TDE MACNO
s.p.a. tecnologie digitali elettroniche

BRUSHLESS DRIVES
DSC SERIES

User manual

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CONTENTS

1. GENERAL SAFETY INFORMATION

All the drives manufactured by TDE MACNO **S.p.A.** of Vicenza which belong to the **DSC** and **DSCT** series comply with the Low Tension 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**.

Important safety norms

In the design, installation, starting up, maintenance and checking of the drives the safety and accident prevention norms must be observed with regard to their specific use.

- Among others the following norms in particular must be observed :

  - CEI 64.8
    Electrical plant using a nominal voltage not greater than 1000V AC - 1500V DC
  - CEI EN 60204-1
    Machine safety; Electrical equipment in machinery
  - CEI EN 60146-1-1
  - LEGISLATIVE DECREE 626/94
    Accident prevention legislation

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 by 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 that there is always sufficient ventilation to discharge what is lost from the drive.**
- **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 supply of voltage cut off. As there are condensers wait at least 8 minutes before accessing the inside of equipment to work on it.**

2. CHARACTERISTICS

Sinusoidal Brushless motors DSC and DSCT drives are realized with a high performance IGBT power module structure, which can operate to high frequency with low losses. Some of the principal characteristics are the following:

- Speed and torque digital regulation. Drive parameters can be set by on-board keypad or serial line. The 3-key keypad allow quick data setting and displaying (4 1/2 digits).
- Speed and position feedback from motor resolver; resolver phase auto-tuning.
- Analog speed, torque and external current limit references from connector (+/-10V), or digital references from memory (set by keypad or by serial line).
- Digital inputs are isolated from regulation; connection with optocouplers.
- Automatic current loop parameters adaptation to the motor. The band of the current regulation is 2kHz.
- Possibility to connect directly to the mains by transformer or autotransformer.
- Regulation circuits can be supplied directly from the power connections or from optional auxiliary supply (to keep data in case of mains supply power fault).
- On-board clamping circuit, except the resistor connected externally.
- Cooling fan, if necessary, incorporated and supplied from the circuit control supplier.
- Parameters saving on EEPROM.
- Easy diagnostic of the drive "state" on the on-boarddisplay or the serial line.
- Fault protections displayed on the on-board keypad or on the serial line: MIN. and MAX. voltage, motor overheating, radiator over-temperature, resolver fault, power alarm (IGBT in protective block), etc.
- Simulated encoder output, tho channels and zero signal, number of pulses per revolution selectable by keypad.
- Single overcurrent protection on every power element.
- Transitory overloading (T<=100msec. from stop and T=2sec. With f>2.5Hz) equal two times the nominal current, with automatic reentry to nominal current.
- Frequency input by standard encoder TTL or by frequency & up/down directional signals.
- Possibility to use drive as point-to-point positioner.
- Sample time for logic inputs and ouputs : approx. 10ms
- Sample time for analog output : approx. 2ms

2.1. TECHNICAL DATA FOR DSC/DSCT DRIVES

2.1.1. REGULATING MAGNITUDES

Analog inputs	Range ± 10 V for speed and torque reference 0 - 10V for current limit Input impedance >20KΩ
Digital inputs	Opto-isolated, with separate supply Input impedance 1.5KΩ with series threshold 12V (≅8mA) level L : < 6V level H : > 18V
Digital outputs	Opto-isolated, transistor NPN with open collector and emitter Drive capacity = 30 Ma
Voltage reference outputs	+10V ± 2% Drive capacity 10 mA
Analog programmable output (A.P.O.)	Range ±10 V with 100 Ω impedance Drive capacity 2 mA
Analog outputs: tachometer (TG.O) Current (IOUT)	±10 V with 100 Ω impedance Drive capacity 2 mA

2.1.2. POWER CIRCUIT (DSC)

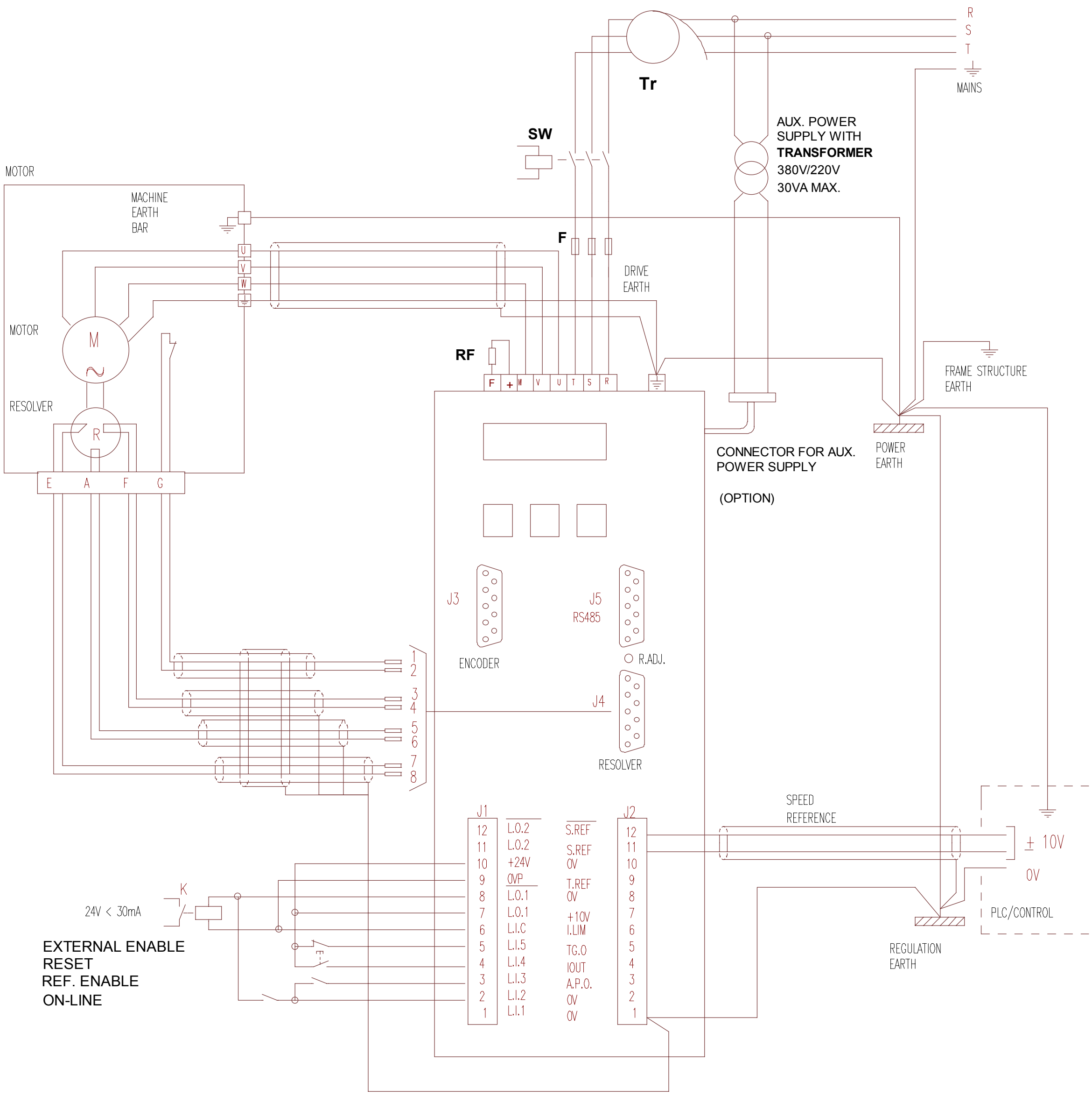
	DSC-03N	DSC-06N	DSC-10N	DSC-15N	DSC-20N	DSC-30N	DSC-40N	DSC-60N
INPUT VOLTAGE	3 x (140 - 240) Veff. 45-65 Hz							
MAX OUTPUT VOLTAGE (Veff)	3 x Vi x 0.9 (Vi = input voltage)							
OUTPUT FREQUENCY	0 - 400 Hz							
NOMINAL RMS CURRENT (A)	3.5	6	10	15	20	30	40	60
MAX RMS CURRENT (A) 100 ms for f=0 2.5 s for f>2.5 Hz	7	12	20	30	40	60	80	120
CLAMPING VOLTAGE	380 V c.c.							
OVERVOLTAGE LEVEL (V)	410							
MAX PEAK CURRENT (t<0.3 sec.) (A)	15			25		38		50
MINIMUM VALUE OF RESISTIVE LOAD Ω (W)	27 (100W)			15 (200W)		10 (300W)		15 (200 W)|| 15 (200 W)

2.1.3. POWER CIRCUIT RATINGS

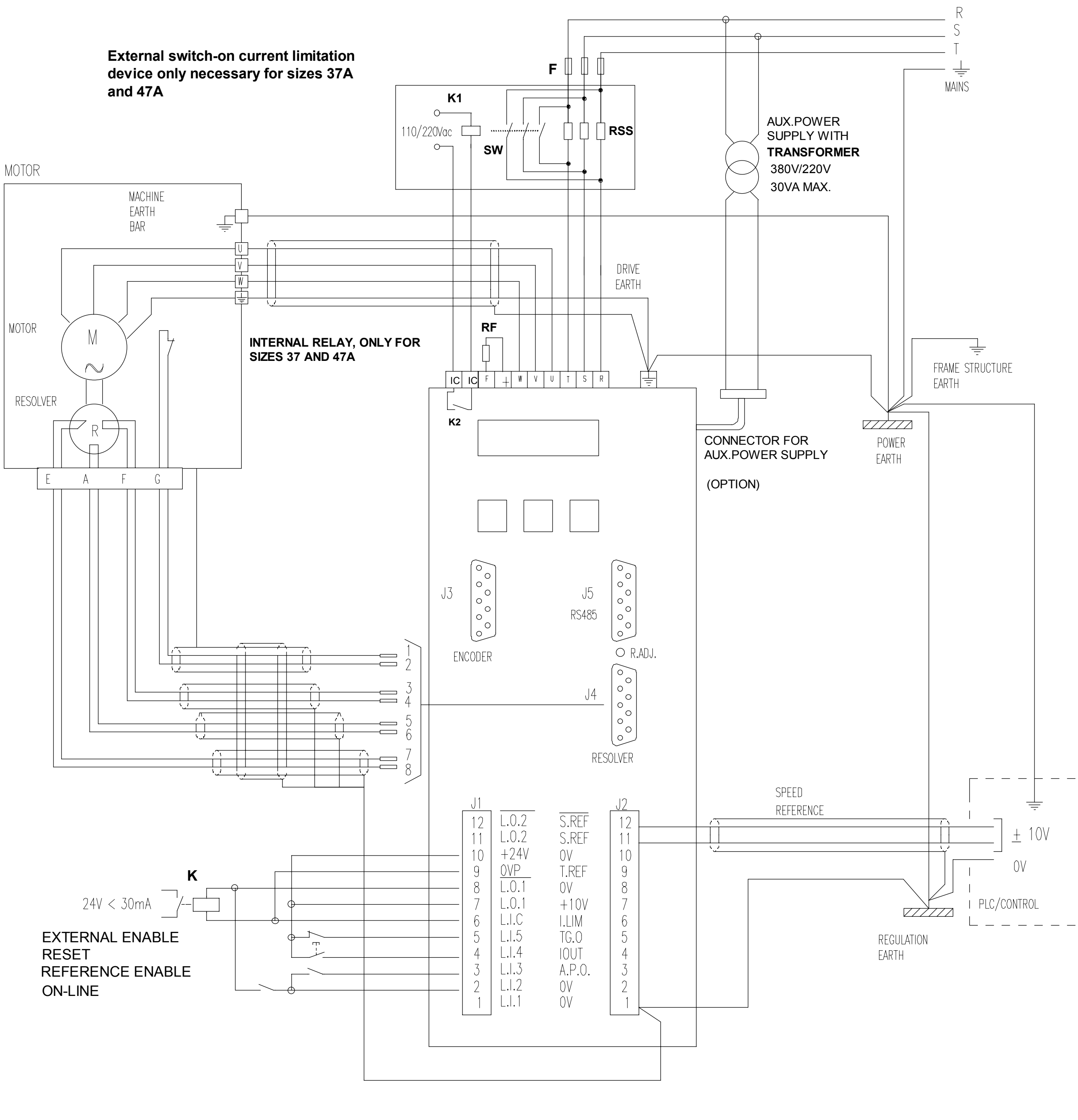
	DSCT-03N	DSCT-07N	DSCT-15N	DSCT-22N	DSCT-28N	DSCT-37N	DSCT-47N
3-PHASE MAIN SUPPLY	3 x (340 ÷ 460) Veff. 45÷65 Hz						
MAX OUT.3-PHASE VOLTAGE	3 x Vi x 0.9 (Vi = voltage input)						
OUTPUT FREQUENCY	0 ÷ 400 Hz						
NOMINAL RMS CURRENT (A)	3.5	7	15	22	28	37	47
MAX RMS CURRENT (A) 100 ms per f=0 2.5 s per f>2.5 Hz	7	14	30	44	56	74	94
CLAMPING VOLTAGE	720 V c.c.						
OVERVOLTAGE LEVEL (V)	800 Vcc						
PEAK CLAMP CURRENT A (t<0.3 sec.)	9		18	24		36	
MINIMUM VALUE OF RESISTIVE LOAD Ω (W)	82 (100W)		82 (100W)|| 82 (100W) ≅ 40Ω 200W	15 (300W) + 15 (300W) ≅ 30Ω 600W		10 (300W) + 10 (300W) ≅ 20Ω 600W	

3. FIRST INSTALLATION INSTRUCTIONS

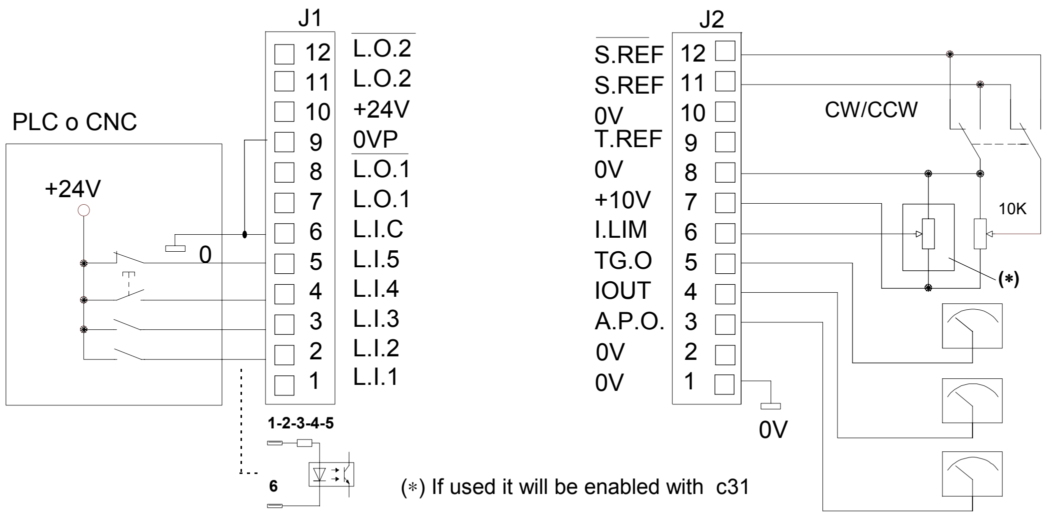
3.1. GENERAL SCHEME OF THE DSC DRIVE CONNECTIONS (3 X 220VAC)



3.2. GENERAL SCHEME OF DSCT DRIVE CONNECTIONS (3 X 380 VAC).



3.3. DEFAULT CONNECTIONS



Meaning and programming of digital I/O defaults (connector J1):

L.I.1	Torque enable	Enables the drive to work with external torque reference signal T.REF(±10V)
L.I.2	Run	Enables the power to the motor.
L.I.3	Reference 1 enable	Enables the speed reference present in S.REF and S.REF/.
L.I.4	Alarm reset	Resets the alarms if the alarm causes have been removed (minimum time of transition T=100mS).
L.I.5	External enable	If this input is in the LOW state, the drive is in alarm A8, and is not ready. (External emergency)
L.O.1 L.O.1/	Drive ready	Active when the drive is ready to run (no alarm presence).
L.O.2 L.O.2/	Drive running	Active when the drive is running.

