TH71072

315/433MHz
ASK Transmitter / LO Source

Features

- ❑ Fully integrated, PLL-stabilized VCO
- ❑ Flexible frequency range from 310 MHz to 450 MHz
- ❑ ASK achieved by on/off keying of internal power amplifier
- ❑ FM possible with external varactor
- ❑ Wide power supply range from 2.2 V to 5.5 V
- ❑ High over-all frequency accuracy
- ❑ Very low standby current
- ❑ Adjustable output power range from -15 dBm to -1 dBm
- ❑ Adjustable current consumption from 4.8 mA to 11.5 mA
- ❑ Single-ended RF output
- ❑ Clock output for µC drive
- ❑ Conforms to EN 300 220 and similar standard

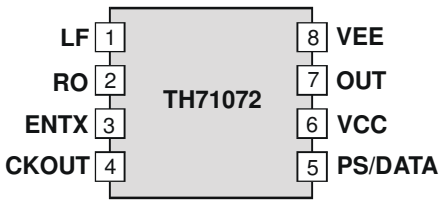
Ordering Information

Part No.	***Temperature Range***	***Package***
TH71072	-40 C° to 85 °C	SOIC8

Application Examples

- ❑ Keyless car and central locking
- ❑ Low-power telemetry
- ❑ Alarm and security systems
- ❑ General digital data transmission
- ❑ General analog audio signal transmission
- ❑ Local oscillator signal generation

Pin Description



General Description

The TH71072 ASK transmitter IC is designed for applications in the European 433MHz industrial-scientific-medical (ISM) band, according to the EN 300 220 telecommunications standard. It can also be used for any other system with carrier frequencies ranging from 310 MHz to 450 MHz (e.g. for applications in the US 315MHz 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 310 MHz to 450 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.

Theory of Operation

General
As depicted in Fig.1, the TH71072 transmitter consists of a fully integrated voltage-controlled oscillator (VCO), a divide-by-32 divider (div32), a phase-frequency detector (PFD) and a 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 power amplifier (PA). RF signal power P_o can be adjusted in six steps from P_o = –15 dBm to -1 dBm, either by changing the value of resistor R_1 or by varying the voltage V_{PS} at pin PS/DATA. The open-collector output (OUT) can be used to either drive a loop antenna or to feed a single-ended load impedance. This could be, for example $\lambda/4$ monopol antenna or a 50Ω output port. In any case, an impedance matching network should be added in order to achieve maximum available RF power.
Bandgap biasing ensures stable operation of the IC at a power supply range of 2.2 V to 5.5 V.

Clock Output
The TH71072 feature a clock output (CKOUT) that can be used to drive a µC. The frequency at CKOUT is $f_{ref}/4$. The clock output is slew-rate limited in order to keep spurious signal emission as low as possible. The voltage swing at CKOUT depends on the capacitive loading at this pin.
It is approximate 2 V_{pp} at C_{load} = 5 pF

ASK Modulation
The TH71072 can be ASK-modulated by applying data directly at pin PS. This turns the PA on and off and therefore leads to an ASK signal at the output.

LO Source
Many applications require a stable RF source. For this purpose, the TH71072 can be used without modulation as an easy-to-use, PLL-stabilized, continuous wave (CW) generator.

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.

Mode Control Logic
The mode control logic allows two different modes of operation as listed in the following table. The mode control pin ENTX is pulled-down internally. This guarantees that the whole circuit is shut down if this pin is left floating.

