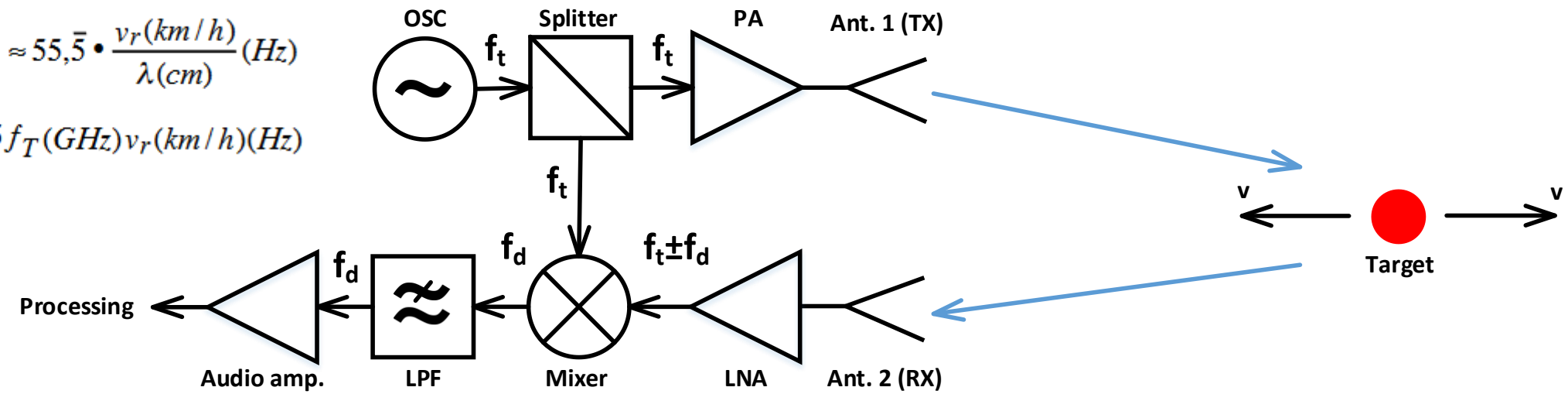
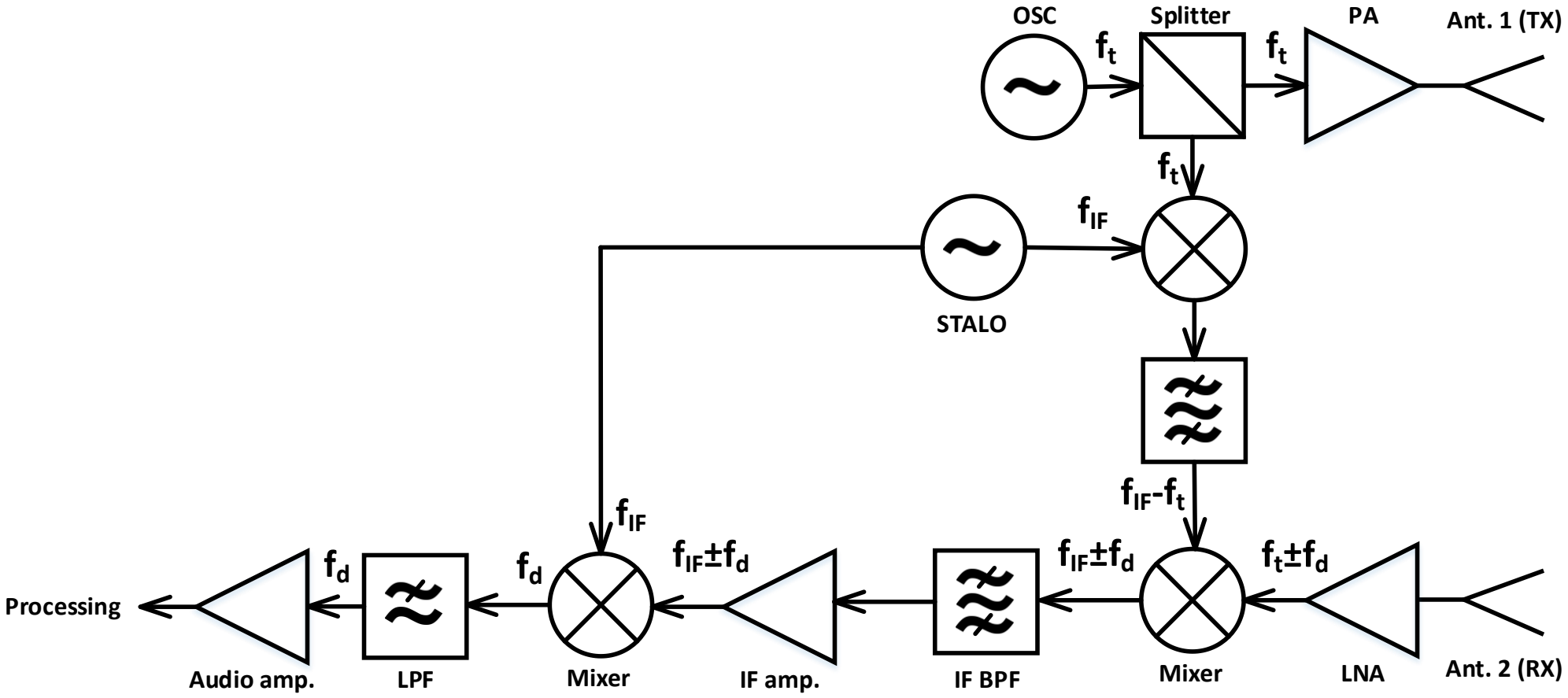
