz

3.2.14 Command: DI - Direction

Function:	it allows to invert the direction of the motor rotation, in case of analog or digital reference. The drive is supplied set to CW rotation, (viewed from shaft end) corresponding to positive during the installation. To know what the actual configuration is, ST command shall be asked.
Syntax:	command input: ■ address DI <CR>
Address type:	axis
Unit of measure:	-
Range:	-
Default:	CW
Password:	no
(∗) addressing:	yes
Opposite to:	-
See also:	ST

Example:
■ 4 DI <CR>: it reverses the direction of motor rotation for axis 4. The display is cleared.

Note: The status can be interrogated via ST command (bit L).

3.2.15 Command: DL - Digital Limit

Function:	it informs the controller that the I limit reference to be considered as active is digital (programmable via IL command).
Syntax:	command input: ■ address DL <CR>
Address type:	axis
Unit of measure:	-
Range:	-
Default:	digital I limit
Password:	yes
(∗) addressing:	yes
Opposite to:	AL
See also:	AL, IL

Notes: Digital I limit is standard on DBM drives, whereas analog I limit is optional.
The status can be interrogated via ST command (bit J).

3.2.16 Command: DR - Digital Reference

Function:	it allows to enable digital (speed or torque) reference. The drive will consider as reference the number set via VE command and ignore connector J7 voltage.
Syntax:	command input: ■ address DR <CR>
Address type:	axis
Unit of measure:	-
Range:	-
Default:	digital reference
Password:	yes
(∗) addressing:	yes
Opposite to:	AR
See also:	AR

Note: the status can be interrogated via ST command (bit I)

3.2.17 Command: ES - Extra parameter for Spare output

Function:	it allows to scale the Analog Outputs (max current, speed reference or error reference) on J8 connector.
Syntax:	data monitoring: ■ address ES <CR> data input: ■ address ES n <CR>
Address type:	1=Analog Output 1 (see J8 connector, pos.4) 2=Analog Output 2 (see J8 connector, pos.5)
Unit of measure:	-
Range:	0 to 255. Analog outputs on J8 connector (±10V, 10 mA max): Max current for axis 1 (SO=1), axis 2 (SO=2) or axis 3 (SO=3): ±(10∗ES/16)V for ±100% max current Speed reference for axis 1 (SO=4), axis 2 (SO=5) or axis 3 (SO=6), and velocity error for axis 1 (SO=7), axis 2 (SO=8) or axis 3 (SO=9): ±[(ES∗NP∗MV)/(786∗MR)]V for ±MV (max velocity)
Default:	16
Password:	yes
(∗) addressing:	no
Opposite to:	-
See also:	MR, MV, NP, SO

Examples:

- ■ 1 SO 1 <CR>: sets analog out1 (J8 conn., pos.4) to max current of axis 1
- ■ 1 ES 16 <CR>: sets analog out1 to ±10V for ±100% max current of axis 1
- ■ 1 ES 32 <CR>: sets analog out1 to ±10V for ±50% max current (zoom-in) of axis 1
- ■ 1 ES 8 <CR>: sets analog out1 to ±5V for ±100% max current (zoom-out) of axis 1
- ■ 2 SO 5 <CR>: sets analog out2 (J8 conn., pos.5) to speed reference of axis 2
- ■ 2 ES 16 <CR>: sets analog out2 to ±10V for ±6140 rpm (if NP=8 and MR=100 have been set for axis 2)

Tab. 3.3 - ES for Max Current (SO=1 to SO=3)

ES	MAX CURRENT	ANALOG OUT
8	100 %	5 V
16	100 %	10 V
32	50 %	10 V

Tab. 3.4 - ES for Speed Reference and Velocity Error (MR=100, SO=4 to SO=9)

2 pole resolver

ES	MV rpm	ANALOG OUT
52	6046	8 V
65	6046	10 V
105	2994	8 V
131	3000	10 V

6 pole resolver

ES	MV rpm	ANALOG OUT
17	6165	8 V
22	5954	10 V
35	2994	8 V
44	2977	10 V
52	2015	8 V
65	2015	10 V

8 pole resolver

ES	MV rpm	ANALOG OUT
13	6046	8 V
16	6140	10 V
26	3023	8 V
33	2977	10 V
39	2015	8 V
49	2005	10 V

3.2.18 Command: ET - Extra parameter for Tacho output

Function:	it allows to scale the Tacho Tests outputs on J8 connector
Syntax:	data monitoring: ■ address ET <CR> data input: ■ address ET n <CR>
Address type:	axis
Unit of measure:	-
Range:	50 to 100. Tacho outputs = $\pm$(ET/10) $\ast$ (MR/100) [V] for $\pm$MV
Default:	80
Password:	yes
($\ast$) addressing:	no
Opposite to:	-
See also:	MR, MV

Examples:

- ■ 1 MV 3000 <CR>: sets max velocity to 3000 rpm for axis 1.
- ■ 1 MR 100 <CR>: sets max velocity reference to 10 V for axis 1.
- ■ 1 ET 50 <CR>: sets ET parameter to 50 for axis 1. The Tacho Test 1 (J8, pos.1) will be ± 5V for ± 3000 rpm.
- ■ 1 ET <CR>: questions axis 1 about the extra parameter for Tacho Test 1. The answer is: "A01 EXTRA PAR. FOR TO = 50".

3.2.19 Command: EV - Error Velocity

Function:	it allows to set the maximum velocity error between reference velocity and the actual speed in rpm. If the set value is overcome, a fault occurs. Value = 0 disables the command.
Syntax:	data monitoring: ■ address EV <CR> data input: ■ address EV n <CR>
Address type:	axis
Unit of measure:	n = rpm
Range:	1 to MV. 0 = disabled
Default:	0
Password:	yes
($\ast$) addressing:	no
Opposite to:	-
See also:	-

Remark: While testing the drives via step response, it is advisable to disable this protection or set a high value of tolerated error, to avoid continuous faults.

Examples:

- ■ 1 EV 100 <CR>: it sets axis 1 to tolerate up to 100 rpm error, without fault.
- ■ 3 EV <CR>: it questions axis 3 about the maximum error allowed. The answer is: "A3 VELOCITY ERROR RPM = 20" (if 20 rpm velocity error has been set for axis 3).

3.2.20 Command: FA - Fault

Function:	as only main faults have front panel LED indications, when the generic LED DRVF lights up, it is necessary to interrogate the drive via FA command. The answer is a codified ASCII string (see below). Another function of the command is to reset the faults
Syntax:	status monitoring and reset: ■ address FA <CR>
Address type:	axis
Password:	no
(∗) addressing:	no

Answer explanation: **A** a **FA** b c d e f g **P** h i j k l **MA** m n o **B** p q r

A	= axis		
a	= axis address		
FA	= fault		
b	= Resolver connection	0 = OK	1 = not OK
c	= Motor temperature	0 = OK	1 = overtemperature
d	= Axis short circuit	0 = OK	1 = short circuit
e	= 3-phase sequence	0 = OK	1 = not coherent phase
f	= Velocity error	0 = OK	1 = not OK
g	= It	0 = off	1 = on
P	= Power supply		
h	= Recovery unit	0 = OK	1 = not OK
i	= PWRS temperature	0 = OK	1 = overtemperature
j	= 220Vac 3-phase sequence	0 = OK	1 = unbalanced phase
k	= n.c.		
l	= Personality card	0 = OK	1 = not OK*
MA	= A module (DBM module)		
m	= BUS BAR voltage	0 = OK	1 = overvoltage/undervoltage
n	= Aux. Volt. ref. to - HV	0 = OK	1 = out of tolerance
o	= A module temperature	0 = OK	1 = overtemperature
B	= B module (eventual expansion module)		
p	= BUS BAR voltage	0 = OK	1 = overvoltage/undervoltage
q	= Aux. Volt. ref. to - HV	0 = OK	1 = out of tolerance
r	= B module temperature	0 = OK	1 = overtemperature

* = in case of checksum error, check the parameters (e.g. KP, KI,...), correct the wrong values and save.

Note: If the expansion missing, the last characters are not significant.

Examples:
■ 1 FA <CR>: if OK, the answer will be: "A1 FA 000000 P 00000 MA 000 B 000"

3.2.21 Command: IL - I Limit (Current Limit)

Function:	it allows to program the peak current. It is useful when undersized motors are used or during special tests.
Syntax:	data monitoring: ■ address IL <CR> data input: ■ address IL n <CR>
Address type:	axis
Unit of measure:	n = % max current
Range:	0 to 100
Default:	100
Password:	no
(∗) addressing:	no
Opposite to:	-
See also:	DL, AL

REMARK: before executing IL command it is necessary to perform DL command.

Examples:

■ 2 IL <CR>: it asks axis 2 about I limit. In default case the answer will be: "A2 CURRENT LIMIT % = 100".

■ 2 IL 90 <CR>: it sets 90% current limit for axis 2.

3.2.22 Command: IT - IT protection

Function:	it allows to manage the IT thermal protections which prevents the motor from an overheating too quick for the PTC operating time. When the integral of current multiplied by time exceeds the IT value, drive limits, after operating time, to nominal motor current (see Tab. 3.5).
Syntax:	data monitoring: ■ address IT <CR> data input: ■ address IT xx n <CR>. xx = special password
Address type:	axis
Unit of measure:	n = ms
Range:	0 to 255. 0 = protection disabled
Default:	see Tab. 3.5
Password:	special password
(∗) addressing:	no
Opposite to:	-
See also:	PC

Notes: IT protections has been implemented from software version 3.5.
IT status can be interrogated via FA command (bit g).

CAUTION: do not change IT parameter. A wrong set of IT can damage the motor.

Tab. 3.5 - IT Protection

The following table shows IT and PC values set in factory.

MOTOR	DRIVE			Operating time at drive peak current		MOTOR	DRIVE			Operating time at drive peak current
	DBM03	IT	PC	(s)			DBM03	IT	PC	(s)
FAS T0						**FAS K0**				
M2 030	1.5	15	24	7.0		005 030	1.5	11	23	8.8
M2 060	1.5	14	38	19.8		"	2.5	11	15	3.7
"	2.5	14	25	8.2		005 060	1.5	12	37	21.8
M4 030	1.5	16	40	19.4		"	2.5	12	25	9.6
"	2.5	16	27	8.4		010 030	1.5	14	40	22.2
M4 060	2.5	12	46	35.3		"	2.5	14	27	9.6
"	5	11	23	8.8		010 060	2.5	14	48	33.3
M8 030	2.5	12	44	31.9		"	5	11	24	9.6
"	5	11	22	8.0		020 030	5	13	26	9.6
M8 060	5	15	42	23		020 060	5	12	48	38.8
"	10	14	25	8.2		"	10	12	29	13.0
FAS T1						**FAS K1**				
M2 030	2.5	9	55	71.3		020 030	2.5	6	48	77.8
"	5	8	27	16.9		"	5	5	24	21.2
M2 060	5	9	54	68.2		020 060	5	6	44	63.9
"	10	8	32	24.1		040 030	5	6	44	63.9
M4 030	5	7	49	69.9		"	10	6	26	20.8
"	10	7	30	24.0		040 045	10	6	40	51.8
M4 045	10	7	44	54.8		060 030	10	6	40	51.8
M6 030	10	4	42	86.6		"	15	5	22	17.7
"	15	4	23	24.2		060 045	10	6	60	132.6
M6 045	10	5	62	173.1		"	15	6	34	36.5
"	15	4	35	58.3		"	25	6	22	14.7
M8 030	10	5	52	112.5		080 030	10	6	53	98.0
"	15	4	29	39.2		"	15	5	29	31.3
M8 045	15	4	41	82.1		080 045	15	6	44	63.9
FAS T2						"	25	6	28	24.3
M2 030	10	8	52	70.2		**FAS K2**				
"	15	8	29	19.6		060 030	10	5	43	72.9
M2 045	15	9	47	49.4		"	15	5	24	21.2
"	25	8	30	21.0		060 045	10	5	60	159.2
M4 020	10	7	59	109.0		"	15	5	33	41.1
M4 030	15	7	50	73.3		120 020	10	5	53	117.6
"	25	6	32	32.1		"	15	5	30	33.6
M6 020	15	6	48	77.8		120 030	15	5	44	76.8
"	25	5	30	33.6		"	25	5	29	31.3
M6 030	25	7	45	57.6		180 020	15	5	38	55.6
M8 020	25	6	39	49.0		180 030	25	5	43	72.9
M8 030	25	6	55	107.1		240 020	25	5	43	72.9
FAS T3						240 030	50	5	29	31.3
M2 020	25	6	48	77.8		**FAS K3**				
M2 030	25	8	70	150.0		240 020	25	3	38	92.8
M3 020	25	6	64	156.6		240 030	50	3	27	45.0
M3 030	50	5	48	93.4		360 020	50	3	30	56.1
M4 020	50	4	40	77.8		360 030	50	3	44	128.0
M4 030	50	6	70	200.1		"	70	3	34	73.1
"	70	5	55	128.5		480 020	50	3	38	92.8
M6 012	25	5	66	204.0		"	70	3	30	56.1
M6 020	50	4	53	147.1		480 030	70	3	41	109.5
"	70	4	42	86.6		"	80	3	31	60.1
M8 012	50	4	42	86.6		720 012	50	3	33	68.6
M8 020	70	4	65	244.9		720 020	70	3	41	109.5
"	80	4	48	116.8		"	80	3	31	60.1
						960 012	50	3	44	128.0
						"	70	3	34	73.1
						"	80	3	25	38.4
						960 020	70	3	51	179.2
						"	80	3	38	92.8

REMARK: the "operating time at drive peak current" is the operating time after a reset. In a steady state condition, this time can be shorter according to the motor thermal simulation. An overtemperature protection via PTC is also provided.

3.2.23 Command: KI - Integral Gain

Function:	it allows to set the speed loop integral gain. KI value is directly proportional to the intensity of the integral action.
Syntax:	data monitoring: ■ address KI <CR> data input: ■ address KI n <CR>
Address type:	axis
Unit of measure:	-
Range:	0 to 255
Default:	20
Password:	no
(∗) addressing:	yes
Opposite to:	-
See also:	KP

Examples:

■ 2 KI <CR>: it asks axis 2 about KI. If it is 40, the answer will be "A4 KI = 40".

■ 2 KI 50 <CR>: it sets the integral gain to 50 for axis 2

3.2.24 Command: KP - Proportional Gain

Function:	it allows to set the speed loop error proportional correction gain. KI value is directly proportional to the intensity of the requested action.
Syntax:	data monitoring: ■ address KP <CR> data input: ■ address KP n <CR>
Address type:	axis
Unit of measure:	-
Range:	0 to 255
Default:	80
Password:	no
(∗) addressing:	yes
Opposite to:	-
See also:	KI

Examples:

■ 4 KI <CR>: it asks axis 4 about KP. If it is 90 the answer will be "A04 KI = 90".

■ 4 KI 50 <CR>: it sets the integral gain to 100 for axis 4.

3.2.25 Command: MR - Max Reference

Function:	it allows to set speed/torque max reference. The drive will automatically make it corresponding to the maximum velocity (see MV command). It is advisable to set MR as near as possible conversion.
Syntax:	data monitoring: ■ address MR <CR> data input: ■ address MR n <CR>
Address type:	axis
Unit of measure:	n = Volt decimal
Range:	50 to 100
Default:	100
Password:	yes
(∗) addressing:	no
Opposite to:	-
See also:	MV

Examples:

■ 1 MV 2000 <CR>:

■ 1 MR 100 <CR>: for axis 1, 10V correspond to 2000 rpm.

■ 3 MR <CR>: it interrogates axis 3 about max. reference. If MR = 10V the answer will be: "A3 MAX REFER. V = 10.0"

REMARK'S: MR command can be executed only after resetting or giving MV command.
In case of torque control, it must be MR = 100.

3.2.26 Command: MV - Max Velocity

Function:	it allows to set max velocity, referred to MR command. Anyway, such a max. speed can never be overcome, either by analog reference or by keyboard command.
Syntax:	data monitoring: ■ address MV <CR> data input: ■ address MV n <CR>
Address type:	axis
Unit of measure:	n = rpm
Range:	200 to 32000
Default:	3000
Password:	yes
(∗) addressing:	yes
Opposite to:	-
See also:	MR, Tab. 2.1

REMARK: max velocity depends on R/D resolution. See Tab. 2.1.

Examples:

- ■ 1 MV 2000 <CR>: sets max velocity for axis 1 to 2000 rpm.
- ■ 1 MR 100 <CR>: for axis 1, 10V correspond to 2000 rpm.
- ■ 1 MV <CR>: interrogates axis 1 about max. velocity. The answer will be: "A1 RPM MAX = 2000"

3.2.27 Command: NP - Number of Resolver Poles

Function:	it informs the controller about the number of poles, so that the right correspondence between mechanical speed and electrical frequency can be set.
Syntax:	data monitoring: ■ address NP <CR> data input: ■ address NP n <CR>
Address type:	axis
Unit of measure:	-
Range:	2 to 8
Default:	-
Password:	yes
(∗) addressing:	yes
Opposite to:	-
See also:	PR

Examples:

- ■ 1 NP 2 <CR>: allows to set 2 poles for axis 1.
- ■ 1 NP <CR>: allows to know the resolver pole number for axis 1. The answer will be: "A1 NUM. OF POLES = 2"

3.2.28 Command: OC - Digital Offset Compensation (<u>only for setup technicians</u>)

Function:	it allows to set the digital velocity offset
Syntax:	data monitoring: ■ address OC <CR> data input: ■ address OC n <CR>
Address type:	axis
Unit of measure:	(n-128) ∗ x / 128 rpm where x=24 for 8 and 2 pole resolver x=32 for 6 pole resolver
Range:	0 to 255. OC = 128 disables offset OC > 128 sets CW offset OC < 128 sets CCW offset
Default:	128
Password:	no
(∗) addressing:	yes
Opposite to:	-
See also:	VO

Note: OC command has replaced KD command from software version 3.2.

Examples:

■ 1 OC 8 <CR>: adjust 30 rpm CCW offset for axis 1 with 6 pole resolver.

■ 4 OC <CR>: if OC = 90, the answer will be "A4 OC = 90".

3.2.29 Command: OF - Off

Function:	it allows to disable the digital Drive Enable for the addressed axis (see Par. 2.2.2.)
Syntax:	command input: ■ address OF <CR>
Address type:	axis
Unit of measure:	-
Range:	-
Default:	digital Drive Enable off
Password:	no
(∗) addressing:	yes
Opposite to:	ON
See also:	ON

REMARK: if opto Drive Enable are not enabled, the following message will be displayed: "ERROR: DRIVE EN. OPEN". If the axis is not phased "AXIS NOT PHASED" will appear. If the jumper G2 is in position 1-2 (closed) the message "NOT POSSIBLE" will appear.

3.2.30 Command: ON - On

Function:	it allows to enable the digital Drive Enable for the addressed axis (see Par. 2.2.2.)
Syntax:	command input: ■ address ON <CR>
Address type:	axis
Unit of measure:	-
Range:	-
Default:	Digital Drive Enable off
Password:	no
(∗) addressing:	yes
Opposite to:	OF
See also:	OF

REMARK: if opto Drive Enable are not enabled, the following message will be displayed: "ERROR: DRIVE EN. OPEN". If the axis is not phased "AXIS NOT PHASED" will appear. If the jumper G2 is in position 1-2 (closed) the message "NOT POSSIBLE" will appear.

3.2.31 Command: OV - Analog Offset

Function:	it allows to monitor and to set the analog offset of speed/ torque analog reference. A fine adjustment of the analog offset can be done with successive steps by setting and monitoring the OV parameter.
Syntax:	data monitoring: ■ address OV <CR> data input: ■ address OV n <CR>
Address type:	axis
Unit of measure:	-
Range:	0 to 255
Default:	128
Password:	yes
(∗) addressing:	no
Opposite to:	-
See also:	VO

3.2.32 Command: PC - Peak Current

Function:	it informs the drive control section about the ratio between motor current and drive peak RMS current. This way, when IT protection is on, drive current will be reduced to nominal motor current.
Syntax:	data monitoring: ■ address PC <CR> data input: ■ address PC xx n <CR>. xx = special password
Address type:	axis
Unit of measure:	n = %
Range:	0 to 100
Default:	see Tab. 3.5
Password:	special password
(∗) addressing:	no
Opposite to:	-
See also:	IT

CAUTION: do not change PC parameter. A wrong set of PC can damage the motor.

3.2.33 Command: PR - Motor Poles to resolver poles Ratio

Function:	it allows to set the ratio between the motor pole number and the resolver pole number.
Syntax:	data monitoring: ■ address PR <CR> data input: ■ address PR n <CR>
Address type:	axis
Unit of measure:	-
Range:	1 to 24
Default:	-
Password:	yes
(∗) addressing:	no
Opposite to:	-
See also:	NP

Examples:

- ■ 2 PR 3 <CR>: sets axis 2 for 6 pole motor and 2 pole resolver
- ■ 2 PR <CR>: questions axis 2 about the ratio between motor poles and resolver pole number. The answer is: "A02 MOTOR/RES. POLES = 3".

CAUTION: a wrong set of PR can damage the motor.

