



beyond  
payment

## Technical Manual

ICT220



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# 1. Equipment

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The ICT220 is the first terminal of the new Ingenico ready to stay in the market for long. It puts together power of new processor, latest security, fast printer, large memory and best design for keyboard with its large keys, display and its general casing. It is a countertop, with wires for power supply or to communicate (Ethernet or Modem). But this terminal is suitable for both the merchant and customer as it can be handling very easily, especially equipped with its Magic Box.

ICT220 is:

- powerful,
- highly secure,
- very robust,
- very reliable,
- easy to operate.

## 1.1. General hardware description

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### 1.1.1. Main characteristics of ICT220 Countertop terminal

<b>Main processor</b>	– RISC ARM9 32 bits running at 450 Mips
<b>Crypto processor</b>	– RISC ARM7 32 bits running at 50Mips
<b>Internal memory</b>	– SDRAM : 8 Mb – FLASH : 16 Mb
<b>Display</b>	– White Backlit 128 x 64 pixel graphic display
<b>Keypad</b>	– 15 keys (including 3 colour keys "Validation", "Correction" and "Cancel") – 4 navigation keys – White backlit
<b>Buzzer</b>	– yes
<b>Main Smart card reader</b>	– synchronous and asynchronous Clock frequency 4.76 MHz – Vcc = 5V, 3V, 1,8V
<b>Magnetic card reader</b>	– Track 1/2/3
<b>2 SAMs</b>	– 2 in standard – asynchronous – Clock frequency 4.76 MHz – Vcc = 5V, 3V, 1,8V
<b>Communications</b>	– Modem : V22, V22bis, v29 fast connect, V32, V32bis – Auto answer – Fast connect
<b>Connections on terminal</b>	– 1 USB slave – 1 USB master – 1 RS232 – 1 telephone line in
<b>Printer</b>	– Thermal printer with graphic mode – Paper detection – Easy loading – 42 characters per line

	<ul style="list-style-type: none"> <li>- 18 lines/second in alphanumeric print mode for a typical receipt</li> <li>- Receipt width: 58 mm</li> <li>- Paper roll diameter: 40 mm</li> <li>- Paper roll length: 17m</li> </ul>
<b>Power supply</b>	- 230 V 50 Hz; External detachable power supply unit
<b>Size</b>	- 83x185x63mm
<b>Weight</b>	- 325g (without paper, without cable)
<b>Environnement</b>	<ul style="list-style-type: none"> <li>- Operating temperature : +5°C to +45°C</li> <li>- Operating humidity : 85% HR to +40°C</li> </ul>
<b>Security</b>	- PCI PED v2.0
<b>Included accessories</b>	<ul style="list-style-type: none"> <li>- Power supply with European connector</li> <li>- Power supply for other countries available on demand</li> <li>- Telephone cable</li> </ul>
<b>Personalization</b>	<ul style="list-style-type: none"> <li>- Lens</li> <li>- Sticker on paper trap</li> <li>- Upper cover</li> <li>- Keypad marking</li> </ul>

Optional on the terminal:

- 16Mo of SDRAM;
- Ethernet 10/100 BaseT.

Accessories:

- Pinshield;
- Ethernet, RS232, USB host, USB slave cables;
- PP30S Pin-Pad;
- Magic Box with connector for power supply, RS232, Ethernet, telephone line.

### 1.1.2. Other characteristics

#### Ergonomics

ICT220 is specially designed to make easier:

- introduction and removal of smart cards;
- magnetic stripe card reading;
- operator guiding, using navigation keys and dialogue;
- input on touch-effect large-key keypad;
- information display using large backlit screen.

#### Integration

Easy integration of the ICT220 in all types of business thanks to the thermal printer's **silence** (see details later in the document) and excellent **ergonomics**.

#### Reliability

ICT220 has been designed to make maintenance easy and to improve reliability.

#### Data security

Data protection characteristics:

- « Tamper detection »;
- « Tamper responsive »;
- « Tamper evidence ».

Powerful algorithms used for encryption and authentication.

### From an ultra-powerful processor through to software development

ICT220 circuit board is based on an ARM 9 processor with very large scale integration: "a circuit board in a chip". It contains a series of smart peripherals and a 32-bit ARM9 RISC processor clocked at 380 MHz, capable of remaining active with very low energy consumption levels.

These manage:

- **Actual isolation** of software, essential in a multi-application context. The design of the processor ensures the integrity of the software applications and their data. Thus no application can have its data or code consulted or altered by another.
- **Simultaneity** among the various peripherals, reducing the transaction time required, for example, when printing while inputting data on the keypad.
- Memory space, which is **directly addressable** by the processor (no paging mechanism). Application development is made easier, and memory space availability is optimal.

Memory space optimization was also in the design brief. The application is compressed and stored in non-volatile memory.

### Software development platform

The application development platform is one of the most efficient on the market. It enables developments and debugging in "C" language in an integrated development environment.

### Embedded operating system

In addition the operating system now onboard each ICT220 offers highly evolved functions such as the **maintenance system**, **local diagnostics** and **remote diagnostics**, functions improving after sales service and enabling efficient equipment management.

See chapter 2.4 Operating system.

### Download

The reduction of download time was a major requirement; it is very reduced, thanks to **data compression** techniques. Of course, **selective downloading** enables one software application to be downloaded or changed independently of the others or the system.

The use of FTP TCP/IP and PPP allows download times to be optimized.

Once the connection has been made with the V32b modem, the downloading of a **120 Kb** software application takes about **1 min**.

Once IP connection has been made with SSL (Ethernet), the downloading of a **120 Kb** software application takes about **2 s**.

The downloading with LLT or USB memory of a **120 Kb** software application takes about **2 s**.

## 1.2. Detailed terminal characteristics

### 1.2.1. Processors

<b>Main CPU</b>	ARM9 32 bits RISC processor
<b>Clock frequency</b>	380 MHz
<b>Capacity</b>	450 MIPS

<b>CRYPTO CPU</b>	ARM7 32-bit RISC processor with flash and RAM memory
<b>Clock frequency</b>	57 MHz
<b>Capacity</b>	50 MIPS

<b>Calendar</b>	Leap-year management
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The power of the ICT220's processors gives the following performance:  
3DES → less than 10µs.

