“Smart” MAC 10 XL

AC Control Built-In

Now in Stock!!!

• “Smart-FFU” Solid State Speed Control
• Standard 2 x 4 format

MAC10 part numbers

120 V   11111-055
220V    11111-056
277V    11111-057
AirCare VariPhase™
µ-Processor Based AC Motor Controller

Offers

• Linear speed control
• Increased efficiency
• Reduced system noise
• User programmable soft-start function
• Integrated error reporting
  – eg, differential pressure switch
• Minimum motor speed setting
• Closed-loop system controls w/ PID
• Network interface – MODBUS
• ‘Plug and Play’ installation
**AirCare VariPhase™**

**Unique 3-Wire Topology for Phase Control**

**Stage 1**
- Auxiliary & Primary chopped

**Stage 2**
- Primary only
- Speed Control

**AirCare 3-wire topology:**
- reduces current rise in motor;
- reduces motor heating;
- reduces motor hum;
- reduces power consumption.

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**Envelope AC Motor/Fan In Box**

<table>
<thead>
<tr>
<th>RPM</th>
<th>Drive Current</th>
<th>Drive Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>0.50</td>
<td>50.0</td>
</tr>
<tr>
<td>350</td>
<td>1.50</td>
<td>150.0</td>
</tr>
<tr>
<td>450</td>
<td>2.50</td>
<td>250.0</td>
</tr>
<tr>
<td>550</td>
<td>3.00</td>
<td>300.0</td>
</tr>
<tr>
<td>650</td>
<td>5.00</td>
<td>500.0</td>
</tr>
<tr>
<td>750</td>
<td>7.00</td>
<td>700.0</td>
</tr>
<tr>
<td>850</td>
<td>9.00</td>
<td>900.0</td>
</tr>
<tr>
<td>950</td>
<td>11.00</td>
<td>1100.0</td>
</tr>
<tr>
<td>1050</td>
<td>13.00</td>
<td>1300.0</td>
</tr>
</tbody>
</table>

**2 Wire**
- Drive Current: 0.50 - 13.00 A
- Drive Power: 50.0 - 1300.0 Watts

**3 Wire**
- Drive Current: 0.50 - 13.00 A
- Drive Power: 50.0 - 1300.0 Watts
SOFT-START
Reduce Start-Up Currents by Half (or more)

Soft-start saves significant installation costs and enhances long-term operating reliability.

Soft-Start – “Register” select Set-Up allows factory-set delay and rise time.
AirCare 3-wire design results in quieter and more efficient operation of the fan motor.

This is a result of significantly lower 3rd and higher harmonics compared to conventional controllers which use a 2-wire connection.
AirCare VariPhase™ – Multi-Fan Platform

For External Multi-Fan or Retrofit application

AirCare VariPhase™
Powers multiple motors (loads) Without de-rating the controller drive capacity
ENVIRCO MAC10 XL
3-wire connection

3-wire connection scheme uses existing motor connections without adding cost or complexity.

Rewire Existing/Stock
MAC10 Standard in minutes!!!
AirCare VariPhase™ employs an adjustable PID algorithm to ensure stable and optimal control of fan speed based on feedback from a wide range of conventional sensors.

VariPhase™ Speed Controller
w/ PID Loop Control

Sensor feedback based on Temperature, Pressure, Humidity, Air flow, or RPM

Digital or Analog Input of Set Value

Feedback Signal

Works with any sensor that has 0-5 volt feedback signal
AirCare’s Air Flow Sensor for Closed-Loop Speed Control

The ultimate low-cost solution for advanced sensing & control in FFUs.

AirCare’s air flow sensor w/ sender connects directly to the Variphase controller via twisted pair cable.
Mac 10 IQ Smart System Part Number

System Reqs.
3 – MAC10-R for every group of 4 FFU’s
1 – MAC10-C for every group of 4 FFU’s
1 – MAC10-PC replaces MAC10-C for groups of 16 FFU

Ask about 120V and 220V smart IQ part numbers

MAC 10 – PC  FFU + Master + Bias  11074-060
MAC 10 – C  FFU + Master  11074-061
MAC 10 – R  FFU (slave)  11074-041

277V PN  11074-041

ENVIROCO CORPORATION
Innovators in clean air technology
AirCare EC Motor Controllers for the MAC 10 IQ

- **ACM1004**: Control interface module up to 4 GE-EC motors (MAC 10 IQ FFUs) on MODBUS LAN.

