SSA SERIES
Installation & Operating Manual

Rev 6/98

SSA - SAFETY INSTRUCTIONS

Read this page carefully before installation and use of the instrument, and follow all instructions in section 6 of Installation Procedures for safe installation of this product.

INTRODUCTION

The following clauses contain information, cautions and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition.

As this product is intended for incorporation into a machine or end-product, the end product must comply with all safety aspects of the relevant requirements of the European Safety of Machinery Directive 89/392/EEC as amended, and with those of the most recent versions of standards EN60204-1 and EN292-2 at least.

Installation, adjustment, maintenance and repair of the instrument shall be carried out only by qualified personnel.

WARNINGS

Any removal from the structure or removal of parts, except those to which access is permitted, is likely to expose live parts and accessible terminals which can be dangerous to live. If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a qualified person who is aware of the hazard involved.

The instrument shall be disconnected from all voltage sources before it is opened (for service method).

Any interruption of the protective earth conductors inside the instrument, is likely to make the instrument dangerous.

Components which are important for the safety of the instrument, may only be renewed by components obtained through Elmo service organization.

Before switching on, ensure that the instrument has been installed in accordance with the Installation Instructions.

Maximum DC supply according the types described in the operating manual.

How to use this manual - Flow Chart

The SSA amplifier is designed for OEM applications. It enables the user to adjust the amplifier for various types of motors and to save valuable adjusting time in repetitive applications.

Use the following flow chart in order to determine the chapters that you should read. If you are a new user of the SSA, you should read chapters 1-4 which will familiarize you with the product.

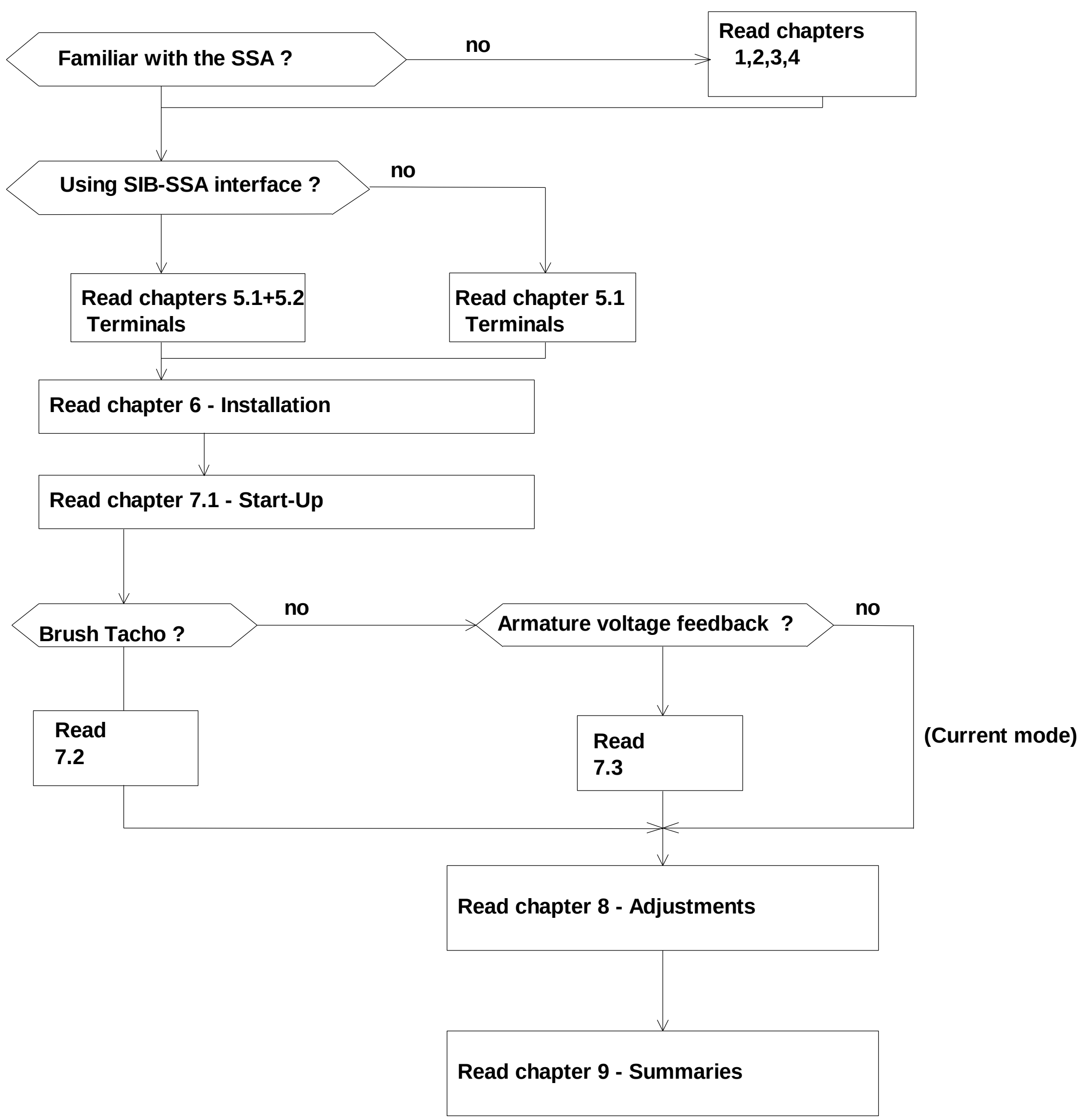


TABLE OF CONTENTS

1. Description

The SSA is a miniature PWM servo amplifier designed for DC servo motors. It utilizes power MOSFETs which contribute to its high efficiency and compact design. The SSA is constructed from two PCBs mounted on a heat sink plate. The lower board contains the power switching transistors which drive the motor, terminals for the power stage, the switch mode power supply and the protection logic. The upper PCB contains the control logic, terminals for the control stage, adjusting trimmers and indication LED's.

Standard features

* Four quadrant operation allows motor acceleration and deceleration under power in both CW and CCW directions.
* Internal DC to DC converter allows for operation from a single supply.
* Zero deadband.
* Excellent linearity.
* 2 inputs.
* Motor current monitor.
* Inhibit/fault indication (open collector).
* Remote control functions: Inhibit and CW/CCW disable.
* Adjustable compensation.
* Continuous and peak current limits.
* Input balance (offset) adjustment.
* External current limit adjustment.
* Operation in two velocity modes (Tacho or armature voltage feedback) or current mode.
* LED diagnostics.
* Removable terminals for easy installation and service.

The amplifiers are fully protected against the following faults:

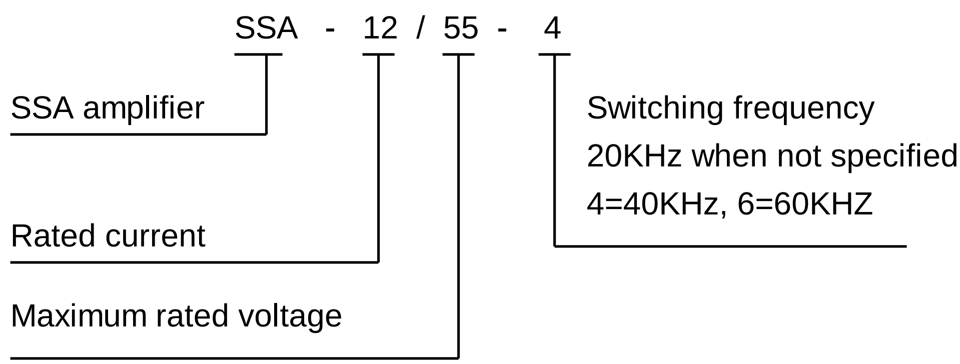
* Under/over voltage.
* Shorts between: outputs, output to ground.
* Excess temperature.

SIB-SSA

The SIB-SSA is an interface board for the SSA that is used to convert the SSA flat ribbon connector to spring type Phoenix terminals. This board has the same size as the SSA board and it can be assembled as an add-on card on top of any SSA amplifier or as a separate panel mount unit.

The SIB-SSA is connected to the SBA amplifier via a 16 wires ribbon cable.

2. Type designation



3. Technical specifications

Type	DC Supply Min-Max(V)*	Current limits Cont/Peak(A)	Size (mm)	Weight Kg
SSA-12/55	10-55	12/30	100x65x30	0.2
SSA-6/100	20-100	6/15	100x65x30	0.2
SSA-8/100	20-100	8/20	100x65x30	0.2
SSA-5/200	40-195	5/10	100X65X30	0.2

* DC output voltage is 90% of DC input voltage.
* 20KHz, 40KHz or 60KHz switching frequency.
* 2KHz current loop response (minimum)

[*] These are the absolute minimum-maximum DC supply voltages under any condition.

* Outputs voltages of ±13V, (15mA each) for external use.
* Efficiency at rated current - 97%.
* Drift: 10µV/°C (referred to input)
* Operating temperature: 0-50°C.
* Storage temperature: -10 - +70°C.

4. Operation of the servo control

4.1 Inputs

The SSA has 2 inputs: A single ended input (no.1) at terminal 1 and a differential input (no.2) at terminals 3,4.

