

SBA SERIES HIGH-POWER SYNCHRO BOOSTER AMPLIFIERS

Make sure the next
Card you purchase
has...



FEATURES



DESCRIPTION

The SBA Series amplifiers are compact units designed to be bolted to a chassis (see mechanical outline). Both 60 and 400Hz units require signal input levels of 90V synchro, 6.81V resolver, 5V resolver, or 2V resolver. Their signal output is high power 90V L-L synchro. A connection to the signal reference voltage provides the power to drive the amplifier. The only other connections are for logic controls: a Disable input and a BIT output. All signal inputs and outputs are transformer-isolated from each other, and logic inputs and outputs are opto-isolated.

The SBA is a high efficiency device. The unit has a Disable control line which allows the output to be turned off when it is not in use, resulting in energy savings. The SBA components are mounted on an aluminum plate that conducts heat efficiently to the chassis where the unit is bolted. There are two package options for the connector location in the long side or the short side of the chassis.

The SBA is fully protected. Current limiting prevents damage from overloads and short circuits. Voltage clamps protect against reference and load transients. A thermal cutout disables the output before critical temperatures are reached.

In addition to high efficiency and protection features, these SBAs have a kick circuit to correct hung-up rotor conditions. When the rotor in a torque receiver is hung up, the automatic kick circuit in the SBA will shift the synchro output by 120° for ½ second to free the hang-up.

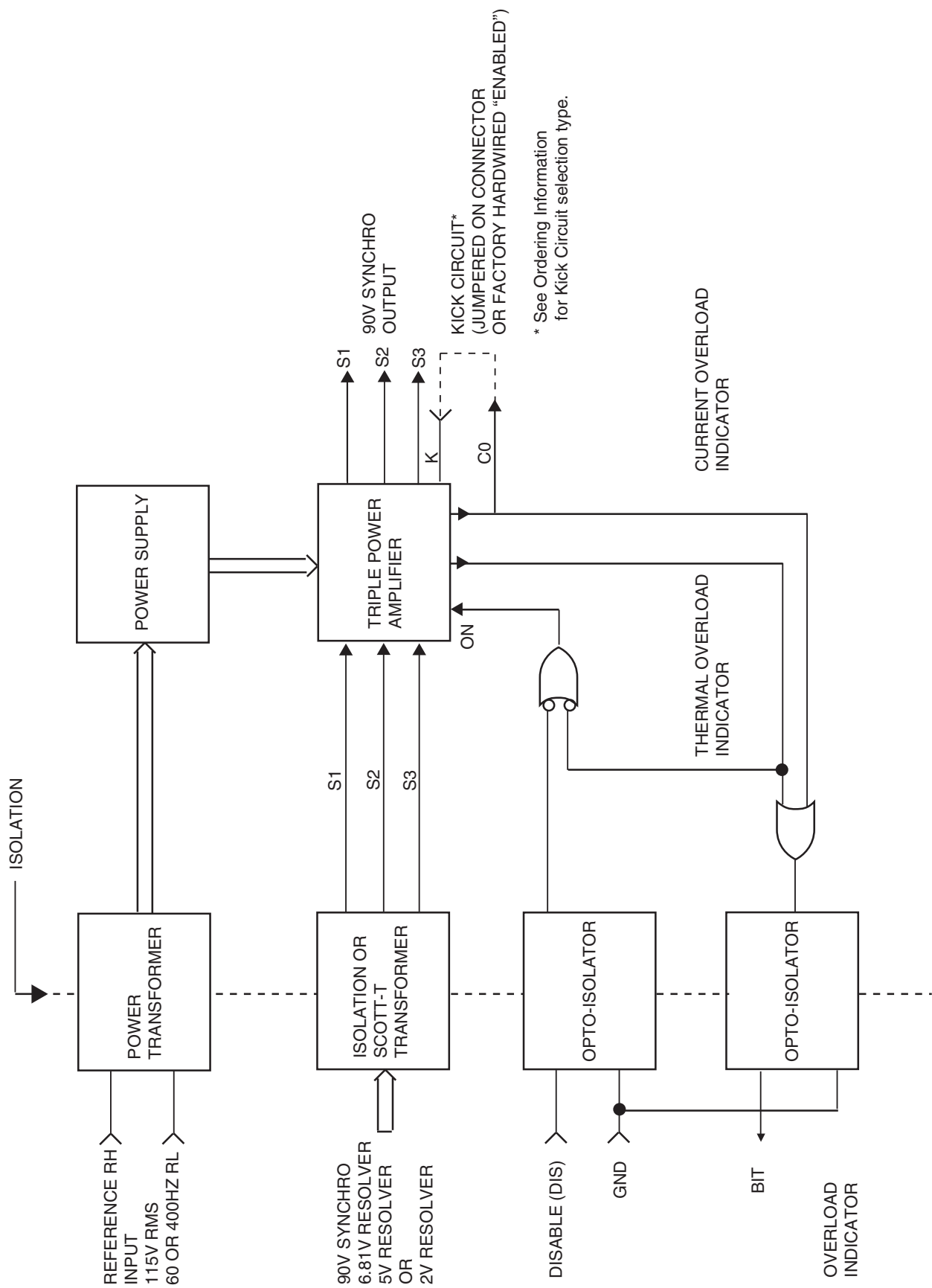
- Most Compact, Easy to Use System for High-Power Synchro Output
- Only One Module Needed to Boost Synchro Signals
 - Powered from reference - No additional external power supplies required
 - Provides high power D/S conversion when used with low power D/S or D/R converter
- 90V, 60 or 400Hz Synchro Outputs:
 - Drive multiple CT and CDX loads up to 25VA
 - Drive torque receiver loads up to $Z_{ss} = 6\Omega$
- Kick Circuit Frees Torque Receiver Rotor to Prevent Hangups
- Very High Efficiency: Disable Input Provides Energy Savings
- Protected against short circuits, overloading, load transients, and temperature
- "Power-Up" in disable or enable mode
- Replacement to the SBA-25001, 2, 3, 4 Series Synchro Boosters
- Reduced weight: 1.25 lb/1.4 lb max.
- Optional chassis selections
- No calibration required