Meaning of the analog signals (connector J2):

S.REF S.REF/	Differential speed reference input ±10V
I.LIM	Maximum current limit 0÷ +10V
TG.O	Actual speed output -10V ÷ +10V
IOUT	Torque current request output -10V ÷ +10V
A.P.O.	configurable analogic output.

Note: L.I.1÷L.I.5 are comanded by signals between the range of 18V÷27V.

3.4. KEYPAD

3.4.1. DESCRIPTION OF KEYBOARD OPERATION

The keyboard has three keys: '**S**' (selection), '**+**' (increase) and '**-**' (decrease), and it has a display with four and a half digits plus the decimal points and the minus sign '-'.

3.4.2. IDLE STATE

When the equipment is switched on, the keyboard displays "**Stop**"; if there are any alarms, the keyboard flashes, displaying "**Stop**" intermittently. When the drive is working, if no special magnitude to be displayed has been set (see '**c13**'), magnitude **d5** is displayed. The keyboard automatically returns to the rest state ten seconds after the last operation, expecting that it doesn,t display an internal quantity or a digital state.

3.4.3. SETTING AND READING OF PARAMETERS AND CONNECTIONS

Press push-button '**S**' and the keyboard will display the last parameter or magnitude selected, then, by using the '+' and ' -' keys, scroll the menu up and down until you find the address of the parameter (**P**) or of the connection (**c**) to be read and, if necessary, corrected. Next to the number of the parameter or connection the letter 'r' appears if the parameter is reserved, '**t**' if it is TDE-reserved and '**n**' if it is a parameter that can be modified only when the drive is not running; all the reserved parameters are '**n**'-type parameters which may be modified only when the drive is not running (off-line).
On pressing key '**S**', the parameter value is displayed and can therefore be read; press '**S**' again to go back to the menu and the system also automatically goes back to the menu 10 seconds after the beginning of the display; to correct the parameter or connection value, when this is displayed, press the '-' and '+' keys at the same time; the decimal point of the first figure at the left then starts to flash, which means that, from that moment on, pressing the '-' and '+' keys changes the value set. The value is changed only from stop if the parameter is OFFLINE or only after the access code, **P50**, has been set, if the parameter is reserved, or **P80** for TDE-reserved parameters.
The TDE-reserved parameters and connections are not listed, unless access code **P80** is set.
Once the value has been corrected, press '**S**' to go back to the menu confirming the modified parameter or connection; to exit without confirming, just wait for ten seconds and then the keyboard will display the address discarding the changed value; if the value is not touched, just press '**S**' to exit (the previous value will be confirmed). Once in the menu, the keyboard automatically returns to the rest state.

3.4.4. DISPLAY OF INTERNAL MAGNITUDES

Move from the menu with the '**+**' or '**-**' keys until the address of the magnitude to be displayed '**dxx**' appears; on pressing '**S**' the address disappears and the value is displayed.
Return to the menu from this state by just pressing '**S**'; returning from the menu to the rest state is automatic after 10 seconds.

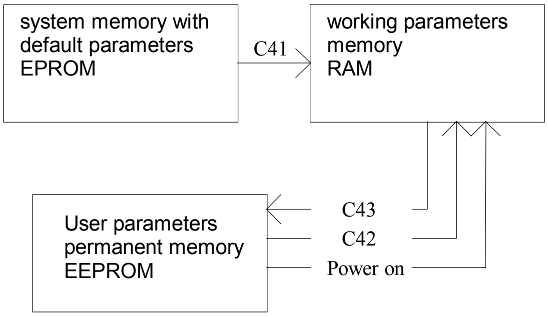
3.4.5. DISPLAY OF I/O AND ALARMS

From the menu use the '+' and '-' keys to move to the address required for the digital inputs (**i**), the outputs (**o**) and the alarms (**A**); the box to the right shows this and the state: 'H' = active (high), 'L' = not active (low). To return to the rest state from this state, just press '**S**'.

ATTENTION: For the complete list of all the magnitudes given by the keypad, refer to the chapter 9 on the user manual.

3.5. SAVING AND RESETTING PARAMETERS

The drive has a permanent memory (EEPROM) where parameters are stored. When the drive is switched on, the drive transfers the parameters from the user permanent memory (EEPROM) to the working memory (RAM). All the parameter 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), it means that permanent values can not be read from the EEPROM; it is necessary to reset the system: reset the default parameters (**c41**=1), and then save them in the user permanent EEPROM memory (**c43**=1), overwriting the wrong parameters.
To return to the initial parameters in the permanent memory (EEPROM) after the changes in the working memory (RAM) have been made, without switching off and on again, just activate connection **c42** (**c42**=1).
These procedures are explained below :



N.B. As the default parameters are standard parameters which are certainly different from the customised parameters, it is important to copy the parameters of the user permanent memory carefully after the installation for each drive, so that, if necessary, they can be copied in a spare drive, or if the memory is resetted with the default parameters.

3.6. DESCRIPTION OF FONDAMENTAL DATA

In the following are described the parameters, the connections and the minimum displaying magnitudes necessary for the initial function of the drive. To have the first general vision of all the data prepared for the customer it's necessary to read the paragraph 9 of the manual user.

3.6.1. PARAMETERS

(Note: n= off-line, r=reserved customer, t= TDE customer)

SECT.		DESCRIPTION	FIELD	DEFAULT	Notes
P	1	JOG 1 speed	±100.0%	0.0%	
P	2	JOG 2 speed	±100.0%	0.0%	
P	3	JOG 3 speed	±100.0%	0.0%	
P	23	Speed loop proportional gain	0.5-100.0	4.0	
P	24	Speed loop lead constant time	4.0-150.0 ms	40.0 ms	
P	50	Reserved parameter access key	0÷9999		n
P	51	Drive identification number for the serial line	1÷255	255	r
P	52	Setting maximum motor speed (rpm/1')	375÷19000	2500	r

3.6.2. CONNECTIONS

(Note: n = off-line , r = reserved to the customer, t = TDE-reserved)

CON.		DESCRIPTION	RANGE	DEFAULT	Notes
c	26	Ramp inclusion	0(excluded) 1(included)	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

3.7. GETTING STARTED

1. Verify that the connections are well done, that the terminals are well tighten and that the correct resolver cable is used (see par 5.1).
2. Disconnect the power terminals of the motor.
3. Supply the drive and after a laps of time it will appear at the display the stable term "stop" if there are no alarms, light blinks if there are.
4. Configure the drive parameters: inputs (**c1** - **c5**), outputs(**c7**-**c8**), and the motor parameters, motor current (**P56**), motor poles (**P53**), resolver poles (**P54**), ecc.
5. Set at a low value (5%) the internal limits, **P35**, **P36**, and set to zero the velocity reference.
6. Reconnect the power terminals of the motor and start running (L.I.2).
7. If no alarm appears, on the display will appear the motors speed in RPM.
8. The motor must be in stillstand the reference is digital or moving very slowly if analog.
9. Setup the limits **P35 P36** and calibrate if necessary the speed offset with the **P4** parameter.
10. Give some reference and verify the correct working, in particular for a correct speed and eventually tune the controller parameters (**P23, P24**) for a better dynamical response of the drive.
11. Execute motor cycles and see that everything is correct.
12. Save the parameters in EEPROM.

ADVISING: If during the operativity just explained, in particular at points 8 and 10, the motor goes over cycles or it doesn't move or it moves in kicking way, verify the correct execution of the electric cables.
The drive is already tuned to the motor specified at the ordering.

3.8. MALFUNCTIONING WITH ALARM SIGNAL : DIAGNOSIS

SAFETY ACTIVE		DESCRIPTION	REMEDIES
A1	Internal supply error	The internal voltages are incorrect	Check the +24V in the pin J1-9 and J1-10
A2	RAM , EEPROM alarm	The drive reads wrong parameter values	If the problem remains after turning on/off the drive, it is necessary to make the C41 configuration (reloading default values) or C42 (reloading EEPROM values) and than use C43 (EEPROM writing). See par. 3.5
A3	Power alarm	The output current from the drive has reached such levels that the saturation control circuit of the I.G.B.T. has intervened; this may be caused by an overcurrent due to dispersion in the cables or in the motor or to a short circuit between the drive output phases. Or it may be due to a breakdown in the regulation.	Check the connection cables particularly on the motor side of the terminal block to remove any dispersion or short-circuiting; check the insulation of the motor itself, doing a dielectric rigidity test, and if necessary replace it. Check that the drive power circuit is working by making it run after disconnecting the motor; if the safety device intervenes the power circuit is damaged. If the safety device only intervenes during working it could be a matter of regulation (replace it along with the current transducers) or vibrations causing voltage transients.
A4	Radiator thermal switch alarm	The radiator temperature sensor has switched on because the radiator temperature is too high.	Check the drive cooling circuit ; the ventilator, its feed and the slits and filters for the entry of air into the cabinet ; if necessary replace them or clean them and ensure that the ambient temperature (near to the drive) is within the permitted limits for the technical characteristics. If everything is in order and the alarm continues even when the drive is cold check the connecting wires to the thermal switch.

SAFETY ACTIVE		DESCRIPTION	REMEDIES
A5	Motor thermal switch alarm	The motor temperature sensor has switched on because of excessive coil temperature.	Check the motor cooling circuit is complete ; the ventilator, its feed, the slits and filters for the entry of air, and if necessary replace or clean them, and also check that the ambient temperature (near to the motor) is within the permitted limits for the technical characteristics. If everything is in order and the alarm signal is still on even when the motor is cold, check the connector wires of the thermal probe and of every auxiliary devices. If it's used a motor with thermal bimetallic protection, if this is measured between pins 1 and 2 of J4 it must be closed. If it's used a motor with thermal protection like PTC, from pins 1 and 2 of J4 it must be measured it's nominal value at the corrisponding ambient temperature.
A6	Motor in thermal overload	The motor overload safety electronic device has been activated by excessive current absorption for prolonged period.	Check the motor load and consider if its reduction may stop the intervention of the safety function. Check the level of the setting thermal current, if necessary correct it, and also check that the value of the thermal constant is sufficiently long. Check the power of the motor being adequate to the load and if necessary increase it.
A7	Resolver failure	Resolver failure indicates that the drive does not find its proper resolver connection	Check the resolver connections and that all connections have been made according to the connection scheme (see motor user's manual and connection scheme). Check the resolver shield and grounds being connected properly (in particular the resolver shield must be wired to pin 1 or 2 of J6, and then the 0V must be grounded).
A8	Intervention of the external alarm	The external enable signal is no more present, and the drive has not the consent to work	The external safety has removed the enable signal to the drive: give it back and reset. The continuity of the connection has been lost; check and remove the fault.
A9	Overspeed	The drive indicates that motor speed is above the max. allowed. (P52)	Check the parameters that change the motor dynamics (P23, P24, P25).
A10	Minimum voltage in the DC power circuit	The voltage of the intermediate circuit of the drive is below the minimum range. The safety functions is tripped when the input voltage drops below the permitted value	Undervoltage may occur when the main transformer power is not sufficient to support the loads, or in case that there is not the correct 220 AC three phase voltage (for instance one phase is not powered). Check the voltage in RST .
A11	Overvoltage of the DC power circuit	The voltage of the intermediate voltage circuit is strongly increased due to excessive regenerative energy coming from the motor, e.g. in slow down phase, and the limit of overtension is exceeded	This alarm can happen if the motor is often breaking in his working cycle. Even overvoltage on the mains side can lead to the intervention of this safety function. If the drive has a clamping circuit check that the value of the resistor is not too high to absorb the peak power. Check, if the resistor is not heating up, its continuity, the connections and functionality of the circuit itself.

SAFETY ACTIVE		DESCRIPTION	REMEDIES
A12	Input configuration error	Two digital input were set with the same function.	Check inputs configuration.
A13	pole setting error	The drive has been set with a wrong poles number (P53, P54).	Check poles number.
A14	Mains connections error	Motor phases U,V,W are inverted.	Check the sequence of motor phases.

4. 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:

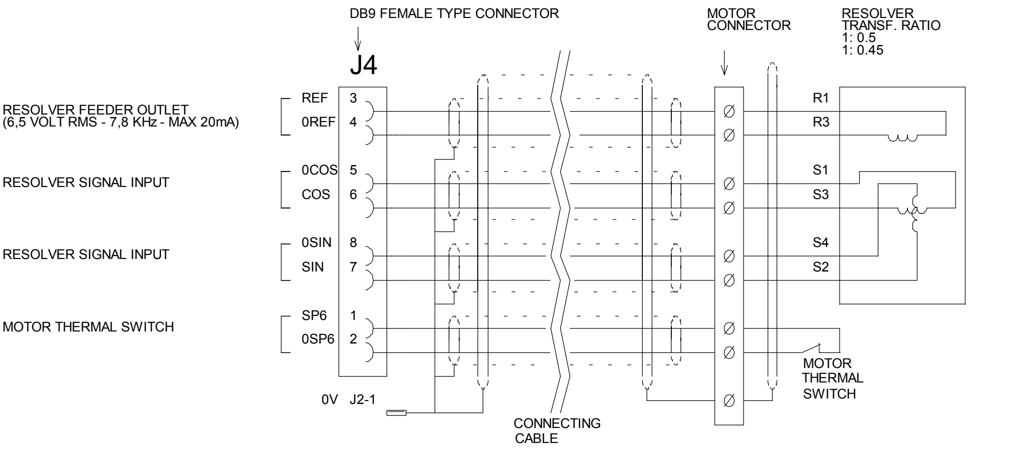
- Use the DSC or DSCT drive with an external EMC filter (Shaffner, …).

