

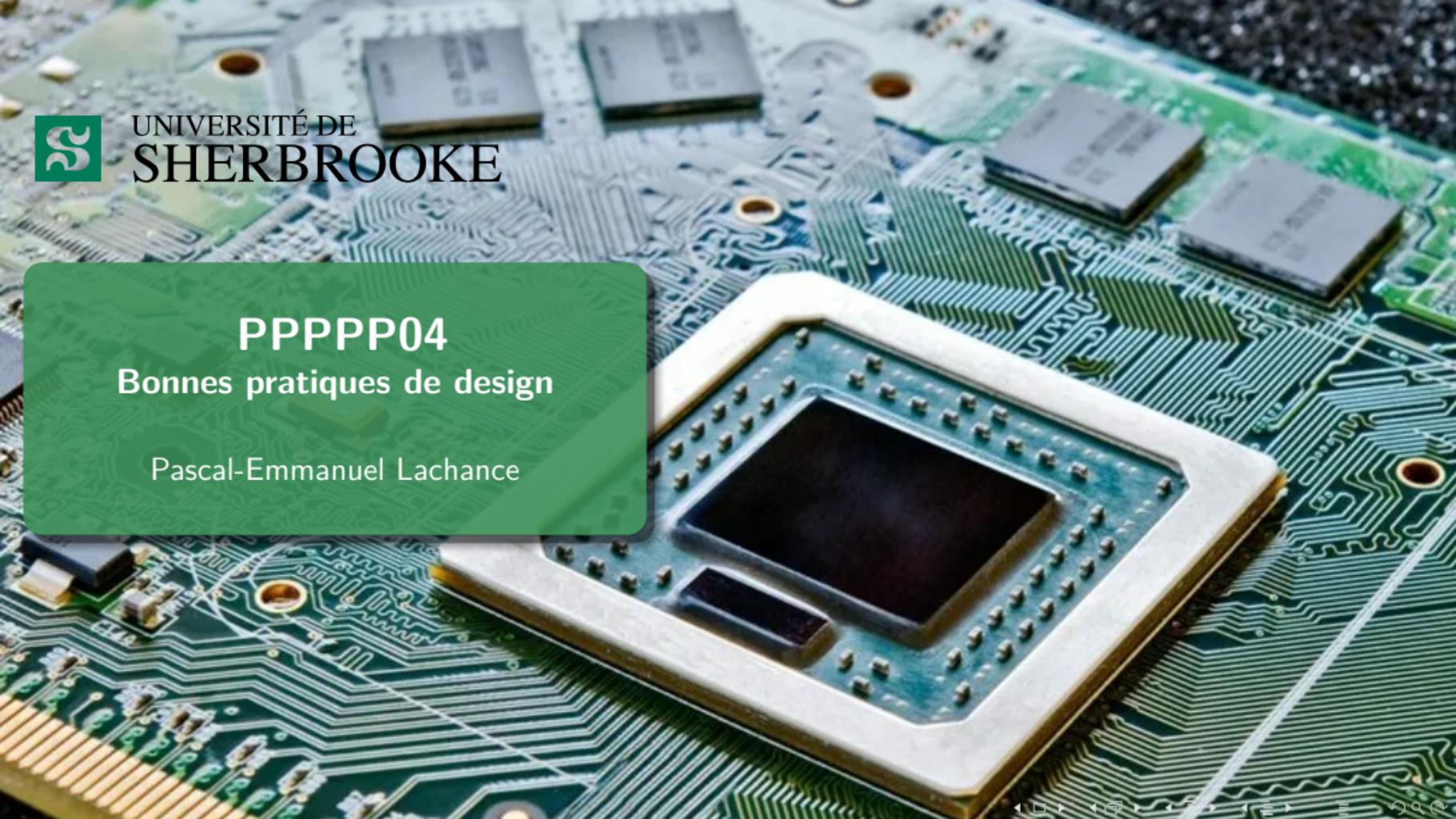


UNIVERSITÉ DE
SHERBROOKE

PPPPP04

Bonnes pratiques de design

Pascal-Emmanuel Lachance



PPPPP04

Bonnes pratiques de design

Par: Pascal-Emmanuel Lachance

-  Comment choisir ses composantes et optimiser son BOM?
-  Comment bien concevoir un symbole et un footprint?
-  Bonnes pratiques de schémas
-  Bonnes pratiques de layout
-  Comment faire un design review?
-  Communication avec fabricants, assembleurs et programmeurs

Bonnes pratiques générales

- Bonnes pratiques générales
 - Définition des besoins
 - Debugging
 - Simulation
- Bonnes pratiques des composantes & BOM
- Bonnes pratiques de schéma

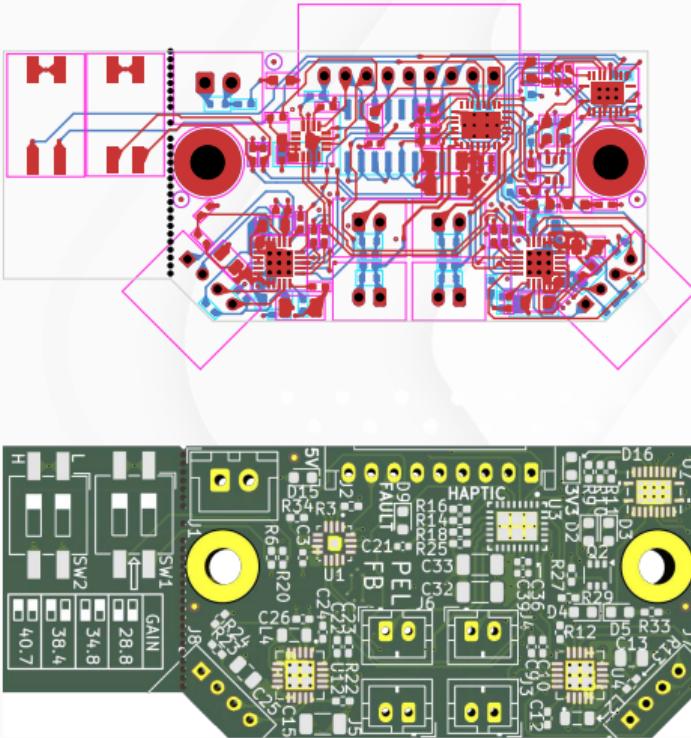
Bonnes pratiques générales

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- Bonnes pratiques de schéma

Mise en contexte — Haptic Board



- Dernier board que j'ai design
 - A24, pour PMC
- Placé au dos de la main au-dessus d'un autre board
- Contrôle des éléments d'haptique
- Dernière partie d'une intégration de 10 PCBs sur le bras



- Dresser une liste des fonctionnalités
 - Activation de 4 solénoïdes
 - Activation de 4 piézo
 - Petit
 - Ne chauffe pas
 - Alimenté 5 V et/ou 3.3 V
 - Contrôlé par I^2C & I^2S
 - Contraintes de bruit électronique

- Dresser une liste des fonctionnalités
- Dresser des requis techniques quantifiables
- Activation de 4 solénoïdes
 - 5 V @ 500 mA chaque
- Activation de 4 piézo
 - 60 V @ 200 Hz AC
- Petit
 - 25.5 mm × 45 mm
- Ne chauffe pas
 - $\Delta T_{max} = 40^\circ\text{C}$
- Alimenté 5 V et/ou 3.3 V
- Contrôlé par I^2C & I^2S
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Définition des besoins

- Dresser une liste des fonctionnalités
- Dresser des requis techniques quantifiables

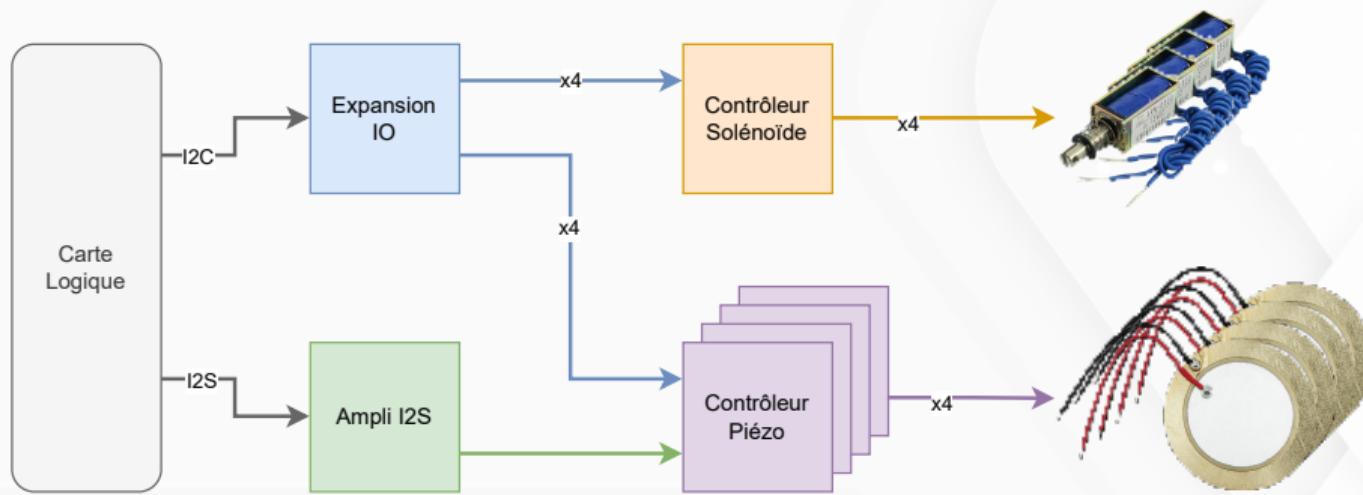
- Combien en as-tu besoin?
- A quel point ils doivent être fiables
- Comment tu vas les tester?
 - Dresser un plan de test!
- Envisager la complexité dès le début

- Activation de 4 solénoïdes
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Schéma-Blocs

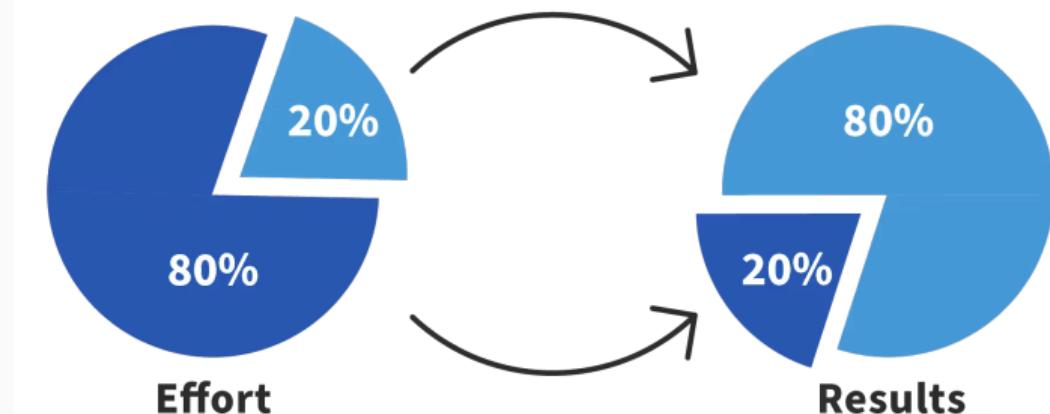
- Faire un schéma-bloc des différentes portions du projet
- À inclure dans le schéma final

- Général
- Power Delivery Network
- MCU/CPU/FPGA
- Communications
- Séquences



- Principe simple:
 - 80% de tes résultats viennent de 20% des efforts
 - Pour obtenir le dernier 20% des résultats, il faut mettre 80% des efforts

Pareto Principle

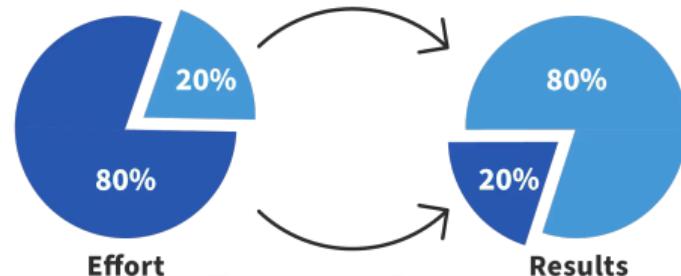


Source: [1]

- Principe simple:
 - 80% de tes résultats viennent de 20% des efforts
 - Pour obtenir le dernier 20% des résultats, il faut mettre 80% des efforts

- 80% des coûts vient de 20% des pièces
- 80% de la complexité vient de 20% du design
- 80% du power consommé par 20% des pièces
- 80% du temps de debug sur 20% des problèmes

Pareto Principle



Source: [1]

Bonnes pratiques générales

- Bonnes pratiques générales
 - Définition des besoins
 - **Debugging**
 - Simulation
- Bonnes pratiques des composantes & BOM
- Bonnes pratiques de schéma

Outils de debugging

Multimètre

- Mesures DC
- Mesures de l'alimentation
- Vérifier des shorts



Oscilloscope

- Temporel
- Meilleur outil
- Bruit
- Communication



Analyseur Logique

- Protocole
- Décodage protocole
- Validation communication



Caméra Thermique

- Température
- Trouver pièce brisée
- Valider requis thermiques



Current Clamp

- Courant
- Mesures de l'alimentation
- Non-intrusif



Power Analyzer — SMU

- Mesure power DC
- Précision
- Logging
- Source



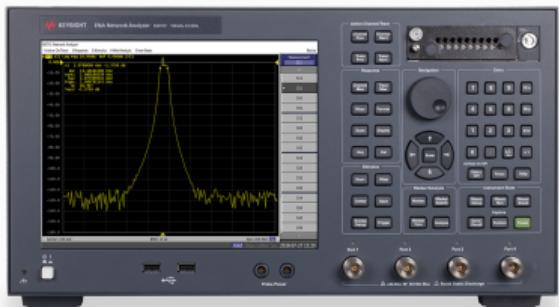
LCR Meter

- Réactance
- Mesure de composants passifs
- Impédance
- Quality Factor



Vector Network Analyzer

- Caractéristiques électriques
- Mesure signal et retour
- Mesure Impédance
- S-Parameter



Spectrum Analyzer

- Oscilloscope sur stéroïdes
- Fourier
- Mesure signal
- Mesure du bruit



Near-Field Probe

- EMI
- Mesure bruit électromagnétique
- Fréquence précise
- EMC



- Avoir plusieurs méthodes de debug
- Design pour pouvoir être debug
- Être conscient des outils de debugging à ta disposition
- Prévoir comment débugger et tester toutes les fonctionnalités
- Rajouter plus de testpoint que nécessaire

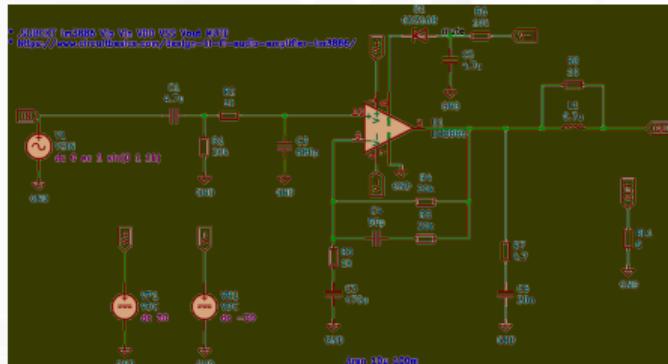
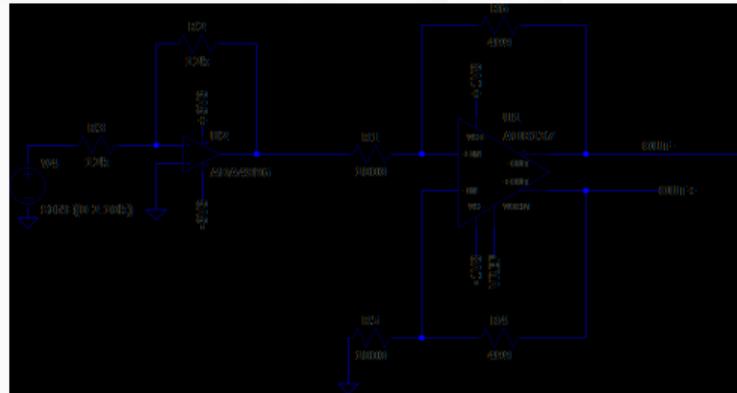
Où vont les testpoints?

- GND GND GND
- Power
- Lignes de communication
- Toute la chaîne analogique
- Clocks et signaux de contrôle
- Et plus!

Bonnes pratiques générales

- Bonnes pratiques générales
 - Définition des besoins
 - Debugging
 - Simulation
- Bonnes pratiques des composantes & BOM
- Bonnes pratiques de schéma

- Décrit un circuit en équations
- Permet de faire des analyses
 - AC
 - DC
 - Transient
 - Noise
- Simulations de circuits AC



Bonnes pratiques des composantes & BOM

- Bonnes pratiques générales
- Bonnes pratiques des composantes & BOM
 - Footprints
 - Symboles
 - Datasheets
 - Recherche de pièces
 - BOM
- Bonnes pratiques de schéma

Bonnes pratiques des composantes & BOM

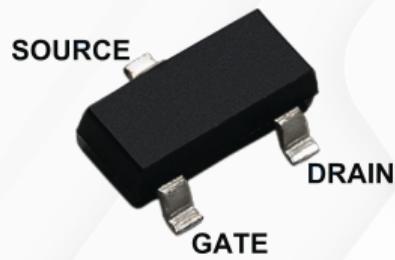
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 - BOM
- Bonnes pratiques de schéma

- Élément très important de la conception de pièces
 - Affecte le layout et l'assemblage
 - Le footprint devrait être clair
 - Le footprint devrait être représentatif
 - Le footprint devrait avoir des bonnes informations mécaniques
 - Le footprint devrait respecter tes capacités d'assemblage
 - Le footprint devrait avoir un modèle 3D
-
- Faire le footprint soi-même
 - Suivre un standard
 - Modifier la pièce plus tard au besoin
 - Avoir des marqueurs de pin 1 consistants
 - Avoir les bonnes couches mécaniques
 - Avoir des bons modèles 3D
 - Valider que le footprint est bon

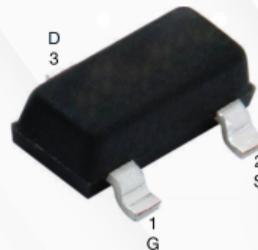
Attention aux footprints!



- Toujours valider tous les footprints
- Faire attention aux sources de footprints
- Faire attention particulière aux transistors!

