# EK94

## *Evaluation Kit*

## APPLICABLE PARTS (SOLD SEPARATELY)

- MSA303

## INTRODUCTION

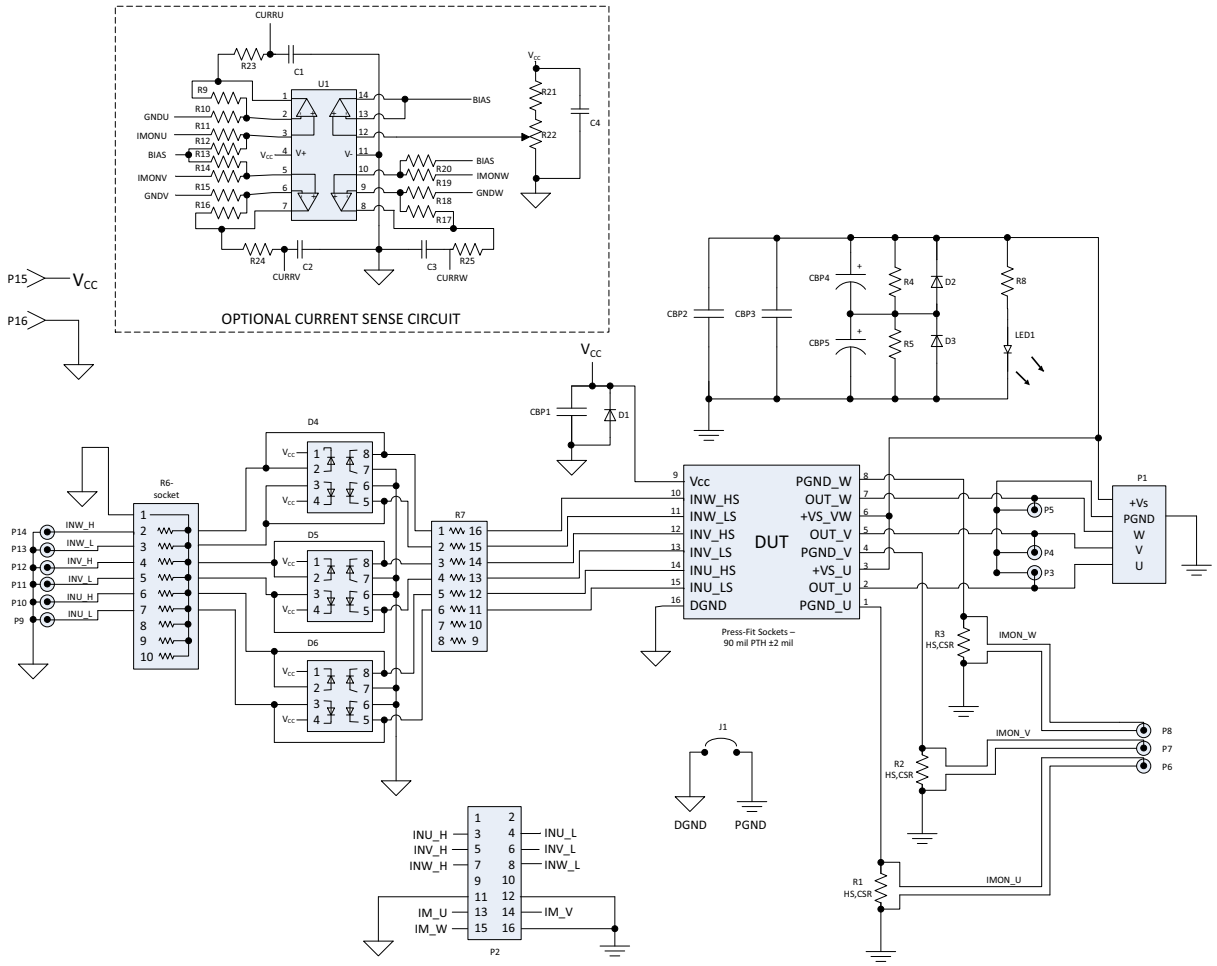
This kit contains everything needed for rapid prototyping with the MSA303 3-phase driver. With a multitude of circuit options, the EK94 offers versatility when in comes to connecting inputs, measuring outputs, and conditioning signals to the specific application environment. High- and low- input signals for each phase may be supplied from any 3 V to 18 V digital controller via standard pin header or SMA connectors. A removable 50 Ω termination resistor is offered for impedance-matched inputs. The layout is carefully optimized for signal and power transmission, while permitting easy integration with system controllers and 3-phase loads.

