# DBM 04

# User's Manual

GB-4517 Rev.9 - Oct/01

# DBM 04 - USER'S MANUAL

| Rev. | Date | Description | Updated Pages |
|---|---|---|---|
| 0 | Sept/96 | Initial Release | |
| 1 | 25/Nov/96 | Add CE-marking according to LVD; correct Tab.3.6 (IT protection); add reference to conductive coating | I-1, 4; III-19; VI-1 |
| 2 | 20/Feb/97 | Correct J1 connector pinout; add figure with single phase EMC filter installation; correct miscellaneous errors | I-9; II-4, 8, 10, 16, 19, 34; III-17; VI-3 |
| 3 | 31/July/97 | Add new standard version of DBM 04 Power Supply; update standards with EN 61800-3, EMC product standard; correct fig.1.5 (EMC/Equipotential bonding); correct tab.3.6 (IT/PC); correct the leakage current of EMC filters; correct miscellaneous errors | I-1 to 7, 9 to 12; II-1 to 40; III-1, 2, 5 to 40; VI-1 to 4, 6 to 8; VII-1, 7 |
| 4 | 24/Oct/97 | Add fig.2.18 (Starting Sequence-Timing Chart); update tab.5.1 to tab.5.4 (parameters settings for T/S curve adjustment); integrate keypad setup parameters; correct miscellaneous errors | I-2; II-4, 5, 6, 8, 10, 12 to 14, 16, 23, 25, 26, 28, 31, 34, 37, 40; III-3, 4, 7, 13, 16, 17, 23, 26, 31 to 36; IV-1, 6; V-1, 3 to 6; VI-3; VII-14 |
| 5 | 30/July/98 | Exchange Section VI (EMC) with Section III (Commands); add Par.1.9 (Rating plate); add Analog Out 3; add Par.2.16 (Module replacement), Par.2.17 (Sizing of PS circuit) and Par.2.18 (Thermal sizing); add reset to SE command; add Fig.7.4 and Fig.7.17; correct miscellaneous errors. | I - 1, 2, 3, 4, 9, 11, 12; II - 4, 5, 14-19, 21, 23, 24, 27, 28, 31, 32-42; III (ex-VI) - 1, 3, 7; IV - 3, 6; V - 2, 4, 6; VI (ex-III) - 4, 14, 15, 24, 29, 31; VII - 4 to 17 |
| 6 | 10/Dec/99 | Add Cautions; correct miscellaneous errors | I - 3; II - 1, 24, 42; III - 4; VI - 1 |
| 7 | 2/Nov/00 | Add UL markings; add PS-6M and PS-120; correct miscellaneous errors | I - all; II - all; III - 1-4, 6, 7; IV - 1, 4 to 6; VI - 2, 9-11, 18, 25-27, 34; VII - 1, 3, 4, 8, 11, 15, 17 |
| 8 | 15/Jun/01 | Update UL markings; add PS-U; correct miscellaneous errors | I - 1, 4 to 16; II - 2 to 6, 9 to 50; VII - 1, 2, 10 |
| 9 | 30/Oct/01 | Add CE markings; correct miscellaneous errors | I - all; II - 4, 7, 15, 16, 17, 18, 29; III - 1, 2, 3, 7; IV - 1; VI - 4; VII - 4, 8 |
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# Accident Protection

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

***WARNING****: L+ and L- pins and Bus Bar's can have voltage ≥810Vdc even after switching off (capacitive voltage).*
*High Voltage - Discharge Time approx. 6 Minutes.*

***WARNING****: High Voltage. The recovery resistor is connected to the Bus Bar's and can have voltage ≥810Vdc.*

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

***CAUTION****: make sure that the correct input voltage, 400V or 460V, has been set.*

***CAUTION****: it is recommended to disconnect the drive and the EMC filters to carry out the AC Voltage Tests of EN 60204-1 (1997), par.19.4, in order to not damage the Y-type capacitors between phases and ground. Moreover the DC voltage dielectric test required by EN 50178 (1997), product family standard, has been carried out in factory as a routine test. The DC Insulation Resistance Tests of EN 60204-1 (1997), par.19.3, may be carried out without disconnecting the drive and the EMC filters.*

***CAUTION****: when required for an emergency stop, opening U2-V2-W2 pins and closing motor phases to resistors, must be preceded by disabling the axis. The delay time must be at least 30 ms.*

***CAUTION:*** *in case of repetitive switching on and off, wait 1 minute between off and on.*

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

***CAUTION****: do not exceed the tightening torque of the table (but see proper data sheets for the tightening torque of input capacitors and power modules and see Section 2 of this Manual for the tightening torque of terminal blocks)*

| **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 |

## EC DECLARATION OF CONFORMITY

**The undersigned, representing the following manufacturer**

| |
|---|
| **Moog Italiana S.r.l., Electric Division** |
| **Via Avosso 94, Casella (Genova), ITALY** |

**herewith declares that the products**

| |
|---|
| Complete Drive Modules series: BRD-4S, DBC III, DBS, DS2000, PDBS<br>Basic Drive Modules series: BRM-4S, DBM 03, DBM 033, DBM 04,<br>Feeding sections series: ADR, BRM-P1, BRM-P2, DBM 03-PS, DBM 033-PS, DBM 04-PS<br>Motor groups series: FAE F/ K/ N/ T/ W, FAS F/ K/ N/ T/ W, FC |

**are in conformity with the provisions of the following EC directives**
(including all applicable amendments)

| ref. n° | title |
|---|---|
| 73/23/EEC | Low Voltage Directive |
| 89/336/EEC | EMC Directive |

**and that the following harmonized standards, or parts thereof, have been applied**

| nr | issue | title | parts |
|---|---|---|---|
| EN 60034-1 | 1998 | Rotating electrical machines. Part 1: Rating and performance | |
| EN 60034-6 | 1993 | Rotating electrical machines. Part 6: IC Code | |
| EN 60034-7 | 1993 | Rotating electrical machines. Part 7: IM code | |
| CEI EN 60204-1 | 1993 | Safety of Machinery. Electrical Equipment of machines. Part 1: General requirements | par. 6.2.3, 20.3, 20.4 |
| EN 60529 | 1991 | IP code | |
| CEI EN 61800-3 | 1996 | Adjustable speed electrical power drive systems. Part 3: EMC product standard including specific test methods | par. 4, 5.3.2, 6.3.2 |
| EN 61800-3 /A11 | 2000 | Amendment A11 | |

**Other references or information required by the applicable EC directives:**
The conformity of products is subjected to the installation of filters and to the procedures included in the proper "Installation Manual". The user has the primary EMC responsibility in following the recommendations of the manufacturer.

**Last two digits of the year in which the CE marking was affixed:** 97

Casella, 2/Nov/2000

Walter Tettamanti
**GENERAL MANAGER**

DEC_SALE.DOC - MOD.176/PMA/4/96

# CE Requirements

- **Cautionary Marking.** See Accident Protection page.

- **Protection against electric shock**. Electronic Equipment intended for installation in closed electrical operating areas kept locked. The lock shall be only opened by authorized person and the access only allowed to skilled persons whilst energized. Where the equipment requires manual intervention, 412.2.1 of HD 384.4.41 S2 shall be consulted.

- **Fixed connection for protection**. The equipment may have a continuous leakage current of more than a.c. 3.5 mA or d.c. 10 mA in normal use and a fixed ground connection is required for protection.

- **RCD**. A d.c. component can occur in the fault current in the event of a fault connection to earth. Only a residual-current-operated protective device (RCD) of Type B is allowed. When the protection in installations with regard to indirect contact is achieved by means of an RCD, their appropriate function/combination shall be verified.

- **Climatic Conditions.** Equipment intended to operate within its performance specification over the range of Class 3K3, as defined in table 1 of EN 60721-3-1, EN 60721-3-2, EN 60721-3-3, EN 60721-3-4, partly modified.

- **Pollution Degree 2 Installation** - The equipment shall be placed in a pollution degree 2 environment, where normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation is to be expected, when the electronic equipment is out of operation.

- **EMC Requirements.** The installer of the equipment is responsible for ensuring compliance with the EMC standards that apply where the equipment is to be used. Product conformity is subjected to filters installation and to recommended procedures, as from Section 3 of this Manual.

- **Second Environment (EMC)**. Equipment intended to be connected to an industrial low-voltage power supply network, or public network which does not supply buildings used for domestic purposes (second environment, according to EMC Standards).
  It is not intended to be used on a low-voltage public network which supplies domestic premises (first environment). Radio frequency interference is expected if used on such a network.

- **Recovery Resistor Cable.** Shielding of the external recovery resistor cable, provided in kit for test purposes, is recommended for ensuring compliance with the EMC standards.

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Agrate Brianza, June 18th, 2001

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Attn.: Mr. Daniele Rolla

**Subject :** **Ind. Cont. Eq., Component - Power Conversion Equipment (NMMS2) (NMMS8)**
**Open Type, Brushless Motor Servo-Drives : "DBM 04 Series"**
**New Power Supply "PS-Universal" - Drive Models Revision**

**Ref. :** **File E194181 Vol. 2, Sec. 1 - Project 01ME07525 - Report Revision**

NOTICE OF AUTHORIZATION TO APPLY THE UL RECOGNITION MARK
AND UL CANADIAN RECOGNITION MARK

This letter is sent on behalf of Underwriters Laboratories Inc. pursuant to the Corporate Services Agreement between Underwriters Laboratories Inc. and UL International Italia Srl.

We find that the product is eligible for Recognition and Follow-Up Service.

This letter temporarily supplements the UL Follow-Up Services Inspection Procedure, and serves as authorization to apply the UL Recognition Mark and Recognition Mark For Canada to the above products.

To provide the manufacturer with the intended authorization to use the UL Recognition Mark and Recognition Mark For Canada you, the Applicant, must send a copy of this Notice to each manufacturing location covered by the UL Follow-Up Service Procedure, File E194181, Vol. 2, Sec. 1.

This authorization is effective only for 90 days from the date of this Notice. Records covering your products are now being prepared and will be sent to you in the near future.

Products produced which bear the UL Recognition Mark and Recognition Mark for Canada shall be identical to those, which were evaluated by UL and are found to comply with UL's requirements. If changes in construction are discovered, authorization to use the UL Recognition Mark and Recognition Mark For Canada may be withdrawn and the products that bear the UL Mark may have to be revised (in the field or at the manufacturer's facility) to bring them into compliance with UL's requirements.

Within Canada, there are federal and local statutes and regulations, such as the Consumer Packaging and Labeling Act, requiring the use of bilingual product markings on products intended for the Canadian market. It is the responsibility of the manufacturer (or distributor) to comply with this law. The UL Follow-Up Service Procedures will only include the English version of the markings.

If we can be of assistance, please do not hesitate to contact the undersigned.

Very truly yours,

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# UL Requirements

- These Brushless Servo-Drives shall be assembled with the guidelines specified in this Manual. Only the configurations with the components tested and described in the UL Report, file E194181, Vol.2, Sec.1, Issue date 03-28-01 and following Revisions can bear the Recognized Component (R/C) Mark. Each assembled configuration shall be evaluated in the UL Listed end-use application.

- The Component – Power Conversion Equipment "DBM 04 Series" is considered UL Recognized in the complete configurations after the assembly of the three main parts of the Drive, that is the Power Supply, the Modules and the Fan Assembly. The Marking, including the R/C Mark and the Drive Model No., shall consider the equipment in its complete configuration.

- These drives shall be used within their ratings, as specified in the marking of the equipment. In particular:
  - rated input voltage, input current, system duty cycle, auxiliary input voltage, auxiliary input power, fan input voltage, fan input power on the label affixed on the fan assembly
  - rated axis continuous output current, axis max output current, module duty cycle on the label affixed on the module

- **Cautionary Marking.** See Accident Protection page.

- **Duty Cycle**. The maximum continuous Drive output current shall be limited to 65 A and to the Maximum Module Current, due to the rated current of the Power Supply and of the Module. According to this reason, the Drive shall be used with a Duty Cycle, as specified in the marking of the equipment.

- **Surrounding Air Temperature** - *"Maximum Surrounding Air Temperature 40°C".* In the final installation considerations shall be given for the need of repeating Temperature test if the unit is mounted with a different Surrounding Air conditions.

- **Pollution degree 2 Installation** - The drive must be placed in a pollution degree 2 Environment.

- **Environmental designation** - *"Open Type Equipment"*.

- **Short Circuit Ratings**. *"Equipment suitable for use on a circuit capable of delivering not more than 5000 rms Symmetrical Amperes, 460 V ac +10% maximum"*

- **Branch Circuit Protection**. The Branch Circuit Protection for Short Circuit shall be provided in the end-use applications by external R/C Fuses (JFHR2), manufactured by Bussmann Div Cooper (UK) Ltd, Semiconductor fuse type, Mod.No. 160 FEE, rated 160 A, 660 Vac, 200 kA A.I.C.

- **Overspeed Protection**. The Power Conversion Equipment is incorporating an Overspeed Protection. See MV command in Section 6 of this Manual.

- **Overvoltage Control**. In the equipment the Overvoltage is controlled by a Transient Suppressive device, with 1500 V Clamping Voltage and min 120 J (10x1000 us or 2 ms) Energy Handling Capability. See also “Bus not normal” protection in Section 4. of this Manual

- **Overload Protection**. The equipment does not incorporate internal overload protection for the motor load. The drive is intended to be used with motors that must have integral thermal protection through a PTC. The overtemperature fault of the drive will trip when the PTC reaches 1.2 kΩ. See J4-J5-J6 connectors in Section 2 of this Manual for wiring.

- **Over-Current Protection**. The drive is provided with a current limiting circuitry. See IL and IT commands in Section 6 of this Manual.

- **Factory Wiring**. These equipments are suitable only for Factory Wiring only, that is the Terminal Blocks and the Connectors for Power Connection Wiring are not suitable for Field Wiring. In particular the DC-Bus Terminal Blocks for the Power Supply and Modules Interconnection shall be usable only with the DC-Bus Interconnection Cables provided by the manufacturer.

- **Wiring**. Wiring shall be made by stranded and/or solid, copper (Cu), 60/75°C (140/167°F) conductor only, and, for terminal blocks, the tightening torque values specified in Section 2 of this Manual shall be applied. These requirements do not pertain to control circuit terminals.

- **Wiring of Recovery Resistor**. The Dynamic Brake Unit Recovery Resistor shall have the connection wiring made with R/C (AVLV2) or insulated with R/C (YDPU2) or R/C (UZCW2) in the end-use installation.

# SECTION 1 - DESCRIPTION

## 1.1 Description

DBM04 four quadrant servodrives provide unrivaled compactness and flexibility through the integration of three axes in a single module.
A power supply is connected directly to the power distribution line at 400 or 460V and can supply up to 6 modules (18 axes). The result is a very suitable solution for all multi-axis applications like machine tools, robotics, packaging, special material working (wood, plastics, glass, rubber, leather, paper).
A microprocessor based structure allows high servo performances with FASTACT and FC servomotors all equipped with a resolver feedback. Drive tuning and configuration are performed via digital parameters (not potentiometers) and stored in non-volatile memory (EEPROM).
Drive set up is possible via a keypad or PC, therefore simplifying installation and providing easy fault diagnosis.

General features:
- digital speed loop
- sinusoidal current waveform
- SMD technology with boards automatically assembled and tested
- automatic Resolver to Digital (R/D) resolution switching (from 16 to 10 bit) to achieve high motion accuracy in the whole speed range (from 0 to 10000 RPM).
- up to 99 axis system configuration
- 10 kHz switching frequency
- operating temperature: 0 to +40°C (exceeding Class 3K3)
- relative humidity: 5% to 85% (no condensation, no formation of ice)
- air pressure: 86 kPa to 106 kPa
- storage temperature: -25 to +55°C (Class 1K4)
- transportation temperature: -25 to +70°C (Class 2K3)
- immunity to vibration: Class V.H.2 according to HD 413.3 S1 (1987)
- maximum case depth of 310 mm

## 1.2 Electrical Data

### PS-Standard Power Supply

- 3-phase power input voltage: 400 or 460 Vac (selectable via switch), ±10%, 50/60 Hz
- 1-phase auxiliary input voltage: 110 or 230 Vac (selectable via jumper), ±10%, 50/60 Hz
- input current: 65 A
- output current: see tab. 1.1
- max number of modules supplied: 4

**PS-6M Power Supply (Standard Plus)**

- 3-phase power input voltage: 400 or 460 Vac (selectable via switch), ±10%, 50/60 Hz
- 1-phase auxiliary input voltage: 110 or 230 Vac (selectable via jumper), ±10%, 50/60 Hz
- input current: 65 A
- output current: see tab. 1.1
- max number of modules supplied: 6

**PS-Standalone Power Supply**

- 3-phase power input voltage: 400 Vac or 460 Vac (set in factory), ±10%, 50/60 Hz
- 1-phase auxiliary input voltage (for data saving): 230 Vac, ±10%, 50/60 Hz
- input current: 65 A
- output current: see tab. 1.1
- max number of modules supplied: 4

**PS-120 Power Supply (Powered Standalone)**

- 3-phase power input voltage: 400 Vac or 460 Vac (set in factory), ±10%, 50/60 Hz
- 1-phase auxiliary input voltage (for data saving): 230 Vac, ±10%, 50/60 Hz
- input current: 120 A
- output current: see tab. 1.1
- max number of modules supplied: 4

**PS-U Power Supply (Special Standalone)**

- 3-phase power input voltage: 400 to 460 Vac, ±10%, 50/60 Hz
- auxiliary input voltage (for data saving): 24 Vdc, ±10%
- input current: 65 A
- output current: see tab. 1.1
- max number of modules supplied: 4

**DBM 04 Module**

- BUS BAR rated voltage: 540 Vdc (with 400 Vac) or 620 Vdc (with 460 Vac)
- three-phase output voltage: 325 Vac (with 400 Vac) or 375 Vac (with 460 Vac)
- output current: see tab. 1.1

**DBM 04 Fan Assembly**

- input voltage: 230 Vac or 115 Vac, +6%/-10%, 50/60 Hz, or 24 Vdc, ±4%
- input power: see tab. 2.1

# TAB. 1.1 - OUTPUT CURRENT

**STANDARD MODULES** (see tab.2.16 for the other possible configurations)

| Model | Output Current | | | | | | | | | Width | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Axis 1 | | | Axis 2 | | | Axis 3 | | | | |
| | Rated | Max | | Rated | Max | | Rated | Max | | | |
| | (Arms) | (Arms) | (A) | (Arms) | (Arms) | (A) | (Arms) | (Arms) | (A) | (mm) | (kg) |
| DBM 04 3-3 | 3 | 6.4 | 9 | 3 | 6.4 | 9 | - | - | - | 120 | 8 |
| DBM 04 6-6 | 6 | 10.6 | 15 | 6 | 10.6 | 15 | - | - | - | 120 | 8 |
| DBM 04 8-8 | 8 | 15.6 | 22 | 8 | 15.6 | 22 | - | - | - | 120 | 8 |
| DBM 04 15-15 | 15 | 29.7 | 42 | 15 | 29.7 | 42 | - | - | - | 120 | 9 |
| DBM 04 25-25 | 25 | 49.5 | 70 | 25 | 49.5 | 70 | - | - | - | 180 | 13 |
| DBM 04 35-35* | 35 | 63.6 | 90 | 35 | 63.6 | 90 | - | - | - | 270 | 18 |
| DBM 04 3-3-3 | 3 | 6.4 | 9 | 3 | 6.4 | 9 | 3 | 6.4 | 9 | 120 | 9 |
| DBM 04 6-6-6 | 6 | 10.6 | 15 | 6 | 10.6 | 15 | 6 | 10.6 | 15 | 120 | 9 |
| DBM 04 8-8-8 | 8 | 15.6 | 22 | 8 | 15.6 | 22 | 8 | 15.6 | 22 | 120 | 9 |
| DBM 04 15-15-15 | 15 | 29.7 | 42 | 15 | 29.7 | 42 | 15 | 29.7 | 42 | 180 | 14 |

* a duty cycle of 92% applies

**POWER SUPPLY - 400/460 Vac**

| Model | Current | | | Auxiliary Input Voltage | Width | Weight |
|---|---|---|---|---|---|---|
| | Output Rated | Output Max | Braking | | | |
| | (A) | (A) | (A) | (V) | (mm) | (kg) |
| PS-Standard Power Supply | 65 | 100 | 100 | 110/230 Vac | 120 | 13 |
| PS-6M Power Supply (Standard Plus) | 65 | 100 | 100 | 110/230 Vac | 120 | 13 |
| PS-Standalone Power Supply | 65 | 100 | 100 | 230 Vac* | 120 | 13 |
| PS-120 Power Supply (Powered Standalone) | 120 | 280 | 175 | 230 Vac* | 180 | 20 |
| PS-U Power Supply (Special Standalone) | 65 | 100 | 100 | 24 Vdc* | 120 | 13 |

* this is not necessary for normal duty but only for data saving

**EXPANSIONS**

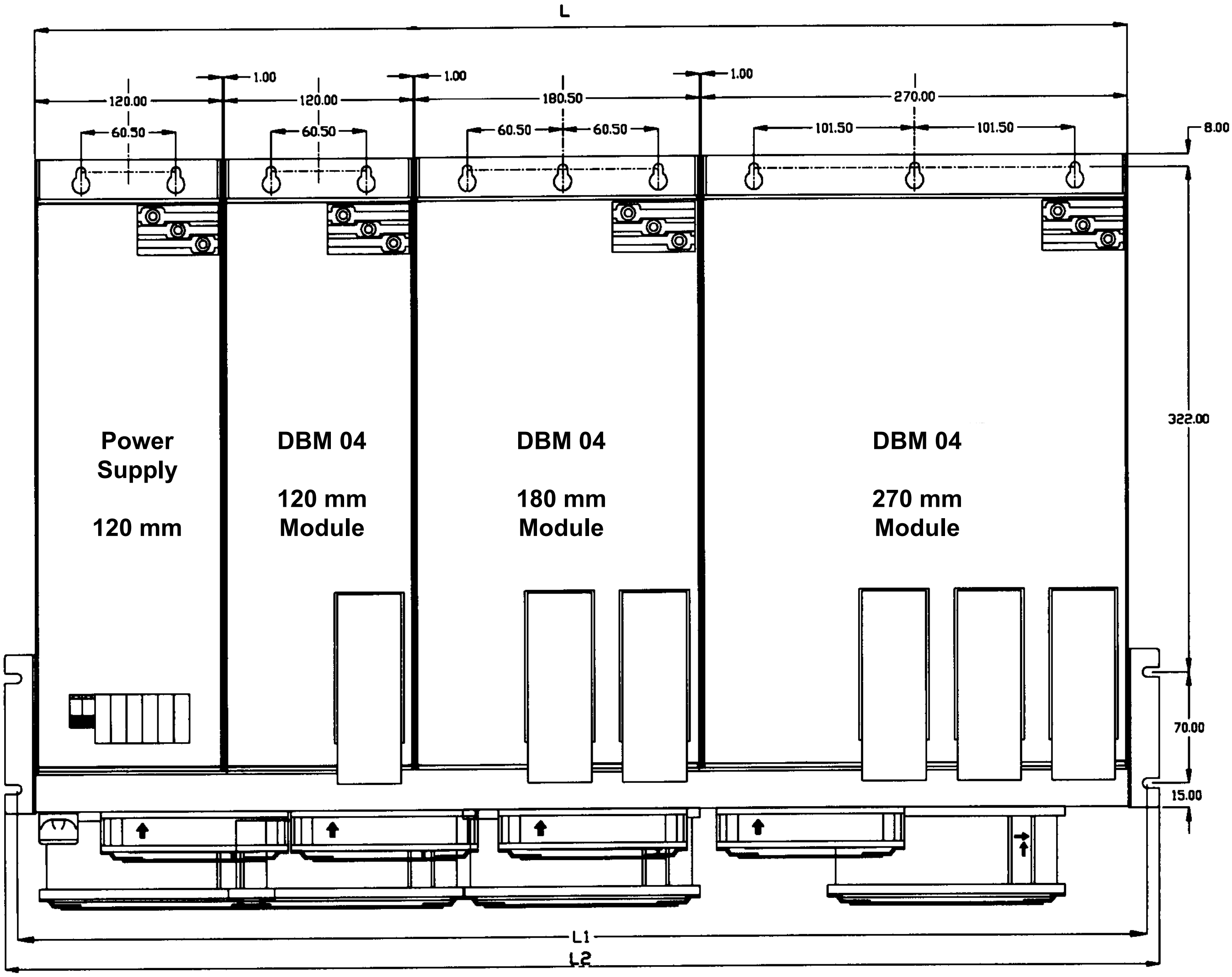
An external expansion module should be used for some configurations, including an axis rated over 35A. This is due to thermal constrictions.
Available expansions modules are shown in the table. To specify an expansion module, please replace the third axis rating number with E, this ensures that the drive is configured for use with an expansion module (e.g. DBM 04 15-15-E).

| Model | Output Current | | | Width | Weight |
|---|---|---|---|---|---|
| | Rated | Max | | | |
| | (Arms) | (A) | (A) | (mm) | (kg) |
| EBM 04 50/140 | 50 | 99 | 140 | 270 | 18 |
| EBM 04 60/180 | 60 | 127 | 180 | 270 | 18 |

## 1.3 Dimensions

Fig. 1.1 and 1.2 (dimensions in mm) show the drilling jig between power supply and drive module. The  modules must be mounted vertically, with the fan housing at the bottom. Leave a clear space of at least 50 cm (19.7 in) over and under the system for air circulation.

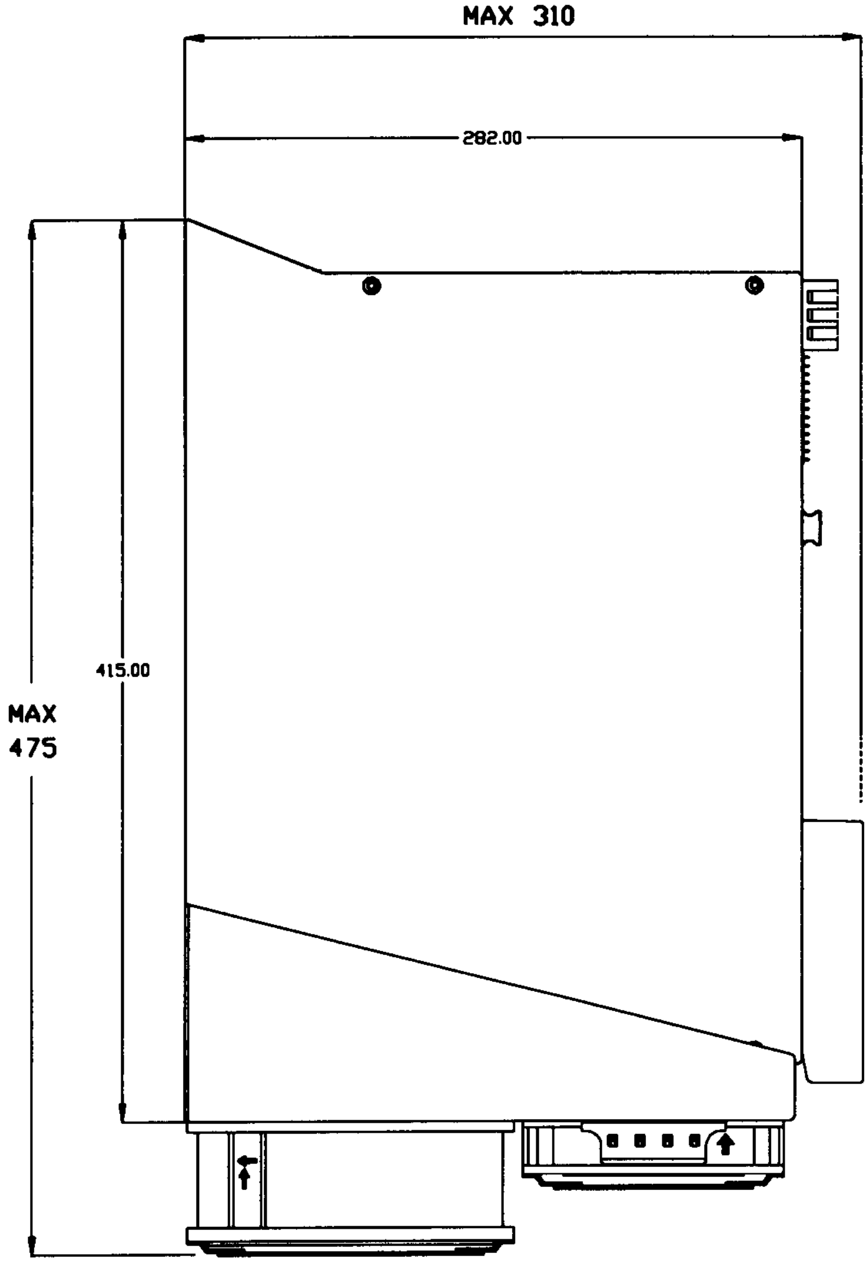
**Fig. 1.1   Front View** (Drill For M5 Screws)




| Configuration | L | L1 | L2 |
|---|---|---|---|
| 1 DBM04 PS + 1 DBM04 120 mm | 241 | 266 | 282 |
| 1 DBM04 PS + 1 DBM04 180 mm | 301.5 | 326 | 342 |
| 1 DBM04 PS + 2 DBM04 120 mm | 362 | 387 | 403 |
| 1 DBM04 PS + 1 DBM04 270 mm | 391 | 416 | 432 |
| 1 DBM04 PS + 1 DBM04 120 mm + 1 DBM04 180 mm | 422.5 | 447 | 463 |
| 1 DBM04 PS + 2 DBM04 180 mm | 483 | 508 | 524 |
| 1 DBM04 PS + 3 DBM04 120 mm | 483 | 508 | 524 |
| 1 DBM04 PS + 1 DBM04 120 mm + 1 DBM04 270 mm | 512 | 537 | 553 |
| 1 DBM04 PS + 2 DBM04 120 mm + 1 DBM04 180 mm | 543.5 | 568 | 584 |
| 1 DBM04 PS + 1 DBM04 180 mm + 1 DBM04 270 mm | 572.5 | 597 | 613 |
| 1 DBM04 PS + 1 DBM04 120 mm + 2 DBM04 180 mm | 604 | 629 | 645 |
| 1 DBM04 PS + 4 DBM04 120 mm | 604 | 629 | 645 |

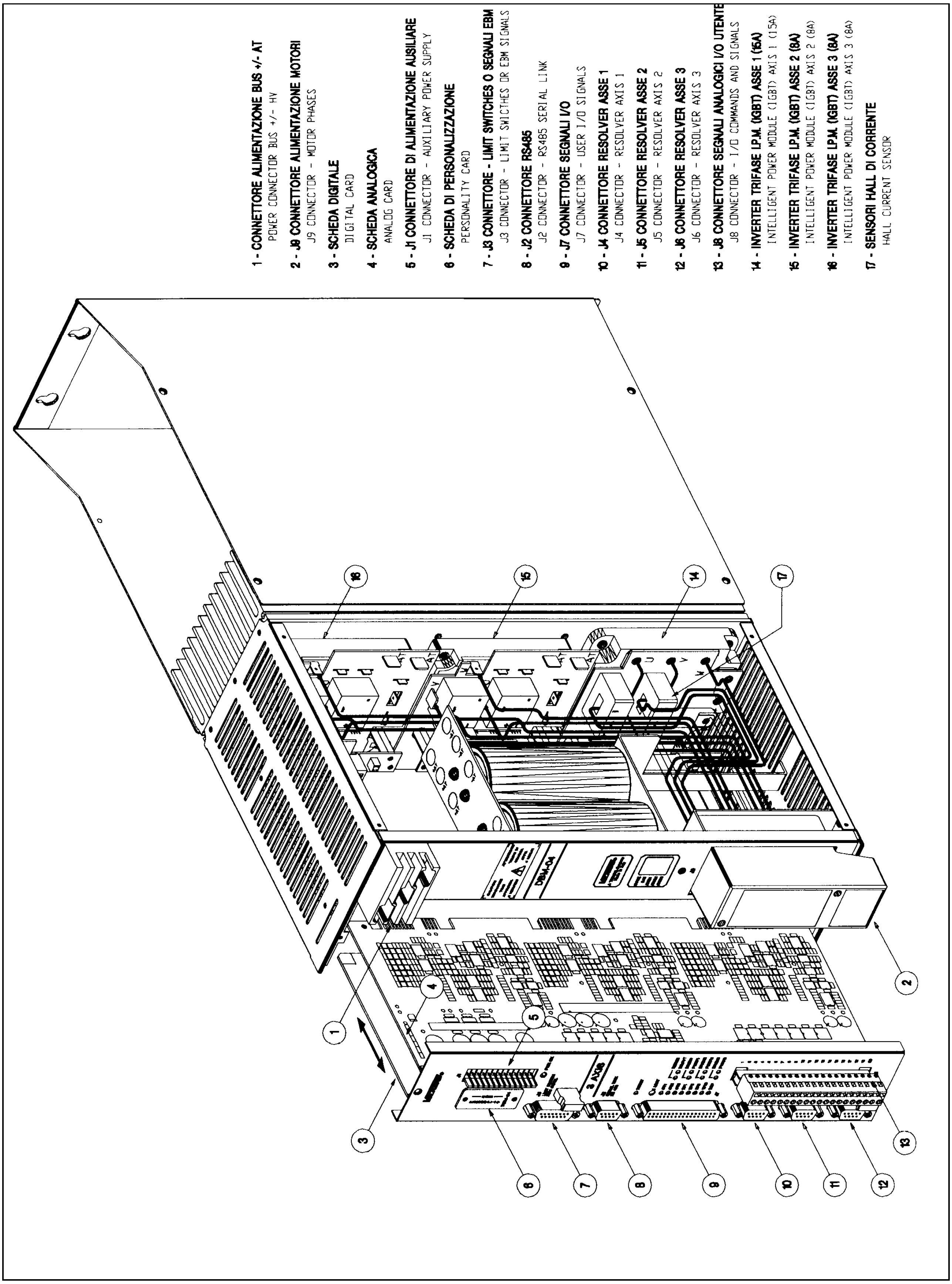
Note: the width of the Power Supply PS-120 is 180 mm. Contact our Sales Locations or Service Centers for the available configurations and dimensions with this Power Supply.

**Fig. 1.2 Side View** (Drill For M5 Screws)



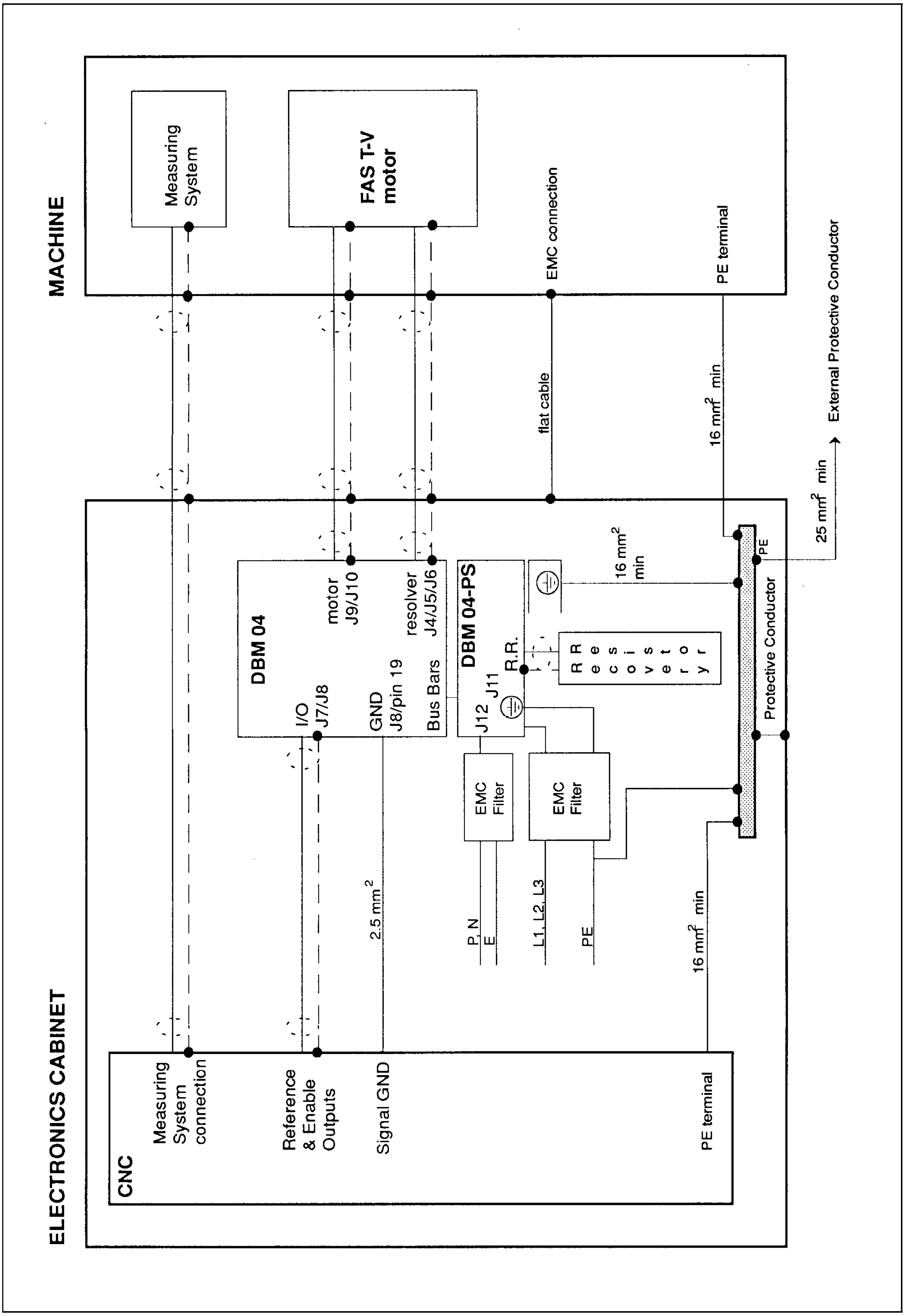
## 1.4 Component Identification

### Fig. 1.3 Component Identification (DBM 04 15-8-8)



## 1.5 System Grounding

### Fig. 1.4 EMC/Equipotential Bonding



## 1.6 Options

- software programmable (from 128 to 16384 pulses per electrical revolution) simulated encoder with marker
- A/D 14 bit converter on the speed reference with the possibility of software choice between 12 bit standard conversion and 14 bit optional conversion
- R/D converter resolution: 8 arc/min 2-axis, 4 arc/min 2-axis, 2 arc/min 2-axis, 8 arc/min 3-axis, 4 arc/min 3-axis, 2 arc/min 3-axis
- installation and setup keypad
- PC communication package: see par. 2.11.2.1
- ADR function: external 24 Vdc UPS with added capacitance to recover braking energy (see Application Note GB-4528)
- frequency reference to use a velocity reference generated by Pulse Frequency Modulation (PFM) from 0 to 100 kHz instead of the standard analog signal (see Application Note I-4521)
- master-slave (electric shaft) special software for DBM 04 with expansion (see Application Note GB-4527)

## 1.7 Rating Plate

The following informations are supplied on the rating plate of DBM 04.

