LT6-P

Multifunction protection relays

Technical manual

Telemecanique

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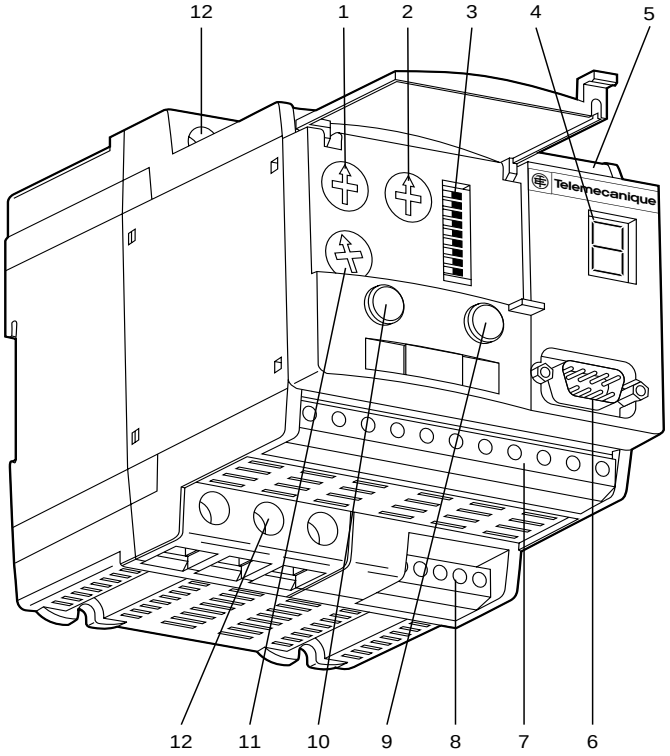
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1 and 2	Rotary selectors for setting the rated motor current
3	DIP switches for communication configuration
4	7-segment fault display
5	16-pin plug-in input connector
6	SUB-D 9-pin connector for the serial link
7	11-pin plug-in output connector
8	5-pin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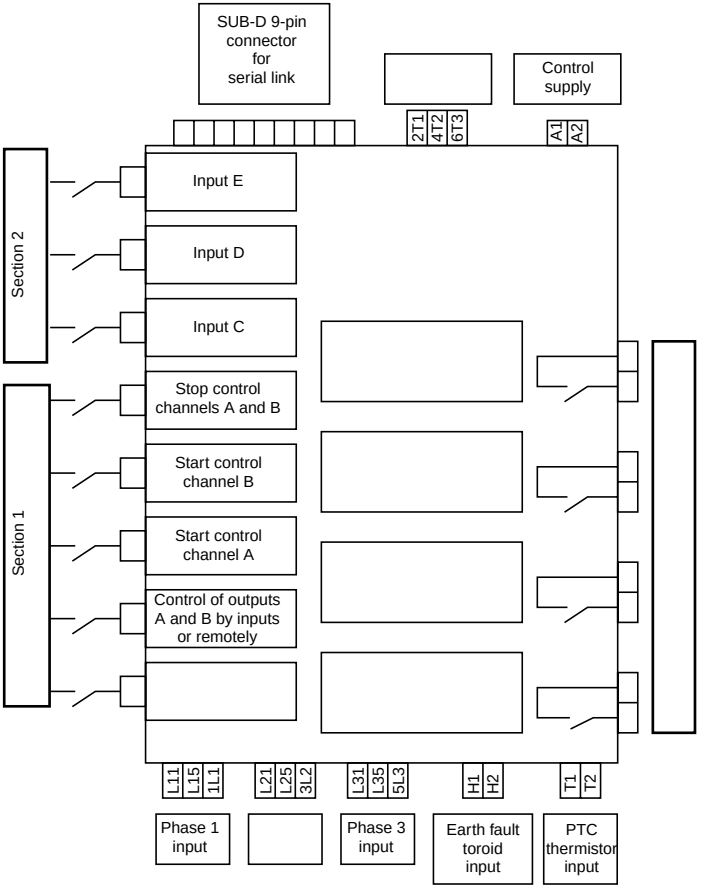
11	Rotary selector for setting the trip class
12	Power terminals


SUB-D 9-pin connector for serial link
Control supply
2T1
4T2
6T3
A1
A2
Section 2
Input E
Input D
Input C
Section 1
Stop control channels A and B
Start control channel B
Start control channel A
Control of outputs A and B by inputs or remotely
L11
L15
1L1
L21
L25
3L2
L31
L35
5L3
H1
H2
T1
T2
Phase 1 input
Phase 3 input
Earth fault toroid input
PTC thermistor input

• Input terminals (product viewed from the front)

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
I1	I2	I3	I4	I5	I6	I7	I8	NC	C1	C2	NC	D1	D2	D3	D4

Discrete inputs — Commons — Reserved

Discrete inputs, section 1

C1 Common section 1
I5 Stop control channels A and B
I4 Start control channel B
I3 Start control channel A
I2 Output control channels A and B :
- either by inputs I3, I4, I5,
- or by serial link.
I1 Reset signal

Discrete inputs, section 2

C2 common section 2
I8 Discrete input E
I7 Discrete input D
I6 Discrete input C

Inputs available for reading by serial link

• Output terminals (product viewed from the front)

11	10	9	8	7	6	5	4	3	2	1
95	96	O1	O2	97	98	93	94	NC	A2	A1

Discrete outputs

95, 96 Control contact channel A
O1, O2 Control contact channel B
97, 98 Fault signalling contact
93, 94 Thermal alarm contact
A1, A2 Control supply

• Measurement input terminals (product viewed from the front)

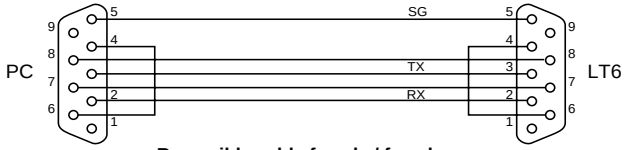
5	4	3	2	1
T1	T2	NC	H1	H2

H2 ┐ Earth fault
H1 ┘ toroid input
NC

T2 ┐ PTC thermistor
T1 ┘ probe input

If this input is unused, connect a 1kΩ resistor, or disable the function via the serial link.

