



## **OceanView – A System for Rapid Development and Reconfiguration of Subsea Tooling Control**

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In the Subsea industry there is a need for an easy way to assemble hardware and software for commanding and reading data back from the various actuators, valves and sensors temporarily attached to an existing system due to the immediate demands of the project. In the past, various serial RS-485 and other interface devices have been hooked to a PC and custom software written to “glue” them all together. Generally, interface to each device is unique and awkward, and a very high level of skill is required to realize useful results. The OceanView Project was initiated to address these difficulties, and now provides a simple user-friendly method to meet this need.

The **OceanView** control system combines the convenience of a “No Software – Plug and Play” solution to the rugged reliability of standard industrial RS-485 I/O modules. The **OceanView** control system consists of 2 parts. **In Oil Modules** – I/O function blocks that will operate at ambient pressure; and **Software** – a robust software package with a Graphical User Interface that allows the user to quickly configure module operation and control.

### **Goals of OceanView Project**

- Reduction in the time and skill level required for configuring and installing the system.
- Subsea electronics will operate when exposed to pressures of up to 5000 psi (10,000 FSW).
- Electronics shall be in a compensated enclosure filled with non-conductive oil.
- Over all system response should be such that there is no more than a 0.125 second lag for a digital signal for any combination of modules up to the limit of the bus
- The system will be controlled by software running on a Surface PC.
- The control software shall have a Graphical User Interface (GUI).
- I/O readings must be displayed in user selectable units.
- Unit conversion factors, span and offset shall be configurable at setup time for every input or output

### **I/O Modules**

OceanWorks, Inc has partnered with ICP-DAS (<http://www.icpdas-usa.com/>) to bring their I-7000 line of RS-485 Intelligent I/O modules to the subsea market. **OceanView** modules, oil bath and depth-adapted from the ICP-DAS units, provide I/O function blocks that will operate at ambient pressure. These modules are pressure tolerant to depths of 10,000 FSW and can be housed in an oil-filled enclosure. The modules are supplied with a number of drivers and example programs (LabView™, Active X, dll, DasyLab and C) so they can be used in many applications.



**OceanView Modules**

### **Watchdog**

The **OceanView** OV-7000 series modules are designed for industrial subsea applications. To enhance system reliability **OceanView** modules use a *Dual Watchdog* system to ensure positive control at all times.

### **Dual watchdog = Communications Watchdog + Module Watchdog**

The *Module Watchdog* will reset the module if its embedded software has a problem or hangs up. If the module watchdog resets; the module will assume its power up state, detect the communications bus and execute the next

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command from the surface computer. The module watchdog is always running and cannot be turned off.

The *Communications Watchdog* monitors the communications link to the surface PC. If the communications link loses contact with the surface PC for a specific period of time (for example the fiber optic MODEMs lose power) all the outputs of the modules will go to their predefined safe states.

The Power Up state and the Communications Lost Safe state of all outputs are user defined and are not required to be the same.

The Dual Watchdog system means that *OceanView* is not dependent on the Windows™ operating system for safety.

### **Module Function**

The *OceanView* module line currently consists of 7 different modules, a customizable subsea module used to interface to serial devices, an RS-232 to RS-485 converter, a communications Indicator module and a Water Detector.

Up to 256 modules can be linked together via a two wire RS-485 network with a baud rate of 1200bps up to 115.2 kbps. All *OceanView* modules are shipped with their baud rate set at 115kbps. All modules have Terminal block connections that accept 16-22 AWG wire. The modules have an operating temperature of -25 to 75°C, a storage temperature of -40 to 80°C, and a Voltage Input of 10 - 30 VDC. All *OceanView* modules have status LEDs. Digital models have LEDs indicating the status of each I/O line. These LEDs allow easy trouble shooting while in a transparent oil filled housing.

Following is a list of *OceanView* Modules:

- OV7017** - 8 Channel Analog Input
- OV7050** - Digital I/O
- OV7080** - Counter/Frequency Input
- OV7024** - 4 Channel, 14 Bit Analog Output
- OV7041** - 14 Channel Isolated Digital Input
- OV7044** - Isolated Digital I/O
- OV7067** - Relay Output
- OV7520** - RS232 to RS485 Converter
- OV7521** - Custom RS485/232 Input/Output (Allows serial devices, such as a compass, to be placed on the RS-485 bus.)
- OV125** - Water Detect
- OV100** – Communications Indicator

### **Software**

The *OceanView* software package allows the user to configure, manipulate and operate the above modules. The software is optimized to make it simple for the user to develop a unique control panel design. *OceanView* has an intuitive interface, fast execution speed and is quick and easy to learn. *No coding or programming is required*

### **Architecture**

The overall philosophy for the *OceanView* software package is simplicity, reliability and straight forward operation.

