

## UHF AM/FM Transmitter

### Description

The U2740B-B is an one-chip multi-purpose UHF ASK/FSK transmitter IC designed for various applications within a wide frequency range. When a Chip-Select (CS) signal is supplied, the IC starts operation (Power-up, XTO, VCO, PD) and the VCO is then locked to  $128 \times f(\text{XTO})$ . The locked status is indicated at the Lock-Detect (LD) output.

The digital data is supplied to either an AM- or FM-input pin, the output power being set via the AM-input pin. A differential output enables simple applications with loop antennas. An output driver (XTO\_out) can be used for clocking the microcontroller.

### Features

- One-chip solution with few external components
- Wide frequency range (200 to 500 MHz)
- Single voltage supply (2.2 to 5.5 V) with power-down feature
- Adjustable output power with differential output for loop antenna
- PLL lock-detect signal
- XTO output for  $\mu\text{C}$  clock
- ESD protection according to MIL-STD. 883 (except Pins 1, 2, 13 and 14)
- Low standby current  $<0.25 \mu\text{A}$  for  $V_S = 3 \text{ V}$
- Single lithium-cell operation

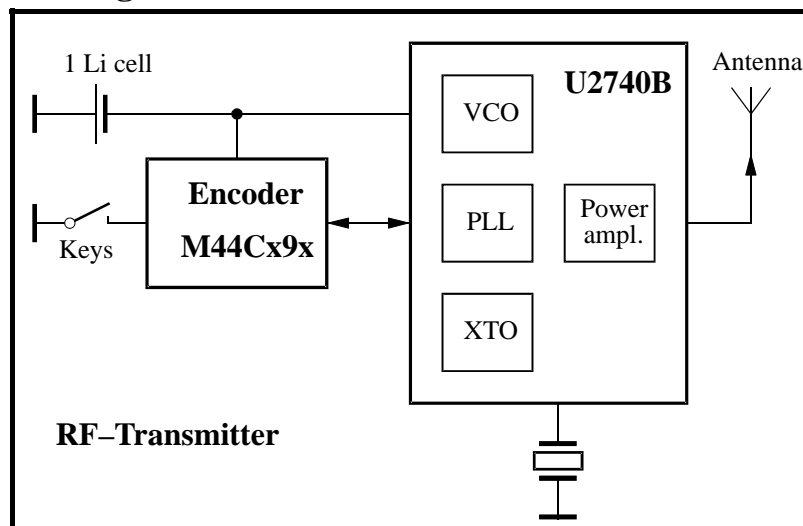
### Applications

- Keyless entry (automotive, domestic,...)
- Alarm systems
- Remote control
- Communication systems

### Ordering Information

Extended Type Number	Package	Remarks
U2740B-BFP	SO16	

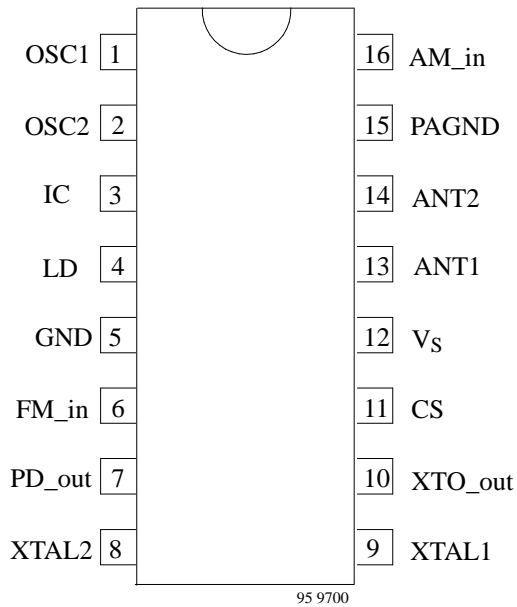
### System Block Diagram



13350

Figure 1. System block diagram

## Pin Description



Pin	Symbol	Function
1	OSC1	VCO tank
2	OSC2	VCO tank
3	IC	Internally connected
4	LD	Lock-detect (open collector)
5	GND	Ground
6	FM_in	FM modulation input
7	PD_out	Phase detector output
8	XTAL2	FM modulation capacitor
9	XTAL1	XTAL
10	XTO_out	XTO output (open collector)
11	CS	Chip-select (power-up)
12	V <sub>S</sub>	Supply voltage
13	ANT1	Differential output 1
14	ANT2	Differential output 2
15	PAGND	Power amplifier ground
16	AM_in	AM modulation input

