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KA7500C SMPS Controller

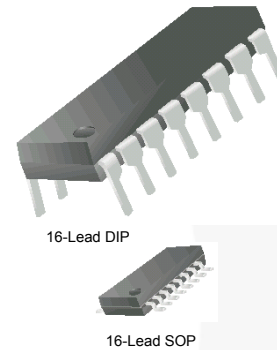
Features

- Internal Regulator Provides a Stable 5V Reference Supply Trimmed to $\pm 1\%$ Accuracy
- Uncommitted Output TR for 200mA Sink or Source Current
- Output Control for Push-Pull or Single-Ended Operation
- Variable Duty Cycle by Dead-Time Control (Pin 4) Complete PWM Control Circuit
- On-Chip Oscillator with Master or Slave Operation
- Internal Circuit Prohibits Double Pulse at Either Output


Description

The KA7500C is used for the control circuit of the pulse-width modulation switching regulator. The KA7500C consists of 5V reference voltage circuit, two error amplifiers, flip flop, an output control circuit, a PWM comparator, a dead-time comparator, and an oscillator.

This device can be operated in the switching frequency of 1kHz to 300kHz. The precision of voltage reference (V_{REF}) is improved up to $\pm 1\%$ with trimming. This provides a better output voltage regulation. The operating temperature range is $-25^{\circ}\text{C} \sim +85^{\circ}\text{C}$.



Ordering Information

| Part Number | Operating Temperature Range |  Eco Status | Package | Packing Method |
|-------------|-----------------------------|--|-------------------------------------|----------------|
| KA7500C | -25 to +85°C | RoHS | 16-Lead Dual Inline Package (DIP) | Tube |
| KA7500CD | | | 16-Lead Small Outline Package (SOP) | Tube |
| KA7500CDTF | | | | Tape and Reel |

 For Fairchild's definition of Eco Status, please visit: http://www.fairchildsemi.com/company/green/rohs_green.html.

