

MHP8564 SINGLE 4 Amp POINT-OF-LOAD REGULATOR

Levels Available
COTS
MILITARY
SPACE

DESCRIPTION

The MHP series are non-isolated Point of Load switching regulators for high reliability Military and Space distributed power applications. Fully integrated, these include a buck controller, inductor, and input / output capacitors combined in a single package. They operate from an input voltage of +4.5V to +5.5V (See Note 1), providing step down power conversion to output voltages as low as 0.5V or lower (See Note 2). Operating features include output voltage adjust, output current limit, enable, external synchronization and soft start. Some models can also be setup in a parallel configuration to increase output current capability and reduce ripple on the input and output supplies. Careful design and layout ensure excellent stability, transient response, and low noise operation. Packaged in a compact metal case, it operates over the full -55°C to +125°C temperature range.

Important: For the latest information, visit our website <http://www.microsemi.com>.



**16 Pin Flat Pack
(MHP8564)**

FEATURES

- Smallest footprint in the Space Industry
- Single 4 Amp product (Note 2)
- Efficiencies to 87%, see Figure 12
- Radiation Hard to 100K rad TID
- SE results show no significant output transients through an LET of 58 MeV/(mg/cm²)
- Optimized for 5V input. Consult factory for higher input voltages. (Note 1)
- Operates down to 4.5 Volts input
- Current Mode Control
- Adjustable output Voltage between 0.5V and 4V (depends on model, see table 3) (Note 2)
- Parallelable models available, described both on this data sheet as well as on the data sheets for the MHP8565P single and the MHP8566 Quad.
- Synchronizable models available (See Table 3)
- Enable function available
- Soft start capable (See Figure 9)
- Operates at a nominal frequency of 500KHz

APPLICATIONS / BENEFITS

- More efficient than competitive POLs (See Figure 11).
- Some models are parallelable

MSC – Lawrence
6 Lake Street,
Lawrence, MA 01841
1-800-446-1158
(978) 620-2600
Fax: (978) 689-0803

Website:
www.microsemi.com

Table 1 – ABSOLUTE MAXIMUM RATINGS ($T_c = +25^\circ\text{C}$ unless otherwise note)

Parameters / Test Conditions	Symbol	Value	Unit
Input Voltage (Note 1)	V_{in}	10	Vdc
Enable Input Voltage	V_{en}	7	Vdc
Sync Input Voltage	V_{sync}	7	Vdc
Approximate Weight	SIP	11	Grams
Operating Temperature Range, Base of Package	T_c	-55 to +125	$^\circ\text{C}$
Storage Temperature Range	T_{stg}	-65 to +150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Parameters / Test Conditions	Symbol	Value	Unit
Series Switch Thermal Resistance, Junction-to-Case, SIP	$R_{\theta JC}$	5	$^\circ\text{C}/\text{W}$

MECHANICAL and PACKAGING

- See Figures 5 through 8, and Tables 5 through 6.

Table 2 – ELECTRICAL CHARACTERISTICS (See Note 5)
($T_A = -55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ unless otherwise noted)

Parameters / Test Conditions	Symbol	Value			Unit
		Min.	Nom	Max.	
Minimum input Voltage (Note 9)	V _{in(min)}	4.5			V
Output Voltage Accuracy V _o = 1.21V	V _{out}	1.19		1.23	V
Post 100K Irradiation, 25°C	V _{out}	1.17		1.24	V
Line regulation 4.5V < V _{in} < 5.5V V _o = 1.21V	K _{vi}	-0.5		+0.5	%
Load regulation 1A < I _{out} < 3A	K _{vo}	-1		+1	%
Synchronizing range (Note 6) 10% < Duty cycle < 90%, V _{sync} = 0 to 4.5V, 25°C	F _{sync}	580		1000	KHz
Sync threshold (25°C) (Note 6)	V _{sync}		1.5	2.2	V
Current Limit V _o = 2.5V	I _{CL}	4.5	6		A
Post 100K Irradiation, 25°C	I _{CL}	4.0			A
Input Voltage on Enable pin to guarantee shutdown I _o = 0A (Note 4)	V _{shdn}	0.13	0.40	0.60	V
Operating Frequency (Sync Pin grounded) (Note 6)	f	440	500	560	KHz
Post irradiation, 25°C		350		540	

