CLEANPAK®
a Nortek Air Solutions Brand

FAN FILTER UNIT
CLEANPAK MODEL CPFFU-DC-EB

INSTALLATION & OPERATION MANUAL

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READ THESE INSTRUCTIONS PRIOR TO USE
KEEP FOR FUTURE REFERENCE

Observe the following to reduce the risk of fire, shock or injury:
In accordance with all applicable standards and codes, only qualified personnel shall perform this work. Check for hidden utilities, particularly electrical lines, with building owner and other contractors prior to cutting or drilling into walls, floors or ceilings. Use this unit only in the manner that the manufacturer intended it to be used. Switch power off at electrical service panel and lock out/tag out electrical panel prior to servicing or working on unit.
Unit contains rotating parts. Unit should not be serviced at installation site even if electrical power is turned off. Fan may continue to rotate without electrical power due to back pressure within the building system.
WARNING - ELECTRICAL SHOCK HAZARD. CAN CAUSE INJURY OR DEATH. DISCONNECT ALL REMOTE ELECTRIC POWER SUPPLIES BEFORE SERVICING.
Ensure that fan has completely stopped running before conducting internal inspection. Unit contains rotating parts. Fan may continue to rotate without electrical power due to back pressure. Do not put fingers into the unit or touch fan wheel during operation to avoid serious injury.
Power wiring must be connected by qualified personnel. USE COPPER SUPPLY WIRES. EXTERNAL WIRING SHALL COMPLY WITH THE REQUIREMENTS FOR A CLASS 1 CIRCUIT. Avoid electrical shocks to power cable and cable connector. Ensure power cable and cable connectors are not damaged. Ensure that wiring is properly connected. Do not attempt to reconstruct this unit. Contact factory for information and service. Do not obstruct air intake or stand on the pre-filter rack or fan intake.

Service
Replace parts only with factory approved parts of like duty.

Warranty
Manufacturer warrants products to be free of defects in material and workmanship if properly installed, cared for and operated under normal conditions with competent supervision.
The warranty period is one year from date of start-up or 18 months from date of shipment, whichever occurs first.
All material or equipment found to be defective within this period shall be replaced or repaired to like-new condition, including all parts (excluding final filters) and labor at no cost. Manufacturer assumes no liability for expenses or repairs made by unauthorized personnel. This warranty shall be considered void if equipment failure is the result of mishandling, abuse, operation beyond capacities, or from other external sources. All components including miscellaneous ship-loose items must be stored in a dry, climate-controlled indoor area. Manufacturer assumes no liability for damage to equipment caused by outside storage. Equipment must be stored in dry, indoor storage. Refer to purchase agreement for further warranty terms.

Components

Fan housings in boxes and/or palettes.
Final filters (ULPA or HEPA) from original filter manufacturer in separate boxes (optional). Follow filter manufacturer's instructions for handling.
Final filter frames (for bottom loaded filter option) on separate palettes.
Optional ACC1 console.

Handling

Prior to any assembly or installation work, perform a physical count of all items on the master ship list. Report any shortages to the factory immediately.
Handle all parts with care to prevent damage during installation.
Parts are cleaned and wrapped to factory standards at the factory.
FROM RECEIPT THROUGH COMPLETE INSTALLATION, THE INSTALLER IS RESPONSIBLE FOR HANDLING ALL PRODUCTS ON THE JOB SITE.
After receiving the parts from the shipper, do not store them outside. Do not store them in high-traffic or unprotected areas.
All parts should be stored in a controlled environment, especially when delivered to job sites with variable (hot or cold) or humid climates. The optimal storage temperature is 70° F (21° C).
It is the responsibility of the installer to protect the parts from damage at all times. Manufacturer does not take responsibility for damage to packaging that may result in damage to the parts.
All parts should be unpackaged in a manner consistent with site/project specific protocol requirements.
Avoid double handling of parts.
Unpack all parts in protocol-approved area prior to moving parts into staging area to be installed.
Wipe down parts as required by protocol taking care not to scratch painted surfaces.
WHEN UNPACKAGING FILTER MEDIA, TAKE CARE IN REMOVING THE PLASTIC BAG SO THAT THE MEDIA IS NOT SCRATCHED IN ANY WAY. DO NOT PUT ANY TYPE OF FORCE, EVEN BY HAND, ON FILTER MEDIA INCLUDING FACE SCREEN DURING HANDLING AND INSTALLATION SINCE IT WILL DAMAGE THE FILTER.
JERKING THE FFU WHEN IN A SIDEWAYS ORIENTATION OR DROPPING IT CAN DAMAGE INTERNAL COMPONENTS.

Installation

Bottom-load final filter frames

If the bottom load final filter frames are provided as an option, install these frames into the grid system with the appropriate gel or gasket seal pre-applied to the grid members. Place FFU atop filter frame. Prior to installing the final filter, check that the clip is at a height just below the bottom of the final filter when fully seated. With the clips against the side of the frame, install final filter into the frame and then rotate out the clips in the frame to hold the final filters. Turn the bolt so as to raise the clip to hold the final filter in place. Note that the bolt is to be turned counter-clockwise to raise the clip when looking up from the bottom. The bolt to raise the clip should not be

over-tightened—it should be turned just enough for the filter to seat completely against the bottom surface of the top ledge of the frame. Use a miniature ratcheting box-end wrench to turn the bolt—this is available by contacting the factory or at automotive stores.
Place FFU atop cartridge.

Scope

Supply and hookup of all power wiring, communication cabling, gateways, PLC, and screen setups, if applicable, are not in CLEANPAK's scope.

Power wiring

Wire the 277VAC single-phase power into the junction box on top of each FFU. Check the label for the correct voltage of the specific unit. This should be performed by a qualified electrician with all appropriate safety measures. The input power wiring into the junction box can be as follows (or follow specific site wiring requirements):

black=hot
white=neutral
green=ground.

DIP switches on each FFU

Where applicable, set the dip switches on each FFU per the attached address sheet—note that the dip switches are in binary notation.

Control of each FFU

There are three options for speed adjustment depending on the system selected:

- Local adjustment knob (no networking): Adjust speed with potentiometer knob.
- Networked: If communicating on a network via Modbus RTU, snap in Category 5 plenum rated patch cables with RJ-45 ends into the FFU controller. It does not matter which RJ-45 jack on the controller you go into and out of. These whips follow a daisy-chain pattern with one whip going into one RJ-45 and the other whip coming out of the other RJ-45 in each controller. Refer to the layout specific drawing for the job. Control can be via an ACC console or the building management system.
    - ACC console: Refer to ACC Console section in the back of this manual.
    - Building Management System: For this option, all hardware, gateways and software are supplied and installed by others. Refer to the ACM1015 networking advanced manual in the back of this manual.

FFU on top-load filter

For the FFU on top-load filter option, place filter onto grid with the appropriate gel or gasket seal pre-applied to the grid members. Place FFU atop filter. If latches are provided on the side of the FFU, clip those on to the side of the filter extrusion.

