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Serial communication protocoll
ModBUS® for all K series
K30 excluded

this document is related to the firmware version 1.7

K Family Communication protocol

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1 Preface

Tecnologic uses ModBUS® RTU communication protocol.
It is a royalty free protocol and it is easy to implement.
For ModBus RTU a vast literature is available also in internet.

The ModBus protocol represent all data in hexadecimal format.
All communication string finish with a check sum type CRC (cyclic redundancy check).
Every devices in a line must have different address.
The protocol allows one master only and up to 255 slaves
Only Master unit can start the transmission by sending the address of the unit and the command to execute.
Only the unit having the same address will answer to the master.

The transmission characteristics are usually programmable:

- Device address: from 1 to 255
- Baud rate: bit per second
- byte format:
  1 start bit
  8 data bitis
  2 final bits composed as follows:
  1 parity bit (even or odd)
  1 stop bit
  or
  no parity bit
  2 stop bits

The K30 allows to configure:

- address (1 – 254)
- Baud rate (1200 – 2400 – 9600 – 19200 – 38400)

The byte format is fixed : 8 bits without parity and 1 stop bit

This document is intended to describe the K 30 controllers using the MODBUS protocol in their communication capability and is mainly directed to technicians, system integrators and software developers.

2 Physical connection

Interface

K series controllers are provided with a RS485 serial communication interface, insulated so that any problem arising from ground potential is removed.
While at rest, the instruments are in a receive condition and are revert to transmission after a correct message has been decoded that matches the configured address.

Line

The instruments are equipped with 2 terminals named A and B.
The connection between TLKs has to be carried on in parallel, i.e. all A terminals have to be connected between them so as B terminals.

A termination resistor of 120 ohm is required to maintain the quiescent condition on the line;
Adopted baud rates range from 1200 to 38400 baud, that is very satisfactory for application performances, yet very slow for RS485 interface. This fact allows the wiring of the line with a medium quality twisted pair cable: total capacity of the line should not exceed 200 nF.

The line can be up to 1000 meters in length.

3 Communication protocol

The protocol adopted by K 30 is a subset of the widely used MODBUS RTU (JBUS)[1] protocol, so that connections are easy for many commercial PLCs and supervisory programs.

For users needing to develop their own communication software, all information is available as well as implementation hints.

The MODBUS RTU (JBUS) communication functions implemented in K series are:

- Function 3 - read n register
- Function 6 - preset one register .
- Function 16 – preset multiple register

These functions allow the supervisory program to read and modify any data of the controller.
The communication is based on messages sent by the master station (host) to the slave stations (K 30) and viceversa.
The slave station that recognises the message as sent to it, analyses the content and, if it is formally and semantically correct, generates a reply message directed back to the master.

The communication process involves five types of messages:

from master to slave	from slave to master
function 3: read n registers request	function 3: read n registers reply
function 6: preset one register request	function 6: preset one register reply
function 16: preset multiple registers request	Function 16: preset multiple registers reply
	exception reply (as reply to all functions in abnormal conditions)

Every a message contains four fields:

- slave address (from 1 to 255): MODBUS RTU (JBUS) reserves address 0 for broadcasting messagesand it is implemented in the K series;
- function code: contains 3, 6 or 16 for specified functions;
- information field: contains data like word addresses and word values as required by function in use;
- control word: a cyclic redundancy check (CRC) performed with particular rules for CRC16.

The characteristics of the asyncronous transmission are 8 bits, no parity, one stop bit.

1 AEG Schneider Automation, Inc. registered trademark

3.1 Function code 3: read multiple registers (maximum 16 registers for K instruments)

This function code is used by the master to read a group of sequential registers present in the slave.

Master request	
Data	Byte
Slave address (1-255)	1
Function code (3)	1
First register address (MSB = Most Significant Byte)	1
First register address (LSB = less Significant Byte)	1
Number of requested registers (MSB)	1
Number of requested registers (LSB)	1
CRC-16 (LSB)	1
CRC-16 (MSB)	1

Slave reply	
Data	Byte
Slave address (1-255)	1
Function code (3)	1
Byte number (n)	1
Data(s)	n
CRC-16 (LSB)	1
CRC-16 (MSB)	1

In the “Data(s)” fild the values of the requested registers are presented in word format [2 byte] : the first byte represent the MSB (Most Significant Byte) while the second byte represent the LSB (Less Significant Byte). This mode will be the same for all requested locations.

Example:

The master requires to the address 1 the value of the locations 25 and 26 (0x19 and 0x1A).

Master request	
Data	Byte (Hex)
Slave address	01
Function code (3 = read)	03
First register address (MSB)	00
First register address (LSB)	19
Number of requested registers (MSB)	00
Number of requested registers (LSB)	02
CRC-16 (LSB)	15
CRC-16 (MSB)	CC

Slave reply	
Data	Byte (Hex)
Slave address	01
Function code (3 = read)	03
Byte number	04
Value of the first register (MSB)	00
Value of the first register (LSB)	0A
Value of the second register (MSB)	00
Value of the second register (LSB)	14
CRC-16 (LSB)	DA
CRC-16 (MSB)	3E

The slave replay means:
The value of the location 25 = 10 (0x000A hexadecimal)
The value of the location 26 = 20 (0x0014 hexadecimal)

3.2 Function code 6: write a single word (one location)

Master request	
Data	Byte
Slave address (1-255)	1
Function code (6)	1
Register address (MSB)	1
Register address (LSB)	1
Value to write (MSB)	1
Value to write (LSB)	1
CRC-16 (MSB)	1
CRC-16 (LSB)	1

Slave reply	
Data	Byte
Slave address (1-255)	1
Function code (6)	1
Register address (MSB)	1
Register address (LSB)	1
Written value (MSB)	1
Written value (LSB)	1
CRC-16 (MSB)	1
CRC-16 (LSB)	1

Example:

The master unit asks to the slave 1 to write in the memory location 770 (0x302) the value 10 (0x0A).

Master request	
Data	Byte (Hex)
Slave address	01
Function code (6)	06
Register address (MSB)	03
Register address (LSB)	02
Value to write (MSB)	00
Value to write (LSB)	0A
CRC-16 (MSB)	A8
CRC-16 (LSB)	49

Slave reply	
Data	Byte (Hex)
Slave address	01
Function code (6)	06
Register address (MSB)	03
Register address (LSB)	02
Written value (MSB)	00
Written value (LSB)	0A
CRC-16 (MSB)	A8
CRC-16 (LSB)	49

3.3 Function code 16: preset multiple registers (maximum 16 registers for K instruments)

This function code allows to preset 16 registers at a time.

