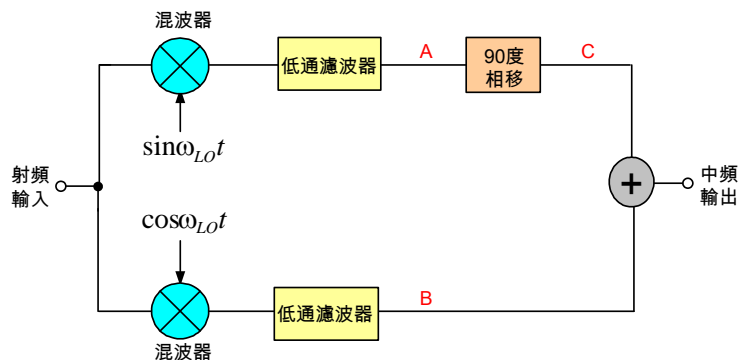


- Read two papers about Transmitter and Receiver Architectures by Prof. B. Razavi and write down your reading experience.
 - Architectures and Circuits for RF CMOS Receivers, 1998, Section I and II
 - RF Transmitter Architectures and Circuits, 1999, Section I and II
- The following figure is the Hartely Image rejection mixer. The image rejection ratio is defined as

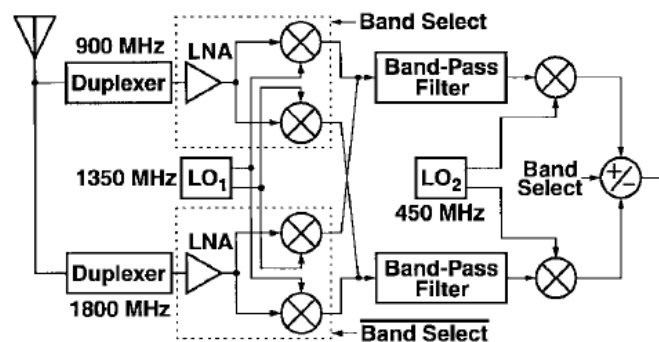
$$IRR \equiv \text{Output (Im/RF)} / \text{Input (Im/RF)} \ll 1$$



- Please derive the IRR under amplitude and phase mismatch ΔA and θ (rad), respectively as:

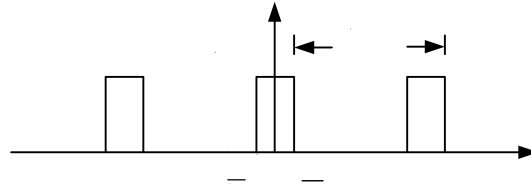
$$|IRR| = \frac{\left(\frac{P_{im}}{P_{sig}} \right)}{\left(\frac{A_{im}^2}{A_{sig}^2} \right)} \approx \frac{(\Delta A / A)^2 + \theta^2}{4}$$

- Plot the locus on the rectangular coordinate of amplitude ratio $\Delta A/A$ and phase error with $IRR = -10$ 、 -20 、 -30 、and -40 dB.
 - What happen if the 90° phase shifter in the above figure be put after the point B?
- The Band Selector +/- shown in the figure is used to select the band of 900/1800MHz, Please explain the operation principle.



Ref: Stephen Wu and B. Razavi, A 900-MHz/1.8-GHz CMOS Receiver for Dual-Band Applications, IEEE JOURNAL OF SOLID-STATE CIRCUITS, VOL. 33, NO. 12, pp. 2178-2185, 1998.

4. (a) Please confirm the formula of Fourier Transformation of a periodic pulse as shown in the following.



$$f(t) = \frac{A\tau}{T} + \frac{2A}{T} \sum_{n=1}^{\infty} \frac{1}{n} \sin \frac{n\pi\tau}{T} \cos n\omega_o t$$

- (b) Please calculate the magnitudes of all the harmonics with duty cycle 1/3 and 1/4.
- (c) A rectangular waveform of $T_{LO}/3$ Duty Cycle has been employed as the local oscillator in the so-called Harmonic Rejection Mixer. See the paper below. Please give a comment on this paper by MediaTek.

Ref: Yen-Horng Chen, Neric Fong, Bing Xu, Caiyi Wang, An LTE SAW-Less Transmitter Using 33% Duty-Cycle LO Signals for Harmonic Suppression, ISSCC p.172, 2015.

