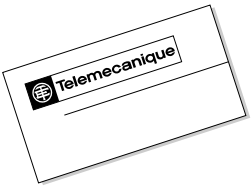
User's manual

LT6-P
Telemecanique

Multifunction protection relays



GROUPE SCHNEIDER

■ Merlin Gerin ■ Square D ■ Telemecanique

1. Contents

1. Contents

2. Glossary / definitions

PTC	Positive Temperature Coefficient. Resistor with a resistance value which increases with temperature and which increases very rapidly as the nominal operating temperature is reached.
RDF	Residual Differential Fault (earth leakage)
rms	Root mean square value of a signal
I	Line current
Ir	Set value of the line current for thermal protection
Id	Phase unbalance current (calculated value)
IΔ	Residual differential fault current (earth leakage current)
IΔr	Set value of the residual differential fault current (earth leakage current)
Iv	Monitoring value of the underload current, a multiple of Ir
Imax	The highest value of the three phase currents ($I_{phase1eff}$, $I_{phase2eff}$ and $I_{phase3eff}$).
Imini	The lowest value of the three phase currents ($I_{phase1eff}$, $I_{phase2eff}$ and $I_{phase3eff}$).
Iav	Sum ($I_{phase1eff}$, $I_{phase2eff}$, $I_{phase3eff}$) / 3.
Isd	Monitoring threshold of the starting current, a multiple of Ir
I_{LC}	Torque limitation current
I_{CC}	Short-circuit current
Discrete	On/Off
θn	Nominal temperature of the iron circuit reached with I = Ir after an infinite time.
θr	Set temperature for the thermal overload alarm.

3. LT6 application circuit diagrams

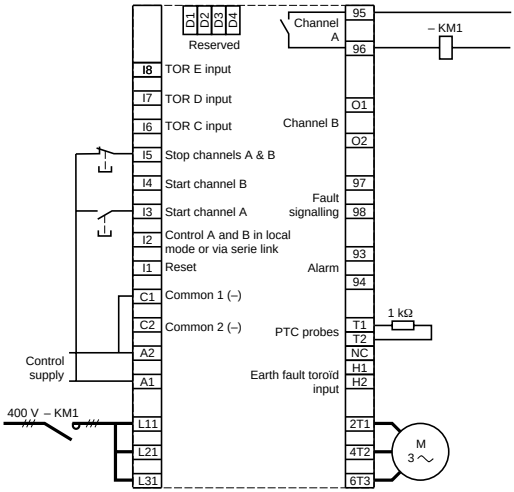
The LT6 can be used as a standard overload protection relay in a standard circuit arrangement, with the protection functions preprogrammed.

It can equally be used in an automation circuit arrangement, enabling the programmable controller to read the measurements available in the LT6 data base.

Finally it offers the possiblity of contactor control.

Description of installation for the three types of use:

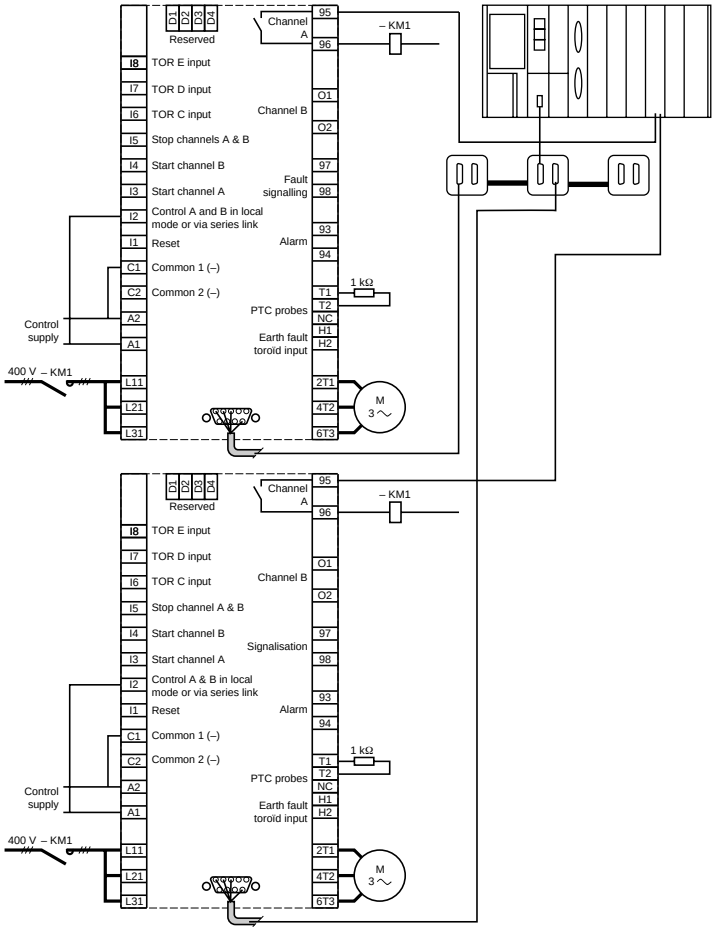
Use of the LT6 as a protection relay



In the event of a fault, the internal contact (95-96) of the LT6 causes the power contactor (KM1) to open.

Adjustment of the protection parameters of the LT6 can be carried out using a PC with LA9P620 software.

Use of the LT6 as a remote protection and measurement relay



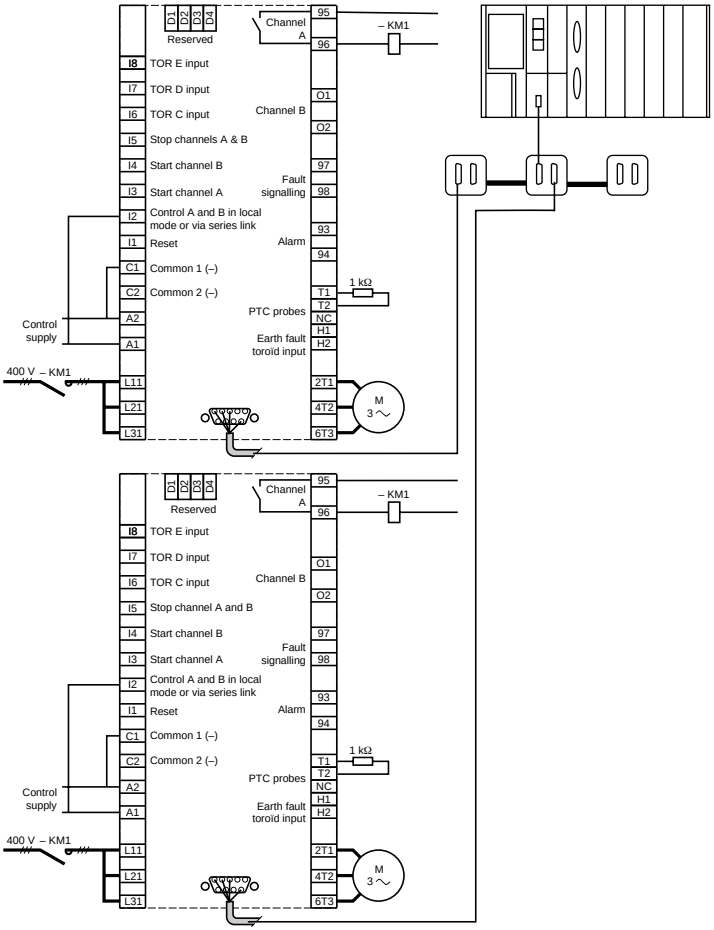
The PLC controls the contactors from its output contacts.

In the event of a fault, contact (95-96) of the LT6 causes the power contactor (KM1) to open.

Using the serial link, the PLC can interrogate the various LT6 relays on the measurements available in the data base.

3. LT6 application circuit diagrams

Use of the LT6 as a protection relay, remote measurement and control



The LT6 causes the power contactor (KM1) to open in the event of a fault.
It measures the current per phase, the earth leakage current, the motor temperature-rise and commumnicates them to the PLC when requested to do so by the latter.
It assures control of the power contactor by receiving commands from the PLC.
All data exchange is via serial link.

4. Description of the product and its accessories

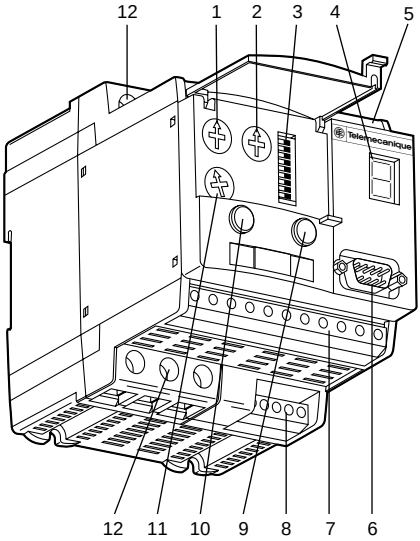
4.1. The products and their operating range:

Product reference	Rating	Model	Control supply	Discrete I/O voltage
LT6P0M005FM	1and 5 A 50/60 Hz (110 to 690 V)	Motor protection	110/230 V ± 20 %	90 to 150 V DC/AC 50/60 Hz
LT6P0M025FM	25 A 50/60 Hz (110 to 690 V)		DC/AC 50/60 Hz	& 90 V to 276 V AC 50/60 Hz

For ratings above 25 A, it is necessary to use external current transformers.
For further details, refer to the pages 48 to 50.

Note: the product operates for a frequency of 50/60 Hz. If this changes the accuracy of the LT6 measurements will be affected.

4.2. Presentation of the front face

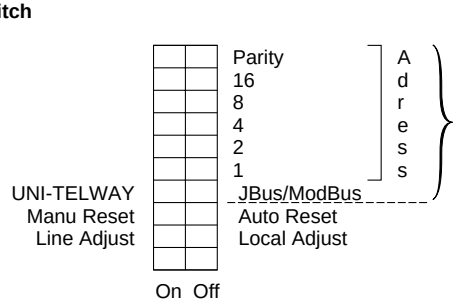


1, 2 Rotary switches for setting the rated motor current
3 DIP switches for communication configuration
4 7-segment fault display
5 16-pin plug-in input connector
6 SUB-D 9-pin connector for the serial link
7 11-pin plug-in output connector
8 5-pin plug-in connector for the measurement
9 Test pushbutton
10 Reset pushbutton
11 Rotary switch for setting the trip class
12 Power terminals

4.2.1. 7-segment display

	Display	Description
Text on the product	0	Running
	1	Alarm
	2	Thermal
	3	P.T.C.
	4	Phase loss
	5	Earth fault
	6	Under current
	7	Over torque
	8	Prolonged starting
	9	Phase reverse
	A	Cos φ
	b	Test button
	C	Watchdog fault
	d	Voltage threshold
Explanations in the Technical Manual	E	Measurement input fault
	F	Parity fault
	H	
	J	Jbus/Modbus fault
	L	Communication fault
	n	
	P	PTC thermistor short-circuit
	S	
	U	UNI-TELWAY fault (absence of polling)

4.2.2. The DIP switch



The change in position of these switches is only taken into account when the LT6 is switched on

Use of the DIP switch: ***the positions of the DIP switch are taken into account on power up.***

"Local Adjust-Line Adjust"

"Local adjust" position:
- The settings on the front face are used by the LT6.

"Line adjust" position:
- The settings transmitted by the communication line are used by the LT6.
- The values transmitted by the communication line are unaffected by the settings on the front face.

"Manu Reset - Auto Reset"
(see section 7.3)

address: 2 cases arise depending on the protocol

Jbus/Modbus: Address from 1 to 63 using the "parity" switch as address weight 32

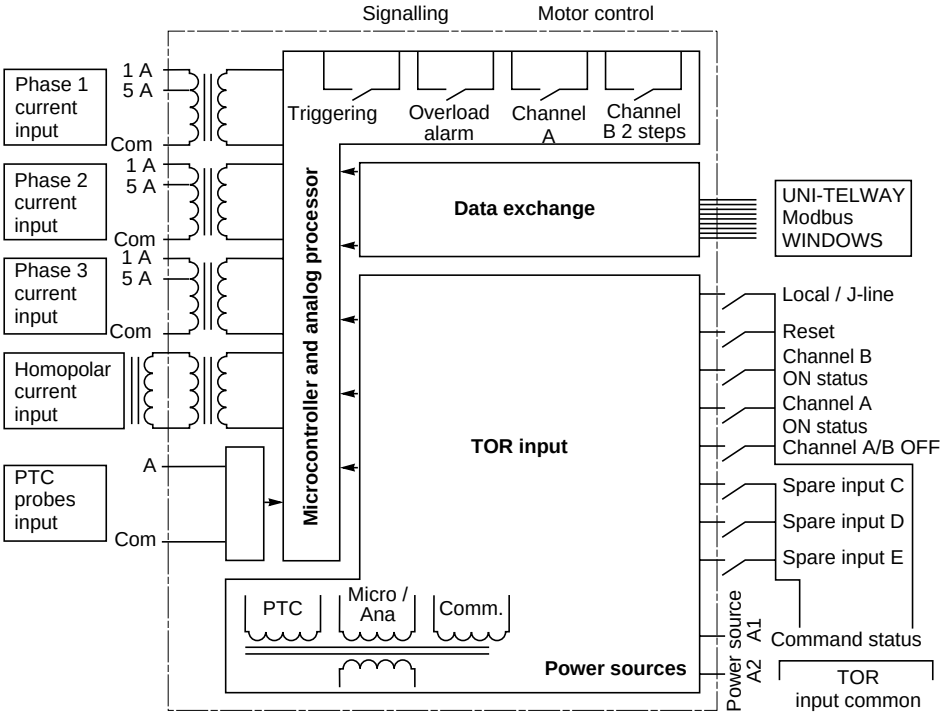
UNI-TELWAY: Address from 1 to 31 using the "parity" switch as parity for address wiring.
Parity = On if the number of address bits is even.
Parit y= Off if the number of address bits is odd.

4.2.3. Current and trip class setting switches

These are Gray code switches.
(see section 6.2 "Thermal overload" protection function)

4.2.4. TEST and RESET pushbutton (see section 7.3 Reset function)

4.3. Product internal circuit diagram

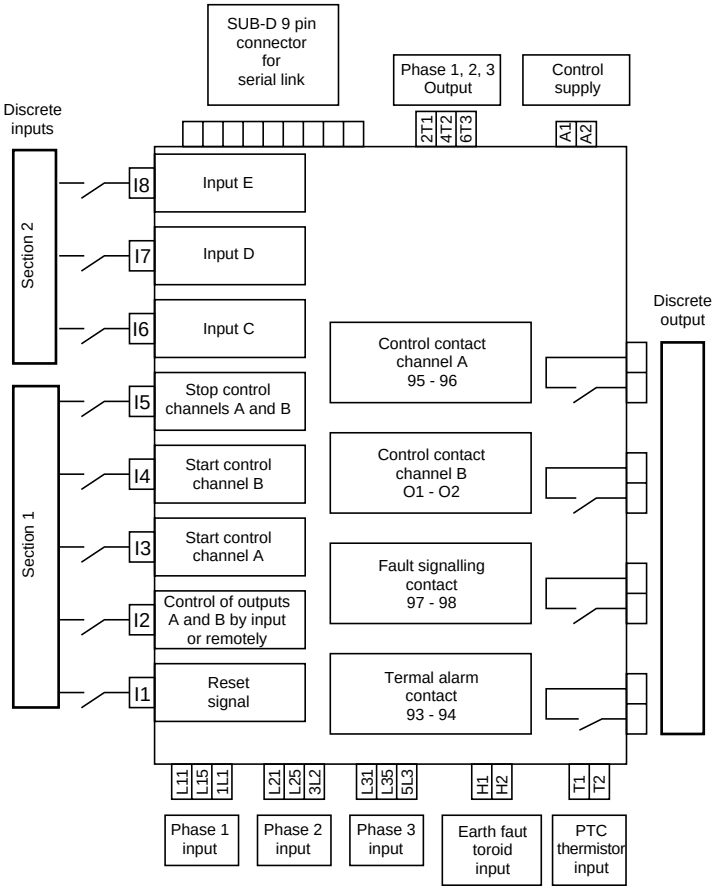


4.4. Parameter entry software under Windows 95, 98, NT4, 2000 and XP: LA9P620

This software is to be installed in a PC in a Windows 3.1 environment.
An interconnection cable forms part of the supply and is used to connect the LT6 to the 9-pin serial link port of the PC (COM1:).
To use the software, the LT6 must be configured in Modbus/Jbus.
The software enables easy access to all the configuration parameters of the LT6 via Windows dialogue boxes (see description section 10).

5. Description of the connections

5.1. Discrete inputs



- The inputs :
  - The discrete inputs are DC from 90 V to 150 V and AC 50/60 Hz from 90 V to 276 V (110 - 230 V ± 20%)
  - The consumption of an input in logic state 1 is at least 1 mA.
  - For an input to be recognised as being in logic state 1 by the software, it must be in stable hardware logic state 1 for at least 4 ms.