Figure 2. Pinning

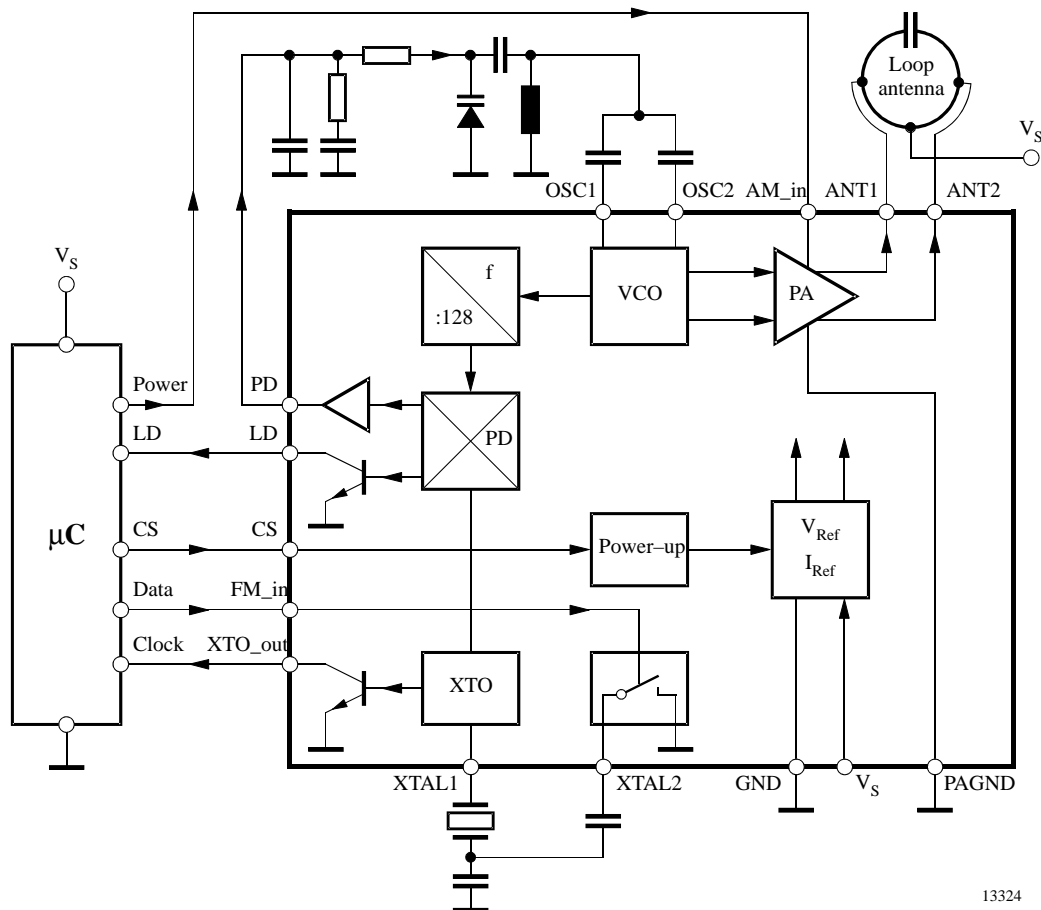


Figure 3. Block diagram

## Circuit Description

The transmitter PLL U2740B contains the complete RF part for a radio control system. The IC consists of a VCO, a complete PLL circuit, a crystal oscillator, a power amplifier and a power-up module. An integrated switch can be used to change the load capacitance of the crystal.

### VCO

The VCO is a voltage-controlled current source. The frequency is determined by the external LC-tank. The frequency is changed via a Varicap diode.

### PLL

The complete PLL consists of a prescaler, a digital phase/frequency detector (PFD) with charge-pump output. The output frequency is locked to 128 times the frequency of the XTO. The PFD, however, operates at a frequency four times lower than that of the XTO. A lock-detect output indicates that the PLL is locked.

### Crystal Oscillator (XTO)

It is a single-pin crystal oscillator, operating at the series resonant frequency of the crystal. Depending on the type of crystal used, this oscillator takes 3 to 20 ms until settling after setting CS to  $V_S$ . The integrated switch can be used to change the load capacitance. Thus, the output frequency is FSK modulated.