ENTX	Mode	Description
0	TX disabled	whole circuit in standby
1	TX enable	TX active

Table 1: Modes of operation

Block Diagram

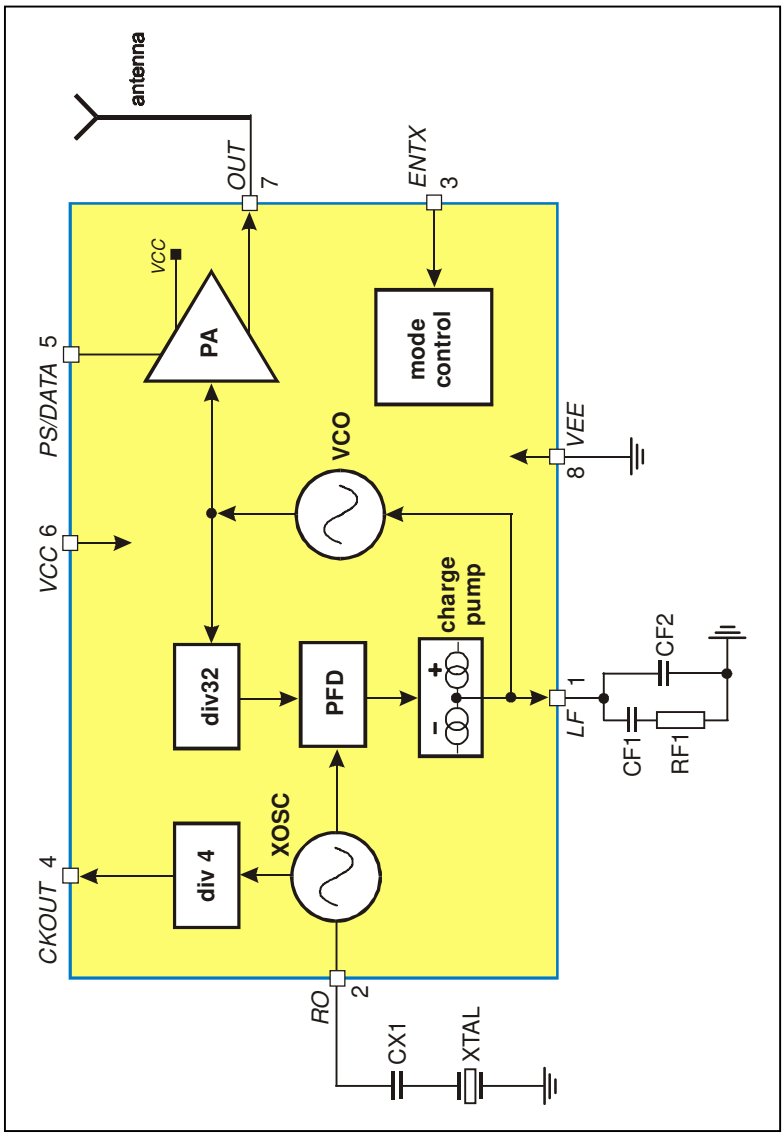
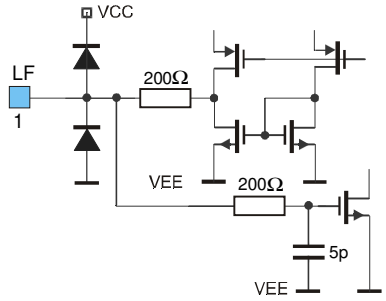
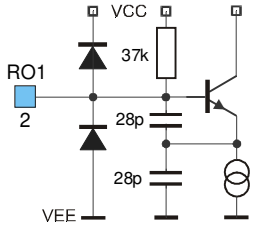
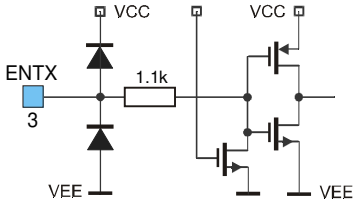
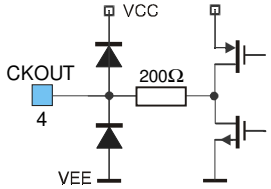
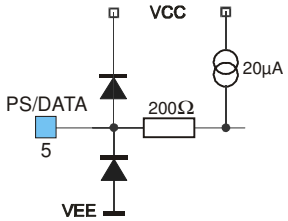
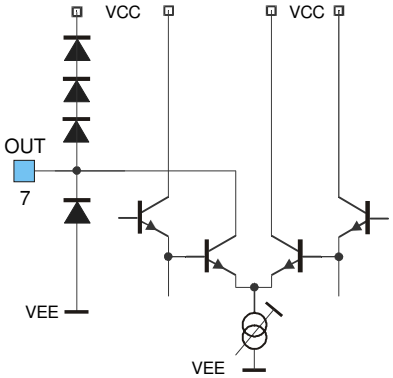


