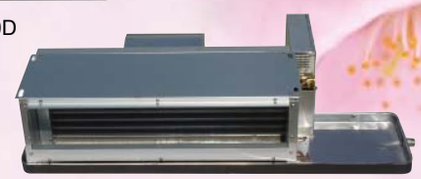
SAKURA®
Air Conditioner

Sakura Air Conditioner
User-friendly, Earth-friendly

SDG-F1200D～SDG-F1400D

SDG-F1000D

SDG-F600D～SDG-F800D



SDG-F400D

DC brushless FCUs

Ref, S- 158 / 02 / 10

SAKURA Air Conditioner

Green energy expert

NATIONAL STANDARD REFRIGERATION LAB

- Simulation of environment temperature & humidity
- System Driving parameters correction
- Indoor / Outdoor unit structure framing
- Reliability test

System specification:

- Input voltage：AC-220V± 10%/50~60Hz
- Operating temperature, humidity：0℃~50℃ ，30%~80%
- Storage temperature, humidity：-10℃~60℃ ，30%~80%
- Carrier wave frequency：15KHz
- Motor：DC brushless, sensorless, 8 poles
- Revolution range：150~1800rpm, even higher
- Capacity: Able to drive Brushless DC motor up to 4kw.
- Changing rate of Revolution：10rpm
- Accuracy：1rpm
- Built-in Power Factor Correction - Power factor 99.9%

Micro-computer control system:
Single board design to ensure high reliability

System technique:

- DC motor driving：UVW 3 wires input to control DC inverter motor.
- Inverter modulation technique：PWM- Pulse Width Modulation.
- Advanced driving technique：Utilize DSP(Digital Signal Processor), be capable to process 50 millions operation per second, it synchronously generates the position of rotor of motor from direct feedback signal→switching phase→driving procedure.
- Constant temperature control：PI(Proportion Integration)

$$U(t)=kp \times e(t) + ki \times \int e(t)\,dt + Uo$$

U(t)：Motor/Compress operation
e(t)：Temp. Differential(Room Temp. - Set Temp.)
kp：Proportion Gain Coefficient
ki：Integration Gain Coefficient
dt：Sampling time
Uo：Offset Constant

Utilize PI(Proportion Integration) technique to deliver optimal temperature.

Breaking DC motor driving technique through：Single CPU to drive twin motors, utilize "Active power factor correction"： Power factor correction reaches over 98%.

System protection:

- IPM overloading current protection
- IPM overl oading voltage protection
- Stroke protection 2KV
- Overloading current protection on motor.

System certificate:

- EMC Approval

Brushless D. C. Motor Control for FCU/ AHU Applications

Evolving market needs and changing energy policies push designers to consider energy efficiency, audible noise, product lifetime, maintenance, and the cost of initial products and operation.

Today's Technology

HVAC&R performance largely depends upon the control capabilities of the compressor and Motor. Traditionally, Permanent Split Capacitor (PSC) and AC motors are widely used in Fan Coil Units & Air Handling Units applications.

The PSC motors have a non-linear speed versus torque characteristic. For this reason, using a variable-speed drive does not give good torque control over the speed range, thus, the motors have low-energy efficiency and tend to be noisy compared to brushless D.C. (BLDC) motors. PSC motors are not ideal for energy-efficient or quiet refrigerators.

Using Brushless D.C. Motors

Brushless D.C. (BLDC) motors are gaining popularity due to their performance advantages over PSC and brushed D.C. (BDC) motors, including the following:

- BLDC motors have a relatively flat speed-torque characteristic. This enables the motor to operate at lower speeds without compromising torque when the motor is loaded.
- The ratio of output power to frame size is higher in BLDC motors. This reduces the size and weight of the product. This also saves the cost of motor mounting and shipping expenses.
- The BLDC motors operate at higher-power efficiency compared to induction motors and BDC motors because they have permanent magnets on the rotor and there are no brushes for commutation.
- Brush inspection is eliminated, making them suitable for limited-access areas like compressors and fans. This also increases the life of the motor and reduces the service requirements.
- BLDC motors have less electromagnetic interference (EMI) generation.

Sensorless Control of a BLDC Motor

Sensorless control of a BLDC motor calls for commutation based on the back EMF produced in the stator windings. Hall sensors are not required for this method.

