IS32LT3962 BOOST AND BUCK-BOOST EVALUATION BOARD GUIDE

GENERAL DESCRIPTION

The IS32LT3962 is a multi-topology dual-channel peak current mode PWM controller designed to drive low side external NMOS FETs for wide input/output voltage range and high LED current applications. An external resistor senses the high side output current of the LED string for each channel. A high-side sense resistor is the most flexible current sensing scheme, since it functions in either boost or buck-boost mode configurations. The controller can be configured with an external resistor to operate between 100kHz~1MHz frequency resulting in small external inductor and capacitors while maintaining high efficiency. Built-in spread spectrum dither frequency to reduce the radiated peak emission and optimize the system EMI performance.

The IS32LT3962 integrates circuitry to detect output open/short, RT/VDD/VREF pins short circuit, over temperature fault conditions. These failure conditions of each channel can be independently reported by the open drain fault reporting pins, FAULTBx.

The IS32LT3962 can independently modulate LED current of each channel using either analog and/or PWM dimming techniques. Each channel features two independent analog dimming pins, ICTRLx and ADJRx. Input DC voltage in the range of 0.06V~2V on the ICTRLx pin and/or ADJRx pin is required for analog dimming. PWM dimming is achieved by directly modulating each PWM/ENx pin with desired PWM duty cycle or by enabling the internal PWM generator circuit. With the internal PWM generator circuit, IS32LT3962 can achieve standalone dual brightness level output. The duty cycle of each channel and frequency of the internal PWM generator is easily programmed by external resistors.

The soft-start function of the IS32LT3962 has been optimized for achieving excellently smooth LED light on effect when using external low duty cycle PWM dimming to do the fade on control. With this optimization, it can prevent the LED output light on with high brightness rapidly and get a comfort fade on visual effect.

The IS32LT3962 is available in a WFQFN-32 package with an exposed pad for enhanced thermal dissipation. It operates from 5V to 80V over the junction temperature range of -40°C to +150°C.

FEATURES

- Dual channel peak current mode controller
- Wide high voltage input range: 5V to 80V
- Each channel supports boost, buck-boost, SEPIC and buck topologies
- Independent dimming for each channel
  - Supports either analog, internal PWM dimming or external PWM dimming
  - Excellent fade on control by low duty cycle PWM dimming
- Standalone dual brightness output by internal PWM dimming
  - Integrated PWM generator
  - 100Hz~1kHz adjustable PWM frequency
  - 6%~100% adjustable PWM duty cycle for each channel
- Excellent analog dimming capability
  - Two analog dimming pins for each channel
  - LED binning capability
  - LED over temperature current roll-off
- Externally programmable VCC input undervoltage output current reduction and input undervoltage-lockout
- ±2.8% output current accuracy over -40°C ~ +150°C temperature
- Adjustable operating frequency range of 100kHz~1MHz
- Internal fixed soft-start to avoid inrush current
- EMI reduction capabilities
  - Spread spectrum function
  - Two channels 180° out-of-phase
- Fault protection with reporting:
  - VCC/VDD/VREF undervoltage lockout (not reported)
  - Programmable output overvoltage protection
  - Output short circuit protection
  - RT/VDD/VREF pin short protection
  - Over temperature protection
- AEC-Q100 Qualified with Temperature Grade 1: -40°C to 125°C
- RoHS & Halogen-Free Compliance
- TSCA Compliance

QUICK START

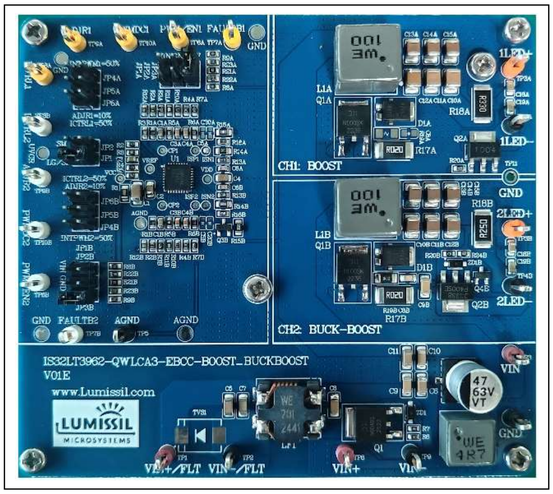

Figure 1 Photo of IS32LT3962 Evaluation Board

RECOMMENDED EQUIPMENT

- 9V~16V, 6A DC power supply
- BOOST LED load (7~16 LEDs in series/0.75A)
- BUCK-BOOST LED load (7~10 LEDs in series/1A)
- Multi-meter

ABSOLUTE MAXIMUM RATINGS

- Power supply ≤ 40V
- Output power ≤ 36W for BOOST topology
- Output power ≤ 30W for BUCK-BOOST topology

Caution: Do not exceed the conditions listed above, otherwise the board will be damaged or output non constant current.

ORDERING INFORMATION

Part No.	Temperature Range	Package
IS32LT3962-QWLCA3-EBCC-BOOST_BUCKBOOST	-40°C to +125°C (Automotive)	WFQFN-32, Lead-free

Table 1 Ordering Information

For pricing, delivery, and ordering information, please contact Lumissil's analog marketing team at analog@Lumissil.com or (408) 969-6600.

TEST PROCEDURE

The IS32LT3962 evaluation board is fully assembled and tested. Follow the steps listed below to verify board operation. Please configure by referring to Table 2 and Table 3.

Caution: Do not turn on the power supply until all connections are completed.

1. Input DC power supply: connect the power supply to TP1 and TP2 of the board.
2. Channel 1 output configuration:
   1) Connect the Channel 1 LED load to TP3A and TP4A on board.
   2) To enable Channel 1: close JP1A or JP3A, and open JP2A; To disable Channel 1: close JP2A.

      Note 1: If testing external PWM dimming, please open JP1A and JP3A to avoid PWM generator damage.
   3) If you need to configure internal PWM dimming or analog dimming, please follow the configuration of Table 2 for operation.
3. Channel 2 output configuration:
   1) Connect the Channel 2 LED load to TP3B and TP4B on board.
   2) To enable Channel 2: close JP1B or JP3B, and open JP2B; To disable Channel 2: close JP2B.

      Note 2: If testing external PWM dimming, please open JP1B and JP3B to avoid PWM generator damage.
   3) If you need to configure internal PWM dimming or analog dimming, please follow the configuration of Table 2 for operation.
4. If you need to configure VCC undervoltage output current reduction (UVCR) function, please follow the configuration of Table 2 for operation.
5. Turn on the power supply and the LED loads will light up.

6. To measure the output current, please connect the current meter (multi-meter) in series with the LED load. No matter if the power supply voltage or output LED load voltage are changed, the output current of the evaluation board will be always constant.

Note 3: if the LED load is fixed which means the output power is constant, the power supply current will change following the power supply voltage. The lower power supply voltage the higher power supply current. Please pay attention to the current limit of your power supply, especially at lower power supply voltage.

7. This evaluation board includes an EMI suppression filter circuit and is designed to meet the CISPR-25 conducted EMI standard. Please follow the configuration of Table 3 for operation.

Caution:

1. ***The output OVP voltage has exceeded the safe voltage (60V), please do not touch live parts.***
2. ***Since the output power is quite high while the DEMO board dimension is compact, the temperature of the components will be quite high. DO NOT touch the components during operation. In practice, some type of heatsinking should be considered, such as mount a larger heatsink and fill with thermal conductive glue for cooling to ensure thermal reliability.***
3. ***EVBs are not to be used as all or part of a production unit.***

CONNECTOR DESCRIPTION

Table 3 defines the interface connectors, while Table 2 lists all test points available on the EVB. These tables detail the correct connection procedures, configuration setup and operational guidelines for this EVB. Figure 2 illustrates the connection diagram along with the default jumper configuration positions.