Fig. 1: TH71072 block diagram with external components

Pin Definition and Description

Pin No.	Name	I/O Type	Functional Schematic	Description
1	LF	analog I/O		connection to loop filter, charge pump output, VCO tuning input
2	RO	analog I/O		XOSC connection to XTAL, Colpitts type crystal oscillator
3	ENTX	input		mode control input, CMOS-compatible with internal pull-down
4	CKOUT	output		clock output, CMOS-compatible
5	PS/DATA	analog I/O		power-select and ASK input, high-impedance comparator logic
6	VCC	supply		positive power supply
7	OUT	output		Power amplifier output, open collector
8	VEE	ground		negative power supply

Technical Data

Absolute Maximum Ratings

Parameter	Symbol	Condition	Min	Max	Unit
Supply voltage	V_{cc}		-0.3	7.0	V
Input voltage	V_{in}	ENTX pin	-0.3	VCC+0.3	V
Input current	I_{in}	ENTX pin	-1.0	1.0	mA
Storage temperature	T_{STG}		-40	150	°C
Electrostatic discharge	V_{ESD}	human body model, MIL STD 833D method 3015.7	-1.0	+1.0	kV

Normal Operating Conditions

Parameter	Symbol	Condition	Min	Max	Unit
Supply voltage	V_{cc}		2.2	5.5	V
Operating temperature	T_a		-40	85	°C
XOSC frequency	f_{ref}	set by the crystal	9.69	14	MHz
VCO frequency	f_c	$f_c = 32 \bullet f_{ref}$	310	450	MHz
Clock frequency	f_{clk}	$f_{clk} = f_{ref} / 4$	2.42	3.50	MHz

DC Characteristics

all parameters under normal operating conditions, unless otherwise stated;
typical values at T_a = 23 °C and V_{cc} = 3 V

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Standby current	I_{SBY}	ENTX=0		0.05	0.1	µA
Operating current	I_{cc}	ENTX=1, V_{PS}=1.1V	7	9	10	mA
Input HIGH voltage	V_{HIGH}	ENTX pin	0.7*V_{cc}		V_{cc}+0.3	V
Input LOW voltage	V_{LOW}	ENTX pin	-0.3		0.3*V_{cc}	V
Input current	I_{in}	ENTX=0	-1		1	µA
Pull down current	I_{pd}	ENTX=1	2	8	15	µA

AC Characteristics

all parameters under normal operating conditions, unless otherwise stated;
typical values at T_a = 23 °C and V_{cc} = 3 V;
ENTX = 1, V_{PS} = 1.1V, f_c = 433.6 MHz, test circuit shown in Fig. 2

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Output power	P_o			-4		dBm
FM deviation	Δf_{FM}	adjustable with varactor and V_{FM}		±6		kHz
Modulation frequency FM	f_{mod}			5		kHz
Data rate ASK	R_{ASK}			40		kbit/s
Reference spurs	P_{ref}	@ $f_c \pm f_{ref}$		-44		dBm
Harmonic content	P_{harm}	@ $2f_c$, $3f_c$, $4f_c$		-40		dBm
Spurious output signal	P_{off}	$V_{PS} \leq 0.1V$		-60		dBm
Phase noise	PN	@ $f_c \pm 500kHz$		-87		dBc/Hz
VCO gain	K_{VCO}			200		MHz/V
Charge pump current	I_{CP}			±260		µA
Clock voltage swing	V_{CKOUT}	C_{load} = 5pF		2		V_{pp}
Start-up time	t_{on}	from ”all OFF” to any other mode			0.9	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

