DATA SHEET

mifare® & I•CODE

CL RM701

Contactless Reader module

Product Specification

July 2004

Revision 3.0

Public

Philips Semiconductors

PHILIPS

MIFARE® & I•Code Contactless Reader module CL RM701

CONTENTS

1 GENERAL INFORMATION

1.1 Scope

This document describes the functionality of the CL RM701 reader module. It includes the functional and electrical specifications and gives the needed details to use this reader module as a reference design. This reader module is designed for an easy adaptation of a contactless reader to a PC and it is ready to design a new application giving the basic hints for a reader hardware development.

1.2 General Description

The CL RM701 contactless reader module is part of the CL RD701, the MIFARE® Pegoda reader. It uses the CL RC632 reader IC for the contactless communication. The CL RC632 is member of a new family for highly integrated reader ICs for contactless communication at 13.56 MHz.

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1.3 Features

- contactless smart card reader module
- based on the CL RC632
- contactless operating frequency 13.56 MHz
- Supports MIFARE® Dual Interface Card ICs and ISO 14443A part 1- 4
- Supports ISO 14443B
- Supports MIFARE® Classic crypto
- Supports ISO 15693
- Supports Philips ICODE®
- Typical operating distance: 75 - 100mm
- CE and FCC compliant
- USB host interface
- USB bus powered 5 VDC power supply
- Unique serial number of each reader device
- Supported by Windows 98 OSR2, Windows ME, Windows 2000 and Windows XP.

1.4 Ordering Information

This module is part of the CL RD 701 reader.

2 FUNCTIONAL UNITS

The CL RM701 is part of the CL RD701 Pegoda reader. Therefore the functional units for the PEGODA reader is described below.

2.1 CL RD701 Pegoda Block Diagram

The CL RD701 Pegoda reader is a complete reader based on the CL RM701. The reader itself is divided in two parts:

- CL RM701: reader module. This reader module is the basic print including the CL RC632, a µ-Controller and all interfaces to a host.
- MF AN700: a flexible Pegoda antenna. This antenna is described in the application note: *MIFARE® MF RM700 Antenna and matching adapter description*

Figure 1shows the CL RD701 Pegoda's basic functional components.

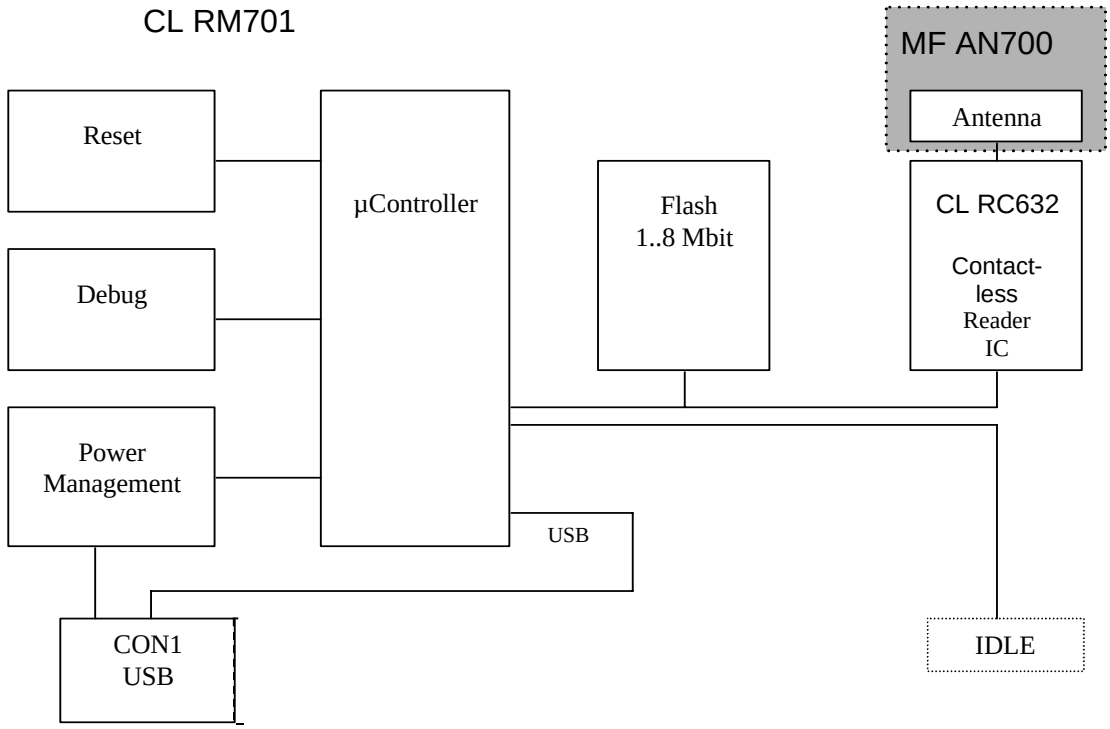

Figure 1. CL RM701 Block-Diagram

The Pegoda reader is designed to offer the user a great freedom to design an application. Several functional blocks can be identified.
Core component of the Pegoda is the CL RC632, the highly integrated ISO 14443AB, ISO 15693 reader IC. For detailed information concerning the CL RC632 please refer to the data sheet: '*MIFARE CL RC632 Highly integrated ISO 14443 reader IC'*.
The CL RC632 is used as an analog front-end unit to communicate via the antenna to a contactless chip card. All relevant data coding to send and receive data according to the ISO 14443AB and ISO 15693 is done internally by the CL RC632. The CL RC632 itself is controlled by a µ-controller.
The µ-controller handles the communication to the host PC via USB. The µ-Controller translates the serial protocol via USB into remote function calls and executes the appropriate command. To be able to implement the complete MIFARE Classic protocol, the ISO 14443-4 open protocol commands as well as ISO 15693 and to handle the host communication a 1.8 Mbit Flash Ram is implemented.
Furthermore, a reset and a power management circuit and several ports are provided for debug purposes.

