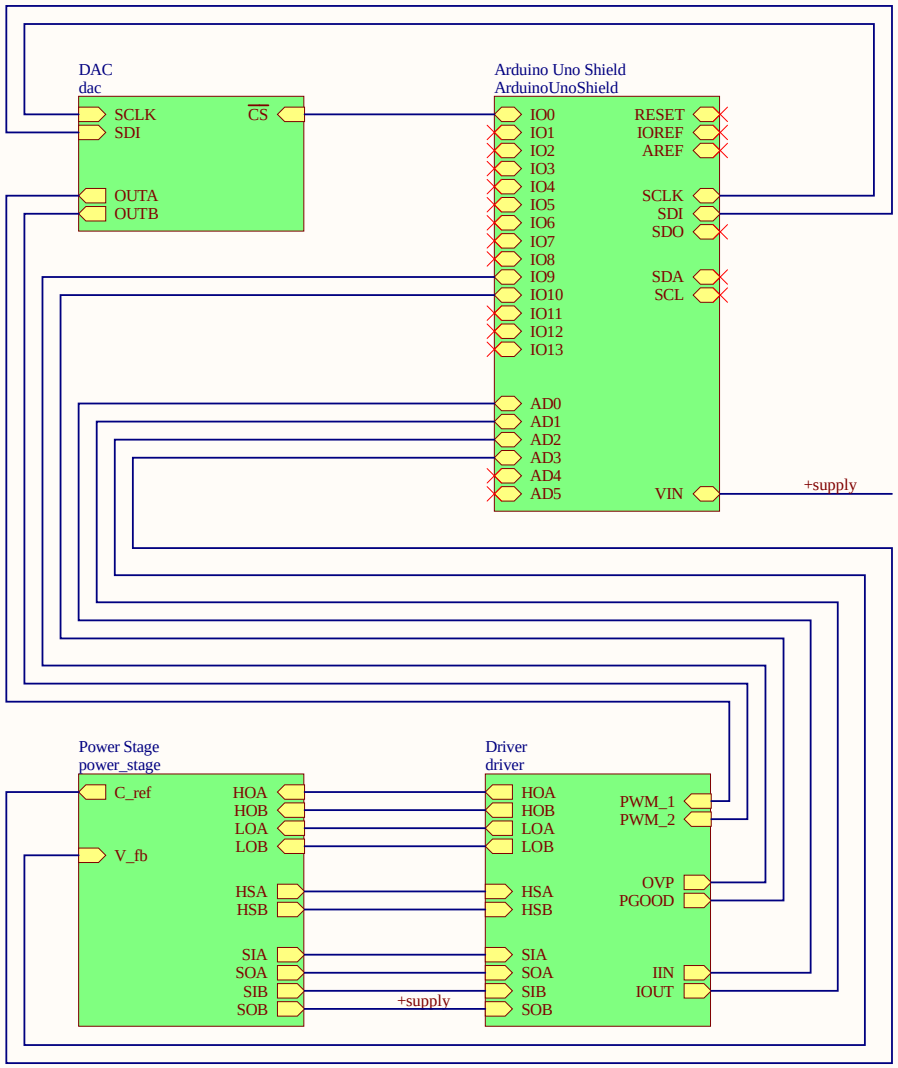
Digital Power

Description:

This sheet shows all the appropriate sub-systems involved in creating a digital-controller for power electronics.

