

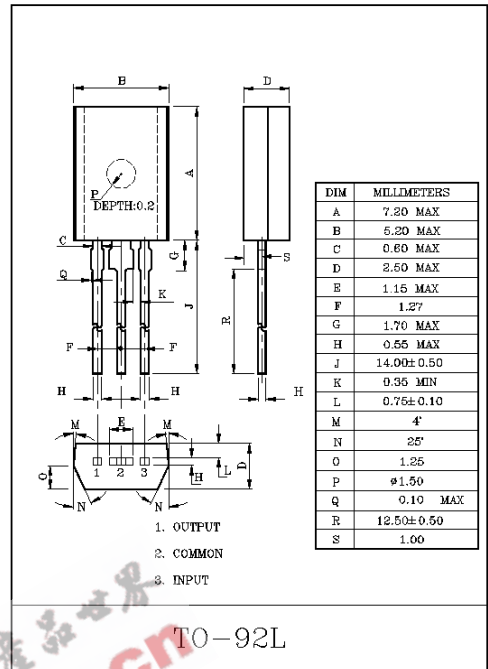
THREE TERMINAL POSITIVE VOLTAGE REGULATORS  
5V, 6V, 7V, 8V, 9V, 10V, 12V, 13V, 15V, 18V, 20V, 24V.

### FEATURES

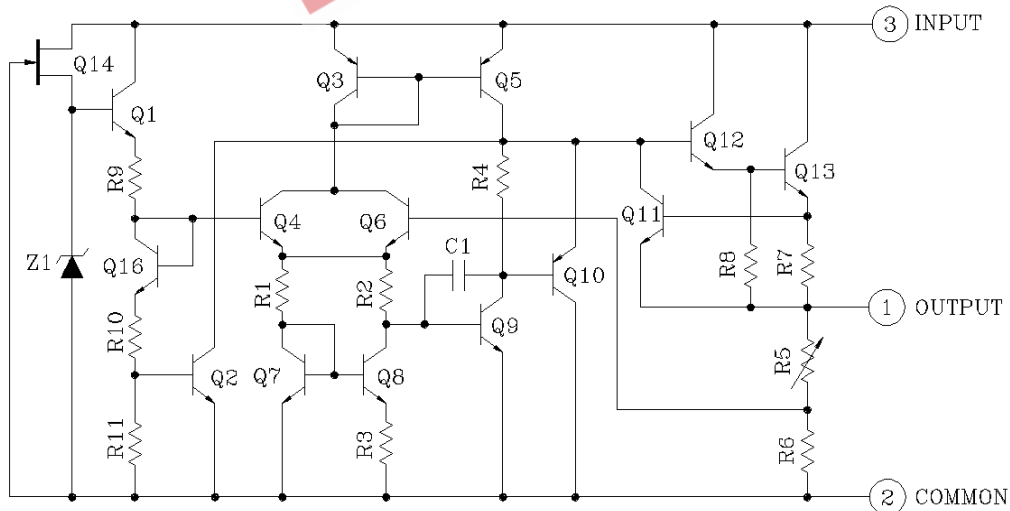
- Suitable for C-MOS, TTL, DTL, HTL Power Supply.
- Internal Short-Circuit Current Limiting.
- Internal Thermal Overload Protection.
- Maximum Output Current of 150mA ( $T_j=25^\circ\text{C}$ ).
- Packaged in TO-92L.

### MAXIMUM RATINGS ( $T_a=25^\circ\text{C}$ )

| CHARACTERISTIC                 | SYMBOL    | RATING    | UNIT             |   |
|--------------------------------|-----------|-----------|------------------|---|
| Input Voltage                  | $V_{IN}$  | (5V~15V)  | 35               | V |
|                                |           | (18V~24V) | 40               |   |
| Power Dissipation              | $P_D$     | 800       | mW               |   |
| Operating Junction Temperature | $T_j$     | -30~150   | $^\circ\text{C}$ |   |
| Operating Temperature          | $T_{opr}$ | -30~75    | $^\circ\text{C}$ |   |
| Storage Temperature            | $T_{stg}$ | -55~150   | $^\circ\text{C}$ |   |



### EQUIVALENT CIRCUIT



# KIA78L05BP/BPV ~ KIA78L24BP/BPV

## ELECTRICAL CHARACTERISTICS

KIA78L05BP/BPV

(Unless otherwise specified,  $V_{IN}=10V$ ,  $I_{OUT}=40mA$ ,  $C_{IN}=0.33\mu F$ ,  $C_{OUT}=0.1\mu F$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ )

| CHARACTERISTIC                                    | SYMBOL                    | TEST CIRCUIT | TEST CONDITION   | MIN.                            | TYP. | MAX. | UNIT            |    |
|---|---------------------------|--------------|--|---------------------------------|------|------|-----------------|----|
| Output Voltage                                    | $V_{OUT}$                 | 1            | $T_j=25^{\circ}C$  | 4.8                             | 5.0  | 5.2  | V               |    |
| Input Regulation                                  | Reg line                  | 1            | $T_j=25^{\circ}C$  | $7.0V \leq V_{IN} \leq 20V$     | -    | 55   | 150             | mV |
|   |                           |              |  | $8.0V \leq V_{IN} \leq 20V$     | -    | 45   | 100             |    |
| Load Regulation                                   | Reg load                  | 1            | $T_j=25^{\circ}C$  | $1.0mA \leq I_{OUT} \leq 100mA$ | -    | 11   | 60              | mV |
|   |                           |              |  | $1.0mA \leq I_{OUT} \leq 40mA$  | -    | 5.0  | 30              |    |
| Output Voltage                                    | $V_{OUT}$                 | 1            | $7.0V \leq V_{IN} \leq 20V$<br>$1.0mA \leq I_{OUT} \leq 40mA$  | 4.75                            | -    | 5.25 | V               |    |
|   |                           |              | $V_{IN}=10V$ ,<br>$1.0mA \leq I_{OUT} \leq 70mA$               | 4.75                            | -    | 5.25 |                 |    |
| Quiescent Current                                 | $I_B$                     | 1            | $T_j=25^{\circ}C$  | -                               | 3.1  | 6.0  | mA              |    |
|   |                           |              | $T_j=125^{\circ}C$   | -                               | -    | 5.5  |                 |    |
| Quiescent Current Change                          | $\Delta I_B$              | 1            | $8.0V \leq V_{IN} \leq 20V$                                    | -                               | -    | 1.5  | mA              |    |
|   |                           |              | $1.0mA \leq I_{OUT} \leq 40mA$                                 | -                               | -    | 0.1  |                 |    |
| Output Noise Voltage                              | $V_{NO}$                  | 1            | $T_a=25^{\circ}C$ , $10Hz \leq f \leq 100kHz$                  | -                               | 40   | -    | $\mu V_{rms}$   |    |
| Long Term Stability                               | $\Delta V_{OUT}/\Delta t$ | 1            |  | -                               | 12   | -    | mV/<br>1.0kHrs  |    |
| Ripple Rejection Ratio                            | RR                        | 2            | $f=120Hz$ ,<br>$8.0V \leq V_{IN} \leq 18V$ , $T_j=25^{\circ}C$ | 41                              | 49   | -    | dB              |    |
| Dropout Voltage                                   | $ V_{IN} - V_{OUT} $      | 1            | $T_j=25^{\circ}C$  | -                               | 1.7  | -    | V               |    |
| Average Temperature Coefficient of Output Voltage | $TC_{VO}$                 | 1            | $I_{OUT}=5mA$  | -                               | -0.6 | -    | mV/ $^{\circ}C$ |    |

