115V / 230V Automatic AC Line Voltage Selector Hybrid IC MK Series MK1110 / MK1210

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1. Introduction

Accompanying the growing demand for 115V/230V common power supplies, Shindengen has developed its MK series of 115V/230V automatic AC line voltage selector with the ability to operate devices at either of these commercial power supply voltages.

Members of the MK series are able to maintain rectification voltage nearly constant by directly detecting commercial power supply voltage, determining if the commercial power supply is a 115V system or 230V system, and automatically selecting to a rectification system that corresponds to the respective system. These hybrid ICs contain an internal triac that serves as the main switch. Since they can be used with a small number of external components, they enable costs to be reduced and design time to be shortened, thereby making them optimal for use in consumer appliances, audio-visual equipment and communication equipment. The package is a lightweight, insulated 7-pin single in-line package, effective in reducing the size of the power supply.

2. Features of the MK Series

(1) Eliminates the risk of power supply damage caused by selecting errors that occasionally occur in 115V (100V) / 230V (200V) common power supplies of the manual selecting type, while also eliminating any noise induction caused by the wiring of a manual switch.
(2) There are no difficulties in transformer design as in the case of wide-range power supplies, and output power can be increased.
(3) The small number of external components makes design easy and economical.
(4) The package is both compact and lightweight, and height after mounting can be held to within 20 mm.
(5) The thickness of the inside mold resin is 0.71 mm or more, and a full-mold package is used that is advantageous for insulation design (dielectric strength: AC 2kV for 1 minute).
(6) A protective function is built in that protects against malfunctions due to momentary power failures and momentary voltage drops (MK1210).
(7) The delay time of voltage doubler rectification (the time until voltage doubler rectification starts after the power switch has been turned on at 115V AC) can be set as desired (MK1210).

3. Explanation of Operation

2-1 Voltage Doubler Rectification and Bridge Rectification

Members of the MK series employ a voltage doubler rectification system in 115V commercial power supplies and a bridge rectification system in 230V commercial power supplies. Figs. 1 and 2 indicate schematic diagrams showing 115V and 230V selecting circuits. Furthermore, members of the MK series are able to accommodate voltages of 90~132V for an AC input voltage of 115V, and 180~276V for an AC input voltage of 230V.

