OMRON

Improving Automated Test Equipment Product Life and Board Density

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eBook

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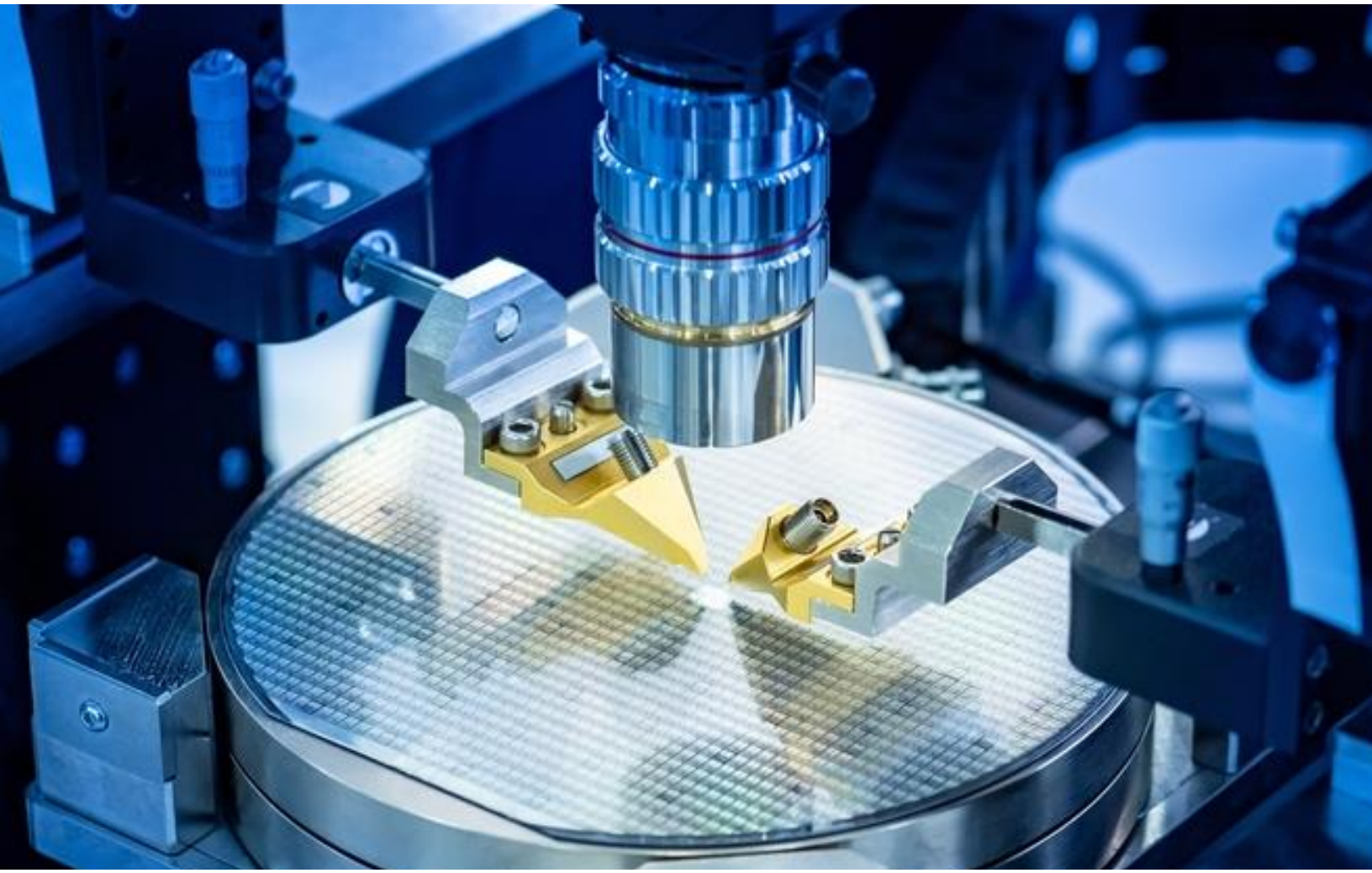


Overview

Semiconductors and consumer electronics have become more sophisticated and complex, required more sophisticated ways to test these devices.