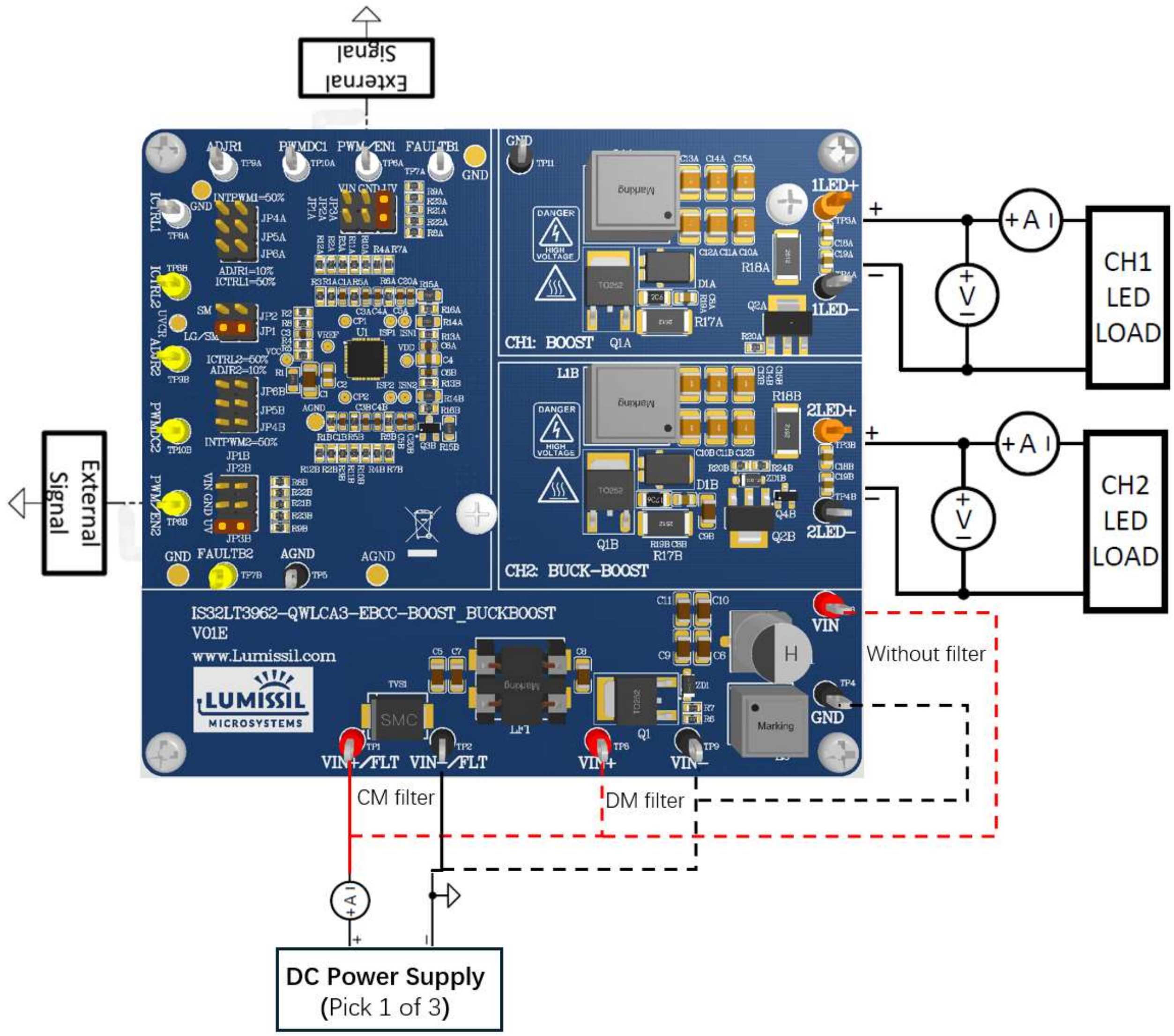

Figure 2 Photo of IS32LT3962 Wiring Schematic

WARNING

The <HIGH VOLTAGE> warning notice means that this open-frame, non-enclosed evaluation board has at least one circuit node with a voltage exceeding 60 VDC, typically including but not limited to the switching node and output voltage. This system is intended solely for laboratory development use and shall only be operated by qualified professionals who have received formal professional training, possessed proficient technical competency, and fully understood the electrical safety hazards related to high-voltage circuit design and application. Do not touch the EVB or its internal circuitry while powered on. High voltage may always be present and poses a risk of electric shock.

WARNING

The <HOT SURFACE> warning notice means this open-frame, non-enclosed evaluation board has at least one component with a surface temperature exceeding 60℃. Typical heat-generating components include, but are not limited to, inductors, diodes and MOSFETs. Do not touch the EVB while it is powered on. High surface temperature may cause burns.

Table 2 Jumper Setting Descriptions

Jumper	Function	Description & Setting
JP1A, JP3A	Channel 1 Enable Control	1. Close JP1A: Enable Channel 1 without external UVLO. 2. Close JP3A: Enable Channel 1 with external UVLO.
JP1B, JP3B	Channel 2 Enable Control	1. Close JP1B: Enable Channel 2 without external UVLO. 2. Close JP3B: Enable Channel 2 with external UVLO.
JP2A, JP2B	Channels or device disabled	1. Close JP2A + JP2B: Disable device, IS32LT3962 enters shut-down mode. 2. Close JP2A: Disable Channel 1. 3. Close JP2B: Disable Channel 2.
JP1, JP2	UVCR Function Control	1. Close JP1 + Open JP2: UVCR enabled (V_{UVCR}= 1.6V); 2. Close JP1 + JP2: UVCR enabled (V_{UVCR}= 0.45V); 3. Open JP1 + JP2: UVCR disabled (V_{UVCR}= 0V).
JP4A	Channel 1 Internal PWM Dimming	1. Close JP4A: Enable internal PWM, 50% duty cycle, 290Hz. 2. Open JP4A: Disable internal PWM, 100% Output.
JP4B	Channel 2 Internal PWM Dimming	1. Close JP4B: Enable internal PWM, 50% duty cycle, 290Hz. 2. Open JP4B: Disable internal PWM, 100% Output.
JP5A, JP6A	Channel 1 Analog Dimming	1. Close JP5A: Enable ADJR1 analog dimming; output current = 10%. 2. Close JP6A: Enable ICTRL1 analog dimming; output current = 50%. 3. Open JP5A+JP6A: Disable analog dimming; output current = 100%.
JP5B, JP6B	Channel 2 Analog Dimming	1. Close JP5B: Enable ADJR2 analog dimming; output current = 10%. 2. Close JP6B: Enable ICTRL2 analog dimming; output current = 50%. 3. Open JP5B+JP6B: Disable analog dimming; output current = 100%.

Table 3 Terminal Setting Descriptions

Terminal	Function	Description & Setting
TP1, TP2 (TP8, TP9) (TP3, TP4)	Device Power Input Port	1. TP1 (VIN+/FLT) = Power Positive, TP2 (VIN-/FLT) = Power Negative; EMI can meet class 5 level. 2. TP8 (VIN+) = Power Positive, TP9 (VIN-) = Power Negative; EMI can meet class 4 level. 3. TP3 (VIN) = Power Positive, TP4 (GND) = Power Negative; EMI can meet class 3 level.
TP5, TP4, TP11	Device Ground Port	1. TP5 (AGND): Directly connected to chip AGND (Pin7). For analog voltage measurement only, DO NOT connect power negative. 2. TP4 or TP11 (GND): Connected to board ground with large copper pour. Oscilloscope probe ground can be connected to TP4 or TP11.
TP3A, TP4A	Channel 1 Output Port	TP3A (1LED+): Channel 1 positive output TP4A (1LED-): Channel 1 negative output
TP3B, TP4B	Channel 2 Output Port	TP3B (2LED+): Channel 2 positive output TP4B (2LED-): Channel 2 negative output
TP6A	Channel 1 External PWM Input Port	TP6A (PWM/EN1): Connected to PWM/EN1 pin.
TP6B	Channel 2 External PWM Input Port	TP6B (PWM/EN2): Connected to PWM/EN2 pin.
TP7A	Channel 1 Fault Reporting Port	TP7A (FAULTB1): Connected to FAULTB1 pin, pulled up to VIN via R9A.
TP7B	Channel 2 Fault Reporting Port	TP7B (FAULTB2): Connected to FAULTB2 pin, pulled up to VIN via R9B.
TP10A	Channel 1 Internal PWM Dimming	TP10A (PWMDC1): Connected to PWMDC1 pin. Apply 0.09 V ~ 3 V to adjust internal PWM duty cycle.
TP10B	Channel 2 Internal PWM Dimming	TP10B (PWMDC2): Connected to PWMDC2 pin. Apply 0.09 V ~ 3 V to adjust internal PWM duty cycle.
TP8A, TP9A	Channel 1 Analog Dimming Port	TP8A (ICTRL1) & TP9A (ADJR1): Connected to corresponding pins. Apply 0.07 V ~ 2 V to adjust output current.
TP8B, TP9B	Channel 2 Analog Dimming Port	TP8B (ICTRL2) & TP9B (ADJR2): Connected to corresponding pins. Apply 0.07 V ~ 2 V to adjust output current.

