APPLICATION NOTE

Getting Started with ATAB5749 Using RF Design Kit Software

ATAB5749

Introduction

The Atmel® software development tool RF Design Kit enables the programming and setting of a wide range of RF automotive products to build RF systems for development purposes. The software is particularly suitable for setting parameters of UHF receiver and transmitter demo boards.

The ATA5749, Atmel's newest UHF transmitter, boasts many new features. The main new feature is its programability. Parameters such as transmit power, the transmit frequency, and the frequency deviation for FSK modulation can be programmed. The latest RF Design Kit (version 1.0.7) supports the ATAB5749, which is the demo board for the transmitter ATA5749. This application note provides an introductions to using the ATAB5749 with the RF Design Kit software.

1. Delivery Status of the Transmitter Board

1.1 Hardware

The front and the rear view of the transmitter board are illustrated in Figure 1-1. The schematic of the board is shown in Figure 1-2 on page 3, and the board layout information is showed in Figure 1-3 on page 4 to Figure 1-5 on page 5. The bill of material of the transmitter board is listed in Table 1-1 on page 5.

The board contains the following parts:

- Lithium battery
- Transmitter matched to the loop antenna.

Note: 1. Atmel offer 2 different demo boards for the ATA5749 due to the Loop Antenna matching, matching to the 315MHz and 433.92MHz.
Generally the ATA5749 can be set in both 315MHz and 433.92MHz transmit frequency with one 13.0MHz crystal. So the 315MHz board can be reprogrammed for 433.92MHz transmitting purposes. In this case the matching elements must be changed to get the optimal transmit power.
Verification with 50Ω matching is possible.

- AVR® ATmega88 is used on the board for programming
- An external microcontroller can be used to set the ATA5749 on the boards since some test points are placed on the control and the programming traces of ATA5749.

Note: The connection between the ATmega88 and ATA5749 can be disconnected by desoldering the jumpers (BR1 to BR4). (See the schematic of the board in Figure 1-2 on page 3.)

- Three buttons are available.
- Two Light Emitting Diodes are available to show the activity status of the board. The LED 1 indicates that the calibration of the internal RC oscillator of ATmega88 exceeds the defined tolerance limits in the software of ATmega88. LED 2 indicates the transmit functions of the transmitter board.

Note: The internal RC oscillator is always calibrated internally when any button is pushed. In case that no exact calibration value can be calculated, the closest value will be taken.
A short flash of the LED 2 indicates the start of the function “Single Telegram” or “Single Pattern” when a button is pressed. The same indicator can be also recognized for start and end of any continuous functionality like “Continuous Telegram”, “Continuous Pattern”, etc.