The current gain of input 1 (current mode) is given by:

$$G_c = \frac{66 \times I_c}{100 + R1} \quad \text{(Amp/Volt)}, \quad R1 \text{ in Kohm}$$

Ic - amplifier rated continuous current

The current gain of the differential input for R6=R7 (current mode) is given by:

$$Gc_d = \frac{6.66 x I_c}{R7} \quad \text{(Amp/Volt)}$$

R7 in Kohm

The current gain in velocity mode is given by (place the appropriate Gc for each input):

$$G_v = \frac{50 \times G_c}{R11} \quad \text{(Amp/Volt)},$$

R11 in Kohm

The maximum input voltage at terminal 1 is calculated by:

$$V1max = 8 + 0.08R1 \quad \text{(Volts)}, \quad R1 \text{ in Kohm}$$

The maximum input voltage at terminal 3,4 is calculated by:

$$Vdmax = 8 + 0.8R6 \quad \text{(Volts)}, \quad R6=R7 \text{ in Kohm}$$

4.2 Velocity mode

In this mode op amp U1/2 is employed as a high gain error amplifier. The amplifier sums velocity command and the tachogenerator feedback signal, and provides the necessary servo compensation and gain adjustments, resulting in stable, optimum servo operation. This op amp is configured with two feedback paths:

One, in the form of a resistive T network, controls the DC gain of this amplifier. The equivalent value of a T network is given by:

$$Rf = \frac{10^{10}}{R11}$$

Resistor R11 (30 ohm) is mounted in solderless terminals so it can be changed easily whenever the DC gain of the error amplifier is to be changed.

The second feedback path controls the AC gain by C3 (0.022 µF), R12 (475 Kohm) and T1. Maximum AC gain is obtained with T1 set fully CW. Setting T1 fully CCW removes AC gain and no lag in response occurs. R12 and C3 are mounted in solderless terminals and can be easily replaced in cases when T1 range is not enough to get optimum response (See 8.5 for details).

The output of the error amplifier is:

$$Vo=(V1Gv1+V2Gv2)x\left[\frac{1 + SxC3xR12}{1 + SxC3xR12(1 + RfxK1/R12)}\right]$$

V1,V2, - Input signals

Gv1,Gv2- Gain of inputs.

K1 = Position factor of the wiper of T1.

Full CW = 1

Full CCW = 0.01

The feedback element must be connected for negative feedback.

The polarity of the SSA servo amplifiers is such that a positive input signal results in a negative voltage at terminal M1 with respect to terminal M2.

4.2.1 Velocity control using armature voltage feedback

Using the differential input amplifier to adjust its value, the armature voltage can be used as velocity feedback in all cases when low regulation ratio and low speed accuracy are acceptable.

4.3 Current mode

In order to operate the servo amplifier as a current amplifier, the velocity loop should be disabled. This is done by converting the error amplifier into a low gain DC amplifier which has a flat response beyond the desired current bandwidth. In this mode, R11 and C3 have to be removed from the circuit.

4.4 Current loop

Current loop control is obtained by op amp U1/3 (Current amplifier) and R20, C11 which form a lag-lead network for current loop. The standard amp is equipped with R20 (100Kohm) and C11 (0.01µF) to get optimum current response for an average motor in this power range. These components are mounted in solderless terminals.

4.5 Current limits

The servo amplifier can operate in the following voltage-current plane:

-Ip	**-Ic**	**+V** **Ic**	**Ip**
Intermittent zone	**Continuous zone**	**-V**	

Ic - Continuous current   Ip - Peak current

Fig. 4.1: Voltage-Current plane

Each amplifier is factory calibrated to have this shape of voltage-current operating area with rated values of continuous and peak current limits. To adjust other values of current limits, the user has to calculate and insert two resistors (one for the continuous limit and one for the peak limit). In addition to these "static" current limits, there are two analog inputs for "dynamic" control of the current limits. By applying 0-3V to the continuous current limit input and/or 0-7V for the peak current limit input, the user can scale down the static current limits from the preset values down to zero.

4.5.1 Time dependent peak current limit

The peak current is so designed that its duration is a function of the peak amplitude and the motor actual operating current before the peak demand. The maximum peak current is available for 2 second. The duration of Ip is given by:

$$Tp = 2.2 \ln \frac{Ip - Iop}{Ip - Ic}$$

Ic - Amplifier continuous current rating.

Ip - Peak demanded (not amplifier Ip)

Iop - Actual operating current before the peak demand.

Example:

A motor is driven by an SSA-12/55 amplifier at constant speed and constant current of 5A. What is the maximum possible duration of a 20A peak ?

$$Tp = 2.2 \ln \frac{20 - 5}{20 - 12} = 1.38 \text{ seconds}$$

4.6 Protective functions

All the protective functions activate internal inhibit. If the cause of the inhibit disappears, the amplifier will restart automatically. The user can monitor this function by checking terminal 12.

4.6.1 Short circuit protection

The short circuit protection uses the capability of the power MOSFET to tolerate high energy peaks for short periods of time. This protection is realized by sensing current in the DC line. Every current peak above a certain value will inhibit the amplifier for a period of approx. 30mS.

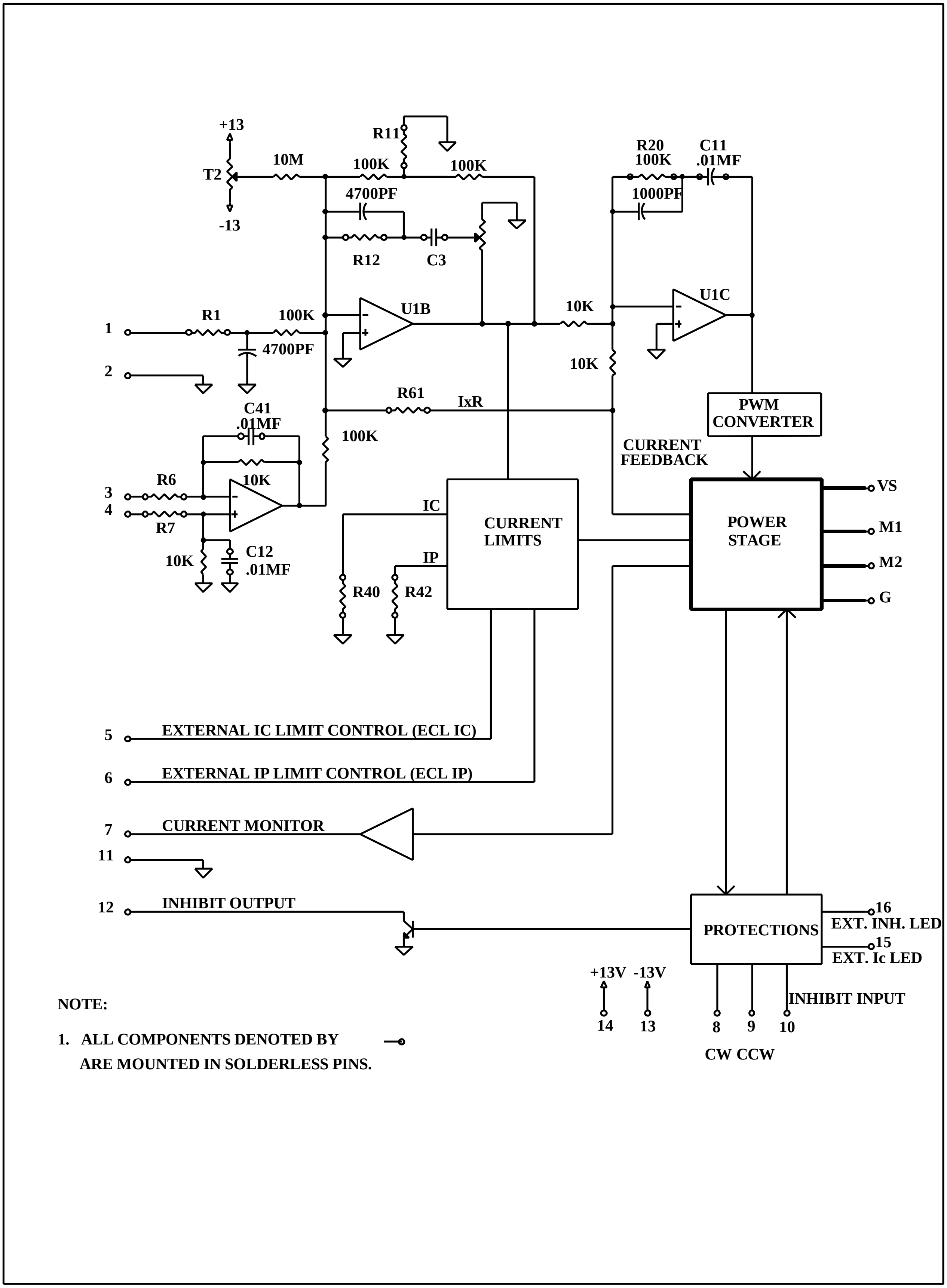
If a short circuit condition still exists, the cycle will repeat endlessly while turning on the Inhibit LED (Inh) to indicate short circuit condition. The amplifier is protected against shorts between outputs, and either output to ground.

