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## NCV7680 Evaluation Board Manual

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### EVALUATION BOARD MANUAL

#### Description

The NCV7680 is an octal LED driver designed for automotive LED rear combination lamps. External programmability of the NCV7680 allows the user to set the tail current and stop currents using a single resistor for each function. An optional external FET is used to help distribute power for high power systems.

The Evaluation Board includes both an NCV7680 (octal driver) and NTD2955 (FET). A switch on the board allows the user to evaluate functionality with and without the FET.

The DIAG pin is brought out for reporting of open circuit conditions.

The LED's mounted on the demo board are jumpered giving flexibility for evaluating customer defined loads.

#### Part Features

- Constant Current Outputs for LED String Drive
- Open LED String Diagnostic with Open-Collector Output
- Soft Start Eliminates EMI Concerns
- Low Dropout Operation for Pre-Regulator Applications
- External Modulation Capable

- On-chip 1 kHz Tail PWM Dimming
- Single Resistor for Stop Current Set Point
- Single Resistor for Tail Dimming Set Point
- Overvoltage & Overtemperature Set Back Power Limitation
- AEC Q100 Qualified
- 16 Lead SOW Exposed Pad
- Lead-free Packaging

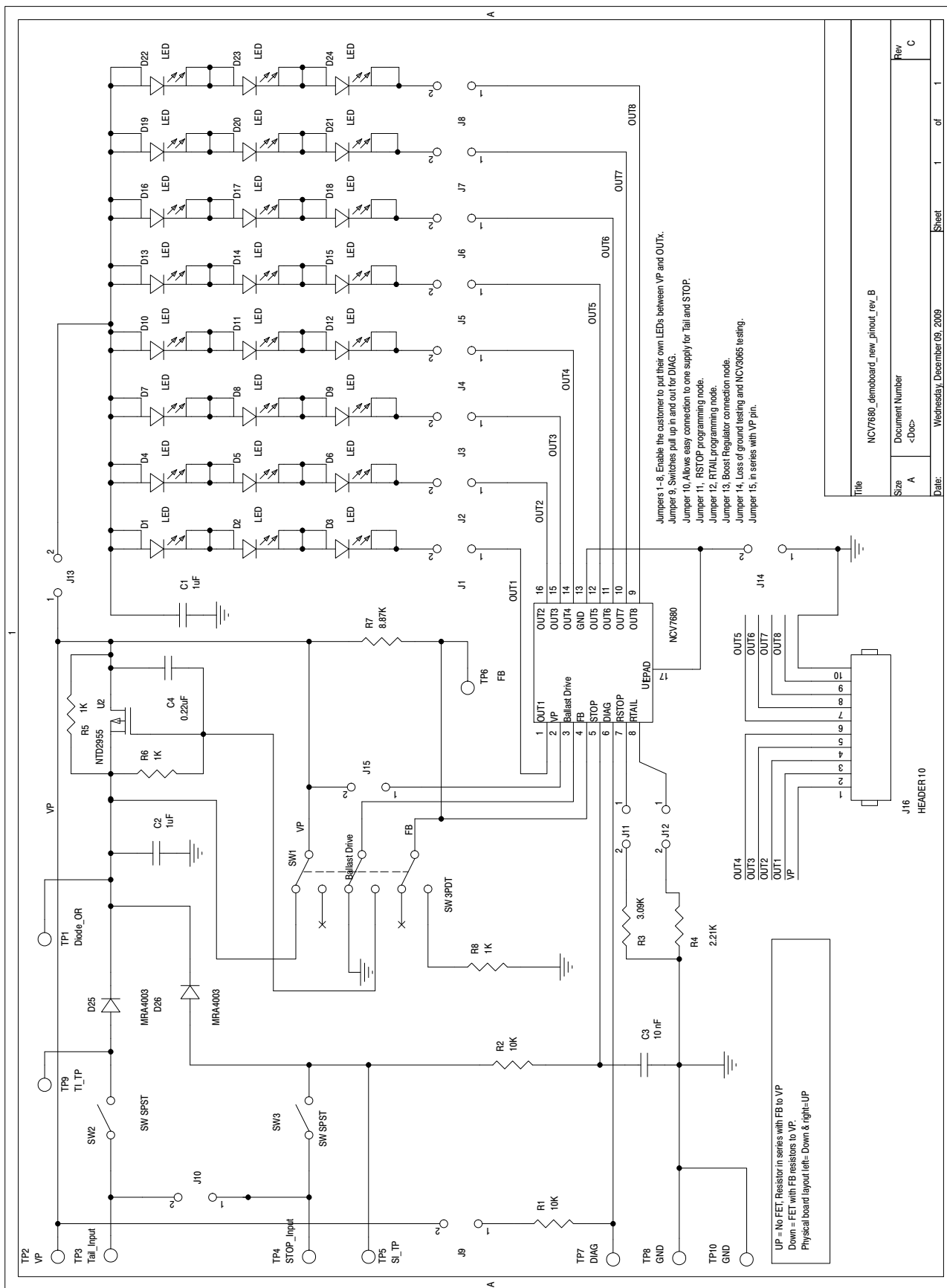
#### Board Features

- Tail Input Switch – Outputs are in the PWM Mode
- STOP Input Switch – Outputs are 100% On
- DIAG Output – Open Circuits are Reported
- LED Isolation – On-board LEDs can be Removed with Jumpers for Alternative LED Evaluation
- STOP Programming Current – Programming Resistor can be Adjusted Externally by Jumper Removal
- Tail Programming Duty Cycle – Programming Resistor can be Adjusted Externally by Jumper Removal



Figure 1. NCV7680EVB Photo

# NCV7680EVB/D



Jumpers 1-8, Enable the customer to put their own LEDs between VP and OUTx.  
 Jumper 9, Switches pull up in and out for DIAG.  
 Jumper 10, Allow easy connection to one supply for Tail and STOP.  
 Jumper 11, RSTOP programming mode.  
 Jumper 12, RTAIL programming mode.  
 Jumper 13, Boost Regulator connection mode.  
 Jumper 14, Loss of ground testing and NCV9065 testing.  
 Jumper 15, in series with VP pin.

UP - No FET Resistor in series with FB to VP  
 Down - FET with FB resistors to VP.  
 Physical board layout left- Down & right-UP

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Rev	C	Sheet	1 of 1
Date:	Wednesday, December 09, 2009		

**Figure 2. NCV7680EVB Schematic**

# NCV7680EVB/D

## Powering up the Board

Equipment Needed – 1 power supply (3/4 Amp)

1. There are 15 jumpers on the board. Start with all 15 jumpers connected. Jumper locations are shown in Figure 3. A list of jumper functionality is shown in the board schematic (Figure 2). Typical connections to the evaluation board are shown in Figure 4.

2. Position switch 1 (SW1) for either external ballast connection (left) or no external ballast connection (right).
3. Connect the power supply.
4. Toggle switch 2 (SW2) for display of the PWM mode (tail).
5. Toggle switch 3 (SW3) for display of 100% duty cycle (STOP).

