

Input & Output Limitations – 2

TIPL 1131

TI Precision Labs – Op Amps

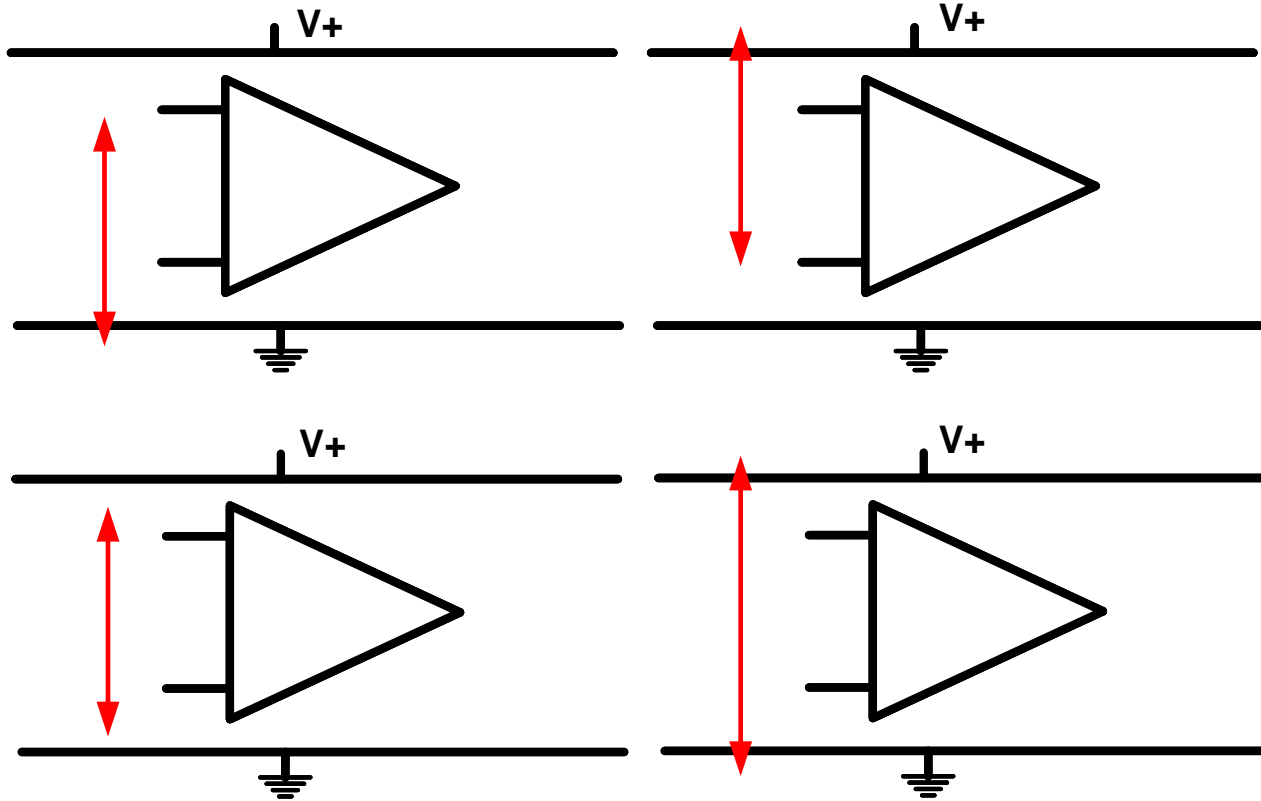
Presented by Ian Williams

Prepared by Art Kay and Ian Williams

Prerequisite: Input & Output Limitations

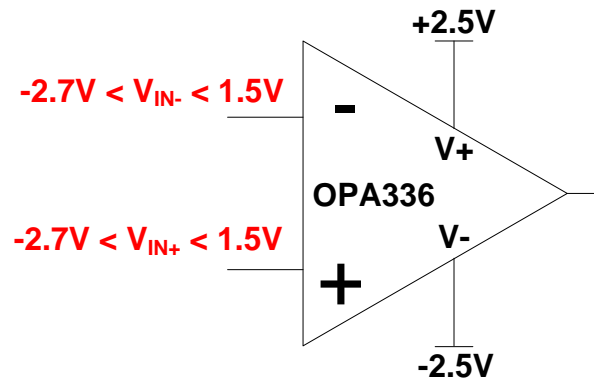
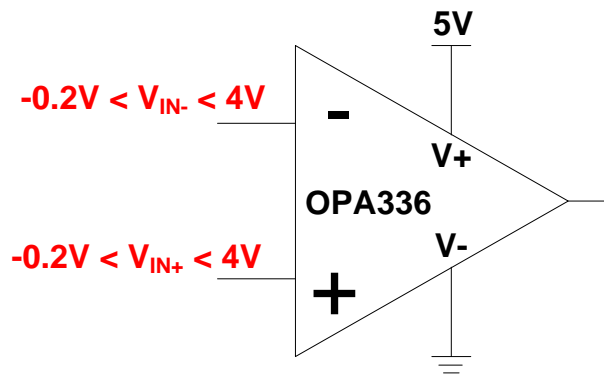
(TIPL 1130)