### Power Amplifier (PA)

As figure 4 shows, the differential PA switches its output current between the two power output pins (ANT1, ANT2). The output current is seven times the current flowing into the AM\_in Pin. The achievable output power is about 1.5 mW.

### Power-up

When CS = 0 V, the circuit is in standby mode with a power-down supply current of type  $I_{S,off} = 0.1 \mu A$ . With CS =  $V_S$ , the circuit is in power-up mode.

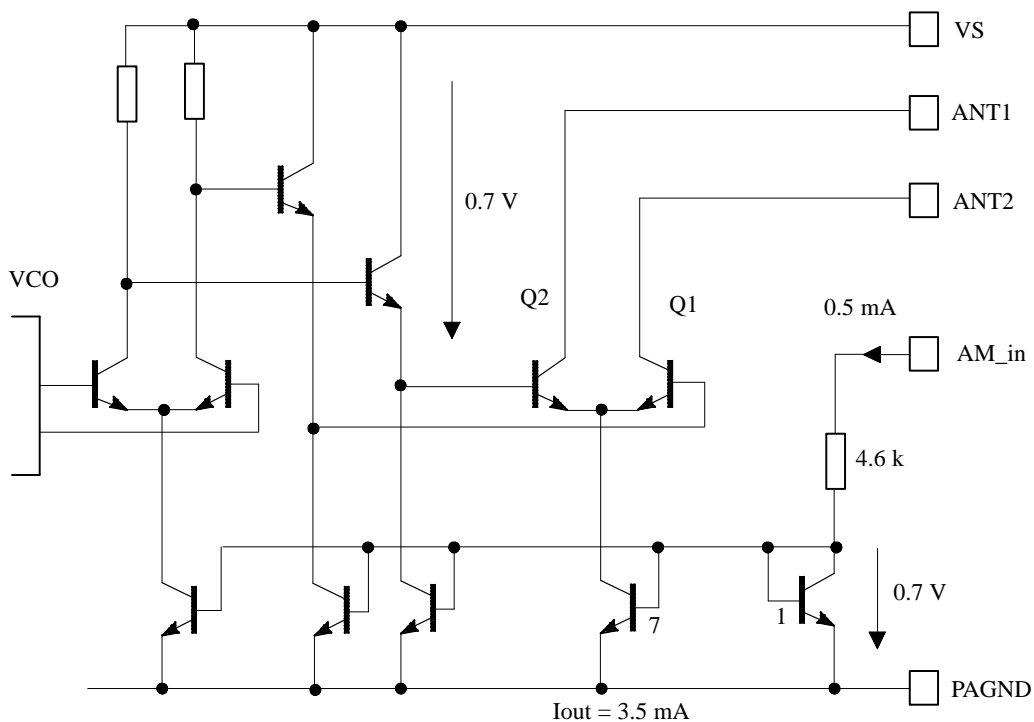


Figure 4. Power output stage of U2740B

## Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Unit
Supply voltage Pin 12	$V_S$	-0.3	5.5	V
Voltage at Pins 13 and 14		-0.3	10	V
Input current AM_in Pin 16			0.75	mA
Output current lock detect Pin 4			1.5	mA
Output current XTO_out Pin 10			1.5	mA
Junction temperature	$T_j$		125	°C
Storage temperature	$T_{stg}$	-55	125	°C

## Thermal Resistance

Parameters	Symbol	Min.	Typ.	Max.	Unit
Junction ambient SO16	$R_{thJA}$			120	K/W

## Operating Range

All voltages are referred to GND (Pin 5) and PAGND (Pin 15),  $T_{amb} = -40$  to  $+85^\circ\text{C}$ , unless otherwise specified

Parameters	Symbol	Min.	Typ.	Max.	Unit
Supply voltage Pin 12	$V_S$	2.4	3.0	5.5	V
Supply voltage, $T_{amb} = -20$ to $+85^\circ\text{C}$	$V_S$	2.2	3.0	5.5	V
Minimum supply voltage, $T_{amb} = 25^\circ\text{C}$			1.8		V
Minimum supply voltage, $T_{amb} = -20^\circ\text{C}$			2.0		V
Carrier frequency		200		500	MHz

