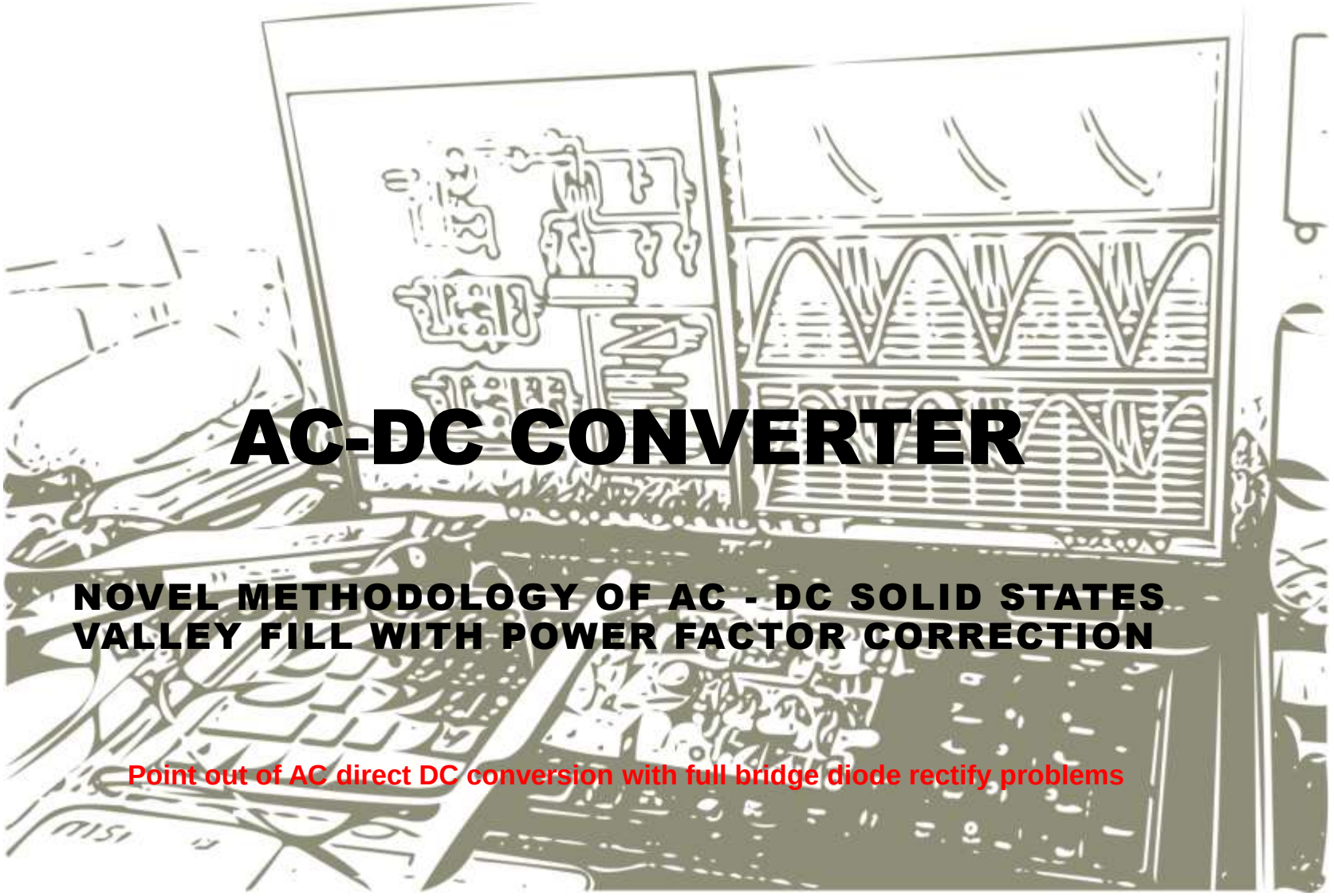


AC-DC CONVERTER

NOVEL METHODOLOGY OF AC - DC SOLID STATES VALLEY FILL WITH POWER FACTOR CORRECTION

Point out of AC direct DC conversion with full bridge diode rectify problems

Jeong.osc@gmail.com

UNDESIRABLE RIPPLE

While half-wave and full-wave rectification can deliver unidirectional current, neither produces a constant voltage.

Producing steady DC from a rectified AC supply requires a smoothing circuit or filter.

In its simplest form this can be just a reservoir capacitor or smoothing capacitor, placed at the DC output of the rectifier.

There is still an AC ripple voltage component at the power supply frequency for a half-wave rectifier, twice that for full-wave, where the voltage is not completely smoothed.

Electrolytic capacitors can evaporate through a temperature-dependent drying-out process, which causes electrical parameters to drift, limiting the service life time of the capacitors.

High-amplitude ripple currents shorten the life of electrolytic capacitors.

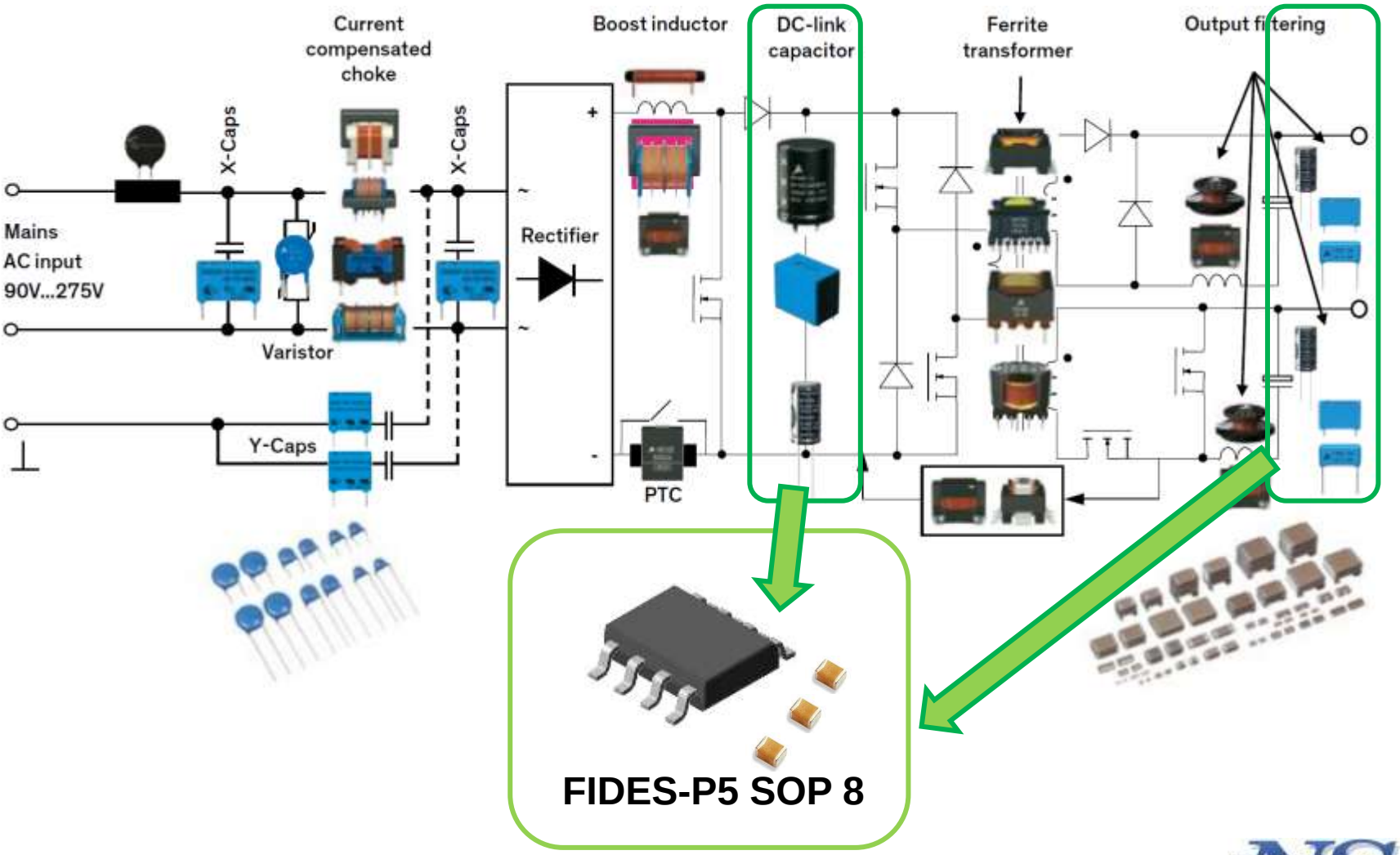
Jeong.osc@gmail.com

COMPETITOR MARKET

At present, Asia-Pacific (APAC) dominates the LED driver IC market, capturing 59.6% of the share in the overall market that is expected to grow at a CAGR of 32.5% from 2010 to 2015. This can be attributed to the factors such as low cost of IC, tax exemptions given by the governments, and presence of Original Equipment Manufacturers/Original Device Manufacturers (OEMs/ODMs).

The market of LED driver IC is highly fragmented and comprises big industry giants and small companies that are based in Asia-Pacific, Europe, and North America. Texas Instruments (U.S.), National Semiconductor (U.S.), ON Semiconductor (U.S.), NXP (The Netherlands), Linear Technology (U.S.), Maxim IC (U.S.), Power Integrators (U.S.), iWatt (U.S.), Macroblock (Taiwan), Fairchild (U.S.), Semtech (U.S.), and others that includes Supertex (U.S.), Austria Microsystems (Austria), Advanced Analogic Technologies (U.S.), Infineon Technologies (Germany), Intersil Corporation (U.S.), Rohm (Japan), Silicon Touch Technology (Taiwan), ST Microelectronics (Switzerland) are some of the key players in the LED driver IC market.

SMPS CAPACITOR PARTS SUBSTITUTION



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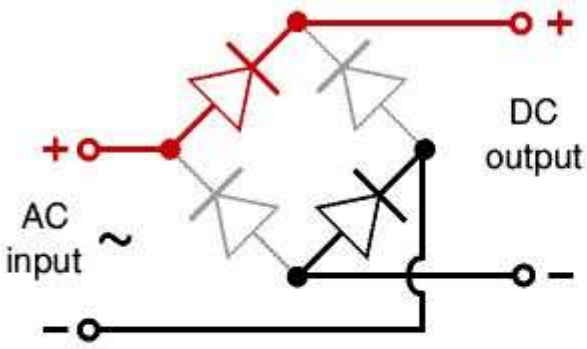
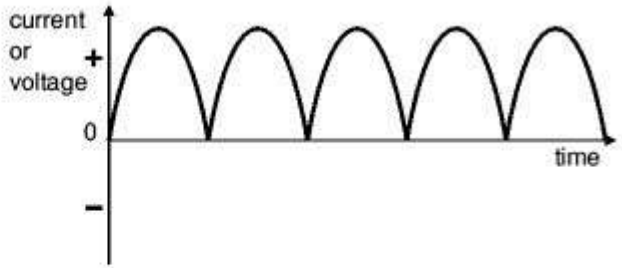
WHAT IS PROBLEMS OF AC-DC CONVERSION



Bridge rectifier

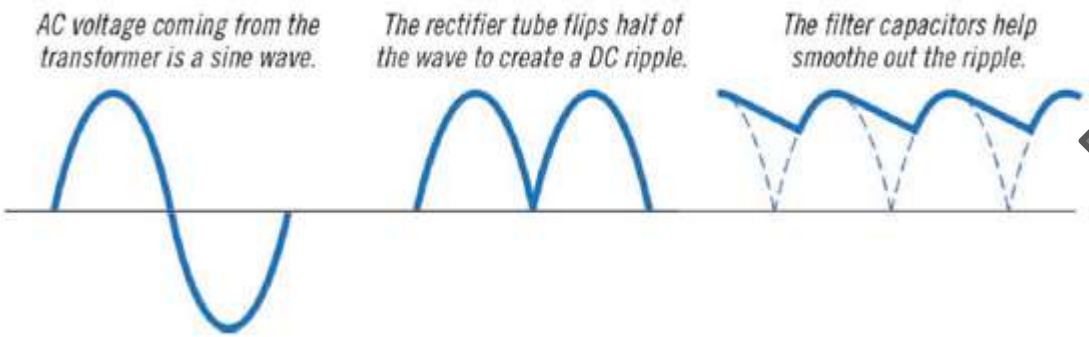
Alternate pairs of diodes conduct, changing over the connections so the alternating directions of AC are converted to the one direction of DC.



