



Business Case for  
Natural Refrigerants

## Tecumseh **IntelliCOOL**

*Energy Savings Using R290 VTC Inverter  
Compressor With TAL Technology*

*Plug In Display Case / Freezing Island Case Study*

Robert Terry

Global Platform Director – Variable Speed Products

Tecumseh Products Company

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# About Tecumseh



- ▶ Founded in 1934 - revolutionized the industry with the first hermetically sealed compressor
- ▶ Global customer base serviced from manufacturing and technical support facilities on four continents
- ▶ Full line of compressors and condensing units applicable to numerous industries.

## Compressor & Condensing Unit Manufacturing



## Case Study: *Customer Rationale, Test Plan, Methodologies*

### Customer Rationale:

***“Using variable speed technology, achieve benefits..***

- ✓ Reduced Energy Consumption
- ✓ Robust “Disturbance Rejection”
- ✓ Rapid “Temp-Recovery”
- ✓ Dual Voltage Input

***“...with compact compressor and minimal changes to existing cabinet.”***

### Test Plan:

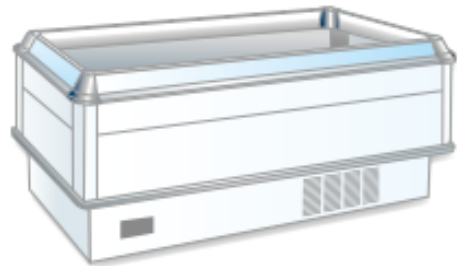
❑ **Select 2 customer cabinets currently using R290 fixed speed compressors:**

1. Measure energy consumption using fixed speed AE2430U compressor in baseline.
2. Replace compressor with VTC inverter compressor with “TAL”.
3. Don’t make any changes to cabinet except optimize refrigerant charge.
4. Measure energy consumption with VTC / TAL configuration.
5. Compare results / make conclusions.

### Test Methods:

- EN ISO23953
- Class 3
  - 25°C/60%RH
- 2 defrost cycles after temp stabilization
- Cabinet 1 – Loaded
- Cabinet 2 – No Load
- Linear regression to calculate 24 hr. consumption for comparisons

## Case Study: *Baseline Cabinet Descriptions*



### Test Cabinet 1 - Baseline

~Size (L)	930L
Application	LBP – Frozen Food
ISO23953 Class	3L1
Power Supply	220 VAC, 60 Hz
Pre-Condenser	Baseline
Expansion Device	Capillary Tube
Condenser	Skin Type
Evaporator	Skin Type
Door	Yes – Glass
Pre-Cond. Fan	Baseline
Pre-Cond. Airflow	Forced
Refrigerant	R290 – 95 (g)
Benchmark Compressor	AE2430U On/Off
Temp Controller	Baseline On/Off

### Test Cabinet 2 - Baseline

~Size (L)	900L
Application	LBP – Frozen Food
ISO23953 Class	Not Declared (ND)
Power Supply	220 VAC, 60 Hz
Pre-Condenser	Baseline
Expansion Device	Capillary Tube
Condenser	Skin Type
Evaporator	Skin Type
Door	Yes – Glass
Pre-Cond. Fan	Baseline
Pre-Cond. Airflow	Forced
Refrigerant	R290 – 110 (g)
Benchmark Compressor	AE2430U On/Off
Temp Controller	Baseline On/Off