Algorithm	RSA	SDA	DDA
<b>Keys</b>			
1024 exp 3	0,4 ms	1 ms	1,5 ms
1024 exp 2 <sup>16</sup> + 1	3 ms	8 ms	13 ms
2048 exp 3	1,1 ms	3 ms	4,5 ms
2048 exp 2 <sup>16</sup> + 1	9 ms	24 ms	38 ms

### Main CPU memory capacity

<b>FLASH</b>	16
<b>SDRAM</b>	8, 16

### Data storage

The ICT220 has a lithium battery.

<b>Characteristics</b>	<ul style="list-style-type: none"> <li>- 3 Volts</li> <li>- 550 mAh</li> <li>- welded</li> </ul>
<b>Forecast battery duration</b>	7 years (With the following assumptions: 1,5 year storage maximum from the manufacturing date at 25° C, and 45 days / year, not powered at 25°C)

## 1.2.2. Data security

### 1.2.2.1. Equipment design

The terminal was designed with the goal of resisting tampering, in order to keep the confidential character of sensitive data (keys or confidential code), and to delete this data as soon as a tamper attempt is detected.

- All the data are inside the cryptoprocessor and are thus physically protected by the chip. This prevents the reading of secret bank keys and confidential codes.
- The display, keypad and smart card readers are controlled by the cryptoprocessor.

### Tamper resistance

- Check of lid opening;
- Check of keypad tampering;
- Check of temperature;
- Check of voltage;
- Protection against drilling;
- Magnetic head protection;
- CAM (Smart Card reader) connector protection.

### Tamper detection

When tampering occurs, the terminal reacts:

- The cryptoprocessor deletes sensitive data,
- The keypad locks.

### Tamper evidence

- A message is displayed to alert the user.

### 1.2.2.2. Software design

Software download is made secure. Only **authentic, signed and certified software** can be downloaded into the terminal.

- The software identification scheme is based on:
  - Asymmetric encryption algorithm with public and private keys;
  - Certified **RSA** cards;
  - Software Signature Tool (SST).
- Application intended to be downloaded into the secure terminal must first be signed by a Software Signature Tool (SST). They can then be remotely downloaded using a TMS (Remote downloading tool) or locally using a LLT (Local Loading Tool).
- Once the application is downloaded, the **cryptoprocessor checks** the downloaded application's certificate and signature. This operation constitutes the authentication. If the downloaded application is authentic, it is accepted.

NOTE: "LLT" and "TMS" solutions are described in the section "Software downloading".

### 1.2.2.3. User design

The product has to be activated before any use. Once activated, the terminal is operational.

Activation enables:

- software downloading,
- product security.

### 1.2.2.4. Standards

Compliance with international specifications for:

- PCI PED 2.0 (Payment Card Industry Pin Entry Device)  
On-line / off-line PIN  
DUKPT, MK/SK, Fixed Key
- EMV Level 1  
Version 4.0 - December 2000
- EMV Level 2  
Version 4.2 - June 2008

## 1.2.3. The isolation mechanism by electronic locking system

### Isolation

Read/write isolation is obtained by USER confinement in the application memory space. Inter-software isolation is controlled by an MMU (Memory Management Unit).

### MMU features

- Hardware protection;
- Complete inter-software protection (read/write);
- Code protection.

### Inviolable memory protection

The controller **checks each access** to the memory.

### The OS is inviolable and protected

The Processor distinguishes two execution worlds:

- USER world: software domain.
- SUPERVISOR world: OS domain.

No software running in the USER world can access the SUPERVISOR world.

This exclusion mechanism is ensured by the processor itself.

Therefore the OS is inviolable, even in the case of an application bug. This system inviolability ensures that the isolation mechanism supervised by the OS always remains operational.

## The OS ensures the inter-inviolability of software applications

The OS can decide the access rights of the USER world at any time.

The **MMU** used by the processor enables the software's addressable space to be delimited.

A software application can only write to the memory space corresponding to the scope of its data field. Any attempt **to write or read** in another space is immediately "trapped" by the controller, generating an exception. Thus the OS keeps a track of this incident for future use with remote diagnostics. The other software applications remain non-violated and operational. Furthermore, the software in question cannot even self-destruct, because its write access to code is denied.

### 1.2.4. Smart card readers

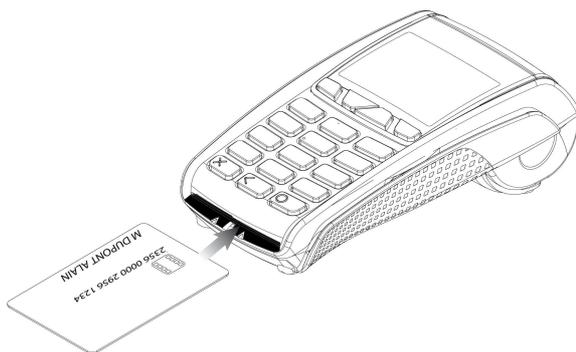
The ICT220 is equipped with:

- 1 main smart card reader named CAM1.

The card is always visible by the user.

- 2 positions for the SAM readers.

#### The CAM readers



- **Main reader CAM1:**  
Located on the front of the terminal, it allows easy introduction and removal of the card; leaving the card always visible to the user.

#### CAM reader features

- International standards ISO 7816.
- EMV Level 1 - 4.0.
- Smart cards and memory cards (asynchronous and synchronous).
- Cards accepted:
  - asynchronous cards to standard ISO 7816 and to EMV specifications
  - synchronous cards (possibility of specific drivers)
- Detection and protection against accidental removal.
- Specially designed ergonomic card introduction zone.

<b>Conformity with ISO standards</b>	– ISO 7816-1, 2, 3
<b>Protocol used</b>	– protocol T=0 & T=1
<b>Convention</b>	– Direct and inverse
<b>Clock frequency</b>	– 4.76 MHz
<b>Protection</b>	– Detection of short-circuit or over-consumption, VCC – Detection of accidental removal by interruption

<b>Power supply voltage Vcc</b>	– 5V, 3V & 1.8V
<b>Grip</b>	– 8 friction contacts (middle chip) – Contact for card presence and removal
<b>Number of operations</b>	– 100,000
<b>Synchronous cards</b>	– Separate logical outputs on contacts 4 and 8 – Possibility of specific drivers development on request.

