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## Features

- Very High Transmitting Frequency Accuracy Compared to SAW Solutions (Enables Receivers at Lower Bandwidth than with SAW Resonators)
- Lower Cost than the Usual Discrete Solutions Using SAW and Transistors
- Supply Voltage 2.2 V to 4.0 V in the Temperature Range of -40°C to 85°C
- XTO Output for Clocking the Microcontroller, Thereby Together with the ATAR090 or ATAR890 Results in the Optimum System Cost-effectiveness
- One-chip Solution with Minimum External Circuitry
- Very Small SSO16 Package, Pitch 0.635, 150 mil
- “Single-ended Open-collector” Output (Same Antennas Can Be Used as in Discrete Solutions, Simpler Adaptation of Magnetic Loop Antennas)
- ESD Protection According to MIL-STD.883 (4 KV HBM) Except Pins XTO1/ 2, ANT and LF

Electrostatic sensitive device.  
Observe precautions for handling.



## Description

The U2745B is a PLL transmitter IC which has been especially developed for the demands of RF low-cost data transmission systems at data rates up to 20 kBaud.

The transmitting frequency range is 310 MHz to 440 MHz. It can be used in ASK systems. The main applications of the U2745B are in the areas of outside temperature metering, socket control, garage door opener, consumption metering, light/fan or air-condition control, jalousies, wireless keyboard and various other consumer market applications.



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## UHF ASK Transmitter

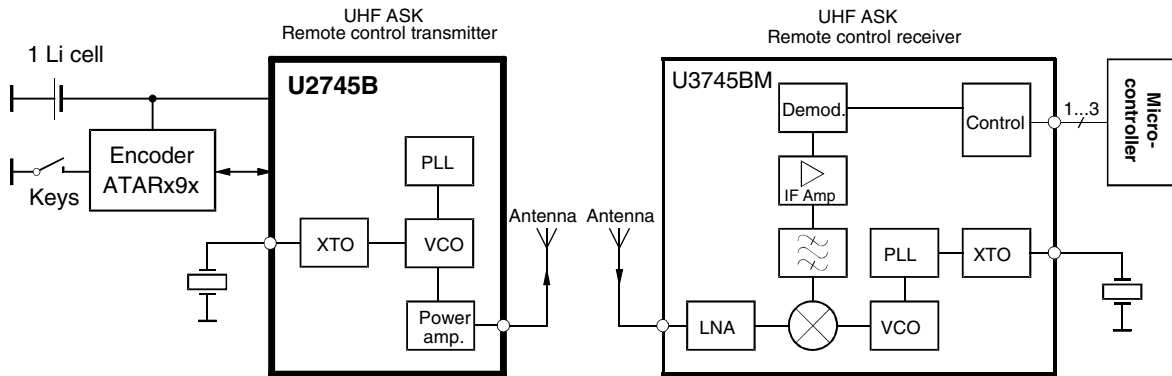
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### U2745B

