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# KA7500B-TD

產品規格說明書

## VOLTAGE MODE PWM CONTROL CIRCUIT

### ■ DESCRIPTION

The KA7500B-TD incorporates all the functions required in the construction of a pulse-width modulation switching circuit. Designed primarily for switching power supply control or DC-DC converters, it offers the systems engineer the flexibility to tailor control circuitry to its own application.

### ■ FEATURES

- \* Complete PWM power control circuitry
- \* Uncommitted outputs for 20.0 mA sink or source current
- \* Output control selects single ended or push pull operation
- \* Internal circuitry prohibits double pulses over total range
- \* Easy synchronization

### ■ TEST CIRCUIT

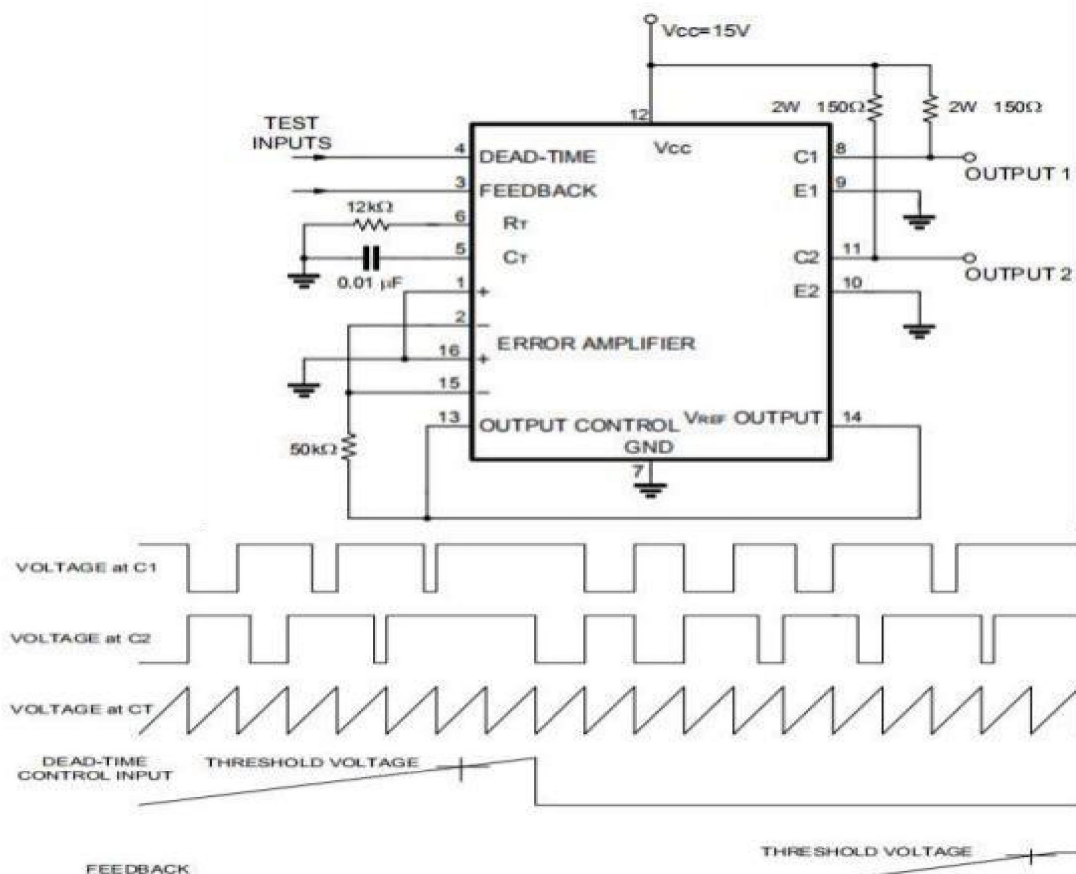
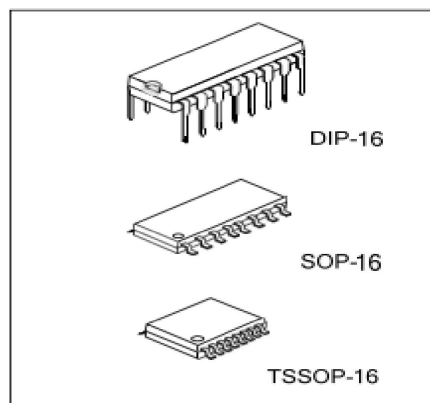


