LF Wake-up Demonstrator ATAK5276-83

1. General Description

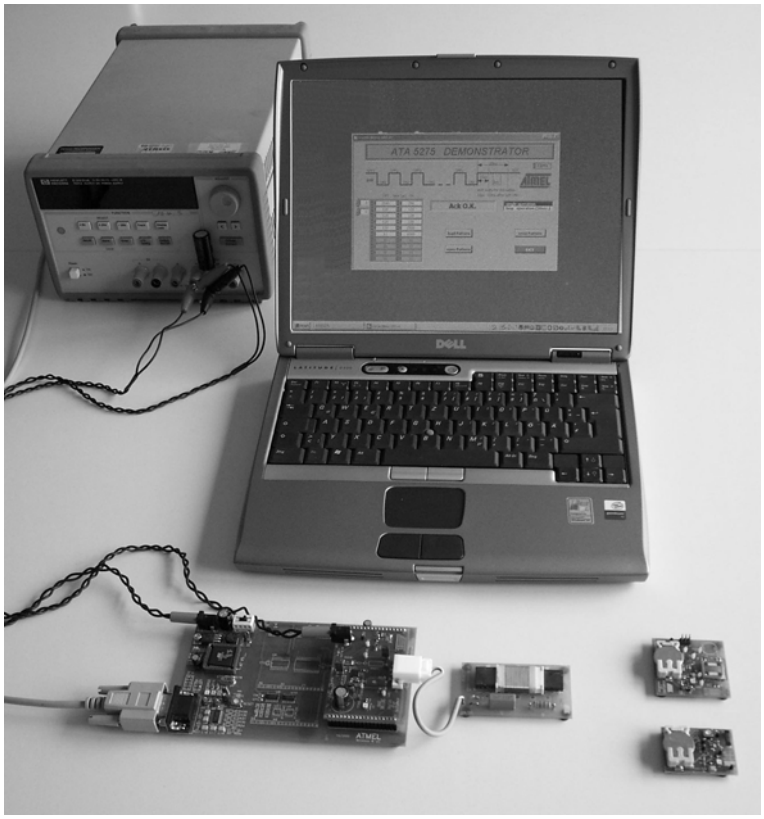
ATAK5276-83 is intended to demonstrate the performance of an LF wake-up channel needed for battery-driven systems. Typical wake-up applications can be found in vehicles for Tire Pressure Monitoring (TPM).

The demonstrator hardware (HW) consists of the LF transmitter board (ATAB5276) patched onto a microcontroller base board and an LF receiver board (ATAB5283). The high antenna driver ability of the transmitter, combined with the sensitive receiver, enables a wake-up distance of up to 2.5 meters.

For the general functionality of the ATA5276 and the ATA5283 please refer to the related datasheets.

2. System Configuration

Figure 2-1. LF Wake-up Demonstration System



ATAK5276-83 LF Wake-up Demonstrator

Application Note

4857C–AUTO–07/06

2.1 Components Included

- ATAB5276 demonstrator board patched onto a microcontroller base board
- ATAB5283 receiver board, inclusive Li battery (optionally, the ATAB5282 receiver board)
- Antenna module
- Serial RS232 interface cable
- Two cables for DC power supply
- CD-ROM installation software and documentation

2.2 Equipment Needed

- Host PC with Windows® 95 or higher
- Power supply 8V to 24V DC 2A (alternative 8V to 24V DC 1A with capacitor 2000 µF/20V at output)

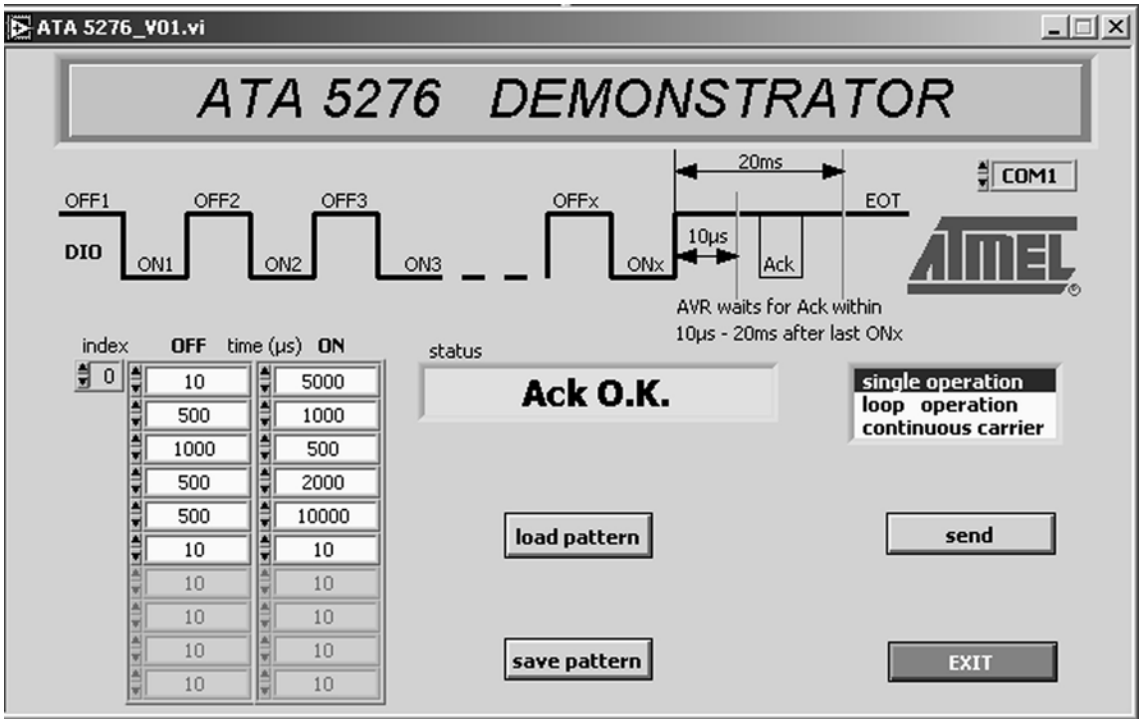
3. Host Software Controlling the ATAB5276 Transmitter Board

Host software is needed to control the transmitter board via the microcontroller on the base board. The software is installed by executing a self-extracting setup file contained on the included CD-ROM (see Section 5. ”Demonstrator: Getting Started” on page 11).

