Common Precautions for All MOS FET Relays

⚠ WARNING

Always turn OFF the power supply before wiring a Relay.
Not doing so may cause electrical shock.

Do not touch the current-carrying parts of the pin section of a MOS FET Relay while the power is being supplied.
An electrical shock may occur.

Precautions for Safe Use

1. Do not apply overvoltages or overcurrents to the input or output circuit of the MOS FET Relay.
   The MOS FET Relay may fail or ignite.
2. Perform soldering and wiring correctly according to specified soldering conditions.
   Using a MOS FET Relay with incomplete soldering may cause overheating when power is applied, possibly resulting in burning.

Precautions for Correct Use

●Derating

You must consider derating to achieve the required system reliability.

To use a MOS FET Relay with high reliability, consider derating the maximum ratings and recommended operating conditions, and allow sufficient leeway in designs based on testing operation in the actual application under the actual operating conditions whenever possible.

(1) Maximum Ratings
The maximum ratings must never be exceeded even instantaneously. This applies individually to each of the ratings. If any of the maximum ratings is exceeded, the internal parts of the MOS FET Relay may deteriorate or the chip may be destroyed. To ensure high reliability in using a MOS FET Relay, sufficiently derate the maximum voltage, current, and temperature ratings when designing the application.

(2) Recommended Operating Conditions
The recommended operating conditions are to ensure that the MOS FET Relay turns ON and OFF reliably.
To ensure high reliability in using a MOS FET Relay, consider the recommended operating conditions when you design the application.

(3) Fail-safe Design
We recommend that you implement fail-safe measures in the design of the application if the failure of, deterioration of characteristics in, or functional errors in the MOS FET Relay will have a serious affect on the safe operation of the system.

●Countermeasures for static electricity

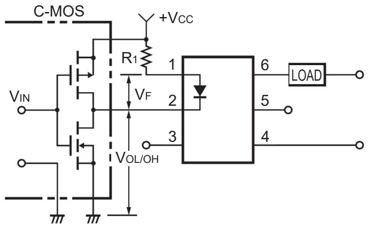
There is a risk of damage to internal elements and impairment of functionality if static electricity is discharged to the pins due to product handling or otherwise.

Reduce the generation of static electricity as much as possible, and implement appropriate measures to prevent charge accumulation near the product.

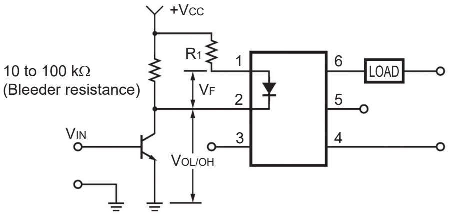
●Typical MOS FET Relay Driving Circuit Examples

The LED input side of the MOS FET is driven by current. If applying a Voltage, add resistance in series with the circuit, so the specified current is applied.
This resistance is referred as "LED current limiting resistance".

C-MOS



Transistor



- To ensure that the MOSFET relay operates correctly, use the following formula to calculate the limiting resistance, and design the circuit accordingly.

$$R_1 = \frac{V_{CC} - V_{OL} - V_{F(ON)}}{I_F}$$

Note: To set the value of $I_{F(ON)}$, check the trigger LED current and recommended operation LED forward current indicated in the catalogue for each model, and set a high value with leeway.

- To ensure that the MOSFET relay resets reliably, calculate the reset voltage using the formula below, and control so that the voltage is lower than this value.

$$V_{F(OFF)} = V_{CC} - I_F R_1 - V_{OH}$$

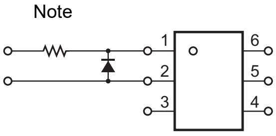
Note: For the $I_{F(OFF)}$ value, set a value that is lower with leeway than the reset LED forward current indicated for each model in the catalogue.

- If the drive transistor has a large leakage current that may cause malfunctioning, add a bleeder resistance.
- Note that voltage-driven type products have a built-in current limiting resistor on the input side, and can be driven by directly applying the specified voltage to the input side terminals.

●Protection from Surge Voltage on the Input Pins

- If any reversed surge voltage is imposed on the input pins, insert a diode in parallel with the input pins as shown in the following circuit diagram and do not impose a reversed voltage of 3 V or higher.

Surge Voltage Protection Circuit Example



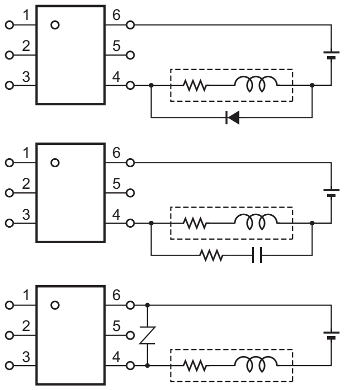
Note: Voltage-driven type products have a built-in current limiting resistor on the input side, so external resistors are not required.

Common Precautions for All MOS FET Relays

●Protection from Spike Voltage on the Output Pins

- If there is an inductive load or other condition that will cause overvoltage that exceeds the absolute maximum rating between the output pins, connect a protective circuit to limit the overvoltage.

