DS10xx

(Hardware rev. 1.10 Firmware rev. 1.13)

Microstepping Stepper Motors Driver

User’s Manual

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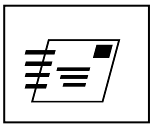
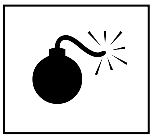
1 Notes, Terms and Warnings

In this manual some symbols, whose meaning is listed below, are used to underline particular arguments.

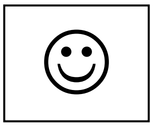
There is a dangerous condition that must be measured and avoided. The not-respect of indications marked with this symbol can cause serious damages to people, animals and things.



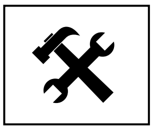
The argument is very wide and could require a deeper examination with the technical support.



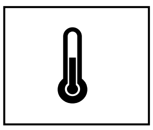
The not-observation of what described could damage the products.



Features and functionalities which cannot be easily found in other products. A shortcut to reach a target is shown.



A change or repairing intervention which can be made directly by the user.



An aspect which is connected to the temperature or longevity of the product.

The terms listed below are also used:

Product

The microstepping driver described herein.

User

Who selects and/or installs and /or uses the product.

Application

The machine, the equipment, the device, etc. on which the product is applied.

2 Risks and Precautions

A T T E N T I O N

Following are listed the most important warnings to be fully comprehended and applied by the user who, in case of non-complete comprehension or impossibility to apply them correctly, must not use the product at all.

!	The DS10xx drivers are components. It is user's responsibility as the installer to be sure the product complies with the rules and regulations in force. The user must also be trained in the installation of the electronic equipment to fully comprehend the features, the calibration parameters and indications contents of this guide. The user must provide for the application of all the local safety laws and regulations in force in the Country and/or application in which the product is used.

!	The user must provide that the product is inaccessible while powered on. The user must also consider that, because of the capacitors inside the driver, it is necessary to wait at least for 30 seconds after the power off before acceding to the driver. According to the external capacitors eventually mounted on the power supply circuit, it is possible the user shall have to wait more time.

!	While working the product produces heat which can raise the temperature of some parts (as heat sink, for example) up to values that can cause burns. Such a condition remains for a long time even after the product has been powered off. The user must provide for the appropriate protections and signals, must train the operator, the staff of the technical support and risk maintenance, and then must state it in the service manual of the finished product.

⚠	The high performance driver is able to produce rapid accelerations with high motor torque. Never touch any mechanical part while the driver is powered on. The user must prearrange the application in order this condition is always granted.

⚠	The power supply of the product must be isolated from the electrical net. The user must always place a protective fuse in series to the power supply circuit.

⚠	The control signals are usually isolated from the power supply while the product is in operation; anyway, while designing the application, the eventuality that in case of breakdown these lines could reach the same potential as the power supply must be considered to meet safety requirements.

⚠	The product could be permanently damaged by corrosive substances (such as gas, salts, etc), liquids or conductive dusts. Even a long and constant exposure to strong vibrations could cause the damage.

⚠	On some damage conditions the driver could emit sparks and fire. The cabinet and the nearby components must be chosen to tolerate this eventuality and to avoid propagation of flames to the application.

⚠	The products cannot be used in life support applications or where the failure of the products could cause death or injury to people, animals or things, or economic losses. The user not able to assure this condition must not use the products herein described.

⚠	Do not dismantle the product, do not try and repair it and do not modify it without being expressly authorized by LAM Technologies.

⚠	If the product is used in any manner that does not comply with the instructions given in this manual, then the product could be permanently damaged. For example, the product could be permanently damaged if power supplied with voltage superior to the allowed one, if supply polarity is inverted, if the motor is connected or disconnected while the driver is operating, and so on.

3 Introduction

3.1 Product Description

The DS10xx High Performance Microstepping Drivers are suitable for driving bipolar two phase stepping motors.
The current regulation is particularly cared and optimized and provides accurate position and smoothness movement of the motor. The use of last generation power components together with the development of an innovative control system its has been possible to reach high level of efficiency, to be compact sized and to reduce driver heating.
The high technology in the product has allowed to overcome the previous full step or fractioned limited step solutions, offering at the same price a product able to drive in microstepping mode with an high step frequency.

The DS10xx drivers series is equipped with a special port called DUP, designed for the setting and diagnostics of the driver.
Through this special device it is possible to intervene on many more parameters than the minimum ones allowed by the dip switches, and to adapt in the best way the driver to the application. The bundled driver software guides the user in the product configuration simply and quickly and assists the user in the diagnostic giving in real time indications on the status of driver, inputs, outputs, etc.

The use of last generation components and technologies, together with the computerized test made on each single unit, gives to the product itself high reliability and economic competitiveness.

3.1.1 Available models

The DS10xx family drivers are available in various models diversified according to the power supply voltage and the phase current delivered by the motor. All the models share the same functional features:

Model	Power supply voltage (Vdc)		Phase effective current (Arms)		Phase peak current (Apk)	
	Min	Max	Min	Max	Min	Max
DS1044	20	50	1	4	1.4	5.6
DS1048	20	50	3	8	4.2	11.3
DS1073	24	90	0.8	3	1.1	4.2
DS1076	24	90	2	6	2.8	8.5
DS1078	24	90	4	10	5.6	14.1
DS1084	45	160	2	4	2.8	5.6
DS1087	45	160	4	8.5	5.6	12
DS1098	45	240	4	10	5.6	14.1

3.1.2 Main Features

- ✓ Microstep resolution up to 25,600 steps/rev in 14 different setting solutions
- ✓ Decimal and binary resolution
- ✓ STEP frequency over 300KHz
- ✓ Wide range of power supply
- ✓ Single supply voltage
- ✓ Current setting with increments of 0.1Arms
- ✓ Accurate current control
- ✓ Resonance damping
- ✓ High efficiency, low losses and contained limited
- ✓ Chopper frequency over 20KHz
- ✓ Automatic current reduction settable from 0% up to 100% with increments of 10%
- ✓ Current reduction time settable from 0,05 up to 10 seconds
- ✓ Optocoupled and differential inputs independently NPN or PNP usable
- ✓ Current reset on each input
- ✓ Wide inputs working range (from 3Vdc up to 30Vdc)
- ✓ Line driving supported
- ✓ ENABLE input
- ✓ BOOST input
- ✓ Optocoupled and differential outputs independently NPN or PNP usable
- ✓ Protective diode for inductive loads
- ✓ Digital signal conditioning for each I/O
- ✓ Colored and numbered removable terminal blocks for easy and fast wiring
- ✓ Efficient and complete diagnostics
- ✓ Over/under voltage protections
- ✓ Phase to phase short circuit protection both direct and crossed
- ✓ Phase to ground short circuit protection
- ✓ Positive supply short circuit protection
- ✓ Temperature protection
- ✓ Interrupted phase alarm independent for each phase
- ✓ Univocal indication for each anomaly
- ✓ Malfunctioning status LED indicator
- ✓ Motor qualification LED indicator
- ✓ STEP input pulse signal indicator
- ✓ Direction change signal indicator
- ✓ Power supply LED indicator
- ✓ Digital realization
- ✓ PC assisted complete and simple setting
- ✓ PC assisted diagnostics
- ✓ Compact size
- ✓ Simple and fast DIN rail mounting
- ✓ Low cost

3.2 Accessories

Code	Description
UDP30	Setting and diagnostic interface
LSP1004	DIN rail kit consisting of hook and spring
LSP4002	Terminal blocks kit consisting of: 1pc. numbered removable terminal block, red color, 2 poles 1pc. numbered removable terminal block, grey color, 5 poles 1pc. numbered removable terminal block, grey color, 10 poles
LSP4004	5pc. numbered removable terminal block, red color, 2 poles
LSP4006	5pc. numbered removable terminal block, grey color, 5 poles
LSP4008	5pc. numbered removable terminal block, grey color, 10 poles

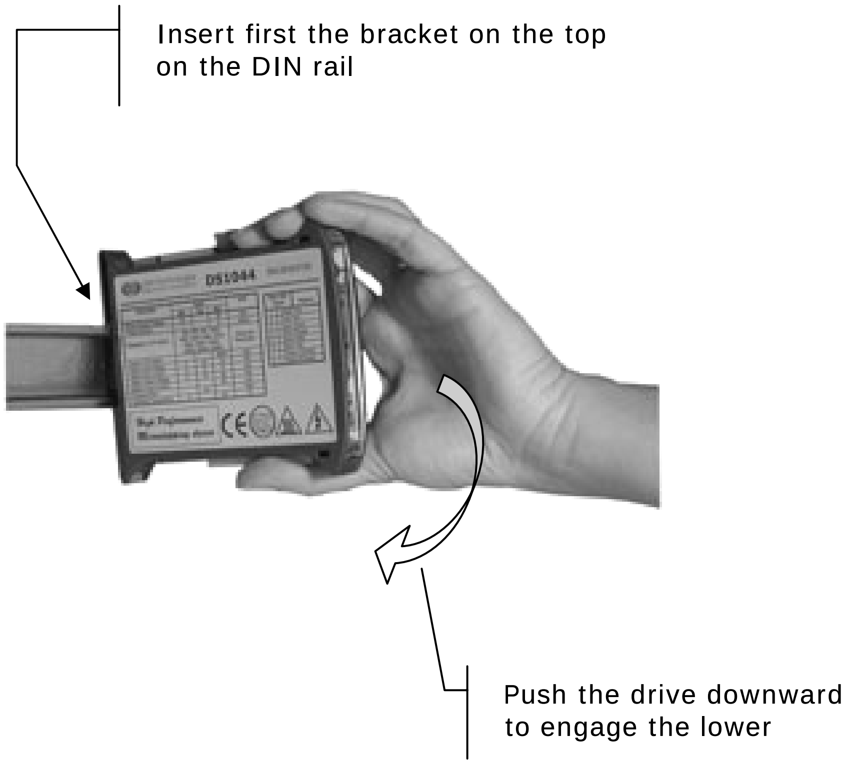
4 Installation

4.1 Inspection

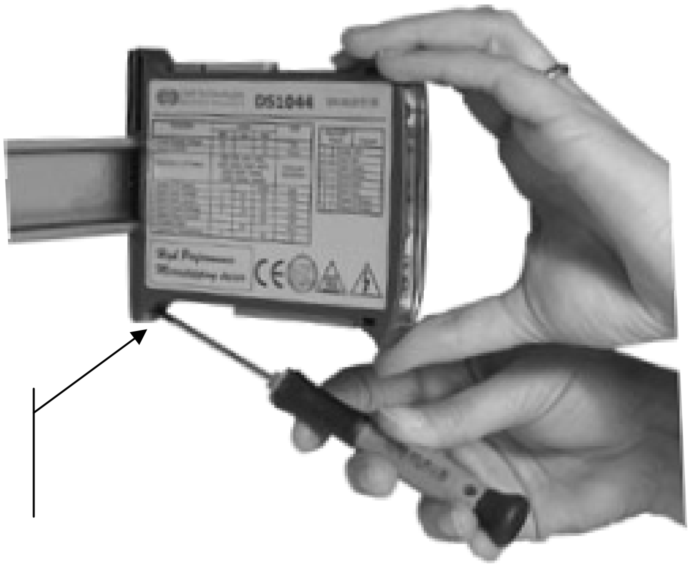
Verify the driver is not damaged, the package is intact and all accessories of the ordered product are included. Furthermore, control the driver code corresponds to the ordered one, eventual special and customized version included. In case of problems please address to the product's vendor.

4.2 Mechanical Installation

The driver is designed to be mounted vertically on a 35mm DIN rail.
To block the driver on the DIN rail, insert first the bracket on the top, on the back of the driver, over the top of the DIN rail, keeping the driver slightly inclined as shown in the figure, then push the driver downward to engage the lower section of the rail. To verify the correct engagement of the driver try and pull it slightly upward to control it is still in position.



To remove the driver from the DIN rail insert a small flat bladed screwdriver into the red colored hook on the bottom, on the back of the driver. Push the hook downward and pull the driver upward slightly rotating it, releasing it from the DIN rail as shown in the figure.

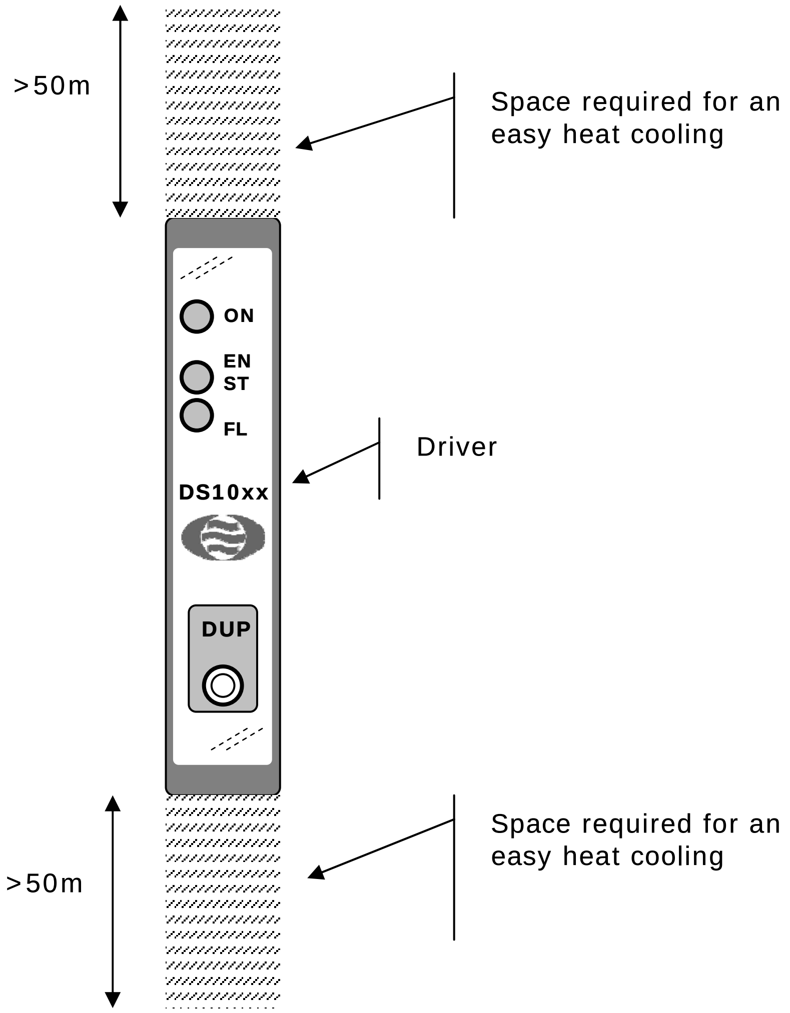


Insert a small flat bladed screwdriver into the red colored hook

Push the screwdriver slightly downward and pull the driver upward, releasing it from the DIN rail

The heat generated by the driver while operating must be dissipated toward the surrounding air. To assist cooling, the driver must be installed vertically in an area with a sufficient air gap of about 50mm above and below the driver itself, with no obstructions (wiring cables are anyway allowed). No space needs to be left on the sides and more drivers can be packaged side by side taking a very compact space.

According to the driver calibration and to the running cycle, the space can be also substantially reduced without compromising the correct working of the driver.