2.2 CL RM701 Host Interfaces

The default configuration for the Pegoda reader offers an USB interface to the host.
Table 2-1 defines possible interface connection types with the CL RM701 the reader PCB for the Pegoda.

Interface Type	CL RD701 Pegoda reader	CL RM701 reader module
USB Type B plug	yes	yes

Table 2-1. Interface types

2.2.1 USB TYPE B PLUG

The USB type B plug is the default configuration of the Pegoda reader to connect the reader to a host PC.

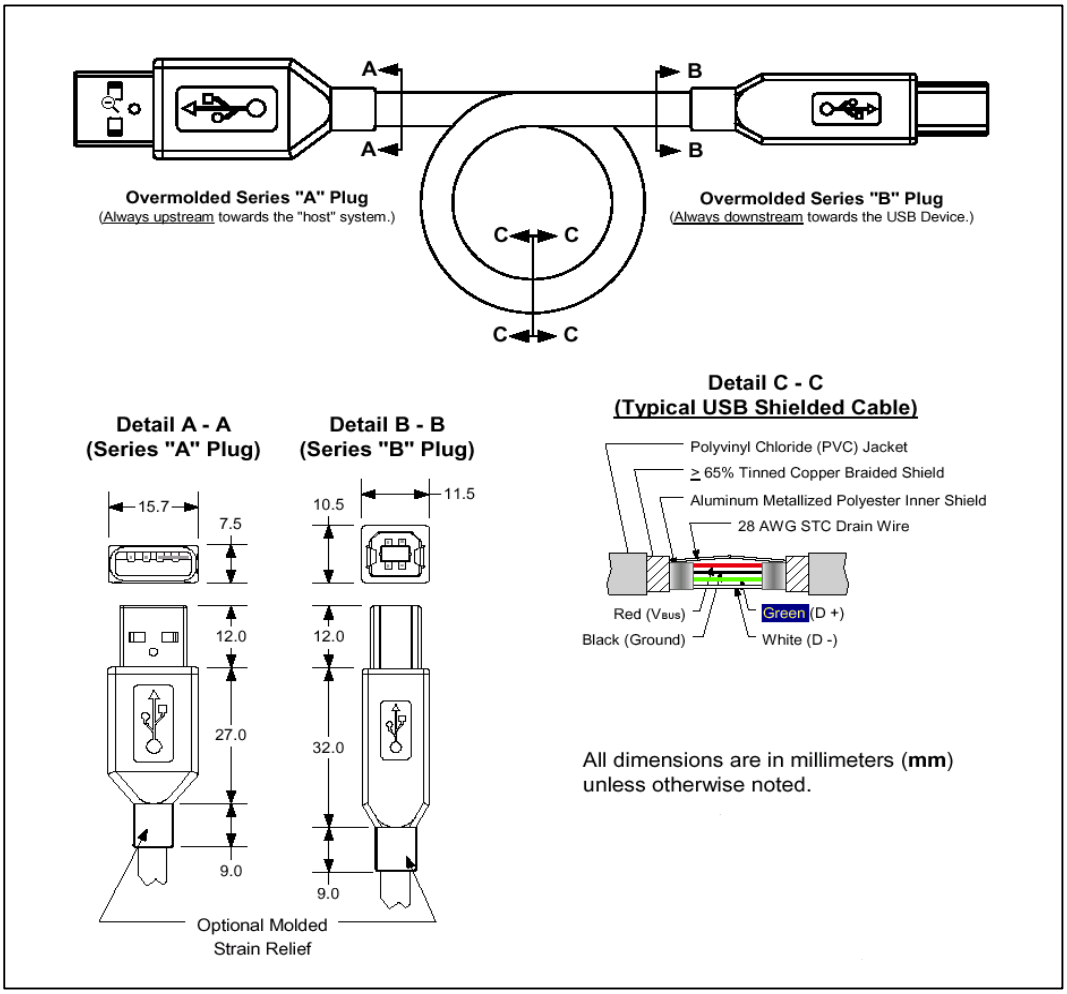

Figure 2. USB Type B connectors

The default configuration uses the USB cable to communicate to the Pegoda as well as to supply the 5 V supply voltage.

2.2.2 POWER SUPPLY

The controller board supports various power supply sources, which have to provide a regulated 5V DC voltage. Figure 4 shows the possible power supply on the CL RM701.
In the default configuration, the Pegoda reader is a USB bus powered reader. No external power supply has to be connected to start to work with the Pegoda.