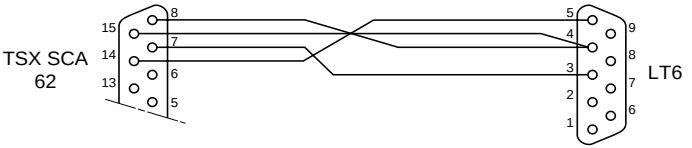
• Communication connector (SUB-D 9-pin - link RS 232 with PC)



Reversible cable female / female

This cable is provided with the LA9P620 software

• Communication connector (link RS 485 with PLC SCA62)



15 points male **9 points female**

• Input terminals (product viewed from the front)

For the LT6-P 1-5 A rating

L11	L21	L31	L15	L25	L35

L11, L21, L31 1A current inputs
L15, L25, L35 5A current inputs
For current values above 25 A, external current transformers must be used with the 1 A or 5 A rating.

For the LT6-P 25 A rating

1L1	3L2	5L3

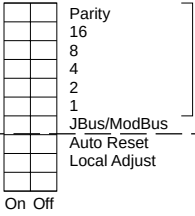
1L1, 3L2, 5L3 25A current inputs

• Output terminals (product viewed from the front)

2T1	4T2	6T3

2T1, 4T2, 6T3 1, 5, 25 A current outputs

• DIP switch

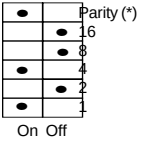


The change of position of these switches is taken into account only at the moment the LT6 is energized.

• Address : for RS 485, RS 232 operation

A bus address is required for communication :
- with Unitelway : from 1 to 31 with definition of address parity.
- with JBus/ModBus : from 1 to 63 (the "Parity" switch is used as weight 32 in the address).

Example : Station 5 Unitelway



(*) Parity = on, if the number of the address bit is even.

• Unitelway–JBus/ModBus

The choice of protocol is made using this switch (the transmission speed is recognised automatically by the product ; 4 800, 9 600 bits/s).

• Manual Reset/Auto Reset

Any relay trip or fault requires an obligatory "Reset". Without this action, the control of channels A and B cannot be restarted.
- in "Auto Reset", the relay resets as soon as the trip conditions have disappeared and if the trip was of thermal origin.

Any other type of trip must be reset by an action identical to "Manual Reset".
- in "Manual Reset", as soon as the trip conditions have disappeared, the relay can be reset using a "Reset" signal (pushbutton on the front face or discrete input or by serial link).

• Line adjust/Local adjust

The switch in position :
- "Local adjust" activates the thermal adjustment parameters on the front face (Ir, trip class).
- "Line adjust" actives the thermal adjustment parameters transmitted by serial link and these values are not then assigned by the settings on the front face.

The other protection parameters can only be accessed for adjustment by serial link.

• Power circuit

- maximum operational voltage: ∿ 690 V 50/60 Hz
- rated current : 1 or 5 A – LT6P0M005FM
  25 A – LT6P0M025FM

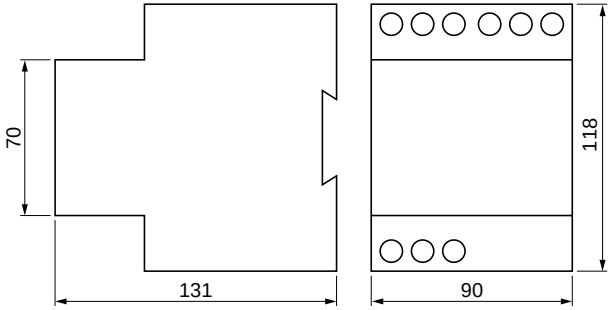
above 25 A, external current transformers must be used.

• Control circuit

- control supply : 90...276 V ⎓ or ∿ 50/60 Hz
- discrete inputs : ⎓ 90...150 V
  ∿ 90...276 V
- channels A and B outputs : voltage ∿ 250 V or ⎓ 30 V – 5 A max

- signalling outputs : voltage ∿ 250 V or ⎓ 30 V – 2 A max
  (resistive load)

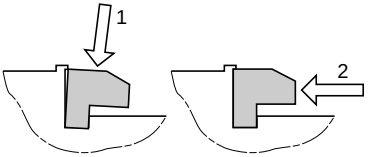
Dimensions of the LT6-P



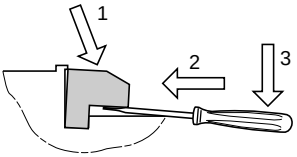
Cabling :

	[mm²]	[mm²]	[mm²]	[mm²]	[mm²]	[mm²]	Ø1 Ø2 [mm]	AWG		
Power	1.5 … 6	1.5 … 6	1.5 … 6	1.5 … 6	1.5 … 6	1.5 … 4	Ø1 4.2 … Ø2 10	16 … 10	Philips N 2 1.7 Nm	Ø 6 1.7 Nm
Command	0.5 … 1	0.5 … 1	0.5 … 1	0.5 … 1	0.5 … 1	0.5 … 0.75		20 … 17		Ø 3 0.7 Nm

Locking of connectors

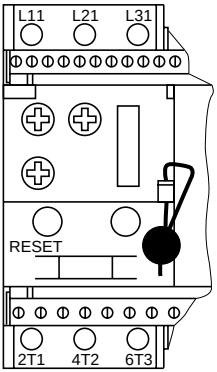


Unlocking of connectors



Operata to an endpoind of the connector

Filling of the bonnet :



	Functions		Parameters		
Protection	**Factory enabled functions**	**Enabled/ disabled by serial link**	**Designation**	**Initial values**	**Setting range which can be accessed by serial link**
Thermal overload			Ir (% rating) Class overload alarm	20 % 5 100 %	20 / 109 % (1) 5 / 30 (1) 0 / 125 %
Temp-rise (PTC)					
Phase unbalance			Id (% de Imoy.) Tripping time during starting Tripping time	30 % Iav. 0.7 s 5 s	10 / 30 % Iav. 0 / 10 s 0 / 10 s
Earth fault (resid. current)			$I_{\Delta r}$ Tripping time	30 A 5 s	0.3 / 30 A 0 / 5 s
Prolonged starting			I_{Sd} (% of Ir) Starting time	150 % Ir 10 s	100 / 500 % Ir 0 / 30 s
Undercurrent (underload)			I_V (% of Ir) Tripping time	30 % Ir 10 s	30 / 90 % Ir 0 / 30 s
Torque limitation			I_{LC} (% of Ir) Tripping time	200 % Ir 10 s	150 / 800 % Ir 0 / 30 s
Cos φ			Cos φ Tripping time	0 10 s	-1 / 1 0 / 10 s
Phase rotation monitoring				normal direction	

