

Technical Information Manual

Revision n. 2
2 April 2008

Mod. A528
*OEM UHF
MULTIREGIONAL
COMPACT READER*

NPO:
00101/07:A528X.MUTx/02

Federal Communications Commission (FCC) Notice (Preliminary)

This device was tested and found to comply with the limits set forth in Part 15 of the FCC Rules. Operation is subject to the following conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received including interference that may cause undesired operation. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This device generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instruction manual, the product may cause harmful interference to radio communications. Operation of this product in a residential area is likely to cause harmful interference, in which case, the user is required to correct the interference at their own expense. The authority to operate this product is conditioned by the requirements that no modifications be made to the equipment unless the changes or modifications are expressly approved by CAEN RFID.

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1. Introduction

The A528 is an OEM UHF multiregional compact reader for integration into label printers, label applicators, handheld devices and in general any fixed or mobile short and medium range device requiring UHF tag programming and reading.

The A528 can operate in both European (ETSI EN 302 208) and US (FCC part 15) regulatory environments and is fully programmable up to 500 mW conducted power. The reader supports EPC Class1 Gen2 protocol.

The module uses the Intel® UHF RFID Transceiver R1000 and features a Gen2 Dense Reader Mode capability. Due to its multiregional capabilities the A528 is ideal for integration in devices requiring compliance to different geographic regions. A service board (Mod. A528ADAT), which allows to manage the A528 via USB and RS232, is available.



Fig. 1-1: Mod. A528 OEM UHF Multiregional compact reader

2. Mod. A528 Technical Specifications

2.1. Mod. A528 Technical Specifications Table

Table 2.1: Mod. A528 Technical Specifications

Frequency band	902÷928 MHz (FCC part 15) 865.600÷867.600 MHz (ETSI EN 302 208)
Output Power Level	Programmable in 8 steps ¹ up to 500 mW @ 5 V (27 dBm)
Output power accuracy	+/- 1dB
Antenna VSWR requirement	2:1 or better for optimum performances
Antenna Connector	Nr. 1 MMCX type
Frequency Tolerance	±10 ppm over the entire temperature range
Number of Channels	10 channels (compliant to ETSI EN 302 208) 50 hopping channels (compliant to FCC part 15)
Standard Compliance	EPC C1G2
Digital I/O	Four I/O lines 3.3V out @ 3mA, 5V tolerant
UART Serial Port	Baudrate: 115200 Databits: 8 Stopbits: 1 Parity: none Flow control: none 3.3 V out, 5 V tolerant 9.6÷115 kbit/s data rate (settable)
USB Device Port	One USB 2.0 Full Speed (12 Mbits per second) device port.
Dimensions	42 x 60 x 6.3 mm ³ (1.65 x 2.36 x 0.25 inches ³)
Supply voltage requirements	4.75V ÷ 5.25V; ripple and noise < 100mVpp; ripple frequency > 100kHz
Electrical Power	1A max @ 5 V (TX/RX mode) ² , 230 mA @ 5 V (idle mode)
Operating Temperature	-20 °C to 60 °C
MTBF	> 200'000 hours
Weight	16 g

¹ Output power levels are the following: 10mW; 25mW; 50mW; 100mW; 200mW; 300mW; 400mW and 500mW

² Typical supply current values @ 5V in TX/RX mode are the following: 0.50A @ Pout=50mW; 0.68A @ Pout=200mW; 0.80A @ Pout=500mW

2.2. External connections

The location of the connectors is shown in Fig. 2.1. Their mechanical specifications are listed here below:

Antenna Port: RF Coax Connector Huber+Suhner type 82MMCX-S50-0-2/111_K (to be used with Huber+Suhner type 11MMCX-50-1-1/111_O)

MOLEX Connector: PCB Headers Molex type 53261-1290
(to be used with Molex Type 51021-1200 + 12pcs crimp terminal type 50058-8100)

MOLEX Connector: PCB Headers Molex type 53261-0290
(to be used with Molex Type 51021-0200 + 2pcs crimp terminal type 50058-8100)