Upon execution of the demonstration software, the setup menu is displayed (see Figure 3-1 on page 3). Clicking *send* causes serial data patterns to be sent via the DIO line to the transmitter. Depending on the mode selection, patterns can be sent in single-operation or loop-operation mode. Pattern data to be sent can either be loaded by clicking on *load pattern*, or by directly editing the table. The index box to the left of the table shows the index number of the OFF/ON timing step located in the top row of the table. A maximum of 100 OFF/ON timing steps can be specified and saved to the AVR® microcontroller. Specially composed patterns may be saved into a new data file.

To demonstrate ATA5276 with ATA5283, an appropriate data file ATA5283.dat is loaded by default. That file includes the preamble protocol for waking up the receiver; followed by modulation data, switching on the LED indicator on the receiver board. With the *continuous carrier* mode selection, the field can be switched on steadily (this feature is useful for antenna evaluation or field strength measurements).

Figure 3-1. Command Settings on the Host Screen



4. Hardware Components

4.1 Transmitter Board ATAB5276_V1 with External Antenna Module

Figure 4-1. Transmitter Board ATAB5276_V1

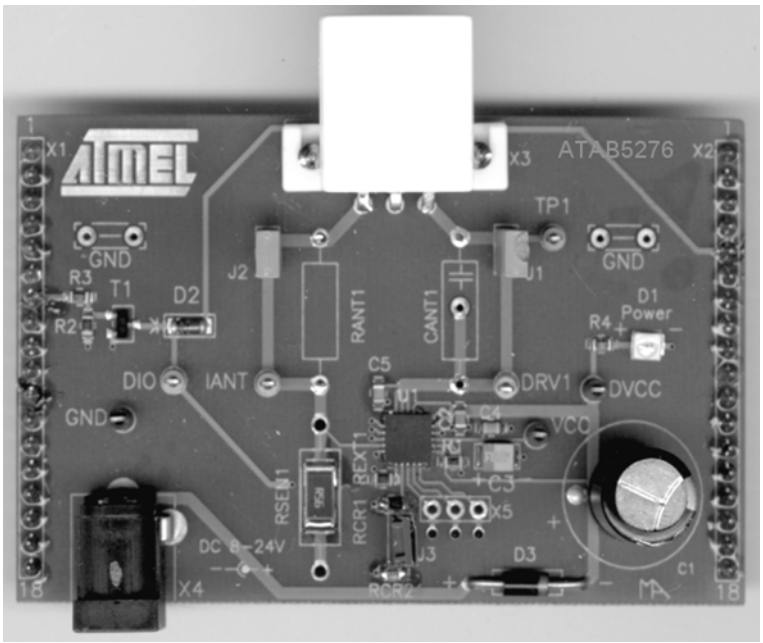
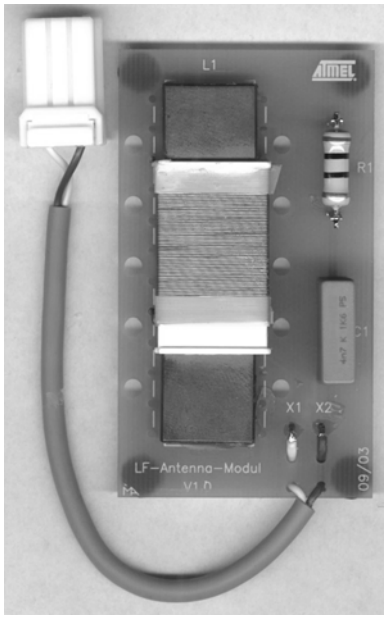


Figure 4-2. Antenna Module



The transmitter board (see Figure 4-1 on page 3) is patched onto a microcontroller base board communicating with a host PC. Operation software must be installed on the host via the enclosed CD-ROM. A power source of typically 12V/2A is used to supply the microcontroller base board and the transmitter board in parallel with separate connectors as seen in Figure 2-1 on page 1. The antenna driver frequency is tracked according to the resonant condition of the antenna in use. An external antenna module (see Figure 4-2 on page 4) is used, with the high voltage capacitor and resistor matching the resonant frequency and Q-factor. The capacitor CANT (C1) is used to match the resonant frequency to fres = 125 kHz ±3 kHz, and the resistor RANT (R1) sets the Q-factor to about 25. With the default module adjustment, a current flow of around 0.6 Ap at VBATT = 12V can be achieved. Therefore, jumper J3 has to be closed ($R_{CR} = R_{CR1}//R_{CR2}$ = 25 kΩ). If Jumper J3 is open ($R_{CR} = R_{CR1}$ = 100 kΩ) the current set point is decreased leading to a regulation level of typically 0.37 Ap.

To reach the maximum antenna current (1.5 Ap), the series resistor RANT (R1) on the antenna module has to be shorted and the current regulation set point has to be set to maximum $R_{CR} = R_{CR1}//R_{CR2}$ = 25 (J3 closed).

Optionally, RANT and CANT can be placed on the board if a customized pure antenna coil will be used. Then, Jumpers J1 and J2 have to be opened.

Note: The power dissipation of shunt resistor RSEN and module resistor RANT must be considered if a high antenna current in continuous operation mode will be programmed.