3.2.34 Command: PW - Password

Function:	it allows the operator to change critical parameters. After executing PW command, it is possible to enter the status in which such modification are permitted. If you want to exit from this mode, set PW again. The DBM 03 release allows to change the password.
Syntax:	command input: ■ address PW n <CR> data input: ■ address PW n <CR>
Address type:	module
Unit of measure:	-
Range:	1 to 255
Default:	PW91
Password:	-
(∗) addressing:	yes
Opposite to:	-
See also:	-

Examples:

■ 1 PW91 <CR>: if previously OFF, the answer is "PASSWORD ON"

■ 1 PW137 <CR>: enters a new password. The answer is "NEW PASSWORD IS 137 SAVE? "

■ 1 SV <CR> saves the new password. Note that all new parameters will be saved, if changed.

■ 1 PW137 <CR>: the answer is be "PASSWORD OFF"

CAUTION: Password protected parameters must be set only when the motor is standstill.

3.2.35 Command: RE - A/D REsolution

Function:	it allows to display the resolution of A/D converter
Syntax:	data monitoring: ■ address RE <CR>
Address type:	module
Unit of measure:	bit
Range:	12 (standard) , 14 (optional)
Default:	-
Password:	no
(∗) addressing:	no
Opposite to:	-
See also:	-

Example:

■ 1 RE <CR>: it questions module 1 about the resolution of A/D converter. The standard answer is: "12 BIT A/D CONVERTER IS PRESENT".

REMARK: the 14 bit A/D resolution is an option (CG5504 code). We recommend to contact the Service Centers to restore the 12 bit resolution from the optional 14 bit resolution.

3.2.36 Command: RN - Minimum of R/D resolution

Function:	it allows to set the minimum of Resolver to Digital converter resolution. The R/D resolution will automatically be switched according to actual speed for optimum system performance between RN (minimum) and RX (maximum). RN must be the maximum R/D resolution according to max speed (see Tab. 3.6) If RN equals RX, the R/D resolution is fixed.
Syntax:	data monitoring: ■ address RN <CR> data input: ■ address RN n <CR>
Address type:	axis
Unit of measure:	bit
Range:	10, 12, 14 and 16 (it must be ≤ RX)
Default:	-
Password:	yes
(∗) addressing:	no
Opposite to:	-
See also:	RX, SE, Tab. 3.6

Example:

- ■ 2 NP 8 <CR>: allows to set the resolver pole number of axis 2 to 8
- ■ 2 MV 3000 <CR>: allows to set max velocity of axis 2 to 3000 rpm
- ■ 2 RN 12 <CR>: allows to set min R/D resolution to 12 bit (max R/D resolution with 8 poles/ 3000 rpm according to Tab. 3.6)
- ■ 2 RN <CR>: questions axis 2 about the minimum of R/D resolution. The answer is: "A02 MINIMAL R/D RES. = 12".

Tab. 3.6 - Max speed versus R/D resolution

	Resolution (bit)			
	10	**12**	**14**	**16**
Max speed with 2 pole resolver (rpm)	24000	12000	3510	877
Max speed with 6 pole resolver (rpm)	8000	4600	1170	292
Max speed with 8 pole resolver (rpm)	6000	3510	877	219

3.2.37 Command: RS - Resolver Shaft

Function:	it informs about the phase shift between motor and resolver.
Syntax:	data monitoring: ■ address RS <CR> data input: ■ address RS n <CR>
Address type:	axis
Unit of measure:	-
Range:	0 to 65535
Default:	-
Password:	yes
(∗) addressing:	no
Opposite to:	-
See also:	-

Examples:

■ 1 RS <CR>: the answer for axis 1 will be: "A1 RESOLVER SHAFT BIT = XXXXX". Where, if the autophasing has been correctly made:
XXXXX = 14000 to 16000 for 6 pole motor and resolver or 8 pole motor and resolver
XXXXX = approx. 17000 or approx. 39000 or approx. 61000 for 2 pole resolver and 6 or 8 pole motor.

3.2.38 Command: RX - Maximum of R/D resolution

Function:	it allows to set the maximum of Resolver to Digital converter resolution. The R/D resolution will automatically be switched according to actual speed for optimum system performance between RN (minimum) and RX (maximum). The default is 16 bit. If acceleration [rad/s^2] > 314000/NP, then RX must be set to 14. If RX equals RN, the R/D resolution is fixed.
Syntax:	data monitoring: ■ address RX <CR> data input: ■ address RX n <CR>
Address type:	axis
Unit of measure:	bit
Range:	10, 12, 14 and 16 (it must be ≥ RN)
Default:	16
Password:	yes
(∗) addressing:	no
Opposite to:	-
See also:	RN, Tab. 3.6

Example:

■ 2 RX <CR>: questions axis 2 about the maximum resolution of R/D. The answer is: "A02 MAXIMAL R/D RES. = 16" (if 16 bit R/D resolution has been set for axis 2).

3.2.39 Command: SA - Set Address

Function:	it is used to assign the module a basic address different from default. A module programmed as "address 1" will automatically assign, for the other axes, the following address, i.e. 2 - 3 (if triple-axis) or 2 (if double-axis).
Syntax:	data input: ■ address SA n <CR>
Address type:	axis
Unit of measure:	-
Range:	1 to 99
Default:	1
Password:	no
(∗) addressing:	no
Opposite to:	-
See also:	AS

REMARK: To perform SA command, only one module at the time must be connected to J2 flat cable.

3.2.40 Command: SE - SIMULATED ENCODER (OPTIONAL)

Function:	it allows to set the number of pulses per electrical revolution of simulated encoder. The number of ppr must be ≤ ppr according to RN (see Tab.3.7)
Syntax:	data monitoring: ■ address SE <CR> data input: ■ address SE n <CR>
Address type:	axis
Unit of measure:	pulses per electrical revolution
Range:	128, 256, 512, 1024, 2048, 4096, 8192, 16384
Default:	-
Password:	yes
(∗) addressing:	no
Opposite to:	-
See also:	RN, RX, Tab. 3.6 and 3.7

REMARK: to enable a new SE value (after setting and saving), reset button on front panel or send pulse to REM reset.

Example:

■ 2 RN 12 <CR>: allows to set min R/D resolution for axis 2 to 12 bit.

■ 2 SE 1024 <CR>: allows to set the pulses per electr. revolution for axis 2 to 1024.

Tab. 3.7 - Max ppr versus R/D resolution

	Resolution (bit)			
	10	**12**	**14**	**16**
Max number of pulses per electrical revolution	256	1024	4096	16384

3.2.41 Command: SO - SPARE OUTPUT

Function:	it allows to set the Analog Outputs on J8 connector. Parameters 1SO (1st module), 4SO (2nd module) and 7SO (3rd module) determine which signal is to be seen at the Analog Out 1 (J8 conn., pos.4). Parameters 2SO (1st module), 5SO (2nd module) and 8SO (3rd module) determine which signal is to be seen at the Analog Out 2 (J8 conn., pos.5). The possible outputs are max current, velocity reference and velocity error. The internal velocity reference has the slope limited by AC and DE commands and differs from the reference at the input connector The analog outputs can be scaled via ES command.
Syntax:	data monitoring(binary output): ■ address SO <CR> data input: ■ address SO n <CR>
Address type:	1=Analog Output 1 for basic address 1 (see J8 connector, pos.4) 2=Analog Output 2 for basic address 1 (see J8 connector, pos.5) 4=Analog Output 1 for basic address 4 (see J8 connector, pos.4) 5=Analog Output 2 for basic address 4 (see J8 connector, pos.5) 7=Analog Output 1 for basic address 7 (see J8 connector, pos.4) 8=Analog Output 2 for basic address 7 (see J8 connector, pos.5)
Unit of measure:	-
Range:	0 to 9. Analog Outputs: SO1=max current axis 1 of the module SO2=max current axis 2 of the module SO3=max current axis 3 of the module SO4=velocity reference axis 1 of the module SO5=velocity reference axis 2 of the module SO6=velocity reference axis 3 of the module SO7=velocity error axis 1 of the module SO8=velocity error axis 2 of the module SO9=velocity error axis 3 of the module
Default:	1SO=1 2SO=2
Password:	yes
(∗) addressing:	no
Opposite to:	-
See also:	ES

Note: the SO command must be executed with digital Drive Enable disabled (via OF command) and the opto Drive Enable enabled.

Example (see also the examples in ES command):
■ 4 SO 6 <CR>: sets velocity reference of axis 6 on Analog Out 1 (J8 connector, pos.4).

3.2.42 Command: SR - Show Release

Function:	it is used to display the software releases of the system.
Syntax:	data monitoring: ■ address SR <CR>
Address type:	module
Unit of measure:	-
Range:	0.00 to 9.99
Default:	-
Password:	no
(∗) addressing:	no
Opposite to:	-
See also:	-

Examples:
■ 1 SR <CR>: the answer can be: "SOFTWARE REL. MC 0.3 DSP 0.12" .

3.2.43 Command: ST - Status

Function:	it allows to display axis status via a codified ASCII string.
Syntax:	status monitoring: ■ address ST <CR>
Address type:	axis
Password:	no
(∗) addressing:	no

Answer explanation: A a **ST** b c d **E** e f g **I** h i j k l

A **= Axis**
a = Axis address

ST **= Status**

b	= Priority (G2 jumper on person.card)	0 = opto (G2=1-2)	1 = keyboard (G2=2-3)
c	= DRIVE OK opto output	0 = absent	1 = present
d	= Expansion module	0 = absent	1 = present

E **= External (opto input configuration)**

e	= DRIVE EN (Drive enable)	0 = OFF	1 = ON
f	= REF EN (Reference Enable)	0 = OFF	1 = ON
g	= N.C.		

I **= Internal (internal variables config.)**

h	= Drive Enable	0 = OFF	1 = ON
i	= Reference Enable	0 = analog	1 = digital
j	= I LIMIT (Current Limit)	0 = analog	1 = digital
k	= System control	0 = velocity	1 = torque
l	= Direction of rotation (viewed from shaft end)	0 = CW	1 = CCW

3.2.44 Command: SV - Save

Function:	it allows to save all parameters in the personality card. If the WP jumper on the Personality Card is closed, the SV command is disabled (see Par.2.2.7).
Syntax:	command input: ■ address SV <CR>
Address type:	module
Unit of measure:	-
Range:	-
Default:	-
Password:	yes
(∗) addressing:	yes
Opposite to:	-
See also:	-

CAUTION: the SV command execution time is 5s. If a reset has been sent during this time "EEPROM ERROR" will appear and some data can be lost. In this case, the following steps must be met:
- close G3 on the personality card
- send 1SV command
- if the basic address is not 1, send 1SA command
- if 2-axis module, disable 3rd axis via AD command
- open G3 on the personality card

3.2.45 Command: TC - Torque Control

Function:	it allows to pass from speed control to torque control. A torque control proportional to the input reference (analog or digital, positive or negative) will be applied to the motor. As for analog reference, max. torque will be given according to max. voltage at the input reference . As for digital reference, max. torque will be given when a value equal to the maximum one (MV command) is set via VE command. Note that, in that case, VE ("velocity") and MV ("max. velocity") mean "torque" and "max torque". It is an actual torque control and not a speed control, with limited torque (see IL command).
Syntax:	command input: ■ address TC <CR>
Address type:	axis
Unit of measure:	-
Range:	-
Default:	velocity control
Password:	yes
(∗) addressing:	yes
Opposite to:	VC
See also:	IL, MV, VE, VC

Note: the status can be interrogated via ST command (bit K)

3.2.46 Command: VC - Velocity Control

Function:	it allows to pass from torque to velocity control.
Syntax:	command input: ■ address VC <CR>
Address type:	axis
Unit of measure:	-
Range:	-
Default:	velocity control
Password:	yes
(∗) addressing:	yes
Opposite to:	TC
See also:	TC

Note: the status can be interrogated via ST command (bit K)

3.2.47 Command: VE - Velocity

Function:	it allows to set velocity, in case the digital reference is enabled (see DR command). If the drive is configured also as torque actuator, it allows to set torque (see TC command). The numeric value can be preceded by "-".
Syntax:	data monitoring: ■ address VE <CR> data input: ■ address VE n <CR>
Address type:	axis
Unit of measure:	n = rpm
Range:	-9999 to MV
Default:	0
Password:	no
(∗) addressing:	no
Opposite to:	-
See also:	VC, MV

Note: the maximum range for - MV is -9999. To have extended range (up to 32000) for negative speed, it is necessary to set +MV and to change direction via DI command.

Examples:

■ 1 VE 500 <CR>: it sets axis 1 to 500 rpm.

■ 2 VE -500 <CR>: it sets axis 2 to -500 rpm.

3.2.48 Command: VO - Analog Velocity Offset Automatic Setting

Function:	it allows to automatically adjust the analog velocity offset	
Syntax:	command input:	■ address VO <CR>
Address type:	axis	
Unit of measure:	-	
Range:	0 to 255	
Default:	0	
Password:	yes	
(∗) addressing:	no	
Opposite to:	-	
See also:	OV	

REMARK'S: *The VO command must be executed with digital Drive Enable off (stopped motor). Before executing the command it is necessary to check that the external opto input Drive Enable is enabled and keyboard Drive Enable is off (OF command).*

Notes: If error > 255, "OUT-OF-RANGE" is displayed.

3.2.49 Command: VS - VELOCITY STRUCTURE

Function:	it allows to set 4 different structures of the velocity control. All the structures have a digital low pass filter processing the speed reference or the speed error signal. The cutoff frequency of this filter can be adjusted by DF parameter (see DF). The value DF=0 switches the filter OFF. **VS=0** selects the speed controller having the feedback KP and KI gains four times higher than the standard gains and a digital low pass filter processing the speed reference signal. This structure should be used in applications where the analog speed reference lines from the CNC are noisy, and high gains are required. **VS=1** selects the speed controller having standard feedback KP and KI gains and a digital low pass filter processing the speed reference signal. This structure should be used in applications where the analog speed reference lines from the CNC are noisy, and normal gains are required. **VS=2** selects the speed controller having the feedback KP and KI gains four times higher than the standard gains and a digital low pass filter processing the speed error signal. This structure should be used in applications with high ratios between load and motor inertia (inertia mismatch), and high gains are required. **VS=3** selects the speed controller having standard feedback KP and KI gains and a digital low pass filter processing the speed error signal. This structure should be used in applications with high ratios between load and motor inertia (inertia mismatch), and normal gains are required.
Syntax:	data monitoring: ■ address VS <CR> data input: ■ address VS n <CR>
Address type:	axis
Unit of measure:	-
Range:	0 to 3. VS=0: gains multiplied by 4, reference filtering VS=1: standard gains, reference filtering VS=2: gains multiplied by 4,error filtering VS=3: standard gains , error filtering
Default:	1
Password:	yes
(∗) addressing:	no
Opposite to:	-
See also:	DF

Note: the VS command must be executed with digital Drive Enable disabled (via OF command) and the opto Drive Enable enabled.

REMARK: to change DBM 01 with DBM 03 with same gains it is necessary to:
1. If PR=1 (motor poles=resolver poles) set VS=1 or VS=3
2. If PR≠1 (ex. FAS T motor with 2 pole resolver) set VS=0 or VS=2

3.3 Protections

3.3.1 Power Supply

Recovery not ok.

Indicated by: LED's DRVF (drive fault) on all drives, LED DBR FAULT, optoisolated output DRIVE OK, bit H of the FA string (see FA command).

Set condition: when recovery power transistor or recovery resistor is broken, in short circuit; when the recovery is active for too much time.

Effect: all drives inhibit torque

Reset condition: if the condition is not present anymore, power off and on monophase voltage.

Power supply overtemperature.

Indicated by: LED's DRVF (drive fault) on all drives, LED OVER TEMP, optoisolated output DRIVE OK, bit I of the FA string (see FA command).

Set condition: when a limit temperature is reached.

Effect: all drives inhibit torque.

Reset condition: if the condition is not present anymore, power off and on monophase voltage.

3.3.2 Drive Module

Resolver not ok.

Indicated by: LED DRVF, LED RF (Resolver Fault), optoisolated output DRIVE OK, bit B of the FA string (see FA command).

Set condition: when the resolver is not connected or in short circuit at the power up, when the resolver fails or is disconnected during running.

Effect: the drive inhibit torque of all axes of the module.

Reset condition: if the condition is not present anymore, reset button on drive or send pulse to REM RESET.

Motor over temperature.

Indicated by: LED DRVF, LED OVT, optoisolated outputs DRIVE OK and MOTOR OK, bit C of the FA string (see FA command).

Set condition: when a limit temperature is reached inside the motor.

Effect: the drive inhibit torque of all axes of the module.

Reset condition: if the condition is not present anymore, reset button on drive or send pulse to REM RESET.

Notes: the fault information via LEDS and opto is reset when the motor temperature goes down the limit, while the drive is disabled until the reset condition has been met.

Short on axis.

Indicated by: LED DRVF, LED SHRT CCT, optoisolated output DRIVE OK, bit D of the FA string (see FA command).

Set condition: when a short circuit is detected between the motor phases, phase and ground, phase and HV.

Effect: the drive inhibit torque of all axes of the module.

Reset condition: if the condition is not present anymore, power off and on the aux power supply.

Motor sequence not coherent.

Indicated by: LED DRVF, optoisolated output DRIVE OK, bit E of the FA string (see FA command).

Set condition: when at level of current measurement, the three motor phases are not a triplet or when a phase is greater than a fixed limit.

Effect: inhibit torque of all axes of the module.

Reset condition: if the condition is not present anymore, reset button on drive or send pulse to REM RESET.

Auxiliary voltages not norm.

Indicated by: LED DRVF, optoisolated output DRIVE OK, bit N of the FA string (see FA command).

Set condition: when the level of +/- 15V or 5V becomes out of tolerance.

Effect: inhibit torque of all axes of the module.

Reset condition: if the condition is not present anymore, reset button on drive or send pulse to REM RESET.

Personality card absent

Indicated by: LED DRVF, optoisolated output DRIVE OK, bit L of the FA string .

Set condition: when the personality card is not present or taken away during running.

Effect: inhibit torque of all axes of the module.

Reset condition: if the condition is not present anymore, reset button on drive or send pulse to REM RESET.

EEPROM error

Indicated by: LED DRVF, optoisolated output DRIVE OK, bit L of the FA string (see FA command), "EE ERROR" on the keyboard.

Set condition: when, after the SV command, a reset has been sent before 5 sec.

Effect: inhibit torque of all axes of the module.

Reset condition: check the parameters (e.g. KP, KI,..), correct the wrong values and save.

Bus not normal.

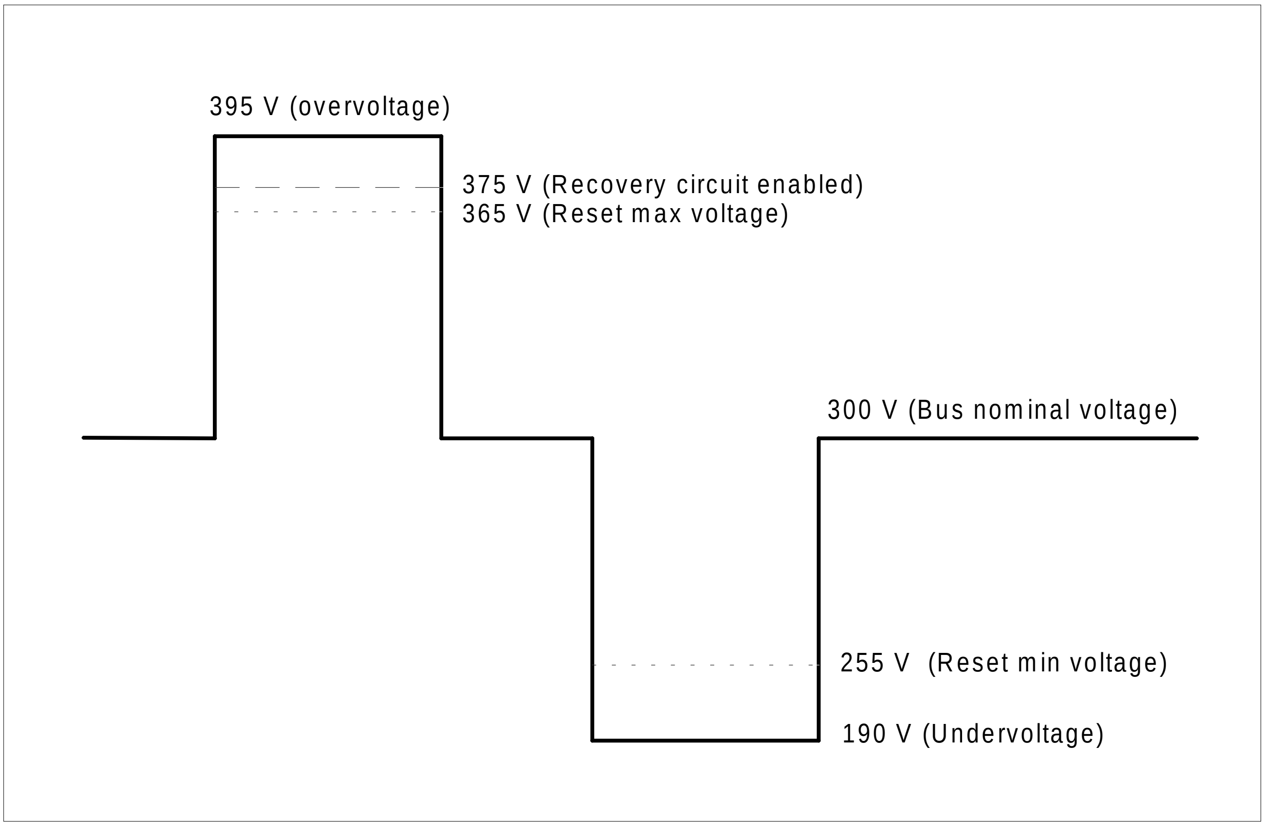
Indicated by: LED DRVF, LED POWER OK, optoisolated output DRIVE OK, bit M of the FA string (see FA command).

