Wave Glider Electrical Interfaces Guide
Part Number: 030-01676

Version A Released 17 June 2011

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Revision History

Rev	Changes	ECO #	Author(s)
A	Initial Release	ECO-0126	CL

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Table of Contents

List of Figures

List of Tables

Introduction

Overview

This document describes the electrical interfaces an end user, a system integrator or a product developer may encounter. Some interfaces have been designed for flexibility and others have been designed to be rigid for increased robustness. . Each connection is described with a pin-out, part numbers for the mating connector/crimp pins and an electrical specification. Examples are provided to illustrate the more complex interfaces.

This document is not a complete specification of the system or of the individual components described here. Communication protocols and software interfaces are described in the Interface Control Description (LRI part number abcdef). Mechanical interfaces are also described elsewhere. For specific 2D drawings or 3D models, please contact Liquid Robotics Inc.

Document Conventions

The table of contents, list of figures and list of tables has been created to make finding information easier. There is also a glossary provided in the appendices to make the jargon and acronyms easier to understand.

Each section is intended to be stand-alone. If you only need information on a single component then you should only need that section.

Duplication of information and referencing other sections will be kept to a minimum, but will be required in some instances. Components are identified by their Liquid Robotics part number. Their informal names may appear in the documentation, but there should always be an identifying part number.

Your components may not look exactly like the ones pictured here. This is due to minor revisions and updates (e.g., solder mask color change on PCBAs). The specifications are the same, unless explicitly called out as being different between revisions or part numbers.

Tables and Figures are used extensively to describe each of the interfaces.

Bullets are used to document options or lists of items.

Numbered lists are used to describe sequences of operations. Please follow the sequence of operations to minimize damage to components or to meet specific timing requirements (e.g. power up sequences).

System Overview

Physical Connectivity

Figure 1 represents a system with all float and glider payloads connected. This is only an example of what is possible; it should not be considered a limiting factor in the overall system design and implementation. The diagram components are described in this section with technical data provided in later sections. The color scheme listed in the table below is to help show similarities and that your system may be different then what is drawn here. These colors only apply to this drawing.

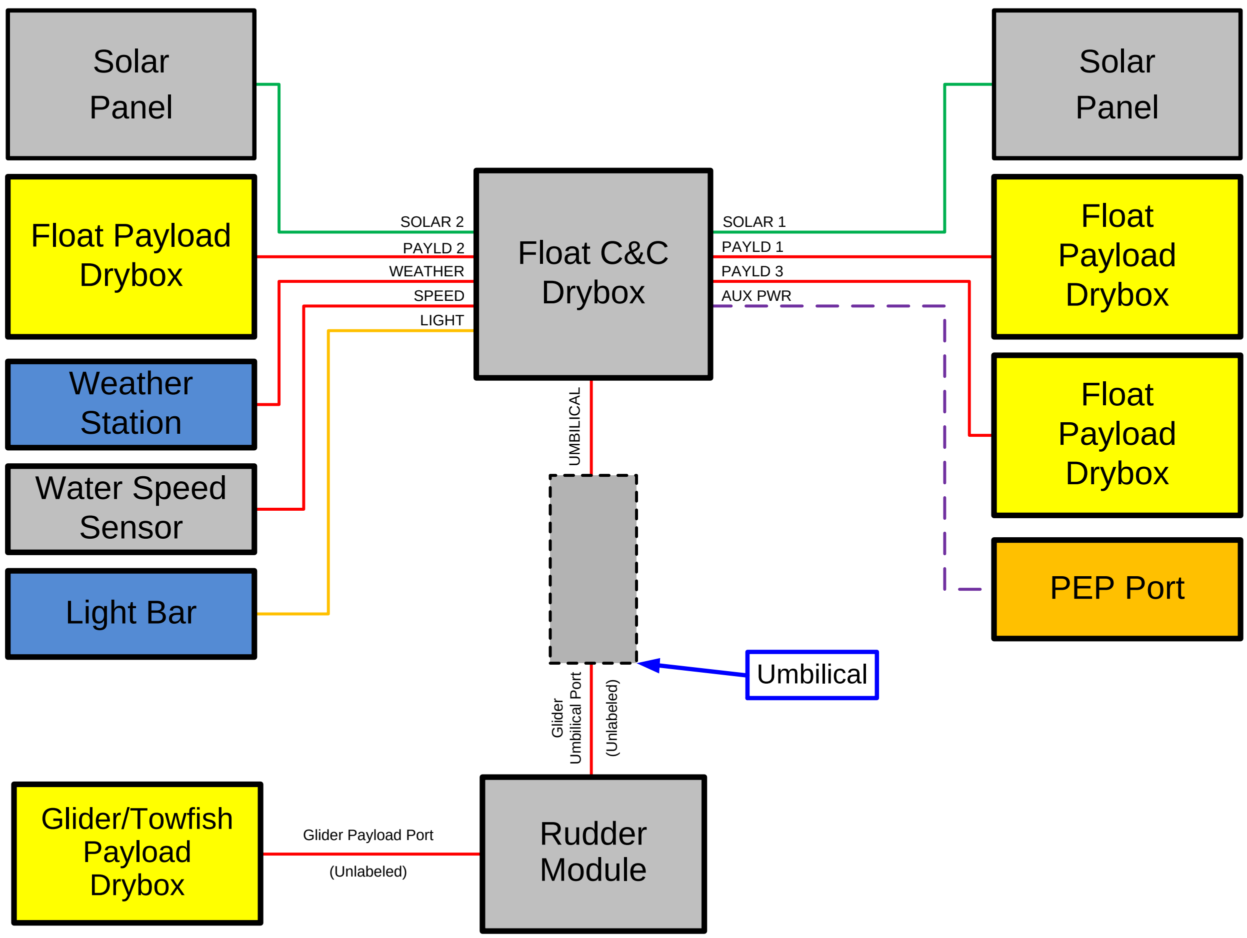

Figure 1: Wave Glider Connection Diagram

Indication	Group	Description
Grey Box	Core System	These components are a part of the core system
Yellow Box	Payloads	End user equipment installation points
Blue Box	Optional Sensors	These are Liquid Robotics provided optional sensors
Green Line	5-pin whip	These are the 5-pin connections for power into the system
Red Line	8-pin whip	These are the 8 pin connections for power and data to components
Orange Line	2-pin whip	This is the 2 pin connection for just power
Purple dash	6-pin whip	This is the whip that provides extra power out and an additional input power point
Orange Box	PEP Port	This connection goes with a standard payload port into one of the yellow boxes
Names	Port Labels	Names in all caps are found on the Float C&C lid

Table 1: Color and Label conventions for system diagram

Solar Panels

The solar panels are used to power the system and to charge the back-up batteries. A system does not require solar panels for short deployments.

The solar panel inputs can be used for other sources of energy as well, such as a wall charger. The alternate forms of energy must meet the Float C&C connection requirements.

Float C&C

The Float C&C acts as the central hub for communication and power. Its main purpose is to maintain power for the end user equipment and to provide a communication path from the user to the vehicle. It contains no customer-accessible components.

Umbilical

The umbilical is the physical and electrical connection between the float and the glider assembly. This assembly provides for power and data to be transferred from the float to the rudder, towfish assemblies or glider dryboxes.

Rudder Module

The rudder module is used to steer the vehicle and to provide electrical and communications connectivity to towfish or glider mounted payloads.

Water Speed Sensor

The water speed sensor provides pilots with feedback about water currents.

Payload Drybox or Towfish

Payload Dryboxes house sensors and other application payloads and is designed to be customer accessible. The LRI-provided Payload Interface Board (PIB) provides electrical and communications connectivity between a Payload Drybox and the Float C&C. A large number of configurations are possible.

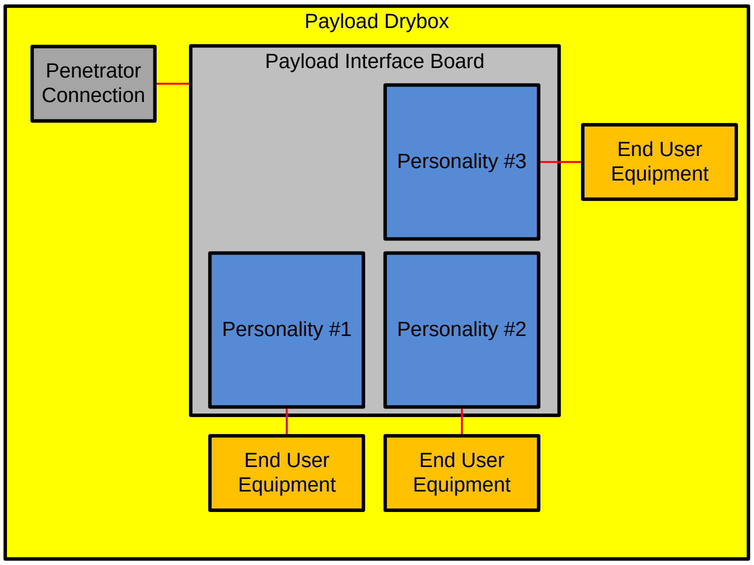

Figure 2: Payload Drybox and its various electrical components

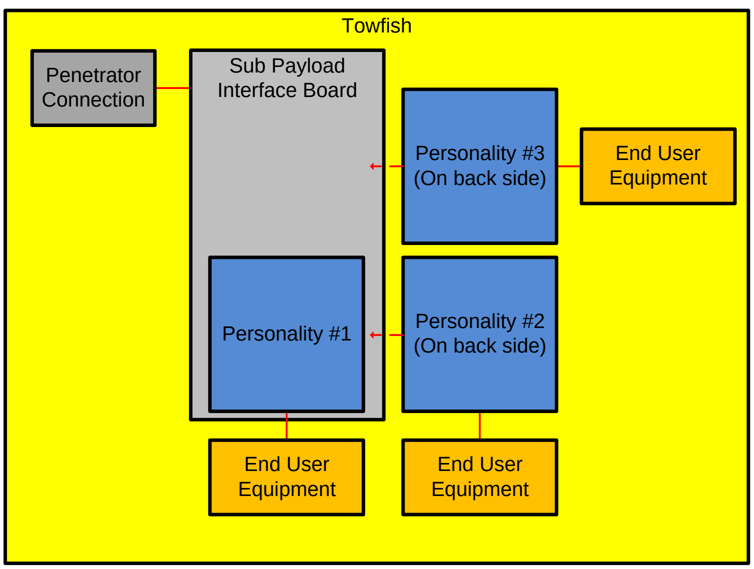

Figure 3: Towfish and its various electronics

PEP Port

The PEP (Payload Extra Power) port can go to its own drybox, but is intended to be a secondary connection to one of the other float dryboxes.

Optional Sensors

The weather station and light bar are Liquid Robotics supplied optional sensors. Each has a dedicated port on the drybox.

Payload Connectivity

This section describes the physical connections between payload boxes and the Float C&C.

Payload Communication Connectivity

Figure 4 shows the possible communication paths. There are dedicated communications paths for each of the float payloads to get data directly to the Float C&C to transfer the data to shore or other payloads. The towfish or glider payloads do not have a direct connection to the Float C&C and consequently must communicate through a payload. The diagram below shows two different approaches for getting data from the glider to the C&C. The path through Payload 1 involves connecting the AUX lines to the electronics within the drybox to aggregate the data with other equipment installed in the Payload 1 drybox. The path through Payload 2 is via jumper wires within the drybox.

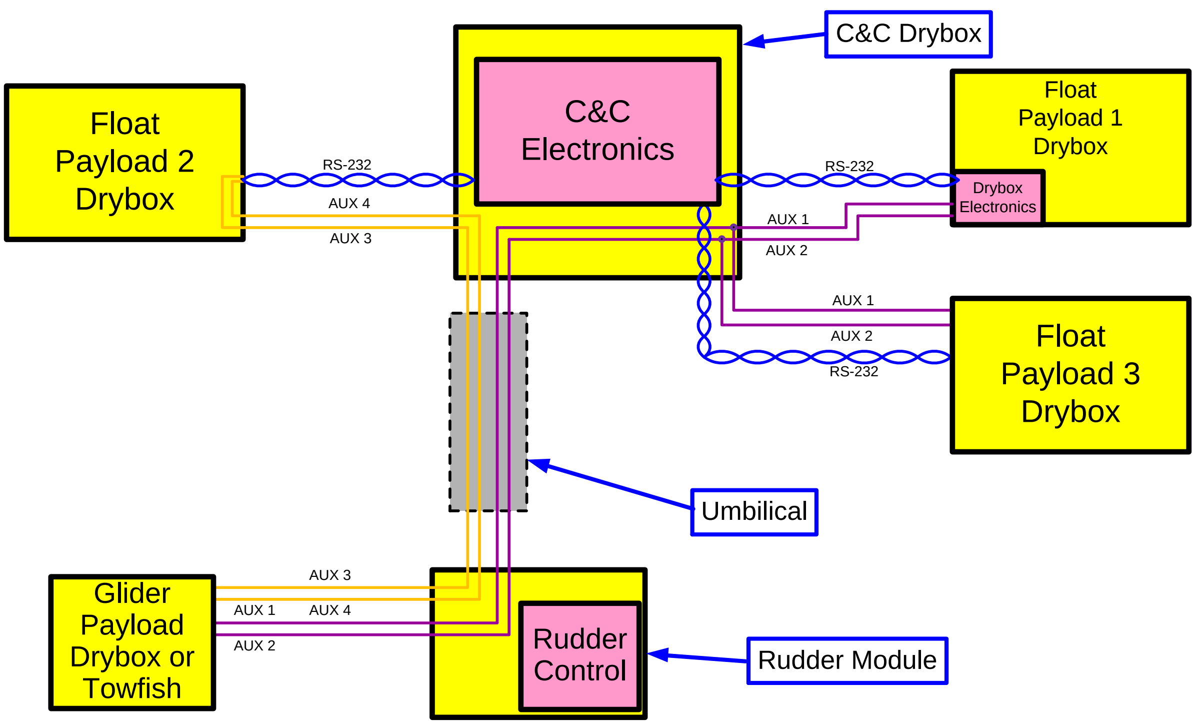

Figure 4: Payload Interconnectivity and Communication Diagram

Payload Power Connectivity

Energizing payloads is done via one of the five WGMS controlled power outputs for payloads on the float and rudder module. On the float, there are the three labeled as PAYLDx ports and the fourth is labeled AUX PWR (PEP Power). There is no label on the rudder module; it is the female connector the male connector is used for the umbilical. Figure 5 shows the AUX PWR port as the purple line and the other payload power paths as red lines. The AUX PWR port is typically connected in parallel with another payload port.

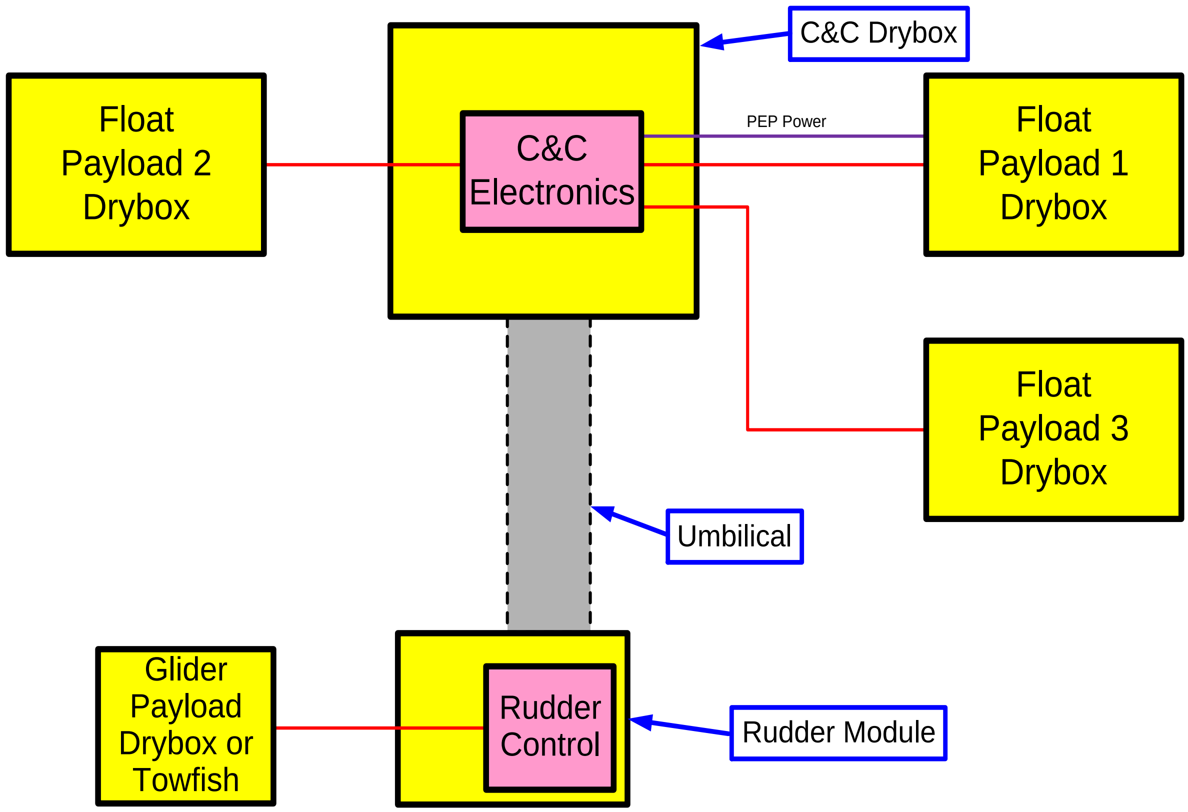

Figure 5: Payload Power Routing

GPS and PPS Connectivity

GPS and PPS are routed directly from the GPS unit to float-mounted payloads through the standard payload connectors. As a customization, those signals can be routed to glider-attached payloads by using the AUX lines.

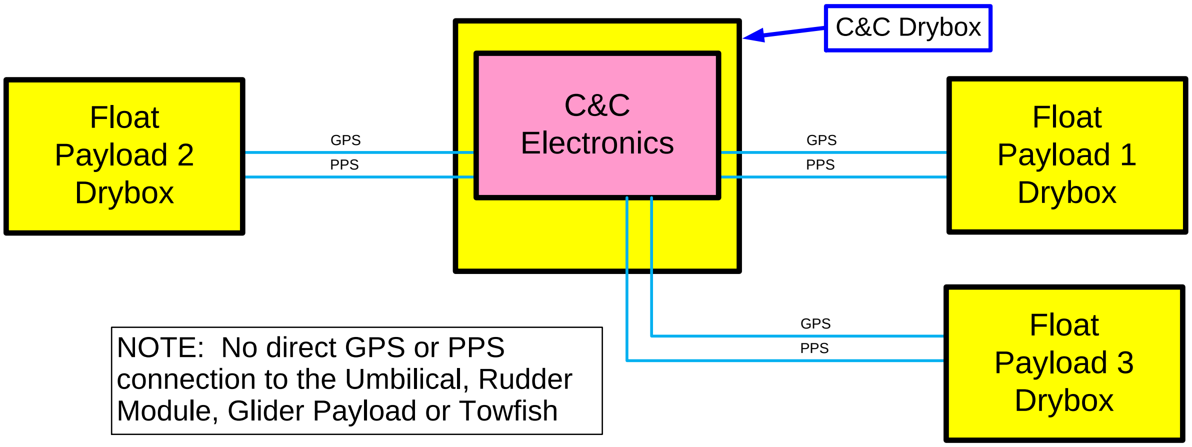

Figure 6: GPS and PPS Routing

Shore Side Connectivity

The Float C&C has two paths for communicating with shore-side applications. Vehicles on a mission typically use an Iridium SBD session. The XBee path is used for pre-launch checks and short-range communications.

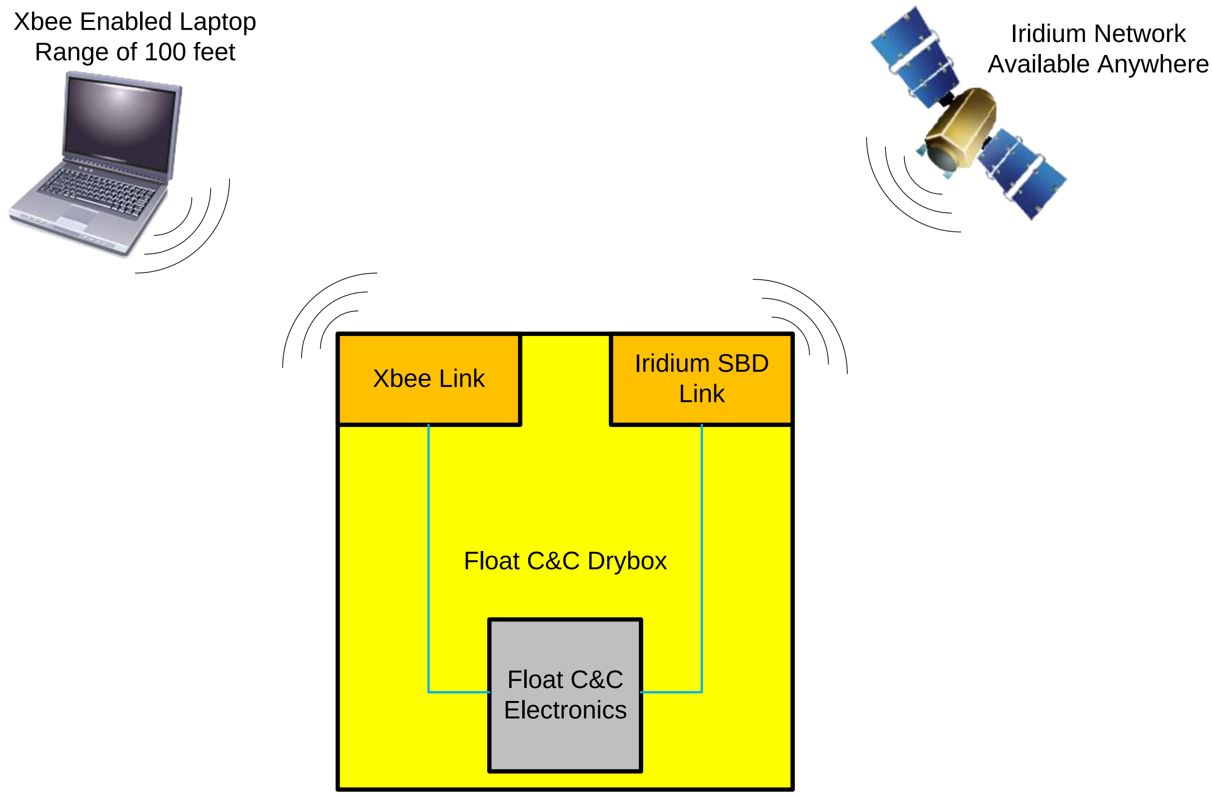

Figure 7: Vehicle Wireless Connectivity Options

Iridium Connectivity

The iridium network is an "always on" satellite-based system with 100% global coverage. This is the main link when on mission and deployed.

XBee Connectivity

XBee is a Zigbee based short-range RF connection that requires a base station to be configured as an XBee relay. This connection has no per use costs associated with it and is lower power than the Iridium communication channel. The typical XBee range is 100ft with line of sight. This sight can reduce greatly depending on objects blocking the path, including waves.

130-00821 (Command and Control Drybox)

Overview

This section describes the interfaces to 130-00821. This drybox is the core component in navigation and overall vehicle control. This drybox provides connections for payloads, sensors and other navigational components.

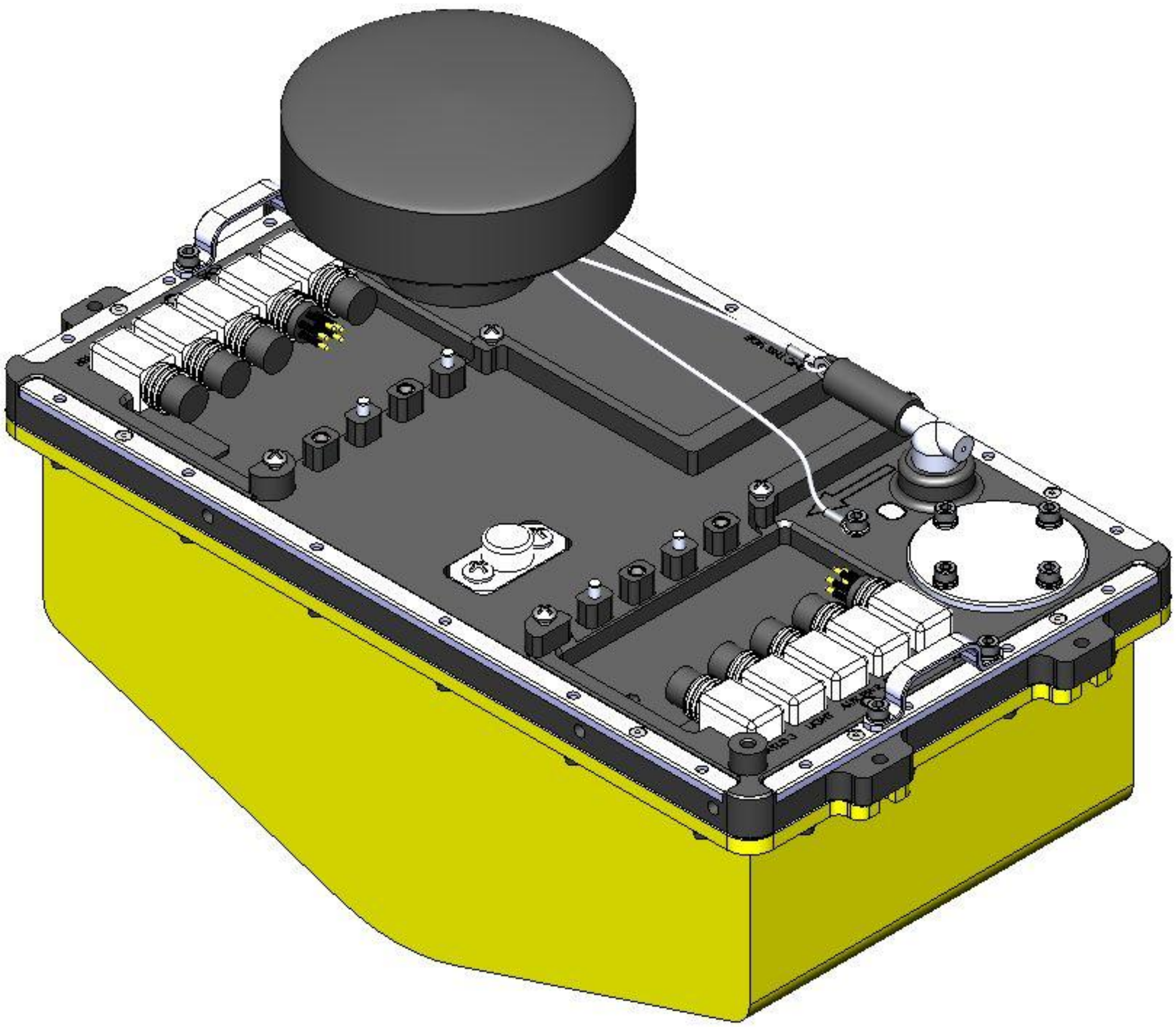

Figure 8: Float C&C

Power Key

The power key turns the system on and off. When pulled out the system will be shutdown. In the shutdown case, the batteries are individually disconnected, and the solar panels and auxiliary power inputs are disconnected from the system. The system is powered on when the key is inserted all the way.

Indicator Light

There is an indicator light next to the power key. This light can be used to verify that the vehicle is ready. The table below shows the potential states of the indicator. Please note that if the XBee communication channel is turn off the Indicator is turned off, because the vehicle is assumed to be out of reach of any users.

Indicator Color	State	Description
Off	Off or XBee disabled	System Off Turn on XBee to verify system state if desired
Red	Error	See WGMS or the XBee console to determine the source of the error
Orange	Indeterminate	System has just powered up and has not had enough time to finish system checks and/or GPS not yet fixed
Green	OK	All systems are functional for launch

Table 2: Indicator light states

Unused Connections

All unused connections must have a dummy plug installed on them. If a connection is left open, it is susceptible to corrosion and leakage. Dummy plugs should be installed when testing on a bench to protect the connectors from mechanical damage.

PAYLD1, PAYLD2, and PAYLD3 Connectors

The three Payload connectors interface to equipment mounted in the float. These connections provide power, communication to the C&C, connectivity to other payloads including glider mounted components and GPS data.

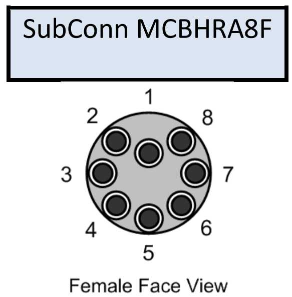

Figure 9: PAYLDx Connector Face

PAYLDx Pin Out

Pin #	Signal Name	Description
1	PPS	GPS pulse-per-second, using RS-232 levels
2	PWR	13.2 Volts regulated at 3.0A continuous
3	TX	RS-232 Transmit Line
4	RX	RS-232 Receive Line
5	AUX1 or AUX3	Glider Connections; exact connections are determined by payload port
6	AUX2 or AUX4	Glider Connections; exact connections are determined by payload port
7	GND	Ground reference for all pins
8	GPS Data	4800 Baud GGA, ZDA, and VTG, using RS-232 levels, 5 second report rate

Table 3: PAYLDx connection pin out

PWR and GND

The power pin provides a regulated 13.2 volts at up to 3A continuous draw. The port will handle surges of up to 3.5A. Any transient current draw greater than 3.5A for more than 160ms will constitute a fault and cause the output to shut off to protect itself.

When sizing the load, care must be taken in sizing the total input capacitance seen by the power switch. If the capacitance is excessively large, the switch sees the output as being shorted, which causes a fault and the power will turn off to protect itself. The maximum allowable input capacitance for each payload port is ~50,000uF.

If the equipment's transients are larger than 3.5A or the input capacitance is greater than 50,000uF, additional circuitry must be added to buffer the power output. This can take the form of an NTC inrush limiter, local batteries, super capacitors, etc.

TX and RX

These communication lines connect directly into the Command and Control processor. This link is used to send data to other payloads and between the ship and shore. This connection is RS-232 at 115,200 baud rate. These signals are provided via a MAX232 compatible circuit.

PPS and GPS Signals

The PPS signal is a 4200ns pulse once a second, with positive polarity with reference to RS-232 pulses. The GPS data is output in NMEA format with the GGA, ZDA and VTG messages reported once every 5 seconds. The order of the messages is not fixed. These signals are present on all payload ports if any single payload port has been turned on.

PAYLD1 Power	PAYLD2 Power	PAYLD3 Power	GPS/PPS Data Stream to all PAYLDx ports
Off	Off	Off	Off
On	Don't Care	Don't Care	On
Don't Care	On	Don't Care	On
Don't Care	Don't Care	On	On

Table 4: When GPS and PPS data is distributed to all ports

Auxiliary Lines

The auxiliary lines provide direct access to other payloads on the float and are connected to the glider assembly. The table below shows how each of the lines is connected. Typical applications have these pins connected as two wire communication paths or low speed analog signals.

Signal Name	UMBILICAL Pin #	PAYLD 1 Pin #	PAYLD 2 Pin #	PAYLD 3 Pin #
AUX1	5	5	No Connection	5
AUX2	6	6	No Connection	6
AUX3	1	No Connection	5	No Connection
AUX4	8	No Connection	6	No Connection

Table 5: Auxiliary line connectivity

PAYLDx Mating Connector

The PAYLDx ports are design to mate to a wet mate-able connector from Teledyne or SubConn. The mating connector should be an 8 pin, male, whip type assembly. An example part number from SubConn is PNARA MCIL8M, which is the penetrator assembly used on the aft and fore float dryboxes.

UMBILICAL Connector

The umbilical connection provides power and communication to the glider and connectivity between the rudder module and the payloads.

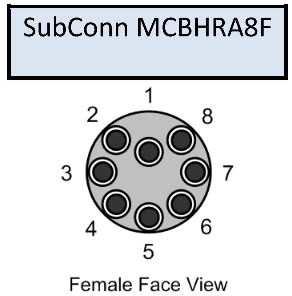

Figure 10: UMBILICAL Connector Face

UMBILICAL Pin Out

Pin #	Signal Name	Description
1	AUX3	Connects to PAYLD 2 pin 5
2	PWR	13.2 Volts regulated at 3.0A continuous
3	A	RS-485 Positive Line
4	B	RS-485 Negative Line
5	AUX1	Connects to PAYLD 1 and PAYLD3 pin 5
6	AUX2	Connects to PAYLD 1 and PAYLD3 pin 6
7	GND	Ground reference for all pins
8	AUX4	Connects to PAYLD 2 pin 6

Table 6: Umbilical connector pin out

PWR and GND

The power pin provides a regulated 13.2 volts at up to 3A continuous draw. The port will handle surges of up to 3.5A. Any transient current draw greater than 3.5A for more than 160ms will constitute a fault and cause the output to shut off to protect itself.

When sizing the load, care must be taken in sizing the total input capacitance seen by the power switch. If the capacitance exceeds ~50,000uF, the switch sees the output as being shorted, which causes a fault and the power will turn off to protect itself

If the equipment's transients are larger than 3.5A or the input capacitance is greater than 50,000uF, additional circuitry needs to be added to buffer the power output. This can take the form of an NTC inrush limiter, local batteries, super capacitors, etc.

The glider payload port further limits the output current to 1.0A. The voltage drop across the umbilical also limits the glider current to no more than 1.0A. All of the current is available at the float connection.

A and B
These are the communication lines that connect directly into the Command and Control processor from the rudder module. This link cannot be used by any end user equipment.

Auxiliary Lines
The auxiliary lines are provided to give direct access to other payloads on the float or connected to the glider assembly. The table below shows how each of the lines is connected. Typical applications have these pins connected as two wire communication paths or low speed analog signals.

Signal Name	UMBILICAL Pin #	PAYLD 1 Pin #	PAYLD 2 Pin #	PAYLD 3 Pin #
AUX1	5	5	No Connection	5
AUX2	6	6	No Connection	6
AUX3	1	No Connection	5	No Connection
AUX4	8	No Connection	6	No Connection

Table 7: Auxiliary line connectivity

UMBILICAL Mating Connector
The UMBILICAL port is designed to mate to a wet mate-able connector from Teledyne or SubConn. The mating connector should be an 8 pin, male, whip type assembly. An example part number from SubConn is MCIL8M, which is the whip assembly used on the umbilical assembly.

