

---

**UHF ASK/FSK Industrial Transmitter**

---

**DATASHEET**

---

**Features**

---

- Integrated PLL loop filter
- ESD protection (3kV HBM/150V MM)
- High output power (7.5dBm) with low supply current (9.0mA)
- Modulation scheme ASK/FSK
  - FSK modulation is achieved by connecting an additional capacitor between the XTAL load capacitor and the open drain output of the modulating microcontroller
- Easy to design-in due to excellent isolation of the PLL from the PA and power supply
- Single Li-cell for power supply
- Supply voltage 2.0V to 4.0V in the temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Package TSSOP8L
- Single-ended antenna output with high efficient power amplifier
- CLK output for clocking the microcontroller
- One-chip solution with minimum external circuitry

---

**Applications**

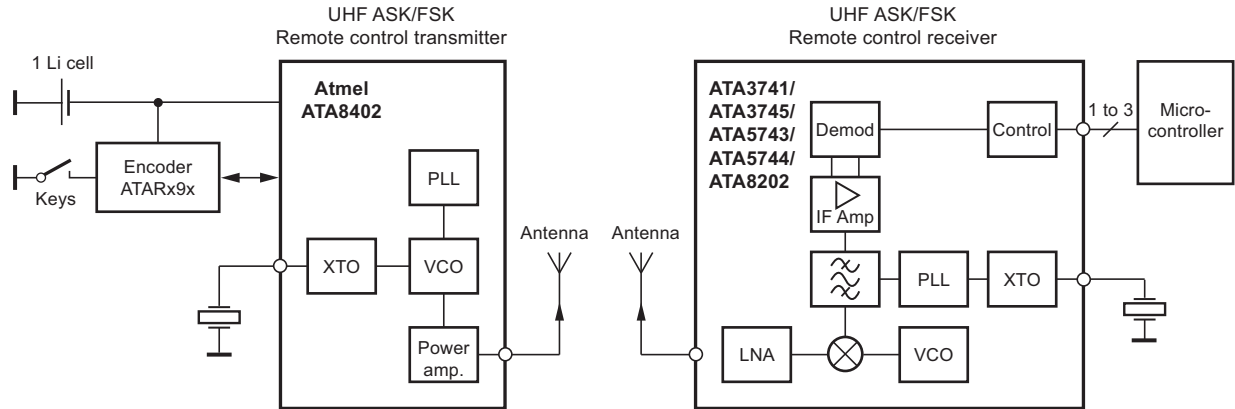
---

- Industrial/aftermarket remote keyless entry systems
- Alarm, telemetering, and energy metering systems
- Remote control systems for consumer and industrial markets
- Access control systems
- Home automation
- Home entertainment
- Toys

# 1. Description

The ATA8402 is a PLL transmitter IC, which has been developed for the demands of RF low-cost transmission systems for industrial applications at data rates up to 50kBaude ASK and 32kBaude FSK modulation scheme. The transmitting frequency range is 429MHz to 439MHz. It can be used in both FSK and ASK systems.

Figure 1-1. System Block Diagram



## 2. Pin Configuration

Figure 2-1. Pinning TSSOP8L

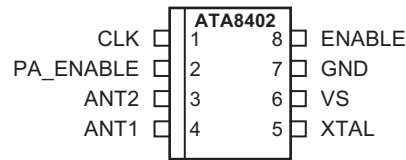
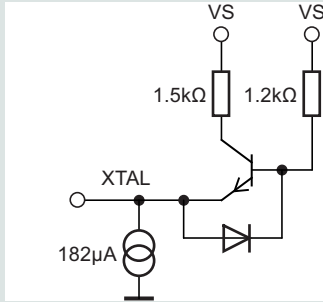
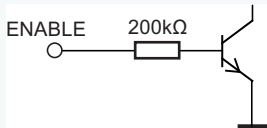