Output: full-wave varying DC

(using all the AC wave)

1. When AC to DC must be come to current zero point.
2. Dammed high current by capacitor.
3. The Electrolytic capacitor



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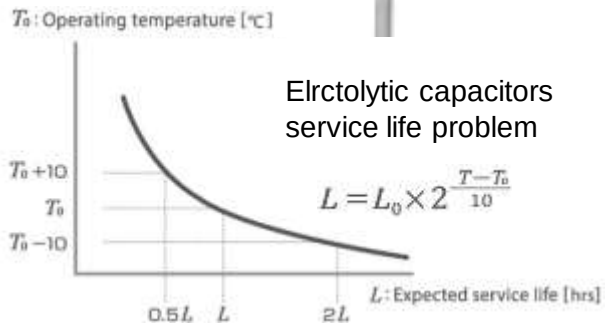
MOVE OVER TO DIGITAL CONTROLLED SOLID CAPACITOR

Substitution

FIDES-P5 SOP 8

MTBF OVER 100K hours sustainable life cycles



Elrctolytic capacitors service life problem

For every rise in operating temperature by 10 degrees centigrade, the service life is shortened to one half, and double for every 10 degree drop(10 degree 2 fold rule). The aluminum electrolytic capacitor is commonly 10 years service life)

Benefit :

1. Long life MTBF
2. Good PFC (over 0.95)
3. Stable operating temperature
4. Small size

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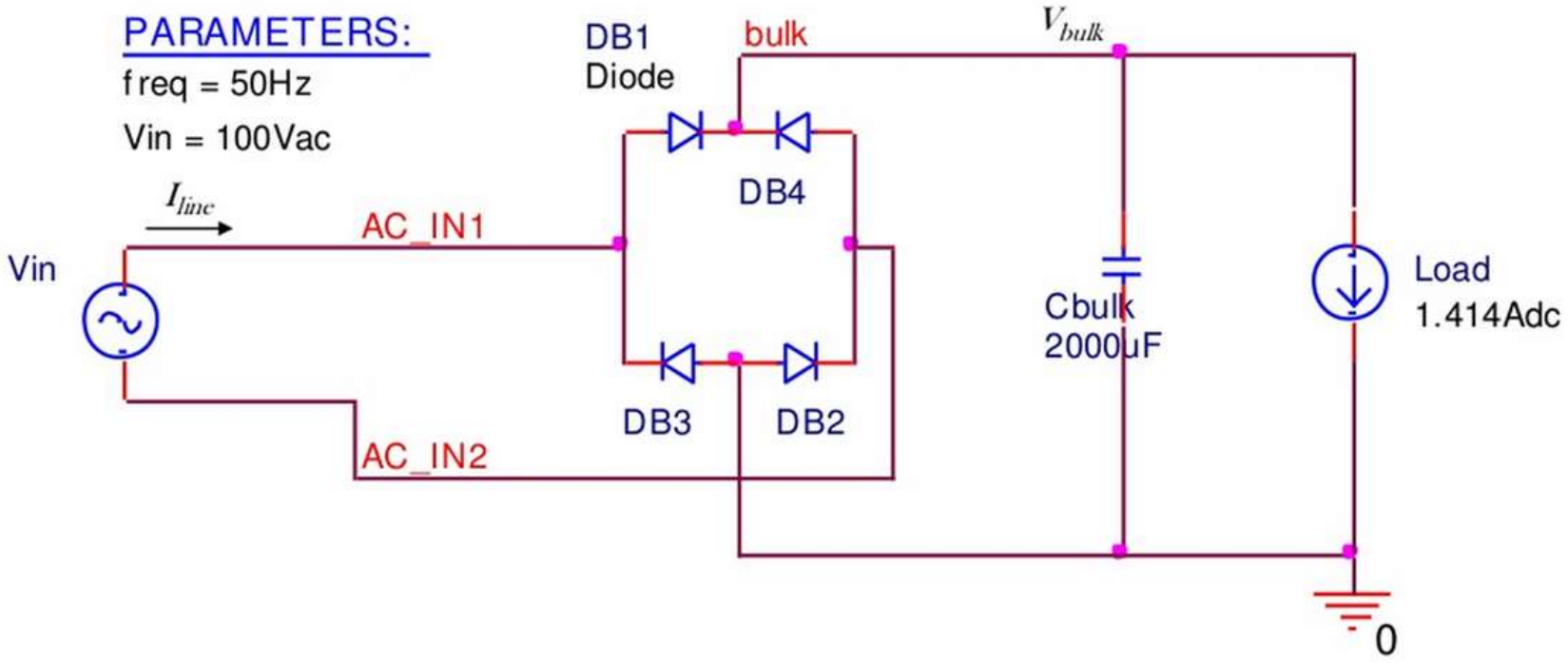
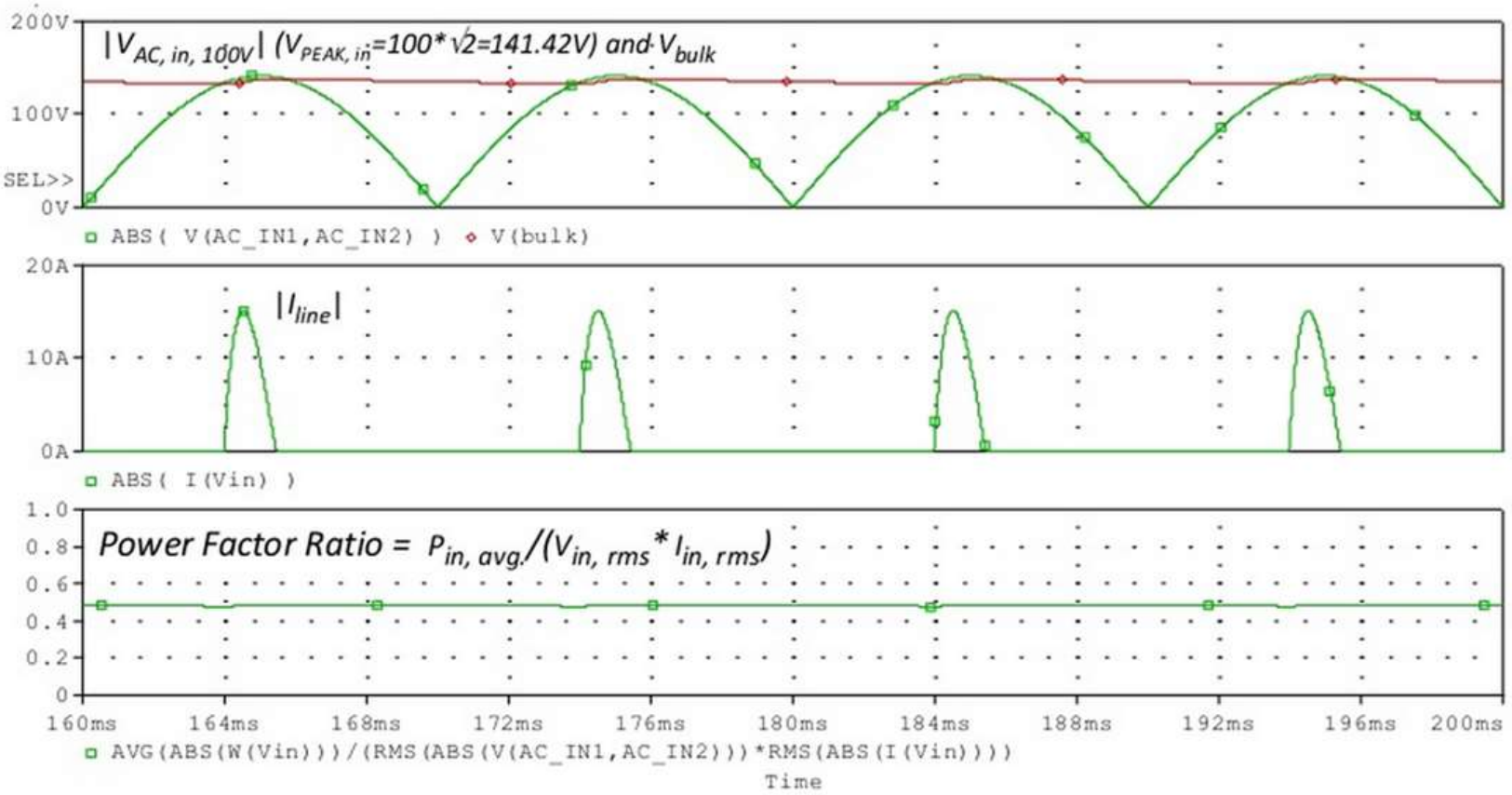
AC-DC CONVERSION



Most electronic ballasts and switching power supplies use a bridge rectifier and bulk storage capacitor to derive raw DC voltage from the utility AC line.
Figure above: Vin=100Vac, 60Hz and Po=200W.

BRIDGE RECTIFYING POWER FACTOR



The uncorrected power factor rectifying circuit draws current from the AC lin when the AC voltage exceeds the capacitor voltage(Vbulk). The current(Iline) is non-sinusoidal. This results in a poor power factor condition where the apparent input power is much higher then real power, figure above, power factor ratios of 0.5 to 0.7 are common.

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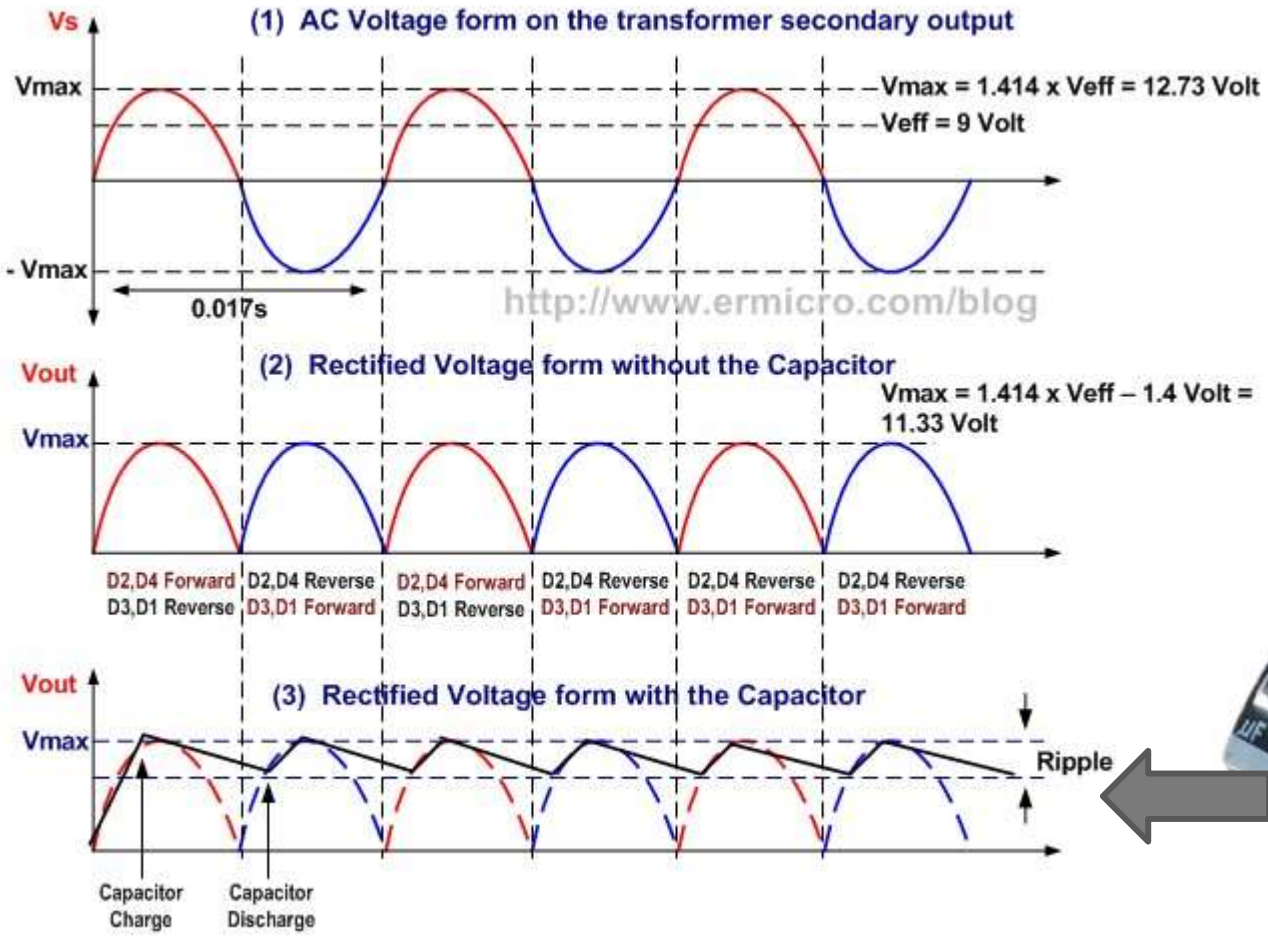
AC-DC RECTIFIER