Block Diagram

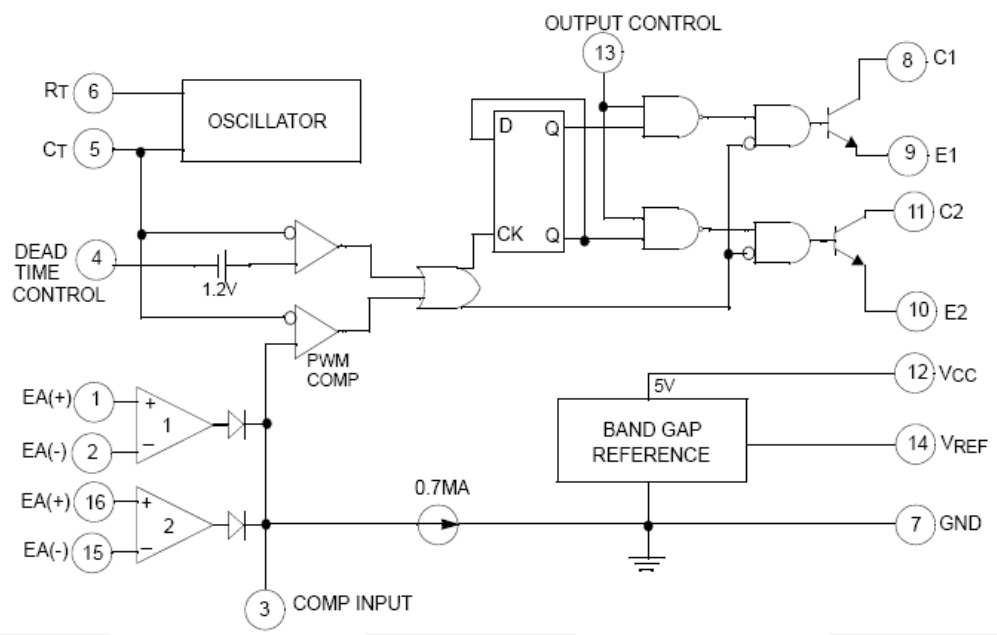


Figure 1. Block Diagram

Typical Application

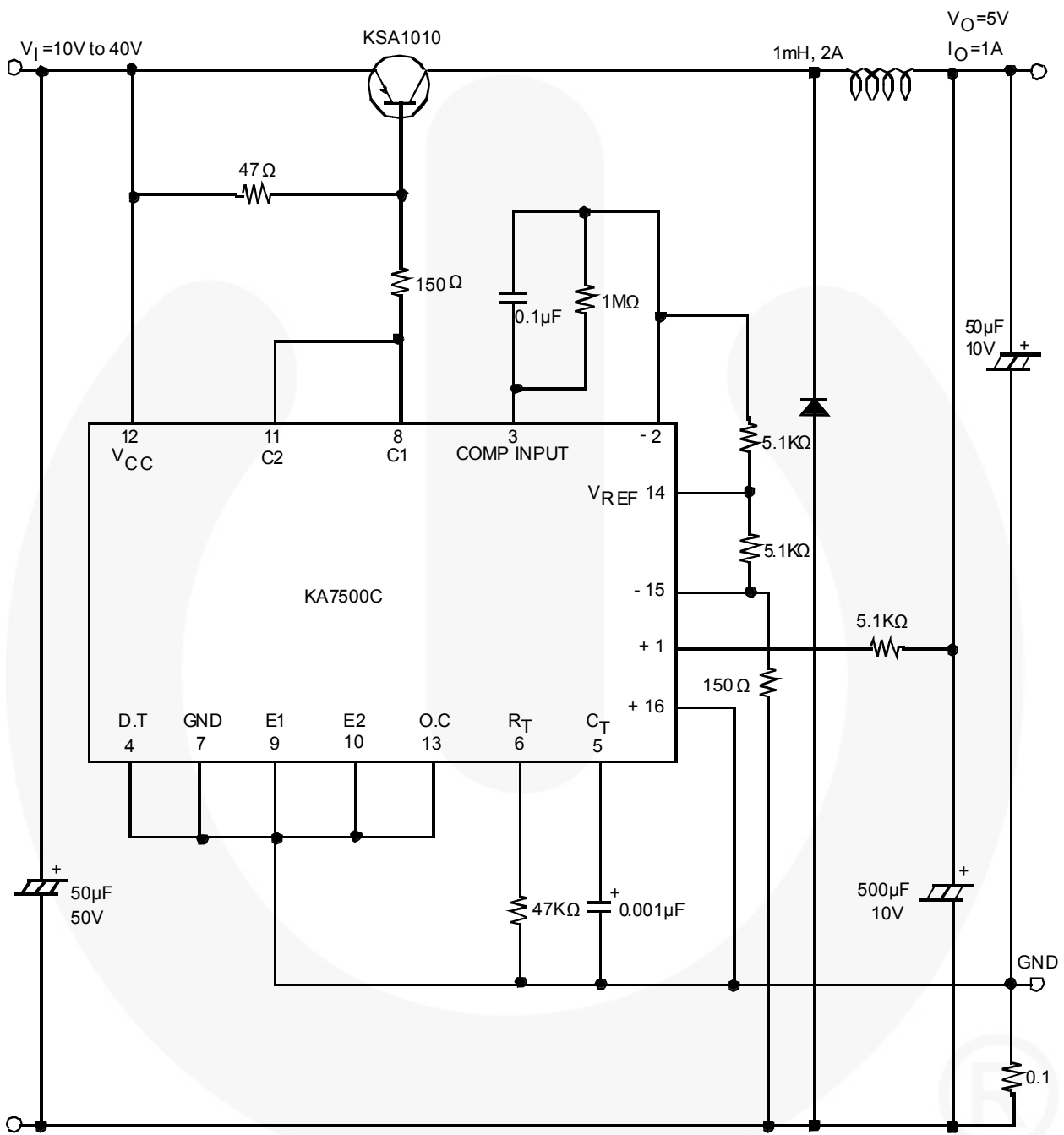


Figure 2. Pulse-Width Modulated Step-Down Converter

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol | Parameter | Min. | Max. | Unit |
|-----------|-----------------------------|----------|----------------|------|
| V_{CC} | Supply Voltage | | 42 | V |
| V_C | Collector Supply Voltage | | 42 | V |
| I_O | Output Current | | 250 | mA |
| V_{IN} | Amplifier Input Voltage | | $V_{CC} + 0.3$ | V |
| P_D | Power Dissipation | KA7500C | 1 | W |
| | | KA7500CD | 0.9 | |
| T_{OPR} | Operation Temperature Range | -25 | +85 | °C |
| T_{STG} | Storage Temperature Rang | -65 | +150 | °C |
| T_J | Junction Temperature | | +125 | °C |