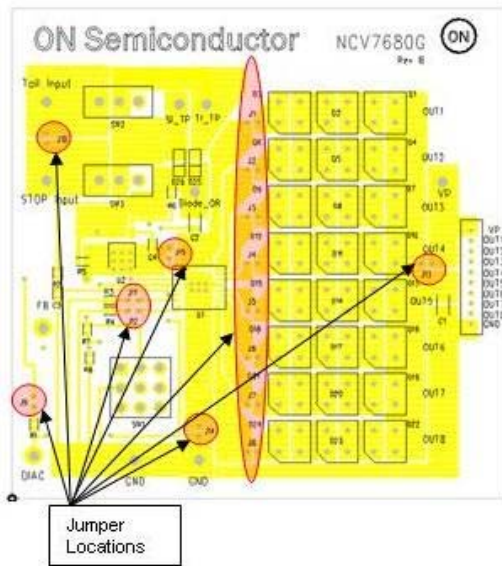


Figure 3. Jumper Locations

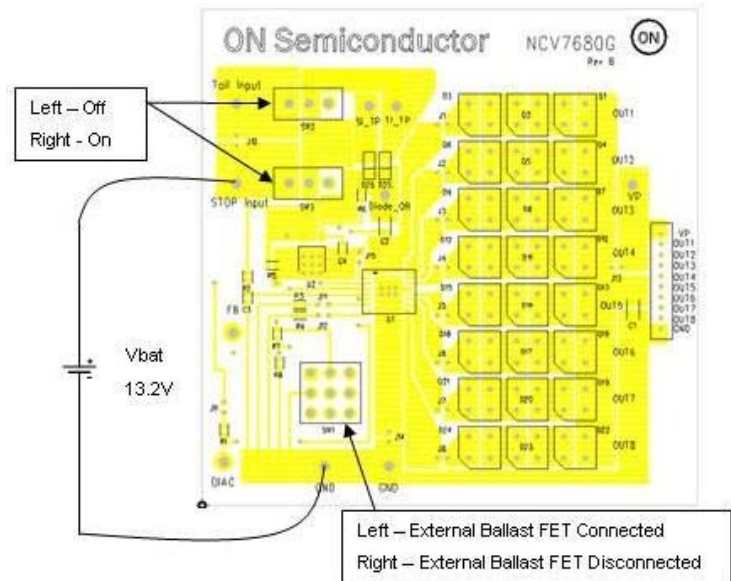


Figure 4. Power Connections

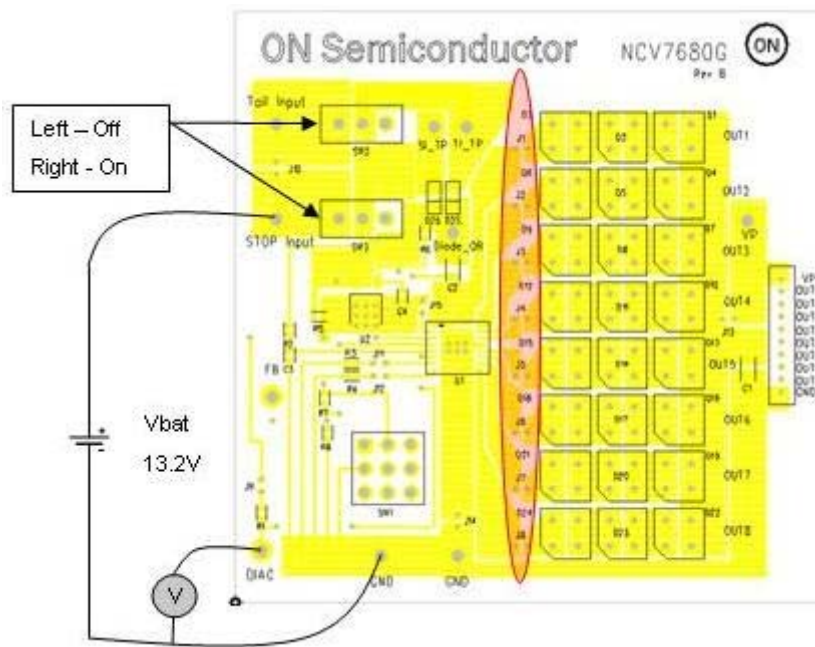
# NCV7680EVB/D

## Jumpers 1-8

Jumpers 1-8 highlight the open circuit functionality of diagnostic pin (DIAG). Monitor DIAG while creating an open circuit by removing any on these jumpers (1-8). DIAG functionality will conform to the variables shown in Table 1.

**Table 1. DIAG Functionality**

Stop Input	Tail Input	OUTX Current 1 - 8	Fault State	DIAG State
0	0	OFF	-	HighZ*
1	0	I <sub>STOP</sub>	Normal	Low
1	0	I <sub>STOP</sub>	Open String	High*
0	1	PWM	Don't Care	High*
1	1	I <sub>STOP</sub>	Normal	Low
1	1	I <sub>STOP</sub>	Open String	High*



**Figure 5. Open Circuit Testing**

# NCV7680EVB/D

## Jumper 9

Jumper 9 disconnects the PC board pullup resistor and allows the user to interface with his own component and power supply to the DIAG pin.

Disconnect Jumper 9. Connect the external resistor to a separate supply. The DIAG pin is limited to 45 V per the maximum ratings table.

Figure 6 shows the test setup for using DIAG with a separate supply.

### MAXIMUM RATINGS (Voltages are with respect to device substrate)

Rating	Value	Unit
VP, Ballast Drive, STOP, DIAG DC Peak Transient	-0.3 to 45 45	V
Output Pin Voltage (OUTX)	-0.3 to 45	V
Output Pin Current (OUTX)	100	mA
Input Voltage (RTAIL, RSTOP, FB)	-0.3 to 5	V
Junction Temperature, T <sub>J</sub>	-40 to 150	°C
Peak Reflow Soldering Temperature: Pb-Free 60 to 150 seconds at 217°C (Note NO TAG)	260 peak	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. DIAG is tested under the conditions shown below from the NCV7680 datasheet.