### 1.7.1 Power Supply

| | | |
|---|---|---|
| CODE: | CYZZZZ | where ZZZZ=model code |
| S/N: | AASS NNNNNN | where AA=year, SS=week, NNNNNN=serial number |
| Vin: | xxx V | nominal three phase input voltage |
| 50/60 Hz | 3-phase | |
| Iin: | xxx $A_{rms}$ | nominal rms input current |
| Iout nom: | xxx $A_{rms}$ | nominal rms output current |
| Iout max: | xxx A | peak output current |

### 1.7.2 Module

| | | |
|---|---|---|
| CODE: | CY1ZZZ XX | where 1ZZZ=model code; XX=option code |
| S/N: | AASS NNNNNN | where AA=year, SS=week, NNNNNN=serial number |
| 3-phase | | |
| D.C.: | XXX% | module duty cycle, related to the max nominal current of the module (34A for 120mm, 53A for 180mm, 65A for 270mm) |
| Axis 1 | $C_1C_2C_3$-$C_4$ | code for motor, resolver, simulated encoder (see below) |
| Iout nom | XX $A_{rms}$ | nominal rms output current |
| Iout max | YYY A | peak output current |
| Axis 2 | $C_1C_2C_3$-$C_4$ | code for motor, resolver, simulated encoder (see below) |
| Iout nom | XX $A_{rms}$ | nominal rms output current |
| Iout max | YYY A | peak output current |
| Axis 3 | $C_1C_2C_3$-$C_4$ | code for motor, resolver, simulated encoder (see below) |
| Iout nom | XX $A_{rms}$ | nominal rms output current |
| Iout max | YYY A | peak output current |

$C_1C_2C_3$-$C_4$

$C_1$=pulses per electrical revolution (C=64, D=128, E=256, F=512, G=1024, H=2048, I=4096, L=8192, M=16384)
$C_2$=motor poles (A=2, B=4, C=6, D=8, E=10, F=12)
$C_3$=resolver poles (A=2, B=4, C=6, D=8, E=10, F=12)
$C_4$ =marker width (A=1, B=1/2, C=1/4, D=no marker)

### 1.7.3 UL Rating Plate

To comply with the UL requirements, the following data are shown on the rating plate of the Fan Assembly. These data are referred to the complete DBM 04 system, UL Recognized, that is Power Supply, one or more modules, fan assembly.
The Duty Cycle is related to the max nominal current of the Power Supply (65A for PS-Standard, PS-Standalone and PS-U).
The Flow Rate (F.R.) is the sum of the fan flow rates of the fan assembly.
Power Supplies and modules intended to be part of a complete DBM 04 system, UL Recognized, are marked “Part of a Recognized System”.

Example:

| | | | | |
|---|---|---|---|---|
| CODE CY2000 - CY2007 A0 - CY1200 A2 - CY1200 A9 - CY1200 A9 - CY4200 | | | | |
| $V_{in}$ 400 $V_{ac}$ | 3-phase | 50/60Hz | $I_{in}$ 27 $A_{rms}$ | - Duty Cycle 100 % |
| Auxiliary Input | $V_{in}$ 110/230 $V_{ac}$ | | $P_{in}$ 240 W | |
| Fan Assembly | $V_{in}$ 115 $V_{ac}$ | | $P_{in}$ 56 W | F.R. 560 $m^3/h$ |

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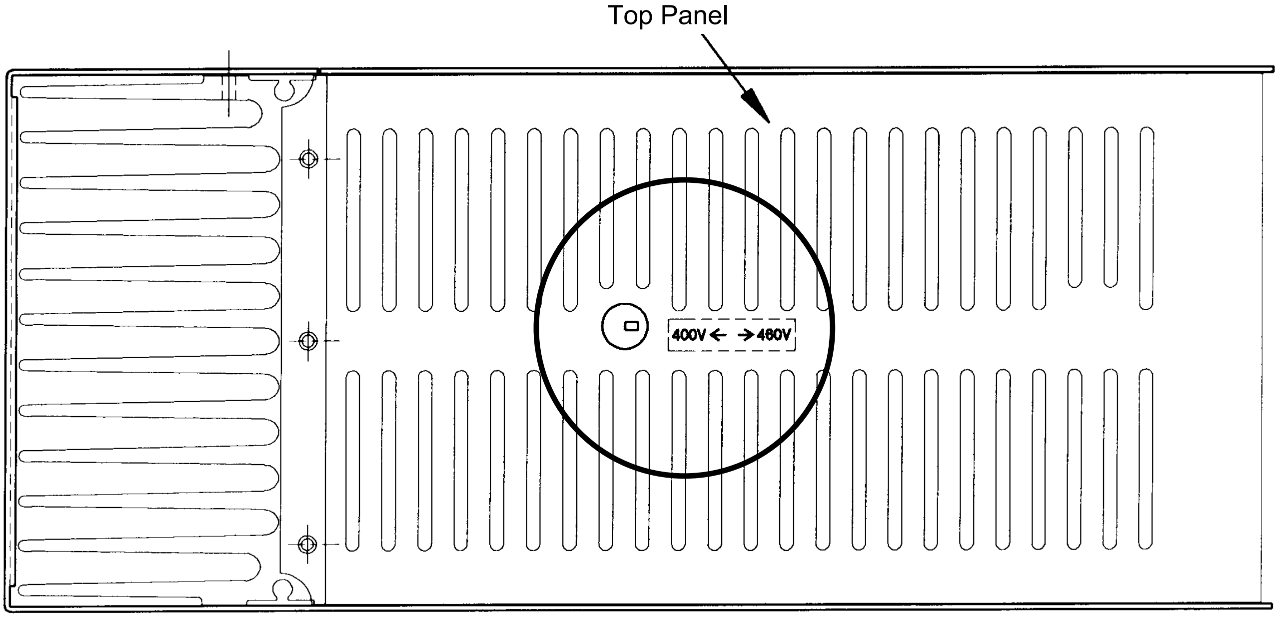
# SECTION 2 - INSTALLATION

***CAUTION**: make sure that the correct input voltage, 400V or 460V, has been set.*

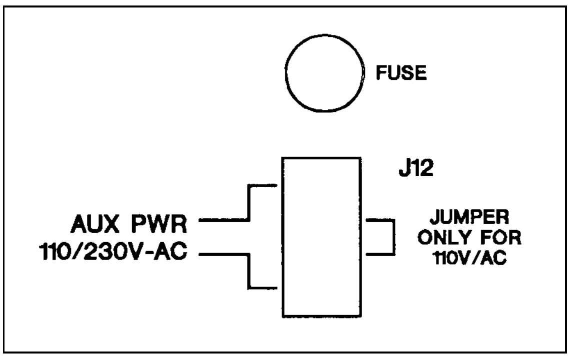
### Fig.2.1 PS-Standard and PS-6M - 400/460V Setting




***CAUTION**: make sure that the correct wiring has been set for auxiliary input voltage on the PS-Standard and PS-6M front panel.*

*- connect the jumper on J12 connector to use 110 Vac*
*<u>or</u>*
*- disconnect the jumper on J12 connector to use 230 Vac*

### Fig.2.2 PS-Standard and PS-6M - 110/230V Jumper



## 2.1 Fuses

### 2.1.1 Internal Auxiliary Fuses

#### 2.1.1.1 PS-Standard and PS-6M

A delayed type fuse, rated 4A/250V, is provided on the front panel, to protect the auxiliary power circuit. The following types are approved:
- Mod.No.SPT 0001.2510 by Schurter AG
- Mod.No. ST520240 by Bussmann Div Cooper (UK) Ltd

#### 2.1.1.2 PS-Standalone and PS-120

A delayed type fuse, rated 3.15A/250V, is provided on the internal base card, to protect the auxiliary power circuit. The following types are approved:
- Mod.No.SPT 0001.2509 by Schurter AG
- Mod.No. ST520231 by Bussmann Div Cooper (UK) Ltd

### 2.1.2 External Power Fuses (one in each phase of the power line)

#### 2.1.2.1 PS Standard, PS-6M, PS-Standalone and PS-U

***CAUTION****: equipment suitable for use on a circuit capable of delivering not more than 5000 RMS symmetrical Amperes, 460V +10% maximum, when protected by semiconductor type fuses, mod.No.160-FEE, manufactured by Bussmann Div.Cooper (UK) Ltd*

#### 2.1.2.2 PS-120

Semiconductor type fuses, mod.No.315-FM (315A/660Vac), manufactured by Bussmann Div.Cooper (UK) Ltd, are recommended.

## 2.2 Soft Start

The soft start circuit (inrush current limiting) is built-in.

## 2.3 Transformers

### 2.3.1 Power Transformer

The system is designed to allow direct operation from a 400/460 Vac three phase power line, without isolation transformer. An isolation transformer may still be required to meet local safety regulations. It is the user responsibility to determine if an isolation transformer is required to meet these requirements.
To size the power transformer 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.

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

### 2.3.2 Auxiliary Power Transformer - PS-Standard and PS-6M

A transformer for the auxiliary line is not necessary.

### 2.3.3 Auxiliary Power Transformer - PS-Standalone and PS-120

If data need to be saved in case of three phase power line failure, a 230 Vac monophase auxiliary line must be connected, via isolation transformer, to the PS-Standalone and PS-120 versions of Power Supply. This is not necessary for normal duty but only for data saving.

***CAUTION**: do not connect directly the auxiliary line but only through a dedicated, isolation transformer with 230Vac ±10%, 50/60 Hz secondary voltage. Rated power must be 60VA for each module (e.g. 240VA for 4 modules)*

## 2.4 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 | | | | |
|---|---|---|---|---|
| **PS-Standard PS-6M PS-Standalone PS-U** | **PS-120** | **Module** | **IGBT's** | **Input Bridge** |
| 25 W | 50 W | 50 W | 16 W/A | 1 W/A |

Example: with one PS-Standard, two modules, a total output current of 60 Arms and continuous unknown braking, the dissipated power is as follows.

Pd = 25 + (2 ∗ 50) + (16 ∗ 60[A]) + (1 ∗ 60[A]) + 750 [recovery resistor power] = 1895 W

## 2.5 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 680V (for 400Vac version) or 790V (for 460V version) 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, PS-Standard, PS-6M, PS-Standalone are provided with 8.2 Ω, 750W recovery resistor, while PS-U is provided with 12 Ω, 750W recovery resistor and PS-120 with 3.9 Ω, 1000W recovery resistor.

***WARNING****: High Voltage. The recovery resistor is connected to the Bus Bar's and can have voltage ≥810Vdc*

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

***CAUTION****: 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 require a non standard recovery resistor.*
*It is suggested contacting our Service Centers.*

***CAUTION****: shielding of the recovery resistor cable, provided in kit for test purposes, is recommended for ensuring compliance with the EMC standards.*

***CAUTION:*** *for UL approval in the end-use installation, the Dynamic Brake Unit Recovery Resistor shall have the connection wiring made with R/C (AVLV2) or insulated with R/C (YDPU2) or R/C (UZCW2)*

## 2.6 Fan Assembly

The ventilation is provided by fans mounted under the modules. The size and the number of fans are according to the system configuration. Selection of the correct Fan Assembly is due by matching Fan Assembly width to the total of the DBM drives package (i.e. Fan = Power Supply and DBM module(s) and DBM expansion module(s)).
Fan input voltage is 230 Vac or 115 Vac or 24 Vdc.

**TAB. 2.1 - FAN ASSEMBLY**

| Model Code | Fan Assembly Width mm | Input Voltage V | Input Power W | Total Flow Rate m3/h |
|---|---|---|---|---|
| CY4300, CY4318, CY4359, CY4360 | 240 | 24 Vdc | 23 | 520 |
| CY4301, CY4323, CY4337, CY4338 | 300 | 24 Vdc | 46 | 1040 |
| CY4302, CY4319, CY4339, CY4340 | 360 | 24 Vdc | 46 | 1040 |
| CY4303, CY4341, CY4342 | 390 | 24 Vdc | 46 | 1040 |
| CY4304, CY4320, CY4334, CY4343, CY4344 | 420 | 24 Vdc | 57 | 1200 |
| CY4305, CY4321, CY4331, CY4335, CY4345, CY4346 | 480 | 24 Vdc | 69 | 1560 |
| CY4306, CY4316, CY4347, CY4348 | 510 | 24 Vdc | 69 | 1560 |
| CY4307, CY4311, CY4349, CY4350 | 540 | 24 Vdc | 69 | 1560 |
| CY4308, CY4351, CY4352 | 570 | 24 Vdc | 69 | 1560 |
| CY4309, CY4312, CY4324, CY4336, CY4353, CY4354 | 600 | 24 Vdc | 92 | 2080 |
| CY4310, CY4355, CY4356 | 750 | 24 Vdc | 92 | 2080 |
| CY4315, CY4357, CY4358 | 660 | 24 Vdc | 92 | 2080 |
| CY4100, CY4118, CY4159, CY4160 | 240 | 230 Vac | 64 | 485 |
| CY4101, CY4123, CY4137, CY4138 | 300 | 230 Vac | 128 | 970 |
| CY4102, CY4119, CY4139, CY4140 | 360 | 230 Vac | 128 | 970 |
| CY4103, CY4141, CY4142 | 390 | 230 Vac | 128 | 970 |
| CY4104, CY4120, CY4134, CY4143, CY4144 | 420 | 230 Vac | 147 | 1130 |
| CY4105, CY4121, CY4131, CY4135, CY4145, CY4146 | 480 | 230 Vac | 192 | 1455 |
| CY4106, CY4116, CY4147, CY4148 | 510 | 230 Vac | 192 | 1455 |
| CY4107, CY4111, CY4149, CY4150 | 540 | 230 Vac | 192 | 1455 |
| CY4108, CY4151, CY4152 | 570 | 230 Vac | 192 | 1455 |
| CY4109, CY4112, CY4124, CY4136, CY4153, CY4154 | 600 | 230 Vac | 256 | 1940 |
| CY4110, CY4155, CY4156 | 750 | 230 Vac | 256 | 1940 |
| CY4115, CY4157, CY4158 | 660 | 230 Vac | 256 | 1940 |
| CY4200, CY4213, CY4214 | 240 | 115 Vac | 56 | 560 |
| CY4201, CY4215, CY4216 | 300 | 115 Vac | 112 | 1120 |
| CY4202, CY4217, CY4218 | 360 | 115 Vac | 112 | 1120 |
| CY4203, CY4219, CY4220 | 390 | 115 Vac | 112 | 1120 |
| CY4204, CY4221, CY4222 | 420 | 115 Vac | 130 | 1300 |
| CY4205, CY4211, CY4223, CY4224 | 480 | 115 Vac | 168 | 1680 |
| CY4206, CY4225, CY4226 | 510 | 115 Vac | 168 | 1680 |
| CY4207, CY4227, CY4228 | 540 | 115 Vac | 168 | 1680 |
| CY4208, CY4229, CY4230 | 570 | 115 Vac | 168 | 1680 |
| CY4209, CY4212, CY4231, CY4232 | 600 | 115 Vac | 224 | 2240 |
| CY4210, CY4233, CY4234 | 750 | 115 Vac | 224 | 2240 |
| CY4235, CY4236 | 660 | 115 Vac | 224 | 2240 |

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

## 2.7 Wire Type

### 2.7.1 Sizing of Wires

It is recommended to use Cu, stranded and/or solid wires, 60/75°C (140/167 °F), UL approved, per the following table.
Note that in the table the wires are sized according to the nominal current. The wires can be undersized if the actual rms current of the application is lower.

**Tab. 2.2 - Sizing of Wires**

| | DBM 04 Model | | | | | Notes |
|---|---|---|---|---|---|---|
| | Power Supply | | Axis | | | |
| | **PS-Standard, PS-6M, PS-U, PS-Standalone** | **PS-120** | **3/9 to 15/42** | **25/70** | **35/90 to 60/180** | - |
| Power Line and ground wiring (No.of wires x AWG) | 4 x 6 AWG | 4 x 2 AWG | - | - | - | - |
| Auxiliary Line wiring (No. of wires x AWG) | 2 x 14 AWG | 2 x 10 AWG | . | . | - | - |
| Motor Power wiring (No.of wires x AWG) | . | . | 4 x 14 AWG | 8 x 14 AWG | 4 x 6 AWG | shielded |
| Recovery Resistor wiring (No.of wires x AWG) | 2 x 10 AWG | 2 x 6 AWG | . | . | . | shielded |
| Dc-Bus (+/-AT) | 8 AWG (provided in kit) | | | | | - |
| Resolver wiring (No.of wires x AWG) | - | | 4 x 2 x 22/20 AWG | | | with 4 pair, each pair twisted and individually shielded with an independent overall shield |

**Tab. 2.3 - AWG/mm$^2$ Conversion Table**

| **AWG** | 22 | 20 | 18 | 16 | 14 | 12 | 10 | 8 | 6 | 4 | 3 | 2 | 1 | 1/0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **mm$^2$** | 0.3 | 0.5 | 0.8 | 1.3 | 2.1 | 3.3 | 5.3 | 8.4 | 13 | 21 | 27 | 34 | 42 | 54 |

**Tab. 2.4 - Tightening torque of Power Connectors/Terminal Blocks**

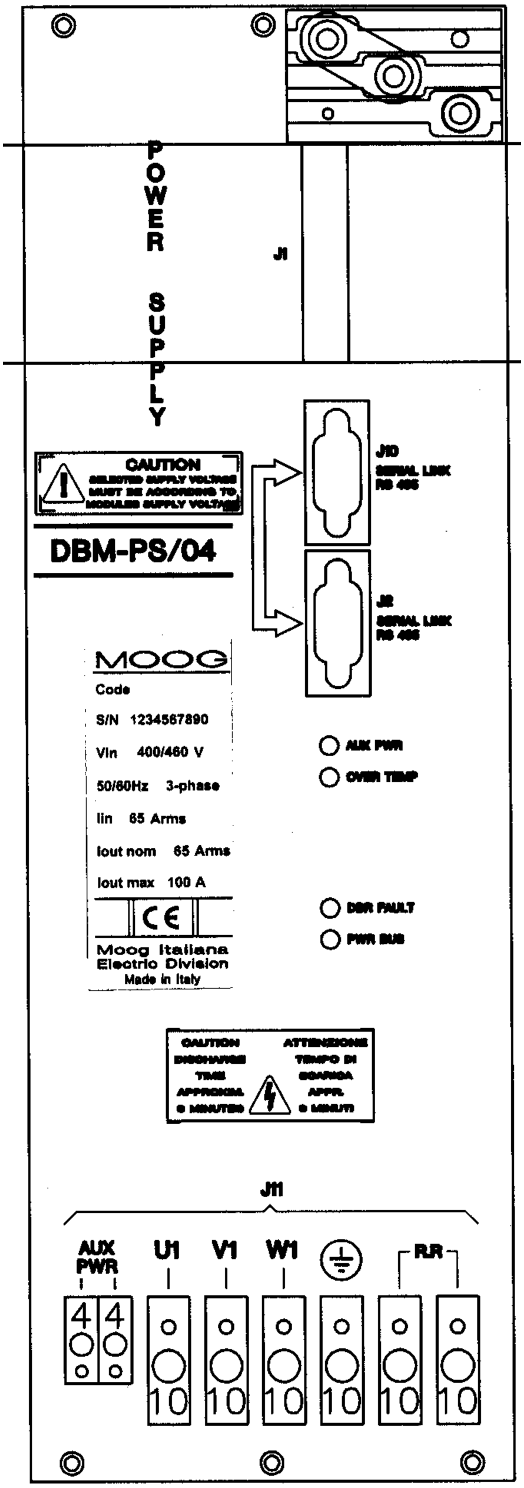
| **Mfg** | **Moog** | **Phoenix Contact Gmbh** | | | **Harting Kgaa** | |
|---|---|---|---|---|---|---|
| | **DC-Bus** | **HDFK 4** | **HDFK 10** | **HDFK 25** | **Han16E** | **HanK 4/0** |
| **lb in** | 53 | 5-7 | 13.2-16 | 35 | 4.4 | 7 |
| **Nm** | 6 | 0.6-0.8 | 1.5-1.8 | 4 | 0.5 | 0.8 |

**Tab. 2.5 - Wire stripping length for Power Connectors/Terminal Blocks**

| | **Phoenix Contact Gmbh** | | | **Harting Kgaa** | | **Wago Gmbh** |
|---|---|---|---|---|---|---|
| | **HDFK 4** | **HDFK 10** | **HDFK 25** | **Han16E** | **HanK 4/0** | **231-104** |
| **in** | 0.35 | 0.43 | 0.75 | 0.28 | 0.55 | 0.33 |
| **mm** | 9 | 11 | 19 | 7 | 14 | 8-9 |

## Fig. 2.3A Power Supply - Front Panels

### PS-Standalone




### PS-Standard and PS-6M

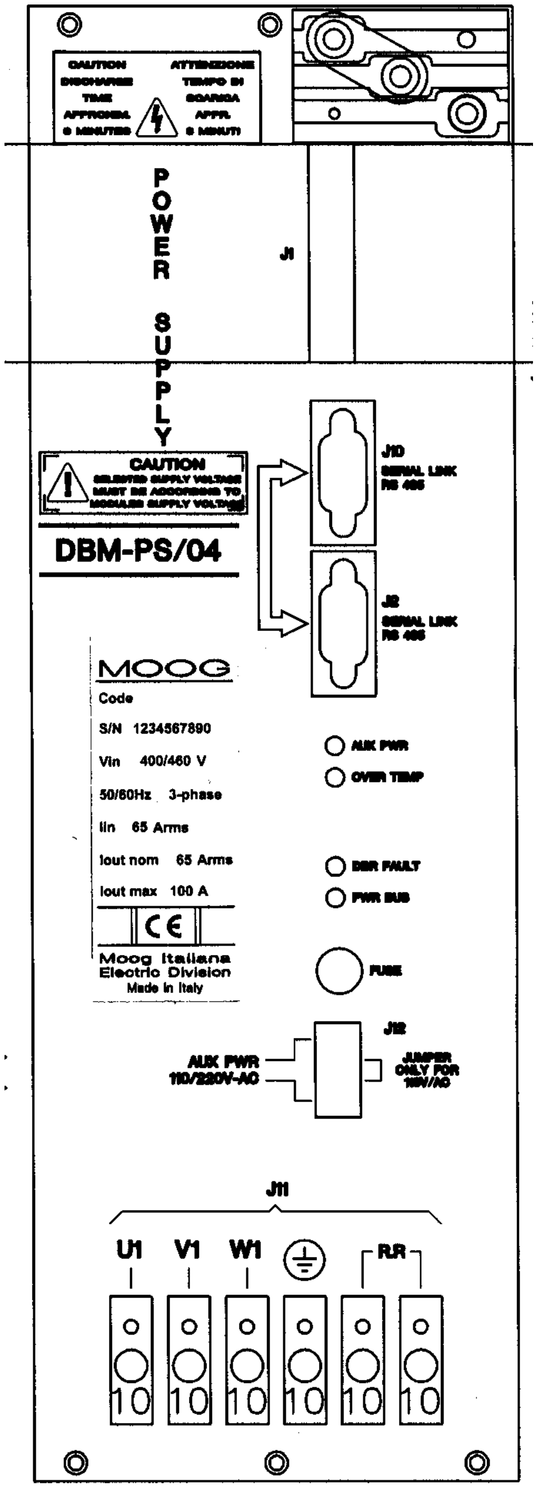


**Fig. 2.3B Power Supply PS-120 - Front Panel**

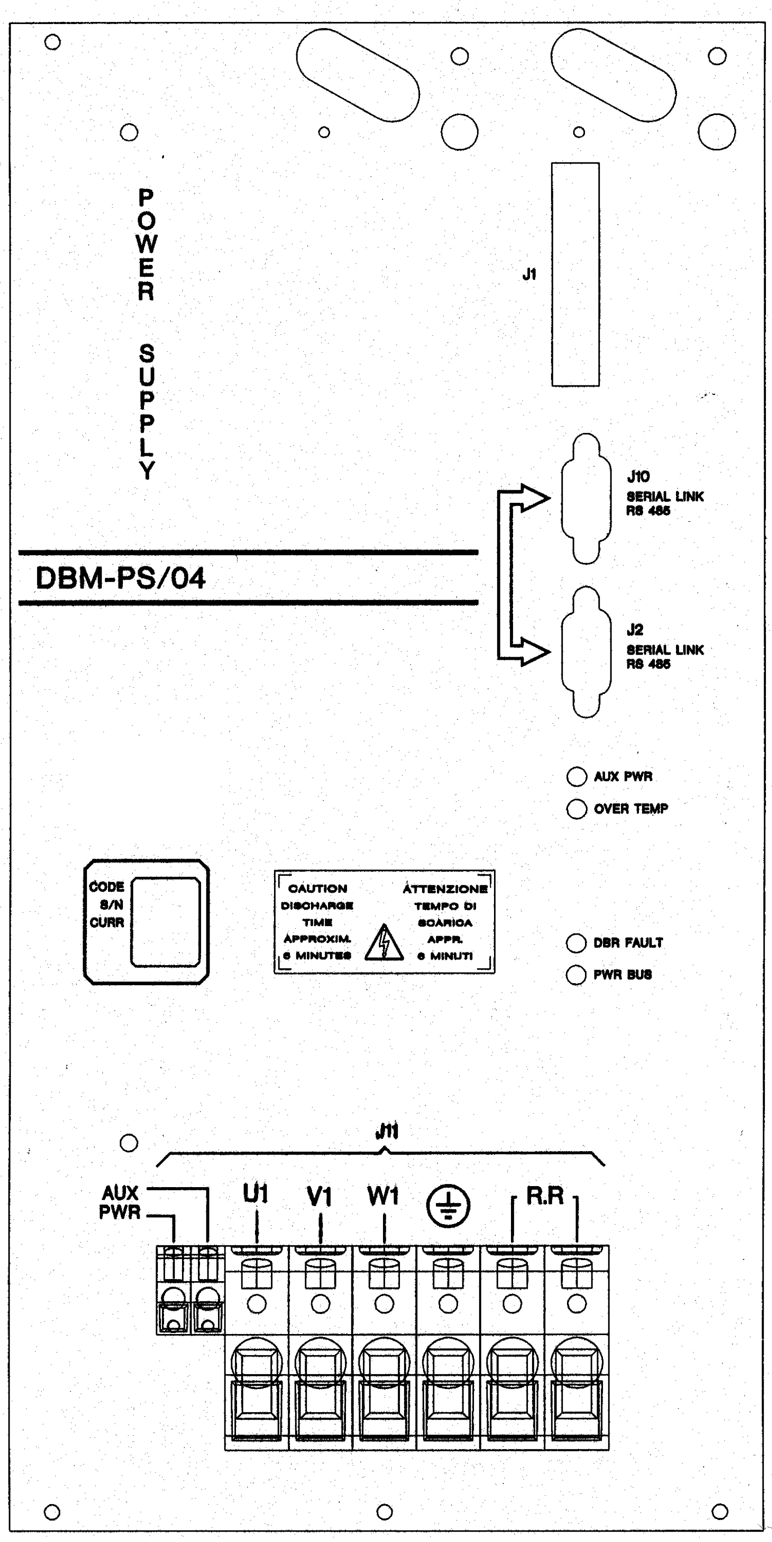
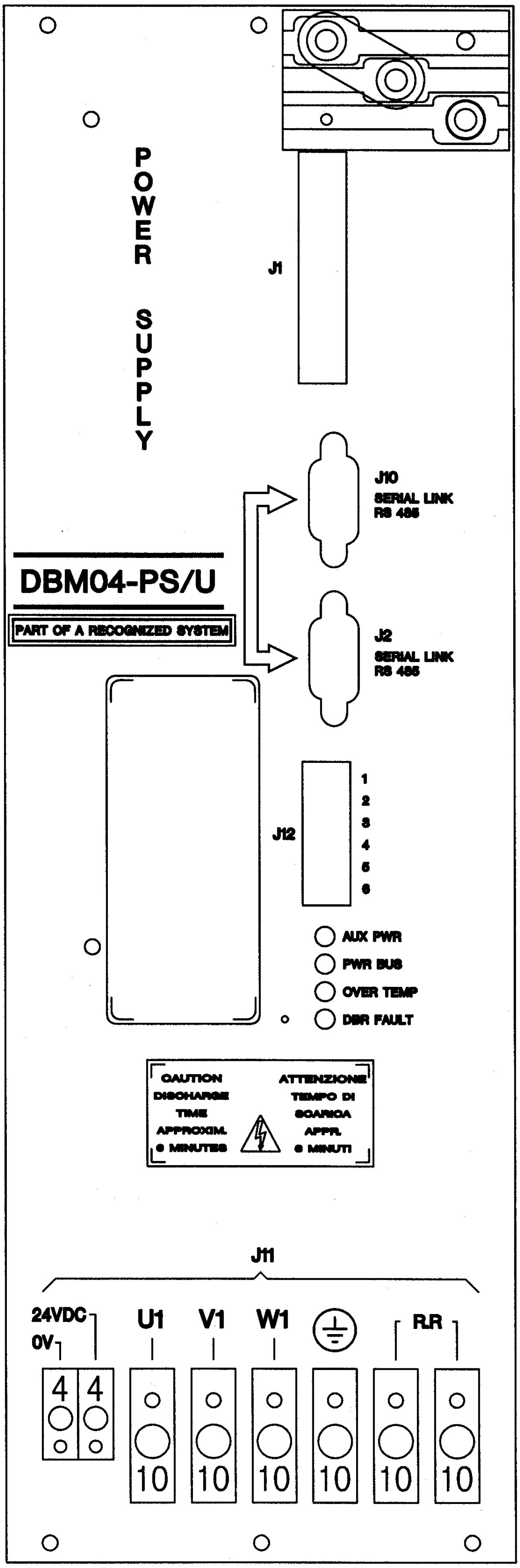


**Fig. 2.3C   Power Supply PS-U - Front Panel**



## 2.8 Power Supply - Wiring

See Par.2.7 for sizing of power wires, tightening torque and wire stripping length. See Section 3 for shielding procedures according to EMC Directive.

