



Q5 SERIES

5W 4:1 Low Noise DC/DC CONVERTER

24-PIN DIP

Key Features

- Efficiency up to 83%
- 1500Vdc isolation
- Short circuit and thermal protection
- 4:1 input voltage range
- External Synchronization
- Less than 10mV output noise
- Metal case
- Six-sided shielding
- 2mA off state current
- Industry standard pinout



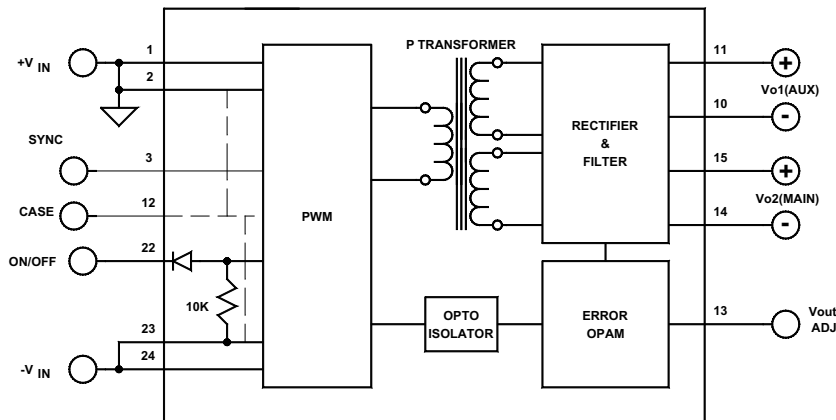
Beta Dyne is protected under various patents, including but not limited to U.S. Patent numbers: 5,777,519; 6,188,276; 6,262,901; 6,452,818; 6,473,3171.

Applications

- Telcom
- Computer Input/Output boards
- Instrumentation
- Medical/Military

Functional Description

The Q5 is a 4:1 input range, low output noise DC/DC Converter in a 24-Pin DIP series. The converter offers a wide input voltage range of 11 to 36V and 18V to 72V range. Single output voltage range from 3.3V to 15Vdc, while dual outputs go from +/-5V to +/-15V. Additional features include total input-to-output isolation, short circuit protection, thermal protection, metal case, soft start, adjustable outputs, and efficiency up to 83%.



Typical Block Diagram

Electrical Specifications
ABSOLUTE MAXIMUM RATINGS

Unless otherwise specified, all parameters are given under typical +25°C with nominal input voltage and under full output load conditions.

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Input Voltage	See Model Selection Guide				
Output Short Circuit Duration	Continuous(Hiccup)				
Internal Power Dissipation				1.2	W

INPUT SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Input Voltage Range (4:1)	See Model Selection Guide				
No Load Input Current	See Model Selection Guide				
Full Load Input Current	See Model Selection Guide				
Input Filter	π Filter				μ F
Reverse Polarity	External series-blocking diode				
Reflected Ripple	$I_O = FL, C_{IN} = 3.3\mu F$ for $24V_{IN}$, $2.2\mu F$ for $48V_{IN}$				
Input Surge Current (20 μ S Spike)				10	A
Short Circuit Current Limit	See Short Circuit Protection		150		% I_{IN}
Off State Current			1		mA
Remote ON/OFF Control					
Supply ON	Pin 22 Open (Open circuit voltage 10V)		10		Vdc
Supply OFF	Pin 22(connect to $-V_{IN}$ (pins#23,24))	0	.5	.8	Vdc
Logic Input Reference	-Input for ON/OFF and SYNC				
SYNC	Referenced to $-V_{IN}$				
Pulse	See figure#11	15	200		nS
Amplitude		0	3.3	5	V

OUTPUT SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Output Voltage Accuracy			± 1	± 2	%
Ripple & Noise	With specified minimum output capacities		10	50	mV
Output Current	See Model Selection Guide				
Line Regulation, Single and Dual			± 5	± 1	%
Line Regulation, Dual Isolated (AUX)	See Single for V_{O2}		± 2	± 3	%
Load Regulation, Single			± 5	± 1	%
Load Regulation, Dual	With balanced loads		± 5	± 1	%
Dual Isolated Output (AUX)	Output fully loaded, See Figure 5; See Single for V_{O2}		± 2	± 3	%
Temperature Coefficient @ FL			0.02		%/°C
Transient Response Time	50% FL to FL to 50% FL, See Figure 2		50	100	mS
Short Circuit Protection ¹	By input current limiting(Hiccup mode)				
Output Adjust Range	See figure#10	± 5		± 10	%

