How to use LM3697

PSIL-LED

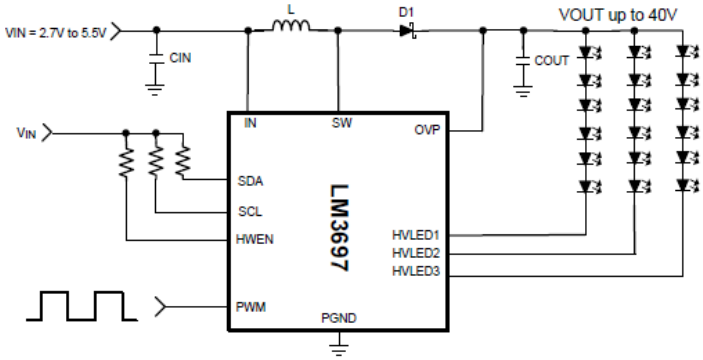
Schematic

- LM3697 is a three channel device
- If less than three channels are needed, following actions are needed:
  - floating unused channel pins
  - Setup register 0x10 and 0x19
  - *Refer to page 5*
- When both Vin and HWEN are high, I2C interface could be communicated
- I2C communication is ready when HWEN is high for at least 20us

t_{HWEN}	First I^2C start pulse after HWEN high	2.7 V ≤ V_{IN} ≤ 5.5 V, POR reset complete	20	µs
		POR reset complete, T_A = 25°C	5.0	

- Once HWEN is toggled, all the registers are reset to default value

Simplified Schematic



LINUX Reference Code

- Pull in the following series of patches. They have been reviewed and there are no pending functional changes that need to be made
- The reference code has been used in multiple customers and projects
- Customer needs to merge them in their own software code accordingly.

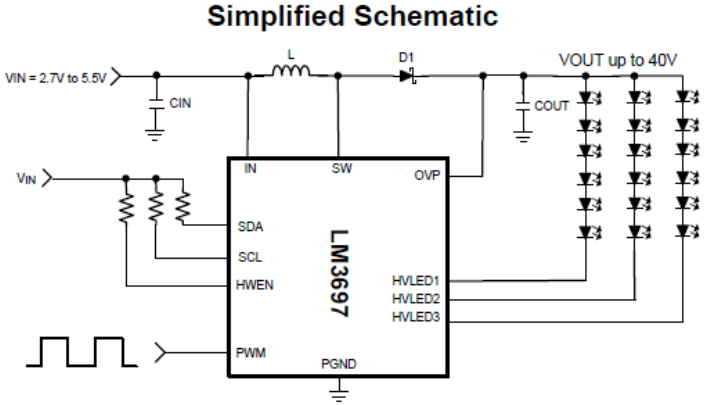
- Link:

  https://lore.kernel.org/patchwork/project/lkml/list/?series=393071

Minimum steps to light up LM3697

- Make sure all the hardware is connected correctly
  - Boost Vin is on
  - HWEN in high
  - Pin IN of LM3697 is on
  - SDA and SCL pull up resistors are connected to IN
  - All the components are soldered correctly
  - LED load is connected
- Chip address: 0x36h.
- Register settings (All three channels are used in this example)

Step	Address	Data	Description
1	0x10	0x07	Use Control B
2	0x1A	0x07	40V OVP
3	0x22	0x07	Brightness LSB, max brightness
4	0X23	0xFF	Brightness MSB, max brightness
5	0x24	0x02	Enable backlight



✓ If all the hardware is correct, and I2C communication is successful, LEDs could be lighten on.

