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 **C**hip-**S**elect (CS) signal is supplied, the IC starts operation (Power-up, XTO, VCO, PD) and the VCO is then locked to 128 × f(XTO). The locked status is indicated at the **L**ock-**D**etect (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 microcontrolller.

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 µC clock
- ESD protection according to MIL–STD. 883 (except Pins 1, 2, 13 and 14)
- Low standby current <0.25 µA for V_S = 3 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

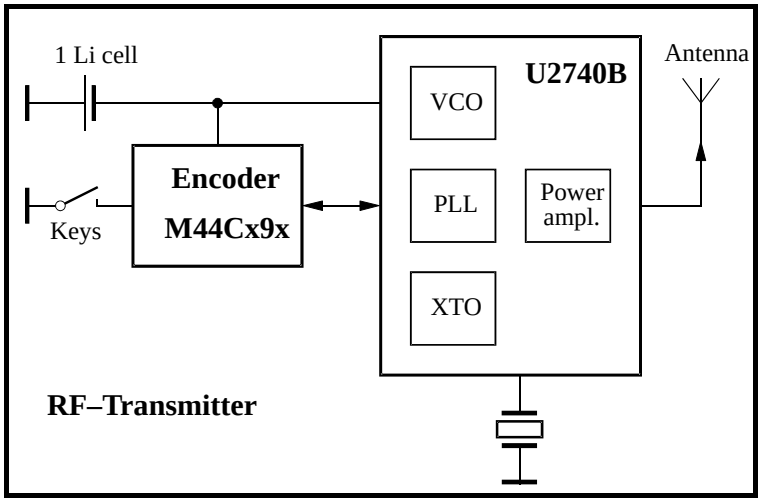

Figure 1. System block diagram

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Pin Description

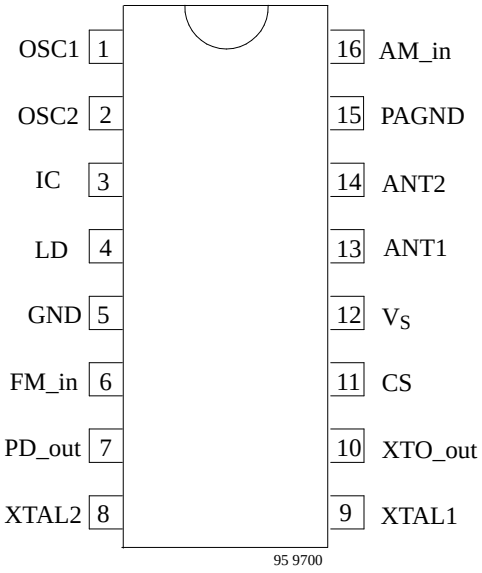

Figure 2. Pinning

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_S	Supply voltage
13	ANT1	Differential output 1
14	ANT2	Differential output 2
15	PAGND	Power amplifier ground
16	AM_in	AM modulation input

