

# A New Controller for Compact Robots, F60, the Smallest and Lightest in the Industry



*Kawasaki robot controllers are entering a new generation. We have developed F60, a controller for compact robots. This product has a size of approximately 77% and a weight of approximately 72% less than those of the conventional E7x series, so achieving the smallest size and the lightest weight in the world for an industrial robot controller. Furthermore, through the utilizing of the latest electronics technologies, functionality, performance, and energy saving have been drastically improved as well.*

## Introduction

With a reduction of the work force associated with the aging population and low birth rate, small robots are increasingly being applied to new fields and their roles have become increasingly important in recent years. It is expected that an increasing number of robots will be used for more sophisticated or cooperative work with humans as an existence or workforce that is close to humans in the future.

## 1 Background

Our conventional small robot controllers are the E7x Series for general-purpose robots and the D6x Series for clean robots, which have totally different platforms, and each of these has been playing an active role in its field. However, more than seven years have passed since these controllers were introduced in the market, and further improvements are desired regarding size, functionality and performance. In order to accelerate the development of new functions or new robots in the small robots market going forward, it is necessary to continue introducing more attractive products into the market while accelerating the development through using a next-generation standardized platform.

## 2 Specifications

The specifications of the next-generation integrated controller F60 are shown in **Table 1**. It supports up to 10-kg

payload robots, and a broad range of applications for robots in the medical and pharmaceutical fields and clean robots are currently under consideration. Moreover, the controller has globally universal specifications to realize shorter delivery times.

## 3 Features

### (1) Smallest and lightest in the industry

The number of printed circuit boards was reduced to the extent possible by reconsidering functions without being restricted by the conventional rules of traditional controller design, while optimizing the component layout by configuring the housing structure through aluminum die-casting and resin, in an effort to pursue downsizing while maintaining high extensibility. As a result, approximately a 77% reduction in dimensions (W 300 × D 320 × H 130 mm) and a 72% reduction in weight (8.3 kg) have been achieved, compared to our conventional E7x Series, making the controller the smallest and lightest in the industry (**Fig. 1**). These new features have enabled a significant reduction in the installation space, and allow the controller to be easily transported by a single person and stacked in multiple layers.

### (2) Energy-saving

The controller adopts energy-saving electronic components to pursue power reduction in the control circuits and has a larger capacitor capacitance for absorbing regenerative energy generated by the robot, achieving a more than 10% power reduction compared to

Table 1 Specification for F60

Structure		Standard: open structure (enclosed structure available by adding components)
Size (mm)		W 300 × D 320 × H 130
Weight (kg)		Standard: 8.3 (max. 17)
Number of controlled axes	Standard	6
	Additional axis in housing	(2)
I/O signals	External control signal	Emergency stop, external hold signal, etc.
	General I/O signal	Standard: 16 points (In housing: + 64 points [max. 80 points], possible additional points including remote I/O: + 128 points [max. 144 points])
Communication function	PC, network communication	LAN: 1000BASE-T/100BASE-TX/10BASE-T × 2 ports RS-232C × 2 ports, USB 2.0 × 3 ports
	Fieldbus	(CC-Link, DeviceNet, PROFIBUS, EtherCAT, EtherNet/IP, PROFINET, etc.)
Memory capacity		16 MB
Auxiliary storage unit		(USB memory)
Power supply specification		200–230 VAC ± 10%, 1 φ , 50/60 Hz
Installation environment		Ambient temperature: 0–45°C, relative humidity: 35–85%, no dew condensation

Items in ( ) are optional

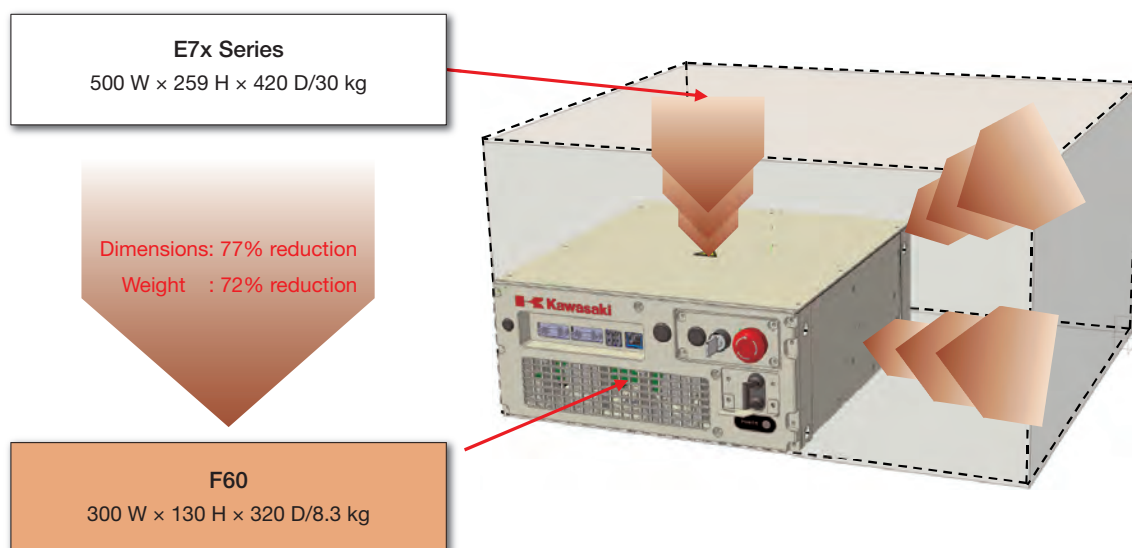


Fig. 1 Size comparison with conventional controller

our conventional products\*.