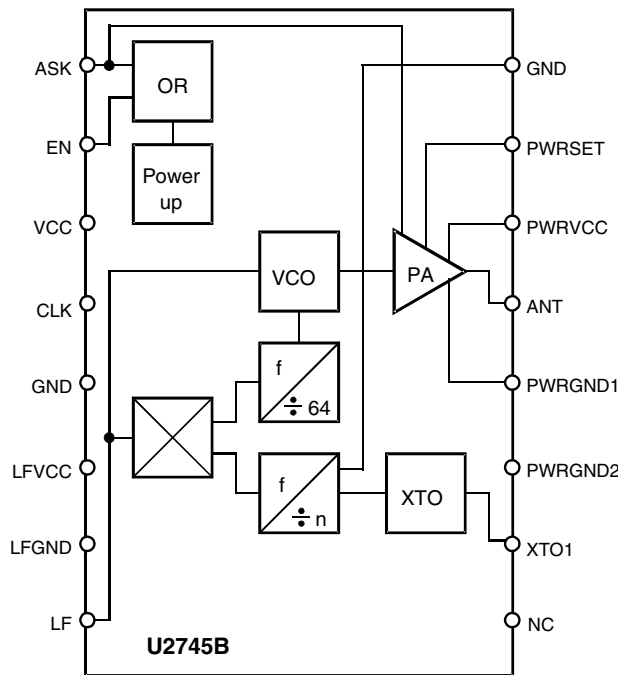
Rev. 4734A-RKE-11/03



**Figure 1. System Block Diagram**

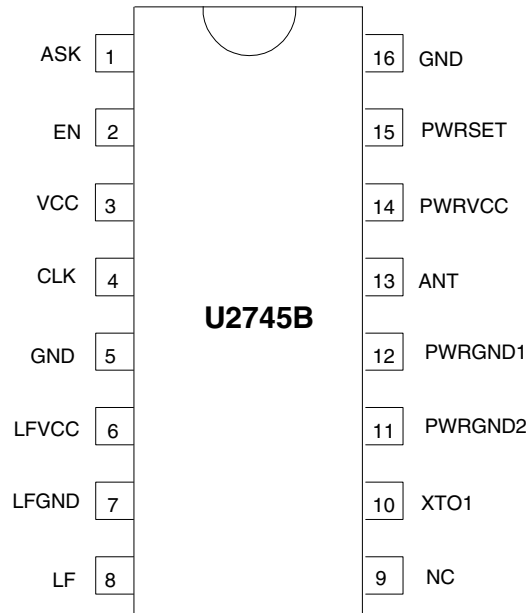


**Figure 2. Block Diagram**



## Pin Configuration

**Figure 3.** Pinning SSO16



## Pin Description

| Pin | Symbol  | Function                       |
|-----|---------|--------------------------------|
| 1   | ASK     | Modulation input ASK           |
| 2   | EN      | Enable input                   |
| 3   | VCC     | Supply voltage                 |
| 4   | CLK     | Clock output                   |
| 5   | GND     | Ground                         |
| 6   | Lfvcc   | Supply voltage VCO             |
| 7   | LFGND   | VCO ground                     |
| 8   | LF      | Circuit PLL loop               |
| 9   | NC      | Not connected                  |
| 10  | XTO1    | Connection for crystal         |
| 11  | PWRGND2 | Power GND2                     |
| 12  | PWRGND1 | Power GND1                     |
| 13  | ANT     | RF output                      |
| 14  | PWRVCC  | Supply voltage power amplifier |
| 15  | PWRSET  | Applied to VCC                 |
| 16  | GND     | Ground                         |

## General Description

The fully integrated VCO and the “single-ended open-collector” output allow particularly simple, low-cost RF miniature transmitters to be assembled. The single-ended output enables a considerably simplified adaptation of both a magnetic loop antenna of any form or a  $\lambda/4$  antenna. This is because the load impedance must not be balanced as would be the case with a differential output.

The XTO's frequency can be selected to be either 13.56 MHz or 9.844 MHz (USA). At these frequencies, crystals have a very fast start-up time ( $< 1.5$  ms), whereby a wait time of 5 to 10 ms is required until the transmitter IC is locked. This means that the processor does not need to poll a lock detect output.

## Functional Description

### ASK Transmission

The U2745B is activated by  $EN = V_S$ .  $V_{ASK}$  must remain 0 V for 5 ms, then the output power can be modulated by means of pin ASK.  $V_{EN}$  remains =  $V_S$  during the transmission of the message. The ASK input activates the power amplifier and the PLL.

### Take-over of the Clock Pulse in the Microcontroller

The clock of the crystal oscillator can be used for clocking the microcontroller. The ATAR090 and ATAR890 have the special feature of starting with an integrated RC oscillator to switch on the U2745B with  $V_{EN} = V_S$ . 5 ms later, the 3.39-MHz clock frequency is present, so that the message can be sent with crystal accuracy.

## Application Circuit

The following component values are recommendations for a typical application.  $C_4$ ,  $C_5$ , and  $C_6$  are block capacitors. The values of these capacitors depend on the board layout.  $C_4 = 1$  nF,  $C_5 = 1$  nF, and  $C_6 = 22$  nF are typically used here. For  $C_5$ , the impedance between  $f = 100$  MHz and  $f = 1$  GHz should be as low as possible.

$C_{Loop1}$  and  $C_{Loop2}$  are selected so that the antenna oscillates in resonance and the adaptation to the appropriate impedance transformation is possible.

$L_{Feed}$  is an inductor for the antenna's DC current supply. A typical value is  $L_{Feed} = 220$  nH.  $L_{Feed}$  can be either printed on the PC board or be a discrete component.

## Output Power Measurement

The following output network (see Figure 4 on page 5) can be used for output power evaluation, the exact values of  $L_{10}$  and  $C_{10}$  are dependent on the layout.

$L_{10}$  and  $C_{10}$  form the transformation network to adopt the output impedance of the IC to  $50 \Omega$ . The following table shows the values for an output power of 2 mW and an  $R_{PWRSET} = 1.2$  k $\Omega$ .