115/230V Manual Selecting Type

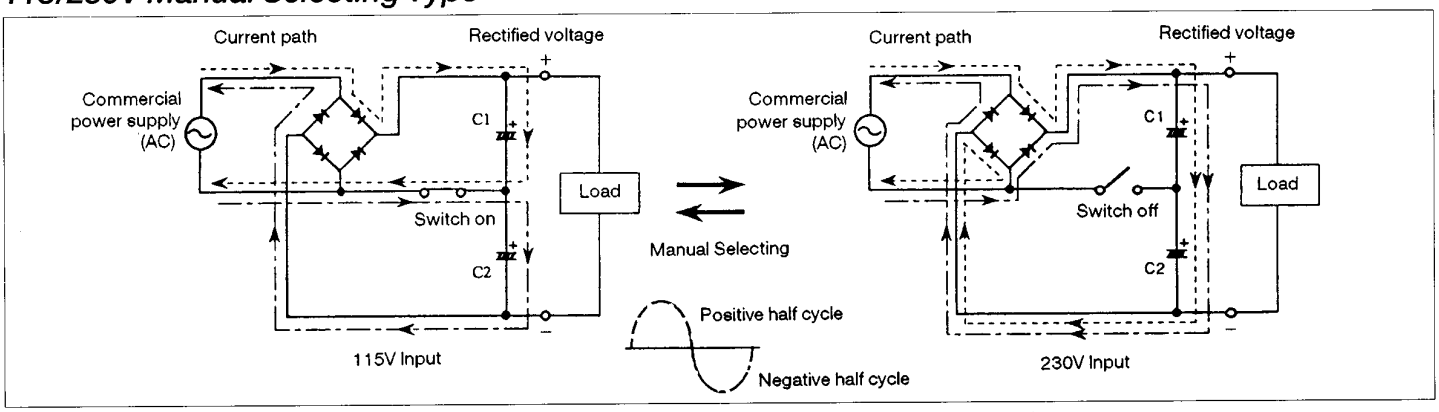


Fig. 1 Manual Selecting Type of 115/230V Common Power Supply

MK Series

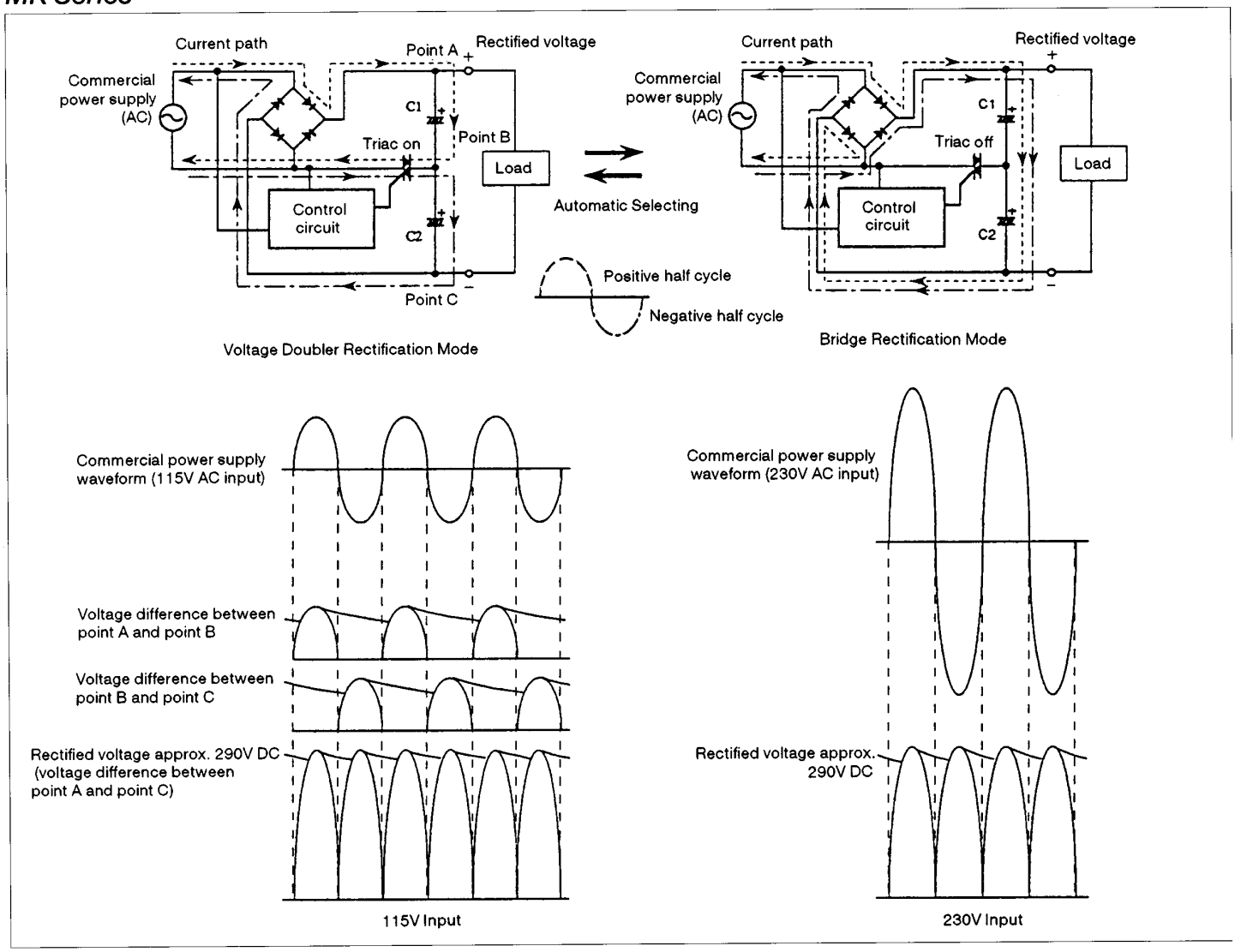


Fig. 2 MK Series

(1) Voltage Doubler Rectification

At a voltage of 115V, the triac is turned on and C1 is charged as indicated by the broken line in Fig. 1 and 2 during the positive half cycle and the single dot broken line during the negative half cycle. When a commercial power supply voltage of 115V enters, the voltages of C1 and C2 reach their peak voltages of 162V DC each (voltage equal to 115V x $\sqrt{2}$). The sum of the voltages of C1 and C2 then becomes the rectified voltage. Therefore, the rectified voltage is approx. 290V DC in the form of a ripple waveform (mean value).

(2) Bridge Rectification

At a voltage of 230V, the triac is off and C1 and C2 are charged along the paths indicated with the broken line during the positive half cycle and with the single dot broken line during the negative half cycle as shown in Figs. 1 and 2. This is equivalent to ordinary bridge rectification. When a commercial power supply voltage of 230V enters, the voltage of the series capacitors of C1 and C2 becomes reaches its peak voltage of 324V (voltage equal to 230 x $\sqrt{2}$). The rectified voltage is approx. 290V DC in the form of a ripple waveform (mean value).

