

LT : Suitable platforms for harsh environments



LT160



LT200



Suitable platforms for harsh environments

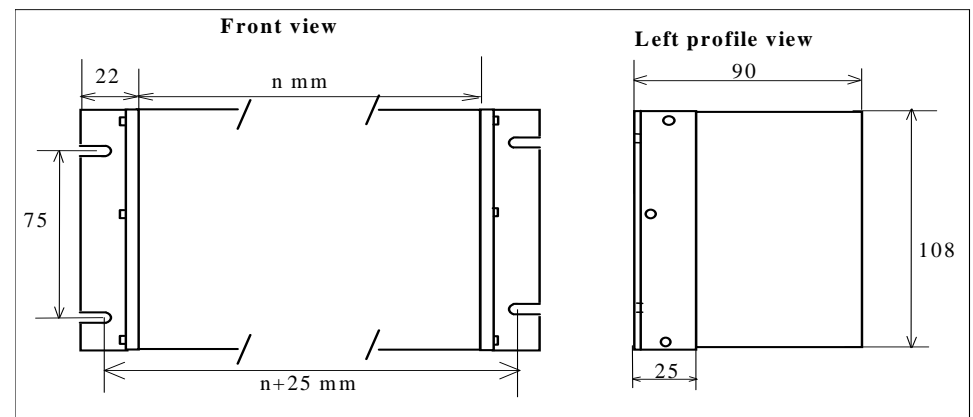
■ Robustness

- Each module is protected by in an aluminium case
- ▶ Operating temperature :
 - LT200 = [-40°C ; +70°C]
 - LT160 = [-20°C ; +70°C]
- ▶ electromagnetic interference immunity
- ▶ high mechanical resistance
- ▶ IP 30 protection
- ▶ excellent thermic dissipation
- ▶ for the heavy vibration constraints, the terminals are equipped of SubD connectors.

Suitable platforms for harsh environments

■ Compacity

- ▶ designed for a shell housing integration.
- ▶ micro platform of several modules
- ▶ applications in box or electrical cabinet
- ▶ the length of the racks is customized.





Suitable platforms for harsh environments

- Modularity and variety
 - ▶ the Inputs / outputs modularity is 8,16,24,32,48 or 64 according to the connectors. The LT can command until 960 inputs/outputs.
 - ▶ Variety of connectors : screw terminals (industrial use) , SubD (embedded use), RJ45
 - ▶ Variety of the size of rack : from 1 I/ block to 15 I/O blocks on One or 3 racks
 - ▶ Variety of mechanical presentation :
 - Small LT in case or box
 - Din rail hanging in 19 inches electrical cabinet
 - Vertical mounting for the big configurations

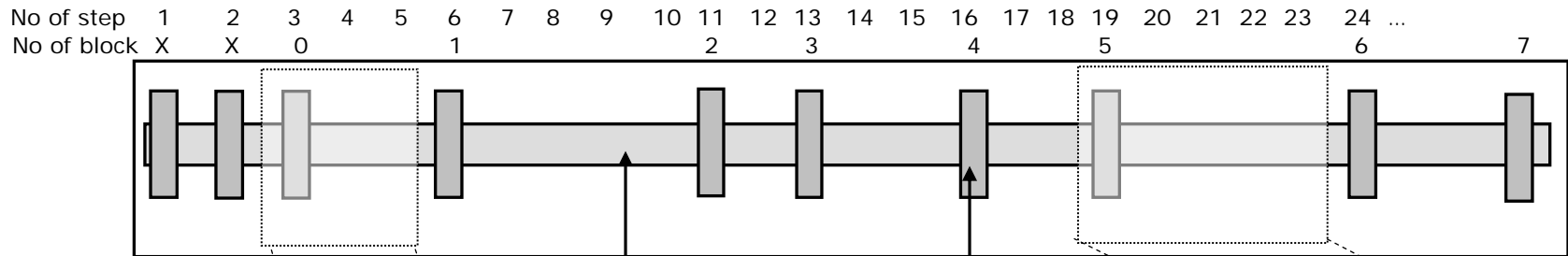


Services

- Assembly and test
 - ▶ The LT assembly and test is factory made before expedition according to the customer configuration on the purchase requirement.
 - ▶ It's ready for use at delivery !!

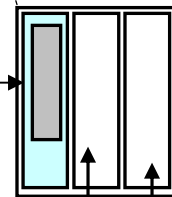
Hardware architecture

One step or slot \Leftrightarrow One physical place (max 30 on the same base) \Leftrightarrow One module
 One block \Leftrightarrow One Logical place between 0 (CPU) and 15 \Leftrightarrow 2,3,4 or 5 modules according to the number of terminal modules
 Power supply module and Extension module are inactive logical blocks \Leftrightarrow No of block = X



Base

Functional module



Terminal module 1

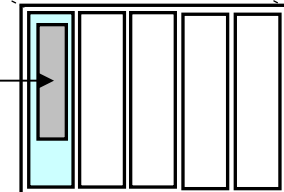
Terminal module 2

Block 0 = CPU.
 Here, the processor board (functional module) with 2 communication modules (terminal modules) on steps 3 to 5.

Bus between Logical places = connectors of blocks

Block Connector (socket).
 Its position (no of step) depends of the width of previous blocks

Block Connector (plug)



Example :
 Block no 5 = One Input/output block.
 Here, the functional module with 4 terminal modules on steps 19 to 23.

Take care than the numero of blocks must continue on the extension base.