- The discrete command "Stop channels A and B", which has priority over all other discrete commands, operates in fail-safe "wire broken" mode (off: state 1 - on: state 0)

- The inputs are arranged in two groups:
  a) The "motor control" group: Start channel A, Start channel B, Stop channels A & B, Line / Local, Reset.
  b) The "Inputs" group: Input C, Input D, Input E. These inputs are free and can be read by serial link (bits 80,5 - 80,6 - 80,7)
  - Each of these groups has a separate common (enabling the use of 2 different voltages).
  - Input E is used by the LT6 for voltage measurement. (see section 6-10)

- PTC thermistor inputs:
  - Use of PTC thermistor probes (see catalogue).
  - If this function is not used, a 1 kΩ resistor (supplied with the product) must be connected across terminals T1 and T2.

- Homopolar toroid inputs:
  - Use of MG homopolar toroids (see Low-voltage Distribution catalogue 95/96 pages D72 to D74).

- Auxiliary supply voltage (110 - 230 V ± 20% DC or 50/60 Hz AC):
  - The LT6 (aux) is immmune to micro-interrupts of duration ≤ 300 ms at a repetition frequency of 0.05 Hz, for utilisation at Un.
  - An auxiliary supply voltage < 80 V ± -10% for a time of ≥ 300 ms is considered to be an interruption of the supply voltage.
  - In the event of an interruption of the auxiliary supply voltage, the LT6 stores the setting parameters.

A micro-interrupt lasting more than 4 microseconds causes inputs I5 (A/B channel off) and I2 (local/line) to go to 0 and opens channels A and B (to prevent the power relay hunting).

5.2. Discrete outputs

- Channel A and B outputs are electromechanical relay contacts:
  - See characteristics on page 50

- The signalling outputs (alarm and trip) are electromechanical relay contacts:
  - PLC compatibility: minimum level of utilisation 5 V 10 mA.

5.3. Power input / outputs

- Cabling capacity:
  - solid cable, flexible cable, flexible cable with cable end: 1.5 to 6 mm^2
  - ring tags: internal Ø 2 to 4.2 mm, external Ø 1 to 10 mm.

- Use of external current transformers:
  - based on IEC 185 and IEC 71 recommendations,
  - input connection 1A (L11 L21 L31) or 5A (L15 L25 L35) depending on the secondary current,
  - minimum power: LT6 consumption = 50 mVA per phase, also take into account the currrent in the CT secondary, and the resistance of the cable,
  - recommended accuracy limit:
    . class of accuracy 5P or 10P (error for currents between In and 2 In: ± 1% or ± 3%),
    . phase offset for rated current ± 18 mrd,
    . compound error: 5% or 10%.

Note:

Use of measurement transformer: standard, saturation threshold not controlled, suitable for current measurement (I to 2I), and possibly for infrequent starting.

Use of protection transformer: specific for motor protection, known saturation threshold, suitable for all motor-starter applications.

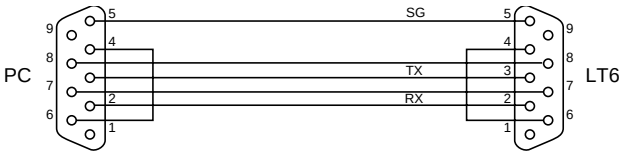
5.4. Serial link

Connection by SUB-D 9-pin connector with RS 232 link (PC link) or RS 485 link (PLC link)

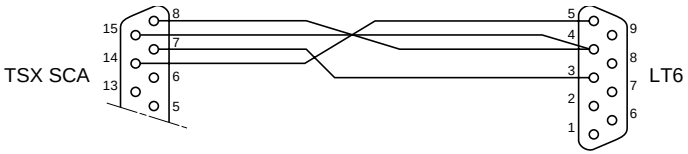
Pin arrangement of the SUbD 9-pin connector:

Pin	Utilisation RS 232		Utilisation RS 485
1			
2	Transmission	(Tx)	
3	Reception	(Rx)	D(A)
4	Data Terminal Ready	(DTR)	OVL
5	Signal Ground	(SG)	D(B)
6	Data Set Ready	(DSR)	
7	Clear To Send	(CTS)	
8	Request To Send	(RTS)	
9			

Connection to PC: reversible cable SUB-D 9-pin female-female connectors
(supplied with the LA9P620 Kit)



Connection to PLC TSX SCA 62:



SUB-D 15 points SCA62 SUB-D 9 points LT6

5.5. Customer connections

Marking of the discrete input terminals (Viewed from the front of the product) with pitch of 5.08

Terminal marking	I1	I2	I3	I4	I5	I6	I7	I8	NC	C1	C2	NC	D1	D2	D3	D4
Description	Reset	Line/ Local	Start A	Start B	Stop A & B	State C	State D	State E		Com Sec 1	Com Sec 2		Réserved			
Description	Section N°1					Section N°2			Non	Commons		Non				
Description	Discrete inputs								Con.			Con.				

Marking of the output terminals (Viewed from the front of the product) with pitch of 7.62

Terminal marking	95	96	O1	O2	97	98	93	94	NC	A2	A1
Description	Channel A contact		Channel B contact		Trip		Alarm		Non connect	Auxiliary supply	

Marking of the measurement terminals (Viewed from the front of the product)

Sequence number	5	4	3	2	1
Terminal marking	T1	T2	NC	H1	H2
Description	PTC thermistor		Non connect	Homopolar toroid	

Marking of the power terminals (Viewed from the front of the product) of the LT6P0M005FM

Description	1A current inputs			5A current inputs		
Terminal marking	L11	L21	L31	L15	L25	L35
Terminal marking	2T1	4T2	6T3			
Description	Current output (1&5A)					

Marking of the power terminals (Viewed from the front of the product) of the LT6P0M025FM

Description	Current inputs		
Terminal marking	L11	L21	L31
Terminal marking	2T1	4T2	6T3
Description	Current output		

6. Protection functions of the LT6

The following protection functions are only guaranteed if the current in the 3 phases (Irms) is higher than 20% of the current setting (Ir). For lower currents, absence of spurious control is guaranteed.

6.1. Configuration table of the LT6

	Functions		Parameters		
Protection	**Factory enabled**	**Enabled/ Inhibited by serial link**	**Name of the value**	**Initial values**	**Setting range**
Thermal overload			Ir (% rating) Class overload alarm	20 % 5 100 % θn	20 / 109 % (1) 5 / 30 (1) 0 / 100 %
Temperature-rise (PTC)					
Phase unbalance			Id (% de Iav) Tripping time during start. Time before tripping	30 % Iav 0.7 s 5 s	10 / 30 % Ir 0 / 10 s 0 / 10 s
Earth fault			$I_{\Delta r}$ Time before tripping	30 A 5 s	0.3 / 30 A 0 / 5 s
Prolonged starting			I_{sd} (% de Ir) Starting time	150 % Ir 10 s	100 / 500 % Ir 0 / 30 s
Undercurrent			I_V (% de Ir) Time before tripping	30 % Ir 10 s	30 / 90 % Ir 0 / 30 s
Torque limitation			I_{LC} (% de Ir) Time before tripping	200 % Ir 10 s	150 / 800 % Ir 0 / 30 s
Cos φ			Cos φ Time before tripping	0.1 10 s	-1 / 1 0 / 10 s
Phase rotation monitoring			enabled	no	yes/no

(1) these values can be enabled and set on the front of the product

Complementary functions	**Factory enabled**	**Enabled/ Inhibited by serial link**	**Name of the value**	**Initial values**	**Setting range**
Voltage threshold			Voltage threshold Time before shed. Reconnection Time before reconnect.	70 % Un 10 000 s 90 % Un 10 000 s	68 / 120 % Un 0 / 100 000 s 68 / 120 % Un 0 / 100 000 s
Short-circuit detection			Icc	15 xIr	
Reset			Time before reset θ°C iron before reset	0 s 100 % θn	0 / 1 000 s 40 / 100 % θn
Motor control			control of A and B outputs	Reverser	Reverser independent 2-step
Self-cooled				Self-cooled	Self / Force cooled
Communi-cation watchdog			outputs A and B are opened in the event of a communication loss		

6.2. Thermal overload

This function enables thermal monitoring of the motor by monitoring the current taken. This function is always enabled

Adjustment on the front face: (Dip switch = local adjust)

Current Ir:

Two rotary switches (Gray code) enable the user to set the product to the current of the motor to be protected from 20% to 109% of the rating selected by the wiring (1 A, 5 A or 25 A):

- The "COARSE SETTING" switch enables adjustment from 20% to 100% of the rating in steps of 10% of the rating.
- The "FINE SETTING" switch enables adjustment from 0% to 9% of the rating in steps of 10% of the rating.
- The sum of the setting of the two switches is equal to the value of the rated current of the motor to be protected.

example: motor 108 A - CT ratio = 200/1: setting $\frac{108 \times 100}{200 \times 1}$ = 54% (50% + 4%)

Trip class:

A rotary switch (Gray code) enables the user to select the operating class of the product.

- The setting range is: Class 5 to class 30 in steps of 5.

Adjustment by communication line (words 84 - 85 - bit 110,F): (Dip switch = line adjust) enables the user:

- to set the product to the rated current (from 20 to 109% in steps of 1%) of the motor to be protected,
- to select the trip class (from 5 to 30 in steps of 5),
- to declare the motor "self-cooled" or "force-cooled" (the cooling time of a self-cooled motor at standstill = 4 x the cooling time of a force-cooled motor).

Note: the front face and line values may be different: the LT6 makes its choice according to the position of the dip switch (local/line)

Reminder of the standard:

• IEC 947-4 § 7.2.1.5.1 case e)

Motor state	I/Ir	10A	10	20	30	⇒ Class
Cold	7.2	2<T≤10	4<T≤10	6<T≤ 20	9<T≤30	⇒ Tripping time (s)

• CEI 947-4 § 7.2.1.5.1 cas c) et d) classe 5 = classe 10A

Motor state	I/Ir	10A	10	20	30	⇒ Class
Hot	1.5	< 120	< 240	< 480	< 720	⇒ Tripping time (s)

Characteristics:
The product conforms to standards IEC 947-4 and IEC 255-8.
The relay responds to one of the I^2t laws (copper/iron...).
For the calculations, the value of current used is the true RMS value (including harmonics).

Note:
The long iron time constant has a tripping threshold equal to 125% of θn.
The short copper time constant has a tripping threshold equal to 200% of θn.
The measurement accuracy (product only) and over a range from 0.3 Ir min. to 8 Ir max. is better than ± 4% [from -25 to + 70° C] at nominal frequencies of 50/60 Hz.

During a supply interrupt of less than 20 mn, the LT6 considers that the motor is stopped and is no longer cooled. The thermal state when power is restored takes this stoppage into account. For longer supply failures, the thermal state of the motor is zero.

6.3. Thermal overload alarm

Accessed by discrete output 93-94 or by bit 80,F , it is used to signal the thermal state of the motor based on the value of a threshold described below.
This function is always enabled.

Adjustment by the communication line (word 86):
- Setting the value of the overload threshold from 0 to 100% of the nominal iron thermal state in steps of 1% by word 86. Setting to 0% provides a contact which is closed on power up. This contact opens in the event of a product fault or loss of the auxiliary power supply.

Initial state of the product
- The value of the overload threshold is set to 100% of θniron.

6.4. Thermal monitoring by PTC thermistor

This function enables thermal monitoring of the motor by built-in (PTC) thermistor probes.

This function is always enabled. Inhibiting this function is carried out by inserting a 1 kΩ resistor across terminals T1T2 to prevent the product tripping on infinite resistance.

Reminder of the standard:

Thermistor marked A IEC 34-11 (for 3 probes < 250 Ω in series)
- Trip values: > 4 000 ohms.
- Tripping range: 1 650 to 4 000 ohms.
- Resetting range: 1 650 to 750 ohms.
- Reset values: < 750 ohms.

Product characteristics:

The configuration below enables the connection of up to 6 probes in series in the same circuit while conforming to the standard (except that the total resistance of the probes circuit will be < 1500 ohms).

- Tripping on open circuit detection: this function is assured by the trip function.
- Trip values: 2 900 ohms ± 200 ohms.
- Reset values: 1 575 ohms ± 75 ohms.
- Short-circuit detection trip: 17 ohms ± 3 ohms.
- Short-circuit detection reset: 24 ohms ± 3 ohms.
- Tripping time (event → action) is > 500 ms (interferesssion) and ≤ 600 ms.

Note: use of PT100 probes is impossible (different standard).

6.5. Phase unbalance and phase loss

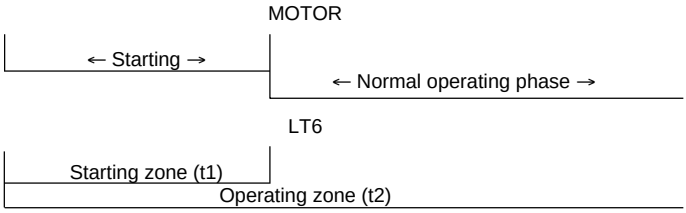
This function monitors the symmetry of the rms currents in the phases.

Adjustment by the communication line (words 87 - 88 - 89):

- The phase unbalance threshold is from 10 to 30% of Iav in steps of 1%
- The acceptable unbalance time before tripping (t2) is adjustable from 0 to 10 s in steps of 0.1 s.
- On motor starting, the time before tripping (t1) is from 0 to 10 s in steps of 0.1 s.

This dual adjustment enables fast tripping on starting in the event of phase loss and thus prevents the motor starting in the wrong direction (e.g. in the case of driving loads).

- Zones covered by the time delay:



Initial state of the product:

- This function is enabled.
- Tripping on phase unbalance is preset to 30% of Ir.
- t2 = 5.0 seconds.
- On motor starting: t1= 0.7 seconds.

Characteristics:

- The accuracy of the tripping time is ± 0.1 s.
- Unbalance is calculated between the highest I_{rms} of the 3 phases and I_{ay}.

6.6. Earth fault

This function monitors insulation faults by a homopolar toroid (fire prevention).

Adjustment by the communication line (words 90 - 91):

Enables the user:

- To adjust sensitivity from 0.3 to 30 A in steps of 0.1 A.
- To adjust the tripping time delay from 0.1 to 5 seconds in steps of 0.1 s.
- A command can be used to inhibit this function (bit 110,3).

Initial state of the product:

- This function is enabled.
- Sensitivity = 30 A and tripping time delay = 5 s.

Characteristics:

Conforms to standard IEC 755 (class TB).
- Sensitivity is from 0.3 to 30 A ($I_{\Delta r}$).
- Maximum tripping times: $I_{\Delta}/I_{\Delta r}$ =1 ⇒ 5 s; $I_{\Delta}/I_{\Delta r} \geq 2 \Rightarrow$ 0.1 s
- Non operation for 0.5 $I_{\Delta r}$ and for I ≥ 6 I_r.
- The accuracy of this measuring chain $I_{\Delta}/I_{\Delta r}$ is less than 10% from 0.3 to 30 A ($I_{\Delta r}$ max).
- The accuracy of the tripping time is ± 0,1 s.

Note: To assure the safety of persons, it is recommended to use a differential relay type Vigirex from Merlin Gerin.
In effect, the LT6 does not meet the standard for Class TA: residual currents of 30 mA and tripping time for $I_{\Delta}/I_{\Delta r}$ = 5 ⇒ 0.04s.

6.7. Undercurrent

This function monitors the draining of pumps... (when associated with the power factor monitoring cos ϕ)

Adjustment by the communication line (words 94 - 95):

- The tripping threshold Iv from 30% to 90% of Ir in steps of 1%.
- The permissible time before tripping from 0 to 30 seconds in steps of 0.1 s.
- A command can be used to enable this function (bit 110,4).

Initial state of the product:

- The function is inhibited.
- Tripping threshold Iv is 30%
- The permissible time before tripping is 10 seconds.

Characteristics:

The undercurrent value is defined by the ratio Imax / Ir.

6.8. Prolonged starting

Tripping of the product after exceeding a current thresholds at the end of a programmed time.

Adjustment by the communication line (words 92 - 93):

Enables the user:
- To adjust the starting time from 0 to 30 seconds in steps of 0.1 s.
- To adjust the current at the end of starting: Isd from 100% to 500% of Ir in steps of 1% of Ir
- To enable this function (bit 110,6).

Initial state of the product:

- Tripping time delay is equal to 10 seconds.
- Current Isd is preset to 150% of Ir.
- The function is inhibited.

Characteristics:

- The accuracy of the tripping time is ±0.1 s.

6.9. Torque limitation, locked rotor

This function can be used, for example, to monitor the jamming of a crusher ...

Adjustment by the communication line (words 96 - 97):

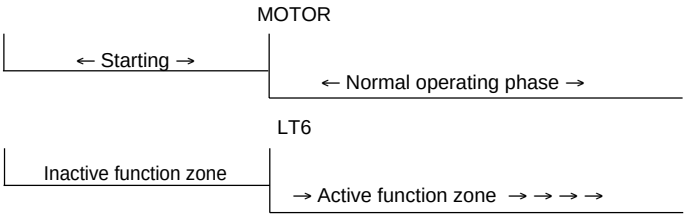
- The tripping threshold (I_{LC}) from 150% to 800% of Ir in steps of 1% of Ir.
- The permissible time before tripping from 0 to 30 seconds in steps of 0.1 s.
- A command can be used to enable this function (bit 110,5).