R1 / kΩ	**0**	**7.5**	**11**	**15**	**24**	**43**
R2 / kΩ	**∞**	**4.7**	**4.7**	**4.7**	**4.7**	**4.7**
V_{PS} / V	**≥ 2**	**1.1**	**0.9**	**0.7**	**0.5**	**0.3**
I_{cc} / mA	11.5	8.6	7.3	6.2	5.3	4.8
P_o / dBm	2	-1	-4	-7	-10	-12
P_{harm} / dBm	≤-40	≤-40	≤-40	≤-45	≤-45	≤-50

If the transmitter is operated at any supply voltage V_{cc}, the values for R_1 and R_2 can be calculated as allows:

$$R_1 = R_2 \bullet \left(\frac{V_{cc}}{V_{PS}} - 1 \right)$$

Crystal Parameter

Parameter	Symbol	Condition	Min	Max	Unit
Crystal frequency	$f_{crystal}$	fundamental mode, AT	9.69	14	MHz
Load capacitance	C_{load}		10	15	pF
Static capacitance	C_0			7	pF
Resonance resistance	R_m			60	Ω
Spurious response	a_{spur}			-10	dB

Test Circuit

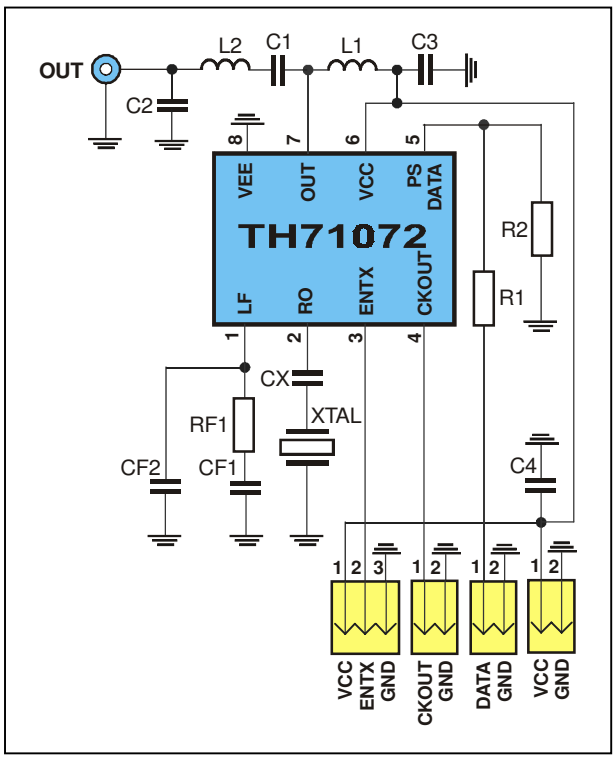


Fig. 2: Test circuit for ASK with 50Ω matching network

Test circuit component list to Fig. 2

Part	Size	Value	Tolerance	Description
CF1	0603	10 nF	±10%	loop filter capacitor
CF2	0603	150 pF	±10%	loop filter capacitor
CX	0603	120 pF	±10%	XOSC capacitor
C1	0603	1 nF	±5%	impedance matching capacitor
C2	0603	3.3 pF	±5%	impedance matching capacitor
C3	0603	330 pF	±10%	blocking capacitor
C4	0805	33 nF	±10%	blocking capacitor
L1	0603	270 nH	±5%	impedance matching inductor
L2	0603	56 nH	±5%	impedance matching inductor
RF1	0603	470 Ω	±10%	foop filter resistor
R1	0603	See output power selection table	±10%	ASK power-select resistor, not requirement at CW mode
R2	0603	See output power selection table	±10%	ASK or CW mode power-select resistor
XTAL	HC49/S	13.55 MHz fundamental wave	±30ppm calibration ±30ppm temp.	crystal, C_{load} = 12 pF to 15 pF, $C_{0,\,max}$ = 7 pF, $R_{m,\,max}$ = 60 Ω

Spectrum Plots

All plots depict TH71072's typical performance at V_{cc} = 3.0 V and T_a = 23 °C, derived with the test circuit shown in Fig. 2.