(1) these functions can be enabled and adjusted from the front face of the product ("local adjust")

Additional functions	**Factory enabled functions**	**Enabled/ Disabled by serial link**	**Designation**	**Initial values**	**Setting range which can be accessed by serial link**
Voltage threshold			Voltage threshold Time before shed. Reconnection Time before recon.	70 % Un 10000 s 90 % Un 10000 s	68 / 120 % Un 0 / 100000 s 68 / 120 % Un 0 / 100000 s
Short-circuit detection			Isc	15 Ir peak	
Reset			Time before reset θ°C before reset	0 s 100 % θn	0 / 1000 s 40 / 100 % θn
Motor control			Control of A and B outputs	Reverser	Reverser Independent 2-step
Self-ventilated				Self-ventilated	Self / force-ventilated
Watchdog for communication			A and B outputs opened if commu-nication is lost		

• Thermal protection

This protection can be adjusted in 2 ways :

either in position "Local adjust"

the rated motor current Ir (A) is set using the two upper rotary selectors, located on the front face of the product, graduated in % of the rating
Formula to be used to calculate the setting of Ir in % :

$$\frac{\text{Ir (A) x 100}}{\text{transformer ratio* x relay rating (A)}}$$

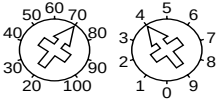
(*) ratio of the external current transformer = $\frac{\text{input current (motor)}}{\text{output current}}$

For applications without external CT, this ratio = 1

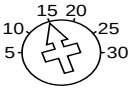
Example of setting to obtain a motor current Ir of 3.7 A :
- the power must be connected to the 5 A current inputs (L15, L25, L35),
- using the previous formula,

$$\frac{3.7 \times 100}{1 \times 5} = 74\ \%$$

Set the top left rotary selector (numbered 1 in the drawing) to position 70 and set the top right rotary selector (numbered 2 in the drawing) to position 4, i.e. a total of 74 %.



Adjustment of the trip class is carried out using the bottom rotary selector (numbered 11 in the drawing) graduated from 5 to 30.
Select the class according to the defined starting time.



Or in position "Line adjust"

the value of (Ir) is preset to 20 % of the product rating and the trip class is preset to 5 (see words 84 and 85 of the LT6 variables).

• Thermal alarm

The threshold can only be adjusted by serial link. Preset to 100 % θn.

• Additional thermal protection by PTC thermistor probes

A maximum of 6 probes can be connected in series.
This function can be inhibited by connecting a 1kΩ resistor across thel terminals of the product, or via the serial link.

• Locked rotor and overtorque protection

By measuring the current, above a threshold, the LT6 trips after a time delay. The threshold and the time delay can only be adjusted by serial link. The threshold can be adjusted from 1.5 to 8 times the rated motor current, and the time delay from 0 to 30 s.
This is inhibited during motor starting and validated at the end of starting.

• Undercurrent (underload) protection

By reading the current values, the LT6 trips below a threshold and after a time delay.
The threshold and the time delay can only be adjusted by serial link; the threshold can be adjusted from 0.3 to 0.9 times the rated motor current, the time delay from 0 to 30 s.

• Earth (ground) fault protection

By measurement of earth leakage (or residual) current, carried out using a homopolar toroid external to the relay (see the LT6 catalogue for references).
Preset for a threshold of 30 A and a time delay of 5 s.
The threshold and the time delay can only be adjusted by serial link; the threshold can be adjusted from 0.3 to 30 A, the time delay from 0 to 5 s.

• Supply phase rotation reversal protection

This protection is enabled by the serial link.
If a phase rotation reversal is detected, the LT6 trips.

• Phase unbalance and phase loss protection

By reading the current in all 3 phases, the LT6 trips above an unbalance threshold and after a time delay.
The function is active with a preset threshold of 0.3 times average current (I av.) and an admissible unbalance time of 5 s in motor operation.
During starting the admissible time is preset by another time delay of 0.7 s.
Both threshold and time delay are adjustable by serial link.
This function can be desabled via serial link.

• Power factor (cosφ) monitoring

This function monitors the phase angle between the current and the motor voltage image.
The motor voltage is measured using spare input E (I8).
This input receives an image of the motor supply voltage.
The threshold and the time delay can only be adjusted by serial link.
The power factor (cosφ) threshold can be adjusted from -1.00 to +1,00 and the time delay from 0 to 10 s.

• Communication watchdog

This function allows the user to configure how the LT6 will react in case of a lost of communication during more than 10 s.
Two choices:

- open of the A and B outputs and return to "ready" as soon as the communication is back,
- no actions on A and B outputs which remain in the status they were before the lost of communication.

This function is available only for LT6 made after december 2001 (code on label > 0149)

• Voltage threshold
below a motor voltage threshold, channels A and B open.

• Short-circuit detection
this function can be used to signal a short-circuit for a threshold of 15 times Ir peak.

It is only an information, protection against short-circuit has to be realized by a circuit breaker or fuses.

• Motor control
the LT6 is the interface of the motor control it protects.
Two outputs can be used to control two contactors to provide:
- control of two independent circuits,
- control of a reverser with interlocking between the 2 channels by monitoring the inputs and the motor current,
- 2-step starting by current monitoring (star-delta).

• Protection function signalling
trips of a thermal origin or linked to current unbalance, thermal alarm, abnormal temperature-rise of the PTC thermistor probes, cosφ measurement too low, locked rotor and overtorque detection, underload , earth fault currents (residual current), phase rotation reversal, prolonged starting.

• Product function signalling
detection of serial link faults,
detection of measurement input operating faults.

• The faults are signalled
- locally by a 7-segment display on the product itself,
- remotely via the serial link.

The protection fault codes for the 7-segment display are given on the front of the product (from 1 to 9, A, b).

The product operating fault codes are :
(the names of the faults from C to U are not given on the front of the product)

C watchdog fault
d load shedding
E measurement input fault
F parity fault
H
J JBus/ModBus fault
L communication watchdog
n
P short-circuit on PTC probe
U Unitelway fault

Each time the LT6 trips, the type of fault, the instantaneous values of currents, voltage, cosφ and thermal states are stored.
A control supply interrupt does not affect the fault storage.