Initial state of the product:

- The tripping time is equal to 10 s.
- The tripping threshold (I_{LC}) at 200% of Ir.
- The function is inhibited.

Characteristics:

Calculation of the torque limitation current.
- The accuracy of the tripping time is ± 0.1 s.
- Zone covered by the time delay:



6.10. Monitoring cos φ and voltage and frequency measurement

This function monitors the difference in phase angle between the motor current and the motor voltage.
The voltage measurement enables the user to:
- improve undercurrent (underload) monitoring,
- make an evaluation of power (with the measurement of the voltage).

Adjustment by the communication line (words 98 - 99):

- The tripping threshold of cos φ is adjustable from - 1 to + 1 in steps of 0.01.
- The tripping time for cosφ is adjustable from 0 to 10 s in steps of 0.1 s.
- The function can be enabled by the line (bit 110,8).

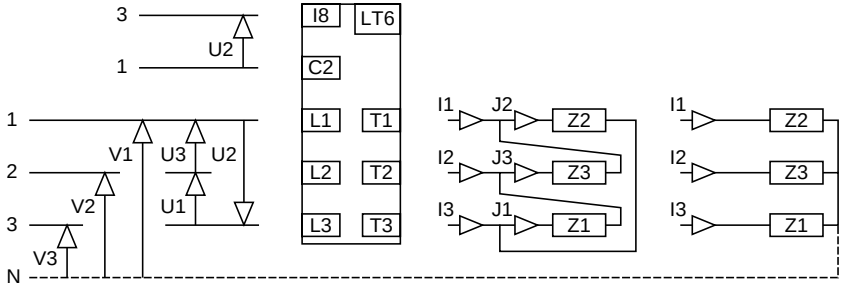
Initial state of the product:

- The tripping threshold for cos φ is 0.
- The tripping time is equal to 10 s.
- The function is inhibited.

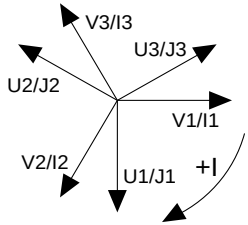
Characteristics:

- Voltage measurement is carried out via the discrete input E (I8). This input receives an image of the voltage U2 (taken between L1 and L3) and the current I3.
  It is calibrated from 150 to 276 V (68% to 120%) where 100% = 230 V.
- The LT6 recognises the direction of phase rotation and corrects as a consequence.

- If the current is measured using a CT, the phase difference caused is not corrected as the accuracy of the CT is better than ± 18 mrd.
- If the voltage is derived from a voltage transformer, the wires of the secondary must be changed over to cancel the phase difference (π).
- The LT6 does not correct phase differences due to the connection of the relay in the motor windings.
- The reference system for the calculation is as follows:



Rotation reference:



- The accuracy of measuring cosj is ± 3° at nominal voltage, with a deviation of 5% over 10 years.

Measurement of the voltage and frequency (words 74-75):

- The accuracy of voltage measurement is ± 5% at rated voltage, with a deviation of 5% over 10 years.
- The accuracy of frequency measurement is ±2%.

6.11. Direction of rotation monitoring

This function monitors the direction of rotation of the protected motor.

Case of "reverser" programming:
Phases L1, L2, L3 (or any circular permutation) are assigned respectively to inputs L11, L21, L31 of the LT6 when channel A is commanded, and to L21, L11, L31 (or any circular permutation) when channel B is commanded.

Case of "2-step" or "independent" programming:
Phases L1, L2, L3 (or any circular permutation) are assigned respectively to inputs L1, L2, L3 of the LT6.

Characteristics:

- The line can be used to enable the function. (Initial state of the product: function inhibited) (bit 110,7).
- The direction of phase rotation is monitored by reading the current in each phase.
- A direction of rotation other than that selected trips the relay.
- Tripping time (event → action) is >100 ms (interference suppression) and <300 ms.

7. Tripping and reset conditions

7.1. Tripping of the LT6 relay

The protection functions which trip the product are:

1	- Thermal trip (iron)	5	- Earth fault	9	- Direction of rotation
2	- Thermal trip (copper)	6	- Undercurrent	10	- Cos φ
3	- PTC thermistor	7	- Torque limitation	11	- Test button
4	- Phase unbalance and phase loss	8	- Prolonged starting		

In all these cases:

Channels A and B open and the trip signalling contact closes.
The LT6 is in the stop condition, i.e. "Start channel A" bit and "Start channel B" bit equal to zero (bits 83,0 to 83,3).

- Following the first trip, a second cause of tripping may appear, whereas channels A and B are both open. In this case the product reacts as follows:
  - the 7-segment display signals the first cause of tripping, together with bits 81,0 to 81,F,
  - the register of the last 5 trips signals all the trips (1st, 2nd,...) (the fault code given above from 1 to 11 is written in word 0).

7.2. LT6 relay fault

The functions which cause the product to show a fault are:

13	- Watchdog	14	- Measurement input	15	- PTC thermistor short-circuit

In all these cases:

Channels A and B open and the trip signalling contact closes.
The LT6 is in the stop condition, i.e. "Start channel A" bit and "Start channel B" bit equal to zero (the fault code given above from 13 to 15 is written in word 0).

7.3. The RESET function of the LT6

- Any trip or fault of the LT6 leads to the necessity of a "Reset". Without a "Reset" channels A & B cannot be restarted.

- The type of reset (Manual/Auto) is defined by the DIP switch on the front of the product.

- In "Automatic" the relay resets itself as soon as the trip conditions have disappeared and in the conditions: "** Reset is only possible if:*" described below. Automatic reset is only authorised if the trip is a thermal trip. Any other type of trip must be reset manually.

- In "Manual" the relay can only be reset by a "Reset" operation. Reset can only occur be a sequence from state 0 to state 1. Blocking in the "Reset" position does not prevent tripping. Resetting can be obtained from 3 different sources:

  - the "reset" button on the front face (can be inhibited by a command from the communication line),
  - the communication line (if discrete input I2 = 1) by activating bit 83,2,
  - the discrete input I1 (if discrete input I2 = 0).

- **Note:** loss of supply voltage, even if prolonged, does not cause the relay to reset. In this case, the cause of tripping is stored (product display and bits 81,0 to 81,F).

- "Reset" is only enabled if:

  1 - The thermal state (iron and copper) is less than a value programmable from 40 to 100% of θn in steps of 1%. The initial state of the value is 100% (word 105).
  2 - At the end of a time delay programmable from 0 to 1000 seconds in steps of 10 s. This time delay is initiated immediately after tripping and has an initial value of zero (word 104).
  3 - The LT6 calculates the time needed for a reset to be enabled. The longest time (Thermal state or time delay) can be accessed in word "Time before reset enabled" (word 72). This value is refreshed every second.

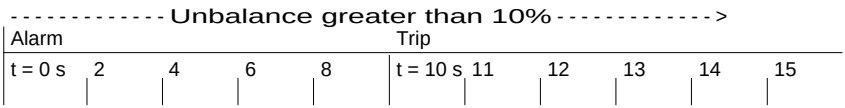
7.4. Starting and stopping the alarm functions

This value is updated every second.

The "Thermal overload alarm" is the only function to act through the discrete output "Alarm".

On tripping on the "Thermal overload alarm" function and any function which exceeds its parameter setting without exceeding its tripping time (phase unbalance, earth fault, undercurrent, torque limitation, cos φ functions).

Example: The phase unbalance and phase loss function is programmed with a threshold of 10% and a tripping time of 10 s.



The corresponding "alarm" bit is set to 1 for the duration of the alarm (bits 82,0 to 82,5).

Note: The 7-segment display shows only the thermal overload alarm.

Stopping of the alarm functions: as soon as there is no alarm.

7.5. TEST function

This function can be carried out:

- locally using the pushbutton on the front face,
- by the communication line by activating bit 83,3.

The Test causes channels A and B to open, and the fault signalling contact to close.

8. Description of the complementary functions

8.1. Motor control

Motor control and monitoring.

8.1.1. The motor control discrete I/O

The LT6 is the control interface for the motor it protects.

- Two outputs of the LT6 (channel A and channel B) can be used to control 2 motor line contactors (*example:* Control of a reverser).
- Two inputs can receive the state of the motor line contactors (channels C and D).
- Three inputs (start channel A, start channel B and stop channels A and B) can be used to control the motor line contactors (in local control).

8.1.2. Choice of motor control

Discrete input I2 can be used to select "line" (state 1, supply on) or "local" (state 0, supply off).

- "Local": Three discrete inputs (I3, I4, I5) can be used to control channels A and B. The communication line can be used to know the state of the inputs and has no effect on the control of the channel A and B outputs.
- "Line": The communication line can be used to control channels A and B (bits 83,0 and 83,1) and to know the state of the inputs (bits 80,0 to 80,7) . The three discrete inputs above have no effect on the control of the channel A and B outputs.

The change of selection stops both channels simultaneously.

8.1.3. Choice of operation of channels A and B

The communication line enables the user to choose the following operating modes for channels A & B:

- "Reverser": Channels A and B cannot be activated at the same time. The initial condition to start one of the two channels is: both channels are inactive and Imax/Ir < 0.2 for a time greater than 100 ms.

- "2-step ": Channels A and B are commanded for 2-step starting of the controlled motor. In this case, the "start channel B" command is inoperative. Any interruption of the cycle below sets the cycle to step 1).

1) Imax/Ir < 0.2 for a time ≥ 2 s	"Motor stopped"
2) Imax/Ir > 0.2	"Beginning of starting"
3) (Imax/Ir > Isd then Imax/Ir < Isd) or (Delay >1.5 x Class)	"End of 1st starting time"
4) Opening of A	
5) Imax/Ir < 0.2 for a time ≥ 0.1 s	
6) Closing of B	
7) Imax/Ir > 0.2	"Start of 2nd step"
8) (Imax/Ir > Isd then Imax/Ir < Isd) or (Delay >1.5 x Class)	"End of starting"

  This mode of operation can be used for star-delta, part-winding, primary resistor starting, etc...

- "Independent" : Channels A and B can be commanded at the same time or separately. They are independent.

- Only one of these modes of operation is enabled at a time.
- In the event of conflict, the order of priority is: 1 = reverser - 2 = independent - 3 = 2-step.
  e.g. request reverser and independent ⇒ reverser
  request independent with reverser allready active ⇒ reverser
- A change of operating mode can only be made when channels A and B are not controlled.
- The initial state of the product is "reverser". The change can be carried out via the communication line (bits 110,A - 110,B - 110,C).
- Discrete command "stop channels A and B" stops both channels simultaneously, when the product is in local mode.
- A trip, a stop command or an auxiliary supply interrupt positions the product to "channel A and B stopped", irrespective of the mode "line" or "local".
- A "Reset", the reappearance of the supply voltage, etc..., do not constitute a command to close channel A or channel B. For channels A or B to be switched on, the start signal must be present.
- If discrete inputs "start channel A" and "stop channel A & B" are set to 1, a "reset" or the appearance of the auxiliary supply causes "reverser", "independent" or "2-step" operation as described above. The same applies to channel B.
- A stop signal or a stop condition for channels A and B always has priority over one or more start signals for channels A and B.

8.2. Motor maintenance

In order to facilitate the maintenance of the controlled motor, a certain number of parameters are available.

8.2.1. The last 5 trips

Saved in E²PROM, they are managed in the form of a shift register (first in / first out) with 5 files . They are available in words 0 to 49.

- Content of a file:

Description
Cause of tripping
Long thermal time constant (iron)
Short thermal time constant (copper)
Rms current phase 1
Rms current phase 2
Rms current phase 3
Unbalance current Id
Value $I_{\Delta r}$ (Earth fault)
Cos φ
Voltage

- The values in the files are the values at the time the LT6 trips.
- Bit 83,C when set to 1 by the user resets all these words.

* Trip cause codes:
(bits 81,1 to 81,F)

Description	
Iron thermal trip	0
Copper thermal trip	1
PTC thermistor	2
Phase unbalance and loss	3
Earth fault	4
Undercurrent	5
Torque limitation	6
Prolonged starting	7
Direction of rotation	8
Cos φ trip	9
Test button	A
Watchdog fault	D
Measurement input fault	E
PTC thermistor short-circuit	F

8.2.2. Trip cause counters

• These are stored in the E^2PROM memory.
List of counters:
(words 50 to 60)

Description
Iron thermal trip
Copper thermal trip
PTC thermistor
Phase unbalance and loss
Earth fault
Undercurrent
Prolonged starting
Torque limitation
Direction of rotation
Test button
Cos φ

When the value of a counter reaches $7FFF_h$ (32767) it changes automatically to 0000_h (0).
Bit 83,D set to 1 by the user enables the counters to be reset. The LT6 automatically resets this word to 0.

8.2.3. The motor line utilisation counters

• List of counters:
(words 61 to 64)

Description
Number of starts
Motor operating time
Number of channel A closing ops
Number of channel B closing ops

• Number of starts: As defined in the section 8.1.3.
• Operating time:
- Time during which I > 0.2 Ir.
- The resolution is 1 second.
- Every 3600 s, 1 hour is added to the hours counter in the E^2PROM.
- Each time the auxiliary supply is switched off it is accepted that the RAM loses the contents of the seconds counter.
- When the value of an E^2PROM counter reaches $7FFF_h$ (32767) it automatically changes to 0000_h (0).

- Number of channel A, channel B closing operations and Number of motor starts.
  - Each time channel A or channel B closes the corresponding E^2PROM counter is incremented.
  - When the value of an E^2PROM counter reaches $7FFF_h$ (32767) it automatically changes to 0000_h (0). Bit 83,E set to 1 by the user enables the counters to be reset. The LT6 automatically sets this word to 0.

8.2.4. Actual values

The following values can be accessed for actual value (refreshed every second)

- Content of the measurements: (words 65 to 75)

Désignation
Long thermal constant (iron)
Short thermal constant (copper)
Rms current phase 1
Rms current phase 2
Rms current phase 3
Unbalance current Id
Value $I_{\Delta r}$ (Earth fault)
Time before Reset enabled
Cos φ
Voltage
Frequency

8.3. Voltage threshold

This function enables deactivation of non priority functions of a system by opening channels A and B of the LT6 if the voltage drops below a certain threshold.

Note: this function requires the voltage to be measured by the LT6 (see section 5.10).

Adjustment by the communication line (words 100 to 103):

- The undervoltage and reconnection thresholds from 68% to 120% of Un in steps of 1% .
- The times before undervoltage and reconnection. From 0 to 100 000 s in steps of 10 s (24 hours).

Initial state of the product:

- The times before undervoltage and reconnection are set to 10 000 s.
- The undervoltage threshold is set to 70% of Un.
- The reconnection threshold is set to 90% of Un.
- The function is inhibited.

Characteristics:

- Undervoltage:
  - When the voltage reaches the load shedding threshold level, the corresponding alarm is activated.
  - If the voltage level remains below the load shedding threshold for the programmed time, channels A and B open.
  - This function is enabled even with channels A and B off: if a start signal arrives when the product is in lundervoltage condition, the signal is stored and the reconnection function will execute the stored signal.
  - This state is signalled by bit 80,B.

- Reconnection:
  - When the voltage reaches the reconnection threshold level:
    . the corresponding alarm is stopped.
    . If the voltage level remains above the reconnection threshold for the programmed time, channels A and B will close if they have an on signal.
  - Reconnection takes into account the selected operation: "reverser", "independent" or "2-step".

- Operation of the data base variables:
  - Bits 80,C and 80,D store the start/stop signals coming from the communication line (bits 83,0 and 83,1) or the discrete inputs (bits 80,0, 80,1 and 80,2).

Undervoltage ⇒
- Bits 80,C and 80,D are unchanged.The setting to 1 of 80,B means that 95-96 and O1-O2 output contacts are open.

During undervoltage time ⇒
- Bits 80,C and 80,D can be controlled (0 or 1) but 95-96 and O1-O2 output contacts keep openned.. Bit 80,B = 1.

Reconnection ⇒
- Closing or 2-step starting depending on bits 80,C and 80,D and 110,A, B, C.
- The reconnection threshold must be ≥ the undervoltage threshold.

8.4. Short-circuit detection

This function enables short-circuit signalling

- This function is always enabled.
- Short-circuit detection threshold: I_{CC} = 15 x Ir peak detected on one of the three phases.
- The accuracy of the value of I_{CC} is ≥ 20%.
- The short-circuit detection word (bit 78,2) is activated as soon as the fault appears and is acknowledged when it is read.

8.5. Monitoring function

Monitoring systems, built into the product, constantly check the correct operation of the LT6, and immediately control the opening of channels A & B in the event of failure.