Table 3 – MODEL NUMBER FUNCTIONALITY CHART

MODEL NUMBER	NOTES	PACKAGE TYPE	OUTPUT TYPE			OTHER FUNCTIONALITY				FORMER P/N
		SIP	Adj	Fixed Note B	Remote Sense Note B	Enable Pin	Parallelable Note A	Output Voltage Range Note 2 Note 8	Internal Compensation	
MHP8564A\$&*	4 Amp Series	✓	✓			✓	Note C	0.5 – 4V	✓	SAT8564A-4\$F-ADJ
MHP8564F\$&*	4 Amp Series	✓		✓		✓	Note C	1.2 – 4V	✓	SAT8564F-4\$F-x.y
MHP8564R\$&*	4 Amp Series	✓			✓	✓	Note C	1.2 – 4V	✓	SAT8564R-4\$F-x.y
MHP8564S\$&*	4 Amp Series	✓	✓			✓	✓	0.5 – 4V	NO	SAT8564S-4\$F-ADJ

Replace "\$" with letter to denote required screening level

- C = COTS
- M = MILITARY
- S = SPACE

Replace "&" with lead bend option

- Blank = No lead bend
- 1 = SMT lead bend
- 2 = lead bend down
- 3 = lead bend up
- 4 = space saving SMT lead bend

Replace "*" with lead finish option

- C = Gold plate
- A = Solder dip over gold plate

NOTE A: Parallelable devices have a synchronizing pin so that units can be driven out of phase from each other for the purpose of input and output Voltage Bus ripple reduction. Other functions necessary for Paralleling are also available

NOTE B: Fixed and remote sense part numbers must be appendaged with fixed value of output Voltage.
Example: MHP8564F\$&-1.8 for a 1.8V fixed output.

NOTE C: Sync PIN is available. Other functions necessary for Paralleling are not available.

Table 4 – SCREENING OPTIONS

TEST	COMMERCIAL	MILITARY	SPACE	MIL-STD-883 Method
	COTS	MIL-PRF-38534 Equivalent		
Element Evaluation	N/A	Military	Space	Note 11
Non-Destruct Wirebond Pull	N/A	Sample	100%	2023
Pre-Cap Visual	N/A	100%	100%	2017
Temperature Cycle	N/A	100%	100%	1010
Constant Acceleration	N/A	100%	100%	2001
PIND	N/A		100%	2020
Pre-Burn In Electrical	N/A	100%	100%	
Burn-In	N/A	100% (160 Hours)	100% (320 Hours)	1015
Final Electrical Tests	100% (25°C)	100%	100%	Note 11
Hermeticity (Fine and Gross Leak)	100%	100%	100%	1014
X-Ray (Note 10)	N/A	N/A	Yes	2012
External Visual	Sample	100%	100%	2009

NOTES:

1. Most internal components are rated at +10 Volts maximum with some as high as 16V, and are therefore properly derated for operation at a nominal input of +5 Volts. For use at higher input voltages, please consult factory about your desired operating voltage and your derating requirements for a check of possible component changes.
2. Internal series switch is self protected and is rated to conduct 4.5 Amps minimum. However, limitations on internal components plus the characteristics of PWM operation conspire to reduce further the minimum available output current, especially at output Voltages above $V_{in}/2$. Minimum available output current is guaranteed to be as specified at output Voltage of 2.5 V down to 1.21 V, assuming a clean layout. At output Voltages below 1.21 V, maximum output current may reduce by up to 1 Amp, depending on actual output Voltage, and load regulation may degrade slightly (up to 1%). At 3.3 V output with a 5 V input, output current reduces by 0.5 A from the value specified at 2.5 V out.
3. Microsemi does not at this time have a MIL-PRF-38534 qualified radiation hardness assurance program.
4. If not used, or when on, Enable pin should be pulled up to a logic one (2.5V min, 7V max) through a resistor of no more than 5K Ohms. Voltage on this pin to disable operation needs to be less than 0.13V.
5. Testing is accomplished at an output load of 1A, and at an output Voltage of 2.5V and an input of 5V unless otherwise specified. Only the specifications with post radiation limits are tested after radiation exposure.
6. Synchronizing pin, if available (see model chart) must be grounded if not used. Consult factory when contemplating use of frequencies above 580 kHz. Pin input impedance is 40K Ohms.
7. All package outline dimensions are in inches.
8. Consult factory for operation at output voltages below 1.0V. Also see Figure 10.
9. Minimum input voltage is guaranteed by line regulation test.
10. Performed at a DLA approved facility.
11. Tested per MIL-PRF-38534 screening flow.

