DBP SERIES
HARDWARE MANUAL

Rev 6/93

ELMO-WARRANTY PERFORMANCE

The warranty performance covers only ELMO's products and only the elimination of problems that are due to manufacturing defects resulting in impaired function, deficient workmanship or defective material. Specifically excluded from warranty is the elimination of problems which are caused by abuse, damage, neglect, overloading, wrong operation, unauthorized manipulations etc.

The following maximum warranty period applies:

12 months from the time of operational startup but not later than 18 months from shipment by the manufacturing plant.

Units repaired under warranty have to be treated as an entity. A breakdown of the repair procedure (for instance of the repair of a unit into repair of cards) is not permissible.

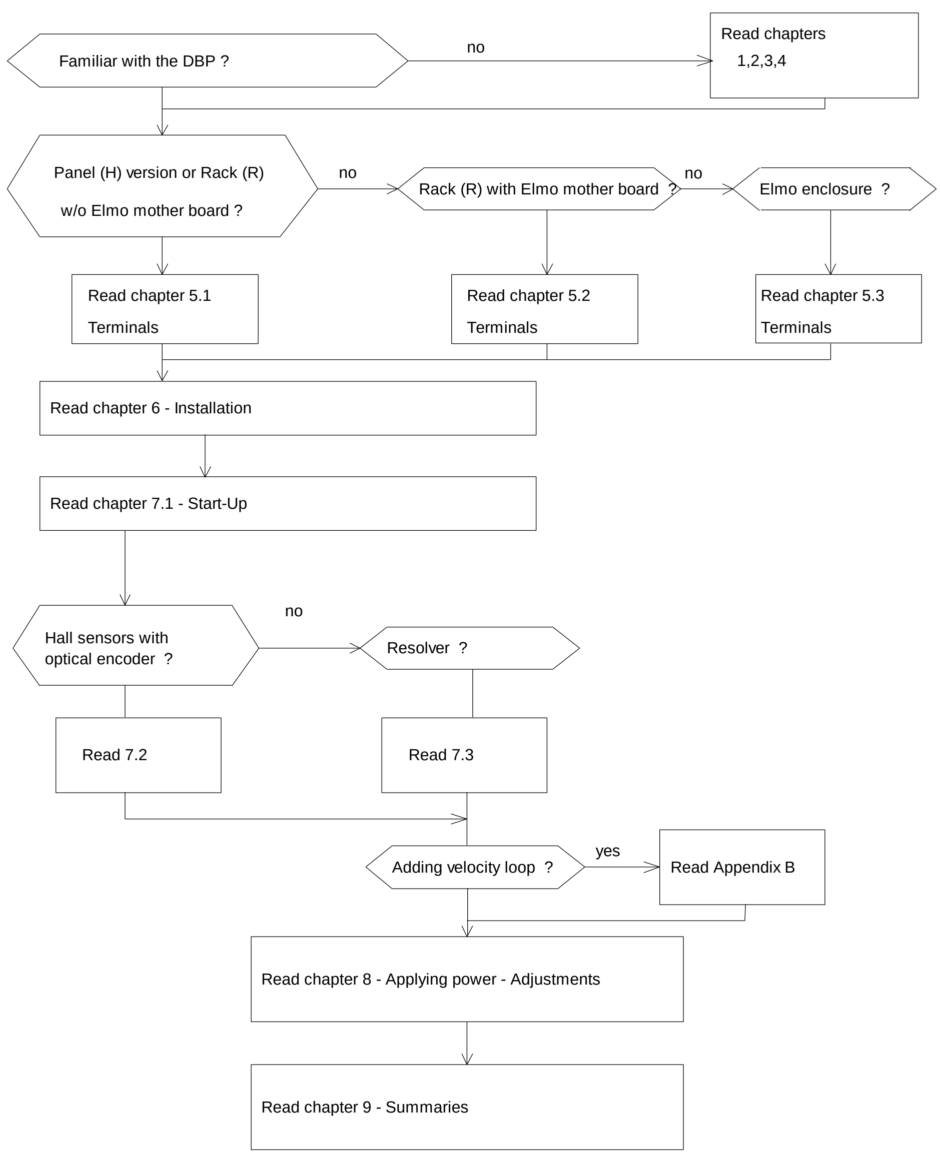
Damage claims, including consequential damages, which exceed the warranty obligation will be rejected in all cases.

If any term or condition in this warranty performance shall be at variance or inconsistent with any provision or condition (whether special or general) contained or referred to in the Terms and Conditions of Sales set out at the back of Elmo's Standard Acknowledge Form, than the later shall prevail and be effective.

How to use this manual - Flow Chart

The DBP HARDWARE MANUAL will lead you toward a successful start-up of your digital amplifier. Please review carefully the following flow chart and write down the chapters that you have to follow in the right order. Only after performing all the steps you may proceed to the software manual.

If you are a new user of the DBP, you better not skip chapters 1-4 which will familiarize you with the product.



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1.Description

The DBP series are digital, full wave, three phase servo amplifiers designed for high performance brushless servo motors in the range of up to 7KW. They utilize power MOSFETs and Surface Mounting Technology which contribute to its high efficiency and compact design. The DBP operates from a single AC supply (either single or three phase) and, when using the galvanic isolation option, it can be connected directly to the Mains.

The DBP is constructed from two main PCBs mounted on a heat sink plate. The lower board contains the rectifying bridge, the power switching transistors which drive the motor, terminals for the power stage, the switch mode power supply, the protection logic and commutation logic. The upper PCB is the Digital Control Board (DCB) which contains the digital control logic, terminals for the control stage, D-type connector for the communication and a 4-digit display.

The DBP requires a position sensor in order to enable its operation. It can be either a Resolver or a combination of an optical encoder and Hall effect sensors. When using a Resolver, a small interface card is mounted on top of the DCB.

The DBP is available in either panel version or rack version with two DIN 41612 connectors. The rack version can be fitted in a panel mount enclosure (ENCD-3U or ENCD-6U), that is specially designed for a simple hook-up procedure.

The amplifiers are fully protected against the following faults:

* Under/over voltage
* Shorts between the outputs or between the outputs to ground.
* RMS current limit.
* Insufficient load inductance.
* Loss of commutation signals.
* Excess temperature.
* Excess position error.

Analog Section Standard Features:

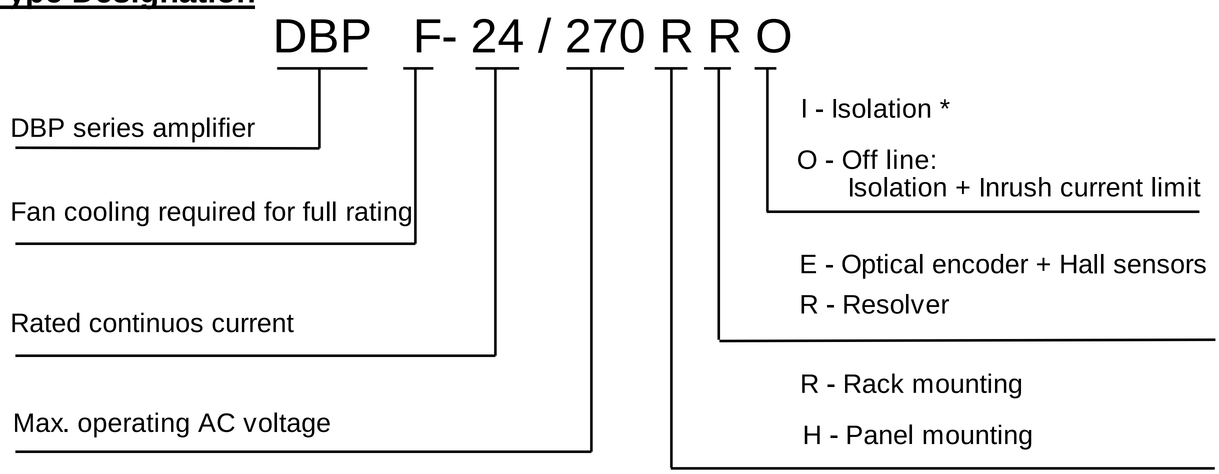
* Single AC supply (single or three phase)
* Zero Deadband.
* Motor current monitor.
* Motor speed monitor.
* Extra differential operational amplifier.

* Standard commutation sensors: Hall effect sensors or a Resolver.
* Galvanic isolation of the control stage - option.

Digital Section Standard Features

* Accepts motion commands via RS232 or RS485
* Buffering for pipe lining instructions prior to execution
* Battery-backed RAM for storing user programs and parameters
* Conditional statements for controlling program execution real- time.
* Programmable time and position trip points
* Variables for entering and changing system parameters
* 5 Uncommitted inputs
* 2 uncommitted high speed inputs.
* 10 Uncommitted outputs
* Arithmetic and logic functions for manipulating parameters
* Digital filter with programmable gain, damping and integrator
* Error handling, end of travel, emergency stop, status reporting.
* 0-600,000 quadrature counts/second speed range
* One analog input - 11 bit resolution
* Master/slave operation with programmable following ratio (master information from an optical encoder or from Pulse and Direction inputs)
* Dual-loop capability
* Adjustable continuous and peak current limits
* 4-digit display for diagnostics.

2. Type Designation



3. Technical Specification

Type	AC Supply* min max	Current limits	Size Panel(H)	Size Rack(R)	Weight (Kg)
DBP-12/135	28- 135	12/24	DBP2	3U/20T	1.4
DBP-20/135	28- 135	20/40	DBP3	6U/21T	3
DBP- 8/270	100- 270	8/16	DBP2	3U/20T	1.4
DBP-16/270	100- 270	16/32	DBP3	6U/21T	3
DBPF-12/135	28- 135	12/24	DBP1	3U/13T	0.7
DBPF-20/135	28- 135	20/40	DBP4	6U/13T	1.3
DBPF-30/135	28- 135	30/60	DBP6	6U/21T	3
DBPF- 8/270	100- 270	8/16	DBP1	3U/13T	0.7
DBPF-16/270	100- 270	16/32	DBP4	6U/13T	1.3
DBPF-24/270	100- 270	24/48	DBP6	6U/21T	3

* These are the absolute minimum-maximum AC supply voltage under any condition.

General

* DC output voltage is 130% of AC input voltage.
* 2KHz current loop response
* Outputs voltages of +5V/0.2A, ±15V/0.1A for external use.
* Efficiency at rated current - 97%.
* Operating temperature: 0 - 50°C.
* Storage temperature: -10 - +70°C.

3.1 Digital I/O specification

Digital Inputs:

High/Low input definition: Vil<1V, Vih>2.4V

Maximum input voltage: 30V

Input impedance: 3-7Kohm

Input hysteresis: typ 1V.

When left open: low level.

Input threshold level can be shifted on request.

The fast inputs capture events (input voltage level going from low to high) of less then 10µsec duration.

Digital Outputs:

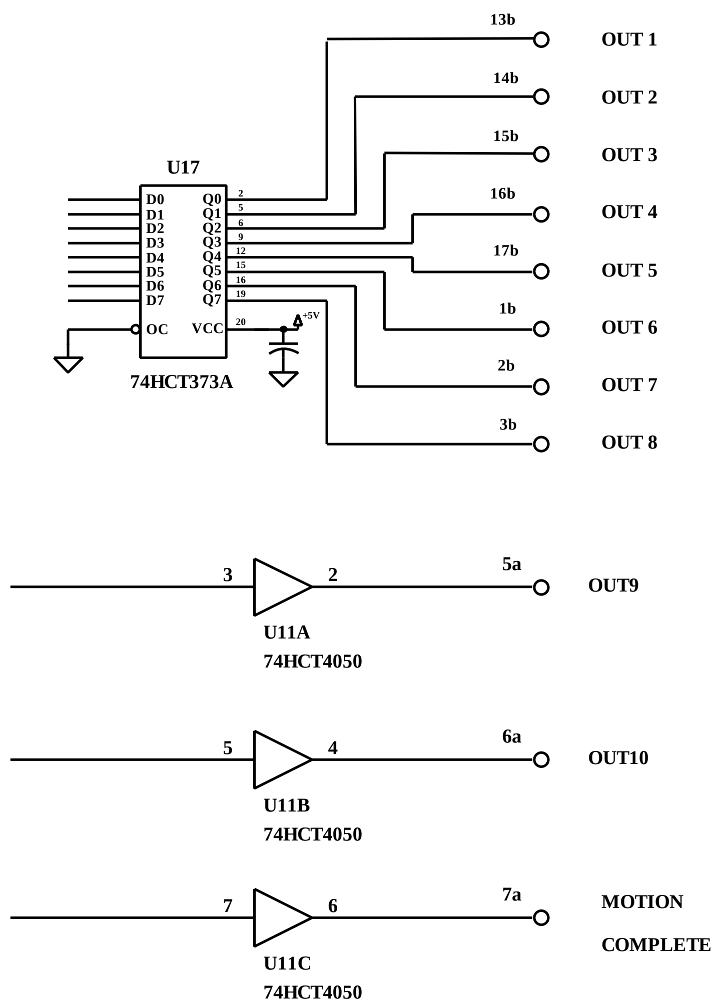
High/Low output definition: Vol<0.4V, Voh>4V

Output level: 0-5V

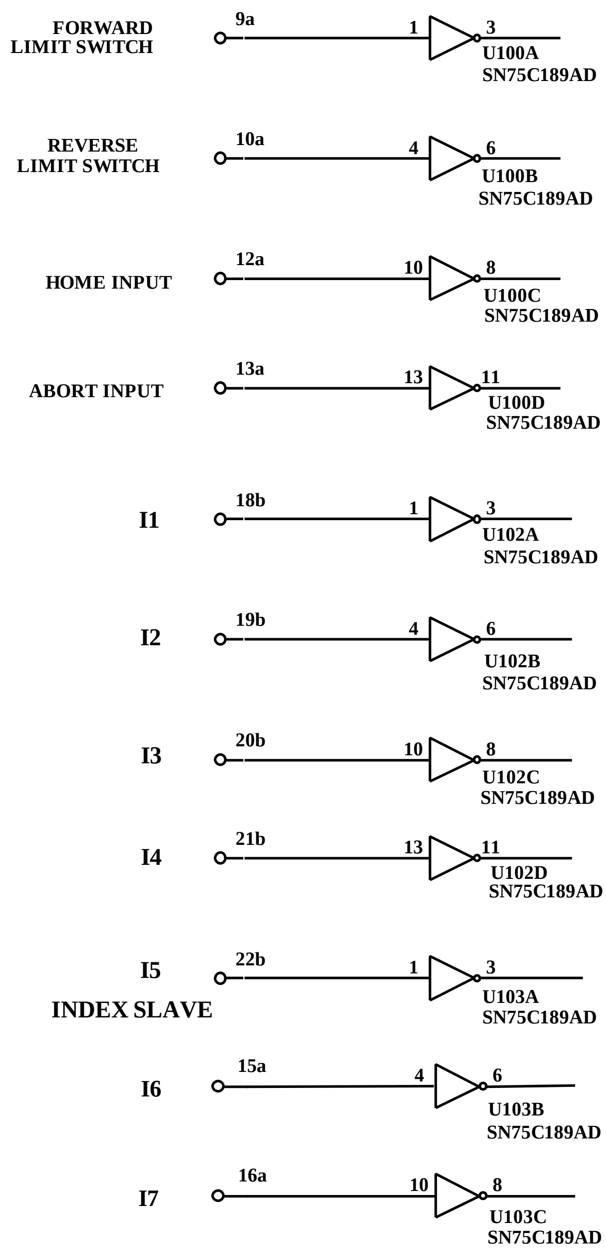
Recommended output current: Iol=Ioh=5mA

Maximum output current ±10mA

The outputs are normally at low level.



DIGITAL OUTPUTS



DIGITAL INPUTS

3.2 Analog input specification

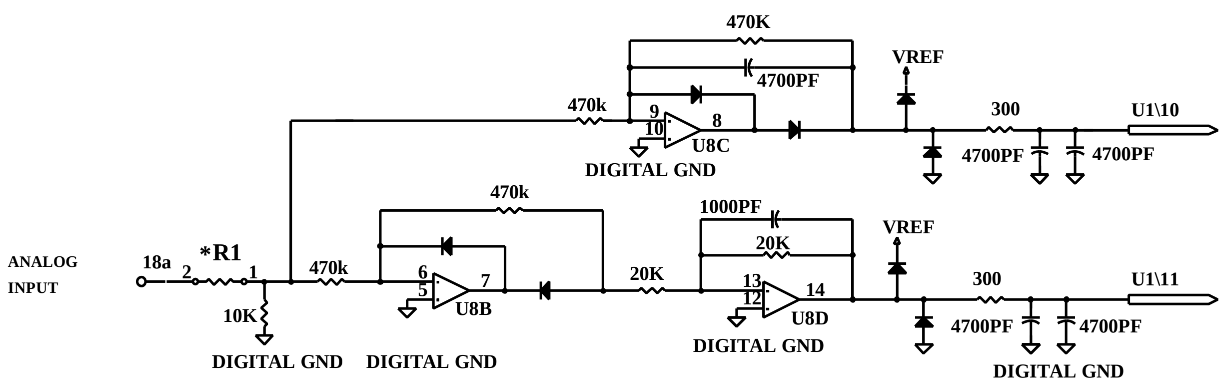
Maximum input voltage:

- When R1 (470ohm) is inserted, the absolute value of the input voltage should be less than 5V.
- When the absolute value is higher than 5V, R1(Kohm) = 2Vi-10 should be inserted.

The µP reads always ±5V.

Resolution of the digital conversion: 11 bit full scale.

Typical offset: 5 bits



ANALOG INPUT

3.3 Sensors specification

3.3.1 Encoder

The encoder must be incremental with two TTL channels in quadrature and 90° phase shift.

High/Low input definition: Vil<1.5V, Vih>3V

Input voltage range: 0-15V

Input hysteresis 1.5V

Input impedance: 1Kohm to 5V.

Maximum frequency main encoder: 150KHz

Maximum frequency auxiliary encoder: 250KHz

Noise protection by analog and digital filters

When left open the input is internally pulled to high level.

3.3.2 Resolver

Resolver Option Feature:

* 10,12,14 and 16 bit resolution set by the user.
* Maximum tracking rate 1040 rps (10 bits).
* Velocity output.
* Encoder A, B, outputs + programmable index output.

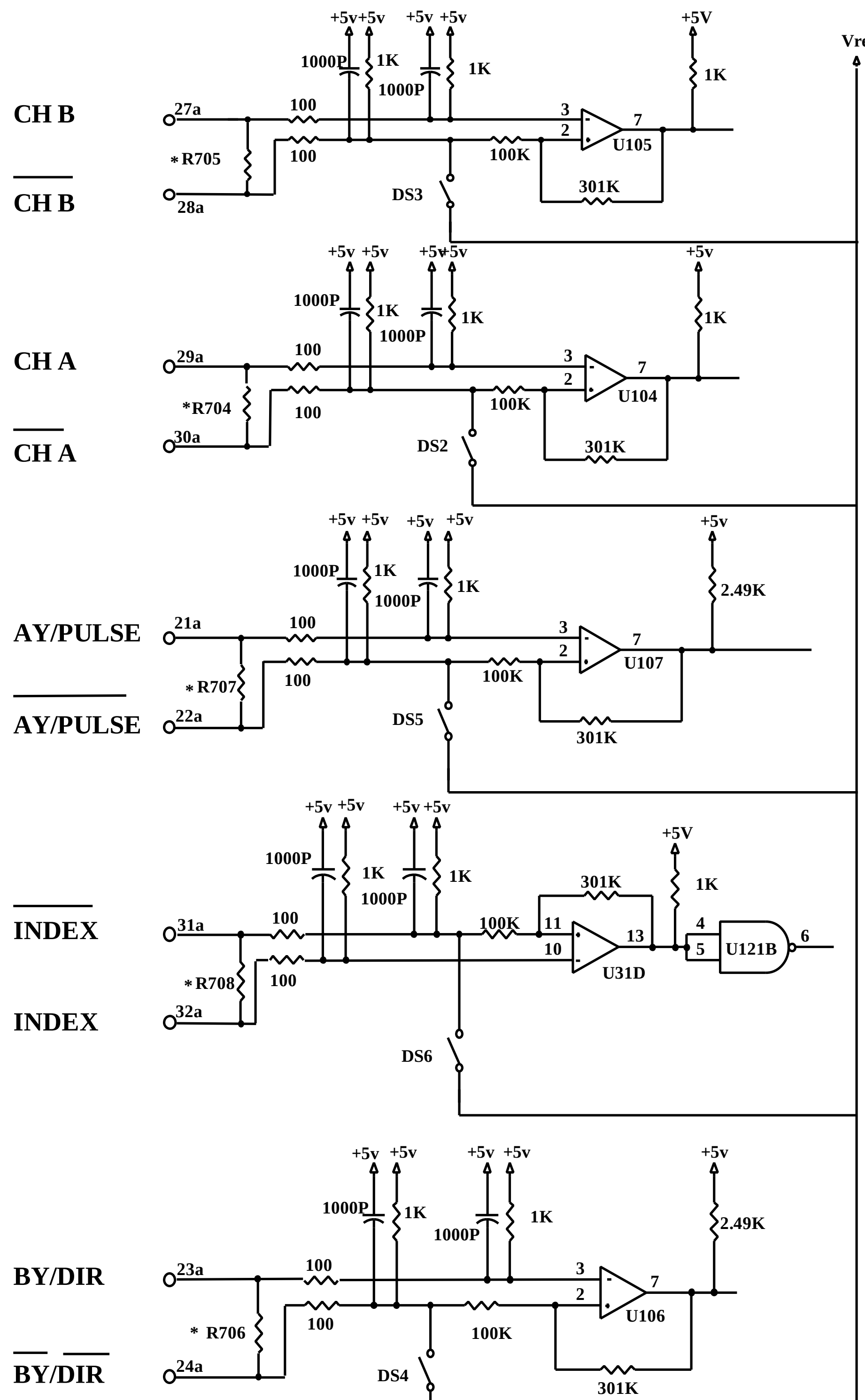
Reference parameters:

Max. voltage: 20Vptp or 7Vrms

Minimum output voltage: 2Vrms

Max. current: 80mA

Max frequency: 20KHz outputs:



REMARK:

R704 - 708 ARE NOT INSTALLED IN FACTORY STANDARD SETTING.

ENCODER INPUTS

3.4 Communication

3.4.1 RS232 Configuration

The RS232 is configured for 8-bit, no parity, full duplex and it will echo all the transmissions.

Baud rates: 300,600,1200,2400,4800,9600,19200,38400,57600

No hardware handshaking is required.

3.4.2 RS485 Configuration

The RS485 is configured for 8-bit, no parity, half duplex.

Baud rates: 300,600,1200,2400,4800,9600,19200,38400,57600

No hardware handshaking is required.

3.5 Battery backup

180mAH battery that at rated operating and storage condition will last for at least 40,000 non operating hours.

3.6 Performance

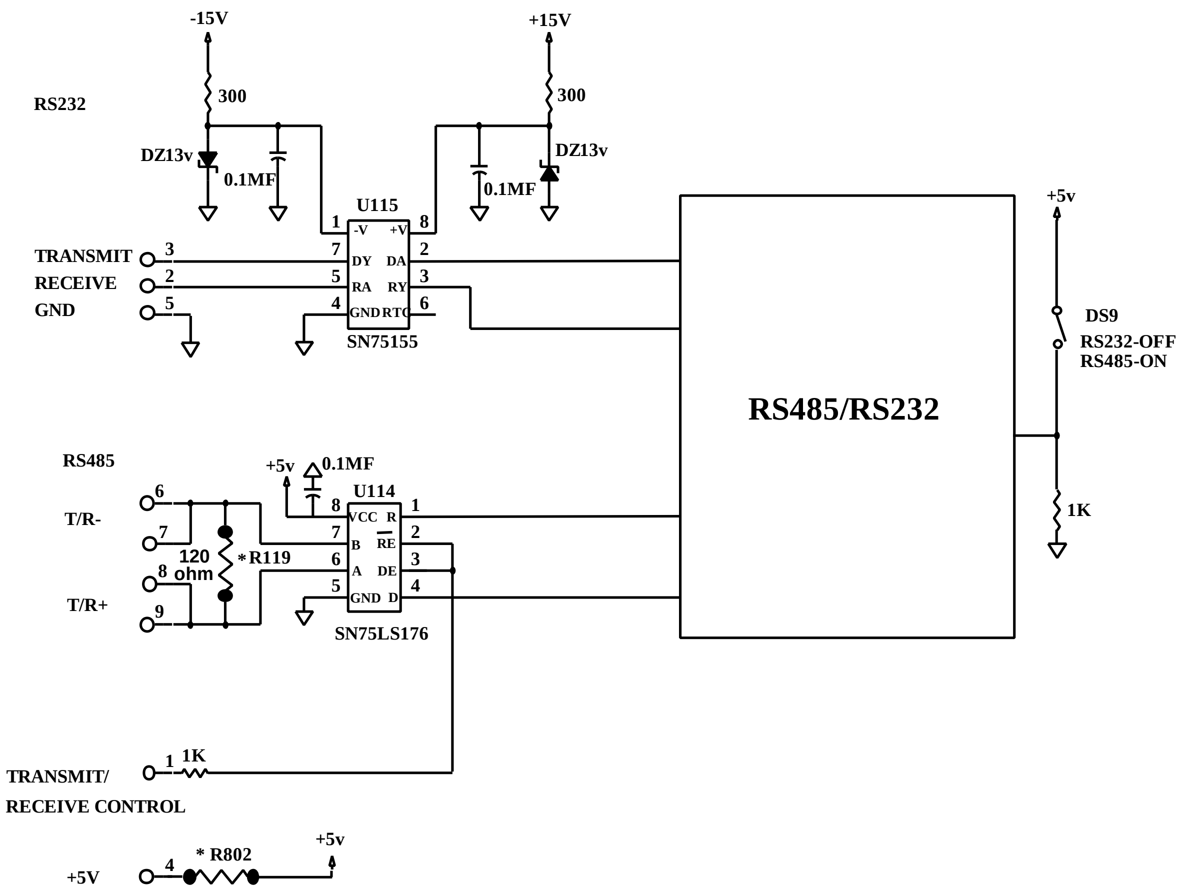
Position range: $\pm 2^{30}$ quadrature counts

Velocity range: $\pm$600,000 counts/sec

Velocity resolution: 1 count/s

Acceleration range: 91 - 11.8×10^{6} count/s

Acceleration resolution: 91 counts/s^{2}



Notes:

*R119 - LINE TERMINATION RESISTOR, USED ON BOTH ENDS OF LONG LINES. NORMALLY NOT MOUNTED.

* R802 - SMD RESISTOR. NORMALLY NOT MOUNTED

COMMUNICATION

4. System Operation

4.1 RS485 and Checksum Protocol

The RS485 in the DCB is configured as 8-bit, no parity, 1 stop bit, half duplex. The following baud rates are available: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600. No hardware handshaking is required.

In the RS-485, which is a Half Duplex system, all the Transmitters and all the Receivers share the same Multidrop wire. Therefore, each character that is transmitted on the line, is automatically received by all the Receivers. This is an inherently "confused" way to transmit data and no "Echo" procedure can assure reliable communication.

In order to solve this reliability problem, it is necessary to use standard protocols procedures.

It is important to understand that using RS485 with the DCB products without any protocol is possible. This is also the default condition whenever the RS485 is activated. However, the reliability of the communication is only assured when activating the protocol. This is done by sending the command CK1 from the host to the DCB.

Chapter 1.2.1 in the DCB Software manual explains the standard protocol used and supplied by Elmo.

4.2 Current Control

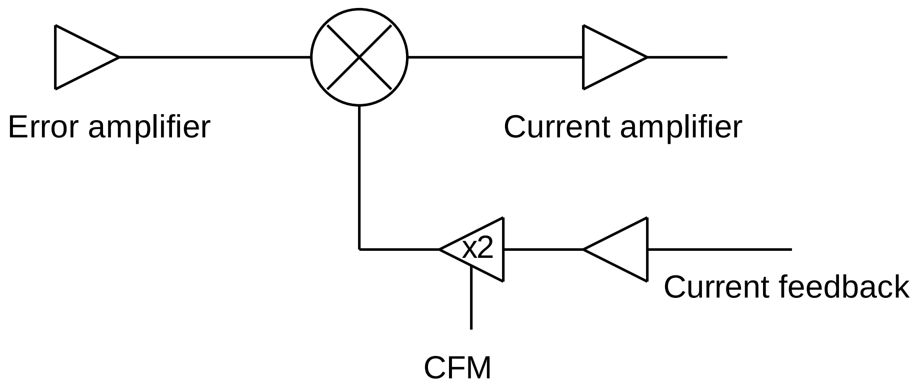
The analog part of the DBP is actually a standard amplifier that operates in current mode. However, the DCB receives continuously analog information about the current magnitude, direction and ripple. This information is processed to obtain digital control of the following features:

* Continuous current limit
* Peak current limit
* Time dependent peak current limit
* Current ripple

4.2.1 Current feedback, Current feedback multiplier (CFM) and Current loop

Three current feedbacks are obtained by measuring the voltage drop across current sensing resistors or by current transformers (when using the isolation option). These three signals are synthesized and multiplexed which result in a single voltage signal proportional to phases currents. It is then compared to the current command. The error is processed by the current amplifier to provide a voltage command to the PWM section.

Current loop control is obtained by op amp U21/A (current amplifier) and R4, C1 which form a lag-lead network for current loop. The standard amp is equipped with R4 and C1 to get optimum current response for an average motor in this power range. These components are mounted in solderless terminals.



The amplifier is equipped with a Current Feedback Multiplier (CFM). By turning DIP switch 2 (on the upper board of the power stage) to ON, the signal of the current feedback is multiplied by 2 and consequently the following changes occur:

- Current gains are multiplied by 2.
- Current monitor is divided by 2.
- Current limits are divided by 2.
- Dynamic range is improved.
- Commutation ripple is reduced.

This function should be activated whenever the rated current AND the peak current of the motor are less than 20% of the amplifier rated continuous and peak limits respectively.

Sometimes, oscillations may occur in the current loop due to the fact that the feedback gain was multiplied. This can be resolved by substituting R4 with a lower value.

4.3 Digital current limits

The servo amplifier can operate in the following voltage-current plane:

-Ip	**-Ic**	**+V** **Ic**	**Ip**
Intermittent zone	**Continuous zone**	**-V**	

Ic - Continuous current   Ip - Peak current

Fig. 4.1: Voltage-Current plane

Each amplifier is factory adjusted to have this shape of voltage-current operating area with rated values of continuous and peak current limits. By using the command CL(n) for the continuous and PL(n) for the peak it is possible to adjust the current limits (continuous and peak independently) from the rated values down to 10% of the rated values.

4.3.1 Time dependent peak current limit

The peak current duration is a programmable parameter which is also a function of the peak amplitude and the motor operating current before the peak demand. The user defines the maximum duration of the full amplitude peak by the instruction PDn - n cannot be more than 2 seconds. In addition to this definition, a digital filter is employed to ensure that the RMS value of the current will not exceed the continuous current limit. The duration of Ip is given by:

$$T_p = 2.2 \ln \frac{I_p - I_{op}}{I_p - I_c}$$

Iop - Actual operating current before the peak demand.

The result of this filter is that the maximum peak can last for a maximum of 2 seconds. A lower peak can last longer.

Example: A motor is driven by an DBPF-10/135 amplifier at constant speed and constant current of 5A. What is the maximum possible duration of a 20A peak ?

$$T_p = 2.2 \ln \frac{20 - 5}{20 - 10} = 0.892 \text{ seconds}$$

4.4 Digital position and speed control

The DCB accepts motion commands via an RS232 or RS485 communication line and receives position feedback in an incremental encoder format either from an encoder or from the resolver/digital circuit. The DCB derives the closed-loop position error by comparing the command position and the feedback position. The error is processed by a digital filter to yield with an analog motor command. The analog ± 5 volt range motor command is then amplified by the power amplifier.

Following is a summary of all the operating modes of the DCB and a detailed discussion of each of them.

Control Modes

Holding Modes.

Start Modes

Program Mode

Termination Modes

Status reporting

Define origin modes

Control Modes

The DCB can be commanded to control the position of a motor, its torque or its velocity using three basic control modes:

- Position Mode
- Velocity Mode
- Position Follower Mode

Position Mode

In the position mode the motor will advance a specified distance and then stop. This distance can be represented as an absolute position (PA n) or as a relative distance from the current position (PR n). The motion will follow a trapezoidal or triangular profile with the acceleration (AC n) and slew velocity (SP n) set by the user.

Velocity Mode

In the velocity mode the motor will accelerate to a specified slew speed. It will hold this speed until a stop condition is received (see termination modes), or a new velocity/direction is commanded.

