



LF Wake-up Demonstrator ATA5278-82

1. General Description

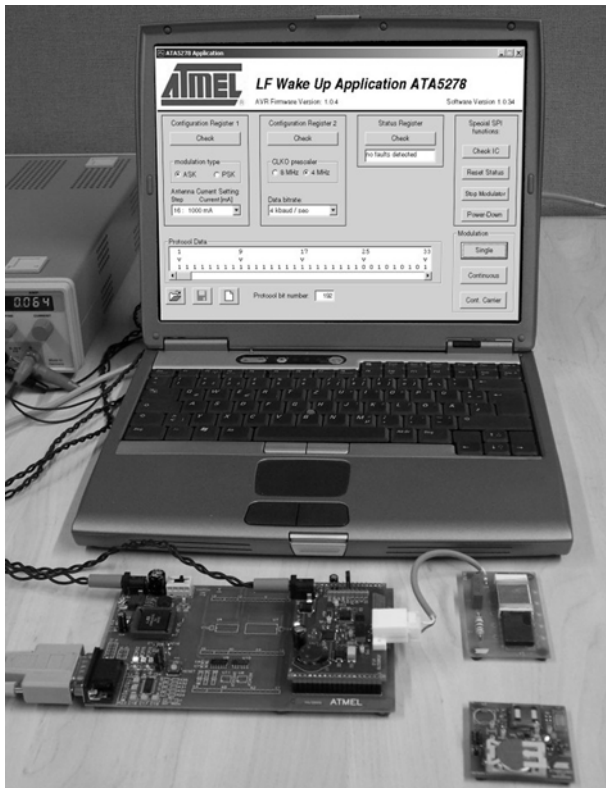
The LF wake-up demonstrator is provided to demonstrate the performance of an LF wake-up channel, mainly needed for battery-driven systems. Typical wake-up applications can be found in vehicles for passive entry (PE) and tire pressure monitoring systems (TPMS).

The offered demonstration system consists of the 125 kHz LF transmitter ATA5278 controlled by host software, combined with the 3D receiver ATA5282. The high antenna driver ability of the transmitter as well the sensitive receiver enable a wake-up distance of up to 3 meters.

For the general functionality of the ATA5278 and ATA5282, please refer to the related data sheets.

2. System Overview

Figure 2-1. LF Wake-up Demonstration System



ATA5278-82 LF Wake-up Demonstrator

Application Note



2.1 Components Included in Kit

- ATAB5278 demonstrator board piggy-backed onto microcontroller baseboard
- ATAB5282 3D receiver board including 3V lithium battery (default), or ATAB5283 1D receiver board including 3V lithium battery (optional)
- Antenna module
- Interface cable RS232
- 2 cables for DC power supply
- CD-ROM installation software and documentation

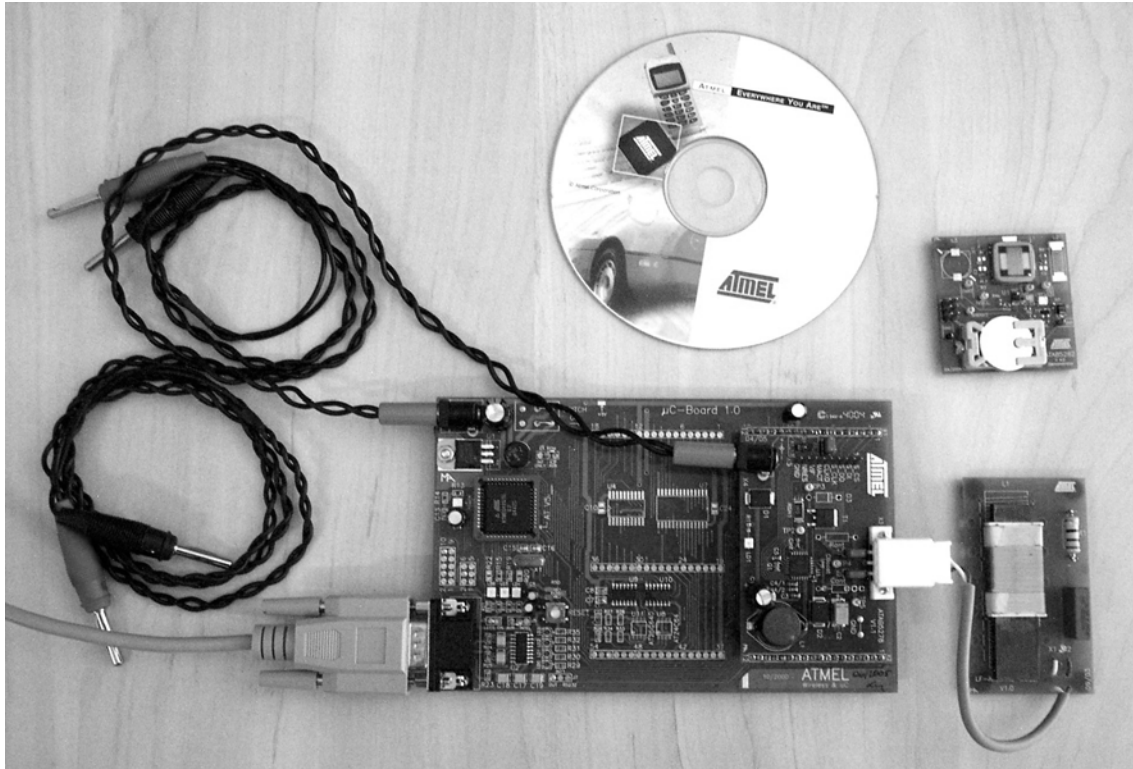
2.2 Equipment Needed

- Host PC running Windows[®] 95 or higher, with CD-ROM drive
- Power supply 8V to 15V DC 1A

3. Hardware Components

The ATAB5278 transmitter interface is patched onto a microcontroller baseboard. The ATmega8515 microcontroller is programmed in C to control the interface and to maintain communication with the host. Therefore, operation software has to be installed on the host via the enclosed CD-ROM. A power source with a voltage range of 8V to 15V/1A is needed to supply, in parallel, both the baseboard and transmitter board by separate cable connectors as shown in [Figure 2-1 on page 1](#) and [Figure 3-1](#).

Figure 3-1. Components Contained in Kit



3.1 Transmitter Board ATAB5278

The transmitter board is plugged into the baseboard via header pin connectors controlled by the AVR[®] microcontroller on the baseboard through the SPI interface.

In accordance with the features provided by the IC, the board is equipped with a choke for the boost converter needed to achieve a wide range of antenna current regulation independent of battery voltage and antenna impedance.

