

Clark Sat-1 PCB design

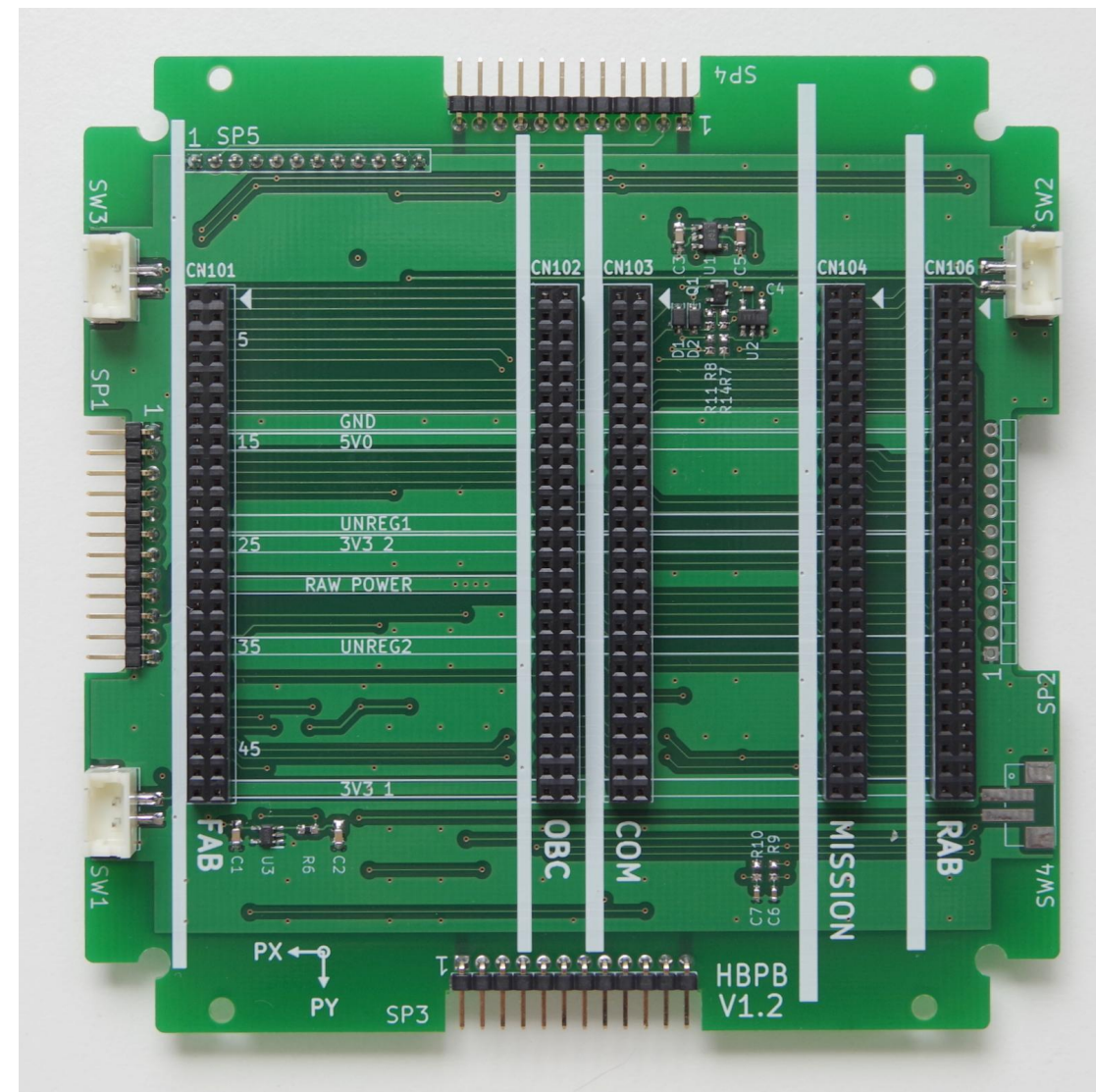
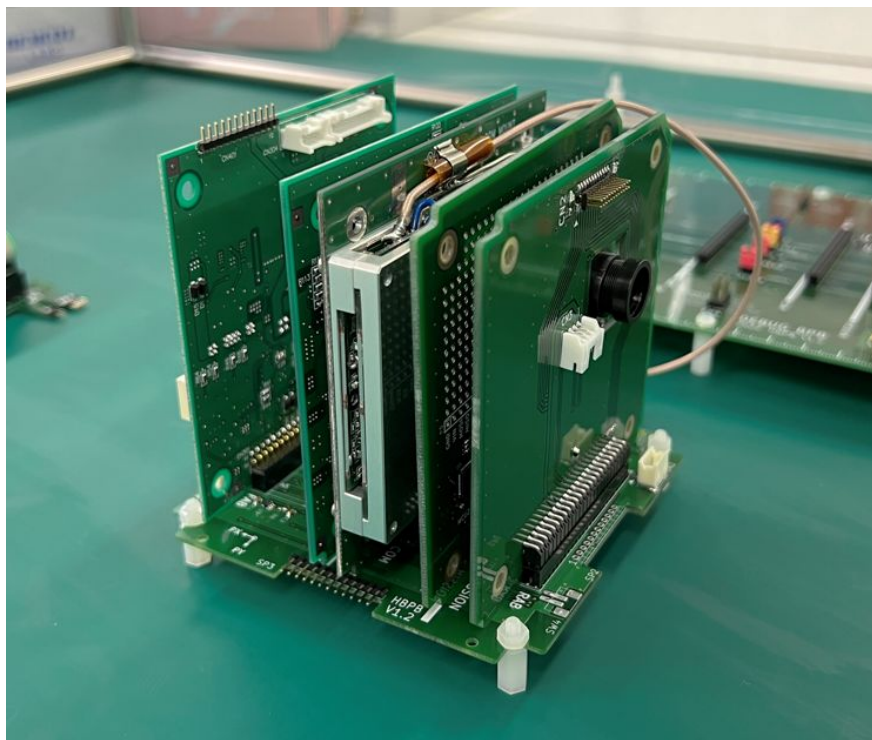
June 8 2022