FFU on bottom-load filter

A. De-energize the electric circuit to the install area.
B. Follow the original filter manufacturer's handling instructions at all times. Do not rack or twist the filter frame or put pressure (even hand pressure) on the filter media at any time. It is recommended that two people handle each filter install and that lifts/jigs be used where appropriate to facilitate a safe install.
C. Set DIP switches in the FFU and prepare the power flexible connection.
D. For bottom load grid, prepare the upper area inside of the grid. Rotate the clip tabs away to be next to the grid member so that the filter can be pushed up as shown in Figure 1. The nut on the clip may need to be loosened a bit to rotate the clip tab. Also remove the triangular plates and two screws as indicated in Figure 3. The plates and screws will be used for reinstall later.
E. Place the filter assembly on top of the FFU hoist. Make sure the filter is seated correctly upon the hoist. There should be minimal movement when attempting the slide the filter while on the hoist. The outer catches should be engaged and preventing the filter components from falling off of the lift. It is important to make sure no part of the filter media is in contact with the hoist.
F. Inspect the gel in the filter channel to see that it is not damaged.
G. Once the filter is settled on the hoist, install the FFU on top of the filter. The FFU should slide inside of the outer edge of the filter unit and rest on a gasketed ledge. Make sure the FFU is seated uniformly around the filter unit and is level. The completed assembly is shown in Figure 2.
H. Coil the long electrical cable on top of the FFU unit so it is not in the way during the install.
I. Roll the FFU hoist into position underneath the ceiling install location.
J. Take care when raising or lowering the lift to make sure the FFU does not fall or catch on anything because the fan unit is not permanently attached to the filter they could separate.
K. Raise the lift to an elevation where the electrical connection can be made. Make the electrical connection to the incoming power source from an adjacent opening, or if it needs to be made from the same opening, do this with a flexible connection prior to fully raising up the assembly into the opening. Make sure the electrical is plugged into the correct port on the junction box. Also make the data connection from the adjacent opening
L. Tuck the excess chord away into the ceiling or on top of the FFU so it will be out of the way when the unit is installed the rest of the way into the ceiling.
M. Carefully raise the assembly flat and level into the grid opening until the gel in the filter trough engages the knife-edge in the bottom load grid. Be careful when seating the filter within the grid opening so as not to put excessive force on the ceiling.
N. If the top of the bottom load grid is to have walkable filters or walkable blank pans or if bottom-load FFUs are installed, it is required that special plates be installed in the corners and the

Figure 1. Non-walkable bottom load filter clip shown rotated out of the way for filter installation. Rotate out perpendicular to grid and tighten nut.

Figure 2. FFU shown on top of lifting hoist.

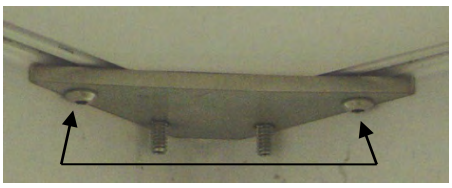

Figure 3. FFU on bottom load filter or walkable bottom load filter clip at corners of grid opening. Torque the screws.

nuts torqued as shown in Figure 3. Slip the corner triangular plate over the set screws. Place the split lock washer under the head of the button head screw. Tighten plate evenly. Torque the button head screws to 24 in.-lbs. Note: The set screws pictured are for alignment purposes. No nuts are required on the set screws.

O. Rotate the 4 clip tabs shown in Figure 1 out perpendicular to the grid member to support the filter and tighten the nuts as required.
P. Once the FFU is installed release the pressure in the lift and slowly lower the lift until the lift is returned to its starting position.
Q. Reverse the above instructions for removal of filters.

Misalignment of cone

If you hear a ticking noise it may be the wheel rubbing against the cone due to misalignment during handling or installation. Flip the switch off and lockout at the disconnect switch and at all appropriate points based on the site safety requirements. Remove the inlet finger guard. Be extremely cautious as the wheel may be back-spinning due to air pressure from other fans even with power off. If the wheel is back-spinning place plastic on the lower portion of the FFU to stop airflow—this should stop the wheel from back-spinning. Loosen the screws on the inlet cone and readjust the cone ensuring that there is uniform gap all round between wheel and cone. Tighten the cone screws. Replace the inlet guard.

Major Internal Electrical Components

Switch
Power supply
Motor
Transformer
Modbus RTU communication board

Operation

Turn switch on top of FFU on.
There are three options for speed adjustment depending on the system selected:

- Local adjustment knob (no networking): Adjust speed with potentiometer knob.
- ACC console: Adjust at ACC console.
- Building Management System: Adjust from BMS.

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OPTIONAL SMALL SYSTEM CONSOLE ACC 1 TO 125 UNITS

Overview

The Small System Console is a simple and economical controller box for controlling and monitoring a network of ACM1015 speed controls up to 125 units.

The Console will have two modes of operation. In general the unit will be scanning the attached units and monitoring their unit function. Upon entering a
special code into the unit the supervisor (or installer) can enter the selection mode and change speeds, turn-on feedback function and initiate and set the speed set-back function. The performance of the units, therefore, can only be adjusted by someone authorized to enter the ADJUST Mode.

The user will be able to choose the desired unit and then the particular operation desired (increase speed, decrease speed etc.). The system also provides key features including a global setting for all units (for set-up), manual
speed set-back mode and pressure switch status feedback (for differential pressure switch feedback connected to each unit).

Monitor and ADJUST Mode (Access Level A4)

- Setback setting to hi-low(Access Level A3)
- Set speed of each unit (Access Level A2)
- Setback speed (global) setting (Access Level A2)
- Differential pressure switch monitoring (Access Level A1)
- Global command for entire zone(Access Level A1)

Up to 125 Units / control

- Easy to Read Display
- Simple Knob Control
- Individual Control/Adjust
- Global command Controls
- Manual Set-back capability
- Differential Pressure switch alarm optional
- 4:1 Speed Range
- Speed Resolution 1%
- Each Unit Addressed
- Differential Pressure switch feedback
- Analog feedback to Console
- Inherent Hi-Reliability
- MODBUS Communication Protocol

Easy to set-up. Easy to use.
The Console communicates through Standard RJ45 connector to the units. The Console connects to the first unit which is then daisy-chain connected to the other units. Upon start-up the Console scans the units on the network and then monitors the units on the line. By watching the Console scroll through the units on-line it is easy to identify if a unit is not connected properly.

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BUILT-IN MODBUS COMMUNICATION ACM1015

Overview
The ACM1015 provides Modbus network and analog control capabilities to a BLDC motor. ACM1015 is fully compatible with the plug and go Modbus system. Simply add a Control Console for a complete control and monitoring solution.

Specifications

- Control Interface for BLDC motor
- Network or Analog Control
- Simple connections
- 4 pin MTA for motor control signals
- RJ45 for networking
- 7 pin terminal for analog inputs
- LED diagnostics
- Board Status
- Network Traffic
- Industry standard Modbus Networking
- RTU protocol
- RS485 9600,8,n,1
- Flexible analog control options
- 0-5V source potentiometer
- Sensor with 0-5V output
- Internal closed loop control
- Open frame PCB with standoffs
- 0-50º C operating temperature
- 3.9” x 2.16” x 0.95”

Installation

ACM1015 gets its low voltage power from the Modbus network (using the network power supply ACM1005, ACM1008 or similar) or from a local 12-24V DC supply or AC transformer.

Two RJ45 jacks provide the In/Out connections for the network cables. The ACM1015 is daisy chained using CAT5 patch cables.