AUX PWR Connector

The auxiliary power connector interfaces to equipment mounted in the float that needs more power than provided by the standard payload ports. It also provides an auxiliary input to the charging circuit. An AIS data stream is also provided if the AIS option is installed and turned on.

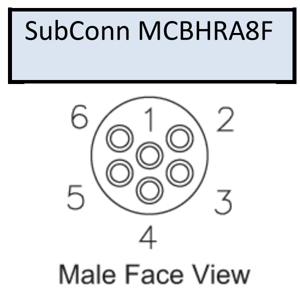

Figure 11: AUX PWR Mating Cable Connector Face

AUX PWR Pin Out

Pin #	Signal Name	Description
1	V-AUX	Auxiliary charging input
2	AIS	AIS data stream
3	PWR	13.2 Volts regulated
4	PWR	13.2 Volts regulated
5	GND	Ground reference for all pins
6	GND	Ground reference for all pins

Table 8: AUX PWR pin out

PWR and GND

The power pin provides a regulated 13.2 volts at up to 6A continuous draw. The port will handle surges of up to 8.0A. Any transient current draw greater than 8.0A for more than 160ms will constitute a fault and cause the output to shut off to protect itself.

When sizing the load, care must be taken in sizing the total input capacitance seen by the power switch. If the capacitance exceeds ~50,000uF the switch sees the output as being shorted, which causes a fault and the power will turn off to protect itself

If the equipment's transients are larger than 8.0A or the input capacitance is greater than 50,000uF, additional circuitry must be added to buffer the power output. This can take the form of an NTC inrush limiter, local batteries, super capacitors, etc.

AIS

This communication line connects directly into the LRI AIS receiver option. This connection is RS-232 at 38,400 baud rate. This signal is provided via a MAX232 compatible circuit.

V-AUX

This is the auxiliary power input pin for external power generation and/or storage into the battery charging circuit and payload regulator.

Voltage Range	Functionality	Current Limit
0-9 Volts	Off/indeterminate	None
9-17	Powers system and small payloads	1.0A
17-22	Full system functionality including charging batteries	3.0A

Table 9: V-AUX current limits

The 3.0A current limit is based on the cabling and connectors to get into the C&C. The 1.0A current limit is based on power dissipation within the Float C&C itself.

AUX PWR Mating Connector

The AUX PWR port mates to a wet mate-able connector from Teledyne or SubConn. The mating connector must be a 6 pin, male, whip type assembly. An example part number from SubConn is MCIL6M, which is a whip assembly.

SOLAR 1 AFT and SOLAR 2 FORE Connectors

The two solar panel connectors interface to solar panels or other power generation equipment. When on shore they often connect to a battery charger.

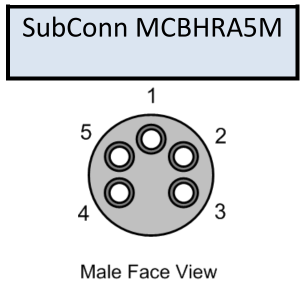

Figure 12: Solar Connector Face

SOLAR Pin Out

Pin #	Signal Name	Description
1	V+	Highest voltage on the solar panel
2	V-	Lowest voltage on the solar panel
3	MID	Mid panel voltage used for shade compensation and bypass diodes
4	DETECT	Signal shorted to pin 5 to detect that the panel is present
5	DETECT	Typically connected to ground

Table 10: SOLAR connection pin out

V+, V-, MID

The system is expecting a solar panel input equivalent to a Kyocera KC40T solar panel. The maximum voltage from V- to V+ is 22.0 volts. The minimum voltage required to charge the system at maximum efficiency is 16.8 volts between V+ and V-. The system can also charge from voltages as low as 9.0 volts between V+ and V-, but the charging system takes a 20-30% efficiency hit.

The maximum current per pin is 3.0A.

The MID pin is used when one-half of the panel is shaded. This can be caused by sensor masts on the vehicle or by environmental conditions. This MID point is used to draw power from the half panel that is still in full sunlight. This voltage is then boosted to a voltage usable by the charging circuit. If the power generation source does not provide this point or does not have shading issues, the charging system is still operational.

See the Solar Panel section for typical power input and how to avoid shading the panel.

Detect

These two pins are shorted together so that the Float C&C can detect the presence or absence of the solar panel. These pins cannot connect to other voltages or inputs as they can cause damage to the system or a misreading of the panel presence.

SOLAR Mating Connector

The SOLAR ports are design to mate to a wet mate-able connector from Teledyne or SubConn. The mating connector should be a 5 pin, male, whip type assembly. An example part number from SubConn is MCIL5F, which is the whip assembly used on the aft and fore solar panels.

WEATHER Connector

The weather station connector interfaces to the LRI Airmar PB200 weather station option. The pin out is similar to a payload so that no damage will occur to either component, but the power and communication type are not compatible with standard payloads.

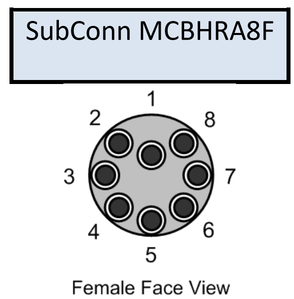

Figure 13: WEATHER Connector Face

WEATHER Pin Out

Pin #	Signal Name	Description
1	N/C	Not Used
2	PWR	13.2 Volts regulated, 300mA maximum
3	RXD-	RS-422 receive from station
4	RXD+	RS-422 receive from station
5	TXD-	RS-422 transmit to station
6	TXD+	RS-422 transmit to station
7	GND	Ground reference for all pins
8	N/C	Not Used

Table 11: Weather connection pin out

PWR and GND

The power pin provides a regulated 13.2 volts at up to 300mA continuous draw. The port will handle surges of up to 500mA. Any transient current draw greater than 500mA for more than 160ms will constitute a fault and cause the output to shut off to protect itself.

TX+, TX-, RX+ and RX-

These are the communication lines that connect directly into the Command and Control processor. This link connects to the weather station using an RS-422 interface. Current systems have all four pins connected, but do not transmit data to the weather station. The Float C&C only listens to the data being reported.

WEATHER Mating Connector

The WEATHER port is design to mate to a wet mate-able connector from Teledyne or SubConn. The mating connector should be an 8 pin, male, whip type assembly. An example part number from SubConn is MCIL8M, which is the assembly used on the Liquid Robotics Weather Stations Assembly.

SPEED Connector

The water speed sensor connector interfaces to the LRI-provided Airmar CS4500 ultrasonic water speed sensor. The pin out is such that if a payload is accidently connected here, no damage will occur to either component, but the power and communication type are not compatible with standard payloads.

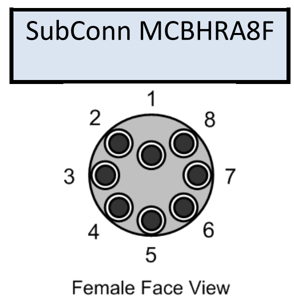

Figure 14: SPEED Connector Face

SPEED Pin Out

Pin #	Signal Name	Description
1	GND	Ground reference for all pins
2	N/C	Not Used
3	PWR	8.0 Volts Regulated, 250mA Maximum
4	Data	Paddle wheel water speed sensor input
5	N/C	Not Used
6	N/C	Not Used
7	N/C	Not Used
8	N/C	Not Used

Table 12: Water speed sensor connection pin out

PWR and GND

The power pin provides a regulated 8.0 volts at up to 250mA continuous draw. The port will handle surges of up to 300mA. Any transient current draws greater than 300mA will fold back the current to protect the regulator.

Data

This is designed to accept an open collector output compatible with the CS4500 water speed sensor. This pin has a weak pull-up (100k) to 3.3 volts.

SPEED Mating Connector

The SPEED port is design to mate to a wet mate-able connector from Teledyne or SubConn. The mating connector should be an 8 pin, male, whip type assembly. An example part number from SubConn is MCIL8M, which is the assembly used on the Liquid Robotics Water Speed Sensor Assembly.

LIGHT Connector

The light connector interfaces to a Liquid Robotics Inc. light mounted on a mast with a weather station.

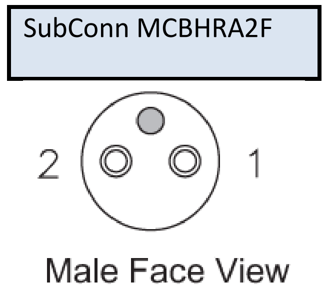

Figure 15: LIGHT Mating Connector Face – Note this is the male face not the female face on the box

LIGHT Pin Out

Pin #	Signal Name	Description
1	PWR	13.2 Volts regulated, 500mA maximum
2	GND	Ground reference for all pins

Table 13: Light connection pin out

PWR and GND

The power pin provides a regulated 13.2 volts at up to 500mA continuous draw. The port will handle surges of up to 1.0A. Any transient current draw greater than 1.0A for more than 160ms will constitute a fault and cause the output to shut off to protect itself.

LIGHT Mating Connector

The LIGHT port is design to mate to a wet mate-able connector from Teledyne or SubConn. The mating connector should be a 2 pin, male, whip type assembly. An example part number from SubConn is MCIL2M, which is the assembly used on the Liquid Robotics Light Bar Assembly.

Power System

Batteries

The Float C&C contains a Li-Ion battery pack that supplies power to the payloads and the core system as needed to supplement the solar panel input. The battery pack can store up to 665 Watt Hours of energy. This energy is shared between the core electronics and the various payloads connected to the system.

Core System Power Draw

The core system typically draws 1.5 to 3.0 watts depending on operating conditions (telemetry rates, wave wash-over, etc.). Use this draw when calculating system sustainability.

Payload Regulator

All PAYLDx, UMBILICAL, and AUX PWR ports all share a common regulator. This regulator is limited to 10.0A output current when the batteries are more than 20% full. When the batteries are less than 20% full the regulators maximum output current declines linearly to 5.0A at empty. The payloads should never exceed these values as it can cause the rudder module to go into a low power mode. The tables below are examples of potential current draws. As long as the individual port draws are not exceeded, they can be any combination of currents through each port.

Port	Current
PAYLD 1	1.0A
PAYLD 2	1.0A
PAYLD 3	1.0A
UMBILICAL (via the rudder module)	0.5A
AUX PWR	1.0A
Total	4.5A

Table 14: Acceptable System Current Draws

Port	Current
PAYLD 1	2.0A
PAYLD 2	2.0A
PAYLD 3	2.0A
UMBILICAL (via the rudder module)	0.5A
AUX PWR	3.0A
Total	9.5A

Table 15: Acceptable System Current Draws Above 20% Battery Charge

Port	Current
PAYLD 1	2.0A
PAYLD 2	2.0A
PAYLD 3	2.0A
UMBILICAL (via the rudder module)	0.5A
AUX PWR	5.0A
Total	11.5A

Table 16: Unacceptable System Current Draws

Power Input

The Float C&C is expecting a solar panel or similar type power source to provide energy to recharge the batteries. To minimize losses the main path to charge the batteries is unregulated so the input must fall within the ranges specified in the SOLAR connections. There is a boost regulator built in to accommodate solar panel shade compensation, but the charging efficiency typically drops by 20-30% by using this stage. The shade compensation circuit is always active and the Float C&C is continuously checking to see if it is needed. The algorithm checks to see whether unregulated or boosted voltage modes provide more power to the system and then leaves that mode in place until the next check time.

There is also an auxiliary charging input via the AUX PWR port. Refer to the AUX PWR port section for specifications and requirements.

Solar Panels

Overview

This section describes the feature set of the standard solar panels. The intent of this section is to provide enough information so that alternative power sources can potentially use the same port as an input power as well as to describe how the system accommodates shade compensation.

Solar Panel Specification

The solar panel laminates are Kyocera KC40T or equivalent. The table below shows the critical specifications that the system has been designed to meet.

Description	Value	Units	Notes
Laminate Width	520	mm	Limited by mounting holes
Laminate Length	645	mm	Limited by mounting holes
Laminate Height	8	mm	Recommended, but not required
Power	40	Watts	Industry standard notation
Vmpp	17.4	Volts	Maximum power point voltage
Impp	2.30	Amps	Maximum power point current
Voc maximum	22.2	Volts	Limiting voltage on the input
Isc maximum	5.0	Amps	Limited by the connector rating
Connection Type	3	Connections	Provides terminals for bypass diodes

Table 17: Solar Panel Specifications

Shading and Shade Compensation

Shading is a significant problem for solar panels. If a single cell becomes shaded, it blocks all current flow through the panel. Please note that a laminate is typically made up of 36 cells and it only takes one cell to be shaded to create problems. For reference, the panels are split in half between the aft and fore sections of the panel.

The design of the panels provides connections for bypass diodes, which allow the use of a half panel to provide power when a single cell is shaded. If a one or more cells in each half panel is shaded then the panel provides zero output. The images below show examples of what constitutes shading of a single cell.

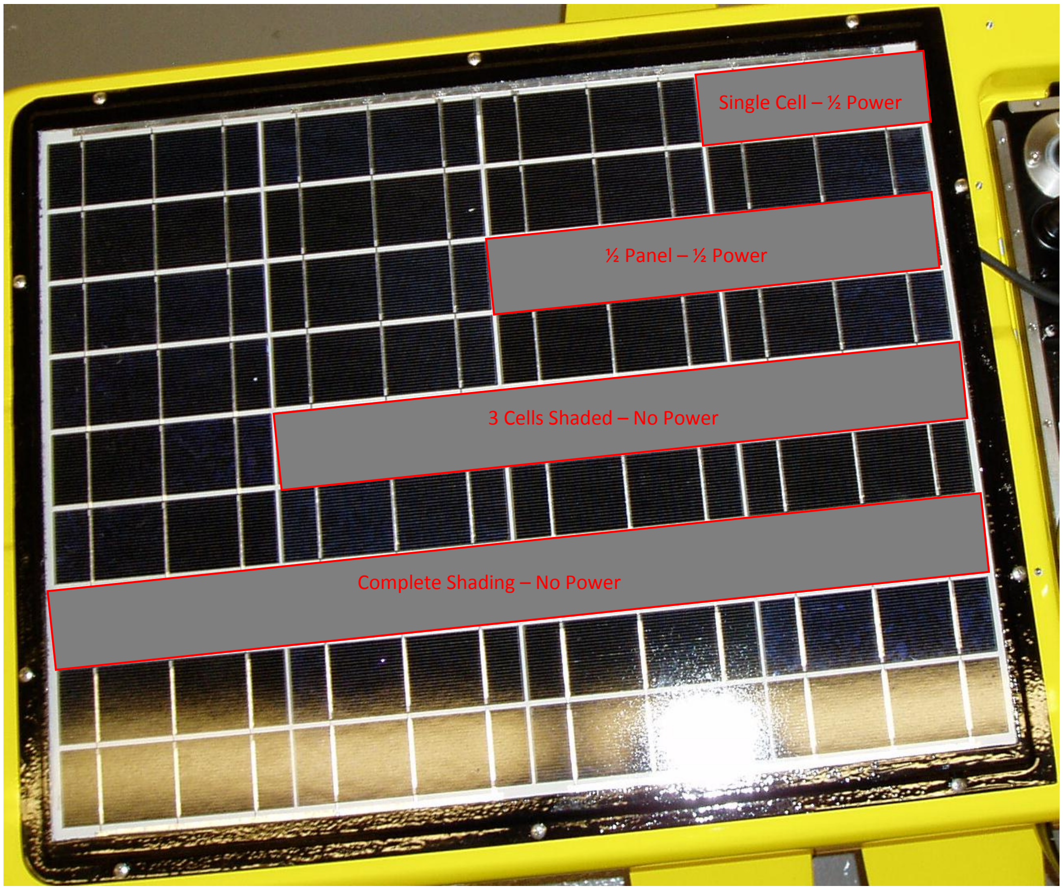

Figure 16: Examples of shading and how they affect power output

Shading in general comes from environmental conditions such as cloud cover and from system components mounted on the vehicle. Shading from environmental conditions is typically temporary and are out of the designers/pilots control. To optimize total power input, all sensors should be mounted below the top of the solar panel. Since this is not always possible, the recommendations below should be followed.

If a tall element such as a mast is required, attempt to design it to be narrower than a single cell. This does not eliminate the shading effects, but only reduces the output proportional to the shading width.

If it is a wide element, attempt to design it to be as short as possible. With this design, shading is not a problem during the middle part of the day.

To maximize power input when there are shading elements on a vehicle, move to a more North South course so that the shadows fall off the sides of the vehicle for most of the day. In the East-West navigational direction, one of the panels may always suffer from shading.

Wall Charging

Overview

This section describes the Liquid Robotics Wall Charger as well as what is recommended as potential replacements.

Charger Connections

An external charger may be connected to either or both of the Float C&C solar panel connectors. This allows charging or “topping-off” of the batteries pre-mission, or when bench testing. For charging to occur, turn on the Float C&C by inserting the switch.

The maximum charging current for each connection is internally limited to 3.0 Amps, regardless of what the charger is capable of supplying. For faster charging, connect a charger to each of the two solar panel connectors.

When using an external charger it is recommended that all payloads and sensors be turned off. This is because the charging energy is shared between the batteries and any enabled payloads or sensors, but the 3.0 amp input limit still applies. The wall charger can add a significant amount of switching power supply noise that may affect the operation of the payloads or sensors.

LRI-Supplied Charger

Liquid Robotics Inc. offers a pre-made external charger specifically designed for the Wave Glider.

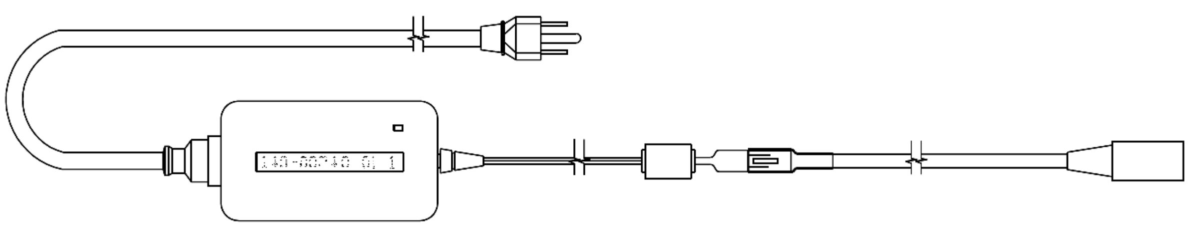

Figure 17: LRI External Charger

Contact Liquid Robotics for more information.

Custom-Made Charger

A custom Wave Glider battery charger can be made from a commercial power supply and a SubConn connector. The power supply voltage must be 9-12 VDC. To minimize charging time, the charger should be capable of delivering at least 3.0 Amps. The connector required to mate with the solar panel connector is a MCBHRA5F SubConn 5-pin Female type, with the pin out listed below.

Pin #	Signal Name	Description
1	V+	Connect to power supply positive pin
2	GND	Connect to power supply negative pin
3	GND	Connect to power supply negative pin
4	DETECT	Signal shorted to pin 5 to detect that the panel is present
5	DETECT	Typically connected to ground

Table 18: Wall Charger Connections

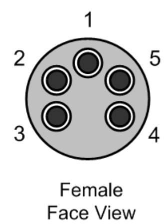

Figure 18: Charger Connector Face

510-00094 (Payload Interface Board – PIB)

Overview

This section covers Payload Interface Board, including how it fits into the system architecture and how to interface to it.

Payload Interface Board Architecture

The Payload Interface Board provides multiple sensors for leak detection and environmental monitoring. It also provides a common interface for Personality Modules, which may be quickly modified to adapt to End User Equipment.

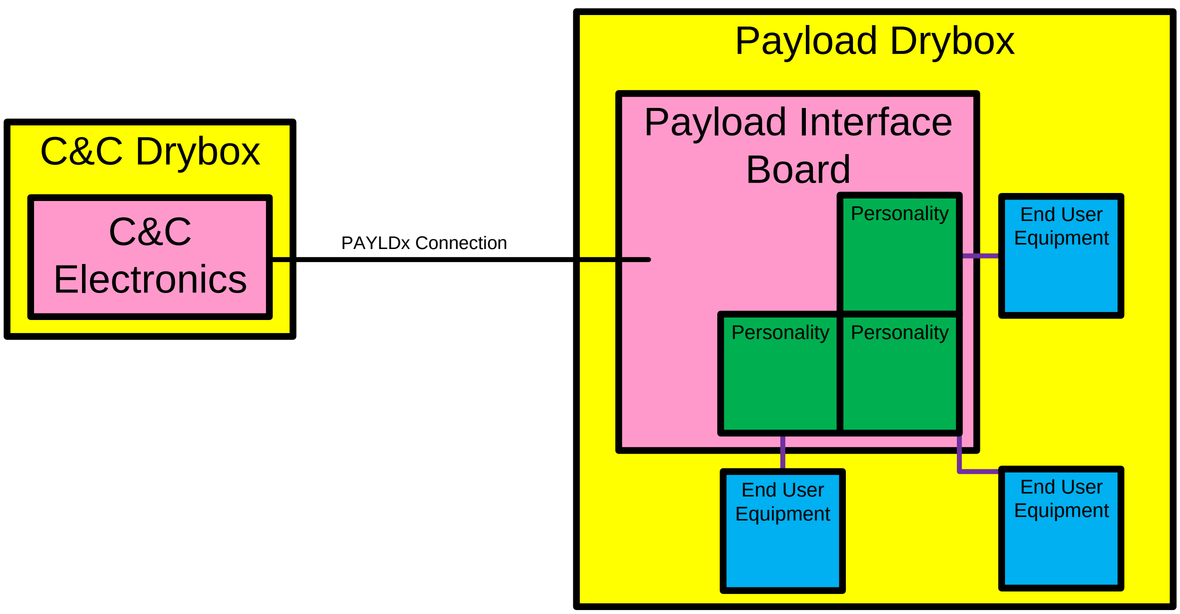

Figure 19: Simple single PIB to three Personality Modules and three pieces of equipment

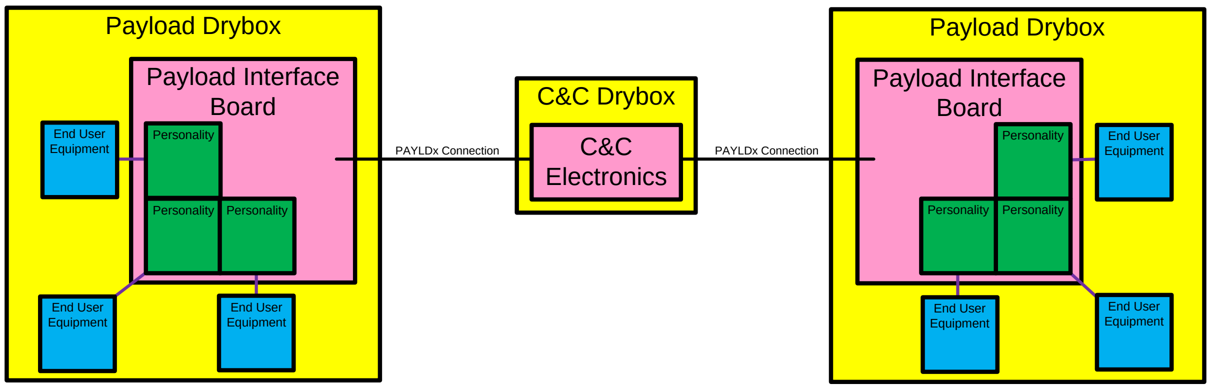

Figure 20: Simple double PIB to a total of 6 pieces equipment

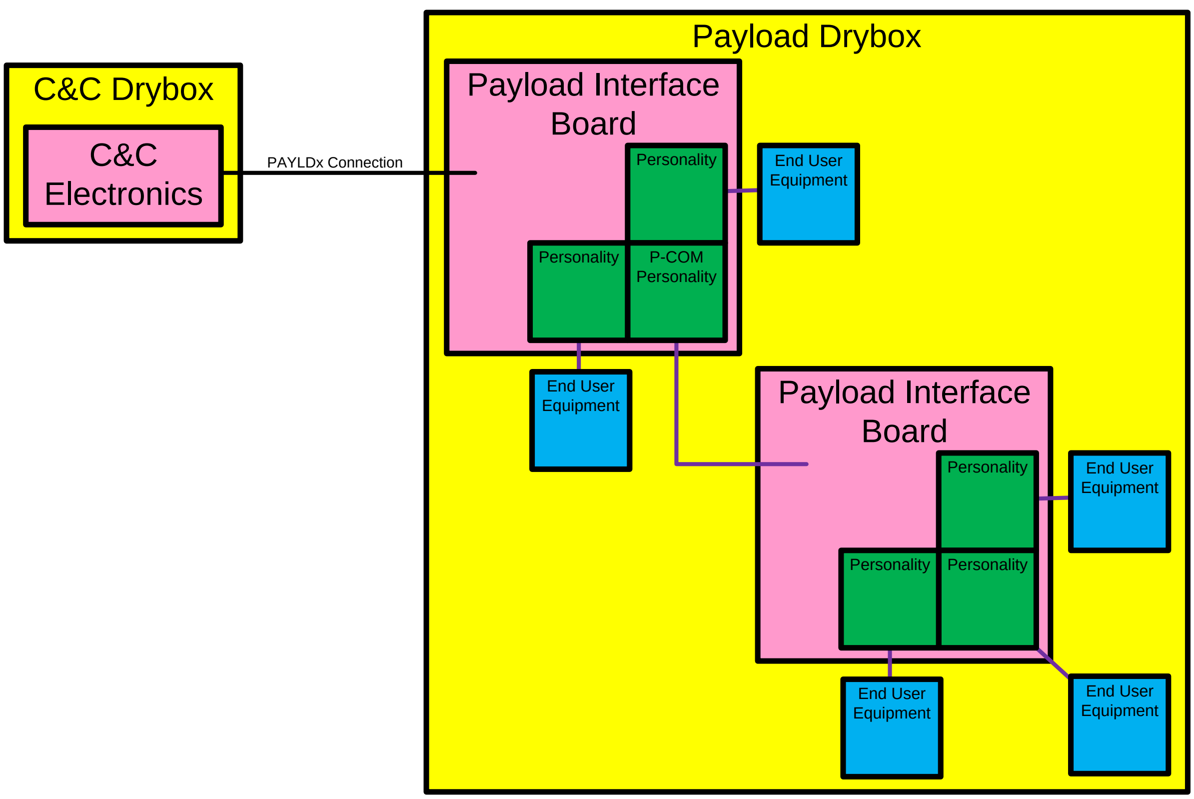

Figure 21: Daisy chained PIBs to expand equipment count in a single drybox

Payload Interface Board Interfaces

This section covers the various connectors and interfaces to the Payload Interface Board (510-00094). Each connection is described with a pin-out, part numbers for the mating connector/crimp pins and an electrical specification.

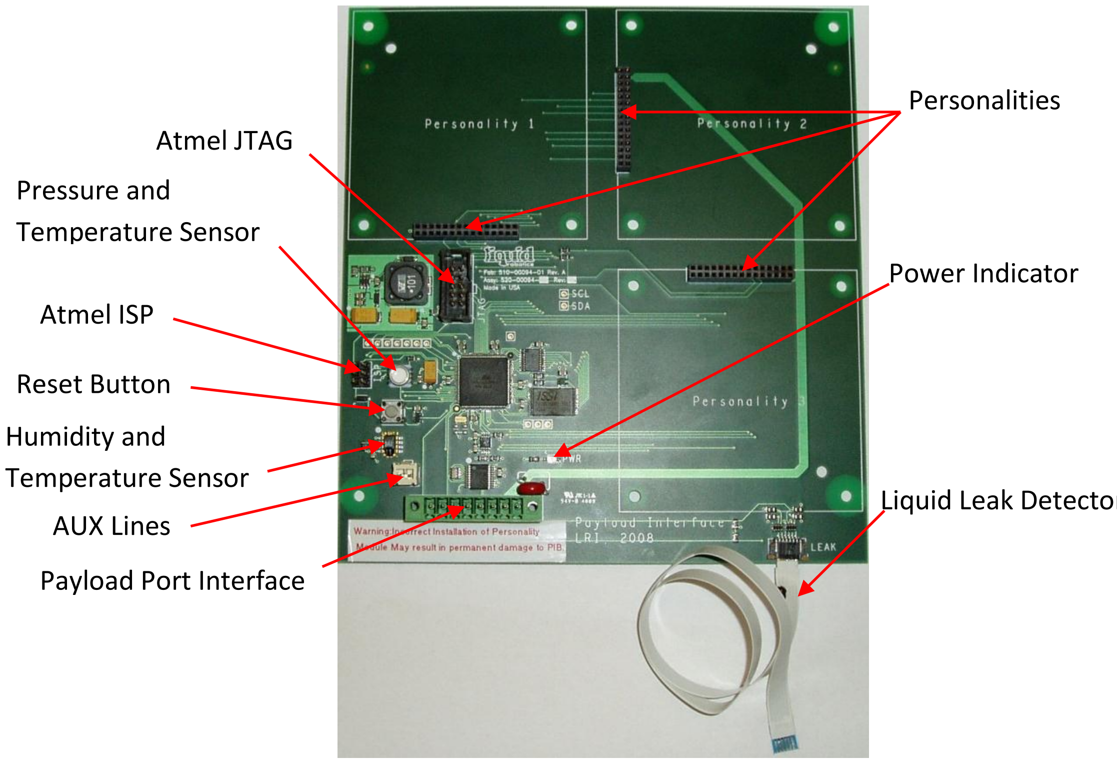

Figure 22: PIB Connector and Sensor Locations

Pressure and Temperature Sensor

The pressure and temperature sensor provides feedback to WGMS on the state of the drybox. The pressure is temperature compensated. It may be used as an early detection mechanism that the seal has failed.

Maximum pressure on the sensor is 14 bars, with a resolution of 1.2 millibar and an accuracy of +/-200 millibar. WGMS reports this value to the nearest kilo-Pascal

The temperature range is -40°C to 85 C with a resolution of 0.015 C. and an accuracy of -2/+6 C. WGMS reports this with a resolution of 1 C.

Reset Button

The reset button is provided for development, testing and debugging. It resets the microcontroller when pressed.

Power Indicator

The power indicator is provided for development, testing and debugging. It notifies the user when the 3.3 volt regulator is functioning, which means a minimum of 6 volts is coming from J7 pin 2 to the regulator. It is not an indicator of the microcontroller health.

Humidity and Temperature Sensor

The humidity sensor provides feedback to the user on the state of the drybox. The humidity is temperature compensated. It may be used as an early detection mechanism that the seal has failed.

The humidity range is 0 to 100% with an accuracy of +/-3% between 20 and 80% relative humidity. The sensor has a resolution of 0.05% relative humidity. The reading is temperature compensated. WGMS reports this with a resolution of 1% relative humidity.

The temperature range is -40°C to 85 C with a resolution of 0.4 C. and an accuracy of +/-2.5 C. WGMS reports this with a resolution of 1 C.

Payload Port Interface – J7

The payload port interface connector typically is the interface to the Float C&C. This is a disconnectable screw terminal to allow for easy removal of the PIB or the standard drybox penetrator cable. The connector is manufactured by Tyco and is part number 284516-8.

8  1

Figure 23: Pin Number Orientation

Payload Port Interface - J7 Pin Out

Pin #	Signal Name	Description	Wire Color
1	PPS	GPS pulse-per-second, using RS-232 levels	Black
2	PWR	13.2 Volts regulated at 3.0A continuous	White
3	TX	RS-232 Transmit Line	Red
4	RX	RS-232 Receive Line	Green
5	AUXA	Glider Connections, exact connections are determined by which payload port it is	Orange
6	AUXB	Glider Connections, exact connections are determined by which payload port it is	Blue
7	GND	Ground reference for all pins	Yellow
8	GPS Data	4800 Baud GGA, ZDA, and VTG, using RS-232 levels, 5 second report rate	White/Black

Table 19: J7 pin out

Payload Port Interface - J7 Electrical Interface

These connections are compatible with all the specification for the PAYLDx ports on the Float C&C drybox.

PWR and GND

The power pin requires 12 volts +/-10% at up to 3A continuous draw.

TX and RX

These communication lines connect between Float C&C and PIB processors. This connection is RS-232 at 115,200 baud rate. These signals are provided via a MAX232 compatible circuit.

PPS and GPS Signals

The PIB does not directly connect to these pins. If the end user equipment needs this information, connect directly to the wires on the penetrator or add additional connections into the screw terminals.

Auxiliary Lines – AUXA & AUXB

The auxiliary lines are provided to give direct access to other payloads on the float or to connect to the glider assembly. These pins connect to J6 (AUX lines) pins 1 and 2 respectively.

Payload Port Interface - J7 Mating Connector

The mating connector is manufactured by Tyco, part number 284510-8. Below is an example photo. It is recommended that ferrules be used with the loose wires as well.

Figure 24: PIB to Penetrator Example Connector

AUX Lines – J6

The AUX lines connector is intended to simplify cabling from the auxiliary lines to a personality module. This is a keyed and latching connector for robustness. The connector is manufactured by Samtec and is part number IPL1-102-01-S-S.

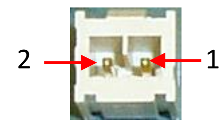

Figure 25: Pin Number Orientation

AUX Lines – J6 Pin Out

Pin #	Signal Name	Description
1	AUXA	Connects to Payload Port Interface pin 5
2	AUXB	Connects to Payload Port Interface pin 6

Table 20: J6 pin out

AUX Lines – J6 Electrical Interface

These connections are direct shorts back to the Payload Port Interface. . It is recommended that the voltage between the two pins not exceed 50 volts or 2.5 amps.

AUX Lines – J6 Mating Connector

There are two options for a mating connector from Samtec. The first and preferred option is to order pre-built cable assembly like MMSS-02-24-L-05.00-S-K. The length can be adjusted as needed by changing the 4-digit number between the L and S (i.e. the XX.XX in MMSS-02-24-L-XX.XX-S-K). The second option is to use a crimp housing and crimp pins, part numbers IPD1-02-S-K and CC79R/L.

Atmel ISP – J5

The Atmel ISP connector is intended to be the production programming interface port. This dual row 0.100" pitch header is unshrouded for quick connection and disconnection in a production environment. This connection is intended for an Atmel ATAVRISP2, but will work with other ATMEL programmers.

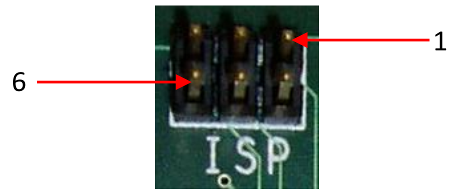

Figure 26: Pin Number Orientation

Atmel ISP – J5 Pin Out

Pin #	Signal Name	Description
1	MISO-ISP	Master In – Slave Out
2	VCC	+3.3 VDC
3	SCLK	Clock for synchronizing data
4	MOSI	Master Out – Slave In
5	RESET	Pin 5 Grounded → Reset
6	GND	Ground reference for all pins

Table 21: J5 pin out

Atmel ISP – J5 Electrical Interface

These connections are compatible with the Atmel ATmega ISP programming interface running at 3.3 volts.

