MINMAX®

MQWI40C Series
Electric Characteristic Note

MQWI40C Series EC Note

DC-DC Power Module 40W

Features

- **Fully Encapsulated Plastic Case for Chassis and DIN-Rail Mounting Version**
- **Ultra-wide 4:1 Input Voltage Range**
- **Fully Regulated Output Voltage**
- **Excellent Efficiency up to 92%**
- **I/O Isolation 2500 VDC**
- **Wide Operating Ambient Temp. Range**
- **Under-voltage, Overload/Voltage and Short Circuit Protection**
- **No Min. Load Requirement**
- **Remote On/Off Control**
- **Conducted EMI EN 55032 Class A Approved**
- **EMC Immunity EN 61000-4-2,3,4,5,6,8 Approved**
- **UL/cUL/IEC/EN 62368-1 Safety Approval & CE Marking**

Applications

- Distributed power architectures
- Workstations
- Computer equipment
- Communications equipment

Product Overview

The MQWI40C series is a range of 40W regulated DC-DC converter modules featuring an ultra-wide 4:1 input voltage range and high efficiency of up to 92%. Housed in a fully encapsulated plastic case with screw terminal connections, the series is available in chassis-mount and DIN-rail-mount versions for easy installation.

Designed for demanding industrial applications, the MQWI40C series features a wide operating ambient temperature range, 2500 VDC I/O isolation, remote on/off control, and comprehensive protection against input under-voltage, overload, over-voltage, and short-circuit conditions. The series also complies with EN 55032 Class A conducted EMI requirements.

Table of contents

Model Selection Guide P2
Input Specifications P2
Remote On/Off Control P2
Output Specifications P2
General Specifications P3
EMC Specifications P3
Environmental Specifications P3
Characteristic Curves P4
Package Specifications P12
Test Setup P13
Technical Notes P13
Remote On/Off Implementation P14
Part Number Structure P15
MTBF and Reliability P15

Model Selection Guide

Model Number	Input Voltage (Range)	Output Voltage	Output Current	Input Current		Max. capacitive Load	Efficiency (typ.)
			Max.	@ Max. Load	@ No Load		@Max. Load
	VDC	VDC	mA(typ.)	mA(typ.)	mA(typ.)	μF	%
MQWI40-24S051C	24 (9 ~ 36)	5.1	8000	1889	90	13600	90
MQWI40-24S12C		12	3330	1850	90	2400	90
MQWI40-24S24C		24	1670	1856	90	600	90
MQWI40-24S48C		48	835	1876	90	150	89
MQWI40-48S051C	48 (18 ~ 75)	5.1	8000	955	55	13600	89
MQWI40-48S12C		12	3330	915	55	2400	91
MQWI40-48S24C		24	1670	908	55	600	92
MQWI40-48S48C		48	835	928	55	150	90

Input Specifications

Parameter		Conditions / Model	Min.	Typ.	Max.	Unit
Input Surge Voltage (100 ms max.)		24V Input Models	-0.7	---	50	VDC
		48V Input Models	-0.7	---	100	
Start-Up Threshold Voltage		24V Input Models	---	---	9	
		48V Input Models	---	---	18	
Under Voltage Shutdown		24V Input Models	---	7.5	---	
		48V Input Models	---	16	---	
Start Up Time	Power Up	Nominal Vin and Constant Resistive Load	---	---	30	ms
	Remote On/Off		---	---	30	ms
Input Filter		All Models	Internal Pi Type			

Remote On/Off Control

Parameter	Conditions	Min.	Typ.	Max.	Unit
Converter On	3.5V ~ 12V or Open Circuit				
Converter Off	0V ~ 1.2V or Short Circuit				
Control Input Current (On)	Vctrl = 5.0V	---	---	0.5	mA
Control Input Current (Off)	Vctrl = 0V	---	---	-0.5	mA
Control Common	Referenced to Negative Input				
Standby Input Current	Nominal Vin	---	3	---	mA

Output Specifications

Parameter	Conditions / Model		Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy			---	±2.0	---	%Vnom.
Line Regulation	Vin=Min. to Max. @Full Load		---	±0.5	---	%
Load Regulation	Io=0% to 100%		---	±1.0	---	%
Minimum Load	No minimum Load Requirement					
Ripple & Noise	0-20MHz Bandwidth	5.1V Output Models	---	---	100	mV P-P
		12V & 24V Output Models	---	---	150	mV P-P
		48V Output Models	---	---	200	mV P-P
Transient Recovery Time	25% Load Step Change(2)		---	250	---	μs
Transient Response Deviation			---	±3	±5	%
Over Voltage Protection	Zener diode clamp		---	120	---	% of Vo
Temperature Coefficient			---	±0.02	---	%/°C
Over Load Protection	Hiccup		---	150	---	%
Short Circuit Protection	Continuous, Automatic Recovery (Hiccup Mode 0.25Hz typ.)					

