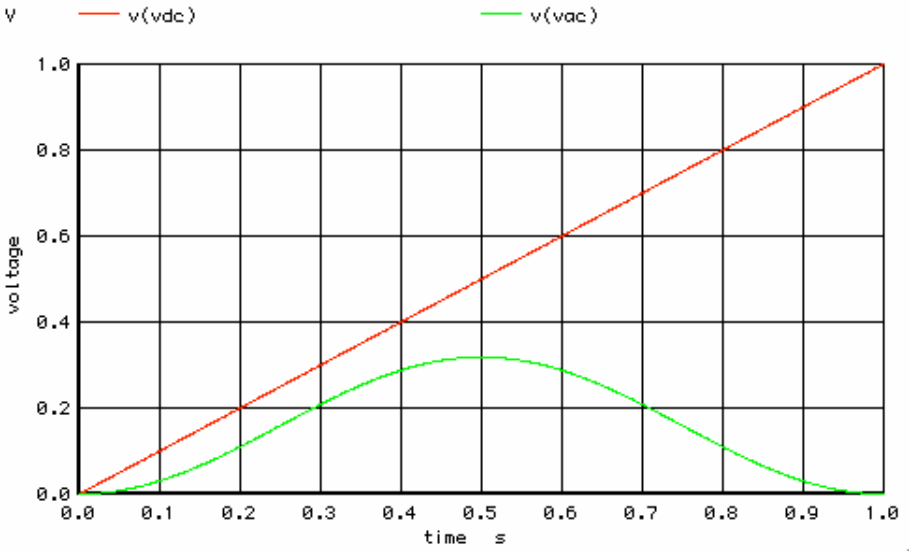
==========Tranlate_between_PM_FM==========




**Frequency Modulating any Carrier by a delta frequency Magnitude**
**at the same frequency Rate**
**is effectively....**

**Phase Modulating the Carrier** **at a 1 radian Magnitude**
**at the same frequency Rate**

## Tranlate_between_PM_FM

```
* dsauersanjose@aol.com  6/13/08
* www.idea2ic.com
*
*           V_DC                V_AC
*          _______             _______
*  I_DC_|_       |     I_AC_|_       |
*       /   \     |          /   \     |
*       \   /   __|__        \   /   __|__
*       /_\_/   _____        /_\_/   _____
*       \___/     |          \___/     |
*         |_      |            |_      |
*        ///     ///          ///     ///
*
```

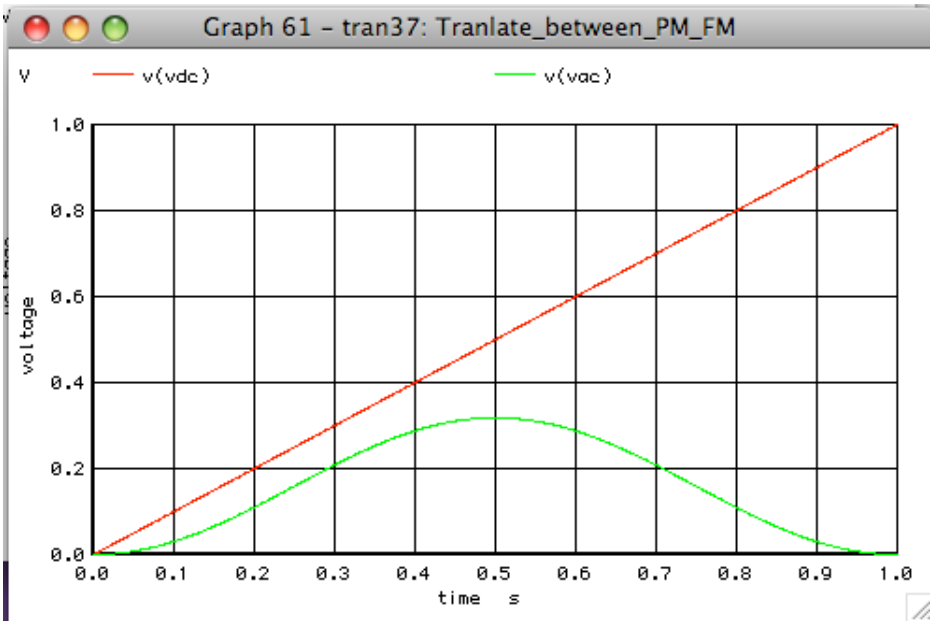
```
*V_SIN#   NODE_P NODE_N        SIN(   V_DC   AC_MAG FREQ   DELAY   FDamp)
*V_PULSE# NODE_P NODE_N        PULSE( VINIT  VPULSE TDELAY TRISE   TFALL   PWIDTH PERIOD )

.OPTIONS  GMIN=1p       METHOD=gear   ABSTOL=1n  TEMP=27 srcsteps = 100  gminsteps = 10
ITL1=400
.OPTIONS  RELTOL=.001   ABSTOL=1n     VNTOL=1n   ITL4=500
*======== ====== ====== ====== ====== ====== ====== ====== ====== ====== ======
IDC       0      VDC    DC     0      PULSE( 0  1 1n 1n  1n  10 100 )
CDC       VDC    0              1
RDC       VDC    0              1000K
IAC       0      VAC    DC     0      SIN(0 1 1 1n )
CAC       VAC    0              1
RAC       VAC    0              1000K
.control
tran      1m     1
run
set       pensize = 1
plot      v(vdc)  v(vac)
plot      v(vac)
.endc
.end
```

