# ADRES
### Automated Demand Response
### and Energy Savings Solution

# Building Automation Objectives

- **Project Energy and Cost Savings**
  - Efficiency Savings - Improvement in air conditioning and heating systems efficiency with ADRES controls.
  - Maintenance Savings -  Reduced emergency call-outs from remote monitoring, programming and control capability.
  - Operational Savings  -  Optimum scheduled PM service from historical data and trend analysis.

- **Remote Monitoring and Alarming of Critical Signal Parameters:**
  - HVAC, Lighting, Solar, Wind, and Refrigeration Equipment and Systems
  - Utility Energy Submetering (Electric, Gas, Water)
  - Building Security, Fire, Lighting, Refrigeration, etc.

- **Automatic Alarm Reporting**
  - ADRESpro server   (for data collection and trend analysis).
  - ADRESpro relays alarms to company or maintenance personnel's text and or email.

# ADRES Automated Demand Response and Energy Savings Solution

# System Overview

Winn EnergyPro Software

ADRESpro cyber secure Server for Control, Program,

Telephone Line

| Monitor | Trends | Schedule | Configure | Contact | Unit Details |

**Generator 1 - Building Backup**

START
STOP
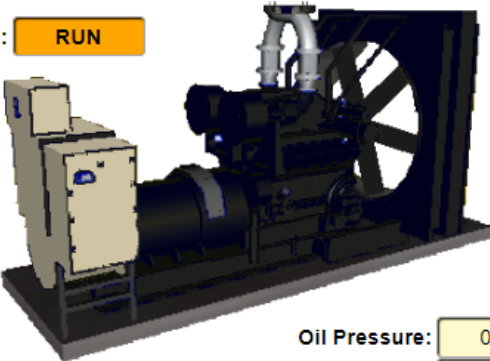
Master Switch: RUN

Coolant Temp: 0

Battery Volts: 0
Ambient Temp: 0
Run Hours: 0

Fuel Temp: 0
Fuel Pressure: 0

Oil Pressure: 0
Engine RPM: 0

Charge Air Temp: 0
Charge Air Pressure: 0

GET READINGS

**System Status**

System Ready: ○     Common Warning: ●
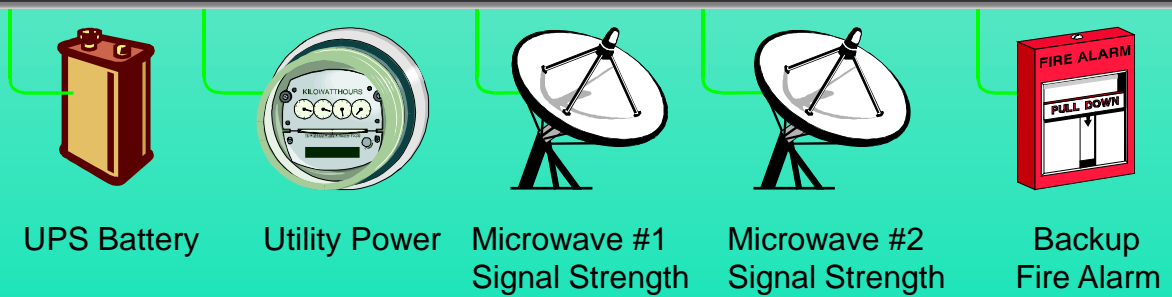Gen Running: ●      Common Fault: ●

**Unit Description**

Generator Type: Kohler 250kW
Controller Type: DEC3+
Serial Number: 2276130
Fuel Type: Diesel
Bldg Number: RDC 5642
Address: 5655 E. Ontario Mills Pkwy
Ontario, CA 91764

