Design Note – DN06022/D
Tracking boost Regulator

ON Semiconductor

Device	Application	Input Voltage	Output Power	Topology	I/O Isolation
CS5171	General	Up to 30V	Circuit dependant	Modified Boost	no

Other Specifications

	Output 1	Output 2	Output 3	Output 4
Output Voltage	Vin +10V	N/A	N/A	N/A

Minimum Efficiency	70%
Operating Temp. Range	-40C to +125 °C

Circuit Description

Adding a current mirror circuit to a typical boost circuit allows the user to select the amount of boost voltage and ensure a constant difference between input and output voltage. This is useful for high side drive applications where a simple voltage doubling circuit is not practical, either because of the voltage range of the components involved or where the input voltage can vary widely. This circuit can also be used at the front end of a power supply to ensure that the PWM controller has enough voltage to start correctly in low input voltage conditions. The schematic shown will maintain a 10V difference between Vin and Vout and is easily changed to provide other voltages.

The PWM in the design example is the CS5171. However, this circuit can be used with any boost controller or regulator. The current mirror circuit, comprising the dual PNP transistor Q1 and the associated resistors, establishes a current that depends on the voltage difference between Vin and Vout. The dual PNP transistor NST30010MXV6 has a Vceo of 30 V so it is used in this example. If higher output voltages are required a device such as the BC856BDW1T1G has a Vceo of 65 V.

In this example Vin =14V nominal, so Vout is 10V greater, i.e., 24V nominal**.** We begin by selecting a reference current in Q1A. We can assign an arbitrary value of 1 mA. Next calculate a value for R2 to establish the reference current. With a reference current of 1mA we get:

$$\frac{(Vout - Vin - Vbe(Q1A))}{1mA} = R2$$

$$\frac{(24V - 14V - 0.6V)}{1mA} = 9.4K\Omega$$

Since the output voltage is not critical we use a 10K Ohm resistor.

This current gets mirrored in Q1B and sets up the feedback voltage to the PWM. The CS5171 has an internal voltage of 1.27V typical, so we choose R3 to give the correct feedback voltage when the current flowing through it is 1mA. In this case, R3 is 1.27K. This gives an output voltage of 24V with Vin =14V.
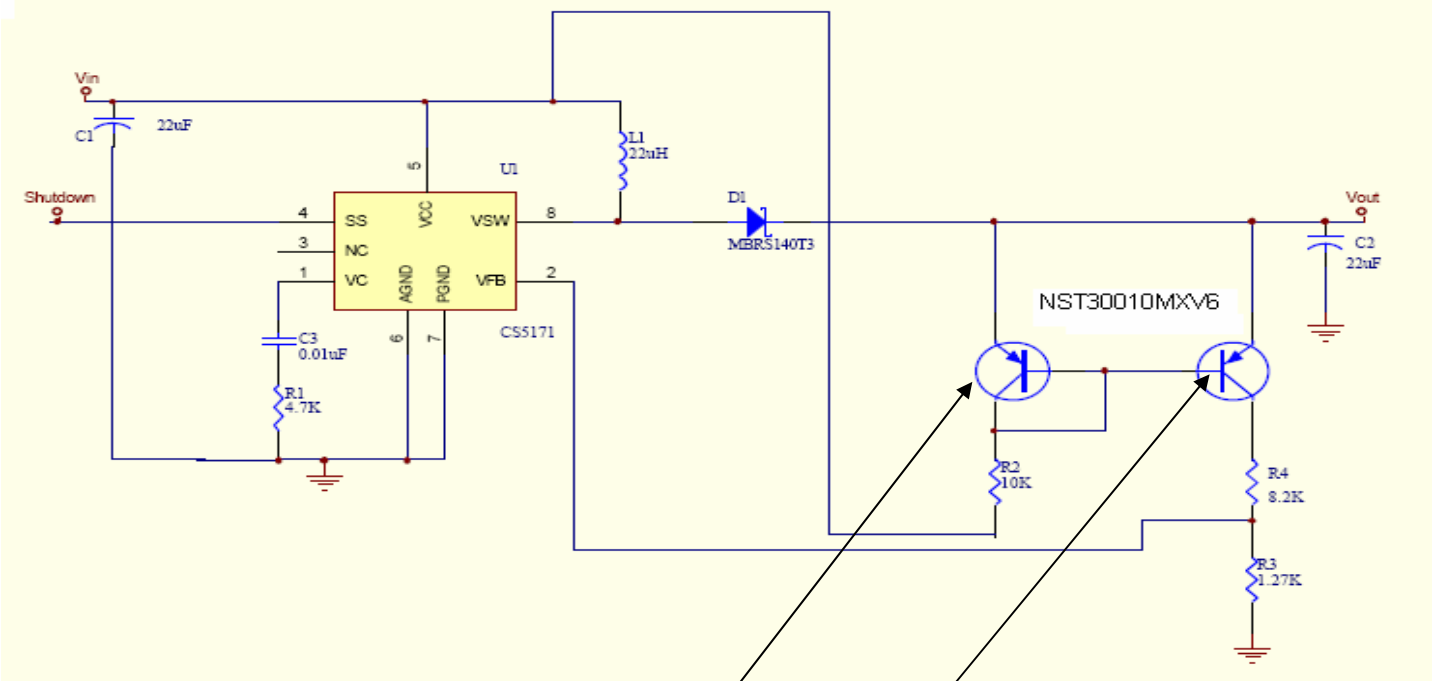
As Vin varies, Vout will track it while maintaining a 10V difference between the input and output. R4 is added to help reduce the power dissipation in Q1B.

As the input voltage varies, Vout will remain a constant 10V above the input voltage. The only limitation is the breakdown voltage of the regulator and transistors used. In this case, since the CS5171 has a V_{sw} (switch input voltage) maximum of 40V, the V_{RRM} of the Schottky rectifier used is 40V, and the Vceo of the transistor pair is 30 V the input voltage should be kept below 20V.

Key Features

- Simple, low cost circuit to ensure a constant boost voltage
- Easily adaptable for any boost circuit. Easy to modify on demo board
- Uses off the shelf components.

Schematic

Vin

C1   22uF

Shutdown

C3
0.01uF

R1
4.7K

U1

SS   VCC   VSW   8

NC   5

VC   VFB   2

AGND   PGND

6   7

CS5171

L1
22uH

D1
MBRS140T3

NST30010MXV6

R2
10K

R4
8.2K

R3
1.27K

C2
22uF

Vout

Q1A   **Q1B**

Bill of Material				
ID	**Description**	**Part Number**	**Value**	**Vendor**
C1	Capacitor		22uF	
C2	Capacitor		22uF	
R1	Resistor		1k	
R2	Resistor		10k	
R3	Resistor		1.27k	
R4	Resistor		8.2k	
Q1A &Q1B	Dual PNP	NST30010MXV6	30V Transistor	ON Semiconductor
L1	Inductor	TP4_220	22uH	Coiltronics
U1	Boost Controller	CS5171		ON Semiconductor
D1	Schottky Rectifier	MBRS140T3	40V 1A	ON Semiconductor

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