### 2.8.1 Signal/ Auxiliary Wiring

**Tab. 2.6 - Power Supply - J1 Conn. - Auxiliary Power Supply (to Modules)**
Panel side: shrouded header with 13 male contacts
Wiring side: connector with 13 female contacts (provided in kit with cable)

| Pos. | Function |
|---|---|
| 1 | Not connected (N.C.) |
| 2 | +18Vdc referred to -HV (540/620 Vdc) |
| 3 | -HV (540/620 Vdc) |
| 4 | 158kHz square wave to high side drives |
| 5 | N.C. |
| 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. 2.7 - Power Supply - J2 Conn. - RS485 Port/Fault signals (to Modules)**
Panel side: Sub-D with 9 male contacts
Wiring side: Sub-D with conductive shell, 9 female contacts (supplied with cable)

| Pos. | Function |
|---|---|
| 1 | + Rx (RS485 serial link) |
| 2 | N.C. |
| 3 | + Tx (RS485 serial link) |
| 4 | Power supply binary coded faults (see Tab.2.8) |
| 5 | + 5Vdc input referred to logic 0V |
| 6 | - Rx (RS485 serial link) |
| 7 | Logic 0V |
| 8 | - Tx (RS485 serial link) |
| 9 | Power supply binary coded faults (see Tab.2.8) |

**Tab. 2.8 - Power Supply binary coded faults**

| J2/pos. 4 | J2/pos. 9 | |
|---|---|---|
| 0 | 0 | OK |
| 0 | 1 | DBR FAULT. Recovery fault |
| 1 | 0 | OVER TEMP. Overtemperature |
| 1 | 1 | Not Used. |

**Tab. 2.9 - Power Supply - J10 Connector - RS485 Port (to keypad or to converter)**

Panel side: Sub-D with 9 female contacts

Wiring side: Sub-D with 9 male contacts (supplied with the optional RS232/485 converter kit or with the optional keypad)

| Pos. | Function |
|---|---|
| 1 | +Rx (RS485 serial link) |
| 2 | N.C. |
| 3 | +Tx (RS485 serial link) |
| 4 | N.C. |
| 5 | +5Vdc output referred to logic 0V for power supply |
| 6 | -Rx (RS485 serial link) |
| 7 | Logic 0V |
| 8 | -Tx (RS485 serial link) |
| 9 | N.C. |

## 2.8.2 Power Wiring

### 2.8.2.1 PS-Standard and PS-6M

**Tab. 2.10 - J11 Connector - Power**

Power: Terminal Blocks Mod.No.HDFK 10 by Phoenix Contact Gmbh

See Par.2.7 for sizing of power wires, tightening torque and wire stripping length

| Name | Function |
|---|---|
| U1 | "L1" phase, three-phase input voltage 400Vac (or 460Vac) |
| V1 | "L2" phase, three-phase input voltage 400Vac (or 460Vac) |
| W1 | "L3" phase, three-phase input voltage 400Vac (or 460Vac) |
| ⏚ | Ground |
| R.R. | Recovery resistor |
| R.R. | Recovery resistor |

**Tab. 2.11 - J12 Connector - Aux Power**

Panel side: shrouded open end header with 4 male contacts

Wiring side: connector Mod.No.231-104/026-000 by Wago Gmbh (provided in kit)

See Par.2.7 for sizing of power wires, tightening torque and wire stripping length

| Name | Function |
|---|---|
| AUX PWR | Auxiliary power supply 230Vac/110Vac |
| JUMPER | Jumper (see Fig.2.2)<br>Open=230Vac - Closed=110Vac |
| JUMPER | |
| AUX PWR | Auxiliary power supply 230Vac/110Vac |

### 2.8.2.2 PS-Standalone

**Tab. 2.12 - J11 Connector - Power**

Aux Power: Terminal Blocks Mod.No.HDFK 4 by Phoenix Contact Gmbh
Power: Terminal Blocks Mod.No.HDFK 10 by Phoenix Contact Gmbh
See Par.2.7 for sizing of power wires, tightening torque and wire stripping length

| Name | Function |
|---|---|
| AUX PWR | Auxiliary power supply 230Vac |
| AUX PWR | Auxiliary power supply 230Vac |
| U1 | "L1" phase, three-phase input voltage 400Vac (or 460Vac) |
| V1 | "L2" phase, three-phase input voltage 400Vac (or 460Vac) |
| W1 | "L3" phase, three-phase input voltage 400Vac (or 460Vac) |
| ⏚ | Ground |
| R.R. | Recovery resistor |
| R.R. | Recovery resistor |

### 2.8.2.3 PS-120

**Tab. 2.13 - J11 Connector - Power**

Aux Power: Terminal Blocks Mod.No.HDFK 4 by Phoenix Contact Gmbh
Power: Terminal Blocks Mod.No.HDFK 25 by Phoenix Contact Gmbh
See Par.2.7 for sizing of power wires, tightening torque and wire stripping length

| Name | Function |
|---|---|
| AUX PWR | Auxiliary power supply 230Vac |
| AUX PWR | Auxiliary power supply 230Vac |
| U1 | "L1" phase, three-phase input voltage 400Vac (or 460Vac) |
| V1 | "L2" phase, three-phase input voltage 400Vac (or 460Vac) |
| W1 | "L3" phase, three-phase input voltage 400Vac (or 460Vac) |
| ⏚ | Ground |
| R.R. | Recovery resistor |
| R.R. | Recovery resistor |

## 2.8.2.4 PS-U

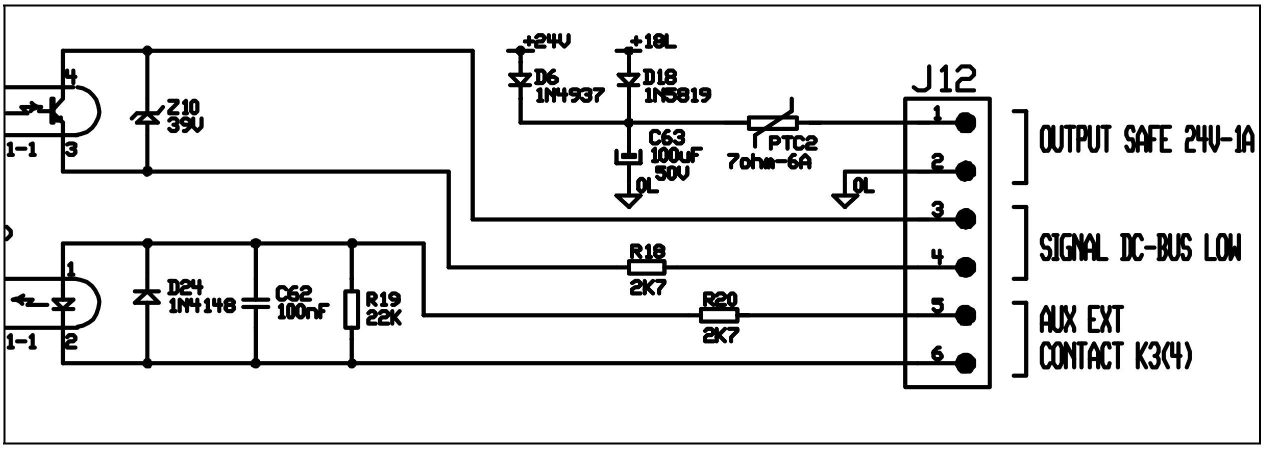
**Tab. 2.14 - J11 Connector - Power**
Aux Power: Terminal Blocks Mod.No.HDFK 4 by Phoenix Contact Gmbh
Power: Terminal Blocks Mod.No.HDFK 10 by Phoenix Contact Gmbh
See Par.2.7 for sizing of power wires, tightening torque and wire stripping length

| Name | Function |
|---|---|
| AUX PWR | Auxiliary power supply 24Vdc |
| AUX PWR | Auxiliary power supply 24Vdc |
| U1 | "L1" phase, three-phase input voltage 400Vac (or 460Vac) |
| V1 | "L2" phase, three-phase input voltage 400Vac (or 460Vac) |
| W1 | "L3" phase, three-phase input voltage 400Vac (or 460Vac) |
| ⏚ | Ground |
| R.R. | Recovery resistor |
| R.R. | Recovery resistor |

**Tab. 2.15 - J12 Connector - Safety**
Panel side: shrouded open end header with 6 male contacts
Wiring side: connector Mod.No.231-106/026-000 by Wago Gmbh (provided in kit)

| Pos. | Name | Function |
|---|---|---|
| 1 | OUTPUT | 24Vdc (max 1A) output to feed an external relay during |
| 2 | SAFE 24V-1A | the anti-freewheeling. See Fig.2.4 |
| 3 | SIGNAL | Output signal for safety. When the opto is OFF (∞ Ω) the DC- |
| 4 | DC-BUS LOW | Bus is over 48V. When the opto is ON (2.7kΩ) the DC-Bus is under 48V. See Fig.2.4 |
| 5 | AUX EXT | Input signal for safety. Normally connected to 24 Vdc. When not |
| 6 | CONTACT | connected to 24 Vdc, the DC-Bus is discharged via the recovery resistor. See Fig.2.4 |

**Fig. 2.4 - J12 Connector - Internal Circuitry**



## 2.9 Power Supply - Led's

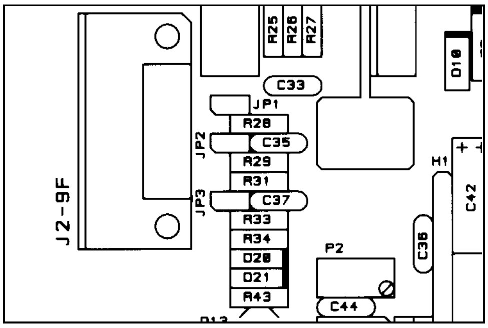
**Tab. 2.16 - Power Supply - Led's**

| Name | Function |
|---|---|
| Yellow LED - PWR-BUS | BUS BAR voltage > 40Vdc<br>***WARNING**: with PS-Standard and PS-6M, active only if the aux power supply is ON* |
| Red LED - DBR FAULT | Recovery unit fault |
| Red LED - OVER TEMP | Module overtemperature via PTC (threshold 70 °C) |
| Green LED - AUX POWER | Auxiliary power supply OK |

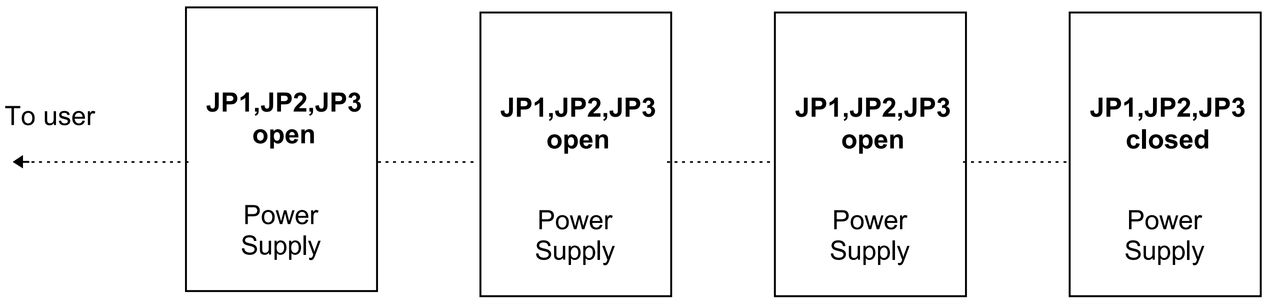
## 2.10 Power Supply - Internal Card Jumpers

**JP1 closed (default)** = connects a 120 Ω resistor between RX+ and RX- of serial link.
**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. 2.5 - Power Supply - Card Jumpers**




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



## Fig. 2.6 Module - Removable Control Panels

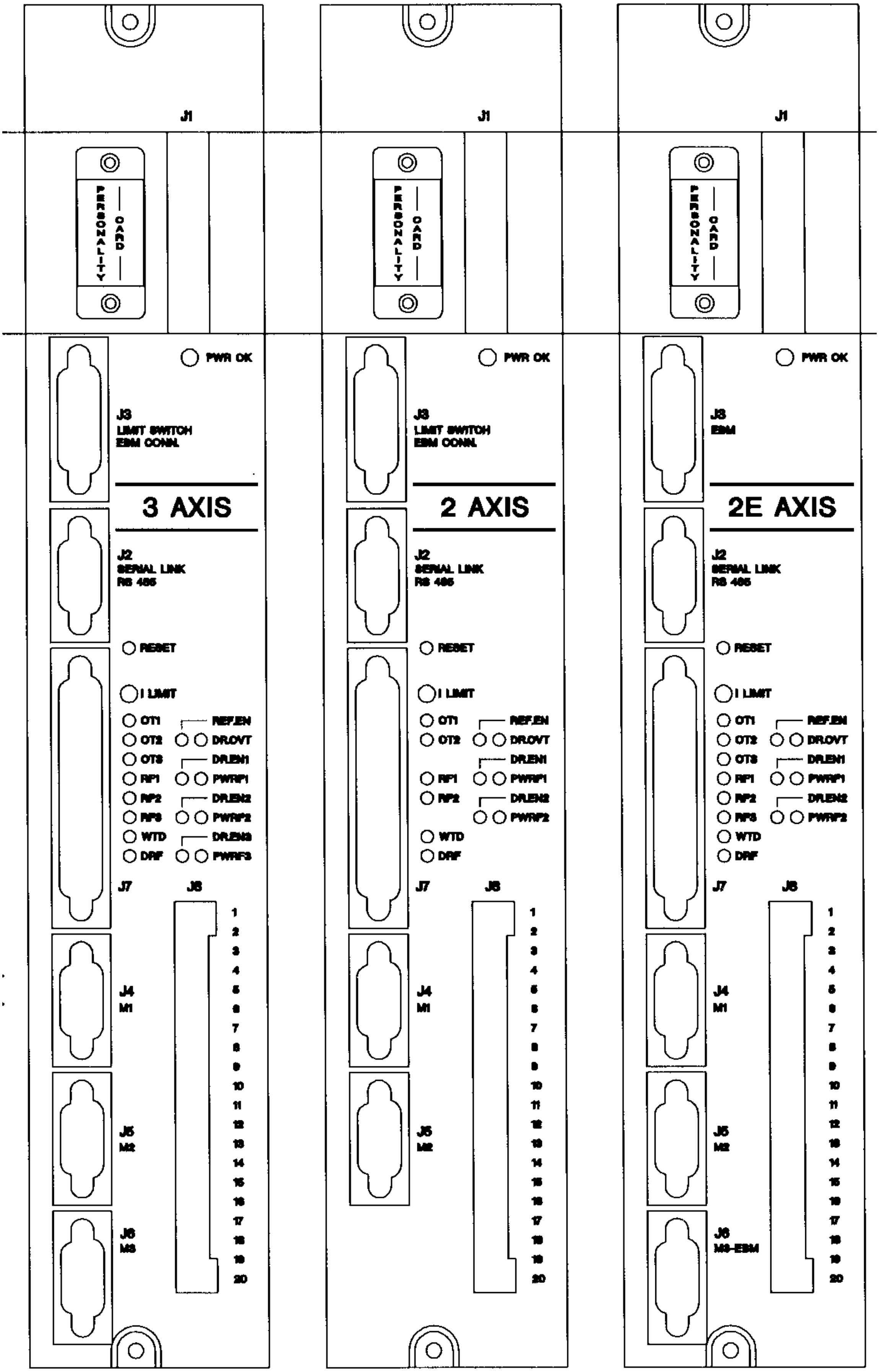


**Fig. 2.7 Expansion-EBM - Removable Control Panel**

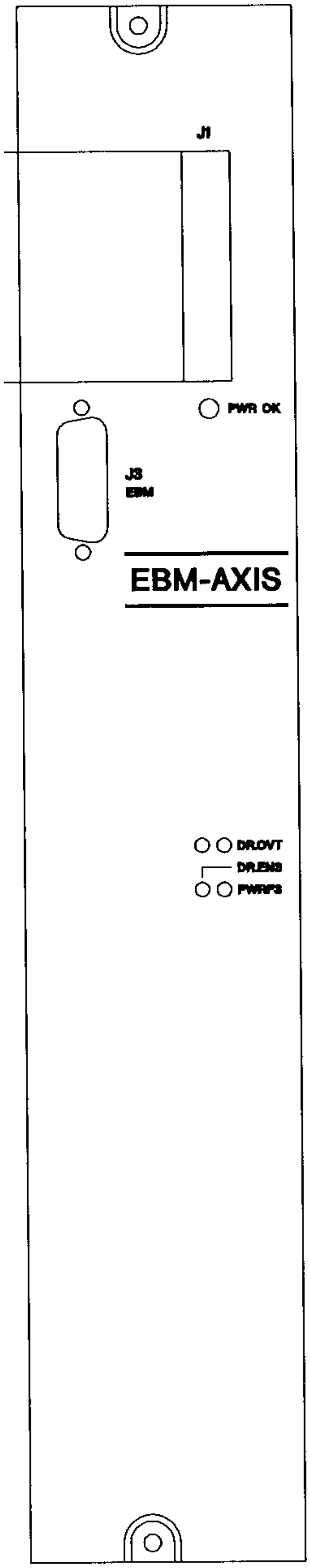
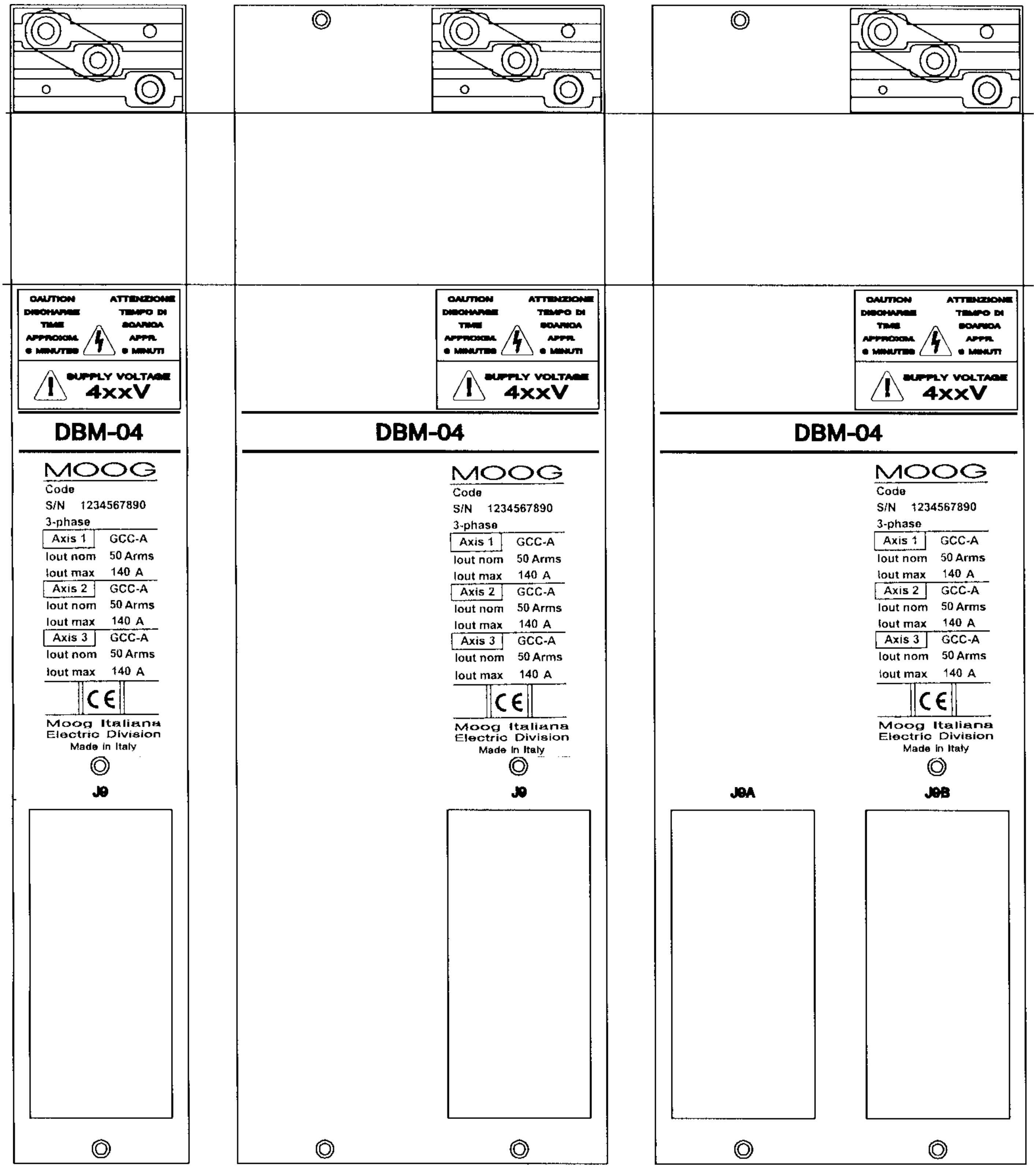
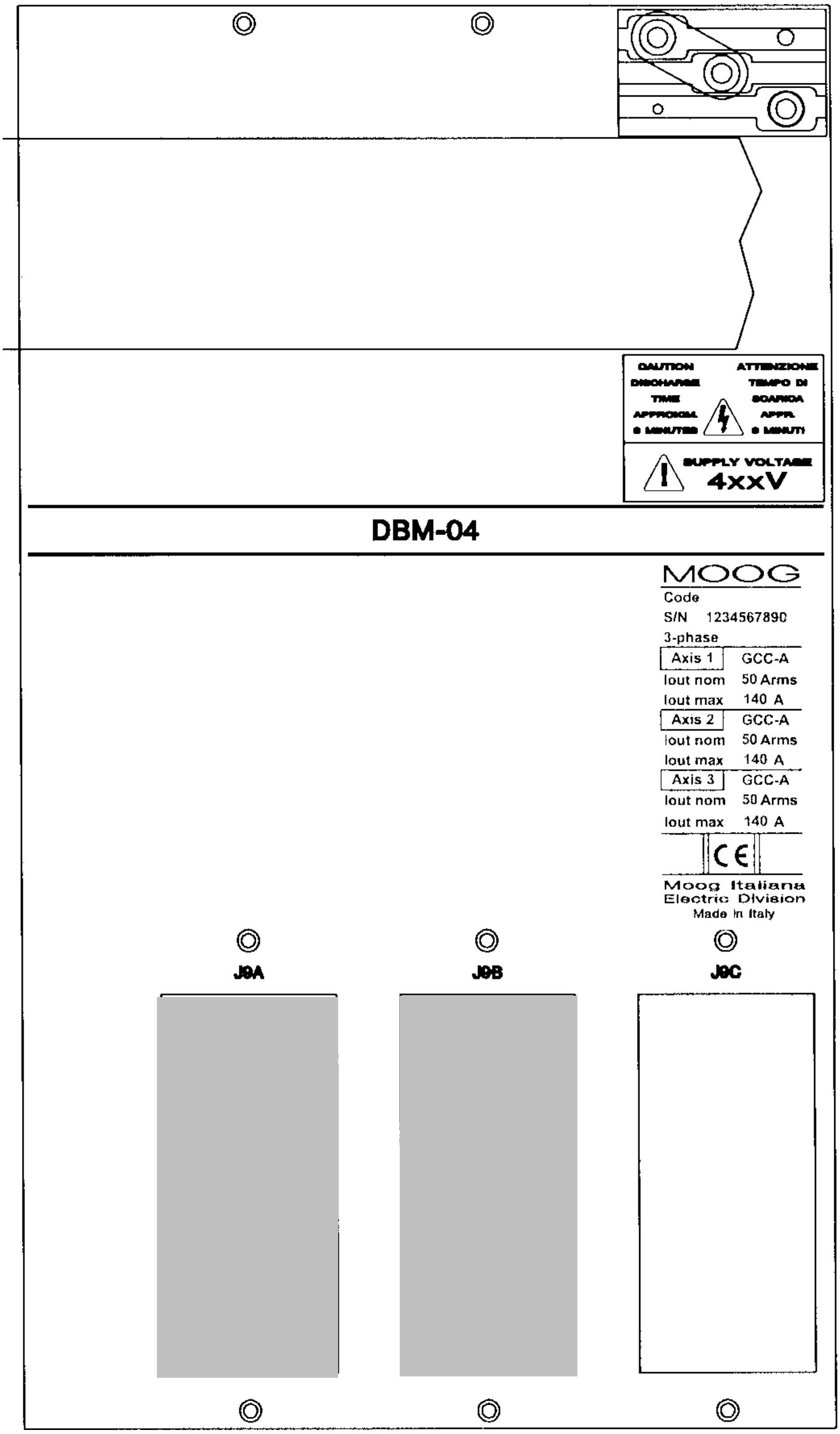


**Fig. 2.8 Module (120 mm/180 mm) - Fixed Panels**



## Fig. 2.9 Module/ Expansion (270 mm) - Fixed Panel




Note: the grey connectors are mounted only in some configurations (see tab.2.27 and 2.28)

## 2.11 Module Wiring

See Par.2.7 for sizing of power wires, tightening torque and wire stripping length. See Section 3 for shielding procedures according to EMC Directive.

**Tab. 2.17 - Module - J1 Connector - Auxiliary Power Supply (to PS/Modules)**
Panel side: shrouded header with 13 male contacts
Wiring side: connector with 13 female contacts (supplied in kit with cable)

| Pos. | Function |
|---|---|
| 1 | Not connected (N.C.) |
| 2 | +18Vdc referred to -HV (540/620 Vdc) |
| 3 | -HV (540/620 Vdc) |
| 4 | 158kHz square wave to high side drives |
| 5 | N.C. |
| 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. 2.18 - Module - J2 Connector - RS485 Port/Fault signals (to PS/Modules)**
Panel side: Sub-D with 9 male contacts
Wiring side: Sub-D with conductive shell, 9 female contacts (supplied by with cable)

| Pos. | |
|---|---|
| 1 | +Rx |
| 2 | N.C. |
| 3 | +Tx |
| 4 | Power supply binary coded faults (see Tab.2.19) |
| 5 | +5Vdc output referred to logic 0V |
| 6 | -Rx |
| 7 | logic 0V |
| 8 | -Tx |
| 9 | Power supply binary coded faults (see Tab.2.19) |

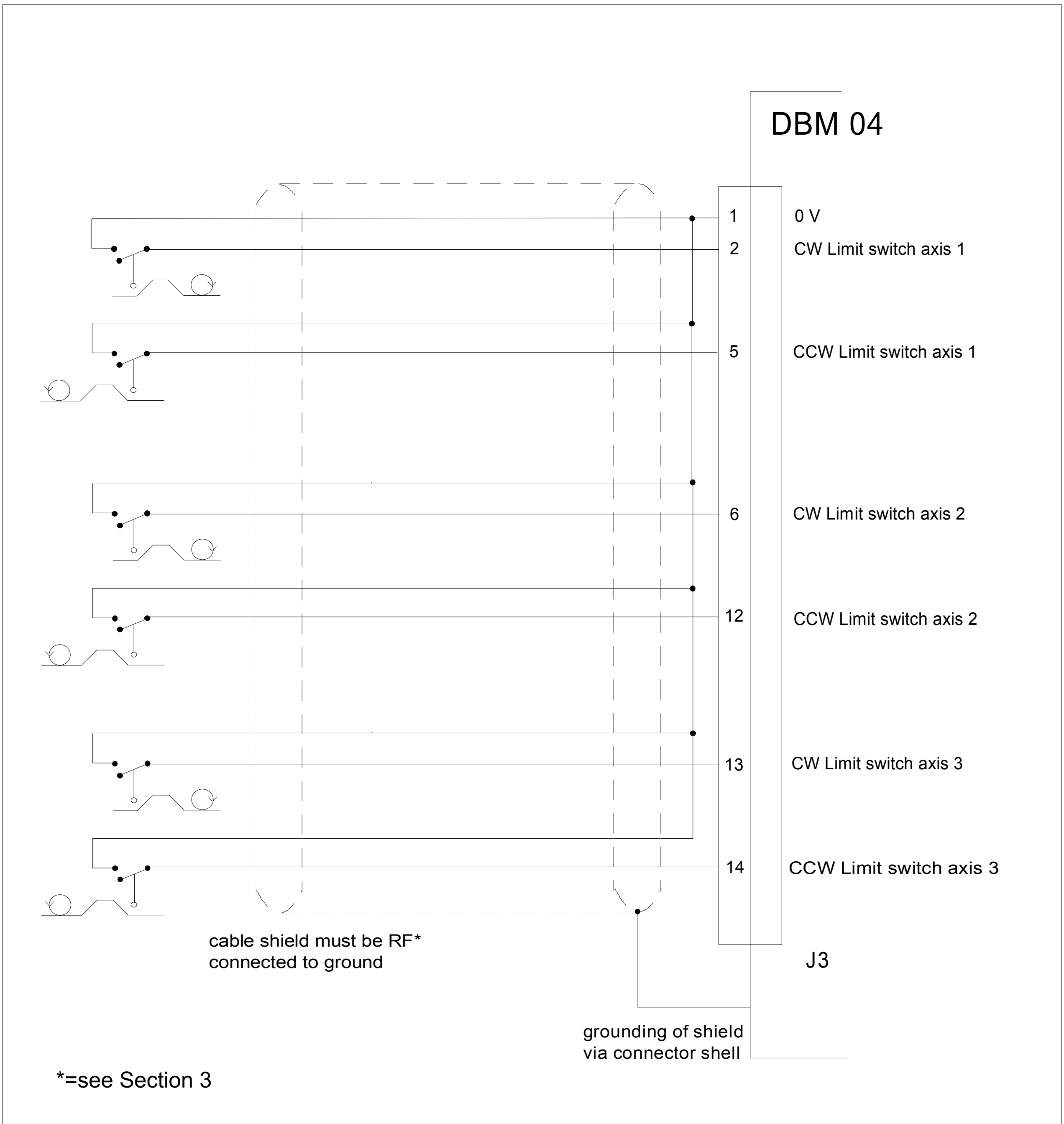
**Tab. 2.19 - Module - Power supply binary coded faults**

| J2/pos. 4 | J2/pos. 9 | |
|---|---|---|
| 0 | 0 | OK |
| 0 | 1 | DBR FAULT. Recovery fault |
| 1 | 0 | OVER TEMP. Overtemperature |
| 1 | 1 | Not Used |

### 2.11.1 Limit Switches/Expansion Wiring

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.

**Fig. 2.10 - Limit Switches Wiring**



**Tab. 2.20 - Module - J3 Connector - Limit Switches (When EBM Expansion Is Not Present)**
Panel side: Sub-D with 15 female contacts
Wiring side: Sub-D with conductive shell, 15 male solder contacts

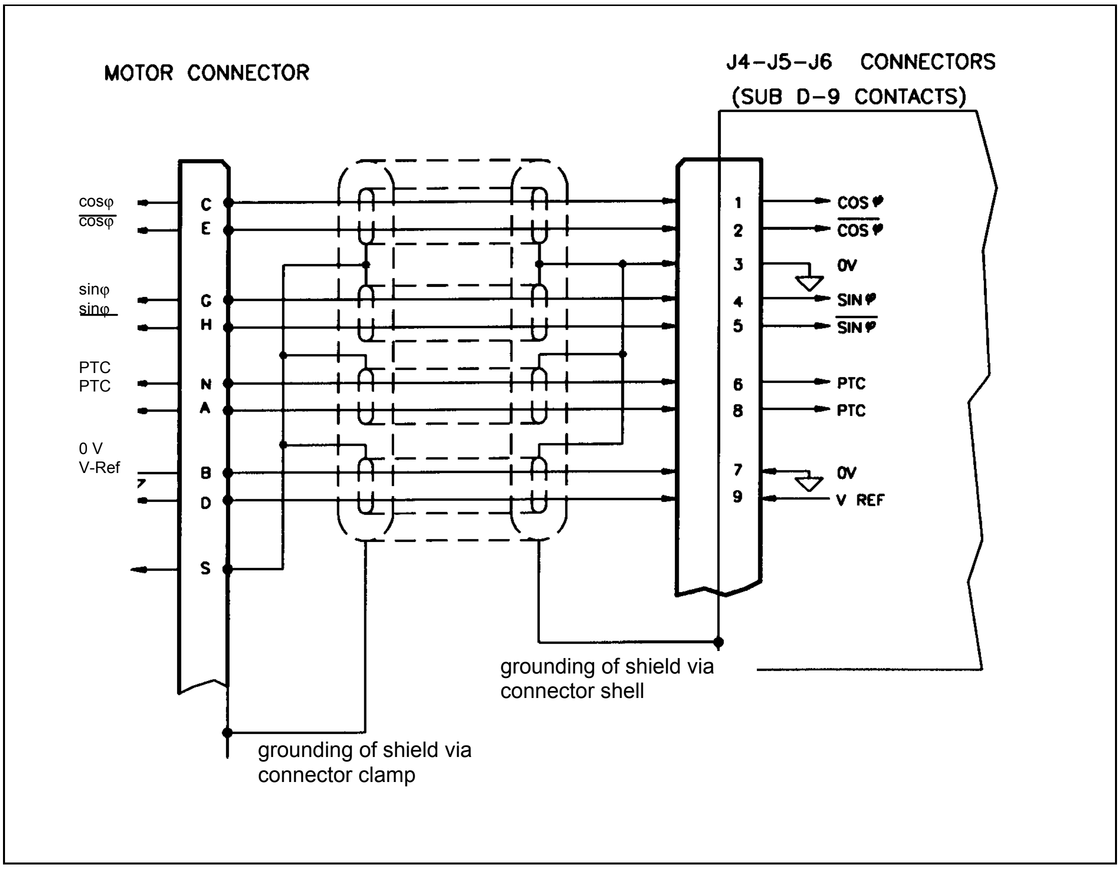
| Pos. | |
|---|---|
| 1 | 0V common |
| 2 | CW limit switch, axis 1 |
| 3 | N.C. |
| 4 | N.C. |
| 5 | CCW limit switch, axis 1 |
| 6 | CW limit switch, axis 2 |
| 7 | N.C. |
| 8 | N.C. |
| 9 | N.C. |
| 10 | N.C. |
| 11 | N.C. |
| 12 | CCW limit switch, axis 2 |
| 13 | CW limit switch, axis 3 |
| 14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

**Tab. 2.21 - Module/Expansion - J3 Connector - Expansion Connection**
Panel side: Sub-D with 15 female contacts
Wiring side: Sub-D with conductive shell, 15 male solder contacts

| Pos. | |
|---|---|
| 1 | 0V common |
| 2 | Auxiliary voltages referred to logic 0V not OK signal |
| 3 | Phase U reference current signal |
| 4 | Torque enabled signal |
| 5 | Short circuit signal |
| 6 | Overtemperature signal |
| 7 | Expansion present signal |
| 8 | Overtemperature signal |
| 9 | N.C. |
| 10 | Phase V reference current signal |
| 11 | Overtemperature signal |
| 12 | N.C. |
| 13 | BUS BAR fault signal |
| 14 | Auxiliary voltages referred to - HV (540/620 Vdc) not OK signal |
| 15 | N.C. |

## 2.11.2 Resolver Wiring

### Fig. 2.11 - Resolver Wiring




| RESOLVER CONNECTOR, MOTOR SIDE | | |
|---|---|---|
| Signal Type | FAS T/ FAS K | FAS N |
| | Pos. | Pos. |
| cosφ | C | 1 |
| $\overline{\cos\varphi}$ | E | 2 |
| V-Ref | D | 10 |
| 0V | B | 7 |
| PTC | N | 8 |
| PTC | A | 9 |
| sinφ | G | 11 |
| $\overline{\sin\varphi}$ | H | 12 |
| shield | S | 3 |

Each DBM module can be connected up to 3 resolvers. Axis 1 resolver must be connected to J4 M1 connector, axis 2 resolver to J5 M2 and axis 3 resolver to J6 M3.
Figure 2.11 shows the wiring lay-out of the resolver with differential output.
We recommend to use 4 pair cables, each pair twisted and individually shielded with an independent overall shield. 20 AWG (0.60 $mm^2$) or 22 AWG (0.38 $mm^2$) wire with low capacitance can be used. We suggest to use ground connections as shown in Fig. 2.11.
Cable length should not exceed 30 m (100 ft.). It is recommended that the signal cable and power cable be separated, if possible, through the use of independent duct (conduit) or by a distance of 12 inches (30 cm).
See Section 3 for shielding procedures according to EMC Directive.

**Tab. 2.22 J4-J5-J6 Connectors - Resolvers**
Panel side: Sub-D with 9 female contacts
Wiring side: Sub-D with conductive shell, 9 male solder contacts

| Pos. | Name | |
|---|---|---|
| 1 | cos | Differential cos signal non-inverted input |
| 2 | $\overline{\text{cos}}$ | Differential cos signal inverted input |
| 3 | Shield | Internally connected to 0V common |
| 4 | sin | Differential sin signal non-inverted input |
| 5 | $\overline{\text{sin}}$ | Differential sin 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) |

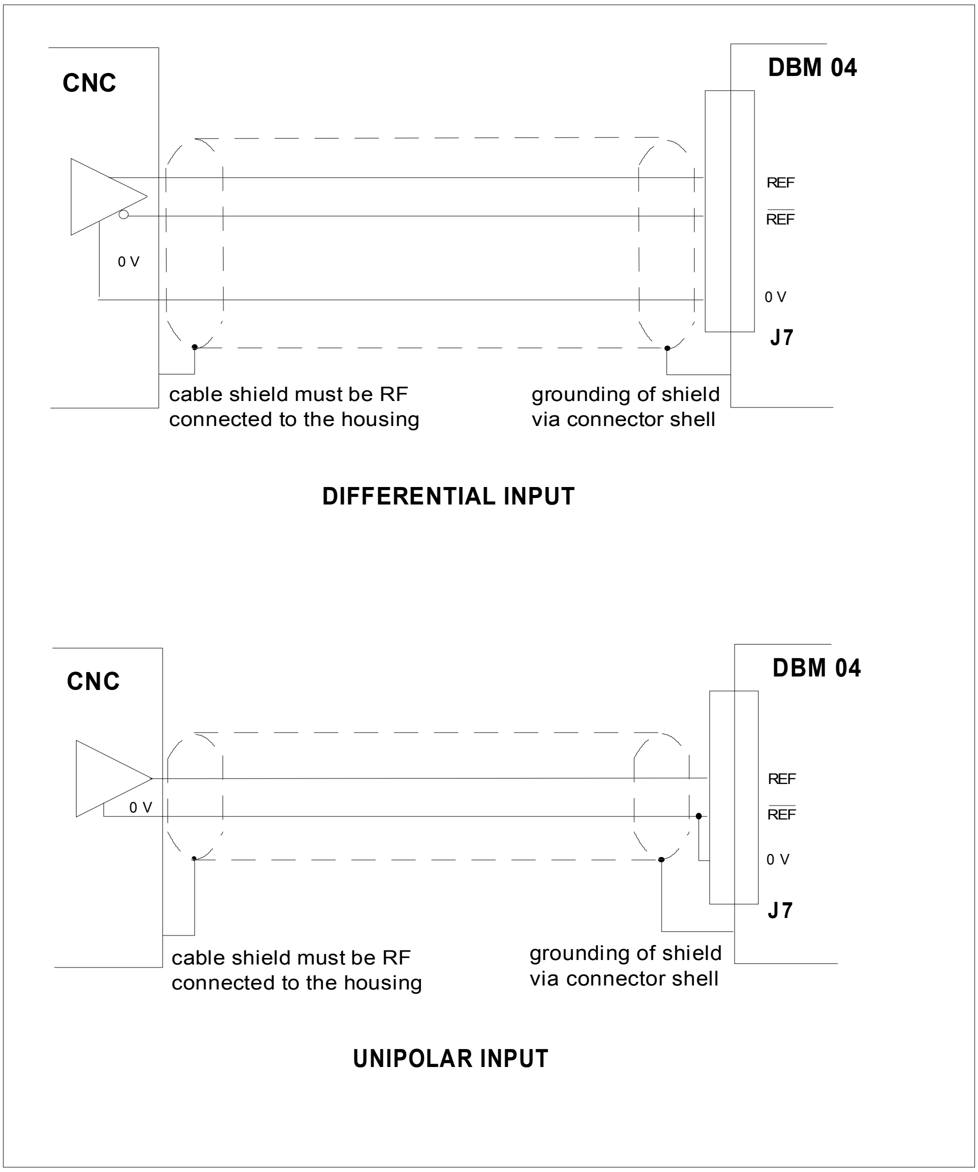
### 2.11.3 I/O Wiring

All the signal cables must be separated from power cables by a distance ≥30 cm.
See Section 3 for shielding procedures according to EMC Directive.