Once the I/O modules are arranged in a network (Standard 2 wire RS-485) the *OceanView* software will scan the network and automatically sense the I/O modules. *OceanView* provides a graphical menu of each connected module's features for the user to arrange and label as required.

### **User Interface**

Once the Bus scan is complete *OceanView* creates a database with information about each module. The information that is automatically retrieved and stored for each module includes:

#### **Module Tag Name**

#### **Module Address**

#### **Module Model Number** (7050, 7021, 7017, etc)

#### **Module Type:** (Analog, Digital, Serial, Mixed)

#### **Number of Inputs**

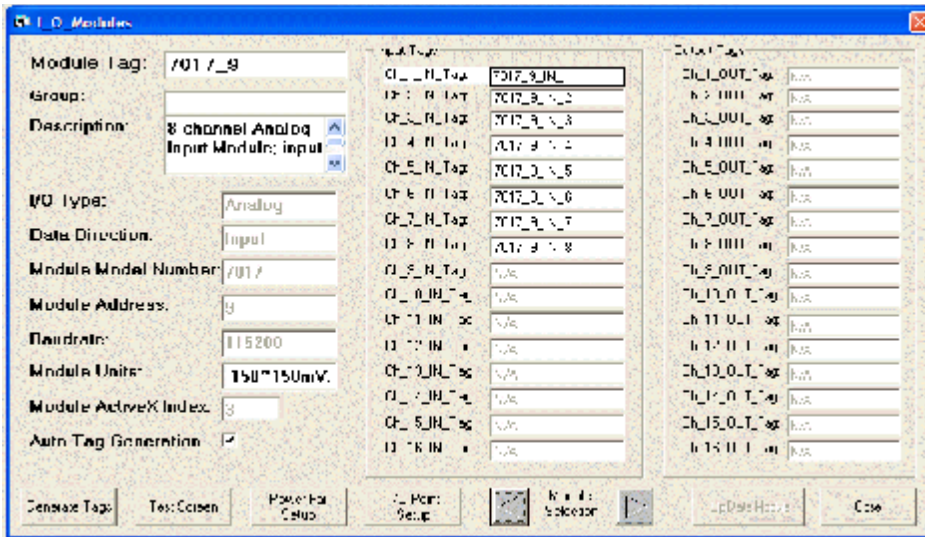
#### **Number of Outputs**

#### **Tag Names of all the I/O Points (Channels)**

The user can interact with the Module Database thru the *I/O Modules Configuration Screen*. The user can change the tag names for individual I/O Points, set/change various module options, Set up the Power Up and Lost Communications output settings and test each module.

The user can select the I/O Point set up button or click on the name of an I/O Channel and the *I/O Point Configuration Screen*. For each I/O Point or channel of each module the user can assign an *on-screen control*. There are many on-screen controls to choose from that are appropriate to subsea control systems, such as valves, gauges, switches and lamps. During control system development each on-screen control can be moved, labeled and configured as the user sees fit.

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I/O Modules Screen

In addition to configuring the on-screen controls appearance; the user can also configure operational parameters of each control such as scaling and alarms. When the user clicks the *Create Control* button a “Data Pipe” is automatically created between a physical I/O Channel on a module and the user selected on-screen control. Information about the Data Pipe, as well as scaling and other data are saved into a database.

*OceanView* dynamically creates an Active X control for the module, as well as an Active X control for on screen control. The Active X controls operate concurrently – the Data Pipe moves data between the Active X controls on either ends of the pipe.

Once the user has the control panel arranged to their satisfaction, the user presses the START button to begin module operation. Each module is polled according to its address. This is accomplished by passing control of the serial port between module Active X controls. This approach scans only bus addresses that are actually connected to the bus and maximizes data throughput of the serial bus. Data sent from the surface PC to the modules is all event driven which also helps maximize bus throughput. Obviously the STOP button stops module operation.

