אוניברסיטת בן-גוריון בנגב

Ben-Gurion University of the Negev

הפקולטה למדעי הנדסה

בית הספר להנדסת חשמל ומחשבים

המחלקה להנדסת חשמל ומחשבים

Faculty of Engineering Science

School of Electrical and Computer Engineering

Dept. of Electrical and Computer Engineering

פרויקט הנדסי שנה ד'

Fourth Year Engineering Project

Final Report

Multi Source Docking Station

Project Number:	**p-2022-040**			**מספר הפרויקט:**
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	Mr. Guy Bar Sovik		מר גיא בר סוביק	
Submitting Date:	24.07.2022			**תאריך הגשה:**

1. Abstract

Multi Source Docking Station

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Advisers' Names: Prof. Mor M. Peretz, Mr. Guy Bar Sovik

mobile electronics is an industry that has been on the rise in recent years. One of the developments supported by this technology is the drone. For the proper operation of the drone, it must be ensured that the energy source which charges the drone will be as efficient as possible.

the common way to charge the drone involves a solar panel via array of solar cells. The voltage that generated from the solar panel goes into a converter that feeds the load at the voltage. Solar panels have a certain voltage-current curve that depends on many variables. we aspire to work around the point on the curve where we get the maximum power.

There are different algorithms to find the optimal working point. This control is performed in a closed circuit by sensing the current / voltage and changing the operating cycle of the converter switch respectively. we control the voltage over the load and the current of the system. Maintaining work around an optimal work point allows for energy savings.

In this project we will examine algorithms and different types of converters. we will design and implement the best option.

Keywords: energy, control, solar, maximum power, working point, converter.

2. תקציר

תחנת עגינה מרובת מקורות

שמות הסטודנטים: בר מוסקוביץ, נועם גלילי

אימייל: barmosko@post.bgu.ac.il

שמות המנחים: פרופ' מור מ. פרץ, מר גיא בר סוביק

כיום אלקטרוניקה ניידת הינה ענף שנמצא בנסיקה גבוהה בשנים האחרונות. אחד מהפיתוחים שנתמכים בטכנולוגיה זו הוא הרחפן- אשר לו שימושים רבים בתעשייה. לצורך פעילות תקינה של הרחפן יש להבטיח כי מקור האנרגיה אשר טוען את הרחפן יהיה יעיל ככל שניתן.

אחת מהדרכים הנפוצות לטעינת הרחפן כוללת פאנל סולארי המורכב ממערך של תאי שמש. המתח המופק מהפאנל הסולארי נכנס לתוך ממיר, ההמיר מזין את העומס במתח הרצוי. לפאנלים סולאריים יש עקומת זרם מתח מסוימת התלויה במשתנים רבים כגון: טמפרטורת סביבה, התיישנות הפאנל, מזג האוויר, העומס המחובר למערכת. בכל אחת מנקודות העבודה על העקומה נקבל הספק מסוים, כאשר נשאף לעבוד סביב הנקודה בה נקבל הספק מקסימלי. אולם, שינוי של העקומה יניב לשינוי של נקודת העבודה המפיקה הספק מקסימלי.

ישנם שיטות בקרה רבות אשר נעזרות באלגוריתמים שונים לצורך מציאת נקודת העבודה האופטימלית. בקרה זו מתבצעת בחוג סגור על ידי חישה של הזרם\מתח ושינוי מחזור הפעולה של מתג הממיר בהתאמה. בכך למעשה אנו שולטים במתח על העומס ומכאן- בזרם של המערכת. שמירה על עבודה סביב נקודת עבודה אופטימלית מאפשרת חסכון אנרגיה.

בפרויקט זה נבחן אלגוריתמים וסוגי ממירים שונים ובהמשך נתכנן ונייסם את האפשרות הטובה ביותר מבחינת גודל פיזי, נצילות גבוהה, עלות כספית.

מילות מפתח: טעינה, רחפנים, אנרגיה, בקרה, סולארי, הספק מירבי, נקודת עבודה, ממיר, נצילות.

3. Introduction

The use of drones began as a means of entertainment or photography for enthusiasts. However, with the increase in the distribution of drones and their capabilities, various uses were added to them, among others as a means of quick and cheap photography. Among the uses in the industry can be found - policing and security: assisting with patrols and chasing suspects, as well as identifying drivers who hold cellphones or commit traffic violations, journalism, and entertainment: coverage of dangerous places, agriculture: accurate and cheap spraying and identification of crop defects. Construction projects: drones allow workers to prevent waste and unwanted construction waste and to optimize the procedure of ordering and purchasing materials - which is now considered one of the most wasteful factors in the .industry, and more

The drones that are available for purchase have undergone a variety of significant improvements in recent years, with better and much more advanced flight capabilities, improved photography capabilities, the ability to overcome unexpected obstacles, operate at greater distances from the operator and even return to him independently in the event of a malfunction or problem - but one thing remains almost Unchanged during the entire period is the available flight time, which continues to be between twenty minutes and half an hour in the most optimistic cases, and even shortens significantly the more you rely on all those new .and advanced technologies we mentioned earlier
Fuel cells or even electric motors may improve the situation compared to the common use of batteries alone but are not particularly relevant for most civilian products and applications. The required solution is the mobilization of solar energy
.to solve the technological limitations

In the recent years there has been a significant increase in the use of renewable energy sources in particular solar energy- illustrates at fig.1. The main goal is to reduce air .pollution. A useful way to work with solar energy is a solar cell
In our project we will focus on these problems by creating the charging stations for the drone .which is based on solar energy

A solar cell consists of a semiconductor that converts light into electrical energy by the photoelectric effect. Fig. 2 shows a typical I-V characteristic of a solar cell. For operation around the maximum power point (MPP), which changes dynamically depending on environmental factors, in the literature survey, we examined many algorithms that perform tracking around this point [2]-[4] we found it appropriate to use the Incremental Conductance .method

At the same time as the MPPT, to properly charge the drone, we strive to get a stable DC voltage output of V400 - a typical voltage level that an inverter component can convert to the mains voltage if necessary. The drone can be connected to the output of the inverter for charging. In fact, in this way we will ensure that the drone is properly charged at the same .time as receiving maximum power

For stabilizing the output to the DC voltage of 400V we used a DC-DC Merged converter PWM Resonant Converter that shown in [1]. This converter is controlled by a controller which is used to sample the input and output current and input voltages for stabilizing the .output voltage and MPPT independently in addition to high efficiency

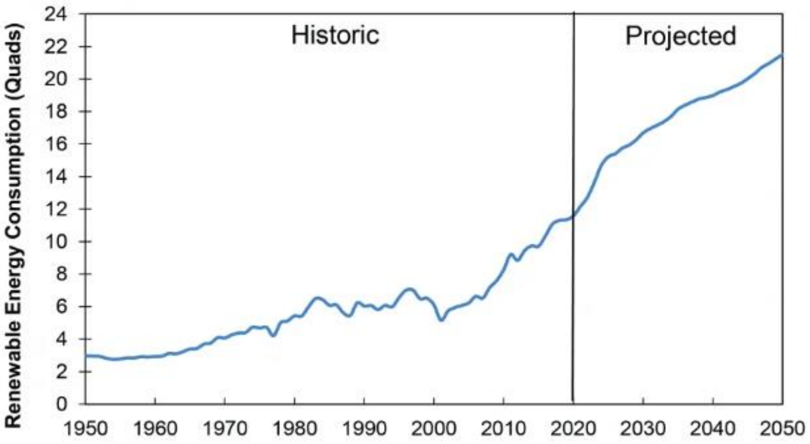

Figure 1 U.S. RENEWABLE ENERGY CONSUMPTION: HISTORIC AND PROJECTED-taken from [1]