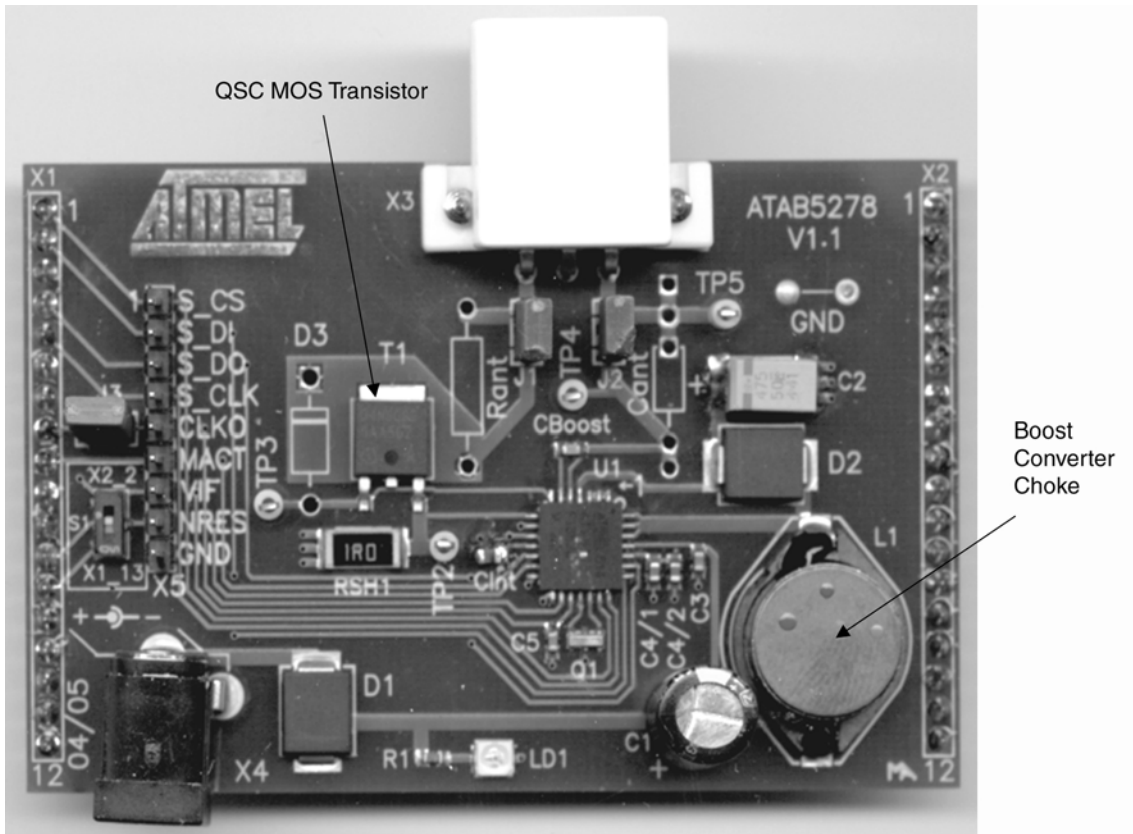
Thanks to the patented Quick Start Control (QSC) feature of the IC, the antenna current can be switched on and off without a slope of the magnetic field, independent of the selected antenna Q factor. Therefore, the board is fitted with an additional high voltage (600V) MOS transistor, T1, switching the antenna loop on and off, synchronized by zero cross detection. Comparisons of data transmission, with and without QSC, are shown by [Figure 6-7 on page 18](#) and [Figure 6-8 on page 19](#).

Generating a fixed antenna driver frequency of 125 kHz, the IC is operated with a stable 8 MHz resonator oscillator. A programmable clock output (8 MHz/4 MHz) is provided on the header pin for external use. The clock can be disconnected from the header using jumper J3. For the application kit, an external antenna module ([Figure 3-3 on page 5](#)) is used, excluding the high-voltage and high-power components from the transmitter board. But, for development purposes, the components for antenna matching can also be placed on the transmitter board, so the pure antenna coil may be connected by the antenna plug. Therefore, the jumpers J1 and J2 have to be opened to release Cant and Rant, matching the resonant frequency and Q factor of the antenna.

With the contained antenna module, the maximum driver ability ($1A_p$) of the transmitter can be achieved. The hardware reset of the IC (NRES) is selectable by S1 from two baseboard controls:

- System reset NRESET S1 position x2_2 (default setting)
- Port PA5 S1 position x1_13

Figure 3-2. Transmitter Board ATAB5278



3.2 Antenna Module

The antenna module is matched by capacitor CANT (C1) to resonant frequency
 $f_{\text{res}} = 125 \text{ kHz} \pm 3 \text{ kHz}$.

Whereas the total antenna quality factor is adjusted by RANT (R1) to typical $Q = 25$.

3.2.1 Typical Parameters at 125 kHz

Coil Inductance:	$L_C = 345 \text{ } [\mu\text{H}] \pm 5\%$
Coil Resistance:	$R_C = 2.5 \text{ } [\Omega]$
Impedance:	$Z_C = 271 \text{ } [\Omega]$
Coil Q Factor	$Q_C = 108$
Resistor	RANT (R1) = $10\Omega/1\text{W}$
Total Q Factor	$Q_t = 25$
Capacitor	CANT (C1) = $4.7 \text{ nF}/600\text{V}$

