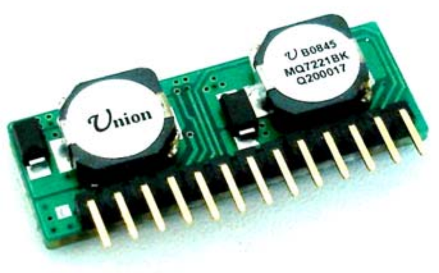
Micro-BiTarzan™ MQ7221BK
4.5~20V Wide input, 0.95~5.5V Output, Dual 3A output, DC-DC Converter



Features

- Wide Operating Voltage: 4.5V ~ 20V
- Dual independent input ends
- Non-isolated
- Output Voltage: 0.95V ~ 5.5V
- Output Current Up to 3A for each channel
- Low output voltage ripple 50mVpp
- Overcurrent / shortcircuit protection
- Remote Control – Positive Logic
- Minimal space on PCB:
  - 38.1 mm x 14.2 mm x 7.2mm or
  - 1.5 in x 0.56 in x 0.28 in
- No derating to +55℃, natural convection
- UL/IEC/EN60950 compliant
- RoHS Compliant

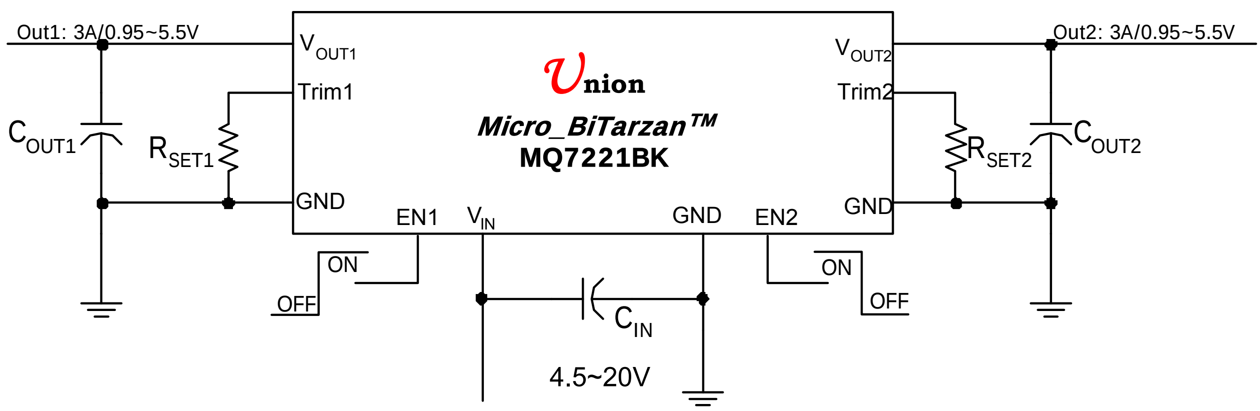
Applications

- Workstations, servers
- Desktop computers
- DSP applications
- Distributed power architectures
- Telecommunications equipment
- Data communications equipment
- Wireless communications equipment

Description

The ***Micro-BiTarzan™*** MQ7221BK Power Modules are non-isolated dc-dc converters that operate over a wide input voltage range of 4.5Vdc to 20Vdc and provide a precisely (2%) regulated dc output. Such a module is suitable to applications with unregulated 12V power supply bus or low-cost ac-wall adapter, which have two and more lower voltages with each current not too high. The modules have a maximum output current rating of 3A for each output at a typical full-load efficiency over 91%. Standard features include remote on/off with positive logic and output voltage wide trim, over-current protection etc。

************************************ ***Typical Application Circuit*** ********************************

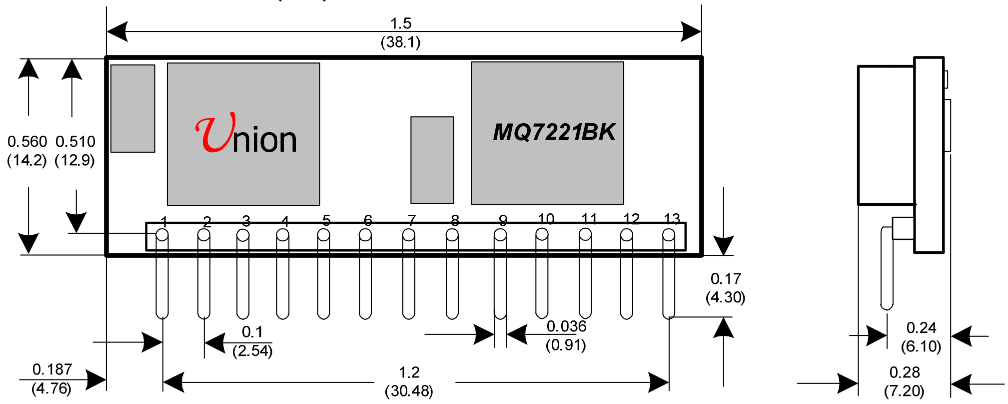


Performance Specifications (at TA=+25℃)

Model	Input V_{IN} Range (V)	Output				Efficiency (%)
		I_{OUT} (A)	Trim Range (V)	Regulation		
				Line (%)	**Load** (%)	
MQ7221BK	4.5~20	3	0.95V~5.5V	4	4	91

Mechanical Specifications

Dimensions are in inches (mm)



PIN	DESCRIPTION
1/6	Vin1/Vin2*
2/7	GND
3/8	Vout1/Vout2
4/9	EN1/EN2
5/10	Trim1/Trim2
11,12,13	N/A

Note: * Vin1, Vin2 are not connected each other internal.

