

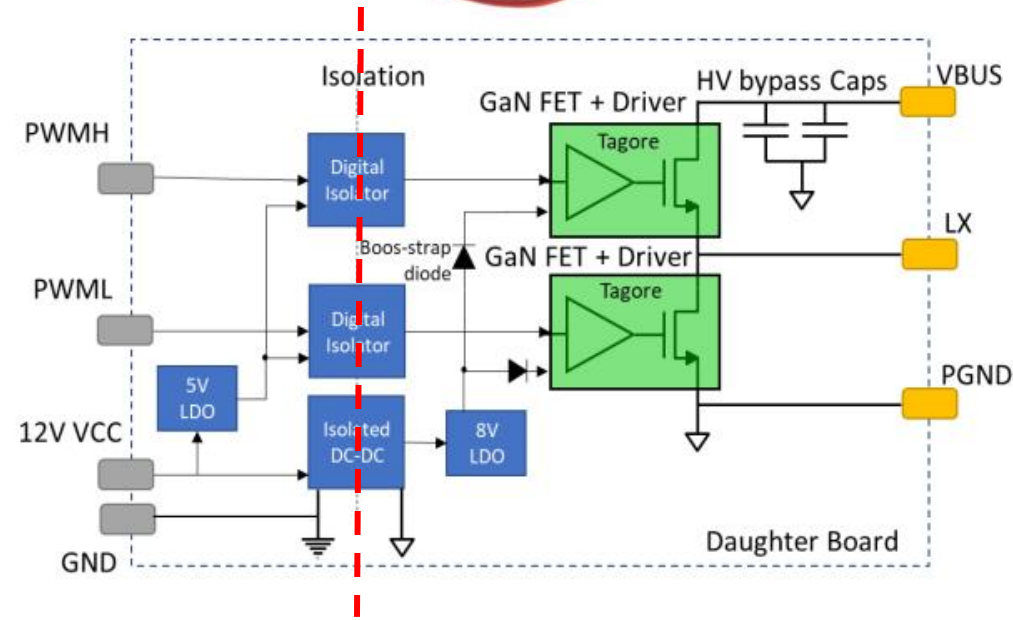
# **Tagore Half-Bridge (HB) GaN EVB**

**with Digital Isolator – Compatible to TP44x00NM Parts Only!**

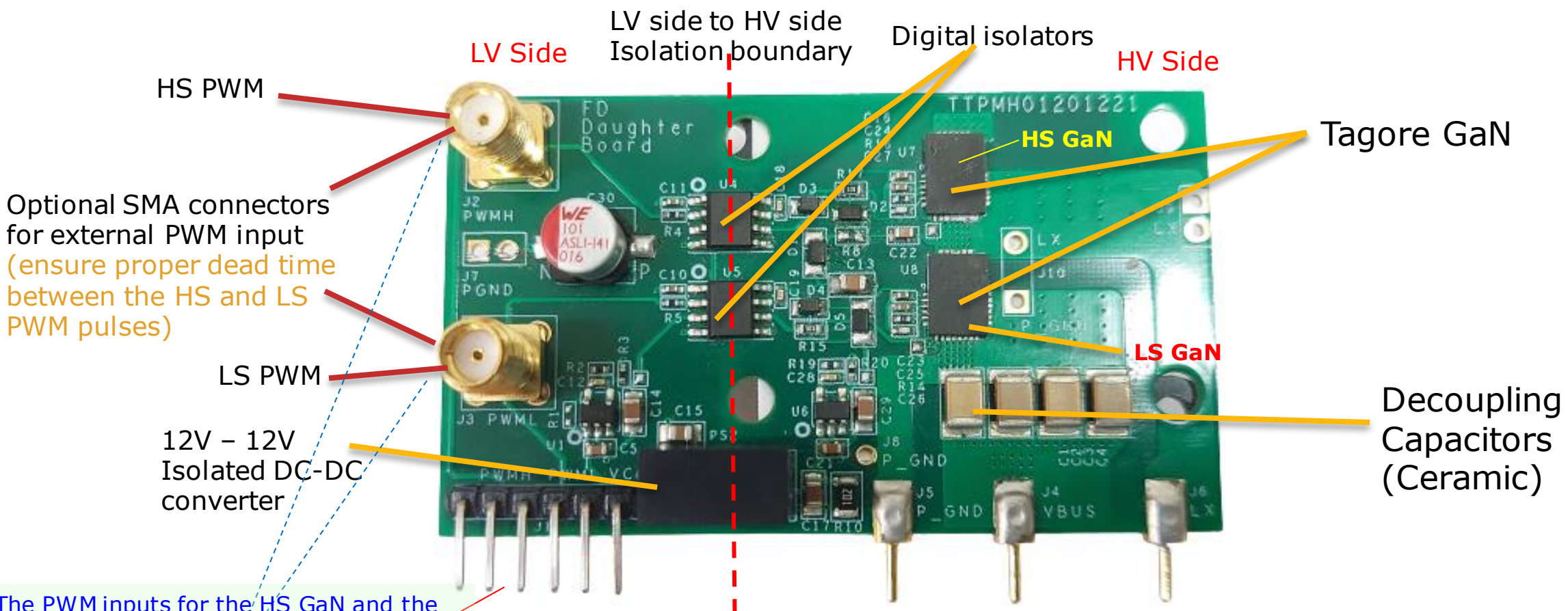
Tagore Technology  
14 Jun 2022

# Tagore GaN Half-Bridge EVB Overview – GaN HB Daughter Card

- Isolated Half Bridge using Tagore's 650V GaN HEMT with integrated driver IC
- Isolated PWM input for both high side and low side device
- Isolated dc-dc converter for low side driver
- Bootstrap diode supply for high side driver
- Fan and heat sink mounted on back side of PCB
- Power connector pins for VBUS, GND, LX
- Header pins for 12V DC input and PWM inputs
- Optional SMA connectors for PWM input
- 4-layer FR4 board design
- Board size of 2.6"x1.5"x1.7" including fan and heat sink



# Half-Bridge GaN EVB – GaN Daughter Card Details



Optional SMA connectors for external PWM input (ensure proper dead time between the HS and LS PWM pulses)

- The PWM inputs for the HS GaN and the LS GaN can be fed either (1) through the SMA connectors, or (2) through the PCB edge connector (Bias Supply and PWM Pins)

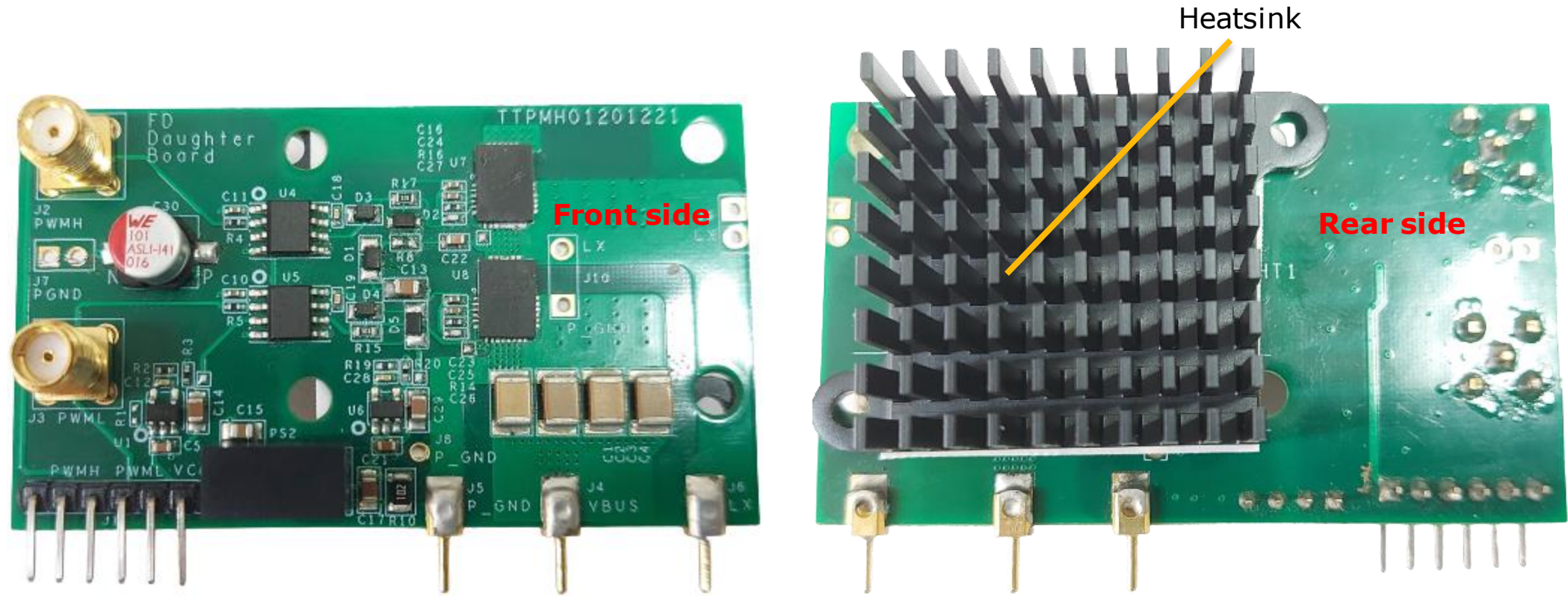
Option (1) can be used if there are two PWM sources with adjustable dead time option is available such as DSP or Microcontroller.