Examples of usable cards:

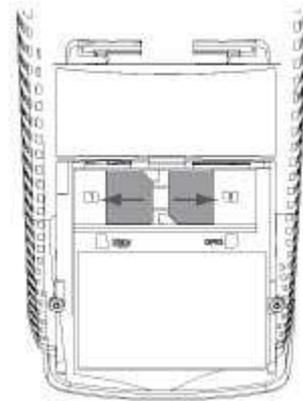
- asynchronous T=0
- asynchronous T=1
- synchronous :
  - GEM Plus: GPM 416/896 5V and compatible
  - GPM 256
  - GPM 271
  - GPM 2k (S10)
  - GPM 8k (S9)
  - GFM 2k (S8)
  - GFM 4k (S8)
  
  - SIEMENS: SLE 404
  - SLE 4418 (S9)
  - SLE 4428 (S9)
  - SLE 4432 (S10)
  - SLE 4436
  - SLE 4442 (S10)
  
  - ATMEL: AT88SC1003
  - etc...

Hardware and software base of the ICT220 is open and enables the development of other specific synchronous drivers.

### 1.2.5. SAM readers (Security Access Module)

2 SAM readers can accept cards in "microsim ID000" (minicard) format.

The SAMs readers are easy to access through two access flaps.

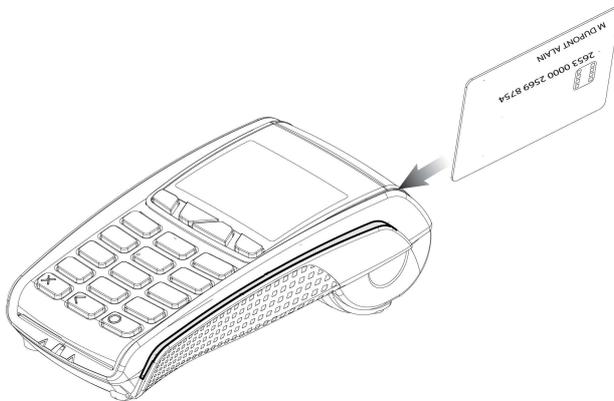


NOTE: Synchronous cards and SAM contacts C4 and C8 are not managed.

These cards are memory extensions and enable to increase the size of the files in the terminal.

### 1.2.6. Magnetic stripe card reader

The ICT220 is equipped with a swipe manual reader.



- Large acceptance range:
  - Slow swipes at 10 cm/sec ;
  - Fast swipes at 100 cm/ sec;
  - High and low coercivity swipe reader.

<b>Reader type</b>	- Manual
<b>Tracks read</b>	- Track: ISO2 - ISO1 – ISO3
<b>Card formats accepted</b>	- ISO 7810, 7811-1, 2, 3, 4 & ISO 7813
<b>Card swipe speed</b>	- 10 cm/s to 100 cm/s
<b>Reading error rate</b>	- < 0.5%
<b>Card slot</b>	- On the upper side of the ICT220
<b>Head lifespan</b>	- 300,000 swipes

### 1.2.7. Keypad – Navigation pad

- **Navigation pad**
  - 4 navigation keys for dropdown menus;
  - backlit.



- **keypad**
  - Numeric keys;
  - Keys with alphanumeric marking;
  - Key 5 and function keys with Braille bumps for visually handicapped;
  - White backlit.

<b>Keypad</b>	
<b>Number of keys</b>	- 19
<b>Type</b>	- Elastomer membrane
<b>Area</b>	- About 47 cm <sup>2</sup>
<b>Number of operations</b>	- 1 million
<b>Pressing force</b>	- about 250 g
<b>Key size</b>	- approx. 16,5 x 8,5 mm (width x height)
<b>Key pitch</b>	- approx. 20,5 x 13,5 mm (horizontal x vertical)
<b>backlit</b>	- By white LED
<b>Tactile effect</b>	- by metallic dome

## Alphanumeric input

The ICT220 enables the input of alphanumeric characters on its keypad. This input is made easier with the keypad's screen-printed alphabetic characters.

### 1.2.8. The display screen



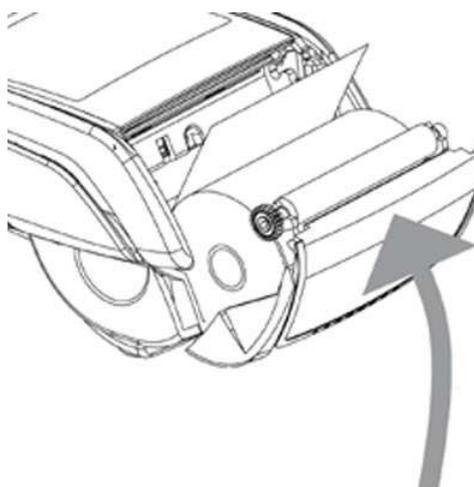
- Graphic monochrome 128 x 64 pixels
- Active zone: 59,5 x 33,1 mm
- White backlit
- FSTN technology

<b>Display</b>	128 x 64
<b>Type</b>	LCD
<b>Diagonal dimension</b>	2.7 inches
<b>Display area</b>	59,5 x 33,1 mm
<b>Number of pixels</b>	128 x 64
<b>Character size (exemple)</b>	
21 char/line*	6 x 8 pts      3,08 x 3,70 mm
16 char/line*	8 x 10 pts     4,12 x 4,63 mm
12 char/line*	10 x 12 pts    5,15 x 5,56 mm
<b>Technology</b>	FSTN
<b>Assembly</b>	Clipped on frame inside terminal
<b>Protection</b>	By PMMA window
<b>Screen</b>	Transflectif

\* The number of characters per line mentioned is for illustration, and it depends on the character font used.

