Simple 3 Amp Step-Down Fixed Voltage Regulators

PRELIMINARY

FEATURES

- 5V, 12V and 15V Output, ±3% Max Over Line and Load Conditions
- Guaranteed 3A Output Current
- Wide Input Voltage Range, from V_{OUT}+2V to 40V (60V for HV)
- Requires Only 4 External Components
- 52 kHz Fixed Frequency Internal Oscillator
- Low Power Standby Mode, I_Q Typically < 200 µA
- Efficiency Typically Over 80%
- Uses Readily Available Standard Inductors
- Thermal Shutdown and Current Limit Protection
- 100% Electrical Thermal Limit Burn-in
- Replacement for LM2576 Series

APPLICATIONS

- Simple High-Efficiency Step-Down (buck) Regulator
- Efficient Pre-Regulator for Linear Regulators
- On-Card Switching Regulators
- Positive to Negative Converter (Inverting, Buck-Boost)
- Isolated Flyback Converter using Minimum Number of External Components
- Negative Boost Converter

DESCRIPTION

The UC1576/UC2576 family of devices provides all the active functions necessary to implement a simple step-down (buck) switching regulator. Utilizing a minimum number of external components, these regulators offer a simple, high efficiency replacement for popular three-terminal adjustable linear regulators, greatly reducing, and in many cases eliminating, the need for a heat sink.

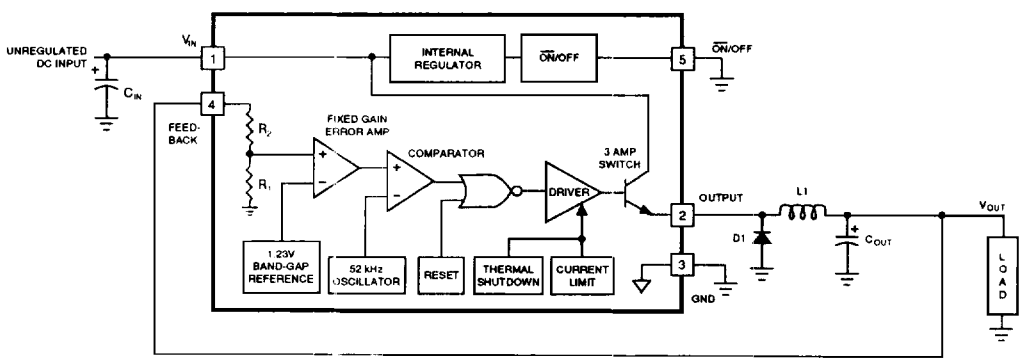
The UC1576/UC2576 series features an output voltage of 5V, 12V or 15V (see Table 1) and is capable of driving a 3A load while maintaining excellent line and load regulation. Other features include internal frequency compensation, an on-chip fixed frequency oscillator with a ±10% tolerance and feedback voltage with ±3% tolerance within specified input voltages and output load conditions. External shutdown with a standby current of 200µA is provided. The output switch includes cycle-by-cycle current limiting and thermal shutdown for full protection under fault conditions.

A standard series of inductors and capacitors are available from several manufacturers optimized for use with the UC1576/UC2576 series. This feature greatly simplifies the design of switched mode power supplies.

CONNECTION DIAGRAM

5-PIN TO-220 (TOP VIEW)
T-PACKAGE

BLOCK DIAGRAM



Note: Pin numbers are for the TO-220 package

ABSOLUTE MAXIMUM RATINGS (Note 1)

If Military/Aerospace specified devices are required, please contact the UICC Sales Office/Distributors for availability and specifications.

Maximum Supply Voltage
- UC1576/UC2576 ..... 45V
- UC2576HV 63V

ON/OFF Pin Input Voltage ..... -0.3 ≤ V ≤ +40V

Output Voltage to Ground (Steady State) ..... -1V

Power Dissipation ..... Internally Limited

Storage Temperature Range ..... -65°C to +150°C

Minimum ESD Rating
- (C = 100 pF, R = 1.5 kΩ) ..... 2 kV
- FB Pin (Pin 4) ..... 1 kV

Lead Temperature
- (Soldering, 10 sec.) ..... 260°C

OPERATING RATINGS

Maximum Junction Temperature ..... 150°C

Temperature Range
- UC1576 ..... -55°C ≤ TJ ≤ +150°C
- UC2576/UC2576HV ..... -40°C ≤ TJ ≤ +125°C

Supply Voltage
- UC1576/UC2576 ..... 40V
- UC2576HV 60V

TEST CIRCUIT AND LAYOUT GUIDELINES *(Figure 1)*

C_{IN} ..... 100 µF, 75V Aluminum Electrolytic
C_{OUT} ..... 1000 µF, 15V Aluminum Electrolytic
D1 ..... Schottky, MBR360
L1 ..... 100 µH (PE-92108) for UC2576-5
220 µH (PE-53116) for UC2576-12, and UC2576-15
5-Pin TO-220 Socket ..... 2936 (Loranger Mfg. Co.)
4-Pin TO-3 Socket ..... 8112-AG7 (Augat Inc.)