Fig. 3: Output spectrum with unmodulated carrier and harmonics

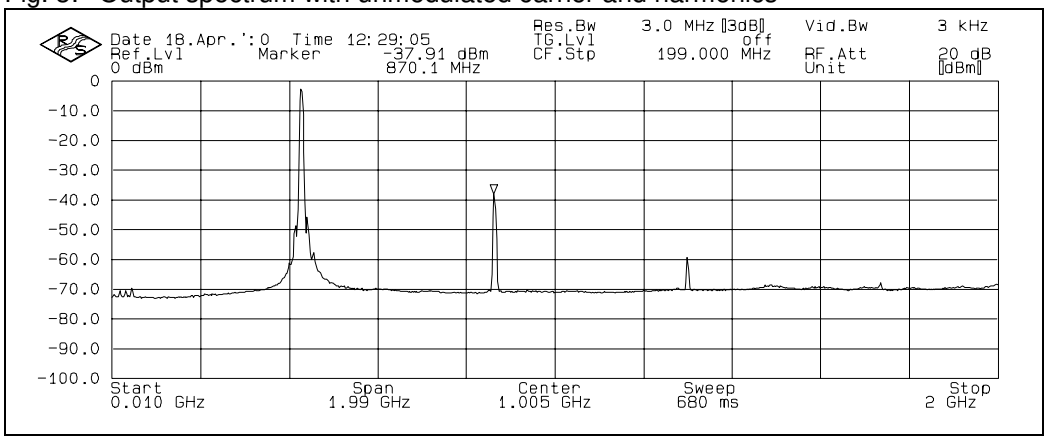


Fig. 4: Output spectrum with unmodulated carrier, clock spurs and PLL reference spurs

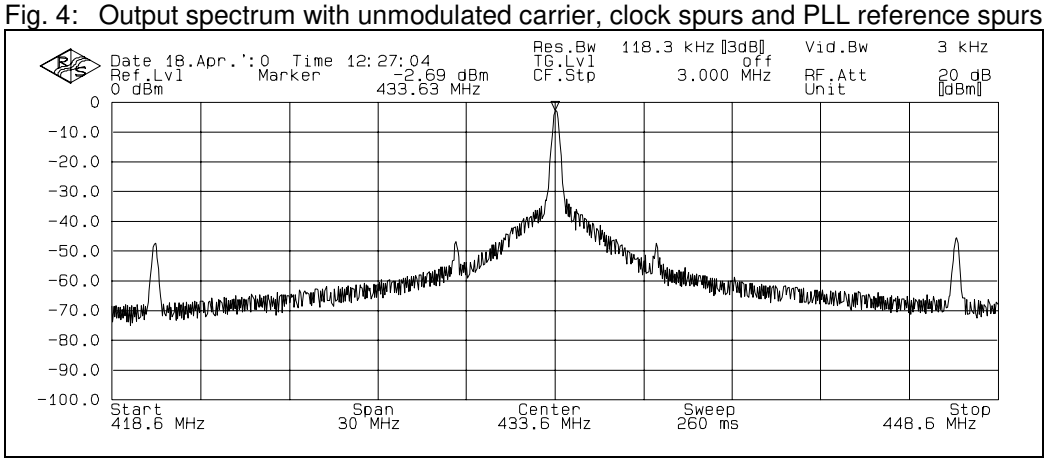
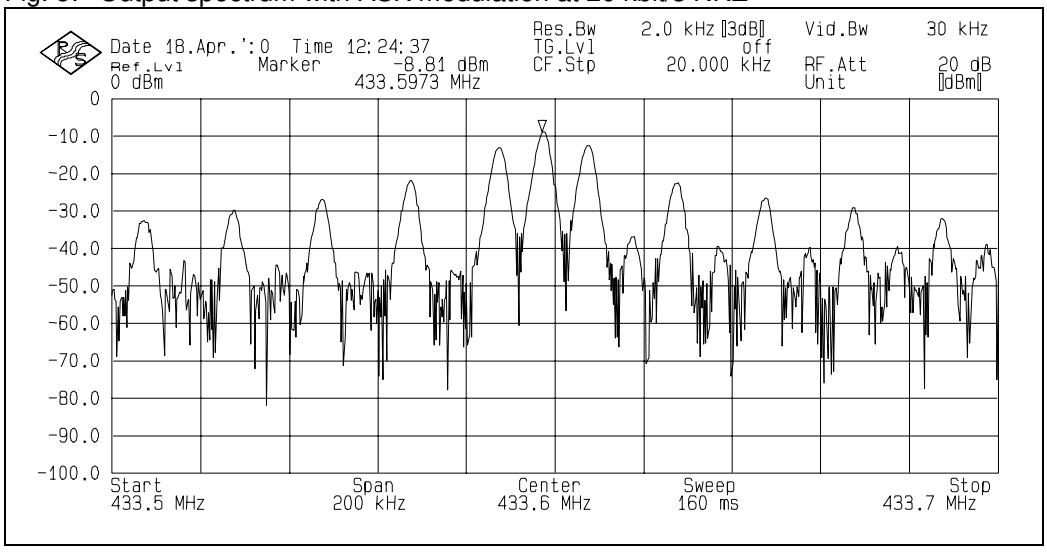