OPERATION FREQUENCY

The operation frequency of two channels is identical and programmed from 100kHz to 1MHz range using a single resistor R_{RT} at RT pin. Higher frequency operation results in smaller component size but increases the switching losses and power NMOS gate driving current and may not allow sufficiently high or low duty cycle. Lower frequency gives better performance but results in larger component size. To set a desired frequency, the resistor value can be calculated by following equation:

$$R_{RT} = \frac{2.15\times10^4}{f_{SW}} - 3.7 \qquad (1)$$

Where R_{RT} is in kΩ. f_{SW} is the operation frequency in kHz. In automotive applications, an operation frequency of 400kHz is a good compromise between component size and efficiency. It also makes the system easier to filter switching noise from sensitive frequency bands and pass EMI tests. If the RT pin is connected to an extremely low value resistor or accidentally shorted to ground, the operation frequency will be over 1MHz. If it exceeds 2.5MHz, the internal circuit will detect it and turn off the power NMOS for protection. When this fault condition is removed, the frequency drops below 2.5MHz, and the operation will recover.

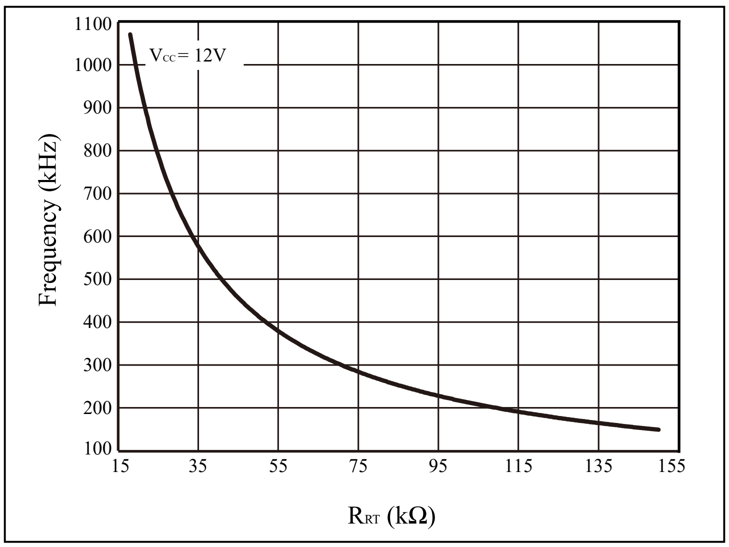

Figure 3 f_{SW} vs. R_{RT}

LED CURRENT CONTROL

Each channel of the IS32LT3962 has individual current control loop which regulates the LED current by the external resistor, R_{ISx}, in series with LED string and connecting to ISPx and ISNx. An internal rail-to-rail current sense amplifier measures the average LED current based on the differential voltage drop between the ISPx and ISNx inputs. Since the ISPx/ISNx only supports high-side current sensing, their common mode voltage (to ground) must be not less than 3V. The voltage across the LED current sense resistor, R_{ISx}, is regulated to the current sense voltage threshold V_{SENSE}, which can be adjusted by the analog dimming and the VCC undervoltage output current reduction functions. When the PWM dimming is not applied, ICTRLx/ADJRx voltage is above 2V and VCC undervoltage output current reduction is disabled, this will result in a full-scale current sense voltage threshold, V_{SENSE}=0.25V (Typ.) and the LED current can be calculated from following equation.

$$I_{LED} = \frac{V_{SENSE}}{R_{IS}} \qquad (2)$$

In order to have an accurate LED current, precision resistors are preferred (±1% recommended). The R_{ISx} resistor should be placed as close as possible to the IS32LT3962 device with minimal trace length on PCB layout.

Table 4 Fault Actions Table

Fault Type	Fault Condition	Device Operation After Fault	FAULTBx Pin	Fault Reset
VCC UVLO	$V_{CC}<V_{UVLO\_F}$	GATE1,2 and DIMOUT1,2 pull low immediately. IC enters standby mode. COMP1,2 reset to zero.	High Impedance	$V_{CC}>V_{UVLO\_R}$
VDD UVLO	$V_{DD}<V_{LDO\_UVLO\_F}$	GATE1,2 and DIMOUT1,2 pull low immediately. IC enters standby mode. COMP1,2 reset to zero.	High Impedance	$V_{DD}>V_{LDO\_UVLO\_R}$
VDD Pin Short	After startup and V_{DD}<1.4V (Typ.)	GATE1,2 and DIMOUT1,2 pull low immediately. IC enters standby mode. COMP1,2 reset to zero.	Pull Low	V_{DD}>2.1V (Typ.)
VREF UVLO	$V_{REF}<V_{LDO\_UVLO\_F}$	GATE1,2 and DIMOUT1,2 pull low immediately. IC enters standby mode. COMP1,2 reset to zero.	High Impedance	$V_{REF}>V_{LDO\_UVLO\_R}$
VREF Pin Short	After startup and V_{REF}<1.4V (Typ.)	GATE1,2 and DIMOUT1,2 pull low immediately. IC enters standby mode. COMP1,2 reset to zero.	Pull Low	V_{REF}>2.1V (Typ.)
Output Overvoltage (LED Open)	$V_{OVx}\geq V_{OVP\_TH}$	GATEx and DIMOUTx pull low immediately. The corresponding channel enters standby mode. COMPx resets to zero.	Pull Low	$V_{OVx}<(V_{OVP\_TH}-V_{OVP\_HY})$ (Note 4)
Power NMOS Current Limit	$V_{CSx}>V_{CS\_TH}$	GATEx pulls low immediately until the next switching cycle.	High Impedance	$V_{CSx}<V_{CS\_TH}$
Output Overcurrent (LED Short)	V_{ISPx}/V_{ISNx}>5V (Typ.) and $(V_{ISPx}-V_{ISNx})>V_{SENSE\_OC}$	No internal protection action is initiated, and the device continues to operate.	Pull Low	$(V_{ISPx}-V_{ISNx})<V_{SENSE\_OC}$ (Note 4)
	V_{ISPx}/V_{ISNx}<5V (Typ.) and $(V_{ISPx}-V_{ISNx})>V_{SENSE\_OC}$	GATEx and DIMOUTx pull low immediately. The corresponding channel enters standby mode. COMPx resets to zero. The channel will operate in hiccup mode (restart every t_{SKIP} period).	Pull Low	
Output Undervoltage (LED Short)	$V_{OVx}<V_{UVD\_TH}$	No internal protection action initiated, and the device continues to operate.	Pull Low	$V_{OVx}>V_{UVD\_TH}$ (Note 4)
RT Pin Short	f_{SW}>2.5MHz (Typ.)	GATE1,2 pulls low immediately.	Pull Low	f_{SW}<2.5MHz (Typ.)
Thermal Shutdown	T_J>175°C (Typ.)	GATE1,2 and DIMOUT1,2 pull low immediately. IC enters standby mode and COMP1,2 reset to zero.	Pull Low	T_J<155°C (Typ.)

Note 4: FAULTBx recovery after t_{FRD}.

