

Design Guide

NO.ED-284-160713

TYPICAL APPLICATION

R1204xxxxA/D/G/H

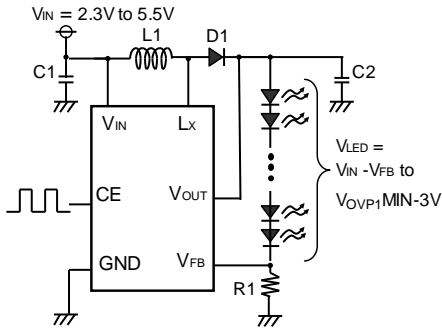


Figure 1.

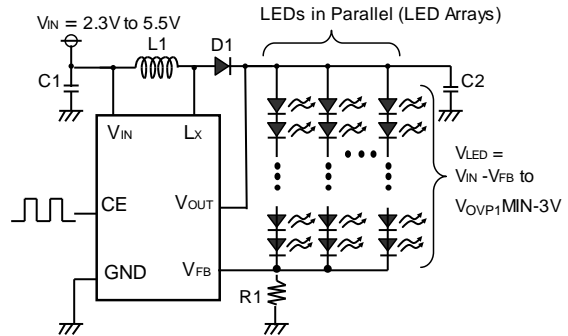


Figure 2.

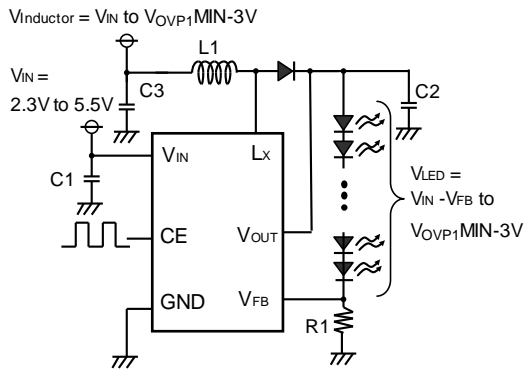


Figure 3.

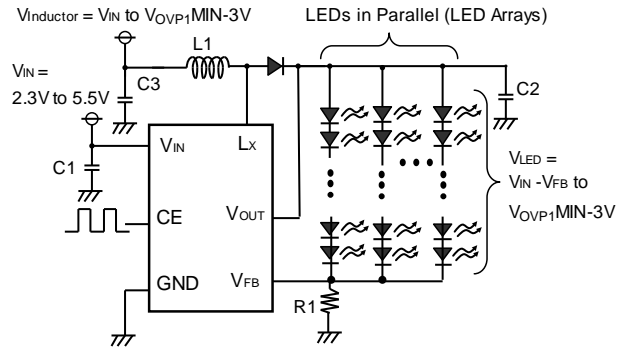


Figure 4.

R1204xxxxB/C/E/F

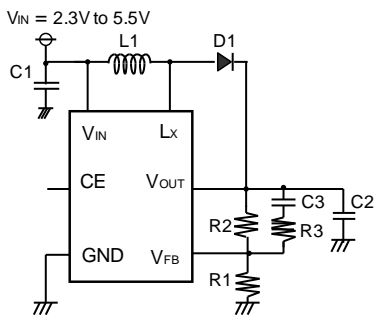


Figure 5.

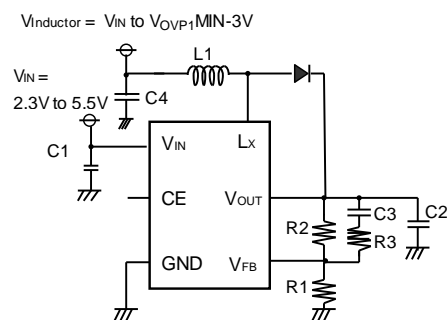


Figure 6.