The automated test equipment industry depends on long-lasting test machines and boards. Keeping test equipment in the field, with the ability to test a variety of devices over a period of years, depends on components that guarantee specifications over millions of cycles. Additionally, as the industry demands more channels at higher currents to enable the advancement of AI chipsets, board density remains a top priority. Options that support board downsizing help increase test capacity and capability.

OMRON, a leader in components for the automated test equipment industry, supplies MOSFET relays and EFC blade pins to improve overall product life and board density. OMRON uses the latest signal relay and blade pin technologies to enable the advancement of automated test equipment and the next generation of semiconductors. These technologies help provide longer product life, save on board space, and improve test reliability.

Context

Evan Kuhn discussed trends and shared how OMRON solutions solve new and ongoing challenges in the automated test equipment industry.

Key Takeaways

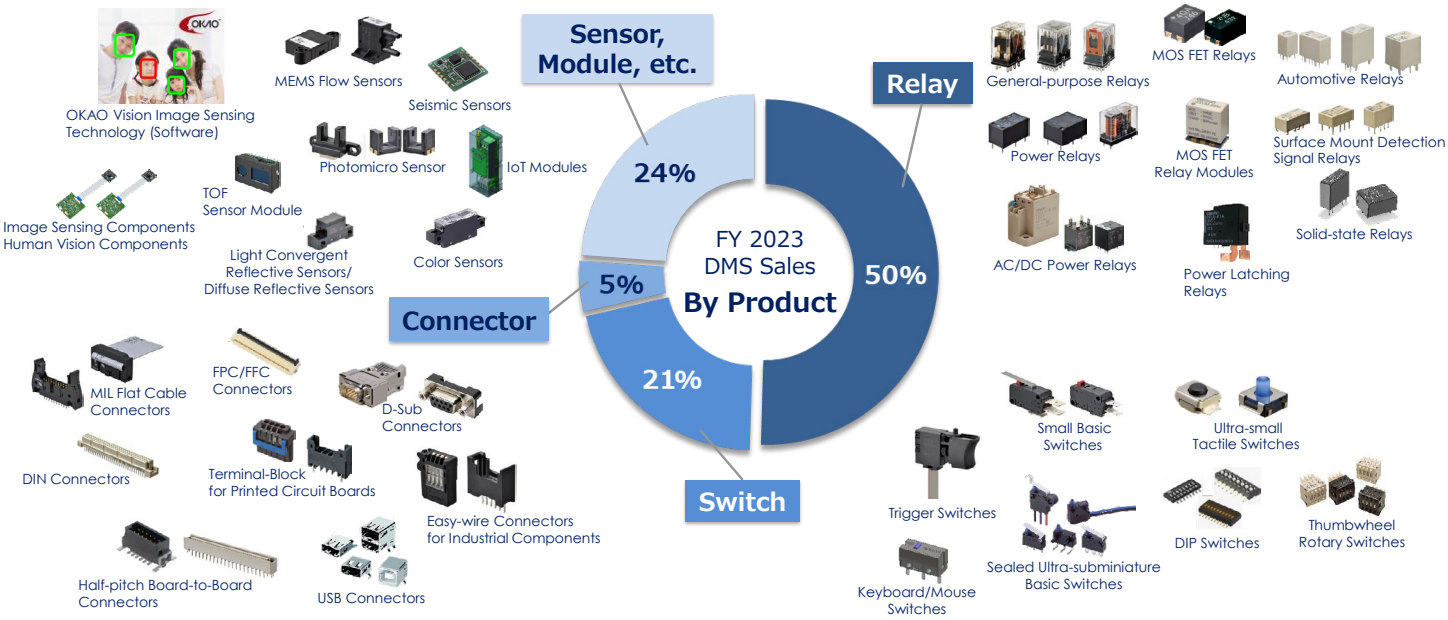
OMRON products help people live more comfortably and contribute to the development of society.

OMRON is centered on its mission of: “Continue to create innovation driven by social needs with automation which empowers people.” In considering the wide range of contemporary social issues, OMRON chose three significant areas that have a major impact on society, where OMRON is well-positioned to leverage its strengths to drive progress:

- Achieving carbon neutrality
- Realizing a digitalized society
- Extending healthy life expectancy

As a division of OMRON, OMRON Device and Module Solutions manufactures relays, sensor modules, switches, and connectors with the goal of providing technology that enhances and enables the next generation of semiconductors through the realization of a digitalized society.