Set condition: See figure 3.2.

Effect: inhibit torque of all axes of the module .

Reset condition: if the condition is not present anymore at analog level (with hysteresis), reset button on drive or send pulse to REM RESET.

FIG. 3.2. BUS BAR Voltage



Auxiliary HV referred voltages not norm.

Indicated by: LED DRVF, optoisolated output DRIVE OK, bit N of the FA string (see FA command).

Set condition: when the level of auxiliary voltages referred to power stage (-HV) becomes out of tolerance.

Effect: inhibit torque of all axes of the module.

Reset condition: if the condition is not present anymore at analog level (with hysteresis) reset button on drive or send pulse to REM RESET.

Drive overtemperature.

Indicated by: LED's DRVF and DRV OVT, optoisolated output DRIVE OK, bit O of the FA string (see FA command).

Set condition: when a limit temperature is reached on the heatsink.

Effect: inhibit torque of all axes of the module.

Reset condition: if the condition is not present anymore power off and on monophase voltage.

Notes: the temperature limit is detected by thermo-switch.

IT

Indicated by: LED DRVF, bit G of the FA string (see FA command).

Set condition: when the integral value IT (integral of current in the motor multiplied by the time) is over taken.

Effect: when the fault is going on the current limit is reduced to the level of the motor rated current (set by PC command).

Reset condition: if the condition is not present anymore, the protection is reset. Push button on drive or send pulse to REM RESET to reset the fault status in FA string.

Watchdog.

Indicated by: LED DRVF, LED WTD, optoisolated output DRIVE OK.

Set condition: when the micro controller or DSP fails.

Effect: inhibit torque or all axes of the module.

Reset condition: if the condition is not present anymore reset button on drive or send pulse to REM RESET.

Overspeed

Indicated by: LED DRVF, optoisolated output DRIVE OK, bit F of the FA string (see FA command).

Set condition: when an error between set speed and actual speed bigger than the programmed via EV command is detected.

Effect: inhibit torque on axis.

Reset condition: when the condition is no longer present, reset button on drive or send pulse to REM RESET.