Real World V_{CM} Range

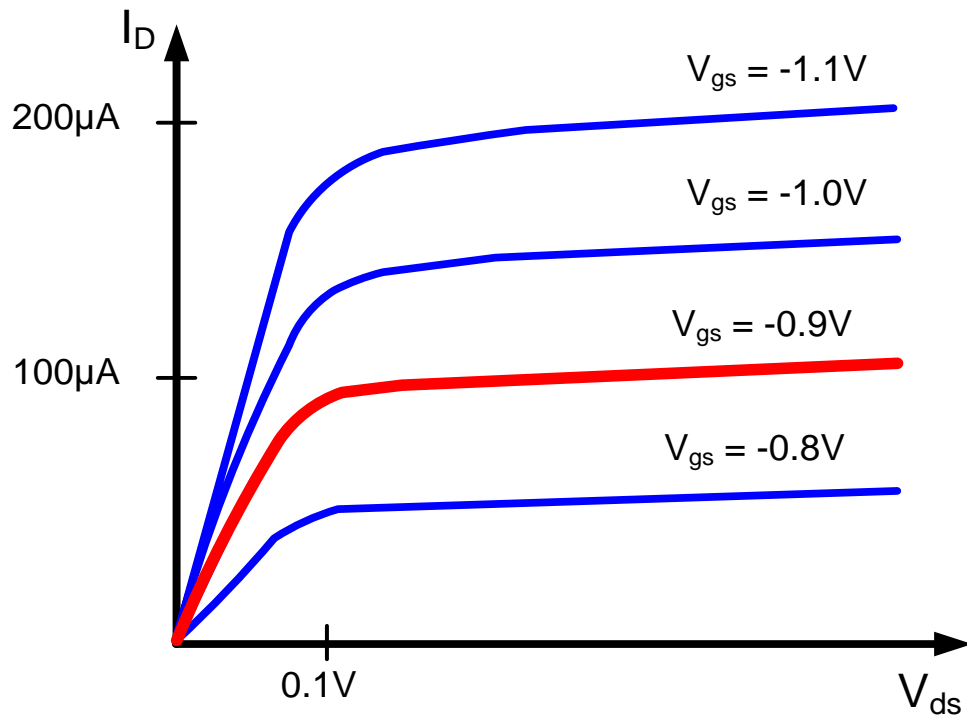
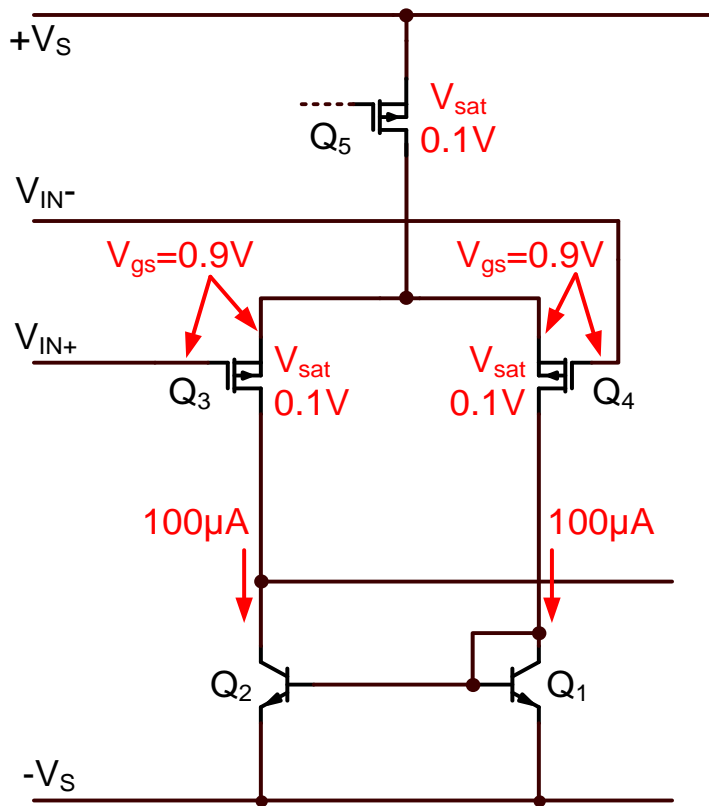


Simple MOSFET Input – V_{CM} to Negative Rail

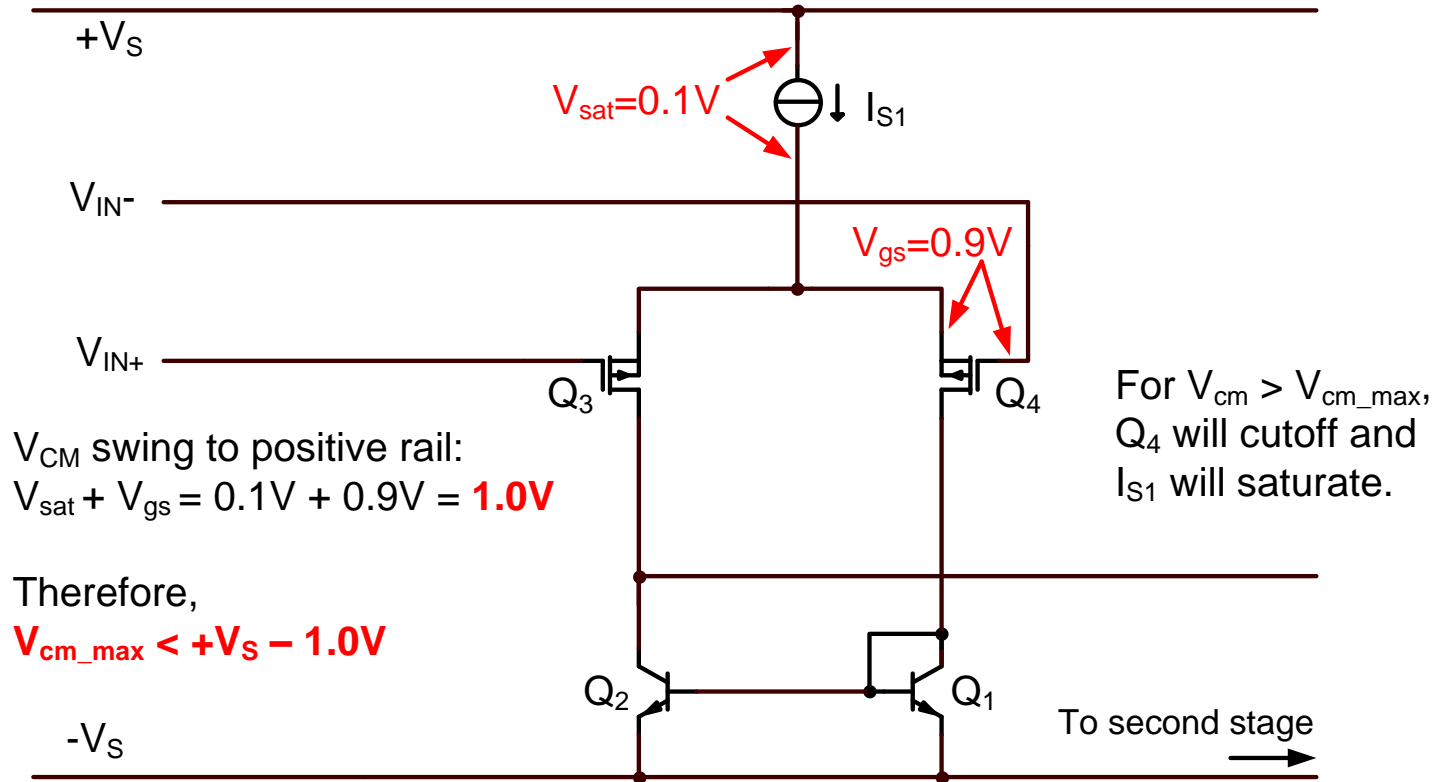
PARAMETER	CONDITION	OPA336N, U OPA2336E, P, U		
		MIN	TYP ⁽¹⁾	MAX
INPUT VOLTAGE RANGE				
Common-Mode Voltage Range	V_{CM}	-0.2		$(V+) - 1$
Common-Mode Rejection Ratio		80	90	
Over Temperature		76		