R1204x Series

NO.ED-284-160713

Inductor Selection

Peak current of inductor (ILmax) in normal mode when the efficiency is 80% can be calculated by the following formula.

$$IL_{max} = 1.25 \times I_{LED} \times V_{OUT} / V_{IN} + 0.5 \times V_{IN} \times (V_{OUT} - V_{IN}) / (L1 \times V_{OUT} \times f_{osc})$$

- When starting up the IC or when adjusting the brightness of LEDs, a large transient current may flow into an inductor (L1).
- ILmax should be equal or smaller than the current limit of the IC.
- When deciding the rated current of inductor, ILmax should be considered.
- It is recommended that L1 with 10 µH to 22 µH be used.

Table 1. Peak Current Values for VIN, VOUT, IOUT, and L1

VIN (V)	VOUT (V)	IOUT (mA)	L1 (µH)	ILmax (mA)
3	21	20	10	280
3	21	20	22	225
3	30	20	10	365
3	30	20	22	305

Table 2. Recommended Inductors

L1 (µH)	Parts No.	Rated Current (mA)	Size (mm)	Versions
10	VLS252010ET-100M	550	2.5 × 2.0 × 1.0	R1204xxxxA/B/C/G
10	VLF302512MT-100M	620	3.0 × 2.5 × 1.2	
10	VLF403212MT-100M	900	4.0 × 3.2 × 1.2	
22	VLF302512MT-220M	430	3.0 × 2.5 × 1.2	R1204xxxxD/E/F/H
22	VLF403212MT-220M	540	4.0 × 3.2 × 1.2	
22	VLF504012MT-220M	800	5.0 × 4.0 × 1.2	

Capacitor Selection

- Place a 1 µF or more bypass capacitor (C1) as close as possible to the VIN and GND pins

[R1204xxxxA/D/G/H]

- Place a 1 µF or more output capacitor (C2) as close as possible to the VOUT and GND pins.
- In the case of operating the inductor using a separated power supply from the IC, place a 1 µF or more bypass capacitor (C3) as close as possible to Vinductor and the GND pin.
- When driving 4 to 5 LEDs, C2 should be 25 V or more.
- When driving 6 to 10 LEDs, C2 should be 50 V or more.

[R1204xxxxB/C/E/F]

- Place 1 µF to 10 µF C2 as close as possible to the VOUT and GND pins.
- In the case of operating the inductor using a separated power supply from the IC, place a 1 µF or more bypass capacitor (C4) as close as possible to Vinductor and the GND pin.

SBD (Schottky Barrier Diode) Selection

- Choose a diode that has low VF, low reverse current IR, and low capacitance.
- SBD is an ideal type of diode for R1204x Series since it has low VF, low reverse current IR, and low capacitance.

Table 3. Recommended Components for R1204xxxxA/D/G/H

Symbol	Rated Voltage (V)	Parts No.
D1	60	CRS12
C1	6.3	CM105B105K06
C2	50	C2012X5R1H105K
		C2012X5R1H225K (R1204xxxxG/H: I _{LED} > 22 mA)
C3	16	C2012X5R1C105K

Symbol	R1204x	Values
R1	R1204xxxxA/D	(10/ LED Arrays* ¹ (Ω))
	R1204xxxxG/H	(20/ LED Arrays* ¹ (Ω))

*¹ LED Arrays indicate the number of parallel LEDs in series.

Table 4. Recommended Components for R1204xxxxB/C/E/F

Symbol	Rated Voltage (V)	Parts No.
D1	60	CRS12
C1	6.3	CM105B105K06
C2	16	C2012X5R1C475K
	25	C2012X5R1E105K
	50	C2012X5R1H105K
C4	16	C2012X5R1C105K

Table 5. Recommended Component Values for R1204xxxxB/C/E/F

V _{SET} (V)	7 < V _{SET} ≤ 10	10 < V _{SET} ≤ 25	25 < V _{SET}
R1 (kΩ)	10	10	10
R2 (kΩ)	(V _{SET} - 1) x R1	(V _{SET} - 1) x R1	(V _{SET} - 1) x R1
R3 (Ω)	0	0	0
C1 (μF)	1.0	1.0	1.0
C2 (μF)	4.7	1.0 × 2	1.0
C3 (pF)	10	10	10
C4 (μF)	1.0	1.0	1.0

PCB LAYOUT CONSIDERATIONS

Current Paths on PCB

Figure 7 and Figure 8 show flows of current paths of the application circuits when MOSFET is ON and when MOSFET is OFF, respectively.

