

# Wider Applications of HL-01 System

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## Abstract

The HL-01 system is a monitoring and control system capable of high-speed sampling and recording, suitable for performance and durability testing of small engines, dynamometer-based testing systems, and components.

This system displays measurement values in real time using graphs, lists, and meters, and saves collected data in CSV (Comma-Separated Values) or Excel files. Furthermore, it can create operation schedules using control output values and ON/OFF switches, and perform automated operation tests. It has been used in motorcycle and tractor engine benches, and is also used for truck engine exhaust gas measurement tests, automobile crash safety performance tests, and engine component performance tests. Recently, it has also been used to collect measurement values during excavation operations on pump dredgers, and its scheduled operation function is expected to be useful for automating excavation operations.

## 1 Preface

The Japanese government has decided to ban the sale of new gasoline-powered vehicles by 2035. By 2035, sales will be limited to Hybrid (HV), Plug-in Hybrid (PHV), Fuel Cell (FCV), and Battery Electric Vehicles (BEV). By 2050, BEVs will be at the majority of the EV shift – close to 100%. However, gasoline-powered vehicles will not disappear immediately. Gasoline-powered vehicles will remain on the roads until 2050, and production lines and testing facilities for gasoline engines and related components will be necessary. In recent years, demand for engine testing equipment for dynamometers has been declining, and requests for new delivery and replacement testing equipment have also decreased year by year. However, there is still a high demand for hardware replacements and software updates due to aging parts.

In this situation, there were several requests to update the logger equipment for dynamometer logging systems, but there were no products that could meet such requirements. Therefore, for products delivered by the Meiden Group whose LCE (Life Cycle Engineering) was due for renewal, we developed and manufactured the HL-01 system to extend the product life of such applicable products and as

part of a maintenance tool.

Initially, we supplied this product primarily as a dynamometer logger, but recently we have received inquiries from other industries. As a general-purpose, high-speed data logger, we are expanding its input data diversification and functionality, responding to requests for data collection related to dredging operations and relatively fast sampling periods for power monitoring of production facilities. This paper introduces the HL-01 system's specifications and functions, the work support tools developed to improve customer's work efficiency. We will also talk about the future wide application developments.

## 2 Specifications and Functions

**Table 1** lists the specifications for the HL-01 system and the simplified GL-02 system. The sampling period is 10 ms for error monitoring and 100 ms for measuring data, making it fast among systems using general-purpose Windows personal computers (PCs). This is achieved by dedicating one of the PC's multiple central processing units (CPUs) to a real-time operating system (INtime). This achieved high-speed and accurate real-time performance.

In addition, in response to requests for using

**Table 1 Specifications of HL-01 System and Simplified Type of GL-02 System**

Points of input data and output data plus sampling periods are shown.

I/O items	HL-01 System		GL-02 System	
	Full custom	Standard custom	Full custom	Minimum custom
Analog input measuring item (ch)	64	32	32	4
Pulse input measuring item (ch)	4		2	
Operation item (ch)	32			
Sampling period (Error monitoring) (ms)	10 (10,000 points max. for saving)			
Sampling period (Measured value gathering) (ms)	100 (25,000 points max. for saving)*1			
Auto-operation control analog output (ch)	8			
BNC (Bayonet Neill-Concelman) terminal analog output (ch)	32		—	—
ON/OFF info digital I/O (points)	128		64	

Note: \*1. The data exceeding the maximum number shall be saved in a separate file.

only some of the HL-01 system's "measurement functions" or "scheduling functions", the GL-02 system series was developed to suit specific applications. The simplified GL-02 system reduces the PC specifications, PLC (Programmable Logic Controller) module size, and software functionality.

To meet customer needs, customers can choose from four lineups: a full custom and standard custom HL-01 system, and a full custom and minimum custom GL-02 system.

**Table 2** lists the features. Standard features are implemented in all lineups. Many optional features are implemented in the HL-01 system (optional features other than multi-language function are not available on the GL-02 system). Therefore, when choosing from the four lineups, you must consider the availability of necessary features in addition to hardware specifications.

When creating a schedule, you can set up to 100 operation commands per routine, and up to 100 routines can be registered. A schedule is created by combining these 100 routines. **Table 3** shows the operation command settings for each step.

**Table 4** shows the list of settings. In channel settings, the PLC module's signal range and maximum and minimum scales are set on the logger PC, and the setting information is sent to the logger PLC. PLC module settings can be changed without

**Table 2 List of Functions**

The standard and optional functions of the HL-01 are shown. For the GL-02 System, setting for part of optional functions is unavailable.