Master request	
Data	Byte
Slave address (1-254)	1
Function code (16)	1
First register address (MSB)	1
First register address (LSB)	1
Number of requested registers (MSB)	1
Number of requested registers (LSB)	1
Byte count	1
Values	n
CRC-16 (LSB)	1
CRC-16 (MSB)	1

Slave reply	
Data	Byte
Slave address (1-254)	1
Function code (16)	1
First register address (MSB)	1
First register address (LSB)	1
Number of written registers (MSB)	1
Number of written registers (LSB)	1
CRC-16 (LSB)	1
CRC-16 (MSB)	1

Example:

The master unit requires to the slave 1 to write in the registers 10314 (0x284A) and 10315 (0x284B) the values 100 (0x64) and 200 (oxC8)

Master request	
Data	Byte (Hex)
Slave address	01
Function code (16)	10
First register address (MSB)	28
First register address (LSB)	4A
Number of requested registers (MSB)	00
Number of requested registers (LSB)	02
Byte count	4
Value 1 (MSB)	00
Value 1 (LSB)	64
Value 2 (MSB)	00
Value 2 ((LSB)	C8
CRC-16 (LSB)	C9
CRC-16 (MSB)	A8

Slave reply	
Data	Byte (Hex)
Slave address	01
Function code (16)	10
First register address (MSB)	28
First register address (LSB)	4A
Number of written registers (MSB)	00
Number of written registers (LSB)	02
CRC-16 (LSB)	69
CRC-16 (MSB)	BE

3.4 The exception reply

K 30 instruments reply with an exception when the request is formally correct, but cannot be satisfied standing particular situations; the reply contains a code indicating the cause of the missing regular reply, the frame is:

Exception reply	
Data	**Byte**
Slave address	1
Function code	1
Error code	1
CRC-16 (LSB)	1
CRC-16 (MSB)	1

K 30 adopts a subset of MODBUS RTU (JBUS) exception code:

- unknown function code 1
- invalid memory address 2
- invalid data field 3
- controller not ready 6

3.5 Cyclic redundancy check (CRC)

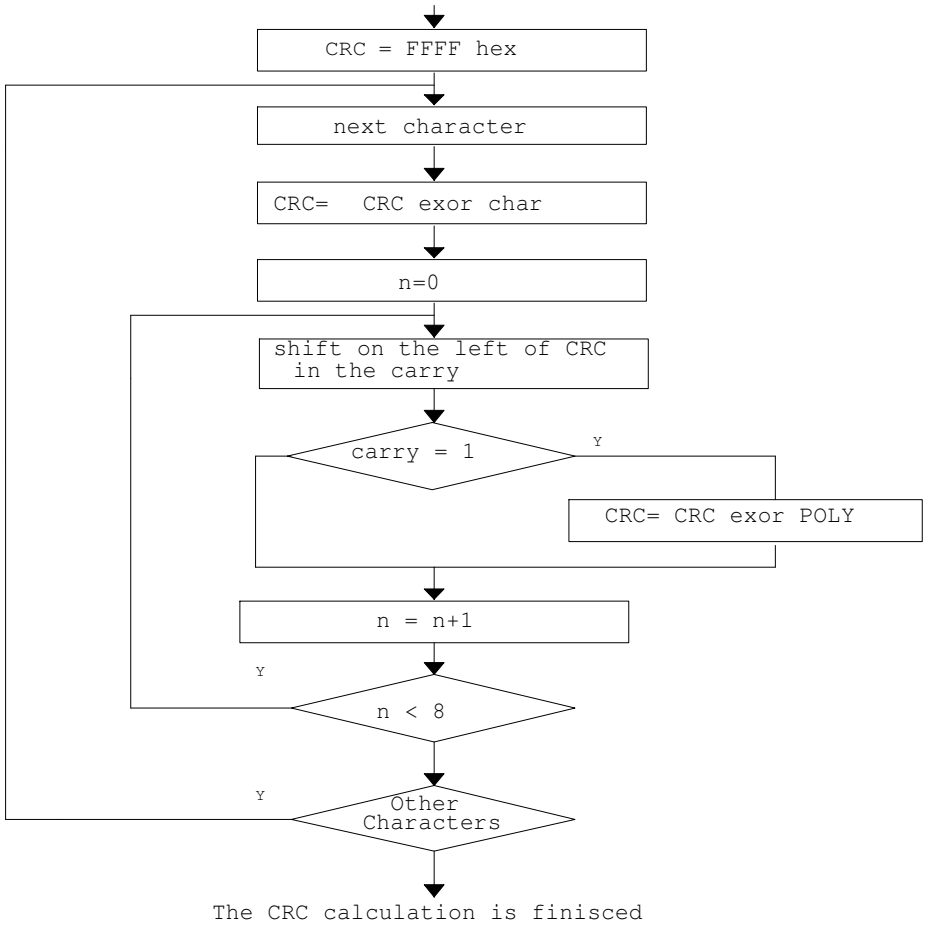
CRC is a check word that permits to verify the integrity of a message.
Every message, sent or received, has in the two last characters the CRC check word.

After receiving a request, the controller checks the validity of the received message comparing the received CRC with the calculated one.

When a reply is ready the controller calculates the CRC word and adds two characters to the prepared message.

CRC calculation is performed on every character of the message, excluding the last two.

Being MODBUS RTU (JBUS) compatible , K series controllers adopt an identical algorithm for CRC calculation, sketched in following diagram:



The polinomial adopted by MODBUS RTU (JBUS) is 1010 0000 0000 0001.
Note: the first transmitted character of the CRC word is the least significant between calculated bytes.

Follows a subrutine made with “C” able to calculate the CTC-16.

```
/* ----------------------------------------------------------------
crc_16          calcolo del crc_16

Parametri di ingresso:
  buffer: stringa di caratteri di cui calcolare il CRC-16
  length: numero di bytes della stringa

Questa funzione ritorna il valore di CRC-16
---------------------------------------------------------------- */
unsigned int crc_16 (unsigned char *buffer, unsigned int length)
```

```
{
    unsigned int i, j, temp_bit, temp_int, crc;

    crc = 0xFFFF;

    for ( i = 0; i < length; i++ ) {
        temp_int = (unsigned char) *buffer++;

        crc ^= temp_int;

        for ( j = 0; j < 8; j++ ) {
            temp_bit = crc & 0x0001;

            crc >>= 1;

            if ( temp_bit != 0 )
                crc ^= 0xA001;
        }
    }
    return (crc);
}
```

Note: all numerical values in the format 0x.... are expressed in hexadecimal format.