General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds	2500	---	---	VDC
I/O Isolation Resistance	500 VDC	1000	---	---	MΩ
I/O Isolation Capacitance	100kHz, 1V	---	---	2800	pF
Switching Frequency		---	285	---	kHz
MTBF (calculated)	MIL-HDBK-217F@25℃, Ground Benign	644,290	---	---	Hours
Safety Approvals	UL/cUL 62368-1/60950-1 recognition(UL certificate), IEC/EN 62368-1(CB-report)				

EMC Specifications

Parameter	Standards & Level			Performance
$EMI_{(5)}$	Conduction	EN 55032	Without external components	Class A
	Radiation		With external components	
EMS	EN 55035			
	ESD	EN 61000-4-2 Air ± 8kV , Contact ± 4kV		A
	Radiated immunity	EN 61000-4-3 10V/m		A
	Fast transient	EN 61000-4-4 ±2kV		A
	Surge	EN 61000-4-5 ±2kV		A
	Conducted immunity	EN 61000-4-6 10Vrms		A
	PFMF	EN 61000-4-8 30A/m for Continuous		A

Environmental Specifications

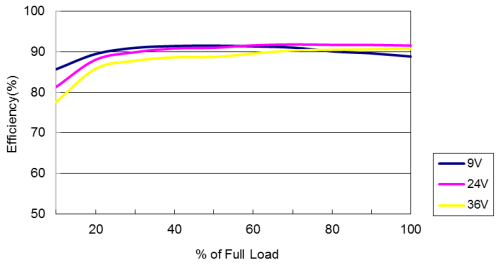
Parameter	Conditions / Model	Min.	Max.	Unit
Operating Ambient Temperature Range Nominal Vin, Load 100% Inom. (for Power Derating see relative Derating Curves)	MQWI40-48S24C	-40	+78	℃
	MQWI40-48S12C		+76	
	MQWI40-24S051C,24S12C MQWI40-24S24C,48S48C		+73	
	MQWI40-24S48C,48S051C		+71	
Thermal Impedance	20LFM Convection	4.75	---	℃/W
	100LFM Convection	3.55	---	℃/W
	200LFM Convection	3.10	---	℃/W
	400LFM Convection	1.95	---	℃/W
Case Temperature		---	+95	℃
Storage Temperature Range		-50	+125	℃
Humidity (non condensing)		---	95	% rel. H

Notes

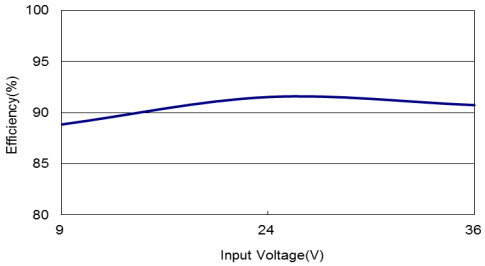
1 Specifications typical at Ta=+25℃, resistive load, nominal input voltage and rated output current unless otherwise noted.
2 Transient recovery time is measured to within 1% error band for a step change in output load of 75% to 100%.
3 We recommend to protect the converter by a slow blow fuse in the input supply line.
4 Other input and output voltage may be available, please contact MINMAX.
5 The external components might be required to meet EMI standard for some of test items. Please contact MINMAX for the solution in detail.
6 Specifications are subject to change without notice.
7 The repeated high voltage isolation testing of the converter can degrade isolation capability, to a lesser or greater degree depending on materials, construction, environment and reflow solder process. Any material is susceptible to eventual chemical degradation when subject to very high applied voltages thus implying that the number of tests should be strictly limited. We therefore strongly advise against repeated high voltage isolation testing, but if it is absolutely required, that the voltage be reduced by 20% from specified test voltage. Furthermore, the high voltage isolation capability after reflow solder process should be evaluated as it is applied on system.

Characteristic Curves

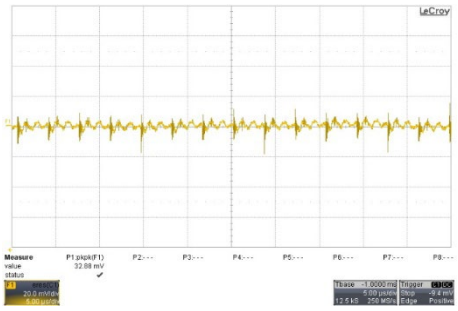
All test conditions are at 25℃ The figures are identical for MQWI40-24S051C



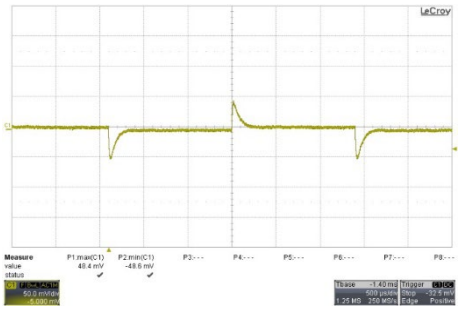
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



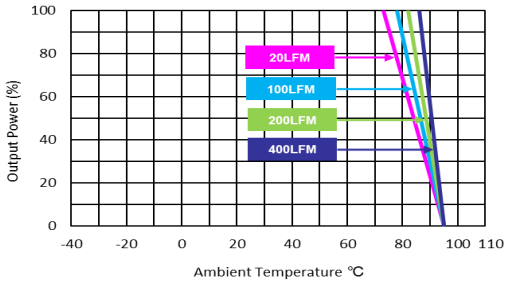
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$

Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load

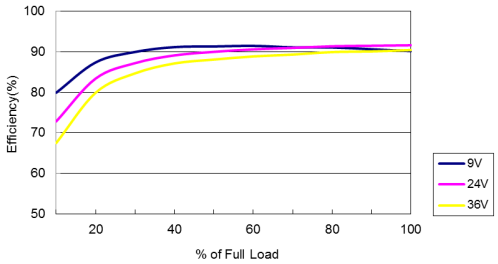
ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