4.6.2 Under/Over voltage protection

Whenever the DC bus voltage is under or over the limits indicated in the technical specifications, the amplifier will be inhibited.

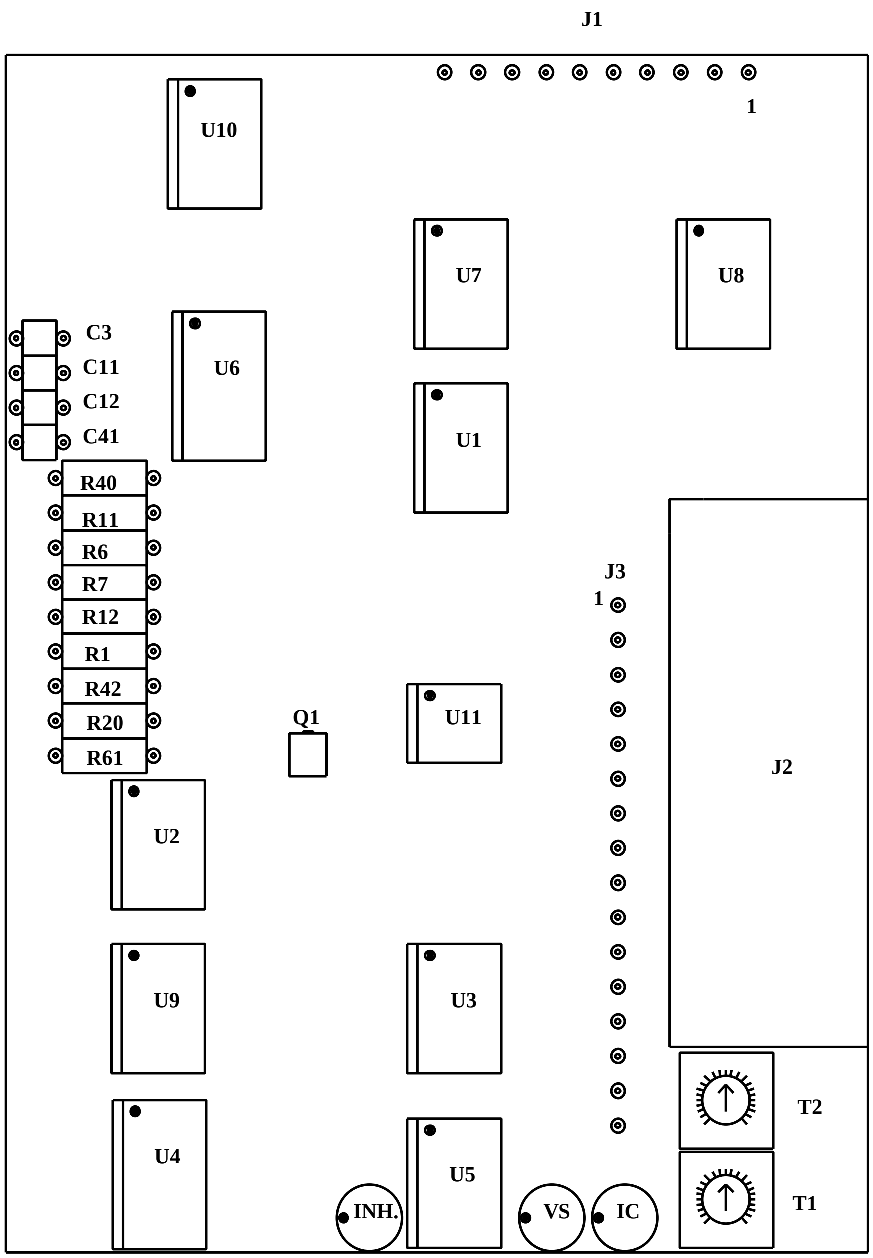
4.6.3 Temperature protection

Temperature sensor is mounted on the heatsink. If, for any reason, the temperature exceeds 90°C the amplifier will be inhibited. The amplifier will restart when the temperature drops below 85°C.



NOTE:

1. ALL COMPONENTS DENOTED BY —o ARE MOUNTED IN SOLDERLESS PINS.



SSA -CONTROL BOARD

5. Terminal Description

5.1 Terminals of the basic SSA

Power Stage

Terminal	Function	Remark
Vs	Power input positive	
M1	Armature output	This output will be negative when a positive signal is fed to one of the inputs.
M2	Armature output	This output will be positive when a positive signal is fed to one of the inputs.
G	Power input common	

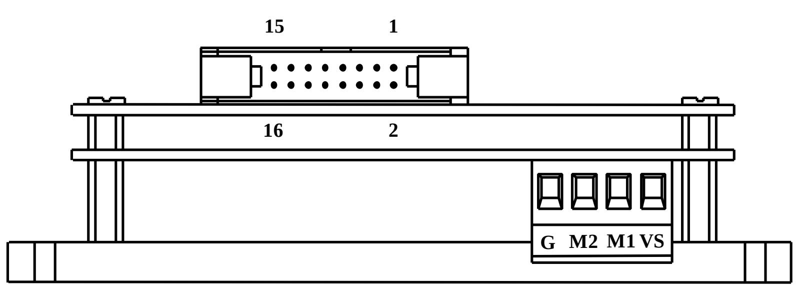
Control stage

Terminal	Function	Remark
1	Reference input	For more details see chapter 4.1.
2	Circuit common	
3	Differential input (negative)	For more details see chapter 4.1.
4	Differential input (positive)	For more details see chapter 4.1.
5	External continuous current limit	For more details see chapter 4.5.
6	External peak current limit	For more details see chapter 4.5.
7	Current monitor	The scale is 3/Ic (V/A)
8	CW disable	Low level input voltage * will disable half of the power bridge and rotation in one direction.

* -1V < Vil < 1V ; 2V < Vih < 30V
Source sink capability - 2mA min.

Control stage - Cont.

Terminal	Function	Remark
9	CCW disable	Low level input voltage * will disable half of the power bridge and rotation in one direction.
10	Inhibit input	Low level input voltage* will disable the power bridge. See 7.1.1 for details
11	Circuit common	
12	Inhibit indication output	Whenever the amplifier is inhibited, whether by an internal or external cause, this open collector output goes low state (Max sink current 10mA).
13	-13V	15mA external load.
14	+13V	15mA external load.
15	Output for external Ic LED	
16	Output for external Inhibit LED	



CONNECTORS

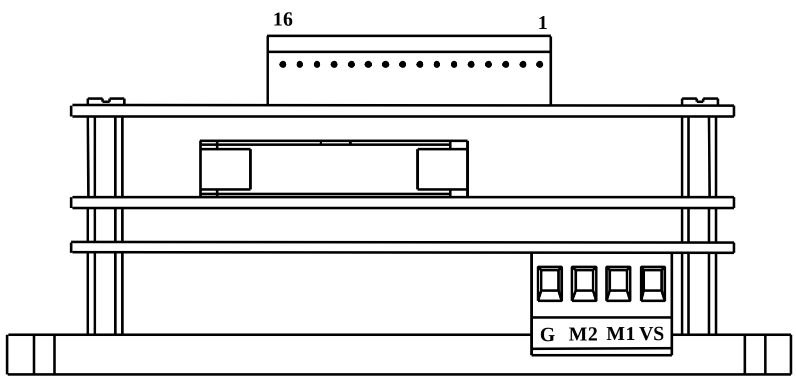
SSA WITHOUT SIB CARD

* -1V < Vil < 1V ;   2V < Vih < 30V

Source sink capability - 2mA min.

5.2 Terminals for SIB-SSA

The numbering of the SIB-SSA terminals (1-16) is identical to the numbering of the SSA control board connector.



CONNECTORS
SSA WITH SIB-SSA CARD

6. Installation procedures

6.1 Mounting

As there are hazardous voltages in some models, and all models require protection against environmental effects/elements, and each may be required to provide adequate earth, these models must be adequately enclosed in accordance with electric shock protection and earth requirements and Enclosure Degrees of Protection requirements in accordance with the most recent version of standard EN60204-1.

The SSA series dissipates its heat by natural convection up to loads of 400W. For higher output load the amplifier should be mounted on an additional heatsink or cooled by fan.

6.2 Wiring

Warning! As the units (some of the models) are used with hazardous voltages (>60vdc), and there is no electrical isolation provided, adequate electrical separation in accordance with the requirements of EN60204-1 (latest version) must be provided at their outputs, and to the supplies.

Proper wiring, grounding and shielding techniques are important in obtaining proper servo operation and performance. Incorrect wiring, grounding or shielding can cause erratic servo performance or even a complete lack of operation.

a) Keep motor wires as far as possible from the signal level wiring (feedback signals, control signals, etc.).
b) If additional inductors (chokes) are required, keep the wires between the amplifier and the chokes as short as possible.
c) Minimize lead lengths as much as is practical. The DC power supply should be mounted as closed as possible to the amplifier.
d) Use a shielded flat ribbon cable for connecting the signals. Avoid running this ribbon in close proximity to power leads or other sources of EMI noise. If you use the SIB-SSA interface, use twisted and shielded wires for connecting all signals (command and feedback).
e) Use a 4 wires twisted and shielded cable for the motor connection.
f) Shield must be connected at one end only to avoid ground loops.
g) All grounded components should be tied together at a single point (star connection). This point should then be tied with a single conductor to an earth ground point.

h) After wiring is completed, carefully inspect all conditions to ensure tightness, good solder joints etc.