GENERAL SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Efficiency	See Model Selection Guide				
Isolation Voltage (1 min.), Input to Output			1500		Vdc
Isolation Voltage (1 min.), Output to Output			500		Vdc
Isolation Resistance			10^9		Ω
Isolation Capacitance			1000		pF
Switching Frequency			185		kHz
Synchronization Switching Frequency			200		kHz
Turn On Delay			15	20	mS
Soft Start Time			10		mS

Unless otherwise specified, all parameters are given under typical +25°C with nominal input voltage and under full output load conditions.

PHYSICAL CHARACTERISTICS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Dimensions (L×W×H)	1.25×0.80×0.40 in. (31.75×20.32×10.16mm)				
Weight	0.56 oz. (15.8g)				
Case Material	Coated metal				
Shielding	Six-sided continuous				
Case Connection					

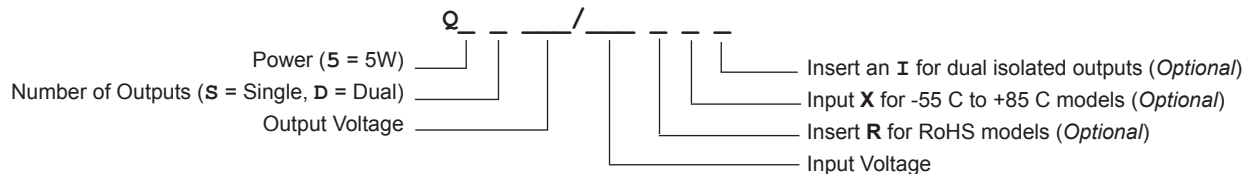
ENVIRONMENTAL SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Operating Temperature Range (Ambient), 24V _{IN}		-40		+60	°C
Operating Temperature Range (Ambient), 48V _{IN}		-40		+70	°C
Storage Temperature Range		-60		+105	°C
Thermal Shutdown with Auto-Recovery	Case temperature		TBD		°C
Thermal Resistance	Maximum case temperature is TBD°C above ambient		TBD		°C/W
Derating					
Humidity	Up to 95% non-condensing				
Cooling	Free-air convection				
MTBF	per MIL-HNBK-217F (Ground benign, +25°C)		1.3x10 ⁶		hours

Model Selection Guide

Model	INPUT				OUTPUT			
	Voltage(V) ₁		Current(A)		Reflected Ripple (mA _{pp})	Voltage (Vdc)	Current (mA)	Efficiency Full Load (%)
	Nominal	Range	No Input	Full Load				
Q5S3.3/24	24	11-36	20	269	20	3.3	1515	77
Q5S5/24	24	11-36	10	262	20	5	1000	79
Q5S12/24	24	11-36	10	249	20	12	416	83
Q5S15/24	24	11-36	10	246	20	15	333	83
Q5S3.3/48	48	18-72	10	135	10	3.3	1515	76
Q5S5/48	48	18-72	10	128	10	5	1000	80
Q5S12/48	48	18-72	10	127	10	12	416	82
Q5S15/48	48	18-72	10	124	10	15	333	82
Q5D5/24	24	11-36	10	260	20	±5	±500	80
Q5D12/24	24	11-36	10	253	20	±12	±208	81
Q5D15/24	24	11-36	10	253	20	±15	±166	82
Q5D5/48	48	18-72	10	132	10	±5	±500	78
Q5D12/48	48	18-72	10	129	10	±12	±208	80
Q5D15/48	48	18-72	10	128	10	±15	±166	81

