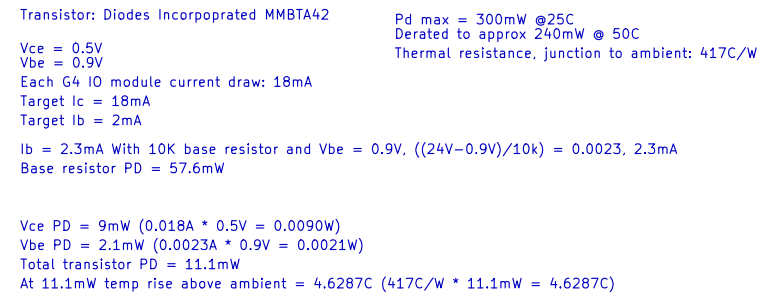


$I_b = 2.3\text{mA}$ (see transistor notes)
Base resistor power dissipation = 57.6mW ($24^2 / 10\text{K}$)

Lower end pull down current = 4.5mA
Upper end pull down current = 4.1mA

Total unit power dissipation 171.6mW (102.9mW + 11.1mW + 57.6mW = 171.6mW)
All outputs active power dissipation = 4.118W (171.6mW * 24 = 4118mW)

Id: 4/25

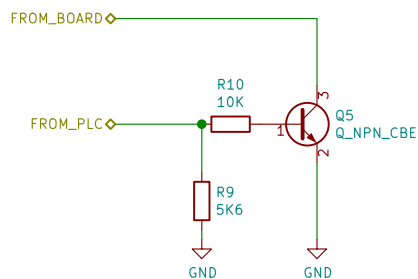


$I_b = 2.3\text{mA}$ (see transistor notes)
Base resistor power dissipation = 57.6mW ($24^2 / 10\text{K}$)

Lower end pull down current = 4.5mA
Upper end pull down current = 4.1mA

Total unit power dissipation 171.6mW (102.9mW + 11.1mW + 57.6mW = 171.6mW)
All outputs active power dissipation = 4.118W (171.6mW * 24 = 4118mW)

Id: 5/25



VDC = 24V
Minimum OPTO22 driver board current: 5mA

Ib = 2.3mA (see transistor notes)
Base resistor power dissipation = 57.6mW (24² / 10K)

With 5.6K (nominal) pull down resistor, current @ 24VDC = 4.3mA (24/5600 = 0.0043)
Pull down resistor power dissipation = 102.9mW (24²/5600)

Variation allowance: Assuming 5% resistor, +25C temperature change, 200ppm/C resistor TCR

Lower end = 5.347K (5.6K * 0.95) * (1 + (0.000200 * 25)) = 5346.6
Upper end = 5.909K (5.6K * 1.05) * (1 + (0.000200 * 25)) = 5909.4

Lower end pull down current = 4.5mA
Upper end pull down current = 4.1mA

Total unit power dissipation 171.6mW (102.9mW + 11.1mW + 57.6mW = 171.6mW)
All outputs active power dissipation = 4.118W (171.6mW * 24 = 4118mW)

Transistor: Diodes Incorporated MMBTA42

Vce = 0.5V
Vbe = 0.9V
Each G4 IO module current draw: 18mA
Target Ic = 18mA
Target Ib = 2mA

Ib = 2.3mA With 10K base resistor and Vbe = 0.9V, ((24V-0.9V)/10k) = 0.0023, 2.3mA
Base resistor PD = 57.6mW

Pd max = 300mW @25C
Derated to approx 240mW @ 50C
Thermal resistance, junction to ambient: 417C/W

Vce PD = 9mW (0.018A * 0.5V = 0.0090W)
Vbe PD = 2.1mW (0.0023A * 0.9V = 0.0021W)
Total transistor PD = 11.1mW
At 11.1mW temp rise above ambient = 4.6287C (417C/W * 11.1mW = 4.6287C)

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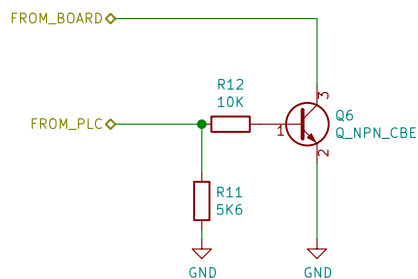
Title: 022 ADAPTER

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Rev: V1.0

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VDC = 24V
Minimum OPTO22 driver board current: 5mA

Ib = 2.3mA (see transistor notes)
Base resistor power dissipation = 57.6mW (24² / 10K)

With 5.6K (nominal) pull down resistor, current @ 24VDC = 4.3mA (24/5600 = 0.0043)
Pull down resistor power dissipation = 102.9mW (24²/5600)

Variation allowance: Assuming 5% resistor, +25C temperature change, 200ppm/C resistor TCR

Lower end = 5.347K (5.6K * 0.95) * (1 + (0.000200 * 25)) = 5346.6
Upper end = 5.909K (5.6K * 1.05) * (1 + (0.000200 * 25)) = 5909.4

Lower end pull down current = 4.5mA
Upper end pull down current = 4.1mA

Total unit power dissipation 171.6mW (102.9mW + 11.1mW + 57.6mW = 171.6mW)
All outputs active power dissipation = 4.118W (171.6mW * 24 = 4118mW)

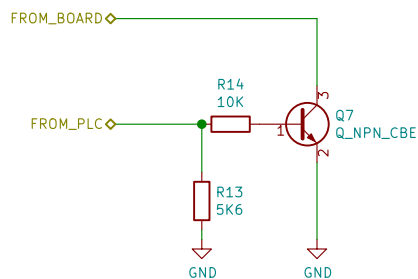
Transistor: Diodes Incorporated MMBTA42

Vce = 0.5V
Vbe = 0.9V
Each G4 IO module current draw: 18mA
Target Ic = 18mA
Target Ib = 2mA

Ib = 2.3mA With 10K base resistor and Vbe = 0.9V, ((24V-0.9V)/10k) = 0.0023, 2.3mA
Base resistor PD = 57.6mW

Pd max = 300mW @25C
Derated to approx 240mW @ 50C
Thermal resistance, junction to ambient: 417C/W

Vce PD = 9mW (0.018A * 0.5V = 0.0090W)
Vbe PD = 2.1mW (0.0023A * 0.9V = 0.0021W)
Total transistor PD = 11.1mW
At 11.1mW temp rise above ambient = 4.6287C (417C/W * 11.1mW = 4.6287C)



VDC = 24V
Minimum OPTO22 driver board current: 5mA

Ib = 2.3mA (see transistor notes)
Base resistor power dissipation = 57.6mW (24² / 10K)

With 5.6K (nominal) pull down resistor, current @ 24VDC = 4.3mA (24/5600 = 0.0043)
Pull down resistor power dissipation = 102.9mW (24²/5600)

