UM0288
User manual

Getting started with the MDK-ST10 board

Introduction

This user manual provides extensive information about the MDK-ST10 board, including board diagrams, associated schematics, main components, and connectors.

The MDK-ST10 board (Motion Development Kit powered by ST10) is a two layer cost-effective development board based on ST10F276 Flash Memory Microcontroller with DSP functionalities, suitable for the development of motion control applications.

A series of connectors ensure the compatibility with many STMicroelectronics driver boards.

Three dedicated connectors allow the user to manage powerSPIN evaluation boards (supporting L6205, -6, -7, -8, and L6235 integrated monolithic motor drivers). In addition, using the MC-connector, all boards compatible with this ST standard connector can be interfaced.

The driving of high loads is also possible through an output connector compatible with VN808 and VN340 Reference Design Boards

Moreover, the RS232, RS485, two CAN and I^2C interfaces can be used for additional external device management.

The development features of MDK-ST10 are enhanced with four male connectors around the microcontroller in which all the pin-outs are available. These connectors are useful in adopting interface boards for developing general purpose applications.

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1 Getting started

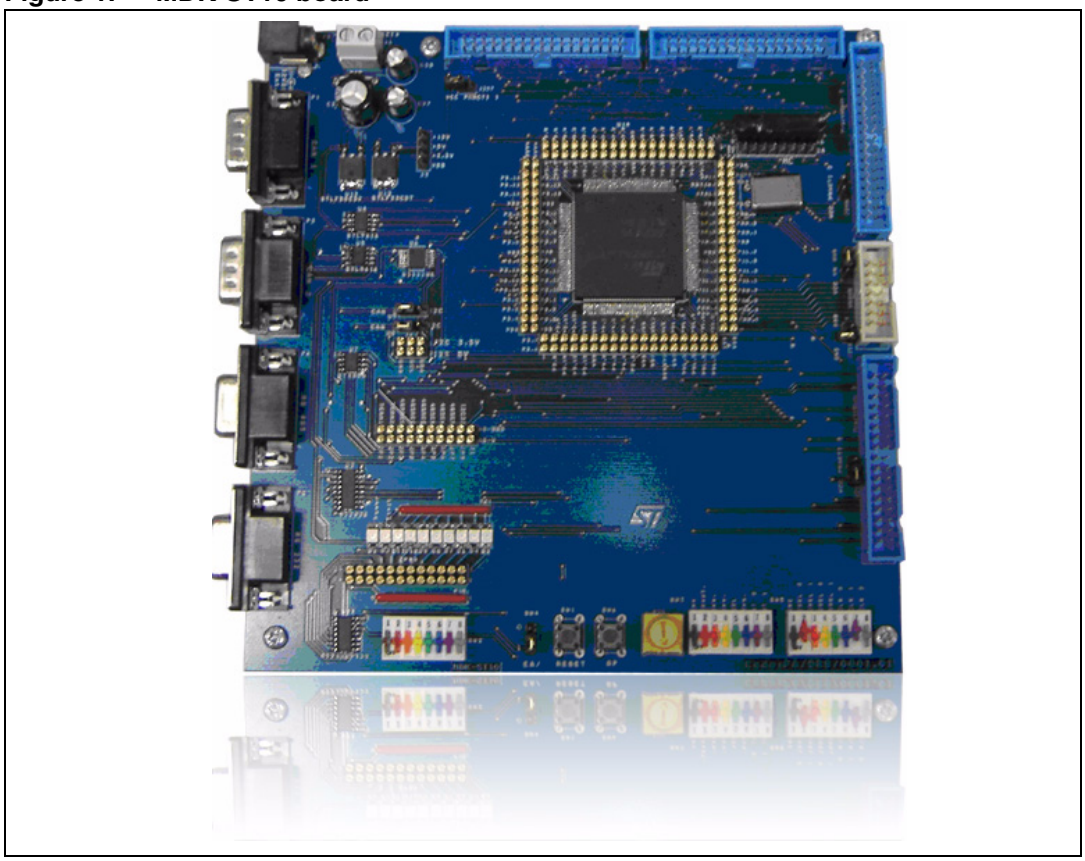
1.1 MDK-ST10 board

MDK-ST10 is designed to allow the user to develop a motion control system based on the microcontroller ST10F276.

The features of MDK-ST10 allow also the integration of the board in a fieldbus network, in fact several communication interfaces are present in the control board.

The board is printed in only two layers with dimensions 16x16.5 cm.

Figure 1. MDK-ST10 board



Key features:

- ST10F276 core (16-bit with DSP @ 64 Mhz,832KB Flash,68 KB Ram)
- RS232
- RS485
- 2 CAN
- I^2C (3.3V and 5V)
- MC Connector
- 3 powerSPIN Connectors
- VN808 board connector.
- All pin-outs available.

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1.2 ST10F276

The core of control board MDK-ST10 is the 16-bit microcontroller ST10F276 which main features are:

- 16-bit CPU with 4-stage pipeline;
- 31.25ns instruction cycle time at 64MHz max CPU clock;
- Multiply/accumulate unit (MAC) 16x16-bit multiplication, 40-bit accumulator;
- Repeat unit;
- Enhanced boolean bit manipulation facilities;
- Additional instructions to support HLL and operating systems;
- Single-cycle context switching support.

Memory organization main features:

- 512K Byte on-chip Flash memory single voltage with erase/program controller+320K Bytes of on-chip extension Flash memory;
- Up to 100K erasing/programming cycles;
- Up to 16 MB linear address space for code and data (5 MB with CAN);
- 2K Bytes on-chip internal RAM (IRAM);
- 66K Bytes on-chip extension RAM (XRAM).