One block = One sale reference = No dismantled device



CPU specifications

	LT160	LT200
Operating System	L.A.I's OS	Linux 2.6.12
Processor	386Ex	PXA255
Clock	50 Mhz	300 Mhz
Memory (ROM)	512 ko	16 Mo (4 Mo for user files)
Memory (RAM)	256 ko	32 Mo
Programming channel	RS232 or Ethernet	USB or Ethernet (RS232 for BIOS)
Ethernet Channel	10 base T	10/100 base T with antivibratory socket
Serial channels	Up to 8 RS232/RS485 links on 4 terminal modules	1 Full modem link on CPU module + 3 RS232/RS485 links on 1 terminal module (35 pin SubD)

Hardware specifications : Logic I/O (1)

MATERIAL		SPECIFICATIONS
Diagnosis		All the I/ O blocks have an internal power supplies status register and a local WDG indicated by a red LED. These information are transmitted to the CPU.
LOGIC INPUTS		
Type		24 Vcc (5 to 30), 48 Vcc (30 to 60)
Modularity		Blocks of 16, 32, 48, 64 inputs according to the type and connectors
Norm		Resistive input IEC 1131 type P, 5,5 k Ω 5mA at 24V
Protection		Against polarity inversions
Display		1 OK LED per input
LOGIC OUTPUTS		
Type		Static 24 Vcc or relay 250 Vca
Nominal current		100 mA, 250 mA, 500 mA, relay 3 A
modularity per block		16, 32 channels according to connectors
Protection		Against the overloads
Output/earth insulation		1 000 to 1 500 Veff according to the connectors
Display		1 LED per output, 1 failure LED per block
RELAIS OUTPUTS		
Type	RE L A Y	Active / Common contact 3A 250 Vca
modularity per block		8,16, 24,32 channels screw terminals. 16,32 channels subD
Protection	O U T P U T	Against the overloads
Output/earth insulation		1 000 to 1 500 Veff according to the connectors
Display		1 LED per output, 1 failure LED per block



Special Logic I/O (2) : DI312 module

**This module controls the wiring
between the sensor and the input of PLC
(anti-intrusion use)**

- 4 states by input :
 - normally opened sensor,
 - normally closed sensor,
 - open circuit between the sensor and the input,
 - short circuit between the sensor and the input
- Detection with resistances near the sensor between 300 and 10 kohms
- The sensor can be 200 meters away from the input.
- 2 bits and 2 LED by input : a green LED for the sensor state, a red LED for the wire failure

Hardware specifications : Analog I/O

ANALOG INPUTS		
Range		-20+20 mA, -10+10 Vcc, -5+5 Vcc
Resolution		13 bits + signe
Number of inputs per block		4, 8, 12, 16 according to the type and connectors
Maximum error at full scale		1% at 25°C
Channel/earth insulation		1 000 Veff to 1 500 Veff according to the connectors
ISOLATED ANALOG INPUTS		
Range		0 to +10 Vcc , 0 to 20 mA
Insulation between channels		1 000 Veff
PT100 INPUTS		
Scale		-200°C to +350 °C
precision		0.5°C
ANALOG OUTPUTS		
Range		4-20 mA, -10+10 Vcc
Resolution		11 bits + signe
Maximum error at full scale		1% at 25°C
Insulation between output and earth		1 000 Veff to 1 500 Veff according to the connectors



Programming capabilities

The same hardware CPU accepts 3 different embedded kernels :

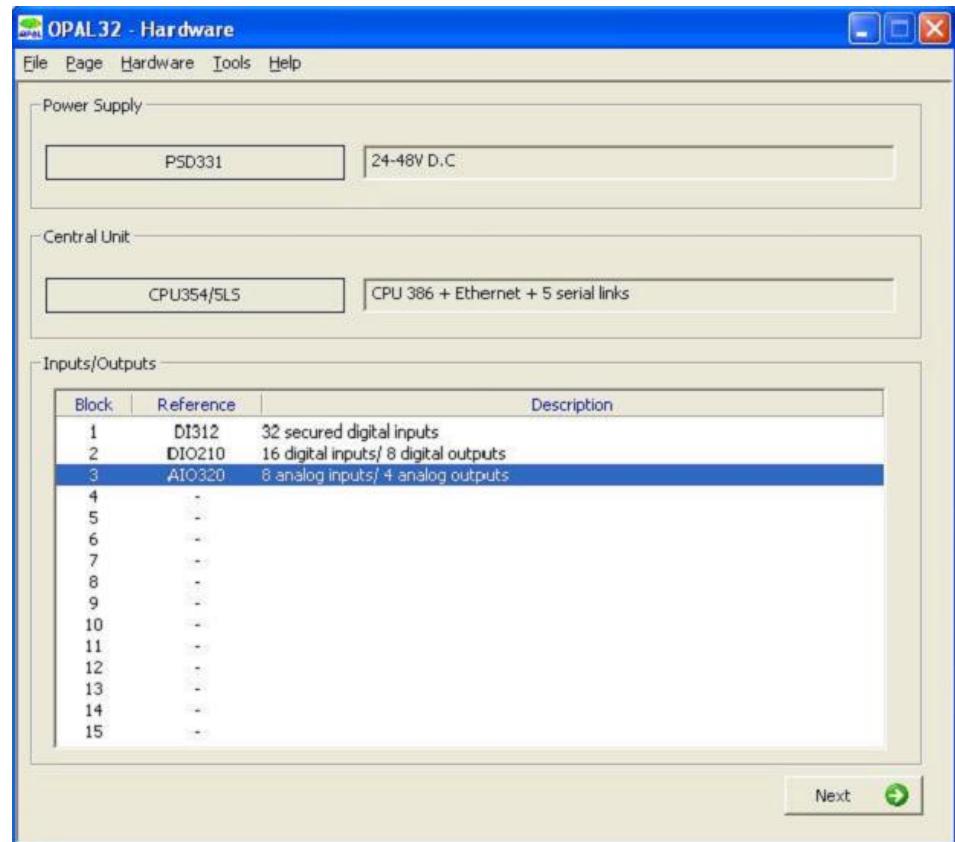
<i>Programming level</i>	<i>PC tool</i>	<i>Embedded kernel</i>	<i>Availability on LT160 target</i>	<i>Availability on LT200 target</i>
Easy and quick start-up & Script language	OPAL32	OPAL	Yes	Yes (June 2009)
IEC 61131-3 programming	Isagraf workbench	Isagraf	Isagraf V3.51 and before	Isagraf V5.1 (June 2009)
C Programming	Linux SDK	Linux BSP	-No-	Yes (Eclipse IDE)