APPLICATION CIRCUITS, 4 Amp PRODUCT

Figure 1 – Basic Fixed Regulator Version

$$V_{out} = V_{ref} \times (1 + R_{adj} / 2490), \text{ with } V_{ref} \sim 1.21 \text{ Volts}$$

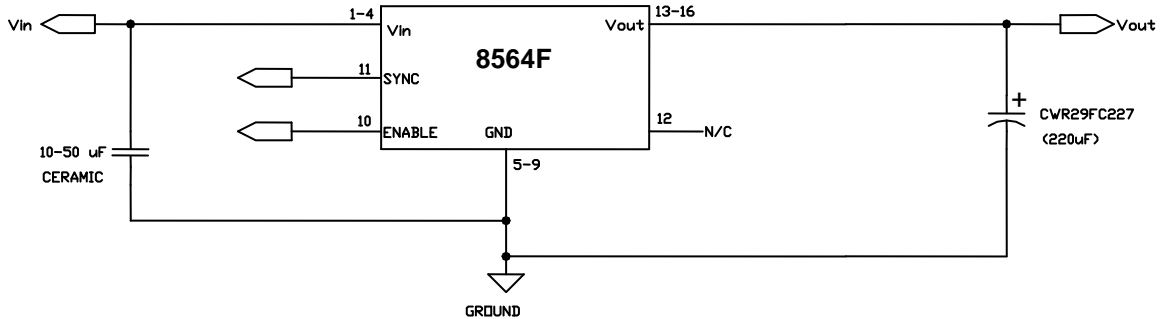


Figure 2 – Adjustable Regulator Version

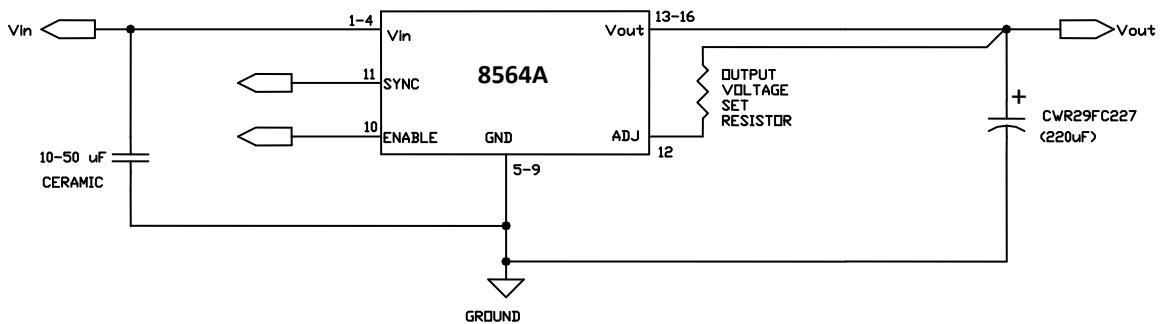
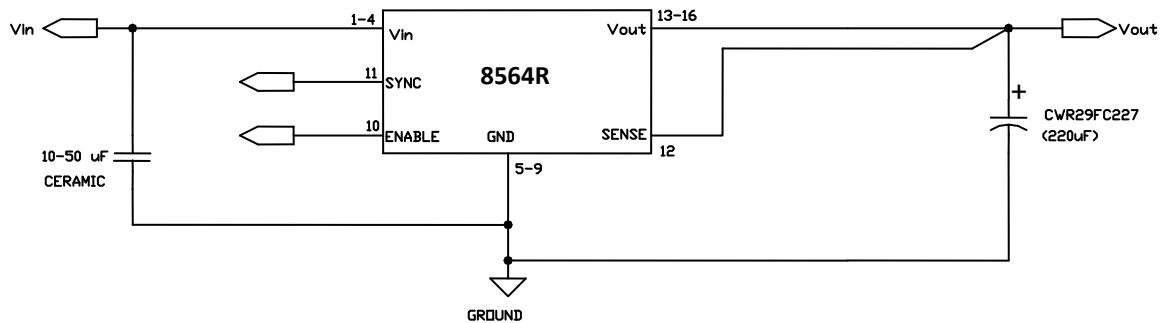
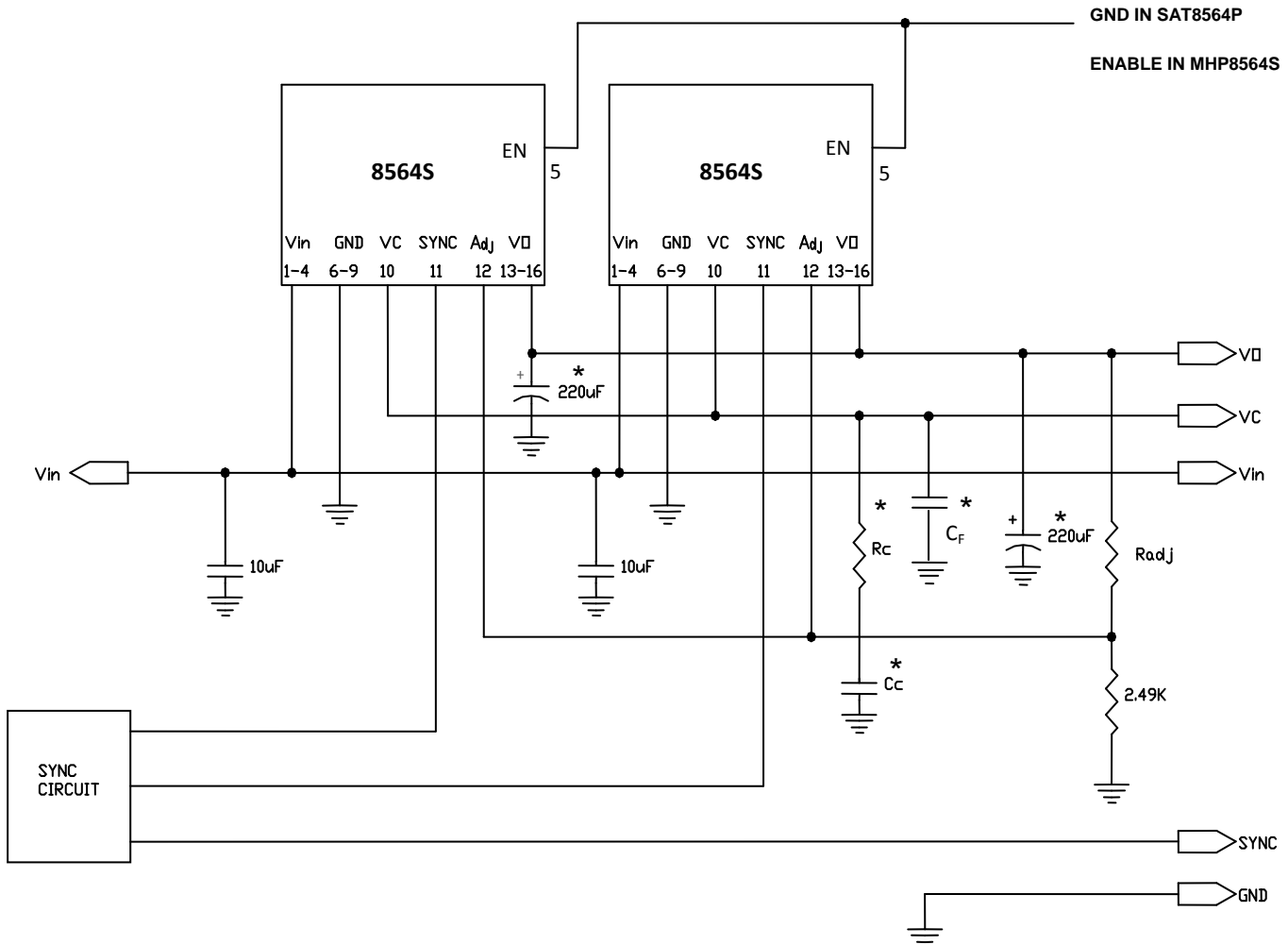


Figure 3 – Remote Sense Version



APPLICATION CIRCUITS, 4 Amp PRODUCT

Figure 4 – Parallel Configuration



* When employing only electrolytic output capacitors, the simplest compensation is a capacitor whose value is 1.5nF times the number of paralleled units. However, a slightly more complex compensation of a resistor (R_c) of value 1.6 kOhms divided by the number of units in parallel, in series with a capacitor (C_c) of value 3900pF times the number of units in parallel, all of which is in Parallel with a capacitor (C_F) of value 1000pf times the number of units in parallel, generally leads to smoother output transitions with less turn on overshoot. Output capacitors should be as shown in Figure 2, one ea CWR29FC227 per regulator.