Data Device Corporation
105 Wilbur Place
Bohemia, New York 11716
631-567-5600 Fax: 631-567-7358
www.ddc-web.com

FOR MORE INFORMATION CONTACT:

Technical Support:
1-800-DDC-5757 ext. 7771



* See Ordering Information for Kick Circuit selection type.

FIGURE 1. SBA BLOCK DIAGRAM

TABLE 1. SBA SERIES SPECIFICATIONS

| PARAMETER | VALUE |
|---|--|
| ACCURACY Passive Loads (CT and CDX) Active Loads (torque receiver) | ±3.0 arc-minutes ±10 arc-minutes |
| SIGNAL INPUT Input Isolation Synchro Input SBA-35001 SBA-35002 Resolver Input SBA-35003 SBA-35004 SBA-35005/SBA-35115 SBA-35006/SBA-35116 SBA-35007 SBA-35008 | Transformer Isolation, 500Vrms max. breakdown to ground Frequency L-L Voltage Impedance 400Hz ±5% 90V +/- 10% 99kΩ min, balanced 60Hz ±5% 90V +/- 10% 99kΩ min, balanced 400Hz ±5% 6.81V +/- 10% 7.4kΩ min, balanced 60Hz ±5% 6.81V +/- 10% 7.4kΩ min, balanced 400Hz ±5% 5V +/- 10% 5.4kΩ 60Hz ±5% 5V +/- 10% 5.4kΩ 400Hz ±5% 2V +/- 10% 4.4kΩ 60Hz ±5% 2V +/- 10% 4.4kΩ Other input line-to-line voltages are available. Please consult factory. |
| SYNCHRO OUTPUT L-L Voltage for Nominal Input Voltage Transformation Ratio Minimum Load Impedance of passive loads Minimum Load Impedance of active loads | 90V ±1% 0.783* Zso 243Ω Zss 6Ω |
| CONTROL LINES Disable (DIS) Overload Indicator (BIT) Kick Circuit (K and CO) | TTL compatible (Internal pull up to logic 1 “disable”) Logic 0 enables power amplifier output if internal temperature does not exceed +125°C. Loading is 2.5mA max at logic 0. Opto-isolated, 4kV RMS max. breakdown to ground. TTL compatible Drive capability is 2 Std. TTL loads. Opto-isolated, 4kV RMS max. breakdown to ground. Logic 1 indicates a fault condition for either of two reasons: 1. A thermal overload occurs where the internal temperature exceeds +125°C, which prevents the Disable control line from enabling the output. 2. A current overload condition exists. (Reference the Kick Circuit section for details) Note: BIT output is not valid when reference voltage is not applied. Configurable by jumper connection in mating connector or factory hardwired, reference ordering info. Normally connected for torque receiver loads (not for passive CT and CDX loads). Shifts output by 120° for ½ sec. to unjam rotor if output is hung up by an overcurrent condition. Repeat every 4½ seconds so long as overcurrent condition persists. Cannot cause damage to SBA or to torque receiver. |
| POWER SUPPLIES Reference Input frequency (must be same as signal reference) Note: Reference voltage is always 115V. Reference Signal Isolation Frequency: • Nominal Value • Range Voltage: • Nominal Value • Range • Max Value Without Damage Current: (Enabled) • No load • Additional With Load Current: (Disabled) | Transformer, isolated, 500Vrms max. breakdown to ground 400Hz 60Hz 380-420Hz 57-63Hz 115Vrms ±10% 130Vrms 350mA RMS max 2mA per mA of output load 250mA RMS max |
| MECHANICAL DESIGN Shock Vibration | MIL-S-901D MIL-STD-167 Type 1 |