Ordering Information

MQ7221BKG-R

Union PartNumber — MQ7221BK

Input Voltage:4.5~20V — G

Right Angle Pin — R

RoHS Compliant — G

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Union Microsystems,Shanghai
Tel: *+86 21 5109 5021*
Fax: *+86 21 5106 2878*
sales@union-pwr.com
www.union-pwr.com

MQ7221BK Absolute Maximum Ratings

Note: These are stress ratings. Exposure of devices to any of these conditions may adversely affect long-term reliability. Proper operation under conditions other than those listed in the Performance Specifications Table is not implied.

Parameter	Symbol	Min	Max	Unit
Input Voltage	V_{IN}	-0.3	23	V
Storage Temperature	T_{STG}	-40	125	℃

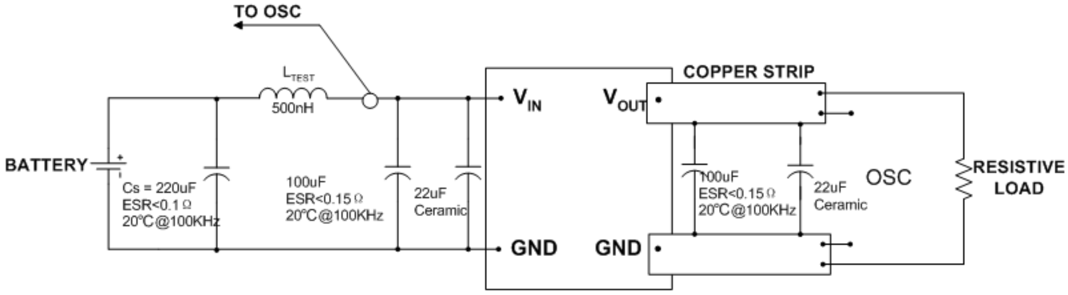
MQ7221BK Electrical Specifications: *(T_A=+25°C, input voltage 12V,unless otherwise noted)*

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Input Voltage Range		V_{IN}	4.5		20	V
Output Current		Io	0		3	A
Output Voltage Set point	100% load	Δ Vo	-4		+4	%
Temperature Regulation	T_A= $T_{A.MIN}$ To $T_{A.MAX}$	-		0.4		$\%V_{O.SET}$
Output Trim Range	***See Performance Specifications (TBD)***					
Line Regulation						
Load Regulation						
Output Ripple and Noise Voltage	***Io=3A,0~20MHz (Detail Please see Ripple Figures, TBD)***					
Transient Response						

General Specifications

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Maximum Capacitive Load	100% resistive load + Aluminum capacitor			10000		μF
	100% resistive load +Sanyo POSCAP			1000		
Over-current Protection	4.5~20V input		3.8		5.2	A
Output short-circuit current	All	Auto-Reset				
Under Voltage Lockout Trip Level	Rising V_{IN}			4.5		V
	Falling V_{IN}			4.2		
Logic High (Module ON)		V_{IH}		2.5	Vin+0.7	V
Logic Low (Module OFF)		V_{IL}	-0.7		0.3	V
Start-up Time	100% resistive load, no external output capacitors			15		mS
Switching Frequency		Fo		340		kHz
Operating Temperature	Natural convection, no forced air flow		-40		85	℃
Vibration	3 Axes, 5 Min Each	10~55Hz，0.35mm，5g				
	3 Axes, 6 Times Each	Peak Deviation 300g，Settling Time 6mS				
MTBF		2,000,000				Hour

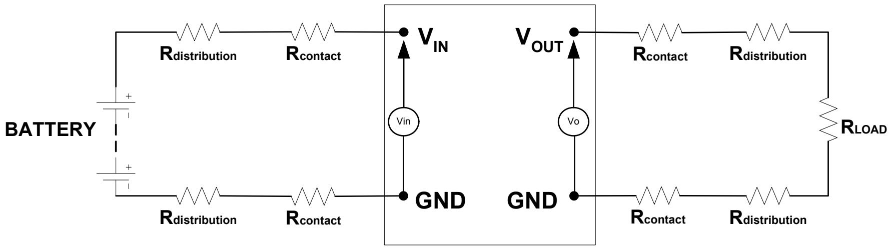
Test Configurations



Test setup for input noise, output noise and ripple

Note:

Output noise is measured with 0.1μ F ceramic capacitor connected at the output. OSC measurement should be made using a BNC socket.



Test setup for efficiency

Note:

All voltage measurements must be taken at the module's terminals, as shown above. If sockets are needed, Kelvin connections are required at the module terminals to avoid measurement errors due to socket contact resistance.

Technical Notes

Input Voltage Range

The MQ7221BK Series can be used in a wide variety of applications, like most of unregulated 12V intermediate power supply bus system or low-cost ac-wall adapter. Its wide input voltage ranges can tolerate worst voltage drop from cheap isolated Brick-type Bus-converter, so it reduces total system cost on power supply. Because of its input is wide from 4.5V to 20V, so the change of power rail between them will not lead to any design changes, this simplifies engineer's load.

Input Ends

MQ72221BK power modules have two independently input ends, which are not connected internal. For single input rail system, they must be connected to input respectively. For dual input rails systems, for example 5V and 12V, each input ends can be connected different input 5V, that adds flexibility for system designers.

Return Current Paths

The MQ7221BK Series is non-isolated DC/DC converters. To the extent possible with the intent of minimizing ground loops, input and output return current should be directed through pin GND as short as possible.

I/O Filtering

All the specifications of the MQ7221BK Series are tested and specified without output capacitors. However, certain input capacitors are necessary to improve the power modules' operating conditions and to reduce the ac impedance. For example, under some conditions, the power modules can't normally start up when fully loaded due to the high ac-impedance input source. External input capacitors serve primarily as energy-storage devices. They should be added close to the input pins of the MQ7221BK and selected for bulk capacitance (at appropriate frequencies), low ESR, and high rms-ripple-current ratings. All external capacitors

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Union Microsystems,Shanghai
Tel: *+86 21 5109 5021*
Fax: *+86 21 5106 2878*
sales@union-pwr.com
www.union-pwr.com

should have appropriate voltage ratings. To reduce the amount of ripple current fed back to the input supply (input reflected-ripple current), an external L-C filter can be added with the inductance as close to the power module as possible.