## Electrical Characteristics DC

All voltages referred to GND (Pin 5),  $V_S = 2.4$  to  $5.5$  V,  $T_{amb} = -40$  to  $+85^\circ\text{C}$ , unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Supply current (power-down)	$V_{11} = 0, I_{16} = 0, V_S = 3$ V Pin 12	$I_{S, OFF}$		0.05	0.25	$\mu\text{A}$
	$V_{11} = 0, I_{16} = 0, V_S = 5.5$ V Pin 12			0.1	0.5	$\mu\text{A}$
Supply current (power-up, transmit space)	$V_{16} = 0$ V, $V_{11} = V_S$	$I_{S, ON}$		5.0	8.0	mA
	$V_{16} = 0$ V, $V_{11} = 3$ V, $V_S = 3$ V, $T_{amb} = 25^\circ\text{C}$ , Pin 12	$I_{S, ON}$	4.5	5.0	6.5	mA
	$V_{16} = 0$ V, $V_{11} = 5.5$ V, $V_S = 5.5$ V, $T_{amb} = 25^\circ\text{C}$ , Pin 12	$I_{S, ON}$	4.5	5.8	7.2	mA
Temperature coefficient of supply current <sup>1)</sup>	TKI			0.18		%/K
Supply current (power-up, transmit mark)	$V_{16} = 3$ V, $V_{11} = 3$ V, $V_S = 3$ V, $T_{amb} = 25^\circ\text{C}$ , Pin 12		8	11	13.5	mA
Power-down voltage	$V_{16} = 0$ V Pin 11	$V_{11, OFF}$			0.4	V
Power-up voltage	$V_{16} = 0$ V Pin 11	$V_{11, ON}$	1.0			V
Power-up current	$V_{11} = 3$ V Pin 11	$I_{11, ON}$		40	65	$\mu\text{A}$
	$V_{11} = 5.5$ V Pin 11			110	150	
Input current FM_in	$V_6 = 3$ V Pin 6	$I_6$		16	25	$\mu\text{A}$
Output current Lock-detect	Pin 4	$I_4$			1	
Output current XTO_out	Pin 10	$I_{10}$			1	mA
Input current AM_in <sup>2)</sup>	R16 = 0 connected to $V_S = 3$ V, Pin 16 $T_{amb} = 25^\circ\text{C}$ $T_{amb} = 85^\circ\text{C}$	$I_{16}$	0.40	0.50	0.60	mA
			0.44	0.55	0.65	mA

Notes:

- There are circuit parts with increasing supply current over temperature. The resulting supply current is  $I_S(T_{amb}) = I_{SDN} (1 + (T_{amb} - 25^\circ\text{C}) \times \text{TKI})$
- This depends on the value of resistor R16 connected to  $V_S$ . If the supply voltage is 2.0 to 3.5 V, Pin 16 can be directly connected to  $V_S$ . For  $V_S = 5$  V, R16 should be 3.9 k $\Omega$ .

## Electrical Characteristics AC

All voltages referred to GND (Pin 5),  $V_S = 2.2$  to  $5.5$  V,  $T_{amb} = -40$  to  $+85^\circ\text{C}$ , unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Extinction ratio	$V_{11} = 3$ V	$20 \times \log(I_{out,ON} / I_{out,off})$	-40	-50		dB
Output current, transmit mark, ( $f_{VCO} = 433.92$ MHz) <sup>3)</sup>	$V_{11} = 3$ V, $V_{16} = 0$ V Pins 13 and 14	$i_{out,pp}$	2.9	3.5	4.2	mA
Output voltage swing	Difference, Pins 13 and 14	$v_{(13-14)pp}$		4	5	V
Phase detector Output current	Pin 7	$I_{PD}$	-1		1	mA
Phase detector Output voltage swing <sup>4)</sup>	Pin 7	$v_{PDpp}$	0.2		$V_S - 0.2$	V
Enable settling time <sup>5)</sup>	Pins 11, 13 and 14	$T_{enable}$			100	$\mu\text{s}$
Modulation bandwidth <sup>6)</sup>	Pin 6	$BW_{FSK}$			50	kHz
Output frequency range	Pins 13 and 14	$f_{VCO}$	200		500	MHz
XTO frequency range	Pins 9 and 10	$f_{XTO}$	1		6	MHz
Modulation bandwidth	Pin 16	$BW_{ASK}$			500	kHz

Notes:

- 3) The output peak-to-peak current is 7 times the current flowing into the AM\_in Pin. The driver stage of the power amplifier is designed so that the output current is switched between Pins 13 and 14.
- 4) The output voltage swing at each collector is limited to 2 V due to the circuit arrangement used. The output power depends on the load impedance. If optimum load impedance of 1.1 k $\Omega$  is used, an output power of  $3.5 \text{ mA}/2 \times \sqrt{2} \times 1.1 \text{ k}\Omega = 1.7 \text{ mW}$  (+2.3 dBm) results.
- 5) This is the time if an external clock is delivered to Pin 9 and Pin 11 is set to  $V_S$  until the circuit operates.
- 6) FSK bandwidth is depending on values for loop filter and VCO, see application note for design hints.