A reliable connection with the spring type connectors (on the SIB-SSA) is achieved with wires of 0.5mm^2 (AWG 20) stripped to a length of 11mm (.043").

6.3 Load inductance

The total load inductance must be sufficient to keep the current ripple within the limits (10%-20% of rated current is recommended). The current ripple (Ir) can be calculated by using the following equation:

$$Ir = \frac{0.5 \times Vs}{f \times L} \quad (A)$$

L - load inductance in mH.

Vs - Voltage of the DC supply in Volts.

f - Frequency in KHz.

If motor inductance does not exceed this value, a choke should be added (on the motor branch) summing together the required inductance

$$Lch = L - Larm$$

Lch - Choke inductance

Larm - Armature inductance

6.4 DC power supply

DC power supply can be at any voltage in the range defined within the technical specifications (chapter 3). The supply source must comply with the safety aspects of the relevant requirements in accordance with the most recent version of the standard EN60950 or equivalent Low Voltage Directive Standard, all according to the applicable Overvoltage Category. If the power source to the power supply is the AC line (through a transformer), safety margins have to be considered to avoid activating the under/over voltage protection due to line variations and/or voltage drop under load.

The nominal DC bus voltage should be in the following range:

$$1.2V_{dcmin} < Vdc < 0.9V_{dcmax}$$

V_{dcmin} - Minimum DC bus in the table of chapter 3

V_{dcmax} - Maximum DC bus in the table of chapter 3

Recommended minimum power supply capacitance for single phase connection:

For SSA-12/55 5600µF

For SSA-6,8/100 3300µF

For SSA-5/200 1500µF

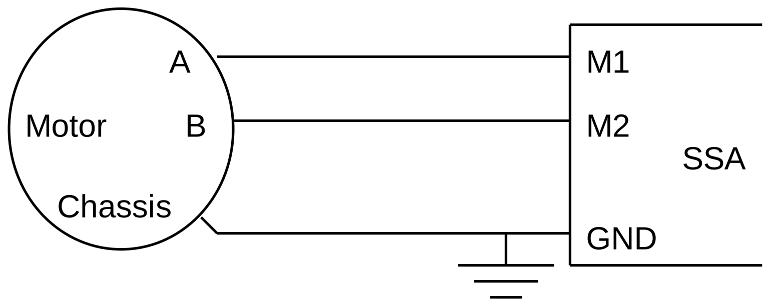
The transformer power should be calculated to have the capability to deliver power to the amplifier (including peak power), without significant voltage drops.

In addition to the above, the transformer must comply with the safety aspects of the relevant requirements in accordance with the most recent version of the standard EN60742 (Isolating and Safety Isolating Transformers).The AC/DC power supply must comply as such, with the relevant safety requirement of the most recent version of the standard EN60950 or equivalent Low Voltage Directive Standard, all according to the applicable Overvoltage Category.

While driving high inertia loads, the power supply must be equipped with a shunt regulator, otherwise, the amplifier will be disabled whenever the capacitors are charged above the maximum voltage.

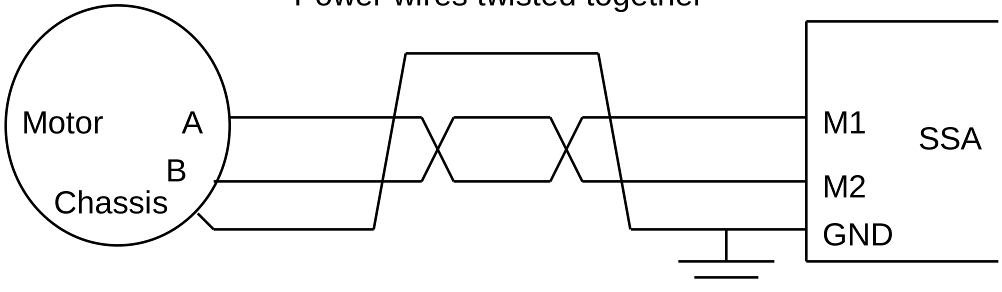
6.5 Wiring diagrams

MOTOR WIRING



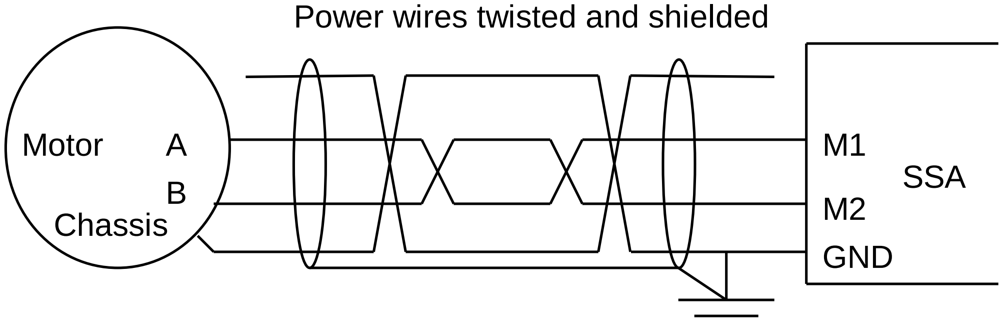
Minimum acceptance

Power wires twisted together

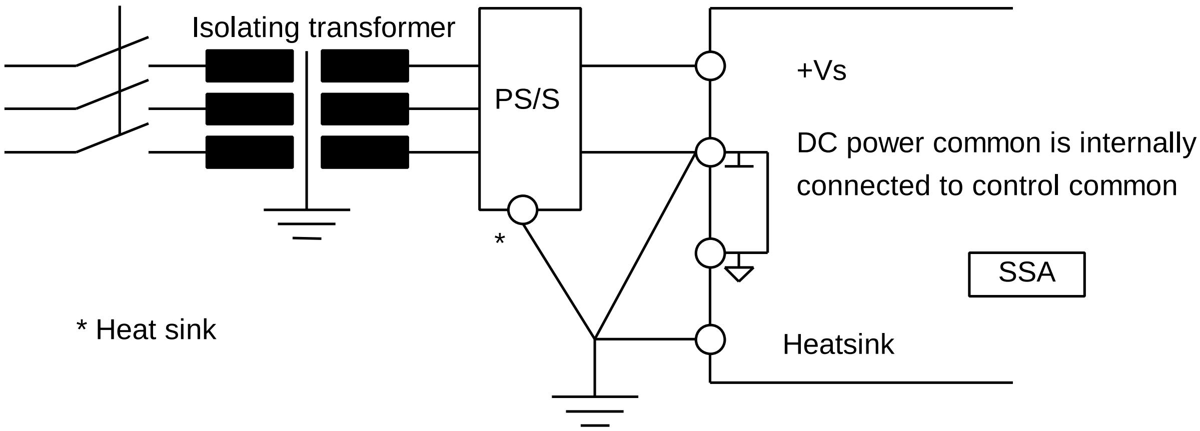


Acceptable for most applications

Power wires twisted and shielded



Optimum wiring, minimum RFI



Guide lines for connecting a non isolated amplifier with an isolating power transformer

Ground:

DC power common

Motor chassis

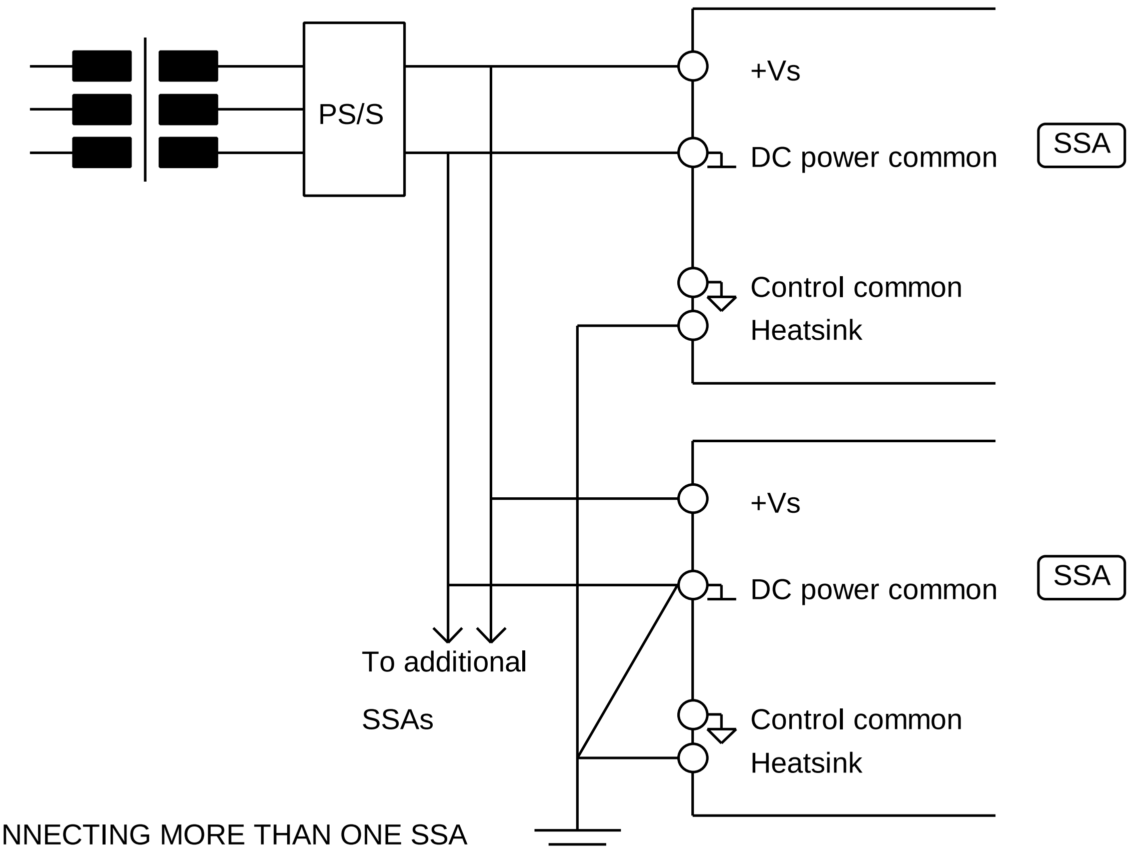
Amplifier's heat sink

Do not ground:

Control common - It is internally connected to the power common. Grounding the control common will create a ground loop.

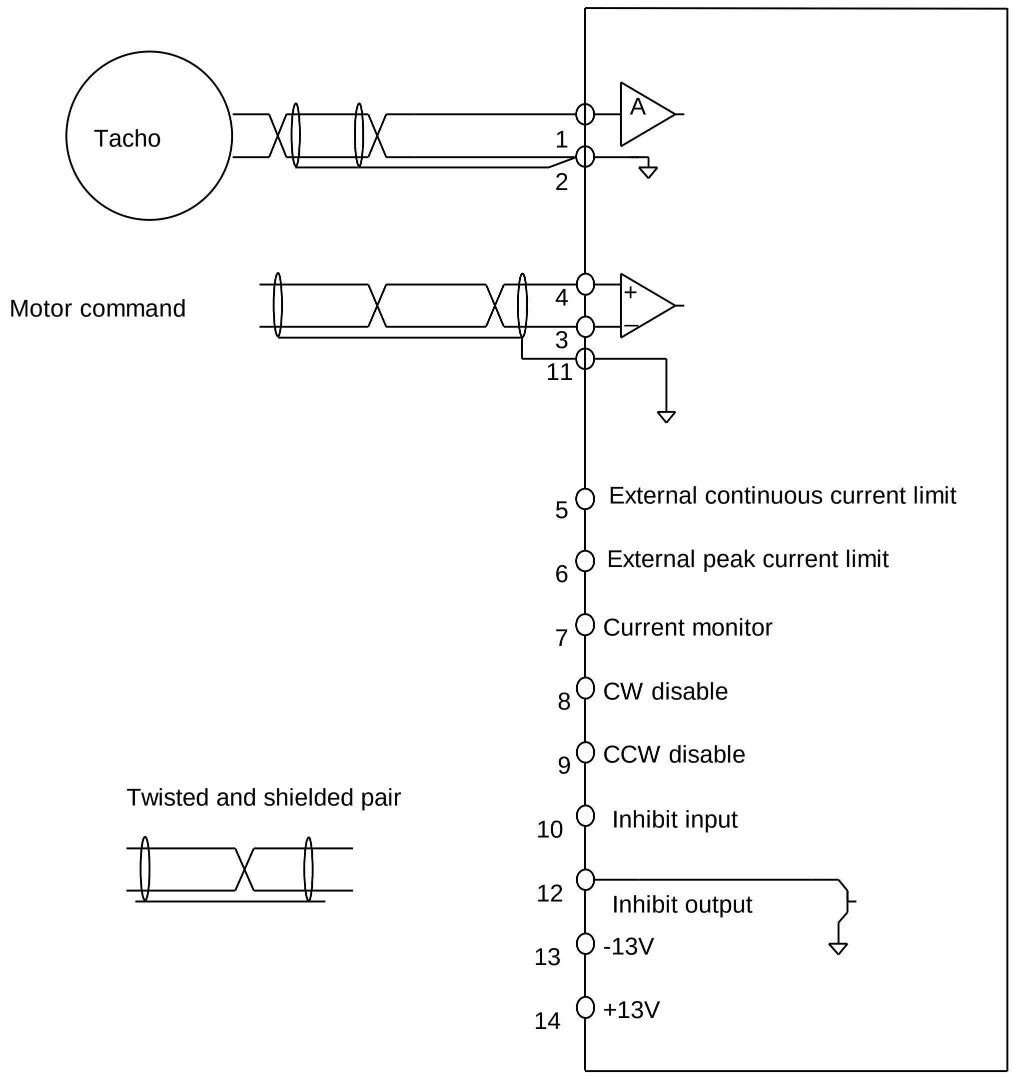
Caution:

- If source of motor command is grounded, use amplifier's differential input. Otherwise, ground loop is created.



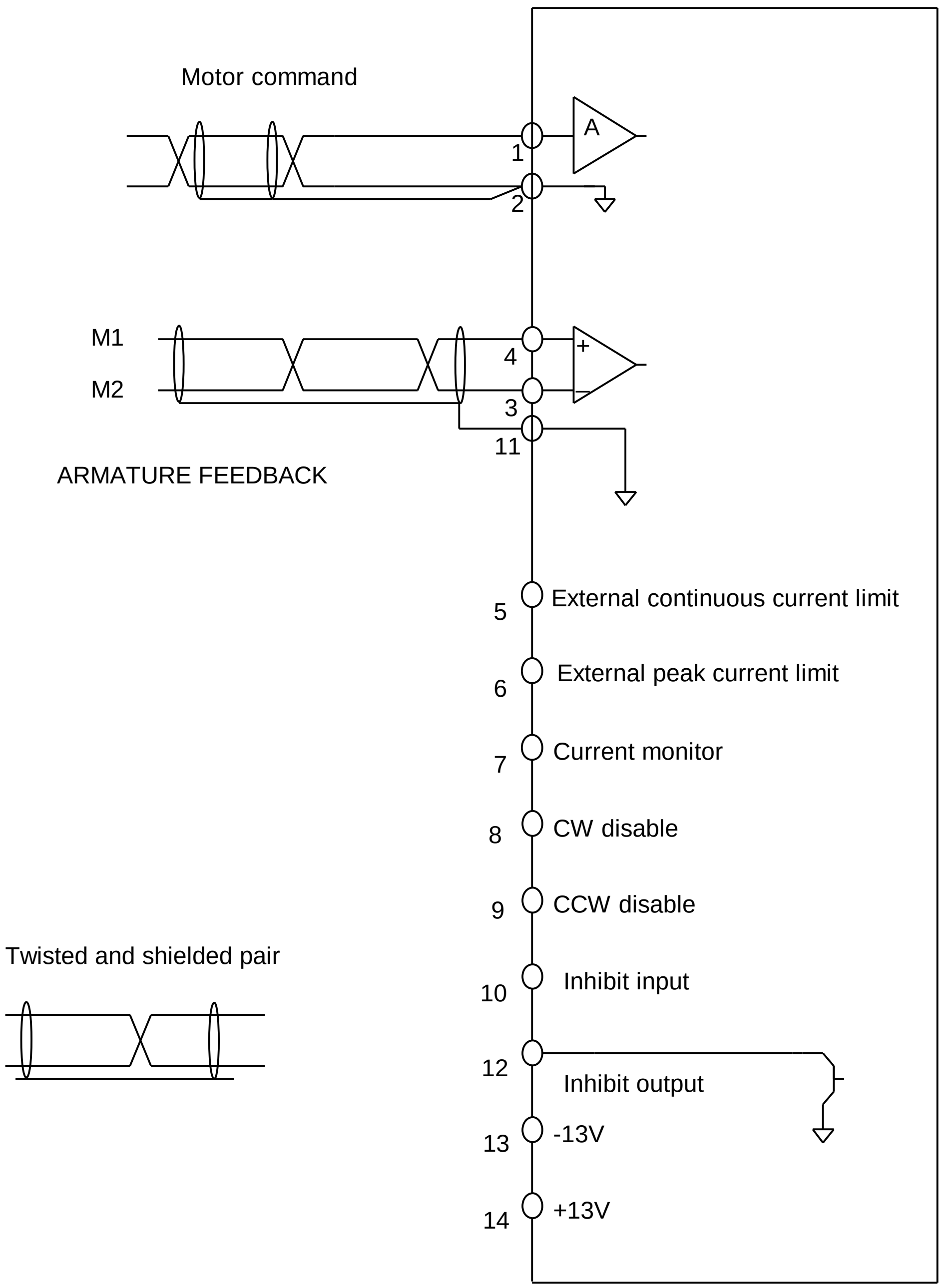
CONNECTING MORE THAN ONE SSA

All rules about supply connections described in the previous page are also valid for multi-SSA connection.