ORDERING GUIDE



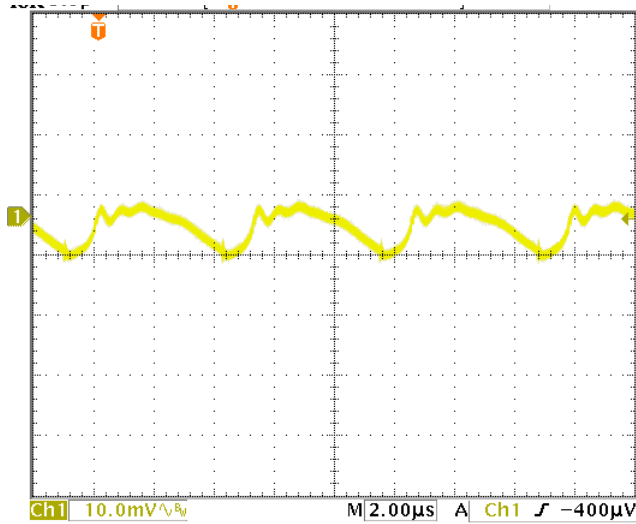


FIGURE 1. Output ripple of Q5S5/48 at $V_{IN}=48V$, $I_{OUT}=1A$ with a $47\mu F$ & $10\mu F$ external capacitors on the output as shown in figure .

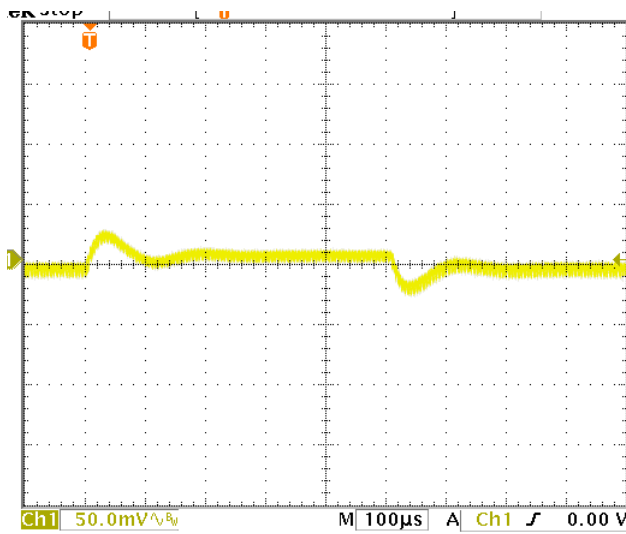


FIGURE 2. Transient response of Q5S5/48 at $48V_{IN}$ with I_{OUT} changing from Full Load to 1/2 Full Load. During transient response, C_O is a low ESR $47\mu F$ capacitor in parallel with a $3.3\mu F$ ceramic capacitor.

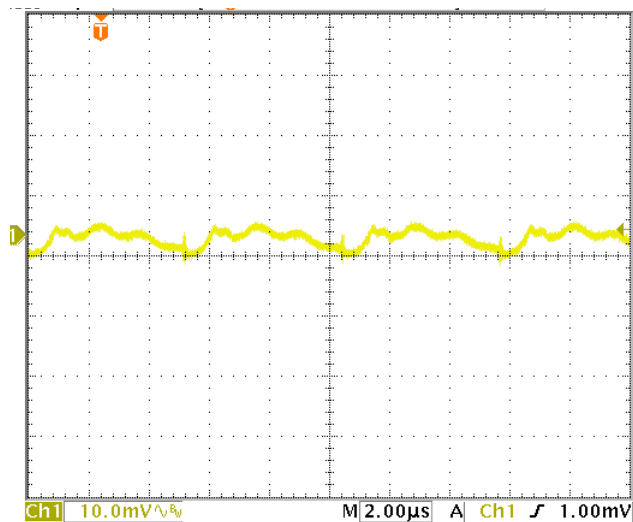


FIGURE 3. Output ripple of Q5S15/48 at $V_{IN}=48V$, @ $I_{OUT}=0.333A$ with $47\mu F$ & $10\mu F$ external capacitors on the output as in figure .

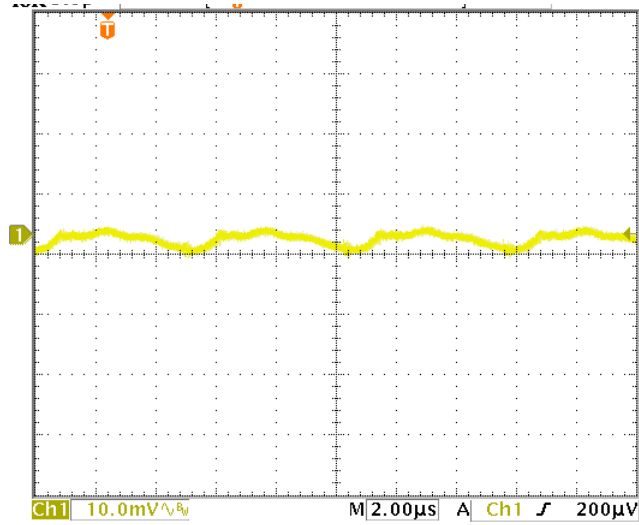


FIGURE 4. Output ripple of Q5S15/24 at $V_{IN}=24V @ I_{OUT}=0.333A$ with $47\mu F$ & $10\mu F$ external capacitors on the output as in figure .

