

# ***BRUSHLESS DRIVES SDR SERIES***

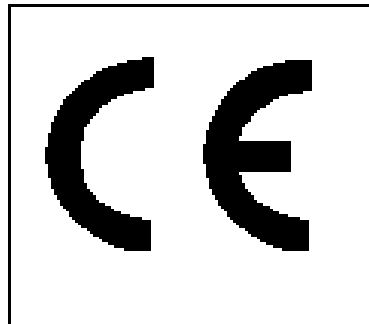
***User manual***

## SUMMARY

<b>1.</b>	<b>GENERAL SAFETY INFORMATION.....</b>	<b>2</b>
1.1	WARNINGS.....	3
<b>2.</b>	<b>SDR DRIVES DESCRIPTION .....</b>	<b>4</b>
2.1.	PRODUCT DESCRIPTION.....	4
2.2.	TECHNICAL CHARACTERISTICS OF THE PRODUCT.....	5
2.3.	CONNECTIONS AND INSTALLATION.....	6
2.4.	SERIAL LINE CONNECTION ( CONNECTOR V3).....	8
2.5.	RESOLVER CONNECTION (CONNECTOR V2).....	8
2.6.	V1 CONNECTOR: SIMULATED ENCODER OR FREQUENCY INPUT .....	9
2.7.	START UP .....	9
2.8.	WORKING MODE:.....	10
2.9.	MAIN PARAMETERS SETTING AND MOTOR ADJUSTMENT:.....	10
2.10.	PARAMETERS SETTING: ADJUSTMENT WITH THE MOTOR.....	12
<b>3.</b>	<b>INSTALLATION.....</b>	<b>13</b>
3.1.	INSTRUCTIONS.....	13
	ENCLOSED ENVIRONMENT , DISSIPATED POWER .....	13
3.2.	VENTILATION .....	14
<b>4.</b>	<b>POWER : CONNECTIONS AND SIZING.....</b>	<b>15</b>
4.1.	MAIN CONNECTION.....	15
4.2.	CONNECTION WITH MOTOR.....	15
4.3.	DRIVE EARTH CONNECTION.....	16
4.4.	TRASFORMER AND PROTECTIVE FUSES SIZING.....	16
4.5.	SOFT-START CIRCUIT.....	16
<b>5.</b>	<b>CONFIGURATIONS .....</b>	<b>17</b>
5.1.	CONFIGURATION OF LOGIC INPUTS AND OUTPUTS .....	17
5.2.	LOGIC OUTPUTS CONFIGURATION.....	18
5.3.	ANALOG OUTPUT CONFIGURATION.....	19
<b>6.</b>	<b>TABLES OF PARAMETERS AND DISPLAYS .....</b>	<b>20</b>
6.1.	TYPES OF PARAMETERS .....	20
6.2.	DESCRIPTION OF THE PARAMETERS IN THE TABLES .....	20
6.3.	PARAMETERS.....	21
6.4.	CONNECTIONS .....	22
6.5.	DISPLAYS .....	22
<b>7.</b>	<b>DESCRIPTION OF THE REGULATION .....</b>	<b>25</b>
7.1.	HOW TO READ THE BLOCK-DIAGRAMS .....	25
7.2.	BLOCK DIAGRAM OF THE REGULATION .....	25
7.3.	SPEED REFERENCE BLOCK .....	25
7.4.	RAMP AND SPEED LIMITS BLOCK .....	26
7.5.	SPEED REGULATOR AND CURRENT LIMITS .....	26
7.6.	CURRENT LIMITS .....	28
7.7.	THERMAL MOTOR PROTECTION.....	28
7.8.	REFERENCES AND SPEED LIMITS SETTING.....	30
7.9.	SETTING MINIMUM - MAXIMUM SPEED AND SPEED RANGE SIGNAL LEVEL.....	30
7.9.1.	PEAK CURRENT LIMITS AND CURRENT RANGE SETTING.....	31
7.10.	SAVING AND RESETTING PARAMETERS .....	31
7.11.	ALARMS AND EXCLUSIONS.....	32
<b>8.</b>	<b>FREQUENCY INPUT.....</b>	<b>33</b>
<b>9.</b>	<b>ANTI-INTERFERENCE MEASURES.....</b>	<b>35</b>

## 1. GENERAL SAFETY INFORMATION

All the drives manufactured by TDE MACNO S.p.A. of Vicenza which belong to the **SDR** series comply with the Low Voltage Directive **CEE 73/23**, as amended by the Directive **CEE 93/68** and the corresponding law of the country of destination.



In their manufacture parts and articles have been applied which comply with the harmonising legislation **EN 60204-1**.

## 1.1 WARNINGS

- Carefully read the manual before installing and using the equipment.
- The manufacturer declines any liability for any improper use of the equipment different from that set out in the manual.
- No alteration or operation not prescribed by the manual is permitted except with the express authorisation of the manufacturer, and must be carried out by qualified personnel. Failure to observe this rule will mean that the manufacturer shall decline any liability for any possible consequences and the guarantee will cease to have effect.
- The setting up and installation may only be carried out by qualified personnel who are responsible for observance of the safety rules imposed by the laws in force.
- If the drive is installed without the proper E.M.C. filter and plugged in low voltage public mains supply, it can cause radio frequency noises or interferences.
- In the specific case for which the equipment is being used it is necessary to take into account the safety regulations for the prevention of accidents. The installation, cabling and opening of the equipment and the drive must all be done with the voltage supply cut off.
- Equipment and drives must be installed in a contact proof case with IP grade protection which complies with the norms.
- Position the equipment in such a way that access for maintenance operations is easy and that there is no danger of interference with moving parts.
- Ensure sufficient ventilation for drive losses.
- Do not use extinguishers containing water when there is fire in proximity to the equipment.
- Avoid at all times the penetration of water and other fluids into the equipment.
- Any work carried out within the equipment must be done with the voltage supply cut off. Wait at least 8 minutes before opening the equipment to allow capacitors to discharge.

## 2. SDR DRIVES DESCRIPTION

### 2.1. PRODUCT DESCRIPTION

The SDR drives series for sinusoidal brushless motors belongs to the TDE MACNO *full digital* family with feedback from resolver. A compact in size and cost effective drive that through the wide possibilities of parameters setting enables high performances for a variety of different applications as well. The SDR has the following characteristics:

- Power supply: 220/240Vca single-phase or three-phase 45/65Hz.
- digital In/Out:
  - 3 inputs to configure (opto-insulated)
  - 1 input (run)
  - 3 digital outputs to configure (opto-insulated)
  - 3 signal led
  - +24V and 0PE for I/O
- +/-10V regulated
- analog In/Out
  - 1 analog output (to configure)
  - 2 analog input (speed , current)
- Sizes 2/4A, 4/8A
  - IGBT power switches
  - Pre-setting for clamping circuit through IGBT
  - RS232 serial line
- Feedback from motor resolver
  - Frequency speed reference input (in encoder pulses)
  - Simulated encoder pulses output

Total:

n. 3 SUB 9 poles connector with the following functions:

- 1- simulated encoder output or frequency speed reference input (**V1**)
- 2- resolver connector (**V2**)
- 3- RS-232 serial line(**V3**)

#### *Operating manual:*

This manual consists of two parts: the first one gives the main information for a first product installation. This first part is divided in the following paragraphs:

- 1- Product description
- 2- Technical characteristics: main technical characteristics of SDR.
- 3- Connections and installation: description of the regulation and power connectors and the SUB connectors of the drive.
- 4- Start up: just an example of a setting up of the drive (from the default configuration for logic inputs and outputs).
- 5- Operating mode: different operating modes and brief description of the main parameters for adjusting the drive to the motor.

The second part gives some more specific information in order to adjust the drive to the particular needs of the customer.

## 2.2. TECHNICAL CHARACTERISTICS OF THE PRODUCT

### SDR-200 SDR-400

TYPE		SDR-200	SDR-400
Output rated current rms	A	2	4
Max. current 100ms for f=0 2,5s for f>2,5Hz	A	4	8
Voltage output	V	Vi*0,9	
Frequency output	Hz	0÷400 Hz	
Operating mode		4 quadrants (optional clamping chopper)	

Power supply		
Effective three-phase power supply	V	220Vac (+10%;-15%)
Modulation frequency	Hz	50 ÷ 60 ± 5%
Note1: single-phase power supply possible Note2: power supply from DC-BUS possible		

Control		
Modulation		Vectorial PWM
Freq. Modulation	KHz	5
Feedback		Resolver (5kHz) 12 bit resolution
External reference		speed, torque
Speed reference		Analog +/-10V 2 programmable internal references (P1, P2) 2 channels frequency input (A,/A, B,/B)
Torque reference		Analog +/-10V

Environment conditions		
Working temperature	°C	0 ÷ +40
Storage temperature	°C	-10 ÷ +60
Humidity	%	Lower than 90% (no condensation)

<b>TECHNICAL CHARACTERISTICS</b>	<ul style="list-style-type: none"> <li>➤ Full digital regulation (speed and current digital loops)</li> <li>➤ Feedback from resolver (for position and speed)</li> <li>➤ Speed reference: analog +/-10V (10bit resolution AD) 2 programmable internal references (P1, P2) 2 channels frequency input (A,/A, B,/B)</li> <li>➤ Torque reference: analog +/-10V (10bit resolution AD)</li> <li>➤ Simulated encoder output: 2 channels A, /A, B, /B and zero top signal (+5V level)</li> <li>➤ Setup of the gain PI of the speed and position units possible</li> <li>➤ Transient overload (up to 2,5 sec.) with automatic return to the rated current</li> </ul>
	<b>SIGNALS</b>
	n. 4 programmable opto-insulated inputs
	n. 3 programmable opto-insulated outputs
	n. 3 display led
	n. 1 programmable analog output (update time = 1ms)
	Voltage reference output +/-10V max. current 10mA

## 2.3. CONNECTIONS AND INSTALLATION

### M2: POWER

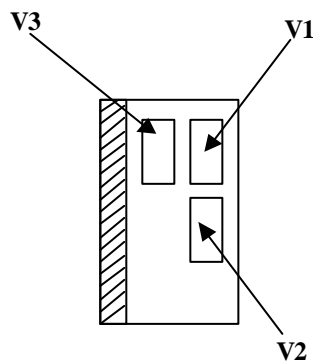
M1 TERMINAL	FUNCTIONS	DESCRIPTIONS
M2-1	0P	0P internal power supply
M2-2	+24V	+24V internal power supply (MAX. 150mA)
M2-3	U	motor phase 'U'
M2-4	V	motor phase 'V'
M2-5	W	motor phase 'W'
M2-6	GROUND	GROUND
M2-7	R	phase 'R' mains voltage
M2-8	S	phase 'S' mains voltage
M2-9	T	phase 'T' mains voltage
M2-10	GROUND	GROUND
M2-11	F	F
M2-12	+	+ VBUS
M2-13	-	- VBUS



To invert the power supply connections on "U,V,W" and the motor cables on "R,S,T" can seriously damage the drive .

### V3: SERIAL LINE (MALE)

V3 TERMINAL	FUNCTIONS	
V3-1	GROUND	
V3-2	RXD	
V3-3	TXD	
V3-4	N.C.	
V3-5	GND	
V3-6	N.C.	
V3-7	N.C.	
V3-8	N.C.	
V3-9	N.C.	