UPS Battery

Utility Power

Microwave #1 Signal Strength

Microwave #2 Signal Strength

Backup Fire Alarm

FIRE ALARM
PULL DOWN

**Cellular Site Overall**

## HVAC Unit and Ductwork

# ADRES Cell Site Installation

ADRES Automated Demand Response and Energy Savings Solution



**Cellular Repeaters**
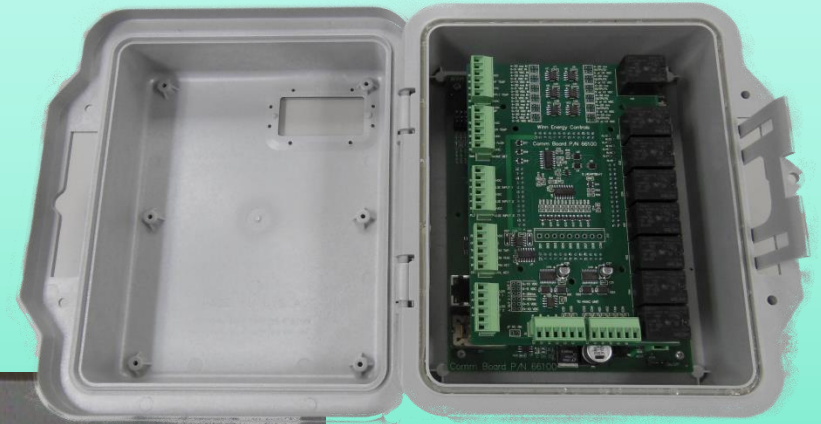
**ADRES Installation**
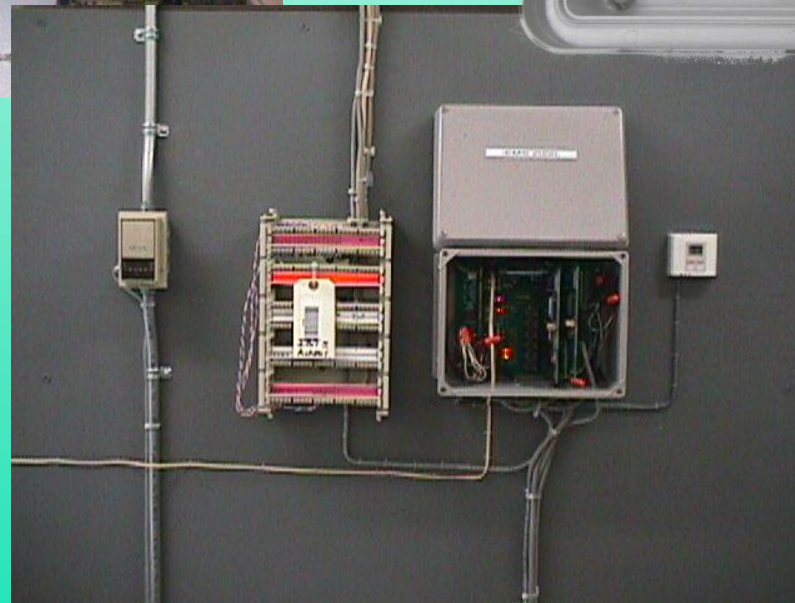
# Typical Building Installation
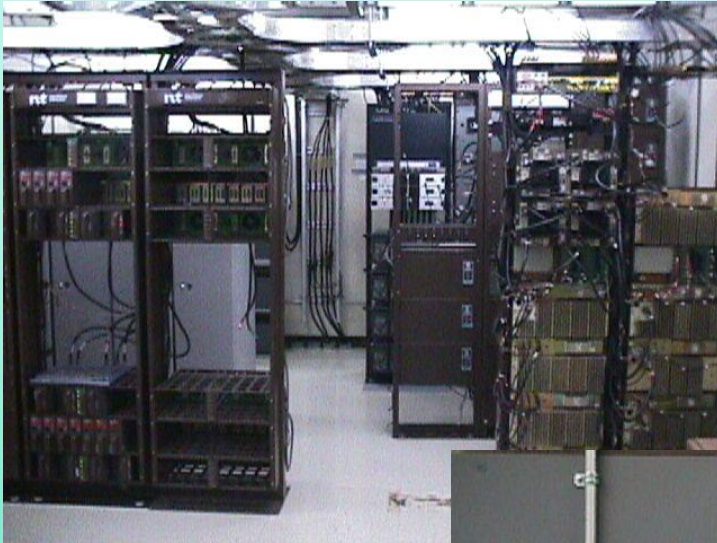
# ADRES
Automated Demand Response and Energy Savings Solution

