USER MANUAL

mifare®

Demonstration System MF EV500

Description of the Hardware

May 1997

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Philips
Semiconductors

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Contents

1 Scope

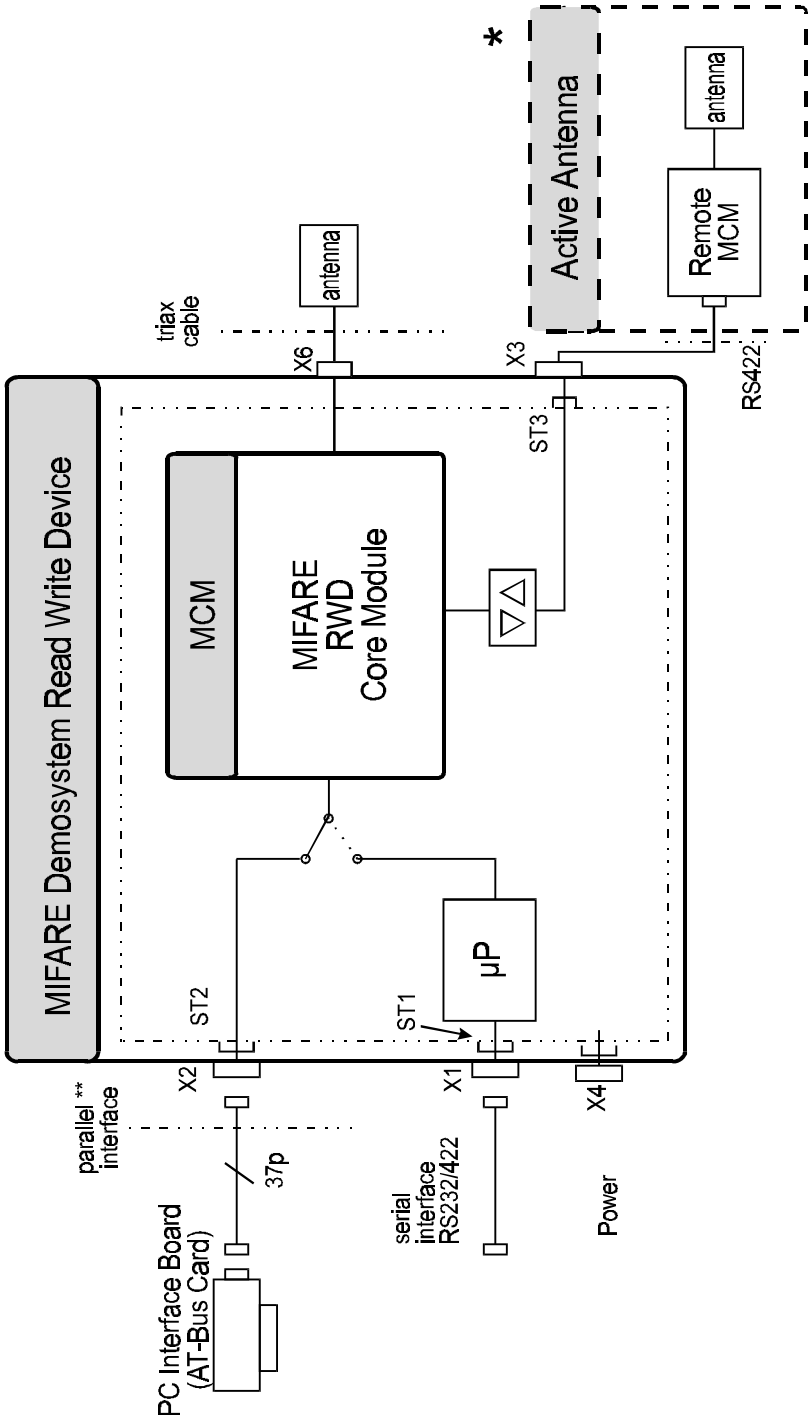
In this document the hardware and the serial system of the MIFARE Demonstration System is described.
For the parallel system please refer to ‘MIFARE - Hardware Independent Low Level Functions’.
For the serial commands please refer to ‘MIFARE Serial Reader - Specification of the Software Requirements’.
The picture on the next page shows the different options for the interface configuration.

