TH71081

868/915MHz ASK Transmitter / LO Source

Description

The TH71081 ASK transmitter / LO source IC is designed for applications in the European 868MHz SRD band, according to the EN 300 220 telecommunications standard. It can also be used for any other system with carrier frequencies ranging from 700 to 1000 MHz (e.g. for applications in the US 915MHz ISM band). The transmitter's carrier frequency f_c is determined by the frequency of the reference crystal f_{ref} that is used. The integrated PLL synthesizer ensures that each RF value, ranging from 700 to 1000 MHz, can be achieved by using a crystal with reference frequency according to: $f_{ref} = f_c/N$, where N = 32 is the PLL feedback divider ratio.

Features

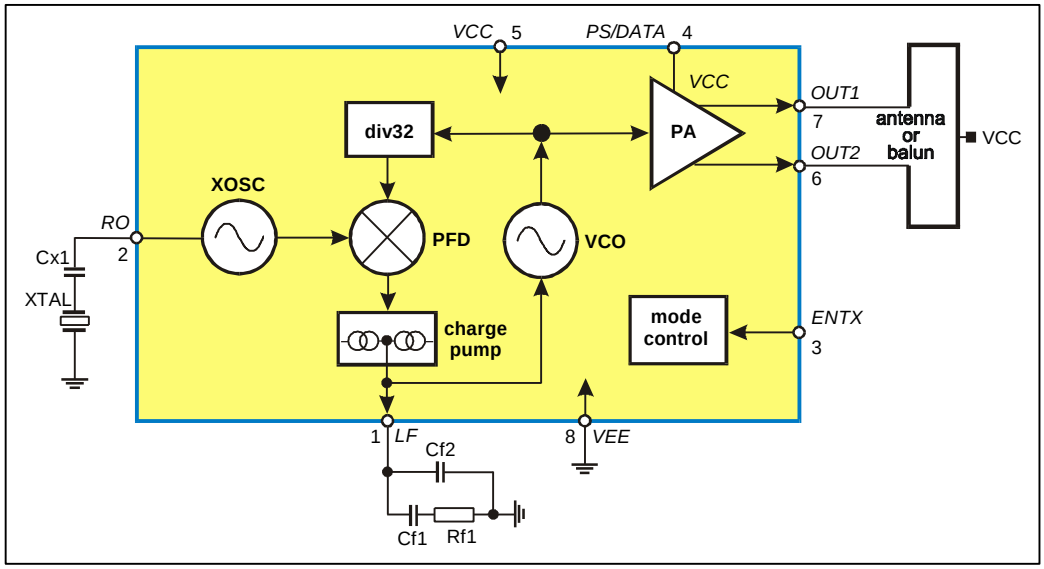
- q fully integrated, PLL-stabilized VCO
- q ASK achieved by level controlling of internal power amplifier
- q FM possible with external varactor diode
- q wide power supply range from 2.0 to 5.5 V
- q flexible frequency range from 700 to 1000 MHz
- q high frequency stability
- q adjustable output power range from -12 to +3 dBm
- q adjustable current consumption from 6 to 12.5 mA
- q very low standby current
- q differential output well-suited for loop antenna
- q conforms to EN 300 220 standard
- q cost-effective package SOP8

Applications

- q keyless car security and central locking
- q low power telemetry
- q alarm systems
- q general digital data transmission
- q general analog audio signal transmission
- q local oscillator signal generation

Block Diagram with External Components

Fig. 1: TH71081 block diagram



Theory of Operation

ASK Modulation

The TH71081 can be ASK-modulated by applying data at pin PS/DATA. The voltage at this pin turns the power amplifier (PA) on and off and therefore leads to an ASK signal at the RF output. Both, simple on/off keying (OOK) and true ASK are possible, because the power of the PA can be set to six different levels and one off state.

Frequency Modulation (FM)

For FM operation an external varactor is required. It simply acts as a pulling capacitor connected in series to the crystal. Then the analog modulation signal, applied through a series resistor, directly modulates the XOSC.

LO Source

Many applications require a stable RF source. For this purpose, the TH71081 can be used without modulation as an easy-to-use, PLL-stabilized, continuous wave (CW) generator.

General

The main parts of the TH71081 transmitter are the fully integrated voltage-controlled oscillator (VCO), the divide-by-32 divider (div32), the phase-frequency detector (PFD) and the charge pump. An external loop filter at pin LF determines the dynamic behaviour of the PLL and suppresses reference spurious signals.

The VCO's output signal feeds the PA. RF signal power P_o can be adjusted, in six steps from P_o = –12 to +3 dBm, either by changing the value of a resistor between pin PS/DATA and ground or by varying the voltage V_{ps} at this pin. The open-collector differential output (OUT1, OUT2) can be used to either directly drive a loop antenna or to be converted to a single-ended impedance by means of a balanced-to-unbalanced (balun) transformer. For maximum available output power, the differential output should be matched to a load of approx. 0.5 to 1.5 kΩ.