	Function name	Explanation
Standard functions	On-line display	Trend graph, performance graph, meter, and list are on-line displayed.
	Measured value monitoring	Upper/lower limits of measured values are monitored. Alarm output in case of deviation. (Monitoring points = 90)
	Screen display setting	Free setting of display items and display positions Layout change according to testing
	Scheduled operation command	Control value and status signal commands forwarded to make schedule and execute operation.
	Schedule establishment	100-step × 100-pattern. Patterns are combined to make schedule.
	Log message	All send/receive data and operations are saved in log message.
	Log message gathering	Log messages are gathered to make a display list of operation frequency and time.
	Window layout setup	Window layout saving, reload, and reset.
	Backup	At system closure, system data are auto-saved. Manual save is also possible.
	Work supporting functions	Setting tool (ST tool)
Display tool (VT tool)		Display and file output (csv Excell) are done at another PC.
Log message (MT tool)		Display, retrieval, and log.
Optional functions	Multi-language mode	Language dictionary files are loaded to enable multi-language display.
	External output (BNC terminal output)	External output of measured and calculation values from BNC terminal.
	External operation linkage	Operation and data acquisition are possible external equipment.
	Load loss and mechanical loss setting	Road load and mechanical loss values are calculated by abc method and transmitted.
	Correlation monitoring	Upper/lower limits of line graphs monitoring by two measuring items (10 cases max.)
	Inner computation	Specific operation processing (16 items max.) *Additional program processing is required.
	Remote monitoring	Monitoring of remote monitor screens *Within the same network

connecting a device for changing the settings to the logger PLC. The abbreviations set in channel settings and operation parameters are used for arithmetic operations in the formulas set in channel settings. In addition, calculations are performed simultaneously with measurement data collection and displayed online on graphs, list meters, and alarm monitoring screens.

**Table 3** Operation Command Setup Items to be set in Steps

Items of 1-step setting for run routines are shown.

Setup items	Setting range and explanation
Control mode	Unit switchover for control output values
Operation time	0.1 sec. to 24 hrs.
Data saving method	Regular data getting period (0.1 to 60 sec.) or individual data getting conditions (times, pitch, display)
Control output value	Goal value at the end of step adjusted to the unit
Inclination	Inclination time to reach the target value
Step alarm	Alarm item, monitor value (upper/lower limits), operation when step out, delay, *10 items max.
Status	ON/OFF output signal *16 items max.
Step transfer	Items, threshold, *2 items max.

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**Table 4** List of Setup Items

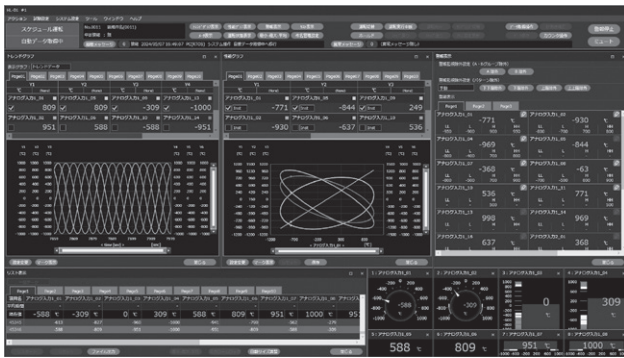
“Maintenance” indicates the maintenance setting items based on maker intention.

Setup screens	Setting items	Contents of setting
ch setting	Analog input item	Item name, abbreviation, unit, range, scale, upper/lower limits
	Pulse input item	Item name, abbreviation, unit, frequency, scale, upper/lower limits
	Operation item	Item name, abbreviation, unit, expression, alarm upper/lower limits
Parameter	Sampling setting	Sampling period, mean data frequency
	Pulse conversion value setting	No. of pulse per rotation
	Various parameter setting	Parameter name, abbreviation, set value (Fixed value or variable value or selection)
Schedule	Schedule setting	Routine No. (Execution order), loop setting (Range frequency)
	Routine setting	Time, control output, step alarm, status, step-up conditions
Screen setting	Trend graph	Axis X, Axis Y, measurement item, unit, scale, *24 items × 10 pages
	Performance graph	Axis X, Axis Y, measurement item, unit, scale, *24 items × 10 pages
	Meter display	Type (Round, bar, digital value), measurement item, unit, scale *16 pcs.
	Measured value monitoring	Monitoring item *30 items × 3 pages
	Correlation monitoring	Axis X, Axis Y, measurement item, upper limit domain, lower limit domain *10 items
	List display	Measurement item, mean/max./min. display *16 items × 10 pages
System setting	Unit setting	Registration of unit used for system
	Control output item setting	Item name, class, unit, signal range, scale
	Load setting (Road load)	Coefficient, exponentiation, table data
	Mechanical loss setting	Coefficient, exponentiation, table data
	Log message display class	Message class display/non-display setting
Maintenance	Analog output setting	Function loading/no-loading, No. of output channels (1~32)
	Alarm monitor setting	Valid/Invalid of extreme upper limit, upper limit, lower limit, extreme lower limit
	Load setting, mechanical loss setting	Install/no-install of load setting function, No. of registrations (1~100)
	ch setting	Tab display/no-display, No. of lines, No. of rows, inner constant setting
	Run parameter setting	Display order, change acceptability, list box, fixed value, segment
	Run schedule setting	Control output, status quantity, step alarm setup frequency, No. of lines, No. of rows
	Trend & performance graph setting	Display page No. (1~10), Axis Y item No. (1~24)
	List display setting	Display page number (1~10), Minimum/maximum, mean display/no-display
	Screen display setting	Display/no-display (Trend, performance graph, meter, alarm monitor, list)
	Log message clear	Log message initialization
	Display language setting	Language switchover (Japanese, English)

Fig. 1 shows the main operation measurement execution screen, and Fig. 2 shows the sub-operation measurement execution screen. Trend graphs display measured values over time, such as in durability tests, and performance graphs display the comparison and characteristics of measured values for selected measurement items, such as in performance tests. Each graph can display four items per Y-axis, allowing up to six Y-axes to be displayed, allowing for 24 graphs to be displayed per page.