**Table 1.** Transformation Network

| f/MHz  | C10/pF | L10/nH | $Z_{Load\_opt}/\Omega$ |
|--------|--------|--------|------------------------|
| 315    | 2.7    | 56     | $260 + j330$           |
| 433.92 | 1.8    | 33     | $185 + j268$           |

Figure 4. Measurement Output Network

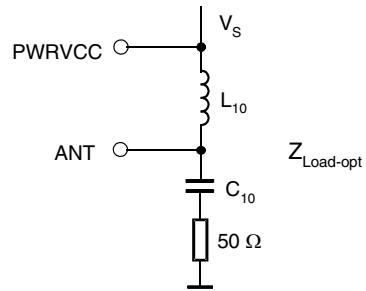
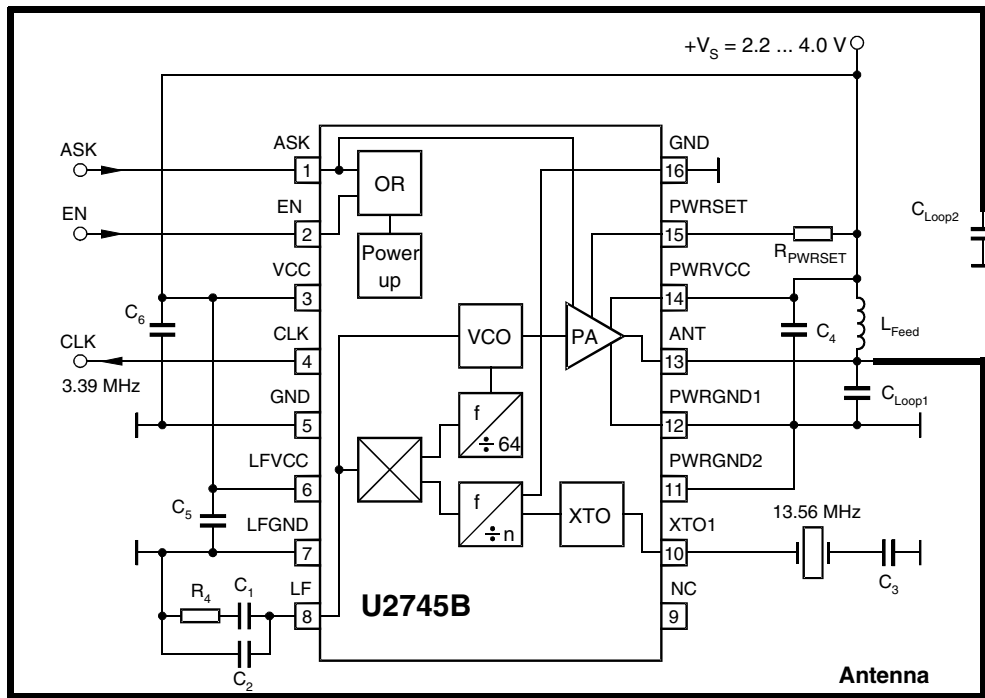


Figure 5. Application Circuit



## 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    | Min. | Max. | Unit |
|----------------------|-----------|------|------|------|
| Supply voltage       | $V_S$     |      | 6    | V    |
| Power dissipation    | $P_{tot}$ |      | 250  | mW   |
| Junction temperature | $T_j$     |      | 150  | °C   |
| Storage temperature  | $T_{stg}$ | -55  | 125  | °C   |
| Ambient temperature  | $T_{amb}$ | -40  | 85   | °C   |

## Thermal Resistance

| Parameters       | Symbol     | Value | Unit |
|------------------|------------|-------|------|
| Junction ambient | $R_{thJA}$ | 180   | K/W  |

## Electrical Characteristics

All parameters are referred to GND (pin 5),  $V_S = 3\text{ V}$ ,  $T_{amb} = 25^\circ\text{C}$ , unless otherwise specified

The possible operating ranges refer to different circuit conditions:  $V_S = 2.2\text{ V}$  to  $4.0\text{ V}$  at  $T_{amb} = -40^\circ\text{C}$  to  $+85^\circ\text{C}$