The AC to DC full wave rectifier Voltage time diagram

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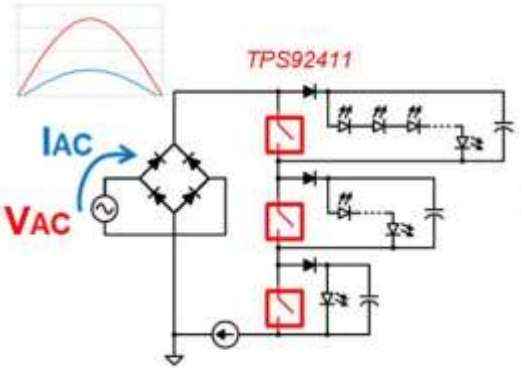
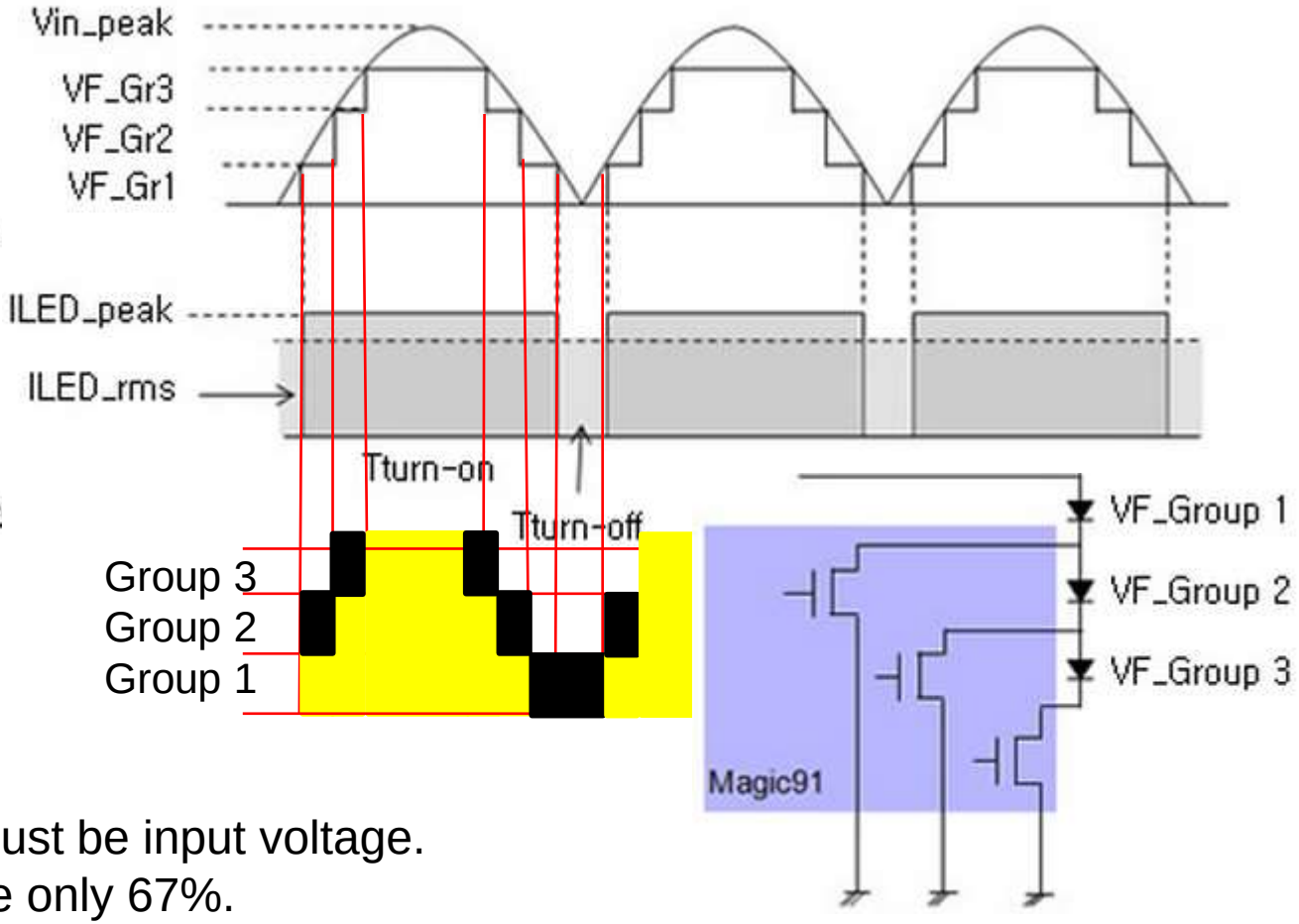
AC DIRECT LED DRIVER PROBLEM DEMYSTIFIED



TPS92411 Switched Line



Demerit

1. Need LED Vf must be input voltage.
2. LED on time are only 67%.
3. LED string illumination are not same.

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VIVIPAROUS RIPPLE PROBLEMS

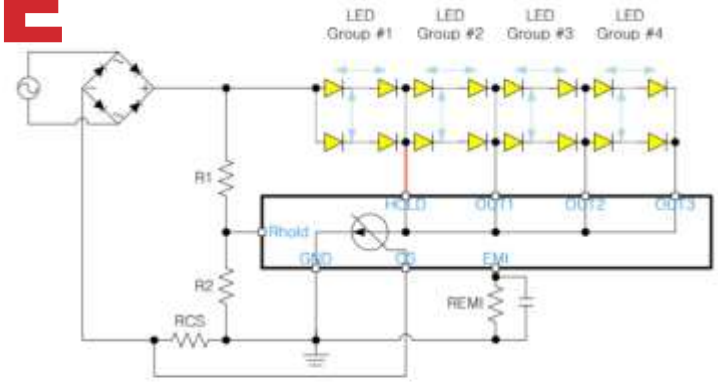
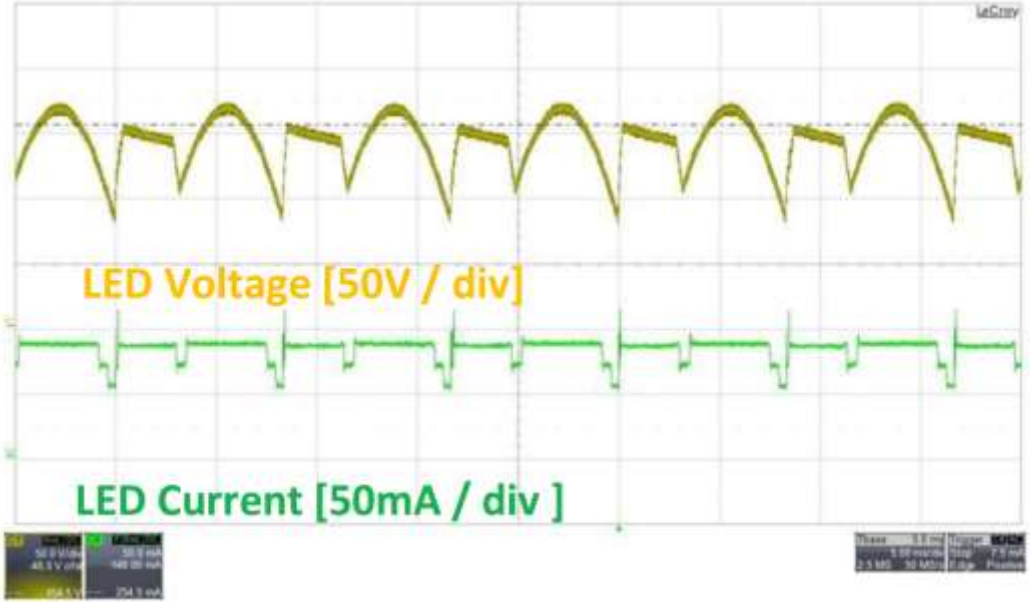


Figure 1. Typical Application Circuit



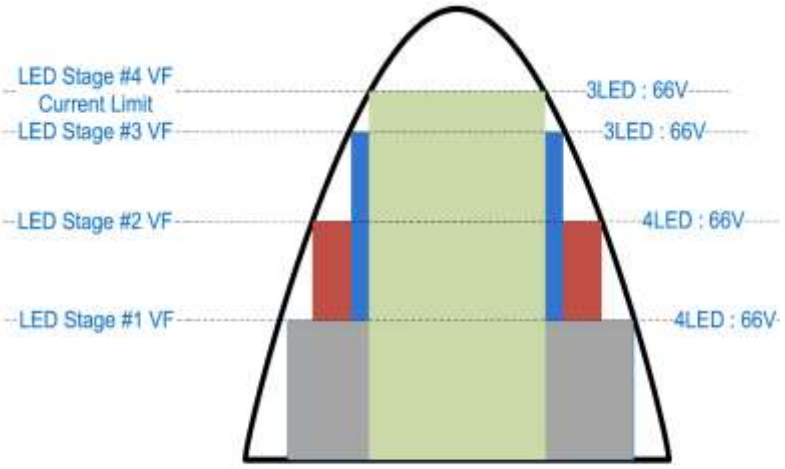


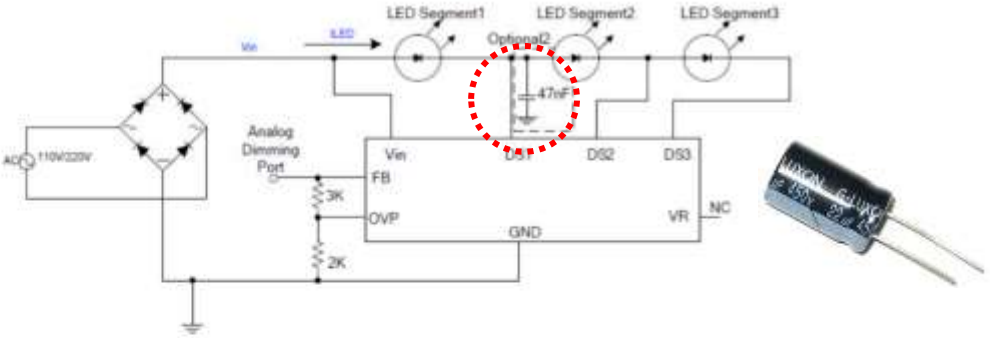
Figure 2. Basic Operation

Jeong.osc@gmail.com

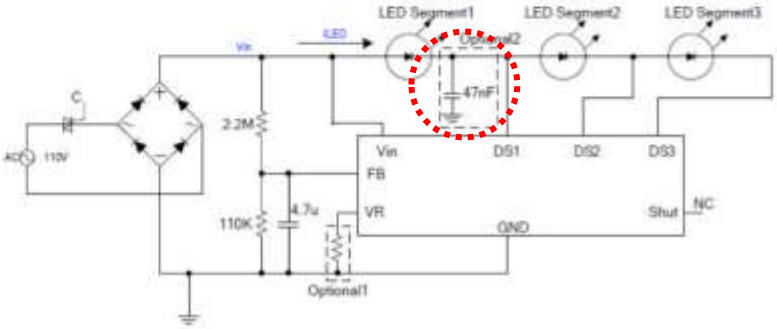
TAKION TKL303

Takion TKL303

◎シンプルな形状:SOP8
◎シンプルな周辺回路
◎フリッカ対策:不点灯期間を無くす谷埋めキャパシタ追加



110V/220Vアナログ調光入力付き構成(点線内は任意選択保護回路)



110Vトライアック調光対応構成(点線内は任意選択保護回路)

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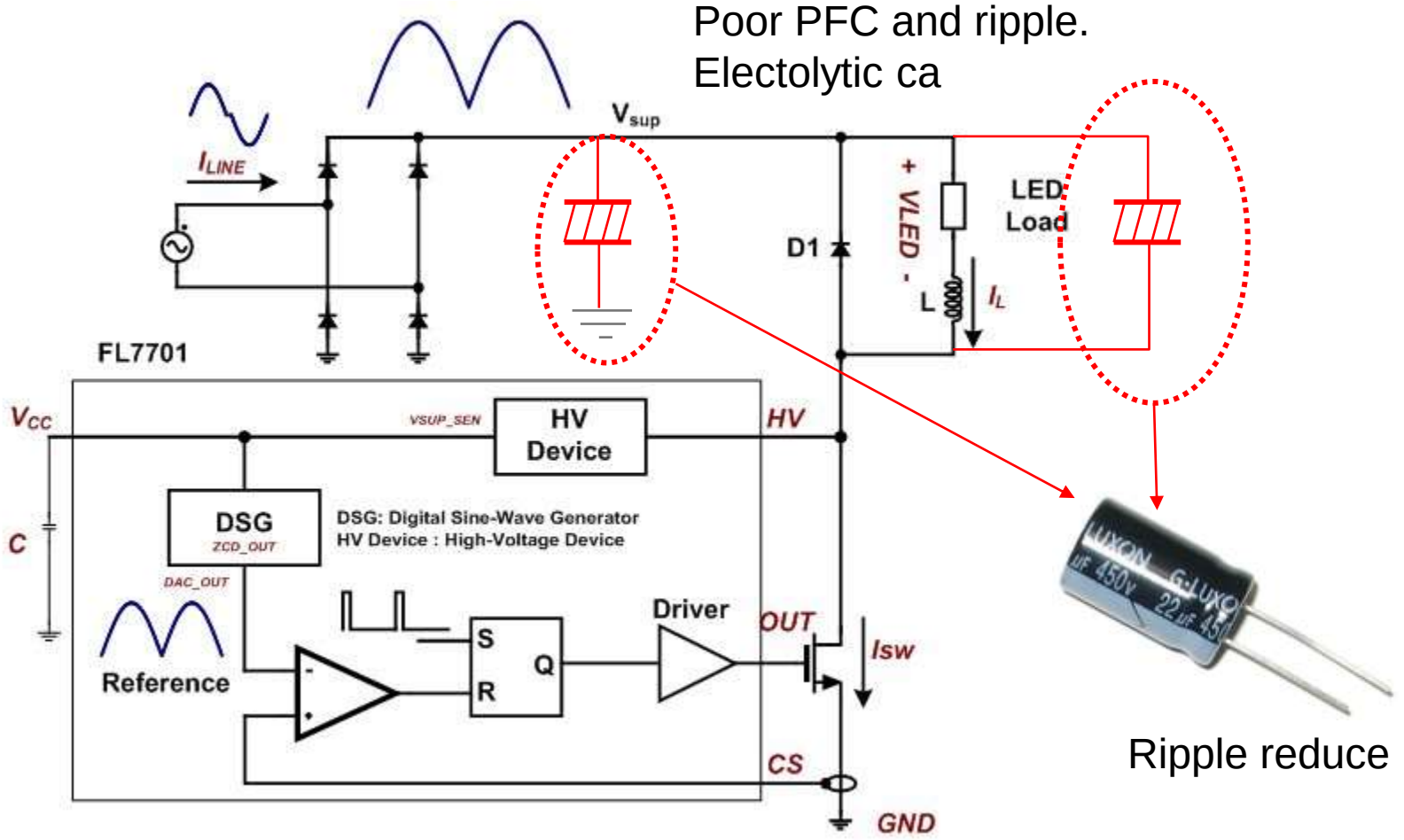
NON ISOLATION BUCK LED DRIVER