*Synchro output tracks reference input

TABLE 1. SBA SERIES SPECIFICATIONS (CONT.)

| PARAMETER | VALUE |
|--|--|
| MECHANICAL DESIGN (CON'T) Conformal Coat, Internal PCB Designed to meet (not tested) Salt Spray Moisture | Acrylic, HumiSeal 1B73 MIL-STD-202, method 101 MIL-STD-202, method 106 |
| THERMAL CHARACTERISTICS Temperature Ranges: (Case Temperature) Operating Storage Heat to be Dissipated Thermal Resistance at Junction of Power Transistor to Heat Sink Thermal Cutoff | -40°C to +85°C (Baseplate temperature not to exceed +85°C) -55°C to +125°C 4 Watts max per VA delivered 2°C/Watt, conduction cooling Amplifier output is disabled whenever internal temperature exceeds +125°C |
| PHYSICAL CHARACTERISTICS Size SBA-350xx (Low Profile) Weight SBA-351xx (High Profile) Weight | 7.4 x 5.06 x 1.32 inches (188 x 129 x 33.5mm) 1.25 lb (0.56kg) max 7.4 x 5.09 x 1.8 inches (188 x 129 x 46mm) 1.4 lb (0.635kg) max |

APPLICATIONS

SBA amplifiers are rugged units, requiring no calibration or adjustment, that can be used wherever high power synchro output is required. They can drive large passive loads such as multiple CTs and CDXs, or active loads such as torque receivers. The SBA can be used to amplify the output of a synchro transmitter directly, but it is most commonly used for D/S conversion. Only two modules are required for high power D/S conversion: a standard, low power hybrid or discrete D/S or D/R converter, and the SBA.

High power synchro drive capability is often required in training simulators, remote indicators, gunfire control, and Navy retransmission systems. The power-conserving features and compactness of the SBA amplifiers makes them especially well-suited for installations requiring multiple units; the DISABLE and BIT logic allow for computer monitoring.

TECHNICAL INFORMATION

FIGURE 1 shows that the SBA consists of three main parts:

- Power Amplifier with a transformer-isolated signal input
- Internal power supply that is transformer-isolated from the reference power source
- Digital controls with opto-isolation

SIGNAL INPUT

90V L-L synchro input passes through an isolation transformer. 6.81V L-L, 5V L-L, and 2V L-L resolver inputs pass through a Scott-T transformer which changes it to S1, S2, S3, synchro format and provides signal isolation. Please consult factory for input voltage levels other than those specified.

POWER-UP/ENABLE

The SBA will power up with all outputs off (disabled) and the user must set the disable (pin 14) control to logic 0 to enable the SBA outputs. The SBA can be configured to power up with the output on. See "Digital Controls" section for more details.

POWER AMPLIFIER

The triple power amplifier accepts synchro input and produces a high power, 90V L-L synchro output. The output is current-limited with a sharp limit transition at 1.0A peak. The current limiting prevents damage from output overloads or short circuits, and voltage clamping prevents damage from load transients.

If the reference input is lost, the amplifier output shuts down. In a shut-down condition, the SBA presents a safe, open circuit configuration to the load. The reference input drives the internal 5V supply which provides the BIT pull up voltage. Without the reference supply the BIT is inactive.