| Parameters  | Test Conditions   | Symbol                   | Min.           | Typ.                 | Max.           | Unit          |
|---|---|--------------------------|----------------|----------------------|----------------|---------------|
| Supply current (power down)   | $V_{ASK}, V_{FSK} \leq 0.3\text{ V}$ , $V_S < 3.6\text{ V}$   | $I_{Soff}$               |                | 2                    | 10             | $\mu\text{A}$ |
| Supply current (power up, output OFF)   | $V_{ASK} = \text{GND}$ , $V_{EN} = V_S$ , $V_S = 3\text{ V}$  | $I_{Son}$                |                | 4.7                  | 6.2            | mA            |
| Supply current (power up, output ON)  | $V_{ASK} = V_S$ , $V_S = 3\text{ V}$ , $R_{PWRSET} = 1.2\text{ k}\Omega$  | $I_{Stransmit}$          |                | 10                   | 12.5           | mA            |
| Output power  | $V_S = 3\text{ V}$ , $T_{amb} = 25^\circ\text{C}$ , $f = 433.92\text{ MHz}$<br>$R_{PWRSET} = 1.2\text{ k}\Omega$  | $P_{Ref}$                | 1              | 3                    | 5              | dBm           |
| Output power variation for $f = 315\text{ MHz}$ compared to $f = 433.92\text{ MHz}$ | $f = 315\text{ MHz}$<br>$P_{out} = P_{Ref} + \Delta P_{Ref}$  | $\Delta P_{Ref}$         |                | 1.5                  |                | dB            |
| Maximum peak output antenna voltage   | at $P_{out} = 2.0\text{ mW}$ ,<br>the load impedance must be selected to meet the $V_{out}$ maximum requirement, the supply current is not dependent on the load impedance tolerance                  | $V_{outmax}$             |                | $V_S - 0.7\text{ V}$ |                | $V_{(peak)}$  |
| Spurious emission   | $f_o \pm (n \times f_{PC})$ where $f_{PC} = 6.78\text{ MHz}$<br>Load capacitance at CLK $\leq 3\text{ pF}$<br>$f = 230\text{ MHz}$ to $470\text{ MHz}$<br>$f < 230\text{ MHz}$ , $f > 470\text{ MHz}$ | Em<br>Em                 |                |                      | -40<br>-58     | dBc<br>dBc    |
| Oscillator frequency XTO  | Crystal frequency = $13.56\text{ MHz}$  | $f_{XTO}$                | 13.56 - 30 ppm | 13.56                | 13.56 + 30 ppm | MHz           |
| Loop bandwidth  | For best LO noise<br>Loop filter components:<br>$C_2 = 3.9\text{ nF}$ , $C_1 = 15\text{ nF}$ , $R_4 = 220\ \Omega$  | $B_{Loop}$               |                | 100                  |                | kHz           |
| Phase noise PLL   | Referring to the phase comparator<br>$f_{PC} = 6.78\text{ MHz}$   | $PN_{PLL}$               |                | -111                 | -105           | dBc/Hz        |
| Phase noise VCO   | at $1\text{ MHz}$<br>at $36\text{ MHz}$   | $PN_{VCO}$<br>$PN_{VCO}$ |                | -90<br>-122          |                | dBc/Hz        |

**Electrical Characteristics (Continued)**

All parameters are referred to GND (pin 5),  $V_S = 3\text{ V}$ ,  $T_{\text{amb}} = 25^\circ\text{C}$ , unless otherwise specified

