Narrow band FM transceiver STD-302

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STD-302 development concept

Transceiver module suitable for industrial applications

1 Superior interference rejection and high receiver sensitivity
2 Stable operation with narrowband FM (modulation index ≦ 1)
3 High TX/RX switching speed required for use in feedback (semi-duplex) systems
4 Compact package with high shock and noise resistance
5 Future-proof design for reliable long-term supply
6 Frequencies other than standard available

1 Superior interference rejection and high receiver sensitivity

Interference rejection

After the antenna input, a matching circuit which also works as an ESD protection circuit is followed by a SAW filter*.

The SAW filter used for STD-302 434 MHz has a pass bandwidth of 433.92 MHz +/- 0.87 MHz (ripple within pass band ≦ 1.5 dB) and more than 50 dB of attenuation is assured at a frequency range 21.4 MHz removed from the center frequency of 433.92 MHz.

*A SAW (surface acoustic wave) is generated and propagated when energy is applied on the surface of an elastic substrate and its amplitude is attenuated exponentially with regard to the depth vector. A SAW filter utilizes this characteristic of SAW.

High sensitivity

There is a gain of 18.7 dB in the process from high frequency amplifying to IF frequency generation performed by the SAW filter, LNA and Down-converter.

SAW filter	Insertion loss -3 dB
LNA	NF = -1.3 dB, G = 15 dB
Down-converter	NF = -8 dB, CG = 16 dB (434 MHz > 21.7 MHz)

The amplified signal is filtered by the following monolithic crystal filter to attenuate unwanted signals other than at 21.7 MHz +/- 7.5 kHz, and is then input to an IF AMP of 21.7 MHz where the signal is amplified and then converted to 450 kHz.

The 450 kHz signal is filtered again by a ceramic filter to attenuate unwanted signals other than at 450 kHz +/- 10 kHz, and is then demodulated to the base band signal by a Quad detector.

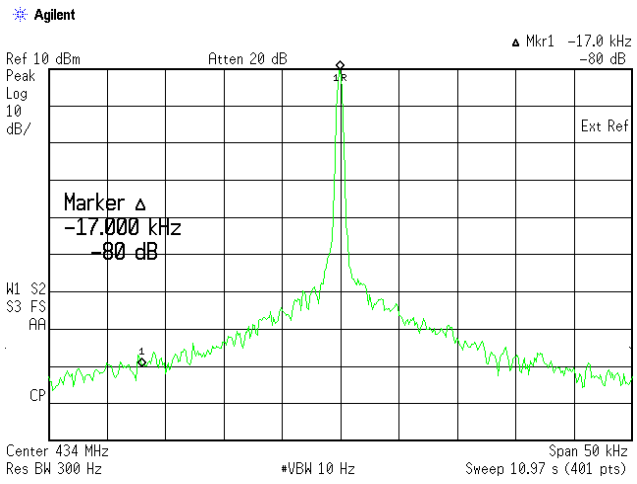
As mentioned above, after RF amplifying, frequency conversion is carried out twice in combination with sharp filtering, which makes it possible to obtain a baseband signal with SNR 12 dB at a received signal strength of -119 dBm.

2 Stable operation with narrowband FM (modulation index ≦1)

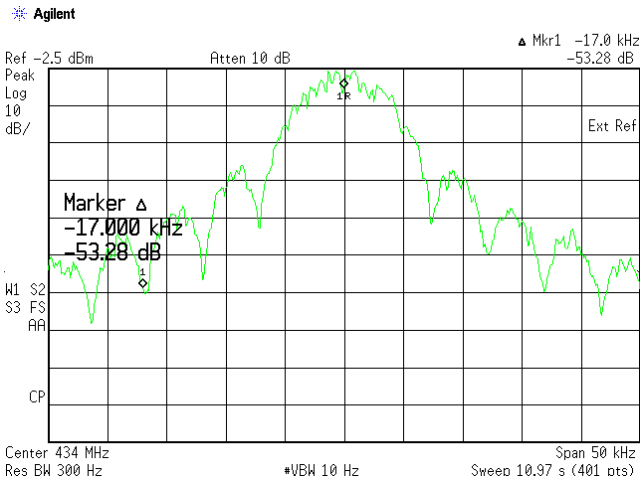
It is generally known that wideband FM is defined as the state in which the modulation index is more than 1, and for narrowband FM, 1 or less than 1. For STD-302, the maximum frequency deviation is 4.8 kHz and the bit rate is 9600 bps (maximum modulation frequency 4.8 kHz), which determines the modulation index as 1.

According to our experiments to make a narrow band system with a single chip IC, the bit rate where communication could be established was 2400 bps (maximum modulation frequency 1.2 kHz) with a maximum frequency deviation of 6 kHz, determining its modulation index as 5 which is not within the scope of narrowband FM.

For stable operation with narrow band FM, the provision of a binarization circuit, and temperature drift characteristics are important factors. Circuit Design, Inc has spent a lot of time on research and tests and has also maintained close contacts with our crystal manufacturer in pursuit of the best specification, resulting in the achievement of a binary FSK narrowband radio module that can operate in a temperature range from –20 C° to + 60 C°.