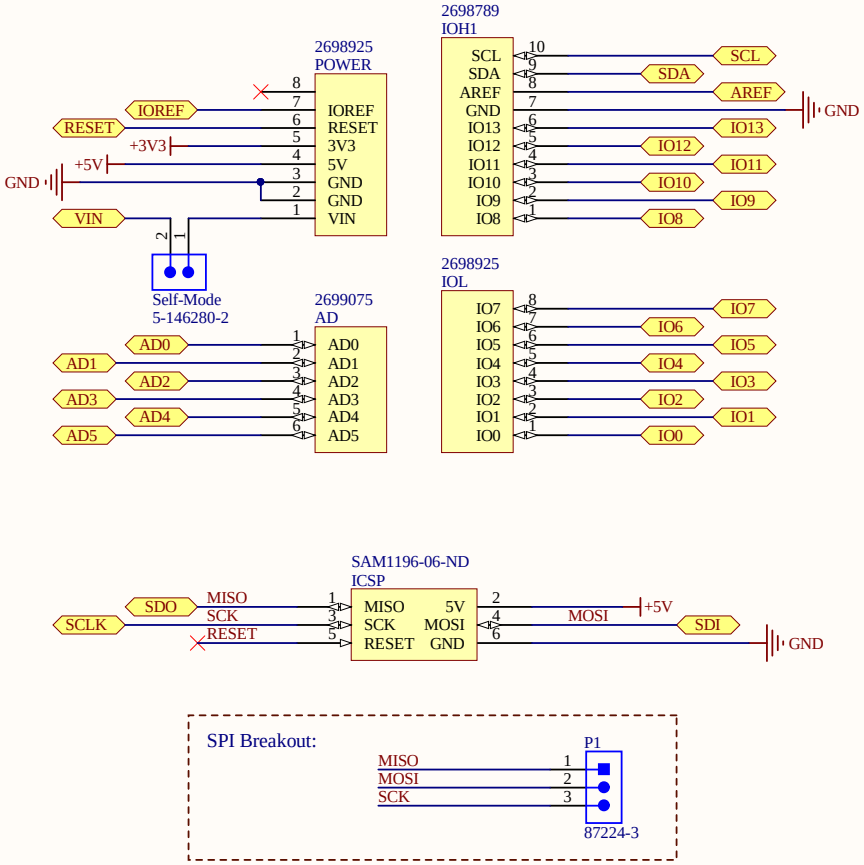


Title	***digital_power.SchDoc***		Omri Nissan - San Luis Obispo California, 93401 United States
Size: A4	Number:2.	Revision:	
Date: 1/25/2020	Time: 11:11:05 AM	Sheet 2 of 8	
File: C:\Users\Public\Documents\Altium\Projects\digital_power\digital_power.SchDoc			

Arduino Uno Shield

Description:

This sheet shows Arduino Uno Sheild connectors and their associated pin name.

