

F113 300MHz-to-450MHz Low-Power, Crystal-Based ASK Transmitter

General Description

The F113 is a high performance, easy to use, single chip ASK Transmitter IC for remote wireless applications in the 300 to 450MHz frequency band. This transmitter IC is a true “data-in, antenna-out” monolithic device. F113 has three strong attributes: power delivery, operating voltage and operating temperature. In terms of power, the F113 is capable of delivering +10 dBm into a 50Ω load. This power level enables a small form factor transmitter (lossy antenna) such as a key fob transmitter to operate near the maximum limit of transmission regulations. In terms of operating voltage, the F113 operates from 1.8V to 3.6V. Many transmitter ICs in the same frequency band stop operating below 2.0V. The F113 will work with most batteries to the end of their useful limits. In terms of operating temperature, the F113 operates from -40°C to +85°C.

The F113 is easy to use. It requires a reference frequency (RF carrier frequency divided by 32 times) generated from a crystal with a few additional external parts to create a complete versatile transmitter.

The F113 operates with ASK/OOK (Amplitude Shift Keying/On-Off Keyed) UHF receiver types from wide-band super-regenerative radios to narrow-band, high performance super-heterodyne receivers. The F113's maximum ASK data rate is 10kbps (Manchester Encoding).

The F113 transmitter solution is ideal for industrial and consumer applications where simplicity and form factor are important.

Features

- Complete UHF transmitter
- Frequency range 300MHz to 450MHz
- Data rates up to 10kbps ASK
- Output Power to 10dBm
- Low external part count
- 1.8V to 3.6V Single-Supply Operation
- Low voltage operation (down to 1.8V)
- Operate with crystals or ceramic resonators
- Small 3mm x 3mm 6-Pin SOT23 Package

Applications

- Fan Controllers
- Remote Power Switches
- Multi-Media Remote Control
- Remote Sensor Data Links
- Infrared Transmitter Replacement

Ordering Information

Part Number	Temp. Range	Package
F113	-40°C to +85°C	SOT23-6

Typical Application

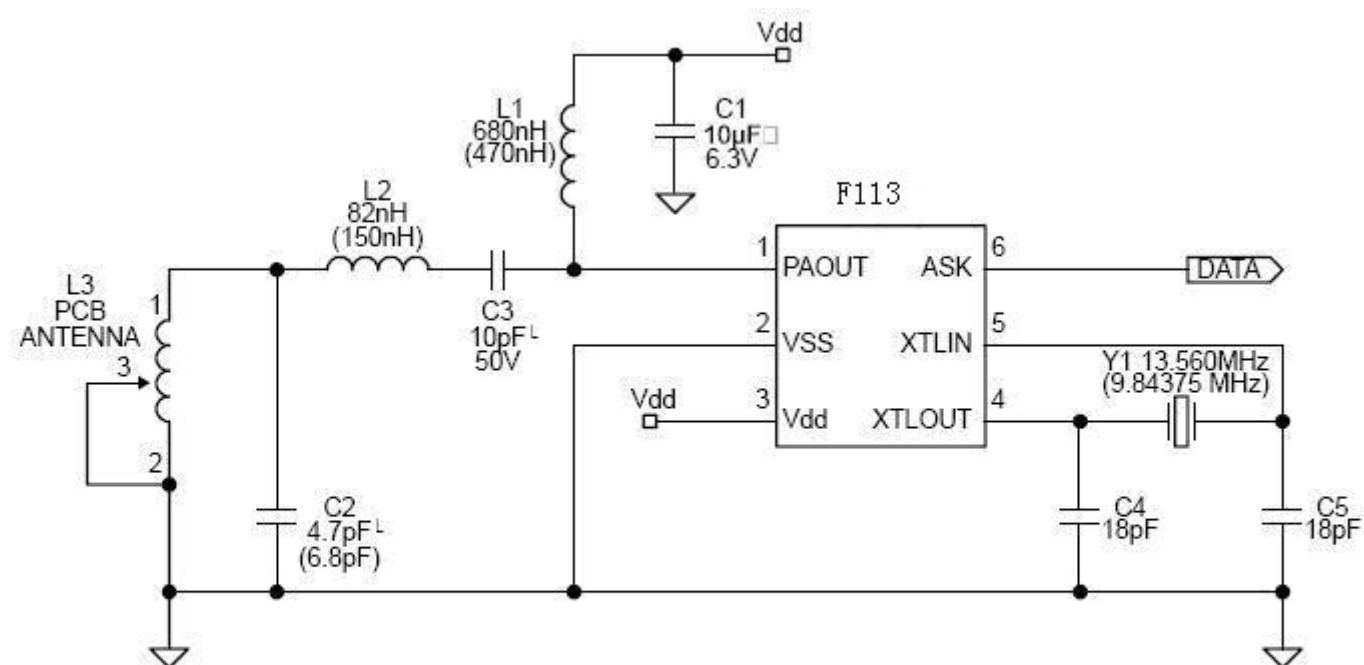
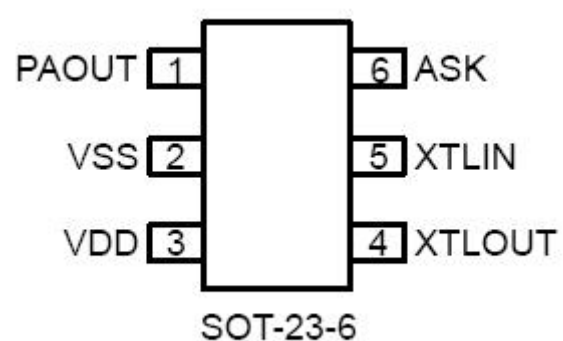