Figure 3-3. Antenna Module

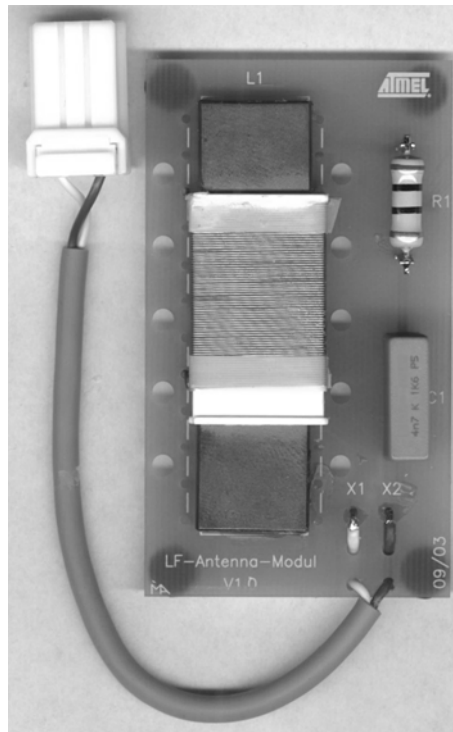
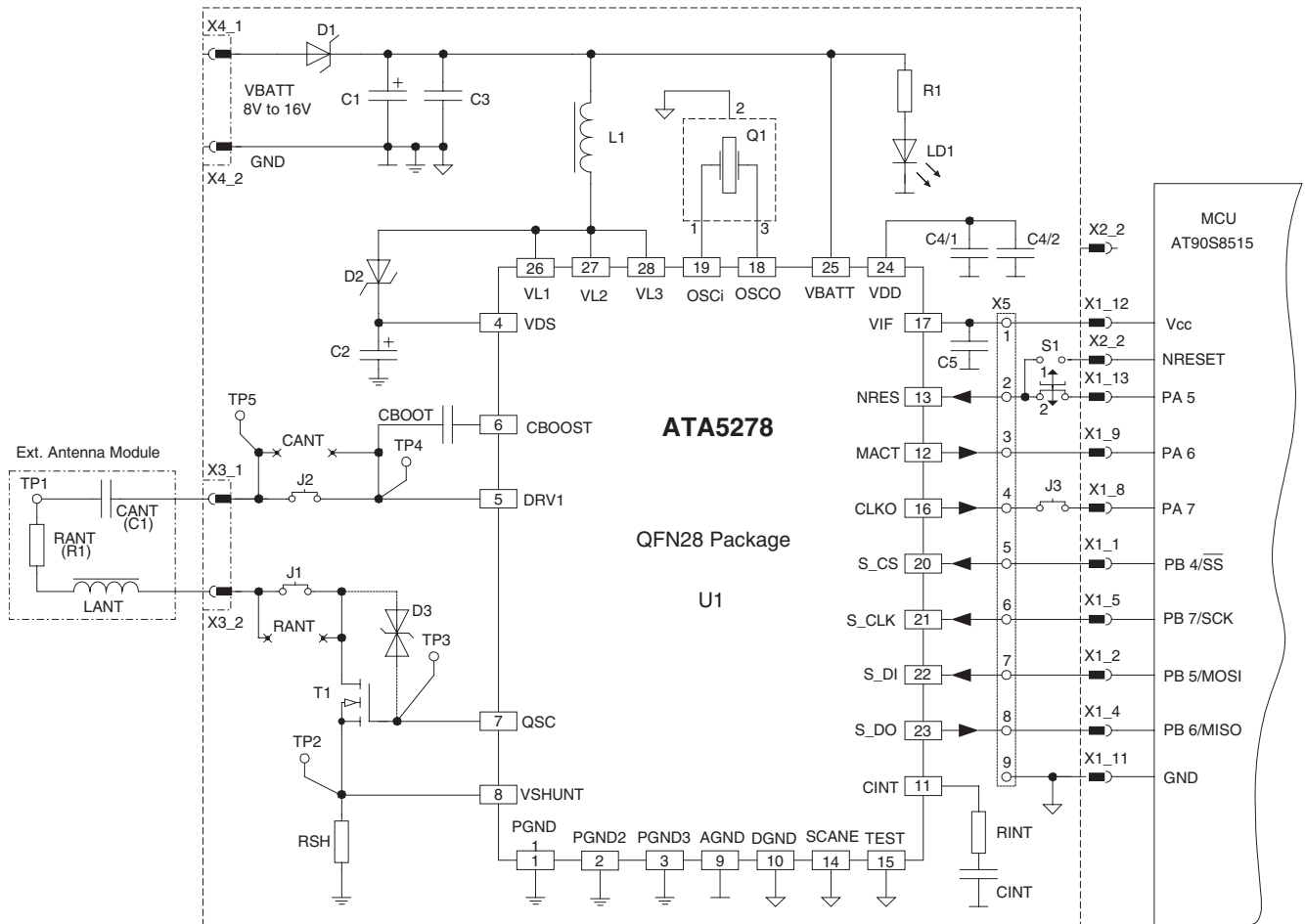


Figure 3-4. Schematic of the Transmitter Board ATAB5278



ATAK5278-82 LF Wake-up Demonstrator

Table 3-1. Parts List of ATA5278 Antenna Interface, ATAB5278

Part No.	Designation	Value	Type	Manufacturer
U1	Transmitter IC		ATA5278	Atmel®
T1	MOS transistor	600V/4.5A/0.95Ω	SPD04N60S5	Infineon®
D1	Diode	Schottky 60V/3A	30BQ060	IR®
D2	Diode	Schottky 60V/3A	30BQ060	IR
D3	Suppressor diode	Optional		
LD1	LED	Red	TLMT 3100	Vishay®
R1	Resistor	1k	SMD	
R2	Resistor	0Ω	SMD	
RSH	Resistor	1.0Ω/1W	SMD	
RINT	Resistor	10k		
RANT	Resistor			
C1	Capacitor	Electrolytic 82 μF/50V	EEUFC1H820	Panasonic®
C2	Capacitor	Tantalum 4.7 μF/50V	SMD	KEMET®
C3	Capacitor	Ceramic 100 nF	SMD	Standard
C4/1	Capacitor	Ceramic 100 nF	SMD	Standard
C4/2	Capacitor	Ceramic 100 nF	SMD	Standard
C5	Capacitor	Tantalum 1 μF/10V	SMD	Standard
C6	Capacitor	Optional	SMD	Standard
CINT	Capacitor	Ceramic 47 nF	SMD	Standard
CBOOTNT	Capacitor	Ceramic 15 nF/50V	SMD	Standard
CANT	Capacitor			
L1	Inductor	22 μH/3.5A/47 mΩ	DO5022-223	Coilcraft®
Q1	Resonator	8 MHz	cstce8M00G55A	Murata®
X1-X2	18-pin connector			
X3	Antenna plug		PN 175781-1	Tyco Electronics™
X4	Power plug			Cliff Electronics®
X5	Header pin	9-pin inline		
J1-J3	2-pole jumper			
S1	Shift switch		CHS-01A1	Copal

3.3 Receiver Board ATAB5282

In addition to the three-channel LF receiver IC, the board is equipped with a 3D antenna (Pre-dan). The antenna has a sensitivity in all directions of approximately 100 mV/Am. Reaching a bandwidth of 4 kbits/s, the antenna Q factor is adjusted by parallel resistors to about 25. Using the total receiver sensitivity and sending the maximal transmitter current of 1A_p, a wake-up distance of at least 2 meters can be achieved in all directions. The board also allows for an optional assembly of separate antenna coils for x, y, z field detection. An LED is used to indicate the received data protocol. Test points and a pin socket allow the measurement of the relevant signals. A 3V lithium battery is used, supplying the receiver with LED indication.