The amplifier is thermally protected by a cutoff that disables the output when the internal temperature reaches +125°C. The output is automatically restored when the temperature drops below +114°C.

The kick circuit in the amplifier is described in a separate section.

THERMAL CONSIDERATIONS

The SBA-35XXX Series are designed so that the junction temperature of its components can never exceed their maximum ratings if the baseplate temperature is held to 85°C or less. Heat sinking is required to optimize the heat spreading across the module and minimize thermal gradients. Adding a thermal con-

ductive interface pad or compound is optional. All SBA hardware must be firmly secured to maintain proper heat conduction. Refer to the flatness spec shown on the mechanical outline drawings.

DIGITAL CONTROLS

Two logic lines emerge from the power amplifier, one indicating whether a current overload condition exists (current overload indicator) and one indicating when the internal temperature exceeds +125°C (thermal overload indicator). Logic 1 signifies overload. The Overload Indicator (BIT) will be at logic 1 when either or both of the indicator lines are at logic 1. To prevent nuisance signals in the BIT, the current overload logic line has a 4-second delay before responding to an actual overload condition.

The Disable (DIS) makes it possible to switch the power amplifier output on or off. The reference input current drain, as indicated in the specifications, is much smaller if the output is off. If several SBA amplifiers are connected to the same reference, their disable lines can be used to sequence the SBA turn-on when the rotors are off null.

The Disable can turn the output on only if two conditions are satisfied:

1. No thermal overload exists
2. Reference input must be supplied

The SBA output can be configured to be always on by shorting pins 14 (DIS) and 16 (GND) together on the connector. The two conditions previously mentioned must still be met for the output to be enabled. This will just eliminate the need for any logic control of the Disable input to enable the SBA output.

KICK CIRCUIT

A hang-up condition can occur in a torque receiver in which the rotor is not driven back to null but stalls at some other angle. The function of the kick circuit in the SBA is to free the hang-up so that the rotor can return to null.

The kick circuit frees rotor hang-ups by shifting the synchro output angle by 120° for a period of 1/2 second. As shown in the block diagram, the kick circuit is activated by connecting the kick input K to the current overload indicator logic line CO. Because the driving current supplied by the SBA is limited to 1 Amp, a

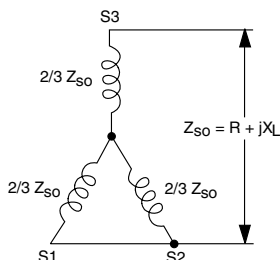


FIGURE 2. ZSO MEASUREMENT

current overload condition will usually exist except around null. Such current overloading, if it persists longer than the 4-second delay in the CO response time, will drive the CO line to logic 1, and activate the kick circuit.

Usually one kick is enough to free a rotor hang-up. However, the kick circuit will repeat its 1/2-second, 120° angleshift every 4.5 seconds as long as the current overload condition persists. Repeated cycling cannot harm the torque receiver or the SBA.

The output currents in the SBA are limited to 1 Amp. Without the kick circuit, large drive currents would be required to reduce the probability of rotor hang-ups. A kick circuit is therefore an important asset in reducing the size and cost of a torque driver.

The kick circuit pin K should be left unconnected for passive loads such as CTs and CDXs.

DRIVING CT AND CDX LOADS

When driving the CT and CDX loads, the SBA must have enough steady-state power capability to drive the Z_{SO} load. Z_{SO} (stator

| TABLE 2. COMMON CT AND CDX LOAD IMPEDANCES | | |
|--|------|---------------------------|
| MILITARY TYPE NUMBER | SIZE | Z _{SO} (NOMINAL) |
| CONTROL TRANSFORMERS | | |
| 11CT4e | 11 | 838 + j4955 |
| 15CT4c | 15 | 1600 + j9300 |
| 15CT6b | 15 | 1170 + j6780 |
| 18CT4c | 18 | 1420 + j13260 |
| 18CT6b | 18 | 1680 + j5040 |
| 23CT4a | 23 | 1460 + j11050 |
| 23CT6a | 23 | 1250 + j3980 |
| CONTROL DIFFERENTIAL TRANSMITTERS | | |
| 11CDX4b | 11 | 253 + j1802 |
| 15CDX4d | 15 | 140 + j1000 |
| 15CDX6c | 15 | 404 + j2290 |
| 18CDX4c | 18 | 63 + j695 |
| 18CDX6d | 18 | 521 + j1605 |
| 23CDX4c | 23 | 32 + j306 |
| 23CDX6c | 23 | 221 + j958 |