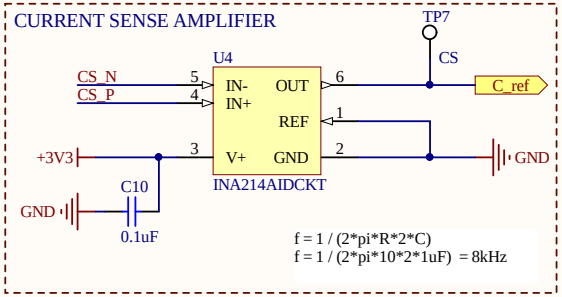


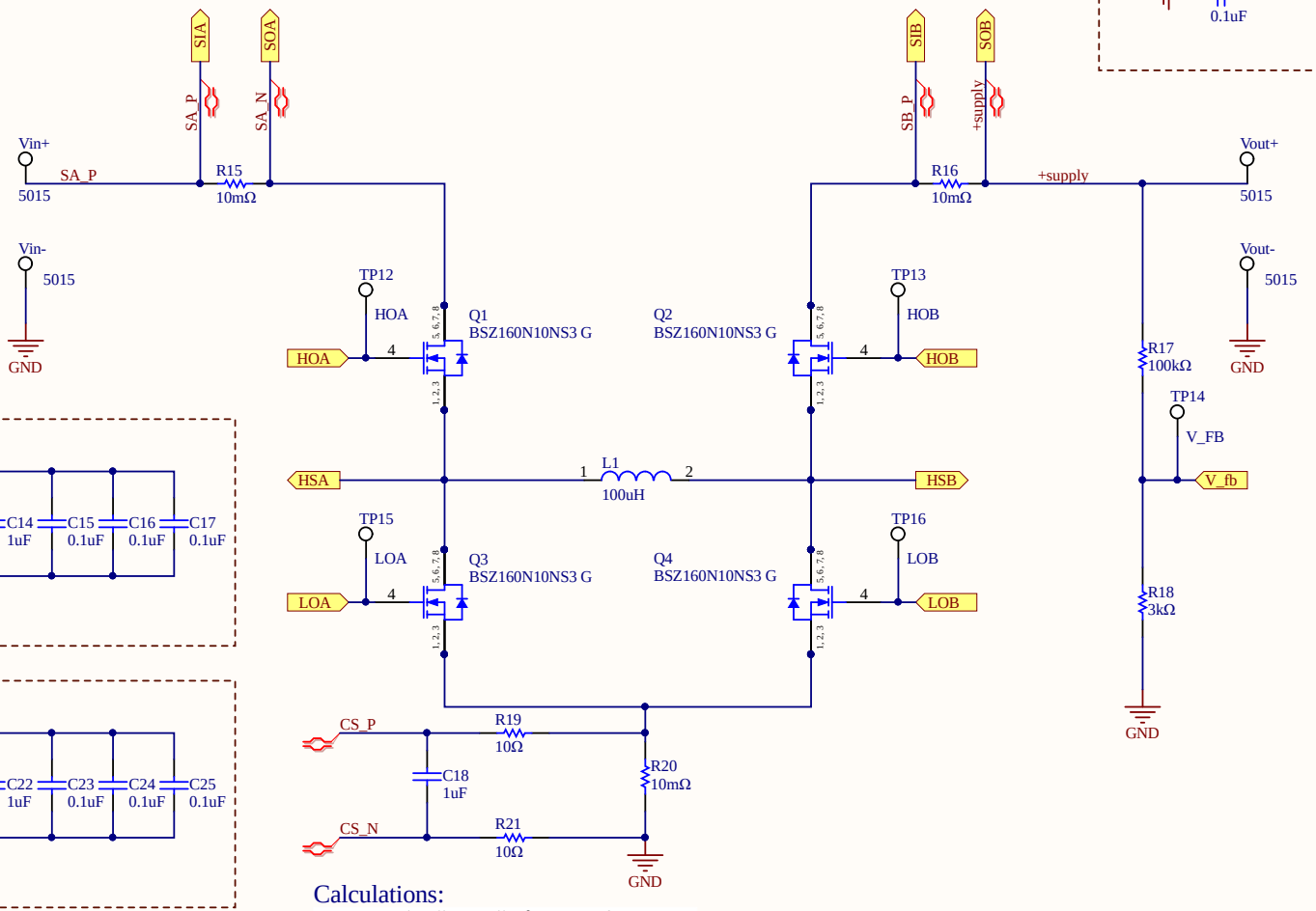
Title	*ArduinoUnoShield.SchDoc*		Omri Nissan - San Luis Obispo California, 93401 United States
Size: A4	Number:3.	Revision:	
Date: 1/25/2020	Time: 11:11:06 AM	Sheet 3 of 8	
File: C:\Users\Public\Documents\Altium\Projects\digital_power\ArduinoUnoShield.SchDoc			

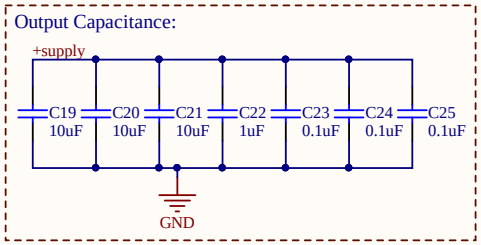
Power Stage

Description:

This sheet shows all the power components (switches and inductors) necessary to create a buck or boost converter.
This sheet also includes the input and output filtering and sense points to create a closed loop system.







Calculations:

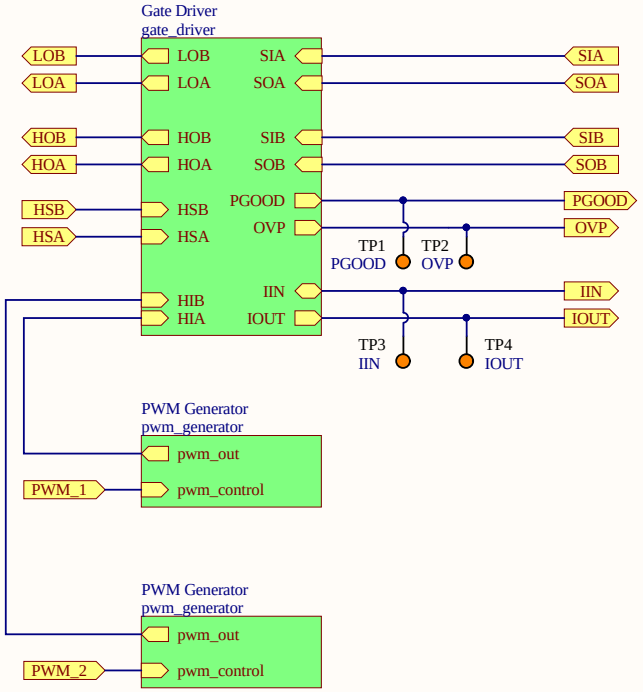
V_out = V_in (R_2/(R_2+R1)), where V_in=10V
V_out = 10V (3kΩ/(3kΩ+100kΩ)) = 0.2913V

