Linear Op Amps: Quick Checks for Oscillations

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Prerequisites

Electrical characterization: Stability

- Following prerequisites are recommended prior to proceeding though the handbook

Prerequisites:

TI-Precision Labs (TIPL) courses:

TIPL - Op Amps: Stability

ti.com/op-amps-stability-training

Pocket reference:

Training: Analog Engineer's Pocket Reference

ti.com/analogrefguide

Application handbook:

A-B-A: Board Level Troubleshooting

ti.com/board-level-troubleshooting

Simulation tools:

Simulations are presented within the handbook. It is recommended to install TINA-TI

TINA-TI can be downloaded for free on ti.com: ti.com/tina-ti

Detecting oscillations using OPA846

Overview:

- Detecting oscillations for a linear amplifier can be challenging.
- Three different techniques will be covered to measure oscillations:
  - Supply Current (Quiescent Current)
  - Output waveform via oscilloscope
  - Antenna method
- The OPA846 has been configured to a low gain amplifier.
  - The datasheet defines that the device is stable for gains > 7.

Bench setup:

- TINA-TI simulation can be used to simulate oscillation behavior.
- Representative image of how the EVM is configured, adding to oscillation effect
  - Low gain set by feedback loop
  - Capacitor attached to the output / inverting input pin

http://www.ti.com/lit/ds/symlink/opa846.pdf

FEATURES

- HIGH BANDWIDTH: 400MHz (G = +10)
- LOW INPUT VOLTAGE NOISE: 1.2nV/√Hz
- VERY LOW DISTORTION: –100dBc (5MHz)
- HIGH SLEW RATE: 625V/µs
- HIGH DC ACCURACY: V_{IO} ±150µV
- LOW SUPPLY CURRENT: 12.6mA
- HIGH GAIN BANDWIDTH PRODUCT: 1750MHz
- STABLE FOR GAINS ≥ 7

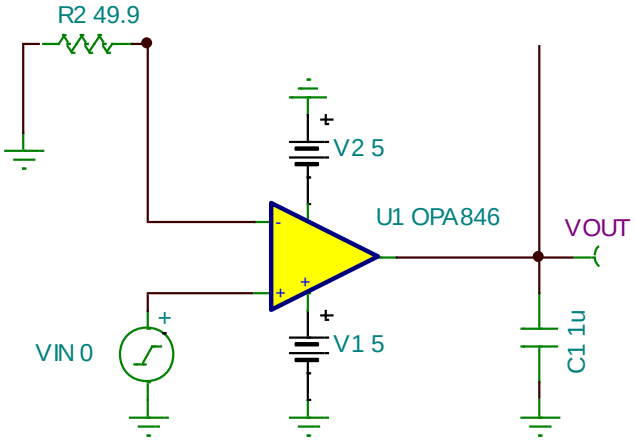

Figure: Representative circuit diagram created in TINA-TI.

Detecting oscillations

Test #1: Supply Current (IQ)

- Measuring a high supply current (or quiescent current) can be an indicator of oscillations.
  - High supply current can be a symptom of oscillations. Not all oscillating parts will have a high supply current.
- This can be measured by connecting the multimeter in series to the supply pin.

PARAMETER	CONDITIONS	OPA846ID, IDBV						
		TYP	MIN/MAX OVER TEMPERATURE					
		+25°C	+25°C[1]	0°C to 70°C[2]	–40°C to +85°C[2]	UNITS	MIN/ MAX	TEST LEVEL[3]
POWER SUPPLY								
Specified Operating Voltage		±5				V	typ	C
Maximum Operating Voltage			**±6**	±6	±6	V	max	A
Maximum Quiescent Current	V_S = ±5V	12.6	**12.9**	13.0	13.2	mA	max	A
Minimum Quiescent Current	V_S = ±5V	12.6	**12.3**	12.1	11.8	mA	min	A
Power-Supply Rejection Ratio (–PSRR)	$–V_S$ = –4.5 to –5.5 (Input Referred)	95	**90**	88	85	dB	min	A

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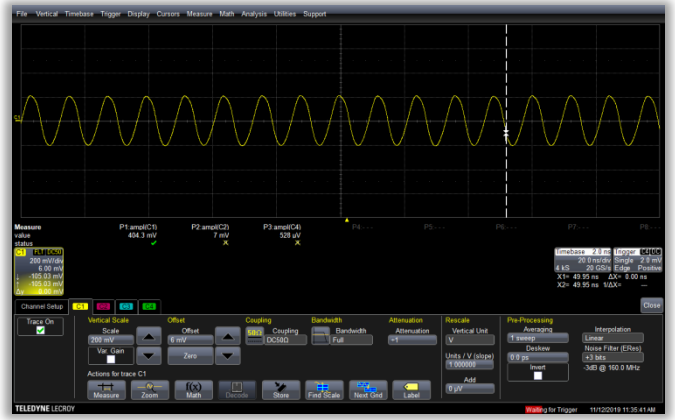
Detecting oscillations

Test #2: Output Waveform

- Oscillations can be observed by monitoring the output waveform on an oscilloscope.
  - Oscilloscope bandwidth should match or be greater than the bandwidth of the TI device.
  - **Example:** OPA846
    - Since the part is operating in the non-linear region, the waveform shape and frequency will vary.
- No input signal is needed in this case as the oscillations are high magnitude.
  - If there are low-level oscillations present, a spectrum analyzer would be needed.



Test #3: Antenna Method

- If the output signal is not readily accessible, a loop antenna connected to an oscilloscope can be used.
- Current is induced in the coil by the magnetic field created by the output oscillations.
  - This waveform can be then seen on the oscilloscope.