- **ACM1014**: Closed-loop control module for a single MAC10 IQ on MODBUS LAN.
ACM1004: GE-ECM Interface Module

- **CAT5** twisted pair RS485 cable
- MODBUS Communication Protocol

**ACM1004**
- Multiple MAC10 IQs

**MAC10 IQ**
- Drives up to 8 ACM 1004 Modules

**Power Mod**
- AC Power

**EC Solution**

Visit [www.aircareautomation.com](http://www.aircareautomation.com)
ACM1014 provides dedicated control of each FFU, providing analog or digital interface and local closed loop self-correction mode.

ACM1014 enables FFU operation as:
- Manual control of FFU using low-cost speed potentiometer
- Closed loop control of the FFU using external sensor
- Network Control and interaction using MODBUS protocol
Network Control Options

LAN Solution

• AirCare Consoles™
  • ACC1-1 global command
  • ACC1- xxx 1-zone
  • ACC2- xxx 2-4 zones

• Peripheral Options
  • ACM1007 Hi/Lo
  • ACM1007 Emerg. Shut-down
  • ACM1009 Alarm Relay
AirCare Small System Network Product Family

- Supports small network “groupings” of 1 to 500 units
- Based on industry standard MODBUS protocol
- ‘Plug and play’ design
- Easy to master user interface
- Features and functions tailored to clean room applications
- Consists of:
  - ACC1-xxx, ACC2-xxx consoles for network control
  - ACMxxxx peripheral modules for external interface
AirCare Small System-Console Family
ACC1 & ACC2

ACC1 – xxx
Single-Zone Console
10, 25, 50, 125 address
(also ACC1-1 global control)

ACC2 – xxx
1 – 4 Zone Console
125, 250, 375, 500 address
AirCare Small System Network Functions
Tailored to Clean Room Applications

- Individual Fan Speed Setting
- Global Set Back (one step back for all fans in % for each zone)
- Global Emergency Shut-down (one step shut-down of cleanroom)
- Network Monitoring & Alarm-Relay Driver (error detection and alarm trip)
  - Differential Pressure Switch (AC - normal open/closed monitoring)
  - RPM monitoring (GE-EC motor monitors rpm activity)
- Global Speed Settings (easy set-up with global commands)
- User-Level Enable via Code Access (Four (4) Access Levels of Control)
AirCare Small System Network
System Features

• Supports small networks
  • ACC1 - 1 zone global, 10, 25,50 and 125 address control
  • ACC2 - up to 4 zones with 125 addresses per zone
• MODBUS LAN fieldbus
  • Industry standard for small network architectures
  • Open-access standard: easy adaptation to custom systems
  • Gateways available to other common fieldbus systems
• True ‘Plug and Play’ Design
  • Self-initiating network set-up and device recognition
  • No install configuration required
  • No complex parameter programming
• Simple User Interface
• Easy wall-mount / robust-housing
ACC1-1 Console provides lowest cost solution for simple global control of AirCare networked fan controllers.

- Set global speed for small cleanroom FFU’s from wall console
- Simple 1- knob control
- Manual/remote set-back capability
AirCare Small System Network
Peripheral Modules:
Building Management Interface

- ACM1007: Remote **High-Low** Interface
  - manual activation or interface to Building Management System
- ACM1007: Remote **Emergency Shut-Down** Interface
  - (manual activation, BMS interface)
- ACM1009: Alarm Relay Driver Interface (set off alarm)
  - (manual, BMS interface)
- AirCare System Information Protocol Option
  - (BMS interface)
Cost Savings Analysis

- **Cost Adders:**
  - Console cost adder
  - ACV1xxx VariPhase Units (1, 2 or 4 FFU per VariPhase)
  - Installation Cost Adder

- **Savings Expectations:**
  - Installation Cost
    - Reduced number of power grids/breakers
  - Balancing Cost – reset/adjust Cleanroom
    - Speed adjustment and room certification
  - Run-energy savings
    - 3-wire reduced power consumption at lower speeds
  - Set-Back Energy Savings
    - Fan set-back saves energy in each fan and extends filter life.

