ROLLCOMM
WORLDWIDE

ROLLCOMM 19 TERMINAL

Revision 1

EVERYTHING...

1. Introduction to the ROLLCOMM 19 Terminal

The ROLLCOMM Terminal is a cutting-edge embedded microcomputer equipped with a versatile set of interfaces. It is capable of maintaining several connections at the same time, while performing different tasks with them. Due to it's embedded nature, the most appropriate task for it is to gather information from various sources, and forward it on another connection. It is capable of running several applications at the same time, so various services can be ran on one Terminal.

The Terminal is based on a customized version of embedded Linux. As a result of this, it is POSIX-compliant, so it comforms to industrial standards. The legendary stability and security of Linux is conserved. Applications running on the Terminal benefit from all modern technologies, like multithreading and distributed computing. However, due to the ARM architecture, the size of the binaries is much smaller than on a desktop PC, resulting in faster application starting, and more space for data. Power consumption is also lower with orders of magnitude than a desktop PC's or laptop's.

2. Networking

The ROLLCOMM Terminal is well equipped with interfaces. Physically it has a 100 MBit Ethernet port (RJ45), a CompactFlash slot, an RS232 serial port, a Digital I/O port, and a USB port. Since the operating system has a modular kernel, it is possible to plug various devices into these ports, e.g. a WiFi network card into the Compact Flash slot, or a USB pendrive into the USB slot. When a Terminal is operating as a ROLLPAY Terminal, these features are disabled due to security reasons.
The Terminal also has a kernel-level built-in firewall. The Linux kernel by itself has a powerful set of routing options, and this together with this firewall makes the Terminal a uniquely secure and flexible network element.

3. Configuring

There are three ways of configuration: an easy, an intermediate, and a hard way. The easy way is using the ROLLCONTROLL utility, which lets administrators safely configure not only the Terminal, but also the running ROLLCOMM products. It is a client-server based 3-tier solution, where the Terminals connect to a ROLLCOMM server on one interface, a ROLLCOM user interface connects the same server on another interface, and selects the Terminal to be configured. This is a safe way of configuring, since the ROLLCONTROLL server won't allow modifications that risk the operability of the Terminal. It also includes configuration support for ROLLCOMM products, e.g. uploading new content.
The intermediate way is only for experts on Linux and networking, with special rights. It is a web interface that is part of the Terminal software suite, and allows an administrator to configure various aspects of the Terminal's behavior, including network settings, Bluetooth settings, and such. While it is a powerful tool to set up a terminal, it has two major disadvantages: it is not aware of ROLLCOMM products, so those can't be configured, and it does not perform any checks on the new settings, so it is possible to misconfigure a Terminal. Such misconfiguration is not fatal, but it takes a Terminal expert to restore the correct settings.

The hard way is only for Terminal experts. It involves the fact that the Terminal is running a special flavor of Linux, and thus an expert can log into it via network or via the RS232 interface. This is a very poor interface with a command prompt, where basic commands can be issued, and configuration files and kernel-level services can be edited. This interface is not only capable of destroying the entire contents of a Terminal, but is also completely unaware of any consequence of a command, so it literally does anything it is asked for. While in certain rare cases this can be very useful, it is highly unrecommended for everyday use, and should only be done by trusted experts of the field.

4. Running applications

The Terminal is able to run more applications simultaneously. These applications are pre-installed on the Terminal, depending on the customer's needs. The only limits for applications are the amount of available RAM and storage. Due to the POSIX architecture and the Linux kernel, an application can have multiple threads, so it can perform multiple tasks. The ROLLCOMM applications are designed to cooperatively share the resources, so any number of ROLLCOMM products can be ran on a single Terminal.

The ROLLCOMM Terminal comes with a preinstalled set of applications chosen by the customer. Applications can be deployed later too. This lets customers begin with a smaller set of products, and as needs rise, deploy further products later. This is a truly unique possibility to build and enhance a ROLLCOMM Terminal network.