Order Number For:		Output Voltage	Temperature Range
Standard Voltage Rating (40V)	High Voltage Rating (60V)		
UC2576T-5.0	UC2576HVT-5.0	5.0	-40°C≤TJ≤+125°C
UC2576T-12	UC2576HVT-12	12.0	
UC2576T-15	UC2576HVT-15	15.0	
UC1576K-5.0		5.0	-55°C≤TJ≤+150°C
UC1576K-12		12.0	
UC1576K-15		15.0	

TABLE 1

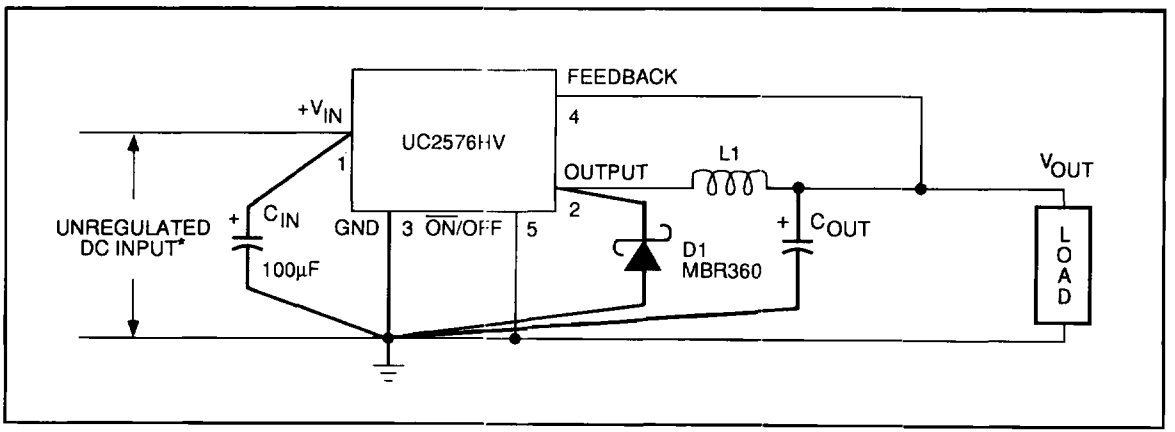


FIGURE 1

Note: *Pin numbers are for the TO-220 package*

* *7-40V (60HV) for-5, 15-35V (60HV) for-12, 17-40V (60HV) for-15*

As in any switching regulator, layout is very important. Rapidly switching currents associated with wiring inductance generate voltage transients which can cause problems. For minimal stray inductance and ground loops, the length of the leads indicated by heavy lines should be kept as **short** as possible. Single-point grounding (as indicated) or ground plane construction should be used for best results.

ELECTRICAL CHARACTERISTICS: (Unless otherwise stated, these specifications apply for T_A=-55°C to +150°C for UC1576-5 and -40°C to +125°C for the UC2576-5/UC2576HV-5, T_A=T_J). Unless otherwise specified, V_{IN} = 12V and I_{LOAD} = 500mA.