Because of CE regulations **the parallel interface** connector of the Demonstration System is covered and may only be used for service purposes

1.1 Definition of Terms

LL-function	Low Level function, the smallest units of the software used for controlling the MIFARE Card
LLL	Low Level Library, the set of LL-functions
OSI	Open System Interconnections
CRC	Cyclic Redundancy Check
RWD	Read Write Device
Host	Any computer with a serial interface for controlling the RWD
PCB	Printed Circuit Board
BCC	Block Check Character
XOR	Logical Exclusive Or
RAM	Random Access Memory
MCM	MIFARE Core Module
MMM	MIFARE Micro Module
MSR	MIFARE Serial Reader

mifare® Demonstration System



*) Remote MCM, passive antenna and the appropriate interface cable are available as option to the Demonstration System.

**) The parallel interface is covered when sold in Europe and may be used for service purposes only

2 HW-Description

In this chapter the digital hardware of the MIFARE Demonstration System is described. This includes the description of the connectors, the description of the jumpers on the PCB and the serial test modes of the system.

2.1 Description of the Connectors

2.1.1 Serial Connector, ST1 at main PCB and X1 at RWD

For the RWD a 9 pin D-SUB male connector is used.
The serial system can be installed as RS232 or RS422. It interfaces via the microcontroller with the MCM. The data transfer works with 115200 baud, 1 start bit, 1stop bit, no parity bit (115200,n,8,1).

RS232:

Pin	Function
2	RX
3	TX
5	GND

RS422:

Pin	Function
1	TX+
2	TX-
3	RX-
4	RX+

The terms shown in the tables above correspond to the definitions in the demonstration system. TX- at the reference system has to be connected with RX- at the host (RS422), and RX at the demonstration system has to be connected with TX at the host (RS232).

2.1.2 Parallel Connector, ST2 at main PCB and X2 at RWD[1]

For the RWD a 37 pin D-SUB male connector is used.
The parallel interface is logically the direct interface to the MCM. In terms of processing time this is the most efficient way to communicate with the card.

[1] the parallel interface is covered when sold in Europe and may be used for service purposes only

Pin	Function	Pin	Function	Pin	Function
1	+5V	8	A3	15	D4
2	+12V	9	A2	16	D3
3	INT	10	A1	17	D2
4	NWR	11	A0	18	D1
5	NRD	12	D7	19	D0
6	NCS/CS	13	D6	20 ... 37	GND
7	ALE	14	D5		

The maximum cable length of the parallel system is 30cm.

2.1.3 Active Antenna, ST3 at main PCB and X3 at RWD

For the RWD a 9 pin D-SUB female connector is used.
With this connector an active antenna can be installed. The driver is a fast RS422 component. The maximum cable length of the active antenna is 100m. It depends on the RS422 drivers and the behaviour of the cable.

active antenna:

Pin	Function
1	NPAUSE+
2	NPAUSE-
5	MOD1
6	KOMP1+
7	KOMP1-
8	VDD
9	GND

MOD1 is only used for a direct access to the card for test purposes (without RF-System).

2.1.4 Power female cinch, X4 at RWD

The external power supply is only necessary if the demonstration system is controlled by the serial interface.