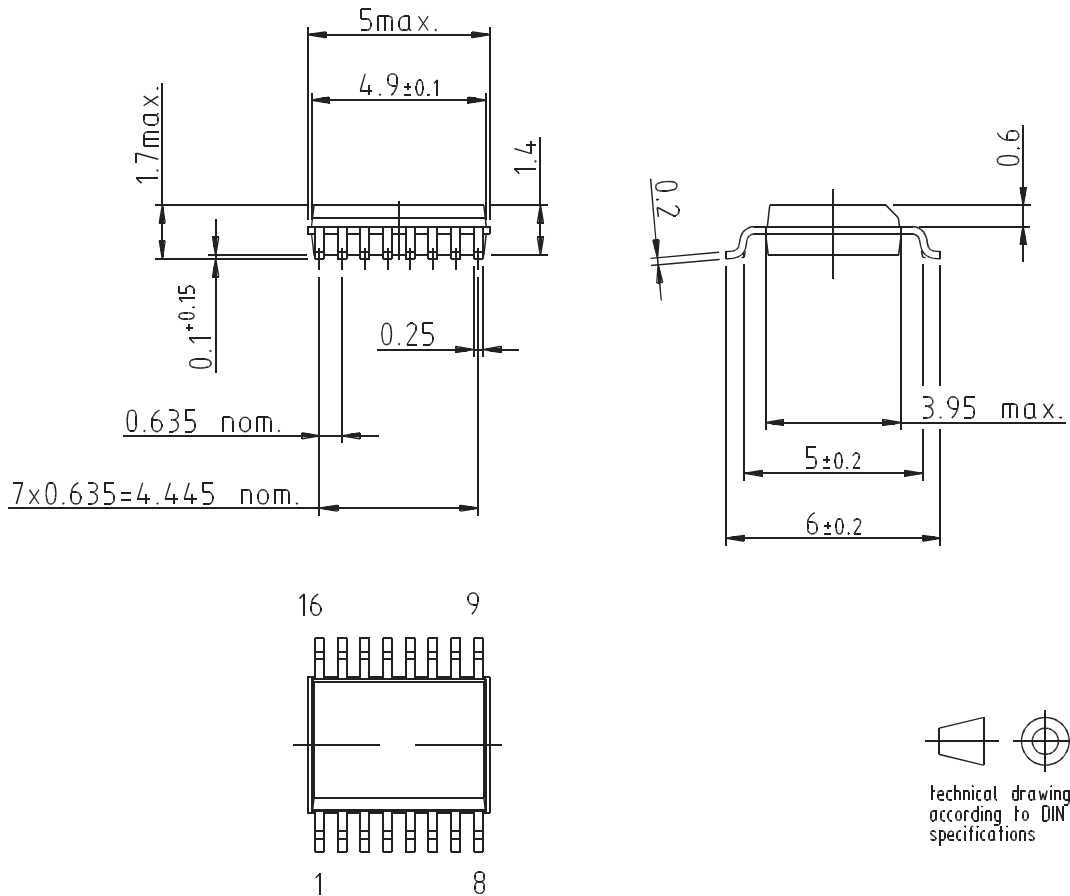
The possible operating ranges refer to different circuit conditions:  $V_S = 2.2\text{ V to }4.0\text{ V}$  at  $T_{\text{amb}} = -40^\circ\text{C to }+85^\circ\text{C}$

| Parameters   | Test Conditions  | Symbol   | Min.                       | Typ.                 | Max.       | Unit   |
|--|--|--|----------------------------|----------------------|------------|--|
| Frequency range of the VCO   |  | $f_{\text{VCO}}$   | 310                        |                      | 440        | MHz  |
| Clock output<br>(CMOS microcontroller compatible)  |  | $\text{Clk}_{\text{out}}$  |                            | $f_{\text{out}}/128$ |            | MHz  |
| Load capacitance at CLK  |  | $C_{\text{CLK}}$   |                            |                      | 10         | pF   |
| Series resonance R of the crystal  | $f_{\text{XTO}} = 13.56\text{ MHz}$<br>$f_{\text{XTO}} = 9.84\text{ MHz}$  | $R_s$<br>$R_s$   |                            |                      | 80<br>100  | $\Omega$   |
| ASK modulation frequency rate  | Duty cycle of the modulation signal = 50%  | $f_{\text{modASK}}$  | 0                          |                      | 20         | kHz  |
| CLK output<br>- Output current Low<br>- Output current Low<br>- Output current High<br>- Output current High | $V_{\text{CLK}} = 0.2 \times V_S$<br>$V_{\text{CLK}} = 0.3 \times V_S$<br>$V_{\text{CLK}} = 0.8 \times V_S$<br>$V_{\text{CLK}} = 0.7 \times V_S$ | $I_{\text{ol}}$<br>$I_{\text{ol}}$<br>$I_{\text{oh}}$<br>$I_{\text{oh}}$       | 150<br>200<br>-150<br>-200 |                      | 100        | $\mu\text{A}$<br>$\mu\text{A}$<br>$\mu\text{A}$<br>$\mu\text{A}$ |
| ASK input<br>- Low level input voltage<br>- High level input voltage<br>- Input current High                 |  | $V_{\text{ASKl}}$<br>$V_{\text{ASKh}}$<br>$I_{\text{ASKh}}$                    | 1.7                        |                      | 0.3<br>140 | V<br>V<br>$\mu\text{A}$  |
| Enable ASK<br>- Low level input voltage<br>- High level input voltage<br>- Input current High                |  | $V_{\text{EN}}$<br>$V_{\text{FSKl}}$<br>$V_{\text{FSKh}}$<br>$I_{\text{FSKh}}$ | 1.7                        |                      | 0.3<br>140 | V<br>V<br>$\mu\text{A}$  |

## Ordering Information

| Extended Type Number | Package | Remarks          |
|----------------------|---------|------------------|
| U2745B-MFB           | SSO16   | Tube             |
| U2745B-MFBG3         | SSO16   | Taped and reeled |

## Package Information



Drawing refers to following types: SS016  
 Package acc. JEDEC MO 137 AB





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