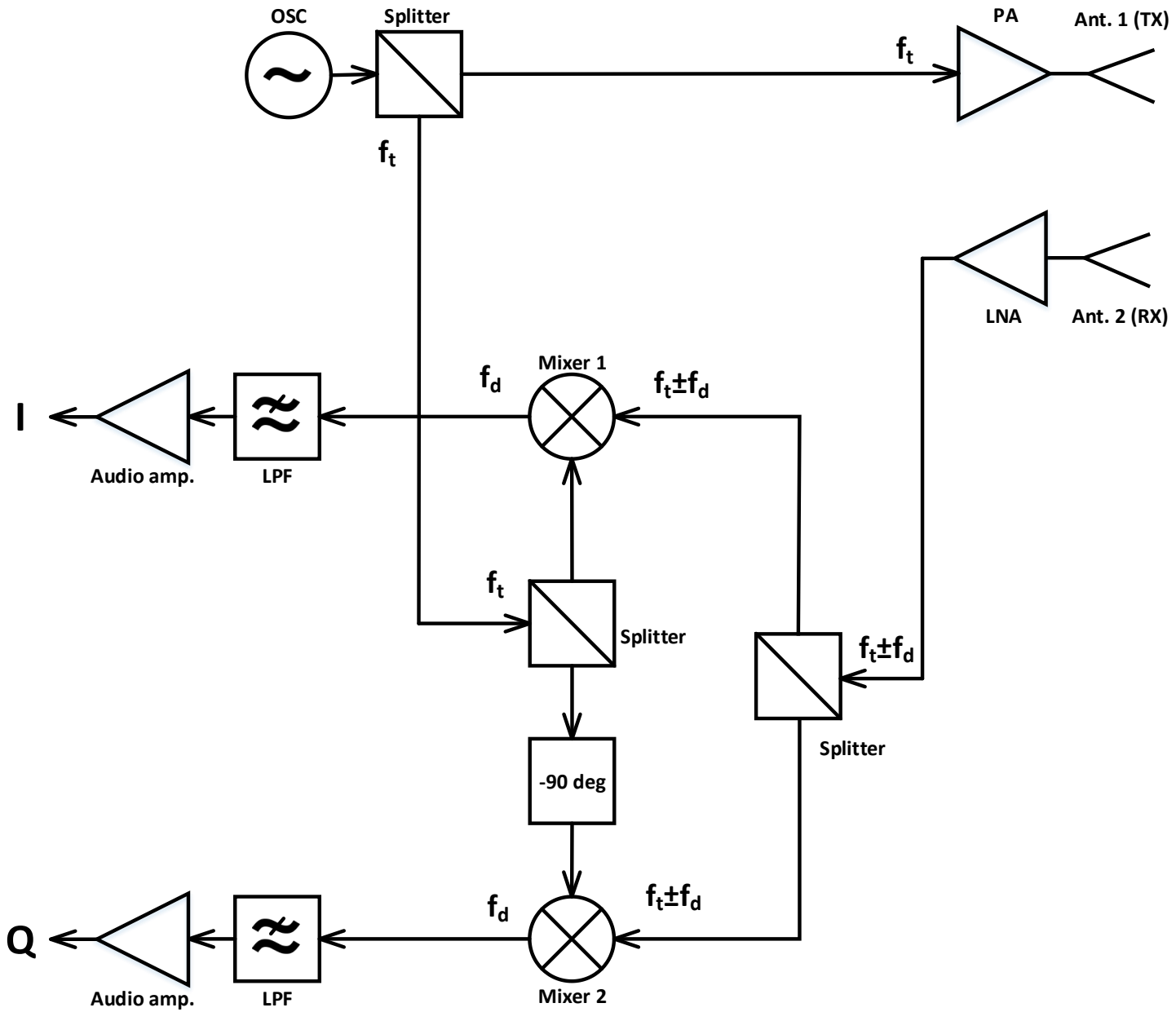
CW