Thus, nearly the same rectified voltage is obtained for both 115V and 230V systems.

In the past, selecting in these rectification methods was performed manually by a switch. However, by using a member of the MK series, selecting can be performed automatically by detecting the commercial power supply voltage and turning the triac on or off. In summary, members of the MK series consist of a triac serving as an electrical switch, and a circuit that controls the on and off status of the triac contained in a compact and lightweight package. Fig. 3 shows an example of equivalent circuits, while Fig. 4 shows the outline dimensions.

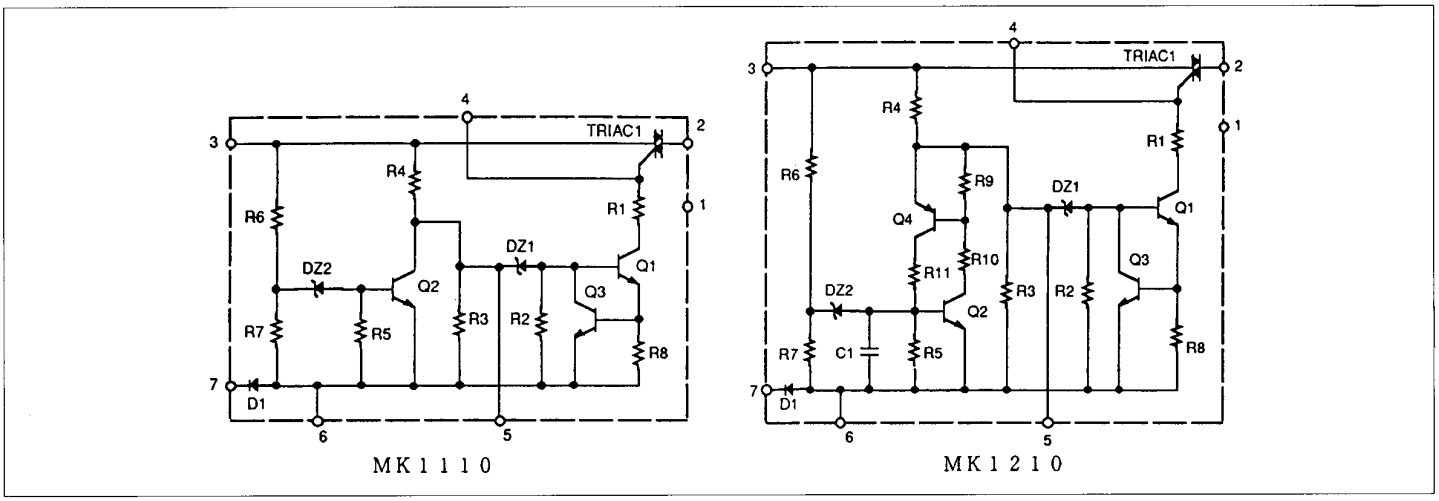


Fig. 3 Equivalent Circuits

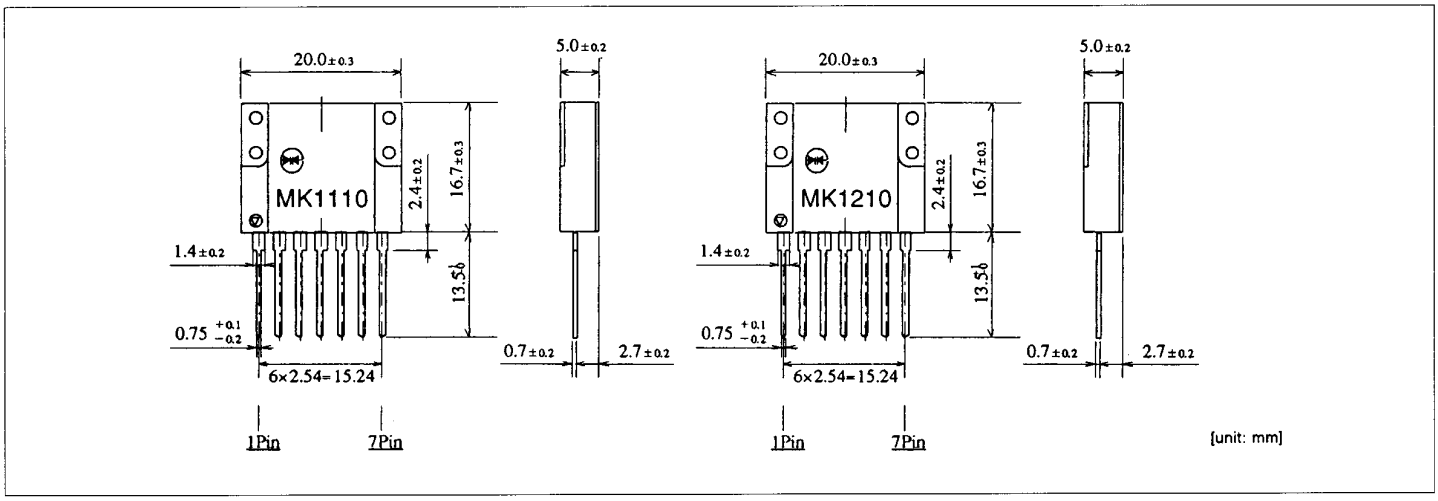


Fig. 4 Outline Dimensions

2-2 Operation of the MK Series

(1) Starting Voltage of Voltage Doubler

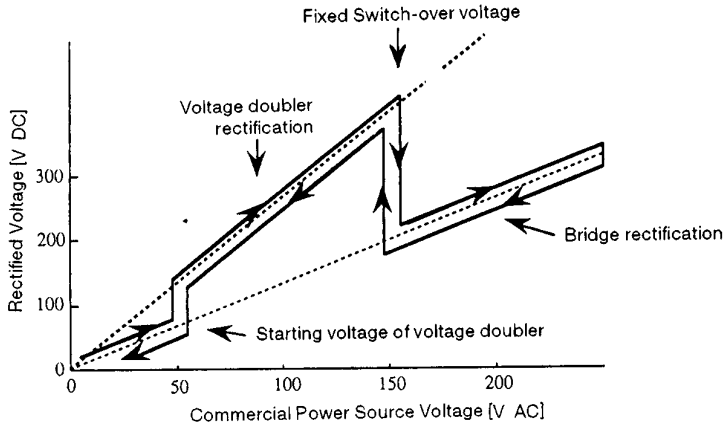
As the commercial power source voltage is gradually increased, the triac is turned on and voltage doubler rectification begins. The voltage at this time is referred to as the starting voltage of the voltage doubler (Fig. 5a, 5b).