OPAL32 quick tool (1)

Easy and intuitive interface → Start up in few minutes configuration step by step :

- Setting up of the hardware configuration

- CPU
- I/O blocks



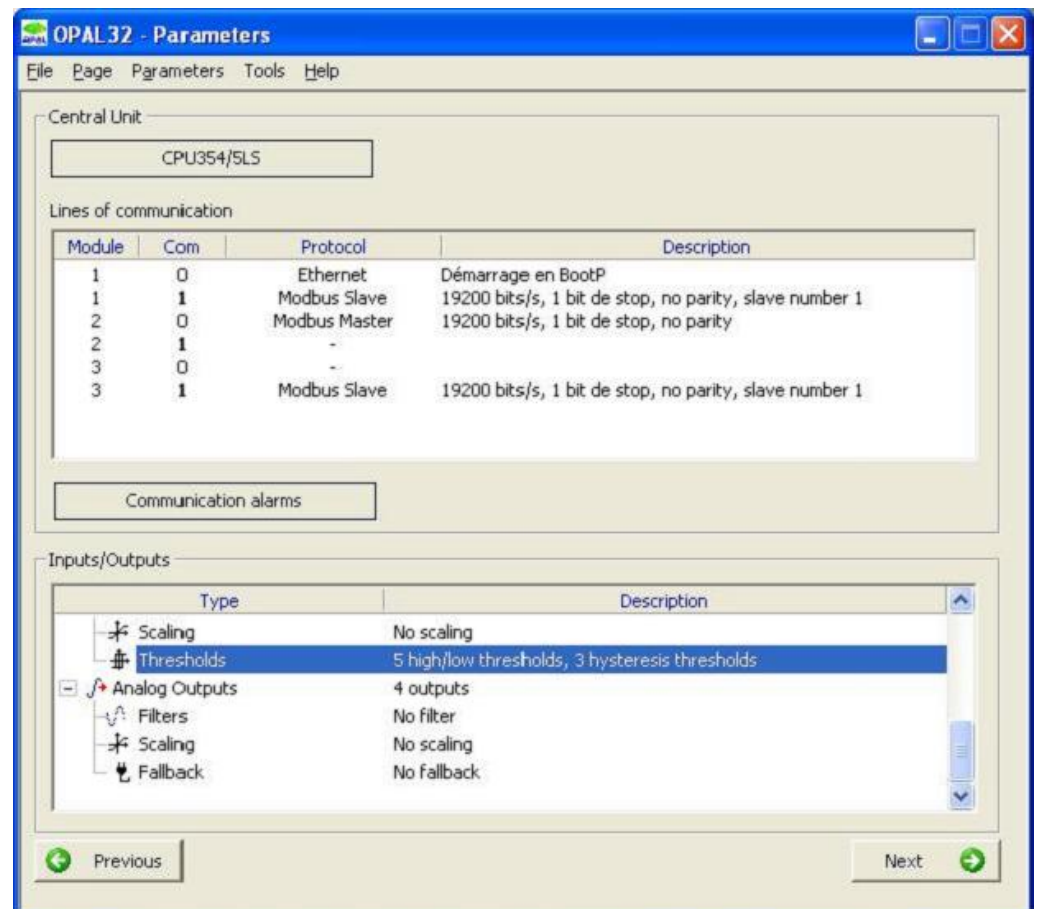
OPAL32 quick tool (2)

Easy and intuitive interface → Start up in few minutes
Configuration step by step :

- Setting up of communications

- Setting up of input/output functions

- Digital inputs : filters, edge counters, timers, wiring control
- Digital outputs : signal type, fallback
- Analog inputs : filters, scaling, thresholds
- Analog outputs : scaling, fallback



OPAL32 quick tool (3)

Easy and intuitive interface → Start up in few minutes
configuration step by step :

■ Dictionary of variables

- Rename,
- Insert,
- Add
- Delete
- Saved data

■ Network management

- Modbus slave table
- Modbus master frame

The screenshot shows the 'OPAL32 - Data' application window. The window title is 'OPAL32 - Data' and it has a menu bar with 'File', 'Page', 'Data', 'Tools', and 'Help'. The main area contains a table with the following columns: Index, Name, Length, Type, Status, and Description. The table lists various variables such as CPU, BLOCK1, BLOCK2, BLOCK3, and several BIT and MOT variables. A context menu is open over the row with Index '004D' and Name 'MYWORDTABLE', showing options: Add, Insert, Modify (highlighted), Duplicate, Delete, and Saved Data. At the bottom of the window, there are 'Previous' and 'Next' buttons with green arrows.