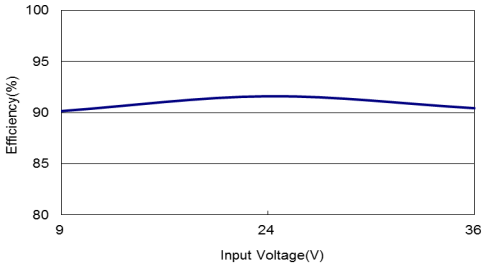
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

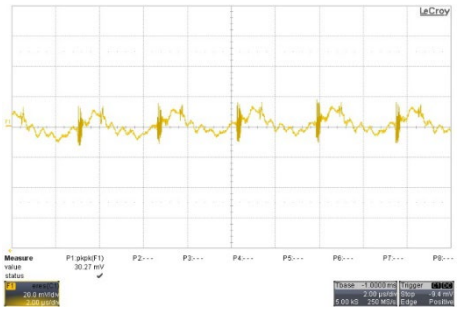
All test conditions are at 25℃ The figures are identical for MQWI40-24S12C



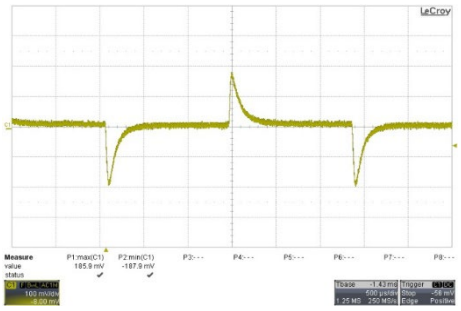
Efficiency Versus Output Current



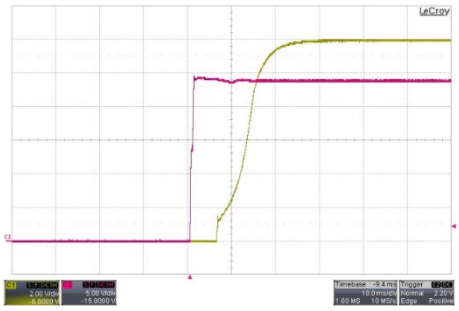
Efficiency Versus Input Voltage
Full Load



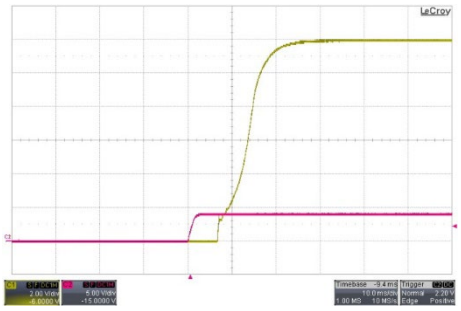
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



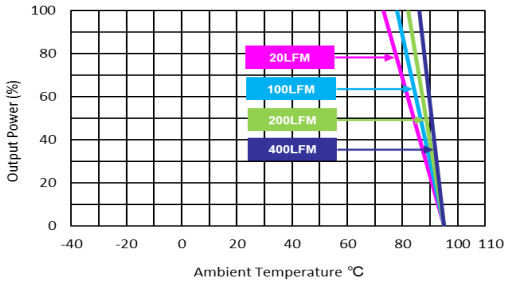
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



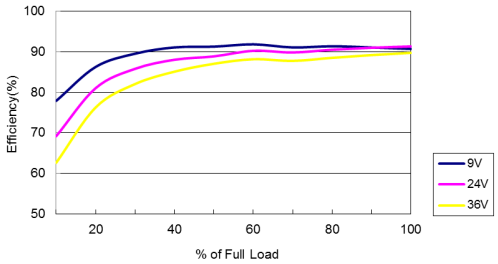
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



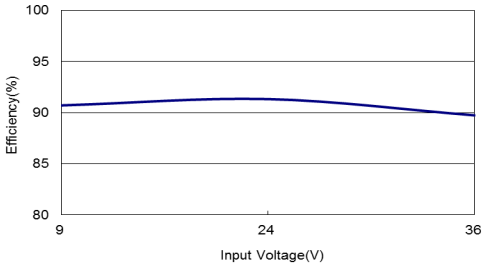
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

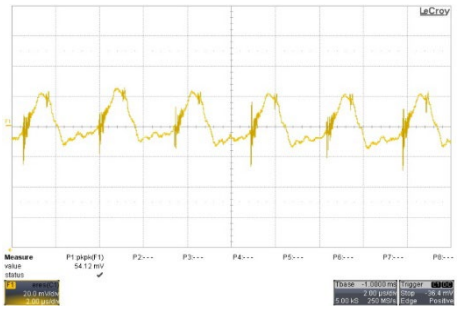
All test conditions are at 25℃ The figures are identical for MQWI40-24S24C



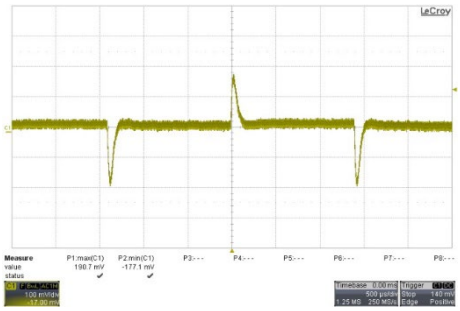
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



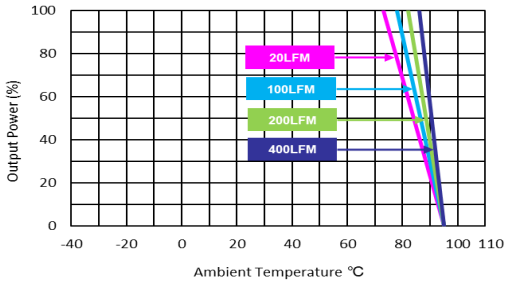
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$

Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load

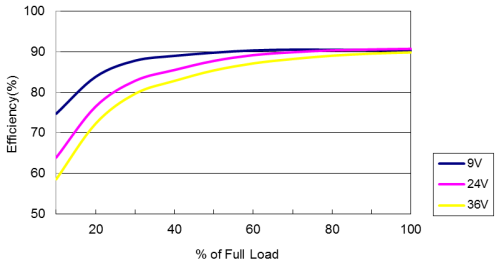
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



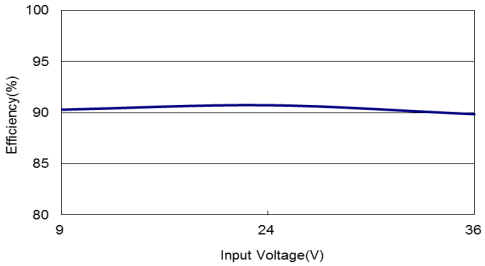
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

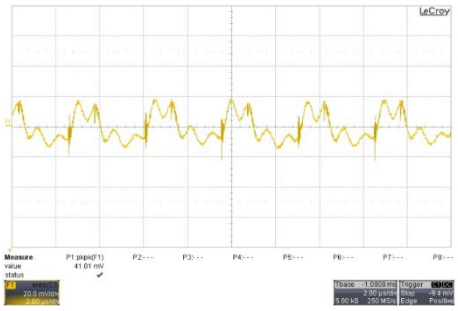
All test conditions are at 25℃ The figures are identical for MQWI40-24S48C



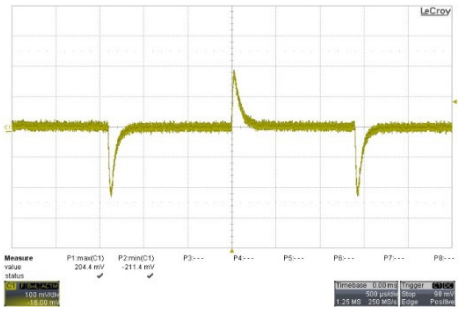
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load

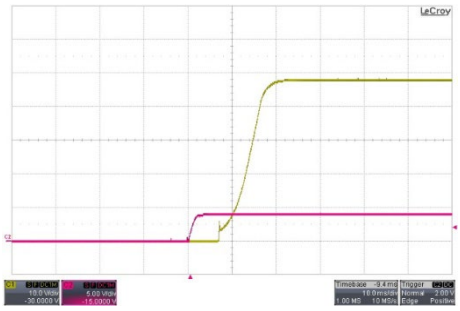


Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load

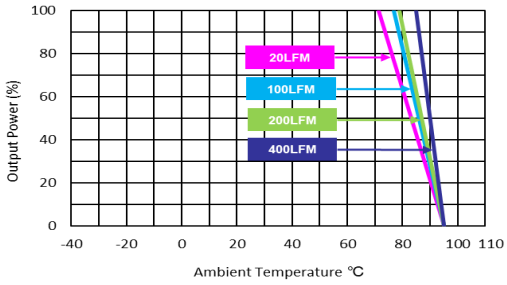


Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$

Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



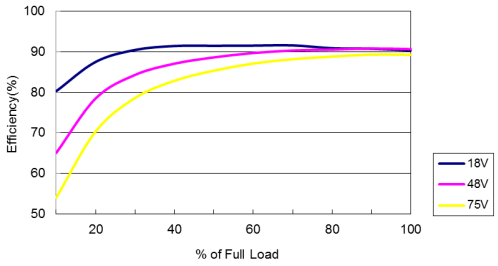
ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



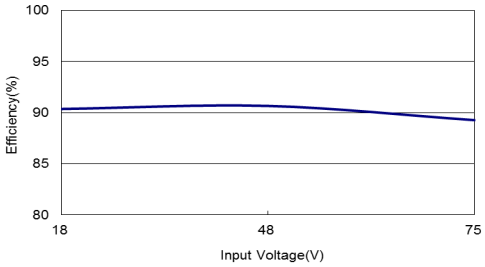
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

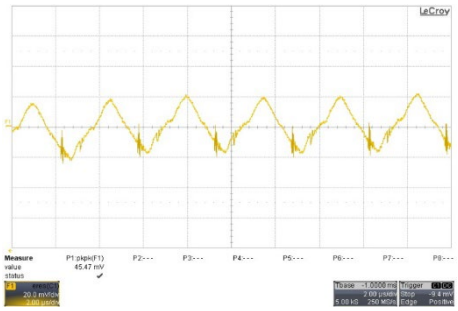
All test conditions are at 25°C The figures are identical for MQWI40-48S051C



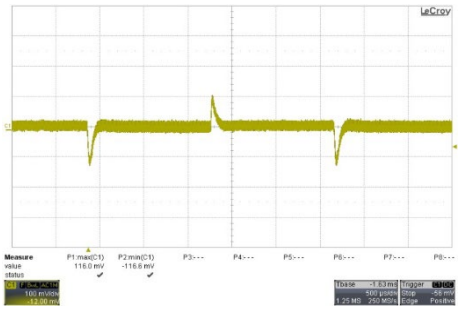
Efficiency Versus Output Current



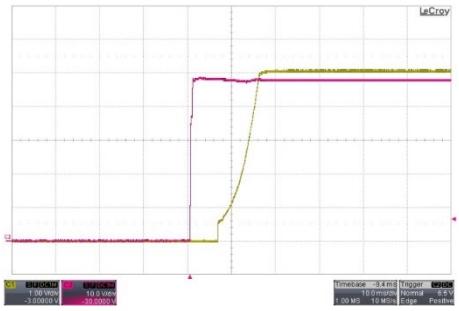
Efficiency Versus Input Voltage
Full Load