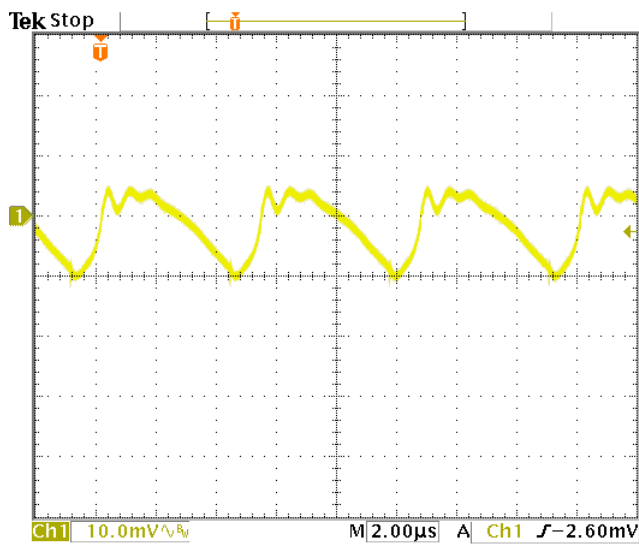


FIGURE 5. Output ripple of Q5S3.3/48 at $V_{IN}=48V @ I_{OUT}=1.66A$ with $47\mu F$ & $10\mu F$ external capacitors on the output as in figure .

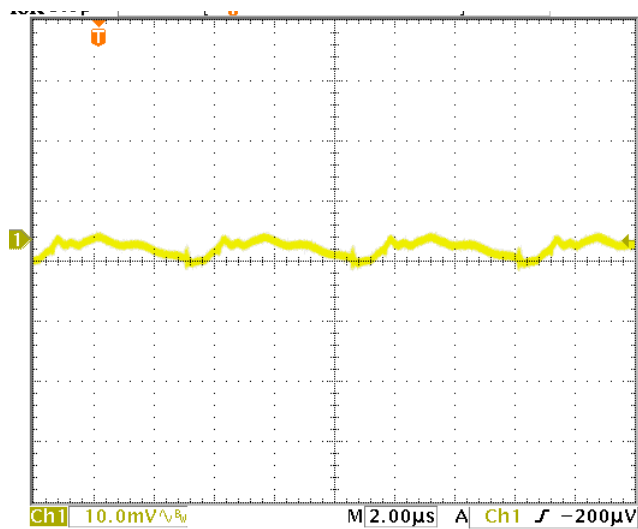


FIGURE 6. Output ripple of Q5D12/48 at $V_{IN}=48V @ I_{OUT}=0.416A$ with $47\mu F$ & $10\mu F$ external capacitors on the output as in figure .