SSA CONTROL CONNECTIONS

TACHOGENERATOR FEEDBACK



SSA CONTROL CONNECTIONS

ARMATURE VOLTAGE FEEDBACK

7. Start - Up Procedures

All the operations of this chapter do not require to power on the unit. The steps of paragraph 7.1 must be performed before proceeding to the appropriate feedback sensor.

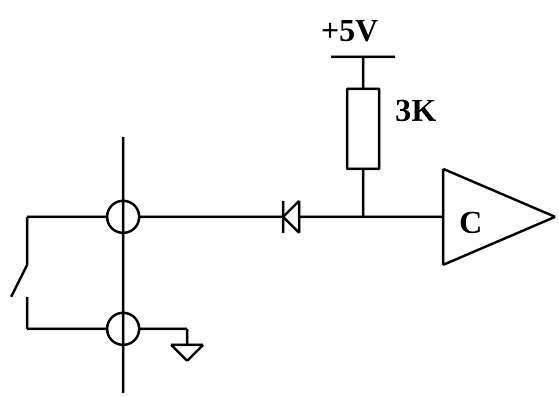
7.1 Common procedures for all amplifiers types

7.1.1 Inhibit logic

Select the desired Inhibit logic you need:

a) Disable by Low

Inhibit function will be activated by connecting its input (terminal 10) to a low level signal. If no signal is applied to this input the amplifier will be enabled upon power on.



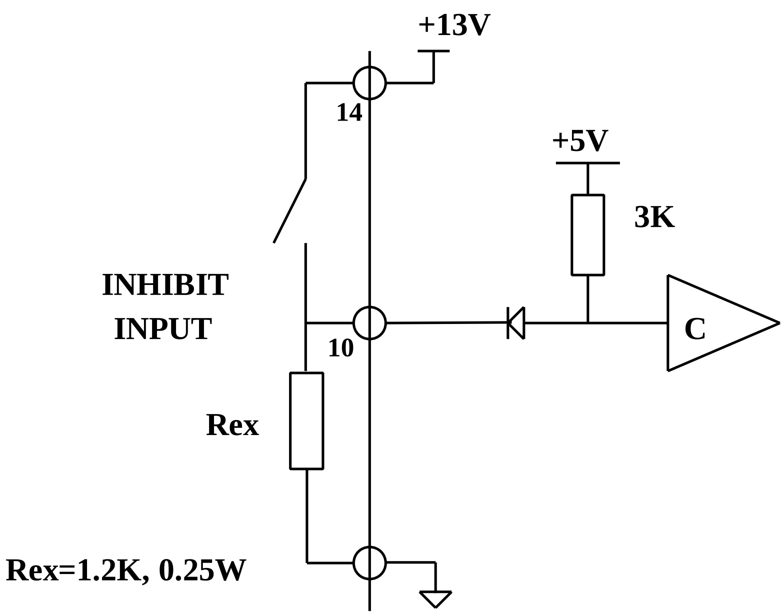
SSA DISABLED BY ACTIVE LOW OR CLOSED CONTACT

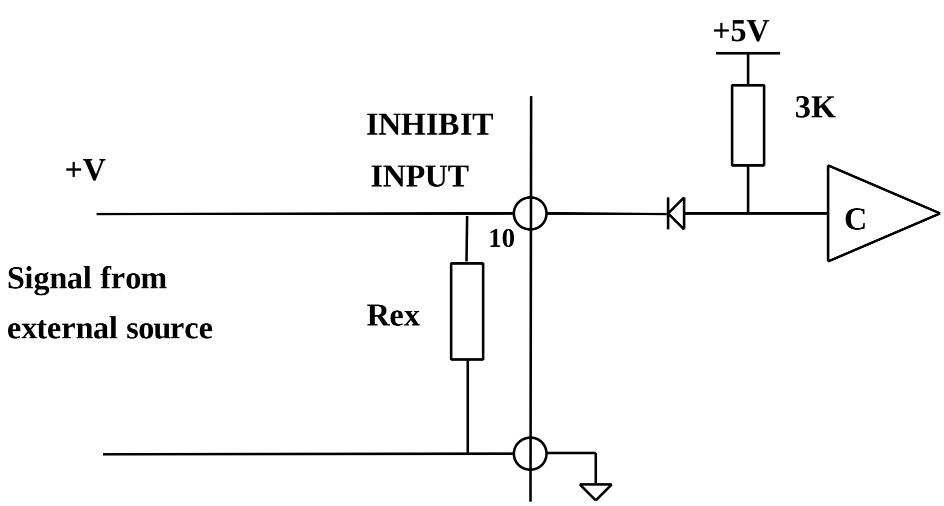
b) Enable by High

Inhibit function will be de-activated by connecting its input (terminal 10) to a high level signal and adding an external resistor (Rex) as in the following examples. If no signal is applied to this input the amplifier will be disabled upon power on.

The power of Rex is given by:

$$P = \frac{V^2}{800} \quad \text{(Watt)}$$





SSA ENABLED BY ACTIVE HIGH OR CLOSED CONTACT

7.1.2 Velocity mode

To operate in velocity mode the velocity loop should be enabled by converting the error amplifier to a high gain PI amplifier. **Make sure that R11 (30 ohm),R12 (475Kohm) and C3 (0.022mF) are installed on the board (in solderless terminals).**

7.1.3 Current mode

a) Converting the amplifier into current mode

To operate in current mode the velocity loop should be disabled by converting the error amplifier to a low gain proportional amplifier.

- Remove R11 (in solderless terminals).

- Remove C3 (in solderless terminals).

In addition, you must make sure that the velocity feedback signal is not entering the error amplifier. If a tachogenerator is used, make sure that it is not connected to the amplifier.

b) Selecting the reference signal gain

The SSA has 2 inputs: single ended input (terminal 1) and a differential input (terminals 3,4).

Care must be taken not to apply input voltage above the maximum input voltage as this will cause the input op amp to operate beyond its limits (±10V) and in extreme cases may even damage the op amp.

The standard procedure recommends to use the differential input for the reference signal.

Following are the input maximum voltage and impedance with the standard values of input resistors:

INPUT - RESISTOR	STANDARD VALUE	MAX. VOLTAGE	Current Gain(A/V) (in current mode)	INPUT IMPEDANCE
Terminal 1 - R1	100 Kohm	25V	0.33xIc	25 Kohm
Differential - R6,7	20Kohm	30V	0.33xIc	30 Kohm

See chapter 4.1 for calculation of other values

7.1.4 Static current limits

The amplifiers' current limits can be adjusted statically (without load) by inserting fix resistors on the logic board.

The current limits are factory adjusted to the amplifier's rated values. Reducing the nominal limits is performed as follows:

a) Continuous current limit adjustment

R40 should be calculated and inserted as follows:

$$Q = \frac{Ic(new)}{Ic(nom)} \qquad 0 < Q < 1$$

Ic(new) - new value of continuous current limit

Ic(nom) - nominal current rating of the amplifier (6, 8 or 12A)

$$R40 = \frac{2Q}{1-Q} \quad (Kohm)$$

b) Peak current limit adjustment

R42 should be calculated and inserted as follows:

$$P = \frac{Ip(new)}{Ip(nom)} \qquad 0 < P < 1$$

Ip(new) - new value of peak current limit.

Ip(nom) - peak current rating of the amplifier (15, 20 or 30A)

$$R42 = \frac{10P}{1-P} \quad (Kohm)$$

7.2 Velocity control using tachogenerator feedback

When using tacho feedback, it is recommended to use the single ended input for the tacho signal and to use the differential input for the reference signal in order to reduce common mode noises.

For tacho voltage at maximum application speed higher than 5V:

R1 = 20xVtm - 100 (Kohm) (R1 $\geq$ 1K)
Vtm - tacho voltage at maximum velocity

R6 = R7 = 2xVdm (Kohm)
Vdm - maximum reference voltage at the differential input.

For tacho voltage at maximum application speed lower than 5V:

R1 = 1K

$$R6 = R7 = \frac{10Vdm}{Vtm} \quad (Kohm)$$

Vdm - maximum reference voltage at the differential input.

7.3 Velocity control using armature voltage feedback

Using the differential input amplifier to adjust its value, the armature voltage can be used as velocity feedback in all cases when low regulation ratio and low speed accuracy are acceptable. Attention must be paid not to saturate the operational amplifier by observing the following restrictions:

R6 = R7 = 2xVs (Kohm)
C12 = C41 = 0.1-0.47µF, ceramic capacitors.

Vs is the DC voltage of the power supply.

The velocity loop is closed by connecting the following terminals:

Terminal M1 to terminal 4.
Terminal M2 to terminal 3.

The reference signal is fed to input 1 and R1 should be calculated as follows:

$$K = \frac{Vs}{Vam}$$

Vam - armature voltage at maximum application speed

$$R1 = 20xV1mxK - 100 \quad (Kohm)$$

V1m - maximum reference voltage at input 1.

Reducing the DC and AC gains of the error amplifier by increasing C3 and R11 is recommended. The final values depend on the type of motor and mechanical load, so optimum results will be achieved by the empirical method. Using this method a speed range of 20:1 and ±3% speed accuracy may be achieved.

