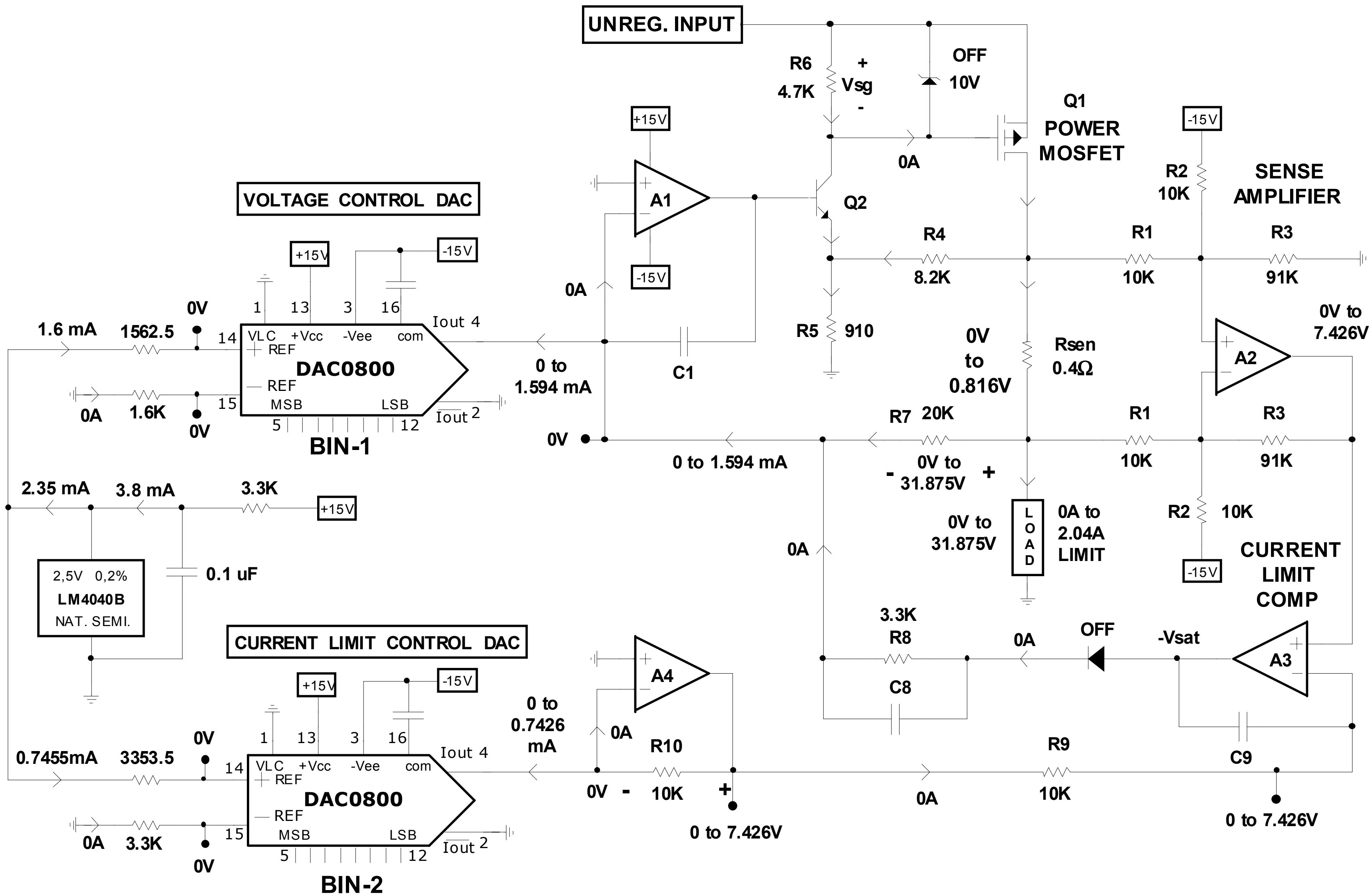
EXAMPLE 7 PROGRAMMABLE POWER SUPPLY ANALYSIS



SENSE AMPLIFIER: Amplifies sense voltage ($I_L R_{sen}$) by gain R_3/R_1 and produces V_{o2} that provides indication of load current. R_2 does not affect gain but attenuates the high input voltages within the input voltage renge of A2. Matching of R_1, R_2 and R_3 resistor pairs is extremely critical to the accuracy of the current limit. Matching should be such that accuracy of I_{limit} is within ½ LSB.