$$f_D = \frac{2v_r}{\lambda} \approx 55{,}\bar{5} \bullet \frac{v_r(km/h)}{\lambda(cm)}(Hz)$$

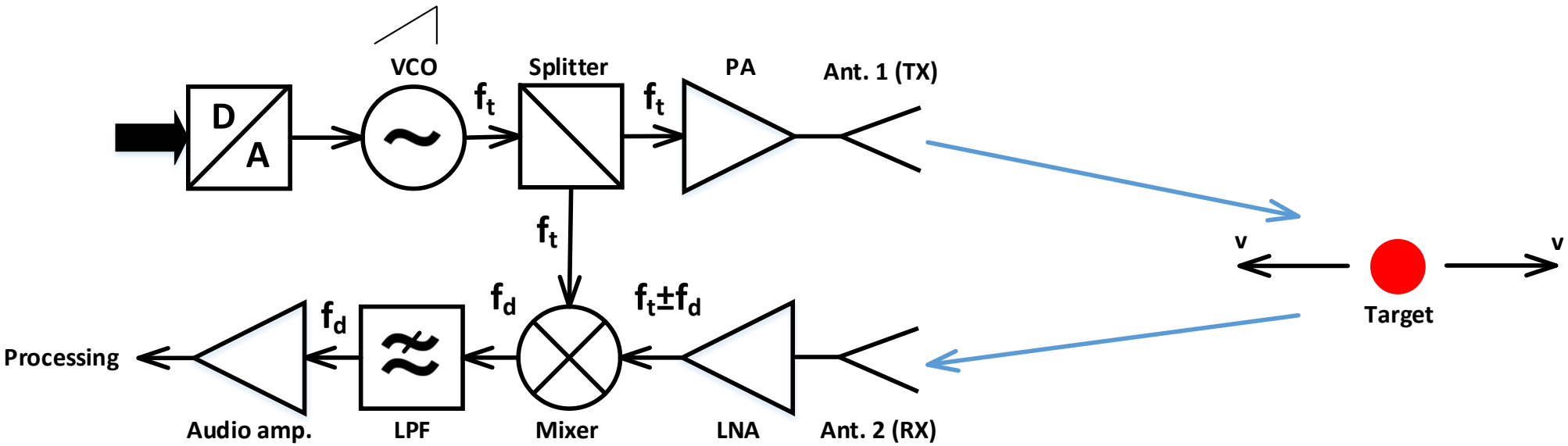
$$f_D = 1{,}85 f_T(GHz) v_r(km/h)(Hz)$$

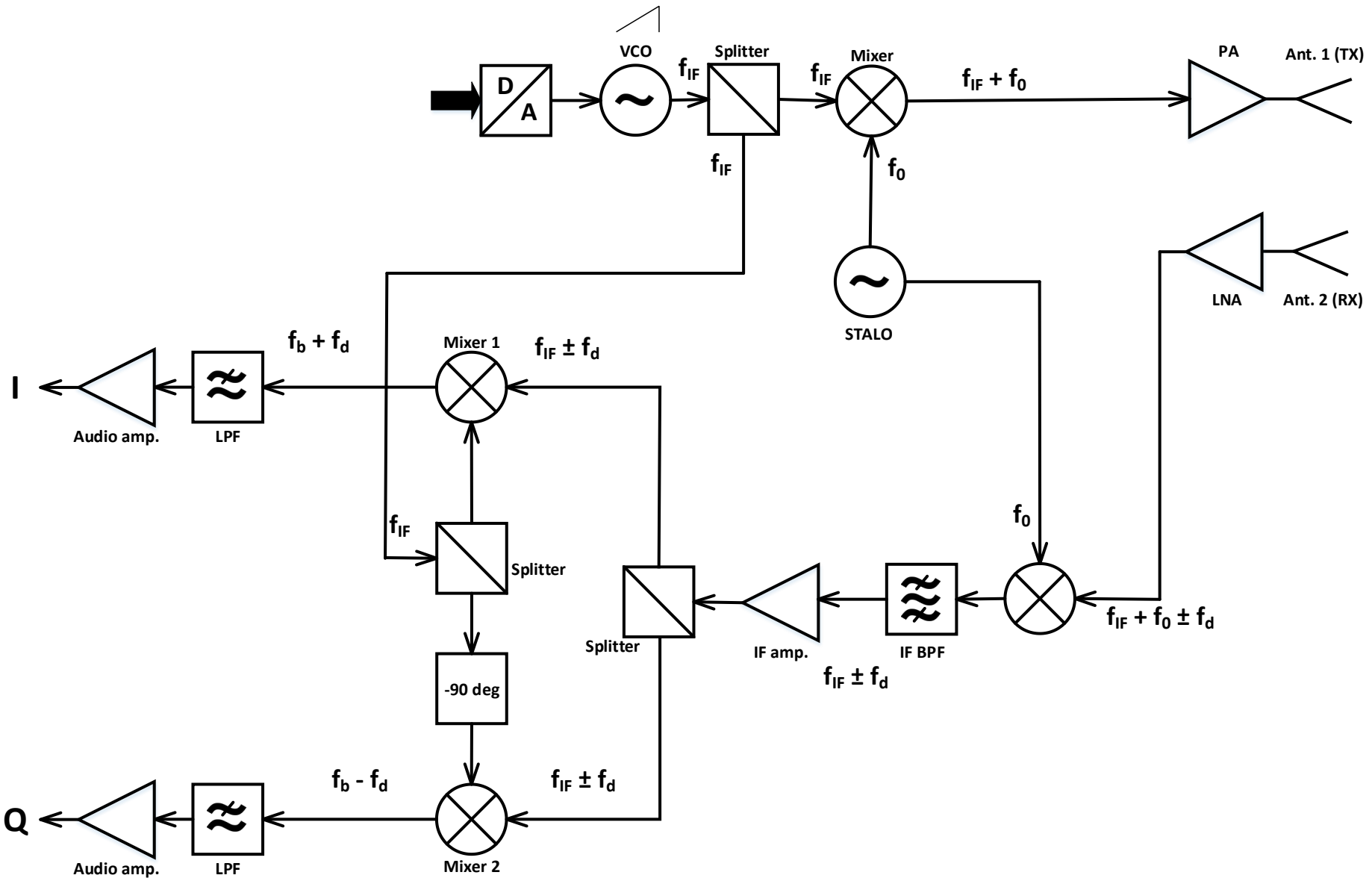



OSC
Splitter
PA
Ant. 1 (TX)
f_t
f_t
f_t
f_{IF}
STALO
f_{IF}-f_t
f_{IF}
$f_{IF}\pm f_d$
$f_{IF}\pm f_d$
$f_t\pm f_d$
f_d
f_d
Processing
Audio amp.
LPF
Mixer
IF amp.
IF BPF
Mixer
LNA
Ant. 2 (RX)