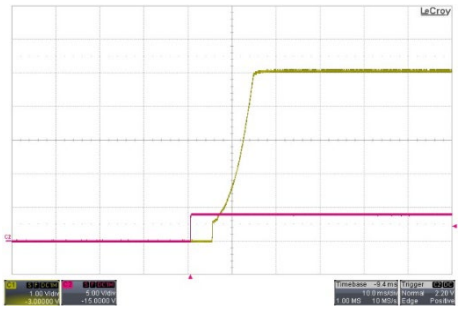
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



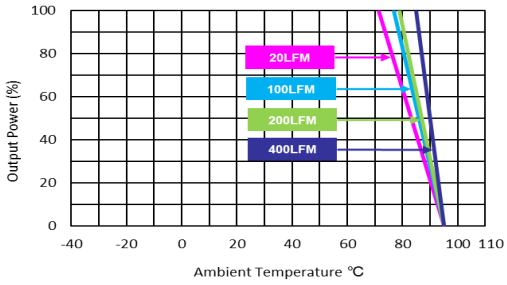
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



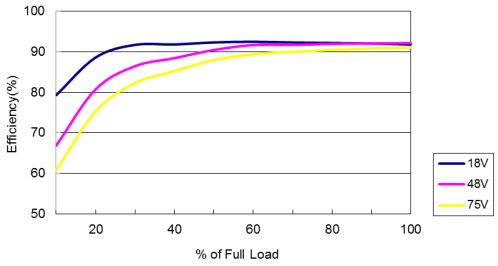
ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



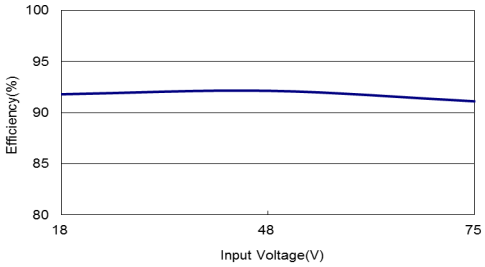
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

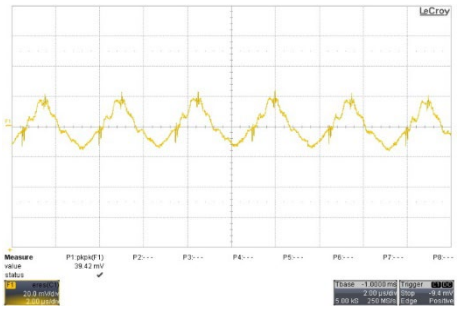
All test conditions are at 25°C The figures are identical for MQWI40-48S12C



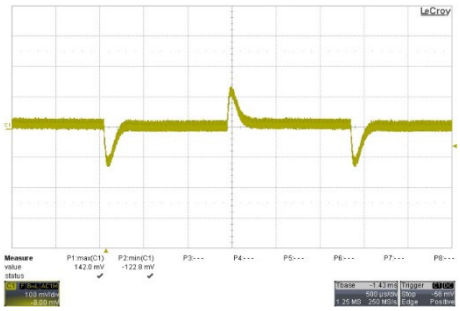
Efficiency Versus Output Current



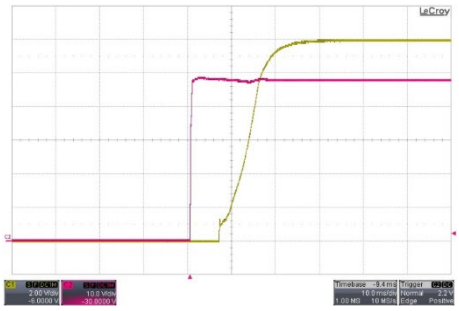
Efficiency Versus Input Voltage
Full Load



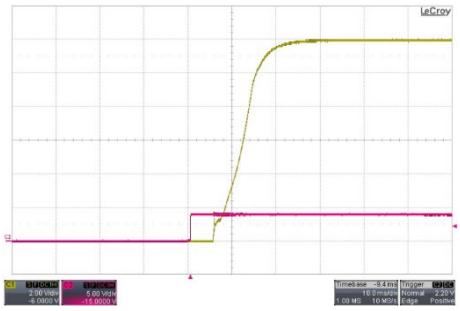
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



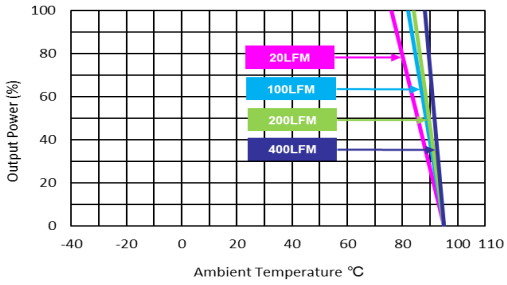
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



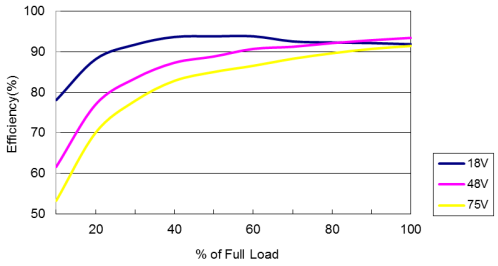
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