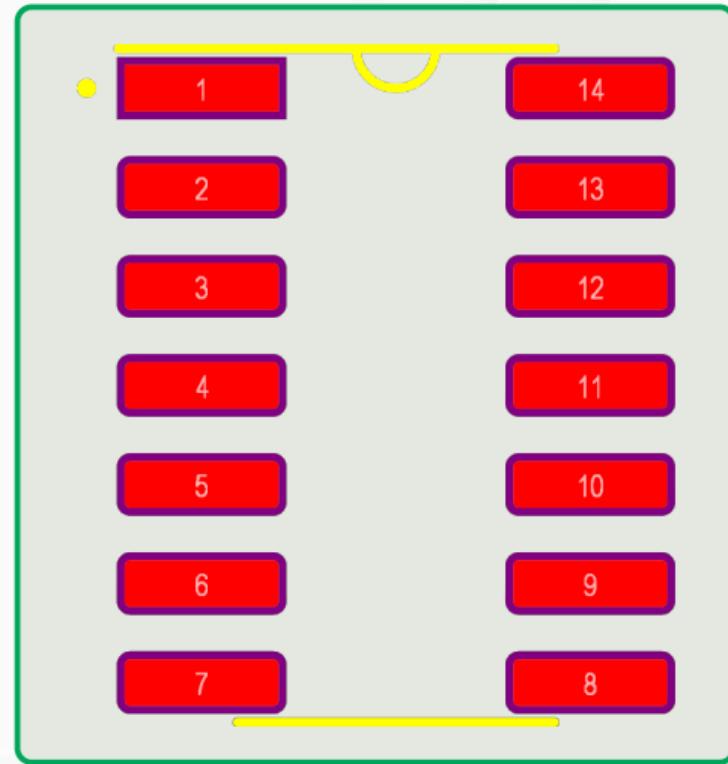


Microchip LND150

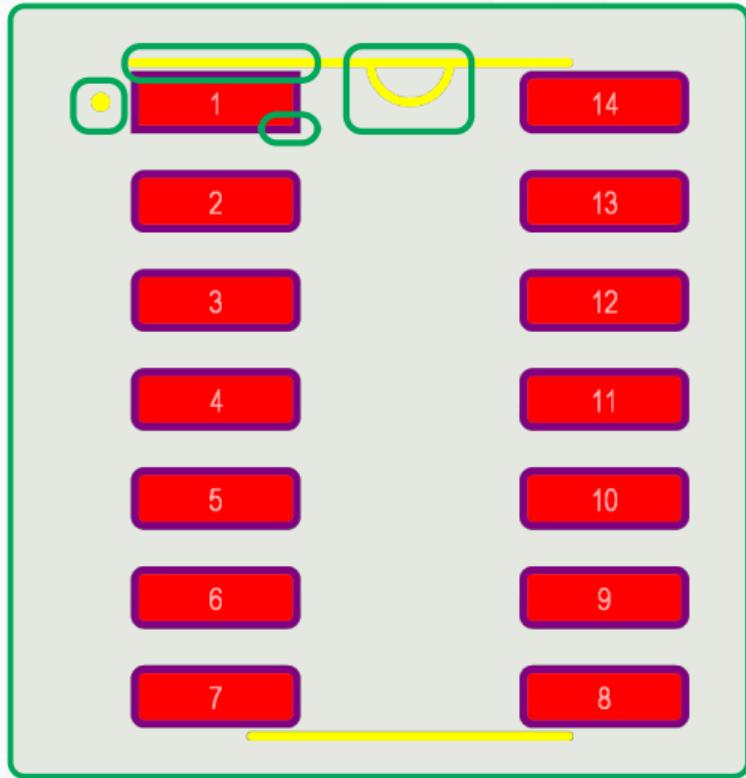


Vishay SQ2318

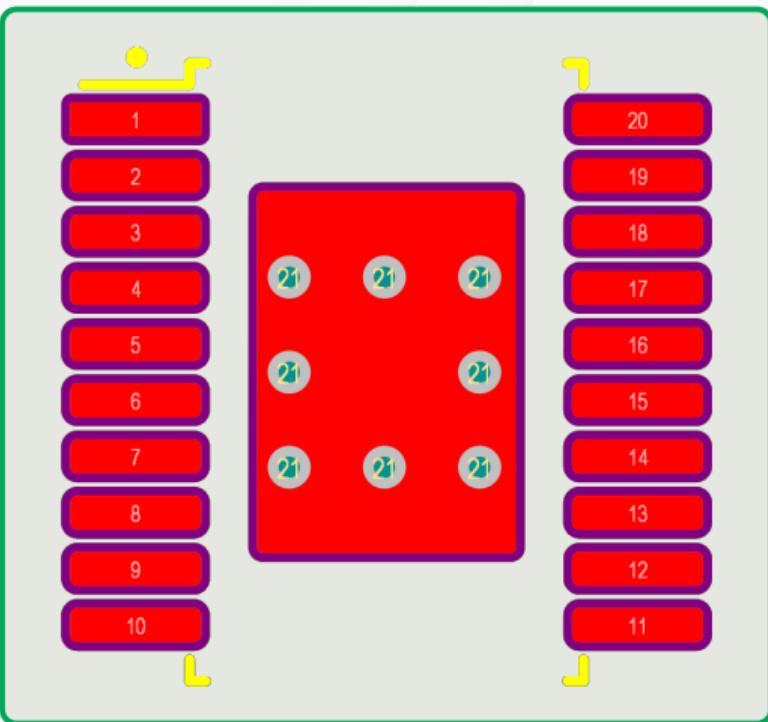
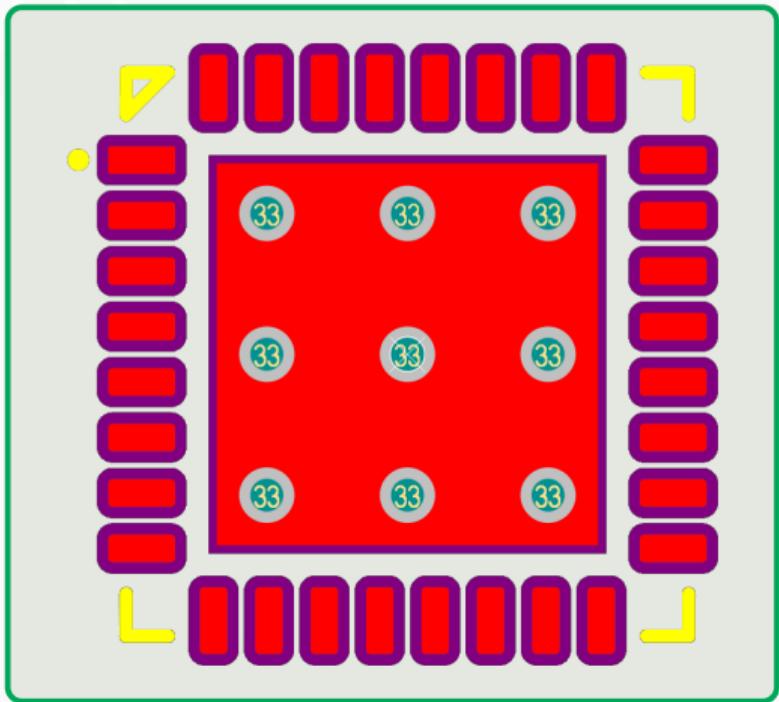
- Doit être visible clairement pendant l'assemblage
 - Couche d'assemblage avec les marqueurs
- Doit être visible après l'assemblage!
- Plusieurs marqueurs possibles
- En vue 3D, il faut pouvoir immédiatement le voir
- Ne pas couvrir avec un via ou d'autre silkscreen!



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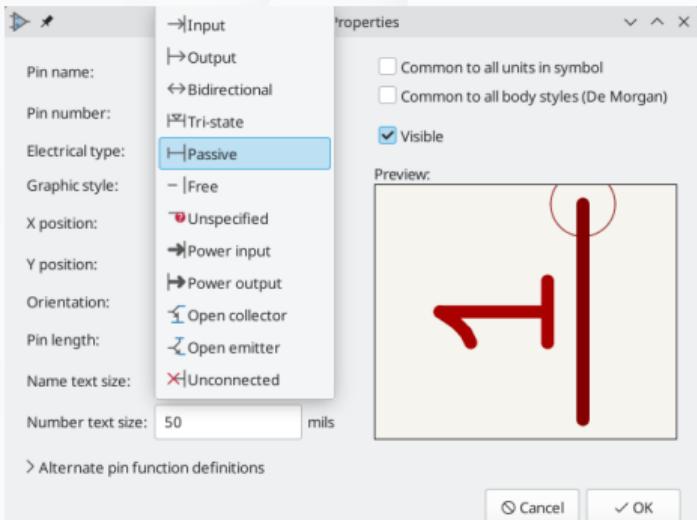
Marqueurs de pin 1



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 - Footprints
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 - Datasheets
 - Recherche de pièces
 - BOM
- Bonnes pratiques de schéma

- Un des éléments de clareté les plus importants
- Affecte aussi le BOM
- La pièce devrait être représentative
- La pièce devrait être facile à lire
- La pièce devrait contenir toutes les informations pour le BOM
- Faire la pièce soi-même
 - Suivre un standard
 - Modifier plus tard pour fitter le schéma
 - Customize le BOM
 - Validation de la pièce
 - Mettre les types électriques



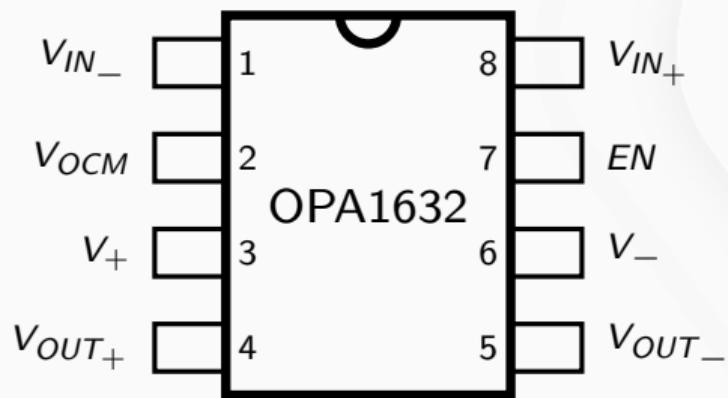
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Pinout du symbole

- Garder les inputs à gauche et outputs à droite
- Ne pas numéroter le symbole comme le footprint
- Utiliser des symboles représentatifs lorsque possible
- Tu ne devrais pas avoir à aller dans la datasheet pour comprendre la pièce

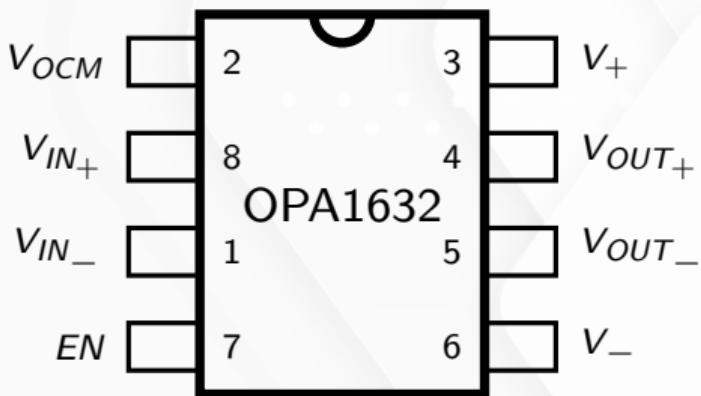
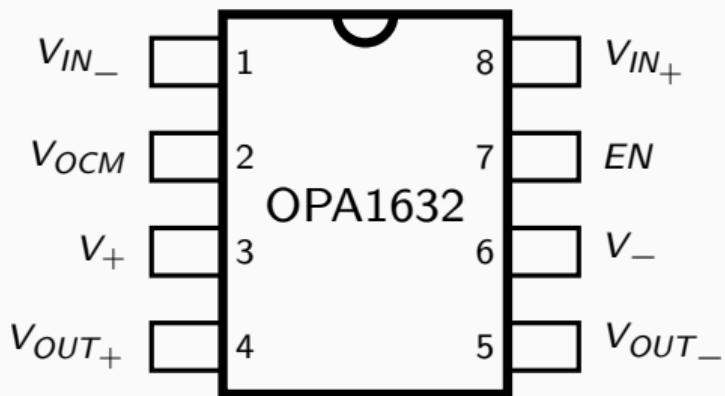
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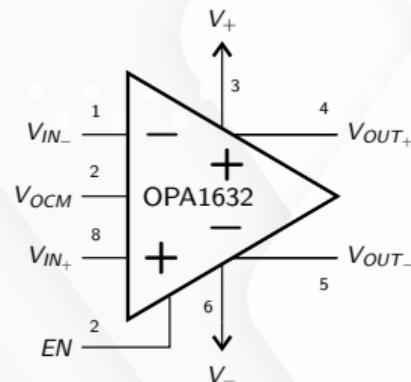
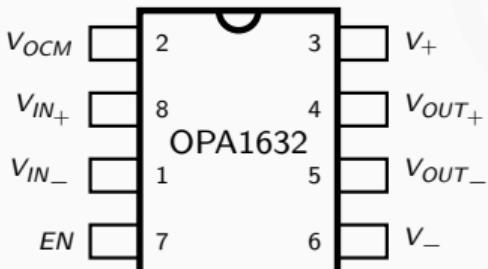
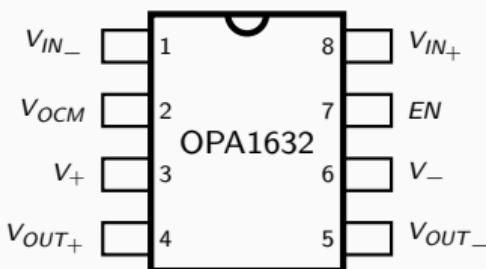
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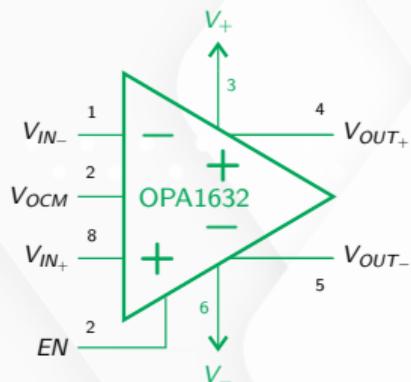
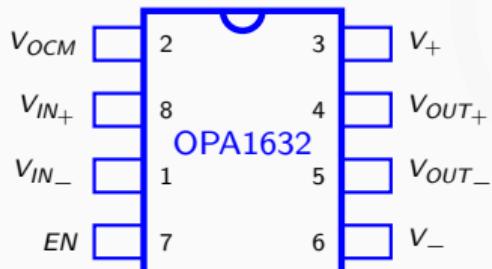
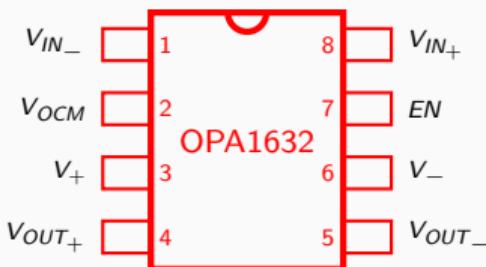
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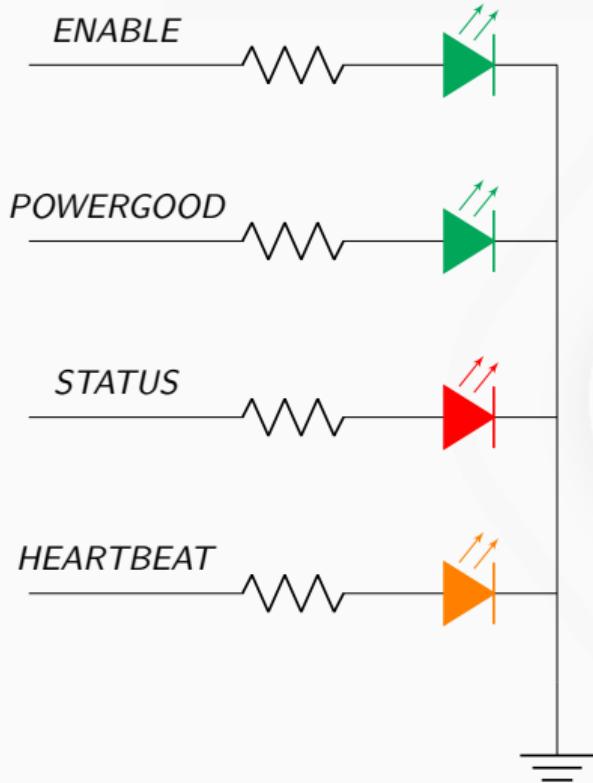


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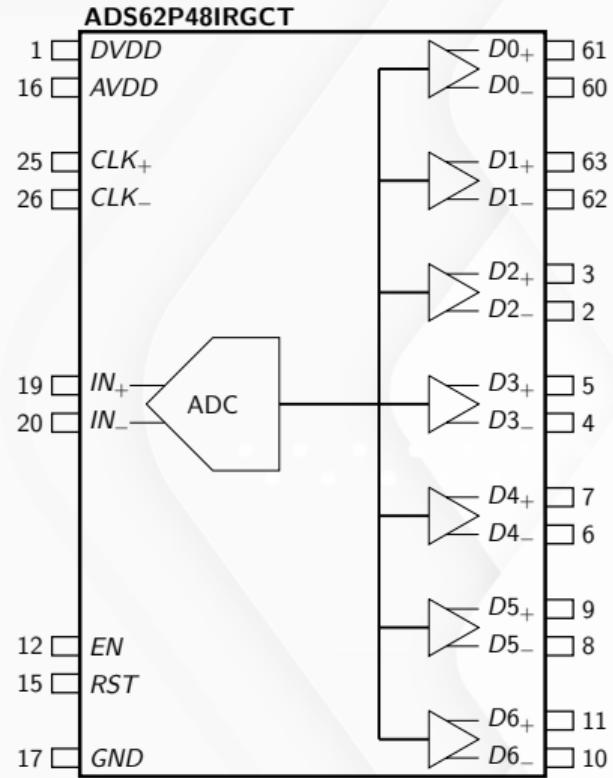
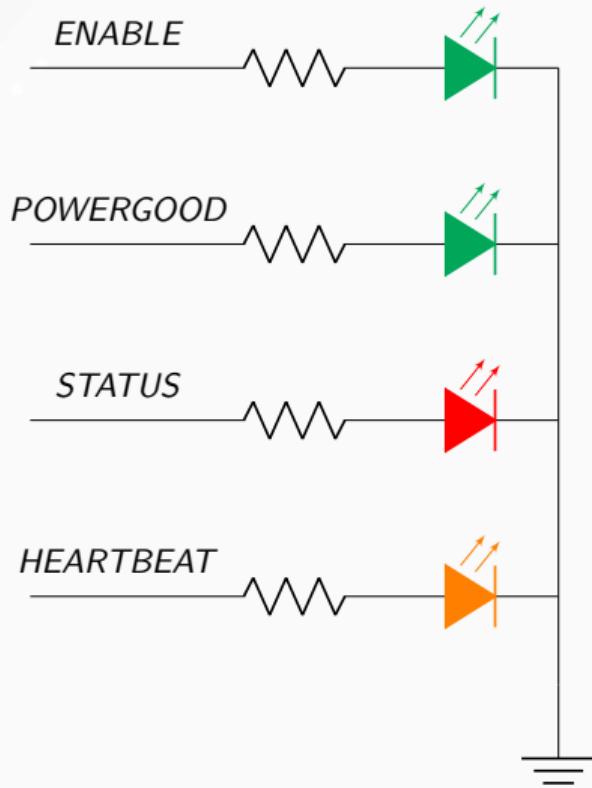
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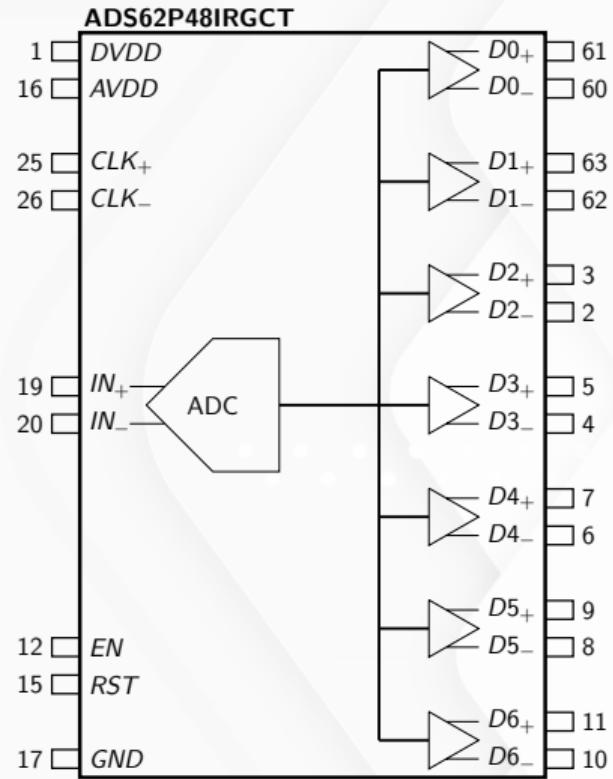
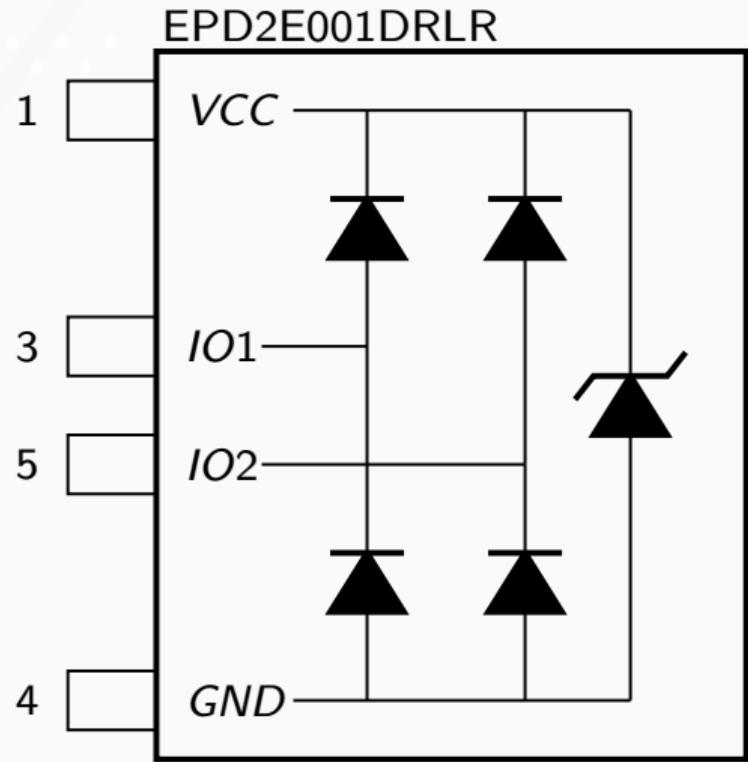
Symboles représentatifs