Title	***power_stage.SchDoc***		Omri Nissan - San Luis Obispo California, 93401 United States
Size: A4	Number:4.	Revision:	
Date: 1/25/2020	Time: 11:11:06 AM	Sheet 4 of 8	
File: C:\Users\Public\Documents\Altium\Projects\digital_power\power_stage.SchDoc			

Driver

Description:

This sheet shows all the drivers for the power stage. The PWM generators are necessary due to the Arduinos inability to generate high frequency PWM signals. Since the low side switches are the inverted version of the high side switches, only 2 pwm generators are necessary.

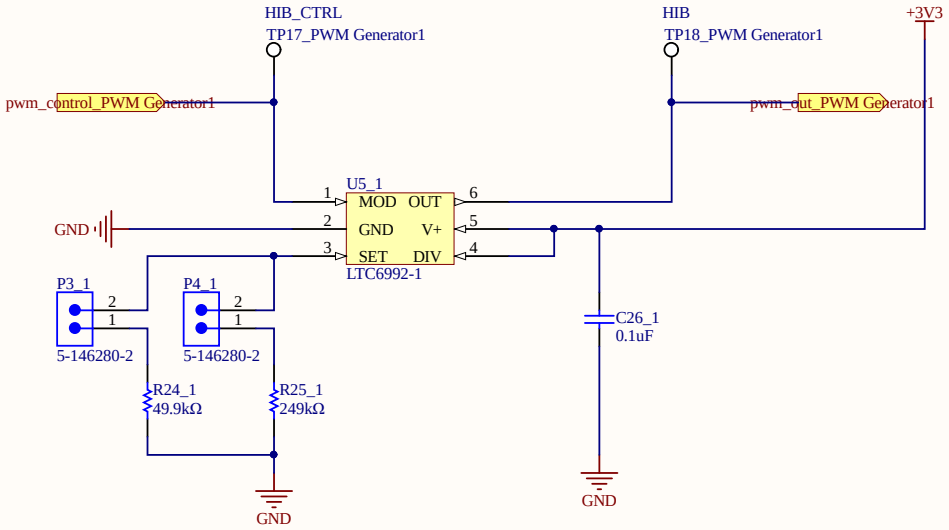


Title	***driver.SchDoc***		Omri Nissan - San Luis Obispo California, 93401 United States
Size: A4	Number:5.	Revision:	
Date: 1/25/2020	Time: 11:11:06 AM	Sheet 5 of 8	
File: C:\Users\Public\Documents\Altium\Projects\digital_power\driver.SchDoc			

PWM Generator

Description:

This sheet shows an analog input 0V-1V that is translated to a PWM duty cycle at higher frequency of choice.
Since the Arduino cannot output high switching frequencies this stage is necessary to drive the MOSFETs.



Calculations:

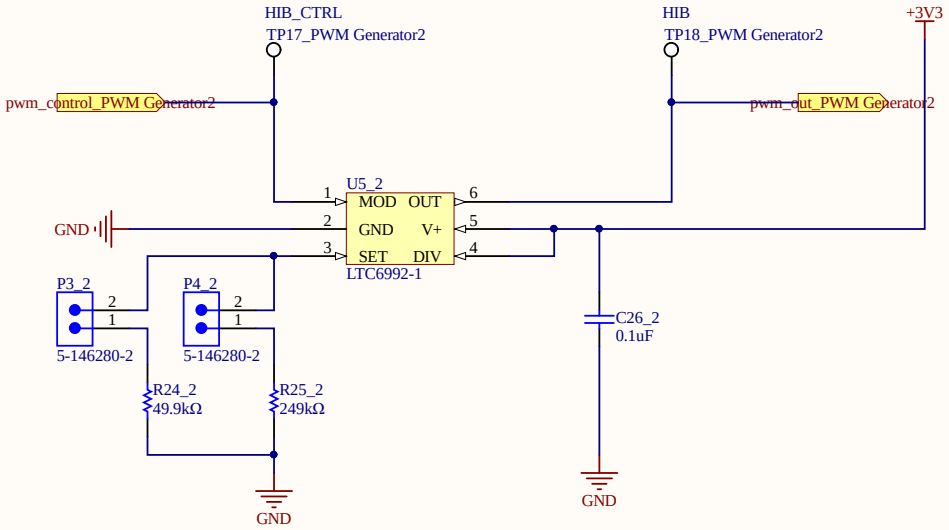
PWM Frequency: f_master = (1MHx * 50kΩ) / R_set
Option 1, 1MHz: R_set = 50kΩ -> R_set = 49.9kΩ
Option 2, 1MHz: R_set = 250kΩ -> R_set = 249kΩ