- 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 gasket

5. DESCRIPTION OF THE SIGNALS ON THE CONNECTORS

5.1. CONNECTING CABLE TO RESOLVER (CONNECTOR J4)

DB9 FEMALE TYPE CONNECTOR TO BE CONNECTED TO RESOLVER AS SHOWN IN THE FOLLOWING FIGURE

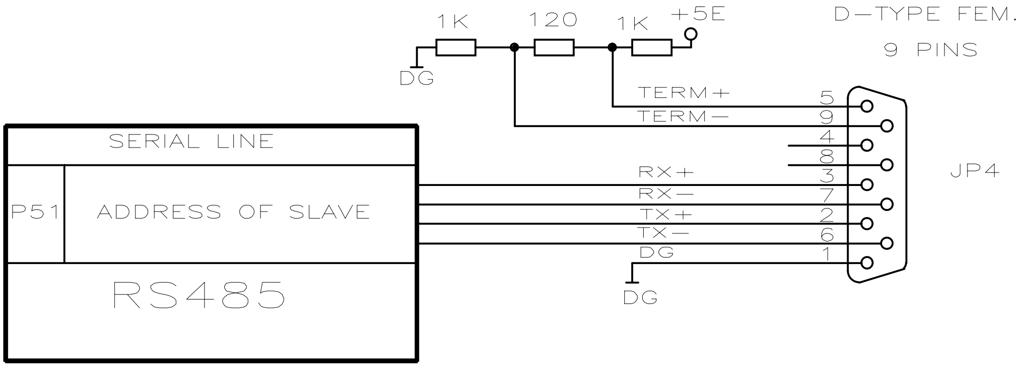


RESOLVER	ARTUS	ES. 26S19RX452b.F	RAP.TRAS. 0.5
USED	TAMAGAWA	ES. TS2640N71E10	RAP.TRAS. 0.5
CABLE	: INTERCOND SPECIALFLEX H 4x(2x0.25SK) COD. 2MB 24P 04R		

THE RESOLVER MUST BE OF THE SAME TYPE ALREADY USED, SEE TABLE, OR THEY MUST HAVE THE SAME FEATURES.
THE CONNECTING CABLE MUST BE 4-BIGHTS PLAIED AND SHIELDED PLUS EXTERNAL SHIELD.
THE SHIELD ON THE CONNECTOR SIDE J4 MUST BE CONNECTED TO TERMINAL 1 OF CONNECTOR J2 AND FINALLY CONNECTED TO THE ADJUSTING EARTH BAR AS SHOW IN PARAGRAPH 1.2.

fig. 1

5.2. SERIAL LINE CONNECTOR (CONNECTOR J5)



The serial line communicates in <u>half duplex</u> on <u>four wires</u>: RX+ and RX- are receiving wires for the drive while TX+ and TX- are transmitting wires. It can be done the connection with only <u>two wires</u> connecting together RX+ and TX+, and RX- and TX- (each couple of wires must be twisted).

There is the possibility to 'terminate' the connection with 120Ω of impedance and polarizing the line connecting the terminals 5 with 3 and 9 with 7.

It is available a simple PC supervisor software (DOS or Windows 95) for the DSC/DSCT series drives.

5.3. SIGNALS ON THE CONNECTORS

5.3.1. LOGIC SIGNALS (CONNECTOR J1)

PIN	FUNCTION	DESCRIPTION	PAR.
1	L.I.1	Logic configurable inputs ON = +24Vdc (>18Vcc) 10mA max. OFF = 0Vcc (<6Vcc) All inputs are opto-insulated from the internal regulation.	7.1
2	L.I.2		
3	L.I.3		
4	L.I.4		
5	L.I.5		
6	L.I.C	Common connection of the logic inputs. Connect to the negative pole of the inputs supply.	7.1
7	L.O.1	Logic configurable output Transistor NPN with free collector (L.O.1) and emitter (/L.O.1), insulated from the regulation and protected from overvoltage. In CONDUCTION when output is ACTIVE : +24 Vdc 30 mA max;	7.2
8	/L.O.1		
9	0VP	Internal supply +24V, insulated from the regulation	
10	+24V		
11	L.O.2	Logic configurable output Transistor NPN with free collector (L.O.1) and emitter (/L.O.1), insulated from the regulation and protected from overvoltage. In CONDUCTION when output is ACTIVE : +24 Vdc 30 mA max;	7.2
12	/L.O.2		

5.3.2. ANALOG SIGNALS (CONNECTOR J2)

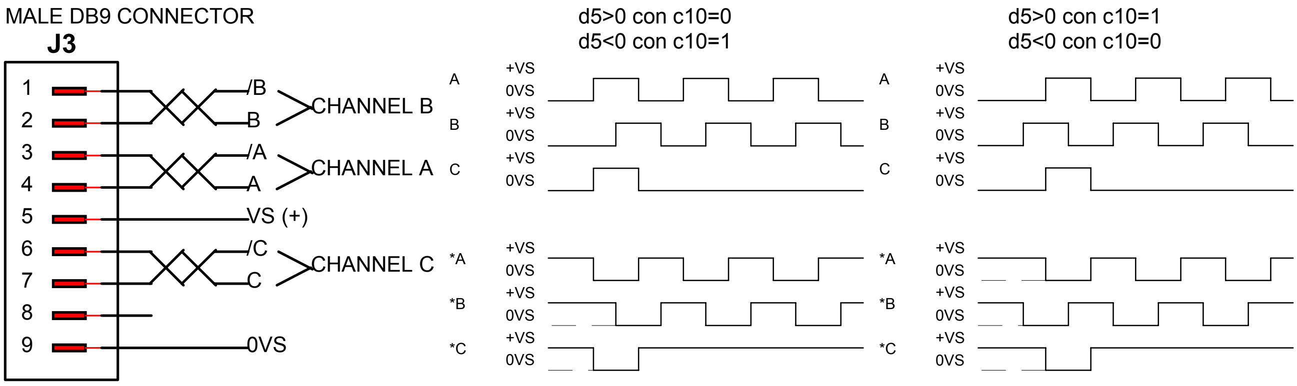
PIN	FUNCTION		PAR.
1	0V	Regulation 0V	
2	0V		
3	A.P.O.	Analog configurable output: ±10V /2mA Default configuration: CURRENT REQUEST(c13=11)	7.3
4	I.OUT	Current request output signal ±10V <2mA	
5	TG.O	Motor speed analog output ±10V <2mA	
6	I.LIM	Analog input Max. Current Limit 0÷+10V <0.5mA	
7	+10V	+10V / 10mA max. Stabilized power supply	
8	0V		
9	T.REF	Analog input Torque Reference ±10V <0.5mA	
10	0V	0V of the speed reference	
11	S.REF	Speed reference differential input. ±2.5V÷ ±10V <0.5mA	
12	/S.REF		

5.3.3. FREQUENCY INPUT CONNECTOR (CONNECTOR J6)

PIN	FUNCTION	
1	FA	Channel /A input.
2	FA/ (F)	Channel A/ input or frequency input.
3	FB	Channel B input.
4	FA (UP/DOWN)	Channel B/ input or UP/DOWN
5	0DG	0V of the frequency input

5.4. SIGNALS ENCODER EMULATION (CONNECTOR J3)

The frequency of the signals depends on the motor revolutions, the number of resolver poles and the selection made (see connection **c10, c11 and c12**) and their behaviour in time depends on the tachometer signal and on **c10** as shown in the figures below



5V≤VS≤30V

Fmax=500KHz for channel

The encoder simulated outputs are all driven by a " LINE DRIVER" type ET7272.Their level in the standard drive version is referred to +5V and than it is connect to the internal supply (TTL +5V). In option there is the possibility to refer the signal level to an external supply whose value must be between +5V and +24V (connection on terminals 5 and 9, (TTL 24V)).

For the immunity it is better to use a differential input (where the signal arrives) in order to avoid loops with zero reference; to limit noise effects it is better to load this input (10mA max).
It is necessary to use a <u>twisted shielded cabe</u> to make a proper connection.

Attention, the external power supply zero is connected with the drive zero; (it is not optoisolated).

Attention, for the encoder simulation with external supply (standard drive version) you must not connect the terminal 5 (VS) because it could seriousuly demage the drive.

6. Power: Connections And Sizing

6.1. POWER OF DSC DRIVE

6.1.1. TRANSFORMER SIZING

The power necessary for a single drive is the power available from the motor shaft; considering that the efficiency of the inverter is of order of 97% and the one of the motor is of order 93%, it can be given from the formula:

Power given by the motor:

$Pw = T * N * 0.1163$ (W) with N = max. working rpm, T = working torque in Nm

For the power of the transformer it's necessary to consider:

KVA(T)=P(KW)*1.1 with 1.1=current form factor

With more inverters in parallel between them the power of the autotransformer or of the transformer can be calculated knowing the sum of the powers of all the motors multiplied with a coefficient<1 that reminds the contemporary use of the drives: that coefficient depends from the type of system and must be evaluated case by case.

6.2. POWER OF DSCT DRIVE

6.2.1. CALCULATION OF THE REACTANCE OR OF THE AUTOTRANSFORMER

For the sizing of the reactance or of the autotransformer, it's necessary to consider the power necessary for a single drive. Considering that the efficiency in the inverter is of order 97% and that of the motor is 93%, the power necessary equals the power raised from the motor divided by the efficiency as reported from the following formula:

$P = T * N * 0.1163$ (W) with N = max. working rpm, T = working torque in Nm

If Vmains is the mains voltage (V) and f is the mains frequency (Hz) then:

$Lchoke \geq 2 * \frac{Vmains^2}{f * P}$ (mH) value of the inductance

$It \cong 0.7 * \frac{P}{Vmains}$ (A) choke thermal current

$Isat \cong 3 * It$ (A) peak saturation current

if it is used an autotransformer or a transformer the ratings of the apparent power VA has to be:

$VA \cong P * 1.2$

6.2.2. SIZING OF PROTECTIVE FUSES AND CABLES

The connection with the mains can be effectuated directly (DSCT) or with the insulating transformer (DSC). Protective fuses must be provided to protect the cables and the drive in case of short-circuit; the cables must be chosen reminding the size of the supplier and of the motor. With the direct insertion to the mains, it must be provided a reactance in series to the supplier to limit the current peak and in part the disturbances on line.

For the peak current it's enough a reactance with a drop of 1-1,5% of the voltage at the nominal current of the supplier.

To choose the fuses follow these rules:

a) In case of direct connection (without a limiting current device) the peak of the start current must be taken in count, and so the size of the fuse must be calculated from the data of the nominal current of the autotransformer or of the transformer multiplied by a factor 2,5 or 3.
b) If there is a soft-start circuit, the multiplied factor can be just a little higher than one.
c) The section of the supplying cables must guarantee a correct intervention of the fuses.

ATTENTION

The necessity of the limiting device (SOFT START) can be evaluated estimating the output impedance of the supplier, so without using that device, it must be higher than these limits:

SIZE 3 - 6 - 10 Z=> 0,21 OHM
SIZE 15 - 20 Z=> 0,16 OHM
SIZE 30 - 40 Z=> 0,12 OHM
SIZE 60 Z=> 0,08 OHM

SIZE OF THE INVERTER	AUTOTRANSFORMER (with Vcc≥1,7%Vn) PASSING POWER	TRANSFORMER (con Vcc≥2,5%Vn) POWER
3 - 6 - 10	3,8KVA	5,8KVA
15 - 20	5,0KVA	7,5KVA
30-40	6,7KVA	10KVA
60	10KVA	15KVA

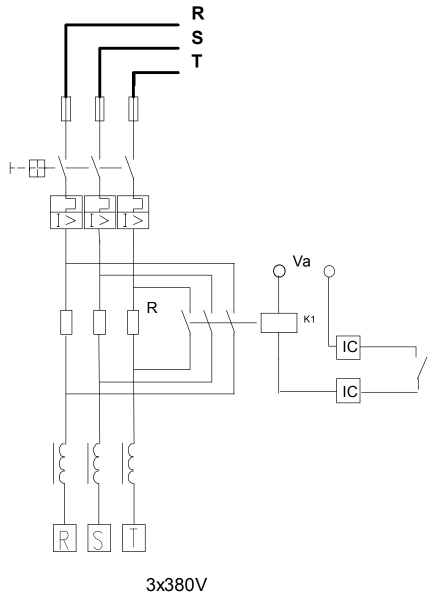
6.3. AUXILIARY POWER SUPPLY (OPTIONAL)

The power fault at the R,S,T input implicates the autonomy for a few seconds of the drive so that it results impossible the manitenance of the data and of the encoder. To solve this problem the TDE MACNO drives are provided of a second input for single-phase supply with an appropriate connector.
The auxiliary supply must be done with a single-phase TRANSFORMER having a power not higher than 30VA (for a single inverter) and a second voltage of 220V/+10/-20% for the series DSC and DSCT.
The connection must be executed as indicated in the paragraphs 3.1 and 3.2.
In the DSCT drives (3x380Vac) it's necessary to give first the mains power and later the auxiliary supply, otherwise the regulation does not switch on.

6.4. CONNECTION WITH SOFT-START CIRCUIT

The DSCT drives till the size of 28A have an incorporated device that limits the insertion current. That kind of device is constituted from a resistor applied after the bridge rectifier and before the capacitors, and from a relay that short-closes when the capacitors have been completely charged from the network voltage.
For the sizes DSCT-37 and DSCT-47 it's provided only the relay whose contact (terminals IC) closes when the capacitors have been charged and the drive is ready to run. That contact must be used together with a contactor and with three resistors to limit the insertion current; the contact is adaptable to open a voltage of 250Vac with a power of 2.5KVA.

Soft-start circuit for DSCT drive:



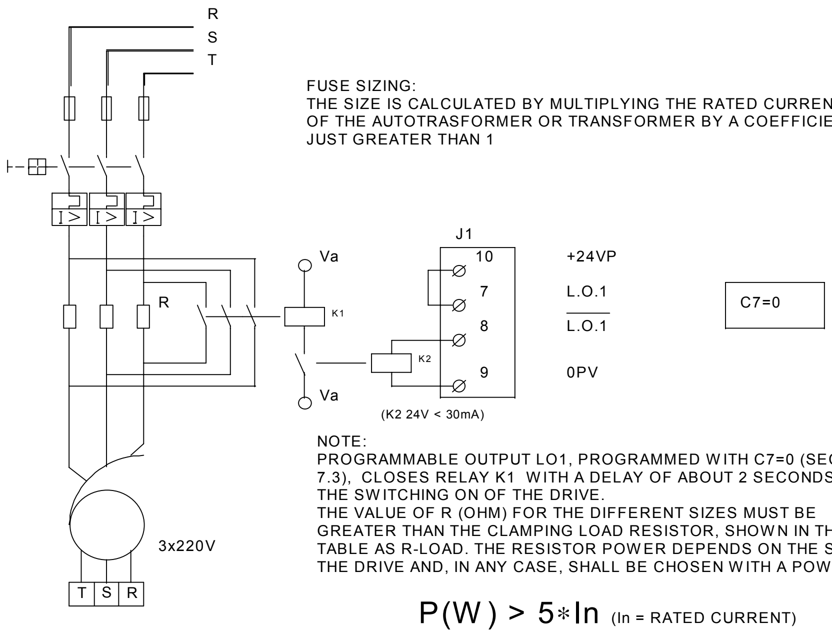
NOTE:

ITHE VALUE OF R (OHM) FOR THE DIFFERENT SIZES MUST BE GREATER THAN THE CLAMPING LOAD RESISTOR

THE RESISTANCE POWER DEPENDS ON THE SIZE AND IN ANY CASE IT SHALL BE CHOSED WITH A POWER :

P(W) > 5∗In (In = RATED CURRENT)

Soft-start circuit for DSC drive:



