Modulation Technologies: Designing Great Commercial Spaces

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Director – Commercial Air Conditioning Marketing
Emerson Climate Technologies

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Director – Global Commercial Scroll Engineering
Emerson Climate Technologies
Today’s Presenters

Bart Powelson

• Director - Commercial Air Conditioning Marketing
• 20+ Years Experience in HVACR Industry
• Responsible for Monitoring Industry Trends/Standards And Specifying and Launching New Compressor and Compressor Electronics Products for Commercial Air Conditioning Applications

Jacob Grosheke

• Director – Global Commercial Scroll Engineering
• 11+ Years Experience in HVACR Industry
• Responsible for New Product Engineering and Engineering Management; Provides Design and Technical Leadership of Large Commercial Fixed Capacity and Modulating Scroll Platforms Including Variable Speed, Digital And Multiples
Agenda

1. Designer Air – What Is It And Who Benefits?
2. Defining Comfort
3. Comparing Constant Volume Versus Variable Air Volume Systems
4. The Types Of Modulation Technologies
Many Upgrades Available In Commercial Spaces

• Designer Lighting
• Designer Faucets
• Designer Countertops/Surfaces
• Designer Flooring
• Designer Wall Finishes

Why Not Consider “Designer Air”? 
## Who Benefits From Designer Air?

<table>
<thead>
<tr>
<th></th>
<th>Occupant</th>
<th>Employees</th>
<th>Owners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restaurant</td>
<td>Diners</td>
<td>Wait/Kitchen Staff</td>
<td>Building Owner</td>
</tr>
<tr>
<td>Retail</td>
<td>Shoppers</td>
<td>Sales Staff</td>
<td>Building Owner</td>
</tr>
<tr>
<td>School</td>
<td>Students</td>
<td>Teachers / Faculty</td>
<td>School District Taxpayers</td>
</tr>
<tr>
<td>Benefits</td>
<td>Comfort, Satisfaction, Customer Loyalty Retention</td>
<td>Employee Productivity, Employee Retention</td>
<td>Improved Efficiency, Reduced Operating Costs, Increased Sales &amp; Profits</td>
</tr>
</tbody>
</table>
Benefits Of Designer Air Systems

Improved Operating Costs
- Increased Efficiency → Lower Energy Spend

Reduced Maintenance Costs
- More Frequent Service Agreements Or Scheduled Maintenance

Financial Payback
- Reduced Life Cycle Cost
- Improved Total Cost Of Ownership
- Possible Utility Or Tax Benefits
What Is Comfort?

• It’s A Perception
• Can Be Different For Everyone
• Can Be Ambiguous And Difficult To Define
• Discomfort Is Easier To Identify Than Comfort
• Tends To Be Stable And Not Fluctuating
• Goldilocks Effect
  – Not Too Hot, Not Too Cold, It’s Just Right
Comfort Has Many Aspects

- **Temperature**
  - Tighter Temperature Control

- **Humidity**
  - Reduced Humidity Levels

- **Air Speed**
  - Ability To Adjust Fan Speed

- **Noise / Sound Quality**
  - Reduced Air Flow And System Cycling
Challenges To Achieving Comfort

• Budget / Competing Upgrades
• Initial Cost Versus Total Cost Of Ownership
• HVAC Is Out Of Sight, Out Of Mind
• Changing Loads
• Shifting Schedules
• Traditional Technologies
  – Fixed Capacity Compressors
  – Fixed Speed Fans

New Technologies Are Available To Address These Challenges And Achieve Enhanced Comfort
Poll Question

How Familiar Are You With Variable Air Volume (VAV) Systems?

1. Unfamiliar With VAV Systems
2. Not Very Familiar
3. Familiar – But Infrequently Specified
4. Very Familiar – Frequently Specified And Installed
Comparing Constant Volume Systems And Variable Air Volume Systems

**Constant Volume**
- Constant Supply Air Flow Rate
- Compressor And Fan Operate At Full Capacity
  - Cycles On/Off To Meet Load
- Temperature Control Achieved Through:
  - On/Off Cycling To Meet Load
  - Terminal Reheat Option
  - Mixed Air Stream Option

**Variable Air Volume (VAV)**
- Variable Air Flow Rate
  - Achieved With Stepped Or Variable Speed Motor
- Compressor Modulates To Maintain Supply Air Temp.
  - Options Include Multiple Compressors, Mechanical Modulation, Variable Speed
- Advantages Include:
  - Precise Temperature Control
  - Increased Dehumidification
  - Enhanced Comfort
  - Energy Savings
  - Increased Reliability
Variable Air Volume Systems Enhance Comfort

Modulation Technologies Enable Precise Climate Control

**Temperature Control**

- Variable speed compressor
- Standard Air Cond./Heat pump

**Humidity Control**

- Modulating compressor
- Fixed speed compressor

Capacity Modulation Technologies Maintain More Even Space Temperature

Modulation Technologies Achieve Longer Run Cycles And Decrease Relative Humidity
Variable Air Volume Systems Offer Several Advantages Over Constant Volume