Figure 1-1. ATAB5749 Demo Board Front and Rear View

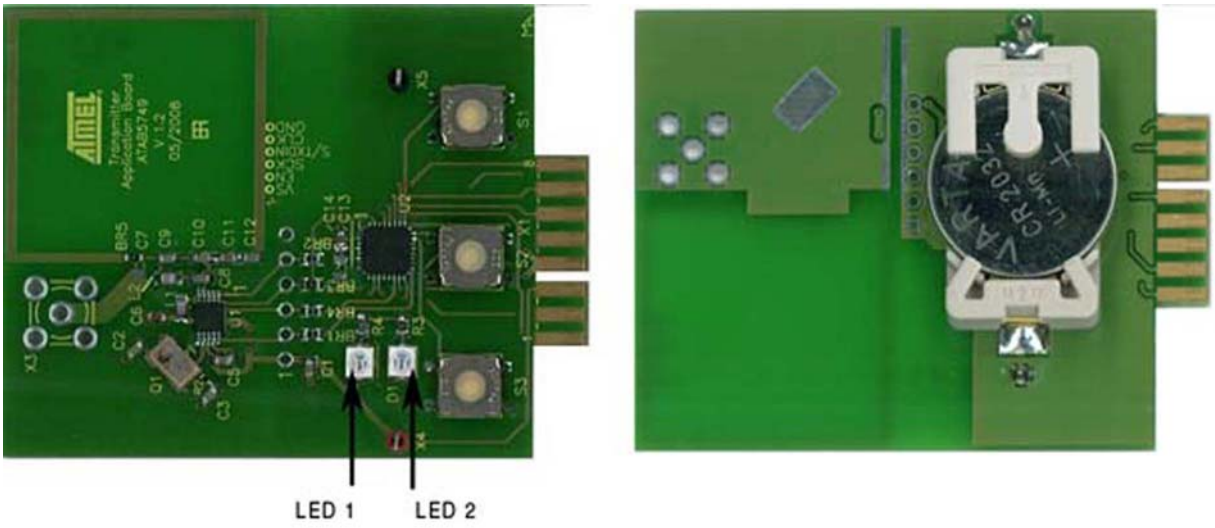


Figure 1-2. Schematic of the Demo Board ATAB5749

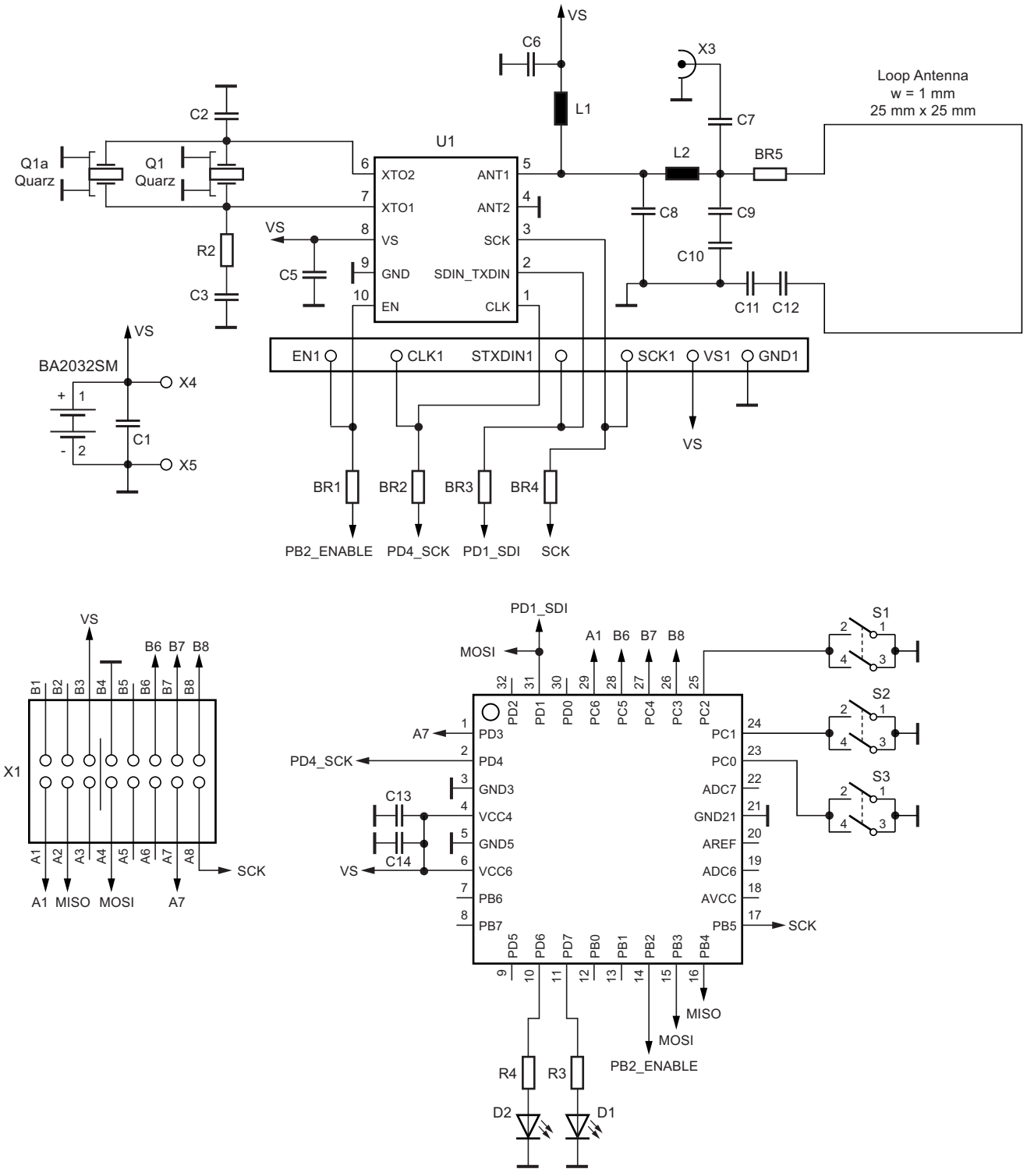


Figure 1-3. Top Layer of the Demo Board ATAB5749

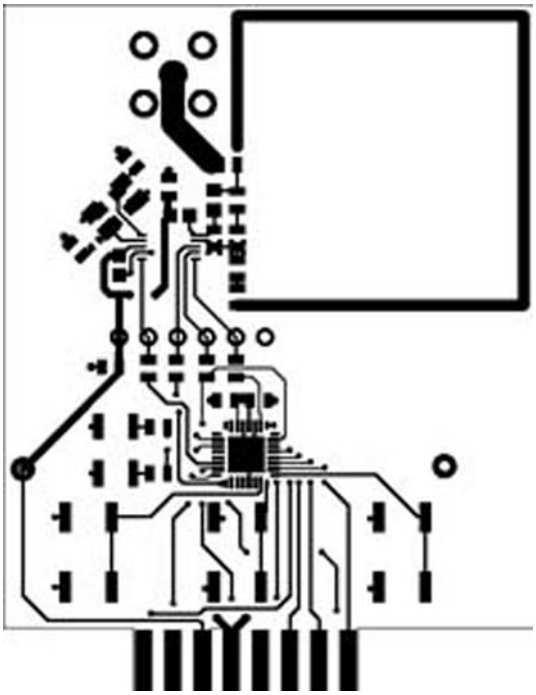


Figure 1-4. Bottom Layer of the Demo Board ATAB5749

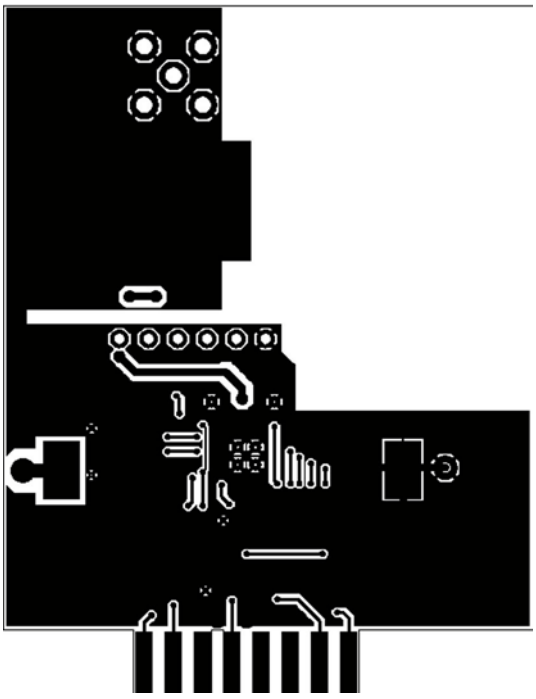


Figure 1-5. Designator

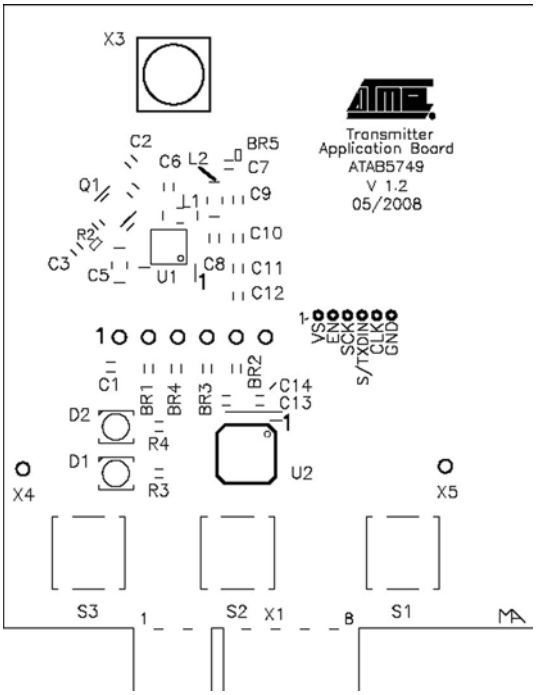


Table 1-1. Bill of Material of the Demo Board ATAB5749

Components	Pieces	315MHz	433MHz	Value	Tolerance	Material	Housing	Manufacturer/ Distributor
BR1, BR2, BR3, BR4	4	x	x	0			0603	
R2, BR5	2	x	x	0			0402	
R3, R4	2	x	x	1kΩ	10%		0603	
C1	1	x	x	100nF	10%	X7R	0603	Murata®
C2, C3	2	x	x	15pF	2%	COG	0603	Murata
C5	1	x	x	68nF	10%	X7R	0603	Murata
C6	1	x	x	1nF	10%	X7R	0603	Murata
C7	n.m.							
C8	1		x	3.9pF	5%	COG	0603	Murata
	1	x		18pF	5%	COG	0603	Murata
C9	1		x	27pF	5%	COG	0603	Murata
	1	x		82pF	5%	COG	0603	Murata
C10	1		x	39pF	5%	COG	0603	Murata
	1	x		82pF	5%	COG	0603	Murata
C11	1		x	3pF	5%	COG	0603	Murata