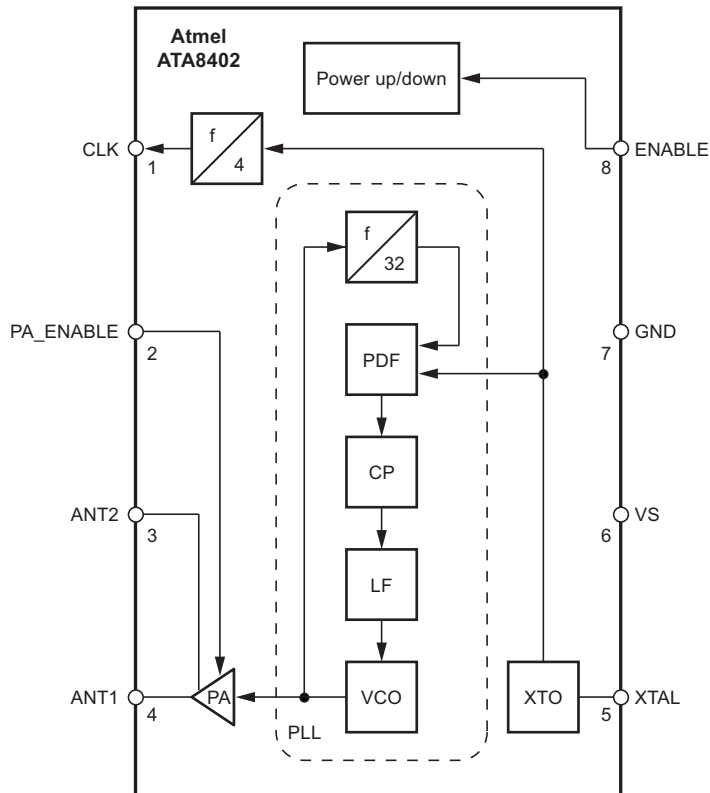
Table 2-1. Pin Description

Pin	Symbol	Function	Configuration
1	CLK	Clock output signal for microcontroller The clock output frequency is set by the crystal to $f_{XTAL}/4$	
2	PA_ENABLE	Switches on power amplifier, which is used for ASK modulation	
3	ANT2	Emitter of antenna output stage	
4	ANT1	Open collector antenna output	

**Table 2-1. Pin Description (Continued)**

Pin	Symbol	Function	Configuration
5	XTAL	Connection for crystal	
6	VS	Supply voltage	See ESD protection circuitry (see <a href="#">Figure 4-5 on page 8</a> )
7	GND	Ground	See ESD protection circuitry (see <a href="#">Figure 4-5 on page 8</a> )
8	ENABLE	Enable input	

**Figure 2-2. Block Diagram**



### 3. General Description

This fully integrated PLL transmitter allows particularly simple, low-cost RF miniature transmitters to be assembled. The VCO is locked to  $32 f_{XTAL}$ , and therefore a 13.56MHz crystal is needed for a 433.92MHz transmitter. All other PLL and VCO peripheral elements are integrated.

The XTO is a series resonance oscillator so that only one capacitor together with a crystal connected in series to GND are needed as external elements.

The crystal oscillator together with the PLL typically needs  $< 1$  ms until the PLL is locked and the CLK output is stable. There is a wait time of  $\geq 1$  ms until the CLK is used for the microcontroller and the PA is switched on.

The power amplifier is an open-collector output delivering a current pulse, which is nearly independent from the load impedance. The delivered output power is therefore controllable via the connected load impedance.

This output configuration enables a simple matching to any kind of antenna or to  $50\Omega$ . A high power efficiency of  $\eta = P_{out}/(I_{S,PA} V_S)$  of 36% for the power amplifier results when an optimized load impedance of  $Z_{Load} = (166 + j223)\Omega$  is used at 3V supply voltage.

### 4. Functional Description

If ENABLE = L and the PA\_ENABLE = L, the circuit is in standby mode, consuming only a very small amount of current, so that a lithium cell used as power supply can work for several years.

With ENABLE = H the XTO, PLL, and the CLK driver are switched on. If PA\_ENABLE remains L, only the PLL and the XTO are running, and the CLK signal is delivered to the microcontroller. The VCO locks to 32 times the XTO frequency.

With ENABLE = H and PA\_ENABLE = H the PLL, XTO, CLK driver, and the power amplifier are on. The power amplifier can be switched on and off with PA\_ENABLE. This is used to perform the ASK modulation.

#### 4.1 ASK Transmission

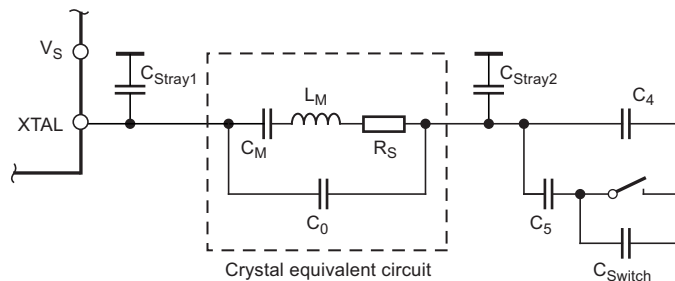
The ATA8402 is activated by ENABLE = H. PA\_ENABLE must remain L for  $t \geq 1$  ms, then the CLK signal can be taken to clock the microcontroller and the output power can be modulated by means of the PA\_ENABLE pin. After transmission, PA\_ENABLE is switched to L and the microcontroller switches back to internal clocking. The ATA8402 is switched back to standby mode with ENABLE = L.