Figure 1: OMRON Device and Module Solutions products



Test equipment and load boards require longer product life and greater board density.

Two key requirements, driven by market trends, have emerged in recent years:

1. **Greater board density.** Growing chipsets, including AI chipsets, put board real estate at a premium. More channels are needed for complex DUTs, with signals sent at higher frequencies. Significant engineering work is required to achieve higher performance in smaller package sizes throughout the automated test equipment industry, driving the need for load boards with increased board density.
2. **Longer product life.** Test equipment and load boards must support a variety of devices and stay in the field for up to decades at a time. Longer product life for test equipment and load boards reduces the amount of rework and downtime, increasing the number of devices tested over time.

OMRON components continuously evolve to contribute new value creation for customer equipment.

OMRON aligns its development with trends in the automated test equipment market. Since 2010, OMRON has reduced its smallest package sizes from 24.5 mm² to 3.08 mm²—smaller than a grain of rice.

> "[Longer product life] saves customers and companies a lot of money, as their machines can . . . maintain stable operations from the first test, all the way to the test in the hundreds of millions."
>
> —Evan Kuhn, Business Development Manager, OMRON

Figure 2: The OMRON signal relay product roadmap

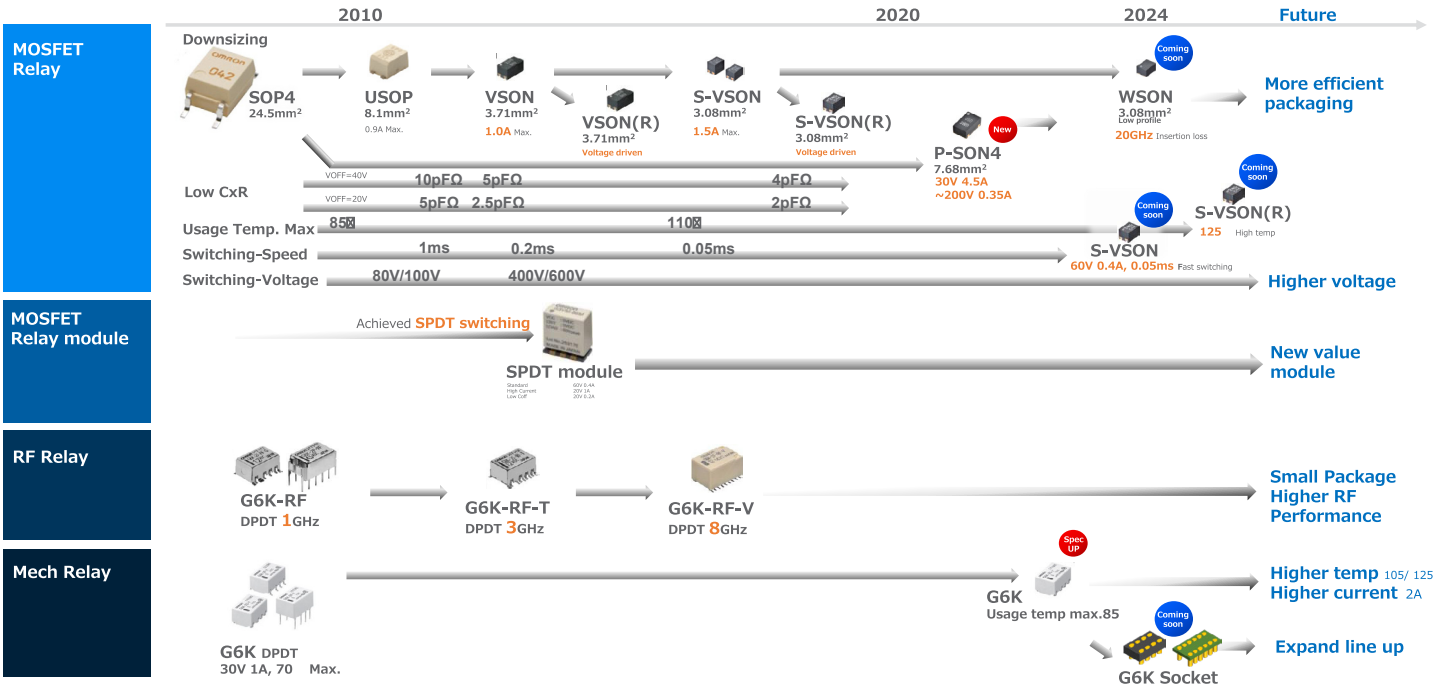
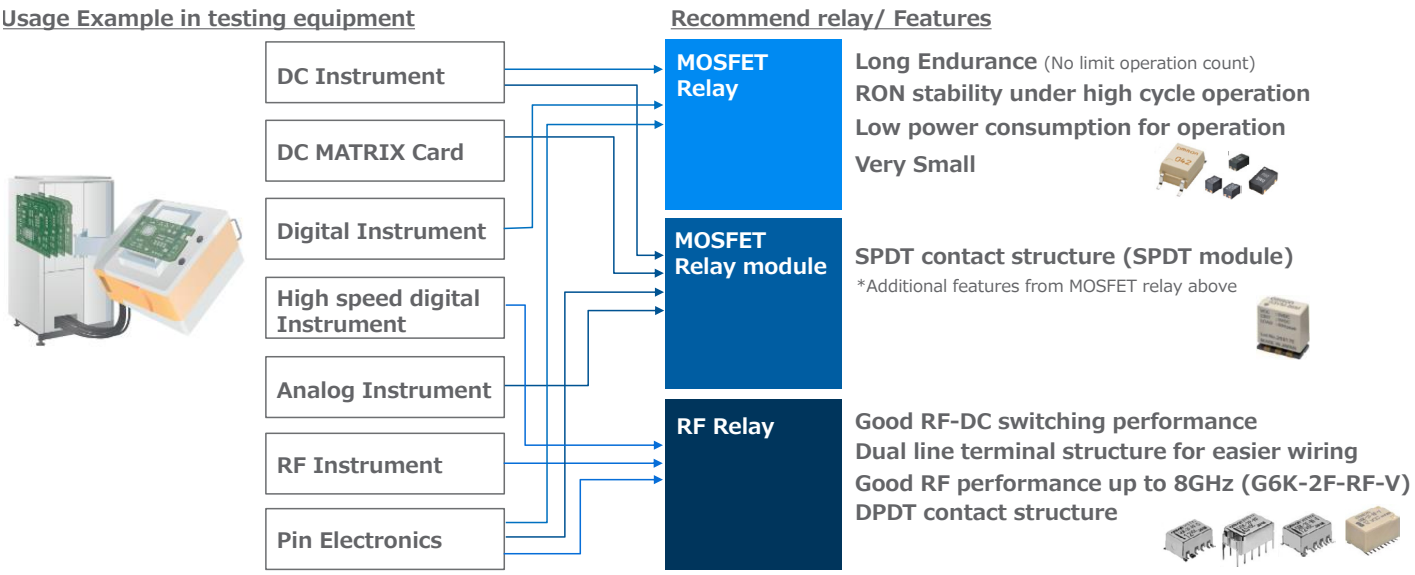