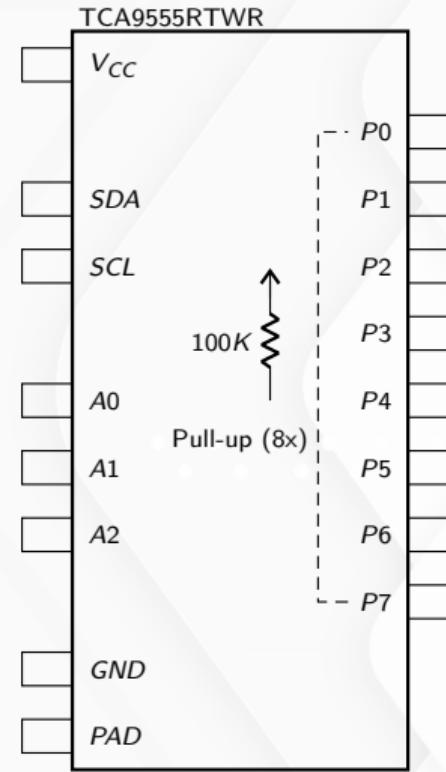
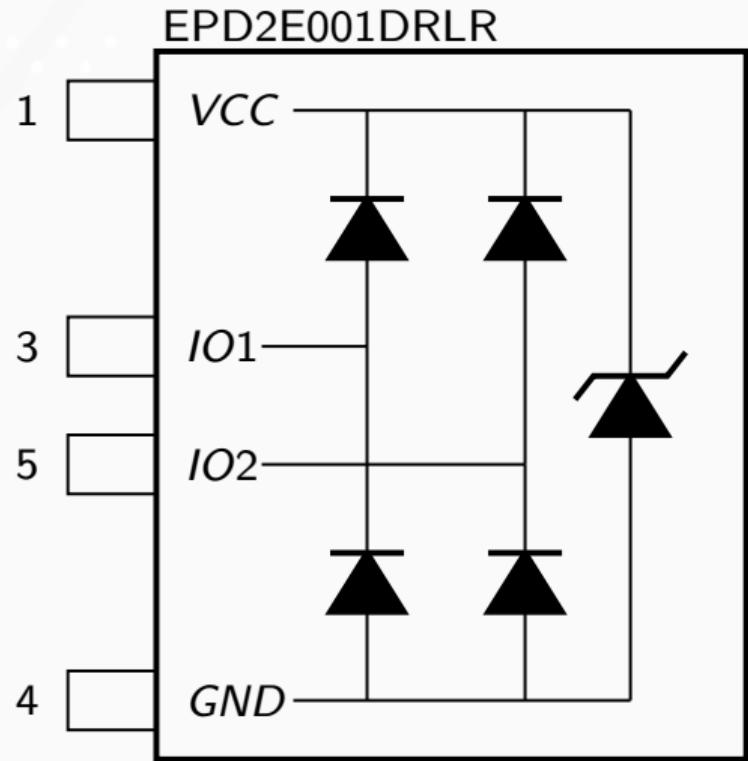
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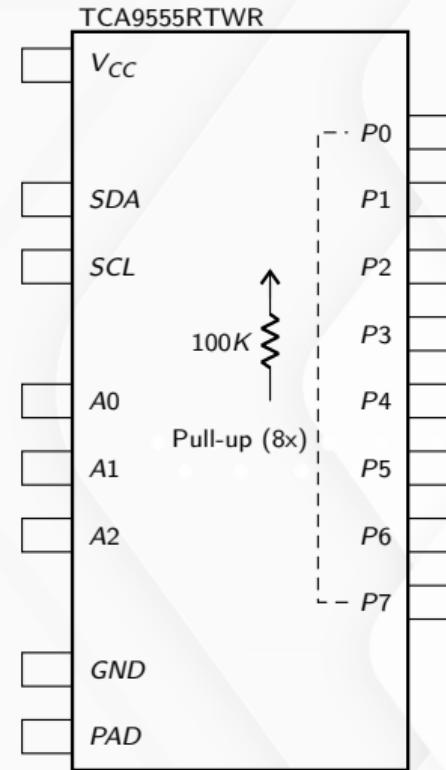
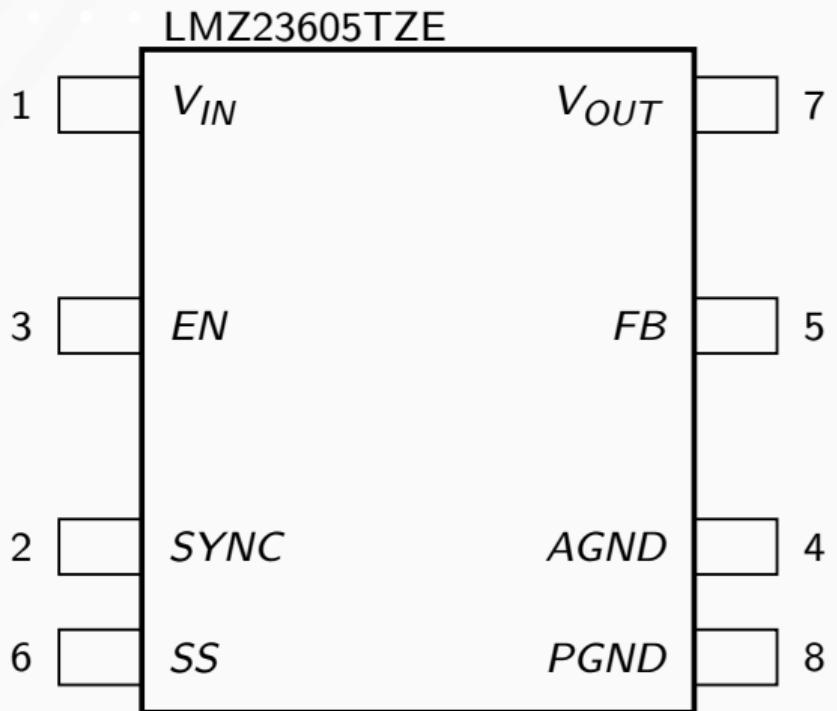
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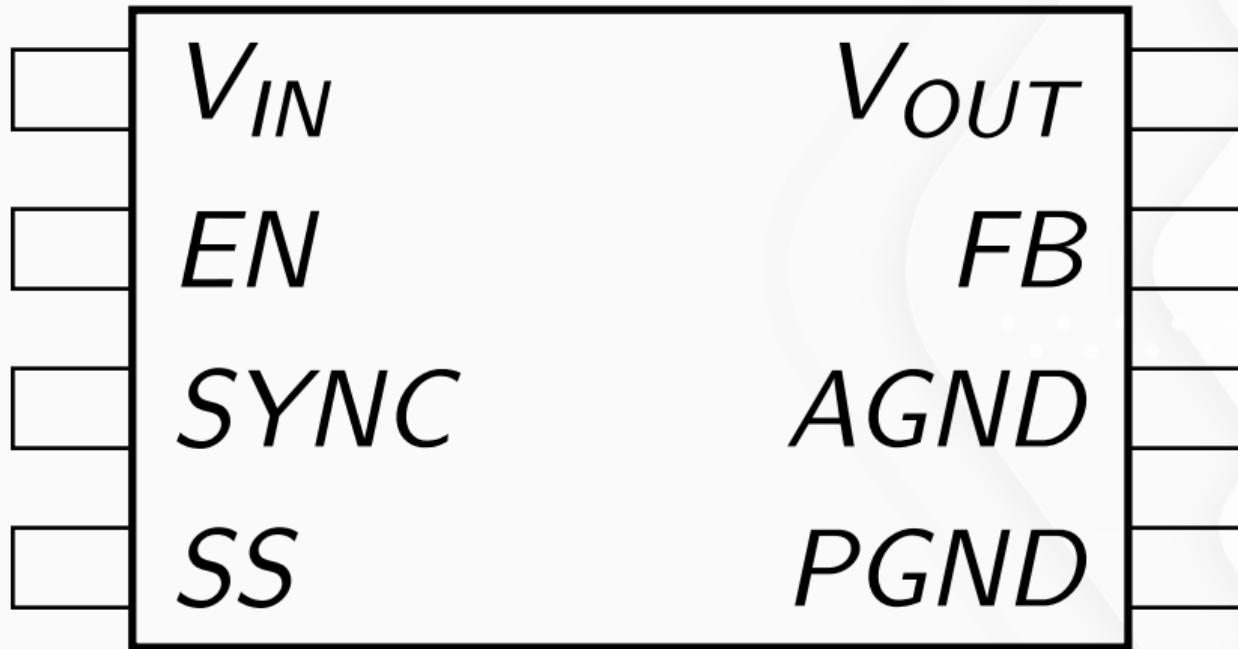
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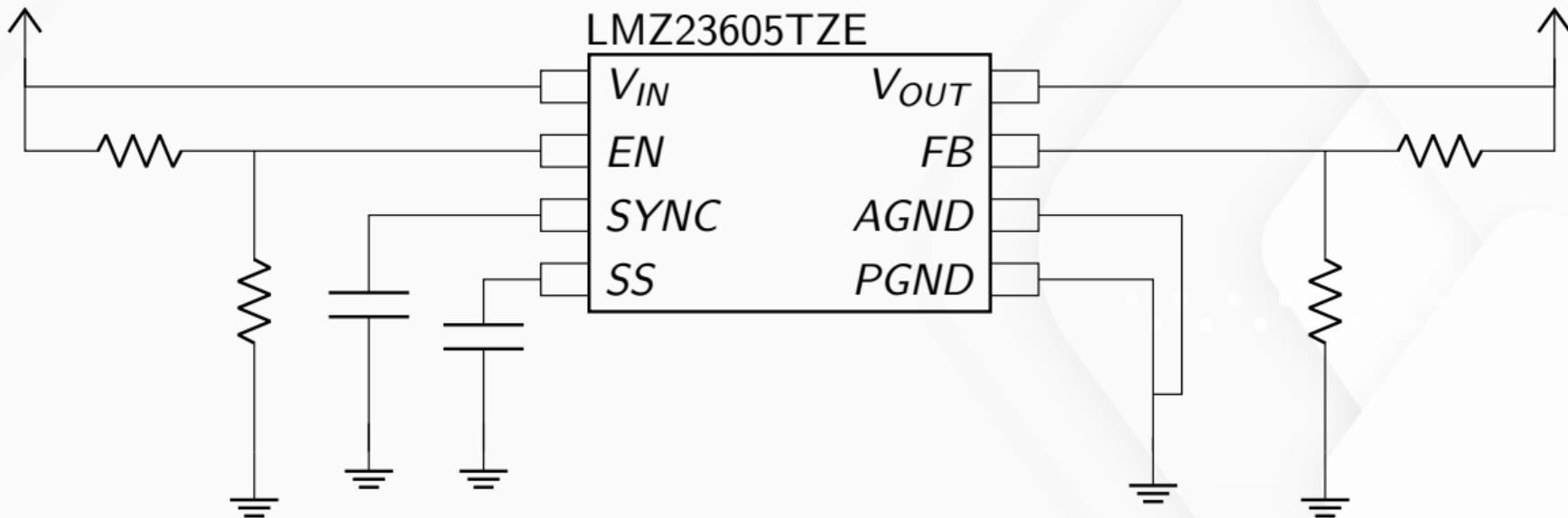


Symboles représentatifs

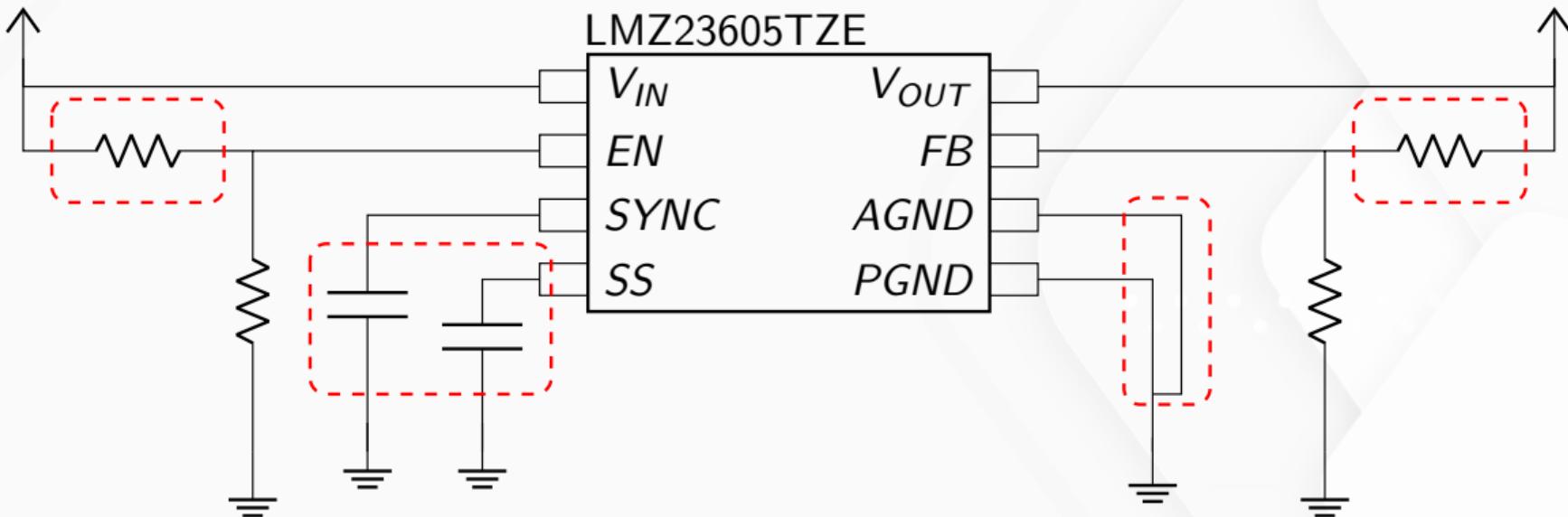


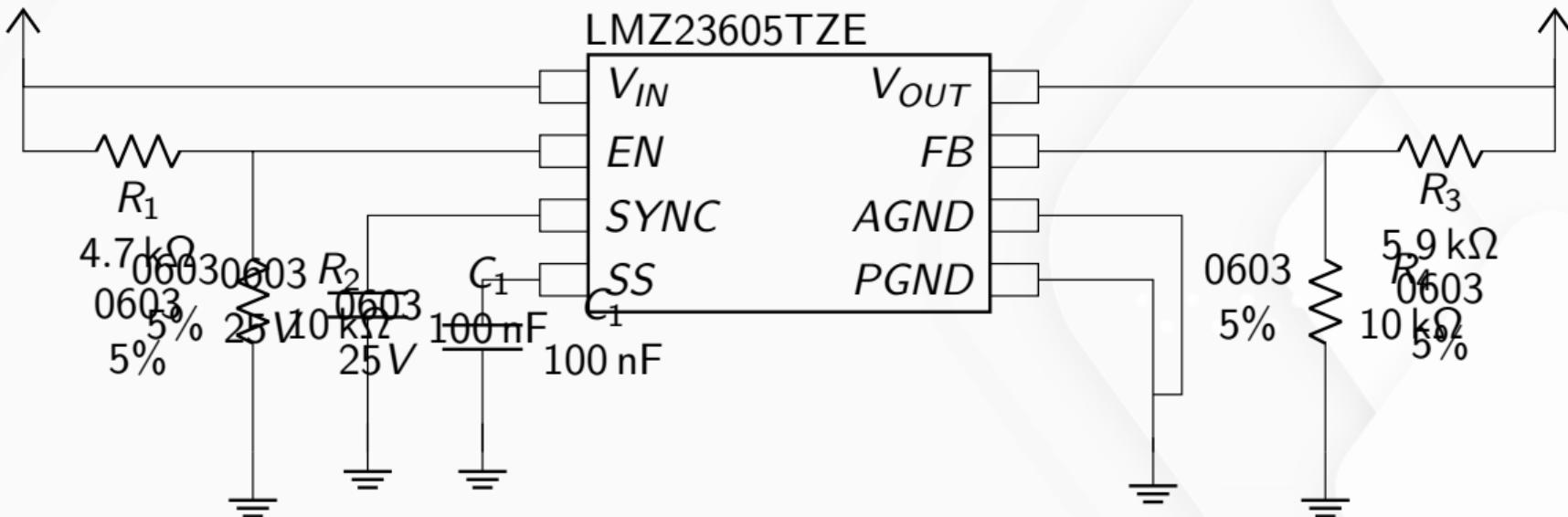
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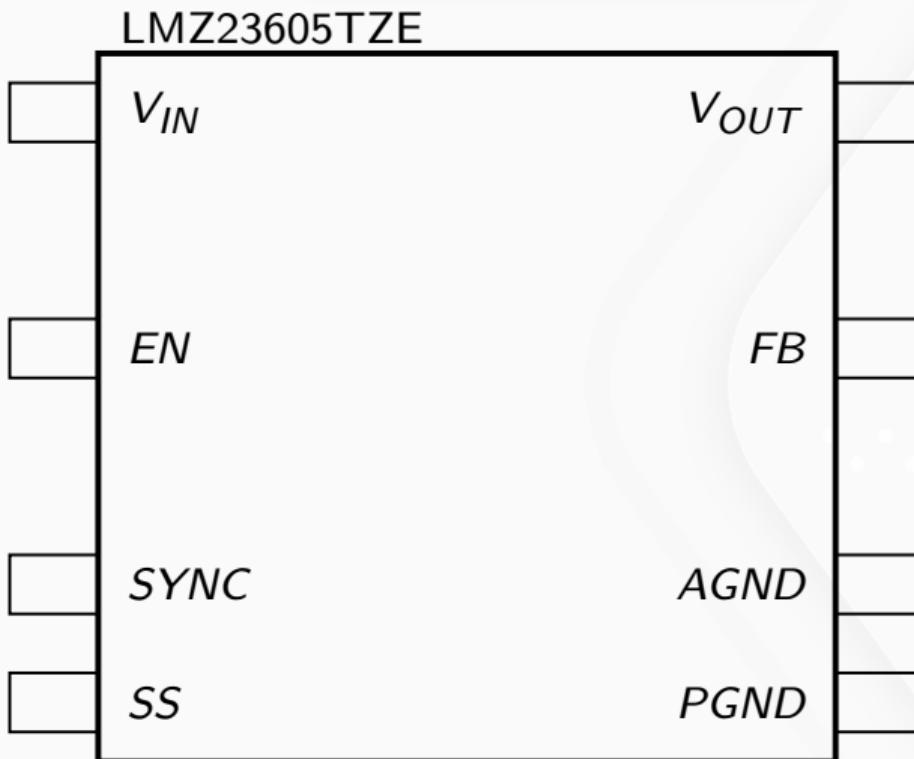




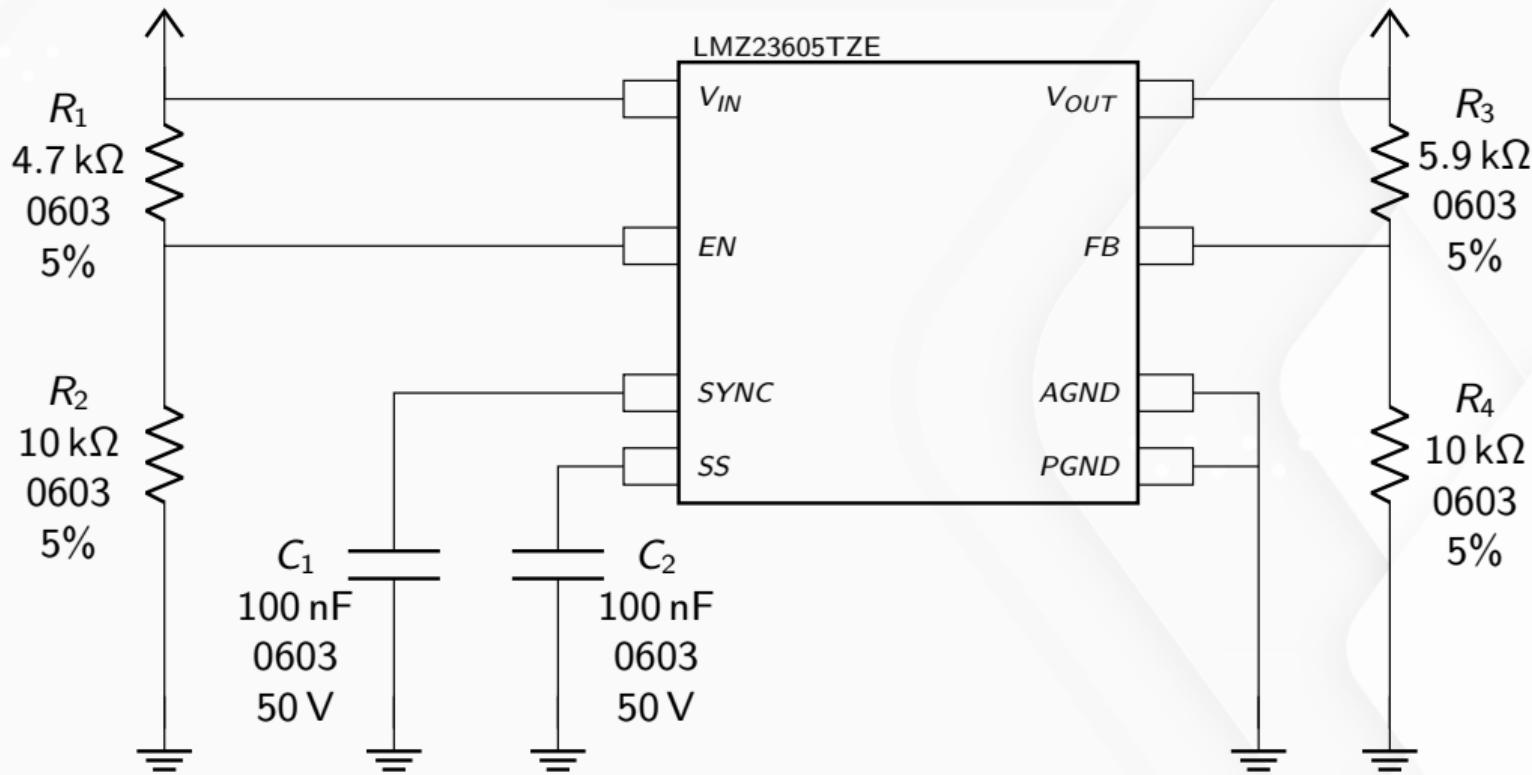
Laisser l'espace pour les composantes passives