Figure 3-5. Receiver Board ATAB5282 V.4

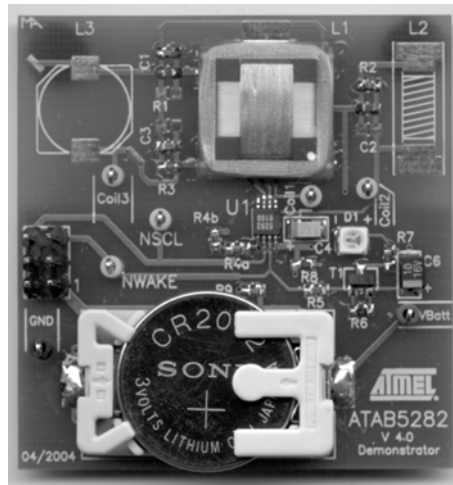
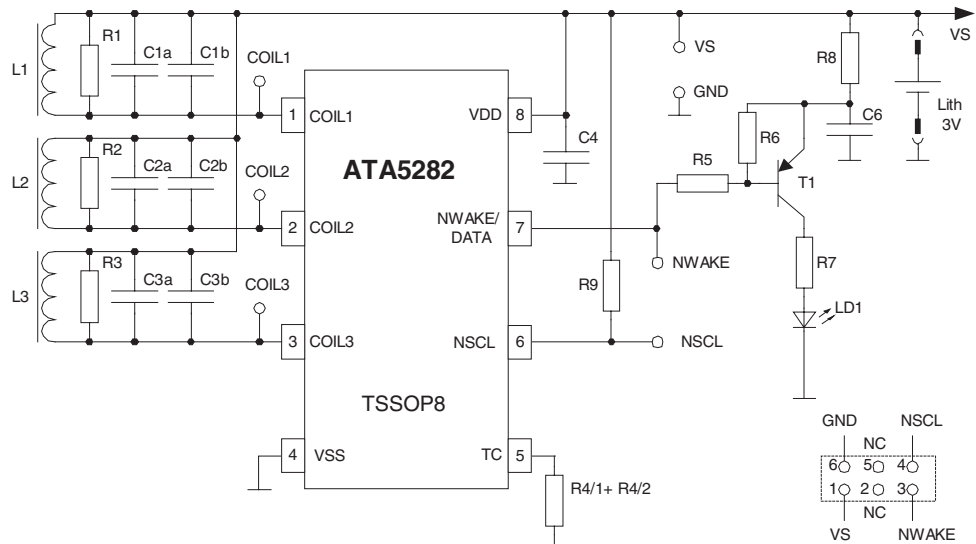


Figure 3-6. Schematic of Receiver Board ATAB5282 V.4



ATAK5278-82 LF Wake-up Demonstrator

Table 3-2. Parts List of the Receiver Board ATAB5282 V.4

Part No.	Designation	Value	Type	Manufacturer
U1	Wake-up IC		ATA5282	Atmel
T1	Transistor	PNP	BC857	
LD1	LED	Red	TLMT 3100	Vishay
L1-(L3)	3D antenna coil	4.77 mH/7.20 mH/Q = 23/29	3DC1515S-0477X P-749 002	Predan
C1	Capacitor	330 pF ±5%/50V	SMD ceramic	e.g., Vishay
C2	Capacitor	330 pF ±5%/50V	SMD ceramic	e.g., Vishay
C3	Capacitor	270 pF ±5%/50V	SMD ceramic	e.g., Vishay
C4	Capacitor	1 µF/10V	Tantal	e.g., Vishay
C6	Capacitor	10 µF/10V	Tantal	e.g., 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		MPD BA2032SM	MPD Inc.
Li-Cell		3V/220 mAh	CR2032	
7 pcs	Test pins			
1 pcs	Test socket	2 × 3 pole		

3.4 Receiver Board ATAB5283 (Optional Offer):

The board, mainly preferred for TPMS applications, is equipped with a 1D LF antenna (Predan).

Received data are indicated by an additional LED display. Once the IC is woken up, it remains in active mode as long as a Reset is executed to re-initialize standby mode.

Test pins allow the measurement of all relevant signals. A 3V lithium battery is used supplying the receiver with LED indication.

Figure 3-7. Receiver Board ATAB5283V3

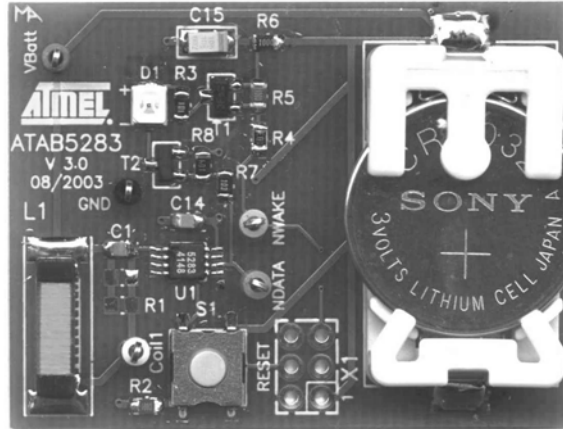
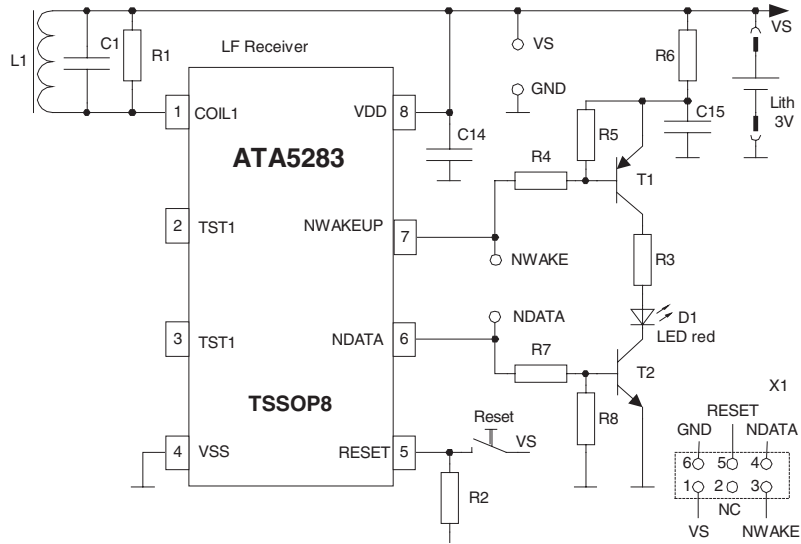


Figure 3-8. Schematic of the Receiver Board ATAB5283 V.3



ATAK5278-82 LF Wake-up Demonstrator

Table 3-3. Parts List of the Receiver Board ATAB5283 V.3

Part No.	Designation	Value	Type	Manufacturer
U1	Wake-up IC		ATA5283	Atmel
T1	Transistor	PNP	BC857	
T2	Transistor	NPN	BC847	
D1	LED	Red	TLMT 3100	Vishay
L1	Antenna coil	7.2 mH/Q = 28	SDTR 1103-0720J	Predan
C1	Capacitor	220 pF ±5%/50V	SMD Ceramic	e.g., Vishay
C1b	Capacitor	Optional		e.g., Vishay
C14	Capacitor	100 nF ±10%/50V	SMD Ceramic	e.g., Vishay
C15	Capacitor	10 µF/10V	Tantal	e.g., Vishay
R1	Resistor	Optional		
R2	Resistor	100 kΩ		
R3	Resistor	100Ω		
R4	Resistor	47 kΩ		
R5	Resistor	100 kΩ		
R6	Resistor	100Ω		
R7	Resistor	10 kΩ		
R8	Resistor	100 kΩ		
Vbatt1	Battery holder		MPD BA2032SM	MPD Inc.
Li-Cell		3V/220 mAh	CR2032	
S1	Shift switch			ITT-Cannon
6 pcs	Test pins			
1 pcs	Test socket	2 × 3 pole		

4. Host Software

The software on the CD-ROM, written in Visual Basic, is used to control the transmitter unit, promoting the substantial IC features and providing easy control using the menu on the host computer.