inner conductor	VDD: 12V
shielding conductor	GND

2.1.5 Antenna, X6 at RWD

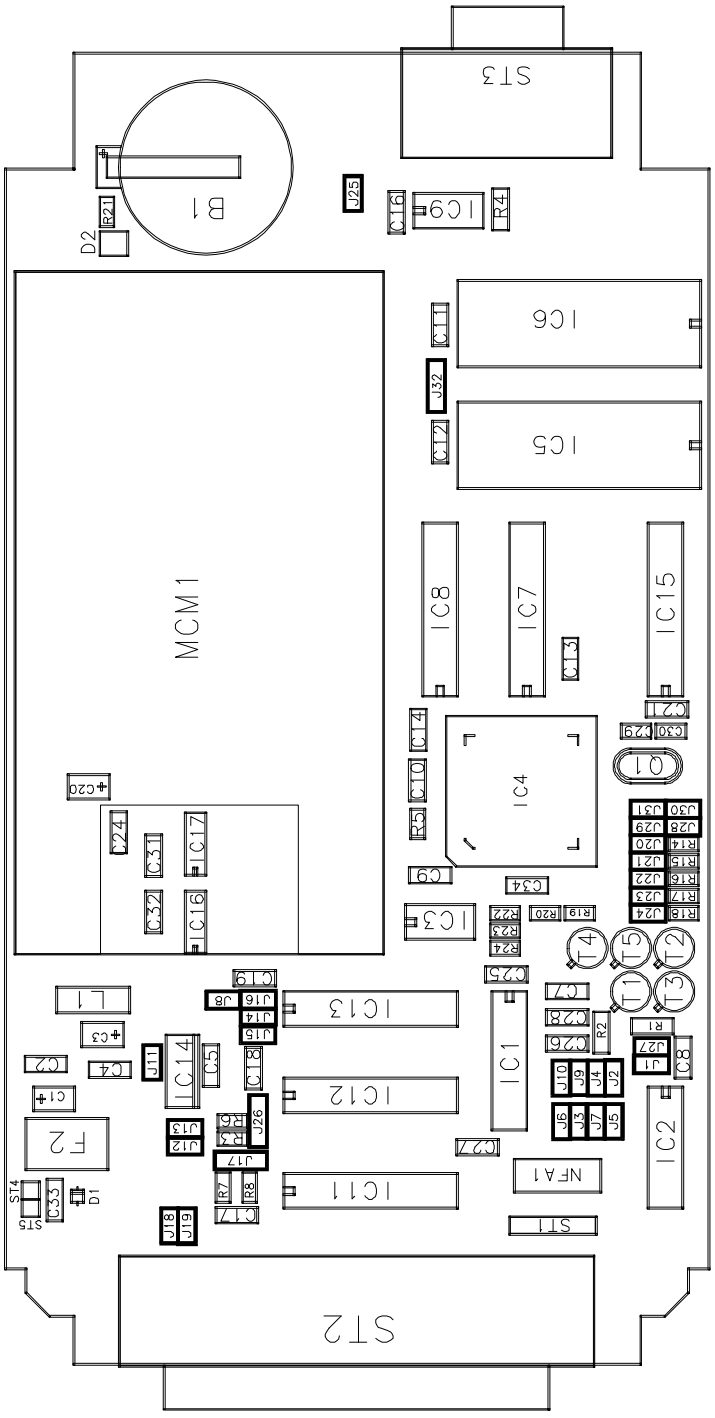
For the RWD a triax connector is used. 'ST6' is not available at the main PCB but it is on the MCM.

This connector is used for the connection of the antenna with a triax-cable with a maximum cable length of 50cm.