Option (2) is good for single PWM source, where the other complementary PWM and dead time is generated in the Mother board (discussed latter).



# Half-Bridge GaN EVB – GaN Daughter Card Details

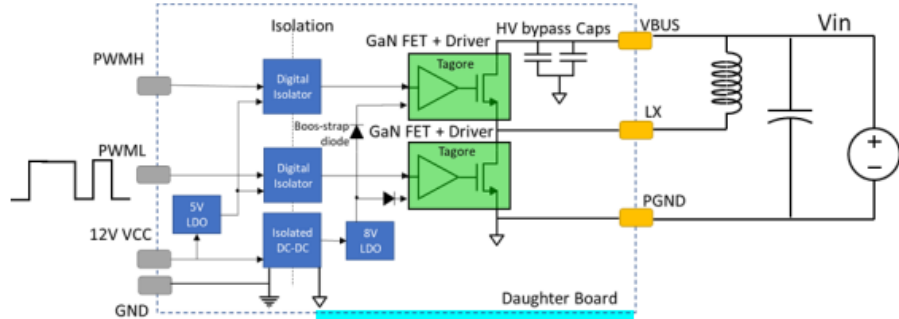
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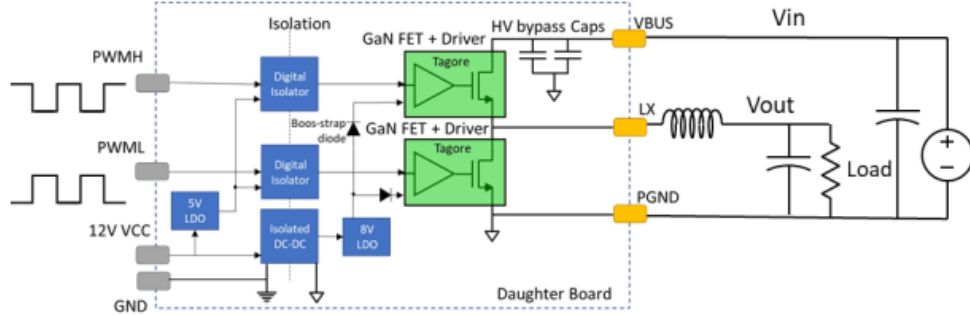
# Tagore GaN HB EVB – Example Use Cases