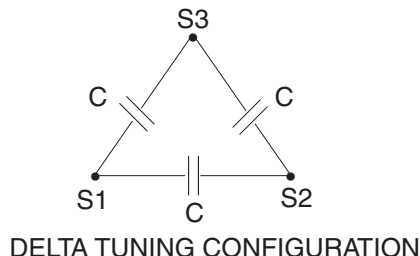


FIGURE 3. CT LOAD TUNING

impedance with rotor open-circuited) is measured as shown in FIGURE 2.

The SBA can drive CT and CDX loads whose Z_{SO} has a magnitude $(R^2 + RL^2)^{1/2}$ which is at least as great as the minimum load impedance of $Z_{SO} = 243\Omega$ listed in the specifications table. TABLE 2 shows the load impedance of some typical control transformers and control differential transmitters. Control transformers are highly inductive loads and it is possible to save power by tuning such loads. FIGURE 3 illustrates three capacitors placed across the legs of the synchro stator in a delta configuration.

The correct value of the capacitance C in Farads is given by:

$$C = \frac{X_L}{4\pi f (R^2 + X_L^2)}$$

where f is the carrier frequency, and R and X are the series real and reactive components of Z_{SO} . Good grade capacitors must be used and they must be able to withstand the full AC output voltage.

When the load has been tuned, more loads can be driven in parallel, because the load impedance Z is increased to:

$$Z = \frac{(R^2 + X_L^2)}{R}$$

DRIVING TORQUE RECEIVER LOADS

In addition to having enough steady state power capability to maintain a torque receiver at null, a torque driver must have a peak transient power sufficient to drive the torque receiver back to null. This transient power capability is indicated by the maximum torque receiver load capability Z_{SS} that can be driven. For the SBA, the maximum load Z_{SS} is 6Ω .

| TABLE 3. COMMON TORQUE RECEIVERS AND LOAD IMPEDANCES | | |
|--|------------------------------|---------------------|
| SYNCHRO | V _{L-L} /FREQ. (HZ) | Z _{SS} (Ω) |
| 11TR4c | 90V/400 | 180 to 250 |
| 15TRx4a | 90V/400 | 50 to 82 |
| 15TRx6a | 90V/60 | 920 |
| 18TRx4a | 90V/400 | 16 to 21 |
| 18TRx6b | 90V/60 | 350 to 430 |
| 23TR6 | 90V/60 | 110 to 145 |
| 23TR6a | 90V/60 | 110 to 145 |
| 23TRx4a | 90V/400 | 6.5 to 8.1 |
| 23TRx6b | 90V/60 | 110 to 145 |

Some common torque receivers and their load impedances Z_{SS} (stator input impedance with rotor shorted) are listed in TABLE 3.

The Synchro Booster Amplifiers are directly compatible with DDC's Digital to Resolver/Synchro Converters. Figure 4 illustrates the connection procedure for this application.