Figure 3: Example testing equipment use cases enabled by OMRON's low-signal relays



OMRON emphasizes high quality, high performance, and innovation in all its solutions, including both electromechanical and semiconductor technologies. OMRON's market-leading relays range from high-current, 300-amp relays for DC rapid shutdown, to very small package MOSFET relays with LED operation. The company's wide variety of low-signal relays, specifically made for testing equipment, enable a range of applications.

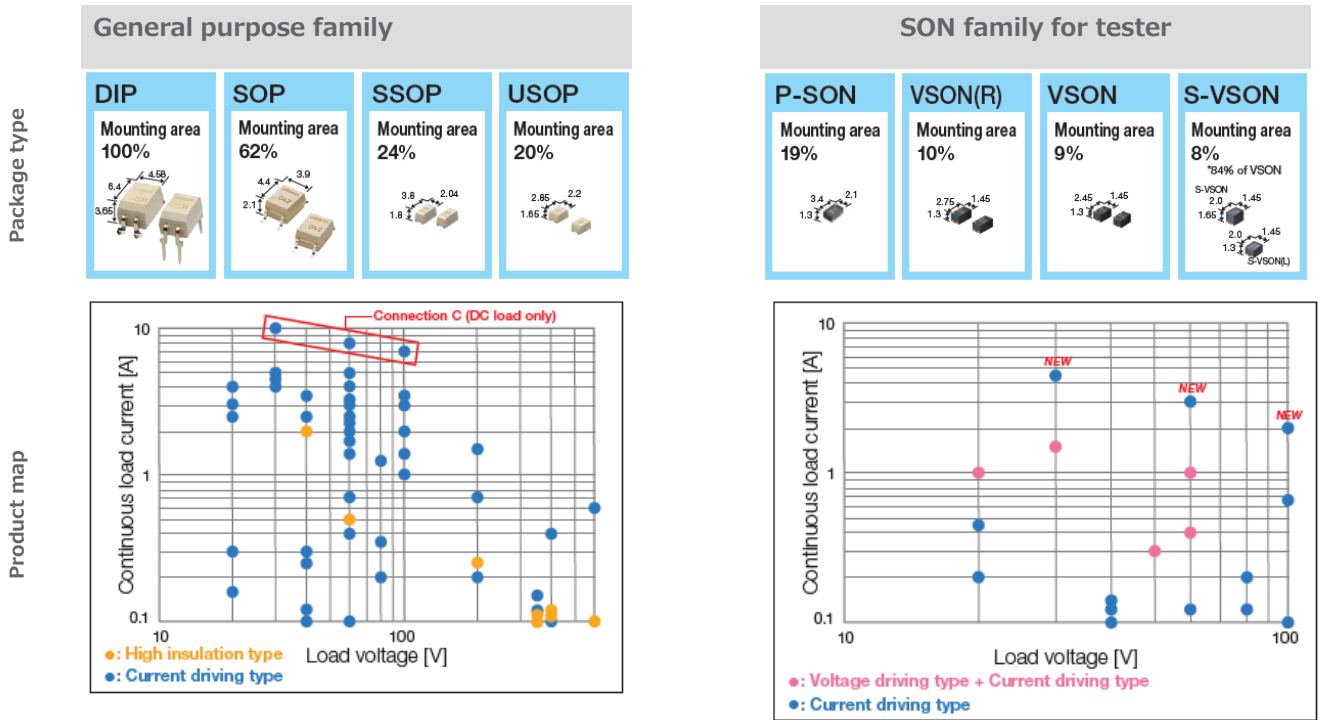
MOSFET Relay

OMRON MOSFET relays provide long endurance. (LED operation means there are no physical contacts moving inside, so there is no limit on operation count.) Each MOSFET relay has an on-resistance specification that remains the same throughout the product's life, with stable RON under high cycle operation. The MOSFETs consume low power for operation—compared to a reed relay, MOSFET relays use significantly less power. For example, OMRON's ultra-sensitive MOSFET relay uses only 4% of the power of a reed relay at only 0.2 mA.

As low signal and reed relays reach the 10-50 million operation range, the physical contacts increase in contact resistance, ultimately requiring test and load board rework, incurring cost and delay in the testing process, and reducing the amount of products that a machine is able to test over time. LED-operated MOSFET relays provide impressive performance without needing the space typically taken by internal contacts and coils. This ensures stable performance for hundreds of millions of operations, reducing equipment rework and greater longevity in the field.

With a diverse lineup of over 200 different models, OMRON's MOSFET relays come in a variety of small, through-hole and surface-mount packages (down to 2.0 x 1.45 x 1.65mm) to drastically save board space. To help with the selection process, the OMRON MOSFET Relay Selector Guide makes it easy to determine the best-fit board for any given application that also optimizes board real estate.

Figure 4: OMRON MOSFET Relay product lineup



OMRON MOSFET Relay Highlights

High-current MOSFET Relay (P-SON package MOSFET Relay G3VM-31WR/-61WR/-101WR/-201WR). Supports high current switching. Contributes high-density mounting by small package (70% space savings over SOP4 package). Long life and reliability, making it suitable for high-current DC testing, device power supply, and more.
CURRENTLY AVAILABLE

RF MOSFET Relay (WSON package MOSFET Relay G3VM-61YR). A new, small-package WSON with a lower profile than S-VSON. Fast switching speed and Low CxR 13.2pF*Ω (typ.) and good Insertion loss—3dB@20GHz (typ.) for digital high-speed signal.
RELEASING SEPTEMBER 2024