T1

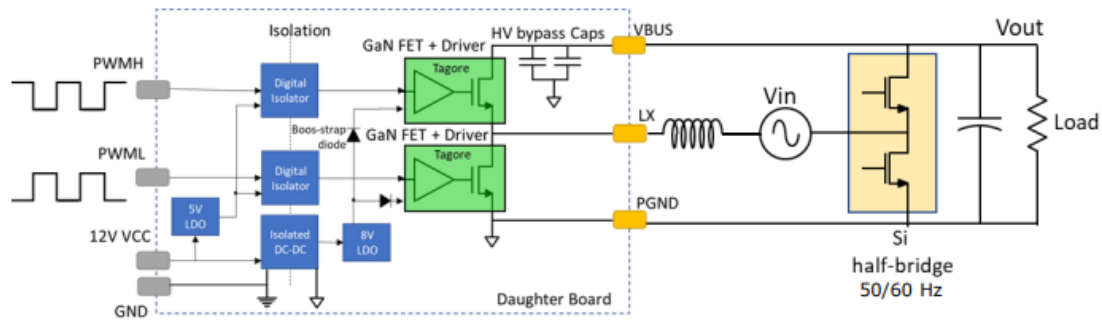
## Double Pulse Test



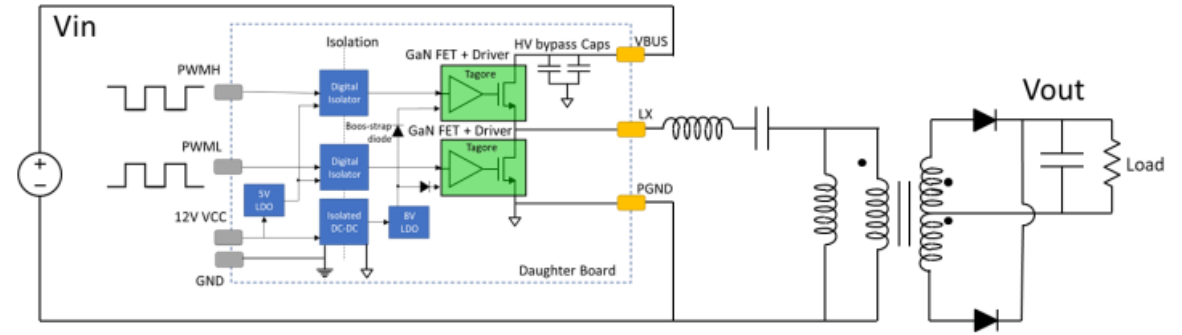
## Buck Converter



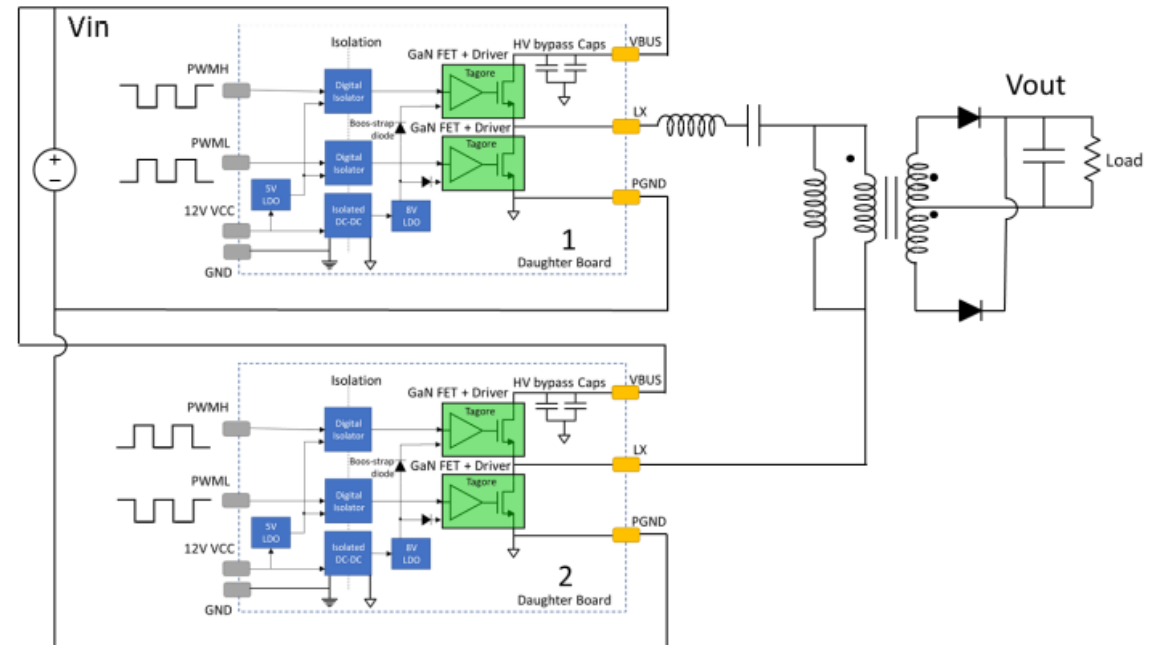
## Totem pole PFC



## Half Bridge LLC Converter



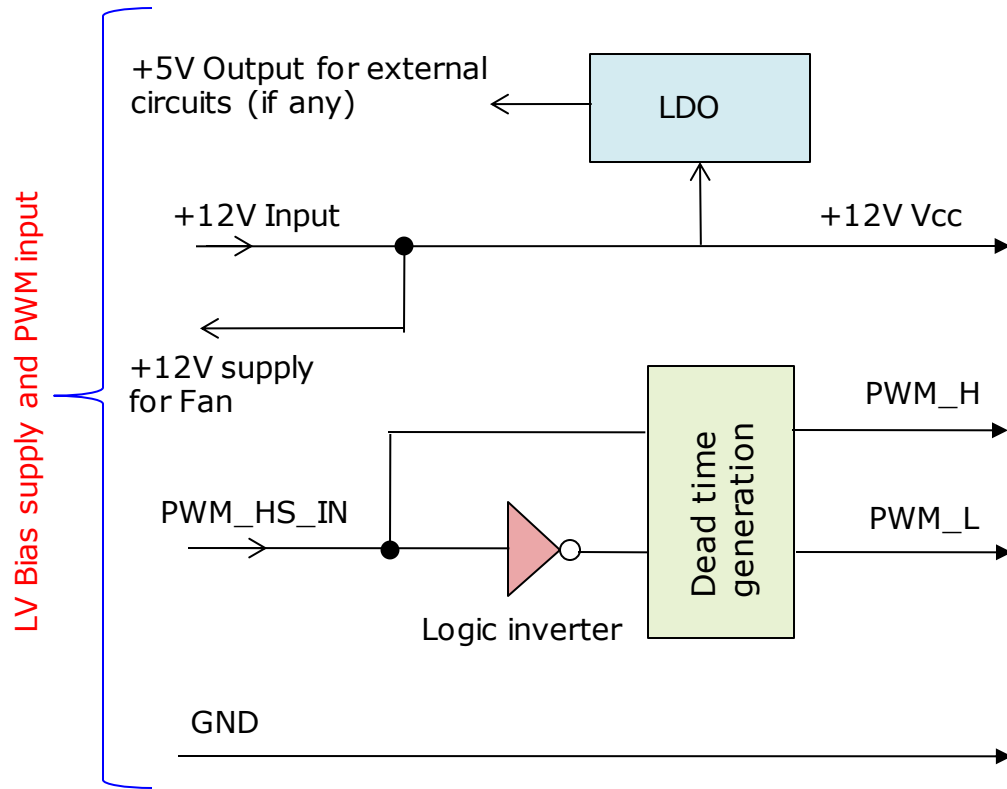
## Full Bridge LLC Converter



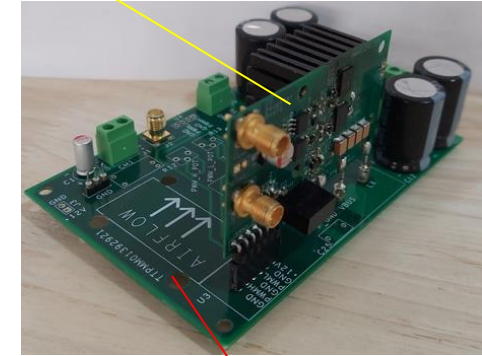
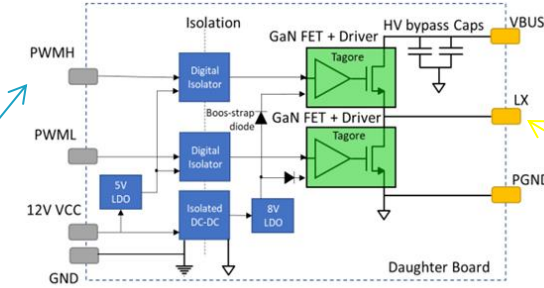
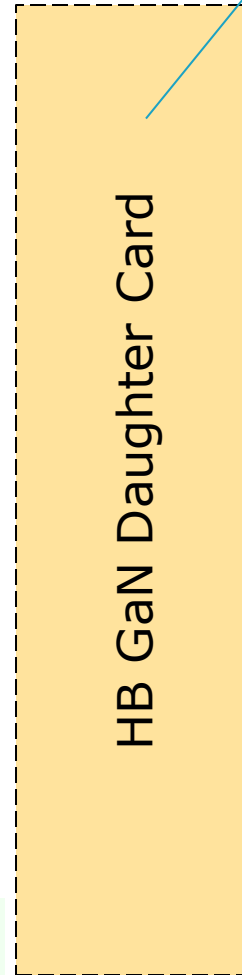
# Tagore GaN HB EVB – How to Use ? (Mother Board Introduction)

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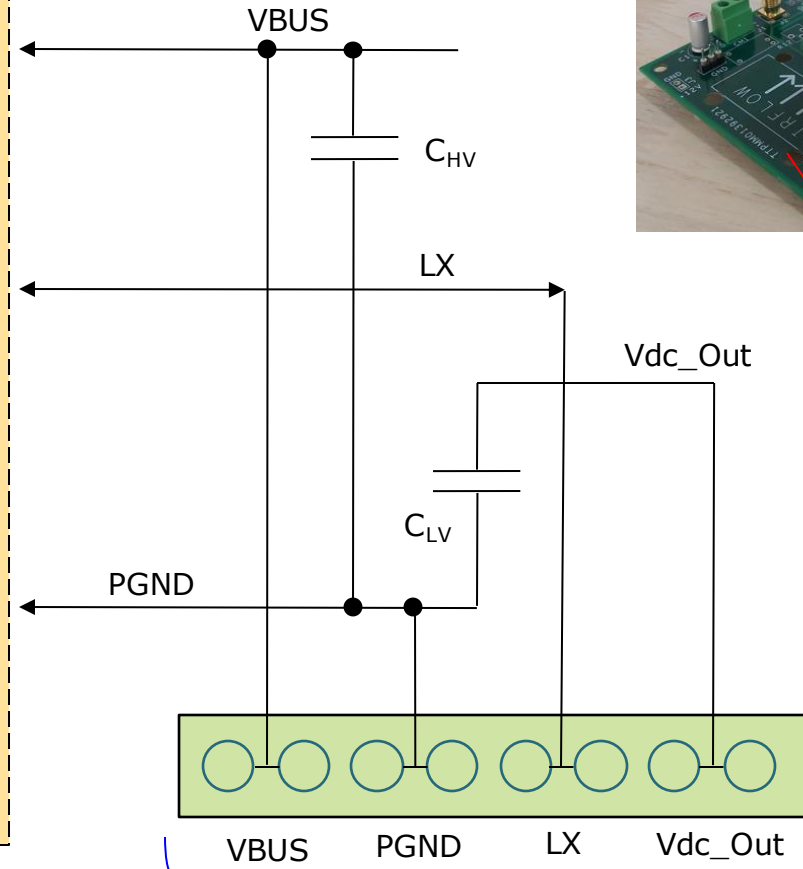
- The GaN HB can be tested stand alone. However, it is recommended to use a dedicated mother board to test the HB EVB. The HB daughter card can be directly plugged into the mother board, which interfaces between all the HV/LV input and output voltages/currents.
- The block diagram representation of the mother board and the Daughter card is shown here.



LV Bias supply and PWM input



Mother board

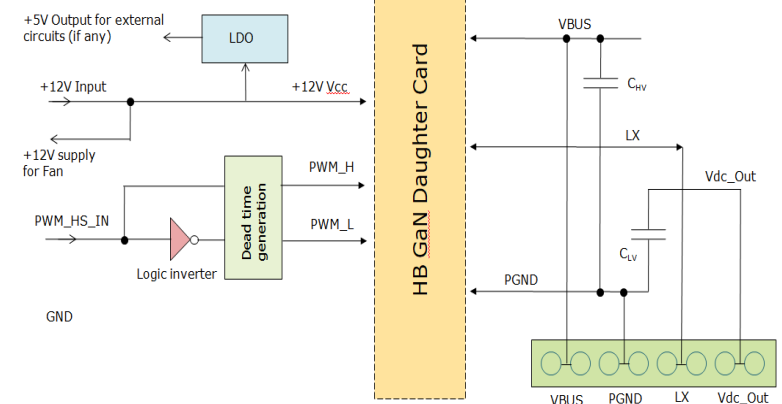
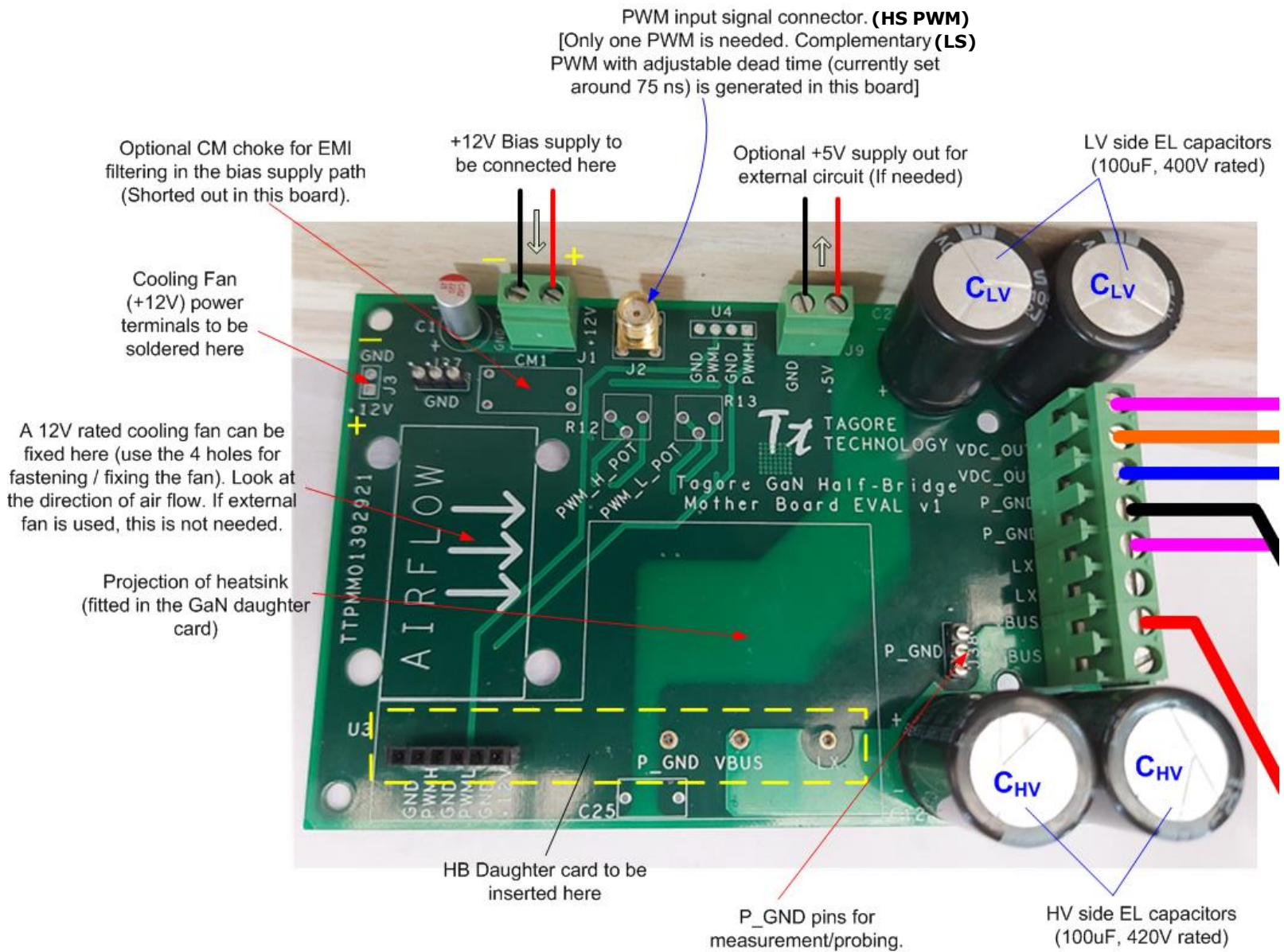