- "Watchdog"

The LT6 has a "Watchdog" independent of the microprocessor which operates on transitions. The microprocessor saves the parameters in E^2PROM each time they are modified. (Parameters: configuration of the LT6: words 84 to 110).

Tripping the watchdog activates the microprocessor reset.

If the microprocessor does not restart, all the outputs receive a signal to open.
The watchdog reiterates the resets until the LT6 can reinitialise.
The thermal stae is 1 by default.
No output will be activated without a signal.
The parameters are reset to the values saved if these values are reliable.
The "watchdog" bit (78,7) is set to 1.
If the values saved <u>are not reliable</u> the LT6 takes the initial values in ROM and the values on the front face (Ir and class).
In this case the thermal state by default is 1.
Use of the initial state is signalled by the "initial state" bit being set to 1. (bit 79,F)

Note: setting bit 79,F to 1 does not prevent new parameters being entered.
Bit 83,F set to 1 by the user enables loading of the initial values (with stopping of channels A and B).

- "Analogue input monitoring"

- The LT6 checks the coherence of its analogue inputs.
- Each analogue measurement has two inputs on the micro controller : A direct input and an amplified input which is used to measure low values. The LT6 regularly checks the coherence of the values read on these two inputs.
- If 10 successive measurements are not coherent, a signal is given to open all the outputs.
- The "measurement input fault" word is set to 1 (bit 81,E).

8.6. Communication watchdog

This function selects the fallback mode of the LT6 in the event of a communication loss in excess of 10 seconds.

Two choices:
- Open channels A and B and return to “Ready” as soon as the communication is restored,
- No action taken on the outputs that remain in the state they were in before the communication loss.

9.1. The physical layer

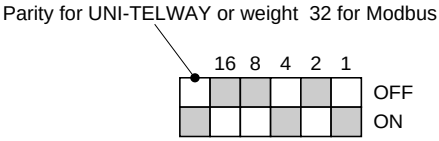
Two types of link on the same SUB D 9-pin connector on the front of the product:

- RS 485,
- RS 232.

(Circuit isolated from the other LT6 relay functions).

2. Configuration of the communication line

- The station address is defined by 6 switches on the front of the product:



Example : Station 5 UNI-TELWAY

The address is recognised by the LT6 during power up. If the address is changed when the LT6 supply is on, it is necessary to switch the LT6 off and then back on for the new address to be taken into account.

- The protocol is defined by 1 switch on the front of the product: Jbus/Modbus - UNI-TELWAY.
- The transmission speed is automatically recognised by the product. Two speeds are possible: 4 800 and 9 600 Bits/s.

9.2. Communication protocol:

Two protocols:
- UNI-TELWAY
- Jbus/ Modbus

The LT6 is slave for both protocols.

1. Characteristics of UNI-TELWAY protocol:

Connection : SUBD 9-pin male
Address : one only per product, from 1 to 31 with configuration by switch on the front of the product
Speed : automatic recognition (4800 or 9600 bits/s)
Number of messages stored on reception : 3
Number of messages stored on transmission : 0
Detection of absence of polling : more than 3 s

Type of object recognised	Byte (8 bits)	Word (16 bits)	Signed integer (16 bits)
segment	104	104	104
type of object	6	7	7
maximum size	218	109	109
min address **max address**	W0 W110	W0 W110	W0 W110
read access **read/write access**	W0 to W110 W83 to W110	W0 to W110 W83 to W110	W0 to W110 W83 to W110

UNI-TELWAY request codes:

Family	Service	Request		Confirm		Description
		Hex	Dec	Hex	Dec	
Access to data	Read a word	04	04	34	52	(W)
	Read objects	36	64	66	102	Bit, word, bit or word strings
	Write a word	14	20	FE	254	(W)
	Write objects	37	55	FE	254	Bit, word, bit or word strings
Unsolicited data	Unsolicited data	FC	252	-	-	Sends data without first receiving a request 26 - 01 - 1.02 - LT6P
General use	Device identification	0F	15	3F	63	Gives the type of product, the version and the commercial reference
	Protocol version	30	48	50	96	
	Status	31	49	61	97	Status of a device
	Mirror	FA	250	FB	251	Test of system and the communication path
	Read error counters	A2	162	D2	210	For device communication fault
	Reset counters	A4	164	FE	254	Reset

Unsolicited data
- The LT6 informs the master of all trips or alarms by sending unsolicited data.
- The unsolicited data is the record of the last trip.
- This message is sent to a "text block" in the master.
- The number of the text block is written in word N°106.
- This function is only enabled if word 98 is >-1 and <33.
- The initial value of word 106 is "-1".
- The destination address of the text block is: Network = 0 ; Station = 254 ; Gate = atext block address + 16 (decimal).
- As the data is not acknowledged by the master, it is repeated three times with one transmission every 3 seconds.

2. Characteristics of Jbus/Modbus protocol:

Connection: SUBD 9-pin male
Address: one only per product from 1 to 63 with configuration by switch on the front of the product
Speed: automatic recognition (4800 or 9600 bits/s)
Transmission parameters: 1 start bit, 8 data bits, 1 stop bit, no parity, 9600 or 4800 bits/s
Separation time:
• 2 characters of one message: less than the transmission time for 3 characters
• 2 messages: greater than the transmission time for 3 characters

Jbus/Modbus frame: RTU Mode

The frame defined for Jbus/Modbus protocol does not include message header or end of message bytes. Its definition is as follows:

Data is transmitted in binary.
CRC 16: cyclical redundancy check.
Detection of the end of the frame is by a silence longer than or equal to 3 characters.

Jbus/Modbus functions:

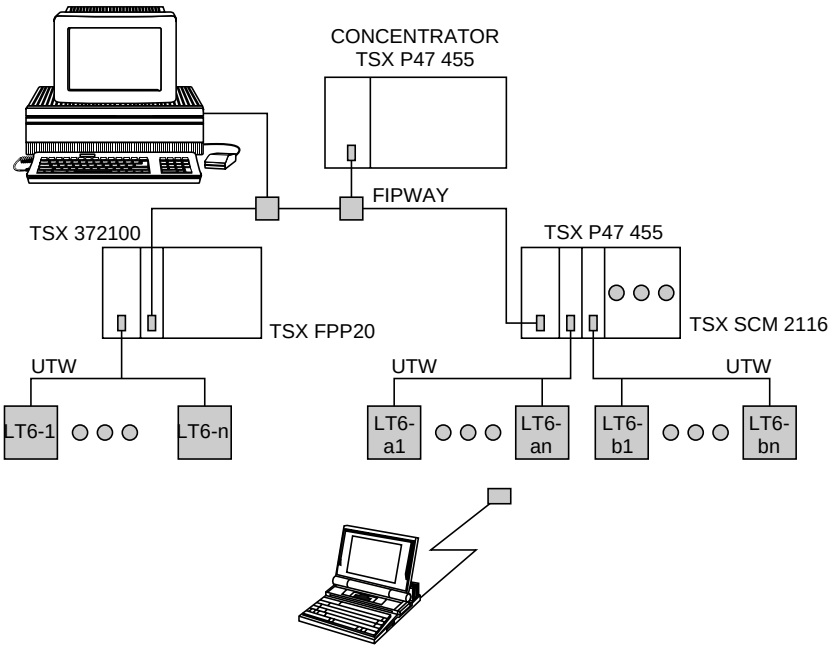
These can be broken down into:
• main functions used for data exchange,
• complementary functions for exchange diagnostics.

Code	Kind of functions	D	Maximum number of words
03	Read N output words (W0 to W110)		111
04	Read N input words (W0 à W110)		111
06	Write an output word	D	
08	Diagnostic with subcodes 00, 0A, 0B, 0C, 0D, 0E, 0F, 10, 11, 12		
11	Read events counter		
16	Write N output words	D	

The functions marked "D" can be used for general dissemination.
The message transmitted by the master must then specify slave number 0.
There is never a confirm message in reply.

9.3. Examples of architecture

9.3.1. UNI-TELWAY architecture



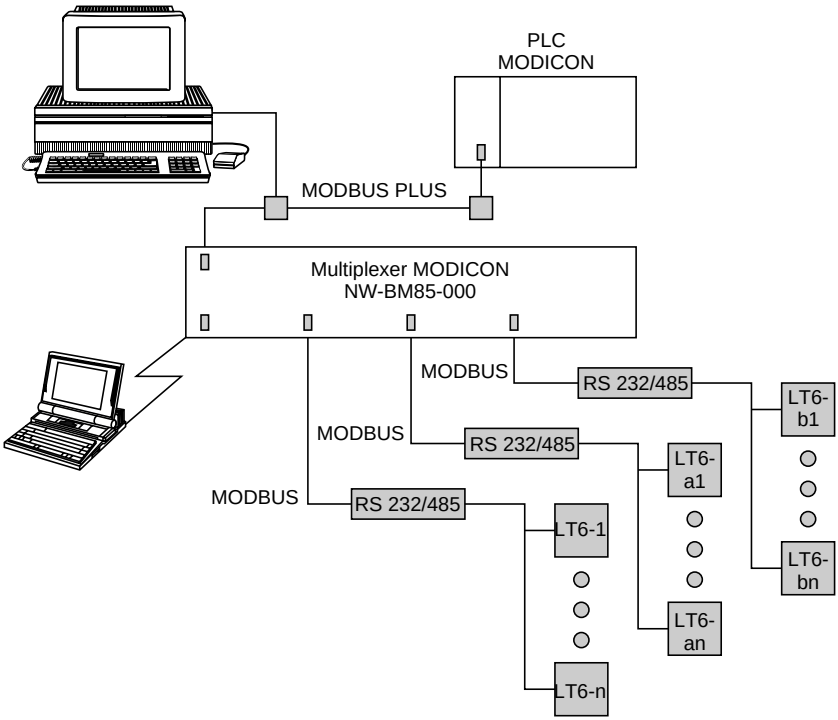
References for connection to Unitelway bus and TELEMECANIQUE programmable controllers

- Screened twisted pair cable: TSX SCA 100 (200, 500)
- Tap-off box: TSX SCA 50
- 2-channel subscriber connector: TSX SCA 62

- Communication coupler
  * for TSX 17-20 PLC: TSX SCG 1161
  * for TSX 37-2* PLC: TSX SCP 114
  * for TSX 47, 67, 87, 107 PLC: TSX SCM 21*6
  * built-in Unitelway port for processor
    TSX P47 425
    TSX 37 2* ***

Note: this does not include all the possibilities available with the "terminal" port.

9.3.2. Modbus architecture

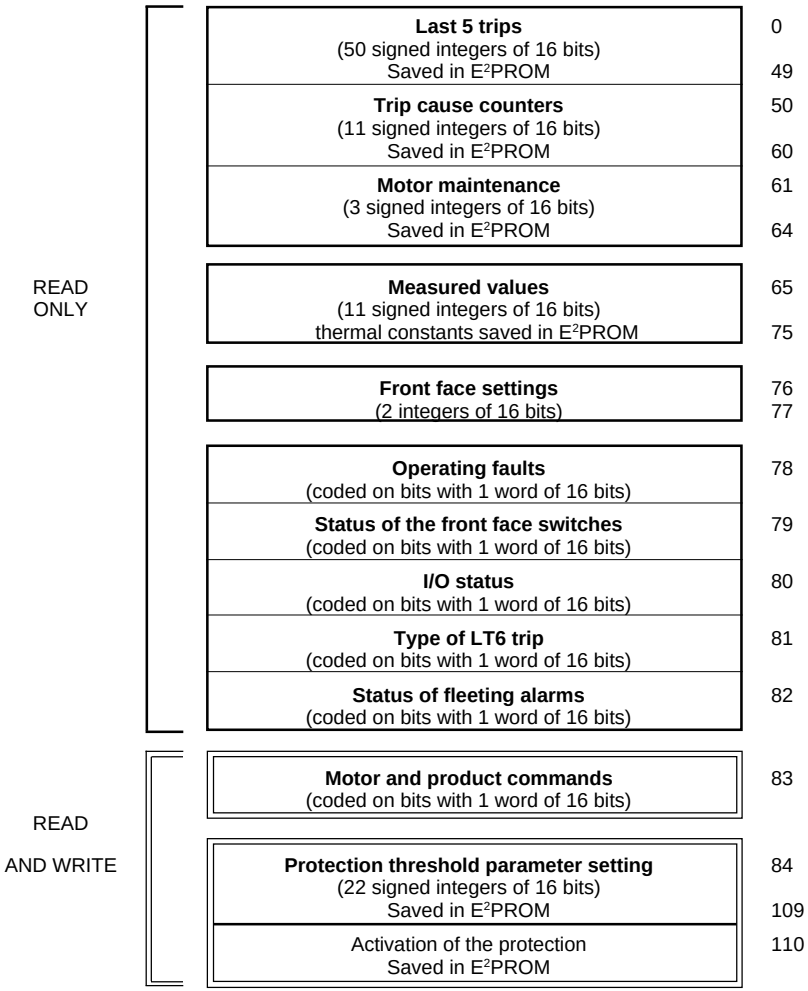


The multiplexer NW-BM85-000 of MODICON consist of:

- 1 communication port with MODBUS PLUS (medium redondance option), in order to communicate with the upper level.

- 4 communication port with MODBUS, with RS 232 support. They allow , adding a RS 232 / RS 485 adaptator to connect several LT6P.

9.4. Database structure (values refreshed every second)



Word	Bit	Name	Initial values	Unit	Values Min / Max	Operation	Comments
READ ONLY							
0		Trip cause			0 / 15	E^2 = Trip cause code	**Register of the last 5 trips**
1		Th. state long const (Fe)		0.01θn	0 / 200	E^2 **Trip (N)**	
2		Th. state short const (Cu)		0.01θn	0 / 200	E^2	
3		Rms current phase 1		1% Ir	0 / 1600	E^2 **This record is also:**	
4		Rms current phase 2		1% Ir	0 / 1600	E^2 **"the unsolicited data"**	
5		Rms current phase 3		1% Ir	0 / 1600	E^2	
6		Unbalance current Id		1% Iav	0 / 100	E^2	
7		Value $I_{\Delta r}$ (Earth fault)		0.1 A	0 / 999	E^2	
8		Cos φ		0.01	-100 / 100	E^2	
9		Voltage		1%	68 / 120	E^2	
10		Trip cause			0 / 15	E^2 = Trip cause code	
11		Th. state long const (Fe)		0.01θn	0 / 200	E^2 **Trip (N - 1)**	
12		Th. state short const (Cu)		0.01θn	0 / 200	E^2	
13		Rms current phase 1		1% Ir	0 / 1600	E^2	
14		Rms current phase 2		1% Ir	0 / 1600	E^2	
15		Rms current phase 3		1% Ir	0 / 1600	E^2	
16		Unbalance current Id		1% Iav	0 / 100	E^2	
17		Value $I_{\Delta r}$ (Earth fault)		0.1 A	0 / 999	E^2	
18		Cos φ		0.01	-100 / 100	E^2	
19		Voltage		1%	68 / 120	E^2	
20		Trip cause			0 / 15	E^2 = Trip cause code	
21		Th. state long const (Fe)		0.01θn	0 / 200	E^2 **Trip (N - 2)**	
22		Th. state short const (Cu)		0.01θn	0 / 200	E^2	
23		Rms current phase 1		1% Ir	0 / 1600	E^2	
24		Rms current phase 2		1% Ir	0 / 1600	E^2	
25		Rms current phase 3		1% Ir	0 / 1600	E^2	
26		Unbalance current Id		1% Iav	0 / 100	E^2	
27		Value $I_{\Delta r}$ (Earth fault)		0.1 A	0 / 999	E^2	
28		Cos φ		0.01	-100 / 100	E^2	
29		Voltage		1%	68 / 120	E^2	
30		Trip cause			0 / 15	E^2 = Trip cause code	
31		Th. state long const (Fe)		0.01θn	0 / 200	E^2 **Trip (N - 3)**	
32		Th. state short const (Cu)		0.01θn	0 / 200	E^2	
33		Rms current phase 1		1% Ir	0 / 1600	E^2	
34		Rms current phase 2		1% Ir	0 / 1600	E^2	
35		Rms current phase 3		1% Ir	0 / 1600	E^2	
36		Unbalance current Id		1% Iav	0 / 100	E^2	
37		Value $I_{\Delta r}$ (Earth fault)		0.1 A	0 / 999	E^2	
38		Cos φ		0.01	-100 / 100	E^2	
39		Voltage		1%	68 / 120	E^2	
40		Trip cause			0 / 15	E^2 = Trip cause code	
41		Th. state long const (Fe)		0.01θn	0 / 200	E^2 **Trip (N - 4)**	
42		Th. state short const (Cu)		0.01θn	0 / 200	E^2	
43		Rms current phase 1		1% Ir	0 / 1600	E^2	
44		Rms current phase 2		1% Ir	0 / 1600	E^2	
45		Rms current phase 3		1% Ir	0 / 1600	E^2	
46		Unbalance current Id		1% Iav	0 / 100	E^2	
47		Value $I_{\Delta r}$ (Earth fault)		0.1 A	0 / 999	E^2	
48		Cos φ		0.01	-100 / 100	E^2	
49		Voltage		1%	68 / 120	E^2	
50		Iron thermal trip		1	0 / 32767	E^2 = Also stored in E^2PROM	**Trip cause counters**
51		Copper thermal trip		1	0 / 32767	E^2	
52		PTC thermistor		1	0 / 32767	E^2	
53		Phase unbalance/loss		1	0 / 32767	E^2	
54		Earth fault		1	0 / 32767	E^2	
55		Undercurrent		1	0 / 32767	E^2	
56		Torque limitation		1	0 / 32767	E^2	
57		Prolonged starting		1	0 / 32767	E^2	
58		Direction of rotation		1	0 / 32767	E^2	
59		Cos φ		1	0 / 32767	E^2	
60		Test button		1	0 / 32767	E^2	