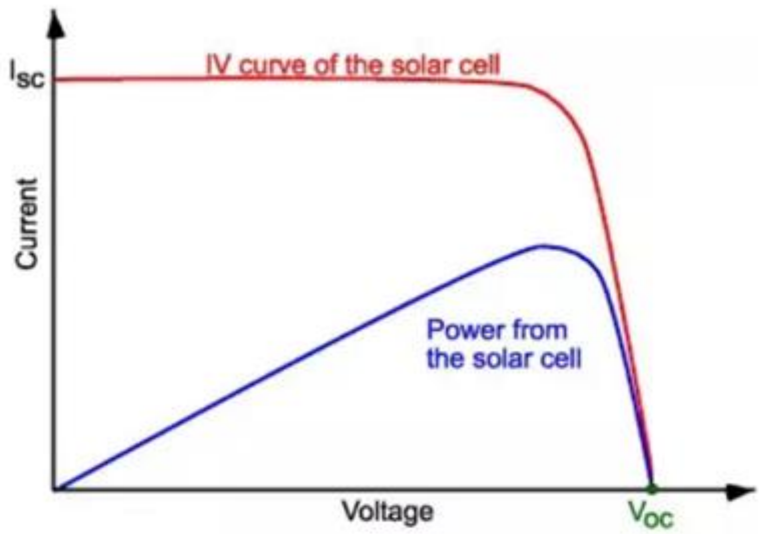

Figure 2 I-V characteristic of solar cell

4. System performance specification

- The optimal climatic condition for the system operations are sunny weather without shading at the solar panel.
- The system will be portable.
- Expected efficiency over 90%
- Expected output voltage 400V
- Max output power 240 W
- Max input voltage 20-40 V

5. Solution Approach and Engineering Design

System block diagram shown at fig. 3

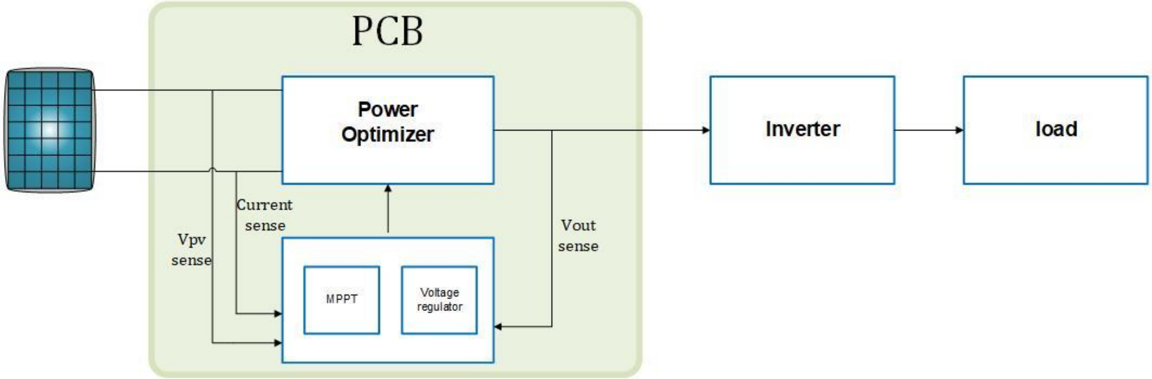

Figure 3 System block diagram

- PV cell that will use as a power source.

- Power optimizer (fig.4). -The main solution that can be useful is a circuit that introduce a merged PWM resonant DC-DC converter (MPRC) topology with high voltage gain for localized PV energy harvesting.
  The topology combines a boost front-end (fig.5) with a series-resonant converter (fig.6) as the back end. Merging is facilitated by sharing the MOSFETs for the operation of both converters.

  Solar panels have a certain voltage-current curve, for each point on the curve we get a certain power. This curve has one point where we get the maximum power, which we want to achieve (MPPT)(fig.2)

  The operation concept of the power optimizer:

  - Using grid-interactive photovoltaic (PV) systems we receive DC voltage from a solar panel.
  - front-end boost converter that connects to the PV module steps up the voltage to a level compatible by the transfer function of $M_{boost} = \frac{1}{1-D}$ while performing MPPT.
    The boost front-end provides the ability to obtain MPPT and is controlled by variation of the duty-ratio. The circuit reflects to the terminals of the panel by a different voltage (different from the output voltage).
  - This voltage is controlled by the duty cycle and the switching frequency. This voltage that we reflect to the panel terminals puts the panel to a certain working point. By changing the duty cycle we will change the working point of the panel until we can get the maximum power out of it.

- Force a square wave voltage on the LC circuit, the LC filters the wave and we are left with a sine wave in the current (under first harmonic approximation) (fig.7).
- The values of the resonant inductor and capacitor effect the quality factor as shown fig. 8
- The transformer will increase the sine wave amplitude in a factor of n (transformer turns ratio).
- The diode array will yield rectifier sine wave current at the output of the circuit (fig.9).
- The AC current will flow through the capacitor and the DC current will flow through the resistor. That will obtain DC voltage at the output of the converter.
- The resonant converter transfer function $M_{SRC} = \frac{sin\,(\pi D)}{1+j\frac{1}{2}\frac{\sqrt{L_{res}/C_{res}}\left(\frac{f_s}{f_r}-\frac{f_r}{f_s}\right)}{8\pi^2}}$
- Merged PWM resonant converter transfer function

$$M = M_{boost} \cdot M_{src} = \frac{1}{1-D}\frac{sin\,(\pi D)}{1+j\frac{1}{2}\frac{\sqrt{L_{res}/C_{res}}\left(\frac{f_s}{f_r}-\frac{f_r}{f_s}\right)}{8\pi^2}}$$

- Control system that includes microprocessor and sensors of voltage and current that will obtain optimal MPPT.