SECTION 4-TROUBLESHOOTING

FIG. 4.1 - DBM-PS Power Supply - AUX PWR green LED off
Auxiliary Power Fault

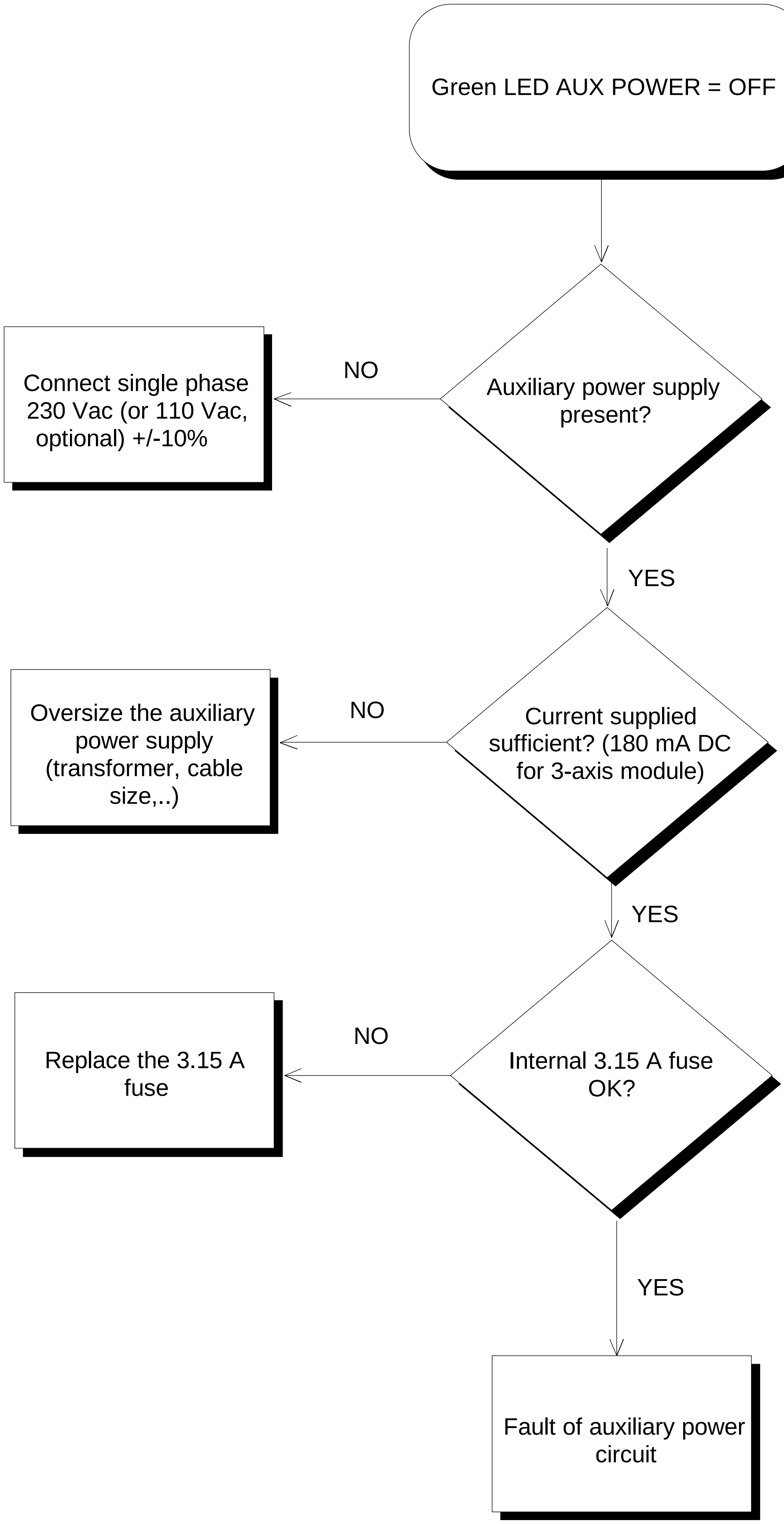


FIG. 4.2 - DBM-PS Power Supply - OVER TEMP red LED on Overtemperature

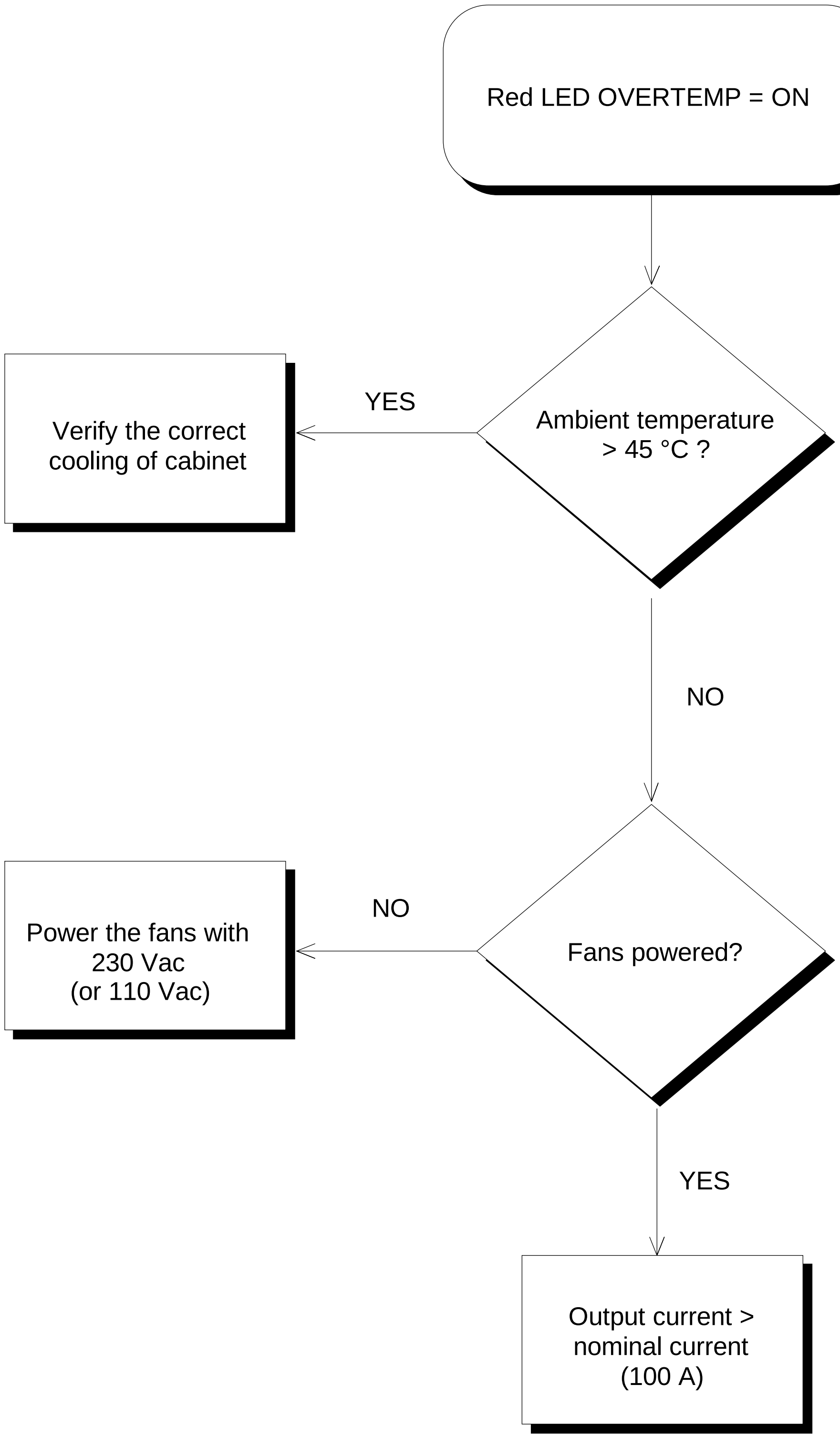


FIG. 4.3 - DBM-PS Power Supply - DBR FAULT red LED on Recovery Fault

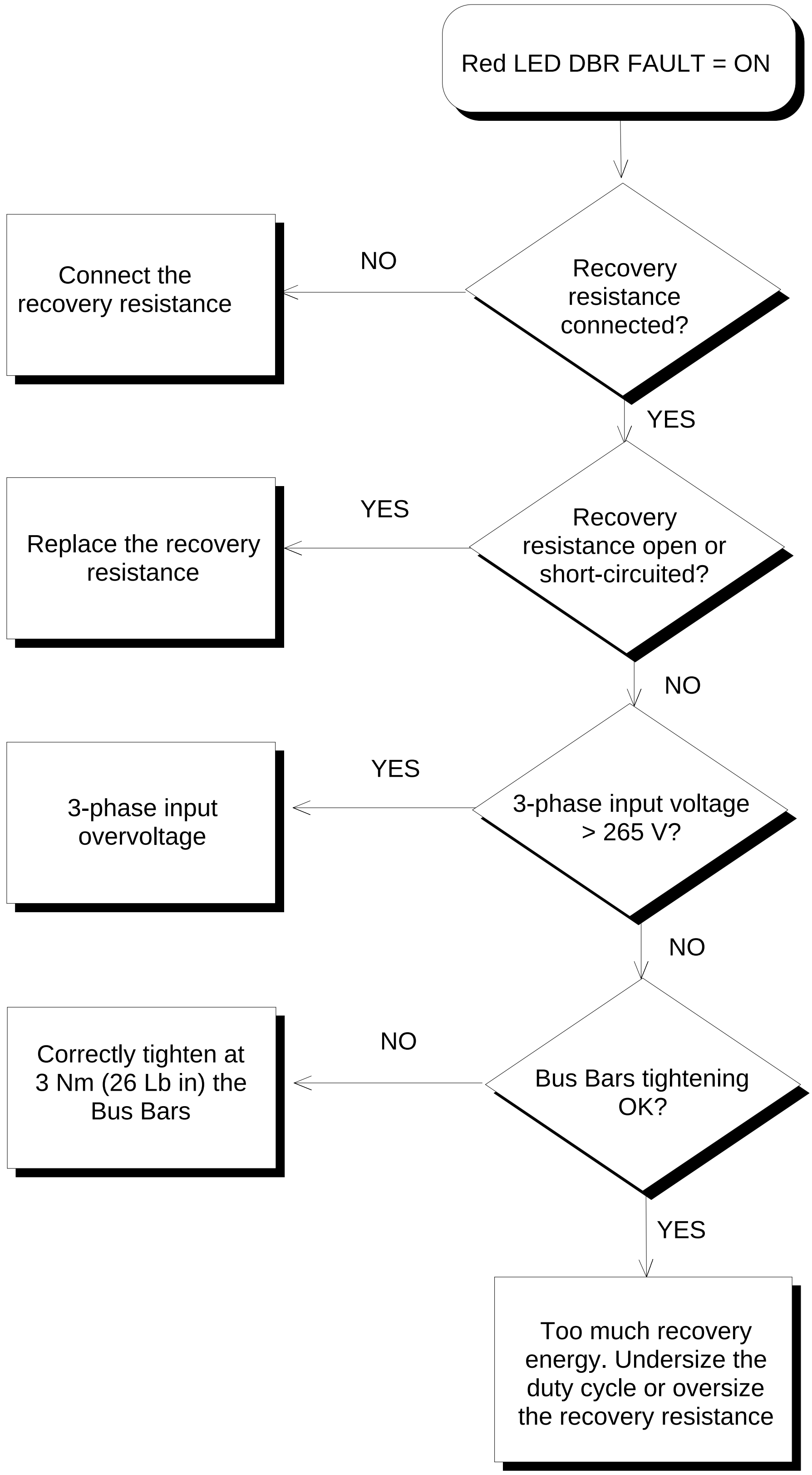


FIG. 4.4 - DBM-PS Power Supply - PWR BUS yellow LED off

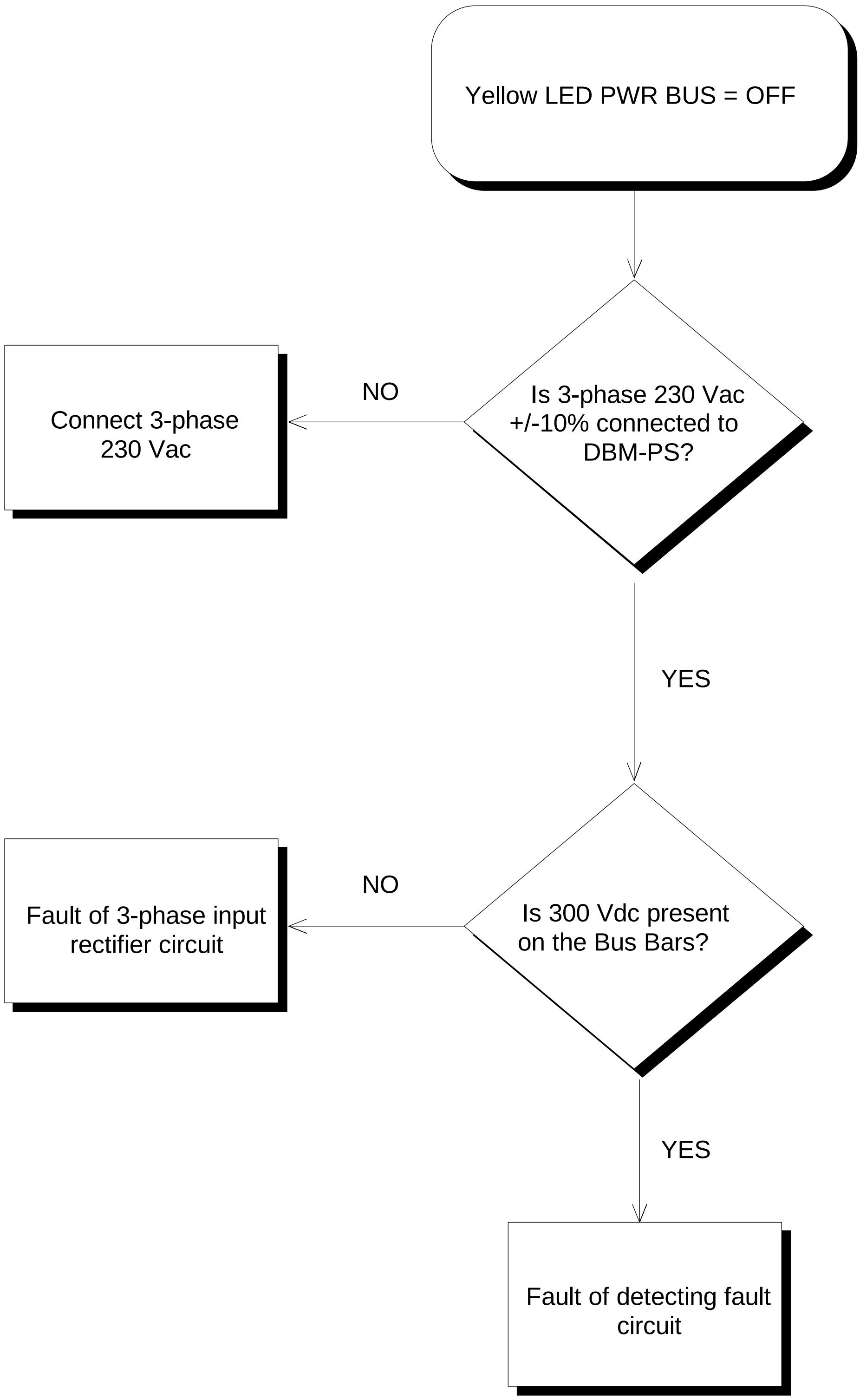


FIG. 4.5 - DBM Module - POWER OK green LED off

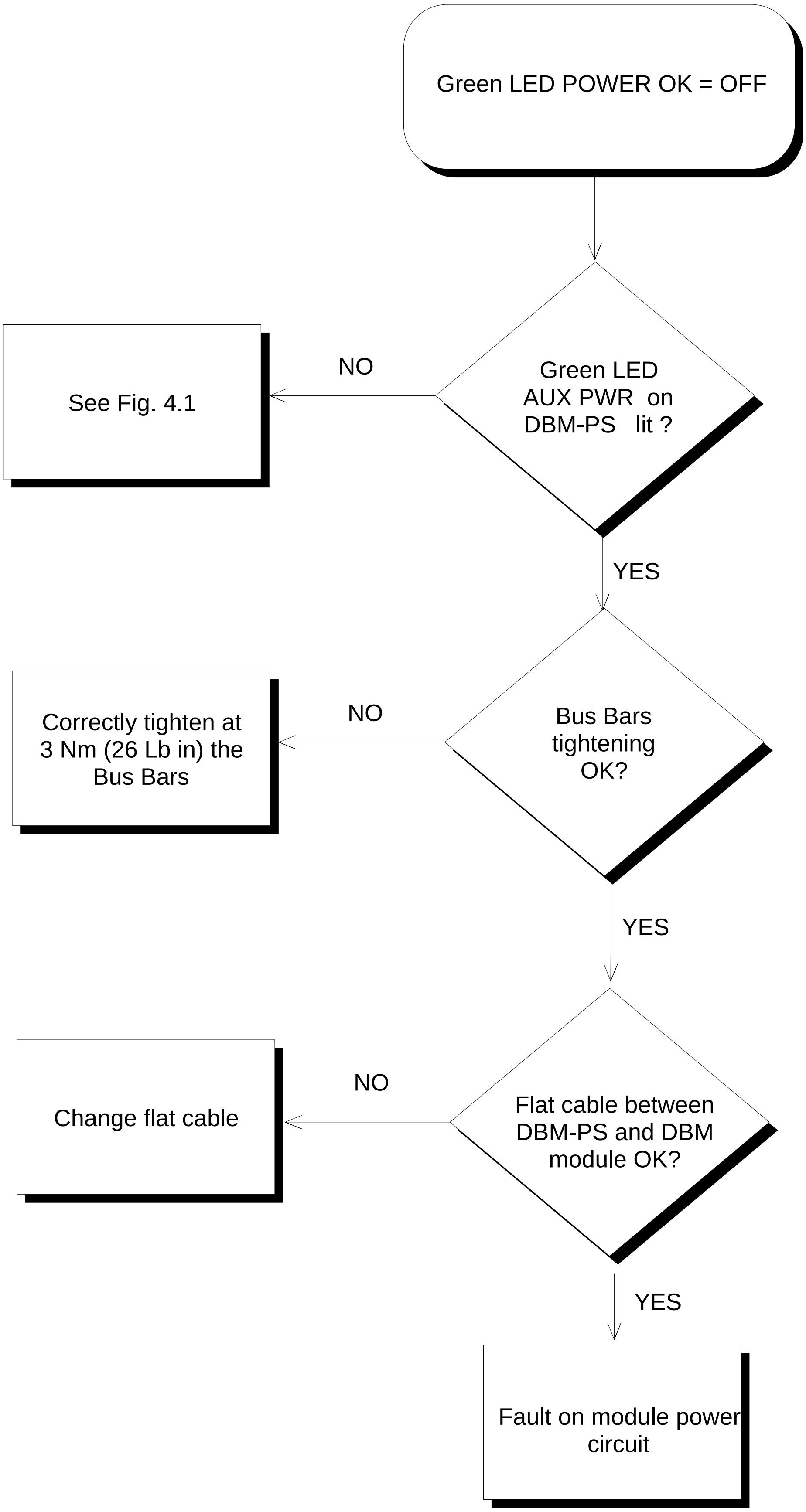


FIG. 4.6 - DBM Module - DRIVE EN green LED off
Drive Enable

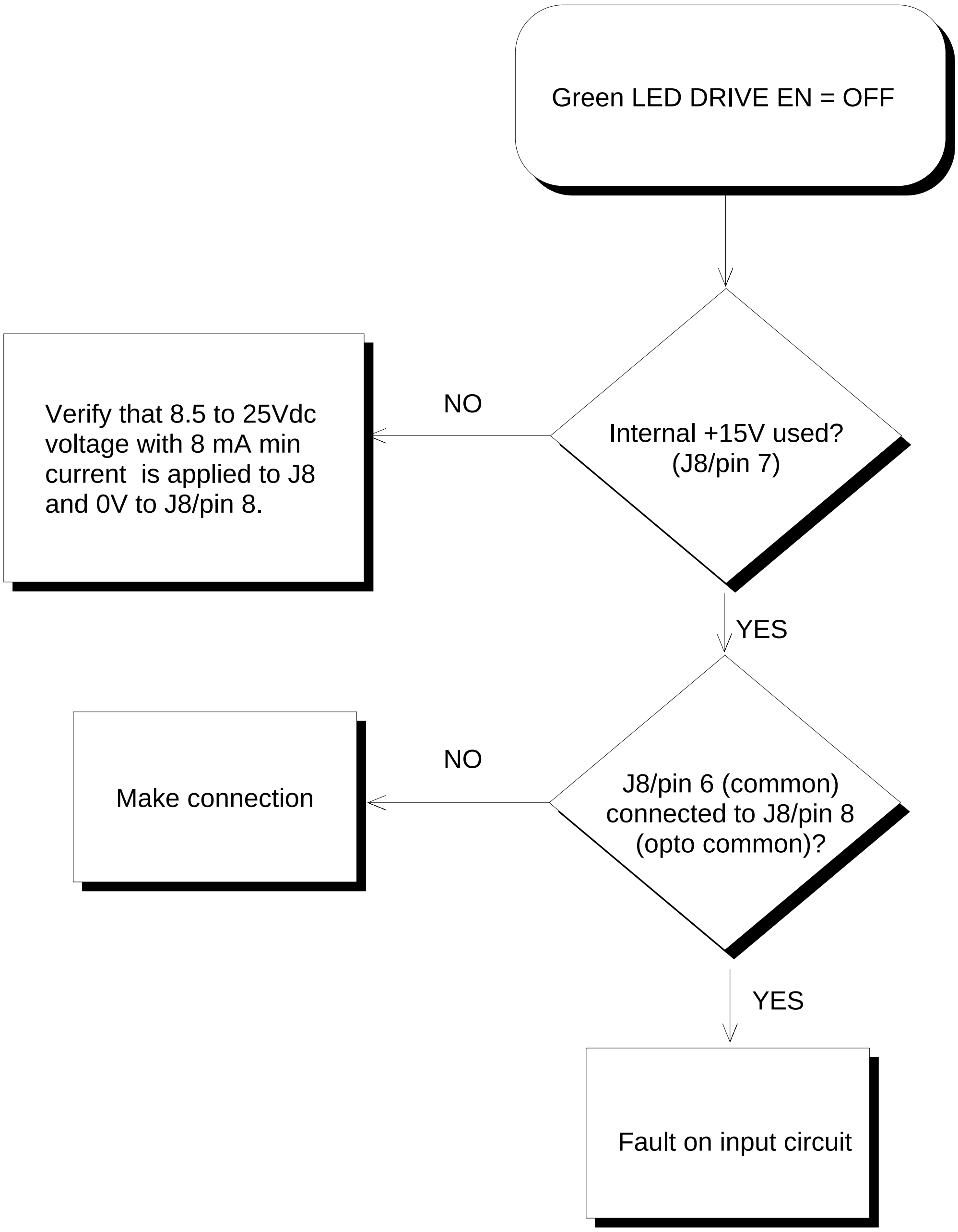


FIG. 4.7 - DBM Module - REF EN green LED off
Reference Enable

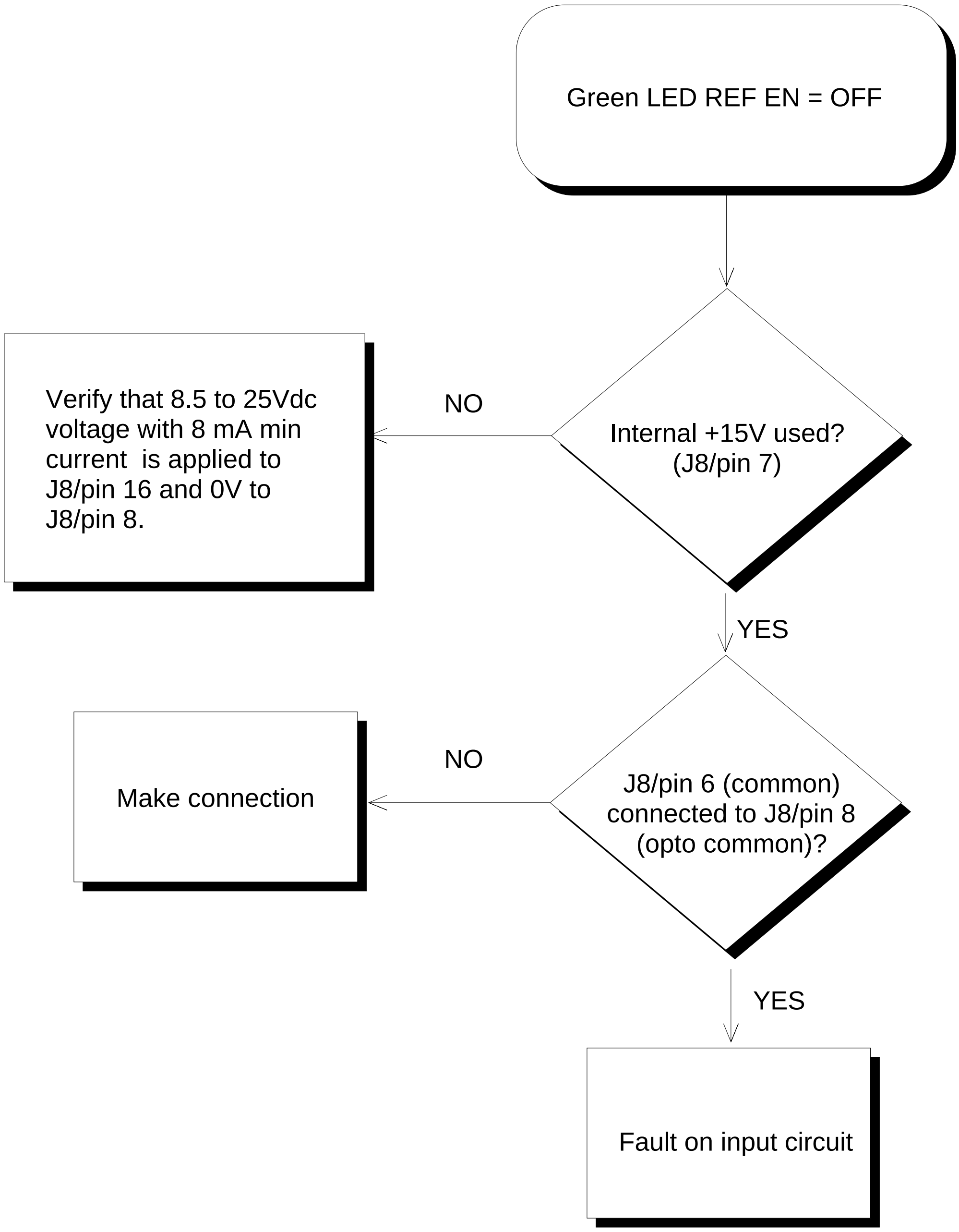


FIG. 4.8 - DBM Module - DRV OVT red LED on
DBM Overtemperature

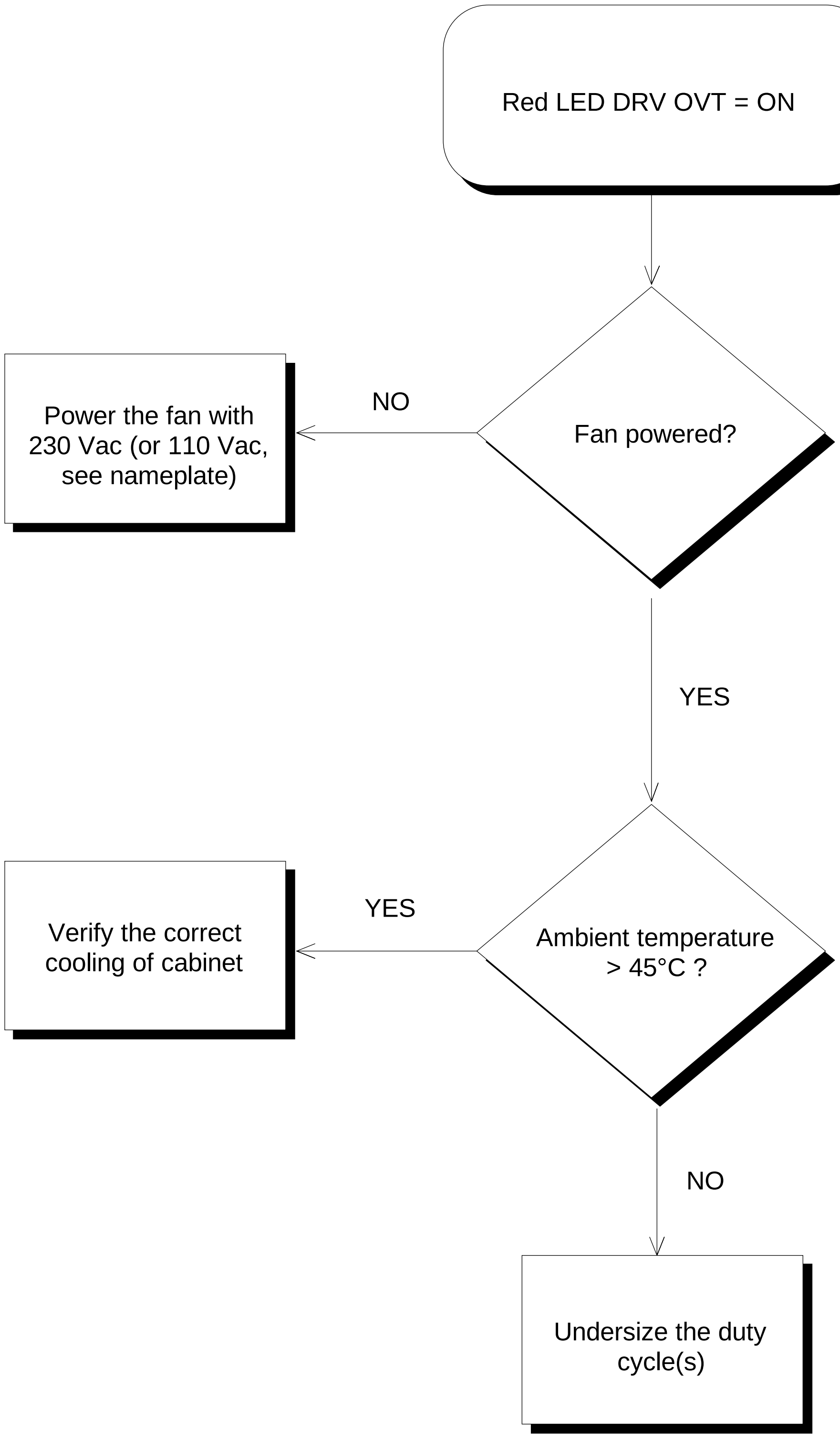


FIG. 4.9 - DBM Module - SHRT CCT red LED on Short Circuit

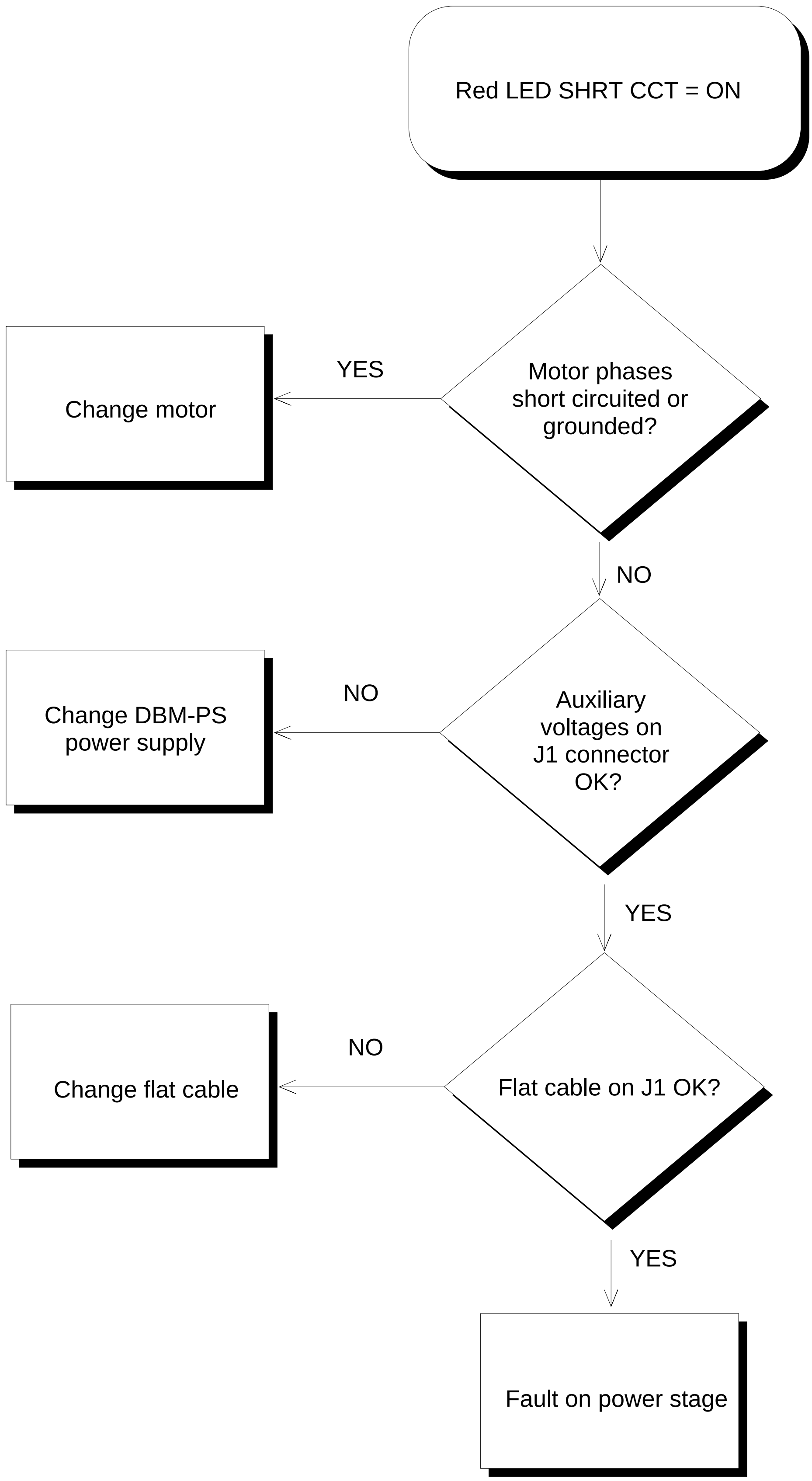


FIG. 4.10 - DBM Module - OVT red LED on
Motor Overtemperature

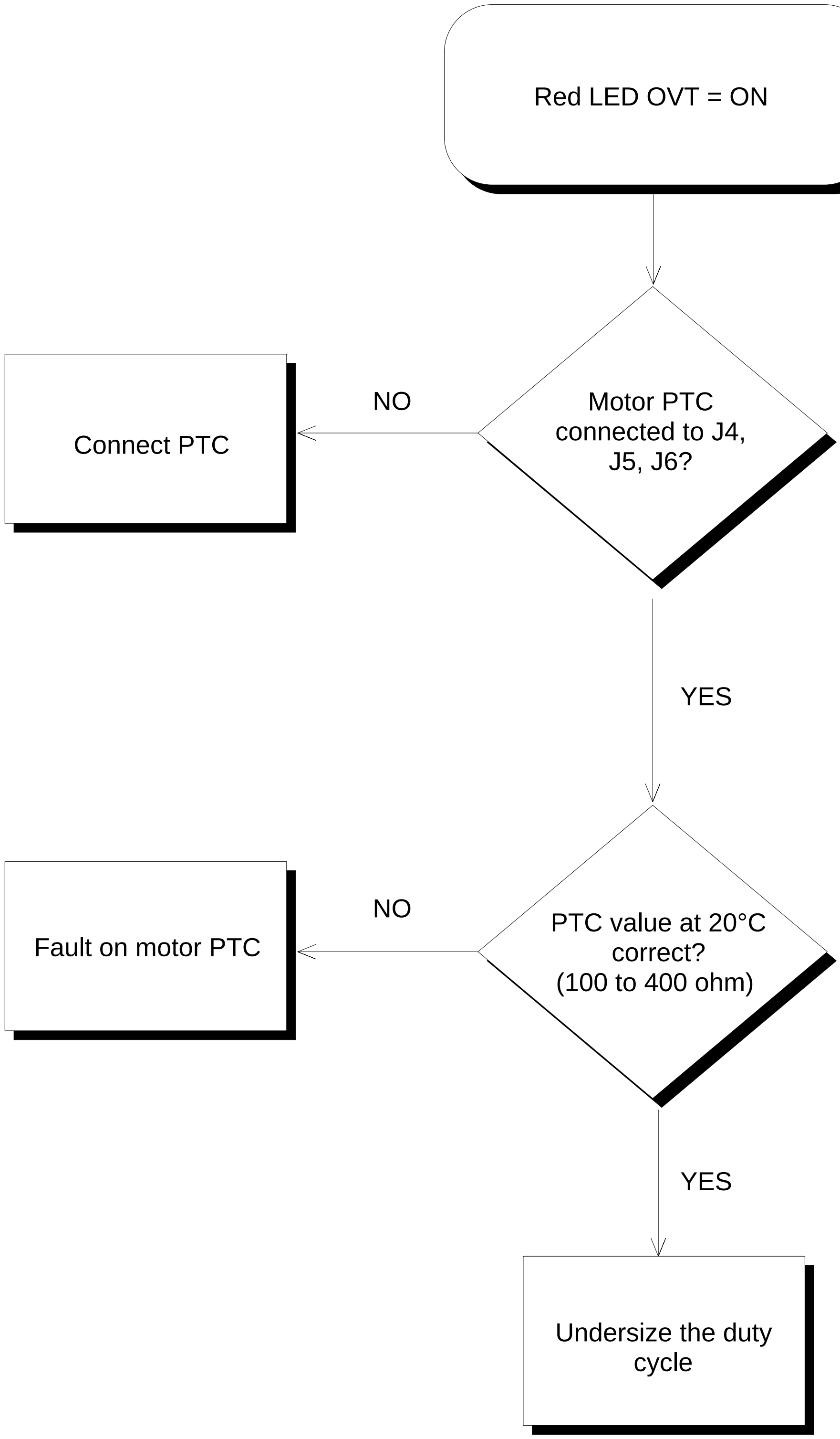