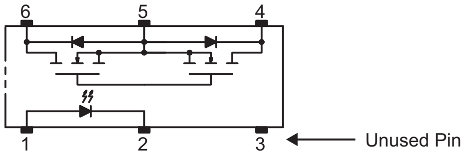
Spike Voltage Protection Circuit Example



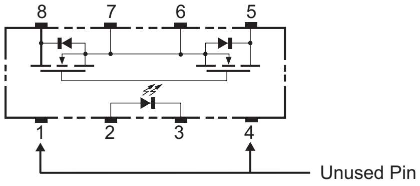
●Unused Pin

The unused pins of each MOSFET relay are used in the internal circuitry. Do not connect to an external circuit.

(Example for 6-pin Relay)

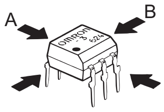


(Example of 8-pin high-capacity type)



●Pin Strength for Automatic Mounting

- In order to maintain the characteristics of the MOS FET Relay, the force imposed on any pin of the MOS FET Relay for automatic mounting must not exceed the following limits.



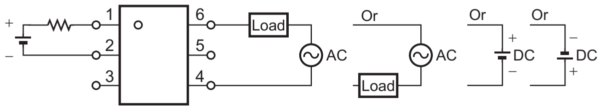
In direction A: 1.96 N
In direction B: 1.96 N

●Load Connection

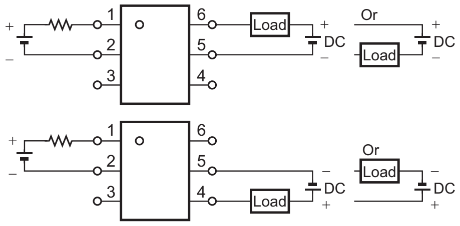
- Do not short-circuit the input and output pins while the MOS FET Relay is operating or it may malfunction.

Example of correct connection

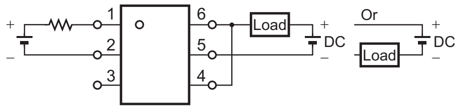
AC/DC connection (A connection)



DC Single Connection (B connection)



DC Parallel Connection (C connection)



●Estimated Life

The following tables show the LEDs that are used in each MOS FET Relay. Estimated life data is given on the following pages. Ask your OMRON representative for any models that are not listed in the table.

This data is the results of estimating the service life from long-term data on a single lot. Use it only as reference data.

MOS FET Relays That Use GaAs LEDs

DIP	SOP		
G3VM-353A/D	G3VM-21GR	G3VM-201G	G3VM-355JR
G3VM-353B/E	G3VM-21GR1	G3VM-201G1	G3VM-401G
G3VM-354C/F	G3VM-41GR4	G3VM-S5	G3VM-401H
G3VM-355CR/FR	G3VM-41GR5	G3VM-201H1	G3VM-402J
G3VM-401BY/EY	G3VM-41GR6	G3VM-202J1	G3VM-601G
G3VM-601BY/EY	G3VM-61G2	G3VM-351G1	G3VM-63G
	G3VM-61H1	G3VM-351GL	
	G3VM-62J1	G3VM-351H	
	G3VM-81G1	G3VM-352J	
	G3VM-81GR	G3VM-353G	
	G3VM-81GR1	G3VM-353H	
	G3VM-81HR	G3VM-354J	
SSOP		**USOP**	
G3VM-21LR	G3VM-101LR	G3VM-21PR10	G3VM-61PR1
G3VM-21LR1	G3VM-21LR11	G3VM-21PR11	G3VM-21PR1
G3VM-41LR4		G3VM-41PR10	G3VM-41PR5
G3VM-41LR5		G3VM-41PR11	G3VM-41PR6
G3VM-41LR6		G3VM-41PR12	G3VM-71PR
G3VM-61LR		G3VM-51PR	G3VM-81PR
G3VM-81LR		G3VM-61PR	G3VM-101PR