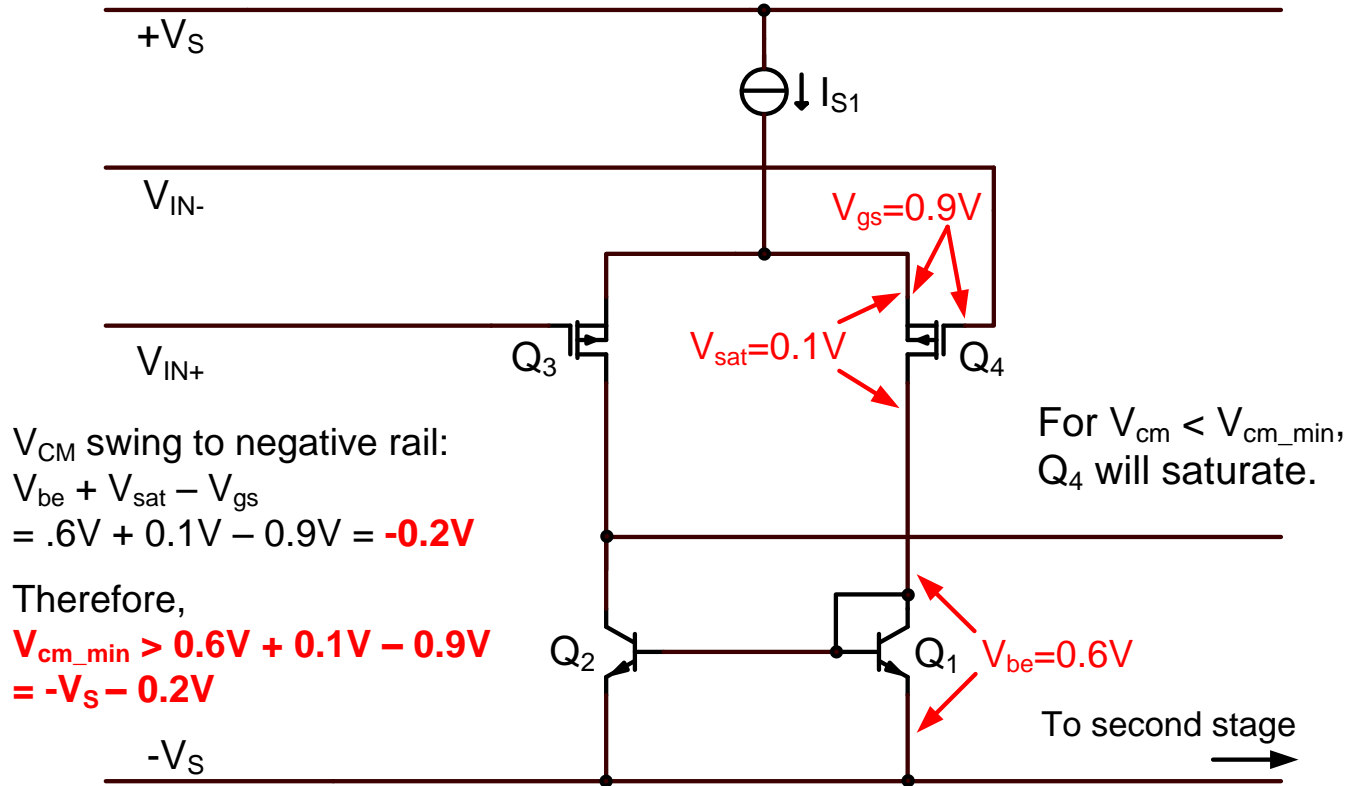
Input Pair Biasing



OPA336 Input Stage – Maximum V_{CM}

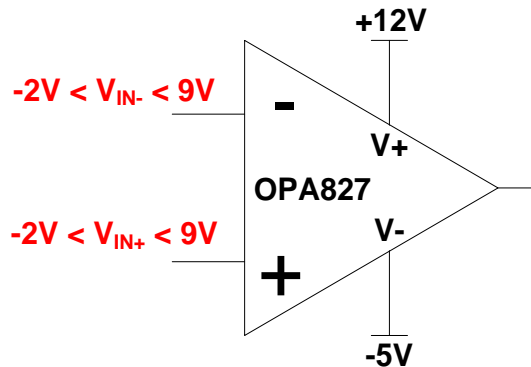


OPA336 Input Stage – Minimum V_{CM}

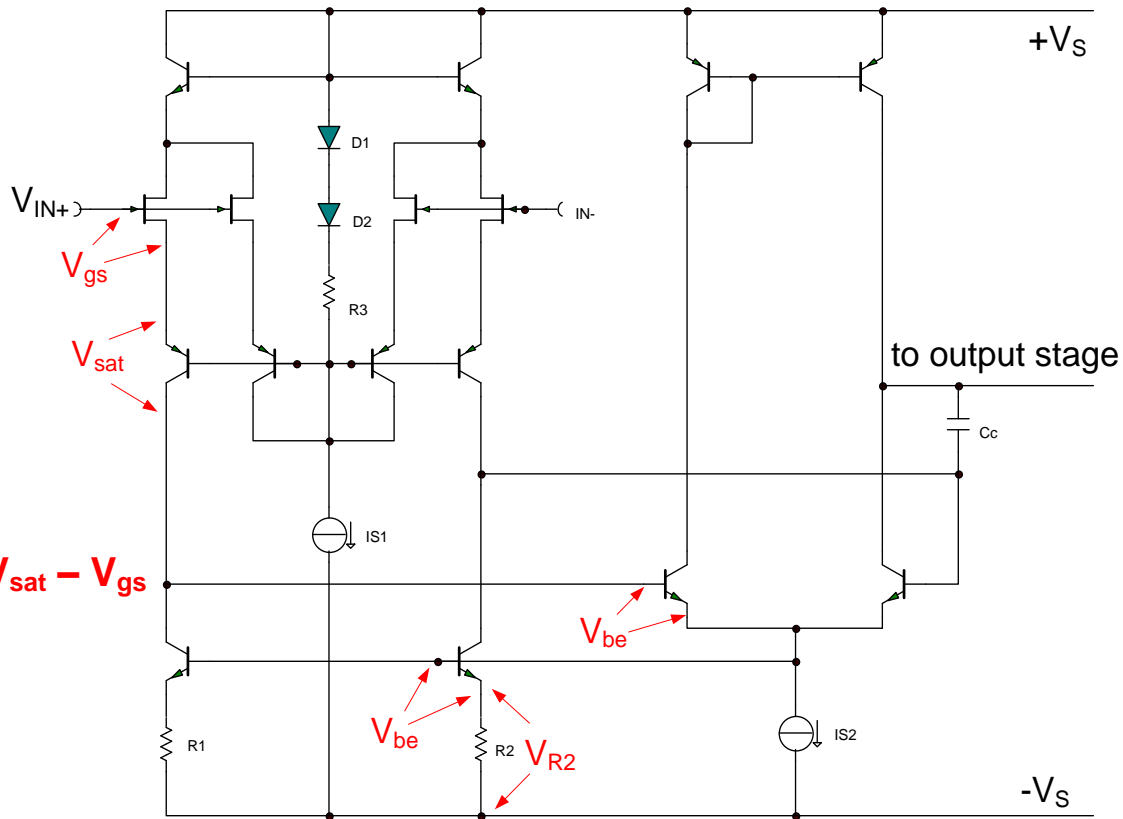


Typical Bipolar or JFET Input – Not Rail-to-Rail

PARAMETER	CONDITIONS	STANDARD GRADE OPA827AI		
		MIN	TYP	MAX
INPUT VOLTAGE RANGE				
Common-Mode Voltage Range	V_{CM}	$(V-)+3$		$(V+)-3$
Common-Mode Rejection Ratio	$(V-)+3V \leq V_{CM} \leq (V+)-3V, V_S < 10V$	104	114	