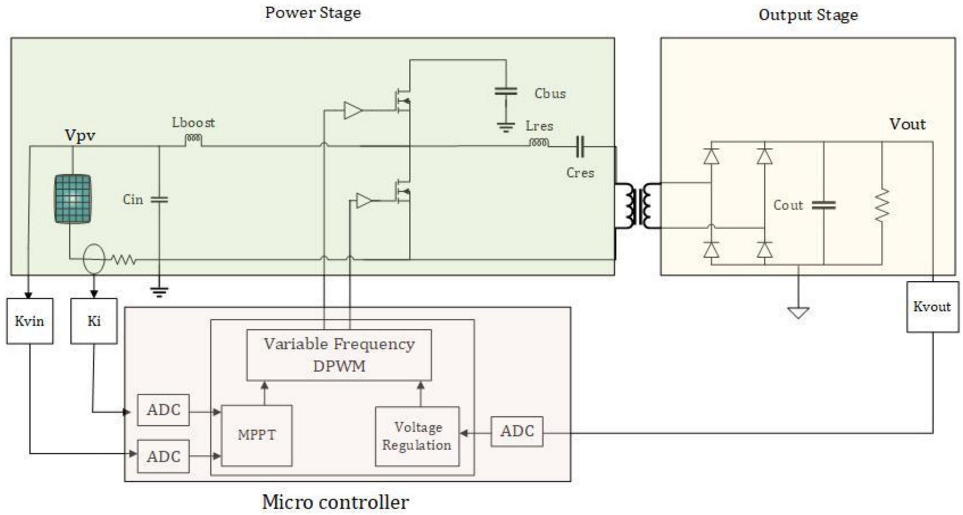

Figure 4. Merged PWM-resonant converter topology

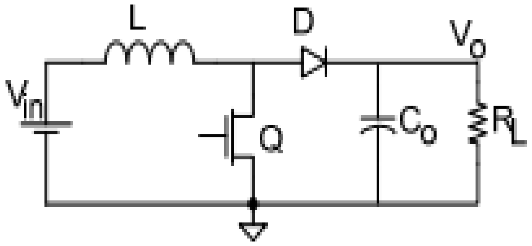

Figure 5 Boost converter

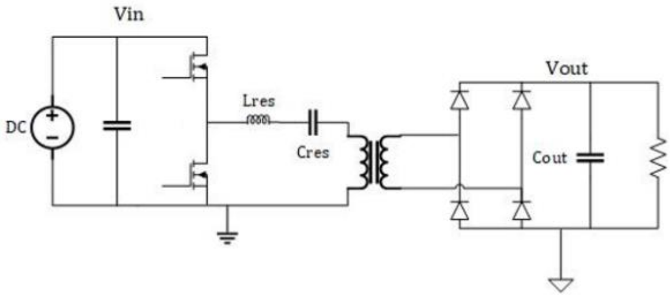

Figure 6 Resonant converter

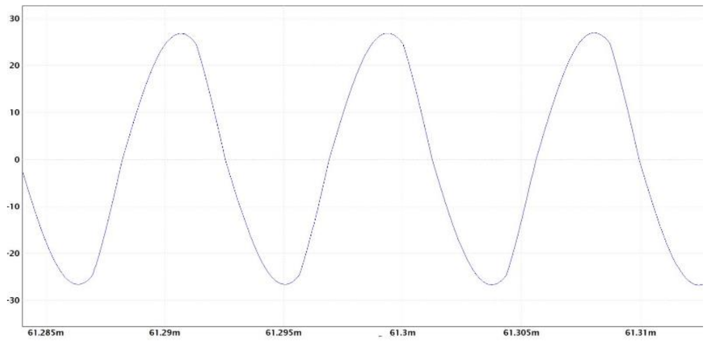

Figure 7 current [A] at LC resonant-taken from simulation

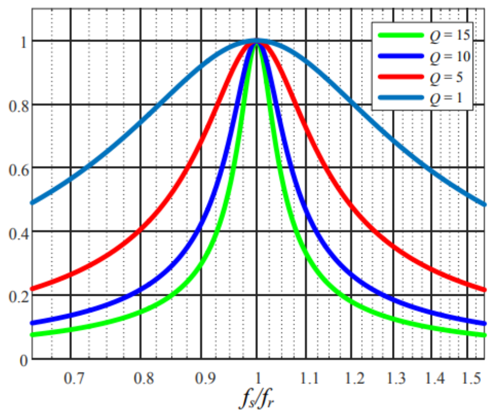

Figure 8 Normalize voltage gain of the SRC

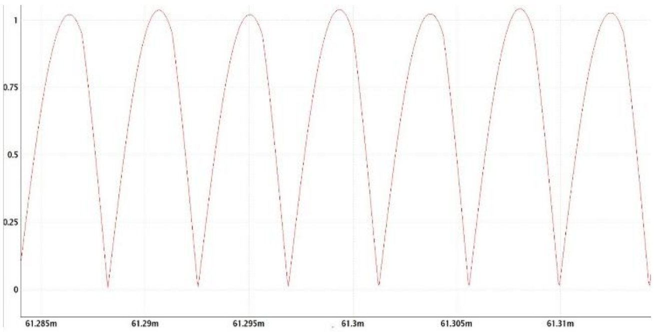

Figure 9- Current [A] at the diode array- yield rectifier sine wave-taken from simulation

MPPT Algorithm

The MPPT algorithm that was chosen is Incremental Conductance. The flow chart of the algorithm shown at fig. 10

- Each time step the input voltage and current sampled
- Approximate the derivative $\frac{\partial P}{\partial V} = \frac{V[n]\cdot I[n]-V[n-1]\cdot I[n-1]}{V[n]-V[n-1]}$
- $\frac{\partial P}{\partial V} = 0$ at MPP
- $\frac{\partial P}{\partial V} > 0$ left of MPP- increase duty cycle
- $\frac{\partial P}{\partial V} < 0$ right of MPP-decrease duty cycle

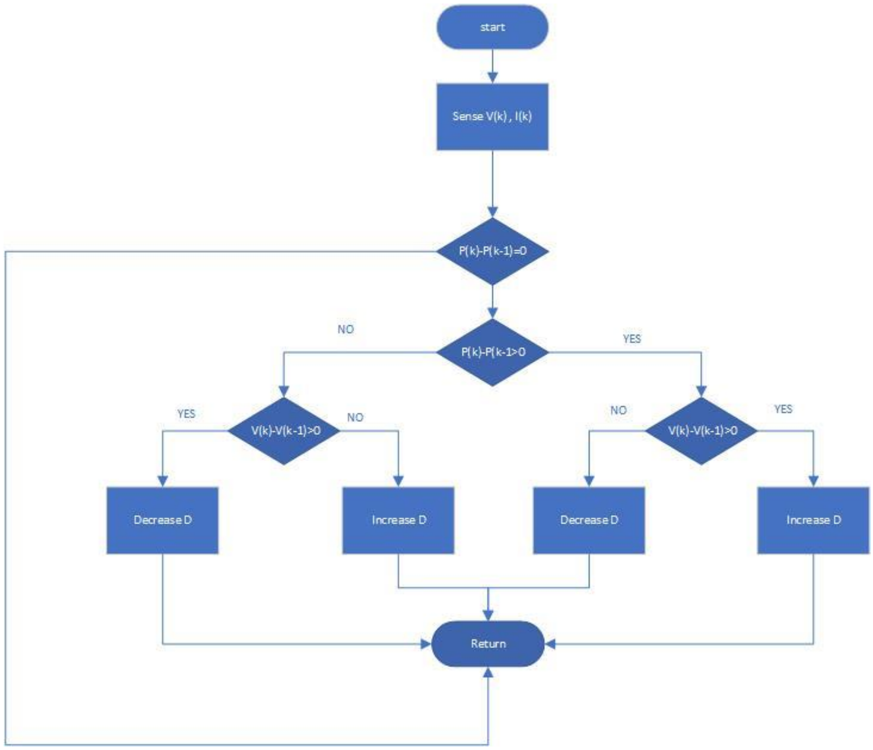

Figure 10 Incremental conductance flow chart

- After understanding the converter operation, we progress to PCB assembly

PCB Assembly

- Choosing component under consideration of efficiency, price, size, value, etc. and simulate for ensure correct operation of the system
- scheme creation on Pspice
- Layout design on Allegro fig. 11