MOS FET Relays That Use InGaAs LEDs

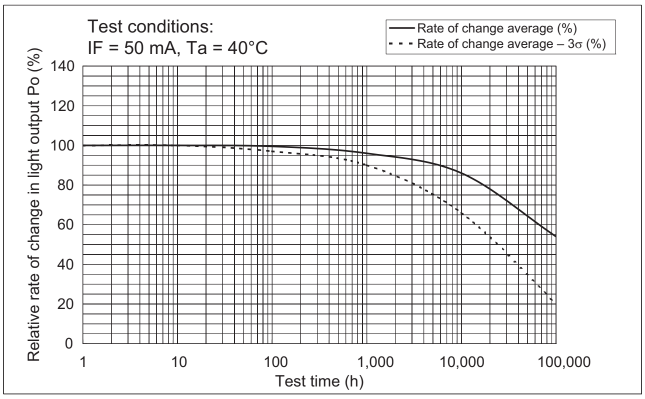
DIP	SOP	VSON	S-VSON(L)
G3VM-61AY1/DY1	G3VM-61G3	G3VM-21UR11	G3VM-31QR
G3VM-201AY1/DY1	G3VM-201G2	G3VM-61UR	G3VM-61QR2
G3VM-351AY1/DY1	G3VM-401G1	G3VM-81UR	G3VM-101QR1
G3VM-401AY1/DY1	G3VM-601G1	G3VM-81UR1	G3VM-41QR10
G3VM-601AY1/DY1	G3VM-61VY2	G3VM-101UR	G3VM-61QR
G3VM-41AY1/DY1	G3VM-351VY	G3VM-21UR1	G3VM-31QV2H
	G3VM-61VY1	G3VM-41UR4	G3VM-61QV3H
	G3VM-61VY3	G3VM-41UR10	G3VM-61QV4H
	G3VM-401VY	G3VM-41UR11	G3VM-61QV3L
	G3VM-61VR	G3VM-41UR12	G3VM-61QR3
	G3VM-61VY4	G3VM-21UR10	**WSON**
	G3VM-351VY1	G3VM-61UR1	G3VM-61YR
	P-SON	G3VM-51UR	
	G3VM-31WR		
	G3VM-61WR		
	G3VM-101WR		

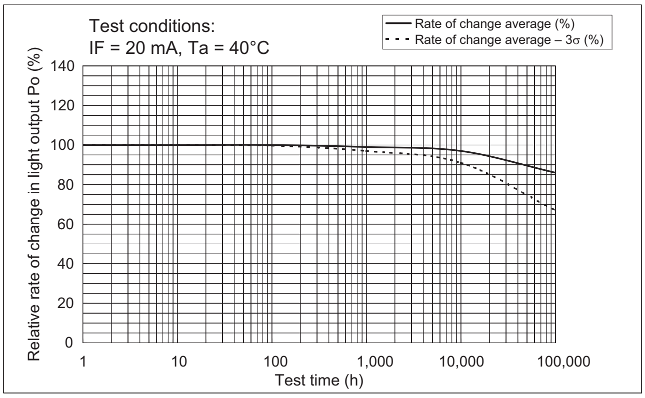
MOS FET Relays That Use GaAlAs LEDs

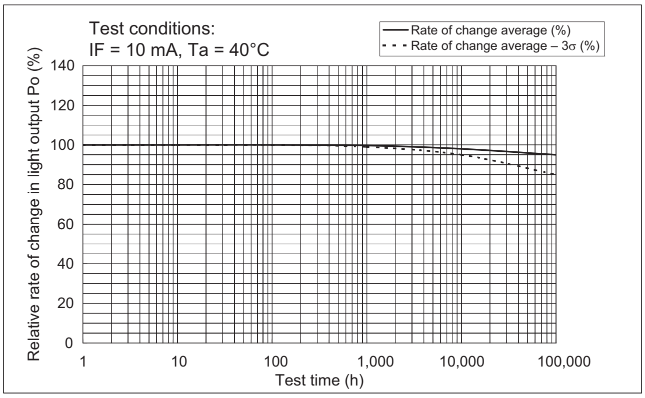
DIP	SOP	SSOP
G3VM-21AR/DR	G3VM-21HR	G3VM-21LR10
G3VM-21BR/ER	G3VM-31HR	G3VM-41LR10
G3VM-41AR/DR	G3VM-41HR	G3VM-41LR11
G3VM-41BR/ER	G3VM-41GR8	
G3VM-61AR/DR	G3VM-61GR2	
G3VM-61BR/ER	G3VM-61HR	
G3VM-61BR1/ER1	G3VM-61HR1	
G3VM-101AR/DR	G3VM-101HR	
G3VM-101BR/ER	G3VM-101HR1	

Common Precautions for All MOS FET Relays

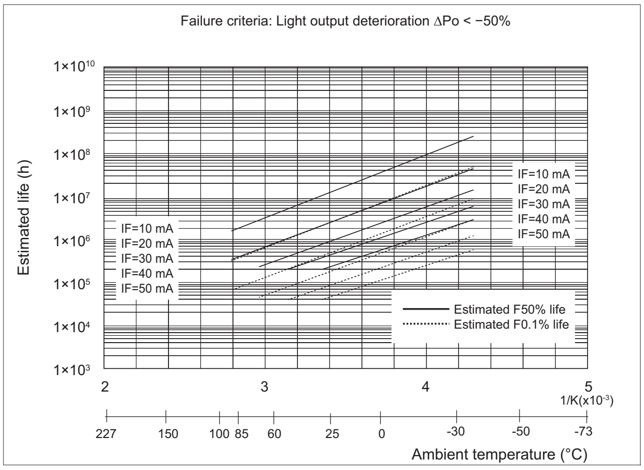
Data on Estimated Temporal Changes in GaAs LEDs

