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Industrial Automation




# Affinity

## Dedicated HVAC/R Drive for Building Automation

1.1kW to 132kW (1.5hp to 200hp)
200V / 400V / 575V / 690V

IP20 (NEMA 1) and IP54 (NEMA 12)

CONTROL TECHNIQUES
www.controltechniques.com

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# Affinity – A dedicated HVAC/R drive

Affinity is Control Techniques' dedicated HVAC/R drive, designed specifically to meet the needs of consultants, contractors and owners of commercial buildings. A comprehensive product line incorporates special drive functionality and accessories to simply and efficiently solve your HVAC/R applications.

## Drive for a sustainable future

Affinity addresses the challenges for both today and the coming years. It is created with more than 30 years of drives experience and based on new research that considered the current and future issues and trends in the HVAC/R industry. Affinity incorporates the features you need to be at the forefront of building technology in relation to sustainability, reliability, communications and performance.

## Deliver on time and within budget every time

Our global support network provides you with assistance through each project phase. We understand the processes and challenges you face in specifying, purchasing and delivering HVAC/R projects, and will provide you with the information, support and services that ensure you can deliver fully optimised solutions on time and within budget.




*It is good to know that wherever the project is, we will be supported by knowledgeable people who understand our needs and our technology*



IP54
(NEMA 12)
Affinity

## Helping you to save energy, day after day

Affinity allows you to minimise wasted energy throughout your buildings by optimising the pump or fan speed to match the environmental conditions within the building. This helps to reduce your energy costs and your carbon footprint. Software tools help to analyse the potential energy savings and can provide the justification to make the capital investment with a known payback period.

*We need to reduce costs and our carbon footprint*

N1652

E171230

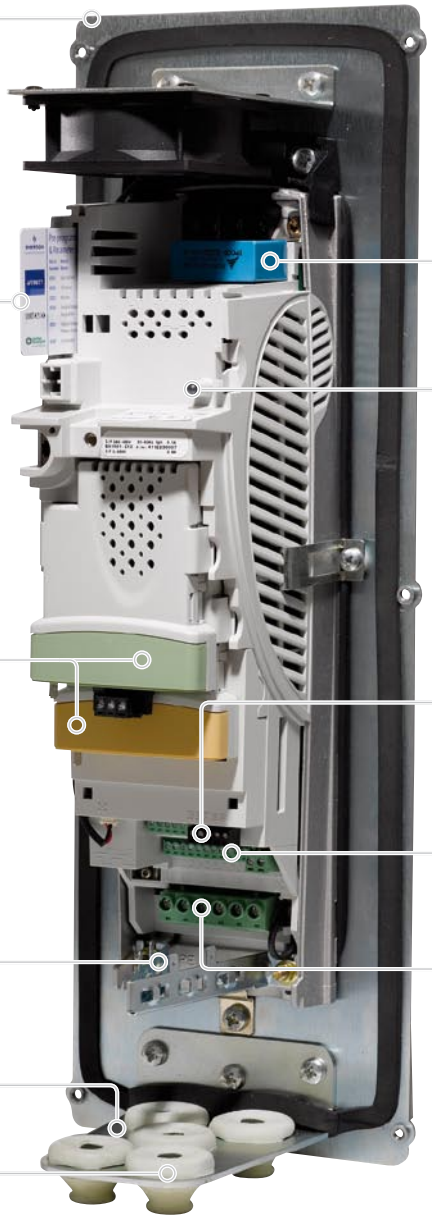
## Affinity features

### Size 1 IP20 (NEMA 1) drive

### Size 1 IP54 (NEMA 12) drive



## Size 1 IP54 (NEMA 12) drive with cover removed



Back plate*

Smartcard for macro, parameter and controller program storage

2 option modules for communications and I/O expansion

**Cable management system**

Bracket providing a grounding point for shielded control and power cables

Gland plate for flexible cable and conduit connection

IP55 grommets to prevent water and dust ingress*

Internal EMC filter

Power on / Drive status LED

Building automation interface connections with pluggable terminals

Control connections with pluggable terminals

Power connections with pluggable terminals

* Applies to IP54 (NEMA 12) drive only

## A complete HVAC/R solution

Affinity includes all of the features you would expect from a dedicated HVAC/R drive, plus more:

