

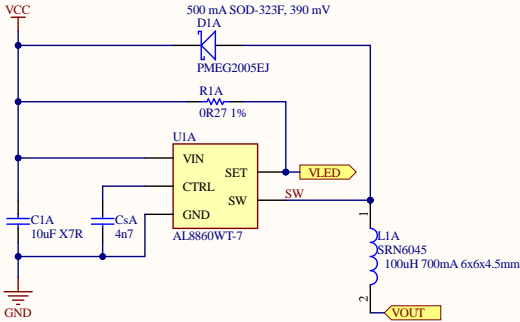
Revision History:

Rev	Date	Description

Sheet Title: Brake Light		
Project:		QUT Motorsport
Size: A3		Number: 1
Version:		Revision: 2
Drawn By: Joseph Richards		Sheet 1 of 3
Print Date: 28/07/2020		Print Time: 8:14:19 PM
File Name: QUTMS-BrakeLight-S00.SchDoc		

2-120, Gardens Point
2 George Street
Brisbane, QLD 4000
Australia





Cs is optional only. Do not use normally

LED Driver Calculations

Voltage max: 40V
Current Max 1A
Duty Cyle Max: 98%
Ton_min: 500ns
Rsw: 0.2 ohms
Rs: 0.27 ohms
RL: 0.5 ohms
L: 100uH
Csoft: 4.7uF
Vin: 12.4V (worst case)

LED Soft Start
Capacitor between CTRL and GND
Soft stst: Csoft x 1.5ms/nF
= 4.7 x 1.5
Tsoft = 7.05ms

LED Current:
 $I_{led} = 0.1 / R_s$
 $= 0.1 / 0.27 = 370mA$

Ripple Current:
 $\Delta I_{led} = I_{led} / 4$
 $= 0.37 / 4 = 92.5mA$

Power Dissipation: $P_d = (1 - \text{estimatedEfficiency}) * V_{in} * I_{led}$
 $= (1 - 0.95) \times 12.4 \times 0.37$
 $= 229 mW$

Red LED Driver Calculations

Red Vd = 2.2V
Red Vled: 4 x Vd = 8.8V

Red LED Switch on time:
 $T_{on} = L \times \Delta I_{led} / (V_{in} - V_{led} - I_{led} \times (R_s + R_L + R_{sw}))$
 $= 100 * 10^{-6} \times 92.5 * 10^{-3} / (12.4 - 8.8 - 0.37 \times (0.27 + 0.5 + 0.2))$
 $= 9.25 * 10^{-6} / 3.24$
 $= 2.54 * 10^{-6}$

Ton = 2854ns

Red LED Switch off time:
 $T_{off} = L \times \Delta I_{led} / (V_{led} + V_d + I_{led} \times (R_s + R_L))$
 $= 100 * 10^{-6} \times 92.5 * 10^{-3} / (8.8 + 2.2 + 0.37 \times (0.27 + 0.5))$
 $= 9.25 * 10^{-6} / 11.28$
 $= 8.20 * 10^{-7}$

Toff = 820ns

RED LED Duty Cycle: $D_{sw} = T_{on} / (T_{on} + T_{off})$
 $= 2854 / (2854 + 820)$
 $= 77.7\%$

Revision History:

Rev	Date	Description

Sheet Title: **LED Driver**

Project:

Size: A3

Number: 2

Version:

Revision: 1

Sheet 2 of 3

Drawn By: Joseph Richards

Print Date: 28/07/2020

Print Time: 8:14:19 PM

File Name: QUTMS-BrakeLight-S01.SchDoc

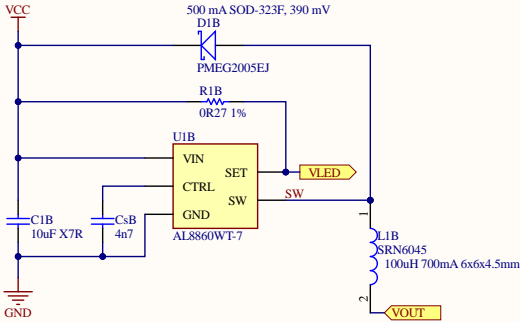
QUT Motorsport

O-120, Gardens Point

2 George Street

Brisbane, QLD 4000

Australia



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LED Driver Calculations

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Current Max 1A
Duty Cyle Max: 98%
Ton_min: 500ns
Rsw: 0.2 ohms
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Vin: 12.4V (worst case)