VTC



Tecumseh IntelliCI

TAL



Tecumseh Adaptive Logic

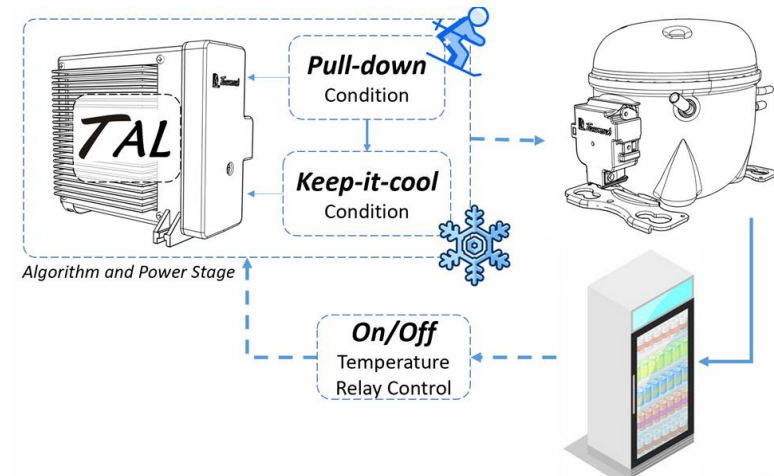
## ✓ VTC1424U Compressor

- R290, 12.47 cm<sup>3</sup> Displacement
- -40.0°C to -10.0°C (-40°F to +14°F)

## ✓ Inverter

- 030F0228 Inverter – Dual Voltage
- 85–135 / 170–260 VAC 50 & 60 Hz
- No PFC, 600W

## ✓ Embedded TAL Algorithm

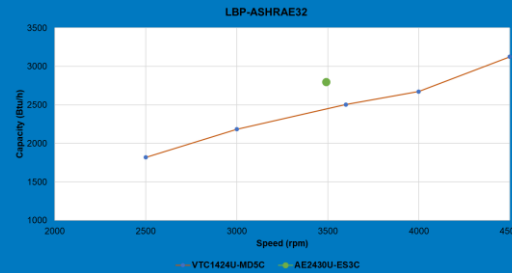




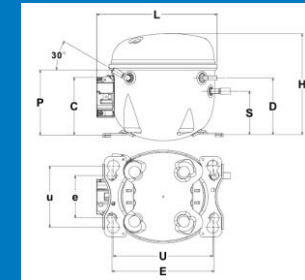
# Case Study: Results

Power - Consumption				
Cabinet	Baseline	kWh/24h	Proposed	kWh/24h
1	AE2430U On/Off	7.770	VTCX1424U / 030F0228	5.807
2	AE2430U On/Off	8.844	VTCX1424U / 030F0228	6.868
Normalized Power -Consumption (%) Reference To AE2430U On/Off				
Cabinet	Baseline	%	Proposed	%
1	AE2430U On/Off	100	VTCX1424U / 030F0228	74.74%
2	AE2430U On/Off	100	VTCX1424U / 030F0228	77.66%

## Power Consumption



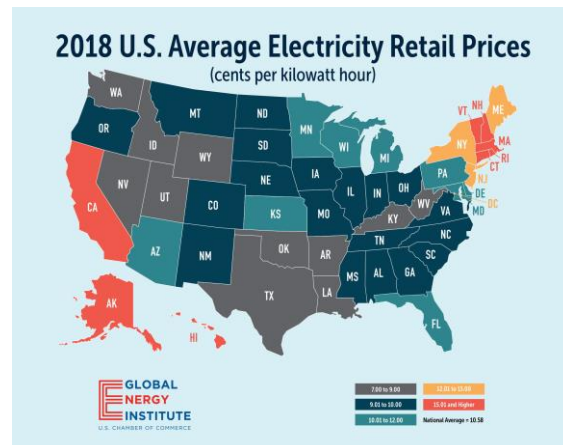
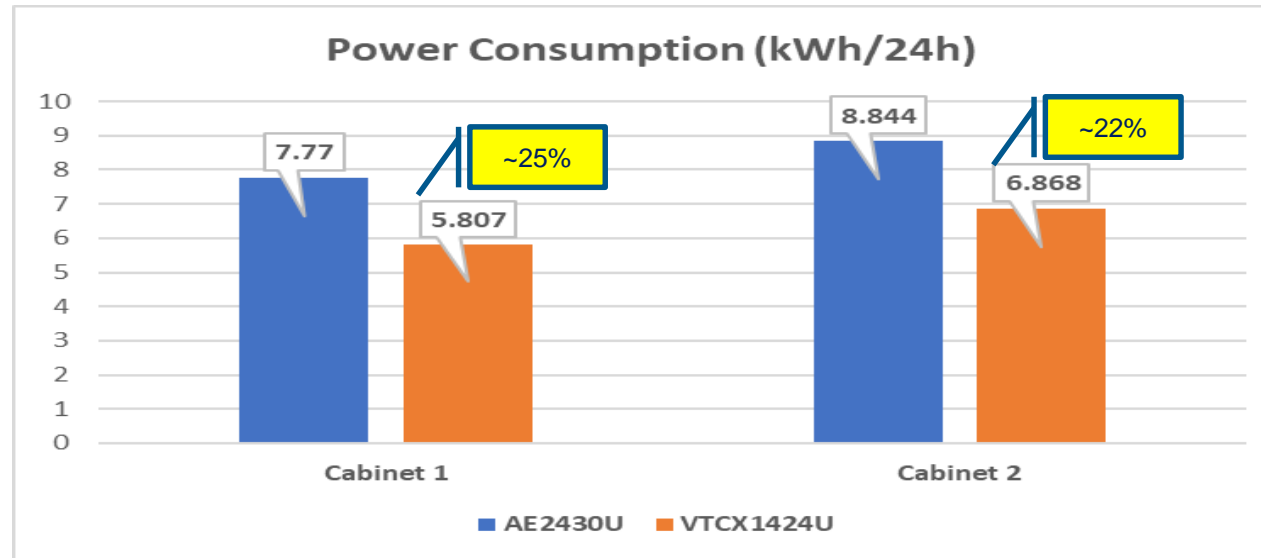
## Compressor Performance