4.2 Typical Parameters of Antenna Module

Coil Inductance:	L_{125} = 345 [µH] ±5%
Coil Resistance:	R_{125} = 2.5 [Ω]
Impedance:	Z_{125} = 271 [Ω]
Module Series Resistor:	RANT (R1) = 10 [Ω]
Series Capacitor:	4.7 nF/1400V
Total Q-Factor:	Q_{125} = 22

Figure 4-3. Schematic of the Transmitter Board ATAB5276_V1

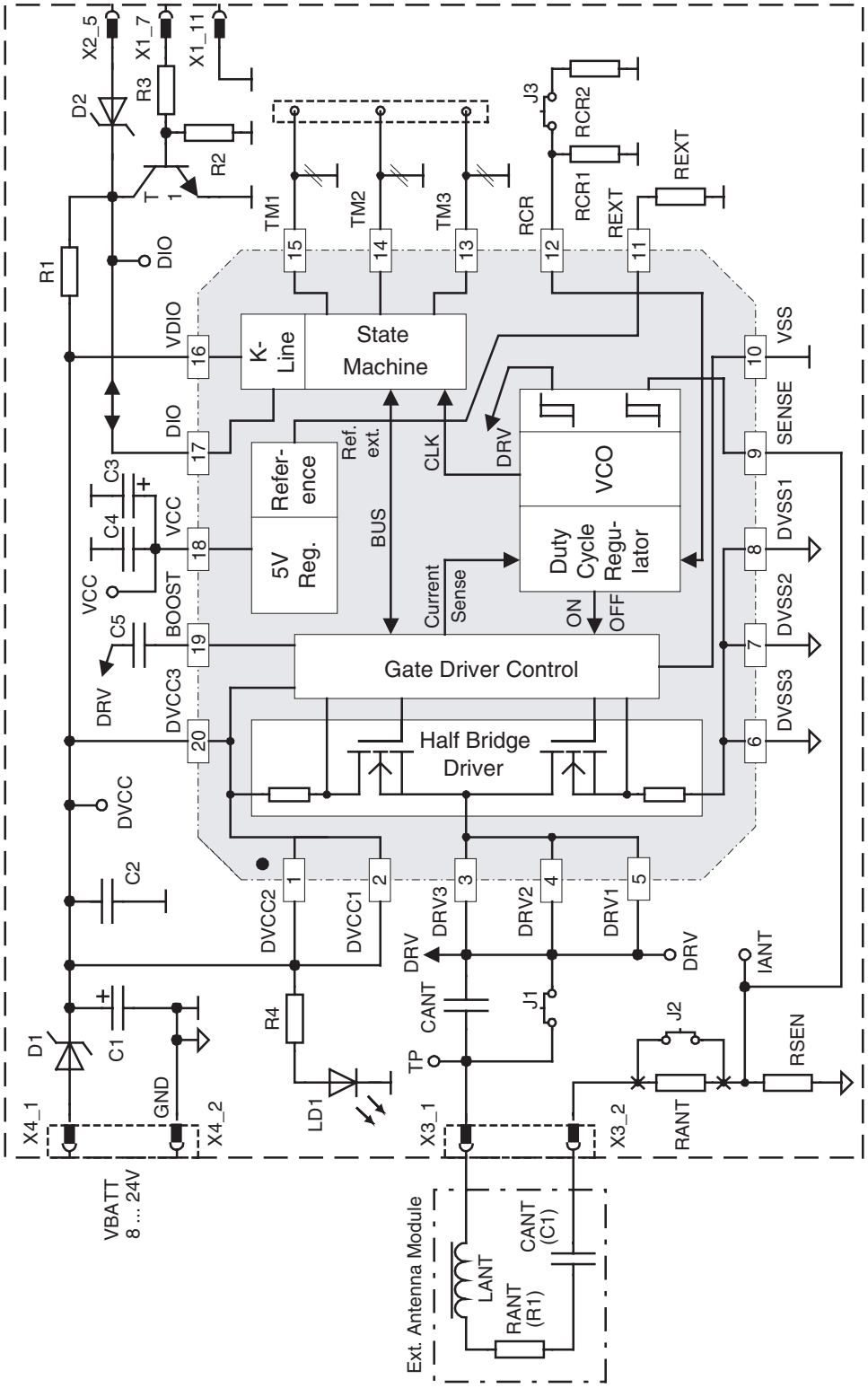


Table 4-1. Parts List of the Transmitter Board ATAB5276_V1

Part No.	Designation	Value	Type	Manufacturer
U1	Transmitter IC	-	ATA5276	Atmel®
T1	NPN transistor	Standard	BC847	-
D3	Schottky diode	50V/1.1A/(40V/1.1A) 5.5A	SL04	for example, Vishay®
D2	Schottky diode	30V/0.2A	BAT42W	for example, Vishay
D1	LED	Red	TLMT3100	for example, Vishay
R1	Resistor	47 kΩ	SMD 0805	for example, Vishay
R2	Resistor	100 kΩ	SMD 0805	for example, Vishay
R3	Resistor	10 kΩ	SMD 0805	for example, Vishay
R4	Resistor	1.8 kΩ	SMD 0805	for example, Vishay
REXT	Resistor	100 kΩ	SMD 0805	for example, Vishay
RCR1	Resistor	100 kΩ	SMD 0805	for example, Vishay
RCR2	Resistor	33 kΩ	SMD 0805	for example, Vishay
RSEN	Resistor	0.56Ω/1W	SMD2512	for example, Vishay
RANT	Resistor	Optional	n.c.	-
C1	Capacitor	Electrolytic 120 µF/50V	EEUFC1H121	Panasonic®
C2	Capacitor	Ceramic 100 nF	SMD 0805	Standard
C3	Tantalum	10 µF/10V	SMD	-
C4	Capacitor	Ceramic 100 nF	SMD 0805	Standard
C5	Capacitor	Ceramic 1 nF	SMD 0805	Standard
CANT	Capacitor	Optional	n.c.	-
DIO, IANT, DRV1, TP1	PCB test terminal	Yellow	-	-
GND	PCB test terminal	Black	-	-
DVCC, VCC	PCB test terminal	Red	-	-
X1–X2	Connector 18 pin	-	-	-
X3	Antenna plug	-	PN 175781-1	Tyco Electronics®
X4	Power plug	(2.1 mm)	-	Cliff Electronics®
J1-J3	Header 2 pole	-	-	-
(J1-J3)	Jumper	2.54 mm	-	-
PCB	Board	ATAB5276 V1.0/1.5 mm	-	Atmel

4.3 Receiver Board ATAB5283

The receiver IC ATA5283 is equipped with a 1D LF antenna on-board.

Received data is indicated by an LED display. Once data is received, the IC can be returned to STANDBY mode by pressing the RESET button. Test pins allow the measurement of all relevant signals. A 3V lithium battery is used, supplying the receiver with LED indication.

