

# HS2000 AND LT9730 SERIES OF IC HANDLERS

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*We have developed the HS2000 series of pick-and-place IC handlers and the LT9730 series of gravity IC handlers. IC handlers used in combination with testers automatically carry untested devices to the socket from the input tray. The devices are automatically sorted and stored in output trays according to the test results. For fine-pitch ICs such as BGA (Ball Grid Array), the HS2000 series employs a pick-and-place handling technique to consecutively process the devices stored in trays. The HS2000 series can achieve high-speed and highly-accurate device transportation and positioning by using linear motors, and thus reduce the jam rate to 1/10 that of conventional types, and greatly improving the operating ratio. Moreover, HS2000 series has fewer parts that cause friction like gears and belts, consequently reducing maintenance costs.*

*On the other hand, for SOP (Small Outline Package), the LT9730 series employs a gravity handling system to process devices stored in stick tubes or aluminum magazines. The LT9730 series has one of the highest throughput rates and is the most functional series of IC handlers in the world, which is achieved by replacing the two parallel heads with four parallel heads and using a new contact. Furthermore, the singulator's automatic jam-clearance mechanism has successfully kept the jam rate to a minimum.*

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## INTRODUCTION

With the emergence of the digital network era, the environment surrounding us has been undergoing rapid changes among which advanced and mobile terminals have become widespread, thus necessitating the need for smaller wafer-thin ICs operating at high frequencies. IC handlers have also been improved to meet diverse market demands.

It is our challenge to develop an IC handler that maximizes the operating ratio of an IC tester at the final inspection stage and thus allows for the configuring of a more stable and effective production system as well as reduces inspection costs. With this design concept in mind, Yokogawa's development of IC handlers aims to reduce jamming and increase yields, as well as improve

UPH (Units per Hour) and MTBF (Mean Time Between Failure) by refining peripherals such as a change kit and socket. Moreover, our strengths as an IC tester manufacturer include low-



**Figure 1** HS2000 IC Handler



**Figure 2** LT9730 IC Handler

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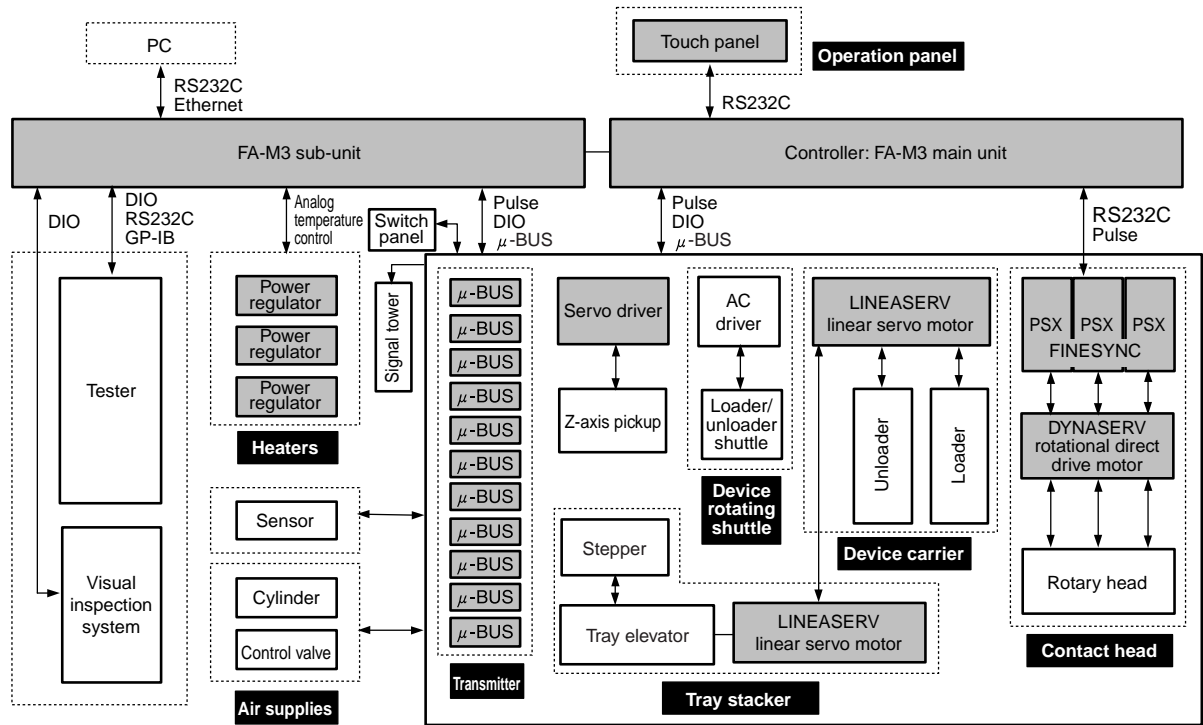


Figure 3 Hardware Configuration of HS2000

noise mechanisms and support for high frequencies during the development of an integrated system incorporating our IC tester. As a result, we have developed the HS2000 series of pick-and-place IC handlers (see Figure 1) and LT9730 series of gravity IC handlers (see Figure 2), whose return on investment is sufficient enough to allow them to be adapted by the production systems of each user. They have been highly rated by a wide range of users since their release.

