

Evaluation Kit for MP400FC

Introduction

The EK65 Evaluation kit is designed to provide a convenient way to breadboard and evaluate design ideas for the MP400FC power operational amplifier. The evaluation board is pre-wired for all required external components. The evaluation board has been laid out and labeled to easily configure the high voltage operational amplifier in a non-inverting differential configuration for single supply operation using the MP400FC boost supply (Refer to Application Note 21). However, the evaluation board is flexible enough to analyze a multitude of standard or proprietary circuit configurations.

Before You Get Started

- Please read this data sheet in it's entirety before starting to construct your evaluation board.
- All APEX amplifiers should be handled using proper ESD precautions.
- Do not change connections while the circuit is powered.
- Initially set all power supplies to the minimum operating voltage allowed in the device data sheet.
- The MP400FC is a high voltage amplifier with an integrated switch mode power supply. Though the input voltage will be 50V or less, the MP400FC can generate voltages greater then 350V. The high generated voltage will be present on the evaluation board. Caution must be used when working with the evaluation board.

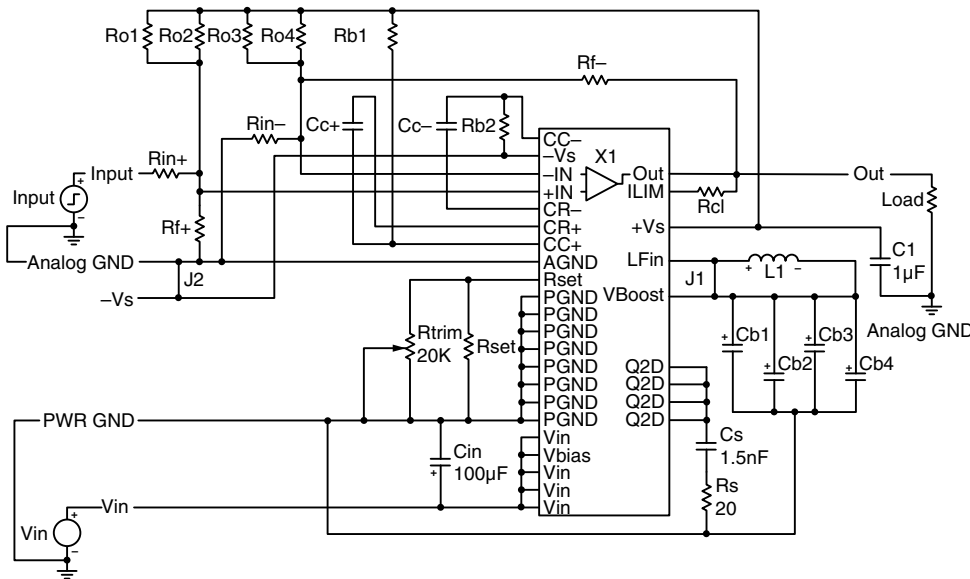


Figure 1 - EK65 Schematic

Parts List (Included with kit)

Ref.	Apex P/N	Description/Vendor	Qty.
N/C	HS26	Heat Sink	1
N/C	MS11	Strip of 30 cage jacks	2
N/C	EVAL65	PC board	1
N/C	93505A430	Hex standoff, 4-40x1/4	4
N/C	90272A105	Screw, 4-40x3/16	4
BJ1-6	571-0100	Banana Jack, PC	6
BN1	146510CJ	BNC, PC mount	1
C1	ZX7R105KTL	Cap. 1 µF, 500V	1
		Novacap	
		ST2225B105K501LLXW	
Cb1	EKMQ401VSN121MP30S	Cap. 120µF, 400V	1
Rtrim	T93YA203KT20	Trim Pot, 20K	1

Required Components (Not included with kit)

Ref. Description

- Cin Capacitor, Low ESR electrolytic, 100 μ F or greater with voltage rating greater than the anticipated input voltage.
- Cb1-4 Cboost capacitor, Low ESR electrolytic with voltage rating greater than the anticipated boost voltage. Refer to the MP400FC data sheet for Cboost selection. One 120 μ F, 400V electrolytic capacitor (Cb1) is supplied with the kit and is adequate for most applications. The value of Cboost is selected to meet required boost supply ripple voltage specifications for the application and to minimize switching noise on the boost supply. Cboost will be as large as reasonably possible, in the range of 100 μ F to 500 μ F. An area on the evaluation board large enough for 4 parallel 22mm diameter capacitors is provided. This allows maximum flexibility in the select of the capacitors for Cboost. Capacitors with snap in terminals should still be soldered to the evaluation board to minimize resistance.
- Rset Boost voltage programming resistor. Refer to the MP400FC data sheet for calculation of Rset. Select a higher standard value resistor and use Rtrim (supplied) to calibrate the boost voltage to the exact desired value. Alternatively, Rtrim can be used alone for a fully adjustable boost supply.
- Rcl Operational amplifier current limit resistor. Refer to the MP400FC data sheet for selection of the current limit resistor.