Most of LED driver are employed.
Poor PFC and ripple.
Electolytic ca



Ripple reduce

RIPPLE AND PFC PROBLEM

Figure. A

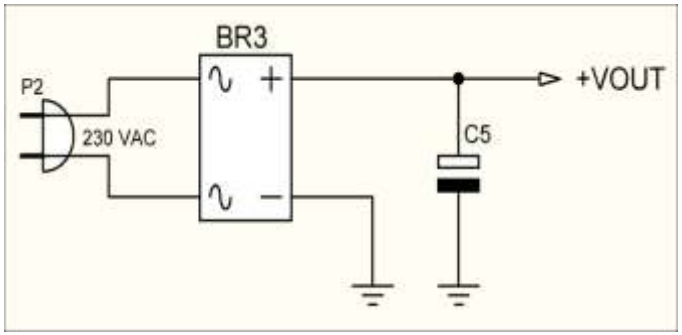


Figure. B

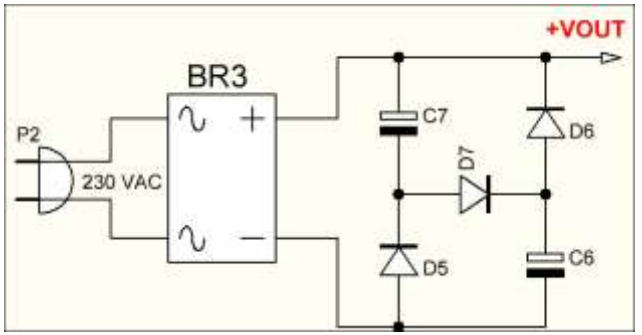


Figure. C

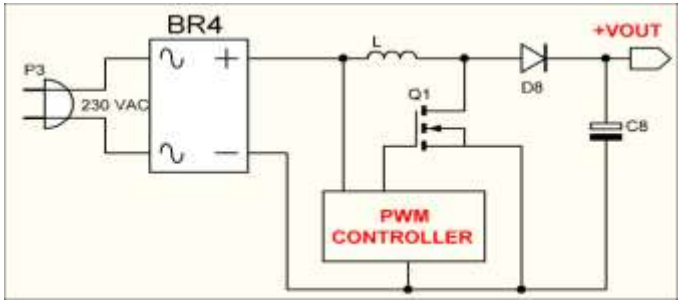
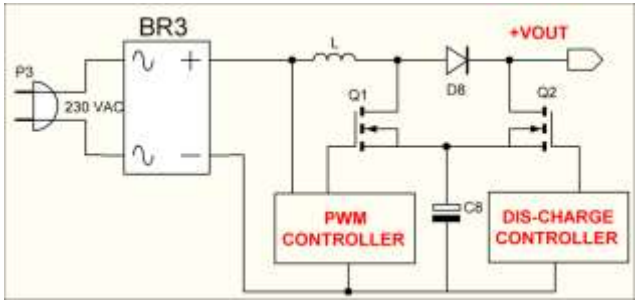


Figure. D



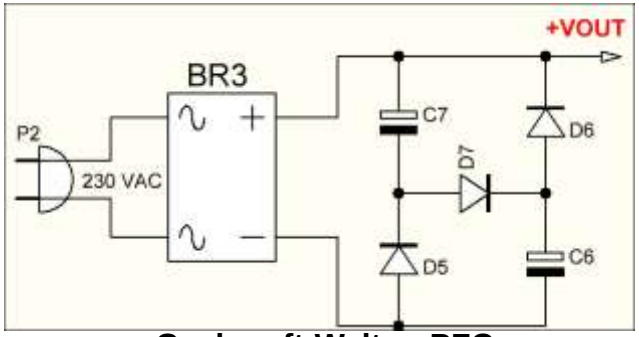
Most electronic ballasts and switching power supplies use a bridge rectifier and a bulk storage capacitor to derive raw dc voltage from the utility a line, figure above : valley fill with passive PFC circuits B and active PFC shown C. The figure D are this novel PFC and regulation methodology.

Jeong.osc@gmail.com

ADVANTAGES - DISADVANTAGES OF VALLEY FILL PASSIVE PFC

Passive power factor correctors have certain advantages, such as

- Simplelicity
- Reliability
- Ruggedness
- Insensitive to noise and surges
- No generation of high frequency EMI
- No high frequency switching losses



Cockcroft-Walton PFC

Disadvantages of passive PFC

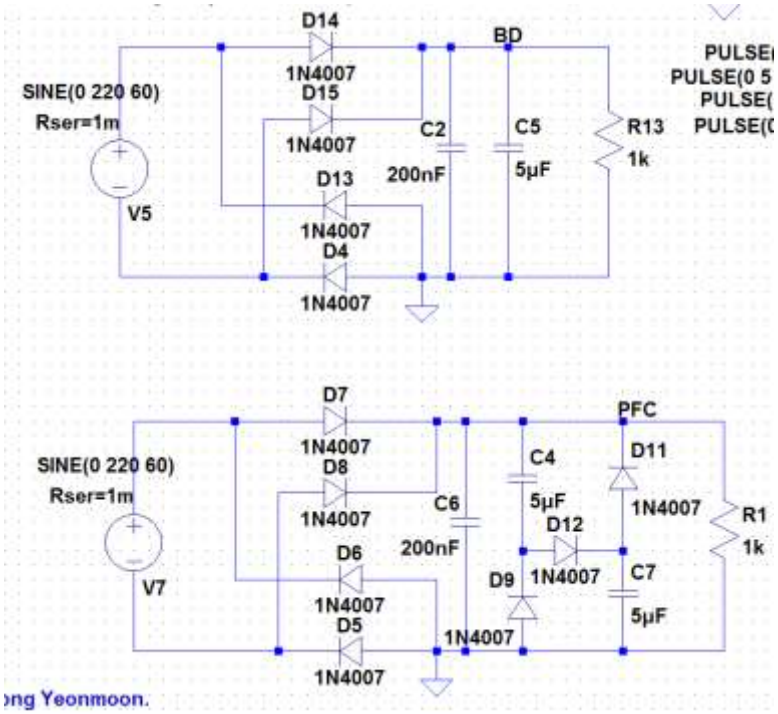
On the other hand, they also several drawbacks

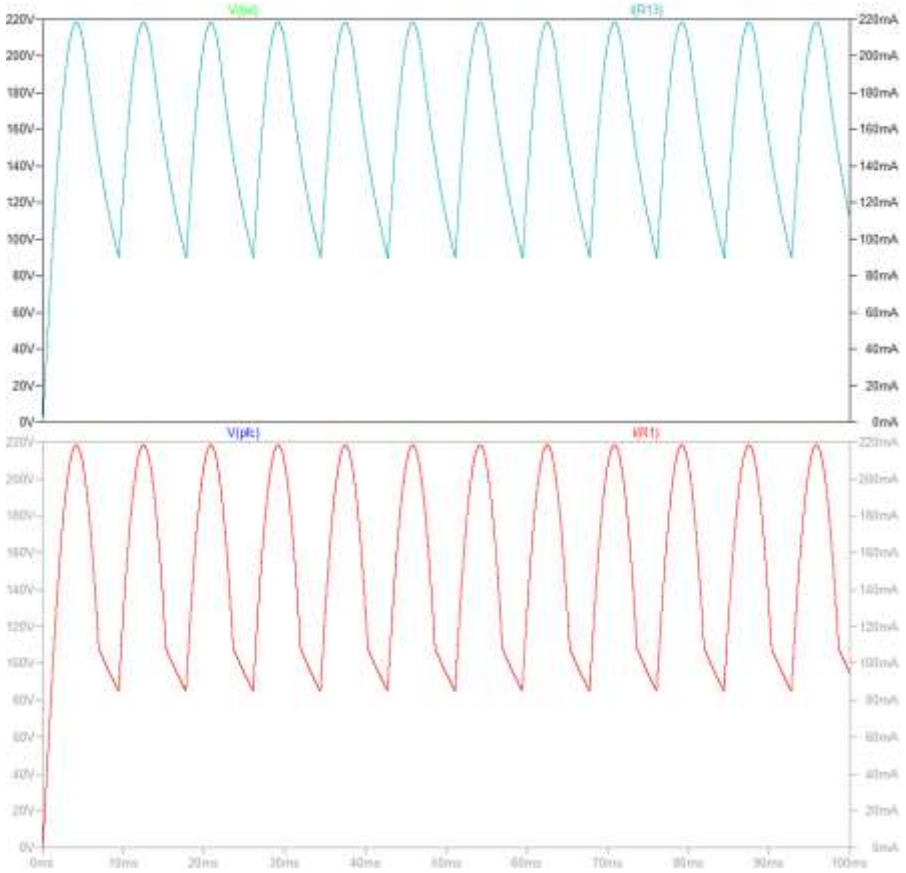
- Solutions based on filters are heavy and bulky, because line frequency reactive components are used
- They have poor dynamic response
- Lack voltage regulation and the shape of their input current depend on the load

Even though line current harmonics are reduced, the fundamental component may show an excessive phase shift that reduces the power factor

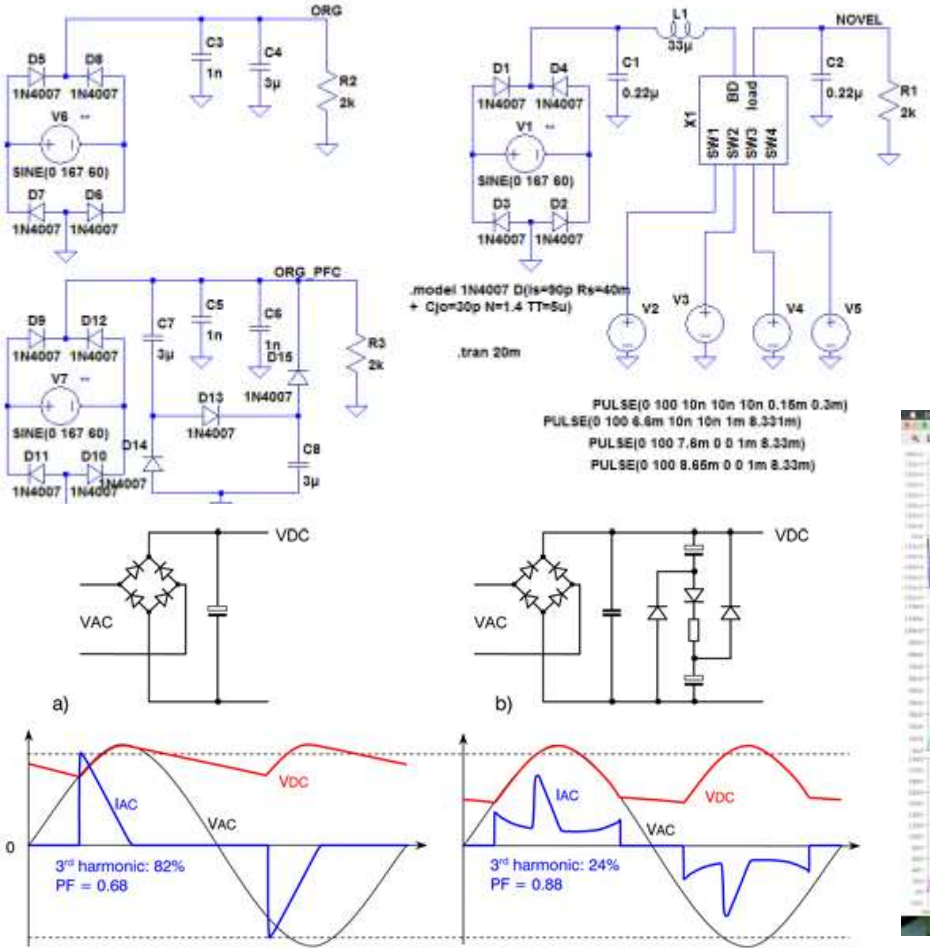
- Parallel resonance at different frequencies occurs too, which can amplify other harmonic
- Big size and expensive