PWR and GND

The power pin is used to provide a reference voltage to the programming adapter. No more than 30mA should be sourced from this pin during programming.

MISO-ISP, MOSI, SCLK and RESET

These are the communication lines that connect between the programmer and the microcontroller. This link should only be used with an Atmel approved programming device.

Atmel ISP – J5 Mating Connector

The mating connector is either an Atmel ATJTAGICE2 with 10 pin to 6 pin adapter cable or an Atmel ATAVRISP2. Other Atmel programmers should work as well, but only these two have been tested over this interface.

Figure 27: Atmel ATJTAGICE2 without the adapter cable

Figure 28: Atmel ATAVRISP2

Atmel JTAG – J4

The Atmel JTAG connector is intended to be the development programming and debug port. This dual row 0.100” pitch header is shrouded with a key for reliable orientation in a development environment. This connection is for an Atmel ATJTAGICE2, but will work with other ATMEL programmers.

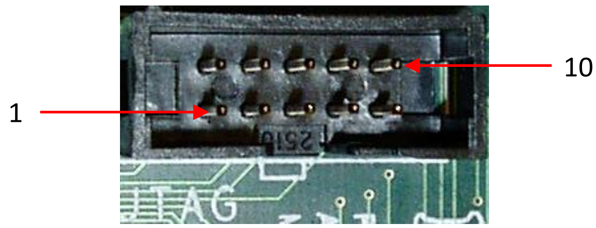

Figure 29: Pin Number Orientation

Atmel JTAG – J4 Pin Out

Pin #	Signal Name	Description
1	TCK	Clock
2	GND	Ground reference for all pins
3	TDO	Data Out
4	VCC	+3.3 VDC
5	TMS	Test Mode Select
6	RESET	Pin 6 Grounded → Reset
7	VCC	+3.3 VDC
8	N/C	No Connection
9	TDI	Data In
10	GND	Ground reference for all pins

Table 22: J4 pin out

Atmel JTAG – J4 Electrical Interface

These connections are compatible with the Atmel ATmega JTAG programming and debugging interface running at 3.3 volts.

PWR and GND

The power pin is used to provide a reference voltage to the programming adapter. No more than 30mA should be sourced from this pin during programming.

TCK, TDO, TMS, TDI and RESET

These are the communication lines that connect between the programmer and the microcontroller. This link should only be used with an Atmel approved programming device.

Atmel JTAG – J4 Mating Connector

The mating connector is an Atmel ATJTAGICE2. Other Atmel programmers should work as well, but this is the only one that has been tested over this interface.

Figure 30: Atmel ATJTAGICE2

Personality Interface – J1, J2, J3

The personality interface connector is intended to be the interface to a variety of personality modules. This interface was designed around flexibility and the ability to identify the specific location. This is a 2mm, dual row, 30 pin header. The connectors are not keyed or shrouded. **Warning incorrect installation of Personality Modules will result in permanent damage to the PIB.** When installing a personality please remove the connector at J7 to guarantee that there is no power present. The connector is manufactured by Samtec and is part number SQT-115-01-L-D.

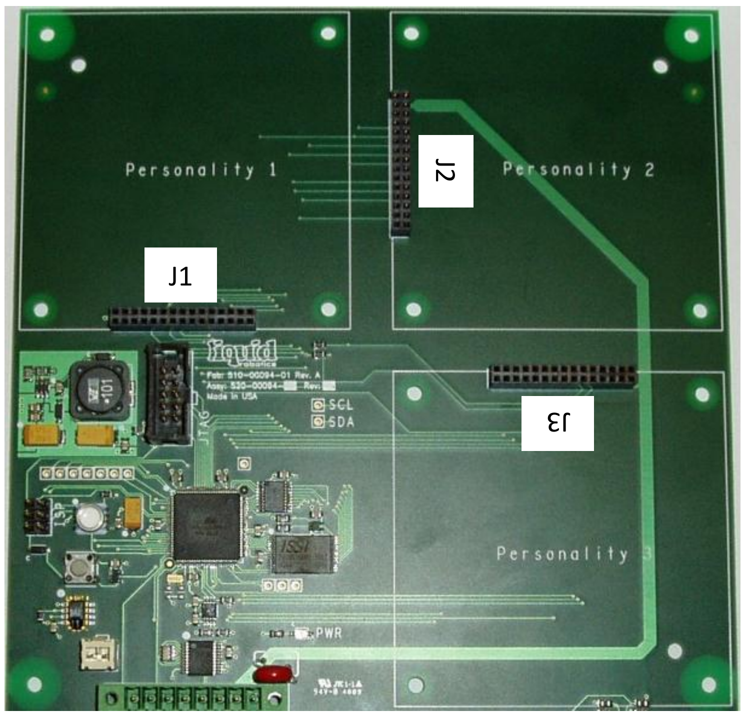

Figure 31: Personality Connector Locations

Figure 32: Pin Number Orientation

Personality Interface – J1, J2, J3 Pin Out

Pin #	Signal Name	Description
1	PWR	Power from C&C
2	GND	Ground
3	PWR	Power from C&C
4	GND	Ground
5	VCC	Regulated +3.3V
6	GND	Ground
7	SDA	I^2C Data Line
8	GND	Ground
9	SCL	I^2C Clock Line
10	GND	Ground
11	TXD	UART Transmit to Personality Module
12	GND	Ground
13	RXD	UART Receive from Personality Module
14	GND	Ground
15	XCK GPIO	Synchronous Serial Clock GPIO (optional)
16	GND	Ground
17	PON	Personality Module Power-On/Enable
18	GND	Ground
19	POK	Personality Module Power OK Response
20	GND	Ground
21	GPIO-0	Connection to microcontroller
22	GND	Ground
23	GPIO-1	Connection to microcontroller
24	GND	Ground
25	GPIO-2	Connection to microcontroller
26	GND	Ground
27	GPIO-3	Connection to microcontroller
28	GND	Ground
29	ADDR2	Personality Module address 2^{nd} bit
30	ADDR1	Personality Module address 1^{st} bit

Table 23: J1, J2, J3 pin out

Personality Interface – J1, J2, J3 Electrical Interface

These connections are 3.3 volt CMOS connections directly to the ATmega2560 on the PIB

PWR

The power pins are a direct connection to J7 pin 2. They should be limited to no more than 1.0 amps per personality module.

VCC
The regulated 3.3 volt supply can provide up to 250 milliamps for the personality modules. This is a sum of all three ports, not a per port limitation. If more current is drawn by the personality modules, the PIB processor can reset.

GND
The ground pins are a direct connection to J7 pin 7 through an internal plane on the PIB. These should all be connected together on the personality module for robustness.

SCL and SDA
These communication lines are common to all of the personality modules. They conform to the I^2C specification for a 3.3 volt bus at up to 400 KHz. The intention of this bus is to allow inter-personality communication and/or a common interface for automatically detecting personality modules. I^2C is available to the personality module. It is also intended to be connected to an I^2C serial EEPROM (Atmel AT24CxxB [except the AT24C08B]) on each personality module, but could be used to control the personality as well. I^2C addresses 7'b1010_xxx should be reserved for EEPROM storage on personality modules. Pull-ups are already provided on the PIB.

TX, RX and XCK
These communication lines provide for an interface to a USART on the microcontroller. If the USART is used in asynchronous mode, the XCK line may be used as a general purpose I/O pin from the microcontroller.

Connector	USART
J7 (for reference only)	USART0
J1/Personality 1	USART1
J2/Personality 2	USART2
J3/Personality 3	USART3

Table 24: Microcontroller USART usage per Personality

PON and POK
The PON and POK signals are used to provide an enable/power on pin and feedback that the system is on and running. If the PON pin will not be used, tie it directly to POK so that it is compatible with all other personality modules. These pins are 3.3 volt CMOS compatible. PON should be brought high and sometime later POK should come high to indicate that the personality module is functional.

GPIO-X
The GPIO lines are provided to give direct access to I/O on the microcontroller. Refer to the ATmega2560 datasheet for specific pin requirements. The table below shows the specific connections made from each personality module to the microcontroller.

Personality Module Interface	J1	J2	J3
21/GPIO-0	PK0	PH4	PF0
23/GPIO-1	PK1	PH5	PF1
25/GPIO-2	PK2	PH6	PF2
27/GPIO-3	PK3	PH7	PF3

Table 25: GPIO-X pin mapping to microcontroller pins per Personality

ADDR1 and ADDR2

The address 1 and address 2 pins are used to identify which specific personality location a personality has been inserted into. These pins should be tied to the I^2C EEPROM, but can also be read by the personality module to determine location. The table below shows the specific addressing of each location on the PIB.

Location	ADDR1/Pin 30	ADDR2/Pin 29
J1	GND	GND
J2	GND	VCC
J3	VCC	GND

Table 26: ADDR1/2 values based on Personality location

Personality Interface – J1, J2, J3 Mating Connector

The mating connector is manufactured by Samtec, and is part number TMM-115-03-G-D.

Liquid Leak Detector – J8

The liquid leak detector connector is designed to interface to a custom cable assembly from Liquid Robotics, part number 140-00277-012. This cable should be mounted at the lowest point in the drybox to detect the presence of a conductive liquid (typically salt water) leaking into the housing.

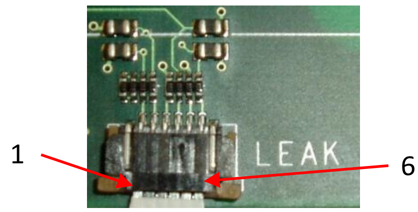

Figure 33: Pin Number Orientation

Liquid Leak Detector – J8 Pin Out

Pin #	Signal Name	Description
1	LEAKCO	Leak cable Continuity Out
2	LEAKCI	Leak cable Continuity In
3	WEAK PULL DOWN	Grounded thru 1K
4	LEAK1	Connection to weak pull down indicates a leak
5	WEAK PULL DOWN	Grounded thru 1K
6	LEAK0	Connection to weak pull down indicates a leak

Table 27: J8 pin out

Liquid Leak Detector – J8 Electrical Interface

These connections are 3.3 volt CMOS connections with ESD protection.

LEAKCO and LEAKCI

The leak cable continuity out and in pins are used to detect the presence of the leak detector cable. The continuity out pin drives both a high and low signal and checks to make sure the continuity in pin follows it.

LEAK0, LEAK1 and WEAK PULL DOWN

The LeakX pins have weak internal pull-ups and the microcontroller watches for these pins to be pulled low indicating a short to the weak pull down pins. These pins are pulled up to 3.3 volts via 47 kilo-ohms resistors.

Liquid Leak Detector – J8 Mating Connector

The mating connector is manufactured by Liquid Robotics and is part number 140-00277-012.

510-01581 and 510-01086 (Sub Payload Interface Board – SubPIB)

Overview

This section covers the Sub Payload Interface Board, both 510-01581 and 510-01086, including how it fits into the system architecture and how to interface to it. If anything is not fully described here, refer to the PIB section as an alternate reference. All of the connector reference designators are the same and this design is completely based on that design.

Sub Payload Interface Board Architecture

The Sub Payload Interface Board is similar to the Payload Interface Board in functionality, but is built around a double-sided assembly architecture that allows for the finished assembly to fit into a towfish assembly or where the smaller form factor is desired. It provides multiple sensors for leak detection and environmental monitoring. It also provides a common interface for Personality Modules, which are intended to be quickly and easily modified to adapt to the End User Equipment.

The main difference for the Sub PIB is that it is intended to be installed in a towfish that does not have a direct connection to the C&C. The figure below shows a basic setup for any towfish design that needs to connect to the C&C. The auxiliary lines are not shown, but it is assumed that Sub PIB is communicating on one of the two pairs of auxiliary lines (which pair depends on the PAYLDx port used on the C&C) to a PIB with a P-COM in a float payload drybox. The power is still delivered via the Rudder Module controls.

The example below is a very basic example and can be combined with or used in scenarios similar to a standard PIB. This includes multiple towfish assemblies and/or payload boxes that have their own PIB/Sub PIB or daisy chaining sub-PIBs within a single towfish or payload box.

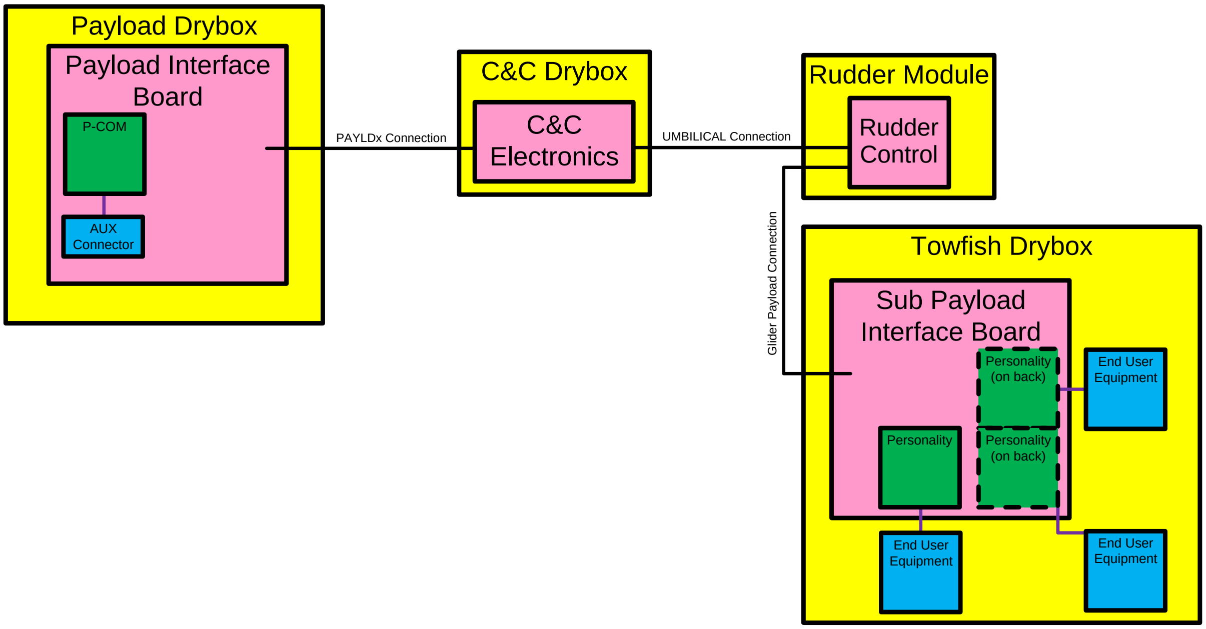

Figure 34: Single Sub PIB in a towfish to three Personality Modules and three pieces of equipment

Sub Payload Interface Board Interfaces

This section covers the various connectors and interfaces to the Sub Payload Interface Board (510-01086 and 510-01581). Each connection is described with a pin-out, part numbers for the mating connector/crimp pins and an electrical specification.

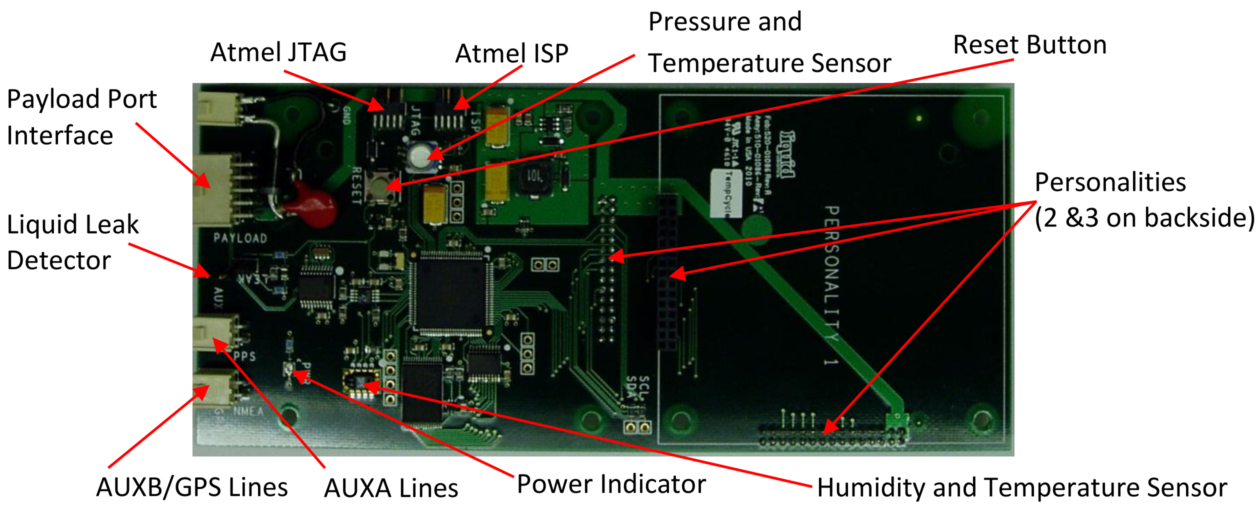

Figure 35: 510-01086 Connector and Sensor Locations

Pressure and Temperature Sensor

The pressure and temperature sensor provides feedback to the user on the state of the drybox or towfish. The pressure is temperature compensated. It can be used as an early detection mechanism that the seal has failed by pressurizing the drybox or towfish and watching for a decrease over time. The PIB does not provide an alarm for a failure, only the data from the sensor. The user must monitor the data to detect the failure.

Maximum pressure on the sensor is 14 bars, with a resolution of 1.2 millibar and an accuracy of +/-200 millibar. WGMS reports this value as to the nearest kilo-Pascal

The temperature range is -40°C to 85 C with a resolution of 0.015 C. and an accuracy of -2/+6 C. WGMS reports this with a resolution of 1 C.

Reset Button

The reset button is provided for development, testing and debugging. It resets the microcontroller when pressed.

Power Indicator

The power indicator is provided for development, testing and debugging. It notifies the user when the 3.3 volt regulator is functioning, which means a minimum of 6 volts is coming from J7 pin 2 to the regulator. It is not an indicator of the microcontroller health.

Humidity and Temperature Sensor

The humidity sensor provides feedback to the user on the state of the drybox or towfish. The humidity is temperature compensated. It can be used as an early detection mechanism that the seal has failed by watching for an increase in the drybox or towfish humidity over time. The PIB does not provide an alarm for a failure, only the data from the sensor. The user must monitor the data to detect the failure.

The humidity range is 0 to 100% with the best accuracy of +/-3% between 20 and 80% relative humidity. The sensor has a resolution of 0.05% relative humidity. The reading is temperature compensated. WGMS reports this with a resolution of 1% relative humidity.

The temperature range is -40°C to 85 C with a resolution of 0.4 C. and an accuracy of +/-2.5 C. WGMS reports this with a resolution of 1 C.

Payload Port Interface – J7

The payload port interface connector is intended to be the interface to a payload port, from either the Float C&C or the Rudder module. This is a latching 0.100" pitch connector from Samtec, part number IPL1-105-01-S-D-RA-K for robustness. The intention of this connection is to interface to either a penetrator or bulkhead connector that exits the payload drybox or towfish, but it can be used to daisy chain from another PIB or Sub PIB.

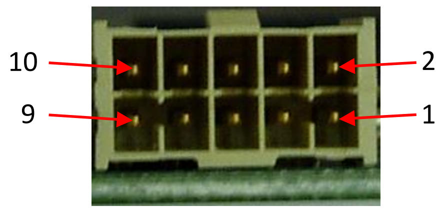

Figure 36: Pin Number Orientation

Payload Port Interface - J7 Pin Out

Pin #	Signal Name	Description	Wire Color
1	PPS	GPS pulse-per-second, using RS-232 levels	Black
2	PWR	13.2 Volts regulated at 3.0A continuous	White
3	TX	RS-232 Transmit Line	Red
4	RX	RS-232 Receive Line	Green
5	AUXA	Glider Connections, exact connections are determined by which payload port it is	Orange
6	AUXB	Glider Connections, exact connections are determined by which payload port it is	Blue
7	GND	Ground reference for all pins	Yellow
8	GPS Data	4800 Baud GGA, ZDA, and VTG, using RS-232 levels, 5 second report rate	White/Black
9	GND	Ground reference for all pins – Typically not used	
10	GND	Ground reference for all pins – Typically not used	

Table 28: J7 pin out

Payload Port Interface - J7 Electrical Interface

These connections are compatible with all the specification for the PAYLDx ports on the Float C&C drybox.

PWR and GND

The power pin requires 12 volts +/-10% at up to 3A continuous draw.

TX and RX

These are the communication lines that connect between the Float C&C and PIB processors. This link should be used by equipment to send data to other payloads and between the ship and shore. This connection is RS-232 at 115,200 baud rate. These signals are provided via a MAX232 compatible circuit.

PPS and GPS Signals

The PPS and GPS lines are not used by the PIB, but are provided via connector J9 for end user equipment use or specific personality modules that require this data. Please see the specification for J9 for more information.

Auxiliary Lines – AUXA & AUXB

The auxiliary lines are provided to give direct access to other payloads on the float or to connect to the glider assembly. These pins connect to J6 (AUX lines) pins 1 and 2 respectively.

Payload Port Interface - J7 Mating Connector

There are two options for a mating connector from Samtec. The first and preferred option is to order pre-built cable assembly like MMSD-05-24-L-06.00-S-K. The length can be adjusted as needed by changing the 4-digit number between the L and S (i.e. the XX.XX in MMSD-05-24-L-XX.XX-S-K). The second option is to use a crimp housing and crimp pins, part numbers IPD1-05-D-K and CC79R/L.

Optional Power Input Port Interface – J10 (510-01581 only)

The optional power input port interface connector is intended to be the interface to a power supply external to the drybox or towfish. This is a latching 0.100" pitch connector from Samtec, part number IPL1-102-01-S-S-RA-K for robustness. The intention of this connection is to interface to either a penetrator or bulkhead connector that exits the payload drybox or towfish to provide power to the SUB-PIB and its personalities without the use of the Rudder module connection. An example of a use for this is to power an SMC (Liquid Robotics part number 510-01232) on to retrieve data from it without powering on the Float C&C.

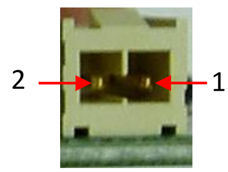

Figure 37: Pin Number Orientation

Optional Power Input Port Interface – J10 Pin Out

Pin #	Signal Name	Description
1	GND	Ground reference for all pins
2	PWR	13.2 Volts regulated at 3.0A continuous

Table 29: J10 pin out

Optional Power Input Port Interface – J10 Electrical Interface

These connections are compatible with all the specification for the PAYLDx ports power connections on the Float C&C drybox.

PWR and GND

The power pin requires 12 volts +/-10% at up to 3A continuous draw.

Optional Power Input Port Interface – J10 Mating Connector

There are two options for a mating connector from Samtec. The first and preferred option is to order pre-built cable assembly like MMSS-02-24-L-05.00-S-K. The length can be adjusted as needed by changing the 4-digit number between the L and S (i.e. the XX.XX in MMSS-02-24-L-XX.XX-S-K). The second option is to use a crimp housing and crimp pins, part numbers IPD1-02-S-K and CC79R/L.

AUX Lines – J6

The AUX lines connector is intended to simplify cabling from the auxiliary lines to a personality module. This is a keyed and latching connector for robustness. The connector is manufactured by Samtec and is part number IPL1-102-01-L-S-RA-K.

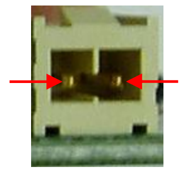

Figure 38: Pin Number Orientation

AUX Lines – J6 Pin Out

Pin #	Signal Name	Description
1	AUXA	Connects to Payload Port Interface pin 5
2	AUXB	Connects to Payload Port Interface pin 6

Table 30: J6 pin out

AUX Lines – J6 Electrical Interface

These connections are direct shorts back to the Payload Port Interface. . It is recommended that the voltage between the two pins not exceed 50 volts or 2.5 amps.

AUX Lines – J6 Mating Connector

There are two options for a mating connector from Samtec. The first and preferred option is to order pre-built cable assembly like MMSS-02-24-L-05.00-S-K. The length can be adjusted as needed by changing the 4-digit number between the L and S (i.e. the XX.XX in MMSS-02-24-L-XX.XX-S-K). The second option is to use a crimp housing and crimp pins, part numbers IPD1-02-S-K and CC79R/L.

GPS/Secondary AUX Lines – J9

The GPS lines connector is intended to simplify cabling from the GPS and PPS signals to a personality module. In a towfish configuration, GPS and PPS are not present on this connector; instead, it is a secondary set of AUX lines that connects to the PAYLD2 connector. This is a keyed and latching connector for robustness. The connector is manufactured by Samtec and is part number IPL1-102-01-L-S-RA-K.

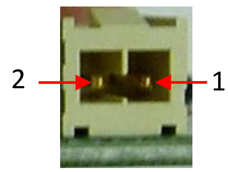

Figure 39: Pin Number Orientation

GPS Lines – J9 Pin Out

Pin #	Signal Name	Description
1	PPS	Connects to Payload Port Interface pin 1
2	NMEA	Connects to Payload Port Interface pin 8

Table 31: J9 pin out as a GPS port

Secondary AUX Lines – J9 Pin Out

Pin #	Signal Name	Description
1	AUXC	Connects to Payload Port 2 pin 5
2	AUXD	Connects to Payload Port 2 pin 6

Table 32: J9 pin out as an AUX port

GPS Lines/Secondary AUX – J9 Electrical Interface

These connections are direct shorts back to the Payload Port Interface. These signals are both RS-232 compatible outputs.

As Secondary AUX lines these are just bare wires that connect to the PAYLD2 port via the rudder module and umbilical.

GPS Lines/Secondary AUX – J9 Mating Connector

There are two options for a mating connector from Samtec. The first and preferred option is to order pre-built cable assembly like MMSS-02-24-L-05.00-S-K. The length can be adjusted as needed by changing the 4-digit number between the L and S (i.e. the XX.XX in MMSS-02-24-L-XX.XX-S-K). The second option is to use a crimp housing and crimp pins, part numbers IPD1-02-S-K and CC79R/L.

Atmel ISP – J5

The Atmel ISP connector is intended to be the production programming interface port. This dual row 0.050" pitch header is shrouded with a key for reliable orientation and quick connection/disconnection in a production environment. This connection is for an Atmel ATAVRISP2 via a Liquid Robotics programming adapter, part number 510-00537, but will work with other ATMEL programmers via the same adapter. The connector itself is manufactured by Samtec and is part number FTSH-105-01-F-D-RA-K.

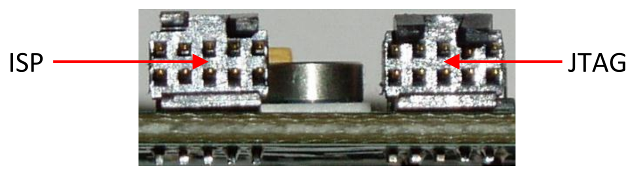

Figure 40: JTAG and ISP Connector Location

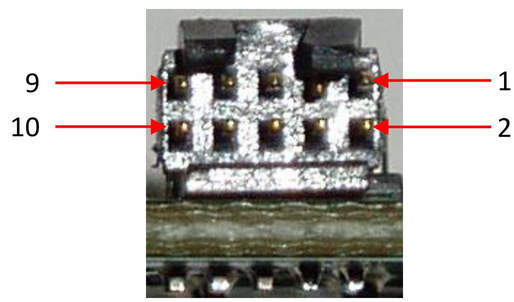

Figure 41: ISP Pin Number Orientation

Atmel ISP – J5 Pin Out

Pin #	Signal Name	Description
1	VCC	+3.3 VDC
2	NC	No Connection
3	GND	Ground reference for all pins
4	SCLK	Clock for synchronizing data
5	GND	Ground reference for all pins
6	MISO-ISP	Master In – Slave Out
7	NC	No Connection
8	MOSI	Master Out – Slave In
9	GND	Ground reference for all pins
10	RESET	Pin 10 Grounded → Reset

Table 33: J5 pin out

Atmel ISP – J5 Electrical Interface

These connections are compatible with the Atmel ATmega ISP programming interface running at 3.3 volts.

PWR and GND

The power pin is used to provide a reference voltage to the programming adapter. No more than 30mA should be sourced from this pin during programming.

MISO-ISP, MOSI, SCLK and RESET

These are the communication lines that connect between the programmer and the microcontroller. This link should only be used with an Atmel approved programming device.

Atmel ISP – J5 Mating Connector

The mating connector is a cable assembly manufactured by Samtec, part number FFSD-05-D-06.00-01-N. This cable then connects to the Liquid Robotics programming adapter, part number 510-00537 and then either to an Atmel ATJTAGICE2 with a 10 pin to 6 pin adapter cable or an Atmel ATAVRISP2. Both of these setup options need to be connected into the ISP connector port on the Liquid Robotics programming adapter. Other Atmel programmers should work as well, but only these two have been tested over this interface.

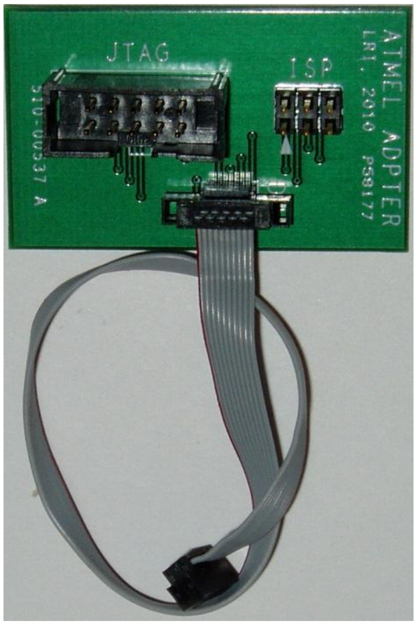

Figure 42: Liquid Robotics Programming Adapter, Part Number 510-00537

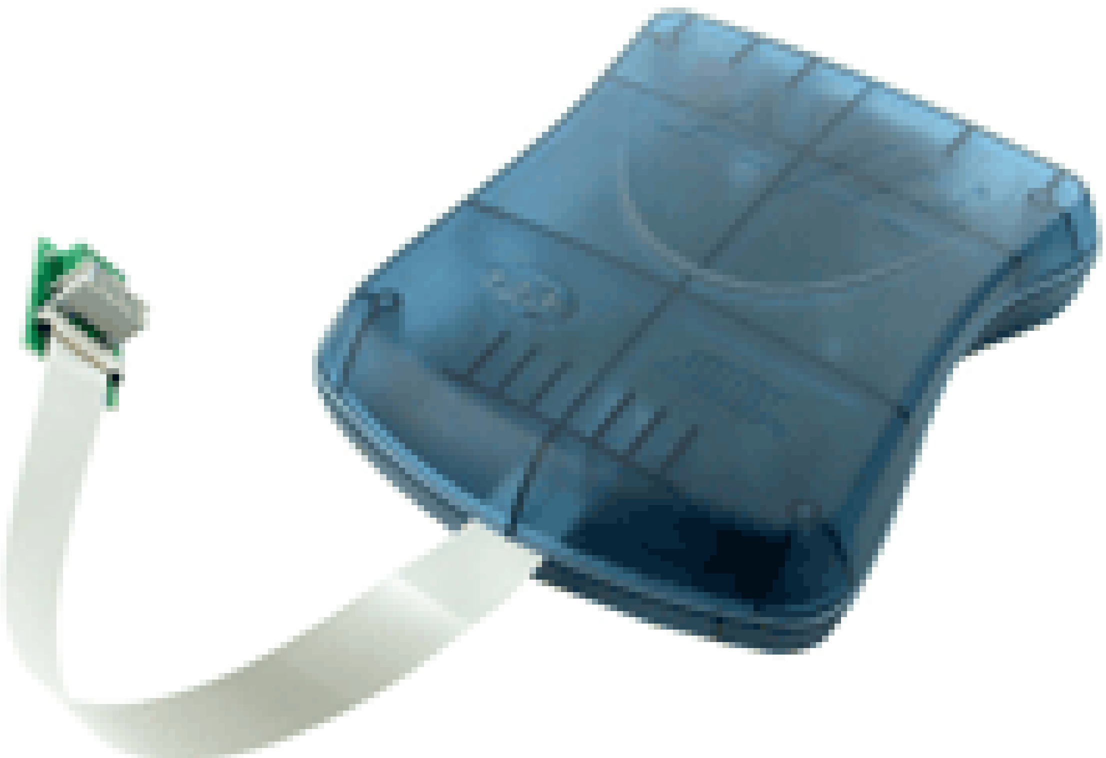

Figure 43: Atmel ATJTAGICE2 without the programming adapter or the 10 pin to 6 pin adapter

Figure 44: Atmel ATAVRISP2 without the programming adapter

Atmel JTAG – J4

The JTAG connector is intended to be the development programming and debug port. This dual row 0.050" pitch header is shrouded with a key for reliable orientation in a development environment. This connection is for an Atmel ATJTAGICE2 via a Liquid Robotics programming adapter, part number 510-00537, but will work with other ATMEL programmers via the same adapter. The connector itself is manufactured by Samtec and is part number FTSH-105-01-F-D-RA-K.

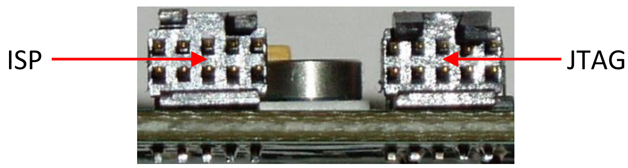

Figure 45: JTAG and ISP Connector Location

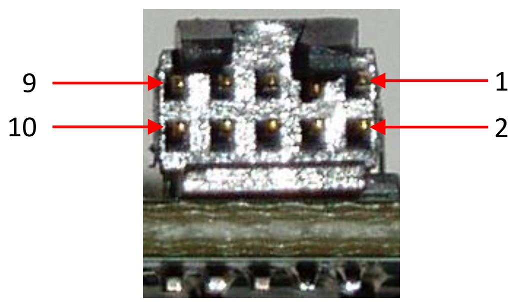

Figure 46: JTAG Pin Number Orientation

Atmel JTAG – J4 Pin Out

This pin out is compatible with the JTAG programmer for the STM32 devices, so that the interfaces could be made common.