#### 4.2 FSK Transmission

The ATA8402 is activated by ENABLE = H. PA\_ENABLE must remain L for  $t \geq 1$  ms, then the CLK signal can be taken to clock the microcontroller, and the power amplifier is switched on with PA\_ENABLE = H. The chip is then ready for FSK modulation. The microcontroller starts to switch on and off the capacitor between the XTAL load capacitor and GND with an open-drain output port, thus changing the reference frequency of the PLL. If the switch is closed, the output frequency is lower than if the switch is open. After transmission, PA\_ENABLE is switched to L, and the microcontroller switches back to internal clocking. The ATA8402 is switched back to standby mode with ENABLE = L.

The accuracy of the frequency deviation with XTAL pulling method is about  $\pm 25\%$  when the following tolerances are considered.

Figure 4-1. Tolerances of Frequency Modulation



Using  $C_4 = 9.2\text{pF} \pm 2\%$ ,  $C_5 = 6.8\text{pF} \pm 5\%$ , a switch port with  $C_{Switch} = 3\text{pF} \pm 10\%$ , stray capacitances on each side of the crystal of  $C_{Stray1} = C_{Stray2} = 1\text{pF} \pm 10\%$ , a parallel capacitance of the crystal of  $C_0 = 3.2\text{pF} \pm 10\%$  and a crystal with  $C_M = 13\text{fF} \pm 10\%$ , typically results in an FSK deviation of  $\pm 21\text{kHz}$  with worst case tolerances of  $\pm 16.3\text{kHz}$  to  $\pm 28.8\text{kHz}$ .

## 4.3 CLK Output

An output CLK signal is provided for a connected microcontroller. The delivered signal is CMOS compatible if the load capacitance is lower than 10pF.

### 4.3.1 Clock Pulse Take-over

The clock of the crystal oscillator can be used for clocking the microcontroller. A special feature of Atmel®'s ATARx9x is that it starts with an integrated RC-oscillator to switch on the ATA8402 with ENABLE = H, and after 1 ms assumes the clock signal of the transmission IC, so that the message can be sent with crystal accuracy.

### 4.3.2 Output Matching and Power Setting

The output power is set by the load impedance of the antenna. The maximum output power is achieved with a load impedance of  $Z_{Load,opt} = (166 + j223)\Omega$ . There must be a low resistive path to  $V_S$  to deliver the DC current.

The delivered current pulse of the power amplifier is 9mA. The maximum output power is delivered to a resistive load of  $465\Omega$  if the 1.0pF output capacitance of the power amplifier is compensated by the load impedance.

An optimum load impedance of:

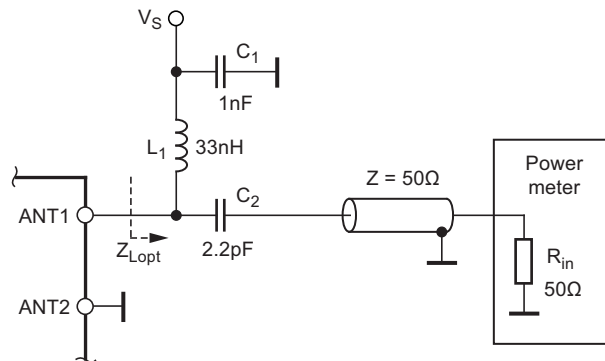
$Z_{Load} = 465\Omega \parallel j/(2 \times \pi \times 1.0pF) = (166 + j223)\Omega$  thus results for the maximum output power of 7.5dBm.

The load impedance is defined as the impedance seen from the ATA8402's ANT1, ANT2 into the matching network. Do not confuse this large signal load impedance with a small signal input impedance delivered as input characteristic of RF amplifiers and measured from the application into the IC instead of from the IC into the application for a power amplifier.

Less output power is achieved by lowering the real parallel part of  $465\Omega$  where the parallel imaginary part should be kept constant.

Output power measurement can be done with the circuit shown in [Figure 4-2 on page 6](#). Note that the component values must be changed to compensate for individual board parasitics until the ATA8402 has the right load impedance  $Z_{Load,opt} = (166 + j223)\Omega$ . Also the damping of the cable used to measure the output power must be calibrated out.