		UC1576-5			UC2576-5 UC2576HV-5			
PARAMETER	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
SYSTEM PARAMETERS (Note 2) Test Circuit *Figure 1*								
Output Voltage	V_{IN} = 12V, I_{LOAD} = 0.5A Circuit of *Figure 1*, T_J = 25°C	4.950	5.0	5.050	4.900	5.0	5.100	V
Output Voltage UC1576/UC2576	0.5A ≤ I_{LOAD} ≤ 3A, 8V ≤ V_{IN} ≤ 40V Circuit of *Figure 1* T_J = 25°C	4.800 4.850	5.0	5.200 5.150	4.750 4.800	5.0	5.250 5.200	V
Output Voltage UC2576HV	0.5A ≤ I_{LOAD} ≤ 3A, 8V ≤ V_{IN} ≤ 60V Circuit of *Figure 1* T_J = 25°C				4.750 4.800	5.0	5.275 5.225	V
Efficiency	V_{IN} = 12V, I_{LOAD} = 3A, V_{OUT} = 5V		77			77		%
DEVICE PARAMETERS								
Oscillator Frequency	(Note 9) T_J = 25°C	43 47	52	62 58	42 47	52	63 58	KHz
Saturation Voltage	I_{OUT} = 3A (Note 3) T_J = 25°		1.4	2.0 1.8		1.4	2.0 1.8	V
Max Duty Cycle (ON)	(Note 4) T_J = 25°	93	98		93	98		%
Current Limit	Peak Current (Note 3) T_J = 25°C	3.5 4.2	5.8	7.5 6.9	3.5 4.2	5.8	7.5 6.9	A
Output Leakage Current	V_{IN} = 40V, (T_J = 25°C), Output = 0V V_{IN} = 60V for HV Output = -1V (Note 5) Output = -1V		7.5	2 30		7.5	2 30	mA
Quiescent Current	(Note 5) T_J = 25°C		5	12 10		5	12 10	mA
Standby Quiescent Current	$\overline{ON}$/OFF Pin = 5V (OFF) T_J = 25°C		50	500 200		50	500 200	µA
Thermal Resistance	K Package, Junction to Ambient K Package, Junction to Case T Package, Junction to Ambient (Note 7) T Package, Junction to Ambient (Note 8) T Package, Junction to Case		35 1.5			 65 45 2		°C/W
$\overline{ON}$/OFF CONTROL Test Circuit *Figure 1*								
$\overline{ON}$/OFF Pin Logic Input Level	V_{OUT} = 0V V_{OUT} = 5V T_J = 25°C	24 2.2	1.5 1.4	 0.8 1.0	2.4 2.2	1.5 1.4	 0.8 1.0	V
$\overline{ON}$/OFF Pin Input Current	$\overline{ON}$/OFF Pin = 5V (OFF) (T_J = 25°C) $\overline{ON}$/OFF Pin = 0V (ON) (T_J = 25°C)		12 0	30 10		12 0	30 10	µA µA

ELECTRICAL CHARACTERISTICS: (Unless otherwise stated, these specifications apply for T_A=-55°C to +150°C for UC1576-12 and -40°C to +125°C for the UC2576-12/UC2576HV-12, T_A=T_J). Unless otherwise specified, V_{IN} = 25V and I_{LOAD} = 500mA.

		UC1576-12			UC2576-12 UC2576HV-12			
PARAMETER	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
SYSTEM PARAMETERS (Note 2) Test Circuit *Figure 1*								
Output Voltage	V_{IN} = 25V, I_{LOAD} = 0.5A Circuit of *Figure 1*, T_J = 25°C	11.88	12.0	12.12	11.76	12.0	12.24	V
Output Voltage UC1576/UC2576	0.5A ≤ I_{LOAD} ≤ 3A,15V ≤ V_{IN} ≤ 40V Circuit of *Figure 1* T_J = 25°C	11.52 11.64	12.0	12.48 12.36	11.40 11.52	12.0	12.60 12.48	V
Output Voltage UC2576HV	0.5A ≤ I_{LOAD} ≤ 3A, 15V ≤ V_{IN} ≤ 60V Circuit of *Figure 1* T_J = 25°C				11.40 11.52	12.0	12.65 12.52	V
Efficiency	V_{IN} = 15V, I_{LOAD} = 3A, V_{OUT} = 12V		88			88		%
DEVICE PARAMETERS								
Oscillator Frequency	(Note 9) T_J = 25°C	43 47	52	62 58	42 47	52	63 58	KHz
Saturation Voltage	I_{OUT} = 3A (Note 3) T_J = 25°		1.4	2.0 1.8		1.4	2.0 1.8	V
Max Duty Cycle (ON)	(Note 4) T_J = 25°	93	98		93	98		%
Current Limit	Peak Current (Note 3) T_J = 25°C	3.5 4.2	5.8	7.5 6.9	3.5 4.2	5.8	7.5 6.9	A
Output Leakage Current	V_{IN} = 40V, T_J = 25°C, Output = 0V V_{IN} = 60V for HV Output = -1V (Note 6) Output = -1V		7.5	2 30		7.5	2 30	A
Quiescent Current	(Note 6) T_J = 25°C		5	12 10		5	12 10	mA
Standby Quiescent Current	$\overline{ON}$/OFF Pin = 5V (OFF) T_J = 25°C		50	500 200		50	500 200	µA
Thermal Resistance	K Package, Junction to Ambient K Package, Junction to Case T Package, Junction to Ambient (Note 7) T Package, Junction to Ambient (Note 8) T Package, Junction to Case		35 1.5			 65 45 2		°C/W
$\overline{ON}$/OFF CONTROL Test Circuit *Figure 1*								
ON/OFF Pin Logic Input Level	V_{OUT} = 0V V_{OUT} = 12V T_J = 25°C	2.4 2.2	1.5 1.4	 0.8 1.0	2.4 2.2	1.5 1.4	 0.8 1.0	V
$\overline{ON}$/OFF Pin Input Current	$\overline{ON}$/OFF Pin = 5V (OFF) (T_J = 25°C)		12	30		12	30	µA
	$\overline{ON}$/OFF Pin = 0V (ON) (T_J = 25°C)		0	10		0	10	µA