Position Follower

It can also control the motor as a position follower of a master encoder or a pulse and direction signals.

Holding Modes.

The holding modes describe the behavior of the system after it has stopped. There are three holding modes:

- Servo
- Motor Off

Servo Mode

In the servo mode (SV) the system maintains stopping position by using its control law to correct for any position errors.

Motor Off Mode

In the Motor Off mode is, the power bridge and the position control are shut off and there no torque is generated by the amplifier. The Motor Off mode is useful in robotics applications in the teaching mode.

Start Modes

There are three start modes to begin a move:

Direct command

A move can be initiated directly by a command from the host or a terminal.

Program

A move can be initiated by a command included in the user program.

Input condition

Another alternative is to have the move started by a conditional statement specified by the user program.

Program Mode

A set of commands can be implemented as a user program to allow for automatic and/or complex types of moves. The user may specify software variables, conditional statements, subroutines and error routines which enable enhanced motion control.

Termination Modes

A motion can be terminated in a variety of ways. In all but emergency termination modes the motor will be decelerated gradually to a stop and then will enter one of the stationary modes (Servo, or Motor Off). In a position mode move, the motion will terminate naturally upon reaching the desired final position. In all of the control modes the motion can be terminated by a command from the host. An additional means of termination is from one of the local inputs.

Activating the forward and reverse limit switch inputs can be another means of terminating a move. Upon contacting the switch, the #[routine will be activated. This is a user programmed routine that should normally include a stop command to decelerate the motor to a full stop.

There are two methods of generating an emergency stop. The first is by an abort command from the host, and the other is by the local abort input. Upon receipt of either of these commands the system will go immediately to its stationary mode.

Another "unnatural" way to terminate a motion is whenever an internal amplifier inhibit (due to one of the protections) occurs. This turns off the power stage and the motor will decelerate to a stop by friction only. There are two modes of handling the internal amplifier inhibit:

Latch Mode

The power stage is disabled and only a reset will release it.

Auto restart

The power stage inhibit will automatically be released upon clearing the cause of the inhibit.

Status Reporting

Status is available to the user in several ways.

Communication

In response to the Tell Status command (TS) the DCB sends a coded message describing the status of the amplifier.

In addition, the host may request certain information at any time. This consists of the state of the system (GN?, ZR?, PL?, KI?), the state of the local inputs (TI), the torque level (TT), the current motor position (TP), the current motor velocity (TV) and the reason for a stop condition (TC).

Refer to the DCB Software Manual for further details.

Hardware signal

Motion complete signal

This output will go to high when motion is complete.

Inhibit output

Whenever the amplifier is inhibited, this open collector output goes to low. When using Elmo's mother boards a potential free relay replaces the open collector output.

4-digit display

Whenever a fault occurs, a fault message will be displayed for easy visual information. See chapter 9.1 for a summary of all amplifier's fault indications.

Define origin modes

The origin is that location at which the absolute position of the motor equals zero. This special location may be defined in two ways. First, the user may send a command (DH) which defines the current motor position to be the origin. The alternate method is to request the DCB to perform the homing sequence by commanding HM.

4.5 Operation of the shunt regulator

A shunt regulator is included in the power supply section of the DBP. The shunt regulator is a switching type, wherein dissipative elements (resistors) are switched across the DC bus, whenever the voltage reaches a predetermined level (Vr). The function of the shunt regulator is to regulate the voltage of the DC bus during the period of motor deceleration, when there is a net energy outflow from the motor to the amplifier. The amplifier handles this reverse energy just as efficiently as it provides energy to the motor, hence, most of the energy is passed through the amplifier to the power supply, where the returning energy charges the filter capacitors above their normal voltage level, as determined by the AC incoming voltage.

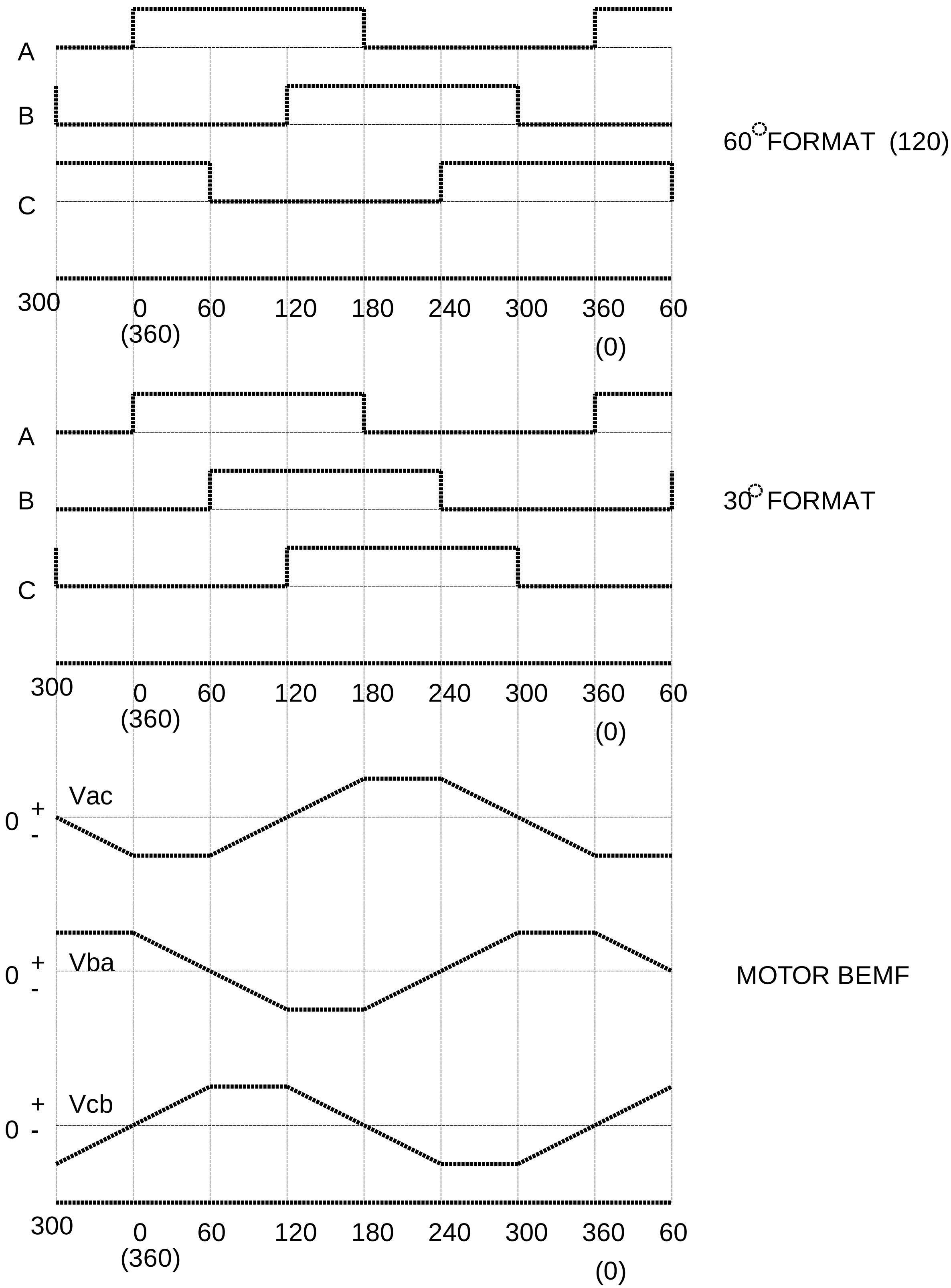
When the capacitors charge-up reaches the predetermined voltage level (Vr), the shunt regulator begins its regulating action. The bus is regulated to this range until regeneration ceases.

All the double Eurocard size amplifiers are equipped with two outputs for connecting an external shunt resistor , hence increasing the power dissipation capability.

SHUNT specifications

Type	Reg. Voltage (Vr)	Internal Reg. Current (A)	External Reg. Current (A)
DBP-12/135	193	13	N/A
DBP-20/135	193	26	21
DBP-8/270	383	8	N/A
DBP-16/270	383	16	12
DBPF-12/135	193	13	N/A
DBPF-20/135	193	26	N/A
DBPF-30/135	193	26	21
DBPF-8/270	383	8	N/A
DBPF-16/270	383	16	12
DBPF-24/270	383	16	12

4.6 Commutation signals format



4.7 Protective functions

All the protective functions except "Low Back-up Battery Voltage" activate an interrupt to the main processor which inhibits the power bridge and disable current flow to or from the motor. The user can interrogate the processor in order to verify the cause of the inhibit. An indication of the fault will appear on the display. The following protections are processed by the DCB:

4.7.1 Short circuit protection

The amplifier is protected against shorts between outputs, or either output to ground, or either output to the positive supply line.

4.7.2 Under/over voltage protection

Whenever the DC bus voltage is under or over the limits indicated in the technical specifications, the amplifier will be inhibited.

4.7.3 Temperature protection

Temperature sensor is mounted on the heatsink. If, for any reason, the temperature exceeds 85°C the amplifier will be inhibited. The amplifier will restart when the temperature drops below 80°C. The user can always interrogate the DCB about the heatsink temperature by using the command T?.

4.7.4 Internal power supply failure

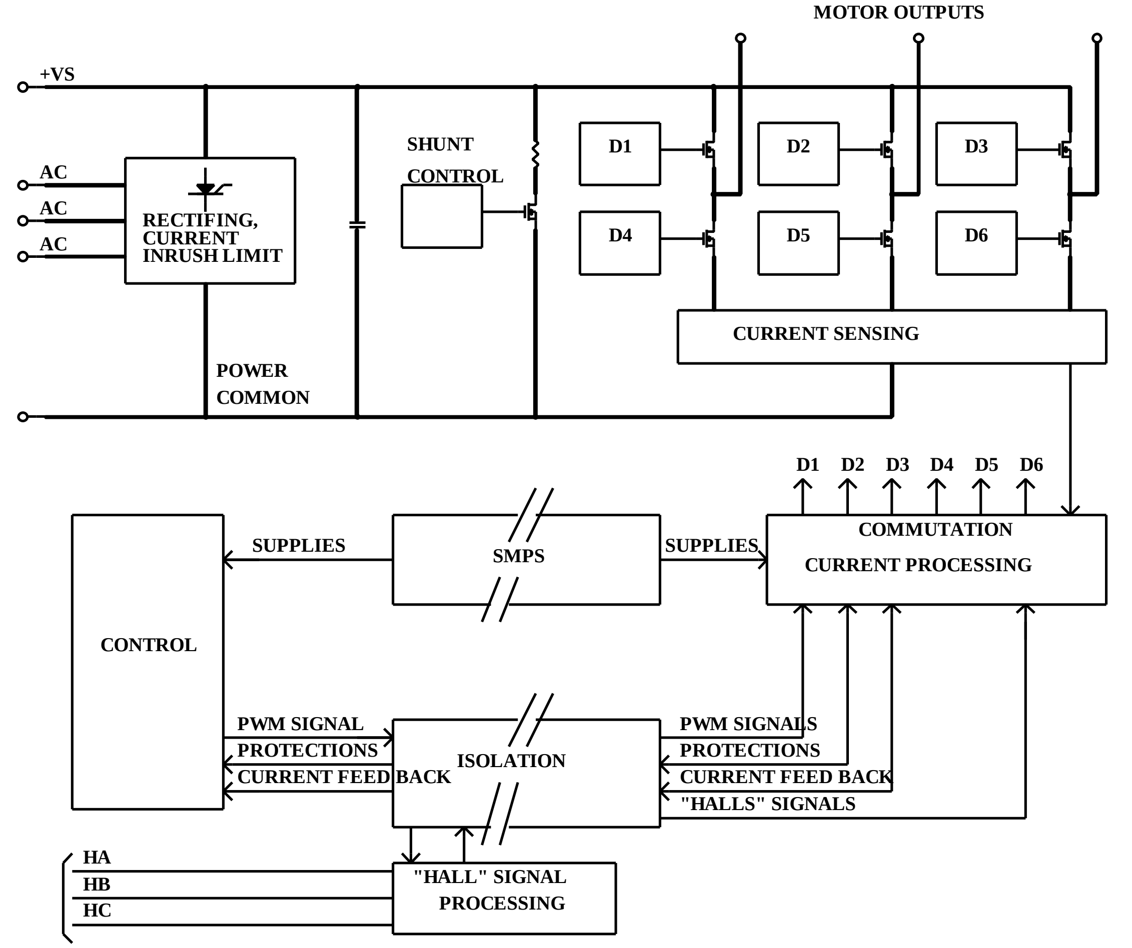
In any case that the sum of the internal power supplies is below 13V or its difference higher than 1V, the amplifier will be inhibited.

4.7.5 Loss of commutation feedback

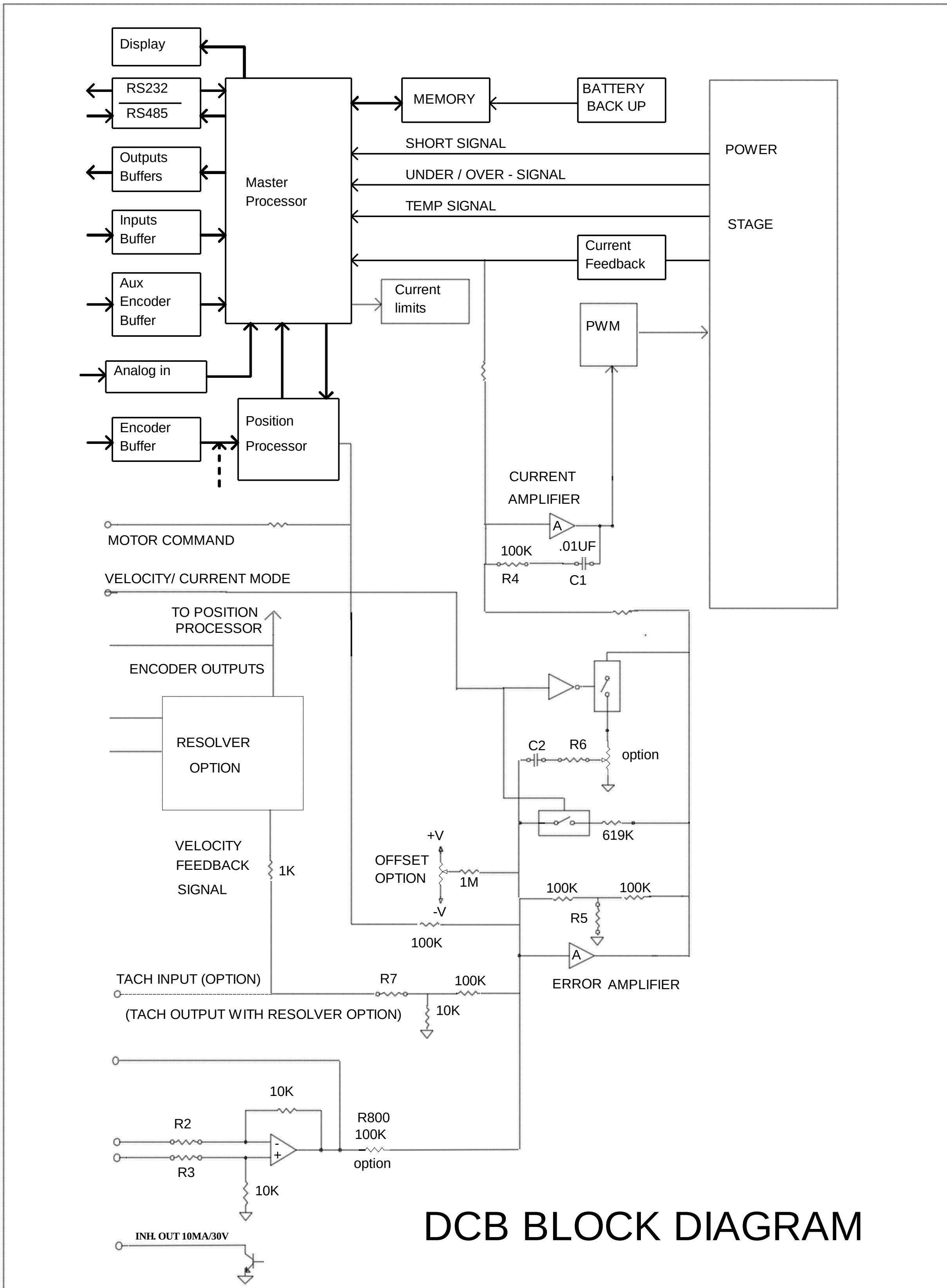
Lack of either of the commutation signals will inhibit the amplifier.

4.7.6 Low back-up Battery voltage

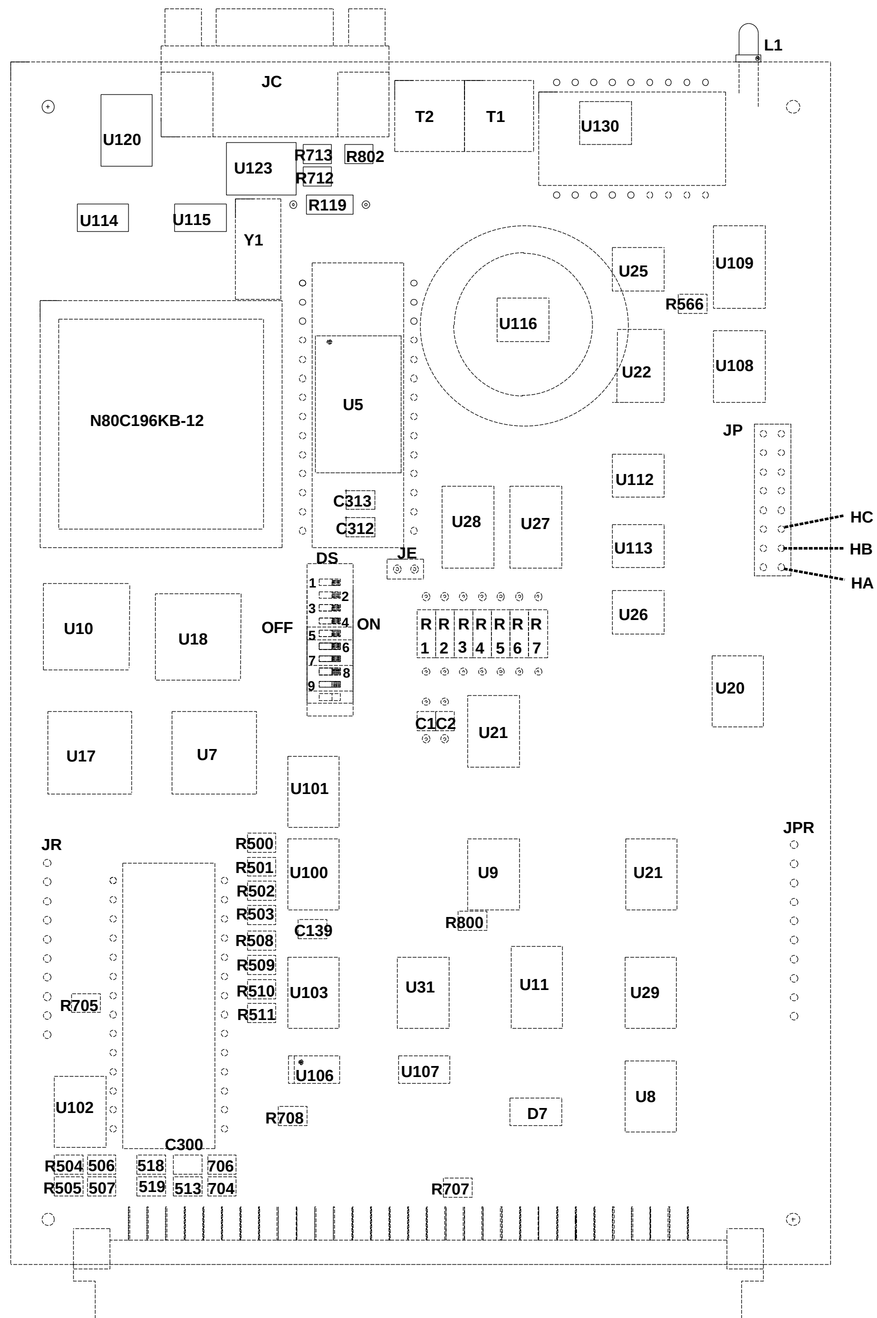
When the battery voltage goes below 2.4V the DCB will send a message on the communication line and will display "BATT" on the display.



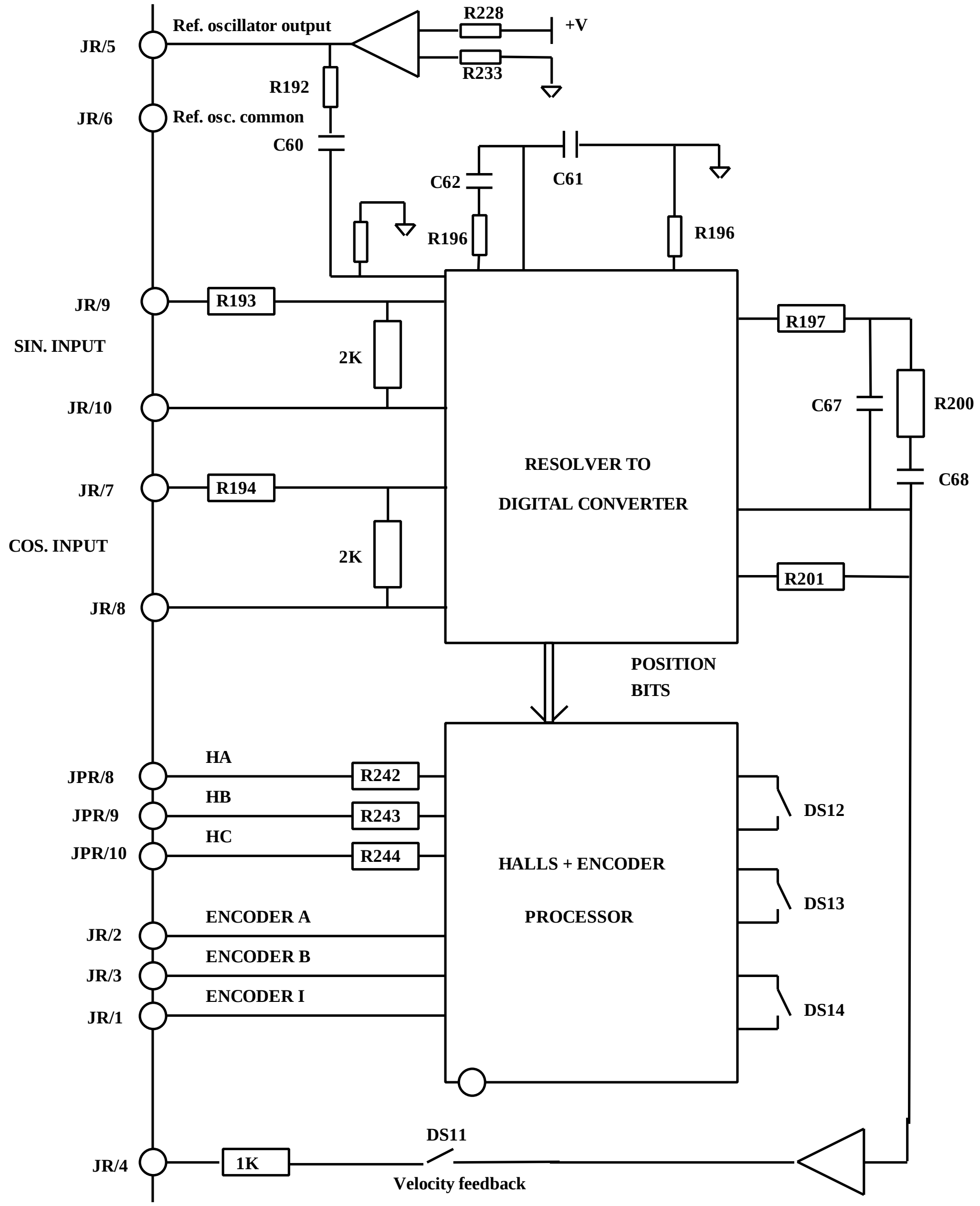
DBP 3U - BLOCK DIAGRAM



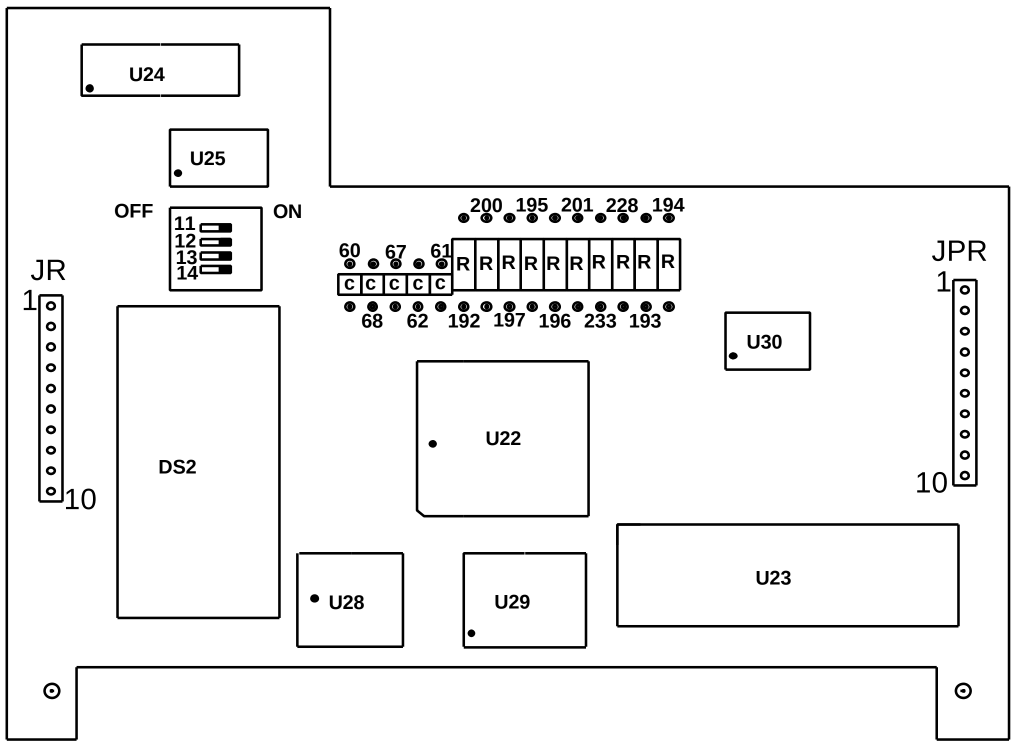
DCB BLOCK DIAGRAM



DCB COMPONENTS LAYOUT



DCB RESOLVER OPTION BLOCK DIAGRAM



RESOLVER BOARD COMPONENTS LAYOUT

5. Terminal Description

5.1 Terminals for Horizontal and Rack mounting versions

POWER BOARD - 3U size

H	R	Function
1	**(32a,c)**	Motor phase A output. With the DIN connector both pins must be connected.
2	**(30a,c**	Motor phase B output. With the DIN connector both pins must be connected.
3	**(28a,c)**	Motor phase C output. With the DIN connector both pins must be connected.
4	**(26a,c)**	AC supply-phase A. With the DIN connector both pins must be connected.
5	**(24a,c)**	AC supply-phase B. With the DIN connector both pins must be connected.
6	**(22a,c)**	AC supply-phase C. With the DIN connector both pins must be connected.
7	**(20a,c)**	DC power positive (+Vs)
8 **9**	**(18a,c** **16a,c)**	DC power common
10	**(14c)**	Hall sensor A *
11	**(12c)**	Hall sensor B *
12	**(10c)**	Hall sensor C *
13	**(8c)**	+15VDC for Hall sensors supply.
14	**(6c)**	Circuit common for the Hall sensors supply (Control common).
15	**(4c)**	24V common - for the fan supply only.
16	**(2c)**	+24VDC, 400mA for use with brushless fan

* $-1V \leq Vil < 1V$; $2V \leq Vih < 30V$
Source sink capability - 2mA min.

Power Board - 6U size - Supplies terminals

H	R	FUNCTION
+VS	**4ac,2ac**	External shunt resistor connection / +VS.
NC		NOT CONNECTED
SO	**8ac**	External shunt resistor connection.
NC		NOT CONNECTED
POW COM	**14ac,12ac**	POWER COMMON
NC		NOT CONNECTED
AC	**20ac,18ac**	AC supply-phase A. With the DIN connector all pins must be connected.
AC	**26ac,24ac**	AC supply-phase B. With the DIN connector all pins must be connected.
AC	**32ac,30ac**	AC supply-phase C. With the DIN connector all pins must be connected.

Power Board - 6U size - Motor terminals

H	R	FUNCTION
HC	**2c**	Hall sensor C *
HB	**4c**	Hall sensor B *
HA	**6c**	Hall sensor A *
-FAN	**8c**	24V common - for the fan supply only
+FAN	**10c**	+24VDC, 400mA for use with brushless fan
MC	**18ac,16ac,14a**	Motor phase C output. With the DIN connector all pins must be connected.
MB	**26c,24ac,22ac**	Motor phase B output. With the DIN connector all pins must be connected.
MA	**32ac,30ac,28c**	Motor phase A output. With the DIN connector all pins must be connected.

* $-1V \leq V_{il} < 1V$; $2V \leq V_{ih} < 30V$
Source sink capability - 2mA min.

Control board

H & R	Function	Remarks
1a	**Output 6**	*
1b	**Current monitor**	This analog output represents the actual current in the motor. The scale (in A/V) is: Ip / 7.5 Ip - Rated peak current of amplifier.
2a	**Output 7**	*
2b	**Velocity / current mode selection**	When input is left open (low level) the analog part of the amplifier is working in current mode. when a high level signal is applied (>2V), the analog part of the amplifier is working as a high gain velocity amplifier.**
3a	**Output 8**	*
3b	**Motion command (±5V)**	This analog output represents the current command from the position loop to the power amplifier. It is useful for monitoring the position loop response.
4a	**Circuit common**	
4b	**Circuit common**	
5a	**Fast output 9**	*
5b	**+5V output**	There are several +5V terminals. The accumulative external load should not exceed 200mA.
6a	**Fast output 10**	*
6b	**Circuit common**	
7a	**Motion Complete**	This output will go to high when motion is complete. *
7b	**+15V output**	100mA.
8a	**Inhibit output**	Whenever the amplifier is inhibited, this open collector output goes low.
8b	**-15V output**	100mA.

---

* Vol<0.4V, Voh>4V, Output level: 0-5V, max output current ±5mA

** Vil<1V, Vih>2.4V, Maximum input voltage: ±30VDC

Control board - cont.

H & R	Function	Remarks
9a	**Forward limit switch**	This committed input activates the #[subroutine.*
9b	**positive input of a differential amplifier.**	See Appendix C.
10a	**Reverse limit switch**	This committed input activates the #[subroutine.*
10b	**Negative input of a differential amplifier.**	See Appendix C.
11a	**Circuit common**	
11b	**Output of a differential amplifier.**	See Appendix C.
12a	**Home switch**	*
12b	**Tachogenerator output/input**	When using the resolver option this output is the velocity monitor with a scale of 8V for maximum speed. See 7.3.
13a	**Abort input**	This input must be connected to high level voltage to enable the amplifier.*
13b	**Output 1**	**
14a	**Circuit common**	
14b	**Output 2**	**
15a	**Fast input 6**	This fast response input can capture events with a duration of less than 10µs. An event is defined as an input voltage transition from low to high. *
15b	**Output 3**	**
16a	**Fast input 7**	Same function as Fast Input 6 (15a). *
16b	**Output 4**	**
17a	**Reset input**	*
17b	**Output 5**	**

---

* Vil<1V, Vih>2.4V, Maximum input voltage: ±30VDC

** Vol<0.4V, Voh>4V, Output level: 0-5V, max output current ±5mA

Control board - cont.