Pin Number	Signal Name	Function	Motor Wire Color
1	+10V	+10V output from motor	Red
2	Tach	Feedback signal from Motor	White
3	0V/Gnd	Common Ground	Blue
4	SPD	PWM speed signal to motor	Yellow

BUILT-IN MODBUS COMMUNICATION ACM1015 REGISTERS

- MODBUS RTU protocol
- Selectable Physical medium: RS485 (2-wire)
- Selectable baud rate 9600, 8, n, 1
- Network wiring method: Dual RJ-45 sockets (2 wire)
- Up to 127 unique addresses selectable by DIP switch settings
- Slew rate limited for improved performance

Table 1 **Register Descriptions**

Register	Upper Byte	Lower Byte	Type	Description
1		Bit 0: Start/Stop	R/W	Enter Decimal 0-stop 1-start
2		Motor Speed (0-100%)	R/W	Enter 0-100% motor speed
3	P Value		R/W	PID – Proportional Variable
4	1 Value		R/W	PID- Integral Variable
5	D Value		R/W	PID- Derivative Variable
6	Motor Speed (RPM)		R	RPM Feedback-Fans with Tach Input
7	Analog Input (0-1023)		R	
8	Minimum Speed Pot (0-1023)		R	
9	Status Flags		R	
10		Default Speed (0-100%)	R/W	Default Power up Speed
11	Version Major	Version Minor	R	
12		Triac Phase Angle (0-100)	R	
13	Max Speed (750-3600rpm)		R/W	Max Speed for Motor
14		Bit 0: Default Start/Stop	R/W	Set 0-stop 1-start for Power Up
15				
16				
17		Number of Good Packets	R/W	
18		Number of Bad Packets	R/W	
19	Reset Counter		R/W	
20	Speed	Update Time	R/W	
21				
22				
23		Configuration Control	R/W	0-Mode0, 1-Mode1, 2-Mode2, 3-Mode3, 4-Mode4, 5-Mode5

Table 4 RJ45 Network Cable Connections

1	2	3	4	5	6	7	8
Bus Power Pass Through	0V(GND)		RS485			0V(GND)	Bus Power Pass Through
		+			-		

Unit	Switch # on AirCare board reading from left to right							
	1	2	3	4	5	6	7	8
1	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
3	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
4	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
5	ON	OFF	ON	OFF	OFF	OFF	OFF	OFF
6	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF
7	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
8	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF
9	ON	OFF	OFF	ON	OFF	OFF	OFF	OFF
10	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF
11	ON	ON	OFF	ON	OFF	OFF	OFF	OFF
12	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF
13	ON	OFF	ON	ON	OFF	OFF	OFF	OFF
14	OFF	ON	ON	ON	OFF	OFF	OFF	OFF
15	ON	ON	ON	ON	OFF	OFF	OFF	OFF
16	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF
17	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
18	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF
19	ON	ON	OFF	OFF	ON	OFF	OFF	OFF
20	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF
21	ON	OFF	ON	OFF	ON	OFF	OFF	OFF
22	OFF	ON	ON	OFF	ON	OFF	OFF	OFF
23	ON	ON	ON	OFF	ON	OFF	OFF	OFF
24	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF
25	ON	OFF	OFF	ON	ON	OFF	OFF	OFF
26	OFF	ON	OFF	ON	ON	OFF	OFF	OFF
27	ON	ON	OFF	ON	ON	OFF	OFF	OFF
28	OFF	OFF	ON	ON	ON	OFF	OFF	OFF
29	ON	OFF	ON	ON	ON	OFF	OFF	OFF
30	OFF	ON	ON	ON	ON	OFF	OFF	OFF
31	ON	ON	ON	ON	ON	OFF	OFF	OFF
32	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF
33	ON	OFF	OFF	OFF	OFF	ON	OFF	OFF
34	OFF	ON	OFF	OFF	OFF	ON	OFF	OFF
35	ON	ON	OFF	OFF	OFF	ON	OFF	OFF
36	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF
37	ON	OFF	ON	OFF	OFF	ON	OFF	OFF
38	OFF	ON	ON	OFF	OFF	ON	OFF	OFF
39	ON	ON	ON	OFF	OFF	ON	OFF	OFF
40	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF
41	ON	OFF	OFF	ON	OFF	ON	OFF	OFF
42	OFF	ON	OFF	ON	OFF	ON	OFF	OFF
43	ON	ON	OFF	ON	OFF	ON	OFF	OFF
44	OFF	OFF	ON	ON	OFF	ON	OFF	OFF
45	ON	OFF	ON	ON	OFF	ON	OFF	OFF
46	OFF	ON	ON	ON	OFF	ON	OFF	OFF
47	ON	ON	ON	ON	OFF	ON	OFF	OFF
48	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF
49	ON	OFF	OFF	OFF	ON	ON	OFF	OFF
50	OFF	ON	OFF	OFF	ON	ON	OFF	OFF
51	ON	ON	OFF	OFF	ON	ON	OFF	OFF
52	OFF	OFF	ON	OFF	ON	ON	OFF	OFF
53	ON	OFF	ON	OFF	ON	ON	OFF	OFF
54	OFF	ON	ON	OFF	ON	ON	OFF	OFF
55	ON	ON	ON	OFF	ON	ON	OFF	OFF
56	OFF	OFF	OFF	ON	ON	ON	OFF	OFF
57	ON	OFF	OFF	ON	ON	ON	OFF	OFF
58	OFF	ON	OFF	ON	ON	ON	OFF	OFF
59	ON	ON	OFF	ON	ON	ON	OFF	OFF
60	OFF	OFF	ON	ON	ON	ON	OFF	OFF
61	ON	OFF	ON	ON	ON	ON	OFF	OFF
62	OFF	ON	ON	ON	ON	ON	OFF	OFF

Unit	Switch # on AirCare board reading from left to right							
	1	2	3	4	5	6	7	8
63	ON	ON	ON	ON	ON	ON	OFF	OFF
64	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF
65	ON	OFF	OFF	OFF	OFF	OFF	ON	OFF
66	OFF	ON	OFF	OFF	OFF	OFF	ON	OFF
67	ON	ON	OFF	OFF	OFF	OFF	ON	OFF
68	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF
69	ON	OFF	ON	OFF	OFF	OFF	ON	OFF
70	OFF	ON	ON	OFF	OFF	OFF	ON	OFF
71	ON	ON	ON	OFF	OFF	OFF	ON	OFF
72	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF
73	ON	OFF	OFF	ON	OFF	OFF	ON	OFF
74	OFF	ON	OFF	ON	OFF	OFF	ON	OFF
75	ON	ON	OFF	ON	OFF	OFF	ON	OFF
76	OFF	OFF	ON	ON	OFF	OFF	ON	OFF
77	ON	OFF	ON	ON	OFF	OFF	ON	OFF
78	OFF	ON	ON	ON	OFF	OFF	ON	OFF
79	ON	ON	ON	ON	OFF	OFF	ON	OFF
80	OFF	OFF	OFF	OFF	ON	OFF	ON	OFF
81	ON	OFF	OFF	OFF	ON	OFF	ON	OFF
82	OFF	ON	OFF	OFF	ON	OFF	ON	OFF
83	ON	ON	OFF	OFF	ON	OFF	ON	OFF
84	OFF	OFF	ON	OFF	ON	OFF	ON	OFF
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86	OFF	ON	ON	OFF	ON	OFF	ON	OFF
87	ON	ON	ON	OFF	ON	OFF	ON	OFF
88	OFF	OFF	OFF	ON	ON	OFF	ON	OFF
89	ON	OFF	OFF	ON	ON	OFF	ON	OFF
90	OFF	ON	OFF	ON	ON	OFF	ON	OFF
91	ON	ON	OFF	ON	ON	OFF	ON	OFF
92	OFF	OFF	ON	ON	ON	OFF	ON	OFF
93	ON	OFF	ON	ON	ON	OFF	ON	OFF
94	OFF	ON	ON	ON	ON	OFF	ON	OFF
95	ON	ON	ON	ON	ON	OFF	ON	OFF
96	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF
97	ON	OFF	OFF	OFF	OFF	ON	ON	OFF
98	OFF	ON	OFF	OFF	OFF	ON	ON	OFF
99	ON	ON	OFF	OFF	OFF	ON	ON	OFF
100	OFF	OFF	ON	OFF	OFF	ON	ON	OFF
101	ON	OFF	ON	OFF	OFF	ON	ON	OFF
102	OFF	ON	ON	OFF	OFF	ON	ON	OFF
103	ON	ON	ON	OFF	OFF	ON	ON	OFF
104	OFF	OFF	OFF	ON	OFF	ON	ON	OFF
105	ON	OFF	OFF	ON	OFF	ON	ON	OFF
106	OFF	ON	OFF	ON	OFF	ON	ON	OFF
107	ON	ON	OFF	ON	OFF	ON	ON	OFF
108	OFF	OFF	ON	ON	OFF	ON	ON	OFF
109	ON	OFF	ON	ON	OFF	ON	ON	OFF
110	OFF	ON	ON	ON	OFF	ON	ON	OFF
111	ON	ON	ON	ON	OFF	ON	ON	OFF
112	OFF	OFF	OFF	OFF	ON	ON	ON	OFF
113	ON	OFF	OFF	OFF	ON	ON	ON	OFF
114	OFF	ON	OFF	OFF	ON	ON	ON	OFF
115	ON	ON	OFF	OFF	ON	ON	ON	OFF
116	OFF	OFF	ON	OFF	ON	ON	ON	OFF
117	ON	OFF	ON	OFF	ON	ON	ON	OFF
118	OFF	ON	ON	OFF	ON	ON	ON	OFF
119	ON	ON	ON	OFF	ON	ON	ON	OFF
120	OFF	OFF	OFF	ON	ON	ON	ON	OFF
121	ON	OFF	OFF	ON	ON	ON	ON	OFF
122	OFF	ON	OFF	ON	ON	ON	ON	OFF
123	ON	ON	OFF	ON	ON	ON	ON	OFF