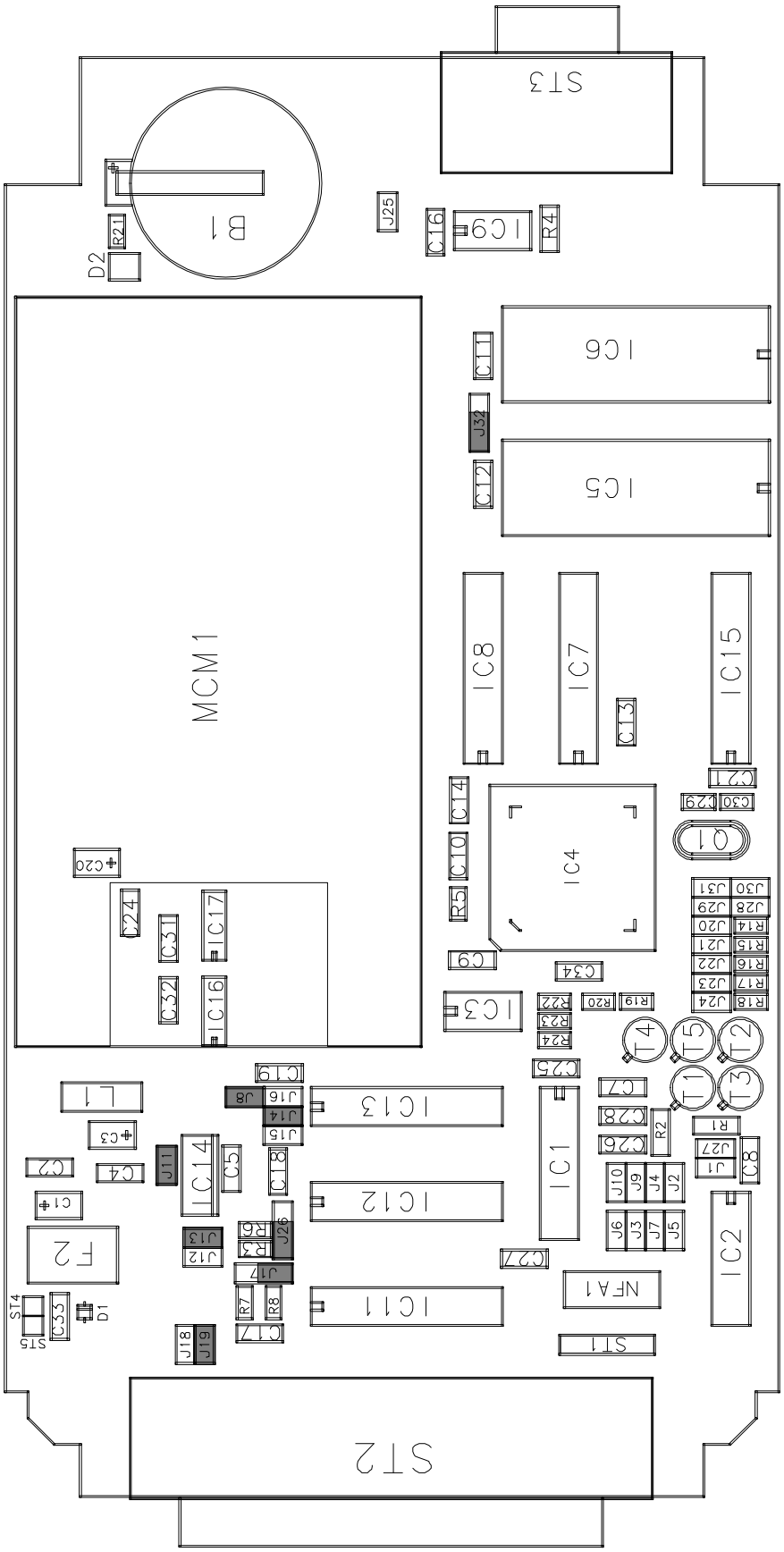
2.2 Jumpers

In the MIFARE Demonstration System many features can be selected with jumpers. There are 31 jumpers on the PCB.