Power circuit Interface (HV)

- The mother board receives a single PWM input (for HS GaN).
- The PWM pulses for LS GaN, and the dead time (adjustable) between the HS and LS GaN's are generated in the mother board.



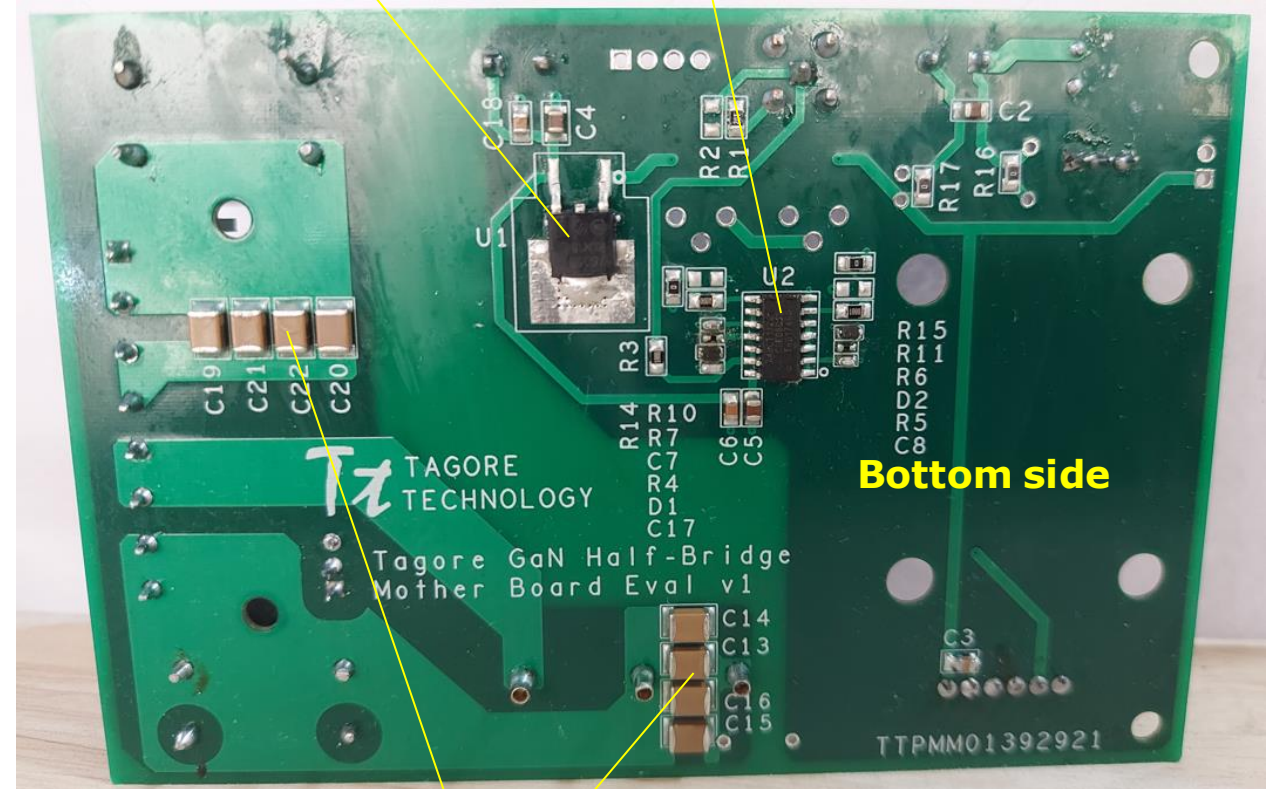
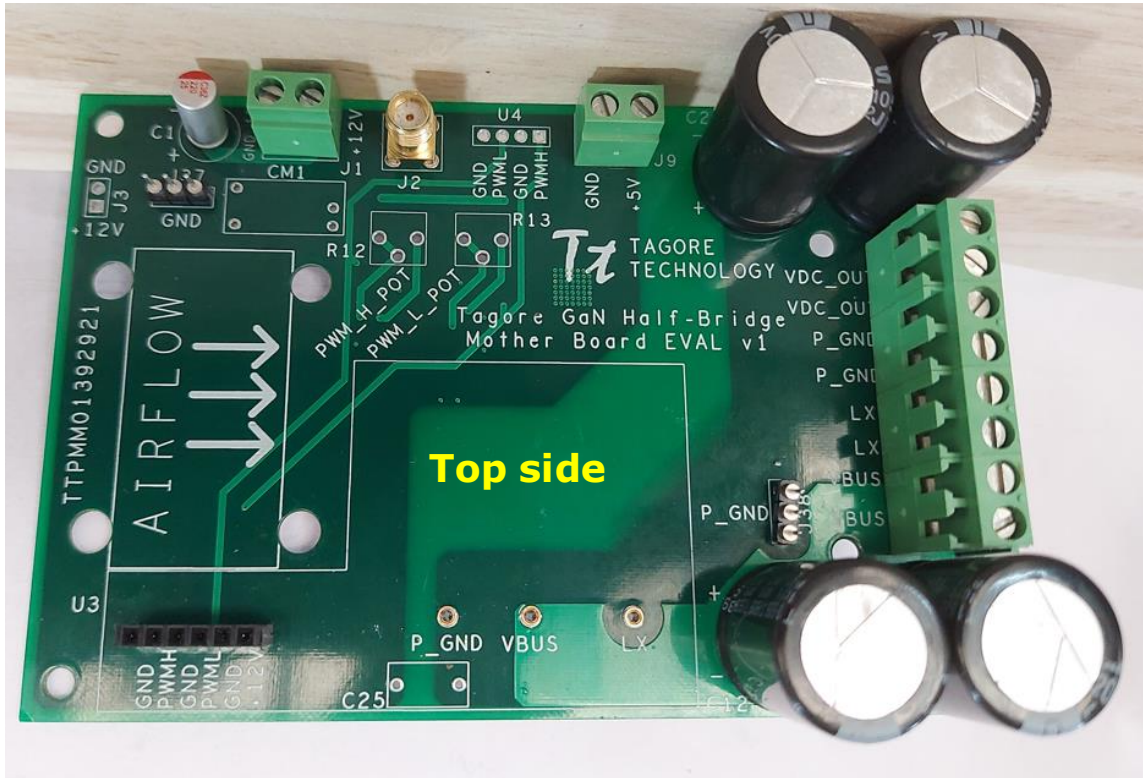
# Half-Bridge GaN EVB – Mother Board Details.