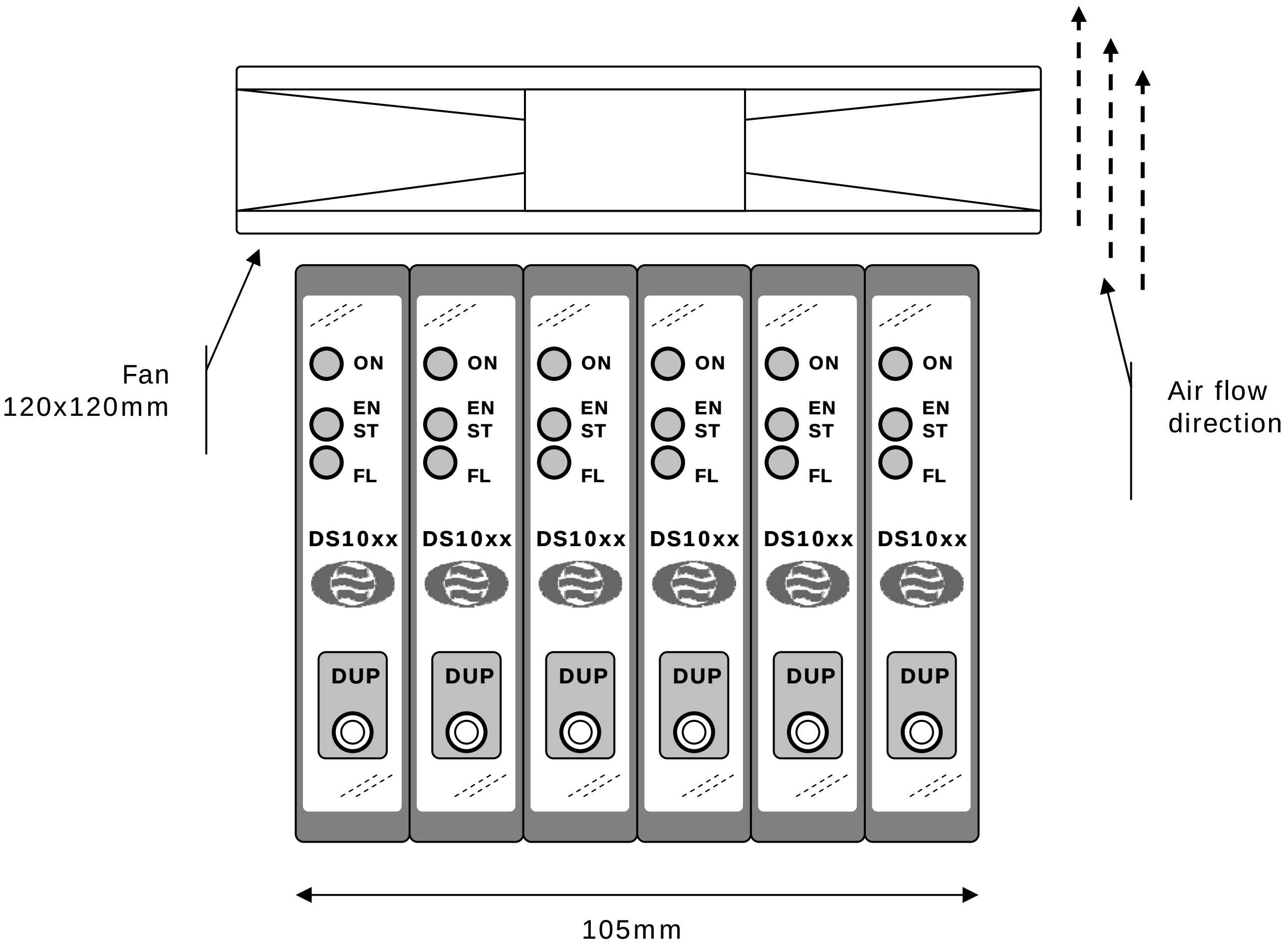


4.3 Air Cooling

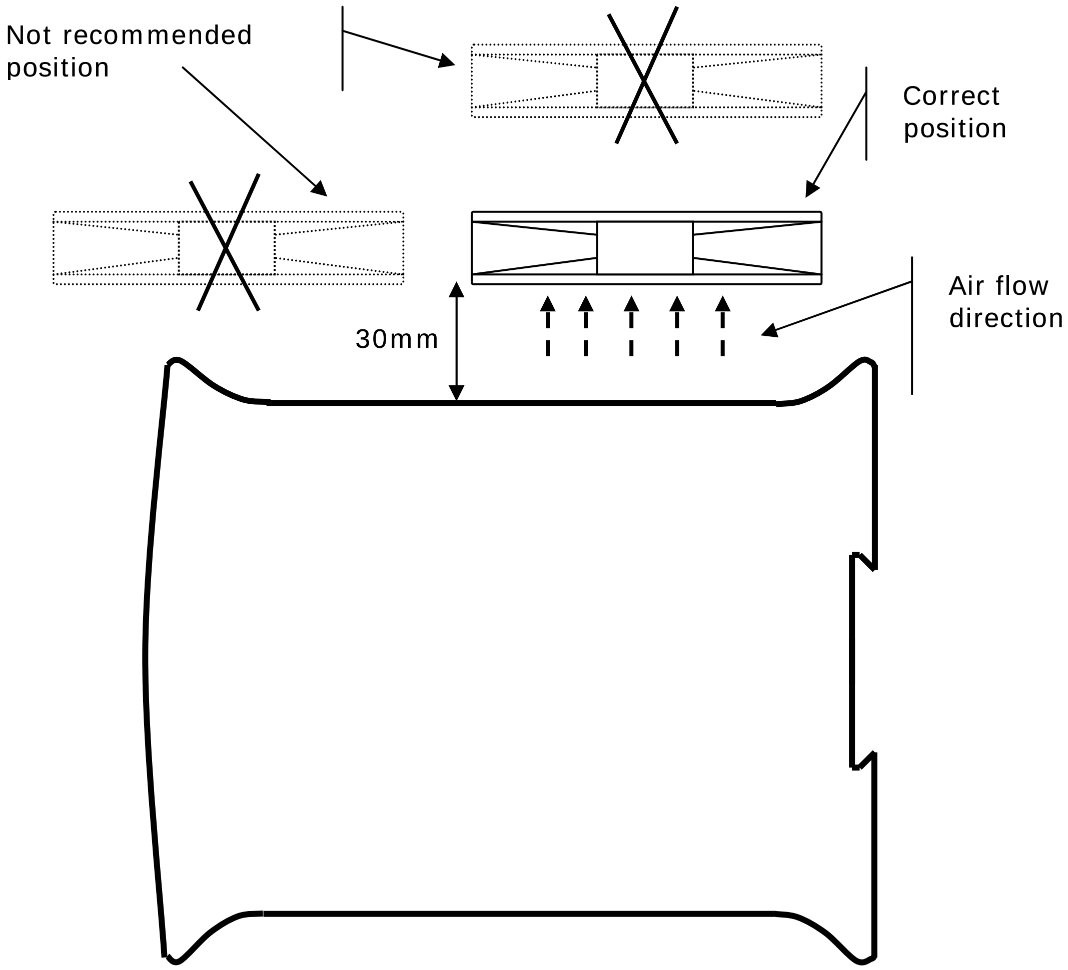
Its exceptional efficiency allows the product to be used even if absence of forced ventilation.

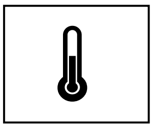
Whereas the driver is used with high calibration current or at high power supply voltage, whereas the working cycle is very heavy or the ambient temperature is high, it is possible to recur to forced ventilation to maintain the driver temperature within the functioning range values.

The fan can be positioned over or under the driver. A lateral position is not recommended. Thanks to the compact size of the driver, an only and economic fan of 120mm x 120mm can supply air circulation sufficient for 6 drivers simultaneously (models of 18mm wide).



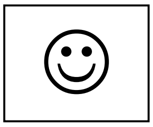
In case of a reduced size fan, it must be set in a rear position and at about 30mm high from the driver. A nearer or more distant position could reduce its effectiveness.



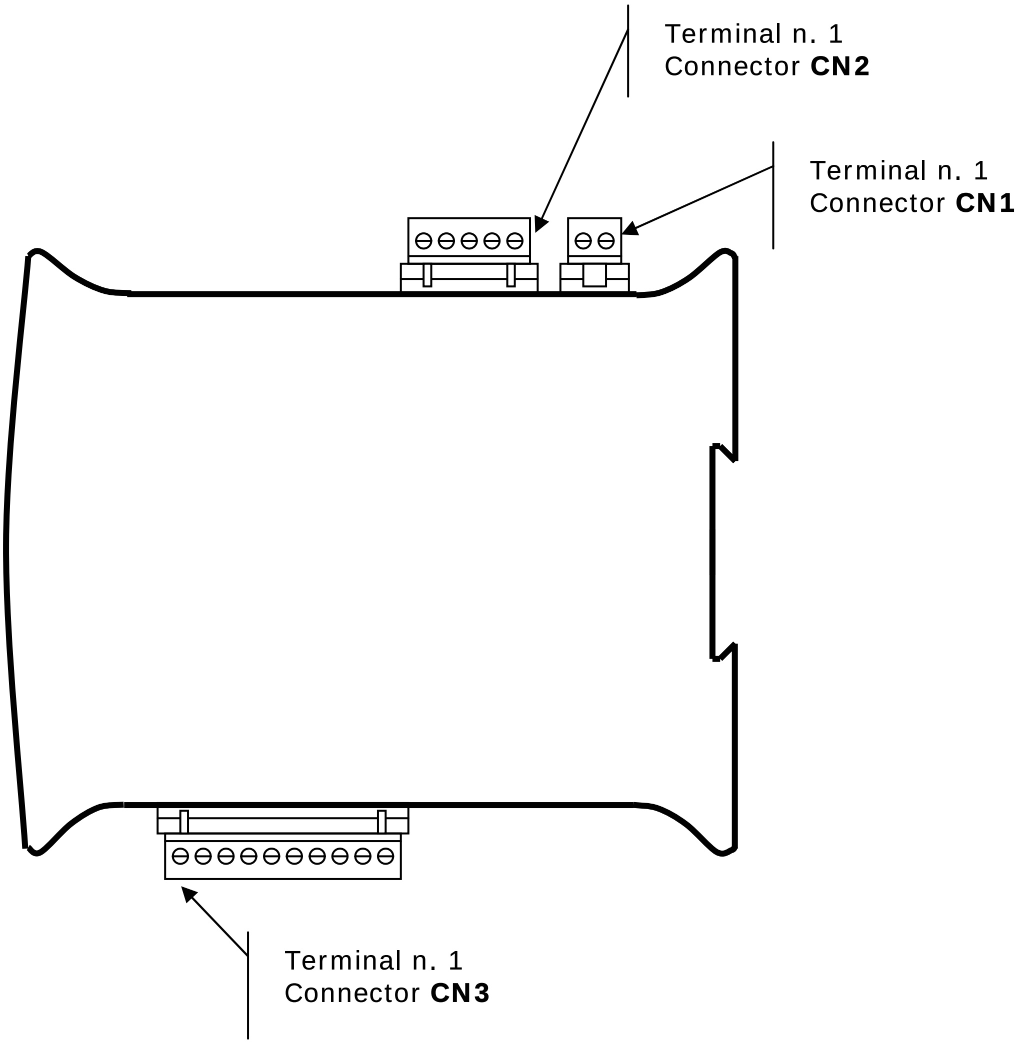


It is important to avoid the driver is covered with powder, dust or other. The buildup of such substances inside the driver could cause the malfunctioning or the breaking of the driver. Filters and necessary solutions must be got ready to avoid them to occur.

4.4 Wiring

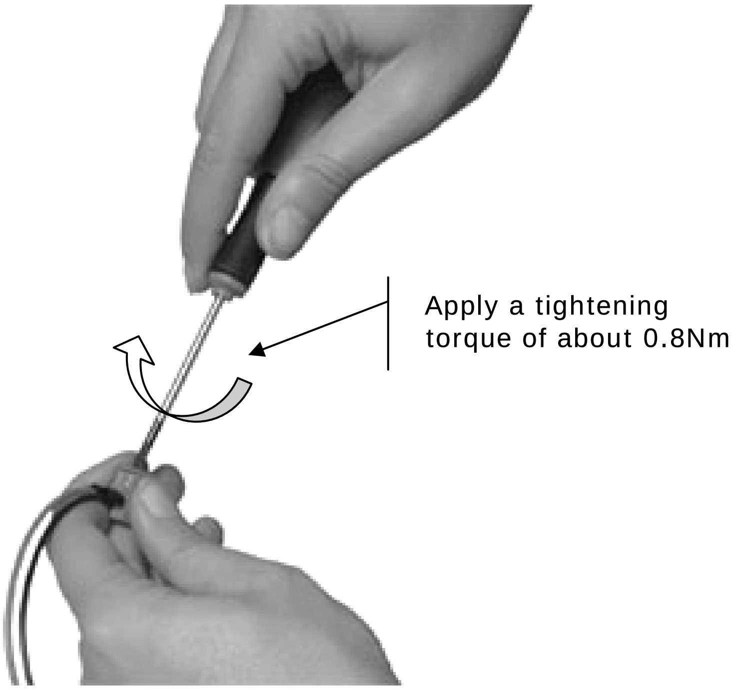


The use of numbered and colored movable terminal blocks makes easier the wiring of the driver.



Each terminal block does not contain iron and is supplied with mobile truck. The clamping screw is slotted head sized for screwdriver of 3 x 0,6mm.

We recommend to apply a tightening torque of about 0.8Nm.



All terminals can tighten correctly cables with section between 0.1mm^2 and 2.5mm^2 (24…14 AWG).

We recommend to skin off the cable for 7/8mm as shown in the figure below.

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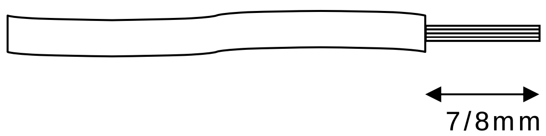
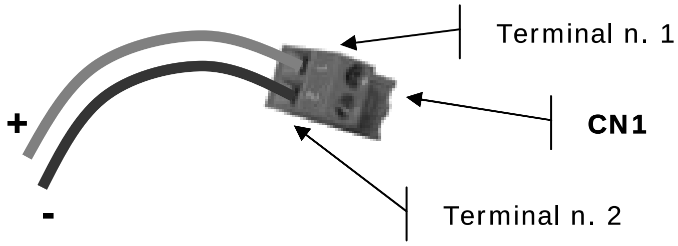


4.4.1 Power Supply

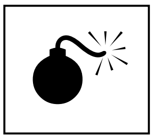
The driver needs a DC supply *Vp* voltage as specified in the table below.
In the highest absorption conditions the power supply must grant a ripple voltage inferior to *Vprp*.

Symbol	Description		Value Min	Value Typ	Value Max	Unit
Vp	Nominal DC supply voltage	**DS1044, DS1048**	**20**		**50**	**Vdc**
		DS1073, DS1076, DS1078	**24**		**90**	**Vdc**
		DS1084 DS1087	**45**		**160**	**Vdc**
		DS1098	**45**		**240**	**Vdc**
Vprp	Allowed ripple voltage	**DS1044, DS1048**			**8**	**Vpp**
		DS1073, DS1076, DS1078			**15**	**Vpp**
		DS1084 DS1087			**25**	**Vpp**
		DS1098			**30**	**Vpp**
Vpbrk	Voltage causing permanent damage	**DS1044, DS1048**	**-0,5**		**58**	**Vdc**
		DS1073, DS1076, DS1078	**-0,5**		**105**	**Vdc**
		DS1084 DS1087	**-0,5**		**210**	**Vdc**
		DS1098	**-0,5**		**265**	**Vdc**
Vph	Over voltage protection intervention threshold	**DS1044, DS1048**	**54**		**56**	**Vdc**
		DS1073, DS1076, DS1078	**96**		**102**	**Vdc**
		DS1084 DS1087	**170**		**180**	**Vdc**
		DS1098	**242**		**255**	**Vdc**
Vpl	Under voltage protection intervention threshold	**DS1044, DS1048**	**18**		**19,5**	**Vdc**
		DS1073, DS1076, DS1078	**21**		**23**	**Vdc**
		DS1084 DS1087 DS1098	**41**		**44**	**Vdc**

The power supply is connected by the red colored 2 poles connector. The positive terminal must be connected to terminal 1, while the negative terminal to the terminal 2.



CN1 - Signals set-up	
Contact n.	**Description**
1	+Vp, positive DC supply voltage
2	-Vp (GND), negative DC supply voltage



Reverse polarity connection damages irreversibly the driver, just as the overcoming of the *Vpbrk* voltage limit.
Do not install the driver before the wiring is complete.

If the distance between the driver and the power supply is more than 1 meter, it is necessary to place near the driver (less than 10cm) an electrolytic capacitor whose features are listed below:

Model	C2 Voltage (Vdc)	C2 Capacity (μF)
DS1044	63	100
DS1048	63	220
DS1073	100	100
DS1076	100	100
DS1078	100	220
DS1084	200	100
DS1087	200	220
DS1098	250	220

To connect together the power supply, the driver and the eventual local capacitor, it is necessary to use a conductor with section adequate to the driver's current calibration (for safety's it is better to use the max current supplied by the driver)

The power supply cable can be installed together with the ones connecting the driver to the motor. We recommend not to place the power supply cable nearby the signal ones.

There are two types of power supplies commonly used, regulated and unregulated. The regulated power supply maintains a stable output voltage which allows to supply the driver even with voltage values near to the allowed maximum ones, as this power supply compensate the net and load fluctuations avoiding the above voltage protection to intervene. The disadvantage of regulated power supplies is their cost.

An unregulated power supply is cheaper, but it requires the consideration of safety's tolerance during its sizing so that, in presence of net and load fluctuations, voltage remains however within the acceptable working values.