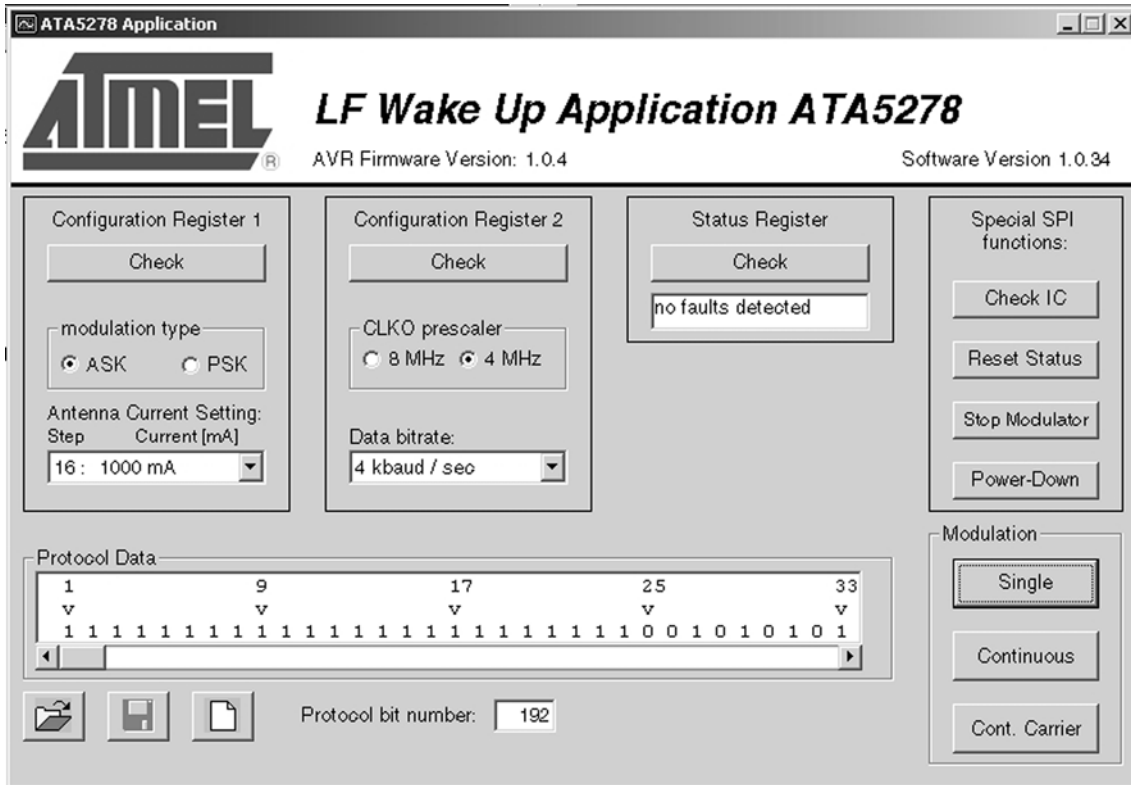
The software installation is performed by a self-extracting setup file contained on the CD-ROM (see Section “[Demonstrator - Getting Started](#)” on page 14).

The host communicates via software with the AVR microcontroller ATmega8515 located on the baseboard. Further, the microcontroller, programmed in C, also maintains the dialog with the ATAB5278 transmitter IC via its SPI interface.

When executing the program file *ATA5278.exe*, the setup menu as seen in [Figure 4-1](#) appears.

The menu enables setting and checking of configuration states as well creating, saving and reloading the data protocol to be sent. An appropriate protocol data file for the ATAB5282 receiver board is loaded by default. The command set and status information displayed by menu based on the SPI command structure described in the data sheet for ATA5278.

Figure 4-1. ATA5278 Application Software



4.1 Configuration Register 1

Enables to set and to check the configuration of the transmitter with regard to the matter of modulation (ASK or PSK) and antenna current level. By pull down menu the antenna current is selectable from 16 steps. By default ASK modulation and antenna current step16 are configured.

In general, the configuration is executed immediately when the related parameter is selected. So if checking the actual configuration the displayed content does not change, except when checking it after power on and the menu parameter was different from default before.

4.2 Configuration Register 2

Allows to chose the frequency of the prescaler clock output CLKO (8 MHz or 4 MHz.) and also the data rate of the protocol to be sent from 1, 2, 3, or 4 kbit/s. By default the parameters are set to CLKO = 4 MHz and Data bitrate = 4 kbit/s.

4.3 Status Register

When checking “Status Register” the state of the transmitter is monitored in terms of communication, data buffer, over current, open load and over temperature. If a related error occurs the state is latched and stops transmission of the data protocol. The latched state can be left by executing the “Reset Status” button.

4.4 Protocol Data

Data to be sent are displayed in the “Protocol Data” window performed for the IC specific space of 192 data bits. The actual data number is indicated by the small window “Protocol bit number”.

By default protocol data are loaded required for LF receiver ATA5282. Independent of that, individual data can also be composed in the window setting logical 1 and 0. Further, data sets can be saved, reloaded and cleared by executing the related symbol buttons at the lower left side of the menu.

4.5 SPI Function

By this function group the IC is controlled in terms of checking the SPI communication replied by message box, stopping modulation and power down the IC. Once the transmitter is set to power down the operation can be continued by executing the Check IC button.

4.6 Menu Item *Modulation*:

Enables three operation modes of LF field transmission.

- Single: Protocol data are sent every time Single button is pressed
- Continuous: Protocol data are sent in loop as long as an other mode is selected or modulation is stopped by *Stop Modulator* button
- Cont. Carrier Unmodulated carrier is sent continuously as long as a other mode is selected or modulation is stopped by *Stop Modulator* button

Note: For *Cont. Carrier* operation mode combined with maximum antenna current, the matching resistor on the antenna module requires a higher power rating.