**Figure 4-2. Output Power Measurement**



## 4.4 Application Circuit

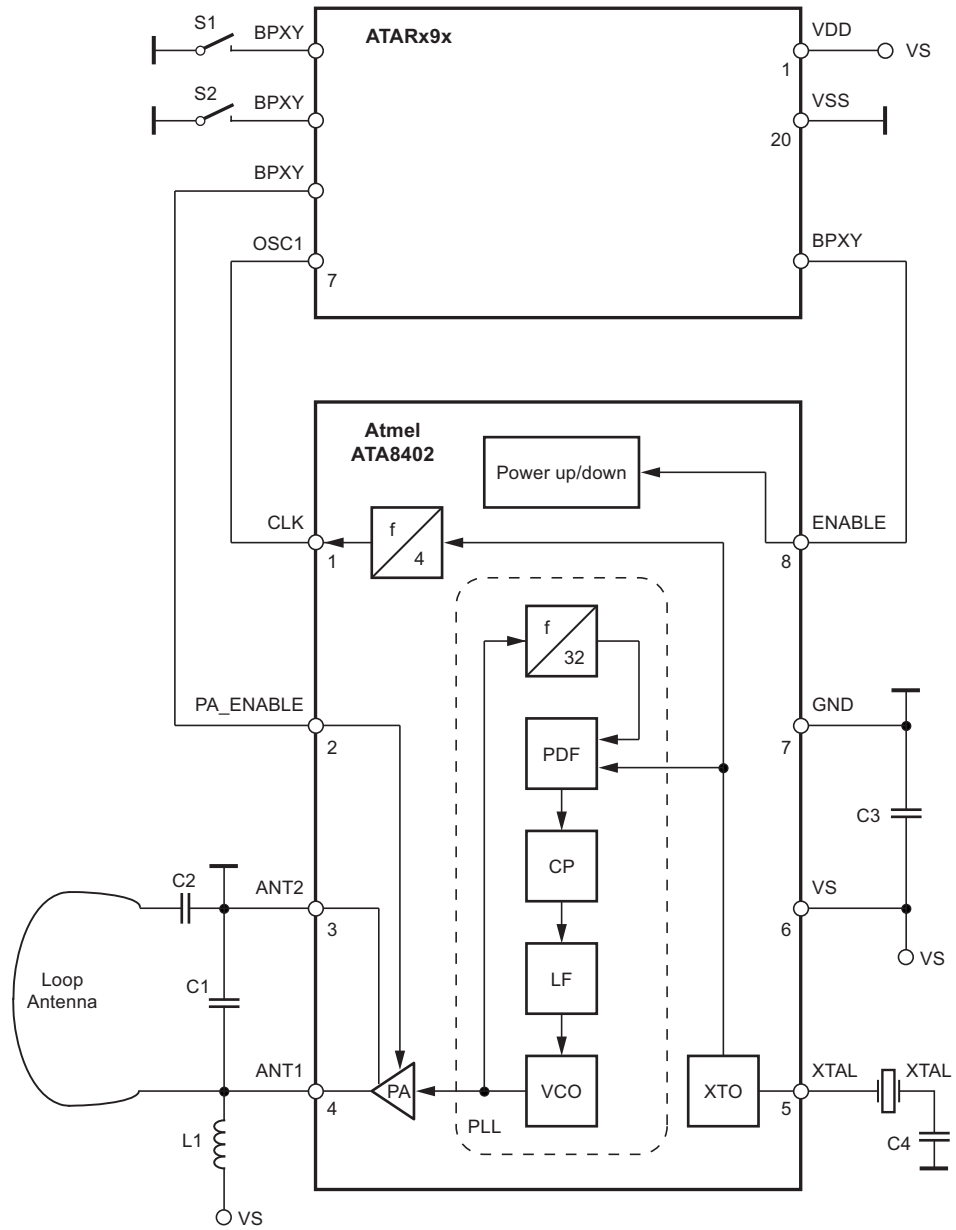
A value of 68 nF/X7R is recommended for the supply-voltage blocking capacitor  $C_3$  (see [Figure 4-3 on page 7](#) and [Figure 4-4 on page 8](#)).  $C_1$  and  $C_2$  are used to match the loop antenna to the power amplifier where  $C_1$  typically is 8.2pF/NP0 and  $C_2$  is 6pF/NP0 (10pF + 15pF in series). For  $C_2$ , two capacitors in series should be used to achieve a better tolerance value and to have the possibility of realizing the  $Z_{Load,opt}$  using standard valued capacitors.