# KIA78L05BP/BPV ~ KIA78L24BP/BPV

## ELECTRICAL CHARACTERISTICS

KIA78L06BP/BPV

(Unless otherwise specified,  $V_{IN}=11V$ ,  $I_{OUT}=40mA$ ,  $C_{IN}=0.33\mu F$ ,  $C_{OUT}=0.1\mu F$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ )

| CHARACTERISTIC                                    | SYMBOL                    | TEST CIRCUIT | TEST CONDITION   | MIN.                            | TYP. | MAX. | UNIT            |    |
|---|---------------------------|--------------|--|---------------------------------|------|------|-----------------|----|
| Output Voltage                                    | $V_{OUT}$                 | 1            | $T_j=25^{\circ}C$  | 5.76                            | 6.0  | 6.24 | V               |    |
| Input Regulation                                  | Reg line                  | 1            | $T_j=25^{\circ}C$  | $8.1V \leq V_{IN} \leq 21V$     | -    | 50   | 150             | mV |
|   |                           |              |  | $9.0V \leq V_{IN} \leq 21V$     | -    | 45   | 110             |    |
| Load Regulation                                   | Reg load                  | 1            | $T_j=25^{\circ}C$  | $1.0mA \leq I_{OUT} \leq 100mA$ | -    | 12   | 70              | mV |
|   |                           |              |  | $1.0mA \leq I_{OUT} \leq 40mA$  | -    | 5.5  | 35              |    |
| Output Voltage                                    | $V_{OUT}$                 | 1            | $8.1V \leq V_{IN} \leq 21V$<br>$1.0mA \leq I_{OUT} \leq 40mA$  | 5.7                             | -    | 6.3  | V               |    |
|   |                           |              | $V_{IN}=11V$ ,<br>$1.0mA \leq I_{OUT} \leq 70mA$               | 5.7                             | -    | 6.3  |                 |    |
| Quiescent Current                                 | $I_B$                     | 1            | $T_j=25^{\circ}C$  | -                               | 3.1  | 6.0  | mA              |    |
|   |                           |              | $T_j=125^{\circ}C$   | -                               | -    | 5.5  |                 |    |
| Quiescent Current Change                          | $\Delta I_B$              | 1            | $9.0V \leq V_{IN} \leq 20V$                                    | -                               | -    | 1.5  | mA              |    |
|   |                           |              | $1.0mA \leq I_{OUT} \leq 40mA$                                 | -                               | -    | 0.1  |                 |    |
| Output Noise Voltage                              | $V_{NO}$                  | 1            | $T_a=25^{\circ}C$ , $10Hz \leq f \leq 100kHz$                  | -                               | 40   | -    | $\mu V_{rms}$   |    |
| Long Term Stability                               | $\Delta V_{OUT}/\Delta t$ | 1            |  | -                               | 14   | -    | mV/<br>1.0kHrs  |    |
| Ripple Rejection Ratio                            | RR                        | 2            | $f=120Hz$ ,<br>$9.0V \leq V_{IN} \leq 19V$ , $T_j=25^{\circ}C$ | 39                              | 47   | -    | dB              |    |
| Dropout Voltage                                   | $ V_{IN} - V_{OUT} $      | 1            | $T_j=25^{\circ}C$  | -                               | 1.7  | -    | V               |    |
| Average Temperature Coefficient of Output Voltage | $TC_{VO}$                 | 1            | $I_{OUT}=5mA$  | -                               | -0.7 | -    | mV/ $^{\circ}C$ |    |

# KIA78L05BP/BPV ~ KIA78L24BP/BPV

## ELECTRICAL CHARACTERISTICS

KIA78L07BP/BPV

(Unless otherwise specified,  $V_{IN}=12V$ ,  $I_{OUT}=40mA$ ,  $C_{IN}=0.33\mu F$ ,  $C_{OUT}=0.1\mu F$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ )

| CHARACTERISTIC                                    | SYMBOL                    | TEST CIRCUIT | TEST CONDITION  | MIN.                            | TYP.  | MAX. | UNIT            |    |
|---|---------------------------|--------------|---|---------------------------------|-------|------|-----------------|----|
| Output Voltage                                    | $V_{OUT}$                 | 1            | $T_j=25^{\circ}C$   | 6.72                            | 7.0   | 7.28 | V               |    |
| Input Regulation                                  | Reg line                  | 1            | $T_j=25^{\circ}C$   | $9.2V \leq V_{IN} \leq 22V$     | -     | 50   | 160             | mV |
|   |                           |              |   | $10V \leq V_{IN} \leq 22V$      | -     | 45   | 115             |    |
| Load Regulation                                   | Reg load                  | 1            | $T_j=25^{\circ}C$   | $1.0mA \leq I_{OUT} \leq 100mA$ | -     | 13   | 75              | mV |
|   |                           |              |   | $1.0mA \leq I_{OUT} \leq 40mA$  | -     | 6.0  | 40              |    |
| Output Voltage                                    | $V_{OUT}$                 | 1            | $9.2V \leq V_{IN} \leq 22V$<br>$1.0mA \leq I_{OUT} \leq 40mA$ | 6.65                            | -     | 7.35 | V               |    |
|   |                           |              | $V_{IN}=12V$ , $1.0mA \leq I_{OUT} \leq 70mA$                 | 6.65                            | -     | 7.35 |                 |    |
| Quiescent Current                                 | $I_B$                     | 1            | $T_j=25^{\circ}C$   | -                               | 3.1   | 6.5  | mA              |    |
|   |                           |              | $T_j=125^{\circ}C$  | -                               | -     | 6.0  |                 |    |
| Quiescent Current Change                          | $\Delta I_B$              | 1            | $10V \leq V_{IN} \leq 22V$                                    | -                               | -     | 1.5  | mA              |    |
|   |                           |              | $1.0mA \leq I_{OUT} \leq 40mA$                                | -                               | -     | 0.1  |                 |    |
| Output Noise Voltage                              | $V_{NO}$                  | 1            | $T_a=25^{\circ}C$ , $10Hz \leq f \leq 100kHz$                 | -                               | 50    | -    | $\mu V_{rms}$   |    |
| Long Term Stability                               | $\Delta V_{OUT}/\Delta t$ | 1            |   | -                               | 17    | -    | mV/<br>1.0kHrs  |    |
| Ripple Rejection Ratio                            | RR                        | 2            | $f=120Hz$ ,<br>$10V \leq V_{IN} \leq 20V$ , $T_j=25^{\circ}C$ | 37                              | 46    | -    | dB              |    |
| Dropout Voltage                                   | $ V_{IN} - V_{OUT} $      | 1            | $T_j=25^{\circ}C$   | -                               | 1.7   | -    | V               |    |
| Average Temperature Coefficient of Output Voltage | $TC_{VO}$                 | 1            | $I_{OUT}=5mA$   | -                               | -0.75 | -    | mV/ $^{\circ}C$ |    |