**M1: Input/Output REGULATION**

M1 TERMINAL	FUNCTIONS	DESCRIPTION
M1-1	-10VOUT	Regulated Output: max. -10V/5mA max.
M1-2	AVSS	AVSS (referred to +10VOUT, -10VOUT)
M1-3	+10VOUT	Regulated Output: max.+10V/5mA max.
M1-4	UPWM	Programmable analog output $\pm 5V / < 2mA$
M1-5	AVSS	AVSS
M1-6	VREG	Speed reference analog input $\pm 10 / 0,25mA$
M1-7	ITORQ	Torque reference analog input $\pm 10 / 0,25mA$
M1-8	TERRA	GROUND
M1-9	TERRA	GROUND
M1-10	L.O.3	Logic outputs to configure:
M1-11	L.O.2	Transistor npn with free collector (+24V) and emitter. L.O1, L.O2, L.O3
M1-12	L.O.1	Opto-insulation from regulation. +24VE 0VE
M1-13	+24V (EXTERN.)	I/O power supply
M1-14	0PE (EXTERN.)	I/O power supply
M1-15	L.I.4	Logic inputs to configure (referred to 0PE)
M1-16	L.I.3	ON= +24Vcc (>18V) 10mA max.
M1-17	L.I.2	OFF= 0Vcc (<6Vcc)
M1-18	L.I.1	Each input is insulated from the regulation

**V1: ENCODER OUTPUT / FREQUENCY INPUT\***

	FUNCTIONS	DESCRIPTION
V1-1	P/B	channel /B for Enc.Out or Freq. Inp. (GND,+5V)
V1-2	PB	channel B for Enc.Out or Freq. Inp. (GND,+5V)
V1-3	P/A	channel /A for Enc.Out or Freq. Inp. (GND,+5V)
V1-4	PA	channel A for Enc.Out or Freq. Inp. (GND,+5V)
V1-5	**	! Do not connect
V1-6	P/C	channel /zero top for Enc.Out. (GND,+5V)
V1-7	PC	channel/ zero top for Enc.Out. (GND,+5V)
V1-8	TERRA	GROUND
V1-9	0VS	0VS

\* The SUB 9 poles connector can be the input for the frequency channels A,/A, B,/B or the simulated encoder output.

\*Default configuration: frequency input ( c52 = 0 )

**V2: RESOLVER AND MOTOR THERMAL SWITCH SIGNALS**

V2 TERMINAL	FUNCTIONS
V2-1	SP6
V2-2	0SP6
V2-3	REF+
V2-4	REF-
V2-5	0COS
V2-6	COS
V2-7	SIN
V2-8	0SIN
V2-9	GROUND



## 2.4. SERIAL LINE CONNECTION (CONNECTOR V3)

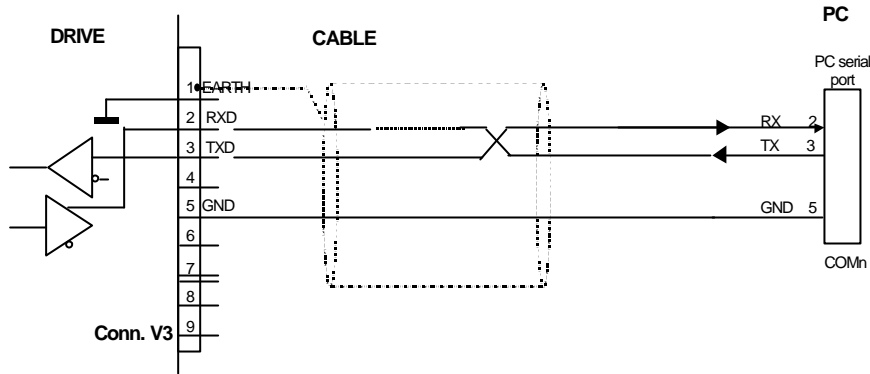


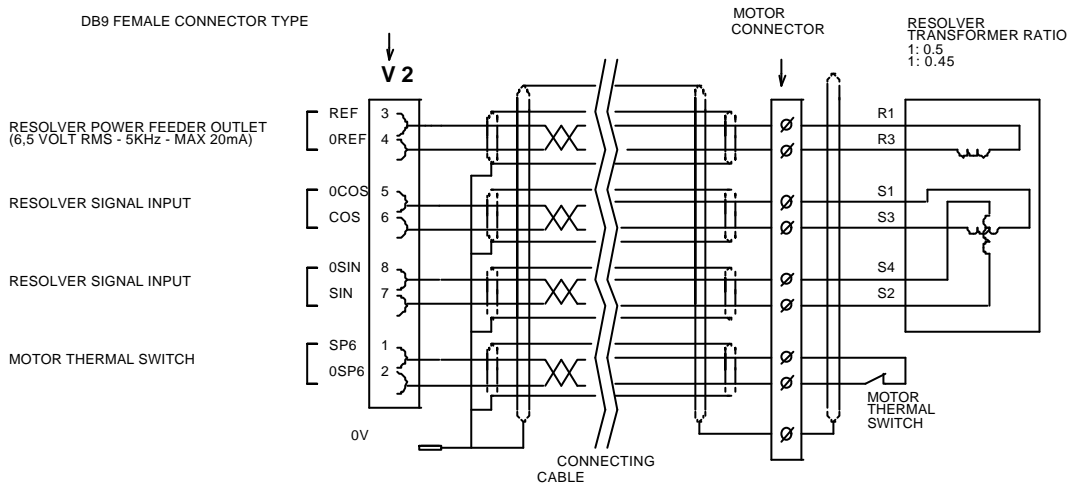
Fig. 1

The serial line communicates in full duplex through two wires: RXD, TXD for reception and transmission.

**Note: twisted communication wires must be used.**  
TDE MACNO supplies on request a supervision software.

## 2.5. RESOLVER CONNECTION (CONNECTOR V2)

THE V2 CONNECTOR TO BE CONNECTED TO RESOLVER AS IN THE FOLLOWING FIG.



RESOLVER	ARTUS	ES. 26S19RX452b.F	RAP.TRAS. 0.5
USED	TAMAGAWA	ES. TS2640N71E10	RAP.TRAS. 0.5
4x(2x0.25SK) COD. 2MB 24P 04R			

RESOLVER MUST BE EITHER THE TYPE INDICATED IN THE TABLE OR WITH SAME FEATURES.  
THE CONNECTING CABLE MUST BE 4-BIGHTS PLAIED AND SHIELDED PLUS EXTERNAL : PLUS EXTERNAL SHIELD.  
THE SHIELDS ON THE CONNECTOR SIDE V2 MUST BE CONNECTED TO TERMINAL 6 OF THE CONNECTOR M2

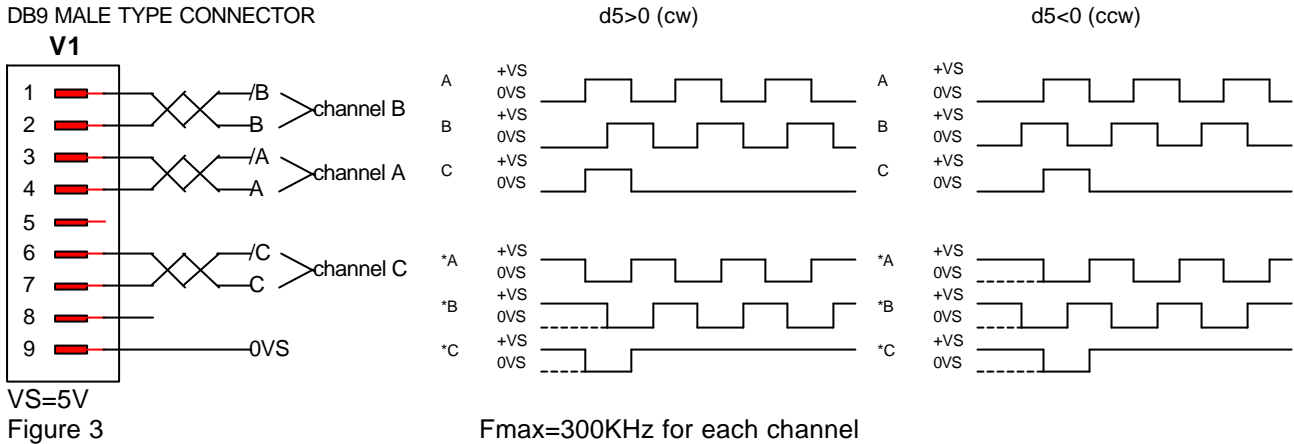
Fig. 2

## 2.6. V1 CONNECTOR: SIMULATED ENCODER or FREQUENCY INPUT

The **V1** connector has two functions according to the set up of the connection **c52**. **c52=0** (*default*) enables the Frequency Input function.

The frequency of the signals depends on the motor revolution, the number of resolver poles and their behaviour in time depends on the tachometer signal and a pulses/revolution number (resolver) equal to 1024.

With the connection **c52=1**, the V1 connector enables the frequency as shown in the figures below:



The *encoder simulated* outputs are all controlled by a “LINE DRIVER” which level is +5V and it is connected to the internal power supply (TTL +5V).

For immunity it is advisable to use a differential input in order to avoid loops with zero reference. To limit noise effects it is better to load this input (10mA max).

**Twisted pair cable is necessary to make a proper connection.**



**Warning! The external power supply zero is connected to the drive zero (it is not opto-insulated).**



**Warning! For the encoder simulation with internal supply DO NOT connect the terminal 5 (VS) because it could seriously damage the drive.**

## 2.7. START UP

According to the *default* configuration, the logic inputs and outputs are as follows:

default configuration		
L.I. 1:	alarm reset	
L.I. 2:	run	
L.I. 3:	REF1EN	
L.I. 4:	REF2EN	
L.O. 1:	drive ready	
L.O. 2:	run ok	
L.O. 3:	CW/CCW rotation	

External speed references are as follows:

REF1EN	REF2EN	Reference type
0	0	External potentiometer
0	1	JOG 1
1	0	Frequency reference
1	1	JOG 2

**LED:**

N. LED	Meaning
1-Green	Run
2-Yellow	Drive Ready
3-Red	Alarm

## 2.8. WORKING MODE:

- *External speed reference, speed - position*

The drive can be controlled through a speed reference, as follows:

- 1) analog reference: from external analog reference in the range of  $\pm 10V$ . In this case, a reference of 10V is the max speed of the motor (set by the parameter P52).
- 2) reference from internal JOG (JOG1 and JOG2) set through parameters P(1) e P(2).
- 3) frequency reference four channels A,/A, B,/B and bi-directional.

As to point 3) there is the possibility to enable a space loop with proportional gain set through the internal parameter P (10).

With  $P(10)=0$ , (null gain of the space loop) the motor rotation speed is proportional to the input frequency.

With  $P(10)>0$ , (no null gain of the space loop) each pulse corresponds to a specific fraction of motor revolution and there is the possibility to restore the position set from the master. (positioner storage is 32.750 pulses).