$C_1$ , together with the pins of ATA8402 and the PCB board wires, forms a series resonance loop that suppresses the 1<sup>st</sup> harmonic. Therefore, the position of  $C_1$  on the PCB is important. Normally the best suppression is achieved when  $C_1$  is placed as close as possible to the pins ANT1 and ANT2.

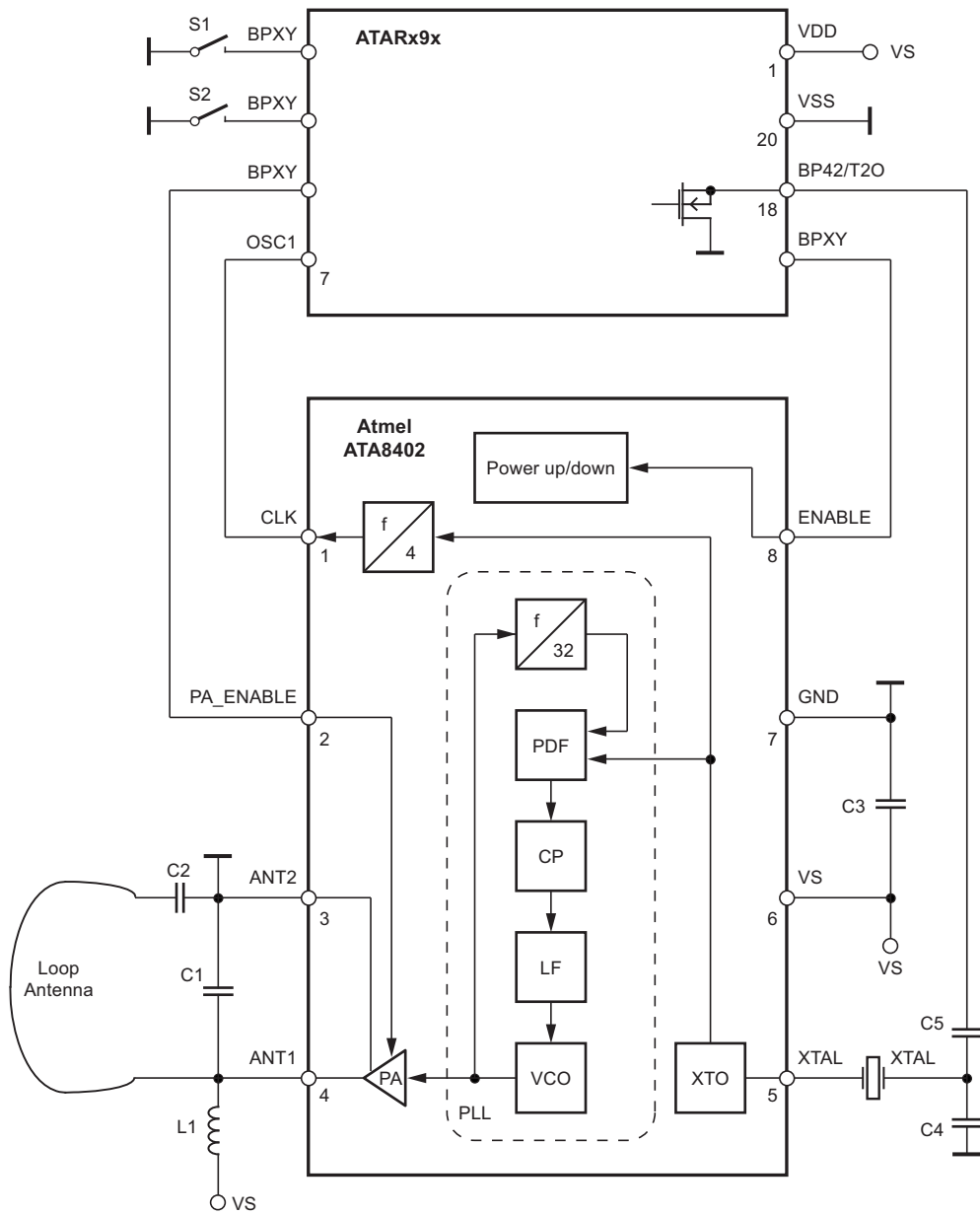
The loop antenna should not exceed a width of 1.5mm, otherwise the Q-factor of the loop antenna is too high.

$L_1$  ([50nH to 100nH]) can be printed on PCB.  $C_4$  should be selected so that the XTO runs on the load resonance frequency of the crystal. Normally, a 15pF load-capacitance crystal results in a value of 12pF.