NOTE: MAX 123 UNITS PER DASH

FILE NAME: 29-00-51.DWG

REV.	DATE	BY	DESCRIPTION
0	MM/YY	DB	XXXXXXXXXXXXX

TOLERANCES UNLESS OTHERWISE SPECIFIED

FRACTIONS : ±1/32
0.0 : ±0.1
0.00 : ±0.03
0.000 : ±0.010
0.0000 : GIVEN
ANGLES : ±0.5°

DRAWN BY: DB

ISSUED ON: 04/08

CHECKED BY:

SCALE:

CLEANPAK INTERNATIONAL™
11241 S. E. HIGHWAY 212
CLACKAMAS OR 97015
Phone (503) 557-4500
Fax (503) 557-4501

TITLE: FFU ACM 1015/1014
ADDRESS DIP SWITCH SETTINGS

SIZE: A

DRAWING NO.: 29-00-51

JOB NO.:

SHEET OF

OPTIONAL ACC CONSOLE MANUAL

AirCare ACC1 Console

Technical Manual

ACC1-10
ACC1-25
ACC1-50
ACC1-125

www.aircareautomation.com

Revision 3.0 28 Nov 07

Product Overview

Product Family Members

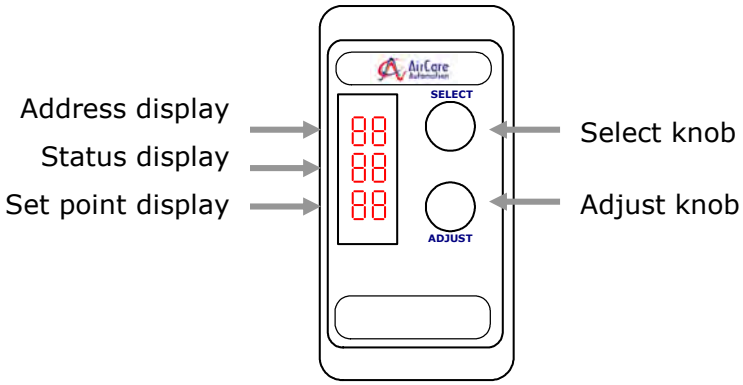
ACC1-10 – Supports up to 10 control modules (address 1-10)
ACC1-25 - Supports up to 25 control modules (address 1-25)
ACC1-50 - Supports up to 50 control modules (address 1-50)
ACC1-125 - Supports up to 125 control modules (address 1-125)

All ACC1 consoles also support the following modules:
ACM1007 standby switch at address 251,
ACM1007 emergency stop switch at address 252
ACM1009 error relay output at address 253

Main Functions

- Controller module status monitoring
- Standby (set-back / hi-lo) function
- Monitoring of fault contacts or pressure switches
- Individual set point / speed adjustment
- Global set point / speed adjustment

Console Description



Addresses 1 - 99 are displayed as '01' – '99'
Address 100 is displayed as alternating '1-' and '00'
Address 101, etc. is displayed by alternating '1-' an '01', etc.

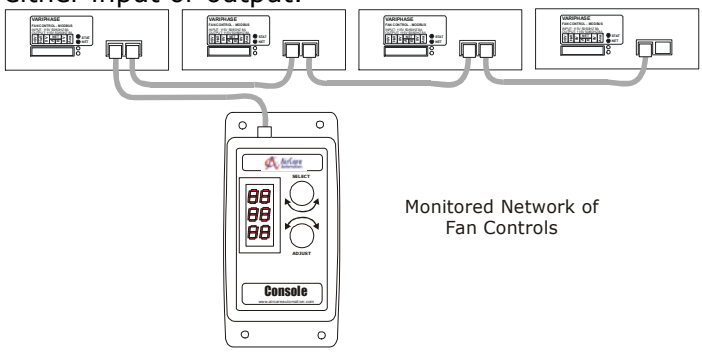
Set point display is percent ('00' – '99', 'on'=100%).

Specifications

Supply Voltage: 8-13Vdc
DC Power Connector: 2.1mm DC power jack
Typical Supply Current: 90mA
(optional) Battery power: 4 x AA size
Typical battery life: 30 hours with alkaline batteries
Network communication protocol: Modbus RTU
Physical communication standard: RS485(2-wire) serial,
Modbus cable required: CAT5 patch cable with RJ45 connector
Serial communication transceivers: 2-wire 1/8" unit load
Operating Temperature: 0-40 degC
Maximum Modbus cable length between modules: 20 meters (65 feet)

Installation

A network is constructed by daisy-chaining controller modules and network I/O modules with the console. Both Modbus RJ45 jacks on the modules can be used for either input or output.



Monitored Network of Fan Controls

All modules must be pre-set with a unique address within the range of the ACC1 console.

DC power to the console can be supplied via:

1. Power supply module connected to the DC power jack,
2. Battery pack (4 of AA batteries), or
3. Modbus network cable via ACM1008 module connected to the network

When power to the ACC1 is turned on, the console will automatically scan and identify all modules connected to the network.

If fault contacts or pressure switches are used, these will be monitored on all control modules.

The control modules will continue to function normally if a connection to the network or console is lost.

If power is turned off & on to any module or console in the network, its functionality and settings will be immediately restored to the same state before power loss.

Power-on sequence

At power-on, the console displays (for 1 second)
firmware version major,
firmware version minor, and
model number.

Then the console scans the network to identify all modules connected, also ACM1007 and ACM1009 modules. If no controller modules are detected, the console beeps and repeats the scan sequence until at least one module is found.

When finished, the console will display (for 1 second):
Top display
The maximum number of control modules possible,
Middle display
'rS' if an ACM1007 is found at address 251 (standby switch input),
'ES' if an ACM1007 is found at address 252 (emergency stop input),
'rL' if an ACM1009 is found at address 253 (error output relay driver),
Bottom display
The total number of control modules found.