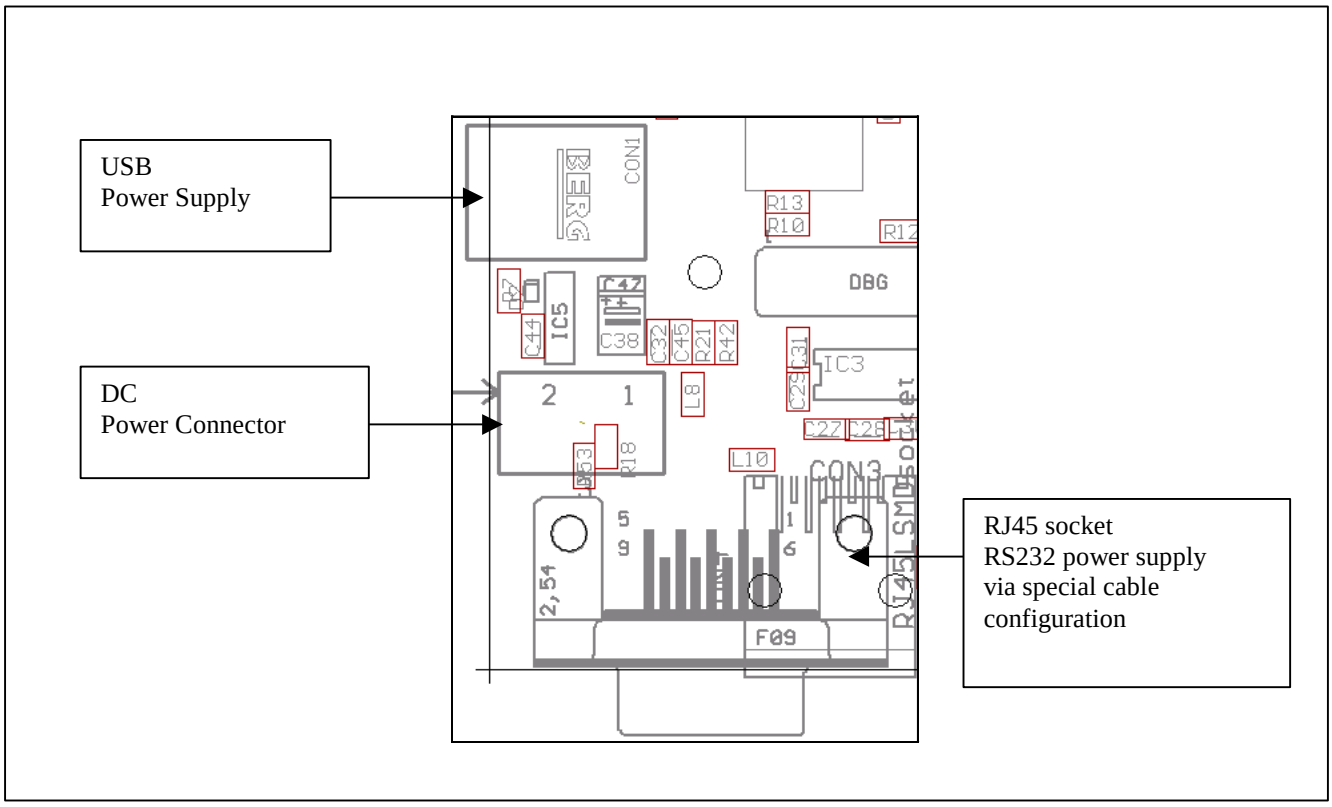

Figure 3. Interface and power supply

Notes:

In order to fulfil the USB specification version 1.1, the reader module behaves after power on like a low power device. Having sent an activate command, the Pegoda is activated and the reader module switches to an idle state resulting in an increased power consumption.

Only 1 power source has to be connected to the board.

2.2.3 BOOT JUMPER AND SERIAL I/O

The Pegoda reader offers a boot jumper to enable a firmware update several serial I/O pins to fulfil different user and application specific requirements. Figure 4 shows the location of the boot jumper and the serial I/O pins.

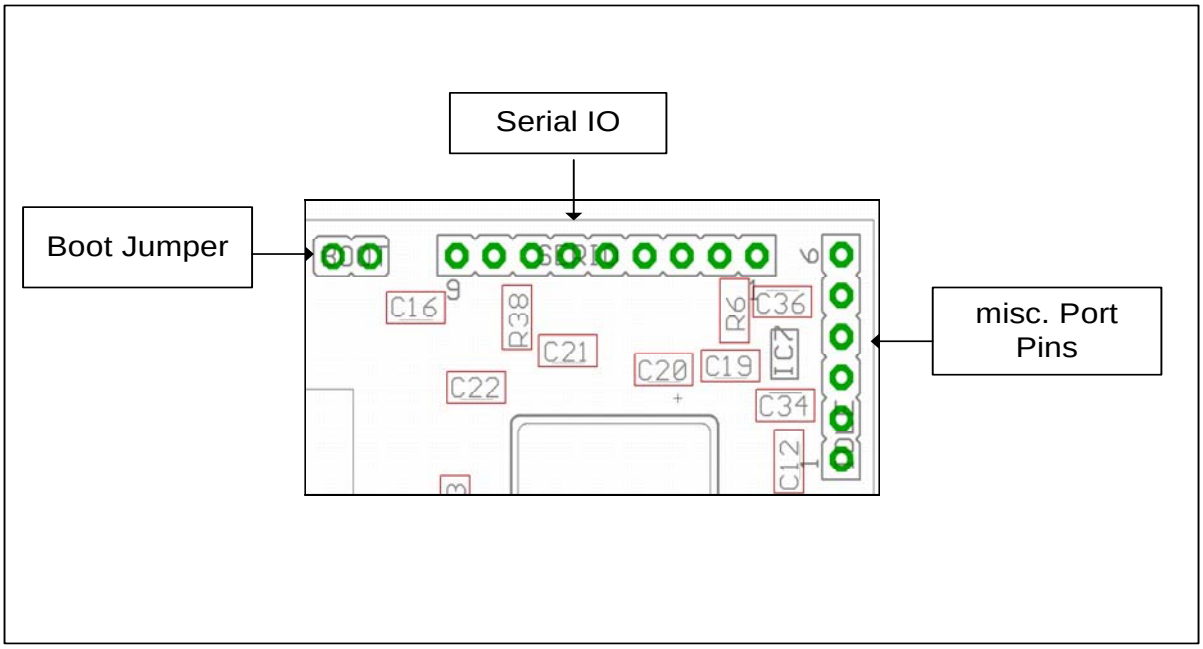

Figure 4. Boot jumper and I/O pins location

2.2.3.1 Boot Jumper

Setting the boot jumper before the board is connected to the power supply, the µ-controller enables the internal bootstrap mechanism. This might be used to download new firmware via the serial interface without additional hardware changes. For detailed description of the µ-controller please refer to the controller's data sheet.

2.2.3.2 Serial I/O

The serial I/O pins allow the user to monitor additional controller lines to fulfil application-related requirements. Table 2-2 describes the I/O pins.

Pin No.	**Description**
1	+ 3.3 V regulated; Controller power supply
2	RxD; asynchronous receive pin; TTL level
3	TxD; asynchronous transmit pin; TTL level
4	DSR; data set ready; asynchronous serial handshake pin; TTL level; synchronous serial Master-Receive/Slave-Transmit
5	DTR; data terminal ready; asynchronous serial hand shake pin; TTL level
6	GND
7	port 3.9; synchronous serial Master-Transmit/Slave-Receive
8	port 3.13; synchronous serial Master-Clock-Out/Slave-Clock-In
9	reset out; microcontroller reset out pin

Table 2-2. I/O pin description

2.2.3.3 Miscellaneous Port Pins

In addition to the I/O pins several miscellaneous port pins can be used to monitor and control the µ-controllers behaviour. Table 2-3 describes the miscellaneous port pins.