	$(V-)+3V \leq V_{CM} \leq (V+)-3V, V_S \geq 10V$	114	126	
Over Temperature	$(V-)+3V \leq V_{CM} \leq (V+)-3V, V_S < 10V$	100		
	$(V-)+3V \leq V_{CM} \leq (V+)-3V, V_S \geq 10V$	110		



OPA827 Input Stage – Minimum V_{CM}



V_{CM} swing to negative rail:

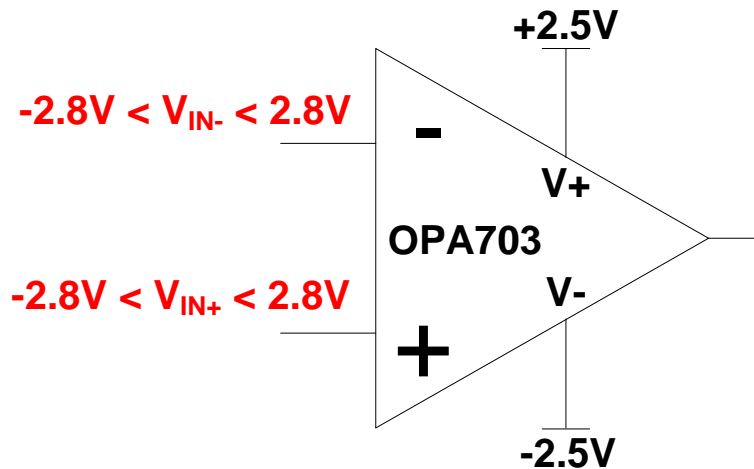
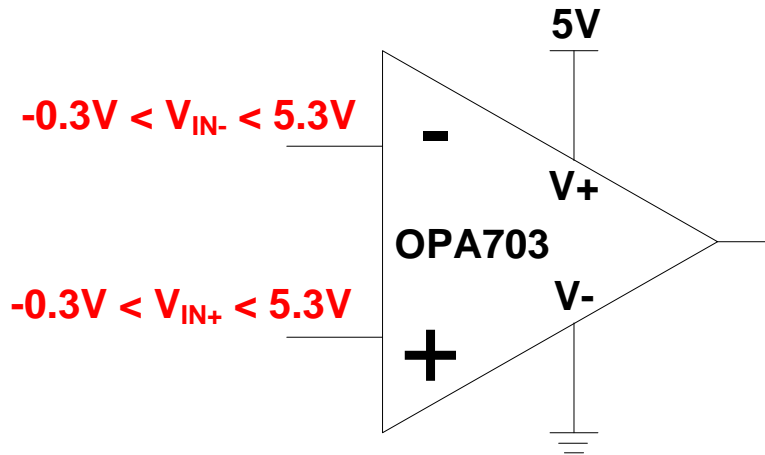
$$V_{CM} > -V_S + V_{R2} + 2V_{be} + V_{sat} - V_{gs}$$

Therefore,

$$-V_S + 3V < V_{CM} < +V_S - 3V$$

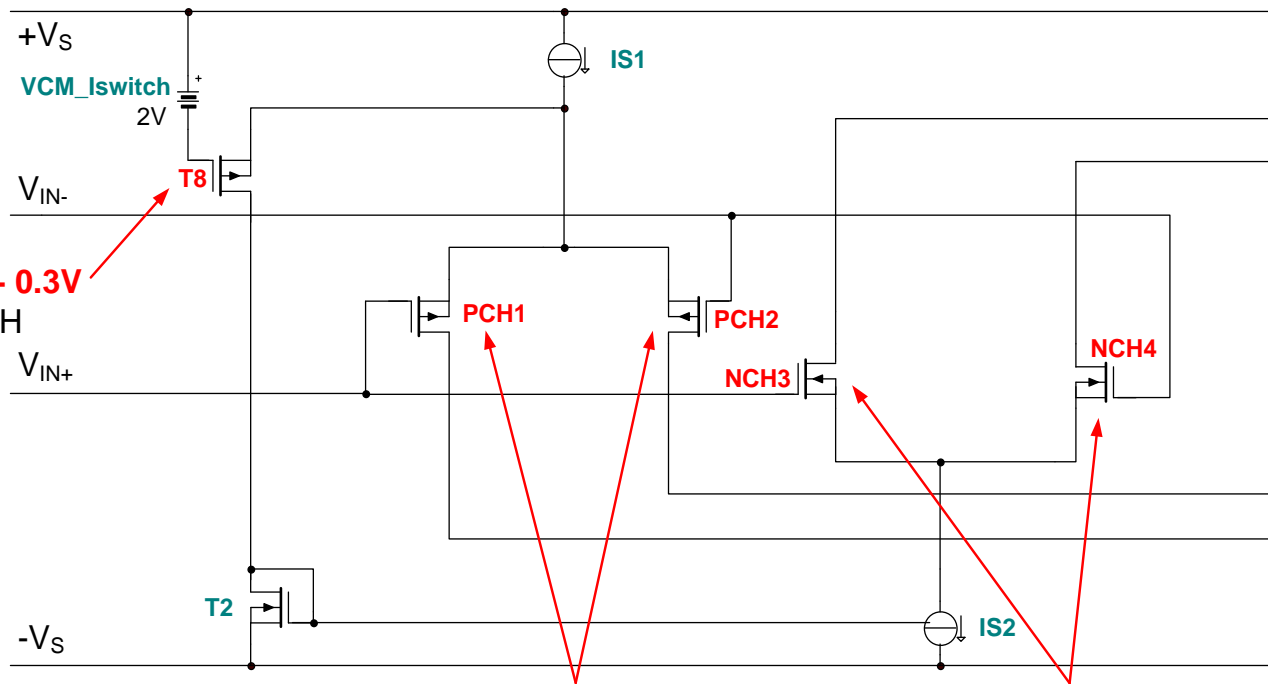
MOSFET Complementary N-P-FET – Rail-to-Rail