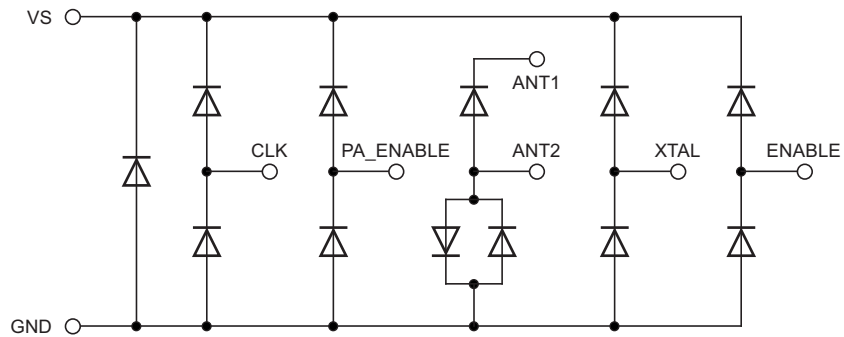
Figure 4-3. ASK Application Circuit



**Figure 4-4. FSK Application Circuit**



**Figure 4-5. ESD Protection Circuit**





## 5. Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Parameters	Symbol	Minimum	Maximum	Unit
Supply voltage	$V_S$		5	V
Power dissipation	$P_{tot}$		100	mW
Junction temperature	$T_j$		150	°C
Storage temperature	$T_{stg}$	-55	+85	°C
Ambient temperature	$T_{amb}$	-55	+85	°C
Input voltage	$V_{maxPA\_ENABLE}$	-0.3	$(V_S + 0.3)^{(1)}$	V

Note: 1. If  $V_S + 0.3$  is higher than 3.7V, the maximum voltage will be reduced to 3.7V.

## 6. Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient	$R_{thJA}$	170	K/W

## 7. Electrical Characteristics

$V_S = 2.0V$  to  $4.0V$ ,  $T_{amb} = 25^\circ C$  unless otherwise specified.

Typical values are given at  $V_S = 3.0V$  and  $T_{amb} = 25^\circ C$ . All parameters are referred to GND (pin 7).

Parameters	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
Supply current	Power down $V_{ENABLE} < 0.25V$ , $-40^\circ C$ to $85^\circ C$ $V_{PA-ENABLE} < 0.25V$ , $25^\circ C$ (100% correlation tested)	$I_{S\_off}$		< 10	350	nA nA
Supply current	Power up, PA off, $V_S = 3V$ , $V_{ENABLE} > 1.7V$ , $V_{PA-ENABLE} < 0.25V$	$I_S$		3.7	4.8	mA
Supply current	Power up, $V_S = 3.0V$ , $V_{ENABLE} > 1.7V$ , $V_{PA-ENABLE} > 1.7V$	$I_{S\_Transmit}$		9	11.6	mA
Output power	$V_S = 3.0V$ , $T_{amb} = 25^\circ C$ , $f = 433.92MHz$ , $Z_{Load} = (166 + j233)\Omega$	$P_{Ref}$	5.5	7.5	10	dBm
Output power variation for the full temperature range	$T_{amb} = 25^\circ C$ , $V_S = 3.0V$ $V_S = 2.0V$	$\Delta P_{Ref}$ $\Delta P_{Ref}$			-1.5 -4.0	dB dB
Output power variation for the full temperature range	$T_{amb} = 25^\circ C$ , $V_S = 3.0V$ $V_S = 2.0V$ $P_{Out} = P_{Ref} + \Delta P_{Ref}$	$\Delta P_{Ref}$ $\Delta P_{Ref}$			-2.0 -4.5	dB dB
Achievable output-power range	Selectable by load impedance	$P_{Out\_typ}$	0		7.5	dBm
Spurious emission	$f_{CLK} = f_0/128$ Load capacitance at pin CLK = 10pF $f_0 \pm 1 \times f_{CLK}$ $f_0 \pm 4 \times f_{CLK}$ Other spurious are lower			-55 -52		dBc dBc

Note: 1. If  $V_S$  is higher than 3.6V, the maximum voltage will be reduced to 3.6V.

## 7. Electrical Characteristics (Continued)

$V_S = 2.0V$  to  $4.0V$ ,  $T_{amb} = 25^\circ C$  unless otherwise specified.

Typical values are given at  $V_S = 3.0V$  and  $T_{amb} = 25^\circ C$ . All parameters are referred to GND (pin 7).