Fast Switching MOSFET Relay (S-VSON package MOSFET Relay G3VM-61QR3). A new lineup in the small-package S-VSON family. Low CxR 13.2pF*Ω (typ.) and fast switching speed 0.05ms (typ.) under IF=10mA condition.
RELEASING SEPTEMBER 2024

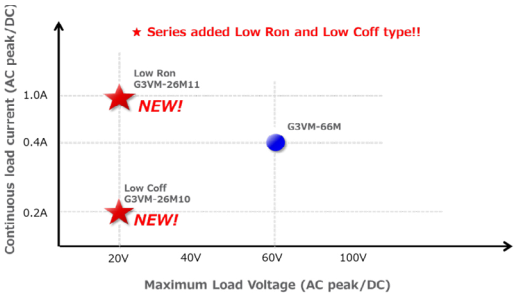
High-temperature MOSFET Relay (S-VSON package MOSFET Relay G3VM-31QV2H/ G3VM-61QV3H /G3VM-61QV3L/G3VM-61QV4H). A new lineup in the small-package S-VSON family. Voltage driven by built in resistor packaging. 125°C maximum ambient temperature.
RELEASING DECEMBER 2024

MOSFET Relay module

OMRON offers one MOSFET relay module package, featuring a single pole, double throw (SPDT) contact structure (G3VM-66M – 60V 400mA; G3VM-26M10 – 20V 200mA, 1.4pF; G3VM-26M11 – 20V 1000mA, 0.25Ω).

Figure 5: OMRON SPFT module

Type	Feature	Main Specification
G3VM-66M	Basic model	60V 400mA
G3VM-26M10	Low Coff	20V 200mA ; 1.4pF
G3VM-26M11	Low Ron	20V 1000mA ; 0.25Ω

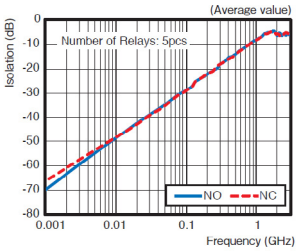


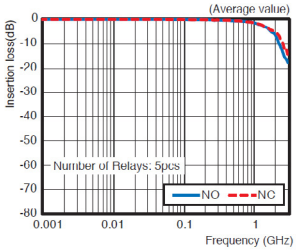
50mm²

G3VM-26M10 Low Coff Type:

Improved RF performance in SPDT configurations

- isolation performance is less than -20 dB at 250MHz
- insertion loss performance is more than -3 dB at 1 GHz

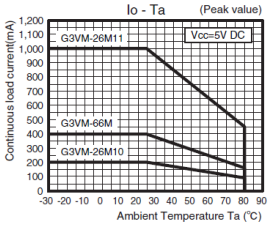




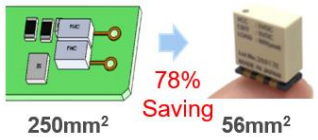
G3VM-26M11 Low Ron Type:

High current specification

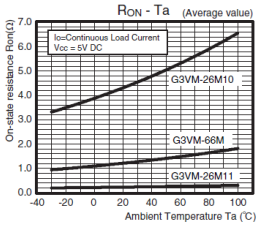
- 1A load current can be applied



This module replaces multiple components and complex circuit on PCB



250mm² 56mm²



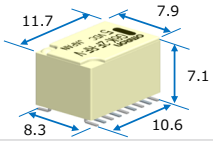
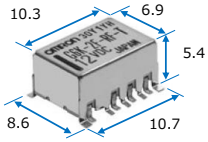
RF Relay

The OMRON G6K-RF series offers good RF-DC switching performance, as well as dual line terminal structure for ease of wiring, and double pole, double throw (DPDT) performance up to 8 GHz. The series supports high board density with a high reliability switching solution for the semiconductor test and manufacturing industries.