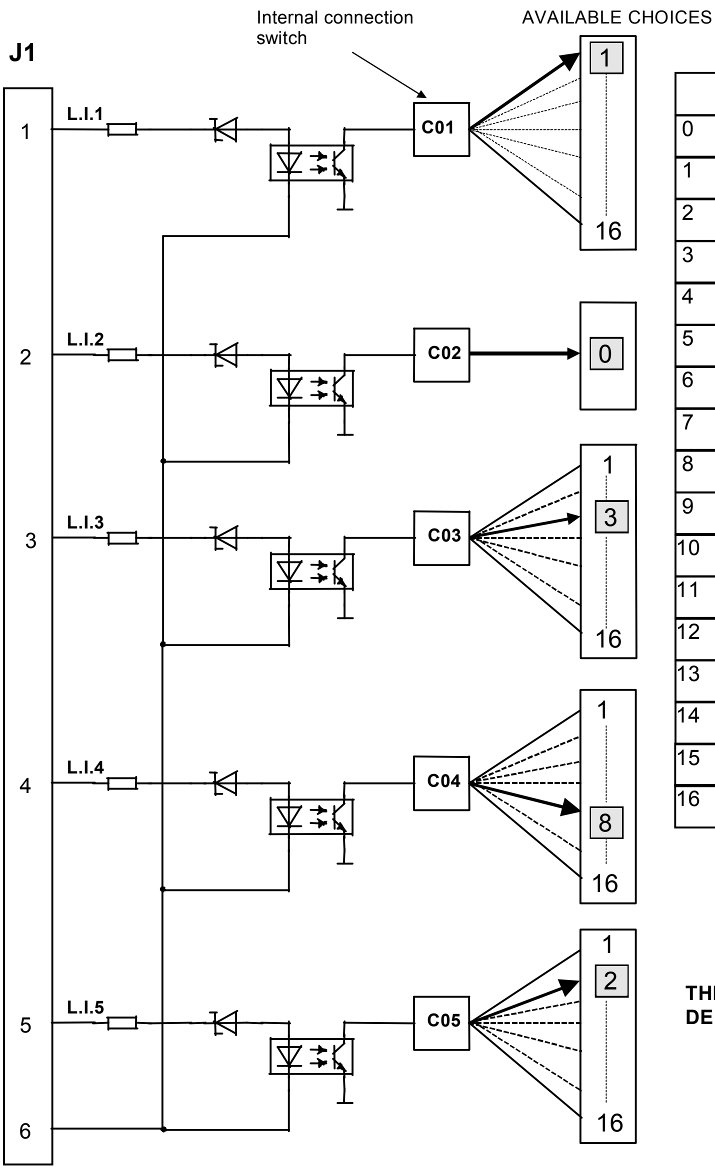
FUSE SIZING:
THE SIZE IS CALCULATED BY MULTIPLYING THE RATED CURRENT OF THE AUTOTRASFORMER OR TRANSFORMER BY A COEFFICIENT JUST GREATER THAN 1

NOTE:
PROGRAMMABLE OUTPUT LO1, PROGRAMMED WITH C7=0 (SECTION 7.3), CLOSES RELAY K1 WITH A DELAY OF ABOUT 2 SECONDS AFTER THE SWITCHING ON OF THE DRIVE.
THE VALUE OF R (OHM) FOR THE DIFFERENT SIZES MUST BE GREATER THAN THE CLAMPING LOAD RESISTOR, SHOWN IN THE TABLE AS R-LOAD. THE RESISTOR POWER DEPENDS ON THE SIZE OF THE DRIVE AND, IN ANY CASE, SHALL BE CHOSEN WITH A POWER:

P(W) > 5∗In (In = RATED CURRENT)

7. CONFIGURATIONS

7.1. LOGIC INPUTS CONFIGURATION



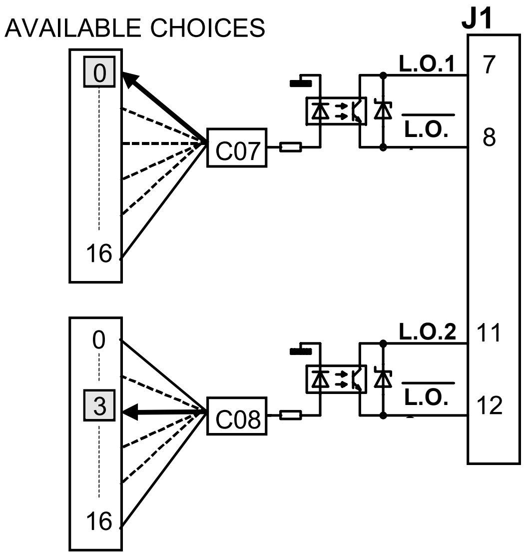
	LISTING OF AVALABLE FUNCTIONS	
0	ON LINE	
1	TORQUE ENABLE	L
2	EXTERNAL ENABLE	H
3	REF1 ENABLE	L
4	REF2 ENABLE	L
5	LIMIT SWITCH 1	H
6	LIMIT SWITCH 2	H
7	EXTERN. LIMIT ENABLE	H
8	ALARMS RESET	L
9	START POSITION 1	L
10	START POSITION 2	L
11	POSITIONER/SPEED	L
12	CW/CCW	L
13	RAMP ENABLE	L
14	START POS.1/POS.2 ALTERNATE	L
15		
16	L= ANALOG REF. / H= REF. FROM c14	

DEFAULT STATE (IF NON ASSIGNED)
H=ON
L=OFF

THE THICK LINE INDICATES THE DEFAULT PROGRAMMING

7.2. LOGIC OUTPUTS CONFIGURATION

AVAILABLE OUTPUT FUNCTIONS	
DRIVE READY	0
MOTOR THERMAL ALARM	1
SPEED GREATER THAN MINIMUM	2
DRIVE ON-LINE	3
CW/CCW	4
SPEED REGULATOR SATURATION	5
RAMP END	6
SPEED IN RANGE	7
CURRENT IN RANGE	8
MOTOR BLOCKED	9
STOP IN POSITION	10
RAMP ACTIVE	11
DECELERATION AREA	12
STOP IN POS. 1	13
STOP IN POS.2	14
	15
SPEED < P41 AND POSITION ERROR < 1	16



THE THICK LINE INDICATES DEFAULT PROGRAMMING

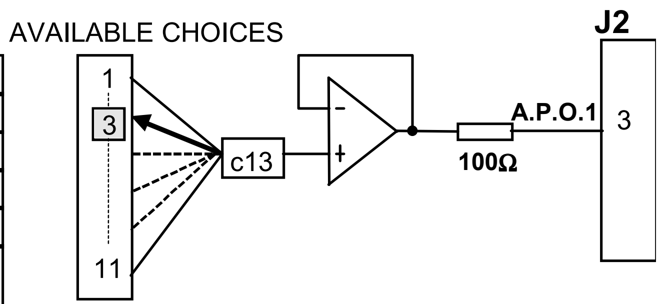
Maximum current 30mA/24Vcc

In the version DSCT (3x380Vac) the logical output **C07** is not programmable and remains then configurated as signal of *drive ready* .
The maximum current is about 30mA.

7.3. ANALOGIC OUTPUT CONFIGURATION

With the connection **c13** it is possible to read on the programmable analog output at the terminal J2-3 some of the internal values; in particular are possible the following scheme connections:

AVAILABLE OUTPUT FUNCTIONS	
EXTERNAL SPEED REFERENCE	1
REFERENCE BEFORE THE RAMP	2
REFERENCE AFTER THE RAMP	3
SPEED FEEDBACK	4
INTEGRAL PART OF THE SPEED REGULATOR	6
EXTERNAL TORQUE REFERENCE	7
CURRENT REQUEST	11



THE THICK LINE INDICATES THE DEFAULT PROGRAMMING

output ±10V/2mA

7.4. OUTPUT ENCODER SIMULATION CONFIGURATION

On the connector J3 there are two simulating channels of a bidirectional encoder with a number of pulses for r.p.m. selectionable with **c11** as indicated in the following table:

c11	Pulse/cycle motor/(**P54/2**)
0	0
1	64
2	128
3	256
4	512
5	1024
6	2048
7	4096

The value of default of **c11**=4
as it can be seen the number of pulses depends even on the number of resolver poles, set in the parameter **P54**, and in particular are valid the numbers written above if the resolver is two poles.
The output of the pulses is comanded by a line driver (ET7272), however the choice of the number of pulses must be done to obtain a maximum frequency for each channel lesser than 500kHz.
Maximum output frequency is computed as follows:

$Fr = \frac{P52}{60} \cdot N \cdot \frac{P54}{2}$, where N is the number of encoder pulses set in **c11**.

Example :

P52 = 3000 c11=5 (1024 pulses per rev.)
P54 = 2 resolver poles

$$Fr = \frac{3000}{60} \cdot 1024 \cdot \frac{2}{2} = 51200\ \mathrm{Hz}$$

The third channel generates a number of zero pulses in phase with channel A, equal to the number of poles of the resolver divided by two (**P54/2**); in particular there is only one zero pulse for one motor rotation with a two-pole resolver.
The position of the zero pulse depends from the way it's connected the resolver on the motor shaft; however respect to the original position, which corresponds to the resolver zero position, the simulated encoder zero position can be moved with 90° electric steps with the connection **c12** as indicated in the following table:

c12	resolver zero pulse shift
0	+0°
1	+90°
2	+180°
3	+270°

The default value is 0.
Those electric degrees corresponds to the mechanical degrees if the resolver is of two poles.
The connection **c10** inverts the channel B of the simulated encoder inverting in this way it's phase respect to channel A, for equal sense of rotation (see paragraph 5.4). For default **c10**=0.

8. DIAGNOSTICS

8.1. DISPLAYS

The logic and analog values can be displayed on keypad or by serial line determining the diagnostic in case of failures, protections or uncorrect working. The respective detailed list is reported on 9.3.

8.2. EXCLUSION AND ALARMS

In presence of any alarm the drive goes in block and the signal DRIVE READY becomes inactive. When the drive is in alarm situation the display flashes; it can be seen which are the alarms looking at the alarm indications (**Axx**) and watching which are active (H); the inactive alarms are low (L).
The alarms reset has effect if the failure causes have been removed. The reset is done by the programmed input or by keypad **c30**=0→1.
With connection **c19** it can be excluded the intervention on the drive of the following alarms:

c19=0	no alarm excluded
c19=1	excluded power alarm (**A3**)
c19=2	excluded radiator thermal switch alarm (**A4**)
c19=4	excluded motor thermal switch alarm (**A5**)
c19=8	excluded overspeed alarm (**A9**)
c19=16	excluded resolver failure alarm (**A7**)

It can be excluded more alarms at the same time by setting in **c19** a number between 1 and 31 calculated in the following way:

c19=1x**A3** + 2x**A4** + 4x**A5** + 8x**A9** + 16x**A7**

where the Ax can assume the values 0 or 1 if it isn't or it is desired the exclusion of the relative alarm.

Example of excluded alarms

C19 = 16	exclusion of resolver alarm
C19 = 8	exclusion overspeed alarm
C19 = 24	exclusion of resolver and overspeed alarms

The excluded alarms, even if do not have effect on the drive, will be anyway displayed on the keypad and in particular **A3** and **A9** make the display flashing.
The motor thermal switch alarm (**A6**) is configurable with the connection **c34** in way that it's intervention can block the drive (**c34**=0) or low the limit of maximum current at the nominal value of the motor (**c34**=1 for default).
The power alarm (**A3**), if operates for an effective problem on the power circuit (for example for a short-circuit), can put in block one or more power IGBT and so the drive can stop even in case of it's exclusion. The reset of the block in that case can be done only switching down the converter.

9. AVAILABLE DATA FROM KEYPAD

9.1. PARAMETERS

(Note: n = off-line, r = reserved to the customer, t = TDE-reserved)

SECT.		DESCRIPTION	FIELD	DEFAULT	Notes
P	1	JOG 1 speed	±100.0%	0.0%	
P	2	JOG 2 speed	±100.0%	0.0%	
P	3	JOG 3 speed	±100.0%	0.0%	
P	4	Analogue speed reference offset 1/100000 parts on speed reference	±19999	0	
P	5	Max CW speed limit	0÷105.0%	100.0%	
P	6	Max CCW speed limit	0÷105.0%	100.0%	
P	7	Position for curve 1 (encoder pulses)	±19999 (*)	0	
P	8	Position for curve 2 (encoder pulses)	±19999 (*)	0	
P	9	Offset (encoder pulses) with respect to resolver zero	±19999	0	
P	10	Gain for positioning (kv)	1÷100%	4	
P	11	CW acceleration time	50÷19999 ms	400 ms	n
P	12	CW deceleration time	50÷19999 ms	400 ms	n
P	13	CCW acceleration time	50÷19999 ms	400 ms	n
P	14	CCW deceleration time	50÷19999 ms	400 ms	n
P	20	level |speed|+|REF| for constant modulation	0÷200.0 %	0.0%	
P	21	Speed loop proportional gain for |speed|+|REF|=0	0.5÷100.0	4.0	
P	22	Speed loop lead time when |speed|+|REF|=0 Integral time P21	4.0÷150.0 ms	40.0 ms	
P	23	Speed loop proportional gain |speed|+|REF|≥P20	0.5-100.0	4.0	
P	24	Speed loop lead constant time when (integral time x gain) for |speed|+|REF|≥P20	4.0-150.0 ms	40.0 ms	
P	25	Speed loop filter constant time	0.2÷20 ms	0.2 ms	
P	27	Starting value of speed regulator integral	±100.0%	0.0%	n
P	31	Torque signal offset (Itorq)	±100.0%	0.0%	
P	32	Torque correction signal constant	±400.0%	100.0%	
P	33	Current limit signal offset (Imax)	±100.0%	0.0%	
P	34	Limit signal correction coefficient	±400.0%	100.0%	
P	35	Max CW current limit	0÷100.0%	100.0%	
P	36	Max CCW current limit	0÷100.0%	100.0%	
P	41	Minimum speed level	0÷100.0%	0.25%	
P	42	Maximum allowed speed level	0÷120.0%	110.0%	
P	43	Lower level speed range for speed relay	±100.0%	-100.0%	n
P	44	Upper value speed range for speed relay	±100.0%	100.0%	n
P	45	Lower value current range for speed relay	±100.0%	-100.0%	n
P	46	Upper value current range for speed relay	±100.0%	100.0%	n
P	50	Reserved parameter access key	0÷9999		n
P	51	Drive identification number for the serial line	1÷255	255	r
P	52	Setting maximum motor speed (rpm/1')	375÷19000	2500	r
P	53	Number of motor poles	2÷12	6	r
P	54	Number of resolver poles	2÷12	2	r
P	55	Resolver phase (degrees)	±180.0	0	r
P	56	Motor rated current in % of drive rated current	10.0%÷100.0%	90.0%	r
P	57	Motor thermal constant time TH	1.0÷600.0 sec.	30.0 sec.	r

(*) from serial line “ ±32750”

SECT.		DESCRIPTION	FIELD	DEFAULT	Notes
P	58	Motor inductance in mH x rated motor current	20÷280 (DSC) 30÷450 (DSCT)	70 (DSC) 100 (DSCT)	r
P	60	External voltage reference corresponding to the maximum motor speed (mV)	2500÷10000	10000	r
P	61	Encoder frequency reference coefficient	0÷16383	4096	
P	80	TDE reserved parameter access key	0÷9999	-	n
P	81	Analogue ref. correction coefficient	50.0%÷199.0%	100.0%	t
P	83	Drive rated correction in % of the current limit	20.0%÷100.0%	50.0%	t
P	84	Drive limit reenter time constant	1.0÷10.0s.	2.5s.	t
P	85	VNS not stabilised voltage measurement coeff.	2500÷10000	4930 (DSC) 9015 (DSCT)	t
P	86	DC bus minimum voltage	180.0÷400.0V	220.0V (DSC) 380.0V (DSCT)	t
P	87	DC bus maximum voltage	200.0÷600.0V	410.0V (DSC) 800.0V (DSCT)	t
P	88	DAC_V coefficient for fs speed output	800÷1250	1000	t
P	89	Minimum flyback voltage (24V)	75.0%÷95.0%	85.0%	t
P	90	Maximum flyback voltage (24V)	100.0%÷120.0%	110.0%	t
P	91	Current reference offset	÷100.0%	0	t
P	92	Current regulator delay compensation	0÷1000 ÷sec	200	t
P	99	Customer code number	0÷9999	95	t

On request, we can change the default value (95) of parameter **P99**, which sets the customer code number (**P50**), to customise the drive.
Bold **P** indicates the most used parameters that had to be setted in a new installation.