- Fire Mode for building occupant safety
- Two independent PID controllers can, for example, control dampers or valve actuators to eliminate external equipment
- Free software tools for
  - Energy saving calculations
  - Harmonic analysis
  - Commissioning and monitoring
- Onboard controller with real-time clock, ideal for reducing costs and improving performance in standalone applications and OEM solutions
- Sleep / wake mode automatically switches off a fan or pump when demand drops below a threshold for a certain time
- Motor pre-heat to prevent condensation
- Low load detection to sense mechanical problems such as a broken drive belt
- All Affinity models have integrated reactors to control supply harmonics. This saves space and cabling costs
- High switching frequency up to 16kHz for quiet motor operation
- Smartcard data storage
  - Specific macros for simplifying set up of common HVAC/R applications
  - Easy back up and copying of drive configuration
- Integrated network connectivity
  - BACnet
  - Metasys N2
  - Modbus RTU
- Optional connectivity, through click-in option modules
  - LonWorks
  - Ethernet
  - Additional I/O
- Pluggable terminals for simple installation and maintenance

### Intelligent Thermal Management

Affinity uses an Intelligent Thermal Management system (ITM) to monitor the temperature of its internal components. In high ambient temperatures the drive automatically adjusts the output to maintain system operation whilst ensuring drive reliability.

*"I want to know that when the system is required to operate beyond the design limits, the drive will continue to perform"*




IP20 (NEMA 1) size 1 Affinity

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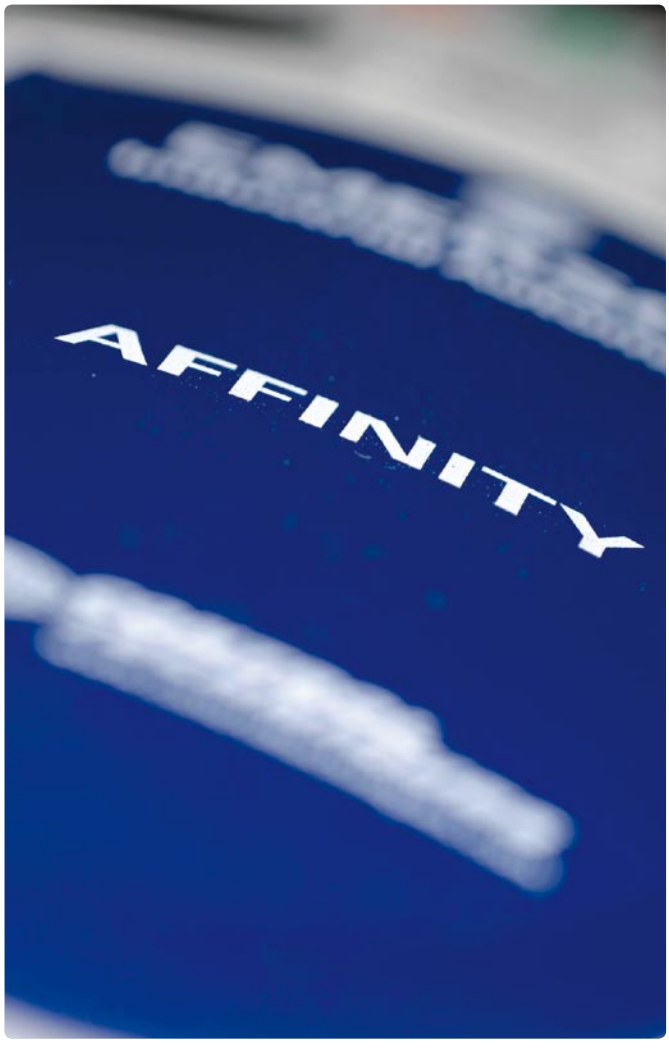
# Specifying HVAC/R drives

## Specify, fit and forget

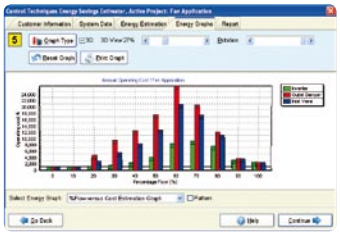
Affinity is available in 6 frame sizes with both IP20 (NEMA 1) and IP54 (NEMA 12) models. It operates with standard global power supplies from 200V through to 690V.
The base technology for Affinity is already proven in commercial and industrial applications around the world.