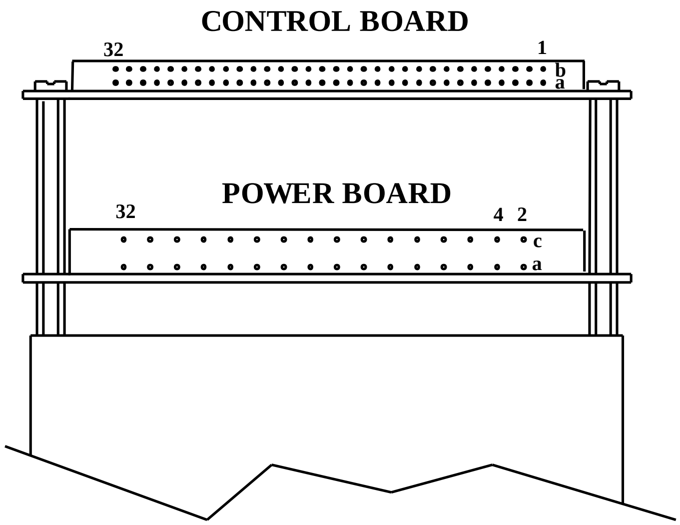
H & R	Function	Remarks
18a	**Analog input**	This input is monitored by the main µP. When |Vi| ≤ 5V, R1=470ohm should be inserted. When |Vi|> 5V, R1(Kohm)=2Vi-10 should be inserted. The µP always reads a range of ±5V.
18b	**Input 1**	*
19a	**+5V output**	There are several +5V terminals. The accumulative external load should not exceed 200mA.
19b	**Input 2**	*
20a	**Circuit common**	
20b	**Input 3**	*
21a	**Auxiliary encoder input (Ay) or pulse input for Pulse and Direction mode.**	
21b	**Input 4**	*
22a	**Auxiliary encoder complementary input (-Ay) or complementary Pulse and Direction mode**	
22b	**Input 5 or Index Input.**	If a homing sequence is required, the Index Input must be connected to Input 5 *
23a	**Auxiliary encoder input (By) or Direction input for Pulse and Direction mode**	
23b	**Resolver reference**	Max. voltage: 20Vptp or 7Vrms Max current: 80mA Max frequency: 20KHz

* Vil<1V, Vih>2.4V, Maximum input voltage: ±30VDC

Control board - cont.

H & R	Function	Remarks
24a	**Auxiliary encoder complementary input (-By) or Complementary Direction input for Pulse and Direction mode**	
24b	**Resolver reference common.**	The reference voltage to the resolver must be taken from terminals 23b and 24b only.
25a	**+5V output**	There are several +5V terminals. The accumulative external load should not exceed 200mA.
25b	**Cosine signal input.**	See 7.3
26a	**Circuit common**	For the auxiliary encoder
26b	**Cosine signal common.**	See 7.3
27a	**Channel B input**	
27b	**Sine signal input.**	See 7.3
28a	**Channel -B input**	
28b	**Sine signal common**	See 7.3
29a	**Channel A input**	
29b	**Circuit common**	For the main encoder
30a	**Channel -A input**	
30b	**Index output**	For resolver option only.
31a	**-Index input**	
31b	**Channel B output**	
32a	**Index input**	
32b	**Channel A output**	

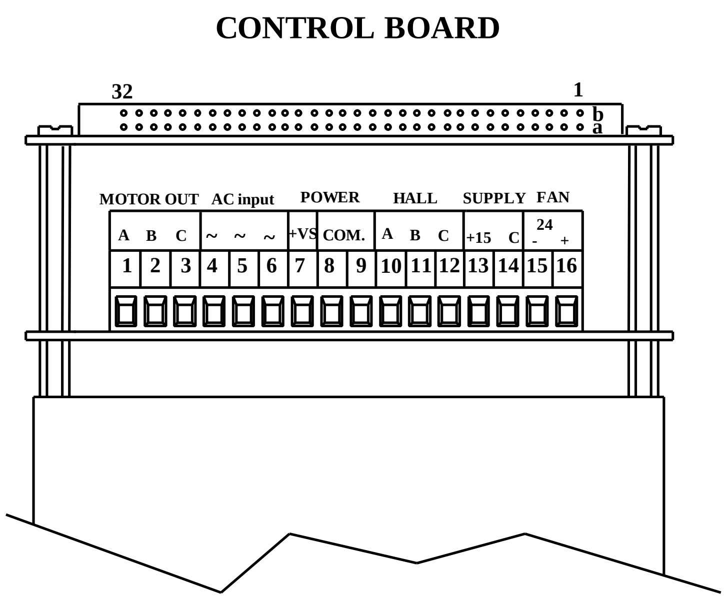
Remark: In the following paragraphs the terminals will be related to all the mounting types as in the following sample:
H/R-2a,E-J4/13.



TERMINALS OF DBP

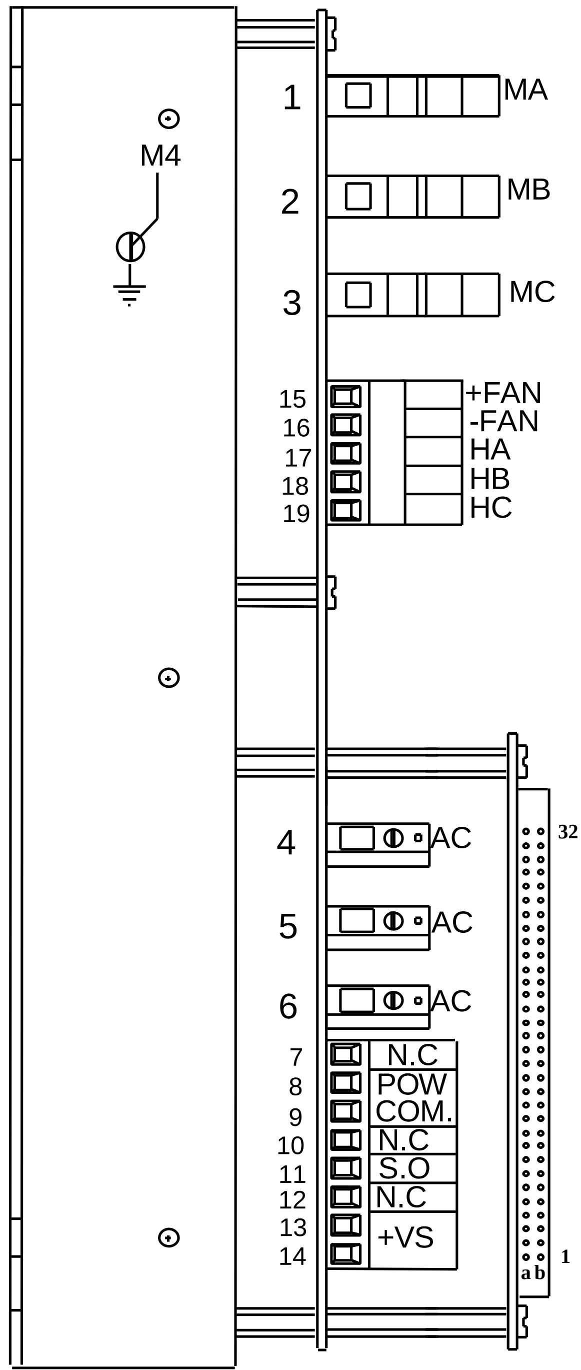
RACK VERSION - 3U SIZE

TERMINALS LAYOUT

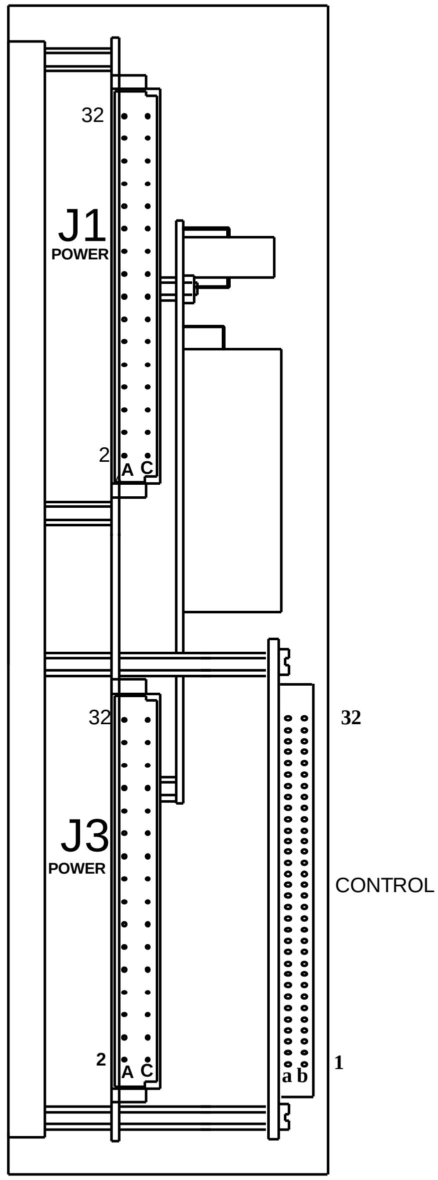


DBP - PANEL (H) MOUNTING TYPE

EUROCARD SIZE TYPES



DBP - PANEL (H) MOUNTING TYPE
DOUBLE EUROCARD SIZE TYPE



DBP-6U RACK TYPE CONNECTORS

5.2 Mother Boards terminals (MBA-DBP/3U and MBA-DBP/6U)

Use: For all DBP amplifiers (3U/6U size) with Resolver or optical encoder feedback. The encoder outputs are driven by line drivers to improve noise immunity.

Termination: Screw type terminals for the power and D-type connectors for the signals.

POWER TERMINALS FOR MBA-DBP/3U

H	R	Function
1	**(32a,c)**	Motor phase A output. With the DIN connector both pins must be connected.
2	**(30a,c**	Motor phase B output. With the DIN connector both pins must be connected.
3	**(28a,c)**	Motor phase C output. With the DIN connector both pins must be connected.
4	**(26a,c)**	AC supply-phase A. With the DIN connector both pins must be connected.
5	**(24a,c)**	AC supply-phase B. With the DIN connector both pins must be connected.
6	**(22a,c)**	AC supply-phase C. With the DIN connector both pins must be connected.
7	**(20a,c)**	DC power positive (+Vs)
8 **9**	**(18a,c** **16a,c)**	DC power common
10		Ground, this terminal is connecred through a screw to the rack chassis.
15	**(4c)**	24V common - for the fan supply only.
16	**(2c)**	+24VDC, 400mA for use with brushless fan

POWER TERMINALS FOR MBA-DBP/6U

Terminal	Function
M1	Motor phase A output.
M2	Motor phase B output.
M3	Motor phase C output.
GND	Ground. This terminal is connected to the ENC chassis.
AC	AC supply-phase A.
AC	AC supply-phase B.
AC	AC supply-phase C.
COM	DC power common
VS	DC power positive
SO	Auxiliary shunt output, for external shunt resistor.

Signals connector - J1 (MBA-DBP/3U and MBA-DBP/6U)

Pin	Function	Remarks
1	**Channel A input**	
2	**Channel -A input**	
3	**Channel B input**	
4	**Channel -B input**	
5	**-Index input**	
6	**Index input**	
7	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
8	**+15V output**	There are several +15V pins. The accumulative external load should not exceed 100mA.
9	**Circuit common**	

Signals connector - J2 (MBA-DBP/3U and MBA-DBP/6U)

Pin	Function	Remarks
1	**Resolver reference**	Max. voltage: 20Vptp or 7Vrms Max current: 80mA Max frequency: 20KHz
2	**Resolver reference common.**	The reference voltage to the resolver must be taken from pins 1 and 2 only.
3	**Cosine signal input.**	See 7.3
4	**Cosine signal common.**	See 7.3
5	**Sine signal input.**	See 7.3
6	**Sine signal common**	See 7.3
7	**+15V output**	There are several +15V pins. The accumulative external load should not exceed 100mA.
8	**-15V output**	There are several -15V pins. The accumulative external load should not exceed 100mA.
9	**Circuit common**	

Signals connector - J3 (MBA-DBP/3U and MBA-DBP/6U)

Pin	Function	Remarks
1	**positive input of a differential amplifier.**	See Appendix C.
2	**Negative input of a differential amplifier.**	See Appendix C.
3	**Output of a differential amplifier.**	See Appendix C.
4	**Circuit common**	
5	**Analog input**	This input is monitored by the main µP. When |Vi| ≤ 5V, R1=470ohm should be inserted. When |Vi|> 5V, R1(Kohm)=2Vi-10 should be inserted. The µP always reads a range of ±5V.
6	**Circuit common**	
7	**Circuit common**	
8	**Current monitor**	This analog output represents the actual current in the motor. The scale (in A/V) is: Ip / 7.5 Ip - Rated peak current of amplifier.
9	**Circuit common**	
10	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
11	**+15V output**	There are several +15V pins. The accumulative external load should not exceed 100mA.
12	**-15V output**	There are several -15V pins. The accumulative external load should not exceed 100mA.
13	**Channel B output**	
14	**Channel A output**	
15	**Index output**	For resolver option only.
16	**Not connected**	
17	**Inhibit output**	Relay contact (potential free). The relay contact is closed whenever the amplifier is enabled. Contact rating: 0.5A, 200V, 10W.

Signals connector - J3 - cont.

Pin	Function	Remarks
18	**Inhibit output**	Relay contact (potential free). The relay contact is closed whenever the amplifier is enabled. Contact rating: 0.5A, 200V, 10W.
19	**Motion command (±5V)**	This analog output represents the current command from the position loop to the power amplifier. It is useful for monitoring the position loop response.
20	**Circuit common**	
21	**Reset input**	*
22	**Circuit common**	
23	**Tachogenerator output/input**	When using the resolver option this output is the velocity monitor with a scale of 8V for maximum speed. See 7.3.
24	**Circuit common**	
25	**Velocity / current mode selection**	When input is left open (low level) the analog part of the amplifier is working in current mode. when a high level signal is applied (>2V), the analog part of the amplifier is working as a high gain velocity amplifier. *
26	**Not connected**	

Signals connector - J4 (MBA-DBP/3U and MBA-DBP/6U)

Pin	Function	Remarks
1	**Input 1**	*
2	**Input 2**	*
3	**Circuit common**	
4	**Input 3**	*
5	**Input 4**	*

* Vil<1V, Vih>2.4V, Maximum input voltage: ±30VDC

Signals connector - J4 - cont.

Pin	Function	Remarks
6	**Input 5 or Index Input.**	If a homing sequence is required, the Index Input must be connected to Input 5.
7	**Circuit common**	
8	**Fast input 6**	This fast response input can capture events with a duration of less than 10µs. An event is defined as an input voltage transition from low to high. *
9	**Fast input 7**	Same function as Fast Input 6 (8).
10	**Circuit common**	
11	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
12	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
13	**Output 7**	**
14	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
15	**Output 1**	**
16	**Output 2**	**
17	**Output 3**	**
18	**Circuit common**	
19	**Output 4**	**
20	**Output 5**	**
21	**Output 6**	**
22	**Circuit common**	
23	**Output 9**	**

* Vil<1V, Vih>2.4V, Maximum input voltage: ±30VDC

** Vol<0.4V, Voh>4V, Output level: 0-5V, max output current ±5mA

Signals connector - J4 - cont.

Pin	Function	Remarks
24	**Output 10**	*
25	**Motion Complete**	This output will go to high when motion is complete. *
26	**Output 8**	*

Signals connector - J6 (MBA-DBP/3U and MBA-DBP/6U)

Pin	Function	Remarks
1	**Auxiliary encoder complementary input (-By) or Complementary Direction input for Pulse and Direction mode**	
2	**Auxiliary encoder input (By) or Direction input for Pulse and Direction mode**	
3	**Auxiliary encoder input (Ay) or pulse input for Pulse and Direction mode.**	
4	**Auxiliary encoder complementary input (-Ay) or complementary Pulse and Direction mode**	

---

* Vol<0.4V, Voh>4V, Output level: 0-5V, max output current ±5mA

Signals connector - J6 - cont.

Pin	**Function**	Remarks
5	**Auxiliary encoder index input**	
6	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
7	**+15V output**	There are several +15V pins. The accumulative external load should not exceed 100mA.
8	**Circuit common**	
9	**Home switch**	*
10	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
11	**Abort input**	This input must be connected to high level voltage to enable the amplifier. *
12	**+5V output**	200mA
13	**Forward limit switch**	This committed input activates the #[subroutine. *
14	**Reverse limit switch**	This committed input activates the #[subroutine. *
15	**Circuit common**	

J1A, FAN TERMINALS - (MBA-DBP/6U ONLY)

10	24VDC common - fan only.
11	+24VDC isolated supply for fan (max. 400mA)

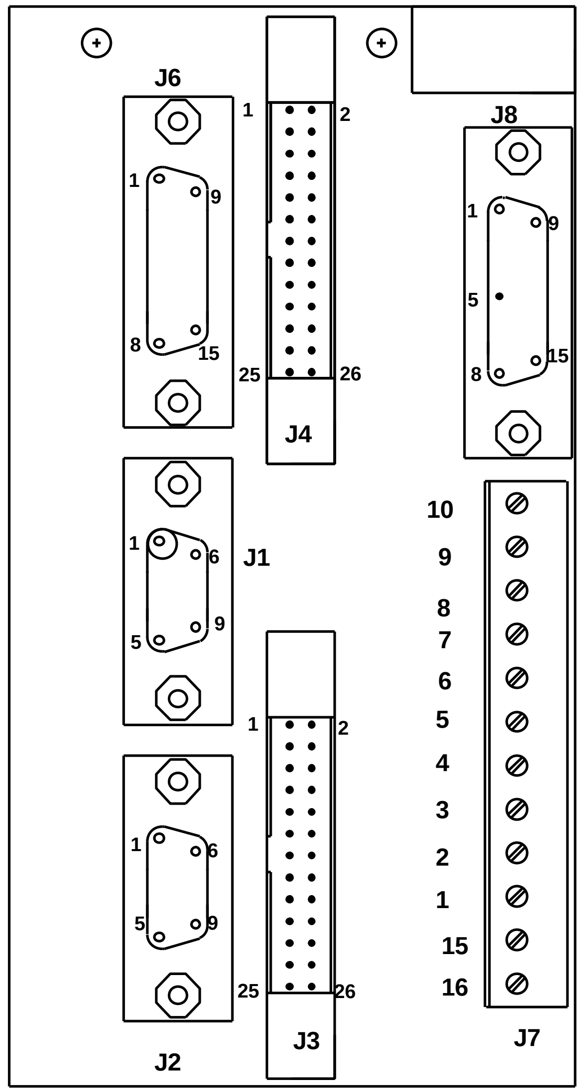
* Vil<1V, Vih>2.4V, Maximum input voltage: ±30VDC

Signals connector - J8 (MBA-DBP/3U and MBA-DBP/6U)

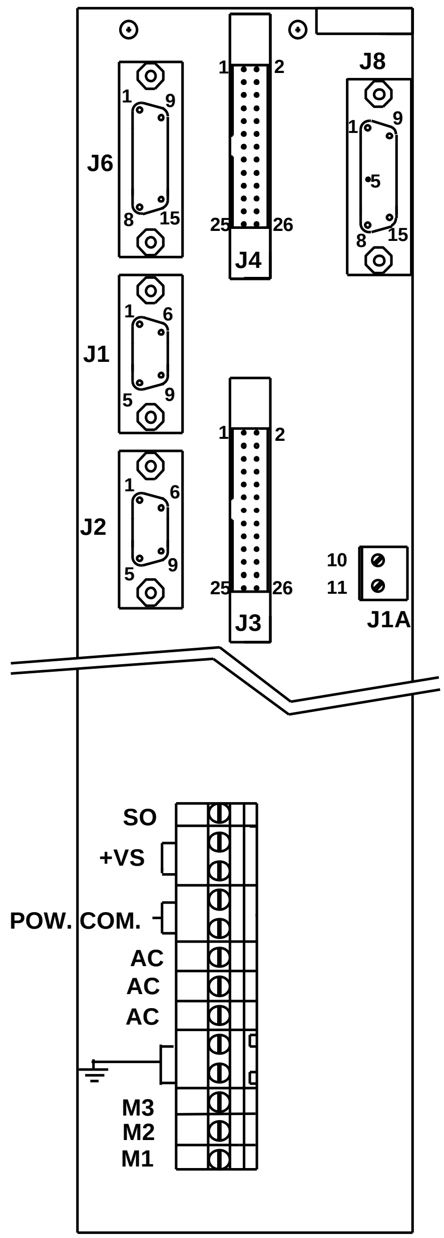
1	**Channel A output**	Main encoder buffered output (20mA, 0-5V)
2	**Channel -A output**	Main encoder buffered output (20mA, 0-5V)
3	**Channel B output**	Main encoder buffered output (20mA, 0-5V)
4	**Channel -B output**	Main encoder buffered output (20mA, 0-5V)
5	**Encoder index output**	For resolver option only buffered output (20mA, 0-5V)
6	**Encoder -index output**	For resolver option only buffered output (20mA, 0-5V)
7	**Circuit common**	
8	**Circuit common**	
9	**Circuit common**	
10	**Hall A**	*
11	**Hall B**	*
12	**Hall C**	*
13	**+15V**	There are several +15V pins. The accumulative external load should not exceed 100mA.
14	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
15	**Circuit common**	

Remark: In the following paragraphs the terminals will be related to all the mounting types as in the following sample:
H/R-2a,E-J4/13.

* $-1V \leq Vil < 1V$; $2V \leq Vih < 30V$
Source sink capability - 2mA min.


J6
1
2
1
9
8
15
25
26
J4
J8
1
9
5
8
15
J1
1
6
5
9
10
9
8
7
6
5
4
3
2
1
15
16
J7
1
2
1
6
5
9
25
26
J3
J2

MBA - DBP/3U



MBA-DBP/6U

5.3 Terminals for DBP mounted in ENCD.

POWER TERMINALS FOR MBA-DBP/3UE (3U size)

Terminal	Function
1	Motor phase A output.
2	Motor phase B output.
3	Motor phase C output.
4	AC supply-phase A.
5	AC supply-phase B.
6	AC supply-phase C.
7	DC power positive (+Vs)
8,9	DC power common
10	Ground
11	Ground

POWER TERMINALS FOR MBA-DBP/6UE (6U size)

Terminal	Function
MA	Motor phase A output.
MB	Motor phase B output.
MC	Motor phase C output.
GND	Ground
AC	AC supply-phase A.
AC	AC supply-phase B.
AC	AC supply-phase C.
POW COM	POWER COMMON
+VS	External shunt resistor connection / +VS.
SO	External shunt resistor connection.

Attention:

DC power commons, control commons and fan common are floating with respect to each other. Do not short them unless specified.
For isolated amplifiers connecting control common to ground is accomplished by inserting R2 (short resistor) on the mother board.

Signals connector - J1 (MBA-DBP/3UE and MBA-DBP/6UE)

Pin	Function	Remarks
1	**Channel A input**	
2	**Channel -A input**	
3	**Channel B input**	
4	**Channel -B input**	
5	**-Index input**	
6	**Index input**	
7	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
8	**+15V output**	There are several +15V pins. The accumulative external load should not exceed 100mA.
9	**Circuit common**	

Signals connector - J2 (MBA-DBP/3UE and MBA-DBP/6UE)

Pin	Function	Remarks
1	**Resolver reference**	Max. voltage: 20Vptp or 7Vrms Max current: 80mA Max frequency: 20KHz
2	**Resolver reference common.**	The reference voltage to the resolver must be taken from pins 1 and 2 only.
3	**Cosine signal input.**	See 7.3
4	**Cosine signal common.**	See 7.3
5	**Sine signal input.**	See 7.3
6	**Sine signal common**	See 7.3
7	**+15V output**	There are several +15V pins. The accumulative external load should not exceed 100mA.
8	**-15V output**	There are several -15V pins. The accumulative external load should not exceed 100mA.
9	**Circuit common**	

Signals connector - J3 (MBA-DBP/3UE and MBA-DBP/6UE)

Pin	**Function**	Remarks
1	**positive input of a differential amplifier.**	See Appendix C.
2	**Negative input of a differential amplifier.**	See Appendix C.
3	**Output of a differential amplifier.**	See Appendix C.
4	**Circuit common**	
5	**Analog input**	This input is monitored by the main µP. When $\lvert V_i \rvert \leq 5V$, R1=470ohm should be inserted. When $\lvert V_i \rvert > 5V$, R1(Kohm)=2Vi-10 should be inserted. The µP always reads a range of $\pm 5V$.
6	**Circuit common**	
7	**Circuit common**	
8	**Current monitor**	This analog output represents the actual current in the motor. The scale (in A/V) is: Ip / 7.5 Ip - Rated peak current of amplifier.
9	**Circuit common**	
10	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
11	**+15V output**	There are several +15V pins. The accumulative external load should not exceed 100mA.
12	**-15V output**	There are several -15V pins. The accumulative external load should not exceed 100mA.
13	**Channel B output**	
14	**Channel A output**	
15	**Index output**	For resolver option only.
16	**Not connected**	
17	**Inhibit output**	Relay contact (potential free). The relay contact is closed whenever the amplifier is enabled. Contact rating: 0.5A, 200V, 10W.

Signals connector - J3 - cont.

Pin	**Function**	Remarks
18	**Inhibit output**	Relay contact (potential free). The relay contact is closed whenever the amplifier is enabled. Contact rating: 0.5A, 200V, 10W.
19	**Motion command (±5V)**	This analog output represents the current command from the position loop to the power amplifier. It is useful for monitoring the position loop response.
20	**Circuit common**	
21	**Reset input**	*
22	**Circuit common**	
23	**Tachogenerator output/input**	When using the resolver option this output is the velocity monitor with a scale of 8V for maximum speed. See 7.3.
24	**Circuit common**	
25	**Velocity / current mode selection**	When input is left open (low level) the analog part of the amplifier is working in current mode. when a high level signal is applied (>2V), the analog part of the amplifier is working as a high gain velocity amplifier. *

Signals connector - J4 (MBA-DBP/3UE and MBA-DBP/6UE)

Pin	**Function**	Remarks
1	**Input 1**	*
2	**Input 2**	*
3	**Circuit common**	
4	**Input 3**	*
5	**Input 4**	*

* Vil<1V, Vih>2.4V, Maximum input voltage: ±30VDC

Signals connector - J4 - cont.

Pin	**Function**	Remarks
6	**Input 5 or Index Input.**	If a homing sequence is required, the Index Input must be connected to Input 5.
7	**Circuit common**	
8	**Fast input 6**	This fast response input can capture events with a duration of less than 10µs. An event is defined as an input voltage transition from low to high. *
9	**Fast input 7**	Same function as Fast Input 6 (8).
10	**Circuit common**	
11	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
12	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
13	**Output 7**	**
14	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
15	**Output 1**	**
16	**Output 2**	**
17	**Output 3**	**
18	**Circuit common**	
19	**Output 4**	**
20	**Output 5**	**
21	**Output 6**	**
22	**Output 8**	**
23	**Output 9**	**

* Vil<1V, Vih>2.4V, Maximum input voltage: $\pm$30VDC

** Vol<0.4V, Voh>4V, Output level: 0-5V, max output current $\pm$5mA

Signals connector - J4 - cont.

Pin	Function	Remarks
24	**Output 10**	*
25	**Motion Complete**	This output will go to high when motion is complete. *

Signals connector - J6 (MBA-DBP/3UE and MBA-DBP/6UE)

Pin	Function	Remarks
1	**Auxiliary encoder complementary input (-By) or Complementary Direction input for Pulse and Direction mode**	
2	**Auxiliary encoder input (By) or Direction input for Pulse and Direction mode**	
3	**Auxiliary encoder input (Ay) or pulse input for Pulse and Direction mode.**	
4	**Auxiliary encoder complementary input (-Ay) or complementary Pulse and Direction mode**	

* Vol<0.4V, Voh>4V, Output level: 0-5V, max output current ±5mA

Signals connector - J6 - cont.

Pin	**Function**	Remarks
5	**Auxiliary encoder index input**	
6	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
7	**+15V output**	There are several +15V pins. The accumulative external load should not exceed 100mA.
8	**Circuit common**	
9	**Home switch**	*
10	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
11	**Abort input**	This input must be connected to high level voltage to enable the amplifier. *
12	**+5V output**	200mA
13	**Forward limit switch**	This committed input activates the #[subroutine. *
14	**Reverse limit switch**	This committed input activates the #[subroutine. *
15	**Circuit common**	

J1A, FAN TERMINALS - (MBA-DBP/3UE and MBA-DBP/6UE)

10	24VDC common - fan only.
11	+24VDC isolated supply for fan (max. 400mA)

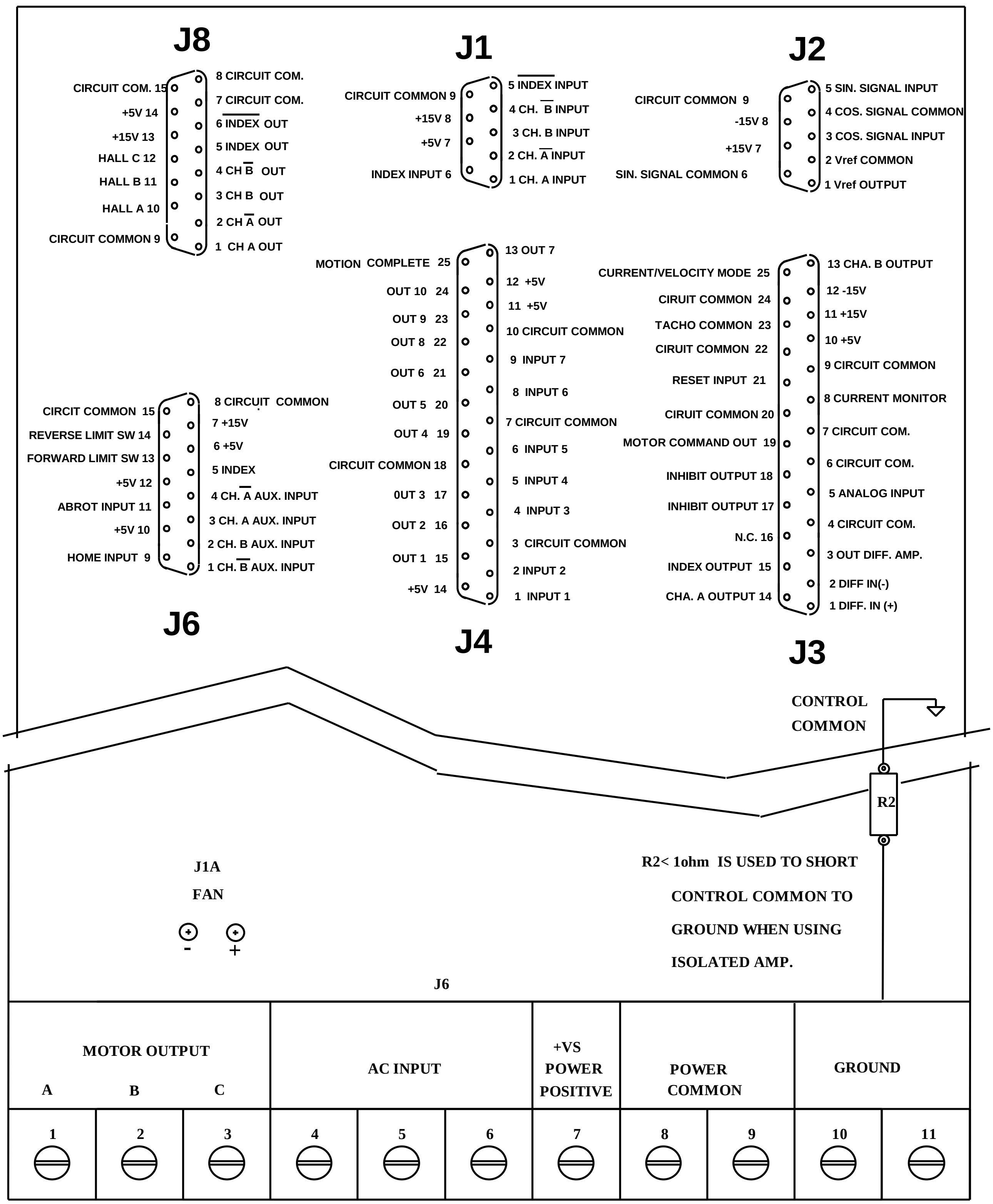
* Vil<1V, Vih>2.4V, Maximum input voltage: ±30VDC

Signals connector - J8 (MBA-DBP/3UE and MBA-DBP/6UE)

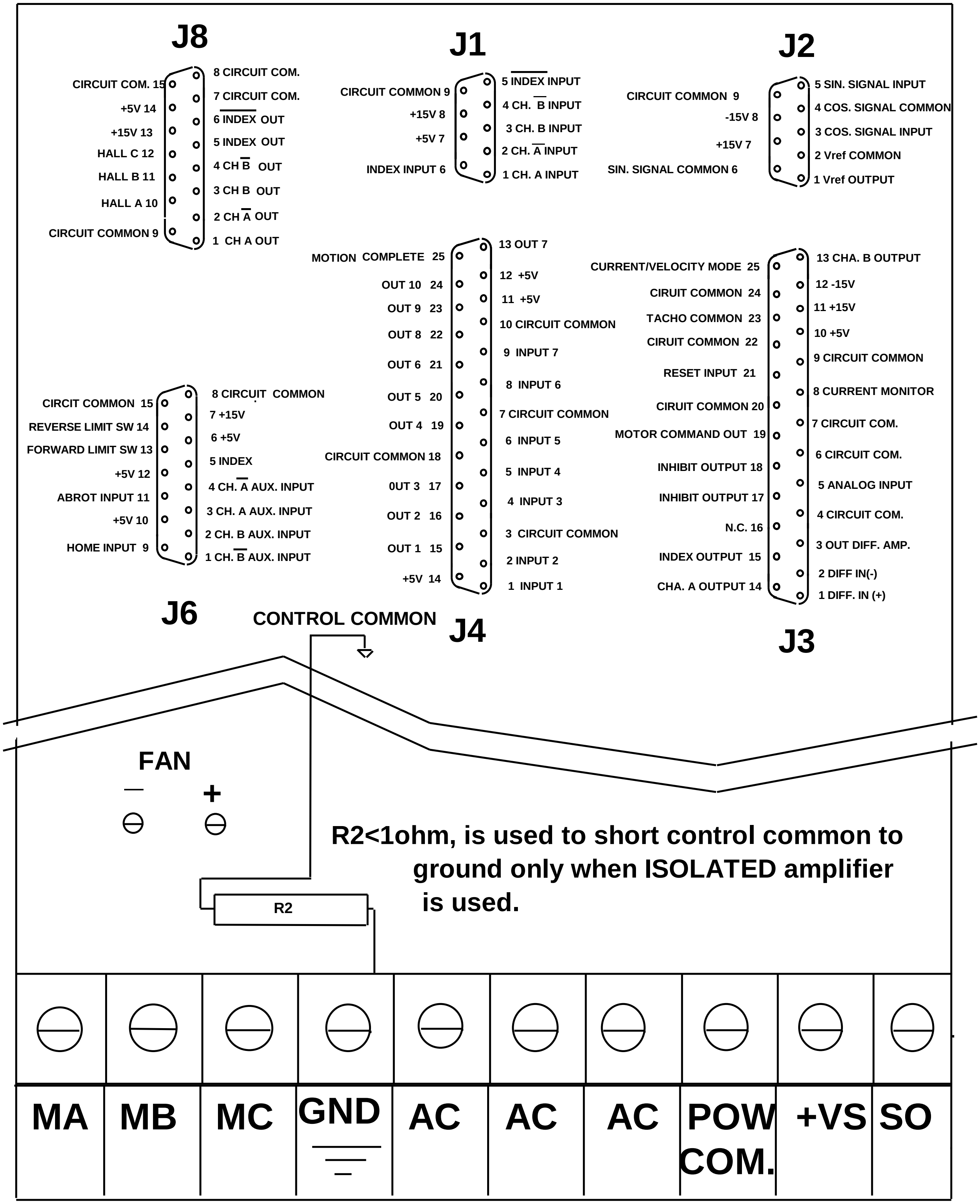
1	**Channel A output**	Main encoder buffered output (20mA, 0-5V)
2	**Channel -A output**	Main encoder buffered output (20mA, 0-5V)
3	**Channel B output**	Main encoder buffered output (20mA, 0-5V)
4	**Channel -B output**	Main encoder buffered output (20mA, 0-5V)
5	**Encoder index output**	For resolver option only buffered output (20mA, 0-5V)
6	**Encoder -index output**	For resolver option only buffered output (20mA, 0-5V)
7	**Circuit common**	
8	**Circuit common**	
9	**Circuit common**	
10	**Hall A**	*
11	**Hall B**	*
12	**Hall C**	*
13	**+15V**	There are several +15V pins. The accumulative external load should not exceed 100mA.
14	**+5V output**	There are several +5V pins. The accumulative external load should not exceed 200mA.
15	**Circuit common**	

Remark: In the following paragraphs the terminals will be related to all the mounting types as in the following sample:
H/R-2a,E-J4/13.