9.2. CONNECTIONS

(Note: n = off-line , r = reserved to the customer, t = TDE-reserved)

CON.		DESCRIPTION	FIELD	DEFAULT	Notes
c	1	Logic input 1 meaning	1-8 (see sect. 7.1)	1 (TQ.EN)	r
c	2	Logic input 2 meaning	0 (see sect. 7.1)	0 (DR.RUN)	r
c	3	Logic input 3 meaning	1-8 (see sect. 7.1)	3 (REF1EN)	r
c	4	Logic input 4 meaning	1-8 (see sect. 7.1)	8 (Fault Reset)	r
c	5	Logic input 5 meaning	1-8 (see sect. 7.1)	2 (EXT.EN)	r
c	7	Logic output 1 meaning	0-9 (see sect. 7.2)	0 (DR.READY)	r
c	8	Logic output 2 meaning	0-9 (see sect. 7.2)	3 (DR.ONLINE)	r
c	9	Speed reference inversion	0 (not inverted) 1(inverted)	0	r
c	10	Simulated encoder channel B inversion	0 (not inverted) 1(inverted)	0	r
c	11	Choice pulse/rev. resolver for simulated encoder	0-7 (see sect. 7.4)	4 (512PPR)	r
c	12	Choice zero simulated encoder phase	0-3 (see sect. 7.4)	0	r
c	13	Meaning programmable analogue output	0-3 (see sect. 7.3)	1	
c	14	Choice external reference	0 (analogue) 1 (frequency)	0	r
c	19	Exclusion alarms A3,A4,A5,A9,A7	0-31 (see sect. 8.2)	0	r
c	20	Exclusion 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(CLOSED)	1	

CON.		DESCRIPTION	FIELD	DEFAULT	Notes
c	25	Parallel bit to LS2	0(OPEN) 1(CLOSED)	1	
c	26	Ramp inclusion	0(excluded) 1(included)	0	
c	27	Stop with or without minimum speed	0(disabled) 1(enabled)	1	
c	28	Stop on limit switches with or without ramp	0(with) 1(without)	0	
c	29	Software drive consent	0(alarm) 1(no alarm)	1	
c	30	Reset alarms	0(disabled) 1(reset)	0	
c	31	External current limit enable (in series to external enable)	0(disabled) 1(enabled)	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	35	Pos./Speed	(0 = Speed. 1 = Pos.)	0	r
c	36	Start Pos. 1	(0 = not active 1 = active)	0	
c	37	Start Pos. 2	(0 = not active 1 = active)	0	
c	38	Zero search direction	(0=CCW,LS2 1 = CW,LS1)	0	n
c	39	relative/absolute positions	(0=relative 1=absolute)	0	
c	40	SW Zero search command	(0 = not active 1 = active)	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	44	Resolver phase auto-tuning command	0(disabled) 1(perform)	0	r
c	45	Current regulator auto-tuning command	0(disabled) 1(perform)	0	r

Bold **C** indicates the most used parameters that had to be setted in a new installation.

9.3. MAGNITUDES WHICH MAY BE DISPLAYED

		DISPLAYS	FIELD
d	1	External speed reference %	±100.0%
d	2	Speed ref. before the ramp %	±100.0%
d	3	Speed ref. after the ramp %	±100.0%
d	4	Speed feedback %	±100.0%
d	5	Motor speed in r.p.m. %	0÷19000
d	6	Integral part of the speed regulator %	±100.0%
d	7	Value of the external torque demand signal %	±100.0%
d	8	External current limit %	0÷100.0%
d	9	Last current limit CW %	0÷100.0%
d	10	Last current limit CCW %	0÷(-100.0)%
d	11	Current demand %	±100.0%
d	12	Voltage on the power circuit (V)	0÷999
d	13	Actual position (encoder pulse)	mod. 20000
d	14	Resolver reading (encoder pulse)	± 1/2 pulses c11
		ALARMS	STATE (H=0N L=OFF)
A	1	Internal supply alarm	L-H
A	2	RAM, EEPROM alarm	L-H
A	3	Power alarm	L-H
A	4	Radiator thermal switch alarm	L-H
A	5	Motor thermal switch alarm	L-H
A	6	Motor in thermal overload	L-H
A	7	Resolver failure	L-H
A	8	External alarm	L-H

		ALARMS	STATE (H=0N L=OFF)
A	9	Overspeed	L-H
A	10	Power circuit minimum voltage	L-H
A	11	Power circuit overvoltage	L-H
A	12	Wrong input configuration	L-H
A	13	Wrong pole setting	L-H
A	14	Wrong power connections	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	5	Logic input iL5 state	L-H
i	9	On-line function state	L-H
i	10	Torque enable function state	L-H
i	11	External consent function state	L-H
i	12	Ref 1 enable function state	L-H
i	13	Ref 2 enable function state	L-H
i	14	Limit switch 1 function state	L-H
i	15	Limit switch 2 function state	L-H
i	16	External current limit enable function state	L-H
i	17	Alarm reset function state	L-H
i	18	Start pos. 1 function state	L-H
i	19	Start pos. 2 function state	L-H
i	20	Pos./Speed function state	L-H
i	21	Reference direction from volt./freq. conv. function state	L-H
i	22	Enable ramp function state	L-H
i	23	Alternate start POS1/POS2	L-H
i	24	Not available	
i	25	L = external analog ref., H = ref. selected by c14	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	9	Drive ready function state	L-H
o	10	Motor thermal device alarm function state	L-H
o	11	Speed over minimum function state	L-H
o	12	Drive on line function state	L-H
o	13	CW rotation function state	L-H
o	14	Saturation speed state function state	L-H
o	15	Ramp end function state	L-H
o	16	Speed in range function state	L-H
o	17	Current in range function state	L-H
o	18	Blocked motor function state	L-H
o	19	Stop in position function state	L-H
o	20	Ramp active	L-H
o	21	Deceleration ramp	L-H
o	22	Stop in POS1	L-H
o	23	Stop in POS2	L-H
o	24		
o	25	Movement end	L-H

10. SETTING AND CALIBRATION

10.1. ADAPTATION WITH MOTOR

Verify and set:

P54	number of resolver poles: see resolver rating plate or catalog
P53	number of motor poles: see motor rating plate or catalog
P55	resolver phase displacement: refer to the table of the paragraph 10.6
P56	motor nominal current/drive nominal current expressed in percent (for example if the motor 12A drive 20A **P56**=12/20*100=60.0%)
P57	thermal constant time; if it isn't noted leave the default value (30sec.)
P58	motor inductance for nominal current: from the motor catalog read the inductance on the terminals mH and multiply it by the current (for example Imotor=12A L=4mH **P58**=48). If the values aren't known leave the parameter of default or execute the autocalibration of the current regulator (**c45**) (see paragraph 10.5).
P52	set the maximum motor speed in r.p.m. in **P52**: see motor data plate
c34.	Set the thermal alarm, leave at zero if it's wanted the continuing function, even with reducted limit,if it's necessary the immediate arrest set 1 in case of alarm action

WARNING: the drive is already tuned to the motor specified at the ordering.

10.2. SETTING REFERENCES AND SPEED LIMITS

The maximum speed equal to ±100.0% of the internal references and ±10V of the analog reference is set at 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 valid especially for parameters **P01, P02, P03, P05, P06, P41, P42....** and is also valid for the '**dxx**' displays.

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

P01=150/2000∗100=7.5%

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

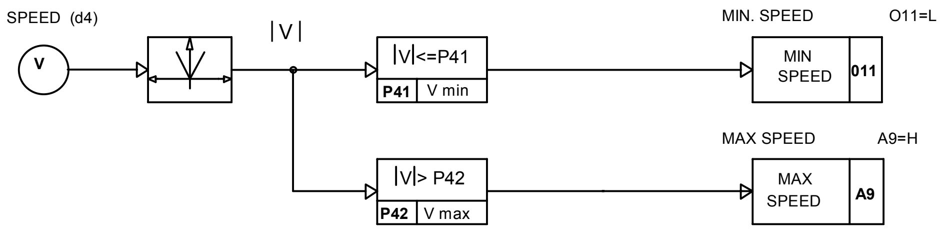
79.2/100∗2000=1584 r.p.m.

10.3. SETTING MINIMUM SPEED, MAXIMUM SPEED AND SPEED RANGE SIGNAL LEVEL.

The settings are all in percent 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**.
The value is expressed in percentage of the maximum speed.
e.g., if Min speed = 6 r.p.m. and **P52**=2000 r.p.m. is wanted, set:

P41=6/2000∗100=0.3%

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

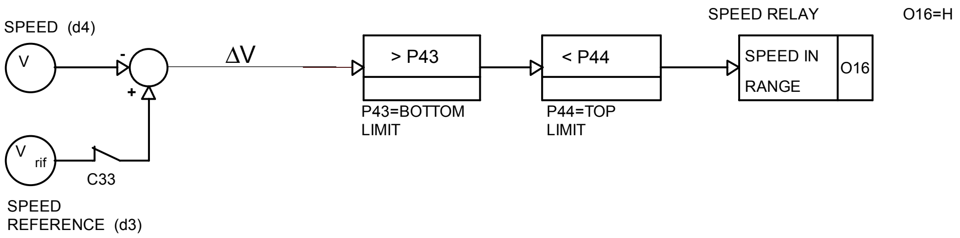


The SPEED RANGE logic signal is a signal which is active when the speed is between the two percentage values set at parameters **P44** and **P43** if connection **c33** is set to 1, while if the connection is set to 0 the output becomes active when the real speed is around the reference signal within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

P43∗**P52** ≤ Vrif -Vreal ≤ **P44**∗**P52** **c33**=0

If you desire the output become active when the motor runs anti-clockwise at a speed between 1200 and 1300 r.p.m. set:
c33=1
P44=(-1200)/P52∗100=-60.0% P52 = 2000
P43=(-1300)/P52∗100=-65.0%

If you desire the output become active whenever the motor speed is equal to the requested speed ±20 r.p.m. the following is set:
c33=0
P43=(-20)/P52∗100=-1% P52 = 2000
P44=+20/P52∗100=1%



10.4. SETTING OF THE PEAK CURRENT LIMIT VALUES AND CURRENT RANGE

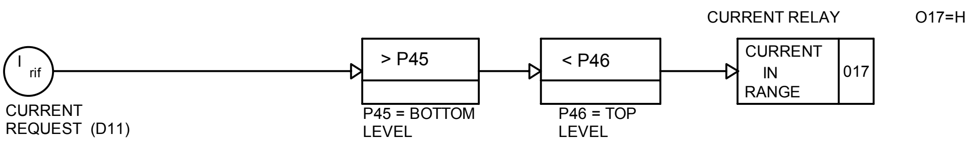
Parameters **P35** and **P36** set the maximum allowed value for the effective peak current that can be delivered by the drive, they are expressed in percentage of the maximum value allowed by the size, e.g.:

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

P35 = **P36** = 33 / 40 ∗ 100 = 82.5%

In the same way those 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 not active (level L) when the current leaves these values. E.g. with the drive and the aforesaid motor, if one wants a logic signal that signals that the current demanded for the motor is greater than the rated one, in the two torque directions, set:

P45 = -11/40 ∗100 = -27.5%
P46 = 11/40 ∗100 = 27.5%
c08 = 08, and so output **oL2** will be active (24V) for current values within ±11A, while for current values higher than 11A in absolute value, it will be set to zero.



10.5. CURRENT LOOP AUTO-TUNING COMMAND

This auto-tuning calculates the value L*In of the connected motor and saves it on parameter **P58** so as to optimise the response of the torque loop. To do this correctly, before starting the auto-tuning set at least the following parameters:

P52 : maximum motor speed (r.p.m.)
P53 : number of motor poles
P54 : number of resolver poles
P56 : rated motor current in % of drive rated current

The motor must be free to rotate because during auto-tuning it makes a full polar rotation.
To start the auto-tuning you must:

1) be in STOP
2) set access key **P50** = 95 (see P99)
3) enter **c45** programming, write "1" and press S

Once started the system reads the inductance for the first time, injecting a current equal to In into the motor and then moves 30 electrical degrees 11 times, performing the measurement for each position. At the end the system calculates the average value of the readings and then saves the value L*In calculated in parameter **P58** and stops (the auto-tuning lasts about 15 seconds)

Before switching off the mains, remember to store the parameters on the permanent memory c43=1

10.6. RESOLVER PHASE AUTO-TUNING COMMAND

This auto-tuning calculates the phase displacement between the resolver and the motor so as to have the maximum possible torque and saves this on parameter **P55**.
To do this correctly, before starting the auto-tuning set at least the following parameters:

P52 : maximum motor speed (r.p.m.)
P53 : number of motor poles
P54 : number of resolver poles
P56 : rated motor current in % of drive rated current

The motor must be free to rotate because during auto-tuning it makes a full polar rotation.
To start the auto-tuning you must:

1) be in STOP
2) set access key **P50**
3) enter **c44** programming, write "1" and press S

Once auto-tuning has started, the system performs the following operations in succession:

1) checks that the ratio between motor poles and resolver poles is correct
2) checks that the direction of rotation of the motor and the resolver is consistent
3) it moves in steps of 120 electrical degrees until one full rotation is completed. It then calculates the value to be set in **P55** and saves it.

If during the auto-tuning the system stops in an alarm state, read the type of alarm, take the necessary action, reset and start the auto-tuning again. In particular if:

1) **A13** (wrong pole setting) triggers, verify which of the **P53** (motor poles) or **P54** (resolver poles) parameters is not set correctly and correct it.

2) **A14** (wrong power connections) triggers, exchange two wires of the connection with the motor, e.g. U and V, and then start the auto-tuning again.

At the end of the auto-tuning the displacement in degrees calculated by the system can be read in **P55**; this value, for known motors with resolver, should differ only by a few degrees from the typical value of the table given below. If not some connections are wrong with respect to the standard; e.g. if the difference is of the order of ± 120° or ±240°, the connection of the drive with the motor power is probably wrong, while if the difference is of the order of ±60° or ±180° the resolver connection is probably wrong with or without errors in the power.

Before switching off the mains, remember to store the parameters on the permanent memory c43=1

MOTORE	MOTOR POLES	RESOLVER POLES	P55
MAGNETIC	6	2	0
ULTRACT	8	2	-117.4
ACM	6	2	0
ACM	8	2	-117.4
LAFERT	6	2	+149
LAFERT	4	2	-120

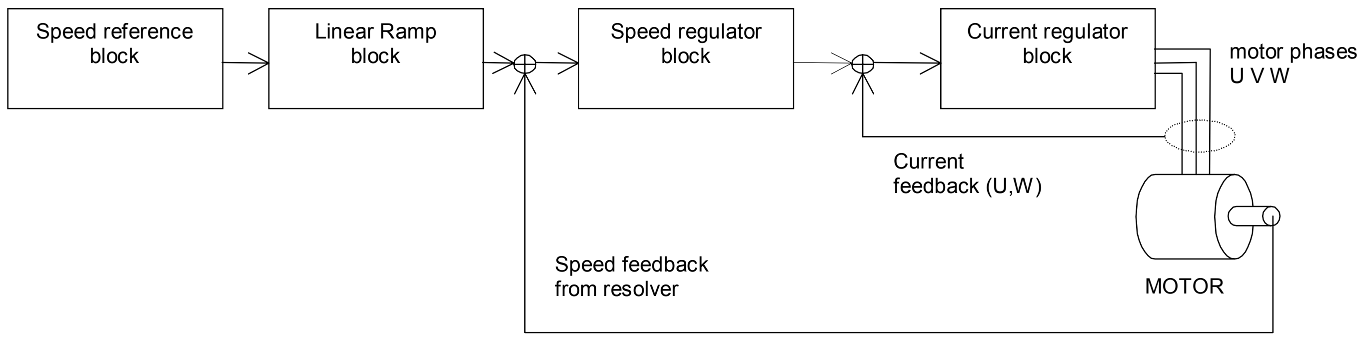
WARNING: the resolver of the motor shipped with the drive is already in phase.