Title	***pwm_generator.SchDoc***		Omri Nissan - San Luis Obispo California, 93401 United States
Size: A4	Number:6.1	Revision:	
Date: 1/25/2020	Time: 11:11:07 AM	Sheet 6.1 of 8	
File: C:\Users\Public\Documents\Altium\Projects\digital_power\pwm_generator.SchDoc			

PWM Generator

Description:

This sheet shows an analog input 0V-1V that is translated to a PWM duty cycle at higher frequency of choice.
Since the Arduino cannot output high switching frequencies this stage is necessary to drive the MOSFETs.



Calculations:

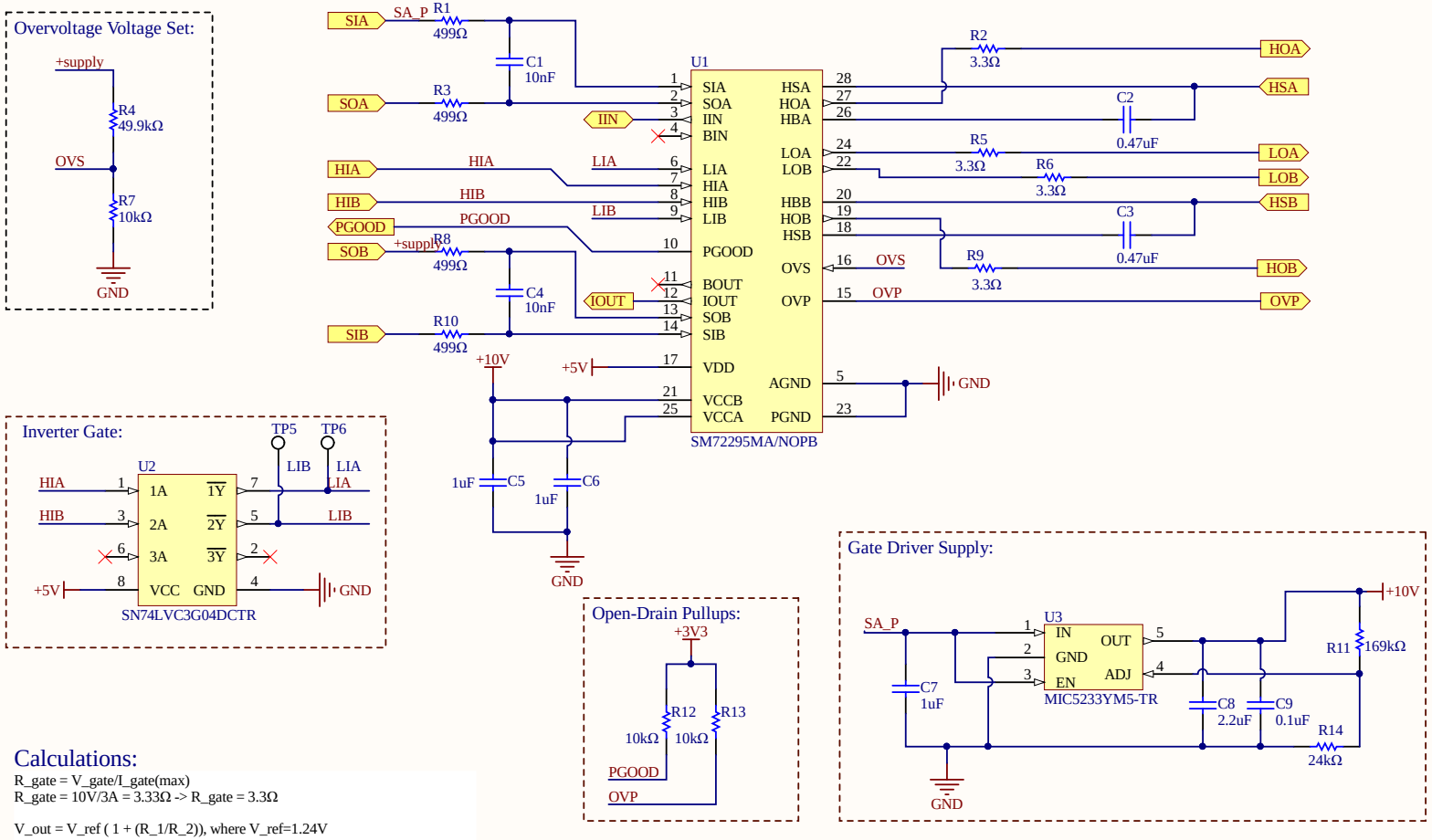
PWM Frequency: f_master = (1MHx * 50kΩ) / R_set
Option 1, 1MHz: R_set = 50kΩ -> R_set = 49.9kΩ
Option 2, 1MHz: R_set = 250kΩ -> R_set = 249kΩ