* $-1V \leq Vil < 1V$; $2V \leq Vih < 30V$
Source sink capability - 2mA min.


J8
8 CIRCUIT COM.
7 CIRCUIT COM.
6 INDEX OUT
5 INDEX OUT
4 CH B OUT
3 CH B OUT
2 CH A OUT
1 CH A OUT
CIRCUIT COM. 15
+5V 14
+15V 13
HALL C 12
HALL B 11
HALL A 10
CIRCUIT COMMON 9
J1
5 INDEX INPUT
4 CH. B INPUT
3 CH. B INPUT
2 CH. A INPUT
1 CH. A INPUT
CIRCUIT COMMON 9
+15V 8
+5V 7
INDEX INPUT 6
J2
5 SIN. SIGNAL INPUT
4 COS. SIGNAL COMMON
3 COS. SIGNAL INPUT
2 Vref COMMON
1 Vref OUTPUT
CIRCUIT COMMON 9
-15V 8
+15V 7
SIN. SIGNAL COMMON 6
J6
8 CIRCUIT COMMON
7 +15V
6 +5V
5 INDEX
4 CH. A AUX. INPUT
3 CH. A AUX. INPUT
2 CH. B AUX. INPUT
1 CH. B AUX. INPUT
CIRCIT COMMON 15
REVERSE LIMIT SW 14
FORWARD LIMIT SW 13
+5V 12
ABROT INPUT 11
+5V 10
HOME INPUT 9
J4
13 OUT 7
12 +5V
11 +5V
10 CIRCUIT COMMON
9 INPUT 7
8 INPUT 6
7 CIRCUIT COMMON
6 INPUT 5
5 INPUT 4
4 INPUT 3
3 CIRCUIT COMMON
2 INPUT 2
1 INPUT 1
MOTION COMPLETE 25
OUT 10 24
OUT 9 23
OUT 8 22
OUT 6 21
OUT 5 20
OUT 4 19
CIRCUIT COMMON 18
0UT 3 17
OUT 2 16
OUT 1 15
+5V 14
J3
13 CHA. B OUTPUT
12 -15V
11 +15V
10 +5V
9 CIRCUIT COMMON
8 CURRENT MONITOR
7 CIRCUIT COM.
6 CIRCUIT COM.
5 ANALOG INPUT
4 CIRCUIT COM.
3 OUT DIFF. AMP.
2 DIFF IN(-)
1 DIFF. IN (+)
CURRENT/VELOCITY MODE 25
CIRUIT COMMON 24
TACHO COMMON 23
CIRUIT COMMON 22
RESET INPUT 21
CIRUIT COMMON 20
MOTOR COMMAND OUT 19
INHIBIT OUTPUT 18
INHIBIT OUTPUT 17
N.C. 16
INDEX OUTPUT 15
CHA. A OUTPUT 14
CONTROL
COMMON
R2
J1A
FAN
-
+
R2< 1ohm IS USED TO SHORT
CONTROL COMMON TO
GROUND WHEN USING
ISOLATED AMP.
J6
MOTOR OUTPUT
A
B
C
AC INPUT
+VS
POWER
POSITIVE
POWER
COMMON
GROUND
1
2
3
4
5
6
7
8
9
10
11

MBA-DBP/3UE



J8
CIRCUIT COM. 15
+5V 14
+15V 13
HALL C 12
HALL B 11
HALL A 10
CIRCUIT COMMON 9
8 CIRCUIT COM.
7 CIRCUIT COM.
6 INDEX OUT
5 INDEX OUT
4 CH B OUT
3 CH B OUT
2 CH A OUT
1 CH A OUT
J1
CIRCUIT COMMON 9
+15V 8
+5V 7
INDEX INPUT 6
5 INDEX INPUT
4 CH. B INPUT
3 CH. B INPUT
2 CH. A INPUT
1 CH. A INPUT
J2
CIRCUIT COMMON 9
-15V 8
+15V 7
SIN. SIGNAL COMMON 6
5 SIN. SIGNAL INPUT
4 COS. SIGNAL COMMON
3 COS. SIGNAL INPUT
2 Vref COMMON
1 Vref OUTPUT
J6
CIRCIT COMMON 15
REVERSE LIMIT SW 14
FORWARD LIMIT SW 13
+5V 12
ABROT INPUT 11
+5V 10
HOME INPUT 9
8 CIRCUIT COMMON
7 +15V
6 +5V
5 INDEX
4 CH. A AUX. INPUT
3 CH. A AUX. INPUT
2 CH. B AUX. INPUT
1 CH. B AUX. INPUT
J4
MOTION COMPLETE 25
OUT 10 24
OUT 9 23
OUT 8 22
OUT 6 21
OUT 5 20
OUT 4 19
CIRCUIT COMMON 18
0UT 3 17
OUT 2 16
OUT 1 15
+5V 14
13 OUT 7
12 +5V
11 +5V
10 CIRCUIT COMMON
9 INPUT 7
8 INPUT 6
7 CIRCUIT COMMON
6 INPUT 5
5 INPUT 4
4 INPUT 3
3 CIRCUIT COMMON
2 INPUT 2
1 INPUT 1
J3
CURRENT/VELOCITY MODE 25
CIRUIT COMMON 24
TACHO COMMON 23
CIRUIT COMMON 22
RESET INPUT 21
CIRUIT COMMON 20
MOTOR COMMAND OUT 19
INHIBIT OUTPUT 18
INHIBIT OUTPUT 17
N.C. 16
INDEX OUTPUT 15
CHA. A OUTPUT 14
13 CHA. B OUTPUT
12 -15V
11 +15V
10 +5V
9 CIRCUIT COMMON
8 CURRENT MONITOR
7 CIRCUIT COM.
6 CIRCUIT COM.
5 ANALOG INPUT
4 CIRCUIT COM.
3 OUT DIFF. AMP.
2 DIFF IN(-)
1 DIFF. IN (+)
CONTROL COMMON
FAN
—
+
R2
R2<1ohm, is used to short control common to ground only when ISOLATED amplifier is used.
MA
MB
MC
GND
AC
AC
AC
POW COM.
+VS
SO

MBA-DBP/6UE

5.4 Communication Port Connector

The serial communication is available via a 9 pins D connector (Jc) with the following pin assignment:

RS232

Pin	Function
2	Receive
3	Transmit
5	Common

When using an IBM XT as an host, pins 4 and 5 should be connected together on the 25 pins D connector (computer side). When using an IBM AT as an host, pins 7 and 8 should be connected together on the 9 pins D connector (computer side).

RS485

Pin	Function
5	Common
6,7	T/R -
8,9	T/R +

6. Installation procedures

6.1 Mounting

The DBP series dissipates its heat by natural convection except DBPF types which are fan cooled. For optimum dissipation the amplifiers have to be mounted with the fins in vertical position.

6.2 Wiring

Proper wiring, grounding and shielding techniques are important in obtaining proper servo operation and performance. Incorrect wiring, grounding or shielding can cause erratic servo performance or even a complete lack of operation.

a) Keep motor wires as far as possible from the signal level wiring (feedback signals, control signals, etc.).

b) If additional inductors (chokes) are required, keep the wires between the amplifier and the chokes as short as possible.

c) Minimize lead lengths as much as is practical. Although the amplifier is protected against long (inductive) supply wires it is recommended to keep the leads as short as possible.

d) Use twisted and shielded wires for connecting all signals (command and feedback). Avoid running these leads in close proximity to power leads or other sources of EMI noise.

e) Use a 4 wires twisted and shielded cable for the motor connection.

f) Shield must be connected at one end only to avoid ground loops.

g) All grounded components should be tied together at a single point (star connection). This point should then be tied with a single conductor to an earth ground point.

h) After wiring is completed, carefully inspect all conditions to ensure tightness, good solder joint etc.

6.3 Load inductance

The total load inductance must be sufficient to keep the current ripple within the limits - 50% of the adjusted continuous current limit. The current ripple (Ir) can be calculated by using the following equation:

$$Ir = \frac{0.5 \times Vs}{f \times L} \quad (A)$$

L - load inductance in mH.

Vs - Voltage of the DC supply in Volts.

f - Frequency in KHz.

If motor inductance does not exceed this value, 3 chokes should be added (to each motor phase) summing together the required inductance

Lch = L - Lp

Lch - Choke inductance

Lp - Total inductance between two phases (in Y connection it is the sum of two phases).

6.4 AC power supply

AC power supply can be at any voltage in the range defined within the technical specifications. It must have the capability to deliver power to the amplifier (including peak power), without significant voltage drops. **Any voltage below the minimum or above the maximum will disable the amplifier.**

The recommended AC voltage are:

$$1.2 \times VAC(min) < VAC < 0.9 \times VAC(max)$$

Note - Single phase connection:

When using a single phase supply, voltage drop due to loading is expected. The magnitude of the voltage drop depends on the load current, motor velocity, stiffness of the power source and total bus capacitance. It is recommended not to use single phase connection for output current higher than 20A.

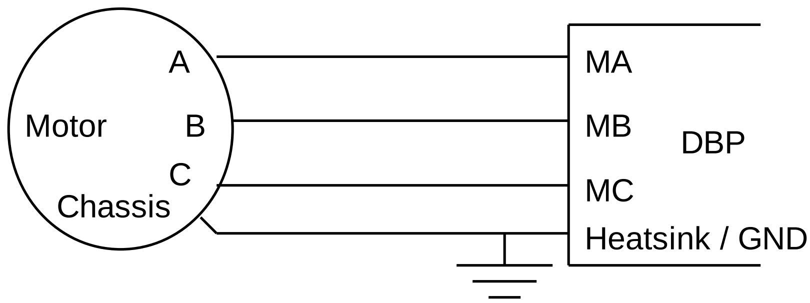
For 3U size amplifiers it is recommended to add external capacitance as follows:

For 135V units up to 1200µF

For 270V units up to 600µF

6.5 Wiring diagrams

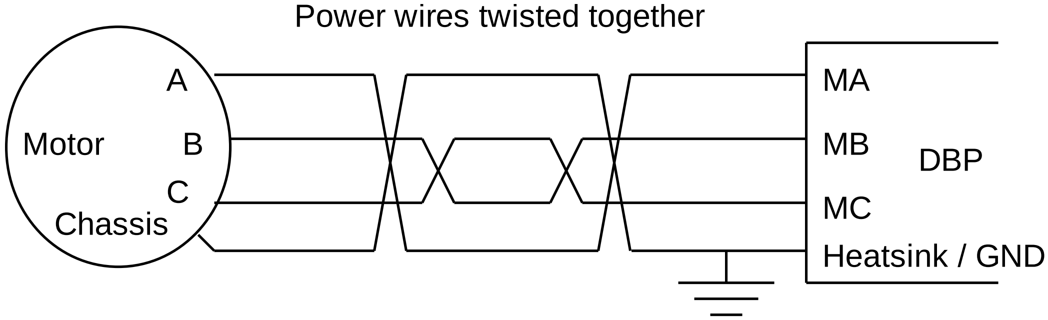
6.5.1 Motor's windings



Minimum acceptance

==

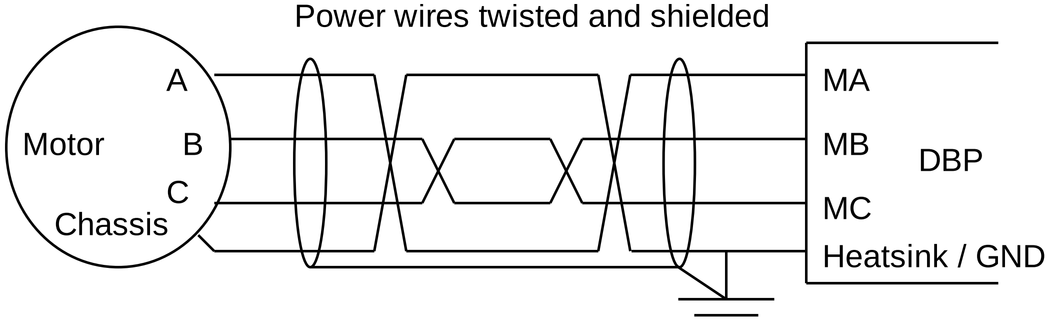
Power wires twisted together



Acceptable for most applications

==

Power wires twisted and shielded



Optimum wiring, minimum RFI

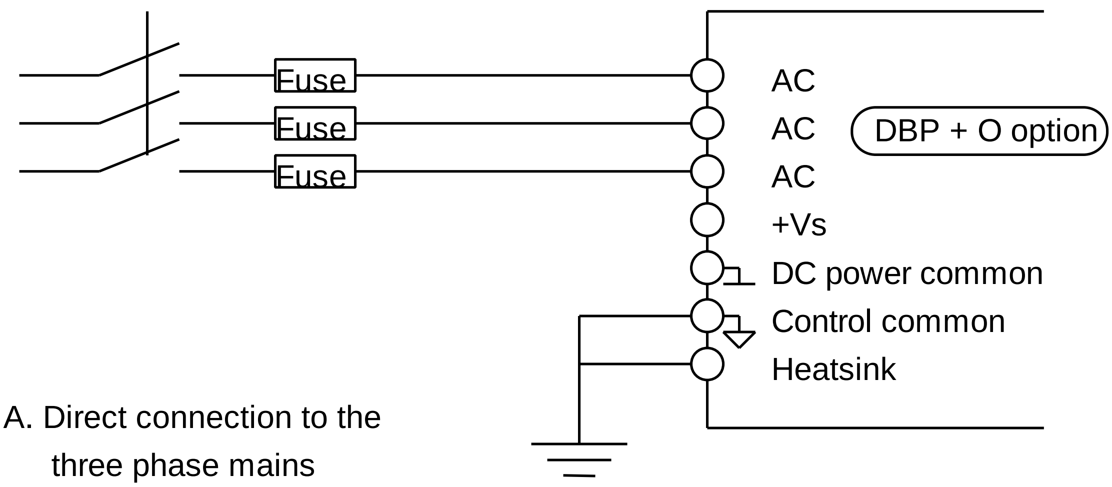
6.5.2 AC power wiring

AC POWER WIRING

NON-ISOLATED AC SUPPLIES:

A) DIRECTLY TO THE MAIN

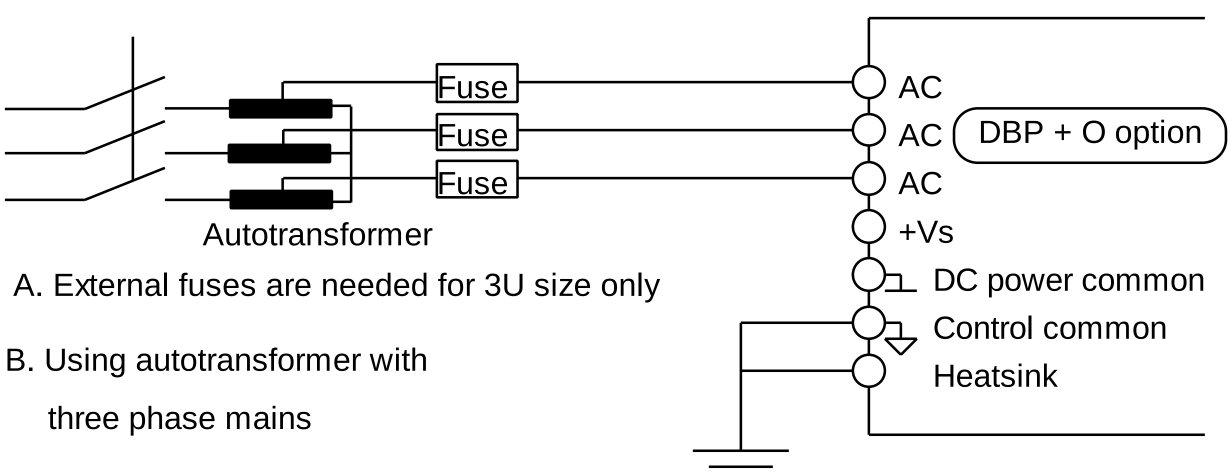
B) USING AUTOTRANSFORMER



A. Direct connection to the three phase mains

B. External fuses are needed for 3U size only

==



A. External fuses are needed for 3U size only

B. Using autotransformer with three phase mains

Guide lines for connecting non-isolated AC supplies

Ground:

Control common

Motor chassis

Amplifier's heatsink

Do not ground:

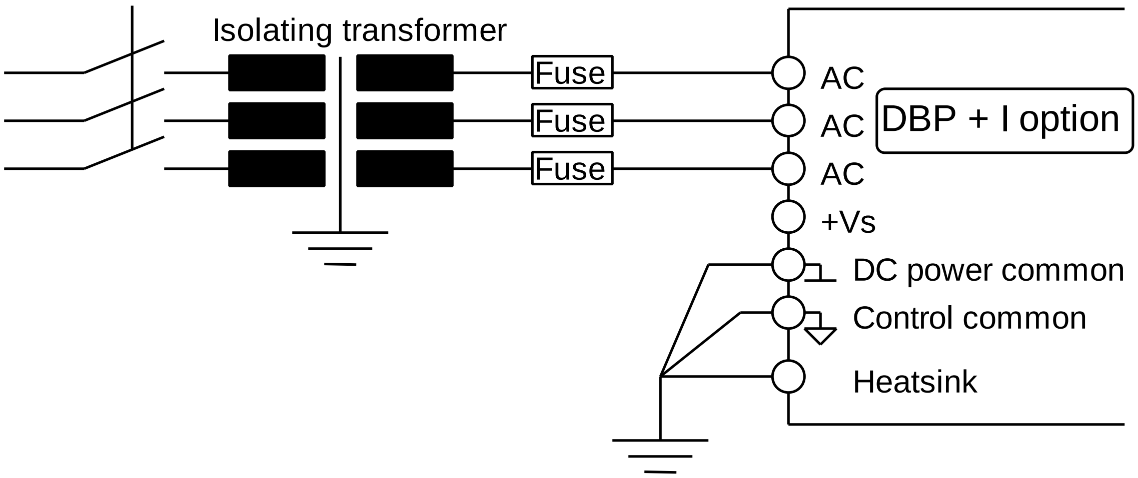
Power common

(The power common is a hot point and any grounding will cause an input rectifier failure).

Caution:

- If source of motor command is grounded, use amplifier's differential input. Otherwise, a ground loop is created.

ISOLATED AC SUPPLIES



A. Extenal fuses are needed for 3U size only

Guide lines for connecting an Isolated amplifier with an isolating power transformer

Ground:

DC power common

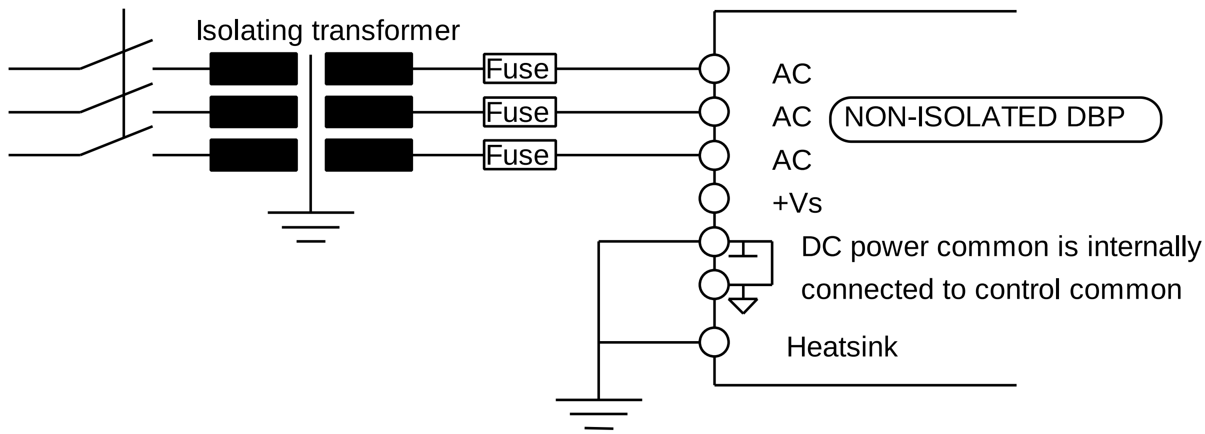
Control common

Motor chassis

Amplifier's heat sink.

Caution:

- If source of motor command is grounded, use amplifier's differential input. Otherwise, a ground loop is created.



A. External fuses are needed for 3U size only

Guide lines for connecting a non isolated amplifier with an isolating power transformer

Ground:

DC power common

Motor chassis

Amplifier's heat sink

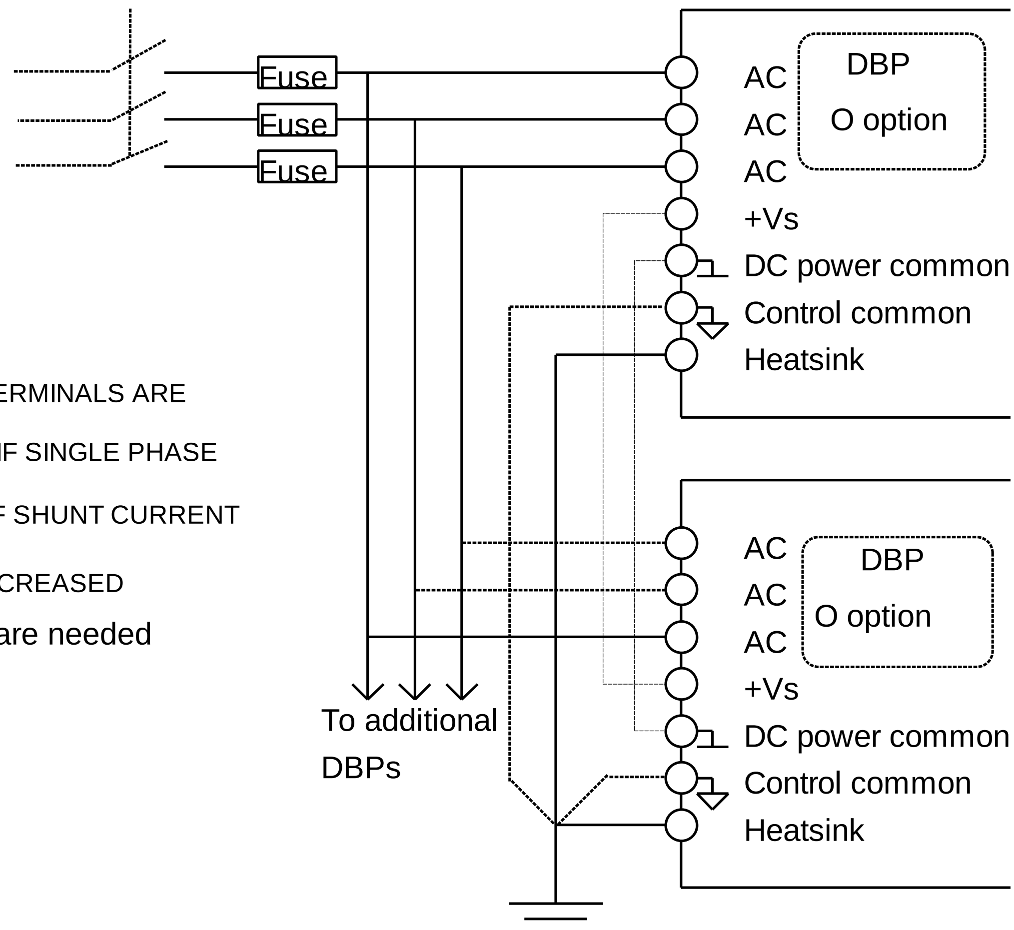
Do not ground:

Control common - It is internally connected to the power common. Grounding the control common will create a ground loop.

Caution:

- If source of motor command is grounded, use amplifier's differential input. Otherwise, a ground loop is created.

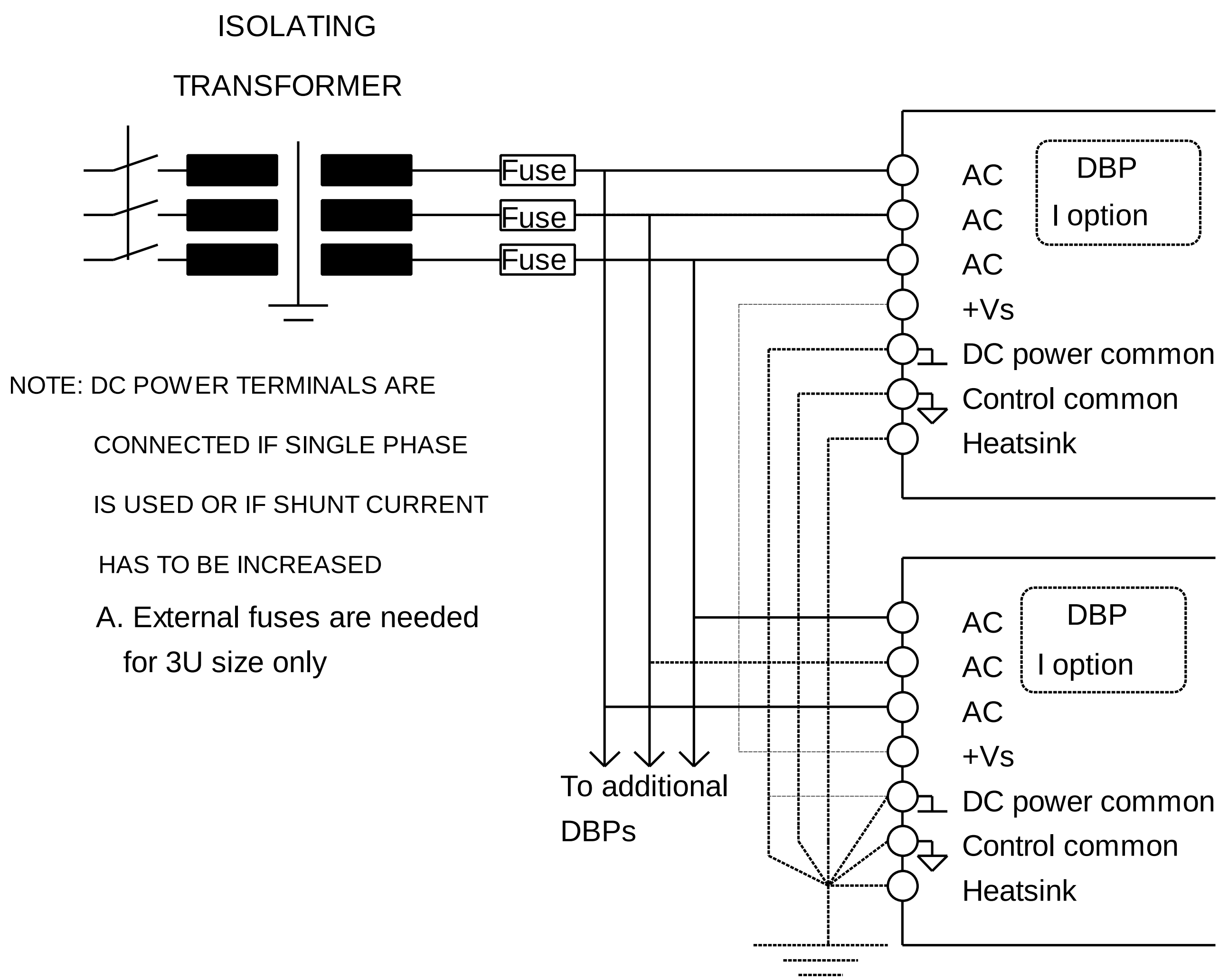
DIRECT CONNECTION TO
THE THREE PHASE MAINS



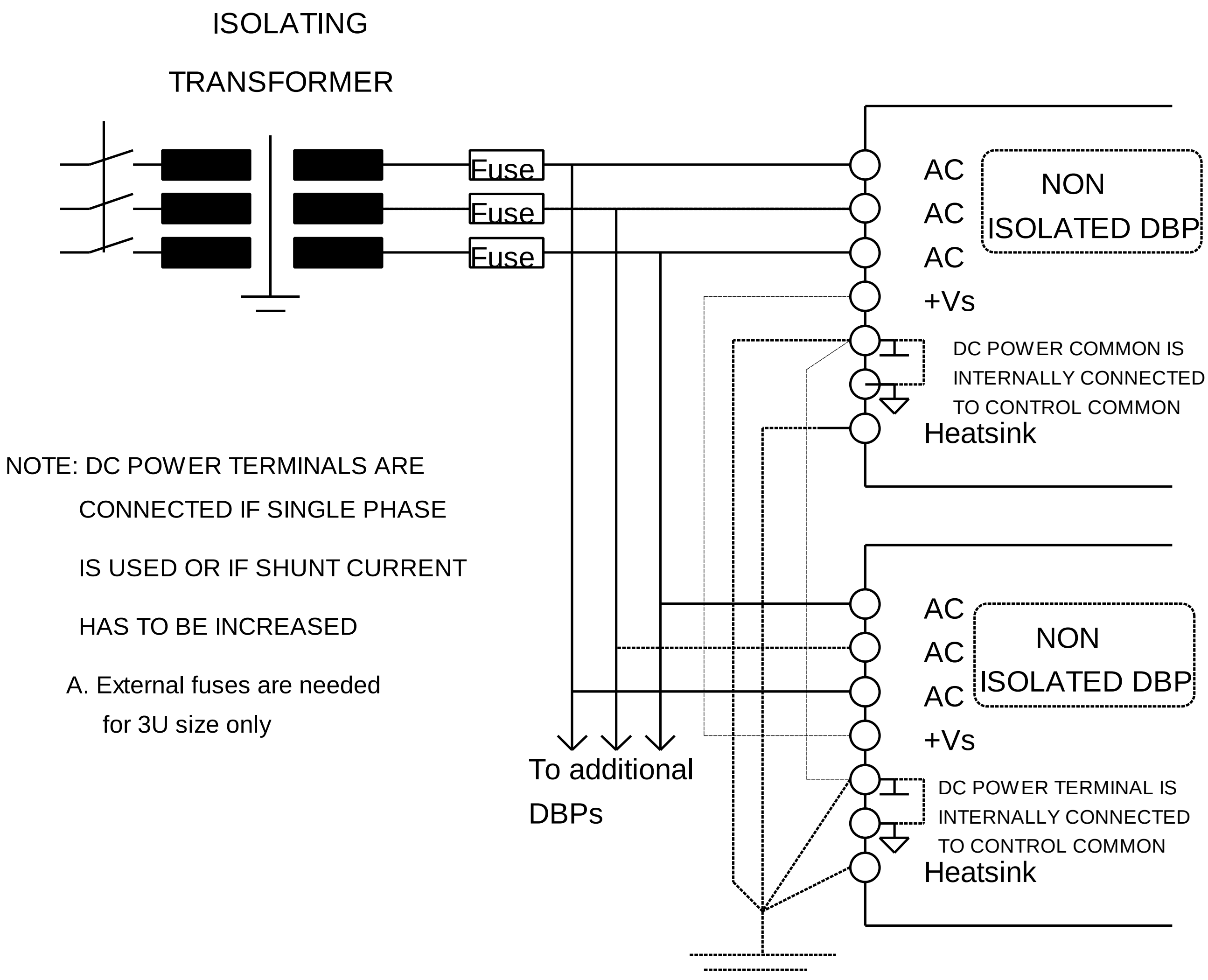
NOTE: DC POWER TERMINALS ARE
CONNECTED IF SINGLE PHASE
IS USED OR IF SHUNT CURRENT
HAS TO BE INCREASED

A. External fuses are needed
for 3U size only

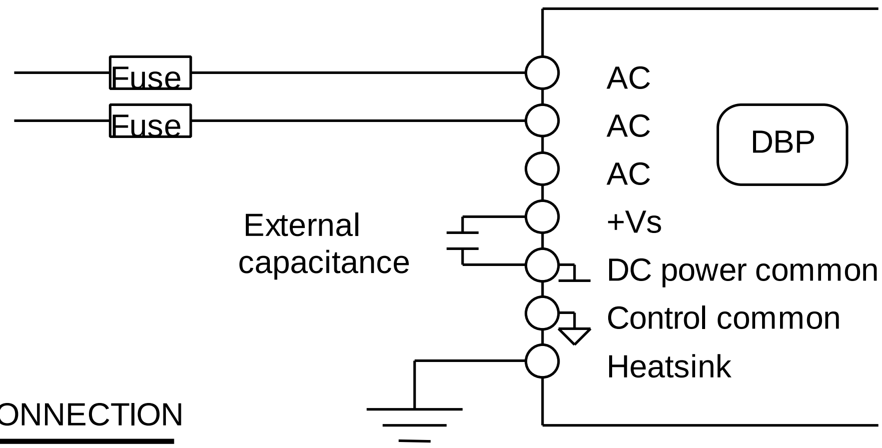
<u>CONNECTING MORE THAN ONE DBP</u>



<u>CONNECTING MORE THAN ONE DBP</u>



<u>CONNECTING MORE THAN ONE DBP</u>



SINGLE PHASE CONNECTION

See chapter 6.4 for details

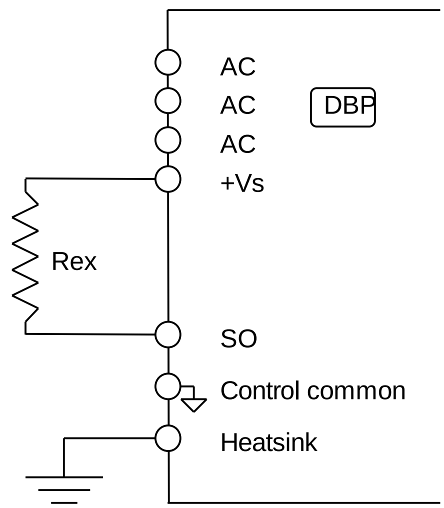
All rules about supply connections described in the previous pages are also valid for multi-IBP and/or single phase connection.