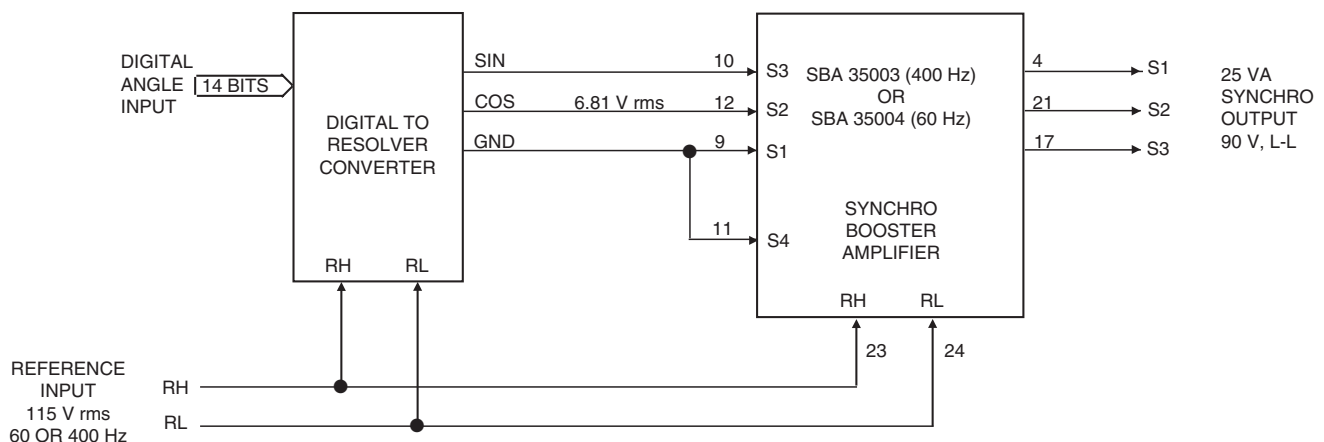


FIGURE 4. D-R TO SBA-35003 OR SBA-35004 CONNECTION DIAGRAM

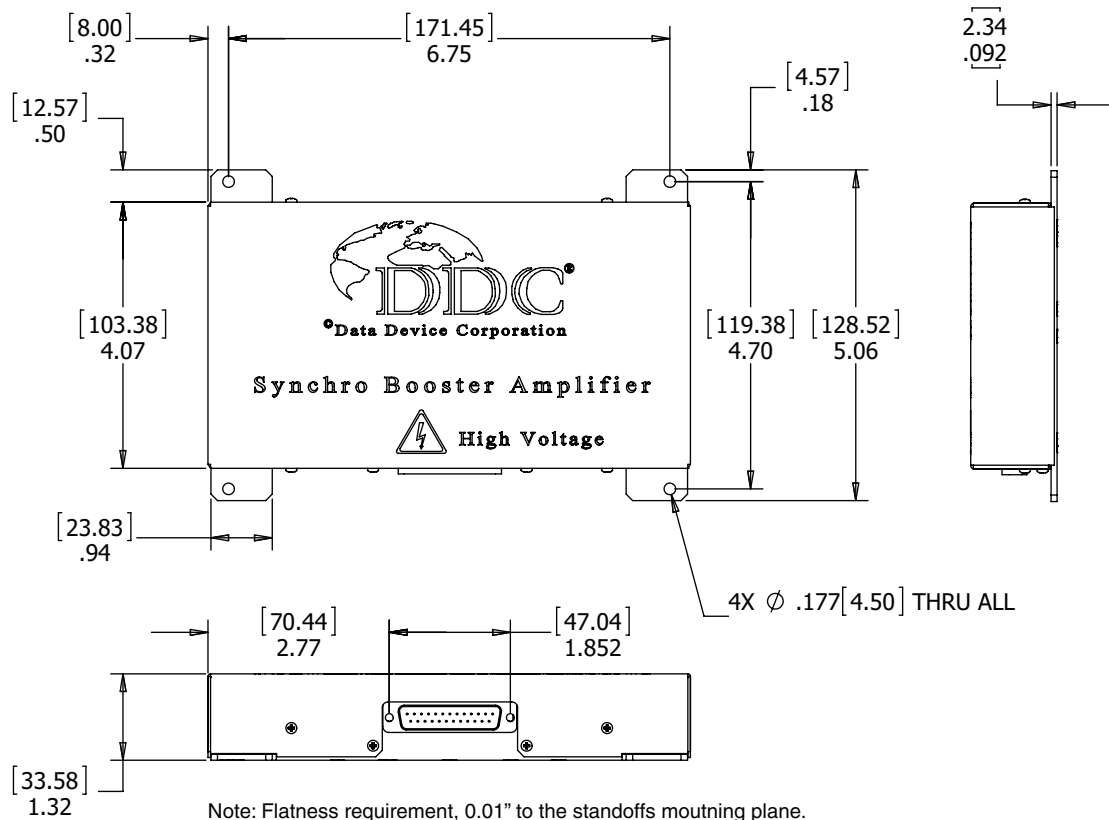


FIGURE 5. SBA-350XX MECHANICAL OUTLINE

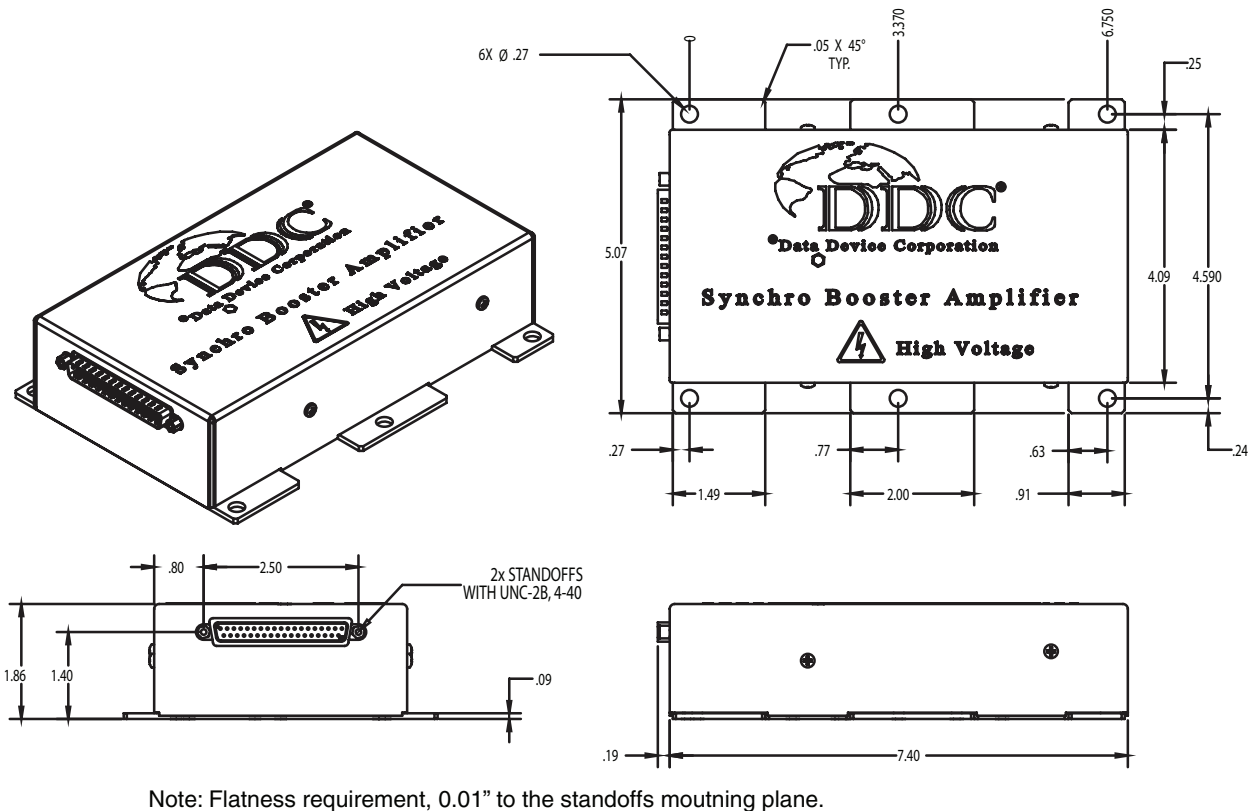


FIGURE 6. SBA-351XX MECHANICAL OUTLINE

TABLE 4. SBA-350XX PINOUTS

| PIN | NAME | PIN | NAME |
|-----|------------|-----|-----------|
| 1 | NC | 14 | DIS INPUT |
| 2 | BIT OUTPUT | 15 | NC |
| 3 | NC | 16 | GND |
| 4 | S1 OUT | 17 | S3 OUT |
| 5 | NC | 18 | CO |
| 6 | K | 19 | NC |
| 7 | TP | 20 | NC |
| 8 | TP | 21 | S2 OUT |
| 9 | S1 IN | 22 | NC |
| 10 | S3 IN | 23 | RH |
| 11 | S4 IN | 24 | RL |
| 12 | S2 IN | 25 | NC |
| 13 | TP | | |

NOTES:

1. Pin S4 is for resolver input versions only.
2. To enable the kick circuit for torque receivers, connect pin 6 to pin 18.
3. NC means no connection is made to this pin internally.
4. TP are test points intended for factory use only.
5. For chassis ground, use the baseplate or the board connector shell.
6. Suggested mating connector:
 Socket "Amp" 205090-1
 Screw "Amp" 5205980-1
 25 Pins "Tyco" 5205207-1