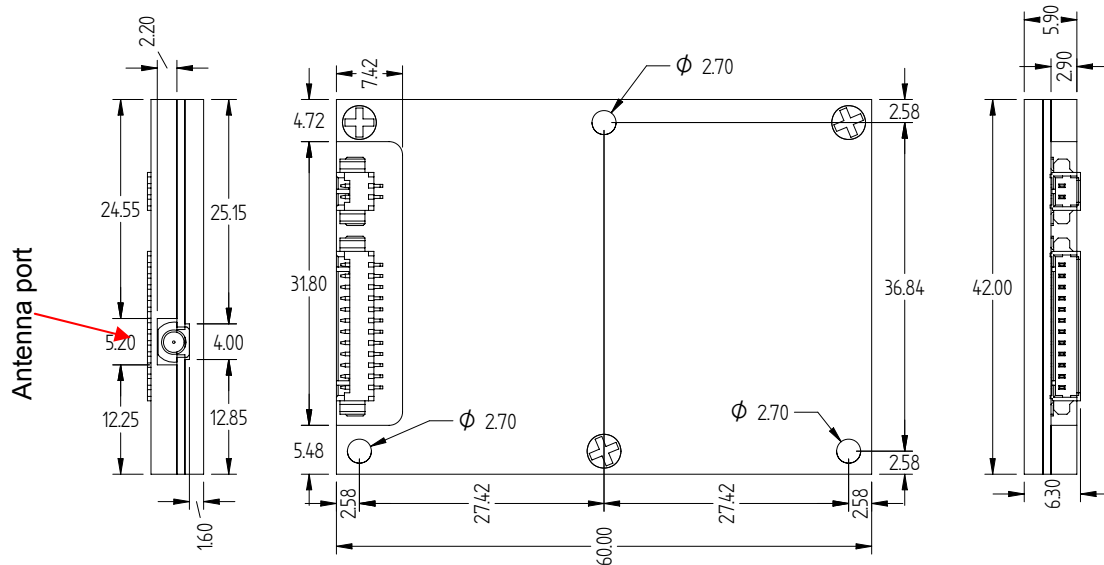


Fig. 2-1: Mod. A528 technical drawings

2.2.1. A528 Main connector pinout

Compact reader A528 MAIN external connector is a Molex SMD, 12 poles, 1.27 pitch connector whose pinout is shown in table below.

Table 2: A528 MAIN connector pinout

Pin	Function	Direction
1	Power Line (+5V)	-
2	/RESET	IN
3	GPIO0	IN/OUT
4	GPIO1	IN/OUT
5	GPIO2	IN/OUT
6	GPIO3	IN/OUT
7	TST_RECOVERY	IN
8	USB PUP	IN
9	RXD	IN
10	TXD	OUT
11	GND	-
12	GND	-

The GPIO0-GPIO3 pin are 4 general purpose bidirectional pins, their default direction (or after a Reset) is OUT.

TST_RECOVERY pin is reserved and shall be used only to perform the microcontroller recovery procedure during which it must be forced at high level (3.3V or 5V).

The RXD/TXD pins are used to communicate with the A528 board via UART port; to establish a link with the device you must configure your COM port as follows³:

1. Baud rate : 115200
2. Parity : None
3. Data bits : 8
4. Stop bits : 1
5. Flow Control: none

³ Since A528 RX/TX are TTL level signals, in order to connect it with a PC, a TTL/RS232 translator shall be used. A528 service board (A528ADAT) hosts both RS232 and USB full interfaces.

