

To our customers,

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## Old Company Name in Catalogs and Other Documents

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Renesas Electronics Corporation

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# DESIGNATION SYSTEM FOR SEMICONDUCTOR DEVICES

The designation system for semiconductor devices such as transistors, diodes, etc. is based on the standards in JIS C 7012 and is called the JIS type number. Also, it is called the EIAJ type number, because the registering of specifications and designations for individual type number is performed by the Electronic Industries Association of Japan (EIAJ).

The detail of the EIAJ designation system is specified in the SD-1, "Designation System for Discrete Semiconductor Devices," of the EIAJ Standards.

This paper is intended to inform you of the outline of the EIAJ designation system and the agreements on its registering, thereby letting you know how semiconductor devices are designated.

## Scope of Applications

The SD-1 specifies the designation system for discrete semiconductor devices such as diodes, transistors, thyristors, etc. Here composite devices, such as twin transistors are included but none of integrated circuits. Since the discrete transistors produced by the semiconductor device manufacturers joining EIAJ are subject to the obligatory registering system, those intended for any of domestic and overseas markets must have the specification and designation registered on EIAJ. As a result, the discrete transistors other than those manufactured for trial or by manufacturers outside EIAJ ought to carry the EIAJ type numbers such as 2SA00~2SD00.

On the contrary, since diodes, FETs, thyristors, photo transistors, etc. are not subject to the obligatory registering system. There are many devices having peculiar type numbers designated by its own manufacturers. Though some registered ones carry the EIAJ type numbers.

## EIAJ Type Numbers

The EIAJ type number consists of (1) a first number symbol; (2) a first letter symbol; (3) a second letter symbol; (4) a second number symbol; and (5) one or more suffix letter symbol if necessary. These symbols have the following significance.

### 1. First number symbol

The first number symbol consists of one digit indicating the class of the discrete semiconductor device. As a rule, letting the number of useful electrical connections or useful electrodes of a device be  $n$ , the first number symbol is  $n-1$ . Consequently, diodes or 2-electrode devices carry a number of 1, transistors or 3-electrode devices carry a number of 2, and tetrodes or 4-electrode devices carry a number of 3. Here the largest number assigned is 4 and therefore devices with more than 5 electrodes always carry a number of 4 as the first number symbol. For instance, the type number, 4SC00, represents an NPN transistor for high frequency use but does not indicate whether five or six or more electrodes are provided (see Fig. 1). Since, however, there are very few semiconductor devices with five or more electrodes, this designation system will cause no problems in practical applications.

An effective electrode is defined as an external electrical connection which is essential to the basic operation of a semiconductor device. Such connection does not include any to shield and or case. An electrode connecting to two external leads is regarded as a single electrode. A composite device enclosing two or more independent device units in a single package carries a first number symbol corresponding to the unit with more electrodes. A composite device containing interconnected units which have no independent characteristics and act as a single device is treated as an equivalent single device. For instance, a twin transistor (with 6 external leads) comprising high-frequency NPN transistors with all independent electrodes is designated as 2SC00. A twin transistor (with 5 external leads) with interconnected collectors is designated 2SC00 also. On the other hand, a twin transistor (with 4 external leads) with interconnected collectors and emitters is designated as 3SC00.

If the collectors are interconnected and the first stage emitter is connected to the base of the second stage, so called Darlington Connection transistor is equivalent to a single transistor and is designated as 2SC00. The above conditions are shown in Fig. 2.

## 2. First letter symbol

The first letter symbol is the capital letter S which represents a semiconductor device.

## 3. Second letter symbol

The second letter symbol is determined by the function or, if necessary, structure (operating form) of a semiconductor device and is specified as shown in Table 1.