INPUT SIGNAL CONNECTIONS

SYNCHRO MODE CONNECT S1, S2, S3

- S1 = X
- S2 = Z
- S3 = Y

RESOLVER MODE CONNECT

- S3 = +SIN
- S1 = -SIN
- S2 = +COS
- S4 = -COS

RESOLVER SINGLE ENDED MODE CONNECT

- S2 = +COS
- S3 = +SIN

TABLE 5. SBA-351XX PINOUTS

| PIN | NAME | PIN | NAME |
|-----|-------------------------------|-----|-------------------------------|
| 1 | S1 OUT | 20 | S2 OUT |
| 2 | S3 OUT | 21 | NC |
| 3 | NC | 22 | NC |
| 4 | NC | 23 | RETURN |
| 5 | NC | 24 | NC |
| 6 | NC | 25 | NC |
| 7 | RL (115V) | 26 | RH (115V) |
| 8 | NC | 27 | NC |
| 9 | NC | 28 | NC |
| 10 | NC | 29 | NC |
| 11 | NC | 30 | NC |
| 12 | NC | 31 | S2 (5.0 V _{L-L}) IN |
| 13 | S3 (5.0 V _{L-L}) IN | 32 | NC |
| 14 | NC | 33 | NC |
| 15 | NC | 34 | DIGITAL GND |
| 16 | NC | 35 | DIGITAL GND |
| 17 | DIS INPUT | 36 | NC |
| 18 | BIT OUTPUT | 37 | CHASSIS |
| 19 | NC | | |

NOTES:

1. Kick Circuit is internally hardwired enabled.
2. NC means no connection is made to this pin internally.

ORDERING INFORMATION

SBA-35 X X X

Input/Output/Case Type

- 001** = 400 Hz, 90VL-L Synchro Input
400 Hz, 90VL-L Synchro Output
Low Profile Case
1 Mating Connector Included
- 002** = 60 Hz, 90VL-L Synchro Input
60 Hz, 90VL-L Synchro Output
Low Profile Case
1 Mating Connector Included
- 003** = 400 Hz, 6.81VL-L Resolver Input
400 Hz, 90VL-L Synchro Output
Low Profile Case
1 Mating Connector Included
- 004** = 60 Hz, 6.81VL-L Resolver Input
60 Hz, 90 VL-L Synchro Output
Low Profile Case
1 Mating Connector Included
- 005** = 400 Hz, 5VL-L Resolver Input)
400 Hz, 90VL-L Synchro Output
Low Profile Case
1 Mating Connector Included
- 006** = 60 Hz, 5VL-L Resolver Input
60 Hz, 90VL-L Synchro Output
Low Profile Case
1 Mating Connector Included
- 007** = 400 Hz, 2VL-L Resolver Input
400 Hz, 90VL-L Synchro Output
Low Profile Case
1 Mating Connector Included
- 008** = 60 Hz, 2VL-L Resolver Input
60 Hz, 90VL-L Synchro Output
Low Profile Case
1 Mating Connector Included
- 115** = 400 Hz, 5VL-L Resolver Input (single ended)
400 Hz, 90VL-L Synchro Output
Kick Circuit Hard-wired Enabled
High Profile Case
- 116** = 60 Hz, 5VL-L Resolver Input (single ended)
60 Hz, 90VL-L Synchro Output
Kick Circuit Hard-wired Enabled
High Profile Case

The information in this data sheet is believed to be accurate; however, no responsibility is assumed by Data Device Corporation for its use, and no license or rights are granted by implication or otherwise in connection therewith.
Specifications are subject to change without notice.

Please visit our web site at www.ddc-web.com for the latest information.



105 Wilbur Place, Bohemia, New York, U.S.A. 11716-2426

For Technical Support - 1-800-DDC-5757 ext. 7771

Headquarters, N.Y., U.S.A. - Tel: (631) 567-5600, Fax: (631) 567-7358

United Kingdom - Tel: +44-(0)1635-811140, Fax: +44-(0)1635-32264

France - Tel: +33-(0)1-41-16-3424, Fax: +33-(0)1-41-16-3425

Germany - Tel: +49-(0)89-15 00 12-11, Fax: +49-(0)89-15 00 12-22

Japan - Tel: +81-(0)3-3814-7688, Fax: +81-(0)3-3814-7689

Asia - Tel: +65-6489-4801

India - Tel: +91 080 301 10 200

World Wide Web - <http://www.ddc-web.com>



DATA DEVICE CORPORATION
REGISTERED TO:
ISO 9001:2008, AS9100C:2009-01
EN9100:2009, JIS Q9100:2009