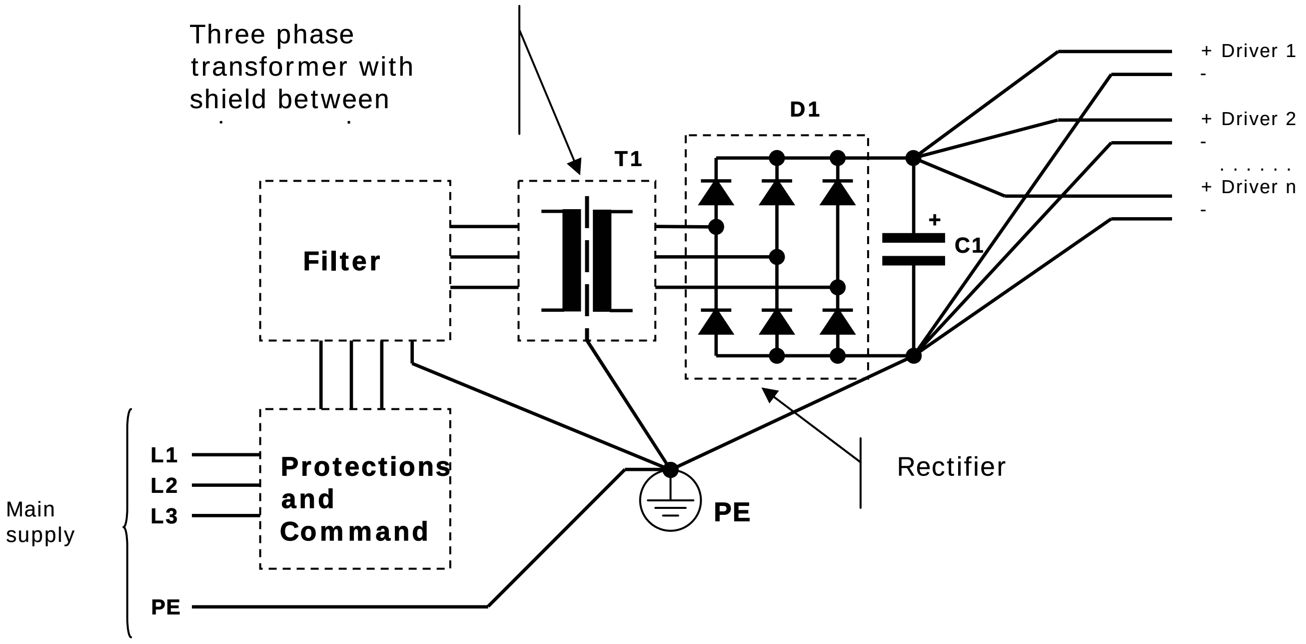
A detailed description about the sizing of the power supply is outside of this manual. The user who decides to construct its own power supply must be technically qualified to size it, to assure its correct working and to fulfill each safety requirements. To determine the power supply output voltage it must be considered the maximum net fluctuation expected on worse operating conditions, the maximum voltage at empty load and minimum voltage at full load, and to assure that the values resulting from these components combination are within the range of max and min. voltage values specified for the chosen driver model.

The potency the power supply must deliver is given by the one absorbed by the load (depending from the torque required to the motor as well as the rotating speed) and by the motor and driver efficiencies. The potency lost on the driver for each model is as shown in the following table:

Model	*Min*	*Typ*	*Max*	*Unit*
DS1044			10	**W**
DS1048			20	**W**
DS1073			10	**W**
DS1076			20	**W**
DS1078			30	**W**
DS1084			30	**W**
DS1087			35	**W**
DS1098			40	**W**

Because of the many variables in play it is clear the impossibility to prior indicate an only one kind of dimensioning valid for each application.
Just for example, not to be considered exhaustive and right for the application, see the following electric layout of an unregulated power supply with a brief indication of the components value.

You can also ask to your own vendor to evaluate if the following values are usable for your application too.



As shown in the layout, the earth wiring must be star like, where the earth connection of various components ends in one only point electrically connected with the metal chassis and the plant earth.
Also the wiring towards the drivers must be star like, with the center of the star on C1 capacitor poles.

It is necessary, as per diagram, to place a filter in series to the transformer primary winding to stop emissions coming from the driver and/or present on the main supply. Furthermore, the filter must be able to support the maximum power required by the driver plus the transformer losses.

It is obligatory to provide on every phase a fuse able to intervene in case of a short circuit at the supply output or a malfunctioning of its parts.

The reduction level the filter must guarantee can vary a lot according to the laws applied to the field to which the application and/or installation belong.
The producers of filters SHAFFNER and CORCOM can be a good reference point to find the right filter.

In the following table the characteristic values of the main transformer components are shown. In the calculation an oscillation of the main supply voltage contained within +/-20% has been considered.

Model	Number of drivers	Secondary T1 (Vac)	Power T1 (VA)	Current D1 (Arms)	Voltage C1 (Vdc)	Capacity C1 (μF)
DS1044	1	30	125	25A	63	3300
	2		250	25A		4700
	3		375	25A		5600
	4..5		600	25A		8200
	6..8		900	35A		10000
DS1048	1	30	250	25A	63	4700
	2		500	25A		6800
	3		750	25A		8200
	4..5		1100	35A		10000
	6..8		1800	50A		15000
DS1073	1	50	150	25A	100	1800
	2		300	25A		2200
	3		450	25A		3300
	4..5		700	25A		4700
	6..8		1000	35A		5600
DS1076	1	50	300	25A	100	2200
	2		600	25A		3300
	3		900	25A		3900
	4..5		1400	35A		4700
	6..8		2100	50A		6800
DS1078	1	50	400	25A	100	3300
	2		800	25A		4700
	3		1200	25A		5600
	4..5		1800	35A		8200
	6..8		2800	50A		10000
DS1084	1	90	350	25A	200	1000
	2		700	25A		1500
	3		1050	25A		1800
	4..5		1600	25A		2200
	6..8		2500	35A		3300
DS1087	1	90	700	25A	200	1500
	2		1400	25A		2200
	3		2000	25A		3300
	4..5		2500	35A		4700
	6..8		5000	50A		6800
DS1098	1	130	1000	25A	250	1800
	2		2000	25A		2200
	3		3000	35A		3300
	4..5		4500	50A		4700
	6..8		7000	50A		6800

The capacitor C1 values can also be obtained placing more capacitors in parallel amongst them. Eventual approximations must be made in excess.
The user can add in parallel to the C1 capacitor a resistor, opportunely dimensioned, to discharge the capacitor more quickly.

The working voltage of the T1 transformer primary winding must be chosen according to the main supply voltage available during the installation of the application. The transformer must have a shield between primary and secondary windings which must be connected to earth with a short and not inductive connection. The secondary winding voltage is meant without the load with the primary winding supplied at the nominal voltage.

The rectifier, besides supporting the maximum current required by the driver, must be able to tolerate the current supplied during the C1 capacitor charge. Such current, as being essentially limited only by the internal resistor of the transformer secondary winding, usually very low, and by the wiring, can also be of elevated entity, even if of short length (it is exhausted when the capacitor is charged).
Furthermore, the rectifier needs an heat sink able to maintain the temperature within the range defined by the manufacturer. The working voltage of the D1 rectifier must be then chosen according to the T1 transformer secondary winding voltage multiplied at least by 2.

In a configuration with more than a driver, where the drivers have not been all calibrated for the max current and/or where the working cycle is not simultaneous, the transformer power can be considerably reduced. Sometimes this can also be made when the motors speed is limited.

The diagram and the components values refer to a three phase power supply. Differently dimensioning the components it is possible to realize a mono phase power supply, which use is not recommended when the required power is greater than 500W.

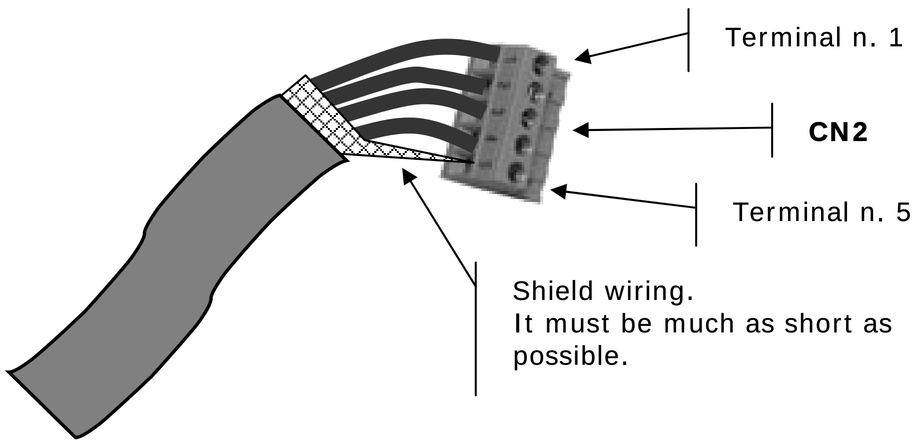
The whole set composed by the filter, the transformer and the power supply must be used only to supply voltage to the drivers. It is not advised to draw other supplies from any of these parts. On the contrary, we suggest to get auxiliary supplies using directly the main supply up the filter.

4.4.2 Motor

The connection between the driver and the motor must be made using shielded cable and connecting the screen to the SHIELD terminal on the driver. The cable shield on the motor side must be connected to the motor body only if this one is electrically insulated from the structure where it is fastened. In case the motor is electrically earth connected (for example through a mechanical fastener) the motor side shield must not be connected.

Only if problems connected to electromagnetic emissions arise it is possible to try and connect the shield from the motor side. Because of possible ground loops which could start, we advise to make this wiring only when strictly necessary.

The driver regulates the current in the motor phases through the supply voltage modulation by chopper technique. The use of a good quality shielded cable and of a correct wiring are essential to better reduce the electromagnetic emissions.



CN2 - Signals set-up	
Contact n.	**Description**
1	FA-, negate output phase A
2	FA+, positive output phase A
3	FB+, positive output phase B
4	FB-, negate output phase B
5	SHIELD (internally connected with a GND)

The cable section can be dimensioned according to the driver current calibration, anyway we suggest to choose a cable suitable for maximum current deliverable from the model of driver itself.

The recommended cable to connect the motor to the driver must have a length inferior to 10mt. For greater cable length, the cable size must be increased to counterbalance the voltage drop.

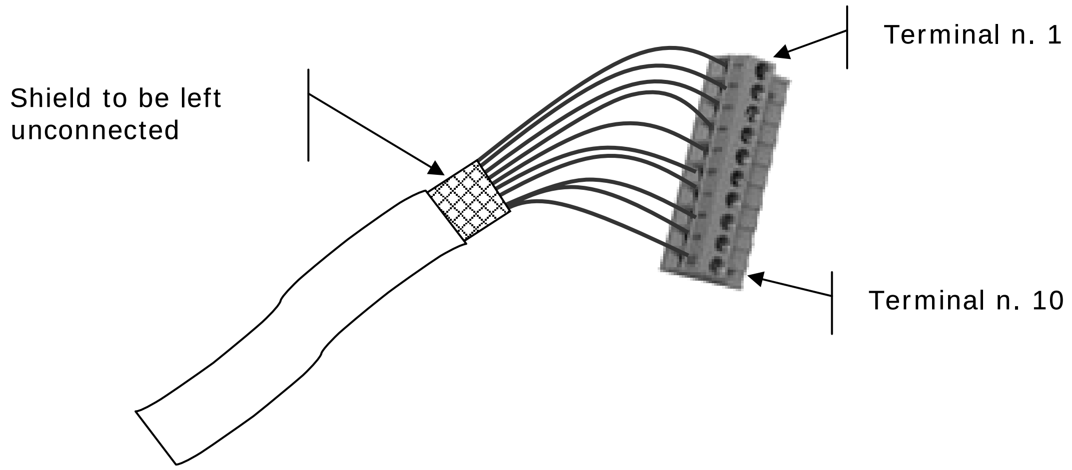
The cable connecting the driver to the motor can be installed together with the power supply one, but it must be kept separate from the signal cables.

If difficulties are met to pass compatibility tests, it is possible to place in series to each phase an inductor with a value included between 10uH and 100uH and with current adequate to the set phase current. The inductor must be placed directly on the driver output.

4.4.3 Control Signals

4.4.3.1 Inputs

The cable used for the control signals wiring must be a shielded type. The shielding must be connected only to the numerical control device side (PC, PLC or other) while on the driver side it must remain unconnected as shown in the figure below.



CN3 - Signals	
Contact N.	**Description**
1	STEP+, motor rotation signal, positive input
2	STEP-, motor rotation signal, negate input
3	DIRECTION+, reverse direction signal, positive input
4	DIRECTION-, reverse direction signal, negate input
5	ENABLE+, current enable (torque) signal, positive input
6	ENABLE-, current enable (torque) signal, negate input
7	BOOST+, current boost signal, positive input
8	BOOST-, current boost signal, negate input
9	FAULT+, driver status, positive output
10	FAULT-, driver status, negate output

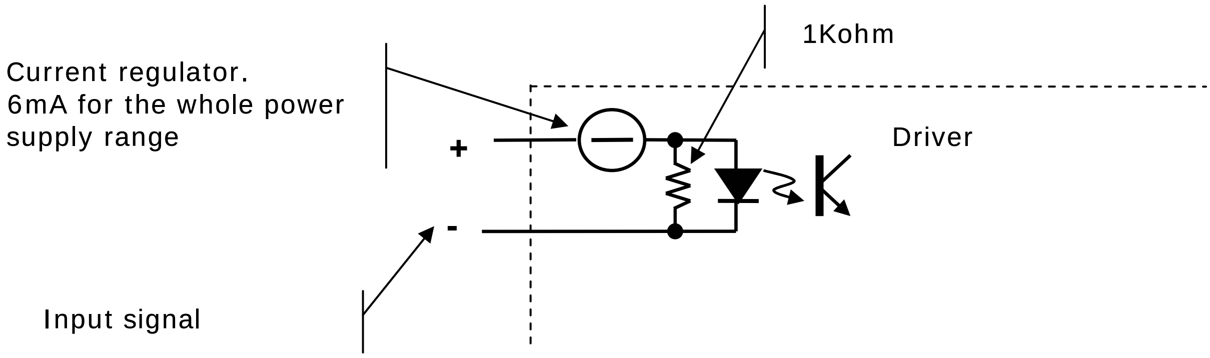
The section of the cable does not have much importance as the circulating currents are meager (in the order of few mA), therefore choose the section according to wiring functionality.

The control signal cable must not be placed together with the power supply or the motor cables. If it happens there is the possibility that the high slew rate voltage and high rate current could be coupled with the logic level signal and corrupt this.

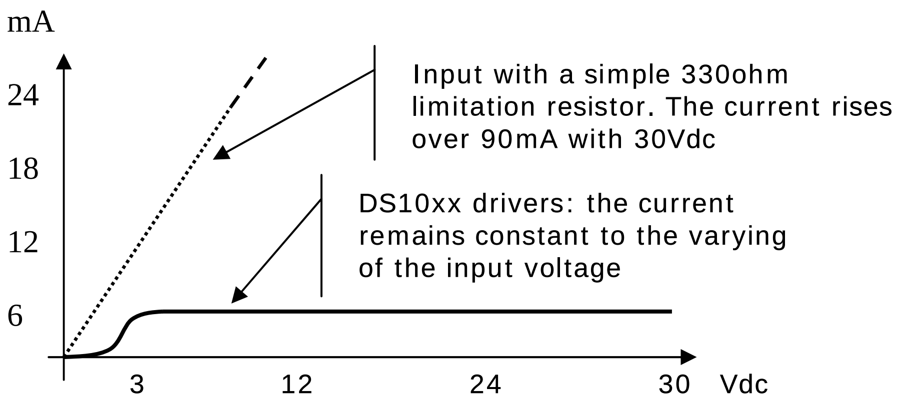
There are totally 4 outputs: STEP, DIRECTION, ENABLE, BOOST and an output called FAULT.

The DS10xx drivers inputs and outputs can be independently connected in NPN and PNP logic. Each input exposes both the connections making possible mixed settings.

All inputs and outputs are optocoupled amongst them, towards the motor and towards the power supply.



The DS10xx drivers have on each input a particular current limitation circuit which grants a constant absorption to the varying of the applied voltage. This device allows a wide input power supply range (from 3Vdc up to 30Vdc) without requiring excessive current to the control equipment.
The most part of drivers now on the market, of the same category, uses to place in series to the input a simple current limitation resistor which reduces the input working voltage setting and causes, moreover, high current values when the input voltage is high. The DS10xx drivers, on the contrary, maintain an almost constant absorption on the whole working range, as shown in the diagram below.



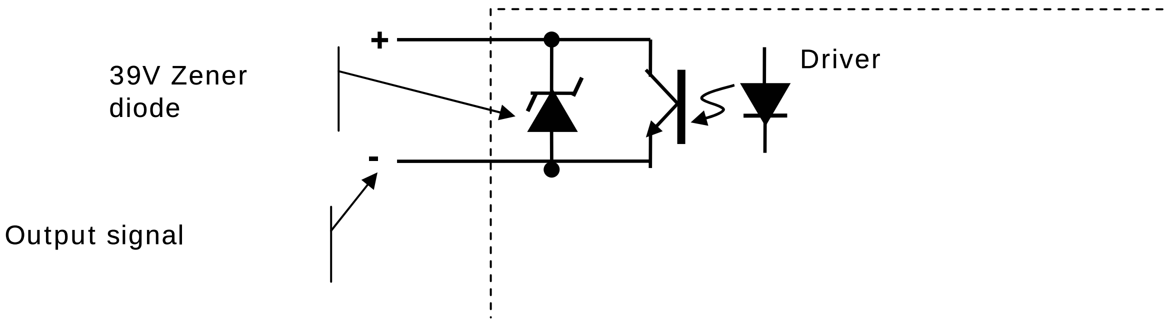
Each single input can be used on line driving mode independently from the others.