PCB Board design in Clark Sat-1

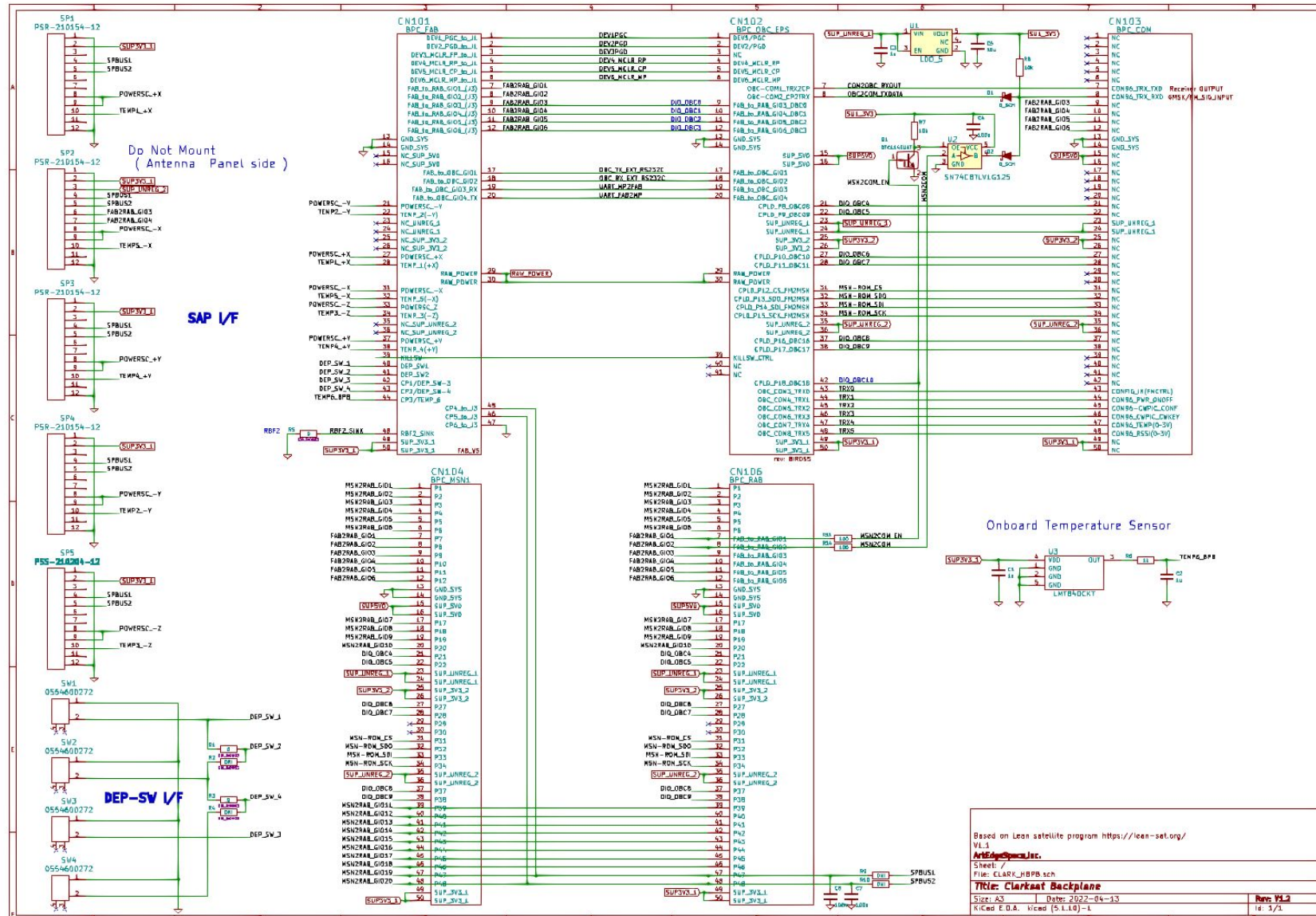
- Solar panel , Antenna panel
 - BIRDS3 based
 - Change PCB color (blue)
- Backplane Board
 - Change 50pin connector pin spacing due to larger battery case
 - Reduced Mission boards from 2 to 1
- Mission Board
 - Camera , IMU, Audio data transfer to COM board.
 - Without attitude control
- Addition of COM board Function
 - Narrow FM mode for DigiTalker, SSTV operation.
- Establishment of BIRDS satellite development system
 - Test cables, boards for Programming/debugging