61	Number os starts		1	0 / 32767	E^2 see glossary	**Motor maintenance**
62	Motor operating time		1 hour	0 / 32767	E^2	
63	N° channel A close ops		1	0 / 32767	E^2	
64	N° channel B close ops		1	0 / 32767	E^2	
65	Long therm const (FE)	50	0.01θn	0 / 200	E^2	**Actual values** These values are always calculated even if the corresponding functions are not enabled
66	Short therm const (CU)	50	0.01θn	0 / 200	E^2	
67	Rms current phase 1		1% Ir	0 / 1600		
68	Rms current phase 2		1% Ir	0 / 1600		
69	Rms current phase 3		1% Ir	0 / 1600		
70	Unbalance current Id		1% Ir	0 / 200		
71	Value $I_{\Delta r}$ (Earth fault)		0.1 A	0 / 999		
72	Time bef. reset enabled		1 s	0 / 1000	Time calculated by the LT6	
73	Cos φ		0.01	- 100 / 100		
74	Voltage		1%	0 / 200		
75	Fréquency		0.1 Hz	0 / 700		
76	"Ir" front face	20	1%	20 / 109	Combination of 2 switches	Initial value of the 3 front face switches
77	"Classe" front face	5	5	5 / 30		
78, 0	Fault	0		0 / 1	1 = All product faults	**Fleeting states** These 16 bits are set to 1 on fault detection. They must be read to be reset to zero
78, 1	Supply fault	0		0 / 1	1 = Supply fault	
78, 2	Short-circuit detection	0		0 / 1	1 = Short-circuit	
78, 3	UNI-TELWAY fault	0		0 / 1	1 = UNI-TELWAY fault	
78, 4	JBus/Modbus fault	0		0 / 1	1 = Jbus/Modbus fault	
78, 5	Line ⇔ Local	0		0 / 1	1 = Change. discrete "Line/Local"	
78, 6	Adj. line ⇔ Adj. local	0		0 / 1	1 = Change. Dip "adj. line/local"	
78, 7	Watchdog fault	0		0 / 1	1 = Fault	
78, 8						
78, 9						
78, A						
78, B						
78, C						
78, D						
78, E						
78, F						
79, 0	Dip "Adress" (Parity)	0		0 / 1	1 = Even parity	**State of discrete inputs** **Front face**
79, 1	Dip "Adress" (16)	0		0 / 1	1 = 16	
79, 2	Dip "Adress" (8)	0		0 / 1	1 = 8	
79, 3	Dip "Adress" (4)	0		0 / 1	1 = 4	
79, 4	Dip "Adress" (2)	0		0 / 1	1 = 2	
79, 5	Dip "Adress" (1)	1		0 / 1	1 = 1	
79, 6	Dip "UNI-TELWAY/Jbus"	1		0 / 1	1 = UNI-TELWAY	
79, 7	Dip "Reset auto/manu"	1		0 / 1	1 = Manual reset	
79,	Dip "Adjust line/local"	0		0 / 1	0 = Local adjust	
79, 9	Reserved	0		0 / 1		
79, A	Reset	0		0 / 1	1 = "Reset" button actuated	
79, B	Test	0		0 / 1	1 = "Test" button actuated	
79, C						
79, D						
79, E						
79, F	Initial values	1		0 / 1	1 = Operation with initial values	(words 84 to 110)
80, 0	Start channel A	0		0 / 1		**State of discrete inputs**
80, 1	Start channel B	0		0 / 1		
80, 2	Stop channels A and B	0		0 / 1		
80, 3	Local-Line	0		0 / 1		
80, 4	Reset	0		0 / 1		
80, 5	Input C	0		0 / 1		
80, 6	Input D	0		0 / 1		
80, 7	Input E	0		0 / 1		
80, 8	Motor starting	0		0 / 1	1 = Starting cycle	**Motor status**
80, 9	Motor running	0		0 / 1	1 = (I > 0.2 Ir)	
80, A						
80, B	Outputs load shed	0		0 / 1	1 = Outputs at 0 as load shed	**State of discrete outputs**
80, C	Channel A	0		0 / 1	1 = Contact channel A closed	
80, D	Channel B	0		0 / 1	1 = Contact channel B closed	
80, E	Trip	0		0 / 1	1 = Product tripped	
80, F	Alarm	0		0 / 1	1 = Alarm	

81, 0	Iron thermal trip	0		0 / 1		
81, 1	Copper thermal trip	0		0 / 1	These bits are set to 1 by a	
81, 2	PTC thermistor	0		0 / 1	product trip and are reset	
81, 3	Phase unbalance/loss	0		0 / 1	to Zero by a "Reset" which	
81, 4	Earth fault	0		0 / 1	may be automatic or	
81, 5	Undercurrent	0		0 / 1	manual	
81, 6	Torque limitation	0		0 / 1		
81, 7	Prolonged starting	0		0 / 1		**Trips**
81, 8	Direction of rotation	0		0 / 1		
81, 9	Cos φ	0		0 / 1		
81, A	Test button	0		0 / 1		
81, B				0 / 1		
81, C				0 / 1		
81, D				0 / 1	These bits are set to 1 by a	**Fault**
81, E	Measurement input fault	0		0 / 1	product fault and are reset	
81, F	PTC therm short-circuit	0		0 / 1	to Zero by a "Reset"	
82, 0	Therm overload alarm	0		0 / 1		
82, 1	Phase unbalance/loss	0		0 / 1		
82, 2	Earth fault	0		0 / 1	These bits are at 1, if the	
82, 3	Undercurrent	0		0 / 1	corresponding thresholds are	
82, 4	Torque limitation	0		0 / 1	exceeded independently of time	**Alarms**
82, 5	Cos φ	0		0 / 1		
82, 6				0 / 1		
82, 7				0 / 1		
82, 8				0 / 1		
82, 9						
82, A						
82, B						
82, C						
82, D						
82, E						
82, F						

READ AND WRITE

83, 0	Start / Stop channel A	0		0 / 1	1 = Start ch. A ; 0 = Stop ch. A	**Motor control**
83, 1	Start / Stop channel B	0		0 / 1	1 = Start ch. B ; 0 = Stop ch. B	(4 bits ⇒
83, 2	Reset	0		0 / 1	1 = Reset ; reset by the LT6	(Reset on trip /
83, 3	Test	0		0 / 1	1 = Test ; reset by the LT6	fault)
83, 4						
83, 5						
83, 6						
83, 7						
83, 8						
83, 9						
83, A						
83, E						
83, C	Reset tripping values	0		0 / 1	1 = Reset tripping values	
83, D	Reset tripping counter	0		0 / 1	1 = Reset tripping counters	**Product**
83, E	Reset maintenance counter	0		0 / 1	1 = Reset Motor maintenance	
83, F	Load initial values	0		0 / 1	1 = Work with initial values	**control**
84	Value of Ir (% rating)	20	1%	20 / 109	E^2 = Also stored in E^2PROM	
85	Value of Class	5	5	5 / 30	E^2 **Thermal overload**	
86	Overload alarm thresh.	100	1% θn	0 / 100	E^2	
87	Id threshold (% of Iav)	30	1%	10 / 30	E^2	
88	Tripping time on starting	7	0.1 s	0 / 100	E^2 **Phase unbalance**	
89	Tripping time in operat'n	50	0.1 s	0 / 100	E^2	
90	I_{Δ} threshold	300	0.1 A	3 / 300	E^2	
91	Tripping time	50	0.1 s	0 / 50	E^2 **Earth fault**	
92	I_{sd} thgreshold (% of Ir)	150	1%	100 / 500	E^2	
93	Strarting time	100	0.1 s	0 / 300	E^2 **Prolonged starting**	
94	I_v threshold (% de Ir)	30	1%	30 / 90	E^2	
95	Tripping time	100	0.1 s	0 / 300	E^2 **Undercurrent**	
96	I_{LC} threshold (% de Ir)	200	1%	150 / 800	E^2	
97	Tripping time	100	0.1 s	0 / 300	E^2 **Torque limitation**	**Parameters**
98	Cos φ threshold	10	0.01	- 100 / 100	E^2	
99	Tripping time	100	0.1 s	0 / 100	E^2 **Cos φ**	**Transmitted by**

100	Level of voltage threshold	70	1% Un	68 / 120	E^2	**communication**
101	Time before shedding	1000	10 s	0 / 10000	E^2	
102	Level of reconnection	90	1% Un	68 / 120	E^2	
103	Time before reconnection	1000	10 s	0 / 10000	E^2 **Voltage threshold**	**line**
104	Time before reset enab.	0	1 s	0 / 1000	E^2	
105	θ°C Fe bef. reset enab.	100	1% θn	40 / 100	E^2 **Reset**	
106	Unsolicited data	- 1	1	- 1 / 32	E^2	
107	Reserved					
108	Value of motor In	0		0 / 32767	E^2 value set by user	
109	Communication watch dog	0		0/1	E^2 1 = watchdog enabled	
110, 0	Thermal overload	1		0 / 1	E^2 1 = Trip / Thermal overload	
110, 1	PTC thermistor	1		0 / 1	E^2 1 = Trip / PTC thermistor	
110, 2	Phase unbalance/loss	1		0 / 1	E^2 1 = Trip / Déséquilibre	
110, 3	Earth fault	1		0 / 1	E^2 1 = Trip / Défaut terre	
110, 4	Undercurrent	0		0 / 1	E^2 1 = Trip / Undercurrent	
110, 5	Torque limitation	0		0 / 1	E^2 1 = Trip / Prolonged starting	
110, 6	Prolonged starting	0		0 / 1	E^2 1 = Trip / Limit. couple	
110, 7	Direction of rotation	0		0 / 1	E^2 1 = Trip / Direction of rotation	
110, 8	Cos φ	0		0 / 1	E^2 1 = Trip / Cos φ	
110, 9	Load shedding	0		0 / 1	E^2 1 = Load shedding active	
11 0, A	Reverser	1		0 / 1	E^2 1 = Reverser control	Only one of these
110, B	Independent	0		0 / 1	E^2 1 = A&B independent control	3 bits at any
110, C	2-step	0		0 / 1	E^2 1 = 2-step starting control	one time
110, D	Front face Test button	1		0 / 1	E^2 0 = Test button active	
110, E	Front face Reset button	1		0 / 1	E^2 0 = Reset button active	
110, F	Sefl-cooled/Force-cooled	1		0 / 1	E^2 1 = Self-cooled	

Note: the product does not have a clock to indicate the time of the fault. It is considered preferable to use a system clock so avoiding time differences between the various LT6 relays.

10. LA9P620 operational software

Characteristics:

- Configuration with Windows 95, 98, NT4, 2000 and XP.
- 2 diskettes 3 1/2"
- 1 reversible 2m cable
- Operation with Modbus protocol only (the LT6 must be configured for Modbus)

Software installation:

- Insert the diskette in drive A:
- Open the file manager
- Open disk A:
- Launch Setup.exe by selecting the file using a double click
- Follow the installation instructions

or use the command "Execute" in the programme manager.

Description of the screens

Menu used to change : password, address, communication port
and to quit the application

Menu used to access the screen which can be accessed in road :
actual measurements, state of product parameters, trip record, counters

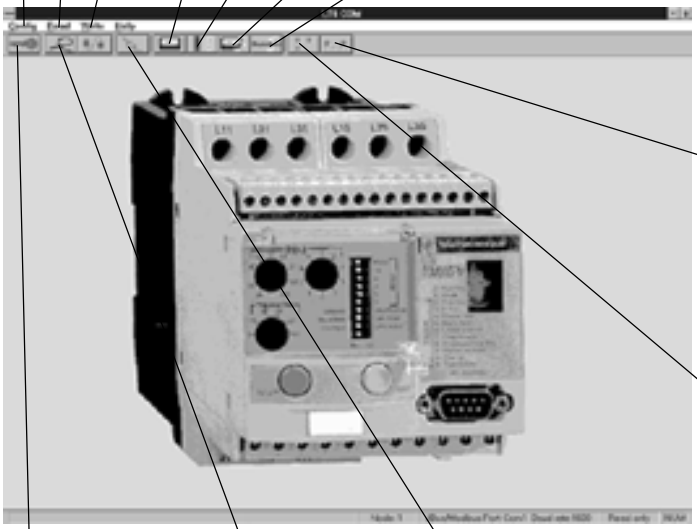
Menu used to access the screens which can be accessed in write ;
protection and control parameters

Displays the screen for reading the actual values

Displays the screen for reading the state of the product parameters

Displays the screen for reading the last 5 trips

Displays the screen for reading the trip
and maintenance counters



Displays the screen for
control parameter entry

Screens which can be accessed only if the password is entered

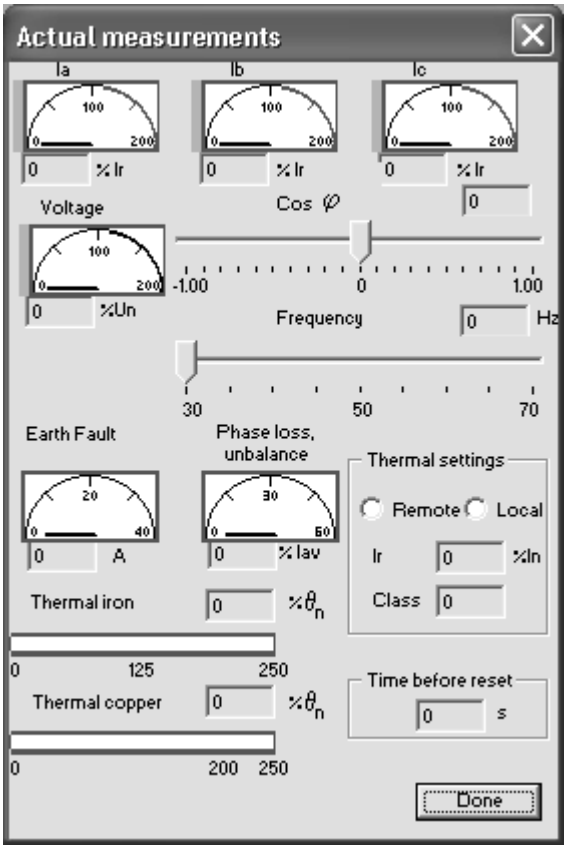
Displays the screen for
protection
parameter entry

Enter password
("enter" by default)

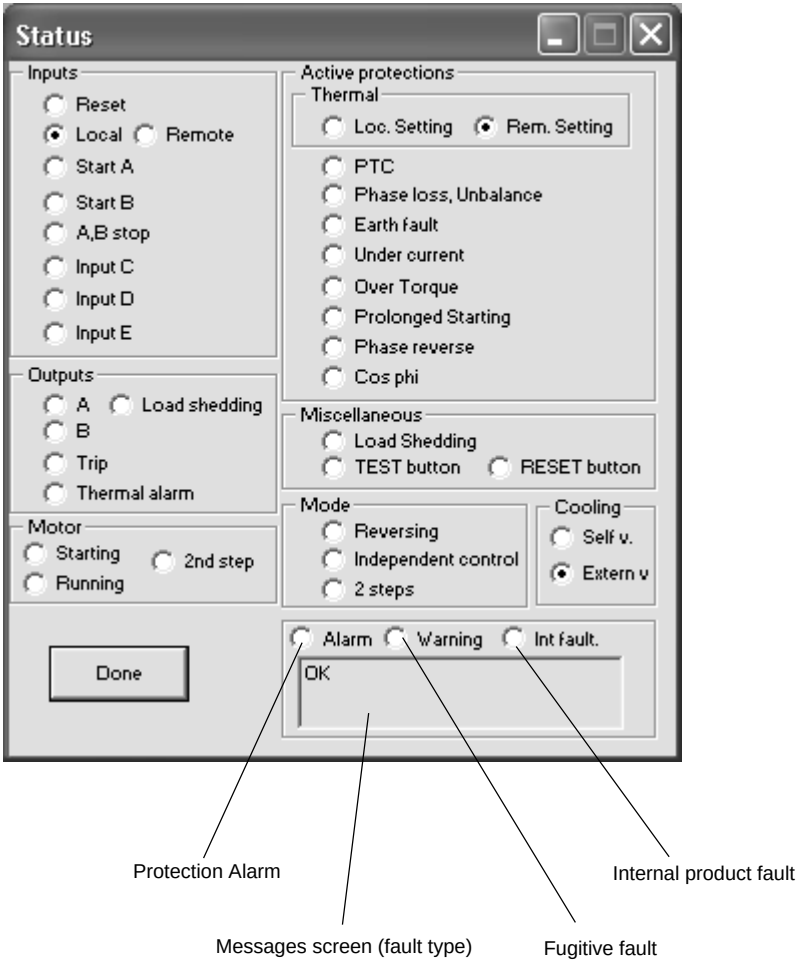
Enter LT6 address
("1" by default)