Symbol	Description	Value			Unit
		Min	Typ	Max	
Vdi	Digital inputs operating voltage	3		30	**Vdc**
Vdibrk	Digital inputs breakdown voltage	-35		+235	**Vdc**
Idi	Current absorbed by the digital inputs	4	6	8	**mA**

4.4.3.2 Outputs

The outputs have a zener diode placed in parallel which allows to connect the output with medium entity loads (for example signal relays) without having to use an external recirculating diode.

The outputs are protected from a short length short circuit, a longer one can damage them permanently.



Symbol	Description	Value			Unit
		Min	Typ	Max	
Vdo	Digital outputs operating voltage	1		30	**Vdc**
Vdobrk	Digital outputs breakdown voltage	-0.5		37	**Vdc**
Vdoz	Zener diode voltage placed in parallel to each output	37	39	42	**Vdc**
Ido	Digital outputs available current			80	**mA**
Idobrk	Digital outputs breakdown current	120			**mA**
Pwdo	Digital outputs dissipable power			300	**mW**

4.4.4 Chassis setting

In order to contain the electromagnetic emissions and to better shield the driver, it is necessary to give particular attention to the setting of the chassis.
The driver must be placed inside a metal case, preferably iron made, capable to successfully shield the electromagnetic emissions. The case must be electrically placed to ground as better described onwards.

Filter

The filter must be correctly placed in series to the main supply. The ideal position is on the chassis edge in order to have a short wiring coming out from the main supply. If, on the contrary, the main supply cables run inside the chassis, they can be invested by electromagnetic interferences making ineffective or much reducing the filter efficiency.
The filter output earth must be connected to the metallic body of the chassis. It is important the connection is of short length and made with a large section and low inductance conductor. The point of connection between ground coming from the filter and the chassis constitutes the star center to which all other components earth must be connected. Moreover, the filter metallic body must be electrically placed in contact with the case.

Transformer

The transformer must be placed close to the filter and must have a shield between the primary and the secondary windings. The shield must be ground connected in the star center obtained inside the case. Furthermore, the transformer metallic body must be electrically connected to the case.

Power Supply

It is advisable to install the power supply near the transformer. The power supply earth, usually the negate pole of the filter capacitor, must be connected to ground in the star center obtained inside the case.

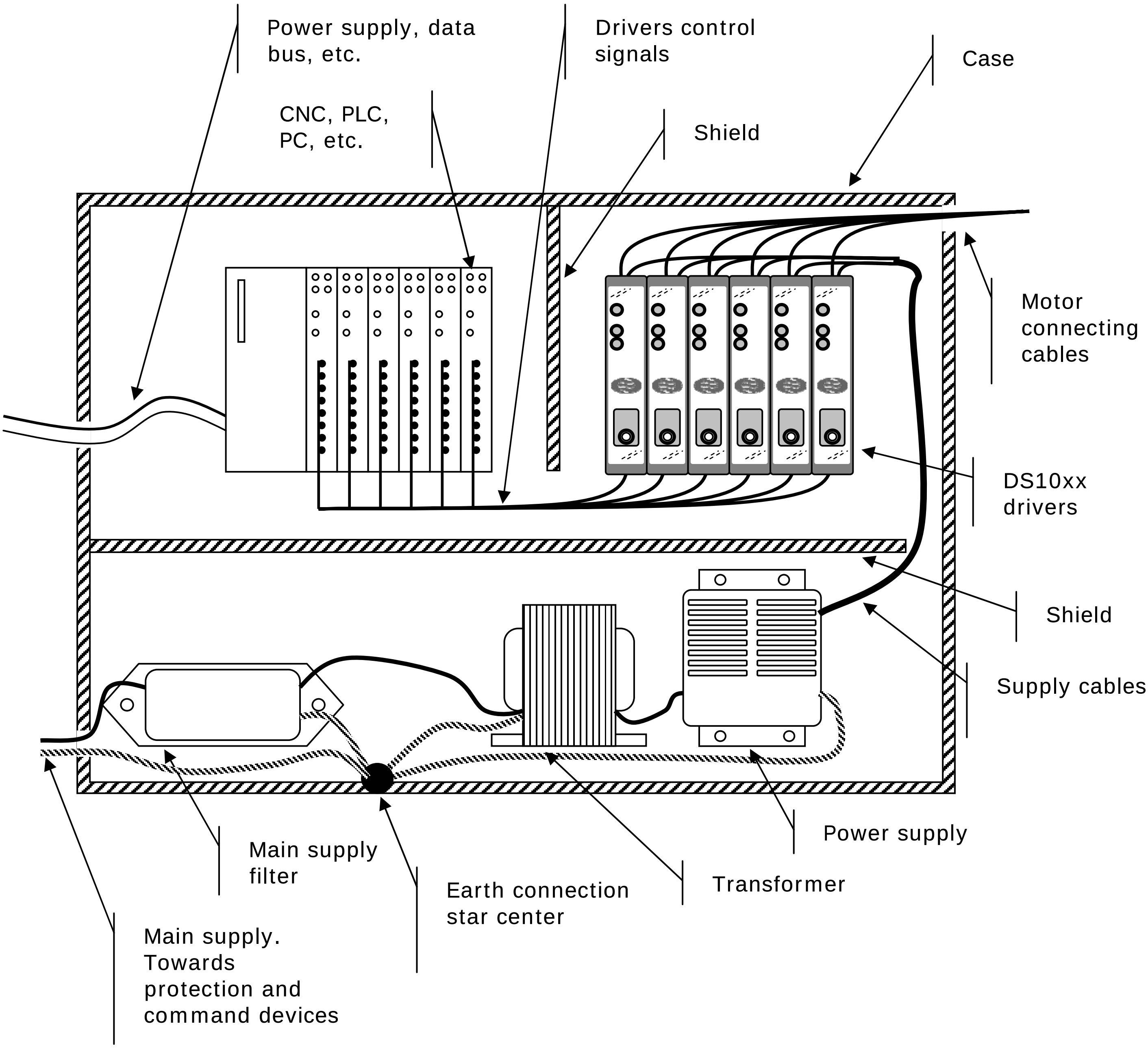
Driver

The driver position must be chosen in order the motor cables can immediately come out from the case without running long distances inside the case itself.

Numerical Control

The numerical control device, PLC or other, which generates the driving signals of the driver must be as far as possible from the drivers and from the power supply group. Moreover, the signals wiring must be remain distant from the power supply and motor cables. When the distance from the numerical control device and the driver and/or the power supply is short, there must be one or more shielding walls, electrically connected to the case.

The following figure shows a possible setting of the chassis.



<u>Safety must never be compromised. Safety is always of first priority.</u>

5 Functionality and Setting

5.1 General description

The driver setting is made through the DUP port. Through this connection it is possible to modify all driver setting parameters, to read their status, the production information and then to update the internal firmware. This latest characteristic deserves particular attention as it allows to maintain the product updated with the last implemented functionality.

To facilitate the driver setting it has been created a software, called *UDP Commander*, designed for Windows platform, particularly immediate and easy to use. The software makes use of the UDP30 interface to communicate with the DUP port of the driver. The UDP30 interface is connected to the PC by the USB port.

To grant high noise immunity and to safeguard the equipment integrity, the connection between the PC and the driver must be of insulated type.
The UDP30 interface makes use of the power supply on the USB port to feed the driver digital section, making possible the setting and the reading of information therein contained even without the power supply.

For a more detailed description on the features and installation of the UDP interface please see the dedicate user's manual.

5.2 Setting

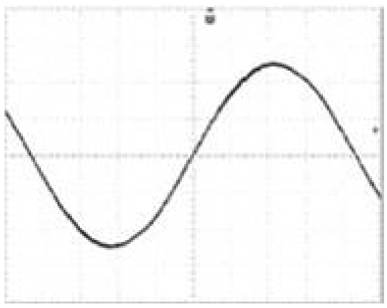
The setting must be made before connecting the motor and starting the equipment.
A non correct setting can damage the motor and/or the equipment.

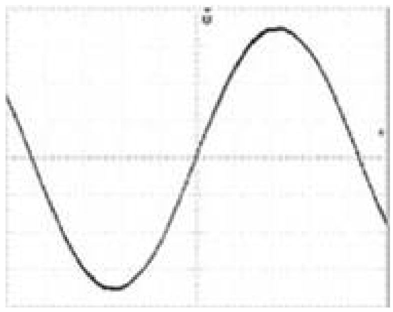
5.2.1 Phase current

It is necessary to pay more attention to the phase current setting as a wrong value can cause the break of the motor.
Following are detailed the minimum and maximum current values among which it is possible to choose according to the various models of driver.

Model	Current value (Arms)	
	Min	Max
DS1044	1	4
DS1048	3	8
DS1073	0.8	3
DS1076	2	6
DS1078	4	10
DS1084	2	4
DS1087	4	8.5
DS1098	4	10

It is important to note that the values listed above are expressed as effective current and not as peak current.
Some producers indicate the peak current. To obtain the effective current value it is sufficient to divide the peak current by 1.41 (this calculation is not applicable in case of full step or not sinusoid currents given to the motor). From what above explained it is clear that a 4Arms driver (4A effective current) is equivalent to a driver with peak current equal to 5.6Ap (4 x 1.41). Do consider this while comparing the features of the DS10xx drivers with other producers devices. The following figures show the phase current supplied by the DS1048 driver calibrated to 5Arms (right figure) and the current of a competitor's driver calibrated to 5Apeak (left figure).





It appears evident how the DS10xx drivers (which characterizes the current to the effective Arms value) supply greater current than those drivers which characterize the phase current as peak value.

The current calibration must be mainly executed according to the motor features. In particular cases it is possible to use an higher current value than the nominal one declared by the motor manufacturer. This could be useful to obtain more torque from the motor, but this method leads to an higher motor heating. If motor temperature exceeds the maximum allowed values the motor could be permanently damaged. Usually, the motor is over supplied only if the working cycle is soft and therefore allows a medium working temperature within the maximum allowed values declared by the manufacturer.
Because of the saturation phenomena of the magnetic circuit inside the motor (which vary from model to model) there is not a direct correspondence between torque and phase current when the nominal value is exceeded. In other words, even doubling the current, a double torque is never obtained from a motor. For this reason it is usually superfluous to over supply the motor of more than 30% of the nominal current.

If the motor works in a worm place or without a mechanic device capable to discharge the heat, it is possible it reaches high temperatures even if supplied by the nominal current. In this case it is possible to introduce a forced ventilation on the motor or, if the torque margins allow it, to reduce the current calibration on the driver. Remember that in this case the benefit obtained in terms of temperature will go at the expense of the torque supplied by the motor. Moreover, consider that when the driver calibration current does not correspond to the motor nominal current, the microstepping movement can lose regularity. In the same way, sometimes it is possible to improve the microstepping movement by slightly modifying the current calibration.

Typically a two phase stepping motor disposes of four wires, two per each phase. In this case the driver current calibration must correspond to the motor current plate. If for example the motor quotes 3A/phase also the driver shall be to be calibrated to 3Arms.

Some motors, supplied with more windings, allow to choose between series and parallel connections.

The series configuration requires a lower phase current but it also exposes a superior inductance towards the driver which penalizes the motor torque at high speeds. Therefore, this kind of connection is used in applications where motor speed is limited or supply voltage sufficiently high.
When a series configuration is used it is necessary to calibrate the driver to the motor phase current multiplied by the coefficient 0.71. If for example we are using a motor with plate current 3A, with the windings connected in series we should calibrate the driver to a current of 2.1Arms (3 * 0.71).
Furthermore take note that the inductance exposed by the motor to the driver is 2 times the single phase one.

On the contrary, the parallel configuration requires an higher phase current but it has the advantage to maintain the torque supplied by the motor more constant to the increasing of the speed. It happens because the inductance exposed by the parallel connection is inferior. This connection is preferable when the supply voltage is low or the motor working speed is high.
When a parallel configuration is used it is necessary to calibrate the driver to the motor phase current multiplied by the coefficient 1,41. If for example we are using a motor with plate current 3A, with the windings connected in parallel we should calibrate the driver to a current of 4.2Arms (3 * 1.41).
Furthermore take note that the inductance exposed by the motor to the driver is in this case the same as the single phase one.

5.2.2 Resolution

The DS10xx drivers permit to choose among many divisions, both of decimal and binary type, as shown in the following table.

Decimal		Binary	
Step / Rev	Microstep / Step	Step / Rev	Microstep / Step
1000	5	200	1
2000	10	400	2
4000	20	800	4
5000	25	1600	8
10000	50	3200	16
25000	125	6400	32
		12800	64
		25600	128

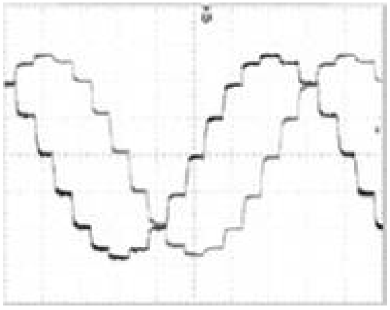
The step/rev in the table are for a stepper motor with 1.8° step angle. If using a motor with a different step angle, the step/rev number will be different too. For example, if using a motor with a 0.9° step angle, the step/rev indicated in the above table must be multiplied by 2.

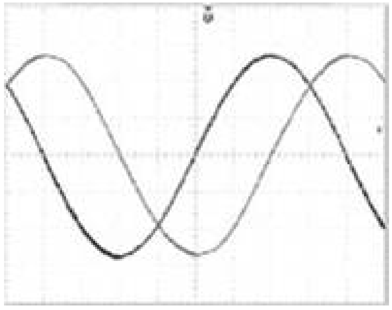
The resolution selection must be made mostly in accordance with the application requirements considering that a greater resolution offers also a better positioning precision and minor vibrations at low speed but, on the other side, it requires a greater pulses frequency applied to the STEP input.

Instead, low resolutions permit to obtain high motor rotation speeds, even with modest pulses frequencies applied to the STEP input, but they can generate vibrations and resonance phenomena when the motor works at low speeds. Furthermore, the positioning precision is reduced.

In order to correctly evaluate the precision, it must be considered that, despite the current regulation offered by the driver is accurate, it exist a mechanical error due to the tolerances and to the constructive features of the motor. In real applications it is difficult to command motor shaft variations inferior to 0.05°.

The left figure shows the current wave form with a resolution of 800 steps/rev (1/4 step) while the right one shows the current wave form with a resolution of 25600 steps/rev (1/128). In both case the motor rotates at the same speed.





When minor resolution is set (left figure) the motor movement is noisy while when the resolution is greater (right figure) the motor moves smoothly and with less vibrations.

In order to maintain the same motor rotation speed, in the example above, the pulses frequency applied to the STEP input is changed from 1KHz, which stands for the 800 steps/rev resolution (left figure), to 32KHz, required by the 25600 steps/rev resolution (right figure).

5.2.3 Automatic current reduction

Stepper motor drivers works at impressed current, i.e. they always supply the motor at the set nominal current independently from the motor giving torque to the load or not.
In other types of motor, as for example in DC or Brushless motors, the driver supplies the motor with the current strictly necessary to maintain the required position or rotation speed. In these cases the driver is able to obtain the information on the position or speed errors through transducers such as tachogenerator, encoder, resolver, etc. Therefore, such a system disposes of a feedback and it is a reactioned or closed loop kind.

On the contrary, the step motors can be used at open-loop without the help of any transducer, also granting constant speeds and precise and repeatable positioning.

What makes this operating method possible is the particular motor and driver conformation. As being without feed-back, it always delivers nominal phase current to the motor which therefore always produces the maximum torque.

When the application is dimensioned in such a way that the requested load torque remains inferior to the one supplied by the motor (on the whole required speed range), the speed and the position are preserved, even without feedback.

When the stepper motor is firm it is often necessary to grant a maintaining torque capable to keep the load in stable position (for example a suspended load), for this reason the driver supplies current to the motor even when it is motionless. However, in many cases the current sufficient to grant this condition is inferior to the required operating value; this happens mainly for two reasons: when the motor is firm there are no inertial loads which develop during speed changes, furthermore the torque / speed curve of the motor reaches its utmost just in proximity of zero speed (motionless motor).

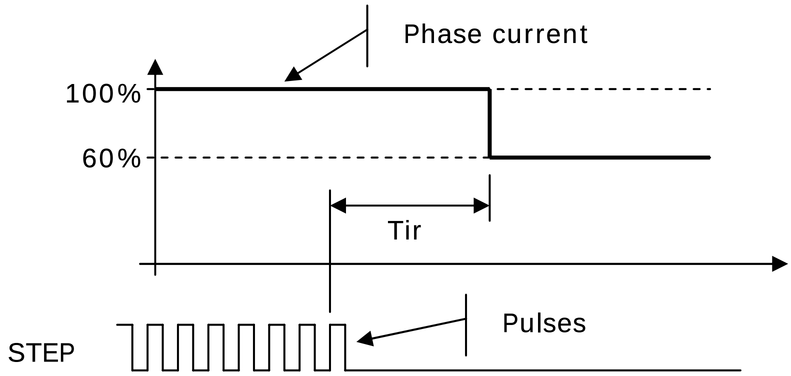
In order to limit the motor and driver heating there is a function able to automatically reduce the current supplied to the motor while in still position.

