

# Intellisys Energy Optimiser Detailed Description



The Intellisys Energy Optimiser (IEO) is capable of controlling up to eight (8) rotary screw or reciprocating compressors. The IEO will load or unload compressors as necessary to maintain a user adjustable, 0.14-2-bar (2-30 psi) pressure band. The pressure is sensed via a single point in the system. This is not a cascading pressure control scheme. The IEO will prevent electrical power surges using control logic that will prevent the simultaneous loading of compressors. Up to eight compressor sequences can be designated by the user to provide customised control of the compressor system. These sequences can be changed automatically on the basis of elapsed time, or on specific events. An event specifies a particular sequence to be run on a specified time of day and day of the week. In the unlikely event of an IEO or communication failure the affected compressor(s) will default to local control and settings. This will provide the maximum protection to the customer's air system.

The following Parameters can be set by the user:

- Target Compressor System Pressure – The single pressure the IEO will attempt to maintain
- Compressor System pressure band – The allowable tolerance range (a setting of 4 will allow +/- 0.14 bar (2 psi) around the Target Compressor System Pressure)
- Compressor load & unload delay – sets the response time to system events
- Sequence control mode – Either Manual, Timed, or Event
- Start Sequencing – Starts the IEO and engages the current sequence
- Stop Sequencing – Stops the IEO and returns each compressor to local control and pressure settings
- Target IntelliFlow System Pressure – The single pressure the IntelliFlow system pressure controller will attempt to maintain
- Low IntelliFlow pressure warning – The low pressure threshold at which the IEO will provide a warning
- High Dewpoint temperature warning – The high dewpoint temperature at which the IEO will provide a warning (dewpoint is sold separately)

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## **IEO.N**

The IEO.N has all the capabilities of the IEO with the additional functionality of Ingersoll-Rand's exclusive "First In / Last Out" Nirvana control methodology. Whenever a compressor is needed in the system, the Nirvana will be the first compressor running. If demand increases beyond the capacity of the Nirvana, a fixed speed compressor will be brought in at full load and the Nirvana's speed will be reduced as necessary to maintain the Target Compressor System Pressure. On the other hand, if demand decreases below the turndown range of the Nirvana, the IEO will unload a fixed speed compressor and the Nirvana's speed will be increased as necessary to maintain the Target Compressor System Pressure. In this mode of operation the Nirvana's benefit to a system is maximized as all of the running fixed speed compressors are at full load and the Nirvana uses its unparalleled turndown.

## **PACKAGING**

All special tools and hardware required for a basic installation are included with the IEO & IEO.N.

The following components are included:

- Intellisys Energy Optimiser mounted in an IP52 (NEMA 12) enclosure. Designed for indoor installations.
- Pressure Transducer with 30 metres (100 ft) of cable
- 305 metres (1,000 ft) of 22 gauge twisted pair cable for connecting the IEO to the compressors.
- RJ11 Crimping tool
- RJ11 connectors
- Installation and Operation Manual

## **INSTALLATION**

The IEO is a self contained and independently powered unit, mounted in an IP52 (NEMA 12) control enclosure. The enclosure is protected by Ingersoll-Rand's standard powder coated finish. A separate 115/230V, 60/50 Hz power supply must be provided to the IEO. If power is interrupted to the IEO but not the compressors, the compressors will revert to local control. The IEO can be installed in ambient temperatures between 0°C and 46°C.

### **PRESSURE TRANSMITTER:**

A single pressure transducer is provided and must be installed at a stable point in the air system. The pressure sensing point should be chosen carefully. It should be free of flow restrictions, excessive pressure drops and excessive demand surges. A common receiver tank is an excellent choice. The pressure transducer can be located up to 30 metres (100 ft) from the IEO. If there are dryers or filters installed in the system between the compressors and the IEO pressure transducer, the IEO's user-set Target Pressure must be adjusted to compensate for the pressure drop caused by these devices.