For 135V types the standard value of

Rex is 9.1ohm/225Watt

For 270V types the standard value of

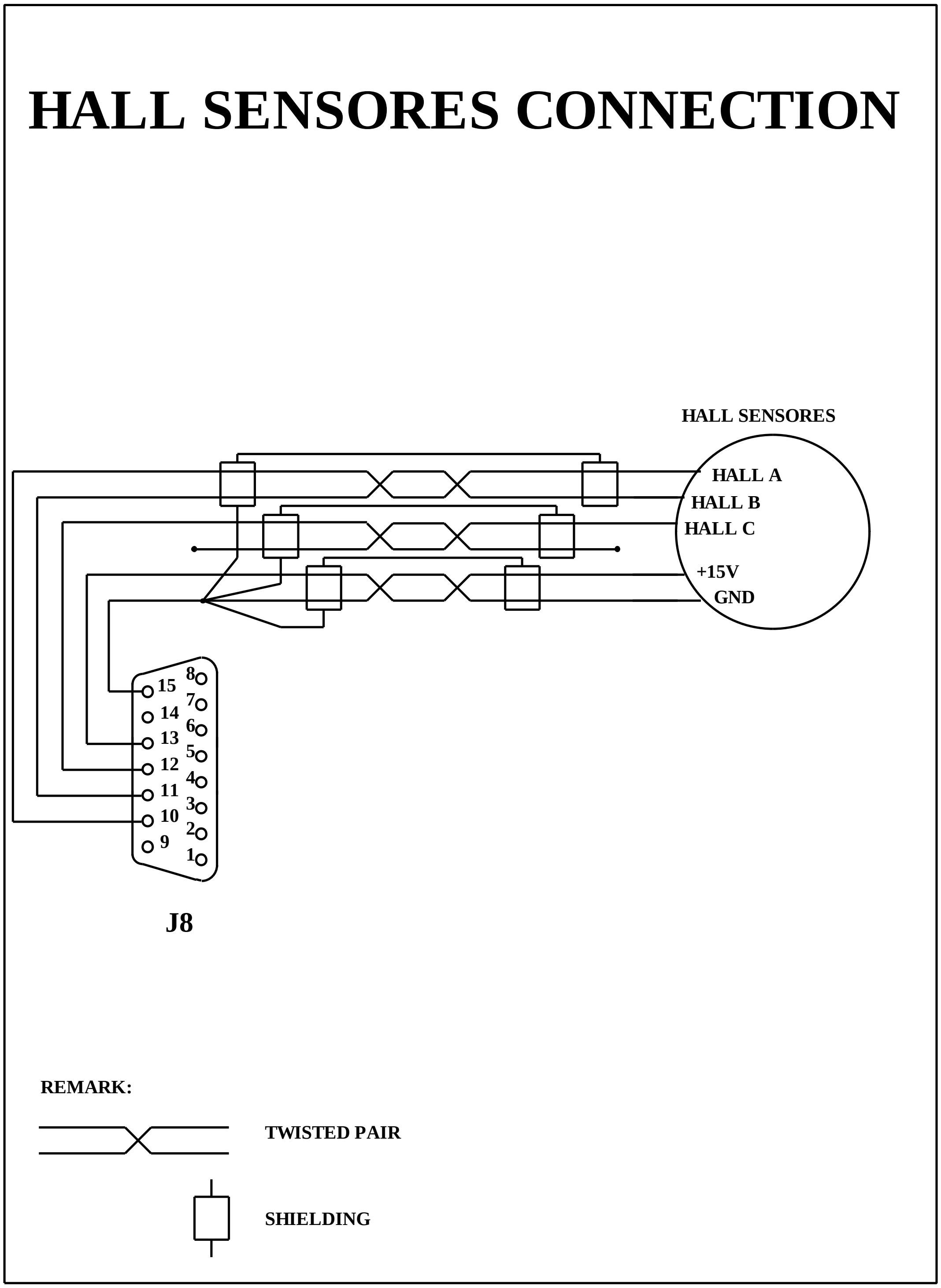
Rex is 33ohm/225Watt



CONNECTING THE EXTERNAL SHUNT RESISTOR

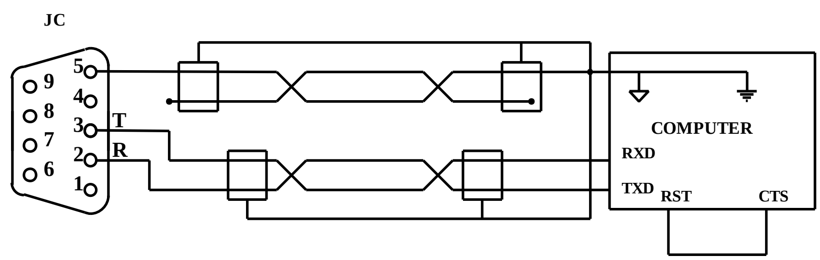
DOUBLE EUROCARD SIZE ONLY

6.5.3 Hall sensors wiring



6.5.4 RS232 Communication wiring

RS232 COMMUNICATION

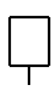


NOTE:

SHIELDING MUST BE CONNECTED AT COMPUTER END ONLY

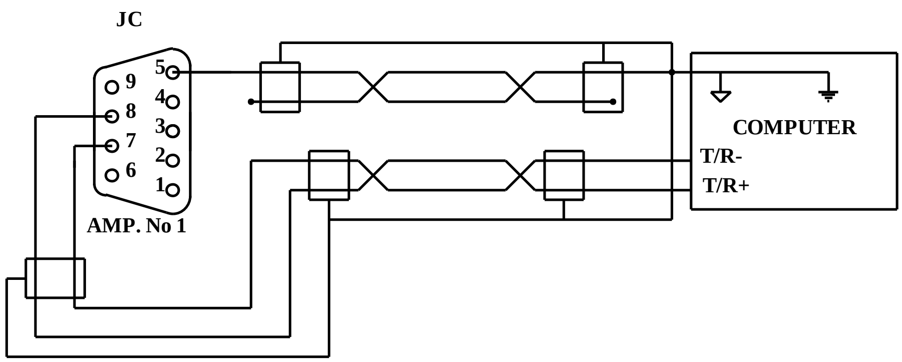
SYMBOLS:


TWISTED PAIR


SHIELDING

6.5.5 RS485 Communication wiring

RS 485 COMMUNICATION

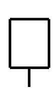


NOTES:

1. SHIELDING MUST BE CONNECTED AT COMPUTER END ONLY
2. PIN No.1 TRANSMIT/RECEIVE CONTROL
3. PIN No.4 +5V

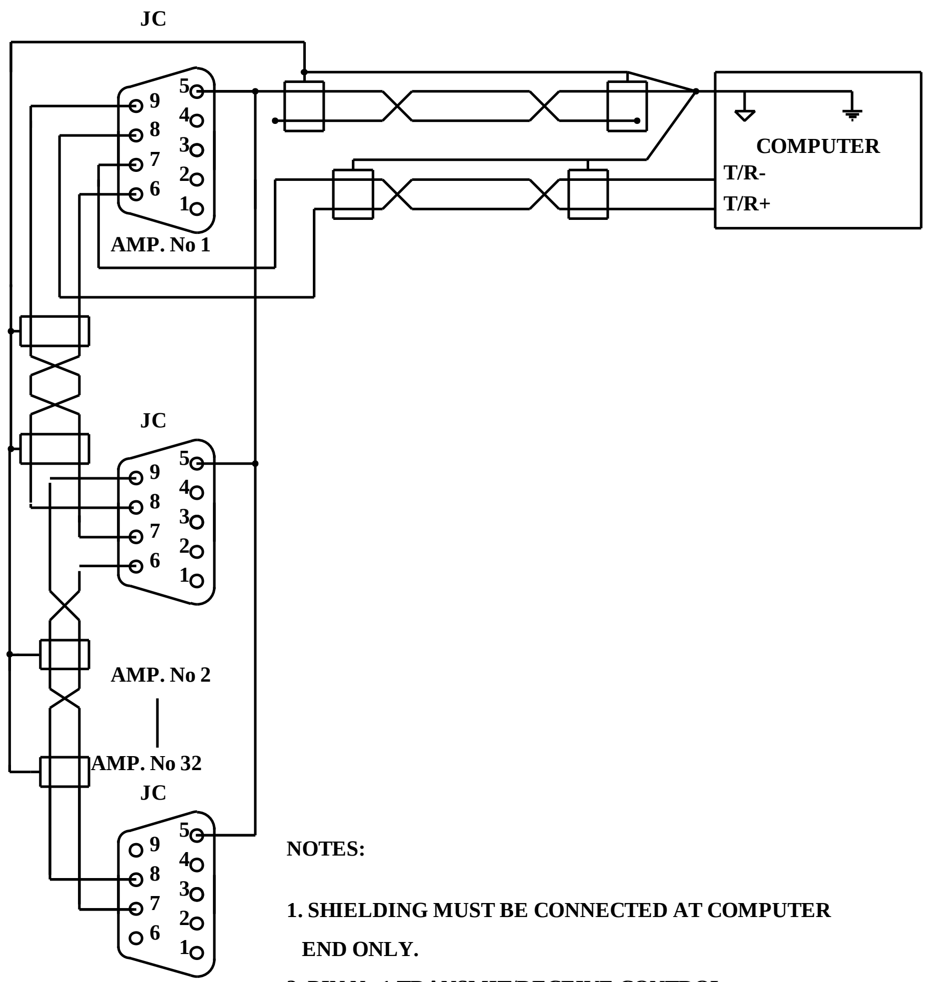
SYMBOLS:

TWISTED PAIR



SHIELDING

RS485 COMMUNICATION

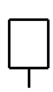


NOTES:

1. SHIELDING MUST BE CONNECTED AT COMPUTER END ONLY.
2. PIN No.1 TRANSMIT/RECEIVE CONTROL
3. PIN No.4 +5V

SYMBOLS:

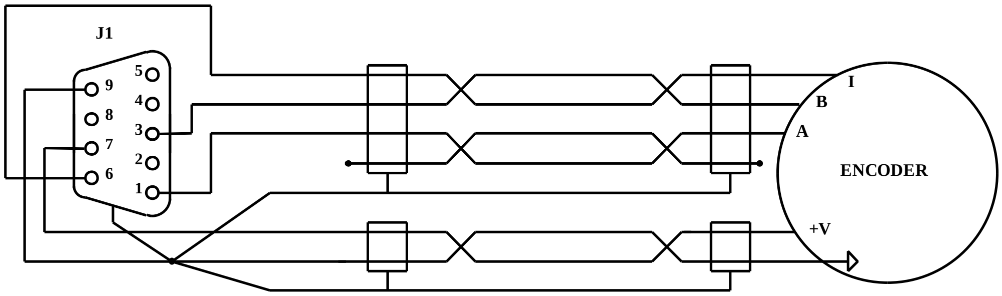
TWISTED PAIR



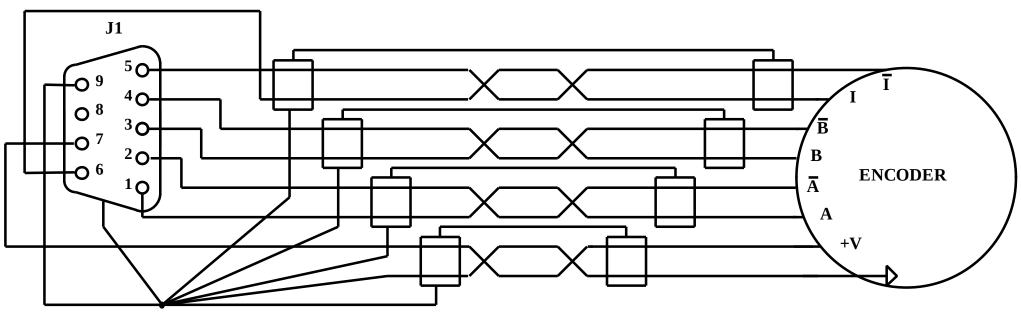
SHIELDING

6.5.6 Main encoder wiring

ENCODER CONNECTION



DIFFERENTIAL ENCODER CONNECTION

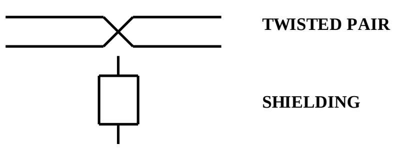


NOTES:

1.THIS CONNECTION IS FOR AN ENCODER WITH +5V SUPPLY.
FOR AN ENCODER OF +15V SUPPLY, USE J1 PIN 8 INSTEAD OF PIN 7.

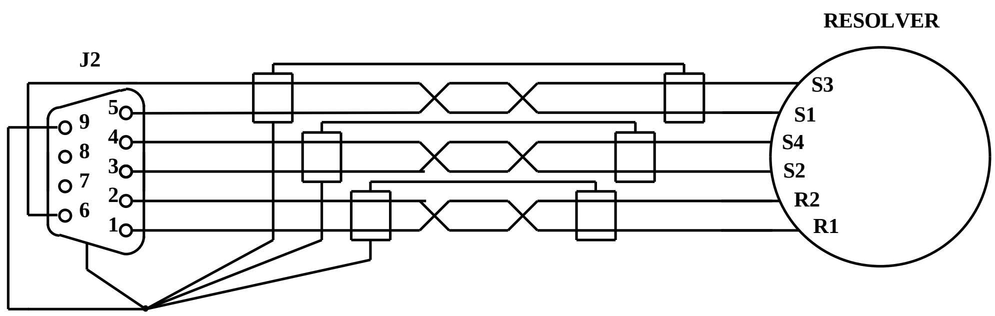
2.THE METAL FRAME OF J1 IS INTERNALLY CONNECTED TO THE DCB COMMON. THE SHIELDING SHOULD BE CONNECTED EITHER TO J1 PIN 9 OR TO THE METAL FRAME OF J1.

SYMBOLS:



6.5.7 Resolver wiring

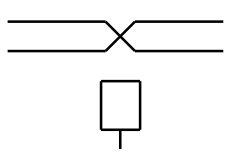
RESOLVER CONNECTION



NOTES:

1. PIN No 7 = +15V
2. PIN No 8 = -15V
3. PIN 9 AND THE METAL FRAME OF J2 ARE INTENALLY CONNECTED TO THE DCB COMMON. THE SHIELDINGS OF ALL THE PAIRS SHOULD BE CONNECTED EITHER TO J2 PIN 9 OR TO THE FRAME OF J2.

SYMBOLS:

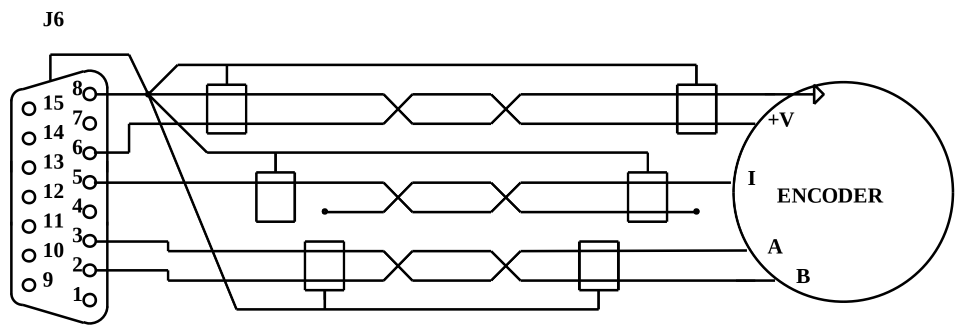


TWISTED PAIR

SHIELDING

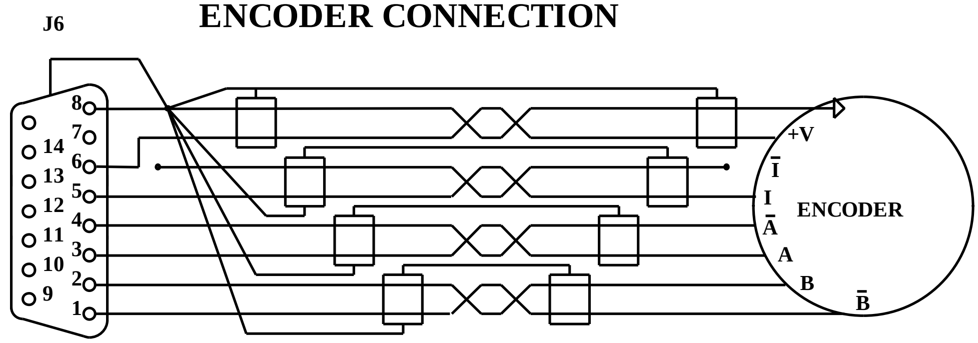
6.5.8 Auxiliary encoder wiring

AUXILIARY ENCODER CONNECTION



DIFFERENTIAL AUXILIARY

ENCODER CONNECTION

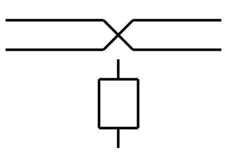


NOTES:

1.THIS CONNECTION IS FOR AN ENCODER WITH +5V SUPPLY.
FOR AN ENCODER OF +15V SUPPLY, USE J6 PIN 7 INSTEAD OF PIN 6.

2.THE METAL FRAME OF J6 AND PIN 8 ARE INTERNALLY CONNECTED TO THE DCB COMMON. THE SHIELDING SHOULD BE CONNECTED EITHER TO J6 PIN 8 OR TO THE METAL FRAME OF J6.

SYMBOLS:

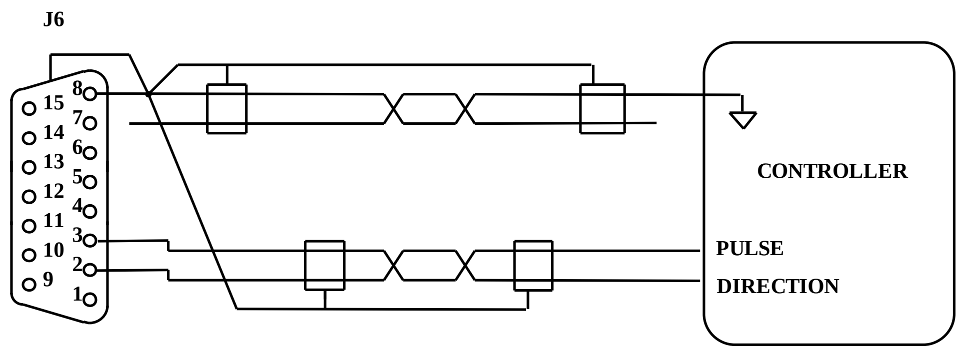


TWISTED PAIR

SHIELDING

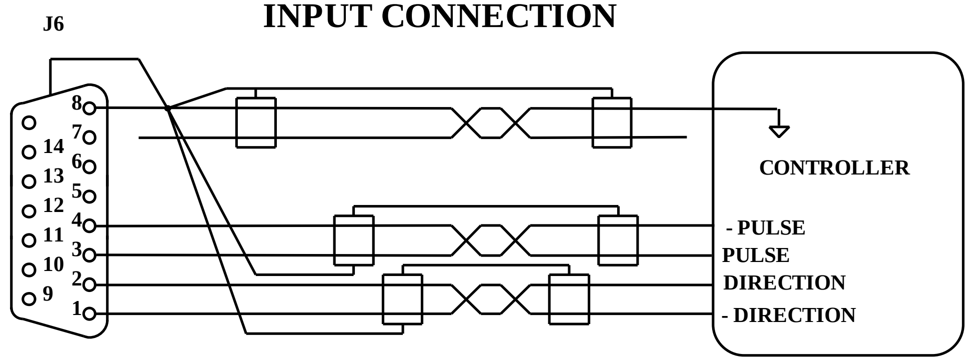
6.5.9 Pulse/Direction signals wiring

PULSE & DIRECTION INPUT CONNECTION



DIFFERENTIAL PULSE & DIRECTION

INPUT CONNECTION

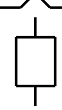


NOTES:

1.THE METAL FRAME OF J6 AND PIN 8 ARE INTERNALLY CONNECTED TO THE DCB COMMON. THE SHIELDING SHOULD BE CONNECTED EITHER TO J6 PIN 8 OR TO THE METAL FRAME OF J6.

SYMBOLS:

TWISTED PAIR



SHIELDING

7. Start - Up Procedures

7.1 Common procedures for all amplifiers types

7.1.1 Commutation signals format

Select the position of DIP switch 1 on the upper board of the power stage according to the commutation signal format the motor has.

DS1 positions:	ON (down): 30°	OFF (up): 60°

For all Resolver versions it should be 60°.

7.1.2 CFM function

Select the position of DIP switch 2 on the upper board of the power stage according to the motor's rated current. If it is less than 20% of the amplifier's rated current select:

DS2 to ON (down)

Otherwise,

DS2 to OFF (up) - No CFM

7.1.3 Abort logic

Make sure that the Abort input is connected to a High (logic) voltage source.

7.1.4 Setting the auxiliary position input format

This step is valid only for those applications that need to use the auxiliary position input. You may skip this step if you do not use it.

When using an Optical encoder

Set DS 7 to OFF

When a the encoder has differential outputs:

Set DS 4 and 5 to OFF

Otherwise they should be ON.

When using Pulse and Direction signals

Set DS 7 to ON

7.1.5 Selecting the communication bus

Select the desired communication bus as follows:

For RS232: Set DS9 to OFF

For RS485: Set DS9 to ON

7.1.6 Preparing the automatic baud rate selection

The DCB baud rate will automatically match the host baud rate when DS1 is set to ON.

Set DS1 to ON

7.2 Setting the main optical encoder format

When a differential encoder is used:

Set DS 2,3,6 to OFF

Otherwise they should be ON.

7.3 Setting the R/D circuit

Set DS 2,3,6 to ON

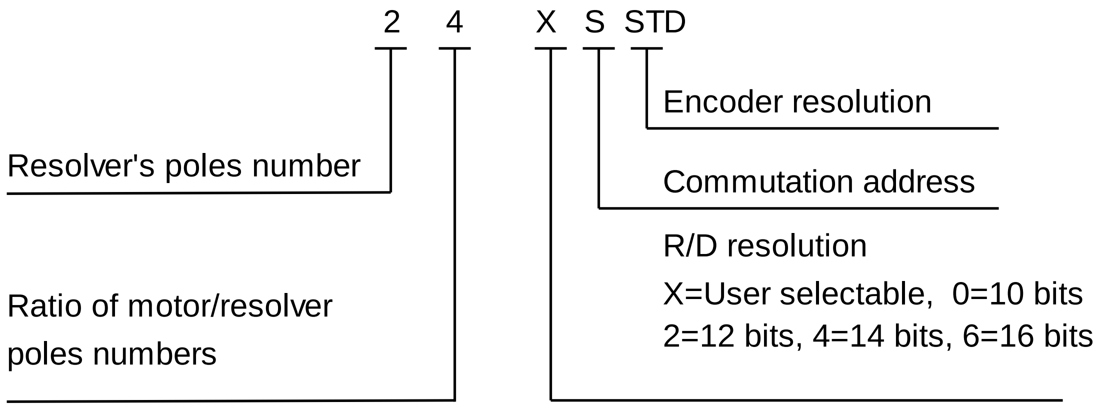
The Resolver interface circuit consists of three basic blocks:

R/D converter

The R/D conversion is done by a variable resolution, monolithic converter type 2S82 of Analog Devices. It accepts two signals from the Resolver (sine and cos.) and converts them into binary position data bits. The resolution of the position bits is user selectable 10, 12 ,14 and 16 (only for standard encoder resolution). In addition, the R/D creates a signal that is proportional to the Resolver velocity. This signal is being used as a velocity feedback.

EPROM

The EPROM creates "Hall" signals by mapping the position data bits accepted from R/D into suitable Hall signals to operate a specific brushless motor. In addition, the encoder index (marker) signal is also produced from the EPROM. The EPROM is designated as follows:



In the S (standard) version zero crossing of phases B C occurs at position address "0" of the Resolver.

Oscillator

Creates sinusoidal waveform signal to excite the primary of the Resolver.

Oscillator Frequency/Amplitude Selection (R228,R233)

The frequency (fr) and amplitude (Vr) needed to excite the Resolver are taken from the Resolver data sheet.

Selecting the frequency:

R228 = 110/fr (Kohm)

0.1KHz < fr (KHz) < 20KHz

Selecting the amplitude:

Pay attention that the RMS amplitude does not exceed 7Vrms or that the peak-to-peak (ptp) value is within the range of $2V \le Vr_{ptp} \le 20V$. For Vr in peak-to-peak value:

R233 = 6/(Vr - 2) (Kohm)

For Vr in RMS value:

R233 = 6/(2.82Vr - 2) (Kohm)

Reference Voltage level to R/D (R192)

In order to adjust the reference voltage input level to 2Vrms, select R192 as follows:

R192 = 50 x (Vr_{rms} - 2) (Kohm)

For Vr_{rms} <2V, install R192=100 ohm.

Signal input level (R193,R194)

The R/D inputs (Vin_{rms}) are adjusted to the sin/cos. Resolver outputs by:

Resolver output = Vin_{rms} = Vr_{rms} x Transformation ratio

R193 = R194 = Vin_{rms} - 2 - R_{stator} (Kohm)

(R_{stator} in Kohm).

When Vin_{rms}<2V, install R193=R194=100 ohm.
The standard R/D converter will not operate for Vin_{rms}<1.8V. Consult factory for OEM applications.

Velocity Signal

The tracking converter technique generates an internal signal at the output of the integrator that is proportional to the rate of change of the input angle. This dc analog output (velocity signal) is buffered and represented at terminal H/R-12b,E-J3/23. **Max output voltage is ±8V.**

This velocity signal can be internally connected to the summing junction of the error amplifier by inserting R7 - see Appendix B for more details. However, the standard procedure does not require closing the velocity loop.

Select maximum actual velocity of the application and calculate the maximum tracking rate T of the Resolver as follows:

T = rpm x Q / 120

T unit is rps: Resolver electrical revolution per second
Q - number of poles of Resolver ;
rpm - mechanical revolution per minute.

Selecting the Resolution

The resolution can be selected to be 10,12,14 or 16 bits by use of DIP switches 13 and 14. When selecting the resolution the rps limits should not be exceeded:

10 bit = 1040 rps

12 bit = 260 rps

14 bit = 65 rps

16 bit = 16.5rps

Resolution	DS13	DS14
10	ON	ON
12	ON	OFF
14	OFF	ON
16	OFF	OFF

Note:

- Each resolution change must be followed by new components selection procedure.
- When changing resolution under dynamic conditions, a period of uncertainty will exist before position and velocity data is valid.

Encoder resolution

In the STD mode (DS12 OFF), the encoder signals A,B are created by the EPLD and can have only the following basic resolutions (for 2 pole Resolver):

256 for 10 bits

1024 for 12 bits

4096 for 14 and 16 bits

When the Resolver is more than 2 poles, the resolution for one shaft rotation will be:

$$Er = QxS / 8$$

Q = number of Resolver poles ;

S = resolution of converter (2^{10},2^{12},or 2^{14})

When different encoder resolution is needed the encoder signals are generated by the EPROM and the R/D resolution is no longer user selectable.

This option requires

- DS12 at ON
- Special EPROM which is programmed for this resolution.

HF Filter (R195, R196, C61, C62)

The function of the HF filter is to reduce the amount of noise present on the signal inputs to the 2S82, reaching the Phase Sensitive Detector and affecting the outputs. Values should be chosen so that

$$15\text{Kohm} < R195 = R196 < 30\text{Kohm}$$

$$C61 = C62 = \frac{160 \times 10^3}{R195 \times fr} \quad (\text{pF})$$

fr = Reference frequency in KHz

R195 in Kohm

This filter gives an attenuation of 3 times at the input to the phase sensitive detector.