In 1956, when the EIAJ designation system was started, this second letter symbol did not use and transistors were designated as 2SOO. In 1959, the designation system for semiconductor devices was changed and the second letter symbol was applied to the semiconductor device with three or more electrodes. Furthermore, in 1971, this second letter symbol was employed to identify those with two or more electrodes, as classified in Table 1. But this classification does not cover all semiconductor devices. The device already registered and designated as ISOO will not be subject to the new designation system, which covers newly registered devices.

At present, both the old and new designation systems are used. The diodes for microwave application are designated as ISTOO, ISGOO, ISVOO, or ISSOO, while the ordinary rectifier diodes and switching diodes still carry a conventional ISOO as well as the above designations.

## 4. Second number symbol

The second number symbol starting with the number 11 indicates the order in registering. This symbol is given to each of the versions classified by the first number and the second letter symbols, and the class with many register applications by semiconductor device manufacturers includes many items. Transistors, for example, cover some 1000 items by 2SA, 700 by 2SB, 2500 by 2SC, and 700 by 2SD. However, FETs cover just over one hundred by each designation.



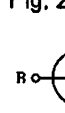

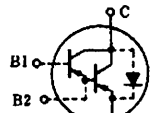
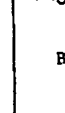
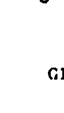
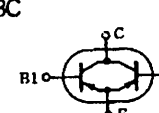
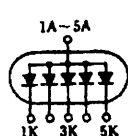
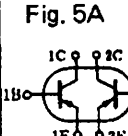
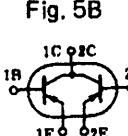
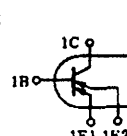
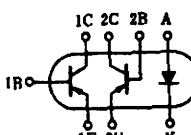
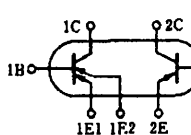
## 5. Suffix letter symbol

The suffix letter symbol is usually attached to the improved or modified devices which must be distinguished from previous versions. Suffix letters A, B, C, D, E, F, G, H, J and K can be used in this order indicate a later and modified version. Here the later or altered version may be substituted for any previous version but may not vice versa. For instance, 2SA708A is a version of 2SA708 with partly modified characteristic and can be substituted for 2SA708, but the reverse substitution may not always be possible.

In addition, for microwave diode, the suffix letter M issued to designate a pair of devices which are identical in outline dimensions and polarity and which have matched electrical characteristics.






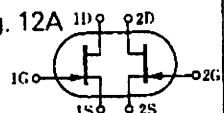
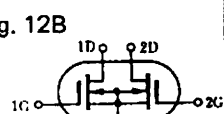
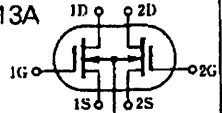
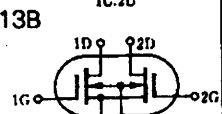
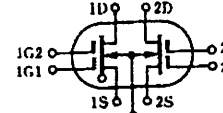
A letter R is used to indicate a reverse polarity diode in an asymmetrical package which is mechanically and electrically identical to a forward polarity device.

## Bipolar Device

	1S	2S	3S
Single Unit	Fig. 1A  Fig. 1B 	Fig. 2A  Fig. 2B  Fig. 2C 	Fig. 3A  Fig. 3B  Fig. 3C 
Composite Device with Identical Units	Fig. 4 	Fig. 5A  Fig. 5B 	Fig. 6 
Composite Device with Different Units		Fig. 7 	Fig. 8 

Note: Dotted line indicates terminal or part not relating to the designation.

## FET

	2S	3S	4S
Single Unit	Fig. 9A  Fig. 9B 	Fig. 10A  Fig. 10B 	Fig. 11A 
Composite Device with Identical Units	Fig. 12A  Fig. 12B 	Fig. 13A  Fig. 13B 	Fig. 14 

U = Substrate  
D = Drain  
G = Gate  
S = Source

Note: Dotted line indicates the connection not relating to the designation.