**Application Circuit (ASK Modulation)**

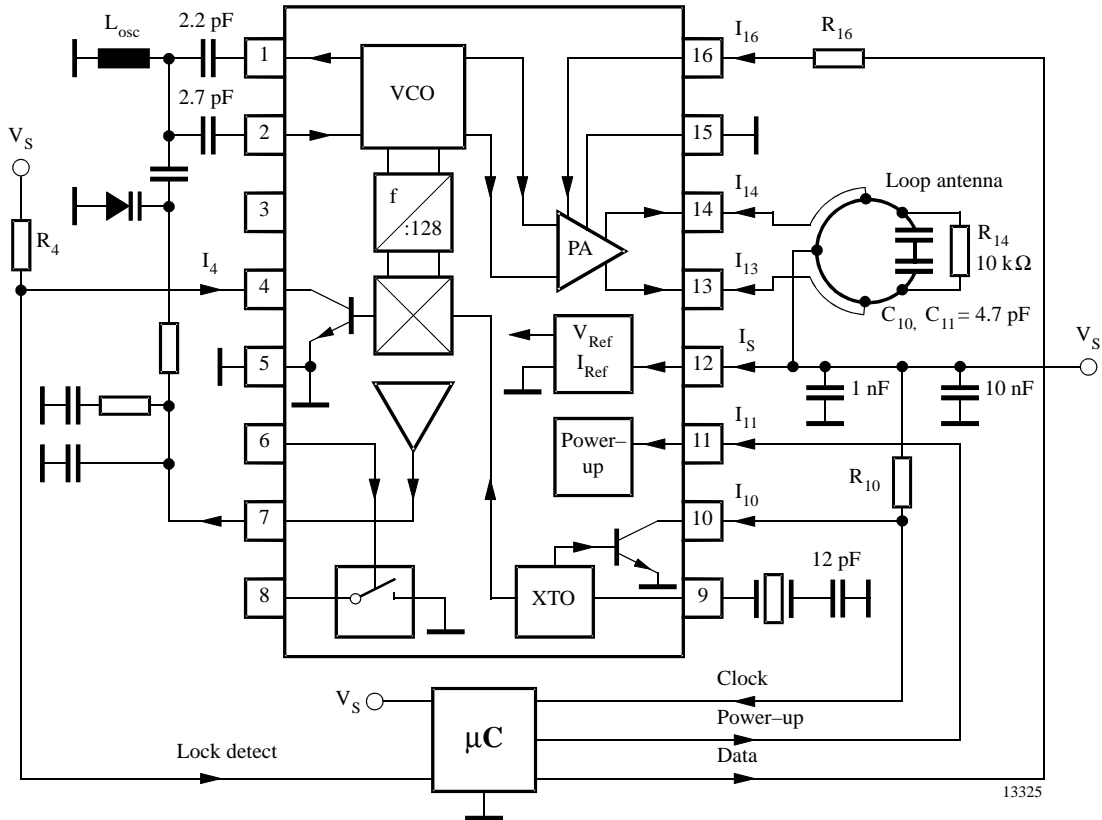


Figure 5.