After 1 second, the console goes into monitor mode and is ready for operation.

Monitor Mode

The console will go to monitor mode after the select and adjust knobs are not moved for 30 seconds.

In monitor mode, the console continuously polls all modules on the network. The following information is displayed:

<u>Address display</u>
- Modbus address of each module

<u>Status display</u>
- 'LO' if network is in standby (setback) mode.
- ' ' if no pressure switch or RPM feedback is enabled
- 'PG' for pressure switch good
- 'PF' for pressure switch fault
- 'rG' for RPM good (RPM >0)
- 'rF' for RPM fault (RPM = 0)

<u>Set point display</u>
- Set point is percent % of full motor speed, or
- If sensor feedback is used, percent % of full scale value, or
- If RPM feedback is used, percent % fo full motor speed.

Up to 2 minutes is needed to react to the ACM1007 and/or update the ACM1009 in a network with a large number of control modules.

User Mode

The user mode is activated by:
- Any movement of the select or adjust knobs during monitor mode; or
- Exit from the options mode.

In user mode, the user can:
1) select a control module with the select knob,
2) adjust the set point of a control module with the adjust knob, and
3) go to the options mode with the select knob.

If 'LO' is shown in the status display (the network is in standby mode), the set points can not be adjusted.

The fault delay is automatically set to zero while in the user mode. During monitor mode, the fault delay is restored to its pre-set value (in options mode).

Options Mode

The options mode allows adjustments to operational parameters of the console.

Entering the options mode

Rotate the select knob counter-clockwise (left) until 'OP' and the current user access level is displayed.

Press the select knob to activate the options mode.

Selecting options

Rotate the select knob after entering the options mode.

<u>Standby (setback) Enable</u>

- 'HI' : All control modules are set to normal operating values.
- 'LO' : The set points of all control modules are reduced by the value in the 'LS' (standby percentage) option setting.

The ACM1007's switch input will override this option setting.

<u>Access Level Enable</u>

- Rotate and press the adjust knob to enter the first two-number code.
- Rotate and press the adjust knob to enter the second two-number code.

Standby (setback / low) Percentage

- When standby is enabled, the set-point on all control modules are reduced by the % set in this option.
- Rotate and press the adjust knob to enter the standby percentage value.

Fault Monitoring

- 'NC' : Normally closed fault contacts.
- 'NO' : Normally open fault contacts.
- 'rP' : Checks for RPM >0.
- '--' : No fault monitoring.
- Rotate and press the adjust knob to set the fault monitoring option.

Global Set Point Change

- Use the adjust knob to select and store the global set point value.

All set points will be updated with the new global setting when exiting the options mode.

Soft-Start

- Rotate and press the adjust knob to write a new soft start setting to all VariPhase control modules.
- A value of '10' causes VariPhase modules to accelerate to full speed in about 50 seconds.
- A value of '00' disables the soft-start feature.

Fault Delay Control

- Rotate and press the adjust knob to set the time delay for fault detection.
- The set value is entered in 10 second units (eg, '05' = 50 seconds).

Exiting the options mode

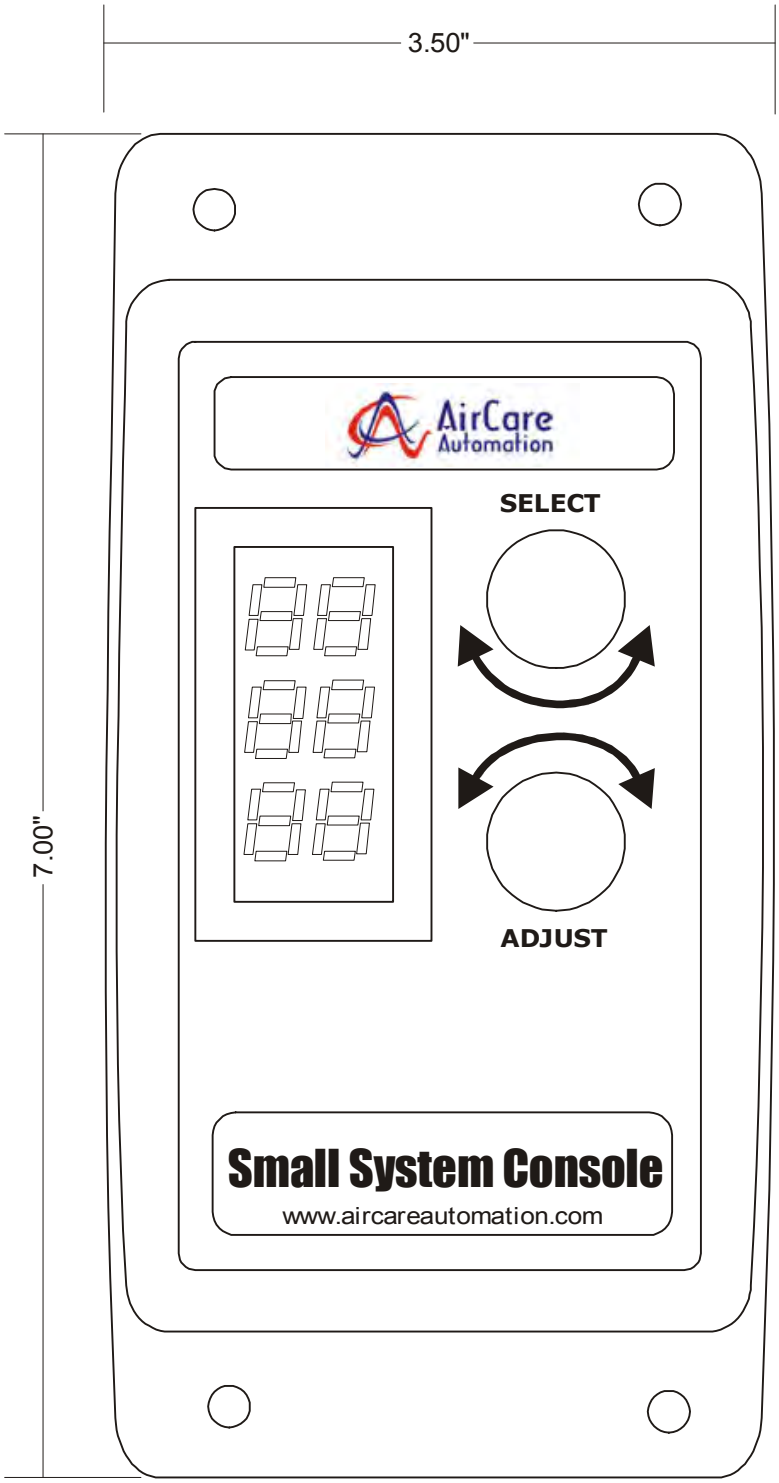
The options mode is exited at any time by:

- pressing the select knob, or
- no movement of any knob for 30 seconds.

Access Level Enable Codes

Access Level	**Pass-code**	**Access permitted:**
A1	12 88	all settings
A2	25 75	set points and standby settings
A3	49 51	standby on/off (Hi/Lo)
A4	50 50	view set points only

ACC1 Dimensions



OPTIONAL ACM1015 NETWORKING ADVANCED MANUAL

REGISTERS:

The fan speed feedback is the best way of monitoring fan status. It is off an actual tachometer output from the motor that is from the inherent sensor built into the motor. Actual feedback from the tachometer sensor in the motor is located in Register 6. Register 6 is the best way of monitoring fan status.

Register 1 is used for stopping (0) and starting (1) the unit while power is on.