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|------------------|--|--------|--------|----------------|------------|
| V_{CC} | Power Supply Voltage | 7 | 15 | 40 | V |
| V_{C1}, V_{C2} | Collector Supply Voltage | | 30 | 40 | V |
| I_{C1}, I_{C2} | Collector Output Current (Each Transition) | | | 200 | mA |
| V_{IN} | Amplifier Input Voltage | 0.3 | | $V_{CC} - 2.0$ | V |
| I_{FB} | Current Into Feedback Terminal | | | 0.3 | mA |
| I_{REF} | Reference Output Terminal | | | 10 | mA |
| R_T | Timing Resistor | 1.8 | 30.0 | 500.0 | K Ω |
| C_T | Timing Capacitor | 0.0047 | 0.0010 | 10.0000 | μ A |
| f_{OSC} | Oscillator Frequency | 1 | 40 | 200 | kHz |
| V_{IN_PWM} | PWM Input Voltage (Pins 3, 4, and 13) | 0.3 | | 5.3 | V |

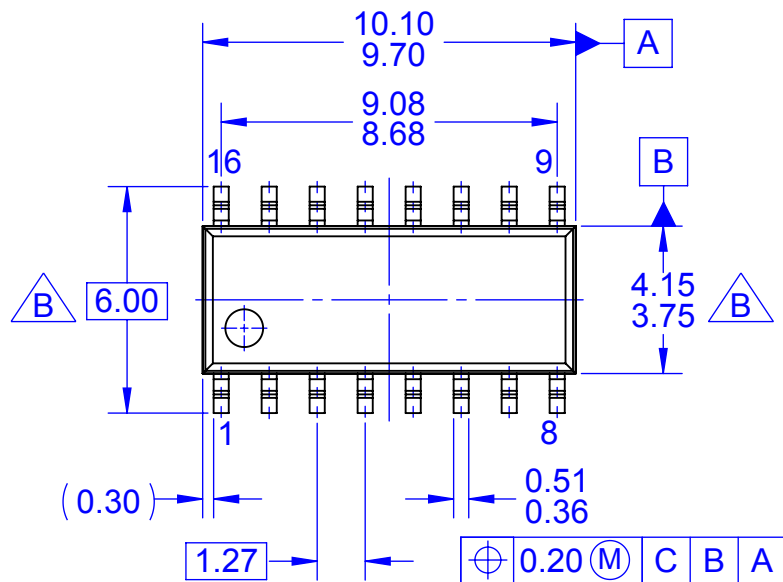
Electrical Characteristics

$V_{CC} = 20V$, $f = 10kHz$, $T_A = -25^{\circ}C$ to $+85^{\circ}C$, unless otherwise specified.