# Typical Wireless Store Application

**Internet Cyber Secure Cellular WAN Communication**

## HEATING AND AIR CONDITIONING CONTROL

**HVAC System 1**          **HVAC System X**

**ADRESpro** ... secure Serv... Control, Pro... Monitor, Dat... and Receivi...

### Unit Details

**Monitor** | Trends | Schedule | Configure | Contact

HVAC - Proshop

| | |
|---|---|
| H/C Control | Cool Only |
| Indoor Fan Mode | Auto |
| Fan Speed | 100% |
| Temp Mode | Program |
| Setpoints | Cool 70 / Heat 60 |

☐ All Units

**UPDATE SETTINGS**

**GET READINGS**

*Latest Reading: 7/5/2018 12:30:00 PM*

Rooftop Temp: 91
Mixed Temp: 20
Economizer % Open: 0
Return Temp: 78
Fan Speed: 100
Supply Temp: 60
Room Temp: 74
WARMER   COOLER
Room Humidity %: N/A

Unit Type: Gas/Electric
Demand Response Status: Utility Control

## UNIVE... CONT...

**Electric / Gas and Water Meter Reading**

**Fire / Security Alarm**

**Freezer Control**

**Cooler Control**

ADRES

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## ADRESpro Secure Web Application

- **Microsoft "Windows 2012 R2 Server based Operating Systems.**

- **Microsoft "Sql Server 2017" Enterprise database.**

- **Full on-line documentation, Installation and User Manuals.**

- **On-line training demonstration and tutorial program.**

- **User expandable and configurable.**

- **Cyber secure WAN communications capable.**

- **All analog and digital signal monitoring channels configurable within ADRESpro software.**

- **Real-Time automated M&V reporting.**

- **Historical data monitoring and logging.**

- **Automatic generation of management reports.**

- **Automatic alarm reporting.**

# ADRES Control Module

● System expandable for additional HVAC, Lighting and Refrigeration Control Modules.

● Cyber secure web browser interface with ADRES Control modules using the ADRESpro application.

● Monitor, data recording and alarming on Utility energy usage. (User Definable)

● Cyber secure cellular WAN wireless communications to remote ADRESpro Server.

● Automatically reports alarm conditions to the Server HVAC, lighting, refrigeration or renewable equipment or utility / building parameters exceed limits.

● All program, control, alarm and monitoring parameters are user configurable within the ADRESpro web application.
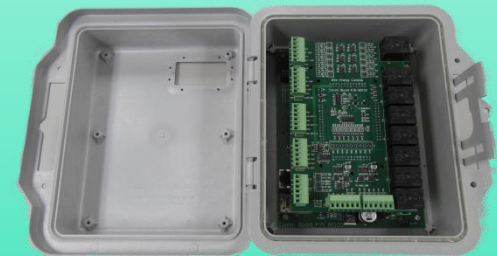
● Controls gas/electric, oil furnaces or heat pumps with either one - four stages of cooling and two stages of heating.

● Records operating times for each HVAC component and cooling / heating degree days on a monthly and yearly basis.

● Program all HVAC operating parameters such as staging temperatures, short cycle times, minimum operating times, anticipation, and other parameters that optimize system performance and economy.

● Program minimum equipment performance levels that when exceeded generate alarm conditions.