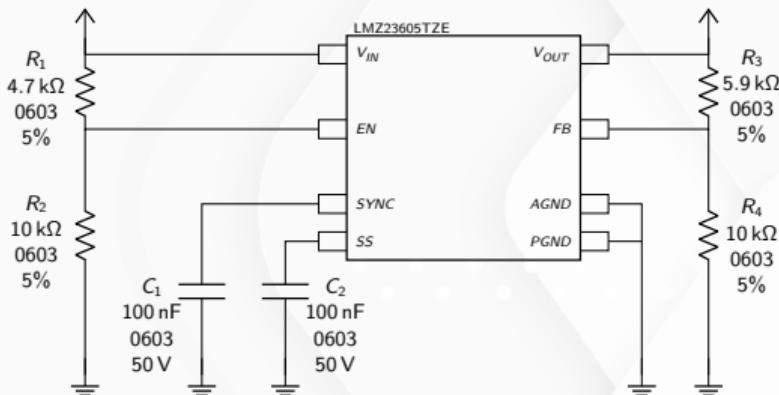
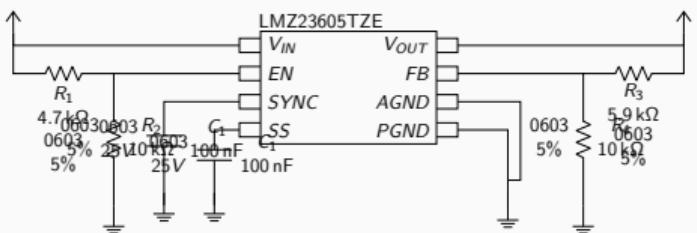




Laisser l'espace pour les composantes passives



Laisser l'espace pour les composantes passives



Informations du BOM

- Toujours mettre la datasheet dans la pièce
- Manufacturier et part number complet (ce qui va être commandé au final)
- Plages d'opérations (température, tension, courant)
- Fournisseurs (avec liens pour les achats)
- Qui a fait le symbole, qui l'a révisé et quand (suivi)

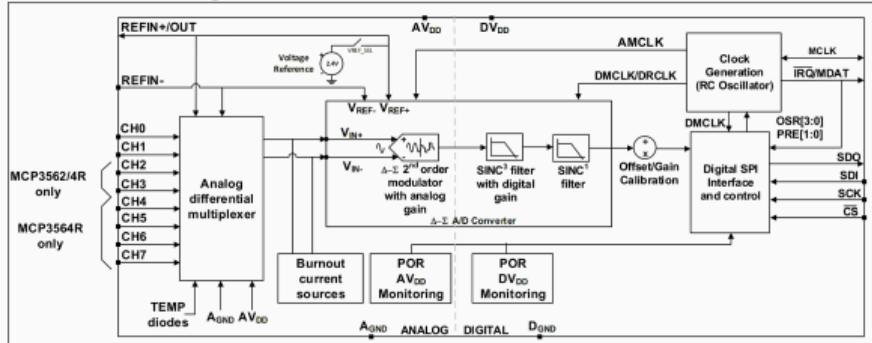
| General | | Pin Functions | | | | | | | |
|------------------------|---|---------------|-------------------------------------|--------------------------|--------|---------|-------------------------------------|--------------------------|------|
| Fields | Name | Value | Show | Show | Name | H Align | V Align | Italic | Bold |
| Reference | U5 | | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Center | Center | <input type="checkbox"/> | <input type="checkbox"/> | |
| Value | MCP3562RT-E/NC | | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Center | Center | <input type="checkbox"/> | <input type="checkbox"/> | |
| Footprint | mcp3562:TSSOP20_ST_MCH-L | | <input type="checkbox"/> | <input type="checkbox"/> | Center | Center | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Datasheet | https://ww1.microchip.com/downloads/aemDocuments/documents/APID/ProductDocuments/ | | <input type="checkbox"/> | <input type="checkbox"/> | Center | Center | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| Description | 24 Bit Analog to Digital Converter 2, 4 Input 2 Sigma-Delta 20-UQFN (3x3) | | <input type="checkbox"/> | <input type="checkbox"/> | Center | Center | <input type="checkbox"/> | <input type="checkbox"/> | |
| Sampling Rate | 153.6 kHz | | <input type="checkbox"/> | <input type="checkbox"/> | Center | Center | <input type="checkbox"/> | <input type="checkbox"/> | |
| Analog Supply Voltage | 2.7 V - 3.6 V | | <input type="checkbox"/> | <input type="checkbox"/> | Center | Center | <input type="checkbox"/> | <input type="checkbox"/> | |
| Digital Supply Voltage | 1.8 V - 3.7 V | | <input type="checkbox"/> | <input type="checkbox"/> | Center | Center | <input type="checkbox"/> | <input type="checkbox"/> | |
| Operating Temperature | -40 C - 125 C | | <input type="checkbox"/> | <input type="checkbox"/> | Center | Center | <input type="checkbox"/> | <input type="checkbox"/> | |

Bonnes pratiques des composantes & BOM

- Bonnes pratiques générales
- Bonnes pratiques des composantes & BOM
 - Footprints
 - Symboles
 - **Datasheets**
 - Recherche de pièces
 - BOM
- Bonnes pratiques de schéma

- Toujours lire la datasheet au complet!

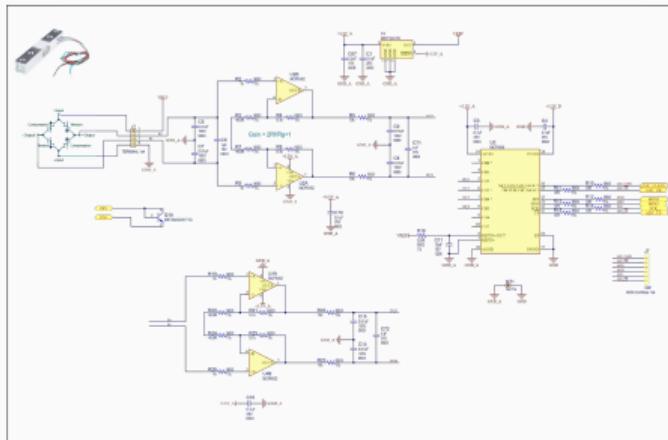
Functional Block Diagram



- Absolute Maximum Ratings**
- Toutes les *Electrical Characteristics*
- Spécifications et équations**
- Description des pins**
- Graphiques (surtout les courbes de power)
- Overview des fonctionnalités
- Modes d'opérations**
- Modes de configurations**
- Alimentation
- Schémas et Layout recommandés**
- Registres

Lecture de datasheets

- Toujours lire la datasheet au complet!
- Lire les schémas d'*evaluation boards*



- Modes d'utilisation
- Schémas
- Layout
- Logiciel / Code / Firmware
- BOM et choix de pièces
- Calculs

Lecture de datasheets

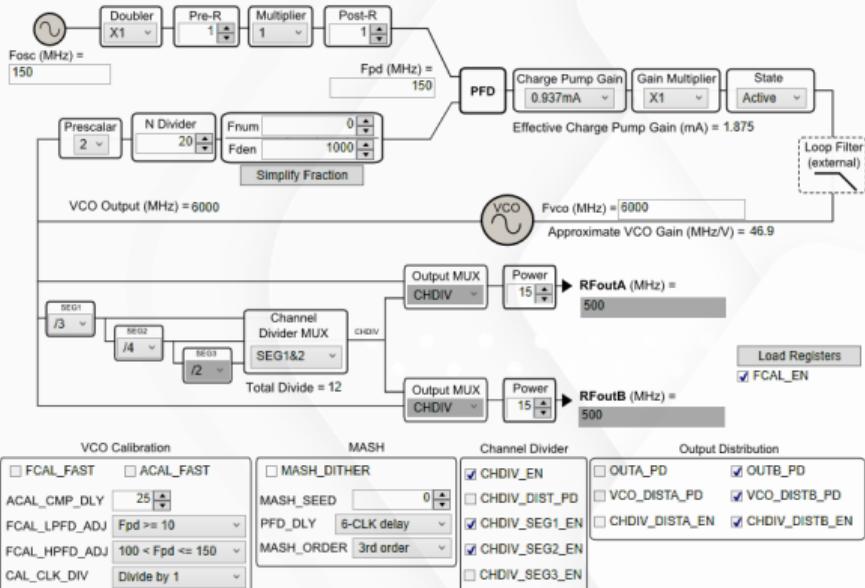
- Toujours lire la datasheet au complet!
- Lire les schémas d'*evaluation boards*
- Lire les application notes
- Modes d'utilisation
- Séquences d'alimentation
- Programmation
- Layouts spécifiques
- Calculs

- Toujours lire la datasheet au complet!
- Lire les schémas d'*evaluation boards*
- Lire les application notes
 - ECP5 and ECP5-5G Family Data Sheet
 - ECP5 and ECP5-5G Hardware Checklist
 - ECP5 and ECP5-5G High-Speed I/O Interface
 - ECP5 and ECP5-5G Memory User Guide
 - ECP5 and ECP5-5G SerDes/PCS Usage Guide
 - ECP5 and ECP5-5G sysCLOCK PLL/DLL
 - ECP5 and ECP5-5G sysIO Usage Guide
 - ECP5 Automotive Family Data Sheet
 - ECP5 Errata - SED Function with Distributed RAM
 - Electrical Recommendations for Lattice SERDES
 - PCB Layout Recommendations for BGA Packages
 - Power Consumption and Management for ECP5 Devices
 - Thermal Management for Lattice Devices

Configurateurs



- Manufacturier donne parfois des configuateurs
- Valider les calculs avec la datasheet
- Ne pas utiliser uniquement le configuateur!
- Donne aussi un BOM sur lequel se fier



Configurateurs (TI WeBench)



Customize TPS566238RQFR - 11.5V-14V to 3.30V @ 5A

Input: DC 11.5 V - 14 V Output: 3.3 V at 5 A Temp: 50 °C +3 Requirements [Change](#)

[SELECT](#)[CUSTOMIZE](#)[SIMULATE](#)[EXPORT](#)

⋮

Summary

Efficiency: 93.5%
BOM Cost: \$1.71
Footprint: 136 mm²

[CHANGE OPTIMIZATION](#)

Configuration Options

Soft Start Time
1.68 ms
(1.68 - 50.4)

Minimum Inductor Current Rating

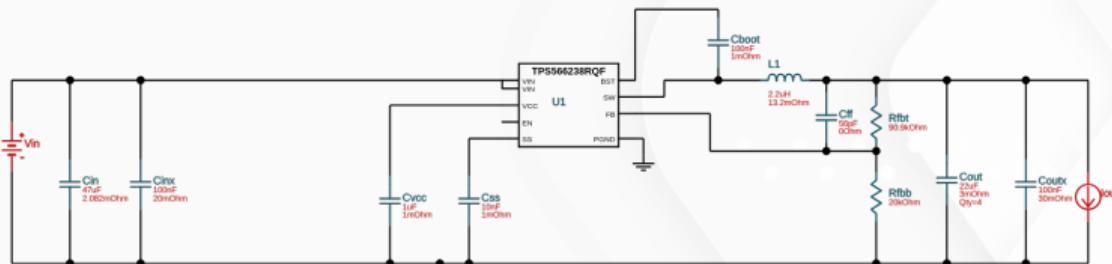
Peak Current

 Add Cff Capacitor(Optional) UVLO voltage

Enable Under Voltage Lock Out
3.3 V
(3.3 - 11.4)

[REDESIGN](#)[SCHEMATIC](#)[BILL OF MATERIALS](#)

Click a component to find out more information or select an alternate part.

[OPERATING VALUES](#)[CHARTS](#)

Vin (V) 14 V
(11.5 - 14)

Iout (A) 5 A
(0 - 5)

[RECALCULATE](#)

Design Suggestions

Pascal-Emmanuel Lachance

PPPPP04

2025-06-01

31 / 73

- Valider toutes les courbes au point d'opération
- Valider les plages d'opérations
 - Sur toutes les IO
 - Sur les alimentations
- Valider les plages de tension
 - Besoin d'un heatsink?
 - Besoin de dissipation thermique?
 - A quel point est-ce que ça va chauffer?

TEMPERATURE SPECIFICATIONS

Electrical Specifications: Unless otherwise specified, all parameters apply for $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, $\text{AV}_{DD} = 2.7\text{V}$ to 3.6V , $\text{DV}_{DD} = 1.8\text{V}$ to $\text{AV}_{DD} + 0.1\text{V}$, $D_{GND} = A_{GND} = 0\text{V}$.

| Parameters | Sym. | Min. | Typ. | Max. | Units | Conditions |
|-----------------------------------|---------------|------|------|------|-------|------------|
| Temperature Ranges | | | | | | |
| Specified Temperature Range | T_A | -40 | — | +125 | °C | |
| Operating Temperature Range | T_A | -40 | — | +125 | °C | |
| Storage Temperature Range | T_A | -65 | — | +150 | °C | |
| Thermal Package Resistance | | | | | | |
| Thermal Resistance, 20-Lead TSSOP | θ_{JA} | — | 44 | — | °C/W | |
| Thermal Resistance, 20-Lead UQFN | θ_{JA} | — | 50 | — | °C/W | |

Note 1: The internal Junction Temperature (T_J) must not exceed the absolute maximum specification of $+150^\circ\text{C}$.

MCP3561

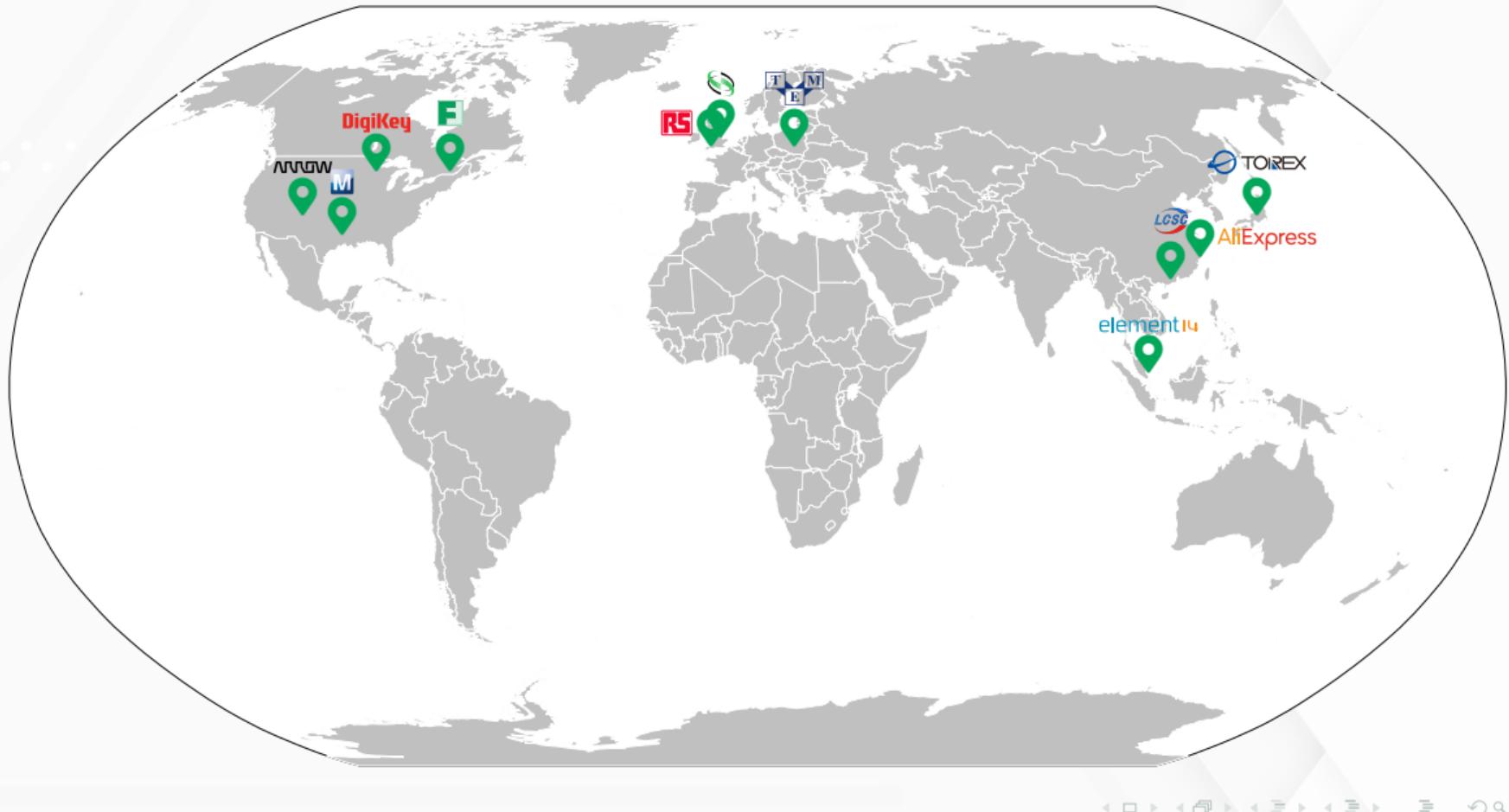
- ADC 24-bit
- Architecture Sigma-Delta
- 8 entrées multiplexées
- Gain programmable
- Capteur de température
- Interface SPI
- Programmable par registres internes



<https://www.microchip.com/en-us/product/mcp3561>

Bonnes pratiques des composantes & BOM

- Bonnes pratiques générales
- Bonnes pratiques des composantes & BOM
 - Footprints
 - Symboles
 - Datasheets
 - Recherche de pièces
 - BOM
- Bonnes pratiques de schéma



- Beaucoup d'outils de recherche

- Mise en situation

- Besoin d'un régulateur 12 V -> 5 V
- Consommation de 2 A
- Besoin de *Undervoltage Lockout*, *Soft Start* et d'une sortie *Power Good*
- Pas trop cher

DigiKey

<https://www.digikey.ca/>

Recherche de régulateur sur Digikey



DigiKey 1 switching regulator 2 Upload a List Search Canada Login or REGISTER 0 item(s) FREE SHIPPING on Orders over \$100 CAD!*

Products ▾ Manufacturers ▾ Resources ▾ Request a Quote Dark Mode Switch

Showing 48,782 Results for "switching regulator"

Filters

Search Within Search

In Stock RoHS Compliant

+ More Filters

Categories

Development Boards, Kits, Programmers
Integrated Circuits (ICs)
Power Supplies - Board Mount
Sensors, Transducers
Soldering, Desoldering, Rework Products
Test and Measurement
Tools

Top Results

| | |
|---|---|
|  Voltage Regulators - DC DC Switching Regulators Power Management (PMIC) 35,417 Items |  DC DC Switching Controllers Power Management (PMIC) 10,125 Items |
|  Voltage Regulators - Linear + Switching Power Management (PMIC) 1,434 Items |  LED Drivers Power Management (PMIC) 1,151 Items |
|  Special Purpose Regulators Power Management (PMIC) 285 Items |  Power Management - Specialized Power Management (PMIC) 125 Items |
|  Current Regulation/Management Power Management (PMIC) 86 Items |  DC DC Converters Power Supplies - Board Mount 44 Items |
|  AC DC Converters, Offline Switchers Power Management (PMIC) 30 Items |  Power Supplies (Test, Bench) Test Equipment 29 Items |
|  Power Distribution Switches, Load Drivers Power Management (PMIC) 22 Items |  DC/DC & AC/DC (Off-Line) SMPS Evaluation Boards Evaluation Boards 19 Items |

Recherche de régulateur sur Digikey



Digikey website interface showing the search process for a regulator.