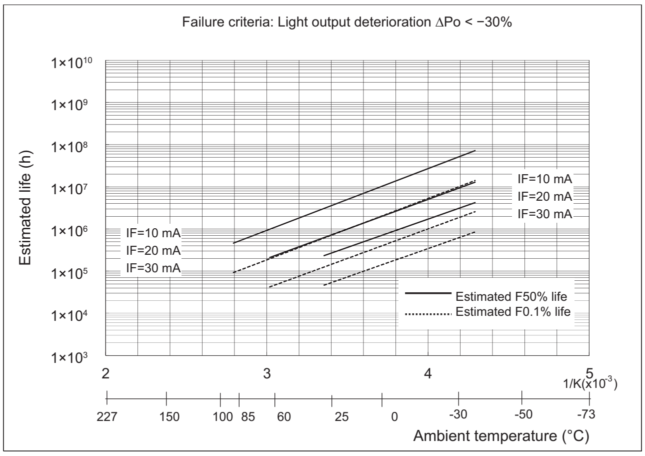






Estimated Life Data for GaAs LEDs





The above estimated life data is reference data that was based on LED long-term appraisal for a single lot.
Operating conditions that exceed the ratings for some models are included, but this in no way implies any warranty for operation that exceeds the ratings.

F50% Life:
For the life to a 50% cumulative failure rate, this is the time that is required for the AVG average line in the data on estimated temporal changes to reach the failure criteria.

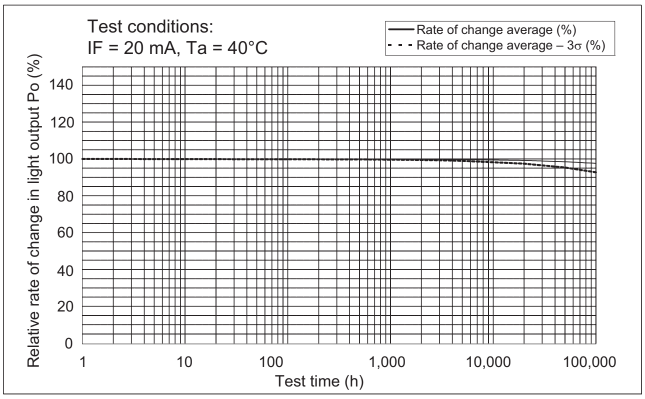
F0.1% Life:
For the life to a 0.1% cumulative failure rate, this is the time that is required for the AVG-3α line in the data on estimated temporal changes to reach the failure criteria.

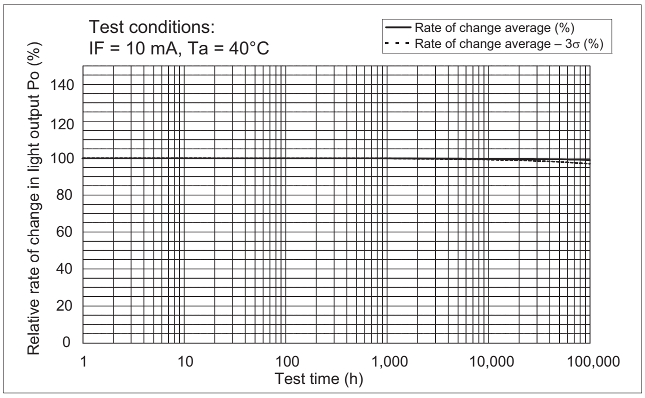
Whether to use estimated F50% life or F0.1% life should be determined based on the reliability required in the actual equipment, however, estimated F0.1% life is normally recommended.

"Optical output deterioration Δpo" is the amount of LED optical output deterioration compared to the initial LED output. When "Optical output deterioration failure criterion Δpo < - 50%", a failure is detected when optical output has deteriorated 50% from the initial output.

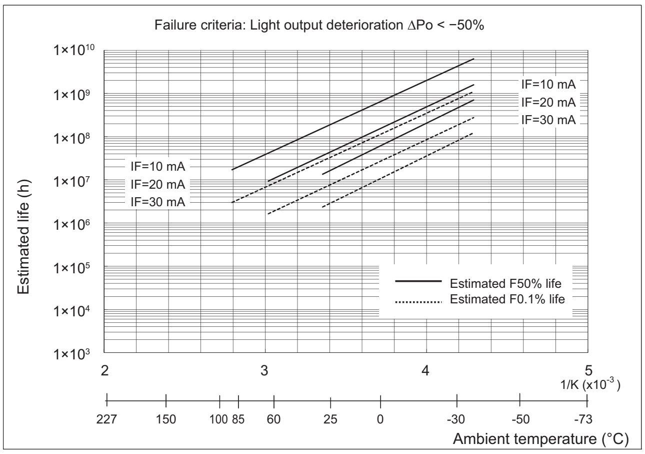
Whether to use optical output deterioration Δpo < - 50% or Δpo < - 30% should be determined based on the amount of leeway to be provided in the LED forward current (I_F) setting with respect to the trigger LED forward current (I_{FT}). However, the Δpo < - 30% graph is normally recommended.