## ABSOLUTE MAXIMUM RATINGS

All specifications listed in the MSA303 datasheet apply to this board, except as noted below. This board uses components that limit MSA303's full operating range in exchange for convenience to the customer.

| Parameter | Symbol | Max | Units | Limited By |
|---|---|---|---|---|
| Output Current, continuous, within SOA | $I_{OUT}$ | 20 | A | DUT-socket |
| Power Dissipation, MSA303 | $P_D$ | 60 | W | DUT-HS |

## Figure 1: Circuit Diagram



## PARTS LIST

| Reference | Manufacturer Part # | Description | QTY |
|---|---|---|---|
| **Printed Circuit Board** | | | |
| EVAL106 | EVAL106 | Printed Circuit Board | 1 |
| **Resistors** | | | |
| R13, 14, 15 | CSR03 | Res, 10mΩ, 16W, 5%, TO-220 | 3 |
| R1,2 | CFR-50JB-52-430K | Res, 430kΩ, 1/2W, 5%, Axial | 2 |
| R5 - R10 | PR03000205109JAC00 | Res 51Ω 5% 3W Axial | 6 |
| R4, 3, 11 | RR03J4R7TB | Res 4.7Ω 5% 3W Axial | 3 |
| R12 | RR03J150KTB | Res, 150kΩ, 3W, 5%, Axial | 1 |
| **Capacitors** | | | |
| C7 | OX7RR105KWN | Ceramic Cap, 1 µF, 200V | 1 |
| C3 - 6, 8 | 2220Y1K00474KXTWS2 | Ceramic Cap, 470nF, 1KV, X7R, 2220 | 5 |
| C1, 2 | 380LX122M400A082 | Electrolytic Cap, 1200µF, 400V | 2 |
| **Diodes** | | | |
| D1 | P6KE27A-TP | TVS diode, 23.1V standoff, 5W | 1 |
| D2, 3 | P6KE400A | TVS diode, 342V standoff, 5W | 2 |
| D11, 12, 13 | UC3611N | Diode, 4 array, 50V, 3A | 3 |
| D4 | LTL2R3KRD-EM | LED, red, 2mA nominal | 1 |
| D5 - 10 | MUR4100EG | Diode, GEN PURP 1000V 4A DO201AD | 6 |
| **Hardware** | | | |
| P1 | M20-9980845 | Pin header, 2 x 8, 0.1" pitch | 4 |
| J2 - J7 | CONBNC002 | BNC connector, PC mount | 6 |
| J8 - 16 | 571-0100 | Banana Jack, horizontal, PC mount | 9 |
| DUT-HS | HS36 | Heatsink, 3" x 3.5" X 0.85" | 1 |
| CSR-HS | CR101-75AE | Heatsink, 3 x TO-220, clip-on | 1 |
| | CLA-TO-21E | Heatsink Cam Clips | 3 |
| | 0374-0-67-80-42-27-10-0 | 0.06" Diameter Cage Jacks | 9 |
| | 2206 | HS36 Hardware, 4-40 x 1.5" screw | 4 |
| | 60900213421 | Jumper | 7 |
| | 5009 | PC Test Point, yellow | 32 |
| SW1-3 | 100SP1 | Switch Toggle SPDT | 3 |
| | 91735A190 | #8-32 x 1/4" panhead screw | 4 |
| | 2221 | #8-32 x 2" standoff | 4 |
| | 0479-0-43-01-34-01-10-0 | 0.04" Diameter Cage Jacks | 13 |

## BEFORE YOU GET STARTED

- All Apex Microtechnology amplifiers should be handled using proper ESD precautions.
- Always use the heat sink included in this kit.
- Always use adequate power supply bypassing.
- Do not change the connections while the circuit is powered.
- Initially set all power supplies to the minimum operations levels allowed in the device data sheet.
- Check for oscillations.
- Please refer to Application Note, AN01 for general operating conditions.