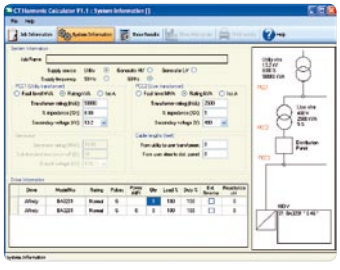

*At the end of one project, I need to be able to move on to the next. I cannot afford to spend time supporting projects that we have already been paid for*

We will help you to specify the drives, put forward the commercial arguments and ensure the drive system complies with regulations for energy efficiency, harmonics and EMC.

- The standard documentation and our online resources provide the information you need to specify Affinity drives in most HVAC/R applications
- **CT Energy Savings Estimator**
  Energy optimising software helps you to calculate the commercial arguments for pay-back periods



- **CT Harmonic Calculator**
  Supply harmonics calculator will help you to economically meet the required standards for your installation



- For any questions, our drive experts are on hand to provide you with their experience and knowledge

*Getting access to key people and information on time can be critical to the success of a project*

## Integration with your Building Management System

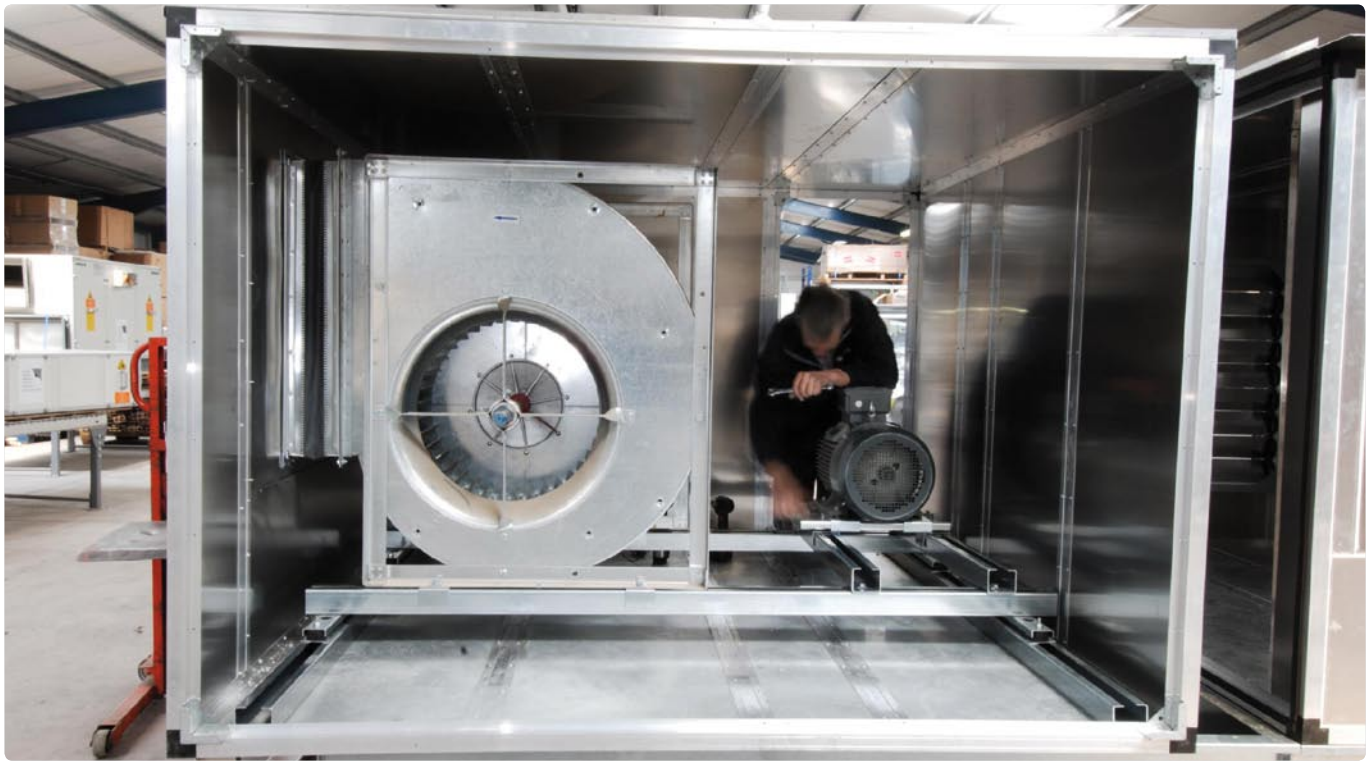
Affinity has all the communications capability you need. Protocols integrated as standard include, BACnet, Metasys N2, and Modbus RTU. Click-in option modules allow specialised communication such as LonWorks and Ethernet to be used.