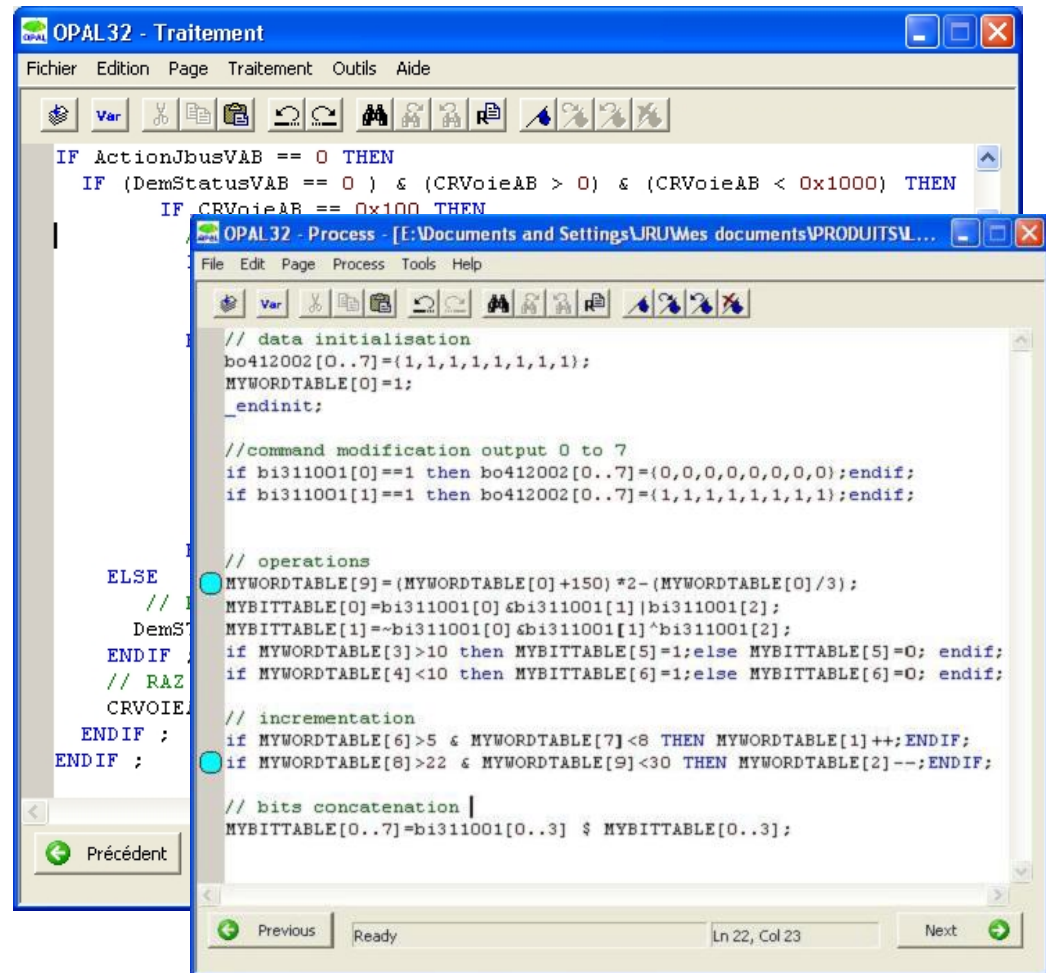
Index	Name	Length	Type	Status	Description
0000	CPU	13	MOT	I	CPU block
0000	BLOCK1	13	MOT	I	I/O block 1
001A	BLOCK2	5	MOT	I	I/O block 2
001F	BLOCK3	18	MOT	I	I/O block 3
0310	bi311001	32	BIT		Block 1 : Digital inputs
0330	bs321001	32	BIT		Block 1 : secured digital inputs alarms
0350	br322001	32	BIT		Block 1 : controled digital inputs mask
0370	bi311002	16	BIT		Block 2 : Digital inputs
0380	bo411002	8	BIT		Block 2 : real digital outputs
0388	bo412002	8	BIT		Block 2 : digital outputs command
0039	mi511003	8	MOT		Block 3 : Analog Inputs
0041	mo611003	4	MOT		Block 3 : Analog Outputs
0450	bs83004	1	BIT		Alarm bit Module 2 Com 0
0460	br350001	32	BIT		Block 1 : digital inputs filtred
0480	br350002	16	BIT		Block 2 : digital inputs filtred
0490	bs110001	1	BIT		Communication alarms summary
04A0	br561003	8	BIT		Block 3 : low threshold indicator
04A8	br562003	8	BIT		Block 3 : high threshold indicator
04B0	MYBITTABLE	20	BIT		
004D	MYWORDTABLE	20			
0061	Ms810001	9			Diagnosis counters Module 0 Com 1
006A	Ms810002	9			Diagnosis counters Module 0 Com 0
0073	Ms810004	9			Diagnosis counters Module 1 Com 0
007C	Ms810005	9			Diagnosis counters Module 2 Com 1

OPAL32 quick tool (4)

Easy and intuitive interface → Start up in few minutes
configuration step by step :

Local process with script
language.
Sequential process line
after line.