# KIA78L05BP/BPV ~ KIA78L24BP/BPV

## ELECTRICAL CHARACTERISTICS

KIA78L08BP/BPV

(Unless otherwise specified,  $V_{IN}=14V$ ,  $I_{OUT}=40mA$ ,  $C_{IN}=0.33\mu F$ ,  $C_{OUT}=0.1\mu F$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ )

| CHARACTERISTIC                                    | SYMBOL                    | TEST CIRCUIT | TEST CONDITION   | MIN.                            | TYP. | MAX. | UNIT            |    |
|---|---------------------------|--------------|--|---------------------------------|------|------|-----------------|----|
| Output Voltage                                    | $V_{OUT}$                 | 1            | $T_j=25^{\circ}C$  | 7.7                             | 8.0  | 8.3  | V               |    |
| Input Regulation                                  | Reg line                  | 1            | $T_j=25^{\circ}C$  | $10.5V \leq V_{IN} \leq 23V$    | -    | 20   | 175             | mV |
|   |                           |              |  | $11V \leq V_{IN} \leq 23V$      | -    | 12   | 125             |    |
| Load Regulation                                   | Reg load                  | 1            | $T_j=25^{\circ}C$  | $1.0mA \leq I_{OUT} \leq 100mA$ | -    | 15   | 80              | mV |
|   |                           |              |  | $1.0mA \leq I_{OUT} \leq 40mA$  | -    | 7.0  | 40              |    |
| Output Voltage                                    | $V_{OUT}$                 | 1            | $10.5V \leq V_{IN} \leq 23V$<br>$1.0mA \leq I_{OUT} \leq 40mA$ | 7.6                             | -    | 8.4  | V               |    |
|   |                           |              | $V_{IN}=14V$ , $1.0mA \leq I_{OUT} \leq 70mA$                  | 7.6                             | -    | 8.4  |                 |    |
| Quiescent Current                                 | $I_B$                     | 1            | $T_j=25^{\circ}C$  | -                               | 3.1  | 6.5  | mA              |    |
|   |                           |              | $T_j=125^{\circ}C$   | -                               | -    | 6.0  |                 |    |
| Quiescent Current Change                          | $\Delta I_B$              | 1            | $11V \leq V_{IN} \leq 23V$                                     | -                               | -    | 1.5  | mA              |    |
|   |                           |              | $1.0mA \leq I_{OUT} \leq 40mA$                                 | -                               | -    | 0.1  |                 |    |
| Output Noise Voltage                              | $V_{NO}$                  | 1            | $T_a=25^{\circ}C$ , $10Hz \leq f \leq 100kHz$                  | -                               | 60   | -    | $\mu V_{rms}$   |    |
| Long Term Stability                               | $\Delta V_{OUT}/\Delta t$ | 1            |  | -                               | 20   | -    | mV/<br>1.0kHrs  |    |
| Ripple Rejection Ratio                            | RR                        | 2            | $f=120Hz$ ,<br>$12V \leq V_{IN} \leq 23V$ , $T_j=25^{\circ}C$  | 37                              | 45   | -    | dB              |    |
| Dropout Voltage                                   | $ V_{IN} - V_{OUT} $      | 1            | $T_j=25^{\circ}C$  | -                               | 1.7  | -    | V               |    |
| Average Temperature Coefficient of Output Voltage | $TC_{VO}$                 | 1            | $I_{OUT}=5mA$  | -                               | -0.8 | -    | mV/ $^{\circ}C$ |    |

# KIA78L05BP/BPV ~ KIA78L24BP/BPV

## ELECTRICAL CHARACTERISTICS

KIA78L09BP/BPV

(Unless otherwise specified,  $V_{IN}=15V$ ,  $I_{OUT}=40mA$ ,  $C_{IN}=0.33\mu F$ ,  $C_{OUT}=0.1\mu F$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ )

| CHARACTERISTIC                                    | SYMBOL                    | TEST CIRCUIT | TEST CONDITION   | MIN.                            | TYP.  | MAX. | UNIT            |    |
|---|---------------------------|--------------|--|---------------------------------|-------|------|-----------------|----|
| Output Voltage                                    | $V_{OUT}$                 | 1            | $T_j=25^{\circ}C$  | 8.64                            | 9.0   | 9.36 | V               |    |
| Input Regulation                                  | Reg line                  | 1            | $T_j=25^{\circ}C$  | $11.4V \leq V_{IN} \leq 24V$    | -     | 80   | 200             | mV |
|   |                           |              |  | $12V \leq V_{IN} \leq 24V$      | -     | 20   | 160             |    |
| Load Regulation                                   | Reg load                  | 1            | $T_j=25^{\circ}C$  | $1.0mA \leq I_{OUT} \leq 100mA$ | -     | 17   | 90              | mV |
|   |                           |              |  | $1.0mA \leq I_{OUT} \leq 40mA$  | -     | 8.0  | 45              |    |
| Output Voltage                                    | $V_{OUT}$                 | 1            | $11.4V \leq V_{IN} \leq 24V$<br>$1.0mA \leq I_{OUT} \leq 40mA$ | 8.55                            | -     | 9.45 | V               |    |
|   |                           |              | $V_{IN}=15V$ , $1.0mA \leq I_{OUT} \leq 70mA$                  | 8.55                            | -     | 9.45 |                 |    |
| Quiescent Current                                 | $I_B$                     | 1            | $T_j=25^{\circ}C$  | -                               | 3.2   | 6.5  | mA              |    |
|   |                           |              | $T_j=125^{\circ}C$   | -                               | -     | 6.0  |                 |    |
| Quiescent Current Change                          | $\Delta I_B$              | 1            | $11.5V \leq V_{IN} \leq 26V$                                   | -                               | -     | 1.5  | mA              |    |
|   |                           |              | $1.0mA \leq I_{OUT} \leq 40mA$                                 | -                               | -     | 0.1  |                 |    |
| Output Noise Voltage                              | $V_{NO}$                  | 1            | $T_a=25^{\circ}C$ , $10Hz \leq f \leq 100kHz$                  | -                               | 65    | -    | $\mu V_{rms}$   |    |
| Long Term Stability                               | $\Delta V_{OUT}/\Delta t$ | 1            |  | -                               | 21    | -    | mV/<br>1.0kHrs  |    |
| Ripple Rejection Ratio                            | RR                        | 2            | $f=120Hz$ ,<br>$12V \leq V_{IN} \leq 24V$ , $T_j=25^{\circ}C$  | 36                              | 44    | -    | dB              |    |
| Dropout Voltage                                   | $ V_{IN} - V_{OUT} $      | 1            | $T_j=25^{\circ}C$  | -                               | 1.7   | -    | V               |    |
| Average Temperature Coefficient of Output Voltage | $TC_{VO}$                 | 1            | $I_{OUT}=5mA$  | -                               | -0.85 | -    | mV/ $^{\circ}C$ |    |