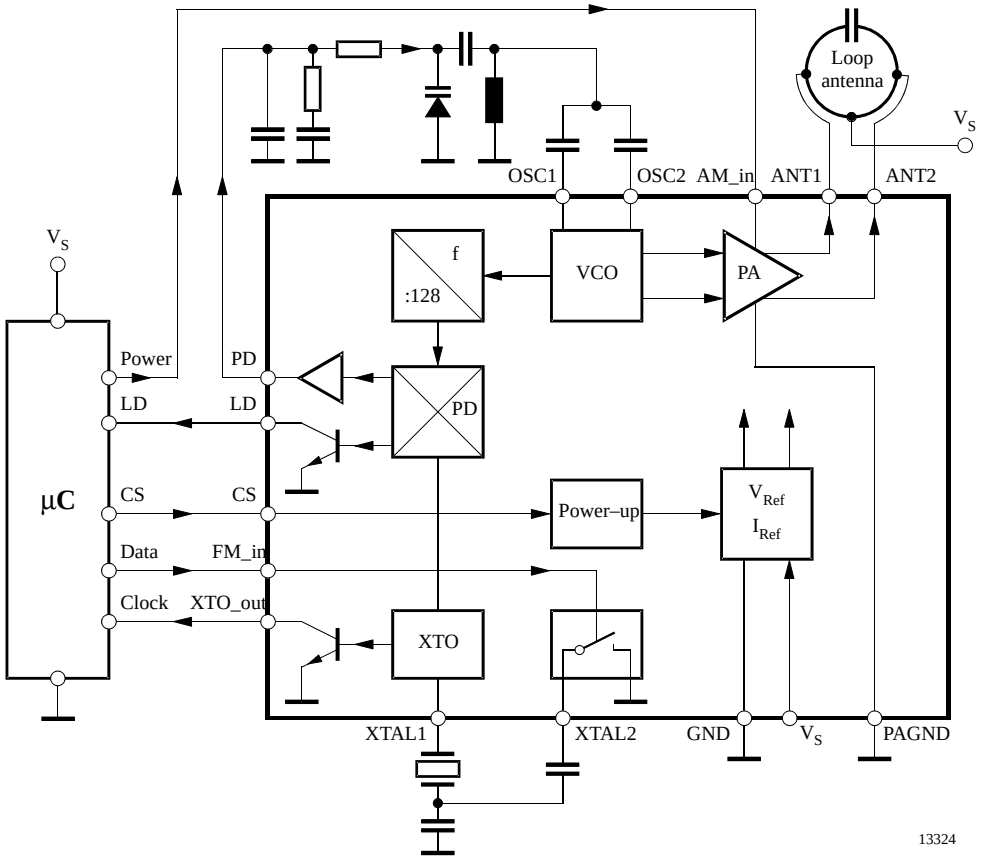

Figure 3. Block diagram

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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. IS,off = 0.1 µA. With CS = V_S, the circuit is in power-up mode.

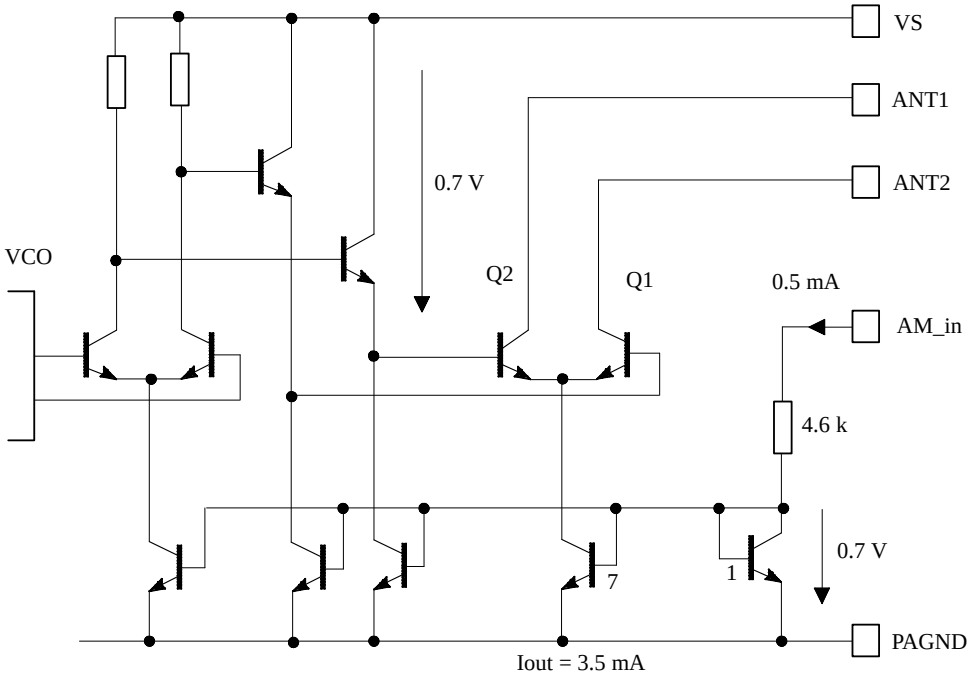

Figure 4. Power output stage of U2740B

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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°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°C		V_S	2.2	3.0	5.5	V
Minimum supply voltage, T_{amb} = 25°C				1.8		V
Minimum supply voltage, T_{amb} = –20°C				2.0		V
Carrier frequency			200		500	MHz

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Electrical Characteristics DC