Figure 4-4. Receiver Board ATAB5283_V3

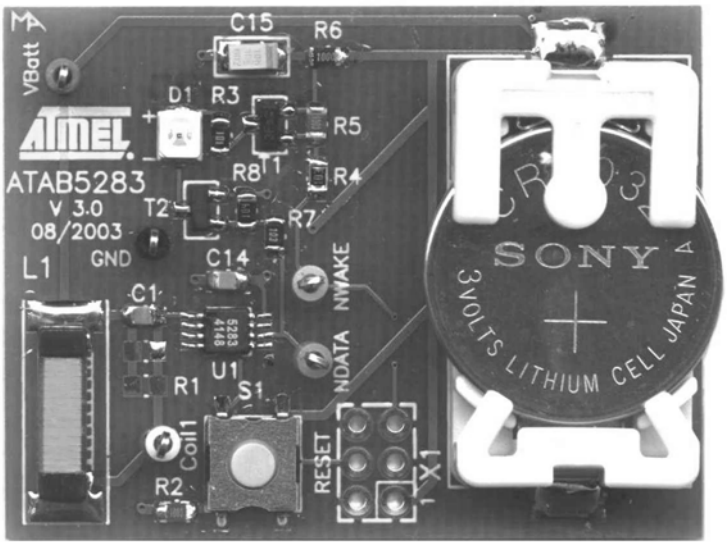


Figure 4-5. Schematic of Receiver Board ATAB5283_V3

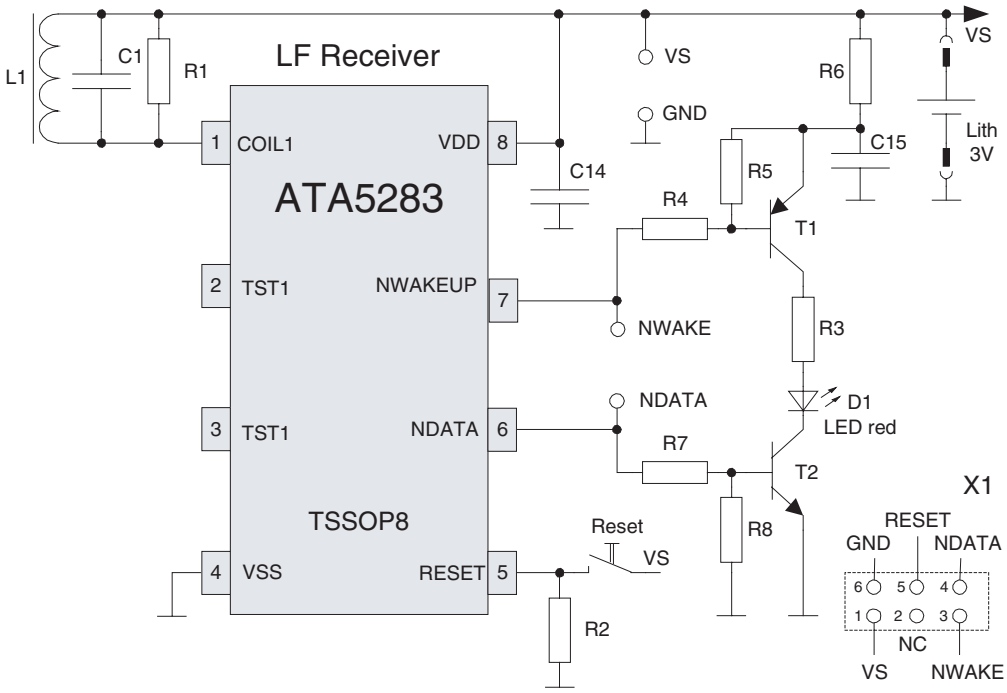


Table 4-2. Parts List of Receiver Board ATAB5283_V3

Part No.	Designation	Value	Type	Manufacturer
U1	Wake-up IC	-	ATA5283	Atmel
T1	Transistor	PNP	BC857	-
T2	Transistor	NPN	BC847	-
D1	LED	Red	TLMT3100	Vishay
L1	Antenna coil	7.2 mH/Q = 28	SDTR1103-0720	Predan
C1	Capacitor	220 pF ±5%/50V	SMD Ceramic	for example, Vishay
C1b	Capacitor	Optional	-	for example, Vishay
C14	Capacitor	100 nF ±10%/50V	SMD Ceramic	for example, Vishay
C15	Capacitor	10 µF/10V	Tantalum	for example, Vishay
R1	Resistor	Optional	-	-
R2	Resistor	100 kΩ	Standard	-
R3	Resistor	100Ω	Standard	-
R4	Resistor	47 kΩ	Standard-	-
R5	Resistor	100 kΩ	Standard-	-
R6	Resistor	100Ω	Standard-	-
R7	Resistor	10 kΩ	Standard-	-
R8	Resistor	100 kΩ	Standard-	-
Vbatt1	Battery holder	-	-	-
Li-Cell	-	3V/220 mAh	CR2032	-
S1	Push button	-	-	ITT-Cannon®
6 pcs	Test pins	-	-	-

4.4 Receiver Board ATAB5282

An LF wake-up demonstration can alternatively be performed with the 3D receiver ATA5282.

Due to the header detection, the Q-factor of the antenna module has to be reduced to Q < 20 (for example, RANT = 15).

The board is equipped with a 3D LF antenna. It offers the possibility of an optional assembly by separate antenna coils for x, y, and z field detection. Additionally, an LED is used to indicate the received data protocol. Test points and a pin socket allow the measurement of all relevant signals. A 3V lithium battery is used, supplying the receiver with LED indication.