AC Coupling of Reference Input (C60)

Select C60 so that there is no significant phase shift at the reference frequency. That is,

$$C60 = \frac{10^6}{fr(\text{KHz}) \times Rx} \quad (\text{pF}) \qquad Rx = \frac{100 \times R192}{100 + R192} \quad (\text{Kohm})$$

R192 in Kohm

If Rx yields less than 50K, install a value of Rx=50K in the C60 equation.

Maximum Tracking Rate (R201)

The VCO input resistor R201 sets the maximum tracking rate of the converter and hence the velocity scaling as at the maximum tracking rate, the velocity output will be 8V.

Decide on your required maximum tracking rate, "T" , in revolutions per second. Note that "T" must not exceed the specified maximum tracking rate or 1/16 of the reference frequency.

$R201 = 5.92 \times 10^7 / T \times p$ (Kohm)

where p = bit per rev
= 1,024 for 10 bits resolution
= 4,096 for 12 bits
= 16,384 for 14 bits
= 65,536 for 16 bits

Closed Loop Bandwidth Selection (C67, C68, R200)

a. Choose the Closed Loop 3dB Bandwidth (f_{bw}) required ensuring that

$$f_{ref} > 10 \times f_{bw}$$

Recommended bandwidth values:
250Hz for 3KHz
300Hz for 5KHz
500Hz for 10KHz

b. Select C67 so that

$$C67 = \frac{2.5 \times 10^9}{R201 \times f_{bw}^2} \quad \text{(pF)}$$

with R201 in Kohm and f_{bw} in Hz as selected above.

c. C68 is given by

$$C68 = 40 \times C67 \quad \text{(pF)}$$

d. R200 is given by

$$R200 = \frac{127 \times 10^{7}}{f_{bw} \times C68} \quad \text{(Kohm)}$$

f_{bw} in Hz, C68 in pF

R200 value should be at least three times R197.

Gain Scaling Resistor (R197)

R197 should be installed according the following table:

536Kohm for 10 bits resolution

130Kohm for 12 bits

33Kohm for 14 bits

8.2Kohm for 16 bits

8. Applying power - Adjustments

Important remarks:
A. If all the previous steps were accomplished you may now disconnect the motor leads, turn the power on and continue with the following adjustments.

Step 1 - Applying Power

Apply power and check for LED Vs of the DCB that should be "ON", indicating that the system supplies are present. The display should read: "F-OK". If you get another message, refer to the following table to find the cause of the problem. Turn the power off, clear the cause of the problem and re-power the unit.

Event	Display	Display after Recurring
DIP switch 1 - ON	BAUD	OK
Load is under cont. current limit	CLIM	C-OK
Battery Low	BATT	B-OK
Abort condition (hardware only)	ABRT	A-OK
Amplifier's power stage disabled*	AMPD	H-OK
-15V out of limits	-15V	F-OK
Under or Over Voltage	VOLT	F-OK
+15V out of limits	+15V	F-OK
Over Temperature	TEMP	F-OK
Commutation problem	CMMT	F-OK
Short condition at the power outputs	SHRT	F-OK

* The AMPD message appears in two cases:
1. When MO (Motor Off) command is given.
2. Position error exceeds the allowed value.

Step 2 - Establishing the communication

Press CR (carriage return) in the host several times until the DCB sends the message "Communication OK".

If you want to "lock" the baud rate in the DCB:

- Turn off the power and remove the amplifier from the rack if it is a rack version.
- Set DS1-OFF.

Now the baud rate you selected is stored in the SRAM.

It is possible to change DS1 at any time. However, the DCB will notice the change only upon power on or hardware reset.

Step 3 - Checking the feedback elements

- Turn on the power.
- Rotate the motor shaft manually and interrogate the position with the instruction:

  TP (CR)

The controller response should vary as the motor is turned. If this does not occur, check the feedback signals.

- When using the auxiliary encoder input, rotate the auxiliary encoder and interrogate the position with the instruction: PY.

The controller response should vary as the encoder is turned. If this does not occur, check the feedback signals. The DCB is counting quadrature pulses. This means that for encoders or resolvers the answer for a TP command will be 4 times the number of basic encoder pulses and for Pulse/Direction mode it will be twice the number of pulses.

Step 4 - Adjusting the current limits

Defining the amplifier type

- Define the maximum current of the amplifier by the instruction:

MCn

n - rated peak current of the amplifier in A as given in the table of chapter 3.

For example: n is 48 for DBPF-24/270

Current limit adjustments

- Define the continuous current limit by the instruction:

CLn.m (n.m - current in A)

- Define the peak current limit by the instruction:

PLn.m (n.m - current in A)

- Define the maximum peak current duration by the instruction:

PDn.m (n.m - seconds)

Step 5 - Latch mode of the protective functions

All the protective functions activate internal inhibit. There are two modes of resetting the amplifier after the cause of the inhibit disappears:

Self Restart: (LM0)

The amplifier is inhibited only for the period that the inhibit cause is present.

Latch (LM1)

Each failure latches the Inhibit and the failure message on the display. For restart (after clearing the failure source), reset has to be performed by applying logic 0 at the reset input (H/R-17a,E-J3/21), or by turning the power off and on.

For safety reason it is recommended to use the amplifier in the LATCH MODE - LM1

Step 6 - Connecting the Motor

- Turn off the power.
- Connect the leads of the motor.
- Turn on the power.

For proper operation, the system must have negative feedback. If the motor remains in the same position and returns to the same position when you turn the motor shaft and let go, then the position feedback is negative as required. If the motor runs away you have positive feedback. To correct the feedback, just reverse the encoder leads.

9. Tables and Summaries

9.1 Display diagnostics

Each amplifier's fault is stored immediately in the DCB RAM. In addition to that, a Failure Message is displayed. Following are all the valid Display Messages:

Event	Display	Display after Recurring
DIP switch 1 - ON	BAUD	OK
Load is under cont. current limit	CLIM	C-OK
Battery Low	BATT	B-OK
Abort condition (hardware only)	ABRT	A-OK
Amplifier's power stage disabled*	AMPD	H-OK
-15V out of limits	-15V	F-OK
Under or Over Voltage	VOLT	F-OK
+15V out of limits	+15V	F-OK
Over Temperature	TEMP	F-OK
Commutation problem (for brushless drives only)	CMMT	F-OK
Short condition at the power outputs	SHRT	F-OK

* The AMPD message appears in two cases:

1. When MO (Motor Off) command is given.
2. Position error exceeds the allowed value.

9.2 Summary of DIP switches

Power stage board

(2 poles DIP switch)

DIP switch	OFF (UP)	ON (DOWN)
DS1	60° commutation signals format	30° commutation signals format
DS2	No CFM	Activate CFM

Control stage board

(9 poles DIP switch)

DIP switch	ON	OFF
DS1	Auto-selection of Baud rate	Latch last value
DS2	Non-differential channel A	Diff. input of channel A
DS3	Non-differential channel B	Diff. input of channel B
DS4	Non-differential channel Ay	Diff. input of channel Ay
DS5	Non-differential channel By	Diff. input of channel By
DS6	Non-differential index	Diff. index
DS7	Pulse/Direction format	Encoder channels format
DS8	N/C	
DS9	RS485	RS232

4 poles DIP switch (for Resolver)

Switch	OFF	ON
DS11	Tacho signal disconnected	Tacho signal connected to error amplifier.
DS12	Standard encoder resolution	Non-standard encoder resolution
DS13	14 bit resolution (DS14-ON) 16 bit resolution (DS14-OFF)	10 bit resolution (DS14-ON) 12 bit resolution (DS14-OFF)
DS14	12 bit resolution (DS13-ON) 16 bit resolution (DS13-OFF)	10 bit resolution (DS13-ON) 14 bit resolution (DS13-OFF)

Appendix A - Current loop response

In most applications it is not necessary to adjust the current loop to achieve the optimum response. When there are extreme electrical parameters in the armature circuit (inductance and resistance) the standard components values of 0.01μF for C1 and 100Kohm for R4 may not yield with the optimum response. The current loop should be optimized as follows:

- Insert R7 (1K) to connect the tacho input to the error amplifier. The amplifier must not be configured into velocity mode. If the resolver option is used, make sure that DS11 is OFF.
- Apply power to the amplifier and send the command BA.
- Provide the tacho input H/R-12b,E-J3/23 with a bi-directional square wave current command (100-200Hz, ±2.0V waveform is often employed).
- Monitor the load current either by a current probe or by the current monitor.

If the current response is not critically damped, use the following procedure:

- Short circuit C1 with a short jumper wire.
- Replace R4 with a decade resistance box. Initially set the box resistance at 10Kohm.
- Apply the square wave test signal to the amplifier input.
- Apply power, and while monitoring the load current, gradually increase the value of the box resistance until optimum response as depicted in Fig A-1 is achieved.
- Substitute the closest standard value discrete resistor for R4 and remove the decade resistance box.
- Remove the shorting jumper across C1, and again check the response using the square wave test signal.
- If the previous step does not yield satisfactory results, if unacceptable overshooting has been noted, substitute a larger value than 0.01 μF; or, if the response is overdamped, substitute a smaller value than 0.01 μF. Repetition of this procedure should yield an optimum choice for C1.

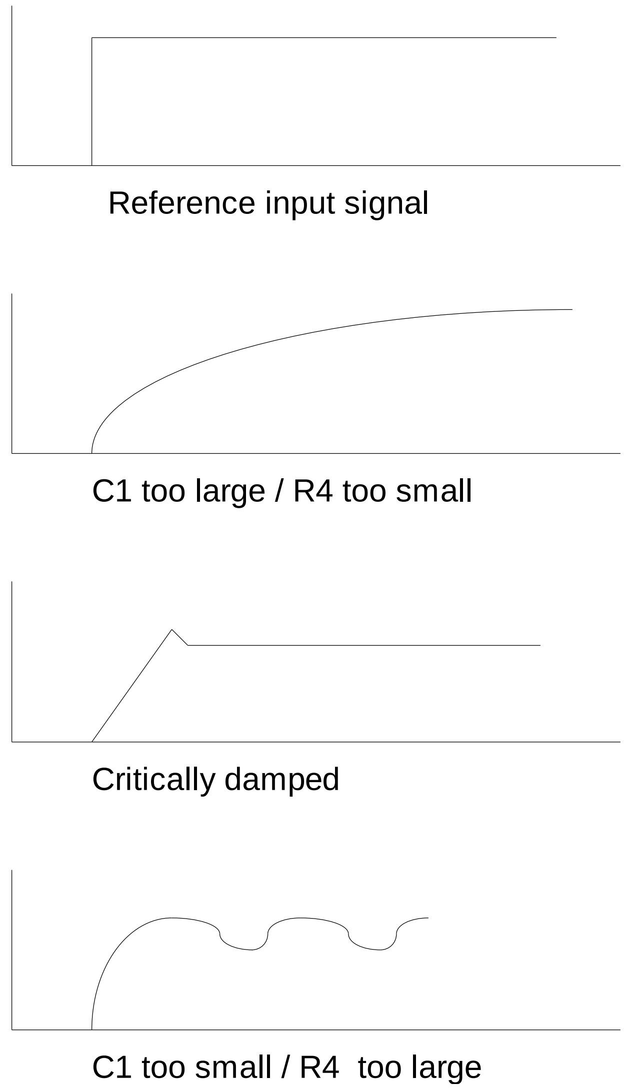


Fig. A-1

Typical current response waveforms

Appendix B - Adding a velocity feedback

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Appendix C - Differential amplifier connection

The differential amplifier is provided for your optional use. It can be used for buffering, inverting or elimination of common mode signals.

The differential amplifier inputs are available at terminals H/R-9b,E-J3/1, H/R-10b,E-J3/2. Terminal H/R-10b,E-J3/2 is the inverting input, terminal H/R-9b,E-J3/1 is the non-inverting input. The output is on terminal H/R-11b,E-J3/3. The differential amplifier can be internally connected to the summing junction by inserting R800.

The differential amplifier may be used as a buffer or as an eliminator of common mode signals. For a non-inverting buffer amplifier, connect the positive signal lead to terminal H/R-9b,E-J3/1 and the negative signal lead to terminal H/R-10b,E-J3/2, and connect terminal H/R-10b,E-J3/2 to the circuit common. For an inverting buffer amplifier, connect the positive signal lead to terminal H/R-10b,E-J3/2, the negative signal lead to terminal H/R-9b,E-J3/1, and connect terminal H/R-9b,E-J3/1 to the circuit common. The output of the differential amplifier is given by:

$$V_o = \frac{10 \times V_1}{10 + R3} \times \left(1 + \frac{10}{R2} \right) - \frac{10 \times V_2}{R2}$$

V_1 - Input voltage of terminal H/R-9b,E-J3/1.
V_2 - Input voltage of terminal H/R-10b,E-J3/2.

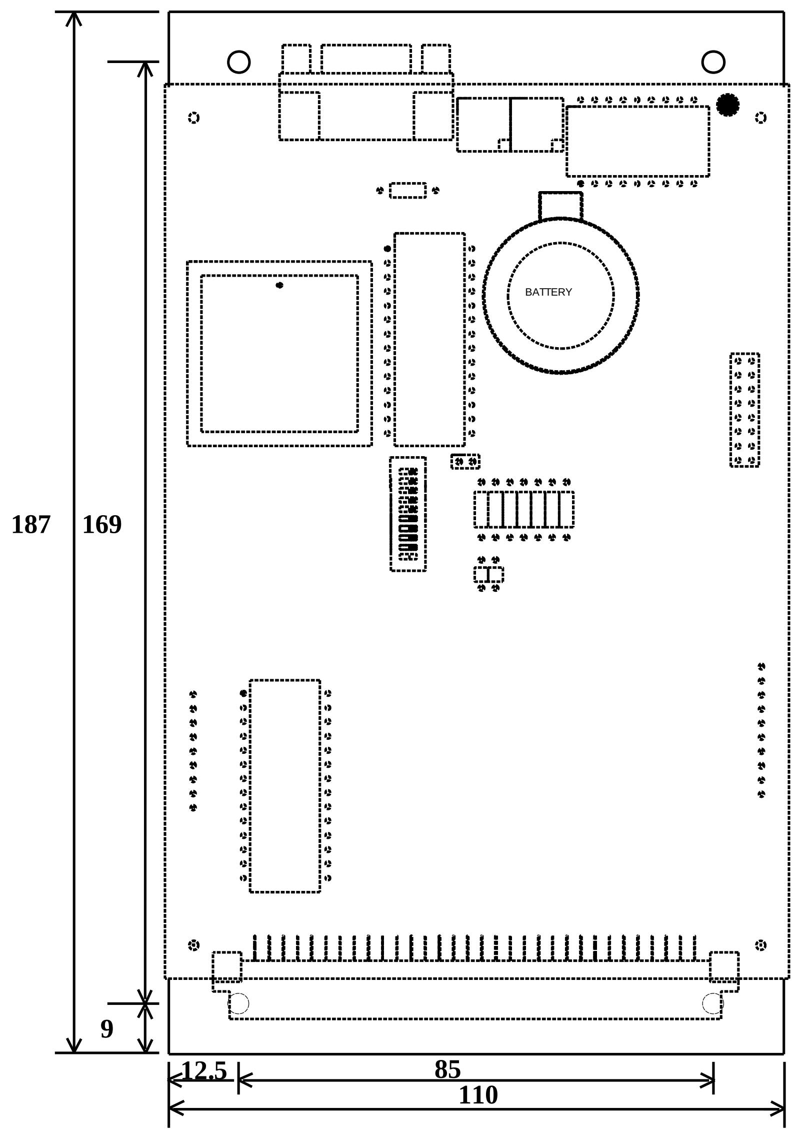
$$V_{1max} \leq 10 + R3; \qquad V_{2max} \leq 100/R2$$

See schematic in chapter 4.

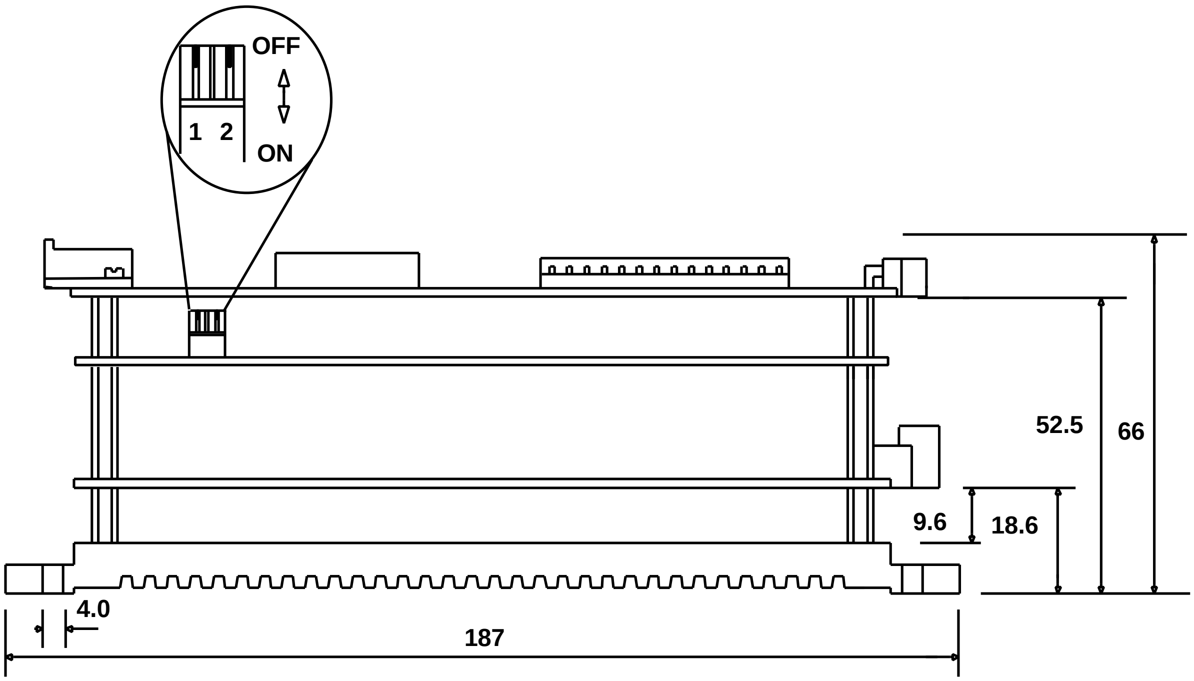
DIMENSIONAL DRAWINGS

IN THE FOLLOWING DRAWINGS ALL THE DIMENSIONS ARE IN MILLIMETERS.