MQ7221BK's output ripple and transient response can be improved with the increasing output capacitance. When using output capacitors, take care that the total output capacitance does not exceed MQ7221BK's Maximum Capacitive Load to avoid the module's protection condition in the start-up.

When an external L-C filter is added to reduce ripple on load, for best results, the filter components should be mounted close to the load circuit rather than the power module.

When testing the relationship between external capacitors and output voltage noise, the oscilloscope's probe should be applied to the module's end directly with scope probe ground less than 10mm in length。

Input Fusing

The MQ7221BK Series is not internally fused. Certain applications and/or safety agencies may require the installation of fuses at the inputs of power conversion components. The selection of the fuses should conform to the following：

1. The fuse value should be selected to be greater than the maximum input current of the module which occurs at the minimum input voltage.
2. Use either slow-blow or normal-blow fuses.
3. Both input traces must be capable of carrying a current of 1.5 times the value of the fuse without opening.

Safety Considerations

MQ7221BK's are non-isolated DC/DC converters. In general, all DC-DC's must be installed in compliance with relevant safety-agency specifications (usually UL/IEC/EN60950). In particular, for a non-isolated converter's output voltage to meet SELV (safety extra low voltage) requirements, its input must be SELV compliant. If the output needs to be ELV (extra low voltage), the input must be ELV.

ON/OFF Control

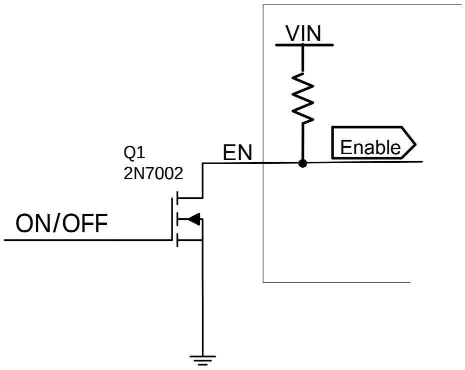

Fig1, Built-in Remote ON/OFF Control Logic Circuit

The MQ7221BK power modules feature an On/Off pin for remote On/Off operation with positive logic. If not using the remote On/Off pin, leave the pin open (module will be On). The On/Off pin signal (Von/Off) is referenced to ground. The two outputs can be controlled independently.

Output Overvoltage Protection

MQ7221BK Series products do not incorporate output overvoltage protection. If the operating circuit requires protection against abnormal output voltage, voltage-limiting circuitry must be provided external to the power module.

Output Overcurrent Protection (OCP)

MQ7221BK incorporates overcurrent and short circuit protection. If the load current exceeds the overcurrent protection setpoint, the MQ7221BK's internal overcurrent-protection circuitry goes into current-fold mode, this will keep a very low output voltage and a continuous 4.5A current. Once the overcurrent or short-circuit released, the module will be back normal operation status.

Caution：***Be careful never to operate MQ7221BK in a "heavy overload" condition that is between the rated output current and the overcurrent protection setpoint. This can cause permanent damage to the components.***

Output Voltage Trimming

MQ7221BK's output voltage can be trimmed in certain ranges. Figure2 shows the circuit used to program output voltage. See Performance Specifications for allowable trim ranges in detail. Also customized products are available.

Trim with external resistor (Fig2), the equation as below:

$$R_{TRIM} = \frac{2303.25}{V_O - 0.95} - 464$$

Resistor values are in Ω; V_O is desired output voltage.
For examples, to trim output to 1.5V, then

$$R_{TRIM} = \frac{2303.25}{1.5 - 0.95} - 464 = 3723.7 \approx 3740$$

So, R_{TRIM} = 3.74kΩ 1%

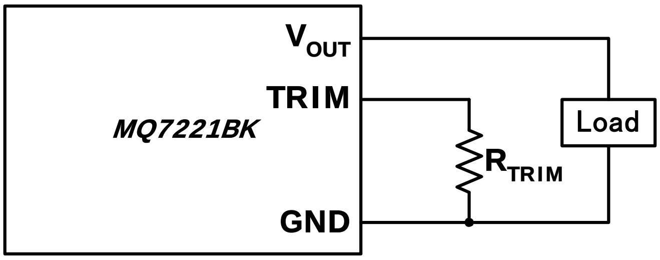

Fig2. Circuit configuration for programming output voltage using external resistor

For most common voltages, the required Trim resistors are as Table 1.

Table 1, the required trim resistors R_{TRIM} for most common voltages

Desired Voltages (V)	R_{TRIM} (kΩ)
0.95	OPEN
1.0	44.2
1.2	8.66
1.5	3.74
1.8	2.26
2.5	1.02
3.3	0.517
5.0	0.104

