PLL Module Configuration

- **Source**: Agilent 33250A at 50 MHz
- **Phase Detector**: MiniCkts ADEX-10L
- **Loop Filter**: TLO82/ LF353 Op-Amp
- **Power Splitter**: MiniCkts ADP-2-1W
- **VCO**: MiniCkts JTOS-75

Diagram labels:
- RF Input
- ADEX-10L
- PD LPF
- PD Out
- TLO82
- VCO Output
- ADP-2-1W
- JTOS-75
- VCO Control Input
- +12v
- GND
- -12v
- VCO Out Test Port
VCO Characterization

-15, -10, & -5 dBm

Agilent 33250A at 50 MHz

Pwr Split MiniCkts ADP-2-1W

Bias to near 50 MHz using op-amp level-shifter or power supply

VCO Test Port

Bias to near 50 MHz using op-amp level-shifter or power supply

0.01 µf

0.01 µf

VCO MiniCkts JTOS-75

Rg = 50Ω

51Ω

 Phase Det. MiniCkts ADEX-10L

To scope with HF reject turned on

To scope with HF reject turned on

-5 dBm Phase Det.
Second Order Loop Filter

Level shifter to set VCO center frequency

\[ \frac{1}{2} TLO82 \] or similar, e.g., \( \frac{1}{2} LF353 \)
Measurement of Loop Parameters

- Experimentally determine natural frequency $\omega_n$ and damping $\zeta$

Measure peak ampl. or RMS ampl. of applied FM

Observe mod. freq. $\Omega = 2\pi \times f$

Set FM Parameters $\Delta f_s = \text{peak dev.}$  
$\nu = \text{mod. freq.}$
Response to a Frequency Step Input

\[ e(t) \frac{K_v}{\Delta f_s} \]

\[ \zeta = \frac{1}{4} \]
\[ \zeta = \frac{1}{2} \]
\[ \zeta = \frac{1}{\sqrt{2}} \]
\[ \zeta = 1 \]
\[ \zeta = 2 \]

Normalized Time \( t\omega_n \)
2nd-Order PLL as a Discriminator

\[ \theta(t) = m_s \sin[\Omega_s t + \theta_s] \]

\[ \hat{\theta}(t) = \frac{K_v}{s} \]

\[ u(t) = m_u \sin[\Omega_s t + \theta_u] \]

\[ |H(j\Omega)| \text{ dB} \]

No peaking

-3 dB

10 kHz

\[ |H(j\Omega)G(j\Omega)| \text{ dB} \]