PARAMETER	CONDITION	OPA703NA, UA, PA OPA2703EA, UA, PA OPA4703EA, UA			UNITS
		MIN	TYP	MAX	
INPUT VOLTAGE RANGE					
Common-Mode Voltage Range	V_{CM}	$(V-) - 0.3$		$(V+) + 0.3$	V
Common-Mode Rejection Ratio over Temperature	CMRR	$V_S = \pm 5V, (V-) - 0.3V < V_{CM} < (V+) + 0.3V$ $V_S = \pm 5V, (V-) < V_{CM} < (V+)$	70 68	90	dB dB
over Temperature		$V_S = \pm 5V, (V-) - 0.3V < V_{CM} < (V+) - 2V$ $V_S = \pm 5V, (V-) < V_{CM} < (V+) - 2V$	80 74	96	dB dB



OPA703 Input Stage – Simplified Schematic

Turns on when
 $+V_S - 2V < V_{CM} < +V_S + 0.3V$
Steals current from PCH

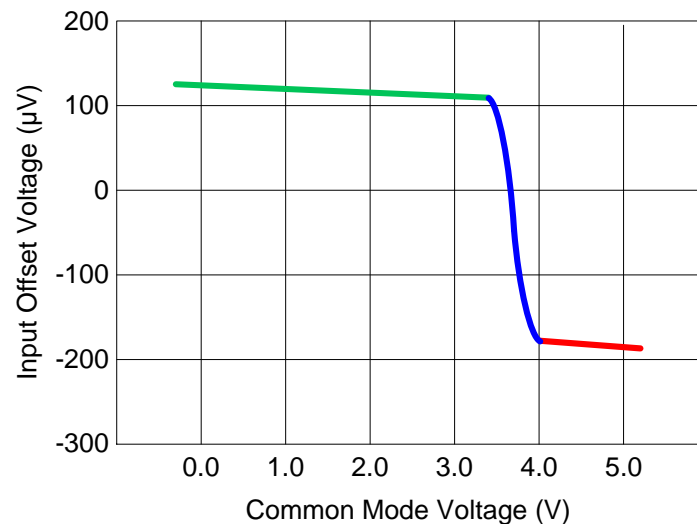
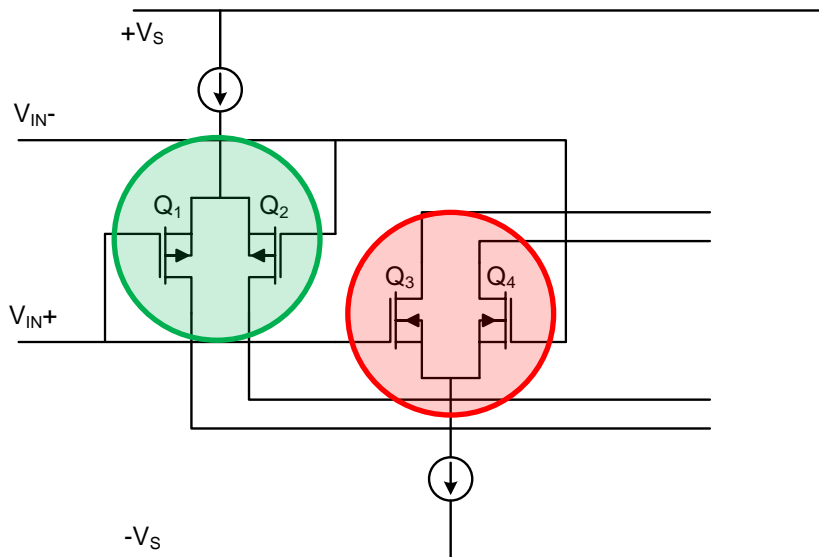