BILL OF MATERIALS

Name	Symbol	Description	Qty	Supplier	Part No.
-	TVS1, C5A, C5B, C20A, C20B, C8A, R19A	NC	0		
PCB	-	100×90×1.6mm, FR-4, 4 layers, 1oz copper	1	-	-
LED Driver	U1	Constant current LED driver controller	1	Lumissil	IS32LT3962
Capacitor	EC1	Electrolytic CAP, 47μF, 63V, IR=119mA, Φ8×10.5mm	1	JIEPP	JVJ63V47M8X10
Capacitor	C1, C5, C6, C11	CAP,2.2μF,50V, ±10%,1206	4	Yageo	AC1206KRX7R9BB225
Capacitor	C1A, C1B	CAP,220nF,50V, ±10%,0603	2	Yageo	AC0603KKX7R9BB224
Capacitor	C2	CAP,0.1μF,50V, ±10%,0805	1	Yageo	AC0805KRX7R9BB104
Capacitor	C3	CAP,1μF,25V, ±10%,0603	1	Yageo	AC0603KRX7R8BB105
Capacitor	C3A, C3B, C4A, C4B	CAP,10nF,50V, ±10%,0603	4	Yageo	AC0603KRX7R9BB103
Capacitor	C4	CAP,1μF,25V, ±10%,0805	1	Yageo	AC0805KKX7R8BB105
Capacitor	C6A, C6B	CAP,10pF,50V, ±10%,0603	2	Yageo	AC0603KRX7R9BB100
Capacitor	C7, C8, C9, C10	CAP,0.1μF,50V, ±10%,1206	4	Yageo	AC1206KRX7R9BB104
Capacitor	C8B	CAP,1nF,100V, ±10%,0805	1	Yageo	AC0805KRX7R0BB102
Capacitor	C9B	CAP,0.1μF,100V, ±10%,1206	1	Yageo	AC1206KKX7R0BB104
Capacitor	C10A, C11A, C12A	CAP,10μF,100V, ±10%,1210	3	Murata	GRM32EC72A106KE05L
Capacitor	C10B, C11B, C12B, C13A, C13B, C14A, C14B, C15A, C15B	CAP,10μF,50V, ±10%,1210	9	Murata	GRM32ER71H106KA12L
Capacitor	C18A, C18B	CAP,22nF,100V, ±10%,0805	2	Yageo	AC0805KRX7R0BB223
Capacitor	C19A, C19B	CAP,22nF,50V, ±10%,0805	2	Yageo	AC0805KRX7R9BB223
Resistor	R1	RES,1Ω, ±5%,0603	1	Yageo	AC0805JR-071RL
Resistor	R1A, R1B	RES,220R, ±5%,0603	2	Yageo	AC0603JR-07220RL
Resistor	R2	RES,51k, ±5%,0603	1	Yageo	AC0603FR-0751KL
Resistor	R2A, R2B, R4A, R4B, R6	RES,10k, ±5%,0603	5	Yageo	AC0603FR-0710KL
Resistor	R3	RES,68k, ±5%,0603	1	Yageo	AC0603FR-0768KL
Resistor	R3A, R3B	RES,47k, ±5%,0603	2	Yageo	AC0603FR-0747KL
Resistor	R4	RES,120k, ±5%,0603	1	Yageo	AC0603FR-07120KL
Resistor	R5	RES,56k, ±5%,0603	1	Yageo	AC0603FR-0756KL
Resistor	R5A, R5B, R8, R22A, R22B	RES,15k, ±5%,0603	5	Yageo	AC0603FR-0715KL
Resistor	R6A, R6B, R23A, R23B	RES,100k, ±5%,0603	4	Yageo	AC0603FR-07100KL
Resistor	R7, R8A, R8B, R9A, R9B	RES,20k, ±5%,0603	5	Yageo	AC0603FR-0720KL
Resistor	R7A, R7B	RES,27k, ±5%,0603	2	Yageo	AC0603FR-0727KL

BILL OF MATERIALS (CONTINUED)

Name	Symbol	Description	Qty	Supplier	Part No.
Resistor	R10A, R10B, R16A	RES,5.1k, ±5%,0603	3	Yageo	AC0603FR-075K1L
Resistor	R11A, R11B	RES,2k, ±5%,0603	2	Yageo	AC0603FR-072KL
Resistor	R12A, R12B	RES,3k, ±5%,0603	2	Yageo	AC0603FR-073KL
Resistor	R13A, R13B, R20A	RES,100R, ±5%,0603	3	Yageo	AC0603FR-07100RL
Resistor	R14A, R14B	RES,10R, ±5%,0805	2	Yageo	AC0805FR-0710RL
Resistor	R15A, R15B	RES,330k, ±5%,0805	2	Yageo	AC0805FR-07330KL
Resistor	R16B	RES,7.5k, ±5%,0603	1	Yageo	AC0603FR-077K5L
Resistor	R17A, R17B	RES,20mΩ, ±1%, 2512	2	UniOhm	25121WF200MT4E
Resistor	R18A	RES,330mΩ, ±1%, 2512	1	UniOhm	25121WF330LT4E
Resistor	R18B	RES,250mΩ, ±1%, 2512	1	UniOhm	25121WF250LT4E
Resistor	R19B	RES,3.3R, ±5%,0805	1	Yageo	AC0805JR-073R3L
Resistor	R20B	RES,2.4k, ±5%,0603	1	Yageo	AC0603FR-072K4L
Resistor	R21A, R21B	RES,0Ω, ±5%,0603	2	Yageo	AC0603JR-070RL
Resistor	R24B	RES,6.2k, ±5%,0603	1	Yageo	AC0603FR-076K2L
Diode	ZD1, ZD1B	DIODE ZENER 7.5V, SOD123	2	DIODES	BZT52HC7V5WF-7
Diode	D1A, D1B	DIODE Schottky 5A,100V, POWERDI®5	2	DIODES	PDS5100-13
MOSFET	Q1	NMOS, 20A, 60V, TO252	1	DIODES	DMN6040SK3-13
MOSFET	Q1A, Q1B	NMOS, 18A, 100V, TO252	2	DIODES	DMN10H100SK3-13
MOSFET	Q2A	NMOS, 4A, 100V, SOT223	1	Yangjie	YJM04N10A
MOSFET	Q2B	PMOS, -2.3A, -100V, SOT223	1	DIODES	DMP10H400SEQ-13
BJT Transistor	Q3B	PNP BJT, -200mA, -40V, SOT23	1	DIODES	MMBT3906-7-F
MOSFET	Q4B	NMOS, 75mA,60V, SOT23	1	ON	2V7002LT3G
Inductor	L1A, L1B	10μH±20%, I_R=9.4A, ISAT=20.3A, 11mΩ, 120V, 11.6×10.5×8.8mm	2	WURTH	74439369100
Inductor	L2	4.7μH±20%, I_R=9.5A, ISAT=16.65A, 8.65mΩ, 120V, 8.8×8.3×7.8mm	1	WURTH	74439358047
Inductor	LF1	9μH±50%, 700Ω@100MHz, I_R=8A, 6mΩ, 80V, 12×11×6mm	1	WURTH	744237701