11. DESCRIPTION OF THE SPEED REGULATION

11.1. EXPLANATION OF THE BLOCK-DIAGRAMS

- The rectangular blocks with **Pxx** represent functions with parameters whose value can be set from the keypad or from the serial line.
- The switches, opened or closed, indicated with **cxx** represent the internal connections settable by the keypad or by 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 **dxx** represent the displayed values.

11.2. BLOCK DIAGRAM OF THE REGULATION



11.3. SPEED REFERENCE BLOCK

- For the external reference from encoder type frequency option, see chapter 14.
- Up to four speed references are possible, one analog and three digital
- The analog reference, ±10V for the maximum speed, is applied to terminals 11 and 12 of connector J2, (differential input); if the signal has an offset (maximum ±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** and **P03**, with base scale ±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:

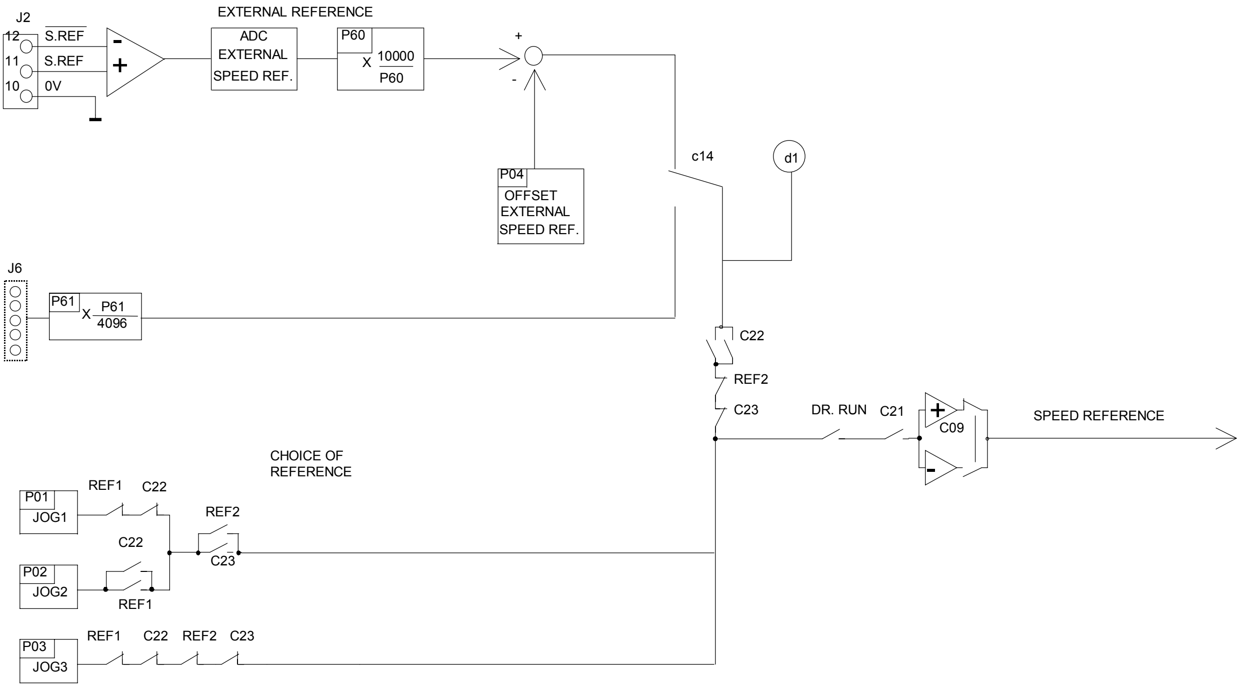
	REF1EN	REF2EN
Analog REF.	H	L
JOG1	L	H
JOG2	H	H
JOG3	L	L

(valid if c22=c23=0)

	c22	**c23**
Analog REF.	1	0
JOG1	0	1
JOG2	1	1
JOG3	0	0

(valid if REF1EN=REF2EN=L)

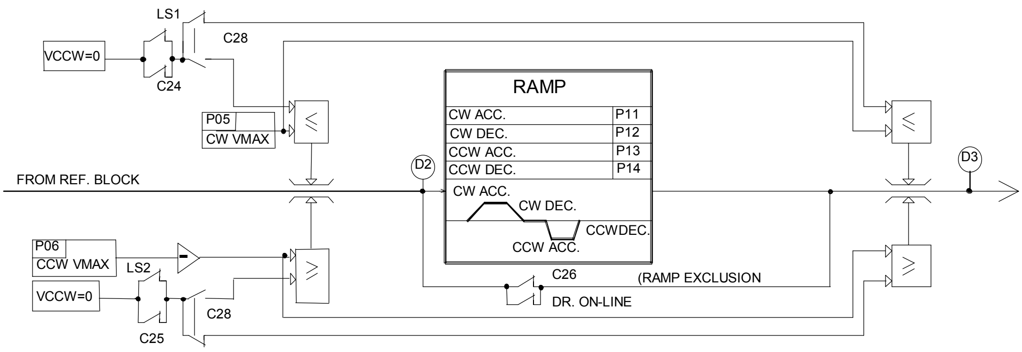
As can be seen from the table the functions of REF1EN and **c22** are the same as for REF2EN and **c23**; **c22**=**c23**=0 are set by default so that REF1EN and REF2EN can be used; **c22** and **c23** are useful if you desire select the reference signal by serial line or by the keypad; in this case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



11.4. RAMP AND SPEED LIMITS BLOCK

Parameters **P05** and **P06** are used to limit the maximum 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.

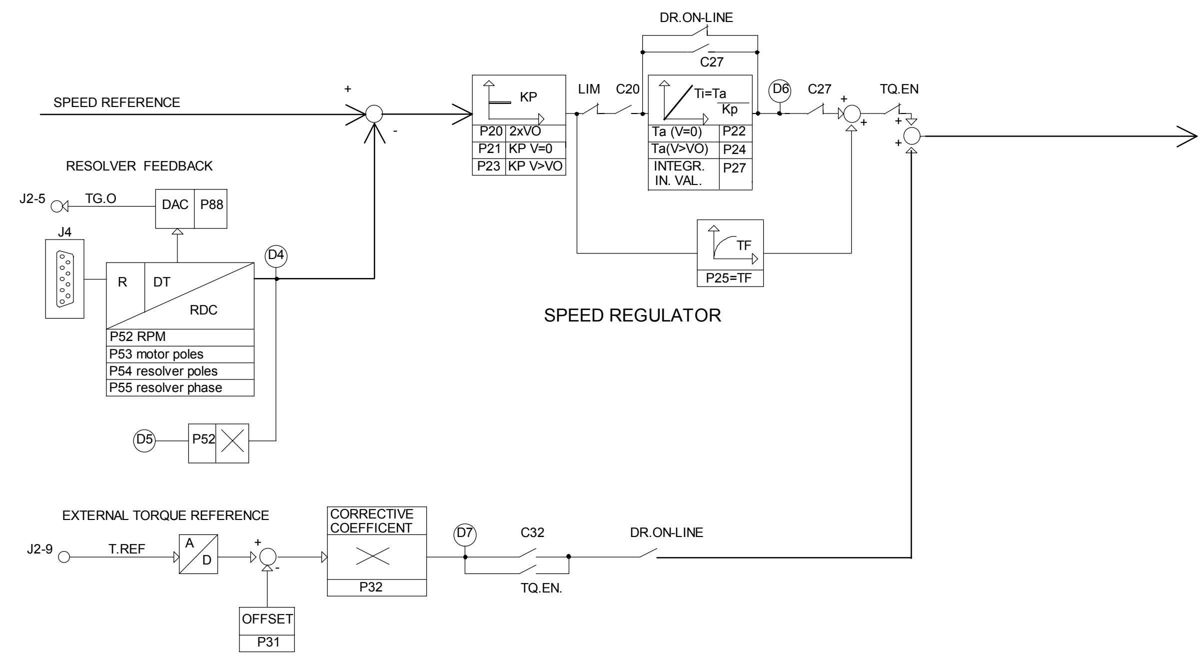
11.4.1. STOP IN PLACE

This function is enabled by keeping the motor on-line with digital reference zero; this can be done in two ways:
1) set **P03**=0 (JOG3=0) and at the same time remove REF1EN and REF2EN (or **c22** and **c23** if used)
2) use LS1 and LS2 opening both contacts after programming both **c24** and **c25** to 1 (default values).

11.5. SPEED REGULATOR AND CURRENT LIMITS

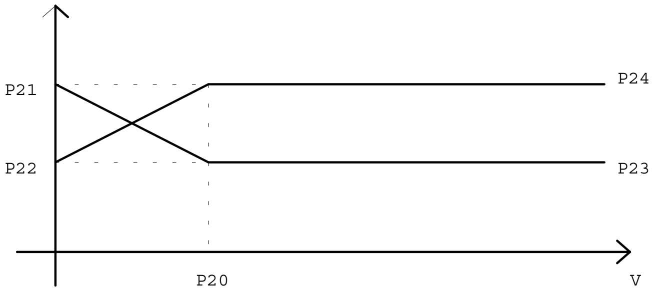
The speed regulator receives the reference from the reference block, and reads the speed feedback from the resolver connected to the motor shaft. The maximum speed in r.p.m. is set in parameter **P52.**
You can have an analog picture of the speed with base scale ±10V at output TG OUT (terminal 5 of connector J2).
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, terminal 9 of connector J2). **P31** (±100.0%) can eliminate the offset and **P32** (±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 Kp, the advance constant Ta (equal to the integration time multiplied by Kp) and the filter time constant Tf. Two values can be set for the parameters, one valid for |speed|+|reference|=0 (**P21**, **P22**) and one valid for |speed|+|reference|≥**P20** (**P23**, **P24**); in the range between 0 and **P20** the system practices a linear interpolation function of the |speed|+|reference| between the set parameters.

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



Kp = P23 + (P21-P23) * (|V| + |Vrif|) / P20   Proportional gain

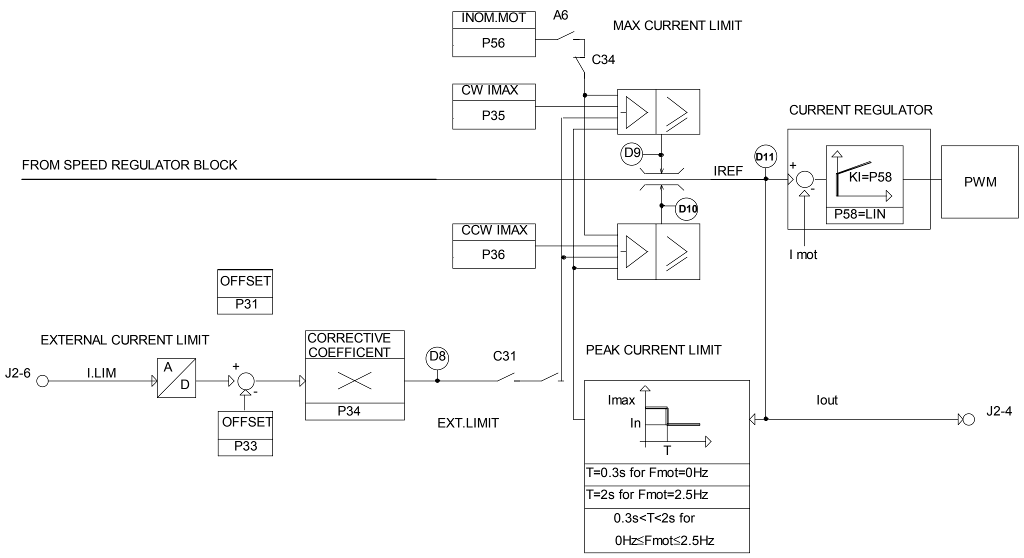
Ta = P24 + (P22-P24) * (|V| + |Vrif|) / P20   Advance constant of the speed stage

with: (|V| + |Vrif|) / P20 $\leq$ 1   where |V| is the absolute value of the speed and |Vrif| 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 ±100.0%): this set 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 9 of connector J2 (Torque ref) and programming **c32=1** ("Torque + speed control" working mode).

11.6. CURRENT LIMITS

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



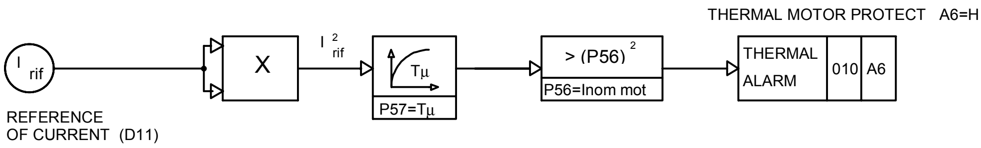
The purpose of which is to limit this value within the lowest level of all the following values :

- parameters **P35** and **P36**
- the analog signal at input J2,6 (**I** lim) corrected if necessary with **P33** and **P34** if the external limit is enabled **c31**=1 and EXT.LIMIT=H; this circuit is normally excluded (default **c31**=0).
- 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 external limitation signal (**I** lim) must be a positive analogue signal between 0 and 10 V from which an offset value **P33** (±100%) can be subtracted and which can then be multiplied by the value of parameter **P34** (field ±400.0%)/100 before making it the current limit in both the CW and CCW direction.
The maximum current is limited within curve $I_{\max} \cdot T$ compatible with the safety of the semiconductors. In particular an integration **I***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 In 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; to obtain this insert the product of the motor phase-phase inductance value in mH multiplied by the motor rated current as parameter **P58**.
An approximate compensation of the loop response delay is provided by advancing the resolver phase as a function of the speed.

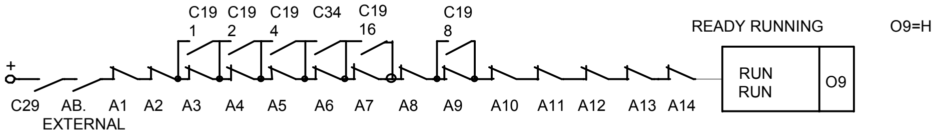
11.7. THERMAL MOTOR PROTECTION

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 circuit operation the motor current value must thus be set in ratio to the rated drive **P56** (0-100%) and the value in seconds 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 of the maximum current limit is reduced to the motor rated current until the temperature is below the limits allowed.

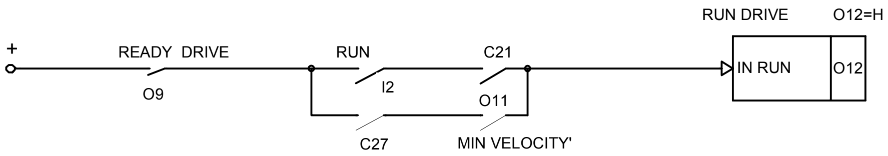


11.8. LOGIC SEQUENCES

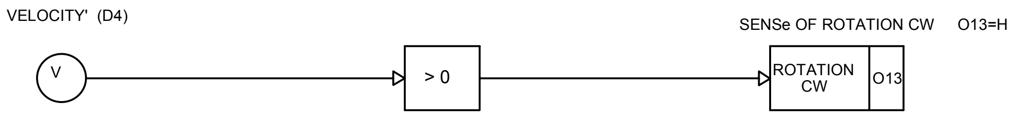
The on line ready active condition, or **o9**=H, occurs when no alarm appears and the external enabling and the enabling via software, or **c29**=1 are present.