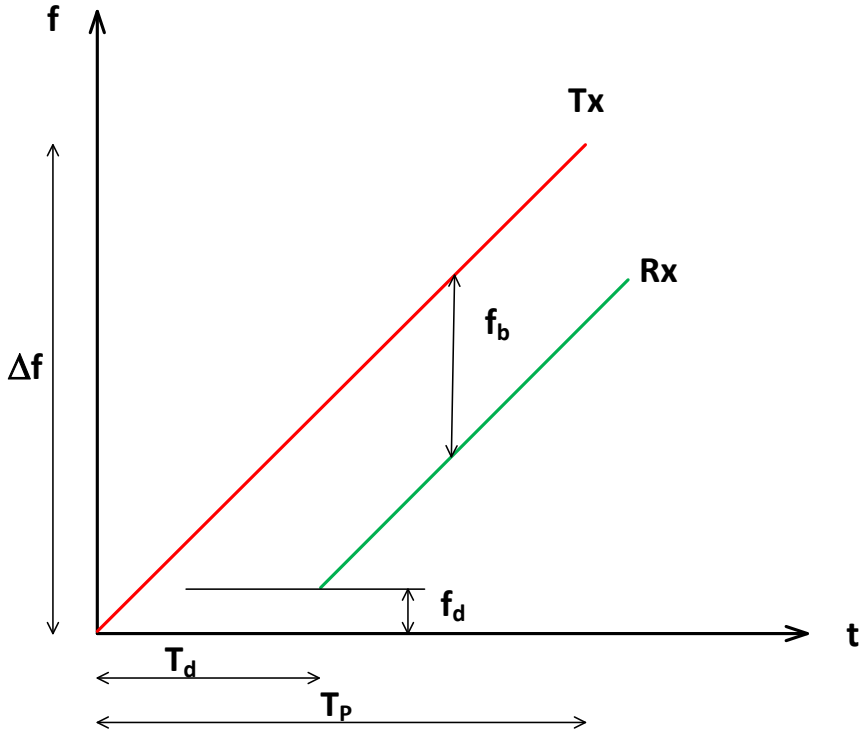

OSC
Splitter
PA
Ant. 1 (TX)
f_t
f_t
LNA
Ant. 2 (RX)
Mixer 1
f_d
$f_t \pm f_d$
I
Audio amp.
LPF
f_t
Splitter
$f_t \pm f_d$
Splitter
-90 deg
f_d
$f_t \pm f_d$
Q
Audio amp.
LPF
Mixer 2

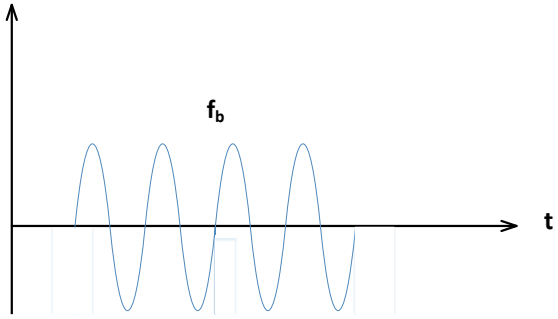
FMCW

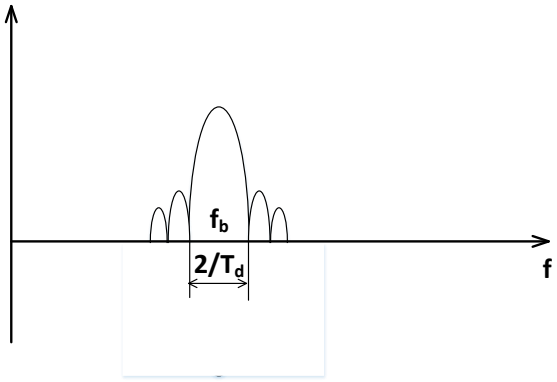

VCO
Splitter
PA
Ant. 1 (TX)
D
A
f_t
f_t
f_t
v
v
Target
f_d
$f_t \pm f_d$
f_d
Processing
Audio amp.
LPF
Mixer
LNA
Ant. 2 (RX)