- *External torque reference*

It is possible to control the drive with external torque reference from analog reference: from external analog reference in the range of  $\pm 10V$ . In this case, a reference of 10V is the max current supplied from the drive (default).

## 2.9. MAIN PARAMETERS SETTING AND MOTOR ADJUSTMENT:

To control the SDR drive it is necessary first to set the main parameters: the motor JOG speed, a possible offset for analog reference, motor characteristics, current and speed loop gains. You can have the complete parameter setting for particular functions or updating in another paragraph of this manual.

PAR.	DESCRIPTION	RANGE	DEFAULT	rappr	Note
P 1	JOG 1 speed	±100.0%	0%	A	
P 2	JOG 2 speed	±100.0%	0%	A	
P 4	Analog speed reference offset 1/100000 parts on speed reference	±19999	0	0	
P 5	Max CW speed limit	0÷105%	100.0%	A	
P 6	Max CCW speed limit	0÷105%	100.0%	A	
P 10	Gain for positioning (kv)	1÷100	4	0	
P 11	CW acceleration time	50÷19999 ms	400 ms	0	
P 12	CW deceleration time	50÷19999 ms	400 ms	0	
P 13	CCW acceleration time	50÷19999 ms	400 ms	0	
P 14	CCW deceleration time	50÷19999 ms	400 ms	0	
P 23	Speed loop proportional gain  speed + REF ≥P20	0.5÷100.0	4	1	
P 24	Speed loop lead constant time when (integral time x gain) for  speed + REF ≥P20	4.0÷150.0 ms	40 ms	1	
P 25	Speed loop filter constant time	0.2÷20 ms	0.4 ms	1	
P 31	Torque signal offset (I <sub>torq</sub> )	±100.0%	0%	B	
P 32	Torque signal finite multiplier	±400.0%	100.0%	B	
P 35	Max CW current limit	0÷100.0%	100.0%	B	
P 36	Max CCW current limit	0÷100.0%	100.0%	B	
P 42	Maximum allowed speed level	0÷120.0%	110.0%	B	
P 50	Reserved parameter access key	0÷9999	(P99)	0	N
P 51	Drive identification number for the serial line	1÷255	255	0	R
P 52	Setting maximum motor speed (n/1')	375÷19000	2500	0	R
P 53	Number of motor poles	2÷12	6	0	R
P 54	Number of resolver poles	2÷12	2	0	R
P 55	Resolver phase ( degrees )	±180.0	0	1	R
P 56	Motor rated current in % of drive rated current	10%÷100%	90%	B	R
P 57	Motor thermal time constant TH	1.0÷600.0 sec.	30.0 sec.	1	R
P 58	Motor inductance in mH x rated motor current / motor voltage	5.0%÷70.0%	20.0%	B	R
P 59	T <sub>i</sub> =L <sub>ff</sub> /R <sub>ff</sub> ms	1-100	20	0	R
P 62	V <sub>nmot</sub> /V <sub>naz</sub>	0.0%÷100.0%	60.0%	B	R
P 63	Finite multiplier K <sub>q1</sub> e K <sub>d1</sub> %	0.0%÷400.0%	73.3%	B	R
P 79	Serial line Baud rate	0÷2	0 = 9600	0	R

Notes:

- 1-The **P1, P2, P4, P5, P6** parameters set the speed (JOG) and the offset for the analog reference and the speed limit in both directions of rotation.
- 2-**P10** sets the proportional gain in case of frequency reference function with space loop active.
- 3-**P11, P12, P13, P14** set the acceleration and deceleration time in both directions.
- 4-**P23, P24, P25** set the speed loop proportional gain, the lead constant time (PI regulator) and the speed loop filter constant time (see operating mode scheme).
- 5-**P31** and **P32, P35** and **P36** set the torque signal offset and the max current limit for the drive.
- 6-**P50** set the reserved parameter access key (in the table marked with the letter 'r'): to modify these parameters with the letter r set P(50)=95.
- P51** sets the drive identification number for the serial line, P(59) sets the baud rate.
- 7-**P52..P59** and **P62, P63** set the motor and drive parameters. In particular P58, P59, P62 and P63 set the current loop gains.

## 2.10. PARAMETERS SETTING: ADJUSTMENT WITH THE MOTOR

Set or check:

- P52** setting maximum motor speed in rpm/1' (revolutions according to the motor rating-plate)
- P54** number of resolver poles (see resolver catalogue)
- P53** number of motor poles (see motor catalogue)
- P55** resolver phase displacement (depends on the motor: see the values table at the end of this chapter).
- P56** motor rated current / drive rated current.
- P57** thermal constant time; if not available, take the default value (30 sec.)
- P58** motor inductance x rated motor current / motor voltage; see values in the motor catalogue.  
P58 value is in %, if not available, take the value of the default parameter.
- P59** time constant from the ratio of winding inductance and resistance  $\frac{L_{motore}}{R_{ff}}$ ; see the value in the motor catalogue; if not available, take the default value (20msec.)
- P62** motor voltage / drive voltage(220V% value. e.g.. 132V/220V = 62%)
- c34** set the thermal alarm function, leave on 0 if the operation is to continue although with lower limit, set 1 if it is to stop immediately if an alarm is given.

**NOTES:** Usually the drive is already adjusted for its particular motor. so it is necessary to follow what above mentioned just in case of modifications.

### 3. INSTALLATION

#### 3.1. INSTRUCTIONS

The drive must be installed in a **vertical** position. If It is installed slantly or horizontally, heat convection would be not regular and it could lead to a drive damaging. All of the control elements must remain well accessible.

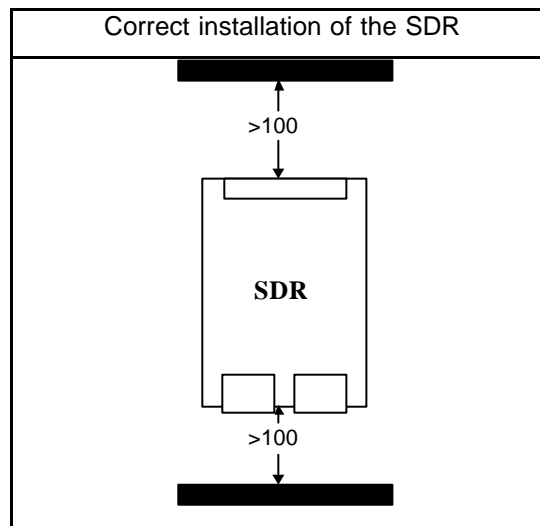


**The life and proper working of the drive depend on the maintenance of the environment temperature between the allowed values of 0°C to +40 °C. The temperature must be checked regularly.**

**Relative air humidity must be below 90% with no condensation formation.**

The drive must be installed in a dust-free and well-ventilated place. Avoid environments, where there are aggressive gases insofar as the presence of abrasive dusts, steam, nebulised oils and salt air could affect the long life of the equipment.

Other equipment should be mounted at sufficient distance from the drive to avoid any metallic residues from drilling or electrical cables falling into the drive. The drive should never be installed near to easily inflammable materials.



**The drive must not be installed in an environment which is subject to strong vibrations ; if the equipment upon which the drive is installed is mobile, suitable cushioning systems must be provided.**



**IP00 protection**

#### ENCLOSED ENVIRONMENT , DISSIPATED POWER

Hereinafter the power dissipated by the drive working under nominal load including losses from ventilation and regulation.

Dissipated power	
	Watt
SDR-200	30
SDR-400	40

max .dissipated power at nominal load

In the case of installation in an enclosed environment, e.g. in a cabinet, it is necessary to take care that the internal temperature does not exceed the environment temperature allowed for the drive ( + 40 °C) .  
The environment may, if necessary, be ventilated with sufficient air flow to take away the heat generated by the drive and other components.

### **3.2. VENTILATION**

A drive has not to be installed in the air cooling flow of another drive or other systems.

## 4. POWER : CONNECTIONS AND SIZING

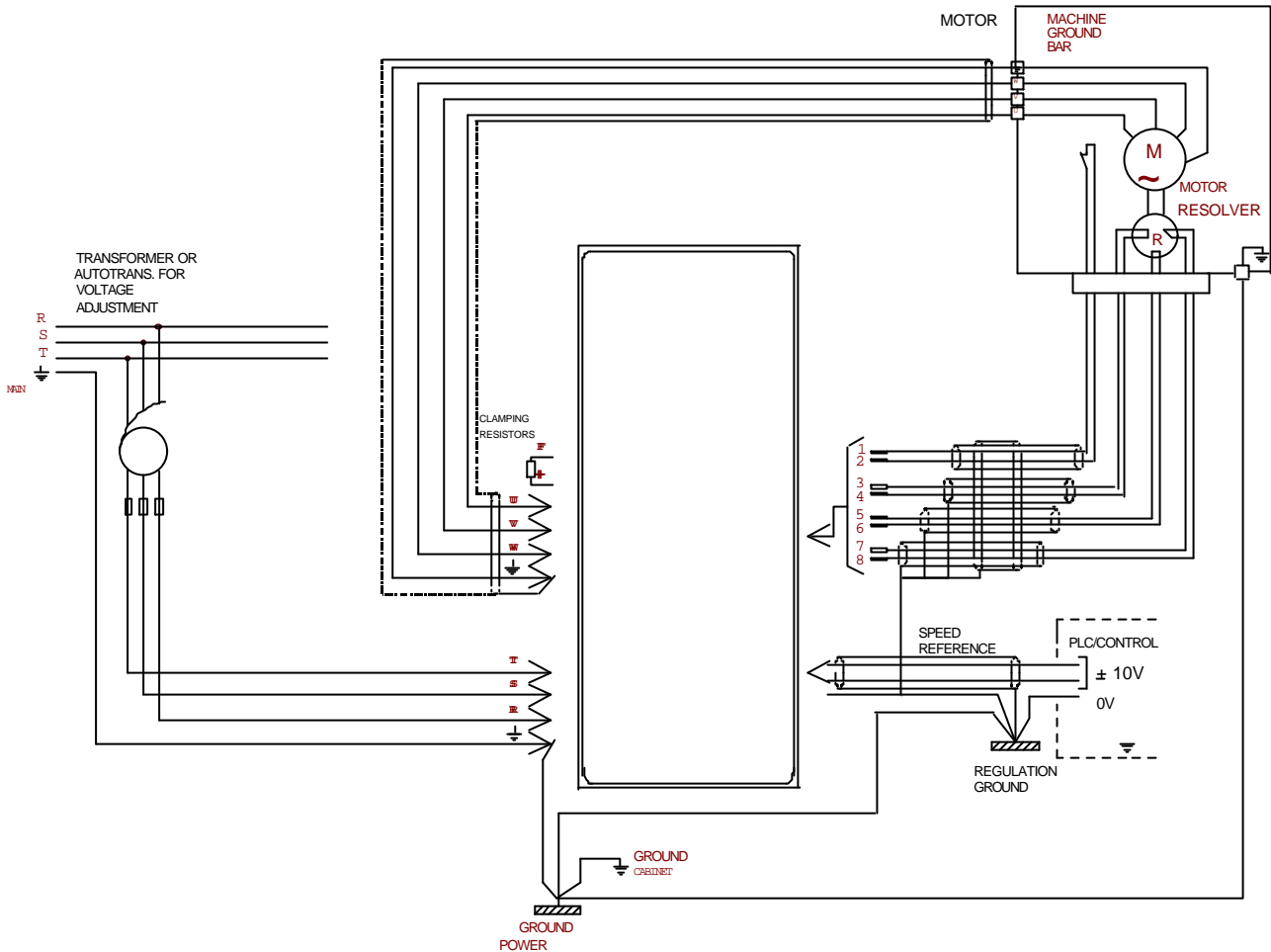


fig. 4

### 4.1. MAIN CONNECTION

To ensure compliance with safety restrictions drive mains connection must be carried out in accordance to the law currently in force governing electrical equipments. The connection to the mains may be made with either a transformer or an autotransformer.