(2) Fixed Switch-over Voltage

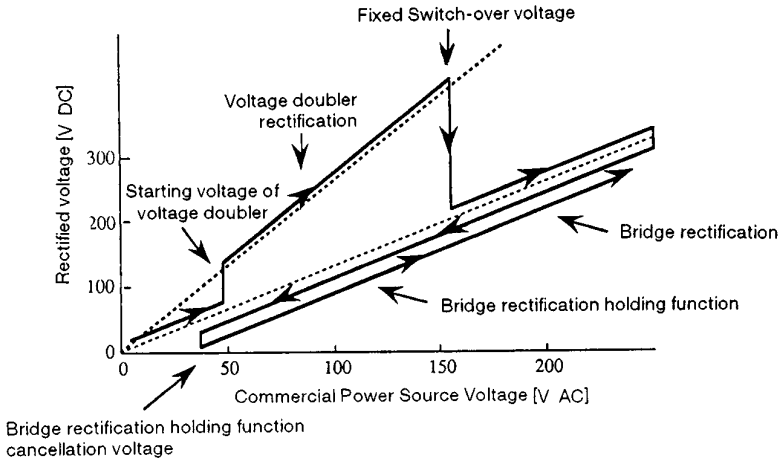
As the commercial power supply voltage continues to increase, the triac is turned off resulting in bridge rectification. The voltage at this time is referred to as the fixed switch-over voltage (Fig. 5a, 5b).

(3) Bridge Rectification Holding Function (Latching Function) (MK1210)

In the MK1210, once a 230V system has been selected to bridge rectification, bridge rectification is holded (Fig. 5b). The function that holds bridge rectification is referred to as the bridge rectification holding function (latching function). Bridge rectification is holded until the commercial power supply voltage drops to the cancellation voltage of the bridge rectification holding function (unlatching voltage). This bridge rectification holding function is useful during momentary power failures and momentary voltage drops in 230V systems.



a. MK1110



b. MK1210

Fig.5 Operation of the MK Series (Calculated Value)