*If the drives cannot integrate with our Building Management System, then we really have no use for them*

## Flexibility without a Building Management System

For system redundancy or for smaller applications without a Building Management System, Affinity offers the possibility of using the onboard Logic and PID controllers, real time clock and flexible I/O. The system is easy to configure, is able to cope with any Building Automation problem and requires no additional space or external components.

*It would be great to have some level of redundancy so that if the Building Management System failed the key equipment continued to operate autonomously*



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# Installing and commissioning HVAC/R systems

Affinity is quick and easy to set-up. The drive's HVAC/R features may be configured using a multilingual keypad, Smartcard, or the supplied commissioning software that guides the user through the configuration process.

*"At the end of a big project the pressure is on and our window for installation and commissioning often gets squeezed. We need to be able to get in there, get it working and get out"*

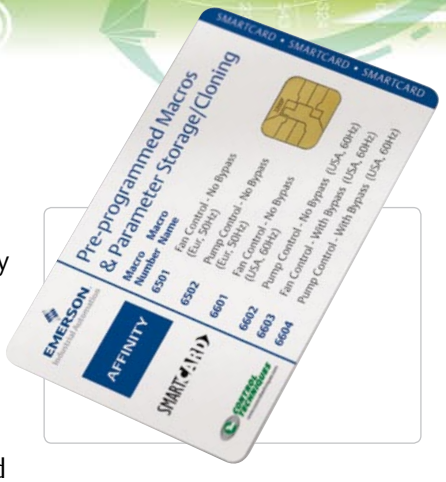
## Simple and intuitive

The Affinity keypad is a simple, intuitive plain language interface for configuring and maintaining the drive. There are no confusing switches or soft keys, only the functions needed to get the job done simply and quickly, with a help button in case more information is required.

*"I just want a simple interface that helps me to get the drive running, and allows me to monitor its performance"*




## Smart start-up




To further assist in maintenance and commissioning, every drive is supplied with a Smartcard; this is a credit card sized data storage device that can quickly download pre-programmed application macros (parameter sets) to the drive or backup and copy settings from one drive to another. Simply insert the Smartcard into the drive and using the keypad, select the appropriate macro for your application. A Macro Guide is included with the drive.

## Flexibility to change specification

Affinity HVAC/R macros and option modules allow you to adapt key drive functionality at any time to meet changing project needs. Option modules for connectivity and I/O are simply clicked into position under the drive cover, requiring no additional space.

*"Occasionally we need to change the way something works during or after the installation, it would be so much better if this could be done without having to remove the equipment"*

## Easy performance tuning

Autotune features help you to get the best performance by measuring the motor and machine attributes and automatically optimising control parameters to maximise energy efficiency.

*"There are some applications you see over and over again, the features to solve these need to be standard in a dedicated HVAC/R drive"*




IP20 (NEMA 1) Affinity range

## Compact size

Affinity has been designed using advanced thermal modelling techniques to ensure that performance is achieved with the most compact dimensions. Larger drives are built on a rigid SMC chassis, which further reduces the dimensions and weight making them exceptionally easy to handle and install.

*Size is important. Space taken up by control equipment is space that cannot be utilised or rented*

## Training

Our training centres located around the world are focused on providing training and resources to ensure you and your team can deal with every drive application.

*We need to be able to get the drives running quickly, every time. Training is critical*

## Living with HVAC/R systems

Once installed, Affinity drives require minimal maintenance. You can expect the drive to give years of reliable service, ensuring the comfort and well being of the building occupants. However, should anything go wrong, our engineers are on hand to provide advice, support and services.

*Once the contractor has left, we need to be able to live with the equipment*

### Remote connectivity

A click-in Ethernet communications option module allows the drive to be accessed from anywhere around the building or even around the world. This can be useful if you outsource your building maintenance or the drives are located in an inaccessible part of the building.