SCHEMATIC

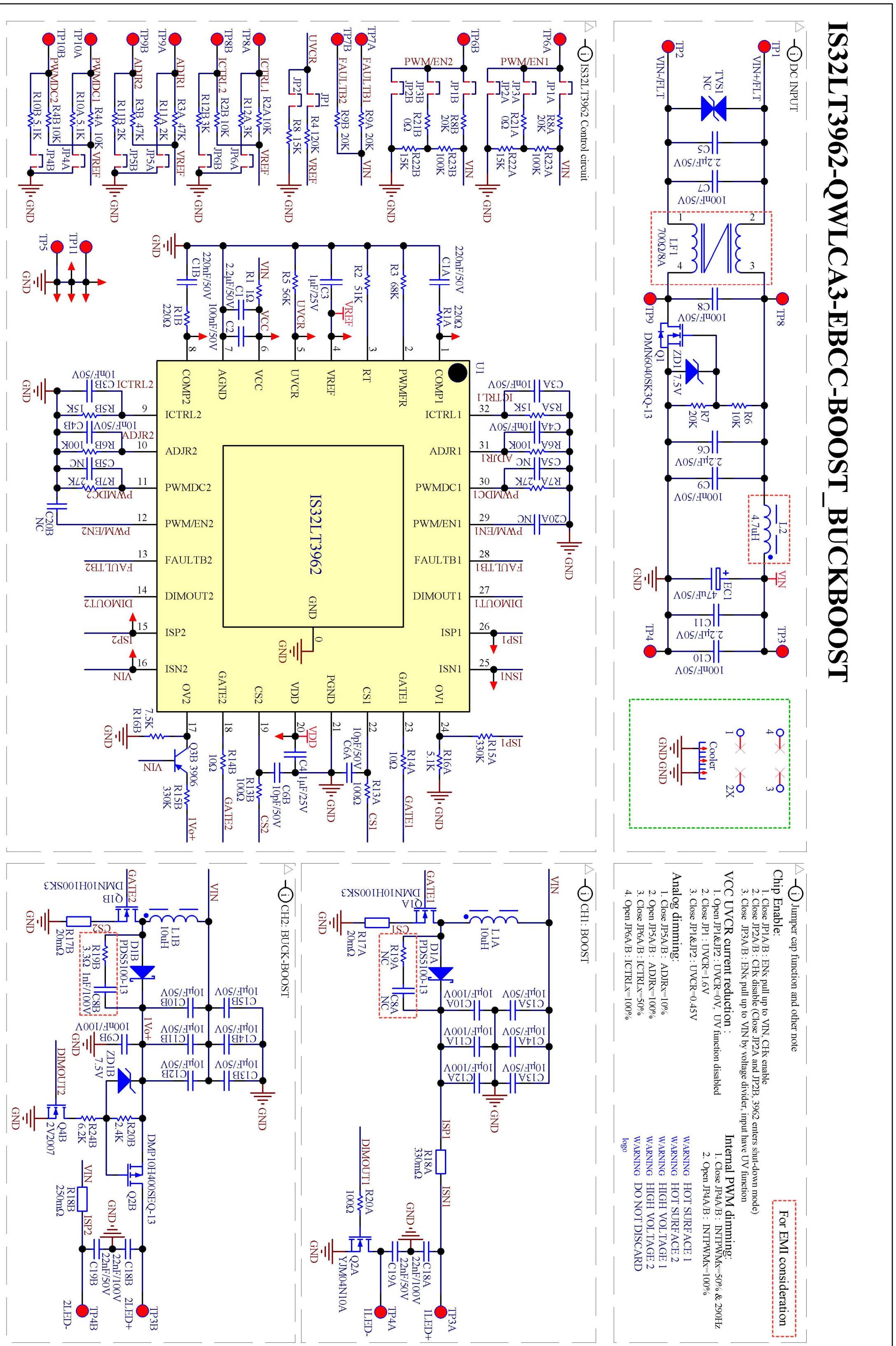

Figure 4 IS32LT3962 DEMO Schematic

Note 5: R6, R7, ZD1 and Q1 form an ideal diode as low loss input reverse polarity protection. They can be replaced by a lower cost Schottky diode, however the much higher forward voltage on Schottky diode will degrade the efficiency and increase thermal on board.

Note 6: The EMI filtering circuits are optional. Using different external components, PCB layout, parameter setting may result in a significantly different EMI performance. Please fine tune EMI filtering circuit based on your actual EMI scan result.

PCB LAYOUT (SIZE: 100 × 90 mm, FR-4, 4 LAYERS, 1OZ COPPER)

Caution: Since the PCB layout is very critical for the EMI performance, please follow this PCB layout's components placement and trace routing for better EMI performance. If need, please contact Lumissil to acquire the PCB layout files/application note for your PCB layout reference.

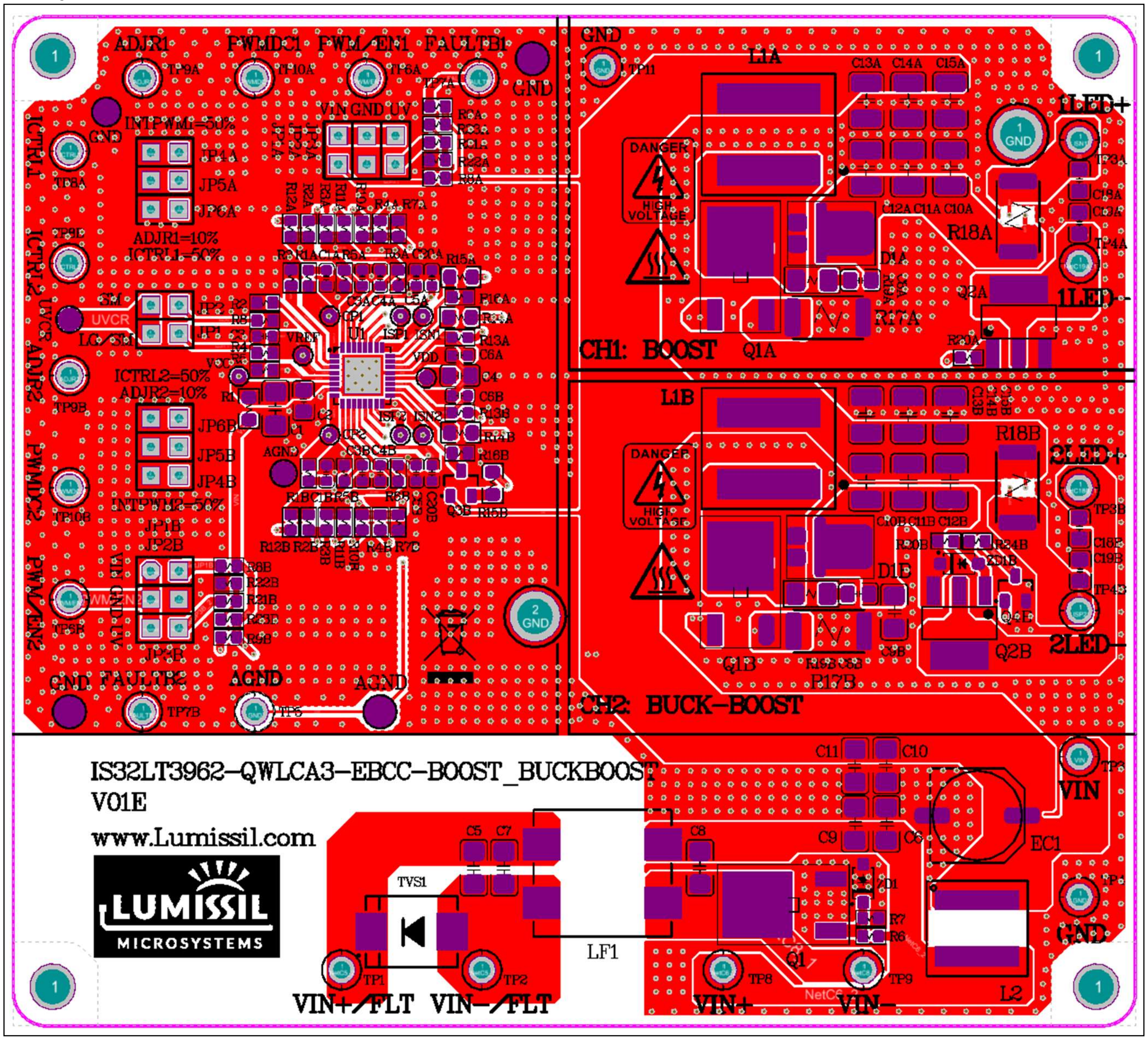

Figure 5 Board Top Layer 1

PCB LAYOUT (SIZE: 100 × 90 mm, FR-4, 4 LAYERS, 1OZ COPPER) (CONTINUED)

Caution: Since the PCB layout is very critical for the EMI performance, please follow this PCB layout's components placement and trace routing for better EMI performance. If need, please contact Lumissil to acquire the PCB layout files/application note for your PCB layout reference