### ELECTRICAL CHARACTERISTICS

(6 V < VP < 16 V, V, STOP = VP, RSTOP = 3.09 kΩ, RTAIL = 2.21 kΩ, -40°C ≤ T<sub>J</sub> ≤ 150°C, unless otherwise noted.)

Characteristic		Min	Typ	Max	Unit
<b>DIAG OUTPUT</b>					
Output Low Voltage	DIAG Active, I <sub>DIAG</sub> = 1 mA	-	0.1	0.4	V
Output Leakage Current	V <sub>DIAG</sub> = 5 V	-	-	10	μA

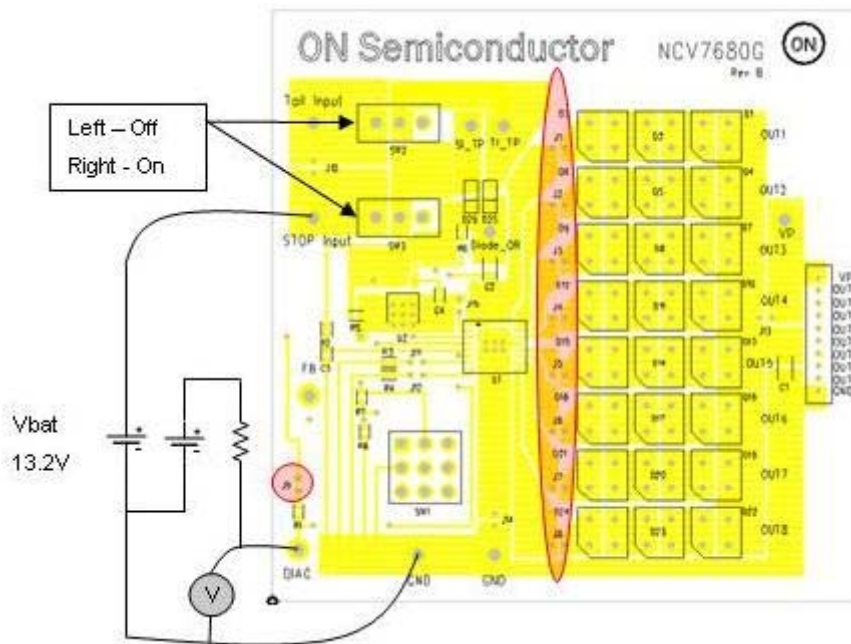


Figure 6. DIAG Connection

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## Jumper 10

Using jumper 10 allows the use of one power supply for both the Tail and STOP functions. Removing J10 allows the use of separate supplies for the Tail Input and the STOP Input.

After removing jumper 10, connect 2 power supplies as shown in Figure 7.