When employing ceramic output capacitors, the simplest compensation is a capacitor whose value is 22nF times the number of units in parallel. This may, however produce an overshoot at turn on. User should check to see that output turn-on, steady state, and transient behavior is acceptable with any chosen compensation scheme.

Sync circuit is not required for parallel operation. If not used, ground all Sync pins.

PACKAGE OUTLINES, 4 Amp PRODUCT (8564)

Figure 5 – Standard Straight Lead Package

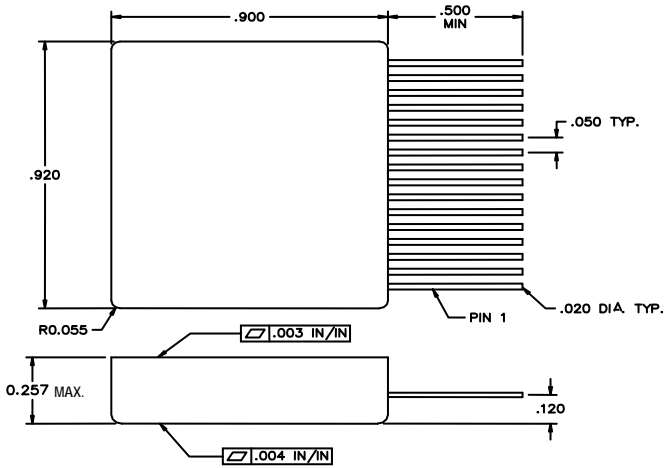


Table 5 – Normal Configurations – 8564A, F, R

PIN #	DESCRIPTION
1-4	Vin
5-9	GND
10	Shutdown
11	Sync
12	Adjust/ Sense*
13-16	Vout

* No connection for Fixed. Adjust pin for adjustable configuration. Sense pin for remote sense version.

Figure 6 – Surface – Mount Lead-Bend

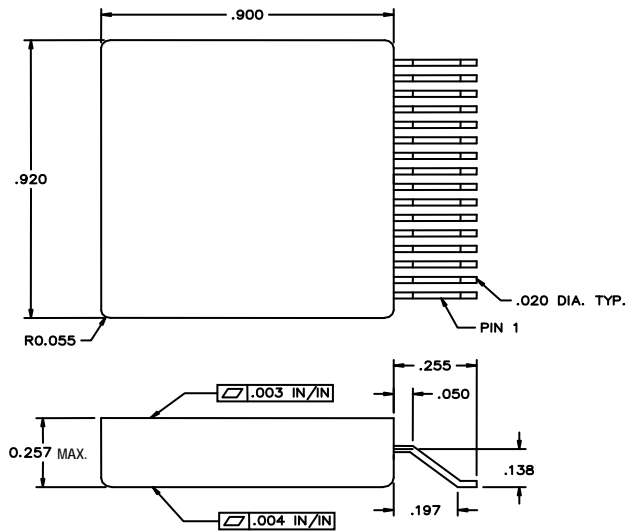


Table 6 – Paralleable Configuration – 8564S

PIN #	DESCRIPTION
1 - 4	Vin
5	Enable
6 - 9	GND
10	Vcomp
11	Sync
12	Adjust
13 - 16	Vout

PACKAGE OUTLINES, 4 Amp PRODUCT (8564)