Q&A: Only 2 channels are used

- Only CH1 and CH2 are used in this example
- Solution:
  - Leave HVLED3 floating
  - According to page4, the register settings are as below

Step	Address	Data	Description
1	0x10	0x03	Use Control B for CH1 and CH2
2	0x1A	0x07	40V OVP
4	0x19	0x03	Disable CH3 feedback
5	0x22	0x07	Brightness LSB, max brightness
6	0X23	0xFF	Brightness MSB, max brightness
7	0x24	0x02	Enable backlight

Simplified Schematic

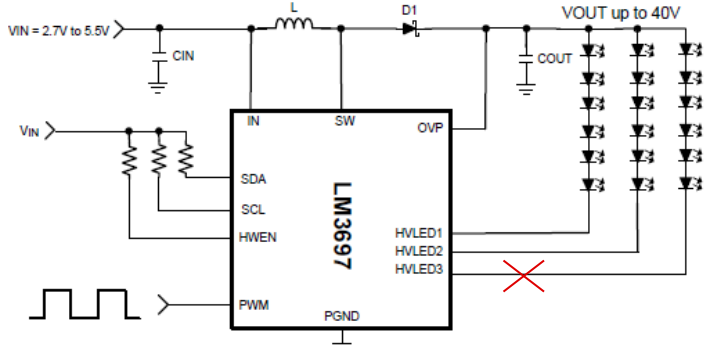


Table 5. HVLED Current Sink Output Configuration (Address 0x10)

Bits [7:3] Not Used	Bit [2] HVLED3 Configuration	Bit [1] HVLED2 Configuration	Bit [0] HVLED1 Configuration
Reserved	0 = Control A 1 = Control B (default)	0 = Control A 1 = Control B (default)	0 = Control A (default) 1 = Control B

Table 11. HVLED Current Sink Feedback Enables (Address 0x19)

Bits [7:3] Not Used	Bit [2] HVLED3 Feedback Enable	Bit [1] HVLED2 Feedback Enable	Bit [0] HVLED1 Feedback Enable
Reserved	0 = LED anode is NOT CONNECTED to COUT 1 = LED anode is CONNECTED to COUT (default)	0 = LED anode is NOT CONNECTED to COUT 1 = LED anode is CONNECTED to COUT (default)	0 = LED anode is NOT CONNECTED to COUT 1 = LED anode is CONNECTED to COUT (default)

Q&A: PWM dimming

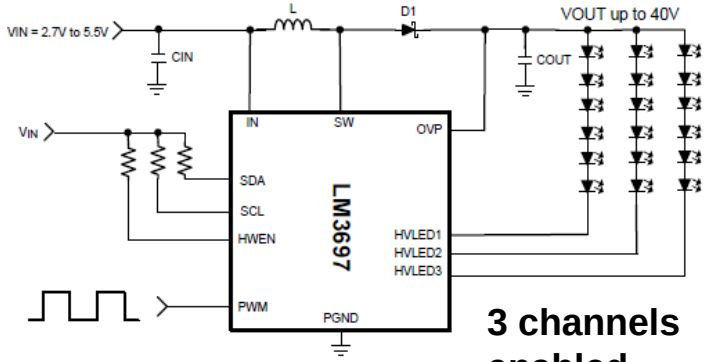
- There is no PWM Only dimming mode
- Enable PWM dimming, output current would be multiply of PWM duty and Brightness code
- Solution:
  - According to page4, the register settings are as below
  - If 0x22 and 0x23 are 00, no output
  - PWM input frequency range is 2kHz to 100kHz
  - All three channels are used in this example

Table 14. PWM Configuration (Address 0x1C)

Bits [7:4] Not Used	Bit [3] PWM Zero Detection Enable	Bit [2] PWM Polarity	Bit [1] Control B PWM Enable	Bit [0] Control A PWM Enable
Reserved	0 = Disable 1 = Enable (default)	0 = Active Low 1 = Active High (default)	0 = Disable (default) 1 = Enable	0 = Disable (default) 1 = Enable

Step	Address	Data	Description
1	0x10	0x07	Use Control B
2	0x1A	0x07	40V OVP
3	0x1C	0x0E	Enable Control B PWM dimming
4	0x22	0x07	Brightness LSB, max brightness
5	0X23	0xFF	Brightness MSB, max brightness
6	0x24	0x02	Enable backlight

Simplified Schematic



3 channels enabled

Q&A: Dimming performance register

Table 6. Control A and B Start-up/Shutdown Ramp Time (Address 0x11 and 0x12)