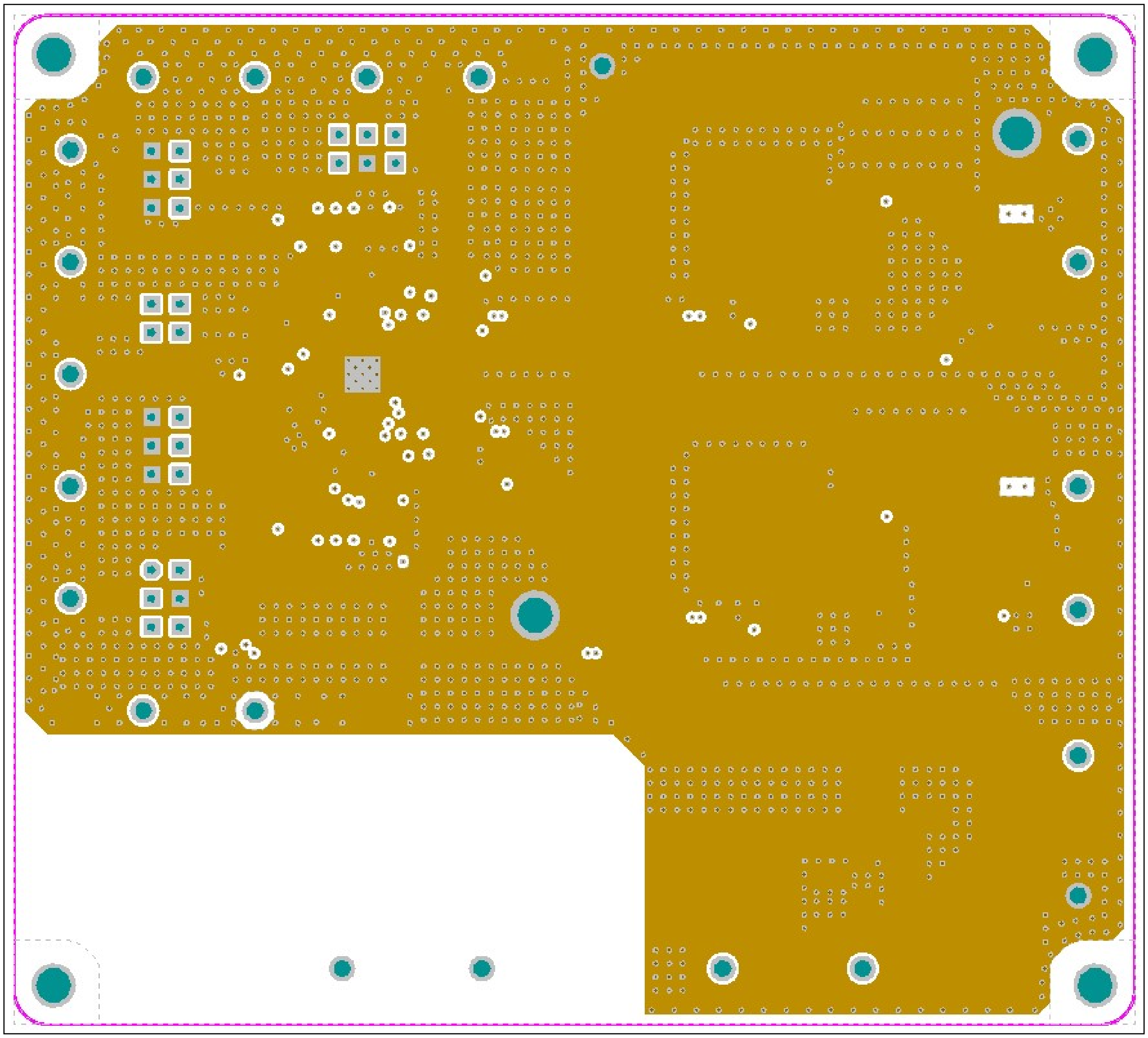

Figure 6 Board Middle GND Layer 2

PCB LAYOUT (SIZE: 100 × 90 mm, FR-4, 4 LAYERS, 1OZ COPPER) (CONTINUED)

Caution: Since the PCB layout is very critical for the EMI performance, please follow this PCB layout's components placement and trace routing for better EMI performance. If need, please contact Lumissil to acquire the PCB layout files/application note for your PCB layout reference

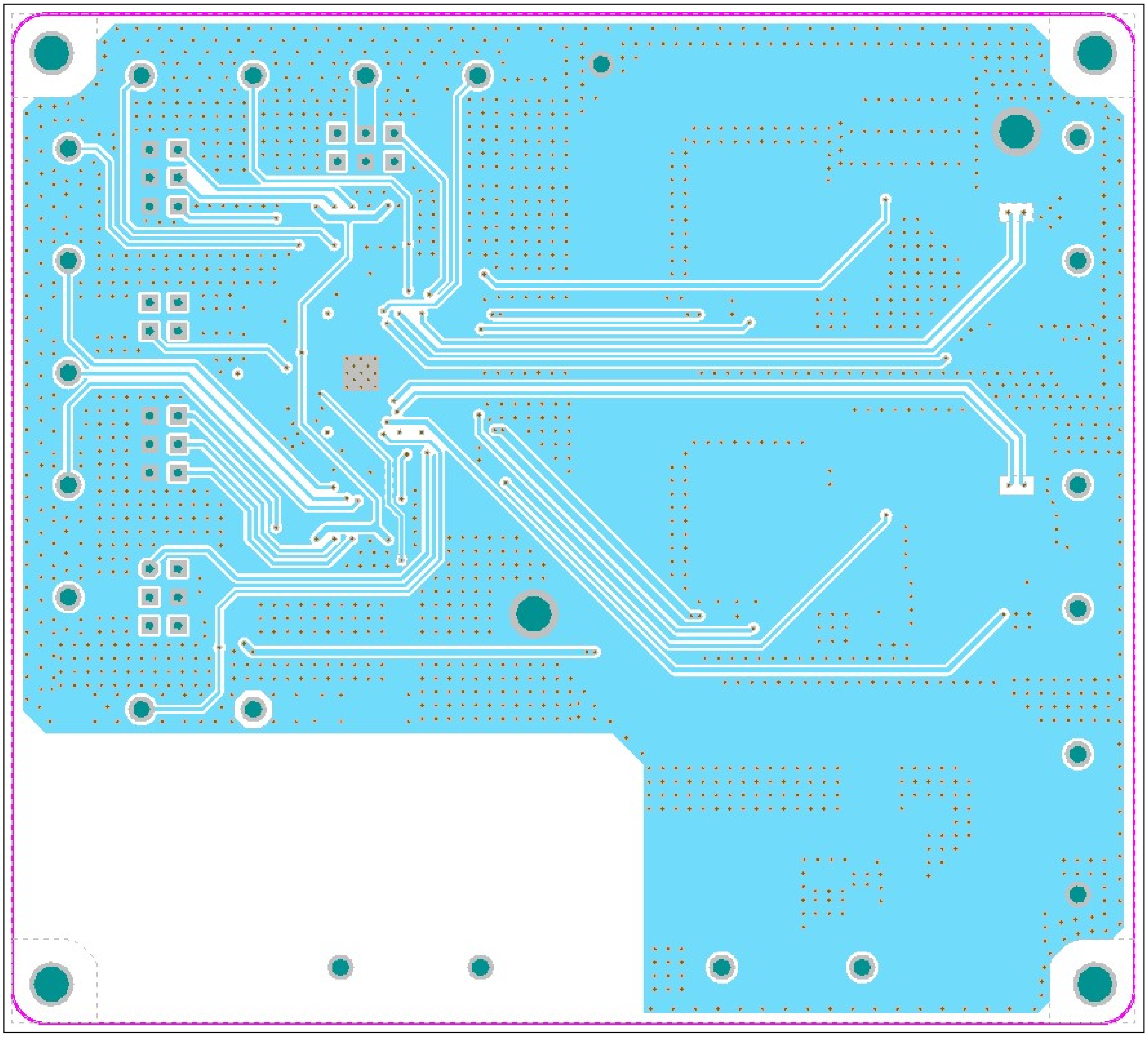

Figure 7 Board Middle Signal Layer 3

PCB LAYOUT (SIZE: 100 × 90 mm, FR-4, 4 LAYERS, 1OZ COPPER) (CONTINUED)

Caution: Since the PCB layout is very critical for the EMI performance, please follow this PCB layout's components placement and trace routing for better EMI performance. If need, please contact Lumissil to acquire the PCB layout files/application note for your PCB layout reference