● All energy data, programs and operating parameters are stored in non-volatile ram to prevent loss during power outages.
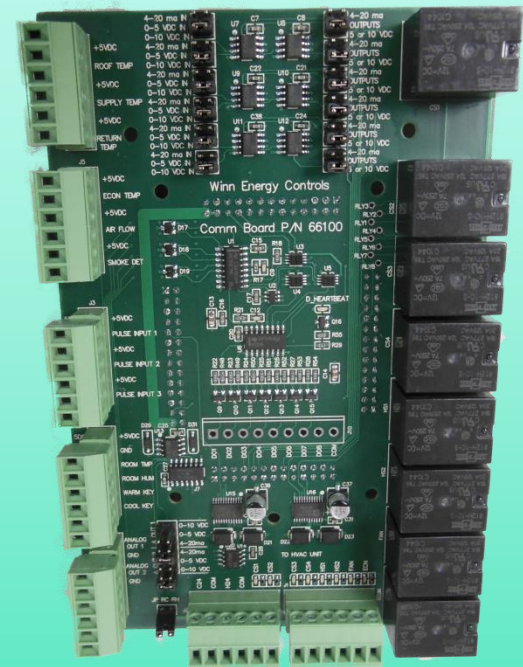
# Comparing a Call for Cooling with and without Energy Recovery

**AVERAGE TEMPERATURE DROP ACROSS THE COIL IN NORMAL OPERATION 20°F (60,000 BTU/HOUR)**

**AVERAGE TEMPERATURE DROP ACROSS THE COIL USING THE ADRES CONTROL 17.5°F (52,500 BTU/HOUR)**

**RETURN AIR TEMPERATURE**

**ROOM TEMPERATURE**

**AVERAGE SUPPLY AIR TEMPERATURE IN NORMAL OPERATION**

**SUPPLY AIR TEMPERATURE WITH THE ADRES**

**AVERAGE SUPPLY AIR TEMPERATURE WITH THE ADR#ES**

TEMPERATURE °F — 75, 70, 65, 60, 55

TIME - MINUTES — 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62

**KW LOAD WITH ADRES 1.5 TO 8.5 KW**

**KW LOAD IN NORMAL OPERATION 8.5KW EFFICIENCY 7,058 BTU/KWH**

**AVERAGE KW LOAD WITH ADRES 5.7KW EFFICIENCY 9,210 BTU/KWH**

KW LOAD — 0 1 2 3 4 5 6 7 8 9

TIME - MINUTES — 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62

Example is based on a typical 5-Ton Air Conditioning system.

- During the call for cooling, the room temperature drops from 75 to 72°F.

- The return air entering the air conditioner is generally 2 or more degrees warmer than room temperature due to the ducts being heated and the make-up rooftop air.

- In normal operation without the ADRES, the supply air is colder because the compressor runs continuously and keeps the temperature drop across the coil at its maximum of 20°F and the maximum 60,000 BTU per hour is provided.

- With the ADRES operating, the supply air temperature is modulated as the compressor is turned on and off by the ADRES.

- With the ADRES operating, the temperature drop across the coil is decreased by about 2.5°F with a corresponding decrease in BTU output to an average of 52,500 BTU per hour.

- With the system operating normally without the ADRES, the load is 8.5 KW and the efficiency of the system is 7,058 BTU per KWH.

- With the ADRES operating, the load varies from 8.5 KW when the compressor is operating to only 1.5 KW in energy recovery with just the indoor fan operating. Efficiency has increased to 9,210 BTU per KWH-- an improvement of 30%.

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# ADRES
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# Comparing a Call for Heating with and without Energy Recovery

**Temperature chart (TEMPERATURE °F vs TIME- MINUTES):**

- SUPPLY AIR TEMPERATURE WITH THE ADRES
- AVERAGE SUPPLY AIR TEMPERATURE WITH THE ADRES
- AVERAGE SUPPLY AIR TEMPERATURE IN NORMAL OPERATION
- AVERAGE TEMPERATURE RISE ACROSS THE FURNACE IN NORMAL OPERATION 56°F (150,000 BTU/HOUR)
- AVERAGE TEMPERATURE RISE ACROSS THE FURNACE WITH ADRES CONTROL 51°F (139,090 BTU/HOUR)
- RETURN AIR TEMPERATURE
- ROOM TEMPERATURE

Temperature axis: 70, 80, 90, 100, 110, 120, 130
Time axis: 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62

**Gas Consumption chart (GAS CONSUMPTION CF PER HOUR vs TIME- MINUTES):**

- AVERAGE GAS CONSUMPTION IN NORMAL OPERATION 150 CF PER HOUR 100,000 BTU PER 100CF
- AVERAGE GAS CONSUMPTION WITH THE ADRES CONTROL 90 CF PER HOUR 154,544 BTU PER 100 CF