### CONFIGURATION AND FEATURES OF HS2000 SERIES

Figure 3 shows the system configuration of the HS2000 series. The features of the major components are given below.

#### Major Features

##### (1) Contact Head

Figure 4 shows the characteristics of the rotary head in the test block. It uses our FINESYNC synchronous motion controller and DYNASERV rotary direct drive motor in order to keep vibration low and thus allow for smooth positioning of the head through an electronic cam control employing a fast synchronization algorithm, realizing a 0.5-second index time (device replacement time). In addition, the operating life of the socket has been improved by accurate positioning repeatability and contact errors have been reduced.

##### (2) Device Carrier

The use of our LINEASERV linear servo motor has made high-speed, accurate positioning possible. The reliable

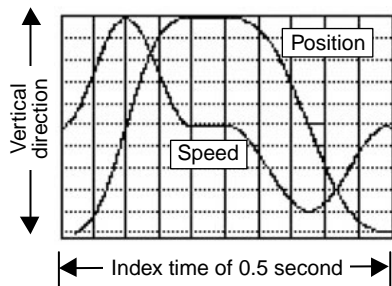


Figure 4 Characteristics of Rotary Head

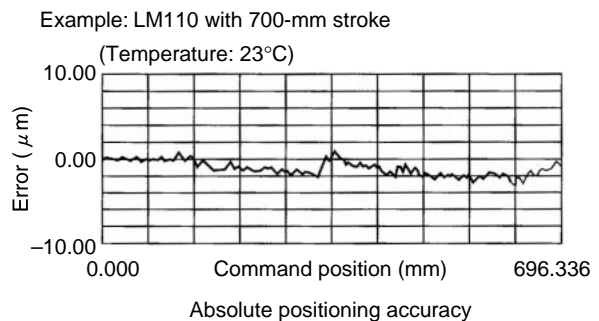
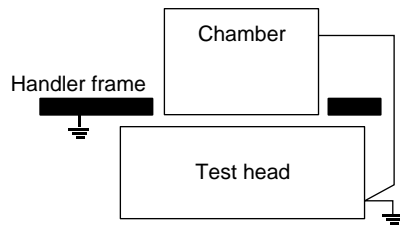


Figure 5 LINEASERV Characteristics



**Figure 6** Separate Grounding of Chamber and Handler Frame

device carrier has reduced the jamming rate to 1/10 that of the conventional type and thus increased operating ratio. Moreover, minimizing the effect of aging maintains stable operation. The linear motor for the loader and unloader uses two sliders for the Y axis to form two coordinates for a single axis and reduce tact time. Figure 5 shows the absolute positioning accuracy of the LM series LINEASERV with a 700-mm stroke to be within  $\pm 2 \mu\text{m}$ .

(3) Shuttle

Both of the loading and unloading shuttles are equipped with a device rotating mechanism that allows shuttle travel and device rotation to be performed simultaneously to eliminate loss of time. The optional device buffer increases the throughput when measuring one or two devices with a four-head handler to one and a half times.

(4) Reducing System Noise

Based on our expertise as a device tester manufacturer, we were able to achieve a system noise as low as about 1/3 or less than that of conventional logic handlers by developing a system integrating our tester. This made it possible to offer an optimum environment for mixed-signal testing. The system's test block is isolated from the handler frame to cut off the noise current path as shown in Figure 6. Noise emission is reduced by independently grounding all components, in particular the chamber and handler frame, to provide greater shielding.

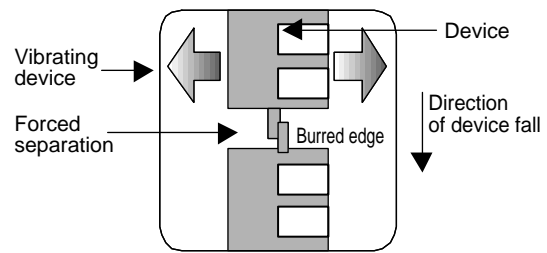
(5) Control System

The main controller adopted for the control system is our FA-M3 universal-range controller. The control signals are serially transferred to eleven blocks of a  $\mu$ -bus terminal unit developed for the HS2000 in order to simplify wiring and reduce failures caused by wiring, and thus improve system reliability.

**Table 1** HS2000 Main Specifications

Item	Description
Package type	QFP, BGA, TSOP, and SOP
Simultaneous measurement	Max. 4 units/test head
Throughput	Max. 4000 UPH
Index time	0.5 sec/4 DUT
Measuring temperature	Room temperature and 50°C to 125°C
Interface	RS232C, Parallel, GP-IB, and SPC
Number of sorting categories	Auto: 2, Manual: 2

\* UPH (Units Per Hour): The amount of devices processed per hour.



**Figure 7** Automatic Jam Clearance Mechanism of Singulator

**Specifications**

Table 1 shows the main specifications of the HS2000.