PCH input pair active for:
 $-V_S - 0.3V < V_{CM} < +V_S - 2V$

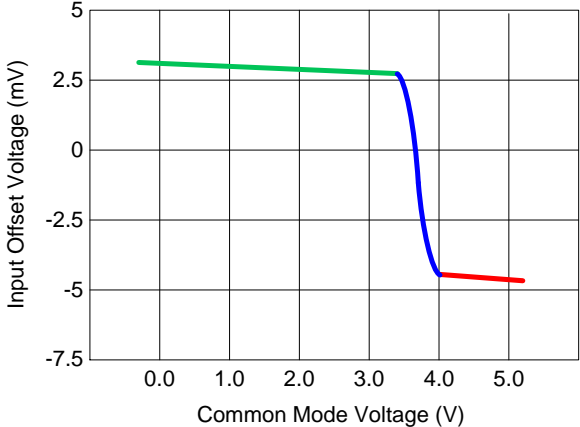
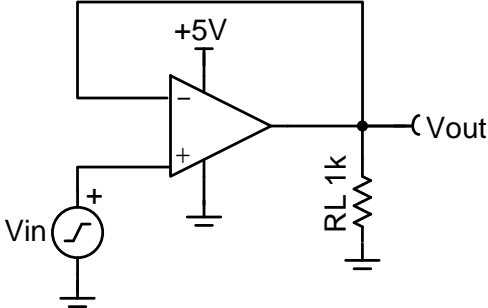
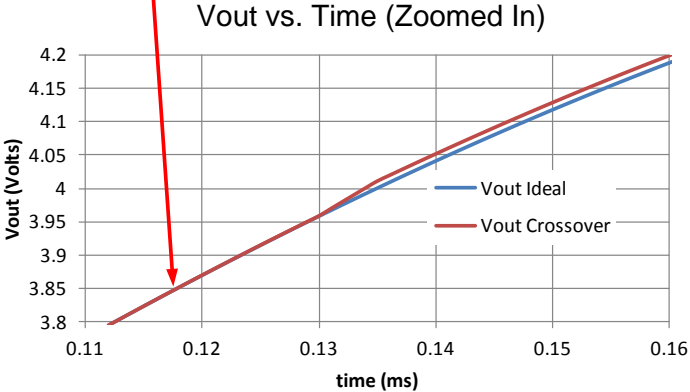
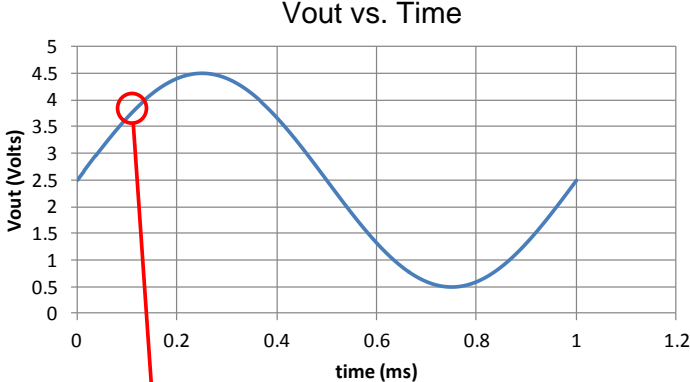
NCH input pair active for:
 $+V_S - 2V < V_{CM} < +V_S + 0.3V$

OPA703 Complementary CMOS – Rail-to-Rail

PARAMETER	CONDITION	MIN	TYP	MAX	UNITS
INPUT VOLTAGE RANGE					
Common-Mode Voltage Range	V_{CM}	$(V-) - 0.3$		$(V+) + 0.3$	V
Common-Mode Rejection Ratio	$CMRR$	$V_S = \pm 5V, (V-) - 0.3V < V_{CM} < (V+) + 0.3V$	70	90	dB
over Temperature		$V_S = \pm 5V, (V-) < V_{CM} < (V+)$	68		dB
		$V_S = \pm 5V, (V-) - 0.3V < V_{CM} < (V+) - 2V$	80	96	dB
over Temperature		$V_S = \pm 5V, (V-) < V_{CM} < (V+) - 2V$	74		dB

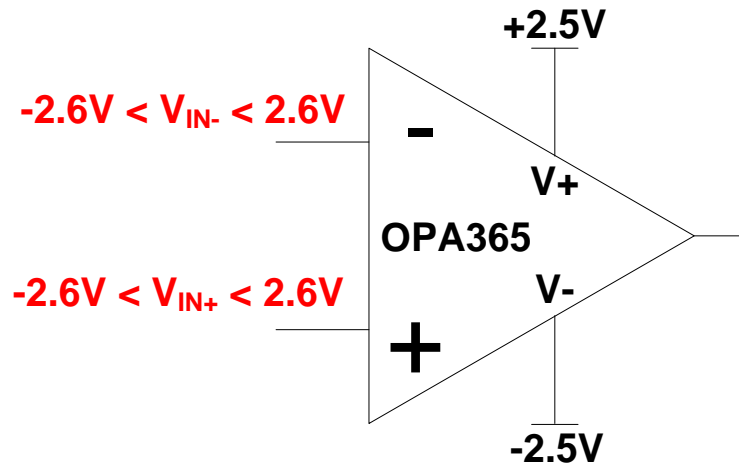
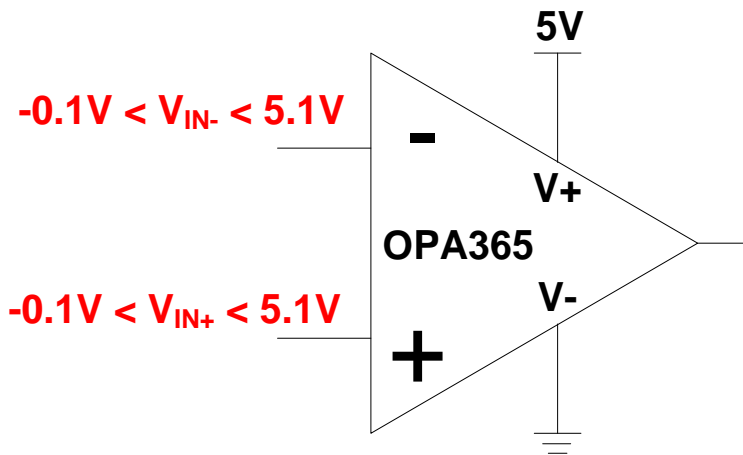