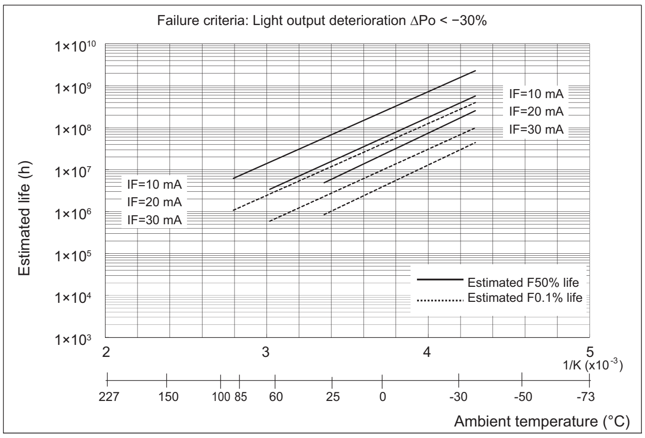
Data on Estimated Temporal Changes in InGaAs LEDs





Estimated Life Data for InGaAs LEDs





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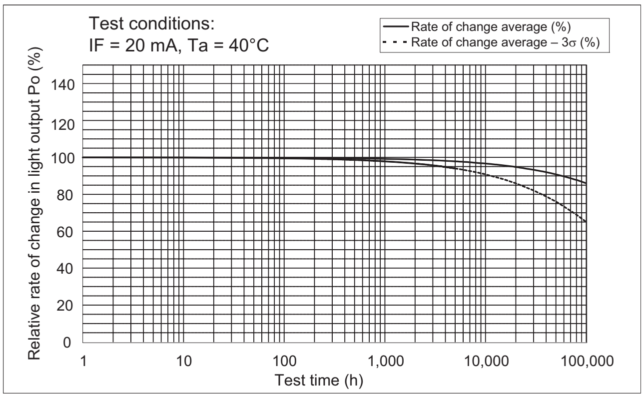
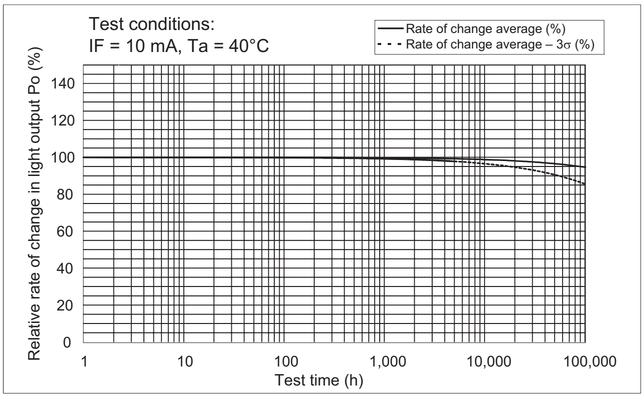
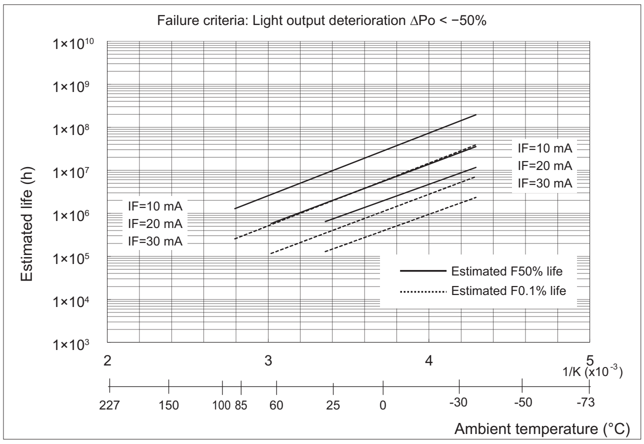
Common Precautions for All MOS FET Relays

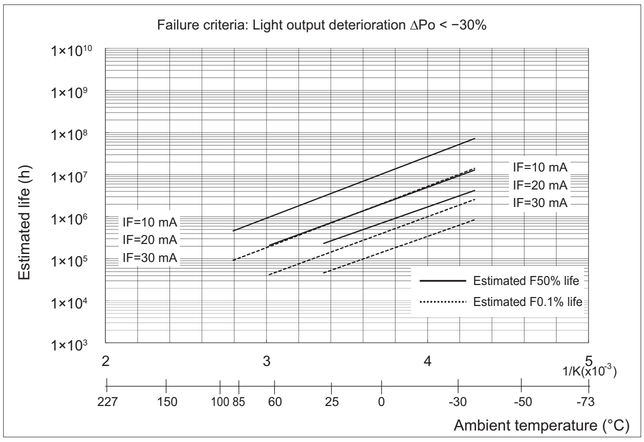
Data on Estimated Temporal Changes in GaAlAs LEDs





Estimated Life Data for GaAlAs LEDs





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Operating conditions that exceed the ratings for some models are included, but this in no way implies any warranty for operation that exceeds the ratings.

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For the life to a 50% cumulative failure rate, this is the time that is required for the AVG average line in the data on estimated temporal changes to reach the failure criteria.

F0.1% Life:
For the life to a 0.1% cumulative failure rate, this is the time that is required for the AVG-3α line in the data on estimated temporal changes to reach the failure criteria.