All voltages referred to GND (Pin 5), V_S = 2.4 to 5.5 V, T_{amb} = –40 to +85°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	µA
	V_{11} = 0, I_{16} = 0, V_S = 5.5 V Pin 12			0.1	0.5	µA
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°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°C, Pin 12	$I_{S, ON}$	4.5	5.8	7.2	mA
Temperature coefficient of supply current [1]	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°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	µA
	V_{11} = 5.5 V Pin 11			110	150	
Input current FM_in	V_6 = 3 V Pin 6	I_6		16	25	µA
Output current Lock-detect	Pin 4	I_4			1	
Output current XTO_out	Pin 10	I_{10}			1	mA
Input current AM_in [2]	R16 = 0 connected to V_S = 3 V, Pin 16 T_{amb} = 25°C T_{amb} = 85°C	I_{16}	 0.40 0.44	 0.50 0.55	 0.60 0.65	 mA mA

Notes:

1) There are circuit parts with increasing supply current over temperature. The resulting supply current is $IS(T_{amb}) = I_{SDN} (1 + (T_{amb} – 25°C) \times TKI)$

2) 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 kΩ.

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Electrical Characteristics AC

All voltages referred to GND (Pin 5), V_S = 2.2 to 5.5 V, T_{amb} = –40 to +85°C, unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Extinction ratio	V_{11} = 3 V	20 × log ($I_{out,ON}$ $I_{out,off}$)	–40	–50		dB
Output current, transmit mark, (f_{VCO} = 433.92 MHz) 3)	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 4)	Pin 7	v_{PDpp}	0.2		V_S–0.2	V
Enable settling time 5)	Pins 11, 13 and 14	T_{enable}			100	µs
Modulation bandwidth 6)	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 kΩ is used, an output power of 3.5 mA/2 × sqrt(2) × 1.1 kΩ = 1.7 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.

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Application Circuit (ASK Modulation)

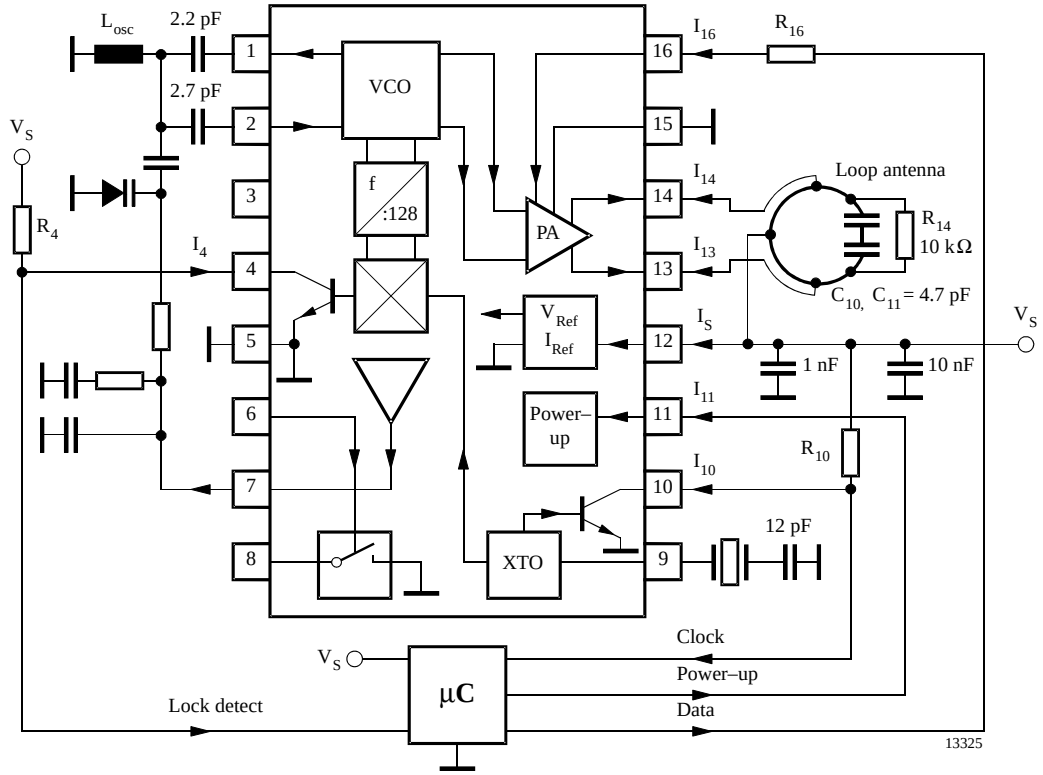

Figure 5.