Pin #	Signal Name	Description
1	VCC	+3.3 VDC
2	TMS	Test Mode Select
3	GND	Ground reference for all pins
4	TCK	Clock
5	GND	Ground reference for all pins
6	TDO	Data Out
7	NC	No connection
8	TDI	Data In
9	GND	Ground reference for all pins
10	RESET	Pin 10 Grounded → Reset

Table 34: J4 pin out

Atmel JTAG – J4 Electrical Interface

These connections are compatible with the Atmel ATmega JTAG programming and debugging interface running at 3.3 volts.

PWR and GND

The power pin is used to provide a reference voltage to the programming adapter. No more than 30mA should be sourced from this pin during programming.

TCK, TDO, TMS, TDI and RESET

These are the communication lines that connect between the programmer and the microcontroller. This link should only be used with an Atmel approved programming device.

Atmel JTAG – J4 Mating Connector

The mating connector is a cable assembly manufactured by Samtec, part number FFSD-05-D-06.00-01-N. The setup is intended to connect to the Liquid Robotics programming adapter, part number 510-00537 and then to an Atmel ATJTAGICE2 via the JTAG port. Other Atmel programmers should work as well, but this is the only one that has been tested over this interface.

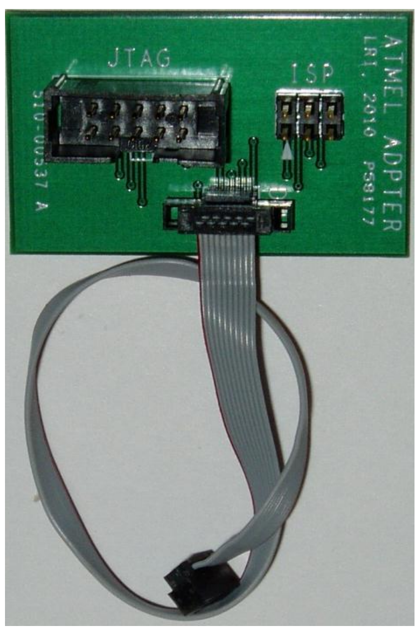

Figure 47: Liquid Robotics Programming Adapter, Part Number 510-00537

Figure 48: Atmel ATJTAGICE2 without the programming adapter

Personality Interface – J1, J2, J3

The personality interface connector is intended to be the interface to a variety of personality modules. This interface was designed around flexibility and the ability to identify the specific location. This is a 2mm, dual row, 30 pin header. The connectors are not keyed or shrouded. Personality 1 is on the top side of the board, while personalities 2 and 3 are on the bottom side of the assembly. Because Personality 3 is directly behind the PIB electronics, please be aware of the personality module stack height, verifying that none of the module components touch the through-hole component leads. **Warning incorrect installation of Personality Modules will result in permanent damage to the PIB.** When installing a personality please remove the connector at J7 to guarantee that there is no power present. The connector is manufactured by Samtec and is part number SQT-115-01-L-D.

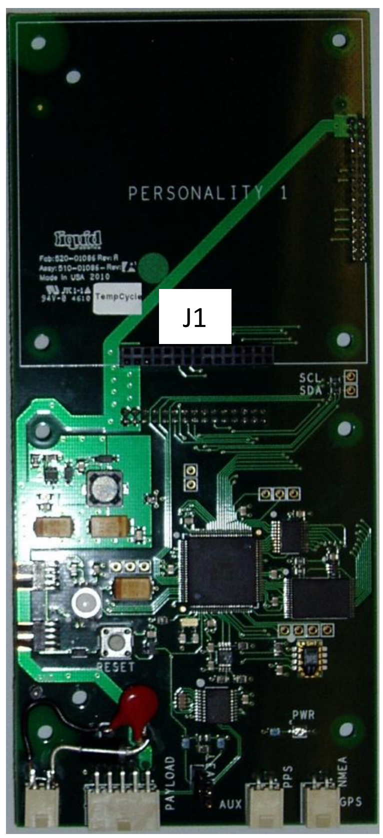

Figure 49: Top Side Personality Connector Locations

Figure 50: Bottom Side Personality Connector Locations

Figure 51: Pin Number Orientation

Personality Interface – J1, J2, J3 Pin Out

Pin #	Signal Name	Description
1	PWR	Power from C&C
2	GND	Ground
3	PWR	Power from C&C
4	GND	Ground
5	VCC	Regulated +3.3V
6	GND	Ground
7	SDA	I^2C Data Line
8	GND	Ground
9	SCL	I^2C Clock Line
10	GND	Ground
11	TXD	UART Transmit to Personality Module
12	GND	Ground
13	RXD	UART Receive from Personality Module
14	GND	Ground
15	XCK GPIO	Synchronous Serial Clock GPIO (optional)
16	GND	Ground
17	PON	Personality Module Power-On/Enable
18	GND	Ground
19	POK	Personality Module Power OK Response
20	GND	Ground
21	GPIO-0	Connection to microcontroller
22	GND	Ground
23	GPIO-1	Connection to microcontroller
24	GND	Ground
25	GPIO-2	Connection to microcontroller
26	GND	Ground
27	GPIO-3	Connection to microcontroller
28	GND	Ground
29	ADDR2	Personality Module address 2nd bit
30	ADDR1	Personality Module address 1st bit

Table 35: J1, J2, J3 pin out

Personality Interface – J1, J2, J3 Electrical Interface

These connections are 3.3 volt CMOS connections directly to the ATmega2560 on the PIB

PWR

The power pins are a direct connection to J7 pin 2. They should be limited to no more than 1.0 amps per personality module.

VCC

The regulated 3.3 volt supply can provide up to 250 milliamps for the personality modules. This is a sum of all three ports, not a per port limitation. If more current is drawn by the personality modules the PIB processor can reset.

GND

The ground pins are a direct connection to J7 pin 7 through an internal plane on the PIB. These should all be connected together on the personality module for robustness.

SCL and SDA

These communication lines are common to all of the personality modules. They conform to the I^2C specification for a 3.3 volt bus at up to 400 KHz. The intention of this bus is to allow inter-personality communication and/or a common interface for automatically detecting personality modules. I^2C is available to the personality module. It is also intended to be connected to an I^2C serial EEPROM (Atmel AT24CxxB [except the AT24C08B]) on each personality module, but could be used to control the personality as well. I^2C addresses 7'b1010_xxx should be reserved for EEPROM storage on personality modules. Pull-ups are provided on the PIB.

TX, RX and XCK

These communication lines provide for an interface to a USART on the microcontroller. If the USART is used in asynchronous mode, the XCK line may be used as a general purpose I/O pin from the microcontroller.

Connector	USART
J7 (for reference only)	USART0
J1/Personality 1	USART1
J2/Personality 2	USART2
J3/Personality 3	USART3

Table 36: Microcontroller USART usage per Personality

PON and POK

The PON and POK signals are used to provide an enable/power on pin and feedback that the system is on and running. If the PON pin will not be used, tie it directly to POK so that it is compatible with all other personality modules. These pins are 3.3 volt CMOS compatible. PON should be brought high and sometime later POK should come high to indicate that the personality module is functional.

GPIO-X

The GPIO lines are provided to give direct access to I/O on the microcontroller. Refer to the ATmega2560 datasheet for specific pin requirements. The table below shows the specific connections made from each personality module to the microcontroller.

Personality Module Interface	J1	J2	J3
21/GPIO-0	PK0	PH4	PF0
23/GPIO-1	PK1	PH5	PF1
25/GPIO-2	PK2	PH6	PF2
27/GPIO-3	PK3	PH7	PF3

Table 37: GPIO-X pin mapping to microcontroller pins per Personality

ADDR1 and ADDR2

The address 1 and address 2 pins are used to identify which specific personality location a personality has been connected to. These pins should be tied to the I^2C EEPROM, but can also be read by the personality module to determine location. The table below shows the specific addressing of each location on the PIB.

Location	ADDR1/Pin 30	ADDR2/Pin 29
J1	GND	GND
J2	GND	VCC
J3	VCC	GND

Table 38: ADDR1/2 values based on Personality location

Personality Interface – J1, J2, J3 Mating Connector

The mating connector is manufactured by Samtec, and is part number TMM-115-03-G-D.

Liquid Leak Detector – J8

The liquid leak detector connector is intended to sit in an orientation such that the leads protrude to the lowest position in the payload box or towfish. The header is manufactured by Samtec and is part number DW-02-20-G-S-750. If necessary this header can be replaced by a connector to cable the leak detector leads to a lower location. The height of the leads is designed around installing the Sub-PIB into a 3" diameter towfish assembly

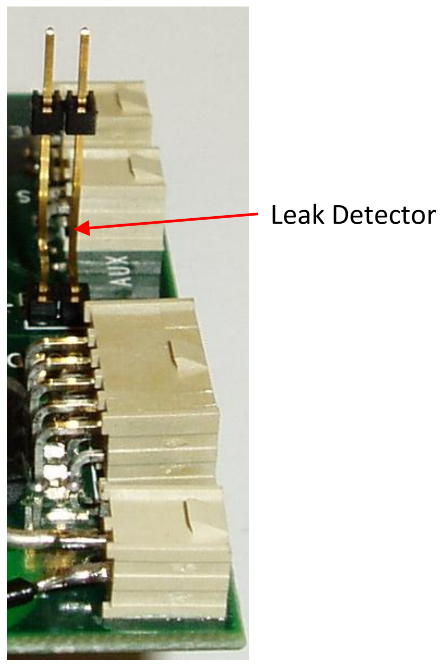

Figure 52: Leak Detector Location

Liquid Leak Detector – J8 Pin Out

Pin #	Signal Name	Description
1	LEAK0	Connection to weak pull down indicates a leak
2	WEAK PULL DOWN	Grounded thru 1K

Table 39: J8 pin out

Liquid Leak Detector – J8 Electrical Interface

These connections are 3.3 volt CMOS connections with ESD protection. The SUB-PIB leak detector looks like a PIB leak detector to the firmware with LEAKCO connected directly to LEAKCI pin of the microcontroller and LEAK1 always pulled high as if there is no leak.

LEAKCO and LEAKCI

The leak cable continuity out and in pins are used to detect the presence of the leak detector cable. These pins are not present on this connector, but are connected together on the microcontroller.

LEAK0, LEAK1 and WEAK PULL DOWN

The LeakX pins have weak internal pull-ups and the microcontroller watches for these pins to be pulled low indicating a short to the weak pull down pins. These pins are pulled up to 3.3 volts via 47 kilo-ohms resistors. The LEAK1 pin does not connect to the leak detector header, but is present for compatibility with the PIB firmware.

Liquid Leak Detector – J8 Mating Connector

There is no mating connector for the Sub PIB leak detector.

510-00097 (P-COM Personality)

Overview

The P-COM personality provides both a switchable power point and a serial communications end point. The power point can be direct power from the Float C&C port, a linear regulator for low noise, or a switching regulator for higher efficiency at lower voltages. The serial communications path supports RS-232 with RTS/CTS flow control as needed, RS-485, or RS-422. There are two released versions of this design, revision A and revision C. This document only covers revision C. If you have a revision A PCBA, contact Liquid Robotics Inc. for specific instructions on your setup.

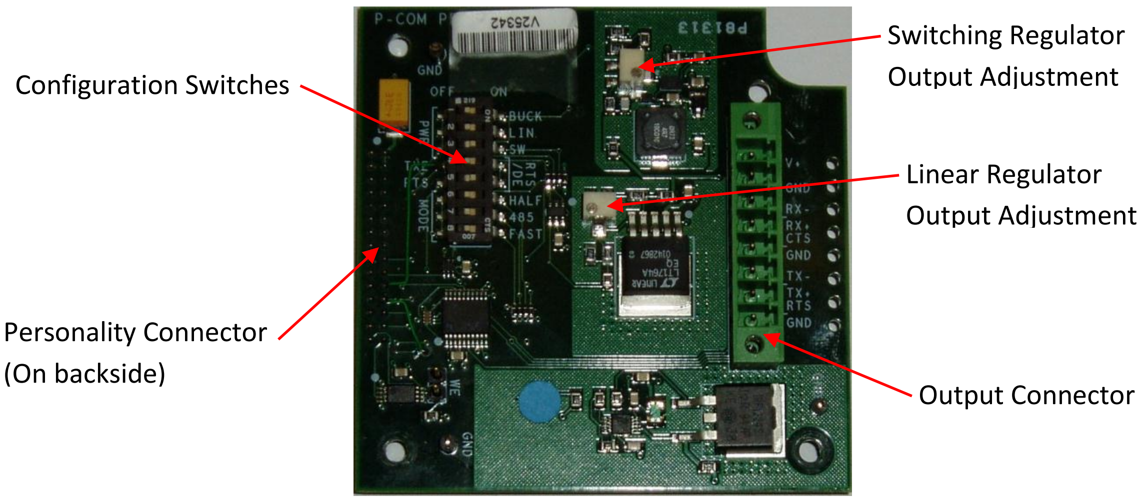

Figure 53: 510-00097 Rev C

Personality Interface – J1

The personality interface connector is the interface to a PIB in one of the three personality slots. Not all of the PIB pins are used. It is a 2mm, dual row, 30 pin header. The connectors are not keyed or shrouded. **Warning incorrect installation of Personality Modules will result in permanent damage to the PIB.** When installing a personality please remove power from the PIB. The connector is manufactured by Samtec and is part number TMM-115-03-G-D.

Figure 54: J1 as viewed from the bottom

Personality Interface – J1 Pin Out

Pin #	Signal Name	Description
1	PWR	Power from C&C
2	GND	Ground
3	PWR	Power from C&C
4	GND	Ground
5	VCC	Regulated +3.3V Input
6	GND	Ground
7	SDA	I^2C Data Line to EEPROM
8	GND	Ground
9	SCL	I^2C Clock Line to EEPROM
10	GND	Ground
11	TXD	Data from the PIB to the end user equipment
12	GND	Ground
13	RXD	Data to the PIB from the end user equipment
14	GND	Ground
15	NC	Unused
16	GND	Ground
17	PON	Power-On/Enable for switch selected output power
18	GND	Ground
19	POK	Power OK Response for switch selected output power
20	GND	Ground
21	RXEn	Used to disable the receiver when operating in half duplex mode
22	GND	Ground
23	TXE	Used to enable the receiver when operating in half duplex mode
24	GND	Ground
25	RTS	Ready to Send output from the PIB
26	GND	Ground
27	CTS	Clear to send input to the PIB
28	GND	Ground
29	ADDR2	EEPROM address line A2
30	ADDR1	EEPROM address line A1

Table 40: J1 pin out

Personality Interface – J1 Electrical Interface

These connections are 3.3 volt CMOS compatible.

PWR

The power pins connect to the inputs of the two regulators and the power switch. They are limited to no more than 1.0 amps per regulator input.

VCC

The regulated 3.3 volt provides up to 50 milliamps for the personality module.

GND

The ground pins are a common ground point for the entire personality module through an internal plane.

SCL and SDA

These communication lines connect only to the EEPROM. They conform to the I^2C specification for a 3.3 volt bus at up to 400 KHz. The intention of this bus is to allow for automatically detecting the personality module. The EEPROM is currently not programmed at the factory.

TX and RX

These communication lines provide a path for data to/from the PIB. The transceiver does the appropriate physical layer translations based on the SW1 settings.

PON and POK

The PON and POK signals provide an enable/power on pin and feedback that the system is on. When PON goes above the 3.3 volt CMOS threshold, the output that is selected by the switch setting is turned on. Once the output stabilizes, the POK pin is pulled high to indicate that the power is stable. If the output goes below its regulation point POK will go low as well to indicate a brown out condition.

RXEn and TXE

These pins are used to control the direction of the transceiver. They also control whether data is echoed back when configured as either RS-485 or RS-422. For RS-485 mode with no echo RXEn and TXE should always be the same level, with low being receive mode and high being transmit mode. For RS-422 mode RXEn must be low and TXE must be high to enable both the driver and receiver at the same time.

RXEn	TXE	Description
Low	Low	Receiver enabled, Transmitter disabled – used for listening a on RS-485 bus
High	Low	Both the receiver and transmitter are disabled – good for low power
Low	High	Both the receiver and transmitter are enabled – used for RS-422 bus
High	High	Receiver disabled, Transmitter enabled – used for talking a on RS-485 bus

Table 41: RXEn and TXE states

RTS and CTS

The RTS and CTS pins can handle a device that uses hardware flow control. RTS is an output stating that the PIB is ready to send data. CTS is an input to the PIB that should trigger when the data is actually sent from the PIB. These pins are not required to be in the correct state for the communications channel to work, unless the end user equipment requires it.

RTS	CTS	Description
Low	Low	PIB not ready to send, end user equipment not ready to receive – PIB has no data to send but is gated
High	Low	PIB ready to send, , end user equipment not ready to receive – PIB has data to send but is gated
Low	High	PIB not ready to send, end user equipment ready to receive – This is an uncommon condition
High	High	PIB ready to send, end user equipment ready to receive – Send the data now

Table 42: RTS and CTS states

ADDR1 and ADDR2

The address 1 and address 2 pins identify to which specific personality location the personality has been connected. These pins are tied to the I^2C EEPROM only.

Personality Interface – J1 Mating Connector

The mating connector is manufactured by Samtec, and is part number SQT-115-01-L-D.

Output Connector – J4

The output connector is the interface to the end user equipment. This is a disconnectable screw terminal to allow for easy removal of the end user equipment. The connector is manufactured by Tyco and is part number 284516-8.

Figure 55: Pin Number Orientation

Output Connector – J4 Pin Out

Pin #	Signal Name	Description
1	V+	Power Output based on switch selection and potentiometer settings
2	GND	Ground
3	RX-	RS-232 Receive or RS-422 Receive –
4	RX+/CTS	RS-232 RTS or RS-422 Receive +
5	GND	Ground
6	TX-	RS-232 Transmit or RS-485-/RS-422 Transmit -
7	TX+/RTS	RS-232 RTS or RS-485+/RS-422 Transmit +
8	GND	Ground

Table 43: J4 pin out

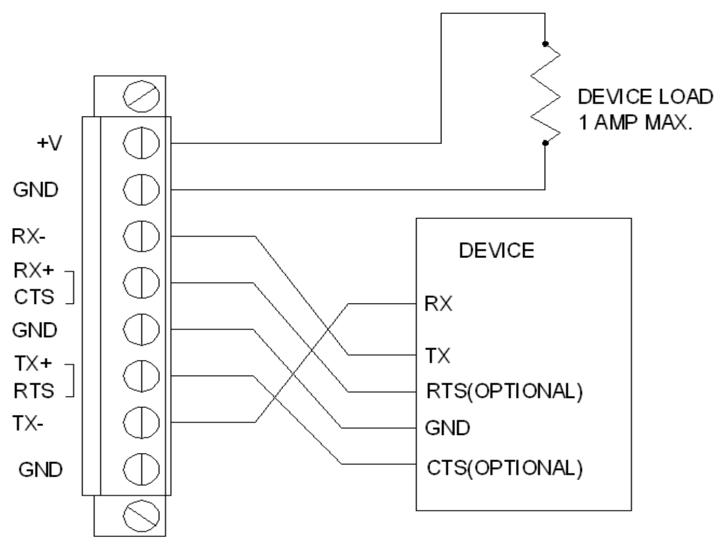

Figure 56: RS-232 based device connection diagram

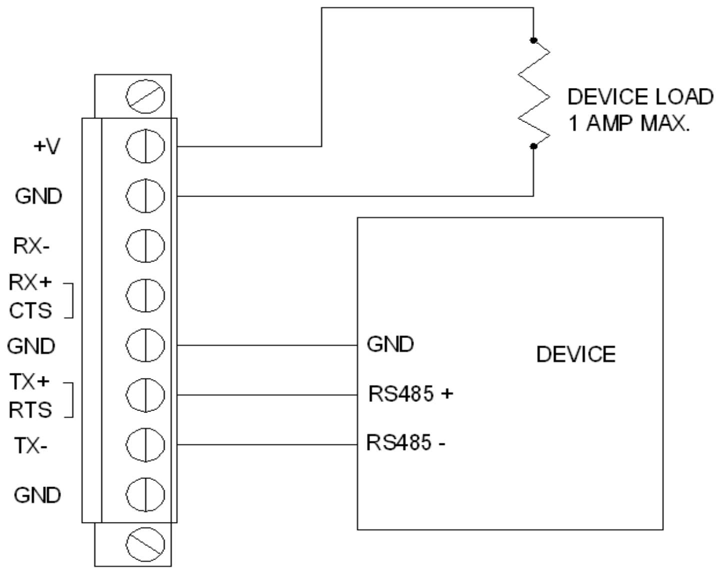

Figure 57: RS-485 half duplex based device connection diagram

Output Connector – J4 Electrical Interface

The communication connections are electrically compatible with the switch-selected protocol being driven by a MAX3160 transceiver. The power connections support the selected power output at up to 1.0 amps.

PWR and GND

The power output voltage is based on the settings of the switch and the regulator potentiometers. This pin is limited to 1.0 amp out, independent of the switch settings.

RX-, RX+/CTS, TX-, and TX+/RTS

These communication lines connect to the end user equipment. The function of the pin is determined by the switch settings. These pins are ESD protected. This path can be slew rate limited if needed for low EMI applications. These signals are provided via a MAX3160 compatible circuit.

Output Connector – J4 Mating Connector

The mating connector is manufactured by Tyco, part number 284510-8 or a connector manufactured by Phoenix contact, part number MCVR 1.5/8-STF-3.5. Below is an example photo. It is recommended that ferrules be used with the loose wires as well.

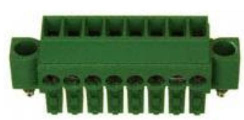

Figure 58: Output Example Connector

Configuration Switch – SW1

The configuration switch is used to select the power output type and the communication protocol type. There are three sections of selections on the switch. The first three switches are used to select which type of power output is used. The next two switches select whether the TXE or the RTS signal is passed through to the transceiver. The last three switches set the operating parameters of the transceiver.

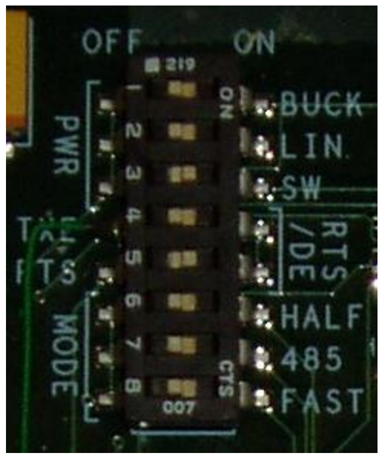

Figure 59: SW1 with all SW1.3 and SW1.5 in the on position

Switch Descriptions – SW1

A switch in the on position means that it is shorted between the input and output pins. In the figure above, on is to the right.

Switch #	Signal Name	Description	Default Position
1	PWR – BUCK	Enables the buck switching regulator as the output enabled by PON – default output voltage of 5.0 volts	OFF
2	PWR – LIN	Enables the LDO linear regulator as the output enabled by PON – default output voltage of 12.0 volts	OFF
3	PWR – SW	Enables the switched output voltage from the Float C&C as the output enabled by PON – typical voltage of 13.2 volts	ON
4	TXE – RTS/DE	Enables the use of TXE for RS-422/RS-485 protocols	OFF
5	RTS – RTS/DE	Enables the use of RTS for RS-232 protocols	ON
6	MODE – HALF	Enables half duplex mode for the RS-485 protocol	OFF
7	MODE – 485	Enables the use of RS-422/RS-485 protocols instead of RS-232	OFF
8	MODE – FAST	Enables the use of data rates faster than 250 kbps	OFF

Table 44: Default values and configuration for switching Float C&C voltage with RS-232 protocol

Switch Selection Examples – SW1

Examples of various switch selections. The power and communications switches can be set independent of each other.

The three tables below show the possible power output options. It is not recommended to enable more than one power output at a time as the POK feedback will only indicate when the lowest voltage has gone out of regulation.

For more information on each of the selectable outputs, see the following three sections. The information here is only how to select each, not how to configure them.

To configure the output to use the linear regulator, turn SW1.2 on.

Switch #	Signal Name	Description	Default Position
1	PWR – BUCK	Enables the buck switching regulator as the output enabled by PON – default output voltage of 5.0 volts	OFF
2	PWR – LIN	Enables the LDO linear regulator as the output enabled by PON – default output voltage of 12.0 volts	ON
3	PWR – SW	Enables the switched output voltage from the Float C&C as the output enabled by PON – typical voltage of 13.2 volts	OFF

Table 45: Configuration for linear regulator

To configure the output to use the switching regulator, turn SW1.1 on.

Switch #	Signal Name	Description	Default Position
1	PWR – BUCK	Enables the buck switching regulator as the output enabled by PON – default output voltage of 5.0 volts	ON
2	PWR – LIN	Enables the LDO linear regulator as the output enabled by PON – default output voltage of 12.0 volts	OFF
3	PWR – SW	Enables the switched output voltage from the Float C&C as the output enabled by PON – typical voltage of 13.2 volts	OFF

Table 46: Configuration for switching regulator

To configure the output to use the Float C&C voltage directly, turn SW1.3 on.

Switch #	Signal Name	Description	Default Position
1	PWR – BUCK	Enables the buck switching regulator as the output enabled by PON – default output voltage of 5.0 volts	OFF
2	PWR – LIN	Enables the LDO linear regulator as the output enabled by PON – default output voltage of 12.0 volts	OFF
3	PWR – SW	Enables the switched output voltage from the Float C&C as the output enabled by PON – typical voltage of 13.2 volts	ON

Table 47: Configuration for switched Float C&C voltage

The three tables below show the most common communications configuration options.

To configure the output for RS-232 at 115,200 kbps with or without flow control make sure only SW1.5 is on.

Switch #	Signal Name	Description	Default Position
4	TXE – RTS/DE	Enables the use of TXE for RS-422/RS-485 protocols	OFF
5	RTS – RTS/DE	Enables the use of RTS for RS-232 protocols	ON
6	MODE – HALF	Enables half duplex mode for the RS-485 protocol	OFF
7	MODE – 485	Enables the use of RS-422/RS-485 protocols instead of RS-232	OFF
8	MODE – FAST	Enables the use of data rates faster than 250 kbps	OFF

Table 48: Configuration for RS-232 communication protocol

Switch #	Signal Name	Description	Default Position
4	TXE – RTS/DE	Enables the use of TXE for RS-422/RS-485 protocols	ON
5	RTS – RTS/DE	Enables the use of RTS for RS-232 protocols	OFF
6	MODE – HALF	Enables half duplex mode for the RS-485 protocol	ON
7	MODE – 485	Enables the use of RS-422/RS-485 protocols instead of RS-232	ON
8	MODE – FAST	Enables the use of data rates faster than 250 kbps	OFF

Table 49: Configuration for RS-485 half duplex communication protocol

Switch #	Signal Name	Description	Default Position
4	TXE – RTS/DE	Enables the use of TXE for RS-422/RS-485 protocols	ON
5	RTS – RTS/DE	Enables the use of RTS for RS-232 protocols	OFF
6	MODE – HALF	Enables half duplex mode for the RS-485 protocol	OFF
7	MODE – 485	Enables the use of RS-422/RS-485 protocols instead of RS-232	ON
8	MODE – FAST	Enables the use of data rates faster than 250 kbps	OFF

Table 50: Configuration for RS-422 communication protocol

Switching Regulator – U1

The switching regulator is used when lower voltages are required at the output of the P-COM. The switching regulator is set to 5.0 volts out, but has an adjustable range of 3.3 to 10.0 volts. Adjust the voltage adjusted by changing the value of potentiometer R3.

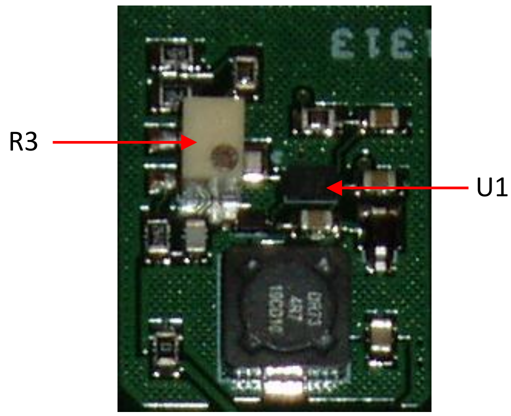

Figure 60: Switching regulator and potentiometer

Switching Regulator Circuit Description – U1

The switching regulator design is based on Linear Technologies LT3503 datasheet and design example. The regulator design has been optimized around a 1.0 amp output current over the entire voltage range. The limiting factor that drove the design to a limited output current range is the heat dissipation from the inductor. The POK signal indicates when the feedback pin is above the reference voltage, but it does not indicate that the regulator has gone over voltage.

To select the switching regulator as the output power source, make sure that SW1.1 is on and both SW1.2 and SW1.3 are off.

Switching Regulator Adjustment – R3

The regulator output is adjustable via the potentiometer R3. The range of the regulator is 3.3 to 10.0 volts. Turning the adjustment screw clockwise will decrease the voltage. Turning the adjustment screw counterclockwise will increase the voltage.

To adjust the voltage disconnect the end user equipment and turn on the P-COM. Measure the voltage across pins 1 and 2 of the output connector with a digital multi-meter. Adjust R3 until the desired voltage is reach. Turn off the P-COM and reconnect the end user equipment. Turn the P-COM on and recheck the voltage under load.

Linear Regulator – U3

Use the linear regulator when a low noise power source is required at the output of the P-COM. The linear regulator is set to 12.0 volts out, but has an adjustable range of 10.0 to 13.0 volts. Adjust the voltage by changing the value of potentiometer R10.

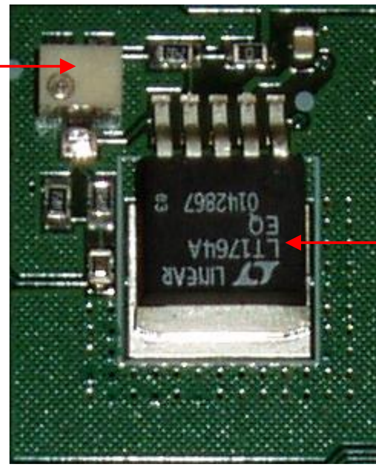

Figure 61: Linear regulator and potentiometer

Linear Regulator Circuit Description – U3

The linear regulator design is based on Linear Technologies LT1764 datasheet and design example. The regulator design has been optimized around a 1.0 amp output current over the entire voltage range. The limiting factor is the heat dissipation from the regulator itself. The POK signal indicates when the feedback pin is above the reference voltage, but it does not indicate that the regulator has not gone over voltage.

To select the linear regulator as the output power source, ensure that SW1.2 is on and both SW1.1 and SW1.3 are off.

Linear Regulator Adjustment – R10

The regulator output is adjustable via the potentiometer R10. The range of the regulator is 10.0 to 13.0 volts. Turning the adjustment screw clockwise will decrease the voltage. Turning the adjustment screw counterclockwise will increase the voltage.

To adjust the voltage disconnect the end user equipment and turn on the P-COM. Measure the voltage across pins 1 and 2 of the output connector with a digital multi-meter. Adjust R3 until the desired voltage is reach. Turn off the P-COM and reconnect the end user equipment. Turn the P-COM on and recheck the voltage under load.

Fully Integrated PIB and Personality Designs

Overview

This section is to provide a view of some of the other options for end user equipment. These are not fully specified here, but are provided as a reference of possibilities and design approaches.

Each of the designs provides pressure, humidity, temperature and leak detection feedback similar to a PIB and has the ability to control the sensor interfaces similar to a P-COM. One of the examples below provides an interface to a higher power OMAP processor running a Linux based operating system. The other design provides an interface for both of the potential AUX pairs in a towfish as well as a path to pass power onto both sensors.

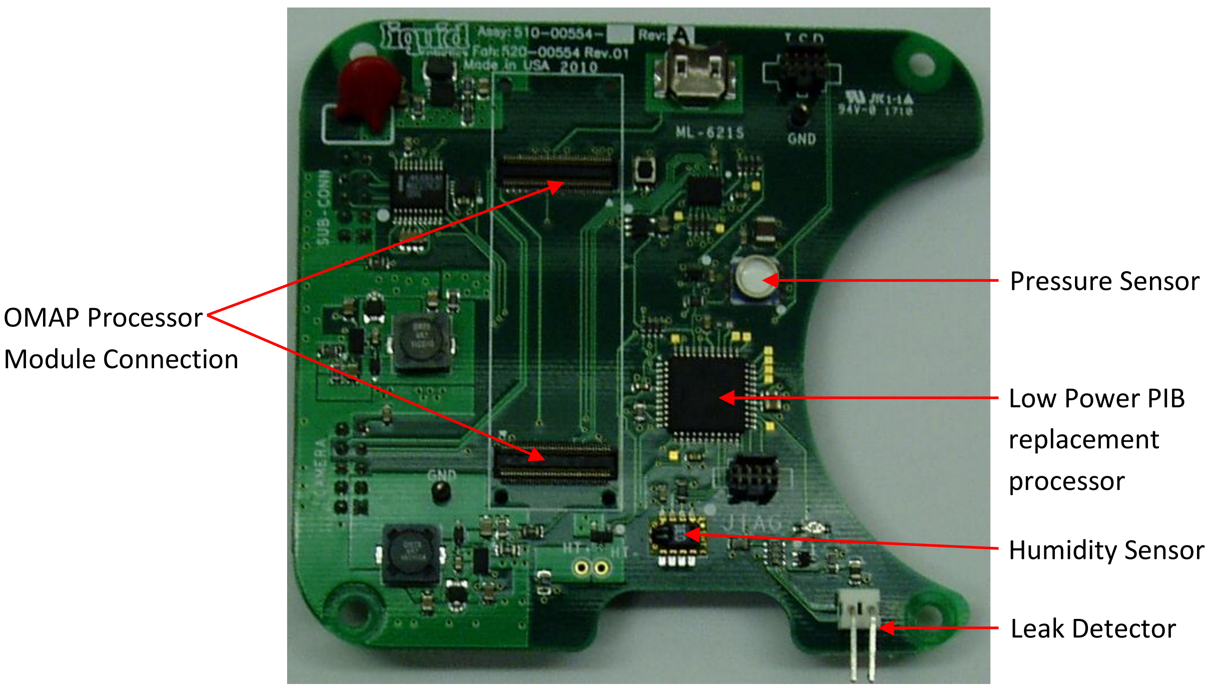

Figure 62: PIB replacement with OMAP Processing Module

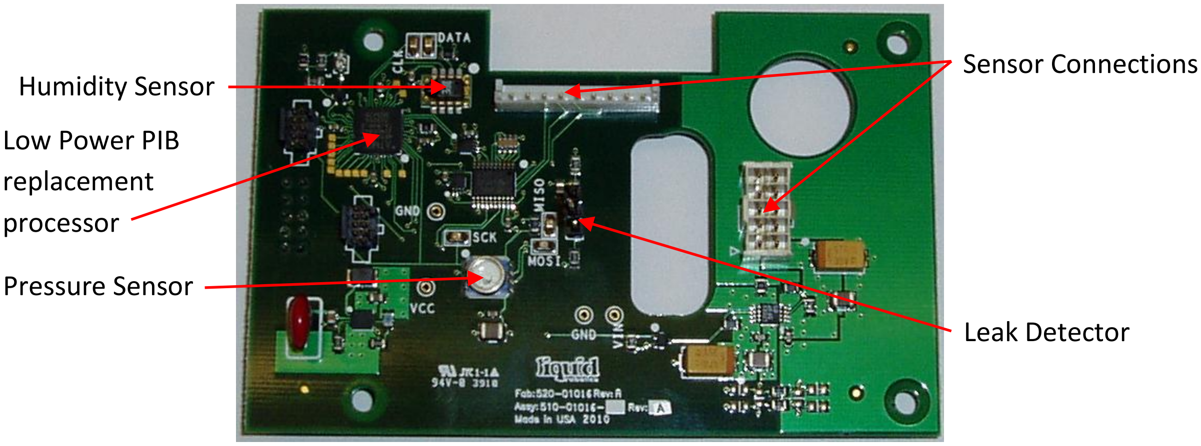

Figure 63: PIB sensors, plus AUX line pass thru connections to specific sensors

510-01232 and 510-00973 (Sensor Management Computer)

Overview

This section covers the various connectors and interfaces to the Sensor Management Computer (parts 510-00973 and 510-01232). Each connection is described with a pin-out, part numbers for the mating connector/crimp pins and an electrical specification.