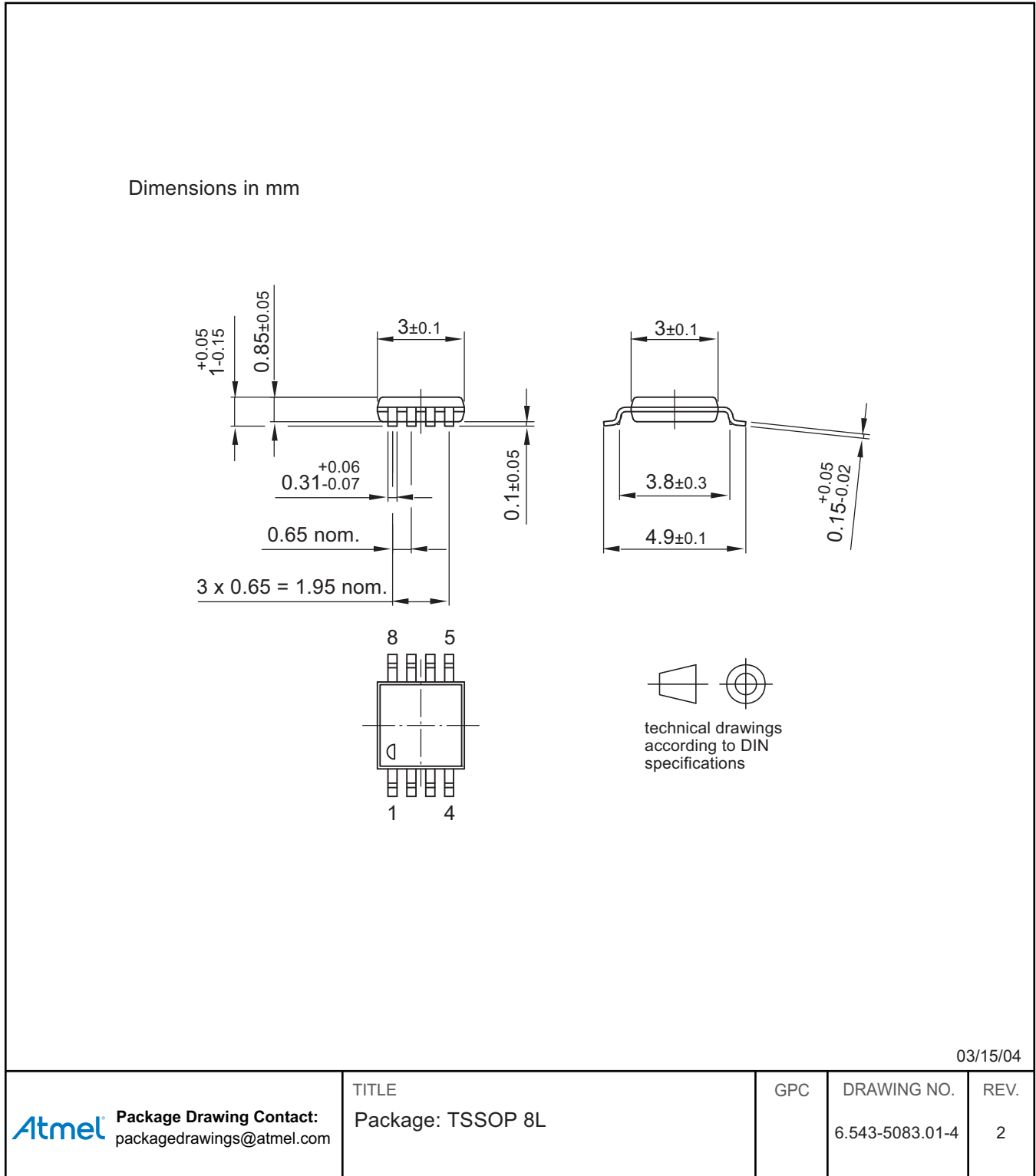
Parameters	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
Oscillator frequency XTO (= phase comparator frequency)	$f_{XTO} = f_0/32$ $f_{XTAL}$ = resonant frequency of the XTAL, $C_M \leq 10$ fF, load capacitance selected accordingly $T_{amb} = 25^\circ C$	$f_{XTO}$		$f_{XTAL}$		ppm
PLL loop bandwidth				250		kHz
Phase noise of phase comparator	Referred to $f_{PC} = f_{XTO}$ , 25kHz distance to carrier			-116	-110	dBc/Hz
In-loop phase noise PLL	25kHz distance to carrier			-86	-80	dBc/Hz
Phase noise VCO	At 1MHz At 36MHz			-94 -125	-90 -121	dBc/Hz dBc/Hz
Frequency range of VCO		$f_{VCO}$	429		439	MHz
Clock output frequency (CMOS microcontroller compatible)				$f_0/128$		MHz
Voltage swing at pin CLK	$C_{Load} \leq 10pF$	$V_{OH}$ $V_{OL}$	$V_S \times 0.8$		$V_S \times 0.2$	V V
Series resonance R of the crystal		$R_s$			110	$\Omega$
Capacitive load at pin XTO					7	pF
FSK modulation frequency rate	Duty cycle of the modulation signal = 50%		0		32	kHz
ASK modulation frequency rate	Duty cycle of the modulation signal = 50%		0		50	kHz
ENABLE input	Low level input voltage High level input voltage Input current high	$V_{IL}$ $V_{IH}$ $I_{In}$	1.7		0.25 20	V V $\mu A$
PA_ENABLE input	Low level input voltage High level input voltage Input current high	$V_{IL}$ $V_{IH}$ $I_{In}$	1.7		0.25 $V_S^{(1)}$ 5	V V $\mu A$