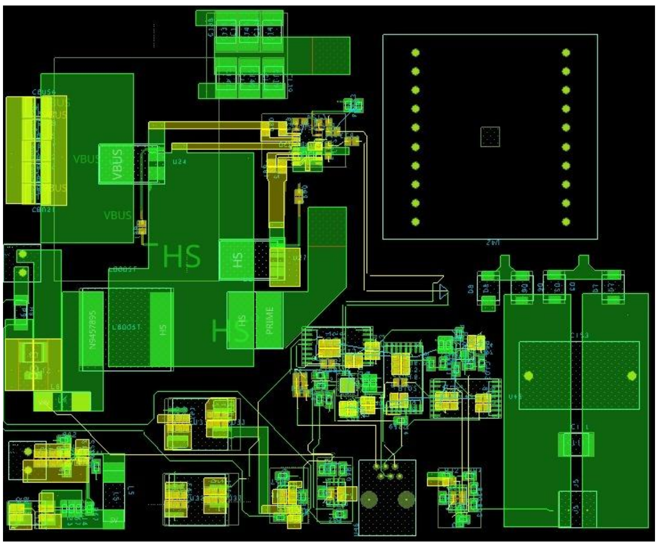

Figure 11 PCB layout

6. Problems and Solutions

During the project we deal with different challenges.
In order to decrease the board dimension and reduce parasitic inductance - decreasing the distance between components was necessary-produce high power density.
The power dissipation by using wide plains requires for preventing the heating of the system.
In addition, the values of the resonant components effect on their size. As the component values increase, so does its physical size. Hence, there is inverse proportionality between resonant components physical size and the resonant frequency due the relation of $f_0 = \frac{1}{2\pi\sqrt{LC}}$, which yield trade off between switches losses and the resonant components size. However, since our circuit work under ZVS the switches losses decrease, and it allow us to increase working frequency.
Furthermore, working with switch frequency close to the resonant frequency yield high resonant current as a result of low impedance of the resonant LC

7. Conclusions and Recommendation

In this study merged PWM DC-DC converter topology has been presented. The converter compose from two stage: boost at the front-end and series resonant at the back-end by sharing their transistors. controlling separately at the duty ratio and switching frequency allow achieve MPPT and voltage regulation while obtaining high efficiency due ZVS. In the future work in order to optimizing the system we aspire to achieve wireless charging of the drone-to reduce human intervention. In addition, inverter assembly at the output of the system getting same AC output voltage of electrical grid.

<u>Budget assessment</u>

<u>Manufacturing</u>

PCB manufacturing – 400$
Circuit components – 400$
Allegro & orcade license -89$ per month.
8 months within 2 semesters, 712$

<u>Engineering Hours</u>

2 students 20$ per hour
12 hours per week, 26 weeks within 2 semesters, 5200$ overall.
University guide 40$ per hour.
One hour per week, 26 weeks within 2 semesters, 1040$ overall.
University professor, 100$ per hour
15 minutes per week, 26 weeks within 2 semesters, 650$ overall.

Total budget evaluation: 8402$

8. Task Management

Task	Status
PDR	Done
Basic topology design	Done
Preliminary report	Done
Basic controller design	Done
PCB circuit scheme	Done
Component selection	Done
Simulations	Done
Design Review	Done
PCB circuit layout	Done
Progress presentation	Done
Poster	Done
Final presentation	Done
final report	In progress