Power circuit Interface (HV) cables

# Half-Bridge GaN EVB – Mother Board Details.

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5V Linear Regulator IC

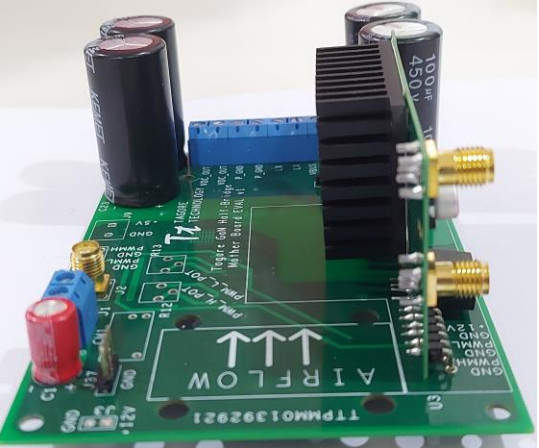
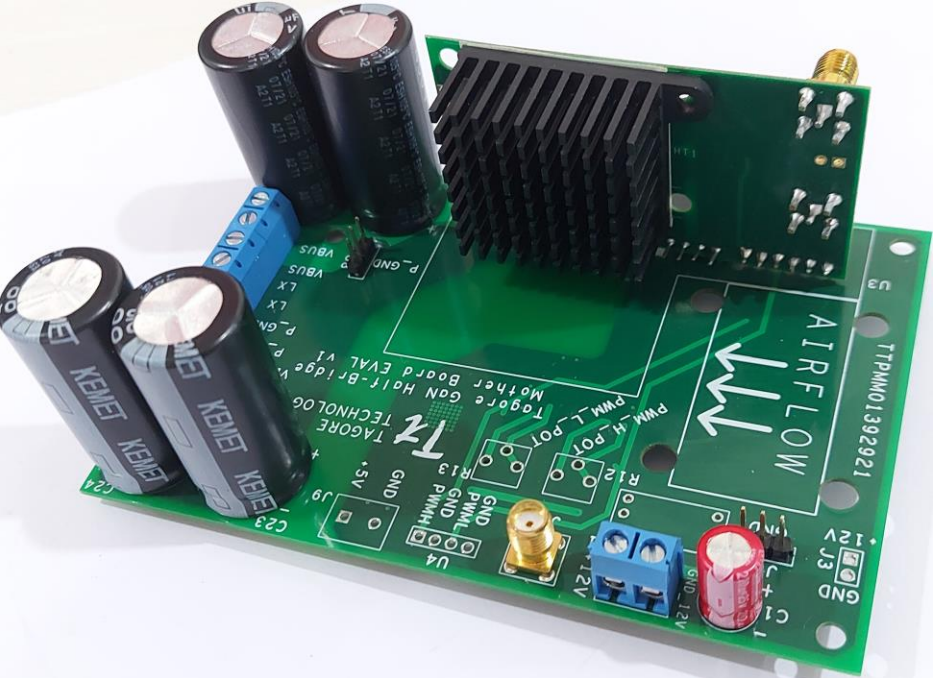
Nand Gate IC for complementary PWM, and Dead time generation

HV MLCCs

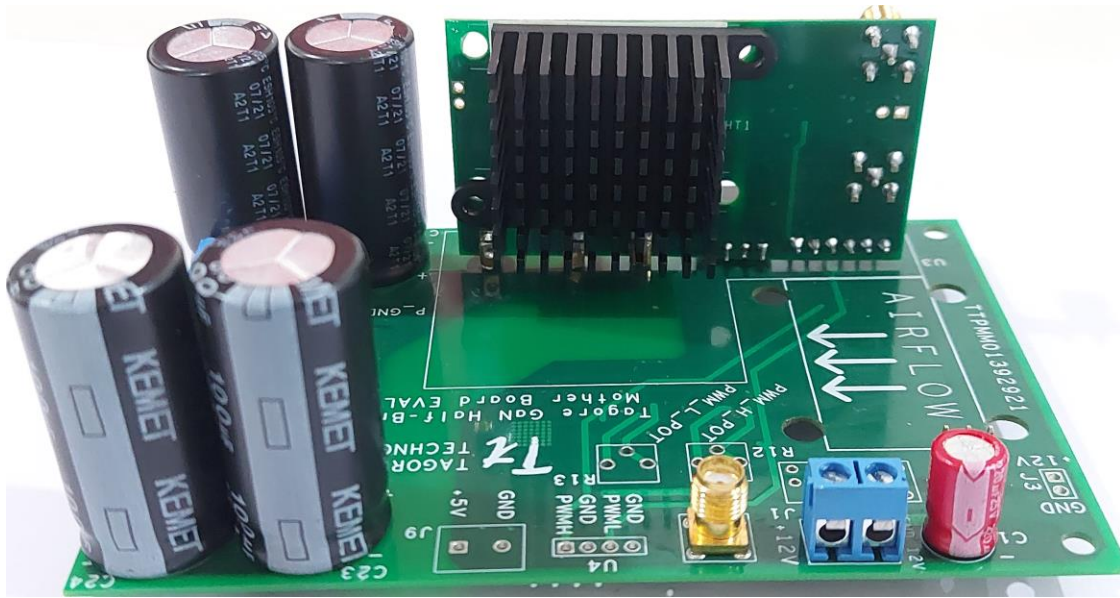
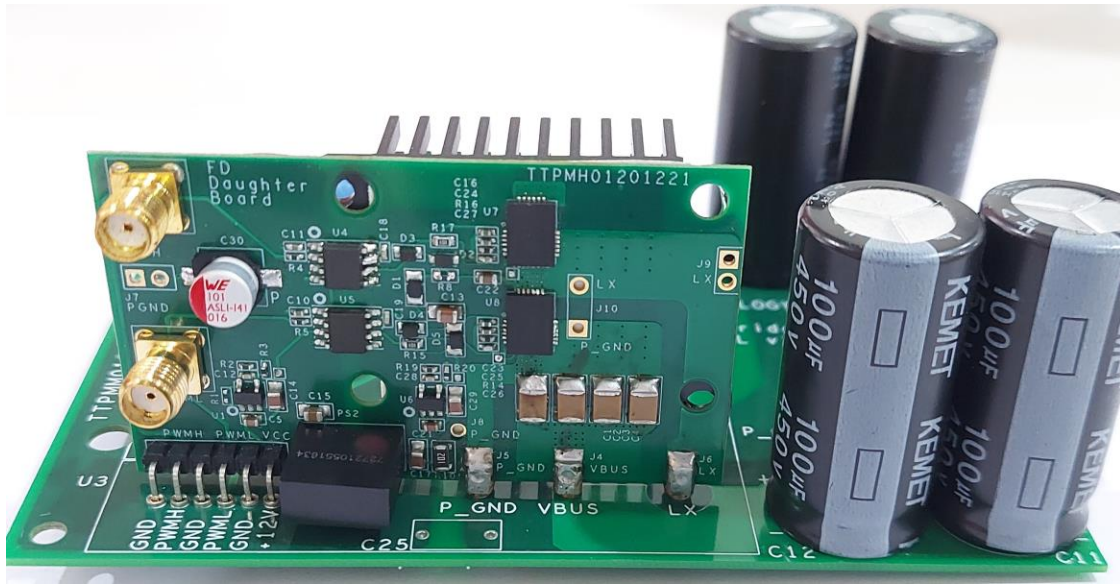


# Complete Tagore's HB GaN EVB – Daughter Card Plugged into Mother Board

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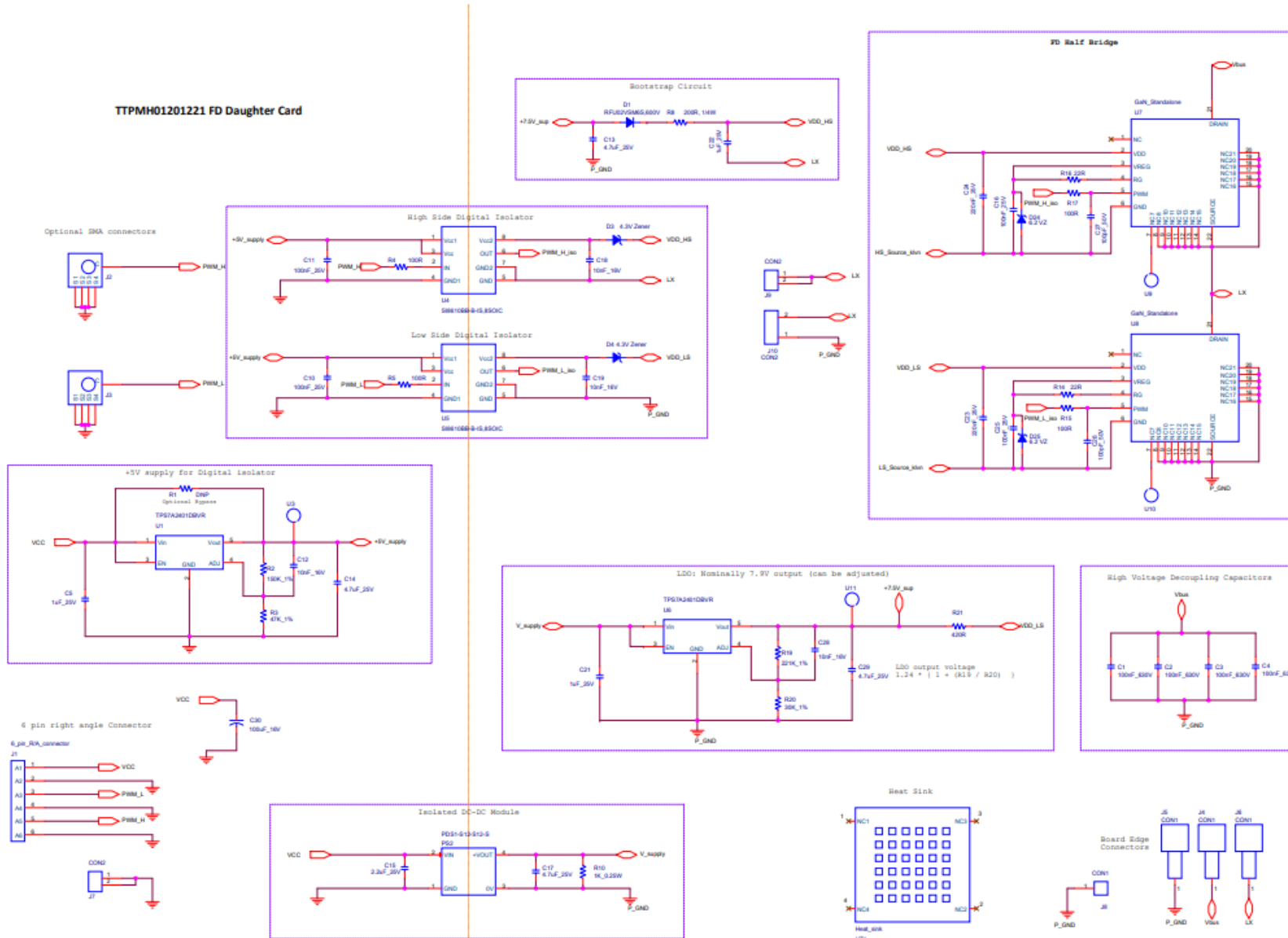