FIG 1. OPERATIONAL TEST CIRCUIT AND WAVEFORMS

## PIN CONFIGURATION

| PIN No. | SYMBAL             | NAME AND FUNCTION             |
|---------|--------------------|-------------------------------|
| 1, 16   | NONINV INPUT       | Error Amplifier NONINV Input  |
| 2, 15   | INV INPUT          | Error Amplifier INV Input     |
| 3       | FEEDBACK           | Output Feedback Voltage       |
| 4       | DEAD- TIME CONTROL | Output DEAD- TIME Control     |
| 5       | CT                 | Timing Capacitor              |
| 6       | RT                 | Timing Resistor               |
| 7       | GND                | Ground                        |
| 8       | C1                 | Internal Power NPN Collect1   |
| 9       | E1                 | Internal Power NPN Emitter1   |
| 10      | E2                 | Internal Power NPN Emitter2   |
| 11      | C2                 | Internal Power NPN Collect2   |
| 12      | VCC                | Supply Voltage                |
| 13      | OUTPUT CONTROL     | Output mode select <b>Vcc</b> |
| 14      | VREF               | Reference Voltage             |

## ABSOLUTE MAXIMUM RATINGS ( unless otherwise specified)

| PARAMETER                                 | SYMBOL           | RATINGS               | UNIT  |
|-------------------------------------------|------------------|-----------------------|-------|
| Supply Voltage( Note 3 )                  | V <sub>CC</sub>  | 41                    | V     |
| Amplifier Input Voltage                   | V <sub>IN</sub>  | V <sub>CC</sub> + 0.3 | V     |
| Collector Output Voltage                  | V <sub>OUT</sub> | 41                    | V     |
| Collector Output Current                  | I <sub>CO</sub>  | 250                   | mA    |
| Power Dissipation (T <sub>A</sub> =25 OC) | P <sub>D</sub>   | 1000                  | mW    |
| Derate at T <sub>A</sub> > 25 OC          |                  | 9.2                   | mW/OC |
| Junction Temperature                      | T <sub>J</sub>   | 125                   | OC    |
| Operating Temperature                     | T <sub>OPR</sub> | -25 ~ +85             | OC    |
| Storage Temperature                       | T <sub>STG</sub> | -40 ~ + 150           | OC    |

Notes: 1 . Absolute maximum ratings are those values beyond which the device could be permanently damaged.  
Absolute maximum ratings are stress ratings only and functional device operation is not implied. 2 . All voltage values, except differential voltages are with respect to the network ground terminal .

## RECOMMENDED OPERATING CONDITIONS

| PARAMETER                                   | SYMBOL           | MIN  | TYP | MAX                | UNIT |
|---------------------------------------------|------------------|------|-----|--------------------|------|
| Supply Voltage                              | V <sub>CC</sub>  | 7    |     | 40                 | V    |
| Amplifier Input Voltage                     | V <sub>IN</sub>  | -0.3 |     | V <sub>CC</sub> -2 | V    |
| Collector Output Voltage                    | V <sub>OUT</sub> |      |     | 40                 | V    |
| Collector Output Current ( each Transistor) | I <sub>C</sub>   |      |     | 200                | mA   |
| Current into Feedback                       | I <sub>F</sub>   |      |     | 0.3                | mA   |
| Timing Capacitor                            | C <sub>T</sub>   | 0.47 |     | 10000              | nF   |
| Timing Resistor                             | R <sub>T</sub>   | 18   |     | 500                | kΩ   |
| Oscillator Frequency                        | f <sub>OSC</sub> | 1    |     | 300                | kHz  |
| Operating Free- Air Temperature             | T <sub>A</sub>   | 0    |     | 70                 | OC   |