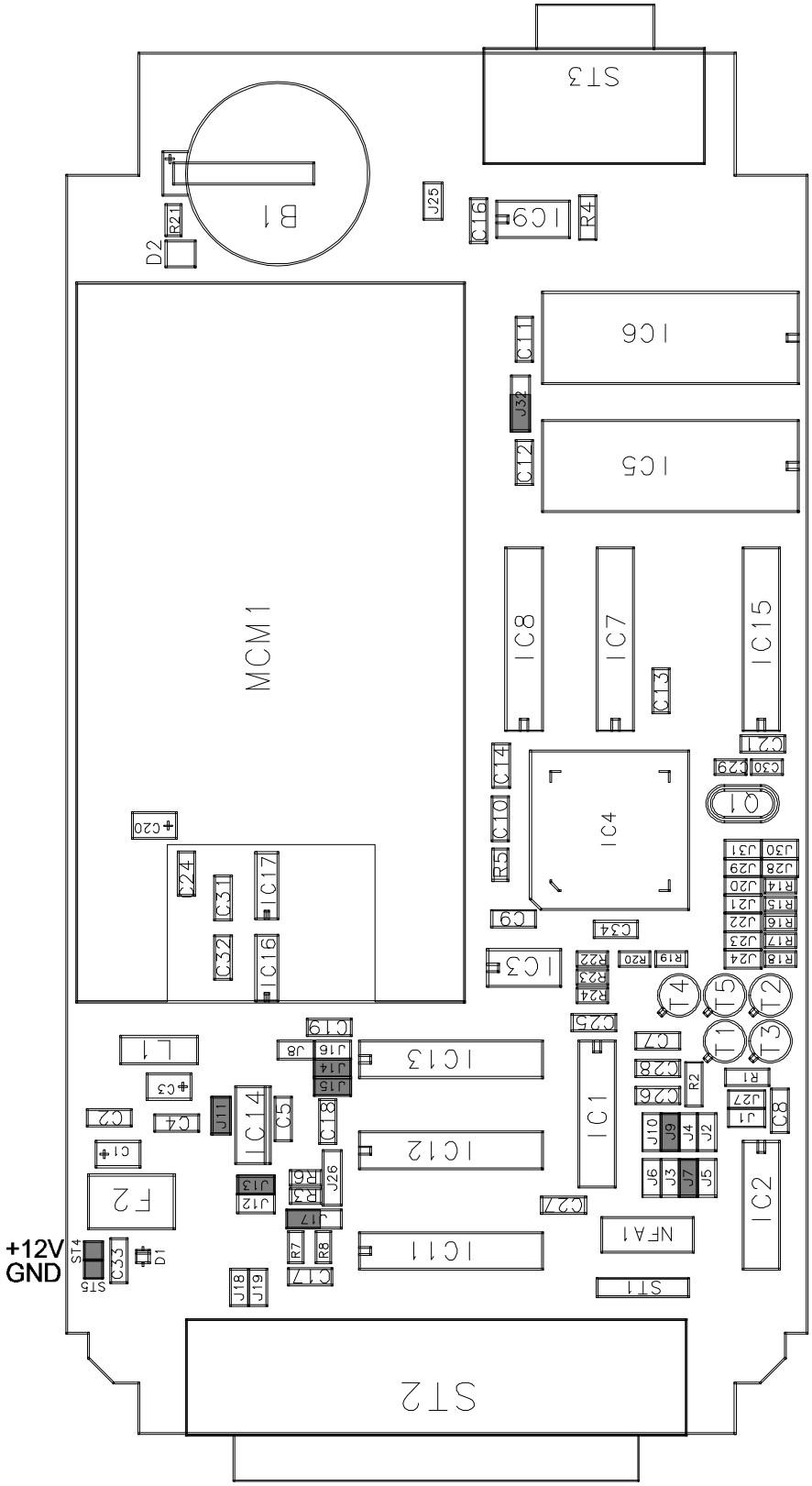
General Arrangement of the Jumpers



2.2.1 Jumper Configuration for the Parallel System



2.2.2 Jumper Configuration for the Serial System



2.2.3 Description of the Jumpers

Jumper	Description	Note
J1	not used	
J2	not used	
J3	RS422 enable	
J4	RS422 enable	
J5	RS422 enable	
J6	RS422 enable	
J7	RS232/TX enable	
J8	CS Pull-up	
J9	RS232/RX enable	
J10	RS422/RX enable	
J11	12 V - VDD enable	
J12	5 V - VDD enable	
J13	12 V - VDD enable	
J14	USE ALE disable	
J15	NCS Pulldown	
J16	Intel-mode disable	
J17	System Select (Coil → Serial System)	
J18	Parallel System: 5 V - VDD	
J19	Parallel System: 12 V - VDD	
J20	Direct LED-Output: (P1.3) LED0	Anode: PCB-border
J21	Direct LED-Output: (P1.5) LED1	Anode: PCB-border
J22	Direct LED-Output: (P1.6) LED2	Anode: PCB-border
J23	Direct LED-Output: (P1.4) LED3	Anode: PCB-border
J24	Direct LED-Output: (P1.7) LED4	Anode: PCB-border
J25	VDD-Cable enable (active antenna)	
J26	CS-Select (at J17 → NCS active)	
J27	RS422 termination resistor enable	
J28	Direct digital Input: (P3.2) IN0	Test mode - Input
J29	Direct digital Input: (P3.3) IN1	
J30	Direct digital Input: (P3.4) IN2	
J31	Direct digital Input: (P3.5) IN3	
J32	Pin 1 of IC 5 = 27C256 (VPP): VDD (default) Pin 1 of IC 5 = 27C512 (A15): GND	

Voltage Supply

VDD-Select	J11	J12	J13	J18	J19	
external 12 V	x	-	x	-	-	
parallel 12 V	x	-	x	-	x	
external 5 V	-	x	-	-	-	
parallel 5 V	-	x	-	x	-	