## Compactness



# Case Study: Results – Power Consumption



## Cabinet 1:

- Savings ~ \$85.98 / year

## Cabinet 2:

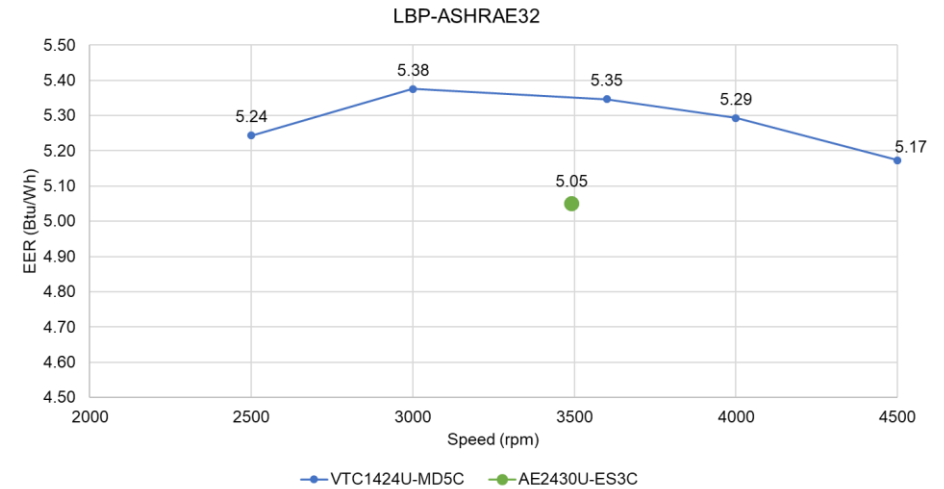
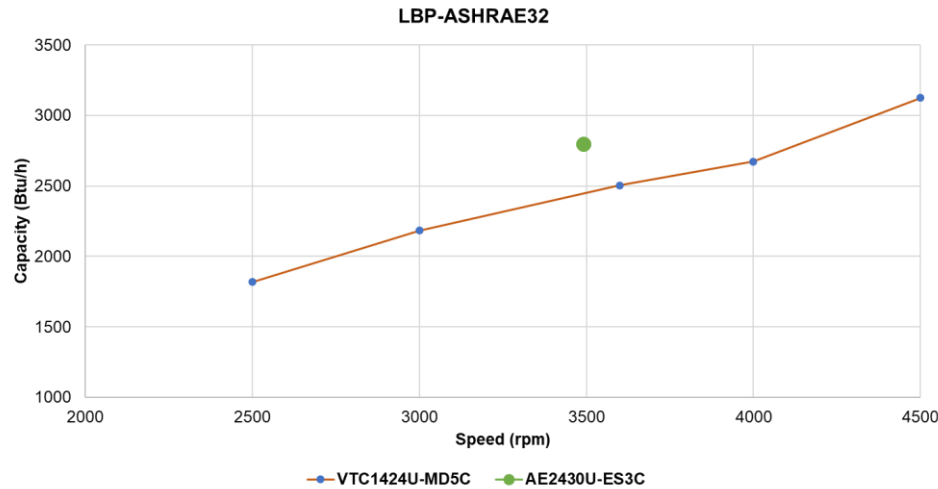
- Savings ~ \$86.54 / year