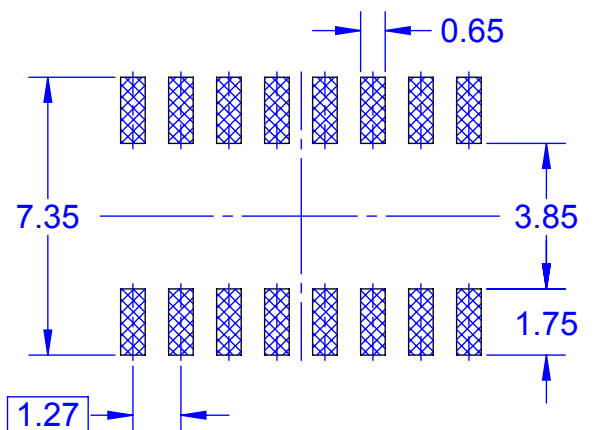
| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|--|--|------|------|----------|---------|
| Reference Section | | | | | | |
| V_{REF} | Reference Output Voltage | $I_{REF}=1mA$, $T_A=25^{\circ}C^{(1)}$ | 4.95 | 5.00 | 5.05 | V |
| | | $I_{REF}=1mA$ | 4.90 | 5.00 | 5.10 | |
| R_{LINE} | Line Regulation | $V_{CC}=7V$ to $40V$ | | 2 | 25 | mV |
| R_{LOAD} | Load Regulation | $I_{REF}=1mA$ to $10mA$ | | 1 | 15 | mV |
| I_{SC} | Short-Circuit Output Current | $V_{REF}=0V$ | 10 | 35 | 50 | mA |
| Oscillation Frequency | | | | | | |
| f_{OSC} | Oscillation Frequency | $C_T=0.001\mu F$, $R_T=30K\Omega$ | | 40.0 | | kHz |
| | | $C_T=0.01\mu F$, $R_T=12K\Omega$, $T_A=25^{\circ}C$ | 9.2 | 10.0 | 10.8 | |
| | | $C_T=0.01\mu F$, $R_T=12K\Omega$, $T_A=T_{LOW}$ to T_{HIGH} | 9.0 | | 12.0 | |
| $\Delta f/\Delta t$ | Frequency Change with Temperature | $C_T=0.01\mu F$, $R_T=12K\Omega$ | | | 2 | % |
| Dead-Time Control Section | | | | | | |
| I_{BIAS} | Input Bias Current | $V_{CC}=15V$, $0V \leq V_4 \leq 5.25V$ | | -2 | -10 | μA |
| $D_{(MAX)}$ | Maximum Duty Cycle | $V_{CC}=15V$, $V_4=0V$, OC $Pin=V_{REF}$ | 45 | | | % |
| V_{ITH} | Input Threshold Voltage | Zero Duty Cycle | | 3.0 | 3.3 | V |
| | | Maximum Duty Cycle | 0 | | | |
| Error Amplifier Section | | | | | | |
| V_{IO} | Input Offset Voltage | $V_3=2.5V$ | | 2 | 10 | mV |
| I_{IO} | Input Offset Current | $V_3=2.5V$ | | 25 | 250 | mA |
| I_{BIAS} | Input Bias Current | $V_3=2.5V$ | | 0.2 | 1.0 | μA |
| V_{CIM} | Common Mode Input Voltage | $7V \leq V_{CC} \leq 40V$ | -0.3 | | V_{CC} | V |
| G_{VO} | Open-Loop Voltage Gain | $0.5V \leq V_3 \leq 3.5V$ | 70 | 95 | | dB |
| B_W | Unit-Gain Bandwidth | | | 650 | | kHz |
| PWM Comparator Section | | | | | | |
| V_{ITH} | Input Threshold Voltage | Zero Duty Cycle | | 4.0 | 4.5 | V |
| I_{SINK} | Input Sink Current | $V_3=0.7V$ | -0.3 | -0.7 | | mA |
| Output Section | | | | | | |
| $V_{CE(SAT)}$ | Output Saturation Voltage Common Emitter | $V_E=0V$, $I_C=200mA$ | | 1.0 | 1.3 | V |
| $V_{CC(SAT)}$ | Emitter-Follower | $V_C=15V$, $I_E=-200mA$ | | 1.5 | 2.5 | |
| $I_{C(OFF)}$ | Collector Off-State Current | $V_{CC}=40V$, $V_{CE}=40V$ | | 2 | 100 | μA |
| $I_{E(OFF)}$ | Emitter Off-State Current | $V_{CC}=V_C=40V$, $V_E=40V$ | | | -100 | |
| Total Device | | | | | | |
| I_{CC} | Supply Current | $Pin6=V_{REF}$, $V_{CC}=15V$ | | 6 | 10 | mA |
| Output Switching Characteristics | | | | | | |
| t_R | Rise Time, Common Emitter, Common Collector | | | 100 | 200 | ns |
| t_F | Fall Time, Common Emitter, Common Collector | | | 25 | 100 | |

Note:

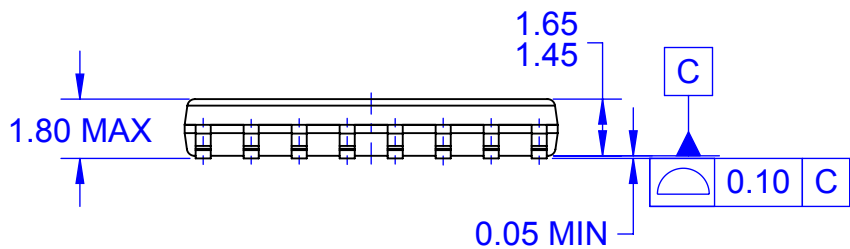
- This is guaranteed where the marking code of the package surface is over 027.