FIG. 4.11 - DBM Module - RF red LED on Resolver Fault

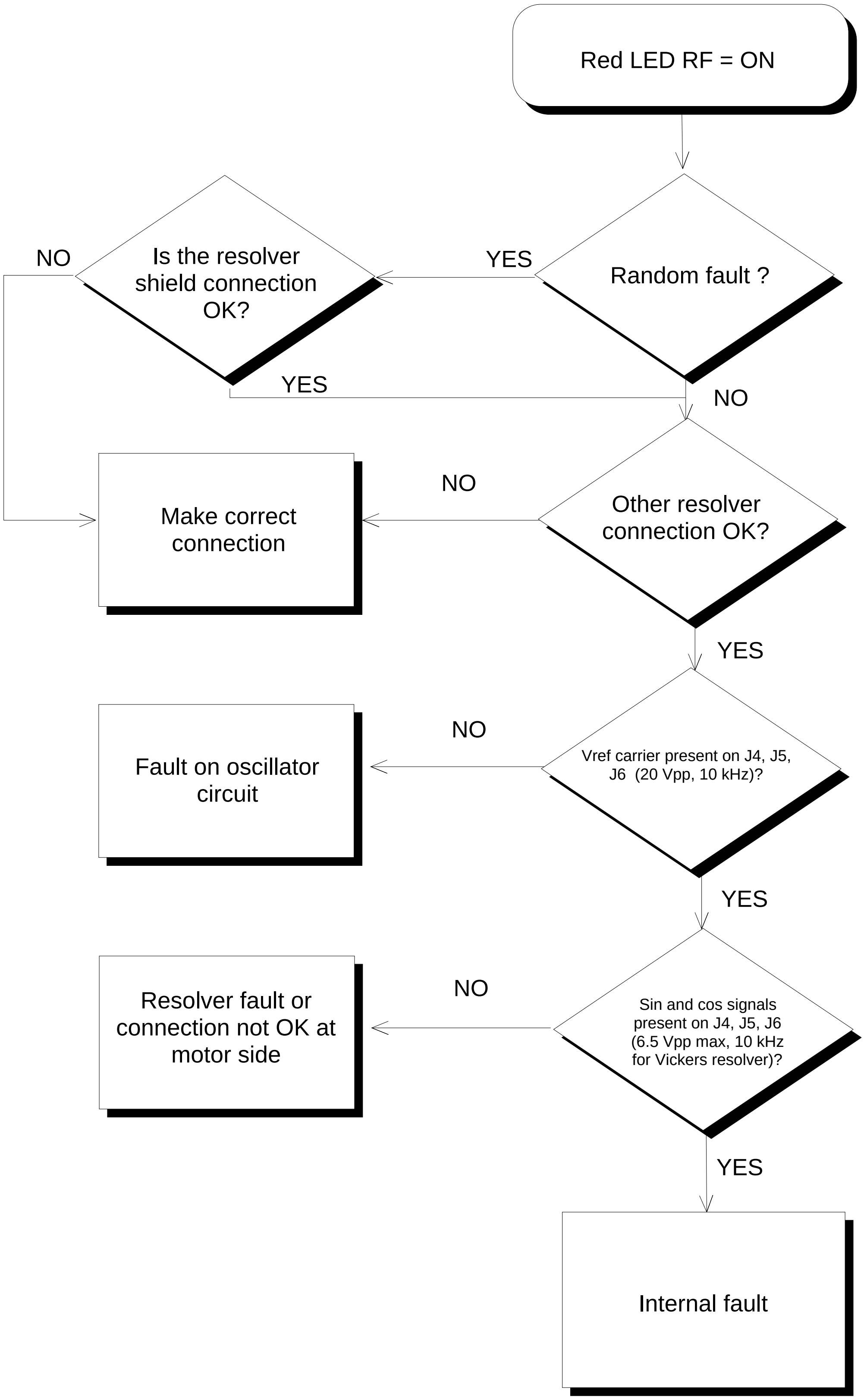


FIG. 4.12 - DBM Module - WTD red LED on Watch Dog

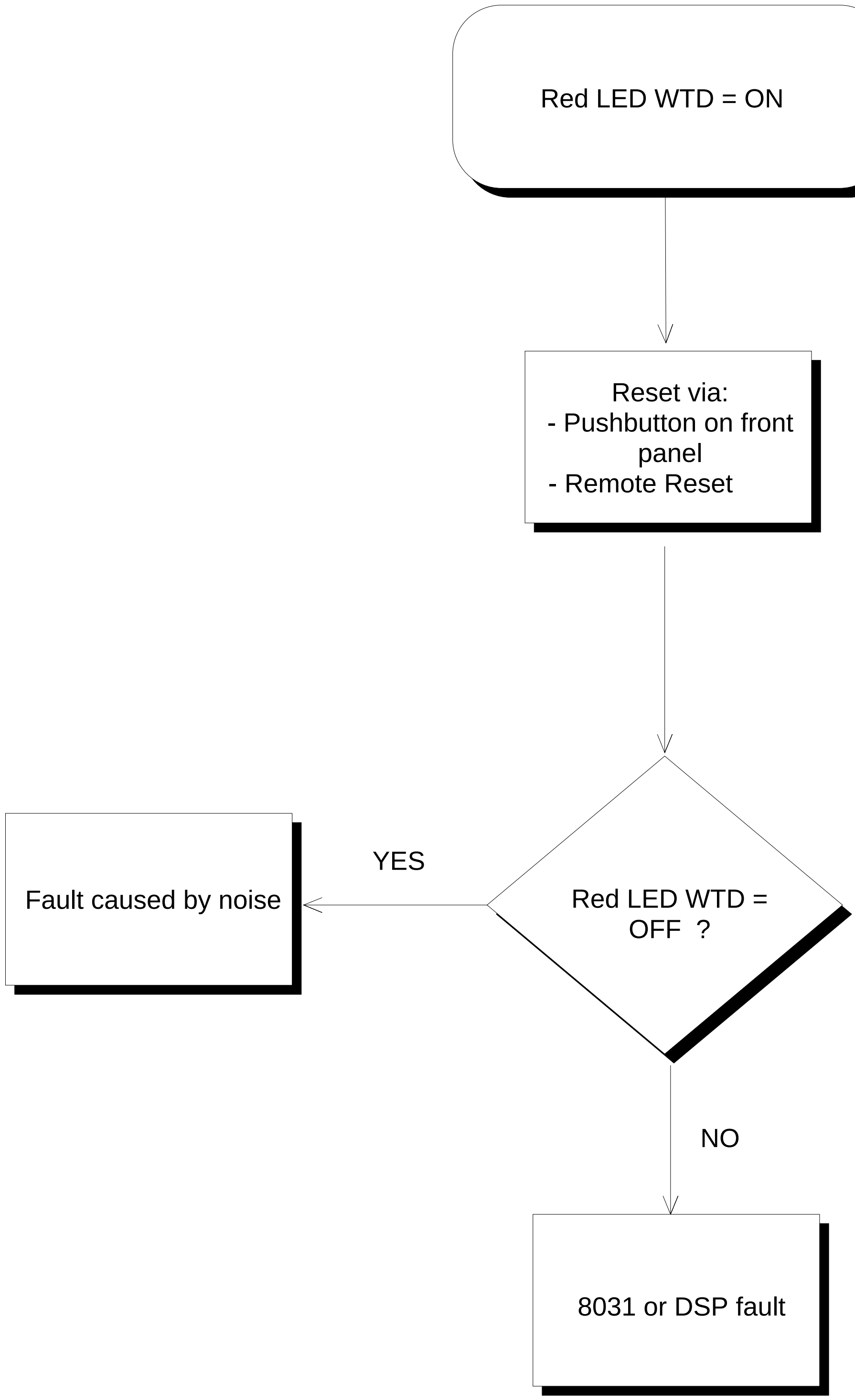


FIG. 4.13 - DBM Module - DRVF red LED on Drive Fault

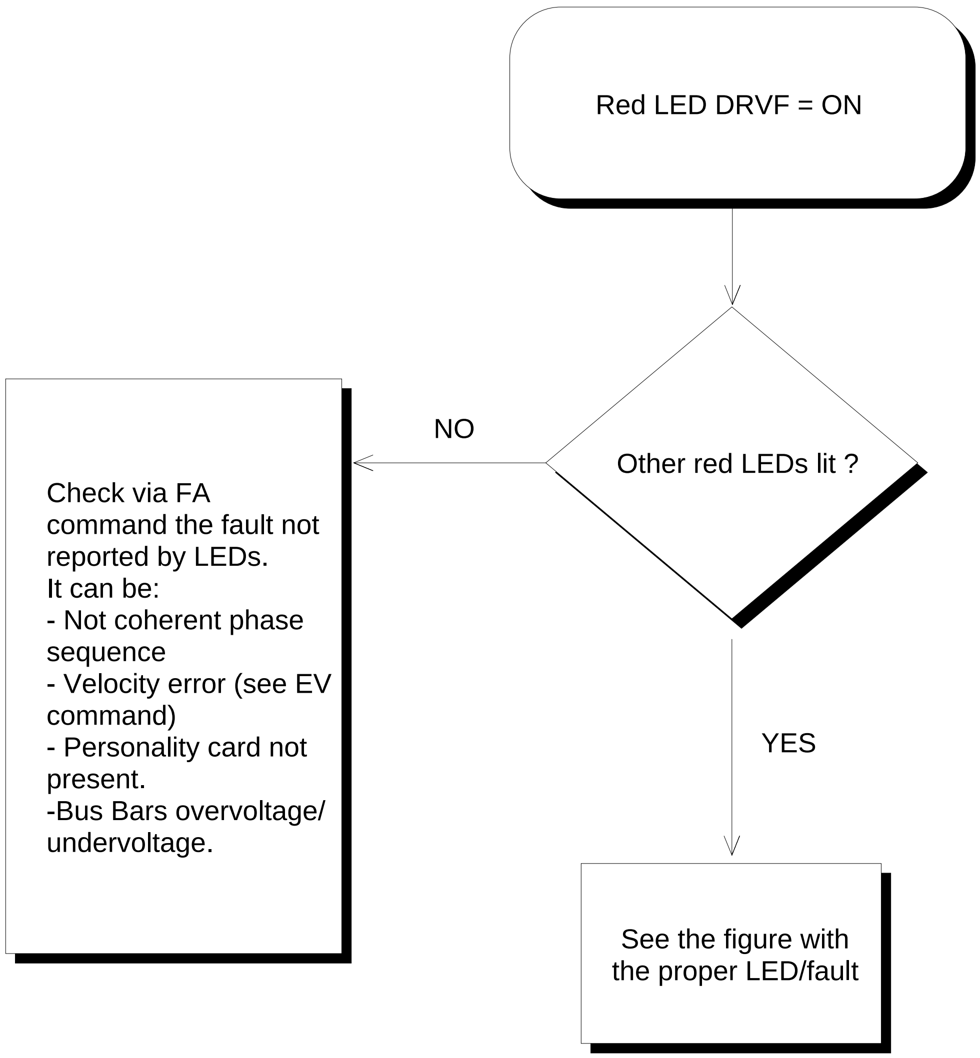


FIG. 4.14 - Motor vibrates

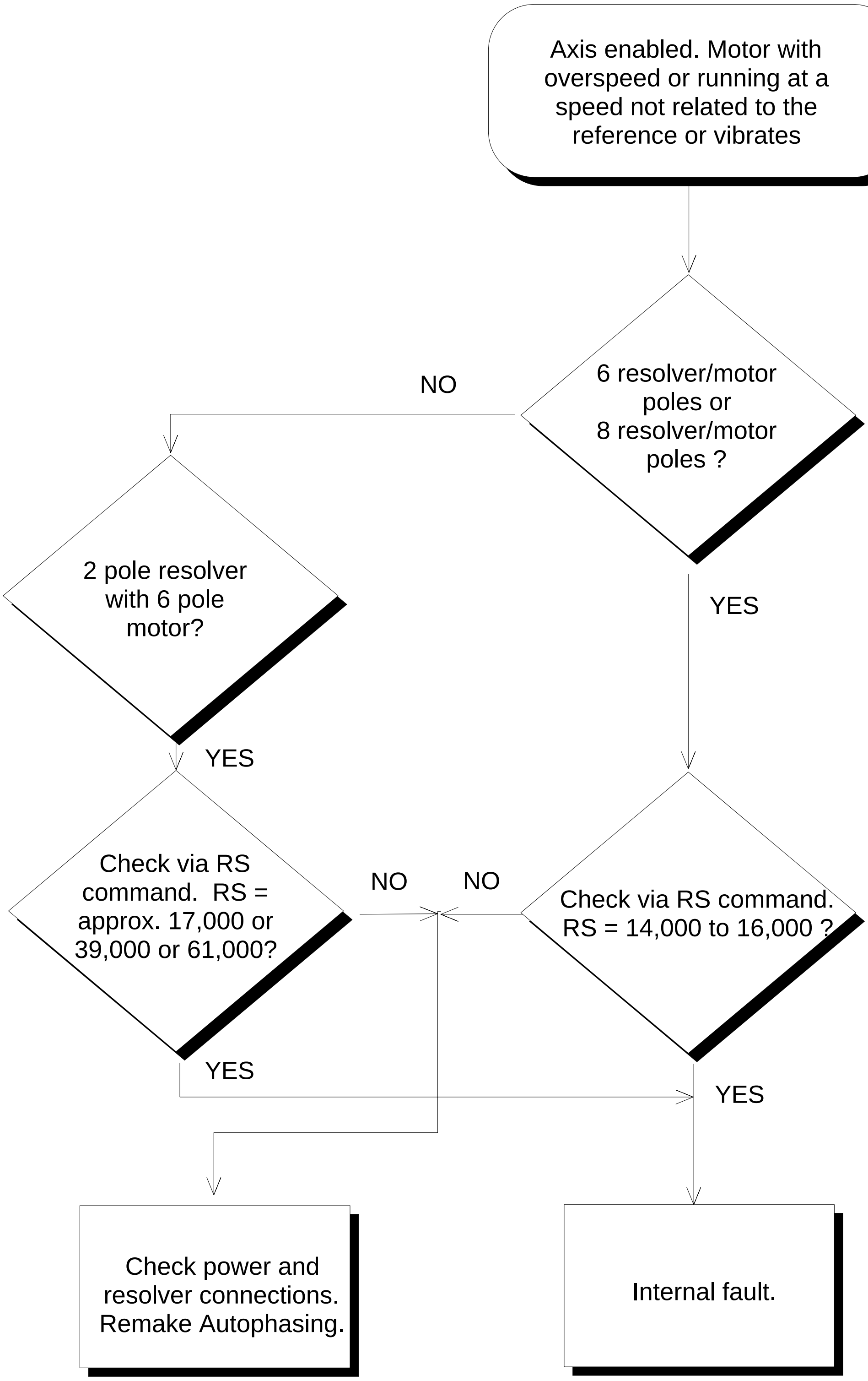


FIG. 4.15 - Keypad fault

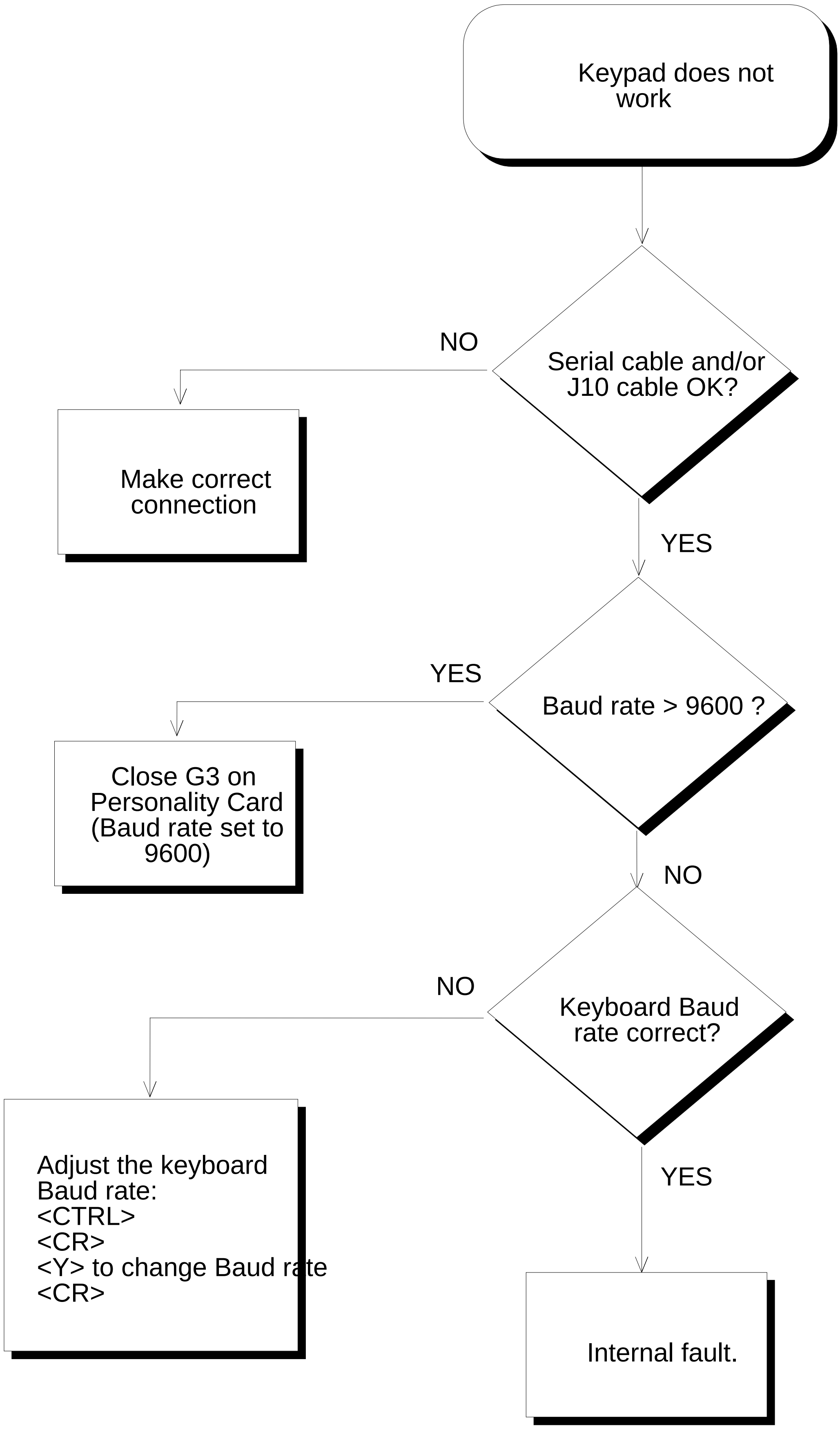
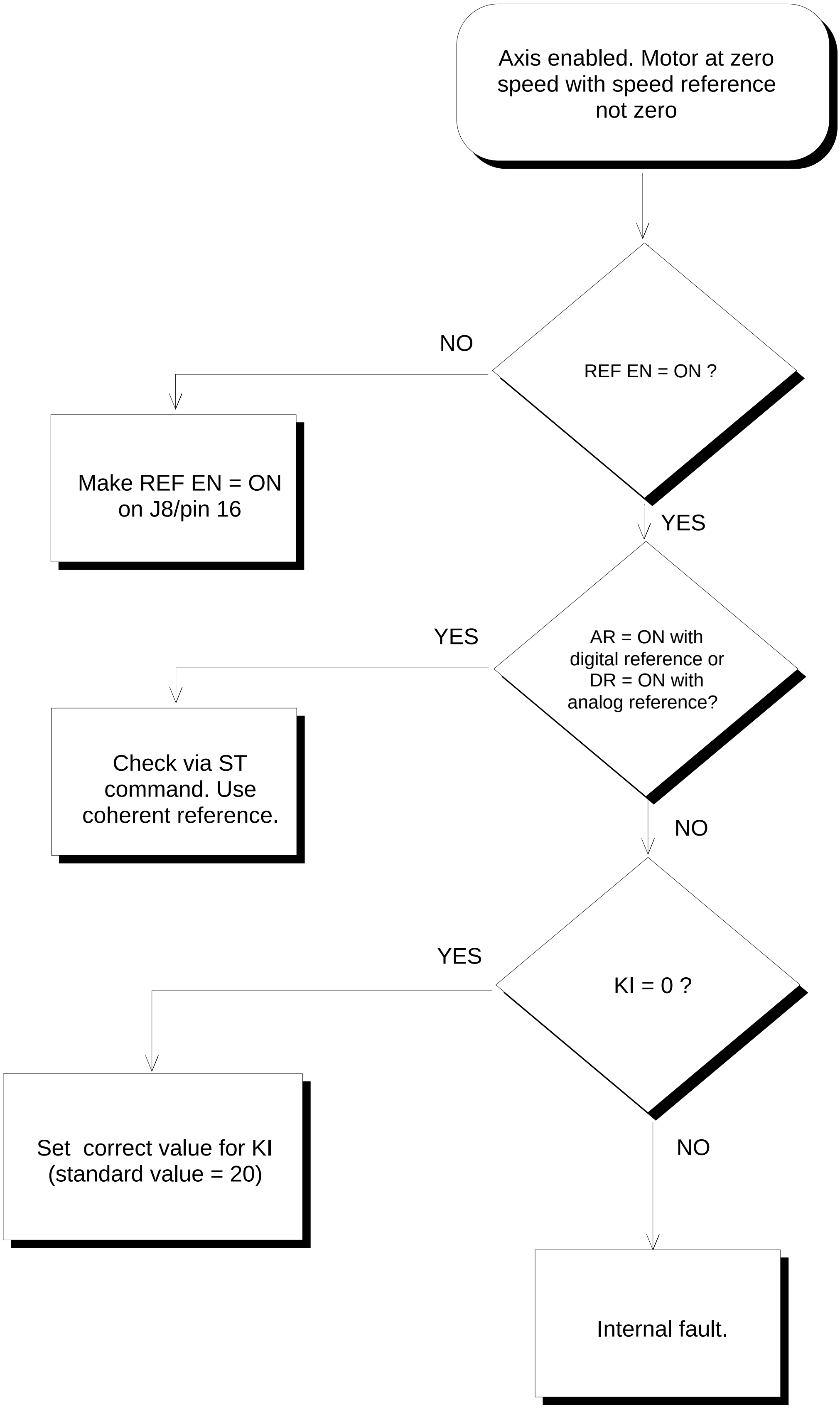


FIG. 4.16 - Motor at zero speed



SECTION 5 - PRINCIPLES OF OPERATION

5.1 Introduction

In this chapter, principles of operation of the drive system comprising the DBM multi-axis module and FAS T and FAS K synchronous motors with permanent magnet excitation will be described. Theoretical background along with the necessary information specific for the DBM will be outline, for the purpose of better understanding of the system, for the aim of a comparison with other systems, and for the ease of the parameter adjustments during the installation phase. Issues of particular importance are the torque generation, current control loops and the speed control loop.