Avg = \$ .12 per kWh (USA)

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# Case Study: *Results – Compressor Performance*



VTC1424U, at full rpm, has more capacity than AE2430U. Allowing faster temperature recovery after defrost and other disturbances

VTC1424U is more efficient, 5.36 vs 5.05 EER @ 3490 rpm, than AE2430U

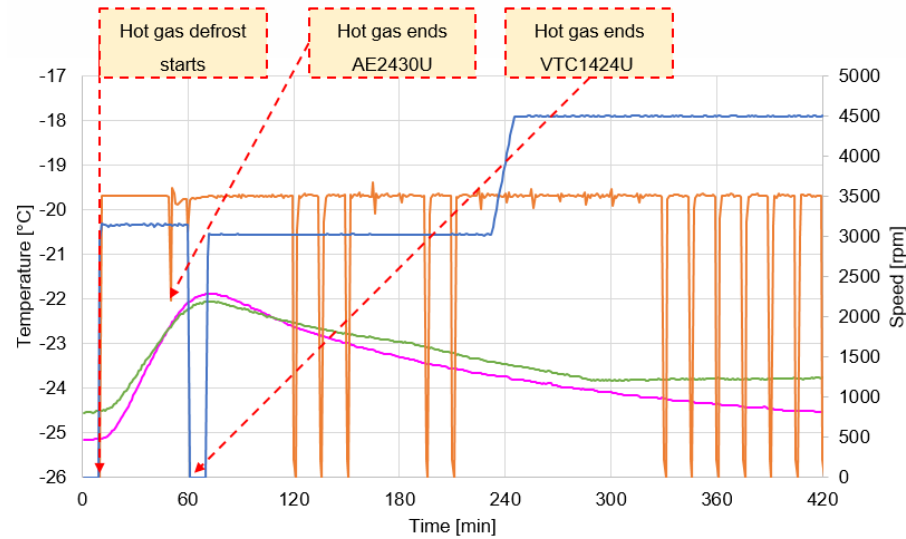
At lower rpm, EER improves



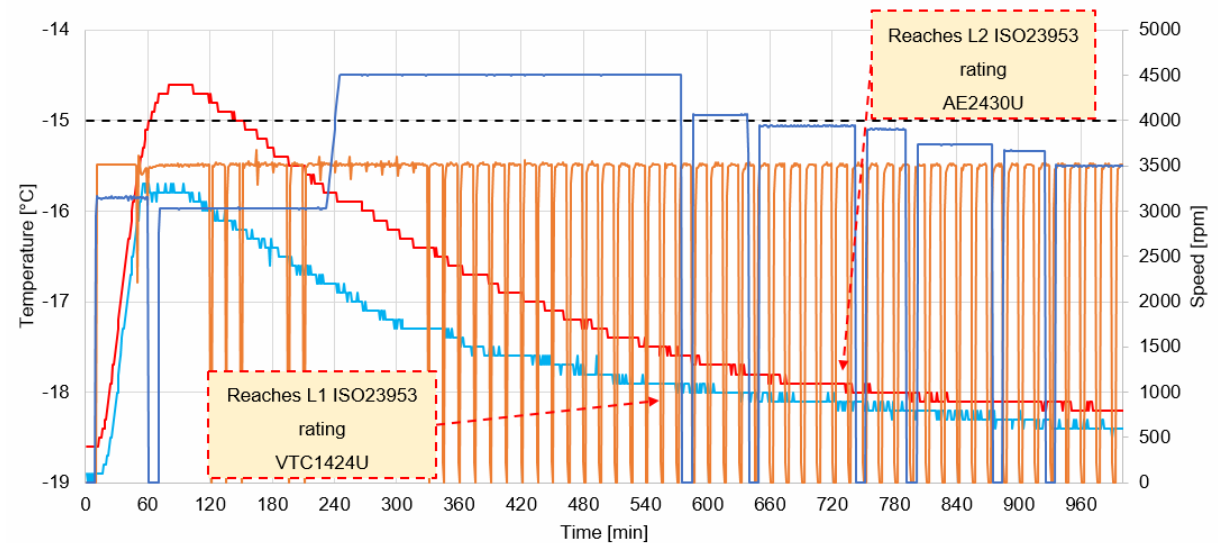
# Case Study: Results – Compressor Performance



## Cabinet #1; Amb.Temp.:25°C; Loaded-cabinet - Warmest M-Package



— AE2430U-ES3C-Avg. Temp.    — VTC1424U-MD5C-Avg. Temp.  
 — AE2430U-ES3C-Speed        — VTC1424U-MD5C-Speed



— AE2430U-ES3C-Highest Temp.    — VTC1424U-MD5C-Highest Temp.  