POWER MOSFET: Provides heavy load current that op amps cannot supply. As load current increases, the small differential input of A1 increases – which means (V_1^+- V_1^-) gfoes up – V_{o1} increases, V_{E2} of Q2 increases, I_{E3}~I_{C3} also increases, which ultimately increases $V_{SG1}=I_{C3}R_6$ and tells the MOSFET to increase its drain and source currents thereby supplying the load current.

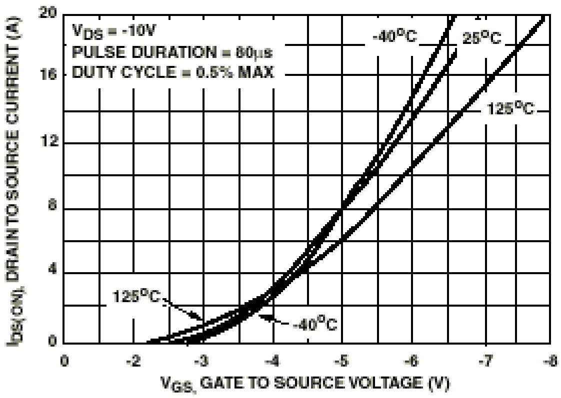
R_4 – R_5 : attenuates voltage $V_{D1} = V_{out}+I_L R_{sen}$ to a low enough level such that $V_{o1} = V_{E2} + 0.7$ does not saturate the output of A1 under worst case conditions. $V_{E2} = V_{D1}\frac{R_5}{R_4+R_5} + I_{E2}\left(R_4 \| R_5\right)$ where $I_{E2} = V_{SG1}/R_6$. V_{E2} will be maximum when V_{D1} is maximum and I_{E2} is also maximum. This will occur at V_{out} max and I_L max. V_{SG1} max can be obtained from the MOSFET characteristics (I_D versus V_{GS}).

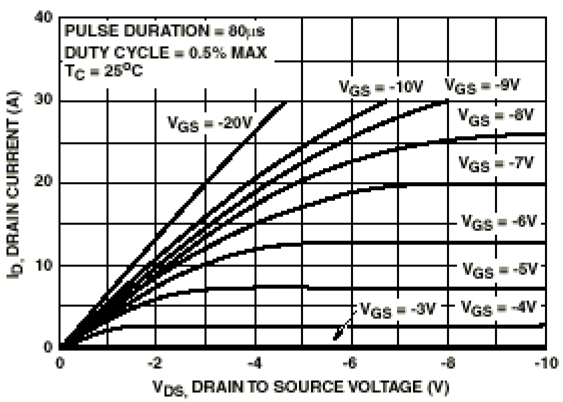
CURRENT LIMIT: Normally there is no current limiting if there is no overload . An overload condition can be detected by A3 which acts as a voltage comparator looking at $V_3^+= V_{o2} = I_L R_{sen} A_{sen}$ and $V_3^- = V_{o4} = V_{DAC2}$. As long as $V_3^+ < V_3^-$, V_{o3} goes into –ve saturation and turns off the diode which keeps the current limit loop open and ineffective. As soon as V_3^+ exceeds V_3^-, V_{o3} goes +ve and turns the diode on which closes the current limit feedback loop and will now force V_3^- to equal V_3^+ and will therefore force $V_{o2} = I_L R_{sen} A_{sen}$ to equal $V_{o4} = I_{DAC2}$*R_{10}.
Therefore I_L will be limited because of –ve feedback through A3 forcing V_{o2} to equal V_{DAC2}=V_{o4}.