5. Demonstrator - Getting Started

- 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 for *ATA5278.exe* is as follows:
 - Using an English language system: \Program Files\Atak5278\Atak5278.exe
 - Using a German language system: \Programme\Atak5278\Atak5278.exe
- When the software program *Atab5278.exe* (located in the installation folder) is executed, the host operating menu appears as seen in [Figure 4-1 on page 12](#).
- Insert the battery into the battery slot of the ATAB5282 (ATAB5283) receiver board and place the board inside the antenna field
- Assemble the demonstrator system according to the configuration shown in [Figure 3-1 on page 2](#)

Note: Write permission is required to install the software to the host system.

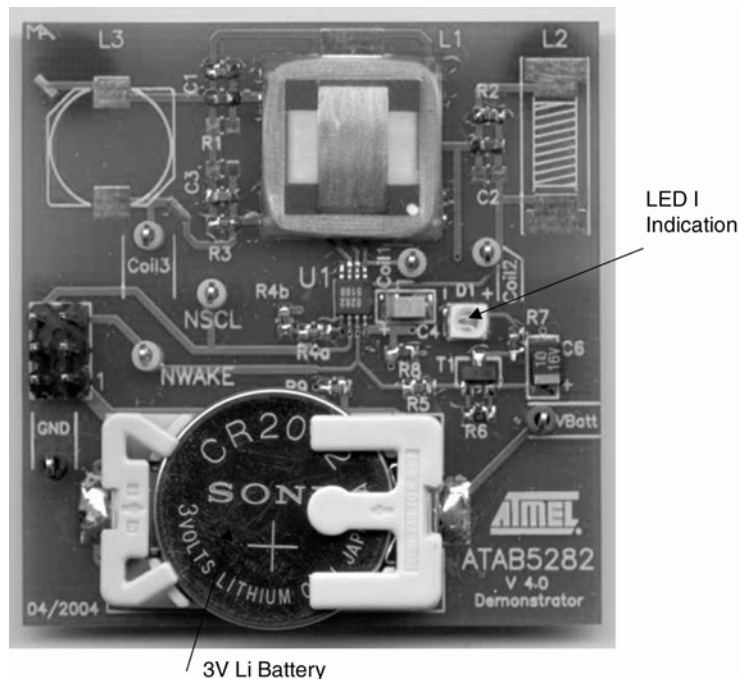
6. Demonstration Performance

After the demonstrator has been started as described in [Section 5.](#), several actions can be carried out.

6.1 Protocol Sent Indicated by LED on Receiver Board

- Insert the battery into the slot of the ATAB5282 (ATAB5283) receiver board, and place the board within a distance of approximately 50 cm along the transmitter antenna axis.

Figure 6-1. ATAB5283 Receiver Board



6.2 Signal Transmission Tx-Rx Measurements

Figure 6-3. Signal Transmission ATAB5278 Transmitter to ATA5282 Receiver

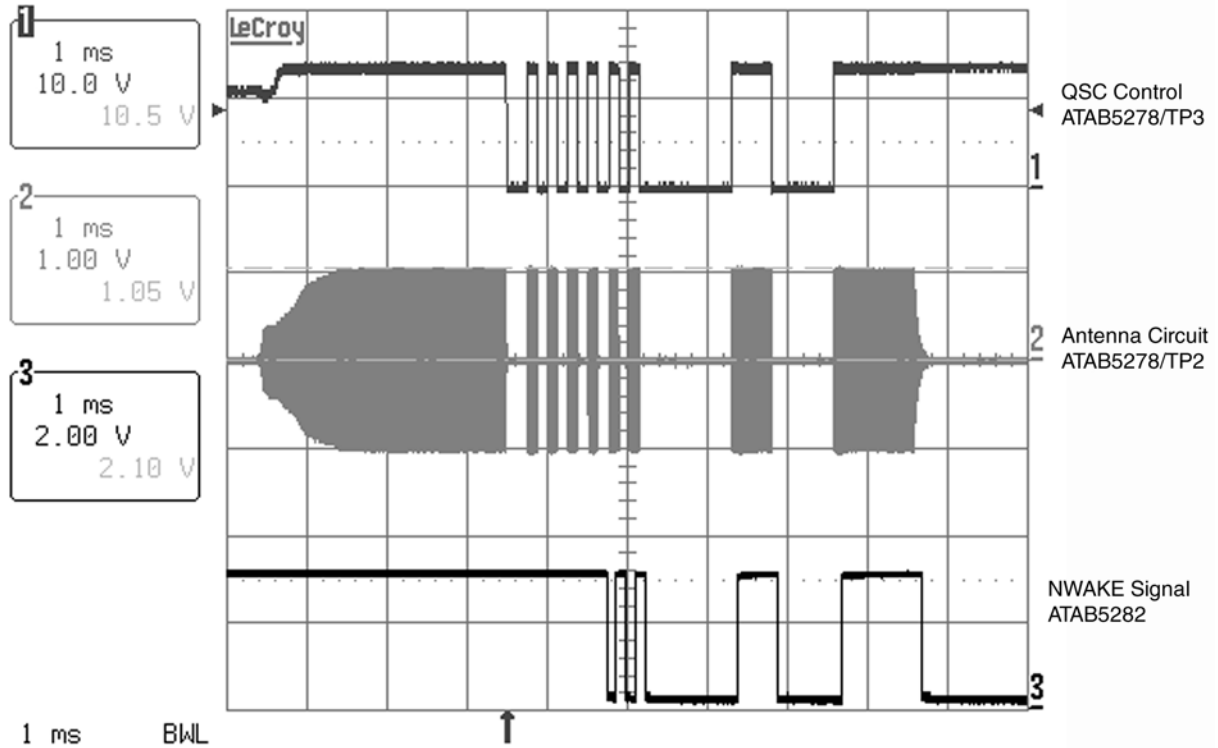
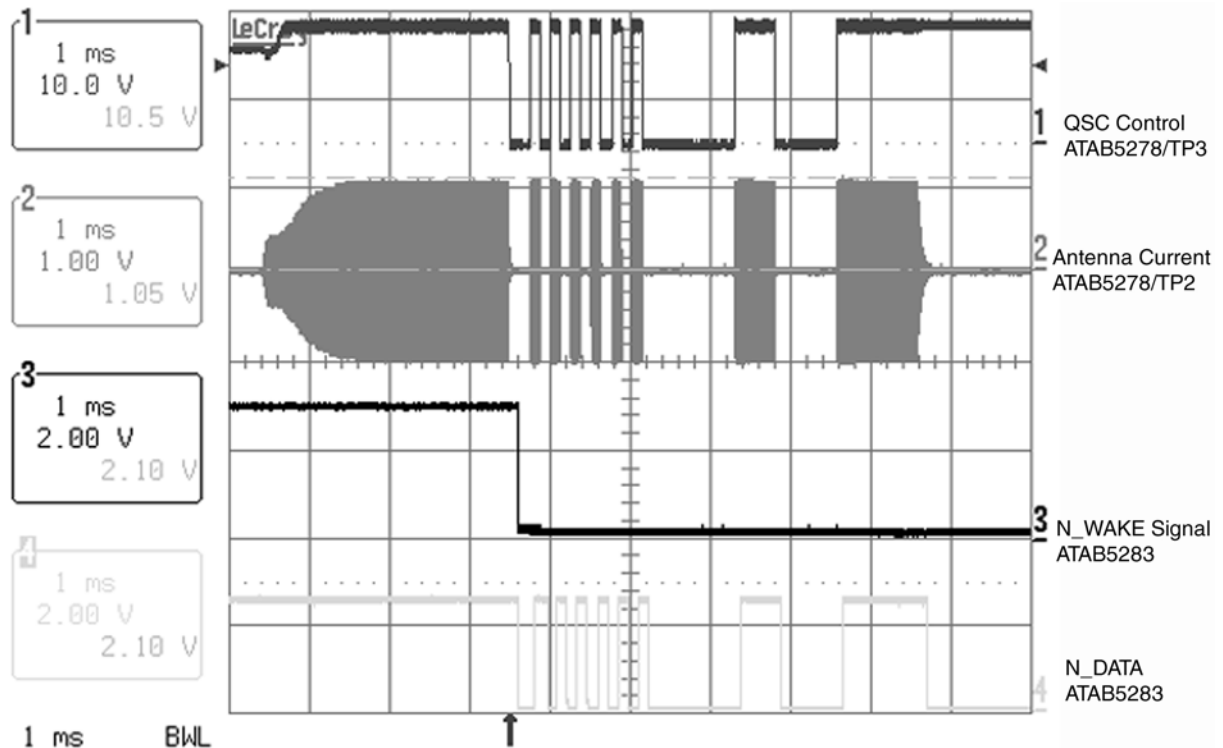