Bandgap biasing ensures stable operation of the IC at a power supply range of 2.0 to 5.5 V. The mode control logic allows the transmitter to be set to standby mode or active operation. The mode control pin ENTX is internally connected to a pull-down resistor. This guarantees that the whole circuit is shut down if ENTX is left open.

ENTX	Mode	Description
0	TX disabled	whole circuit in stand by
1	TX enabled	TX active

Electrical Characteristics

Absolute Maximum Ratings

Parameter	Symbol	Condition	Min	Max	Unit
supply voltage	V_{cc}		-0.3	7.0	V
input voltage	V_{in}	@ ENTX	-0.3	VCC+0.3	V
input current	I_{in}	@ ENTX	-1.0	1.0	mA
storage temperature	T_{str}		-40	150	°C

Operating Conditions

Parameter	Symbol	Min	Max	Unit
supply voltage	V_{cc}	2.0	5.5	V
ambient temperature	T_a	-40	85	°C
VCO frequency	f_c	700	1000	MHz
XOSC frequency	f_{ref}	25	32	MHz

DC Characteristics

T_a = -40 to +85 °C,
V_{cc} = 2.1 to 5.5 V,
typical values at T_a = 23 °C and V_{cc} = 3 V

Parameter	Symbol	Condition	Min	Typ	Max	Unit
standby current	I_{stb}	ENTX=0		< 0.1	0.1	µA
operating current	I_{cc}	ENTX=1, R2=47kΩ	7	9	10	mA
input HIGH voltage	V_{HIGH}	@ ENTX	0.7*V_{cc}		V_{cc}+0.3	V
input LOW voltage	V_{LOW}	@ ENTX	-0.3		0.3*V_{cc}	V
input current @ V_{LOW}<V_{In}<V_{HIGH}	I_{in}	@ ENTX	-10		10	µA

AC Characteristics

T_a = -40 to +85 °C,
V_{cc} = 2.1 to 5.5 V,
typical values at T_a = 23 °C and V_{cc} = 3 V

(ENTX = 1, R2 = 47 kΩ, f_c = 868.35 MHz, test circuit shown in **Fig. 2**)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
output power	P_o	CW mode		-1		dBm
max. data rate at ASK	R_{ASK}			40		kbit/s
max. modulation frequency at FM	f_{mod}	with external varactor between pin RO and XTAL		20		kHz
FM deviation	Δf_{FM}	adjustable with varactor and V_{FM}		±12		kHz
reference spurs	P_{ref}	@ $f_c \pm f_{ref}$		-40		dBm
harmonic content	P_{harm}			-45		dBm
phase noise	L	CW mode @ $f_c \pm$ 500kHz		-87		dBc/Hz
VCO gain	k_{VCO}			300		MHz/V
charge pump current	I_{CP}			±260		µA
start-up time	t_{on}	transition from ENTX = 0 to 1		0.7		ms

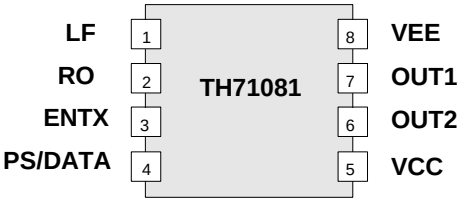
Output Power Selection

typical values at T_a = 23 °C and V_{cc} = 3 V,

(ENTX = 1, f_c = 433.6 MHz, test circuit shown in **Fig. 2**, C2 and C3 to adjust for P_o and P_{harm})

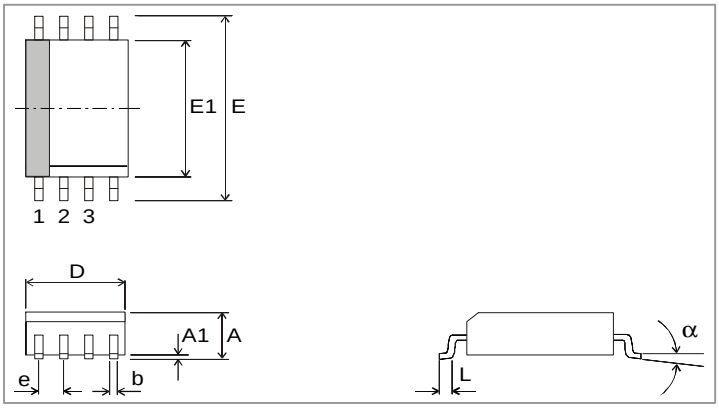
R2 / kΩ	**≥ 68**	**56**	**47**	**39**	**27**	**15**
V_{ps} / V	**≥ 2**	**1.2**	**0.9**	**0.7**	**0.5**	**0.3**
I_{cc} / mA	12.5	9.5	8.5	6.5	5.8	5.0
P_o / dBm	3.0	0.5	-1.0	-4.0	-8.0	-12.0
P_{harm}/dBm	≤-36	≤-40	≤-40	≤-45	≤-45	≤-50
C2 / pF	TBD	TBD	TBD	TBD	TBD	TBD
C3 / pF	TBD	TBD	TBD	TBD	TBD	TBD