• Test

- locally using the TEST pushbutton on the front of the relay,
- remotely by serial link,

the test causes the contacts controlling the contactors to open and the fault signalling contact to close..

• Reset

The reset mode is selected using the configuration selector on the front face of the product.

– Manual Reset

. manually using the RESET pushbutton on the front of the relay,
. locally by input I1 controlled by a pushbutton mounted on the front of the control panel,
. remotely by serial link.

– Auto Reset

. only thermal trips can be reset in automatic mode on condition that the motor is able to restart. Any other type of trip must be reset by an action identical to that for Manual Reset.

• Control of motor contactors (channel A, channel B)

- locally using inputs such as I3, I4, I5, where input I2 = 0,
- remotely by serial link where input I2 = 1.

The **LA9P620** kit comprises :

- two 3.5" format diskette.

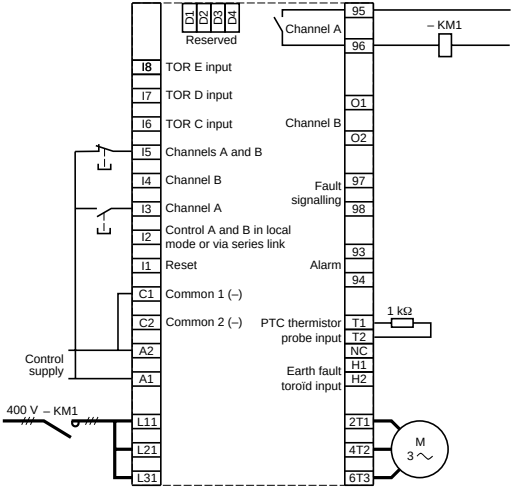
- a cable for connection between the LT6 SUB-D 9-pin connector and a 9-pin series port (port COM1) of a PC type computer.

The computer must operate with Windows 95, 98 or NT4 environment.

On condition that the LT6 has power up and on JBus/ModBus protocol, screens enable :
- software parameters to be entered for dialogue with the LT6,
- definition of the type of motor control,
- adjustment of the protection parameters,
- display of the LT6 data.

After parameter setting, the PC can be disconnected and reconnected at any time during operation.

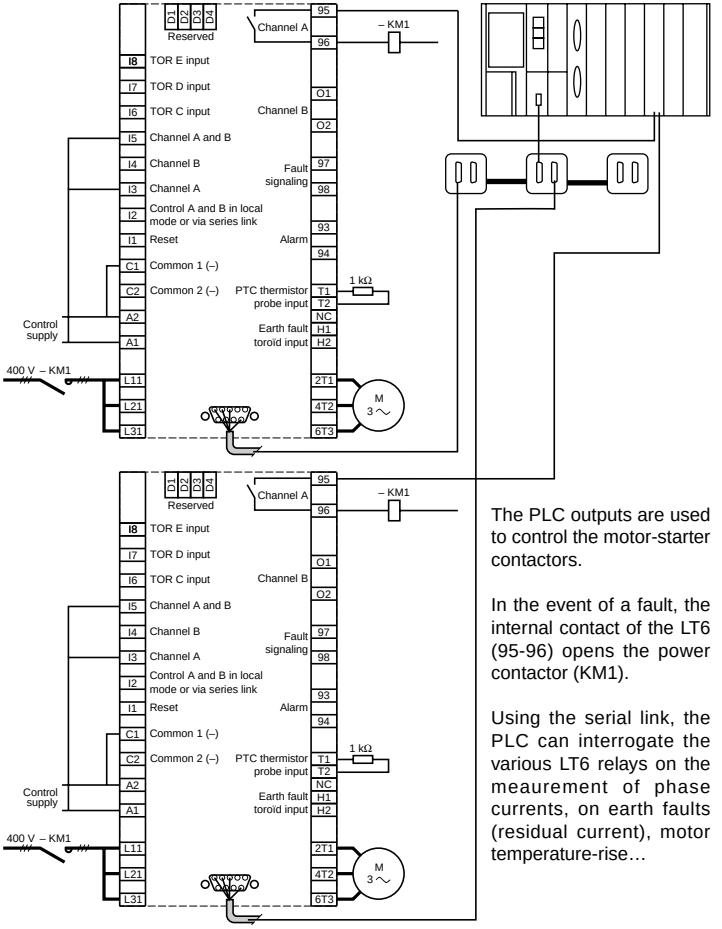
Utilisation of the LT6 (1 A rating) as a protection relay



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

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

Utilisation of the LT6 (1 A rating) as a remote protection and measuring relay

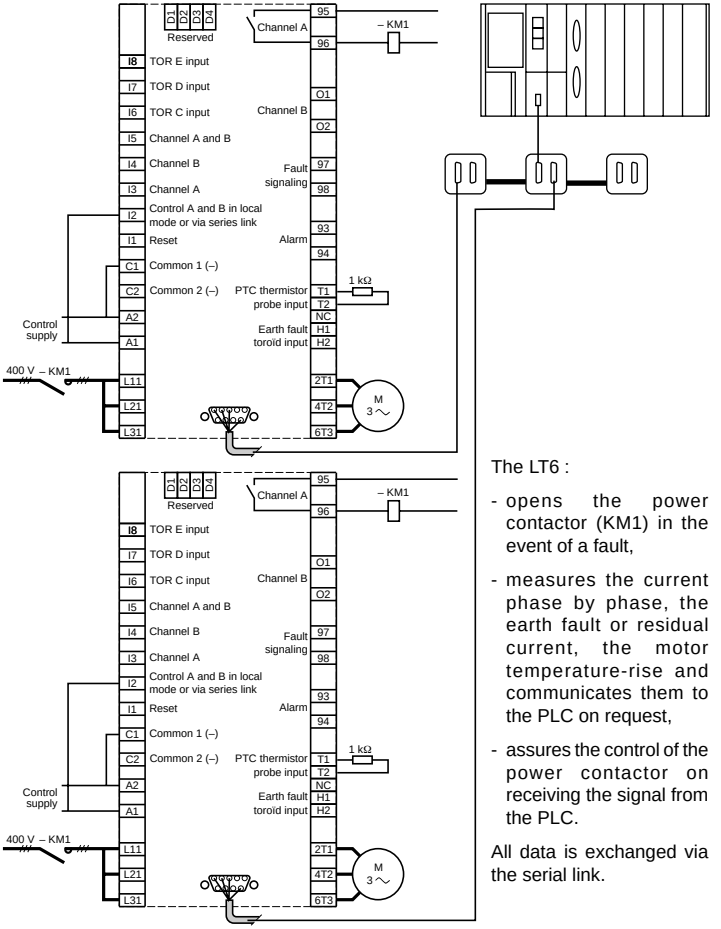


The PLC outputs are used to control the motor-starter contactors.