Figure 7 – Right Angle Lead-Bend

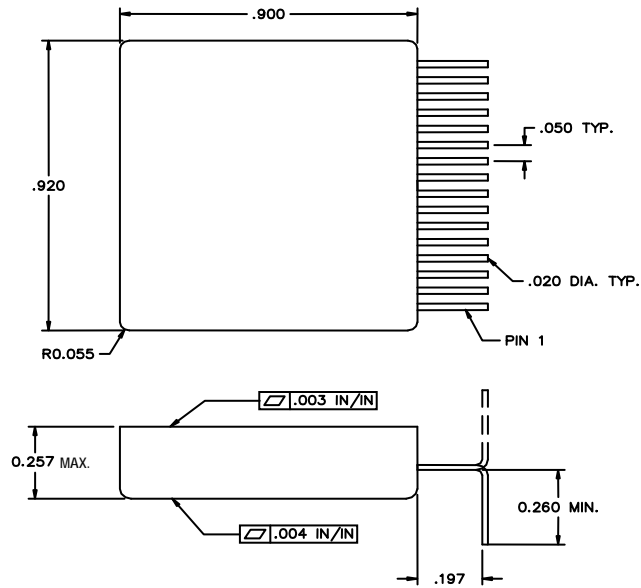
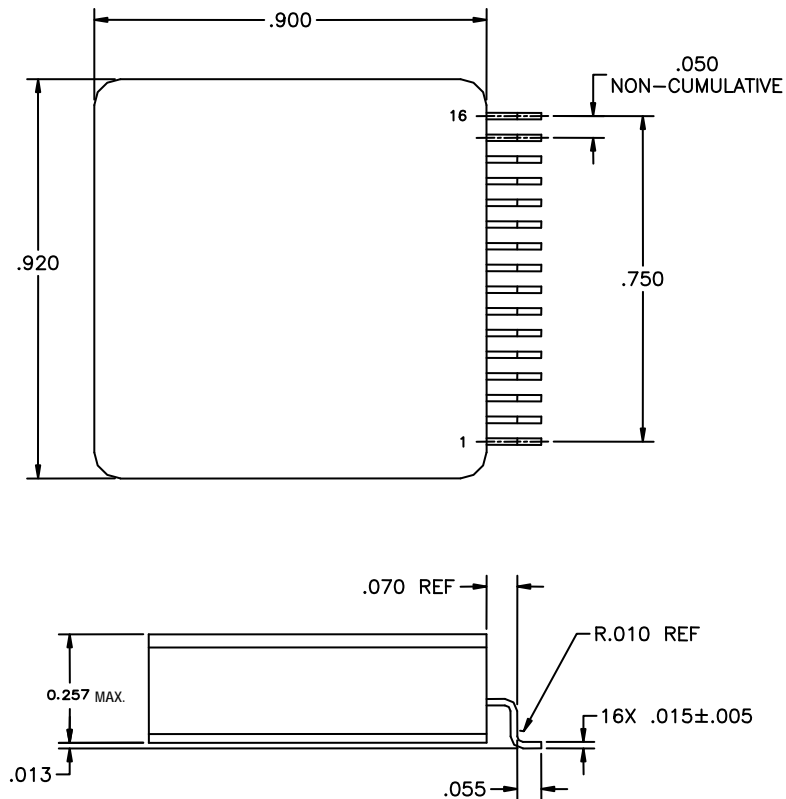
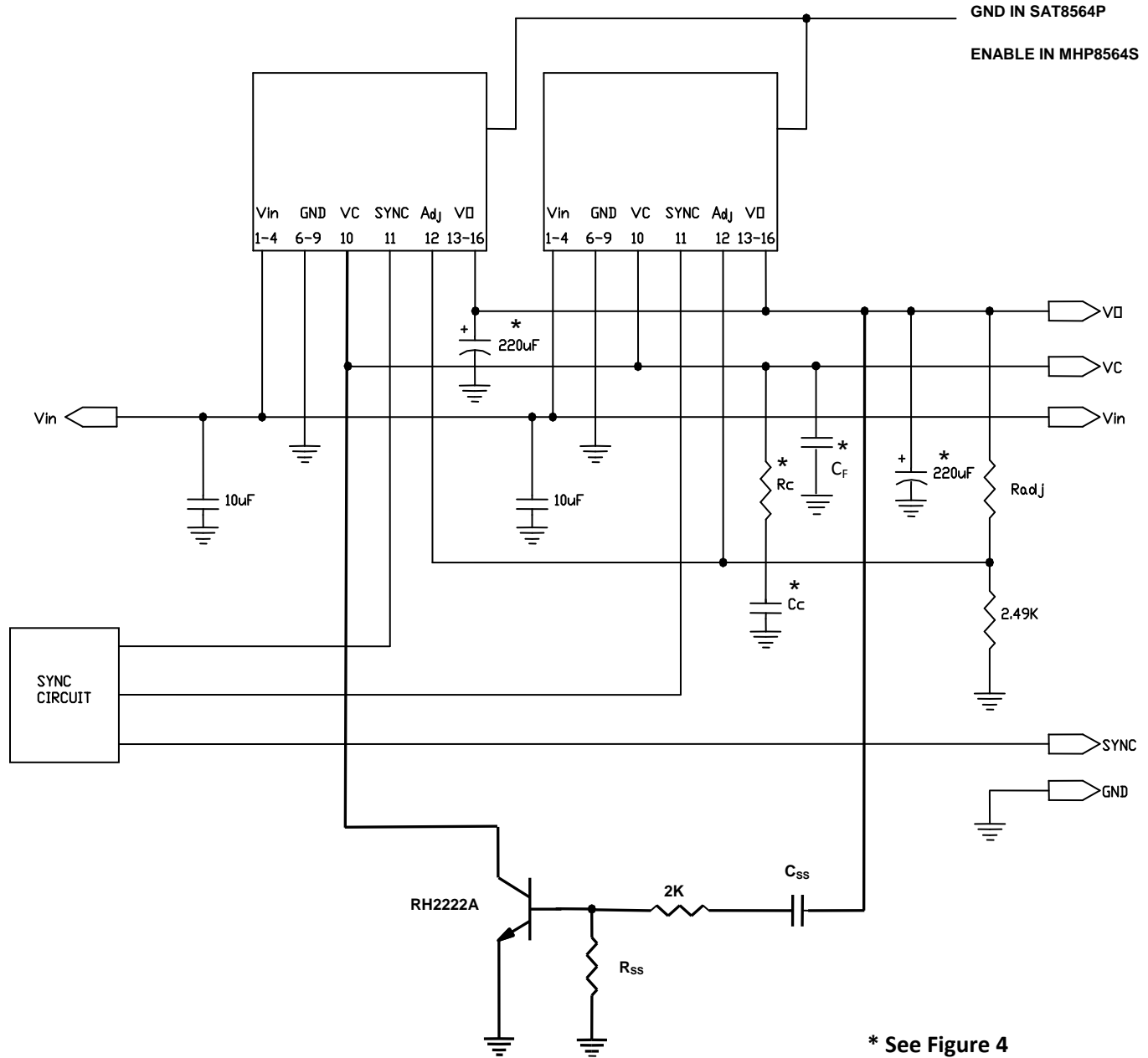