## ELECTRICAL CHARACTERISTICS

| PARAMETER                              | SYMBOL               | TEST CONDITIONS                                                                         | MIN  | TYP | MAX  | UNIT |
|----------------------------------------|----------------------|-----------------------------------------------------------------------------------------|------|-----|------|------|
| <b>REFERENCE SECTION</b>               |                      |                                                                                         |      |     |      |      |
| Output Voltage                         | V <sub>OUT</sub>     | I <sub>OUT</sub> = 1 mA                                                                 | 4.75 | 5   | 5.25 | V    |
| Input Regulation                       | V <sub>IN</sub>      | V <sub>CC</sub> = 7V ~ 40V                                                              |      | 2   | 25   | mV   |
| Output Regulation                      | V <sub>OUT</sub>     | I <sub>OUT</sub> = 1 ~ 10 mA                                                            |      | 1   | 15   | mV   |
| Output Voltage Change with Temperature |                      | ΔT <sub>A</sub> = MIN ~ MAX( note 2 )                                                   |      | 0.2 | 1    | %    |
| Short- Circuit Output Current          | I <sub>O( SC )</sub> | V <sub>REF</sub> = 0                                                                    |      | 35  |      | mA   |
| <b>OSCILLATOR SECTION</b>              |                      |                                                                                         |      |     |      |      |
| Frequency                              | F                    | C <sub>T</sub> =0.01μF, R <sub>T</sub> =12kΩ                                            |      | 10  |      | kHz  |
| Standard Deviation of Frequency        |                      | All Values of V <sub>CC</sub> C <sub>T</sub> , R <sub>T</sub> , T <sub>A</sub> constant |      | 10  |      | %    |
| Frequency Change with Voltage          |                      | V <sub>CC</sub> = 7V ~ 40V, T <sub>A</sub> = 25 OC                                      |      | 0.1 |      | %    |
| Frequency Change with Temperature      |                      | C <sub>T</sub> =0.01μF, R <sub>T</sub> =12kΩ , ΔT <sub>A</sub> = MIN ~ MAX              |      |     | 12   | %    |