	1	x		5pF	5%	COG	0603	Murata
C12	1		x	2.2pF	5%	COG	0603	Murata
	1	x		8.2pF	5%	COG	0603	Murata
C13	n.m.							
C14	1		x	100nF	10%	X7R	0603	Murata

Table 1-1. Bill of Material of the Demo Board ATAB5749 (Continued)

Components	Pieces	315MHz	433MHz	Value	Tolerance	Material	Housing	Manufacturer/ Distributor
L1	1		x	27nH	2%	0603CS	0603	Coilcraft®
	1	x		47nH	2%	0603CS	0603	Coilcraft
L2	1		x	12nH	2%	0603CS	0603	Coilcraft
	1	x		27nH	2%	0603CS	0603	Coilcraft
Q1	1	x	x	13MHz			5032//3225	KSS®
U1	1	x	x	ATA5749			TSSOP10	Atmel
U2	1	x	x	ATmega88			MLF32	Atmel
D1, D2	2	x	x	TLMD3100			P-LCC-2 (sizeB)	Vishay®

1.2 Software

The board ATAB5749 is be delivered with default settings as detailed in the Table 1-2 below.

Table 1-2. Software Default Settings of the ATAB5749

ATA5749 - 433MHZ		ATA5749 - 315MHZ	
Control Register - Values		Control Register - Values	
Band selection:	367MHz to 450MHz	Band selection:	300MHz to 368MHz
RF frequency:	433.92MHz (FREQ = 14353)	RF frequency:	315MHz (FREQ = 3741)
Modulation:	FSK	Modulation:	FSK
FSK shift:	±30kHz (FSEP = 75)	FSK shift:	±30kHz (FSEP = 75)