The DS10xx drivers allow to define accurately both the current reduction percentage and the timing from the motor stop to the reduction intervention. The regulation dynamics is extraordinarily wide and allows to change the current between 0% and 100% of the nominal current and the timing from few milliseconds up to 10 seconds. Such a flexibility can hardly be found in other drivers of the same class.
Setting a value equal to 0% the current is completely set off when motor is firm, while setting 100% the current is always maintained at the nominal value.

The current reduction percentage must be set considering the real torque required by the application when the motor is firm, while the second parameter (the timing) must be set according to the time that the load takes to stable after the stop of the motor or to the application working cycle.

Observe that removing the current reduction with motor at rest (that is to say setting the 100% value) the motor and the driver heat more. It is therefore suggested to make this calibration only if the application requires an high static torque to the motor.

The following diagram shows the relation between pulses applied to the STEP input and the automatic current reduction.



After the last STEP input disable/enable transition the *Tir* time starts to pass, after which the automatic current reduction intervenes to reduce the phase current, in the example, to the 60% of the nominal value (read at the set configuration value).

The BOOST input allows to manually reduce the current even while motor is rotating. This feature can be useful to reduce the heating when the whole torque supplied by the motor is not required (for example when the load moves at constant speed).

☺ Through the DIRECTION input it is then possible to suspend the automatic current reduction. A commutation from the enable to the disable status sets to zero the timer used for the automatic current reduction intervention. Therefore, changing the DIRECTION input with a time inferior to *Tir* (time set for the automatic current reduction) the reduction never intervenes, maintaining the motor always supplied by the nominal current.

5.2.4 Inputs and outputs conditioning

The DS10xx drivers implement a simple and flexible setting of the input and output lines hardly findable in other products of the same category.
The inputs and the outputs can be enabled, disabled, negate, always enable or always disable, independently from the real input status and independently one from the other. Furthermore, all this is obtainable without the hardware interventions on the driver, or dip-switch, jumpers, etc.

Following is the description of the supported operative modes:

Enable

The input in this status is normally (directly) interpreted by the driver.

Disabled

This mode is equivalent to disconnect the input signal from the driver, any input status change is ignored.

Direct

The signal applied to the input is elaborated by the driver in direct mode, without inversion.

Negate

The signal applied to the input is elaborated by the driver in negate mode (reverse). When the input is active the driver works as the input is inactive and vice versa.

Active

The driver elaborates the input as it was always active independently from its real status. If, for example, we wish the driver is enabled autonomously at the start, without the necessity to activate the ENABLE input, it is sufficient, through the configuration, to put that input in the active status.

Inactive

The driver elaborates the input as it was always inactive independently from its real status. This could be useful to block the rotating direction always in one sense (applying this configuration to the DIRECTION input) or to disable permanently the driver without intervening on the wirings (applying therefore the configuration to the ENABLE input).

In the following table are listed the inputs and outputs with their own possible settings and a graphical representation of how the signal is treated (high level = active input, low level = inactive input).

Input signal	Conditioning type	Signal "seen" by the driver	Available for the signals				
			STEP	DIRECTION	ENABLE	BOOST	FAULT
	**Enabled**		Yes	No	No	No	No
	**Disabled**		Yes	No	No	No	No
	**Direct**		No	Yes	Yes	Yes	Yes
	**Negate**		No	Yes	Yes	Yes	Yes
	**Active**		No	Yes	Yes	Yes	Yes
	**Inactive**		No	Yes	Yes	Yes	Yes

5.2.5 Alarms and Protections conditioning

In order to protect the driver and to make easier the location of the most common functioning or setting anomalies, the DS10xx drivers are equipped with many alarms and a complete diagnostics.

Furthermore, the extraordinary flexibility offered by the product allows to singularly configure the operative mode of each alarm choosing among *Automatic, Permanent, Enable or Disable.*
The configuration is made without the necessity to intervene on the driver's hardware, without jumper, dip-switch, etc.

Automatic

The driver constantly examines the alarm condition and when this disappears it provides autonomously to remove the signal and to turn back to the operative status.

Permanent

Each alarm condition remains in the driver memory. To remove the signal the driver must be switched off and then switched on again.

Enable

The breakdown condition signal remains till the driver is not disabled through the ENABLE input.

Disable

The alarms are disabled and ignored by the driver. For security reasons some protections cannot be put in this status.

In the following table are resumed the various possible settings for each single alarm.

Alarm type / protection	Possible setting			
	Automatic	Permanent	Enable	Disable
Under voltage	Yes	Yes	Yes	No
Over voltage	Yes	Yes	Yes	No
Over temperature	Yes	Yes	Yes	No
Phase-to-phase short circuit	Yes	Yes	Yes	No
Phase-to-ground short circuit (GND)	Yes	Yes	Yes	No
Phase-Vp short circuit	Yes	Yes	Yes	No
Interrupted Phase A	Yes	Yes	Yes	Yes
Interrupted Phase B	Yes	Yes	Yes	Yes

For a complete description of protections and alarms see chapter 5.5 Protections.

5.3 Inputs and outputs

5.3.1 General description

The DS10xx drivers have inputs and outputs which can be used in NPN or PNP logics.
Each input presents both connections allowing also mixed configurations. All the inputs and outputs are optocoupled, among them, towards the motor and towards the power supply.

5.3.2 Inputs

In the following explanation it is assumed that the real status of input signals is the same seen by the driver. In other words, during setting no signal conditioning must have been made (*Direct or Enable* setting).

STEP

This input is used to command the motor rotation. Any time the input goes from the inactive to the active status the motor makes an angle step as defined by the resolution setting (see chapter 5.2.2 Resolution). The effective rotation direction (clockwise or counter-clockwise) depends on the DIRECTION input status and on the connection between the motor phases and the driver.
Any pulse applied to the STEP input sets to zero the timer counting associated to the automatic current reduction.
With the automatic current reduction active, a new pulse applied to the STEP input restores the current to the nominal value again.

DIRECTION

This input is used to reverse the motor rotation direction. When the input is active the motor moves in the direction opposite to the one obtained with the inactive set input. The effective rotation direction, clockwise or counter-clockwise, cannot be prior determined as it depends on the connection sequence between the driver and the motor.
The DIRECTION input has another important function; if the motor phase current is reduced because of the automatic current reduction (see chapter 5.2.3 Automatic current reduction) a change of the DIRECTION input status forces the current to the nominal value again.
This original feature avoids the automatic current reduction to intervene simply changing the DIRECTION input status in a sufficiently quick way to avoid the same automatic current reduction to occur (i.e. in a time inferior to the one set for the *Tir* parameter).

It is possible to use this technique also to restore the current to the nominal value in advance respect to the first pulse applied to the STEP input.
Through the configuration it is possible to condition this signal to better adapt it to the application (see chapter 5.2.4 Inputs and outputs conditioning).

ENABLE

This input is used to enable the driver. When the input is active the driver is enabled and supplies current to the motor; on the contrary when the input is inactive the motor current is null.

ATTENTION, do not use the ENABLE input to put the application in security. The only way to be sure the motor is not supplied is to remove the supply from the driver and wait for at least 30 seconds.

Setting the ENABLE input as inactive, the signaling of the no more active alarms configured as *Enable* is removed (for more details see chapter 5.2.5 Alarms and Protections conditioning).
Through the configuration it is possible to condition this signal to better adapt it to the application (see chapter 5.2.4 Inputs and outputs conditioning).

BOOST

This input is used for the boost functionality or manual current reduction.
The BOOST input allows to over supply the motor to obtain greater torque (required for example to win inertial forces) or, on the contrary, to reduce the phase current if not totally necessary (in order to contain the driver and motor heating). When the input is inactive, to the motor is applied the nominal phase current while if the input is active the current is reduced by the percentage defined by the configuration (see chapter 5.2.3 Automatic current reduction).
To realize the over supply function it is necessary to maintain the BOOST input active and set the driver in order that the set nominal current, reduced by the percentage indicated by the *Vir* parameter, is equivalent to the phase current required by the normal functioning. Bringing then the input to the inactive status the current will reach the setting nominal value, over supplying the motor by a percentage pair to the difference between 100% and the *Vir* parameter value (for example, if *Vir* is set for the 75% the phase current will be increased by 25%, 100%-75%=25%).

When the application does not need continuously the maximum motor torque, it is possible to use the BOOST input to reduce the phase current and consequently the heat dissipated on the driver and on the motor. To obtain the maximum torque the BOOST input must be left inactive, on the contrary when a smaller torque is sufficient the BOOST input must be activated.
The operating logics above described can be easily inverted by conditioning the signal given by the configuration (see chapter 5.2.4 Inputs and outputs conditioning).

5.3.3 Outputs

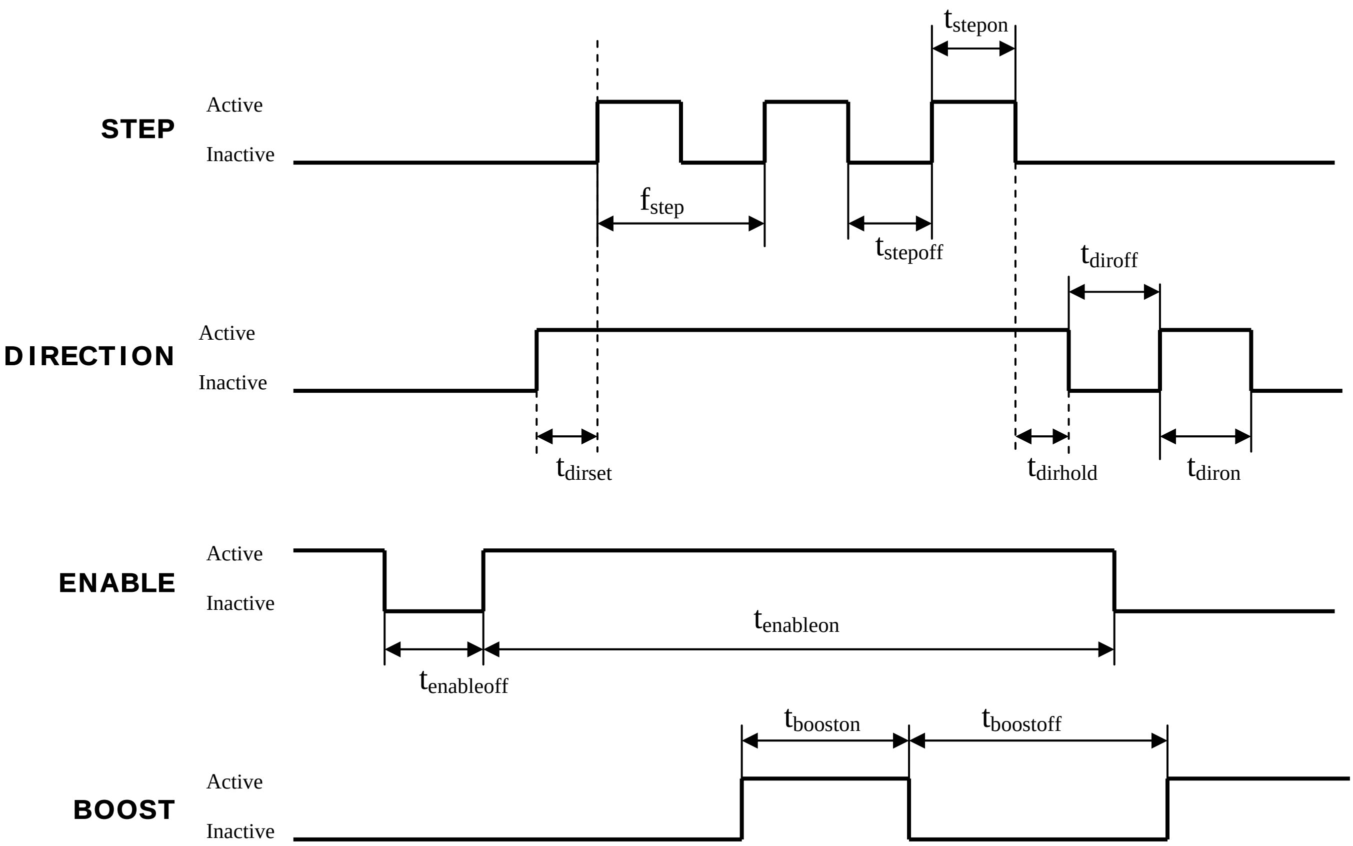
In the following explanation of the single output signals it is assumed that during setting no signal conditioning has been made:

Fault

When the driver is in the operating status the output is active, on the contrary when there is the signaling of one or more alarms the output is inactive.
Through the configuration it is possible to condition this signal to invert its logic and to adapt it to the application (see chapter 5.2.4 Inputs and outputs conditioning).

5.3.4 Timing relations among control signals

The input signals must observe some exact temporal relations to assure the correct driver functioning. If such relations are not respected the driver is not damaged but it can produce unexpected results and position loss of the motor.



Symbol	Description	Value			Unit
		Min	Typ	Max	
f_{step}	Step frequency (Equivalent step/rev)			6000	rpm
t_{stepon}	Active STEP input timing	1.3			μsec
$t_{stepoff}$	Inactive STEP input timing	2			μsec
t_{dirset}	DIRECTION signal setting respect to STEP	16			μsec
$t_{dirhold}$	DIRECTION signal maintaining respect to STEP	16			μsec
t_{diron}	Active DIRECTION input timing	300			μsec
t_{diroff}	Inactive DIRECTION input timing	300			μsec
$t_{enableon}$	Active ENABLE input timing	300			μsec
$t_{enableoff}$	Inactive ENABLE input timing	300			μsec
$t_{booston}$	Active BOOST input timing	300			μsec
$t_{boostoff}$	Inactive BOOST input timing	300			μsec

5.4 Signal LEDs

The driver has three signal LEDs: the green one called *On*, the yellow LED called *Enable* / *Step* and the red one called *Fault*.

On

The LED called *On* lights up when the driver is supplied with a voltage sufficient to allow a correct functioning of the control electronics.
When the LED is on the driver is able to elaborate the information but it is not necessarily in the working status (for examples, because the supply voltage is beyond the working limits or the temperature is excessive).

Enable / Step

This LED supplies at the same time various information on the status of the driver and of the signal inputs.
When the ENABLE input is active the LED is fixed lighted up, when the input is inactive the LED is off.
When pulses reach the STEP input the LED status reverts for an instant. In other words, in presence of pulses to the STEP input and with the ENABLE input active, the LED is mostly lighted up with short switching off; while with the ENABLE input inactive and pulses to the STEP input, the LED remains mostly off with short lighting flashes.
The LED inverts its position for an instant even in presence of a status change of the DIRECTION input.
This original working method allows an immediate wiring diagnostics and also points out eventual electric noises. In this case, in fact, there will be a yellow LED's flashing even when the control equipment (PC or others) is not active.
The driver features grant at least a LED lighting flash in presence of pulses on the STEP input or transitions on the DIRECTION input. However, keep present that, if the events are too close, part of the subsequent events could not be visualized.

Relation between the yellow LED and the ENABLE, STEP and DIRECTION inputs

STEP / DIRECTION	ENABLE	Yellow LED status
Inactive / No status change	Inactive	On Off
Inactive / No status change	Active	On Off
Pulses / Status change	Inactive	On Off
Pulses / Status change	Active	On Off

Fault

This LED lights up each time there is at least an alarm signaling.
When the LED is lighted up, the driver is not operative and the motor is without supply (observe that also in this condition the yellow LED continues in its own activity as described in the previous chapter).

In presence of an alarm the red LED lights up and starts a sequence of flashing related to the kind of problem found.
The following table shows the association between the number of flashes and the error found.

Codification of errors signaled by red LED	
Number of flashes	**Problem description**
1	Under voltage, the supply voltage is inferior to *Vpl* value
2	Over voltage, the supply voltage is superior to *Vph* value
3	Over temperature, the heat sink voltage is superior to *Tchh*
4	Phase-to-phase short circuit, one or two phases are in short circuit
5	Phase-to-ground short circuit (GND), phase in short circuit with ground
6	Phase-Vp short circuit, one phase is in short circuit with power supply
7	Interrupted phase A, connection between driver and motor is missing
8	Interrupted phase B, connection between driver and motor is missing

If more than a problem occurs at the same time the lighting flashes sequences associated to each one of them are cyclically executed. If for example the over temperature condition occurs together with the over voltage one, the LED will flash twice and then three times alternatively till when the malfunction signaling will be removed.

The driver features grant at least a visualization cycle for each activated alarm. For this reason it is not possible to remove an alarm before the first visualization cycle is finished.

Note that each error signaling can be removed differently according to how the driver has been set (for a close examination see chapter 5.2.5 Alarms and Protections conditioning).