LED Soft Start
Capacitor between CTRL and GND
Soft stst: Csoft x 1.5ms/nF
= 4.7 x 1.5
Tsoft = 7.05ms

LED Current:
Iled = 0.1 / Rs
= 0.1 / 0.27 = 370mA

Ripple Current:
Idelta = Iled / 4
= 0.37 / 4 = 92.5mA

Power Dissipation: Pd = (1 - estimatedEfficiency) * Vin* Iled
= (1 - 0.95) x 12.4 x 0.37
= 229 mW

Red LED Driver Calculations

Red Vd = 2.2V
Red Vled: 4 x Vd = 8.8V

Red LED Switch on time:
Ton = L x Idelta / (Vin - Vled - Iled x (Rs + RL + Rsw))
= 100*10^-6 x 92.5*10^-3 / (12.4 - 8.8 - 0.37 x (0.27 + 0.5 + 0.2))
= 9.25*10^-6 / 3.24
= 2.54*10^-6

Ton = 2854ns

Red LED Switch off time:
Toff = L x Idelta / (Vled + Vd + Iled x (Rs + RL))
= 100*10^-6 x 92.5*10^-3 / (8.8 + 2.2 + 0.37 x (0.27 + 0.5))
= 9.25*10^-6 / 11.28
= 8.20*10^-7

Toff = 820ns

RED LED Duty Cycle: Dsw = Ton / (Ton + Toff)
= 2854 / (2854 + 820)

= 77.7%

Revision History:

Rev	Date	Description

Sheet Title: **LED Driver**

Project:		QUT Motorsport O-120, Gardens Point 2 George Street Brisbane, QLD 4000 Australia	
Size: A3	Number: 2	Version:	Revision: 1
Drawn By: Joseph Richards		Sheet 2 of 3	
Print Date: 28/07/2020		Print Time: 8:14:19 PM	
File Name: QUTMS-BrakeLight-S01.SchDoc			



A

B

C

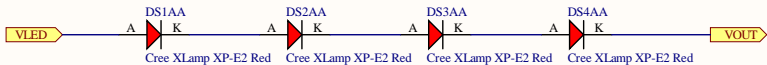
D

A

B

C

D



Red LED Array Calculations

Max Current: 1A
Forward Voltage: 2.2V
Forward Current: 370mA

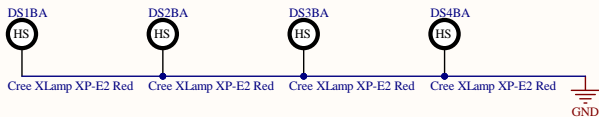
Total Voltage Drop: $4 \times 2.2 = 8.8\text{V}$

Total Power: $8.8 \times 0.37 = 3.27\text{W}$

Luminous Flux: 68.2 lm @ 370mA

Luminous Intensity: 68.2 lm/130 deg = 18.8cd


Total Brightness: $4 \times 18.8 = 75.2\text{cd}^*$
*Meets International UN standards (60-180cd)



Revision History:

Rev	Date	Description

Sheet Title: Red LED Array		
Project:		QUT Motorsport O-120, Gardens Point 2 George Street Brisbane, QLD 4000 Australia
Size: A3	Number: 3	
Version: 1		
Revision: 1		
Drawn By: Joseph Richards		Sheet 3 of 3
Print Date: 28/07/2020 Print Time: 8:14:19 PM		File Name: QUTMS-BrakeLight-S02.SchDoc



A

B

C

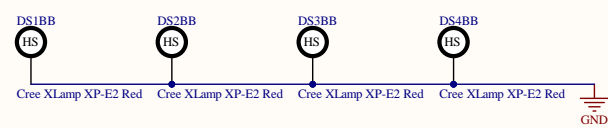
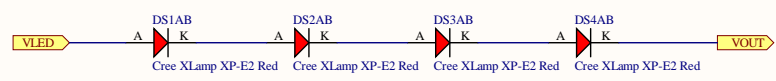
D