Pin No.	**Description**
1	+ 3.3 V regulated; Controller power supply
2	port 6.2; Chip Select Line 2;
3	port 2.1; fast external interrupt line 2
4	port 6.3; Chip Select Line 3;
5	Reset In; microcontroller reset in; negative logic
6	GND

Table 2-3. Miscellaneous port pins

3 CL RM701 PCB DESCRIPTION

The following parts describe the CL RM701 schematic, the part list and the layout of the PCB completely in order to give the user the possibility to take the Pegoda reader as a reference design for an own reader development.

3.1 Schematic

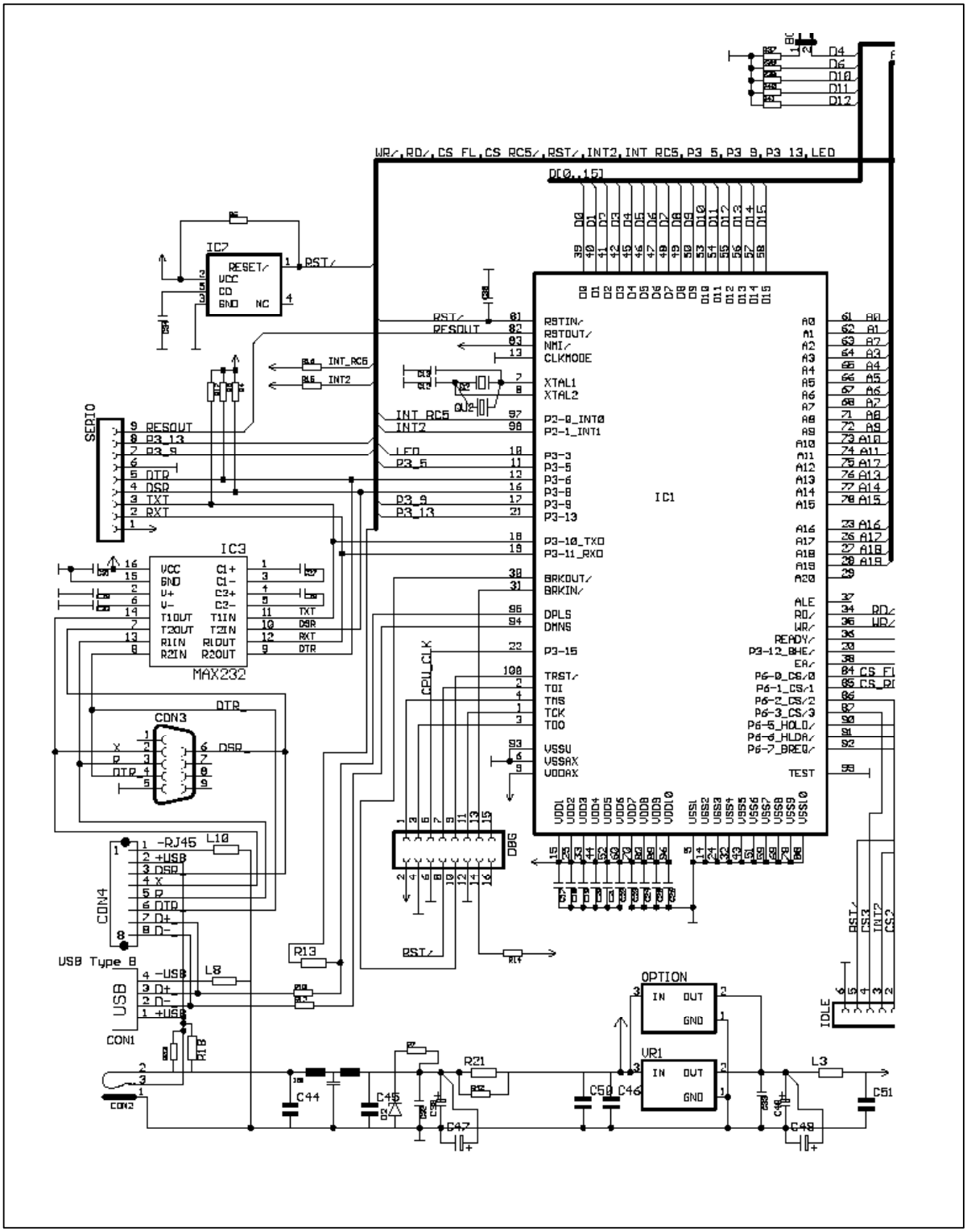

Figure 5. CL RM701 Schematic

The schematic is cut at the right edge. The following page shows right part.

