APPLICATION NOTE

Trek Amplifiers

Driving Capacitive Loads with Trek Amplifiers

Introduction

In applications which involve driving capacitive loads, the useful bandwidth of the amplifier is often limited by the peak output current capability of the amplifier rather than the amplifier's AC gain bandwidth characteristics. Engineers at Trek have designed many amplifiers with various voltage and current levels which can be used to drive capacitive loads. The table on page 2 lists selected Trek Amplifiers with their voltage and current ranges. The internal capacitance [C int] of each amplifier is in the [C int] column also included on the table. To determine which Trek model amplifier is most suitable for your application:

1. Substitute the peak-to-peak voltage [Vp-p] in Volts that will be applied to your load into the appropriate equation for driving capacitive loads with sine, triangle, or square waves. Use the table on page 2 to make the initial selection of the Trek amplifier with the appropriate voltage characteristics.

2. Select the internal capacitance value for the selected Trek amplifier from the C int [pF (picofarad = 10^{-12} F)] column and substitute the value into the [C int] variable of the equation.

3. Add the capacitive value in Farads of your load [C load] into the equation.

4. Add the desired frequency [f] in Hertz or square wave slope [dV/dt] of the output waveform into the equation.

5. Solve for the peak current [Ipeak] required of the amplifier.

If the calculated peak current is equal to or less than the peak current range of the amplifier, the Trek amplifier will not be bandwidth limited due to output current limitations. For example, if the calculated peak current is equal to or less than 20 mA, the Model 20/20C will not be bandwidth limited due to output current limitations. Please refer to the following diagrams and formulas for assistance, or contact Trek for technical guidance:

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Driving Capacitive Loads with Sine Waves

Ipeak = [C load + C int] · π · f · Vp-p

where:

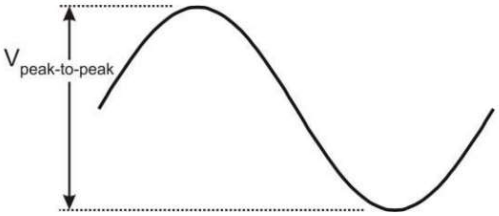
I = the peak current required of the amplifier

C load = the load capacitance (include the load cabling capacitance)

C int = the internal output capacitance of the amplifier

f = the maximum output frequency

Vp-p = the peak -to-peak voltage at the output.



Driving Capacitive Loads with Triangle Waves

Ipeak = [C load + C int] · 2 · f · Vp-p

where:

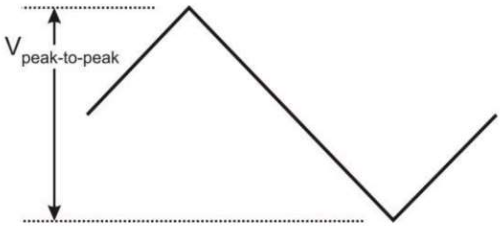
I = the peak current required of the amplifier

C load = the load capacitance (include the load cabling capacitance)

C int = the internal output capacitance of the amplifier

f = the maximum output frequency

Vp-p = the peak -to-peak voltage at the output.



Driving Capacitive Loads with Square Waves

Ipeak = [C load + C int] · dV/dt

where:

I = the peak current needed from the amplifier

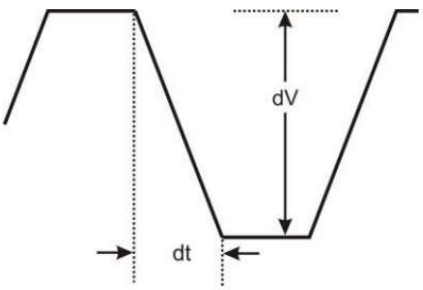
C load = the load capacitance (include the load cabling capacitance)

C int = the internal output capacitance of the amplifier

dV = the peak value of the square wave

dt = the rise time required

dV/dt = the slope of the rise/fall time



Driving Capacitive Loads with Trek Amplifiers

Model	Output Voltage (DC or Peak AC)	Internal Capacitance (C int)*	Output Current (DC or Peak AC)
50/12	±50 kV	34 pF	±12 mA
40/15	±40 kV	43 pF	±15 mA
30/20A	±30 kV	50 pF	±20 mA
P0621 P or N	P: 0 to +30 kV N: 0 to -30 kV	57 pF	±20 mA
20/20C	±20 kV	60 pF	±20 mA
20/20C-HS	±20 kV	75 pF	±20 mA DC or±60 mA peak AC for 1 ms
10/40A	±10 kV	60 pF	±40 mA
10/40A-HS	±10 kV	133 pF	±40 mA DC or±120 mA peak AC for 1 ms
PD07016	±10 kV	60 pF	±60 mA DC or±300 mA peak AC for 20 ms
10/10B-HS	±10 kV	55 pF	±10 mA DC or±40 mA peak AC for 1 ms
610E	±10 kV	66 pF	±2 mA
PD05034	±7.5 kV	50 pF	±50 mA DC or±160 mA peak AC for 60 ms
609B-3	±10 kV	66 pF	±2 mA
5/80	±5 kV	70 pF	±80 mA
5/80-HS	±5 kV	160 pF	±80 mA DC or±240 mA peak AC for 1 ms
609E-6	±4 kV	50 pF	±20 mA
PZD2000A	±2 kV	400 pF	±200 mA DC or±400 mA peak AC for 2 ms
623B	±2 kV	50 pF	±40 mA
677B	±2 kV	330 pF	±5 mA
2220	±2 kV	300 pF	±10 mA
2210	±1 kV	300 pF	±20 mA
PZD700A	±700 V +1.4 kV or -1.4 kV	270 pF 135 pF	±100 mA ±50 mA
PZD700A M/S	±700 V +1.4 kV or -1.4 kV	530 pF 270 pF	±200 mA ±100 mA
2205	±500 V	300 pF	±40 mA
601C	±500 V or +1 kV or -1 kV	400 pF	±10 mA DC or ±20 mA peak AC
PZD350A	±350 V +700 V or -700 V	365 pF 230 pF	±300 mA
PZD350A M/S	±350 V +700 V or -700 V	730 pF 460 pF	±300 mA
2100HF	±150 V	150 pF	±300 mA
603	±125 V 0 to +250 V 0 to -250 V	800 pF	±40 mA DC or ±80 mA peak AC

Note*: [pF (pico farad = 10^{-12})]

ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than four decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

Our products enable customer innovation in complex applications for a wide range of industries including semiconductor equipment, industrial, manufacturing, telecommunications, data center computing, and medical. With deep applications know-how and responsive service and support across the globe, we build collaborative partnerships to meet rapid technological developments, propel growth for our customers, and innovate the future of power.

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