# KIA78L05BP/BPV ~ KIA78L24BP/BPV

## ELECTRICAL CHARACTERISTICS

### KIA78L10BP/BPV

(Unless otherwise specified,  $V_{IN}=16V$ ,  $I_{OUT}=40mA$ ,  $C_{IN}=0.33\mu F$ ,  $C_{OUT}=0.1\mu F$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ )

| CHARACTERISTIC                                    | SYMBOL                    | TEST CIRCUIT | TEST CONDITION   | MIN.                            | TYP. | MAX. | UNIT            |    |
|---|---------------------------|--------------|--|---------------------------------|------|------|-----------------|----|
| Output Voltage                                    | $V_{OUT}$                 | 1            | $T_j=25^{\circ}C$  | 9.6                             | 10   | 10.4 | V               |    |
| Input Regulation                                  | Reg line                  | 1            | $T_j=25^{\circ}C$  | $12.5V \leq V_{IN} \leq 25V$    | -    | 80   | 230             | mV |
|   |                           |              |  | $13V \leq V_{IN} \leq 25V$      | -    | 30   | 170             |    |
| Load Regulation                                   | Reg load                  | 1            | $T_j=25^{\circ}C$  | $1.0mA \leq I_{OUT} \leq 100mA$ | -    | 18   | 90              | mV |
|   |                           |              |  | $1.0mA \leq I_{OUT} \leq 40mA$  | -    | 8.5  | 45              |    |
| Output Voltage                                    | $V_{OUT}$                 | 1            | $12.5V \leq V_{IN} \leq 25V$<br>$1.0mA \leq I_{OUT} \leq 40mA$ | 9.5                             | -    | 10.5 | V               |    |
|   |                           |              | $V_{IN}=16V$ , $1.0mA \leq I_{OUT} \leq 70mA$                  | 9.5                             | -    | 10.5 |                 |    |
| Quiescent Current                                 | $I_B$                     | 1            | $T_j=25^{\circ}C$  | -                               | 3.2  | 6.5  | mA              |    |
|   |                           |              | $T_j=125^{\circ}C$   | -                               | -    | 6.0  |                 |    |
| Quiescent Current Change                          | $\Delta I_B$              | 1            | $13V \leq V_{IN} \leq 25V$                                     | -                               | -    | 1.5  | mA              |    |
|   |                           |              | $1.0mA \leq I_{OUT} \leq 40mA$                                 | -                               | -    | 0.1  |                 |    |
| Output Noise Voltage                              | $V_{NO}$                  | 1            | $T_a=25^{\circ}C$ , $10Hz \leq f \leq 100kHz$                  | -                               | 70   | -    | $\mu V_{rms}$   |    |
| Long Term Stability                               | $\Delta V_{OUT}/\Delta t$ | 1            |  | -                               | 22   | -    | mV/<br>1.0kHrs  |    |
| Ripple Rejection Ratio                            | RR                        | 2            | $f=120Hz$ ,<br>$13V \leq V_{IN} \leq 24V$ , $T_j=25^{\circ}C$  | 36                              | 43   | -    | dB              |    |
| Dropout Voltage                                   | $ V_{IN} - V_{OUT} $      | 1            | $T_j=25^{\circ}C$  | -                               | 1.7  | -    | V               |    |
| Average Temperature Coefficient of Output Voltage | $TC_{VO}$                 | 1            | $I_{OUT}=5mA$  | -                               | -0.9 | -    | mV/ $^{\circ}C$ |    |

# KIA78L05BP/BPV ~ KIA78L24BP/BPV

## ELECTRICAL CHARACTERISTICS

KIA78L12BP/BPV

(Unless otherwise specified,  $V_{IN}=19V$ ,  $I_{OUT}=40mA$ ,  $C_{IN}=0.33\mu F$ ,  $C_{OUT}=0.1\mu F$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ )

| CHARACTERISTIC                                    | SYMBOL                    | TEST CIRCUIT | TEST CONDITION   | MIN.                            | TYP. | MAX. | UNIT            |    |
|---|---------------------------|--------------|--|---------------------------------|------|------|-----------------|----|
| Output Voltage                                    | $V_{OUT}$                 | 1            | $T_j=25^{\circ}C$  | 11.5                            | 12   | 12.5 | V               |    |
| Input Regulation                                  | Reg line                  | 1            | $T_j=25^{\circ}C$  | $14.5V \leq V_{IN} \leq 27V$    | -    | 120  | 250             | mV |
|   |                           |              |  | $16V \leq V_{IN} \leq 27V$      | -    | 100  | 200             |    |
| Load Regulation                                   | Reg load                  | 1            | $T_j=25^{\circ}C$  | $1.0mA \leq I_{OUT} \leq 100mA$ | -    | 20   | 100             | mV |
|   |                           |              |  | $1.0mA \leq I_{OUT} \leq 40mA$  | -    | 10   | 50              |    |
| Output Voltage                                    | $V_{OUT}$                 | 1            | $14.5V \leq V_{IN} \leq 27V$<br>$1.0mA \leq I_{OUT} \leq 40mA$ | 11.4                            | -    | 12.6 | V               |    |
|   |                           |              | $V_{IN}=19V$ , $1.0mA \leq I_{OUT} \leq 70mA$                  | 11.4                            | -    | 12.6 |                 |    |
| Quiescent Current                                 | $I_B$                     | 1            | $T_j=25^{\circ}C$  | -                               | 3.2  | 6.5  | mA              |    |
|   |                           |              | $T_j=125^{\circ}C$   | -                               | -    | 6.0  |                 |    |
| Quiescent Current Change                          | $\Delta I_B$              | 1            | $16V \leq V_{IN} \leq 27V$                                     | -                               | -    | 1.5  | mA              |    |
|   |                           |              | $1.0mA \leq I_{OUT} \leq 40mA$                                 | -                               | -    | 0.1  |                 |    |
| Output Noise Voltage                              | $V_{NO}$                  | 1            | $T_a=25^{\circ}C$ , $10Hz \leq f \leq 100kHz$                  | -                               | 80   | -    | $\mu V_{rms}$   |    |
| Long Term Stability                               | $\Delta V_{OUT}/\Delta t$ | 1            |  | -                               | 24   | -    | mV/<br>1.0kHrs  |    |
| Ripple Rejection Ratio                            | RR                        | 2            | $f=120Hz$ ,<br>$15V \leq V_{IN} \leq 25V$ , $T_j=25^{\circ}C$  | 36                              | 41   | -    | dB              |    |
| Dropout Voltage                                   | $ V_{IN} - V_{OUT} $      | 1            | $T_j=25^{\circ}C$  | -                               | 1.7  | -    | V               |    |
| Average Temperature Coefficient of Output Voltage | $TC_{VO}$                 | 1            | $I_{OUT}=5mA$  | -                               | 1.0  | -    | mV/ $^{\circ}C$ |    |