5. Appendix: Technical Overview

5.1 Device Features Overview

- Enables Bluetooth networking between multiple devices and networks
- Serves up to 19 simultaneous Bluetooth connections
- Offers an open platform for adding local applications
- Acts as a transparent router or bridge

Supports all key communication standards:

- Bluetooth
- Ethernet
- Wi-Fi, GSM/GPRS/EDGE via external CF card
- USB, RS232 and GPIO

- Incorporates packet filtering firewall
- All relevant Bluetooth profiles and API's supported
- 100 meter range / Software configurable for support 10 meter range
- DHCP Support for plug-and-play installation
- Uncompromised security: SSH, Firewall and 128 bit Bluetooth encryption
- Unicode support for a true multi-lingual environment
- Multiple applications running simultaneously
- Database of several known Bluetooth devices
- Simple and secure mounting accessory available
- Bluetooth 2.0+EDR, CE and FCC certified
- Size: 130x80x35mm
- Weight: 450g
- Operation temperature: 0 to +55°C
- 32 MB SDRAM
- 32 MB Flash
- Atmel AT91RM9200-CI 180MHz CPU
- 4 x Led
- 1 x Power Led
- Compact Flash slot
- Buzzer
- Real time clock

- CPU: Atmel AT91RM9200-CI is the main processing unit.
- Data flash: Data flash (Atmel AT45DB642 or compatible) is used as non-volatile memory for operating system and applications.
- SDRAM: SDRAM (Samsung K4M563233E-EN1H000 or compatible) is used as RAM memory for operating system and applications.
- RTC: Real-Time Clock (RST M41T94MQ6).
- Bluetooth #1 (#2, #3 and #4)
  ROLLCOMM Terminal 19 has three Bluetooth radio modules. Fourth slot is unoccupied.

5.2 Electrical Characteristics

Rating	Min	Max
Storage temperature	0 °C	+550 °C
Supply voltage: VDC	9V	24V
Input current (at 12VDC)	90mA	400mA

5.3 Bluetooth Radio Characteristics

Common physical layer specifications.
The common physical layer specifications are shown in the table below.

Item	Specification
Operating Frequency	2400 MHz to 2483.5 MHz (ISM-Band)
Carrier Spacing	1.0 MHz
Channels	79
Duplexing	TDD
Symbol Rate	1-3 Mbps
TX Modulation Polarity	Binary one: Positive frequency deviation

General specifications.

The general specifications are show in the table below.

Item	Specification
Supply Voltage	3.3 V ± 0.1 V regulated voltage. (Noise < 10 mVP-P)or 5-9V unregulated voltage
Supply Current	Maximum current in TX mode: 170 mA Maximum current in RX mode: 170 mA
Frequency Range	2400 MHz … 2483.5 MHz (ISM-Band)
Guard Band	2 MHz < F < 3.5 MHz (Europe, Japan, USA)
Carrier Frequency	2402 MHz … 2480 MHz, F = 2402 + k MHz, k = 0 … 78
Modulation Method	GFSK (1 Mbps), π/4 DQPSK (2Mbps) and 8DQPSK (3Mbps)
Hopping	1600 hops/s, 1 MHz channel space
Maximum Data Rate	GFSK: Asynchronous, 723.2 kbps / 57.6 kbps Synchronous: 433.9 kbps / 433.9 kbps π/4 DQPSK: Asynchronous, 1448.5 kbps / 115.2 kbps Synchronous: 869.7 kbps / 869.7 kbps 8DQPSK: Asynchronous, 2178.1 kbps / 177.2 kbps Synchronous: 1306.9 kbps / 1306.9 kbps
Receiving Signal Range	-82 to -20 dBm (Typical)
Receiver IF Frequency	1.5 MHz (Center Frequency)
Transmission Power	Minimum: -11 ... -9 dBm ; Maximum: +14 ... +18 dBm
RF Input Inpedance	50 Ω
Baseband Crystal	16 MHz
Input / Output Interfaces	6 GPIO, PCM, SPI, UART, USB
Operation Temperature	273K … 328K. (-40°C … +85°C)
Storage Temperature	233K … 358K (-40°C … +85°C)
Compliance	Bluetooth specification, version 2.0+EDR
USB Specification	USB specification, version 1.1

Software

Supported Protocols

Media	Protocols
Internet protocols	IP, PPP, TCP, UDP, ICMP, HTTP, FTP, SSH, DHCP
Bluetooth protocols	SDP, L2CAP, RFCOMM, HCI, LMP, BNEP

Supported Bluetooth profiles

Bluetooth profile	Abbreviation
File Transfer Profile	FTP
Generic Access Profile	GAP
LAN Access Profile	LAP
Object Push Profile	OPP
Personal Area Networking Profile	PAN
Serial Port Profile	SPP