Pin Description



Pin #	Pin Name	Description
1	LF	charge pump output / input to VCO control port
2	RO	XOSC connection to XTAL, base of bipolar transistor
3	ENTX	mode control input, CMOS-compatible with internal pull-down res.
4	PS/DATA	power-select and ASK input, high-impedance comparator logic
5	VCC	positive power supply
6	OUT2	differential power amp output, open collector
7	OUT1	differential power amp output, open collector
8	VEE	negative power supply

Package Information



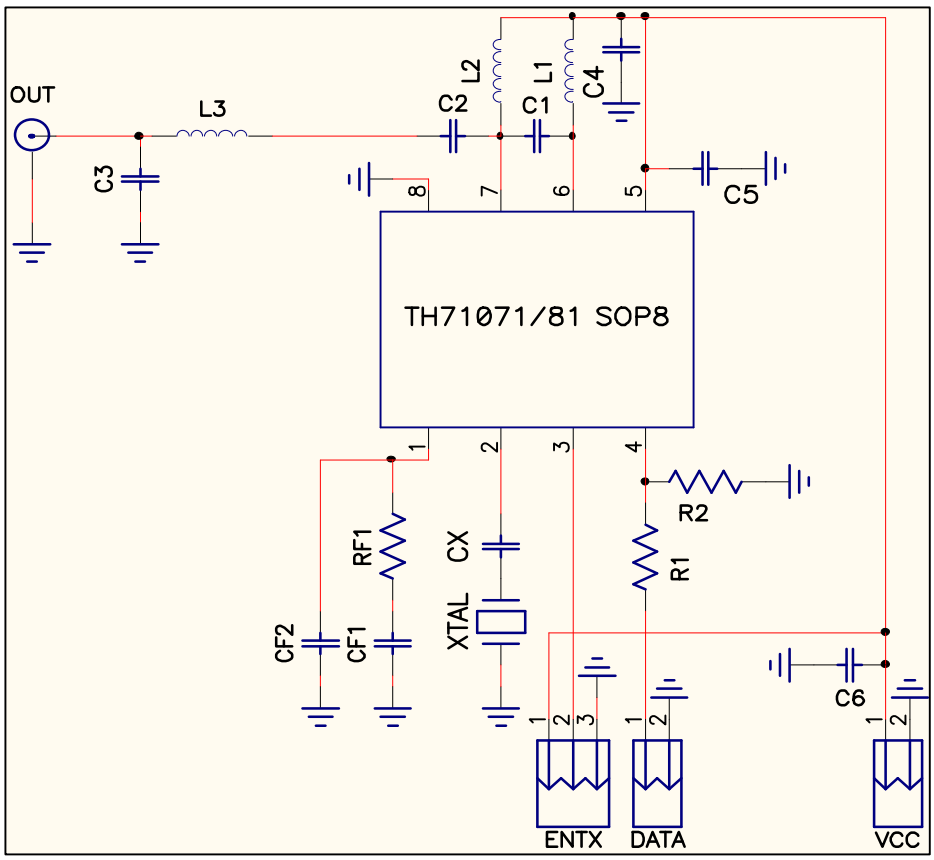
SOP 8

Dimension : mm

	D	E1	E	A	A1	e	b	L	Copl	α
min	4.80	3.80	5.80	1.35	0.10	1.27	0.33	0.40		0°
max	5.00	4.00	6.20	1.75	0.25		0.51	1.27	0.10	8°

Test Circuit

Fig. 2: test circuit for ASK, OOK or CW mode; with 50Ω matching network



test circuit component list

Part	Size	Value	Tolerance	Description
CF1	0603	5.6 nF	±10%	loopfilter capacitor
CF2	0603	4.7 pF	±10%	loopfilter capacitor
CX	0603	15 – 470 pF	±5%	optional XOSC capacitor, to trim carrier frequency
C1	0603	TBD pF	±5%	balun capacitor
C2	0603	TBD pF	±5%	balun capacitor
C3	0805	TBD pF	±5%	impedance matching capacitor
C4	0603	330 pF	±10%	blocking capacitor
C5	0603	330 pF	±10%	blocking capacitor
C6	0805	33 nF	±20%	blocking capacitor
L1	0603	TBD nH	±5%	balun inductor
L2	0603	TBD nH	±5%	balun inductor
L3	0603	TBD nH	±5%	impedance matching inductor
RF1	0603	3.6 kΩ	±10%	loopfilter resistor
R1	0603	TBD	±10%	ASK power-select resistor, not required at CW mode
R2	0603	TBD	±10%	ASK or CW mode power-select resistor
XTAL	HC49/S	27.1344 MHz fundamental wave	±30ppm calibration ±30ppm temp.	crystal, C_{load} = 12pF, $C_{0,max}$ = 4pF, C_m = 20fF, R_m= 10 -20Ω