Axis: 0, 50, 100, 150, 200

**KW Load chart (KW LOAD vs TIME- MINUTES):**

- KW LOAD IN NORMAL OPERATION .9KW (166,666 BTU / KW)
- KW LOAD IN NORMAL OPERATION .9KW (154,544 BTU / KW)

Axis: 0, 0.5, 1.0, 1.5, 2.0

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Example is based on a typical 150,000 BTU Gas Furnace.

- During the call for heating, the room temperature rises from 69 to 72°F.

- The return air entering the furnace may be higher or lower than the room temperature depending on the location of the return ducts. A warmer return air temperature (worst case) is assumed for the analysis.

- In normal operation without the ADRES, the supply air is warmer because the gas burner runs continuously and keeps the temperature drop across the furnace or heat exchanger at its maximum of 56°F and the maximum 150,000 BTU per hour is provided.

- With the ADRES operating, the supply air temperature is modulated as the gas valve is turned on and off by the ADRES.

- With the ADRES operating, the temperature drop across the furnace is decreased by about 5°F with a corresponding decrease in BTU output to an average of 139,090 BTU per hour.

- With the system operating normally without the ADRES, the gas consumption is 150 CF per at an efficiency of 100,000 BTU per 100 CF of gas. The KW load is .9KW for the indoor fan operating at low

- With the ADRES operating, the average gas consumption drops to 90 CF of gas per hour and the efficiency increases to 154,544 BTU per 100 CF of gas. The electrical load efficiency decreases slightly from 166,666 BTU/KW to 154,544 BTU/KW.

| | Normal Operation | Operation with ADRES |
|---|---|---|
| Gas Consumption | $.75 | $.45 |
| KWH Consumption | $.09 | $.09 |
| BTU Output | 150,000 | 139,090 |
| Total Cost per 100,000 BTU | $.56 | $.39 |

Based on $.50 per therm of gas and $.10 per KWH.

# Measuring and Verifying Energy Savings

**Measure Operating Voltage and Current for Each Load Using AC Voltmeter and Amprobe.**
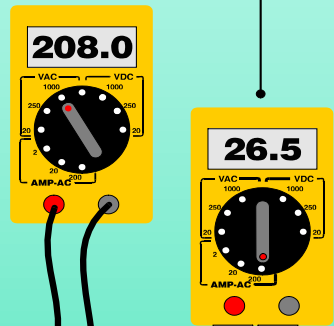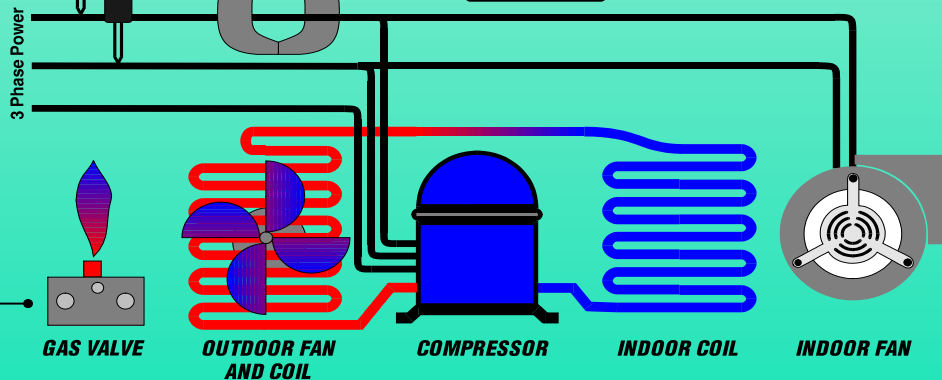
**The emc$^2$ performs a 14 or 28-day test, activating and deactivating the emc$^2$ on alternating days.**

**The emc$^2$ records the total hours each component operated on the days the emc$^2$ was activated and the days it was deactivated.**