Active Antenna

VDD Cable	J25	
enable	x	only at 12 V-VDD allowed
disable	-	

System-Select

System Select	J17	
parallel	bottom	view of component part, 37 pin connector left
serial	top	

parallel	J8	J14	J15	J16	J26	
CS active, A/D	-	x	x	-	right	separate data- & address bus
NCS active, A/D	x	x	-	-	left	separate data- & address bus
CS active, AD	-	-	x	-	right	shared data- & address bus
NCS active, AD	x	-	-	-	left	shared data- & address bus

parallel	J1	J2	J3	J4	J5	J6	J7	J9	J10	J27	
all modes	-	-	-	-	-	-	-	-	-	-	serial disabled

serial (µC)	J1	J2	J3	J4	J5	J6	J7	J9	J10	J27	
RS232	-	-	-	-	-	-	x	x	-	-	
RS422	-	-	x	x	x	x	-	-	x	x	

serial (µC)	J8	J14	J15	J16	J26	
all modes	-	x	x	-	-	CS active, separate data-& address bus

Others

I/O	J20	J21	J22	J23	J24	J28	J29	J30	J31	
digital output	x	x	x	x	x	-	-	-	-	
digital input	-	-	-	-	-	x	x	x	x	

Examples for the JUMPER Assignment:

Jxx	parallel, 12V	serial RS232, 12 V ext.	serial. RS232 5 V ext.	parallel, 5V ext.
01	-	-	-	-
02	-	-	-	-
03	-	-	-	-
04	-	-	-	-
05	-	-	-	-
06	-	-	-	-
07	-	x	x	-
08	x	-	-	x
09	-	x	x	-
10	-	-	-	-
11	x	x	-	-
12	-	-	x	x
13	x	x	-	-
14	x	x	x	x
15	-	x	x	-
16	-	-	-	-
17				
18	-	-	-	-
19	x	-	-	-
20	-	-	-	-
21	-	-	-	-
22	-	-	-	-
23	-	-	-	-
24	-	-	-	-
25	-	-	-	-
26		-	-	
27	-	-	-	-
28	-	-	-	-
29	-	-	-	-
30	-	-	-	-
31	-	-	-	-
32				

-... *not mounted*

x ... *mounted*

 *Double jumper, (horizontal, mounted left)* **)*

 *Double jumper (vertical, mounted bottom)* **)*

**) View of Component part, 37 pin connector left*

2.3 Serial Test Modes

If J28 (IN0) is connected during the boot sequence of the serial system (after power up), the serial test mode is enabled. This mode is a stand alone mode. It can be left only with a reboot of the system with J28 not connected.

There are 4 functions in the serial test mode, depending on J29 and J31. If J30 is connected, no data is sent via the serial interface (115.200, N, 8, 1).

The jumpers are only read during the boot sequence.

J29	J31	Description
0	0	Request
0	1	Read
1	0	Write/Read
1	1	not yet implemented

0 ... Jumper mounted
1 ... Jumper not mounted

Test-Request

A request code is sent every 20ms. ‘R’ is sent via the serial interface if enabled.
LED4 toggles every second.

Test-Read

The block address 0 is read from the card permanently and the serial number of the card is sent via the serial interface in ASCII-format, if enabled.

LEDs:	LED4	NOTAG
	LED3	any failure
	LED2	read OK

called functions:
request
anticoll
select
authentication
read
halt

Test-Write/Read

The address 62 is written with two different strings and a check read is done permanently. The serial number of the card is sent via the serial interface in ASCII-format if enabled. After each valid access the firmware waits for about 80ms until the next access starts.

LEDs:	LED4	NOTAG
	LED3	any failure
	LED2	write/read OK
	LED1	compare error

called functions:
request
anticoll
select
authentication
write
read
halt

If an error occurs during a low-level-function-call, one byte corresponding to the function is sent via the serial interface if enabled.

request	N
anticoll	A
select	S
authentication	U
read	R
write	W
halt	H

If a compare error occurs the ‘C’ sign is sent via the serial interface if enabled. The system waits for one second and LED1 is cleared only with the next NOTAG.

The serial number is sent as a 8 byte hexadecimal number with a CR/LF (0x0D, 0x0A) ahead of and a space (0x20) after the number.

written strings:
str1: `‘MIKRON-TEST-DATA’`
str2: `‘mikron test data’`

3 Protocol Definition HOST ↔ RWD

In this chapter the communication of the control unit with the RWD is described. The communication is defined in two protocol layers: the transmission protocol (OSI Level 2) and the commands (OSI Level 7). OSI Level 1 is available as RS232 or RS422.