9. References

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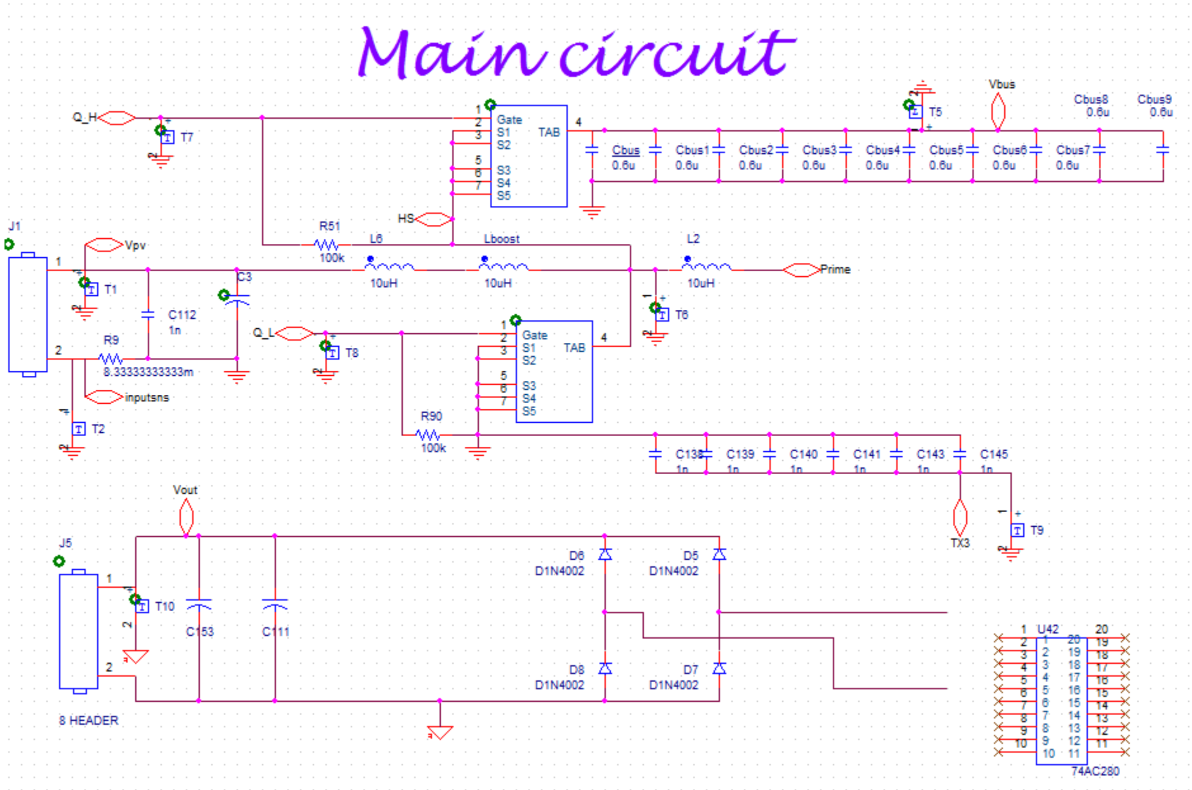
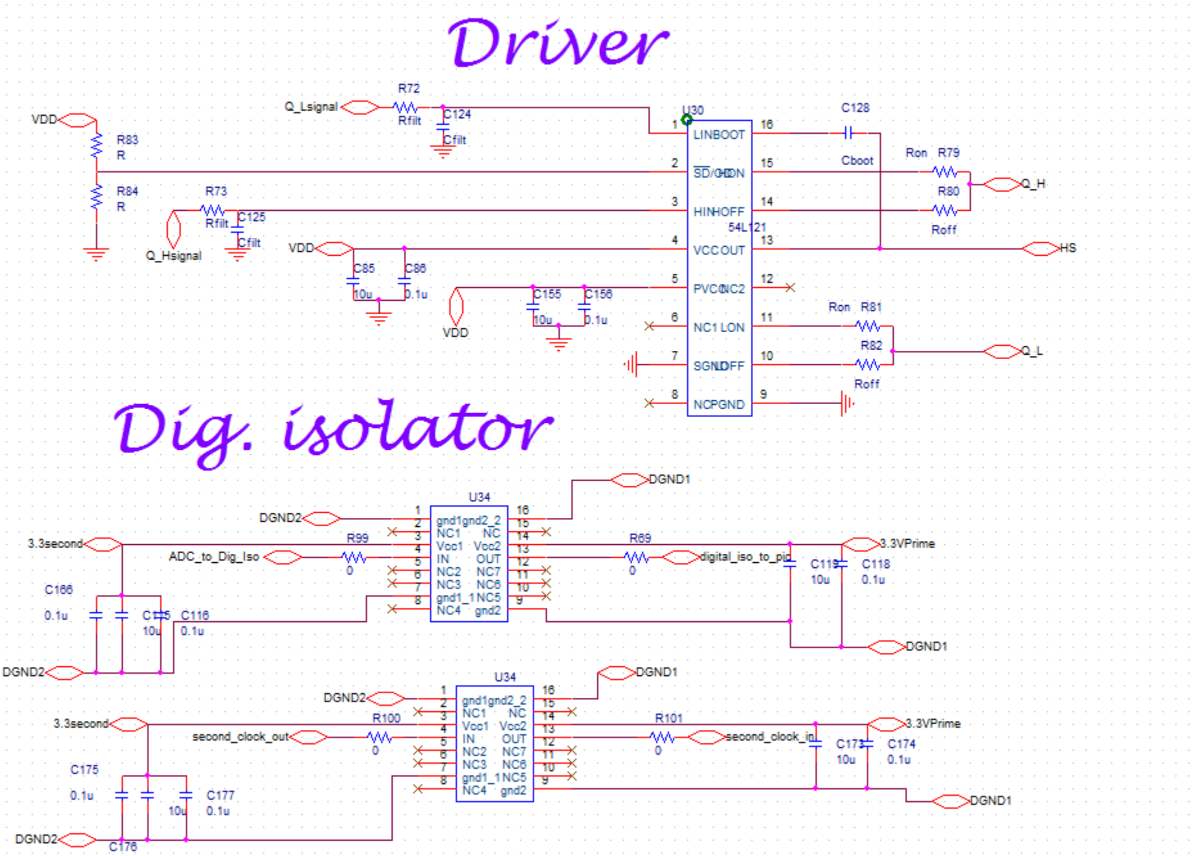
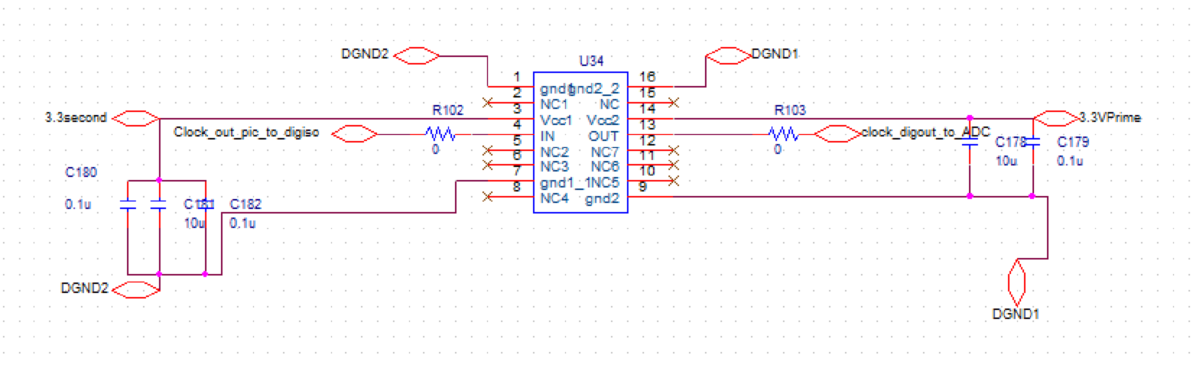
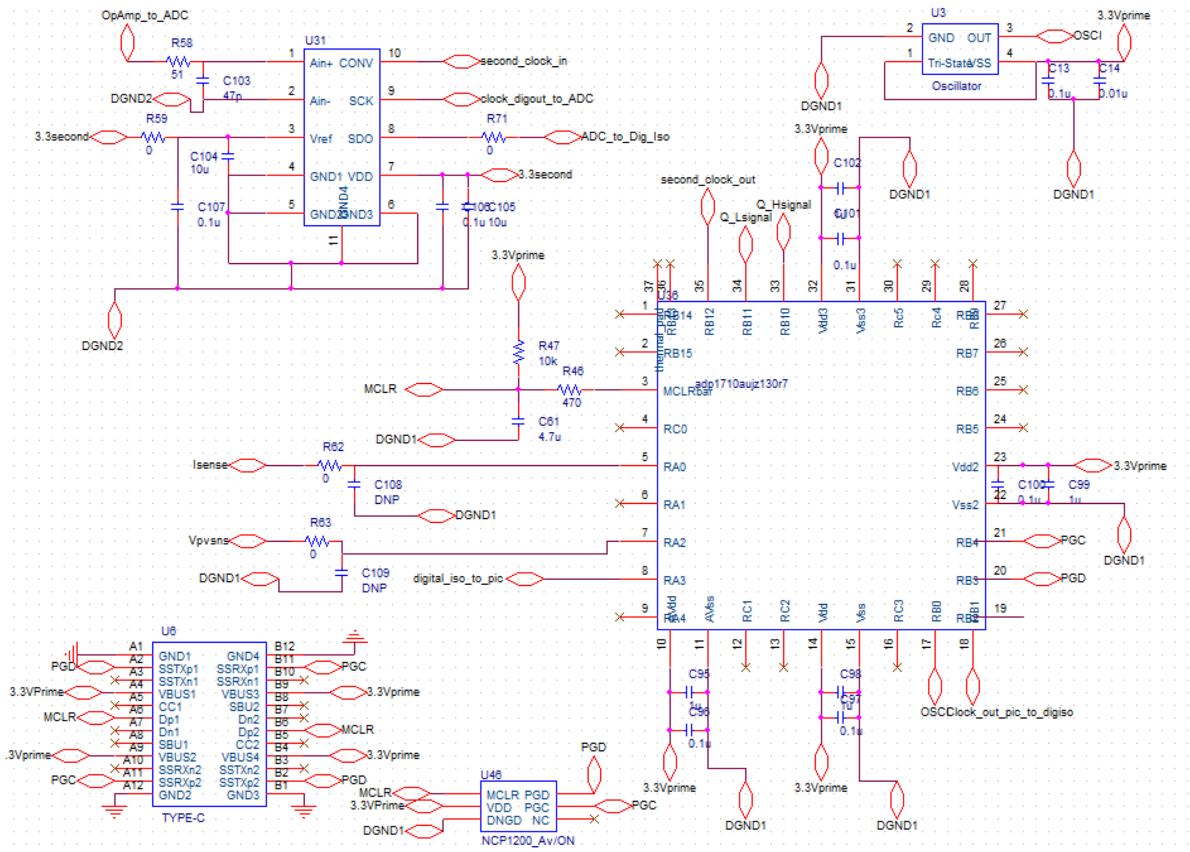
10. Appendix

