

Rapid Prototyping and Circuit Miniaturization for Down-Hole Deployment

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Introduction:

In order to enable the IMS down-hole deployment, significant circuit-size reduction needed to be done to allow the circuit boards to fit inside the environmental probe housing. Previous circuits such as the bench-top gate controller¹ and high voltage supply are too large for down-hole deployment.

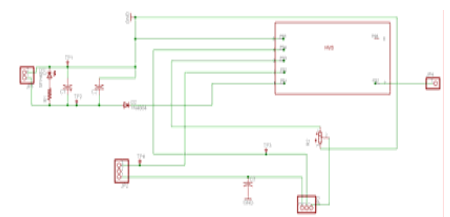
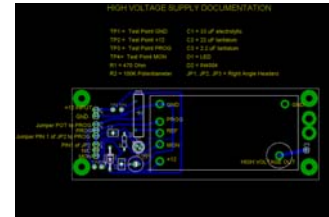


¹BSU's original bench-top Gate Controller

Method of Size-Reduction:

Besides searching out compact parts to replace larger counterparts, using a Printed Circuit Board (PCB) router to create small, compact, and accurate boards has proven very beneficial. Some of the advantages of using an in-house PCB router for Rapid Prototyping:

- Quick turn-around (hours, instead of weeks)
- Self-documented board layouts³
- Compact, reproducible, and reliable boards



³Documented PCB layout (left) and schematic (right)

Procedure for Creating a PCB:

- Schematic entry in Eagle software
- Design the PCB layout to be compatible with the system
- Convert layout to Gerber files
- Mill/Drill the PCB with router⁵
- Clean board and solder on components in their corresponding positions

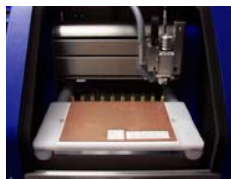
Future Developments:

- Design a single-rail Gate Control System
- Design down-hole FPGA board (control)
- Implement temperature, pressure, and humidity sensors

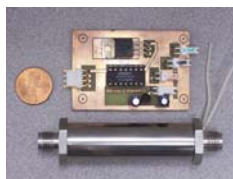


²Bench-top Gate Controller (left) and bench-top High Voltage Supply (right)

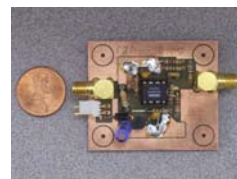
IMS Circuit Board Designs Produced:



⁵PCB Router



Heater Control Circuit



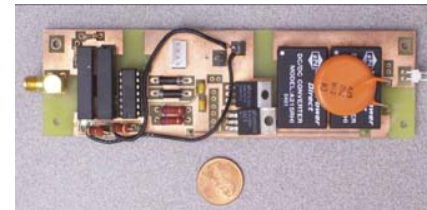
Preamp Circuit



IMS Driver Circuit

Conclusion:

Redesigning the bench-top circuits using the correct selection of components and PCB routing has made down-hole deployment possible. For example, BSU's bench-top Gate Controller¹ circuit was originally 6" X 4" and has been reduced to 5.75" X 1.6" making it more size efficient for down-hole deployment.⁴



⁴Miniaturized Gate Controller circuit (left) and High Voltage Supply circuit (right) produced by PCB router