3.1 The 3964-Protocol

The 3964-Protocol is a transmission protocol for a point to point connection between a control unit and the RWD (OSI-Level 2).

The 3964-Protocol is a bisync protocol with the data size of 8 bit. The baud rate is 115.200, 1 start bit, 1 stop bit, no parity bit (115.200, N, 8, 1). The maximum size of user data is 32 bytes.
To start a communication the receiver and the transmitter must be ready. The sender starts with **Start of Text** (STX), if the receiver answers **Data Link Escape** (DLE) data can be transmitted.

At the end of the data transmission the sender transmits (DLE) **End of TEXT** (ETX). (DLE) is necessary to distinguish a control character from a data byte. If (10H) is transmitted within a data block it is transmitted twice to distinguish it from the control character (DLE).

If the receiver detects no error in the transmission it answers (DLE). If an error is detected the receiver sends **Not Acknowledge** (NAK). In this case the receiver may also send nothing and wait until the sender reappears the message. In both cases the sender tries to repeat the entire data transmission three times. To establish a data link the sender tries three times to send (STX). The Character-Delay-Time is 0.5 s, which is the time in which the receiver has to transmit the control characters on the senders request.

A check-character (BCC) is sent within the data (INFO[n] = BCC).

INFO [n]= INFO [0] ⊕ INFO[1] ⊕ .... ⊕ INFO [n-1]

⊕.... XOR.

3.2 Character Definition

char	value	description
STX	0x02	start of text
ETX	0x03	end of text
ACK	0x06	acknowledge
DLE	0x10	data link escape
NAK	0x15	not acknowledge

3.3 Schematic Description

Host		**RWD**		
- Sender		- Receiver		
STX	⇒			; receiver ready ?
	⇐	DLE	| no response	; yes !
INFO[0]	⇒			
:				
INFO[n]	⇒			
DLE	⇒			
ETX	⇒			; end of transmission
	⇐	DLE	| NAK | no response	; acknowledgement

Host		**RWD**	
- Receiver		- Sender	
	⇐	STX	; receiver ready ?
DLE | no response	⇒		; yes !
	⇐	INFO[0]	
		:	
	⇐	INFO[n]	
	⇐	DLE	
	⇐	ETX	; end of transmission
DLE | NAK | no re.	⇒		; acknowledgement

If an error occurs the sender tries three times to send the data. If this is not possible it stops sending data. The character delay is set to 0.5 seconds, which is the time in which the receiver has to transmit the control characters upon the sender’s request. This is also the maximum delay time between two characters during the communication.
The sequence number is sent within the data. After a correct command/response exchange the sequence number is increased by 1.

3.4 Data Formats

3.4.1 Host ⇒ RWD

SeqNr	Command	Len	Data[0] ... Data[m]	BCC
INFO[0]				INFO[n]

SeqNr ...	Sequence number of the protocol	(1 byte)
Command ...	Command number	(1 byte)
Len ...	Data length	(1 byte)
Data[i] ...	Data byte	

3.4.2 RWD ⇒ Host

SeqNr	Status	Len	Data[0] ... Data[m]	BCC
INFO[0]				INFO[n]

SeqNr ...	Sequence number of the protocol	(1 byte)
Status ...	Result of the called low-level function	(1 byte)
Len...	Data length	(1 byte)
Data[i]...	Data byte	

3.5 General Notes

- The '|' symbol in the text means the OR - function.
- The '0x' symbol in the text means the prefix to a hexadecimal number.
- If any failure occurs while a command is executed, no data is sent to the host computer. (Status, Len=0 !!!)
- The PC-SW-library is built with Borland C/C++ V4.52
- Required files for programming user-software.

MIF1LOW.H	(include file parallel system)
MIF1LOW.LIB	(library file parallel system, memory model large)
MIF1SER.H	(include file serial system)
MIF1SER.LIB	(library file serial system, memory model large)

If a software is written in which the parallel and the serial system are used, MIF1LOW.H must be included in the source file before MIF1SER.H.

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.	

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