Enter communication port
("comm 1" by default)

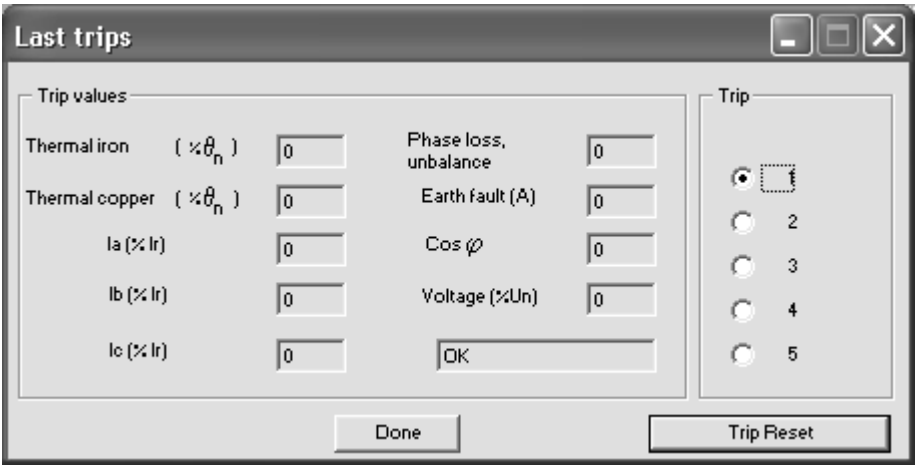
Display of the value of instantaneous measurements



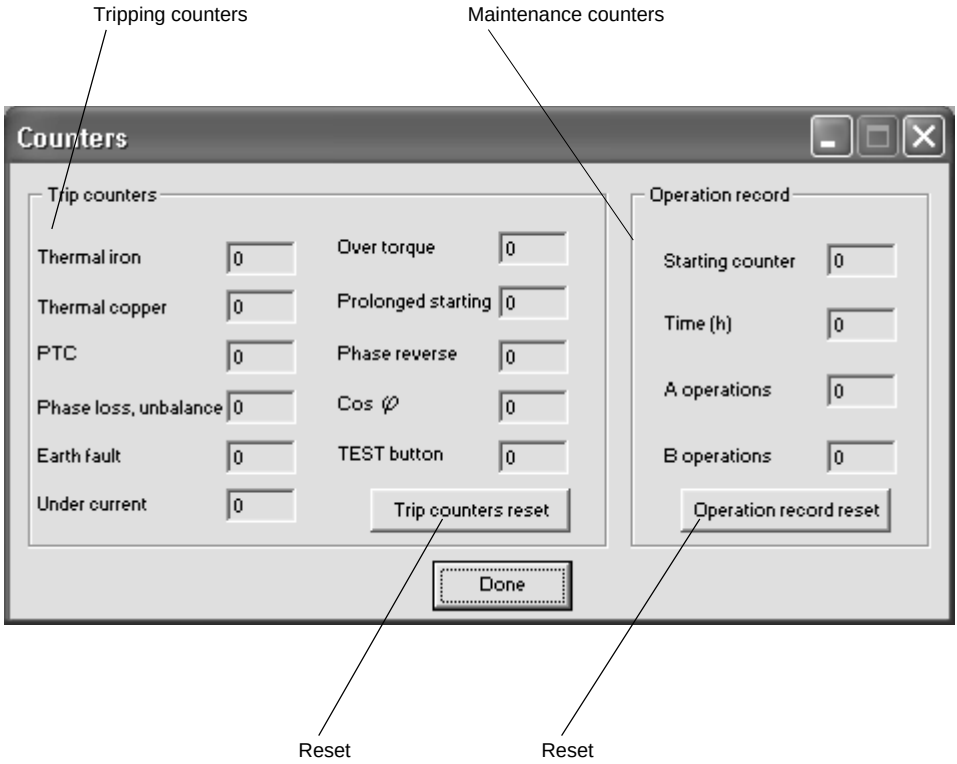
Product status Display



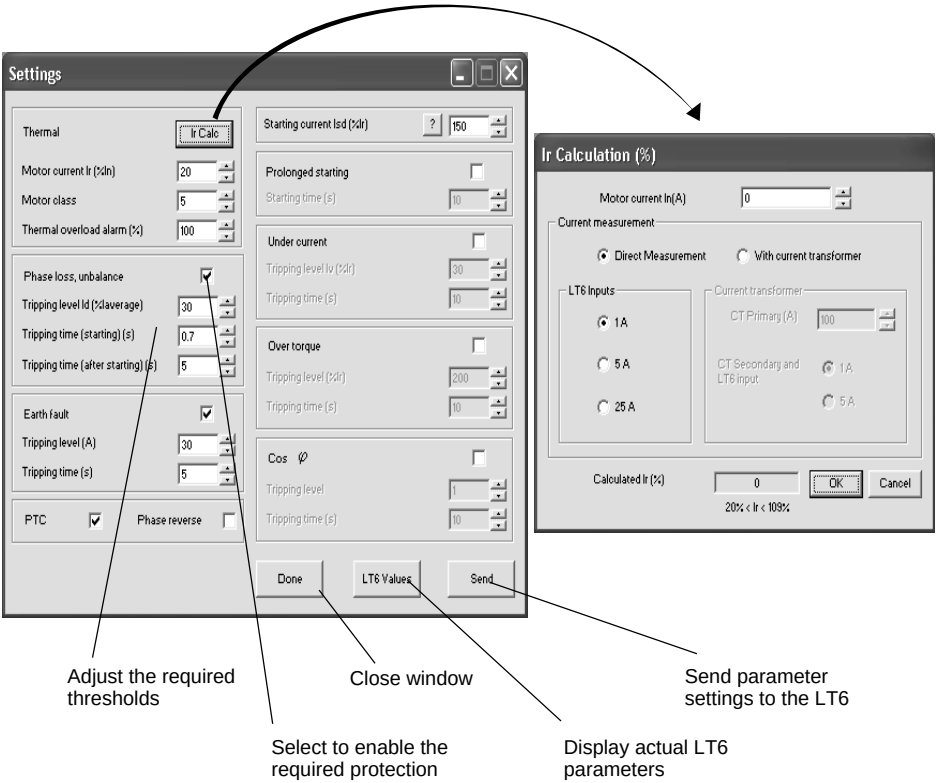
Display the 5 last trips



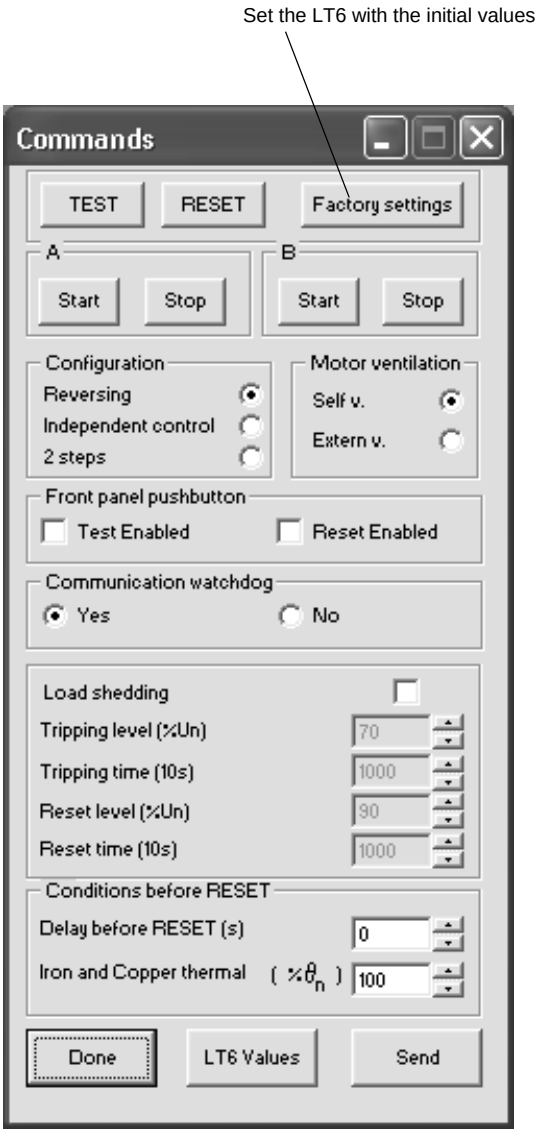
Counters Display



Protection parameter setting

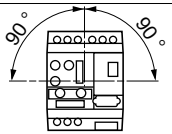


Commands setting



11. Characteristics

Environment

Conforming to standards			IEC 947-4-1, IEC 34-11, IEC 755, VDE 0106, VDE 0660.
CE Marking			Meets the essential requirements of the Low Voltage equipement (LV) & Electromagnetic Compatibility (EMC) European Community Directives.
Approvals pending			UL 508, CSA, PTB
Protective treatment			"TH"
Degree of protection	Conforming to IEC 947-1		IP 20 (1)
Shock resistance	Conforming to IEC 68-2-27		15 gn, 11 ms
Vibration resistance	Conforming to IEC 68-2-6		2 gn (3 to 100 Hz)
Ambient air temperature around the device	Storage	**°C**	- 35…+ 85
	Operation	**°C**	- 20…+ 70
Flame resistance	Conforming to UL 94		V0
Maximum operating altitude		**m**	2000
Operating position	In relation to normall vertical mounting plane		
Resistance to electrostatic discharge	Conforming to IEC 1000-4-2 level 3	**kV**	8
Resistance to electromagnetic interference	Conforming to IEC 1000-4-3 level 3	**V/m**	10
Resistance to fast transient currents	Conforming to IEC 1000-4-4 level 4	**kV**	2
Resistance to conducted radio-frequency disturbances			Conforming to IEC 1000-4-6 level 3
Rated undissipated pulse withstand (U imp)	Conforming to IEC 947-1	**kV**	6
Rated dissipated puls withstand			Conforming to IEC 1000-4-5 level 3
Resistance to low frequency disturbances, supply harmonics			Conforming to IEC 947-2 Appendix F Clause F4.1
Resistance to micro-breaks			Conforming to IEC 1000-4-11

(1) Only applicable when power cabling to relay exceeds the following sizes : 1.5 mm^2 fitted with cable end or 2.5 mm^2 not fitted with cable end.

11. Characteristics

Power circuit characteristics

Relay type			**LT6-P0●005FM**	**LT6-P0●025FM**
Rated insulation voltage (Ui)	Conforming to IEC 947-1	**V**	∼ 690	∼ 690
Operating frequency		**Hz**	50/60	50/60
Rated operational current		**A**	1 or 5 (1)	25
Cabling				
Solid cable	1 or 2 conductors	**mm²**	1.5…6	
Flexible cable without cable end	1 or 2 conductors	**mm²**	1.5…6	
Flexible cable with cable end	1 or 2 conductors	**mm²**	1.5…4	
Terminal tightening torque		**N.m**	1.7	
Associated protection				
By circuit breaker	≤ 25 A		1 A rating : ≤ GV2-L05 5 A rating : ≤ GV2-L10	≤ GV2-L22
	> 25 A using current transformers		Merlin Gerin MCCB NS●●●MA	
By fuses	≤ 25 A		1 A rating : ≤ aM 2 A, gG 4 A 5 A rating : ≤ aM 6 A, gG 16 A	≤ aM 25 A, gG/gM 50 A
	> 25 A Using current transformers		≥ aM 32 A, gG/gM 63 A	

Control circuit supply characteristics

Rated insulation voltage (Ui)	Conforming to IEC 947-1	**V**	∼ 380
Operating voltage		**V**	⎓ or ∼ 50/60 Hz : 90…276
Cabling	Plug-in connector		
Solid cable	1 or 2 conductors	**mm²**	0.5…1
Flexible cable without cable end	1 or 2 conductors	**mm²**	0.5…1
Flexible cable with cable end	1 conductor	**mm²**	0.5…1
	2 conductors	**mm²**	0.5…0.75
Terminal tightening		**N.m**	0.7

(1) Using external current transformer for operating currents exceeding 25 A.

Discrete input characteristics

Rated insulation voltage (Ui)	Conforming to IEC 947-1	**V**	∿ 250
Operating voltage		**V**	⎓ 90...150, ∿ 90…276
Current consumption	Minimum transient value	**mA**	≥ 1 (changing from 0 state to 1 state in t ≥ 4 ms)
Input impedance		**kΩ**	56

Discrete output characteristics

Rated insulation voltage (Ui)	Conforming to IEC 947-1	**V**	∿ 380
Type of output	Relay		1 N/O per channel
Associated fuse protection	Conforming to IEC 947-5	**A**	6 (type gG)
a.c. loads			
Rated voltage		**V**	∿ 250
Permissible power for category DC-15		**VA**	500 (Ie = 0.5 A, Ue = ∿ 250 V, Ith = 5 A, cos φ = 0.4 for 100,000 operations)
Associated with contactor			**LC1-K, LC2-K, LC7-K, LC8-K LC1-D09 to D95, LC1-F115 to F150**
d.c. loads			
Rated voltage		**V**	⎓ 30
Permissible power for cotegory DC-15 Associated with contactor		**VA**	50 (Ie = 0.5 A, Ue = ⎓ 30 V, Ith = 5 A, L/R ≤ 25 ms for 100,000 operations) **LP1-K, LP2-K, LP1-D09 and D12 LP1-D18 to D32 (with LA4-DC1U or DC2U) LP1-D40 to D80 (with LA4-DC3U)**

Signalling output characteristics

Rated insulation voltage (Ui)	Conforming to IEC 947-1	**V**	∿ 380
Type of output	Relay		1 N/O per channel
Associated fuse protection	Conforming to IEC 947-5	**A**	2 (type gG)
Current limit	At U = ⎓ 5 V	**mA**	10
a.c. loads			
Rated voltage		**V**	∿ 250
Permissible power for category AC-15		**W**	250 (Ie = 0.2 A, Ue = ∿ 250 V, Ith = 2 A, 300,000 operatios for resistive load)
Associated with contactor			**LC1-K, LC2-K, LC7-K, LC8-K with suppressor block LA4-KE**
d.c. loads			
Rated voltage		**V**	⎓ 30
Permissible power for cotegory DC-15 Associated with contactor		**W**	50 (Ie = 0.2 A, Ue = ⎓ 30 V, Ith = 2 A, 300,000 operations for resistive load) **LP1-K, LP2-K with suppressor block LA4-KC**

External current transformer characteristics (transformer not included)

Conforming to standards			IEC 185, IEC 71
Accuracy class			Classe 5P
Accuracy limit factor			15