For a detailed description on the various alarms and protections see chapter 5.5 Protections.

When in the driver the *Loader* (an always resident small software necessary for the firmware update) is active, the *Fault* LED remains always on.

5.5 Protections

5.5.1 General description

The driver is equipped with efficient protections which protect its integrity whenever one of the most common problems occurs. Furthermore, some alarms have been implemented; they can detect positioning errors even before the motor starts to move.

In spite of the care and attention used in the development and manufacturing of the driver, an installation or an use not in compliance with the indications present in this manual, or out of stated maximum limits, can damage the driver permanently.

Through the configuration it is possible to define the driver behavior on the occurring of the various alarm conditions.

For example, it is possible to choose and make permanent an alarm or to set the driver so that it is automatically re-enabled as soon the alarm condition is ceased. For a detailed description about the various configuration options see chapter 5.2.5 Alarms and Protections conditioning.

When there is at least an alarm signal the driver is not active and the motor is not supplied, consequently the torque is null.

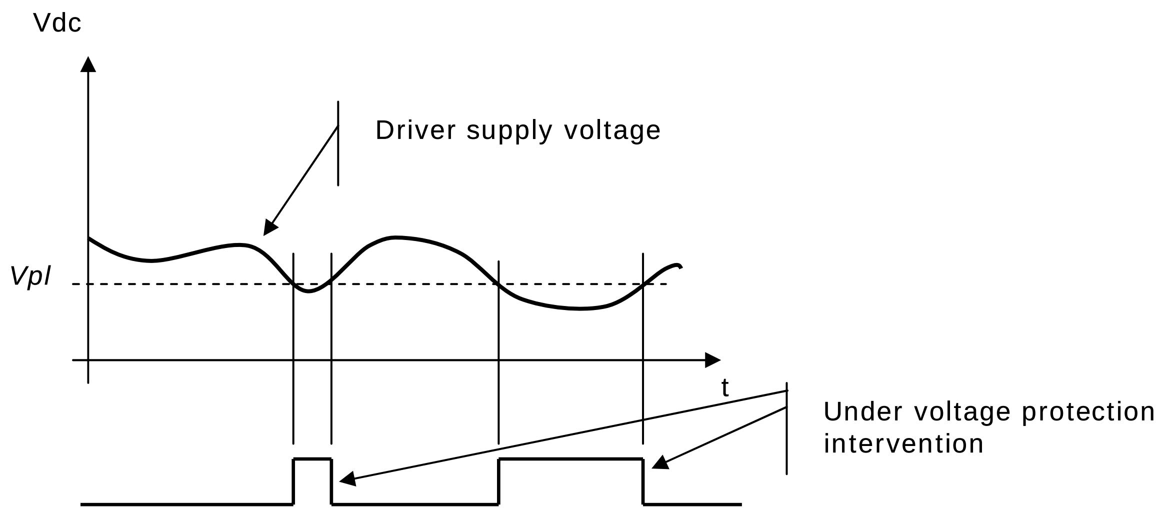
5.5.2 Under voltage

The under voltage alarm intervenes when the driver supply voltage is inferior to the *Vpl* value. Such value varies according to the driver model as per the following table.

Model	**Vpl value**			***Unit***
	Min	***Typ***	***Max***	
DS1044		20		**Vdc**
DS1048		20		**Vdc**
DS1073		24		**Vdc**
DS1076		24		**Vdc**
DS1078		24		**Vdc**
DS1084		45		**Vdc**
DS1087		45		**Vdc**
DS1098		45		**Vdc**

The driver constantly verifies the supply voltage value; it is sufficient this goes beyond the *Vpl* threshold for few instants to generate the under voltage alarm. It does not have to be astonishing the fact that the protection intervenes despite the measured voltage is within the functioning limits, as it is possible that, because of the main supply fluctuations or cables length, the voltage that effectively reaches the driver becomes, in particular moments (for example during the motor acceleration phase), inferior to *Vpl* value.

In order to make a correct measurement it is necessary to act directly on the driver supply terminal blocks using a band-pass instrument of at least 10KHz (as for example an oscilloscope) able to memorize the voltage transients minimum values.



If the supply voltage is very near to the driver functioning limit and sporadically the under voltage alarm intervenes, it is possible, in some cases, to solve the problem reducing the distance between the power supply and the driver, increasing the cables section or placing an electrolytic capacitor near the driver itself.

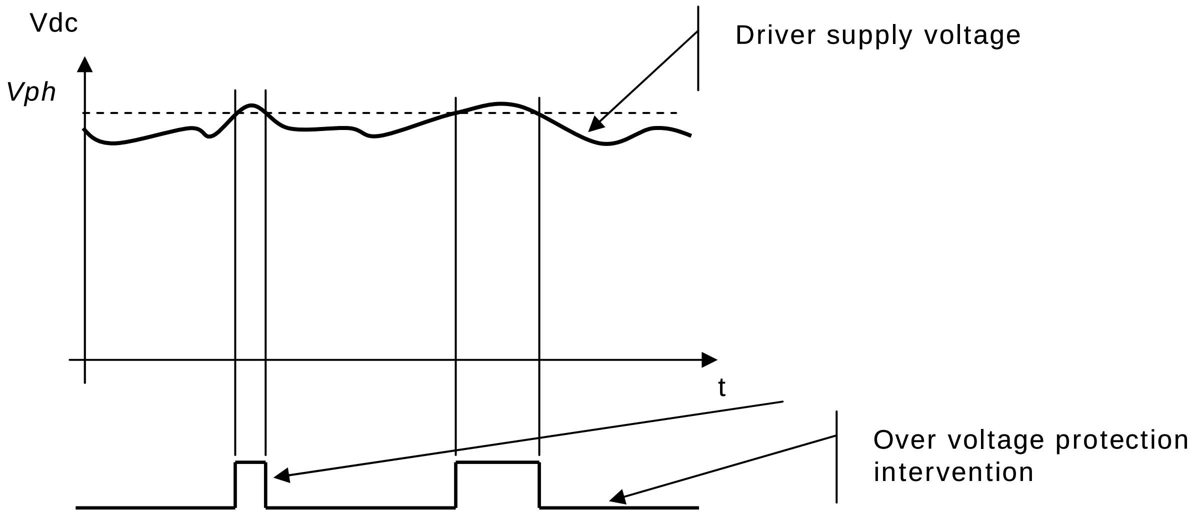
5.5.3 Over voltage

The over voltage protection intervenes when the supply voltage is superior to the *Vph* value. In this condition the driver protects the power stage turning it off. Such value varies according to the driver model, as per the following table.

Model	**Vph value**			**Unit**
	Min	***Typ***	***Max***	
DS1044		55		**Vdc**
DS1048		55		**Vdc**
DS1073		90		**Vdc**
DS1076		98		**Vdc**
DS1078		98		**Vdc**
DS1084		175		**Vdc**
DS1087		175		**Vdc**
DS1098		248		**Vdc**

The driver constantly controls the supply voltage and when it goes beyond the *Vph* value, even also for few instants, the over voltage protection intervenes. It does not have to be astonishing the fact that the protection intervenes despite the measured voltage is within driver functioning limits. In fact it is possible that, in some occasions (sudden motor decelerations, sudden voltage changes, etc.) the voltage which supplies the driver goes beyond the *Vph* value causing the protection intervention.

In order to make a correct measurement of the effective driver supply voltage it is necessary to act directly on the supply terminal blocks of the driver itself, using a band-pass instrument of at least 10KHz and able to capture the voltage transients peaks.



If the supply voltage is very near to the driver functioning limit and the over voltage alarm sporadically intervenes, it is possible in some cases to solve the problem reducing the distance between the power supply and the driver, increasing the cables section or placing an electrolytic capacitor near the driver.

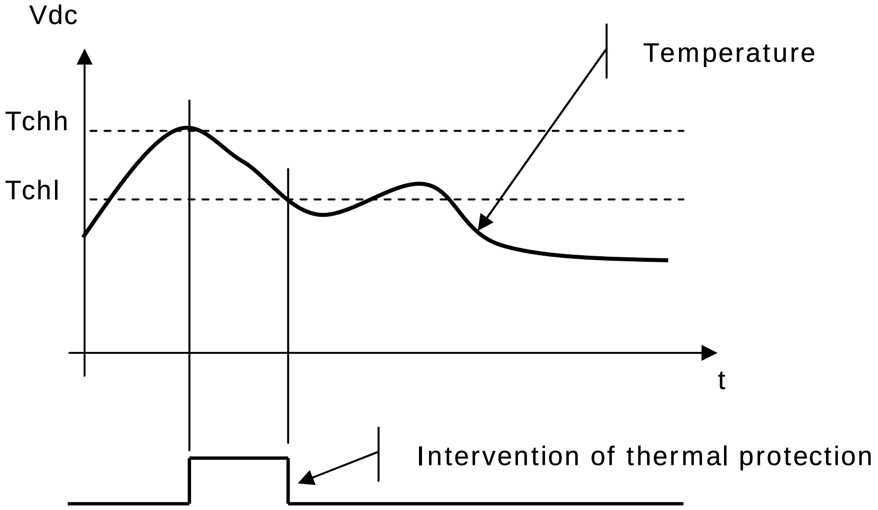
ATTENTION, if the supply voltage increases a lot beyond the maximum functioning value, and in particular it goes beyond the *Vpbrk* breakdown voltage, the driver will be irreversibly damaged.

When the over voltage protection intervenes because of the energy returned from the motor during the deceleration phase, which causes a bus voltage rise beyond the *Vph* value, it is possible to avoid such condition using a braking resistor calibrated to intervene before the bus voltage reaches the *Vph* value.
The power supplies of the DP10xx2 series integrate this functionality and represent a valid solution to solve this problem.

5.5.4 Over temperature

The over temperature protection intervenes when the driver power stage temperature goes beyond the *Tchh* value. In this condition the driver stops working.
When the temperature falls below *Tchl* the alarm signal is removed or not in compliance with the driver configuration (see chapter 5.2.5 Alarms and Protections conditioning).

Symbol	Description	Value			Unit
		Min	Typ	Max	
Tchh	Intervention threshold of thermal protection	84	86	89	**°C**
Tchl	Restoration threshold of thermal protection	64	66	69	**°C**



5.5.5 Phase-to-phase short circuit

In case of a motor wirings short circuit, on the same phase or on different ones (cross phase short circuit), the driver stops working and activates the phase-to-phase short circuit protection. This kind of protection requires a careful survey to find the cause of the short circuit. Consider that the short circuit can be, apart in the wiring, inside the motor.
According to the driver configuration (see chapter 5.2.5 Alarms and Protections conditioning) the protection can be removed through a turning off and on cycle or disabling temporaneously the driver through the ENABLE signal.

5.5.6 Phase-to-ground short circuit

The protection starts whenever one of the connections towards the motor is in short circuit with the driver ground connection (GND). In these conditions the driver protects itself switching off the supply to the motor and turning in an inactive status. This protection requires a careful survey to find the cause of the short circuit. Consider that the short circuit can be, apart in the wiring, inside the motor.
According to the driver configuration (see chapter 5.2.5 Alarms and Protections conditioning) the protection can be removed through a turning off and on cycle or disabling temporaneously the driver through the ENABLE signal.

5.5.7 Phase-to-Vp short circuit

Whenever one of the phase connections cause a short circuit with the positive supply voltage (+Vp) the phase-to-Vp short circuit protection starts. When this condition occurs the driver protects itself switching off the supply to the motor and turning in an inactive status.
According to the driver configuration (see chapter 5.2.5 Alarms and Protections conditioning) the protection can be removed through a turning off and on cycle or disabling temporaneously the driver through the ENABLE signal.

5.5.8 Interrupted phase A, interrupted phase B

If the connection between the driver and the motor is interrupted, also of a single phase, or an inner motor winding is damaged (interrupting itself) the driver activates the interrupted phase alarm. The signal is distinguished for the phase A and phase B for a more accurate diagnostics.
Take present that the driver makes the interrupted phase control only with the driver enabled and with the motor at rest or with rotation speed inferior to 15 rpm (independently by the set resolution).

5.6 Advanced functionalities

5.6.1 General description

The innovative hardware structure of the driver allows to integrate advanced functionalities compared to the common step and direction drivers, without penalizing the product cost and size.

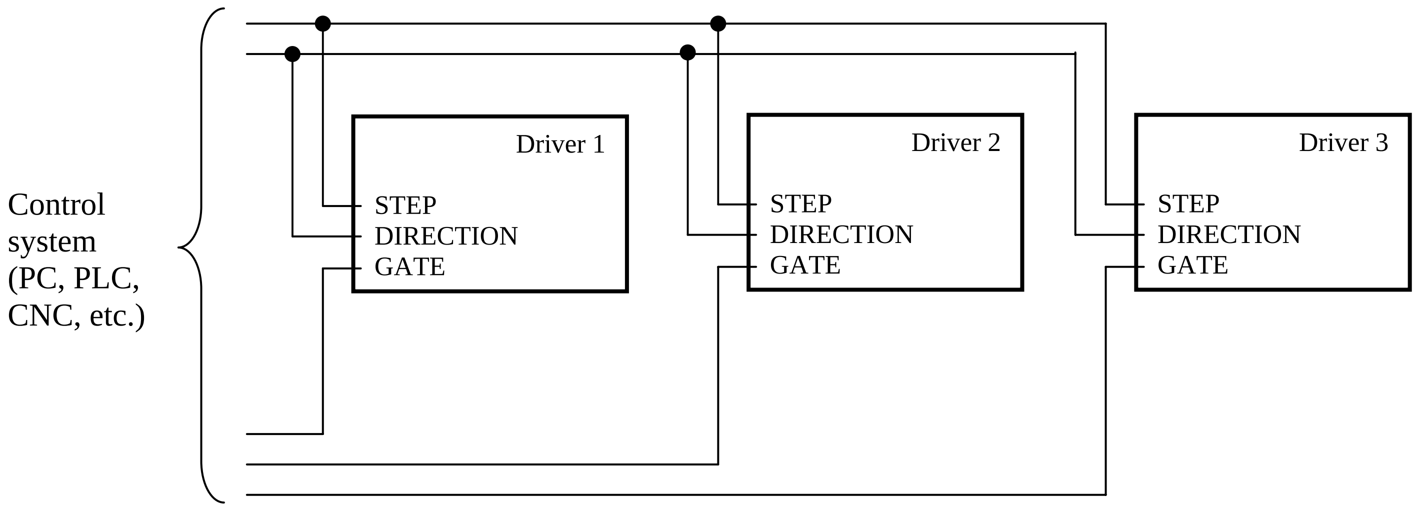
This manual describes the functions present in the firmware revision indicated on the cover. Subsequent revisions could integrate further functions and it is therefore advisable to always verify to have the last manual edition visiting the site www.lamtechnologies.com.

The available advanced functionalities are *Gate* and *Oscillator*.

5.6.2 Gate

The *Gate* function allows to enable or not the execution of the pulses applied to the STEP input through a GATE control signal.

This characteristic makes possible the use of a single step source to control more drivers when contemporary movements are not required, as shown in the following representation.



In this case the control system sends a step and direction signal to all the drivers contemporaneously, while the GATE signal is activate from time to time on the only driver the control system wants to move. The drivers with the GATE signal not activate ignore the pulses and maintain the motor firm.

5.6.2.1 Configuration

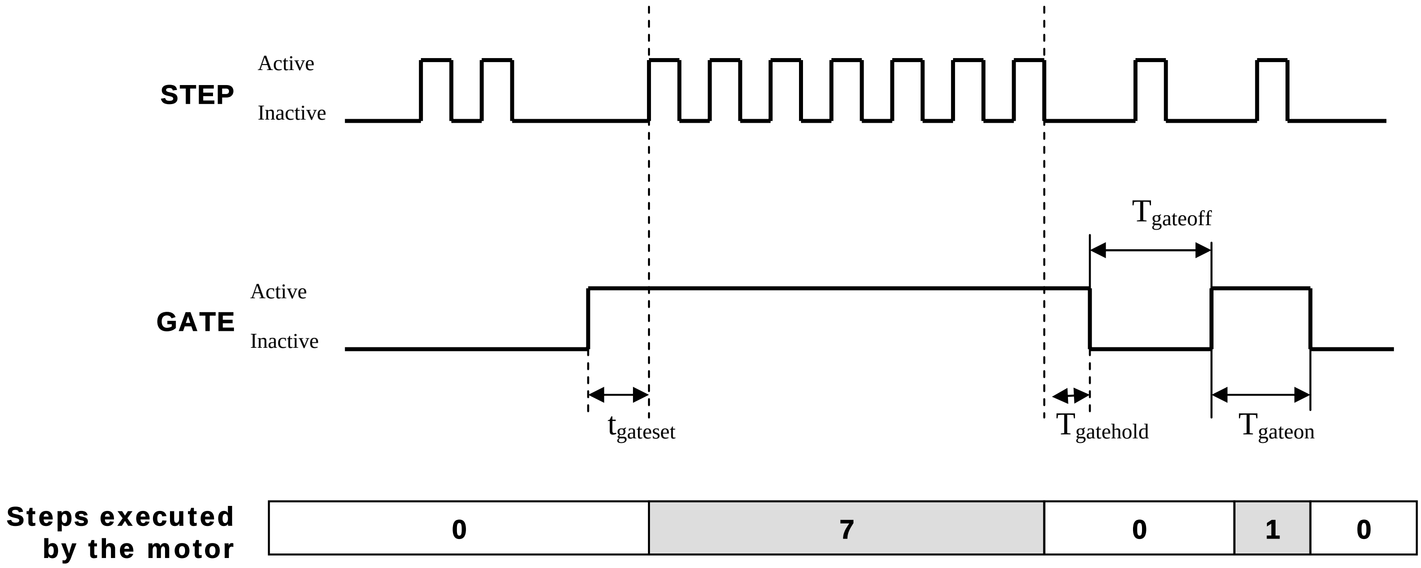
To make the *Gate* operating it is necessary to select in the *UDP Commander* software the option button marked *Gate*.
Then it is necessary to define the input to be used as GATE to enable the execution of the pulses applied to the STEP input by the driver. The selection is made through the drop-down list.
Defined the input to be used as GATE, it is possible to intervene through the signal conditioning (drop-down list on the right of the previous one) to adapt it to the logic level used by the control system.