- Parasitic elements (impedance, inductance or capacitance) in the paths pointed with red arrows in Figure 7 and Figure 8 influence stability of the system and cause noise outbreak. It is recommended that these parasitic elements be minimized.
- In addition, except for the paths of LED load, it is recommended that the all wirings of the current paths be made as short and wide as possible.

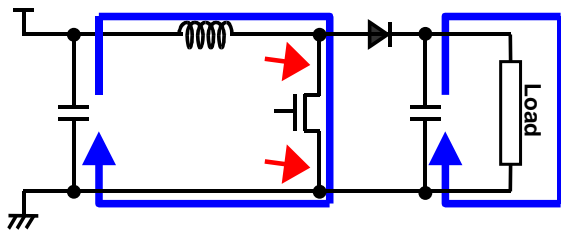


Figure 7. MOSFET-ON

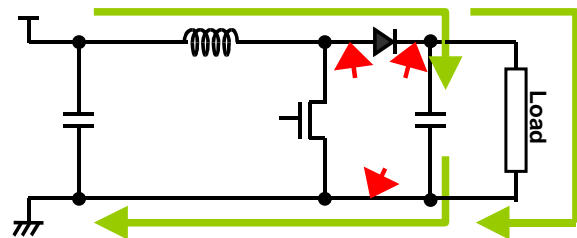


Figure 8. MOSFET-OFF

PCB Layout Recommendation

- Place C1 as close as possible to the V_{IN} and GND pins. Also, connect the GND pin to the wider GND plane.
- Make the L_x land pattern as small as possible.
- Make the wirings between the L_x pin, the inductor and the diode as short as possible. Also, connect C2 as close as possible to the cathode of the diode.
- Place C2 as close as possible to the GND pin.

Typical PCB Layout

PKG: DFN(PLP)1820-6pin

R1204Kxx2A/D/G/H

Figure 9. Typical Board Layout - Topside

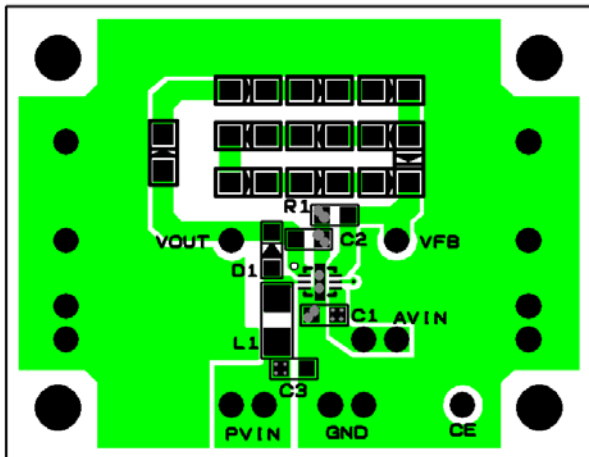
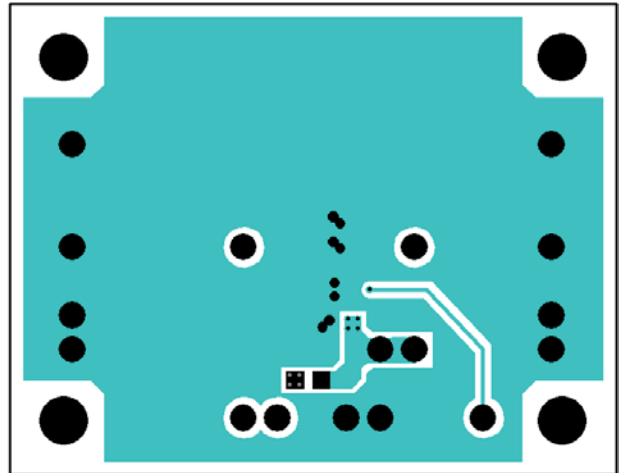