Connection to the drive must be stable and with cables suitable for the three-phases, the terminals marked R S T and the ground and the PE  $\perp$ .

The main connection can be done through a transformer or autotransformer.

The single-phase power supply is available too. In this case it is possible to use two of the three terminals R,S,T.

### 4.2. CONNECTION WITH MOTOR

Make the connections as shown in the figure 1.

The choice of the line cables shall take into account the current absorbed by the motor (see rating plate) and the current required by the single drive, calculated according to the required power multiplied by 1.1 (current form factor) . The motor must connected to the terminals marked U, V and W with the ground cable connected to the PE  $\perp$ .

The U,V,W phases short circuit causes the drive block.

In case of interruption between the motor and the drive by means of electromagnetic switches (remote switches, thermal relays etc.) it is necessary to ensure the drive being disabled before the interruption in the motor-drive connection.

The advance time on the blocking of the drive can be obtained by simply playing on the delay of the opening of the electromechanical parts ; however a minimum time of 30 ms is required.



### 4.3. DRIVE EARTH CONNECTION

The leakage current is the current that the drive discharges to the ground connection. The amount of this leakage current depends on the length of the cable, on the presence or not of the shield (with the shield the leakage current is higher) and on the motor and the PWM frequency value.

Anti-interference filters can even increase the current leakage. The leakage current contains high frequency interference variables. To avoid electromagnetic compatibility problems with other equipment, the drive ground connection has to be carried out with a single cable with the right diameter.



**The drive cannot work without a protection conductor surely connected to ground.**

### 4.4. TRASFORMER AND PROTECTIVE FUSES SIZING

Power need of each single drive, considering that the drive efficiency is about 97% and that the motor efficiency is about 93%, is equal to the motor power divided by the efficiencies and it can be obtained by the formula below :

Power delivered by the motor

$$P(\text{KW}) = \frac{T * N * 6,28}{0.9 * 60 * 1000} = \frac{T * N * 0.1163}{1000} \quad \text{where} \quad \begin{array}{l} N = \text{max. working r.p.m. with the torque considered} \\ T = \text{working torque in Nm} \end{array}$$

For the transformer power, consider:

$$\text{KVA(T)} = P(\text{KW}) * 1.1 \quad \text{with } 1.1 = \text{current form factor}$$

With more drives in parallel, the power of the autotransformer or the transformer can be calculated according to the sum of the powers of all the motors, multiplied by a coefficient <1 that takes into account the simultaneous use ; this coefficient depends on the type of machine and must be evaluated case by case.

The size of protection fuses can be calculated through the autotransformer or transformer nominal current value multiplied by a factor just greater than one. The section of the line cables must guarantee a correct intervention of the fuses.

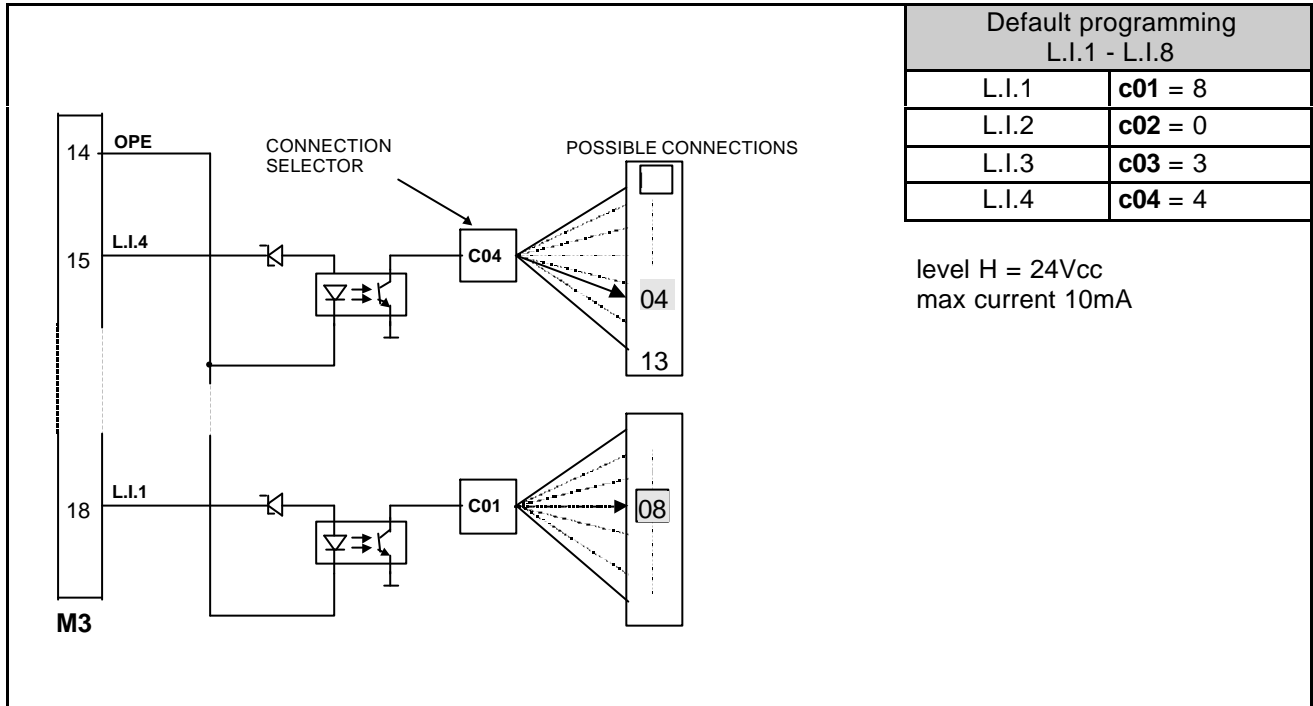
### 4.5. SOFT-START CIRCUIT

The SDR series is provided with on board soft-start circuit for firing current limitation: between one firing and the next one wait at least for 3 minutes.

## 5. CONFIGURATIONS

### 5.1. CONFIGURATION OF LOGIC INPUTS AND OUTPUTS

Logic inputs L.I.1-L.I.4 can be "connected" to a logic function through the connections **c01-c04**. L.I.2 can not be changed and it is programmed to logic function 0: drive on-line (output stage enable).

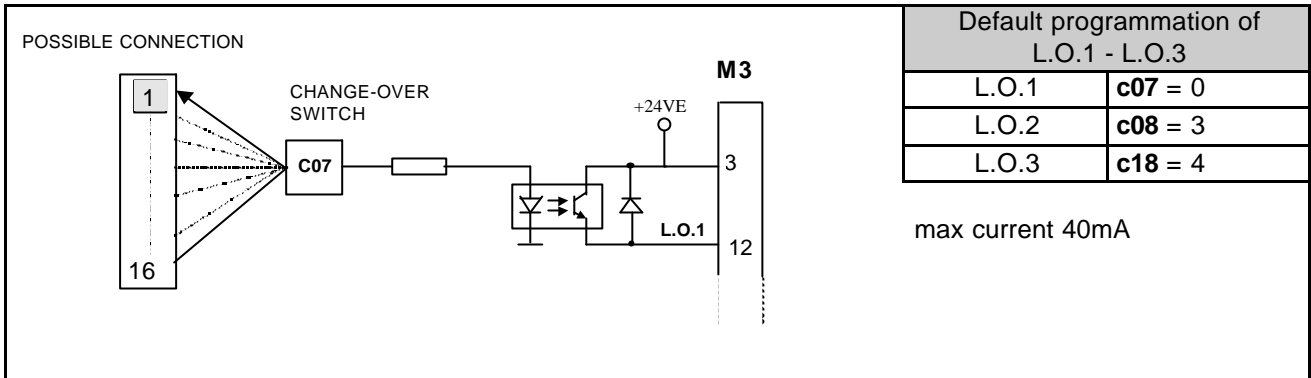


The following table contains the available logic functions. If a logic function is not programmed to any logic input, it gets the default value. The actual value of these functions is displayed in the "i" parameters.

	Available logic functions	Def
0	Drive on line (output stage enabled)	
1	Speed control excluded (just torque control)	L
3	REF. 1 enable (REF1EN)	L
4	REF. 2 enable (REF2EN)	L
5	Limit switch 1 (LS1)	H
6	Limit switch 2 (LS2)	H
8	Alarms reset	L
12	CW/CCW direction selector	L
13	Linear ramp stage enable	L

## 5.2. LOGIC OUTPUTS CONFIGURATION

Logic outputs L.O.1-L.O.3 can be "connected" to a logic function through the connections **c07-c08** and **c18**.

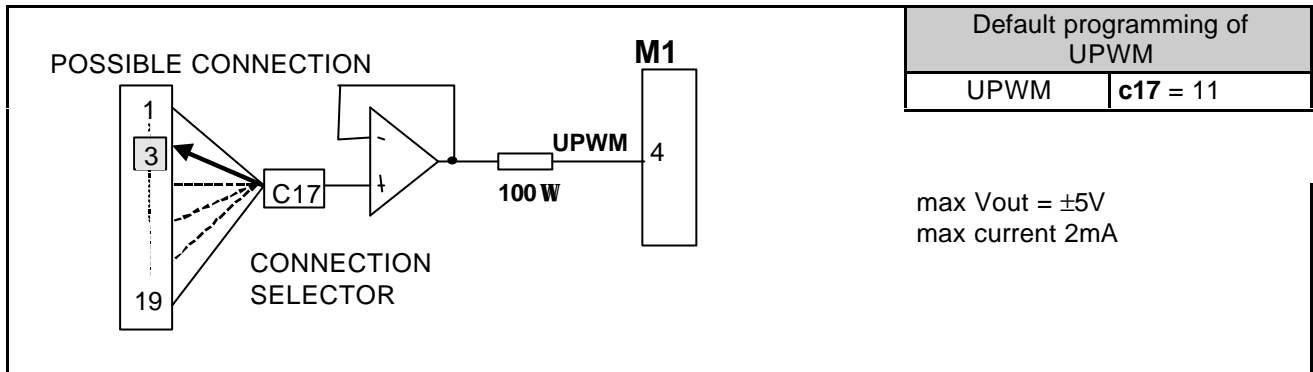


The following table contains the available logic functions.