Output power (with 50Ω matching):	+12.5dBm (PWR = 15)	Output power (with 50Ω matching):	+12.5dBm (PWR = 15)
Clock Only Mode:	Normal Mode	Clock Only Mode:	Normal Mode
CLK output:	3.25MHz ($f_{CLK} = f_{XTO}/4$)	CLK output:	3.25MHz ($f_{CLK} = f_{XTO}/4$)
Clock on:	Clock port is ON	Clock on:	Clock port is ON
Telegram			
Data rate:	1,000Kbit/s (Manchester)		
Preburst:	24 bits (24.000 ms)		
Testword (Hex):	F09AF09A		
Pattern			
TStep:	90.91µs		
Pattern Length:	24 bit (2.1818ms)		
Pattern (Hex):	0x5555h		
Programmable Push Buttons			
Button S1:	Continuous telegram		
Button S2:	Single telegram		
Button S3:	Continuous carrier (unmodulated)		

In order to use the ATAB5749 board, an additional board as well as the RF Design Kit software is needed. Either the ATAB-RFMB or ATAB-STK-F is used as a microprocessor board interfacing the RF Design Kit software and the transmitter board. For further information about the hardware refer to the application notes “ant_hd-rf-desing-kit_041105_sec.pdf” and “ant_hd-flamingo_181105_sec.pdf”.