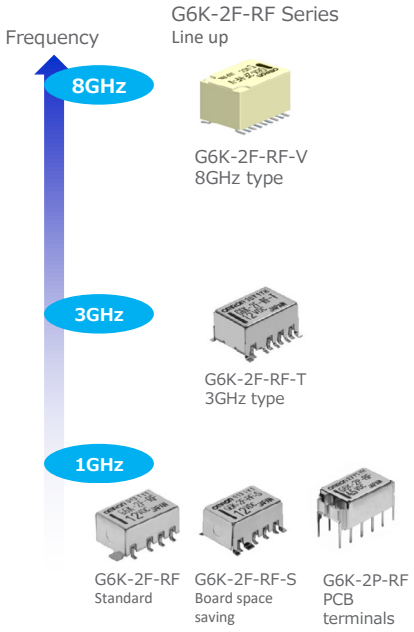
Figure 6: G6K-RF series contributes high performance and efficiency RF/LVDS testing

■ Features

1. DPDT(2c), available differential transmission signal
2. For High-speed signal switching, available 9.6Gbps
3. Low coil power consumption 100mW
4. Smaller size, Surface-mounting terminal

		G6K-2F-RF-V	G6K-2F-RF-T
Frequency		DC～8GHz Impedance50Ω	DC～3GHz Impedance 50Ω
Shape			
High frequency characteristics※	Insertion loss	3.0dBMax. @8GHz	0.2dBMax. @1GHz 0.6dBMax. @3GHz
	V.SWR	3.57Max. @8GHz	1.2Max. @1GHz 1.4Max. @3GHz
	Isolation	15dBMin. @8GHz	20dBMin. @1GHz 18dBMin. @3GHz
Mounting area		11.7x8.3mm(97mm^2)	10.7x8.6mm(92mm^2)

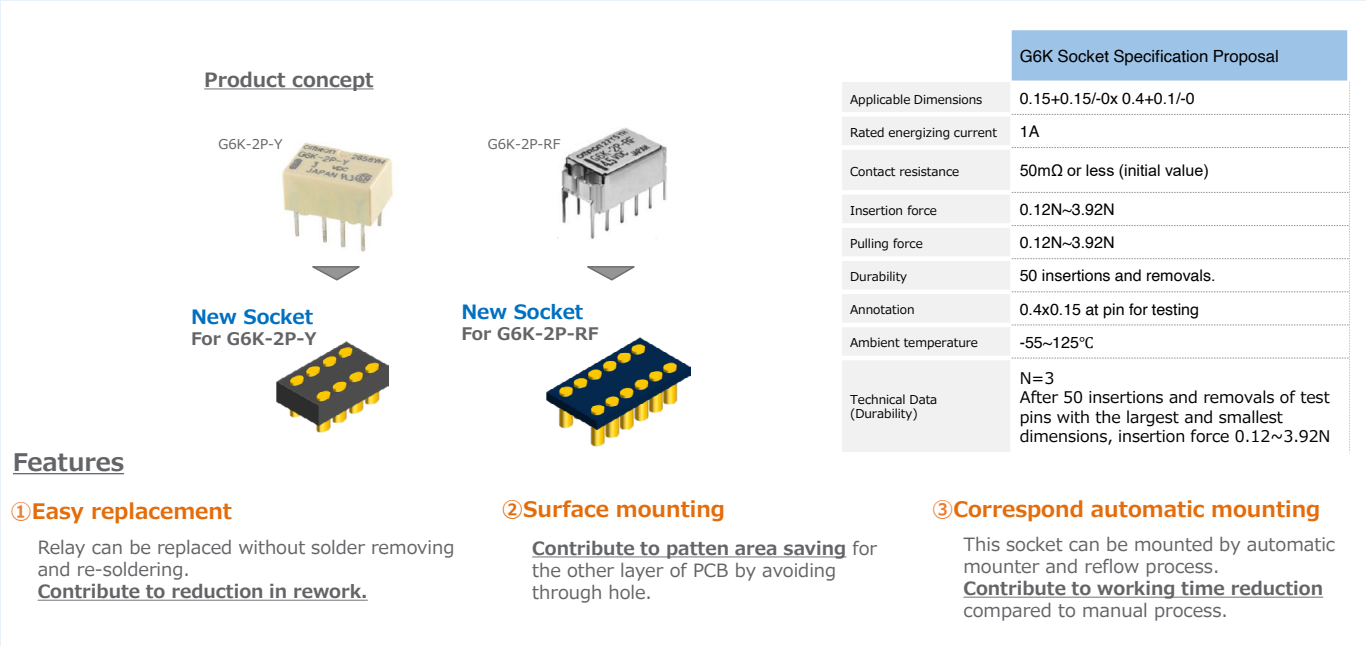
*Measurement condition :G6K-2F-RF-V, differential transmission. Others, single-ended.



