News Release

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Renesas Technology Releases LFPAK-i Top-Surface-Radiation Type Package for Power MOSFETs as New Package Offering 40% Reduction in Mounted Thermal Resistance

— Offering higher thermal radiation characteristics and larger current enabling reduction in size of server DC-DC power supplies, plus compatibility with SOP-8 —

Tokyo, June 28, 2004 — Renesas Technology Corp. today announced the development of the LFPAK-i (Loss-Free Package – inverted) top-surface-radiation type package as a new power MOSFET package offering greatly improved thermal radiation characteristics through use of a top-mounted heat sink, together with increased current capability, by means of a structure that emits heat from the upper surface. In the initial phase products using the LFPAK-i, three power MOSFETs — the HAT2165N, HAT2166N, and HAT2168N — for server DC-DC power supply voltage regulator (VR) are being released, with sample shipments scheduled to begin in July 2004 in Japan.

Features of the new package are summarized below.

(1) Approximately 30% increase in current capacity through 40% reduction in mounted thermal radiation resistance value compared with previous Renesas Technology packages

The LFPAK-i uses a structure in which the heat-radiating die header is exposed on the upper surface of the package, and when a heat sink is mounted on top (when using forced-air cooling), the mounted thermal resistance value in the thermal saturation state is reduced by 40%, from 25ºC/W to 15ºC/W, compared with Renesas Technology's current LFPAK package using a structure whereby heat is dissipated into the printed wiring board. This enables an approximately 30% increase in current to be achieved compared with the LFPAK, allowing server VRs to be made smaller.

(2) SOP-8 compatibility

The LFPAK-i has the same electrode arrangement and footprint as the industry-standard SOP-8 package, enabling the same kind of system design and mounting to be used as for the SOP-8.

< Product Background >

A VR that supplies power to a server's CPU and memory converts a 12 V input voltage to the lower voltage, typically 1.3 V, required by the CPU and memory. With the increased high current associated with faster CPUs and memory and the lower voltages associated with miniaturization, the relevant voltage and current are predicted to change from approximately 1.3 V and 70 A at present to 0.8 V and 150 A in the future. In order to handle such a low voltage and high current, high-current capability is also desired of the power MOSFETs installed in a VR to perform current control.

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The structure of a typical surface-mount power device provides for generated heat to be dissipated into the printed wiring board. However, in applications such as servers that incorporate a large number of VRs, the rise in board temperature caused by a higher current is a problem, and since the approach of radiating heat above a board is reaching its limits, manufacturers are beginning to mount heat sinks on the top of products and implement thermal radiation by means of forced-air cooling.

To meet this market need and help solve the associated problems, Renesas Technology has developed the new LFPAK-i package optimized for top-surface radiation through the use of a structure in which the heat-radiating die header is exposed on the top of the package.

< Details of the New Package >

The newly developed LFPAK-i employs a structure that retains the advantages of Renesas Technology's current LFPAK package using a bonding-wire-less structure achieving low resistance and low inductance*[1] for highly efficient power supplies, while mounting a heat-radiating die header on the upper surface to enable heat to be dissipated efficiently from a top-mounted heat sink. The LFPAK-i can be mounted using the same electrode arrangement and footprint as the industry-standard SOP-8 package.

In a comparison of package-top heat sink mounting (when using forced-air cooling) with a conventional LFPAK, the mounted thermal radiation resistance value in the thermal saturation state was actually reduced by 40%, from 25ºC/W to 15ºC/W. This makes it possible to reduce the rise in PWB temperature that has previously threatened to be a problem.

It is also possible to reduce the rise in power MOSFET channel temperature (ΔTch) with the same applied power, thereby also reducing on-resistance*[2], which is proportional to channel temperature. For example, when a heat sink is mounted on the top of an LFPAK-i and power equivalent to 2 W power consumption is applied, the rise in power MOSFET channel temperature (ΔTch) can be reduced by 20ºC from the 50ºC of an LFPAK to 30ºC. This is equivalent to an approximately 7% decrease in on-resistance (calculated on the basis of a reduction in power MOSFET temperature from 120ºC to 100ºC through the ability to lower the channel temperature by 20ºC).