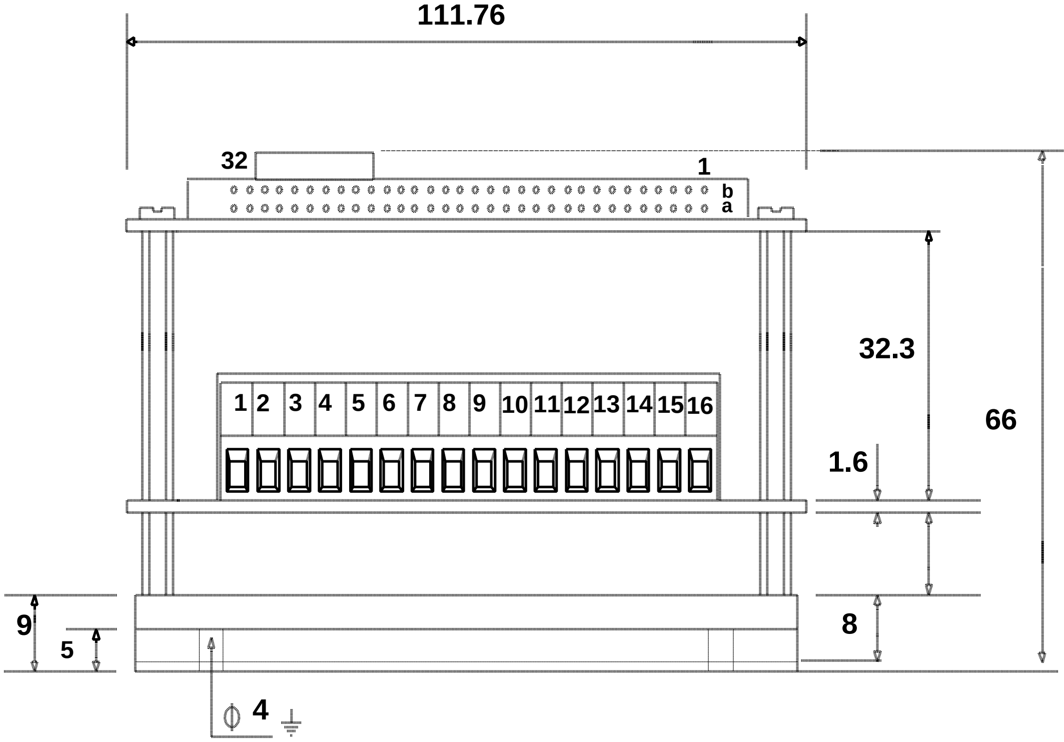
PANEL (H), DBP1



DBP1 - TOP VIEW

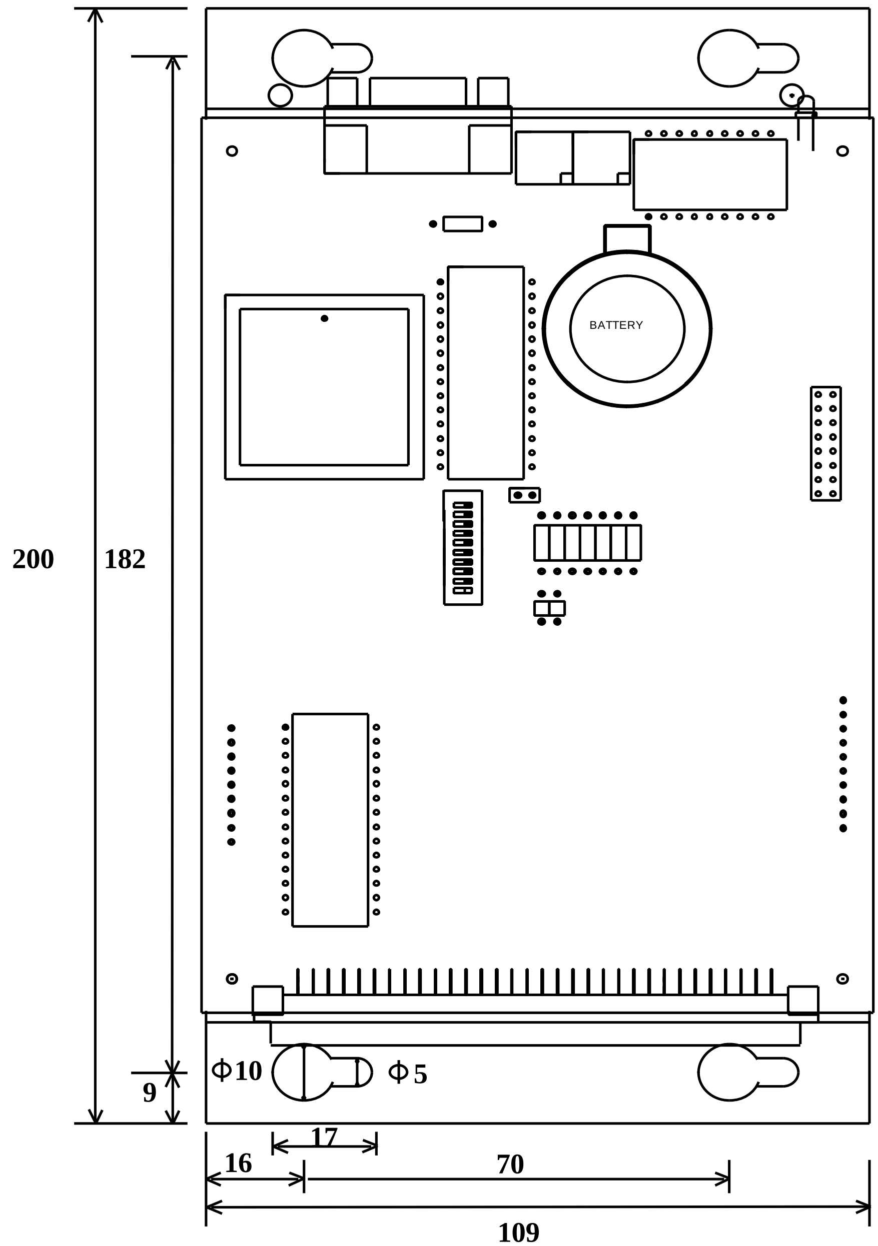


DBP1 - SIDE VIEW 1

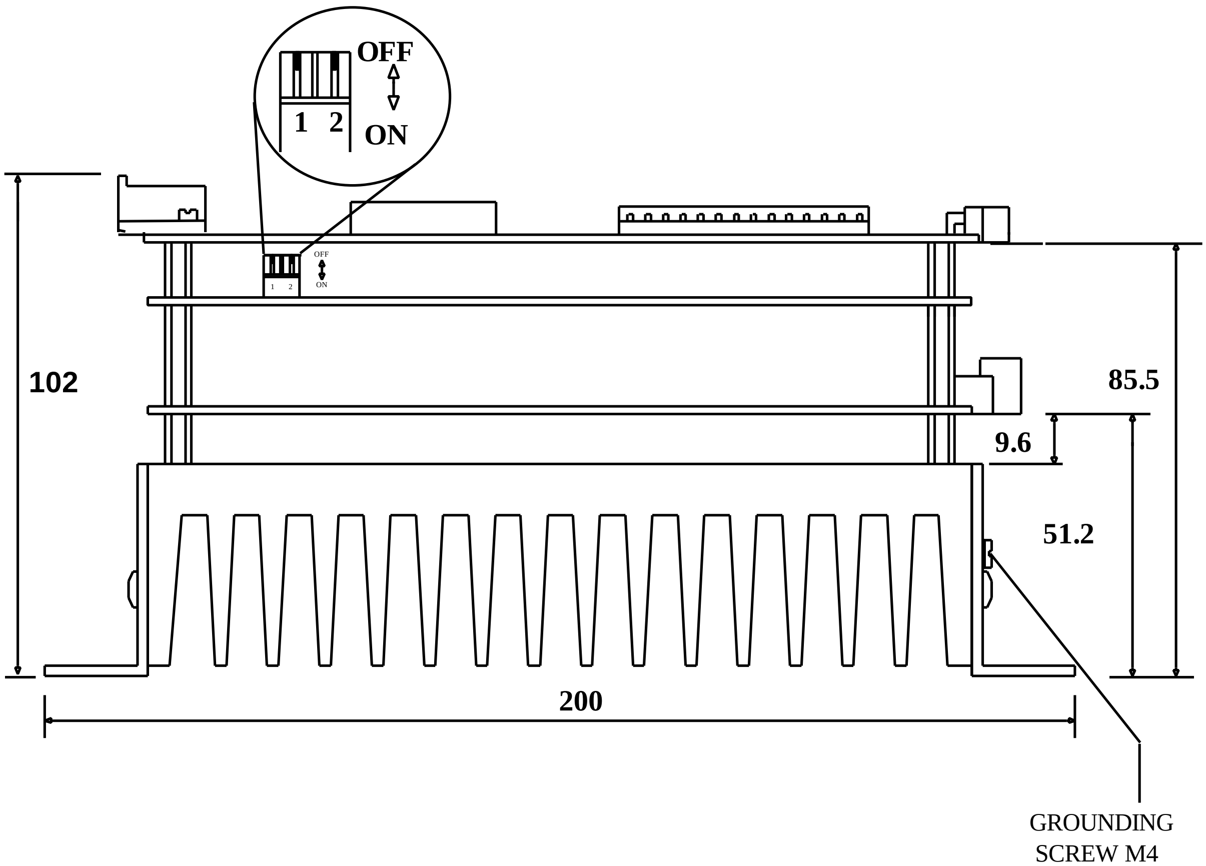


DBP1 - SIDE VIEW 2

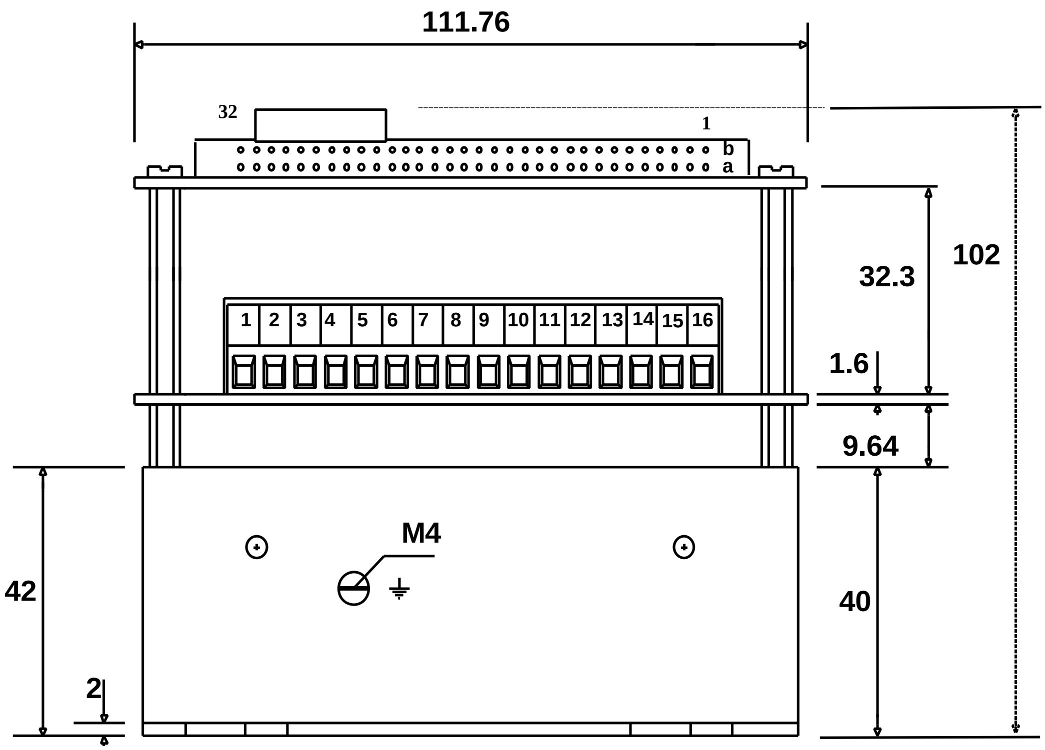
PANEL (H), DBP2



DBP2 - TOP VIEW

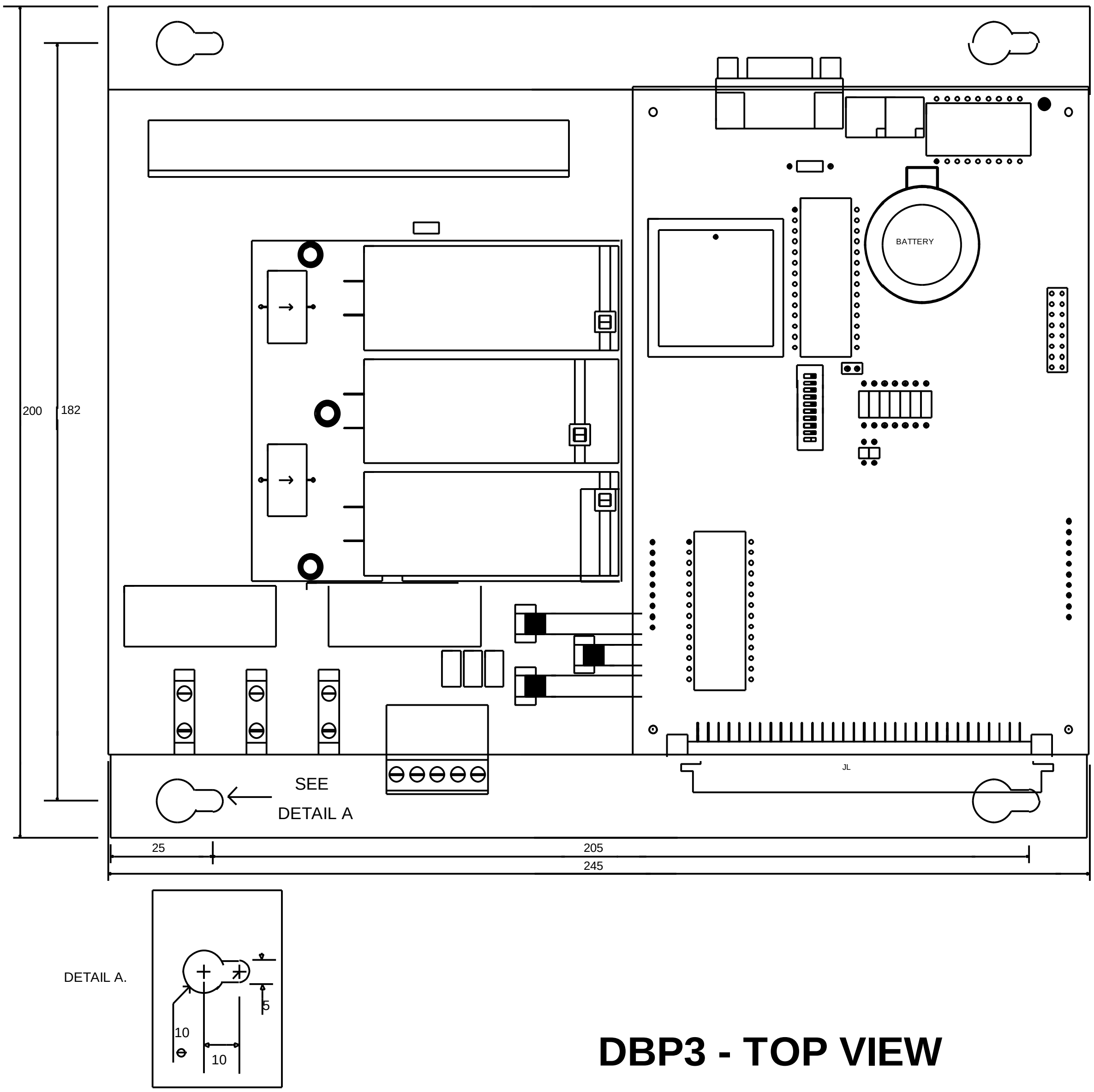


DBP2 - SIDE VIEW 1

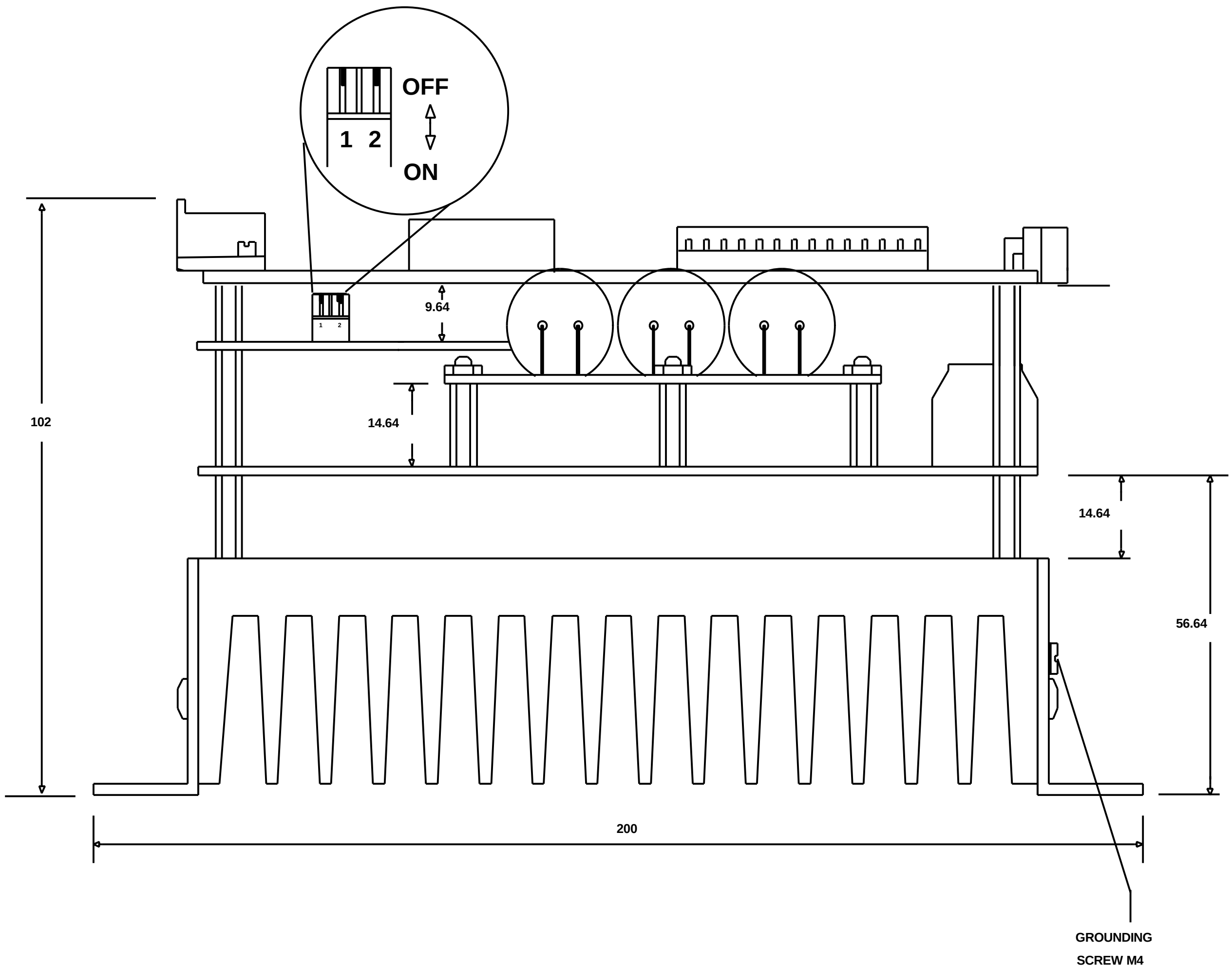


DBP2 - SIDE VIEW 2

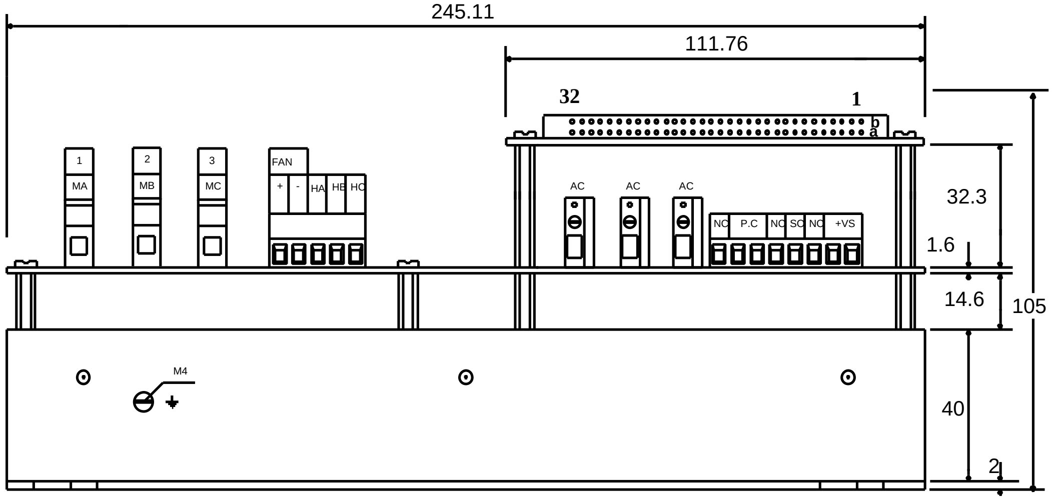
PANEL (H), DBP3



DBP3 - TOP VIEW

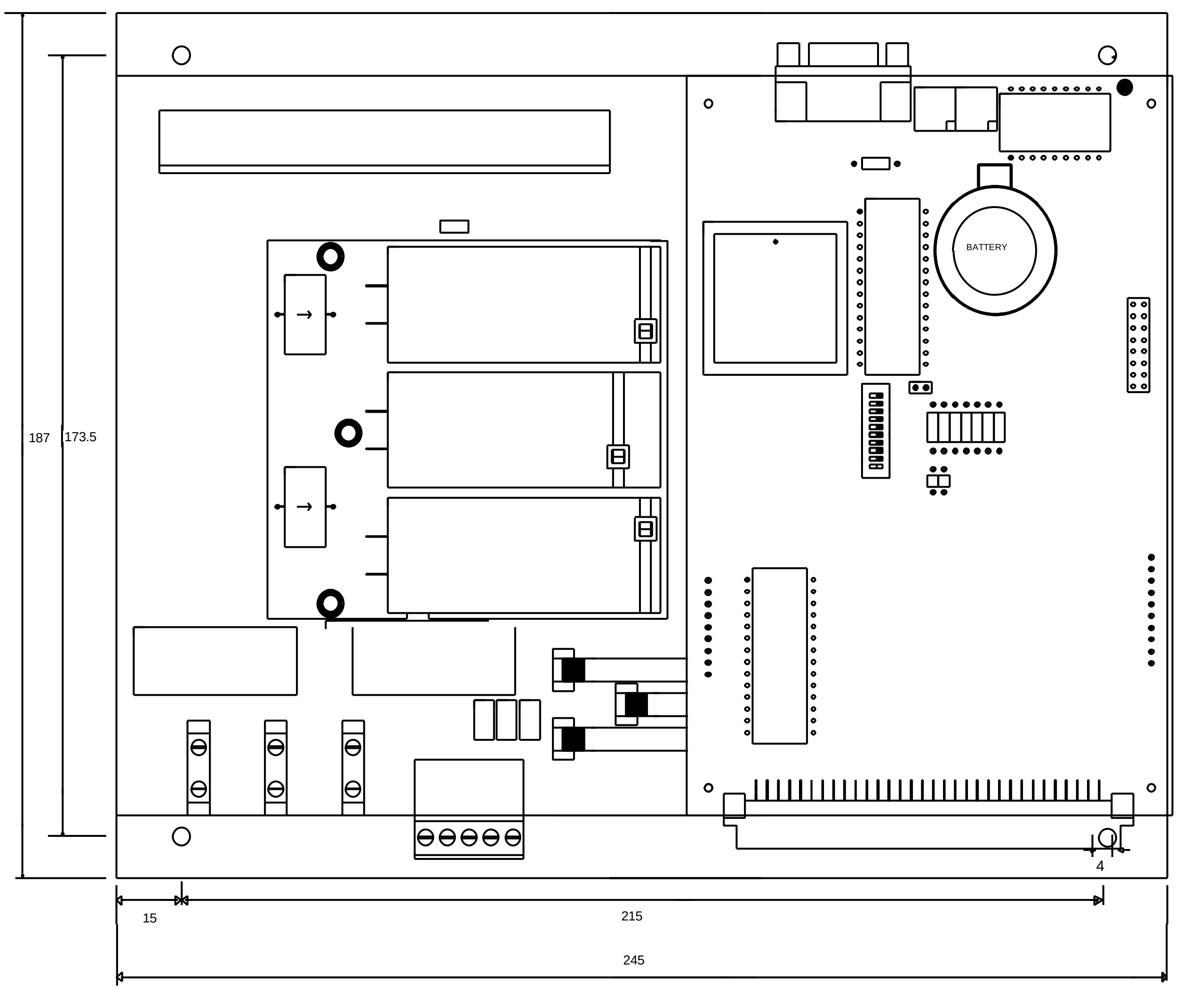


DBP3 - SIDE VIEW 1

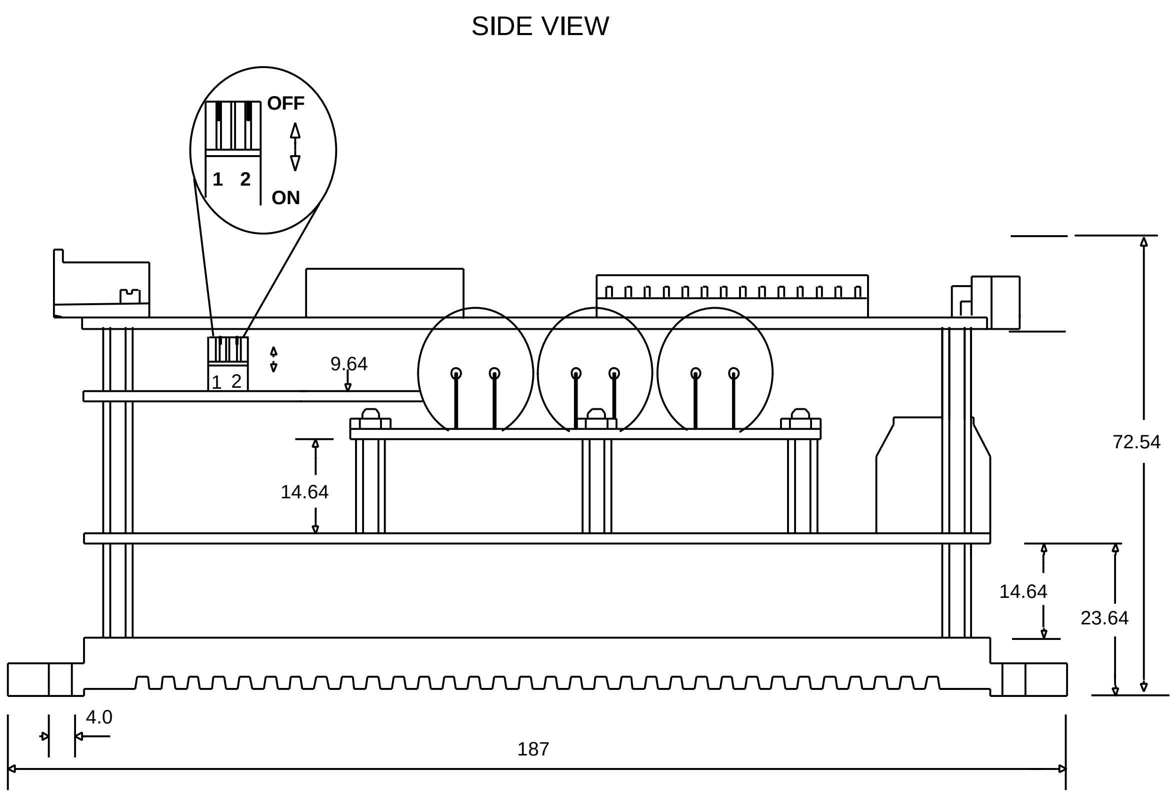


DBP3 - SIDE VIEW 2

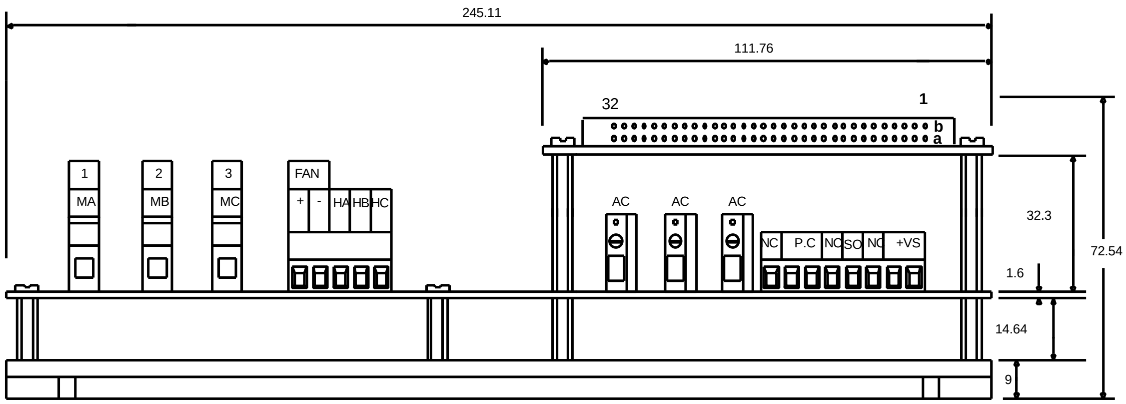
PANEL (H), DBP4



DBP4 - TOP VIEW

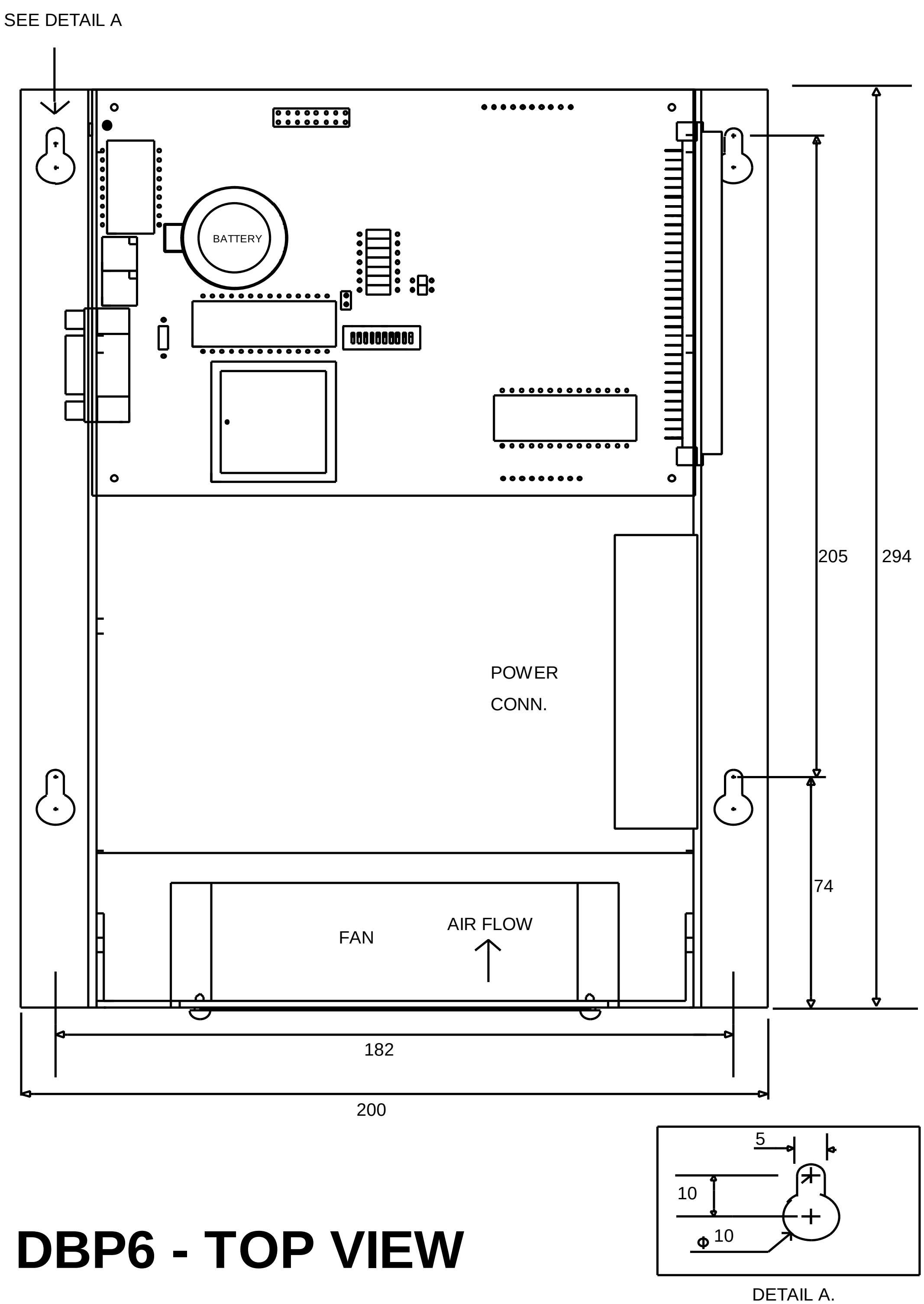


DBP4 - SIDE VIEW 1



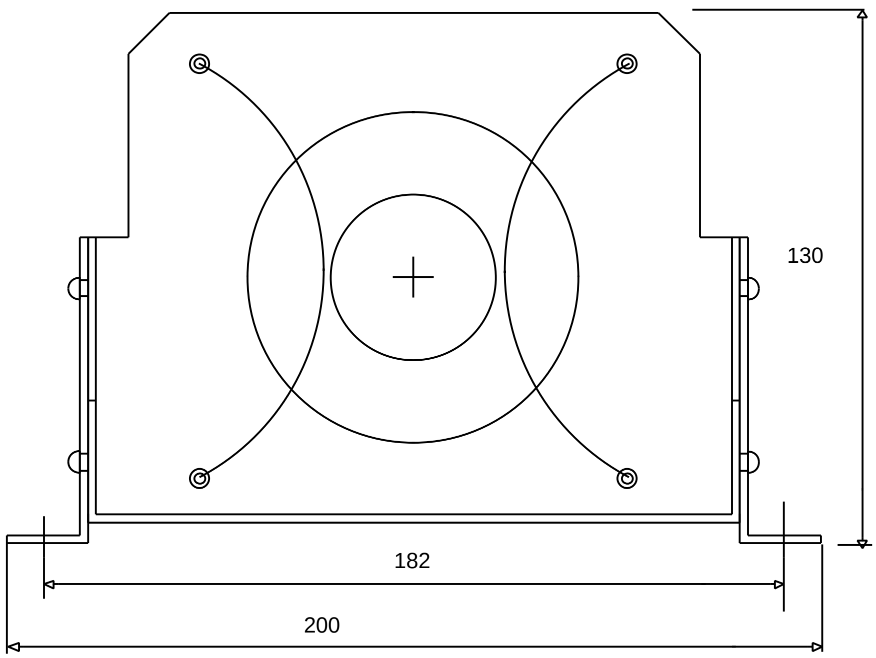
DBP4 - SIDE VIEW 2

PANEL (H), DBP6

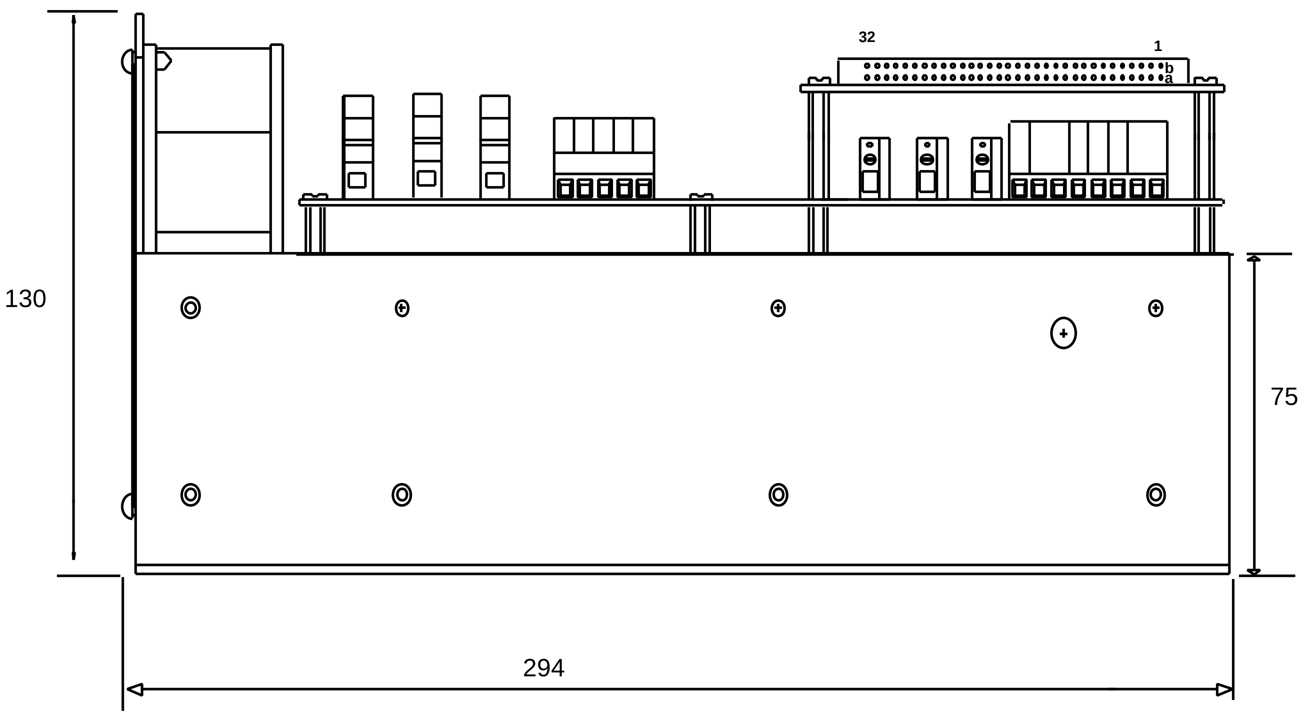


DBP6 - TOP VIEW

FRONT VIEW

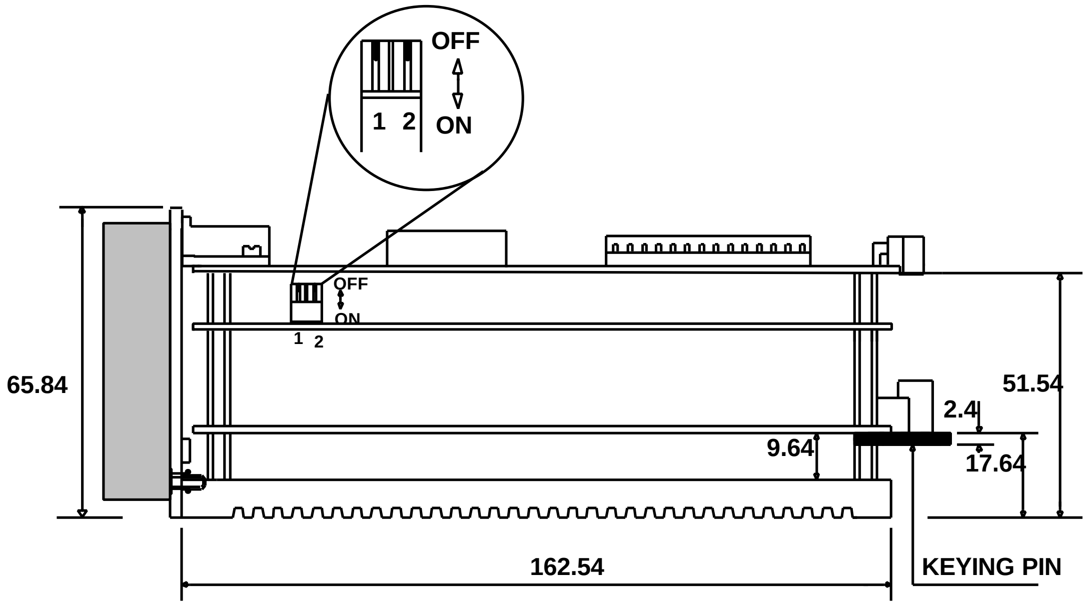


DBP6 - SIDE VIEW 1



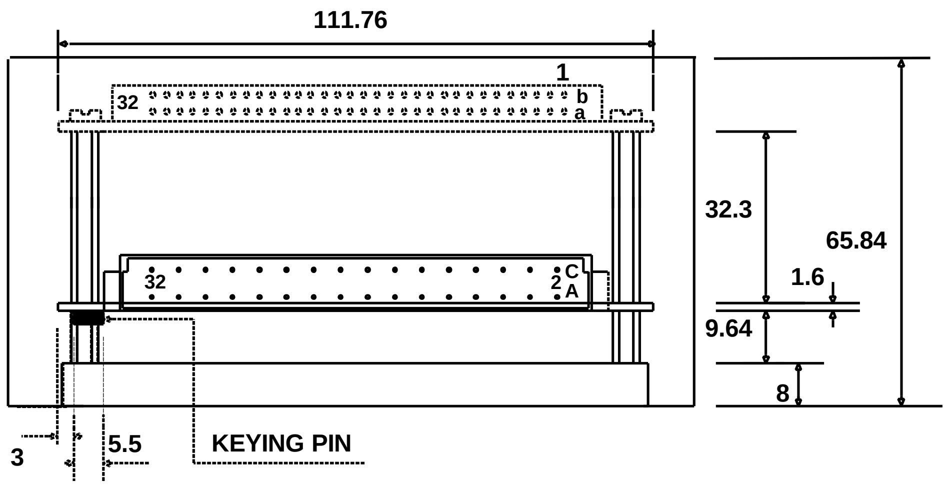
DBP6 - SIDE VIEW 2

RACK 3U/13T



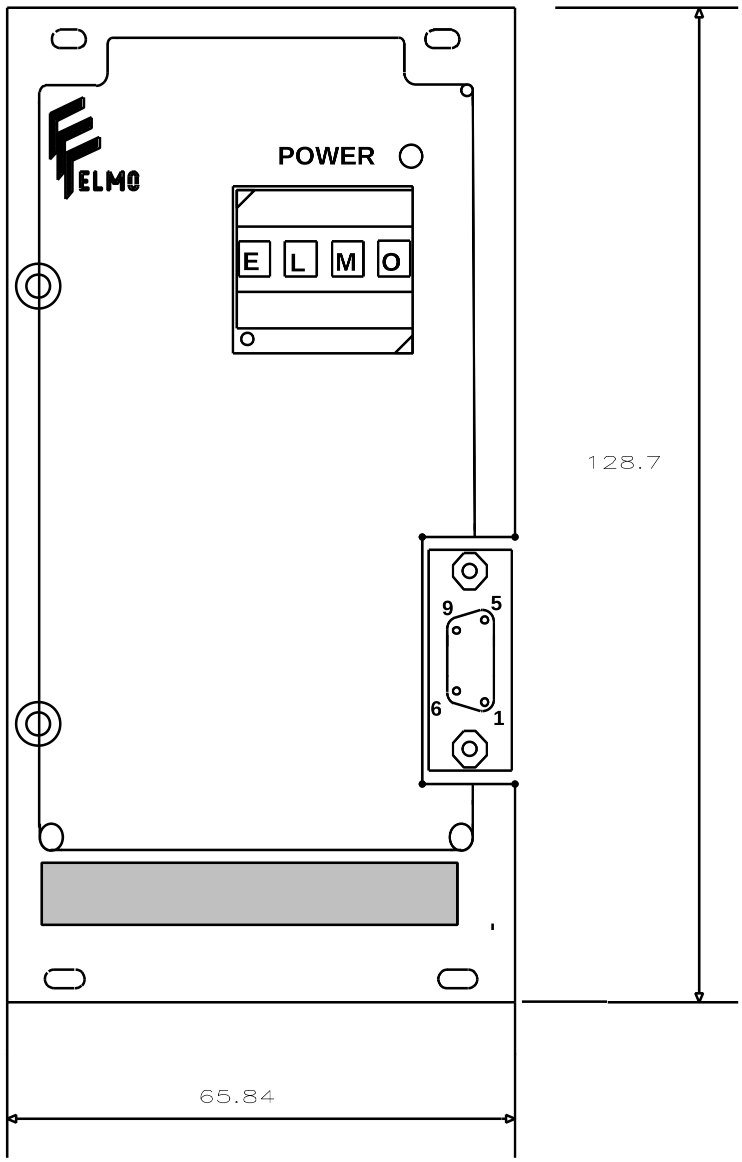
DBP RACK MOUNTING (3U/ 13T)

SIDE VIEW 1



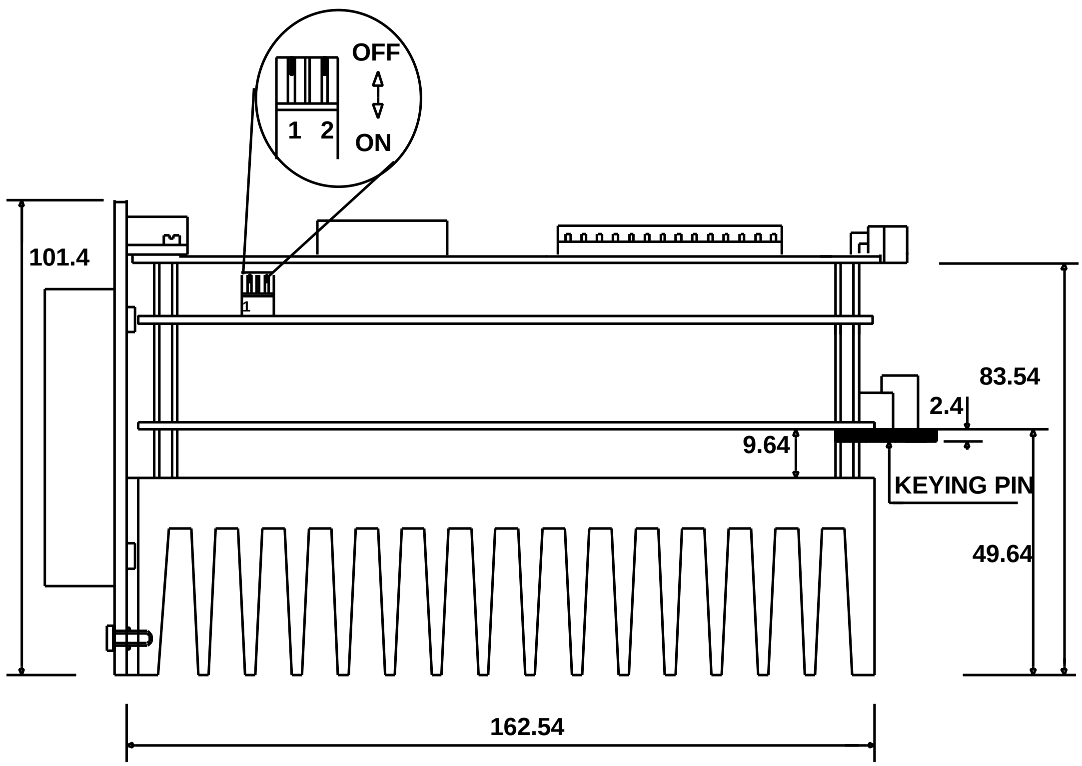
DBP RACK MOUNTING (3U/ 13T)