4 Data exchange

This section contains informations about data exchanged with TLK series controllers concerning numerical and not numerical data, with their formats and limits.

4.1 Some definitions

All exchanged data are in the form of 16 bit words.
Two types of data are distinguished: numerical and symbolic (or not numerical).
Numerical data represents the value of a quantity (e.g. the measured variable, the set point).

Symbolic data represents a particular value in a set of values (e.g. the thermocouple type in the set of available ones : J,K,S...).
Both types are coded as integers number : signed numbers for numerical and unsigned numbers for symbolic.
A numerical data, coded as an integer, is coupled with appropriate number of decimal digits to represent a quantity with the same engineering units adopted aboard the instrument.

Numerical data are in fixed point representation; however we make a distinction between two kinds of data:

- the first kind has determined and unmodifiable decimal point position;
- the second has programmable decimal point position (dP parameter).

4.2 Memory zones

All readable and writable data appear to be allocated as 16 bit words in the memory of the instrument.
The memory map has three zones:
- varaibles,
- parameters,
- instrument identification code.

Following parameters explore the characteristics of each zone.

4.3 Variables zones

In this zone there is a collection of main TLK controller variables, it is a group of frequently computed or updated data residing in volatile memory.

4.4 MOST IMPORTANT CHANGE

A) during parameter modification **by push-button**, the serial interface continue to operate without any "limit" (you can see by serial link the value of all parameters and you can set it also)

B) When you write a value in a location the instrument will operate as follows:
B.1) if you write a value within parameter range, the instrument will accept it; the new value will be memorized and the instrument will send back the standard answer.
B.2) If you try to write a value OUT of parameter range, the instrument will refuse the new value; the new value will NOT be memorized and the instrument will send an exception message to the master.
These are available data:

5 Address map

All K instruments use only words :

Initial address		Final address		mining
Hex	Dec	Hex	Dec	
1	1	13	21	Group of variables common to all new Tecnologic's instruments.
200	512	250	592	Group of variables compatible with the old Tecnologic's instruments (before K series)
280	640	31B	795	Configuration parameters
2800	10240	2891	10385	Repetition of the configuration parameters. It was added in order to maintain the compatibility with the older Tecnologic's prodocts.

n.	Address		Description	Dec	r/w
	HEX	Dec.			
1A	1	1	**PV : Measured value** Note: When a measuring error is detected the instrument send: -10000 = Underrange 10000 = Overrange 10001 = Overflow of the A/D converter 10003 = Variable not available	dP	r
2A	2	2	**Number of decimal figures of the measured value**		r
3A	3	3	**Operative set point** (value)	dP	r
4A	4	4	**Power output** Range: -100.00 ÷ 100.00 (%) Note: This parameter is ever writeable but it will be active only when the instrument operate in Manual mode.	2	r/w
5A	5	5	**Active set point selection** 0 = SP 1 1 = SP 2 2 = SP 3 3 = SP 4	0	r/w
6A	6	6	**SP 1** Range: SPLL ÷ SPLH	dP	r/w
7A	7	7	**SP 2** Range: SPLL ÷ SPLH	dP	r/w
8A	8	8	**SP 3** Range: SPLL ÷ SPLH	dP	r/w
9A	9	9	**SP 4** Range: SPLL ÷ SPLH	dP	r/w
10A	A	10	**Alarms status** bit 0 = Alarm 1 status bit 1 = Alarm 2 status bit 2 = Alarm 3 status bit 3÷8 = reserved bit 9 = LBA status bit 10 = power feilure indicator bit 11 = Generic error bit 12÷15 = reserved	0	r
11A	B	11	**Outputs status** (physical outputs) bit 0 = Output 1 status bit 1 = Output 2 status bit 3 = Output 3 status bit 4 = Output 4 status bit 5 = Output 5 status bit 6÷15 = Reserved When an output is driven by serial link, the relative bit will remain equal to 0.	0	r

n.	Address		Description	Dec	r/w
	HEX	Dec.			
12A	C	12	**Instrument status** bit 0 = Automatic bit 1 = manual bit 2 = Standby bit 3 = Remote Set point (temporary) used bit 4 = Auto-tuning active bit 5 = Self tuning active bit 6 = Reserved bit 7 = Timer running bit 8 = Soft start running bit 9 = Ramp for set point change (up or down) running bit 10 = Delay at start up (od) running bit 11 = Program running bit 12 = Measure status (0 = OK while 1 = error). bit 13÷15 = Reserved	0	r
13A	D	13	**Alarms reset** 0 = Not resetted 1 = Resetted	0	r/w
14A	E	14	**Alarms acknowledge** 0 = Not acknowledge 1 = acknowledge	0	r/w
15A	F	15	**Control status** 0 = Automatic 1 = Manual 2 = Stand-by	0	r/w
16A	10	16	**Remote set point (temporary)** (from serial link) Range: SPLL ÷ SPLH **Note**: the remote set point is memorized in RAM	dP	r/w
17A	11	17	**Auto tuning activation** 0 = not active 1 = active	0	r/w
18A	12	18	**Power output used when a measuring error is detected.** Range: -100 ÷ 100 **Note**: This valie is memorized in RAM	0	r/w
19A	13	19	**Default parameters loading.** 481 = Default parameter loading	0	r/ w
20A	14	20	**Parameters table identification code** Range: 0 ÷ 65535 Note The word is composed by two parts: Low byte – Version of the parameter table High byte - Version of the family protocoll	0	r
21A	15	21	**Instrument identification code** 11 = K30	0	r