2.2.2. A528 MAIN connector electrical characteristics

Table 2.3: A528 main connector electrical characteristics

Pin name	Pin No.	Parameter	Min.	Typ.	Max.	Unit
+5V	1	Supply DC voltage	4.75	5.00	5.25	V
		Power supply requirements – Ripple Voltage			100	mVpp
		Power supply requirements - Ripple Frequency	100			kHz
		Supply DC current	0.23		1.0	A
/RESET	2	VIL	-0.3		1.0	V
		VIH	2.4		3.6	V
		Internal pull-up resistance	10	20		kΩ
		Pulse width	1			μs
GPIO[0:3]	3, 4, 5, 6	VOL	0		0.4	V
		VOH	2.0		3.3	V
		Output current			3.0	mA
		VIL	-0.3		0.8	V
		VIH	2.0		5.5	V
		Input current			1	μA
TST-Recovery	7	VIH	2.0		5.5	V
USB PUP	8	VIH	2.0		5.5	V
RXD	9	VIL	-0.3		0.8	V
		VIH	2.0		5.5	V
		Input current			1	μA
TXD	10	VOL	0		0.4	V
		VOH	2.4		3.3	V
		Output current			1.5	mA
GND	11,12					

2.2.3. Power supply connection

In the following schematic suggested A528 power supply connection is shown.

The use of fuse F1 is recommended since A528 doesn't provide internal current limitation protection. Diode D1 avoid damage to the reader in case of reverse polarity connection. The use of optional LC filter improves reader immunity in presence of noisy power supply.

In order to ensure the correct operation of the reader the power supply shall not enter in burst mode (switching frequency less than 100kHz) when A528 reader is in idle mode (supply current less than 0.2A). As a rule of thumb the power adapter shall have a maximum current rating from 1A to 1.5A.

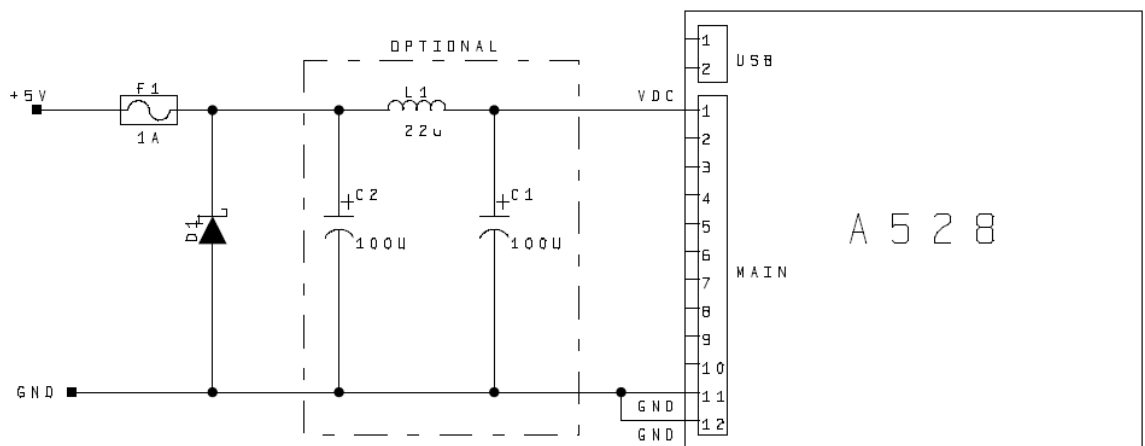


Fig. 2-2: Mod. A528 power supply connection

2.2.4. General purpose I/O connections

The GPIO0-GPIO3 pins are 4 general-purpose bidirectional pins. Their default direction after a power on reset or a general reset is set to Output.

GPIO, when configured as Outputs, can be used to drive indicators as leds or buzzers or to send trigger signal to others equipments.

GPIO, when configured as Inputs, can accept control signals from other equipments or trigger signals from sensors (i.e. photocells).

In the following schematic an example of application of GPIO is shown.