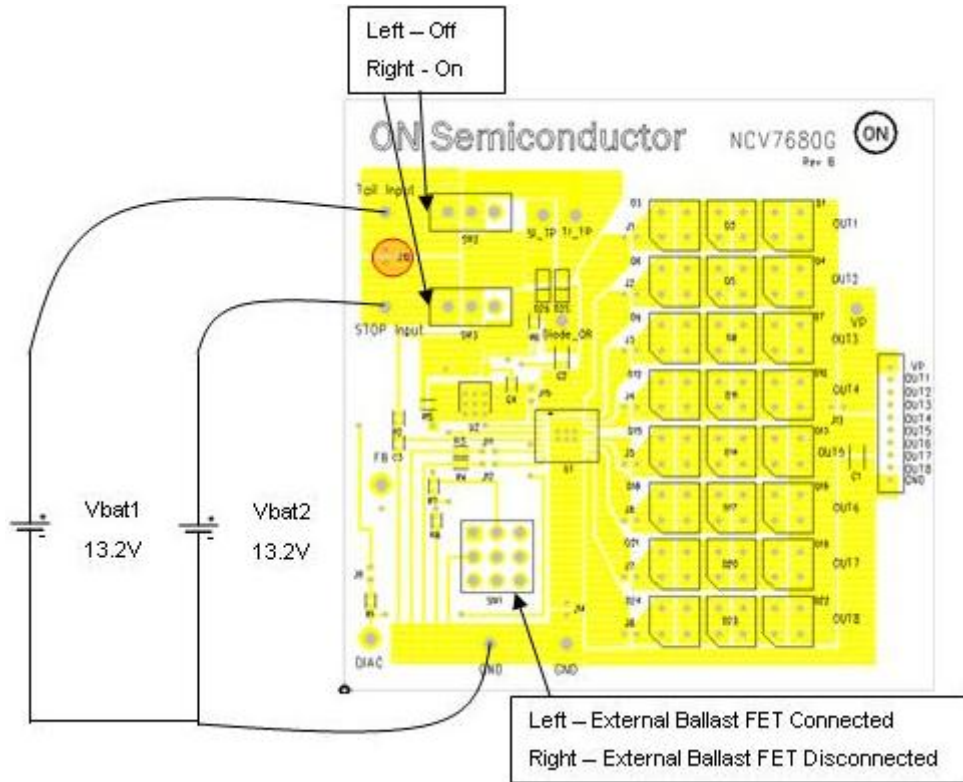


Figure 7.

# NCV7680EVB/D

## Jumpers 11 and 12

Jumpers 11 and 12 allow the user to program the LED output currents.

Remove the jumper to disconnect the PC board resistor and connect a different value.

Resistor values and resultant output programmed currents can be calculated using these design equations.

$$\text{OUTX} = 100 \times \frac{R_{\text{STOP\_BIAS\_Voltage}}}{R_{\text{STOP}}} \quad (\text{eq. 1})$$

$$R_{\text{TAIL}} = 4 \times R_{\text{STOP}} \times (\text{DC} + 0.1) \quad (\text{eq. 2})$$