Group of variables compatible with the old Tecnologic's instruments (before K series)

n.	Address		Description	Dec	r/w
	HEX	Dec.			
1B	0200	512	**PV : Measured value** As address 1		
2B	0201	513	**Number of decimal figure of the measured value** As address 2		
3B	0202	514	**Power output** As address 4	2	r
4B	0203	515	**Power output of the heating output** Range: 0 ÷ 100.00 (%)	2	r
5B	0204	516	**Power output of the cooling output** Range: 0 ÷ 100.00 (%)	2	r
6B	0205	517	**Alarm 1 status** 0 = OFF 1 = ON	0	r
7B	0206	518	**Alarm 2 status** 0 = OFF 1 = ON	0	r
8B	0207	519	**Alarm 3 status** 0 = OFF 1 = ON	0	r
9B	0208	520	**Operative set point** As address 3		
10B	020A	522	**LBA status** 0 = OFF 1 = ON	0	r
11B	020F	527	**Control status** 0 = Automatic 1 = Manual 2 = Standby 3 = Tuning	0	r/w
12B	0224	548	**Status / remote control of the Output 1** 0 = OFF 1 = ON Note: This parameter is writeable when out 1 is “not used” by the controller (o1F output 1 function = nonE) This parameter is memorized in RAM	0	r/w
13B	0225	549	**Status / remote control of the Output 2** 0 = OFF 1 = ON Note: This parameter is writeable when out 2 is “not used” by the controller (o2F output 2 function = nonE) This parameter is memorized in RAM	0	r/w
14B	0226	550	**Status / remote control of the Output 3** 0 = OFF 1 = ON Note: This parameter is writeable when out 3 is “not used” by the controller (o3F output 3 function = nonE) This parameter is memorized in RAM	0	r/w

n.	Address		Description	Dec	r/w
	HEX	Dec.			
15B	0227	551	**Status/remote control of the Output 4** 0 = OFF 1 = ON Note: This parameter is writeable when out 4 is “not used” by the controller (o4F output 4 function = nonE) This parameter is memorized in RAM	0	r/w
16B	0240	576	**Digital input 1 status** 0 = OFF 1 = ON Note: The digital input 1 status shows its status even if the input is not used	0	r/w
17B	0241	577	**Digital input 2 status** 0 = OFF 1 = ON Note: The digital input 2 status shows its status even if the input is not used	0	r/w
18B	0244	580	**Program status** 0 = Not configured 1 = Reset (not running) 2 = Run 3 = Hold 4 = Wait 5 = End	0	r/w
19B	0245	581	**Timer status** 0 = Not configured 1 = Reset 2 = Run 3 = Hold 4 = End	0	r/w
20B	0246	582	**Program step in execution** 0 = Program not active 1 = ramp step 1 2 = soak step 1 2 = ramp step 2 4 = soak step 2 5 = ramp step 3 6 = soak step 3 7 = ramp step 4 8 = soak step 4 9 = END	0	r
21B	0247	583	**Remaining time to the program end** Range: 0 ÷ 65535 (when Pru=hh.mm the E.U. is minutes, when Pru=mm.ss the E.U. Is seconds) Note**:** When the program is not running this parameter is equal to zero.	2	r
22B	248	584	**Program events status** 0 > E1 = 0 E2 = 0 1 > E1 = 1 E2 = 0 2 > E1 = 0 E2 = 1 3 > E1 = 1 E2 = 1	0	r
23B	249	585	**Remaining time to the timer end** Range: 0 ÷ 65535 (Hours when Tru=hh.mm, Minutes when Tru=mm.ss) 0 ÷ 9959 (tenth of seconds when Tru=SSS.d) Note: When the timer is not active this parameter is equal to zero.	2 1	r

n.	Address		Description	Dec	r/w
	HEX	Dec.			
24B	24A	586	**Wattmeter**: The meening of this parameter is defined by the CO.ty parameter setting. 0 CO.ty = 0ff KW CO.ty = 1 Kwh CO.ty = 2 Energy used during program execution (Kwh) CO.ty = 3 worked days CO.ty = 4 Worked hours CO.ty = 5	0	r
25B	250	592	**Power output when the instrument is in manual mode** Campo: -100.00 ÷ 100.00 (%)	2	r/w

Configuration parameters

inP group (Inputs parameters)

n.	Para meter	address		Mining	Values	Dec	r/w
		Hex	Dec				
1	HcFG	2800	10240	**Built in Hardware**	0 = 0 > TC/RTD 1 = 1 > TC/PTC 2 = 2 > Corrente 3 = 3 > Volt	0	r
2	SEnS	2801	10241	**Input type** Note: According to the built in hardware Hardware: TC, Pt100 TC, PTC, NTC Current (I) Voltage (V)	0 = J, 1 = crAL, 2 = S , 3 = r, 4 = t, 5 = ir.J, 6 = ir.cA, 7 = Pt1, 8 = 0.50 (mV), 9 = 0.60 (mV), 10 = 12.60 (mV) 0 = J, 1 = crAL, 2 = S ,3 = r, 4 = t, 5 = ir.J, 6 = ir.cA, 7 = Ptc, 8 = ntc, 9 = 0.50 (mV), 10 = 0.60 (mV), 11 = 12.60 (mV) 0 = 0.20 (mA), 1 = 4.20 (mA) 0 = 0.1 (V) 1 = 0.5(V), 2 = 1.5(V), 3 =0.10(V), 4 = 2.10(V)	0	r/w
3	dP	2802	10242	**Decimal figures**	0 ÷ 3 for linear inputs 0 ÷ 1 for TC, RTD, PTC, NTC	0	r/w
4	SSc	2803	10243	**Initial scale readout for linear inputs**	-1999 ÷ FSC (E.U.)	dP	r/w
5	FSc	2804	10244	**Full scale readout for linear inputs**	SSC ÷ 9999 (E.U.)	dP	r/w
6	unit	2805	10245	**Engineering unit.**	0 = C > °C 1 = F > °F	0	r/w
7	FiL	2806	10246	**Digital input filter** Note This filter affect the control, the retrasmission and the alarm actions.	0 = (oFF) ÷ 200	1	r/w
8	inE	2807	10247	**Selection of the Sensor Out of Range type that will enable the safety output value**	0 = our > Over and Under 1 = or > Over-range 2 = ur > Under-range	0	r/w
9	oPE	2808	10248	**Safety output value**	-100 ÷ 100 (%)	0	r/w