Crossover Distortion

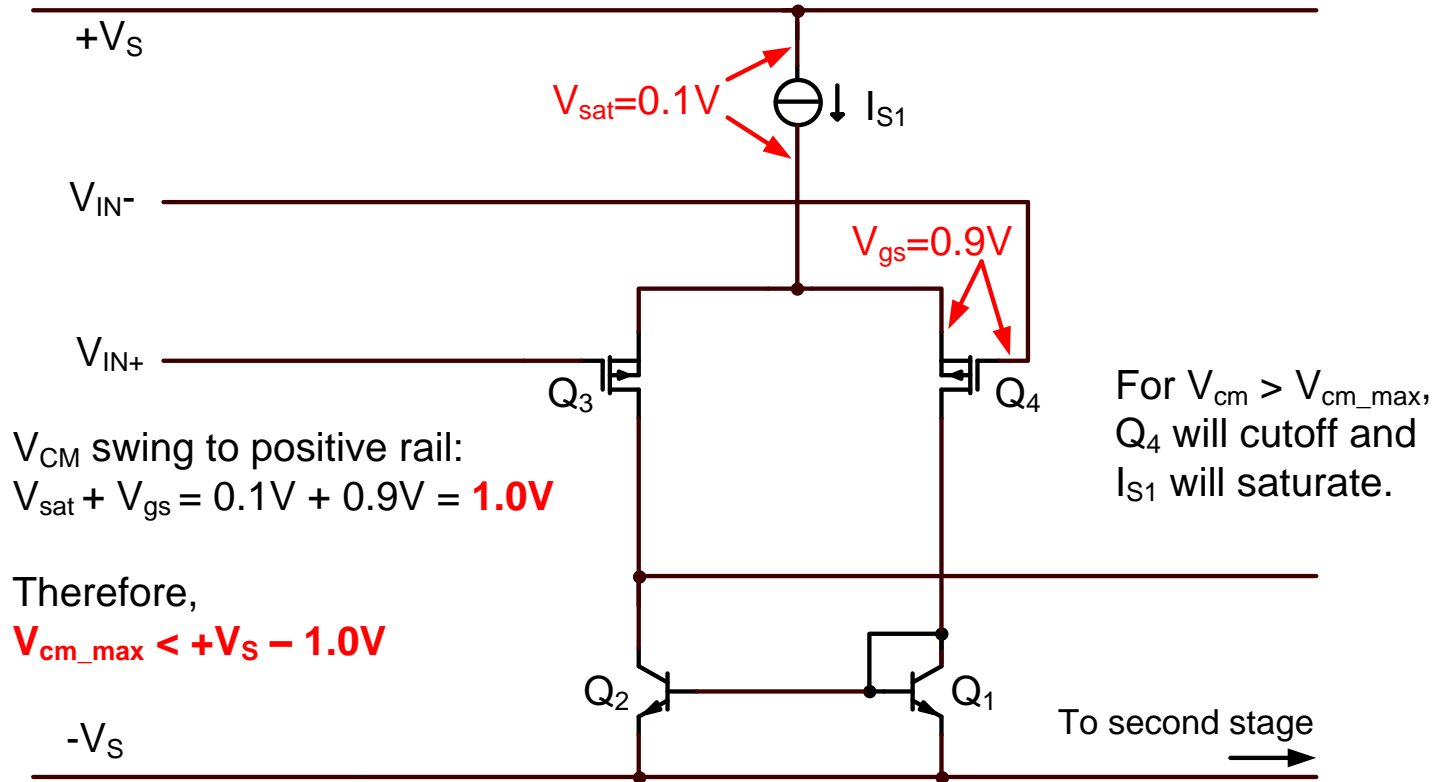


MOSFET Charge Pump – Rail-to-Rail

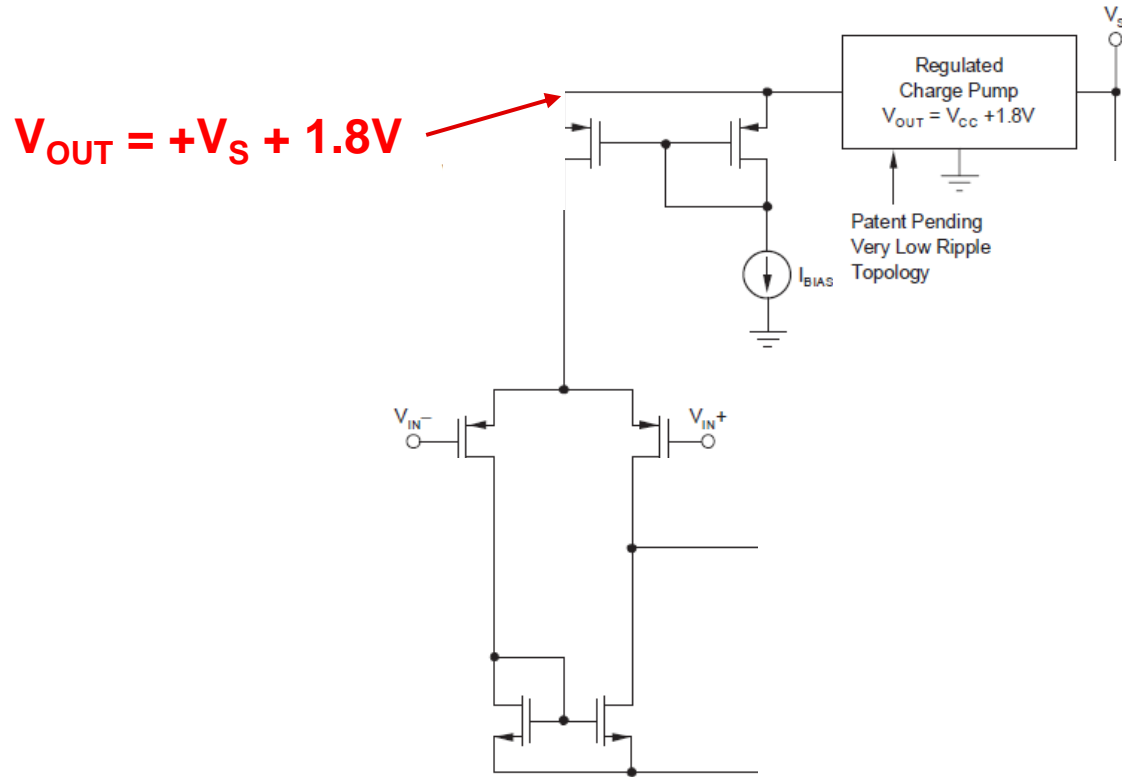
PARAMETER	TEST CONDITIONS	OPAx365			UNIT
		MIN	TYP	MAX	
INPUT VOLTAGE RANGE					
Common-Mode Voltage Range	V_{CM}	$(V-) - 0.1$		$(V+) + 0.1$	V
Common-Mode Rejection Ratio	$(V-) - 0.1V \leq V_{CM} \leq (V+) + 0.1V$	100	120		dB



Remember from Earlier in the Presentation...