Figure 1. F113 ASK Key Fob Design for 315 MHz and 433.92 MHz
 Note: Values indicated in parentheses are for 315MHz

Pin Configuration



Pin Description

Pin Number MSOP-6	Pin Name	Pin Function
1	PA_OUT	PA output
2	VSS	Ground
3	VDD	Voltage Drain Drain (Input): Positive Power Supply
4	XTLOUT	Crystal Out (Output): Reference oscillator output connection.
5	XTLIN	Crystal In (Input): Reference oscillator input connection.
6	ASK	ASK DATA Input

Absolute Maximum Ratings ⁽¹⁾

Supply Voltage VDD	+5.0V
Voltage on PAOUT	+7.2V
Voltage on I/O Pins	VSS-0.3 to VDD+0.3
Storage Temperature Range	-65°C to +150°C
Lead Temperature (soldering, 10 seconds)	+300°C
ESD Rating	2KV ⁽³⁾

Operating Ratings ⁽²⁾

Supply Voltage VDD	1.8V to 3.6V
Ambient Operating Temperature (TA)	-40°C to +85°C
Programmable Transmitter Frequency Range	300MHz to 450MHz

Electrical Characteristics ⁽⁴⁾

Specifications apply for VDD = 3.0V, TA = 25°C, Freq_{REFOSC} = 13.560MHz, EN = VDD.

Bold values indicate -40°C to 85°C unless otherwise noted. 1kbps data rate 50% duty cycle. RL 50ohm load (matched)

Parameter	Condition	Min	Typ	Max	Units
Power Supply					
Mark Supply Current I _{ON}	@ 315MHz, P _{OUT} = +10dBm		12.3		mA
	@ 433.92MHz, P _{OUT} = +10dBm		12.5		mA
SPACE supply current, I _{OFF}	@ 315MHz		2		mA
	@ 433.92 MHz		2		mA
RF Output Section and Modulation Limits:					
Output power level, P _{OUT} ASK "mark"	@315MHz ⁽⁴⁾		10		dBm
	@433.92MHz ⁽⁴⁾		10		dBm
Harmonics output for 315 MHz	@ 630MHz ⁽⁴⁾ 2nd harm.		-39		dBc
	@945MHz ⁽⁴⁾ 3rd harm.		-53		dBc
Harmonics output for 433.92 MHz	@ 867.84MHz ⁽⁴⁾ 2nd harm.		-55		dBc
	@1301.76MHz ⁽⁴⁾ 3rd harm.		-55		dBc
Extinction ratio for ASK			70		dBc
ASK Modulation					
Data Rate				10	kbps
Occupied Bandwidth	@315MHz ⁽⁶⁾		<700		kHz
	@433.92MHz ⁽⁶⁾		<1000		kHz
VCO Section					
315 MHz Single Side Band Phase Noise	@ 100kHz from Carrier		-76		dBc/Hz
	@ 1000kHz from Carrier		-79		dBc/Hz
433.92 MHz Single Side Band Phase Noise	@ 100kHz from Carrier		-72		dBc/Hz
	@ 1000kHz from Carrier		-81		dBc/Hz
Reference Oscillator Section					
XTLIN, XTLOUT	Pin capacitance		2		pF
External Capacitance	See Schematic C17 & C18		18		pF
Oscillator Startup Time ⁽⁵⁾	Crystal: HC49S		300		μs
Digital / Control Section					
Output Blanking	VDD transition from LOW to HIGH		500		μs