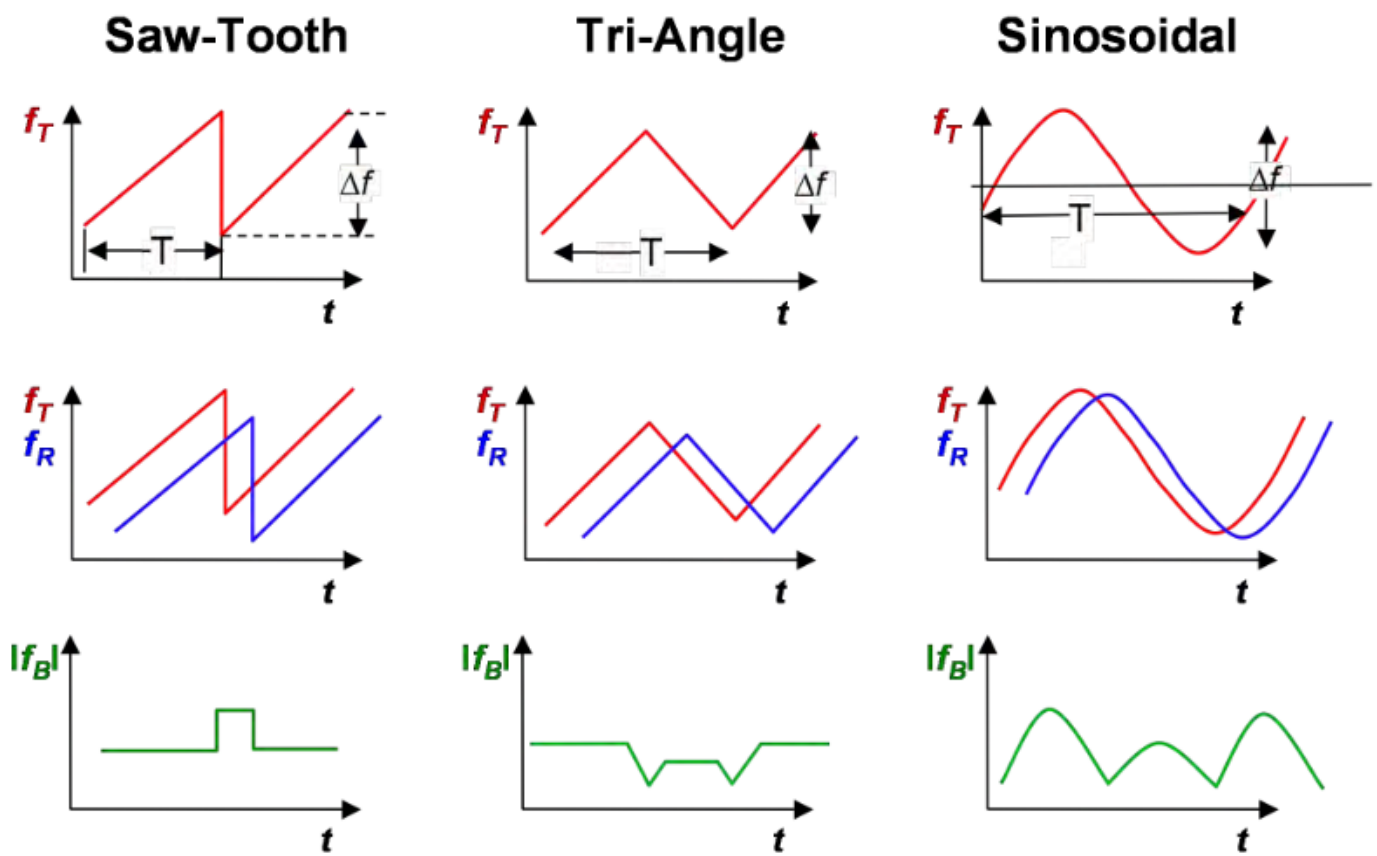

D
A
VCO
f_{IF}
Splitter
f_{IF}
Mixer
$f_{IF} + f_0$
PA
Ant. 1 (TX)
f_{IF}
f_0
STALO
LNA
Ant. 2 (RX)
$f_b + f_d$
Mixer 1
$f_{IF} \pm f_d$
I
Audio amp.
LPF
f_0
f_{IF}
Splitter
Splitter
IF amp.
IF BPF
$f_{IF} + f_0 \pm f_d$
$f_{IF} \pm f_d$
-90 deg
$f_b - f_d$
$f_{IF} \pm f_d$
Q
Audio amp.
LPF
Mixer 2

FMCW









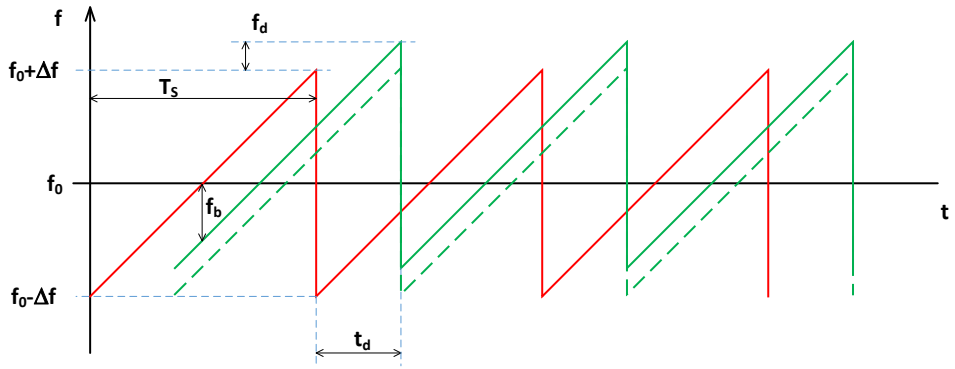
$T = Peroid\,,\ \Delta f = Frequency\ sample\,,$