4. Examples of Application Circuits

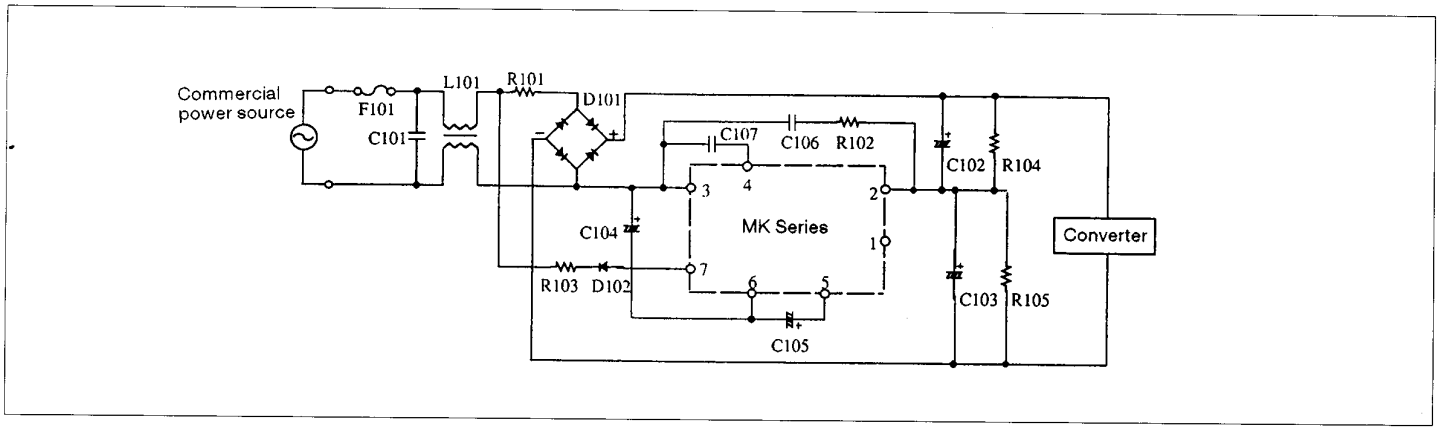


Fig. 6 Application Circuit

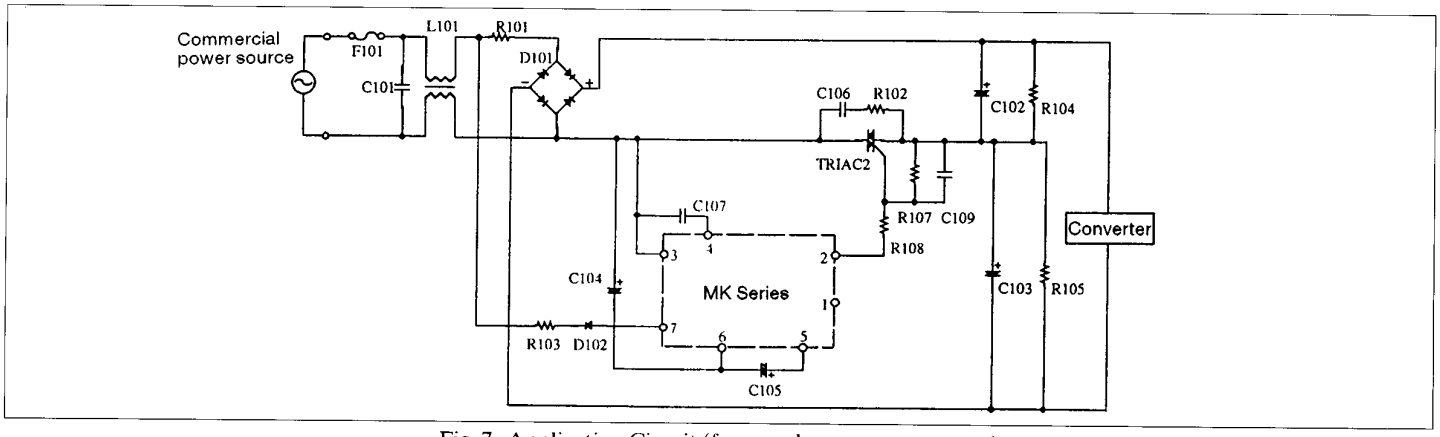


Fig. 7 Application Circuit (for even larger output power)

Although the above circuit can be used for power supplies up to roughly 150W, the below circuit can be used for power supplies having an even larger capacity than Fig. 6.

Please refer to the application manuals that have been made available for other details.

Remarkable progress has been achieved in the areas of hybrid IC functions for power device applications, improved quality, reduced costs and shortened delivery times in applications including CAD utilization, monolithic IC mounting and semiconductor assembly technology.

For the future, Shindengen intends to place emphasis on the creation of products having new functions that conform to the needs of the market while still satisfying the above requirements with respect to quality, cost and delivery time.

References

1) Tabata: "Trends and Applications of Hybrid IC", Denshi Gijutsu, 1992-5, Vol. 34, No. 6

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