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●Cleaning Flux from the MOS FET Relays

(1) Clean flux from the MOS FET Relay so that there will be no residue of reactive ions, such as sodium or chlorine.
Some organic solvents will react with water to produce hydrogen chloride or other corrosive gases, which may cause deterioration of the MOS FET Relays.

(2) When washing off the flux with water, make sure that there will be no residue of reactive ions, particularly sodium or chlorine.

(3) During water washing, do not scrub the marks on the surface of the MOS FET Relay with a brush or your hand while there is cleaning liquid on the MOS FET Relay. The marks may come off.

(4) Clean the flux from the MOS FET Relays with the chemical action of the solvent for submersed cleaning, shower cleaning, or steam cleaning. To minimize the effect on the MOS FET Relays, do not place the MOS FET Relay in the solvent or steam for more than 1 minute at a temperature of 50°C.

(5) If you use ultrasonic cleaning, keep the time short. If the cleaning time is too long, the sealing characteristics of the molded resin and frame materials may deteriorate.
The recommended basic conditions are given below.
Recommended Conditions for Ultrasonic Cleaning:
Frequency: 27 to 29 kHz
Ultrasonic wave output: 300 W max. (0.25 W/cm^2 max.)
Cleaning time: 30 s max.
Also, suspend the MOS FET Relays in the cleaning solution so that the MOS FET Relay and PCB do not come into direct contact with the ultrasonic transducer.

●Solder Mounting

Perform solder mounting under the following recommended conditions to prevent the temperature of the MOS FET Relays from rising.

<Flow Soldering>

PCB Terminals

(Set Temperature of Flow Bath)

Solder type	Preheating	Soldering	Count
(Lead solder) SnPb	150°C 60 to 120 s	260°C 10 s max.	Once only
(Lead-free solder) SnAgCu	150°C 60 to 120 s	260°C 10 s max.	Once only

Note: We recommend that you verify the suitability of solder mounting under actual conditions.

Surface-mount Terminals

If you are considering mounting a surface mount pin type by flow soldering, please consult us.

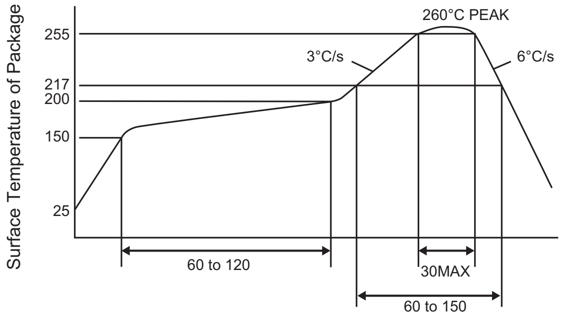
<Reflow Soldering>

Surface-mount Terminals

(Surface Temperature of Package)

Solder type	Preheating	Soldering		Count
(Lead solder) SnPb	140 to 160°C 60 to 120 s	210°C 30 s max.	Peak: 240°C max.	Up to twice

(Lead-free solder) SnAgCu recommended profile



Reflow repetitions : Up to twice Time (s)

Note: 1. We recommend that you verify the suitability of solder mounting under actual conditions.
2. When SSOP, USOP, VSON, S-VSON(L), or WSON products are ordered with (TR), tape package product is delivered in moisture-proof packaging. If ordered without (TR), tape-cut product is delivered in non moisture-proof packaging. Mount a tape cut product by manual soldering. Tape cut products absorb moisture because a non moisture-proof package is used. Risk of package cracking or other damage due to thermal stress if reflow soldering is performed.

Manual Soldering (Once Only)

Perform manual soldering at 350°C for 3 s or less or at 260°C for 10 s or less.

Note: The manual soldering condition for P-SON, VSON, S-VSON(L), and WSON series products is 260°C within 10 seconds.

●Storage Conditions

(1) Store the MOS FET Relay where they will not be subjected to water leaks or direct sunlight.

(2) When transporting or storing the MOS FET Relays, observe all precautions on the packaging boxes.

(3) Keep the storage location at normal temperature, normal humidity, and normal pressure. Guidelines for the temperature and humidity are 5 to 35°C and a relative humidity of 45% to 75%.

(4) Do not store the MOS FET Relay in locations that are subject to corrosive gases, such as hydrogen sulfide gas, or to salt spray, and do not store them where there is visually apparent dust or dirt.

(5) Store the MOS FET Relay in a location that has a relatively stable temperature. Radical changes in temperature during storage will cause condensation, which may oxidize or corrode the leads and interfere with solder wetting.

(6) If you remove MOS FET Relays from the packages and then store them again, use storage containers that have measures to prevent static electricity.

(7) Do not under any circumstances apply any force to the MOS FET Relays that would deform or alter them in any way.

(8) This product is warranted for one year from the date of purchase or the date of delivery to the specified location.
If the MOS FET Relays are stored for more than about one year under normal conditions, we recommend that you confirm solderability before you use the MOS FET Relays.