Pspice Scheme




Driver
Q_Lsignal
R72
Rfilt
C124
Cfilt
VDD
R83
R
R84
R
R73
Rfilt
C125
Cfilt
Q_Hsignal
U30
LINBOOT
SD/CHDN
HINHOFF
54L121
VCCOUT
PVCCNC2
NC1 LON
SGNDLOFF
NCPGND
C128
Cboot
Ron R79
R80
Roff
Q_H
HS
C85
10u
C86
0.1u
C155
10u
C156
0.1u
Ron R81
R82
Roff
Q_L
Dig. isolator
U34
DGND1
DGND2
3.3second
ADC_to_Dig_Iso
R99
0
gnd1gnd2_2
NC1 NC
Vcc1 Vcc2
IN OUT
NC2 NC7
NC3 NC6
gnd1_1NC5
NC4 gnd2
R69
0
digital_iso_to_pic
3.3VPrime
C119
10u
C118
0.1u
C166
0.1u
C115
10u
C116
0.1u
R100
0
second_clock_out
R101
0
second_clock_in
C173
10u
C174
0.1u
C175
0.1u
C177
0.1u
10u
C176


DGND2
U34
DGND1
3.3second
Clock_out_pic_to_digiso
R102
0
gnd1gnd2_2
NC1 NC
Vcc1 Vcc2
IN OUT
NC2 NC7
NC3 NC6
gnd1_1NC5
NC4 gnd2
R103
0
clock_digout_to_ADC
3.3VPrime
C178
10u
C179
0.1u
C180
0.1u
C181
10u
C182
0.1u


OpAmp_to_ADC
R58
51
C103
47p
DGND2
R59
0
3.3second
U31
Ain+ CONV
Ain- SCK
Vref SDO
GND1 VDD
GND2 GND3
GND4
second_clock_in
clock_digout_to_ADC
R71
0
ADC_to_Dig_Iso
3.3second
C104
10u
C107
0.1u
C106
0.1u
C105
10u
DGND2
U3
GND OUT
Tri-State/SS
Oscillator
OSCI
3.3Vprime
C13
0.1u
C14
0.01u
DGND1
3.3Vprime
C102
C101
0.1u
DGND1
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Q_Lsignal
Q_Hsignal
3.3Vprime
R47
10k
R46
470
MCLR
C61
4.7u
DGND1
U36
adp1710aujz130r7
RB14
RB15
MCLRbar
RC0
RA0
RA1
RA2
RA3
RA4
RB12
RB11
RB10
Vdd3
Vss3
Rc5
Rc4
RB9
RB7
RB6
RB5
Vdd2
Vss2
RB4
RB3
RB2
AVdd
AVss
RC1
RC2
Vdd
Vss
RC3
RB0
RB1
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R62
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C108
DNP
DGND1
Vpvsns
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0
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DNP
DGND1
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3.3Vprime
C100
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C99
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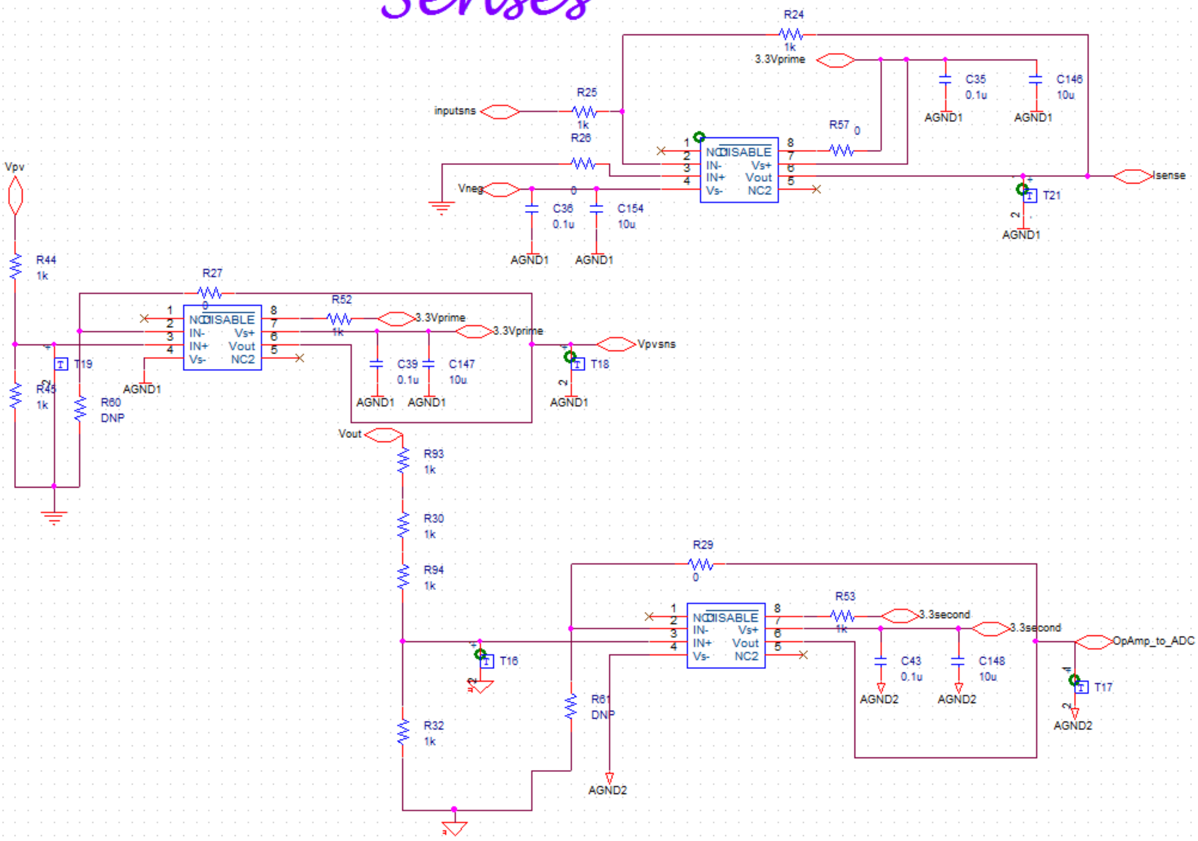
DGND1
PGC
PGD
C95
1u
C96
0.1u
C98
1u
C97
0.1u
3.3Vprime
DGND1
3.3Vprime
DGND1
OSC
Clock_out_pic_to_digiso
U6
GND1 GND4
SSTXp1 SSRXp1
SSTXn1 SSRXn1
VBUS1 VBUS3
CC1 SBU2
Dp1 Dn2
Dn1 Dp2
SBU1 CC2
VBUS2 VBUS4
SSRXn2 SSTXn2
SSRXp2 SSTXp2
GND2 GND3
TYPE-C
PGD
3.3VPrime
MCLR
.3Vprime
PGC
PGC
3.3Vprime
MCLR
3.3Vprime
PGD
U46
MCLR PGD
VDD PGC
DNGD NC
NCP1200_Av/ON
PGD
MCLR
3.3VPrime
DGND1
PGC