Figure 4-6. Receiver Board ATAB5282_V4

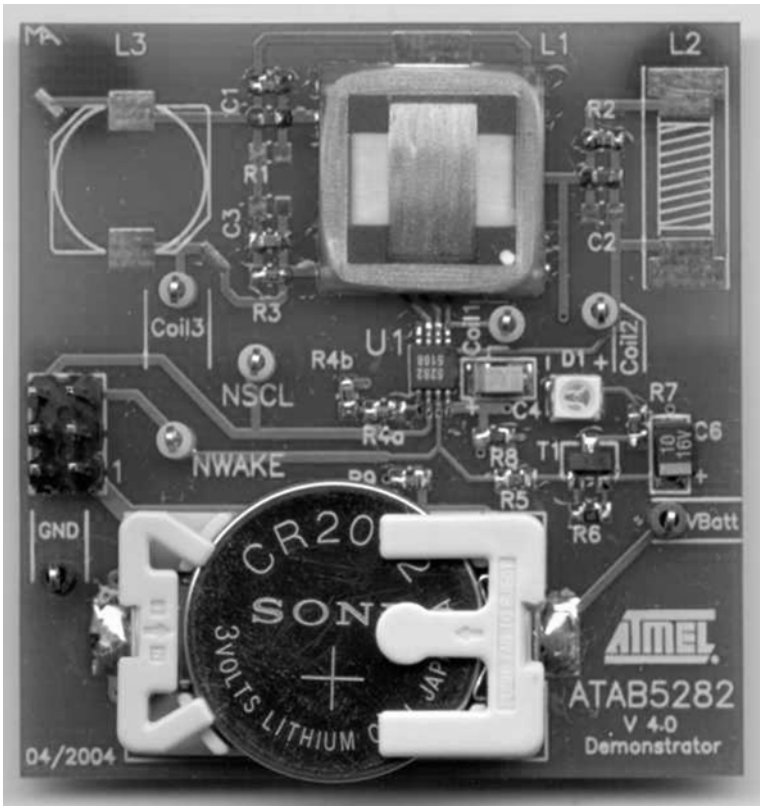


Figure 4-7. Schematic of Receiver Board ATAB5282_V4

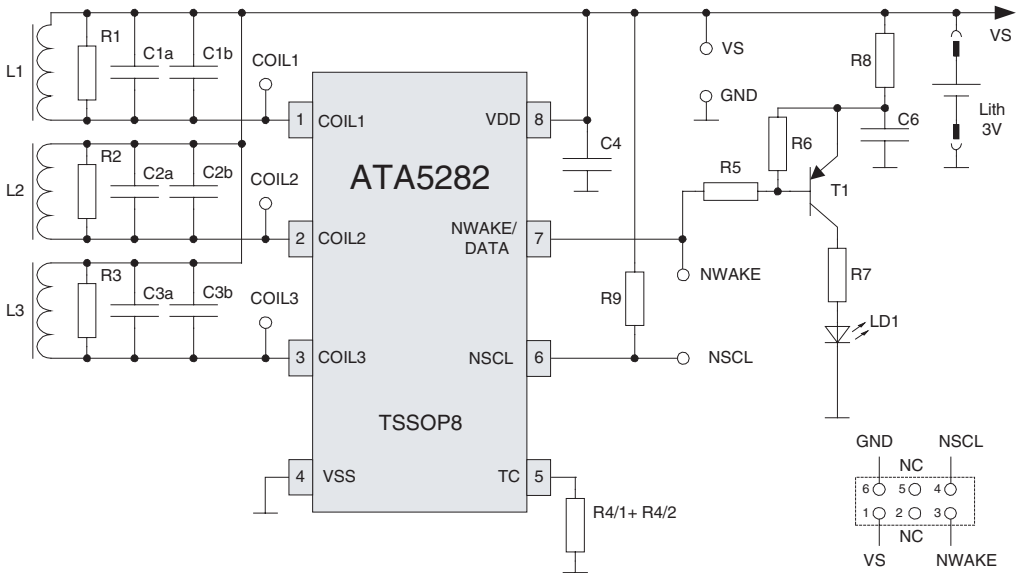


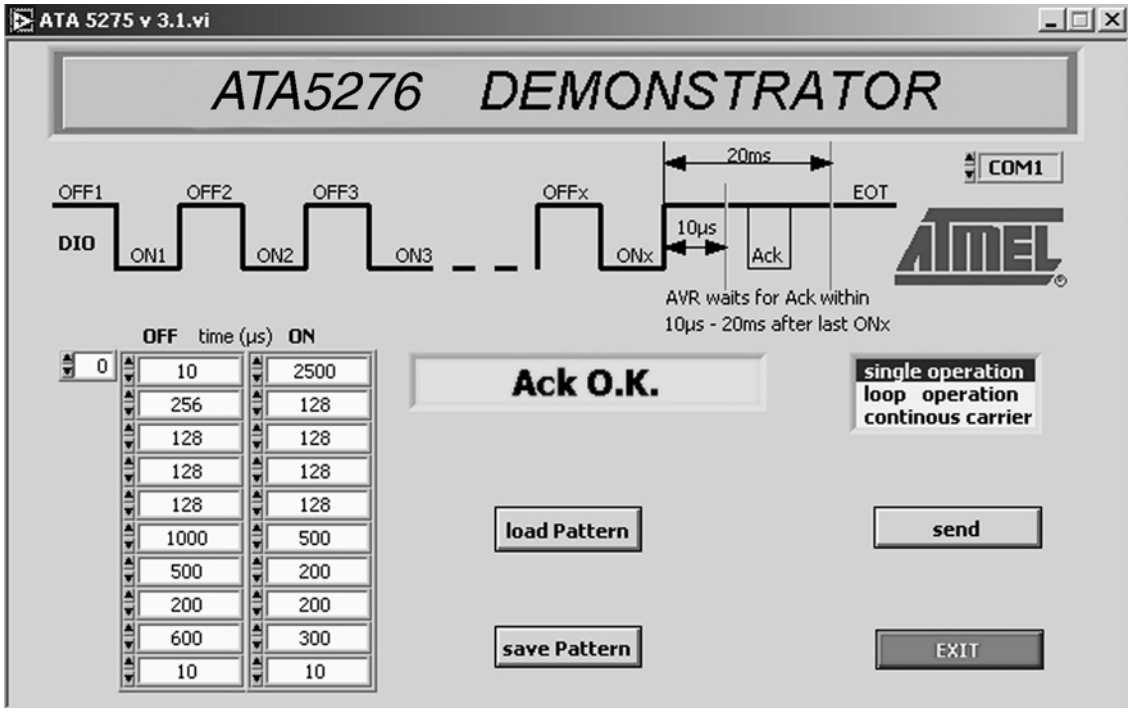
Table 4-3. Parts List of the Receiver Board ATAB5282_V4