### 1.2.9. Printer

Easy and fast paper loading



- Bar type thermal printer
- Silent
  - < 56 dB à 1 m.
- Fast:
  - 24 characters/line,
  - About 18 lines/second in alphanumeric print mode (standard receipt),
  - Fast paper-advance function: More than 40 mm/s.
- Graphics

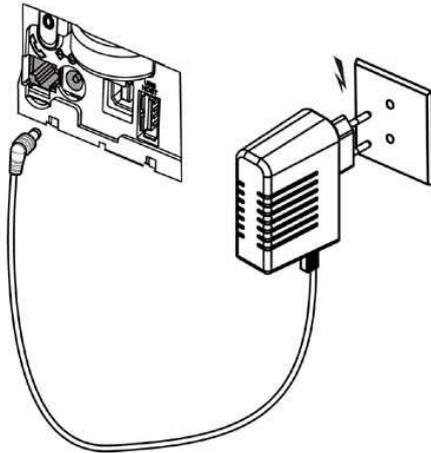
<b>Characters size</b>	– > 3 x 2 mm (H x l)
<b>Characters font</b>	– Software defined
<b>Number of characters/line</b>	– 24 in standard modes
<b>Printing attributes</b>	– Modes: condensed (48 characters/line), bold, double height, double width
<b>Printing colour</b>	– Black
<b>Paper loading</b>	– Easy paper loading system
<b>Paper presence detection</b>	– Optical sensor
<b>Graphic mode</b>	– Definition of graphic characters or LOGOS – 384 pixels/line
<b>Paper rolls:</b> Paper color Paper width Diameter Lenght	– White – 58 mm – 40 mm – about 18 m

### 1.2.10. Modem

- Modem V22, V22bis, V29 Fast connect, V32, **V32bis**, (respectively 1200, 2400, 9600, 14400 bauds);
- V34 available on option (might be in standard later on).
- Full duplex synchronous or asynchronous;
- Full software setting;
- AT compatible;
- Built in the terminal, communicates with PSTN;
- Galvanic isolation 2500 V / 1 min ;
- Responder, Initiator, busy line detection;
- Fast connect.

<b>Dialer</b>	<ul style="list-style-type: none"> <li>- Possible use of private exchanges</li> <li>- DTMF dial-up according to 4 software set levels</li> <li>- Pulsed dial-up</li> <li>- Checking of routing and tones</li> </ul>
<b>Electronic interface</b>	<ul style="list-style-type: none"> <li>- V29 Fast connect, <b>V32bis</b>, V32</li> <li>- V42, V42b, MNP4 &amp; MNP5</li> <li>- V22 b, V22 ( variant B), - Full duplex - asynchronous - synchronous</li> </ul>
<b>Framing</b>	<ul style="list-style-type: none"> <li>- Software set</li> </ul>
<b>Emission levels</b>	<ul style="list-style-type: none"> <li>- Software set</li> </ul>
<b>Reception levels</b>	<ul style="list-style-type: none"> <li>- Operation from 0 to -43 dBm; carrier loss from -43 to -48 dBm</li> </ul>
<b>Line quality</b>	<ul style="list-style-type: none"> <li>- Line error rate tolerated: from <math>10^{-3}</math> to <math>10^{-6}</math></li> </ul>
<b>Protection</b>	<ul style="list-style-type: none"> <li>- Line differential security: 250 V non-destructive</li> </ul>
	<ul style="list-style-type: none"> <li>- Galvanic isolation between line interface and modem: 2500 volts /1 min</li> </ul>
<b>Connectivity</b>	<ul style="list-style-type: none"> <li>- <b>Plug-in</b> cable, length 3 m, fitted with RJ11 at both ends.</li> <li>- Connection to network by RJ11 socket + adapter phone jack if necessary</li> </ul>
<b>Logic</b>	<ul style="list-style-type: none"> <li>- AT compatible command set</li> <li>- Setting of DTMF emission levels, data, Framing, etc.</li> <li>- Setting of adaptability to local network conditions</li> <li>- Setting of dial-up characteristics (intertrains, delays, etc.)</li> <li>- Setting using the keypad</li> </ul>

### 1.2.11. Power supply unit



- Wall-mount unit
- Standard, rectified regulated
- Meeting international safety standards

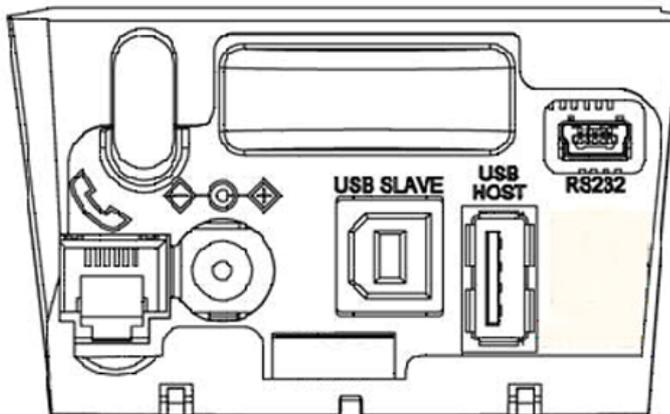
The power supply unit is adapted to the constraints and standards in force in the country of use.

The characteristics of the power supply unit for Europe (not UK) are:

<b>Input voltage</b>	- 230V - 50 Hz
<b>Output voltage</b>	- 8 V, 2 A
<b>Protection</b>	- Against surges : Thermal fuse placed on primary - Against conducted interference: integrated filter
<b>Standards</b>	- Europe: CE - USA: UL, CSA, CEC (in progress) - Australia: C-Tick
<b>Mechanical interface</b>	- Power supply jack with safety catch - Straight flexible cable - About 1,8 meters long between ICT220 and power supply, plug in on ICT220 side.
<b>Weight</b>	- 115 g
<b>Dimensions</b>	- approx 77 x 25 x 89 mm (L x w x h)

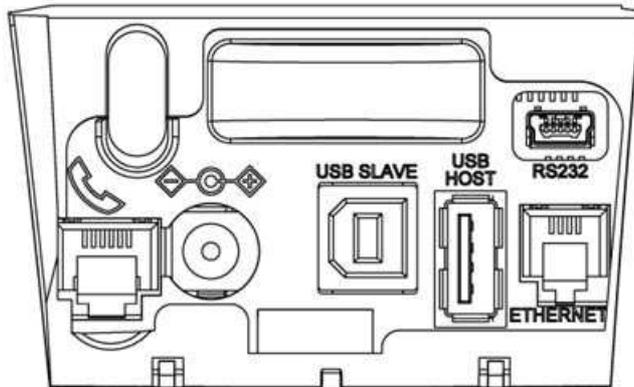
### 1.2.12. External links

Rs232 version



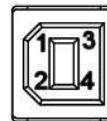
- Phone line Port
- USB slave (USB B - function)
- USB master (USB A - host)
- Conform to USB2.0 (full speed)
- Simplified RS232