### Security

To prevent accidental or malicious changing of the control panel settings *OceanView* has three Security levels of operation. A password is

required to move up to the next level of operation. The 3 operating modes are:

### Configuration Mode

- Engineering System Design level.

### Setup Mode

- Senior operator level.

### Operation Mode

- Operator Level.

### User Selectable Communications Drop Response

In all serial communications there is a possibility that some or all of the communications can be garbled or lost temporarily.

In *OceanView* this creates a module timeout error. During operation, if the serial link degrades for some reason (such as noise or a poor connection) it can become annoying to have constant timeout errors popping up on the screen. *OceanView* allows several options to deal with time out errors, thus allowing the user to complete the mission and repair the system later.

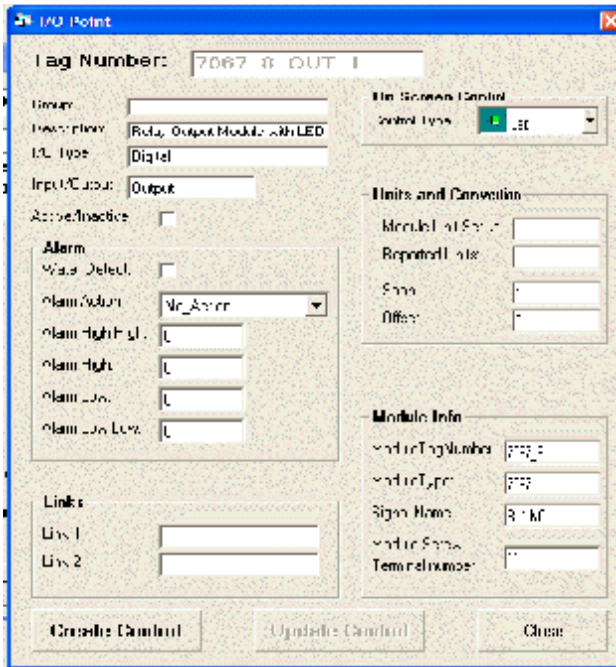
- **Do Nothing** – time out errors are not generated or logged. This is particularly useful if there is a module failure but the rest of the system remains operable and can otherwise complete the mission.
- **Display an Error after n Dropouts** – time out errors are generated, displayed and logged after the user selected number *n* have occurred.
- **Log an Error after n Dropouts** - time out errors are generated and logged, but not displayed and after the user selected number *n* have occurred. This is useful when you are troubleshooting a problem.

### Alarms

The Alarm system alerts the operator of an alarm condition and records that condition in the alarm log.