Moreover, when thermal radiation design is carried out on the assumption that an identical rise in channel temperature occurs under identical conditions, an approximately 30% current increase can be achieved with the LFPAK-i. A 30% improvement in current density making it possible to decrease the number of power MOSFETs that need to be installed in a VR, enabling VRs to be made smaller.

< Details of the New Products >

The HAT2165N, HAT2166N, and HAT2168N being released in this phase are 30 V withstand-voltage N-channel power MOSFETs for highly efficient server VR use that offer low thermal resistance and on-resistance.

By mounting a heat sink on the top of these devices, the mounted thermal radiation resistance value in the thermal saturation state (when using forced-air cooling) is reduced by 40%, from 25ºC/W to 15ºC/W, and current increased by approximately 30%, compared with Renesas Technology's current HAT2165H, HAT2166H, and HAT2168H using LFPAK packages.

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When configuring a VR with a voltage specification of 1.3 V and current specification of 60 A, for example, a total of 16 conventional power MOSFETs are required for a 4-phase configuration at 15 A per phase (eight sets each comprising one high-side element and one low-side element*3), but with these new products each phase can be increased by approximately 30%, to 20 A, enabling a 3-phase configuration to be used that requires a total of 12 power MOSFETs (six sets each comprising one high-side element and one low-side element), and so allowing the VR to be made smaller.

Renesas Technology's well-established 0.35 µm process 8th-generation trench structure is used for the elements, enabling low on-resistance figures (at VGS = 10 V) of 2.8 mΩ typ. for the HAT2165N, 3.2 mΩ typ. for the HAT2166N, and 6.3 mΩ typ. for the HAT2168N to be achieved.

The HAT2168N is ideal for use as a VR high-side element (for control switch use), and the HAT2165N and HAT2166N for use as low-side elements (for synchronous rectification). The low-Ron type HAT2165N and HAT2166N are also suitable for use in synchronous rectification handling a high power switching power supply secondary-side current (low-voltage output Vout = 3.3 V or less).

Notes: 1. Inductance: Inductance that is naturally present in wiring, having a value approximately proportional to the length of the wiring. The larger this value, the less readily gate current for turning a power MOSFET on and off flows, impeding high-speed switching. In high-frequency switching regions, in particular, inductance is a cause of major switching loss.

2. On-resistance: Operational resistance when a power MOSFET operates. On-resistance is the parameter that most affects power MOSFET performance, with performance increasing as on-resistance decreases.

3. High-side and low-side elements: These elements are used as non-insulating type DC-DC converter switches, enabling voltage conversion to be performed by means of alternate on/off switching while maintaining synchronization between the high side and low side. The high-side switch is the DC-DC converter control switch, and the low-side switch is the synchronous rectification switch. Usually, server VR input voltage Vin is 12 V while the CPU uses a lower voltage of 1.2 V to 1.3 V or less, and therefore for the high-side on-period a narrow pulse of approximately 10% or so of one cycle is controlled, and the remaining 90% is the on-period of the low-side element, so that an element whose characteristics emphasize switching speed is selected for the high-side element, and an element whose characteristics emphasize low on-resistance (low RDS(on)) is selected for the low-side element.

* Product names, company names, or brands mentioned are the property of their respective owners.

< Typical Applications >

- Server DC-DC converters (VRs)
- Switching power supply secondary-side (low-voltage output Vout = 3.3 V or less) synchronous rectification

< Prices in Japan > *For Reference

Product Name	Package	Sample Price [Tax included] (Yen)
HAT2165N	LFPAK-i	160 [168]
HAT2166N	LFPAK-i	140 [147]
HAT2168N	LFPAK-i	100 [105]

< Specifications >

Ta = 25ºC

	Maximum Ratings		On-Resistance RDS(on) (mW)				
			VGS = 4.5 V		VGS = 10 V		
Product Name	VDSS (V)	ID (A)	typ.	max.	typ.	max.	Package
HAT2165N	30	55	3.7	5.6	2.8	3.6	LFPAK-i (SOP-8 compatible)
HAT2166N	30	45	4.3	6.4	3.2	4.1	
HAT2168N	30	30	9.1	13.8	6.3	8.2	

Information contained in this news release is current as of the date of the press announcement, but may be subject to change without prior notice.

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