## ■ ELECTRICAL CHARACTERISTICS( Cont. )

| PARAMETER                                                     |                   | SYMBOL          | TEST CONDITIONS                                        | MIN               | TYP | MAX  | UNIT |
|---------------------------------------------------------------|-------------------|-----------------|--------------------------------------------------------|-------------------|-----|------|------|
| <b>AMPLIFIER SECTION</b>                                      |                   |                 |                                                        |                   |     |      |      |
| Input Offset Voltage                                          | Error             | $V_{I(OFF)}$    | $V_{OUT}(\text{pin } 3)=2.5V$                          |                   | 2   | 10   | mV   |
| Input Offset Current                                          |                   | $I_{I(OFF)}$    | $V_{OUT}(\text{pin } 3)=2.5V$                          |                   | 25  | 250  | nA   |
| Input Bias Current                                            |                   | $I_{I(BIAS)}$   | $V_{OUT}(\text{pin } 3)=2.5V$                          |                   | 0.2 | 1    | μA   |
| Common- Mode Input Voltage Range                              | Error             |                 | $V_{CC}=7V \sim 40V$                                   | -0.3 ~ $V_{CC}-2$ |     |      | V    |
| Open- Loop Voltage Amplification                              |                   |                 | $\Delta V_{OUT}=3V, V_{OUT}=0.5V \sim 3.5V$            | 70                | 95  |      | dB   |
| Unity- Gain Bandwidth                                         |                   | $GBW$           |                                                        |                   | 800 |      | kHz  |
| Common- Mode Rejection Ratio                                  | Error             | $CMRR$          | $V_{CC}=40V, T_A=25^\circ C$                           | 65                | 80  |      | dB   |
| Output Sink Current( pin 3 )                                  |                   | $I_{O(SINK)}$   | $V_{ID}=-15mV \sim -5V, V(\text{pin } 3)=0.5V$         | 0.3               | 0.7 |      | mA   |
| Output source Current( pin 3 )                                |                   | $I_{O(SOURCE)}$ | $V_{ID}=15mV \sim -5V, V(\text{pin } 3)=3.5V$          | -2                |     |      | mA   |
| <b>OUTPUT SECTION</b>                                         |                   |                 |                                                        |                   |     |      |      |
| Collector off- state current                                  |                   | $I_{C(OFF)}$    | $V_{CE}=40V, V_{CC}=40V$                               |                   | 2   | 100  | μA   |
| Emitter off- state Current                                    |                   | $I_{E(OFF)}$    | $V_{CC}=V_C=40V, V_E=0$                                |                   |     | -100 | μA   |
| Collector - emitter Saturation Voltage                        | Common- emitter   |                 | $V_E=0, I_C=200mA$                                     |                   | 1.1 | 1.3  | V    |
|                                                               | Emitter- Follower |                 | $V_C=15V, I_E=-200mA$                                  |                   | 1.5 | 2.5  | V    |
| Output Control Input Current                                  |                   |                 | $V_{IN}=V_{REF}$                                       |                   |     | 3.5  | mA   |
| <b>DEAD TIME CONTROL SECTION</b>                              |                   |                 |                                                        |                   |     |      |      |
| Input bias (pin 4)                                            |                   | $I_{I(BIAS)}$   | $V_{IN}=0 \sim 5.25V$                                  |                   | -2  | -10  | μA   |
| Maximum duty cycle, each output                               |                   |                 | $V_{IN}(\text{pin } 4)=0$                              | 45                |     |      | %    |
| Input threshold Voltage( pin 4 )                              |                   | $V_{TH R}$      | Zero duty Cycle                                        |                   | 3   | 3.3  | V    |
|                                                               |                   |                 | Maximum duty cycle                                     | 0                 |     |      |      |
| <b>PWM COMPARATOR SECTION</b>                                 |                   |                 |                                                        |                   |     |      |      |
| Input Threshold Voltage( pin 3 )                              |                   | $V_{TH R}$      | Zero Duty cycle                                        |                   | 4   | 4.5  | V    |
| Input Sink Current (pin 3 )                                   |                   | $I_{I(SINK)}$   | $V(\text{pin } 3)=0.7V$                                | 0.3               | 0.7 |      | mA   |
| <b>TOTAL DEVICE</b>                                           |                   |                 |                                                        |                   |     |      |      |
| Standby Supply Current                                        | $V_{CC}=15V$      | $I_{ST-BY}$     | pin 6 at $V_{REF}$ , all other Inputs and outputs open |                   | 6   | 10   | mA   |
|                                                               | $V_{CC}=40V$      |                 |                                                        |                   | 9   | 15   | mA   |
| Average supply current                                        |                   |                 | $V(\text{pin } 4)=2V$                                  |                   | 7.5 |      | mA   |
| <b>SWITCHING CHARACTERISTICS, <math>T_A=25^\circ C</math></b> |                   |                 |                                                        |                   |     |      |      |
| Output Voltage Rise Time                                      |                   | $t_R$           | Common- emitter configuration                          |                   | 100 | 200  | ns   |
| Output Voltage Fall Time                                      |                   | $t_F$           |                                                        |                   | 25  | 100  | ns   |
| Output Voltage Rise Time                                      |                   | $t_R$           | Emitter- follower configuration                        |                   | 100 | 200  | ns   |
| Output Voltage Fall Time                                      |                   | $t_F$           |                                                        |                   | 40  | 100  | ns   |

- Notes: 1 . All typical Values except for temperature coefficient are at  $T_A=25^\circ C$ .  
 2 . For conditions shown as MIN or MAX, use appropriate value under recommended operating conditions.  
 3 . Duration of the short- circuit should not exceed one second.  
 4 . Standard deviation is a measure of the statistical distribution the mean as derived from the formula:

$$\sigma = \sqrt{\frac{\sum_{n=1}^N (x_n - \bar{x})^2}{N-1}}$$