Figure 10. Typical Board Layout - Backside



R1204Kxx2B/C/E/F

Figure 11. Typical Board Layout - Topside

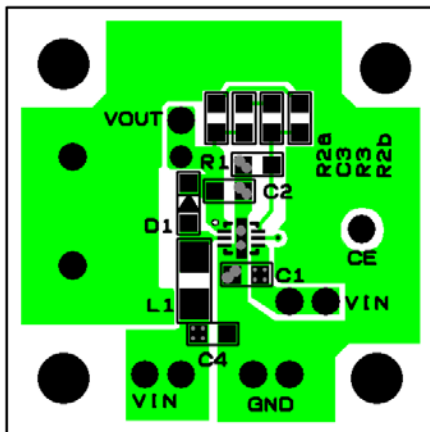
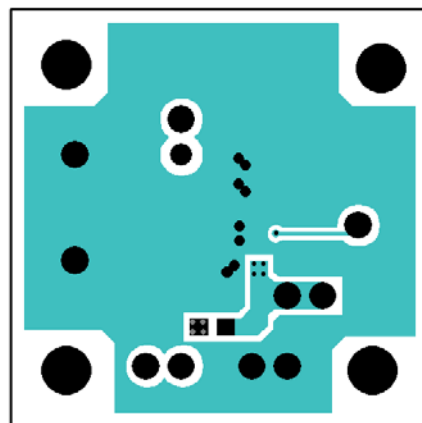


Figure 12. Typical Board Layout - Backside



R1204x Series

NO.ED-284-160713

PKG: TSOT-23-6pin

R1204Nxx3A/D/G/H

Figure 13. Typical Board Layout - Topside

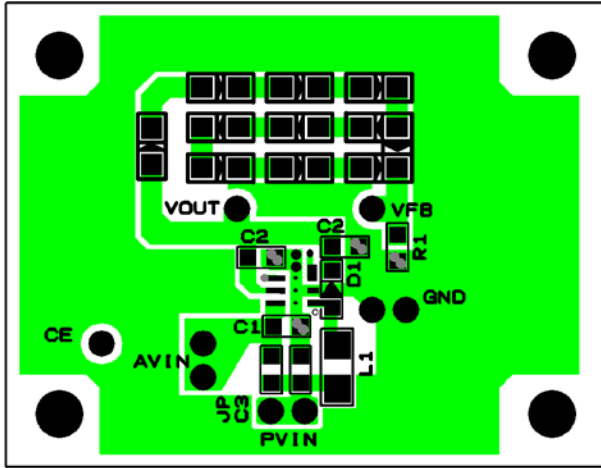
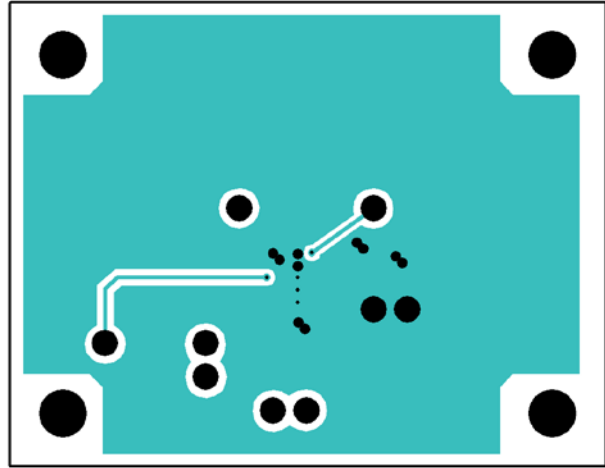