Variation allowance: Assuming 5% resistor, +25C temperature change, 200ppm/C resistor TCR

Lower end = 5.347K (5.6K * 0.95) * (1 + (0.000200 * 25)) = 5346.6
Upper end = 5.909K (5.6K * 1.05) * (1 + (0.000200 * 25)) = 5909.4

Lower end pull down current = 4.5mA
Upper end pull down current = 4.1mA

Total unit power dissipation 171.6mW (102.9mW + 11.1mW + 57.6mW = 171.6mW)
All outputs active power dissipation = 4.118W (171.6mW * 24 = 4118mW)

Transistor: Diodes Incorporated MMBTA42

Vce = 0.5V
Vbe = 0.9V
Each G4 IO module current draw: 18mA
Target Ic = 18mA
Target Ib = 2mA

Ib = 2.3mA With 10K base resistor and Vbe = 0.9V, ((24V-0.9V)/10k) = 0.0023, 2.3mA
Base resistor PD = 57.6mW

Pd max = 300mW @25C
Derated to approx 240mW @ 50C
Thermal resistance, junction to ambient: 417C/W

Vce PD = 9mW (0.018A * 0.5V = 0.0090W)
Vbe PD = 2.1mW (0.0023A * 0.9V = 0.0021W)
Total transistor PD = 11.1mW
At 11.1mW temp rise above ambient = 4.6287C (417C/W * 11.1mW = 4.6287C)

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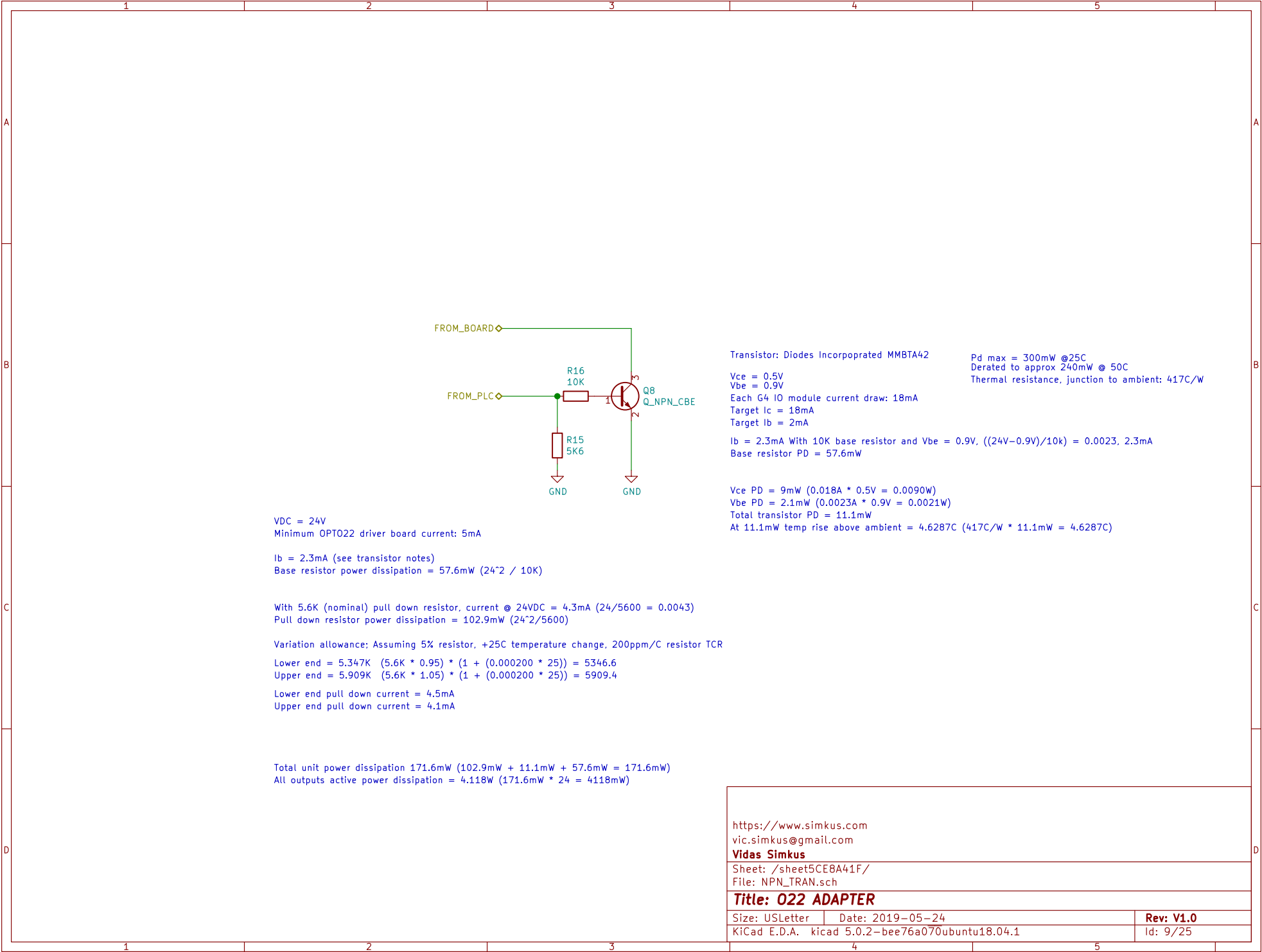
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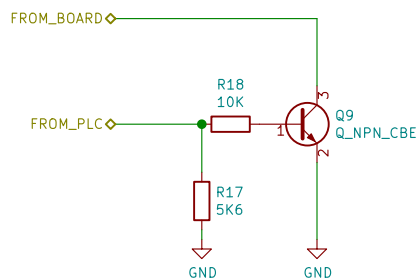
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Rev: V1.0

Id: 8/25





VDC = 24V
Minimum OPTO22 driver board current: 5mA

Ib = 2.3mA (see transistor notes)
Base resistor power dissipation = 57.6mW ($24^2 / 10K$)

With 5.6K (nominal) pull down resistor, current @ 24VDC = 4.3mA ($24/5600 = 0.0043$)
Pull down resistor power dissipation = 102.9mW ($24^2/5600$)

Variation allowance: Assuming 5% resistor, +25C temperature change, 200ppm/C resistor TCR

Lower end = 5.347K ($5.6K * 0.95$) * ($1 + (0.000200 * 25)$) = 5346.6
Upper end = 5.909K ($5.6K * 1.05$) * ($1 + (0.000200 * 25)$) = 5909.4

Lower end pull down current = 4.5mA
Upper end pull down current = 4.1mA

Total unit power dissipation 171.6mW ($102.9mW + 11.1mW + 57.6mW = 171.6mW$)
All outputs active power dissipation = 4.118W ($171.6mW * 24 = 4118mW$)