*REMARKs:*

- *DRIVE OK (J7 connector): 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.*
- *SIMULATED ENCODER SIGNALS (J7 connector):*
  *- in specially 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.*
  *- for lengths in excess of 5 m (16 ft.) the cable must have 3 pairs, each pair twisted.*

### Fig. 2.12 - Speed Reference Wiring



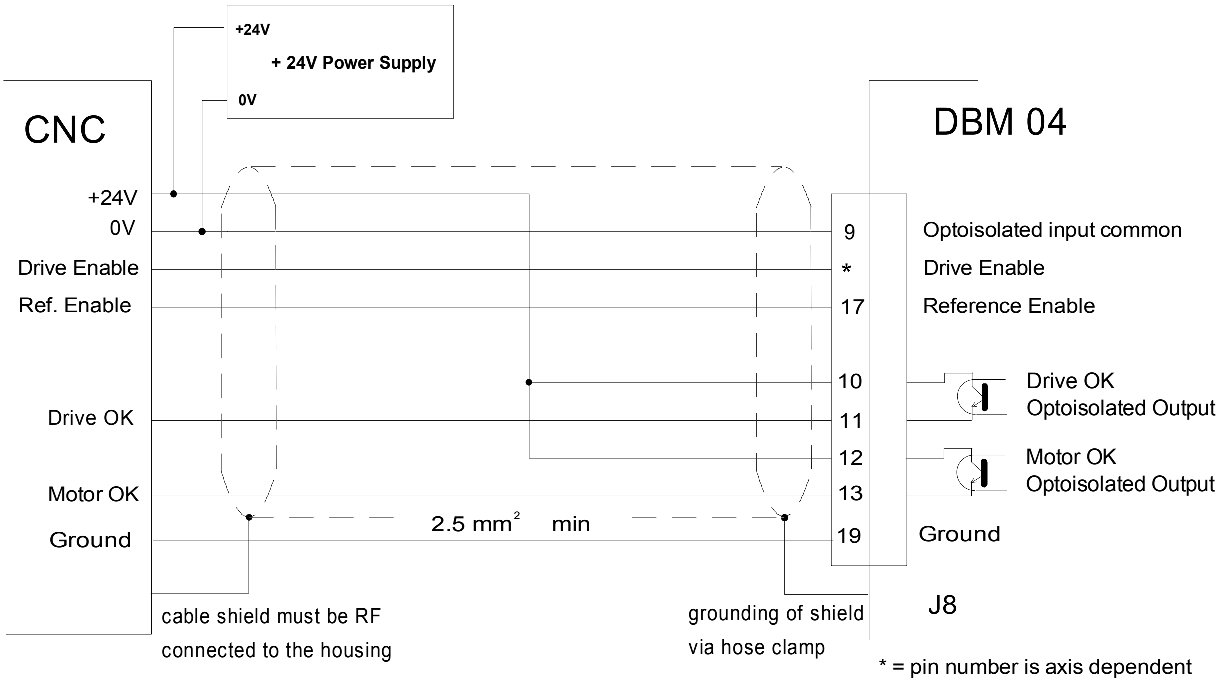
**Tab. 2.23 - J7 Connector - I/O Commands, Signals and Encoder Outputs**
Panel side: Sub-D with 37 female contacts
Wiring side: Sub-D with conductive shell, 37 male solder contacts

| **Pos.** | **Name** | |
|---|---|---|
| 1 | 0V | 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 Current Limit input axis 3<br>0V = zero current<br>+10V (or not connected) = max current |
| 13 | ILIMIT2 | Analog Current Limit input axis 2<br>(0 to +10V ) |
| 14 | ILIMIT1 | Analog Current Limit input axis 1<br>(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. 2.12 |
| 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. 2.12 |
| 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. 2.12 |
| 19 | +15V | +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 |

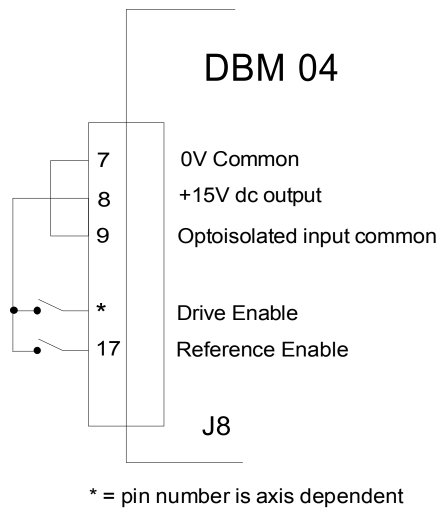
| | | |
|---|---|---|
| 30 | | Shield. Internally connected to 0V |
| 31 | DRIVE OK 1 * | Drive OK output, axis 1. Imax=5mA.<br>0V=not OK<br>+5V=OK |
| 32 | DRIVE OK 2 * | Drive OK output, axis 2. Imax=5mA.<br>0V=not OK<br>+5V=OK |
| 33 | DRIVE OK 3 * | Drive OK output, axis 3. Imax=5mA.<br>0V=not OK<br>+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. 2.12 |
| 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. 2.12 |
| 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. 2.12 |
| 37 | -15V | - 15Vdc output (I max = 30mA) |

* Note: $\overline{\text{I LIMIT}}$ inputs available on request instead of DRIVE OK outputs

### Fig. 2.13 - Input/Output Wiring




+ 24V POWER SUPPLY




+ 15V INTERNAL SUPPLY
(for drive test)

**Tab. 2.24 - J8 Connector - I/O Commands and Signals**
Panel side: shrouded open end header with 20 male contacts
Wiring side: connector with 20 female contacts, screw termination

| Pos. | Name | |
|---|---|---|
| 1 | TACHO TEST 1 | tachometer output, axis 1. Range: (ET*/10)V for max speed |
| 2 | TACHO TEST 2 | tachometer output, axis 2. Range: (ET*/10)V for max speed |
| 3 | TACHO TEST 3 | tachometer output, axis 3. Range: (ET*/10)V for max speed |
| 4 | ANALOG OUT 1 | analog output 1. See Tab. 2.25/26 and ES, SO commands |
| 5 | ANALOG OUT 2 | analog output 2. See Tab. 2.25/26 and ES, SO commands |
| 6 | ANALOG OUT 3 | max current output, axis 3 (100% of max current = 10V) |
| 7 | 0L | logic 0V |
| 8 | +15V | +15Vdc output (Imax = 30mA) |
| 9 | OPTO 0V | Optoisolated 0V |
| 10 | DRIVE OK | Collector of Drive OK optoisolator (see Fig.2.13) |
| 11 | $\overline{\text{DRIVE OK}}$ | Emitter of Drive OK optoisolator (see Fig.2.13) |
| 12 | MOTOR OK | Collector of Motor OK optoisolator (see Fig.2.13) |
| 13 | $\overline{\text{MOTOR OK}}$ | Emitter of Motor OK optoisolator (see Fig.2.13) |
| 14 | DRIVE EN1 | Drive enable 1: optoisolated input for axis 1 torque enable. See Fig. 2.13 |
| 15 | DRIVE EN2 | Drive enable 2: optoisolated input for axis 2 torque enable. See Fig. 2.13 |
| 16 | DRIVE EN3 | Drive enable 3: optoisolated input for axis 3 torque enable. See Fig. 2.13 |
| 17 | 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) |
| 18 | REM RESET | Remote reset: optoisolated input for logic section reset, equivalent to push button on the front panel |
| 19 | GROUND | Ground. It must be connected to CNC ground with 2.5 $mm^2$ wire as short as possible |
| 20 | GROUND | Ground (connected to 19) |

* default ET=80

**Tab. 2.25 - ANALOG OUT - ADDRESS SETTING (SO COMMAND)**

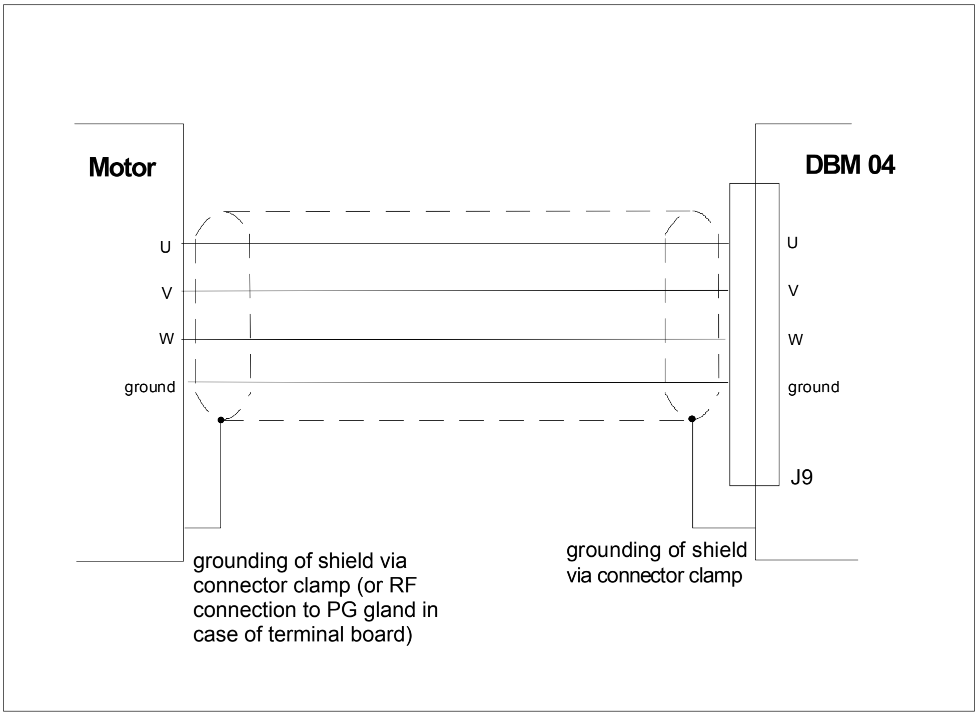
| SO | Address | SO | Address | SO | Address |
|---|---|---|---|---|---|
| **1SO** | Analog Out 1 first module | **4SO** | Analog Out 1 second module | **7SO** | Analog Out 1 third module |
| **2SO** | Analog Out 2 first module | **5SO** | Analog Out 2 second module | **8SO** | Analog Out 2 third module |

**Tab. 2.26 - ANALOG OUT - OUTPUT SETTING (SO COMMAND)**

| SO | Max Current | SO | Velocity Reference | SO | Velocity Error |
|---|---|---|---|---|---|
| **SO1** | axis 1 | **SO4** | axis 1 | **SO7** | axis 1 |
| **SO2** | axis 2 | **SO5** | axis 2 | **SO8** | axis 2 |
| **SO3** | axis 3 | **SO6** | axis 3 | **SO9** | axis 3 |

### 2.11.4 Motor Phases Wiring

**Fig. 2.14 - Motor Phases Wiring (only one axis shown)**




All the motor phases must be connected from J9 connector(s) to motor connector(s). Note that M1 always corresponds to the more powerful axis, while M3 must not be connected in 2 axis configuration.
There several motor power connections, depending on module configuration (see Tab.2.27 and Tab.2.28).
See Section 3 for shielding procedures according to EMC Directive.

***CAUTION**: the resolver wiring must match the motor wiring, i.e. the resolver cable running from M1 motor must be connected to J4 M1 connector, the resolver cable running from M2 motor must be connected to J5 M2 connector, the resolver cable running from M3 motor must be connected to J6 M3 connector.*

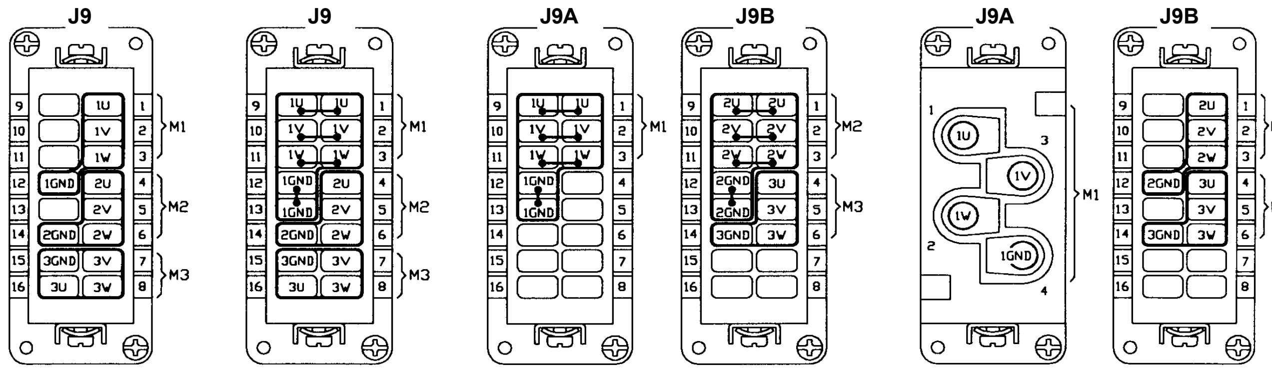
***CAUTION**: the U-V-W motor phase sequence of the connector at the drive side must match the U-V-W motor phase sequence of the connector at the motor side.*

***CAUTION**: do not parallel power connection cables to achieve requested section: this will increase the capacitance value at levels that may irreversibly damage the drive. If the value of capacitance of motor and cables, seen from drive output, exceeds 30 nF it is necessary to verify with Moog technicians the need of an adequate choke in series.*

## Tab. 2.27 - J9 Connector(s) - Motor Phases (1/2)

16 pins connector: Mod.No. Han16E by Harting Kgaa
4 pins connector: Mod.No.HanK 4/0 by Harting Kgaa
See Par.2.7 for sizing of power wires, tightening torque and wire stripping length

### Wiring side connector view and DBM04 Configurations




| M1 | M2 | M3 |
|---|---|---|
| 3/9 | 3/9 | 3/9 |
| 6/15 | 3/9 | 3/9 |
| 8/22 | 3/9 | 3/9 |
| 15/42 | 3/9 | 3/9 |
| 6/15 | 6/15 | 3/9 |
| 8/22 | 6/15 | 3/9 |
| 15/42 | 6/15 | 3/9 |
| 8/22 | 8/22 | 3/9 |
| 15/42 | 8/22 | 3/9 |
| 15/42 | 15/42 | 3/9 |
| 6/15 | 6/15 | 6/15 |
| 8/22 | 6/15 | 6/15 |
| 15/42 | 6/15 | 6/15 |
| 8/22 | 8/22 | 6/15 |
| 15/42 | 8/22 | 6/15 |
| 8/22 | 8/22 | 8/22 |
| 15/42 | 8/22 | 8/22 |
| 15/42 | 15/42 | 6/15 |
| 15/42 | 15/42 | 8/22 |
| 15/42 | 15/42 | 15/42 |
| 3/9 | 3/9 | |
| 6/15 | 3/9 | |
| 8/22 | 3/9 | |
| 15/42 | 3/9 | |
| 6/15 | 6/15 | |
| 8/22 | 6/15 | |
| 15/42 | 6/15 | |
| 8/22 | 8/22 | |
| 15/42 | 8/22 | |
| 15/42 | 15/42 | |

| M1 | M2 | M3 |
|---|---|---|
| 25/70 | 3/9 | 3/9 |
| 25/70 | 6/15 | 3/9 |
| 25/70 | 8/22 | 3/9 |
| 25/70 | 15/42 | 3/9 |
| 25/70 | 6/15 | 6/15 |
| 25/70 | 8/22 | 6/15 |
| 25/70 | 15/42 | 6/15 |
| 25/70 | 8/22 | 8/22 |
| 25/70 | 15/42 | 8/22 |
| 25/70 | 15/42 | 15/42 |
| 25/70 | 3/9 | |
| 25/70 | 6/15 | |
| 25/70 | 8/22 | |
| 25/70 | 15/42 | |

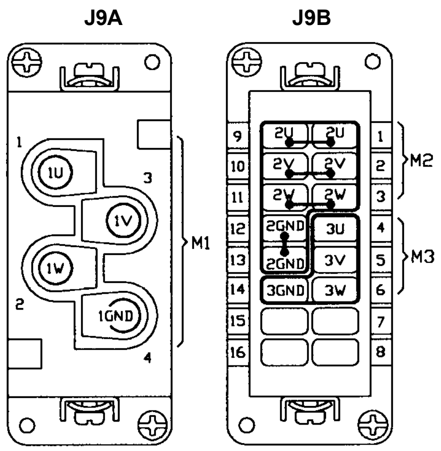
| M1 | M2 | M3 |
|---|---|---|
| 25/70 | 25/70 | 3/9 |
| 25/70 | 25/70 | 6/15 |
| 25/70 | 25/70 | 8/22 |
| 25/70 | 25/70 | 15/42 |
| 25/70 | 25/70 | |

| M1 | M2 | M3 |
|---|---|---|
| 35/90 | 3/9 | 3/9 |
| 35/90 | 6/15 | 3/9 |
| 35/90 | 8/22 | 3/9 |
| 35/90 | 15/42 | 3/9 |
| 35/90 | 6/15 | 6/15 |
| 35/90 | 8/22 | 6/15 |
| 35/90 | 8/22 | 8/22 |
| 35/90 | 15/42 | 6/15 |
| 35/90 | 15/42 | 8/22 |
| 35/90 | 15/42 | 15/42 |
| 35/90 | 3/9 | |
| 35/90 | 6/15 | |
| 35/90 | 8/22 | |
| 35/90 | 15/42 | |

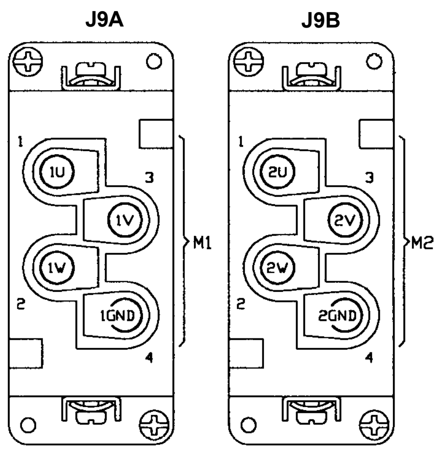
## Tab.2.28 - J9 Connector(s) - Motor Phases (2/2)

16 pins connector: Mod.No. Han16E by Harting Kgaa
4 pins connector: Mod.No.HanK 4/0 by Harting Kgaa
See Par.2.7 for sizing of power wires, tightening torque and wire stripping length

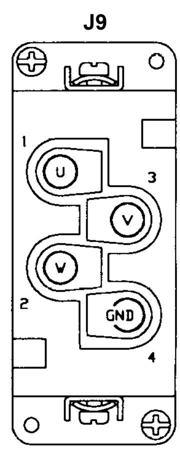
### Wiring side connector view and DBM04 Configurations




| M1 | M2 | M3 |
|---|---|---|
| 35/90 | 25/70 | 3/9 |
| 35/90 | 25/70 | 6/15 |
| 35/90 | 25/70 | 8/22 |
| 35/90 | 25/70 | |




| M1 | M2 |
|---|---|
| 35/90 | 35/90 |




| EBM |
|---|
| 50/140 |
| 60/180 |

## 2.12 Module - Led's

### Tab. 2.29 - Module - Led's

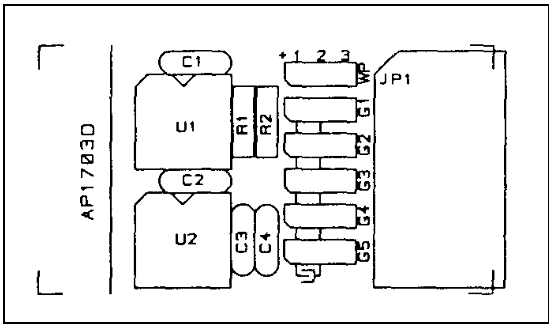
| Name | Function |
|---|---|
| Red LED DRF | generic fault: the fault can correspond, according to the type, to a LED on the front end; if other red LED's are not on, out of the considered one, it is necessary to interrogate the drive via serial link to know the fault reason (see FA command) |
| Red LED WTD | Watch dog - signal; microprocessor circuit faults; this LED is on during reset |
| Red LED RF1 | Resolver 1 fault - signal; resolver M1 fault, sin /cos signals interrupted, short circuit between signals or 10kHz carrier abnormal |
| Red LED RF2 | Resolver 2 fault - signal; resolver M2 fault, sin /cos signals interrupted, short circuit between signals or 10kHz carrier abnormal |
| Red LED RF3 | Resolver 3 fault - signal; resolver M3 fault, sin /cos signals interrupted, short circuit between signals or 10kHz carrier abnormal |
| Red LED OT1 | Motor M1 overtemperature |
| Red LED OT2 | Motor M2 overtemperature |
| Red LED OT3 | Motor M3 overtemperature |
| Red LED DR.OVT | Module overtemperature |
| Red LED PWRF1 | Intelligent Power Module axis 1 fault |
| Red LED PWRF2 | Intelligent Power Module axis 2 fault |
| Red LED PWRF3 | Intelligent Power Module axis 3 fault |
| Green LED REF.EN | Reference enable |
| Green LED DR.EN 1 | Axis 1 enable (see also ON command) |
| Green LED DR.EN 2 | Axis 2 enable (see also ON command) |
| Green LED DR.EN 3 | Axis 3 enable (see also ON command) |
| Green LED PWR OK | Auxiliary power OK |

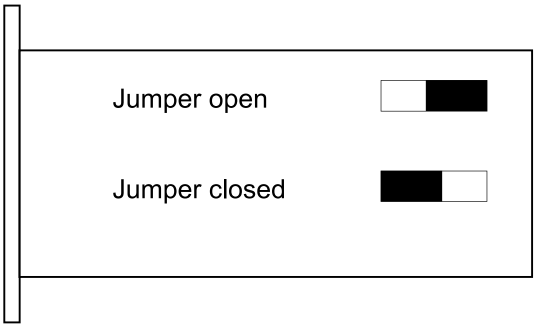
## 2.13 Personality Card Jumpers

**WP (default: open)**: if closed, the EEPROM is write protected and the Save (SV) command is 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 "keypad"
**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. 2.15 - Personality Card**




### 2.13.1 G2 Jumper: "Keypad" or "Opto" Priority

The jumper G2 on the personality card gives priority to keypad or to opto to execute "Drive Enable" command. " Drive Enable" opto isolated signals are connected to J8/ pos.13, 14, 15.

**G2 open** = keypad priority = the keypad (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.

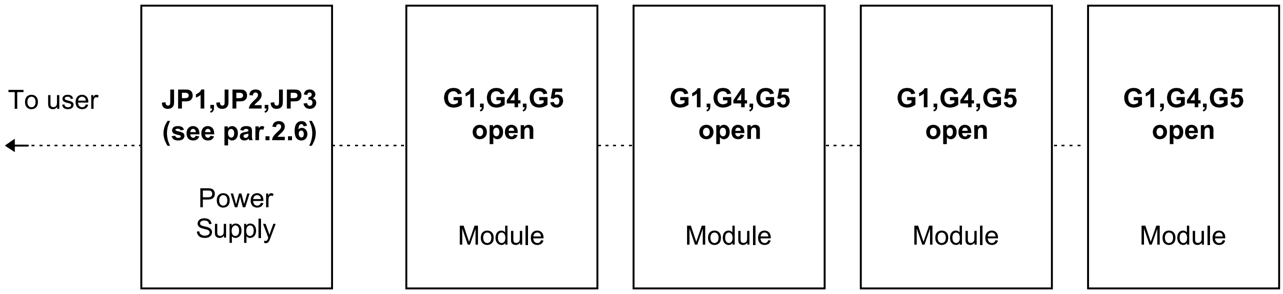
**G2 closed** = opto priority = the optocouplers are the master and the keypad can only be used for parameters setup.

Note:
1. See par.2.16.1 if the keypad does not communicate with the drive
2. "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".

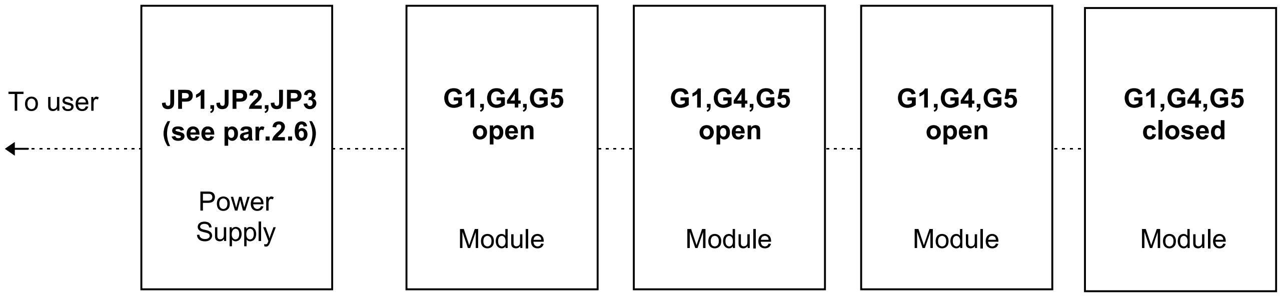
### 2.13.2 G1-G4-G5 Jumpers: Link Termination's

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**




### 2.13.3 G3 Jumper: Basic Configuration

The jumper G3 on the personality card allows, if closed, to set 9600 Baud rate and basic address 1. This configuration can be used to restore the communication in case of fault of the serial link. When the communication has been restored, the G3 jumper must be open.

### 2.13.4 WP Jumper: Write Protection

The jumper WP on the personality card allows, if closed, to write protect the EEPROM. If closed, the Save (SV) command is disabled.

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

## 2.14 Potentiometer/Button

**Tab. 2.30 - Potentiometer/Button**

| | |
|---|---|
| I LIMIT POTENTIOMETER | Peak current control.<br>A full CCW rotation will set the current to zero.<br>A full CW rotation will set the current to 100%. |
| RESET BUTTON | Digital control card reinitialization and reset of protections. |

## 2.15 Input/Output Characteristics

**Tab. 2.31 - Input/Output Characteristics**

| | |
|---|---|
| OPTOISOLATED INPUTS<br>Drive enable 1,2,3<br>Reference enable<br>Remote reset | z in =1.2 kΩ<br>I nom = 10 mA (8 to 20 mA)<br>Vmin = 15Vdc<br>Vmax = 25V |
| OPTOISOLATED OUTPUTS<br>Drive OK/ Motor OK | z out = 1.2 kΩ<br>I max = 20 mA<br>Vnom < 25 Vdc |
| Analog tacho outputs 1,2,3 | z out = 100 Ω<br>I max = 5 mA<br>Range: see ET command<br>Gain error = ±10% over production spread<br>Max linearity error: ±2% over full range |
| Analog Out1<br>Analog Out2 | z out = 100 Ω<br>I max = 10 mA<br>Full scale = ±10V |
| Velocity differential Reference Signals 1,2,3 | z in > 20 kΩ<br>Full scale = ±10V |
| Simulated Encoder differential output signals | z out = 100 Ω<br>Full scale = 7V (RS422/RS485 compatible) |

## 2.16 Serial Link Connection

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

### 2.16.1 Optional Keypad

The keypad is an optional accessory product which can be used for drive setup and monitoring. The keypad must be connected to J10 connector of Power Supply.
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".

### 2.16.2 Connection to Personal Computer

#### 2.16.2.1 RS232/RS485 Full-duplex Converter

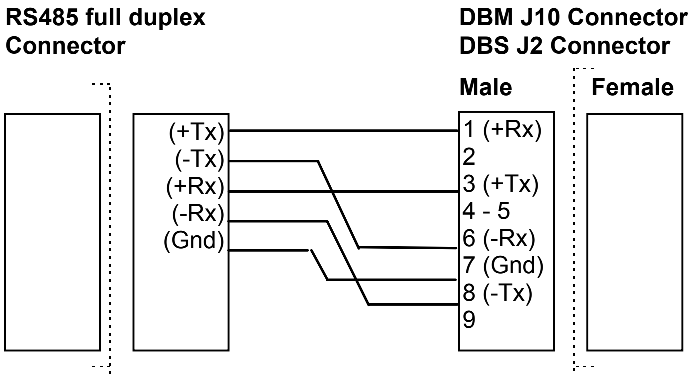
The RS422 interface wiring is based on one-to-one, no multidrop, principle. Four wires are used. With RS422, you can transmit and receive data simultaneously (full-duplex).
The RS485 half-duplex uses only two wires. It allows multidrop communication. With RS485 half-duplex, you cannot transmit and receive simultaneously.
We 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. 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

- An optoisolated PC board RS 485 full-duplex driver can also be used. The following wiring must be used.




### 2.16.2.2 DBTALK Program

- **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**

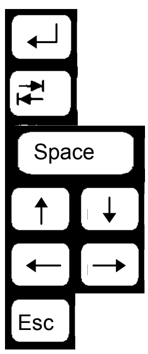
- Insert diskette into drive A or drive B
- Type <a:install> (or <b:install>)

**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
```

- **SETUP** to choose

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