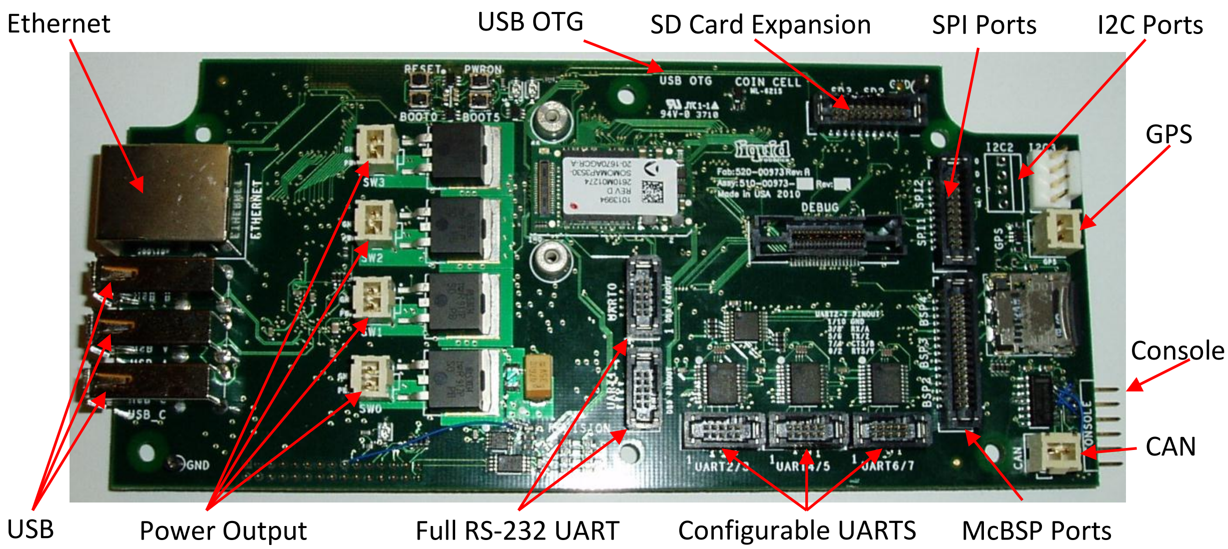

Figure 64: SMC Connector Locations

Console Port

The console port is the main interface to the processor module. This port is used to login to the Sensor Management Computer Linux console and is the primary debug point. After deployment, this port is typically unavailable. This connection is intended to connect directly to an FTDI TTL-232R-3V3. The TTL-232R-3V3 should be oriented such that pin 1 (black lead) is to the left when reading CONSOLE.

Console Port Pin Out

The pin out on the console port is from left to right.

Pin #	SMC Name	Notes
1	GND	System Ground
2	RTS#	Not currently used, but available to support hardware flow control
3	NC	5V signal from USB converter
4	RXD	Data into the SMC
5	TXD	Data out of the SMC
6	CTS#	Not currently used, but available to support hardware flow control

Table 51: Console port pin out

Console Port Electrical Interface

The console port is a 3.3 volt level CMOS serial port intended to be interfaced to a level converter to support either a USB interface or an RS-232 style interface. For a detailed specification of the I/O levels, see the datasheet for the TI TXS0104E.

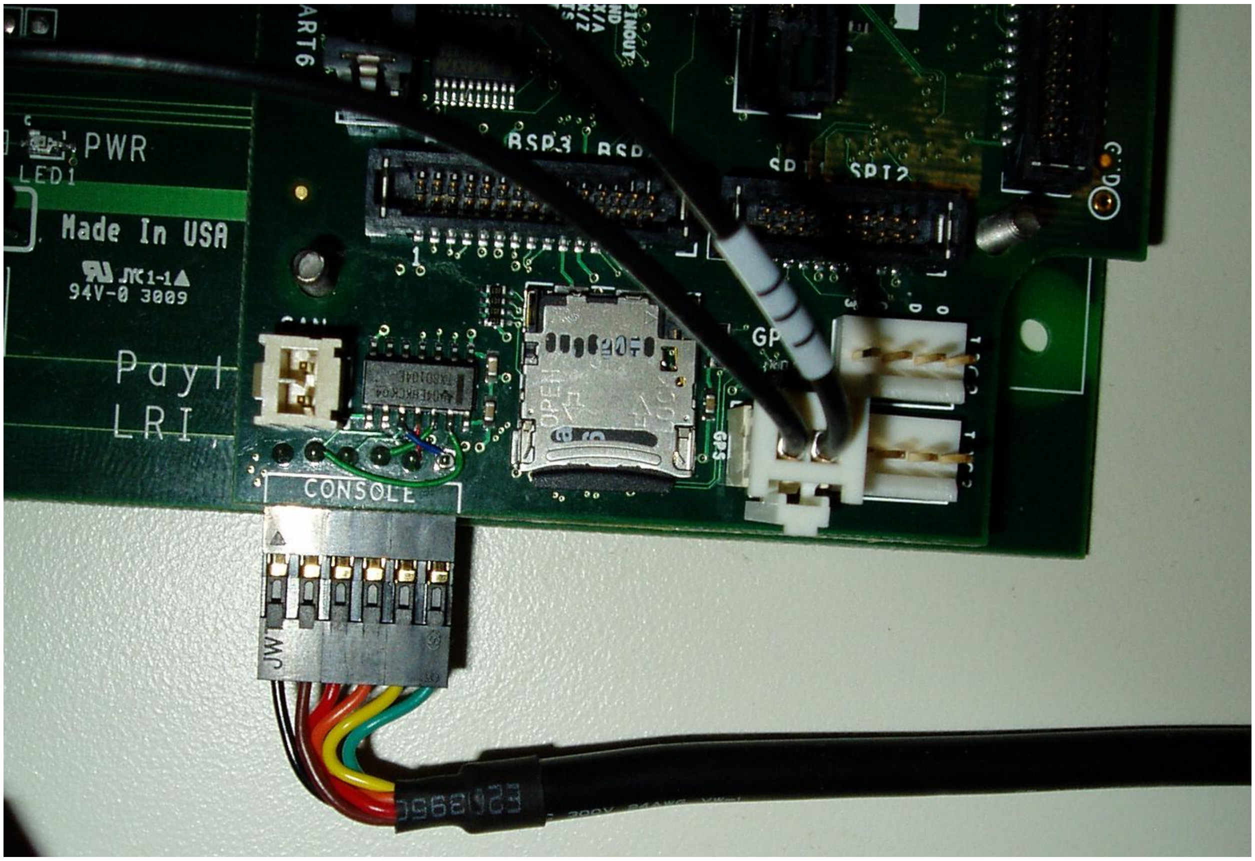

Figure 65: Console Port Connected

Full RS-232 Ports (UART0 and UART1)

The full RS-232 ports implement a complete RS-232 interface that is compatible with a standard DB-9 pin out. One option for connecting up to this port is to use the Liquid Robotics Inc. cable assembly 140-01233 that converts the connector directly to a DB9. The connector is keyed and latching for robustness.

Full RS-232 Port Pin Out

Pin #	SMC Name	Notes
1	CD	Carrier Detect output
2	RX	Data into the UART
3	TX	Data out of the UART
4	DTR	Data Terminal Ready output
5	GND	Ground
6	DSR	Data Set Ready input
7	RTS	Request To Send output
8	CTS	Clear To Send input
9	RI	Ring Indicator input
10	GND	Ground, but intended as a no connect

Table 52: Full RS-232 port pin out

Full RS-232 Electrical Interface

These connections are compatible with all standard RS-232 drivers.

Full RS-232 Mating Connector

There are two options for a mating connector from Samtec. The preferred option is to order a pre-built cable assembly such as SFSD-05-28-G-05.00-SR. The length can be adjusted as needed by changing the 4-digit number between the G and SR (i.e. the XX.XX in SFSD-05-28-G-XX.XX-SR). The second option is to use a crimp housing and crimp pins, part numbers ISDF-05-D-M and CC03R/L.

Configurable UART Ports (UART2/3, UART4/5, and UART6/7)

The configurable UART ports implement a dual, software configurable UART port that supports any of the following three options, RS-232 with RTS/CTS support, RS-485 full/half duplex and RS-422. One option for connecting to this port is to use the Liquid Robotics Inc. cable assembly 140-01234 that converts the connector directly to two DB9s. The connector is keyed and latching for robustness.

Configurable UART Port Pin Out

Pin #	SMC Name	Notes
1	GND-A	Ground for even numbered port
2	RTS-B	Request To Send output for odd numbered port
3	RX-A	Data into the UART for the even numbered port
4	CTS-B	Clear To Send input for even numbered port
5	TX-A	Data out of the UART for the even numbered port
6	TX-B	Data out of the UART for the odd numbered port
7	CTS-A	Clear To Send input for even numbered port
8	RX-B	Data into the UART for the odd numbered port
9	RTS-A	Request To Send output for even numbered port
10	GND-B	Ground for odd numbered port

Table 53: Configurable UART port pin out

Configurable UART Electrical Interface

These connections are supported by the Maxim driver IC MAX3160EEAP+

Configurable UART Mating Connector

There are two options for a mating connector from Samtec. The preferred option is to order a pre-built cable assembly such as SFSD-05-28-G-05.00-SR. The length can be adjusted as needed by changing the 4-digit number between the G and SR (i.e. the XX.XX in SFSD-05-28-G-XX.XX-SR). The second option is to use a crimp housing and crimp pins, part numbers ISDF-05-D-M and CC03R/L.

GPS/PPS Port

The GPS/PPS port is the interface to the GPS/PPS data coming in from the float. This connection connects directly to the incoming connection or to the header on the PIB. The SMC is expecting the GPS string to be at 4800 Baud and contain the following three NEMA strings, GGA, ZDA, and VTG, using RS-232 levels. The connector is keyed and latching for robustness.

GPS/PPS Port Pin Out

Pin #	SMC Name	Notes
1	GPS	GPS Data into the system – Connects to pin 8 of the PIB header
2	PPS	PPS timing pulse into the system – connects to pin 1 of the PIB header

Table 54: GPS/PPS port pin out

GPS/PPS Electrical Interface

These inputs are capable of handling +/-15 volt signals. They are intended to level shift RS-232 signals down to 1.8 volt CMOS logic. These inputs are simple N-FET level shifts/inverters.

GPS/PPS Mating Connector

There are two options for a mating connector from Samtec. The preferred option is to order a pre-built cable assembly such as MMSS-02-24-L-05.00-S-K. The length can be adjusted as needed by changing the 4-digit number between the L and S (i.e. the XX.XX in MMSS-02-24-L-XX.XX-S-K). The second option is to use a crimp housing and crimp pins, part numbers IPD1-02-S-K and CC79R/L.

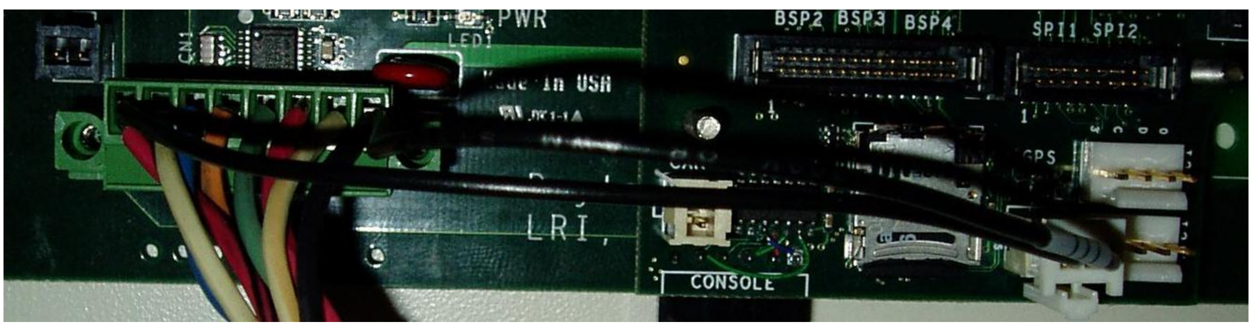

Figure 66: GPS/PPS Connections with a PIB

Power Ports

The power ports are software controllable switches to enable/disable sensors as needed. The connector is keyed and latching for robustness.

Power Port Pin Out

Pin #	SMC Name	Notes
1	PWR	12 Volt +/-10% output at up to 2 A
2	GND	Ground

Table 55: Power port pin out

Power Electrical Interface

These outputs are capable of providing 12 volts +/-10% at up to 2 amps. The total system current only supports up to 3 amps into the SMAC so the sum of currents out is the limiting factor, not the switches. The current through the switch can be read in software.

Power Mating Connector

There are two options for a mating connector from Samtec. The preferred option is to order a pre-built cable assembly such as MMSS-02-24-L-05.00-S-K. The length can be adjusted as needed by changing the 4-digit number between the L and S (i.e. the XX.XX in MMSS-02-24-L-XX.XX-S-K). The second option is to use a crimp housing and crimp pins, part numbers IPD1-02-S-K and CC79R/L.

CAN Port

The CAN port is currently not supported, but is intended for inter-SMC communication and/or for specific sensors that require a CAN interface. The information provided here is for future use only. The connector is keyed and latching for robustness.

CAN Port Pin Out

Pin #	SMC Name	Notes
1	CANH	CAN non-inverting output
2	CANL	CAN inverting output

Table 56: CAN port pin out

CAN Electrical Interface

This output is supported by a TI SN65HVD230DR transceiver. One thing to note is that this interface is running at 3.3 volts, and although this meets the ISO 11898 standard (CAN specifications), it may not be compatible with older 5.0 volt CAN bus systems.

CAN Mating Connector

There are two options for a mating connector from Samtec. The recommended option is to order a pre-built cable assembly such as MMSS-02-24-L-05.00-S-K. The length can be adjusted as needed by changing the 4-digit number between the L and S (i.e. the XX.XX in MMSS-02-24-L-XX.XX-S-K). The second option is to use a crimp housing and crimp pins, part numbers IPD1-02-S-K and CC79R/L.

USB Ports (not USB OTG)

These ports are not supported.

USB OTG Port

The USB OTG port meets the USB OTG specification. The USB OTG interface is currently not supported in the Linux kernel. To use the USB OTG port as the host a special mini A to B (or mini B) cable is required. A standard A to mini B cable will turn the SMC into a slave device.

USB OTG Port Pin Out

See the USB OTG specification.

USB OTG Electrical Interface

See the USB OTG specification.

USB OTG Mating Connector

See the USB OTG specification.

Ethernet Port

The Ethernet port meets the 10/100 Base T Ethernet specification. The connector is specified as a latching RJ-45.

Ethernet Port Pin Out

See the Ethernet specification.

Ethernet Electrical Interface

See the Ethernet specification.

Ethernet Mating Connector

See the Ethernet specification.

SD Card Expansion Port

The SD Card Expansion port supports additional data storage. This interface connects directly to the Torpedo module/OMAP processor so the signals must be level shifted to 1.8 volts. This port is untested.

SD Card Expansion Port Pin Out

Pin #	SMC Name	Notes
1	1V8	1.8 Volt output for supplying a logic level reference, limit draw to less than 10mA
2	3V3	3.3 volts for powering any needed circuits
3	SD2_CLK	SD card interface #2 clock output
4	SD2_CDn	SD card interface #2 card detect input
5	SD2_DAT3	SD card interface #2 data bit 3 I/O
6	SD2_CMD	SD card interface #2 command output
7	SD2_DAT1	SD card interface #2 data bit 1 I/O
8	SD2_DAT2	SD card interface #2 data bit 2 I/O
9	GND	Ground
10	SD2_DAT0	SD card interface #2 data bit 0 I/O
11	1V8	1.8 Volt output for supplying a logic level reference, limit draw to less than 10mA
12	3V3	3.3 volts for powering any needed circuits
13	SD3_CLK	SD card interface #3 clock output
14	SD3_CDn	SD card interface #3 card detect input
15	SD3_DAT3	SD card interface #3 data bit 3 I/O
16	SD3_CMD	SD card interface #3 command output
17	SD3_DAT1	SD card interface #3 data bit 1 I/O
18	SD3_DAT2	SD card interface #3 data bit 2 I/O
19	GND	Ground
20	SD3_DAT0	SD card interface #3 data bit 0 I/O

Table 57: SD card expansion port pin out

SD Card Expansion Electrical Interface

The inputs and outputs here are referenced to the OMAP 1.8 volt logic levels. The 1.8 volt output is intended only for level shifters as needed and the rest of the circuit should be run from 3.3 volts.

SD Card Expansion Mating Connector

There are two options for a mating connector from Samtec. The recommended option is to order a pre-built cable assembly such as SFSD-10-28-G-05.00-SR. The length can be adjusted as needed by changing the 4-digit number between the G and SR (i.e. the XX.XX in SFSD-10-28-G-XX.XX-SR). The second option is to use a crimp housing and crimp pins, part numbers ISDF-10-D-M and CC03R/L.

SPI Expansion Port

The SPI Expansion port supports additional circuitry for expanded operation. This interface connects directly to the Torpedo module/OMAP processor so the signals will need to be level shifted to 1.8 volts. This port is untested.

SPI Expansion Port Pin Out

Pin #	SMC Name	Notes
1	1V8	1.8 Volt output for supplying a logic level reference, limit draw to less than 10mA
2	3V3	3.3 volts for powering any needed circuits
3	SPI1_CS2	SPI interface #1 chip select 2 output
4	SPI1_CS3	SPI interface #1 chip select 3 output
5	SPI1_CS0	SPI interface #1 chip select 0 output
6	SPI1_CS1	SPI interface #1 chip select 1 output
7	SPI1_SIMO	SPI interface #1 slave in master out output
8	SPI1_CLK	SPI interface #1 clock output
9	GND	Ground
10	SPI1_SOMI	SPI interface #1 slave out master in input
11	1V8	1.8 Volt output for supplying a logic level reference, limit draw to less than 10mA
12	3V3	3.3 volts for powering any needed circuits
13	SPI2_CS2	SPI interface #2 chip select 2 output
14	SPI2_CS3	SPI interface #2 chip select 3 output
15	SPI2_CS0	SPI interface #2 chip select 0 output
16	SPI2_CS1	SPI interface #2 chip select 1 output
17	SPI2_SIMO	SPI interface #2 slave in master out output
18	SPI2_CLK	SPI interface #2 clock output
19	GND	Ground
20	SPI2_SOMI	SPI interface #2 slave out master in input

Table 58: SPI expansion port pin out

SPI Expansion Electrical Interface

The inputs and outputs here are referenced the OMAP 1.8 volt logic levels. The 1.8 volt output is intended only for level shifters as needed and the rest of the circuit should be run from 3.3 volts.

SPI Expansion Mating Connector

There are two options for a mating connector from Samtec. The recommended option is to order a pre-built cable assembly such as SFSD-10-28-G-05.00-SR. The length can be adjusted as needed by changing the 4-digit number between the G and SR (i.e. the XX.XX in SFSD-10-28-G-XX.XX-SR). The second option is to use a crimp housing and crimp pins, part numbers ISDF-10-D-M and CC03R/L.

McBSP Expansion Port

The McBSP Expansion port supports additional circuitry for expanded operation. This interface connects directly to the Torpedo module/OMAP processor so the signals will need to be level shifted to 1.8 volts. This port is untested.

McBSP Expansion Port Pin Out

Pin #	SMC Name	Notes
1	1V8	1.8 Volt output for supplying a logic level reference, limit draw to less than 10mA
2	3V3	3.3 volts for powering any needed circuits
3	BSP2_I/O1	McBSP interface #2 general purpose I/O 1
4	BSP2_I/O0	McBSP interface #2 general purpose I/O 0
5	BSP2_DR	McBSP interface #2 DR
6	BSP2_I/O2	McBSP interface #2 general purpose I/O 2
7	BSP2_FSX	McBSP interface #2 FSX
8	BSP2_DX	McBSP interface #2 DX
9	GND	Ground
10	BSP2_CLKX	McBSP interface #2 CLKX
11	1V8	1.8 Volt output for supplying a logic level reference, limit draw to less than 10mA
12	3V3	3.3 volts for powering any needed circuits
13	BSP3_I/O1	McBSP interface #3 general purpose I/O 1
14	BSP3_I/O0	McBSP interface #3 general purpose I/O 0
15	BSP3_DR	McBSP interface #3 DR
16	BSP3_I/O2	McBSP interface #3 general purpose I/O 2
17	BSP3_FSX	McBSP interface #3 FSX
18	BSP3_DX	McBSP interface #3 DX
19	GND	Ground
20	BSP3_CLKX	McBSP interface #3 CLKX
21	1V8	1.8 Volt output for supplying a logic level reference, limit draw to less than 10mA
22	3V3	3.3 volts for powering any needed circuits
23	BSP4_I/O1	McBSP interface #4 general purpose I/O 1
24	BSP4_I/O0	McBSP interface #4 general purpose I/O 0
25	BSP4_DR	McBSP interface #4 DR
26	BSP4_I/O2	McBSP interface #4 general purpose I/O 2
27	BSP4_FSX	McBSP interface #4 FSX
28	BSP4_DX	McBSP interface #4 DX
29	GND	Ground
30	BSP4_CLKX	McBSP interface #4 CLKX

Table 59: McBSP expansion port pin out

McBSP Expansion Electrical Interface

The inputs and outputs here are referenced to the OMAP 1.8 volt logic levels. The 1.8 volt output is intended only for level shifters as needed and the rest of the circuit should be run from 3.3 volts.

McBSP Expansion Mating Connector

There are two options for a mating connector from Samtec. The recommended option is to order a pre-built cable assembly such as SFSD-15-28-G-05.00-SR. The length can be adjusted as needed by changing the 4-digit number between the G and SR (i.e. the XX.XX in SFSD-15-28-G-XX.XX-SR). The second option is to use a crimp housing and crimp pins, part numbers ISDF-15-D-M and CC03R/L.

I2C Ports (I2C2 and I2C3)

The I2C ports are for debug only in the 510-00973 design. In the 510-01232 design, they have an expansion capability as specified below. The 510-00973 connectors are keyed. The 510-01232 PCBA connector is keyed and latching for robustness.

I2C Ports 510-01232 Pin Out

Pin #	SMC Name	Notes
1	3V3	3.3 volt output to power external circuits
2	3V3	3.3 volt output to power external circuits
3	I2C2_SCL	I2C2 serial clock output
4	I2C3_SCL	I2C3 serial clock output
5	I2C2_SDA	I2C2 serial data I/O
6	I2C3_SDA	I2C3 serial data I/O
7	GND	Ground
8	GND	Ground
9	GND	Ground
10	GND	Ground

Table 60: I2C ports 510-01232 pin out

I2C Electrical Interface

This interface conforms to the I2C specification for 3.3 volt logic levels and supports up to 400 KHz operation.

I2C Ports 510-01232 Mating Connector

There are two options for a mating connector from Samtec. The recommended option is to order a pre-built cable assembly such as SFSD-05-28-G-05.00-SR. The length can be adjusted as needed by changing the 4-digit number between the G and SR (i.e. the XX.XX in SFSD-05-28-G-XX.XX-SR). The second option is to use a crimp housing and crimp pins, part numbers ISDF-05-D-M and CC03R/L.

Schematics

This section includes schematics for the components listed in detail here. This includes the Personality Interface Board, Sub PIB, P-COM and SMC. Other schematics are available upon request.

