

Understanding the Obstacle Detection Chirp Configuration Maximum Range and Range Resolution

mmwave_automotive_toolbox\labs\lab0004_obstacle_detection\chirp_configs\ods_default_config.cfg

```

sensorStart
flushCfg
dfeDataOutputMode 1
channelCfg 15 3 0
adccfg 2 1
adcbufCfg -1 0 0 1 1
profileCfg 0 77 7 7 58.0 0 0 67.978 1 256 5020 0 0 36
chirpCfg 0 0 0 0 0 0 0 1
chirpCfg 1 1 0 0 0 0 0 2
frameCfg 0 1 32 0 100 1 0
lowPower 0 1
guiMonitor 1 1 1 0
cfarCfg 1 4 12 4 2 8 2 350 30 2 0 5 20
dbscanCfg 4 4 13 20 3 256
sensorStart

```

Figure 8. ODS Profile Configuration

Profile Configuration

```
profileCfg 0 77 7 7 58.0 0 0 67.978 1
```

Format used by mmWave SDK.

Description provided based on

C:\ti\mmwave_sdk_02_00_00_04\docs\mmwave_sdk_user_guide.pdf

ProfileCfg		ODS config
	profileId	0
	startFreq (GHz, float)	77
	idleTime (u-sec, float)	7
	adcStartTime (u-sec, float)	7
	rampEndTime (u-sec, float)	58.0
	txOutPower	0
	txPhaseShifter	0
	freqSlopeConst (MHz/usec)	67.978
	txStartTime (u-sec, float)	1
	numAdcSamples (uint)	256

	digOutSampleRate (ksps)	5020
	hpfCornerFreq1 0: 175 KHz 1: 235 KHz 2: 350 KHz 3: 700 KHz	0
	hpfCornerFreq2 0: 350 KHz 1: 700 KHz 2: 1.4 MHz 3: 2.8 MHz	0
	rxGain (dB)	36

The Programming Chirp Parameters in TI Radar Devices” AppNote Provides more details about these parameters

<http://www.ti.com/lit/an/swra553/swra553.pdf>

Following snapshot from this AppNote helps to understand graphically the parameters

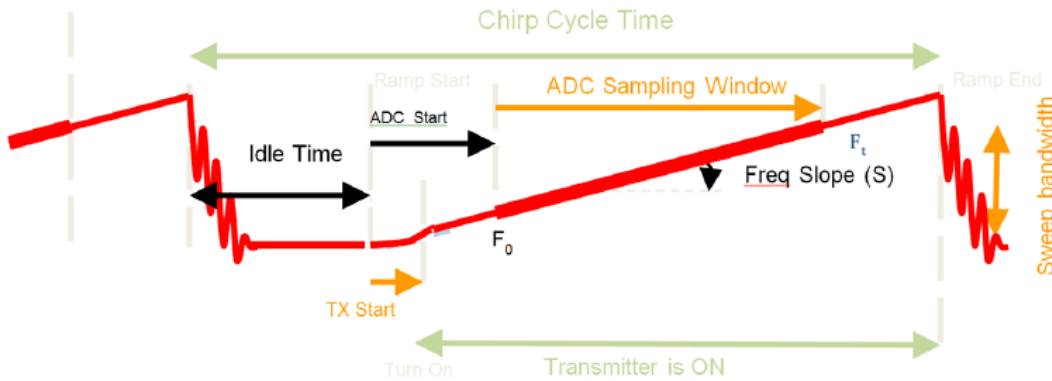


Figure 1. Typical FMCW Chirp

Chirp Configuration

```
8 chirpCfg 0 0 0 0 0 0 0 0 1
9 chirpCfg 1 1 0 0 0 0 0 0 2
```

We notice that MIMO is being used since 1Tx Antenna is enabled at a time.

Profile Configuration

```
10 frameCfg 0 1 32 0 100 1 0
```

frameCfg		ODS config
	chirp start index	0
	chirp end index	1
	number of loops	32

	number of frames	infinite
	frame periodicity (ms, float)	100
	Trigger select 1: Software trigger 2: Hardware trigger.	1
	frameTrigDelay (ms, float)	0

So one frame has

- 64 chirps
 - 32 of type 0
 - 32 of type 1
- Frame Periodicity is 10 fps

Range Max, Range Resolution Max

The mmWave Equations described in the mmWave Training for Range:

<https://training.ti.com/intro-mmwave-sensing-fmcw-radars-module-1-range-estimation?cu=1128486>

https://training.ti.com/sites/default/files/docs/mmwaveSensing-FMCW-offlineviewing_0.pdf

The Range Resolution (d_{res}) depends only on the Bandwidth swept by the chirp

$$d_{res} = \frac{c}{2B}$$

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Notice that $B = STc$.

What is T_c based on parameters above?

$T_c = \text{numAdcSamples} / \text{digOutSampleRate}$

An ADC sampling rate of F_s limits the maximum range of the radar to

$$d_{max} = \frac{F_s c}{2S}$$

So,

For ODS chirp configuration

$$d_{max} \sim (5.02\text{MHz} * 3.10^8 \text{ m/s}) / (2 * 68\text{MHz/} \mu\text{sec}) = (5.02 * 3.10^8) / (2 * 68 * 10^6) \text{ m} = 11.07\text{m}$$

$$d_{res} \sim 3.10^8 \text{ m/s} / (2 * 68\text{MHz/} \mu\text{sec} * (256 \text{ samples} / 5020 \text{ kilosamples/sec})) = 3.10^2 \text{ m/} \mu\text{sec} / (2 * 68\text{MHz/} \mu\text{sec} * (256 / 5.02 \text{ usec})) = 4.326\text{cm}$$