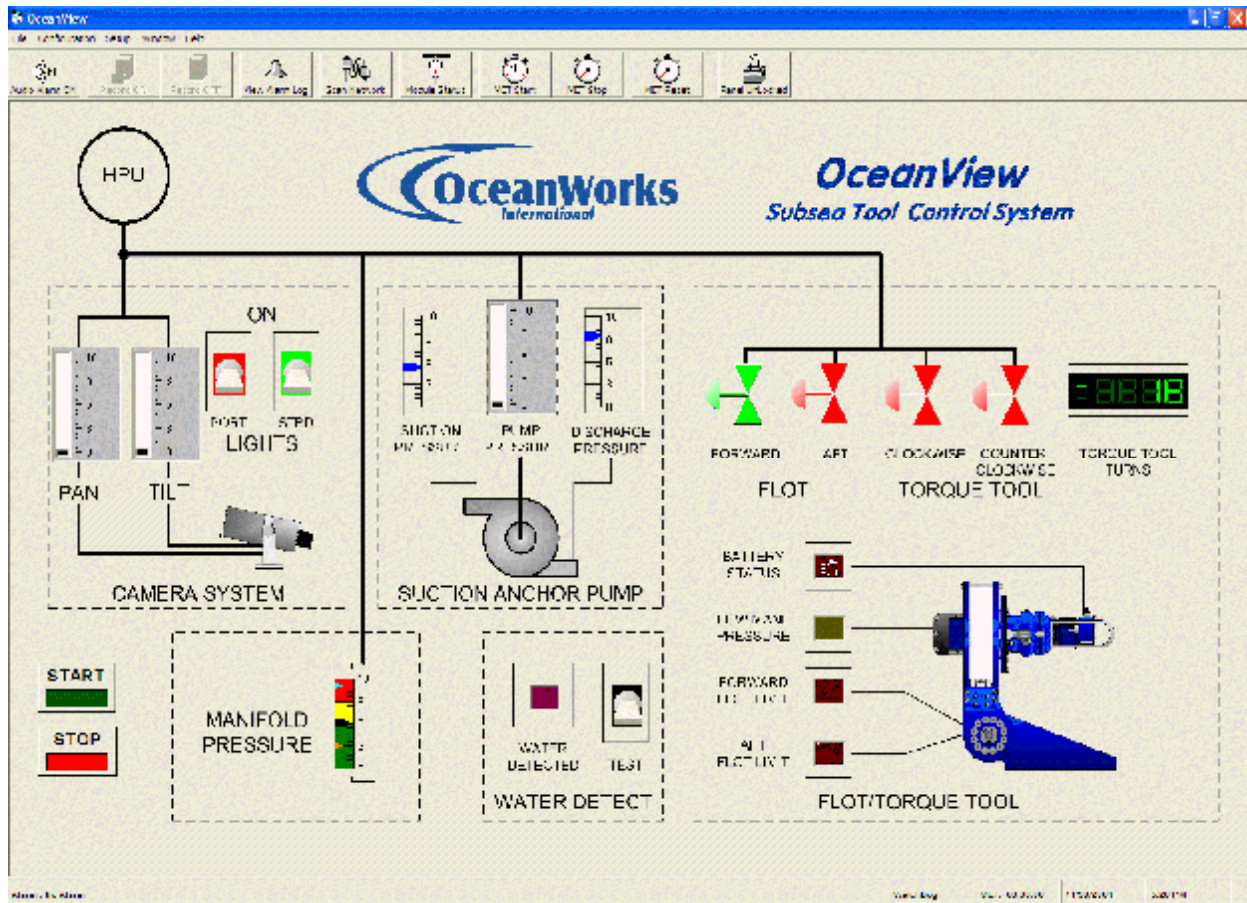
Each I/O point can have 4 possible Alarm conditions which are set by the user.

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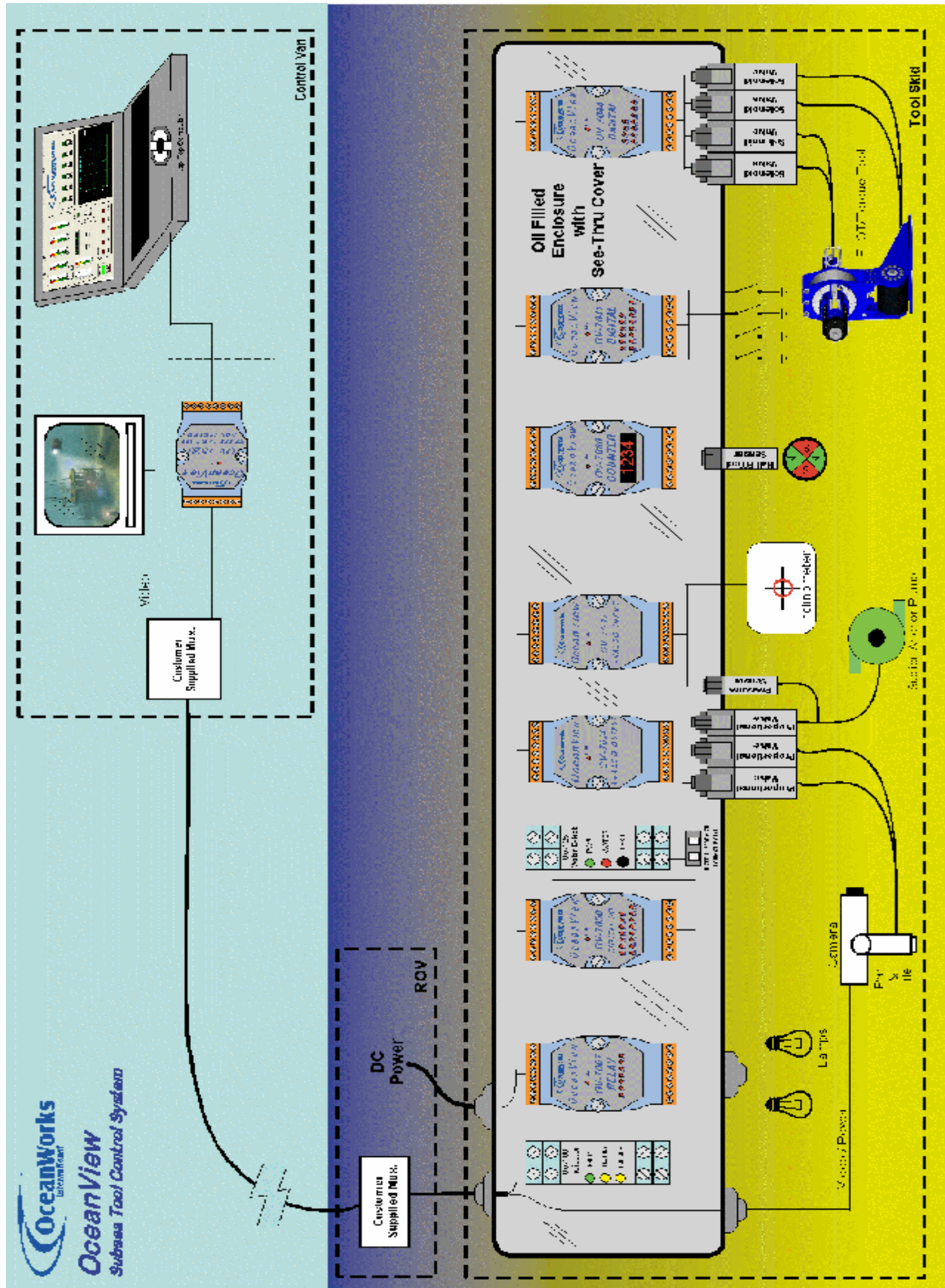
I/O Point Screen