# KIA78L05BP/BPV ~ KIA78L24BP/BPV

## ELECTRICAL CHARACTERISTICS

KIA78L13BP/BPV

(Unless otherwise specified,  $V_{IN}=21V$ ,  $I_{OUT}=40mA$ ,  $C_{IN}=0.33\mu F$ ,  $C_{OUT}=0.1\mu F$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ )

| CHARACTERISTIC                                    | SYMBOL                    | TEST CIRCUIT | TEST CONDITION  | MIN.                            | TYP. | MAX.  | UNIT            |    |
|---|---------------------------|--------------|---|---------------------------------|------|-------|-----------------|----|
| Output Voltage                                    | $V_{OUT}$                 | 1            | $T_j=25^{\circ}C$   | 12.45                           | 13   | 13.55 | V               |    |
| Input Regulation                                  | Reg line                  | 1            | $T_j=25^{\circ}C$   | $16V \leq V_{IN} \leq 28V$      | -    | 125   | 270             | mV |
|   |                           |              |   | $17V \leq V_{IN} \leq 28V$      | -    | 105   | 225             |    |
| Load Regulation                                   | Reg load                  | 1            | $T_j=25^{\circ}C$   | $1.0mA \leq I_{OUT} \leq 100mA$ | -    | 22    | 120             | mV |
|   |                           |              |   | $1.0mA \leq I_{OUT} \leq 40mA$  | -    | 11    | 60              |    |
| Output Voltage                                    | $V_{OUT}$                 | 1            | $16V \leq V_{IN} \leq 28V$<br>$1.0mA \leq I_{OUT} \leq 40mA$  | 12.54                           | -    | 13.86 | V               |    |
|   |                           |              | $V_{IN}=21V$ , $1.0mA \leq I_{OUT} \leq 70mA$                 | 12.54                           | -    | 13.86 |                 |    |
| Quiescent Current                                 | $I_B$                     | 1            | $T_j=25^{\circ}C$   | -                               | 3.2  | 6.5   | mA              |    |
|   |                           |              | $T_j=125^{\circ}C$  | -                               | 3.2  | 6.0   |                 |    |
| Quiescent Current Change                          | $\Delta I_B$              | 1            | $17V \leq V_{IN} \leq 28V$                                    | -                               | -    | 1.5   | mA              |    |
|   |                           |              | $1.0mA \leq I_{OUT} \leq 40mA$                                | -                               | -    | 0.1   |                 |    |
| Output Noise Voltage                              | $V_{NO}$                  | 1            | $T_a=25^{\circ}C$ , $10Hz \leq f \leq 100kHz$                 | -                               | 90   | -     | $\mu V_{rms}$   |    |
| Long Term Stability                               | $\Delta V_{OUT}/\Delta t$ | 1            |   | -                               | 28   | -     | mV/<br>1.0kHrs  |    |
| Ripple Rejection Ratio                            | RR                        | 2            | $f=120Hz$ ,<br>$17V \leq V_{IN} \leq 27V$ , $T_j=25^{\circ}C$ | 34                              | 41   | -     | dB              |    |
| Dropout Voltage                                   | $ V_{IN} - V_{OUT} $      | 1            | $T_j=25^{\circ}C$   | -                               | 1.7  | -     | V               |    |
| Average Temperature Coefficient of Output Voltage | $TC_{VO}$                 | 1            | $I_{OUT}=5mA$   | -                               | 1.2  | -     | mV/ $^{\circ}C$ |    |

# KIA78L05BP/BPV ~ KIA78L24BP/BPV

## ELECTRICAL CHARACTERISTICS

### KIA78L15BP/BPV

(Unless otherwise specified,  $V_{IN}=23V$ ,  $I_{OUT}=40mA$ ,  $C_{IN}=0.33\mu F$ ,  $C_{OUT}=0.1\mu F$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ )

| CHARACTERISTIC                                    | SYMBOL                    | TEST CIRCUIT | TEST CONDITION  | MIN.                            | TYP. | MAX.  | UNIT            |    |
|---|---------------------------|--------------|---|---------------------------------|------|-------|-----------------|----|
| Output Voltage                                    | $V_{OUT}$                 | 1            | $T_j=25^{\circ}C$   | 14.4                            | 15   | 15.6  | V               |    |
| Input Regulation                                  | Reg line                  | 1            | $T_j=25^{\circ}C$   | $17.5V \leq V_{IN} \leq 30V$    | -    | 130   | 300             | mV |
|   |                           |              |   | $20V \leq V_{IN} \leq 30V$      | -    | 110   | 250             |    |
| Load Regulation                                   | Reg load                  | 1            | $T_j=25^{\circ}C$   | $1.0mA \leq I_{OUT} \leq 100mA$ | -    | 25    | 150             | mV |
|   |                           |              |   | $1.0mA \leq I_{OUT} \leq 40mA$  | -    | 12    | 75              |    |
| Output Voltage                                    | $V_{OUT}$                 | 1            | $17.5V \leq V_{IN} \leq 30V$<br>$1.0mA \leq I_{OUT} \leq 40mA$    | 14.25                           | -    | 15.75 | V               |    |
|   |                           |              | $V_{IN}=23V$ , $1.0mA \leq I_{OUT} \leq 70mA$                     | 14.25                           | -    | 15.75 |                 |    |
| Quiescent Current                                 | $I_B$                     | 1            | $T_j=25^{\circ}C$   | -                               | 3.3  | 6.5   | mA              |    |
|   |                           |              | $T_j=125^{\circ}C$  | -                               | -    | 6.0   |                 |    |
| Quiescent Current Change                          | $\Delta I_B$              | 1            | $20V \leq V_{IN} \leq 30V$  | -                               | -    | 1.5   | mA              |    |
|   |                           |              | $1.0mA \leq I_{OUT} \leq 40mA$                                    | -                               | -    | 0.1   |                 |    |
| Output Noise Voltage                              | $V_{NO}$                  | 1            | $T_a=25^{\circ}C$ , $10Hz \leq f \leq 100kHz$                     | -                               | 90   | -     | $\mu V_{rms}$   |    |
| Long Term Stability                               | $\Delta V_{OUT}/\Delta t$ | 1            |   | -                               | 30   | -     | mV/<br>1.0kHrs  |    |
| Ripple Rejection Ratio                            | RR                        | 2            | $f=120Hz$ ,<br>$18.5V \leq V_{IN} \leq 28.5V$ , $T_j=25^{\circ}C$ | 34                              | 40   | -     | dB              |    |
| Dropout Voltage                                   | $ V_{IN} - V_{OUT} $      | 1            | $T_j=25^{\circ}C$   | -                               | 1.7  | -     | V               |    |
| Average Temperature Coefficient of Output Voltage | $TC_{VO}$                 | 1            | $I_{OUT}=5mA$   | -                               | -1.3 | -     | mV/ $^{\circ}C$ |    |