Union Microsystems,Shanghai
Tel: +86 21 5109 5021
Fax: +86 21 5106 2878
sales@union-pwr.com
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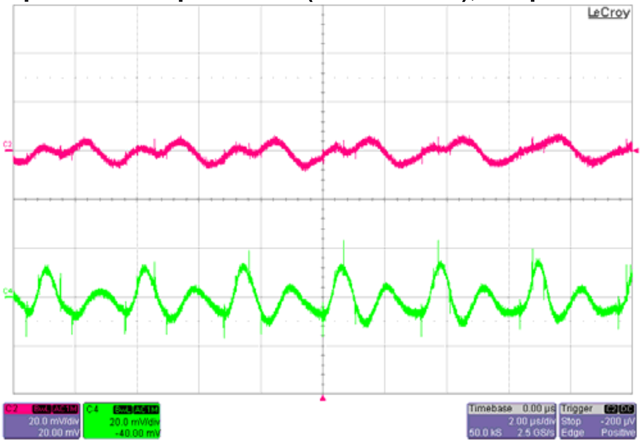
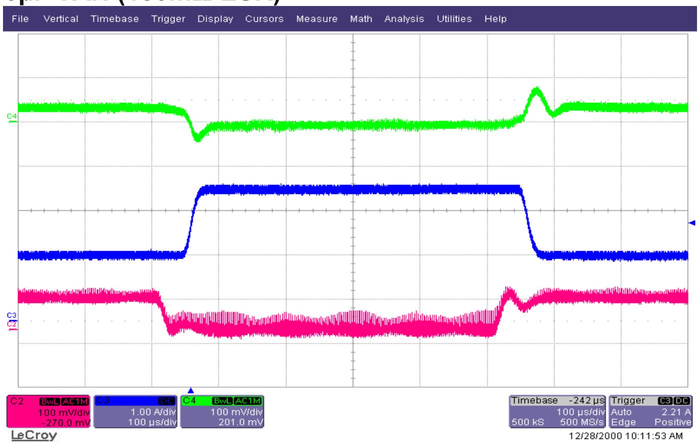
MQ7221BK Typical Characteristics – output adjusted to 0.95V

General conditions:

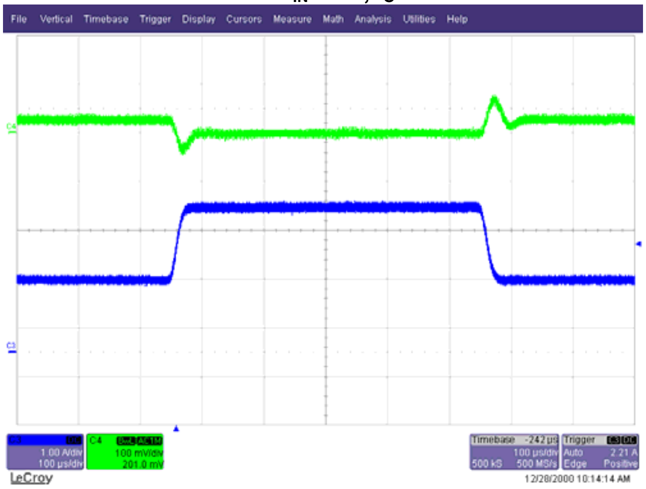
Input filter 100μFx2 TAN (150mΩ ESR), Output filter 100μF TAN (150mΩ ESR)



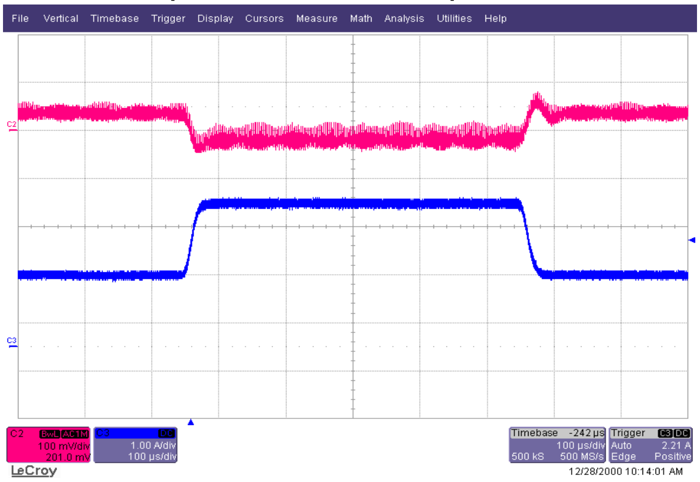
Noise V_{IN}=12V, I_O=3A



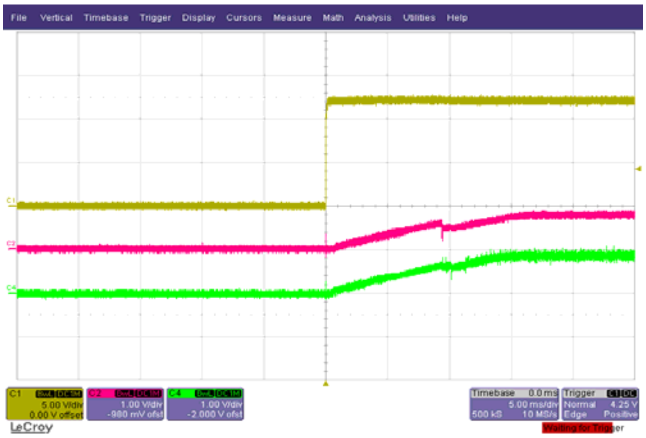
Transient Response V_{IN}=12V, I_O=3A Step from 1.5A~3A~1.5A



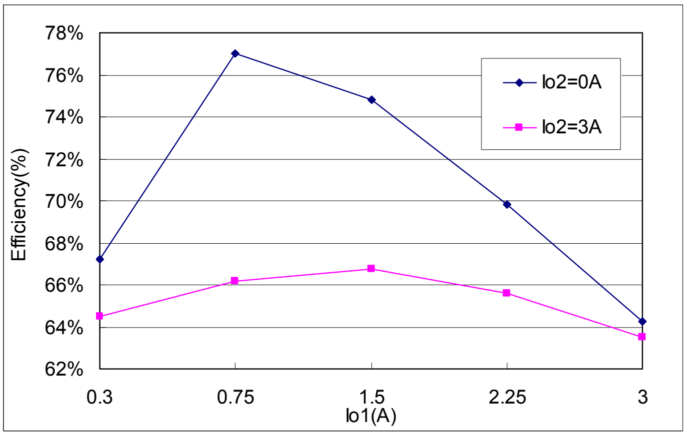
Transient Response V_{IN}=12V, I_O=3A Step from 1.5A~3A~1.5A(Vo1)