SIDE VIEW 2



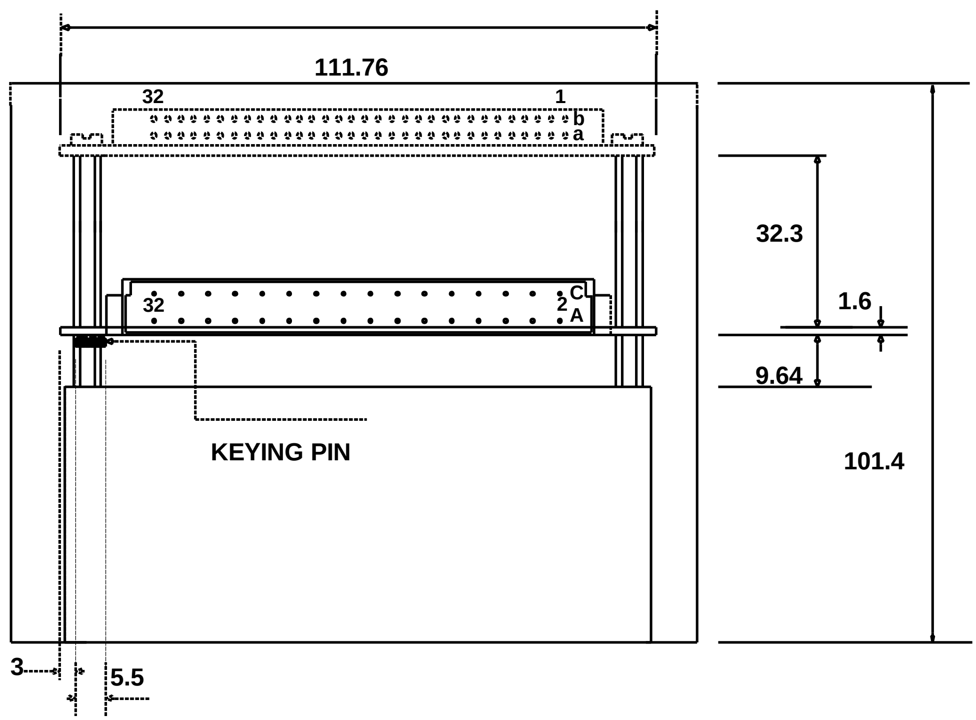
FRONT PANEL FOR DBP 3U/13T

RACK 3U/20T



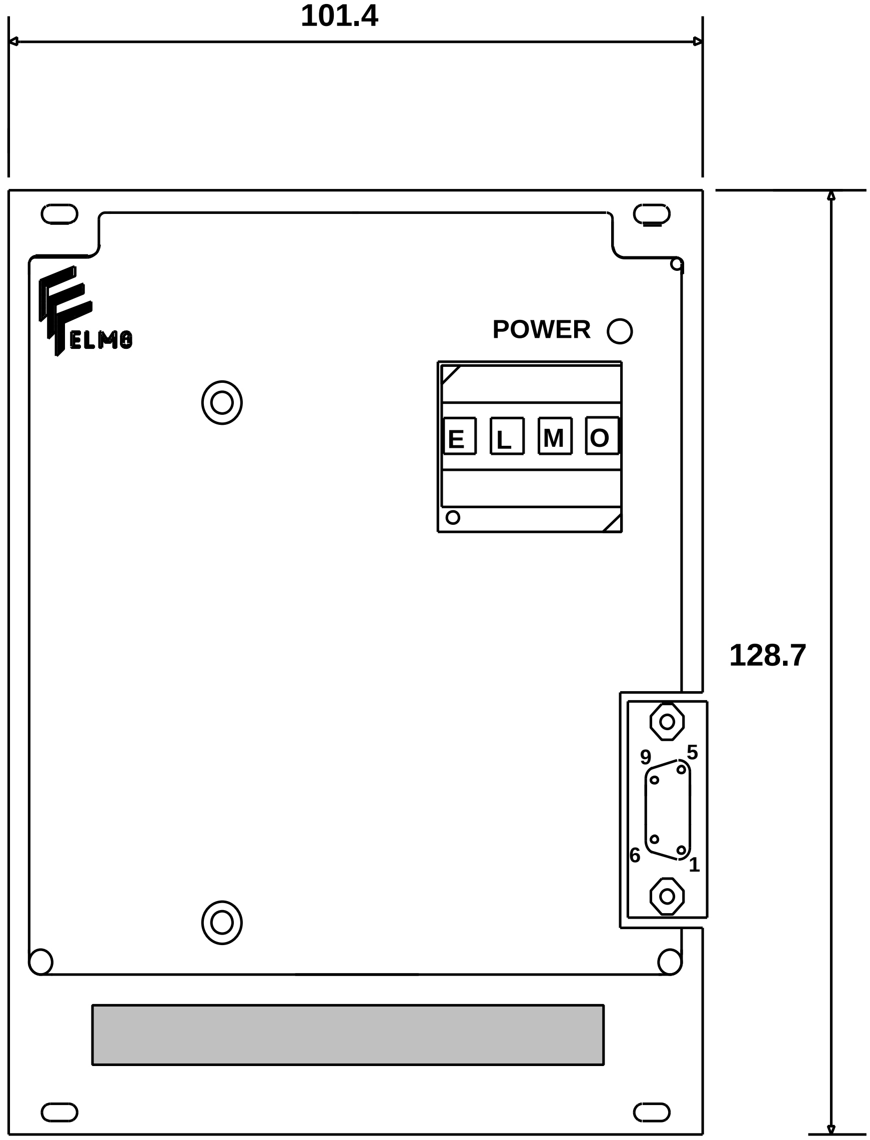
DBP RACK MOUNTING (3U/20T)

SIDE VIEW 1



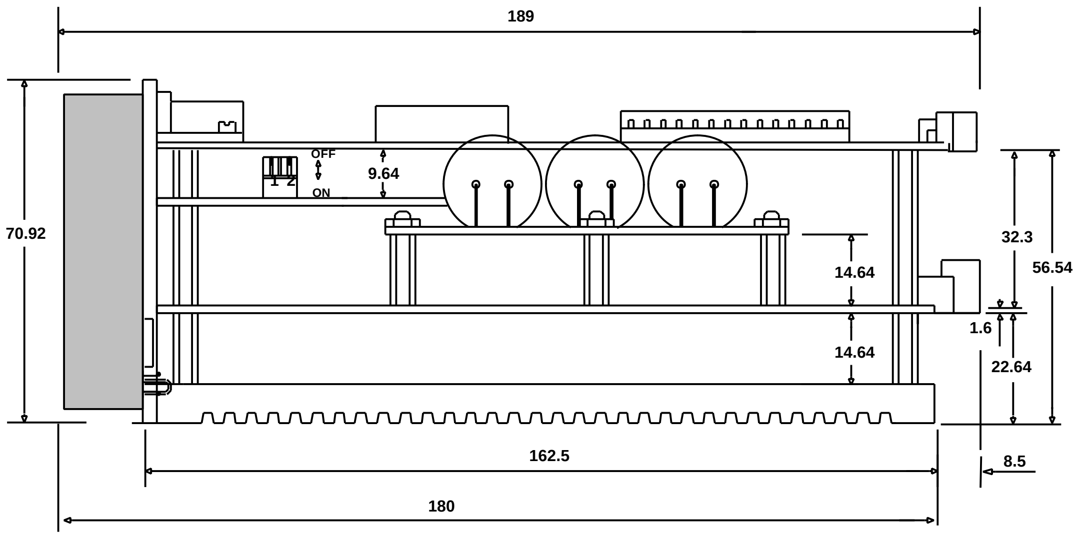
DBP RACK MOUNTING (3U/ 20T)

SIDE VIEW 2



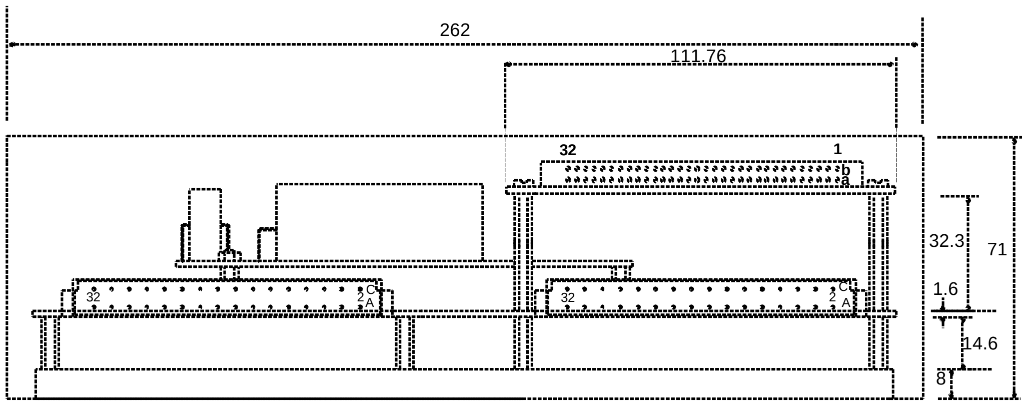
FRONT PANEL FOR DBP 3U/ 20T

RACK 6U/14T



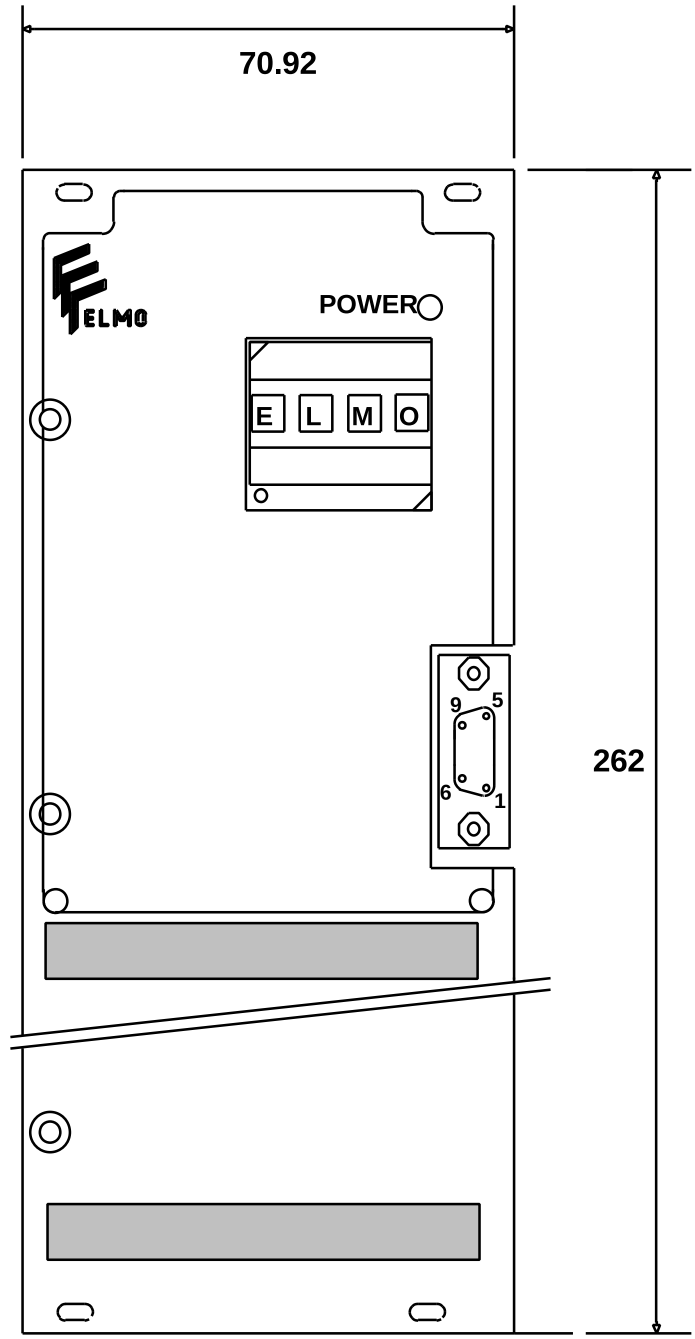
DBP RACK MOUNTING (6U/14T)

SIDE VIEW 1



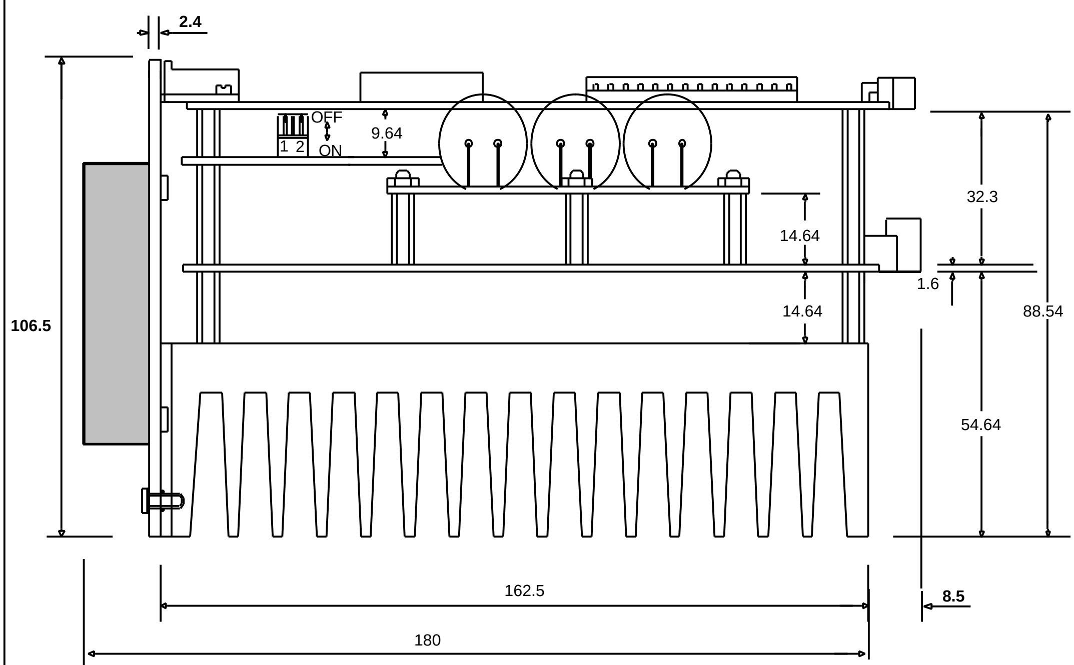
DBP RACK MOUNTING (6U/14T)

SIDE VIEW 2



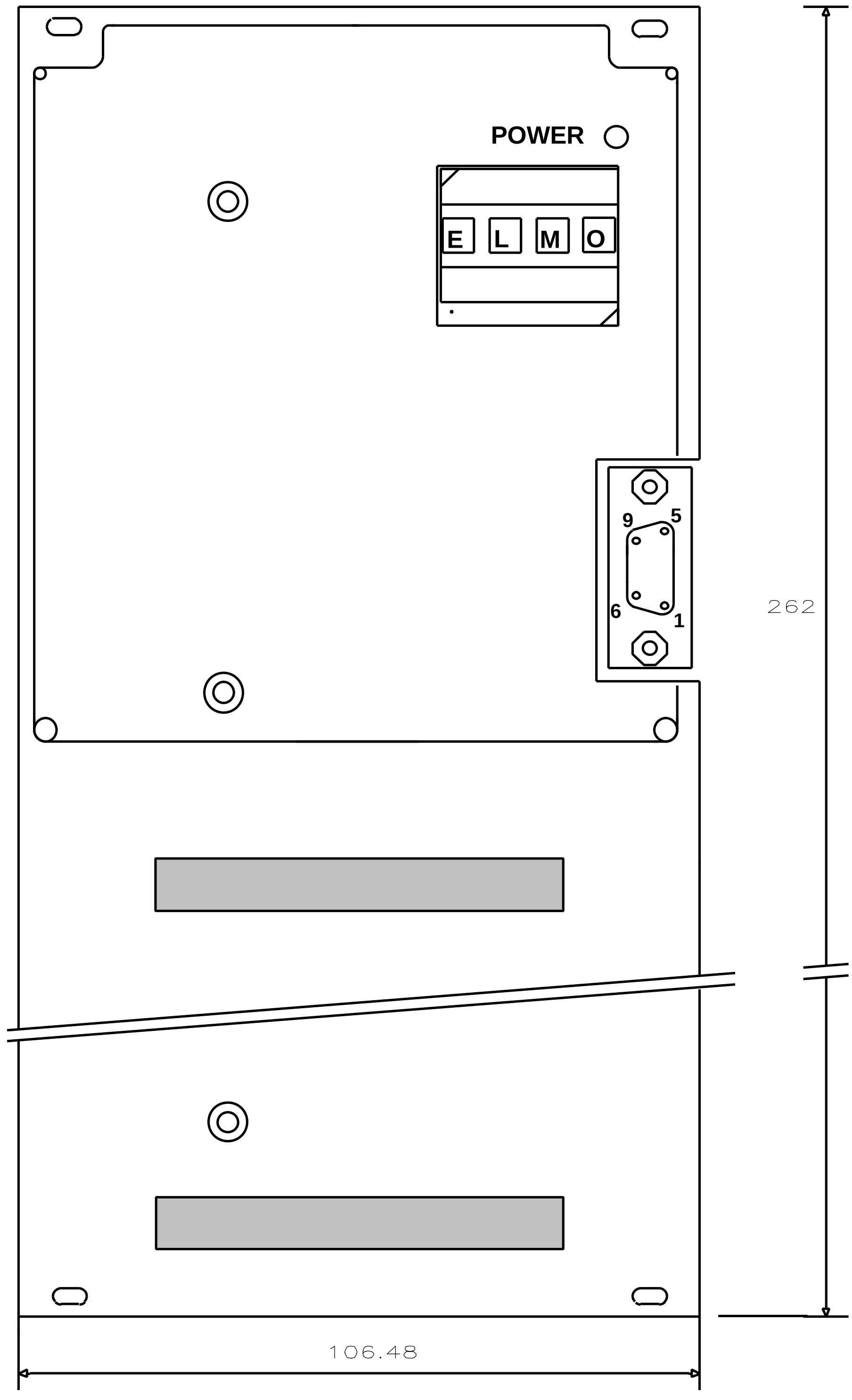
FRONT PANEL FOR DBP 6U/14T

RACK 6U/21T



DBP RACK MOUNTING (6U/21T)

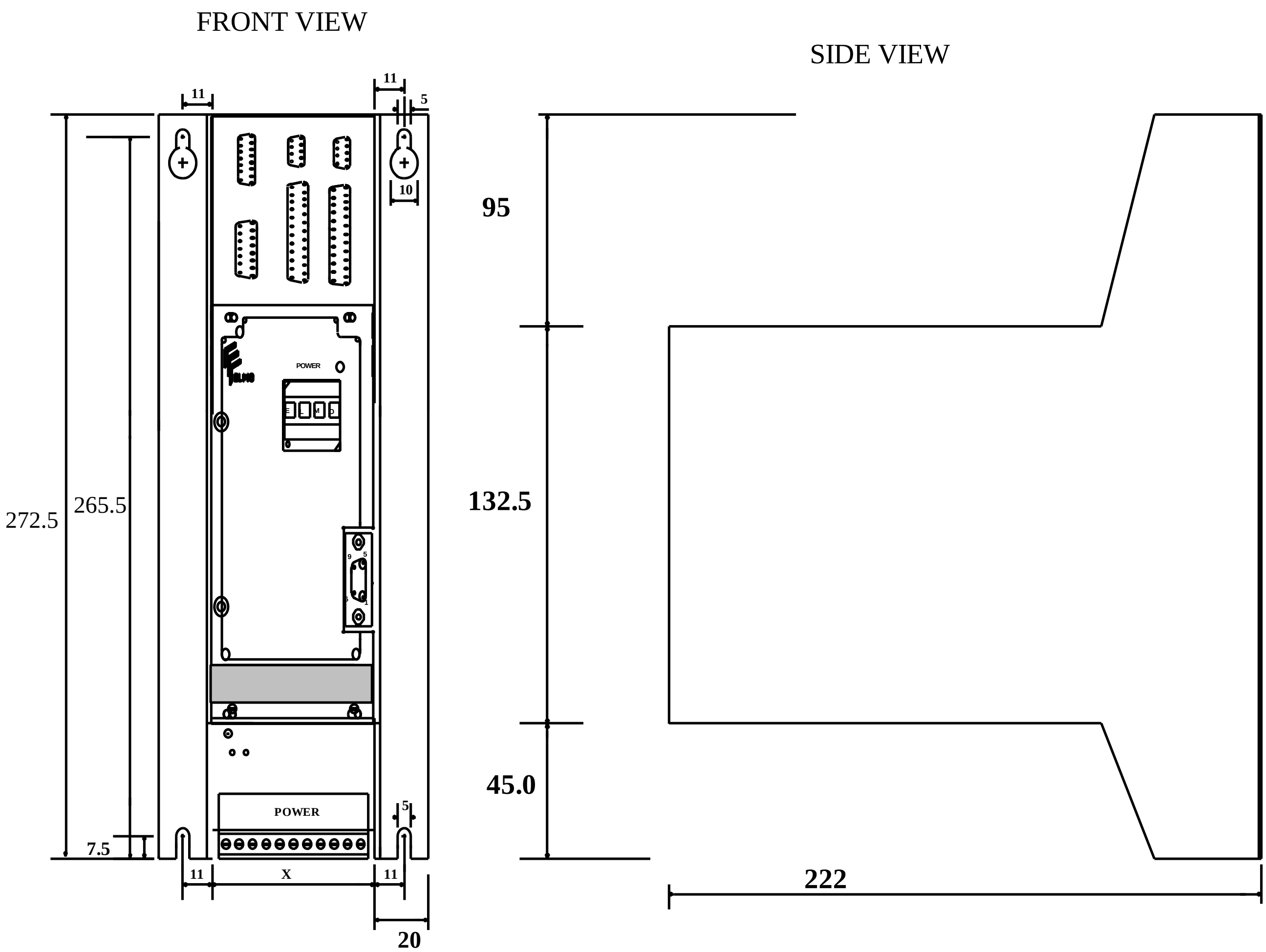
SIDE VIEW 1



FRONT PANEL FOR DBP 6U/21T

ENCD - 3U/...

ENCD - 3U/...



Standard Sizes

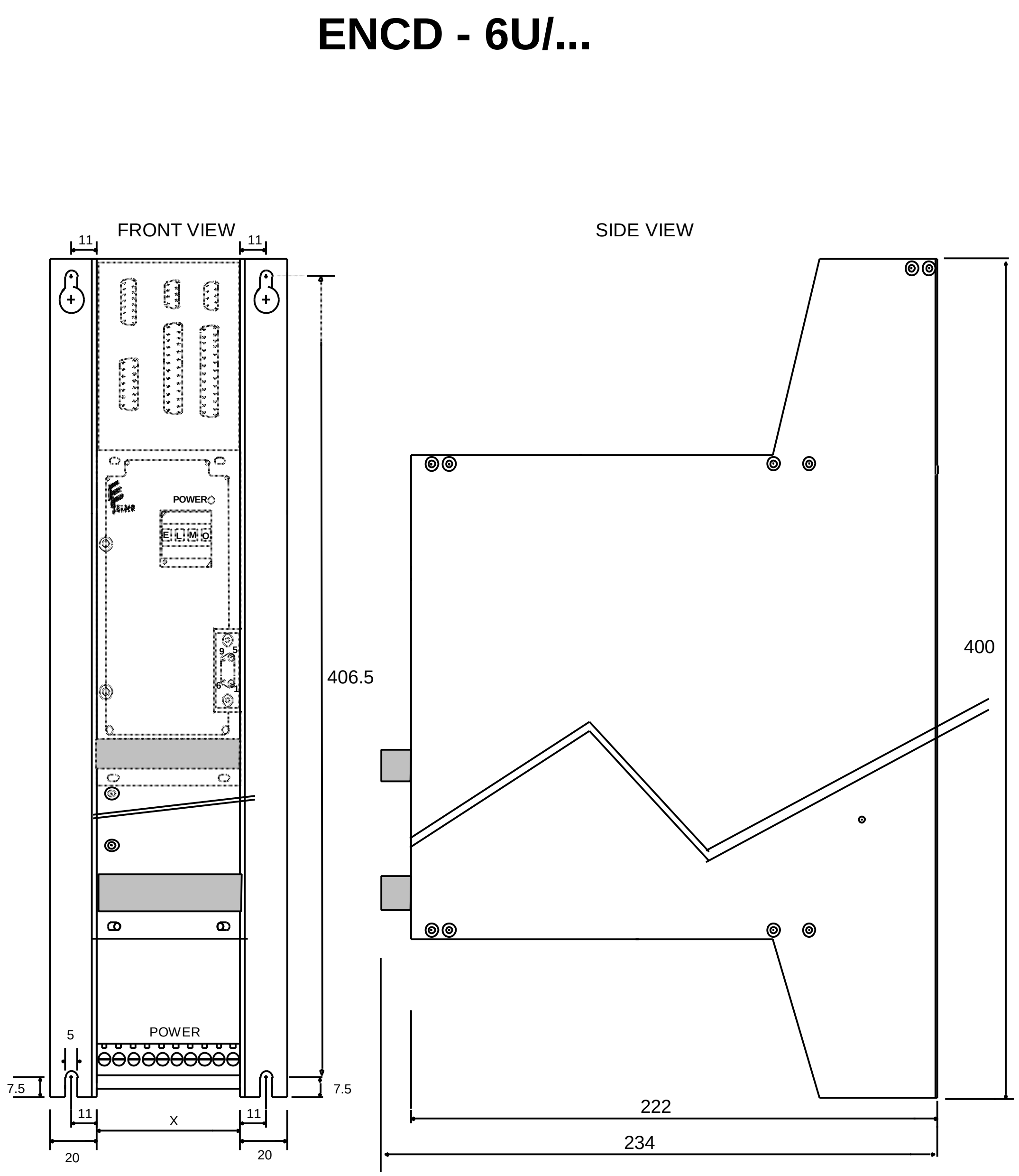
	12T	16T	20T	24T	36T
X	62.0	82.3	102.7	123.0	184.0

NOTE:

ALL DIMENSIONS ARE IN mm.

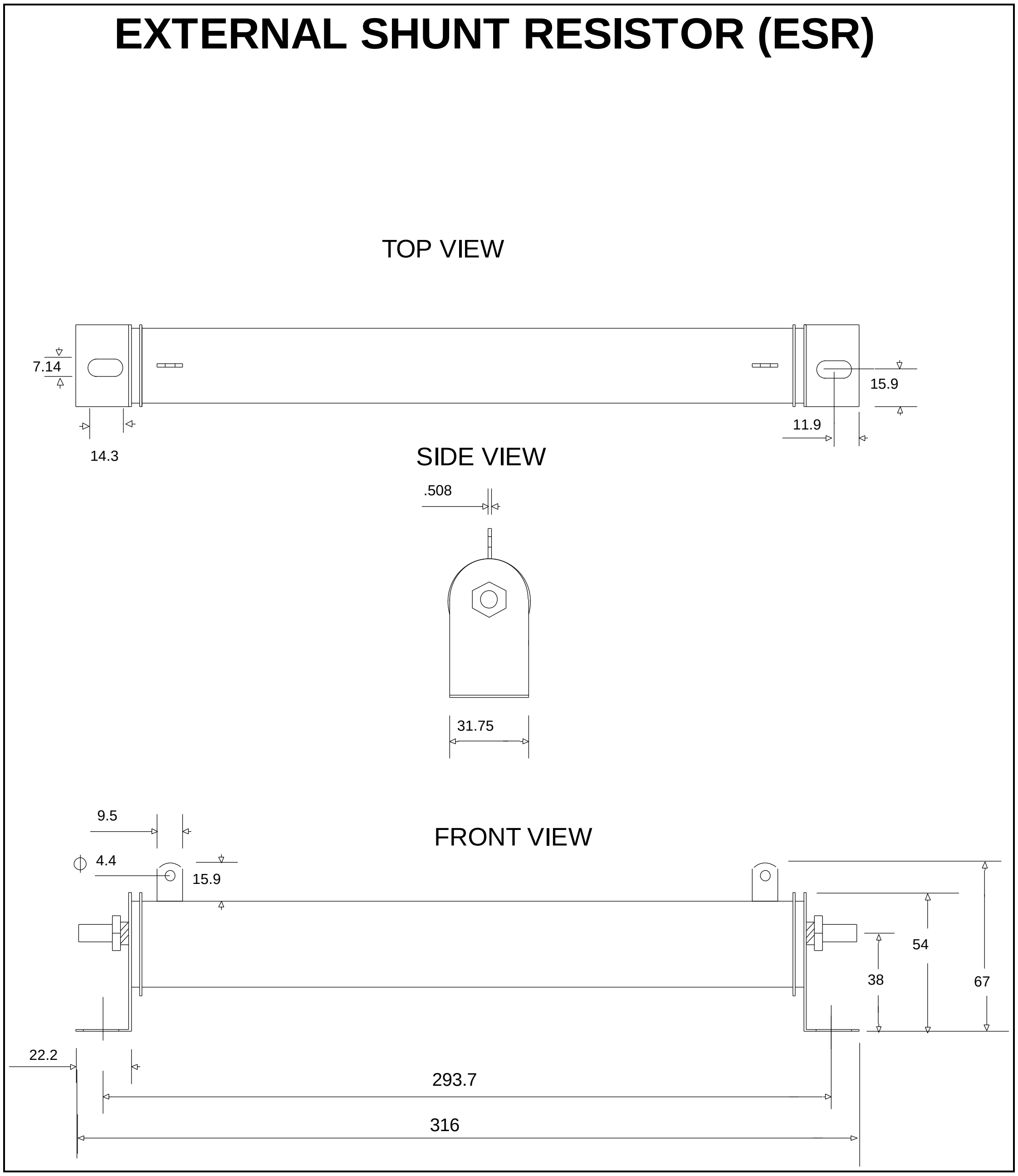
For non-standard sizes:
X = 5.08 x n + 1mm

ENCD - 6U/...



NOTES:
1. ALL DIMENSIONS ARE IN mm.
2. X = n x 5.08+1, n = number of T

EXTERNAL SHUNT RESISTOR



List of ELMO Service Centers

ISRAEL

Elmo Motion Control LTD
34 Segula ST.
Petah-Tikva 49103
Tel: (03)934-5059
Fax: (03)934-5126

U.S.A

Elmo Motion Control INC.
1200 Woodruff Road, Suite C-22,
Greenville, SC 29607
Tel: (803) 288-9316
Fax: (803) 288-9318

EUROPE

Elmo Motion Control
Stanserstr. 7
CH-6362 Stansstad, Switzerland
Tel: (041) 610775
Fax: (041) 610778

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AUSTRIA

Kwapil
POB 64
A-1091 Wien
Tel: (0222) 342597
Fax: (0222) 311203

BENELUX

Eltromat B.V.
Looierij 26
4760 AB Zevenbergen
The Netherlands
Tel: (01680) 25925
Telefax: (01680) 28485

FINLAND

OY Scandrive
Elsankuja 2 K
SF-02231 Espoo
Tel: 358-0-8035044
Fax: 358-0-8035055

FRANCE

A 2 V SA
11-12 Rue Eugene HENAFF,
78190 Trappes,
Tel: (1) 30620101
Fax: (1) 30626204

GERMANY

IME GmbH
Brugger str. 8
D-78628 Rottweil
Tel: 0741/22091
Fax: 0741/22060

ITALY

Servotecnica SRL
Viale Lombardia 20
20095 Cusano Milanino (MI)
Tel: (02) 66401010
Fax: (02) 66401020

SWEDEN

Aratron AB
P.O.B 20087,
Kratsbodavagen 50,
S-16120 Bromma
Tel: 8-981875
Fax: 8-984281

UNITED KINGDOM

INMOCO Limited
4 Brunel Close
Drayton Fields
Daventry NN11 5LE
Tel: 0327/300320
Fax: 0327/300319