TRADITIONAL RECTIFIER RIPPLES



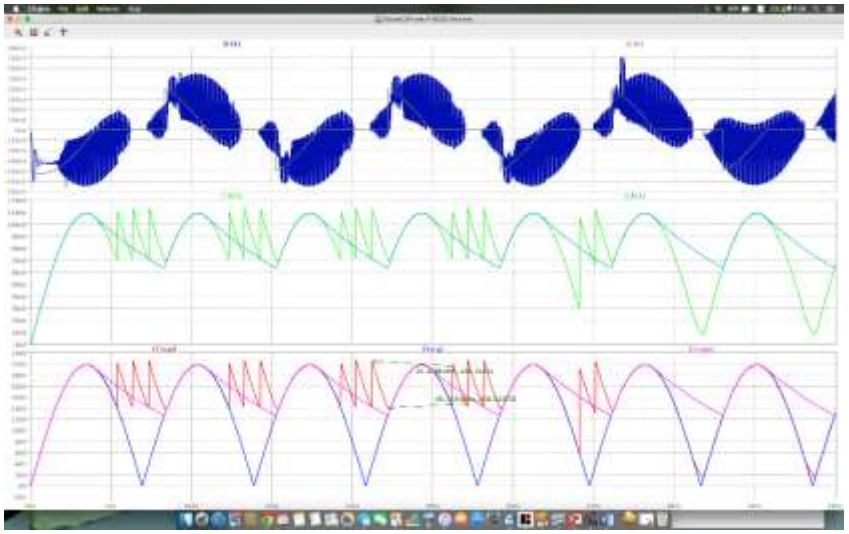


REGULATION RIPPLE COMPARED



The all circuits are AC 167V /60Hz at 2K load.

Reliability and size with costs incurring tremendously good.



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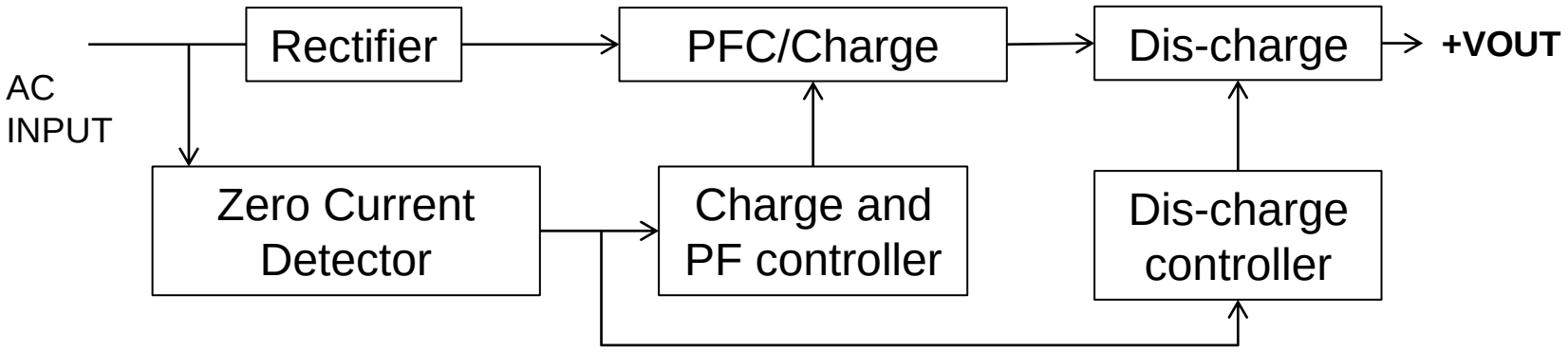
NOVEL TOPOLOGY OF SOLID STATE CAP FUNCTION BLOCK



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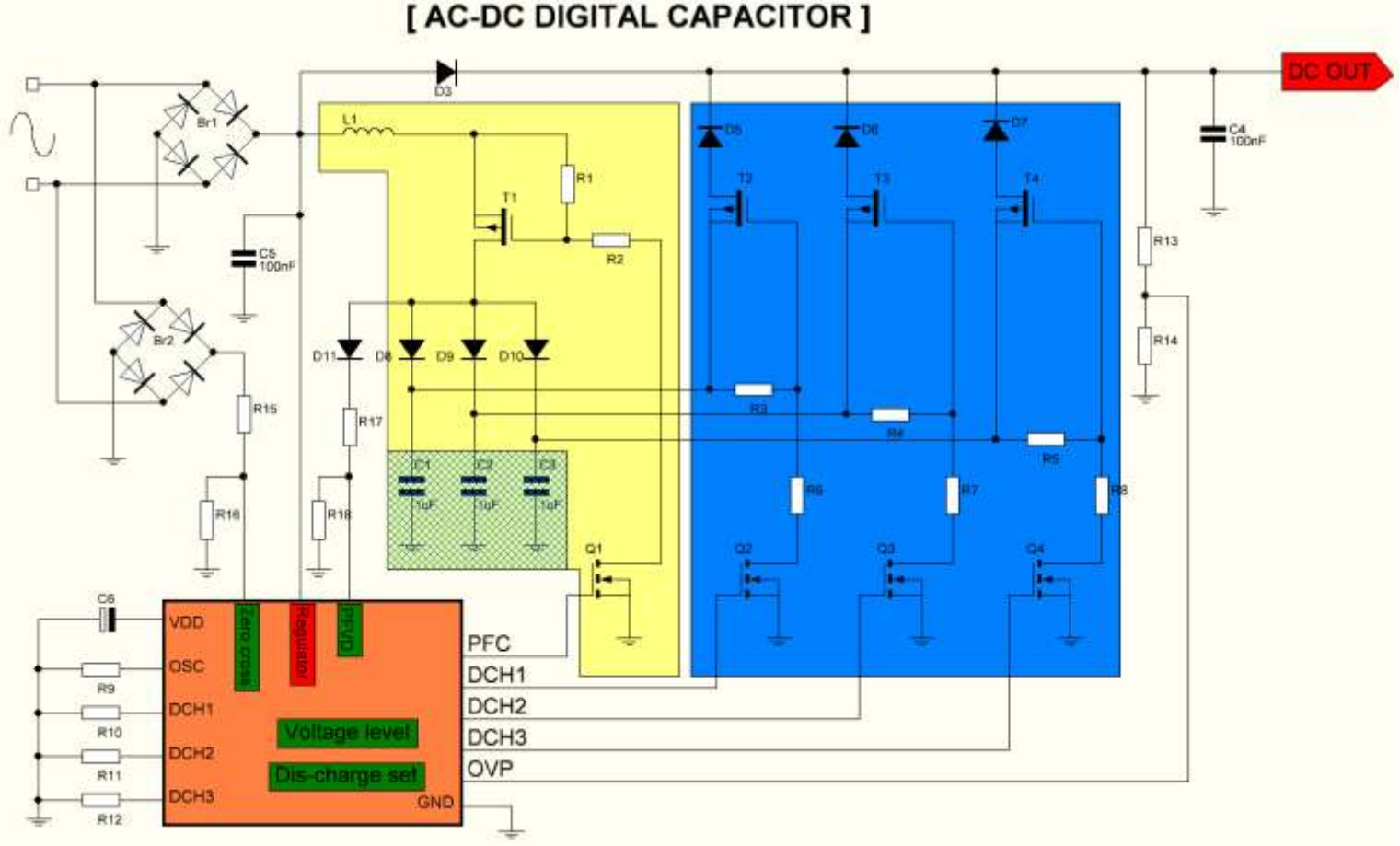
DIGITAL CAPACITOR BLOCK DIAGRAM