Principle of Operation (ASK Modulation)

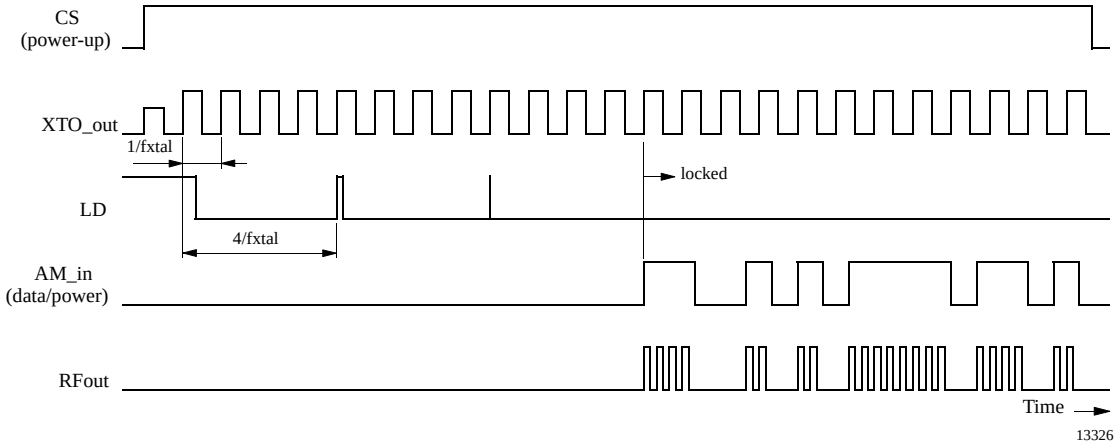

Figure 6.

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Application Circuit (FSK Modulation)

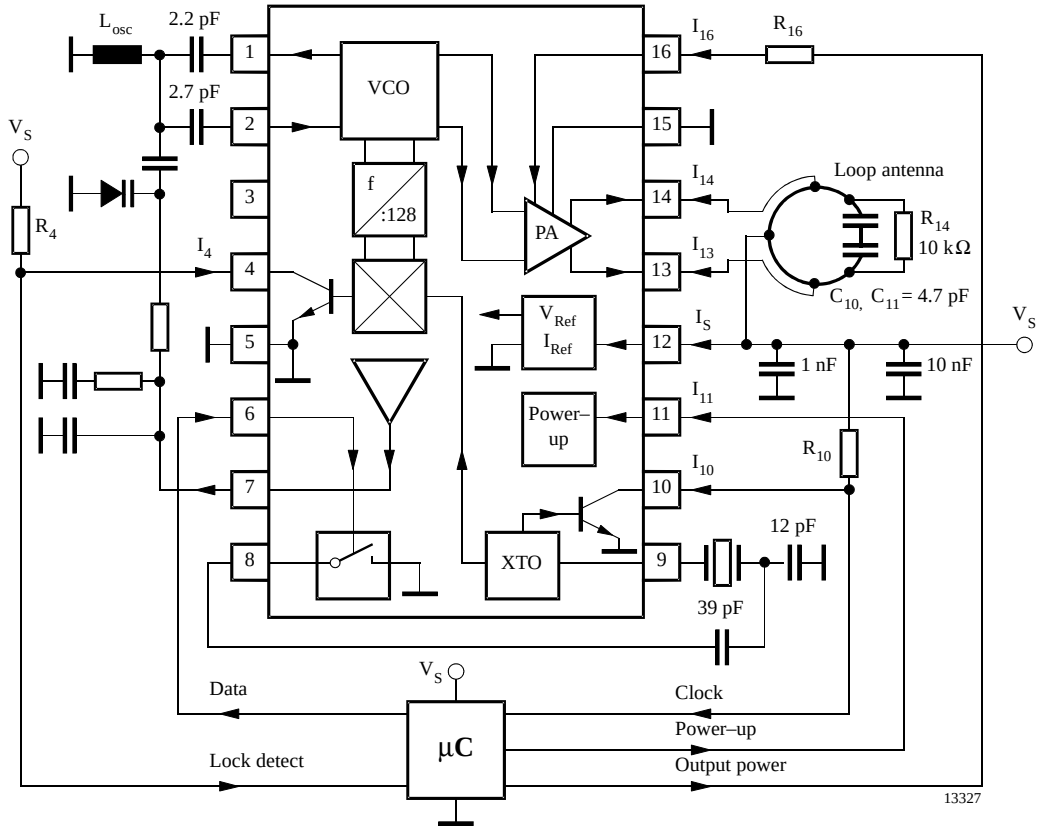

Figure 7.

