

Driving Capacitive Loads

Driving Capacitive Loads with Trek Amplifiers

Also refer to "Choosing the Correct Capacitive Load Amplifier" Application Note

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 [V_{p-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 [I_{peak}] required of the amplifier.

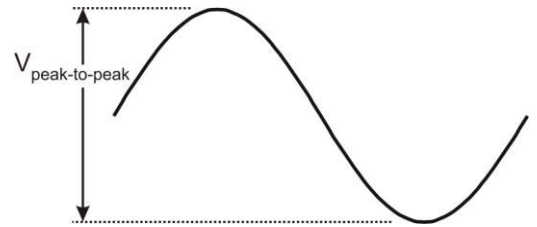
If the calculated peak current is equal to or less than the peak current range of the amplifier, the Trek amplifier will not be bandwidth limited due to output current limitations. For example, if the calculated peak current is equal to or less than 20 mA, the Model 20/20C will not be bandwidth limited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

Driving Capacitive Loads with Sine Waves

$$I_{\text{peak}} = [C_{\text{load}} + C_{\text{int}}] \cdot f \cdot V_{\text{p-p}}$$

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
- V_{p-p} = the peak -to-peak voltage at the output.

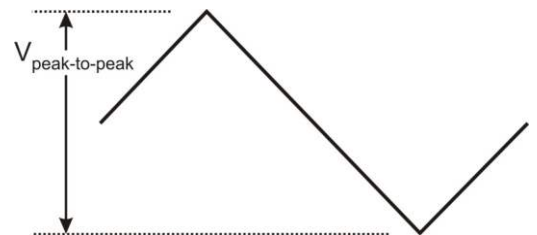


Driving Capacitive Loads with Triangle Waves

$$I_{\text{peak}} = [C_{\text{load}} + C_{\text{int}}] \cdot 2 \cdot f \cdot V_{\text{p-p}}$$

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
- V_{p-p} = the peak -to-peak voltage at the output.

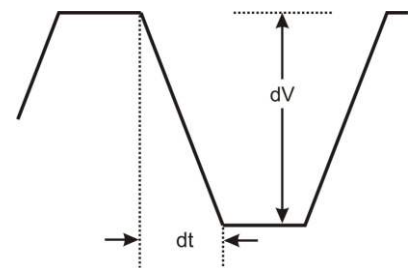


Driving Capacitive Loads with Square Waves

$$I_{\text{peak}} = [C_{\text{load}} + C_{\text{int}}] \cdot dV/dt$$

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



Amplifier Selection Table for Capacitive Load Applications

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	75pF	±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 s
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 s
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	270 pF	±100 mA
	+1.4 kV or -1.4 kV	135 pF	±50 mA
PZD700A M/S	±700 V	530 pF	±200 mA
	+1.4 kV or -1.4 kV	270 pF	±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	365 pF	±200 mA
	+700 V or -700 V	230 pF	±100 mA
PZD350A M/S	±350 V	730 pF	±400 mA
	+700 V or -700 V	460 pF	±200 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

* [pF (pico farad = 10⁻¹²)]



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