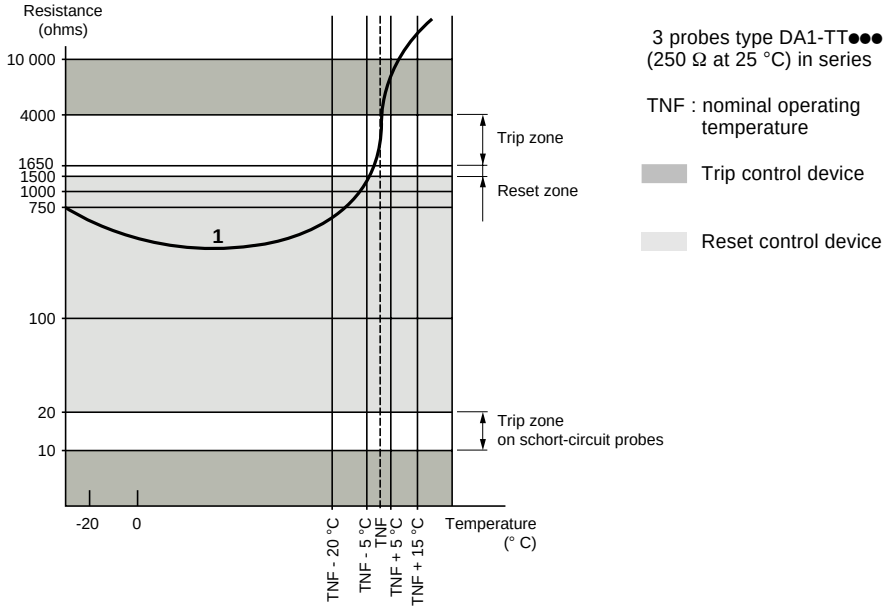
11. Characteristics

Probe type			**DA1-TT●●●**

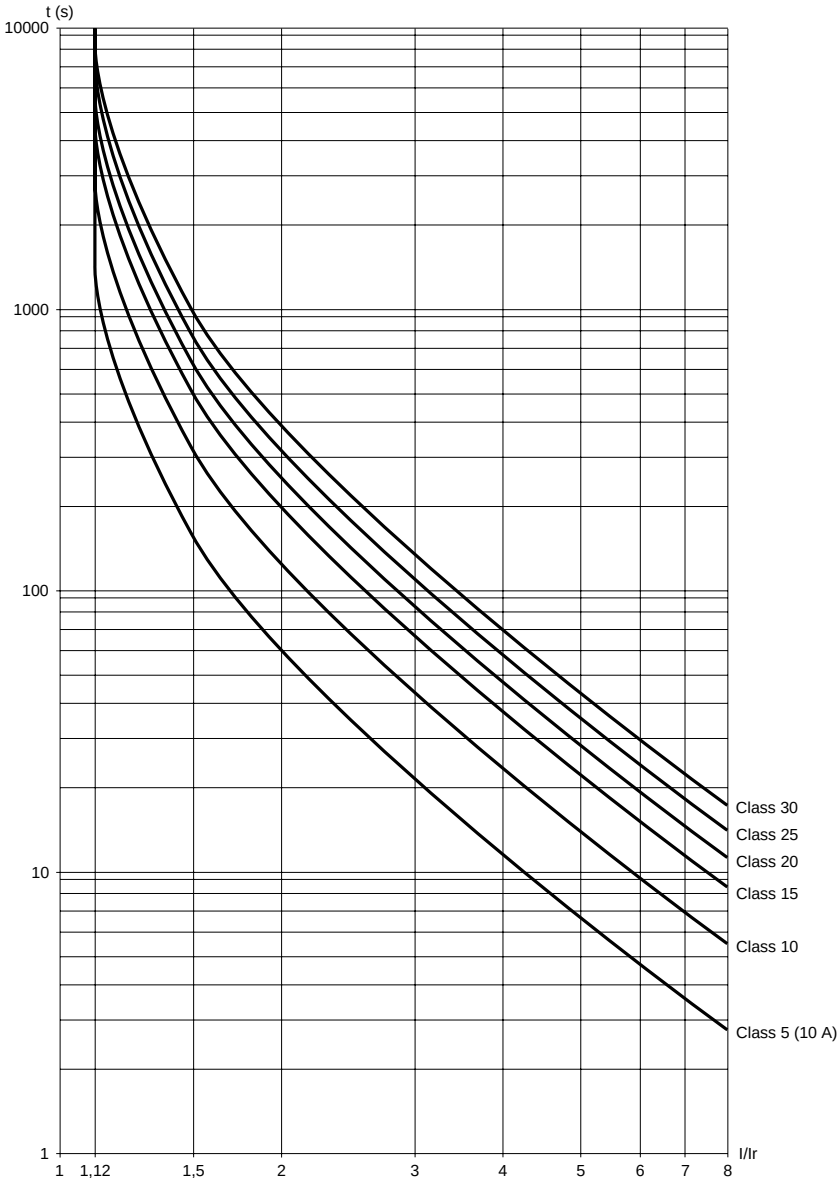
Probe characteristics

Conforming to standards			IEC 34-11 mark A
Resistance	At 25 °C	Ω	3 x 250 in series
Rated operational voltage (Ue)	Per probe	**V**	⎓ 2.5 max.
Rated insulation voltage (Ui)		**kV**	2.5
Insulation			Reinforced
Cable lengths	Between probes	**mm**	250
	Between probe and motor terminal block	**m**	1

Guaranteed operating zones : examples with 3 probes type DA1-TT●●● (250 Ω at 25 °C) connected in series, conforming to IEC 34-11, mark A.

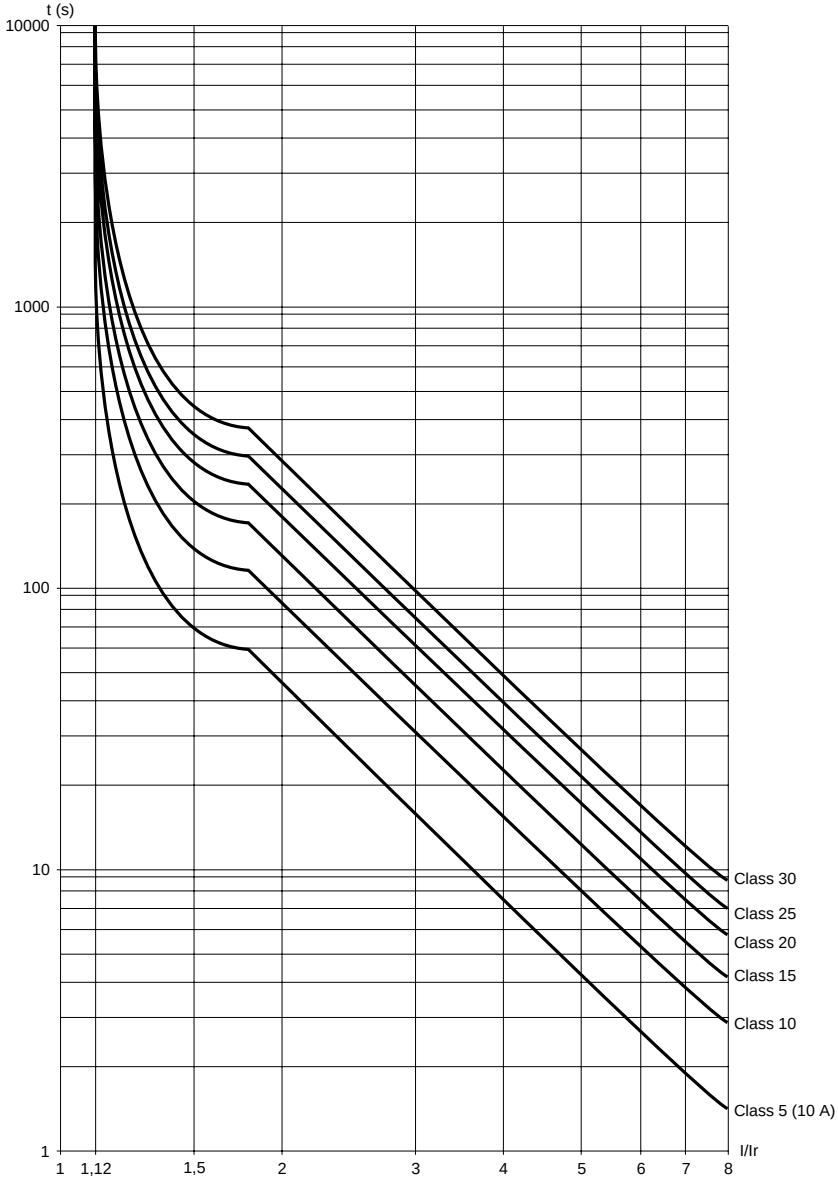


Cold stat curves (1)



(1) Tripping time accuracy : ± 8 % to 7.2 x I/Ir.

Hot start curves (1)



(1) Tripping time accuracy : ± 8 % to 7.2 x I/Ir.

3-pole multifunction protection relays

LT6-P0M005FM

Operational current **A**	Reference	Weight kg
0.2…1	**LT6-P0M005FM**	1.030
1…5	**LT6-P0M005FM**	1.030
5…25	**LT6-P0M025FM**	1.030

Configuration software

Description	For use with	Reference	Weigth kg
Kit comprising : - 3" 1/2 diskettes (2) - 2 m connecting cable fitted either end with 9-pin SUB-D connector (femalle-femalle)	All ratings of relay	**LA9-P620**	0.550

Earth fault toroids

Products marketed under the Merlin Gerin brandname; for ordering reference : please refer to our "Low voltage distribution 95/96" catalogue, pages D72 to D74

Sensitivity	Internal Ø du tore **mm**	Type	Weigth kg
0.3…30 A	30	**TA30**	0.120
	50	**PA50**	0.200
	80	**IA80**	0.420
	120	**MA120**	0.530
	200	**SA200**	1.320
	300	**GA300**	2.230
	POA	**POA**	1.300
	GOA	**GOA**	3.200

13. References

DA1-TT●●●

PTC termistor probes

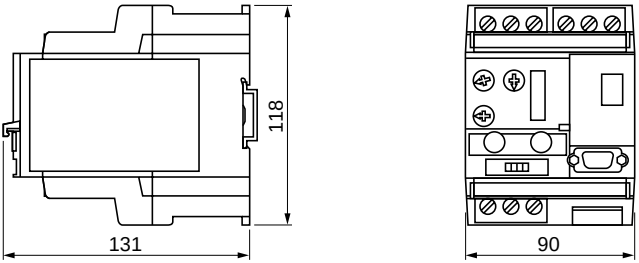
Description	Nominal operating temperature (NOT) °C	Sold in lots of	Unit reference	Weight kg
Triple probes	90	10	**DA1-TT090**	0.010
	110	10	**DA1-TT110**	0.010
	120	10	**DA1-TT120**	0.010
	130	10	**DA1-TT130**	0.010
	140	10	**DA1-TT140**	0.010
	150	10	**DA1-TT150**	0.010
	160	10	**DA1-TT160**	0.010
	170	10	**DA1-TT170**	0.010

Marking accessories (to be ordered separately)

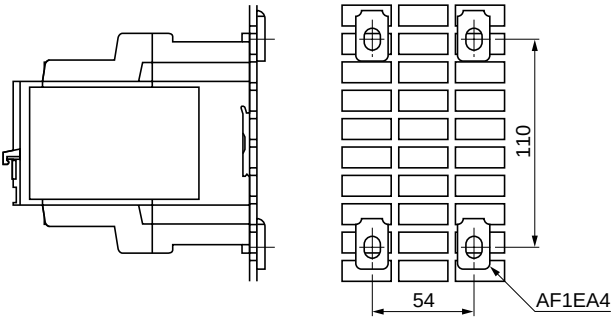
Clip-in markers (maximum of 5 markers per relay)	Strips of 10 identical numbers (0 to 9)	25	**AB1-R●** (1)	0.002
	Strips of 10 lidentical capital letters (A to Z)	25	**AB1-G●** (1)	0.002

(1) When ordering, complete the reference with the number or letter required.

Protection relays LT6-P
LT6-P0M●●●FM
on 35 mm ⊔ mounting rail

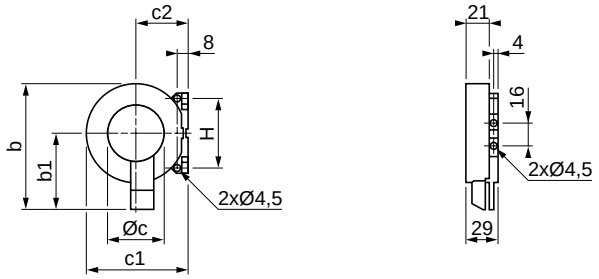


on pre-slotted mounting plate AM1-PA



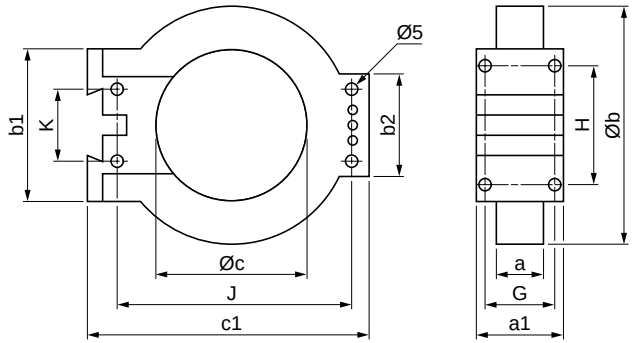
14. Dimensions, mounting

Earth fault toroids TA30, PA50



Type	b	b1	Øc	c1	c2	H
TA30	83	53	30	60	31	50
PA50	109	66	50	87	45	60

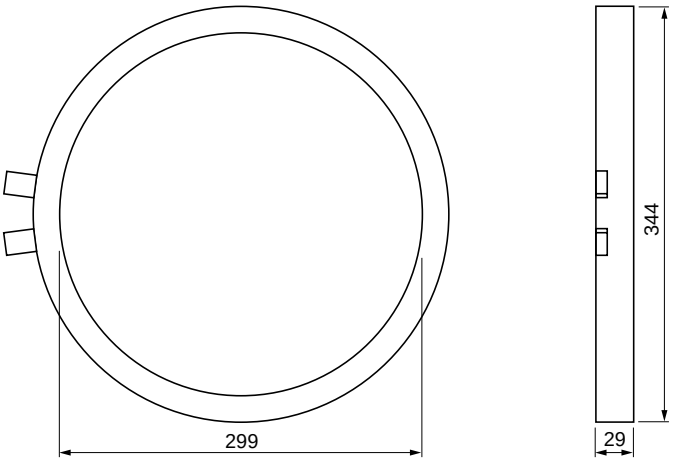
Earth fault toroids IA80, MA120, SA200



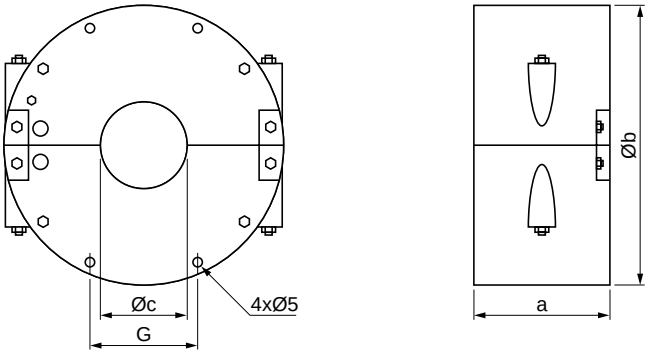
Type	a	a1	Øb	b1	b2	Øc	c1	G	H	J	K
IA80	26,5	44	122	80	55	80	150	35	65	126	40
MA120	26,5	44	164	80	55	120	190	35	65	166	40
SA200	29	46	256	120	90	196	274	37	104	254	60

14. Dimensions, mounting

GA300



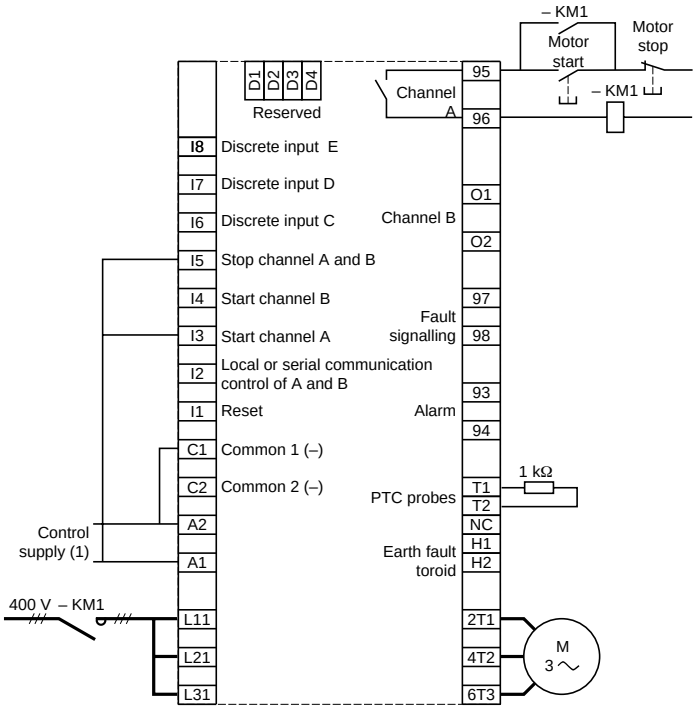
POA, GOA



Type	a	Øb	Øc	G
POA	72	148	46	57
GOA	78	224	110	76

Motor control : D.O.L. starting (channels A and B set for reversing or independent control)

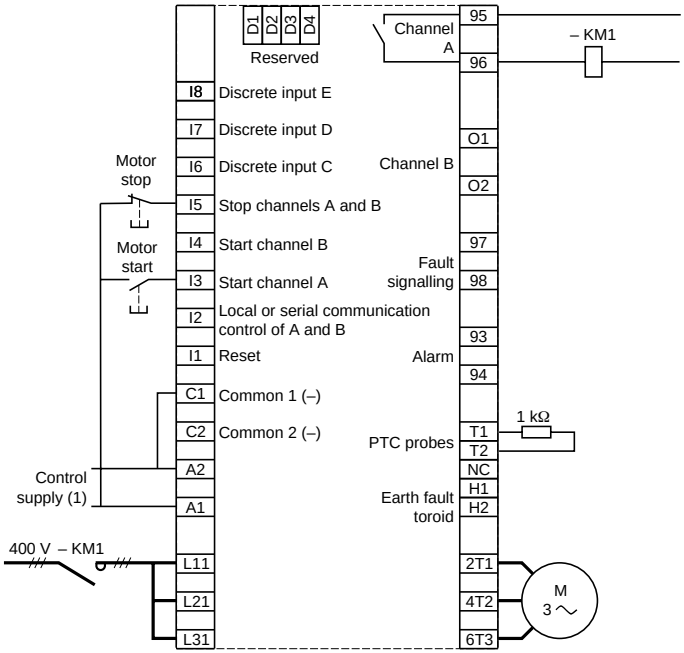
Control from front face of relay



(1) For d.c. control supplies the inputs I1 to I8 must be connected to the positive line.