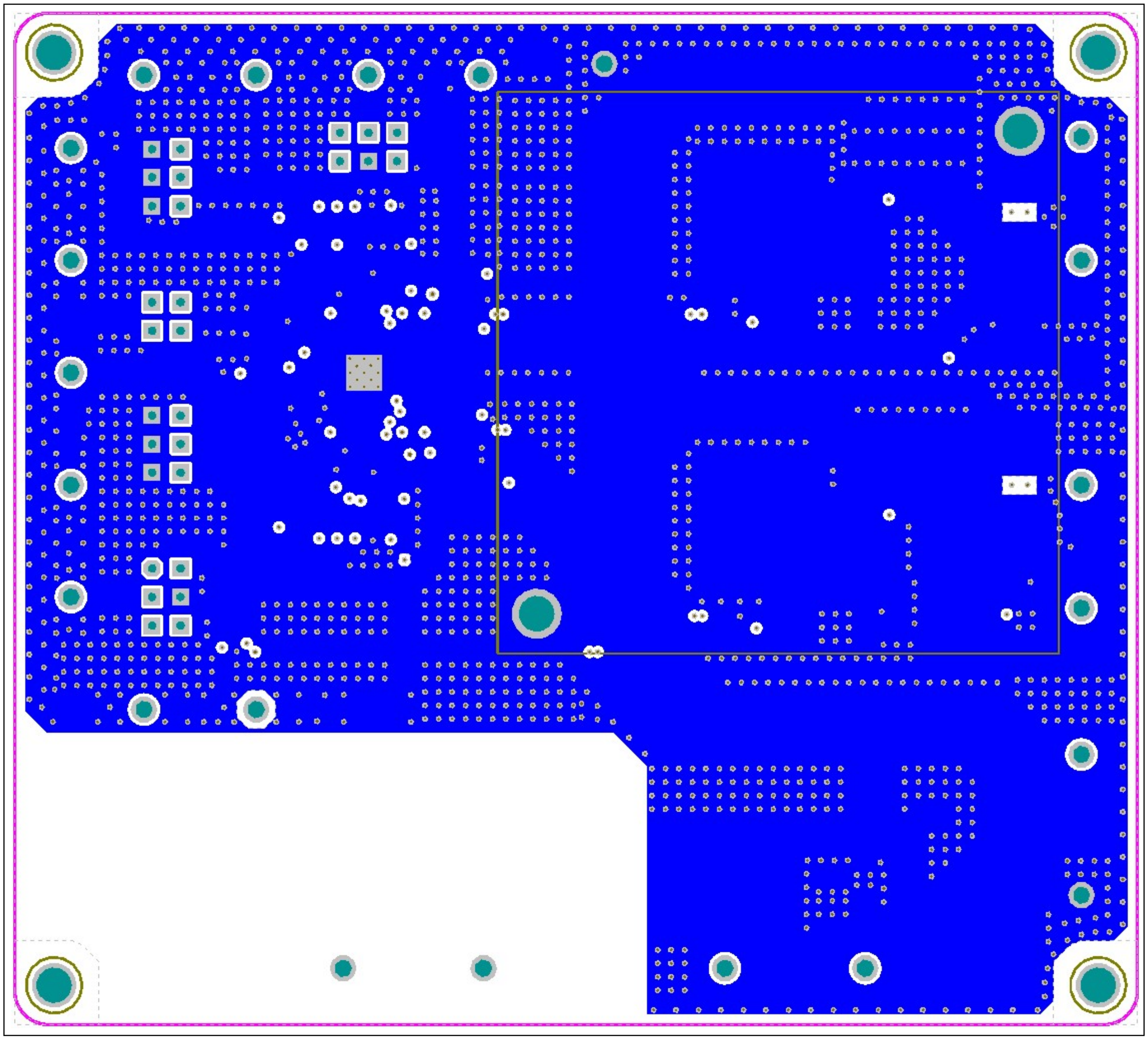

Figure 8 Board Bottom GND Layer 4

CONDUCTED EMI PERFORMANCE

Test condition: V_{IN}= 12V, CH1: V_{LED}= 30V, I_{LED}= 0.75A, CH2: V_{LED}= 30V, I_{LED}= 1A, naked board without any shielding.

Test standard: CISPR-25 Class 5 and Class 4 conducted EMI (Blue: Peak scanning, Red: Average scanning).

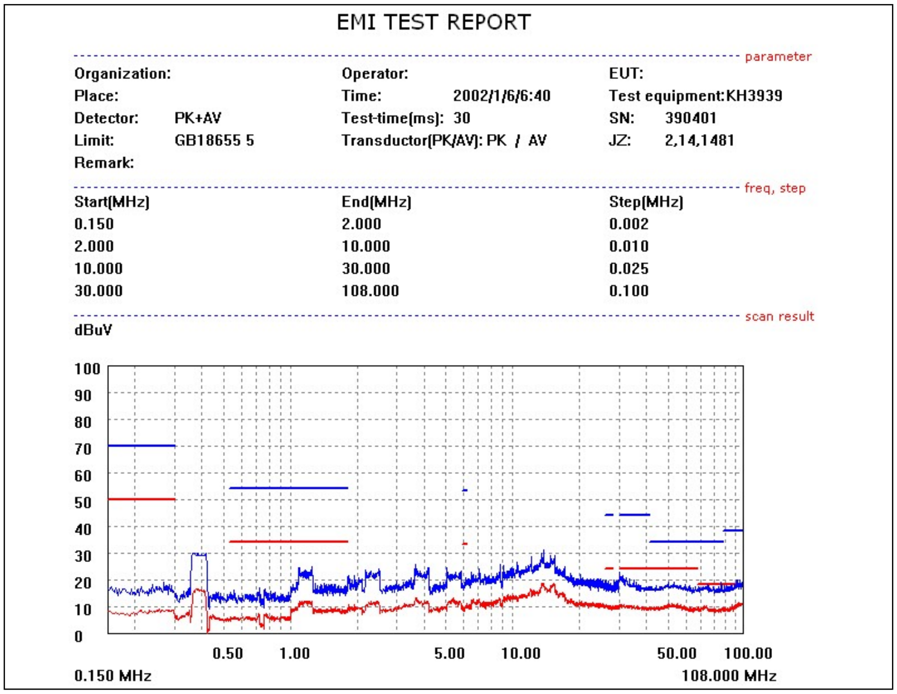

Figure 9 CISPR-25 Class 5 Conducted EMI Scan (Input in TP1 and TP2, with the input common mode choke)

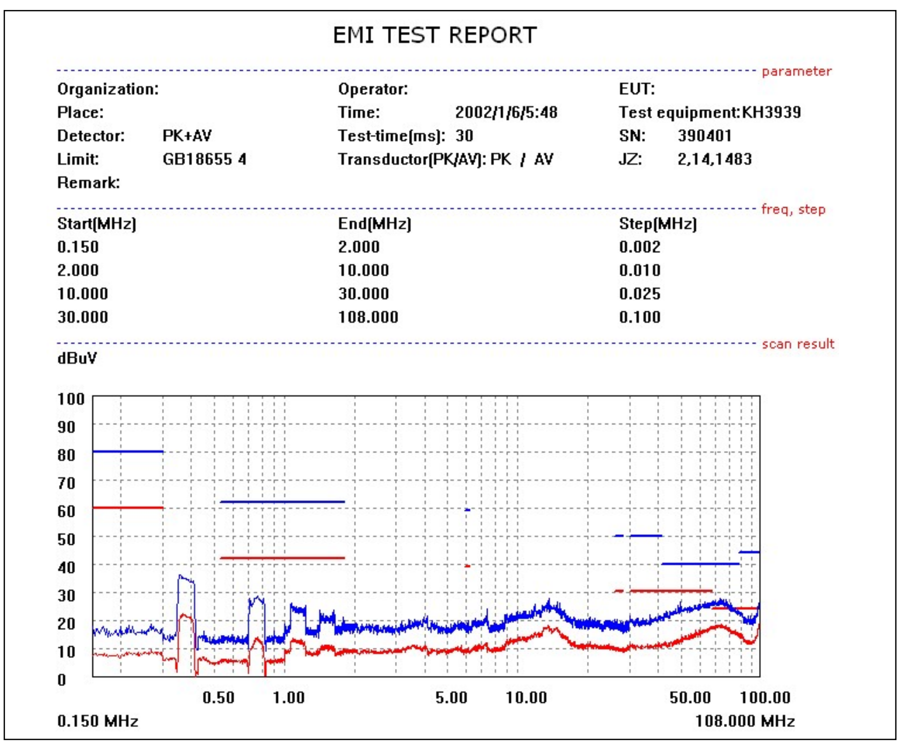

Figure 10 CISPR-25 Class 4 Conducted EMI Scan (Input in TP8 and TP9, without the input common mode choke)

CONDUCTED EMI PERFORMANCE (CONTINUED)

Test condition: V_{IN}= 12V, CH1: V_{LED}= 30V, I_{LED}= 0.75A, CH2: V_{LED}= 30V, I_{LED}= 1A, naked board without any shielding.