### **COMPRESSORS:**

Compressors equipped with INTELLISYS controls will be connected to the IEO through the supplied standard 22 gauge twisted pair wires. Standard modular telephone type connectors (RJ11) will be used to terminate the connections.

Non-Intellisys compressors (including non Ingersoll-Rand compressors) will each require an ISC Interface II kit for connecting to the IEO or IEO.N. The twisted pair phone cord will be run from the IEO to the ISC Interface II box. The box will then be wired into the compressors pressure switch (or appropriate terminations for microprocessor based compressors) to provide the load / unload signal.

### **AUTO START & STOP:**

Automatic Start & Stop is required on each compressor to receive the full energy savings benefit of the IEO or IEO.N. The IEO or IEO.N will not have direct control over the auto start/stop function of each compressor. A compressor will stop if it meets its criteria for doing an auto stop, which is set on the individual compressor. A compressor would then restart if it received a load command from the IEO or

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IEO.N. The compressor will start unloaded. Units without the auto start/stop function will run unloaded until the load command is received.

## **OPERATION**

### **SYSTEM CONFIGURATION**

Within the system configuration screen as part of the initial set up a user access code can be entered. This will avoid tamper by unauthorized users. Also within this screen the local Ingersoll-Rand service contact information, language and units of measure can be imputed.

### **SETUP:**

Once the IEO is properly setup it will operate automatically. Every IEO or IEO.N comes preset from the factory with default settings. In order to realise the full benefits of the IEO or IEO.N some field customization is required. Each compressor in the system is assigned a number 1 through 8. With the IEO, the user can determine which compressor will operate as a lead compressor and in what order the others will follow. With the IEO.N, a Nirvana compressor (when present and so designated) will always operate as the lead compressor and the user will determine what order the others will follow. This is accomplished by programming up to eight (8) sequences, designated **A** through **H**. Sequences are automatically changed using a process called rotation.

Rotating from the current sequence to a new sequence can be initiated either automatically or manually. The automatic method can be one of two different schemes: one based on accumulated compressor run hours, and the other based on a programmed event cycle. The control schemes are referred to as TIMED, EVENT and MANUAL modes. Both the Timed mode and the Event mode cause the sequences to rotate on a predetermined condition, without operator intervention. Up to eight sequences, designated A-H, can be preset by the operator, and the same eight are used in both the Timed mode and the Event mode. Their order of rotation depends on which mode is selected and how the operator presets that particular mode.

### **TIMED MODE:**

Timed mode is ideally suited to installations where all compressors are the same horsepower and the goal is to balance the accumulated hours on all machines to better facilitate maintenance. The Timed scheme rotates every time the accumulated running hours of a sequence equals the preset hours chosen by the user. The time is adjustable from 1 to 1000 hours in one (1) hour intervals. "Running Hours" is defined as the elapsed time that at least one compressor on the IEO is running, and only when the IEO is in Timed mode.

The rotation order is always A through the last sequence preset, then back to A. If Timed mode is selected and no change has been made to the number of compressors since the last time Timed mode was active, then operation will resume in the sequence (rotating to it if necessary) and with the accumulated running hours that were present when Timed mode was exited. The only setup required uniquely for the Timed scheme is the input of the total run hours at which to rotate. If the total run hours set point is changed, the running hours will be reset to 0.

### **EVENT MODE:**

Event mode is ideally suited to installations where all compressors are not the same horsepower and the plant experiences varying load conditions. Examples include multi-shift operations or operations that use equipment with high air requirements on certain days or at certain times. Energy efficiency can be maximized by programming the compressors that most closely match the air demand.

The programmed Event scheme rotates every time a preset day and time occurs, thereby initiating the sequence that was assigned to that event. There can be up to nine (9) events programmed, and each event has a day designator (a day or group of days), time-of-day, and sequence letter (A-H) assigned to it by the user.