$$R_{\text{STOP\_BIAS\_Voltage}} = 1.08 \text{ V (typ)}$$

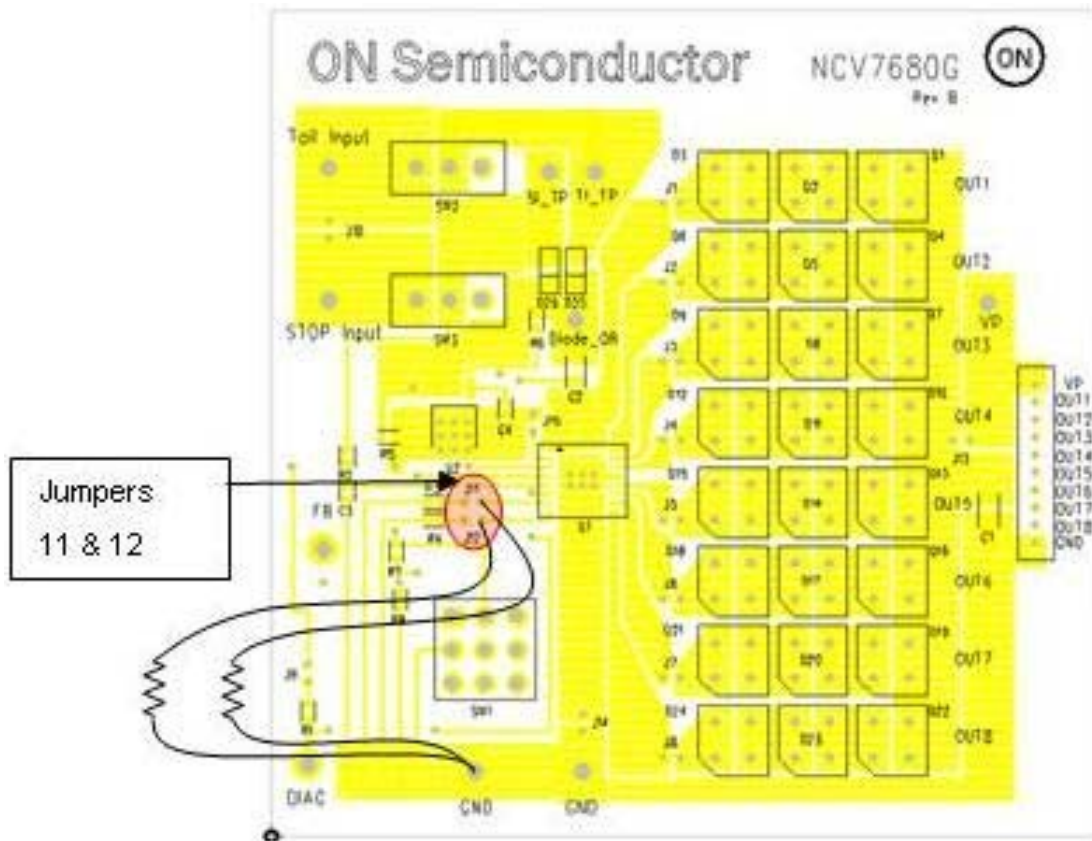


Figure 8. Programming Resistors



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## Jumper 13

Jumper 13 disconnects the common top anode connection of the LED's.

When used with jumpers 1-8 allows the user to drive external LED's. Figure 9 highlights using the connections