## RS232 & Ethernet version

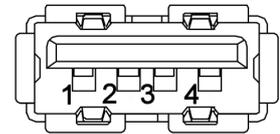


- Phone line Port
- USB slave (USB B - function)
- USB master (USB A - host)  
Conform to USB2.0 (full speed)
- Ethernet (for network)
- Simplified RS232

USB Slave	
Electronic interface	USB slave
Number of wires	1= 5V 2= D- 3= D+ 4= GND
Mechanical interface	USB type B jack
Logical interface	12 Mbps max
Connection examples	- Local downloading tool - Point of sale integration



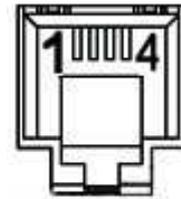
USB master	
Electronic interface	USB master
Number of wires	1= 5V regulated 250 mA (*) 2= D- 3= D+ 4= GND
Mechanical interface	USB type A jack
Logical interface	Low speed : 1,5 Mbps High speed : 12 Mbps
Connection examples	- Check reader equipped with USB - PP30S, P30 - Fingerprint sensor - Contactless target, external modem, ...



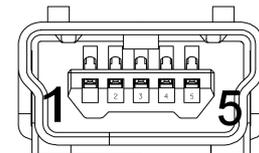
(\*) 250 mA max available on USB compatible with Pin-Pad P30 and PP30S.

USB conform USB2.0 (full speed)

Ethernet (according the terminal type)	
Electronical interface	IEEE 802.3
Number of wires	1 = RX- 2 = RX+ 3 = TX- 4 = TX+
Mecanical interface	Modular jack 4 points RJ11
Logical interface	Compatible 10Mbps and 100 Mbps
Connection examples	ADSL box, ...

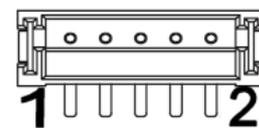


COMo (according the terminal type)	
Electronical interface	RS232 Simplified
Number of wires	RTS RX TX GND
Available power supply	5V *
Mecanical interface	mini-USB type B jack 1 = 5V (*) 2 = Tx 3 = Rx 4 = RTS 5 = GND
Logical interface	300 - 115 kbps Software set Framing
Connection examples	<ul style="list-style-type: none"> <li>- Local downloading tool</li> <li>- Cash register</li> <li>- Check reader</li> <li>- Computer</li> <li>- External modem</li> <li>- Converter box RS 485</li> </ul>



(\*) 250 mA max to share out between the two links (COM and USB master).

COM2 (according the terminal type)	
Electronical interface	RS232 Simplified
Number of wires	CTS DTR RX TX GND
Mechanical interface	Wire to board connectors 1 = Tx 2 = Rx 3 = DTR 4 = CTS 5 = GND
Logical interface	300 - 115 kbps
Connection examples	<ul style="list-style-type: none"> <li>- Cash register</li> <li>- Check reader</li> <li>- Computer</li> <li>- External modem</li> <li>- Converter box RS 485</li> </ul>



### 1.2.13. Buzzer

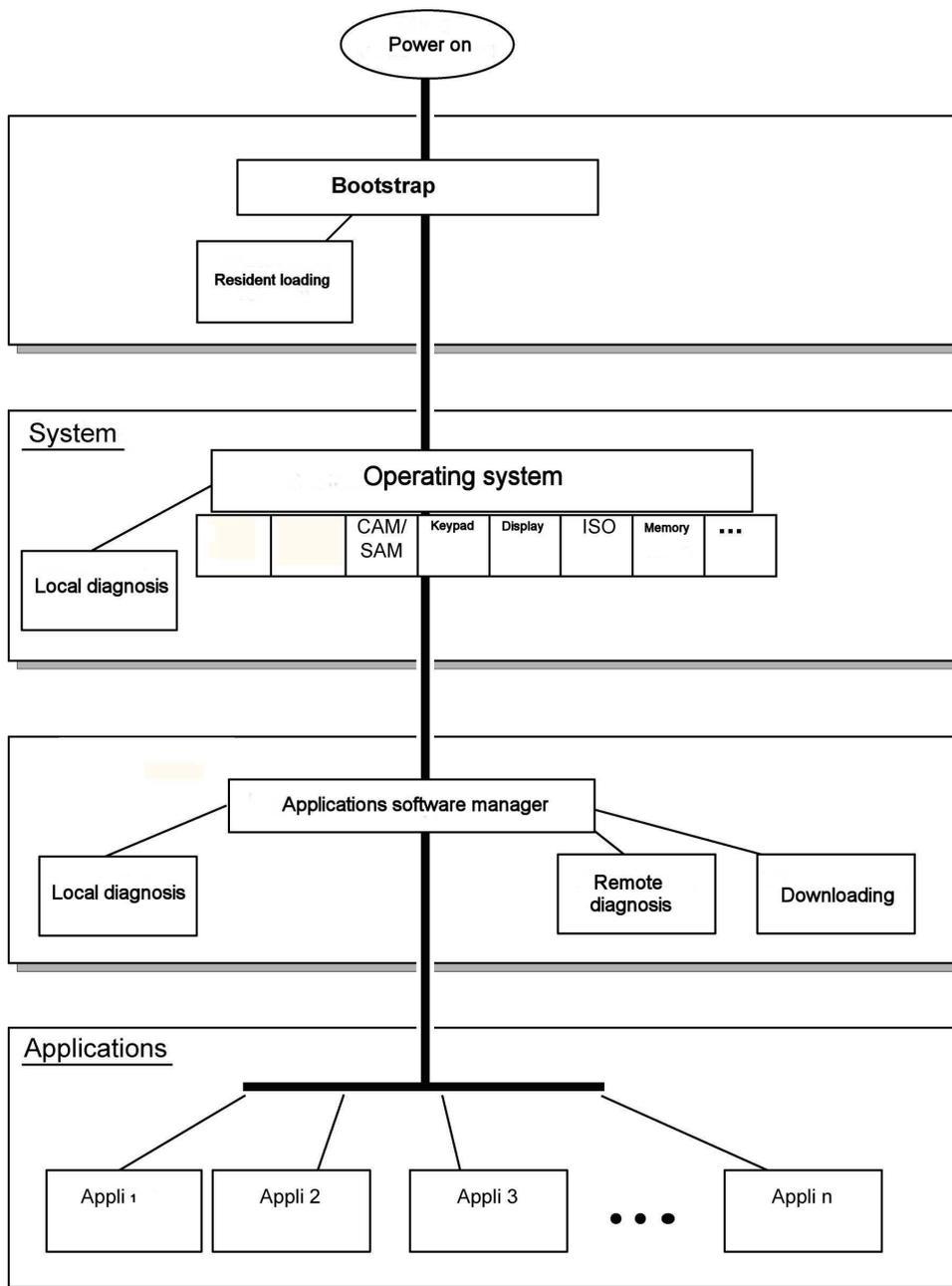
- Control by applications.
- Power greater than 55 dB to 1 meter.
- Frequency set by software.