Part No.	Designation	Value	Type	Manufacturer
U1	Wake-up IC	-	ATA5282	Atmel
T1	Transistor	PNP	BC857	-
LD1	LED	Red	TLMT3100	Vishay
L1-L3	3D Antenna Coil	4.77 mH/5.89 mH/Q = 37/35	3DC1515S-0477X	Predan
C1	Capacitor	330 pF ±5%/50V	SMD Ceramic	for example, Vishay
C2	Capacitor	330 pF ±5%/50V	SMD Ceramic	for example, Vishay
C3	Capacitor	270 pF ±5%/50V	SMD Ceramic	for example, Vishay
C4	Capacitor	1 µF/10V	Tantalum	for example, Vishay
C6	Capacitor	10 µF/10V	Tantalum	for example, Vishay
R1	Resistor	180 kΩ	SMD 0805	-
R2	Resistor	180 kΩ	SMD 0805	-
R3	Resistor	390 kΩ	SMD 0805	-
R4/1	Resistor	1 MΩ	SMD 0805	-
R4/2	Resistor	1 MΩ	SMD 0805	-
R5	Resistor	47 kΩ	SMD 0805	-
R6	Resistor	100 kΩ	SMD 0805	-
R7	Resistor	100Ω	SMD 0805	-
R8	Resistor	100Ω	SMD 0805	-
R9	Bridge	10 kΩ	SMD 0805	-
Vbatt1	Battery holder	-	-	-
Li-Cell	-	3V/ 220 mAh	CR2032	-
7 pcs	Test Pins	-	-	-
1 pcs	Test Socket	2 x 3 pole	-	-

5. Demonstrator: Getting Started

1. Build up the demonstrator system according to the configuration shown in Figure 2-1 on page 1.
2. Install the demonstration software by executing setup.exe and following the menu instructions.
   If, during the installation process, the proposed default folder is accepted, the path of ATA5276.exe is as follows:
   - Using an English-language Windows system: \ Program Files\Ata5276\Ata5276.exe
   - Using a German-language Windows system: \ Programme\Ata5276\Ata5276.exe
3. Copy the default patterns ATA5283.dat and ATA5282.dat from the CD-ROM to the installation folder.
4. When the software program ATAB5276.exe (located in the installation folder) is executed, the host operating menu as shown in Figure 5-1 appears.

Figure 5-1. Operating Menu on Host

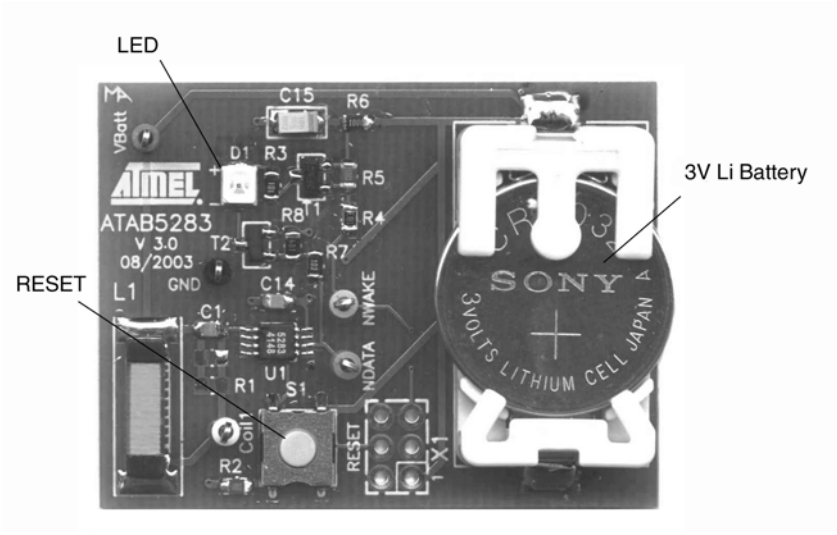


6. Demonstration Performance

6.1 Protocol Sent Indicated by LED on Receiver Board

1. After starting the demonstrator, insert the battery into the slot of the ATAB5283/ATAB5282 receiver board and place the board within a distance of about 50 cm of the ATAB5276, along the transmitter antenna axis.
2. Press the RESET button once to reset the AGC control of the ATA5283 as shown in Figure 6-1).

Figure 6-1. ATAB5283 Receiver Board

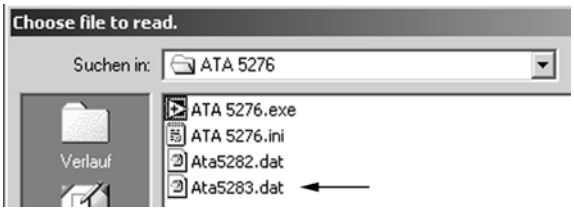


3. The ATA5283 data pattern is already loaded by default. If appropriate, ATA5282.dat or a custom file can be loaded. To do this, click on *load Pattern* (see Figure 6-2).

Figure 6-2. Load Pattern

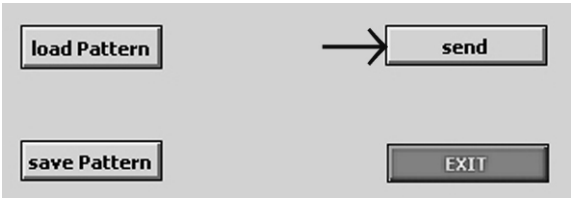
4. Select one of the *.dat* files (see Figure 6-3 on page 13). The ATA5283.dat protocol consists of a preamble followed by data which will be indicated by LED. In contrast, the ATA5282 requires, in addition, a header ID after the preamble before data are sent. These patterns are offered by ATA5282.dat file.