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

Using the serial link, the PLC can interrogate the various LT6 relays on the meaurement of phase currents, on earth faults (residual current), motor temperature-rise…

Utilisation of the LT6 (1 A rating) as a remote protection, measuring and control relay

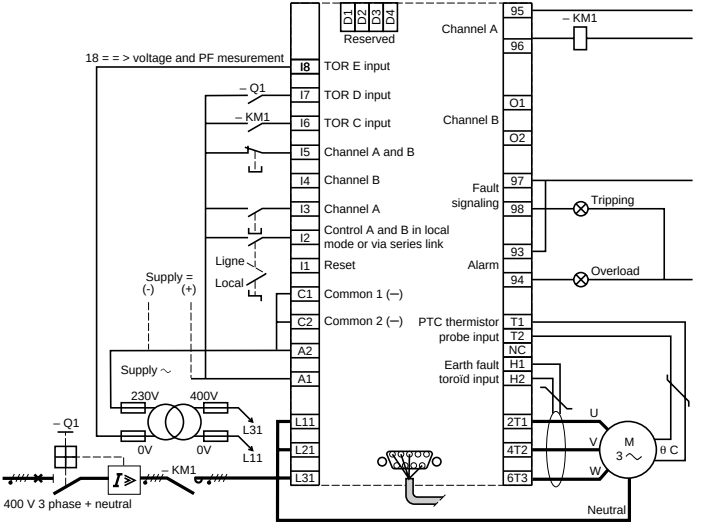


The LT6 :

- opens the power contactor (KM1) in the event of a fault,
- measures the current phase by phase, the earth fault or residual current, the motor temperature-rise and communicates them to the PLC on request,
- assures the control of the power contactor on receiving the signal from the PLC.

All data is exchanged via the serial link.

Example of circuit diagram connection



The LT6 can be connected to a multi-drop bus using standard RS 485 or an RS 232 link.
This function is galvanically isolated from the other functions of the relay and is available on a SUB-D 9-pin connector on the front of the product. A number of accessories are available to facilitate connection to a TSX series 7 PLC :
- cables for bus connection TSX-CSA●●●●
- subscriber socket TSX-SCA●●

Serial link configuration selector (see page 52).

Exchange of data

- the LT6 is invariably slave.

- the transmission speed is recognised automatically by the product. Two speeds are possible : 4 800, 9 600 bits/s.

Structure of the data

This is composed of 16 bit words.
The words can be accessed :
– either in read only (W0 to W82)

. record of the last 5 trips
. trip and operating counters
. instantaneous motor values
. state of : product and operating faults discrete inputs discrete outputs motor starting trips and alarms

– or in read / write (W83 to W110)

. motor and product control
. protection parameters
. choice of the type of protection and operation (certain protective features are always active, such as thermal protection, PTC thermistor, phase unbalance, earth fault).

Initial product configuration

The LT6 has an initial factory-set standard configuration (refer to the tables of parameter setting words 84 to 109 showing the initial values).
Bit 79,F indicates whether the LT6 is still in this configuration.
Bit 83,F enables the user to reload the intitial configuration of the LT6.

Words of the last 5 trips (read only)

Word	Name	Initial values	Unit	Range	Operation
0	Trip cause			0 / 15	E^2 Trip cause code
1	Th. state long t. const (Fe)		0.01θn	0 / 200	E^2 **Trip (N)**
2	Th. state short t. const (Cu)		0.01θn	0 / 200	E^2 (last trip)
3	Phase 1 rms current		1 % Ir	0 / 1600	E^2
4	Phase 2 rms current		1 % Ir	0 / 1600	E^2
5	Phase 3 rms current		1 % Ir	0 / 1600	E^2
6	Current unbalance Id		1 % Im	0 / 100	E^2
7	Value $I_{\Delta r}$ (earth fault)		0.1 A	0 / 999	E^2
8	Cosφ		0.01	-100/100	E^2
9	Voltage		1 %	68/120	E^2
10 to 19	As above				Trip cause code **Trip (N - 1)**
20 to 29	As above				Trip cause code **Trip (N - 2)**
30 to 39	As above				Trip cause code **Trip (N - 3)**
40 to 49	As above				Trip cause code **Trip (N - 4)**

Trip cause counter words (read only)

Word	Name	Initial values	Unit	Range	Operation
50	Iron thermal trip		1	0 / 32767	E^2 = And stored E^2 PROM
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 (underload)		1	0 / 32767	E^2
56	Torque limitation		1	0 / 32767	E^2
57	Prolonged starting		1	0 / 32767	E^2
58	Phase reversal		1	0 / 32767	E^2
59	cosφ		1	0 / 32767	E^2
60	Test pushbutton		1	0 / 32767	E^2

Motor maintenance words (read only)

61	Number of start		1	0 / 32767	E^2
62	Motor operating time		1 hour	0 / 32767	E^2
63	N° of channel A close		1	0 / 32767	E^2
64	N° of channel B close		1	0 / 32767	E^2

Measured value words (instantaneous values in read only)

65	Therm. long t. const. (Fe)	50	0.01θn	0 / 200	E^2
66	Therm. short t. const. (Cu)	50	0.01θn	0 / 200	E^2
67	Phase 1 rms current		1 % Ir	0 / 1600	
68	Phase 2 rms current		1 % Ir	0 / 1600	
69	Phase 3 rms current		1 % Ir	0 / 1600	
70	Current unbalance Id		1 % Im	0 / 200	
71	Value of $I_{\Delta r}$ (Earth fault)		0.1 A	0 / 999	
72	Time before Reset		1 s	0 / 1000	Time calculated by the LT6
73	Cosφ		0,01	-100/100	
74	Voltage		1 %	0 / 200	
75	Frequency		0.1 Hz	0 / 700	