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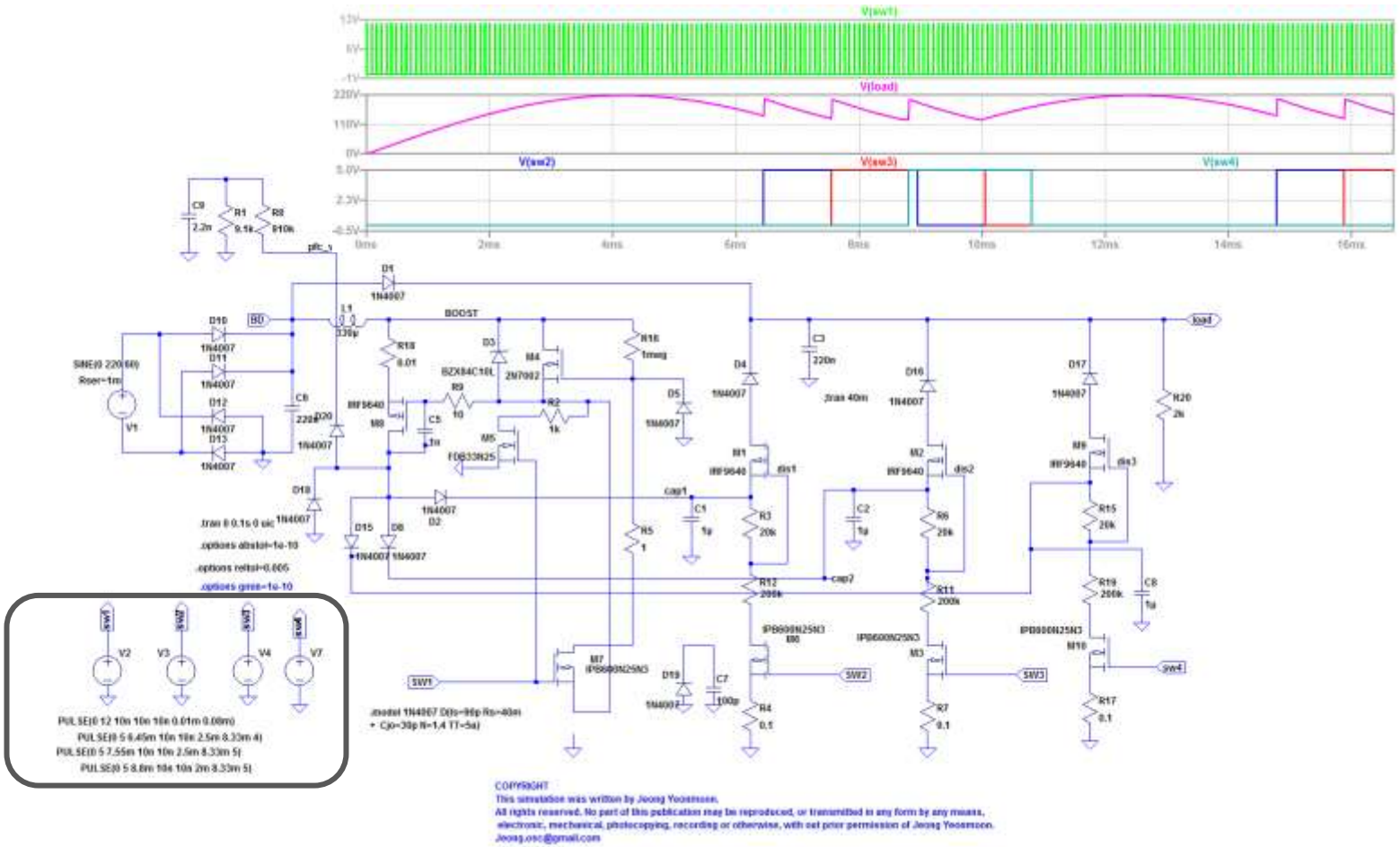
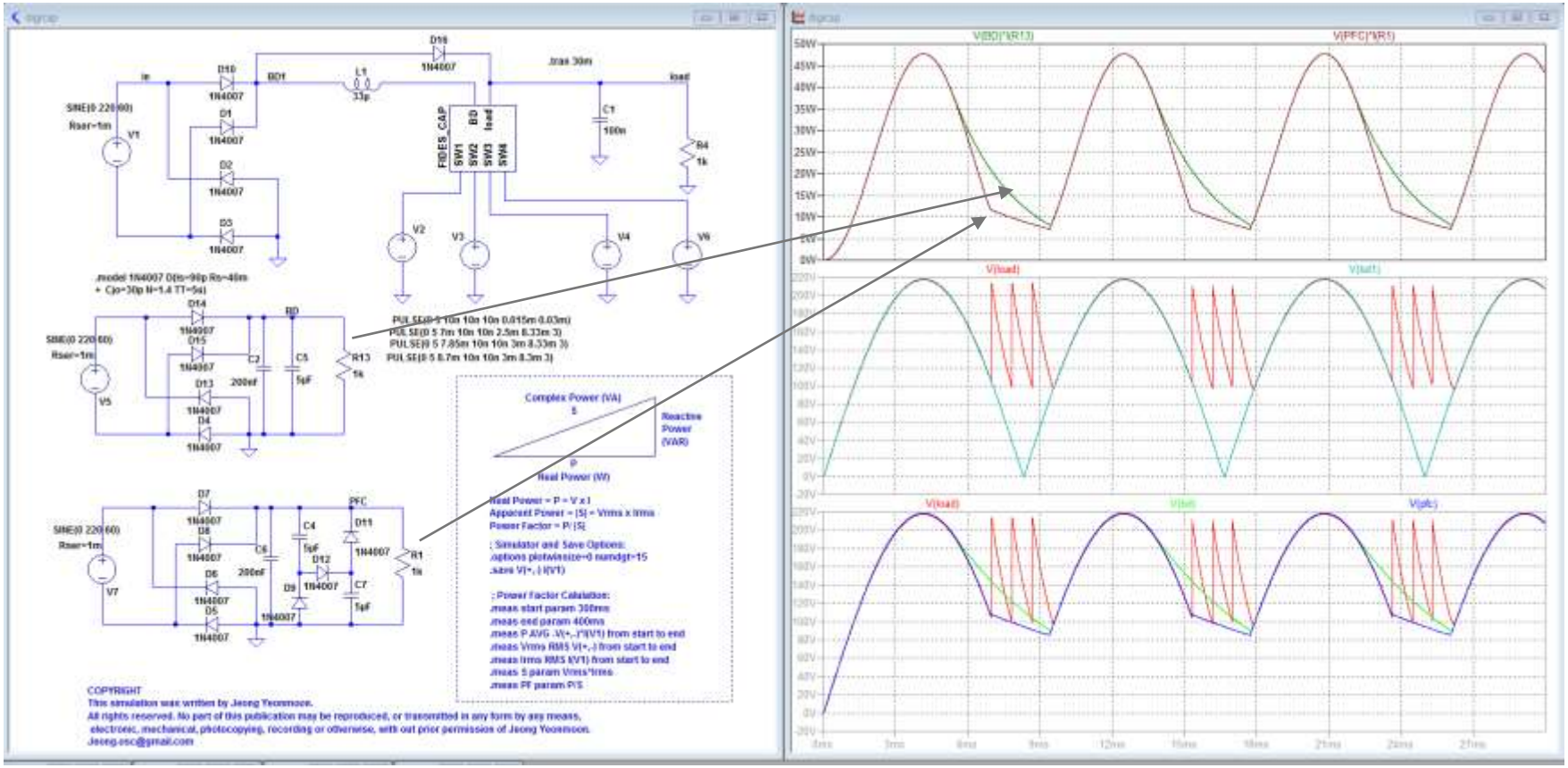
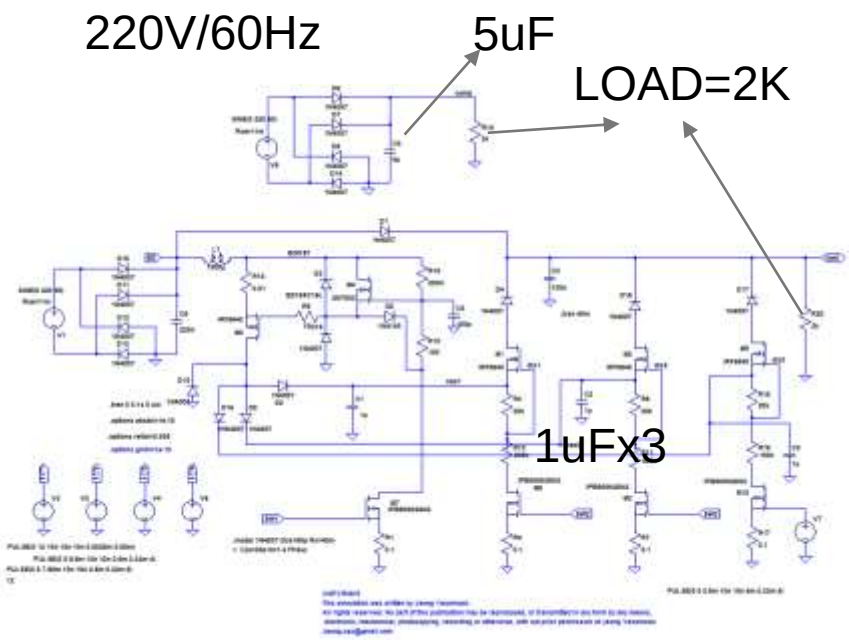
DRIVE WAVE FORMS

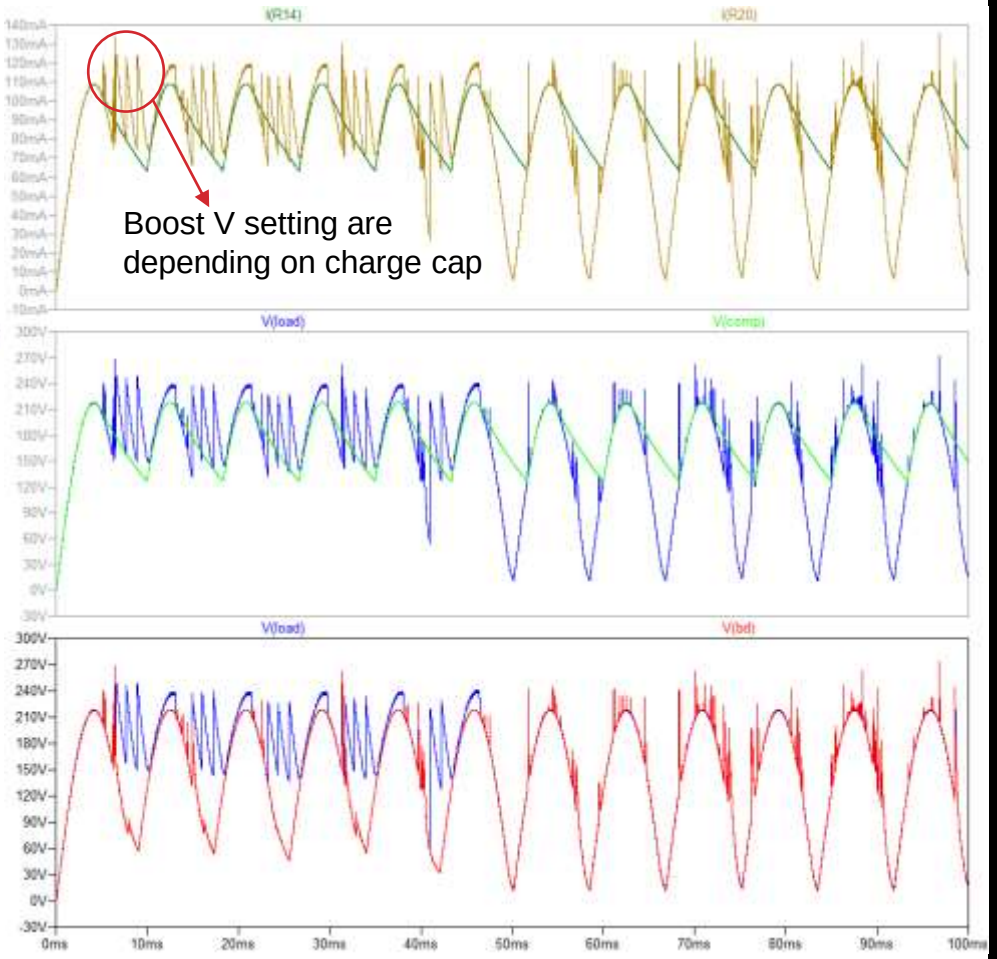


SOLID STATE VALLEY FILL WITH PF CORRECTION TOPOLOGY



DIGITAL CAPACITOR WAVE FORM

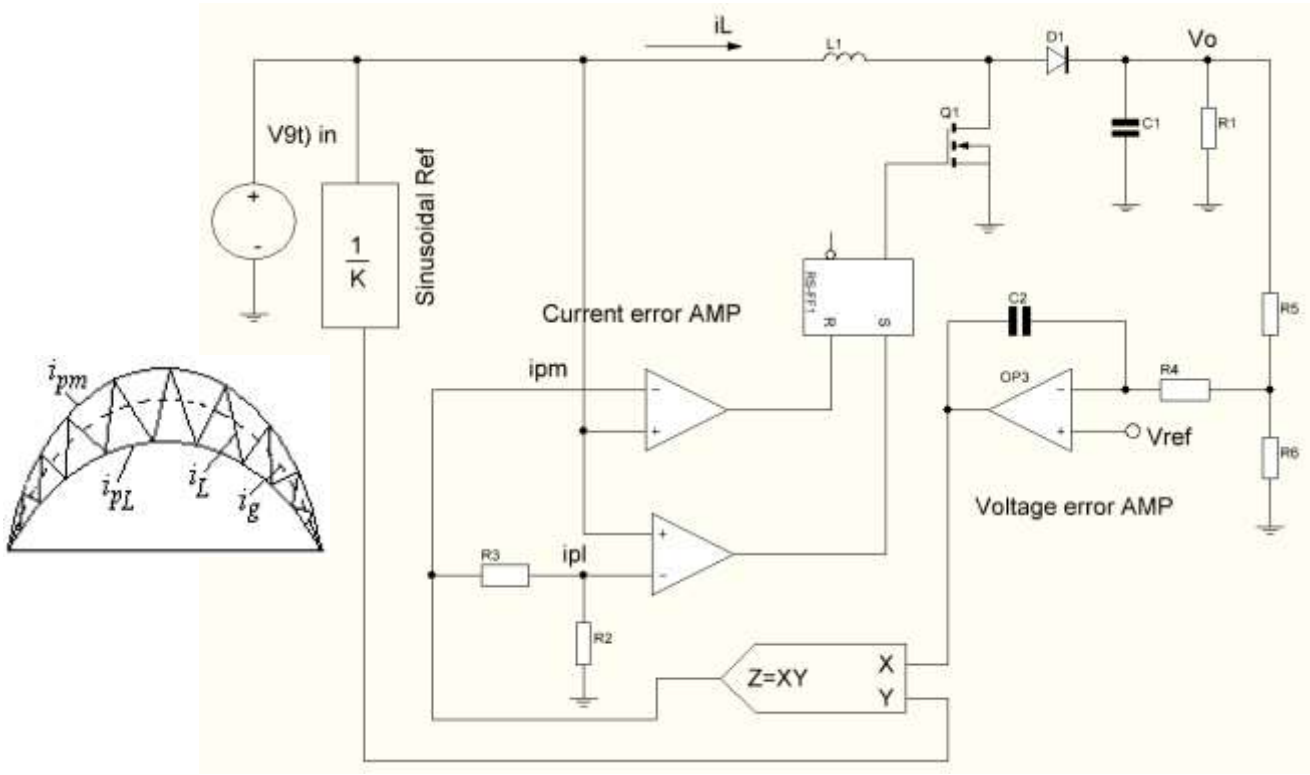




AC220V/60Hz LOAD=2K
Ordinary rectifier ECAP are 5uF

Jeong.osc@gmail.com

SINGLE PHASE BOOST PFC CONVERTER USING HYSTERESIS CURRENT MODE CONTROL TECHNIQUE



Hysteresis comparators are used to impose hysteresis band around the reference current. The hysteresis control scheme provides excellent dynamic performance because it acts quickly.
Also, an inherent peak current limiting capability is provided. This type of control in which two sinusoidal current references *ipm*, *ipL* is generated corresponding to maximum and minimum boundary limits.