**Principle of Operation (ASK Modulation)**

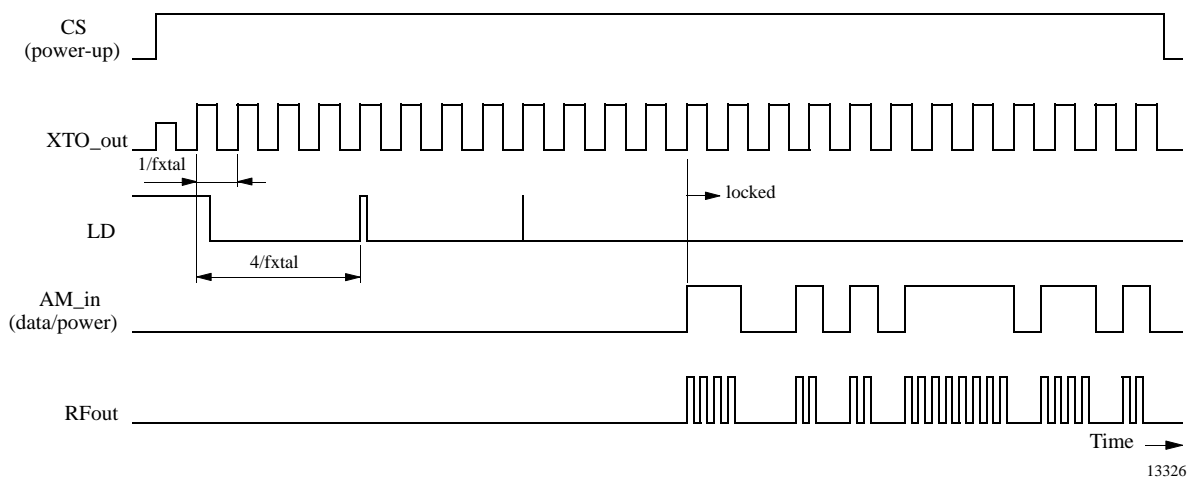


Figure 6.

## Application Circuit (FSK Modulation)

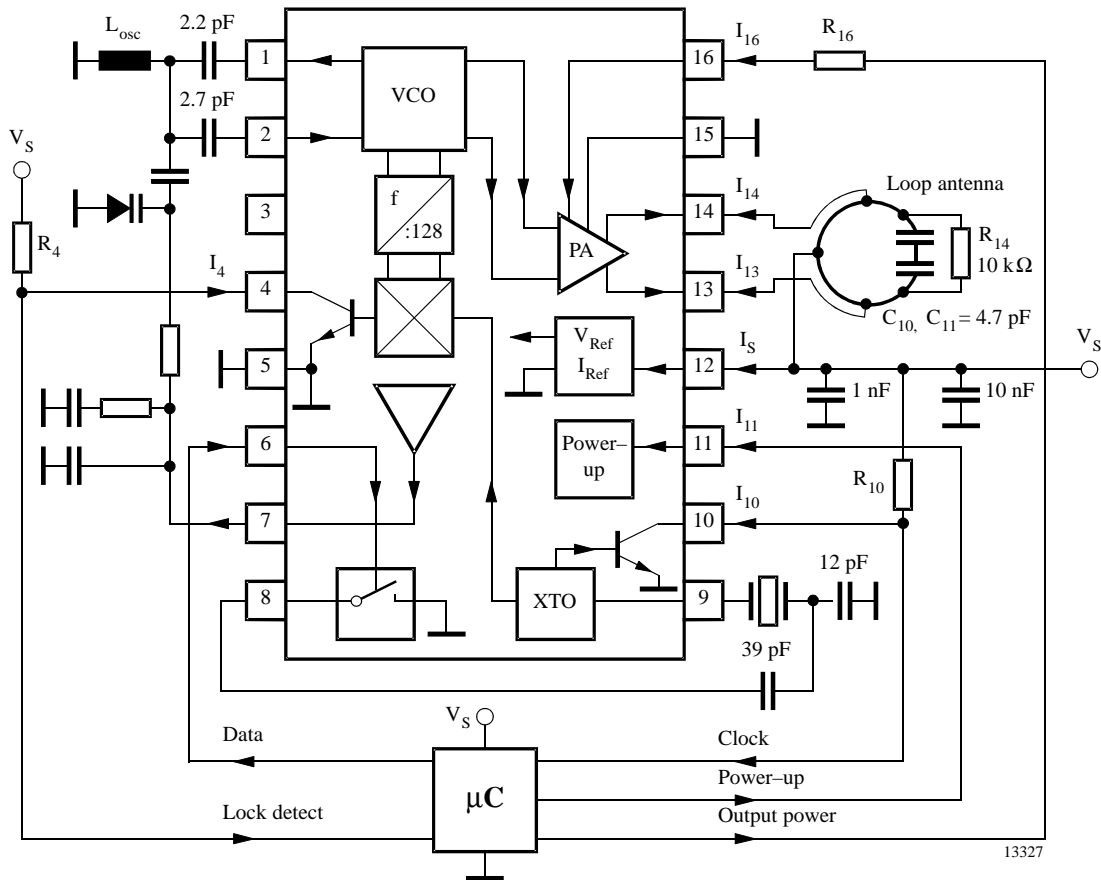


Figure 7.