Senses



R24
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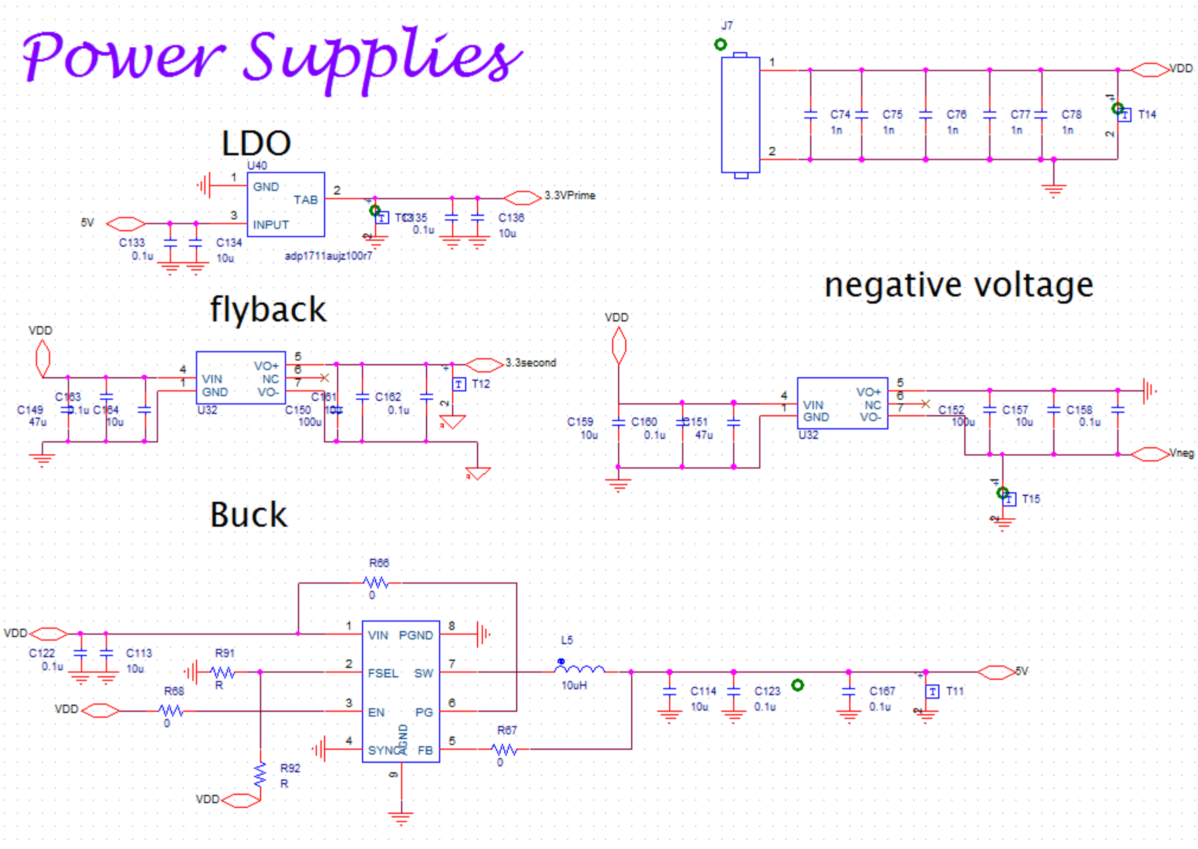
3.3Vprime
C35
0.1u
C146
10u
AGND1
inputsns
R25
1k
R26
R57
0
NC DISABLE
IN- Vs+
IN+ Vout
Vs- NC2
Isense
Vneg
T21
C36
0.1u
C154
10u
Vpv
R44
1k
R27
0
R52
1k
3.3Vprime
C39
0.1u
C147
10u
T19
T18
Vpvsns
R45
1k
R60
DNP
Vout
R93
1k
R30
1k
R94
1k
R29
0
R53
1k
3.3second
C43
0.1u
C148
10u
OpAmp_to_ADC
T16
T17
AGND2
R61
DNP
R32
1k


Power Supplies
LDO
U40
GND
TAB
INPUT
adp1711aujz100r7
5V
3.3VPrime
C133 0.1u
C134 10u
C135 0.1u
C136 10u
flyback
VDD
U32
VIN
GND
VO+
NC
VO-
3.3second
T12
C149 47u
C150 100u
C162 0.1u
Buck
R66 0
VIN
PGND
FSEL
SW
EN
PG
SYNC
FB
AGND
R91 R
R68 0
R92 R
R67 0
L5 10uH
C122 0.1u
C113 10u
C114 10u
C123 0.1u
C167 0.1u
T11
5V
J7
C74 1n
C75 1n
C76 1n
C77 1n
C78 1n
T14
VDD
negative voltage
C159 10u
C160 0.1u
C151 47u
C152 100u
C157 10u
C158 0.1u
Vneg
T15

Shopping Basket

Product Detail	Customer #	Order Qty.	Price (USD)	Ext. (USD)
Mouser #: 595-ISO7810DWR QuickView **Mfr. #:** ISO7810DWR **Manufacturer:** Texas Instruments **Desc.:** Digital Isolators Highest isolation rating, single-channel, reinforced digital isolator 16-SOIC -55 to 125 **RoHS:** RoHS Compliant	Customer #	3 **Packaging Choice:** Cut Tape **Availability** 3 Ships Now	$5.09	$15.27
Mouser #: 78-VS-4ECH06-M3/9AT QuickView **Mfr. #:** VS-4ECH06-M3/9AT **Manufacturer:** Vishay **Desc.:** Rectifiers 4 Amp 600 Volts Hyperfast - Low QRR **RoHS:** RoHS Compliant By Exemption	Customer #	4 **Packaging Choice:** Cut Tape **Availability** 4 Ships Now	$0.74	$2.96
Mouser #: 673-PA4349.104ANLT QuickView **Mfr. #:** PA4349.104ANLT **Manufacturer:** Pulse **Desc.:** Fixed Inductors 100uH 11A 13mm 20% SMT **RoHS:** RoHS Compliant	Customer #	1 **Packaging Choice:** Cut Tape **Availability** 1 Ships Now	$7.83	$7.83
Mouser #: 579-IC33CK64MP103EM5 QuickView **Mfr. #:** dsPIC33CK64MP103-E/M5 **Manufacturer:** Microchip **Desc.:** Digital Signal Processors & Controllers - DSP, DSC 16 Bit DSC, Single Core, 64K Flash, 8K RAM, 100MHz, 36Pin , E-temp **RoHS:** RoHS Compliant	Customer #	1 **Availability** 0 Ships Now 1 Backordered Long lead time reported on this product.	$3.50	$3.50
Mouser #: 651-5442565 QuickView **Mfr. #:** 5442565 **Manufacturer:** Phoenix Contact **Desc.:** Fixed Terminal Blocks BC-508X14- 2 GN 5.08 MM PITCH **RoHS:** RoHS Compliant By Exemption	Customer #	1 **Availability** 1 Ships Now	$1.38	$1.38
Mouser #: 490-TB007-508-02BE QuickView **Mfr. #:** TB007-508-02BE **Manufacturer:** CUI Devices **Desc.:** Fixed Terminal Blocks 2 24 Poles, Screw Type, Horizontal, 5.08 Pitch, 24 12 (AWG), Terminal Block Connector **RoHS:** RoHS Compliant By Exemption	Customer #	2 **Availability** 2 Ships Now	$0.66	$1.32