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ELECTRICAL CHARACTERISTICS: (Unless otherwise stated, these specifications apply for T_A=-55°C to +150°C for UC1576-15 and -40°C to +125°C for the UC2576-15/UC2576HV-15, T_A=T_J). Unless otherwise specified, V_{IN} = 30V and I_{LOAD} = 500mA..

		UC1576-15			UC2576-15 UC2576HV-15			
PARAMETER	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
SYSTEM PARAMETERS (Note 2) Test Circuit *Figure 1*								
Output Voltage	V_{IN} = 30V, I_{LOAD} = 0.5A Circuit of *Figure 1*, T_J = 25°C	14.85	15.0	15.15	14.70	15.0	15.30	V
Output Voltage UC1576/UC2576	0.5A ≤ I_{LOAD} ≤ 3A, 18V ≤ V_{IN} ≤ 40V Circuit of *Figure 1* T_J = 25°C	14.40 14.45	15.0	15.60 15.45	14.25 14.40	15.0	15.75 15.60	V
Output Voltage UC2576HV	0.5A ≤ I_{LOAD} ≤ 3A, 18V ≤ V_{IN} ≤ 60V Circuit of *Figure 1* T_J = 25°C				14.25 14.40	15.0	15.83 15.68	V
Efficiency	V_{IN} = 18V, I_{LOAD} = 3A, V_{OUT} = 15V		88			88		%
DEVICE PARAMETERS								
Oscillator Frequency	(Note 9) T_J = 25°C	43 47	52	62 58	42 47	52	63 58	KHz
Saturation Voltage	I_{OUT} = 3A (Note 3) T_J = 25°		1.4	2.0 1.8		1.4	2.0 1.8	V
Max Duty Cycle (ON)	(Note 4) T_J = 25°	93	98		93	98		%
Current Limit	Peak Current (Note 3) T_J = 25°C	3.5 4.2	5.8	7.5 6.9	3.5 4.2	5.8	7.5 6.9	A
Output Leakage Current	V_{IN} = 40V, T_J = 25°C, Output = 0V V_{IN} = 60V for HV Output = -1V (Note 6) Output = -1V		7.5	2 30		7.5	2 30	mA
Quiescent Current	(Note 6) T_J = 25°C		5	12 10		5	12 10	mA
Standby Quiescent Current	$\overline{ON}$/OFF Pin = 5V (OFF) T_J = 25°C		50	500 200		50	500 200	µA
Thermal Resistance	K Package, Junction to Ambient K Package, Junction to Case T Package, Junction to Ambient (Note 7) T Package, Junction to Ambient (Note 8) T Package, Junction to Case		35 1.5			 65 45 2		°C/W
$\overline{ON}$/OFF CONTROL Test Circuit *Figure 1*								
$\overline{ON}$/OFF Pin Logic Input Level	V_{OUT} = 0V V_{OUT} = 12V	2.4	1.5 1.4	0.8	2.4	1.5 1.4	0.8	V
	T_J = 25°C	2.2		1.0	2.2		1.0	
$\overline{ON}$/OFF Pin Input Current	$\overline{ON}$/OFF Pin = 5V (OFF) (T_J = 25°C)		12	30		12	30	µA
	$\overline{ON}$/OFF Pin = 0V (ON) (T_J = 25°C)		0	10		0	10	µA

Note 1: *Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics.*

Note 2: *External components such as the catch diode. Inductor, input and output capacitors can affect switching regulator system performance. When the UC1576/UC2576 Is used as shown in the Figure 1 test circuit, system performance will be as shown in system parameters section of Electrical Characteristics*

Note 3: *Output (pin 2) sourcing current. No diode, inductor or capacitor connected to output.*

Note 4: *Feedback (pin 4) removed from output and connected to 0V.*

Note 5: *Feedback (pin 4) removed from output and connected to 12V to force the output transistor OFF.*