5.2 Torque Generation

The DBM is designed for the torque and speed control of synchronous motors with permanent magnets on the rotor and with the sinusoidal distribution of the stator windings along the stator circumference. Rather than "trapezoidal EMF" motors with concentrated stator windings, these motors have sinusoidal electromotive force, induced in the windings during the rotation of the rotor. Such motors have to be supplied with sinusoidal stator phase currents. Having these currents shifted by $2\pi/3$ relative to each other, and setting the stator current frequency at ω_r, the resultant magnetomotive force will be a vector I_S rotating at the rotor speed. The magnetomotive force angle relative to the rotor flux Ψ_r is marked θ_i (see Fig. 1).

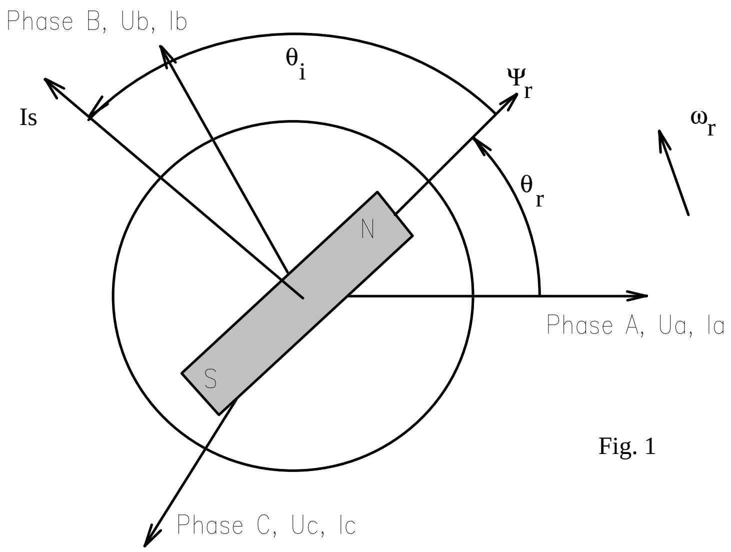


Fig. 1

Having a constant amplitude of phase currents, the current vector will rotate at ω_r, having a constant amplitude along the period. Hence, conditions of obtaining ripple-free electromagnetic torque are fulfilled. The torque generation and the current control loops are conditioned by the shaft sensor, which is giving the rotor speed and the rotor position information. An application of synchronous motor calls for an absolute position sensor, in order to set the current angle θ_i between the magnetomotive force and the rotor flux.

DBM is designed to interface with resolvers as the motor shaft sensors. Details of the speed/position sensing are described in par. 5.4 . In Fig. 1, θ_r stands for the angular displacement of the rotor flux with respect to the phase A winding of the stator. Assuming the speed of rotation ω_r,

$$\theta_\mathrm{r} = \theta_0 + \omega \mathrm{t}. \tag{1}$$

Electromotive forces, induced in the stator windings will be:

$$\begin{aligned} e_A &= \Psi_\mathrm{r}\ \omega_\mathrm{r} \cos(\theta_\mathrm{r} + \pi/2) \\ e_B &= \Psi_\mathrm{r}\ \omega_\mathrm{r} \cos(\theta_\mathrm{r} - \pi/6) \\ e_C &= \Psi_\mathrm{r}\ \omega_\mathrm{r} \cos(\theta_\mathrm{r} - 5\pi/6) \end{aligned} \tag{2}$$

In order to obtain the magnetomotive force vector as described in the Fig. 1, the stator phase currents has to be:

$$\begin{aligned} i_A &= I_s \cos(\theta_\mathrm{r} + \theta_\mathrm{i}) \\ i_B &= I_s \cos(\theta_\mathrm{r} + \theta_\mathrm{i} - 2\pi/3) \\ i_C &= I_s \cos(\theta_\mathrm{r} + \theta_\mathrm{i} - 4\pi/3) \end{aligned} \tag{3}$$

From the above equation, one can derive the power of the electromechanical conversion; that is, the power flowing through the machine air gap as the consequence of mutual interaction of the stator and rotor fluxes:

$$P_{em} = e_A\, i_A + e_B\, i_B + e_C\, i_C =$$
$$= \frac{\sqrt{3}}{2}\, \omega_{\mathrm{r}}\, \Psi_{\mathrm{r}}\, I_s \cos(\pi / 2 - \theta_i) \tag{4}$$

The electromagnetic torque obtained by dividing the air-gap power with the field frequency:

$$T_{em} = \frac{\sqrt{3}}{2}\, \Psi_{\mathrm{r}}\, I_s \cos(\pi / 2 - \theta_i) \tag{5}$$

From (4) and (5), one can conclude that the usage of the motor with the sinusoidal electromotive force in the regime of sinusoidal current supply gives a shaft torque that does not possess the torque ripple, inherent to the brushless DC motors with trapezoidal electromotive force. As can be seen from (5), the torque depends on the amplitude of the stator current and on the angular displacement between the rotor flux and the stator magnetomotive force.

The DBM performs control of the torque magnitude through the stator current amplitude I_S. The phase advance θ_i of the stator current is set to $+\pi/2$ in the cases when it is necessary to accelerate in the sense of ω_r. For decelerating (with respect to the sense of rotation shown in Fig. 1), the phase advance θ_i of the stator current is set to $-\pi/2$. Such a choice leads to the maximum torque for the given stator current; that is, in the maximum Nm/A. In order to insure maximized torque per amps, the DBM control software is equipped with "Auto phasing" routine for the drive self-adjustment (see par. 3.2.5).

5.3 Current Control Loops

Control of the magnetomotive force of the stator is implemented through the PI control of the stator phase currents. That is, the amplitude and the spatial orientation of the vector I_S is performed by controlling its components. Equation (3) gives the references of the motor phase currents; that is, they are bringing out waveforms that should be the stator phase currents. It can be seen that the amplitude I_S plays the role of the torque demand, or the torque reference. Apart of the torque reference, the derivation of the current references calls for the information about the rotor position θ_r, which is obtained from a Resolver to Digital converter, connected to the resolver mounted on the motor shaft.

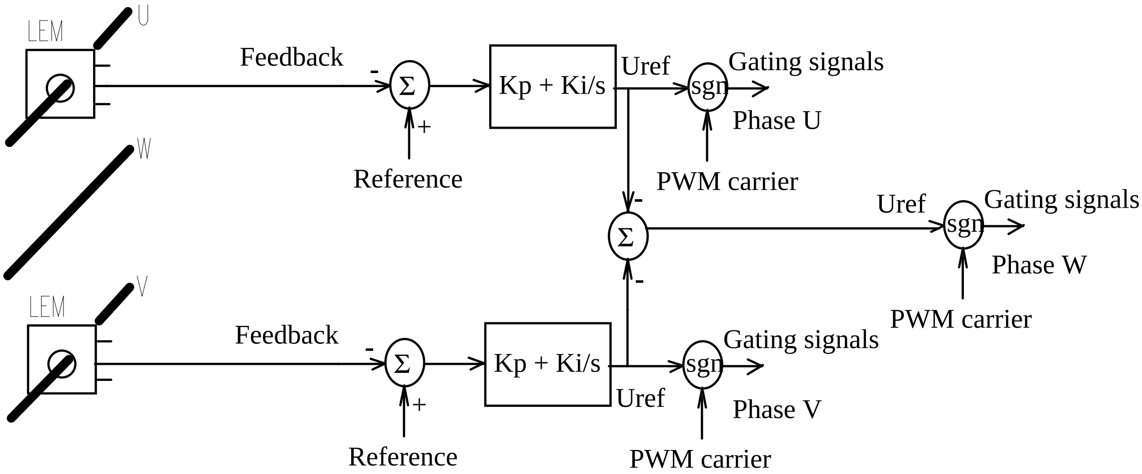


Fig. 2

The phase currents U and V are measured by the LEM current sensors. These sensors behave as current transformers capable of sensing both AC and DC components of the current. The error discriminators (see Fig. 2) are determining the error, that is, the deviation of the measured phase currents with respect to the references. The current references U and V are obtained from the DSP, through the D/A channel, from the torque reference and using the coordinate transformation from the rotor (d,q) to the stator (a,b,c) reference frame. The current errors obtained are processed through the two PI current regulators.

The presence of 2, and not 3 current regulators for the 3 motor phase currents is due to the fact that the phase currents are tied by the relation $i_A+i_B+i_C=0$. Hence, only two of them are mutually independent variables. Therefore, current control scheme possesses 2 PI controllers; the introduction of the third (redundant) one will deteriorate the performances.

At the output of the PI current controllers for phases U and V, the reference values for the phase voltages U and V is obtained. The reference voltage for the phase W is obtained by U_W= -U_U+ U_V. The three voltage references obtained in the prescribed manner are brought to the PWM modulation block.

The comparators in Fig. 2 (labeled "sgn") are supplied by the triangular PWM carrier . Comparison of the modulation signals (that is, the voltage references) with the PWM carrier gives gating signals. These signals consist of pulses with the width determined by respective modulation signal. The nature of this signals is digital (either 0 or 1). Their state determines the three phase inverter switching. Finally, the average phase voltage, brought to the motor winding, corresponds to the voltage references shown in Fig. 2.

Since the implementation of the scheme in Fig. 2 is analog, proportional and integral gains of the current controller are determined by the value of resistors and capacitors used. For the purpose of allowing the matching of DBM with a non standard motor, these components are mounted on a removable plug-in modules, namely, the PWM90 hybrids. These hybrids are fitted into the drive during the factory test. At this time, the current gain is adjusted according to the motor that is going to be used in conjunction with the drive. Current gains are optimized in the sense of maximizing the current loop bandwidth, while still keeping the noise, current ripple, and overshoot at an acceptable level.

The bandwidth of the current loop lies in the range of 900-1200 Hz. In terms of the torque response time, the motor fed from a DBM will respond to the torque command with a rise time 200 µs.

5.4 Speed and Position Sensing

The DBM multi-axis drive is equipped with an interface for resolver-type shaft sensors. These sensors are preferred for the reason of inherent absolute position sensing, much wider operating temperature range than the optical devices, and a robustness intrinsic to the resolver mechanical mounting (that is, the one of an electric machine). Resolvers have a pair of detection windings on the stator side, name "SINE" and "COSINE" winding, spatially displaced by 90 degrees. Excitation of the resolver is performed by a 10kHz, 7Vrms sinusoidal signal, supplied to the resolver from the DBM module. By means of a rotational transformer, fitted within the resolver, the excitation is being fed to the excitation winding installed inside the rotor of the resolver. Through a transformer action, 10kHz electromotive forces will be induced in the detection winding.

The amplitude (and phase) of these electromotive forces depend upon the shaft position. Namely, when the shaft is in such a position that the rotor excitation winding of the resolver is aligned with the "SINE" detection winding, the induced electromotive force in the "SINE" winding will be on its maximum, and will be in phase with the excitation signal. At the same time, the voltage detected at the terminals of the "COSINE" winding will be close to zero (i.e., will be zero if we disregard the noise). Moreover, assuming that the "SINE" winding spatial axes is in opposite direction with respect to the excitation winding, the situation will be alike, but the "SINE" winding voltage will be in counter-phase with respect to the excitation signal. In the end, the ratio of the "SINE" and the "COSINE" signals taken at the instant of positive peak of the excitation sinusoid will uniquely determine the shaft position.

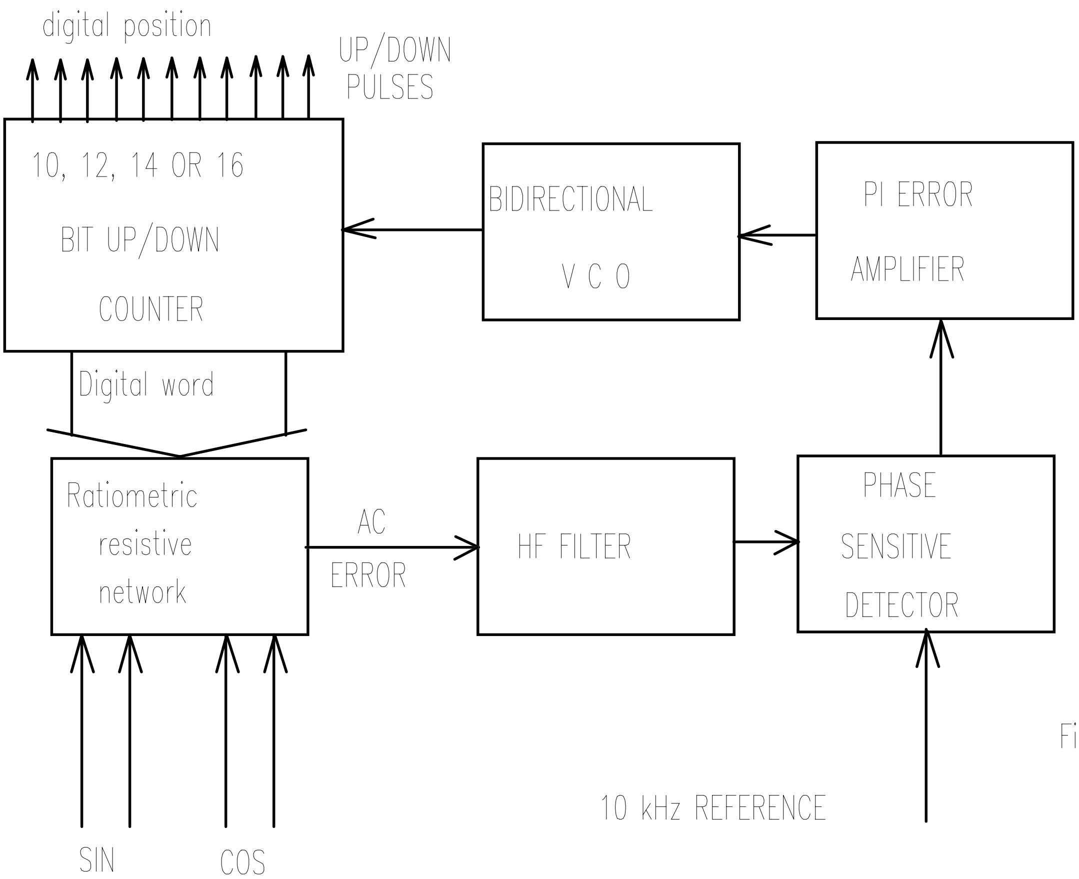


Fig. 3

The process of extracting the shaft position from the detected signals is done by means of a monolithic R/D converter (see Fig. 3). The key element is the ratiometric resistive net. The digital counter in Fig. 3 contains the shaft position information in the form of a digital word. Specific bits of this digital word are fed to the resistive net, in order to commutate internal resistances within the net. Analog net inputs are supplied by detected SINe and COSine signals, fed from the resolver to the DBM module by a shielded cable. The net is made in such a way that its output (that is, the AC error in Fig. 3) is zero if the digital word correspond to the current shaft position, i.e. to the ratio of the SINe and COSine signals.

If the digital word does not correspond to the measured SIN/COS ratio, the AC error signal will be generated. The amplitude of the AC error will correspond to the magnitude of the existing difference between the SIN/COS ratio and the digital position stored in the UP/DOWN counter. The phase of the AC errors signal is determined by the error sign. For positive errors, the AC error will be a 10kHz sinusoid in phase with the excitation signal, and vice versa. Due to the presence of the high frequency noise, the AC error signal has to be filtered by an high frequency RC filter (HF FILTER block in the Fig. 3). The process of demodulation of the error is, in effect, a form of multiplication of the AC error by the excitation signal. As the result of this operation, an error signal is obtained, having the average value correspondent to the R/D converter internal error. Hence, the function of the "phase sensitive demodulator" in Fig. 3 is to express the internal angular error in the form of a DC signal. This signal is, in turn, fed to the input of a PI error analog amplifier.. The presence of the integral action insures that the steady state error will be zero.

The output of the PI error amplifier is fed to the UP/DOWN Voltage Controlled Oscillator. The function of this block (see Fig. 3) is similar to the conventional VCO. The difference is that the VCO used is able of accepting bipolar input signals. In other words, the positive input signal fed to the VCO will produce UP counts of the digital counter, with a frequency proportional to the magnitude of the input signal. In situations where the input to the VCO is negative, resulting counts will be DOWN, i.e. decrementing. This way, the R/D converters position tracking loop is closed. The digital word from the UP/DOWN counter is read by the DSP. Position information is used for the purpose of performing the rotational transformation of variables from the rotor d-q coordinate frame to the stator stationary a-b-c frame. Moreover, the shaft position, taken in the form of a digital word, serves as the input to the speed observation block, illustrated in Fig. 4:

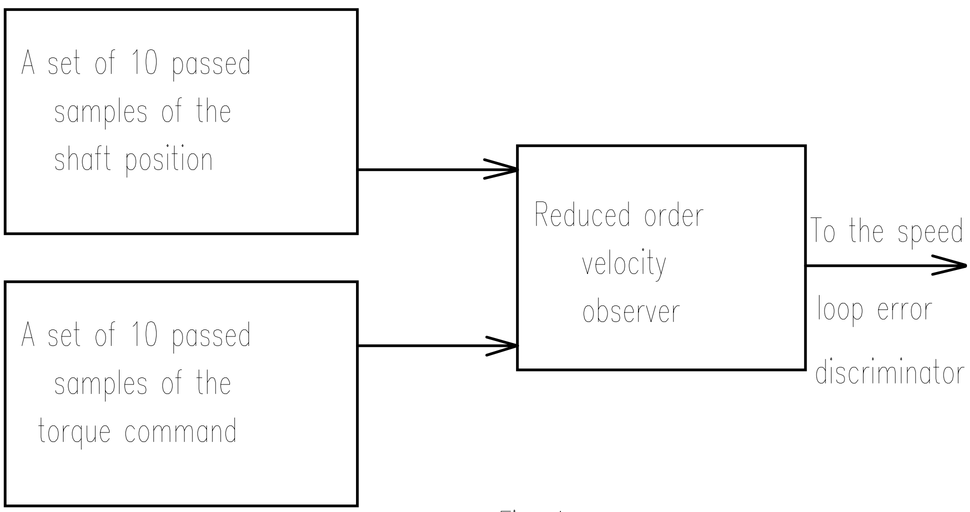


Fig. 4

5.5 Speed Loop

The speed control loop is implemented by the Digital Signal Processor fitted into the DBM module control board. The speed reference normally comes from a CNC in the form of +10V/-10V analog signal. Alternatively, the speed reference might be set by a dumb terminal or a PC computer, through the RS485 serial link. Speed control loops of the axes are completely independent of each other. The feedback for the speed loop error discrimination is obtained from the velocity observer, illustrated in Fig. 4. Simplified block diagram of the speed control loop is given in Fig. 5, presented in a form suitable for easier understanding of feedback gains. This block diagram should be used for the estimation of the drive performance in the stage of system selection and sizing.

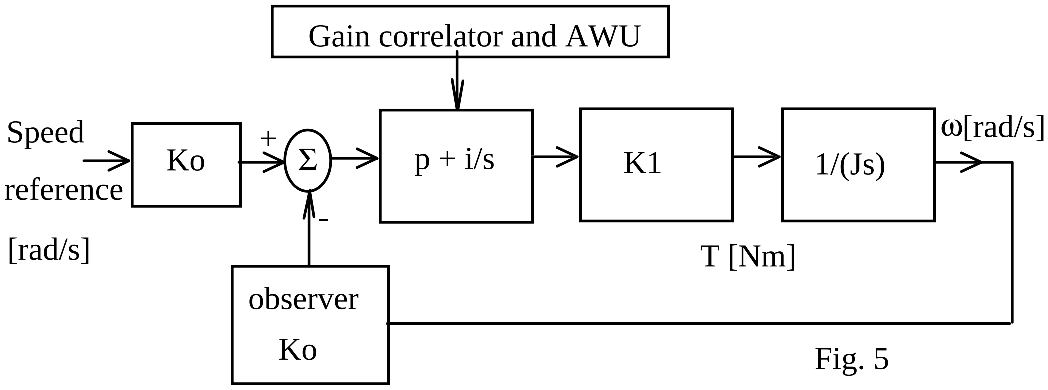


Fig. 5

The speed observation constant Ko in Fig. 5 is Ko=50.06 [1/(rad/s)]. The K1 block in Fig. 5 approximates the drive power section and the motor. It is assumed that the response of the current control loop may be neglected with respect to the dynamics of the speed loop.

Notice: As the result of more detailed analysis, that takes into account the interaction of both loops, it is concluded that said simplification results in an error of less than 2%. Hence, the user is encouraged to use Fig. 5 simplification as a toll for the system performance estimation.

The value of the parameter K1 may be calculated from the drive peak current (25 A in the case of DBM 10/25) and the motor torque constant Kt:

$$K1[Nm] = \frac{I_{peak}[A] * K_t[Nm / A]}{1e6} \tag{6}$$

The quantity J in Fig. 5 stands for the total motor+load inertia in [kgm^2]. The values of the feedback parameters *p* and *i* are influenced by the numerical values KP and KI, imposed by the user via serial link. Moreover, particular control routines performing the correlation and the AWU (Anti Wind Up) are influencing the values of the gains internal to the Digital Signal Processor. These routines are designed so as to optimize the drive performance in various operating conditions and to alleviate the problems of noise and imperfection of the current controller. In the simplified analysis, illustrated in Fig.5, their influence on the gains should be neglected.