Transient Response V_{IN}=12V, I_O=3A Step from 1.5A~3A~1.5A(Vo2)



Start-up With V_{IN}=12V, I_O=3A



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Fax: *+86 21 5106 2878*
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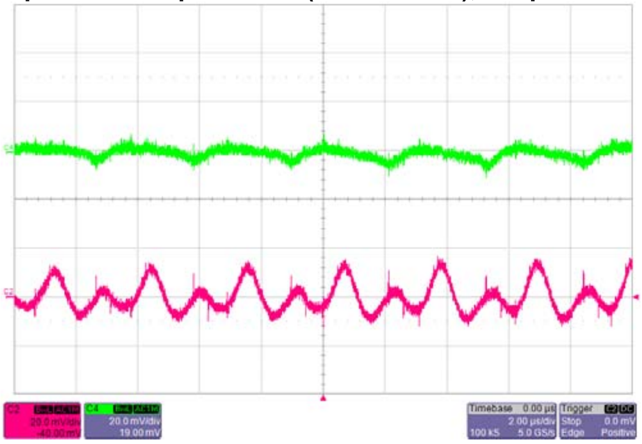
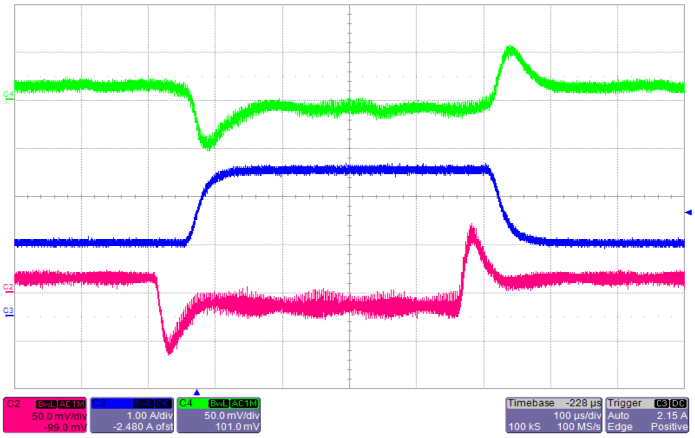
MQ7221BK Typical Characteristics – output adjusted to 1.5V

General conditions:

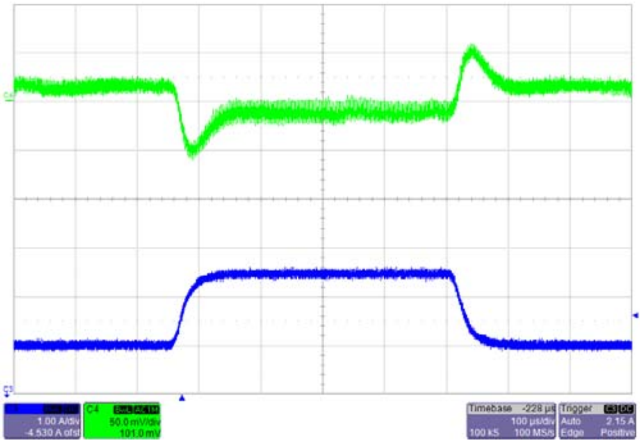
Input filter 100μFx2 TAN (150mΩ ESR), Output filter 100μF TAN (150mΩ ESR)



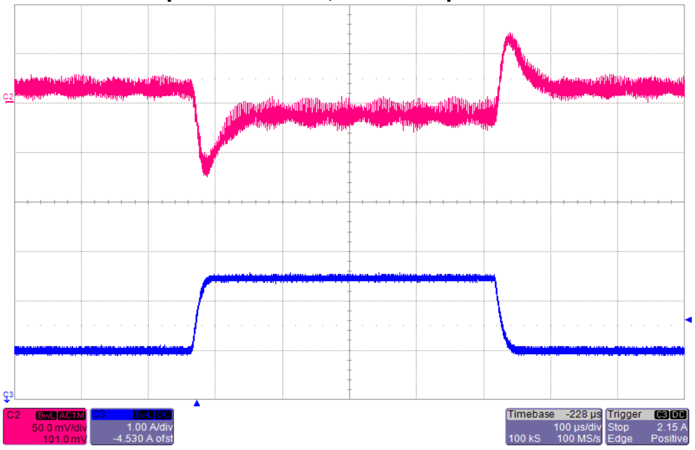
Noise V_{IN}=12V, I_O=3A



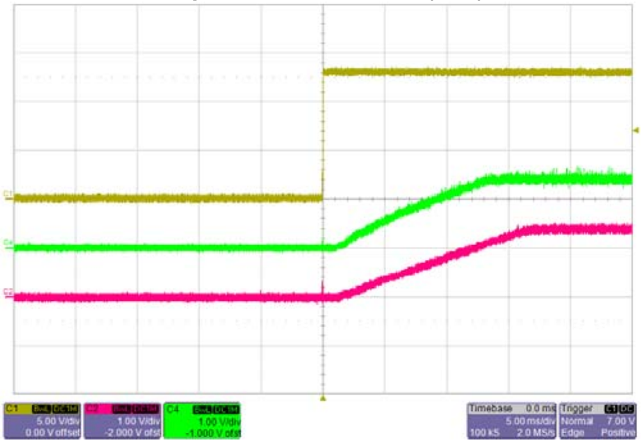
Transient Response V_{IN}=12V, I_O=3A Step from 1.5A~3A~1.5A