on the board edge. Figure 10 highlights an alternative connection. Note, two channels are shown in Figure 10 disconnecting jumpers 1, 2, and 13. This can be expanded for all 8 channels.

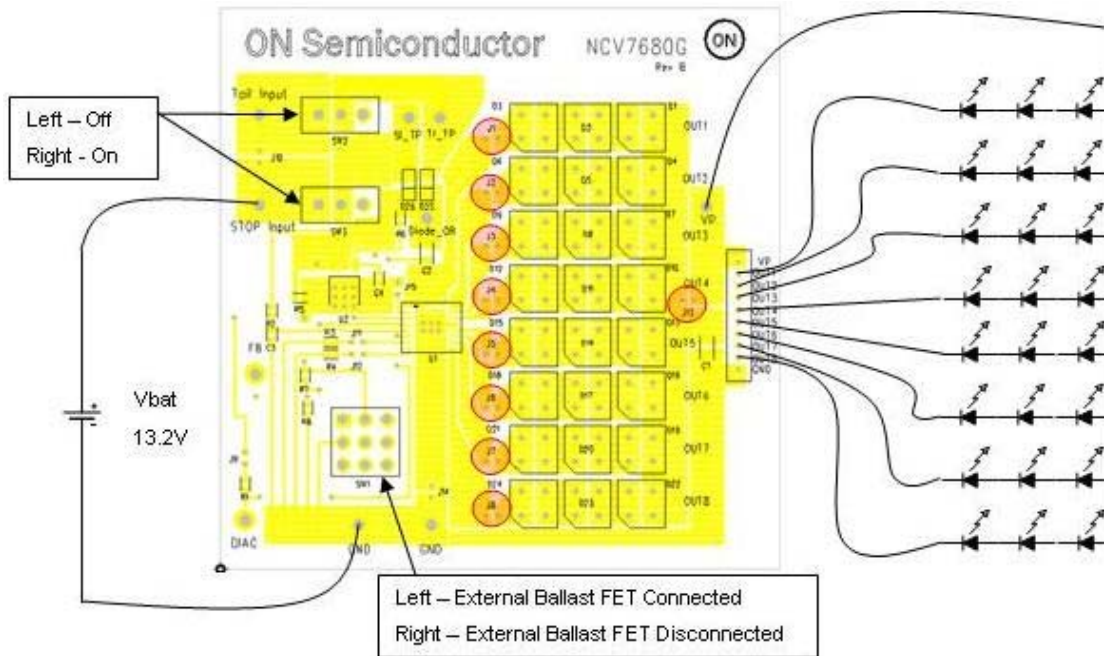


Figure 9. External LED's

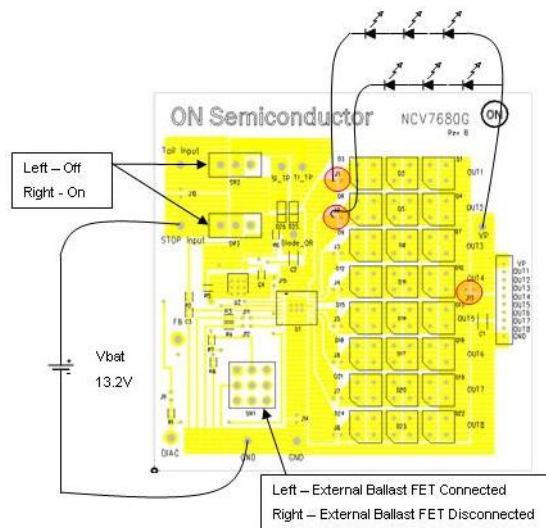
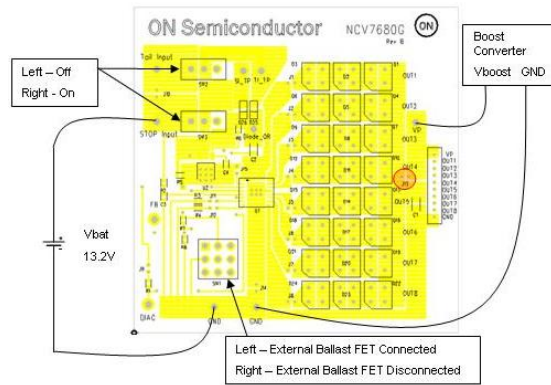