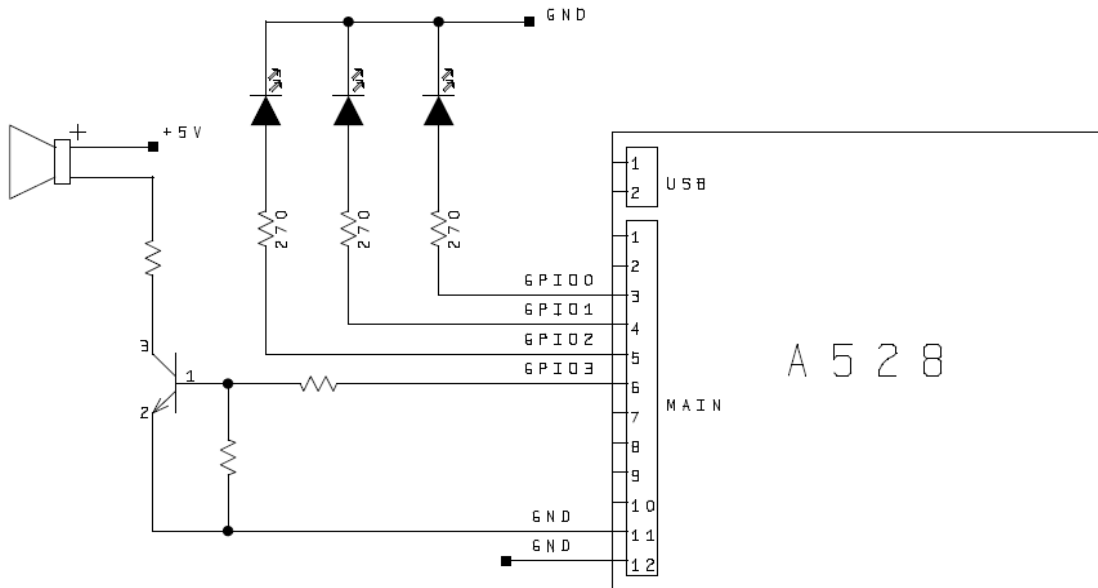


Fig. 2-3: Mod. A528 GPIO connection example

2.2.5. External reset

A528 manual reset can be performed by forcing at low level /RESET pin for 1 μ S at least. /RESET pin is pulled-up by an internal resistor.

Fig. 2-4: Mod. A528 external reset

2.2.6. UART connection

The RXD/TXD pins are used to communicate with the A528 board via UART port. Since A528 RX/TX are TTL level signals, in order to connect it with a PC, a TTL/RS232 translator shall be used (please refer to the diagram below)⁴.

To establish a link with the device host COM port shall be configured as follows:

1. Baud rate: 115200
2. Parity: None
3. Data bits: 8
4. Stop bits: 1
5. Flow Control: none

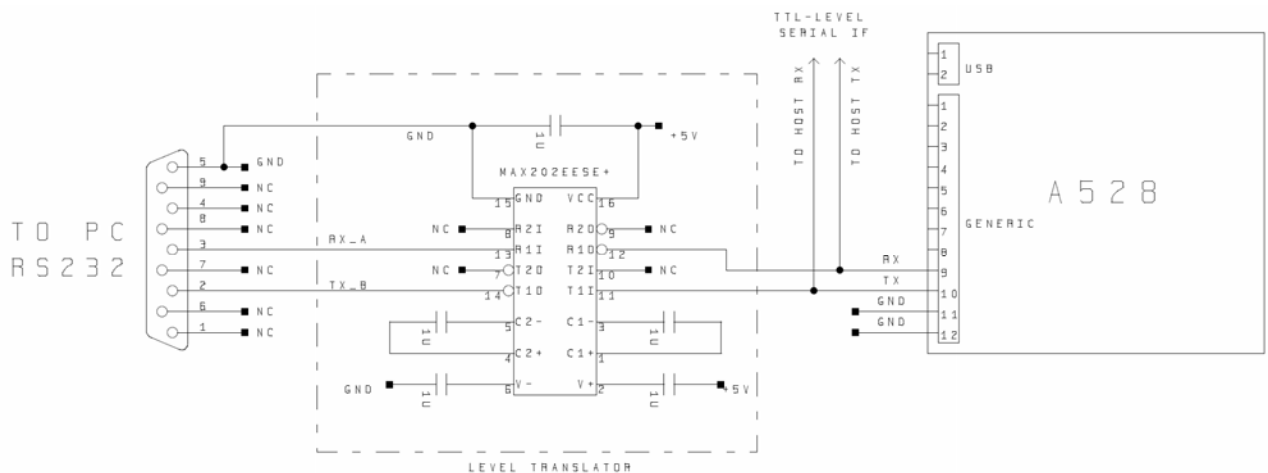


Fig. 2-5: Mod. A528 RS232 connection

2.2.7. A528 recovery

TST_RECOVERY pin is reserved and shall be used only to perform the microcontroller recovery procedure during which it must be forced at high level (3.3V or 5V).