Note 6: *Feedback (pin 4) removed from output and connected to 25V to force the output transistor OFF.*

Note 7: *Junction to ambient thermal resistance (no external heat sink) for the 5 lead TO-220 package mounted vertically, with 1/2 inch leads in a socket, or on a PC board with minimum copper area.*

Note 8: *Junction to ambient thermal resistance (no external heat sink) for the 5 lead TO-220 package mounted vertically, with 1/4 inch leads soldered to a PC board containing approximately 4 square inches of copper area surrounding the leads.*

Note 9: *The oscillator frequency reduces to approximately 18 kHz in the event of an output short or an overload which pulls the output lower than 3V for UC2576-5.0, or lower than 7.2V for UC2576-12 and lower than 9V for UC2576-15. This self protection features lowers the average power dissipation of the IC by lowering the minimum duty cycle from 5% down to approximately 2%.*

Note 10: *Refer to RETS UC1576K For current revision of military RETS/SMD.*

Typical Performance Characteristics *(Circuit of Figure 1)*

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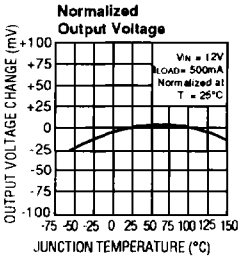
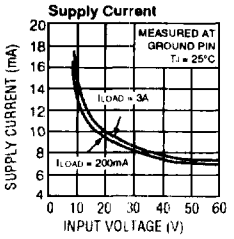
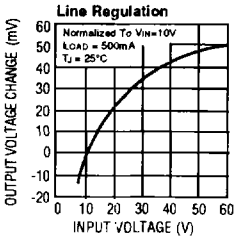
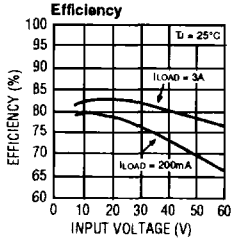
UC1576-5.0/UC2576-5.0

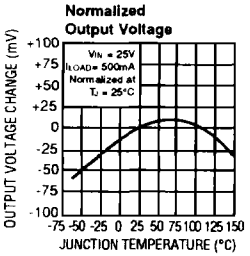


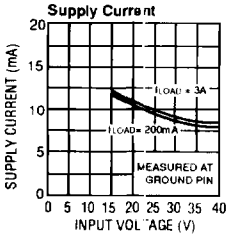


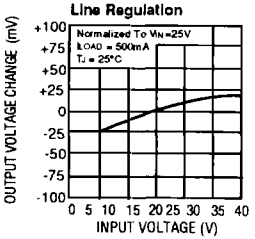


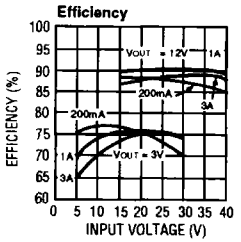


UC1576-12/UC2576-12

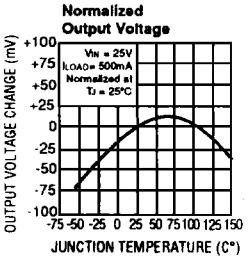


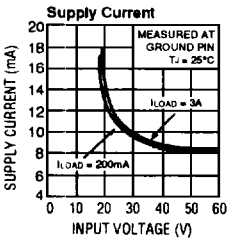


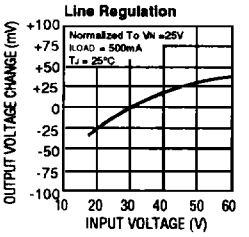


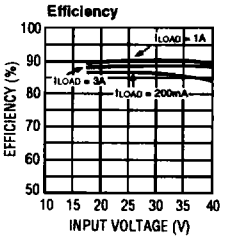


UC1576-15/UC2576-15

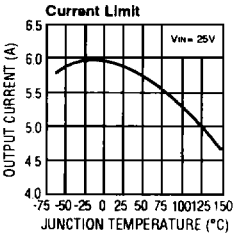


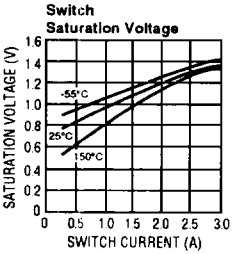


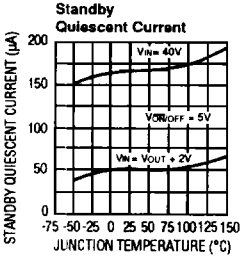




Other Characteristics:







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