Available logic functions	
0	Drive ready
1	Motor thermal alarm
2	Speed greater than minimum
3	drive on-line (output stage enabled)
4	CW/CCW
5	Speed regulator in saturation
6	Ramp end
7	Speed in range relay
8	Current in range relay
9	Motor blocked
11	Ramp active

### 5.3. ANALOG OUTPUT CONFIGURATION

By means of the connection **c17**, some of the internal variables can be read on the programmable analog outputs of terminals:



Available internal variables	
1	External speed reference
2	Speed reference before the linear ramp block
3	Speed reference after the linear ramp block
4	Speed feedback
6	Integral part of the speed regulator
7	External torque reference
11	Current reference
15	Iq current (torque)
16	Id current (direct)
17	Vq torque voltage
18	Vd direct voltage
19	Motor total voltage

## 6. TABLES OF PARAMETERS AND DISPLAYS

### 6.1. TYPES OF PARAMETERS

	Type	Description
P	Parameters	Numerical values
c	Connections	Logic switches with 2 or more contacts.
d	Displays	Internal drive values (voltage, current, speed,...)
A	Alarms	Diagnostics of the drive
i	Inputs	State of logic inputs and of logic functions
o	Outputs	State of logic outputs and of logic functions

### 6.2. DESCRIPTION OF THE PARAMETERS IN THE TABLES

Column "**PAR**" contains the parameter name as it is displayed on the keypad.

Column "**DESCRIPTION**" contains a brief description of the parameter.

Column "**RANGE**" contains maximum and minimum limits, and the units of the parameter.

Column "**BS**" contains a letter or a number :

- A letter means that the parameter is a number "x" whose value is a percent of a base scale number.

from internal number to percent value	from percent value to internal number
Percent value = $100 * x / \text{base scale}$	$x = \text{percent value} * \text{base scale} / 100$

base scale table

Letter	description
A	Base scale = 16383
B	Base scale = 4095

- A number means that the parameter is a number "x" whose value is scaled by a power of 10 :

from internal number to real value	from real value to internal number
$\text{real value} = x/10^n$	$x = \text{real value} * 10^n$

conversion ratio table

Number	description
0	$n = 0 \text{ par} = x$
1	$n = 1 \text{ par} = x/10$
2	$n = 2 \text{ par} = x/100$

Column "**Note**" contains the informations about the writing protections of parameters:

- n = parameter value can be changed only if drive is off-line
- r = parameter value can be changed only if the customer code number is set in **P50**
- t = parameter value can be changed only if the TDE MACNO code number is set in **P80**

Parameter **P99** contains the customer code number (**P50**). On demand this code can be customized.

### 6.3. PARAMETERS

PAR	DESCRIPTION	RANGE	DEFAULT	BS	NOTE
P 1	JOG 1 speed	±100.0%	0%	A	
P 2	JOG 2 speed	±100.0%	0%	A	
P 4	Analog speed reference offset 1/100000 parts on speed reference	±19999	0	0	
P 5	Max CW speed limit	0÷105.0%	100.0%	A	
P 6	Max CCW speed limit	0÷105.0%	100.0%	A	
P 10	Gain for positioning (kv)	0÷100	4	0	
P 11	CW acceleration time	50÷19999 ms	400 ms	0	
P 12	CW deceleration time	50÷19999 ms	400 ms	0	
P 13	CCW acceleration time	50÷19999 ms	400 ms	0	
P 14	CCW deceleration time	50÷19999 ms	400 ms	0	
P 20	level  speed + REF  for constant modulation	0÷200.0 %	0%	B	
P 21	Speed loop proportional gain for  speed + REF =0	0.5÷100.0	4.0	1	
P 22	Speed loop lead time when  speed + REF =0 Integral time P21	4.0÷150.0 ms	40.0 ms	1	
P 23	Speed loop proportional gain  speed + REF ≥P20	0.5-100.0	4.0	1	
P 24	Speed loop lead constant time when (integral time x gain) for  speed + REF ≥P20	4.0-150.0 ms	40.0 ms	1	
P 25	Speed loop filter constant time	0.4÷20 ms	0.4 ms	1	
P 27	Starting value of speed regulator integral	±100.0%	0%	B	n
P 31	Torque signal offset (ltorq)	±100.0%	0%	B	
P 32	Torque correction signal constant	±400.0%	100.0%	B	
P 35	Max CW current limit	0÷100.0%	100.0%	B	
P 36	Max CCW current limit	0÷100.0%	100.0%	B	
P 41	Minimum speed level	0÷100.0%	0.2%	B	
P 42	Maximum allowed speed level	0÷120.0%	110.0%	B	
P 43	Lower level speed range for speed relay	±100.0%	-100.0%	B	n
P 44	Upper value speed range for speed relay	±100.0%	100.0%	B	n
P 45	Lower value current range for speed relay	±100.0%	-100.0%	B	n
P 46	Upper value current range for speed relay	±100.0%	100.0%	B	n
P 50	Reserved parameter access key	0÷9999	(P99)	0	n
P 51	Drive identification number for the serial line	1÷255	255	0	r
P 52	Setting maximum motor speed (n/1')	375÷19000	2500	0	r
P 53	Number of motor poles	2÷12	6	0	r
P 54	Number of resolver poles	2÷12	2	0	r
P 55	Resolver phase ( degrees )	±180.0	0	1	r
P 56	Motor rated current in % of drive rated current	10.0%÷100.0%	90.0%	B	r
P 57	Motor thermal constant time TH	1.0÷600.0 sec.	30.0 sec.	1	r
P 58	Motor inductance in mH x rated motor current / motor voltage	0.0-100.0%	20.0	B	r
P 59	Ti=Lff/Rff ms	1-100	20	0	r
P 60	External voltage reference corresponding to the maximum motor speed (mV)	2500÷10000	10000	0	r
P 61	Encoder frequency reference coefficient	0÷16383	4096	0	
P 62	Vnmot/Vnaz	0.0%-100.0%	60.0%	B	r
P 63	Correction coefficient Kq1 e Kd1 %	0.0%-400.0%	73.3%	B	r
P 79	Serial line Baud rate	0÷2	0 = 9600	0	
P 80	TDE reserved parameter access key	0÷9999	-	0	n
P 81	Analog ref. correction coefficient	50.0%÷199.0%	100.0%	B	t
P 82	Current correction coefficient	100.0%÷200.0%	111.0%	B	t
P 83	Drive rated correction in % of the current limit	20.0%÷100.0%	50.0%	B	t
P 84	Drive limit reenter time constant	1.0÷10 sec.	2.5 sec.	1	t
P 85	VNS not stabilised voltage measurement coeff.	50.0%÷200.0%	100.0%	B	t
P 86	DC bus minimum voltage	60.0%÷130.0%	70.0%	B	t
P 87	DC bus maximum voltage (% P92)	50.0%-120.0%	105.0%	B	t
P 92	Voltage brake (% VDC BUS)	65.0%÷150.0%	124.0%	B	t

PAR	DESCRIPTION	RANGE	DEFAULT	BS	NOTE
P	94 Choice 0=Speed/ 1=Curr	0-1	0	0	t
P	95 Torque current (P94=1)	0.0%-100.0%	25.0%	B	t
P	99 Customer code number	0÷9999	95	0	t

## 6.4. CONNECTIONS

CON.	DESCRIPTION	RANGE	DEFAULT	Notes
C	1 Logic input 1 meaning	1-13	1 (AL.RESET)	r
c	2 Logic input 2 meaning	0	0 (DR.RUN)	r
c	3 Logic input 3 meaning	1-13	3 (REF1EN)	r
c	4 Logic input 4 meaning	1-13	4 (REF2EN)	r
c	7 Logic output 1 meaning	0-16	0 (DR.READY)	r
c	8 Logic output 2 meaning	0-16	3 (DR.O.LINE)	r
c	9 External speed ref. Inversion	0 (not inverted) 1(inverted)	0	r
c	11 Choice pulse/rev. Resolver for simulated encoder	0-7	4 (512 PPR)	r
c	14 Choice external reference	0 (analog) ; 1 (fr.4channels);	0	r
c	17 Meaning analog output	0-19	11	r
c	18 Meaning logic output 3	0-16	4 (CW/CCW)	r
c	19 Excl. Alarms A3-A5-A7-A9	0-31	0	r
c	20 Excl. Integral on speed regulator	0 (not excluded) 1 (excluded)	0	n
c	21 Software on line	0(stop) 1(run)	1	
c	22 Parallel bit to REF1	0(OFF) 1(ON)	0	
c	23 Parallel bit to REF2	0(OFF) 1(ON)	0	
c	24 Parallel bit to LS1	0(OPEN) 1(CLOSE)		
c	25 Parallel bit to LS2	0(OPEN) 1(CLOSE)		
c	26 Ramp inclusion	0(excluded) 1(included)	0	
c	27 Stop with or without min. speed	0(disabled) 1(enabled)	1	
c	29 Software drive consent	0(alarm) 1(no alarm)	1	
c	30 Reset alarms	0(disabled) 1(reset)	0	
c	32 Enable torque input	0(disabled) 1(enabled)	0	
c	33 relative or absolute speed data	0(relative) 1(absolute)	0	
c	34 Motor thermal devices causes drive block	0(do not stop) 1(stop)	0	
c	41 Reset default values	0(disabled) 1(reset)	0	n
c	42 Reset EEPROM values	0(disabled) 1(reset)	0	n
c	43 EEPROM writing	0(disabled) 1(reset)	0	n
c	52 Freq. Input (0)-Encoder Out(1)	0÷1	0	r
c	54 Serial protocol (TDE/Modbus)	0÷1	1	r

## 6.5. DISPLAYS

	INTERNAL VALUES	RANGE	BS
d	0 Software version		2
d	1 External speed reference %	±100.0%	A
d	2 Speed ref. Before the ramp %	±100.0%	A
d	3 Speed ref. After the ramp %	±100.0%	A
d	4 Speed feedback %	±100.0%	B
d	5 Motor speed in r.p.m. %	0÷19000	0

		INTERNAL VALUES	RANGE	BS
d	6	Integral part of the speed regulator %	±100.0%	B
d	7	Value of the external torque demand signal %	±100.0%	B
d	8	External current limit %	0÷100.0%	B
d	9	Current limit CW %	0÷100.0%	B
d	10	Current limit CCW %	0÷(-100.0)%	B
d	11	Current demand %	±100.0%	B
d	12	CC BUS Voltage (V)	0÷999	0
d	14	Resolver reading (encoder pulse)	± ½ pulses c11	0
d	15	Torque current Iq	±100.0%	B
d	16	Direct current Id	±100.0%	B
d	17	Torque voltage Vq	±100.0%	B
d	18	Direct voltage Vd	±100.0%	B
d	19	Motor voltage Vm	0÷100.0%	B

		ALARMS	STATE (H=ON L=OFF)
A	2	RAM, EEPROM alarm	L-H
A	3	Power failure	L-H
A	5	Motor thermal switch	L-H
A	6	Motor thermal protection	L-H
A	7	Resolver failure	L-H
A	8	External alarm	L-H
A	9	Overspeed	L-H
A	10	Power supply minimum voltage	L-H
A	11	Power supply overvoltage	L-H
A	12	Input configuration error	L-H
A	13	Pole setting error	L-H
A	14	Mains supply connections error	L-H