In the following diagram a manual recovery mechanism is shown: in order to perform the A528 boot recovery the jumper JP1 shall be inserted, then A528 shall be switched on by applying 5V supply voltage for 5s at least. After that the reader shall be switched off and the jumper removed: at the next switch on the reader will execute the boot recovery program.

For further details please see § 2.5.

⁴ A528 service board (A528ADAT) hosts both RS232 and USB full interfaces.

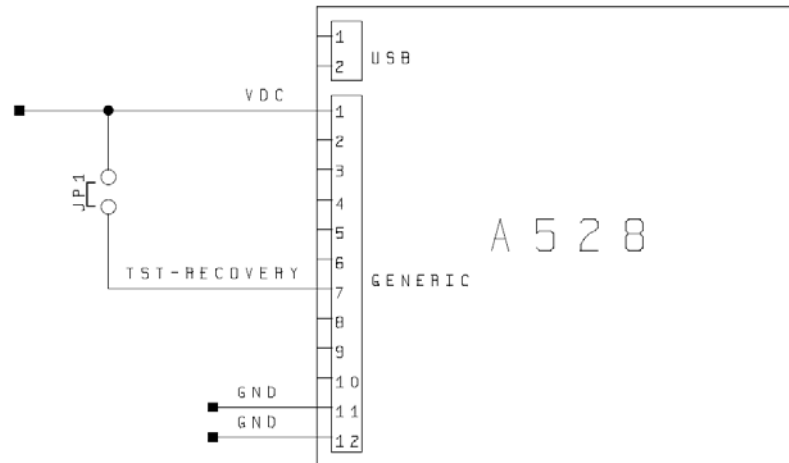


Fig. 2-6: Mod. A528 TST-recovery connection

2.2.8. A528 USB connector pinout

A528 USB interface connector is a Molex SMD, 2 poles, 1.27 pitch connector whose pinout is shown in table below.

Table 2.4: USB connector electrical specifications

Pin	Function	Direction	Description
1	DDM	IN/OUT	USB data -
2	DDP	IN/OUT	USB data +

A528 board provides only the USB data signals; in order to implement a full USB interface some external components shall be used. The external circuit necessary for A528 USB operation is shown in the schematic below.