**208.0**

VAC — VDC
1000 1000
250 250
20 20
2 2
20 200
AMP-AC

**26.5**

VAC — VDC
1000 1000
250 250
20 20
2 2
20 200
AMP-AC

**3 Phase Power**

emc$^2$
*energy Management Component*
HVAC ENERGY RECOVERY COMPONENT

STATUS
SECOND STAGE
HEAT   CALL   RECOVERY   Y2 W2
COOL   CALL   RECOVERY   HFAN
W-STAT
W-SYS
Y-STAT
Y-SYS
TR
TR
TS
TS
24VAC
24VAC COM

**DDM2 DATA DISPLAY MONITOR**

**10.83**

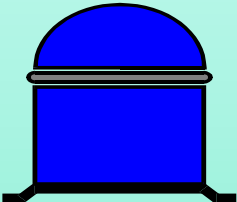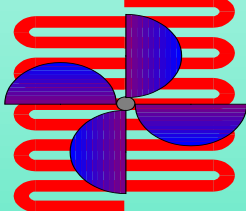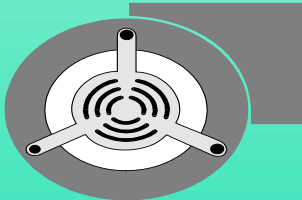| CALL TIME | ER TIME | REF CALL TIME | TEST DAY |
| SUPPLY TEMP | RETURN TEMP | ER START TEMP | ER STOP TEMP |
| HEATING COOLING | MONITOR PROBE 1 | MONITOR PROBE 2 | STATUS MSG |
| TIME CHECK | RESET | SYSTEM STATUS | SELECT TEST |

**The DDM2 displays the test data as well as any diagnostics, supply and return air temperatures and the status of the test.**

**Input gas rating is taken from the furnace nameplate.**

*GAS VALVE*  *OUTDOOR FAN AND COIL*  *COMPRESSOR*  *INDOOR COIL*  *INDOOR FAN*

WIN

# ADRES
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and Energy Savings Solution

# A/C Energy Recovery Savings

| | Power Rating | Power Consumption without the EMS2000 | Power Consumption with the EMS2000 |
|---|---|---|---|
| **Compressor** | 208 VAC<br>3 Phase<br>26.5 Amps<br>208 x 1.73 x 26.5<br><br>9.53 KW | 10.83 Hours Call Time<br>9.53KW x 10.83Hr<br><br>103.20 KWHrs | 11.71 Hours Call Time<br>4.55 Hours Recovery Time<br>9.53KW x (11.71 - 4.55)Hr<br><br>68.23 KWHrs |
| **Outdoor Fan** | 208 VAC<br>1 Phase<br>2.7 Amps<br>208 x 2.7<br><br>.56 KW | 10.83 Hours Call Time<br>.56KW x 10.83Hr<br><br>6.06 KWHrs | 11.71 Hours Call Time<br>4.55 Hours Recovery Time<br>.56KW x (11.71 - 4.55)Hr<br><br>4.00 KWHrs |
| **Indoor Fan** | 208 VAC<br>1 Phase<br>6.5 Amps<br>208 x 6.5<br><br>1.35 KW | 10.83 Hours Call Time<br>1.35KW x 10.83Hr<br><br>14.62 KWHrs | 11.71 Hours Call Time<br>1.35KW x 11.71Hr<br><br>15.80 KWHrs |
| **Total Energy Consumption per day** | | 123.88 KWHrs | 88.03 KWHrs<br>28.9% Savings |
| **Daily Operating Cost @ $.10KWHrs**<br>**Saving/Day with the EMS2000** | | $12.38 per day | $8.80 per day<br>$3.58 per day |

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# ADRES Automated Demand Response and Energy Savings Solution

# Built-In Comfort Protection

## DEMAND MONITOR

- During an extended call for cooling or heating as would occur during periods of high demand, the emc2 decreases its energy recovery.

- This is achieved by increasing the compressor ON cycle so that more BTUs are delivered to the indoor envelope.