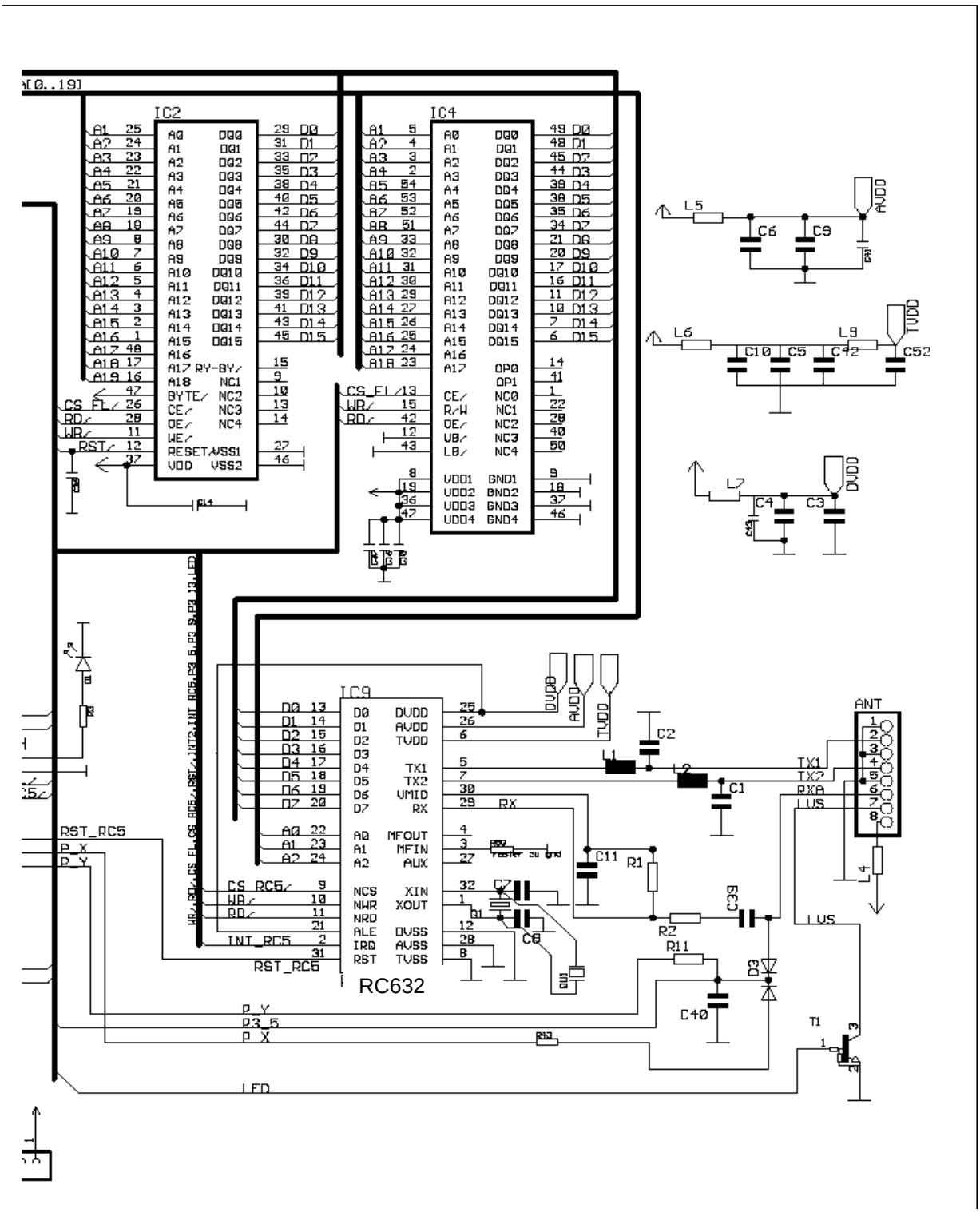

Figure 6. CL RM701 schematic (continued)

3.2 Part List

The part list gives a complete overview about the used components. If no supplier or order number is given these parts are standard components.

Parts are subject to multi-sourcing and can be replaced with equivalent part without notice.

Qty	Part	Value	Package	Remarks	CL RM 701
1	PCB	72x72		scratched edges	X
1	ANT	PHD1x8	1X08	single pin row	X
1	BOOT	PHD1x2	JP1	bootstrap jumper	X
2	C1, C2	68p	C0805	NPO, 2 %	X
2	C3, C6	100p	C0805	NP0, 5 %	X
2	C4, C5	10n	C0805	X7R	X
2	C7, C8	33p	C0805	NPO, 5 %	X
1	C9	10n	C0805	X7R	X
1	C10	100p	C0805	NP0, 5 %	X
1	C11	100n	C0805	NPO, 10 %	X
1	C12	47p	C0805	NPO, 5 %	X
17	C14, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C41, C42, C43, C44, C45	100n	C0805	X7R	X
7	C15, C27, C28, C29, C30, C37, C46	100n	C0805	X7R	n.a.
1	C31	4n7	C0805	X7R	X
2	C32, C33	2u2	C0805	ceramic decoupling capacitance 6,3 V 10 %	X
1	C34	220n	C0805	X7R	X
4	C35, C36, C50, C51	10n	C0805	X7R	X
2	C38, C48	33u10V	TANTAL-D	Tantal	X
1	C39	1n	C0805	NPO, 10 %	X
1	C40	22n	C0805	NPO, 5 %	n.a.
2	C47, C49	option	ES-2,5	optional to part C38, C48	X

Qty	Part	Value	Package	Remarks	CL RM 701
1	C52	10p	C0805	NP0, 5 %	X
1	CON1	USB Type B	RWD61729	USB, Type B, socket	X
1	CON2	DC PWR socket	HOHLB02	DC power socket, outer diam. 5,5 mm inner diam. 2,5 mm	n.a.
1	CON3	DB9 socket	F09H	9 pol. DSub Socket	n.a.
1	CON4	RJ45LSMD socket	555764-1	RJ45 Connector for RS232, Power, USB	n.a.
1	D1	TOP-LED	PLCC2	SMD LED green, PLCC2 package	X
1	D2	5,6	DIO-MINI	BZV55C 5,6 V SOD-80, MINIMELF	X
1	D3	DKKSOT23	SOT23C	Schottky Diode 30 V SOT23 BAT64-05	n.a.
1	DBG	PHD2x8	FE08-2		n.a.
1	IC1	C161U_M	TQFP-100	SAB-C161U-LF V1.3	X
1	IC2	AM29F800B	TSOP48	(A)M29F400B	X
1	IC3	MAX232	SO16	MAX232ECSE	n.a.
1	IC4	TC554161	TSOPII54	SRAM TC554161AFT-V	n.a.
1	IC5	DSS30655Y5S102M100	EMI	EMI filter	X
1	IC7	MC33465N-27atr	SOT-23-5	Reset IC MC33465N-27atr	X
1	IC9	RC632	SO-32L	CL RC 632	X
1	IDLE	PHD1x6	FE06		n.a.
2	L1, L2	1u	L_NL322	NL322522T-1R0J, 5%	X
2	L3, L4	470nH			X
3	L5, L6, L7	0		Substitute Resistor 0R	X
2	L8, L10	100nH			X
1	L9	22nH			X
1	OPTION	option	TO220V	optional equipment for part VR1	X