Electrical Characteristics (continued)

Parameter	Condition	Min	Typ	Max	Units
Digital Input ASK Pin	High (V _{IH})	0.8×V _{DD}			V
	Low (V _{IL})			0.2×V _{DD}	V
Digital Input Leakage Current ASK Pin	High (V _{IH})		0.05		μA
	Low (V _{IL})		0.05		μA
Under Voltage Lock Out (UVLO)			1.6		V

Notes:

1. Exceeding the absolute maximum rating may damage the device.
2. The device is not guaranteed to function outside its operating rating.
3. Devices are ESD sensitive. Handling precautions recommended. Human body model, 1.5k in series with 100pF.
4. Measured using Test Circuit in Figure 2.
5. Dependent on crystal
6. RBW = 100kHz, OBW measured at -20dBc.

Test Circuit

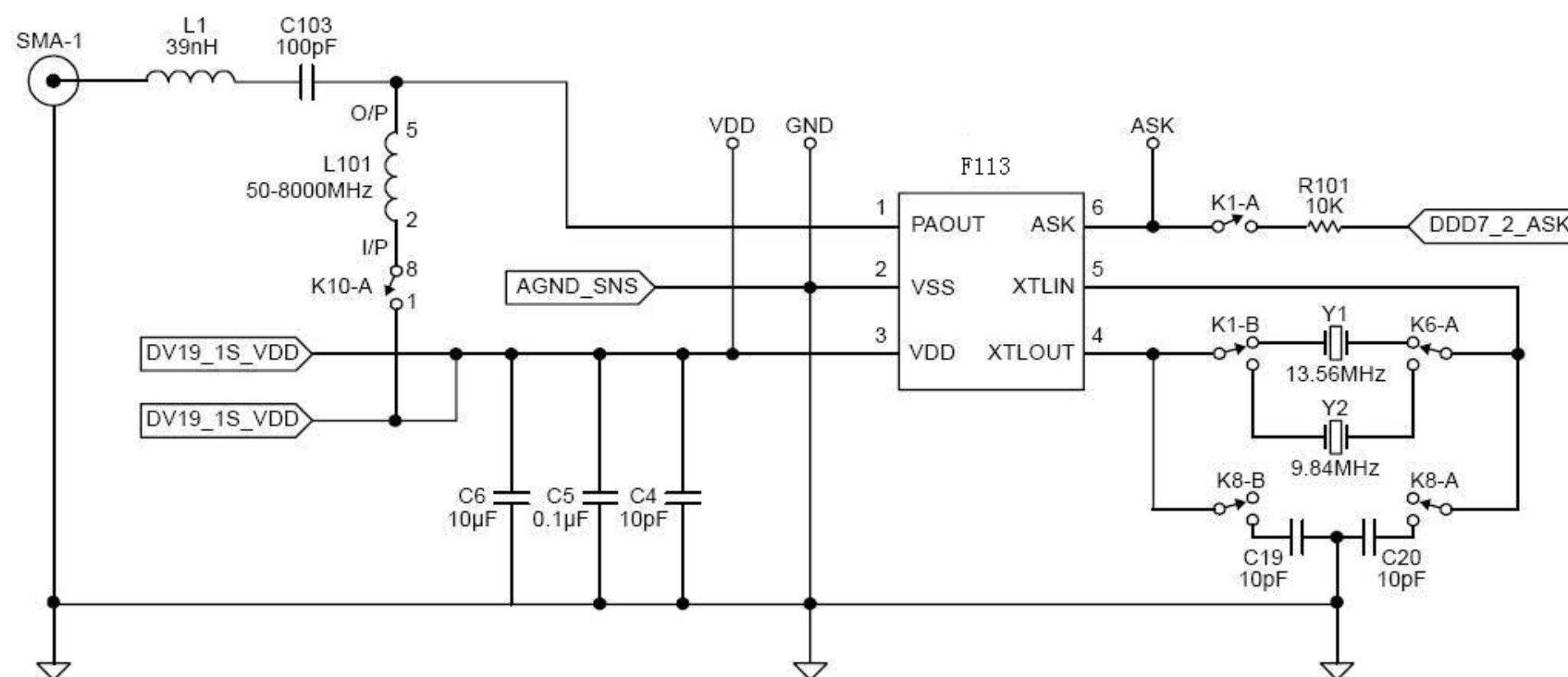


Figure 2. F113 Test Circuit

Functional Diagram

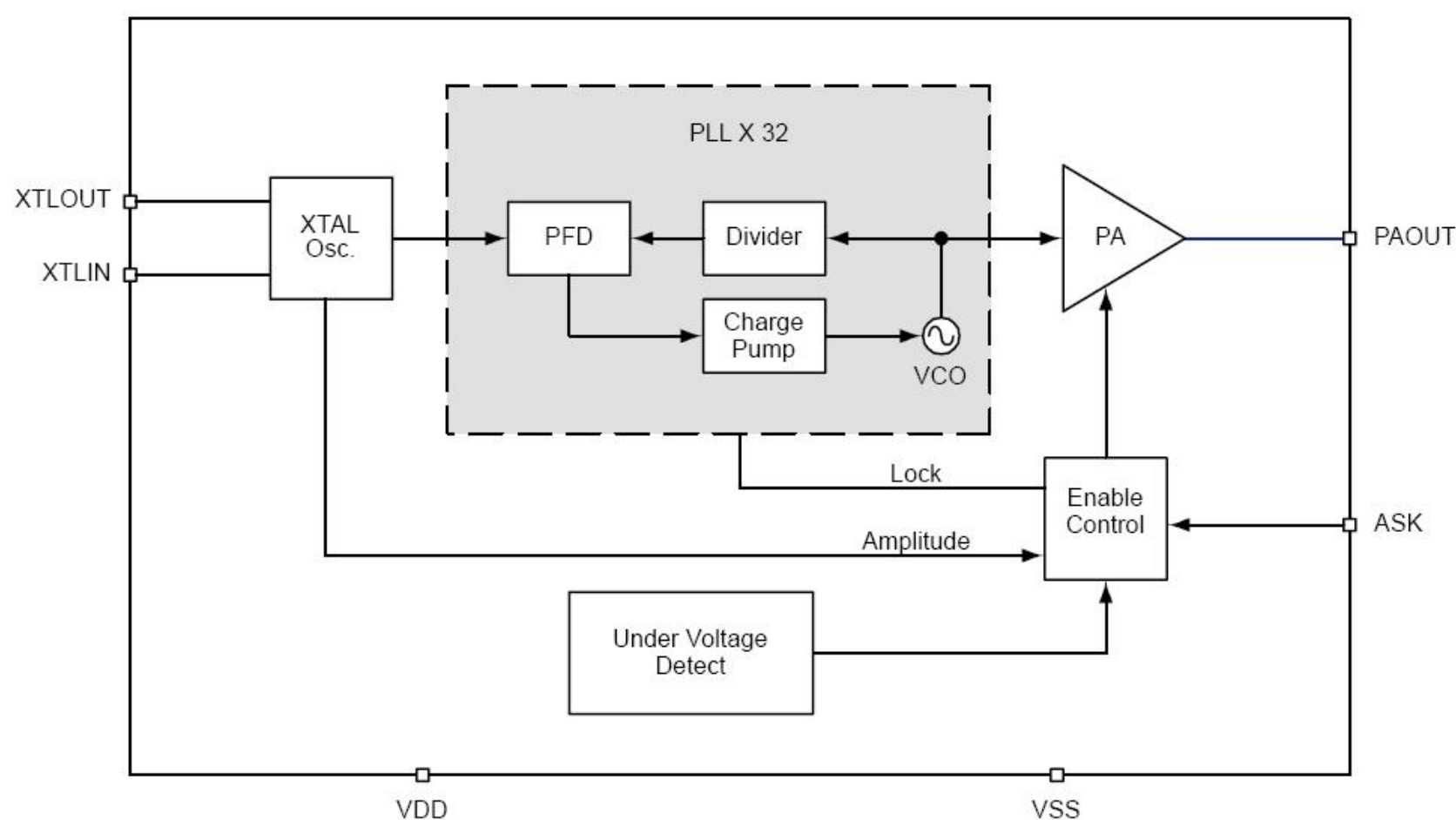


Figure 3. Functional Block Diagram F113

Functional Description

Figure 3 is a functional block diagram of the F113 transmitter. The F113 is best described as a phase locked transmitter. The F113 system is partitioned into five functional blocks:

- PLL×32
- Power amplifier
- Enable control
- Under voltage detection

Crystal Oscillator

The reference oscillator is crystal-based Pierce configuration, designed to accept crystals with frequency from 9.375MHz to 14.0625MHz.