Transistor: Diodes Incorporated MMBTA42

Vce = 0.5V
Vbe = 0.9V
Each G4 IO module current draw: 18mA
Target Ic = 18mA
Target Ib = 2mA

Ib = 2.3mA With 10K base resistor and Vbe = 0.9V, $((24V-0.9V)/10k) = 0.0023$, 2.3mA
Base resistor PD = 57.6mW

Vce PD = 9mW ($0.018A * 0.5V = 0.0090W$)
Vbe PD = 2.1mW ($0.0023A * 0.9V = 0.0021W$)
Total transistor PD = 11.1mW
At 11.1mW temp rise above ambient = 4.6287C ($417C/W * 11.1mW = 4.6287C$)

Pd max = 300mW @25C
Derated to approx 240mW @ 50C
Thermal resistance, junction to ambient: 417C/W

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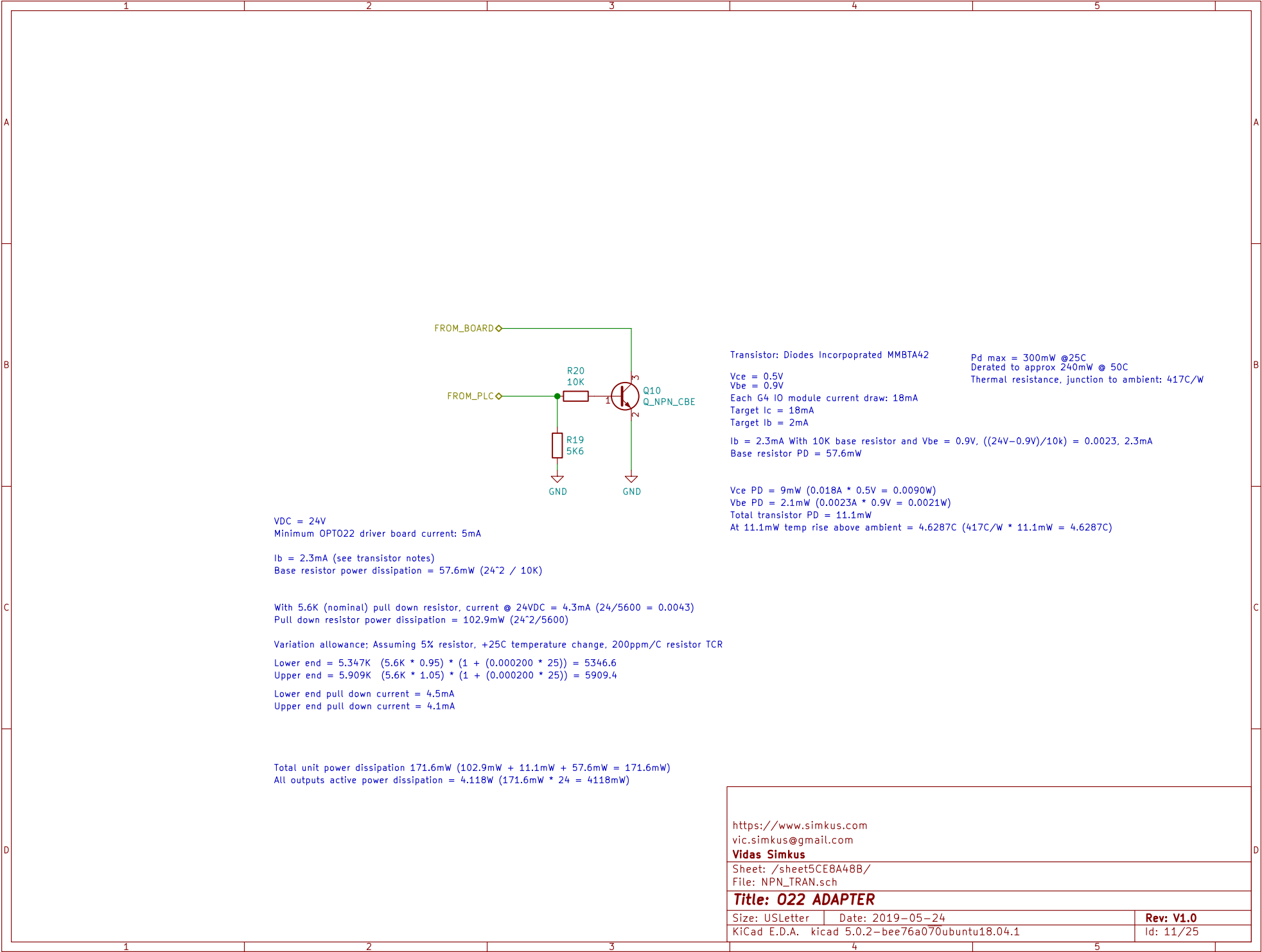
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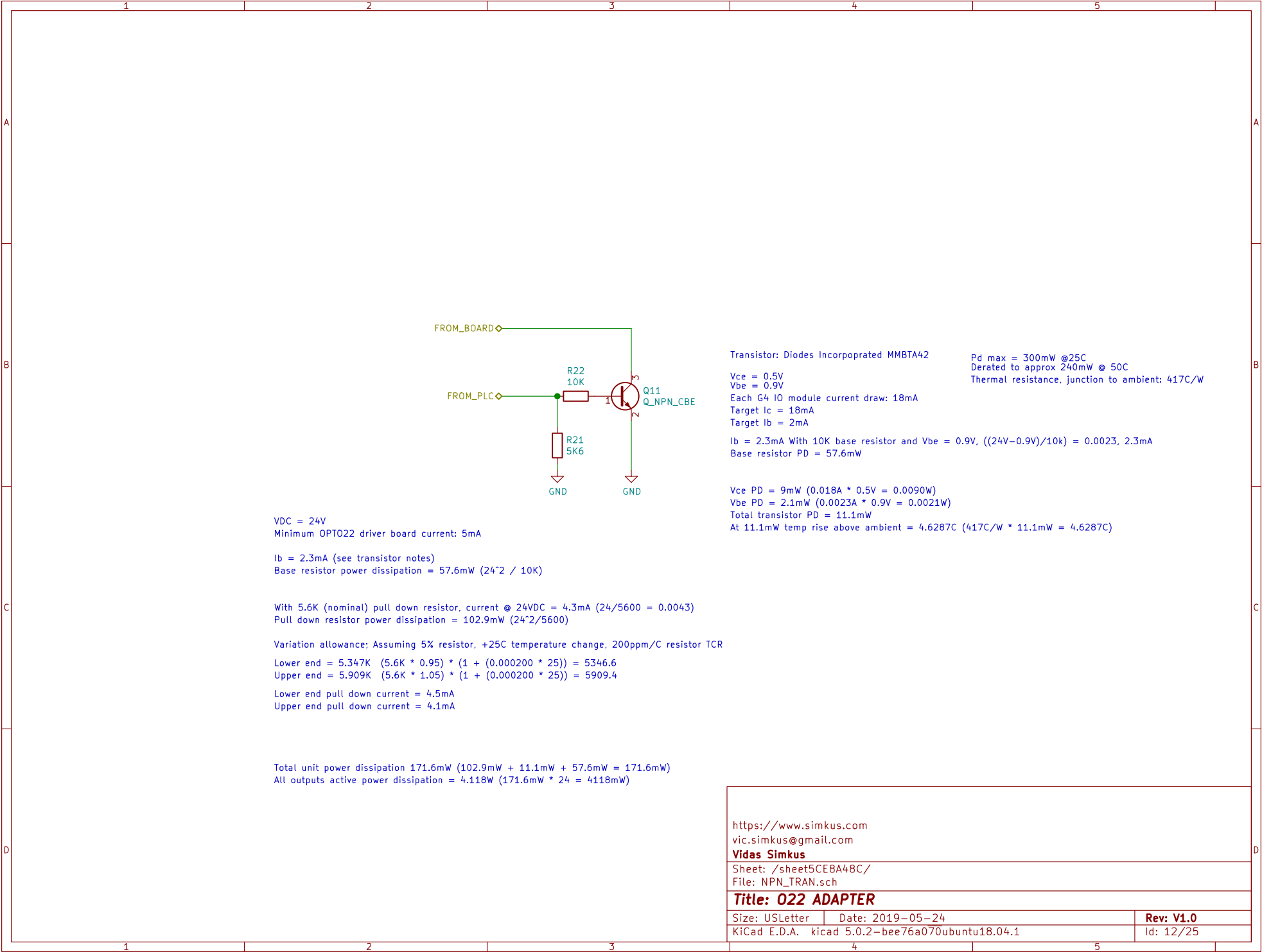
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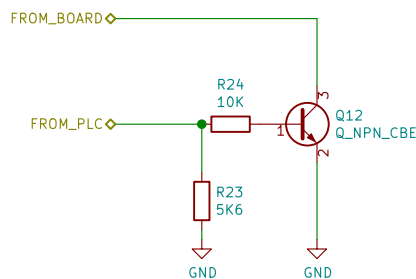
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Rev: V1.0