5.4 Physical Interfaces

UART Interface

- Sipex SP3238E Intelligent RS232 Transceiver or compatible
- Sipex SP3243EUCA Intelligent RS232 Transceiver or compatible
- UART Connector AMP 747840-4 or similar

USB Host

- USB Host Protection Circuit ST USB6B1RL or compatible
- USB Connector Framatome FCI 73725-0110B or compatible

Ethernet Transceiver

- Davicom DM9161E or compatible
- Ethernet connector Pulse J1012F21K or compatible

Compact Flash

- Connector Molex 1.27 CF card reader low profile 67155-0002 or compatible

Digital I/O

- Framatome NK-connector, 16 pin male straight or compatible

Power Input

- Power DC-jack 2.0mm SMT KLD-SMT2-0202-A-TR or compatible

5.5 Bluetooth technical specification

The Bluetooth system operates in the license-free 2.4 GHz ISM (Industrial Science Medial) band using frequency hopping spread spectrum (FHSS). In the vast majority of countries around the world this frequency band is 2400 - 2483.5 MHz. Some countries have, however, national limitations on the frequency range. In order to comply with these national limitations, special frequency hopping algorithms have been specified for these countries. It should be noted that products implementing the reduced frequency band will not work with products implementing the full band. Products implementing the reduced frequency band must therefore be considered local versions.

The Bluetooth frequency band is divided into distinct channels with 1 MHz channel spacing. In order to comply with out-of-band regulations in each country, a guard band is used at the lower and upper band edge. The frequency range is 2.400 - 2483.5 MHz, and the corresponding channels are f = 2402 + k MHz; k = 0 - 78. Transmission utilizes channel hopping over the specified range at 1600 kHz hop frequency. When operating in countries that permit the use of only a subset of the overall spectrum, transmission utilizes only the approved portions of the spectrum. The Bluetooth system utilizes Gaussian frequency shift keying (GFSK). The signaling rate is 1 Mbit/s.

The Bluetooth system transceivers are classified into three power classes to support different link ranges.

- **Power Class 1.**
  Output power is 1-100 mW (0-20 dBm) with mandatory power control ranging from 4 to 20 dBm.

- **Power Class 2.**
  Output power is 0.25 - 2.5 mW (-6 - +4 dBm) with optional power control.

- **Power Class 3.**
  Output power is less than 1 mW (0 dBm) with optional power control.

Rollcom terminal supports a 100 meter link range with Option 1 (Power Class 1).

The radio frequency signal propagates in free space as a spherical wave, from a point source to all directions equally. In reality, the actual signal source always differs from a theoretic isotropic signal source. The power distribution of wireless telecommunication equipment in space is determined by the antenna radiation pattern. In free space the signal propagates with the speed of light and attenuates with 1/r2 relation. In reality, the environment always differs from free space. The propagation environment of wireless telecommunication equipment is restricted by all obstacles.
The basic mechanism of radio propagation is attributed to reflection, diffraction, and scattering depending on existing obstacles. Since the radio frequency signal propagates omnidirectionally, the transmitted signal arrives at the receiver following multiple paths deformed by the aforementioned propagation mechanisms.

The received signal is the superposition of attenuated and delayed replicas of the transmitted signal, leading to fading of the transmitted signal and broadening of the duration of the transmitted pulse. The transmitted pulse delay spread leads to inter-symbol interference (ISI) because the subsequent symbols interfere with each other. The ISI leads to a bit error probability (BIT) floor that is independent of the signal to noise ratio (SNR). Depending on the time delay spread of the transmitted pulse or the amount of widening that the transmitted pulse experiences across the radio channel, the multipath interference differs. When the time delay spread of the transmitted signal is very small with respect to the signaling time, the multipath interference essentially leads to the signal fading phenomena of the received signal. When the time delay spread of the transmitted signal is high with respect to the signaling time, the multipath interference leads to the symbol interference phenomena of the received signal as well.

A major difference between indoor and outdoor environments is that the former is considerably more sensitive to changes in the geometry of the environment than the latter. This is because of the differences in distance between obstacles. For example, a door being shut rather than open may have a major impact on an indoor environment whereas a comparable event in an outdoor environment may have a minor impact.

The Bluetooth standard has been designed to operate in noisy radio frequency environments. Transmission utilizes fast frequency hopping and short packages to make the link efficient and robust. Fast hopping and short packages limit the impact of interfering devices on the same frequency band.

EVERYWHERE

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