Frequency Modulation Frequency modulation (FM) was introduced by E.A. Armstrong in the 1930's as an alternative to the AM commonly in use at the time for broadcasting. The advantage to frequency modulation is that, for a given transmitted power, the signal–to–noise ratio is much higher at the receiver output than it is for AM. The digital version of FM, frequency–shift keying, has been in use since an even earlier date. In FM, the frequency of the carrier is modulated to follow the amplitude of the message signal. To be more specific, if ⍰ ⍰ mt with peak value p m is a message signal , then the instantaneous frequency ⍰ ⍰ f t is given by ⍰ ⍰ f t f kmt ⍰ ⍰ ⍰ ⍰, c f of the carrier (17) where c f is the carrier frequency and f k is a proportionality constant called the "frequency sensitivity." The term k m t f ⍰ ⍰ is called the "frequency deviation" of the instantaneous frequency from the carrier 117 118 frequency, and the peak frequency deviation f p f km ⍰ ⍰ is an important FM system parameter. Given the instantaneous frequency, we can find the total instantaneous angle ⍰ ⍰ t ⍰ of the carrier by integrating the instantaneous frequency. That is, ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ 0 0 2 2 2 0. t t c f t f d f t k m d ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ (18) Since the initial angle ⍰ ⍰ 0 ⍰ is of no consequence, we can simplify the equations by taking ⍰ ⍰ 0 0 ⍰ ⍰ . The transmitted FM signal is then given by ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ 0 0 cos cos 2 2 cos 2 2 . c t c c f t c c p g t A t A f t k m d A f t f m m d ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰ ⍰