Qty	Part	Value	Package	Remarks	CL RM 701
1	Q1	13.56MHz	HC49U-V	SMD-Quarz, HC 49 US SMD, 13,56 MHz SMD or through hole contacts	X
1	QU1	option	HC49U-V	optional for part Q1	X
1	Q2	8MHz	SD3	SMD-Quarz, HC 49 US SMD, 8MHz, SMD or through hole contacts	X
1	QU2	option	SD3	optional for part Q2	X
1	R1	820	R0805	NP0, 1 %	X
1	R2	560	R0805	NP0, 1 %	X
1	R3	470	R0805	5 %	X
12	R4, R5, R6, R14, R15, R16, R17, R37, R38, R39, R40, R41	10k	R0805	5 %	X
1	R7	82	R0805	5 %	X
2	R10, R12	27	R0805	1 %	X
1	R11	11k	R0805	2 %	n.a.
1	R13	1k5	R0805	5 %	X
5	R18, R21, R42, R50, R53	0	R0805		X
1	R43	820	R0805	1 %	n.a.
2	S1, S2	Screw		2.5x7 mm tin screw	X
2	S1I, S2I	Isolate		screw isolation foil	X
1	SERIO	PHD1x9	FE09		n.a.
1	T1	BCR108	SOT-23	switching transistor	X
1	VR1	LT1086_SMD	DDPAK	voltage regulator 3.3 V SMD (LT1086CM-3.3) or through hole contacts (LT1086CT-3.3)	X

Table 3-1. Part List CL RM701

3.3 Layout

The CL RM701 is designed using a 4 layer PCB. The following figures show the component placements and all layers in a single shot.

3.3.1 PLACEMENT

Figure 7 shows the complete component placement of the CL RM701.

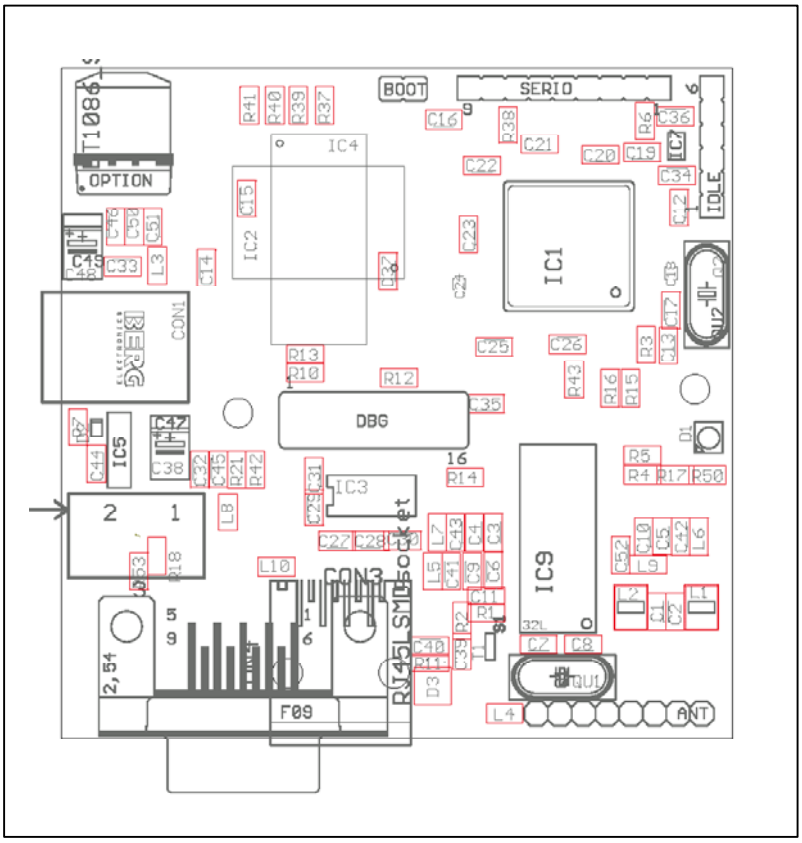

Figure 7. CL RM701 Placement

3.3.2 TOP LAYER

Figure 8 shows the top layer of he CL RM701.

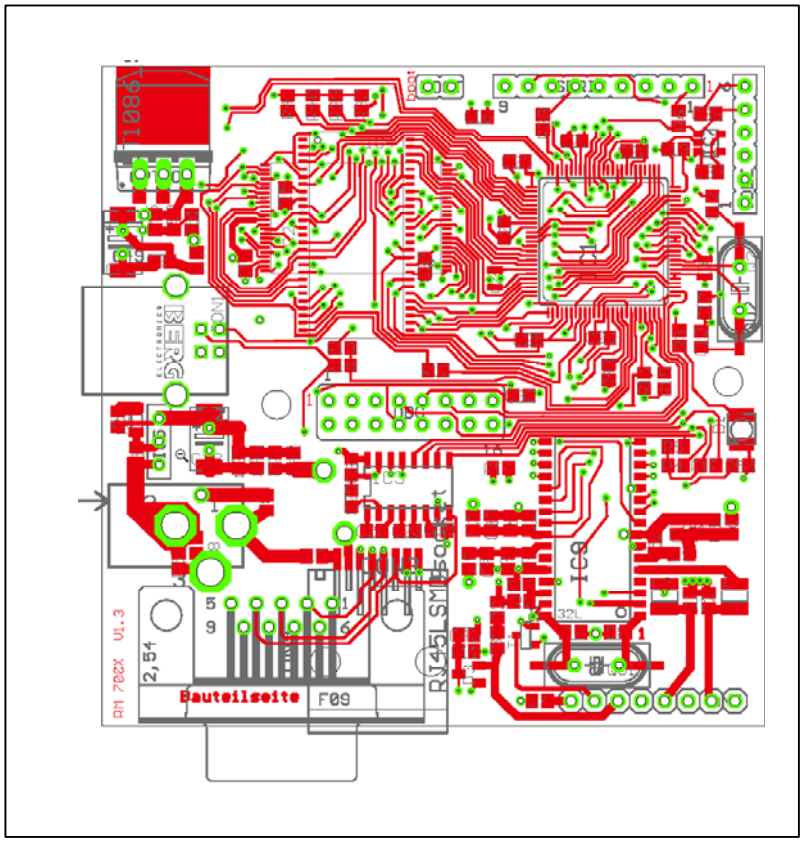

Figure 8. CL RM701 Top Layer

3.3.3 SUPPLY LAYER

Figure 9 shows the supply layer of he CL RM701.