“Smart” Small Cleanroom Systems pay for themselves rapidly and enhance performance
Initial Calculation - 5-6 FFU units
- loading per AC line if you use plate rating
  [ assumes MAC10 XL – 115V AC, 3.0 ampere rating]
  [ AC line – 20 Ampere breaker max. current draw]

PROBLEMS
1) Max. run current at 85% speed = 3.5 Ampere (above plate rating)
   lose 1 unit – need to design to worst case current
2) Start up current > 5 ampere per fan
   lose 1 more unit!! – using 20A rating at start-up; still support only 5

Real Loading – 3-4 FFU units

AirCare VariPhase Benefit – 5-6 fans
Soft-Start keeps peak current below 3.2 amperes.
3-wire operation keeps Max. current to plate rating

AirCare VariPhase™ allows more fans per AC breaker line;
Saving significant installation and electrician fees
### TRIAC Control Energy Savings Payback

For a 50 controller w/o setback mode (one speed 24/7)

<table>
<thead>
<tr>
<th></th>
<th>2 Wire Energy Saved</th>
<th>3 Wire Energy Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work saved watts=</td>
<td>25W</td>
<td>50W</td>
</tr>
<tr>
<td>Work hrs/wk=</td>
<td>168 hrs</td>
<td>168 hrs</td>
</tr>
<tr>
<td>Reduced kWh/wk=</td>
<td>10.0kWh</td>
<td>14.2kWh</td>
</tr>
<tr>
<td>Reduced kWh/yr=</td>
<td>520.0kWh</td>
<td>738.4kWh</td>
</tr>
<tr>
<td>$ Saved/FFU/yr=</td>
<td>$32.76</td>
<td>$65.52</td>
</tr>
<tr>
<td>Utility $/yr saved=</td>
<td>$1,638.00</td>
<td>$3,276.00</td>
</tr>
</tbody>
</table>

#### Work Hours Data

<table>
<thead>
<tr>
<th>High speed:</th>
<th>2wire</th>
<th>3wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>% speed=</td>
<td>82%</td>
<td>82%</td>
</tr>
<tr>
<td>% power=</td>
<td>90%</td>
<td>80%</td>
</tr>
<tr>
<td>watts=</td>
<td>225</td>
<td>200</td>
</tr>
</tbody>
</table>

#### Reference Data

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>cost/kWh=</td>
</tr>
<tr>
<td>full power=</td>
</tr>
</tbody>
</table>

$1,638.00 $3,276.00
# Energy Savings Payback w/Setback

For 50 controller w/console system - 9hr/day, 5day/wk operation

## 2 Wire Energy Saved

<table>
<thead>
<tr>
<th>Saved</th>
<th></th>
<th>3 Wire Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work saved watts=</td>
<td>25W</td>
<td>50W</td>
</tr>
<tr>
<td>Work hrs/wk=</td>
<td>45 hrs</td>
<td>45 hrs</td>
</tr>
<tr>
<td>Non work saved watts=</td>
<td>72.5W</td>
<td>97.5W</td>
</tr>
<tr>
<td>Reduced kWh/wk=</td>
<td>123 hrs</td>
<td>123 hrs</td>
</tr>
<tr>
<td>Reduced kWh/wk=</td>
<td>10.0kWh</td>
<td>14.2kWh</td>
</tr>
<tr>
<td>Reduced kWh/yr=</td>
<td>520.0kWh</td>
<td>738.4kWh</td>
</tr>
<tr>
<td>$ Saved/FFU/yr=</td>
<td>$78.00</td>
<td>$110.76</td>
</tr>
<tr>
<td>Utility $/yr saved=</td>
<td>$3,900.00</td>
<td>$5,538.00</td>
</tr>
</tbody>
</table>

## Work Hours Data

<table>
<thead>
<tr>
<th>High speed: 2wire</th>
<th>Low speed 2wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>% speed= 82%</td>
<td>% speed= 64%</td>
</tr>
<tr>
<td>% power= 90%</td>
<td>% power= 71%</td>
</tr>
<tr>
<td>watts= 225</td>
<td>watts= 177.5</td>
</tr>
</tbody>
</table>

## Non Work Hours Data

<table>
<thead>
<tr>
<th>High speed: 3wire</th>
<th>Low speed 3wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>% speed= 82%</td>
<td>% speed= 64%</td>
</tr>
<tr>
<td>% power= 80%</td>
<td>% power= 61%</td>
</tr>
<tr>
<td>watts= 200</td>
<td>watts= 152.5</td>
</tr>
</tbody>
</table>