Fig. 5: Output spectrum with ASK modulation at 20 kbit/s NRZ



Package Information

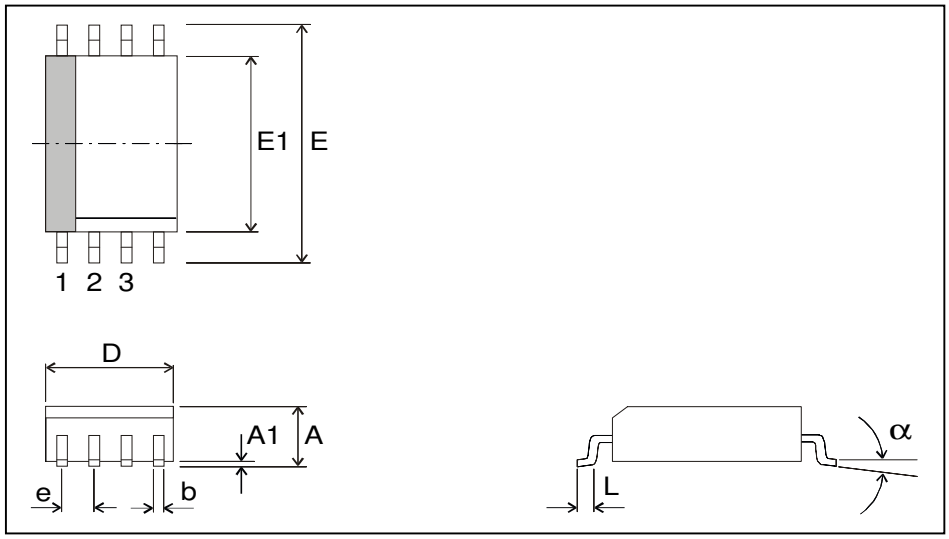


Fig. 6: SOIC8 (Small Outline Package)

all Dimension in mm, coplanarity < 0.1mm									
	D	**E1**	**E**	**A**	**A1**	**e**	**b**	**L**	**α**
min	4.80	3.81	5.80	1.32	0.10	1.27	0.36	0.41	0°
max	4.98	3.99	6.20	1.72	0.25		0.46	1.27	8°
all Dimension in inch, coplanarity < 0.004”									
min	0.189	0.150	0.2284	0.060	0.0040	0.05	0.014	0.016	0°
max	0.196	0.157	0.2440	0.068	0.0098		0.018	0.050	8°

Your Notes

Important Notice

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