Title	***pwm_generator.SchDoc***		Omri Nissan - San Luis Obispo California, 93401 United States
Size: A4	Number:6.2	Revision:	
Date: 1/25/2020	Time: 11:11:07 AM	Sheet 6.2 of 8	
File: C:\Users\Public\Documents\Altium\Projects\digital_power\pwm_generator.SchDoc			

Gate Drive

Description:

This sheet shows the gate driver circuitry and any external circuitry to operate it. The SM72295 has all the logic to drive a 4-switch Buck-Boost. Since the low switch is always the reciprocate as the high side switch, an inverter is



Calculations:

R_gate = V_gate/I_gate(max)
R_gate = 10V/3A = 3.33Ω -> R_gate = 3.3Ω

V_out = V_ref (1 + (R_1/R_2)), where V_ref=1.24V
V_out = 1.24V (1 + (169kΩ/24kΩ)) = 9.972V

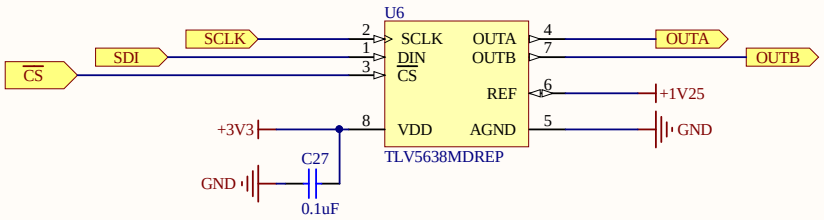
V_ovs = V_dd (1 + (R_1/R_2)), where V_dd=5V, Vout≈30V
V_ovs = 5V (1 + (49.9kΩ/10KΩ)) = 29.95V

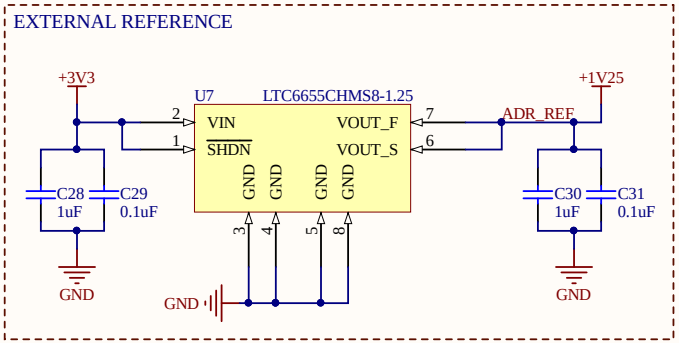
Title	*gate_driver.SchDoc*		Omri Nissan - San Luis Obispo California, 93401 United States
Size: A4	Number:7.	Revision:	
Date: 1/25/2020	Time: 11:11:07 AM	Sheet 7 of 8	
File: C:\Users\Public\Documents\Altium\Projects\digital_power\gate_driver.SchDoc			

Digital-to-Analog Converter (DAC)