n.	Para meter	address		Mining	Values	Dec	r/w
		Hex	Dec				
10	diF1	2809	10249	**Digital input 1 function** Note: The digital input status is available even if the input is “not used”.	0 = oFF > not used 1 = Alarm Reset 2 = Alarm acknowledge (ACK) 3 = Hold of the measured value 4 = Stand by mode 5 = HEAt with SP1 and CooL with “SP2” 6 = Timer run/hold/reset [transition] 7 = Timer run [transition] 8 = Timer reset [transition] 9 = Timer run/hold [Status] 10 = Program run 11 = Program reset 12 = Program hold 13 = Program run/hold 14 = Program run/reset 15 = Instrument in Manual mode 16 = Sequential set point selection 17 = SP1 / SP2 selection 18 = Set point Binary selection 19 = Digital inputs in parallel to the UP and Down keys	0	r/w
11	diF2	280A	10250	**Digital input 12 function** Note: The digital input status is available even if the input is “not used”.	0 = oFF > not used 1 = Alarm Reset 2 = Alarm acknowledge (ACK) 3 = Hold of the measured value 4 = Stand by mode 5 = HEAt with SP1 and CooL with “SP2” 6 = Timer run/hold/reset [transition] 7 = Timer run [transition] 8 = Timer reset [transition] 9 = Timer run/hold [Status] 10 = Program run 11 = Program reset 12 = Program hold 13 = Program run/hold 14 = Program run/reset 15 = Instrument in Manual mode 16 = Sequential set point selection 17 = SP1 / SP2 selection 18 = Set point Binary selection 19 = Digital inputs in parallel to the UP and Down keys	0	r/w

out Group

n.	Parameter	Address		Meaning	Values	Dec	r/w
		Hex	Dec				
12	o1F	280B	10251	**Out 1 function**	0 = nonE > Output not used 1 = H.rEG > Heating output 2 = c.rEG > Cooling output 3 = AL > Alatm output 4 = t.out > Timer output 5 = t.HoF > Timer out -OFF in hold 6 = P. End > Program end 7 = P.HLd > Program Hold 8 = P.uit > Program wait 9 = P.run > Program Run 10 = P.Et1 > Program Event 1 11 = P.Et2 > Program Event 2 12 = or.bo > Over-range &burnout 13 = P.FaL > Power failure 14 = bo.PF > Burnout & power Fail 15 = diF1 > The output repeats the digital input 1 status 16 = diF2 > The output repeats the digital input 2 status 17 = St.bY> Instruemnt in stand by mode	0	r/w
13	o1AL	280C	10252	**Alarms linked up with the out 1**	0÷ 31 +1 > Alarm 1 +2 > Alarm 2 +4 > Alarm 3 +8 > Loop break alarm + 16 > sensor break (burn out)	0	r/w
14	o1Ac	280D	10253	**Out 1 action**	0 = dir > Direct 1 = rEV = Reverse 2 = dir.r > Direct with reversed LED 3 = rev.r > reverse with reversed LED	0	r/w
15	o2F	280E	10254	**Out 2 function**	See o1.F	0	r/w
16	o2AL	280F	10255	**Alarms linked up with the out 2**	See o1.AL	0	r/w
17	o2Ac	2810	10256	**Out 2 action**	See o1Ac	0	r/w
18	o3F	2811	10257	**Out 3 function**	See o1.F	0	r/w
19	o3AL	2812	10258	**Alarms linked up with the out 3**	See o1.AL	0	r/w
20	o3Ac	2813	10259	**Out 3 action**	See o1Ac	0	r/w
21	o4F	2814	10260	**Out 4 function**	See o1.F	0	r/w
22	o4AL	2815	10261	**Alarms linked up with the out 4**	See o1.AL	0	r/w
23	o4Ac	2816	10262	**Out 4 action**	See o1Ac	0	r/w

AL1 Group

n.	Parameter	address		Meaning	Values	Dec	r/w
		Hex	Dec				
24	AL1t	2817	10263	**Alarm 1 type**	0 = nonE. 1 = LoAb > Absolute low alarm 2 = HiAb > Absolute high alarm 3 = LHAb > Absolute band alarm 4 = LodE > Deviation low alarm 5 = HidE > Deviation high alarm 6 = LHdE > Band alarm	0	r/w
25	Ab1	2818	10264	**Alarm 1 function**	0 ÷ 31 +0 = no function +1 = not active at power up +2 = latched alarm +4 = Acknowledgeable alarm +8 = Mask alarm at power up and after a set point change. + 16 = sensor break (burn out)	0	r/w
26	AL1L	2819	10265	- For High and low alarms, it is the low limit of the AL1 threshold - For band alarm, it is low alarm threshold	from -1999 to AL1H (E.U.)	dP	r/w
27	AL1H	281A	10266	- For High and low alarms, it is the high limit of the AL1 threshold - For band alarm, it is high alarm threshold	From AL1L to 9999 (E.U.)	dP	r/w
28	AL1	281B	10267	**Alarm 1 threshold**	From Al1L to Al1H (E.U.)	dP	r/w
19	HAL1	281C	10268	**Alarm 1 hysteresis**	From 0 = (oFF) to 9999 (E.U.)	dP	r/w
30	AL1d	281D	10269	**Alarm 1 delay**	From 0 = (oFF) to 9999 (s)	0	r/w
31	AL1o	281E	10270	**Alarm 1 enabling during Stand-by mode, aut of range.**	0 = alarm disabled 1 = alarm enabled in standby mode 2 = alarm enabled in out of range. 3 = alarm enabled in stand-by mode and out-of-range	0	r/w

AL2 group

n.	Parameter	Address		Meaning	Values	Dec	r/w
		Hex	Dec				
32	AL2t	281F	10271	**Alarm 2 type**	0 = nonE. 1 = LoAb > Absolute low alarm 2 = HiAb > Absolute high alarm 3 = LHAb > Absolute band alarm 4 = LodE > Deviation low alarm 5 = HidE > Deviation high alarm 6 = LHdE > Band alarm	0	r/w
33	Ab2	2820	10272	**Alarm 2 function**	0 ÷ 31 +0 = no function +1 = not active at power up +2 = latched alarm +4 = Acknowledgeable alarm +8 = Mask alarm at power up and after a set point change. +16 = sensor break (burn out)	0	r/w
34	AL2L	2821	10273	- For High and low alarms, it is the low limit of the AL1 threshold - For band alarm, it is low alarm threshold	From -1999 to AL2H (E.U.)	dP	r/w

n.	Parameter	Address		Meaning	Values	Dec	r/w
		Hex	Dec				
35	AL2H	2822	10274	- For High and low alarms, it is the high limit of the AL1 threshold - For band alarm, it is high alarm threshold	From AL2L to 9999 (E.U.)	dP	r/w
36	AL2	2823	10275	**Alarm 2 threshold**	From AL2L to AL2H (E.U.)	dP	r/w
37	HAL2	2824	10276	**Alarm 2 hysteresis**	From 0 = (oFF) to 9999 (E.U.)	dP	r/w
38	AL2d	2825	10277	**Alarm 2 delay**	From 0 = (oFF) to 9999 (s)	0	r/w
39	AL2o	2826	10278	**Alarm 2 enabling during Stand-by mode, aut of range.**	0 = alarm disabled 1 = alarm enabled in standby mode 2 = alarm enabled in out of range. 3 = alarm enabled in stand-by mode and out-of-range	0	r/w