## Principle of Operation (FSK Modulation)

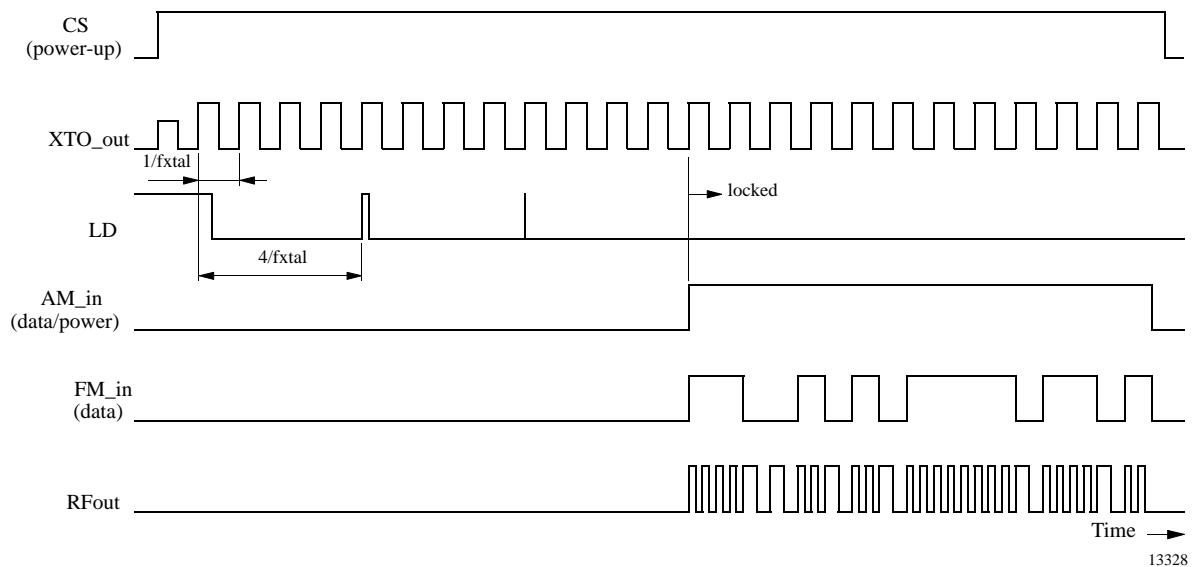


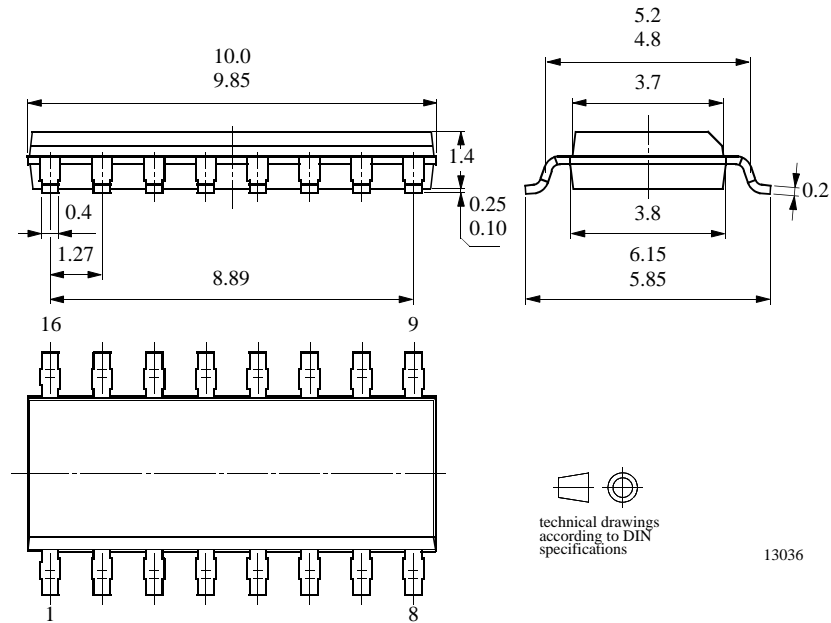
Figure 8.



**Package Information**

Package SO16

Dimensions in mm



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