Common Precautions for All MOS FET Relays

●Usage Conditions

<Temperature>

The electrical characteristics of the MOS FET Relays are limited by the application temperature.

If you use them at temperatures outside of the operating temperature range, the electrical characteristics of the MOS FET Relays will not be achieved and the MOS FET Relays may deteriorate. For that reason, you must determine the temperature characteristics in advance and apply derating* to the design of the application. (*Derating reduces stress.) Consider derating in the operating temperature conditions and apply the recommended operating temperature as a guideline.

<Humidity>

If the MOS FET Relays are used for a long period of time at high humidity, humidity will penetrate the Relays and the internal chips may deteriorate or fail. In systems with high signal source impedance, leaks in the board or leaks between the leads of the MOS FET Relays can cause malfunctions. If these are issues, consider applying humidity-resistant processing to the surfaces of the MOS FET Relays. On the other hand, at low humidity, damage from the discharge of static electricity becomes a problem. Low humidity may cause damage due to electrostatic discharge. Unless moisture proofing is implemented, use within a relative humidity range of 40 to 60%.

<Disposal>

LEDs containing arsenic compounds are used in these products. Do not destroy, cut, crush or chemically decompose these products as the powder and vapor produced are harmful to the human body.

●Considerations when handling MSL3 products

Moisture proof package (MSL)	Package
MSL1	DIP, SOP
MSL3	SSOP, USOP, P-SON, VSON, S-VSON(L), WSON

Surface mount products may have a crack when thermal stress is applied during surface mount assembly after they absorb atmospheric moisture. Therefore, please observe the following precautions.

(1) This moisture proof bag may be stored unopened within 12 or 24 months at the following conditions. (Check the expiration date listed on the actual moisture proof bag.)
Temperature: 5°C to 30°C
Humidity: 90% (Max.)

(2) After opening the moisture proof bag, the devices should be assembled within 168 hours in an environment of 5°C to 30°C / 70%RH or below.

(3) If upon opening, the moisture indicator card shows humidity 30% or above (Color of indication changes to pink) or the expiration date has passed, the devices should be baked in taping with reel. After baking, use the baked devices within 72 hours, but perform baking only once.
Baking conditions: 60±5°C. For 64 to 72 hours.
Expiration date: 12 or 24 months from sealing date, which is imprinted on the label affixed. (Check the expiration date listed on the actual moisture proof bag.)

(4) Repeated baking can cause the peeling strength of the taping to change, then leads to trouble in mounting. Furthermore, prevent the devices from being destructed against static electricity for baking of it.

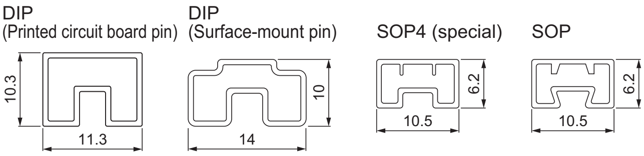
(5) If the packing material of laminate would be broken the hermeticity would deteriorate.
Therefore, do not throw or drop the packed devices.

(6) Tape-cut SSOP, USOP, P-SON, VSON, S-VSON(L), or WSON are packaged without humidity resistance. Use manual soldering to mount them. (MSL not supported)

●Stick packaging

<Stick shape and dimensions>

Unit: mm

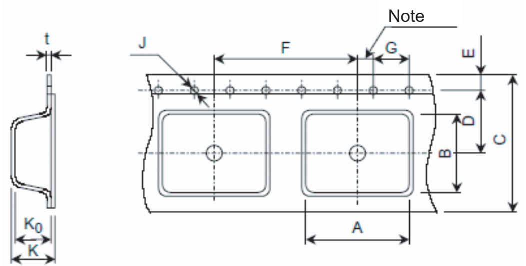


Type of package	DIP4	DIP6	DIP8	DIP4	DIP6	DIP8	Special SOP4	SOP4	SOP6	SOP8
Pin type	Printed circuit board pin			Surface-mount pin						
Number of Relays	100	50	50	100	50	50	125	100	75	50
Height (mm)	10.3			10			6.2			
Width (mm)	11.3			14			10.5			
Length (mm)	525			525			555			

●Tape Packaging

<Tape Form and Dimensions>

Unit: mm



Note: DIP, SOP: 2.0±0.1
Others: 2.0±0.05

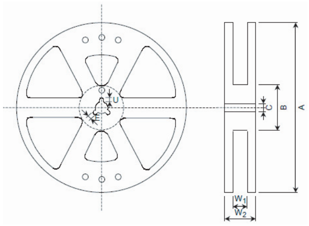
Unit: mm

Type of package			DIP4	DIP6	DIP8	Special SOP4	SOP4
Dimension symbol (See figure.)	A	Dimensions	10.4±0.1			4.0±0.1	4.3±0.1
	B		5.1±0.1	7.6±0.1	10.1±0.1	7.6±0.1	7.5±0.1
	C		16±0.3			12±0.3	
	D		7.5±0.1			5.5±0.1	
	E		1.75±0.1				
	F		12.0±0.1			8.0±0.1	
	G		4.0±0.1				
	J		1.5+0.1/-0				
	k		4.55±0.2			2.9±0.2	2.6±0.2
	ko		4.1±0.1			2.6±0.1	2.4±0.1
	t		0.4±0.05			0.3±0.05	