Test standard: CISPR-25 Class 3 conducted EMI (Blue: Peak scanning, Red: Average scanning).

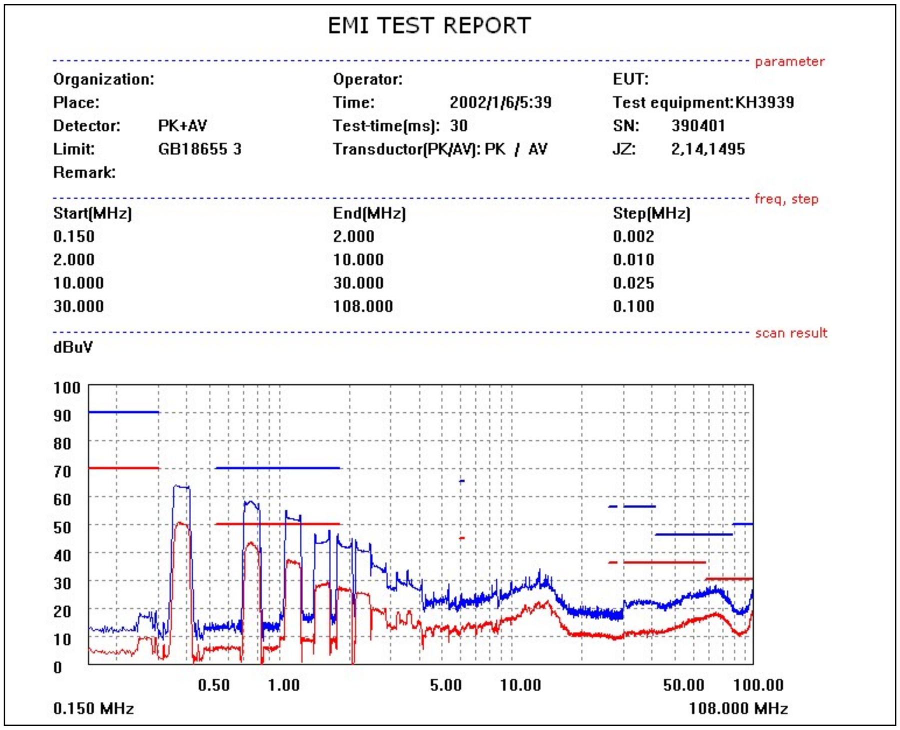

Figure 11 CISPR-25 Class 3 Conducted EMI Scan (Input in TP3 and TP4, without the input common mode choke and inductor choke)

EFFICIENCY AND LINE REGULATION

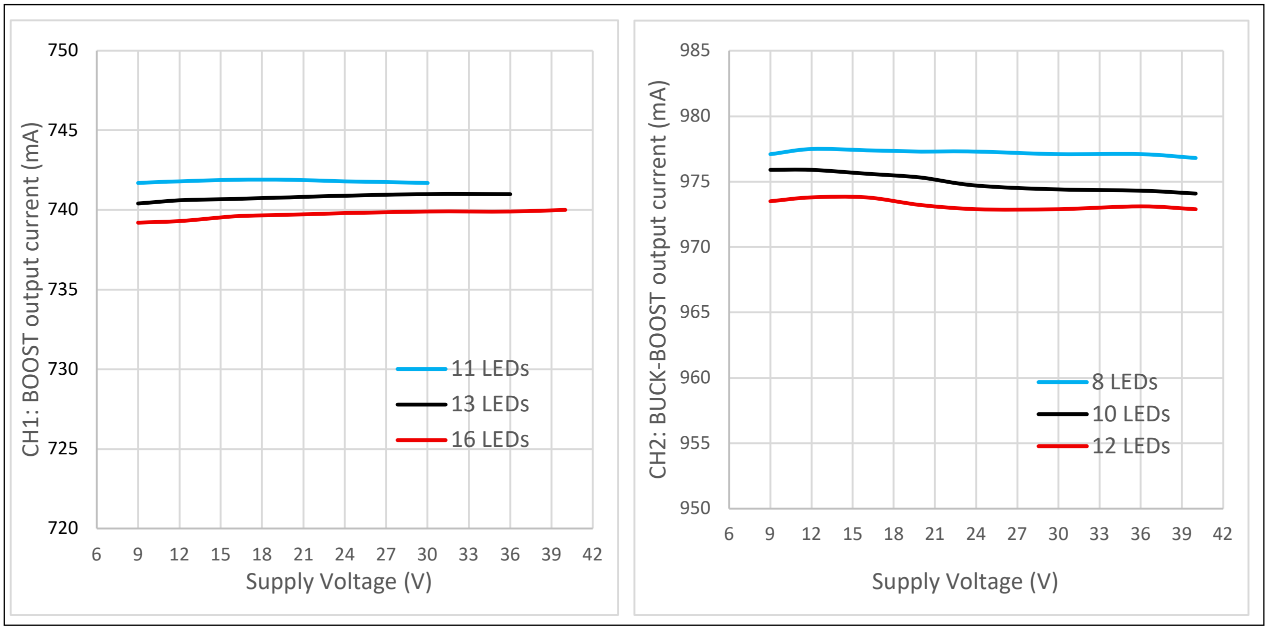

Figure 12 Line Regulation

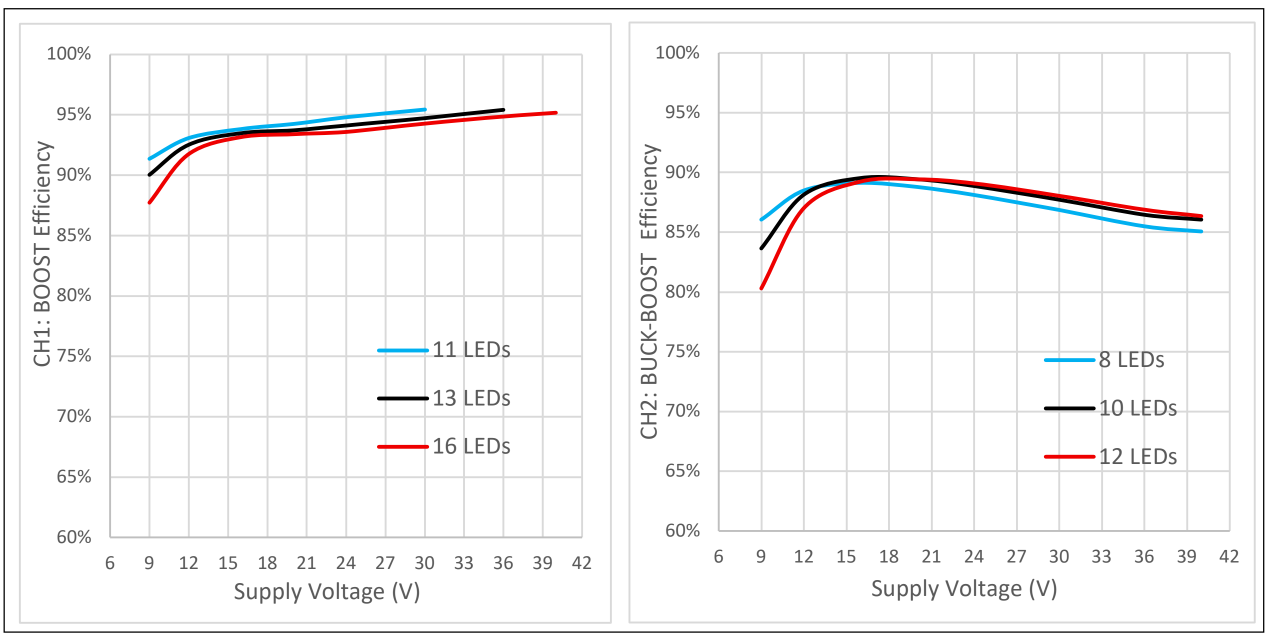

Figure 13 Efficiency vs. V_{IN}

REVISION HISTORY

Revision	Detail Information	Data
A	Initial release	2026.05.22