Calculating R61 for IxR compensation

In order to improve the speed stability in various load conditions, an IxR compensation is required. This is achieved by inserting R61. The value of R61 can either be achieved empirically (chapter 8.4) or by using the following equation:

$$R61 = \frac{2.4xVam(R1+100)}{IcxV1mxRa} \quad (Kohm)$$

R1, Vam, V1m same values as above.

Ic - Amplifier's nominal current

Ra - Total armature resistance **in Kohm**

8. Amplifier adjustment and diagnostics

Important remarks:

A. If all the previous steps were accomplished you may now turn the power on and continue with the following adjustments. You may skip the step for current mode or velocity mode according to your application.

B. In some applications, especially those where the motor electrical parameters (total inductance and resistance in the armature circuit) are much smaller or larger than normally encountered, the current loop response should be optimized before proceeding with the following steps - See Appendix A.

8.1 Balance adjustment

If the motor is rotating with the command signal at zero voltage, a balance adjustment will be necessary. Turn the balance trimmer (T2) as required until the motor stops. As a rule, have the command signal connected and set to zero when balancing the amplifier. This way, any offset in the command signal will be canceled.

8.2 Verifying the static current limits

To measure the current limits, a load must be connected (choke or motor armature) to the armature output. Measurement can be done either by direct current measurement or by using the current monitor (terminal 7).

$$\text{current monitor scale} = \frac{3}{I_{c(nom)}} \quad \text{(V/A)}$$

8.3 External Current Limit (ECL) adjustment

If you do not use this feature, skip this chapter.

The amplifiers' static current limits can be scaled down dynamically by two external voltage signals.

a) ECL function on continuous current limit:

$$I_c = \frac{V5 \times I_c(nom)}{3}$$

V5 - voltage applied at terminal 5.

Voltages between 0 to 3V will control continuous current limit from zero to Ic(nom) or Ic(new) as set in the static adjustment.

b) ECL function on peak current limit:

$$I_p = \frac{V6 \times I_p(nom)}{7.5}$$

V6 - voltage applied at terminal 6.

Voltages between 0 to 7.5V will control peak current limit from zero to Ip(nom) or Ip(new) as set in the static adjustment. Maximum permissible voltage at these terminals is ±12V

8.4 Adjustment of the IxR compensation

If you do not use this feature, or if you have already calculated and inserted R61 according to 7.3, skip this chapter.

In order to improve the speed stability in various load conditions, the following procedure should be performed:

a. Connect a decade resistor box in the terminals of R61 - start with 1Mohm
b. Run motor at 2/3 of nominal speed.
c. Apply nominal load.
d. Decrease resistance value until motor speed reaches the no load speed.
e. Install R61 as close as possible to the decade box value.
f. Notice that a high compensation may result in unstable operation of the amplifier.

8.5 Response adjustment (Velocity mode only)

In most applications optimum response is achieved by adjusting the compensation (COMP) trimmer. Adjustment procedure is as follows:

- Provide the amplifier with a low frequency, bi-directional square wave velocity command (A 0.5Hz, ±2V waveform is often employed).
- Apply power to the amplifier, and while monitoring the tachometer signal, gradually adjust the COMP trimmer from the CCW toward the CW position. Optimum response (critically-damped) should be achieved at some position before reaching full CW on T1. Fig 8.1 illustrates the types of waveforms observed for various setting of T1.

In some applications, especially those where the load inertia is much smaller or larger than normally encountered, the standard compensation components values of 0.033µF for C3 and 470Kohm for R12 may not allow an optimum setting of the COMP trimmer T1. In fact, the velocity loop may be unstable for any setting of T1.

In these cases different values for C3 and R12 must be chosen. The following procedure can be used to select these values:

- Short circuit C3 with a short jumper wire.
- Replace R12 with a decade resistance box. Initially set the box resistance at 20Kohm.
- Set T1, the COMP trimmer to approximately midrange.
- Input a 0.5Hz, 2V bi-directional square wave velocity command signal to the amplifier.
- Apply power, and while monitoring the tachometer signal, gradually increase the value of the box resistance until optimum response as depicted in Fig 8.1 is achieved.
- Substitute the closest standard value discrete resistor for R12 and remove the decade resistance box.
- Remove the shorting jumper across C3, and again check the response using the squarewave test signal. If near optimum results are obtained, trim the response using the COMP trimmer T1 for the optimum.

- If the previous step does not yield satisfactory results, if unacceptable overshooting has been noted, substitute a larger value than 0.033 µF; or, if the response is overdamped substitute a smaller value than 0.033 µF. Repetition of this procedure should yield an optimum choice for C3.

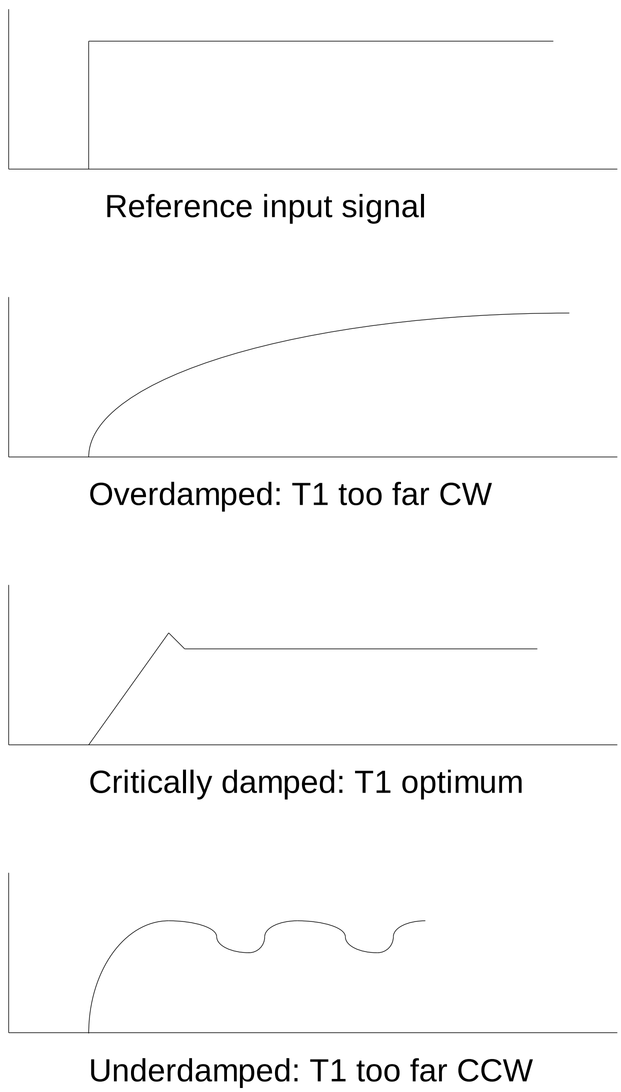


Fig. 8.1

Typical velocity response waveforms

9. Tables and Summaries

9.1 Adjusting trimmers

Two trimmers are installed on the upper board of the amplifier with the following functions:

T1 (compensation) - see 8.5.

T2 (balance) - See 8.1.

9.2 LED diagnostics

Three LEDs are installed on the upper board of the amplifier with the following designations: Ic, In, Vs. Under normal operation only Vs should illuminate (Vs indicates the existence of supply voltages). The following table represents the faults indications of the LEDs:

	1	2
In	X	
Ic		X
Vs	X	X

X - Illuminated LED

1. One or more of: external inhibit, under/over voltage, short circuit, excess temperature.
2. Continuous current limit.

Appendix A - Response adjustment - current loop

In most applications it is not necessary to adjust the current loop to achieve the optimum response. When there are extreme electrical parameters in the armature circuit (inductance and resistance) the standard components values of 0.01µF for C11 and 100Kohm for R20 may not yield with the optimum response. The current loop should be optimized as follows:

- Turn the amplifier to a current amplifier by removing R11 and R12.
- Provide the amplifier with a bi-directional square wave current command (100-200Hz, ±2V waveform is often employed).
- Apply power to the amplifier, and monitor the load current either by a current probe or by the current monitor.

If the current response is not critically damped, use the following procedure:

- Short circuit C11 with a short jumper wire.
- Replace R20 with a decade resistance box. Initially set the box resistance at 10Kohm.
- Apply the square wave test signal to the amplifier input.
- Apply power, and while monitoring the load current, gradually increase the value of the box resistance until optimum response as depicted in Fig A-1 is achieved.
- Substitute the closest standard value discrete resistor for R20 and remove the decade resistance box.
- Remove the shorting jumper across C11, and again check the response using the square wave test signal.
- If the previous step does not yield satisfactory results, if unacceptable overshooting has been noted, substitute a larger value than 0.01 µF; or, if the response is overdamped, substitute a smaller value than 0.01 µF. Repetition of this procedure should yield an optimum choice for C11.