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VDC = 24V
Minimum OPTO22 driver board current: 5mA

Ib = 2.3mA (see transistor notes)
Base resistor power dissipation = 57.6mW ($24^2 / 10K$)

With 5.6K (nominal) pull down resistor, current @ 24VDC = 4.3mA ($24/5600 = 0.0043$)
Pull down resistor power dissipation = 102.9mW ($24^2/5600$)

Variation allowance: Assuming 5% resistor, +25C temperature change, 200ppm/C resistor TCR

Lower end = 5.347K ($5.6K * 0.95$) * ($1 + (0.000200 * 25)$) = 5346.6
Upper end = 5.909K ($5.6K * 1.05$) * ($1 + (0.000200 * 25)$) = 5909.4

Lower end pull down current = 4.5mA
Upper end pull down current = 4.1mA

Total unit power dissipation 171.6mW ($102.9mW + 11.1mW + 57.6mW = 171.6mW$)
All outputs active power dissipation = 4.118W ($171.6mW * 24 = 4118mW$)

Transistor: Diodes Incorporated MMBTA42

Vce = 0.5V
Vbe = 0.9V
Each G4 IO module current draw: 18mA
Target Ic = 18mA
Target Ib = 2mA

Ib = 2.3mA With 10K base resistor and Vbe = 0.9V, $((24V-0.9V)/10k) = 0.0023$, 2.3mA
Base resistor PD = 57.6mW

Vce PD = 9mW ($0.018A * 0.5V = 0.0090W$)
Vbe PD = 2.1mW ($0.0023A * 0.9V = 0.0021W$)
Total transistor PD = 11.1mW
At 11.1mW temp rise above ambient = 4.6287C ($417C/W * 11.1mW = 4.6287C$)

Pd max = 300mW @25C
Derated to approx 240mW @ 50C
Thermal resistance, junction to ambient: 417C/W

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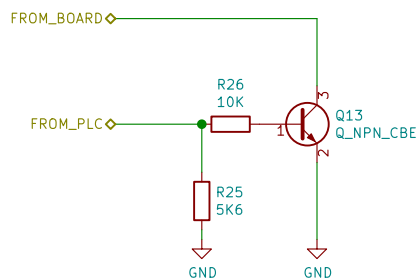
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Rev: V1.0

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VDC = 24V
Minimum OPTO22 driver board current: 5mA

Ib = 2.3mA (see transistor notes)
Base resistor power dissipation = 57.6mW (24² / 10K)

With 5.6K (nominal) pull down resistor, current @ 24VDC = 4.3mA (24/5600 = 0.0043)
Pull down resistor power dissipation = 102.9mW (24²/5600)

Variation allowance: Assuming 5% resistor, +25C temperature change, 200ppm/C resistor TCR

Lower end = 5.347K (5.6K * 0.95) * (1 + (0.000200 * 25)) = 5346.6
Upper end = 5.909K (5.6K * 1.05) * (1 + (0.000200 * 25)) = 5909.4

Lower end pull down current = 4.5mA
Upper end pull down current = 4.1mA

Total unit power dissipation 171.6mW (102.9mW + 11.1mW + 57.6mW = 171.6mW)
All outputs active power dissipation = 4.118W (171.6mW * 24 = 4118mW)

Transistor: Diodes Incorporated MMBTA42

Vce = 0.5V
Vbe = 0.9V
Each G4 IO module current draw: 18mA
Target Ic = 18mA
Target Ib = 2mA

Ib = 2.3mA With 10K base resistor and Vbe = 0.9V, ((24V-0.9V)/10k) = 0.0023, 2.3mA
Base resistor PD = 57.6mW

Pd max = 300mW @25C
Derated to approx 240mW @ 50C
Thermal resistance, junction to ambient: 417C/W

Vce PD = 9mW (0.018A * 0.5V = 0.0090W)
Vbe PD = 2.1mW (0.0023A * 0.9V = 0.0021W)
Total transistor PD = 11.1mW
At 11.1mW temp rise above ambient = 4.6287C (417C/W * 11.1mW = 4.6287C)

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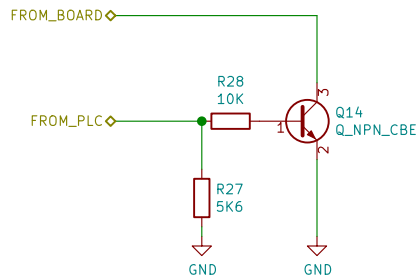
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Rev: V1.0

