Frequency modulation techniques

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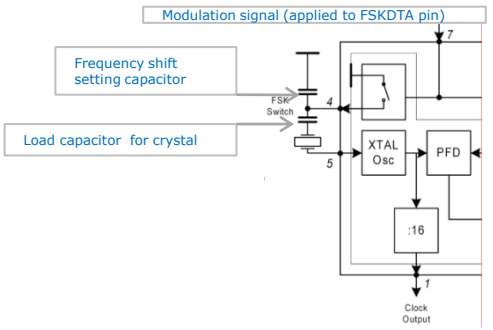
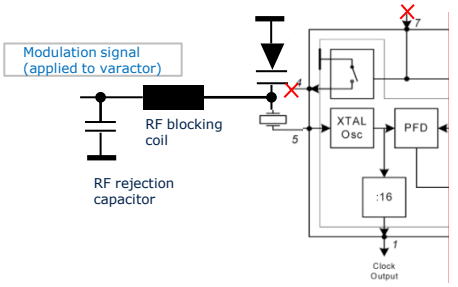
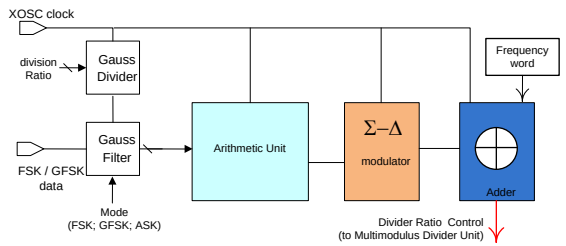
Overview of FM modulation techniques

Modulator type	Short description	Advantages	Disadvantage	Block diagram	Key feature
Switched capacitor	▪ a chip-internal transistor is switched ON and OFF by the modulating signal. The frequency is pulled (between *FSK_low* and *FSK_high*) values due to this additional (switched) capacitor **Typical representatives** TDK510x and TDK511x family PMA5110 and PMA7105; PMA7106; PMA7107; PMA7110 family	▪ simple, robust, easy to implement ▪ works "on the fly" , no need to program anything, just apply the power and the modulating and control signal	▪ the maximum frequency shift is determined mainly by parameters of the crystal (crystal pullability) and ▪ careful selection for value of the frequency setting capacitor (*C*) is required ▪tradeoff between startup time and frequency shift capability (due to inherent nature of crystal resonators) ▪ unwanted but low energy transients may appear in spectrum due to capacitor switching		Low cost , simple solutions
With external varactor	▪ the crystal pulling is achieved over a varactor ▪ for higher demands of linearity a pair of varactors may be connected into antiparalel group **Typical representatives** The solution can be applied to the TDK510x ; TDK511x and PMA5110 / PMA71xx family	▪ clean, predictable spectrum, very low amount of transients, less sideband noise as by switched capacitor type modulator ▪ works "on the fly" , no need to program anything, just apply the power and the modulating signal	The maximum frequency shift is determined by: ▪ parameters of the crystal used in application (-->crystal pullability) and varactor characteristics (i.e. *Cmax/Cmin* ratio) ▪ limitations regarding *Cmin* / *Cmax* capacitance variation (of varactor) due to low power supply voltage and limited modulation signal voltage swing		
Digital modulator	▪ the digital modulation is achieved by seamlessly changing the division ratio of a Fractional-N type synthesizer between two "end" frequencies **Typical representatives** TDA5150 transmitter, TDA5340 transceiver	▪ almost unlimited freedom in setting the size and shape of frequency shift vs. time function ▪ switchover between FSK and GFSK over software (by reprogramming some of SFR registers) ▪ no special crystal pullability requirements, the crystal swings always on same frequency ▪ well suited for multichannel systems ▪ for identical modulation indexes the occupied bandwidth (OBW) of a GFSK signal is less then of a FSK signal, thus GFSK is more effective in terms of spectrum usage	▪ to avoid (minimize) fractional spurs some rules in choice of the synthesizer's fractional part ratio have to be obeyed ***Note:*** *this does not limit the system's flexibility in terms of reference clock selection* ▪ a Host (usually microcontroller) is required to program the chip before transmission can be started ***Note:*** *this is not a real drawback, as by most practical applications a microcontroller is part of the system. Steering functions and modulation signal (data stream) are derived usually from the uC unit.*	 TDA5150; Digital Modulator block	Easy design-in High flexibility, Multiband, multichannel