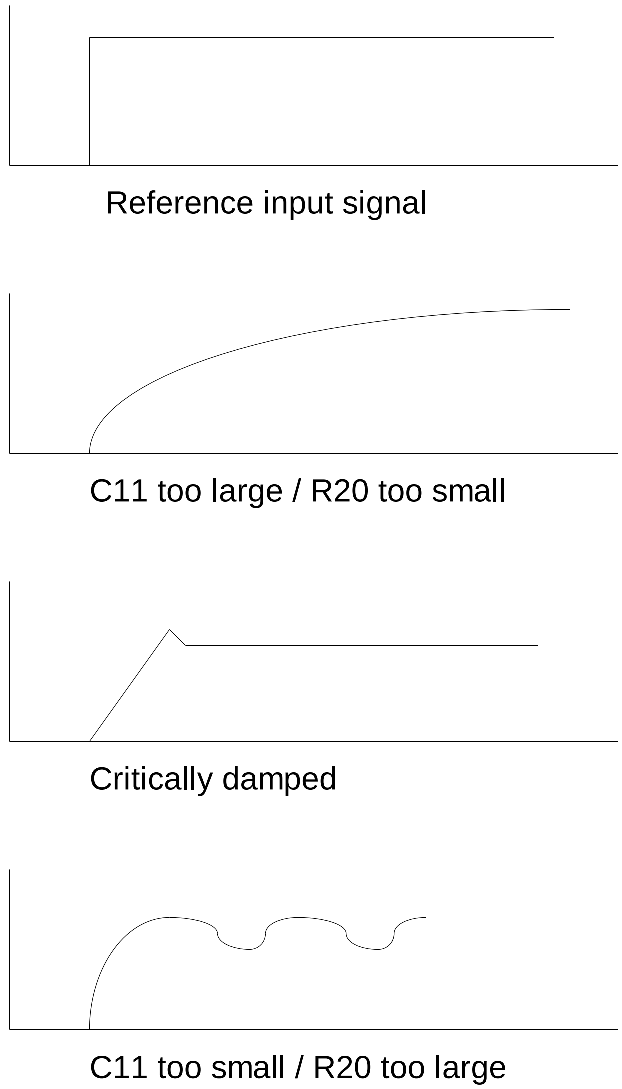
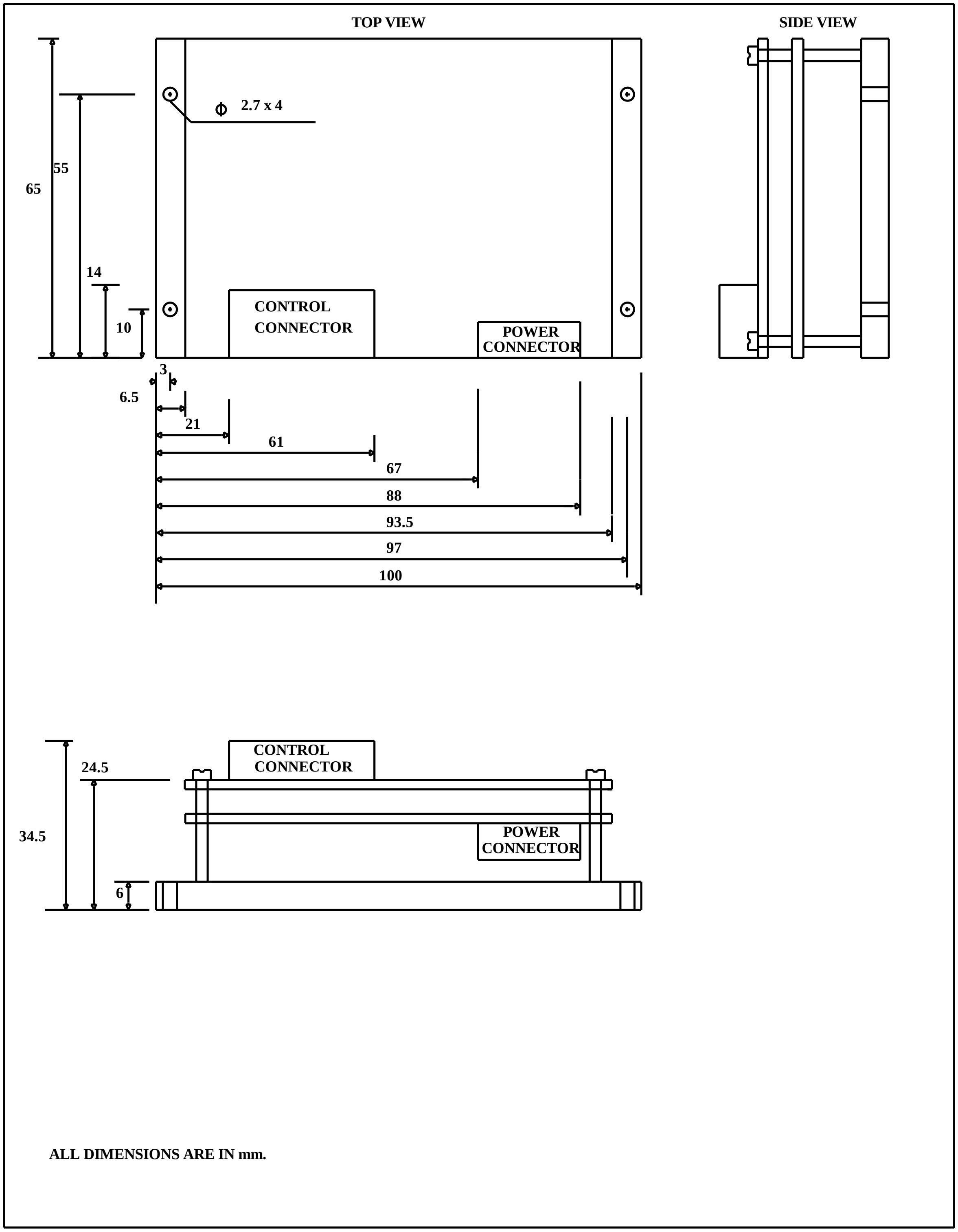
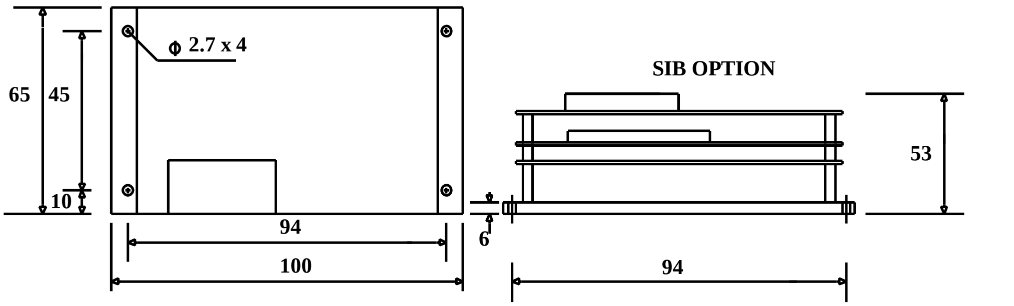


Fig. A-1

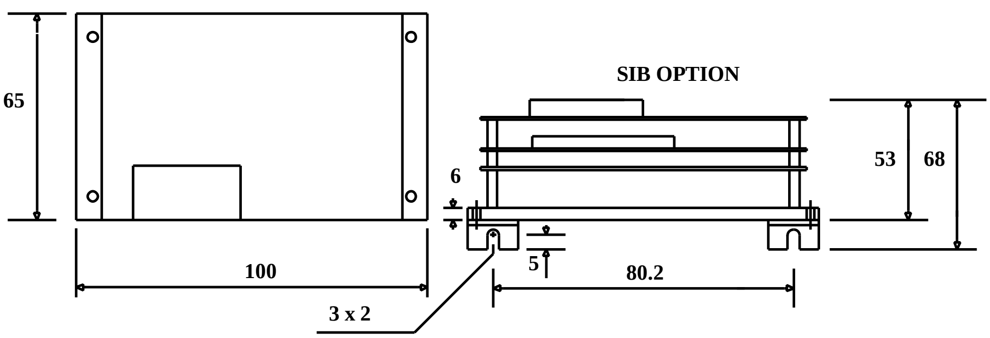
Typical current response waveforms

DIMENSIONAL DRAWINGS


TOP VIEW
SIDE VIEW
2.7 x 4
65
55
14
10
CONTROL CONNECTOR
POWER CONNECTOR
3
6.5
21
61
67
88
93.5
97
100
CONTROL CONNECTOR
24.5
34.5
POWER CONNECTOR
6
ALL DIMENSIONS ARE IN mm.



SSA WITH SIB-SSA CARD



SSA WITH RIGHT ANGLE

MOUNTING LEGS

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The warranty performance covers only ELMO's products and only the elimination of problems that are due to manufacturing defects resulting in impaired function, deficient workmanship or defective material. Specifically excluded from warranty is the elimination of problems which are caused by abuse, damage, neglect, overloading, wrong operation, unauthorized manipulations etc.

The following maximum warranty period applies:

12 months from the time of operational startup but not later than 18 months from shipment by the manufacturing plant.

Units repaired under warranty have to be treated as an entity. A breakdown of the repair procedure (for instance of the repair of a unit into repair of cards) is not permissible.

Damage claims, including consequential damages, which exceed the warranty obligation will be rejected in all cases.

If any term or condition in this warranty performance shall be at variance or inconsistent with any provision or condition (whether special or general) contained or referred to in the Terms and Conditions of Sales set out at the back of Elmo's Standard Acknowledge Form, than the later shall prevail and be effective.