LOGIC INPUTS		STATE (H=ON L=OFF)	
i	1	Logic input iL1 state	L-H
i	2	Logic input iL2 state	L-H
i	3	Logic input iL3 state	L-H
i	4	Logic input iL4 state	L-H
i	9	On-line signal state	L-H
i	10	Torque enable signal state	L-H
i	12	Ref 1 enable signal state	L-H
i	13	Ref 2 enable signal state	L-H
i	17	Alarm reset signal state	L-H
i	21	Reference direction from volt./freq. conv. signal state	L-H
i	22	Enable ramp signal state	L-H
i	25	External reference 0=analog , 1= frequency	L-H

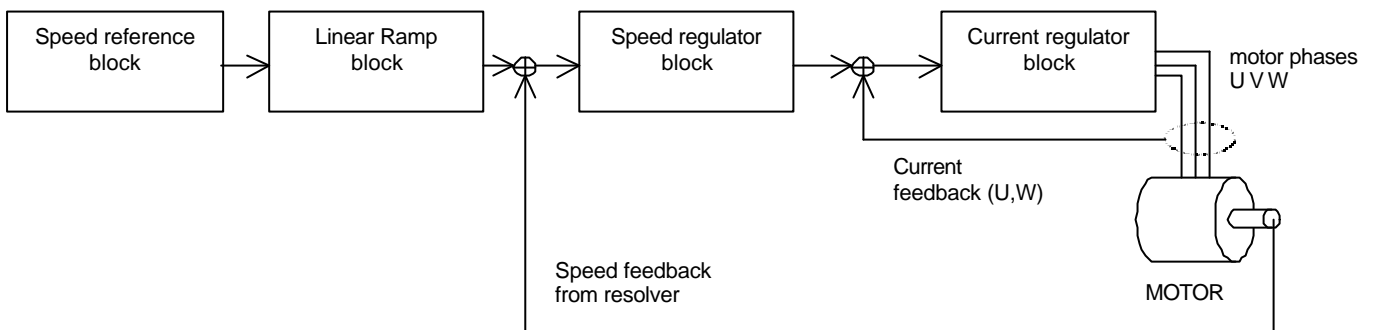
LOGIC OUTPUTS		STATE (H=ON L=OFF)	
o	1	Logic output oL1 state	L-H
o	2	Logic output oL2 state	L-H
o	3	Logic output oL3 state	L-H
o	9	Drive ready signal state	L-H
o	10	Motor thermal protection signal state	L-H
o	11	Speed over minimum signal state	L-H
o	12	Drive on line signal state	L-H
o	13	CW rotation signal state	L-H
o	14	Saturation speed state signal state	L-H
o	15	Ramp end signal state	L-H
o	16	Speed in range signal state	L-H
o	17	Current in range signal state	L-H
o	18	Blocked motor signal state	L-H
o	20	Ramp signal state	L-H

## 7. DESCRIPTION OF THE REGULATION

### 7.1. HOW TO READ THE BLOCK-DIAGRAMS

- The rectangular blocks with **Pxx** represent functions with parameters whose value can be set from the serial line.
- The switches, open or closed, indicated with **cxx** are the internal connections to be set from the serial line and are indicated in the state corresponding to value "0".
- The connections that can have more than two positions are indicated like commutators whose positions correspond to the allowed values (the one indicated on the closed line is the default value).
- The open or closed contacts identified with a name (for example REF1) indicate functions operated by logic inputs or internal logic programmable functions (see ch. "Configurations").
- Internal logic functions normally indicated with a rectangular block
- The circle blocks identified with **dx** represent the displayed values.

### 7.2. BLOCK DIAGRAM OF THE REGULATION



### 7.3. SPEED REFERENCE BLOCK

- For the external reference from encoder type frequency option, see chapter "Frequency input".
- Up to four speed references are possible, one analog and three digital.
- The analog reference,  $\pm 10V$  for the maximum speed, is applied to terminals 7 and 8 of connector M1, if the signal has an offset (maximum  $\pm 1,9999V$ ) it can be compensated by means of parameter **P04** whose value is given in hundreds of microvolts, resolution 1/100000 of the base scale.
- If the maximum speed (set in **P52**) must be reached with an external reference voltage value  $< 10V$ , this value can be set in mV in parameter **P60** (default P60=10000); it should be remembered however that this operation reduces the reference resolution.
- The three digital references can be set in parameters **P01**, **P02** with base scale  $\pm 100.0\%$  for the maximum speed; the external reference can be inverted via software by means of connection **c09** (0= not inverted, 1=inverted, default=0).
- The choice between the various references is made by means of inputs REF1EN, REF2EN or connections **c22** and **c23** according to the following table:

	REF1EN	REF2EN
Analog REF.	L	L
JOG1	L	H
FREQ. INPUT	H	L
JOG3	H	H

(valid if c22=c23=0)

	c22	c23
Analog REF.	0	0
JOG1	0	1
FREQ.INPUT	1	0
JOG2	1	1

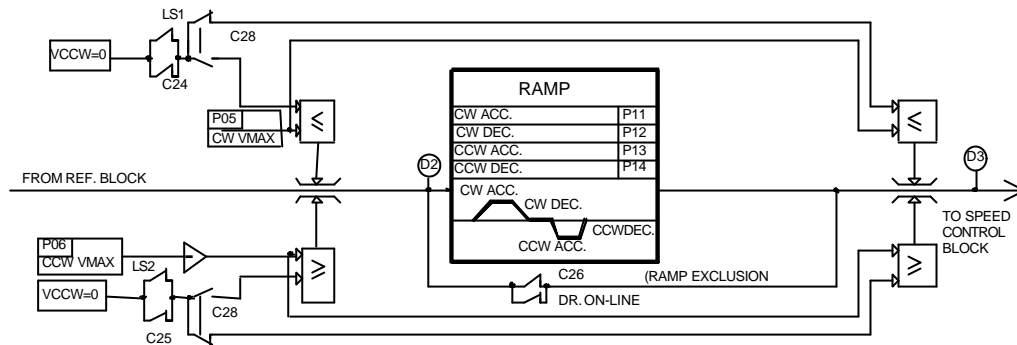
(valid if REF1EN=REF2EN=L)

As can be seen from the table the functions of REF1EN and **c22** are the same as for REF2EN and **c23**; **c22=c23=0** are set by default so that REF1EN and REF2EN can be used; **c22** and **c23** are useful if you desire select the reference signal by serial line; in this case REF1EN and REF2EN, must not be configured in the logic inputs, and are both in the not active state (L).

## 7.4. RAMP AND SPEED LIMITS BLOCK

Parameters **P05** and **P06** are used to limit the maximum speed reference in the two directions of movement and can be programmed in the range 0-105.0%; it should be remembered that as the regulation is digital, the actual speed of the motor will never exceed the limit set in **P05** and **P06**.

A linear ramp can be included in the speed reference by programming **c26=1**. (default value **c26=0**). The acc. cw, dec. cw, acc. ccw and dec. ccw times from speed=0 to max speed = **P52** are set directly in msec. in parameters **P11**, **P12**, **P13** and **P14**.



The LIMIT SWITCHES **LS1**, **LS2**, or the equivalent connections **c24**, and **c25** are used to limit the range of movement of the motor. If used, they act directly on the speed reference. If the motor turns CW, at **LS1** opening or **c24=0** the reference is set to zero; If the motor turns CCW, at **LS2** opening or **c25=0** the reference is set to zero. The motor can stop without ramp if **c28=0** or with ramp if **c28=1** and **c26=1**. By default **LS1**, **LS2**, if not used, and **c24** and **c25** are equal to 1 (no limitation).

Once the motor has reached the limit switch it stops and does not continue any further in the same direction. If the reference is inverted it can return in the opposite direction.

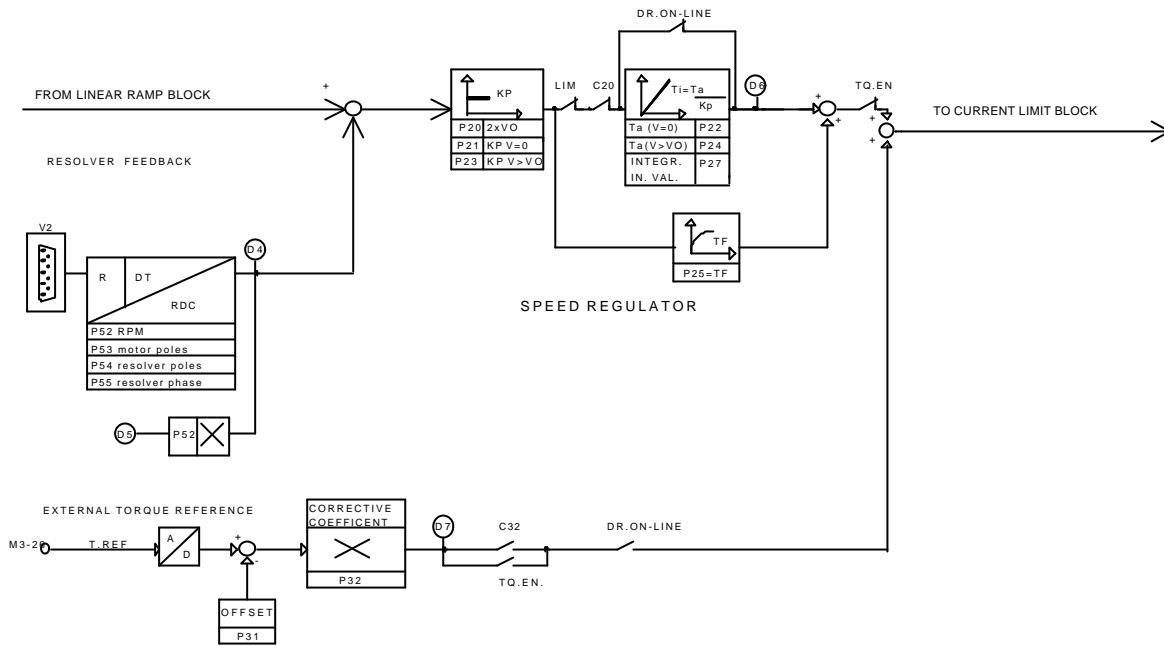
## 7.5. SPEED REGULATOR AND CURRENT LIMITS

The speed regulator receives the reference from the reference block, and reads the speed feedback from the resolver connected to the motor shaft. The maximum speed in r.p.m. is set in parameter **P52**.

The drive has three working modes:

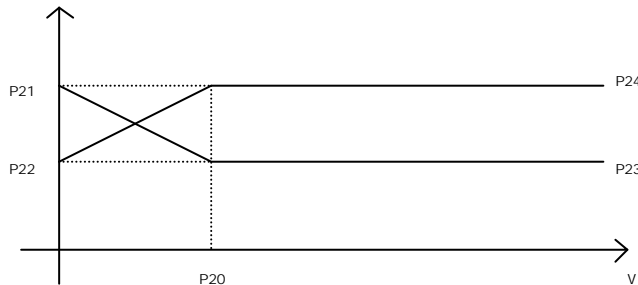
1. Speed control
2. Speed + torque control
3. Torque control

The input TQ ENABLE select between modes 1 and 3: the drive works in "Speed control" mode if TQ ENABLE = L otherwise if TQ ENABLE=H (input active) the whole speed stage is excluded and the system works with the external torque reference signal (analog input TQREF, M1-7). **P31** ( $\pm 100.0\%$ ) can eliminate the offset and **P32** ( $\pm 400.0\%$ ) is a multiplicative coefficient.