Sensorless control has two distinct advantages: increased reliability and lower costs. Inherently, systems with fewer components are more reliable. The motor generates heat and an elevated temperature accelerates Hall sensor failures. The cost savings are achieved, not only with the piece part pricing of the Hall sensor, but also since the Hall sensor wires are not necessary.

At least five wires can be eliminated.

Until now, we have seen the commutation based on the rotor position from the Hall sensor. Manipulating the back EMF signals, instead of the Hall sensors, can commutate the BLDC motors. The amplitude of back EMF depends upon three factors: the angular velocity of the rotor, the number of turns in the stator winding, and the rotor-magnetic field. Once the motor is designed, the rotor-magnetic field and the number of turns in the stator windings remain constant.

The factors that govern the back EMF are the angular velocity or speed of the rotor. The back EMF increases proportionally to the rotor speed. However, back EMF can be estimated for a given speed using the back EMF constant provided in the motor data sheet.

Another aspect to consider is very low-speed operation. Because the back EMF is proportional to the rotation speed, at very-low speeds, the back EMF would have very low amplitude with which to detect zero crossing. From standstill, motors need to be started in open loop.

When sufficient back EMF is built in to detect the zero cross point, the control should be shifted to the back EMF sensing. The minimum speed at which the back EMF can be sensed is calculated from the back EMF constant of the motor.

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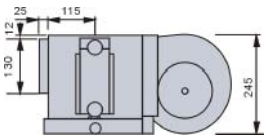
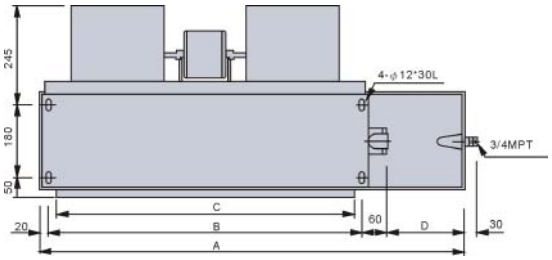
DC brushless FCUs

Performance \ Model			SDG-F400D	SDG-F600D	SDG-F800D	SDG-F1000D	SDG-F1200D	SDG-F1400D
Supply water temperature 7℃ Cooling capacity Kcal/hr		DC	2018~3550	2543~4500	2556~5600	3650~7750	4250~9000	4600~10800
Static pressure of air duct	0pa	CFM	598	717	803	1130	1345	1577
	10pa		569	682	770	1106	4309	1542
	20pa		540	653	746	1083	1257	1507
	30pa		511	625	728	1059	1221	1471
	40pa		482	597	696	1036	1185	1436
	50pa		453	565	671	1012	1144	1400
Operation voltage		(V)	220					
DC	Fan speed		(Varible Air Volume，minimum variation 1 rpm)					
	Current	(A)	0.28~0.11	0.37~0.13	0.48~0.15	0.8~0.12	0.86~0.13	1.04~0.14
	Power consumption	(w)	61~20	106~22	119~22	175~27	190~28	228~31
Rotation speed of motor (RPM)		DC	900~450	1000~450	1050~450	1100~480	1050~480	1100~480
Motor		Pc	1	1	1	2	2	2
Blower		Pc	2	2	2	3	4	4
Water supply/return pipe		inch	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"
Drain pipe		inch	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"
Weight		Kg	17.8	19.4	23.1	30.4	34.6	36.8

1800 RPM MOTOR SPECIFICTION				
VOLT	220V	BRACKET	ψ97	
FREQ	60HZ	SHAFTOUT	ψ12.7	
TYPE	BRUSHLESS DC			
RATE	POWER	240W	POLES	8
	CONT.		CLASS	E
ITEM / SPEC.		60Hz		
NO LOAD	AMP.	0.14A ↓		
	WATT	18W ↓		
	RPM	1770RPM		
RATED	AMP.	1.79A ↓		
	WATT	410W ↓		
	RPM	1800±40RPM		
	TORQUE	(0.20 Kg–cm)		
	LOAD NO	#29		
(△t)TEMP RISE AMB TEMP 36℃	COIL	UNDER 72℃		
	BEARING	UNDER 52℃		
COIL RESISTANCE (20℃ DC OHM) ±5%	A COIL	29.3 Ω	B COIL	29.3 Ω
	COIL	29.3 Ω		
NAME	NUMBER	COLOR	COIL	
WIRE	1	BLACK	1015#18	
WIRE	2	WHITE	1015#18	
WIRE	3	RED	1015#18	





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