AL3 Group

n.	Parameter	Address		Meaning	Values	Dec	r/w
		Hex	Dec				
40	AL3t	2827	10279	**Alarm 3 type**	0 = nonE. 1 = LoAb > Absolute low alarm 2 = HiAb > Absolute high alarm 3 = LHAb > Absolute band alarm 4 = LodE > Deviation low alarm 5 = HidE > Deviation high alarm 6 = LHdE > Band alarm	0	r/w
41	Ab3	2828	10280	**Alarm 3 function**	0 ÷ 31 +0 = no function +1 = not active at power up +2 = latched alarm +4 = Acknowledgeable alarm +8 = Mask alarm at power up and after a set point change. +16= sensor break (burn out)	0	r/w
42	AL3L	2829	10281	- For High and low alarms, it is the low limit of the AL1 threshold - For band alarm, it is low alarm threshold	From -1999 to AL3H (E.U.)	dP	r/w
43	AL3H	282A	10282	- For High and low alarms, it is the high limit of the AL1 threshold - For band alarm, it is high alarm threshold	From AL3L to 9999 (E.U.)	dP	r/w
44	AL3	282B	10283	**Alarm 3 threshold**	From AL3L to AL3H (E.U.)	dP	r/w
45	HAL3	282C	10284	**Alarm 2 hysteresis**	From 0 = (oFF) to 9999 (E.U.)	dP	r/w
46	AL3d	282D	10285	**Alarm 3 delay**	From 0 = (oFF) to 9999 (s)	0	r/w
47	AL3o	282E	10286	**Alarm 3 enabling during Stand-by mode, aut of range.**	0 = alarm disabled 1 = alarm enabled in standby mode 2 = alarm enabled in out of range. 3 = alarm enabled in stand-by mode and out-of-range	0	r/w

LbA Group

n.	Parameter	address		Meaning	Values	Dec	r/w
		Hex	Dec				
48	LbAt	282F	10287	**Loop break alarm time**	From 0 = (oFF) to 9999 (s)	0	r/w
49	LbSt	2830	10288	**Delta measure used by LBA during Soft start**	From 0 = (oFF) to 9999 (E.U.)	dP	r/w
50	LbAS	2831	10289	**Delta measure used by LBA**	From 0 = (oFF) to 9999 (E.U.)	dP	r/w
51	LbcA	2832	10290	**Condition for LBA enabling**	0 = uP > active when Pout =100% 1 = dn > Active when Pout= -100% 2 = both > Active in both cases	0	r/w

rEG Group

n.	Parameter	Address		Meaning	Values	Dec	r/w
		Hex	Dec				
52	cont	2833	10291	**Control type** When heating **and** cooling outputs are programmed When heating **or** cooling outputs are programmed	0 = Pid > PID control 1 = nr > neutral zone On/OFF 0 = Pid > PID control 1 = On.FA > asymmetrical ON/OFF 2 = On.FS > symmetrical ON/OFF	0	r/w
53	Auto	2834	10292	**Auto tune selection**	-4 = Oscillating auto-tune with automatic restart at power up (after soft start) and after **all** set point change. -3 = Oscillating auto-tune with manual start. -2 = Oscillating auto-tune with automatic start at the first power up only. -1 = Oscillating auto-tune with automatic restart at every power up 0 = Not used 1 = Fast auto tuning with automatic restart at every power up 2 = Fast auto-tune with automatic start at the first power up only. 3 = FAST auto-tune with manual start 4 = FAST auto-tune with automatic restart at power up (after soft start) and after a set point change.	0	r/w
54	Aut.r	2835	10293	Manual start of the auto-tune Note: it is r/w when a auto-tune with manual start is selected, it is read only in all other cases	0 = oFF > The instrument is NOT performing auto-tune 1 = on > The instrument is performing the auto-tune	0	r/w
55	SELF	2836	10294	**Self-tuning enabling**	0 = no > self tuning disabled 1 =YES > self tuning enabled	0	r/w
56	HSEt	2837	10295	**Hysteresis of the ON/OFF control**	From 0 to 9999 (E.U.)	dp	r/w
57	cPdt	2838	10296	**Time for compressor protection**	From 0 = (oFF) to 9999 (s)	0	r/W
58	Pb	2839	10397	**Proportional band**	From 1 to 9999 (E.U.)	dp	r/w
59	int	283A	10398	**Integral time**	From 0 = (oFF) to 10000 = (inF) (s)	0	r/w
60	dEr	283B	10399	**Derivative time**	From 0 = (oFF) to 9999 (s)	0	r/w
61	Fuoc	283C	10300	**Fuzzy overshoot control**	From 0 to 200	2	r/w

n.	Parameter	Address		Meaning	Values	Dec	r/w
		Hex	Dec				
62	H.Act	283D	10301	**Heating output actuator**	0 = SSr > SSR 1 = rEly > relay 2 = Slou > slow actuator	0	r/w
63	tcrH	283E	10302	**Heating output cycle time**	From 0 = (oFF) to 1300 (s)	1	r/w
64	PrAt	283F	10303	**Power ratio between heating and cooling action**	From 1 to 9999	2	r/w
65	c.Act	2840	10304	**Cooling output actuator**	0 = SSr > SSR 1 = rELY > relay 2 = SLou > slow actuator	0	
66	tcrc	2841	10305	**Cooling output cycle time**	From 0 = (oFF) to 1300	1	r/w
67	rS	2842	10306	**Manual reset** (Integral pre-load)	From -1000 to 1000 (%)	1	r/w
68	od	2843	10307	**Delay at power up**	From 0 = (oFF) to 9959 (hh.min)	2	r/w
69	St.P	2844	10308	**Maximum power output used during soft start**	From -100 to 100 (%)	0	r/w
70	SSt	2845	10309	**Soft start time**	From 0 = (oFF) to 800 = (inF) (h.min)	2	r/w
71	SSth	2846	10310	**Threshold for soft start disabling**	From -2000 = (oFF) to 9999 (E.U.)	dP	r/w