 — AE2430U-ES3C-Speed              — VTC1424U-MD5C-Speed

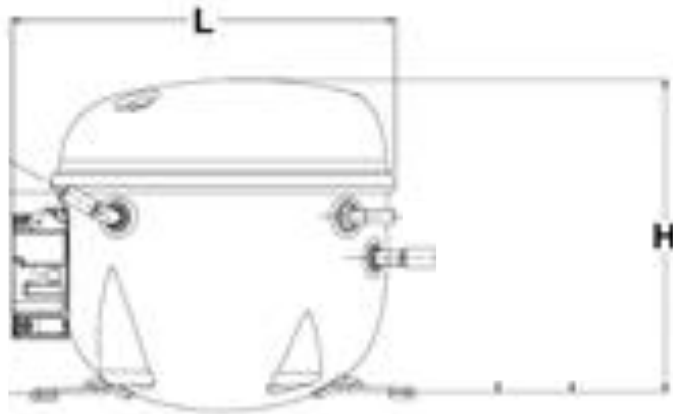
Compressor	Moment solenoid valve closes (Defrost ends) [min]	Moment the cabinet achieve product classification temperature [min]	Temperature recovery time [min]	Recovery time comparison [%]
AE2430U-ES3C	50	733 – L2	683	Ref.
VTC1424U-MD5C	64	570 – L1	506	-25.9%



## Case Study: *Results – Compactness*



*VTC1424U Shown For Reference*



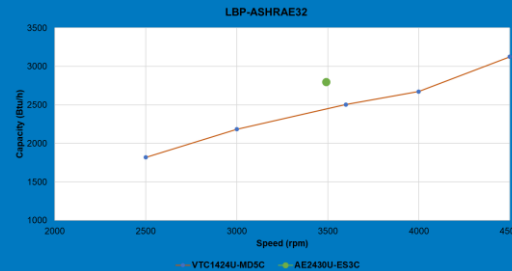
(mm)	L	H
AE2430U	251	207.1
VTC1424U	200	167.4

~20% Reduction  
In L & H Dims.

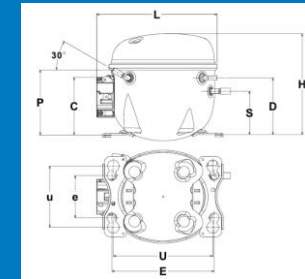
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## Power Consumption



## Compressor Performance



## Compactness





THANK YOU



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