Front face adjustment words

76	"Ir" front face	20	1 %	20 / 109	Combination of 2 selectors
77	"Class" front face	5	5	5 / 30	

Operating status and fault words LT6 (read only)

Word	Name	Initial values	Unit	Range	Operation
78, 0	Fault	0		0 / 1	1 = all product faults.
78, 1	Supply fault	0		0 / 1	1 = supply fault
78, 2	Short-circuit detection	0		0 / 1	1 = Short-circuit = 15 Ir
78, 3	Unitelway fault	0		0 / 1	1 = Unitelway fault
78, 4	JBus/ModBus fault	0		0 / 1	1 = JBus/ModBus fault
78, 5	Choice of output control	0		0 / 1	1 = change choice (discrete)
78, 6	Choice Line adj/Local adj	0		0 / 1	1 = change choice (DIP)
78, 7	Watchdog fault	0		0 / 1	1 = fault
78, 8				0 / 1	
78, 9				0 / 1	
78, A				0 / 1	
78, B				0 / 1	
78, C				0 / 1	
78, D				0 / 1	
78, E				0 / 1	
78, F				0 / 1	

These 16 bits are set to 1 on detection of a fault. They must be read to reset them to 0.

Front face control status words (read only)

79, 0	"Address" dipsw. (Parity)	0		0 / 1	1 = Even address parity
79, 1	"Address" dipsw. (16)	0		0 / 1	1 = 16
79, 2	"Address" dipsw. (8)	0		0 / 1	1 = 8
79, 3	"Address" dipsw. (4)	0		0 / 1	1 = 4
79, 4	"Address" dipsw. (2)	0		0 / 1	1 = 2
79, 5	"Address" dipsw. (1)	1		0 / 1	1 = 1
79, 6	"Unitelway/JBus" dipsw.	0		0 / 1	0 = Unitelway
79, 7	"Reset auto/man" dipsw.	0		0 / 1	0 = Manual reset
79, 8	"Adjust line/local" dipsw.	0		0 / 1	0 = Local adjust
79, 9	Reserved	0		0 / 1	
79, A	Reset	0		0 / 1	= 1 "Reset" pushbutton actuated
79, B	Test	0		0 / 1	= 1 "Test" pushbutton actuated
79, C				0 / 1	
79, D				0 / 1	
79, E				0 / 1	
79, F	Initial values	1		0 / 1	1 = LT6 operates with initial values

Input status words (read only)

Word	Name	Initial values	Unit	Range	Operation
80, 0	Start channel A	0		0 / 1	
80, 1	Start channel B	0		0 / 1	
80, 2	Stop channels A and B	0		0 / 1	
80, 3	Control outputs A and B	0		0 / 1	0 = by inputs, 1 = by serial link
80, 4	Reset	0		0 / 1	
80, 5	Spare input C	0		0 / 1	
80, 6	Spare input D	0		0 / 1	
80, 7	Spare input E	0		0 / 1	
80, 8	Motor starting	0		0 / 1	1 = starting cycle
80, 9	Motor run	0		0 / 1	1 = (I>0.2Ir)
80, A				0 / 1	

Output status words (read only)

80, B	Outputs shed	0		0 / 1	1 = outputs A and B at zero
80, C	Channel A	0		0 / 1	1 = channel A contact closed
80, D	Channel B	0		0 / 1	1 = channel B contact closed
80, E	Trip	0		0 / 1	1 = product tripped
80, F	Alarm	0		0 / 1	1 = alarm

Type of trip and measurement fault words (read only)

81, 0	Iron thermal trip	0		0 / 1	
81, 1	Copper thermal trip	0		0 / 1	
81, 2	PTC thermistor	0		0 / 1	
81, 3	Phase unbalance / loss	0		0 / 1	
81, 4	Earth fault	0		0 / 1	
81, 5	Undercurrent (underload)	0		0 / 1	These bits are set to 1 by the
81, 6	Torque limitation	0		0 / 1	product tripping and are reset
81, 7	Prolonged starting	0		0 / 1	by a manual or automatic
81, 8	Phase reversal	0		0 / 1	"Reset"
81, 9	Cosφ	0		0 / 1	
81, A	Test pushbutton	0		0 / 1	
81, B				0 / 1	
81, C				0 / 1	
81, D	Watchdog fault			0 / 1	
81, E	Measurement input fault	0		0 / 1	
81, F	PTC thermistor short-cct	0		0 / 1	

Alarm words (read only)

Word	Name	Initial values	Unit	Range	Operation
82, 0	Thermal overload alarm	0		0 / 1	
82, 1	Phase unbalance/loss	0		0 / 1	
82, 2	Earth fault	0		0 / 1	
82, 3	Undercurrent (underload)	0		0 / 1	
82, 4	Torque limitation	0		0 / 1	
82, 5	Cosφ	0		0 / 1	
82, 6				0 / 1	
82, 7				0 / 1	
82, 8				0 / 1	
82, 9				0 / 1	
82, A				0 / 1	
82, B				0 / 1	
82, C				0 / 1	
82, D				0 / 1	
82, E				0 / 1	
82, F				0 / 1	

These bits are at 1 if the corresponding thresholds are exceeded, irrespective of time.

Motor and product control words (read and write)

Word	Name	Initial values	Unit	Range	Operation
83, 0	Control channel A	0		0 / 1	1 = Start chan A ; 0 = Stop chan A
83, 1	Control channel B	0		0 / 1	1 = Start chan B ; 0 = Stop chan B
83, 2	Reset	0		0 / 1	1 = Reset ; reset by LT6
83, 3	Test	0		0 / 1	1 = Test ; reset by LT6
83, 4				0 / 1	
83, 5				0 / 1	(a trip or a fault resets
83, 6				0 / 1	the 4 bits)
83, 7				0 / 1	
83, 8				0 / 1	
83, 9				0 / 1	
83, A				0 / 1	
83, B				0 / 1	
83, C	Reset trip values			0 / 1	1 = Reset trip values
83, D	Reset trip counters	0		0 / 1	1 = Reset trip counters
83, E	Reset maint'ce counters	0		0 / 1	1 = Reset motor maintenance
83, F	Load initital values	0		0 / 1	1 = Operate with initial values