Payload Interface Board 510-00094

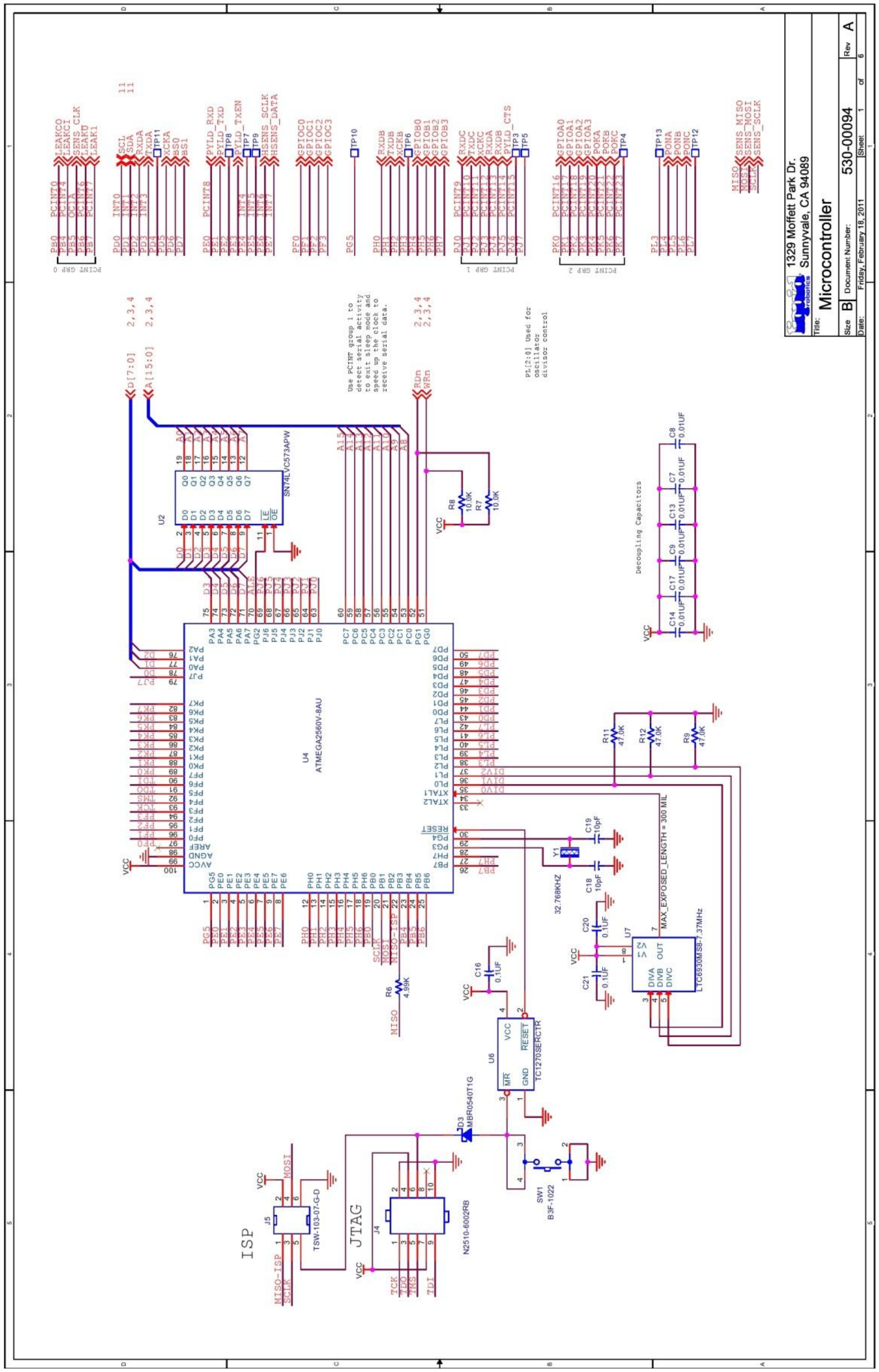

Figure 67: 530-00094 (PIB Schematic) page 1

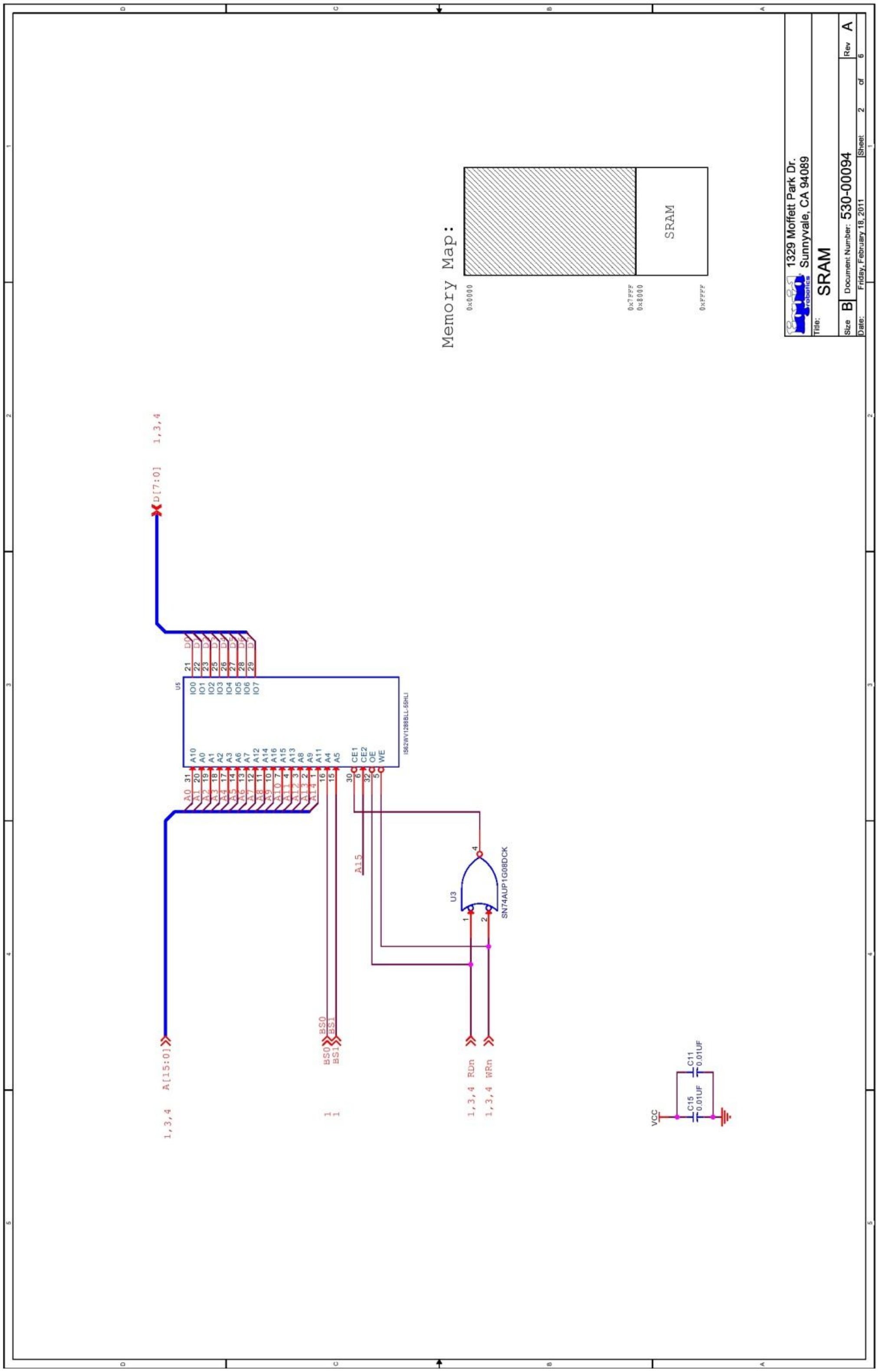

Figure 68: 530-00094 (PIB Schematic) page 2

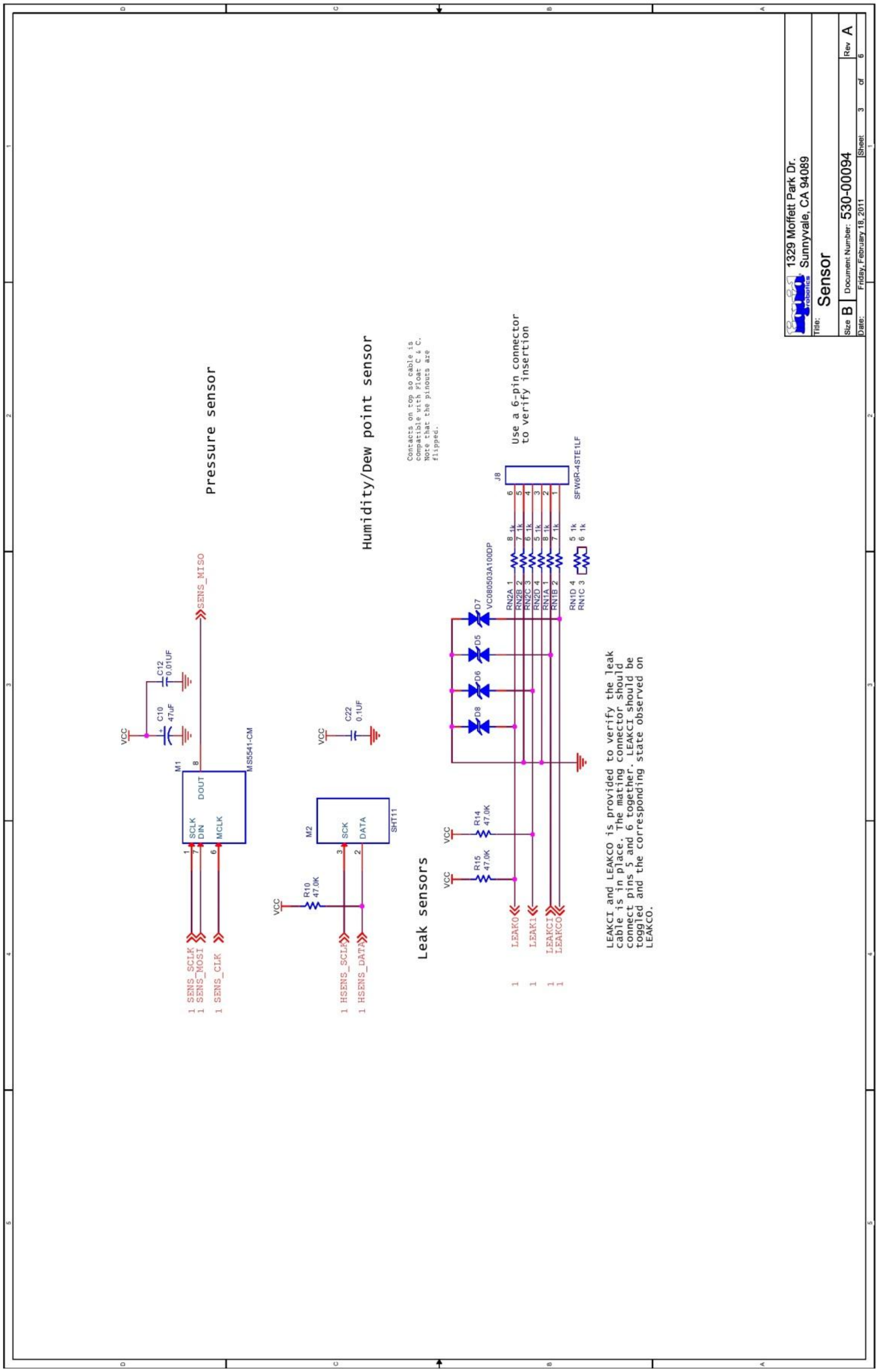

Figure 69: 530-00094 (PIB Schematic) page 3

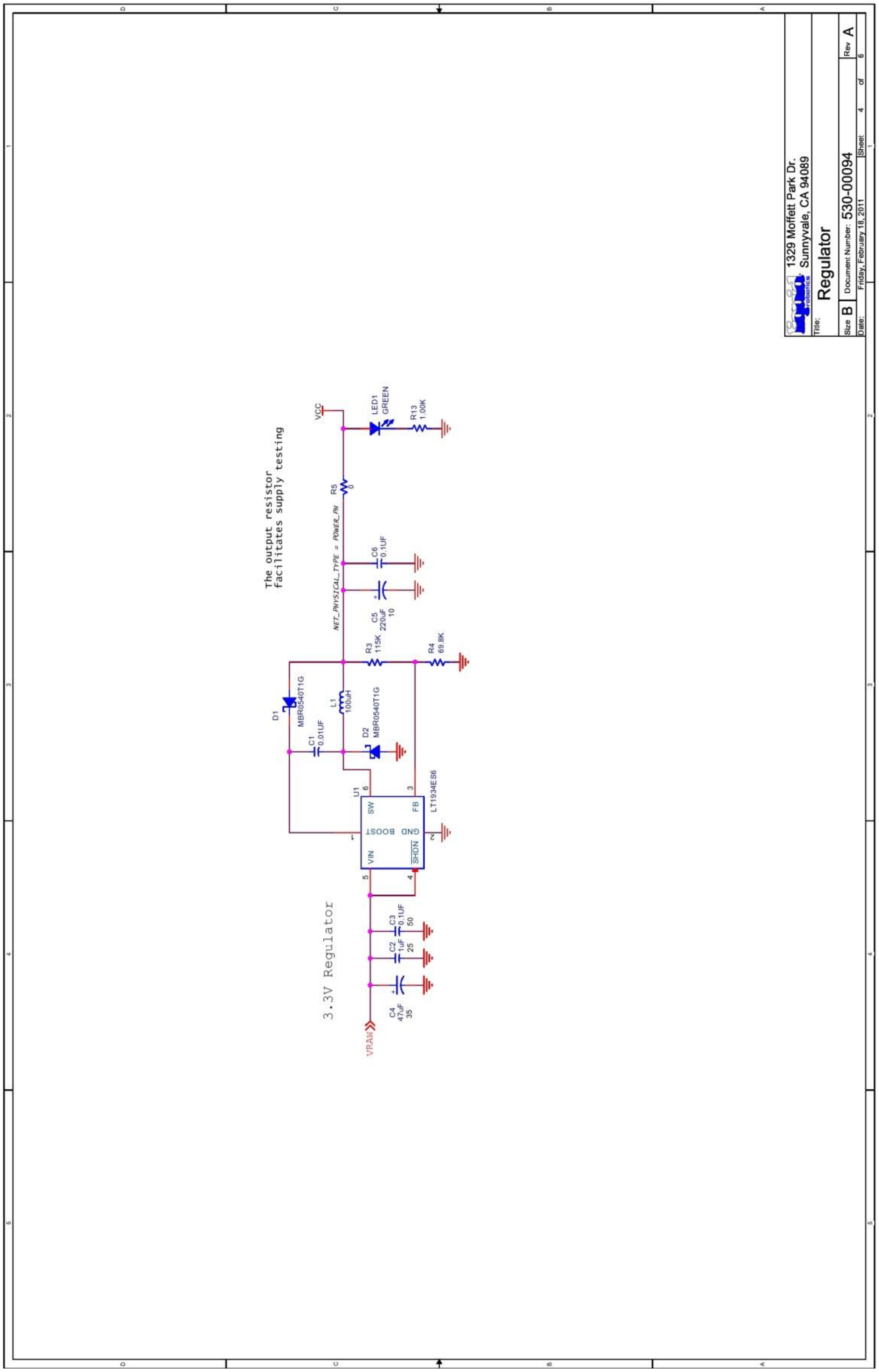

Figure 70: 530-00094 (PIB Schematic) page 4

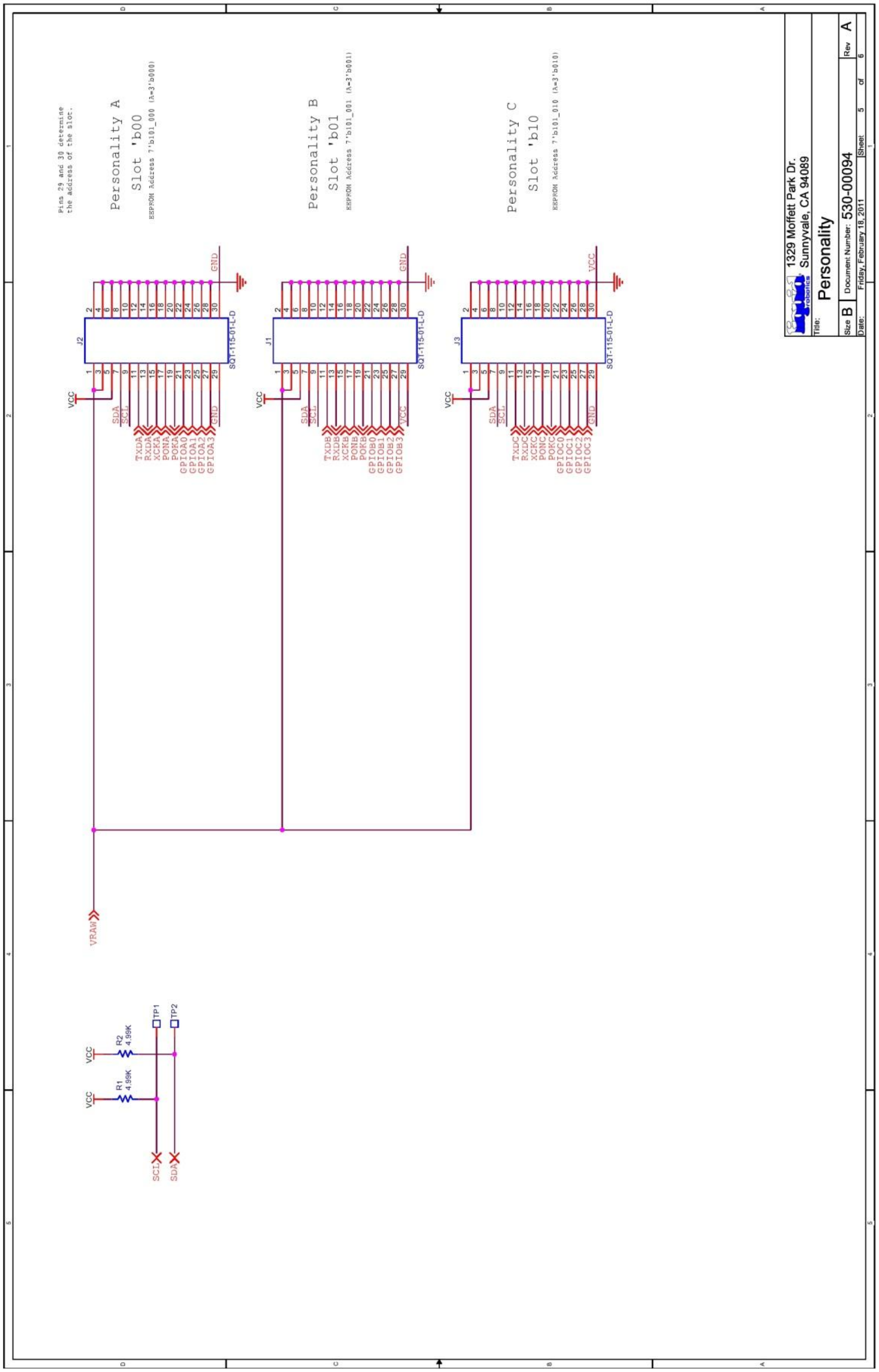

Figure 71: 530-00094 (PIB Schematic) page 5

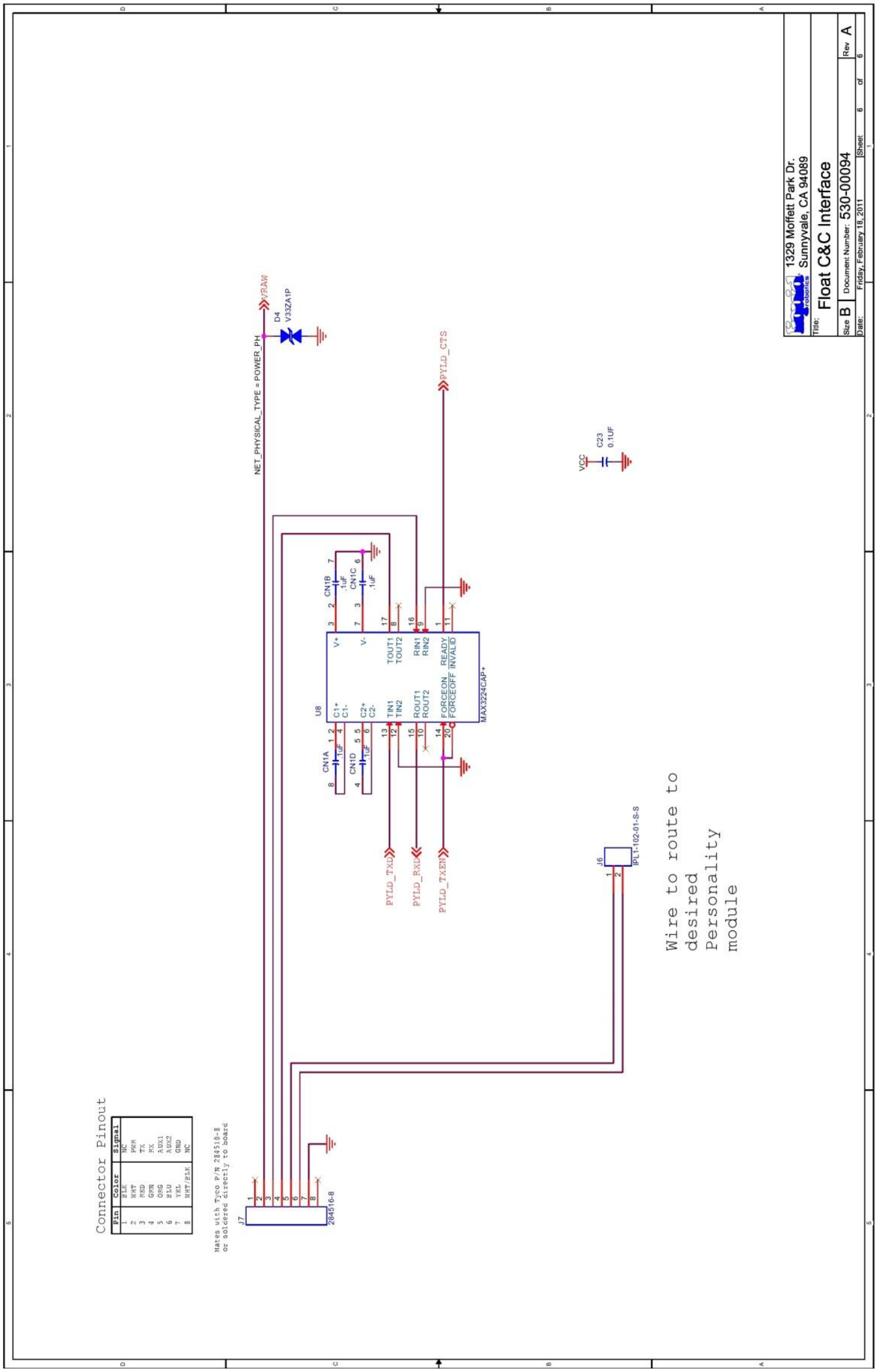

Figure 72: 530-00094 (PIB Schematic) page 6

Sub Payload Interface Board 510-01581

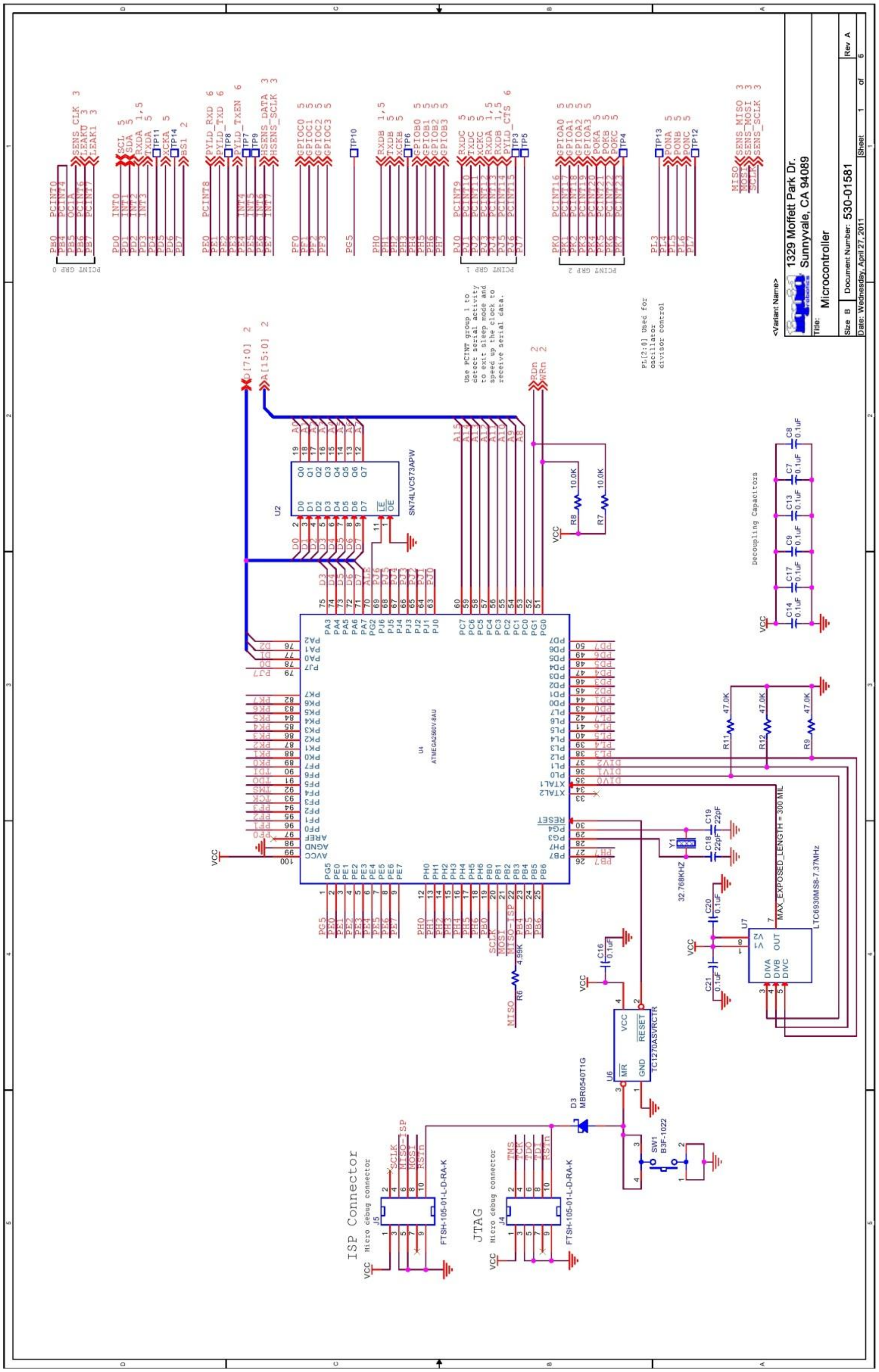

Figure 73: 530-01581 (Sub PIB Schematic) page 1

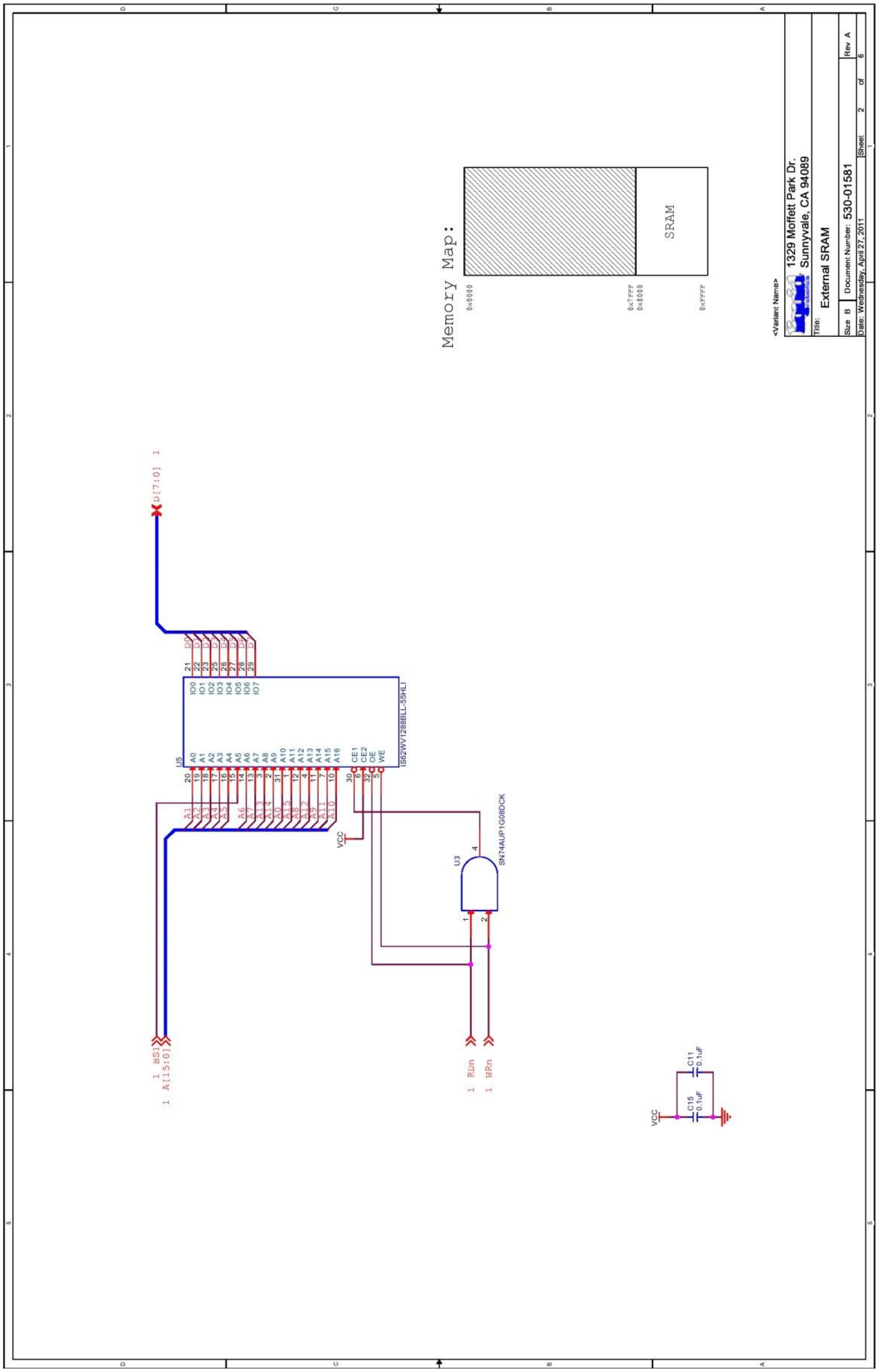

Figure 74: 530-01581 (Sub PIB Schematic) page 2

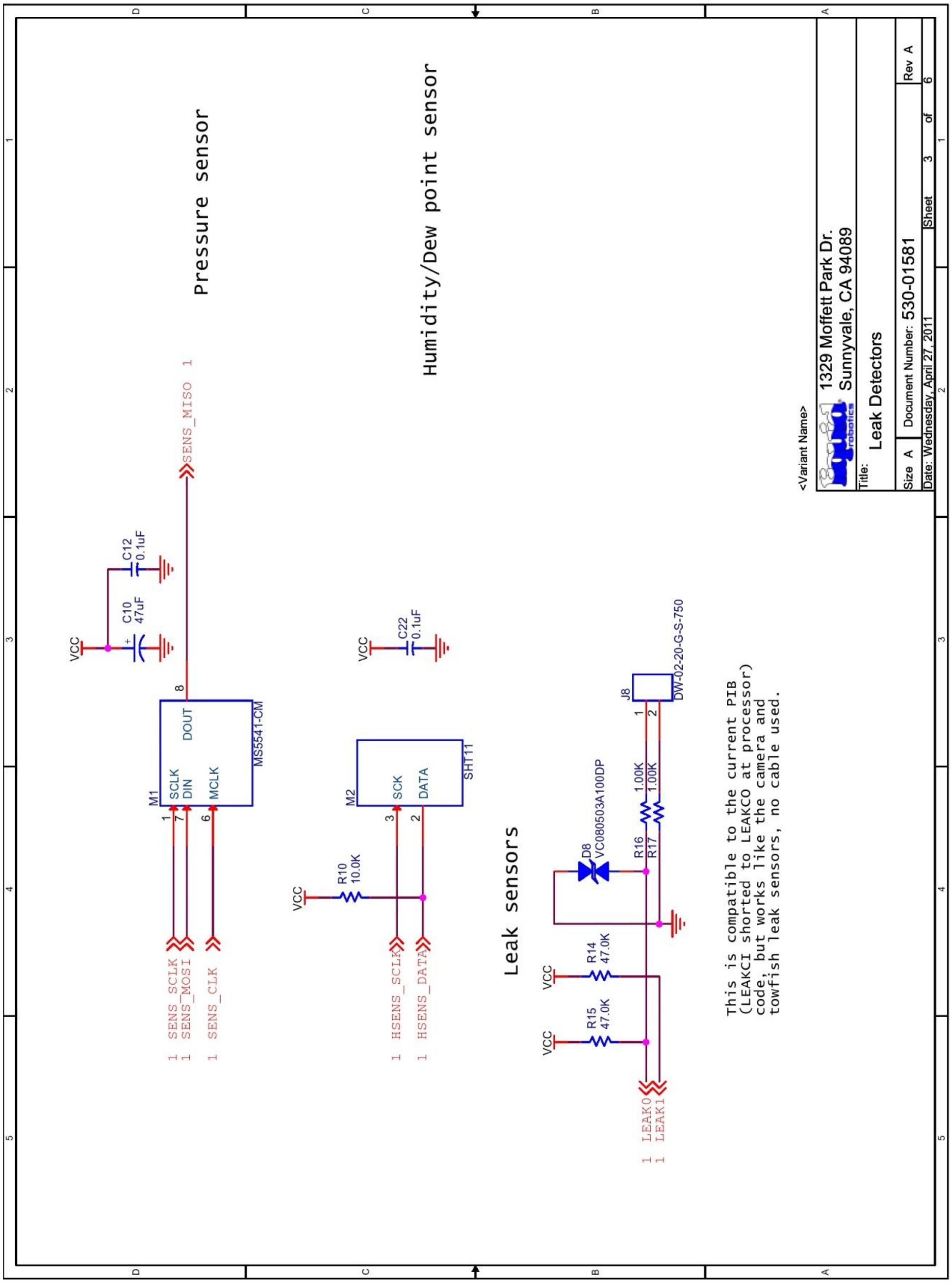

Figure 75: 530-01581 (Sub PIB Schematic) page 3

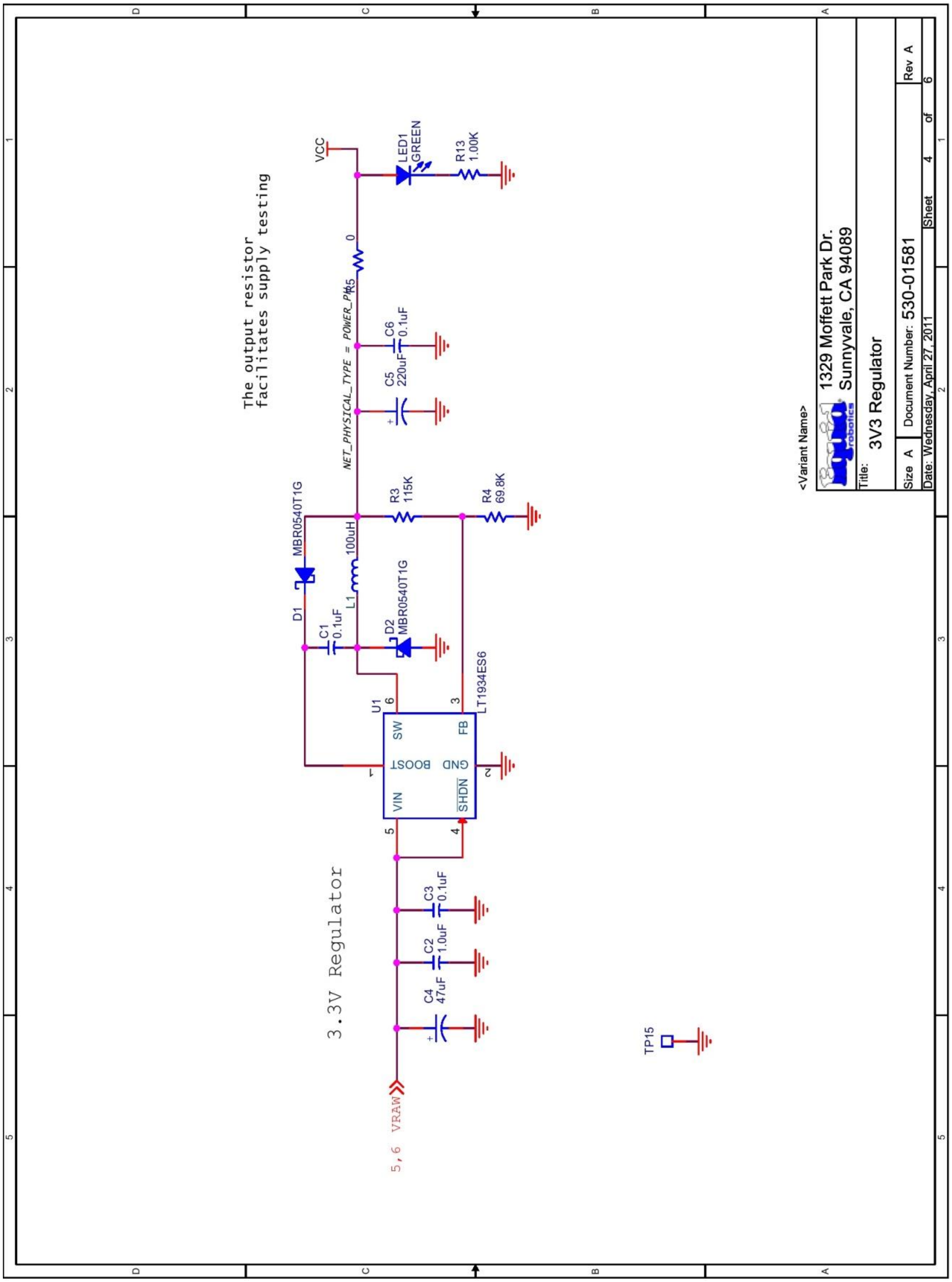

Figure 76: 530-01581 (Sub PIB Schematic) page 4

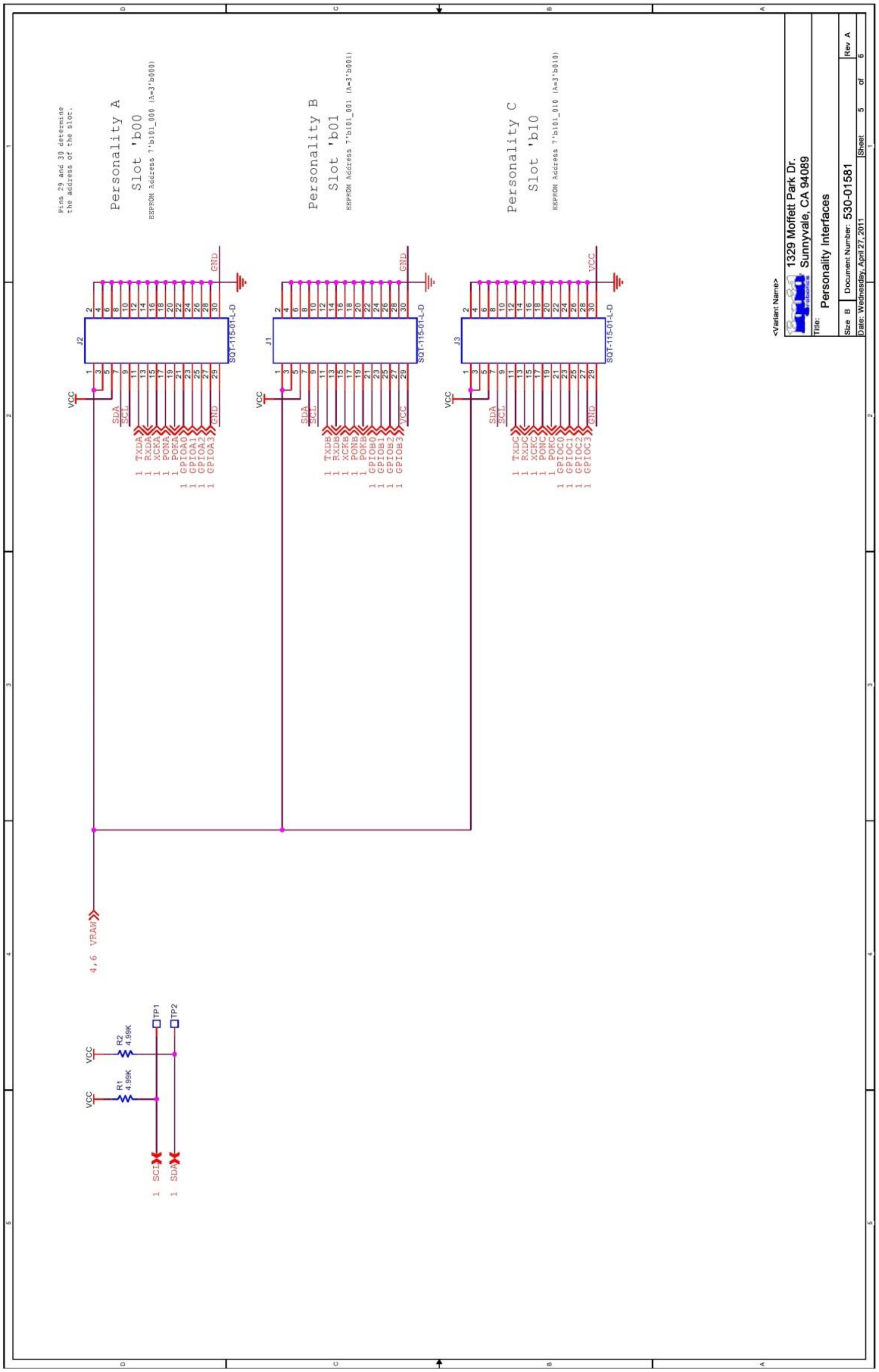

Figure 77: 530-01581 (Sub PIB Schematic) page 5

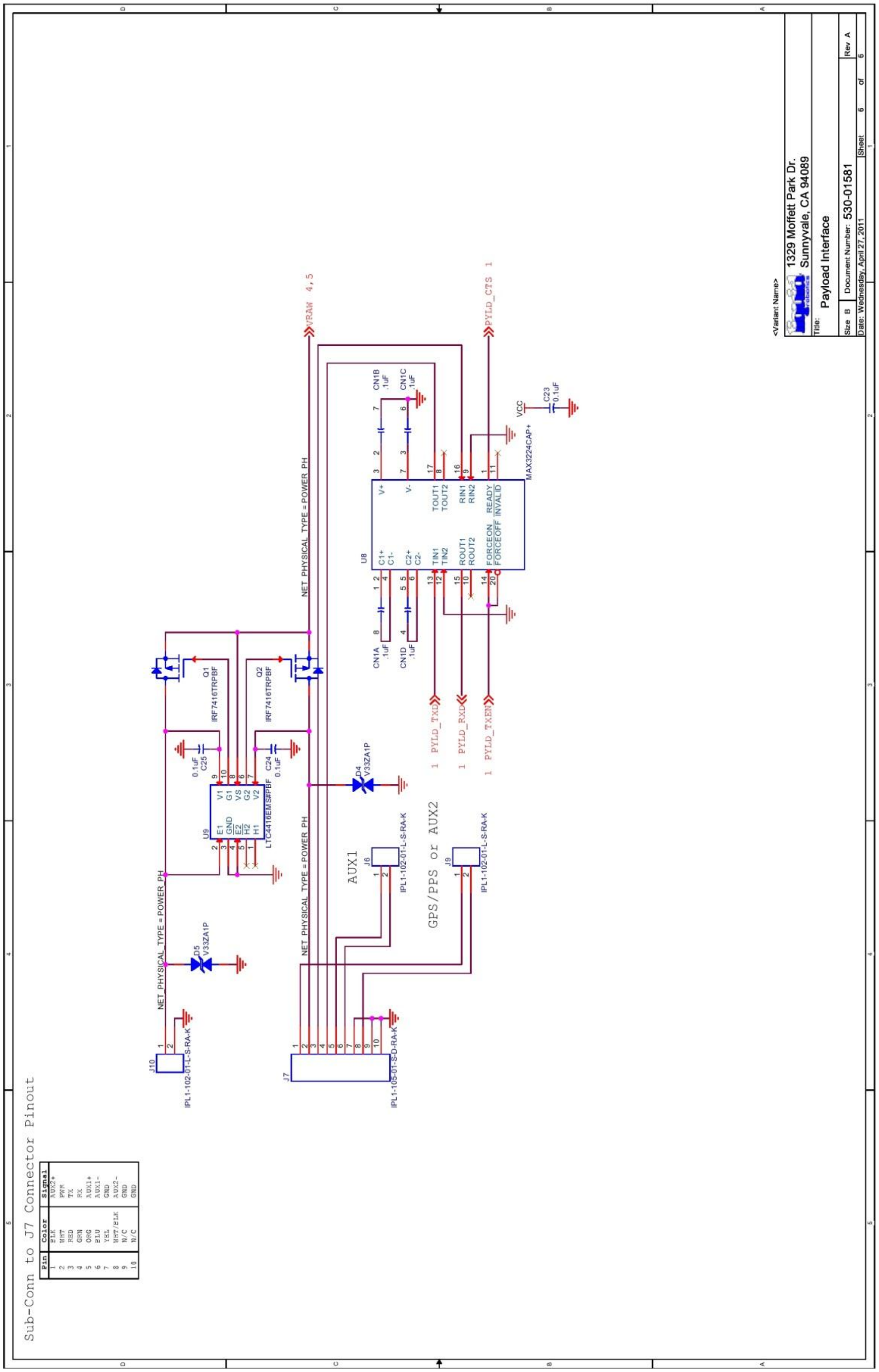

Figure 78: 530-01581 (Sub PIB Schematic) page 6

P-COM Board 510-00097

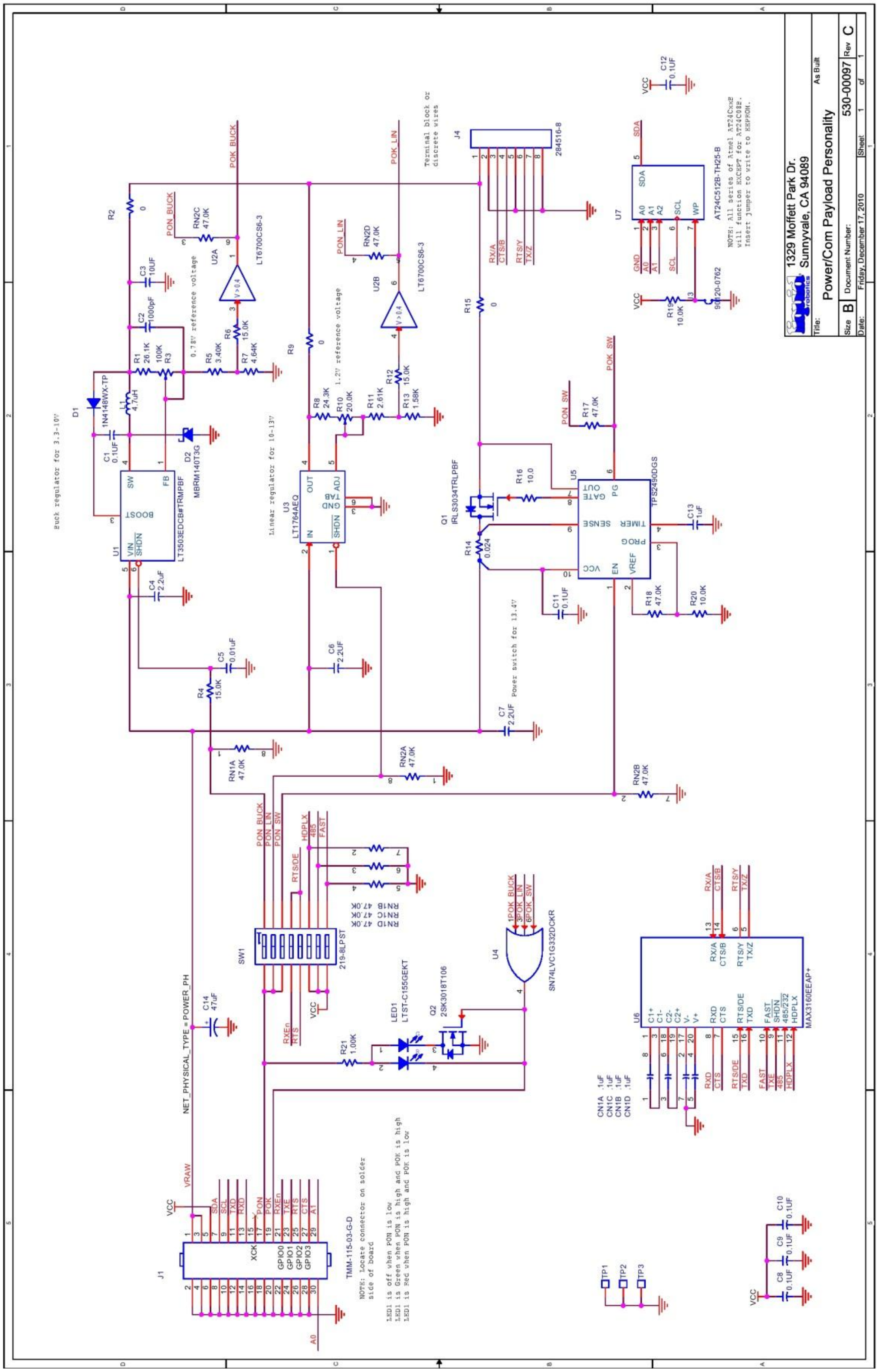

Figure 79: 530-00097 (P-COM Schematic) page 1

SMC Board 510-01232

Pages 14-16 have been omitted because they are duplicates of page 13. The only difference is where the I2C address pins are connected as shown on page 11 of the schematic.

Pages 18-22 have been omitted because they are duplicates of page 17. The only difference is where the mode pins and transceiver pins physically connect. The connections are shown on page 7 for the transceiver pins and pages 25-27 for the mode pins.

Page 24 has been omitted because it is duplicates of page 13. The only difference is where the transceiver pins physically connect. The connections are to J19 instead of J12.

Pages 26-27 have been omitted because they are duplicates of page 25. The only difference is where the mode pins physically connect. The connections are shown on page 7