```
PROGRAM SETUP MENU

LANGUAGE
SERIAL LINK

ESC per Chiudere
```

```
PROGRAM SETUP MENU

ITALIANO
ENGLISH

ESC per Chiudere
```

```
PROGRAM SETUP MENU

COM1: at 3F8
COM2: at 2F8

ESC per Chiudere
```

- **UTILITY** to

⇒ Scan Baud rates

ADDRESS AND BAUDRATE AUTOMATIC SCANNING

| C | BAUD | C | BAUD | C | BAUD | C | BAUD | C | BAUD | C | BAUD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9600 | 18 | | 35 | | 52 | | 69 | | 86 | |
| 2 | 9600 | 19 | | 36 | | 53 | | 70 | | 87 | |
| 3 | 9600 | 20 | | 37 | | 54 | | 71 | | 88 | |
| 4 | | 21 | | 38 | | 55 | | 72 | | 89 | |

⇒ Scan Faults

06-17-1996 AUTOMATIC FAULT SCANNING 20:06:40

| C | FAULT DESCRIPTION | C | FAULT DESCRIPTION |
|---|---|---|---|
| A01 | FA000000 P00000 MA000 B000 | | |
| A02 | FA000000 P00000 MA000 B000 | | |
| A03 | FA000000 P00000 MA000 B000 | | |

⇒ 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>**

| SETUP PERSONALITY CARD |
|---|
| COM : FUNCTION SELECTION |
| RESTORE PARAMETER<br>STORAGE PARAMETER |

| FILE SETUP SELECTION | | | | | |
|---|---|---|---|---|---|
| POLI=6/6 RPM=3000 SE=1024 | | | | | |
| DF1 | ST1 | ST5 | ST9 | ST13 | ST17 |
| DF2 | ST2 | ST6 | ST10 | ST14 | ST18 |
| DF3 | ST3 | ST7 | ST11 | ST15 | ST19 |
| DF4 | ST4 | ST8 | ST12 | ST16 | ST20 |

⇒ Set Baud rates

⇒ Start the Autophasing procedure

⇒ Set the "Adjustment of Torque/Speed curve" procedure

- **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**

| | | |
|---|---|---|
| Send Command<br>Driver Answer<br>Communication Status | -- REGULAR -- | 1st ADDRESS[01]]<br><br>SET ADDRESS [01] |

| POWER SUPPLY FAULT | |
|---|---|
| OVERTEMPERATURE<br>BRAKING CIRCUIT<br>220Vac INPUT | |
| PERSONALITY CARD | |

| SELECTED AXIS FAULT | |
|---|---|
| MOTOR OVERTEMPERATURE<br>RESOLVER DISCONNECTED<br>AXIS SHORT CIRCUIT<br>NOT CONGRUENT PHASE<br>VELOCITY ERROR<br>I2T Protection | |

| (A) MODULE FAULT (DBM) | |
|---|---|
| OVERTEMPERATURE<br>BUS BAR VOLTAGE<br>AUX VOLTAGE Ref. - AT | |

| (B) MODULE FAULT (EBM) | |
|---|---|
| OVERTEMPERATURE<br>BUS BAR VOLTAGE<br>AUX VOLTAGE Ref. - AT | |

## ⇒ Display the Status

| Send Command<br>Driver Answer<br>Comunication Status | -- REGULAR -- | 1st ADDRESS[01]]<br>SET ADDRESS [01] |
|---|---|---|

| MODULE STATUS | |
|---|---|
| REFERENCE ENABLE | ON |
| Opto DRIVE OK OUTPUT | OFF |
| PRIORITY (G2 DROP) | KEYBOARD |
| EXPANSION (EBM) | ADVISED |

| SELECTED AXIS STATUS | ENABLED |
|---|---|
| DRIVE ENABLE | ON |
| TORQUE ENABLE | OFF |
| REFERENCES | DIGITAL |
| ILIMIT | DIGITAL |
| SYSTEM CONTROL | VELOCITY |
| ROTATION | C.CLOCKWISE |

| SPARE OUTPUT | |
|---|---|
| ANALOG OUT 1 | EV AXIS 2 |
| ANALOG OUT 2 | IOUT AXIS 3 |

| (B) MODULE FAULT (EBM) | |
|---|---|
| OVERTEMPERATURE<br>BUS BAR VOLTAGE<br>AUX VOLTAGE Ref. - AT | |

## ⇒ See/Change parameters

**To change one parameter type the command string on the PC keyboard. Example: 3VE3000**

| Send Command<br>Driver Answer<br>Communication Status | 3VE3000<br>-- REGULAR -- | 1st ADDRESS[01]<br>SET ADDRESS [03] |
|---|---|---|

MODULE S / REFERENCE EN / Opto DRIVE O / PRIORITY (G2 / EXPANSION ( / SPARE OU / ANALOG OUT 1 / ANALOG OUT 2

| COM | |
|---|---|
| NP | 6 |
| PR | 1 |
| RS | 15168 |
| CP | 1742 |
| VE | 0 |
| VS | 1 |
| DF | 0 |

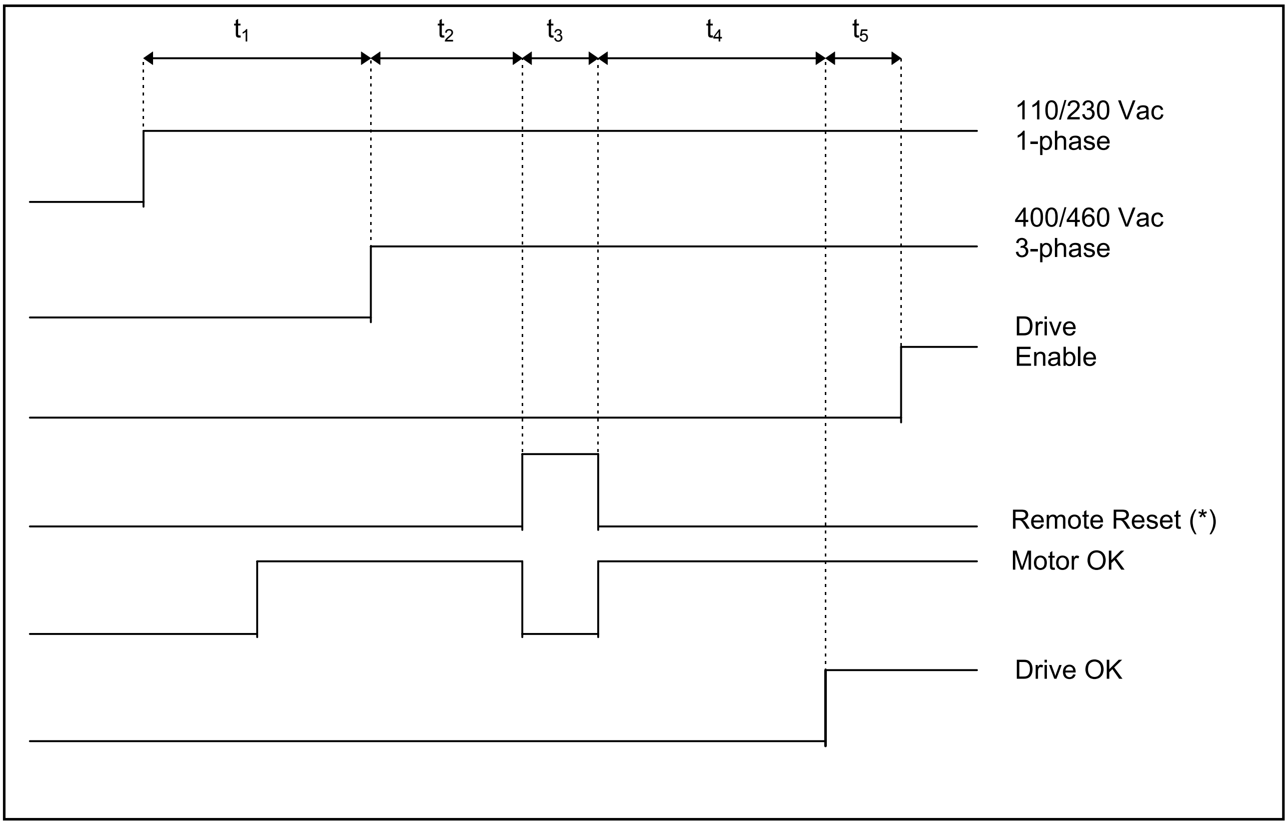
| COM | |
|---|---|
| AC | 0 |
| DE | 0 |
| EV | 0 |
| OV | 128 |
| OC | 128 |
| CU | 128 |
| CV | 128 |

| COM | |
|---|---|
| IT | 7 |
| PC | 50 |
| IL | 100 |
| MV | 3000 |
| MR | 10.0 |
| KI | 20 |
| KP | 80 |

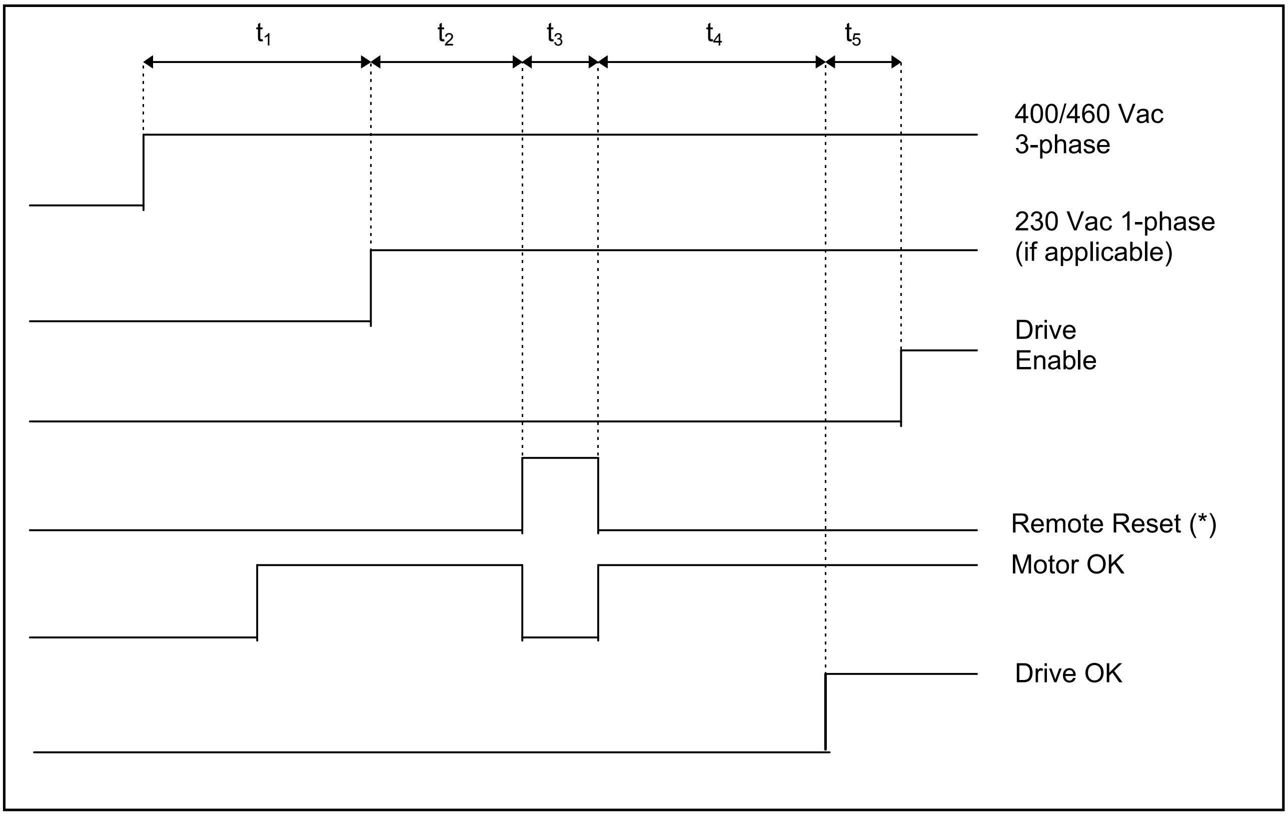
| COM | |
|---|---|
| SE | 1024 |
| RX | 16 |
| RN | 12 |
| ET | 80 |
| ES | 16 |
| BR | 9600 |

## Fig.2.16 - STARTING SEQUENCE - TIMING CHART

**1. PS-Standard and PS-6M:** **$t_1$ = 8 to 10 s, $t_2 \geq$ 1 s, $t_3 \geq$ 20 ms, $t_4$ = 3 s, $t_5 \geq$ 0.5 s**



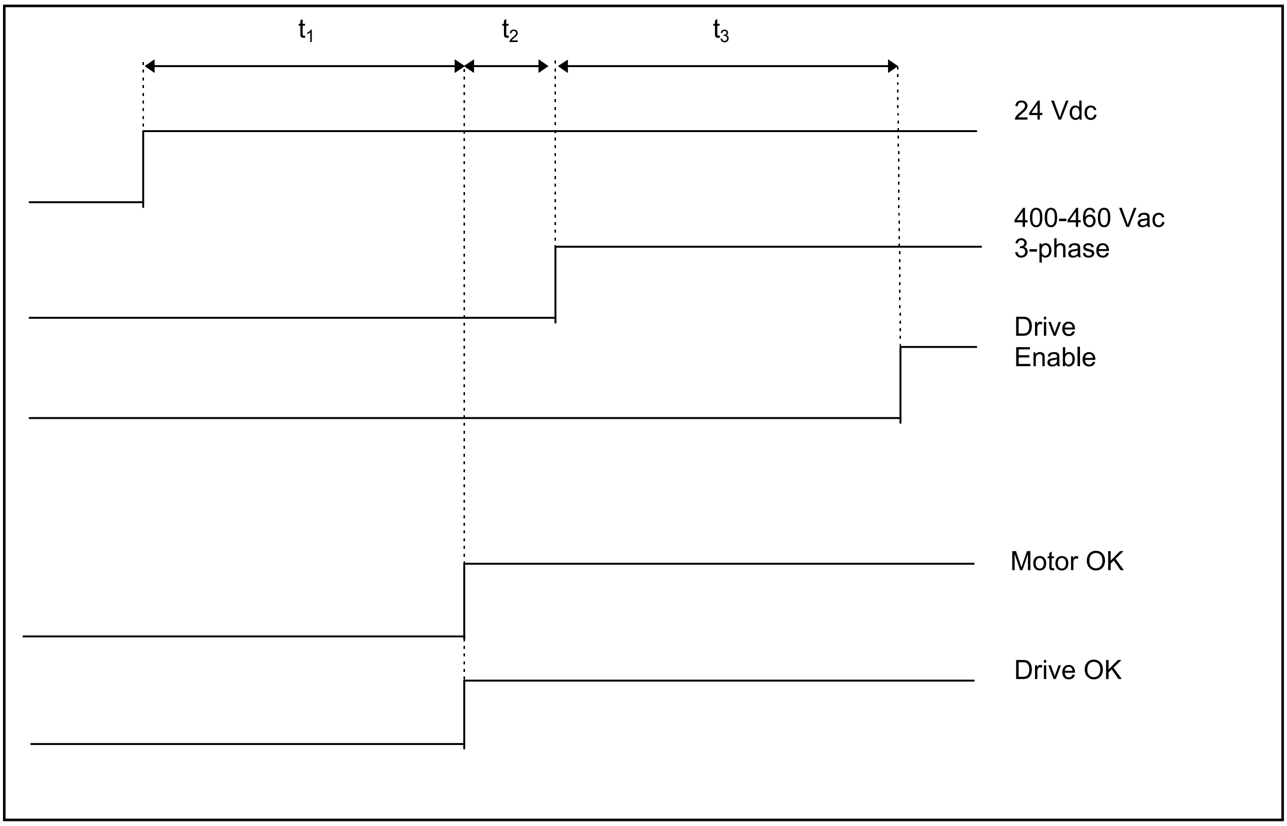

**2. PS-Standalone and PS-120:** **$t_1 \geq$ 20 ms, $t_2 \geq$ 1 s, $t_3 \geq$ 20 ms, $t_4$ = 3 s, $t_5 \geq$ 0.5 s**




*(*) **CAUTION**: the Remote Reset must be a single nonrepetitive signal. Otherwise it must be filtered with 500 Hz cutoff frequency.*

**3. PS-U:** $t_1$ **= 6 s,** $t_2$ **= 2 to 4 s,** $t_3$ **= 4 s**

***WARNING:*** *make sure that the AUX EXT CONTACT (pos.5 and 6 of J12 connector) is connected to 24Vdc before starting.*



## 2.17 Starting Sequence

The starting sequence depends on the type of Power Supply. See Fig.2.16 for the Timing-chart.

* PS-Standalone and PS-120
1. Apply the 400Vac (or 460Vac) three phase power voltage
2. Apply (if applicable) the 230 Vac single phase auxiliary voltage via dedicated transformer

* PS-Standard and PS-6M
1. Apply the 230 Vac (or 110Vac) single phase auxiliary voltage
2. Apply the 400Vac (or 460Vac) three phase power voltage

* PS-U
1. Apply the 24 Vdc auxiliary voltage
2. Apply the 400Vac (or 460Vac) three phase power voltage

***WARNING**: High Voltage - Discharge time approx. 6 minutes.*

- 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 triple-axis or with address 1,2 if double-axis).

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

FROM KEYPAD

| | |
|---|---|
| 1 SA 4 <CR> | Assign basic address 4 to the second module |
| 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), MR (max reference) and other required 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).

### 2.17.1 Autophasing

- Check that the motor is free to rotate in both directions.
- Check that no fault condition occurs (red drive-fault leds off).
- The jumper G2 on the personality card must be open.
- 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 KEYPAD | |
| 4 PW91 <CR> | Give the password for the 2nd module |
| *PASSWORD ON* | The correct answer is displayed |
| <CR> | Only for optional keypad. |
| 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.

### 2.17.2 Wiring Check

Axes being phased 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 open for keypad 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 KEYPAD | |
| 5 ON <CR> | Enable digital drive-enable for axis 5 |
| ○ | 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 |
| ● | Drive enable led will be off |

### 2.17.3 CNC Priority

With CNC, the following procedures must be followed.

#### 2.17.3.1 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 sent 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.

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

| | |
|---|---|
| FROM KEYPAD | |
| 1 PW91 <CR> | Give the password for the 1st module |
| *PASSWORD ON* | The correct answer is displayed |
| 4 PW91 <CR> | Give the password for the 2nd module |
| *PASSWORD ON* | The correct answer is displayed |
| * AR <CR> | Enable analog reference for all axes |
| 1 SV <CR> | Save the configuration for the 1st module |
| 4 SV <CR> | Save the configuration for the 2nd module |
| 1 ST <CR> | Ask the status for axis 1 |
| *A1 ST___ E___ I_0___* | Displays the axis 1 status. Check the 0 in the 2nd bit after I |
| ... | Repeat ST command and check other axes |

#### 2.17.3.2 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, to solder G2 jumper 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.*

When the above procedure is completed, the CNC is the master and the keypad is the slave, as follows:

| | |
|---|---|
| PARAMETERS MANAGED BY CNC: | drive enable, reference enable, speed references. |
| PARAMETERS MANAGED BY KEYPAD: | all dynamic parameters (acceleration, deceleration, KI, KP, etc.), status and fault. |

### 2.17.4 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.

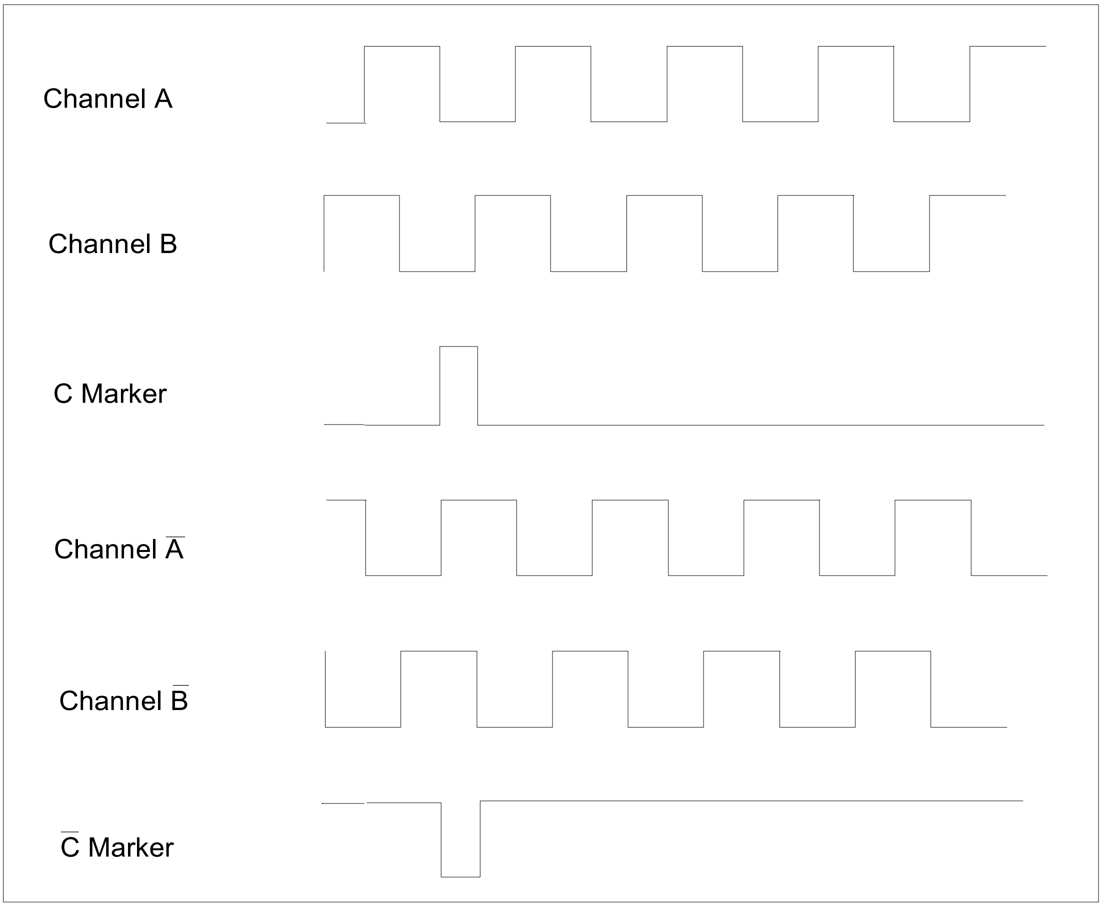
*REMARK: the adjustment of the <u>digital</u> velocity offset must not be used to adjust the analog velocity offset and it is reserved to <u>setup technicians</u>. It can be made by providing 0 digital speed reference (VE=0) and setting OC command. The opto Drive Enable must be high.*

## 2.18 - Resolver To Encoder Option

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 16384 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. 2.17 - Simulated Encoder (CW Rotation When Viewed From Shaft End)**




Note: to make C Marker high when Channel A and Channel B are high (like Siemens), swap Channel A with Channel $\overline{A}$ and Channel B with Channel $\overline{B}$.

### 2.18.1 Setup For Encoder Resolution

The number of pulses per electrical revolution of simulated encoder can be set via SE software command.

Example of a setup for axis 1.

| | |
|---|---|
| FROM KEYPAD | |
| 1 PW91 <CR> | Give the standard password for axis 1 |
| *PASSWORD ON* | The correct answer is displayed |
| <CR> | Only for optional keypad |
| 1 SE 4096 <CR> | Set 4096 ppr to axis 1 |
| 1 SE <CR> | Ask the number of ppr for axis 1 |
| *A01 SIMULATED ENCODER = 4096* | |
| 1 SV <CR> | Save |

*REMARK: the maximum number of pulses per electrical revolution depends on the R/D resolution. See the following Table.*

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.

### 2.18.2 R/D Resolution

The resolution of Resolver to Digital converter will automatically be switched according to actual speed for optimum system performance between minimum (see RN command in the User's Manual) and maximum resolution (see RX command).
The speed range of R/D resolution is included in the following table.

**Tab. 2.32 - 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 |

## 2.19 Mechanical Brake

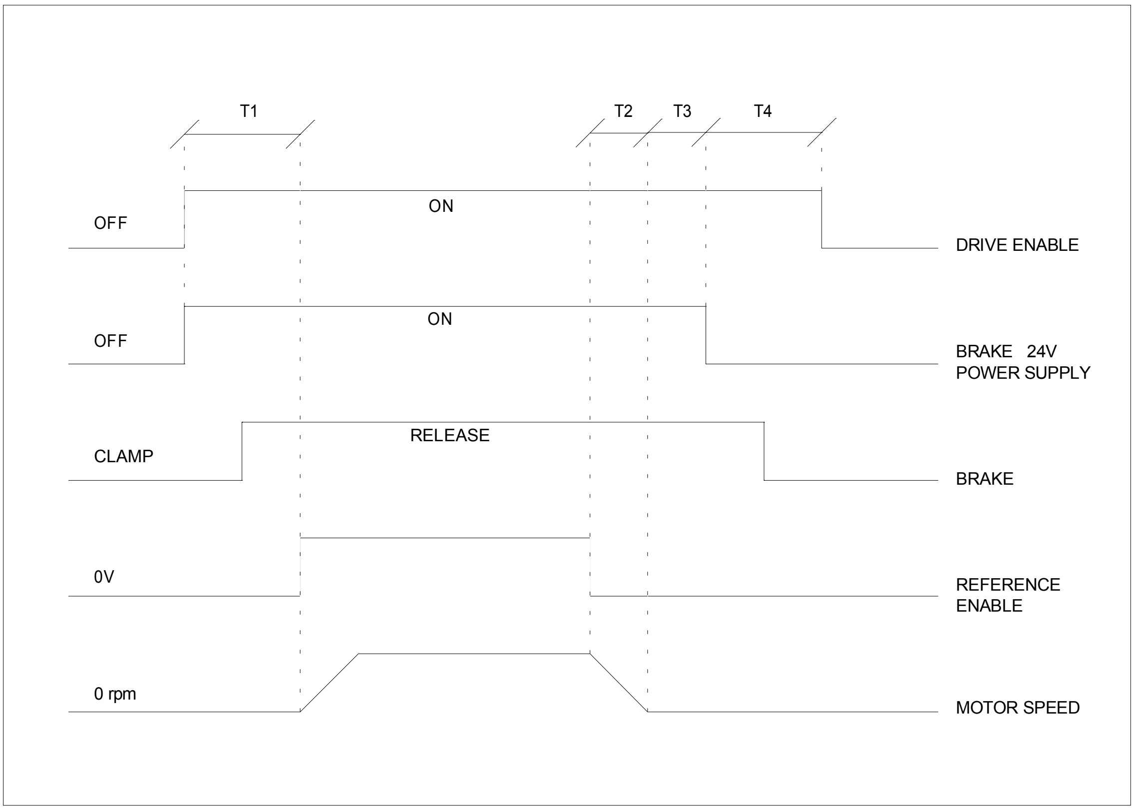
FAS series servomotors have as option a 24 Vdc electromagnetic safety brake.

***CAUTION**: safety brake must be clamped and released with motor at standstill. Premature failure of the brake will result if brake is used for dynamic stopping of the motor.*

The release of the brake (from 0V to +24V) and the clamp (from +24V to 0V) must follow the sequence in Fig. 2.18.

### FIG. 2.18 - BRAKING SEQUENCE, TIMING CHART

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



## 2.20 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 (+HV, -HV and GND) and disconnect all connectors and flat cables.
- Unscrew the anchor screw on the top of the module and remove the module.
  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 keypad or PC all application dependent parameters. In particular: pole number, max velocity, max reference voltage, Ilimit, internal ramp generator.

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# SECTION 3 - ELECTROMAGNETIC COMPATIBILITY (EMC)

## 3.1 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.
DBM04 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 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.

## 3.2 Filtering

The following filters are recommended.

### 3.2.1 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 | DBM04 PS-Standard, PS-Standalone, PS-6M, PS-120 (Aux Pwr) |
| - | Schaffner FN 250-12/07 | (12) | 250 | DBM04 PS-U (Aux Pwr) |
| 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 | DBM04 PS Standard, PS-6M, PS-U and PS-Standalone |
| AT6014 | Schaffner FN 258-75/34 | 75 (85) | 3 x 480 | |
| AT6015 | Schaffner FN 258-100/35 | 100 (120) | 3 x 480 | DBM04 PS120 |

### 3.2.2 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:

- **DBM04 PS-Standard + DBM 04 6-6-6 + DBM 04 6-6-6** and contemporaneity factor of 0.8.

For this application it is not necessary to use the 55A filter of the table.

The reference current is $Iin = 6 * 6 * 0.8 = 28.8$ A

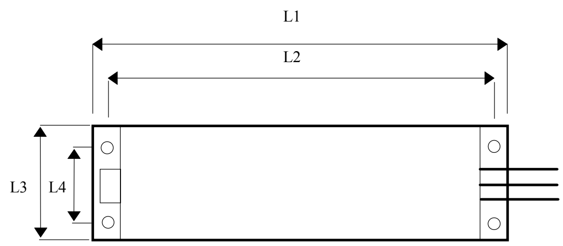
A 30A filter (FN 258-30/7) can safely be used.

### 3.2.3 Filter Dimensions

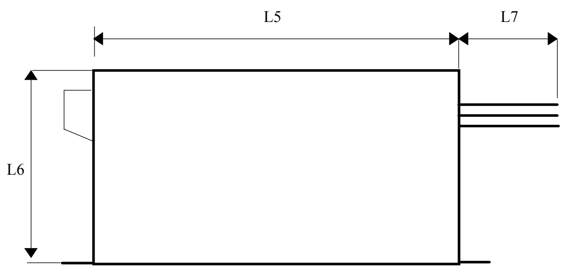
| **Code** | **Trade-mark** | **Dimensions [mm]** | | | | | | | **Weight** |
|---|---|---|---|---|---|---|---|---|---|
| | | **L1** | **L2** | **L3** | **L4** | **L5** | **L6** | **l7** | **[kg]** |
| AT6008 | Schaffner FN 250-6/07* | 85 | 75 | 54 | 0 | 65 | 30 | 300 | 0.24 |
| | Schaffner FN 250-12/07* | 85 | 75 | 54 | 0 | 65 | 40 | 300 | 0.31 |
| 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 and 12/07 filters have wiring leads (length=300mm) at both sides.

**TOP VIEW**




**SIDE VIEW**



### 3.2.4 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:

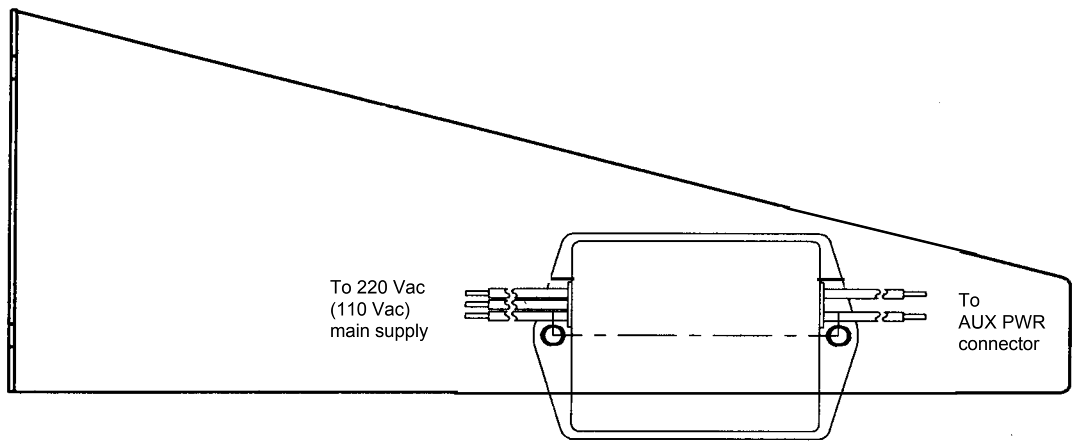
| FILTER | Max torque |
|---|---|
| FN 250 - 6/07 | 0.8 Nm |
| FN 250 - 12/07 | 0.8 Nm |
| FN 258 - 7/07 | 0.8 Nm |
| FN 258 - 16/07 | 0.8 Nm |
| FN 258 - 30/07 | 1.8 Nm |
| FN 258 - 42/07 | 1.8 Nm |
| FN 258 - 55/07 | 3.0 Nm |
| FN 258 - 75/34 | 3.0 Nm |
| FN 258 - 100/35 | 4.0 Nm |

- The filter can produce high leakage currents (see Data Sheets by Schaffner)

- 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*

- The single phase filter can be installed on the left shoulder of the fan housing (Power Supply side), as in the following figure:



## 3.3 Wiring And Grounding

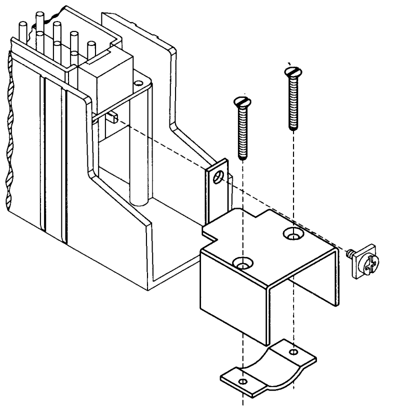
All the following cables must be shielded, with 85% minimum shielding coverage:

- power motor cable (see Fig.3.1 and 3.2)

NOTES: if a power terminal board is used at motor side, the shield must be RF connected 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.3.2.

- resolver cable (see Fig.2.11 and Fig.3.2 motor side)

**Fig. 3.1 - Grounding Of Shield To Motor Connector At Drive Side**



- recovery resistor cable.

***CAUTION****: the recovery resistor cable provided in kit is only for test purposes and not EMC compliant.*

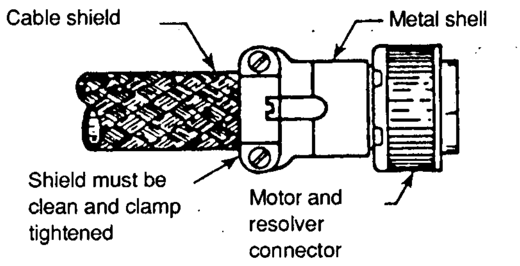
- Reference, Enable and OK cable

- 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. 3.2 - Grounding Of Shield To Connectors At Motor Side**

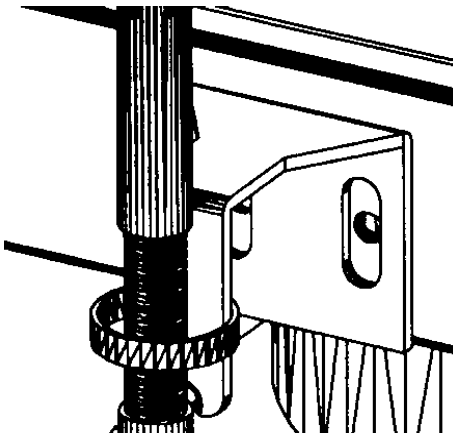



In case of Sub-D connector, cable shield must be grounded to the metallic hood.

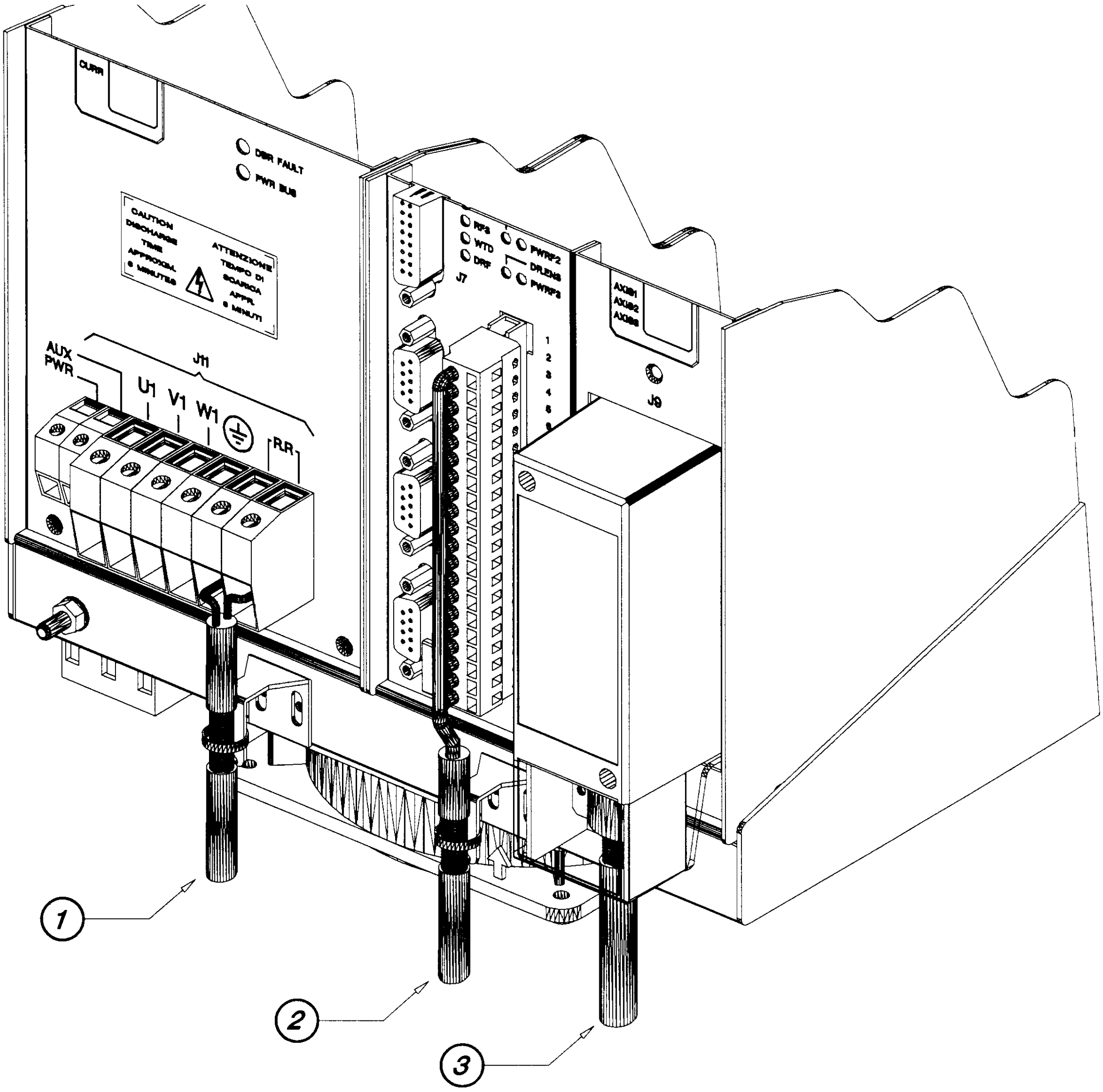
When there is not connector at drive side, a kit with stand-off, screws and hose clamps is provided.

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.3.3.

**Fig. 3.3 - Grounding Of Shield Without Connector**



## Fig. 3.4 - Cable Grounding At Drive Side



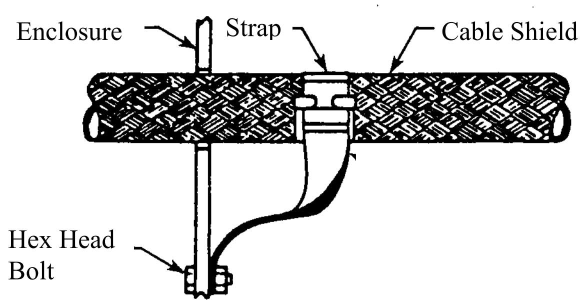