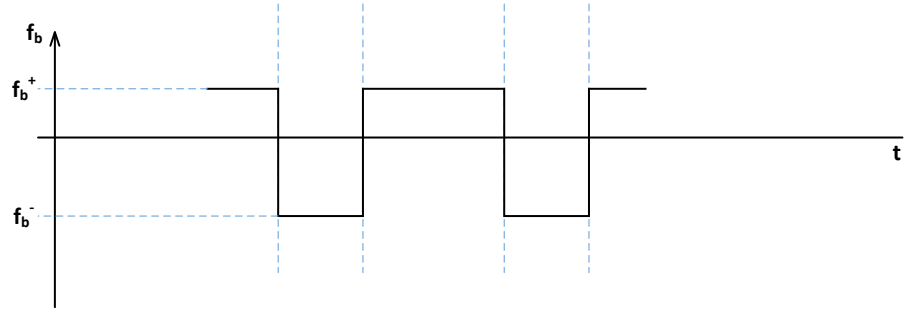
$f_T(t) = Transmit\ \ frequency$

$f_R(t) = \mathrm{Re}ceiving\ \ frequency = f_T(t-\tau) \pm f_D\,,$

$f_B = "Beatfrequency"\ \ (Mixeroutput) = f_T - f_R$

Linear sawtooth FMCW waveform

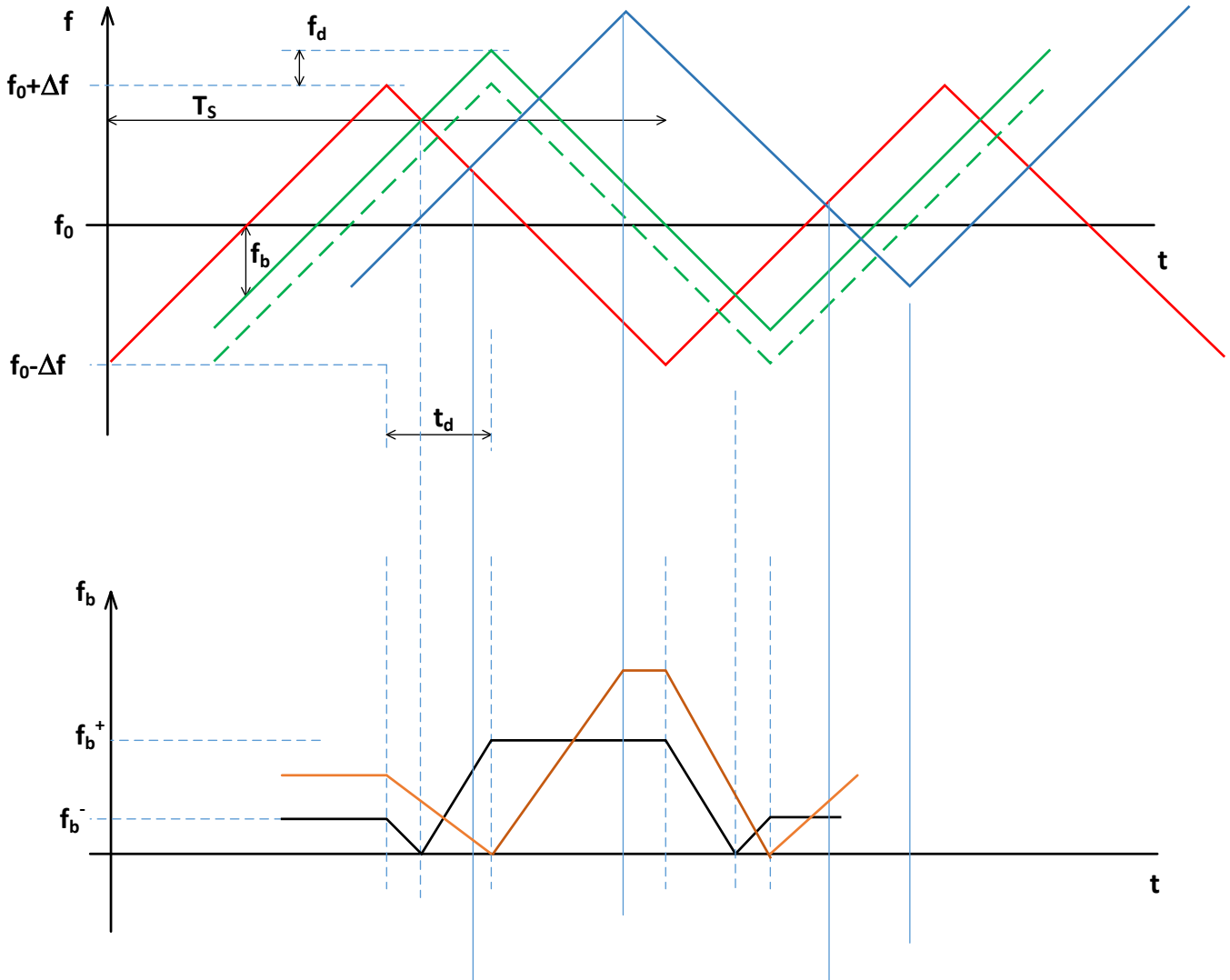


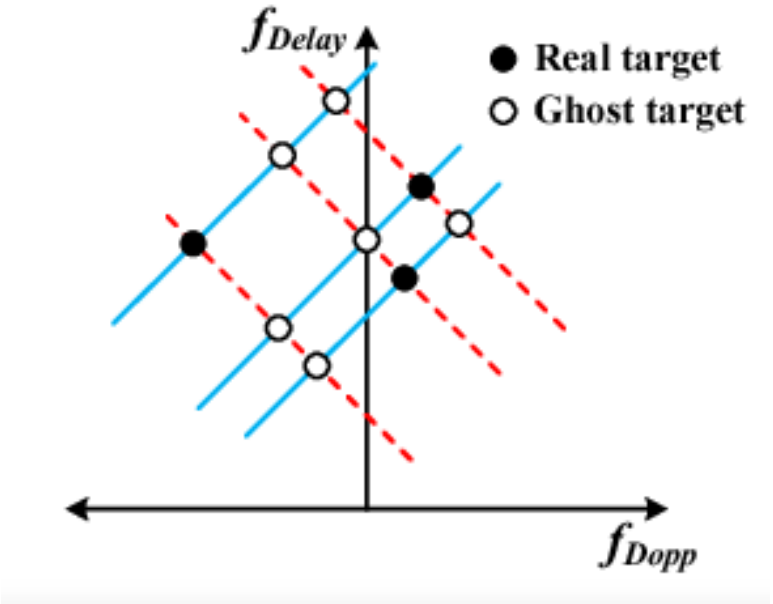