- Step 1: The Digikey logo is highlighted with a green arrow.
- Step 2: The 'Products' menu is highlighted with a green arrow. A green circle labeled '2' highlights the 'Connectors' category under the 'Power' section.
- Step 3: The 'Connectors' category is selected, highlighted with a green arrow. A green circle labeled '3' highlights the 'Connectors' category in the dropdown menu.
- Step 4: The 'Integrated Circuits (ICs)' category is selected, highlighted with a green arrow. A green circle labeled '4' highlights the 'Integrated Circuits (ICs)' category in the dropdown menu.

The main search bar at the top contains the placeholder text "Enter keyword or part #". The navigation bar includes "Upload a List", a search icon, and a Canadian flag icon. The top right corner shows "Login or REGISTER" and a shopping cart icon indicating "0 item(s)". A banner at the top right says "FREE SHIPPING on Orders over \$100 CAD!*

The main content area features a Texas Instruments advertisement for Linear - Amplifiers - Instrumentation, OP Amps, Buffer Amps, showing a chip image and a circuit board image. Below the ad, there are sections for SEE ALL, PMIC, Specialized ICs, Logic, Memory, Interface, Embedded, Data Acquisition, Clock/Timing, Discrete, Embedded Computers, Isolators, Development Boards, Kits, Programmers, and Automation & Control.

The left sidebar lists various product categories: PRODUCTS (VIEW ALL), AUTOMATION & CONTROL, BOXES, ENCLOSURES, RACKS, CABLE ASSEMBLIES, CABLES, WIRES, CONNECTORS, ELECTROMECHANICAL, HARDWARE, FASTENERS, INTEGRATED CIRCUITS (ICs), NETWORKING SOLUTIONS, PASSIVES, POWER, and TOOLS. The TOOLS section includes PCB Builder, CONVERSION CALCULATORS, SCHEME-IT, REFERENCE DESIGN LIBRARY, and CROSS REFERENCE.

The bottom navigation bar includes icons for back, forward, search, and other site functions.

Recherche de régulateur sur Digikey



Product Index > Integrated Circuits (ICs) > Power Management (PMIC) > Voltage Regulators - DC DC Switching Regulators

Dark Mode Share

Voltage Regulators - DC DC Switching Regulators

Search Within Results: 35,417 Filters Stacked Scrolling

| Manufacturer | Series | Packaging | Product Status | Function | Output Configuration | Topology |
|--|------------------------------------|---|--|---|--|---|
| <input type="text"/> Search Filter | <input type="text"/> Search Filter | Bag | Active | Ratiometric Ratiometric, Step-Up Ratiometric, Step-Up/Step-Down Step-Down Step-Down, Step-Up/Step-Down Step-Down/Inverted Step-Up Step-Up, Step-Down Step-Up, Step-Down, Step-Up/Step-Do... Step-Up, Step-Up/Step-Down | Negative Positive Positive and Negative Positive and Negative (Dual Rail) Positive or Negative Positive or Negative, Isolation Capable Positive, Isolation Capable | Boost Boost, Buck Boost, Buck-Boost Boost, Buck-Boost, Flyback, SEPIC Boost, Buck, Buck-Boost Boost, Buck, Cuk, Flyback, Forward Converter Boost, Buck, Cuk, Flyback, Forward Converter Boost, Charge Pump |
| 3PEAK ABILIC Inc. Allegro MicroSystems Alpha & Omega Semiconductor Inc. Altera ams-OSRAM USA INC. Analog Devices Inc. Analog Devices Inc./Maxim Integrated Analog Technologies | * | Box Bulk Case Cut Tape (CT) Digi-Reel® ACT510x Strip Tape & Box (TB) Tape & Reel (TR) Tray Tube | Discontinued at Digi-Key Last Time Buy Not For New Designs Obsolete | | | |
| | | | <input type="button"/> Clear (1) | | | |

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Exclude Marketplace Products

Apply All 9,551 of 35,417 Results



Recherche de régulateur sur Digikey



Product Index > Integrated Circuits (ICs) > Power Management (PMIC) > Voltage Regulators - DC DC Switching Regulators

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| 3PEAK ABILIC Inc. Allegro MicroSystems Alpha & Omega Semiconductor Inc. Altera ams-OSRAM USA INC. Analog Devices Inc. Analog Devices Inc./Maxim Integrated Analog Technologies | * | Box Bulk Case Cut Tape (CT) Digi-Reel® ACT510x Strip Tape & Box (TB) Tape & Reel (TR) Tray Tube | Discontinued at Digi-Key Last Time Buy Not For New Designs Obsolete | | | |
| | | | <input type="button"/> Clear (1) | | | |

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Product Index > Integrated Circuits (ICs) > Power Management (PMIC) > Voltage Regulators - DC DC Switching Regulators

Dark Mode Share

Voltage Regulators - DC DC Switching Regulators

Search Within Results: 9,551 Filters Stacked Scrolling

| Output Type | Number of Outputs | Voltage - Input (Min) | Voltage - Input (Max) | Voltage - Output (Min/Fixed) | Voltage - Output (Max) | Current - Output | Frequency - Switching |
|---|---|--|---|---|---|--|--|
| <input checked="" type="checkbox"/> Adjustable | <input checked="" type="checkbox"/> 1 | <input checked="" type="checkbox"/> 11.1V | <input checked="" type="checkbox"/> 12V | <input checked="" type="checkbox"/> ±5V | <input checked="" type="checkbox"/> 4.68V | <input checked="" type="checkbox"/> 1.8A (Switch) | <input checked="" type="checkbox"/> 4kHz ~ 2MHz |
| <input checked="" type="checkbox"/> Adjustable (Fixed) | <input checked="" type="checkbox"/> 1 or 2 | <input checked="" type="checkbox"/> 11.9V | <input checked="" type="checkbox"/> 12.4V | <input checked="" type="checkbox"/> 5V | <input checked="" type="checkbox"/> 4.73V | <input checked="" type="checkbox"/> 1.9A (Switch) | <input checked="" type="checkbox"/> 100Hz ~ 100kHz |
| <input checked="" type="checkbox"/> Adjustable (Programmable) | <input checked="" type="checkbox"/> 2 | <input checked="" type="checkbox"/> 12V | <input checked="" type="checkbox"/> 13.5V | <input checked="" type="checkbox"/> 5V, 5V | <input checked="" type="checkbox"/> 4.8V | <input checked="" type="checkbox"/> 2A | <input checked="" type="checkbox"/> 220Hz ~ 140kHz |
| <input checked="" type="checkbox"/> Fixed | <input checked="" type="checkbox"/> 2-Dual | <input checked="" type="checkbox"/> 12.96V | <input checked="" type="checkbox"/> 13.5V | <input checked="" type="checkbox"/> 5.1V | <input checked="" type="checkbox"/> 4.9V | <input checked="" type="checkbox"/> 2A (Switch) | <input checked="" type="checkbox"/> 1kHz ~ 5kHz |
| <input checked="" type="checkbox"/> PFM | <input checked="" type="checkbox"/> 3 | <input checked="" type="checkbox"/> 13V | <input checked="" type="checkbox"/> 14V | <input checked="" type="checkbox"/> 5.1V (5.1V) | <input checked="" type="checkbox"/> 4.95V | <input checked="" type="checkbox"/> 2A (Switch), 1 2A (Switch) | <input checked="" type="checkbox"/> 2kHz |
| <input checked="" type="checkbox"/> Programmable | <input checked="" type="checkbox"/> 4 | <input checked="" type="checkbox"/> 14V | <input checked="" type="checkbox"/> 15V | <input checked="" type="checkbox"/> 5.2V | <input checked="" type="checkbox"/> 5V | <input checked="" type="checkbox"/> 2A, 1.7A | <input checked="" type="checkbox"/> 3kHz |
| <input checked="" type="checkbox"/> Programmable (Fixed) | <input checked="" type="checkbox"/> 8 | <input checked="" type="checkbox"/> 15V | <input checked="" type="checkbox"/> 16V | <input checked="" type="checkbox"/> 5.1V (5.5V) | <input checked="" type="checkbox"/> 5.5V | <input checked="" type="checkbox"/> 2A, 1A | <input checked="" type="checkbox"/> 4kHz ~ 10kHz |
| <input checked="" type="checkbox"/> PS2/USB | <input checked="" type="checkbox"/> - | <input checked="" type="checkbox"/> 15.2V | <input checked="" type="checkbox"/> 16.2V | <input checked="" type="checkbox"/> 5.2V | <input checked="" type="checkbox"/> 5.04V | <input checked="" type="checkbox"/> 2A, 2A | <input checked="" type="checkbox"/> 5kHz ~ 30kHz |
| <input checked="" type="checkbox"/> PWM | <input checked="" type="checkbox"/> - | <input checked="" type="checkbox"/> 15.5V | <input checked="" type="checkbox"/> 16.5V | <input checked="" type="checkbox"/> 5.1V | <input checked="" type="checkbox"/> 5.1V | <input checked="" type="checkbox"/> Clear (122) | <input checked="" type="checkbox"/> 5.5kHz ~ 30kHz |
| <input checked="" type="checkbox"/> PWM Signal | <input checked="" type="checkbox"/> - | <input checked="" type="checkbox"/> 15.8V | <input checked="" type="checkbox"/> 16.8V | <input checked="" type="checkbox"/> Clear (337) | <input checked="" type="checkbox"/> Clear (280) | <input checked="" type="checkbox"/> Clear (2,516) | <input checked="" type="checkbox"/> Clear (2,516) |
| | <input checked="" type="checkbox"/> Clear (102) | <input checked="" type="checkbox"/> Clear (78) | | <input checked="" type="checkbox"/> Clear (337) | <input checked="" type="checkbox"/> Clear (280) | <input checked="" type="checkbox"/> Clear (2,516) | <input checked="" type="checkbox"/> Clear (2,516) |

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2,516 of 9,551 Results

Recherche de régulateur sur Digikey



Product Index > Integrated Circuits (ICs) > Power Management (PMIC) > Voltage Regulators - DC DC Switching Regulators

Dark Mode Share

Voltage Regulators - DC DC Switching Regulators

Search Within Results: 1,396 Filters Stacked Scrolling

| Manufacturer | Series | Packaging | Function | Topology | Output Type | Voltage - Input (Min) | Voltage - Input (Max) |
|---|--------------------|------------------|----------------------------|------------------------------------|----------------------|-----------------------|-----------------------|
| EVVO | Search Filter | Bulk | Step-Down | Boost, Charge Pump, Flyback, SEPIC | Adjustable | 4.5V | 90V |
| Infineon Technologies | ACOT® | Cut Tape (CT) | Step-Up, Step-Down | Boost, Flyback, Forward Converter | Adjustable (Fixed) | 5V | 60V |
| MaxLinear, Inc. | ACOT™ | Digi-Reel® | Step-Up, Step-Up/Step-Down | Boost, Flyback, SEPIC | Programmable | 5.5V | 61V |
| Microchip Technology | D-CAP2™ | Strip | Step-Up/Step-Down | Boost, SEPIC | Programmable (Fixed) | 6V | 65V |
| Monolithic Power Systems Inc. | D-CAP2™, Eco-Mode™ | Tape & Reel (TR) | | Buck | | 6.5V | 75V |
| Nissinbo Micro Devices Inc. | D-CAP3™ | Tray | | Buck-Boost | | 7V | 76V |
| onsemi | DCS-Control™ | Tube | | Buck, Boost | | 7.5V | 80V |
| Reed Semiconductor Corp. | Eco-Mode™ | | | Buck, Buck-Boost | | 8V | 100V |
| Renesas Electronics Corporation | EZBuck™ | | | Buck, SEPIC | | 9V | 105V |
| <input type="button" value="Clear (15)"/> | | | | | | | |

Stocking Options Environmental Options Media Exclude Apply All 1,160 of 1,396 Results

In Stock RoHS Compliant Datasheet Marketplace Products

Normally Stocking Photo EDA/CAD Models

APPLIED FILTERS Remove All

Mounting Type Number of Outputs Function Current - Output Operating Temperature Output Configuration Voltage - Input (Max)
Voltage - Output (Max) Voltage - Input (Min) Voltage - Output (Min/Fixed) Product Status Stocking Options Environmental Options Media

Recherche de régulateur sur Digikey



APPLIED FILTERS Remove All

Mounting Type Number of Outputs Function Current - Output Operating Temperature Output Configuration Voltage - Input (Max)

Voltage - Output (Max) Voltage - Input (Min) Voltage - Output (Min/Fixed) Product Status Stocking Options Environmental Options Media

Exclude Manufacturer

Showing 1 - 25 of 1,160 Sort By: Featured Download Table

| | Mfr Part # | Quantity Available | Price | Series | Package | Product Status | Function | Output Configuration | Topology | Output Type | Number of Outputs | Voltage - Input (Min) | Voltag |
|--------------------------|---|--------------------|---|-----------|---|----------------|-----------|----------------------|----------|-------------|-------------------|-----------------------|--------|
| | Mfr Part # | Quantity Available | Price | Series | Package | Product Status | Function | Output Configuration | Topology | Output Type | Number of Outputs | Voltage - Input (Min) | Voltag |
| <input type="checkbox"/> | TPS562243DRLR IC REG BUCK ADJ 2A SOT563 <i>Texas Instruments</i> | 3,899 In Stock | 1 : \$0.22000 Cut Tape (CT) 4,000 : \$0.08776 Tape & Reel (TR) | TPS56224x | Tape & Reel (TR) Cut Tape (CT) Digi-Reel® | Active | Step-Down | Positive | Buck | Adjustable | 1 | 4.2V | |
| <input type="checkbox"/> | TPS562246DRLR IC REG BUCK ADJ 2A SOT563 <i>Texas Instruments</i> | 3,230 In Stock | 1 : \$0.22000 Cut Tape (CT) 4,000 : \$0.08776 Tape & Reel (TR) | TPS56224x | Tape & Reel (TR) Cut Tape (CT) Digi-Reel® | Active | Step-Down | Positive | Buck | Adjustable | 1 | 4.2V | |
| <input type="checkbox"/> | TPS563203DRLR IC REG BUCK ADJ 3A SOT563 <i>Texas Instruments</i> | 1,704 In Stock | 1 : \$0.22000 Cut Tape (CT) 4,000 : \$0.08776 Tape & Reel (TR) | - | Tape & Reel (TR) Cut Tape (CT) Digi-Reel® | Active | Step-Down | Positive | Buck | Adjustable | 1 | 4.2V | |
| <input type="checkbox"/> | TPS562202DRLR IC REG BUCK ADJ 2A SOT563 <i>Texas Instruments</i> | 10,197 In Stock | 1 : \$0.25000 Cut Tape (CT) 4,000 : \$0.10186 Tape & Reel (TR) | - | Tape & Reel (TR) Cut Tape (CT) Digi-Reel® | Active | Step-Down | Positive | Buck | Adjustable | 1 | 4.3V | |
| <input type="checkbox"/> | TPS562207DRLR IC REG BUCK ADJ 2A SOT563 <i>Texas Instruments</i> | 3,984 In Stock | 1 : \$0.25000 Cut Tape (CT) 4,000 : \$0.10186 Tape & Reel (TR) | - | Tape & Reel (TR) Cut Tape (CT) Digi-Reel® | Active | Step-Down | Positive | Buck | Adjustable | 1 | 4.3V | 17V |
| <input type="checkbox"/> | TPS563202DRLR IC REG BUCK ADJ 3A SOT563 <i>Texas Instruments</i> | 16,196 In Stock | 1 : \$0.29000 Cut Tape (CT) | - | Tape & Reel (TR) Cut Tape (CT) | Active | Step-Down | Positive | Buck | Adjustable | 1 | 4.3V | 17V |



Recherche de régulateur sur Digikey



| TPS56224243DRLR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|-------------------------------------|--------------------------|------------|--|----------|---|-------------------------------------|--------------------------|-----|-----------------------------------|--------------------------|--------------------------|--------|---------------------------|--------------------------|--------------------------|-----------|--|--------------------------|--------------------------|-------------|--------|--------------------------|--------------------------|----------|-----------|--------------------------|--------------------------|----------------------|----------|--------------------------|--------------------------|----------|----------------------|--------------------------|--------------------------|-------------|----------------------------|--------------------------|--------------------------|-------------------|---|--------------------------|--------------------------|-----------------------|------|--------------------------|--------------------------|-----------------------|-----|--------------------------|--------------------------|------------------------------|----------------------|--------------------------|--------------------------|------------------------|----|--------------------------|--------------------------|------------------|--------------------|--------------------------|--------------------------|-----------------------|---------|--------------------------|--------------------------|-----------------------|-----|--------------------------|--------------------------|-----------------------|--------------------|--------------------------|--------------------------|-------|---|--------------------------|--------------------------|
|  <p>Image shown is a representation only. Exact specifications should be obtained from the product data sheet.</p> | DigiKey Part Number Manufacturer Manufacturer Product Number Description Manufacturer Standard Lead Time Customer Reference Detailed Description Datasheet EDA/CAD Models | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Datasheet | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | TPS56224243DRLR Models | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Product Attributes | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; padding: 5px;">Type</th> <th style="text-align: left; padding: 5px;">Description</th> <th style="text-align: right; padding: 5px;">Select All</th> <th style="text-align: center; padding: 5px;"> </th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">Category</td><td style="padding: 5px;">Integral Circuit (IC) Power Management (PMIC) Voltage Regulators - DC-DC Switching Regulators</td><td style="text-align: right; padding: 5px;"><input checked="" type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Mfr</td><td style="padding: 5px;">Texas Instruments</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Series</td><td style="padding: 5px;">TPS56224x</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Packaging</td><td style="padding: 5px;">Tape & Reel (TR) <input checked="" type="checkbox"/> Car Tape (CT) <input type="checkbox"/> DigiReel (DR) <input type="checkbox"/></td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Part Status</td><td style="padding: 5px;">Active</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Function</td><td style="padding: 5px;">Step-Down</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Output Configuration</td><td style="padding: 5px;">Positive</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Topology</td><td style="padding: 5px;">Buck</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Output Type</td><td style="padding: 5px;">Adjustable</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Number of Outputs</td><td style="padding: 5px;">1</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Voltage - Input (Min)</td><td style="padding: 5px;">4.2V</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Voltage - Input (Max)</td><td style="padding: 5px;">17V</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Voltage - Output (Min/Fixed)</td><td style="padding: 5px;">8.6V</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Voltage - Output (Max)</td><td style="padding: 5px;">7V</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Current - Output</td><td style="padding: 5px;">2A</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Frequency - Switching</td><td style="padding: 5px;">1.28MHz</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Synchronous Rectifier</td><td style="padding: 5px;">Yes</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Operating Temperature</td><td style="padding: 5px;">-40°C ~ 125°C (TJ)</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> <tr> <td style="padding: 5px;">Grade</td><td style="padding: 5px;">-</td><td style="text-align: right; padding: 5px;"><input type="checkbox"/></td><td style="text-align: center; padding: 5px;"><input type="checkbox"/></td></tr> </tbody> </table> | | Type | Description | Select All | | Category | Integral Circuit (IC) Power Management (PMIC) Voltage Regulators - DC-DC Switching Regulators | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Mfr | Texas Instruments | <input type="checkbox"/> | <input type="checkbox"/> | Series | TPS56224x | <input type="checkbox"/> | <input type="checkbox"/> | Packaging | Tape & Reel (TR) <input checked="" type="checkbox"/> Car Tape (CT) <input type="checkbox"/> DigiReel (DR) <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | Part Status | Active | <input type="checkbox"/> | <input type="checkbox"/> | Function | Step-Down | <input type="checkbox"/> | <input type="checkbox"/> | Output Configuration | Positive | <input type="checkbox"/> | <input type="checkbox"/> | Topology | Buck | <input type="checkbox"/> | <input type="checkbox"/> | Output Type | Adjustable | <input type="checkbox"/> | <input type="checkbox"/> | Number of Outputs | 1 | <input type="checkbox"/> | <input type="checkbox"/> | Voltage - Input (Min) | 4.2V | <input type="checkbox"/> | <input type="checkbox"/> | Voltage - Input (Max) | 17V | <input type="checkbox"/> | <input type="checkbox"/> | Voltage - Output (Min/Fixed) | 8.6V | <input type="checkbox"/> | <input type="checkbox"/> | Voltage - Output (Max) | 7V | <input type="checkbox"/> | <input type="checkbox"/> | Current - Output | 2A | <input type="checkbox"/> | <input type="checkbox"/> | Frequency - Switching | 1.28MHz | <input type="checkbox"/> | <input type="checkbox"/> | Synchronous Rectifier | Yes | <input type="checkbox"/> | <input type="checkbox"/> | Operating Temperature | -40°C ~ 125°C (TJ) | <input type="checkbox"/> | <input type="checkbox"/> | Grade | - | <input type="checkbox"/> | <input type="checkbox"/> |
| Type | Description | Select All | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category | Integral Circuit (IC) Power Management (PMIC) Voltage Regulators - DC-DC Switching Regulators | <input checked="" type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mfr | Texas Instruments | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Series | TPS56224x | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Packaging | Tape & Reel (TR) <input checked="" type="checkbox"/> Car Tape (CT) <input type="checkbox"/> DigiReel (DR) <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Part Status | Active | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Function | Step-Down | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Output Configuration | Positive | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Topology | Buck | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Output Type | Adjustable | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Number of Outputs | 1 | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Voltage - Input (Min) | 4.2V | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Voltage - Input (Max) | 17V | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Voltage - Output (Min/Fixed) | 8.6V | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Voltage - Output (Max) | 7V | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Current - Output | 2A | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Frequency - Switching | 1.28MHz | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Synchronous Rectifier | Yes | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Operating Temperature | -40°C ~ 125°C (TJ) | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Grade | - | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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| QUANTITY | UNIT PRICE | EXT PRICE |
|----------|------------|-----------|
| 1 | \$0.2200 | \$0.22 |
| 10 | \$0.1910 | \$1.91 |
| 25 | \$0.1396 | \$3.94 |
| 100 | \$0.1140 | \$11.40 |
| 250 | \$0.1049 | \$26.23 |
| 500 | \$0.0993 | \$49.66 |
| 1,000 | \$0.0949 | \$94.69 |

* All Digi-Reel orders will add a \$7.00 mailing fee.