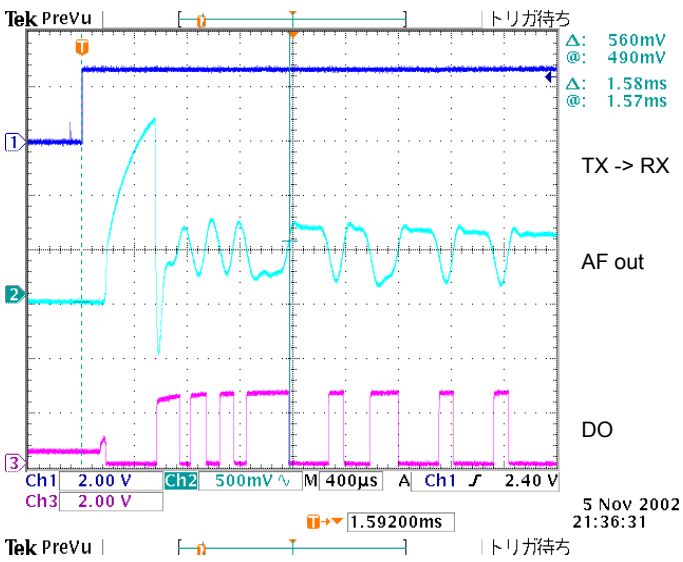
434MHz unmodulated



434MHz PN9 9600 bps

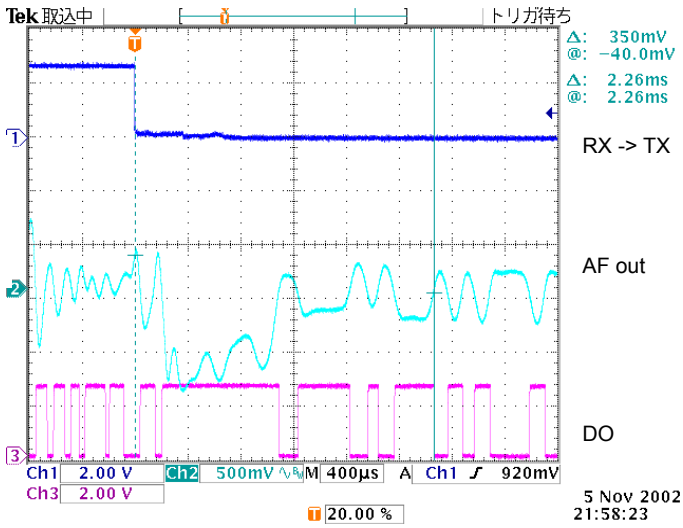
3 High TX/RX switching speed required for use in feedback (semi-duplex) systems

We have succeeded in accelerating the TX/RX switching time up to 5 ms using one VCO and the MIX method. An automatic threshold control circuit that is strongly resistant to noise and frequency drift is employed as a binarization circuit which enables direct interface with a CPU, making it possible to binarize a signal with a minimum pulse width from 100 µs to a maximum of 5 ms. For 9600 bps speed, using a preamble of 100 bits/10.4 ms (110011001100…is effective) and 96 bits/10 ms constituted by synchronous signal, ID code, command and checksum, it is possible to achieve a command response of 20.4 ms x 2 = 40.8 ms.



TX -> RX

Output data, AF out 25°C

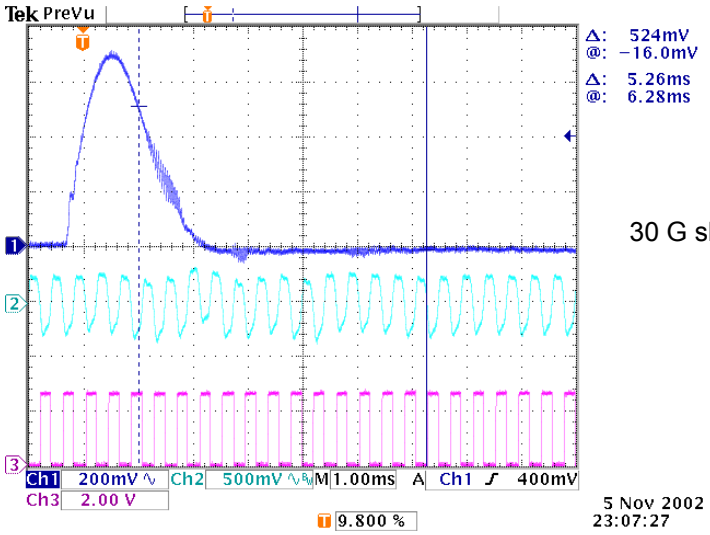


RX -> TX

Output data, AF out 25°C

4 Compact package with high shock and noise resistance

The GND of STD-302 is strengthened using a 4-layered PCB (full internal-layer GND). The VCO and PLL circuits, which are sensitive to noise, vibration and voltage change, are protected in a special shield casing. In addition, the whole PCB is covered from both front and back with a robust casing to provide resistance against noise and vibration caused by PCB bending.



30 G shock vs. Received data

5 Future-proof design for reliable long-term supply

Under current circumstances where component manufacturers may cut production of a certain part, Circuit Design Inc. emphasizes design using discrete, interchangeable parts to ensure a long-term supply of the product. Since room for improvement and part change has been accounted for in design, we can provide the product with the same basic performance over a long period of time.

6 Frequencies other than standard available

Standard frequency ranges are 434 MHz and 869 MHz band for the European market (EN 300 220 compliant) and 429 MHz and 1216 MHz band for the Japanese market (ARIB STD-T 67 compliant). The following custom frequencies are available by changing the VCO oscillation range, filters and constant values of resonators; 447 MHz (Korea), 458 MHz (UK), 915 MHz (USA)

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