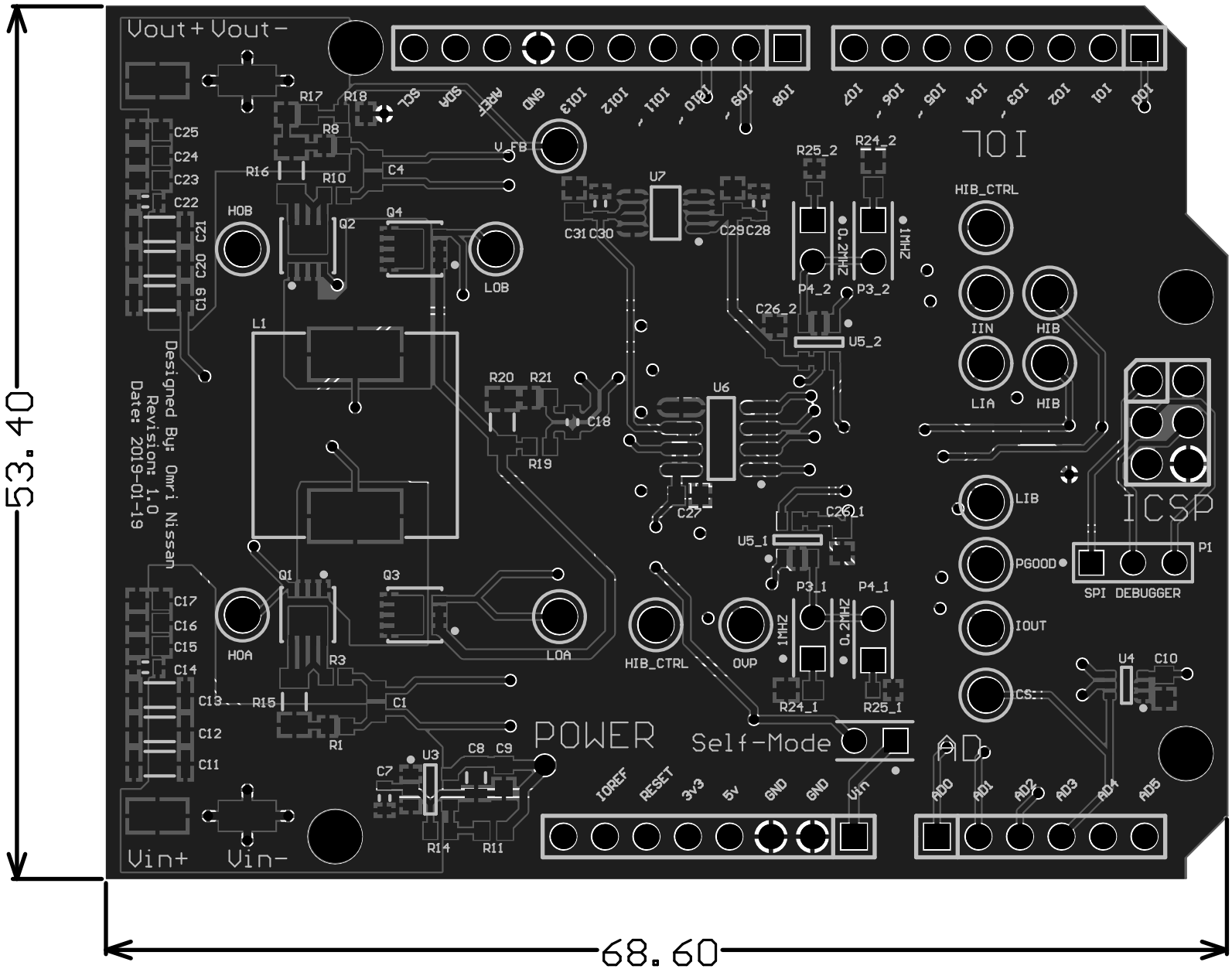
Description:

This sheet shows interface between the Arduino and PWM generator using a DAC. The DAC is 12-bit with either internal or external refrence.





Title	dac.SchDoc		Omri Nissan - San Luis Obispo California, 93401 United States
Size: A4	Number:.	Revision:	
Date: 1/25/2020	Time: 11:11:08 AM	Sheet 8 of 8	
File: C:\Users\Public\Documents\Altium\Projects\digital_power\dac.SchDoc			


53.40
68.60
Vout+
Vout-
Vin+
Vin-
Designed By: Omri Nissan
Revision: 1.0
Date: 2019-01-19
POWER
Self-Mode
ICSP
SPI DEBUGGER
HIB_CTRL
HOB
LOB
HOA
LOA
OVP
V_FB
IIN
HIB
LIA
LIB
PGOOD
IOUT
CS
IOREF
RESET
3v3
5v
GND
GND
Vin
AD0
AD1
AD2
AD3
AD4
AD5
L1
U1
U2
U3
U4
U5_1
U5_2
U6
U7
P1
P3_1
P4_1
P3_2
P4_2
0.2MHZ
1MHZ