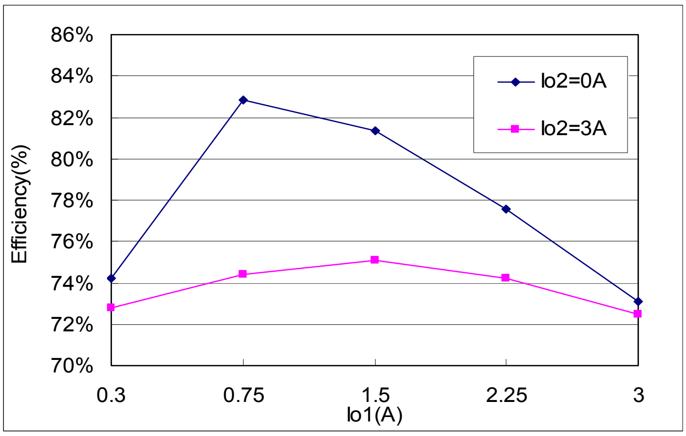
Transient Response V_{IN}=12V, I_O=3A
Step from 1.5A~3A~1.5A(Vo1)



Transient Response V_{IN}=12V, I_O=3A
Step from 1.5A~3A~1.5A(Vo2)



Start-up With V_{IN}=12V, I_O=3A



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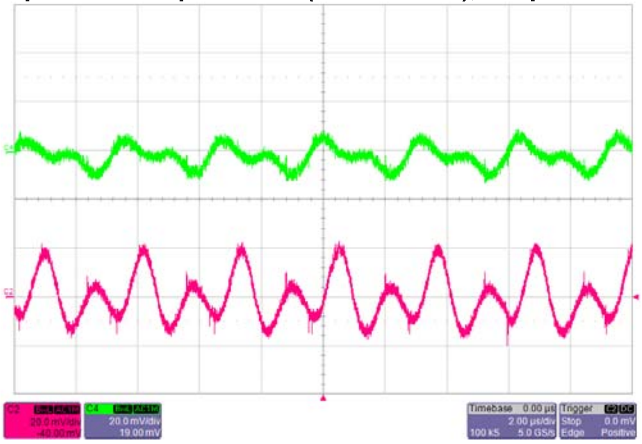
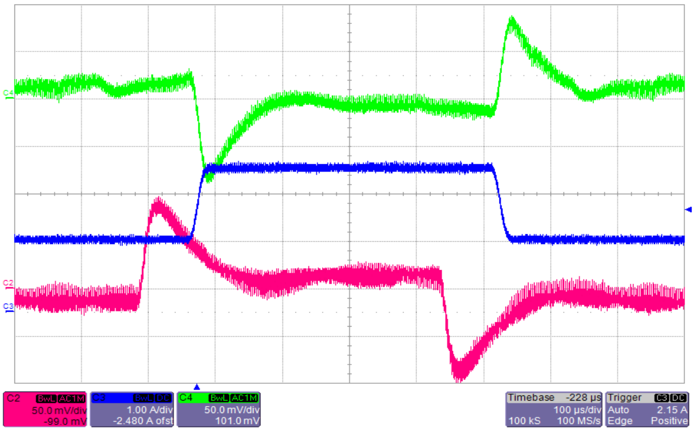
MQ7221BK Typical Characteristics – output adjusted to 3.3V

General conditions:

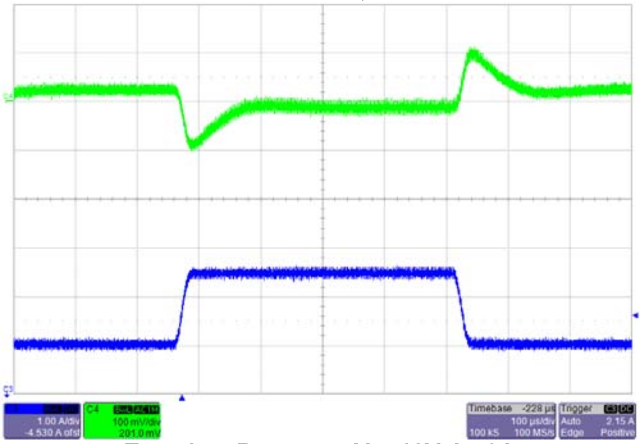
Input filter 100μFx2 TAN (150mΩ ESR), Output filter 100μF TAN (150mΩ ESR)



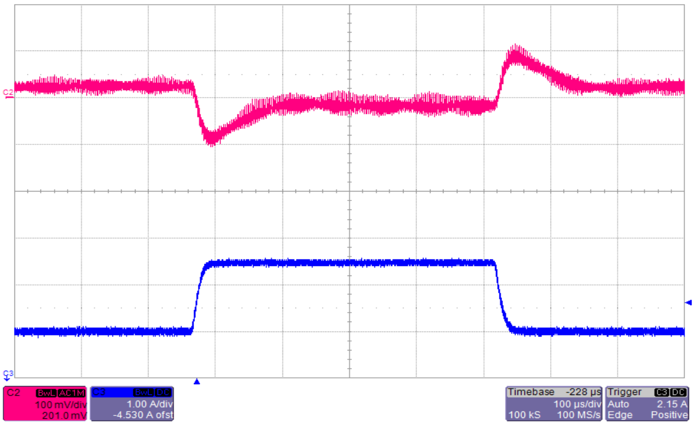
Noise V_{IN}=12V, I_O=3A



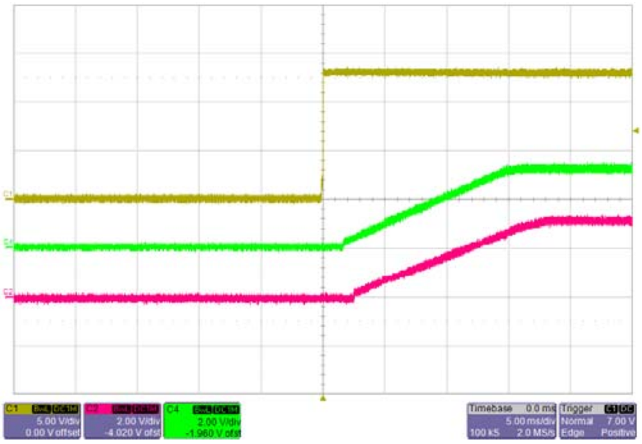
Transient Response V_{IN}=12V, I_O=3A Step from 1.5A~3A~1.5A