**1 = Recovery resistor cable**
**2 = Reference, Enable, OK cable**
**3 = Motor power cable**

**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.

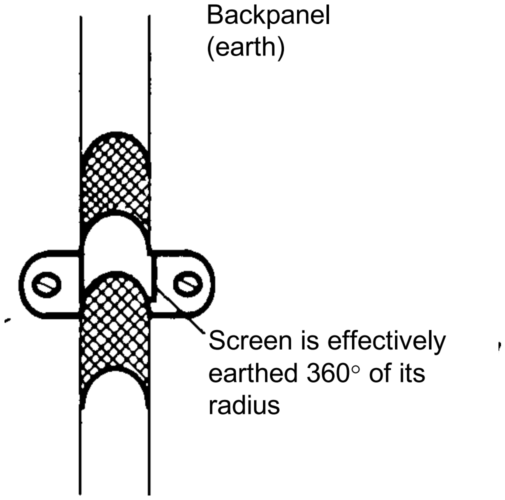
*REMARKs:*
*- the shields of cables inside the cabinet must be 360° clamped to the cabinet wall (see Fig. 3.5).*
*- "noisy" cables must be kept away from "sensitive" cables by at least 30 cm (12 in). Noisy cables include input-power wires, motor power and brake wiring. Sensitive cables include analog 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. 3.6 - 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.3.6).*

**Fig. 3.5 - Clamping To Cabinet**




## 3.4 Recovery Resistor/ Motor Choke

To meet the EMC Directive, the ventilated enclosures containing dynamic braking resistors 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.*

## 3.5 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 (see Fig.1.4).

## 3.6 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 DBM 04 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 Tests of EN 60204-1 (1997), par.19.4, in order to not damage the Y-type capacitors between phases and ground. Moreover the DC voltage dielectric test required by EN 50178 (1997), product family standard, has been carried out in factory as a routine test. The DC Insulation Resistance Tests of EN 60204-1 (1997), par.19.3, may be carried out without disconnecting the drive and the EMC filters.*

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# SECTION 4 - PROTECTIONS

## 4.1 Power Supply

**Recovery not ok.**

Indicated by: LED's DRF (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 circuit 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 (PS-Standard and PS-6M) or 3-phase voltage (PS-Standalone, PS-120 and PS-U)).

**Power supply overtemperature.**

Indicated by: LED's DRF (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 (PS-Standard and PS-6M) or 3-phase voltage (PS-Standalone, PS-120 and PS-U).

## 4.2 Drive Module

**Resolver not ok.**

Indicated by: LED DRF, LED RF1/RF2/RF3 (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 DRF, LED OT1/OT2/OT3, 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.

**Power fault.**

Indicated by: LED DRF, LED PWRF1/PWRF2/PWRF3, optoisolated output DRIVE OK, bit D of the FA string (see FA command).

Set conditions:
1. When a short circuit is detected between motor phases, phase and ground, phase and HV.
2. When overcurrent is detected in motor phases.
3. Overheating of power modules (locked rotor condition).
4. Undervoltage of internal supply of power modules

Effect: the drive inhibit torque.

Reset condition: if the condition is not present anymore, power off and on the power supply. In case of condition 3. (overheating) wait at least 3 minutes before power up the drive.

### Auxiliary voltages not normal

Indicated by: LED DRF, optoisolated output DRIVE OK

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 DRF, 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 DRF, 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.**

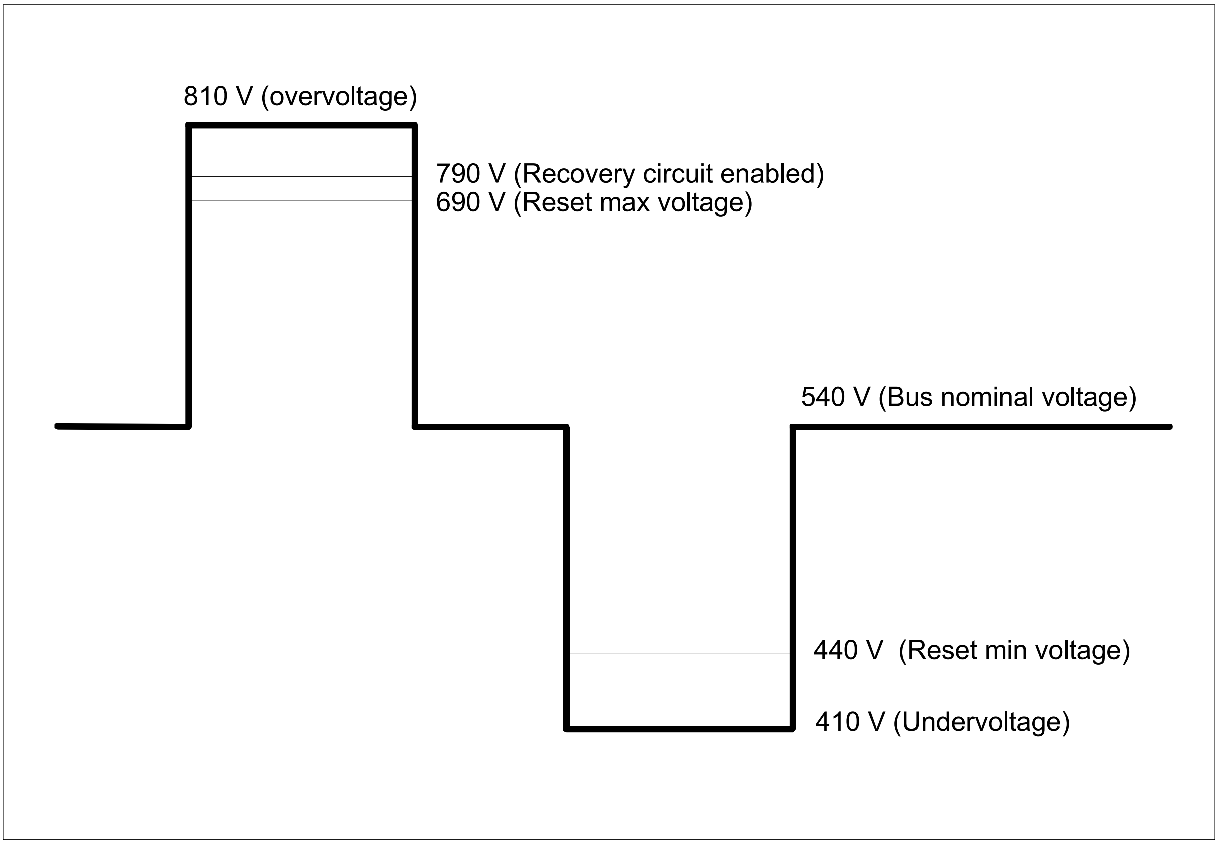
Indicated by: LED DRF, LED POWER OK, optoisolated output DRIVE OK, bit M of the FA string (see FA command).

Set condition: See figure 4.1.

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. 4.1 Bus Bar Voltage**



**Auxiliary HV referred voltages not norm.**

Indicated by: LED DRF, 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.

**Overspeed**

Indicated by: LED DRF, 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.

**Drive overtemperature.**

Indicated by: LED's DRF and DR.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 DRF, bit G of the FA string (see FA command).

Set condition: when the current exceeds the nominal motor current for a time longer than the time stated by the motor thermal model (see IT command and Tab.6.6)

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. To reset the fault status in FA string, push button on drive or send pulse to REM RESET.

**Watchdog.**

Indicated by: LED DRF, 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.

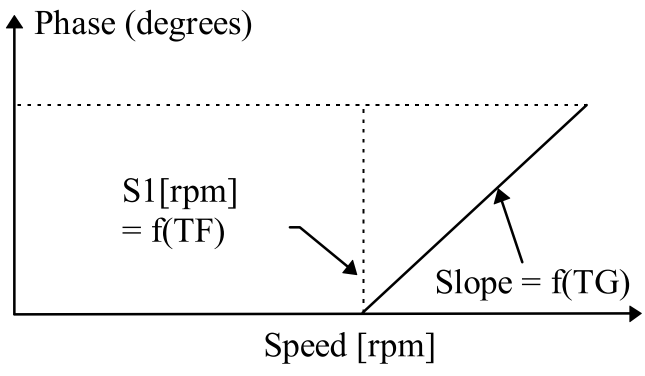
# SECTION 5 - ADJUSTMENT OF TORQUE/SPEED CURVE

In most of the DBM 04 applications, the magneto-motive force (MMF, that is, the stator current vector) is perpendicular to the rotor flux. In such a way, the torque constant ( [Nm] per Ampere) is maximized.
In some applications requiring extremely high speed and high frequency of the stator current, the phase lag caused by the current controller imperfection might degrade the drive torque constant. The current controller implemented within the DBM 04 drive results in a phase lag of 9 degrees at the output frequency of 270 Hz.
Due to the phase lag, the spatial displacement between the rotor flux and the stator MMF will be less than 90 degrees (electrical) and the torque will diminish as the cosine function of the phase lag, and to optimize the Torque/Speed curve.
DBM 04 drive might compensate this phase lag and the lack of torque through the user programmable phase advance. That is, an additional phase advance might be inserted into the drive vector rotator, rendering the possibility to compensate for the current controller phase lag.
Along with the conventional synchronous PM motors, the DBM 04 might run PM motors with pronounced saliency effect ($Ld \neq Lq$) and ensuring reluctance torque. The peak of total electromagnetic torque for this family of PM motors is obtained with flux-MMF angles different that 90 electrical degrees.
For the purpose of maximizing the torque per Amp constant of synchronous reluctance motors, the phase advance in function of the speed and stator current is provided as a standard feature of the DBM 04

### 5.1 Phase-speed relation

According to the requirements, the phase-speed curve equals zero for all the speeds below the speed **S1**[rpm] (see Fig. 5.1). Above that speed, the phase rises with the speed with a constant slope. Hence, two parameters (**TF** and **TG** in the following text) are sufficient for the purpose of customizing the phase-speed demagnetization curve. **TF** parameter will define the speed **S1**[rpm]. From the stall up to the **S1**[rpm], the phase(speed) correction will have the value zero. Above **S1**[rpm], the phase(speed) correction will rise up with the constant slope. This slope is defined by the second, **TG** parameter.

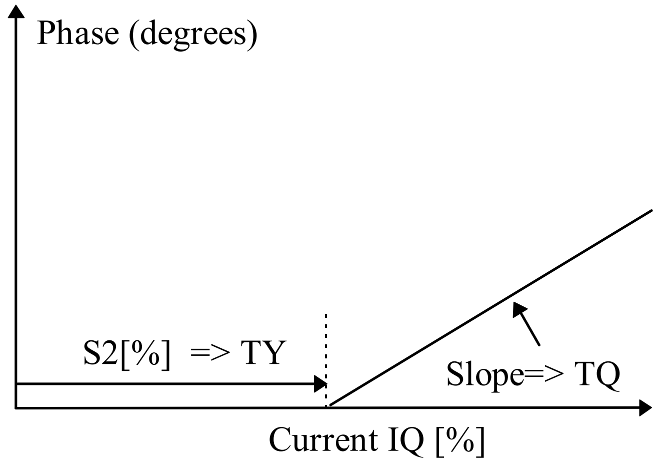
**FIG. 5.1 - PHASE-SPEED CURVE**



### 5.2 Phase-current relation

The phase-current curve is linearly rising or falling for the currents IQ>0, starting at the current level S2[%] defined by the **TY** parameter, with a slope defined by **TQ** parameter.

**FIG. 5.2 - PHASE-CURRENT CURVE**




Hence, the point S2[%] is defined by **TY** parameter. According to requirements, the phase-current curve might increase at a steeper slope for the values of IQ superior to S2[%]. For this purpose, the fourth, **TQ** parameter is provided in order to program the slope of the phase-current curve for the values bigger than S2[%].

### 5.3 Parameters Setting for FAS T-V

To optimize the match between FAST-V brushless servomotors and DBM 04 drive, the following parameters settings have been found to be the best choice. With these parameters the motor provides, at the nominal speed and with nominal voltage - 5% (that is 380$V_{ac}$ for 400$V_{ac}$-and 437$V_{ac}$ for 460$V_{ac}$), a Max Torque <u>from 1.5 to 3 times</u> the Max Torque without the optimization algorithm.

**Tab. 5.1 - Parameters Setting for 400V and 6-pole resolver**

| Motor type | DBM 04 | IL | TF | TG | TY | TQ |
|---|---|---|---|---|---|---|
| **FAS T0 V2 060** | 3/9 | 100 | 60 | 3 | 115 | 19 |
| **V4 060** | 3/9 | 100 | 60 | 3 | 87 | 26 |
| **V8 060** | 6/15 | 100 | 106 | 4 | 127 | 21 |
| | | | | | | |
| **FAS T1 V2 030** | 3/9 | 100 | 38 | 8 | 94 | 22 |
| **V2 060** | 6/15 | 100 | 106 | 4 | 127 | 21 |
| **V4 030** | 6/15 | 100 | 58 | 7 | 166 | 30 |
| **V4 045** | 6/15 | 100 | 88 | 5 | 133 | 22 |
| **"** | 8/22 | 100 | 58 | 5 | 89 | 25 |
| **V6 030** | 6/15 | 100 | 58 | 7 | 127 | 21 |
| **"** | 8/22 | 100 | 42 | 7 | 87 | 19 |
| **V6 045** | 8/22 | 100 | 92 | 6 | 127 | 21 |
| **"** | 15/42 | 88 | 60 | 5 | 66 | 28 |
| **V8 030** | 6/15 | 100 | 60 | 7 | 97 | 14 |
| **"** | 8/22 | 100 | 48 | 7 | 66 | 16 |
| **V8 045** | 15/42 | 100 | 60 | 4 | 74 | 23 |
| | | | | | | |
| **FAS T2 V2 030** | 8/22 | 100 | 32 | 6 | 51 | 22 |
| **V2 045** | 15/42 | 100 | 60 | 5 | 102 | 26 |
| **V4 020** | 8/22 | 100 | 30 | 9 | 76 | 17 |
| **V4 030** | 15/42 | 100 | 36 | 7 | 74 | 17 |
| **V6 020** | 15/42 | 100 | 32 | 12 | 69 | 15 |
| **V6 030** | 15/42 | 100 | 54 | 8 | 66 | 14 |
| **"** | 25/70 | 73 | 54 | 9 | 40 | 22 |
| **V8 020** | 15/42 | 100 | 32 | 8 | 102 | 16 |
| **"** | 25/70 | 65 | 30 | 7 | 61 | 27 |
| **V8 030** | 25/70 | 100 | 52 | 7 | 102 | 16 |
| | | | | | | |
| **FAS T3 V2 020** | 15/42 | 100 | 30 | 7 | 140 | 23 |
| **V2 030** | 25/70 | 100 | 42 | 7 | 135 | 21 |
| **V3 020** | 25/70 | 100 | 28 | 8 | 122 | 20 |
| **V3 030** | 25/70 | 100 | 54 | 9 | 79 | 15 |
| **"** | 35/90 | 100 | 46 | 9 | 61 | 15 |
| **V4 020** | 25/70 | 100 | 36 | 9 | 94 | 19 |
| **V4 030** | 35/90 | 100 | 52 | 7 | 76 | 17 |
| **V6 012** | 25/70 | 100 | 22 | 15 | 112 | 19 |
| **V6 020** | 35/90 | 100 | 30 | 12 | 0 | 9 |
| **V8 012** | 35/90 | 100 | 20 | 16 | 76 | 14 |
| **V8 020** | 50/140 | 100 | 30 | 10 | 0 | 10 |
| **"** | 60/180 | 77 | 30 | 10 | 0 | 13 |

**Tab. 5.2 - Parameters Setting for 400V and 2-pole resolver**

| Motor type | DBM 04 | IL | TF | TG | TY | TQ |
|---|---|---|---|---|---|---|
| **FAS T0 C2 060** | 3/9 | 100 | 20 | 8 | 115 | 19 |
| **C4 060** | 3/9 | 100 | 20 | 10 | 87 | 26 |
| **C8 060** | 6/15 | 100 | 34 | 13 | 127 | 21 |
| | | | | | | |
| **FAS T1 C2 030** | 3/9 | 100 | 12 | 23 | 94 | 22 |
| **C2 060** | 6/15 | 100 | 34 | 13 | 127 | 21 |
| **C4 030** | 6/15 | 100 | 18 | 20 | 166 | 30 |
| **C4 045** | 6/15 | 100 | 28 | 16 | 133 | 22 |
| **"** | 8/22 | 100 | 18 | 14 | 89 | 25 |
| **C6 030** | 6/15 | 100 | 18 | 20 | 127 | 21 |
| **"** | 8/22 | 100 | 14 | 21 | 87 | 19 |
| **C6 045** | 8/22 | 100 | 30 | 19 | 127 | 21 |
| **"** | 15/42 | 88 | 20 | 16 | 66 | 28 |
| **C8 030** | 6/15 | 100 | 20 | 22 | 97 | 14 |
| **"** | 8/22 | 100 | 16 | 22 | 66 | 16 |
| **C8 045** | 15/42 | 100 | 20 | 13 | 74 | 23 |
| | | | | | | |
| **FAS T2 C2 030** | 8/22 | 100 | 10 | 18 | 51 | 22 |
| **C2 045** | 15/42 | 100 | 20 | 16 | 102 | 26 |
| **C4 020** | 8/22 | 100 | 10 | 26 | 76 | 17 |
| **C4 030** | 15/42 | 100 | 12 | 20 | 74 | 17 |
| **C6 020** | 15/42 | 100 | 10 | 37 | 69 | 15 |
| **C6 030** | 15/42 | 100 | 18 | 23 | 66 | 14 |
| **"** | 25/70 | 73 | 18 | 26 | 40 | 22 |
| **C8 020** | 15/42 | 100 | 10 | 25 | 102 | 16 |
| **"** | 25/70 | 65 | 10 | 22 | 61 | 27 |
| **C8 030** | 25/70 | 100 | 16 | 21 | 102 | 16 |
| | | | | | | |
| **FAS T3 C2 020** | 15/42 | 100 | 10 | 22 | 140 | 23 |
| **C2 030** | 25/70 | 100 | 14 | 21 | 135 | 21 |
| **C3 020** | 25/70 | 100 | 8 | 25 | 122 | 20 |
| **C3 030** | 25/70 | 100 | 14 | 26 | 79 | 15 |
| **"** | 35/90 | 100 | 18 | 27 | 61 | 15 |
| **C4 020** | 25/70 | 100 | 12 | 28 | 94 | 19 |
| **C4 030** | 35/90 | 100 | 16 | 21 | 76 | 17 |
| **C6 012** | 25/70 | 100 | 6 | 45 | 112 | 19 |
| **C6 020** | 35/90 | 100 | 10 | 36 | 0 | 9 |
| **C8 012** | 35/90 | 100 | 6 | 49 | 76 | 14 |
| **C8 020** | 50/140 | 100 | 10 | 30 | 0 | 10 |
| **"** | 60/180 | 77 | 10 | 30 | 0 | 13 |

**Tab. 5.3 - Parameters Setting for 460V and 6-pole resolver**

| Motor type | DBM 04 | IL | TF | TG | TY | TQ |
|---|---|---|---|---|---|---|
| **FAS T0 V2 060** | 3/9 | 100 | 78 | 3 | 163 | 29 |
| **V4 060** | 3/9 | 100 | 82 | 4 | 140 | 31 |
| **V8 060** | 6/15 | 100 | 128 | 4 | 204 | 35 |
| | | | | | | |
| **FAS T1 V2 030** | 3/9 | 100 | 48 | 8 | 145 | 26 |
| **V2 060** | 6/15 | 100 | 128 | 4 | 204 | 35 |
| **V4 030** | 6/15 | 100 | 76 | 7 | 245 | 88 |
| **"** | 8/22 | 100 | 92 | 7 | 158 | 31 |
| **V6 030** | 6/15 | 100 | 76 | 7 | 238 | 50 |
| **"** | 8/22 | 100 | 58 | 7 | 161 | 30 |
| **V6 045** | 8/22 | 100 | 116 | 8 | 230 | 35 |
| **"** | 15/42 | 88 | 70 | 6 | 120 | 33 |
| **V8 030** | 6/15 | 100 | 76 | 7 | 245 | 53 |
| **"** | 8/22 | 100 | 60 | 7 | 166 | 24 |
| **V8 045** | 15/42 | 100 | 86 | 5 | 151 | 27 |
| | | | | | | |
| **FAS T2 V2 030** | 8/22 | 100 | 54 | 9 | 143 | 24 |
| **V2 045** | 15/42 | 100 | 88 | 6 | 174 | 44 |
| **V4 020** | 8/22 | 100 | 46 | 7 | 197 | 43 |
| **V4 030** | 15/42 | 100 | 60 | 7 | 166 | 30 |
| **V6 020** | 15/42 | 100 | 38 | 11 | 166 | 24 |
| **V6 030** | 15/42 | 100 | 72 | 7 | 222 | 65 |
| **"** | 25/70 | 73 | 66 | 7 | 133 | 50 |
| **V8 020** | 15/42 | 100 | 52 | 9 | 235 | 62 |
| **"** | 25/70 | 65 | 52 | 11 | 140 | 64 |
| **V8 030** | 25/70 | 100 | 76 | 7 | 225 | 53 |
| | | | | | | |
| **FAS T3 V2 020** | 15/42 | 100 | 48 | 9 | 230 | 56 |
| **V2 030** | 25/70 | 100 | 76 | 13 | 225 | 59 |
| **V3 020** | 25/70 | 100 | 48 | 12 | 217 | 47 |
| **V3 030** | 25/70 | 100 | 76 | 9 | 225 | 77 |
| **"** | 35/90 | 100 | 60 | 9 | 174 | 28 |
| **V3 030+1.5mH** | 25/70 | 100 | 46 | 9 | 143 | 24 |
| **"+1.5mH** | 35/90 | 100 | 38 | 8 | 110 | 24 |
| **V4 020** | 25/70 | 100 | 50 | 11 | 225 | 59 |
| **V4 030** | 35/90 | 100 | 76 | 11 | 230 | 71 |
| **V4 030+1.5mH** | 35/90 | 100 | 54 | 11 | 133 | 22 |
| **V6 012** | 25/70 | 100 | 30 | 15 | 243 | 22 |
| **V6 020** | 35/90 | 100 | 42 | 12 | 148 | 18 |
| **V8 012** | 35/90 | 100 | 26 | 12 | 207 | 29 |
| **V8 020** | 50/140 | 100 | 46 | 10 | 189 | 32 |
| **"** | 60/180 | 77 | 46 | 10 | 145 | 40 |
| **V8 020+1.5mH** | 50/140 | 100 | 26 | 12 | 112 | 20 |
| **"+1.5mH** | 60/180 | 77 | 26 | 12 | 87 | 25 |

**Tab. 5.4 - Parameters Setting for 460V and 2-pole resolver**

| Motor type | DBM 04 | IL | TF | TG | TY | TQ |
|---|---|---|---|---|---|---|
| FAS T0 C2 060 | 3/9 | 100 | 26 | 10 | 163 | 29 |
| C4 060 | 3/9 | 100 | 26 | 12 | 140 | 31 |
| C8 060 | 6/15 | 100 | 42 | 12 | 204 | 35 |
| | | | | | | |
| FAS T1 C2 030 | 3/9 | 100 | 16 | 24 | 145 | 26 |
| C2 060 | 6/15 | 100 | 42 | 12 | 204 | 35 |