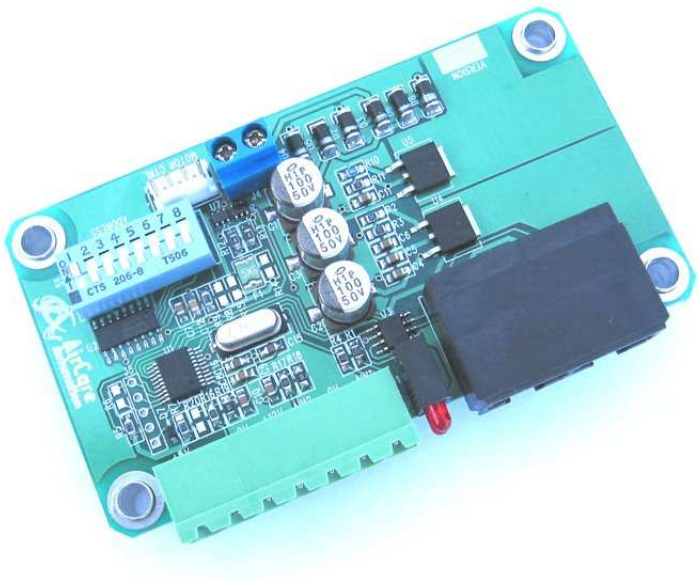
Register 14 is used to determine default run status, stop (0) or start (1) upon power up. To change the speed of the motor while the system is powered the operator should use Register 2.

Once the room is balanced, the individual FFU speed settings (0-100%) should be entered into Register 10. This is the default speed setting, which the card sends to the motor upon power up.

AirCare ACM1015

Advanced Technical Manual

ACM1015 MODBUS® Equipped
Interface for EBM Brushless DC Motors



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Contents

About the Advanced Technical Manual

This document contains detailed functional and configuration information for AirCare's ACM1015 Interface Module. It provides complete information on all aspects of ACM1015 operation. Application notes provide additional information on control interfacing options.

Product Overview

The ACM1015 provides MODBUS network and analog control capabilities to any compatible EBM BLDC motor. ACM1015 is fully compatible with AirCare's plug-and-go MODBUS system. Simply add an AirCare Control Console for a complete control and monitoring solution.

Features

- Control Interface for EBM BLDC motor
- Network or Analog Control
- Simple connections
    - o 4 Pin MTA for motor control signals
    - o RJ45 for networking
    - o 7 Pin terminal for analog inputs
- LED diagnostics
    - o Board Status
    - o Network Traffic
- Industry standard MODBUS Networking
    - o RTU Protocol
    - o RS485 9600,8,n,1
- Flexible analog control options
    - o 0-5V source
    - o Potentiometer
    - o Sensor with 0-5V output
    - o Internal closed-loop control
- PWM Speed Command Signal
    - o 10V, 100Hz
- Field-adjustable Number of Pulses Per Revolution
    - o Programmed by Modbus register write.
    - o Programmed value stored in non-volatile memory.
    - o Values of 1, 2 and 3 accepted.
- TACH Motor Speed Input
    - o 10V @ 1mA needed switched to ground.
    - o Maximum 5000 RPM measured
    - o Minimum 60 RPM measured
- Powered from isolated AC or DC supply
    - o 10 – 24V AC, 20mA
    - o 12 – 30V DC, 20mA
- OEM module
    - o Open-frame PCB with standoffs
    - o 0-50°C operating temperature

Part Numbers and Ratings

Control for EBM BLDC motor: ACM1015 B1012 Rev A

General Operation

Modbus Host (Master)

An AirCare networked system requires a compatible Modbus host. In most cases this will be an AirCare Automation Console, but other Modbus devices can be used if configured correctly. Refer to the Network Specification section of this document for more information.

Modbus Register Assignments

Modbus register assignments are detailed in Table 4.

Modes

ACM1015 operates in one of six selectable modes:

Mode 0	Network speed control, open loop (default)
Mode 1	Network speed control, closed-loop using analog feedback
Mode 2	Network speed control, closed-loop using motor tach feedback
Mode 3	Analog speed control, open loop
Mode 4	Analog speed control, closed-loop using analog feedback
Mode 5	Analog speed control, closed-loop using motor tach feedback

"Note as of April, 2008: Please note that the AirCare closed loop control function has not yet been ported to the EBM platform. This port is planned for June, 2008. If you wish to operate the ACM1015 in closed-loop mode, please check with AirCare Automation to ensure that closed-loop-compatible firmware has been implemented."

The Mode is selected using Modbus Register 23. Each mode is explained in detail later in this document.

PRELIMINARY: All Closed Loop control modes use a fully programmable PID loop to allow response and stability adjustments.

Address DIP Switches

Each ACM1015 device in a network must be set to a unique address. The address value is set in binary using the eight DIP switches of switch bank S1. The selected addresses should be within the range supported by the AirCare console. Valid addresses for the ACM1015 are 1 through 200. Do not set ACM1015 to address 0. Address 0 is reserved for the Control Console (MODBUS master). Do not set the ACM1015 to addresses greater than 200, as addresses greater than 200 are reserved.

Address switch settings are checked by the ACM1015 only at power-up. Power must be cycled (OFF/ON) before any address changes take effect.

Even if an analog control mode has been selected, an ACM1015 will still respond to all Modbus communications.

Mode 0: Network speed control, open loop

In Mode 0, the motor speed is set using Modbus Register 2. Speed is specified as a value from 0 to 100 representing a percentage of motor speed. ACM1015 uses the speed set-point to generate a 0 to 100% PWM control signal to the motor.

Mode 0 is the factory default mode.

The relationship between the percentage set-point value and actual motor speed is dependent on the motor and the motor's operating profile. It is approximately linear in most applications. ACM1015 will measure the actual speed of the motor using the tach signal but will not make any adjustments based on the actual motor RPM.

The "Minimum Speed Limit Setting" register, Register 8, and the "Closed Loop Speed Limit" register, Register 13, have no effect in this mode.

Registers relevant to this mode:

- Register 1 "Run/Stop" (R/W)
  – To enable motor, write a value of 1; To disable motor, write a value of 0
- Register 2 "Motor Set Speed" (R/W)
  – Motor speed value. Values may be written from 0 to 100
- Register 12 "Current Motor Speed Instruction" (R)
  – Power signal applied to the motor by the ACM1015. Identical to Register 1

(R/W) = Read/Write
(R) = Read Only

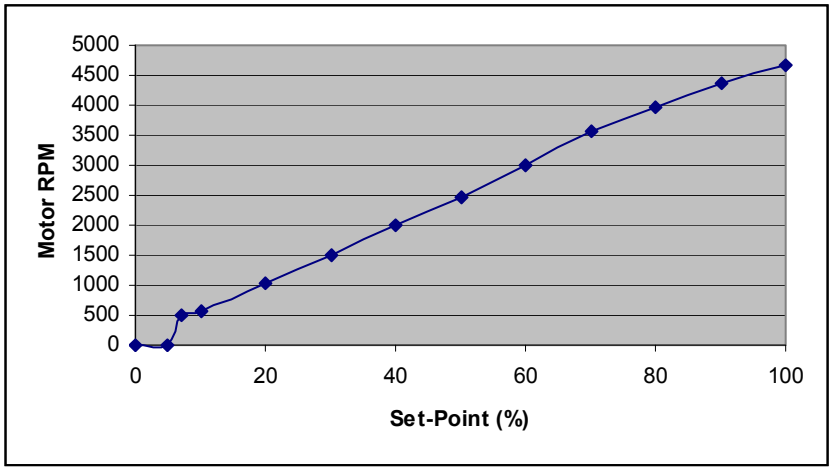

Figure 1

Mode 1: Network speed control, closed-loop using analog feedback

Mode 1 is typically used to hold a networked controlled pressure or temperature set-point. The analog sensor should provide a 0 to 5Vdc signal to the ANA2 control terminal.