- Numerical and boolean operations
- « If then else endif » structure
- Array operations
- Timing functions
- Frame communications start
- Parser (syntactical analyser)
- Stop/start steps



```
OPAL32 - Traitement
Fichier Edition Page Traitement Outils Aide
Var
IF ActionJbusVAB == 0 THEN
  IF (DemStatusVAB == 0) & (CRVoieAB > 0) & (CRVoieAB < 0x1000) THEN
    IF CRVoieAB == 0x100 THEN
      // data initialisation
      bo412002[0..7]=(1,1,1,1,1,1,1,1);
      MYWORDTABLE[0]=1;
      _endinit;
      //command modification output 0 to 7
      if bi311001[0]==1 then bo412002[0..7]=(0,0,0,0,0,0,0,0);endif;
      if bi311001[1]==1 then bo412002[0..7]=(1,1,1,1,1,1,1,1);endif;
      // operations
      MYWORDTABLE[9]=(MYWORDTABLE[0]+150)*2-(MYWORDTABLE[0]/3);
      MYBITTABLE[0]=bi311001[0] $ bi311001[1] | bi311001[2];
      MYBITTABLE[1]=~bi311001[0] $ bi311001[1] ^ bi311001[2];
      if MYWORDTABLE[3]>10 then MYBITTABLE[5]=1;else MYBITTABLE[5]=0; endif;
      if MYWORDTABLE[4]<10 then MYBITTABLE[6]=1;else MYBITTABLE[6]=0; endif;
      // incrementation
      if MYWORDTABLE[6]>5 & MYWORDTABLE[7]<8 THEN MYWORDTABLE[1]++;ENDIF;
      if MYWORDTABLE[8]>22 & MYWORDTABLE[9]<30 THEN MYWORDTABLE[2]--;ENDIF;
      // bits concatenation |
      MYBITTABLE[0..7]=bi311001[0..3] $ MYBITTABLE[0..3];
    ENDIF ;
  ENDIF ;
ENDIF ;
CRVOIEAB

OPAL32 - Process - [E:\Documents and Settings\JRU\Mes documents\PRODUITS\M...
File Edit Page Process Tools Help
Var
// data initialisation
bo412002[0..7]=(1,1,1,1,1,1,1,1);
MYWORDTABLE[0]=1;
_endinit;
//command modification output 0 to 7
if bi311001[0]==1 then bo412002[0..7]=(0,0,0,0,0,0,0,0);endif;
if bi311001[1]==1 then bo412002[0..7]=(1,1,1,1,1,1,1,1);endif;
// operations
MYWORDTABLE[9]=(MYWORDTABLE[0]+150)*2-(MYWORDTABLE[0]/3);
MYBITTABLE[0]=bi311001[0] $ bi311001[1] | bi311001[2];
MYBITTABLE[1]=~bi311001[0] $ bi311001[1] ^ bi311001[2];
if MYWORDTABLE[3]>10 then MYBITTABLE[5]=1;else MYBITTABLE[5]=0; endif;
if MYWORDTABLE[4]<10 then MYBITTABLE[6]=1;else MYBITTABLE[6]=0; endif;
// incrementation
if MYWORDTABLE[6]>5 & MYWORDTABLE[7]<8 THEN MYWORDTABLE[1]++;ENDIF;
if MYWORDTABLE[8]>22 & MYWORDTABLE[9]<30 THEN MYWORDTABLE[2]--;ENDIF;
// bits concatenation |
MYBITTABLE[0..7]=bi311001[0..3] $ MYBITTABLE[0..3];
Précédent
Previous Ready Ln 22, Col 23 Next
```

OPAL32 quick tool (5)

Easy and intuitive interface → Start up in few minutes
configuration step by step :

- Uploading the configuration to the target
- On line dynamic diagnosis

The screenshot shows the 'Visualisation dynamique des variables' window. At the top, it indicates 'Automate en marche'. Below is a table with columns: Nom, Adresse, Longueur, Type, Valeur, and Description. A context menu is open over the 'mi511006' row, showing options: Adresse, Valeur, Modifier, Développer tout, Réduire tout. The 'Valeur' sub-menu is open, showing 'Hexadécimal', 'Décimal signée' (checked), and 'Décimal non signée'.

Nom	Adresse	Longueur	Type	Valeur	Description
bs321004	0181	32	BIT		Bloc 4 : alarmes de sécurité entrées TOR
br322004	01A1	32	BIT		Bloc 4 : masque des entrées contrôlées
bi311005	01C1	16	BIT		Bloc 5 : Entrées TOR
bo411005	01D1	8	BIT		Bloc 5 : sorties TOR réelles
bo412005	01D9	8	BIT		Bloc 5 : commandes de sorties TOR
bo412005[0]	01D9			0	
bo412005[1]	01DA			1	
bo412005[2]	01DB			0	
bo412005[3]	01DC			1	
bo412005[4]	01DD			1	
bo412005[5]	01DE			0	
bo412005[6]	01DF			0	
bo412005[7]	01E0			0	
mi511006	001F	8	MOT		
mo611007	0027	8	MOT		
mo611007[0]	0027			200	
mo611007[1]	0028			0	
mo611007[2]	0029			0	
mo611007[3]	002A			660	

OPAL32 quick tool (6)

LT200 only

- Dating of change states of variables (bit or word) → events
- Resolution of dating : ms
- Precision of dating : depends of the process cycle (5 – 20 ms)
- Automatic or On demand dating
- Events are available for Modbus master
- Events can be viewed by embedded server web

The screenshot shows the 'OPAL32 - Data' application window. The window title is 'OPAL32 - Data' and it has a menu bar with 'File', 'Page', 'Data', 'Tools', and 'Help'. The main area contains a table with the following columns: Index, Name, Length, Type, Status, and Description. The table lists various data points, including CPU blocks, I/O blocks, digital inputs, digital outputs, analog inputs, and analog outputs. A context menu is open over the row with Index '004D' and Name 'MYWORDTABLE'. The menu options are: Add, Insert, Modify (highlighted), Duplicate, Delete, and Saved Data (with a right-pointing arrow). At the bottom of the window, there are 'Previous' and 'Next' buttons with left and right arrows respectively.