Figure 14. Typical Board Layout - Backside



R1204Nxx3B/C/E/F

Figure 15. Typical Board Layout - Topside

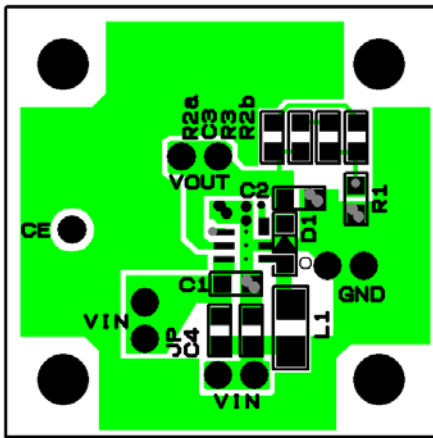
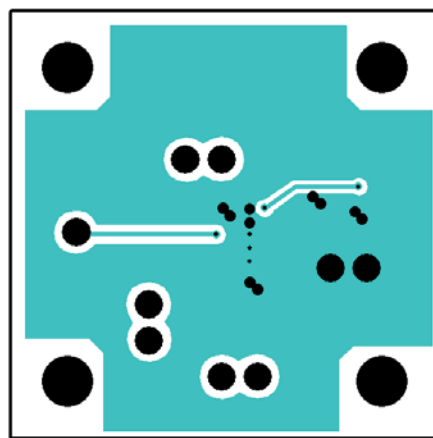


Figure 16. Typical Board Layout - Backside





1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to Ricoh sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without prior written consent of Ricoh.
3. Please be sure to take any necessary formalities under relevant laws or regulations before exporting or otherwise taking out of your country the products or the technical information described herein.
4. The technical information described in this document shows typical characteristics of and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under Ricoh's or any third party's intellectual property rights or any other rights.
5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death (aircraft, spacevehicle, nuclear reactor control system, traffic control system, automotive and transportation equipment, combustion equipment, safety devices, life support system etc.) should first contact us.
6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. Anti-radiation design is not implemented in the products described in this document.
8. Please contact Ricoh sales representatives should you have any questions or comments concerning the products or the technical information.



Ricoh is committed to reducing the environmental loading materials in electrical devices with a view to contributing to the protection of human health and the environment.

Ricoh has been providing RoHS compliant products since April 1, 2006 and Halogen-free products since April 1, 2012.

RICOH RICOH ELECTRONIC DEVICES CO., LTD.

<http://www.e-devices.ricoh.co.jp/en/>

Sales & Support Offices

RICOH ELECTRONIC DEVICES CO., LTD.

Higashi-Shinagawa Office (International Sales)
3-32-3, Higashi-Shinagawa, Shinagawa-ku, Tokyo 140-8655, Japan
Phone: +81-3-5479-2857 Fax: +81-3-5479-0502

RICOH EUROPE (NETHERLANDS) B.V.

Semiconductor Support Centre
Prof. W.H. Keesomlaan 1, 1183 DJ Amstelveen, The Netherlands
Phone: +31-20-5474-309

RICOH INTERNATIONAL B.V. - German Branch

Semiconductor Sales and Support Centre
Oberrather Strasse 6, 40472 Düsseldorf, Germany
Phone: +49-211-6546-0

RICOH ELECTRONIC DEVICES KOREA CO., LTD.

3F, Haesung Bldg, 504, Teheran-ro, Gangnam-gu, Seoul, 135-725, Korea
Phone: +82-2-2135-5700 Fax: +82-2-2051-5713

RICOH ELECTRONIC DEVICES SHANGHAI CO., LTD.

Room 403, No.2 Building, No.690 Bibo Road, Pu Dong New District, Shanghai 201203, People's Republic of China
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

RICOH ELECTRONIC DEVICES CO., LTD.

Taipei office
Room 109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623