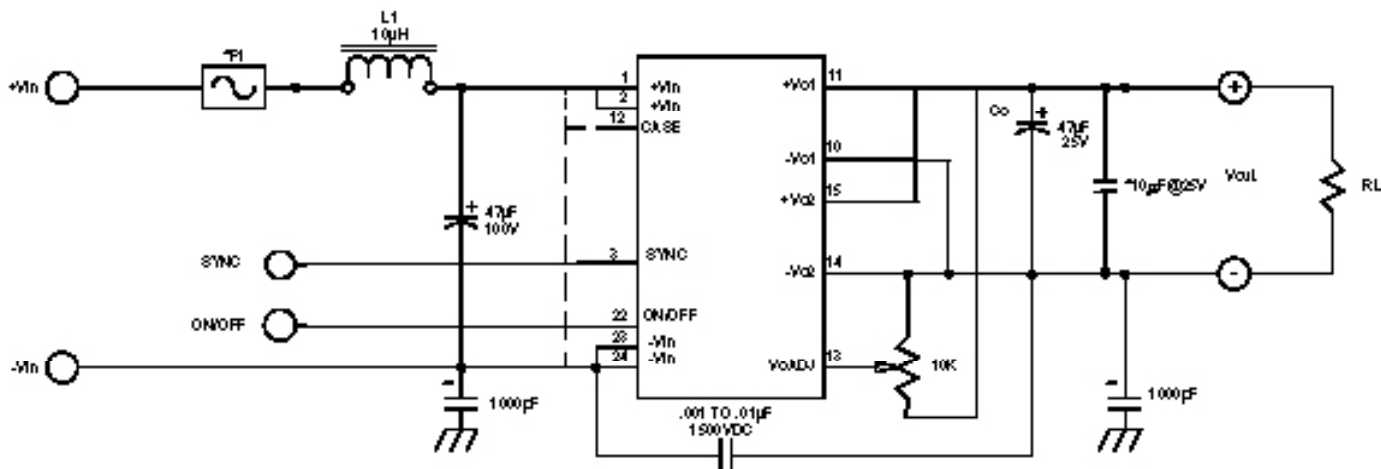


FIGURE 7. Typical connection diagram of Q5 Single

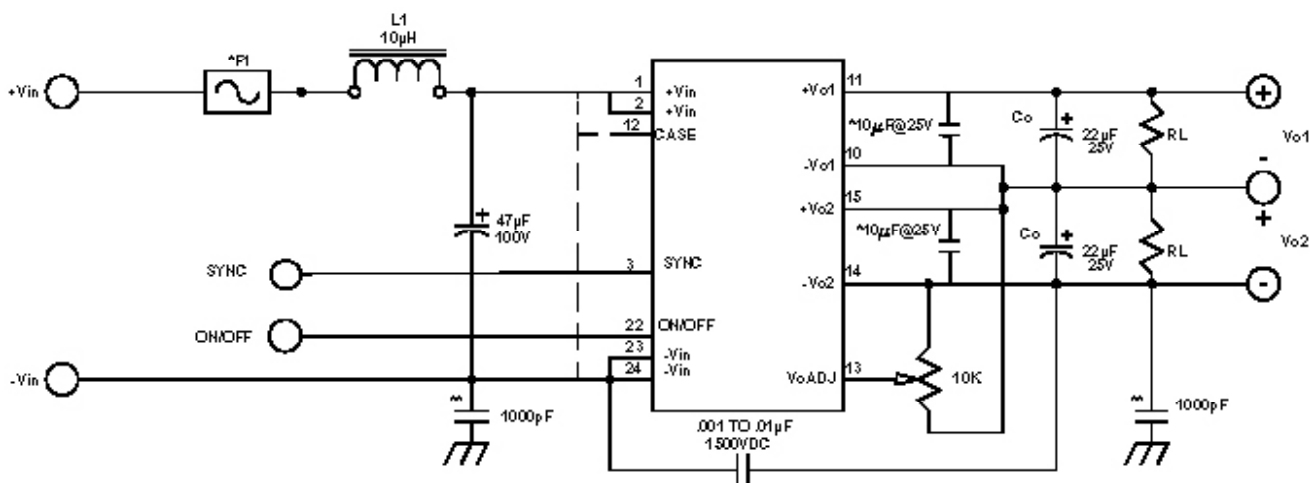


FIGURE 8. Typical connection diagram of Q5 Dual

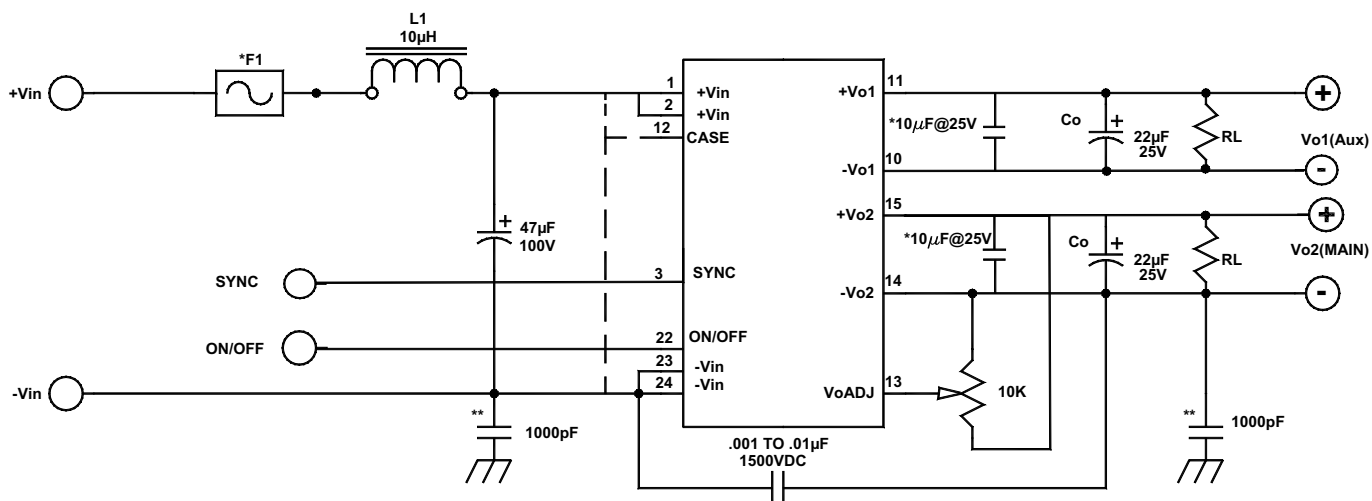
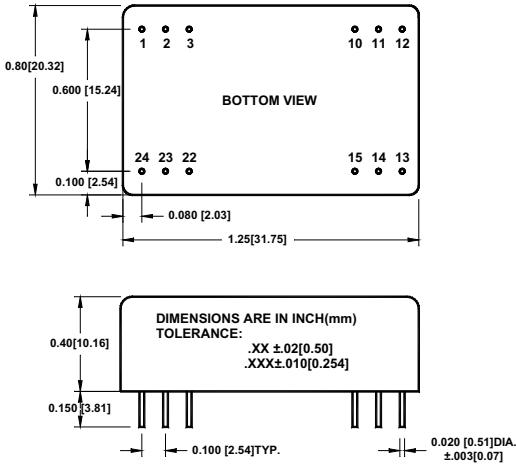


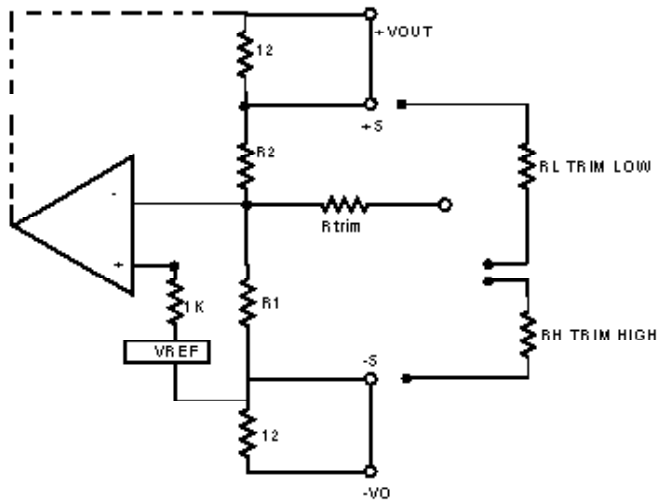
FIGURE 9. Typical connection diagram of Q5 Dual-Isolated

*Note: F1 is a 1A slow blow fuse for 24V_{IN}, F1 is a 0.5A slow blow fuse for 48V_{IN}

MECHANICAL SPECIFICATIONS



Pin	Function		
	SINGLE	Dual	Dual-Isolated
1	+V _{IN}	+V _{IN}	+V _{IN}
2	+V _{IN}	+V _{IN}	+V _{IN}
3	SYNC	SYNC	SYNC
10	No Pin	-V _{O1}	-V _{O1 (AUX)}
11	No Pin	+V _{O1}	+V _{O1 (AUX)}
12	CASE PIN	CASE PIN	CASE PIN
13	V _{OUT ADJ}	V _{OUT ADJ}	V _{OUT ADJ}
14	-V _{OUT}	-V _{O2}	-V _{O2 (MAIN)}
15	+V _{OUT}	+V _{O2}	+V _{O2 (MAIN)}
22	ON/OFF	ON/OFF	ON/OFF
23	-V _{IN}	-V _{IN}	-V _{IN}
24	-V _{IN}	-V _{IN}	-V _{IN}



$$R_L = \frac{(V_o - V_{ref})R_1 \cdot R_2}{V_{ref}(R_1 + R_2) - V_o R_1} - R_t \quad \text{in } k\Omega$$

$$R_H = \frac{R_1 \cdot R_2}{\left(\frac{V_o}{V_{ref}} - 1\right)R_1 - R_2} - R_t \quad \text{in } k\Omega$$

VO	VREF	R2	R1	Rtrim
3.3V	1.225	4.22K	2.49K	0
5V	2.5	2.49K	2.49K	11K
12V	2.5	9.53K	2.49K	20K
15V	2.5	15K	3.01K	23.7K

FIGURE 10. Single Output adjustment equations.