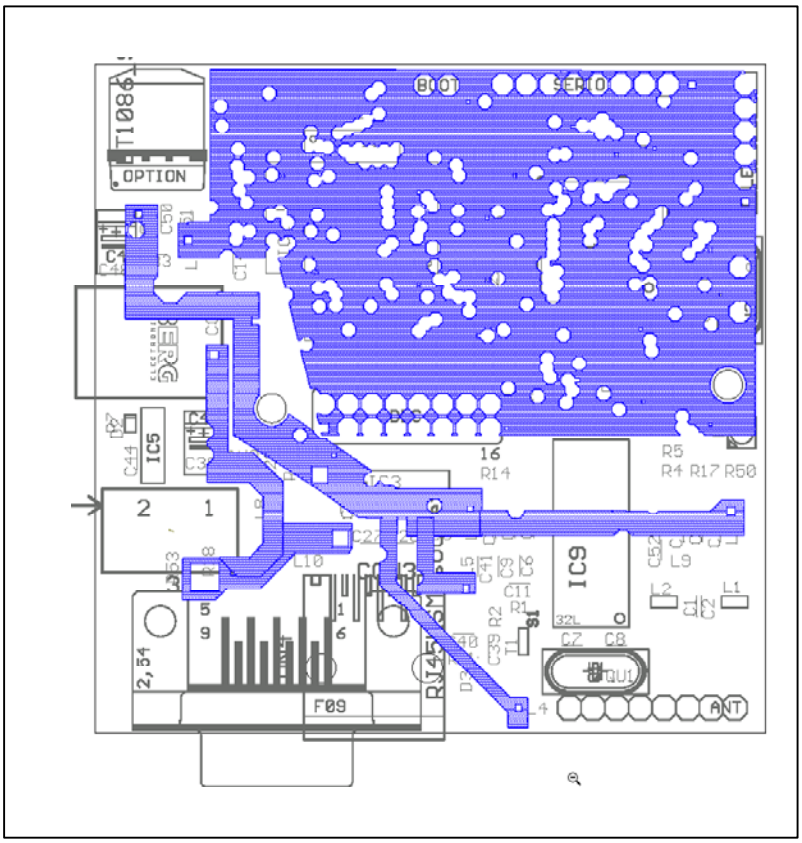

Figure 9. CL RM701 Supply Layer

3.3.4 GROUND LAYER

Figure 10 shows the ground layer of he CL RM701.

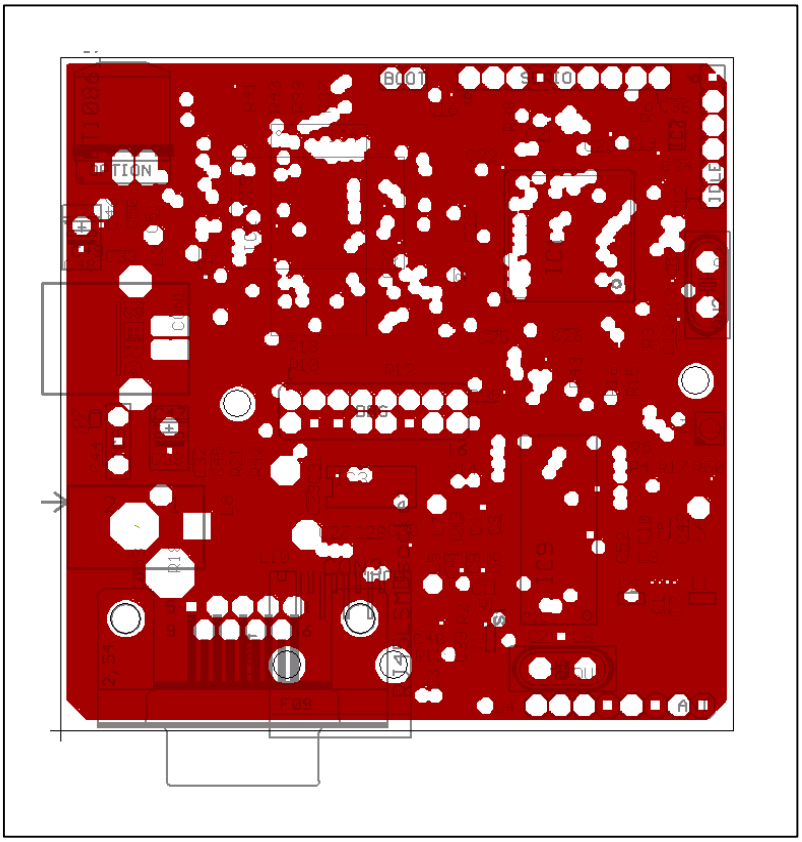

Figure 10. CL RM701 Ground Layer

3.3.5 BOTTOM LAYER

Figure 11 shows the bottom layer of he CL RM701.