In Mode 1, Modbus register 2 sets the closed-loop system set-point from 0 to 100%. Once Mode 1 is enabled, ACM1015 measures the voltage on the ANA2 analog input and scales it to a 0 to 100% value. This is compared to the percentage set-point and fed into the internal PID controller. The PID controller then calculates and sets the actual motor speed using the P, I and D coefficients.

Registers relevant to this mode:

- Register 1 – To enable motor, set to 1 (Write)
- Register 2 – Motor speed value (Write)
- Register 3 – 'P' coefficient. Sets closed-loop gain (Write)
- Register 4 – 'I' coefficient. Sets closed-loop integrator (Write)
- Register 5 – 'D' coefficient. Sets closed-loop differentiator (Write)
- Register 12 – Actual motor speed value / output of PID controller (Read)
- Register 20 – Sets the time between PID updates in 0.1 second increments (Write)
- Register 24 – Analog Input ANA2 level from 0 to 1000 (Read)

Mode 2: Network speed control, closed-loop using tach feedback

Mode 1 is typically used to hold a networked controlled motor speed over a variation in motor load. Electronically commutated motors do this internally, but Mode 2 may be employed to cancel any non-linearities in the PWM control signal. The stability of the control loop may be affected by the motors internal control loop.

In Mode 2, Modbus register 2 sets the closed-loop system set-point from 0 to 100%. This is scaled internally to an RPM set-point from 0 to Motor Max Speed (Register 13). Once Mode 1 is enabled, ACM1015 measures the motor's tach output signal. This is compared to the RPM set-point and fed into the internal PID controller. The PID controller then calculates and sets the actual motor speed using the P, I and D coefficients.

Registers relevant to this mode:

- Register 1 – To enable motor, set to 1 (Write)
- Register 2 – Motor speed value (Write)
- Register 3 – 'P' coefficient. Sets closed-loop gain (Write)
- Register 4 – 'I' coefficient. Sets closed-loop integrator (Write)
- Register 5 – 'D' coefficient. Sets closed-loop differentiator (Write)
- Register 12 – Actual motor speed value / output of PID controller (Read)
- Register 13 – Motor Max Speed. This is used to scale the set-point (Write)
- Register 20 – Sets the time between PID updates in 0.1 second increments (Write)

"Note as of April, 2008: Please note that the AirCare closed loop control function has not yet been ported to the EBM platform. This port is planned for June, 2008. If you wish to operate the ACM1015 in closed-loop mode, please check with AirCare Automation to ensure that closed-loop-compatible firmware has been implemented."

Mode 3: Analog speed control, open loop

In Mode 3, the motor speed is set using a voltage from 0 to 5V into Analog input ANA1. This is measured and scaled to a value from 0 to 100%. ACM1015 uses the speed set-point to generate a 0 to 100% PWM control signal to the motor.

The relationship between the percentage setpoint value and actual motor speed is dependent on the motor and the motor's operating profile. It is approximately linear in most applications. ACM1015 will measure the actual speed of the motor using the tach signal but will not make any adjustments based on the actual motor RPM.

The Minimum Speed Adjustment Register (Register 8) limits the lowest speed that can be set using ANA1. This is also expressed as a percentage value.

Registers relevant to this mode:

- Register 7 "Analog 1 Input" (R)
  – Analog Input ANA1 level, values from 0 to 1000
- Register 8 "Minimum Speed Limit Setting" (R/W)
  – Minimum speed applied to the motor: 0 to 100%
- Register 12 "Current Motor Speed Instruction" (R)
  – Power signal applied to the motor by the ACM1015. Identical to Register 1

(R/W) = Read/Write
(R) = Read Only

Mode 4: Analog speed control, closed-loop using analog feedback

Mode 1 is typically used to hold an analog controlled pressure or temperature set-point. The analog sensor should provide a 0 to 5Vdc signal to the ANA2 control terminal.

The reference set-point is controlled by the analog level on ANA1. Once Mode 4 is enabled, ACM1015 measures the voltages on both analog control inputs and scales them to a 0.100% value. The error is fed into the internal PID controller. The PID controller then calculates and sets the actual motor speed using the P, I and D coefficients.

Registers relevant to this mode:

- Register 3 – 'P' coefficient. Sets closed-loop gain (Write)
- Register 4 – 'I' coefficient. Sets closed-loop integrator (Write)
- Register 5 – 'D' coefficient. Sets closed-loop differentiator (Write)
- Register7 – Analog Input ANA1 level from 0 to 1000 (Read)
- Register 12 – Actual motor speed value / output of PID controller (Read)
- Register 20 – Sets the time between PID updates in 0.1 second increments (Write)
- Register 24 – Analog Input ANA2 level from 0..1000 (Read)

Mode 5: Analog speed control, closed-loop using tach feedback

Mode 5 is typically used to hold an analog controlled motor speed over a variation in motor load. Electronically commutated motors do this internally, but Mode 2 may be employed to cancel the non-linearities in the PWM control signal. The stability of the control loop may be affected by the motors internal control loop.

The reference set-point is controlled by the analog level on ANA1. Once Mode 4 is enabled, ACM1015 measures the voltages on the ANA2 analog control input and scales it to a PRM value using the Motor Max Speed register. This is compared to the RPM set-point and fed into the internal PID controller. The PID controller then calculates and sets the actual motor speed using the P, I and D coefficients.

Registers relevant to this mode:

- Register 3 – 'P' coefficient. Sets closed-loop gain (Write)
- Register 4 – 'I' coefficient. Sets closed-loop integrator (Write)
- Register 5 – 'D' coefficient. Sets closed-loop differentiator (Write)
- Register7 – Analog Input ANA1 level from 0 to 1000 (Read)
- Register 12 – Actual motor speed value / output of PID controller (Read)
- Register 13 – Motor Max Speed. This is used to scale the set-point (Write)
- Register 20 – Sets the time between PID updates in 0.1 second increments (Write)

LED Indicators

Status LED

The STAT LED is software-controlled by the ACM1015 micro. The STAT LED flashes continuously at 1Hz indicating the software is running. In addition, any time the control responds to a Modbus message, ACM1015 inverts the state of the STAT as each byte is sent, causing it to flicker briefly.

If the incoming Modbus packet is corrupted, the STAT led will not flicker. Note that Modbus commands sent to Address 0 (Global) will not cause the STAT to flicker because no response is allowed according to MODBUS protocol.

Net LED

The NET LED is driven directly by the RECEIVE data signal. The NET LED shows all network traffic on a 2-wire network. The NET LED is intended to confirm low-level network connectivity, independent of micro or firmware functionality. If A/B network wires are swapped, the NET LED will be normally on, providing quick diagnostics of this common condition.

NET LED Status Meaning	
LED off	**- Power lost** **- No communications**
LED flickering	**Network data traffic in progress**
LED on	**A/B network wires swapped**

Electrical Wiring and Specifications

Control Input Connector Port J3

7 position 0.2" Pluggable Terminal Block

1	2	3	4	5	6	7
+5V Out	Tach Signal (Note 1)	0V (GND)	+12V Out	Analog Input #2	0V (GND)	Analog Input #1

Table 1

Notes

1) Pin 2 of Port J3 is internally connected to the Tach signal from motor (J1 Pin 2). J3 Pin 2 can be used in two ways:
    a. As an input, receiving a TACH signal from an external source, such as a photo-tachometer.
    b. As an output of the TACH signal from the motor, such as monitoring by an oscilloscope.
2) Mating Part for Control Connector : Phoenix 5.08mm Terminal Block Plug #1757064 or or order directly from AirCare p/n ACS2203.

