Table 1, since the skin and muscle has a high dielectric constant [5], the penetration depth of radiated signal is rapidly attenuated in the outer tissue, and the other power reflected from the motion of the object is measured with this remote sensing system [6]. The received signal is properly amplified by LNA for signal's entering into the mixer, and then filtered by band-pass filter for obtaining the IF signal and monitoring the wave information within 0.6~3.3Hz (for heart rate), 0.33~0.5Hz (for respiration) [7].

A. The budget analysis in 1.9GHz system

The magnitude of source power used in this experiment is 16dBm. The signal passing 6dB coupler from port1 to port3 is 10dBm. It is attenuated by 3dB in attenuator. To extract the shifted frequency, the power of reference signal entering in mixer is 7dBm. Because the insertion loss of coupler is 1.4dB, the other signal passing coupler from port1 to port2 is 14.6dBm. It passes circulator which has the insertion loss, 0.28dB, from port1 to port2. The input power of antenna is about 14.3dBm. The antenna of this system is directional microstrip antenna for PCS repeater. Its gain is about 7dBi. The backscattered signal power received by the antenna is about 1~6dBm. The low noise amplifier's gain is 30dB and the maximum noise figure is 1.2 dB.

B. The budget analysis in 10GHz system

The magnitude of source power used in this experiment is 11dBm. Instead of coupler in Fig.1, power divider is used in this system. And the attenuator is omitted. The signal passed by power divider from port1 to port3 is 8dBm. It is used as the reference signal entered to mixer which is about 7dBm for extracting the shifted frequency. The other signal passing coupler from port1 to port2 is also about 8dBm. It passes circulator which has the insertion loss 0.3dB from port1 to port2. The input power of antenna is about 7dBm. The antenna used in the system is the parabolic antenna. Its gain is 27dBi and bandwidth is 1% centered 10GHz. The power of signal received by antenna is about -5~0dBm. The low noise amplifier's gain is 8dB and the maximum noise figure is 2 dB

3. The measured results

In this paper, all measured data is performed at 1.9GHz and 10GHz, respectively.

A. The measured results in 1.9GHz system

Fig. 2 shows heart rates and respiration waveform measured at 0.5m-distance between the system and the vibrating target. In this experiment, we use the system of Fig. 1. Fig. 2 (a), (b) stands for heart rates and respiration, respectively. The measured results in the 1.9GHz system are introduced only in 0.5m-distance. If we install this system in the PCS set, 1.9GHz vital sign detection system can be used by portable instrument in near future.

B. The measured results in 10GHz system

In Fig. 3, the first waveform (a), compounded with respiration and heart rates information, is the filtered signal in 0.03-3.3Hz. As shown in Fig. 3 (b) and (c), we can obtain the respiration and heart rate through re-filtering signal within 0.03-0.5Hz and 0.6-3.3Hz, respectively. By comparing heart rates (c) with ECG signal (d)'s peak position, we can verify that this system is implemented correctly. The period of ECG's peak time is consistent with heat rates. In Fig.4, (a) is stands for the detected heart rates and respiration at 1m-distance. The (b) and (c) indicate vital signs detected from 3m and 5m, respectively. Fig. 4 shows that as long as the distance is, detected signal become weak by attenuation of signal power according to the distance. But, we can find successfully the information of