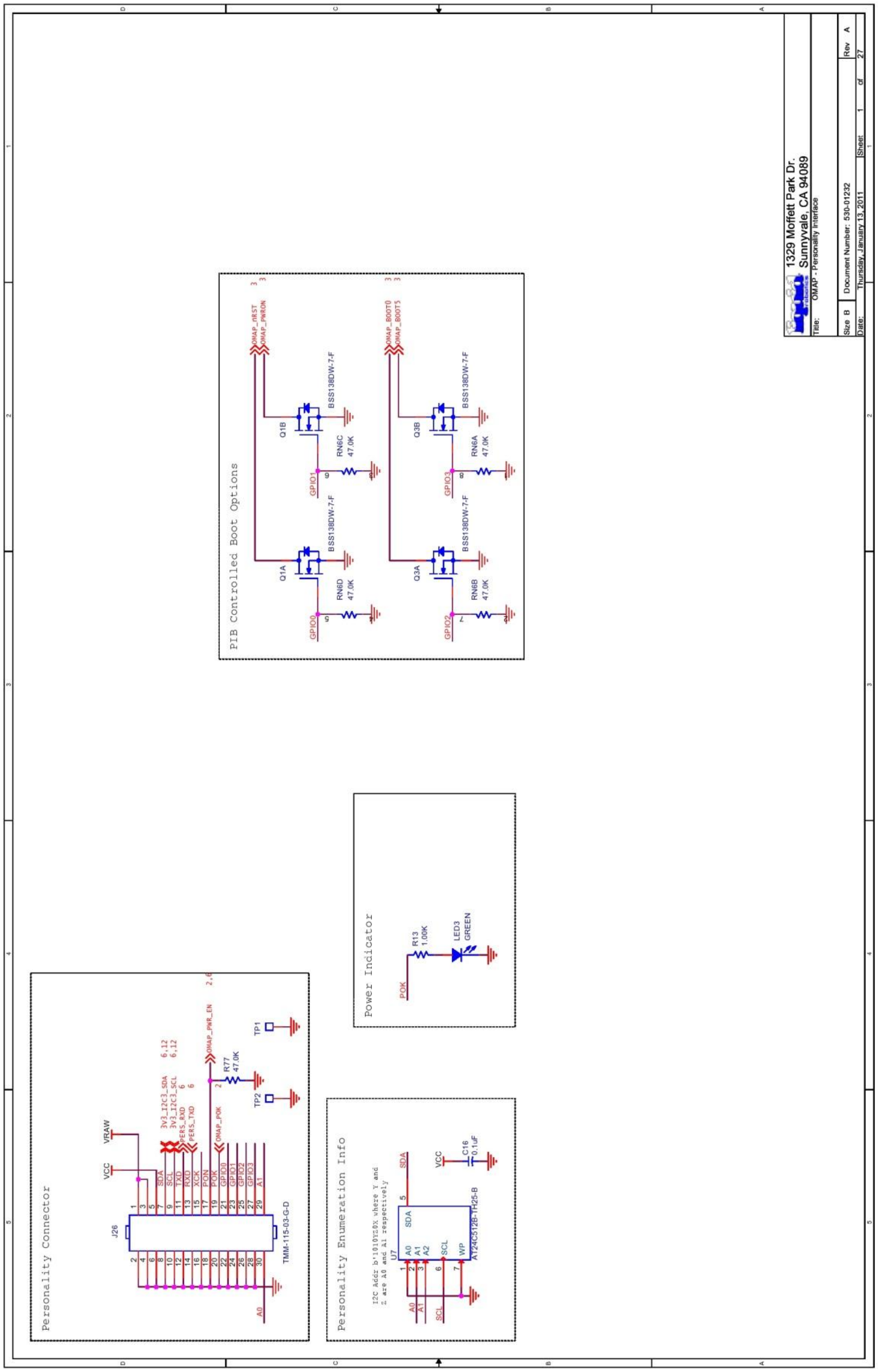

Figure 80: 530-01232 (SMC Schematic) page 1

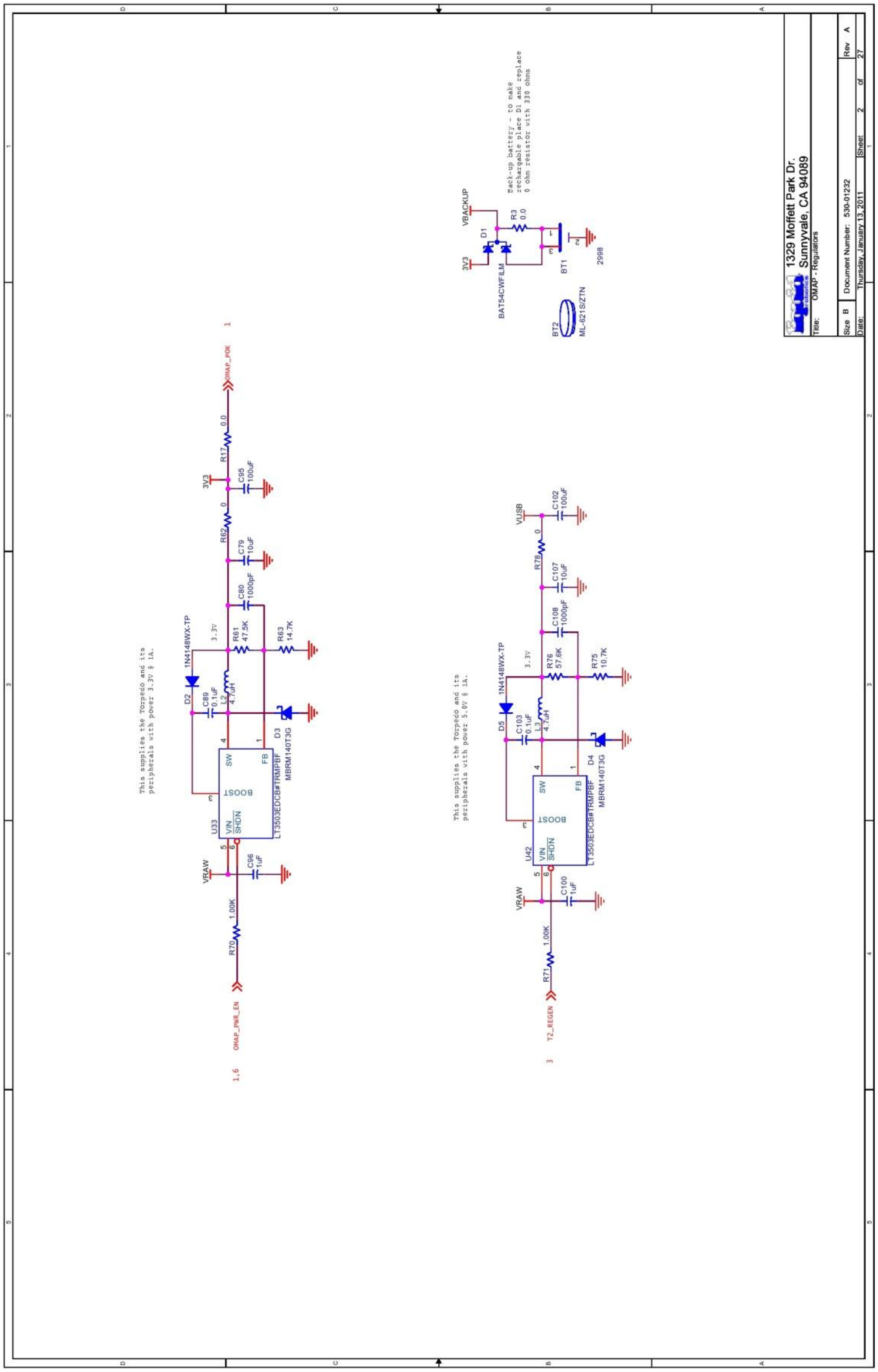

Figure 81: 530-01232 (SMC Schematic) page 2

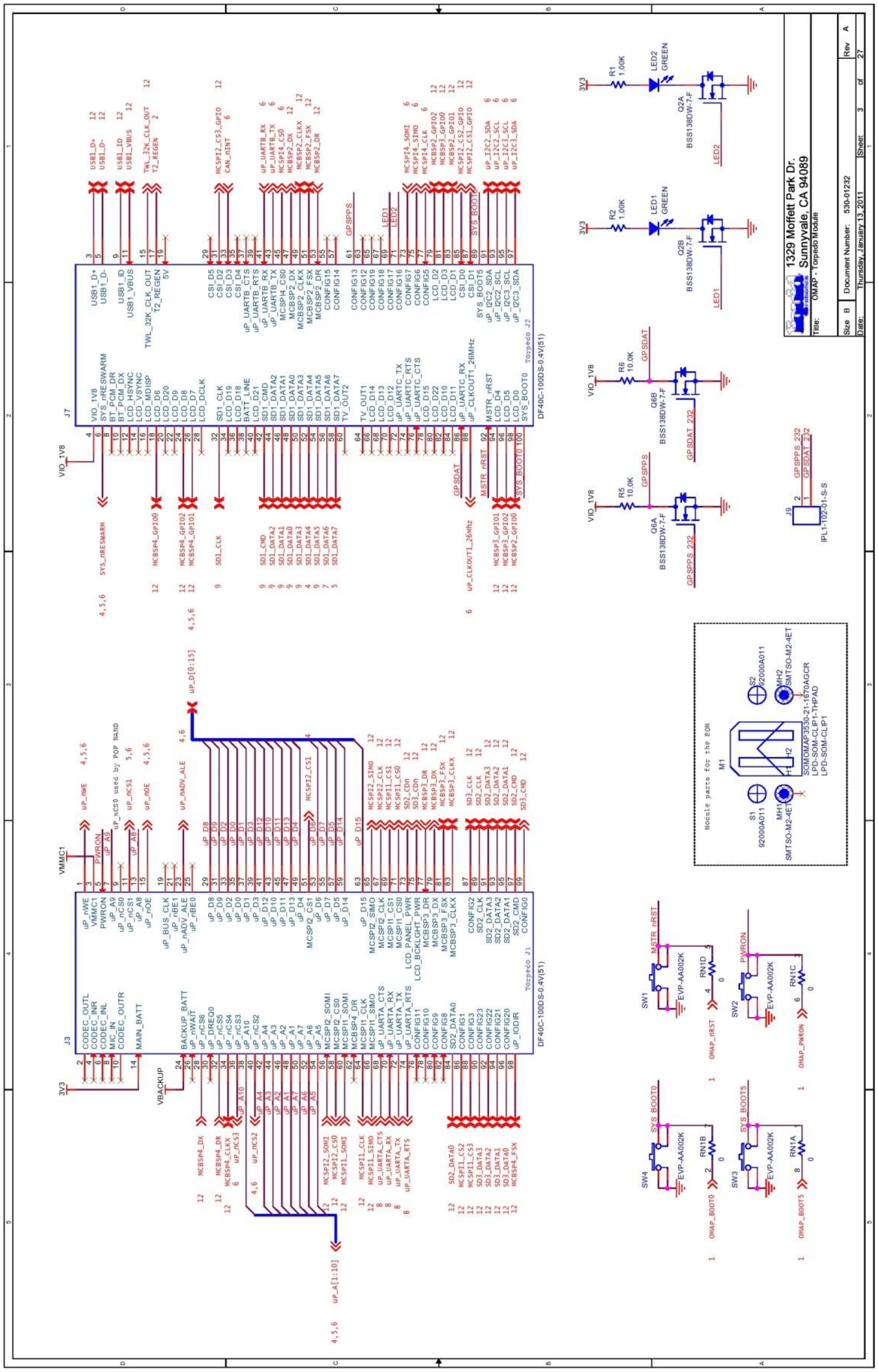

Figure 82: 530-01232 (SMC Schematic) page 3

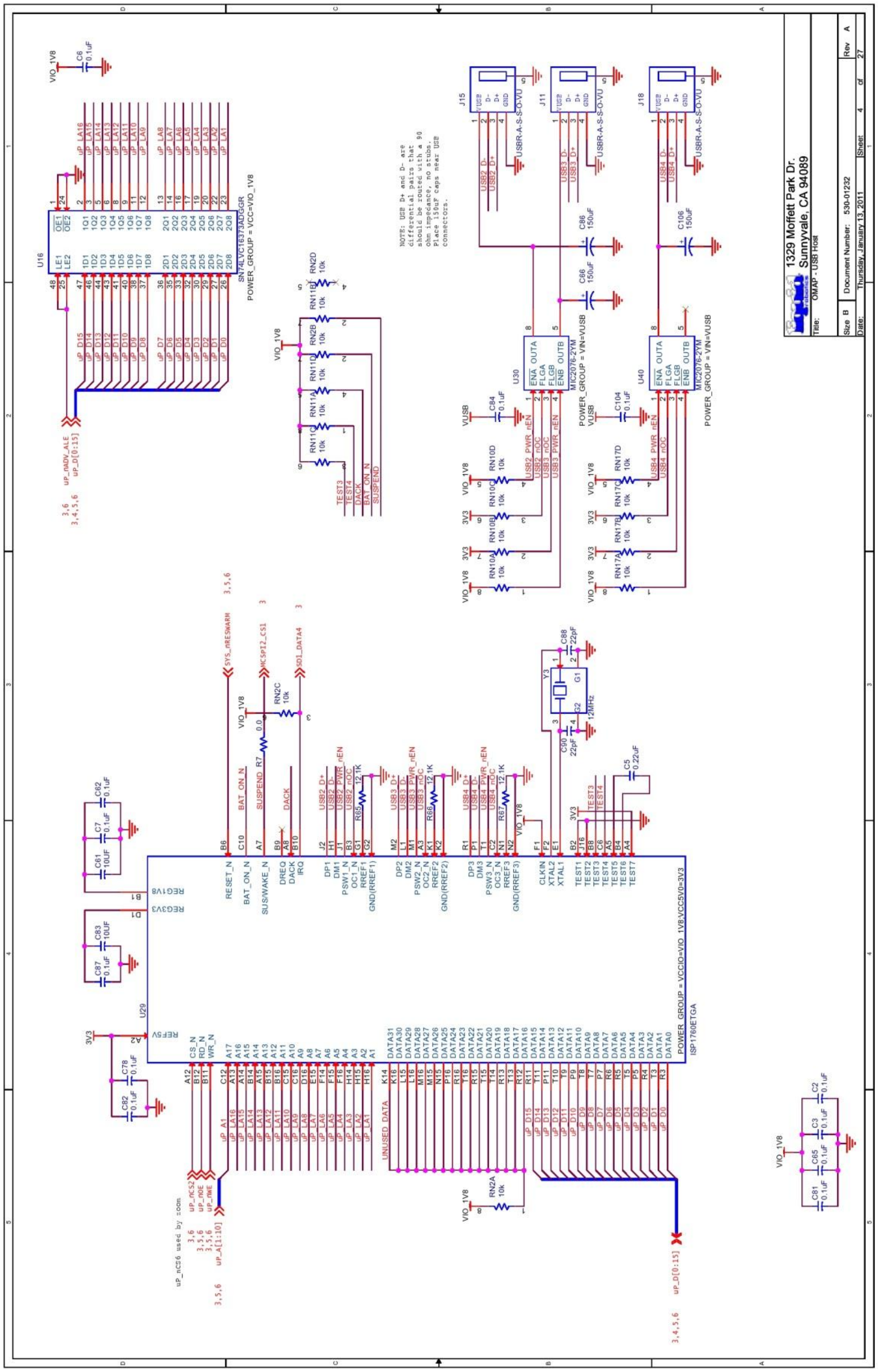

Figure 83: 530-01232 (SMC Schematic) page 4

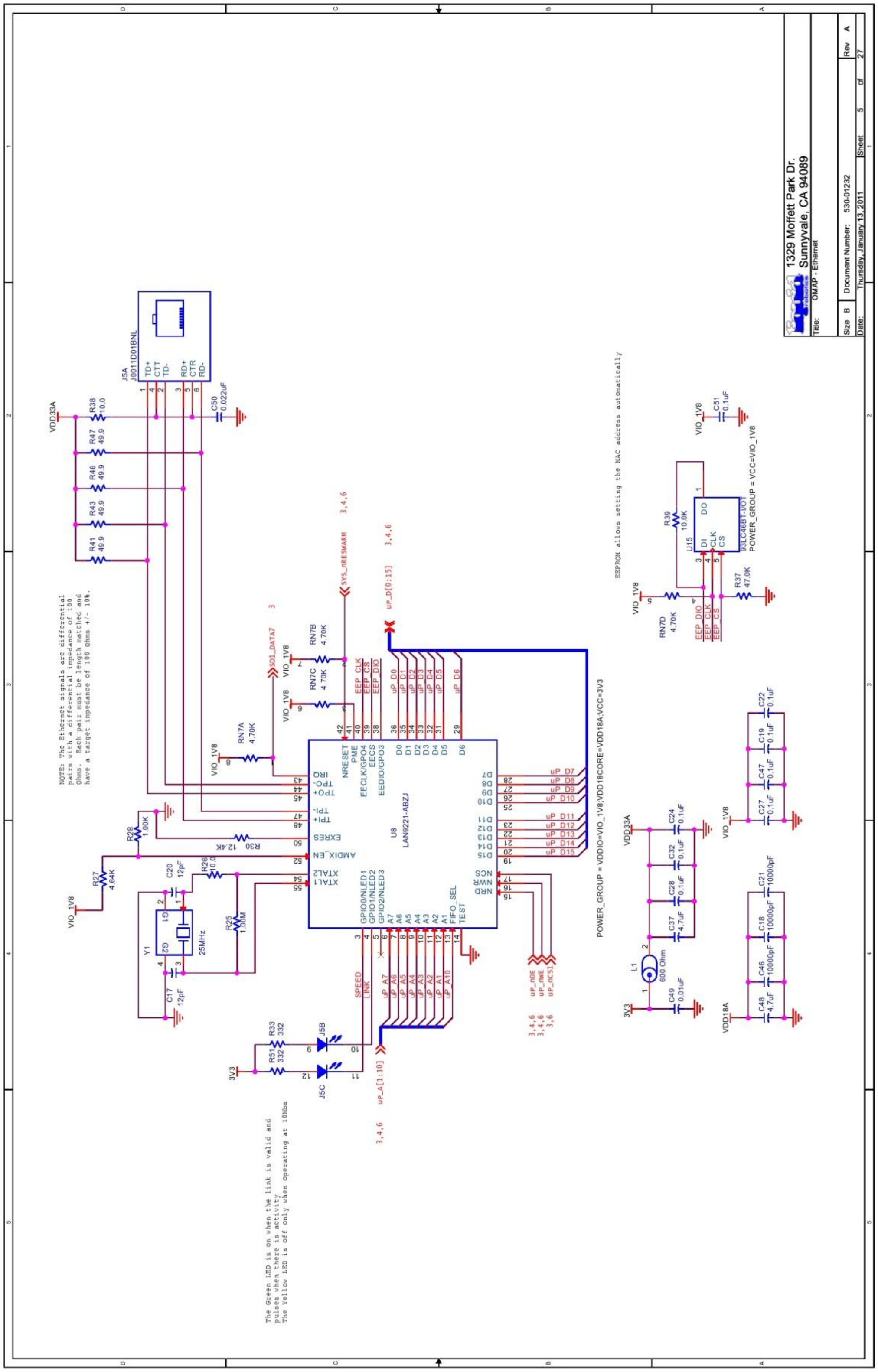

Figure 84: 530-01232 (SMC Schematic) page 5

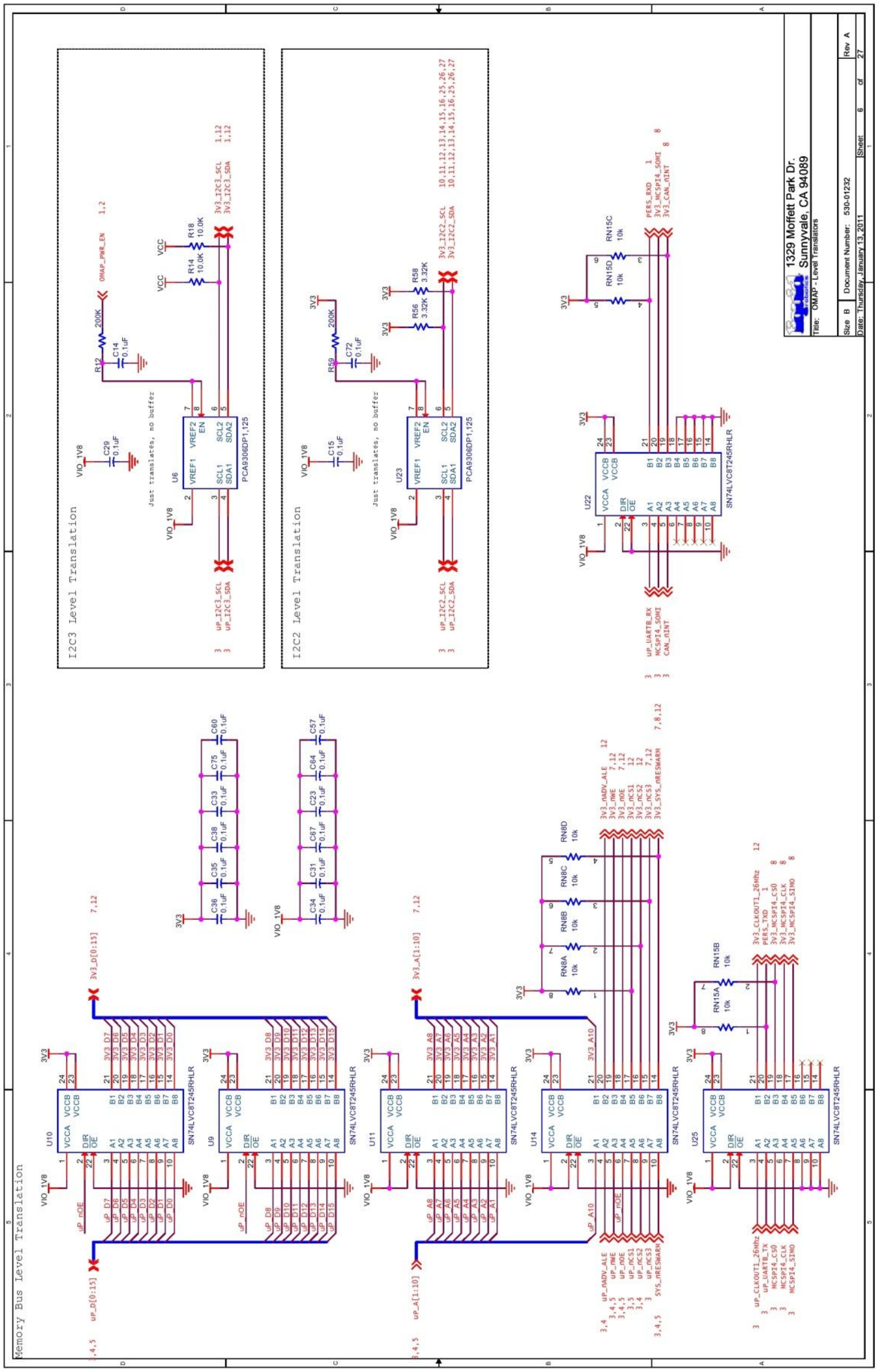

Figure 85: 530-01232 (SMC Schematic) page 6

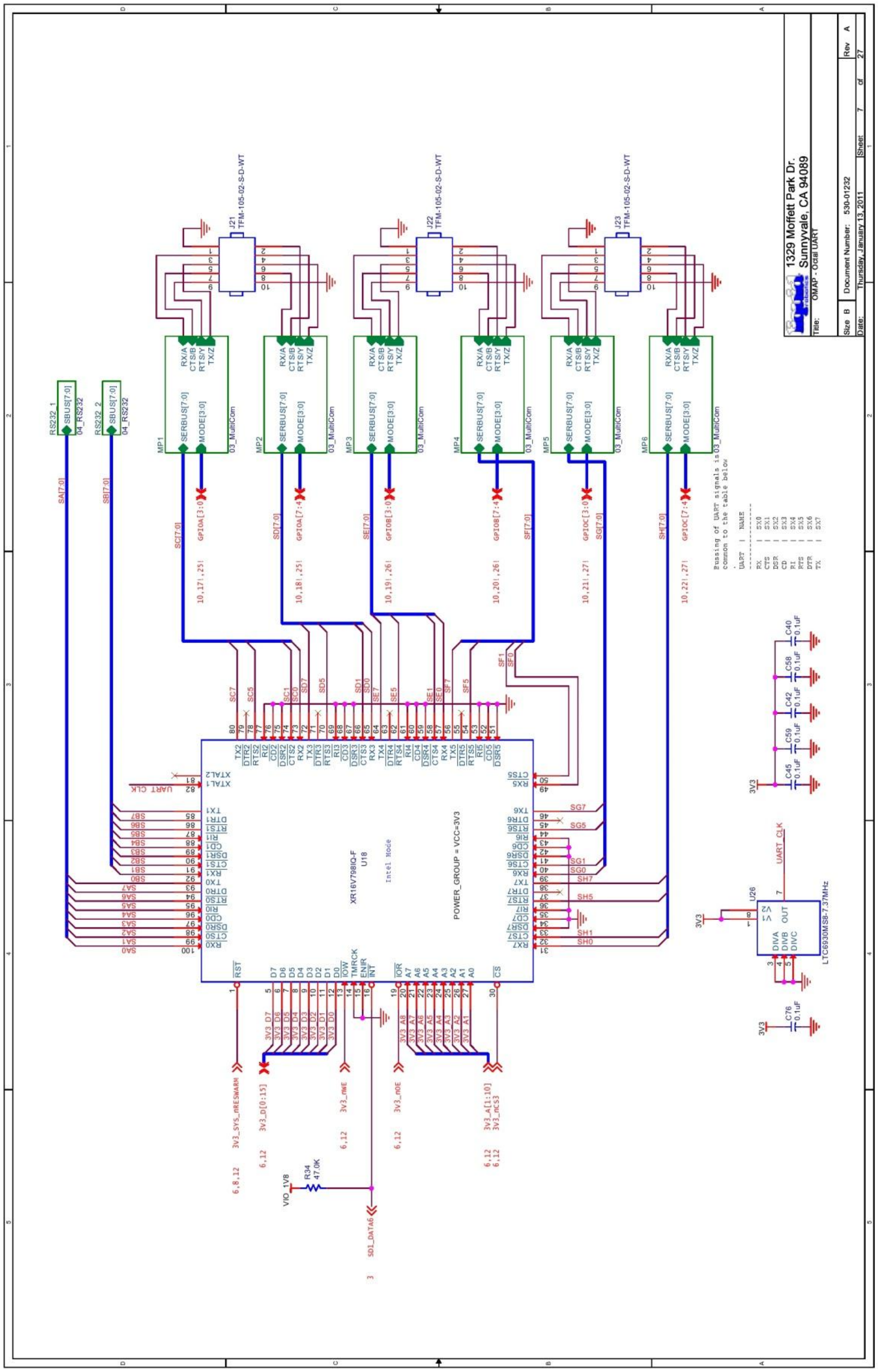

Figure 86: 530-01232 (SMC Schematic) page 7

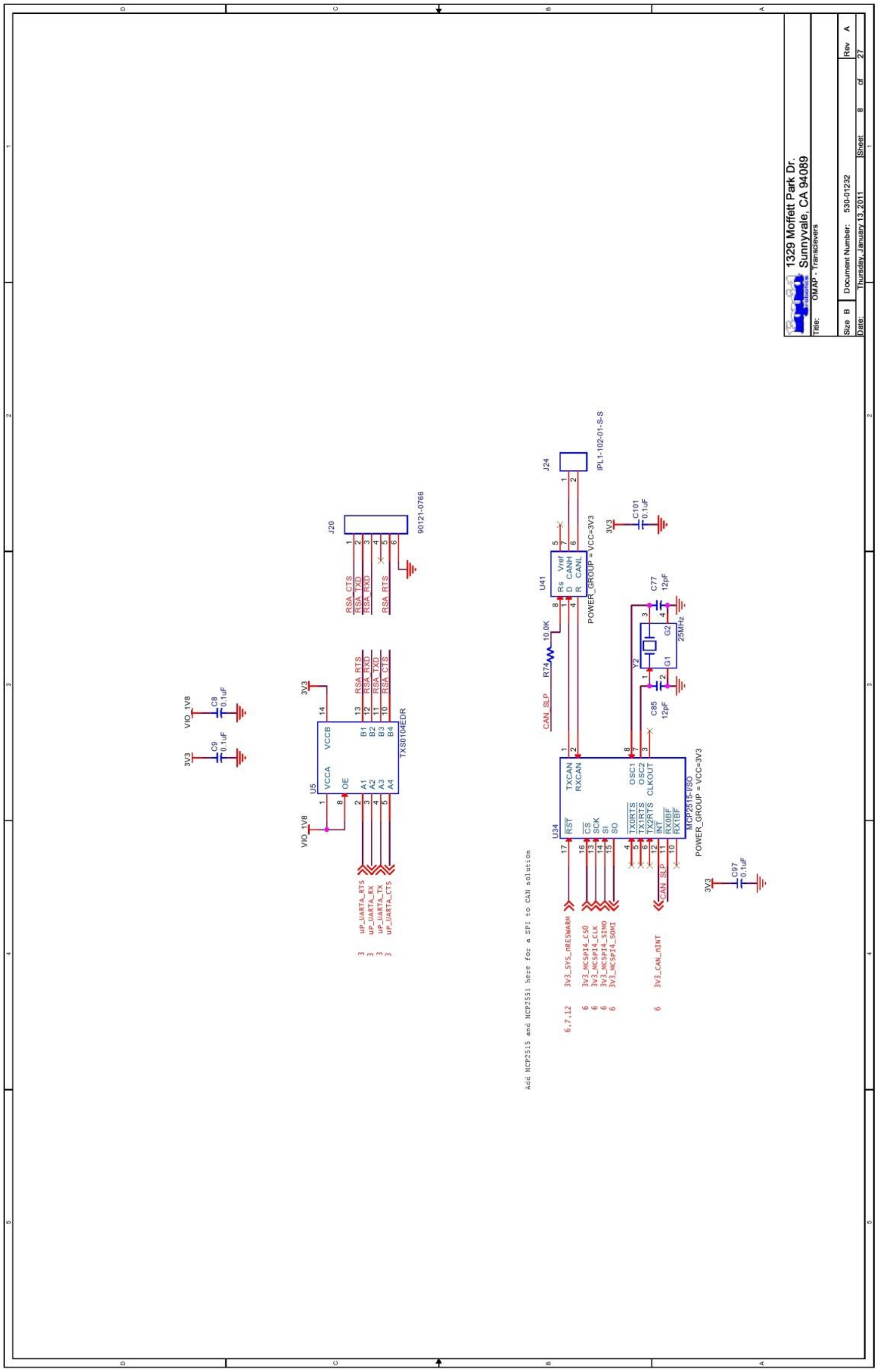

Figure 87: 530-01232 (SMC Schematic) page 8

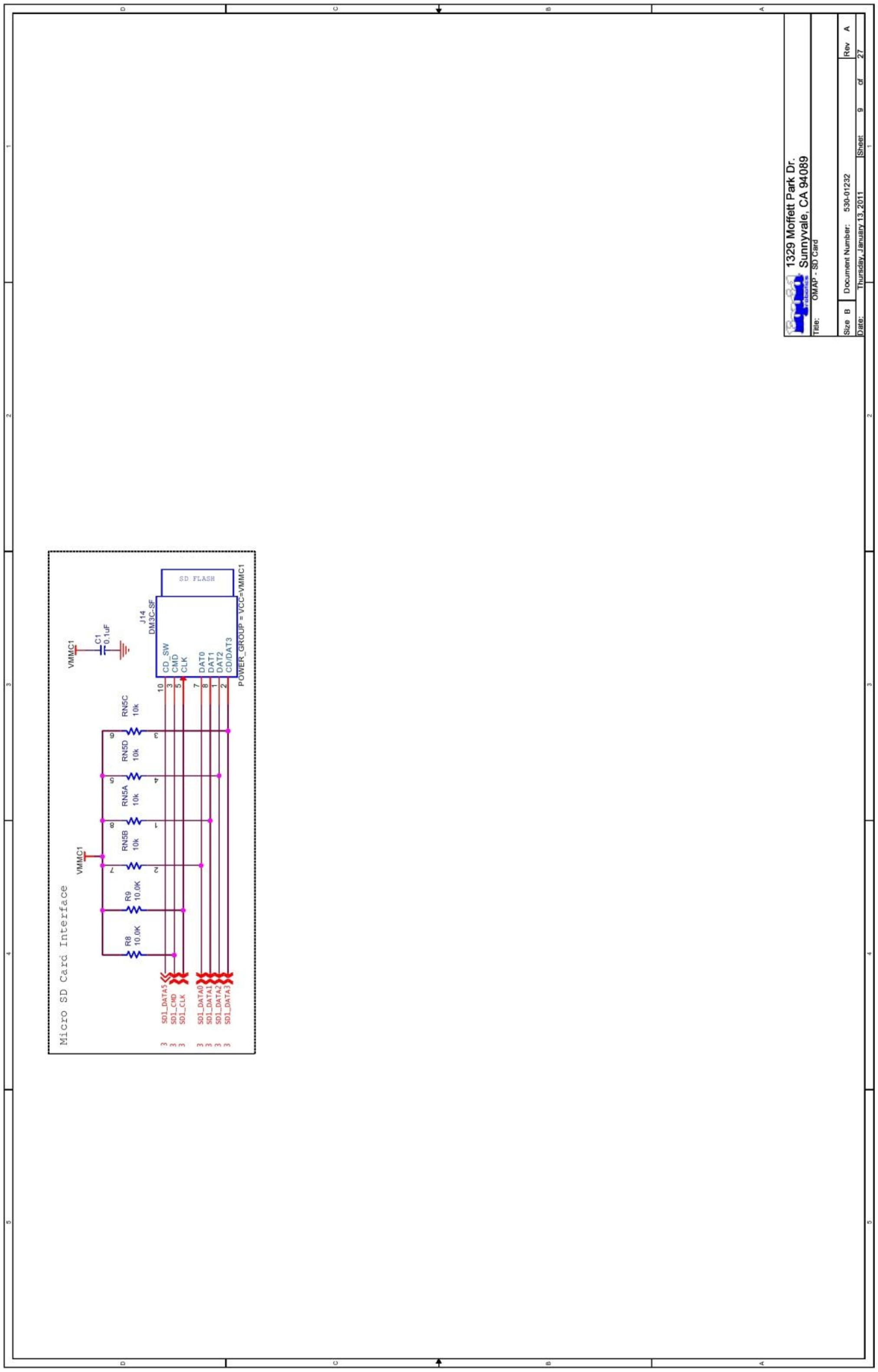

Figure 88: 530-01232 (SMC Schematic) page 9

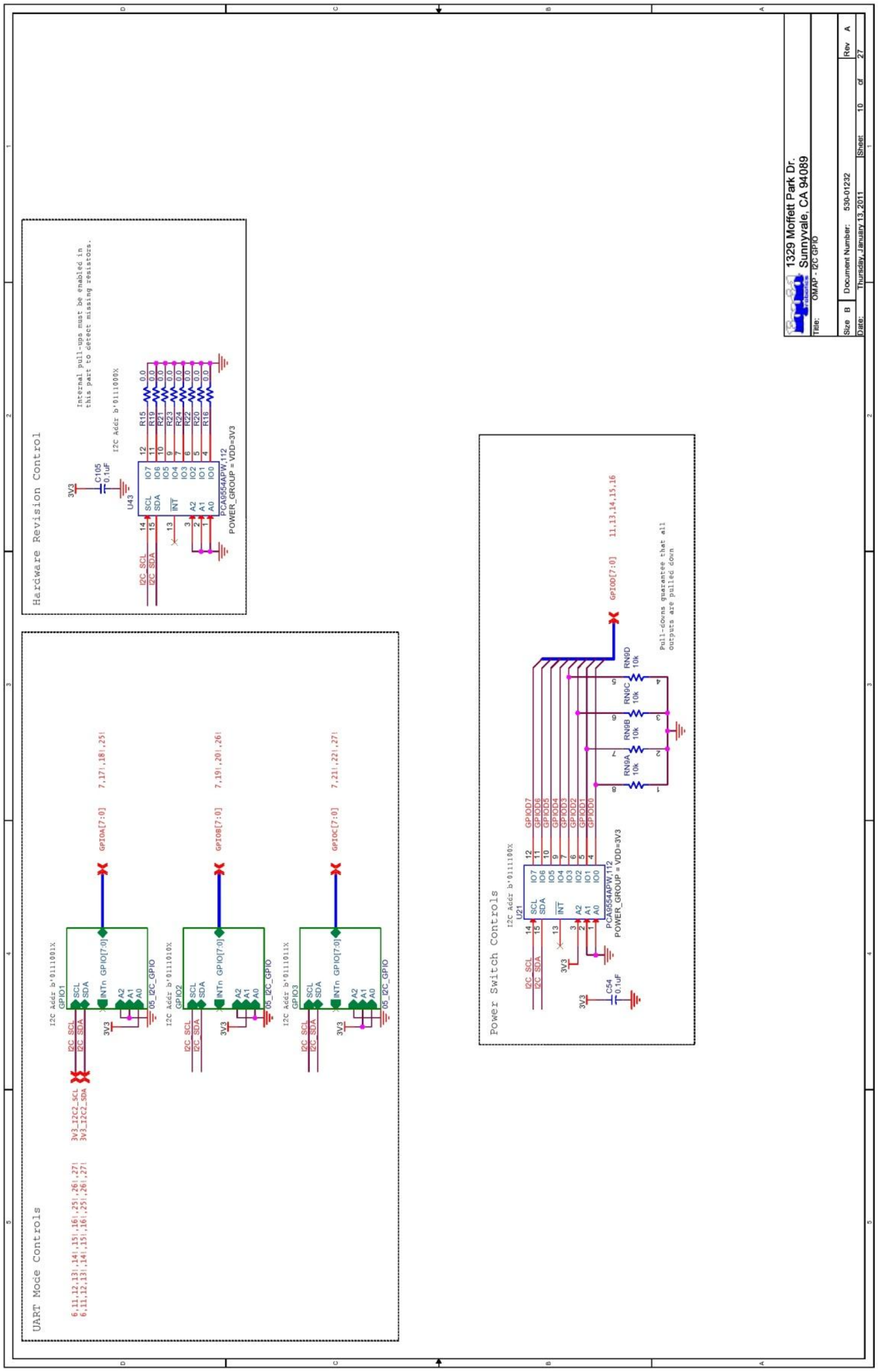

Figure 89: 530-01232 (SMC Schematic) page 10

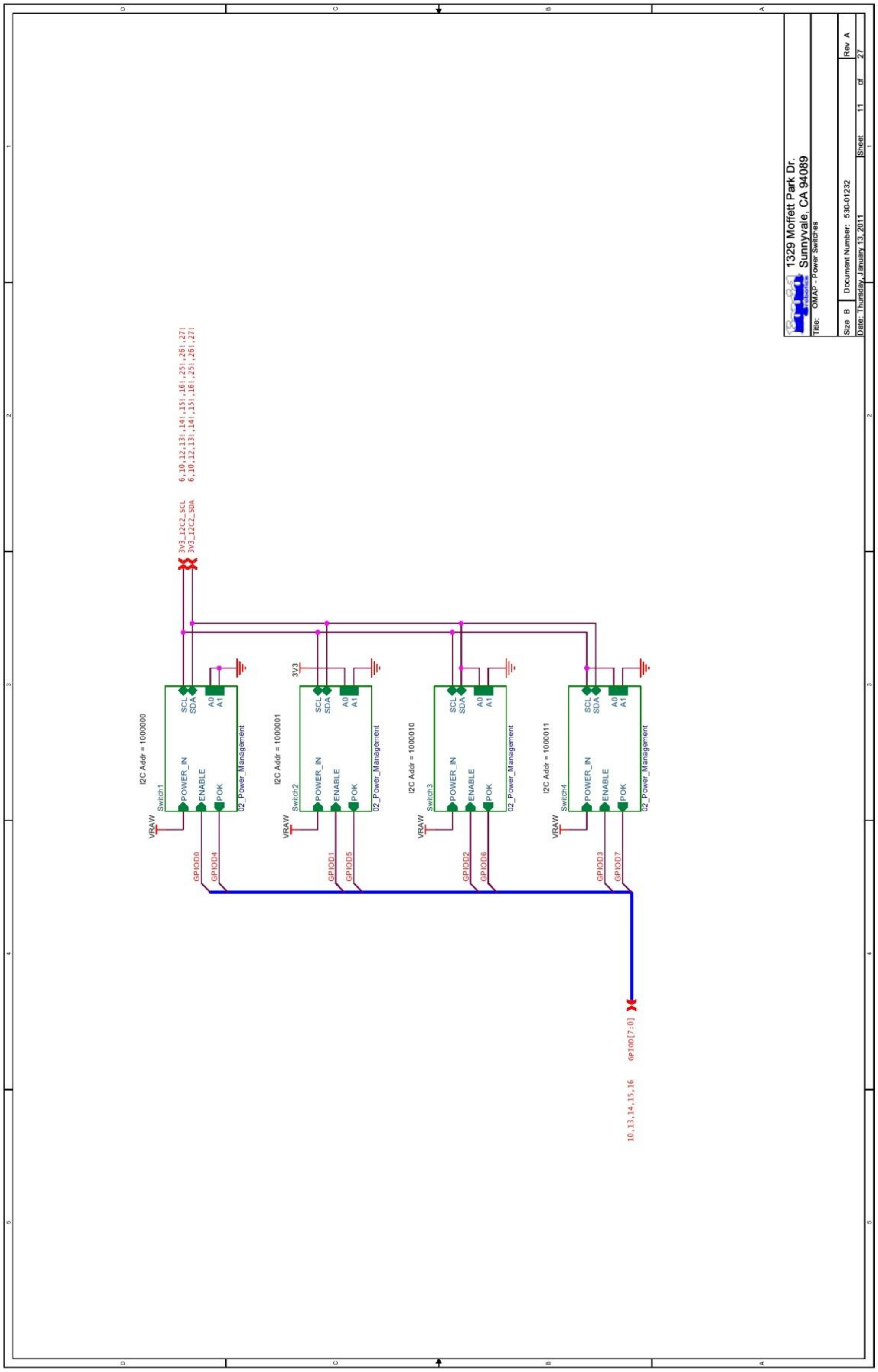

Figure 90: 530-01232 (SMC Schematic) page 11

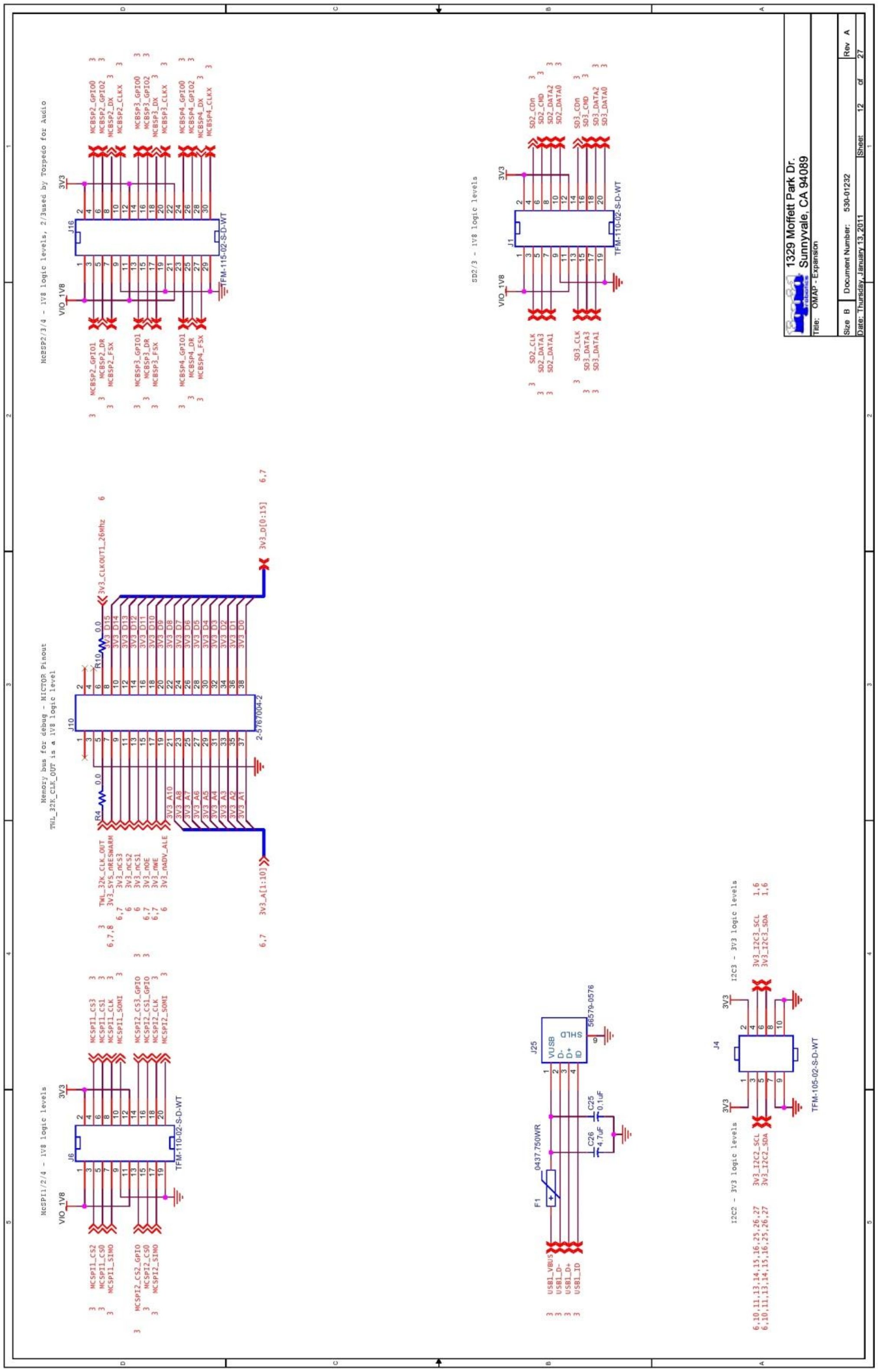