"Events" are numbered one through nine (1-9), and each can be activated by programming its day, time and sequence or deactivated by programming it to UNUSED. Any one "Sequence" of the eight (A-H) previously preset sequences can be assigned to each event. The UNUSED designator can be assigned to

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the Event in place of a sequence. "Day Designators" can be assigned to each Event, and can be one of four (4) types, as follows:

DAY is any one specific day of the week, Monday through Sunday

WEEKEND is always both Saturday and Sunday

WEEKDAY is always Monday through Friday

DAILY is always every day identically the same, Monday through Sunday

The "Time-of-day" that a sequence is to begin can be assigned to each Event and can be on any hour or quarter of an hour. This is the time the event (rotation to assigned sequence) begins, then that event continues until the next event begins.

In case two Events have identical Day Designators and Time-of-Days, the lower numbered Event has priority.

Anytime the Event mode is selected, the sequence assigned to the current day and time "period" is initiated. That is, the IEO will internally search through the entire list of Events to determine which Event (and sequence) is supposed to be currently active.

The setup required uniquely for the Event mode is the assigning of 1) a Sequence letter, 2) a Day Designator, and 3) a Time-of-Day to each Event number.

## **MANUAL MODE:**

The IEO intelligently rotates the compressor sequences in order to maintain plant air pressure while eliminating power spikes from starting multiple compressors at once. The following is a description of the steps the IEO will go through when replacing the current sequence with a new sequence. It is assumed that sequences may be changed on a time basis or because of a manual selection. The objective is to install a new sequence without starting any unnecessary compressors or causing a loss of air pressure. A six-compressor sequence is used as an example.

Old Sequence	1 2 3 4 5 6
New Sequence	4 6 3 1 2 5

The new sequence will immediately be loaded and will become the operational sequence.

The IEO will find the left most unloaded unit i.e. the unit closest to the lead compressor. If any units to the right of this unit are loaded, the left most unloaded unit will load if the system air pressure is stable or falling. This step will be repeated every 60 seconds until there are no unloaded units to the left of the loaded units.

Changes in demand will cause units to load from the left and unload from the right.  
Changes in demand will speed the process of changing sequences

The IEO will only unload units due to a change in demand. When changing sequences, the IEO will load units. The increased air supply will cause any unnecessary units to unload.

## **POWER OUTAGE / RETURN LOGIC:**

The IEO is fully compatible with compressors equipped with Power Outage Restart Option (PORO). The IEO will store its operating state in non-volatile memory. This information is retained in the case of loss of power. If the IEO was in event mode operation at the time the power was lost, the IEO would scan the events and execute the event, which would have been in operation had power not been lost.

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## **SEQUENCING:**

The IEO will try to maintain a single pressure band for all compressors by loading as many compressors as necessary. It is assumed that all compressors will operate in the on/off line mode and will not modulate. When the pressure is between the upper and lower limits of the pressure band, the IEO will take no action. The action the IEO will take when the pressure falls below the lower limit or rises above the upper limit or above the maximum pressure limit will be described below. The pressure band is adjustable from 0.14-2-bar (2 – 30 psi). The user will set the Target Compressor System Pressure and the System Pressure Band.

The IEO.N will function exactly the same with the exception of the Nirvana compressor in the first position which will have its speed adjusted as required to maintain the single pressure band. When the pressure is between the upper and lower limits of the pressure band, the IEO.N will take no action with respect to loading or unloading compressors. It will however, continue to adjust the speed of the lead Nirvana tin an attempt to maintain the Target Compressor System Pressure.

## **LINE PRESSURE FALLS BELOW THE LOWER PRESSURE LIMIT:**

When the line pressure falls below the lower pressure limit, the delay load timer will begin. When the delay load timer times out, the next compressor will load. If this compressor was stopped due to an auto restart situation, it will start. The one exception to this is if the line pressure falls 0.14 bar (2 psi) or more below the lower pressure limit and the first unit to load has not loaded, the delay load timer will be bypassed and the unit will load. This exception will not be repeated until the line pressure has risen above the lower pressure limit and starts to fall again. When a unit loads, the delay load timer will be reset and restarted. This process will repeat until the line pressure begins to rise. If the line pressure stops rising and is not above the lower pressure limit, the delay load timer will be reset and restarted. Once the delay load timer times out, the compressor will load (or start, if stopped) if the line pressure is still steady or is falling. The delay load timer will have no effect on the operation when the line pressure is above the lower pressure limit.