Figure 8 – Space Saving Surface Mount Lead Bend.



PACKAGE OUTLINES, 4 Amp PRODUCT (8564)

Figure 9 – Soft Start Implementation

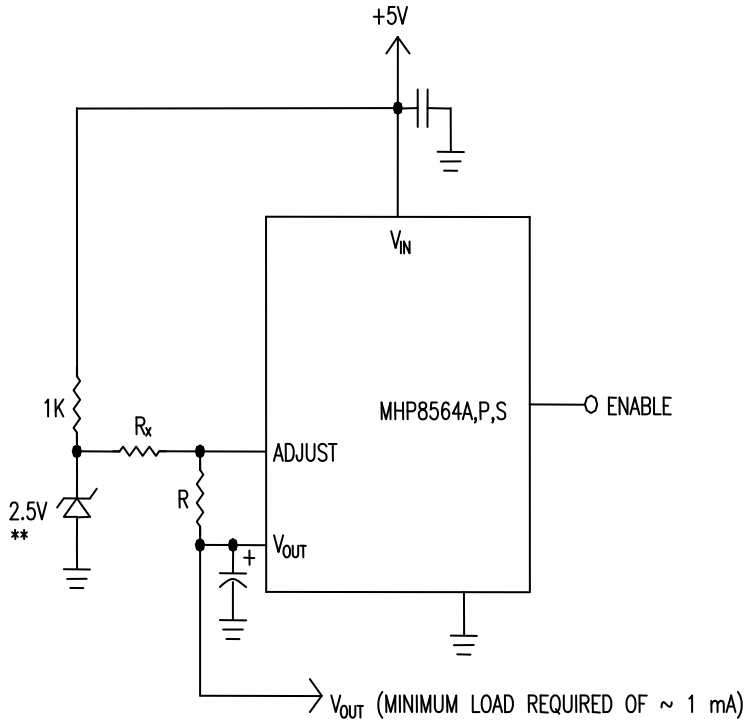


$$\text{Rise Time} = \frac{(R_{ss})(C_{ss})(V_{out})}{0.7}$$

Example: with $R_{ss} = 47K$ and $C_{ss} = 15nF$, Rise Time = 2.5ms

PACKAGE OUTLINES, 4 Amp PRODUCT (8564)