Index	Name	Length	Type	Status	Description
0000	CPU	13	MOT	I	CPU block
000D	BLOCK1	13	MOT	I	I/O block 1
001A	BLOCK2	5	MOT	I	I/O block 2
001F	BLOCK3	18	MOT	I	I/O block 3
0310	bi311001	32	BIT		Block 1 : Digital inputs
0330	bs321001	32	BIT		Block 1 : secured digital inputs alarms
0350	br322001	32	BIT		Block 1 : controled digital inputs mask
0370	bi311002	16	BIT		Block 2 : Digital inputs
0380	bo411002	8	BIT		Block 2 : real digital outputs
0388	bo412002	8	BIT		Block 2 : digital outputs command
0039	mi511003	8	MOT		Block 3 : Analog Inputs
0041	mo611003	4	MOT		Block 3 : Analog Outputs
0450	bs83004	1	BIT		Alarm bit Module 2 Com 0
0460	br350001	32	BIT		Block 1 : digital inputs filtred
0480	br350002	16	BIT		Block 2 : digital inputs filtred
0490	bs110001	1	BIT		Communication alarms summary
04A0	br561003	8	BIT		Block 3 : low threshold indicator
04A8	br562003	8	BIT		Block 3 : high threshold indicator
04B0	MYBITTABLE	20	BIT		
004D	MYWORDTABLE	20			
0061	Ms810001	9			Diagnosis counters Module 0 Com 1
006A	Ms810002	9			Diagnosis counters Module 0 Com 0
0073	Ms810004	9			Diagnosis counters Module 1 Com 0
007C	Ms810005	9			Diagnosis counters Module 2 Com 1

OPAL32 quick tool (6)

LT200 only

An embedded web server allows :

- a remote diagnosis of the LT by an Internet explorer
- a remote read/write access to the internal dictionary
- a remote view of stored events
- a download of the embedded event file to a CSV file in the PC.

The screenshot shows the web interface for the OPAL32 system. At the top, there is a navigation menu with links: Accueil, Système, Variables, Horodatage, and Contact. The main content area is titled "Informations système LT200 OPAL" and is divided into several sections:

- Noyau OPAL:** Displays "Version : V0.3" and "Date : 22/10/08".
- Performances:** Displays "Cycle Courant : 7 ms", "Cycle Min. : 6 ms", and "Cycle Max. : 12 ms".
- Voies de communication:** A table showing communication channels.
- Status général:** Displays "Initialisation terminée" with a green checkmark.
- Entrées/sorties:** A list of 15 digital inputs/outputs, each with a status indicator (green checkmark or dash).

Bornier	Voie	Protocole
0	0	Modbus Esclave
1	1	Eth Ethernet
1	1	Modbus Maître
1	2	-
1	3	-

Entrées/sorties
1. DI310 ✓
2. DO310 ✓
3. AI210 ✓
4. DI312 ✓
5. DI0210 ✓
6. AI110 ✓
7. AO121 ✓
8. DI410 ✓
9. -
10. -
11. -
12. -
13. -
14. -
15. -

At the bottom, a footer reads: "Tous droits réservés - Leroy Automation ©2008 - V0.2" with a small French flag icon.

IEC61131-3 Programming : Isagraf

The Isagraf workbench offers the five IEC 61131-3 powerful languages :