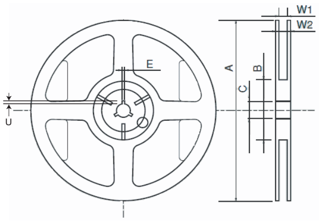
Type of package			SOP6	SOP8	SSOP4	USOP4	VSON4 VSON(R)4	S-VSON(L)4	WSON4	P-SON4
Dimension symbol (See figure.)	A	Dimensions	7.5±0.1		2.35±0.2	2.6±0.1	1.6±0.1			3.6±0.1
	B		6.7±0.1	10.5±0.1	4.5±0.1	3.55±0.1	3.0±0.1	2.25±0.1		2.4±0.1
	C		16±0.3		12±0.3		8.0±0.2			8.0±0.1
	D		7.5±0.1		5.5±0.1		3.5±0.1			
	E		1.75±0.1							
	F		12±0.1		4.0±0.1					8.0±0.1
	G		4.0±0.1							
	J		1.5+0.1/-0							
	k		2.5±0.2	2.4±0.2	2.4±0.1	2.25±0.1	---			
	ko		2.3±0.1	2.2±0.1	2.1±0.1	1.95±0.1	1.5±0.1	1.5±0.1	1.0±0.1	1.5±0.1
	t		0.3±0.05			0.3±0.1	0.2±0.05			

<Reel Form and Dimensions>

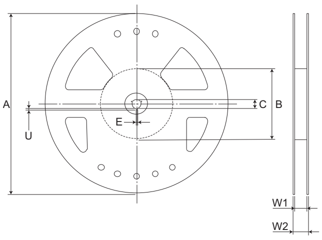
DIP/SOP
SOP4 special (TR)



SSOP/USOP/P-SON/VSON/
S-VSON(L)/WSON/
SOP4 special (TR05)/SOP4 (TR05)/
SOP6 (TR05)



DIP (TR05)



Unit: mm

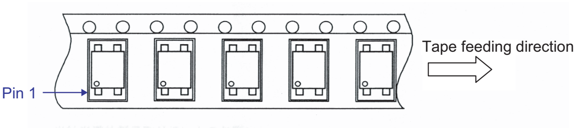
Type of package			DIP4/DIP6/DIP8		SOP4/SOP4 (Special)	SOP6
Tape name			(TR05)	(TR)	(TR05)	
Dimension symbol (See figure.)	A	Dimensions	254±2 dia.	380±2 dia.	180±2.0 dia.	
	B		100±1 dia.	80±1 dia.	60±1.0 dia.	
	C		13±0.5 dia.			
	E		2.0±0.5			
	U		4.0±0.5			
	W1		17.5±0.5	17.5±0.5	13.5±0.5	17.±0.5
	W2		21.5±1.0	21.5±1.0	17.5±1.0	21.5±1.0

Type of package			SOP4/ SOP4 (Special)	SOP6/SOP8	SSOP4/ USOP4	P-SON4/ VSON4/ VSON(R)4/ S-VSON(L)4/ WSON4
Tape name			(TR)		(TR05)	
Dimension symbol (See figure.)	A	Dimensions	330±2 dia.		180+0/-4 dia.	180±3 dia.
	B		80±1 dia.		60±1 dia.	
	C		13±0.5 dia.			
	E		2.0±0.5			
	U		4.0±0.5			
	W1		13.5±0.5	17.5±0.5	13±0.3	9.0±0.3
	W2		17.5±1.0	21.5±1.0	15.4±1.0	11.4±1.0

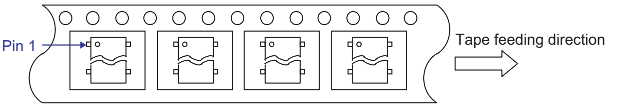
<Taping Direction>

The orientations of the MOS FET Relays in the depressions in the carrier tapes are shown below.

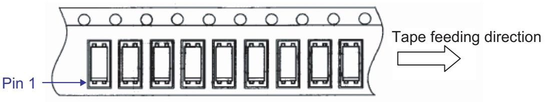
(1) SOP4 Pins



(2) SOP6, SOP8, DIP4, DIP6, or DIP8 Pins



(3) SSOP4, USOP4, P-SON4, VSON4, S-VSON(L)4, or WSON4 pin types



<Number of Relays Per Reel>

Type of package		DIP4	DIP6	DIP8	Special SOP4	SOP4	SOP6	SOP8
Number of Relays	TR	1,500			3,000	2,500		
	TR05	500						–

Type of package		SSOP4	USOP4	VSON4 VSON(R)4	S-VSON(L)4	P-SON4	WSON4
Number of Relays	TR	–					
	TR05	500					

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