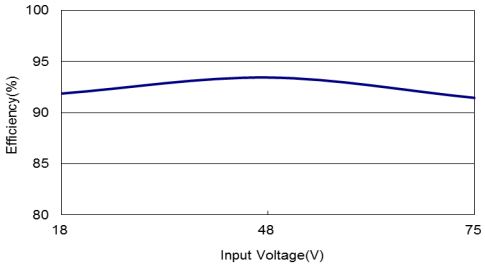
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

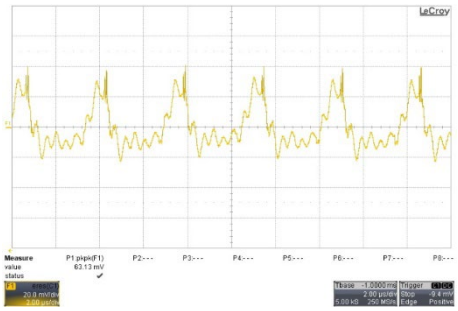
All test conditions are at 25°C The figures are identical for MQWI40-48S24C



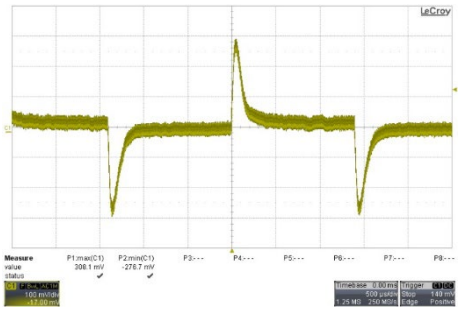
Efficiency Versus Output Current



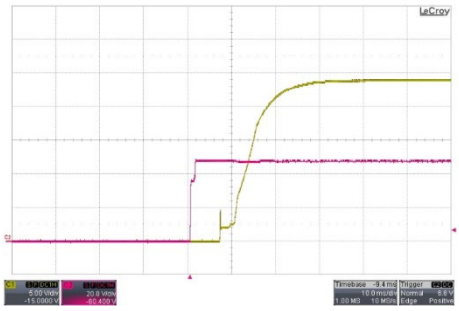
Efficiency Versus Input Voltage
Full Load



Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load

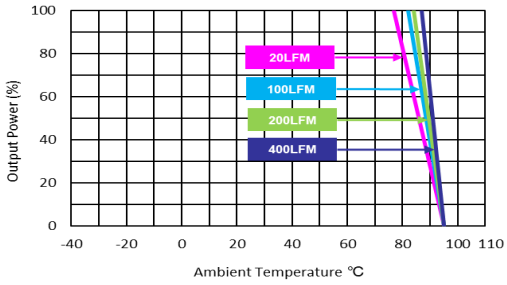


Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load

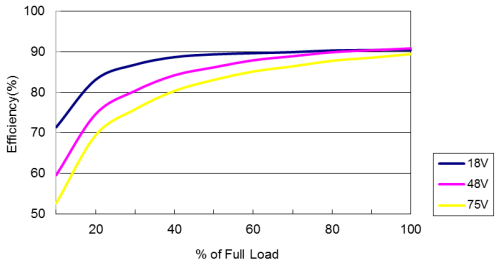
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



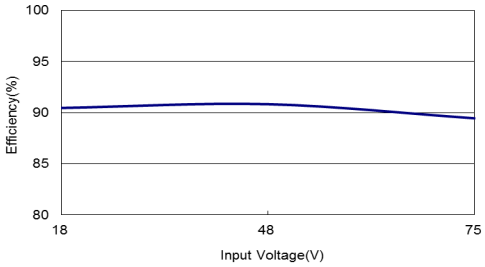
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

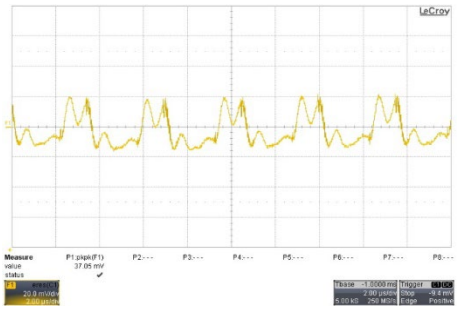
All test conditions are at 25°C The figures are identical for MQWI40-48S48C



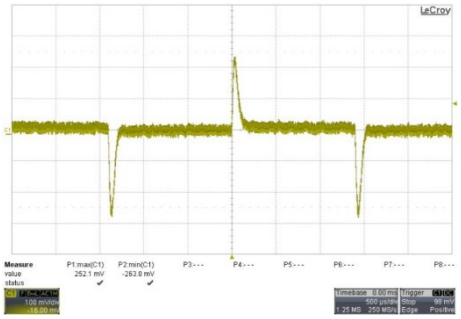
Efficiency Versus Output Current



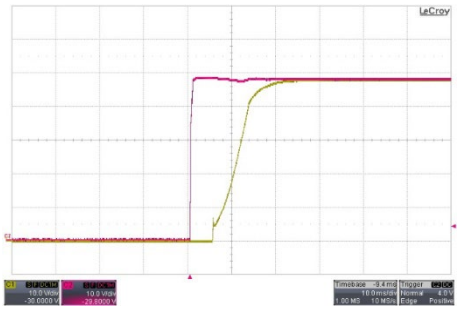
Efficiency Versus Input Voltage
Full Load