Tape & Reel (TR)

| QUANTITY | UNIT PRICE | EXT PRICE |
|----------|------------|------------|
| 4,000 | \$0.08776 | \$351.04 |
| 8,000 | \$0.08518 | \$681.44 |
| 12,000 | \$0.08309 | \$1,006.68 |
| 20,000 | \$0.08246 | \$1,640.28 |
| 28,000 | \$0.08182 | \$2,295.68 |
| 40,000 | \$0.08082 | \$3,232.68 |
| 100,000 | \$0.07939 | \$7,909.08 |

 Manufacturers Standard Package

* All Digi-Reel orders will add a \$7.00 reeling fee.

 TEXAS
INSTRUMENTS

TPS562243, TPS562246
SLUS098 – JUNE 2024

TPS56224x 4.2V to 17V Input, 2A, Synchronous Buck Converter in SOT563

1 Features

- Configured for a wide range of applications
 - Input voltage range: 4.2V to 17V
 - Output voltage range: 0.6V to 7V
 - Reference voltage: 0.6V
 - $\pm 1.5\%$ reference voltage accuracy
 - Integrated FETs: 100mΩ and 55mΩ
 - Low quiescent current for TP5562243: 110µA
 - Switching frequency: 1280kHz
 - Maximum 95% large duty cycle operation
 - Fixed soft-start time: 1.4ms
 - Ease of use and small design size
 - TPS562243 Eco-mode and TPS562246 FCCM mode at light load
 - D-CAP³™ control mode with fast transient response
 - Support start-up with prebiased output
 - Non-latch for OTL and UVLO protection
 - Cycle-by-cycle over current limit
 - Hiccup mode for UV protection
 - Operating junction temperature range: -40°C to 125°C
 - SOT563 package: 1.6mm x 1.6mm
 - Create a custom design using the TPS56224x with the [WRENCH® Power Designer](#)

3 Description

The TPS56224x is a simple, easy-to-use, synchronous buck converter with input voltage ranging from 4.2V to 17V and supports up to 2A continuous current.

The device is designed to operate with minimum external component counts and low standby current.

This switch mode power supply (SMPS) device employs D-CAP3 control mode providing a fast transient response and supporting both low equivalent series resistance (ESR) output capacitors such as specialty polymer and ultra-low ESR ceramic capacitors with no external compensation components.

The TPS562243 operates in Eco-mode, which maintains high efficiency during light load operation. The TPS562246 operates in FCCM mode, which keeps the same frequency and lower output ripple during all load conditions. The TPS56224x integrates complete protection including OCP, UVLO, OTP, and LVP with hiccup.

The TPS56224x is available in a 6pin, 1.6mm x 1.6mm SOT563 (DRL) package. The junction temperature is specified from -40°C to 125°C.

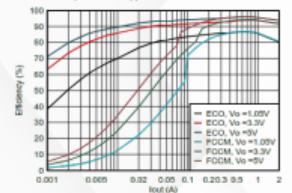
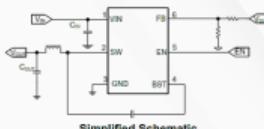
2 Applications

- WLAN/Wi-Fi access point
 - Modem (cable/DSL/GFAST)
 - Small business router
 - Electricity meter
 - STV and DVR
 - Appliances

| Device Information | | | |
|--------------------|----------|-----------------|-----------------|
| Part Number | Mode | Package | Package Size |
| TPS62243 | Eco-mode | DRL (SOT363, 6) | 1.60mm x 1.60mm |
| TPS62243M | ECG mode | | |

(1) For more information, see [Section 10](#).
(2) The package size (length × width) is a nominal value and indicates where values are specified.

below plus, where applicable.



5.5 Electrical Characteristics

Over operating $T_J = -40^\circ\text{C} - 125^\circ\text{C}$, $V_{IN} = 12\text{ V}$ (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------------------------|--------------------------|--|-----|-----|-----|------|
| INPUT SUPPLY VOLTAGE | | | | | | |
| VIN | Input voltage range | | 4.2 | 17 | 17 | V |
| I _{VIN} | VIN supply current | No load, $V_{EN} = 1.5\text{ V}$, non-switching, ECO version | | 110 | | µA |
| | | No load, $V_{EN} = 1.5\text{ V}$, $V_{FB} = 0.9\text{ V}$, FCCM version ⁽¹⁾ | | 350 | | µA |
| I _{INSDN} | VIN shutdown current | $V_{EN} = 0\text{ V}$ | | 7 | | µA |
| UVLO | | | | | | |
| UVLO | VIN undervoltage lockout | Wake up VIN voltage | 3.6 | 3.8 | 4 | V |
| UVLO | VIN undervoltage lockout | Shut down VIN voltage | 3.2 | 3.4 | 3.6 | V |
| UVLO | VIN undervoltage lockout | Hysteresis VIN voltage | | 400 | | mV |
| FEEDBACK VOLTAGE | | | | | | |
| V _{FB} | FB voltage | $T_J = 25^\circ\text{C}$, $V_{IN} = 4.2 - 17\text{ V}$ | 591 | 600 | 609 | mV |
| V _{FB} | FB voltage | $T_J = -40^\circ\text{C} \text{ to } 125^\circ\text{C}$, $V_{IN} = 4.2 - 17\text{ V}$ | 588 | 600 | 612 | mV |

Recherche de régulateur sur Digikey



Product Index > Integrated Circuits (ICs) > Power Management (PMIC) > Voltage Regulators - DC DC Switching Regulators >

RoHS Semiconductor BD95841MUV-E2

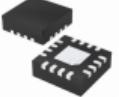


Image shown is a representative only. Exact specification should be obtained from the product data sheet.

BD95841MUV-E2

DigiKey Part Number: BD95841MUV-E2TR-NQ

Manufacturer: Rohm Semiconductor

Manufacturer Product Number: BD95841MUV-E2CTR-NQ

Description: IC REG BUCK ADJ 4A 16V/16V

Manufacturer Standard Lead Time: 17 Weeks

Customer Reference:

Detailed Description: Buck Switching Regulator IC Positive Adjustable 0.8V

Output 4A 16-VTO/FN Exposed Pad

Datasheet: [Datasheet](#)

IDA/CAD Models: BD95841MUV-E2 Models

Product Attributes

| TYPE | DESCRIPTION | SELECT ALL |
|------------------------------|---|--------------------------|
| Category | Integrated Circuits (IC) Power Management (PMIC) Voltage Regulators - DC DC Switching Regulators | <input type="checkbox"/> |
| MR | Rohm Semiconductor | <input type="checkbox"/> |
| Series | NFB | <input type="checkbox"/> |
| Packaging | Tape & Reel (TR) <input type="checkbox"/> Cut Tape (CT) <input type="checkbox"/> Digi-Reel <input type="checkbox"/> | <input type="checkbox"/> |
| Part Status | Active | <input type="checkbox"/> |
| Function | Step-Down | <input type="checkbox"/> |
| Output Configuration | Positive | <input type="checkbox"/> |
| Topology | Buck | <input type="checkbox"/> |
| Output Type | Adjustable | <input type="checkbox"/> |
| Number of Outputs | 1 | <input type="checkbox"/> |
| Voltage - Input (Min) | 7.5V | <input type="checkbox"/> |
| Voltage - Input (Max) | 16V | <input type="checkbox"/> |
| Voltage - Output (Min/Fixed) | 0.8V | <input type="checkbox"/> |
| Voltage - Output (Max) | 5.5V | <input type="checkbox"/> |
| Current - Output | 4A | <input type="checkbox"/> |
| Frequency - Switching | 500kHz = 800kHz | <input type="checkbox"/> |
| Synchronous Rectifier | Yes | <input type="checkbox"/> |
| Operating Temperature | -20°C ~ 100°C (TA) | <input type="checkbox"/> |
| Mounting Type | Surface Mount | <input type="checkbox"/> |

Dark Mode Share 

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| 1 | \$1,04900 | \$1.04 |
| 10 | \$0,74700 | \$7.47 |
| 25 | \$0,67440 | \$16.88 |
| 100 | \$0,59470 | \$59.47 |
| 250 | \$0,55908 | \$139.77 |
| 500 | \$0,53272 | \$265.68 |
| 1,000 | \$0,51483 | \$514.83 |

* All Digi-Key orders will add a \$7.00 mailing fee.

Tape & Reel (TR)

| QUANTITY | UNIT PRICE | EXT PRICE |
|----------|------------|------------|
| 3,000 | \$0,49149 | \$1,474.47 |
| 6,000 | \$0,48937 | \$2,899.42 |
| 9,000 | \$0,47435 | \$4,369.15 |
| 15,000 | \$0,46901 | \$7,300.18 |
| 21,000 | \$0,46431 | \$9,780.51 |

Manufacturers Standard Package

7.5V to 15V, 4A Integrated MOSFET 1ch Synchronous Buck DC/DC Converter

BD95841MUV

BD95841MUV

● Description

BD95841MUV is a 1ch synchronous buck converter that can generate output voltage (0.8V to 5.5V) at the input voltage range (7.5V to 16V). Space-saving and high efficiency converter which can be easily integrated due to built-in H-MOSFET power transistors. The IC also incorporates H-Rreg™ technology, a Rohm proprietary constant ON TIME control mode which facilitates ultra-high transient response against changes in load without external compensation components. Fixed soft start function, power good function, and short circuit / over voltage protection with timer latch functions are incorporated. The BD95841MUV is designed for power supplies for Digital AV Equipment.

● Applications

- LCD TVs
- Set Top Boxes (STB)
- DVD/Blu-ray players/recorders
- Broadband Network and Communication Interface
- Amusement, other.

● Typical Application

The diagram illustrates the internal architecture of the BD95841MUV IC. It features a central current-mode controller with a fixed ON TIME control mode. Key internal components include a primary-side driver, a primary-side feedback loop with a bandgap reference, a secondary-side driver, and a secondary-side feedback loop. External connections include the VIN pin (1), VFB pin (14), VREGD pin (13), TEST pin (15), GND pin (16), FB pin (12), EN pin (11), SW pin (10), and VOUT pin (9). A thermal pad is also indicated near the IC package.

Figure 1. Typical Application Circuit

This diagram shows the top view of the BD95841MUV IC package, specifically the QFN16V3030 version. It displays the 16 pins in a square configuration. The pins are labeled as follows: VIN (1), VFB (2), VREGD (3), TEST (4), GND (5), FB (6), EN (7), SW (8), VOUT (9), PGOOD (10), PGOOD (11), GND (12), VREGD (13), EN (14), SW (15), and GND (16).

Figure 2. Pin Configuration

Pascal-Emmanuel Lachance

PPPPP04

2025-06-01

37 / 73

Bonnes pratiques des composantes & BOM

- Bonnes pratiques générales
- Bonnes pratiques des composantes & BOM
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 - Symboles
 - Datasheets
 - Recherche de pièces
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- Bonnes pratiques de schéma

Erreurs communes dans un BOM

- Erreurs de copier-coller
- Items manquants
- Mauvaise pièce commandée

Erreurs communes dans un BOM

| Designators | Value | Footprint |
|--------------------|--------|-----------|
| C1, C3, C4, C5, C9 | 10 µF | 1206 |
| C2, C7, C8, C11 | 100 nF | 0402 |
| C6 | 10 µF | 1206 |

- Erreurs de copier-coller
- Items manquants
- Mauvaise pièce commandée

| Designators | Description |
|-------------|--------------------|
| F1 | Fuse Holderr |
| F2 | Fuse 2A |

| Designators | Description | Part number |
|-------------|-----------------|-----------------|
| U1 | Régulateur 1.8V | AP2120N-3.3TRG1 |

Éviter des erreurs de copier-coller



- Se faire une page avec une liste des composantes passives utilisées
- Retourner à la page et copier la composante désirée

RESISTORS

DNF

| | | | | | | | | | | | | | | | | | | | |
|----------------------|----------------------|----------------------|----------------------|---------------------|---------------------|----------------------|----------------------|---------------------|---------------------|--------------------|--------------------|--------------------|--------------------|---------------------|----------------------|---------------------|------------------|---------------------|--|
| | | | | | | | | | | | | | | | | | | | |
| 0402 1/16W 10% | 0402 1/10W 10% | 0603 1/16W 10% | 0402 1/10W 10% | 0603 1/16W 5% | 0603 1/16W 5% | 0603 1/16W 10% | 0603 1/16W 10% | 0603 1/16W 2% | 0603 1/16W 2% | 0603 1/8W 5% | 0402 1/8W 1% | 0603 1/8W 2% | 0402 1/8W 1% | 0402 1/8W 10% | 0402 1/8W 0.5% | 0402 1/8W 10% | 2512 2W 1% | 0603 1/8W 10% | |

CAPACITORS

DNF

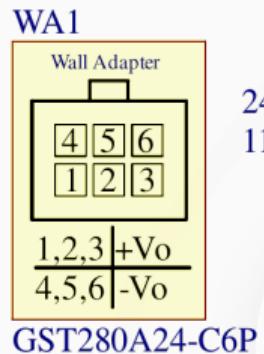
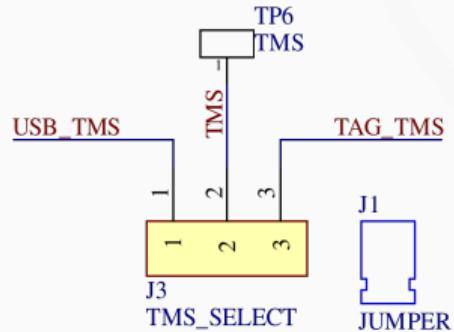
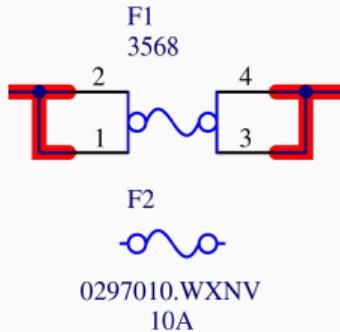
| | | | | | | | | | |
|---|--------------------------------|---------------------------------|---------------------------------|----------------------------------|---------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|
| 47uF 35V 2917 T498X476K035ATE500 399-11397-1-ND | 47uF 30V 1206 50V | 4.7uF 30V 0805 50V | 470nF 30V 0402 50V | 220nF 30V 1812 200V | 100nF 30V 0402 25V | 47nF 30V 0201 25V | 470pF 30V 0402 25V | 220pF 30V 0402 25V | 2.2pF 30V 0402 25V |
|---|--------------------------------|---------------------------------|---------------------------------|----------------------------------|---------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|

- Créer une librairie spécifique au projet
- Créer des symboles spécifiques pour toutes les composantes passives
- Pas besoin de page bizarre ou de fignolage avec les options
- Dans les deux cas:
 - Choisir des modèles de passives dès le début du projet

Quoi mettre dans un BOM

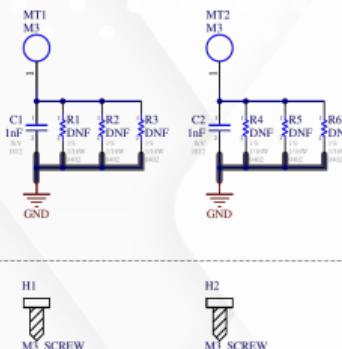


- Tout ce qui fait partie d'un assemblage
- Pas juste ce qui va directement sur le PCB
 - Vis, standoffs, washers
 - Câbles, alimentations, boîtiers
 - Fusibles, connecteurs, écrans, jumpers
 - Stencils, pâte, heatsinks



Input : 18V to 25.2V
(from a 6S battery)

Input: 24V
(from wall adapter)



- Plusieurs personnes impliquées
 - Achats
 - Assemblage du PCB
 - Assemblage du produit
 - Debugging
- Valider qu'il y a tout ce qu'il faut acheter
- Valider qu'il ne manque rien
- Valider que toutes les composantes font du sens
- Valider qu'il n'y a pas d'incompatibilité
- Valider que les part # matchent

Un assemblage va coûter environ autant que les pièces

- Pièces plus petites ont besoin de procédés avancés
 - BGA
 - Small-pitch
 - 0201
- Pièces complexes = assemblages complexes
 - Heatsinks et pâte thermique
 - Shielding EMI
 - Connecteurs funky
 - Pogo pins
- Beaucoup de pièces = + passages dans la PnP
- Courbes de températures spécifiques

Ton coût de vente devrait être 2.5x ton coût de production

Source: [3]

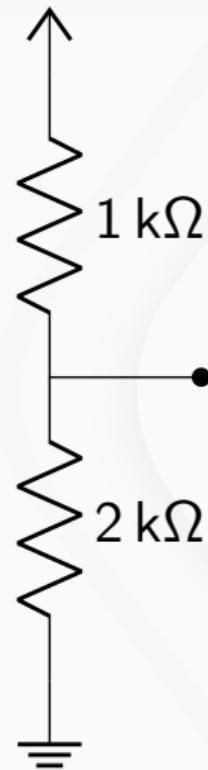
- Frais de shipping, packaging, retour
- Yield et testing
- Distributeurs veulent une part du profit
- Il faut tirer un profit assez gros pour être sustenable
- Il faut tirer un profit assez gros pour que ça vaille la peine

- On veut donc *diminuer la taille du BOM*
- Nombre de pièces limitées dans la PnP (~ 48 dans la PnP du 3iT)
- Chaque pièce est commandée en quantité minimum
- Gaspillage + Augmenter complexité assemblage
- Il faut donc **consolider** le BOM

Minimum Order Quantity: 70

| Value | Qty | Cost | Total | Real Total |
|--------------|-----|------|-------|------------|
| 1 kΩ | 20 | 2¢ | 40¢ | 1.4\$ |
| 2 kΩ | 1 | 2¢ | 2¢ | 1.4\$ |
| Total | | | | 2.8\$ |

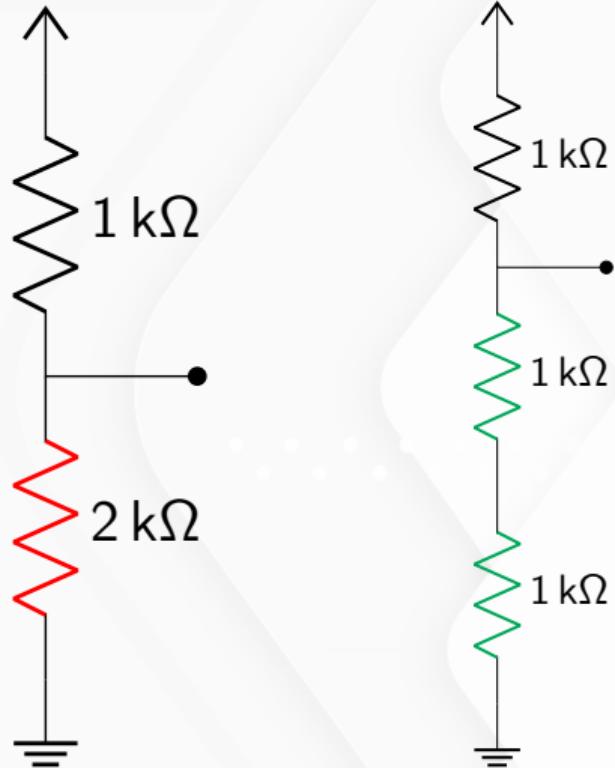
- Les minimum order quantity peuvent affecter le prix
- Une seule résistance peut en valoir 70
- Combiner des résistances en série ou parallèle!