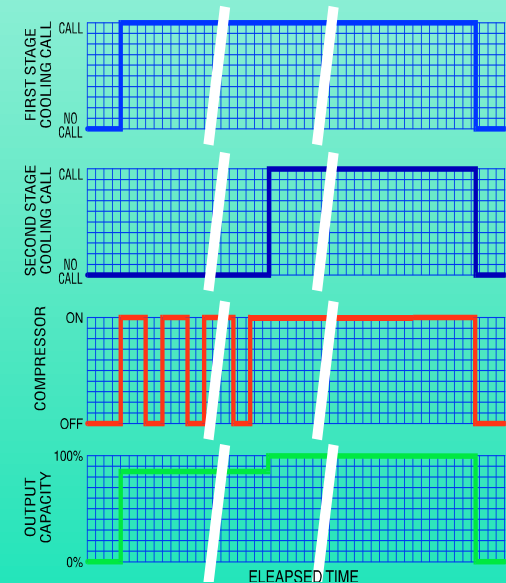- As the On cycle is lengthened, the output capacity approaches 100%.
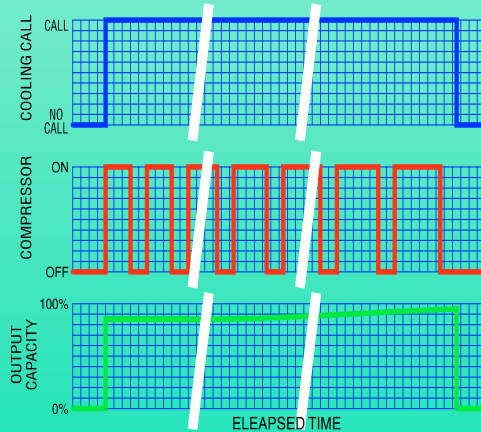
## RETURN AIR MONITOR

- During a call for cooling or heating, the emc2 will terminate energy recovery if it detects a degradation of comfort level as indicated by the return air temperature.

- If this condition occurs, cycling of the gas valve or compressor is terminated.
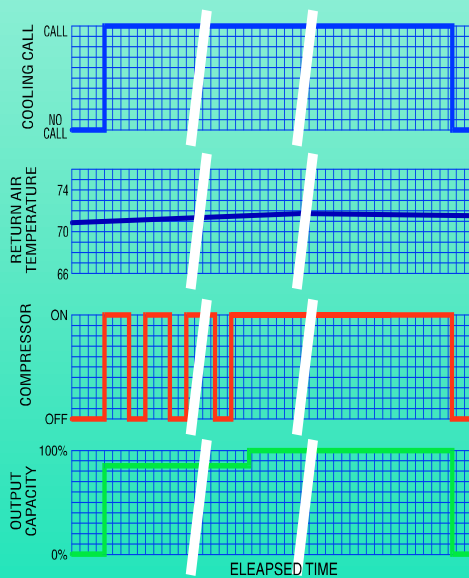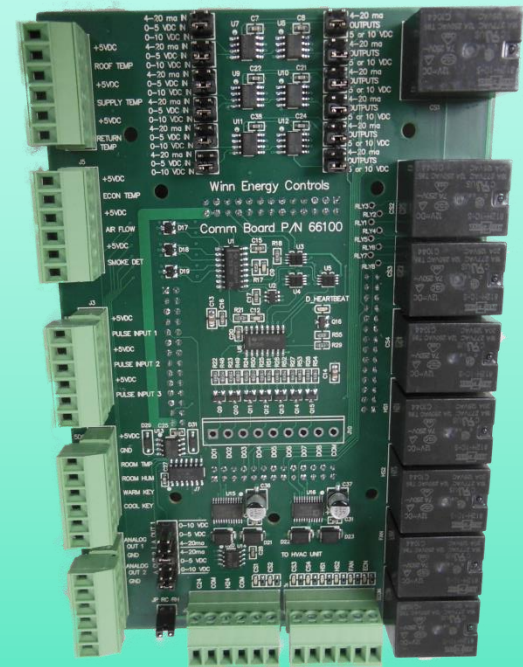
## STAGE 2 MONITOR

- During a call for cooling or heating, energy recovery is terminated when a second stage call is detected.