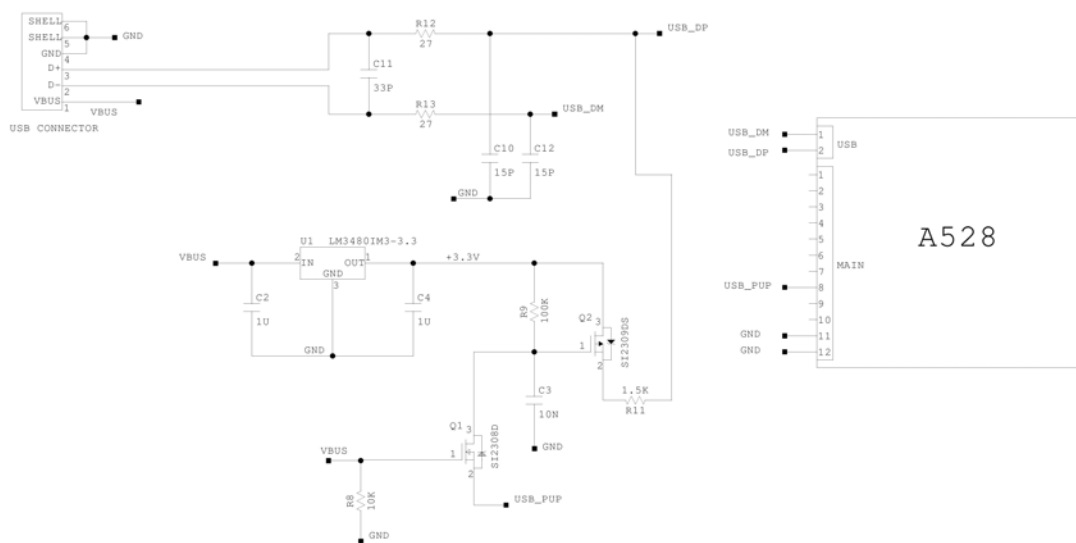


Fig. 2-7: Mod. A528 USB interface connection

2.2.9. USB connector pinout electrical characteristics

Pin name	Pin No.	Parameter	Min.	Typ.	Max.	Unit
DDM	1	V_{IL}			0.8	V
		V_{IH}	2			V
		V_{OL}	0		0.3	V
		V_{OH}	2.8		3.3	V
		Recommended external series resistor		27		Ω
DDP	2	V_{IL}			0.8	V
		V_{IH}	2			V
		V_{OL}	0		0.3	V
		V_{OH}	2.8		3.3	V
		Recommended external series resistor		27		Ω

Table 2.5: A528 USB connector electrical characteristics

2.2.10. Antenna port specifications

In the following table the pinout of A528 antenna is shown.

Pin	Function	Direction	Description
INNER	RF OUT	OUT	RF output
OUTER	GND	-	Ground

Table 2.6: RF port pinout

Parameter	Min.	Typ.	Max.	Unit
RF output power	10		500	mW
	10		27	dBm
Output power vs. power setting accuracy			± 1	dB
RF port impedance		50		Ω
Recommended antenna VSWR			2:1	-

Table 2.7: RF port electrical characteristics

2.3. Reader – Tag link profiles

A528 reader supports different modulation and return link profiles according to EPC Class1 Gen2 protocol.

In the following table are reported all profiles that have been tested for the compliance with ETSI and FCC regulations.

Link profile #	Regulation	Modulation	Return Link
0	ETSI - FCC	DSB-ASK; f=40kHz	FM0; f = 40kHz
1	ETSI	DSB-ASK; f=40kHz	Miller (M=2); f = 160kHz
2	ETSI - FCC	PR-ASK; f=40kHz	Miller (M=4); f = 250kHz
3	ETSI	PR-ASK; f=40kHz	Miller (M=4); f = 300kHz
4	FCC	DSB-ASK; f=160kHz	FM0; f = 400kHz
5	FCC	PR-ASK; f=40kHz	Miller (M=2); f = 250kHz

Table 2.8: A528 reader - tag link profiles

2.4. Host communication interfaces

A528 reader allows the user to manage host communication through two different protocols⁵:

1. CAEN communication protocol.

In this case the host-reader interface is serial and A528 is fully compatible with all the CAEN Demos and libraries included in the Easy2Read SDK.

2. Intel communication protocol.

In this case the host-reader interface is USB and A528 is fully compatible with

⁵ Serial / CAEN protocol is implemented starting from FW release 1.1.5.

Intel RFID Tracer and libraries included in the Intel SDK. Using Intel protocol, serial interface has debug purpose only.

The default setting of the A528 reader is the Serial/CAEN choice, in order to switch to the INTEL protocol on USB interface you shall follow the steps described below:

1. Connect to the reader, using a RS232 cable⁶, with the Hyperterminal (or with any other terminal emulation application) with the following settings:
 - baud rate: 115200
 - data bits: 8
 - parity: none
 - stop bits: 1
 - Flow control: None
2. Type quickly the word "CAEN" (in capital letters) in the Hyperterminal window.
3. Type "chgprot" in the hyperterminal window
4. Select the "USB interface" and "INTEL protocol" options when prompted.