*Note: F1 is a 1A slow blow fuse for 24V_{IN}, F1 is a 0.5A slow blow fuse for 48V_{IN}

EXTERNAL SYNCHRONIZATION

The SYNC pin can be used to synchronize the internal oscillator to external clock. An open drain output is the recommended interface between the external clock to the Q5 SYNC pin as shown in figure 11. The clock pulse width must be greater than 15ns. The external clock frequency must be greater than the frequency of the Q5.

Multiple Q5 converters can be synchronized together simply by connecting the converters SYNC pins together as shown in figure 12. Care should be taken to ensure the ground potential differences between the converters are minimized. In this configuration all the converters will be synchronized to the highest frequency device. The SYNC pin is a CMOS buffer with pull-up current limited to 200micro amps. If the external device forces the SYNC pin low before the internal oscillator ramp completes its charging cycle, the ramp will reset and another cycle begins. If the SYNC pins of multiple Q5 converters are connected together, the first SYNC pin that pulls low will reset the oscillator ramp of all the other converters. All converters will operate in phase when synchronized using the SYNC feature. Up to five devices can be synchronized using this method.

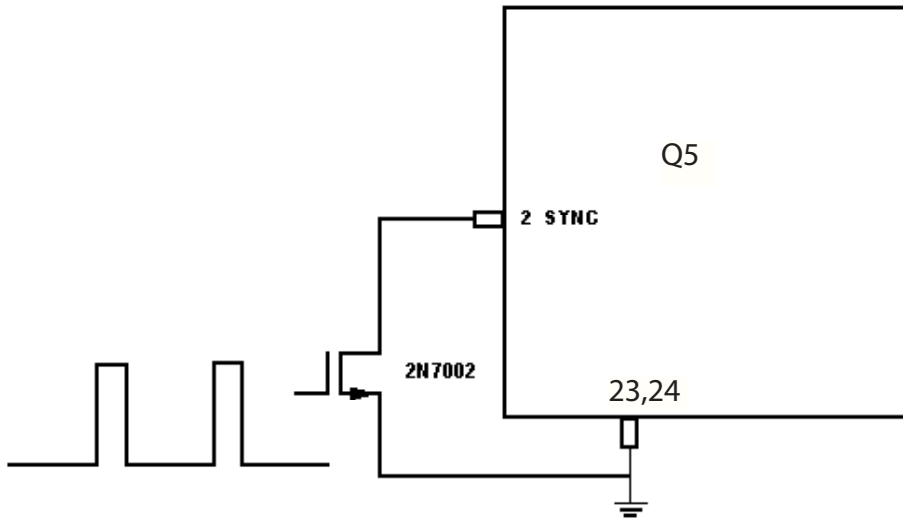


FIGURE 11. SYNC from external clock

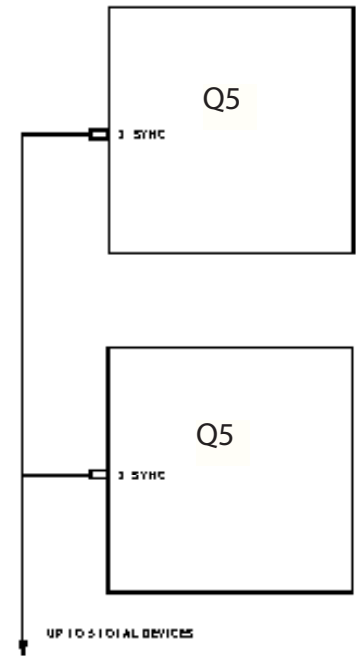


FIGURE 12. SYNC of multiple devices

Notes:

1. The $24V_{IN}$ (9-36) converters turn on between $10.5V_{IN}$ - $11V_{IN}$ and they operate down to $8V_{IN}$.