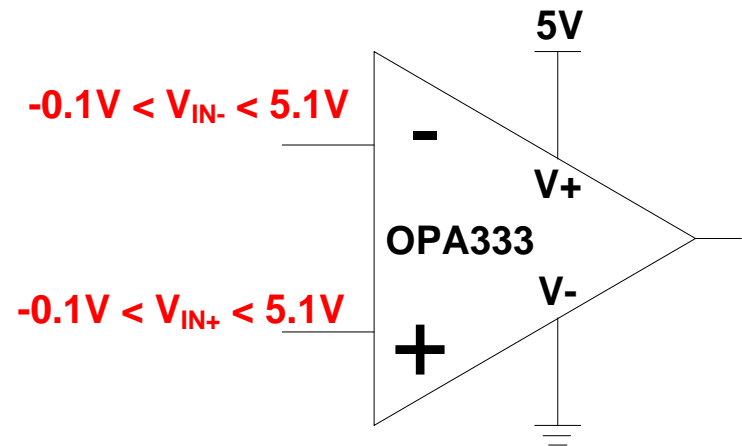
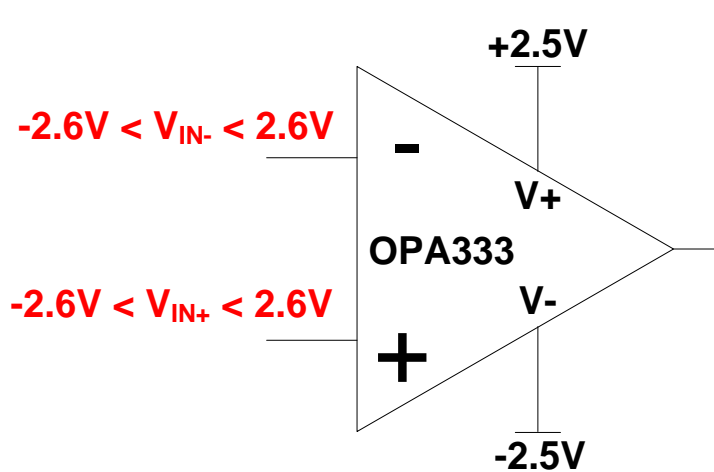


OPA365 MOSFET Charge Pump – Rail-to-Rail

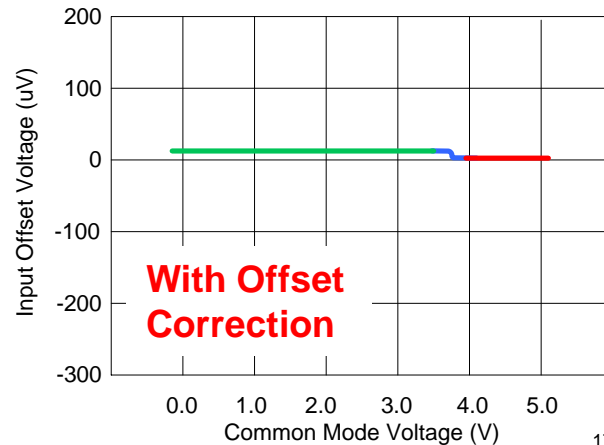
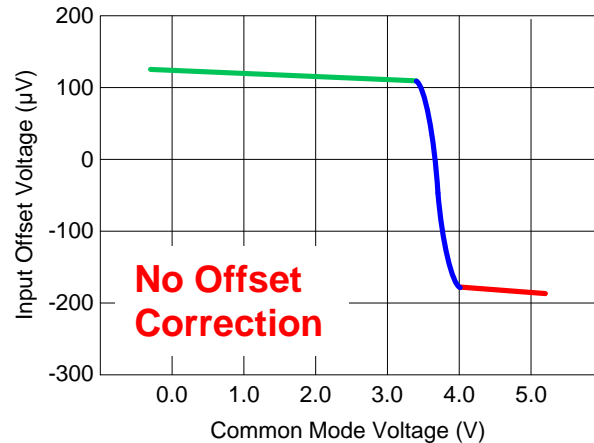
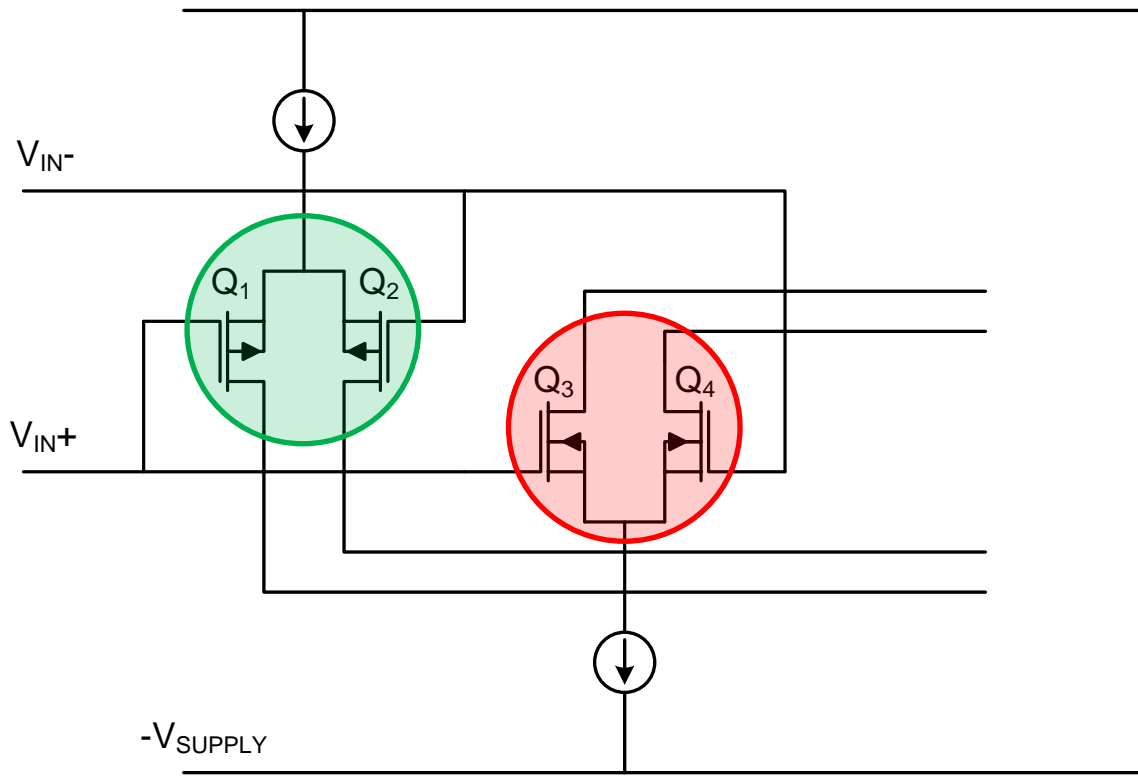


Zero Drift MOSFET – Rail-to-Rail

PARAMETER	TEST CONDITIONS	OPA333, OPA2333			UNIT
		MIN	TYP	MAX	
INPUT VOLTAGE RANGE					
Common-Mode Voltage Range	V_{CM}	$(V-) - 0.1$		$(V+) + 0.1$	V
Common-Mode Rejection Ratio	$CMRR$	$(V-) - 0.1V < V_{CM} < (V+) + 0.1V$	106	130	dB



Zero Drift MOSFET – Rail-to-Rail



Thanks for your time!
Please try the quiz.