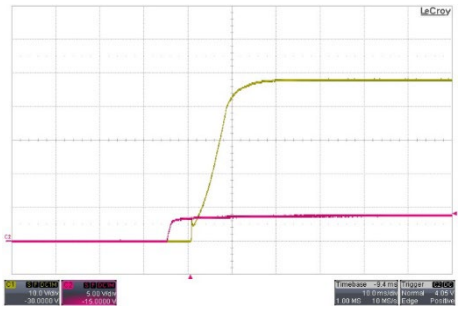
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



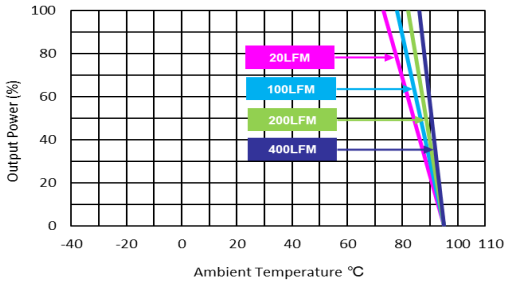
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



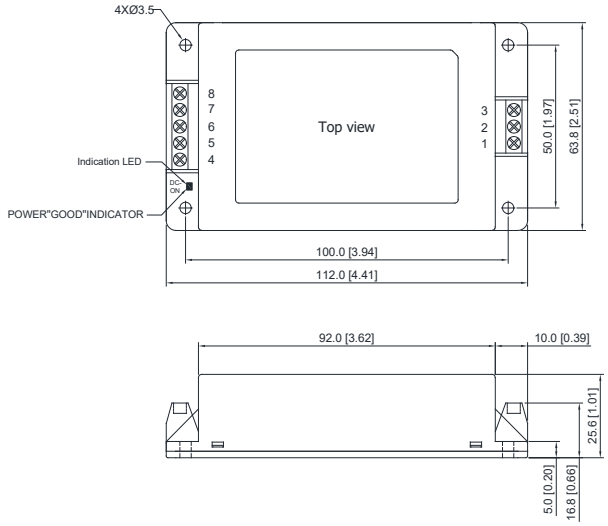
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



Derating Output Current Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Package Specifications Chassis Mounting

Mechanical Dimensions



Note:

Screw type Terminal: Wires 1.5mm^2 max.

Recommended Terminal Screw tightening torque: 0.5Nm (3.5lb.in.) max.

Connections

Pin	Funtion
1	Remote On/Off
2	-Vin
3	+Vin
4	+Vout
5	NC
6	-Vout
7	NC
8	NC

NC: No Connection

▶ All dimensions in mm (inches)

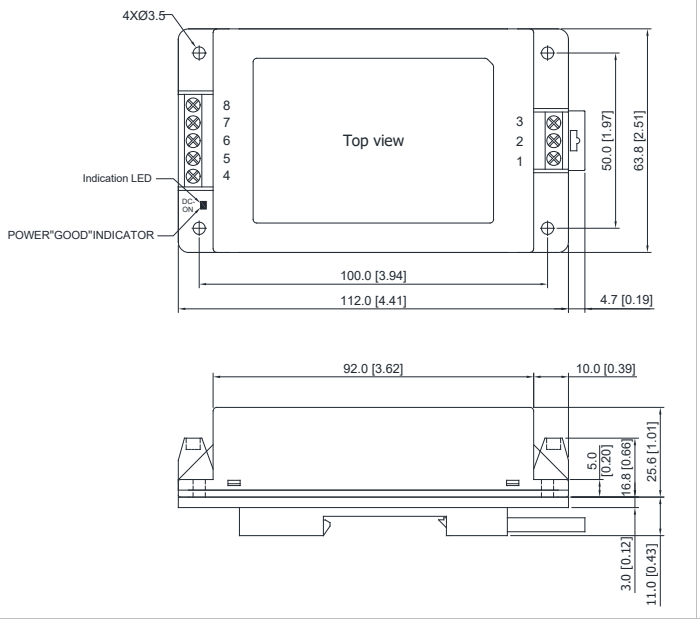
▶ Tolerance: ±0.5 (±0.02)

Physical Characteristics

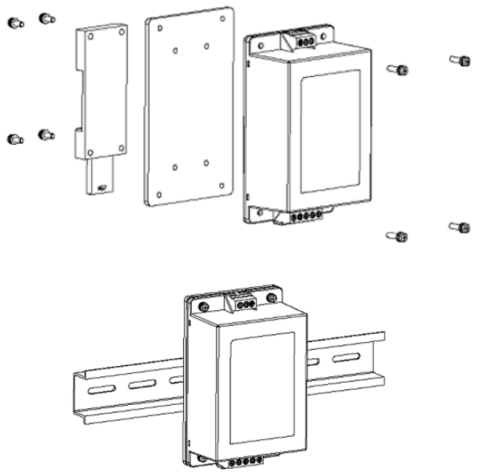
Case Size	:	112.0x63.8x25.6mm (4.41x2.51x1.01 inches)
Case Material	:	Plastic resin (flammability to UL 94V-0 rated)
Weight	:	162g

Package Specifications with DIN Rail Mounting Bracket (order code AC-DIN-02)

Mechanical Dimensions



DIN-Rail Mounting Kit



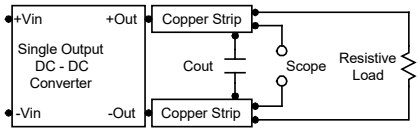
Physical Characteristics

Case Size	:	112.0x63.8x25.6mm (4.41x2.51x1.01 inches)
Case Material	:	Plastic resin (flammability to UL 94V-0 rated)
Weight	:	216g

Test Setup

Peak-to-Peak Output Noise Measurement Test

Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20 MHz. Position the load between 50 mm and 75 mm from the DC-DC Converter.