The drive thus starts 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** ⇒ **o11**=L).



The direction of rotation becomes active, or **o13**=H, if the rotation is clockwise and thus V>0.



For further analysis of sequential logics see paragraphs 10.2 and 10.3.

12. REPLACING AN SC DRIVE WITH A DSC (SCT WITH A DSCT)

The connectors of the DSC drives are the same as those of the SC series apart from connector J1 which has two more terminals, J1-11 and J1-12; all the other terminals (J1 1-10) coincide, so that the only precaution which needs to be taken is to insert the cable connector so that it occupies only the first 10 terminals.
The connector of the analogue signals J2 has the same number of terminals, but when in the SC analogue series terminal J2 -3 is a 0V, in the DSC digital series the analogue output is programmable. Because of this difference any connection of an earth wire or zero wire to terminal J2-3 (existing in the SC series) is removed and cabled to terminal J2-1 or J2-2.
In the DSC series the sign of the TG OUT output is inverted with respect to the SC series.
Respecting the warnings given above, the DSC drive is replaced with the SC drive by connecting the fixed terminals in the same way and using the same extractable connectors. For correct working, the digital inputs and outputs (**c1**-**c8**) must be programmed with the default values and **c9**=1 and **c10**=1 must be programmed.
The other parameters and the other connections are then adjusted depending on the application, taking account of the motor poles (**P53**), the resolver poles (**P54**), the resolver displacement (**P55**), the maximum motor revs (**P52**), the ramp ON or OFF(**c26**), and finally adapting the gains for the dynamic response acting on **P23**.

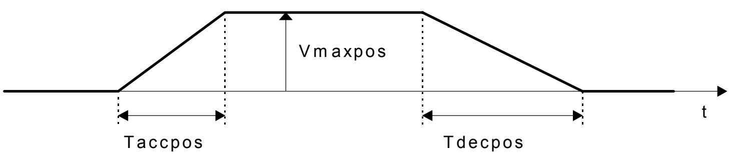
13. POSITIONER

13.1. USE OF THE BRUSHLESS MOTOR DRIVE AS POSITIONER

The drive can be used in point to point positioner function with a maximum of two different movements, unless it is continuously modified by the serial line. For the modality of the positioner the following parameters are active in this way: **P01, P02, P03, P07, P08, P09, P10** and the following software switches: **c26, c35, c36, c37, c38, c40**. The numbers to be set, **P07** and **P08**, are given in pulses within a maximum number of 19999, referring to the pulses/rev elettr. resolver number chosen in **c11**(with the use of the serial line the maximum limit of run raises to ±32750 pulses)..
The sign of the movement number imposed defines the movement direction independent of the speed sign;

Positive sign = CW movement (speed **d5**≥0)
Negative sign = CCW movement (speed **d5**≤0)

For the maximum speed and the acceleration and deceleration times are used the same parameters as the speed regulator; in particular with reference to the figure below for the two movements the parameters in the table are used.



$$T_{accpos} = T_{acc}\frac{V_{maxpos\%}}{100} \qquad T_{decpos} = T_{dec}\frac{V_{maxpos\%}}{100}$$

	Pos. 1	Pos. 2
Displacement number in encoder pulses	P07	P08
Max displacement speed in % of P52	P01	P02
Acceleration time up to Vmaxmotor P52	P11	P13
Deceleration time from Vmaxmotor P52	P12	P14

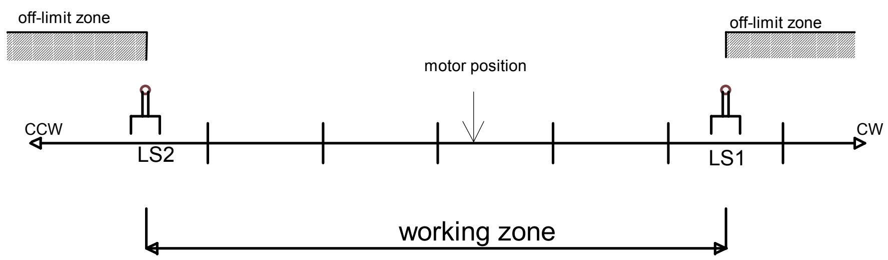
The positioner mode can be selected via software setting connection **c35**=1 (by default **c35**=0) or via hardware by means of one of the logic inputs, after it has been configured by means of **c1**, **c3**, **c4** or **c5** and enabling the ramp connection **c26**=1.
The movement starts on the rise front of one of the programmed inputs. This start signal can be given also while a positioning is in course, but it must be kept in logic state H until the actual positioning has terminated. The following programming possibilities have thus been added to the logic inputs:

The displacement numbers (**P07**, **P08**) can also be changed during the movement by means of the serial line, and are accepted at the first stop, after the *stop in position* signal. Because of this, once all the parameters for the two movements are set, the serial line can be used to obtain changes in number, leaving the other parameters unaltered (the average time between two movements started by a serial command is nearly of 15ms).

The brushless drive with resolver intrinsically contains one absolute number in the arc of an electrical rotation of the resolver itself; normally however the size of the displacement required is much greater than one revolution so that in systems where positionings are to be made with reference to an absolute number a suitable sensor must be placed on the whole travel which, once reached by the motor, allows the system to know its position. Given that normally the precision or repetivity of the sensors is not sufficient the system does not consider the sensor as ‘zero’, but considers as zero reference the ‘zero’ number of the resolver revolution from the side of the direction of movement towards which the motor is sent to look for the sensor (**c38**=0 search in CCW rotation, **c38**=1 search in CW rotation).

13.2. ZERO-POSITION SEARCH

Sometimes the machine where the drive is mounted should execute movements refferred to a reference position (Zero-position). For these cases is provided in the drive an automatic "Zero-position search" procedure. This procedure is suited for machines moving in a "working zone" between two "off-limits zones" by limit-switches :



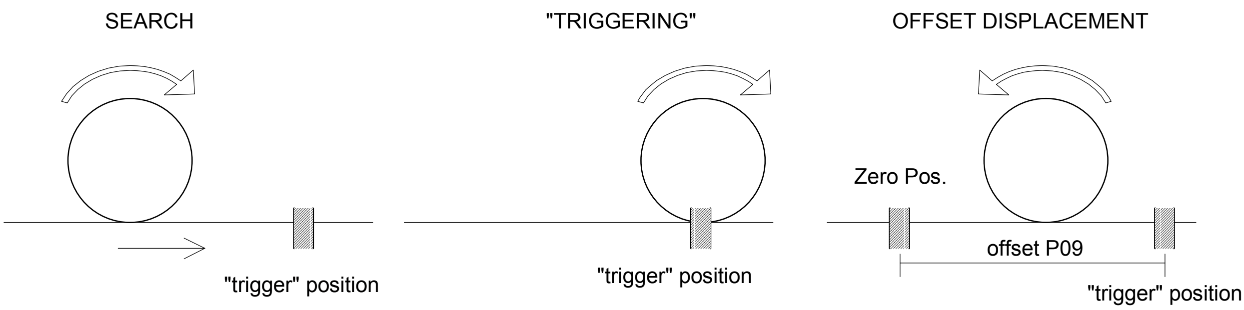
If the limit-switches are used only as "zero-position sensor" for the "zero-position search" procedure, they must be connected to the drive only during this procedure, and then disconnected from the drive in the normal working. This can happen in a circular-movement machine: a machine without off-limit zones.
If **c38=0** the search direction is CCW and the "zero-position sensor" is LS2. If **c38=1** the search direction is CW and the "zero-position sensor" is LS1. The motor must be initially in the working zone.
The "zero-position search" procedure is as following:

Parameter settings	description
P03	search speed (% of P52)
P09	displacement offset (enc. pul.)
c38	search direction

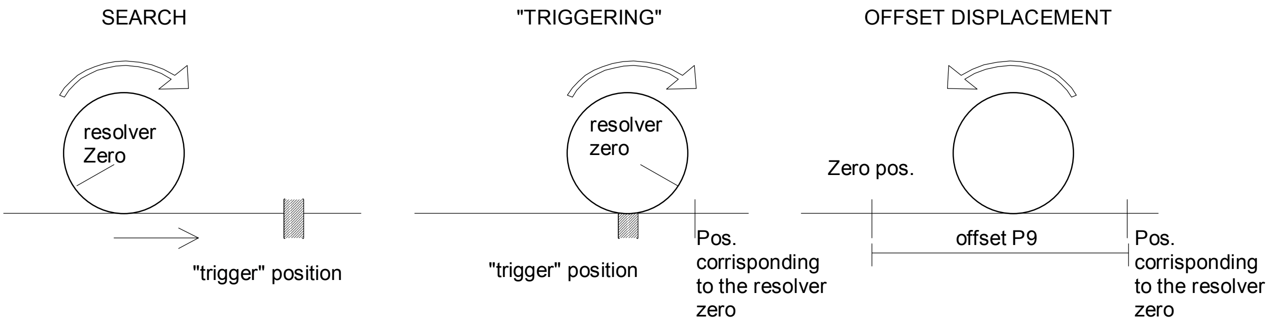
1. Start the procedure.
2. The motor moves in the direction specified by c38 at speed specified by P03 versus the extermity of the working zone. The sign of P03 is not considered, because the direction is determined only by c38.
3. The motor is triggered by a limit-switch and stops.
4. The motor moves in the opposite direction (versus the working zone) until the offset position (set in P09) is reached. This offset is used to move the motor to a zero position lying in the working zone.
5. The absolute position counter of the drive (displayed in d13) is thus set to zero and the procedure is complete.

In the "trigger" in the phase 3 can be :

- A limit-switch (LS1 or LS2, depends on the search direction).
- c24= 0 or c25=0, depends on the search direction.



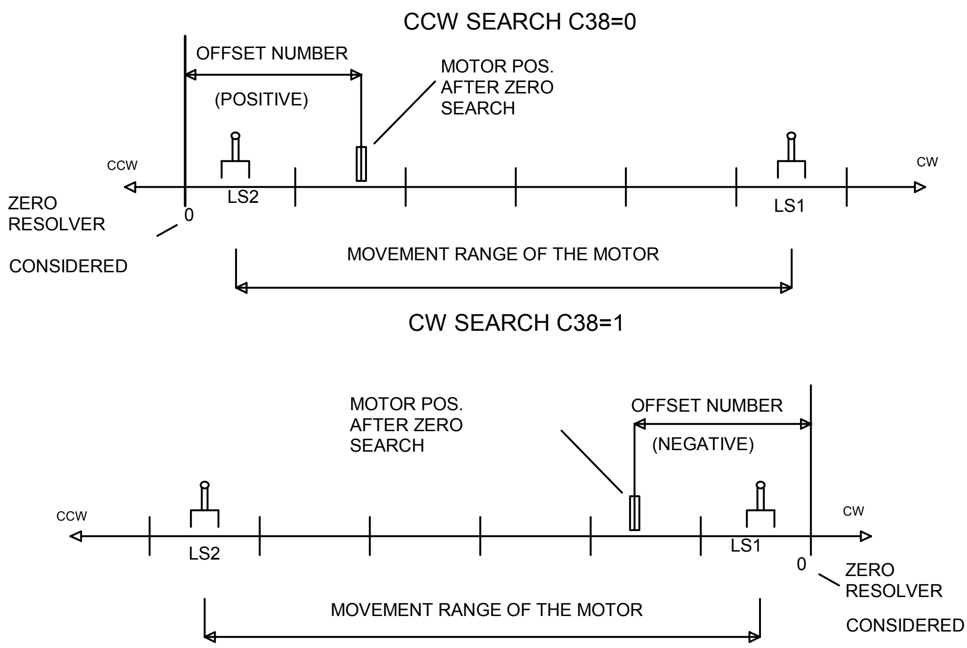
In the figure can be seen that the trigger of a limit-switch is not instantaneous: between the trigger and his acquisition by the drive can lap a few milliseconds. So the motor stops in an unspecified point in the shadowed zone, and the offset displacement (offset P09) can be uncertain.



So the offset displacement is calculated from the position corresponding to the nearest resolver zero. In this way the positioning precision is 0,005/CP degree, where CP is the number of resolver polar couples.
To find the desired offset displacement it is suggested to set in P09 a displacement of exactly one motor revolution:

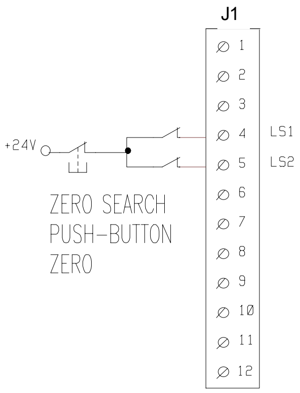
P9 = Number of enc. puls. set in c11 x P54/2,

and then, looking at the position where the motor stops, to adjust the value of P09 until the motor stops in the desired position. **WARNING**: the offset displacement set in P09 must be not less than one motor revolution.



The zero search command can be made via software setting **c40**=1 (it resets automatically once the offset position has been reached), or via hardware making the two limit switches LS1 and LS2 operate at the same time after two logic inputs have been assigned to these functions and then restoring the situation (see diagram).

c4=6	LS2 = terminal J1-4
c5=5	LS1 = terminal J1-5



At the end of a positioning, the *stop in position* function is activated.
To have this function as active signal on the logic outputs LO1 (LO2) program **c07** = 10 (**c08** = 10). This signal changes to the non-active state as soon as one starts for a new positioning.

13.3. POSSIBLE USES

13.3.1. TWO SPEEDS AND TWO POSITIONS

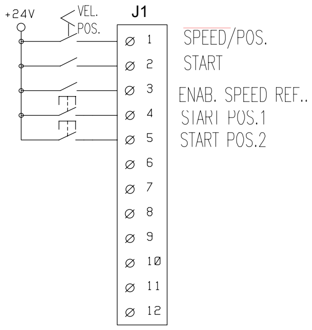
Displacements both in speed and in position with movements not referred to any initial absolute number.

Definition of inputs

c1	= 11	input 1 = position/speed
c2	= 0	on line
c3	= 3	enabling external reference
c4	= 9	start input for positioning according to curve 1
c5	= 10	start input for positioning according to curve 2
c35	= 0	speed mode
c26	= 1	ramp ON
P03	= xx.x%	slow displacement speed

Displacement 1	Displacement 2
P01	P02
P07	P08
P11	P13
P12	P14

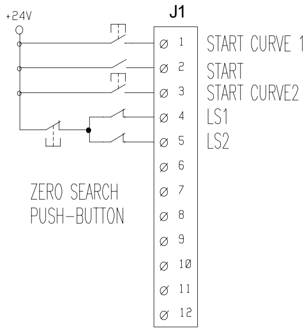
With input 1 not active speed mode on line (input 2 active) one goes in speed with internal reference **P03** and the ramps set; if input 3 is active one changes from the **P03** speed to the external speed (potentiometer). With input 1 active position mode on line (input 2 active) the motor switches on but remains stopped on the spot. Activating input 4 by pulse the motor performs displacement 1, activating input 5 the motor performs displacement 2.