The SPEED REGULATOR is a standard PI (Proportional-integral) with a first-order filter on the speed error. Parameter settings are possible for the proportional gain  $K_p$ , the advance constant  $T_a$  (equal to the integration time constant multiplied by  $K_p$ ) and the filter time constant  $T_f$ . Two values can be set for the parameters, one valid for  $|\text{speed}| + |\text{reference}| = 0$  (**P21**, **P22**) and one valid for  $|\text{speed}| + |\text{reference}| \geq \text{P20}$  (**P23**, **P24**); in the range between 0 and **P20** the system practices a linear interpolation function of the  $|\text{speed}| + |\text{reference}|$  between the set parameters.

In practice the speed regulator operates with the constants calculated according to the following equations:



$$K_p = P23 + (P21 - P23) * (|V| + |V_{rif}|) / P20 \quad \text{Proportional gain}$$

$$T_a = P24 + (P22 - P24) * (|V| + |V_{rif}|) / P20 \quad \text{Advance constant of the speed stage}$$

with:  $(|V| + |V_{rif}|) / P20 \leq 1$

where  $|V|$  is the absolute value of the speed and  $|V_{rif}|$  is the absolute value of the reference and **P20** is the double value of the speed to which the constants are to be set.

In this way for special machines the regulator may behave differently at low speed, when the machine friction may dominate, than at high speed when the inertial torque may be more important. However putting **P20=0** only **P23** and **P24** are working (default value).

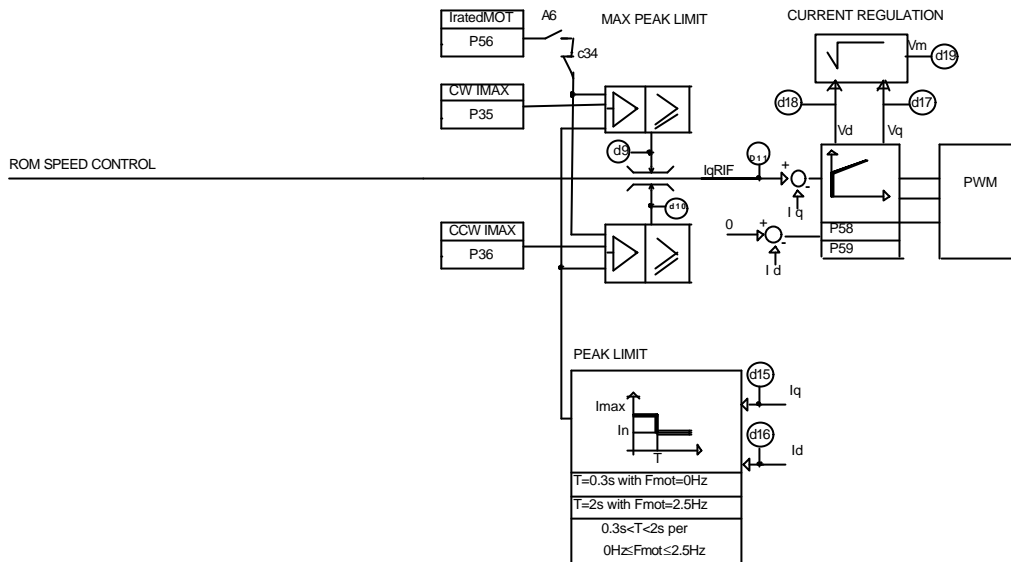
Proportional gains (**P21**, **P23**) are referred to the limit current of the drive: they express the ratio between current command and speed error; the integral constant and the filter constant are expressed in msec. The integral action of the speed regulator, which can be seen in the display **d6**, can be excluded by setting the connection **c20=1** (default **c20=0** integral inserted).

With a function generator in the analog reference input the response can be optimised (after the ramp has been excluded) checking the output **TG OUT**.

The initial value of the speed regulator integrator can be set to parameter **P27** (scale  $\pm 100.0\%$ ): this sets the initial current value when the drive is started, to start against brake or with unbalanced loads. If an analog signal proportional to the unbalance is available, it may be used by connecting it to terminal 26 of connector M3 (Torque ref) and programming **c32=1** ("Torque + speed control" working mode).

## 7.6. CURRENT LIMITS

The current reference, after the speed stage output and the torque input, pass through the limiter circuit.



The purpose of which is to limit this value within the lowest level of all the following values :

- parameters **P35** and **P36**
- the value given by the peak current limitation circuit
- the value given by the motor thermal protection circuit.

Parameters **P35** and **P36** have a regulation range 0-100.0% of the maximum value (limit current) and can independently limit the torque value required in the two directions of rotation CW, CCW.

The maximum current is limited within curve  $I_{max} \cdot T$  compatible with the safety of the semiconductors. In particular an integration  $I \cdot t$  is made and when this value tends to exceed the maximum allowed, which is a function of the working frequency, the maximum current level which can be required is reduced to a little more than the rated drive current.

The value curve is such that with motor stopped the overload of twice the rated current  $I_n$  can be maintained for about 0.1 sec., when the motor turns at a number of revs corresponding to a frequency greater than 2.5Hz (revs which depend on the number of poles of motor **P53**) this value can be maintained for 2.5sec; frequencies between 0 and 2.5Hz have intermediate values.

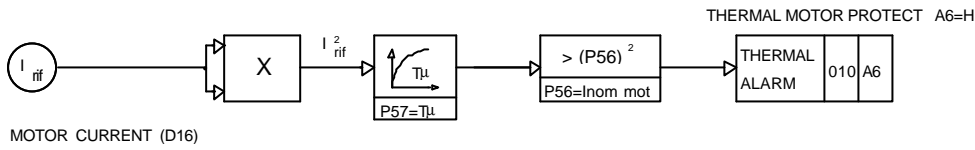
The motor current regulation is of traditional type with PWM with however adaptation of the gain to optimise the response as a function of the motor features.

## 7.7. THERMAL MOTOR PROTECTION

The motor protection circuit acts by calculating the square of the value of the current absorbed by the motor and integrating it over time according to the motor thermal constant. The result is a value which simulates the heating in the motor windings, which must not exceed the maximum allowed value, otherwise alarm **A6** becomes active.

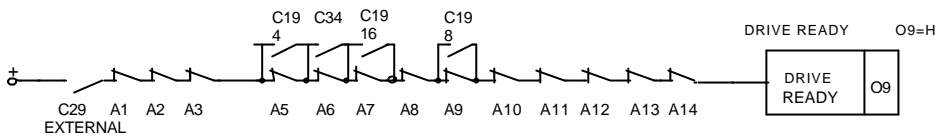
For correct operation of the circuit the motor current value must thus be set in ratio to the rated drive **P56** (0-100%) and the value of the motor thermal constant **P57** (10-600 sec.).

Circuit operation causes the drive to stop immediately deactivating DR.READY if **c34=1**; if **c34=0** it allows continuation of the drive operation, but however the maximum current limit is reduced to the motor rated current until the temperature is below the limits allowed.

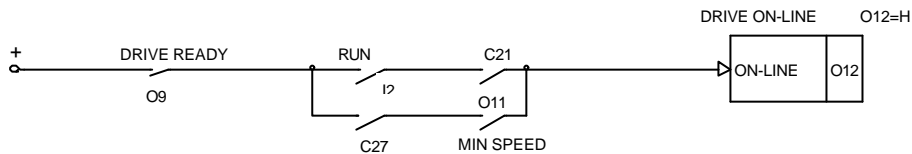


**Logic Sequences**

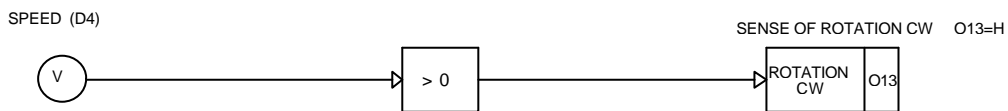
The on line ready active condition, **o9=H**, occurs when no alarm appears, and the external enabling and the enabling via software, **c29=1** are present.



The drive thus can go online if **o9=H**, **c21=1** and digital input **i2** (on line) is active; If the on-line command becomes inactive the power will be instantaneously interrupted (**c27=0**) or will be interrupted only when the motor has been slowed down to a minimum speed by the controller (**c27=1**). This minimum speed can be with parameter **P41** (if  $|V| < P41 \Rightarrow o11=L$ ).



L'allarme per max. velocità **A9** diventa attivo se la velocità del motore supera in valore assoluto quella impostata nel parametro **P42**. The direction of rotation becomes active, **o13=H**, if the rotation is clockwise and thus  $V > 0$ .



The "speed in range" relay becomes active, **o16=H**, when speed  $V$  is  $P43 < V < P44$  if **c33=1**; or when speed error  $Err$  is  $P43 < Err < P44$  if **c33=0**. The "current in range" relay becomes active, **o17=H**, when the current reference  $I$  is  $P45 < I < P46$ .

## 7.8. REFERENCES AND SPEED LIMITS SETTING

The maximum speed equal to  $\pm 100.0\%$  of the internal references and  $\pm 10V$  of the analog reference is set in parameter **P52** directly in revolutions per minute.

All the percentage values set on the speed references, on the speed limits and on the thresholds refer to this value. This is especially for parameters **P01**, **P02**, **P05**, **P06**, **P41**, **P42**.... and also for the 'dxx' display signals.

Ex 1) if **P52**=2000 r.p.m. and a JOG1 speed of 150 r.p.m. is needed, set:

$$P01 = 150/2000 * 100 = 7.5\%$$

Ex 2) if on **d1** is displayed a reference of 79.2%, this means that the motor speed reference is :

$$79.2/100 * 2000 = 1584 \text{ r.p.m.}$$

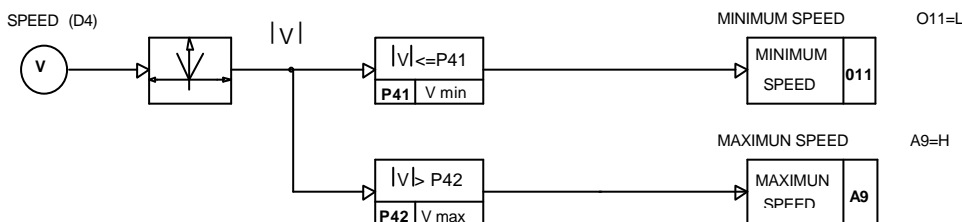
## 7.9. SETTING MINIMUM - MAXIMUM SPEED AND SPEED RANGE SIGNAL LEVEL.

The settings are all percentages and refer to **P52**. The minimum speed logic signal is a signal which is active when the motor speed in absolute value is greater than the value set at parameter **P41**.

e.g., if Min speed = 6 r.p.m. and **P52**=2000 r.p.m. is needed, set:

$$P41 = 6/2000 * 100 = 0.3\%$$

The maximum speed alarm occurs when the motor speed exceeds in absolute value the speed set at parameter **P42** as a percentage of **P52**.