<table>
<thead>
<tr>
<th></th>
<th>Constant Air Volume</th>
<th>Variable Air Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression: Indoor Fan:</td>
<td>Fixed Speed None</td>
<td>Modulated Stepped Or VS Stepped Or VS</td>
</tr>
<tr>
<td>Outdoor Fan:</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Load Matching (Comfort)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Dehumidification</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Part Load Efficiency</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sound</td>
<td>X</td>
<td>✓</td>
</tr>
<tr>
<td>Vibration</td>
<td>X</td>
<td>✓</td>
</tr>
</tbody>
</table>
Types Of Modulation Technologies

**Mechanical Modulation**
- Multiple Compressors → Tandems/Trios
- Stepped/Two-Step → UltraTech
- Continuous → Digital

**Speed Control**
- Variable Speed
- Tandems With Variable Speed + Fixed

As a result of new efficiency regulations, 66% of contractors expect an increase in the sales of modulating systems.
Copeland Scroll UltraTech™

Two-Step Modulation

• By Mechanically Unloading, Compressor Operates At 67% And 100%

• Optimized For High Part-Load Efficiency

• Offers Improved Temperature And Humidity Control

• 2-5HP Range

• Ideal For Mid-Tier SEER And IEER Based Light Commercial Split And Package Applications
Copeland Scroll Digital™

Continuous Modulation

- Separation Of Scroll Elements Alternately Loads And Unloads Compressor
- By Controlling Separation Times, Compressor Is Precisely Operated Between 10-100%
- Precise Temperature & Humidity Control
- 3-15HP Range (Tandems Up to 30HP)
- Ideal For Mid-Tier Comfort Light Commercial Split, Package And Chiller Applications
Tandems And Trios

**Multiple Compressors**

- Multiple Steps Of Capacity
- Independent Operation – No Lead/Lag
- Extensive Reliability Testing In Every Design
- Over 150 Even And Uneven Combinations
- High Part-Load And Full-Load Efficiency
- 3-120HP Range
- Ideal For Commercial Splits, Rooftops And Chillers
Copeland Scroll™ Variable Speed

Next Generation Variable Speed

• Variable Frequency Drive Dynamically Controls Compressor Motor Speed

• High Efficiency Embedded Magnet Motor Delivers Breakthrough Part-Load Efficiency

• Wide 20-120% Speed Range Provides Superior Temperature And Humidity Control

• Proven Reliability Enhanced With CoreSense™ Technology In Drive

• 2-10T Range

• Ideal For Premium Light Commercial Rooftop, Chiller And Geothermal Applications
### Compressor Modulation Technology Comparison

<table>
<thead>
<tr>
<th>Modulation Technology</th>
<th>Products</th>
<th>Range</th>
<th>Part Load Efficiency</th>
<th>Full Load Efficiency</th>
<th>Comfort</th>
<th>Applied Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UltraTech (Two-Step)</strong></td>
<td>2-5HP</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Best</td>
</tr>
<tr>
<td><strong>Digital (Continuous)</strong></td>
<td>3-15HP</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Better</td>
</tr>
<tr>
<td><strong>Variable Speed</strong></td>
<td>2-10HP</td>
<td>Highest</td>
<td>Low</td>
<td>Highest</td>
<td>Highest</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Multiples</strong></td>
<td>3-120HP</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Best</td>
</tr>
</tbody>
</table>
Hybrid Modulation Technologies Options

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<tr>
<th>For A 10 Ton RTU...</th>
<th>10%</th>
<th>50%</th>
<th>100%</th>
<th>110%</th>
<th>Over-Speed</th>
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<tbody>
<tr>
<td><strong>Single, Digital Compressor</strong></td>
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<td><strong>ZPD103</strong></td>
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<td><strong>Tandem, Fixed Speed + Digital</strong></td>
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<td><strong>ZP54K5 + ZPD54K5</strong></td>
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<td><strong>Single, VS Compressor</strong></td>
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<td><strong>ZPV063</strong></td>
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<tr>
<td><strong>Tandem, Fixed Speed + VS</strong></td>
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<td><strong>ZP54K5 + ZPV038</strong></td>
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Combining Technologies In Multiples Unlocks Additional Modulation Range
Summary

Consider “Designer Air”; Elevate The HVAC Decision
- Numerous Benefits To Occupants And Building Owners

Designer Air Systems Provide Enhanced Comfort
- Temperature Control, Humidity, Variable Air Flow, Sound Quality

Consider Advantages Of Variable Air Volume Systems
- Enabled By Modulation Technologies

Understand Modulation Technology Options Available To You
- Variable Speed Systems Deliver Superior Comfort And Excellent Efficiency
- Mechanical Modulation Can Affordably Provide Enhanced Comfort
To Learn More On “Getting Comfortable With Designer Air”, Please Visit Our Webpage At emersonclimate.com/designerair

Stay Tuned For More Emails Containing Information And Timing On Our Next Webinar!