SP Group

n.	Parameter	Address		Meaning	Values	Dec	r/w
		Hex	Dec				
72	nSP	2847	10311	**Number of used set points**	From 1 to 4	0	r/w
73	SPLL	2848	10312	**Minimum set point value**	From -1999 to SPHL (E.U.)	dP	r/w
74	SPHL	2849	10313	**Maximum set point value**	From SPLL to 9999 (E.U.)	dP	r/w
75	SP 1	284A	10314	**Set point 1**	From SPLL to SPLH (E.U.)	dP	r/w
76	SP 2	284B	10315	**Set point 2**	From SPLL to SPLH (E.U.)	dP	r/w
77	SP 3	284C	10316	**Set point 3**	From SPLL to SPLH (E.U.)	dP	r/w
78	SP 4	284D	10317	**Set point 4**	From SPLL to SPLH (E.U.)	dP	r/w
79	SPAt	284E	10318	**Active set point selection**	0 = SP 1 1 = SP 2 2 = SP 3 3 = SP 4	0	r/w
80	SP.rt	284F	10319	**Remote set point type**	0 = rSP > The value coming from serial link is used as remote set point (RSP). 1 = trin > The value coming from serial link will be algebraically added to the local set point selected by SPAt and the sum becomes the operative set point 2 = PErc > The value coming from serial will be scaled on the input range and this value will be used as remote set point	0	r/w

n.	Parameter	Address		Meaning	Values	Dec	r/w
		Hex	Dec				
81	SPLr	2850	10320	**Local/remote set point selection**	0 = Loc > Local 1 = rEn > Remote	0	r/w
82	SP.u	2851	10321	**Rate of rise for positive set point change (ramp up)**	From 1 to 10000 = (inF) units per minute	2	r/w
83	SP.d	2852	10322	**Rate of rise for negative set point change (ramp down)**	From 1 to 10000 = (inF) units per minute	2	r/w

tin group

n. -	Parameter	address		Meaning	Values	Dec	r/w
		Hex	Dec				
84	tr.F	2853	10323	**Independent timer function**	0 = nonE > Timer not used 1 = i.d.A > Delayed start timer 2 = i.uP.d > Delayed start at power up 3 = i.d.d > Feed-through timer 4 = i.P.L > Asymmetrical oscillator with start in OFF 5 = i.L.P > Asymmetrical oscillator with start in ON	0	r/w
85	tr.u	2854	10324	**Engineering tuning of the time**	0 = hh.nn > Hours and minutes 1 = nn.SS > Minutes and seconds 2 = SSS.d > seconds and thenth of seconds	0	r/w
86	tr.t1	2855	10325	**Time 1**	From 1 to 9959 (hh.min) when tr.u = 0 From 1 to 9959 (mm.ss) when tr.u = 1 From 1 to 9959 (tenth of second) when tr.u = 2	2 1	r/w
87	t.t2	2856	10326	**Time 2**	From 0 (oFF) to 9959 (inF) (hh.min) when tr.u = 0 From 0 (oFF) to 9959 (inF) (mm.ss) when tr.u = 1 From 0 (oFF) to 9959 (inF) (tenth of second) when tr.u = 2	2 1	r/w
88	tr.St	2857	10327	**Timer status**	0 = rES 1 = run 2 = HoLd	0	r/w

PrG Group

n.	Parameter	address		Meaning	Values	Dec	r/w
		Hex	Dec				
89	Pr.F	2858	10328	**Programmer action at power up**	0 = nonE > Program not used 1 = S.uP.d > Start at power up with a first step in stand by 2 = S.uP.S > Start at power up 3 = u.diG > Start at RUN command detection only 4 = U.dG.d > Start at RUN command detection with a first step in stand by	0	r/w

n.	Parameter	address		Meaning	Values	Dec	r/w
		Hex	Dec				
90	Pr.u	2859	10329	**Engineering unit of the time (soak)**	0 = hh.nn > hours and minutes 1 = nn.SS > minutes and seconds	0	r/w
91	Pr.E	285A	10330	**Instrument behaviour at the End of the program execution**	0= cnt > continue (the instrument will use the set point of the last soak until a reset command is detected) 1 = SPAt > go to the set point selected by [79] SPAt parameter 2 = St.bY > Go in stand by mode.	0	r/w
92	Pr.Et	285B	10331	**Time of the "end program" indication**	From 0 = (oFF) to 10000 = (inF) (mm.ss)	2	r/w
93	Pr.S1	285C	10332	**Set point of the first soak**	From SPLL to SPHL (E.U.) -8000 = Program END	dP	r/w
94	Pr.G1	285D	10333	**Gradient of the first ramp**	From 1 to 10000 = (inF) (Unit/min) where inF = step transfer	1	r/w
95	Pr.t1	285E	10334	**Time of the first soak**	From 0 to 9959	2	r/w
96	Pr.b1	285F	10335	**Wait band of the first soak**	From 0 = (oFF) to 9999 (E.U.)	0	r/w
97	Pr.E1	2860	10336	**Event of the first group**	From 00.00 to 11.11 (binary)	2	r/w
98	Pr.S2	2861	10337	**Set point of the second soak**	From SPLL to SPHL (E.U.) -8000 = Program END	dP	r/w
99	Pr.G2	2862	10338	**Gradient of the second ramp**	From 1 to 10000 = (inF) (Unit/min) where inF = step transfer	1	r/w
100	Pr.t2	2863	10339	**Time of the second soak**	From 0 to 9959	2	r/w
101	Pr.b2	2864	10340	**Wait band of the second soak**	From 0 = (oFF) to 9999 (E.U.)	0	r/w
102	Pr.E2	2865	10341	**Event of the second group**	From 00.00 to 11.11 (binary)	2	r/w
103	Pr.S3	2866	10342	**Set point of the third soak**	From SPLL to SPHL (E.U.) -8000 = Program END	dP	r/w
104	Pr.G3	2867	10343	**Gradient of the third ramp**	From 1 to 10000 = (inF) (Unit/min) where inF = step transfer	1	r/w
105	Pr.t3	2868	10344	**Time of the third soak**	From 0 to 9959	2	r/w
106	Pr.b3	2869	10345	**Wait band of the third soak**	From 0 = (oFF) to 9999 (E.U.)	0	r/w
107	Pr.E3	286A	10346	**Events of the third group**	From 00.00 to 11.11 (binary)	2	r/w
108	Pr.S4	286B	10347	**Set point of the fourth soak**	From SPLL to SPHL (E.U.) -8000 = Program END	dP	r/w
109	Pr.G4	286C	10348	**Gradient of the fourth ramp**	From 1 to 10000 = (inF) (Unit/min) where inF = step transfer	1	r/w
110	Pr.t4	286D	10349	**Time of the fourth soak**	From 0 to 9959	2	r/w
111	Pr.b4	286E	10350	**Wait band of the fourth soak**	From 0 = (oFF) to 9999 (E.U.)	0	r/w
112	Pr.E4	286F	10351	**Events of the fourth group**	From 00.00 to 11.11 (binary)	2	r/w
113	Pr.St	2870	10352	**Program status**	0 = rES 1 = run 2 = HoLd	0	r/w