Parameter adjustment words (read and write)

Word	Name	Initial values	Unit	Range	Operation
84	Value of Ir (% of 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 threshold	100	1 % θn	0 / 100	E^2
87	Id threshold (% of I av)	30	1 %	10 / 30	E^2
88	Tripping time on starting	7	0.1 s	0 / 100	E^2 **Phase unbalance/loss**
89	Tripping time during op.	50	0.1 s	0 / 100	E^2
90	$I_{\Delta r}$ 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} threshold (% de Ir)	150	1 %	100 / 500	E^2
93	Starting 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 (underload)**
96	L_{LC} threshold (% de Ir)	200	1 %	150 / 800	E^2
97	Tripping time	100	0.1 s	0 / 300	E^2 **Torque limitation**
98	cosφ threshold	10	0,01	-100/100	E^2
99	Tripping time	100	0.1 s	0 / 100	E^2 **cosφ control**
100	Level of load shedding	70	1% Un	68/120	E^2
101	Time before shedding	1000	10 s	0/10000	E^2 **Load shedding**
102	Level of reconnection	90	1% Un	68/120	E^2
103	Time before reconnection	1000	10 s	0/10000	E^2
104	Time before Reset active	0	1 s	0 / 1000	E^2
105	θ°C Fe bef. Reset active	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 data stored by user
109	Communication watchdog	0		0/1	E^2 1 = watchdog enabled

Word 106 corresponds to sending data to a text block. The data is made up of words 0 to 9 (last trip words). Initial value - 1 corresponds to no data sent to master.
Reconstruction of the destination address by the LT6 :
Network = 0
Station = 254
Gate = word 106 + 16 (decimal)

Parameter adjustment words (read and write)

Word	Name	Initial values	Unit	Range	Operation
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/Phase unbalance
110, 3	Earth fault	1		0 / 1	E^2 1 = trip/Earth fault
110, 4	Undercurrent (underload)	0		0 / 1	E^2 1 = trip/Underload
110, 5	Torque limitation	0		0 / 1	E^2 1 = trip/Prolonged starting
110, 6	Prolonged starting	0		0 / 1	E^2 1 = trip/Torque limitation
110, 7	Phase reversal	0		0 / 1	E^2 1 = trip/Phase reversal
110, 8	Cosφ	0		0 / 1	E^2 1 = trip/Cosφ
110, 9	Load shedding	0		0 / 1	E^2 1 = load shedding active
110, A	Reverser	1		0 / 1	E^2 1 = Reverser control
110, B	Independent	0		0 / 1	E^2 1 = Channels A&B independent
110, C	2-step	0		0 / 1	E^2 1 = 2-step starting control
110, D	Front face Test hbutton	1		0 / 1	E^2 1 = Test pushbutton active
110, E	Front face Reset button	1		0 / 1	E^2 1 = Reset pushbutton active
110, F	Self/Forced ventilated	1		0 / 1	E^2 1 = Self-ventilated

Bits 110, 0 to 110, 2 cannot be accessed in write.
Bits 110, A to 110, C cannot be set to 1 together, only one of them.

The LT6 is slave with both Unitelway and JBus/ModBus.

Introduction

Refer to the documents below for general information and programming with Unitelway and JBus/ModBus protocols.

Unitelway

Description	Reference
Unitelway Bus reference manual	TSX D24 004 E
User's manual for TSX 21-6 Channel 1 Unitelway Bus	TSX D24 005 E
User's manual for TSX SCG 116 Unitelway module for TSX 17-20 programmable controller	TSX D24 007 E

JBus/ModBus

Description	Reference
User's manual for TSX SCM 22 JBus/ModBus	TSX D24 002 E
User's manual for TSX SCG 1131/1161 JBus/ModBus module for TSX 17-20	TSX D24 010 E

LT6 characteristics :

Connection : SUB-D 9-pin male
Address : one per product, from 1 to 31
(configuration by DIP switch)
Speed : automatic recognition
(4800 and 9600 bits/s)
Number of messages stored on reception : 3
Number of messages stored on transmission : 0
No polling detection : > 3 s

Type of object recognised	Bytes (8 bits)	Words (16 bits)	Signed integer (16 bits)
Segment	104	104	104
Type of object	6	7	7
Maximum size	218	109	109
Minimum address Maximum 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

Request codes

Family	Service	Request		Confirm		Description
		Hex.	Dec.	Hex.	Dec.	
Access to data	Read a word	04	04	34	52	Reads a word (W)
	Read objects	36	64	66	102	Reads objects (bits, words, bit or word strings,…)
	Write a word	14	20	FE	254	Writes a word (W)
	Write objects	37	55	FE	254	Writes objects (bits, words, bit or word strings,…)
Unsolicited data	Unsolicited data	FC	252	–	–	Sends data without first receiving a request
General use	Device identification	0F	15	3F	63	Gives the type of product, its version and commercial reference
	Protocol version	30	48	50	96	Defines version and parameters of the communication protocol
	Status	31	49	61	97	Gives data with details on the status of a device
	Mirror	FA	250	FB	251	Test of system and the communication path
	Read error counters	A2	162	D2	210	Manages the record of the device communication errors
	Reset counterrs	A4	164	FE	254	Resets the device error counters

General

The exchange of data between computer systems programmable controllers and other intelligent systems must be carried out in a common language.
This language must be as simple as possible and easily understood at every level. Nevertheless it must be possible to check each exchange in order to ensure the integrity of the data transfer. The variables exchanged are therefore inserted into a frame comprising, basically, the following :

Heading	Address	Request	Data	Check	End

Each protocol defines the presence, the format, the contents of all the various groups of variables surrounding the area of data.

This structuring enables definition of the beginning and length of the messages, the system to which the messages are addressed, if necessary, the type of function requested, the variables themselves, a check parameter and an end code, which validates the complete message.
This frame differs in form and content for each type of protocol.
In the rest of this document, the ModBus and JBus functionalities are grouped together under the term ModBus.

ModBus frame defined for communication with the LT6

RTU mode

The frame defined for the ModBus protocol does not include heading bytes or end bytes. Its definition is as follows :

Address	Request	Data	CRC16

Data is transmitted in binary.
CRC16 : cyclical redundancy check.
Detection of the end of the frame is by a silence ≥ 3 characters.