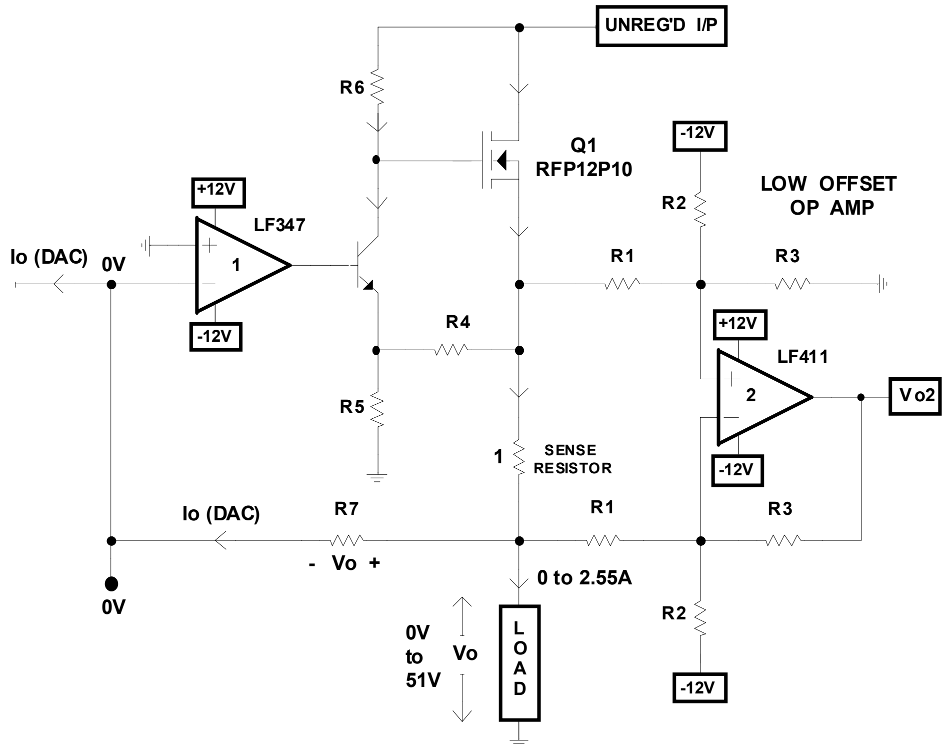
STABILITY OF FEEDBACK LOOPS: C_1, C_8 and C_9 are critical to the stability of the many feedback loops and will dictate the response time of the power supply to sudden changes in load current and voltage.

EXAMPLE-8 DESIGN OF PROGRAMMABLE POWER SUPPLY

MOSFET CHARACTERISTICS







GENERAL SPECIFICATIONS: V_O = 0 to 51V,BIN1 = 0 to 255, ΔV_o = 0,2V, I_{LIMIT} = 0 to 2.55A, BIN2 = 0 to 255, ΔI_L = 10 mA

LF347 DATA (V_{SUP} =±15V)				RFP10P12 DATA			
	MIN	TYP	MAX		MIN	TYP	MAX
V_{out} swing	±12V	±13,5V		$V_{(TH)}$ at 1 mA	-2V		-4V
V_{in} range	±11V	+15V, -12V		$V_{GS\ (MAX)}$			±20V
V_{io} @ 25°C		5 mV	10 mV	$V_{DS\ (MAX)}$			-120V
LF411 DATA (V_{SUP} =±15V)				R_{ON},V_{GS}=-10V		0,5Ω	
V_{out} swing	±12V	±13,5V		C_{iss},V_{DS}=-25V		1,7 nF	
V_{in} range	±11V	+14.5V,-11.5V					
V_{io} @ 25°C		0.8 mV	2 mV				

DESIGN EXAMPLE-9 DIGITAL CONTROL OF AC AND DC COMPONENTS