- When second stage is activated, the compressor or gas valve is kept ON to provide maximum BTU output.

# ADRES Automated Demand Response and Energy Savings Solution

# Lighting Control Board Features

● Controls and monitors eight individual lighting circuits.

● Records operating times for each lighting circuit on a monthly and yearly basis.

● Program all lighting schedules and operating parameters such as on / off times for exterior signage and parking, override times for after hour work, and other parameters that optimize system performance and economy.

●Optional occupancy sensor and light sensors for added control and system integration.

● All energy data, programs and operating parameters are stored in non-volatile ram to prevent loss during power outages.
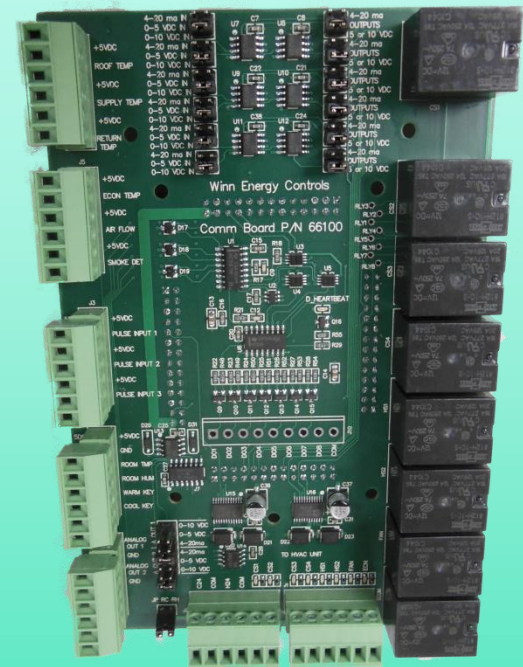
● Monitor eight analog and eight digital signals.

● Program both high and low limits for each signal. An alarm will be generated if these limits are exceeded.

● Select if alarm is to be on both high and low limits, low limit only, high limit only or monitor only.

● Program a time delay before control initiates an alarm.

● Alarm will be reset if out-of-limit conditions does not persist during the time delay.

● Automatically reports alarm conditions to the secure ADRESpro Server and receive via SMS or email.

# ADRES Automated Demand Response and Energy Savings Solution

# Analog Channel Setup in ADRESpro

Lighting | Monitor | Trends | Schedule | Configure | Contacts

Lighting | Analog | Digital

| Channel | Parameter | Units | Alarm Low Condition | Low Alert Condition | High Alert Condition | Alarm High Condition | Alarm Delay | Alarm Condition | Instrument Type | Conversion Low | Conversion High | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Room Temp | Deg F | | | | | | | Thermistor | | | EDIT |
| 2 | Placeholder 2 | kWh | | | | | | | | | | EDIT |
| 3 | Placeholder 3 | kWh | | | | | | | | | | EDIT |
| 4 | Placeholder 4 | kWh | | | | | | | | | | EDIT |
| 5 | Placeholder 5 | kWh | | | | | | | | | | EDIT |
| 6 | Placeholder 6 | kWh | | | | | | | | | | EDIT |
| 7 | Placeholder 7 | kWh | | | | | | | | | | EDIT |
| 8 | Placeholder 8 | kWh | | | | | | | | | | EDIT |

SET ANALOG        GET ANALOG

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# End User Benefits

- **Typical 1-2 Year Return on Investment with implementation of the "Cyber Secure Wireless" ADRES automated demand response and energy savings solution.**

- **Remote access via secure web browser to buildings for real-time or historical electric, gas and water consumption.**

- **Integrated alarm reporting system for heating and air conditioning equipment, lighting, solar, solar thermal, wind and other renewable technologies as well as critical building and utility energy usage parameters.**

- **Modular and expandable system for future growth.**

- **Database and trend analysis of equipment and performance.**

- **Optimum scheduling of equipment service based on actual equipment run hours.**

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