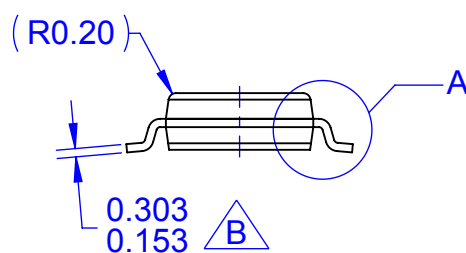
TOP VIEW



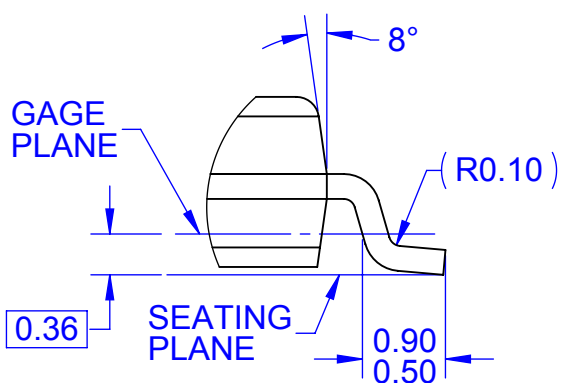
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FRONT VIEW



SIDE VIEW



DETAIL A
SCALE 3:1

NOTES:

A. THIS DRAWING COMPLIES WITH JEDEC MS-012, EXCEPT AS NOTED

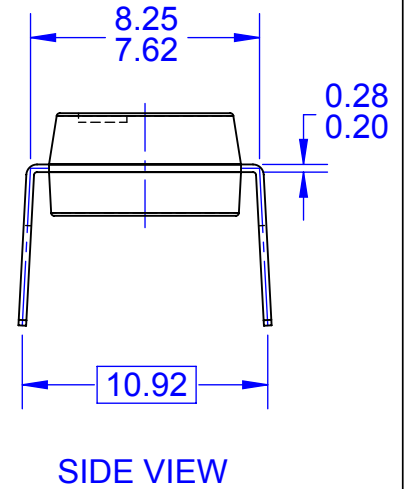
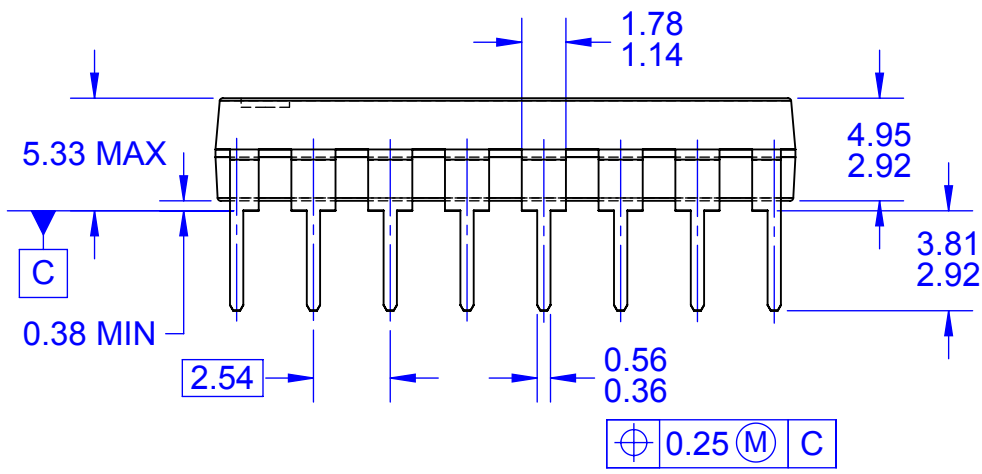
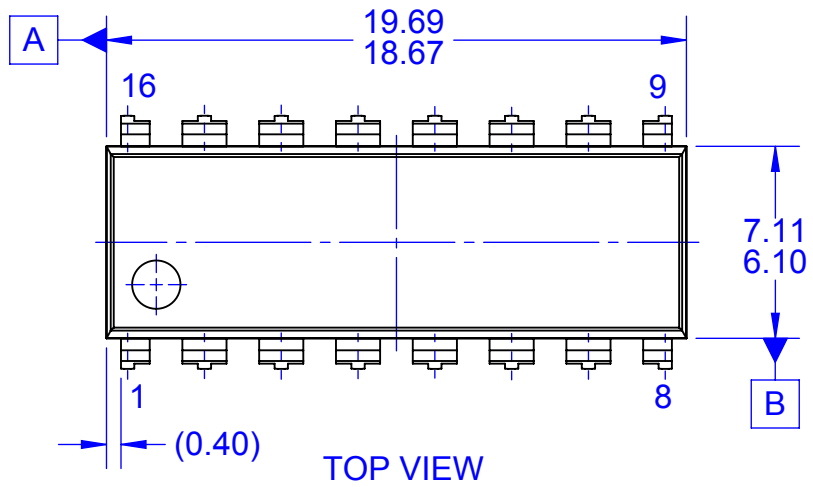
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