Optional Components (Not included with kit)

Ref. Description

- Lf Boost supply filter inductor. The MP400FC includes a 47 μ H inductor in series with the LFin pin and the +Vs supply of the high voltage op amp. This on board inductor forms a 2 pole LC filter with C1 and an on board parallel 0.1 μ F capacitor. Combined with a properly selected Cboost, the high voltage DC boost voltage will be sufficiently clean for most applications. However an external inductor between Vboost and LFin, or Vboost and +Vs can be used for additional filtering of the Boost supply voltage if necessary. Addition capacitance can be added to the filter between +Vs and AGND.
- Cs, Rs Also useful for boost supply filtering. These components form an RC snubber from drain to source of the boost supply MOSFET switch. This snubber will help reduce or eliminate overshoot and ringing of the MOSFET switch at switch turn-off that can appear on the boost supply voltage. The component values shown on the schematic are adequate for most applications but can be adjusted for your specific application. The power in the resistor can be estimated by the formula $PD = F \cdot C \cdot V^2$, where
 $F = 100$ KHz of the switching supply
 $C =$ the value of Cs
 $V =$ the anticipated Vboost voltage.
 Rs must be non-inductive. MP900 and MP9000 series resistors from Caddock Electronics or equivalent resistors can be used.
 Rs may require a heat sink such as Apex part number HS28 or HS23. Mounting holes for a heat sink are provided on the evaluation board that will accommodate either of these heat sinks.
- Cc+, Cc- High voltage op amp compensation capacitors. Refer to the MP400FC data sheet for component selection.
- Ro1-4, Rf+, Rf-, Ri+, Ri- Op amp gain setting and input bias resistors used for the single supply differential configuration described in applications note 21. Appendix A of apps note 21 provides a procedure for the design of the differential configuration and selection of these components. Apps note 21 can be down loaded from the Apex web site. The locations on the board for Ro1-4 are large enough for up to a 3W resistor. 3W 1% resistor style CPF from Vishay Dale are widely available through distribution. RN60, RN65 or RN70 style 1/2W 1% resistors can be used for the other resistors.

Assembly

During assembly, refer to Figure 1, Figure 2 and the MP400FC data sheet.

- Note that the silk screen side of the circuit board is labeled as the "component side". The other side of the circuit board will be referred to in these instructions as the "DUT side" of the board.

10. J2 is required to connect the high voltage op amp –Vs to AGND for single supply operation. If an external negative supply voltage will be used, replace J2 with a high quality ceramic bypass capacitor of at least 1 μ F, and jumper –Vs to BJ1. BJ1 can be used to connect the negative supply to the evaluation board.
11. Rin+ and Rin- when installed as marked on the component side of the board near BJ1 and BN1, will configure the op amp in the non-inverting configuration with Rin- to AGND and Rin+ to the input BNC. For an inverting configuration, rotate Rin+ to AGND and Rin- to the input.
12. If the snubber Cs and Rs will be used, select and insert the components at the location marked near DUT pins 12 – 15. If the calculated power dissipation indicates that a heat sink is required for Rs, install it with Rs. Cs and Rs can be installed after you have started evaluating your design if they are found to be needed.
13. Vin power can be supplied to your circuitry in the breadboard area. There are two pads located below the breadboard area near BN1. One labeled Vin and one labeled PGND can be jumpered into your circuit as needed.
14. Mount the electrolytic capacitors at Cin, and Cboost from the component side of the PCB. Match the polarity markings on the PCB. Solder from the DUT side of the PCB. Be sure to fill the holes with solder.
15. Apply a thin, uniform layer of thermal grease to the back side of the MP400FC. Position the amplifier over the mounting holes of the HS26 heat sink. Firmly push the amplifier onto the heat sink while slightly rotating the amplifier back and forth, ending with the mounting holes of the amplifier over the mounting holes in the heat sink.
16. Attach the amplifier to the heat sink with the supplied 4-40 x 1/4" male-female hex spacer. Tightened with a hex nut driver. Make the hex spacers snug but do not over tighten as this provides no benefit and may break the hardware.
17. Carefully lower the PCB assemblies onto the heat sink/amplifier assembly until the pins of the amplifier engage in and are fully seated in the cage jacks aligning the mounting holes in the PCB to the hex spacers. Use the supplied 4-40 x 3/16" screws to attach the PCB assembly to the hex spacers.
18. Hook up power and signals as necessary. The amplifier is now ready for testing.



Figure 3 - EK65 Assembly