Caracteristicss

Connection : SUB-D 9-pin
Address : 1 only per product, from 1 to 63 (configuration by DIP switch)
Speed : automatic recognition (4800, 9600 bits/s)
Transmission parameter : 1 start bit, 8 data bits, 1 stop bit, no parity, 9600 or 4800 bits/s
Time between 2 characters of a message : < transmission time for 3 characters
Time between 2 messages : > transmission time for 3 characters

ModBus functions

ModBus functions include :
- main functions which enable data exchange,
- complementary functions which enable exchange diagnostics.

The definition of "read" and "write" functions are as follows, as seen by the master.

Code	Kind of functions	D	Max. number of words
03	Read N output words (W0 to W110)		111
04	Read N input words (W0 to W110)		111
06	Write an output word	D	
08	Diagnostic (see details)		
11	Read events counter		
16	Write N output words	D	28

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

Details of the functions

Code 03 : read N output words.
This function is used to read output words (words which can be written and read in the slave by the master).

Code 04 : read N input words.
As above, but applied to input words (words which the master can only read).

Code 06 : write one output word.
Used to write one output word of 16 bits (only accessible in write).

The diagnostic function code 08 is always accompanied by a sub-code.
All the counters are on 16 bit

Code 08/00 : echo.
This function tells the slave interrogated to return the full message sent by the master.

Code 08/0A : counter reset.
This function resets all the counters monitoring the slave's exchanges to zero.

Code 08/0B : number of correct messages seen on the line without checksum or CRC error.
This function can be used to read a 16 bit counter (incremented from 0 to H'FFFF) which totalizes the number of messages seen on the line and processed by the slave.

Code 08/0C : number of messages received with checksum (CRC) error or the number of messages received with more than 255 bytes and not interpreted or messages received with at least one character having a parity error, "overrun", "framing", "break" on the line.

Code 08/0D : number of exception answers.
Reading of a 16 bit counter which totalizes the number of exception messages transmitted by a slave to the master (following an incorrect frame, even if it is not transmitted due to a request received by dissemination).

Code 08/0E : number of messages addressed to the slave excluding dissemination.
Reading a 16 bit counter giving the total number of messages sent to the slave irrespective of their nature.

Code 08/0F : number of disseminated messages received without error.
Reading a 16 bit counter giving the total number of messages sent to the slave irrespective of their nature.

Code 08/10 : not significant.

Code 08/11 : number of answers "LT6 not ready".

Code 08/12 : number of messages received with at least one character having a parity error, "overrun", "framing", "break" on the line.

Code 11 : read events counter
- a status (always zero),
- a counter which is incremented each time a correct message is received (form and content) sent to the slave except for exception answers.

Code 16 : write N output words
This function enables the master to write the output words in the slave (words which can be written or read).

Following a mains supply failure or disconnection or a change in the communication parameters (speed, protocol), the diagnostics and events counters are reset to zero.

Read N words : function 3 or 4

Question

Slave N°	03 or 04	N° of first word PF	N° of first word PI	Number of words PF	Number of words PI	CRC16
1 byte	1 byte	2 bytes		2 bytes		2 bytes

Answer

Slave N°	03 or 04	Number of bytes read	Value of first word PF	Value of first word PI	Value of last word PF	Value of last word PI	CRC16
1 byte	1 byte	1 byte	2 bytes		2 bytes		2 bytes

Example : read words W0100 to W0108 of slave 2

Question	02	04	0064	0008	33E1		
Answer	02	04	08	0064		006C	CRC16
				Value of W0100		Value of W0108	

Write an output word : function 6

Question

Slave N°	06	Word N°		Value of word		CRC16
		PF	PI	PF	PI	
1 byte	1 byte	2 bytes		2 bytes		2 bytes

Answer

Slave N°	06	N° du mot		Value of word		CRC16
		PF	PI	PF	PI	
1 byte	1 byte	2 bytes		2 bytes		2 bytes

Example : write value 109 = H6D in word 0084 of slave 2

Question and answer	02	06	0054	006D	CRC16

Diagnostic : function 8

Question and answer

Slave N°	0B	Sub-code	Data	CRC16
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Sub-code	Question data	Answer data	Function executed
00	XX YY	XX YY	Echo
0A	00 00	00 00	Reset counters
0B	00 00	XX YY	XXYY = counter value
0C	00 00	XX YY	XXYY = counter value
0D	00 00	XX YY	XXYY = counter value
0E	00 00	XX YY	XXYY = counter value

Read events counter : function 11 (H'08')

Question

Slave N°	0B	CRC16
1 byte	1 byte	2 bytes

Answer

Slave N°	0B	00	00	Counter value PF	Counter value PI	CRC16
1 byte	1 byte	2 bytes		2 bytes		2 bytes

Write N output words : function 16 (H'10')

Question

Slave N°	10	N° of first word PF	N° of first word PI	Number of words	Number of bytes	Value first word PF	Value first word PI	CRC16
1 byte	1 byte	2 bytes		2 bytes	1 byte	2 bytes		2 bytes

Answer

Slave N°	10	N° of first word PF	N° of first word PI	Number of words PF	Number of words PI	CRC16
1 byte	1 byte	2 bytes		2 bytes		2 bytes

Example : write values 2 and 3 in words W0100 and W0101 of slave 2

Question	02	10	0064	0002	04	0002	0003	CRC16
Answer	02	10	0064	0002	CRC16			

Exception answer

An exception answer is given by a slave when it cannot execute the request that has been sent to it.

Exception answer format :

Slave N°	Answer code	Error code	CRC16
1 byte	1 byte	1 byte	2 bytes

Answer code : function code of the request + H'80 (the most significant bit is set to 1).

Error code : 1 = the function requested is not recognised by the slave.
2 = the numbers (addresses) of the words indicated when making the request do not exist in the slave.
3 = the values of the words indicated when making the request are not permitted in the slave.
4 = LT6 not ready

CRC16 calculation

The CRC16 is calculated based on all the bytes of the message by applying the following method.

Initialise the CRC (16 bit register) to H'FFFF.

Do from the first byte of the message to the last :
CRC XOR <byte> → CRC
Repeat 8 times
Shift the CRC one bit to the right
If the output bit = 1, faire CRC XOR H'A001 → CRC
End do

End do

The CRC obtained will be transmitted least significant bit first, most significant next.

XOR = exclusive OR.

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