| C4 030 | 6/15 | 100 | 24 | 22 | 245 | 88 |
| C4 045 | 6/15 | 100 | 28 | 16 | 235 | 44 |
| " | 8/22 | 100 | 30 | 21 | 158 | 31 |
| C6 030 | 6/15 | 100 | 24 | 22 | 238 | 50 |
| " | 8/22 | 100 | 18 | 22 | 161 | 30 |
| C6 045 | 8/22 | 100 | 38 | 24 | 230 | 35 |
| " | 15/42 | 88 | 22 | 18 | 120 | 33 |
| C8 030 | 6/15 | 100 | 24 | 22 | 245 | 53 |
| " | 8/22 | 100 | 20 | 20 | 166 | 24 |
| C8 045 | 15/42 | 100 | 28 | 16 | 151 | 27 |
| | | | | | | |
| FAS T2 C2 030 | 8/22 | 100 | 18 | 28 | 143 | 24 |
| C2 045 | 15/42 | 100 | 28 | 18 | 174 | 44 |
| C4 020 | 8/22 | 100 | 14 | 22 | 197 | 43 |
| C4 030 | 15/42 | 100 | 20 | 22 | 166 | 30 |
| C6 020 | 15/42 | 100 | 12 | 32 | 166 | 24 |
| C6 030 | 15/42 | 100 | 24 | 22 | 222 | 65 |
| " | 25/70 | 73 | 22 | 21 | 133 | 50 |
| C8 020 | 15/42 | 100 | 16 | 26 | 235 | 62 |
| " | 25/70 | 65 | 16 | 33 | 140 | 64 |
| C8 030 | 25/70 | 100 | 24 | 20 | 225 | 53 |
| | | | | | | |
| FAS T3 C2 020 | 15/42 | 100 | 16 | 28 | 230 | 56 |
| C2 030 | 25/70 | 100 | 24 | 40 | 225 | 59 |
| C3 020 | 25/70 | 100 | 16 | 36 | 217 | 47 |
| C3 030 | 25/70 | 100 | 20 | 28 | 225 | 77 |
| " | 35/90 | 100 | 24 | 27 | 174 | 28 |
| C3 030+1.5mH | 25/70 | 100 | 14 | 26 | 143 | 24 |
| "+1.5mH | 35/90 | 100 | 12 | 25 | 110 | 24 |
| C4 020 | 25/70 | 100 | 16 | 32 | 225 | 59 |
| C4 030 | 35/90 | 100 | 24 | 33 | 230 | 71 |
| C4 030+1.5mH | 35/90 | 100 | 18 | 32 | 133 | 22 |
| C6 012 | 25/70 | 100 | 10 | 44 | 243 | 22 |
| C6 020 | 35/90 | 100 | 14 | 37 | 148 | 18 |
| C8 012 | 35/90 | 100 | 8 | 37 | 207 | 29 |
| C8 020 | 50/140 | 100 | 14 | 29 | 189 | 32 |
| " | 60/180 | 77 | 14 | 29 | 145 | 40 |
| C8 020+1.5mH | 50/140 | 100 | 8 | 35 | 112 | 20 |
| "+1.5mH | 60/180 | 77 | 8 | 35 | 87 | 25 |

# SECTION 6 - COMMANDS

## 6.1 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 keypad 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 keypad 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.

## 6.2 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. 6.1 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 |
| CG | Current gain |
| 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 |
| MV | Max velocity |
| NP | Number of poles |
| OC | Velocity Fine offset |

| Symbol | Command |
|---|---|
| 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 |
| TF | T/S adjustment (1/4) |
| TG | T/S adjustment (2/4) |
| TQ | T/S adjustment (3/4) |
| TY | T/S adjustment (4/4) |
| VC | Velocity Control |
| VE | Velocity |
| VO | Velocity Offset |
| VS | Velocity structure |
| | |

**Tab. 6.2 - Standard/Default Configuration**

| | Standard | 1 address | 2 address | 3 address | 4 address | 5 address | 6 address |
|---|---|---|---|---|---|---|---|
| **AC** | 0 | | | | | | |
| **AL** | DL | | | | | | |
| **AR** | DR | | | | | | |
| **BR** | 9600 | | | | | | |
| **CG** | 2 | | | | | | |
| **CU** | - | | | | | | |
| **CV** | - | | | | | | |
| **DE** | 0 | | | | | | |
| **DF** | 0 | | | | | | |
| **DL** | DL | | | | | | |
| **DR** | DR | | | | | | |
| **ES** | 16 | | | | | | |
| **ET** | 80 | | | | | | |
| **EV** | 0 | | | | | | |
| **IL** | 100 | | | | | | |
| **IT** | see Tab.6.6 | | | | | | |
| **KI** | 10 | | | | | | |
| **KP** | 20 | | | | | | |
| **MR** | 100 | | | | | | |
| **MV** | - | | | | | | |
| **NP** | - | | | | | | |
| **OC** | - | | | | | | |
| **OV** | 128 | | | | | | |
| **PC** | see Tab.6.6 | | | | | | |
| **PR** | - | | | | | | |
| **RN** | - | | | | | | |
| **RX** | - | | | | | | |
| **RS** | - | | | | | | |
| **SA** | 1 | | | | | | |
| **SE** | - | | | | | | |
| **TC** | VC | | | | | | |
| **TF** | see Sect.V | | | | | | |
| **TG** | see Sect.V | | | | | | |
| **TQ** | see Sect.V | | | | | | |
| **TY** | see Sect.V | | | | | | |
| **VC** | VC | | | | | | |
| **VO** | 128 | | | | | | |
| **VS** | 1 | | | | | | |

Note: with G3 jumper on the personality card closed, BR=9600 and SA=1 are set.

## AC - Acceleration

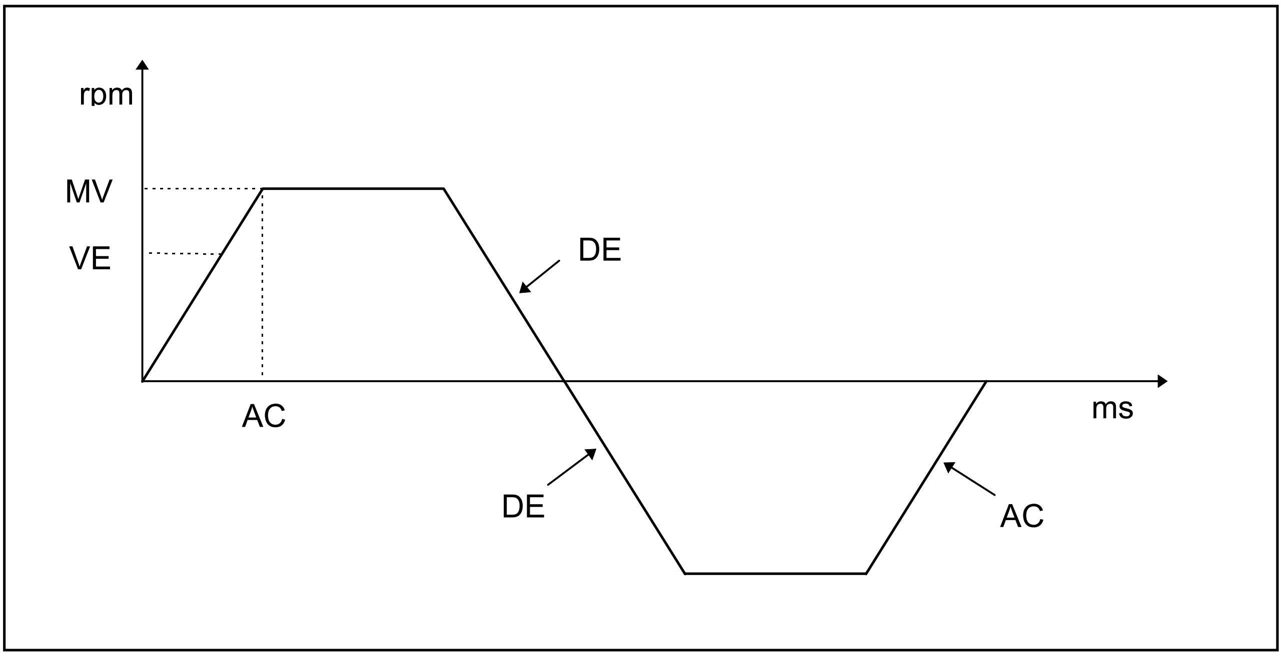
| | |
|---|---|
| Function: | it allows to set an acceleration ramp. Whatever the input reference (analog or digital), the system will follow it, but accelerations will never be faster than those set by this command. It can be useful when the drive is connected to rather simple position controllers ( e.g. max, 0, -max), with an application requiring progressive accelerations. |
| Syntax: | data monitoring: ■ address AC <CR><br>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. 6.1 - Acceleration/Deceleration**



## 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><br>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.

## AE - Axis Enabled

| | |
|---|---|
| Function: | the AE command enables an axis and relative faults. |
| Syntax: | data monitoring: ■ address AE <CR><br>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.

## 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. 12, 13 and 14 (range 0 to 10V). The status can be interrogated via ST command.

*REMARK: DBM 04 has the "Analog I limit" as standard.*

## 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 open, which means priority from the keypad (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".

## AR - Analog Reference

| | |
|---|---|
| Function: | AR command allows enabling analog (speed or torque) reference. The drive will follow as reference the voltage of connector J7 pins, ignoring VE command given from keypad. |
| 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).

## 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".

## BR - Baud Rate

| | |
|---|---|
| Function: | it allows to change transmission speed of the serial link. |
| Syntax: | data monitoring: ■ address BR <CR><br>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 also at keypad side, it is necessary to type <Control> and after <CR>. Type <Y> to change Baud Rate and after <CR>.

## CG - Current Gain

| | |
|---|---|
| Function: | The current loop gain of the DBM drive might be adjusted through the serial link communication. A dedicated CG parameter with 4 discrete values is introduced in order to set the current error gain. |
| Syntax: | data monitoring: ■ address CG <CR><br>data input: ■ address CG n <CR> |
| Address type: | axis |
| Unit of measure: | - |
| Range: | 0=very low gain<br>1=medium low<br>2=medium high<br>3=very high |
| Unit of measure: | - |
| Default: | 2 |
| Password: | YES |
| (∗) addressing: | no |
| Opposite to: | - |
| See also: | - |

## 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".

## 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><br>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.*

## 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><br>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.*

## DE - Deceleration

| | |
|---|---|
| Function: | it allows to set a deceleration ramp. Whatever the input reference (analog or digital), the system will follow it, but decelerations 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 decelerations (see Fig. 6.1). |
| Syntax: | data monitoring: ■ address DE <CR><br>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"

## DF - Digital Filter

| | |
|---|---|
| Function: | it allows to set a low-pass digital filter. The filter reduces high frequency noise and resonance's<br>When the Velocity Structure command is VS=0 or VS=1, the velocity reference is filtered.<br>When the Velocity Structure command is VS=2 or VS=3, the velocity error is filtered.<br>The value DF=0 switches the filter OFF |
| Syntax: | data monitoring: ■ address DF <CR><br>data input: ■ address DF n <CR> |
| Address type: | axis |
| Unit of measure: | - |
| Range: | 0 to 255. The filter bandwidth is:<br>$f\,[Hz] = \{\ln[1/(1-DF/512)]\}/(2\pi * 300\ 10^{-6})$ |
| 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. 6.3 - 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 |

## 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).

## 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 |

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

## 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)

## 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><br>data input: ■ address ES n <CR> |
| Address type: | 1=Analog Output 1 (see J8 connector, pos.4)<br>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):<br>Max current for axis 1 (SO=1), axis 2 (SO=2) or axis 3 (SO=3):<br>±(10∗ES/16)V for ±100% max current<br>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):<br>±[(ES∗NP∗MV)/(786∗MR)]V for ±MV (max velocity) |
| Default: | 16 |
| Password: | yes |
| (∗) addressing: | no |
| Opposite to: | - |
| See also: | MR, MV, NP, SO, Tab.6.4, Tab.6.5 |

Examples:

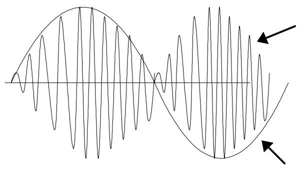
| | |
|---|---|
| ■ 1 SO 1 <CR>: | sets analog out1 (J8 conn., pos.4) to max current of axis 1 of the first module |
| ■ 1 ES 16 <CR>: | sets analog out1 to ±10V for ±100% max current of axis 1 |
| ■ 1 ES 32 <CR>: | sets analog out1 to ±10V for ±50% max current (zoom-in) of axis 1 |
| ■ 1 ES 8 <CR>: | sets analog out1 to ±5V for ±100% max current (zoom-out) of axis 1 |
| ■ 8 SO 5 <CR>: | sets analog out2 (J8 conn., pos.5) to speed reference of axis 2 of the third module |
| ■ 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. 6.4 - 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 |

REMARK

The voltage at the Analog Output represents the envelope of the actual current.




1. To calculate the max current, Imax:
- check the max current of the drive (see the rating plate or par.1.3).
- search for the max Analog Out voltage during the entire duty cycle.
- % scale according to ES, and Tab.6.4

2. To calculate the max rms current, $Imrms = \frac{Imax}{\sqrt{2}}$:

3. To calculate the rms current:
- calculate the max rms current for each step of the duty cycle (acceleration, deceleration, ...)
- use the following formula $Irms = \sqrt{\frac{Imrms1^2 * t1 + Imrms2^2 * t2 + ...}{t1 + t2 + ...}}$

SPECIAL CASES

Sinusoidal Analog Output: $Irms = \frac{Imax/\sqrt{2}}{\sqrt{2}} = \frac{Imax}{2}$

Triangular Analog Output (I Limit): $Irms = \frac{Imax/\sqrt{2}}{\sqrt{3}} = \frac{Imax}{2.45}$

**Tab. 6.5 - 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 |

## ET - Extra parameter for Tacho output

| | |
|---|---|
| Function: | it allows to scale the Tacho Tests outputs on J8 connector |
| Syntax: | data monitoring: ■ address ET <CR><br>data input: ■ address ET n <CR> |
| Address type: | axis |
| Unit of measure: | - |
| Range: | 50 to 100. Tacho outputs = $\pm$(ET/10) $*$ (MR/100) [V] for $\pm$MV |
| Default: | 80 |
| Password: | yes |
| ($*$) 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".

## 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><br>data input: ■ address EV n <CR> |
| Address type: | axis |
| Unit of measure: | n = rpm |
| Range: | 1 to MV. 0 = disabled |
| Default: | 0 |
| Password: | yes |
| ($*$) 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.

■ 1 EV <CR>: it questions axis 1 about the maximum error allowed. The answer is: "A1 VELOCITY ERROR RPM = 100".

## FA - Fault

| | |
|---|---|
| Function: | as only main faults have front panel LED indications, when the generic LED DRF 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 occurred at logic level (also resettable via push button). |
| 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 | = Bus Bar voltage (Axis 3 only) | 0 = OK | 1 = under 430V |
| 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 | = n.c. | | |
| 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"

## 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><br>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.

## 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. 6.6). |
| Syntax: | data monitoring: ■ address IT <CR><br>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. 6.6 |
| Password: | special password |
| (∗) addressing: | no |
| Opposite to: | - |
| See also: | PC |

Notes: 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. 6.6 - IT Protection

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

| MOTOR | | DRIVE | | | | | Operating time at drive peak current |
|---|---|---|---|---|---|---|---|
| | **In (A)** | **In (A)** | Ip (A) | **IT** | **PC** | **IL** | (s) |
| **FAS K0V 020 060** | 2.9 | 8 | 22 | 12 | 18 | 100 | 4.9 |
| **FAS K1V 080 030** | 5.3 | 15 | 42 | 2 | 17 | 100 | 26.2 |
| **FAS T0 V2 060** | 1.1 | 3 | 9 | 9 | 17 | 100 | 5.8 |
| **FAS T0 V4 060** | 1.5 | 3 | 9 | 8 | 23 | 100 | 12.1 |
| **FAS T0 V8 060** | 3 | 6 | 15 | 8 | 28 | 100 | 18.2 |
| **FAS T1 V2 030** | 1.7 | 3 | 9 | 6 | 26 | 100 | 20.8 |
| **FAS T1 V2 060** | 3.26 | 6 | 15 | 5 | 30 | 100 | 33.6 |
| **FAS T1 V4 030** | 3.34 | 6 | 15 | 6 | 31 | 100 | 30.0 |
| **FAS T1 V4 045** | 4.22 | 6 | 15 | 5 | 39 | 100 | 58.9 |
| **"** | 4.22 | 8 | 22 | 5 | 27 | 100 | 27 |
| **FAS T1 V6 030** | 4.26 | 6 | 15 | 5 | 40 | 100 | 62.2 |
| **"** | 4.26 | 8 | 22 | 5 | 27 | 100 | 27 |
| **FAS T1 V6 045** | 6.27 | 8 | 22 | 5 | 40 | 100 | 62.2 |
| **"** | 6.27 | 15 | 42 | 6 | 21 | 87 | 17.9 |
| **FAS T1 V8 030** | 4.93 | 6 | 15 | 5 | 46 | 100 | 84.8 |
| **"** | 4.93 | 8 | 22 | 4 | 31 | 100 | 45.1 |
| **FAS T1 V8 045** | 7.58 | 15 | 42 | 4 | 25 | 100 | 28.8 |
| **FAS T2 V2 030** | 5.1 | 8 | 22 | 5 | 32 | 100 | 38.5 |
| **FAS T2 V2 045** | 8.4 | 15 | 42 | 5 | 28 | 100 | 29.1 |
| **FAS T2 V4 020** | 5.6 | 8 | 22 | 4 | 35 | 100 | 58.3 |
| **FAS T2 V4 030** | 8.5 | 15 | 42 | 4 | 28 | 100 | 36.4 |
| **FAS T2 V6 020** | 8.2 | 15 | 42 | 4 | 27 | 98 | 35.2 |
| **FAS T2 V6 030** | 11.6 | 15 | 42 | 4 | 39 | 100 | 73.6 |
| **"** | 11.6 | 25 | 70 | 4 | 23 | 84 | 34.4 |
| **FAS T2 V8 020** | 10.4 | 15 | 42 | 3 | 35 | 100 | 77.7 |
| **"** | 10.4 | 25 | 70 | 5 | 21 | 77 | 27.9 |
| **FAS T2 V8 030** | 15.5 | 15 | 42 | 3 | 52 | 100 | 187.5 |
| **"** | 15.5 | 25 | 70 | 3 | 31 | 100 | 60.1 |
| **FAS T3 V2 020** | 12.7 | 15 | 42 | 4 | 42 | 100 | 86.6 |
| **"** | 12.7 | 25 | 70 | 7 | 25 | 70 | 34.8 |
| **FAS T3 V2 030** | 19 | 25 | 70 | 4 | 38 | 100 | 69.6 |
| **FAS T3 V3 020** | 17.5 | 25 | 70 | 3 | 35 | 100 | 77.7 |