The SPEED RANGE logic signal is a signal which is active when the speed is between the two percentage values set at parameters **P44** and **P43** if connection **c33** is set to 1, while if the connection is set to 0 the output becomes active when the real speed is about the reference signal within the band set in the two parameters, i.e.:

$$P43 * P52 \leq V_{rif} - V_{real} \leq P44 * P52 \quad c33=0$$

If the output has to be active when the motor runs CCW at a speed between 1200 and 1300 r.p.m. set:

$$c33=1$$

$$P44 = (-1200)/2000 * 100 = -60.0\%$$

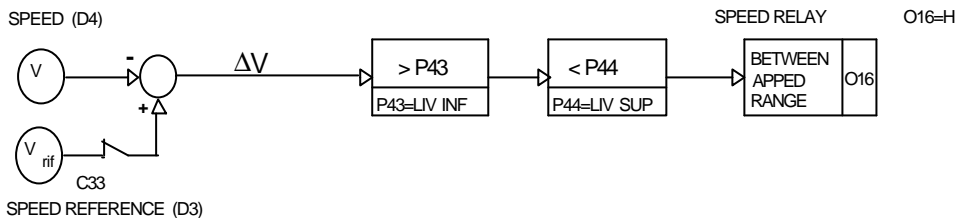
$$P43 = (-1300)/2000 * 100 = -65.0\%$$

If the output has to be active when the motor speed is equal to the required speed  $\pm 20$  r.p.m. set the following:

$$c33=0$$

$$P43 = (-20)/2000 * 100 = -1\%$$

$$P44 = +20/2000 * 100 = 1\%$$



### 7.9.1. PEAK CURRENT LIMITS AND CURRENT RANGE SETTING

Parameters **P35** and **P36** set the maximum allowed value for the effective peak current that can be delivered by the drive, they are in percentage of the maximum value allowed according to the size, e.g.:

If drive  $I_{max}$  is 40A and  $I_n$  motor = 11A and you want to limit the maximum current which can be delivered to a value not greater than 33A (three times  $I_n$  motor), set:

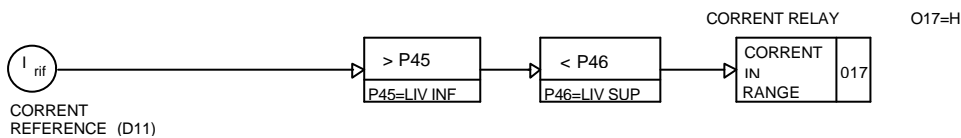
$$P35 = P36 = 33 / 40 * 100 = 82.5\%$$

The same calculations are performed, if you want to use the current range logic function. This function is active (level H) when the current is between the two values set in **P45** and **P46**, while it is disabled (level L) when the current rises these values. E.g. with the drive and the aforesaid motor, if you want a logic signal signalling that the current demand for the motor is greater than the rated one, in both the torque directions, set:

$$P45 = -11/40 * 100 = -27.5\%$$

$$P46 = 11/40 * 100 = 27.5\%$$

**c10** = 08, and output **oL2** will be active (24V) for current values within  $\pm 11A$ , while for current values higher than 11A in absolute value, it will be set to zero.



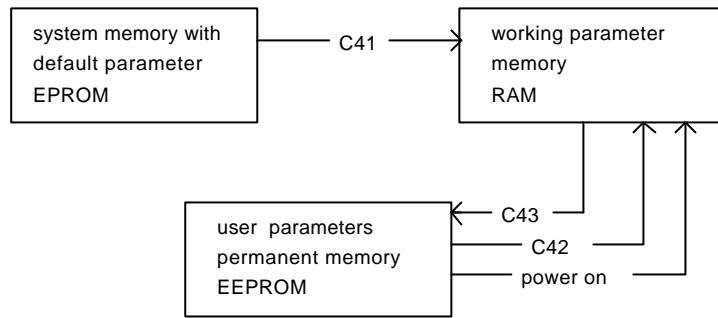
### 7.10. SAVING AND RESETTING PARAMETERS

When you switch on the drive, all the parameters are transferred from the user permanent memory (EEPROM) to the working memory (RAM). All the parameters changes are stored in the working memory (RAM); to save these changes in the user permanent memory (EEPROM), activate the connection (**c43**=1). If there is an EEPROM alarm (**A2**=H), the permanent values will not be found in the working memory; to recover the system, write new values on the permanent memory and then reset. To do this, use the default parameters, which are written in the system memory (EPROM); these are first transferred to the working memory (**c41**=1) and then saved in the user permanent memory (**c43**=1), then the recovering, which usually takes place when there is a permanent failure, is carried out.

To return to the initial parameters in the permanent memory (EEPROM) after the changes in the working memory (RAM), just activate connection **c42** (**c42**=1) without switching off and on again.

These procedures are explained below :





N.B. As the default parameters are standard parameters different from the customised ones, it is important for each drive to save carefully the parameters of the user permanent memory after the installation, so that, if necessary, they can be copied into a spare drive.

## 7.11. ALARMS AND EXCLUSIONS

When an alarm occurs, the drive stops and the DR.READY signal becomes not-active 'L'. To deactivate the alarms, first remove the cause and then reset the alarms (fault reset) on the programmed input by passing from a not-active to an active state or by means of **c30=0→1**. Connection **c19** can be used to exclude the following alarms blocking the drive:

- c19=0** no alarm excluded
- c19=4** motor thermal switch (**A5**) excluded
- c19=8** overspeed (**A9**) excluded
- c19=16** resolver failure excluded (**A7**)

Several alarms can be excluded at the same time by setting in **c19** a number between 1 and 31 calculated as follows:

$$c19 = 4 \times A5 + 8 \times A9 + 16 \times A7$$

The motor thermal alarm (**A6**) is configurable through **c34** connection:

c34 = 0 (default)	Max. current limit reduced to nominal current
c34 = 1	Stops the drive

## 8. FREQUENCY INPUT

The drive can have an analog reference speed or a frequency reference speed. By setting two of the four digital inputs (Rifer. Frequency, Chap.1) and according to the value of c14, the external speed reference can be selected as follows:

C14	External reference
0	Analog
1	Four channel frequency reference

With **P10=0** the motor speed is proportional to the input frequency.

With **P10>0** the motor speed is proportional to the input frequency and an internal space control loop is active (proportional gain=P10) so every input pulse correspond to a partial motor rotation.

With **P10>0** you can recover the position set by the master. **The memory of the positioner is 32750 pulses**

- duplex frequency input encoder type 4 channels (0V ÷ +5V). Maximum frequency speed reference: 300kHz. (V1)

If you use SDR as a **master** (c52=1) the output frequency is equal to:

$$Fr = 1024 \frac{P52}{60} \frac{P54}{2}$$

The speed of the slave is a function of the input frequency, once the parameter P61 and the number of encoder pulses /electric revolution have been set (set by **c11**).

The desired drive speed can be obtained from an input frequency  $Fr$  by setting **P61** as follows:

$$P61 = RPM_{slave} \cdot \frac{4096 \cdot N}{60 \cdot Fr}$$

$RPM_{slave}$

N

$Fr$

P61 is the ratio between the speed of the slave and of the master

desired speed of the slave at frequency  $Fr$

number of encoder pulses /electric revolution (set by **c11**)

Input frequency

### Examples of a SLAVE connected to a MASTER with frequency input as standard encoder.

From a MASTER we have considered the simulated encoder signals A<sub>i</sub>/A<sub>i</sub>,B<sub>i</sub>/B<sub>i</sub> and we have connected them to a SLAVE frequency input. By programming the parameter P61 it's possible to select the sliding between two drives. (**P61=4096** correspond to a ratio=1)

MASTER	SLAVE
	c11=5 (1024)
P52=3000rpm	P52=2500 rpm
	P61=4096
The SLAVE runs at the same speed of the MASTER	

MASTER	SLAVE
	c11=5 (1024)
P52=2500rpm	P52=2500 rpm
	P61=2048
The SLAVE runs half the speed of the MASTER	

MASTER	SLAVE
	c11=5 (1024)
P52=2500rpm	P52=2500 rpm
	P61=8192
The SLAVE runs double speed the MASTER	

Note. The max allowed error is 32750 pulses.

**c11** is the number of pulses/ resolver revolution and you can set it in the slave:

<b>c11</b>	puls/rev motor/( <b>P54/2</b> )
0	0
1	64
2	128
3	256
4	512
5	1024
6	2048
7	4096

Default value **c11=4**.

## 9. ANTI-INTERFERENCE MEASURES

Electrical and electronic equipment can interfere each other through the mains connections or other metal connections between each other. In order to minimise or eliminate this reciprocal interference it is necessary the drive being correctly installed in conjunction with anti-interference devices (if required).

The following advice regards a mains power supply which is not disturbed. If interference exists other measures must be taken to reduce the interference itself.

In these latter cases giving general advice is not possible and if the anti-interference measures do not lead the desired results we would kindly ask you please to contact TDE MACNO.

- Ensure that all the equipment in the cabinet is well connected to the ground bar using short cables with starconnections. In particular , it is important that any control equipment connected to the drive, e.g. PLC, is grounded by using short wires.
- The drive must be fixed with screws and washers to ensure a good electrical connection between the external container and the metallic support, connected to ground, and to the switchboard. If necessary remove the paint to ensure a good contact.
- For the motor connection use only shielded or armoured cable and connect the shielding to ground both at the drive end and at the motor end. If it is not possible to use shielded cable the motor cables should be placed in a metal channel which is connected to ground.
- Keep the motor connection, drive and control connection cables separate from each other and at a distance from each other.
- For the braking resistance cable connection use shielded cable connecting the shield to ground on both sides, the drive side and the resistor side.
- Lay the control cables at a distance of at least 10 cm from any parallel power cables. In this case too it is advisable to use a separate metal channel which is also connected to ground. If the control cables should cross over the power cables maintain a cross-over angle of 90°.
- Ensure that any RC groups or flywheel diode for coils for the remote switches, relays and other electromagnetic switches installed in the same cabinet as the drive are mounted directly onto the coil connections themselves.
- Make all connections of control, measuring and regulation external systems with shielded cables.
- Cables which can radiate interference must be placed separately and distant from the drive control cables.

If the drive operates in a particularly noise sensitive environment it is also necessary to take the following measures to reduce the conducted and radiated interference:

- Take all necessary measures with regard to the cabinet thus to block radiated emissions, like grounding all metal parts, the use of minimum hole openings in the external walls and the use of conducting gaskets.

## In this manual

The contents of this manual is referred to 1.00 software version

If you have any questions about equipment installation or working,  
do not hesitate to contact us:

brushless.products@tdemacno.it

**TDE MACNO**  
s.p.a. tecnologie digitali elettroniche

via dell'oreficeria, 41 36100 Vicenza tel.0444/343555  
store: via dell'oreficeria, 27/B  
Internet.address: [www.tdemacno.com](http://www.tdemacno.com)  
Internet E-Mail: [brushless@tdemacno.it](mailto:brushless@tdemacno.it)  
telefax 0444/343509

Without explicit written authorisation from TDE MACNO it is forbidden to duplicate or memorise in any information system , any parts of this manuals.

TDE MACNO reserved itself the power of change in any moment the contents of this manual without particular warning

TDE MACNO declines any liability for errors in this manual and for the possible consequences.