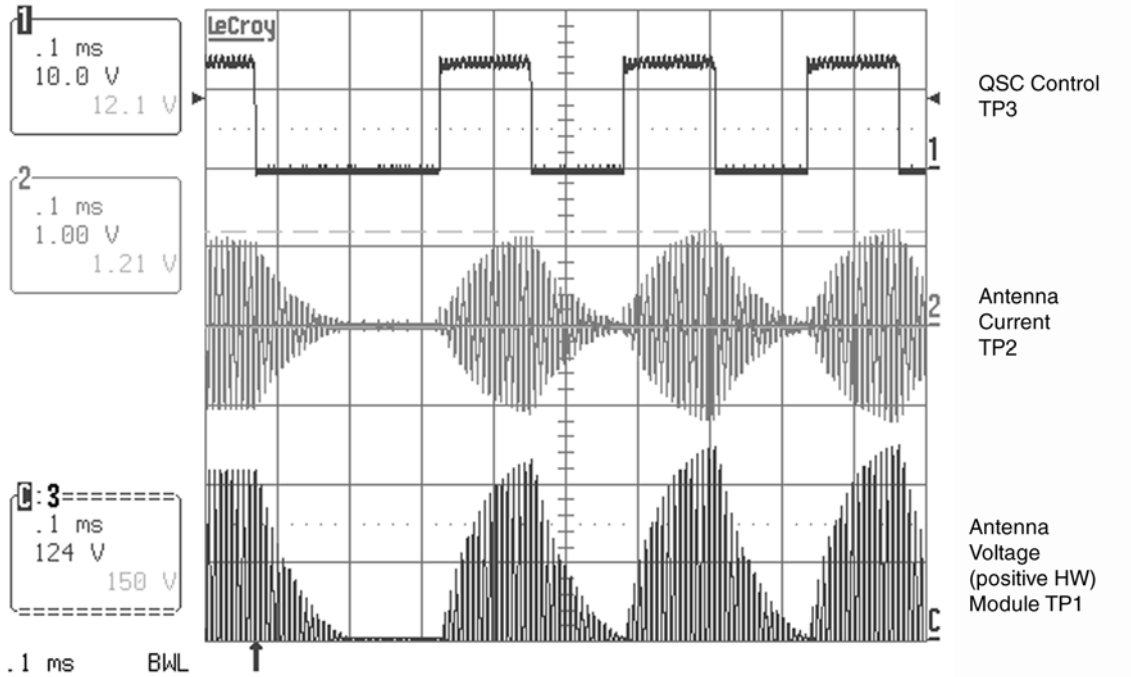
Figure 6-4. Signal Transmission ATAB5278 Transmitter to ATA5283 Receiver



6.3 QSC Feature Measurement at ATAB5278 Board

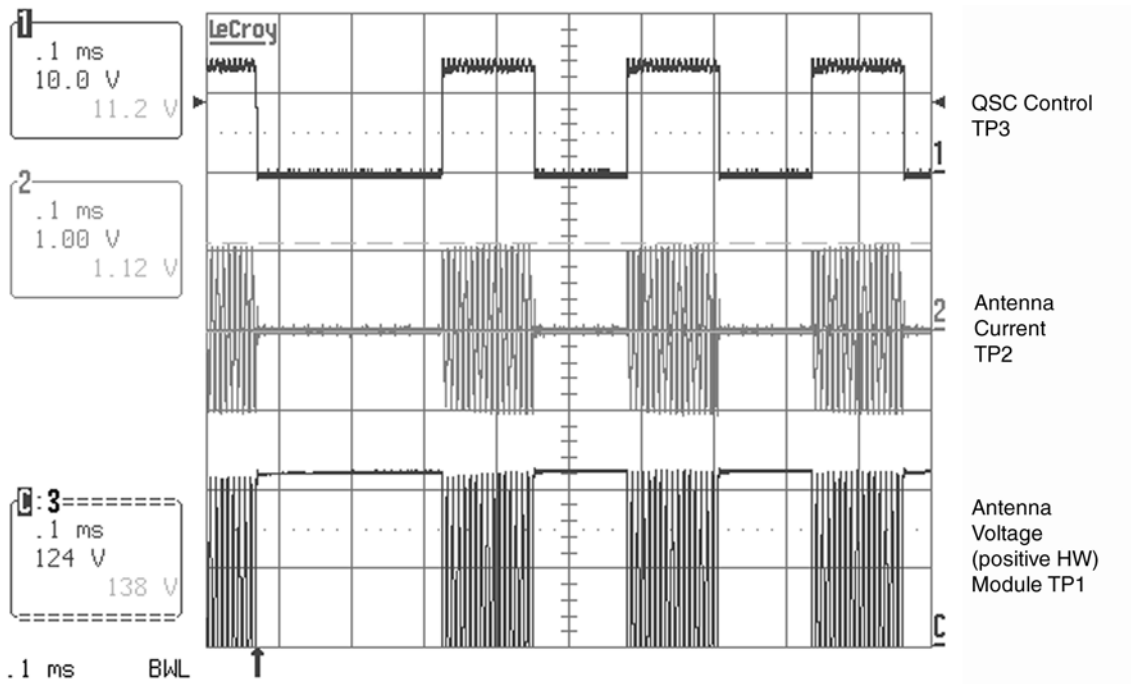
Data transmission without QSC function can be performed by shorting QSC transistor T1 (connect TP2 with x3_2). Due to the antenna's Q factor, the current and voltage signals do not reach final pulse level of protocol data (Figure 6-5). The higher the antenna Q factor, the flatter the signal slope and the smaller the reachable signal data rate.