Fig. 1 Use of First Number Symbol

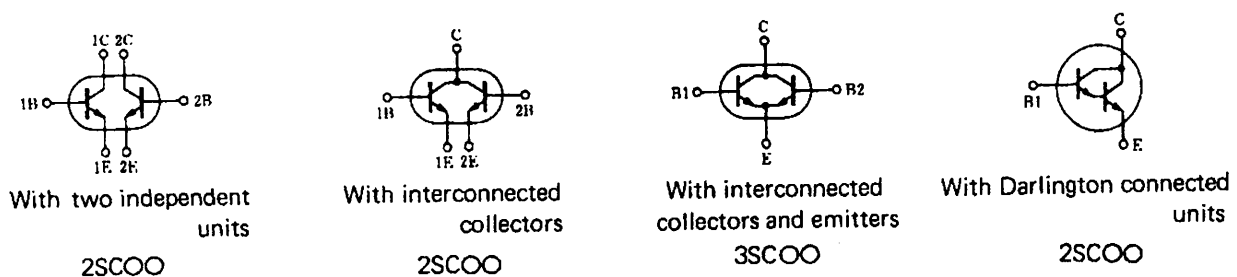


Fig. 2 Composite Devices with Different Internal Connections

**Table 1 Specification for Second Letter Symbol**

Letter	Major Function
A	High-frequency transistor of PNP type or the like
B	Low-frequency transistor of PNP type or the like
C	High-frequency transistor of NPN type or the like
D	Low-frequency transistor of NPN type or the like
E	Tunnel diode
F	Reverse blocking thyristor, Reverse conducting thyristor
G	Gunn diode
H	Uni-junction transistor
J	P-channel field effect transistor
K	N-channel field effect transistor
L	
M	Bidirectional thyristor
N	
P	Light sensitive device
Q	Light emitting device
R	Rectifier diode
S	Small signal diode (mixer, detector, switching, video detection, Schottky barrier, point contact)
T	Avalanche diode (IMPATT diode, avalanche and transit time diode)
U	
V	Variable capacitance diode, Snap-off diode, PIN diode
W	
X	
Y	
Z	Voltage Regulator Diode, Voltage Reference Diode

### Suffix Letter Representing Matched Pair of Microwave Diodes

The specification for matched pair of microwave diodes is shown in the attachment of the SD-1. The device treated as a pair with a matched pair characteristic is designated by the suffix letter M. The specification for matched pair of microwave diodes is as follows:

#### 1. Microwave mixer diode

- |  |                 |
|--|-----------------|
| (a) Conversion loss unbalance,                   | 0.3 dB maximum  |
| (b) Intermediate frequency impedance unbalance,  | 25 ohms maximum |
| (c) Isolation of signal to local oscillator arm, | 13 dB maximum   |

#### 2. Microwave video detector diode

- |   |   |
|---|---|
| (a) Figure of merit unbalance,  | 1 dB maximum<br>where unbalance = $10 \log_{10} \frac{M_1}{M_2}$<br>where $M_1$ and $M_2$ are individual figure of merit and $M_1 \geq M_2$ to get unbalance a positive number. |
| (b) The video impedance deviation of one, of the paired diodes with lower impedance is within 20% of that of the other diode. |   |

### Suffix Letter for Reverse Polarity of Diode

The paired two diodes identical in electrical characteristic and external form but opposite in electrode polarity are identified by the letter R which is suffixed to the diode of reverse polarity. When a mounting base (stud, flange, etc.) where part of the package is used for an electrical connection, the definitions of forward and reverse polarities are given as follows:

#### 1. Rectifier Diode

In forward-polarity devices, the mounting base is the cathode terminal. And in reverse-polarity devices, the mounting base is the anode terminal. Here, the suffix letter R is followed by a letter symbol, A, B, C, D, E, F, G, H, J, K or the like which indicates a variation of the device.

#### 2. Voltage Regulator Diodes and Voltage Reference Diodes

The forward and reverse polarities are defined in the same way as the rectifier diode.