- **No Action** – I/O Point has no alarm condition
- **Log Only** – Alarm condition is written to the alarm log and appears in the status bar but the operator is not required to acknowledge the alarm.
- **Audio/Visual** - Alarm condition is written to the alarm log, appears in the status bar and an audio/visual indication alerts the operator. The I/O point control that is causing the alarm is surrounded with a barber pole pattern. The operator is required to acknowledge the alarm to stop the audio/visual indication.
- **Water Detect** – Special Alarm condition is written to the alarm log, appears in a special place in the status bar and an audio/visual indication alerts the operator which I/O point control is causing the alarm. The operator is required to acknowledge the alarm to stop the audio/visual indication.



Typical User developed control panel

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Typical applications for each type of OceanView module.

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The Alarm Log records all alarm conditions, which are defined by the user as well as the water detect signal and each time module operation is started or stopped. For each alarm **time, date, mission elapse time, Tag name of the I/O, alarm type, module Tag, operator** are recorded in a comma delimited text file. A status bar at the bottom of the control panel displays the last alarm action placed in the Alarm Log.

### **Other Features**

*OceanView* has additional features to aid in the subsea tooling mission:

- Graphs of user selected I/O channels. The user can have multiple graphs, all graphing at different rates.
- Data logging of user selected channels.
- The user will be able to view the Alarm log from within *OceanView* in real time.
- Simple graphics development features that can be used to enhance the appearance of the control panel.
- The user can select any graphic image (jpg,.gif,.bmp or metafile) as the background for the control panel. This feature allows the user to draw a detailed mimic of their application in a CAD package such as AutoCAD™ and import it as the background for their control panel – High end looks; without the high end hassle.
- Several types of printed output are possible, including:
  - Ø A report of one or more records in the module database
  - Ø A report of one or more records in the I/O Point database
  - Ø Print out of the Alarm Log
  - Ø Print out a Screen Image of the Control Panel

### **Typical Applications**

The *OceanView* System can be used for a variety of subsea control applications. Typical examples include;

- Controlling a tooling package that attaches to an ROV. This prevents the need to modify the host ROV's control system to accommodate custom tooling. It is particularly useful in a situation where the configuration of the tool changes frequently or where the tool moves from one ROV to another. The ability to rapidly create and re-create a Graphical User Interface reduces confusion and reduces operator mistakes.
- Controlling Remotely Operated Tool (ROT) systems.

- R&D / Scientific applications which require modification of features without necessitating a software redevelopment.

*OceanView* can also be used to configure and control auxiliary or spare I/O as part of a permanent ROV or Manned submersible control system

### **Conclusion**

Oceanworks, Inc. has developed a control system that combines proven technology with an easily configured Graphical User Interface. The *OceanView* System allows the offshore operator to quickly configure and re-configure control systems with off-the-shelf electronics and software.

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