# KIA78L05BP/BPV ~ KIA78L24BP/BPV

## ELECTRICAL CHARACTERISTICS

### KIA78L18BP/BPV

(Unless otherwise specified,  $V_{IN}=27V$ ,  $I_{OUT}=40mA$ ,  $C_{IN}=0.33\mu F$ ,  $C_{OUT}=0.1\mu F$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ )

| CHARACTERISTIC                                    | SYMBOL                    | TEST CIRCUIT | TEST CONDITION   | MIN.                            | TYP. | MAX. | UNIT            |    |
|---|---------------------------|--------------|--|---------------------------------|------|------|-----------------|----|
| Output Voltage                                    | $V_{OUT}$                 | 1            | $T_j=25^{\circ}C$  | 17.3                            | 18   | 18.7 | V               |    |
| Input Regulation                                  | Reg line                  | 1            | $T_j=25^{\circ}C$  | $21.4V \leq V_{IN} \leq 33V$    | -    | 32   | 325             | mV |
|   |                           |              |  | $22V \leq V_{IN} \leq 33V$      | -    | 27   | 275             |    |
| Load Regulation                                   | Reg load                  | 1            | $T_j=25^{\circ}C$  | $1.0mA \leq I_{OUT} \leq 100mA$ | -    | 30   | 170             | mV |
|   |                           |              |  | $1.0mA \leq I_{OUT} \leq 40mA$  | -    | 15   | 75              |    |
| Output Voltage                                    | $V_{OUT}$                 | 1            | $21.4V \leq V_{IN} \leq 33V$<br>$1.0mA \leq I_{OUT} \leq 40mA$ | 17.1                            | -    | 18.9 | V               |    |
|   |                           |              | $V_{IN}=27V$ , $1.0mA \leq I_{OUT} \leq 70mA$                  | 17.1                            | -    | 18.9 |                 |    |
| Quiescent Current                                 | $I_B$                     | 1            | $T_j=25^{\circ}C$  | -                               | 3.3  | 6.5  | mA              |    |
|   |                           |              | $T_j=125^{\circ}C$   | -                               | -    | 6.0  |                 |    |
| Quiescent Current Change                          | $\Delta I_B$              | 1            | $22V \leq V_{IN} \leq 33V$                                     | -                               | -    | 1.5  | mA              |    |
|   |                           |              | $1.0mA \leq I_{OUT} \leq 40mA$                                 | -                               | -    | 0.1  |                 |    |
| Output Noise Voltage                              | $V_{NO}$                  | 1            | $T_a=25^{\circ}C$ , $10Hz \leq f \leq 100kHz$                  | -                               | 150  | -    | $\mu V_{rms}$   |    |
| Long Term Stability                               | $\Delta V_{OUT}/\Delta t$ | 1            |  | -                               | 45   | -    | mV/<br>1.0kHrs  |    |
| Ripple Rejection Ratio                            | RR                        | 2            | $f=120Hz$ ,<br>$23V \leq V_{IN} \leq 33V$ , $T_j=25^{\circ}C$  | 32                              | 38   | -    | dB              |    |
| Dropout Voltage                                   | $ V_{IN} - V_{OUT} $      | 1            | $T_j=25^{\circ}C$  | -                               | 1.7  | -    | V               |    |
| Average Temperature Coefficient of Output Voltage | $TC_{VO}$                 | 1            | $I_{OUT}=5mA$  | -                               | -1.5 | -    | mV/ $^{\circ}C$ |    |

# KIA78L05BP/BPV ~ KIA78L24BP/BPV

## ELECTRICAL CHARACTERISTICS

### KIA78L20BP/BPV

(Unless otherwise specified,  $V_{IN}=29V$ ,  $I_{OUT}=40mA$ ,  $C_{IN}=0.33\mu F$ ,  $C_{OUT}=0.1\mu F$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ )

| CHARACTERISTIC                                    | SYMBOL                    | TEST CIRCUIT | TEST CONDITION   | MIN.                            | TYP. | MAX. | UNIT            |    |
|---|---------------------------|--------------|--|---------------------------------|------|------|-----------------|----|
| Output Voltage                                    | $V_{OUT}$                 | 1            | $T_j=25^{\circ}C$  | 19.2                            | 20   | 20.8 | V               |    |
| Input Regulation                                  | Reg line                  | 1            | $T_j=25^{\circ}C$  | $23.5V \leq V_{IN} \leq 35V$    | -    | 33   | 330             | mV |
|   |                           |              |  | $24V \leq V_{IN} \leq 35V$      | -    | 28   | 285             |    |
| Load Regulation                                   | Reg load                  | 1            | $T_j=25^{\circ}C$  | $1.0mA \leq I_{OUT} \leq 100mA$ | -    | 33   | 180             | mV |
|   |                           |              |  | $1.0mA \leq I_{OUT} \leq 40mA$  | -    | 17   | 90              |    |
| Output Voltage                                    | $V_{OUT}$                 | 1            | $23.5V \leq V_{IN} \leq 35V$<br>$1.0mA \leq I_{OUT} \leq 40mA$ | 19.0                            | -    | 21.0 | V               |    |
|   |                           |              | $V_{IN}=29V$ , $1.0mA \leq I_{OUT} \leq 70mA$                  | 19.0                            | -    | 21.0 |                 |    |
| Quiescent Current                                 | $I_B$                     | 1            | $T_j=25^{\circ}C$  | -                               | 3.3  | 6.5  | mA              |    |
|   |                           |              | $T_j=125^{\circ}C$   | -                               | -    | 6.0  |                 |    |
| Quiescent Current Change                          | $\Delta I_B$              | 1            | $24V \leq V_{IN} \leq 35V$                                     | -                               | -    | 1.5  | mA              |    |
|   |                           |              | $1.0mA \leq I_{OUT} \leq 40mA$                                 | -                               | -    | 0.1  |                 |    |
| Output Noise Voltage                              | $V_{NO}$                  | 1            | $T_a=25^{\circ}C$ , $10Hz \leq f \leq 100kHz$                  | -                               | 170  | -    | $\mu V_{rms}$   |    |
| Long Term Stability                               | $\Delta V_{OUT}/\Delta t$ | 1            |  | -                               | 49   | -    | mV/<br>1.0kHrs  |    |
| Ripple Rejection Ratio                            | RR                        | 2            | $f=120Hz$ ,<br>$25V \leq V_{IN} \leq 35V$ , $T_j=25^{\circ}C$  | 31                              | 37   | -    | dB              |    |
| Dropout Voltage                                   | $ V_{IN} - V_{OUT} $      | 1            | $T_j=25^{\circ}C$  | -                               | 1.7  | -    | V               |    |
| Average Temperature Coefficient of Output Voltage | $TC_{VO}$                 | 1            | $I_{OUT}=5mA$  | -                               | -1.7 | -    | mV/ $^{\circ}C$ |    |