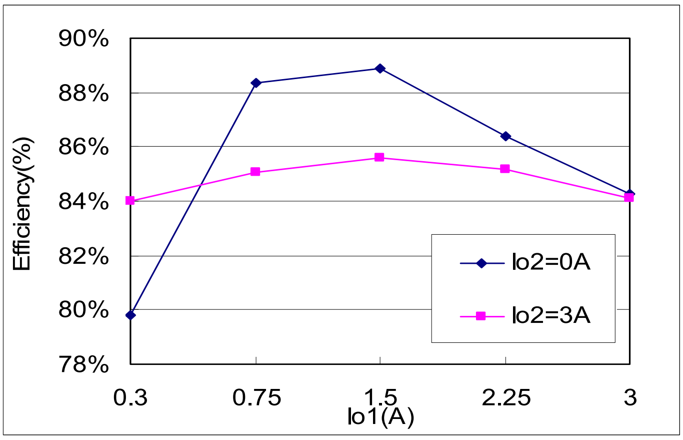
Transient Response V_{IN}=12V, I_O=3A Step from 1.5A~3A~1.5A(Vo1)



Transient Response V_{IN}=12V, I_O=3A Step from 1.5A~3A~1.5A(Vo2)



Start-up With V_{IN}=12V, I_O=3A



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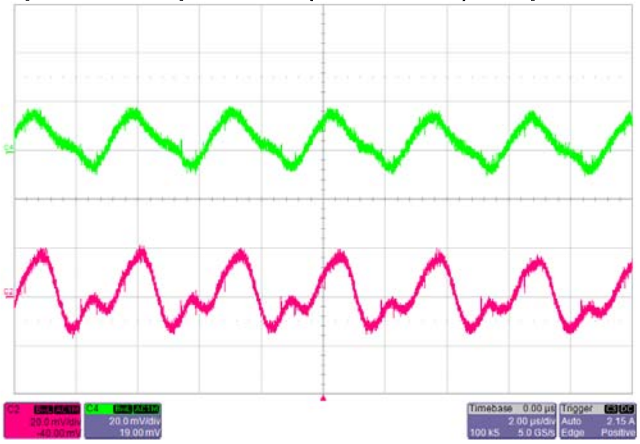
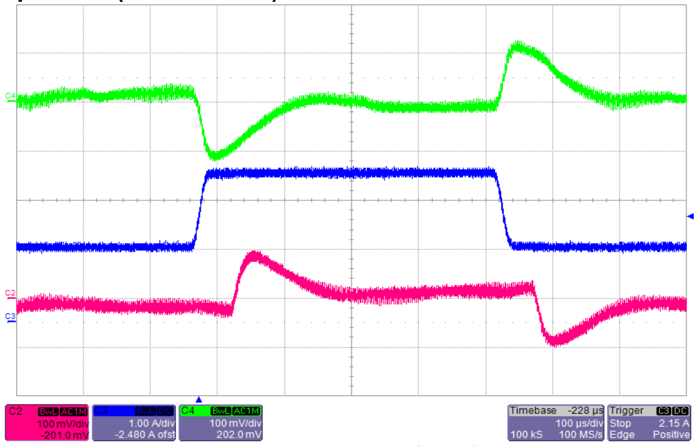
MQ7221BK Typical Characteristics – output adjusted to 5.0V

General conditions:

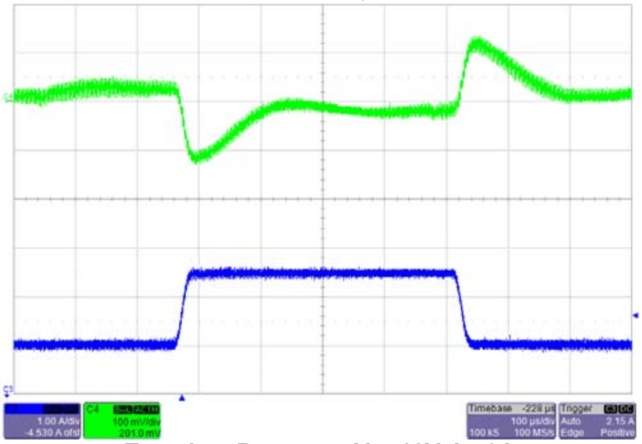
Input filter 100μFx2 TAN (150mΩ ESR), Output filter 100μF TAN (150mΩ ESR)