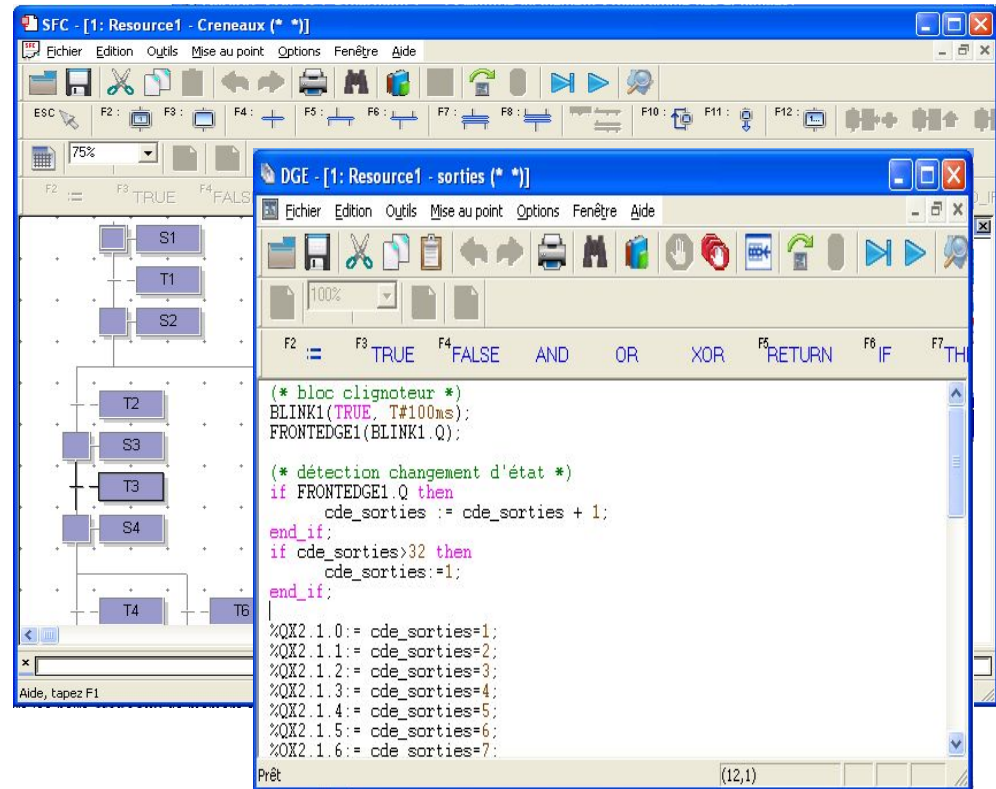
*SFC Sequential Flow Chart
(Grafcet)*

ST Structured Text

LD Ladder Diagram

IL Instruction List

*FC Flow Chart (Logic
diagram)*



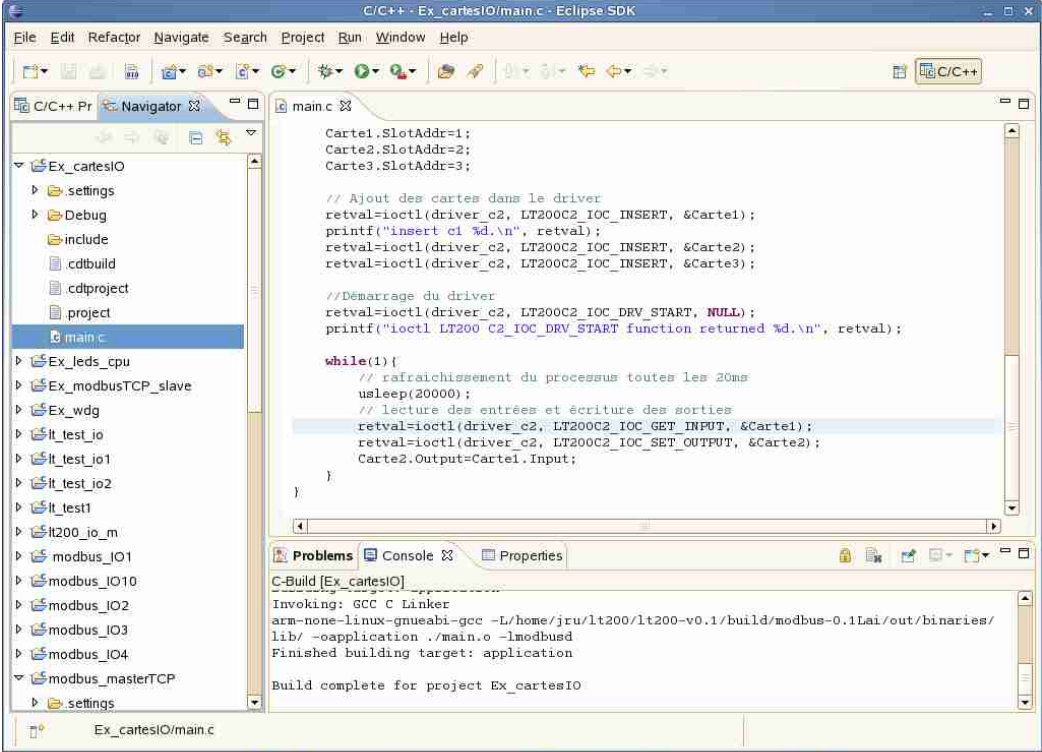
Programming : SDK

LT200 only

The Linux Software Development Kit (SDK) offers :

- a range of tools to easily develop applications on the hardware platforms LT200, ACS23 and RIOM Ethernet.
- a compact implementation of the GNU/Linux operating system based on the 2.6.12 Linux kernel release.
- an embedded version of Linux with a proven background, combined with a high reliability journaling Flash File system