Motor Control Connections

Control Port J1

ACM to ECM Cable Control Wiring

Pin Number	Signal Name	Function	EBM Wire Color
1	n/c	n/c	Red*
2	Tach	Tachometer signal from motor	White
3	OV/GND	Common Ground	Blue
4	SPEED	PWM speed signal to motor	Yellow

Table 2

***The red wire from the motor can be terminated to Pin 1, but serves no function and makes no internal connection.**

Mating connector for ACM1015 Control Port J1: AMP MTA 640442-4

Mating connector for ACM1015 EBM Motor: Motor comes with flying leads – no additional connector is necessary.

Power Wiring

ACM1015 needs its own source of low-voltage AC or DC power. The motor being controlled has its own separate AC power connection.

Local Power

ACM1015 has a terminal block to allow connection of a local power source. This can be low-voltage AC directly from a small transformer, or DC from a DC power supply. In either case, the supply should be floating (not connected to ground) as applied to the ACM1015. ACM1015 power becomes referenced to ground through the MODBUS RS485 network.

	Nominal Voltage	**Supply Range** (Absolute Limits)	**Current Requirements**
AC Supply	12-24Vac	10-28Vac	20mA
DC Supply	24Vdc	14-30Vdc	20mA

Table 3

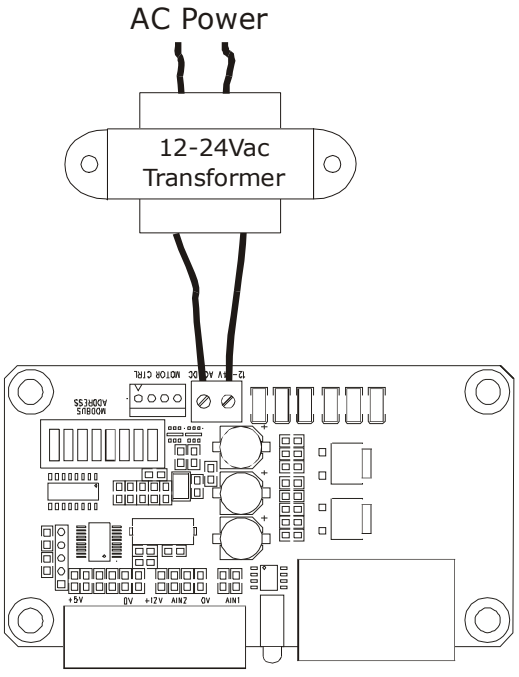

Figure 2: Low Voltage Power Connection

Communications Specification

Register Descriptions

Register	Upper Byte	Lower Byte	Valid Entry	Type	Commands
1		Run/Stop	0 = Stop 1 = Run	R/W	03, 06, 08
2	Motor Set Speed (0-100%)		0-100	R/W	03, 06, 08
3	P Value		0-100	R/W	03, 06, 08
4	I Value		0-100	R/W	03, 06, 08
5	D Value		0-100	R/W	03, 06, 08
6	Feedback RPM		N/A	R	03
7	Analog 1 Input (Increments of 5mV)		N/A	R	03
8	Minimum Speed Limit Setting (0-100% of max speed)		0-100	R/W	03, 06, 08
9		Status Flags	See Pg 12	R	03
10		Speed on Power-Up (0-100%)	0-100	R/W	03, 06, 08
11	Version Major	Version Minor	N/A	R	03
12	Current Motor Speed Instruction (0-100% Duty Cycle) See Pg 12 for description		N/A	R	03
13	Closed Loop Speed Limit (750-3600rpm)		750-3600	R/W	03, 06, 08
14		Run/Stop on Power-Up	0 = Stop 1 = Run	R/W	03, 06, 08
15					
16					
17		Number of Good Packets	0 = Reset	R/W	03, 06, 08
18		Number of Bad Packets	0 = Reset	R/W	03, 06, 08
19	Power Reset Counter		0 = Reset	R/W	03, 06, 08
20	Speed Update Time "Time (sec) until speed is changed from old register value to new register value"		1-20	R/W	03, 06, 08
21					
22					
23		Mode Selection (See pgs. 4-7) and Enable Communication Watchdog	See pg 13	R/W	03, 06, 08
24	Analog 2 Input (Increments of 5mV)		N/A	R	03
26		Comm Watchdog Number of Reset Events	0 = Reset	R/W	03, 06, 08
27		Number of Pulses per Revolution	1, 2, 3	R/W	03, 06, 08
100		Product ID	N/A	R	03

Table 4

Key

Assigned Byte
Unused

NOTE: Commands are MODBUS commands the ACM1015 can use for each of the registers below

- 03: Read holding registers
- 06: Write single registers
- 08: Reset Slave

Default Reset

To reset non-volatile registers to factory default values, write 65535 (FFFF hex) to Register 14, and then cycle power.

STATUS FLAGS - Register 9 – Low Byte

Bit Position	Name	Description	Type
0	AdcCh	Signals which Analog Input is presently being sampled.	R
1	Run	Set when motor is running	R
2			R
3			
4	Tick	Toggles every 0.1 seconds to indicate system time	R
5			
6			
7	Analog Low	Set if Analog input is below 50%	R

Table 5

Register 12 Current Motor Speed Instruction (0-100% Duty Cycle)

Used for closed loop applications in which Register 2 is the desired set speed and register 12 is the actual motor speed duty cycle as the closed loop control function regulates applied motor power to maintain your desired set point.

Register 27 Number of Pulses per Revolution

Used to determine how many pulses coming back from the motor equal 1 revolution. Please refer to the motor manufacturer's specification for what this value should be. With EBM EC motors this value can be either 1, 2, or 3.

MODE SELECTION AND WATCHDOG ENABLE - Register 23

Communication Watchdog

ACM1015's communication watchdog feature acts as a safe guard against system crashes.

If a Modbus packet with a valid CRC is not received at least every 30 seconds, the watchdog activates and causes a complete microcontroller reset. Should a watchdog event occur, a non-volatile counter is incremented. This counter can be read in Register 26. Writing to Register 26 clears the counter. This feature can be enabled by writing a value to Register 23 with the Bit 4 set.

MODE	Name	Valid Entry with Watchdog Off	With WD ON
0	Network Speed Control, Open Loop (Default)	0	16
1	Network Speed Control, closed-loop using analog feedback	1	17
2	Network speed control, closed-loop using tach feedback	2	18
3	Analog Control, Open Loop	3	19
4	Analog speed control, closed-loop using analog feedback	4	20
5	Analog speed control, closed-loop using tach feedback	5	21
6	Not Implemented	6	22
7	Not Implemented	7	23
8	Not Implemented	8	24
9	Not Implemented	9	25
10	Not Implemented	10	26
11	Not Implemented	11	27
12	Not Implemented	12	28
13	Not Implemented	13	29
14	Not Implemented	14	30
15	Not Implemented	15	31

Table 6

Transmission Specifications

- MODBUS® RTU protocol over RS485
- 9600, 8, n, 1
- Slew rate limited transceivers for improved network performance

RJ45 Network Cable Connections

1	2	3	4	5	6	7	8
Bus Power Pass Through	0V (GND)	**RS485**				0V (GND)	Bus Power Pass Through
		+	nc	nc	-		

Table 7

Mechanical Dimensions