# KIA78L05BP/BPV ~ KIA78L24BP/BPV

## ELECTRICAL CHARACTERISTICS

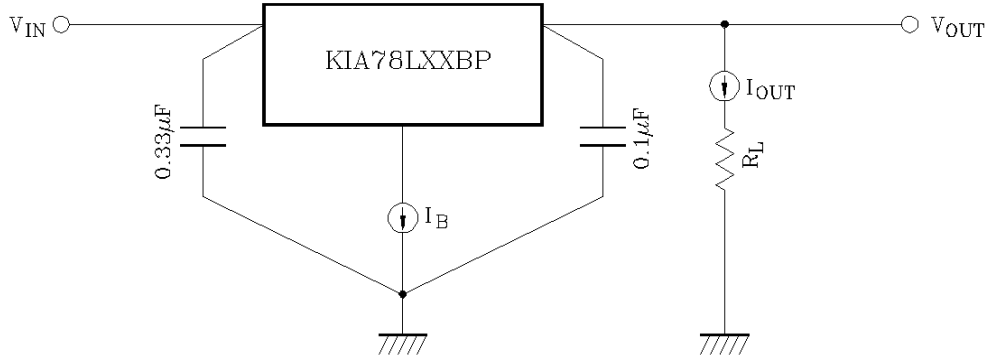
### KIA78L24BP/BPV

(Unless otherwise specified,  $V_{IN}=33V$ ,  $I_{OUT}=40mA$ ,  $C_{IN}=0.33\mu F$ ,  $C_{OUT}=0.1\mu F$ ,  $0^{\circ}C \leq T_j \leq 125^{\circ}C$ )

| CHARACTERISTIC                                    | SYMBOL                    | TEST CIRCUIT | TEST CONDITION   | MIN.                            | TYP. | MAX. | UNIT            |    |
|---|---------------------------|--------------|--|---------------------------------|------|------|-----------------|----|
| Output Voltage                                    | $V_{OUT}$                 | 1            | $T_j=25^{\circ}C$  | 23                              | 24   | 25   | V               |    |
| Input Regulation                                  | Reg line                  | 1            | $T_j=25^{\circ}C$  | $27.5V \leq V_{IN} \leq 38V$    | -    | 35   | 350             | mV |
|   |                           |              |  | $28V \leq V_{IN} \leq 38V$      | -    | 30   | 300             |    |
| Load Regulation                                   | Reg load                  | 1            | $T_j=25^{\circ}C$  | $1.0mA \leq I_{OUT} \leq 100mA$ | -    | 40   | 200             | mV |
|   |                           |              |  | $1.0mA \leq I_{OUT} \leq 40mA$  | -    | 20   | 100             |    |
| Output Voltage                                    | $V_{OUT}$                 | 1            | $27.5V \leq V_{IN} \leq 38V$<br>$1.0mA \leq I_{OUT} \leq 40mA$ | 22.8                            | -    | 25.2 | V               |    |
|   |                           |              | $V_{IN}=33V$ , $1.0mA \leq I_{OUT} \leq 70mA$                  | 22.8                            | -    | 25.2 |                 |    |
| Quiescent Current                                 | $I_B$                     | 1            | $T_j=25^{\circ}C$  | -                               | 3.5  | 6.5  | mA              |    |
|   |                           |              | $T_j=125^{\circ}C$   | -                               | -    | 6.0  |                 |    |
| Quiescent Current Change                          | $\Delta I_B$              | 1            | $28V \leq V_{IN} \leq 38V$                                     | -                               | -    | 1.5  | mA              |    |
|   |                           |              | $1.0mA \leq I_{OUT} \leq 40mA$                                 | -                               | -    | 0.1  |                 |    |
| Output Noise Voltage                              | $V_{NO}$                  | 1            | $T_a=25^{\circ}C$ , $10Hz \leq f \leq 100kHz$                  | -                               | 200  | -    | $\mu V_{rms}$   |    |
| Long Term Stability                               | $\Delta V_{OUT}/\Delta t$ | 1            |  | -                               | 56   | -    | mV/<br>1.0kHrs  |    |
| Ripple Rejection Ratio                            | RR                        | 2            | $f=120Hz$ ,<br>$29V \leq V_{IN} \leq 39V$ , $T_j=25^{\circ}C$  | 31                              | 35   | -    | dB              |    |
| Dropout Voltage                                   | $ V_{IN} - V_{OUT} $      | 1            | $T_j=25^{\circ}C$  | -                               | 1.7  | -    | V               |    |
| Average Temperature Coefficient of Output Voltage | $TC_{VO}$                 | 1            | $I_{OUT}=5mA$  | -                               | -2.0 | -    | mV/ $^{\circ}C$ |    |

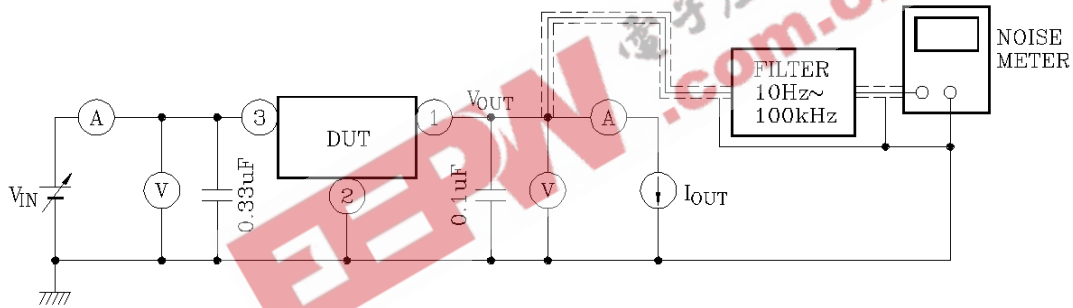
# KIA78L05BP/BPV ~ KIA78L24BP/BPV

## TEST CIRCUIT/STANDARD APPLICATION CIRCUIT

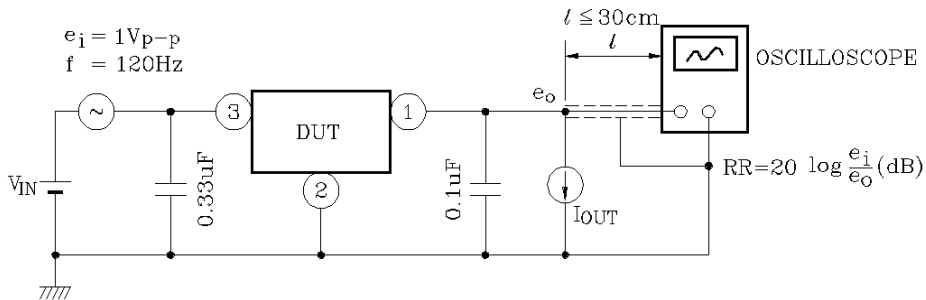


## TEST CIRCUITS

1.  $V_{OUT}$ ,  $R_{reg \cdot line}$ ,  $R_{reg \cdot load}$ ,  $V_{OUT}$ ,  $I_B$ ,  $\Delta I_B$ ,  $V_{NO}$ ,  $\Delta V_{OUT} / \Delta t$ ,  $|V_{IN} - V_{OUT}|$ ,  $TC_{VO}$