Take into account that when the GATE input is active the driver executes the pulses applied to the STEP input, while with the GATE input inactive the signals applied to the STEP input are ignored.

It is important to note that the signal defined as GATE continues to carry out its natural function, if for example the ENABLE input is used as GATE, it will be essential to condition the *Enable* signal “seen” by the driver as *Active* (through the drop-down list on the *Control signals* panel inside *Driver configuration*) so that the driver remains always enable whichever is the logic level assumed by the ENABLE input which carries out the GATE function. If, as further example, the BOOST input is used as GATE, it would be better to set the *Boost* signal “seen” by the driver as *Inactive* (through the drop-down list on the *Control signals* panel inside *Driver configuration*). This to avoid that the status change of the BOOST input also causes an alteration of the current supplied to the motor (for more details on the natural functionality of the BOOST input see chapter 4.4.3.1 Inputs).

5.6.2.2 Time relations among control signals

In the following graph it is shown the relation among the GATE input status, the pulses applied to the STEP input and the steps really executed by the driver.



To grant a correct execution of the given commands it is necessary to respect some time relations among the signals. In the following table are detailed the limits to be observed.

Symbol	Description	Value			Unit
		Min	Typ	Max	
$T_{gateset}$	GATE signal setting in respect to STEP	200			μsec
$T_{gatehold}$	GATE signal holding in respect to STEP	200			μsec
T_{gateon}	Active GATE input time	500			μsec
$T_{gateoff}$	Inactive GATE input time	500			μsec

5.6.3 Oscillator

The *Oscillator* function allows to command the motor movement through a *start/stop* signal rather than through the pulses normally applied to the STEP input.

This function is particularly useful when there is not the possibility to generate step pulses or when there is a feedback (a sensor or other) which supplies a response on the position reached by the motor or on the result obtained by the same (for example a register control).

☺ The *Oscillator* function uses up to two inputs. A first input is used to command the motor start and stop (START/STOP input), while a second input can be configured to select the motor rotation speed between two available ones (SELECT input).

5.6.3.1 Configuration

To make the *Oscillator* function operating it is necessary to select in the *UDP Commander* software the option button marked *Oscillator*.

Then it is possible to choose the input to be used as START/STOP signal and to define the SELECT input for the frequency selection, using the corresponding drop-down list.
For each signal it is then possible to set the digital conditioning to adapt its behavior to the control system logic levels.

The motor rotation occurs when the START/STOP input is active (and the motor is enabled). Instead, with the START/STOP input inactive the driver works standardly and the motor rotation is commanded through the STEP input.
☺ This original characteristic allows, for example, to use the oscillator for gross movements and to use then the STEP input to execute the fine position adjustment.

The motor rotation speed depends on the frequency set in the oscillator function and on the resolution set on the *Driver configuration* panel.

To know the steps/min completed by a 200steps/rev motor it is possible to apply the following formula:

rpm = 60 * Fosc / stprev

where: rpm = steps/min completed by the motor
Fosc = frequency set in the oscillator function
stprev = steps/rev set

For example, if we have set a resolution equal to 1/16 step, a frequency of 800Hz and we use a 200 steps/rev motor, we will obtain a motor rotation speed equal to 200 steps/min. Applying the formula we will obtain:

rpm = 60 * 800 / 3200 = 200

The driver does not execute acceleration and deceleration ramps, it is therefore necessary to pay attention to the configuration parameters choice to avoid that a too high rotation speed generates the start stall or the loss of steps at the motor stop.
The maximum speed at which it is possible to start and stop the motor in absence of ramp depends on many factors, among which the motor torque (which depends on the phase current), the rotor inertia, the load inertia, frictions, etc.
The maximum value can be determined provisionally starting from a low rotation speed to then increase it till when the loss of step is detected. Obtained this value, it is possible to apply a security coefficient equal to 0.7 and use as maximum value for the application the maximum speed decreased by 30%.

☺

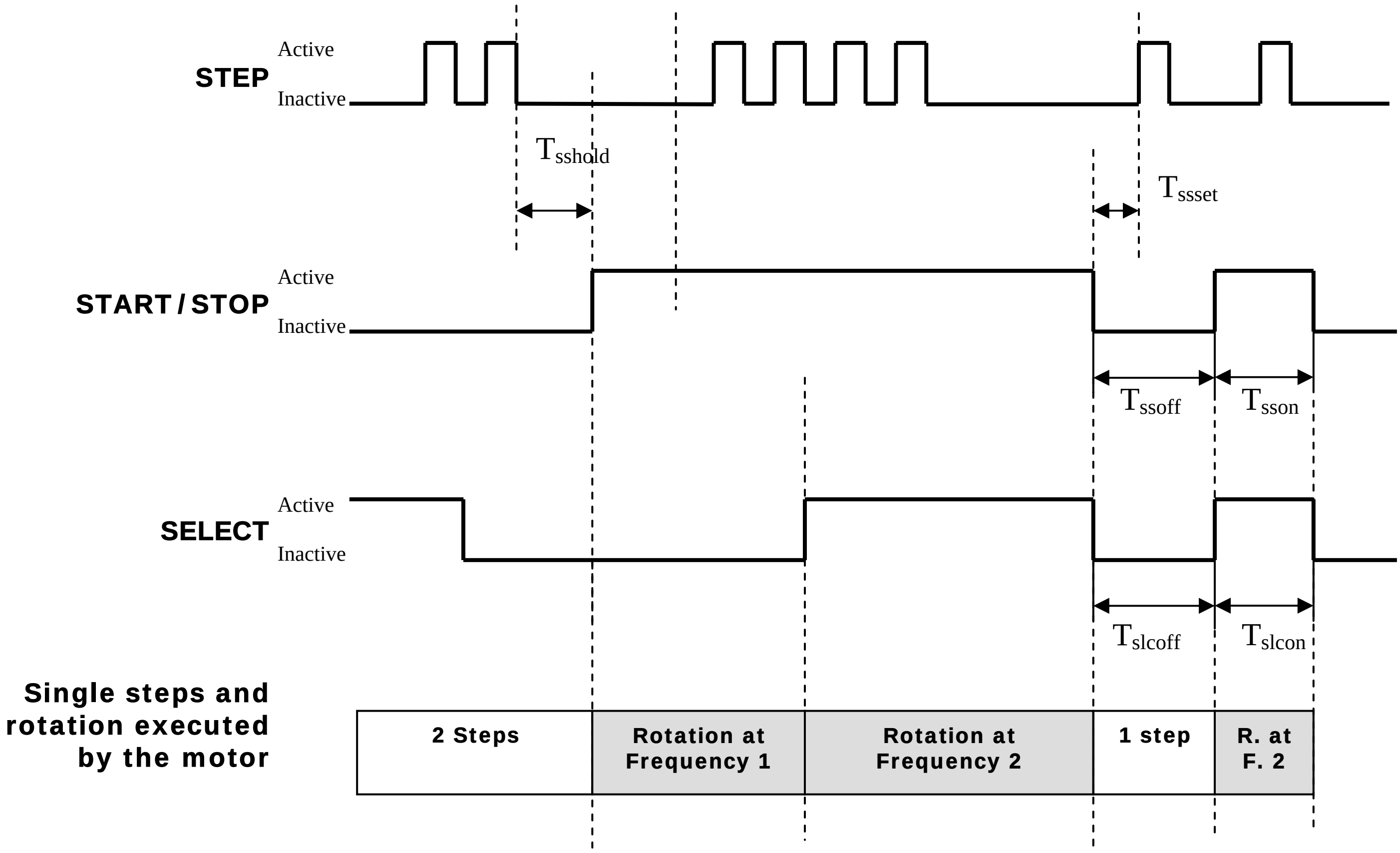
In the *Oscillator* function it is possible to set up to two different frequencies (which produce two different rotation speeds) which can be selected in real time, also during the motor rotation, through the SELECT input.

The *Frequency 1* is selected when the SELECT input is inactive, while the *Frequency 2* becomes operating when the SELECT input is active.

Take into account that the chosen signals for the START/STOP and SELECT roles continue to carry out their own natural function, therefore not to incur in unexpected behaviors it is essential to condition the signal through the corresponding drop-down list on the *Control signals* panel inside *Driver configuration*.
If, for example, the DIRECTION input is chosen to carry out the SELECT function (for instance because the rotation direction reverse is not necessary) it is essential to set the *Direction* signal as *Active* or *Inactive* on the *Driver configuration* panel to avoid that the change of the input logic level produces the motor direction reverse.

5.6.3.2 Time relations among control signals

In the following graphs it is shown the relation among the STEP input, the START/STOP and SELECT inputs status, and the motor.



To grant a correct execution of the given commands it is necessary to respect some time relations among the signals. In the following table are detailed the limits to be observed.

Symbol	Description	Value			Unit
		Min	Typ	Max	
T_{ssset}	START/STOP signal setting in respect to STEP	200			μsec
T_{sshold}	START/STOP signal holding in respect to STEP	200			μsec
T_{sson}	Active START/STOP input time	500			μsec
T_{ssoff}	Inactive START/STOP input time	500			μsec
T_{slcon}	Active SELECT input time	500			μsec
T_{slcoff}	Inactive SELECT input time	500			μsec

6 Technical data

The following are the electric, physical and mechanical details of each single driver.

DS1044					
Symbol	**Description**	**Value**			**Unit**
		Min	**Typ**	**Max**	
Vp	Power supply voltage	20		50	**Vdc**
If	Phase current (**effective current**)	1		4	**Arms**
Vir	Automatic current reduction	0		100	**%**
Tir	Current reduction intervention time	0.05		10	**s**
Vprp	Allowed ripple (100Hz)			8	**Vpp**
Vpbrk	Permanent breakdown voltage	-0,5		60	**Vdc**
Vph	Over voltage protection intervention	56.0		57.5	**Vdc**
Vpl	Under voltage protection intervention	18.5		19.7	**Vdc**
Tchh	Thermal protection intervention threshold	84	86	94	**°C**
Tchl	Thermal protection restoration threshold	64	66	69	**°C**
Plss	Power lost on the driver			10	**W**
Res	Step resolution available	200, 400, 800, 1000, 1600, 2000, 3200, 4000, 5000, 6400, 10000, 12800, 25000, 25600			**Step / Rev.**
Ml	Motor inductance seen by the driver	0.8		50	**mH**
Vdi	Digital input voltage range	3		30	**Vdc**
Vdibrk	Digital input breakdown voltage	-35		+35	**Vdc**
Idi	Digital input supply current	4	6	8	**mA**
Vdo	Digital output voltage range	1		30	**Vdc**
Vdobrk	Digital output breakdown voltage	-0.5		37	**Vdc**
Vdoz	Output zener diode voltage	37	39	42	**Vdc**
Ido	Digital output current range			50	**mA**
Idobrk	Digital output breakdown current	120			**mA**
Pwdo	Digital output dissipable power			300	**mW**
Fch	Chopper frequency		20		**KHz**
Prt	Protections and alarms	Over/Under voltage, Short circuit Overheating, Break phase			
Mechanical Specifications					
FDh	Height	100.4			**mm**
FDl	Depth	119.0			**mm**
FDw	Width	17.5			**mm**
FDnw	Weight	180			**gr**
Rated range of use					
FCa	Altitude			2000	**m**
Idr	*If* current degrading every 1000m beyond the *FCa* altitude value		5		**%**
FCt	Temperature	0		50	**°C**
FCh	Humidity (no condensing)	5		90	**%**
Conditions of storage and transport					
SCa	Altitude			4000	**m**
SCt	Temperature	-20		60	**°C**
SCh	Humidity (no condensing)	5		95	**%**

DS1048					
Symbol	**Description**	**Value**			**Unit**
		Min	**Typ**	**Max**	
Vp	Power supply voltage	20		50	**Vdc**
If	Phase current (**effective current**)	3		8	**Arms**
Vir	Automatic current reduction	0		100	**%**
Tir	Current reduction intervention time	0.05		10	**s**
Vprp	Allowed ripple (100Hz)			8	**Vpp**
Vpbrk	Permanent breakdown voltage	-0.5		60	**Vdc**
Vph	Over voltage protection intervention	56		57.6	**Vdc**
Vpl	Under voltage protection intervention	18.5		19.7	**Vdc**
Tchh	Thermal protection intervention threshold	84	86	94	**°C**
Tchl	Thermal protection restoration threshold	64	66	69	**°C**
Plss	Power lost on the driver			20	**W**
Res	Step resolution available	200, 400, 800, 1000, 1600, 2000, 3200, 4000, 5000, 6400, 10000, 12800, 25000, 25600			**Step / Rev.**
Ml	Motor inductance seen by the driver	0.5		30	**mH**
Vdi	Digital input voltage range	3		30	**Vdc**
Vdibrk	Digital input breakdown voltage	-35		+35	**Vdc**
Idi	Digital input supply current	4	6	8	**mA**
Vdo	Digital output voltage range	1		30	**Vdc**
Vdobrk	Digital output breakdown voltage	-0.5		37	**Vdc**
Vdoz	Output zener diode voltage	37	39	42	**Vdc**
Ido	Digital output current range			50	**mA**
Idobrk	Digital output breakdown current	120			**mA**
Pwdo	Digital output dissipable power			300	**mW**
Fch	Chopper frequency		20		**KHz**
Prt	Protections and alarms	Over/Under voltage, Short circuit Overheating, Break phase			
Mechanical Specifications					
FDh	Height	100.4			**mm**
FDl	Depth	119.0			**mm**
FDw	Width	35			**mm**
FDnw	Weight	270			**gr**
Rated range of use					
FCa	Altitude			2000	**m**
Idr	*If* current degrading every 1000m beyond the *FCa* altitude value		5		**%**
FCt	Temperature	0		50	**°C**
FCh	Humidity (no condensing)	5		90	**%**
Conditions of storage and transport					
SCa	Altitude			4000	**m**
SCt	Temperature	-20		70	**°C**
SCh	Humidity (no condensing)	5		95	**%**

DS1073

Symbol	Description	Value			Unit
		Min	Typ	Max	
Vp	Power supply voltage	24		90	**Vdc**
If	Phase current (**effective current**)	0.8		3	**Arms**
Vir	Automatic current reduction	0		100	**%**
Tir	Current reduction intervention time	0.05		10	**s**
Vprp	Allowed ripple (100Hz)			15	**Vpp**
Vpbrk	Permanent breakdown voltage	-0.5		105	**Vdc**
Vph	Over voltage protection intervention	95		98	**Vdc**
Vpl	Under voltage protection intervention	22.5		23.5	**Vdc**
Tchh	Thermal protection intervention threshold	84	86	94	**°C**
Tchl	Thermal protection restoration threshold	64	66	69	**°C**
Plss	Power lost on the driver			10	**W**
Res	Step resolution available	200, 400, 800, 1000, 1600, 2000, 3200, 4000, 5000, 6400, 10000, 12800, 25000, 25600			**Step / Rev.**
Ml	Motor inductance seen by the driver	0,8		50	**mH**
Vdi	Digital input voltage range	3		30	**Vdc**
Vdibrk	Digital input breakdown voltage	-35		+35	**Vdc**
Idi	Digital input supply current	4	6	8	**mA**
Vdo	Digital output voltage range	1		30	**Vdc**
Vdobrk	Digital output breakdown voltage	-0.5		37	**Vdc**
Vdoz	Output zener diode voltage	37	39	42	**Vdc**
Ido	Digital output current range			50	**mA**
Idobrk	Digital output breakdown current	120			**mA**
Pwdo	Digital output dissipable power			300	**mW**
Fch	Chopper frequency		20		**KHz**
Prt	Protections and alarms	Over/Under voltage, Short circuit Overheating, Break phase			
	Mechanical Specifications				
FDh	Height		100.4		**mm**
FDl	Depth		119.0		**mm**
FDw	Width		17.5		**mm**
FDnw	Weight		180		**gr**
	Rated range of use				
FCa	Altitude			2000	**m**
Idr	*If* current degrading every 1000m beyond the *FCa* altitude value		5		**%**
FCt	Temperature	0		50	**°C**
FCh	Humidity (no condensing)	5		90	**%**
	Conditions of storage and transport				
SCa	Altitude			4000	**m**
SCt	Temperature	-20		70	**°C**
SCh	Humidity (no condensing)	5		95	**%**