A

B

C

D



Red LED Array Calculations

Max Current: 1A
Forward Voltage: 2.2V
Forward Current: 370mA

Total Voltage Drop: $4 \times 2.2 = 8.8\text{V}$


Total Power: $8.8 \times 0.37 = 3.27\text{W}$

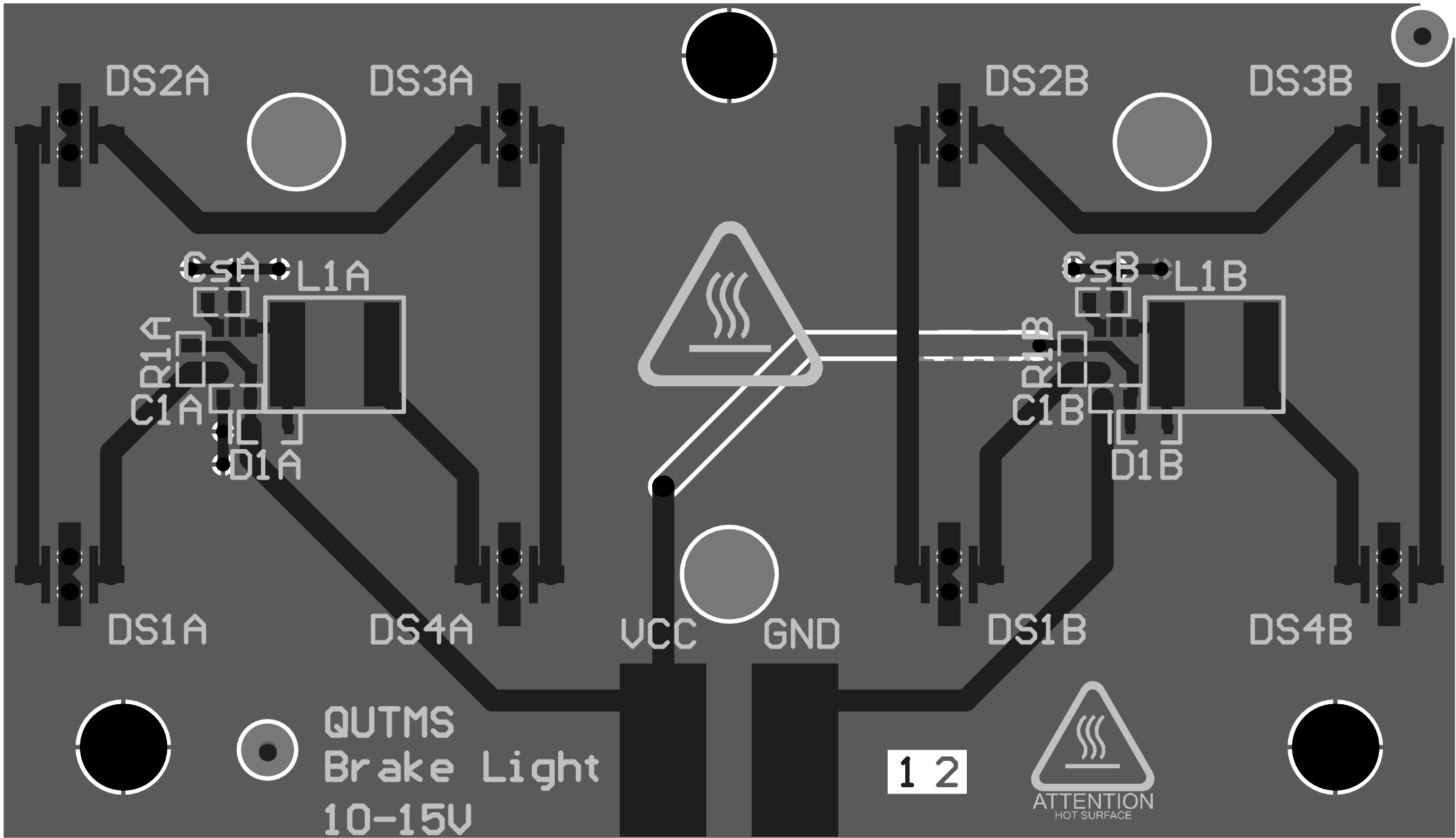
Luminous Flux: 68.2 lm @ 370mA

Luminous Intensity: 68.2 lm/130 deg = 18.8cd

Total Brightness: $4 \times 18.8 = 75.2\text{cd}^*$
*Meets International UN standards (60-180cd)

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Sheet Title: Red LED Array			
Project:		QUT Motorsport O-120, Gardens Point	
Size: A3	Number: 3	Version:	2 George Street
		Revision: 1	Brisbane, QLD 4000
Drawn By: Joseph Richards		Sheet 3 of 3	Australia
Print Date: 28/07/2020 Print Time: 8:14:19 PM		File Name: QUTMS-BrakeLight-S02.SchDoc	
			



Board Stack Report