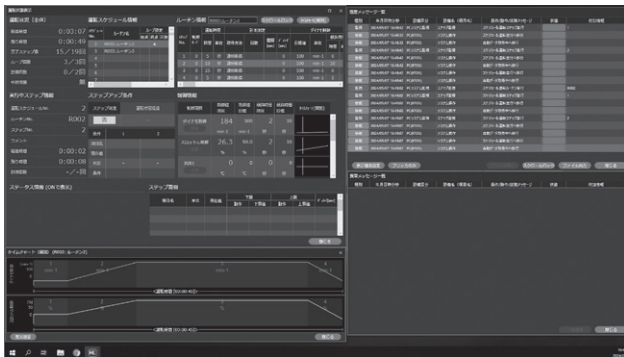
In addition to round meters, digital displays and bar meters can be selected for meter display, and up to 16 windows can be displayed.

The size and position of the windows displayed



**Fig. 1 Operation Measurement Run Screen (Main)**

Respective display screens are shown for trend graph (for durability test), performance graph (for performance test), alarm display (measured value monitoring), list display, and meter display.



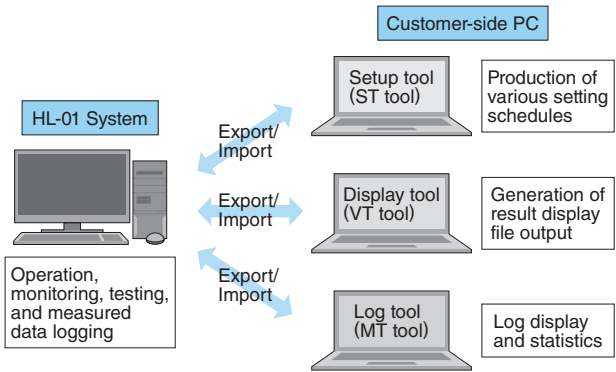
**Fig. 2 Operation Measurement Run Screen (Sub)**

Operation status display (scheduled run), log message, and time chart are shown.

on each screen can be freely changed, and the layout settings can be saved. This allows you to create layouts tailored to your test or user, and switch between them for use.

### 3 Improving Work Efficiency with Work Support Tools

One of the HL-01 system’s key features is its work support tools. **Fig. 3** shows the benefits of these tools. We developed a configuration tool (HL-01-ST) for various test setup tasks, a display tool (HL-01-VT) for data reference, analysis, and output, and a log message tool (HL-01-MT) for managing system log messages and displaying rankings of ON/OFF counts and durations in addition to displaying and searching. These work support tools can be run on a PC at a user’s desk without using the HL-01 system, thereby increasing system uptime and streamlining work. They also improve the work environment in sites with poor system installation



**Fig. 3 Advantages of Work Support Tools**

Settings, display, and output tasks can be performed on PC other than the main system tasks.



**Fig. 4 Pump Dredger “Daisan Asia Maru”**

The hull is secured by spuds, and the vessel swings to excavate the ground using the cutter at the end of the rudder. Dredging pumps are used to suction and transport mud.

environments.

The log message tool aggregates log messages and displays in a ranking form for such data as error codes, operation data, ON/OFF counts, ON durations, and OFF durations. By being able to check the frequency of errors and the operating hours of the equipment, the system can provide a guide for when maintenance or replacement is required based on the degree of deterioration and wear of the equipment and parts.

### 4 Applying the HL-01 System to Other Industries

The HL-01 system has been integrated into the construction management system for the pump dredger “Daisan Asia Maru.” **Fig. 4** shows the pump dredger called “Daisan Asia Maru.”

Currently, the HL-01 system collects dredging

and operational information from excavation work. In the future, the collected information will be used to digitize excavation operation techniques, deriving on-site information and the corresponding optimal operation command patterns. During subsequent excavation work, the system will instantly analyze on-site conditions and automatically select operation command patterns, leading to automated operation.

In addition to data collection, we are working on the development of the HL-01 system to incorporate operation command patterns into its scheduled operation functions and executing operations based on pattern commands, thereby contributing to automated operation.

## 5 Postscript

We introduced the HL-01 high-speed data logger system and its applications.

In the data-driven society that is likely to emerge in earnest, data visualization (collection of previously uncollected data) and data volume expansion (collection of even more detailed and larger amounts of data than previously collected data) will be essential. High-speed data loggers are a versatile tool.

Going forward, we would like to continue improving and developing our data logging system in response to customer's demands on dynamometer-applied testing systems and from other industries.

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