## ASSEMBLY INSTRUCTIONS

During the assembly, please refer to the circuit schematics, assembly drawings, and the data sheet of the part being used on the evaluation kit.

1. Note that each side of the EVAL106 circuit board is identified as either the Component side or the DUT (Device Under Test) side. The component side has the designators printed on that side.
2. First, start by soldering in the cage jacks that will be used pug in the MSA303. Note that the cage jacks for the output pins have a maximum current rating of 20A.
3. Solder the surface-mount capacitors C3 - C8 on the Component side.
4. Install the smaller through hole components starting with diodes and resistors R1 & R2. After the smaller through hole components are soldered, including SW1-SW3 and test points, the power resistors (not including current sense resistors) can be soldered.
5. Use a piece of heavy wire (16 to 14 AWG, 1.3 to 1.8 mm) to short J1. This should be the only connection between digital ground (DGND) and power ground (PGND).
6. Install R13, R14, and R15. Their heights must be set by the widened portion of the pins resting on the Component side of the PCB. This will place the plastic package 4mm above the PCB.
7. Apply a thin layer of thermal grease (not included) the backside of R13, R14, and R15. Place the CSR-HS (CR101-75AE; the smaller of the two included heatsinks) behind these resistors, with the mounting lugs engaging the PCB holes. Solder these mounting lugs while keeping the heatsink perpendicular to the board.
8. From either side, slide the cam clips (CLA-TO-21E) into the hooked slot of the CSR-HS. The tabs should be pointed at a 45° angle down and away from the heatsink. Once the clip is in front of a resistor, flip the tab all the way up to apply pressure to each resistor.
9. Install P1 and J2 - J16 (BNC connectors and banana jacks)
10. Install electrolytic bypass capacitors CBP4 and CBP5, ensuring that the orientation matches the circuit schematic drawing.
11. HS36 will be used to sandwich MSA303 between EVAL106 and HS36. HS36 has threaded 4-40 holes, so no nuts are needed for the 1.5" 4-40 screws. Thermal grease should be applied to the back of MSA303.
12. Use the #8-32 x ¼" screws to mount a 2-inch standoff on each corner of the PCB.

## HEATSINK GUIDELINES

Determining heatsink size for MSA303 depends on several factors. Refer to MSA303 datasheet for more information on calculating power dissipation, thermal resistance, and finding thermal ratings.

## MOTOR CONTROL

P1 is designed to match the “remote amplifier” connector on Precision Motion Device's DK78113 developer kit for the Juno Velocity & Torque Control IC. Follow the instructions in the DK78113 User Manual to connect a remote amplifier. Applications requiring torque control will require the Current Sense gain and offset circuit described below. Use default values when pairing with the Juno device.

Other motor control ICs may be used with EK76, but these may require different wiring and/or current sense circuits.

## TEST ASSEMBLY

### *EQUIPMENT NEEDED*

1. Power Supplies
2. Digital Controller or 6+ Channel Pattern Generator
3. Oscilloscope
4. Proper Heatsinking System

## TEST SETUP

Make sure all supplies are turned off before connection. Connect the power supplies $V_{CC}$ and $+V_S$. See MSA303 datasheet for acceptable voltage levels. The LED will be visibly bright for voltages 30V and above. For lower voltages, consider using a smaller-value resistor for R12.

When sequencing power supplies, use the following order:
Power ON: $V_{CC}$, then $+V_S$
Power OFF: $+V_S$, then $V_{CC}$

It is recommended to first test the device with no load attached. Ensure the output waveform follows the expected results before connecting a load. Consider power dissipation in the amplifier, sense resistors, and the load.

## NEED TECHNICAL HELP? CONTACT APEX SUPPORT!

For all Apex Microtechnology product questions and inquiries, call toll free 800-546-2739 in North America. For inquiries via email, please contact apex.support@apexanalog.com. International customers can also request support by contacting their local Apex Microtechnology Sales Representative. To find the one nearest to you, go to www.apexanalog.com