# Complete Tagore's HB GaN EVB – Daughter Card Plugged into Mother Board Tz



# Half-Bridge GaN EVB – Daughter Card Schematic

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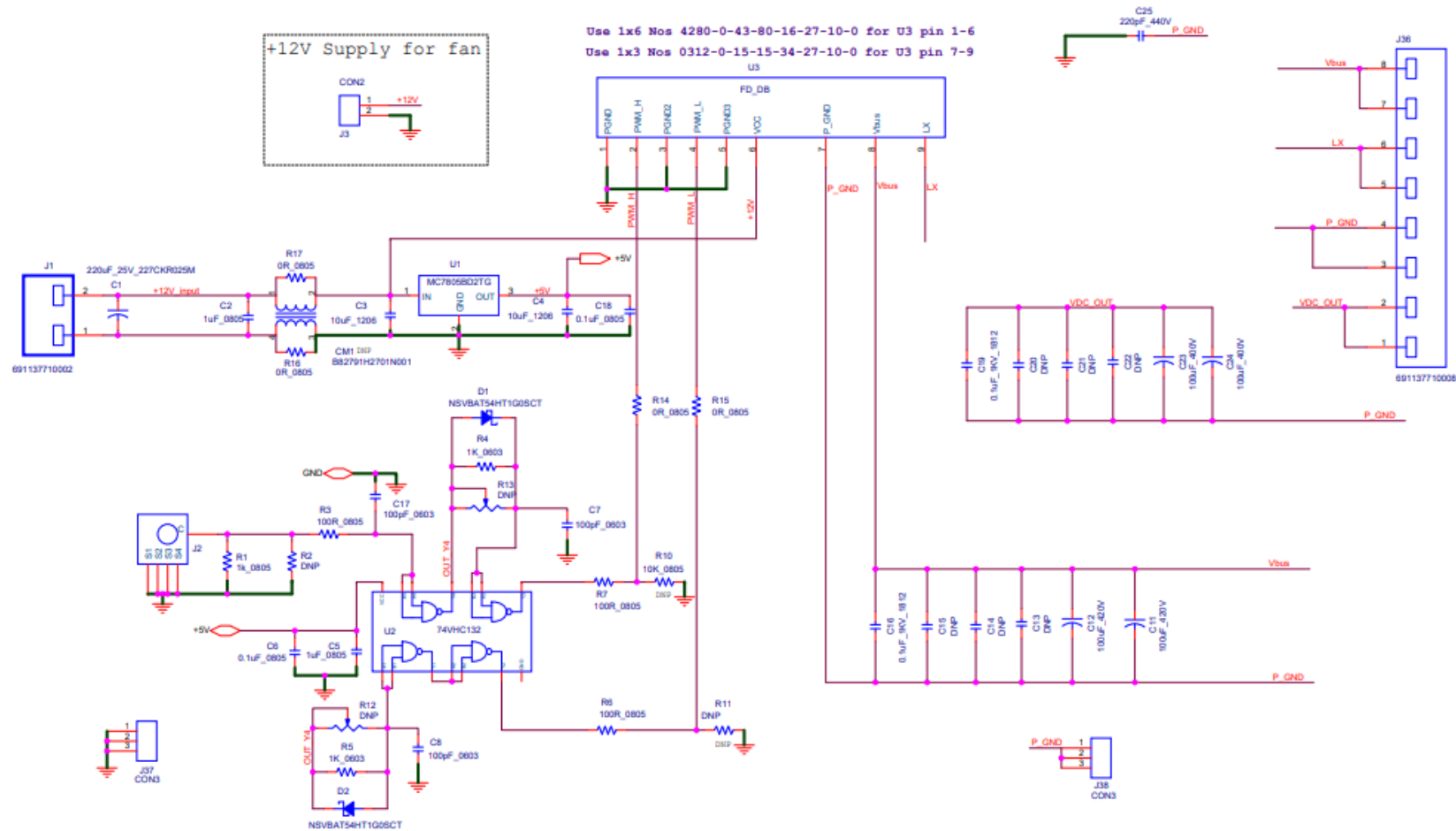


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# Half-Bridge GaN EVB – Mother Board Schematic

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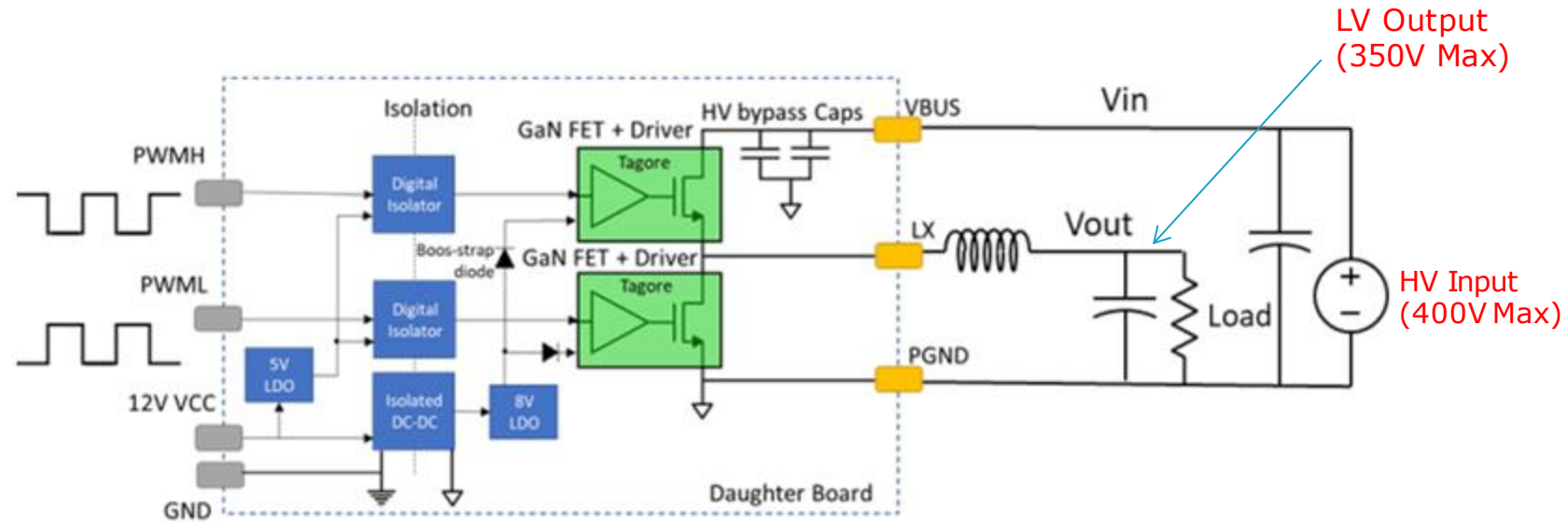
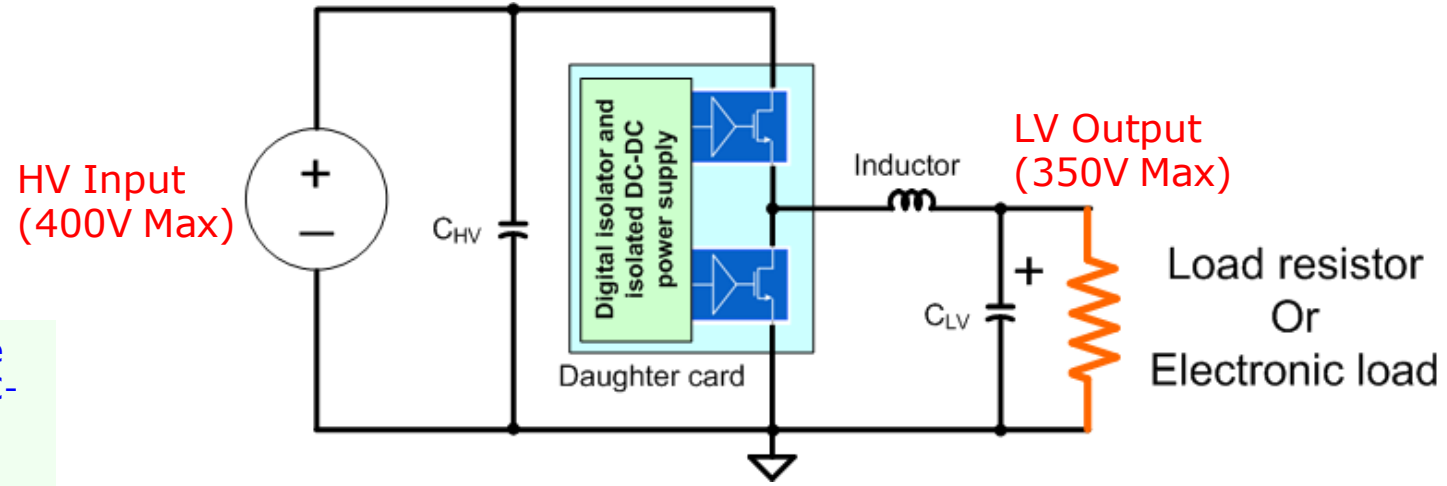
# Half-Bridge GaN EVB Application – DC-DC Buck Converter

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-This slide shows an example case, where the EVB can be configured to realize a DC-DC Buck Converter.