Figure 6-3. Select Data Files



5. When the send button is pressed, the loaded protocol (pattern) is sent by the transmitter (see Figure 6-4). By default *single operation* mode is enabled, meaning that the protocol is sent once when the *send* button is pressed. In *loop operation*, the protocol is sent continuously. Using the default ATAB5276 transmitter setting (I_{ant} = 0.6 Ap), the ATAB5283/ATAB5282 receiver should be able to detect the protocol at a distance of up to about 2 meters along the antenna axis. Longer distances can also be reached by increasing the antenna current, for example to 1.5 Ap with shorted RANT on the antenna module. Each protocol cycle received is indicated by LED on the receiver board ATAB5283/ATAB5282. (see Figure 6-1 on page 12).

Figure 6-4. Send Pattern



Note: Whenever the position of the ATAB5283 receiver is moved inside the field, a reset has to be performed to re-initialize the AGC control. Do not operate the system near disturbed environments, for example, monitors or SMPS units. The field radiation may negatively influence the system performance.

6.2 Error Diagnosis

Several parameters are monitored by the IC, such as undervoltage, overtemperature, antenna frequency range, and antenna current. The acknowledge bit is returned by the IC after the pattern has been sent.

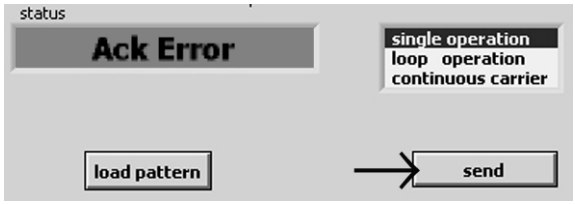
The status of the acknowledge is displayed by the program. It displays *Ack O.K.* if no error is detected, and *Ack Error* if a failure has occurred (see Figure 6-5).

Using the demonstrator system antenna, current undervoltage monitoring can be easily performed, for example:

- Turn the voltage of the power source below 6.5V
- Short or open the antenna module via the plug

In both cases the *Ack Error* message is displayed after pressing send.

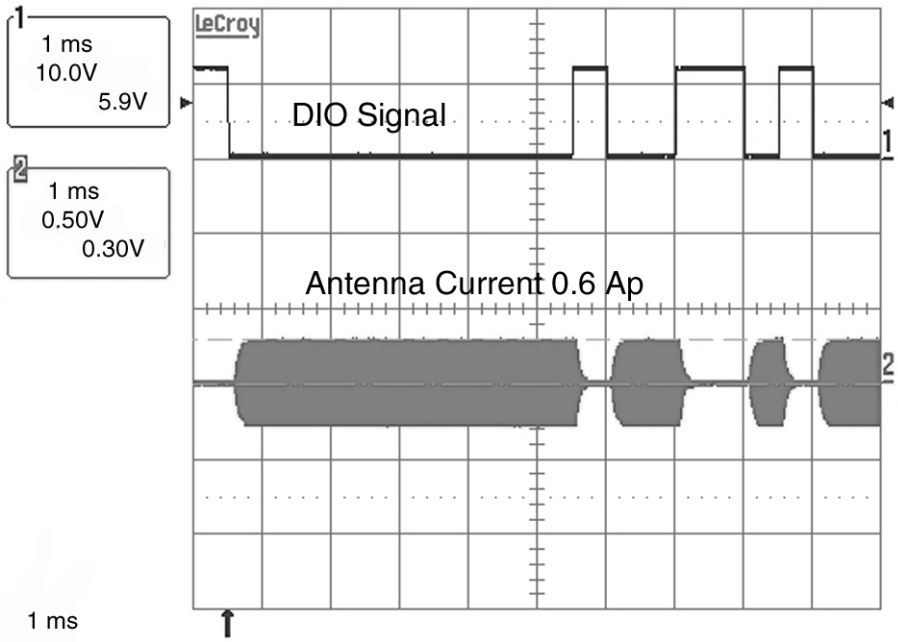
Figure 6-5. Acknowledge Status



6.3 Antenna Current Measurements

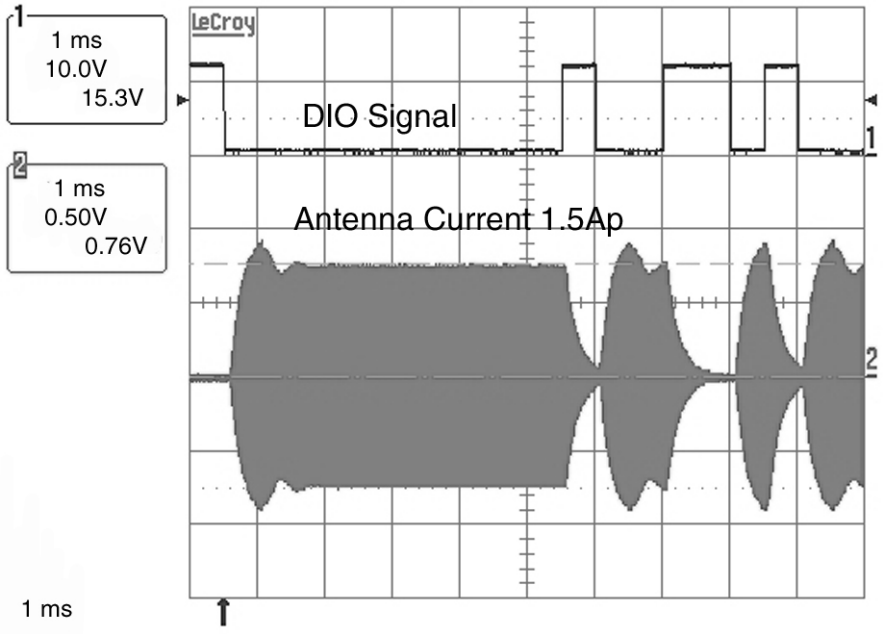
Using the standard antenna module, the maximum antenna current measures about 0.6 Ap at 12V operating voltage (see Figure 6-6). At this antenna current, the IC is out of regulation because the current does not reach the set point of 1.5 Ap determined by RCR = RCR1//RCR2 = 25 kΩ

Figure 6-6. Antenna Current out of Regulation



To reach the current regulation level of 1.5 Ap (see Figure 6-7), the series resistor RANT (R1) on the antenna module has to be shorted. In this case, the antenna quality factor is increased to Q = 108. Due to the high Q-factor, the current regulation leads to a short overswing during the switch-on phase. In the shorted R1 state, the antenna can also be operated with half current 0.75 Ap by opening jumper J3 (RCR = RCR1 = 100 kΩ).