Technical Notes

Remote On/Off

Positive logic remote on/off turns the module on during a logic high voltage on the remote on/off pin, and off during a logic low. To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the -Vin terminal. The switch can be an open collector or equivalent. A logic low is 0V to 1.2V. A logic high is 3.5V to 12V. The maximum sink current at the on/off terminal (Pin 1) during a logic low is -100µA.

Overload Protection

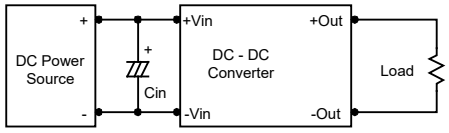
To provide hiccup mode protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure overload for an unlimited duration.

Overvoltage Protection

The output overvoltage clamp consists of control circuitry, which is independent of the primary regulation loop, that monitors the voltage on the output terminals. The control loop of the clamp has a higher voltage set point than the primary loop. This provides a redundant voltage control that reduces the risk of output overvoltage. The OVP level can be found in the output data.

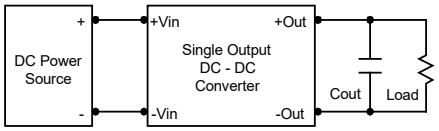
Input Source Impedance

The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup. Capacitor mounted close to the power module helps ensure stability of the unit, it is recommended to use a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 kHz) capacitor of a 10µF for the 24V and 48V devices.



Output Ripple Reduction

A good quality low ESR capacitor placed as close as practicable across the load will give the best ripple and noise performance. To reduce output ripple, it is recommended to use 4.7µF capacitors at the output.

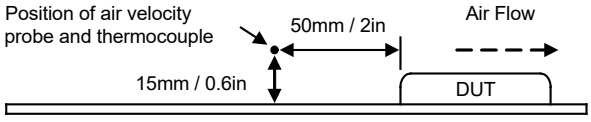


Maximum Capacitive Load

The MQWI40C series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in the data sheet.

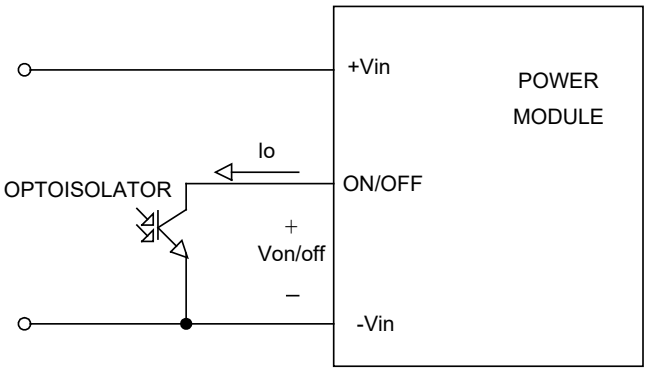
Thermal Considerations

Many conditions affect the thermal performance of the power module, such as orientation, airflow over the module and board spacing. To avoid exceeding the maximum temperature rating of the components inside the power module, the case temperature must be kept below 95°C. The derating curves are determined from measurements obtained in a test setup.

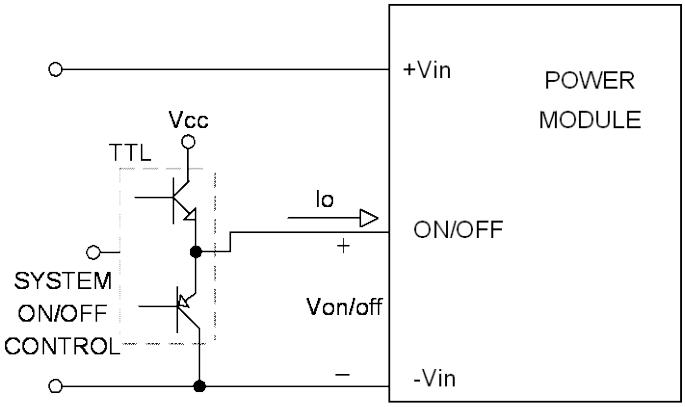


Remote On/Off Implementation

The positive logic remote On/Off control circuit is included. Turns the module ON during logic High on the On/Off pin and turns OFF during logic Low. The On/Off input signal (Von/off) that referenced to GND. If not using the remote on/off feature, please open circuit between on/off pin and -Vin pin to turn the module on.



Isolated-Closure Remote ON/OFF



Level Control Using TTL Output

Part Number Structure

M	Q	WI	40	-	24	S	051	C
	Package Type 2.51" X 4.41"	Ultra-wide 4:1 Input Voltage Range	Output Power 40 Watt		Input Voltage Range 24: 9 ~ 36 VDC 48: 18 ~ 75 VDC	Output Quantity S: Single	Output Voltage 051: 5.1 VDC 12: 12 VDC 24: 24 VDC 48: 48 VDC	Mounting Type Chassis

MTBF and Reliability

The MTBF of MQWI40C series of DC-DC converters has been calculated using

MIL-HDBK 217F NOTICE2, Operating Temperature 25℃, Ground Benign.

Model	MTBF	Unit
MQWI40-24S051C	644,290	Hours
MQWI40-24S12C	941,748	
MQWI40-24S24C	972,219	
MQWI40-24S48C	1,020,462	
MQWI40-48S051C	877,674	
MQWI40-48S12C	1,149,302	
MQWI40-48S24C	1,145,246	
MQWI40-48S48C	1,212,786	