COMING SOON: G6K Sockets

OMRON is developing new sockets for frequent use of its G6K series. Two sockets (G6K-2P-Y and G6K-2P-RF) are expected to release within the next year. With sockets, technicians can easily replace relays on boards through a simple pull and reinstall—no potentially damaging desoldering and resoldering required.

Figure 7: Sockets reduce rework for traditional electromechanical relays



	G6K Socket Specification Proposal
Applicable Dimensions	0.15+0.15/-0x 0.4+0.1/-0
Rated energizing current	1A
Contact resistance	50mΩ or less (initial value)
Insertion force	0.12N~3.92N
Pulling force	0.12N~3.92N
Durability	50 insertions and removals.
Annotation	0.4x0.15 at pin for testing
Ambient temperature	-55~125℃
Technical Data (Durability)	N=3 After 50 insertions and removals of test pins with the largest and smallest dimensions, insertion force 0.12~3.92N

High-durability EFC blade pins help keep device inspection equipment running longer.

Test pins commonly used in inspection equipment can provide inconsistent test reliability and contact resistance, which causes an increase in rework and downtime for testing. OMRON blade pins are manufactured by utilizing its proprietary electro formed component (EFC) process technology.

EFC enables OMRON to produces custom pin and socket designs to provide greater durability, reliability, and performance for a range of applications. The EFC material is a nickel-based alloy that provides high-proof strength while remaining similar in conductivity to phosphor or titanium copper alloys. OMRON's custom EFC blade pins provide much longer test durability and higher test pass rates over time, supporting well above 300,000 operations in various applications at 99-100% test pass rates.

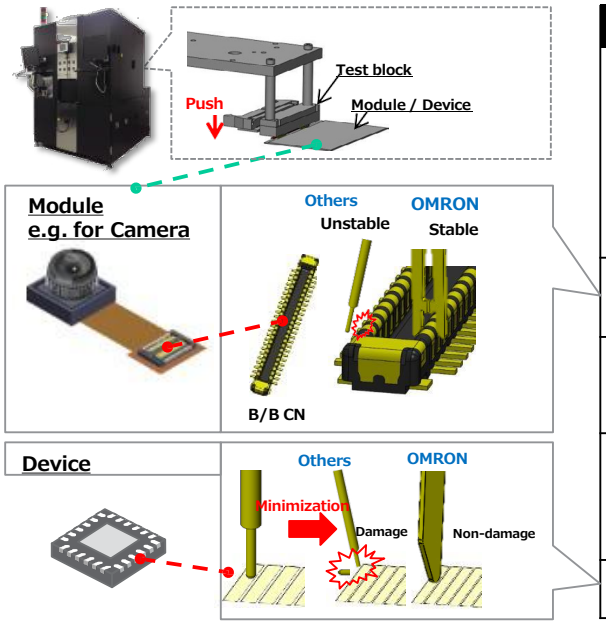
"The EFC design value is the ability to customize. . . . From contact resistance to signal integrity into the high frequencies, the blade pin will be designed from top to bottom to fit your need."

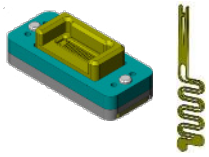
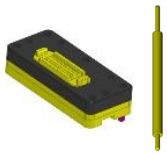
Evan Kuhn, Business Development Manager, OMRON

In addition to blade pins, OMRON provides core housing, pin blocks, and socket solutions, all designed to ease testing in the overall manufacturing lineup. By enabling more devices to be tested over time, OMRON products ultimately save downtime, reduce rework, and ensure devices are tested properly, from start to finish, in the manufacturing process.

Figure 8: EFC helps improve productivity

■ **Improving test productivity with EFC (Electro Formed Components) blade pin against other test pins.**



Item	OMRON "EFC blade pin"	Others "Pogo Pin"
Appearance		
Test pass rate	99~100%	80~99%
Test durability	300k~ times	100k ~ 200k times
Contact resistance	30mΩ	70mΩ
Test pitch	0.175mm~	0.35mm~

Additional Information

To learn more about OMRON electronics, visit omron.com/global/en