Motor control : D.O.L. starting (channels A and B set for reversing or independent control)

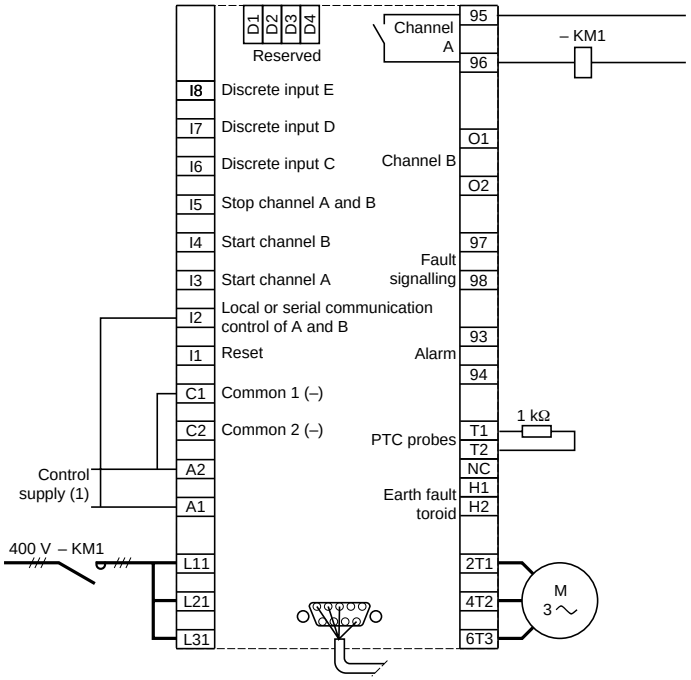
Control via discrete inputs of relay



(1) For d.c. control supplies the inputs I1 to I8 must be connected to the positive line.

Motor control : D.O.L. starting (channels A and B set for reversing or independent control)

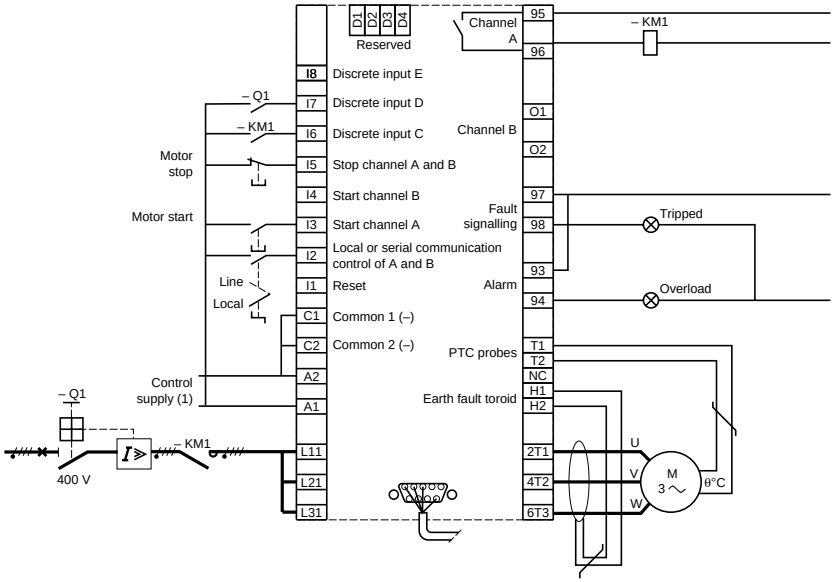
Control via serial link communication (UNI-TELWAY, Jbus/Modbus)



(1) For d.c. control supplies the inputs I1 to I8 must be connected to the positive line.

Motor control : D.O.L. starting

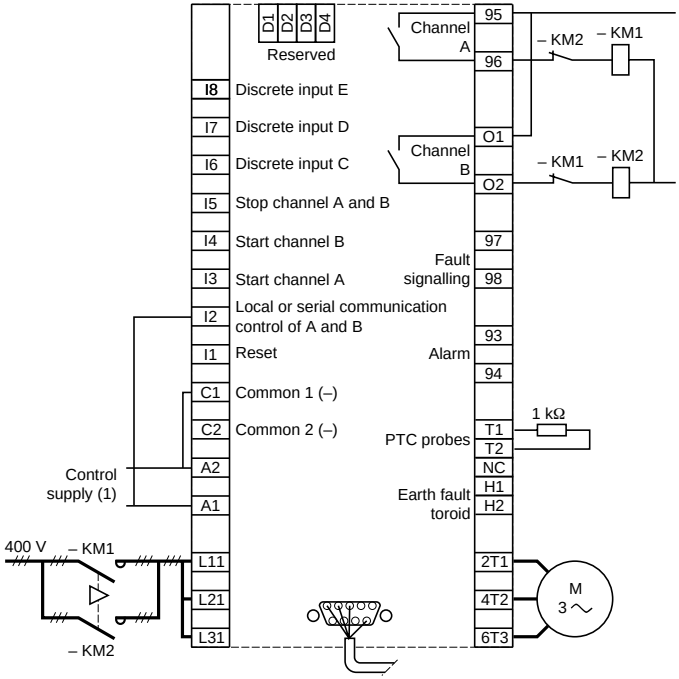
Control via serial link communication with signalling, earth fault toroid, PTC probes, state of power components.
Channels A and B set for reversing or independent control.
Possible to control the motor via discrete input ("local" position) or by serial link communication.



(1) For d.c. control supplies the inputs I1 to I8 must be connected to the positive line.

Motor control : reverser starting

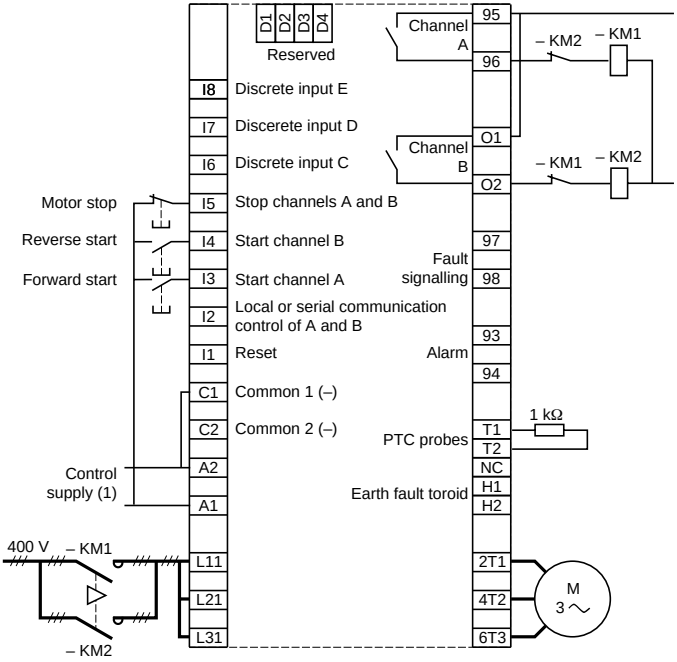
Control via serial link communication
Channels A and B set for reversing control



(1) For d.c. control supplies the inputs I1 to I8 must be connected to the positive line.

Motor control : reverser starting

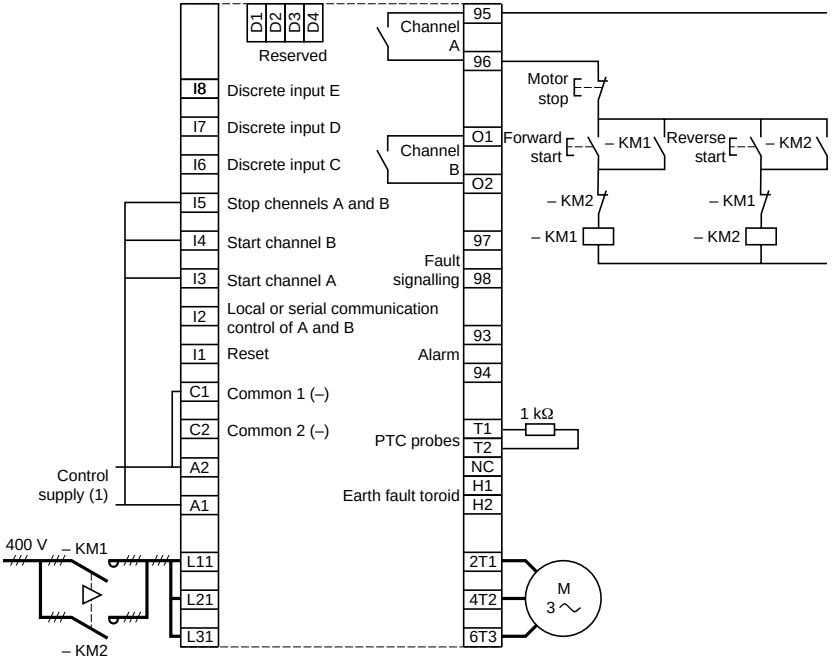
Control via discrete inputs of relay
Channels A and B set for reversing control



(1) For d.c. control supplies the inputs I1 to I8 must be connected to the positive line.

Motor control : reverser starting

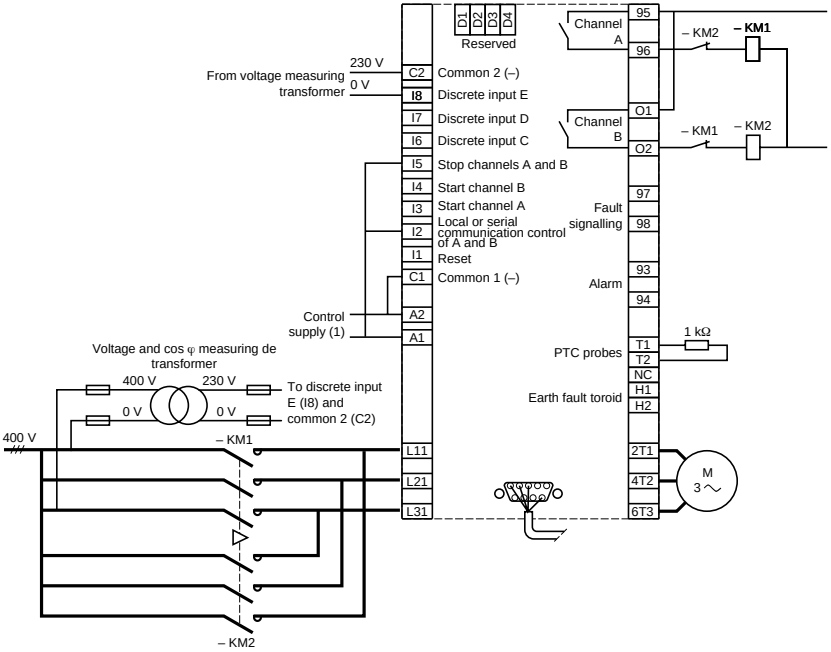
Control from front face of relay
Channels A and B set for independent control



(1) For d.c. control supplies the inputs I1 to I8 must be connected to the positive line.

Motor control : reverser starting with measurement of cos φ and voltage

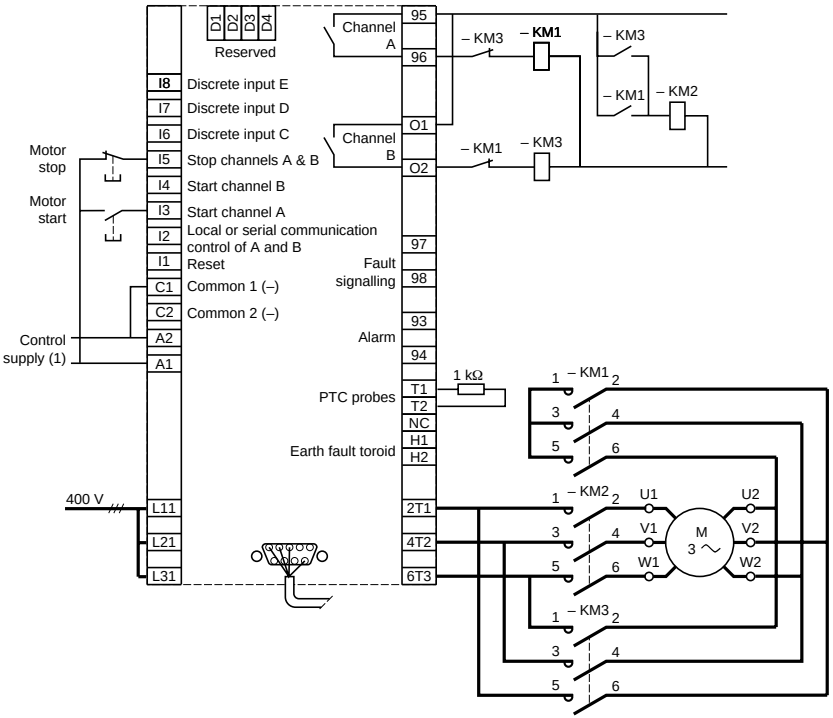
Control via serial link communication
Channels A and B set for reversing control



(1) For d.c. control supplies the inputs I1 to I7 must be connected to the positive line.

Motor control : star-delta starting (cannels A and B set for 2-stage control)

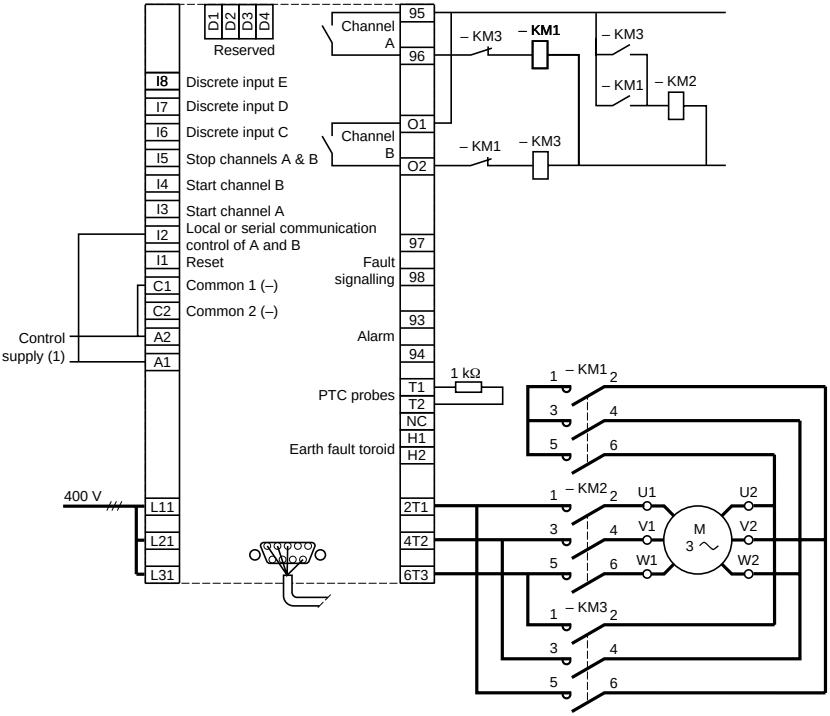
Control via discrete inputs of relay



(1)For d.c. control supplies the inputs I1 to I8 must be connected to the positive line.

Motor control : star-delta starting (channels A and B set for 2-stage control)

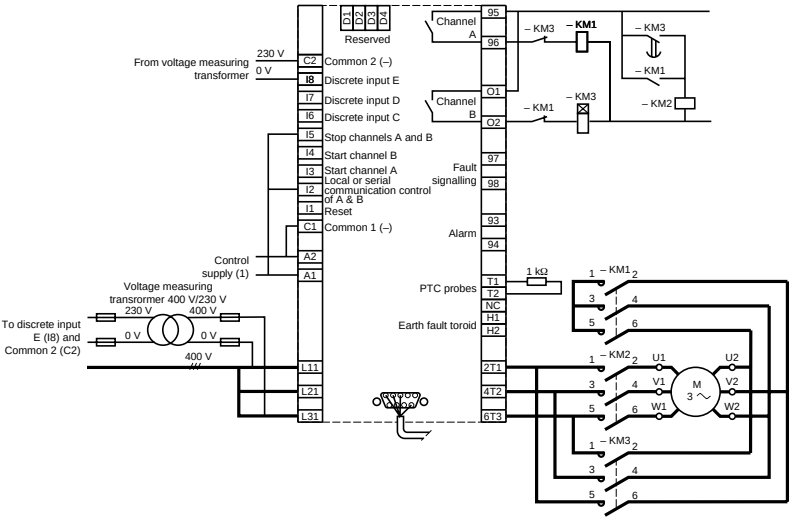
Control via serial link communication



(1) For d.c. control supplies the inputs I1 to I8 must be connected to the positive line.

Motor control : start-delta starting with adjustable time delay

Control via serial link communication
Channels A and B set for 2-stage control



(1) For d.c. control supplies the inputs I1 to I7 must be connected to the positive line.

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