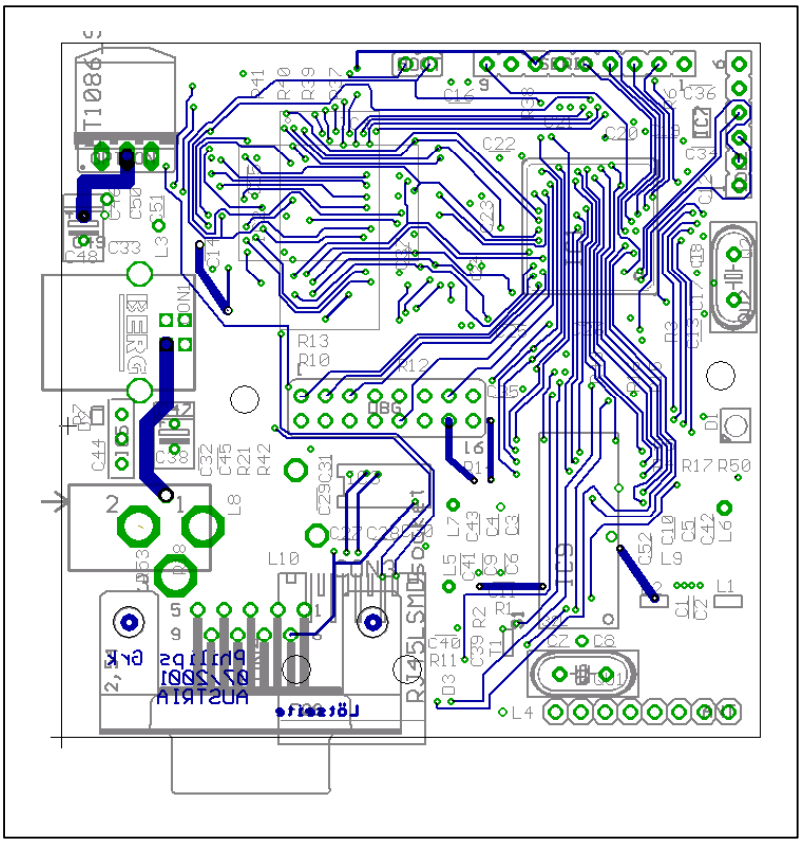

Figure 11. CL RM701 Bottom Layer

3.3.6 TOP & BOTTOM LAYER

Figure 12 shows the top and bottom layer of the CL RM701.

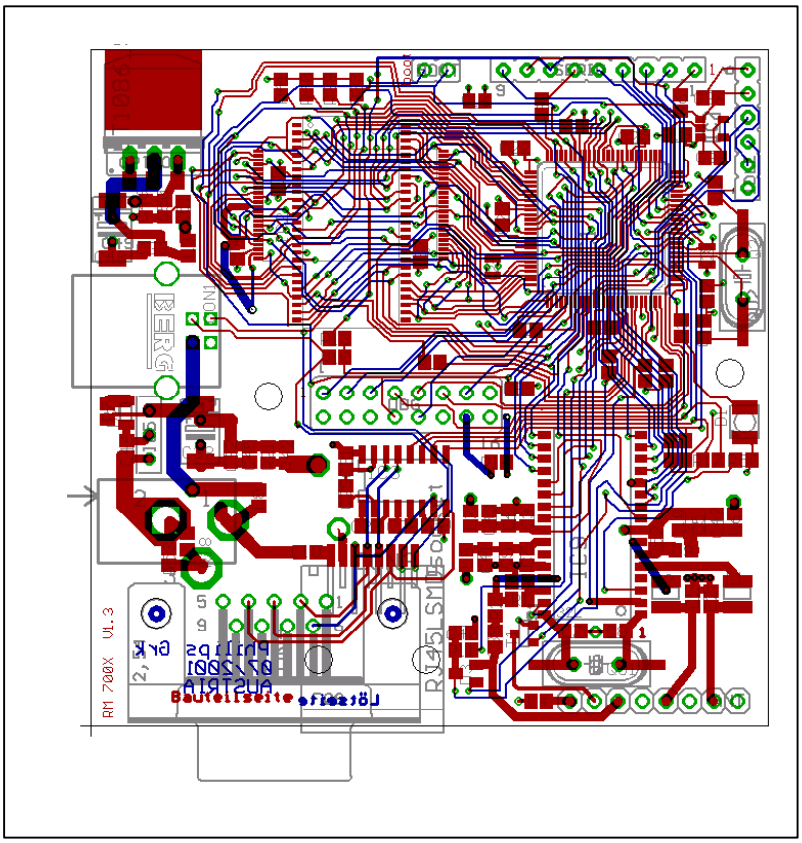

Figure 12. CL RM701 Top and Bottom view

4 ELECTRICAL CHARACTERISTICS

4.1 Operating Condition Range

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
T_{amb}	Ambient Temperature	-	-10	+25	+70	°C
VDD	DC Supply Voltage	DVSS = 0V	4.5	5.0	5.5	V

Table 4-1: Operating Condition Range

4.2 Current Consumption

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
I_{DVDD}	Supply Current	StandBy	-	70	-	mA
		Idle, RF off	-	160	-	mA
		Idle, RF on	-	250	-	mA

Table 4-2: Current Consumption

4.3 Operating distance

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
OD	operating distance	Used antenna : MF AN 700, measured from the middle of the reader surface	-	75	-	mm

Table 4-3. Operating Distance

4.4 Interface Characteristics

4.4.1 USB-CHARCTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
USB-baud	USB- baudrate	cable length max. 3 m	-	12	-	Mbaud

Table 4-4. USB Characteristics

4.5 Electromagnetic Compatibility

The CL RM701 is a reader module and this module does not fulfil any FCC or CE certifications.

The CL RM701 reader module is part of CL RD701. This reader fulfils the following requirements of electromagnetic compatibility:

FCC, Part 15 and CE.

For detailed information, refer to the data sheet

CL RD701 MIFARE® Pegoda Contactless Smart Card Reader.

5 REVISION HISTORY

REVISION	DATE	CPCN	PAGE	DESCRIPTION
3.0	July 2004	-	-	Product Version
2.0	April 2004	-	-	first published version

Table 5-1: Document Revision History

Definitions

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics section of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

Life support applications

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so on their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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