Minimum Order Quantity: 70

| Value | Qty | Cost | Total | Real Total |
|--------------|------------|-------------|--------------|-------------------|
| 1 kΩ | 20 | 2¢ | 40¢ | 1.4\$ |
| 2 kΩ | 1 | 2¢ | 2¢ | 1.4\$ |
| Total | | | | 2.8\$ |

| Value | Qty | Cost | Total | Real Total |
|--------------|------------|-------------|--------------|-------------------|
| 1 kΩ | 22 | 2¢ | 44¢ | 1.4\$ |
| Total | | | | 1.4\$ |



Minimum Order Quantity: 70

| Designators | Value | Footprint | Qty | Cost | Total | Real Total |
|--------------------|-------|-----------|-----|------|-------|--------------|
| C14, C15, C16, C17 | 1 µF | 0603 | 4 | 10¢ | 40¢ | 7\$ |
| C25, C26, C27, C28 | 1 µF | 1206 | 4 | 1¢ | 4¢ | 70¢ |
| Total | | | | | | 7.7\$ |

- C25, C26, C27 & C28 sont des condensateurs gros et cheap
- C14, C15, C16 & C17 sont des condensateurs plus chers
- On a besoin des caractéristiques de ces condensateurs plus chers dans une section
- Dans des faibles quantités d'assemblage, il peut être mieux d'acheter juste des condensateurs chers

Minimum Order Quantity: 70

| Designators | Value | Footprint | Qty | Cost | Total | Real Total |
|--------------------|--------------|------------------|------------|-------------|--------------|-------------------|
| C14, C15, C16, C17 | 1 µF | 0603 | 4 | 10¢ | 40¢ | 7\$ |
| C25, C26, C27, C28 | 1 µF | 1206 | 4 | 1¢ | 4¢ | 70¢ |
| Total | | | | | | 7.7\$ |

| Designators | Value | Footprint | Qty | Cost | Total | Real Total |
|-------------------------|--------------|------------------|------------|-------------|--------------|-------------------|
| C14, C15, C16, C17, C25 | 1 µF | 0603 | 5 | 10¢ | 50¢ | 7\$ |
| Total | | | | | | 7\$ |

Quand utiliser des pièces qui coûtent cher?



| Part Number | Type | Voltage | Tolérance | Ratings | Coût/100 |
|----------------------|------|---------|-----------|----------|----------|
| CGA2B3X7R1H473K050EB | X7R | 50 V | 10% | AEC-Q200 | 2.94\$ |
| GRM155R71E473KA88D | X7R | 16 V | 20% | - | 1.86\$ |

On PCB: 10

Minimum Order Quantity: 100

2 Million / année

2 prototypes pour l'uni

Quand utiliser des pièces qui coûtent cher?



| Part Number | Type | Voltage | Tolérance | Ratings | Coût/100 |
|----------------------|------|---------|-----------|----------|----------|
| CGA2B3X7R1H473K050EB | X7R | 50 V | 10% | AEC-Q200 | 2.94\$ |
| GRM155R71E473KA88D | X7R | 16 V | 20% | - | 1.86\$ |

On PCB: 10

Minimum Order Quantity: 100

2 Million / année

Option 1:

$$\frac{2.94\$}{100} \cdot 10 \cdot 2\,000\,000 = 588\,000\$$$

2 prototypes pour l'uni

Commande = quantité minimale

Option 2:

Option 1: 2.94\$

Option 2: 1.86\$

$$\frac{1.86\$}{100} \cdot 10 \cdot 2\,000\,000 = 372\,000\$$$

$$2.94\$ - 1.86\$ = 1.08\$$$

$$588\,000\$ - 372\,000\$ = 216\,000\$$$

Bonnes pratiques de schéma

- Bonnes pratiques générales
- Bonnes pratiques des composantes & BOM
- Bonnes pratiques de schéma
 - Clareté
 - Notes
 - Testpoints et Debugging
 - Outils
 - Autre
 - Design Review

- **Tout devrait être dans le schéma électrique**
- C'est un outil et un document de référence pour *tout le monde*
 - Layout
 - Programmation
 - Assemblage
 - Surtout, un outil de debugging
- Un bon schéma contient toute l'information nécessaire pour faire ces tâches
- En mettre plus que pas assez
- Tu ne devrais pas avoir à ouvrir une datasheet pour comprendre un schéma

Bonnes pratiques de schéma

- Bonnes pratiques générales
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- **Mettre les inputs à gauche et les outputs à droite**
 - Le schéma devrait "flow" naturellement
 - Devraient bien se faire si les symboles sont bien faits
- **Faire des groupes ou "modules" avec des fonctionnalités distinctes**
 - Bien indiquer les sections
 - Les sections devraient aussi flow de gauche à droite
 - Prendre de l'espace lorsque nécessaire
- **Prendre de l'espace lorsque nécessaire**
 - Laisser le schéma respirer
 - Laisser la place pour du texte
 - Mettre le découplage à part

- **Toujours travailler sur une grille**

- Toujours garder la même taille de grille
- Je recommande 100 mils

- **Éviter des longues traces qui passent au travers du schéma**

- Utiliser des net names
- Mettre les parties du schéma en sections
- Regrouper des groupes de plusieurs nets en bus

- **Rentre le schéma le plus lisible possible**

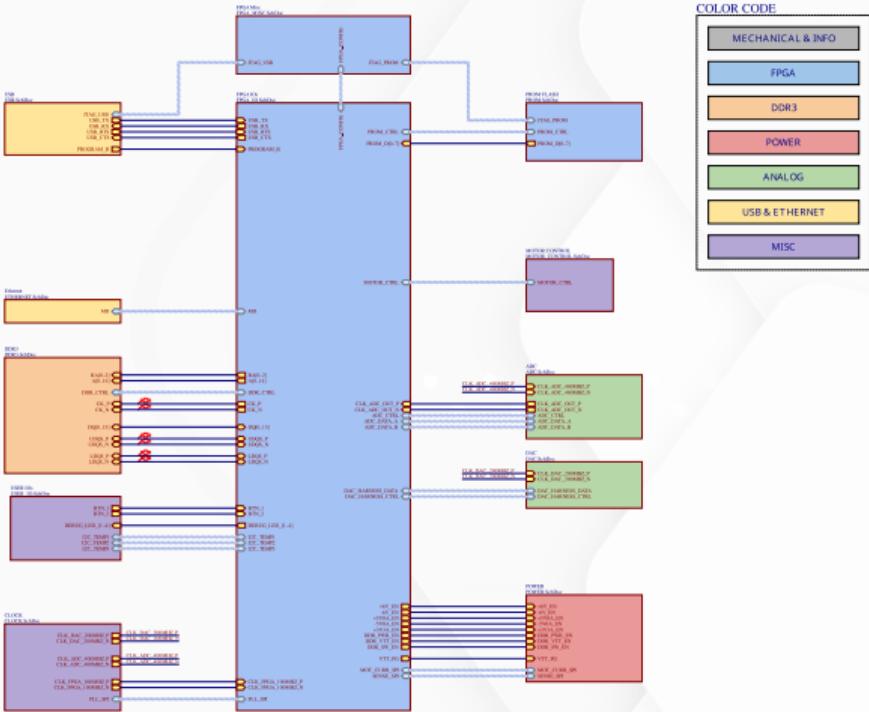
- Laisser le schéma respirer
- Éviter tous les croisements
- Aligner tout ce qui est alignable
- Pas de GND dans les airs; pas de VCC sur le côté

- Utiliser des noms de nets clairs sur les connexions importantes
 - Aide le layout
 - Indique la fonctionnalité des connexions
 - Permet de séparer une page en sous-blocs
- Utiliser les types de nets
 - Local Net Labels → Entre les sous-blocs
 - Global Net Labels → Apparaît sur le diagramme hiérarchique, connecte les pages
 - Power Labels → Pour toutes les connexions au PDN
- Utiliser des net classes
 - Indications pour les design rules
- Mettre des couleurs sur les nets
 - Code de couleurs sur le PDN

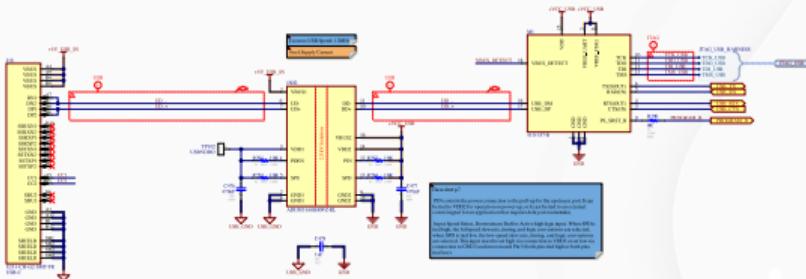
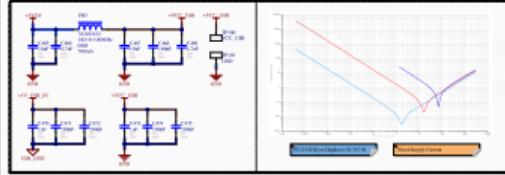
Modèle Hiérarchique



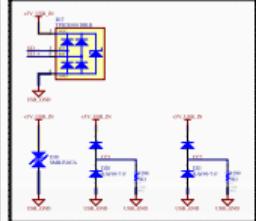
- Possible de tout mettre sur une page
 - Mieux de séparer les fonctionnalités par pages
 - Sous-fonctionnalités dans des sous-blocs
 - Page hiérarchique contient les plus grosses interconnexion
 - Permet de répéter plusieurs fois un module similaire
 - Code de couleur
 - Nom représentatifs
 - Inputs à gauche, outputs à droite



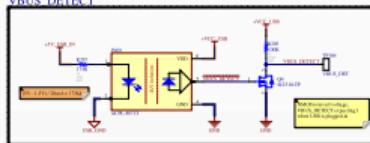
DECOUPLING



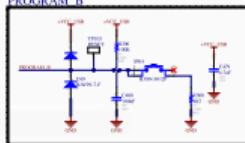
ESD



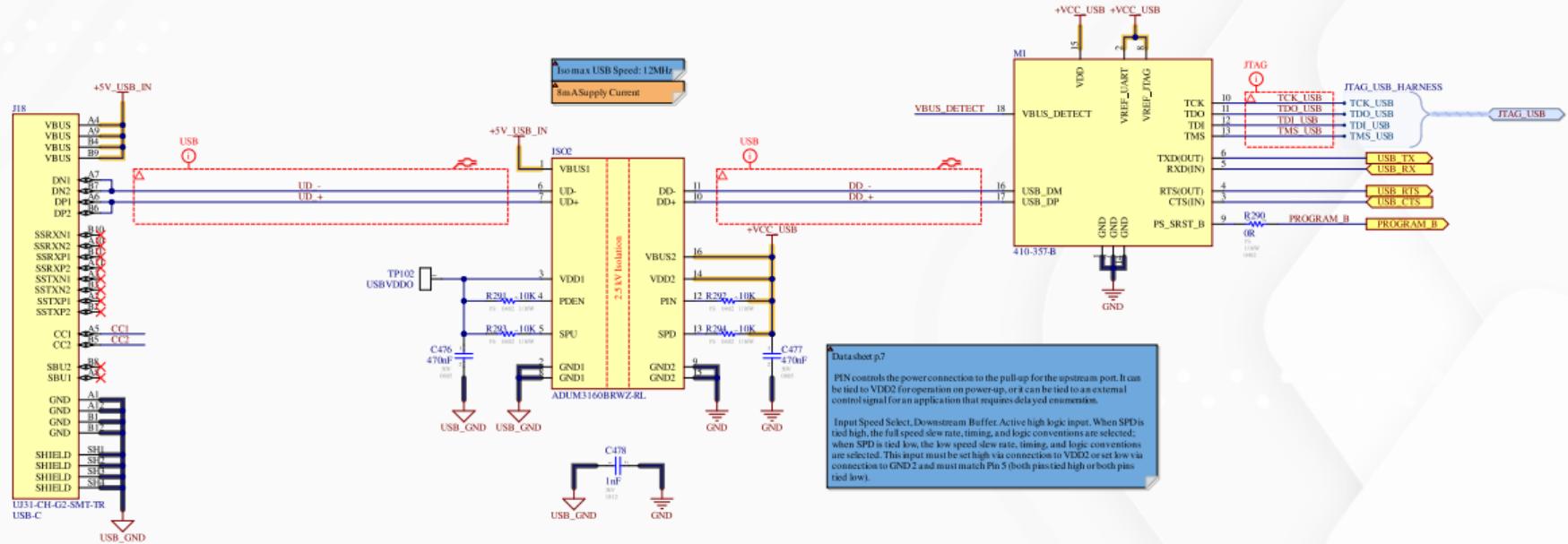
VBUS_DETECT



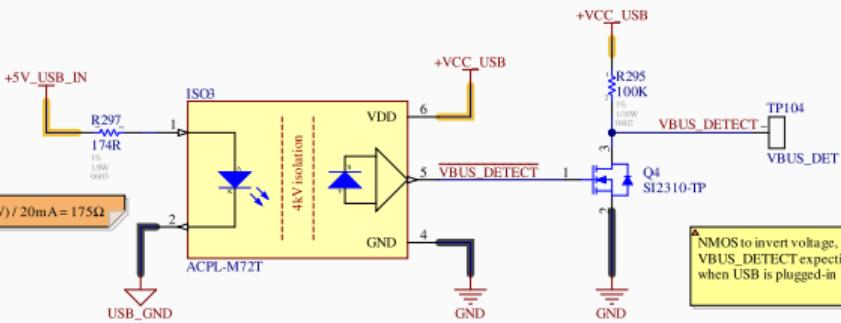
PROGRAM_B



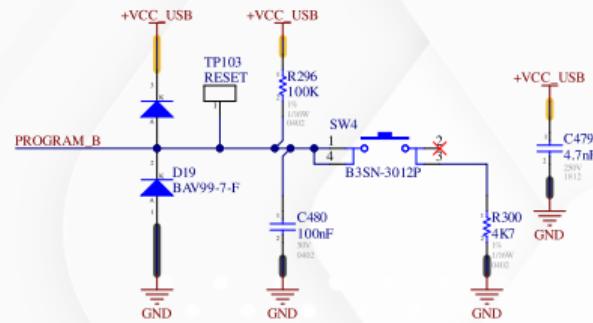
| Project Summary | |
|-----------------|--------------|
| USB | |
| Project Name | PLEADES |
| Design ID | Udc5.5T_APPI |
| Date | 11x17 |
| Group | Group 1 |
| Page | A |
| Page Number | 14 of 22 |



VBUS_DETECT



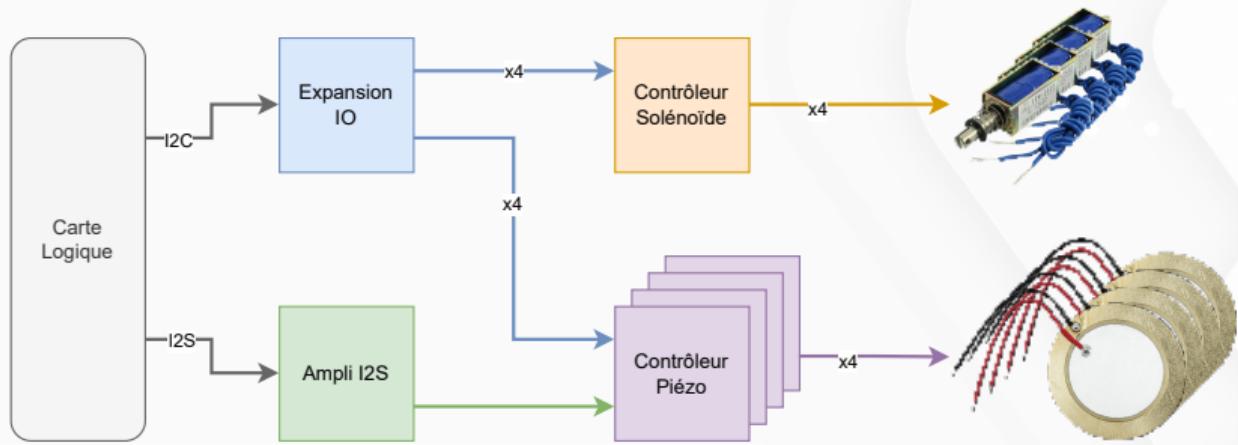
PROGRAM_B



Bonnes pratiques de schéma

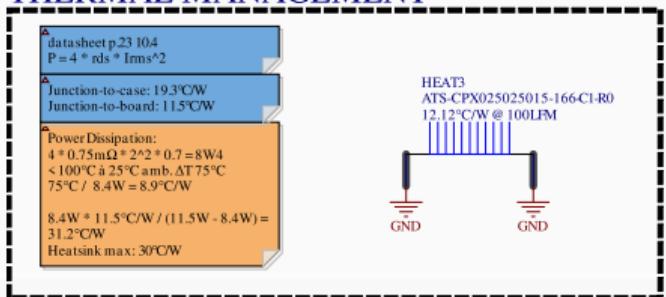
- Bonnes pratiques générales
- Bonnes pratiques des composantes & BOM
- Bonnes pratiques de schéma
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 - Autre
 - Design Review

- Le schéma électrique devrait contenir des schémas-blocs
- Schémas comme au chapitre 1
- Draw.io intégré dans le schéma électrique
- Utiliser les blocs hiérarchique comme schéma-bloc!



- Notes pour l'assemblage et le placement
- Notes pour tous les calculs
- Extraits pertinents de datasheet (avec p#)
- Configurations choisies
- Adresses de chips, modes de contrôle
- Courbes et graphiques
- Informations sur les pins (configuration etc.)

THERMAL MANAGEMENT



COLOR CODE

General Notes

Assembly, Part Locations, Fabrication, Debug Information etc.

Datasheet info

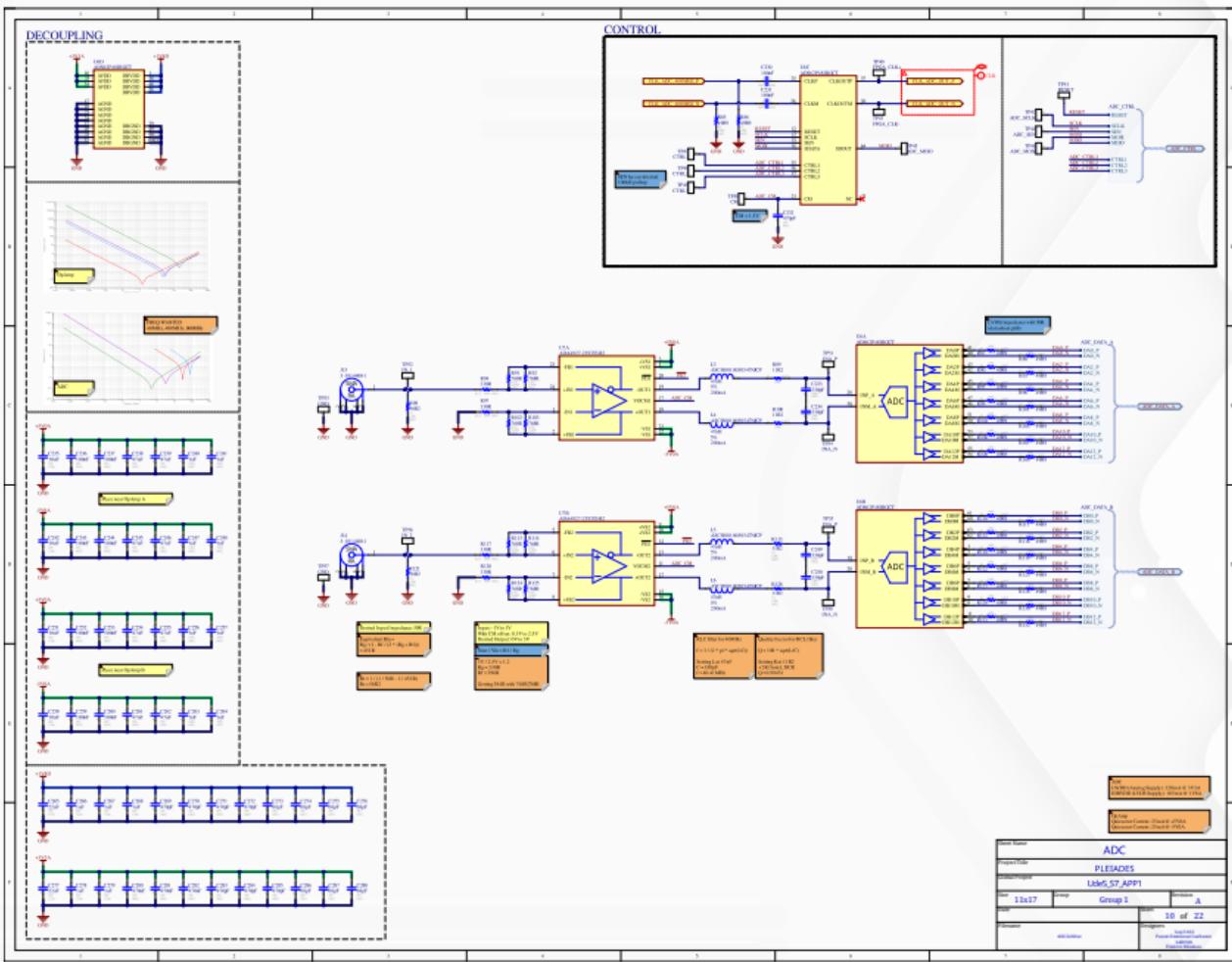
Part information, addresses, registers, pull-up/pull-downs, excerpts & tables etc.