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VDC = 24V
Minimum OPTO22 driver board current: 5mA

Ib = 2.3mA (see transistor notes)
Base resistor power dissipation = 57.6mW ($24^2 / 10K$)

With 5.6K (nominal) pull down resistor, current @ 24VDC = 4.3mA ($24/5600 = 0.0043$)
Pull down resistor power dissipation = 102.9mW ($24^2/5600$)

Variation allowance: Assuming 5% resistor, +25C temperature change, 200ppm/C resistor TCR

Lower end = 5.347K ($5.6K * 0.95$) * ($1 + (0.000200 * 25)$) = 5346.6
Upper end = 5.909K ($5.6K * 1.05$) * ($1 + (0.000200 * 25)$) = 5909.4

Lower end pull down current = 4.5mA
Upper end pull down current = 4.1mA

Total unit power dissipation 171.6mW ($102.9mW + 11.1mW + 57.6mW = 171.6mW$)
All outputs active power dissipation = 4.118W ($171.6mW * 24 = 4118mW$)

Transistor: Diodes Incorporated MMBTA42

Vce = 0.5V
Vbe = 0.9V
Each G4 IO module current draw: 18mA
Target Ic = 18mA
Target Ib = 2mA

Ib = 2.3mA With 10K base resistor and Vbe = 0.9V, $((24V-0.9V)/10k) = 0.0023$, 2.3mA
Base resistor PD = 57.6mW

Vce PD = 9mW ($0.018A * 0.5V = 0.0090W$)
Vbe PD = 2.1mW ($0.0023A * 0.9V = 0.0021W$)
Total transistor PD = 11.1mW
At 11.1mW temp rise above ambient = 4.6287C ($417C/W * 11.1mW = 4.6287C$)

Pd max = 300mW @25C
Derated to approx 240mW @ 50C
Thermal resistance, junction to ambient: 417C/W

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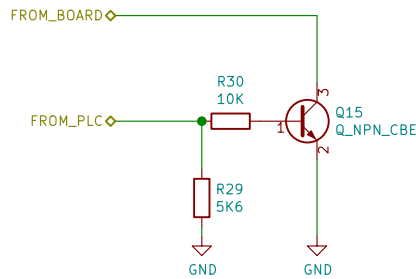
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Rev: V1.0

Id: 15/25



VDC = 24V
Minimum OPTO22 driver board current: 5mA

Ib = 2.3mA (see transistor notes)
Base resistor power dissipation = 57.6mW ($24^2 / 10K$)

With 5.6K (nominal) pull down resistor, current @ 24VDC = 4.3mA ($24/5600 = 0.0043$)
Pull down resistor power dissipation = 102.9mW ($24^2/5600$)

Variation allowance: Assuming 5% resistor, +25C temperature change, 200ppm/C resistor TCR

Lower end = 5.347K ($5.6K * 0.95$) * $(1 + (0.000200 * 25)) = 5346.6$
Upper end = 5.909K ($5.6K * 1.05$) * $(1 + (0.000200 * 25)) = 5909.4$

Lower end pull down current = 4.5mA
Upper end pull down current = 4.1mA

Total unit power dissipation 171.6mW ($102.9mW + 11.1mW + 57.6mW = 171.6mW$)
All outputs active power dissipation = 4.118W ($171.6mW * 24 = 4118mW$)

Transistor: Diodes Incorporated MMBTA42

Vce = 0.5V
Vbe = 0.9V
Each G4 IO module current draw: 18mA
Target Ic = 18mA
Target Ib = 2mA

Ib = 2.3mA With 10K base resistor and Vbe = 0.9V, $((24V-0.9V)/10k) = 0.0023$, 2.3mA
Base resistor PD = 57.6mW

Vce PD = 9mW ($0.018A * 0.5V = 0.0090W$)
Vbe PD = 2.1mW ($0.0023A * 0.9V = 0.0021W$)
Total transistor PD = 11.1mW
At 11.1mW temp rise above ambient = 4.6287C ($417C/W * 11.1mW = 4.6287C$)

Pd max = 300mW @25C
Derated to approx 240mW @ 50C
Thermal resistance, junction to ambient: 417C/W

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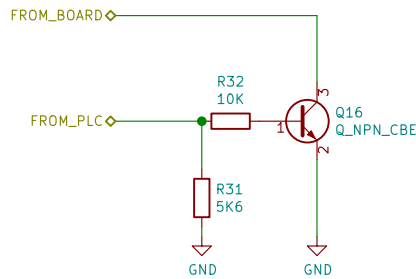
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Rev: V1.0

Id: 16/25



VDC = 24V
Minimum OPTO22 driver board current: 5mA

Ib = 2.3mA (see transistor notes)
Base resistor power dissipation = 57.6mW ($24^2 / 10K$)

With 5.6K (nominal) pull down resistor, current @ 24VDC = 4.3mA ($24/5600 = 0.0043$)
Pull down resistor power dissipation = 102.9mW ($24^2/5600$)

Variation allowance: Assuming 5% resistor, +25C temperature change, 200ppm/C resistor TCR

Lower end = 5.347K ($5.6K * 0.95$) * $(1 + (0.000200 * 25)) = 5346.6$
Upper end = 5.909K ($5.6K * 1.05$) * $(1 + (0.000200 * 25)) = 5909.4$

Lower end pull down current = 4.5mA
Upper end pull down current = 4.1mA

Total unit power dissipation 171.6mW ($102.9mW + 11.1mW + 57.6mW = 171.6mW$)
All outputs active power dissipation = 4.118W ($171.6mW * 24 = 4118mW$)

Transistor: Diodes Incorporated MMBTA42

Vce = 0.5V
Vbe = 0.9V
Each G4 IO module current draw: 18mA
Target Ic = 18mA
Target Ib = 2mA

Ib = 2.3mA With 10K base resistor and Vbe = 0.9V, $((24V-0.9V)/10k) = 0.0023$, 2.3mA
Base resistor PD = 57.6mW

Pd max = 300mW @25C
Derated to approx 240mW @ 50C
Thermal resistance, junction to ambient: 417C/W

Vce PD = 9mW ($0.018A * 0.5V = 0.0090W$)
Vbe PD = 2.1mW ($0.0023A * 0.9V = 0.0021W$)
Total transistor PD = 11.1mW
At 11.1mW temp rise above ambient = 4.6287C ($417C/W * 11.1mW = 4.6287C$)

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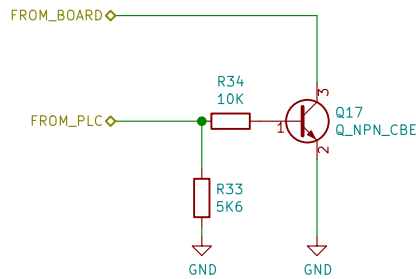
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Rev: V1.0