Note: 1. If  $V_S$  is higher than 3.6V, the maximum voltage will be reduced to 3.6V.

## 8. Ordering Information

Extended Type Number	Package	MOQ	Remarks
ATA8402C-6AQY	TSSOP8L	5000 pcs	Taped and reeled, Pb-free

## 9. Package Information



## 10. Revision History

Please note that the following page numbers referred to in this section refer to the specific revision mentioned, not to this document.

Revision No.	History
4982D-INDCO-07/14	<ul style="list-style-type: none"><li>• Put datasheet in the latest template</li></ul>
4982C-INDCO-08/12	<ul style="list-style-type: none"><li>• Features on page 1 changed</li></ul>
4982B-INDCO-03/12	<ul style="list-style-type: none"><li>• Features on page 1 changed</li><li>• Section 8 “Ordering Information” on page 11 changed</li></ul>



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

© 2014 Atmel Corporation. / Rev.: 4982D-INDCO-07/14

Atmel®, Atmel logo and combinations thereof, Enabling Unlimited Possibilities®, and others are registered trademarks or trademarks of Atmel Corporation in U.S. and other countries. Other terms and product names may be trademarks of others.

DISCLAIMER: The information in this document is provided in connection with Atmel products. No license, express or implied, by estoppel or otherwise, to any intellectual property right is granted by this document or in connection with the sale of Atmel products. EXCEPT AS SET FORTH IN THE ATMEL TERMS AND CONDITIONS OF SALES LOCATED ON THE ATMEL WEBSITE, ATMEL ASSUMES NO LIABILITY WHATSOEVER AND DISCLAIMS ANY EXPRESS, IMPLIED OR STATUTORY WARRANTY RELATING TO ITS PRODUCTS INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT. IN NO EVENT SHALL ATMEL BE LIABLE FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, PUNITIVE, SPECIAL OR INCIDENTAL DAMAGES (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS AND PROFITS, BUSINESS INTERRUPTION, OR LOSS OF INFORMATION) ARISING OUT OF THE USE OR INABILITY TO USE THIS DOCUMENT, EVEN IF ATMEL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. Atmel makes no representations or warranties with respect to the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and products descriptions at any time without notice. Atmel does not make any commitment to update the information contained herein. Unless specifically provided otherwise, Atmel products are not suitable for, and shall not be used in, automotive applications. Atmel products are not intended, authorized, or warranted for use as components in applications intended to support or sustain life.

SAFETY-CRITICAL, MILITARY, AND AUTOMOTIVE APPLICATIONS DISCLAIMER: Atmel products are not designed for and will not be used in connection with any applications where the failure of such products would reasonably be expected to result in significant personal injury or death ("Safety-Critical Applications") without an Atmel officer's specific written consent. Safety-Critical Applications include, without limitation, life support devices and systems, equipment or systems for the operation of nuclear facilities and weapons systems. Atmel products are not designed nor intended for use in military or aerospace applications or environments unless specifically designated by Atmel as military-grade. Atmel products are not designed nor intended for use in automotive applications unless specifically designated by Atmel as automotive-grade.

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Atmel:](#)

[ATA8402C-6AQY-66](#)



## Стандарт Электрон Связь

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

### Наши контакты:

**Телефон:** +7 812 627 14 35

**Электронная почта:** [sales@st-electron.ru](mailto:sales@st-electron.ru)

**Адрес:** 198099, Санкт-Петербург,  
Промышленная ул, дом № 19, литера Н,  
помещение 100-Н Офис 331