**HS2000 Series Lineup**

The HS2000 series lineup consists of three models: HS2000, HS2100, and HS2200. The HS2100 is a compact version with a width of 1500 mm and the HS2200 is a basic version of the HS2100. Users can select a model with the best combination of functions and price for their needs.

**CONFIGURATION AND FEATURES OF LT9730 SERIES**

In response to conflicting user demands for features such as multi-heads, high speed, and space saving, the LT9730 series has more than tripled processing speed compared to conventional models and realized a four-head handler, while maintaining the equivalent footprint (space requirement) of conventional models. The features of the major components are given below.

**High-speed Processing**

To obtain the maximum throughput of 24,000 UPH, we enhanced the device supply capability, reduced the index time of the contact head, and increased the sorting speed.

(1) Device Supply Capability

The supply capability was upgraded from a double-shuttle to a six-shuttle system, achieving the maximum supply of 18,000 or 1.6 times the 10,800 of conventional models.

(2) Index Time of Contact Head

Inheriting the traditional contact method as well as shortening the head stroke has obtained a quick index time of 0.6 second compared to 0.8 second of conventional models.

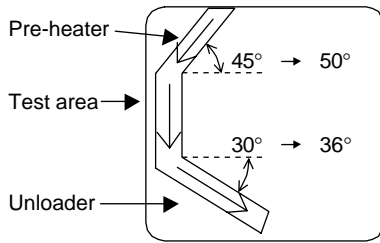
(3) Sorting Speed

Conventional sorting shuttles sort defective and non-defective devices using a motor as the drive source. The LT9730 employs cylinder-driven twin shuttles for every two heads and thus offers a higher speed.

**Lower Jamming Rate**

(1) Singulator with Automatic Jam Clearance Adjuster

When a series of linked devices on each rail are individually separated by a singulator, jamming often occurs due to



**Figure 8** Device Sliding Tilting Angle

devices with burred edges. We greatly reduced the jamming rate by vibrating the singulator with a cylinder (see Figure 7).

(2) Optimization of Device Sliding Angle

Increasing the device sliding angle (see Figure 8) accelerates device sliding, and consequently enhances the UPH and reduces jamming. With the LT9730, we reduced jamming by optimizing the tilting angle from 45 degrees to 50 degrees for the pre-heater and from 30 degrees to 36 degrees for the unloader.

(3) Cross Guide Mechanism

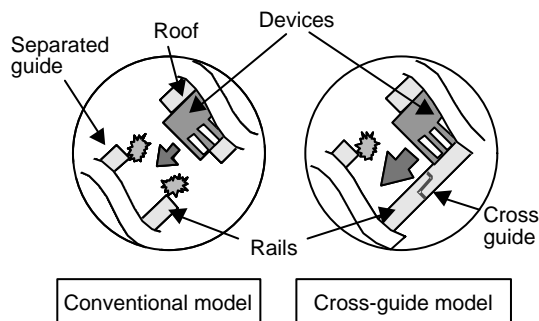
The conventional model provides no integrated guide for devices to be exchanged between fixed units such as the rail and its roof, and the shuttles, and this insecure positioning is also a cause of jamming. The LT9730 is equipped with mechanical cross guides (stoppers) (see Figure 9) between the units. This allows secure device positioning and smooth exchange, leading to reduced jamming.

**Space Saving**

For saving space, we shortened the distance that the loader and unloader carries the magazine while maintaining a 60-mm pitch between the heads. We also reduced the wiring by changing the I/O wiring from a conventional one-to-one connection to an RS485 interface, and then enhanced the communication speed and throughput.

**Specifications**

Table 2 shows the main specifications of the LT9730.



**Figure 9** Cross Guide Mechanism

**Table 2** LT9730 Main Specifications

Item	Description
Package type	SOP, TSOP, and TSSOP
Contact method	Socket, Kelvin, and PTB (for high frequency measurement)
Throughput	Max. 24,000 UPH
Index time	0.6 sec or less/device
Measuring temperature	Room temperature and 60°C to 155°C
Interface	RS232C, Parallel, GP-IB, and SPC
Loader capacity	40 multi-lane magazines and 100 tubes
Unloader capacity	Auto: 40 magazines and 100 tubes
Number of sorting categories	Max. 10

**CONCLUSION**

We will focus on the future development items for the HS2000, such as various contact engineering and enriching the lineup to facilitate system configuration depending on the application. With the LT9730, we will develop a series of eight-head models in addition to the current four-head series to satisfy growing market needs for multi-head IC handlers.

To continue providing users with an efficient production environment, we will work on developing optimum testing solutions along with creating innovative technologies based on our expertise as a tester manufacturer. Furthermore, in response to market changes, we will pursue customer benefits by developing core technologies on our own and by teaming up with others in many other fields. ◆

**REFERENCE**

(1) Ode Tsuyoshi et al., "IC Handler HS1000," Yokogawa Technical Report, Vol. 42, No. 3, 1998, pp. 103-106 in Japanese.