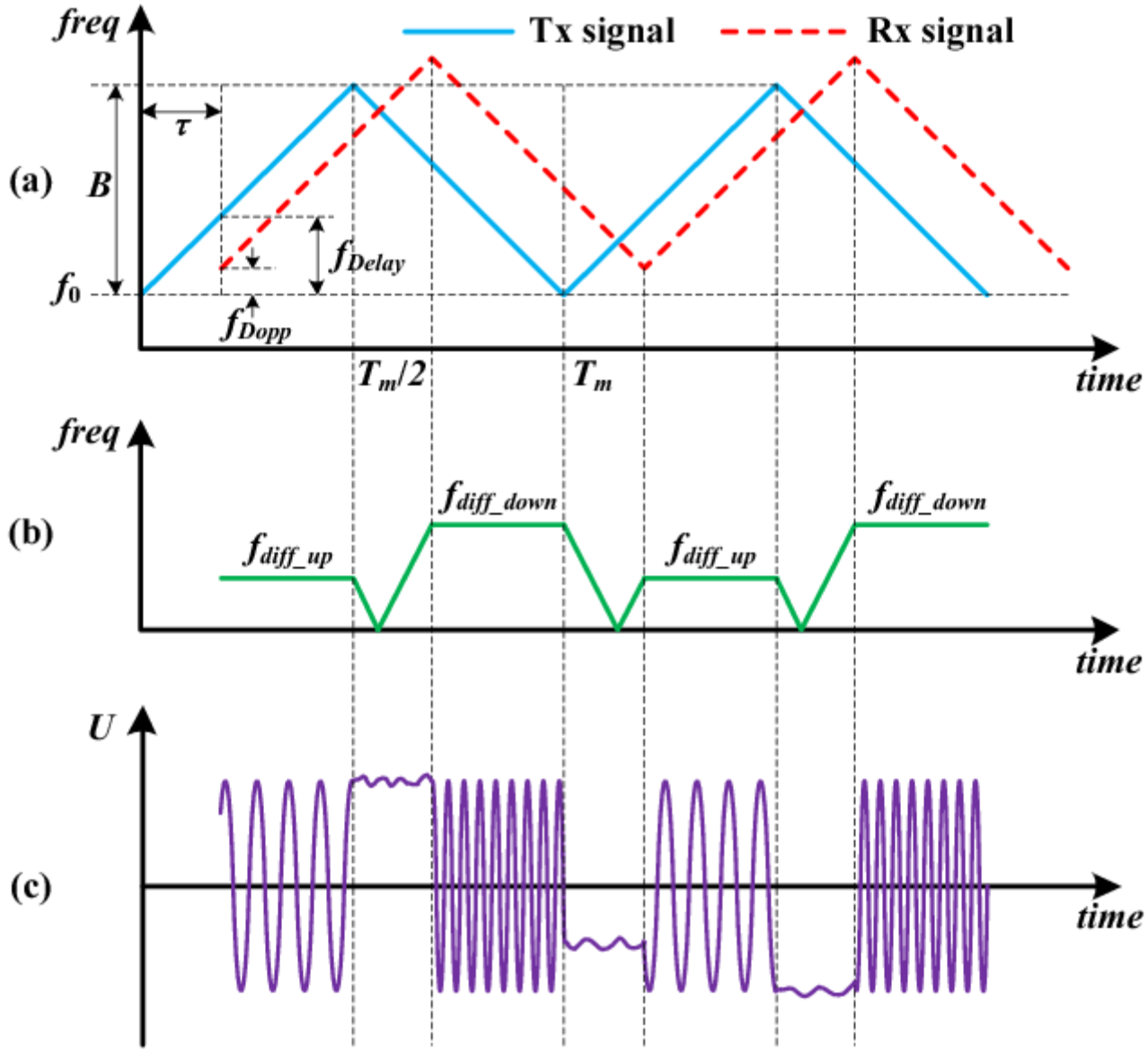
- $f_b^+ = \frac{\Delta f}{T_s/2} t_d - f_d = \frac{4\Delta f}{cT_s} R - f_d$
- $f_b^- = -\frac{\Delta f}{\frac{T_s}{2}} t_d - f_d = -\frac{4\Delta f}{cT_s} R - f_d$

- $R = \frac{cT_s}{8\Delta f} \frac{\left(f_b^+ - f_b^-\right)}{2}$
- $f_d = -\frac{\left(f_b^+ + f_b^-\right)}{2}$