Id: 17/25



VDC = 24V
Minimum OPTO22 driver board current: 5mA

Ib = 2.3mA (see transistor notes)
Base resistor power dissipation = 57.6mW ($24^2 / 10K$)

With 5.6K (nominal) pull down resistor, current @ 24VDC = 4.3mA ($24/5600 = 0.0043$)
Pull down resistor power dissipation = 102.9mW ($24^2/5600$)

Variation allowance: Assuming 5% resistor, +25C temperature change, 200ppm/C resistor TCR

Lower end = 5.347K ($5.6K * 0.95$) * $(1 + (0.000200 * 25)) = 5346.6$
Upper end = 5.909K ($5.6K * 1.05$) * $(1 + (0.000200 * 25)) = 5909.4$

Lower end pull down current = 4.5mA
Upper end pull down current = 4.1mA

Total unit power dissipation 171.6mW ($102.9mW + 11.1mW + 57.6mW = 171.6mW$)
All outputs active power dissipation = 4.118W ($171.6mW * 24 = 4118mW$)

Transistor: Diodes Incorporated MMBTA42

Vce = 0.5V
Vbe = 0.9V
Each G4 IO module current draw: 18mA
Target Ic = 18mA
Target Ib = 2mA

Ib = 2.3mA With 10K base resistor and Vbe = 0.9V, $((24V-0.9V)/10k) = 0.0023$, 2.3mA
Base resistor PD = 57.6mW

Pd max = 300mW @25C
Derated to approx 240mW @ 50C
Thermal resistance, junction to ambient: 417C/W

Vce PD = 9mW ($0.018A * 0.5V = 0.0090W$)
Vbe PD = 2.1mW ($0.0023A * 0.9V = 0.0021W$)
Total transistor PD = 11.1mW
At 11.1mW temp rise above ambient = 4.6287C ($417C/W * 11.1mW = 4.6287C$)

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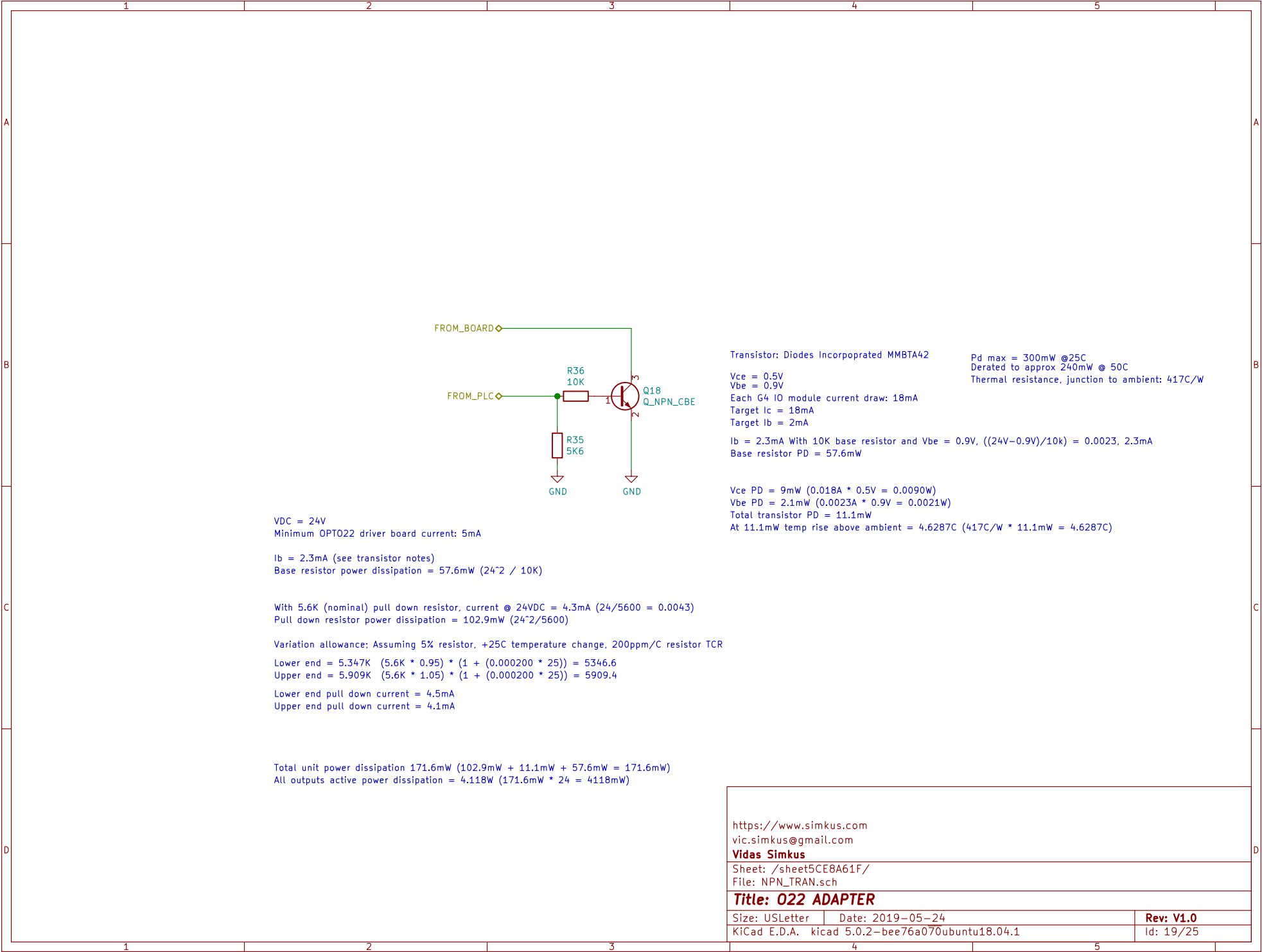
Title: 022 ADAPTER

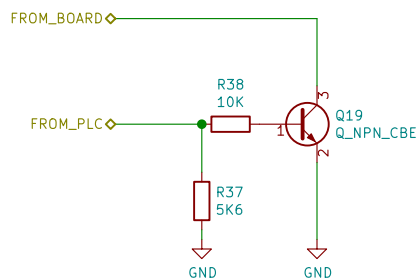
Size: USLetter Date: 2019-05-24

KiCad E.D.A. kicad 5.0.2-bee76a070ubuntu18.04.1

Rev: V1.0

Id: 18/25





VDC = 24V
Minimum OPTO22 driver board current: 5mA

Ib = 2.3mA (see transistor notes)
Base resistor power dissipation = 57.6mW (24² / 10K)