- The HS GaN acts as the main converter switch, while the LS GaN acts as the synch. Rectifier.

- The mother board is used with single PWM input (for HS GaN). The PWM signal for the LS GaN, and the associated dead time (between HS and LS GaN gating pulses) are generated in the Mother board. The dead time can be adjusted by changing two timing resistors. Currently it is set at around 75ns.



# Half-Bridge GaN EVB Application – DC-DC Buck Converter



PWM input signal connector. (**HS PWM**)  
[Only one PWM is needed. Complementary (**LS**) PWM with adjustable dead time (currently set around 75 ns) is generated in this board]

Optional CM choke for EMI filtering in the bias supply path (Shorted out in this board).

+12V Bias supply to be connected here

Optional +5V supply out for external circuit (If needed)

LV side EL capacitors (100uF, 400V rated)

Inductor (> 750uH) to be connected as shown.

Load resistor Or Electronic load to be connected here.  
(Note: LV EL caps are 400V rated. Ensure voltage at these terminals are less than 380V).

400V DC (Max) source to be connected here.  
(Note: HV EL caps are 420V rated. Don't apply more than 400V at these terminals).

Optional CM choke for EMI filtering in the bias supply path (Shorted out in this board).

Cooling Fan (+12V) power terminals to be soldered here

A 12V rated cooling fan can be fixed here (use the 4 holes for fastening / fixing the fan). Look at the direction of air flow. If external fan is used, this is not needed.

Projection of heatsink (fitted in the GaN daughter card)

HB Daughter card to be inserted here

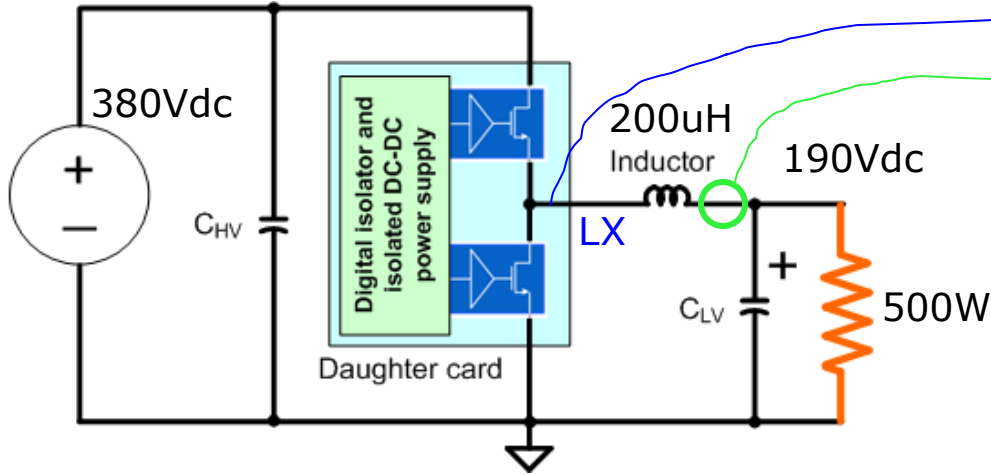
P\_GND pins for measurement/probing.

HV side EL capacitors (100uF, 420V rated)

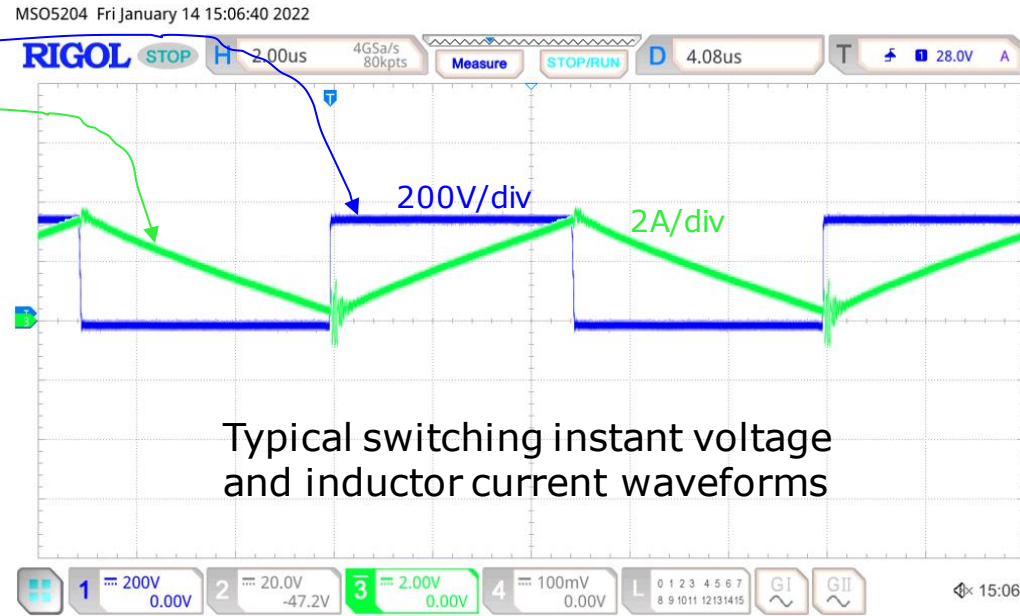


# Half-Bridge GaN EVB – Buck Converter Waveforms

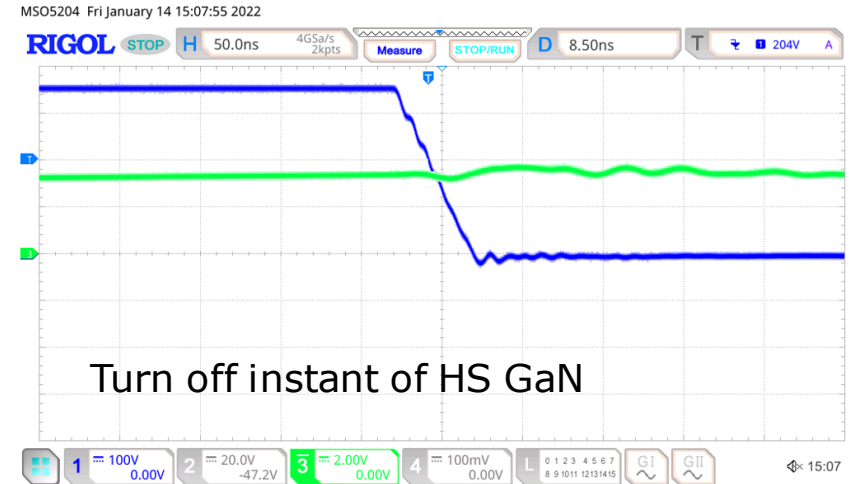
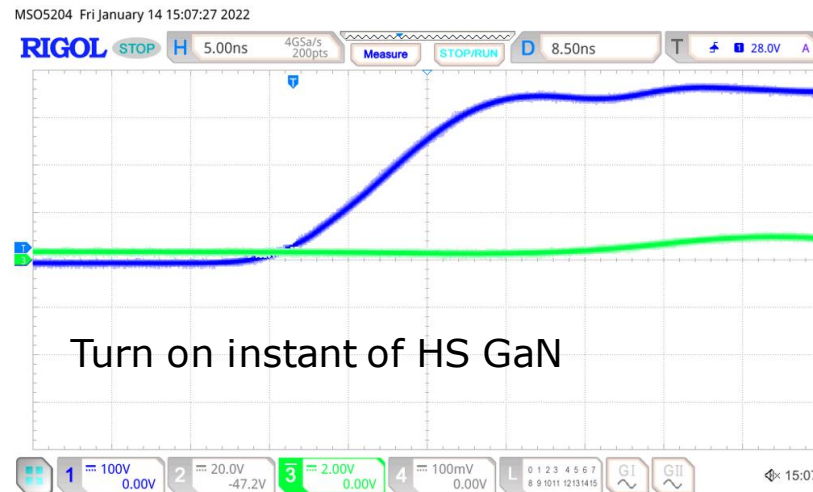
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Fsw: 100kHz  
Dead time: 75ns