*It is great that we can allow an outside expert to access the drive remotely when we have a problem*







IP20 (NEMA 1) size 1 to 3 Affinity

### Much less noise

Affinity uses a unique control strategy called Rotor Flux Control (RFC) to generate the power output waveforms. Unlike some other methods of control, this allows the quality of the output waveform to be selected by adjusting the switching frequency. There is a direct correlation between output quality and audible noise, where higher frequencies produce less audible noise and heating within the motor. This allows more flexibility for positioning HVAC/R equipment close to noise sensitive areas.

*The HVAC/R system should be unobtrusive to everyone that occupies the building*

## Support when I need it

We are committed to serving you. This is achieved through a global team of automation experts within our Drive Centres and distributors, who understand your operational needs. We have a passion for delivering solutions and service for drives and drive systems.

*Working with Control Techniques gives us piece of mind, knowing that we can always speak with a drive expert, any time of day*




## Environmental safety and electrical conformance

- IP54 (NEMA 12) and UL Type 12 module, or
- IP20 (NEMA 1) module and, with optional conduit box fitted, UL Type 1 module
  - IP20 (NEMA 1) module meets IP54 when through panel mounted
- Humidity 95% maximum (non condensing) at 40°C
- Altitude: 0 to 3000m, derate 1% per 100m between 1000m and 3000m
- Vibration: Tested in accordance with IEC 60068-2-64
- Mechanical Shock Tested in accordance with IEC 60068-2-29
- Storage temperature -40°C to 50°C
- Electromagnetic Immunity complies with EN 61800-3 and EN 61000-6-2
- With on board EMC filter, complies with EN 61800-3 (2nd environment)
- EN 61000-6-3 and EN 61000-6-4 with optional footprint EMC filter
- IEC 61000-3-4 Supply conditions
- IEC 60146-1-1 Supply conditions
- IEC 61800-5-1 (Power Drive Systems)
- IEC 61131-2 I/O
- EN 60529 Ingress protection
- EN 50178 / IEC 62103 Electrical safety
- UL508C, UL840
- EN 61000-6-2, EN 61000-6-4 EMC

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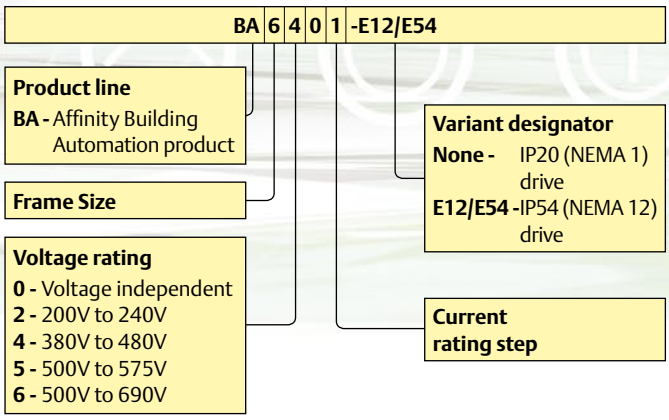
# Affinity model codes and ratings for IP20 (NEMA 1) and IP54 (NEMA 12) drives

## Model code explanation




## 200-240VAC +/- 10% (kW@220V) (HP@230V)

| Frame Size | Modules | Max Cont Current (A) | Typical Motor Output Power (kW) | (HP) |
|---|---|---|---|---|
| 1 | BA1201 | 5.2 | 1.1 | 1.5 |
| | BA1202 | 6.8 | 1.5 | 2 |
| | BA1203 | 9.6 | 2.2 | 3 |
| | BA1204 | 11 | 3 | 3 |
| 2 | BA2201 | 15.5 | 4 | 5 |
| | BA2202 | 22 | 5.5 | 7.5 |
| | BA2203 | 28 | 7.5 | 10 |
| 3 | BA3201 | 42 | 11 | 15 |
| | BA3202 | 54 | 15 | 20 |
| 4 | BA4201 | 68 | 18.5 | 25 |
| | BA4202 | 80 | 22 | 30 |
| | BA4203 | 104 | 30 | 40 |
| 5 | BA5201 | 130 | 37 | 50 |
| | BA5202 | 154 | 45 | 60 |