## 2. Software

The terminal has a software architecture that supports several applications coexisting without mutual interference.

The OS is multitask, real-time and pre-emptive. The inputs/outputs are managed under interruptions. This means the peripherals can be processed simultaneously, and thus improves the terminal's performance. It can be downloaded to FLASH memory.

### 2.1. Software architecture



The software architecture is divided into three levels:

- System
- Multi-application manager
- Independent applications

The system manages access to all the terminal's peripherals. Access is completed via standard C primitives for all the input/output peripherals (keypad, printer, etc.) and via specific primitives for other peripherals (smart cards and magnetic stripe cards). Further, the system takes charge of memory management. It allocates memory space to the software applications and controls access.

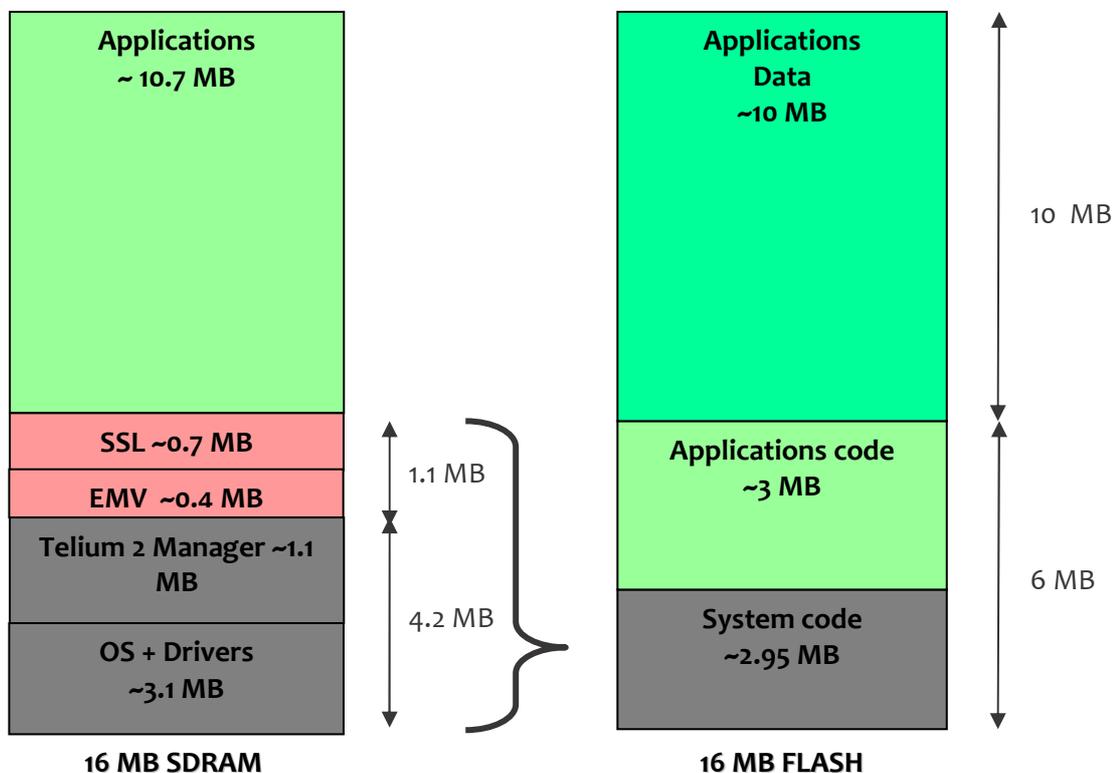
The multi-applications manager is the entity that calls on the various applications downloaded in the terminal in response to the various events that occur in the terminal.

The applications are modeled around the demands made by the multi-applications manager. Each request or input point represents a processing operation to be performed. Each application manages the execution of these processing operations according to its specifications. This standardization based on input points simplifies the implementation of the applications on terminals. The ICT220 provides natural access to the modularity concepts and improves the maintainability and quality of the applications.

## 2.2. Memory space allocation

This part describes the memory usage as it is known at the present moment, this is subject to change.

Exemple of a rough memory space allocation for a 16MB Flash + 16MB SDRAM configuration.



## 2.3. Software security management

---

The terminal is designed to execute authentic software only and to this in a ranked context.

The terminal performs the following checks

- During a software download, the terminal checks:
  - Its authenticity, by checking its signature with the RSA algorithm with RSA-2048 algorithm.
- Before running a software, the terminal checks:
  - Its presence by looking for the software's identity.
  - Its integrity by checking checksums and CRCs.

## 2.4. Operating system

---

### 2.4.1. Bootstrap

Bootstrap is resident.

The bootstrap very briefly takes control of the terminal following each powering up to perform the initialization and the self-test. Then it automatically runs the OS which in turn starts the applications manager.

Thus the Bootstrap provides the following functionalities:

- Memory and checksum self-test;
- Local download of the OS if absent;
- OS authenticity check and start-up.

### 2.4.2. Operating system (OS) characteristics

The OS is downloaded (locally or remotely) into the memory. It is upgradeable. After a few fractions of a second following powering up, it takes control. It checks the presence, integrity and authenticity of the system components and application present in the terminal.