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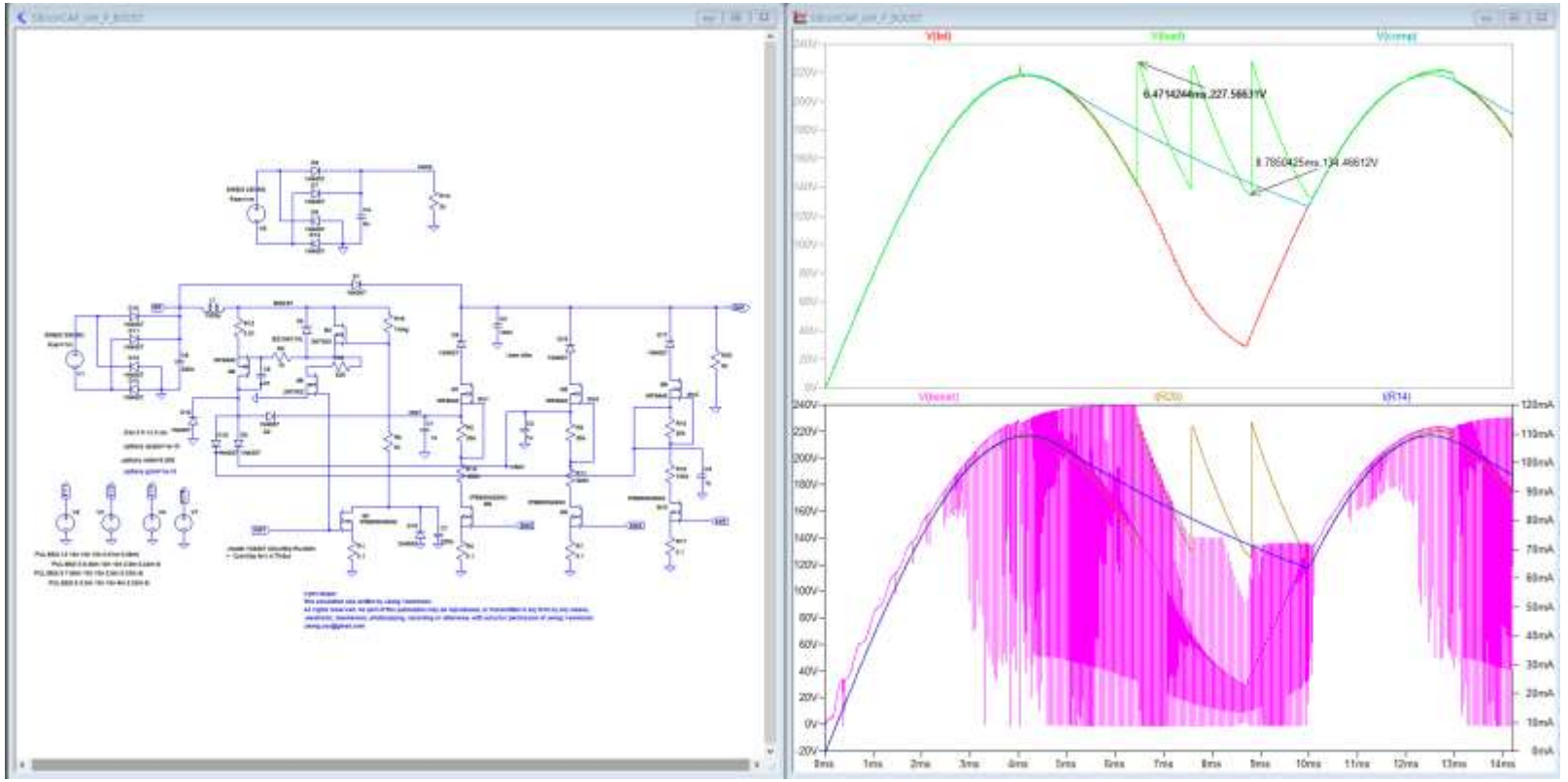
ADVANCED SOFT SWITCHING PFC EXAMPLES



The soft-switching PFC technique combines the advantages of PWM mode and resonant mode techniques with an additional resonant network consisting of a resonant inductor, a resonant capacitor and an auxiliary switch. The AC/DC converter operates in PWM mode during most portion of a switching cycle but operates in resonant mode during the switch turn-on and turn-off intervals. As a result, the PFC circuit works at constant switching frequency and the power switch turns on and off at zero current or zero voltage conditions. Thus efficiency and power factor both improved by this technique. This figure shows boost PFC circuit with a soft switching network

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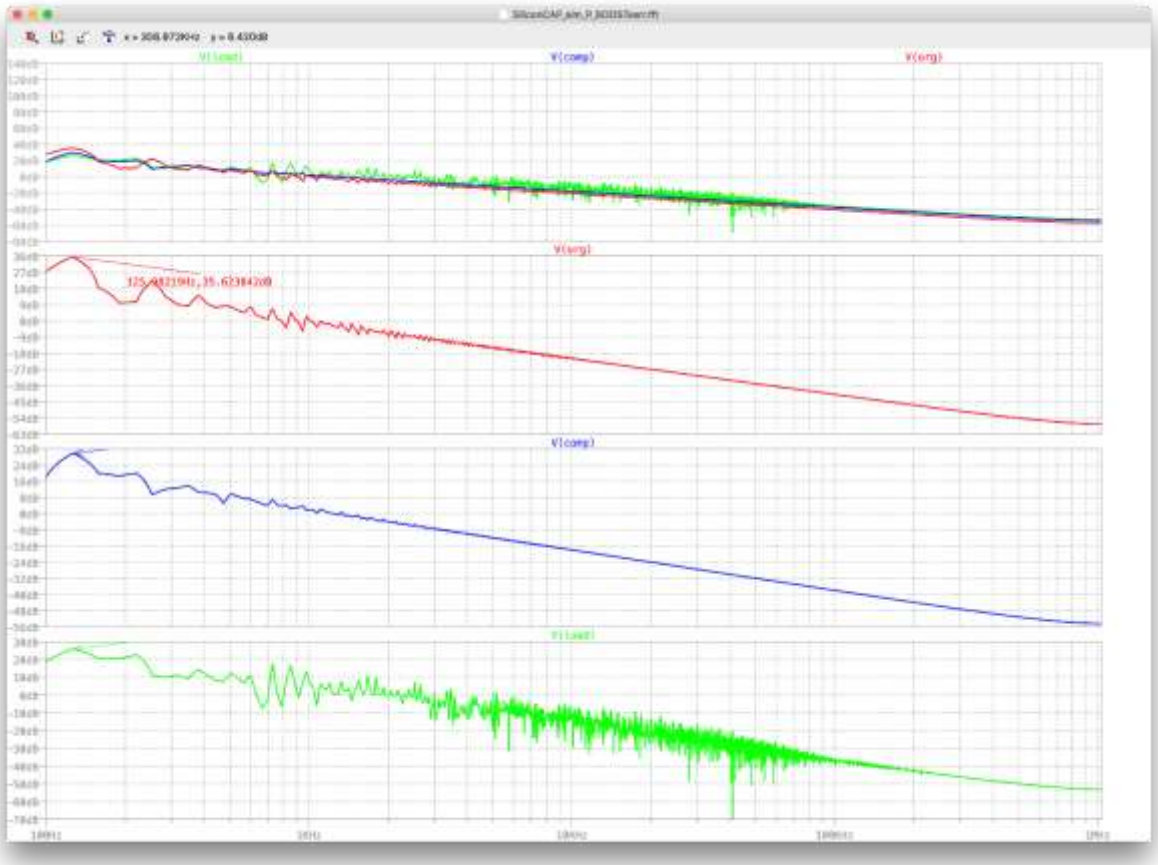
EMI COMPARE



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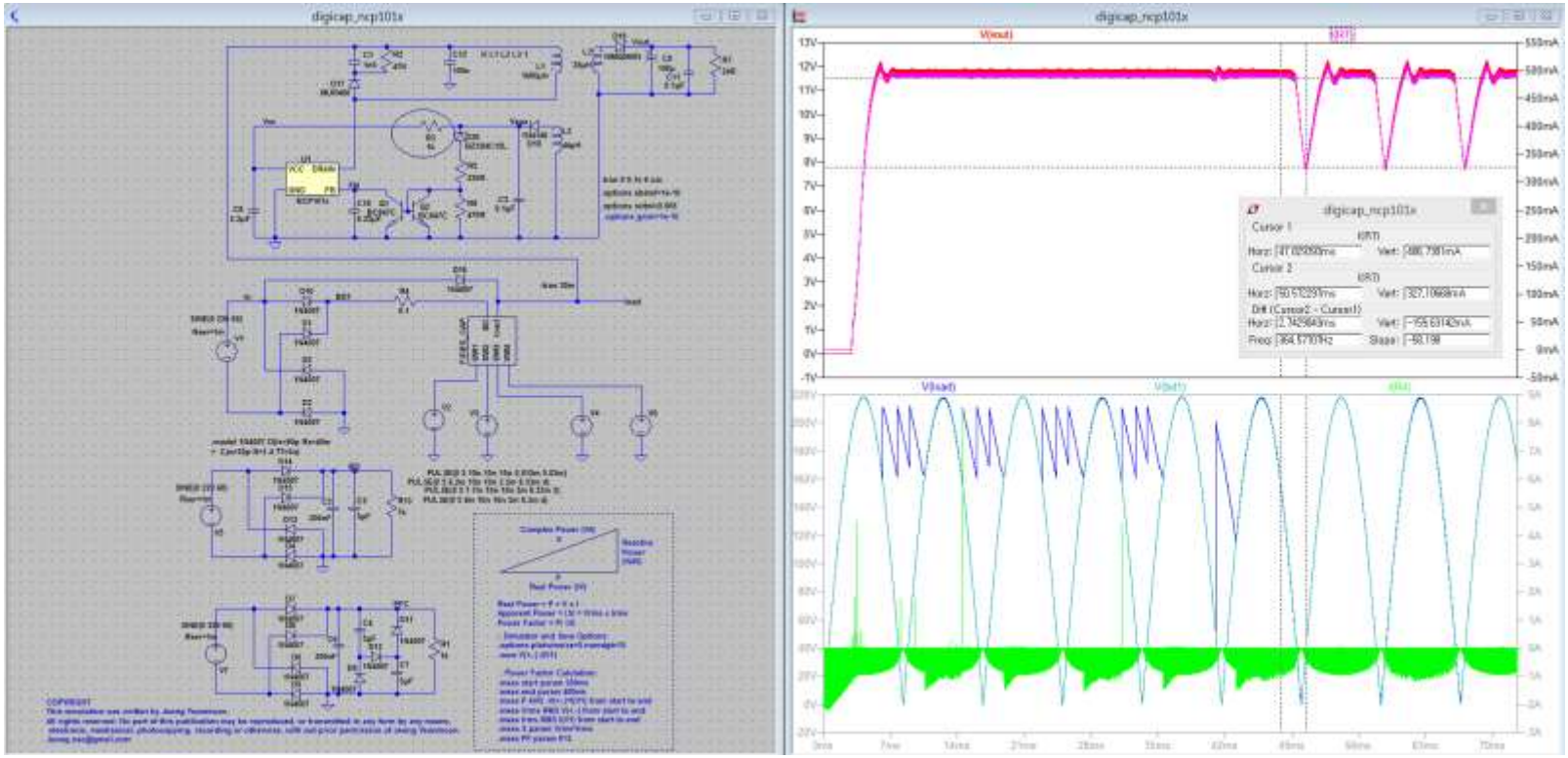
ONSEMI NXP101X WITH DIGICAP



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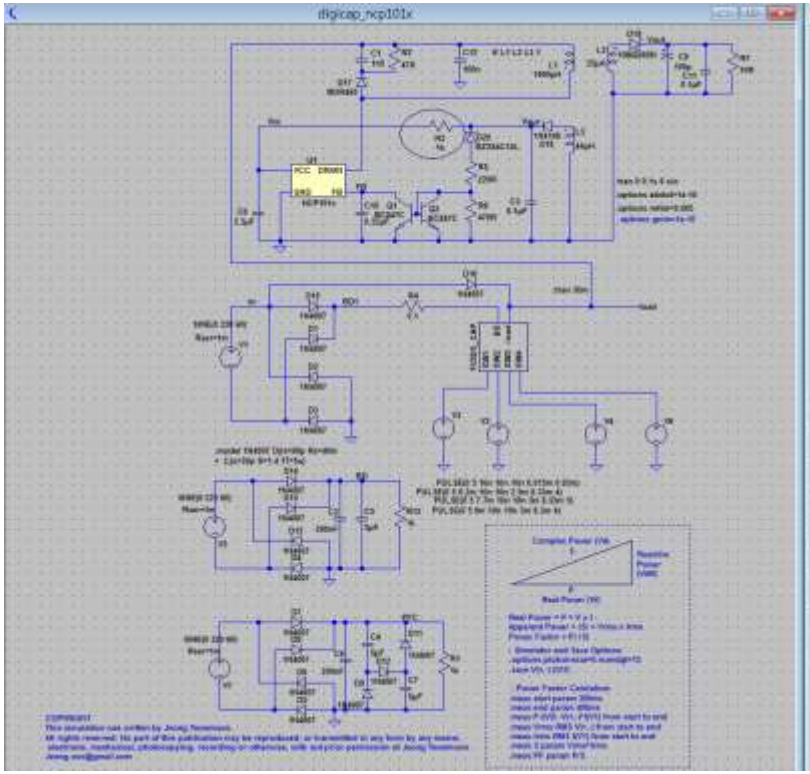
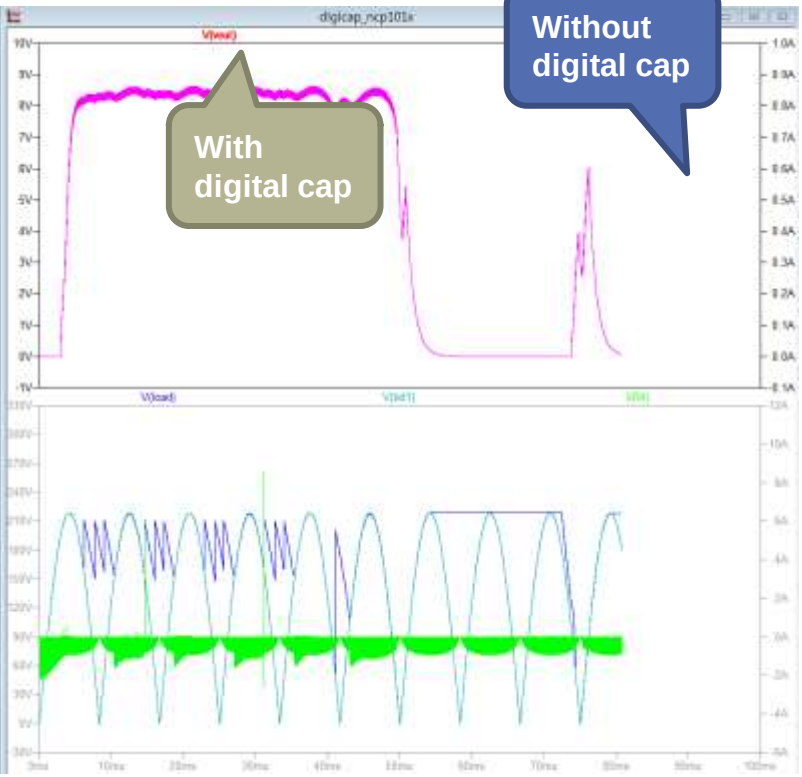
OVERLOAD RIPPLE COMPARE