DS1076					
Symbol	**Description**	**Value**			**Unit**
		Min	**Typ**	**Max**	
Vp	Power supply voltage	24		90	**Vdc**
If	Phase current (**effective current**)	2		6	**Arms**
Vir	Automatic current reduction	0		100	**%**
Tir	Current reduction intervention time	0.05		10	**s**
Vprp	Allowed ripple (100Hz)			15	**Vpp**
Vpbrk	Permanent breakdown voltage	-0.5		105	**Vdc**
Vph	Over voltage protection intervention	95		98	**Vdc**
Vpl	Under voltage protection intervention	22.5		23.5	**Vdc**
Tchh	Thermal protection intervention threshold	84	86	94	**°C**
Tchl	Thermal protection restoration threshold	64	66	69	**°C**
Plss	Power lost on the driver			20	**W**
Res	Step resolution available	200, 400, 800, 1000, 1600, 2000, 3200, 4000, 5000, 6400, 10000, 12800, 25000, 25600			**Step / Rev.**
Ml	Motor inductance seen by the driver	0,6		40	**mH**
Vdi	Digital input voltage range	3		30	**Vdc**
Vdibrk	Digital input breakdown voltage	-35		+35	**Vdc**
Idi	Digital input supply current	4	6	8	**mA**
Vdo	Digital output voltage range	1		30	**Vdc**
Vdobrk	Digital output breakdown voltage	-0.5		37	**Vdc**
Vdoz	Output zener diode voltage	37	39	42	**Vdc**
Ido	Digital output current range			50	**mA**
Idobrk	Digital output breakdown current	120			**mA**
Pwdo	Digital output dissipable power			300	**mW**
Fch	Chopper frequency		20		**KHz**
Prt	Protections and alarms	Over/Under voltage, Short circuit Overheating, Break phase			
Mechanical Specifications					
FDh	Height	100.4			**mm**
FDl	Depth	119.0			**mm**
FDw	Width	35			**mm**
FDnw	Weight	270			**gr**
Rated range of use					
FCa	Altitude			2000	**m**
Idr	*If* current degrading every 1000m beyond the *FCa* altitude value		5		**%**
FCt	Temperature	0		50	**°C**
FCh	Humidity (no condensing)	5		90	**%**
Conditions of storage and transport					
SCa	Altitude			4000	**m**
SCt	Temperature	-20		70	**°C**
SCh	Humidity (no condensing)	5		95	**%**

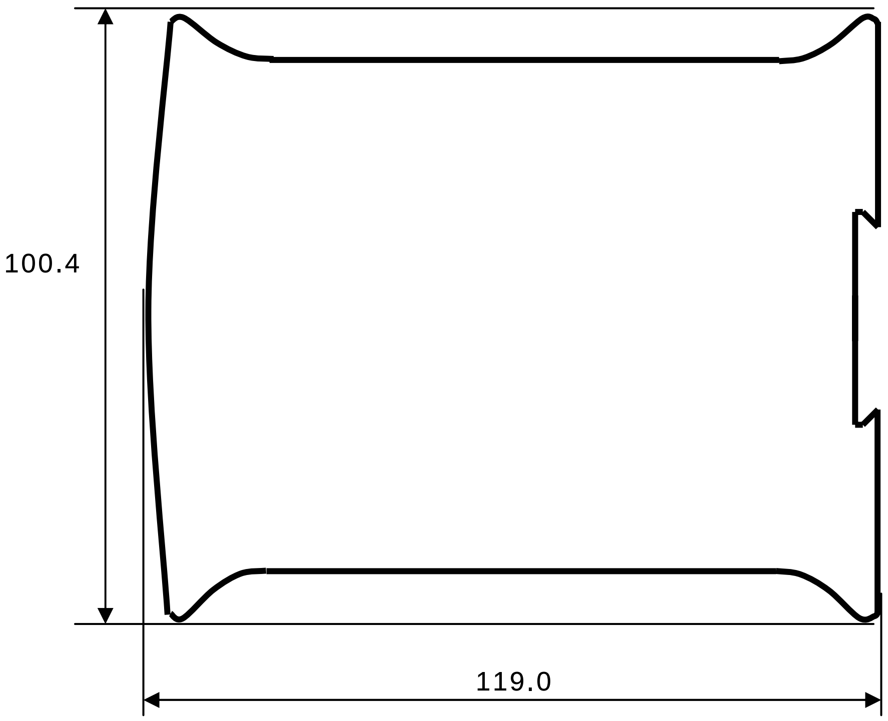
DS1078

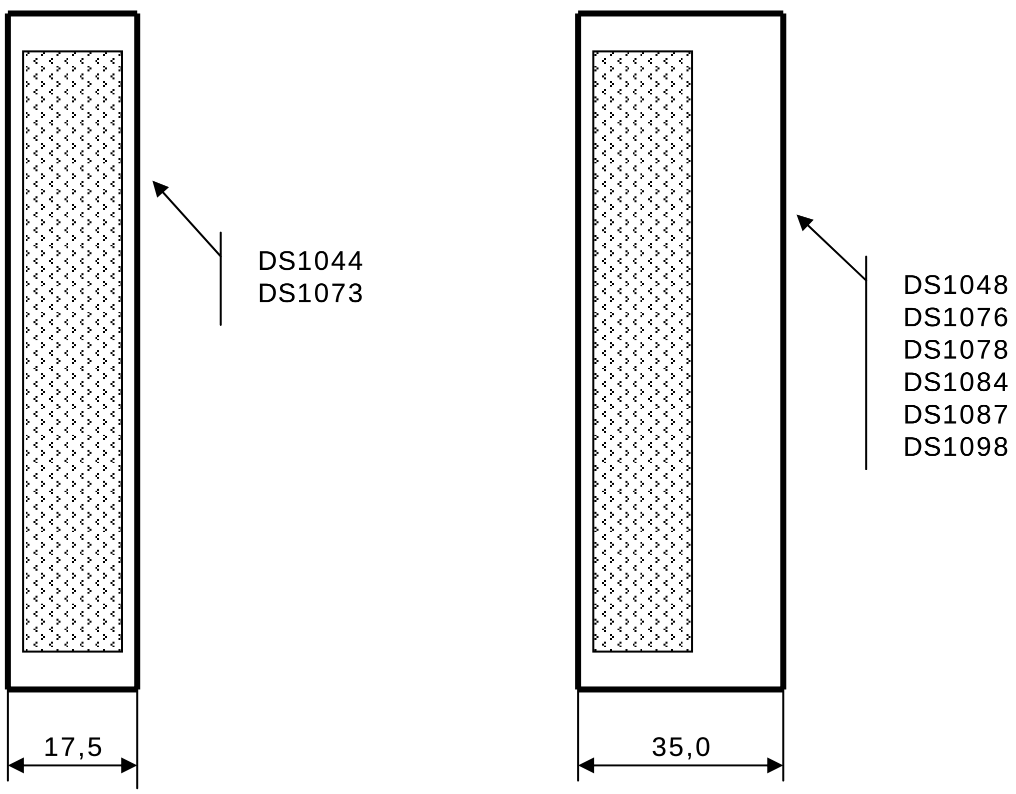
Symbol	Description	Value			Unit
		Min	Typ	Max	
Vp	Power supply voltage	24		90	**Vdc**
If	Phase current (**effective current**)	4		10	**Arms**
Vir	Automatic current reduction	0		100	**%**
Tir	Current reduction intervention time	0.05		10	**s**
Vprp	Allowed ripple (100Hz)			15	**Vpp**
Vpbrk	Permanent breakdown voltage	-0.5		105	**Vdc**
Vph	Over voltage protection intervention	95		98	**Vdc**
Vpl	Under voltage protection intervention	22.5		23.5	**Vdc**
Tchh	Thermal protection intervention threshold	84	86	94	**°C**
Tchl	Thermal protection restoration threshold	64	66	69	**°C**
Plss	Power lost on the driver			30	**W**
Res	Step resolution available	200, 400, 800, 1000, 1600, 2000, 3200, 4000, 5000, 6400, 10000, 12800, 25000, 25600			**Step / Rev.**
Ml	Motor inductance seen by the driver	0,5		30	**mH**
Vdi	Digital input voltage range	3		30	**Vdc**
Vdibrk	Digital input breakdown voltage	-35		+35	**Vdc**
Idi	Digital input supply current	4	6	8	**mA**
Vdo	Digital output voltage range	1		30	**Vdc**
Vdobrk	Digital output breakdown voltage	-0.5		37	**Vdc**
Vdoz	Output zener diode voltage	37	39	42	**Vdc**
Ido	Digital output current range			50	**mA**
Idobrk	Digital output breakdown current	120			**mA**
Pwdo	Digital output dissipable power			300	**mW**
Fch	Chopper frequency		20		**KHz**
Prt	Protections and alarms	Over/Under voltage, Short circuit Overheating, Break phase			
	Mechanical Specifications				
FDh	Height		100.4		**mm**
FDl	Depth		119.0		**mm**
FDw	Width		35		**mm**
FDnw	Weight		270		**gr**
	Rated range of use				
FCa	Altitude			2000	**m**
Idr	*If* current degrading every 1000m beyond the *FCa* altitude value		5		**%**
FCt	Temperature	0		50	**°C**
FCh	Humidity (no condensing)	5		90	**%**
	Conditions of storage and transport				
SCa	Altitude			4000	**m**
SCt	Temperature	-20		70	**°C**
SCh	Humidity (no condensing)	5		95	**%**

DS1084					
Symbol	**Description**	**Value**			**Unit**
		Min	**Typ**	**Max**	
Vp	Power supply voltage	45		160	**Vdc**
If	Phase current (**effective current**)	2		4	**Arms**
Vir	Automatic current reduction	0		100	**%**
Tir	Current reduction intervention time	0.05		10	**s**
Vprp	Allowed ripple (100Hz)			25	**Vpp**
Vpbrk	Permanent breakdown voltage	-0.5		210	**Vdc**
Vph	Over voltage protection intervention	177		181	**Vdc**
Vpl	Under voltage protection intervention	26		27	**Vdc**
Tchh	Thermal protection intervention threshold	84	86	94	**°C**
Tchl	Thermal protection restoration threshold	64	66	69	**°C**
Plss	Power lost on the driver			30	**W**
Res	Step resolution available	200, 400, 800, 1000, 1600, 2000, 3200, 4000, 5000, 6400, 10000, 12800, 25000, 25600			**Step / Rev.**
Ml	Motor inductance seen by the driver	1		50	**mH**
Vdi	Digital input voltage range	3		30	**Vdc**
Vdibrk	Digital input breakdown voltage	-35		+35	**Vdc**
Idi	Digital input supply current	4	6	8	**mA**
Vdo	Digital output voltage range	1		30	**Vdc**
Vdobrk	Digital output breakdown voltage	-0.5		37	**Vdc**
Vdoz	Output zener diode voltage	37	39	42	**Vdc**
Ido	Digital output current range			50	**mA**
Idobrk	Digital output breakdown current	120			**mA**
Pwdo	Digital output dissipable power			300	**mW**
Fch	Chopper frequency		20		**KHz**
Prt	Protections and alarms	Over/Under voltage, Short circuit Overheating, Break phase			
Mechanical Specifications					
FDh	Height	100.4			**mm**
FDl	Depth	119.0			**mm**
FDw	Width	35			**mm**
FDnw	Weight	270			**gr**
Rated range of use					
FCa	Altitude			2000	**m**
Idr	*If* current degrading every 1000m beyond the *FCa* altitude value		5		**%**
FCt	Temperature	0		50	**°C**
FCh	Humidity (no condensing)	5		90	**%**
Conditions of storage and transport					
SCa	Altitude			4000	**m**
SCt	Temperature	-20		70	**°C**
SCh	Humidity (no condensing)	5		95	**%**

DS1087					
Symbol	**Description**	**Value**			**Unit**
		Min	**Typ**	**Max**	
Vp	Power supply voltage	45		160	**Vdc**
If	Phase current (**effective current**)	4		8.5	**Arms**
Vir	Automatic current reduction	0		100	**%**
Tir	Current reduction intervention time	0.05		10	**s**
Vprp	Allowed ripple (100Hz)			25	**Vpp**
Vpbrk	Permanent breakdown voltage	-0.5		210	**Vdc**
Vph	Over voltage protection intervention	177		181	**Vdc**
Vpl	Under voltage protection intervention	26		27	**Vdc**
Tchh	Thermal protection intervention threshold	84	86	94	**°C**
Tchl	Thermal protection restoration threshold	64	66	69	**°C**
Plss	Power lost on the driver			30	**W**
Res	Step resolution available	200, 400, 800, 1000, 1600, 2000, 3200, 4000, 5000, 6400, 10000, 12800, 25000, 25600			**Step / Rev.**
Ml	Motor inductance seen by the driver	0.6		35	**mH**
Vdi	Digital input voltage range	3		30	**Vdc**
Vdibrk	Digital input breakdown voltage	-35		+35	**Vdc**
Idi	Digital input supply current	4	6	8	**mA**
Vdo	Digital output voltage range	1		30	**Vdc**
Vdobrk	Digital output breakdown voltage	-0.5		37	**Vdc**
Vdoz	Output zener diode voltage	37	39	42	**Vdc**
Ido	Digital output current range			50	**mA**
Idobrk	Digital output breakdown current	120			**mA**
Pwdo	Digital output dissipable power			300	**mW**
Fch	Chopper frequency		20		**KHz**
Prt	Protections and alarms	Over/Under voltage, Short circuit Overheating, Break phase			
Mechanical Specifications					
FDh	Height	100.4			**mm**
FDl	Depth	119.0			**mm**
FDw	Width	35			**mm**
FDnw	Weight	270			**gr**
Rated range of use					
FCa	Altitude			2000	**m**
Idr	*If* current degrading every 1000m beyond the *FCa* altitude value		5		**%**
FCt	Temperature	0		50	**°C**
FCh	Humidity (no condensing)	5		90	**%**
Conditions of storage and transport					
SCa	Altitude			4000	**m**
SCt	Temperature	-20		70	**°C**
SCh	Humidity (no condensing)	5		95	**%**

DS1098					
Symbol	***Description***	***Value***			***Unit***
		Min	***Typ***	***Max***	
Vp	Power supply voltage	45		240	**Vdc**
If	Phase current (**effective current**)	4		10	**Arms**
Vir	Automatic current reduction	0		100	**%**
Tir	Current reduction intervention time	0.05		10	**s**
Vprp	Allowed ripple (100Hz)			30	**Vpp**
Vpbrk	Permanent breakdown voltage	-0.5		265	**Vdc**
Vph	Over voltage protection intervention	242		255	**Vdc**
Vpl	Under voltage protection intervention	35		37	**Vdc**
Tchh	Thermal protection intervention threshold	84	86	94	**°C**
Tchl	Thermal protection restoration threshold	64	66	69	**°C**
Plss	Power lost on the driver			40	**W**
Res	Step resolution available	200, 400, 800, 1000, 1600, 2000, 3200, 4000, 5000, 6400, 10000, 12800, 25000, 25600			**Step / Rev.**
Ml	Motor inductance seen by the driver	0.6		30	**mH**
Vdi	Digital input voltage range	3		30	**Vdc**
Vdibrk	Digital input breakdown voltage	-35		+35	**Vdc**
Idi	Digital input supply current	4	6	8	**mA**
Vdo	Digital output voltage range	1		30	**Vdc**
Vdobrk	Digital output breakdown voltage	-0.5		37	**Vdc**
Vdoz	Output zener diode voltage	37	39	42	**Vdc**
Ido	Digital output current range			50	**mA**
Idobrk	Digital output breakdown current	120			**mA**
Pwdo	Digital output dissipable power			300	**mW**
Fch	Chopper frequency		20		**KHz**
Prt	Protections and alarms	Over/Under voltage, Short circuit Overheating, Break phase			
Mechanical Specifications					
FDh	Height	100.4			**mm**
FDl	Depth	119.0			**mm**
FDw	Width	35			**mm**
FDnw	Weight	270			**gr**
Rated range of use					
FCa	Altitude			2000	**m**
Idr	*If* current degrading every 1000m beyond the *FCa* altitude value		5		**%**
FCt	Temperature	0		50	**°C**
FCh	Humidity (no condensing)	5		90	**%**
Conditions of storage and transport					
SCa	Altitude			4000	**m**
SCt	Temperature	-20		70	**°C**
SCh	Humidity (no condensing)	5		95	**%**





Dimensions expressed in millimeters. Not full-scale drawings.

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