2. Getting Familiar with the RF Design Kit

To learn about the installation of the RF Design Kit software, refer to the application note “ant_sd-rf-design-kit_041105_sec.pdf”. The following is a list of the first steps to take when working with the RF Design Kit and the transmitter board:

- Connect the RS232 cable between the microprocessor board, the ATAB-RFMB or ATAB-STK-F, to an unused PC serial port.
- Connect the Microprocessor board with a 12V power supply.
- Switch on the 12V DC power supply of the microprocessor board before running the RF design Kit software.
- The file “RF-Designkit.exe” runs the software and test the connection to the microprocessor board.
- The latest RF Design Kit software is the version 1.0.7. This can be seen from the **Help** menu refer to the Figure 2-1.

Figure 2-1. IRF Design Kit Software Version Information Window



- For the RF Design Kit Version 1.0.7, the AVR® software version on the microprocessor board must be version 1.0.10. This information can be also seen from the **Help** menu. Please refer to Figure 2-2.

Figure 2-2. Information Window of the AVR Software Version on the Microprocessor Board



- It is important to remove the lithium cell from the battery holder of the transmitter board before programming the board with the microprocessor board. If the battery is still in the holder during the programming progress, an error message will be generated by the software requesting removal of the battery. This error massage is illustrated in Figure 2-3.

Figure 2-3. Error Code for Removing the Battery during the Programming Process



- Plug the transmitter board into the socket on the microprocessor board. The RF transmitter type and the software version of the microprocessor on the demo board can be observed by clicking on the Transmitter Information button



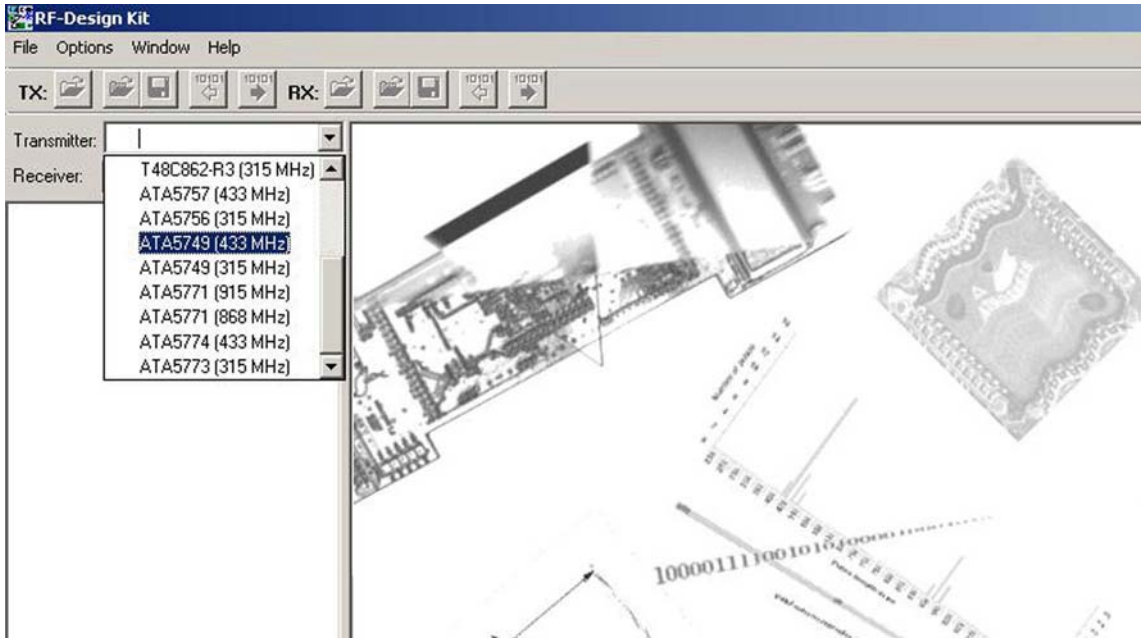
- After clicking the Transmitter Information button, the Info dialog box is displayed (see Figure 2-4). The firmware version and the type of transmitter board is displayed.