The maintenance subsystem takes control in the following cases:

- if no authentic application is present;
- or if a manual action by the operator is made when powering up;
- or if it is activated by application.

The maintenance subsystem ensures, among other things, the downloading of the applications.

The OS ensures the start of the multitask core and then runs of the application by making a set of services available to them:

- **Multitask management:** Availability of a pre-emptive real-time environment, based on interruptions, events and mail boxes. This management enables simultaneous processing, which improves the terminal's performance.
- **Input/output management:** This is carried out under interruptions, generally in buffered mode. Thus, the applications developer enters a "conventional" C context.
- **System alarms management:** Certain incidents (e.g. swipe card reading error) detected by the OS are recorded. They can be used later by the maintenance subsystem during remote or local diagnostics.
- **Application alarms management:** A number of incidents detected by the applications can be saved by the OS at their request. This recording is used later as in the case of system alarms.
- **Application isolation management:** The OS provides the mechanisms described in the section on software isolation and memory protection. Between software isolation is managed by an **MMU** (Memory Management Unit).
- **Applications download management:** The OS offers the downloading services described in the section "Software download"

## 2.5. Manager

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The main functions offered by the manager are the following:

- Application management;
- Terminal initialisation;
- Terminal maintenance;
- Card recognition and routing to the application.

When EMV DC module is present, it selects the application:

- EMV applications (conform with EMV level 2);
- non EMV applications.

### 2.5.1. Terminal initialisation

#### 2.5.1.1. Operating requirements

To function, the terminal has to be equipped with its OS, the applications manager and at least one application. If one of the three components is missing, the terminal warns the operator who has to load it.

If no application is initialized, the applications manager displays a message asking for an application to be initialized.

If at least one application is initialized, the terminal is operational. The applications manager then awaits an event to poll the software applications loaded in the terminal.

### **2.5.1.2. Common parameters Initialisation**

The applications manager is used to initialize the common parameters:

Date, time, message display language, phone network configuration data, Pin-pad connection, local downloading of remote diagnostics.

### **2.5.2. Terminal maintenance**

The terminal has maintenance functions for:

- Properties;
- Local downloading;
- Diagnostics.

#### **2.5.2.1. Properties**

The properties function is used to print the following tickets:

- List of applications downloaded into the terminal: version number, checksum, etc. The applications manager prints this information for itself and for the operating system;
- Applications call time: remote collect, download, etc;
- Total number of transactions in each application file contained in the terminal.

### 2.5.2.2. Download

The downloading function uses the parameters downloaded during the initialization of the application manager.

The program update function is used to update the terminal by:

- Using a special local downloading tool connected to the terminal;
- Using a remote downloading tool;
- Using a USB key.

### 2.5.2.3. Diagnostics

The diagnostic is used for:

- **Local diagnostics**

saving consists of two groups of items:

- Incident counters: used for repetitive-type incidents, when only the number of occurrences is of use, e.g. the number of incorrect swipe readings.
- Exceptional events. The information content depends on the type of incident. Generally this is the date and time, and then information on the incident itself. These events are saved in a revolving file where the most recent are kept.

- **Remote diagnostics**

This allows the operator to make a call to the server to transfer information saved in the terminal. The server can thus enrich a database for ensuring efficient monitoring of equipment, propose preventive maintenance services, operating statistics, etc.

## 2.6. Software downloading

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### 2.6.1. Downloading

Software can be downloaded:

- Locally via the serial port (COM or USB).
- Remotely via
  - the switched telephone network (PSTN)
  - X25
  - Ethernet
  - TCP/IP network.
- By a USB key.

The techniques used:

- data compression;
- authenticity checking;
- memory allocation management, etc.

best optimize the downloading operations.

Hence savings in downloading time, use security, ease of upgrade, and number of software programs installed in the terminal.

### 2.6.2. LLT(Local Loading Tool)

The LLT is used for local software downloading.

The LLT is comprised of:

- PC running Windows XP/ 2000 / NT4, Vista;
- Ingenico downloading software;
- PC-terminal connection cable.

Local downloading is carried out:

- Using the PC with the LLT installed, on the USB slave port;
- Automatic switching to the local loader of the OS.

Possible connection by USB slave port: speed about 8 Mbps.

Selection of the software to download is guided on the PC screen using an Explorer-type windowing system (Windows Loader).

The downloading time of a 1Mo application is 4s by USB port.

### 2.6.3. Downloading by USB key

Downloading by USB key allows the downloading without any other tool.

Downloading time is equal to USB.

#### 2.6.4. TMS (Terminal Management Server)

See Chapter 3 **Terminal management system – TMS.**

#### 2.6.5. Downloading and managing memory allocation in the terminal

- Before the downloading, the system checks that the memory space is available.
- Software downloading (possibly compressed) is done into flash.
  - If software is deleted, the system frees the space.
  - If software is upgraded, the system downloads the new software, checks it and then deletes the old.
- The whole memory zone remains used and usable. No zone is reserved for upgrades.
- When the terminal starts up (power up or reset) the applications are decompressed and the code copied into RAM.

#### 2.6.6. Improved software downloading

Includes the following characteristics:

- Downloading via FTP TCP/IP and PPP for optimized downloading.  
V32b downloading performance is:
  - about 14.4 kbps on the original files.Once the connection has been made with the V32b modem, the downloading of a **120 Kb** application takes about **1 min.**
- Downloading can be done by IP via Ethernet on a SSL secured channel.
- Data compression according to algorithm based on the Lempel-Ziv method ensuring compression rates of about 40%.
- For downloading, only the improved application will be downloaded. In addition, the terminal manages this and not the remote server, which offers operating security during multiple sources downloading.
- Recall management in case of communication breakdown. This service enables an interrupted downloading to be resumed at the same place where it had lost connection and only to downloading the unfinished part.
- The downloaded software is executed securely, using the authenticity check.

#### 2.6.7. Starting the downloading

The downloading can be made from:

- **Manually:** The applications manager at the merchant request Launch a downloading. This is especially the case of a program update or the addition of new software into the terminal's memory. In this case the procedure is simplified to the maximum.

Thus, the user starts the call **from the applications manager** by choosing the upgrade function from the dialogue menus and keys. Dial-up and connection to the server are automatic.