It is pre-loaded and configured into the embedded Flash of the target.



```
C/C++ - Ex_cartesIO/main.c - Eclipse SDK
File Edit Refactor Navigate Search Project Run Window Help
C/C++ Pr Navigator main.c
Ex_cartesIO
  settings
  Debug
  include
  .cdtbuild
  .cdtproject
  project
  main.c
Ex_ieds_cpu
Ex_modbusTCP_slave
Ex_wdg
it_test_io
  it_test_io1
  it_test_io2
  it_test1
  it200_io_m
modbus_IO1
modbus_IO10
modbus_IO2
modbus_IO3
modbus_IO4
modbus_masterTCP
  settings
Ex_cartesIO/main.c

main.c
Cartel.SlotAddr=1;
Carte2.SlotAddr=2;
Carte3.SlotAddr=3;

// Ajout des cartes dans le driver
retval=ioctl(driver_c2, LT200C2_IOC_INSERT, &Cartel);
printf("insert c1 %d.\n", retval);
retval=ioctl(driver_c2, LT200C2_IOC_INSERT, &Carte2);
retval=ioctl(driver_c2, LT200C2_IOC_INSERT, &Carte3);

//Démarrage du driver
retval=ioctl(driver_c2, LT200C2_IOC_DRV_START, NULL);
printf("ioctl LT200 C2_IOC_DRV_START function returned %d.\n", retval);

while(1){
// rafraichissement du processus toutes les 20ms
usleep(20000);
// Lecture des entrées et écriture des sorties
retval=ioctl(driver_c2, LT200C2_IOC_GET_INPUT, &Cartel);
retval=ioctl(driver_c2, LT200C2_IOC_SET_OUTPUT, &Carte2);
Carte2.Output=Cartel.Input;
}

Problems Console Properties
C-Build [Ex_cartesIO]
Invoking: GCC C Linker
arm-none-linux-gnueabi-gcc -L/home/jru/lt200/lt200-v0.1/build/modbus-0.1Lai/out/binaries/lib/ -oapplication ./main.o -lmodbus
Finished building target: application
Build complete for project Ex_cartesIO

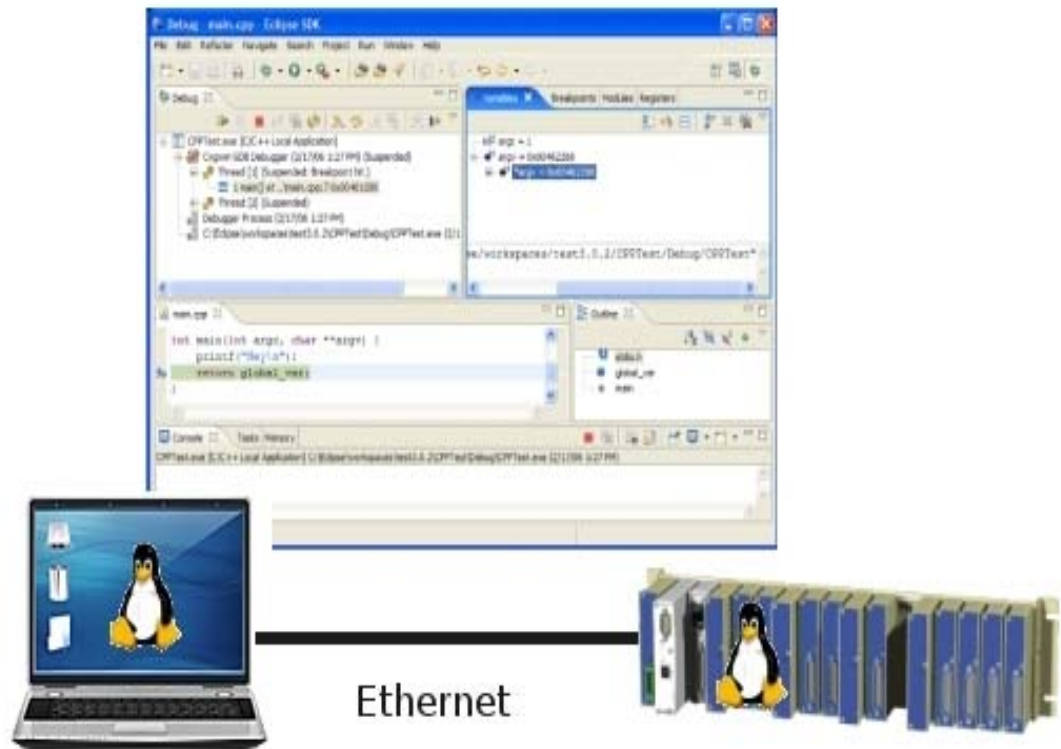
Applications Raccourcis Bureau Firefox (3) Gestionnaire C/C++ - Ex... ast mer 28 mai, 10:50
```

Programming : SDK

LT200 only

Features

- ▶ 2.6.12 based Linux kernel release
- ▶ Complete GNU tool chain:
 - ARM C/C++ cross-compiler (GCC)
 - Remote Debugger (GDB)
 - GNU C/C++ standard libraries
- ▶ Journaling Flash File System (JFFS2)
- ▶ 4 MB onboard Flash disk space for the user.
- ▶ Linux Device drivers for peripherals : I/O boards, serial links, memories ...
- ▶ System utilities
- ▶ DHCP client
- ▶ Web server supporting both static and, via CGI, dynamic HTML pages
- ▶ FTP server
- ▶ SNMP agent (V1, V2C, V3)
- ▶ TELNET server
- ▶ Modbus TCP protocol (master and slave)
- ▶ Asynchronous Modbus protocol (master and slave)





Main references (1) : Military shelters

THALES AIR SYSTEMS - JANUARY 2009 Military radars

« Now the LT200 equips and controls the new radar of THALES : The GROUND MASTER 400

Connected on the embedded Ethernet network,
one LT200 in the antenna and one LT200 in the shelter start and supervise the good working order of the system (energy, computers, transmissions, ...) .

Monitoring and supervision can be remote and local with the embedded web server in the CPU. »

Programming : C language





Main references (2) : Energy management

Sub-station power
management :

FRANCE : 1500 Vcc Lines, 25
kV High Speed Train Lines

KOREA : Korean High Speed
Train network (Seoul-Pusan
line)

IEC1131 programming with
Isagraf



Main references (3) : safety sites

④ French Atomic Energy Authority

- Sites of Saclay, Villacoublay, Bruyères le Châtel, Grenoble , Cadarache ...

④ Atomic Energy Plant

- COGEMA (Marcoule, Pierrelatte)



Anti intrusion systems. Surrounding fence surveillance.
All systems use inputs with remote control of wire sensor.

Main references (4)

... and since 1996, many applications in

- industry
- transportation (shelters)
- environment (water treatment)
- building management
- airports, train stations
- energy management
- ...