With 5.6K (nominal) pull down resistor, current @ 24VDC = 4.3mA (24/5600 = 0.0043)
Pull down resistor power dissipation = 102.9mW (24²/5600)

Variation allowance: Assuming 5% resistor, +25C temperature change, 200ppm/C resistor TCR

Lower end = 5.347K (5.6K * 0.95) * (1 + (0.000200 * 25)) = 5346.6
Upper end = 5.909K (5.6K * 1.05) * (1 + (0.000200 * 25)) = 5909.4

Lower end pull down current = 4.5mA
Upper end pull down current = 4.1mA

Total unit power dissipation 171.6mW (102.9mW + 11.1mW + 57.6mW = 171.6mW)
All outputs active power dissipation = 4.118W (171.6mW * 24 = 4118mW)

Transistor: Diodes Incorporated MMBTA42

Vce = 0.5V
Vbe = 0.9V
Each G4 IO module current draw: 18mA
Target Ic = 18mA
Target Ib = 2mA

Ib = 2.3mA With 10K base resistor and Vbe = 0.9V, ((24V-0.9V)/10k) = 0.0023, 2.3mA
Base resistor PD = 57.6mW

Pd max = 300mW @25C
Derated to approx 240mW @ 50C
Thermal resistance, junction to ambient: 417C/W

Vce PD = 9mW (0.018A * 0.5V = 0.0090W)
Vbe PD = 2.1mW (0.0023A * 0.9V = 0.0021W)
Total transistor PD = 11.1mW
At 11.1mW temp rise above ambient = 4.6287C (417C/W * 11.1mW = 4.6287C)

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Sheet: /sheet5CE8A620/
File: NPN_TRAN.sch

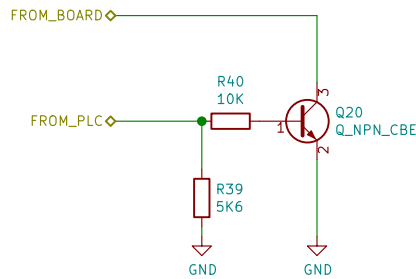
Title: 022 ADAPTER

Size: USLetter Date: 2019-05-24

KiCad E.D.A. kicad 5.0.2-bee76a070ubuntu18.04.1

Rev: V1.0

Id: 20/25



VDC = 24V
Minimum OPTO22 driver board current: 5mA

Ib = 2.3mA (see transistor notes)
Base resistor power dissipation = 57.6mW ($24^2 / 10K$)

With 5.6K (nominal) pull down resistor, current @ 24VDC = 4.3mA ($24/5600 = 0.0043$)
Pull down resistor power dissipation = 102.9mW ($24^2/5600$)

Variation allowance: Assuming 5% resistor, +25C temperature change, 200ppm/C resistor TCR

Lower end = 5.347K ($5.6K * 0.95$) * ($1 + (0.000200 * 25)$) = 5346.6
Upper end = 5.909K ($5.6K * 1.05$) * ($1 + (0.000200 * 25)$) = 5909.4

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Total unit power dissipation 171.6mW ($102.9mW + 11.1mW + 57.6mW = 171.6mW$)
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Base resistor PD = 57.6mW

Vce PD = 9mW ($0.018A * 0.5V = 0.0090W$)
Vbe PD = 2.1mW ($0.0023A * 0.9V = 0.0021W$)
Total transistor PD = 11.1mW
At 11.1mW temp rise above ambient = 4.6287C ($417C/W * 11.1mW = 4.6287C$)

Pd max = 300mW @25C
Derated to approx 240mW @ 50C
Thermal resistance, junction to ambient: 417C/W

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Sheet: /sheet5CE8A621/
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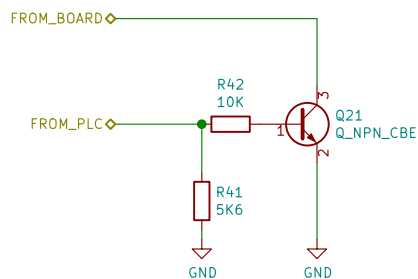
Title: 022 ADAPTER

Size: USLetter Date: 2019-05-24

KiCad E.D.A. kicad 5.0.2-bee76a070ubuntu18.04.1

Rev: V1.0

Id: 21/25



VDC = 24V
Minimum OPTO22 driver board current: 5mA

Ib = 2.3mA (see transistor notes)
Base resistor power dissipation = 57.6mW (24² / 10K)

With 5.6K (nominal) pull down resistor, current @ 24VDC = 4.3mA (24/5600 = 0.0043)
Pull down resistor power dissipation = 102.9mW (24²/5600)

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Total unit power dissipation 171.6mW (102.9mW + 11.1mW + 57.6mW = 171.6mW)
All outputs active power dissipation = 4.118W (171.6mW * 24 = 4118mW)