Figure 6-7. Antenna Current in Regulation



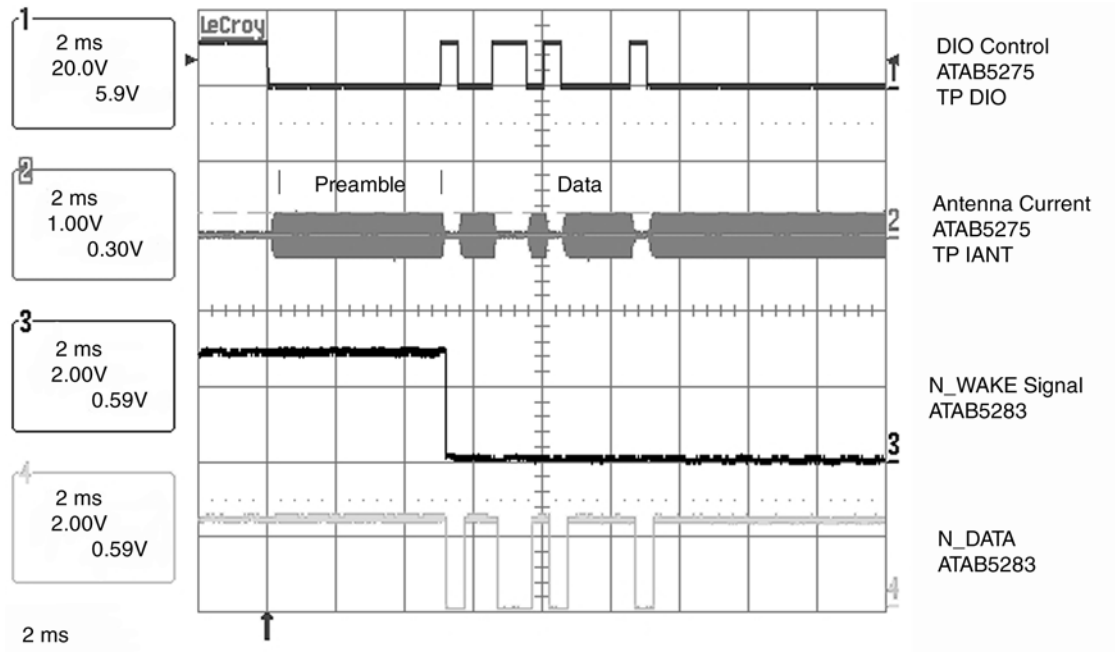
Note: Consider the power dissipation of shunt resistor RSEN and module resistor RANT when operating the driver continuously (loop operation mode).

When operating the driver out of current regulation, the PWM stage is controlled by a 1:1 duty cycle. This could be an advantage with respect to the radiated harmonics in contrast to using regulation mode.

6.4 Signal Transmission Measurements

The relationship of the sent and received protocol can be measured on the boards ATAB5276 (transmitter) and ATAB5283 (receiver) via the related test pins TPx. Figure 6-8 on page 16 shows an example of the send protocol with the default data pattern and the default transmitter current of 0.6 Ap.

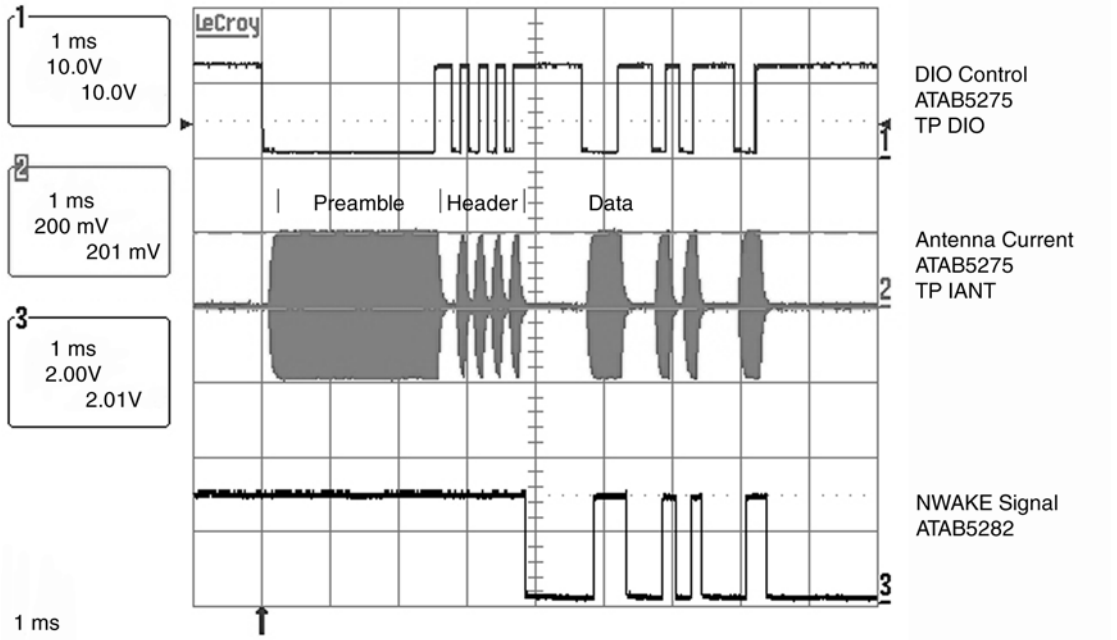
Figure 6-8. Signal Transmission ATAB5276 Transmitter to ATAB5283 Receiver



A similar protocol transmission to the 3D receiver is shown in Figure 6-9.

Due to the header detection, the Q-factor of the transmitter antenna module is reduced to a value of Q = 13 (RANT = 18Ω).

Figure 6-9. Signal Transmission ATAB5276 Transmitter to ATAB5282 Receiver



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