Figure 10 – Circuit for Creating Regulated Output Voltages below 1.21 Volts



Rx Value	
Model	Rx
8564A	868Ω
8564F	N/A
8564R	N/A
8564P	1.29K
8564S	1.29K

$$V_{out} = 1.21 - R \text{ (K-Ohms)}$$

Example: If $R = 0.21K$ Ohms (210 Ohms), $V_{out} = 1.21 - 0.21 = 1.0V$, within the limits of the tolerances of the components used.

** RAD Hard Zener or other fixed voltage >2V may be used. For any voltage other than 2.5V, resistor values would have to be adjusted accordingly.

Figure 11 – MHP8564 Typical Efficiency vs Typical Competitive POL (Vin = 5V, Vout = 3.3V)

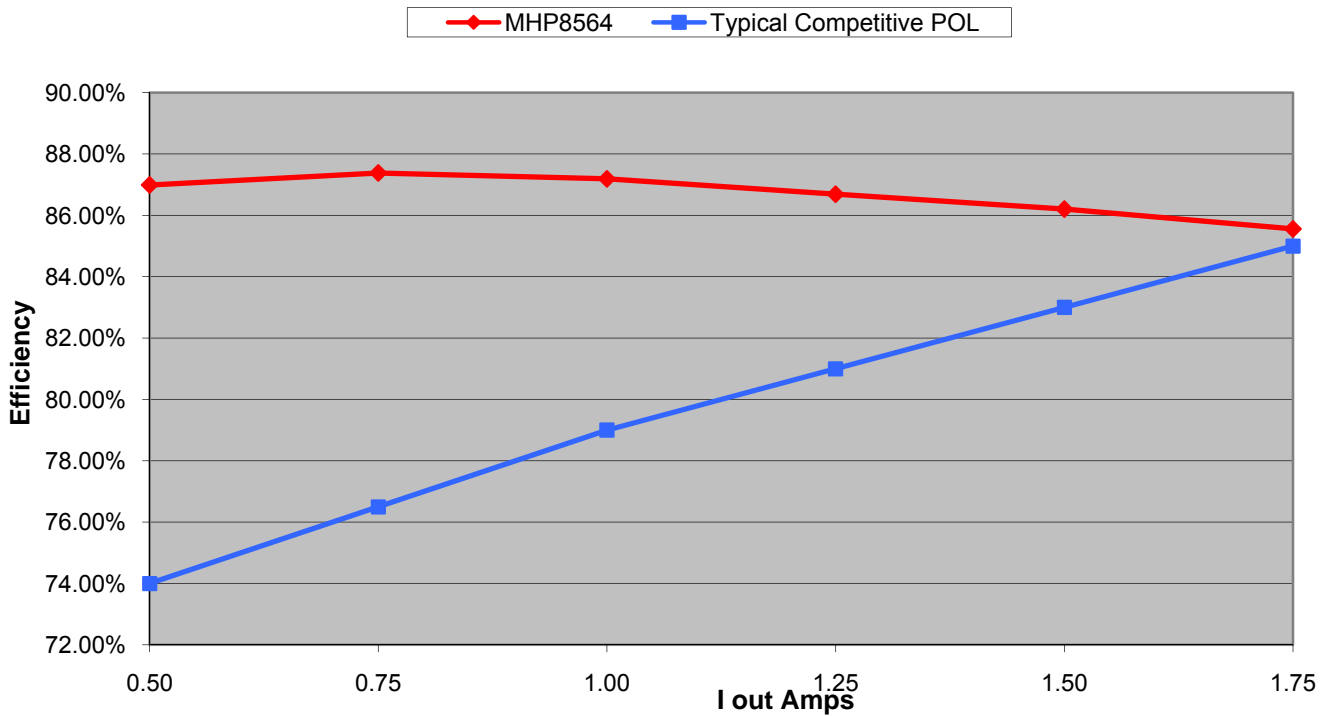


Figure 12 – MHP8564 Typical Efficiency Curves (Vin = 5V)