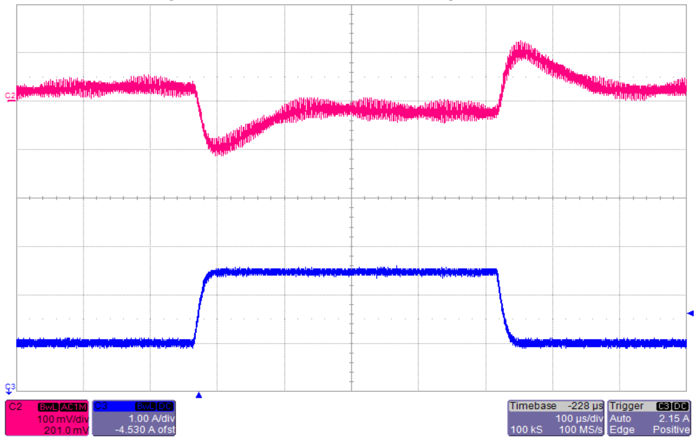
Noise V_{IN}=12V, I_O=3A



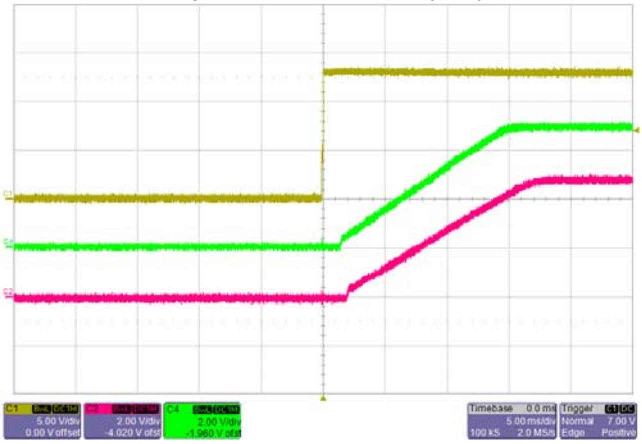
Transient Response V_{IN}=12V, I_O=3A Step from 1.5A~3A~1.5A



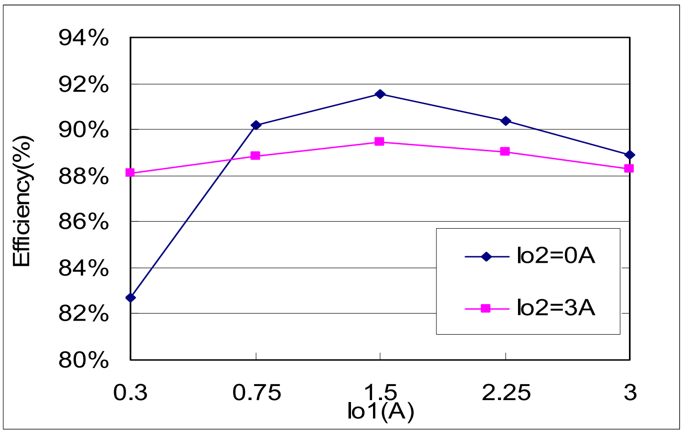
Transient Response V_{IN}=12V, I_O=3A
Step from 1.5A~3A~1.5A(Vo1)



Transient Response V_{IN}=12V, I_O=3A
Step from 1.5A~3A~1.5A(Vo2)



Start-up With V_{IN}=12V, I_O=3A



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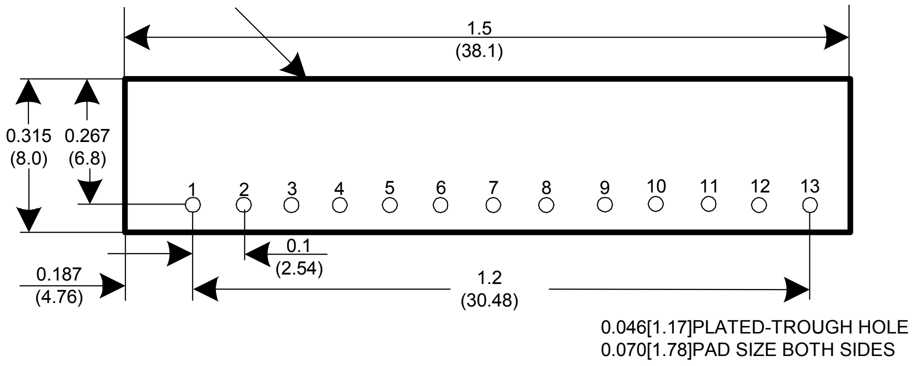
Recommended Hole Pattern

Dimensions are in inches (millimeters)

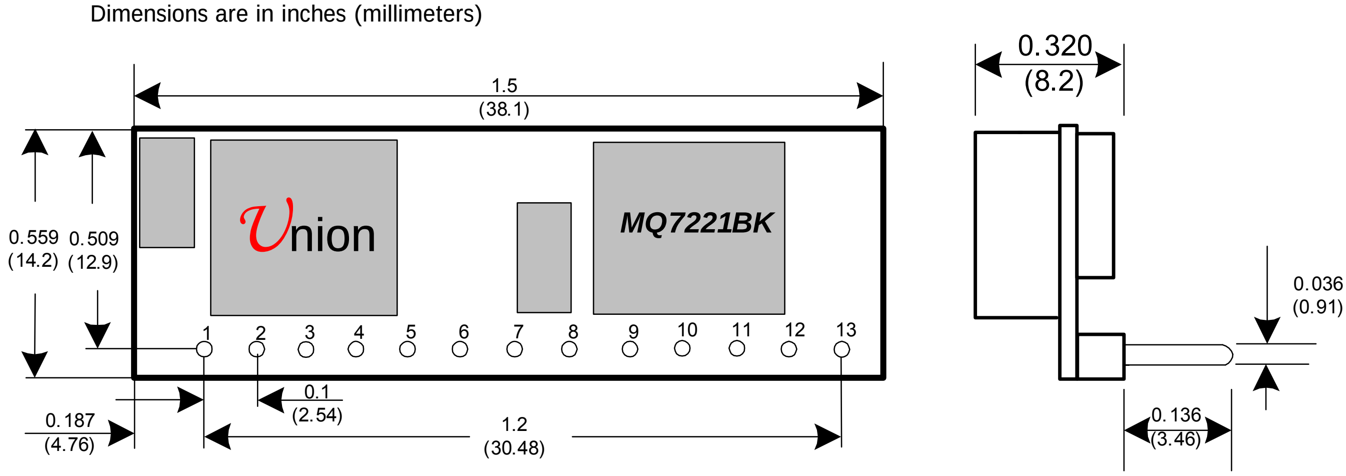


About Pin description, please refer to page2

Component-side footprint

Mechanical Specifications for "R" suffix

Dimensions are in inches (millimeters)



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Tel: *+86 21 5109 5021*
Fax: *+86 21 5106 2878*
sales@union-pwr.com
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