

# **TRD Gas System Slow** **Control at MIT- Cambridge**

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# Overview

- Help Design and Build Control Systems for TRD Gas System Prototype and Flight Systems.
  1. Prototype System
    - o Tested Mixing Program for Prototype Box S using USCM V02.
  2. “Commercial Version”
    - o Test Software and Electronic Prototypes (Roma) for Whole Gas System using USCM V03
  3. Flight System

# TRD Gas System Overview

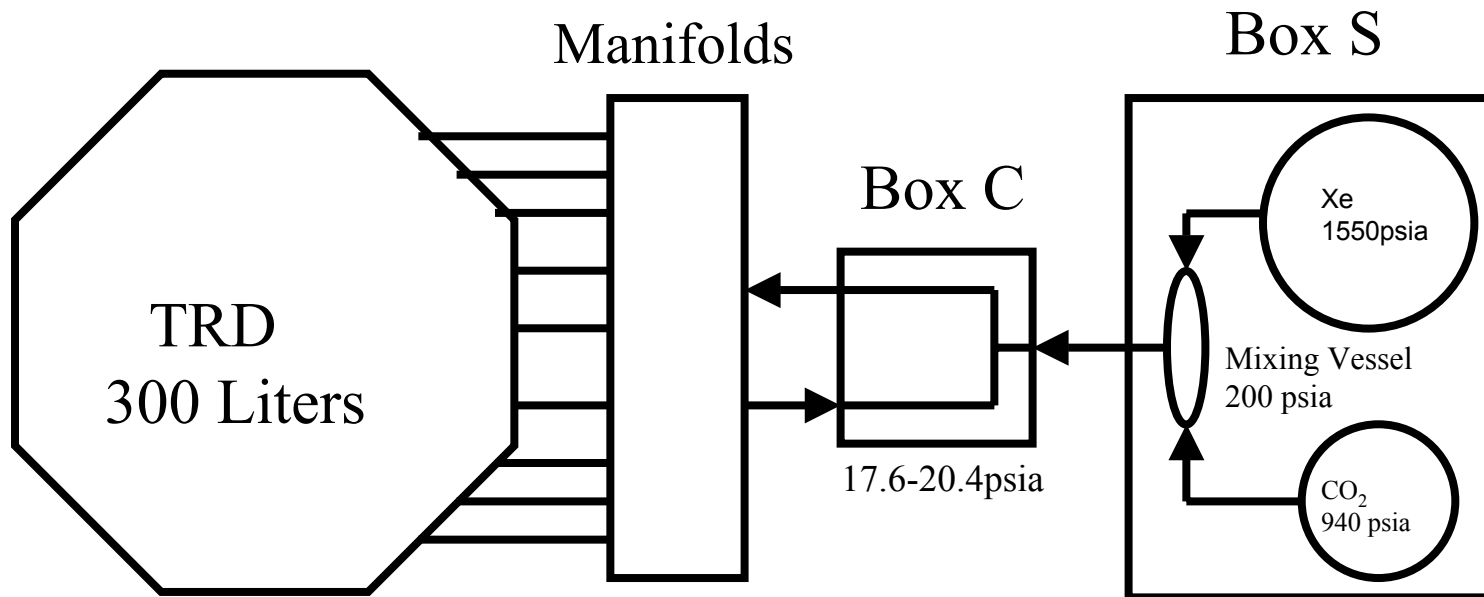
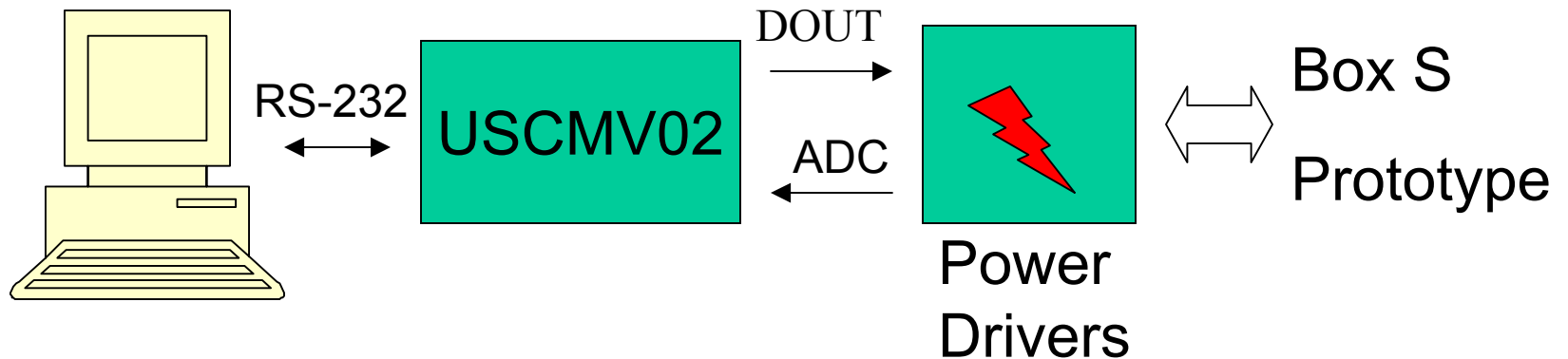


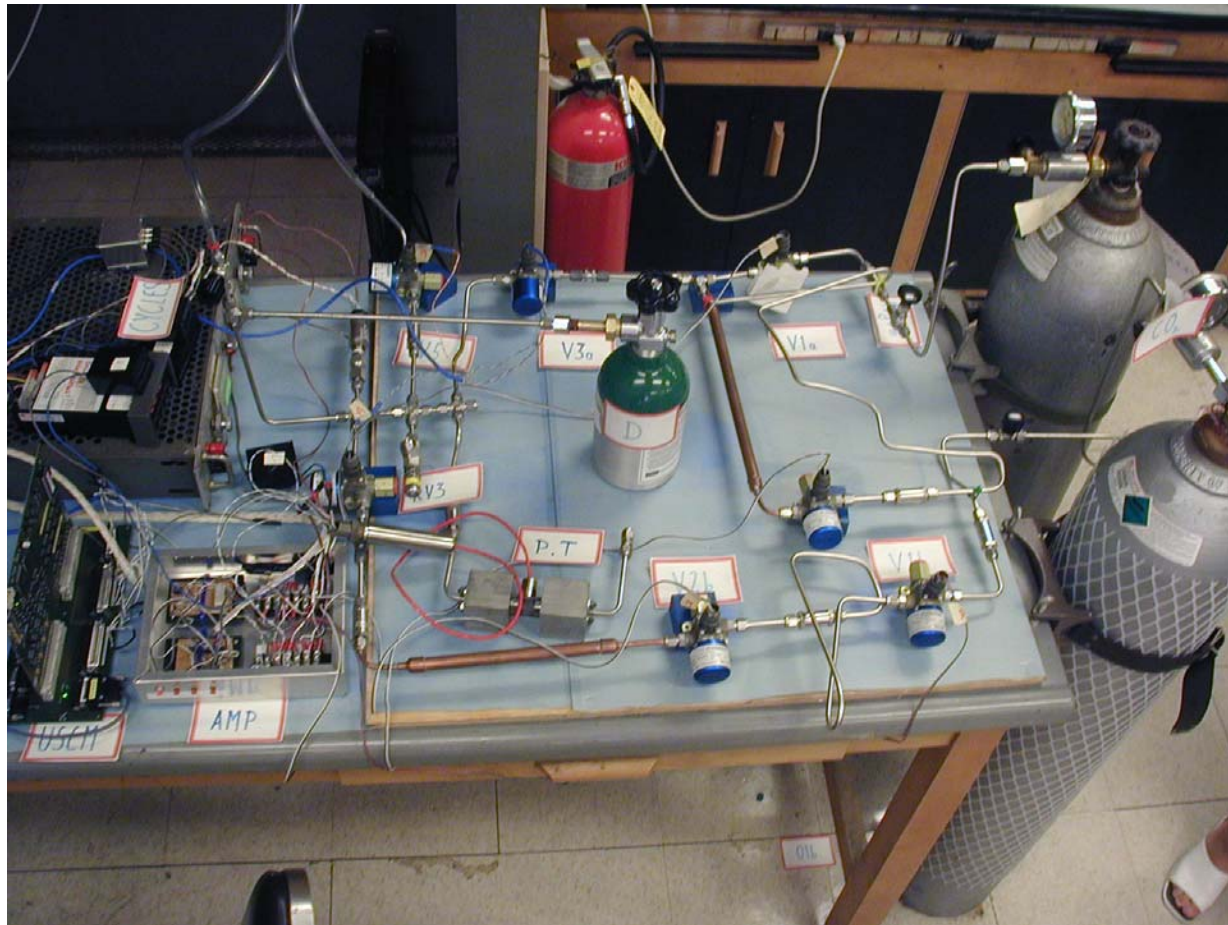
Figure 1: Schematic Arrangement of the TRD gas system. All pressure are given at 25 °C.

# Prototype System (1)



- 500 Mixing Cycles.
- 0.5% Accuracy
- Currently Used in Closed System Test

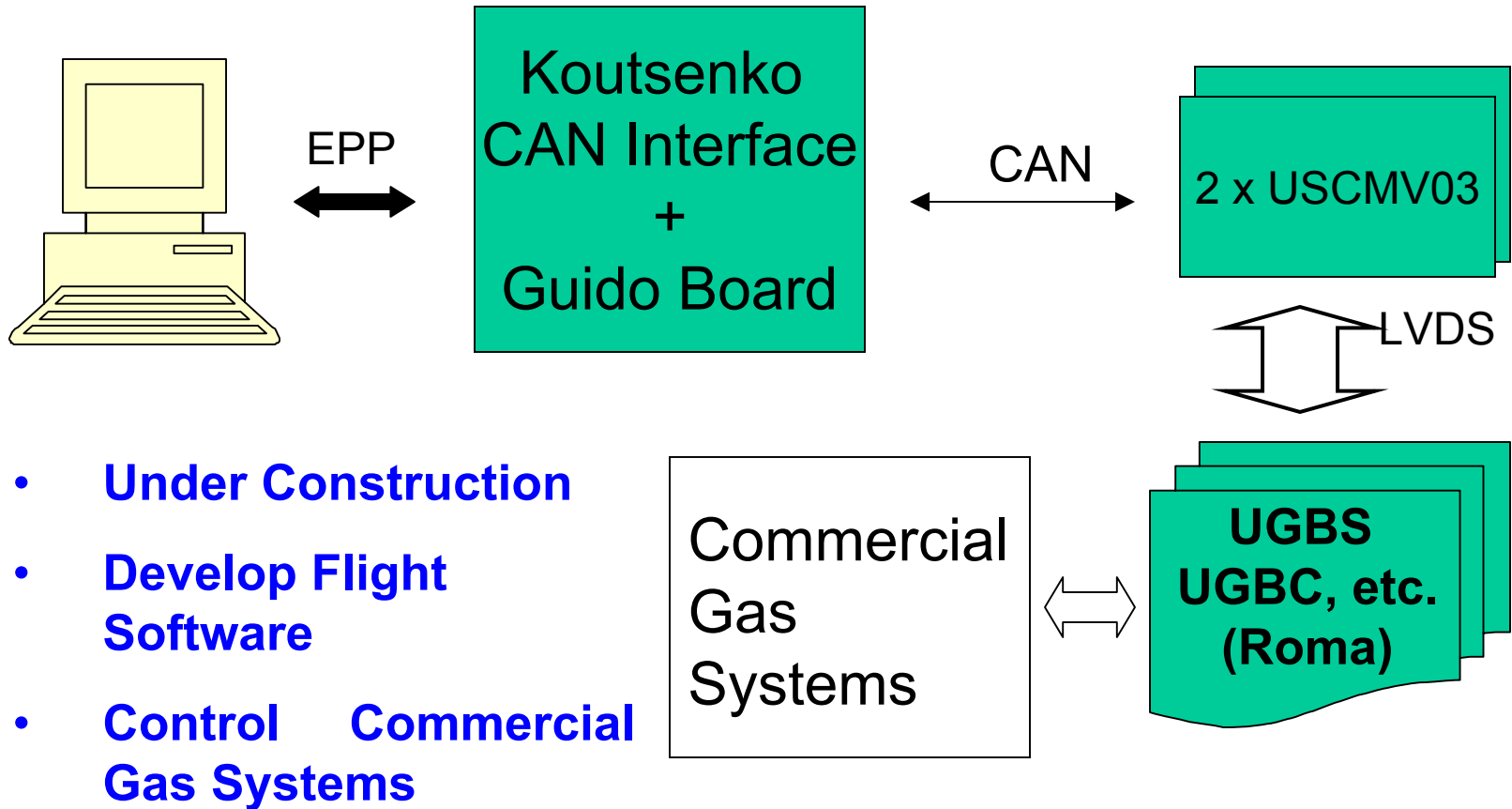
# Prototype System (2)



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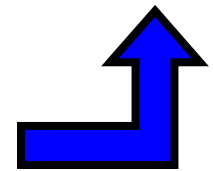
# Electronics for Commercial System



# Box S Electronic Simulator



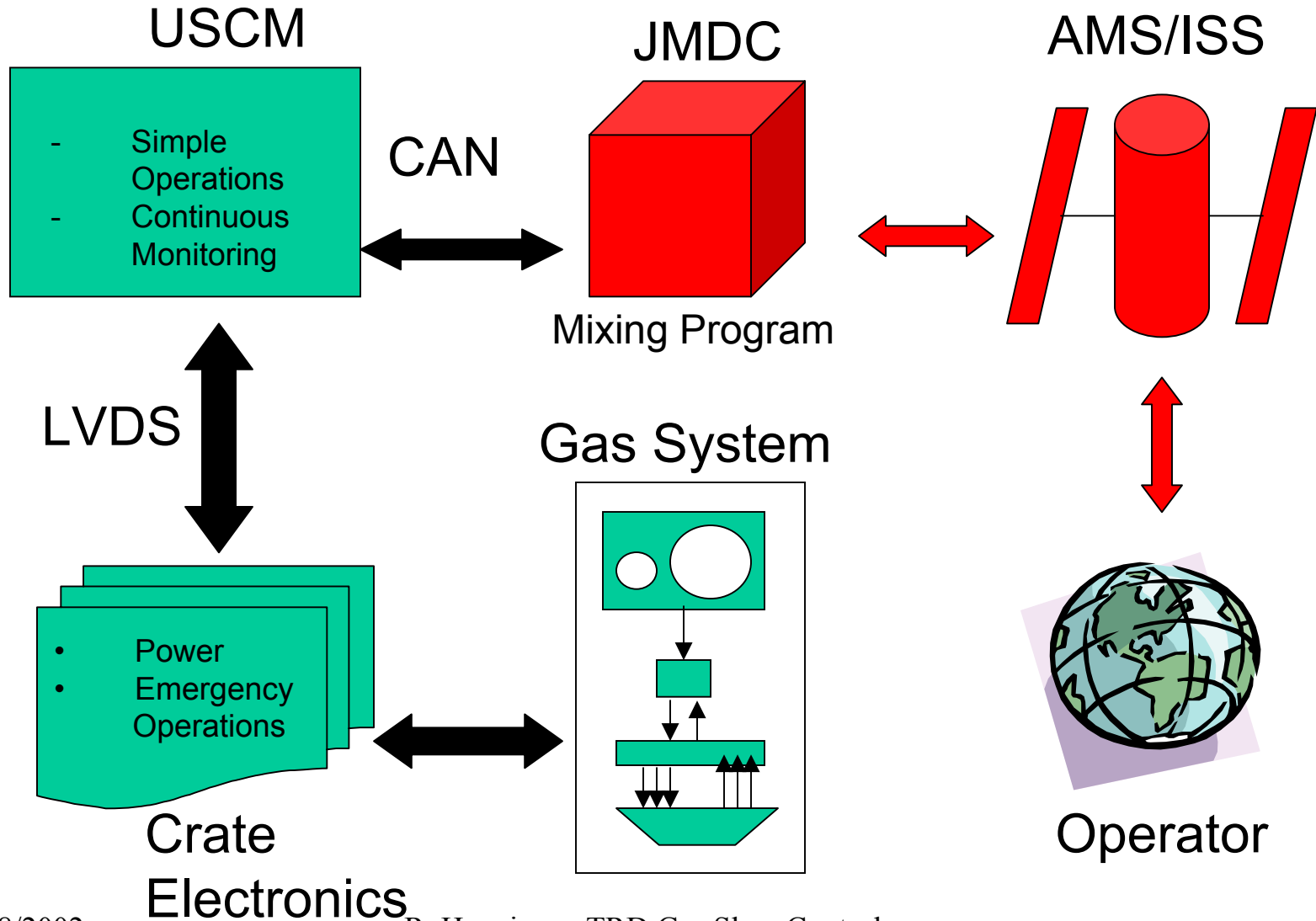
Roma



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# Flight System



# Mixing Operation

- **Mixing Program On Ground and JMDC**
- **Following Sequence:**
  1. **Start with Known Mixture in D Vessel. Vent D if mixture unknown.**
  2. **Fill required partial pressure of CO<sub>2</sub>**
  3. **Fill required partial pressure of Xe.**
  4. **Vent to Box C when required.**
- **Minimize ground communication**
- **Gas Transfer Controlled by Time Valve is Open.**
- **Timing of Valve operations performed by UGBS, not USCM!**

# We Appreciate the Help of:

- Volker Commichau
- Klaus Hangarter
- Clemens Camps
- Alexei Lebedev
- Vladimir Koutsenko

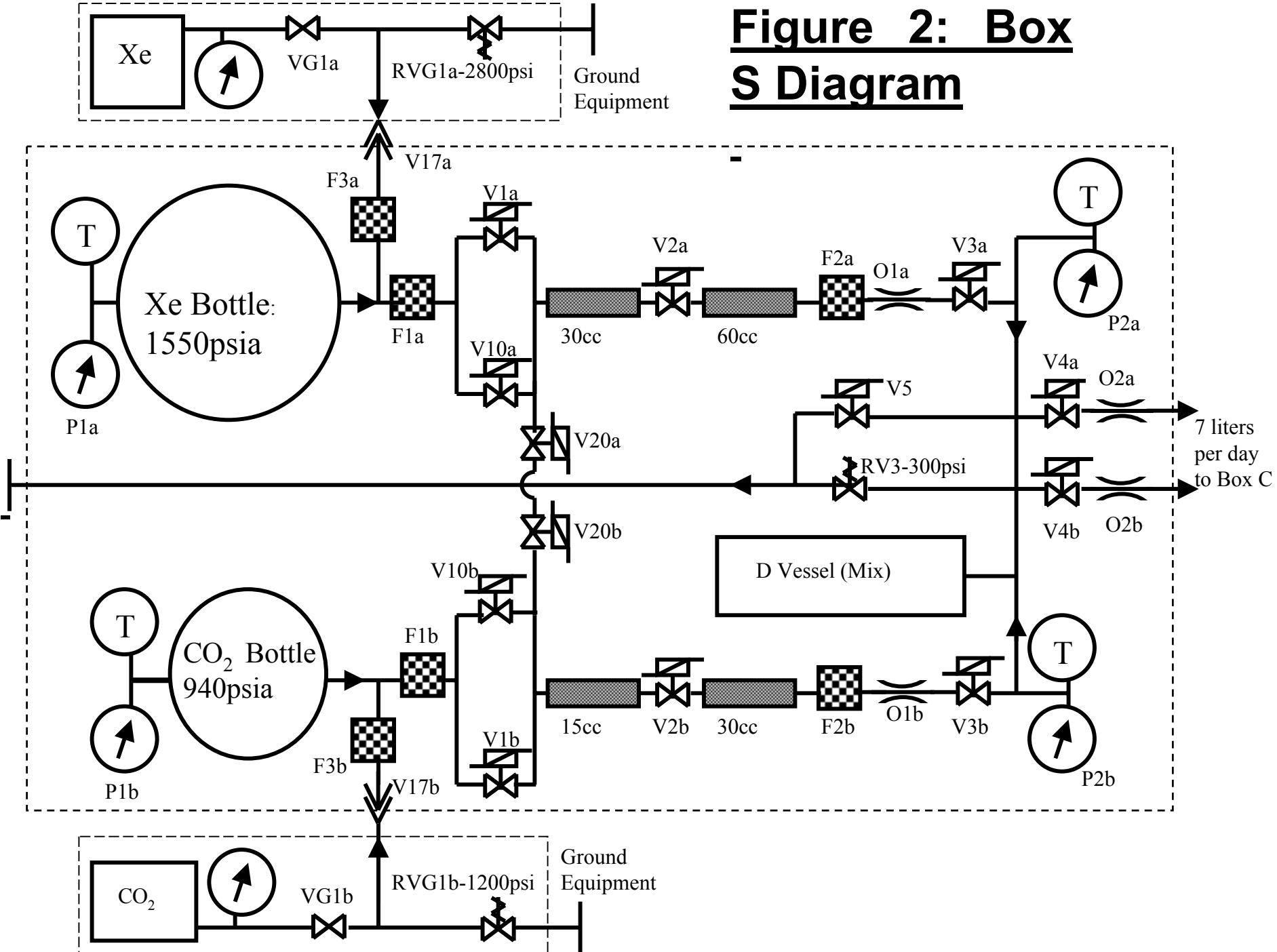
# Box S Signals and Power

# of Conductors	Purpose	Component	Voltage	Current	Description
<b>Box S Power</b>					
52 = 2 x 2 x 13	Valve Power	MV100 & MV197	24V	1.0A	Hold Valve Open When Current is On
16 = 2 x 2 x 4	Pressure Sensor Power	GP:50	24V	100mA	
<b>Box S Signals.</b>					
<b>Signals From Box S</b>					
39 = 3 x 13	Valve Status	MV100 *	5V?	n/a	Valve Mechanical Status (open / closed)
12 = 3 x 4	Pressure Sensor Readout	GP:50	0--5V	n/a	Pressure and Temperature Analog Value
	Dallas Sensor (TBD)				Read by USCM

# Box S Emergency Response

<b>State</b>	<b>Problem</b>	<b>Action</b>
P1A > 2000psi	Xe Vessel Overpressure (non-critical)	Stage 1 Safety Action
P1A > 2400psi	Xe Vessel Overpressure (critical)	Stage 2 Safety Action
P1B > 2000psi	CO2 Vessel Overpressure (non - critical)	Stage 1 Safety Action
P1B > 2400psi	CO2 Vessel Overpressure (critical)	Stage 2 Safety Action
P2A > 250 psi	D Vessel Overpressure (non-critical)	Stage 1 Safety Action
P2B > 250psi	D Vessel Overpressure (non-critical)	Stage 1 Safety Action
P2A > 280 psi OR P2B > 280psi	D-Vessel Overpressure (critical)	Vent D Vessel. Stage 2 Safety Action
T>Tmax OR T<Tmin	Temperature Outside Limits	Stage 1 Safety Action. Turn on Heater if Cold
<b>Contingency has to provided to remove P-Sensor input from decision process if it fails.</b>		

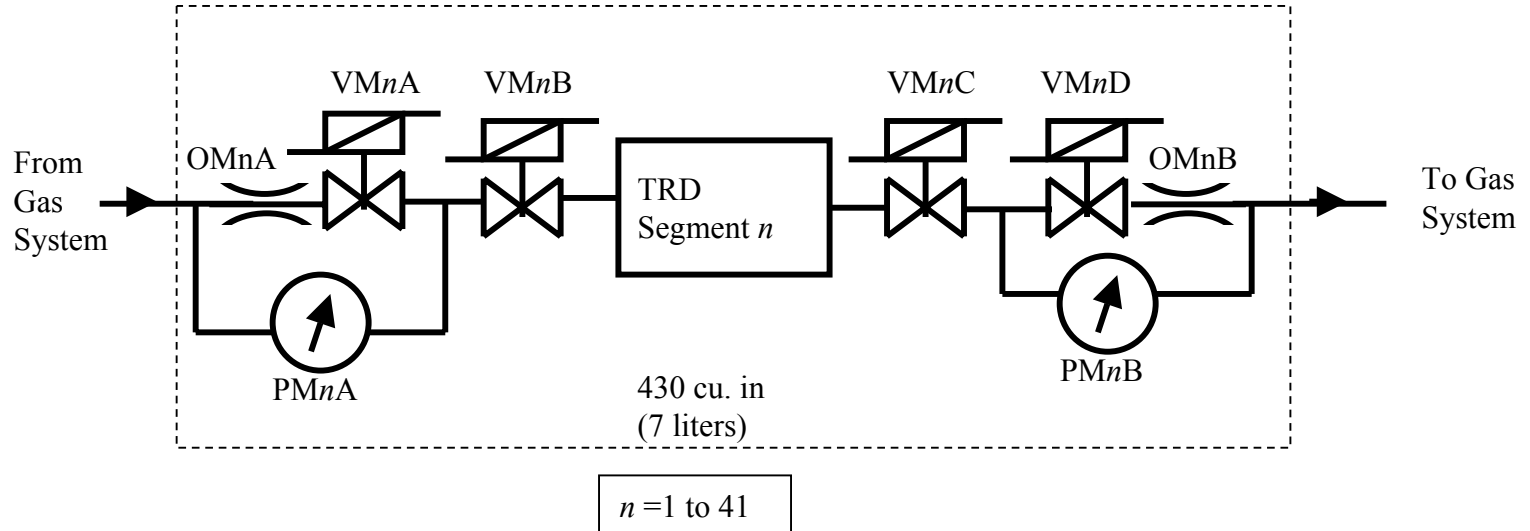
**Figure 2: Box S Diagram**



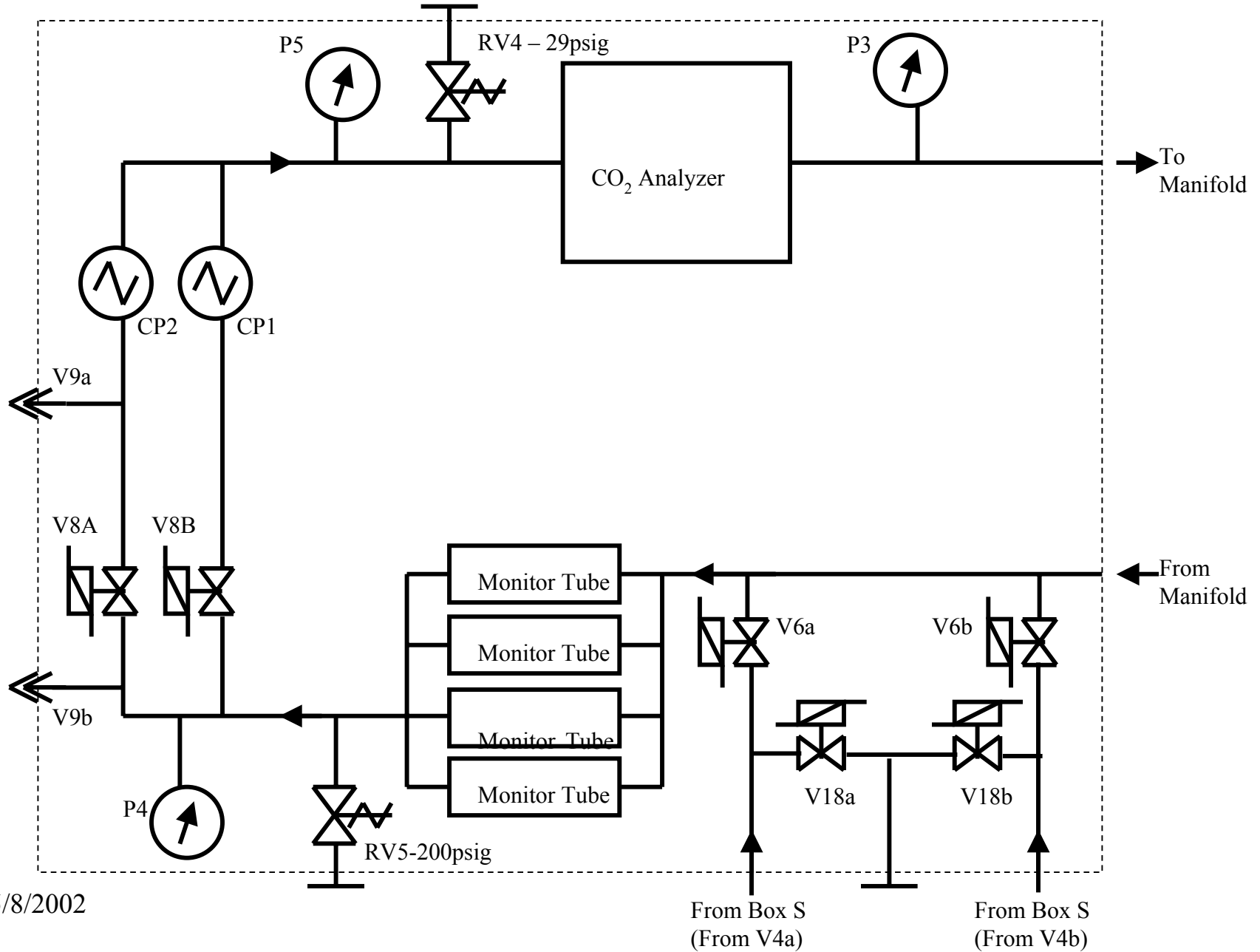
# Box S Pinout

JS1A & JS1B (37 pin)		JS2 (21pin)		JS3 (31pin)	
Pin #	Connection	Pin #	Connection	Pin #	Connection
1	V1A +E	1	V1A O	1	V10B O
2	V10A +E	2	V1A C	2	V10B C
3	V3A +E	3	V20A SCOM	3	V2B SCOM
4	V20B +E	4	V10A O	4	V3B O
5	V3B +E	5	V10A C	5	V3B C
6	V4A +E	6	V2A SCOM	6	V4A SCOM
7	V5 +E	7	V3A O	7	V5 O
8	V1A -E	8	V3A C	8	V5 C
9	V10A -E	9	V1B SCOM	9	V4B SCOM
10	V3A -E	10	V20B O	10	unconnected
11	V20B -E	11	V20B C	11	P1A SR
12	V3B -E	12	V1A SCOM	12	P1B P
13	V4A -E	13	V20A O	13	P1B T
14	V5 -E	14	V20A C	14	P2A SR
15	P1A -E	15	V10A SCOM	15	P2B P
16	P1B -E	16	V2A O	16	P2B T
17	unconnected	17	V2A C	17	V10B SCOM
18	P1A +E	18	V3A SCOM	18	V2B O
19	P1B +E	19	V1B O	19	V2B C
20	V20A +E	20	V1B C	20	V3B SCOM
21	V2A +E	21	V20B SCOM	21	V4A O
22	V1B +E			22	V4A C
23	V10B +E			23	V5 SCOM
24	V2B +E			24	V4B O
25	V4B +E			25	V4B C
26	unconnected		+E : + Excitation Voltage	26	P1A P
27	V20A -E		-E : - Excitation Voltage	27	P1A T
28	V2A -E		O : Open Status Indicator	28	P1B SR
29	V1B -E		C: Close Status Indicator	29	P2A P
30	V10B -E		SCOM : Status Common (+5V ?)	30	P2A T
31	V2B -E		SR : Signal Return	31	P2B SR
32	V4B -E		P : Pressure Readout		
33	P2A -E		T: Temperature Readout		
34	P2B -E				
35	unconnected				
36	P2A +E				
37	P2B +E				

# Manifolds



# Figure 3: Box C



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