- For an upgrade, the user has nothing to enter.
  - For a new software request, the user is guided on screen to make the choice. The business's ID is not requested. The ID saved in the terminal is automatically transmitted to the server.
- 
- **Through management application:** The application at the request of the centre or the merchant. In this case, the downloading is fully automatic. The downloading ticket lets the business know.
  - **Call Scheduling:** terminal can be set to call at schedule date and time to regularly check of the content is up to date.

## 2.7. Development workstation

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### Introduction

The software is written in high level C language in a multi-applications environment. Ingenico makes available all the software and equipment required for development. This includes the documentation. Also, training sessions are offered.

### Required configuration

The development workstation executes on a Pentium PC running under Windows 2000/XP/Vista.

Integrated environment (Eclipse) takes care of the software development phases:

- Project creation,
- edition,
- compilation/edition of links under GNU,
- signature,
- downloading,
- simulation,
- remote debugger.

### Supply

The development workstation comprises:

- M<sup>2</sup>OS software licence which includes:
  - Operating system,
  - Applications software manager,
  - Libraries,
  - Related documentation in PDF files.
- User licence of SST (Software Signature Tool);
- User licence of LLT (Local Loading Tool);
- RSA Card and smart card reader for signing applications software.

### Related services

- Technical support

Lasts 6 months following the training.

It includes access to the hot-line, and to the updates of the documentation and software during this period.

- Software terminal package

Software packages are available allowing easy development for applications (EMV level 2, ...)

## 3. Terminal management system - TMS

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### 3.1. Introduction

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Ingenico developed its own Terminal Estate Management System called IngEstate. It is a link between an organisation with an estate of payment terminals and their merchants. It allows users to remotely manage payment terminals, modify their software content and interact with merchants.

### 3.2. Basic functions

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The basic functions are:

- be able to locally download software on a terminal using a direct cable link (usually RS232);
- be able to remotely download software on a particular terminal using modems and IP connections;
- be able to remotely download applications and configuration updates to a large estate of terminals;
- be able to upload terminal configurations and check software status;
- be able to inform merchants when terminals are out of use during maintenance periods.

### 3.3. Advanced functions

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The advanced functions are extremely various, with new ones being requested frequently:

- draw statistics and reports about terminal configurations;
- optimise automatic call scheduling/download balancing for large estates of terminals;
- be able to display written messages on the terminal, using the display or the printer;
- be able to easily configure a complete terminal (i.e. several applications) and to download it in one operation;
- be able to analyse the status of terminal software and do only delta downloads (i.e. only the parts that are damaged or need updates);
- be able to download to either a PIN Pad or a terminal when connected;
- Customise the system easily;
- Integrate with systems such as SAP easily;
- ... and many others.

### 3.4. Customers savings with Ingenico TMS solution

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The most obvious cost saving is not having to send a technician to service the terminal at the merchant location. Many other costs savings are derived from the ability to have a “clean” estate; better diagnostics and remote software repairs mean less shipping of replacement terminals, less downtime, less mail and phone communication costs, more efficient update campaigns, etc.

## 4. Services

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<b>Training</b>	<ul style="list-style-type: none"><li>- Installation and exploitation</li><li>- Softwares</li><li>- OEMC/M<sup>2</sup>OS development ( days)</li><li>- EMV Level 2 package (2 days)</li><li>- Development workstation SDK</li></ul>
<b>Support</b>	<ul style="list-style-type: none"><li>- Hot-line support</li><li>- Technical assistance</li></ul>
<b>After-Sales Service</b>	<ul style="list-style-type: none"><li>- Fixed cost repair of ICT220</li></ul>
<b>Downloading server centre</b>	<ul style="list-style-type: none"><li>- User licence</li><li>- Installation and commissioning</li><li>- User training</li><li>- Hot-line support</li><li>- Technical assistance</li></ul>
<b>Softwares / Licences</b>	<ul style="list-style-type: none"><li>- User licence for local loading tool, LLT</li><li>- User licence for applications software</li><li>- User licence for M<sup>2</sup>OS</li><li>- Licence for software signature tool, SST</li><li>- Licence for "EMV Level 2 package "</li><li>- Licence for TCP/IP</li><li>- .....</li></ul>

## 5. Standards

ICT220 complies with:

- European standards on personal safety (EN 60950);
- European standards on the disturbance produced by equipment and immunity characteristics;
- Standard concerning microcircuit cards reader.

### Immunity characteristics

Tests of immunity to:	Standards
electrostatic discharges	IEC 61000-4-2 (1995+A1/1998+A2/2000)
radio-frequency electromagnetic fields	IEC 61000-4-3 (2002 + A1/2002)
electrical fast transients/bursts	IEC 61000-4-4 (2004)
surges	IEC 61000-4-5 (2005)
radio disturbances	IEC 61000-4-6 (2003+A1/2004+A2/2006)
Magnetic fields	IEC 61000-4-8 (1993+A1/2000)
voltage dips, short interruptions and voltage variations	IEC 61000-4-11 (2004)

### Disturbance produced by the equipment

	Standards	Details
Conducted disturbance	EN 55022 éd. 1998 / A1-2000 / A2-2003	Class B
Radiated disturbance	EN 55022 éd. 1998 / A1-2000 / A2-2003	Class B
Limits for harmonic current emissions	EN 61000-3-2 (2000+A2/2005)	
Limitation of voltage fluctuations and flicker	EN 61000-3-3 (1994+A1/2001)	

### Operating condition

	Standards	Details
Temperature		+5°C to +45°C
Max relative humidity (no condensation)		85%HR at +40°C

### Storage condition

	Standards	Details
Temperature		-20°C to +55°C
Max relative humidity (no condensation)		85%HR at +55°C

## 6. Documentation

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Description	Contents
Technical instructions	Detailed description of the ICT220
Description of the software workshop	Introduction to the software development workshop
Description of the Server	Introduction to the downloading server
Software catalogue	Descriptive list of the available software
Software use guide	Using the standard functions of the software described
Loading instructions	Method of loading and downloading software into the terminal
Reference instructions of the applications software manager	Detailed description of the applications software manager functions
Software reference instructions	Detailed description of all the functions, messages, and tickets of the software described

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