Figure 6-5. Sent Data Without QSC



When QSC feature is enabled, transistor T1 switches off the resonating antenna at maximum peak voltage. Hence, energy remains stored in the resonant capacitor. After switch on, the antenna field jumps up immediately (Figure 6-6 on page 18). Using the QSC feature the achievable signal data rate is not affected by the antenna Q factor.

Figure 6-6. Sent Data With QSC

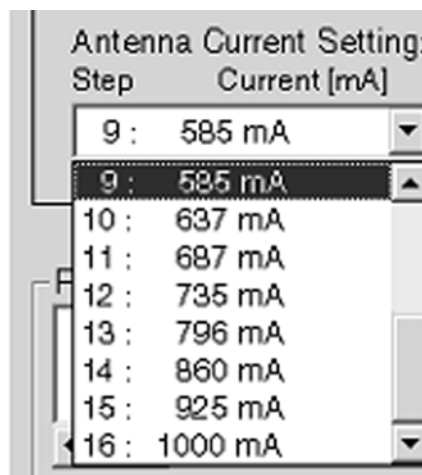


6.4 Current Setting

The antenna current setting can be selected from 16 levels via drop-down menu (Figure 6-7).

In default mode the maximum current is set to typically 1000 mA. Related antenna current measurements with various levels can be performed and measured on board as shown in Figure 6-3.

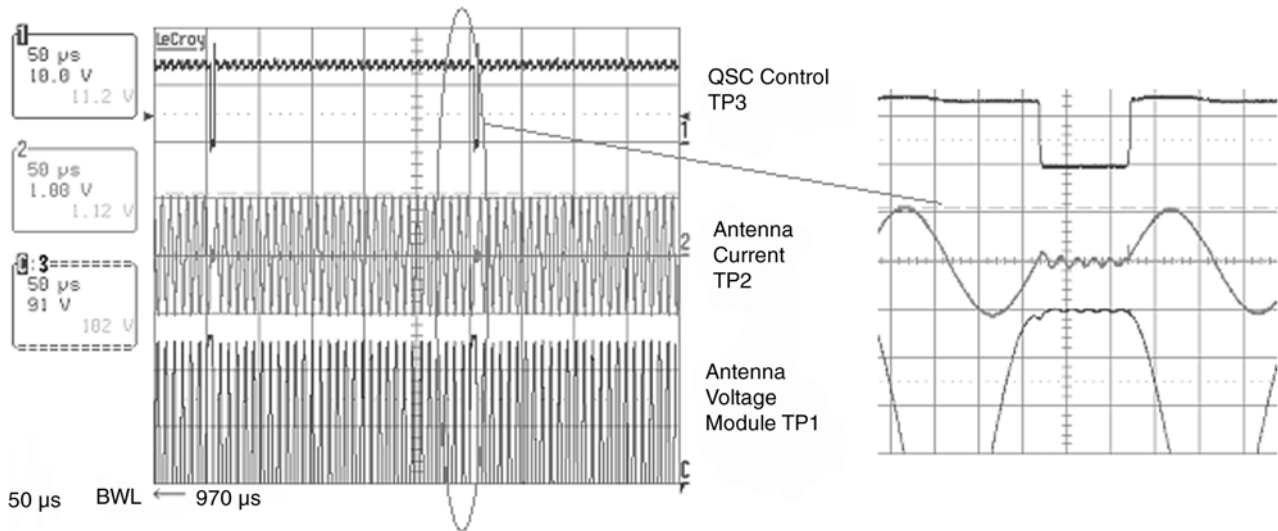
Figure 6-7. Antenna Current Selection



6.5 PSK Modulation

Special applications may need to transmit data by PSK modulation of the 125 kHz carrier frequency. Even though an appropriate receiver is not available, the modulation can be done by the ATA5278, as shown in [Figure 6-8](#).

Figure 6-8. PSK Modulation



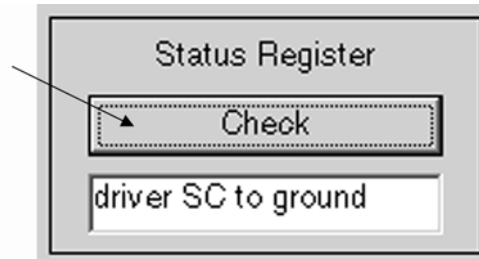
6.6 Diagnosis Functions

The IC protects itself from destruction if a fault occurs. For demonstration, the antenna diagnosis information can be checked and readout using the Status Register menu.

6.6.1 Antenna Short Circuit During Protocol Sent

- Short TP5 to GND and send protocol
- Click **Check** in the Status Register box, and the message *driver SC to ground* is displayed indicating a Short Circuit to ground (Figure 6-9 on page 20)
- Eliminate failure and click **Reset Status** to continue

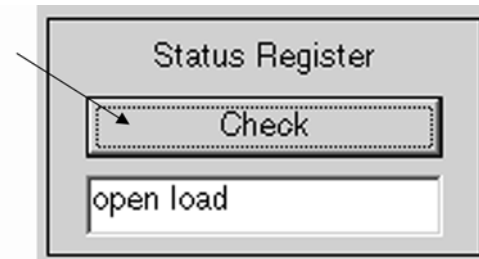
Figure 6-9. Status Register Menu



6.6.2 Antenna Break During Protocol Sent

- Disconnect the antenna module, and send the protocol
- Click **Check** in the Status Register box, and the message *open load* is displayed (Figure 6-10)
- Eliminate failure and click **Reset Status** to continue

Figure 6-10. Status Register Menu



Diagnosis information mentioned in the data sheet, such as overtemperature and illegal SPI commands, cannot be easily performed by the demonstrator.



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