**1/2PI =** 0.15915494309189535 = 0.3183098861837907

==========END_OF_SPICE==========

To Covert PDF to plain text click below
http://www.fileformat.info/convert/doc/pdf2txt.htm




A little thought experiment...

If a DC current of 1 Amp magnitude is applied to a
1 Farad capacitor, then over 1 second it will swing
1 volt.

If an AC current of 1 Amp magnitude is applied to a
1 Farad capacitor, then over 1 second it will swing
+/- 1/2*PI volts.

If a 1MHz is increased in frequency by a DC magnitude
of 1Hz, then over 1 second it will have 1,000,001
cycles as opposed to 1,000,000 cycles. In other words
its phase will be off by 2*PI radians.

If a 1MHz is modulated in frequency by a 1Hz AC signal
also at a 1Hz peak magnitude, then over 1 second its
Phase will vary 1/2*PI less than for the DC frequency offset.
In other words it will vary +/- 1 radian in phase.

The same applies to a 1GHz signal that is modulated
by a 1kHz AC signal which is also at a 1kHz peak magnitude.
It will vary in phase by +/- 1 radian over 1msec.

So FM modulation using the same frequency for both
signal modulation and modulation magnitude is equivalent
to Phase modulation at with same signal delayed by 90 degrees
at 1 radian modulation magnitude.

Frequency Modulating any Carrier by the same frequency twice

**is effectively**
**Phase Modulating the Carrier at a 1 radian Magnitude**

***#1=============WinSpiceVersion=================**

```
Tranlate_between_PM_FM
* dsauersanjose@aol.com  6/13/08
* www.idea2ic.com
*
*          V_DC              V_AC
*          ______            ______
*  I_DC_|_      |    I_AC_|_      |
*     /   \     |       /   \     |
*     \/ \/   __|__     \/ \/   __|__
*     /\_/\   _____     /\_/\   _____
*     \___/     |       \___/     |
*       |_      |_        |_      |_
*      ///     ///       ///     ///
*
```

```
*V_SIN#   NODE_P NODE_N        SIN(   V_DC   AC_MAG FREQ   DELAY  FDamp)
*V_PULSE# NODE_P NODE_N       PULSE( VINIT  VPULSE TDELAY TRISE  TFALL  PWIDTH PERIOD )

.OPTIONS  GMIN=1p       METHOD=gear   ABSTOL=1n  TEMP=27 srcsteps = 100  gminsteps = 10
ITL1=400
.OPTIONS  RELTOL=.001   ABSTOL=1n     VNTOL=1n   ITL4=500
*======== ====== ====== ====== ====== ====== ====== ====== ====== ======
IDC       0      VDC    DC     0      PULSE( 0  1 1n 1n  1n  10 100 )
CDC       VDC    0              1
RDC       VDC    0              1000K
IAC       0      VAC    DC     0      SIN(0 1 1 1n )
CAC       VAC    0              1
RAC       VAC    0              1000K


.control
tran      1m     1
run
set       pensize = 1
plot      v(vdc)  v(vac)
plot      v(vac)
.endc


.end
```