After a reset the reader will reply to the INTEL commands.

In order to switch from Serial/CAEN protocol to the INTEL protocol on USB interface you shall follow the steps described below:

1. Connect to the reader, using a RS232 cable⁷, with the Hyperterminal (or with any other terminal emulation application) with the following settings:
 - baud rate: 115200
 - data bits: 8
 - parity: none
 - stop bits: 1
 - Flow control: None
2. Stop the boot process pressing the spacebar within 6 seconds from the power on.
3. Type "chgprot" in the hyperterminal window.
4. Select the "Serial interface" and "CAEN protocol" options when prompted.

After a reset the reader will reply to the CAEN commands.

2.5. A528 Firmware Upgrade

The A528 reader firmware upgrade can be performed via USB or RS232⁸ interface.

⁶ Assuming to use A528 adapter board and a PC as host

⁷ Assuming to use A528 adapter board and a PC as host

⁸ Assuming to use A528 adapter board and a PC as host

2.5.1. A528 USB Recovery/FW upgrade

USB upgrade is based on Atmel Smart Arm Microcontroller Boot Assistant (hence forth referred to as "SAM-BA"). The SAM-BA tools is distributed by Atmel via

http://www.atmel.com/dyn/products/tools_card.asp?tool_id=3883

(download and install AT91-ISP.exe file).

USB upgrade requires the following steps:

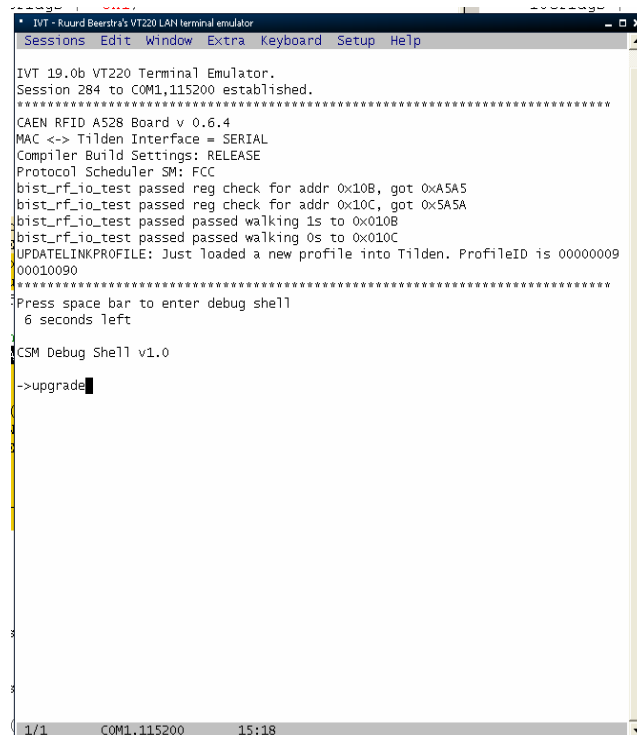
1. With power supply disconnected, connect with a short circuit J1 pin 4 (GPIO4) and TP1 pad.
2. With short circuit inserted connect the power supply to the board and wait for 5 seconds at least.
3. Disconnect the power supply.
4. Remove the short circuit between pin 4 of J1 and TP1.
5. Connect the power supply and the USB cable to A528ADAT.
6. At this point, Windows XP will detect the platform (in SAM-BA mode) and display the "Found New Hardware Wizard".
7. The first screen asks if Windows can connect to Windows Update to search for the software, select: "No, not this time" and then click the NEXT button.
8. On the next wizard screen, select: "Install the software automatically", then click the NEXT button.
9. A dialog will popup indicating that the driver has not passed "Windows Logo Testing", click the "CONTINUE ANYWAY" button.
10. When the last screen appears, click the "Finish" button to dismiss the New Hardware Wizard
11. Reboot PC when prompted.
12. Run the SAM-BA v2.6 application on the WinXP host machine
13. When a dialog box appears, ensure AT91SAM7S256-EK is selected in the drop down list then click on the "USB connection" button. Note that a number of the names in the dropdown list are similar so ensure you select the correct one.
14. Ensure the "FLASH" tab is selected.
15. Enter the path in the "Send File Name:" or use the corresponding "Browse" button to find and select the file containing the new firmware. Latest release can be downloaded from CAEN RFID website (<http://www.caen.it/rfid>)
16. Click the "Send File" button.
17. Click "Yes" in response to "Do you want to unlock involved lock region(s)". Click "No" in response to "Do you want to lock involved lock region(s)". Finally - confirm the programming by clicking the "Compare sent file with memory" button. When SAM-BA reports that the files are identical click the "OK" button.
18. Exit the SAM-BA application via the File -> Quit option.
19. To ensure correct behaviour of Windows XP, click the "Safely Remove Hardware" icon in the Windows system tray, and Stop the Atmel Test Board entry and power DOWN your A528ADAT (disconnect power supply)