Relation between the gains *p* and *i* in Fig. 5 and the parameters KP and KI imposed by the user is given by:

$$\begin{aligned} p &= 8.31 * KP \\ i &= 1635 * KI \end{aligned} \qquad (7)$$

The range of parameters KP and KI is: 0 to 255. For typical 5-10 Nm motor connected to the load having 3-5 times the motor inertia, the speed loop bandwidth can up to 60Hz, having at the same time the torque ripple below 1.5%. Higher bandwidths might be obtained at the penalty of an increased torque ripple. In a typical application, the torque ripple is originated by the noise at the drive analog inputs, imperfection of the sensors and finite resolution of A/D and D/A converters applied within the drive control board.

SECTION 6 - ELECTROMAGNETIC COMPATIBILITY (EMC)

6.1 European Directive (89/336/EEC)

Compliance with the European Directive 89/336/EEC is required for all electric and electronic products brought onto the European market after December 31st, 1995.
DBM03 drives with FASTACT motors meet the following EMC product standard related to the Directive:

EN 61800-3 (1996) and EN 61800-3/A11 (2000): "Adjustable speed electrical power drive systems. Part 3: EMC product standard including specific test methods".
Second environment (industrial) compatibility levels.

Remark: equipments not intended to be used on a low-voltage public network which supplies domestic premises. May cause radio frequency interference.

Tests have been made in an independent, competent body, test house.

The installer of the drive is responsible for ensuring compliance with the EMC regulations that apply where the drive is to be used. We recommend filtering as per par.3.2 and wiring, grounding and screening as per par.3.3 and 3.4.

6.2 Filtering

6.2.1 Filter Types

Code	**Trade-mark**	**Rated Current [A] at 50°C (40°C)**	**Max Voltage [Vac] at 50°C**	**Drive type**
AT6008	Schaffner FN 250-6/07	(6)	250	DBM03 PS (Aux)
AT6009	Schaffner FN 258-7/07	7 (8.4)	3 x 480	
AT6010	Schaffner FN 258-16/07	16 (19.2)	3 x 480	
AT6011	Schaffner FN 258-30/07	30 (36)	3 x 480	
AT6012	Schaffner FN 258-42/07	42 (50.4)	3 x 480	
AT6013	Schaffner FN 258-55/07	55 (66)	3 x 480	
AT6014	Schaffner FN 258-75/34	75 (85)	3 x 480	
AT6015	Schaffner FN 258-100/35	100 (120)	3 x 480	DBM03 PS

6.2.2 FILTER SIZING

The filter/drive coupling in the previous table is a standard coupling. The filter can be undersized according to the rms input current of the actual application. This should be done not only because, as a matter of fact, undersizing the filter means less money, but because the undersized filter provides better performance to EMC.

Example:

- **DBM PS 03 + DBM 03 5-5-5 + DBM 03 5-5-5** and contemporaneity factor of 0.8.

For this application it is not necessary to use the 100A filter of the table.

The reference current is $Iin = 6 \ast 5 \ast 0.8 = 24$ A

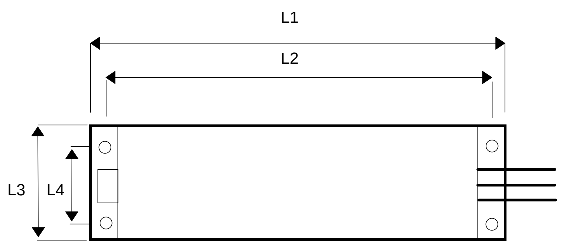
A 30A filter (FN 258-30/7) can safely be used.

6.2.3. FILTER DIMENSIONS

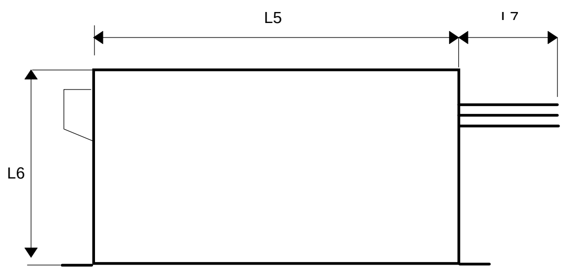
Code	Trade-mark	Dimensions [mm]							Weight
		L1	L2	L3	L4	L5	L6	l7	[kg]
AT6008	Schaffner FN 250-6/07*	85	75	54	0	65	30	300	0.24
AT6009	Schaffner FN 258-7/07	255	240	50	25	225±0.8	126±0.8	300	1.1
AT6010	Schaffner FN 258-16/07	305	290	55	30	275±0.8	142±0.8	300	1.7
AT6011	Schaffner FN 258-30/07	335	320	60	35	305	150	400	1.8
AT6012	Schaffner FN 258-42/07	329	314	70	45	300	185	500	2.8
AT6013	Schaffner FN 258-55/07	329	314	80	55	300	185	500	3.1
AT6014	Schaffner FN 258-75/34	329	314	80	55	300	220	terminal block	4
AT6015	Schaffner FN 258-100/35	379±1.5	364	90±0.8	65	350±1.2	220±1.5	terminal block	5.5

*= the FN250-6/07 filter has wiring leads (length=300mm) at both sides.

TOP VIEW



SIDE VIEW



6.2.4 FILTER INSTALLATION

- The filter must be mounted on the same panel as the drive.

CAUTION: leave a clear space of at least 60mm around the filter for air circulation when the cabinet does not have forced ventilation.

- The filter must be connected as close as possible to the drive input. If the separation between filter and drive exceeds around 30 cm (1 ft.) then a flat cable should be used for the RF connection between filter and drive

REMARK: when mounting the drive and the filter to the panel, it is essential that any paint or other covering material be removed before mounting the drive and the filter.

- The maximum torque of mounting screws is as follows:

FILTER	Max torque
FN 250 - 6/07	0.8 Nm
FN 258 - 7/07	0.8 Nm
FN 258 - 16/07	0.8 Nm
FN 258 - 30/07	1.8 Nm
FN 258 - 42/07	1.8 Nm
FN 258 - 55/07	3.0 Nm
FN 258 - 75/34	3.0 Nm
FN 258 - 100/35	4.0 Nm

- The filter can produce high leakage currents (see Table)

FILTER	Leakage current*
FN 250 - 6/07	1.3 mA
FN 258 - 7/07	17 mA
FN 258 - 16/07	19 mA
FN 258 - 30/07	25 mA
FN 258 - 42/07	26 mA
FN 258 - 55/07	26 mA
FN 258 - 75/34	26 mA
FN 258 - 100/35	26 mA

* Note: if two phases are interrupted, worst case leakage current could reach 6 times higher levels

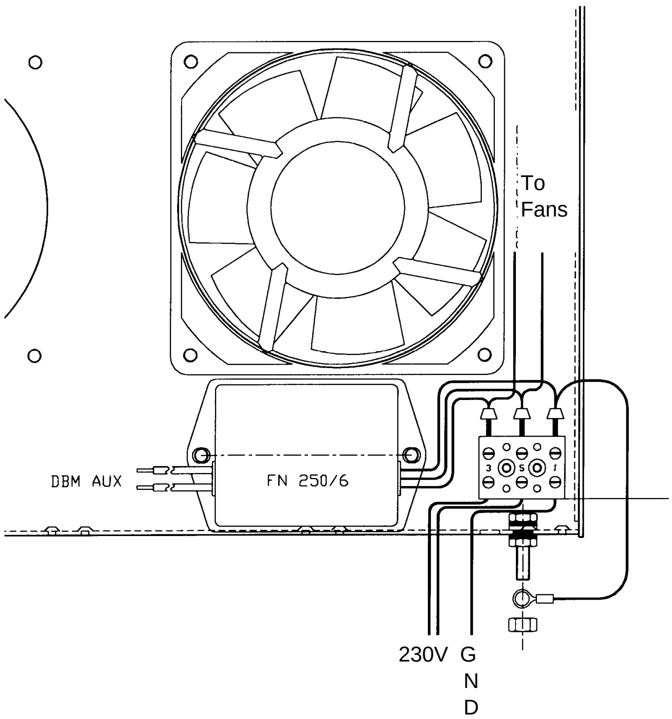
- The capacitors within the filters have discharge resistors.

CAUTION: the filter must be connected to ground before connecting the supply

WARNING: HIGH VOLTAGE - DISCHARGE TIME APPROX. 10 seconds

- Where single phase power supply is needed, the single phase filter can be installed on the fan housing.
Figure 6.1 shows installation and wiring of FN 250 6/07 filter on fan housing of DBM 03 drive.

FIG. 6.1 - FN 250-6/07 FILTER INSTALLATION ON DBM 03 DRIVE



6.3 WIRING AND GROUNDING

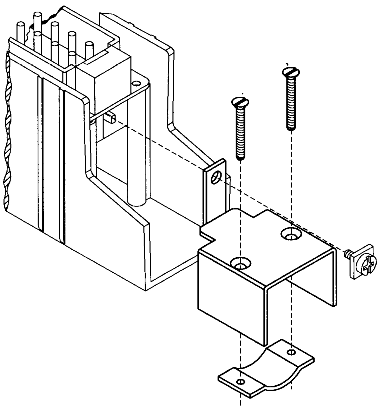
All the following cables must be shielded, with 85% minimum shielding coverage:

- power motor cable (see Fig.6.2 and 6.3)

NOTES: if a power terminal board is used at motor side, the shield must be RF connected to to a metallic PG gland.
- connectors at motor side can have a threaded clamp. Cable shield must be grounded in the same way as in Fig.6.3.

- resolver cable (see Fig.2.3 and 6.3 motor side)

FIG. 6.2 - GROUNDING OF SHIELD TO MOTOR CONNECTOR AT DRIVE SIDE



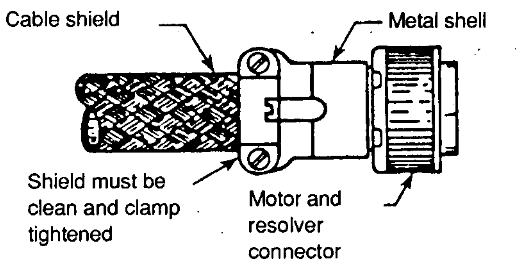
- recovery resistor cable

***CAUTION**: the unshielded cable provided with the drive is only for test purposes and not EMC compliant.*

- Reference, Enable and OK cable
- RS485 cable (flat cable between modules excluded)
- simulated encoder cable (if applicable)

The shields of the cables must be connected at both ends to the proper housing via full circumferential bond to metallic connectors or hose clamps.

FIG. 6.3 - GROUNDING OF SHIELD TO CONNECTORS AT MOTOR SIDE



In case of Sub-D connector, cable shield must be grounded to the metallic hood.

When there is not connector at drive side, a kit with stand-off, screws and hose clamps is provided.

The shield of the cable must be uncovered from insulation coating and RF connected to the stand-off through the hose clamp, as in Fig.6.4.

FIG. 6.4 - GROUNDING OF SHIELD WITHOUT CONNECTOR

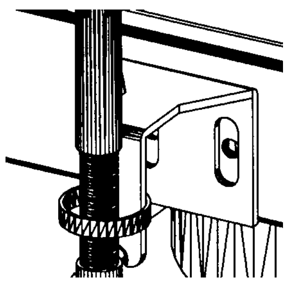
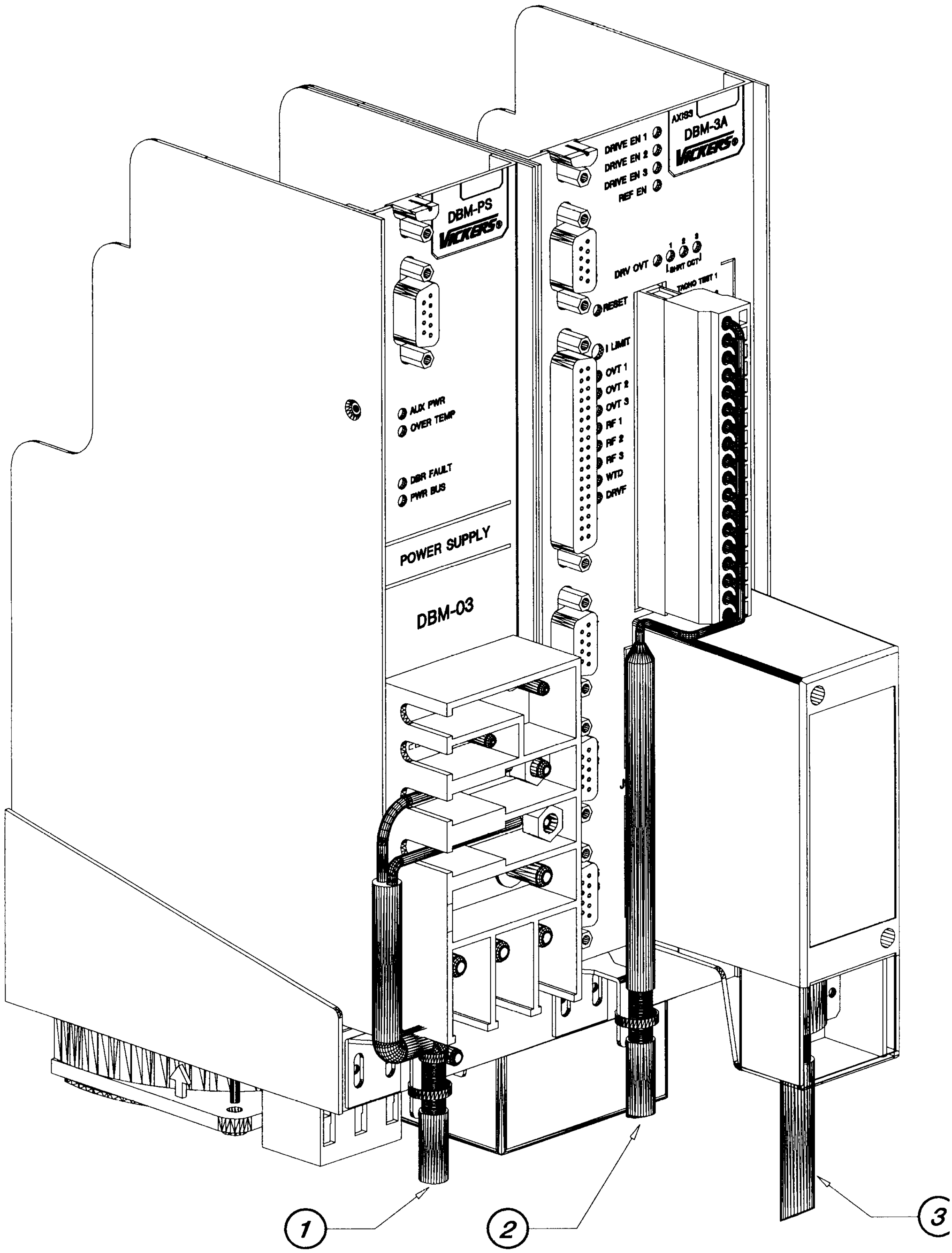


FIG. 6.5 - CABLE GROUNDING AT DRIVE SIDE

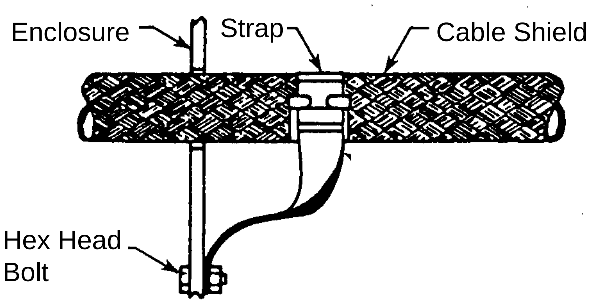


1 = Reference, Enable, OK cable
2 = Recovery resistor cable
3 = Motor power cable
Sub-D and unshielded cables not shown

It is not necessary to shield the input power wires, the bus bars, the flat cables between the modules.

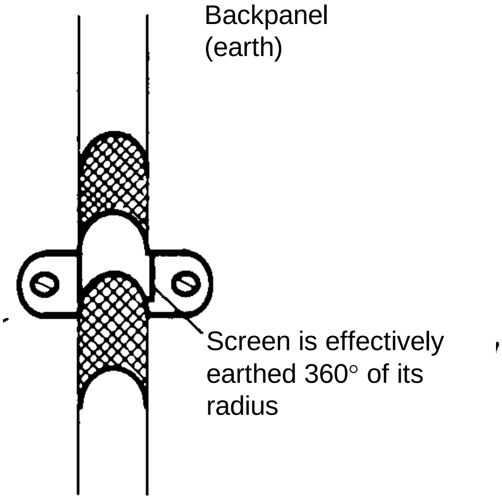
REMARKs:
- the shields of cables inside the cabinet must be 360° clamped to the cabinet wall (see Fig. 6.6).
- "noisy" cables must be kept away from "sensitive" cables by at least 30 cm (12 in). Noisy cables include input-power wires, motor power and brake wiring. Sensitive cables include analog or digital signal cables: resolver cable; reference, enable and OK cable; RS485 serial link; simulated encoder wiring.
- where noisy cables must cross power cables, this must be done with angles as near to 90° as possible.

FIG. 6.7 - PARTITION PENETRATION



- the crossing of the cabinet should be accomplished with a low impedance connection between cable shield and enclosure. If a connector is not involved, the shortest practical lengths of connecting strap should be used (see Fig.6.7).

FIG. 6.6 - CLAMPING TO CABINET



6.4 RECOVERY RESISTOR / MOTOR CHOKE

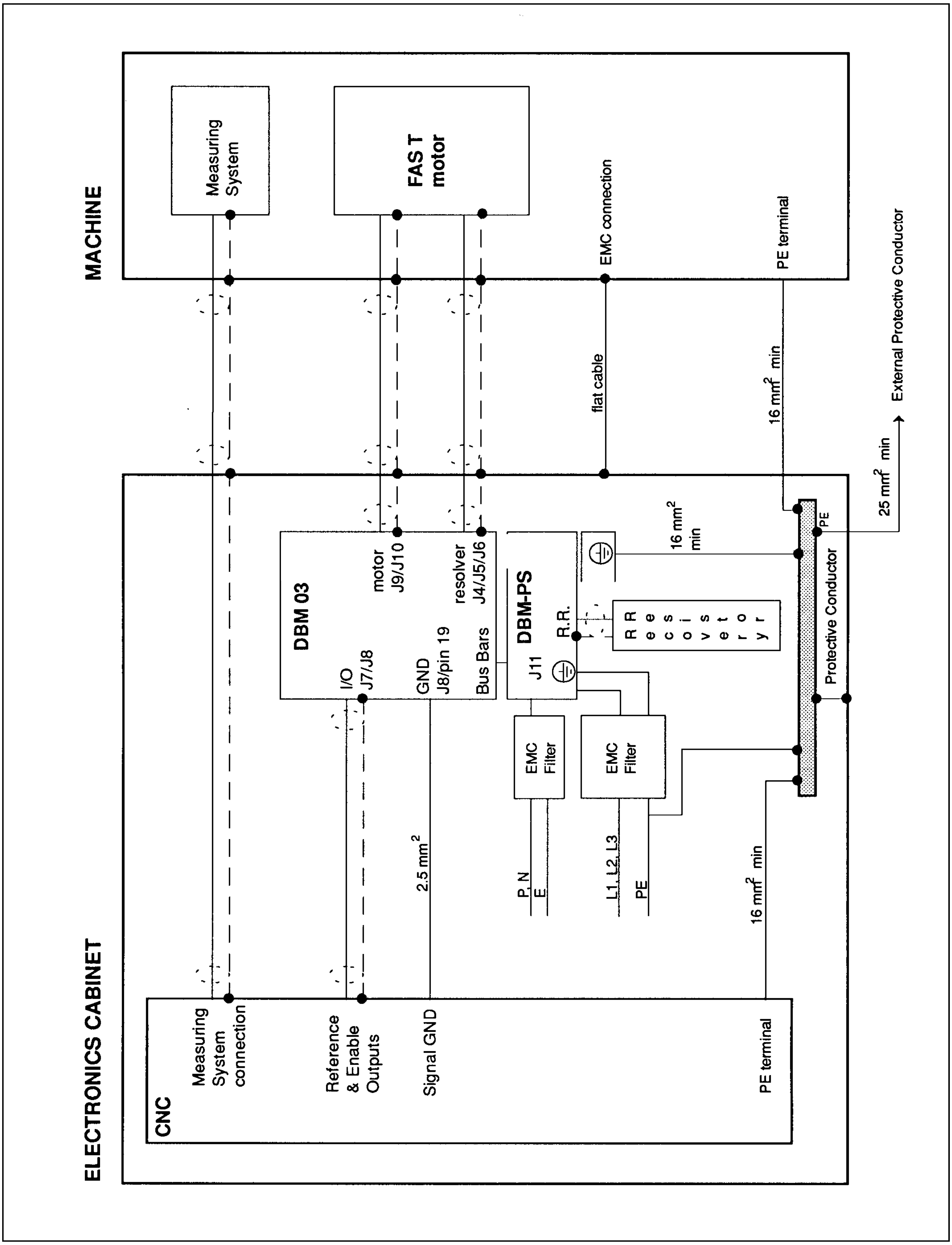
To meet the Machinery Directive "the ventilated enclosures containing dynamic braking resistors shall provide a degree of protection of at least IP22" (EN 60204-1, par. 13.3).
To meet the EMC Directive, these enclosures must be conductive. The cable of recovery resistor must be shielded and the shield must be 360° clamped at both sides.
In some applications (e.g. some size 3 FAS T motors) a choke in series for each motor phase has to be added. This choke must be shielded.