Figure 91: 530-01232 (SMC Schematic) page 12

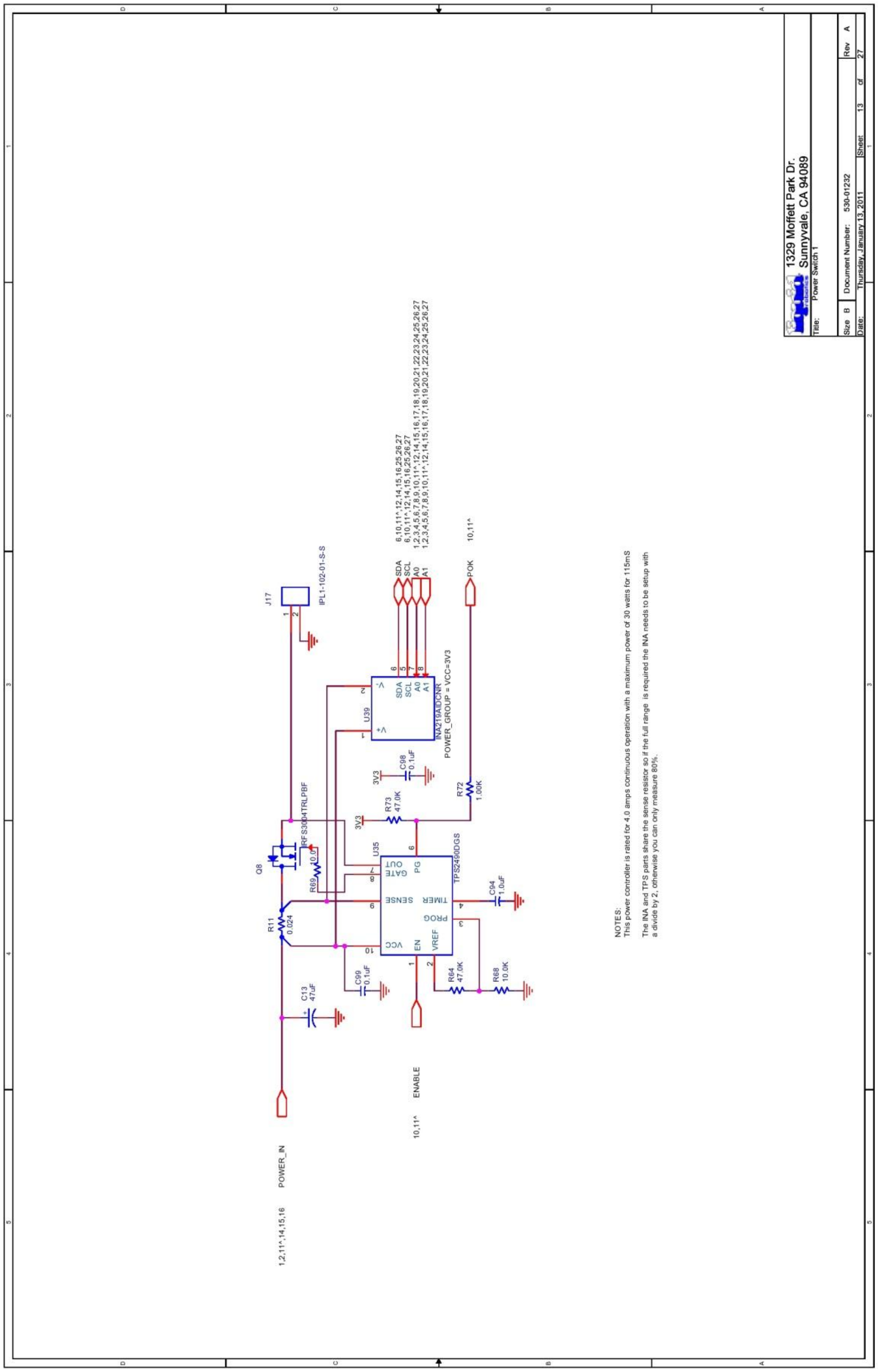

Figure 92: 530-01232 (SMC Schematic) pages 13-16

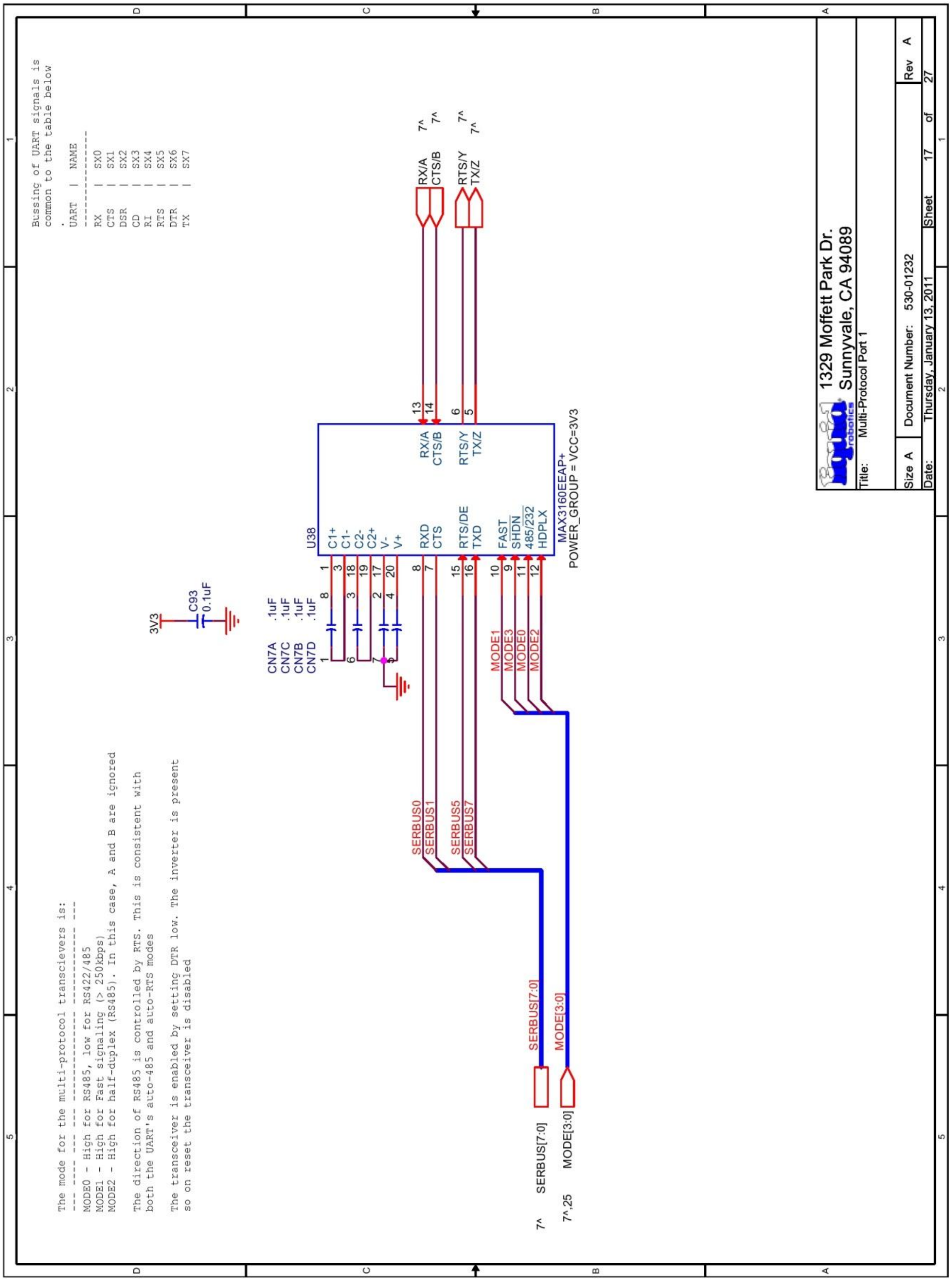

Figure 93: 530-01232 (SMC Schematic) pages 17- 22

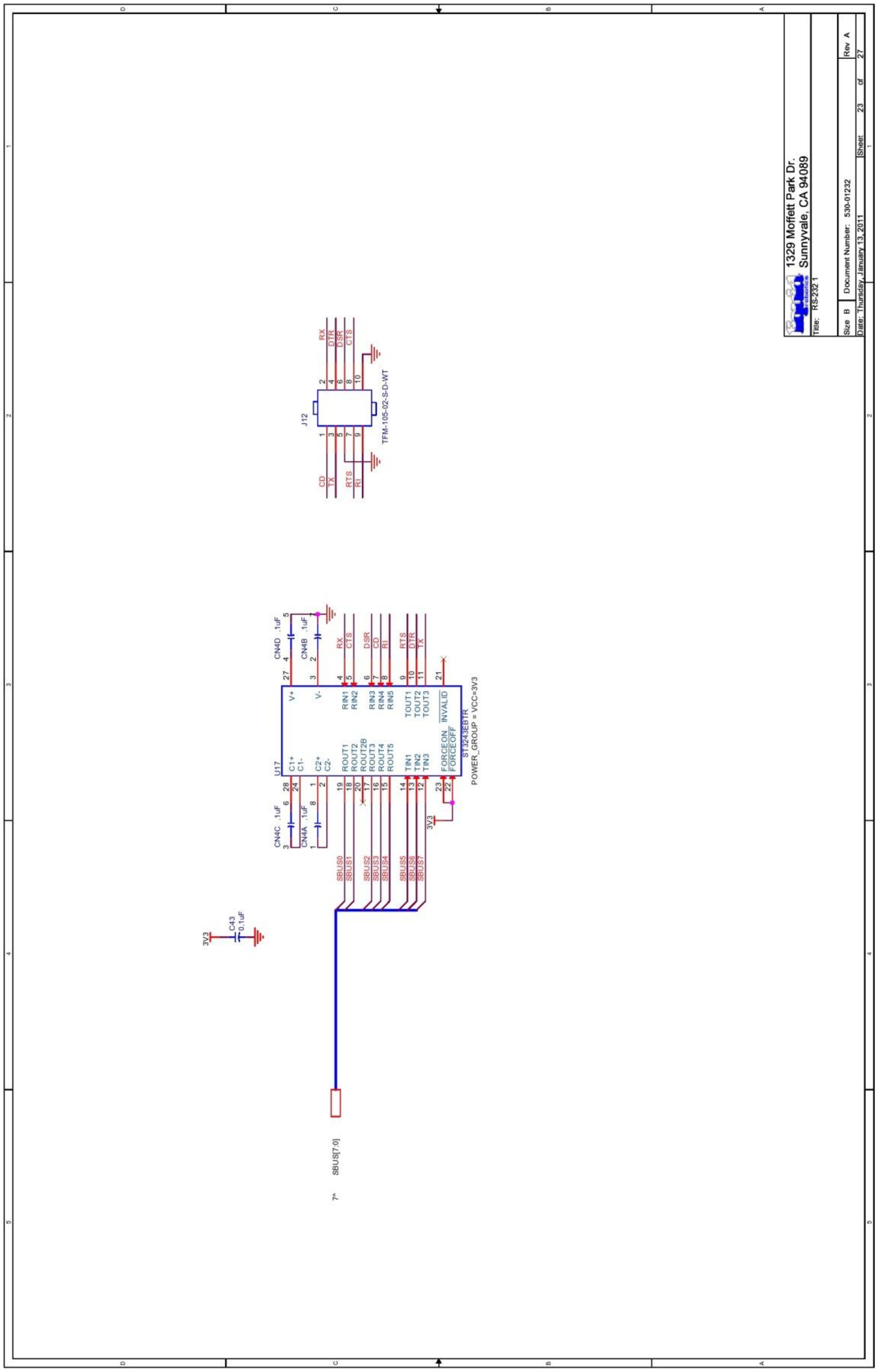

Figure 94: 530-01232 (SMC Schematic) pages 23-24

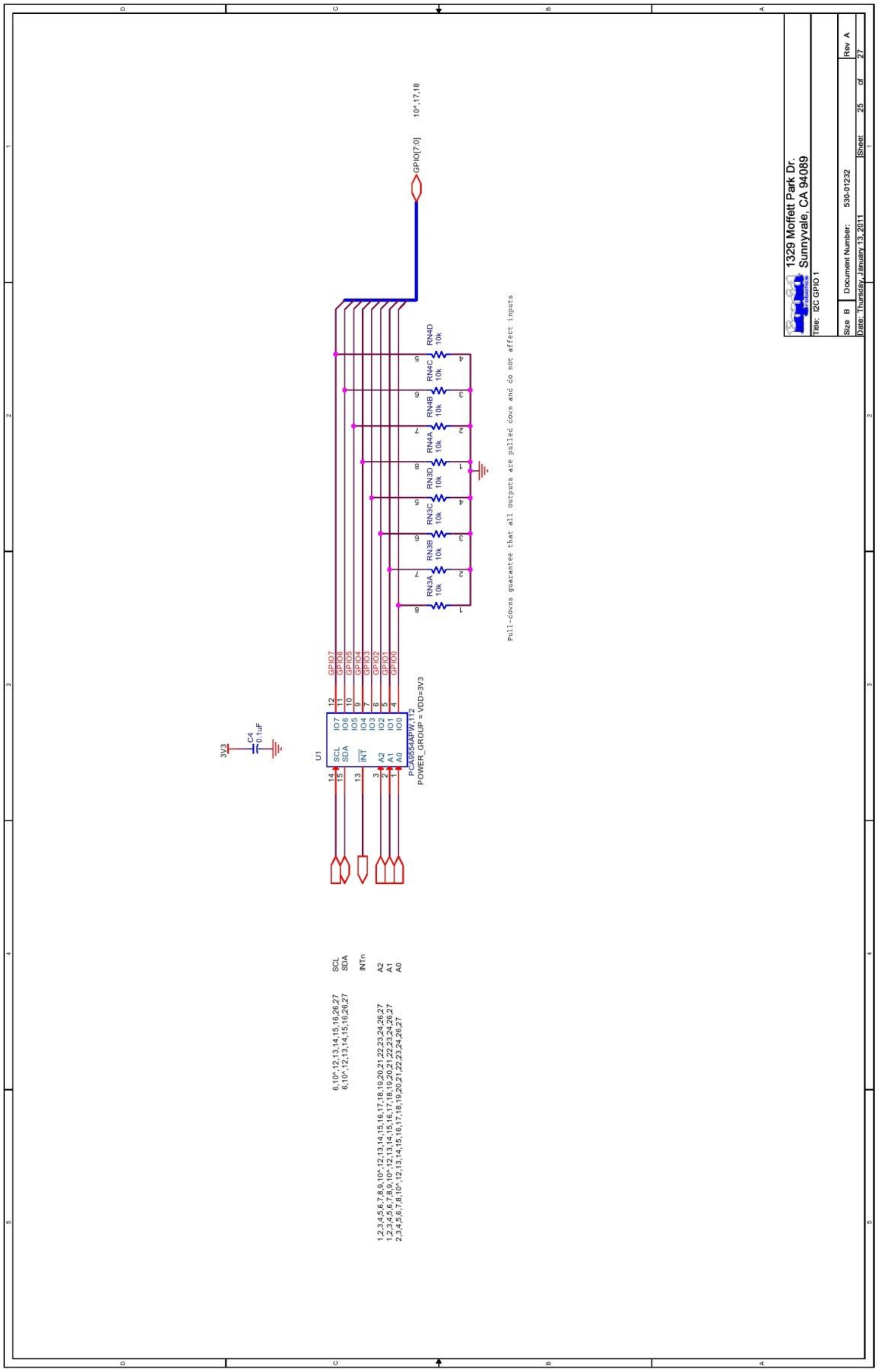

Figure 95: 530-01232 (SMC Schematic) pages 25-27

Glossary

AUX: Auxiliary line/pin for any possible use. Not to be confused with the AUX PWR port or any of its pins.

AUX Pair: Refers to either the pair that goes to PAYLD2 or the pair that goes to PAYLD1 and PAYLD3.

AUX PWR port: Physical labeling of the PEP port on the Float C&C drybox lid.

C&C: Alternate name for the Float Command and Control drybox.

End User Equipment: Any device or sensor that is not part of the core system, but is added to the final assembly. This can include C3s, CTDs, wave sensors, power generation or storage devices, etc.

Float C&C: See C&C.

PEP Port: Alternate name for the AUX PWR port.