Figure 2-4. Information Window of the Firmware Version and the Type of the Transmitter Board



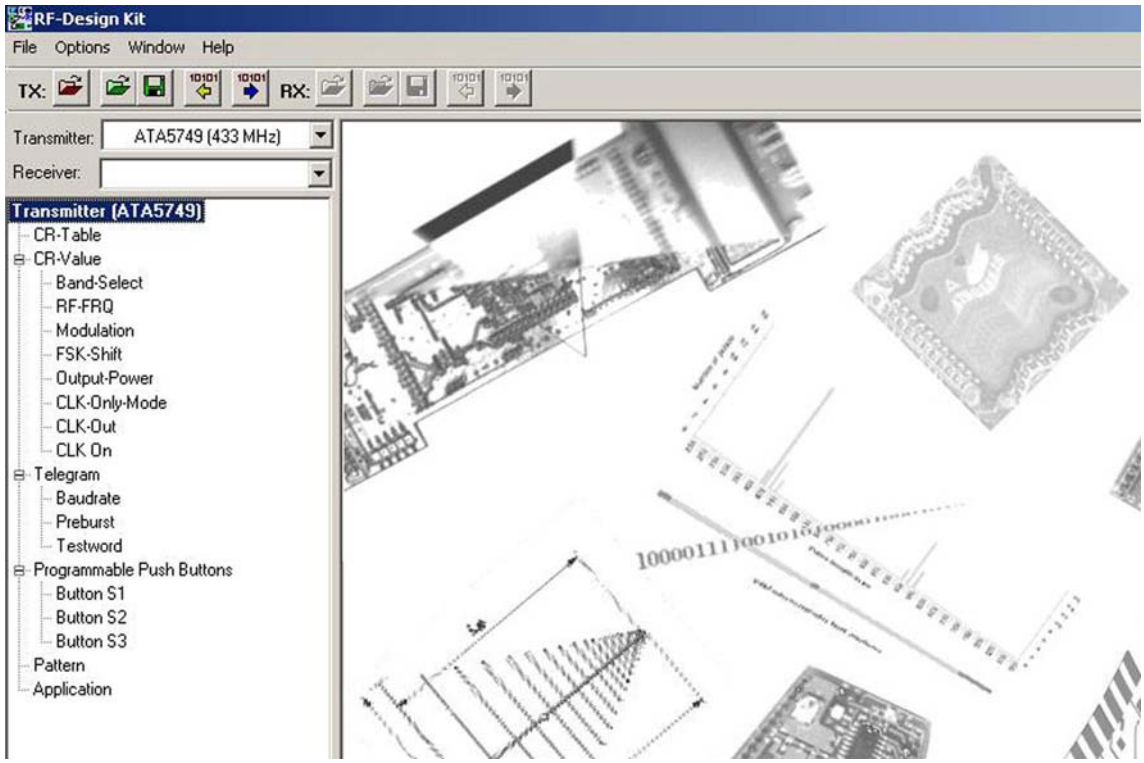
- The correct transmitter can be selected from the Transmitter drop down menu (see Figure 2-5).

Figure 2-5. Transmitter Section by the Corresponding Part Number



- After selecting the correct transmitter, in this case the ATA5749 (315MHz) or ATA5749 (433MHz), a menu of parameter settings is displayed (see Figure 2-6).

Figure 2-6. Parameter Settings of the Corresponding Part Number



TX Buttons:



Load TX default settings into the RF design software. Note: this is not stored on the transmitter board.



Load custom settings into the RF design software.



Save custom settings.



Read and display the whole current settings from the transmitter board.



Write the current settings from the RF Design software to the transmitter board.

Control Register Table (CR-Table):

This table illustrates the internal register configuration of the ATA5749. The configuration bytes can be modified directly in the CR-Table by clicking in the field of the binary value.