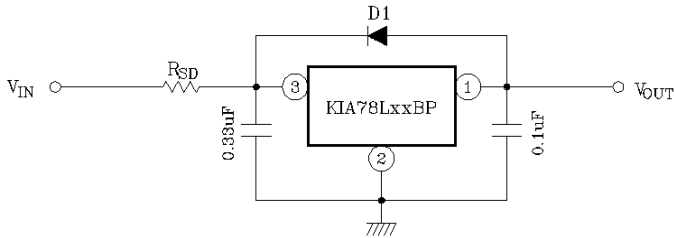


2. RR



# KIA78L05BP/BPV ~ KIA78L24BP/BPV

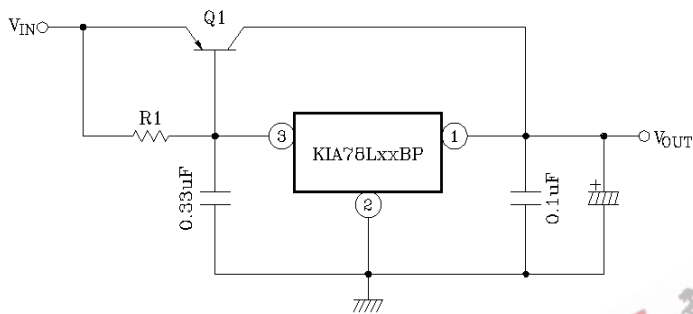
## (1) STANDARD APPLICATION



D1 : Protection Diode  
High speed diode D1 should be connected as shown in the figure if the condition  $V_{IN} < V_{OUT}$  might occur by surge voltage or power supply ON/OFF.

$R_{SD}$  : Power limiting resistor for large  $V_{IN}$ , resistor  $R_{SD}$  is needed to limit IC power dissipation.

## (2) A. CURRENT BOOST VOLTAGE REGULATOR



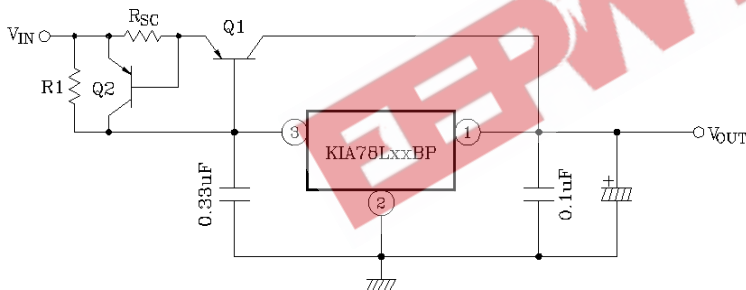
Heat sink is needed for Q1

$$R1 \leq \frac{V_{BE1}}{I_B(\text{MAX})}$$

where,  $V_{BE1}$  :  $V_{BE}$  of external transistor Q1

$I_B(\text{MAX})$  : Quiescent current of IC

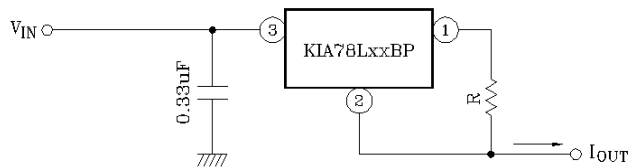
## B. SHORT-CIRCUIT PROTECTION



$$R_{SC} = \frac{V_{BE2}}{I_{SC}}$$

where,  $I_{SC}$  : Short-Circuit current

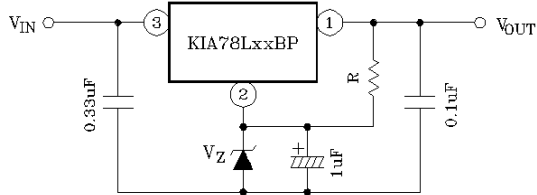
## (3) CURRENT REGULATOR



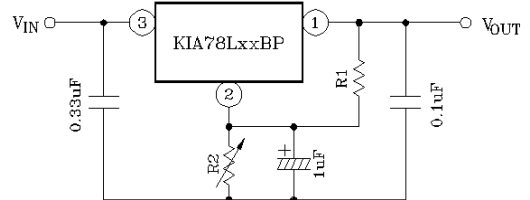
$$I_{OUT} = \frac{V_{OUT}}{R} + I_B$$

# KIA78L05BP/BPV ~ KIA78L24BP/BPV

## (4) VOLTAGE BOOST REGULATOR

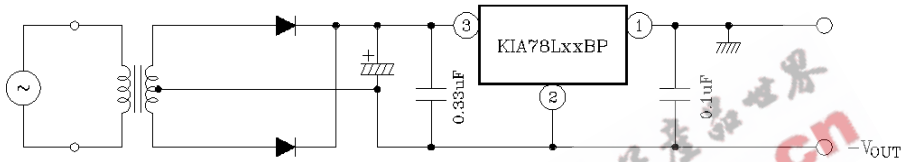


$V_{OUT} = V_Z + V_{OUT} \text{ (of IC)}$   
 A little of current in resistor R is needed.

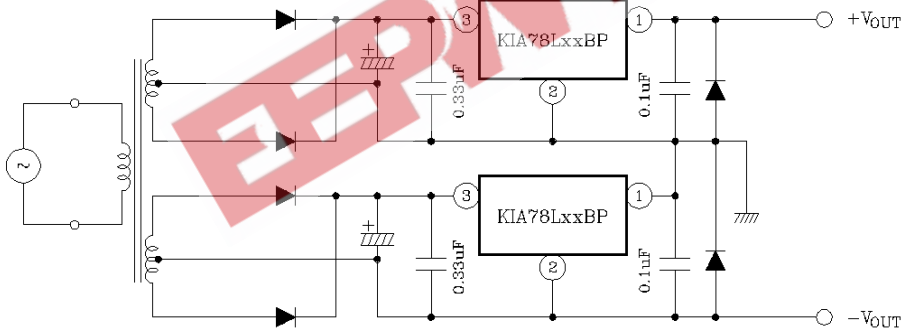


$$V_{OUT} = R_2 \left( I_B + \frac{V_{OUT} \text{ (of IC)}}{R_1} \right) + V_{OUT} \text{ (of IC)}$$

## (5) NEGATIVE REGULATOR



## (6) POSITIVE AND NEGATIVE REGULATOR





# KIA78L05BP/BPV ~ KIA78L24BP/BPV

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## PRECAUTIONS FOR USE

When such a high voltage as exceeds 10V beyond the fixed output voltage (Typ. value) of IC is applied to the output terminal of IC, the IC may be destroyed. In such a case, it is advised to prevent an excessive voltage from being applied to the IC by connecting a zener diode between the output terminal and the GND. Especially, in the current boost circuit as shown in example (2) of application circuits, an input voltage may be suddenly applied to the output terminal of IC in the form of steps, and that in case of light load, an excessive voltage may be transiently applied to the output terminal of IC: So that great care should be taken to this matter. In this case, in addition to the above, it may become necessary to consider such a countermeasure as the output capacitor in use is replaced with a capacitor of larger capacitance, or as R1 (a resistor for IC bias current) or bypass is replaced with a resistor of smaller resistance according to circumstance or as the input voltage is gradually raised.

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# KIA78L05BP/BPV ~ KIA78L24BP/BPV