Mouser #: 538-217184-0001 QuickView Mfr. #: 217184-0001 Manufacturer: Molex Desc.: USB Connectors Mid-Mnt DR SMT 24Ckt Type C Rec. Lifecycle: New Product: New from this manufacturer.	Customer #	1 Availability 1 Ships Now	$1.06	$1.06
Mouser #: 511-STDRIVEG600TR QuickView Mfr. #: STDRIVEG600TR Manufacturer: STMicroelectronics Desc.: Gate Drivers High voltage half-bridge gate driver for GaN transistors RoHS: RoHS Compliant Lifecycle: New Product: New from this manufacturer.	Customer #	1 Packaging Choice: Cut Tape Availability 1 Ships Now	$2.90	$2.90
Mouser #: 584-C2355IMSE-12PBF QuickView Mfr. #: LTC2355IMSE-12#PBF Manufacturer: Analog Devices Inc. Desc.: Analog to Digital Converters - ADC 12-Bit, 3.5 Msps Serial ADC Unipolar RoHS: RoHS Compliant	Customer #	1 Availability 1 Ships Now	$15.24	$15.24
Mouser #: 863-NCV1117ST33T3G QuickView Mfr. #: NCV1117ST33T3G Manufacturer: onsemi Desc.: LDO Voltage Regulators 3.3V 1.0A Automotive RoHS: RoHS Compliant	Customer #	1 Packaging Choice: Cut Tape Availability 0 Ships Now 1 Backordered Long lead time reported on this product.	$0.72	$0.72
Mouser #: 863-NVBGS4D1N15MC QuickView Mfr. #: NVBGS4D1N15MC Manufacturer: onsemi Desc.: MOSFET PTNG 150V IN SUZHOU D2PAK7L FOR AUTOMOTIVE RoHS: RoHS Compliant By Exemption	Customer #	2 Availability 2 Ships Now	$18.94	$37.88
Mouser #: 584-AD8029ARZ QuickView Mfr. #: AD8029ARZ Manufacturer: Analog Devices Inc. Desc.: High Speed Operational Amplifiers HIGH PERFORMANCE RRIO RoHS: RoHS Compliant	Customer #	3 Availability 0 Ships Now 3 Backordered Long lead time reported on this product.	$3.03	$9.09

Mouser #: 584-ADP2370ACPZ5.0R7 QuickView **Mfr. #:** ADP2370ACPZ-5.0-R7 **Manufacturer:** Analog Devices Inc. **Desc.:** Switching Voltage Regulators 800mA Buck 5.0Vout **RoHS:** RoHS Compliant	Customer #	1 **Packaging Choice:** Cut Tape **Availability** 1 Ships Now	$4.72	$4.72
Mouser #: 669-EB13E2H2H-40T QuickView **Mfr. #:** EB13E2H2H-40.000M TR **Manufacturer:** ABRACON **Desc.:** Standard Clock Oscillators 40MHz 3.3Vdc 50ppm -40C +85C **RoHS:** RoHS Compliant	Customer #	1 **Packaging Choice:** Cut Tape **Availability** 0 Ships Now 1 Backordered Long lead time reported on this product.	$1.24	$1.24
Mouser #: 279-TLRP3A20DR008FTE QuickView **Mfr. #:** TLRP3A20DR008FTE **Manufacturer:** TE Connectivity **Desc.:** Current Sense Resistors - SMD TLRP 2512 2.0W R008 1% 50PPM 4K RL **RoHS:** RoHS Compliant **Lifecycle:** NEW **New Product:** New from this manufacturer.	Customer #	1 **Availability** 1 Ships Now	$0.68	$0.68
Mouser #: 80-C2220X205KARLAUTO QuickView **Mfr. #:** C2220X205KARLCAUTO **Manufacturer:** KEMET **Desc.:** Multilayer Ceramic Capacitors MLCC - SMD/SMT 250V 2uF X7R 2220 10% AEC-Q200 **RoHS:** RoHS Compliant **Lifecycle:** NEW **New Product:** New from this manufacturer.	Customer #	3 **Packaging Choice:** Cut Tape **Availability** 3 Ships Now	$6.40	$19.20
Mouser #: 581-22201C106M4Z2A QuickView **Mfr. #:** 22201C106M4Z2A **Manufacturer:** Kyocera AVX **Desc.:** Multilayer Ceramic Capacitors MLCC - SMD/SMT 100V 10uF X7R 2220 20% Flex AEC-Q200 **RoHS:** RoHS Compliant	Customer #	10 **Packaging Choice:** Cut Tape **Availability** 10 Ships Now	$5.71	$57.10

Mouser #: 81-KCM55V5C2J443JDLL QuickView **Mfr. #:** KCM55V5C2J443JDL2L **Manufacturer:** Murata **Desc.:** Multilayer Ceramic Capacitors MLCC - SMD/SMT **RoHS:** RoHS Compliant **Lifecycle:** NEW **New Product:** New from this manufacturer.	Customer #	10 **Availability** 10 Ships Now	$4.20	$42.00
Mouser #: 70-IHSM4825ER220L QuickView **Mfr. #:** IHSM4825ER220L **Manufacturer:** Vishay **Desc.:** Fixed Inductors 22uH 15% **RoHS:** RoHS Compliant By Exemption	Customer #	1 **Packaging Choice:** Cut Tape **Availability** 1 Ships Now	$4.98	$4.98
Mouser #: 490-PQP1-D12-S3-M QuickView **Mfr. #:** PQP1-D12-S3-M **Manufacturer:** CUI Inc. **Desc.:** Isolated DC/DC Converters dc-dc isolated, 1 W, 9~18 Vdc input, 3.3 Vdc, 303 mA, single regulated output, SMT **RoHS:** RoHS Compliant	Customer #	2 **Availability** 2 Ships Now	$7.86	$15.72

המלצת ציון (ע"י מנחה אקדמי) לדו"ח מסכם

<u>אם יש צורך, לכל סטודנט/ית בנפרד</u>

מספר הפרויקט: P-2022-040

הפרויקט: תחנת עגינה מרובת מקורות – Multi Source Docking Station

שם המנחה החיצוני:

שם המנחה מהמחלקה: פרופ' מור מ. פרץ, מר גיא בר סוביק

שם הסטודנט/ית: בר מוסקוביץ ת.ז.: 204573661

שם הסטודנט/ית: נועם גלילי ת.ז.: 204609382

%		חלש 55-64	בינוני 65-74	טוב 75-84	ט"מ 85-94	מצוין 95-100	
20	הצגת הגישה והתכנון ההנדסי						
20	הצגת התוצאות וניתוח השגיאות						
20	הסקת מסקנות						
10	גילוי יוזמה וחריצות						
20	פתרון בעיות, מקוריות ותרומה אישית (מעבר למילוי ההנחיות)						
10	עמידה בלו"ז ורמת הביצוע המעשי						

אם יש כוונה לפרסם/ יפורסם מאמר, שם כתב העת ומועד משוער להגשה:

ציין אם יש כוונה לשקול המלצה כפרויקט מצטיין:

הערות נוספות: