



Goodrich ISR Systems

Piccolo External Interface

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The *Piccolo Autopilot avionics system and all of its versions (such as *Piccolo*, *Piccolo Plus*, *Piccolo II*, *Piccolo LT*, and *Piccolo SL*) were designed for use **only** on un-manned aircraft. **USE OF THESE PICCOLO AUTOPILOT PRODUCTS IN AIRCRAFT WITH HUMAN OCCUPANTS IS PROHIBITED BY THE FEDERAL AVIATION ADMINISTRATION.** Cloud Cap Technology, Inc. is not permitted to sell the *Piccolo Autopilot* to any customer that intends to use the product on aircraft with human occupants.*

Piccolo External Interface Change Log

Date	Section	Change
June 7, 2011	Table 1 Table 5	Updated pin 27 & 44 on <i>Piccolo SL</i> interface table
January 3, 2011	Table 5	Added I/O index number for pin 28. In the notes below the table, corrected BAN references for servos 10, 11, 12, and GPIO_0
November 24, 2010	Figure 8	Corrected pin location call outs on the 25 pin secondary connector of the <i>Piccolo II</i> .
September 28, 2010	Table 5	In the <i>Piccolo SL</i> external interface table, corrected function descriptions for the following pins: 13, 16, 28, 45.
August 19, 2010	Figure 7 Figure 8 Figure 9 Figure 10	Added pin number diagrams for all the <i>Piccolo Autopilot</i> external interface connectors.
August 17, 2010	Table 1 Table 5	The definitions for the Program/User pins (32 and 49) on the <i>Piccolo SL</i> Microdot connector were reversed. Pin 49 is RX and pin 32 is TX.
June 7, 2010	Table 2	Corrected note in the <i>Piccolo</i> , <i>Piccolo Plus</i> , and <i>Piccolo II</i> external interface table. The PCC payload external I/O index and servo index are not the same.
May 12, 2010	Table 5	Corrected notes on servo 9, incorrectly noted as servo 5.
November 20, 2009	Table 4 Table 5	The servo number for the payload index 5 and 6 on the <i>Piccolo SL</i> and <i>LT</i> was listed incorrectly, and has been fixed. Payload index 5 (TPU_B2) is servo number 6, and Payload index 6 (TPU_B3) is servo number 5.

1 Vehicle Interface Connections

There are five versions of the Piccolo autopilot: Piccolo (no longer available), Piccolo Plus and Piccolo LT (both no longer available to new customers), Piccolo II, and Piccolo SL. The Piccolo, Piccolo Plus and Piccolo II versions share a common main board design and hence have many external interface features in common. The Piccolo LT is smaller, has limited radio options and uses a different external interface. The Piccolo SL has all of the features and radio options of a full featured autopilot and is applicable for the smallest electric UAVs or other applications where size and cost are a primary consideration.

1.1 External I/O - Piccolo/Piccolo Plus/Piccolo II

Piccolo, Piccolo Plus, and Piccolo II support a 44-pin high-density filtered external interface connector (see **Figure 1**). The connector chosen, while not the smallest or highest density available, provides a cost-effective solution in a small footprint. Benefits include the following:

- Integral capacitive filtering for minimizing EMI
- A robust electro-mechanical vehicle interface
- Readily available low-cost industry standard mating connectors
- No special tooling required for mating wire harness fabrication
- Provision for continuous shielding across the connector interface for enhanced EMI protection.



Figure 1 - Piccolo Plus Front Panel

All I/O pins are ESD protected at point of entry and the Maxim RS232 transceiver used provides enhanced on-chip 15kV ESD protection for the two serial interfaces. The main DC input is reverse polarity as well as ESD protected.

1.1.1 Mating 44-Pin Connector Specification

Connector, D-Sub HD 44 HD-22:

- CCT p/n: 760-00330-00
- Digikey p/n: A2078-ND
- Amp p/n: 48366-1

Pins, 22-28 Awg HD-22:

- CCT p/n: 760-00329-00
- Digikey p/n: A2088-ND
- Amp p/n: 748333-4

1.2 Additional External I/O - Piccolo II

Piccolo II has a second external interface connector: a 25-pin Micro-D connector, that provides additional I/O, serial ports and analog inputs (**Figure 2**).



Figure 2 - Piccolo II Front Panel

1.2.1 Mating 25-Pin Connector Specification (Piccolo II only)

The mating connector is supplied with the Piccolo II. It comes with a 18 inch long pigtail that the user can mate to as needed.

Note: It is up to the user to properly terminate the unused as well as the used connections.

Connector, 25 Position Socket Pigtail Harness:

- CCT p/n: 760-00636-00
- Glenair p/n: MWDM2L-25S-6K1-18B

1.3 External I/O - Piccolo LT

Piccolo LT uses a 37-pin Micro-D connector (**Figure 3**).



Figure 3 - Piccolo LT Front Panel

1.3.1 Mating 37-Pin Connector Specification (Piccolo LT)

The mating connector is supplied with the Piccolo LT. It comes with a 18 inch long pigtail which the user can mate to as needed.

Note: It is up to the user to properly terminate the unused as well as the used connections.

Connector - 37 Position Socket Pigtail Harness:

- CCT p/n: 760-01085-00
- Glenair p/n: MWDM2L-375-4K1-36B

1.4 External I/O - Piccolo SL

Piccolo SL uses a 51-pin Micro-D connector (**Figure 4**).



Figure 4 - Piccolo SL Front Panel

1.4.1 Mating 51-Pin Connector Specification (Piccolo SL)

The mating connector is supplied with the Piccolo SL. It comes with a 18 inch long pigtail which the user can mate to as needed.

Note: It is up to the user to properly terminate the unused as well as the used connections.

Connector - 51 Position Socket Pigtail Harness:

- CCT p/n: 760-01937-00
- Glenair p/n: MWDM2L-51S-4K1-36B

1.5 UHF and GPS Antenna

Additionally the Piccolo front panel has two SMA (SSMA for LT and SL) coaxial connectors that are used for the vehicle UHF and GPS antenna connections. It is recommended that low loss RG174 or RG316 cable be used for all external cabling. SMA connectors were chosen due to their availability, ease of use, and robustness.

1.5.1 GPS Antenna Power for Active Antennas

The default output voltage for active GPS antennas are outlined below.

- Piccolo/Piccolo Plus – 3V
- Piccolo II – 5V
- Piccolo LT – 5V
- Piccolo SL – 5V

Note: Piccolo or Piccolo Plus units can be alternately configured for 5V antenna power. Piccolo II, LT and SL are 5-volt output only.

1.6 Pitot and Static Pressure Ports

Two pressure port fittings provide the interface to the vehicle pitot/static system. The nipples take 3/32 ID tubing. We use Cole Parmer 3/32 inch ID, 5/32 inch OD, 1/16 inch wall lab grade Tygon tubing (part number 06408-63 type R-3603).

2 Vehicle Interface Configurations

The mix of signals provided on the external interface connector support many different vehicle configurations. The most common configuration is outlined below but custom implementations that meet your specific interface requirements can also be accommodated.

2.1 Typical Configuration

A typical configuration (**Figure 5**) includes the following:

- 10 PWM outputs for driving control surfaces
- Two serial connections (five for Piccolo II), GPS and UHF antenna connections
- Flight termination and or ignition connection, power inputs, RPM input, and optional payloads attached via the CAN bus

The external serial links are used for payloads and secondary data-links. Seven TPU lines are available (by re-tasking the control surface lines) for discrete timing, I/O, or PWM. A switched deadman output is available that can be used for flight termination in the event of upstream hardware or software failure, or as a general purpose On/Off switch for controlling payloads or other aircraft systems.

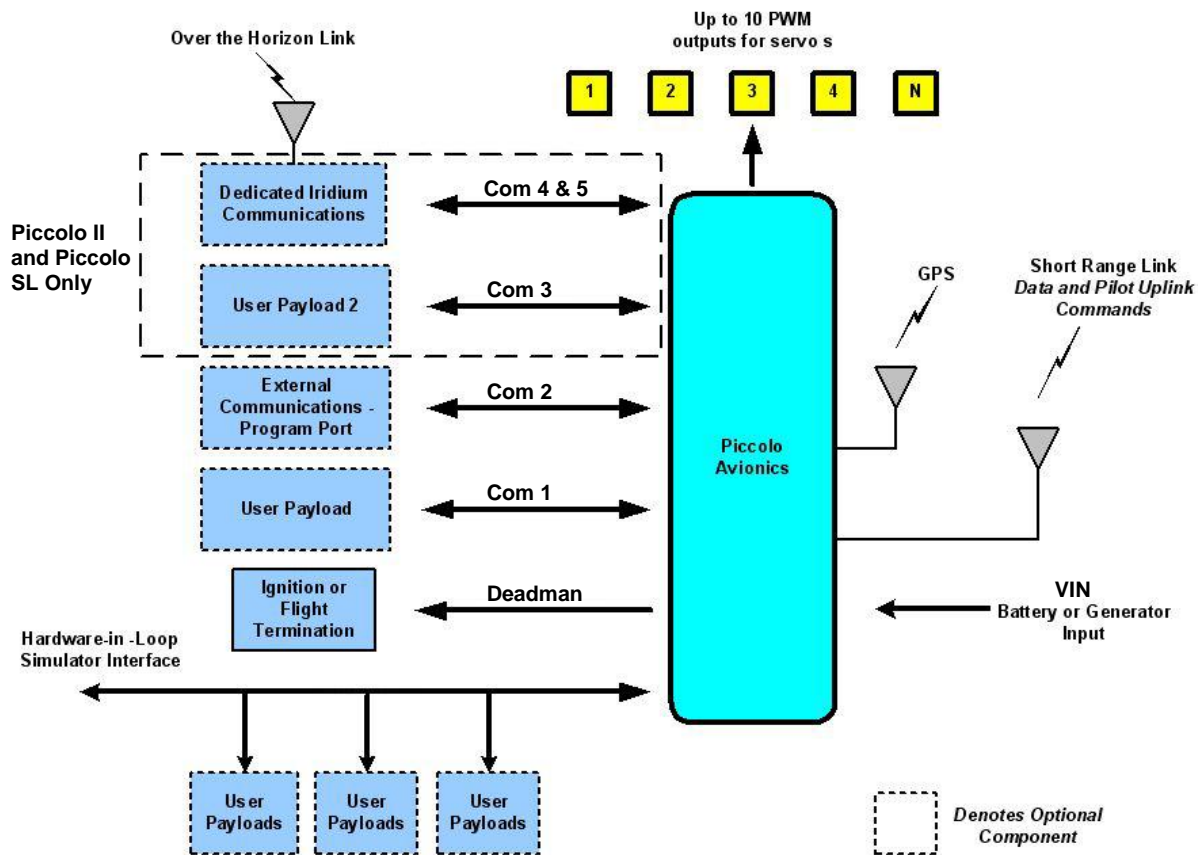


Figure 5 - Typical Configuration

3 Functional Descriptions

3.1 DC Inputs

3.1.1 Main VIN

Piccolo, Piccolo Plus and Piccolo II were designed for a nominal DC input (VIN) of 12 volts with an operational input voltage range of 8-20 VDC (**Figure 6**). Piccolo LT and SL also use a nominal 12 volt input, but the LT accepts voltages from 4.8 to 20 VDC and SL accepts voltages from 4.8 to 30 volts.

3.1.2 Servo Power

All Piccolo autopilots are designed for a nominal servo power input (**SERVO_Vin_1 or SERVO_VIN**) of 4.8 or 6.0 volts. This input was designed to accommodate typical RC hobby servos. Servo load current is limited to a maximum of 2-amps (limited by the external connector). If the servo load is expected to be greater than 2-amps and the autopilot serial number is 555 or above, a second servo power input (**SERVO_Vin_2**) is available. (It is not available on Piccolo LT.) You can parallel the two input pins to double the servo load capacity.

Note: Make sure to double the ground pins.

If you have questions regarding this configuration please contact us for more details.

*Note: Piccolo LT and Piccolo serial numbers prior to 555 do not support the second servo power input pin (**SERVO_Vin_2**.)*

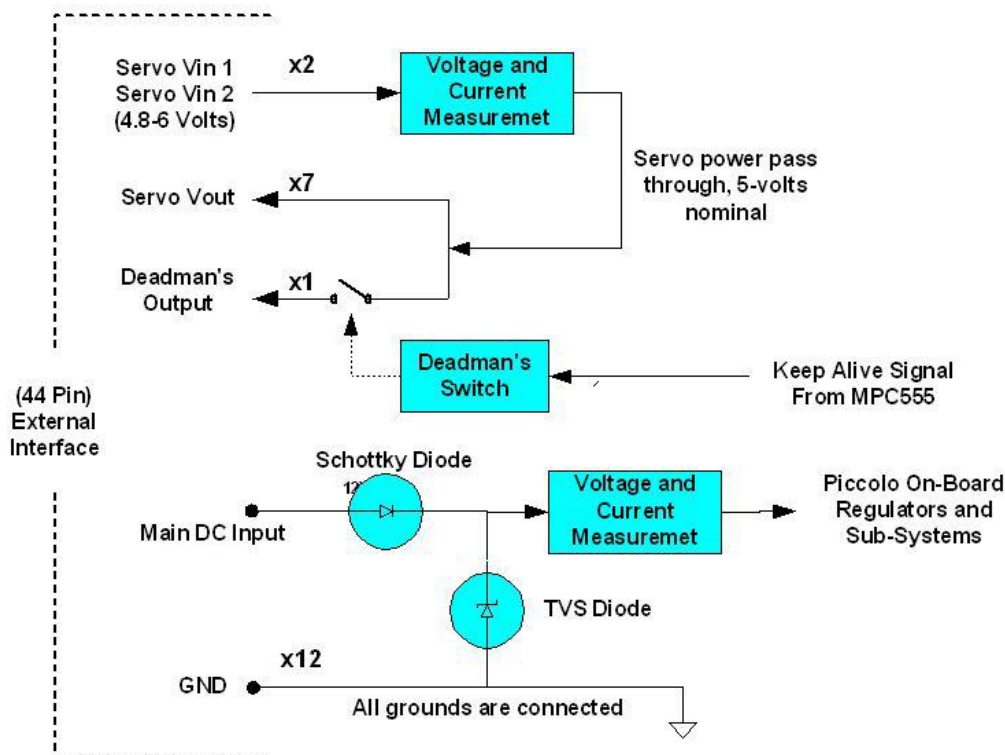


Figure 6 - Piccolo DC Inputs and Outputs

3.2 DC Outputs

The interface connector provides seven (five on Piccolo LT) un-switched (**SERVO_VOUT**) and one switched (**Deadman Output**) DC outputs.

3.2.1 Servo DC Outputs

These outputs are used to power the vehicle control surface actuators, typically RC model servos. The voltage on these outputs tracks whatever voltage is applied to the **SERVO_Vin** pin(s). The Piccolo acts as a pass through and in the process measures both the voltage and current of this user supplied voltage rail.

3.2.2 Deadman Output

The deadman switch consists of a power MOSFET driven by a watchdog timer circuit. The deadman switch requires that software periodically service a hardware line to keep the switch active. Hence if the system fails, either due to software or hardware failure, the deadman switch turns off. This switch can be connected to an ignition system, or other flight termination system, and so provides a measure of safety in the event that the system fails. Please refer to the *Piccolo User's Guide* for further details on how to setup and use the deadman output.

The MOSFET switch can drive up to a 1-amp load and is powered from **SERVO_Vin**. When activated (turned on) it will provide a voltage level of **SERVO_Vout** (4.8-6.0 volts nominal), when deactivated (turned off) it will float the output, disconnecting the load.

3.3 Serial I/O

All versions of Piccolo support two two-wire RS232 universal asynchronous receiver transmitter (UART) serial ports on the primary vehicle interface connector (P1). Piccolo II, which has an additional external interface connector (P2), provides three two-wire RS232 interfaces. COM2 can support baud rates up to 115200, all other ports support up to 57600. The details of each port are given in **Table 1**.

Table 1 - Serial Ports Pins and Default Functions

Port	Plus	II	LT	SL	Default function
COM1	33(Rx), 34(Tx) on P1		26(Rx), 27(Tx) on P1	50(Rx), 33(Tx) on P1	Payload 1
COM2	31(Rx), 32(Tx) on P1		6(Rx), 7(Tx) on P1	32(Tx), 49(Rx) on P1	External Communications/ Firmware programming
COM3	NA	2(Rx), 3(Tx) on P2	NA	46(Rx), 29(Tx) on P2	Payload 2
COM4	NA	6(Rx), 7(Tx) on P2	NA	NA	Iridium Communications
COM5	NA	4(Rx), 5(Tx) on P2	NA	27(Tx), 44(Rx) on COM5	Iridium Control

3.4 PWM Outputs

The primary interface connector offers the option to directly drive up to 10 (6 on LT) standard RC servos providing PWM outputs for each.

3.5 Controller Area Network Interface

A Controller Area Network (CAN) serial interface is also provided for bussed or multi-drop applications. The CAN bus is a robust two wire differential serial bus designed for use in high EMI environments. It has seen wide use in automotive and industrial control applications and should prove to be well suited for UAV applications. The CAN bus is primarily used to provide the link between the Piccolo avionics and the Piccolo hardware in the loop simulator¹. Follow up products will include a number of payload modules that will connect using this interface. CCT envisions a 5-wire interface **CANH**, **CANL**, **V1**, **V2**, **GND** plus an overall shield. Nominally **V1** and **V2** would be 5V and 12V respectively for CAN connected modules.

Piccolo II provides access to a second CAN bus on its additional interface connector for custom applications.

3.6 No-Connects

If you have a Piccolo or Piccolo Plus prior to serial number 555, you must access to two no-connects (NC1 and NC2), which if needed can be used for custom applications. Call CCT for further details.

If you have a Piccolo Plus or Piccolo II serial number 555 or above, these pins are configured as secondary servo power inputs (**SERVO_Vin_2** and **GND**). This was added to provide for operating with larger servo loads (current loads above 2-amps). See section 3.1.2 for more information.

¹ Hardware in loop simulation is arguably one of the most important features of any UAV development system.

4 Signal Descriptions

4.1 Piccolo, Piccolo Plus, and Piccolo II

Piccolo, Piccolo Plus, and Piccolo II use a 44 pin connector. Pin locations are shown in **Figure 7**.

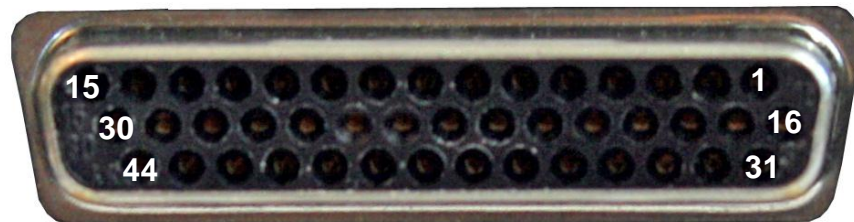


Figure 7 - Pin Locations 44-Pin Connector

Table 2 P1 - External Interface Connector Pin Assignments

Note: PCC Payload External I/O Index and Servo Index are not the same.

PIN	I/O Index	NAME	Type	LEVEL	FUNCTION
15		GND		*	Gnd for servo 0
30		SERVO_VOUT	O	!	Power for servo 0
44	7	SERVO_0_PWM	O	5V	PWMSM[0] Servo 0 signal output - Left Aileron
14		GND		*	Gnd for servo 1
29		SERVO_VOUT	O	!	Power for servo 1
43	8	SERVO_1_PWM	O	5V	PWMSM[1] Servo 1 signal output - Left Elevator
13		GND		*	Gnd for servo 2
28		SERVO_VOUT	O	!	Power for servo 2
42	9	SERVO_2_PWM	O	5V	PWMSM[2] Servo 2 signal output - Left Throttle
12		GND			Gnd for servo 3
27		SERVO_VOUT	O	!	Power for servo 3
41	10	SERVO_3_PWM	O	5V	PWMSM[3] Servo 3 signal output - Left Rudder
11		GND		*	Gnd for servo 4
26		SERVO_VOUT	O	!	Power for servo 4
40	11	SERVO_4_PWM	O	5V	PWMSM[16] Servo 4 signal output - Left Flap
10		GND		*	Ground for servo 5
25		SERVO_VOUT	O	!	Power for servo 5
39	0	SERVO_5_PWM	I/O	5V	TPU_A[0] Servo 5 signal output - Right Aileron
9		GND		*	Ground for servo 6
24		SERVO_VOUT	O	!	Power for servo 6
38	1	SERVO_6_PWM	I/O	5V	TPU_A[1] Servo 6 signal output - Right Elevator
37	2	SERVO_7_PWM	I/O	5V	TPU_A[2] Servo 7 signal output - Right Throttle
36	3	SERVO_8_PWM	I/O	5V	TPU_A[3] Servo 8 signal output - Right Rudder
35	4	SERVO_9_PWM	I/O	5V	TPU_A[4] Servo 9 signal output - Right Flap
23		SERVO_VIN_1	I		Servo power input 4.8-6V nominal
8		GND		*	Servo power ground
16		SERVO_VIN_2 / NC1	I		Before serial number 555, this is a no-connect
17		GND / NC2			Before serial number 555, this is a no connect
6		DEADMAN'S OUTPUT	O		Switched SERVO_VOUT - controlled by deadman circuit

7		CAN_GND		*	CAN Ground
22		CAN_HI_A	I/O	CAN	CAN A Serial High
21		CAN_LO_A	I/O	CAN	CAN A Serial Low
5	5	SERVO_10_PWM / Left RPM	I/O	5V	TPU_B[2] User Configurable I/O, Defaults as Left RPM input
20	6	SERVO_11_PWM / Right RPM	I/O	5V	TPU_B[3] User Configurable I/O, Defaults as Right RPM input
34		TXD_RS232	0	232	COM1 TX - Payload 1 - TPU_B[0]
33		RXD_RS232	I	232	COM1 RX - Payload 1 - TPU_B[1]
4		GND		*	
19		*PROGRAM/USER	I	5V	Program/User Mode Control Input - MPIO32B5
18		*HRESET	I	3.3V	Hardware Reset - active low
3		GND		*	Ground
32		SCI_2_TX_232	O	RS232	COM2 TX - ExtCom/Program Port
31		SCI_2_RX_232	I	RS232	COM2 RX - ExtCom/Program Port
1		VIN	I		Main DC Input - 8-20 Vin
2		GND		*	Ground

! SERVO Vouts are tied together on the Piccolo board.

* GND are tied together on the Piccolo board.

- **I/O Index:** Is the payload index that the Piccolo user interfaces and communications specifications use to refer to a given signal. In the Piccolo, Piccolo Plus, and Piccolo II this index is different from the servo number.
- **SERVO_(0-4) PWMSM[0-3,16] (0-5 volt output):** In the default mode these are configured as PWM outputs and are used to control the actuators on left side of the airplane. They can be independently configured for GPIO if not needed for actuator control.
- **SERVO_VIN_1 (4.8-6.0 volt input):** User supplied input voltage used to power the servos.
- **SERVO_VOUT (output):** Multiple outputs are tied directly to **Servo_Vin** voltage level – typically these are used as servo power pins.
- **DEADMAN'S OUTPUT (output):** The signal output voltage is normally the same as the **SERVO_Vin_1** input DC voltage. The output voltage is switched to GND by an on-board deadman circuit as controlled by hard set timeouts and Piccolo software commands. Typically used for ON/OFF control of an ignition or flight termination system.
- **SERVO_(6-10), TPU_A[0-4] (0-5 volt input/output):** In the default mode these are configured as PWM outputs and are used to control the right side of the airplane. They can be independently configured for GPIO if not needed for actuator control.
- **TPU_B[2-3] (0-5 volt input/output):** In the default mode these are configured as RPM inputs for a left and right engine respectively. They can also be independently configured for GPIO.
- **CAN_HI_A:** CAN level I/O

- **CAN_LO_A**: CAN level I/O
- **CAN_GND**: Same as system ground (GND).
- **TXD_RS232 (RS232 output)**: Driven by TPU B CH0 on the MPC555. This is the COM1 output that defaults to payload 1 transmit.
- **RXD_RS232 (RS232 input)**: Received by TPU B CH1 on the MPC555. This is the COM1 input that defaults to payload 1 transmit.
- ***PROGRAM/USER (5 volt input)**: When held low during a reset, the MPC555 boots in monitor mode. Once in monitor mode, the application code is loaded to flash. When left floating or driven high during a reset, the MPC555 runs user application code. The pin has a 10k pull-up to 3.3 volts.
- ***HRESET (0-3.3 volt input)**: When pulled low forces the MPC555 into a hard reset. The pin has a 10k pull-up to 3.3 volts.
- **SCI_2_TX_232 (RS232 level output)**: Driven by SCI CH2 TX on the MPC555. This is the COM2 output that defaults to external communications transmit. It is also used for firmware programming.
- **SCI_2_RX_232 (RS232 level input)**: Received by SCI CH2 RX on the MPC555. This is the COM2 input that defaults to external communications receive. It is also used for firmware programming.
- **NC [1-2]**: No connect pins on Piccolo and Piccolo Plus serial numbers below 555. On Piccolo Plus and Piccolo II's serial numbers 555 and above, NC1 and NC2 are configured by default as secondary inputs for servo power, **SERVO_Vin_2** and **SERVO_GND** respectively.
- **VIN (8-20 volt input)**: DC input voltage used to power the onboard 5.5-volt and 3.3-volt switching regulators.
- **GND**: Common ground tied to the internal ground plane of the avionics and the shell of the main interface connector.

4.2 Piccolo II Secondary Connector

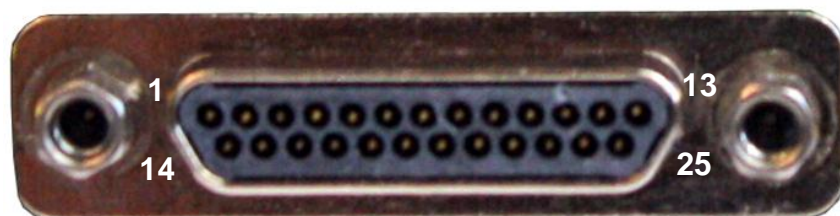


Figure 8 - Pin Locations 25-Pin Secondary Connector

Table 3 P2 - Piccolo II Micro-D Connector Pin-out

24		CAN_LO_B	I/O	CAN	Serial TX/RX
13		CAN_HI_B	I/O	CAN	Serial TX/RX
12		AIN0	I	5V	10 bit analog input
11		AIN1	I	5V	10 bit analog input
10		AIN2	I	5V	10 bit analog input
9		AIN3	I	5V	10 bit analog input
22		AGND			Analog ground
23		AGND			Analog ground
21	1 2	SERVO_12_P WM	I/O	5V	TPU_B8 / GPIO3
19	1 3	SERVO_13_P WM	I/O	5V	TPU_B9 / GPIO4
17	1 4	SERVO_14_P WM	I/O	5V	TPU_B10 / GPIO5
15	1 5	SERVO_15_P WM	I/O	5V	TPU_B11 / GPIO6
8		GND			Ground
18		GND			Ground
20		GND			Ground
7		TXD1_232	O	RS232	COM4 TX – Iridium Comm.
6		RXD1_232	I	RS232	COM4 RX – Iridium Comm.
16		GND			Ground
5		TXD2_232	O	RS232	COM5 TX – Iridium DTR
4		RXD2_232	I	RS232	COM5 RX – Iridium CD
14		GND			Ground
3		TXD3_232	I/O	RS232	COM3 TX – Payload 2 – TPU_B4
2		RXD3_232	I/O	RS232	COM3 RX – Payload 2 – TPU_B5
1		GND			Ground
25		No Connection			

- **Index:** Is the payload index that the Piccolo user interfaces and communications specifications use to refer to a given signal. In the Piccolo, Piccolo Plus, and Piccolo II this index is different from the servo number.
- **CAN_HI_B:** CAN level I/O
- **CAN_LO_B:** CAN level I/O
- **AIN[0-4] (0-5 volt inputs):** User configurable 10-bit analog inputs. Each input has a 100pF capacitor to ground and a 1k ohm series resistor. See the *Piccolo User's Guide* for more information about configuration and use.
- **AGND:** Returns for the four analog inputs.
- **TPU B[8-11] (0-5 volt I/O):** Can also be independently configured for GPIO.
- **GND:** Returns for any of the digital I/O.
- **TXD1 (RS232 output):** This is the COM4 output that defaults to Iridium transmit..

- **RXD1 (RS232 input)** : This is the COM4 input that defaults to Iridium receive.
- **TXD2 (RS232 output)** : This is the COM5 output that defaults to Data Terminal Ready (DTR) output to Iridium modem.
- **RXD2 (RS232 input)** : This is the COM5 input that defaults to Carrier Detect (CD) input from Iridium modem.
- **TXD3 (RS232 output)** : This is the COM3 output that defaults to payload 2 transmit data.
- **RXD3 (RS232 input)** : This is the COM3 input that defaults to payload 2 receive data.

4.3 Piccolo LT

Piccolo LT uses a 37 pin connector which supports fewer servo outputs. Pin locations are shown in **Figure 9**.



Figure 9 - Pin Locations 37-Pin Connector

Table 4 P1 - Piccolo LT Micro-D Connector Pin-out

PIN	I/O Index	NAME	TYPE	LEVEL	FUNCTION
19	0	SERVO_0_PWM	O	5V	TPU_A[0] Servo 0 signal output - Left Aileron
18		SERVO_Vout		!	Power for servo 0
17		GND		*	Gnd for servo 0
16	1	SERVO_1_PWM	O	5V	TPU_A[1] Servo 1 signal output - Elevator
15		SERVO_Vout		!	Power for servo 1
14		GND		*	Gnd for servo 1
13	2	SERVO_2_PWM	O	5V	TPU_A[2] Servo 2 signal output - Throttle
12		SERVO_Vout		!	Power for servo 2
11		GND		*	Gnd for servo 2
37	3	SERVO_3_PWM	O	5V	TPU_A[3] Servo 3 signal output - Rudder
36		SERVO_Vout		!	Power for servo 3
35		GND		*	Gnd for servo 3
34	4	SERVO_4_PWM	O	5V	TPU_A[4] Servo 4 signal output - Right Aileron
33		SERVO_Vout		!	Power for servo 4
32		GND		*	Gnd for servo 4
22	6	SERVO_5_PWM	O	5V	TPU_B[3] Servo 5 signal output - Flap
31		Servo GND		*	Ground for Servo VIN
30		Servo VIN	I		Servo Power input 4.8-6V DC (4 or 5-cell pack)
29		Deadman's Output	O	*	Switched Output Voltage (Deadman's Switch)
28		Deadman's GND			Ground for Deadman's
1		Piccolo VIN	I		Main DC Input - 4.8 - 20 volts

2		Piccolo GND			Main Ground
27		TXD_RS232	0	232	COM1 TX - Payload 1 - TPU_B[0]
26		RXD_RS232	I	232	COM1 RX - Payload 1 - TPU_B[1]
25		GND			Ground
24		*PROGRAM/USER	I	5V	Program/User Mode Control Input - MPIO32B5
23		*HRESET	I	5V	Hardware Reset - active low
7		SCI_2_TX_232	O	RS232	COM2 TX - ExtCom/Program Port
6		SCI_2_RX_232	I	RS232	COM2 RX - ExtCom/Program Port
5		GND			Ground
10		CAN_HI_A	I/O	CAN	CAN A Serial High - Simulation Port
9		CAN_LO_A	I/O	CAN	CAN A Serial Low - Simulation Port
8		GND			Ground
4	5	SERVO_6_PWM	I/O	5V	TPU_B[2] / User Configurable I/O, Defaults as RPM input
3		GND		*	Ground
21		GND		*	Ground
20		EXT_5V_PPS	O	5V	GPS pulse per second output

! SERVO Vouts are tied together on the Piccolo board.

* GND are tied together on the Piccolo board.

- **I/O Index:** Is the payload index that the Piccolo user interfaces and communications specifications use to refer to a given signal.
- **SERVO_(0-5), TPU_A[0-4], TPU_B3 (0-5 volt output):** In the default mode these are configured as PWM outputs and are used to control the servo actuators. They can be independently configured for GPIO if not needed for actuator control.
- **SERVO_Vin (4.8-6.0 volt input):** User supplied input voltage used to power the servos.
- **SERVO_VOUT (output):** Multiple outputs are tied directly to **Servo_Vin** voltage level – typically these are used as servo power pins.
- **Deadman's output (output):** The signal output voltage is normally the same as the **SERVO_Vin** input DC voltage. The output voltage is switched to GND by an on-board deadman circuit as controlled by hard set timeouts and Piccolo software commands. Typically used for ON/OFF control of an ignition or flight termination system.
- **SERVO_6, TPU_B[2] (0-5 volt input/output):** In the default mode this is configured as an RPM input for the left engine. It can also be independently configured for GPIO or as a servo actuator.
- **CAN_HI_A :** CAN level I/O
- **CAN_LO_A:** CAN level I/O
- **TXD_RS232 (RS232 output):** Driven by TPU B CH0 on the MPC555. This is the COM1 output that defaults to payload 1 transmit.
- **RXD_RS232 (RS232 input):** Received by TPU B CH1 on the MPC555. This is the COM1 input that defaults payload 1 transmit.

- ***PROGRAM/USER (0-3.3 volt input)**: When held low during a reset the MPC555 boots in monitor mode from which application code can be loaded to flash; when left floating or driven high during a reset the MPC555 runs user application code. The pin has a 10k pull-up to 3.3 volts.
- ***HRESET (0-3.3 volt input)**: When pulled low forces the MPC555 into a hard reset. The pin has a 10k pull-up to 3.3 volts.
- **SCI_2_TX_232 (RS232 level output)**: Driven by SCI CH2 TX on the MPC555. This is the COM2 output, which defaults to external communications transmit, and is also used for firmware programming.
- **SCI_2_RX_232 (RS232 level input)**: Received by SCI CH2 RX on the MPC555. This is the COM2 input, which defaults to external communications receive, and is also used for firmware programming.
- **VIN (4.8-20 volt input)**: DC input voltage used to power the onboard 6.0-volt and 3.3-volt switching regulators.
- **GND**: Common ground tied to the internal ground plane of the avionics and the shell of the main interface connector.
- **EXT_5V_PPS**: This is the pulse per second signal coming directly from the uBlox GPS.

4.4 Piccolo SL

Piccolo SL uses a 51 pin connector. Pin locations are shown in **Figure 10**.



Figure 10 - Pin Location 51-Pin

Table 5 P1 - Piccolo SL Micro-D Connector Pin-out

PIN	I/O Index	NAME	TYPE	LEVEL	FUNCTION
21	0	SERVO_0_PWM	I/O	5V	TPU_A[0] Servo 0 signal output - Left Aileron
38		SERVO_VOUT		!	Power for servo 0
3		GND		*	Gnd for servo 0
22	1	SERVO_1_PWM	I/O	5V	TPU_A[1] Servo 1 signal output - Elevator
39		SERVO_VOUT		!	Power for servo 1
4		GND		*	Gnd for servo 1
23	2	SERVO_2_PWM	I/O	5V	TPU_A[2] Servo 2 signal output - Throttle
40		SERVO_VOUT		!	Power for servo 2
5		GND		*	Gnd for servo 2
24	3	SERVO_3_PWM	I/O	5V	TPU_A[3] Servo 3 signal output - Rudder
41		SERVO_VOUT		!	Power for servo 3

6		GND		*	Gnd for servo 3
25	4	SERVO_4_PWM	I/O	5V	TPU_A[4] Servo 4 signal output - Right Aileron
42		SERVO_VOUT		!	Power for servo 4
7		GND		*	Gnd for servo 4
26	9	SERVO_9_PWM	I/O	5V	TPU_A[5]servo 9 signal output – Nosegear
43		SERVO_VOUT		!	Power for servo 9
8		GND		*	Gnd for spare servo 9
27	7	SERVO_7_PWM	I/O	5V	TPU_B[14] Spare Servo 7/User configurable GPIO/ COM5 TX-TTL Level
44	8	SERVO_8_PWM	I/O	5V	TPU_B[15] Spare Servo 8/User configurable GPIO / COM5 RX - TTL Level
9		GND			Ground
45	12	SERVO_12_PWM	I/O	0-5V	BAN50/MDA28 Spare Servo 12 or Analog Input
28	15	GPIO_0	I/O	0-5V	BAN51/MPI06 Spare GPIO or Analog Input
10		GND		*	Ground
20		VIN	I		Main DC Input - 4.8 - 30 volts
19		VIN GND		*	Ground for Piccolo Vin
36		Servo VIN	I		Servo Power input 4.8-6V DC (4 or 5-cell pack)
37		Servo VIN	I		Servo Power input 4.8-6V DC (4 or 5-cell pack)
1		Servo VIN GND		*	Ground for Servo VIN
2		Servo VIN GND		*	Ground for Servo VIN
18		DEADMAN'S OUTPUT	O		Switched Output Voltage (Deadman's Switch)
35		EXT_5V_PPS	O	5V	Pulse per second output (5V TTL) From GPS
17		GND		*	Ground for Deadman
33		TXD1_RS232	O	RS232	COM1 TX – Payload 1 – TPU_B[0]
50		RXD1_RS232	I	RS232	COM1 RX – Payload 1 – TPU_B[1]
15		GND		*	Ground
30	5	SERVO_6_PWM	I/O	5V	TPU_B[2] / User Configurable I/O, Defaults as RPM input
47	6	SERVO_5_PWM	I/O	5V	TPU_B[3]/ Spare Servo 5/User configurable I/O
12		GND		*	Ground
51		CAN_HI_A	I/O	CAN	CAN A Serial High – CAN Bus
34		CAN_L0_A	I/O	CAN	CAN A Serial Low - CAN Bus
16	10	SERVO_10_PWM	I/O	0-5V	BAN48/PWMSM18 Spare Servo 10 or Analog Input
48		PROGRAM#_USER	I	5V	Program/User Mode Control Input
31		HRESET#	I	5V	Reset to Piccolo SL (active low)
13	11	SERVO_11_PWM	I/O	0-5V	BAN49/PWMSM19 Spare Servo 11 or Analog Input
32		SCI_2_TXD_232	O	RS232	COM2 Serial TX - Program/User
49		SCI_2_RXD2_232	I	RS232	COM2 Serial RX - Program/User
14		GND		*	Ground
29		TXD3_RS232/Spare2	O	RS232	COM3 - Serial TX from Piccolo SL (Spare)
46		RXD3_RS232/Spare1	I	RS232	COM3 - Serial RX to Piccolo SL (Spare)
11		GND		*	Ground

! SERVO_VOUT signals are tied together on the Piccolo SL board.

* GND are tied together on the Piccolo SL board.

- **I/O Index:** Is the payload index that the Piccolo user interfaces and communications specifications use to refer to a given signal.
- **SERVO_(0-5, 7-9)_PWM, TPU_A[0-5], TPU_B3, TPU_B[14-15] (0-5 volt input/output):** In the default mode these are configured as PWM outputs and are used to control the servo actuators. They can be independently configured for GPIO if not needed for actuator control.
- **SERVO_VIN (4.8-6.0 volt input):** User supplied input voltage used to power the servos. **SERVO_VIN** current and voltage is monitored on the Piccolo SL PCB.
- **SERVO_VOUT (output):** Multiple outputs are tied directly to **Servo_VIN** voltage level – typically these are used as servo power pins.
- **DEADMAN'S OUTPUT (output):** The signal output voltage is normally the same as the **SERVO_VIN** input DC voltage. The output voltage is switched to GND by an on-board deadman circuit as controlled by hard set timeouts and Piccolo software commands. Typically used for ON/OFF control of an ignition or flight termination system.
- **SERVO_6_PWM, TPU_B2 (0-5 volt input/output):** In the default mode this is configured as the left engine RPM input. It can also be independently configured for GPIO or as a servo actuator.
- **SERVO_(10-11)_PWM, PWMSM[18-19], BAN[48-49] (0-5 volt input / output):** In the default mode these are configured as analog inputs. However they can be used for GPIO or actuator control if not being used for analog input.
- **SERVO_12_PWM, DASM28, BAN50 (0-5 volt input/output):** In the default mode this is configured as an analog input. However it can be used for GPIO or actuator control if not being used for analog input.
- **GPIO_0, MPIO6/BAN51 (0-5 volt input/output):** In the default mode this is configured as an analog input. However it may be used for GPIO if not being used for analog input.
- **CAN_HI_A :** CAN level I/O
- **CAN_LO_A:** CAN level I/O
- **TXD1_RS232 (RS232 level output):** Driven by TPU B CH0 on the MPC555. This is the COM1 output that defaults to payload 1 transmit.
- **RXD1_RS232 (RS232 level input):** Received by TPU B CH1 on the MPC555. This is the COM1 input that defaults to payload 1 receive.
- **SCI_2_TXD2_RS232 (RS232 level output):** Driven by SCI CH2 TX on the MPC555. This is the COM2 output, which defaults to external communications transmit, and is also used for firmware programming.

- **SCI_2_RXD2_RS232 (RS232 level input)**: Received by SCI CH2 RX on the MPC555. This is the COM2 input, which defaults to external communications receive, and is also used for firmware programming.
- **TXD3_RS232/Spare2 (RS232 level output)**: Driven by TPU B CH4 on the MPC555. This is a spare transmit channel.
- **RXD3_RS232/Spare1 (RS232 level input)**: Received by TPU B CH5 on the MPC555. This is a spare receive channel.
- **PROGRAM#_USER (0-3.3 volt input)**: When held low during a reset the MPC555 boots in monitor mode from which application code can be loaded to flash; when left floating or driven high during a reset the MPC555 runs user application code. The pin has a 10k pull-up to 3.3 volts.
- **HRESET# (0-3.3 volt input)**: When pulled low forces the MPC555 into a hard reset. The pin has a 10k pull-up to 3.3 volts.
- **EXT_5V_PPS**: This is the pulse per second signal, level-shifted from the 3.3V PPS output of the uBlox GPS.
- **VIN (4.8-30 volt input)**: DC input voltage used to power the onboard 3.3-volt switching regulators.
- **GND**: Common ground tied to the internal ground plane of the avionics and the shell of the main interface connector.