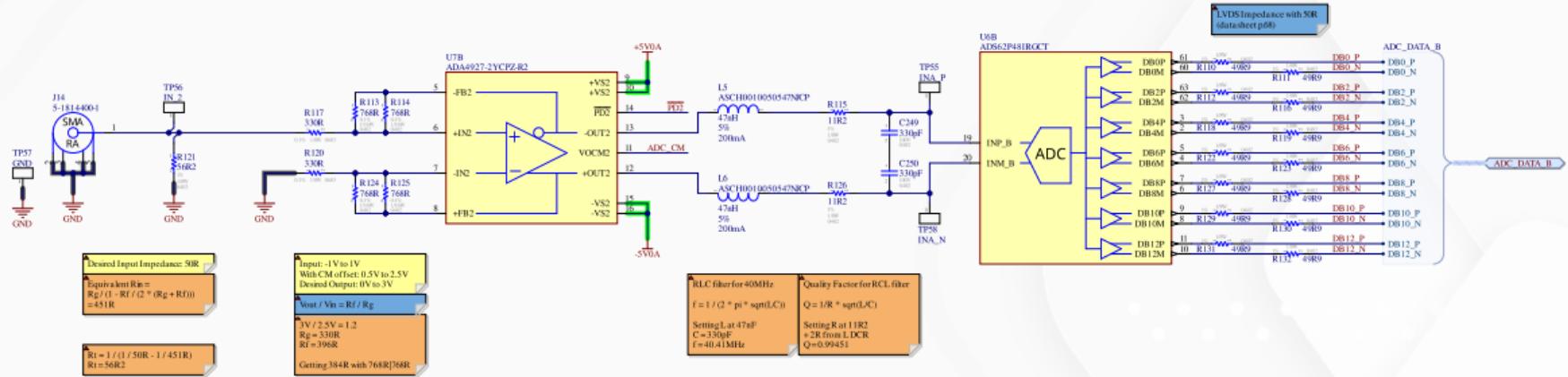
Calculations

Values, tensions & currents, passives, etc.

TODO

Things that are left to be done, and who should do it

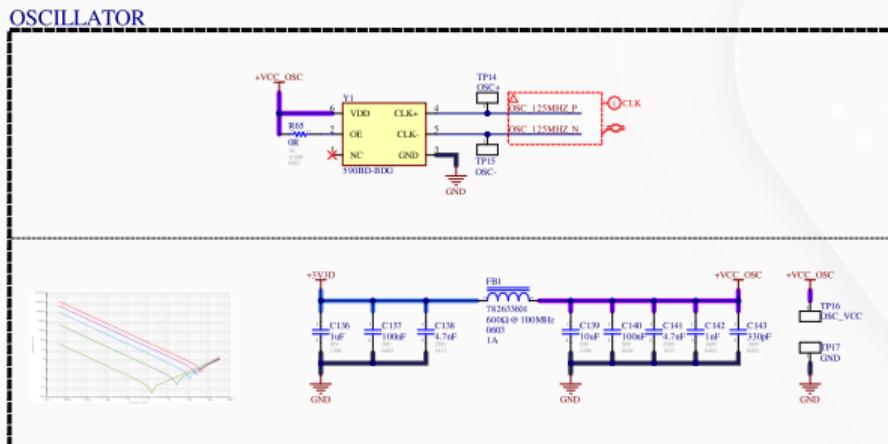


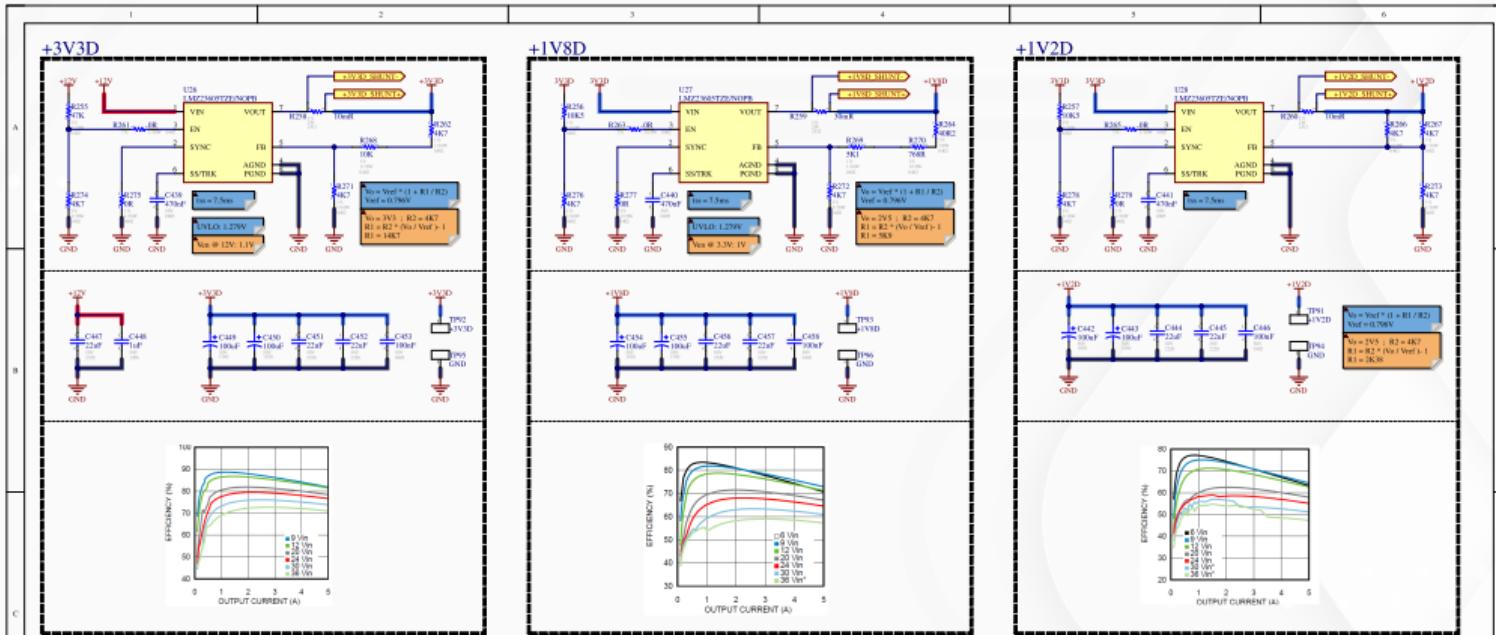


- **Calculer le power pour chaque bloc / chaque page**
 - Très important pour le design du PDN
- Indiquer les courbes d'efficacité des régulateurs
- Indiquer les courbes d'impédance du découplage des chips

ADC
 IAVDD (Analog Supply): 320mA @ 3V3A
 IDRVD (LVDS Supply): 165mA @ 1V8A

OpAmp
 Quiescent Current: 25mA @ +5V0A
 Quiescent Current: 25mA @ -5V0A





LUG994 p.32
The Spartan-6 FPGA can be powered up and powered down in any sequence. Because the three FPGA A supply inputs must be valid to release the POR and can be supplied in any order, there is no FPGA-specific voltage sequencing requirement.

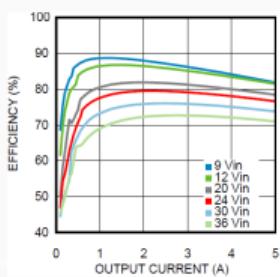
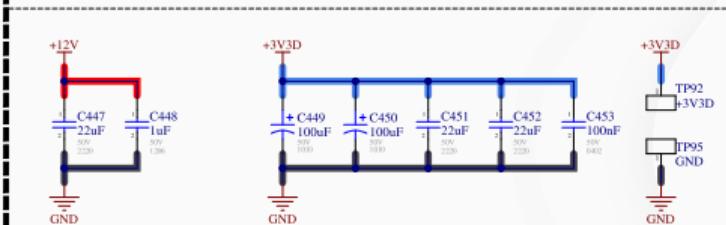
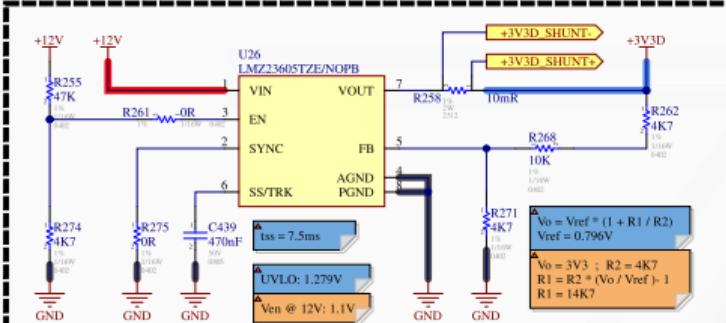
Table 6: Power Supply Ramp Time

| Symbol | Description | Speed Grade | Ramp Time | Units |
|---------------------------|--|-------------|--------------|-------|
| V_{CINIT} | Internal supply voltage ramp time | -3, -2N, -2 | 0.20 to 50.0 | ms |
| V_{CODE} ⁽¹⁾ | Output drivers bank 2 supply voltage ramp time | -1L | 0.20 to 40.0 | ms |
| V_{CLOCK} | Auxiliary supply voltage ramp time | All | 0.20 to 50.0 | ms |

VOCINT: 3A @ 1V2D
VOCaux: 250mA @ 3V3
VOCDD: 6A 100mA @ 2V3
6.485W

| | | | |
|----------------|---|-------|---------|
| Sheet Name | POWER | | |
| Project Title | PLEIADES | | |
| Global Project | UdeS_57_APP1 | | |
| Size | 11x17 | Group | Group 1 |
| Date | Sheet 20 of 22 | | |
| Filename | Designers POWER_PDF.schDoc Paul-Etienne Lachance Julien Frédéric Blouin | | |

+3V3D



▲ UG394 p.32

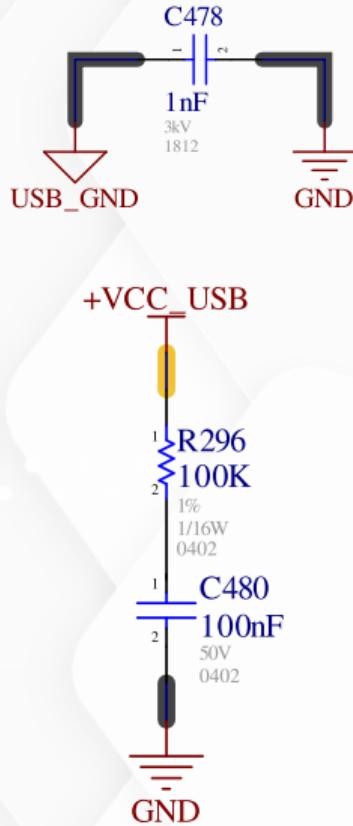
The Spartan-6 FPGA can be powered up and powered down in any sequence. Because the three FPGA supply inputs must be valid to release the POR and can be supplied in any order, there is no FPGA-specific voltage sequencing requirement.

Table 6: Power Supply Ramp Time

| Symbol | Description | Speed Grade | Ramp Time | Units |
|------------------|--|-------------|--------------|-------|
| V_{CCINTR} | Internal supply voltage ramp time | -3, -3N, -2 | 0.20 to 50.0 | ms |
| | | -1L | 0.20 to 40.0 | ms |
| $V_{CCO2}^{(1)}$ | Output drivers bank 2 supply voltage ramp time | All | 0.20 to 50.0 | ms |
| V_{CCAUXR} | Auxiliary supply voltage ramp time | All | 0.20 to 50.0 | ms |

▲ DS162 p.7

- Indiquer les informations pertinentes sur les composantes
 - Tolérances
 - Packages
 - Types
 - Puissance
 - Part #
- Essayer de toujours garder tout le texte horizontal
- Tous les noms de nets et de pièces en MAJUSCULES
- Donner des noms aux testpoints, boutons, switches, LEDs, connecteurs...



Bonnes pratiques de schéma

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Mettre plus de testpoints qu'on pense en avoir besoin

Questions que je ne me suis jamais posé:

Questions que je me suis déjà posé:

Mettre plus de testpoints qu'on pense en avoir besoin

Questions que je ne me suis jamais posé:

- Pourquoi j'ai mis autant de testpoints?
- J'aurais tu été mieux sans autant de testpoints?
- Est-ce que mon board aurait mieux marché avec moins de testpoints?
- J'aurais probablement été mieux avec moins de testpoints de ground, hein?

Questions que je me suis déjà posé:

- Comment ça j'ai rien pour checker mon I²C?
- J'ai tu vraiment besoin de me plugger sur mon condensateur pour lire mon 3.3V?
- Pourquoi j'ai pas mis de testpoint sur ma loop de feedback?
- Combien de courant y consomme mon circuit?
- Est-ce que j'ai vraiment juste un seul testpoint de GND?

Où mettre des testpoints

- Tous les rails d'alimentation
- Liens de communication (SPI, I²C, UART...)
- À plusieurs niveaux dans une chaîne analogique
- Pins de configuration, d'état
- IO
- Clocks
- GND GND GND

Prendre plusieurs mesures en même temps

- Plusieurs rails d'alimentation
- SCA + SCL
- Différent points dans une chaîne analogique
- All of the above, at once

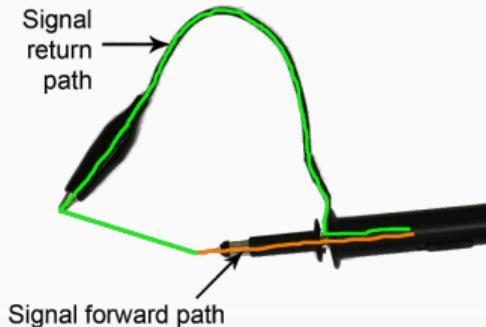
Minimiser la taille de la loop

- Mesure plus loin = plus d'inductance
- Plus d'inductance = plus de bruit sur la mesure

→ Tous les grounds ne sont pas égaux! ←

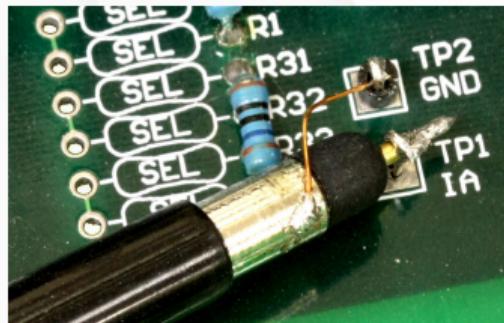
Prendre plusieurs mesures en même temps

- Plusieurs rails d'alimentation
- SCA + SCL
- Différent points dans une chaîne analogique
- All of the above, at once



Minimiser la taille de la loop

- Mesure plus loin = plus d'inductance
- Plus d'inductance = plus de bruit sur la mesure



[4]

Bonnes pratiques de schéma

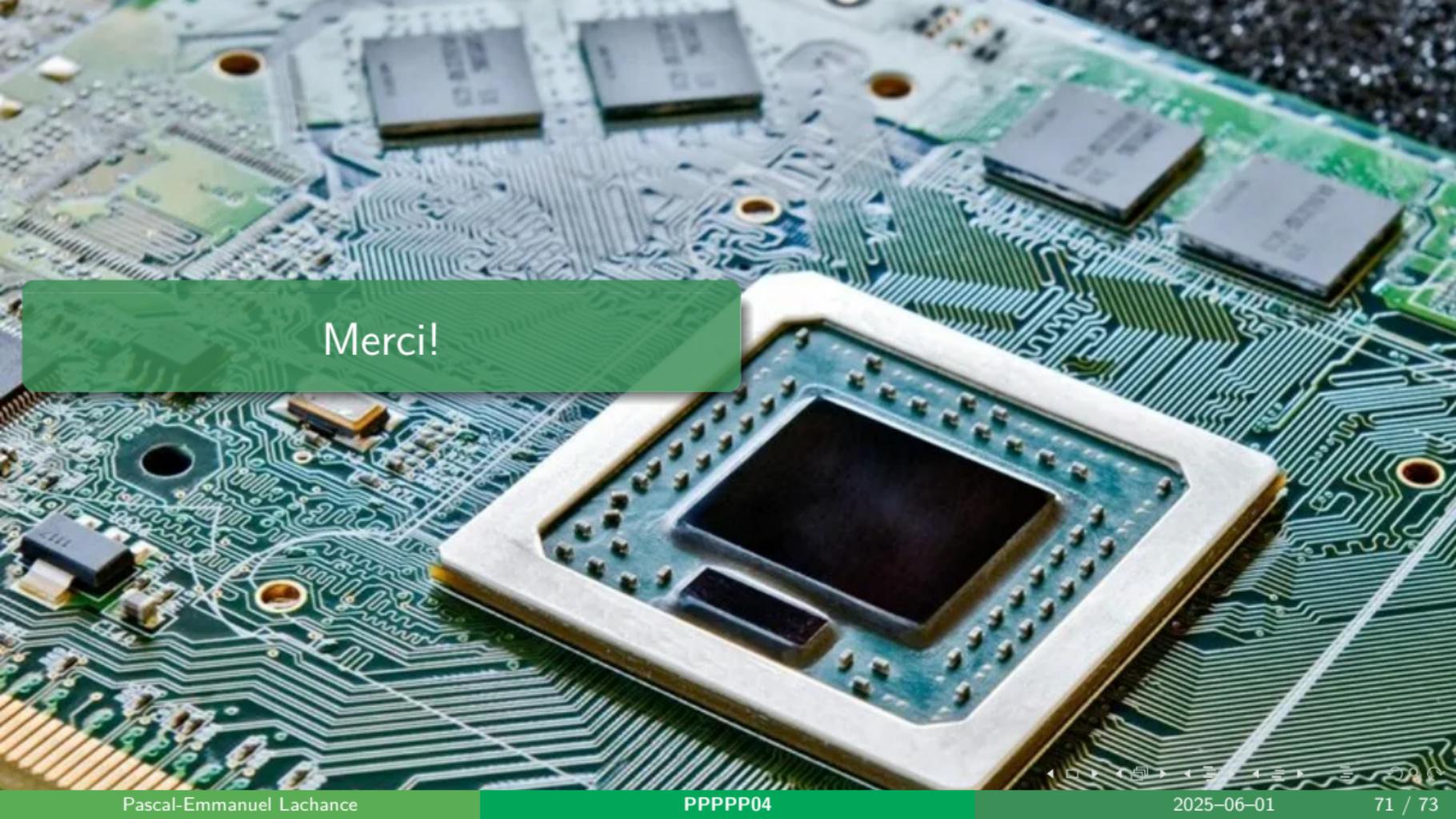
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Merci!

Prochain PPPPP

Comment se déplace un signal?

- Où l'impédance est la plus faible?
- Retour de courant
- Ground Bounce
- Vitesse de déplacement d'un signal
- Tout est une ligne de transmission

- [1] *The pareto principle*, Mar. 2025. [Online]. Available: <https://www.interaction-design.org/literature/topics/pareto-principle>.
- [2] *Symbols and symbol libraries*, Mar. 2025. [Online]. Available: https://docs.kicad.org/8.0/fr/eeschema/eeschema_symbols_and_libraries.html.
- [3] D. L. Jones, *The economics of selling your hardware project*,
<https://www.eevblog.com/2014/05/28/the-economics-of-selling-your-hardware-project/>, Accessed: 2025-05-24, May 2014.
- [4] H. Daniyal, “Investigation of digital current control based on zero average current error concept,” Ph.D. dissertation, May 2011.