PAn Group

n.	Parameter	Address		Meaning	Values	Dec	r/w
		Hex	Dec				
114	PAS2	2871	10353	**Level 2 password: Assistance**	From 0 = (oFF) to 999	0	r/w

n.	Parameter	Address		Meaning	Values	Dec	r/w
		Hex	Dec				
115	PAS3	2872	10354	**Level 3 password: Configuration**	From 0 to 999	0	r/w
116	uSrb	2873	10355	**U button function during run time**	0 = nonE > No function 1 = tunE > Auto-tune/self-tune enabling. 2 = oPLo > Manual mode. 3 = AAc > Alarm reset 4 = ASi > Alarm acknowledge 5 = chSP > Sequential set point selection 6 = St.by > Stand by mode 7 = Str.t > Timer run/hold/reset 8 = P.run > Program run 9 = P.rES > Program reset. 10 = P.r.H.r > Program run/hold/reset	0	r/w
117	diSP	2874	10356	Display management	0= nonE > Standard display 1 = Pou > Power output 2 = SPF > Final set point 3 = SPo > Operative set point 4 = AL1 > Alarm 1 threshold 5 = AL2 > Alarm 2 threshold 6 = AL3 > Alarm 3 threshold 7 = Pr.tu > Increasing time count of the current soak. 8 = Pr.td > Decreasing time count of the current soak. 9 = P.t.tu > Increasing time count of the total program time. 10 = P.t.td > Decreasing time count of the total program time. 11 = ti.uP > Increasing time of the timer 12 = ti.du > Decreasing time of the timer 13 = Perc > Percent of the power output used during soft start.		r/w
118	AdE	2875	10357	**Bargraph deviation**	From 0 = (oFF) to 9999 (E.U.)	Dp	r/w
119	FiLd	2876	10358	**Digital filter on the displayed value**	From 0 = (oFF) to 9999	1	r/w
120	DSPu	2877	10359	**Status of the instrument at power up**	0 = AS.Pr > Starts in the same way it was prior to the power down. 1 = Auto > Starts in AUTO mode 2 = oP.o > Starts in Manual mode with a power out equal to 0 3= StbY > Starts in stand-by mode	0	r/w
121	oPr.E	2878	10360	**Operative modes enabling**	0 = ALL > All 1 = Au.oP > Only Auto and Man. 2 = Au.Sb > Only Auto and Stand-by	0	r/w
122	oPEr	2879	10361	**Operative mode selection**	0 = Auto > Auto 1 = oPLo > Manual 2 = StbY > stand by	0	r/w

SEr Group

n.	Parameter	Address		Meaning	Values	Dec	r/w
		Hex	Dec				
123	Add	287A	10362	**Instrument address**	From 0 = (oFF) to 254	0	r/w

n.	Parameter	Address		Meaning	Values	Dec	r/w
		Hex	Dec				
124	bAud	287B	10363	**Baud rate**	0 = 1200 baud 1 = 2400 baud 2 = 9600 baud 3 = 19200 baud 4 = 38400 baud	0	r/w
125	tr.SP	287C	10364	**Remote set point retransmission**	0 = not used 1 = Operative Set point 2 = Control output percent	0	r/w

con Group (Wattmeter)

n.	Parameter	Address		Meaning	Values	Dec	r/w
		Hex	Dec				
126	co.tY	287D	10365	**Measurement type**	0 = Off- not used 1 = Istantaneous power (KW) 2 = Power consumption (KW/h) 3 = Power consumption during program run. 4 = Worked days 5 = Worked hours	0	r/w
127	UOLt	287E	10366	**Nominal voltage**	From 1 to 999 (Volt)	0	r/w
128	cur	287F	10367	**Nominal current**	From 1 to 9999 (A)	0	r/w
129	H.Job	2880	10368	**Threshold of the worked days/hours**	From 0 = (oFF) to 9999	0	r/w

cAL Group

n.	Parameter	Address		Meaning	Values	Dec	r/w
		Hex	Dec				
130	A.L.P	2881	10369	**Adjust low point**	From -1999 to A.H.P-10 (E.U.)	dP	r/w
131	A.L.o	2882	10370	**Adjust low offset**	From -300 to 300 (E.U.)	dP	r/w
132	A.H.P	2883	10371	**Adjust high point**	From A.L.P+10 to 9999 (E.U.)	dP	r/w
133	A.H.o	2884	10372	**Adjust high offset**	From -300 to 300 (E.U.)	dP	r/w

Identification code zone

This zone provides only informations for identifying model, order code and software release of the K series instrument.

Starting from the address 0800H it's possibile to read the instrument name (TLK41, etc) and from the address 0x80A (up to 0x818) it's possibile tro read the instrument sales code (starting from 2.2 version)

6 Performance

After receiving a valid request the instrument prepares the reply, then sends it back to the master station according following specifications:

- a minimum time is granted greater or equal 3 characters time (depending on adopted baud rate, allowing line direction reversal)
- the reply is ready to be transmitted in less then 20 ms except in case 3;

A 20 ms silence on the line is necessary to recover from abnormal contitions or erroneous messages; this means that a time less than 20 ms is allowed between any two characters in the same message.

Tecnologic S.p.A.
Via Indipendenza, 56
27029 Vigevano (PV) Italia

Tel. ++39/0381/69871
Fax ++39/0381/698730
e-mail : support@tecnologic.it
info@tecnologic.it

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