Principle of Operation (FSK Modulation)

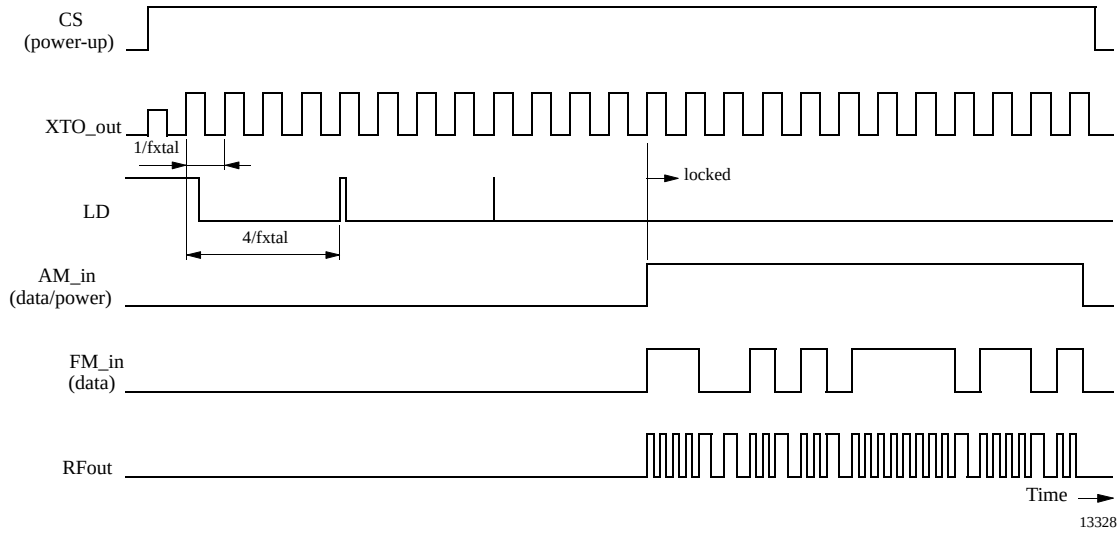

Figure 8.

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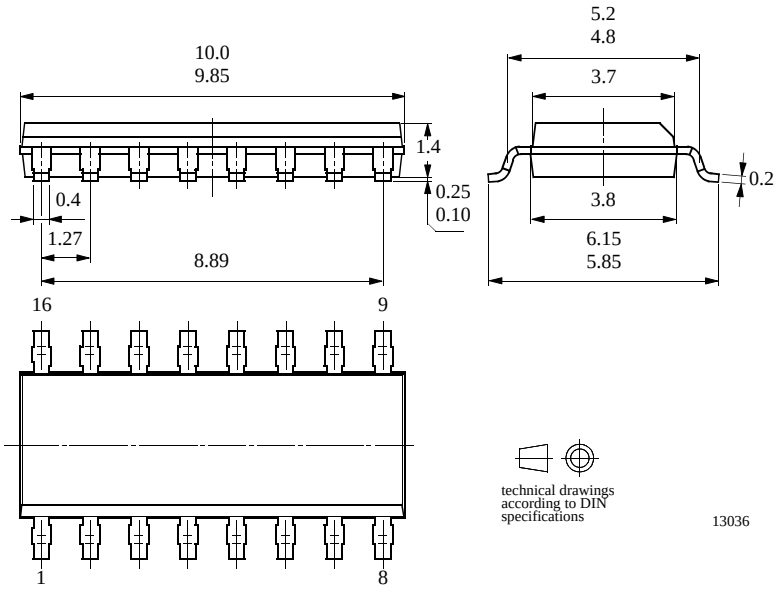
Package Information

Package SO16
Dimensions in mm



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It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

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1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively

2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA

3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

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