Crystal Oscillator Parameters for ASK Operation

Figure 4 shows a reference oscillator circuit configuration for ASK operation. The reference oscillator is capable of driving crystals with ESR range from 20 Ω to 300 Ω

When the ESR of crystal is at 20 Ω the crystal parameter limits are:

ESR 20 Ω

Cpar 2 to 10pF

Cmo 10 to 40fF

PLL x32

The function of PLLx32 is to provide a stable carrier frequency for transmission. It is a "divide by 32" phase locked loop oscillator.

Power Amplifier

The power amplifier serves two purposes: 1) to buffer the VCO from external elements and 2) to amplify the phase locked signal. The power amplifier can produce +10dBm at 3V (typical).

Enable Control

Enable control gates the ASK data. It only allowstransmission when Lock, Amplitude and Under Voltage Detect conditions are valid.

Under Voltage Detect

"Under voltage detect" block senses operating voltage.If the operating voltage falls below 1.6V, "under voltage detect" block will send a signal to "enable control" block to disable the PA.

Application Information

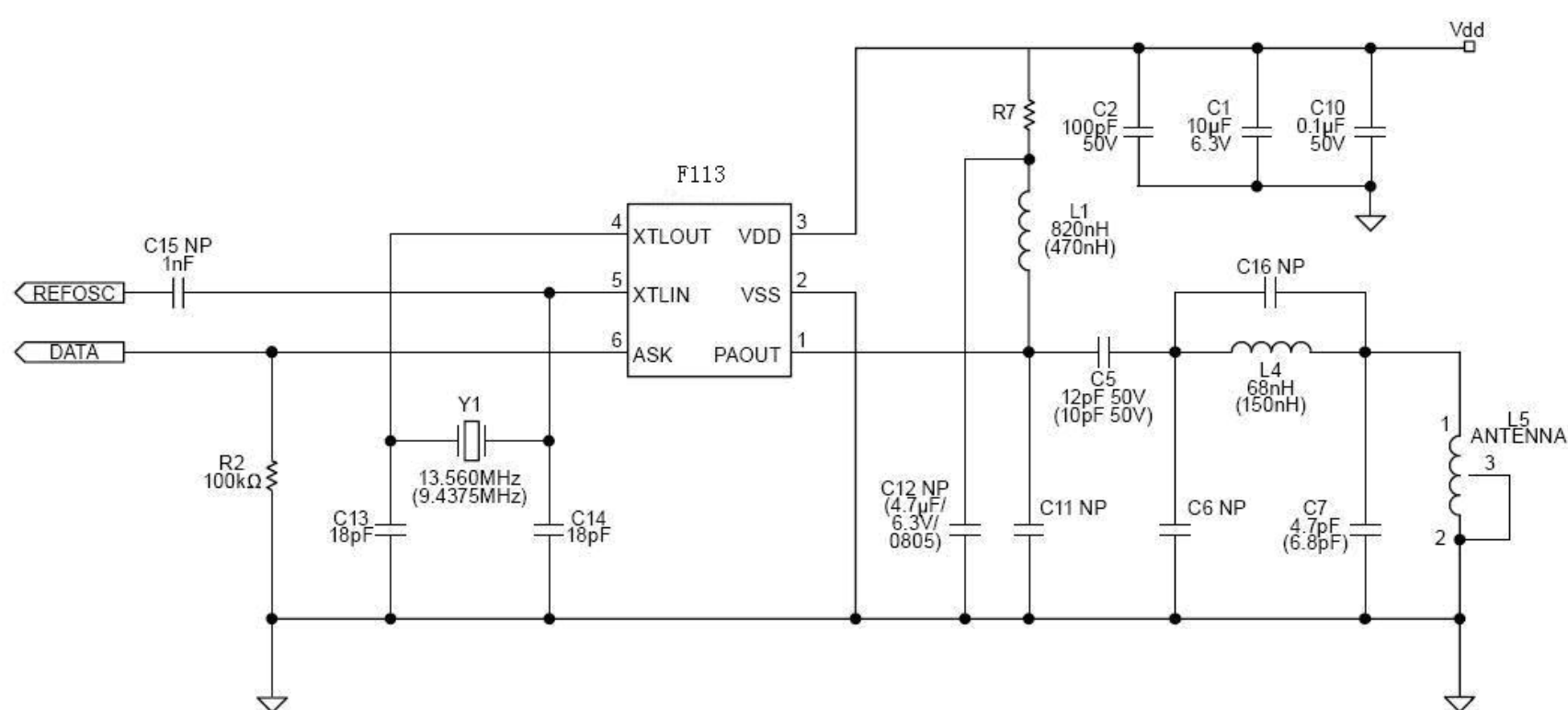
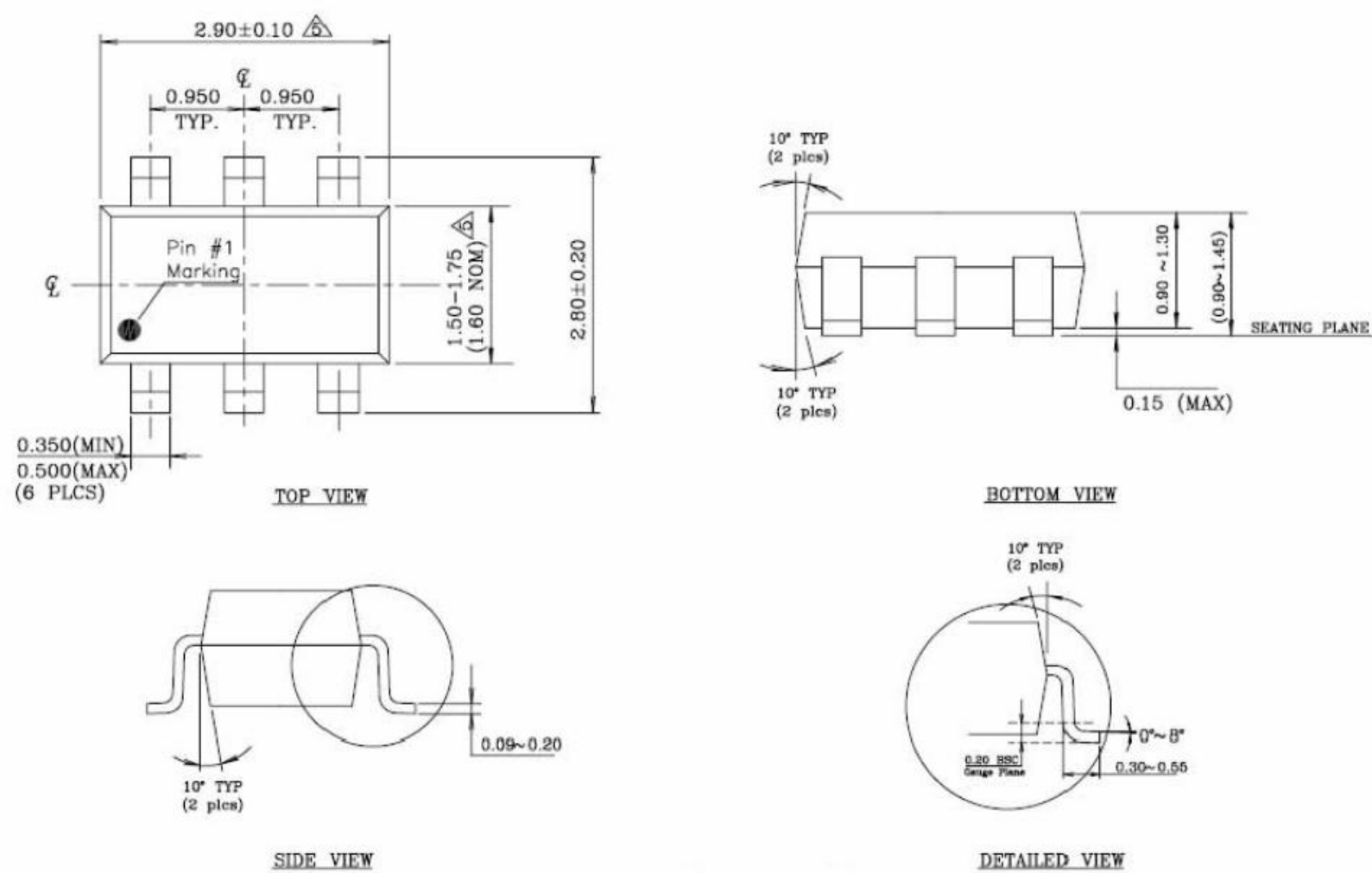


Figure 6. ASK 433.92MHz and (315MHz)

Notes:

1. Components labeled NP are not placed.
2. Values without parentheses are for 433.92 MHz and values in parentheses are for 315MHz.
3. Value of R7 is selected to vary the output power.

Package Information



6-Pin Sot Package Type (SOT23-6)

Notes:

1. (L) means Lead Free.
2. The Lead Free mark is placed in-front of the date code.