Figure 2-7. Control Register Table



Control Register Value (CR-Value) (Figure 2-8 on page 11):

This window interprets the register configuration setting of CR-Table. If the setting in the CR-Table is changed, the CR-Value window shows the change automatically and vice versa. The following parameters of the ATA5749 can be set:

- **Band Selection:** either 300MHz to 368MHz or 367MHz to 450MHz.
- **RF Frequency:** The transmit frequency of the board can be determined by selecting the value of the FREQ register. The *green check mark* in the drop down menu shows the FREQ values allowed; the *red cross* shows the values not allowed.
- **Modulation:** sets the modulation of the board either to ASK Mode or FSK Mode

- **FSK Shift:** the frequency deviation of the FSK modulation can be set with this menu by determining the value of the FSEP register.
- **Output Power:** this menus sets the transmit power of the IC for 50Ω matching. The value can be programmed from –0.5dBm to 12.5dBm in 1dB step. The *green check mark* in the drop down menu shows the default setting of the demo board, the 12.5dBm transmit power output at 50Ω matching. The matching of the loop antenna is optimized for the 12.5dBm transmit power. The power setting can be programmed as described in the datasheet with the constraint that the default matching of the loop antenna would not be the optimum matching for other power setting. The power setting with the suboptimal matching due to the default matching is marked with the *yellow check mark*. The *red cross* in the drop down menu shows the values that are not allowed.
- **Clock Only Mode:** in this menu “Clock Only Mode” or “Normal Mode” can be chosen. With Clock Only Mode, the ATA5749 generates a clock signal based on the crystal frequency for the microcontroller and no transmission will be performed.
- **CLK Output:** this menu sets the clock output frequency (f_{CLK}) of the ATA5749 based on the crystal frequency (f_{XTO}). ATA5749 is able to generate two different clock frequencies, the $f_{XTO/8}$ or $f_{XTO/4}$. As the crystal frequency of the ATAB5749 is 13.0MHz, a 3.25MHz or 1.625MHz clock frequency can be generated.
- **Clock On:** this menu allows the user to switch on and off the clock output of the ATA5749. Under normal operation of the ATAB5749, the clock output of the transmitter must be always switched on because the data generated by the microprocessor is derived from this clock frequency. Only during the transmitting of the continuous carrier, can the clock frequency can be negligible. Figure 2-9 shows the warning displayed by the software if the clock output must be deactivated.

Figure 2-8. Control Register Value

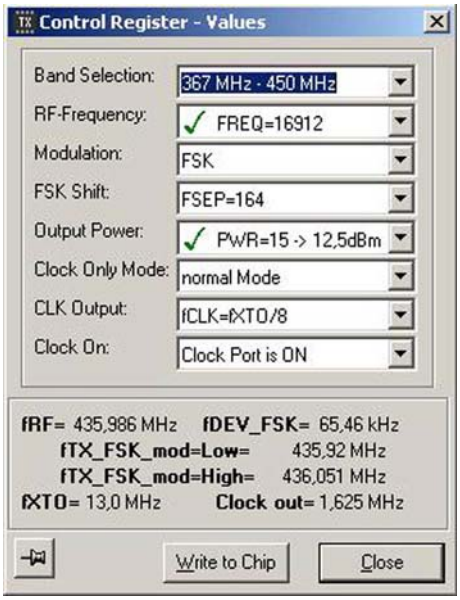


Figure 2-9. Error Code when Clock Output of the ATAB5749 Must be Deactivated



Telegram:

The following parameters of the telegram to be transmitted can be determined in this menu:

- Data rate can be set between 0.5Kbit/s to 40Kbit/s in 1Kbit/s step
- Preburst can be defined between 8 bits to 1000 bits in 8 bit step
- Testword is the data content of the telegram up to 4 data bytes length.

Note: All the information in this menu is based on the Manchester coding scheme.