2.5.2. A528 RS232 FW upgrade

To perform the FW upgrade via RS-232 interface these steps shall be followed:

1. Turn off the reader
2. Connect the reader with the RS232 serial cable to your PC using the adapter board A528ADAT.
3. Setup a serial terminal (such hyperterminal available on all windows OS) with the following settings:
 - baud rate: 115200
 - data bits: 8
 - parity: none
 - stop bits: 1
 - Flow control: None
4. Turn on the reader.

If A528 is configured to use INTEL protocol a boot message (see Fig. 2-8) will appear press the space bar within 6 seconds from boot.



```

IVT - Ruurd Beerstra's VT220 LAN terminal emulator
-----
Sessions Edit Window Extra Keyboard Setup Help
IVT 19.0b VT220 Terminal Emulator.
Session 284 to COM1,115200 established.
*****
CAEN RFID A528 Board v 0.6.4
MAC <-> T11den Interface = SERIAL
Compiler Build Settings: RELEASE
Protocol Scheduler SM: FCC
bist_rf_io_test passed reg check for addr 0x10B, got 0xA5A5
bist_rf_io_test passed reg check for addr 0x10C, got 0x5A5A
bist_rf_io_test passed walking 1s to 0x010B
bist_rf_io_test passed walking 0s to 0x010C
UPDATELINKPROFILE: Just loaded a new profile into T11den. ProfileID is 00000009
00010090
*****
Press space bar to enter debug shell
6 seconds left

CSM Debug Shell v1.0

->upgrade
  
```

Fig. 2-8: Mod. A528 debug shell window

If A528 is configured to use CAEN protocol no boot message will appear: in this case you shall type quickly and in capital letters the word "CAEN".

5. After that in both cases a prompt ">" should be displayed. The reader is waiting for commands to be sent over the serial port.
6. Type "upgrade", press return and disconnect the serial port

7. Launch the upgrade tool (AT91SAM7SERIALBOOT.exe) provided into CAEN SDK CD-ROM on your PC.
8. Select the COM port you are using (typically is COM1) with the radio button on the left of the main window and press the connect button.
9. Click the Open button and Browse until you find the .bin firmware upgrade image
10. Press the Download button. If, for any reason, the upgrade procedure fails, do not power off the reader but press the download button again.
11. At the end power off the reader and power it on again.

Firmware upgrade has been completed.

If some problems occur in this procedure the recovery of module operation can be obtained by performing the procedure described in § 2.5.1.

2.5.3. Regulatory Compliance (FCC)

This equipment has been tested and found to comply with Part 15 of the FCC Rules.

NOTE:

(a) Any changes or modification not approved by CAEN RFID could void the user's authority to operate the equipment.

(b) The A528 Module, which is rated at 500 mW output, are approved for operation with the CAENRFID antenna Mod. WANTENNAX010 (Linear polarized 3dBi gain 915 MHz PIFA antenna). Use of other than the approved antenna with this unit may result in harmful interference with other users, and cause the unit to fail to meet regulatory requirements. Professional installation is required for A528 Module.