#### 3. Microwave Diodes

The larger diameter terminal of the package is identified as the diode base. In forward-polarity devices, the diode base is the anode terminal. And in reverse-polarity devices, the diode base is the cathode terminal.

#### 4. Microwave Matched Pair Diodes

The paired two microwave diodes identical in outline dimensions but different in polarity and electrical characteristic are identified by the suffix letter MR which is attached to the one with a reverse polarity.

Examples:

1S23      Forward polarity

1S23R      Reverse polarity

1S23M      A matched pair of forward polarity diode 1N23

1S23MR      A matched pair of one forward polarity diode 1N23 and one reverse polarity diode 1N23R

1S23RM    A matched pair, of reverse polarity diode 1S23R

One of the suffix letters, A, B, C, D, E, F, G, H, J or K is preceded by M, R, MR or RM.

Examples:

1S23M, 1S23AM, 1S23AMR, 1S23ARM

### **Designation for Performance Range**

The devices each consisting of group may be provided with different type number. Also, a combination of the basic type number and the following symbols, which indicates the performance range, separated by a hyphen between the basic type number may be used. This designation system is specified in SD-1 Attachment 2 as shown in the table in page 7.

### **Marking on Devices**

It is necessary to mark the proper type numbers not only on individual devices but on the packing for each unit and the outside packing such as carton box. However, this regulation is accompanied by exceptional agreements, which permit a symbol, color code or the like on a small-sized device where marking of the type number is impossible, or permit any marking or color code specified by the customer. Also, the device without marking is permitted. In any of the above cases, the packing must carry a registered type number.

In marking on devices, deletion of the first number symbol and the first letter symbol is also permitted. For example, C1507 is marked on the 2SC1507 package.

### **Ownership of the Registered Designation**

After the registering at EIAJ, the specification and the type number are held commonly by the industry, and manufacture of the registered goods is opened to every manufacturer. Consequently, it happens that some devices carry a type number, being manufactured by two or more manufacturers.

Although this system has been employed for electron tubes for a long time, it presents more increasing aspect as a result of the advanced manufacturing techniques intending for identical characteristics and the user's needs for compatible devices.

### **Manufacturers Outside EIAJ**

The semiconductor devices produced by the manufacturers outside EIAJ are not subjected to the regulations of the SD-1 designation system. And, in many cases, such manufacturers are operated by foreign capitals.

However, in response to EIAJ's proposal to the registering of specification and designation, some manufacturers have started registering on EIAJ.



## 1. Voltage Regulator Diode

Example: 1SZ99 R - C 4V7

Basic Type Number	Polarity	Letter Indicating the Allowance of Zener Voltage	Typical Zener Voltage Indicated by Volt Unit
Designated according to the text of SD-1 specification.  The polarity-suffix relationship is also determined by the text.	No polarity is indicated for the device with forward polarity where mounting base is the cathode terminal, or the device which has symmetrical package.  The device with reverse polarity where mounting base is the anode terminal is identified by R.	A : 1% B : 2% C : 5% D : 10% E : 20%	Typical value of Zener voltage relating to the nominal current rating throughout the performance range. V is used in place of a decimal point if necessary.

## 2. Rectifier Diode, Reverse Blocking Thyristor, Bidirectional Thyristor

Examples: 1SR99 R - 100  
2SF99 - 100  
2SM99 - 100

Basic Type Number	Polarity	Maximum Rating of Repetitive Peak Reverse Voltage Indicated by Volt Unit
Designated according to the text of SD-1 specification  The polarity-suffix relationship is also determined by the text.	No polarity is indicated for the device with forward polarity where mounting base is the cathode terminal, or the device which has symmetrical package.  The device with reverse polarity where mounting base is the anode terminal is identified by R.	Thyristors are given the maximum rating of repetitive peak reverse voltage or of repetitive peak off-state voltage of which the lower value.



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