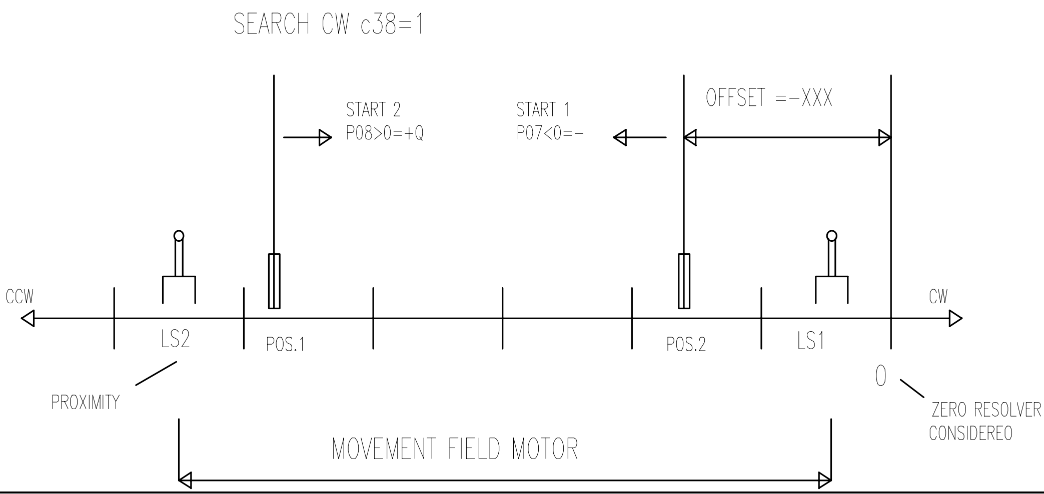
13.3.2. TWO ABSOLUTE POSITIONS WITH LIMIT SWITCH

c1	= 9	start curve 1
c2	= 0	on line
c3	= 10	start curve 2
c4	= 5	LS1
c5	= 6	LS2
c26	= 1	ramp ON
c35	= 1	position mode
P03	= xx	zero search speed

c38	= 0	search ‘0’ counterclockwise LS2	= 1	search ‘0’ clockwise LS1
P09	= +xxxx	offset	= -xxxx	offset
Displacement 1	CW		CCW	

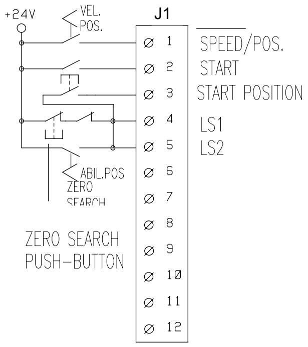


When on line the motor stops in place waiting for commands. If the zero search push-button is pressed the search ’0’ procedure is performed and it is positioned on absolute number offset **P09**. From here one can give start 1 or start 2; note that from the offset position to go CW a positioning with positive number must be made, to go CCW a positioning with negative number must be made.



13.3.3. SPEED, POSITION WITH INITIAL ABSOLUTE NUMBER

c1	= 11	position/speed
c2	= 0	on line
c3	= 9	start pos. 1
c4	= 5	limit switch LS1 (absolute microswitch)
c5	= 6	limit switch LS2 (absolute microswitch)



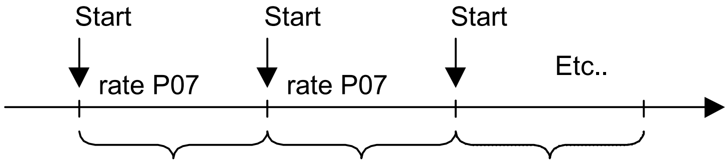
As the limit switch needed to initialise the system blocks the motor movement in the search direction, if the movement must be free the "*search zero/enable positioning*" selector switch is needed, which excludes the limit switch when it is in the second condition while it enables the start position push-button.

13.4. POSITIONER IMPROVEMENTS

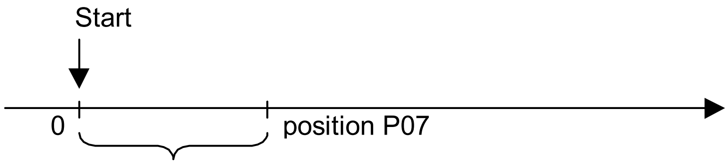
The positioning speed can be taken from the external analog reference (SREF, /SREF) by setting P01=0 or P02=0 (depends on the used movements). This speed reference is read at the start of the movement, and variations during the movement do not cause any effect.

In the old versions the positioner could make only cumulative movements: each movement is referred to the previous. Now the positions of the movements can be also expressed in reference to a zero position: by setting **c39=0** the "cumulative rate" positioning mode is chosen, by setting **c39=1** the "absolute position" positioning mode is chosen.

Cumulative rate:



absolute position:



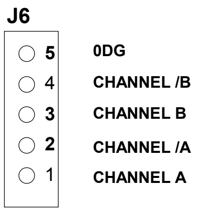
14. FREQUENCY INPUT(OPTIONAL)

The brushless digital drives have an optional frequency input. (it's necessary specify this in the commercial order). So it's possible to have an analog reference speed (J2-11 e J2-12) or a frequency reference speed (connector J6) by selecting on software switch C14.

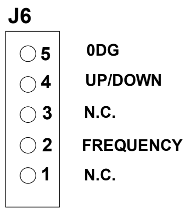
c14	working mode
0	analog reference (default)
1	frequency reference (encoder)
2	frequency reference (freq. and up/down)

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 loop is activated (proportional gain=P10) so every input pulse corrisponde to a partial motor rotation. Maximum allowed error is 32750 pulses; errors greater than this are not considered.

- frequency input as standard encoder (TTL signals)



- frequency input by only two single channels (unipolar signals with amplitude from 5V to 24V) Maximum frequency speed reference: 300khz.



If the signal UP/DOWN = 0V the displayed speed is positive (D5>0) and the motor turns CW.
If the signal 0V< UP/DOWN <= 24V the displayed speed is negative (D5<0) and the motor turns CCW.

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

$$P61 = RPM_{slave} \cdot \frac{4096 \cdot N}{60 \cdot Fr} \cdot c14,$$

RPM_{slave}	desired speed of the slave at the frequency Fr
N	number of encoder pulses/elctrical rev. (set in c11)
Fr	input frequency
$c14$	connection c14

If the input frequency is genearted from a DSC/DSCT as master drive (the following par. are in the master drive):

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

Examples of a DSC/DSCT SLAVE connected to a DSC/DSCT MASTER with frequency input as standard encoder.
From a DSCx MASTER we have considered the simulated encoder signals A,A,B,B and we have connected them to a DSCx SLAVE frequency input. By programming the parameter P61 it's possible to select the sliding between two DSCx (P61=4096 => 100%).

MASTER	SLAVE
c11=4 (512)	c11=4 (512)
P52=2500rpm	P52=2500 rpm
	P61=4096
The SLAVE run at the same MASTER speed	

MASTER	SLAVE
c11=4 (512)	c11=4 (512)
P52=2500rpm	P52=2500 rpm
	P61=2048
The SLAVE run at half of MASTER speed	

MASTER	SLAVE
c11=4 (512)	c11=4 (512)
P52=2500rpm	P52=2500 rpm
	P61=8192
The SLAVE run double of MASTER speed	

To obtain good performances at low speed, it's necessary to select a sufficient high encoder resolution (C11 in DSCx MASTER).

Example: With the drives set as in the following table, the desired speed of the slave is 1/4 of the master.

MASTER	SLAVE
c11=7 (4096)	c11=7 (4096)
P52=3000rpm	c14=1 (A, A/,B,B/)
P54=2	

Input frequency of the slave is : $Fr = 4096\frac{3000}{60}\frac{2}{2} = 204800Hz$

the above formula for P61 is:

$$P61 = RPM_{slave} \cdot \frac{4096 \cdot N}{60 \cdot Fr} \cdot c14,$$

and with the real parameters yelds:

$$P61 = 750 \cdot \frac{4096 \cdot 4096}{60 \cdot 204800} \cdot 1 = 1024$$

With 4096 enc. pulses/electrical rev. each motor shaft rev. corresponds to 4096 reference pulses (with 2 pole resolver), and each reference pulse corresponds to 1/4096 rev. of the motor shaft.

14.1. END OF MOVEMENT LOGIC OUTPUT

The drive can output an "end of movement" signal. This signal can be obtained from one of the logic output by configuring the corresponding internal connection : C07 = 16 or C08 = 16 (only C08 for DSCT); it is available only when c14=1 or c14=2 and P10>0 (space loop active). This signal (025 = H active) or L01/ L01\ H (transistor in saturation) or L02 / L02\ H (transistor in saturation) has the following meaning: the drive has speed < minimum (P41) and space erroro < 1 enc. pul. (with c11=4) or space error < 2 (c11=5) ecc...

14.2. IMPROVEMENTS FOR THE FREQUENCY REFERENCE INPUT

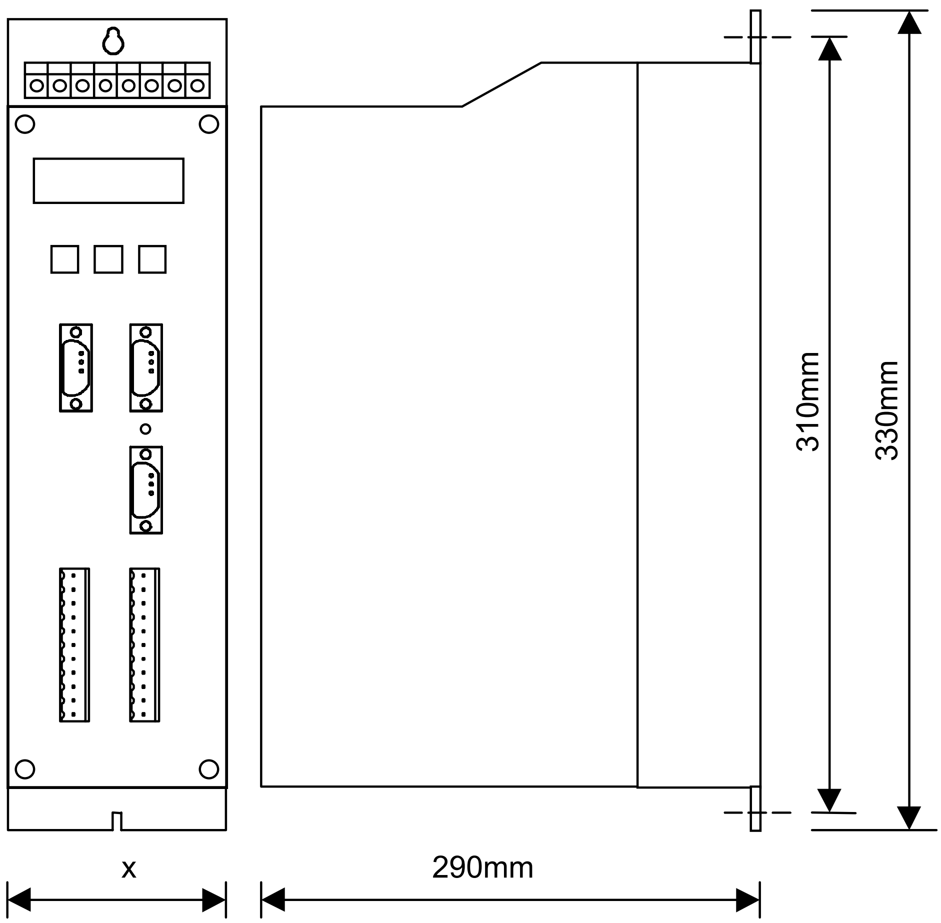
The selection of the external speed reference is made by one of the 5 digital inputs L.I.1 – L.I.5 configured to the value 16 and by c14, as is described in the following table :

L.I.	C14	External ref. selected
0	X	Analog
1	0	Analog
	1	Frequency from encoder
	2	Frequency and up/down

X = don't care

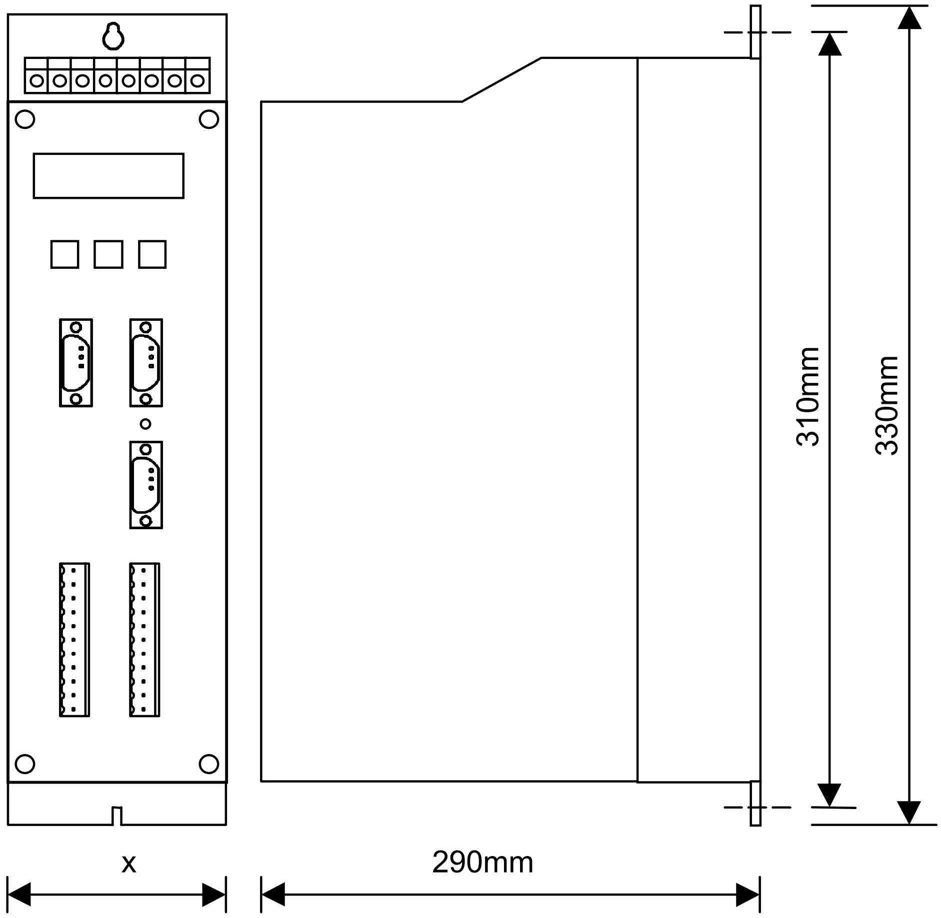
15. DIMENSIONS AND SIZES

15.1. DIMENSIONS AND SIZES OF DSC DRIVES



	DSC-03N	DSC-06N	DSC-10N	DSC-15N	DSC-20N	DSC-30N	DSC-40N	DSC-60N
DIMENSIONS mm.	x = 68				x = 100	x = 130		x = 192
WEIGHT Kg	5,2				7	8,7		9,5

15.2. DIMENSIONS AND SIZES OF DSCT DRIVES



	DSCT-03N	DSCT-07N	DSCT-15N	DSCT-22N	DSCT-28N	DSCT-37N	DSCT-47N
DIMENSIONS mm.	x = 68		x = 100	x = 130		x = 192	
WEIGHT Kg	5,2		7	8,7		9,5	

manual V07 11/01/2000

The contents of this manual is referred up to 4.34 (DSC) e 4.35 (DSCT) software version

If you have any questions about equipment installation or working,
don't hesitate to contact us:

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