Bits [7:4] Start-up Ramp	Bits [3:0] Shutdown Ramp
0000 = 2048 µs (default) 0001 = 262 ms	0000 = 2048 µs (default) 0001 = 262 ms

Table 7. Control A and B Run-Time Ramp Time (Address 0x13)

Bits [7:4] Transition Time Ramp Up	Bits [3:0] Transition Time Ramp Down
000 = 2048 µs (default) 001 = 262 ms	000 = 2048 µs (default) 001 = 262 ms

- 0x11, 0x12 and 0x13 are used to control dimming ramp time.
- Customer could adjust according to real application to make it slower.

Q&A: Dimming configuration register

Table 9. Control A and B Brightness Configuration (Address 0x16)

Bits [7:4] Not Used	Bit [3] Control B Dither Disable	Bit [2] Control A Dither Disable	Bit [1] Not Used	Bit [0] Control A/B Mapping Mode
Reserved	0 Enable (default) 1 Disable	0 Enable (default) 1 Disable	Reserved	0 Exponential (default) 1 Linear

- Bit[3] and Bit[2]: **keep enabled**, don't change
- Bit[0]: Exponential dimming is recommended for a more uniform transition for human eye. When use 11bit exponential dimming, the code calculation is

$$I_{LED} = I_{LED\_FULLSCALE} \times 0.85^{\left(44 - \frac{\frac{Code}{8} + 1}{5.8181818}\right)} \times D_{PWM}$$

where the **Code** is the value in register 0x22 and 0x23 (for control B in this case)
Dpwm is the PWM duty cycle if PWM dimming is enabled.

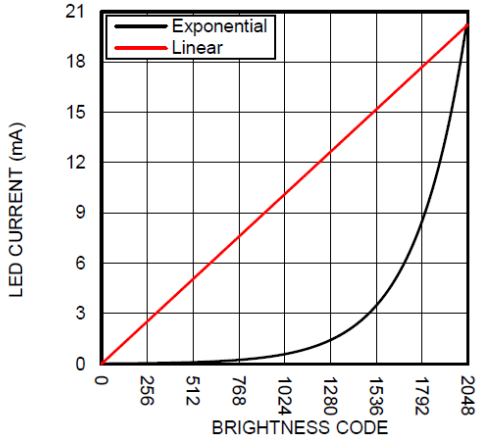


Figure 11. LED Current Mapping Modes (11-Bit)

Q&A: Maximum current

Table 10. Control A and B Full-Scale Current Setting (Address 0x17 and 0x18)

Bits [7:5] Not Used	Bits [4:0] Control A, B Full-Scale Current Select Bits
Reserved	00000 = 5 mA
	10011 = 20.2 mA (default)
	11111 = 29.8 mA (0.8 mA steps, FS = 5 + code * 0.8 mA)

- Maximum current in each channel is determined by which Control bank A or B is assigned to in register 0x10
- Maximum current in each Control bank could be set in register 0x17 for Control A and 0x18 for Control B.
- For the cases in this file, use 0x18 to set Control B maximum current.

Q&A: Boost control setup

Table 12. Boost Control (Address 0x1A)

Bits [7:5] Not Used	Bit [4] Auto-Headroom Enable	Bit [3] Auto-Frequency Enable	Bits [2:1] Boost OVP Select	Bit [0] Boost Frequency Select
Reserved	0 = Disable (default) 1 = Enable	0 = Disable (default) 1 = Enable	00 = 16 V (default) 01 = 24 V 10 = 32 V 11 = 40 V	0 = 500 kHz (default) 1 = 1 MHz

- Bit[4]: **KEEP disable**, don't change
- Bit[2:1]: setup higher than max LED forward voltage + 1V to leave some margin.

  max LED forward voltage is under max LED current at lowest ambient temperature, this could be found in LED datasheet.
- Bit[0]: usually higher Boost switching frequency has better efficiency at heavy load, customer could set it according to real application.

Thank you!