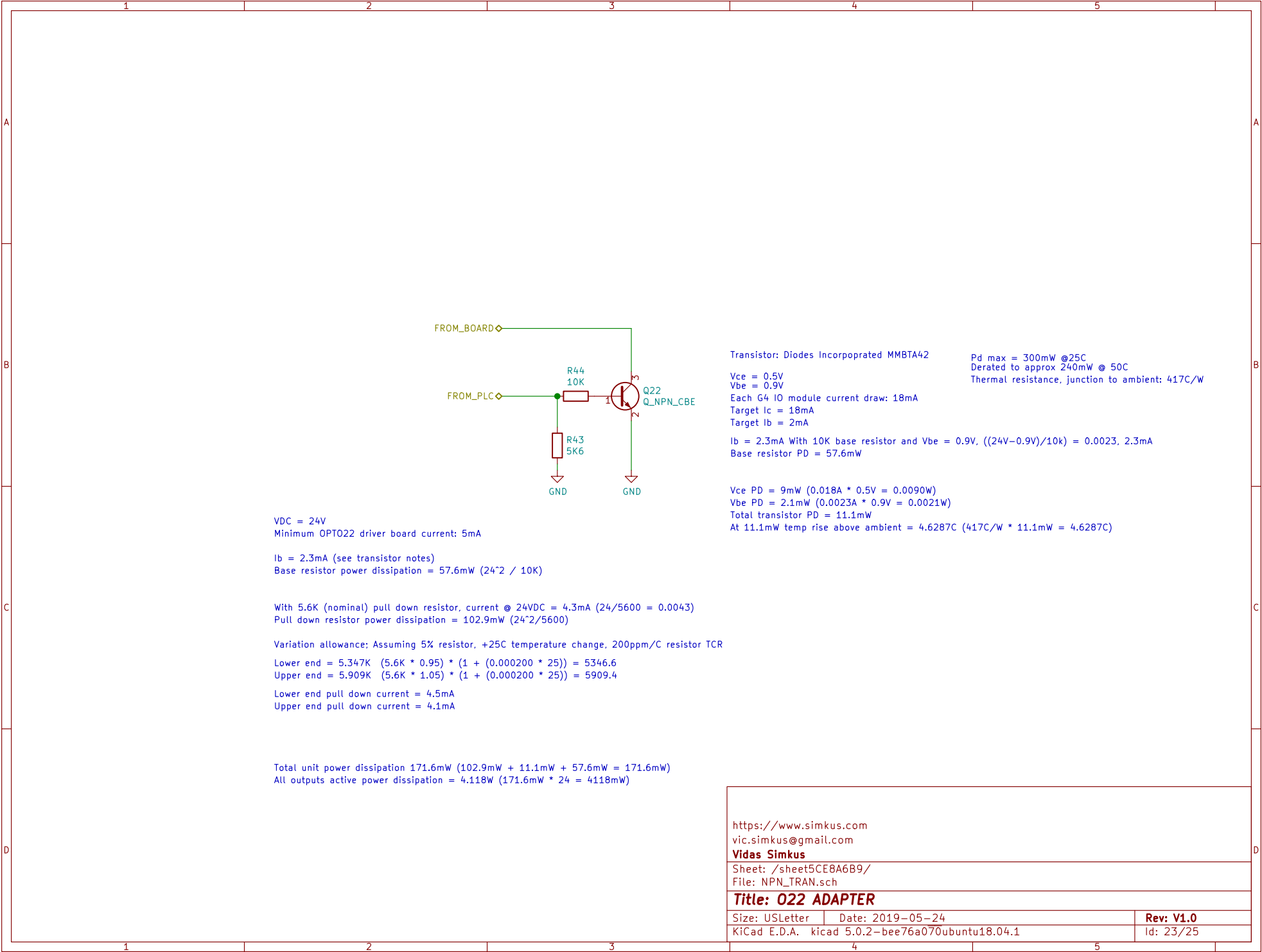
Transistor: Diodes Incorporated MMBTA42

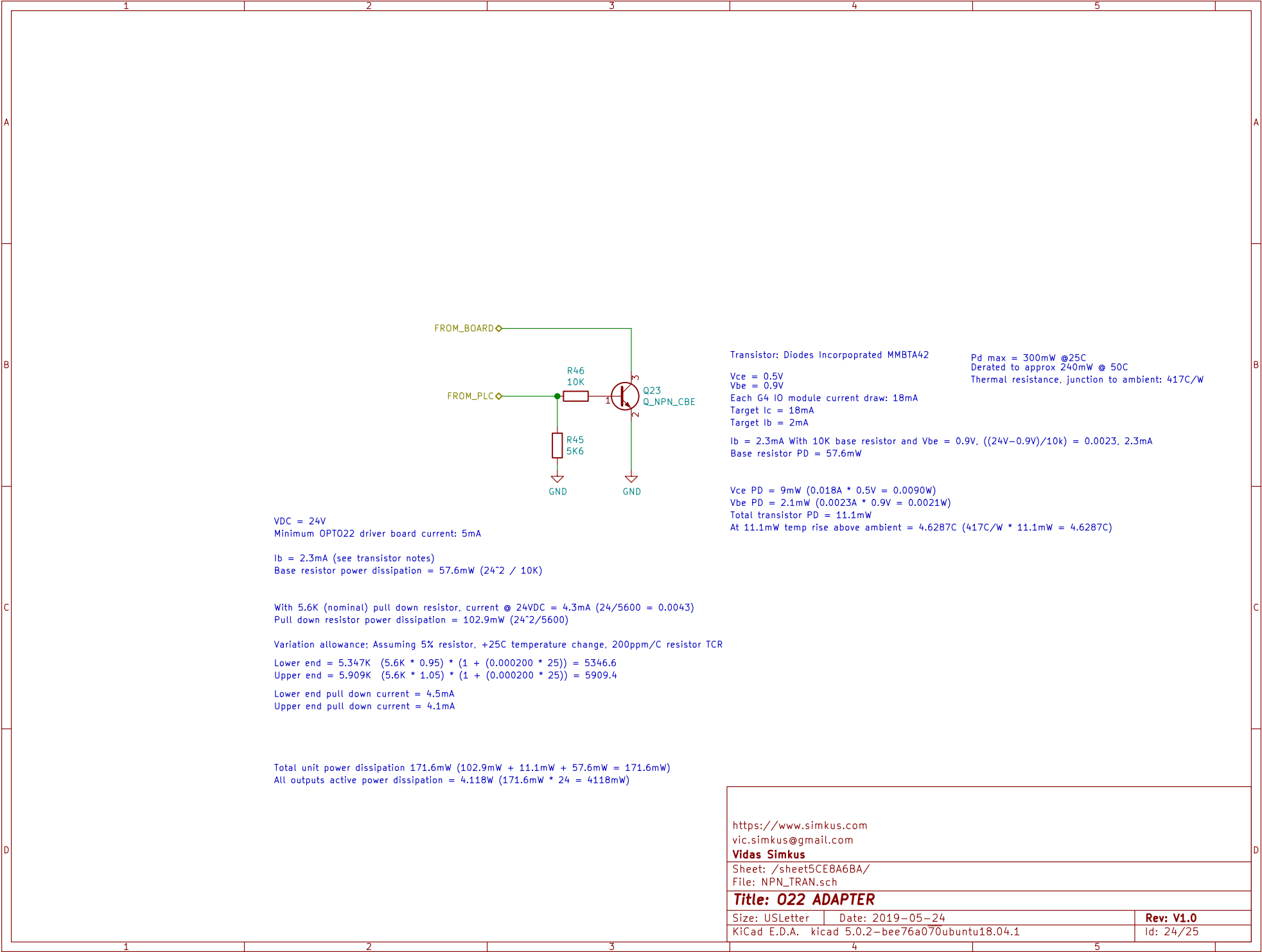
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Target Ic = 18mA
Target Ib = 2mA

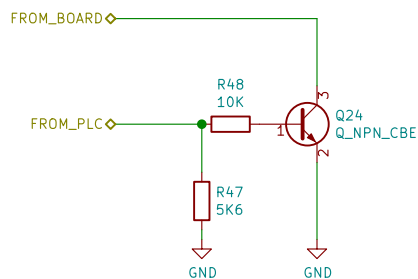
Ib = 2.3mA With 10K base resistor and Vbe = 0.9V, ((24V-0.9V)/10k) = 0.0023, 2.3mA
Base resistor PD = 57.6mW

Pd max = 300mW @25C
Derated to approx 240mW @ 50C
Thermal resistance, junction to ambient: 417C/W

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Total transistor PD = 11.1mW
At 11.1mW temp rise above ambient = 4.6287C (417C/W * 11.1mW = 4.6287C)







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