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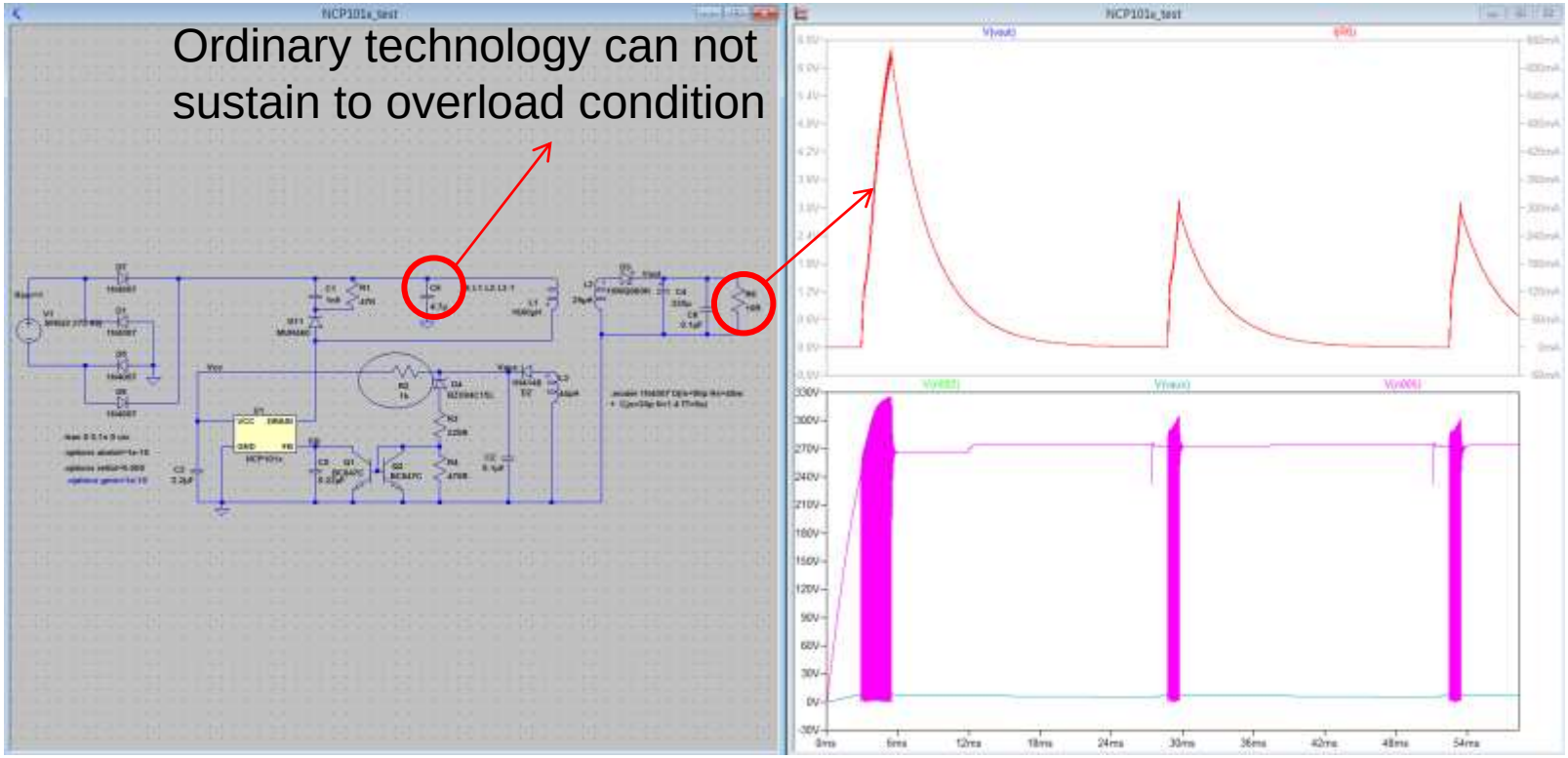
ORDINARY SMPS OVERLOAD CONDITION



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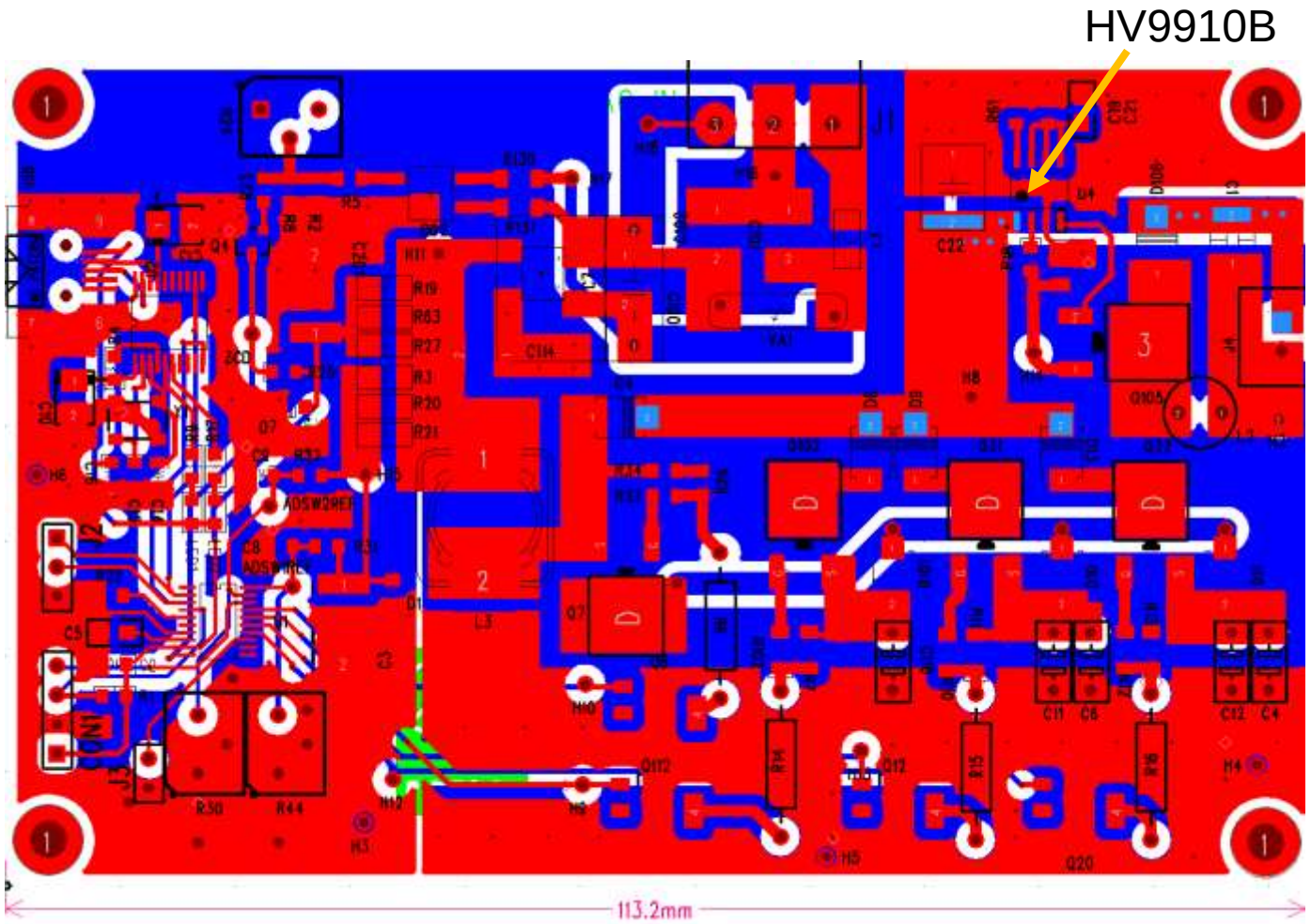
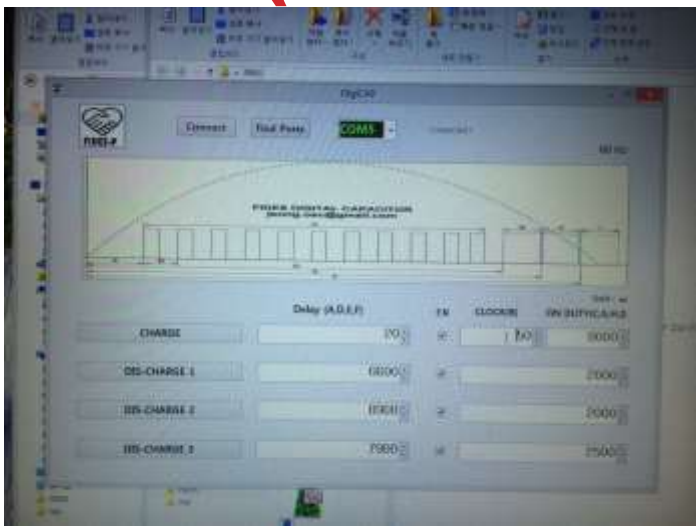
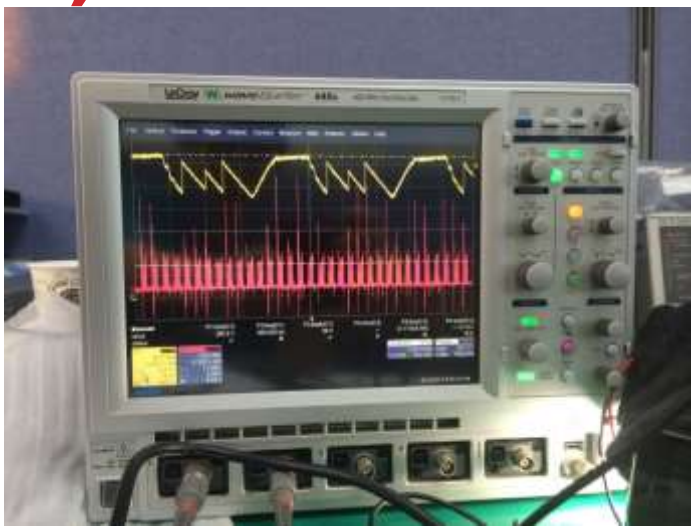
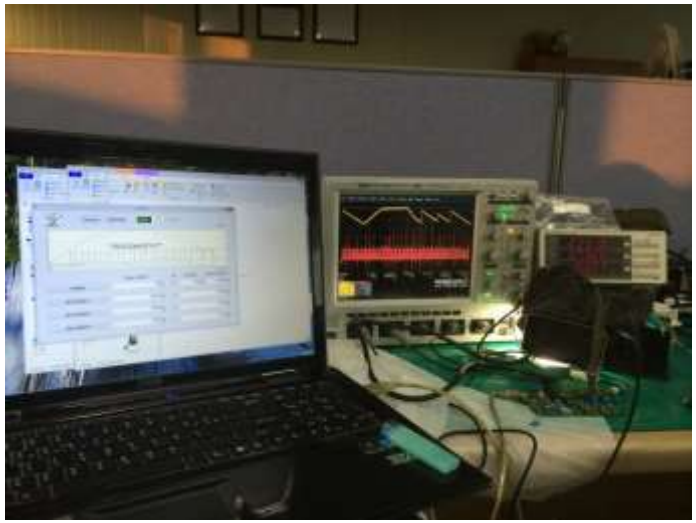
FIDES-DIGICAP DEMO



HV9910B + SILICON CAP DEMO (LOAD LED16W)







Jeong.osc@gmail.com

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Jeong.osc@gmail.com