Bus for communication with external peripherals:

- Programmable external bus characteristics for different address ranges;
- 8-bit or 16-bit external data bus;
- Multiplexed or de-multiplexed external address/data buses;
- Five programmable chip-select signals;
- Hold-acknowledge bus arbitration support.

Interrupts:

- 8-channel peripheral event controller for single cycle interrupt driven data transfer;
- 16 priority level interrupt system with 56 sources, sampling rate down to 15.6ns @ 64MHz.

Timers and PWM units:

- Two multi-functional general purpose timer units with 5 timers;
- 8-channel PWM units.

ADC main features:

- 24-channel @ 10-bit resolution;
- 3µs conversion time @ 64MHz CPU clock.

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Other general characteristics are the following:

- Two 16-channel CAPTURE/COMPARE units;
- Two synchronous / asynchronous serial channels;
- Two high-speed synchronous channels;
- Two CAN 2.0B interfaces;
- Programmable watchdog timer and oscillator watchdog;
- On-chip bootstrap loader;
- On-chip PLL;
- Direct or clock input;
- Real Time Clock;
- Up to 111 general-purpose I/O lines;
- Idle, power-down and stand-by modes;
- Temperature range: -40 +125°C;
- 144-pin PQFP/TQFP packages.

Refer to the ST10F276 datasheet for the block diagram and pin-out information.

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2 MDK-ST10 connectors

2.1 RS232 interface

The MDK-ST10 board is provided with one RS232 standard connector for serial communication with external devices, it is used with standard female DB9 connectors.

Only the Rx and Tx signals are used for the serial communication.This is the interface used to program the microcontroller, using a standard RS232 cable.

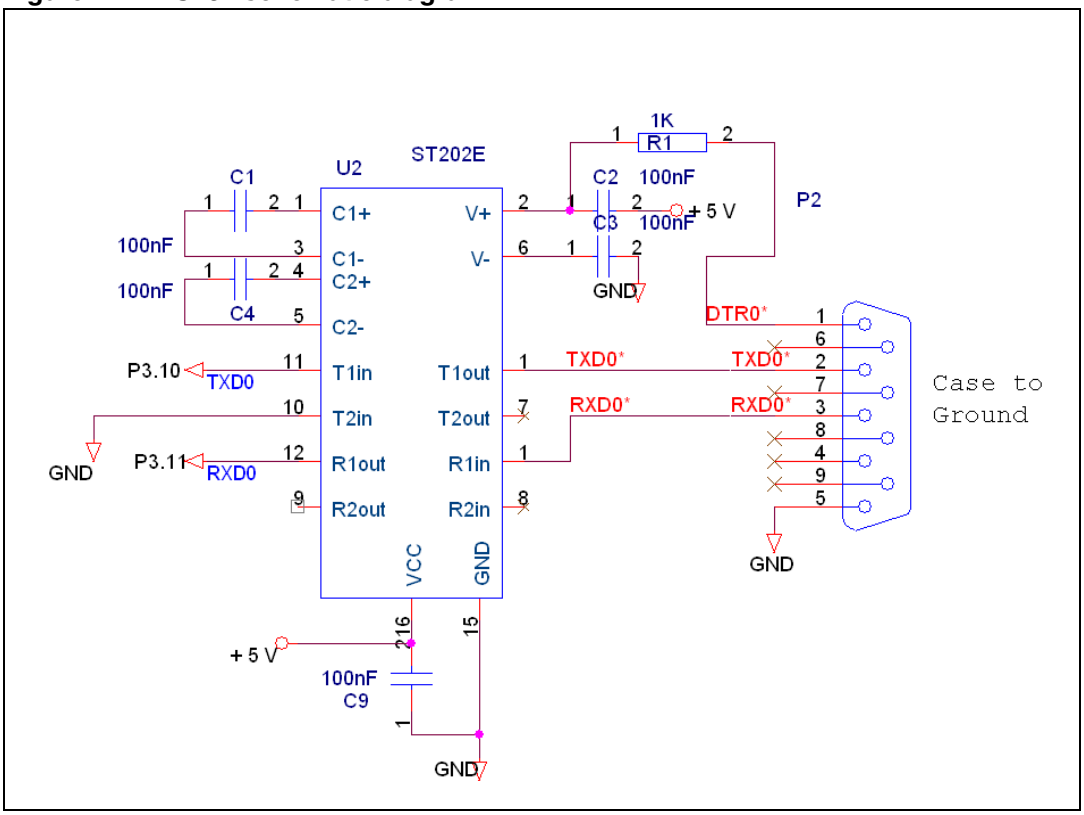
The table below lists the signals associated with each pin:

Table 1. RS232 connector pin description

Pin	Signal	ST10 Pin	Description
2	RX	P3.11	Receive Data
3	TX	P3.10	Transmit Data
5	GND	-	System Ground
1,4,6,7,8,9	NC	NC	Not connected

In order to adapt the TTL signal to RS232 level, the ST202E transceiver is used.

Figure 2. RS232 schematic diagram



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2.2 RS485 interface

MDK-ST10 is furnished with a RS485 serial interface, the generation of differential signals is obtained through an ST485A transceiver connected as shown in *Figure 3*. Endpoint channel termination for RS485 can be set by closing jumpers JP3, JP4 and JP8 indicated with “485 RES”. Terminating resistors are chosen to be compliant with ProfiBus DP cable type A (refer to the schematic *Figure 3*).

To enable the 485 transceiver and to connect it to microcontroller, jumpers JP5, JP6 and JP7 have to be closed and are indicated “485 EN”.

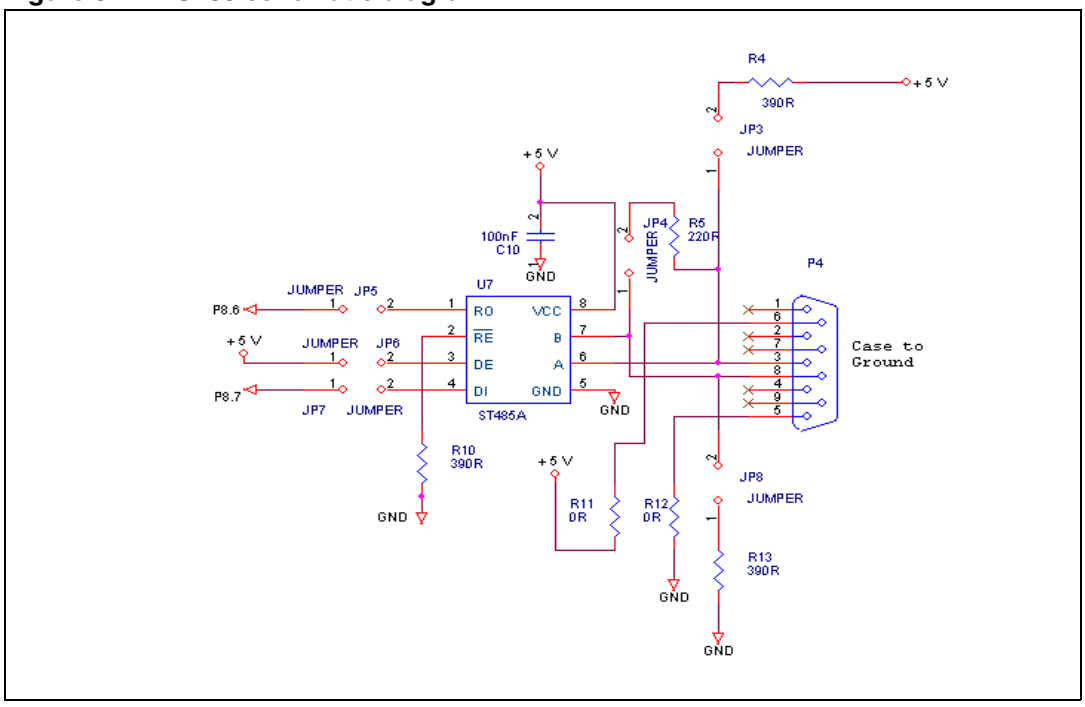
A male DB9 connector is used in the board layout.

Table 2. RS485 connector pin description

Pin	Signal
3	A
8	B
5	GND
6	VCC
1,2,4,7,9	Not connected

ST10 Pin	Signal
P8.7	Tx
P8.6	Rx

Figure 3. RS485 schematic diagram



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2.3 CAN interfaces

MDK-ST10 is equipped with two CAN (Controller Area Network) connectors. The termination of the two bus lines (with a 120Ω resistor) is obtained by closing the jumper JP1 (for CAN1) and JP2 (for CAN2) as indicated on the board by “TERM1” and “TERM2”.

The microcontroller ST10F276 shares the pins of the second CAN interface with those of the I^2C bus, so to enable the use of the second CAN channel the jumpers U9 and U8 have to be placed in position “CAN 2”. Otherwise, position “I2C” assures the connection of I^2C to the microcontroller.

The physical interface with the bus is realized through two STL9616 transceivers.

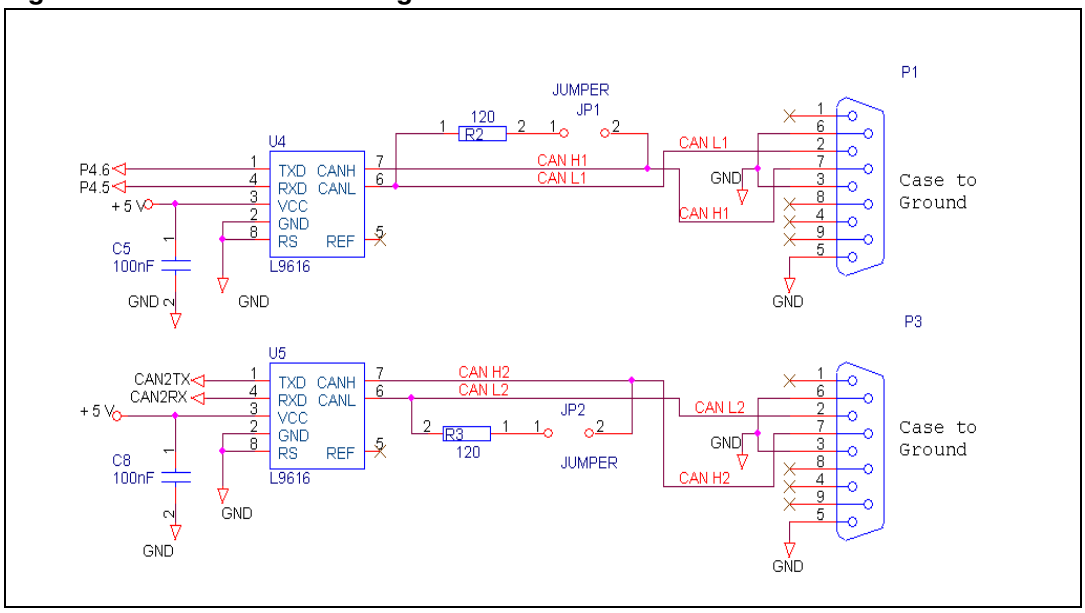
Two male standard DB9 connectors are used to connect the CAN channels.

Table 3. CAN connector pin description

Pin	Signal
2	CAN L
7	CAN H
3,5,6	GND
1,4,8,9	Not connected

ST10 Pin	Signal
P4.6	Tx (CAN 1)
P4.5	Rx (CAN 1)
P4.7	Tx (CAN 2)
P4.4	Rx (CAN 2)

Figure 4. CAN schematic diagram



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2.4 I²C interface

A configurable I²C connection (Connector JF1) present on-board is used to interface both 5V and 3.3V devices that work with the I²C bus. Pins 1, 3 and 5 (data, clock and GND) are 5V-compliant whereas pins 2,4 and 6 (data, clock and GND) refer to 3.3V.

The translation of logic levels is obtained through an ST3378E device. To enable the I²C bus, switches U8 and U9 must be in the position “I2C” (see also *Section 2.2*). Additionally, if it is necessary for the 3.3V bus to be enabled, jumper JP9 (indicated by “I2C33”) must be closed. This jumper enables the ST3378 device.

Table 4. I²C connector pin description

Pin	Signal
1	Data 3.3 V
2	Data 5V
3	Clock 3.3V
4	Clock 5V
5	GND
6	GND

ST10 Pin	Signal
P4.7	SDA (data)
P4.4	SCL (clock)

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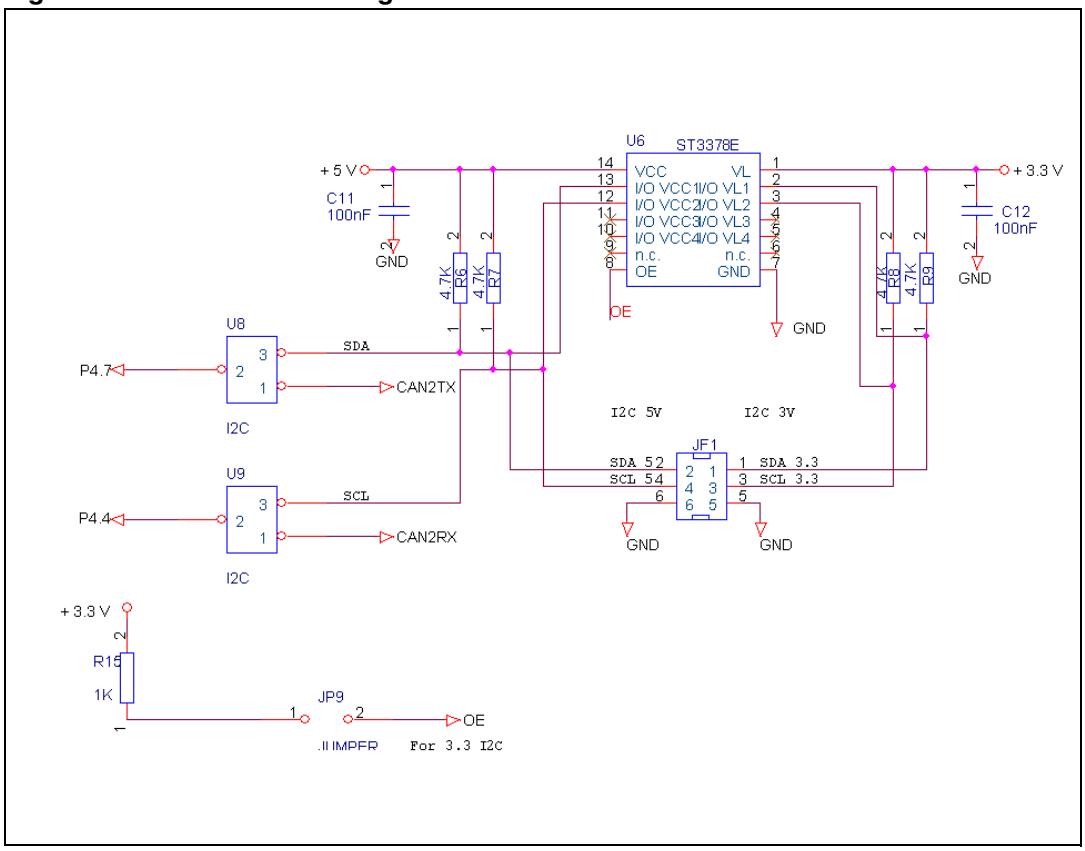
Figure 5. I²C schematic diagram



2.5 powerSPIN connectors

MDK-ST10 has three male connectors (34 pins) compatible with evaluation boards (EVAL 62xx) for the powerSPIN family with monolithic motor control chips: (L62xx devices).

The micro pins needed to control these boards are reported on the connectors.

When closed, jumpers “VCC Practi1”, “VCC Practi2” and “VCC Practi3” (J207,J208 and J209) supply 5V DC to powerSPIN boards.

PIN No.	practiSPIN 1	practiSPIN 2	practiSPIN 3	Functionality
1	5V via Jumper J207 (VCC PRACTI 1)	5V via Jumper J208 (VCC PRACTI 2)	5V via Jumper J209 (VCC PRACTI 3)	-
2	P2_10	P2_11	P2_12	Interrupt
3	P5_5	P5_6	P5_7	ADC
4	P0L.0	P0L.1	P0L.2	GPIO
7	P1L.0	P1L.1	P1L.2	ADC
8	P0L.3	P0L.4	P0L.5	GPIO
10	P0L.6	P0L.7	P6.3	GPIO
14	P6.0	P6.1	P6.2	GPIO

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PIN No.	practiSPIN 1	practiSPIN 2	practiSPIN 3	Functionality
20	P2.0	P2.1	P2.2	GPIO / Capcom
22	P8.0	P8.1	P8.2	PWM / GPIO
23	GND	GND	GND	-
26	P7.4	P7.5	P7.6	GPIO / Capcom
28	P7.0	P7.1	P7.2	PWM / GPIO
31	P2.13	P2.14	P2.15	GPIO / Capcom
32	P2.3	P2.4	P2.5	GPIO / Capcom
33	P1H.4	P1H.5	P1H.6	GPIO / Capcom
5,6,9,				
11-13,15-19,21,24,25,				
27,29,30,34	NC	NC	NC	-

Some connector signals (eight) are shared with MC connector (refer to *Section 2.4*), so in order to use the 3 powerSPIN connectors, the J206 jumpers have to placed in the position “Practi” position.

These connectors are indicated in the board layout with “practiSPIN 1”, “practiSPIN 2” and “practiSPIN 3”

2.6 MC connector

A standard ST Motor Control (shielded 34-pin) connector is present in the MDK-ST10 board to interface power boards compliant with this interface.

ST10 signals needed to manage boards compliant with this standard are available through this connector.

Table 5. MC connector description

PIN No.	ST10 PIN	Functionality	Value
1	P2.9	Interrupt	Fault
3	P7.0	PWM	PWM1_H
5	P8.0	PWM	PWM1_L
7	P7.1	PWM	PWM2_H
9	P8.1	PWM	PWM2_L
11	P7.2	PWM	PWM3_H
13	P8.2	PWM	PWM2_L
14	P5.4	ADC	BUS voltage
15	P5.0	ADC	Curr. Ph. A
17	P5.1	ADC	Curr. Ph. B
19	P5.2	ADC	Curr. Ph. C

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PIN No.	ST10 PIN	Functionality	Value
21	P6.7	GPIO	NTC
23	P8.3	PWM	Dissipative PWM
25	-	5V	5V
26	P5.3	ADC	Heatsink
27	P4.3	GPIO	PFC Sync
28	-	3.3V	3.3V
29	P7.3	PWM	PFC PWM
31	P3.6	T3 IN	Encoder A
33	P3.4	T3 EUD	Encoder B
2,4,6,8,			
10,12,16,			
18,20,22,			
24,30,32	-	GND	GND

Some connector signals (eight) are shared with practiSPIN connectors, so in order to use the MC Connector, jumper J206 has to placed in the position “MC” (see *Section 2.5*).

This connector is indicated by “MC Connector”.

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2.7 VN808 / GP connector

Connector “VN808” is a 14-pin socket compatible with VN808 evaluation boards.

A complete port of microcontroller is available through this connector

Table 6. VN/808 GP connector description

Pin	Value
1	5V via Jumper J210 ("VCC VN 808")
2	GND via Jumper J211 ("GND VN 808")
3	P6.4
4	P0H.0
5	P0H.1
6	P0H.2
7	P0H.3
8	P0H.4
9	P0H.5
10	P0H.6
11	P0H.7
12	NC
13	NC
14	NC

Note: Refer to the VN808 evaluation board for the exact matching of input and output

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3 Power supply

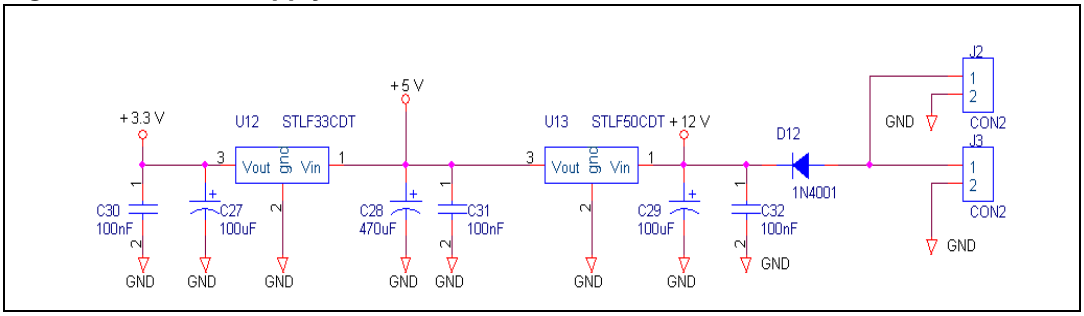
The power supply for the microcontroller is obtained through a low drop voltage regulator LF50 and the supply voltage of the board can reach 12 Volts.

A 3.3 V voltage regulator (LF33) is connected in chain with the previous one in order to provide the connector with a 3.3V supply for I^2C and external devices.

All the voltage levels of the board are related to connector J3.

The board is provided with two power supply connectors, a jack plug-in standard connector (J2) and a wire guard connector (J3).

Figure 6. Power supply



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4 MDK-ST10 configuration

MDK-ST10 has a series of dip-switches and jumpers that allow the configuration of the microcontroller (during the reset phase) and of the board.

The two 8-bit dip switch selectors SW3 and SW4 relate to the start-up configuration of microcontroller ST10 and are directly connected to the MCU's port pins P0L and P0H.

A functional description of each of the board's switches now follows.

4.1 Switch configuration

Note: The features are to be considered enabled when a switch is in the ON position.

4.1.1 Switch SW3

1: *EmuMode:* this switch selects the Emulation Mode when enabled (maintained low during a reset). This mode of operation allows the user to access the XBUX peripherals via the external bus interface. The EmuMode can be also used for special emulator purposes.

2: *Adapt Mode:* this switch allows the ADAPT Mode when selected (maintained low during a reset). In this mode of operation ST10 goes into a passive, floating state. This mode allows the user to switch the Control Unit virtually OFF so the user can develop applications for special emulator purposes only.

3, 4: *Reserved*

5: *BSL Mode:* this switch is used to be able to flash the device, it has to be enabled in order to start the loading of code into the microcontroller through a serial interface via PC and a Flash tool (for example, ST10Flasher).
This switch activates the on-chip bootstrap loader when it's high during the reset phase. In BSL mode, the on-chip bootstrap loader is activated and a small start code (about 32 bytes) is loaded into the internal RAM of ST10 via the serial interface (ASC0).
ST10 remains in BSL mode until a hardware reset occurs. This mode of operation may also be exited through a software reset instruction.

6: *Reserved*

7, 8: *External Bus 0, 1:* these switches allow the user to work in bus mode. *Table 7* shows the bit configurations of MDK-ST10 are reported.

Table 7. External Bus chip initialization

Ext. Bus 1	Ext. Bus 0	Ext. Data Bus Width	Ext. Address Bus Mode
ON	ON	8-bit Data	Demultiplexed Addresses
ON	OFF	8-bit Data	Multiplexed Addresses
OFF	ON	16-bit Data	Demultiplexed Addresses
OFF	OFF	16-bit Data	Multiplexed Addresses

Note: Factory settings of SW3 are: ALL BITS OFF.

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4.1.2 Switch SW5

1: *Write Conf.:* This switch selects the mode of operation for the pins $\overline{WR}$ and $\overline{BHE}$. When enabled they are in standard mode, otherwise the alternate function is selected.

2, 3: *Chip Sel. (0-1):* these switches define the number of active chip select lines after a reset signal occurs. This allows the user to select which pins of port 6 drive the external chip select signals and which may be used for general purpose I/O lines. See *Table 8* below for the correct configuration:

Table 8. Chip Select lines settings

Chip Sel. 1	Chip Sel. 0	Active Chip Selected	Comment
OFF	OFF	From CS0 to CS4	Port 6 pins available for I/O.
OFF	ON	None	Default of MDK-ST10.
ON	OFF	CS0, CS1	
ON	ON	From CS0 to CS2	

4, 5: *Segm. Addr.(0-1):* these switches establish the number of active segment address lines. In this way it is possible to select the pins of port 4 to work as general I/O lines as well as to become a part of the controller address logic. See *Table 9* for details about settings.

Table 9. Segment Address Lines

Segm. Addr. 1	Segm. Addr. 0	Segment Address Lines	Directly addressable space
OFF	OFF	A17, A16	256 KByte.
OFF	ON	From A23 to A16	16 MByte, CAN modules disabled.
ON	OFF	None	64 KByte.
ON	ON	From A19 to A16	1 MByte, default setting.

6, 7, 8: *Clock Sel.(0-1-2):* since the ST10F276 includes an internal PLL circuit, the external oscillator device does not need to be driven by a high frequency crystal.

The board is equipped with an 8MHz crystal and these three switches allow the configuration of the prescaler for the CPU clock. Refer to *Table 10* below for further details.

Table 10. Selection of CPU clock

Clock Sel. 2	Clock Sel. 1	Clock Sel. 0	CPU-Clock Fcpu=fxtal*F	Ext. Clock Input Range (MHz)	PLL Mode
OFF	OFF	OFF	Fxtal x 4	4 to 8	Active
OFF	OFF	ON	Fxtal x 3	5.3 to 10.6	Active
OFF	ON	OFF	Fxtal x 8	4 to 8	Active
OFF	ON	ON	Fxtal x 5	6.4 to 12	Active
ON	OFF	OFF	Fxtal x 1	1 to 64	Inactive

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Clock Sel. 2	Clock Sel. 1	Clock Sel. 0	CPU-Clock Fcpu=fxtal*F	Ext. Clock Input Range (MHz)	PLL Mode
ON	OFF	ON	Fxtal x 10	4 to 6.4	Active
ON	ON	OFF	Fxtal x 0.5	2 to 12	Active
ON	ON	ON	Fxtal x 16	4	Active

4.1.3 EA switch

SW4 is the switch for enabling Single Chip Mode. By default it is in the ON state (1). It can be set to OFF state (0) only if external Flash is connected to the MDK-ST10 board.

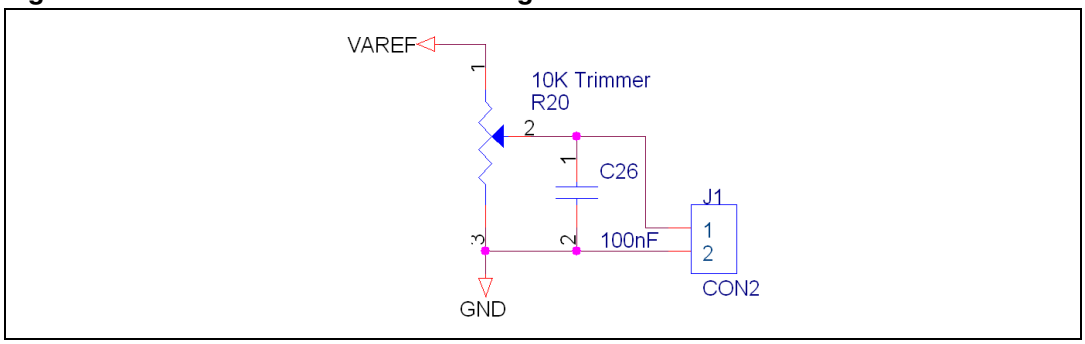
4.1.4 General purpose hardware

General Purpose Switch SW2: A user switch useful for general purpose applications, in fact it is connected to a 24-pin connectors (JP10, even lines) and uses a pull-up to 5V or a connection to ground. A series of LEDs are connected to the odd connector lines.

General Purpose Push button SW6: A pushbutton, GP, is connected to pin 23 of connector JP10 and can be connected to the microcontroller to perform general purpose applications.

General Purpose Potentiometer: Connector J1 controls the output of a 10K trimmer useful for general purpose applications.

Figure 7. Potentiometer schematic diagram



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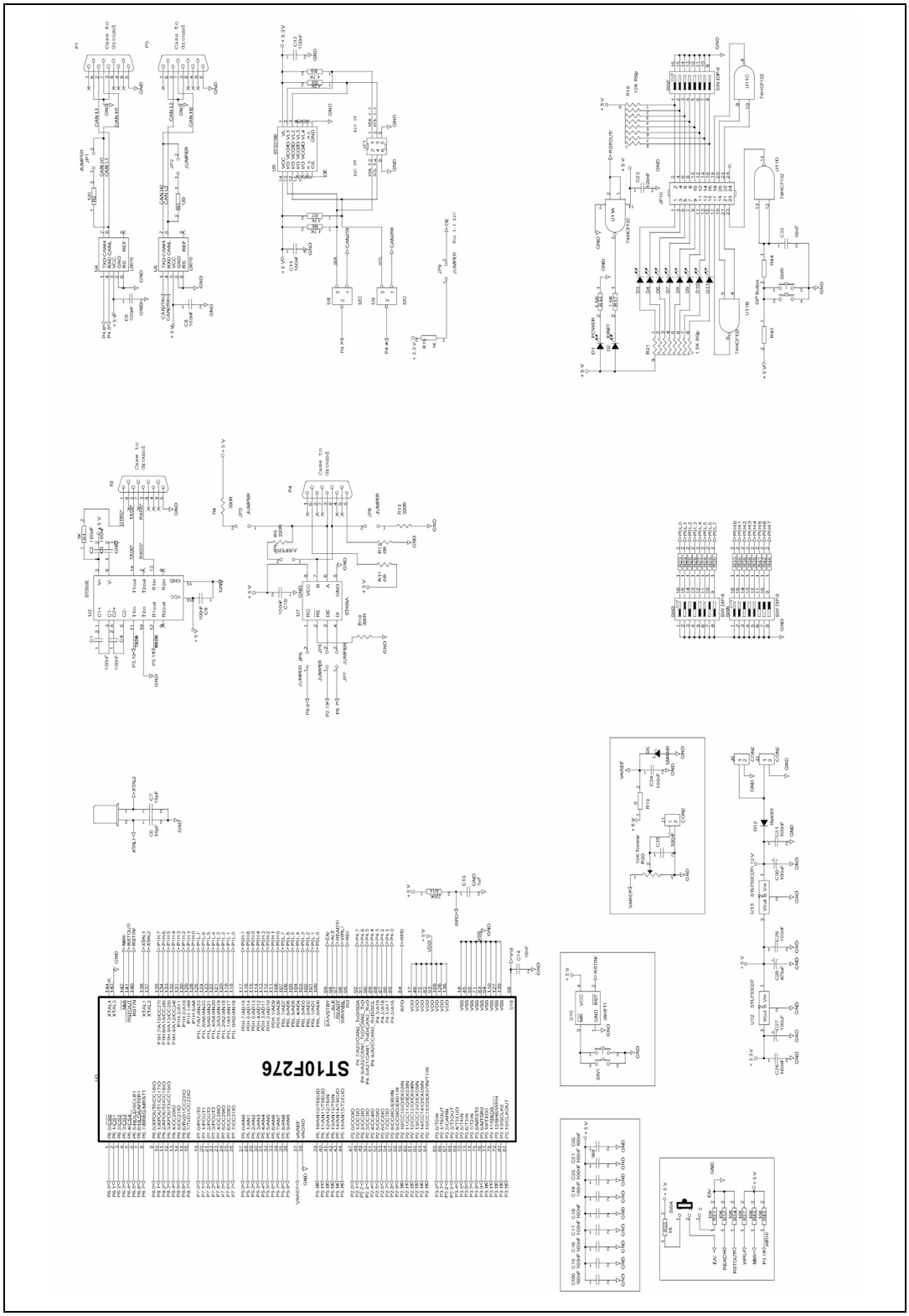
5 MDK-ST10 schematics



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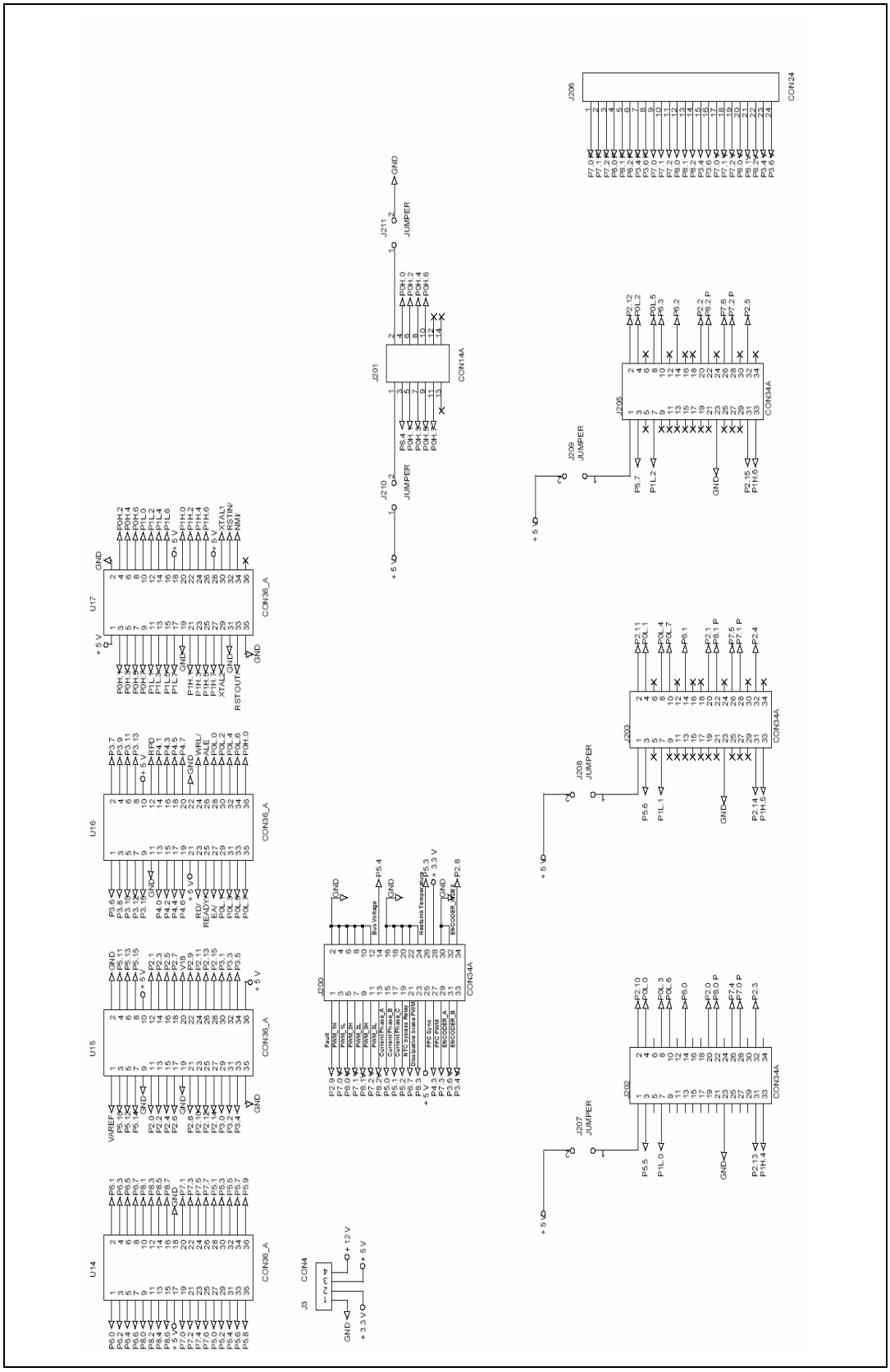

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6 MDK-ST10 bill of material

Item	Quantity	Reference part	value	Type	Order Code
1	25	C1, C2, C3, C4, C5, C8, C9, C10, C11, C12, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C29, C31, C100	100nF	SMD0805	
2	2	C6, C7	15pF	SMD0805	
3	1	C13	1uF	SMD0805	
4	2	C14, C32	10 nF	SMD0805	
5	2	C27, C30	100 uF	SMD0805	
6	1	C28	470 uF	SMD0805	
7	10	D1, D2, D3, D4, D6 ,D7, D8, D9, D10, D11	HLMP3 (LED diodes)	SMD1206	
9	1	D12	1N4001 Diode		
10	1	JF1	Strip 2x6 2.54 mm pitch		
11	14	JP1, JP2, JP3, JP4, JP5, JP6, JP7, JP8, JP9, J207, J208, J209, J210, J211	JUMPER 2 pin 2.54 mm pitch		
12	1	JP10	Strip 12x2 2.54 mm pitch		
13	3	J1, J2, J6	CON2 2 pin 2.54 mm pitch		
14	1	J3	Strip 1x4 2.54 mm pitch		
15	4	J200, J202, J203, J205	CON34A 2.54 mm pitch		
16	1	J201	CON14A 2.54 mm pitch		
17	1	J206	Strip 3x8 2.54 mm pitch		
18	2	P1, P3	CONNECTOR DB9 MALE		
19	2	P2, P4	CONNECTOR DB9 FEMALE		
21	3	R1, R15, R22	1k	SMD1206	
22	2	R2, R3	120	SMD1206	
23	3	R4, R10, R13	390R	SMD1206	
24	1	R5	220R	SMD1206	
25	4	R6, R7, R8, R9	4.7K	SMD1206	

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Item	Quantity	Reference part	value	Type	Order Code
26	2	R11, R12	0R	SMD1206	
27	1	R14	220K	SMD1206	
28	2	R16, R17	1.5K	SMD1206	
29	1	R18	10K Res strip 1x9 2.54mm pitch		
30	1	R19	0	SMD1206	
31	1	R20	10K Trimmer	SMD1206	
32	1	R21	1.5K Res strip 1x9 2.54mm pitch		
33	24	R23, R24, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R43, R44, R45, R46	10K	SMD1206	
34	1	SW1	Reset Button	Push button switch	
35	3	SW2, SW3, SW5	SW DIP-8	DIP-8 switch	
36	1	SW4	Strip 1x3 2.54 mm pitch		
37	1	SW6	GP Button	Push button switch	
38	1	U1	XTAL	Crystal 8 MHZ	
39	1	U2	ST202E	SMD SO16	ST202EBD
40	1	U3	ST10F276	PQFP144	ST10F276Z5T3
41	2	U4, U5	L9616	SMD SO-8	L9616-TR
42	1	U6	ST3378E	TSSOP14	ST3378ETTR
43	1	U7	ST485A	SMD SO8	ST485ABDR
44	2	U8, U9	Strip 1x3 2.54 mm pitch		
45	1	U10	STM811	SMD -SOT143-4	STM811LW16F
46	1	U11	74HCF132	SMD -SO14	M74HCT132M1R
47	1	U12	LF33	DPAK	LF33CDT
48	1	U13	LF50	DPAK	LF50CDT
49	4	U14, U15, U16, U17	Strip 2x18 2.54 mm pitch		

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7 Revision history

Table 11. Document revision history

Date	Revision	Changes
09-Oct-2006	1	Initial release.

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Appendix A Bibliography

ST10F276, DATASHEET - Rev 1.2 (Jan. 2005).

ST10F276, USER'S MANUAL - Release 1.6 (Jul. 2005).

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