\* Compared with the power consumption through the combination of the E7x Controller and RS010N robot in a palletizing motion.

### (3) Universal specification/improved safety

It is necessary to divide the conventional E7x Series controllers into different types in order to support the safety standards of each region, such as Asia, Europe and the U.S. The F60 controller has realized universal specifications by standardizing the safety circuit through utilizing the functional safety technology. The safety circuit of the F60 is certified to PLe/Cat. 4 (ISO 13849-1) and SIL 3 (IEC 61508), boasting a higher safety performance than that of the conventional series. Moreover, it supports the Cubic-S robot operation safety unit (refer to Kawasaki Technical Review No. 178 [this issue] pp. 10–14), allowing for the use of small robots that are safer and more secure.

### (4) Expandability and new functions

The F60 controller was designed with a high degree of expandability and functionality enhancement in mind, while achieving the smallest size in the industry.

#### (i) Enhancing the network function

In the F60, easy connection to more networks or devices has been enabled through improving the CPU performance and reinforcing the interfaces. It supports not only the conventional fieldbus but also high-speed Ethernet. Moreover, it can be equipped with a Bluetooth interface as an option, which allows for easy connection to GigE (Gigabit Ethernet)-compatible vision cameras or tablets.

#### (ii) Incorporating external servo amplifiers for up to two axes

Owing to the housing made of die-casting aluminum that increases heat dissipation of the entire housing, the F60 can incorporate servo amplifiers on up to two axes with its minimal size.

#### (iii) Implementing the remote I/O function

Conventionally, the general-purpose I/O boards supplied by Kawasaki were mounted within the controller, and it was necessary to draw many wires outside. In the F60, the interface between the boards is serialized, which makes it possible to install the same I/O board or analog I/O board in locations remote from the controller with reduced wiring.

## 4 Controller assembled by a robot

The development concept for the F60 is a structure that allows for easy assembly and maintenance, with the aim of making it the industry's first "controller that can be assembled by a robot."

(i) The F60 is provided with a structure in which printed circuit boards are stacked from the bottom up, so that it can be assembled by compact robots manufactured by Kawasaki (**Fig. 2**).

(ii) In the F60, the number of electric components and the number of harnesses are minimized, as it is difficult to assemble them using a robot (four compared to approximately 40 in the E7x Series).

The number of components, including printed circuit boards, electric components and harnesses, was radically reduced while enhancing reliability through the realization of i and ii mentioned above. Additionally, due to easy assembly, the F60 is expected to be produced not only in Japan but also overseas.

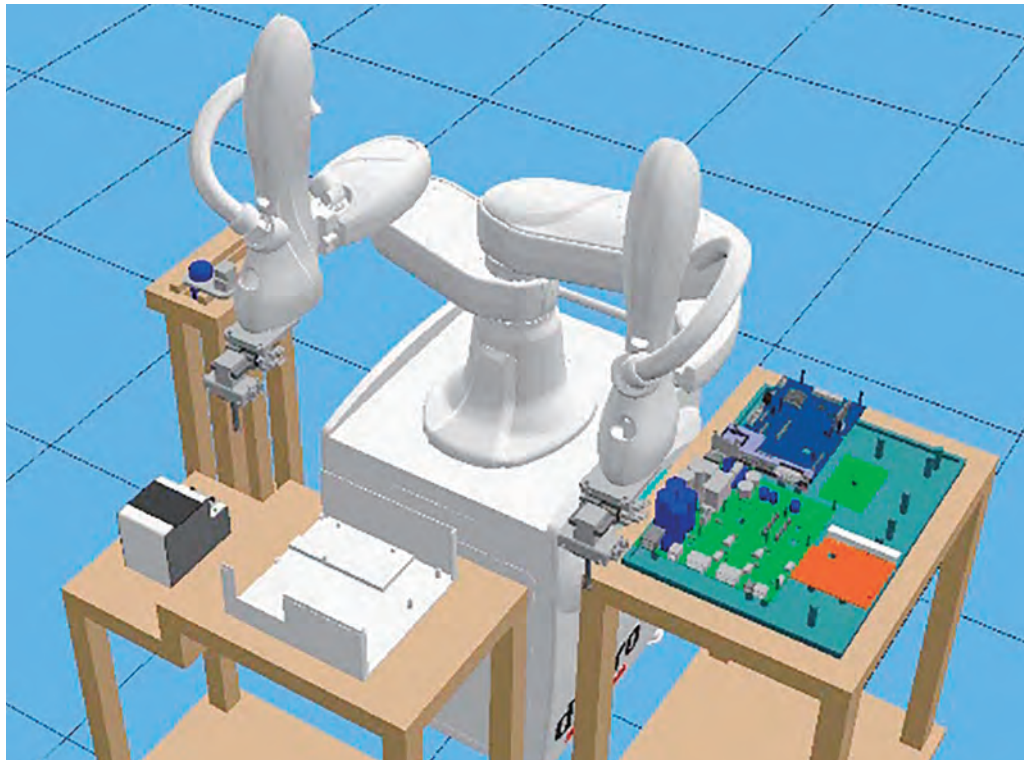


Fig. 2 Image of F60 Assembly using the duAro dual-arm SCARA cooperative robot

## Conclusion

Distribution of the F60 controller introduced in this article started in December of 2016. Since then, it has been playing an active role along with many of Kawasaki's small robots. In the future, the technologies that have been accumulated and introduced in this development will be applied not only to small models but also to all of Kawasaki's controllers.

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