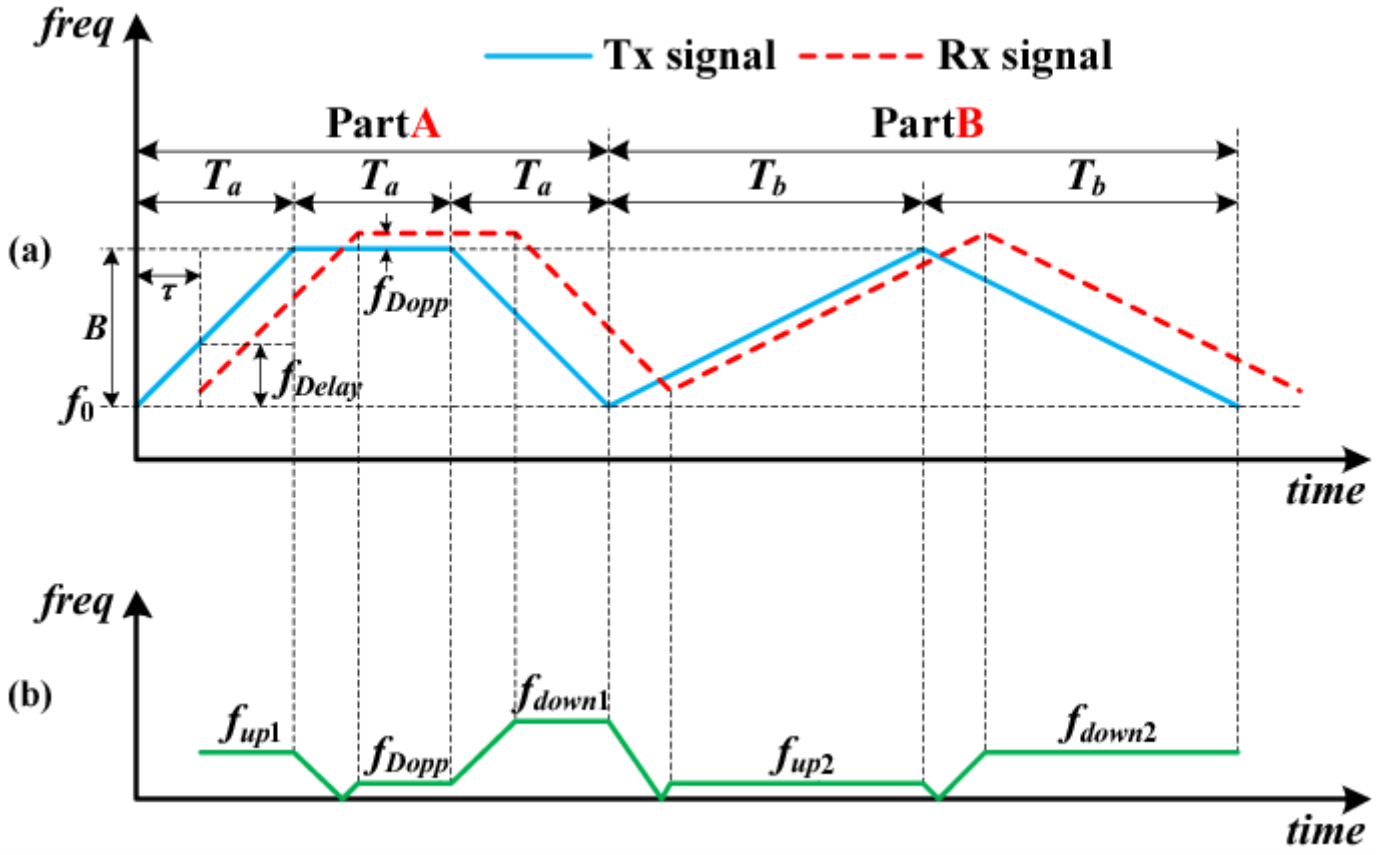
Linear Triangular FMCW



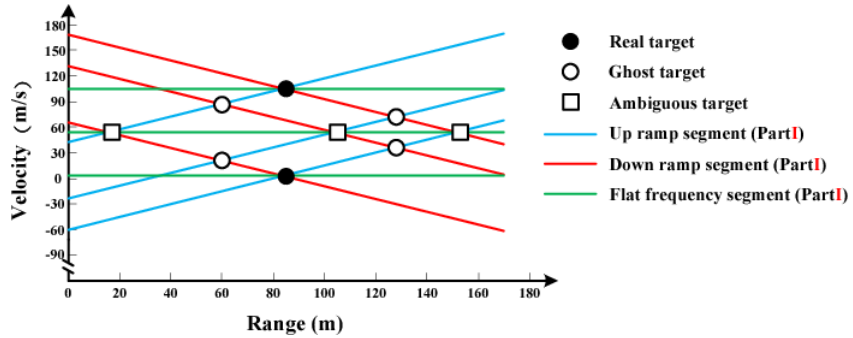



freq
Tx signal
Rx signal
(a)
B
τ
f_0
f_{Delay}
f_{Dopp}
$T_m/2$
T_m
time
freq
(b)
f_{diff_up}
f_{diff_down}
f_{diff_up}
f_{diff_down}
time
U
(c)
time

Segmented Linear FMCW



squares) exist with the same velocity.



missed.