Figure 10. External LED's (alt. connection) (two channels shown)

# NCV7680EVB/D

Isolation of VP using jumper 13 will also allow the use of a boost converter to add additional headroom for more LEDs in a string. See Figure 11 for setup.



**Figure 11. Voltage Boost**

# NCV7680EVB/D

## Jumper 14

Jumper 14 is the ground connection for the NCV7680. This can be used to measure ground current of the IC or test for loss of ground conditions.

## Jumper 15

Jumper 15 is a series connection for VP. This can be used to measure the quiescent current of the NCV7680. Remove jumper 15 and put an ammeter between the pins of the jumper.

### BILL OF MATERIALS (NCV7680 Demonstration Board)

Designator	Qty	Description	Value	Tolerance	Footprint	Manufacturer	Manufacturer Part Number	Substitution Allowed	Pb-Free
U1	1	NCV7680 (SOW-16 epad)	-	-	751R_02_B	ON Semiconductor	NCV7680PDWG	No	Yes
U2	1	NTD2955	-	-	DPAK3_SMD	ON Semiconductor	NTD2955T4G	No	Yes
U3, (D25, D26)	2	MRA4003	-	-	SMA_DIODE	ON Semiconductor	MRA4003T3G	No	Yes
D1-D24	24	Superflux LED (Lumileds)	Amber	N/A	LED_SUPERFLUX	Philips	HPWN-BL00-0002	No	Yes
C1,C2	2	Input / Output Capacitor	1 $\mu$ F, 50V	( $\pm$ 10%) X7R	1210	KEMET	C1210C105K3RACTU	Yes	Yes
C3	1	Debounce Capacitor	10nF, 50V	( $\pm$ 10%) X7R	0805	AVX	08055C103KAT	Yes	Yes
C4	1	Loop Stabilization Capacitor	0.22 $\mu$ F, 50V	( $\pm$ 10%) X7R	0805	Murata	GCM21BR71H224KA37L	Yes	Yes
R1, R2	2	Logic I/O Resistor	10k	1%	0805	Yageo America	RC0805FR-0710KL	Yes	Yes
R3	1	Stop Current Program Resistor	3.09k	1%	0805	Yageo America	RC0805FR-073K09L	Yes	Yes
R4	1	Tail Current Program Resistor	2.21k	1%	0805	Yageo America	RC0805FR-072K21L	Yes	Yes
R7	1	VP Program Resistor	8.87k	1%	0805	Yageo America	RC0805FR-078K87L	Yes	Yes
R5, R6, R8	3	VP Support Resistor	1k	1%	0805	Yageo America	RC0805FR-071KL	Yes	Yes
J16	1	Jumper Posts (SIP 10), 100mil spacing	-	-	SIP10	Molex-Waldom Electronics Corp	22-28-4103	Yes	Yes
J1-J15	30	Jumper Posts 100 mil spacing	-	-	JMP	Molex-Waldom Electronics Corp	22-28-4023	Yes	Yes
J1-J15	15	Jumper	-	-	-	Sullins Electronic Corp	SSC02SYAN	Yes	Yes
TP1-TP10	10	Connector Posts	-	-	TURRET	Vector Electronics	K24C/M	Yes	Yes
SW1	1	Ballast FET enable switch (3PDT)	-	-	NKK_3PDT_M2032	NKK of America	M2032SS1W03-RO	Yes	Yes
SW2, SW3	2	STOP / Tail control switch (SPDT)	-	-	C&K_7101	C&K	7101SYCQE	Yes	Yes

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