## **LINE PRESSURE RISES ABOVE THE UPPER PRESSURE LIMIT:**

When line pressure rises above the upper pressure limit, the last compressor to load will unload. A delay unload timer will begin. When the delay unload timer times out, the next compressor will unload if the line pressure is still above the upper limit. The delay load timer will be reset and restarted. This process will repeat until the line pressure begins to fall. If the line pressure stops falling while above the upper pressure limit, the process will continue. The delay unload timer will have no effect on the operation when the line pressure is below the upper pressure limit.

## **LINE PRESSURE RISES ABOVE THE MAXIMUM PRESSURE LIMIT:**

If the pressure rises above the maximum pressure limit (0.34 bar (5 psi) above the upper pressure limit), all compressors will unload at once. When the pressure falls to the upper pressure limit, all but the lag compressor will load if it has been less than one minute since all the compressors have unloaded. If it has been more than one minute since all the compressors unloaded only the lead compressor will load. The pressure will have to fall to the lower pressure limit for any other compressors to load.

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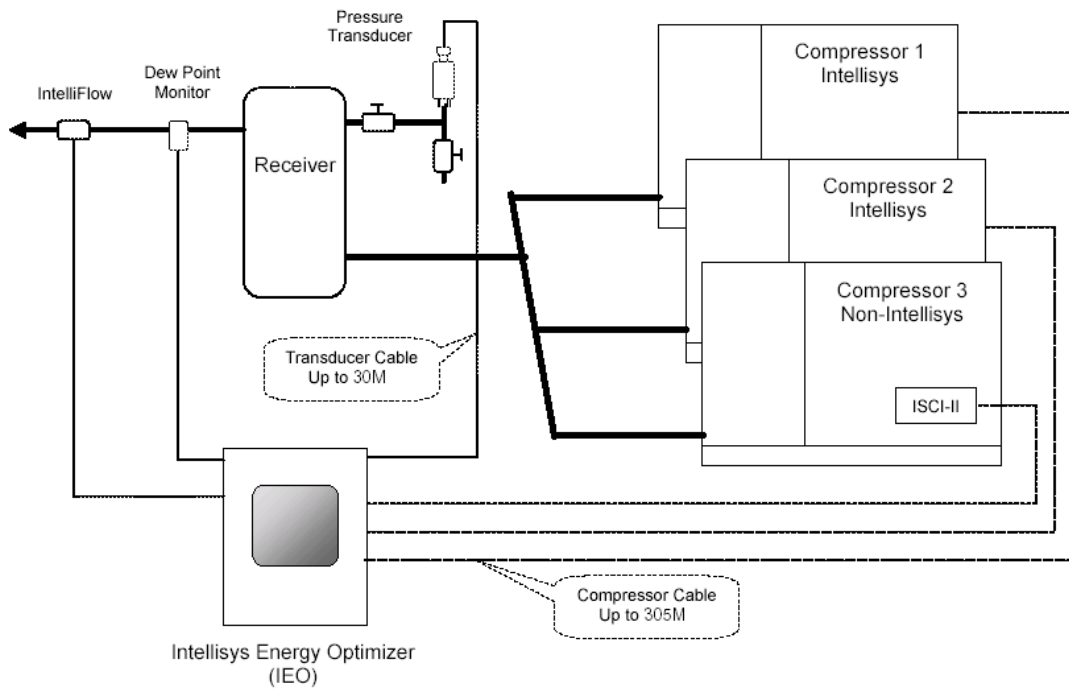


Figure 7.1 TYPICAL AIR SYSTEM