## Reference Data

- cost/kWh= $0.15
- full power= 250W

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*ENERVICO CORPORATION
Innovators in clean air technology*
## MAC 10 IQ Energy ROI

### Energy Cost Comparison

<table>
<thead>
<tr>
<th>UNIT</th>
<th>COST</th>
<th>POWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>XL 2x4</td>
<td>$600.00</td>
<td>220</td>
</tr>
<tr>
<td>IQ 2x4</td>
<td>$850.00</td>
<td>100</td>
</tr>
</tbody>
</table>

### Step 1
Enter the customer cost of each unit.

### Step 2
Enter the power consumption of each unit.

### Step 3
Enter the number of units in the job (for unit cost just enter a 1).

### Step 4
Cell C8 gives the additional capital cost for the unit(s).

### Step 5
Determine the customer's cost of energy and enter the label at that cost. Compare the energy savings in each column to determine the estimated payback period. If the additional cost is greater than all three columns then the payback exceeds 18 months.

### Table

<table>
<thead>
<tr>
<th>ELEC COST ($/kwh)</th>
<th>6 MONTHS</th>
<th>12 MONTHS</th>
<th>18 MONTHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.02</td>
<td>525.6</td>
<td>1051.2</td>
<td>1576.8</td>
</tr>
<tr>
<td>$0.03</td>
<td>515.51</td>
<td>1031.02</td>
<td>1550.14</td>
</tr>
<tr>
<td>$0.04</td>
<td>505.43</td>
<td>1010.54</td>
<td>1524.65</td>
</tr>
<tr>
<td>$0.05</td>
<td>495.35</td>
<td>991.06</td>
<td>1499.17</td>
</tr>
<tr>
<td>$0.06</td>
<td>485.28</td>
<td>971.58</td>
<td>1473.69</td>
</tr>
<tr>
<td>$0.07</td>
<td>475.21</td>
<td>952.10</td>
<td>1448.21</td>
</tr>
<tr>
<td>$0.08</td>
<td>465.14</td>
<td>932.62</td>
<td>1422.73</td>
</tr>
<tr>
<td>$0.09</td>
<td>455.07</td>
<td>913.14</td>
<td>1397.25</td>
</tr>
<tr>
<td>$0.10</td>
<td>445.00</td>
<td>893.66</td>
<td>1371.77</td>
</tr>
<tr>
<td>$0.11</td>
<td>434.93</td>
<td>874.18</td>
<td>1346.29</td>
</tr>
<tr>
<td>$0.12</td>
<td>424.86</td>
<td>854.70</td>
<td>1320.81</td>
</tr>
<tr>
<td>$0.13</td>
<td>414.79</td>
<td>835.22</td>
<td>1295.33</td>
</tr>
<tr>
<td>$0.14</td>
<td>404.72</td>
<td>815.74</td>
<td>1269.85</td>
</tr>
<tr>
<td>$0.15</td>
<td>394.65</td>
<td>796.26</td>
<td>1244.37</td>
</tr>
</tbody>
</table>

### Additional Information

- **Energy Savings**
- **Op Hrs**
- **KWh Saved**
- **EC Solution**

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**ENVIRICO Corporation**

Innovators in clean air technology
"Smart" Cleanroom Benefits

- **Low Cost Network System**
  - Out-of-the-Box system solution control FFU from wall console
  - Re-configure/adjust FFU’s to meet room certification in minutes
- **Energy Savings**
  - Lower power usage at lower speed
  - Optimize fan speeds so do not waste energy by overdriving cleanroom
  - Set back FFU’s during off hours [one command set-back option]
    - Saves energy
    - Extends filter life (lowers filter replacement cost)
- **Improved Performance during speed reduction**
  - Linear speed adjustments – easy change
  - Eliminates current increase during speed reduction
  - Reduces “hum” of motor significantly during reduction
- **Reduced 3rd Harmonic for same airflow**
- **Reduced installation/ run cost**
  - Electrical wiring installation reduced with soft-start and 3-wire
  - Balancing and certification adjustments done quickly
  - Motor and filter life extended
  - Optimized air flow control uses only
    the power needed (energy conservation).