## 380-480VAC +/- 10% (kW@400V) (HP@460V)

| Frame Size | Modules | Max Cont Current (A) | Typical Motor Output Power (kW) | (HP) |
|---|---|---|---|---|
| 1 | BA1401 | 2.8 | 1.1 | 1.5 |
| | BA1402 | 3.8 | 1.5 | 2 |
| | BA1403 | 5 | 2.2 | 3 |
| | BA1404 | 6.9 | 3 | 5 |
| | BA1405 | 8.8 | 4 | 5 |
| | BA1406 | 11 | 5.5 | 7.5 |
| 2 | BA2401 | 15.3 | 7.5 | 10 |
| | BA2402 | 21 | 11 | 15 |
| | BA2403 | 29 | 15 | 20 |
| 3 | BA3401 | 35 | 18.5 | 25 |
| | BA3402 | 43 | 22 | 30 |
| | BA3403 | 56 | 30 | 40 |
| 4 | BA4401 | 68 | 37 | 50 |
| | BA4402 | 83 | 45 | 60 |
| | BA4403 | 104 | 55 | 75 |
| 5 | BA5401 | 138 | 75 | 100 |
| | BA5402 | 168 | 90 | 125 |
| 6 | BA6401 | 205 | 110 | 150 |
| | BA6402 | 236 | 132 | 200 |

## 500-575VAC +/- 10% (kW@575V) (HP@575V)

| Frame Size | Modules | Max Cont Current (A) | Typical Motor Output Power (kW) | (HP) |
|---|---|---|---|---|
| 3 | BA3501 | 5.4 | 3 | 3 |
| | BA3502 | 6.1 | 4 | 5 |
| | BA3503 | 8.4 | 5.5 | 7.5 |
| | BA3504 | 11 | 7.5 | 10 |
| | BA3505 | 16 | 11 | 15 |
| | BA3506 | 22 | 15 | 20 |
| | BA3507 | 27 | 18.5 | 25 |
| 4 | BA4603* | 36 | 22 | 30 |
| | BA4604* | 43 | 30 | 40 |
| | BA4605* | 52 | 37 | 50 |
| | BA4606* | 62 | 45 | 60 |
| 5 | BA5601* | 84 | 55 | 75 |
| | BA5602* | 99 | 75 | 100 |
| 6 | BA6601* | 125 | 90 | 125 |
| | BA6602* | 144 | 110 | 150 |

*The same model can be used on a 575V or a 690V supply, and has two different output ratings. For example: BA4603 is suitable for a 22kW output motor on a 575V supply and a 30kW output motor on a 690V supply. Can be used on IT supplies - all voltages, Grounded delta supplies - all voltages except 690V.

## 500-690VAC +/- 10% (kW@690V) (HP@690V)

| Frame Size | Modules | Max Cont Current (A) | Typical Motor Output Power (kW) | (HP) |
|---|---|---|---|---|
| 4 | BA4601 | 22 | 18.5 | 25 |
| | BA4602 | 27 | 22 | 30 |
| | BA4603 | 36 | 30 | 40 |
| | BA4604 | 43 | 37 | 50 |
| | BA4605 | 52 | 45 | 60 |
| | BA4606 | 62 | 55 | 75 |
| 5 | BA5601 | 84 | 75 | 100 |
| | BA5602 | 99 | 90 | 125 |
| 6 | BA6601 | 125 | 110 | 150 |
| | BA6602 | 144 | 132 | 175 |

**Notes:**

For size 1 to 6 IP20 (NEMA 1) drives and size 1 to 3 IP54 (NEMA 12) drives, the continuous current ratings given are for maximum 40°C (104°F) [/50°C(122°F) with derating],1000m altitude and 3.0kHz switching. For size 4 to 6 IP54 (NEMA 12) drives, the continuous current ratings given are for maximum 35°C (95°F) [/40°C (104°F) with derating], 1000m altitude and 3.0kHz switching.

Select model on actual motor full load current.

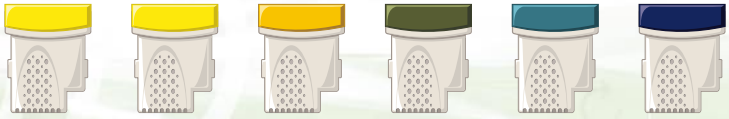
All drives include keypad and internal EMC filters.