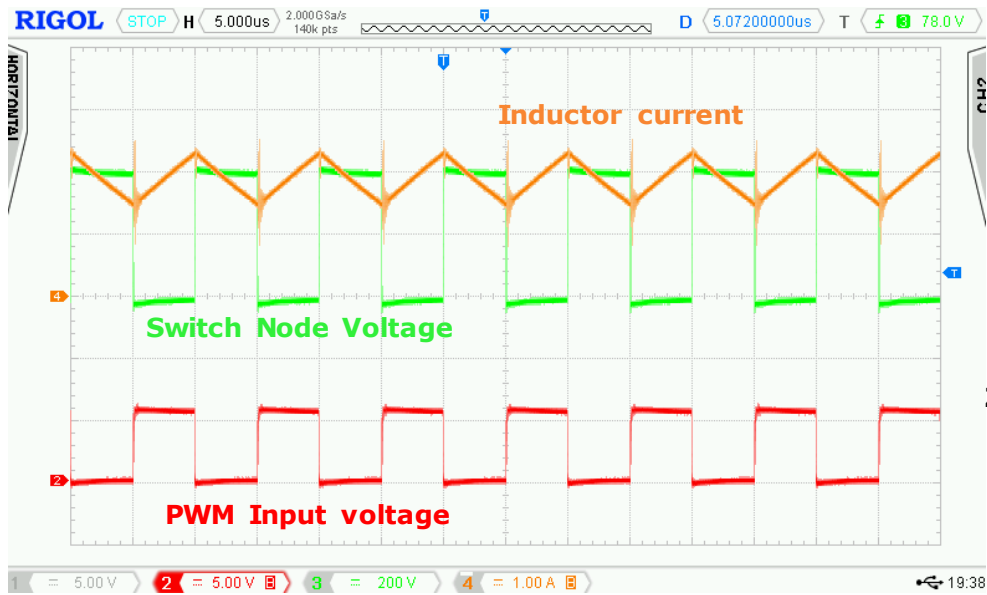


Blue – Switching Node Voltage (voltage across LS GaN)  
Green – Inductor current

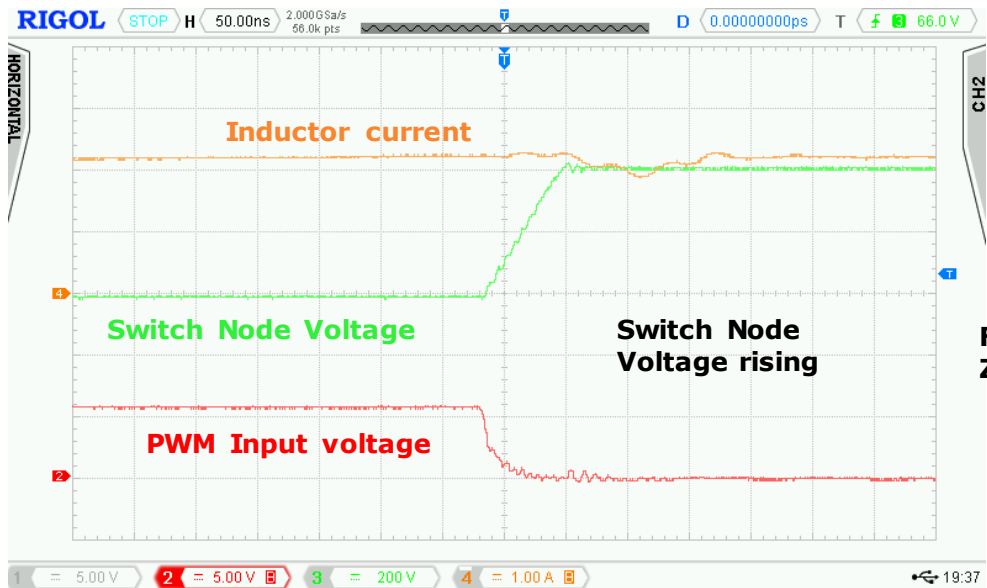
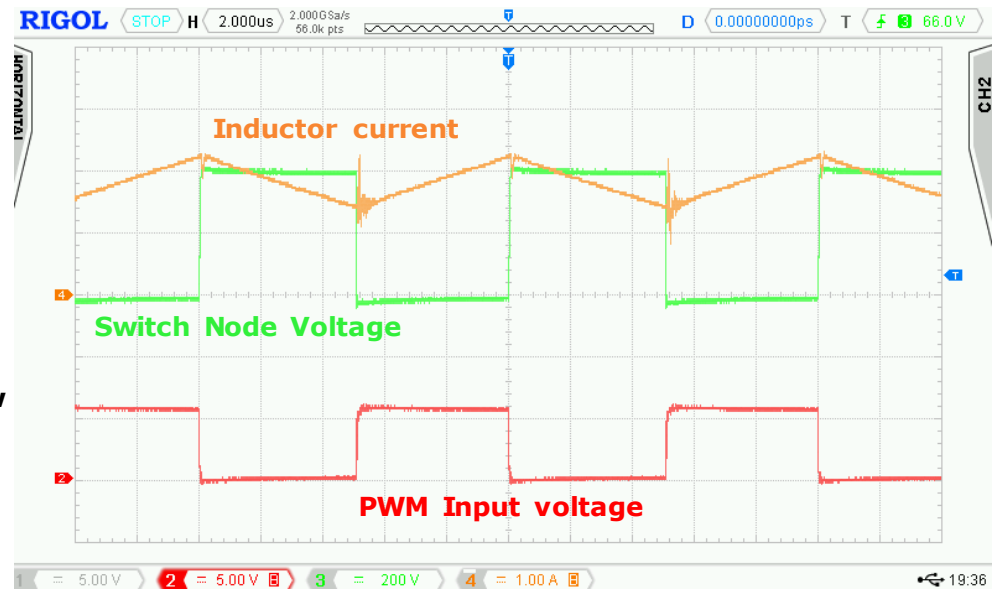


# Half-Bridge GaN EVB – Boost Converter Waveforms (200V To 400V)

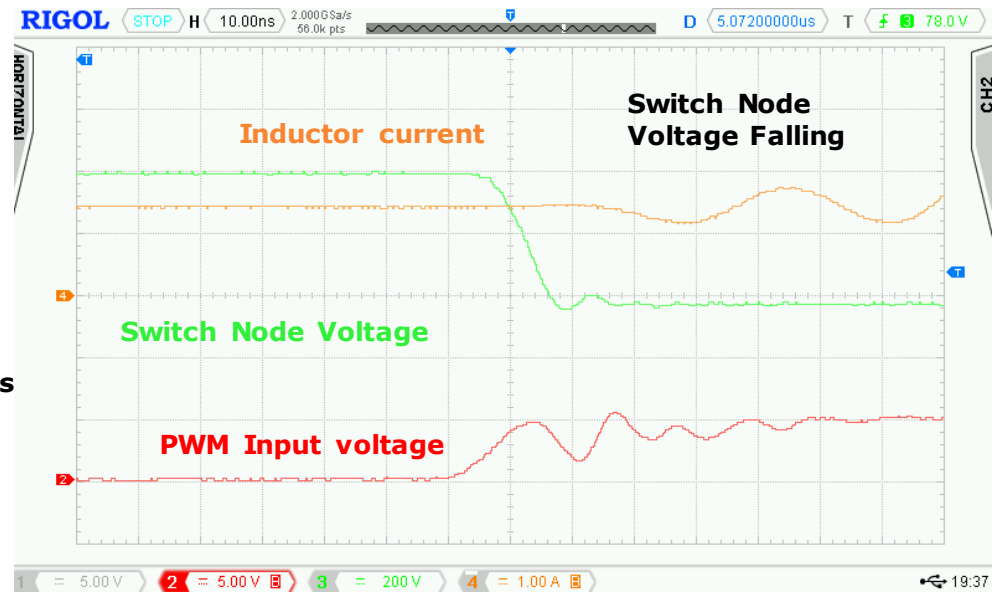
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Zoomed-In view



Further Zoomed-In views



# Half-Bridge GaN EVB – Standard Operation Procedure

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- Arrange for, a 400V DC source, 500W load resistor, 12V bias supply, 750uH, 4A Inductor, PWM signal source with variable duty cycle and a cooling fan.
- Make the electrical connection as shown in slide 14 (DC-DC buck converter). Keep the 400V DC supply output to 0V and OFF.
- Connect the PWM signal generator output to the SMA connector. Set the duty cycle to 48%.
- Plug in the daughter card as shown in slides 9 and 10.
- Fix two thermocouple probes to the HS and LS GaN to continuously monitor the case temperatures.
- Turn on the cooling fan to cool the heat sink fitted on the daughter card.
- Gradually increase the HV DC power supply from 0V to 400V, while monitoring the GaN temperatures.
- Do the various measurements/probing.
- Turn off the HV power supply, if any GaN case temperature exceeds 110 Deg. C.
- The HS and LS GaN dead time is set for 75ns. It can be changed by adjusting the resistors R4 and R5 in the mother board.



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**Thank You!**