Programmable Push Buttons:

This section lists the possible functions of the three buttons on board:

- Single telegram
- Continuous telegram
- Single pattern
- Continuous pattern
- Continuous preburst
- Continuous carrier (unmodulated)

Pattern:

For the pattern, the following parameters can be set:

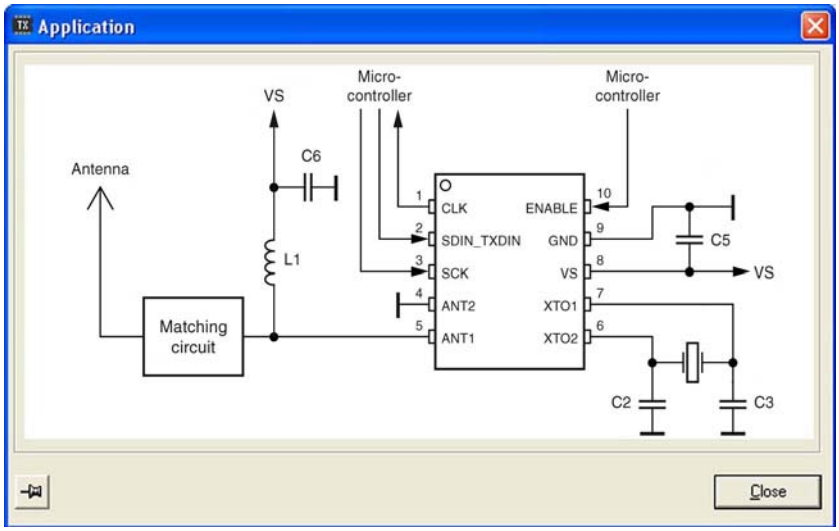
- Data rate can be set between 0.5Kbit/s to 40Kbit/s in 1Kbit/s step,
- Pattern length can be set between 8 bits to 256 bits in 8 bits step
- Pattern data

Note: The construction of the Pattern consist only of the determined bits due to the configuration of the Pattern menu, so without Preburst the pattern configuration is not Manchester coded.

Application:

If this menu is selected, a simple illustration of the application circuit of the ATA5749 is displayed (see Figure 2-10).

Figure 2-10. The Simple Application Circuit Shown in the RF Design Kit Software



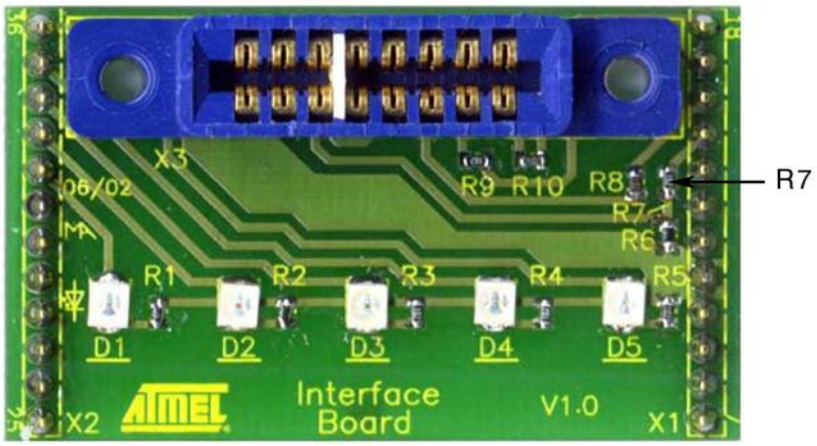
- After programming the parameters, the transmitter board can be unplugged from the interface on the microprocessor board.
- Insert the lithium cell into the battery holder of the transmitter board.
- The transmitter board is ready for verification.

3. Hardware Compatibility Issue

The latest ATAB-RFMB hardware version is necessary for programming the ATAB5749. For hardware delivered before July 2008, the resistor R7 (1kΩ) on the transmitter interface board must be replaced with 0Ω resistor. Refer to Figure 3-1 for the position of the R7.

A grey jack is generally delivered with the older version of the Atmel transmitter board. This is not the case for ATAB5749. This kind of jack may not be used for ATAB5749; if used, the functionality of the board is not guaranteed.

Figure 3-1. Transmitter Interface Board - Hardware Modification







Atmel Corporation 1600 Technology Drive, San Jose, CA 95110 USA **T:** (+1)(408) 441.0311 **F:** (+1)(408) 436.4200 | **www.atmel.com**

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