# Options, weights and dimensions

## Options

### Input/Output click-in option modules

SM-I/O 32 | SM-I/O Plus | SM-I/O Lite | SM-I/O 120V | SM-I/O PELV | SM-I/O 24V Protected



### Communications click-in option modules

SM-Lon | SM-Profibus DP | SM-DeviceNet | SM-Ethernet



### Additional EMC filters to EN61000-6-4

Affinity's built-in EMC filter complies with EN 61800-3. External EMC filters are available for compliance with EN 61000-6-4.

| IP20 (NEMA 1) Drive | Filter order code | IP20 (NEMA 1) Drive | Filter order code | IP54 (NEMA 12) Drive | Filter order code | IP54 (NEMA 12) Drive | Filter order code |
|---|---|---|---|---|---|---|---|
| BA1201 to BA1202 | 4200-6118 | BA3401 to BA3403 | 4200-6305 | BA1201-E12/54 to BA1202-E12/54 | 4200-6125 | BA3401-E12/54 to BA3403-E12/54 | 4200-6318 |
| BA1203 to BA1204 | 4200-6119 | BA4401 to BA4403 | 4200-6406 | BA1203-E12/54 to BA1204-E12/54 | 4200-6124 | BA4401-E12/54 to BA4403-E12/54 | 4200-6414 |
| BA2201 to BA2203 | 4200-6210 | BA5401 to BA5402 | 4200-6503 | BA2201-E12/54 to BA2203-E12/54 | 4200-6218 | BA5401-E12/54 to BA5402-E12/54 | 4200-6505 |
| BA3201 to BA3202 | 4200-6307 | BA6401 to BA6402 | 4200-6603 | BA3201-E12/54 to BA3202-E12/54 | 4200-6320 | BA6401-E12/54 to BA6402-E12/54 | 4200-6605 |
| BA4201 to BA4203 | 4200-6406 | BA3501 to BA3507 | 4200-6309 | BA4201-E12/54 to BA4203-E12/54 | 4200-6414 | BA3501-E12/54 to BA3507-E12/54 | 4200-6319 |
| BA1401 to BA1404 | 4200-6118 | BA4601 to BA4606 | 4200-6408 | BA1401-E12/54 to BA1404-E12/54 | 4200-6125 | BA4601-E12/54 to BA4606-E12/54 | 4200-6415 |
| BA1405 to BA1406 | 4200-6119 | BA5601 to BA5602 | 4200-6504 | BA1405-E12/54 to BA1406-E12/54 | 4200-6124 | BA5601-E12/54 to BA5602-E12/54 | 4200-6506 |
| BA2401 to BA2403 | 4200-6210 | BA6601 to BA6602 | 4200-6604 | BA2401-E12/54 to BA2403-E12/54 | 4200-6218 | BA6601-E12/54 to BA6602-E12/54 | 4200-6606 |

### Weights and dimensions




| Frame Size | Weight | | | | |
|---|---|---|---|---|---|
| | Model | IP20 (NEMA 1) drive | | IP 54 (NEMA 12) drive | |
| | | kg | lb | kg | lb |
| 1 | BA1201 to BA1204, BA1401 to BA1404 | 5 | 11 | 9 | 20 |
| | BA1405 and BA1406 | 5.8 | 12.8 | | |
| 2 | All | 7 | 15.4 | 12 | 26.5 |
| 3 | All | 15 | 33.1 | 25 | 55 |
| 4 | All | 30 | 66.1 | 40 | 88 |
| 5 | All | 55 | 121.3 | 70 | 154 |
| 6 | All | 75 | 165.3 | 90 | 198 |

| Frame Size | Dimension | | | | | |
|---|---|---|---|---|---|---|
| | IP20 (NEMA 1) drive | | | IP54 (NEMA 12) drive | | |
| | H | W | D | H | W | D |
| 1 | 386mm (15.20in) | 100mm (3.94in) | 219mm (8.62in) | 560mm (22.05in) | 184mm (7.24in) | 264mm (10.39in) |
| 2 | 389mm (15.32in) | 155mm (6.10in) | | 552mm (21.73in) | 236mm (9.29in) | 262mm (10.32in) |
| 3 | | 250mm (9.84in) | 260mm (10.24in) | 544mm (21.42in) | 331mm (13.03in) | 302mm (11.89in) |
| 4 | 547mm (21.54in) | 310mm (12.21in) | 298mm (11.73in) | 703mm (27.68in) | 386mm (15.20in) | 346mm (13.62in) |
| 5 | 858mm (33.78in) | | | 1211mm (47.68in) | 416mm (16.38in) | 347mm (13.66in) |
| 6 | 1169mm (46.02in) | | | 1522mm (59.92in) | 416mm (16.38in) | 348mm (13.70in) |