REMARK: when mounting the enclosure of recovery resistor or motor choke to the panel, it is essential that any paint or other covering material be removed before mounting the enclosure of recovery resistor or motor choke.

6.5 SCREENING

To effectively screening the system all the single screens (CNC, electronic cabinet, machine, motor housing, cables) must be connected together to effectively form one screen.

FIG. 6.8 EMC GENERAL WIRING/SCREENING



6.6 SAFETY ASPECTS

Noise suppression of Motor and Drive systems involves consideration of the earthing system, and its effectiveness at high frequencies. It should not be forgotten that is the safety system too and that the safety must take priority over EMC.
To reduce the radiated emissions, the use of capacitance to earth is very effective. In fact DBM03 drives have Y-type capacitors near the input power supply connector and Schaffner filters also include them. These capacitors conduct current from phase to earth; this can be in the order of hundreds of milliamperes.

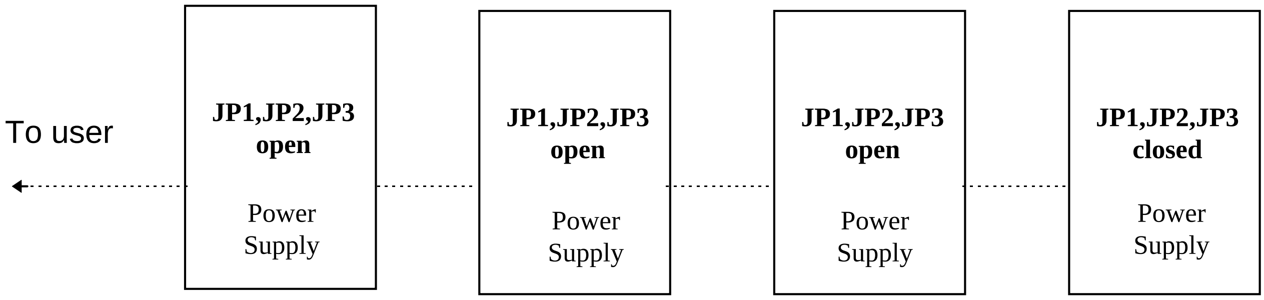
WARNING: appropriate safety measures should be taken to ensure that this potentially dangerous current flows to earth.

CAUTION: it is recommended to disconnect the drive and the EMC filters to carry out the "AC Voltage Test" of the EN 60204-1 (par.20.4), according to the Machinery Directive (89/392/EEC) and to the Low Voltage Directive (73/23/EEC) in order not to damage the Y-type capacitors between phases and ground while parts of circuits can be floating and possibly damaged during the test.
To make anyway this test it is recommended contacting our Service Centers.

APPENDIX A - SERIAL LINK MULTIDROP

A.1 DBM-PS Internal Jumpers (see par. 1.6)

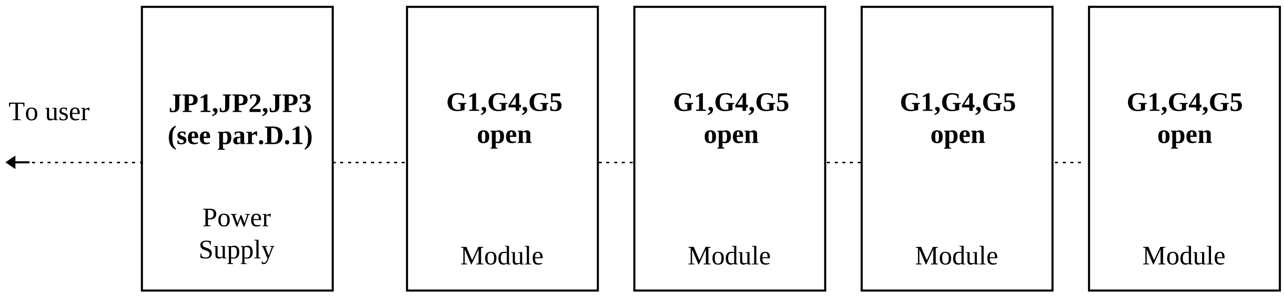
In case of multidrop, the following configuration must be used.



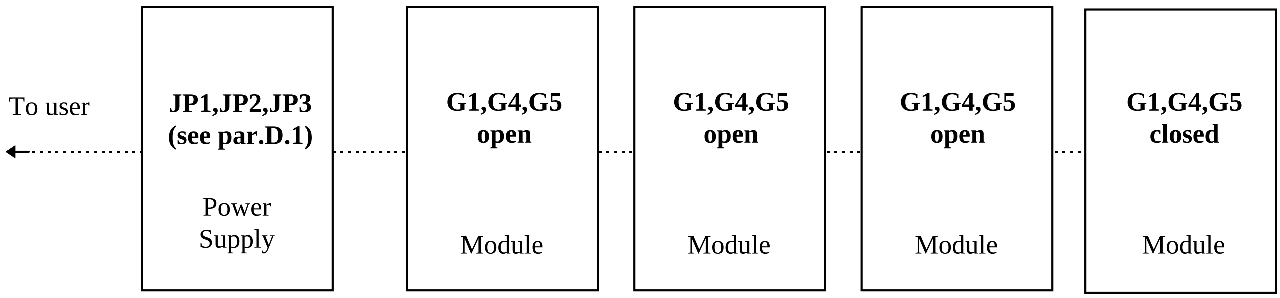
A.2 Personality Card Jumpers (see par.2.2.7.1)

By default G1, G4 and G5 jumpers on the personality card are open (no link termination's on modules). In fact, usually, it is not necessary to close G1, G4 and G5 jumpers because the link termination's are already closed on the power supply; anyway, in specially noisy environments, could be necessary to close them also, as follows.

- **Environment without noise**



- **Specially noisy environment**

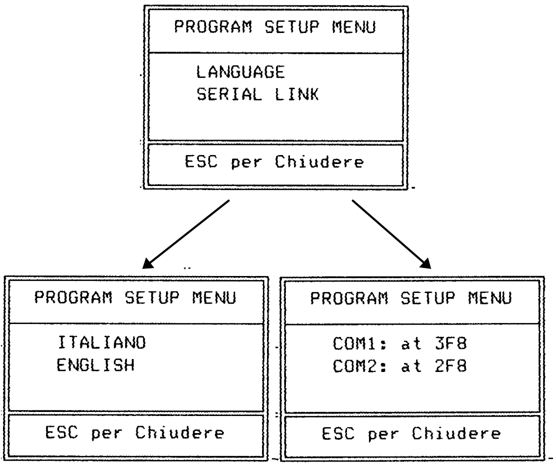


APPENDIX B - DBTALK

To help you communicate with DBM/DBS drives quickly and easily, DBTALK provides several features:

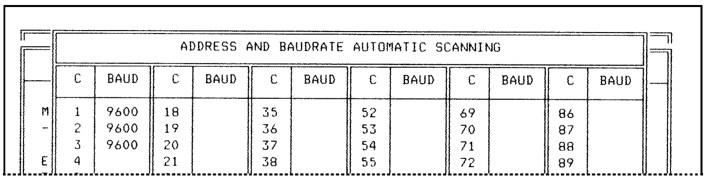
- **SETUP** to choose

⇒ Language: Italian or English
⇒ Serial link : COM1 or COM2

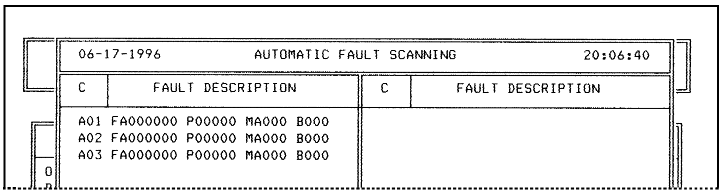


- **UTILITY** to

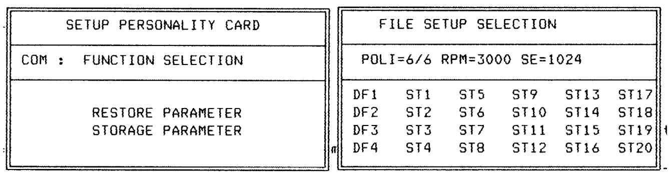
⇒ Scan Baud rates



⇒ Scan Faults



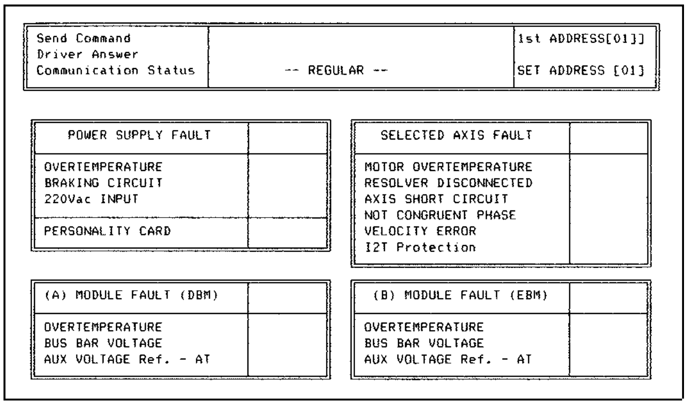
⇒ Restore/store Personality Card parameters
To save the actual parameter set, select STORAGE PARAMETER, select the file (e.g. ST1), press <TAB> to change the description and press <CR>



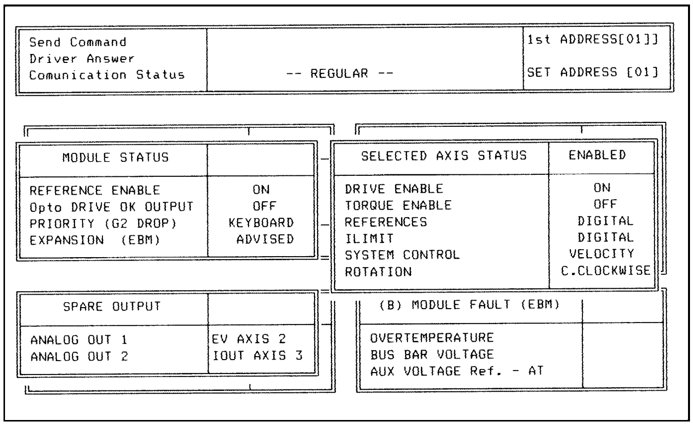
⇒ Set Baud rates
⇒ Start the Autophasing procedure
⇒ Set Defluxing (see DBS User's Manual)

- **MANUAL** to

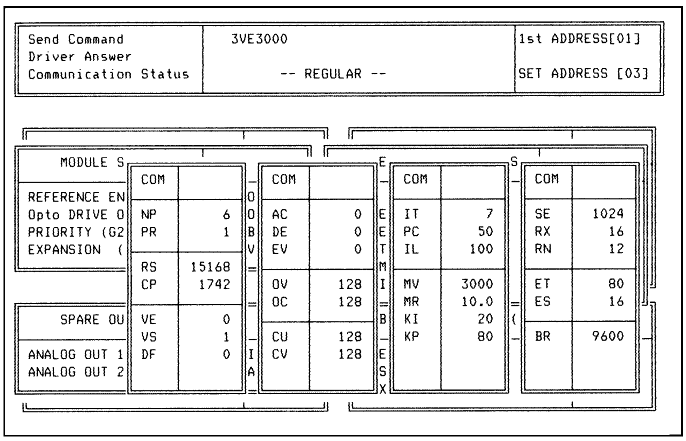
⇒ See/Reset Faults
If the fault condition is not present anymore, the fault will be reset automatically. To reset the fault on the screen, go to the next screen with the arrow keys



⇒ Display the Status



⇒ See/Change parameters
To change one parameter type the command string (see Drive Manual) on the PC keyboard. Example: 3VE3000



- **INTERFACE REQUIREMENTS**

The RS422 interface wiring is based on one-to-one, no multidrop, principle. Four wires are used. With RS422, you can transmit and receive data simultaneously (full-duplex).
The RS485 half-duplex uses only two wires. It allows multidrop communication. With RS485 half-duplex, you cannot transmit and receive simultaneously.
DBM03 supports RS485 full-duplex with four wires (RS422 compatible). Up to 99 DBM and up to 15 DBS drives can be connected in multidrop configuration.

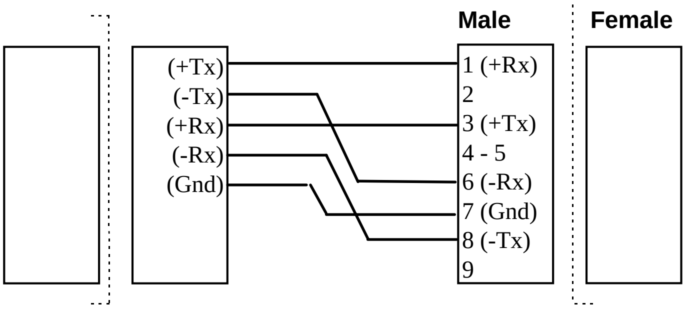
⇒ **RS232/485 CONVERTER KIT**

This very small external converter provides a full-duplex interface between PC and DBM/DBS.
The converter must be fit directly into a COM port (RS232) of a PC. This way the link becomes purely RS485, less susceptible to noise and able to transmit over much longer distances than RS232.

The kit includes:
- the converter to fit into DB25-S connector of the PC (COM port)
  The DTE/DCE switch of the converter must be set to DCE (Data Communications Equipment)
- a DB25 to DB9 interface (to be used if the PC COM port is DB9-S)
- a 2 m cable to connect the converter to DBM J10 connector or DBS J2 connector

⇒ An opto-isolated PC card RS 485 full-duplex is also available. The following wiring must be used.

RS485 full duplex Connector **DBM J10 Connector DBS J2 Connector**



- **PC REQUIREMENTS**

- 80286, 80386, 80486 microprocessor or better
- Hard disk and one diskette drive. You need 2 Mbytes of disk space and 512 kbytes of RAM
- CGA, EGA, VGA, MCGA graphics card (color VGA recommended)
- MS-DOS 6.2 or later
- ANSI.SYS in CONFIG.SYS

- **DBTALK PROGRAM**

The DBTALK program is available on floppy disk

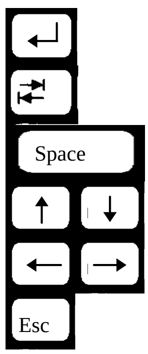
- **INSTALL PROGRAM**

- Insert diskette into drive A or drive B
- Type <a:install> (or <b:install>)
  The installation program will create the Directory C:\DBTALK, will copy all the files in this new directory and will start the program

- **START PROGRAM** (after the first installation)

- Type <cd dbtalk>
- Type <start>

- **MOVE IN THE PROGRAM**



Start the selected procedure
Select the field
Reread parameters
Move up/down
Go to previous/next screen
Exit/Go to previous menu

- **SELECT PROGRAM**

⇒ DBM linker
⇒ DBS linker
⇒ PDBS Linker (see PDBS Application Manual)
⇒ Setup

```
SELECTING DESIRED PROGRAM

DBM LINKER
DBS LINKER
PDBS LINKER
SETUP PROGRAM
```

APPENDIX C - MODULE REPLACEMENT

Once DBM module to be replaced has been identified, it is necessary to follow this procedure:

- Disconnect the power.
- Remove the Bus Bars (+AT, -AT and GND) and disconnect all connectors and flat cables (see Fig. 1.1).
- Unscrew the anchor screw on the top of the module and remove the module.
- Only for same DBM versions:
  Remove the Personality Card, at the left of J1 connector, by loosening the two screws. After removing the card, disconnect the flat cable.

REMARK: on the personality card a EEPROM is mounted. All dynamic parameters (dynamic settings, autophasing, analog interfaces, ...) are stored in this EEPROM after every reset.
In case of module replacement, it is recommended to save all parameters with the save (SV) command before removing the Personality Card ready for installation in the replacement module. This retains and transfers all the previous module information's.

Remove the Personality Card from the new module and replace with the old one.

- Mount the new module and tighten the anchor screw at the top.
- Reassemble the Bus Bars, all the connectors and flat cables.
- Check all connections.
- Enable the auxiliary voltage and check by the optional keyboard or PC all application dependent parameters. In particular: pole number, max velocity, max reference voltage, Ilimit, internal ramp generator.

CAUTION: personality card of DBM 03 has a software different from DBM 01 personality card. Do not swap personality cards between the two versions.
To change DBM 01 with DBM 03 see Par.2.2.7.

APPENDIX D - INPUT SIZING

D.1 Sizing of Power Transformer/Autotransformer

It is necessary to refer to the rated output power of the motors (the output power with 65K winding overtemperature is included in the Technical Data table of catalogs of servomotors), to sum the power of single axes, to multiply the sum by the contemporaneity factor (factors often utilized are K_c=0.63 for 2 axes, K_c=0.5 for 3 axes, K_c=0.38 for 4 axes, K_c=0.33 for 5 axes, K_c=0.28 for 6 axes), and by a correction coefficient (=1.2), accounting for the losses of the motor/drive system.

$P = \Sigma P_{im} * K_c * 1.2$ [W]

D.2 Sizing of Fuses

It is necessary to divide the above calculated power by the 300 V DC Bus.

$I_f = P / 300$ [A; W, V]

Fuses must be the delay type because of high peak current inrush of the internal capacitors.

D.3 Auxiliary Power Transformer

Auxiliary power (55 W for each 3-axis module) and fan power (60 W for each pair of fans) must be added.

D.4 Thermal sizing of cabinet

To calculate cabinet cooling requirements, table below provides estimated equipment power dissipation values. If the application employs continuous braking, it is necessary to include the recovery resistor power dissipation (use the nominal power of recovery resistor if actual application recovery dissipation is unknown).

Power Dissipation			
Power Supply	**Module**	**IGBT's**	**Input Bridge**
25 W	50 W	16 W/A	1 W/A

Example: with one Power Supply, two modules, a total output current of 60 Arms and continuous uncalculated braking, the dissipated power is as follows.

Pd = 25 + (2 ∗ 50) + (16 ∗ 60[A]) + (1 ∗ 60[A]) + 370 [recovery resistor power] = 1515 W

APPENDIX E - MECHANICAL BRAKE

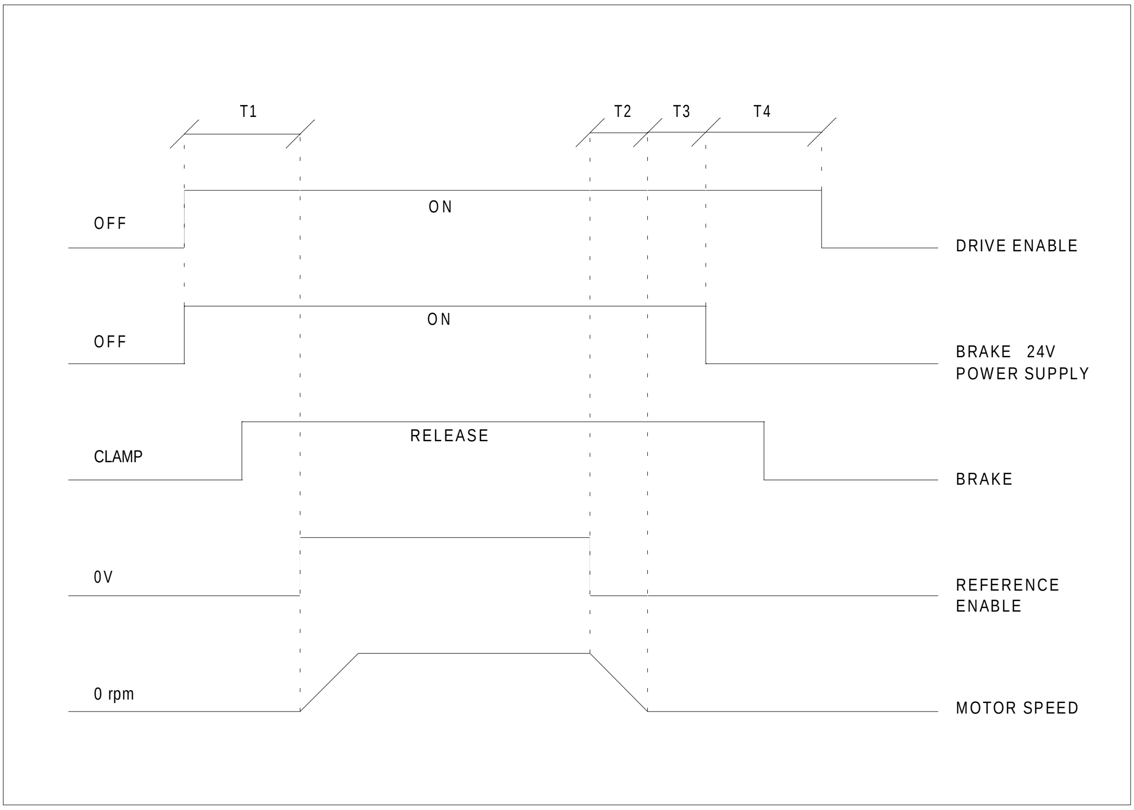
FAS series servomotors have as option a 24 Vdc electromagnetic safety brake.

CAUTION: safety brake must be clamped and released with motor at standstill. Dynamic brakings can seriously damage the brake and reduce the braking torque.

The release of the brake (from 0V to +24V) and the clamp (from +24V to 0V) must follow the sequence in Fig. E.1.

FIG. E.1 - Braking Sequence, Timing Chart

Note: T1 ≥ 200 ms, T2 = application dependent, T3 = 100 ms, T4 ≥ 200 ms



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