| **FAS T3 V3 030** | 23.3 | 25 | 70 | 4 | 47 | 100 | 111.3 |
| **"** | 23.3 | 35 | 90 | 3 | 36 | 100 | 82.6 |
| **FAS T3 V4 020** | 21.2 | 25 | 70 | 3 | 42 | 100 | 115.4 |
| **FAS T3 V4 030** | 30.9 | 35 | 90 | 4 | 48 | 100 | 116.8 |
| **FAS T3 V6 012** | 18.8 | 25 | 70 | 3 | 37 | 100 | 87.6 |
| **FAS T3 V6 020** | 26.4 | 35 | 90 | 3 | 41 | 100 | 109.5 |
| **FAS T3 V6 030** | 44 | 50 | 140 | 3 | 44 | 97 | 128.0 |
| **FAS T3 V6 030** | 44 | 60 | 180 | 3 | 34 | 100 | 77.5 |
| **FAS T3 V8 012** | 22.9 | 35 | 90 | 3 | 35 | 100 | 77.7 |
| **FAS T3 V8 020** | 36 | 50 | 140 | 3 | 36 | 100 | 82.6 |
| **"** | 36 | 60 | 180 | 4 | 28 | 79 | 60.0 |

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.

## 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><br>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

## 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><br>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.

## 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><br>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.*

## 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 keypad command. |
| Syntax: | data monitoring: ■ address MV <CR><br>data input: ■ address MV n <CR> |
| Address type: | axis |
| Unit of measure: | n = rpm |
| Range: | 200 to 32000 |
| Default: | motor dependent |
| Password: | yes |
| (∗) addressing: | yes |
| Opposite to: | - |
| See also: | MR, Tab. 6.7 |

*REMARK: max velocity depends on R/D resolution. See Tab. 6.7.*

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"

## 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><br>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"

## 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><br>data input: ■ address OC n <CR> |
| Address type: | axis |
| Unit of measure: | (n-128) ∗ x / 128 rpm<br>where x=24 for 8 and 2 pole resolver<br>x=32 for 6 pole resolver |
| Range: | 0 to 255. OC = 128 disables offset<br>OC > 128 sets CW offset<br>OC < 128 sets CCW offset |
| Default: | - |
| Password: | no |
| (∗) addressing: | yes |
| Opposite to: | - |
| See also: | OV, VO |

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".

## OF - Off

| | |
|---|---|
| Function: | it allows to disable the digital Drive Enable for the addressed axis |
| 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.*

## ON - On

| | |
|---|---|
| Function: | it allows to enable the digital Drive Enable for the addressed axis To use the digital Drive Enable, G2 jumper on the personality card must be open (see par. 2.9.1) and the opto Drive Enable on J8 connector must be enabled (to +15V) |
| 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.*

## OV - Analog Offset

| | |
|---|---|
| Function: | it allows to monitor and to set the analog offset of speed/ torque analog reference.<br>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><br>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 |

## 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><br>data input: ■ address PC xx n <CR>. xx = special password |
| Address type: | axis |
| Unit of measure: | n = % |
| Range: | 0 to 100 |
| Default: | see Tab. 6.6 |
| 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.*

## 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><br>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.*

## 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.<br>The DBM 04 release allows to change the password. |
| Syntax: | command input: ■ address PW n <CR><br>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.*

## 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".

## 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).<br>RN must be the maximum R/D resolution according to max speed (see Tab. 6.7)<br>If RN equals RX, the R/D resolution is fixed. |
| Syntax: | data monitoring: ■ address RN <CR><br>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. 6.7 |

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. 6.7)
- ■ 2 RN <CR>: questions axis 2 about the minimum of R/D resolution. The answer is: "A02 MINIMAL R/D RES. = 12".

### Tab. 6.7 - 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 |

## RS - Resolver Shaft

| | |
|---|---|
| Function: | it informs about the phase shift between motor and resolver. |
| Syntax: | data monitoring: ■ address RS <CR><br>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.

## 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).<br>The default is 16 bit.<br>If acceleration [rad/$s^2$ ] > 314000/NP, then RX must be set to 14.<br>If RX equals RN, the R/D resolution is fixed. |
| Syntax: | data monitoring: ■ address RX <CR><br>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. 6.7 |

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).

## 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.*

## SE - Simulated Encoder (Optional)

| | |
|---|---|
| Function: | it allows to set the number of pulses per electrical revolution of simulated encoder.<br>The number of ppr must be ≤ ppr according to RN (see Tab.6.7) |
| Syntax: | data monitoring: ■ address SE <CR><br>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, Tab.6.8 |

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

### Tab. 6.8 - Max ppr versus min R/D resolution (RN)

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

## 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 (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 (pos.5).<br>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.<br>The analog outputs can be scaled via ES command. |
| Syntax: | data monitoring(binary output): ■ address SO <CR><br>data input: ■ address SO n <CR> |
| Address type: | Analog Output 1, Analog Output 2 and module (see Tab.6.9) |
| Unit of measure: | - |
| Range: | 0 to 9 (max current, velocity reference, velocity error, see Tab.6.10) |
| Default: | 1SO=1<br>2SO=2 |
| Password: | yes |
| (∗) addressing: | no |
| Opposite to: | - |
| See also: | ES, Tab.6.9 and 6.10 |

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):
■ 1 SO 6 <CR>: sets velocity reference of axis 3 on Analog Out 1 (J8 connector, pos.4).

### Tab. 6.9 - ANALOG OUT - ADDRESS SETTING

| **SO** | **Address** | **SO** | **Address** | **SO** | **Address** |
|---|---|---|---|---|---|
| **1SO** | Analog Out 1 first module | **4SO** | Analog Out 1 second module | **7SO** | Analog Out 1 third module |
| **2SO** | Analog Out 2 first module | **5SO** | Analog Out 2 second module | **8SO** | Analog Out 2 third module |

### Tab. 6.10 - ANALOG OUT - OUTPUT SETTING

| **SO** | **Max Current** | **SO** | **Velocity Reference** | **SO** | **Velocity Error** |
|---|---|---|---|---|---|
| **SO1** | axis 1 | **SO4** | axis 1 | **SO7** | axis 1 |
| **SO2** | axis 2 | **SO5** | axis 2 | **SO8** | axis 2 |
| **SO3** | axis 3 | **SO6** | axis 3 | **SO9** | axis 3 |

## 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" .

## 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=closed) | 1 = keypad (G2=open) |
| 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 |

## 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.2.9). |
| 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*

## 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)

## TF - Parameter for the adjustment of Torque/Speed curve

| | |
|---|---|
| Function: | Current loop of a typical AC drive suffers the phase lag at extremely high output frequencies (speeds). This lag reduces the resulting torque-per-amp ratio. To counterbalance this phenomenon the current vector relative to the motor flux is advanced, through TF, TG, TY, and TQ parameters (see the dedicated Section 5).<br>The values TF=255, TG=0, TQ=0, TY=255 disable the function. |
| Syntax: | data monitoring: ■ address TF <CR><br>data input: ■ address TF n <CR> |
| Address type: | axis |
| Unit of measure: | - |
| Range: | 0 to 255 |
| Default: | see Tab.5.1 to 5.4 |
| Password: | yes |
| (∗) addressing: | no |
| Opposite to: | - |
| See also: | TG, TQ, TY |

## TG - Parameter for the adjustment of Torque/Speed curve

| | |
|---|---|
| Function: | Current loop of a typical AC drive suffers the phase lag at extremely high output frequencies (speeds). This lag reduces the resulting torque-per-amp ratio. To counterbalance this phenomenon the current vector relative to the motor flux is advanced, through TF, TG, TY, and TQ parameters (see the dedicated Section 5).<br>The values TF=255, TG=0, TQ=0, TY=255 disable the function. |
| Syntax: | data monitoring: ■ address TG <CR><br>data input: ■ address TG n <CR> |
| Address type: | axis |
| Unit of measure: | - |
| Range: | 0 to 255 |
| Default: | see Tab.5.1 to 5.4 |
| Password: | yes |
| (∗) addressing: | no |
| Opposite to: | - |
| See also: | TF, TQ, TY |

## TQ - Parameter for the adjustment of Torque/Speed curve

| | |
|---|---|
| Function: | Current loop of a typical AC drive suffers the phase lag at extremely high output frequencies (speeds). This lag reduces the resulting torque-per-amp ratio. To counterbalance this phenomenon the current vector relative to the motor flux is advanced, through TF, TG, TY, and TQ parameters (see the dedicated Section 5). The values TF=255, TG=0, TQ=0, TY=255 disable the function. |
| Syntax: | data monitoring: ■ address TQ <CR><br>data input: ■ address TQ n <CR> |
| Address type: | axis |
| Unit of measure: | - |
| Range: | 0 to 255 |
| Default: | see Tab.5.1 to 5.4 |
| Password: | yes |
| (∗) addressing: | no |
| Opposite to: | - |
| See also: | TF, TG, TY |

## TY - Parameter for the adjustment of Torque/Speed curve

| | |
|---|---|
| Function: | Current loop of a typical AC drive suffers the phase lag at extremely high output frequencies (speeds). This lag reduces the resulting torque-per-amp ratio. To counterbalance this phenomenon the current vector relative to the motor flux is advanced, through TF, TG, TY, and TQ parameters (see the dedicated Section 5). The values TF=255, TG=0, TQ=0, TY=255 disable the function. |
| Syntax: | data monitoring: ■ address TY <CR><br>data input: ■ address TY n <CR> |
| Address type: | axis |
| Unit of measure: | - |
| Range: | 0 to 255 |
| Default: | see Tab.5.1 to 5.4 |
| Password: | yes |
| (∗) addressing: | no |
| Opposite to: | - |
| See also: | TF, TG, TQ |

## 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)

## 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><br>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.

## 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 keypad Drive Enable is off (OF command).*

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

## 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.<br>**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.<br>This structure should be used in applications where the analog speed reference lines from the CNC are noisy, and high gains are required.<br>**VS=1** selects the speed controller having standard feedback KP and KI gains and a digital low pass filter processing the speed reference signal.<br>This structure should be used in applications where the analog speed reference lines from the CNC are noisy, and normal gains are required.<br>**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.<br>This structure should be used in applications with high ratios between load and motor inertia (<u>inertia mismatch</u>), and high gains are required.<br>**VS=3** selects the speed controller having standard feedback KP and KI gains and a digital low pass filter processing the speed error signal.<br>This structure should be used in applications with high ratios between load and motor inertia (<u>inertia mismatch</u>), and normal gains are required. |
| Syntax: | data monitoring: ■ address VS <CR><br>data input: ■ address VS n <CR> |
| Address type: | axis |
| Unit of measure: | - |
| Range: | 0 to 3.<br>VS=0: gains multiplied by 4, reference filtering<br>VS=1: standard gains, reference filtering<br>VS=2: gains multiplied by 4,error filtering<br>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.

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# SECTION 7 - TROUBLESHOOTING

### FIG. 7.1 - DBM-PS Power Supply - OVER TEMP red LED on Overtemperature

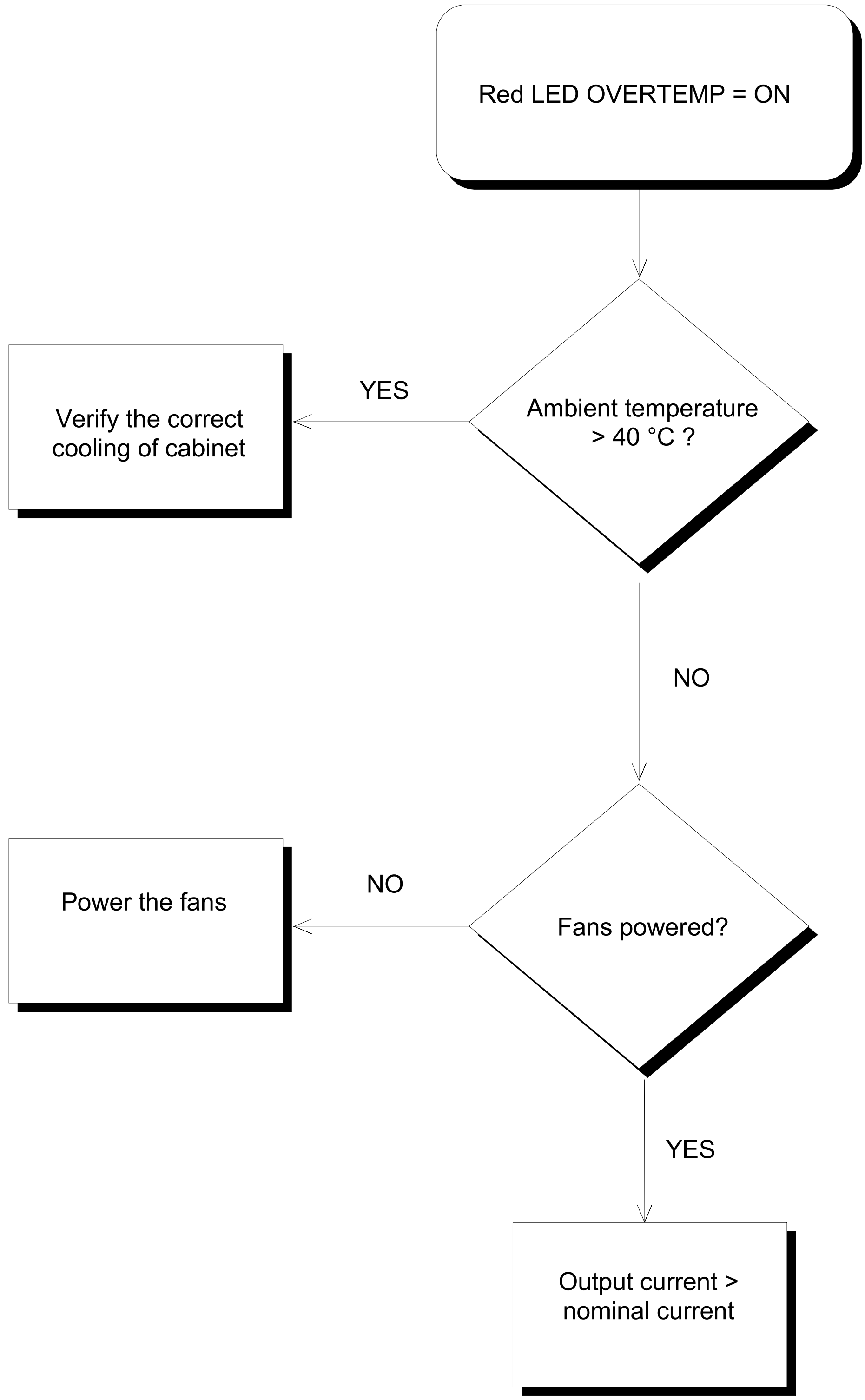


**FIG. 7.2 - DBM-PS Power Supply - DBR FAULT red LED on Recovery Fault**

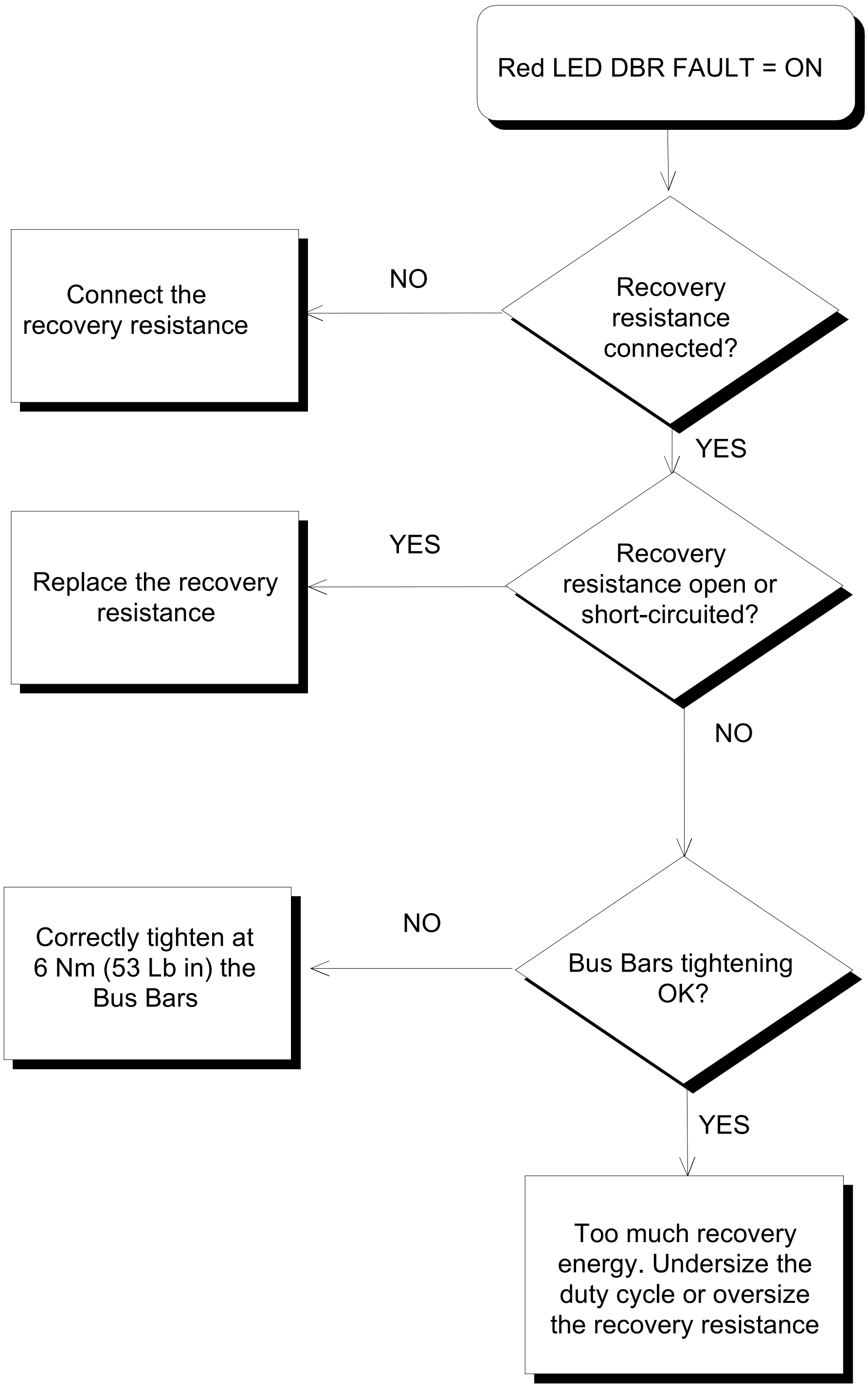


**FIG. 7.3 - DBM-PS Power Supply - PWR BUS yellow LED off**

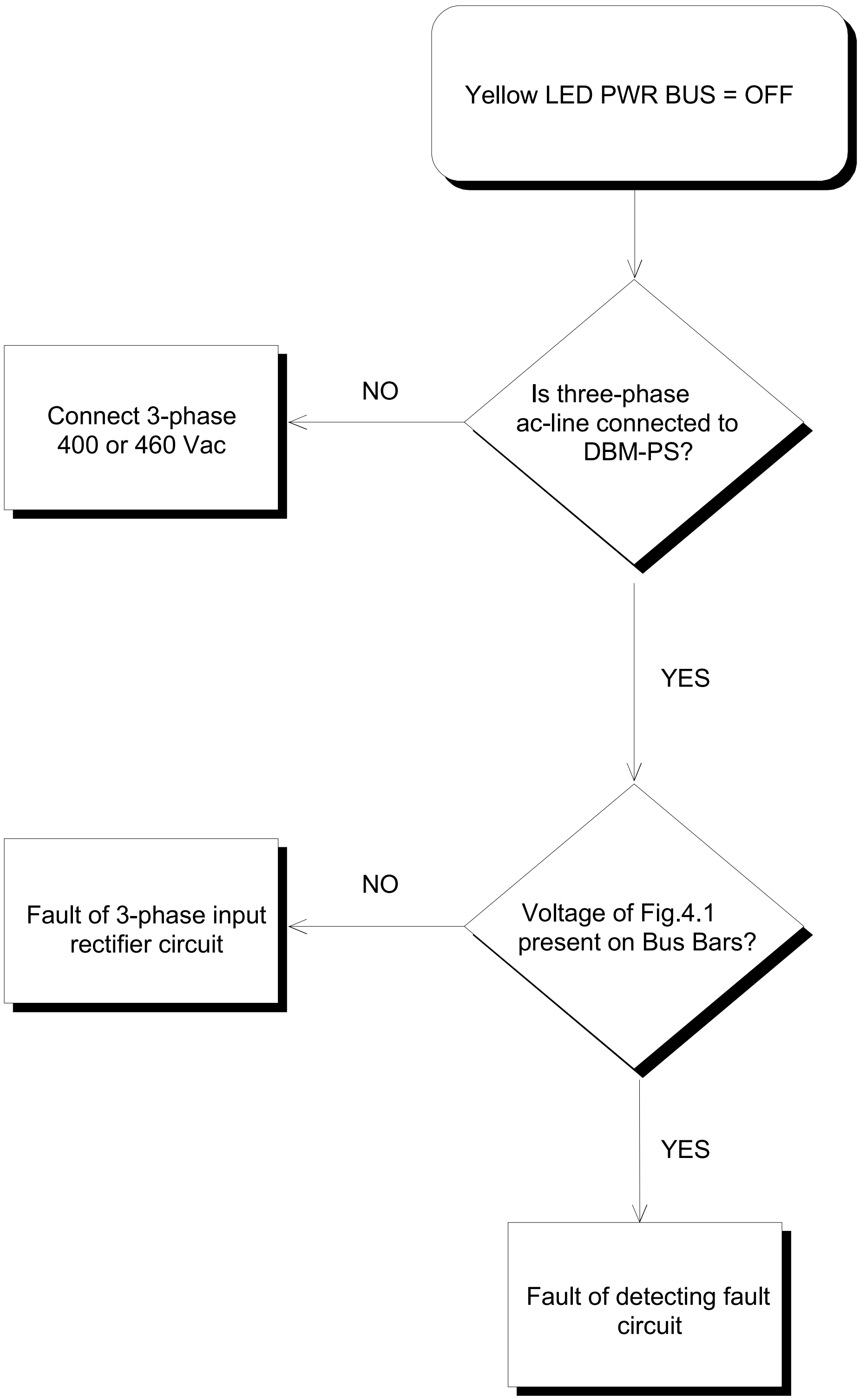


**FIG. 7.4 - DBM PS-Standard and PS-6M Power Supply - AUX PWR green LED off**

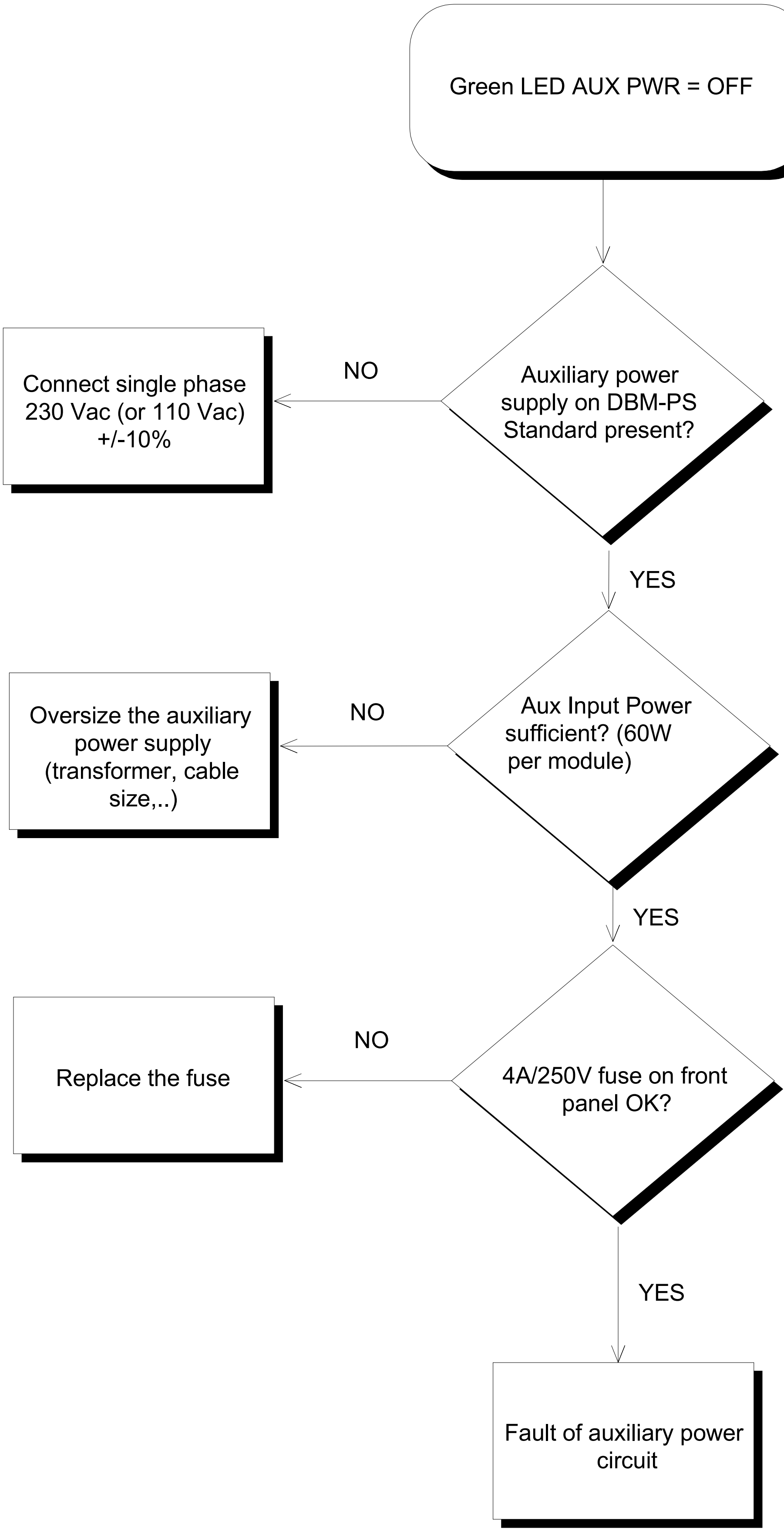


**FIG. 7.5 - DBM Module - POWER OK green LED off**

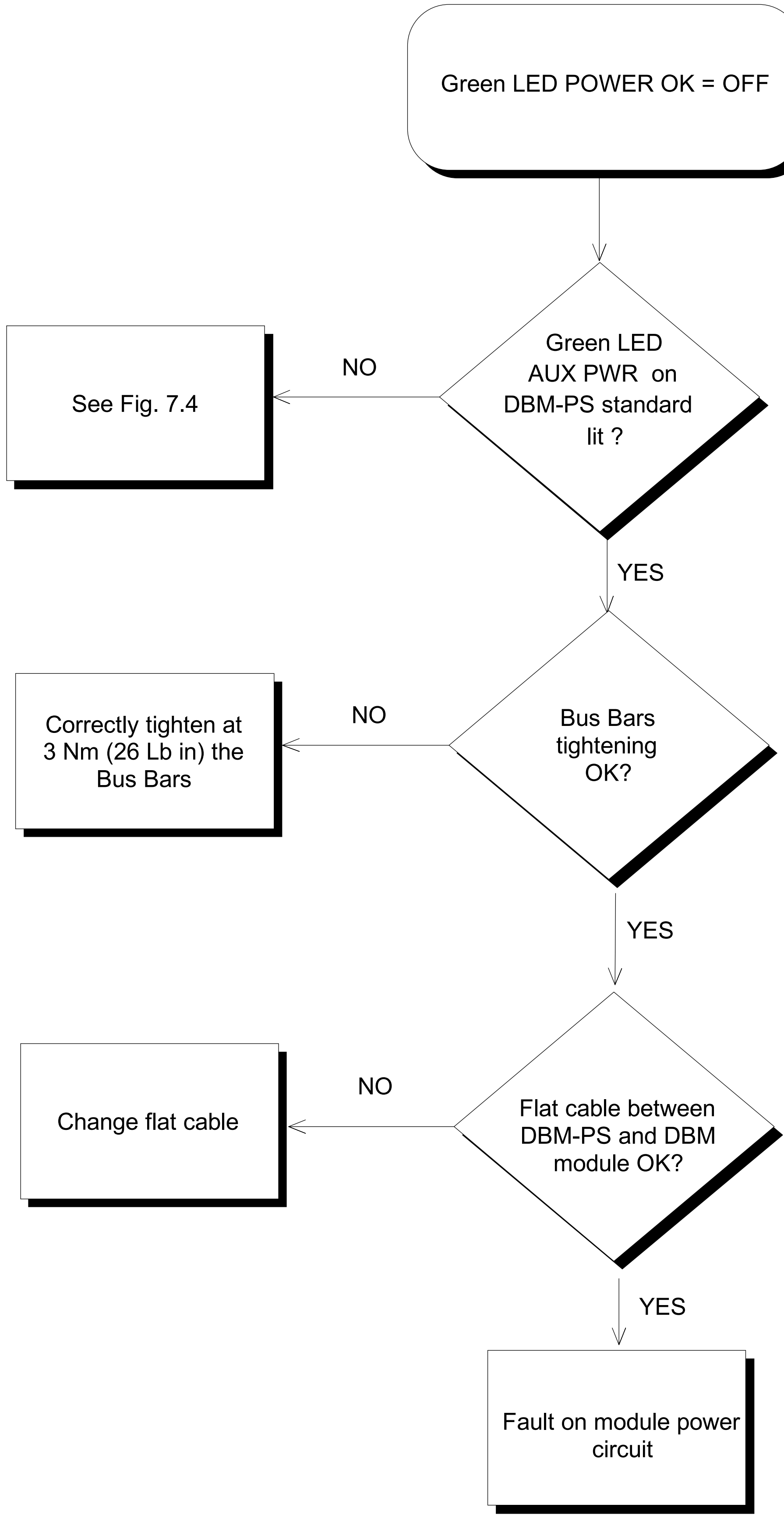


**FIG. 7.6 - DBM Module - DR.EN1/DR.EN2/DR.EN3 green LED off**
**Drive Enable Axis 1/Axis 2/Axis 3**

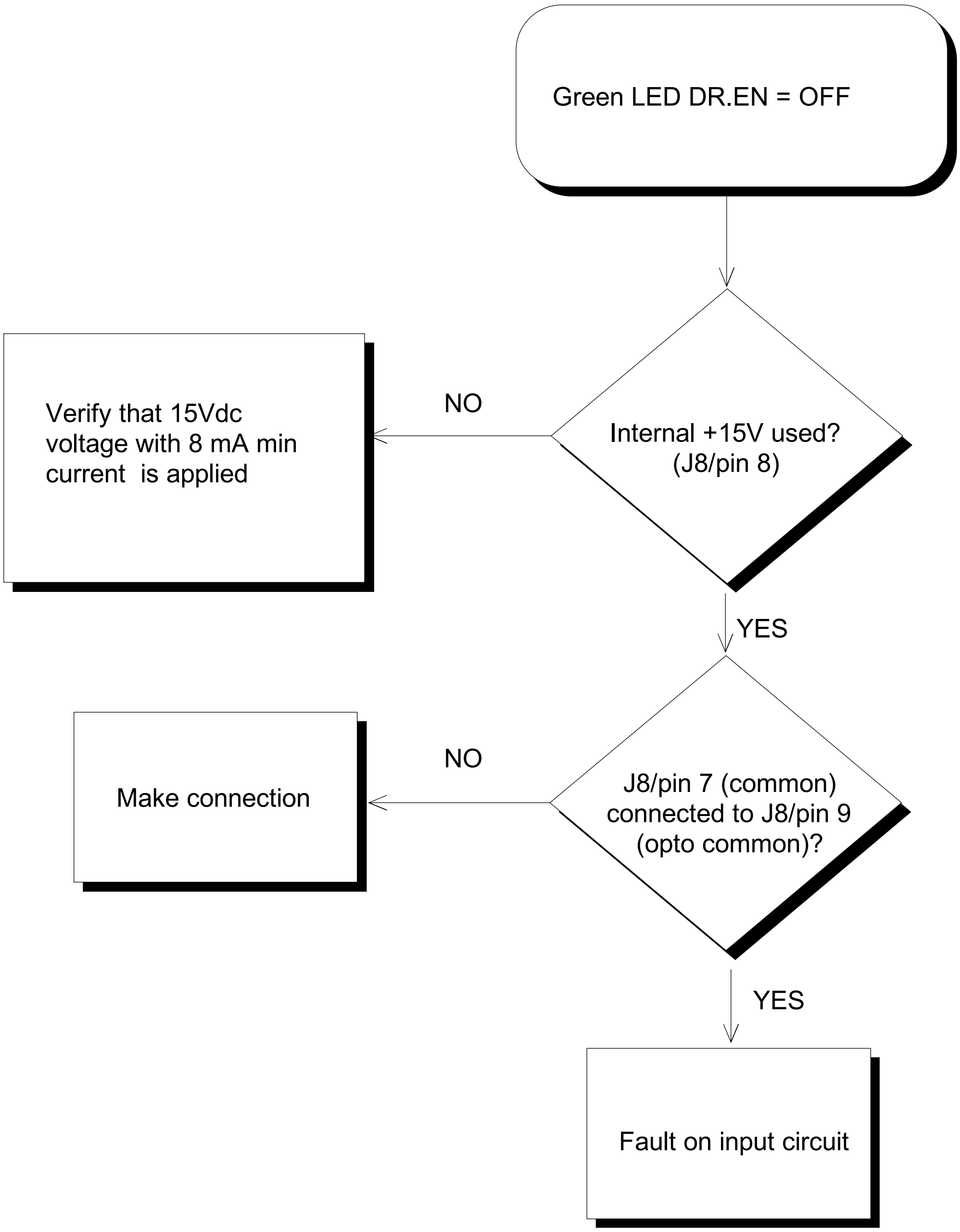


**FIG. 7.7 - DBM Module - REF.EN green LED off**
**Reference Enable**

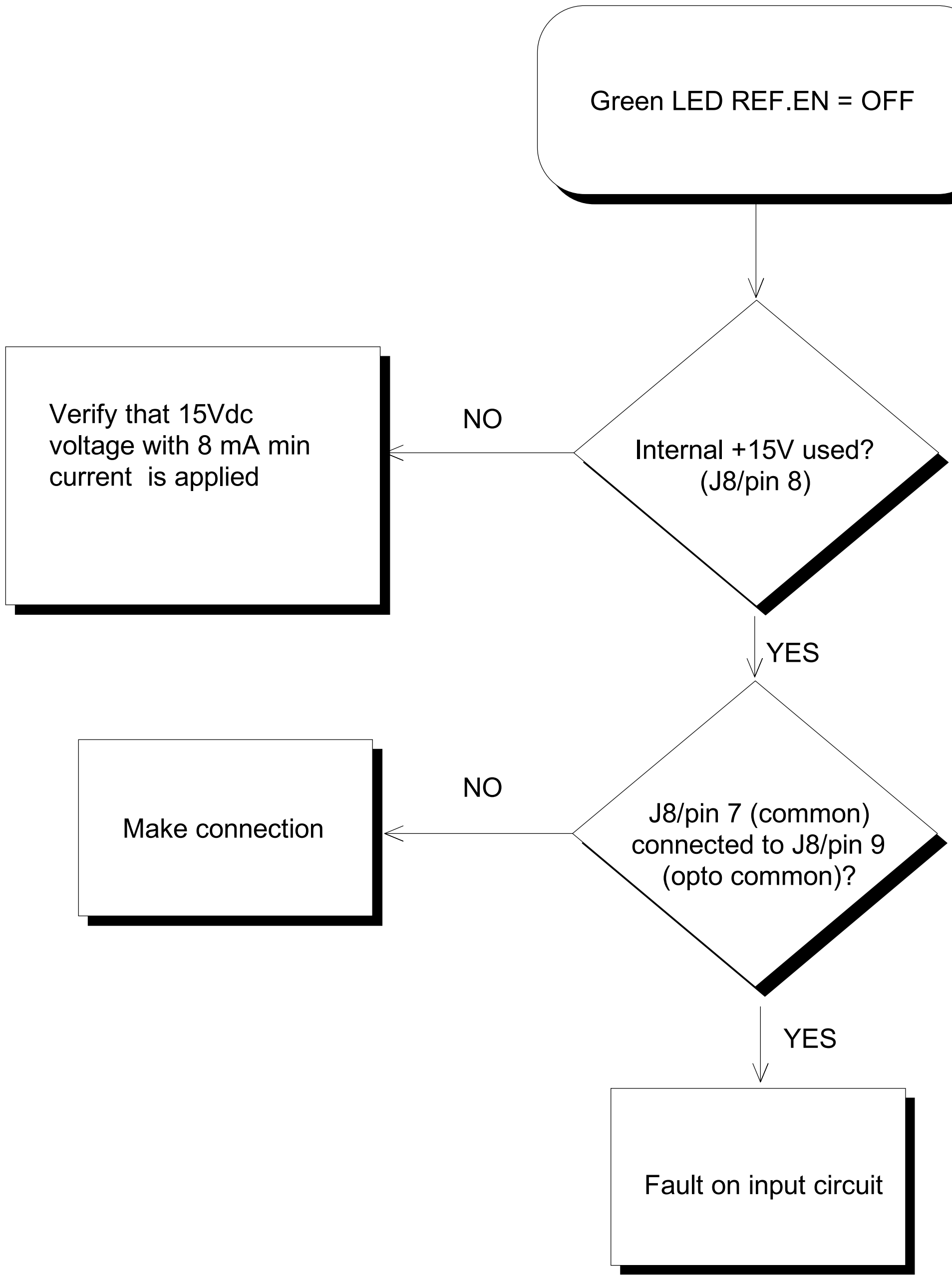


**FIG. 7.8 - DBM Module - DR.OVT red LED on**
**DBM Overtemperature**

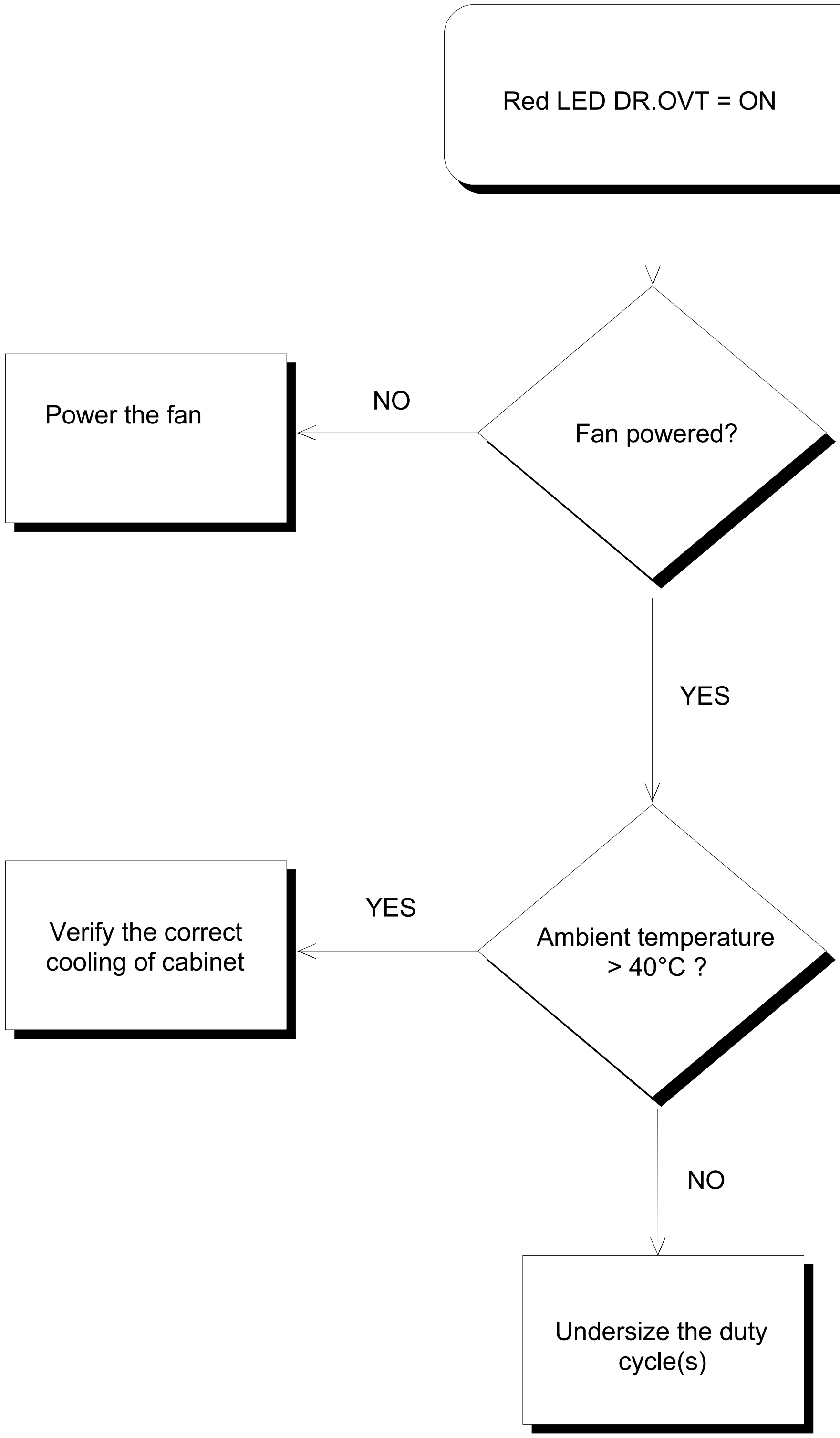


**FIG. 7.9 - DBM Module - PWRF1/PWRF2/PWRF3 red LED on**
**Power Circuit Fault Axis 1/Axis 2/Axis 3**

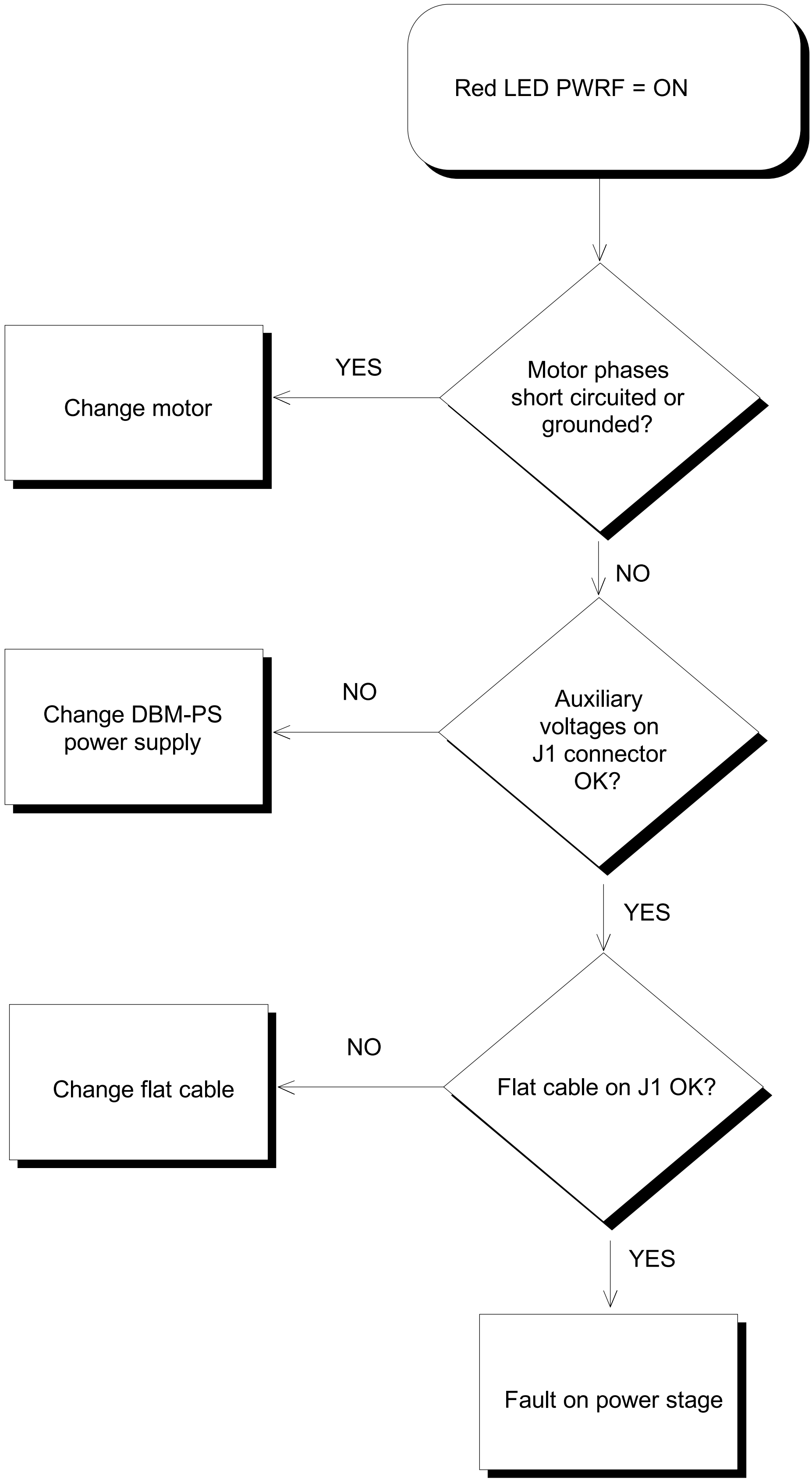
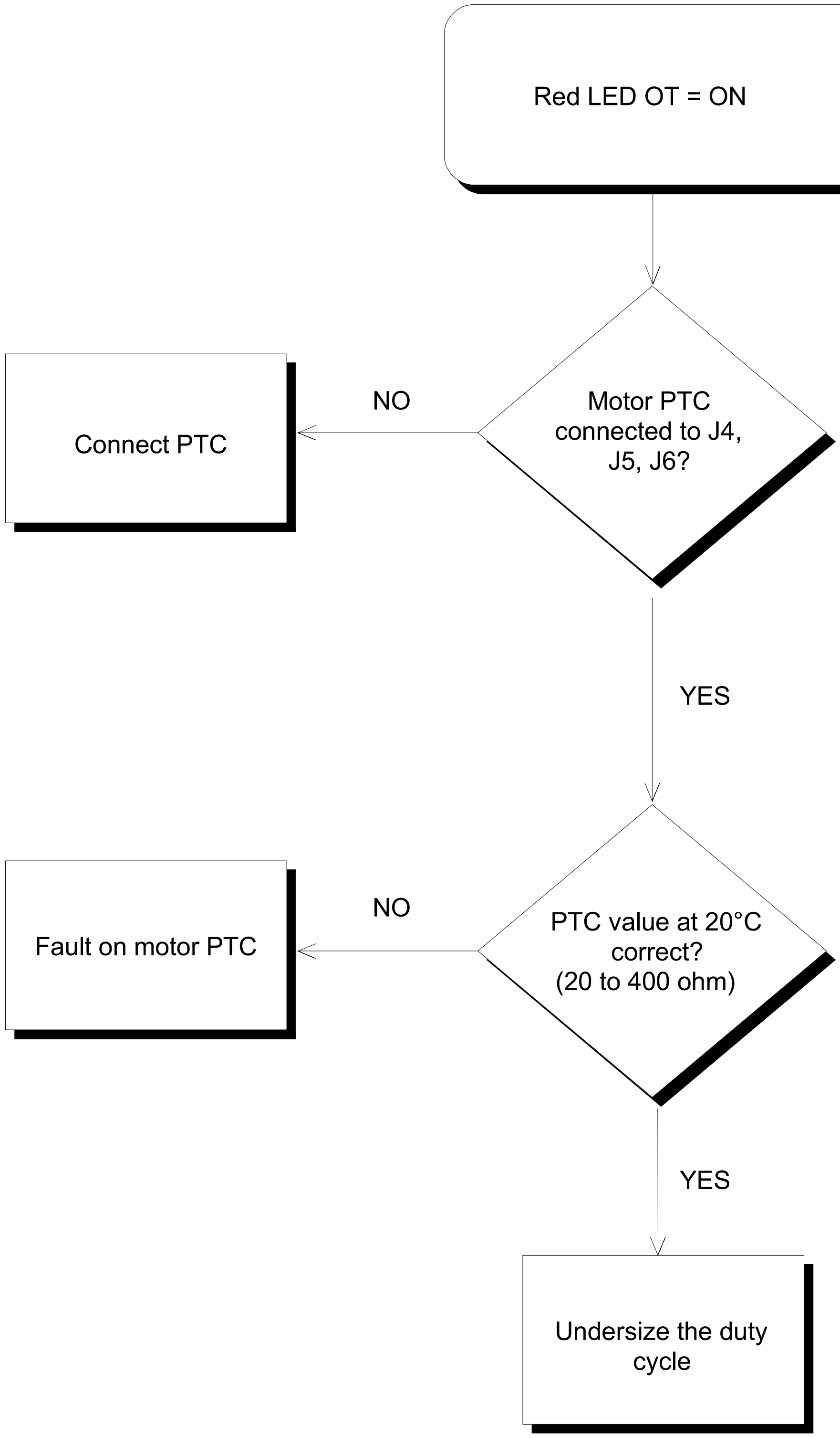


**FIG. 7.10 - DBM Module - OT1/OT2/OT3 red LED on**
**Motor Overtemperature Axis 1/Axis 2/Axis 3**



## FIG. 7.11 - DBM Module - RF1/RF2/RF3 red LED on Resolver Fault Axis 1/Axis 2/Axis 3

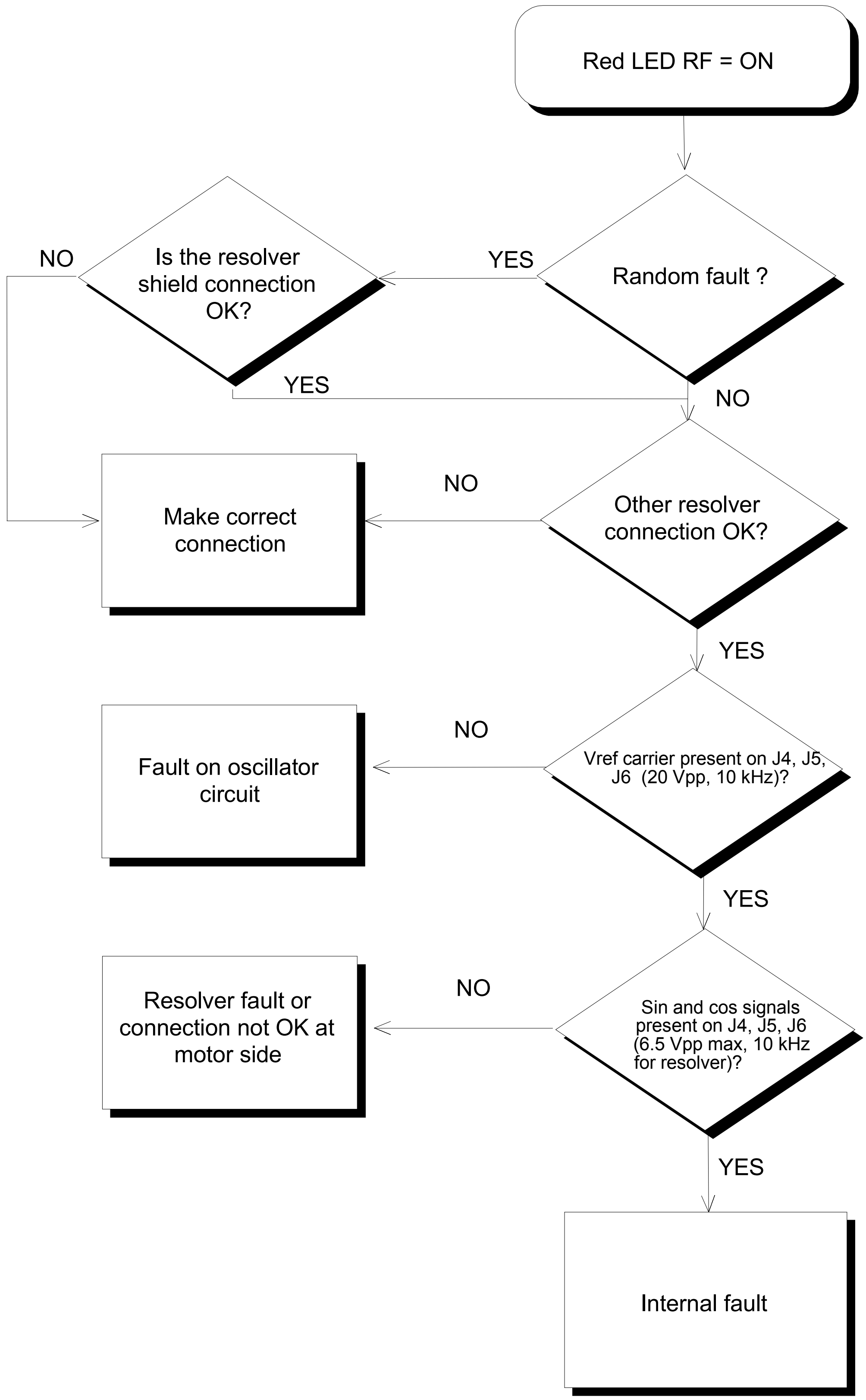


**FIG. 7.12 - DBM Module - WTD red LED on Watch Dog**

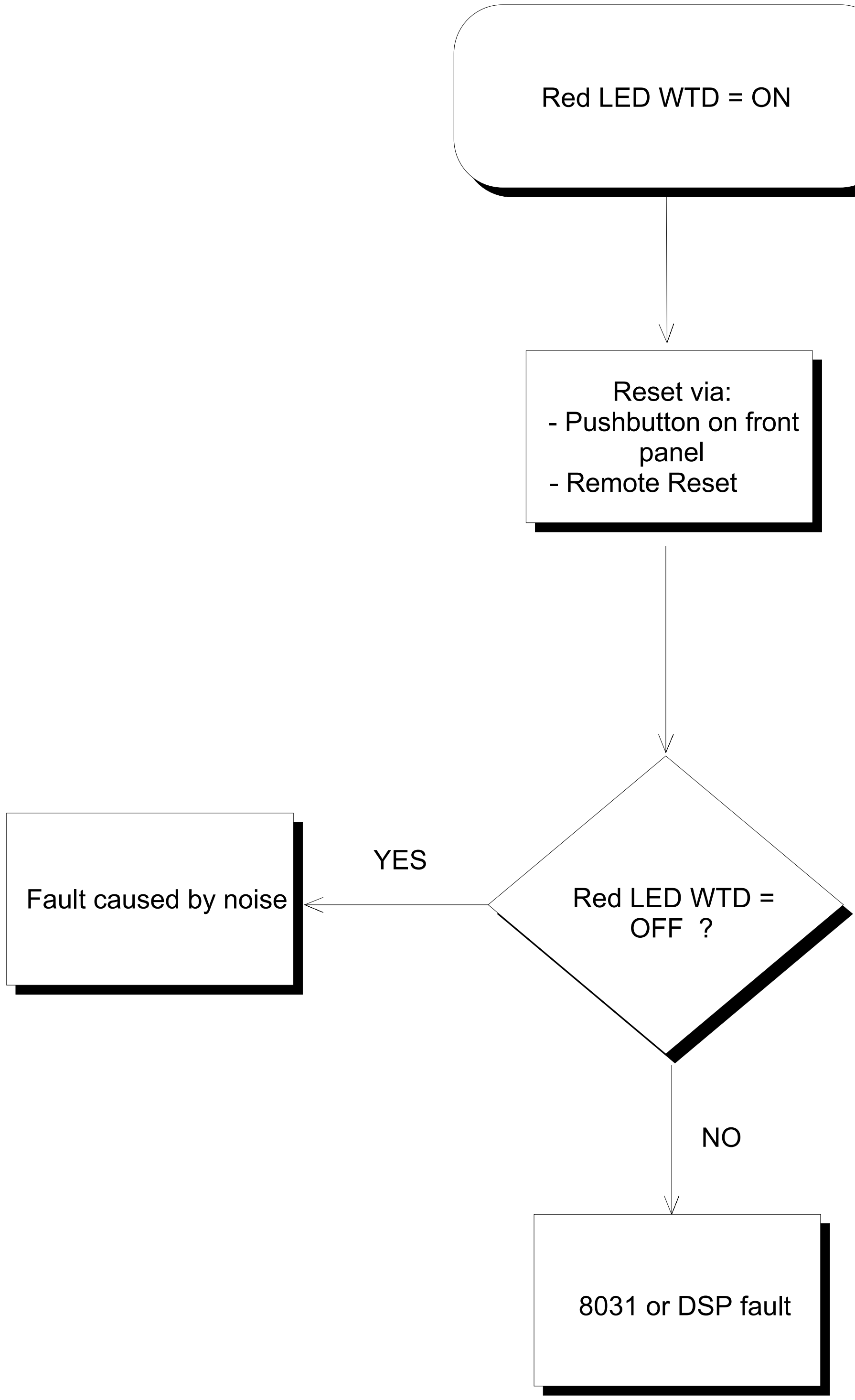


**FIG. 7.13 - DBM Module - DRF red LED on Drive Fault**

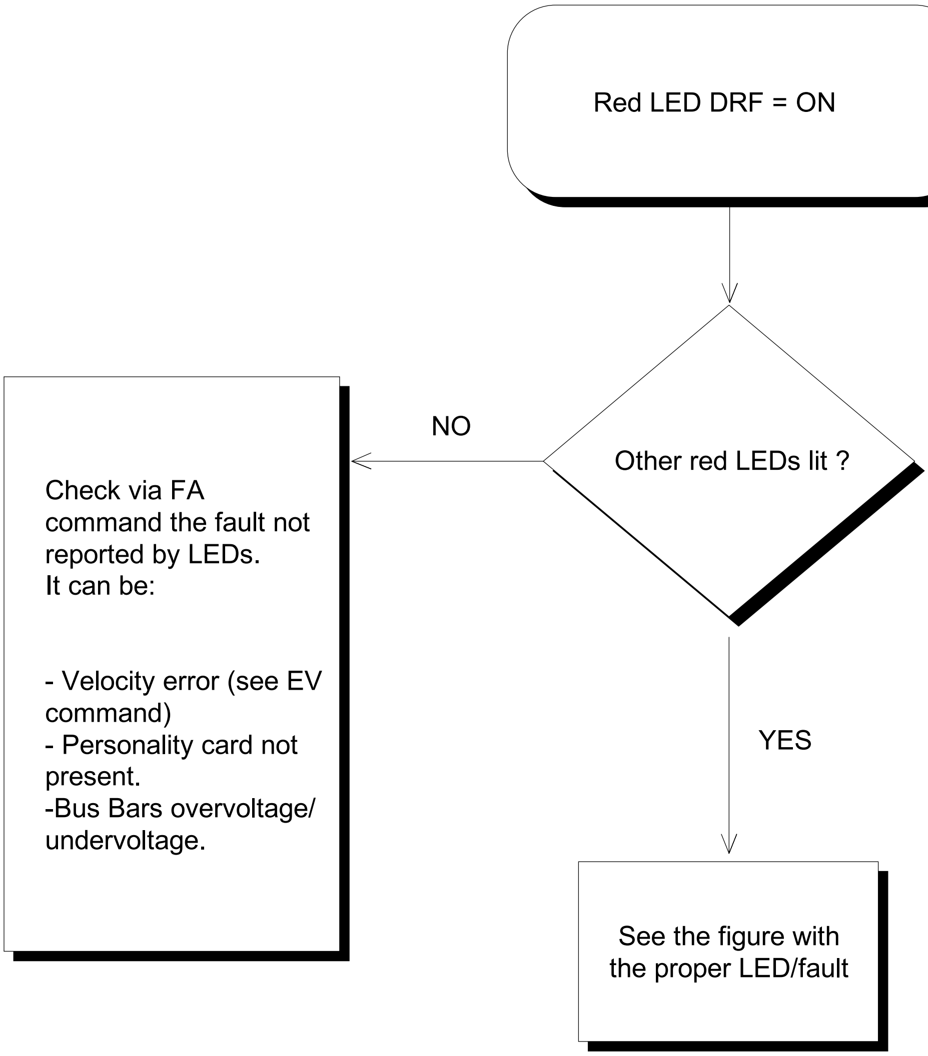


**FIG. 7.14 - Motor vibrates**

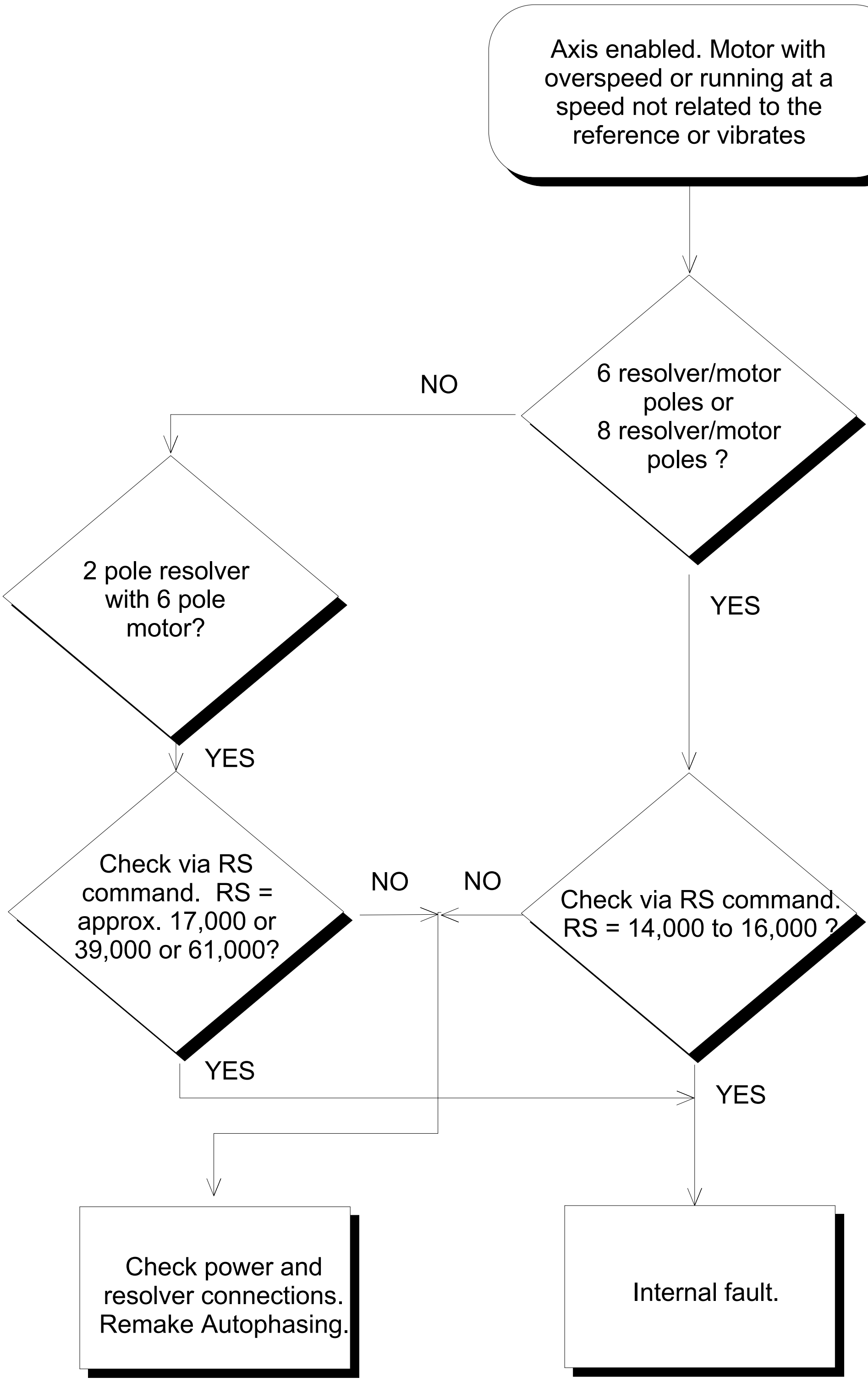


**FIG. 7.15 - Keypad fault**

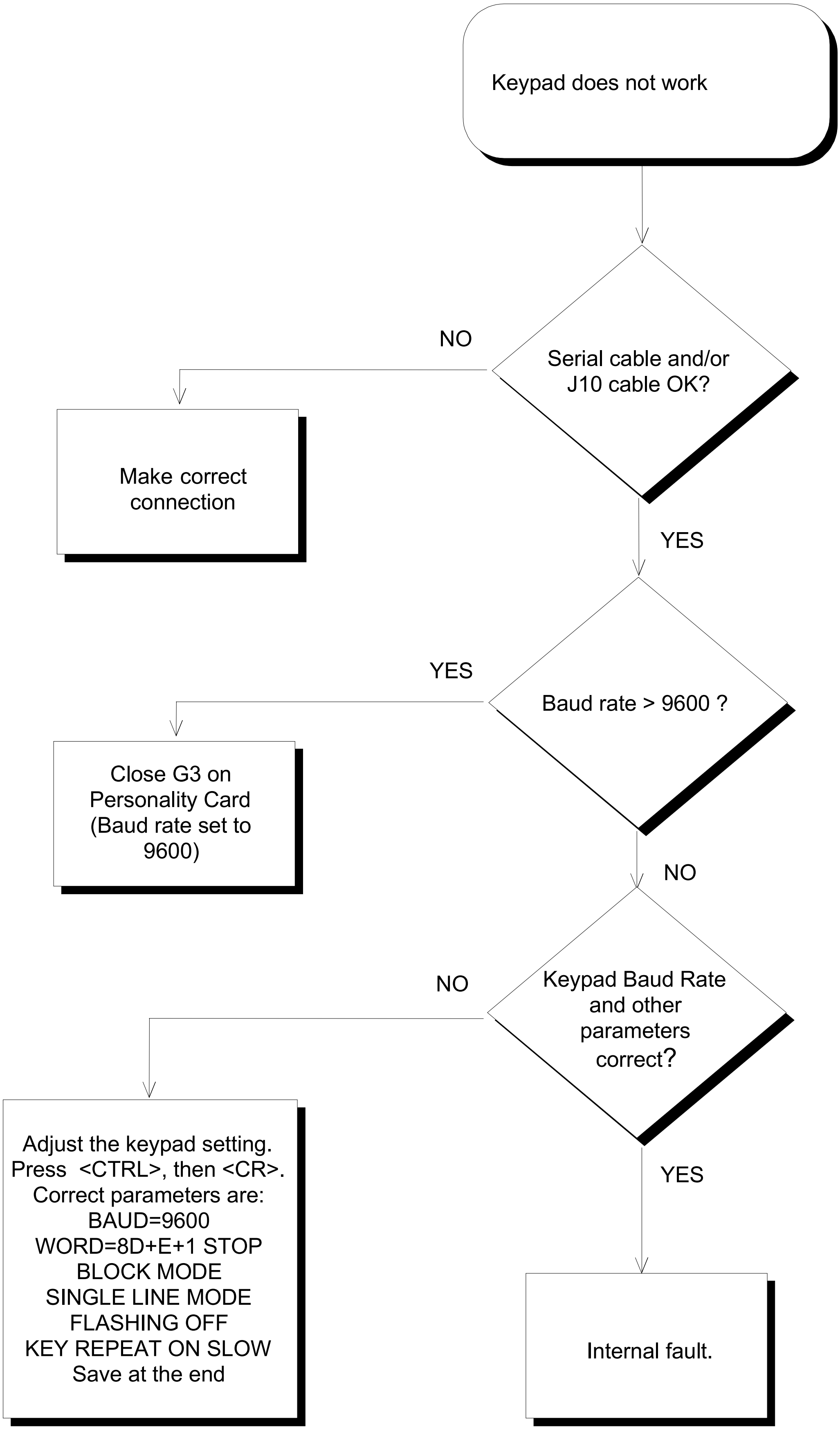


**FIG. 7.16 - Motor at zero speed**

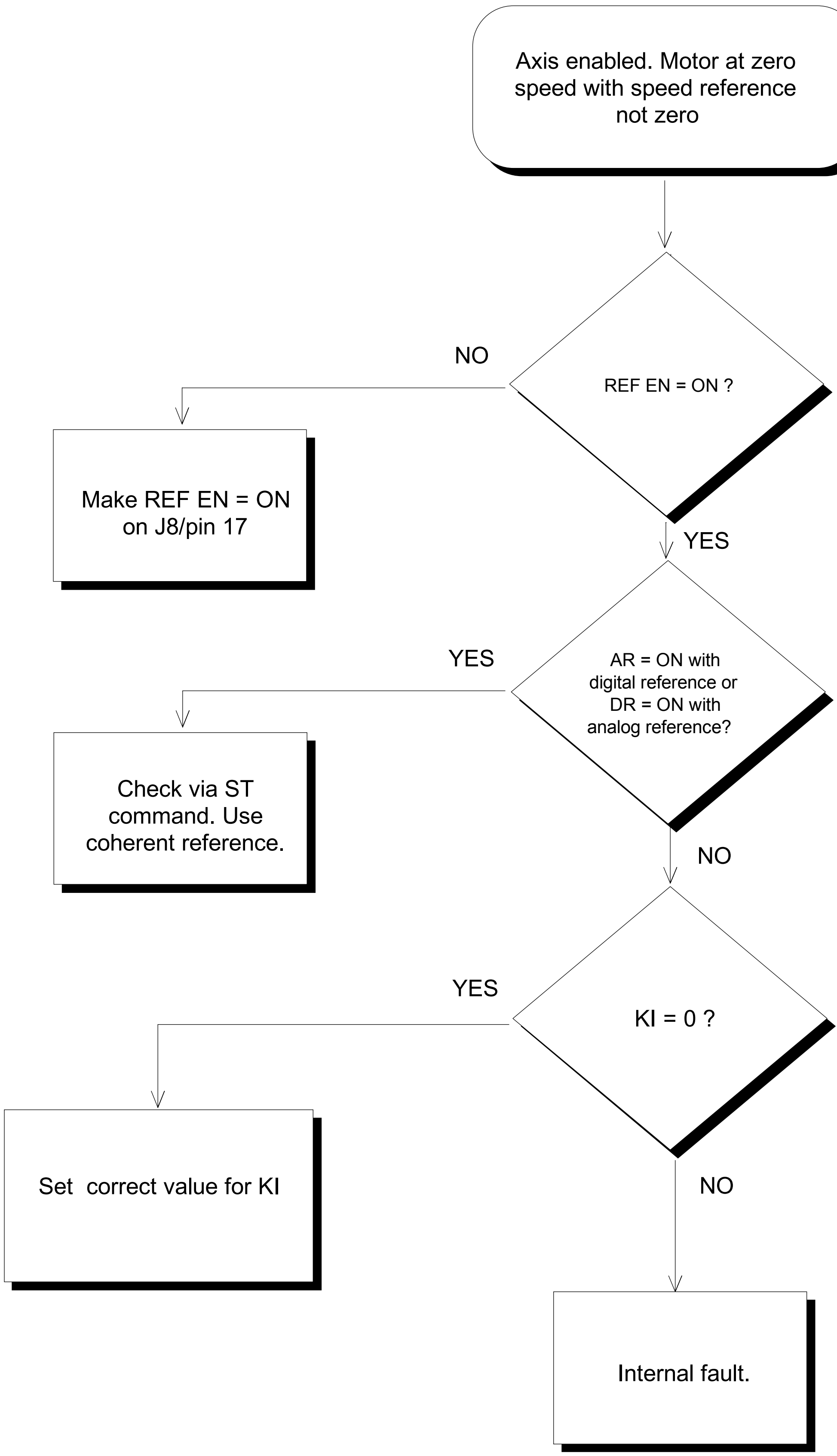
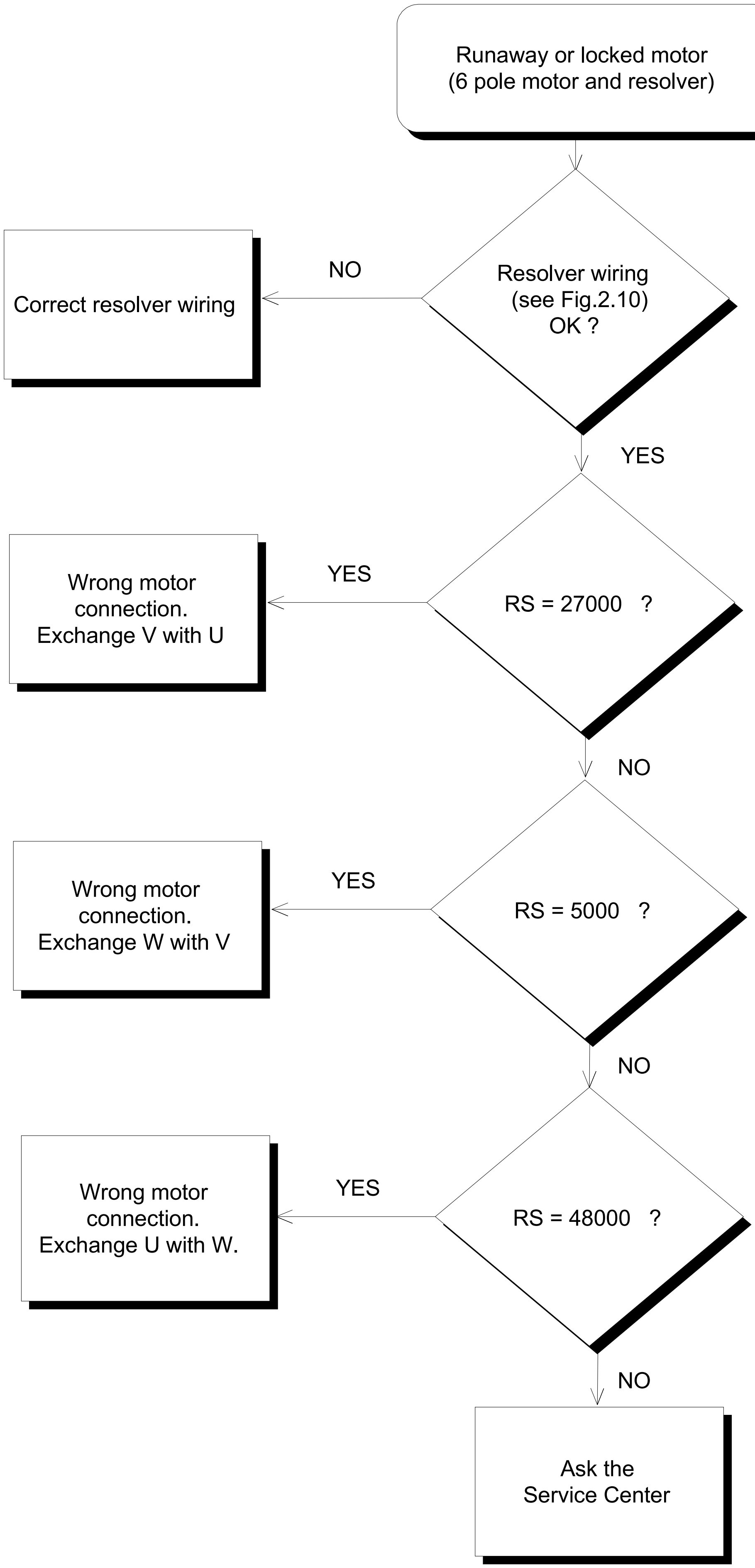


**FIG. 7.17 - Runaway or locked motor (6 pole motor and resolver)**



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