Clark Sat-1 Hardware Backplane Board

- BIRDS-3&4 based
- Move OBC & COMboard connector position
- Reduce Mission connector



Clark Sat-1 Hardware Backplane Board Schematic



- Connect same pins from BUS
- Mission to RAB GIO bus (20)
 - Most connections are unused

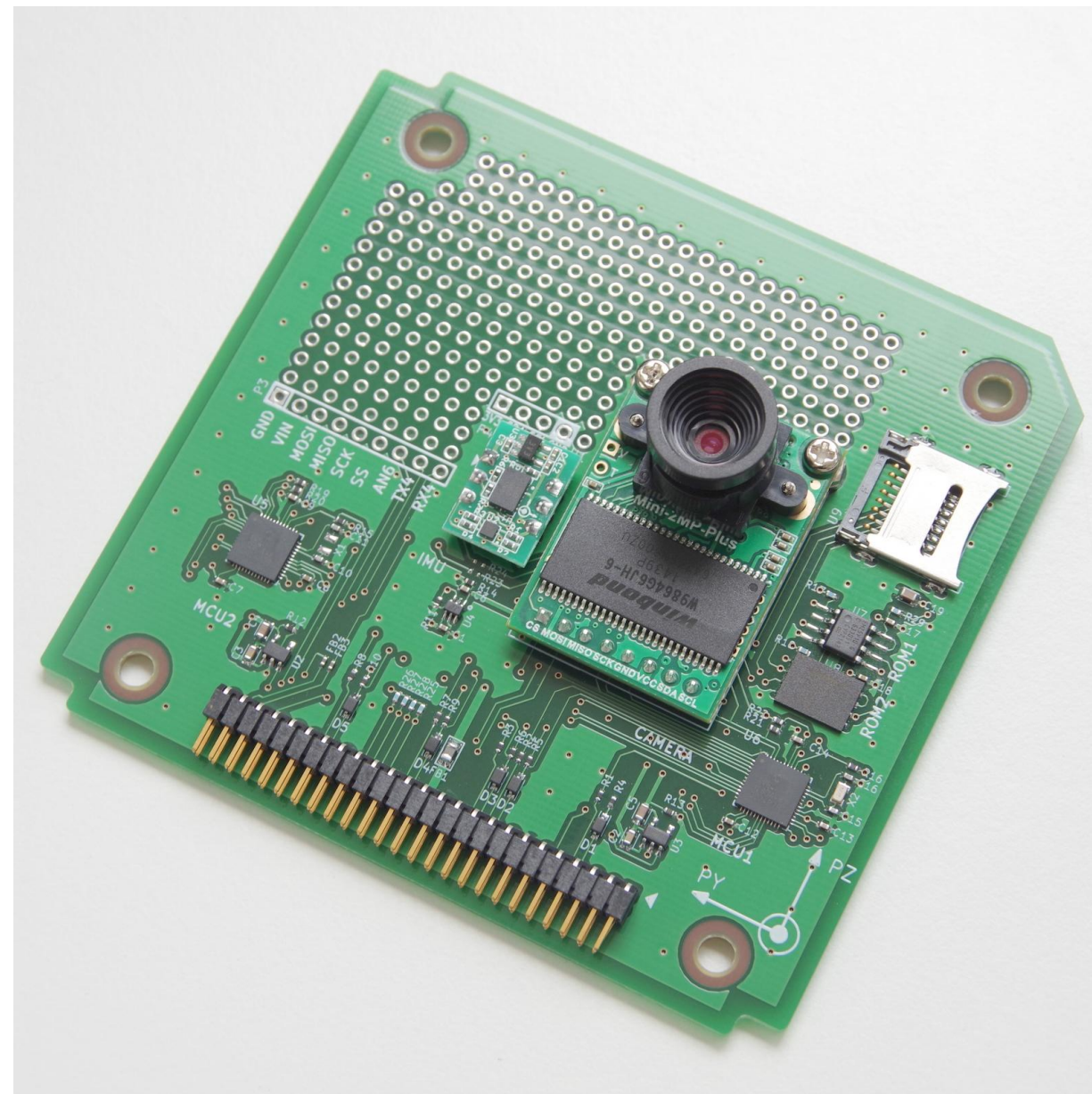
Clark Sat-1 Mission Board

MCU1 function

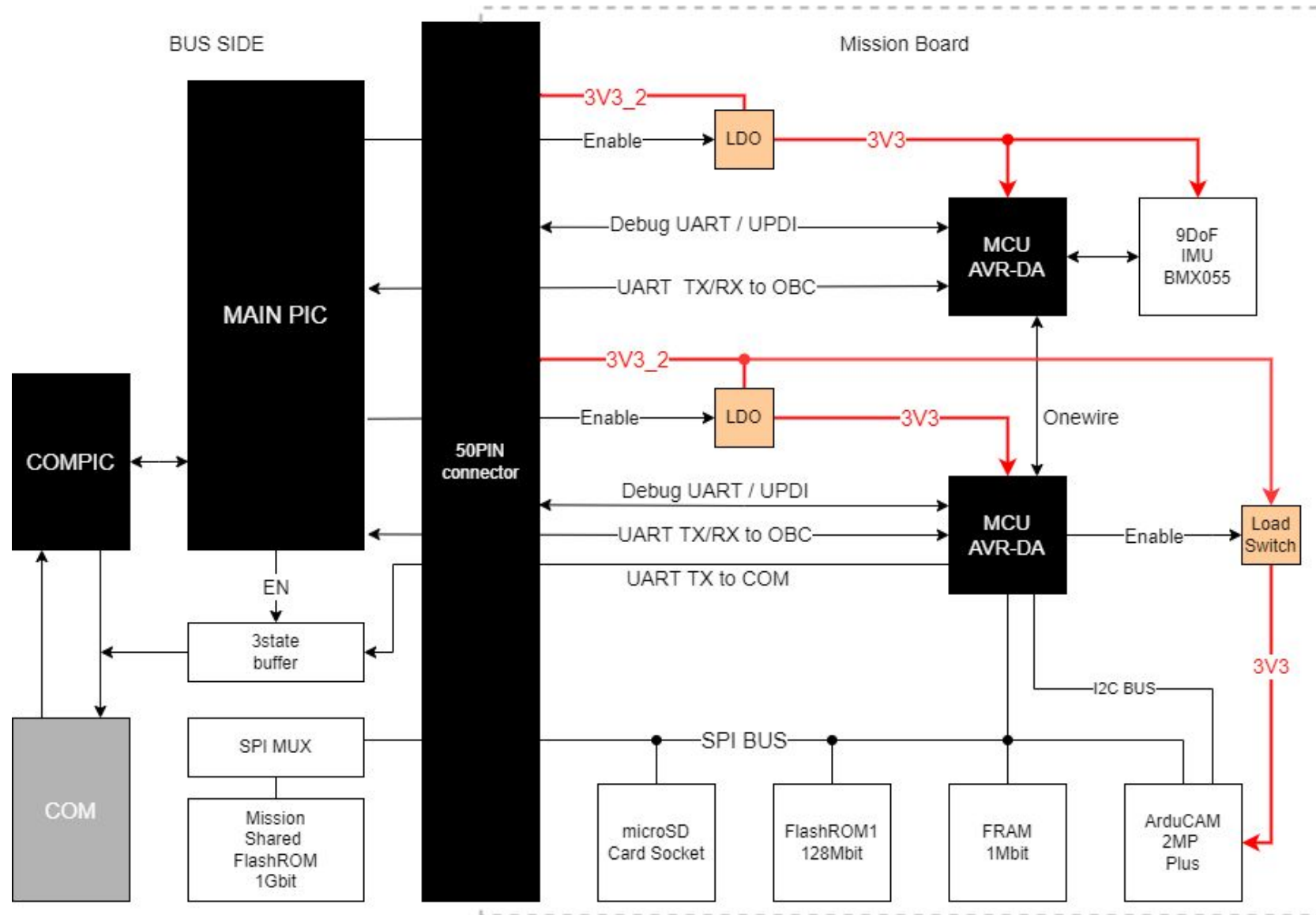
- Camera
- FM data player

MCU2 function

- 9DoF IMU
- Universal Area & IO (experimental)



Mission Board Block Diagram



FM transmit mode Operation design

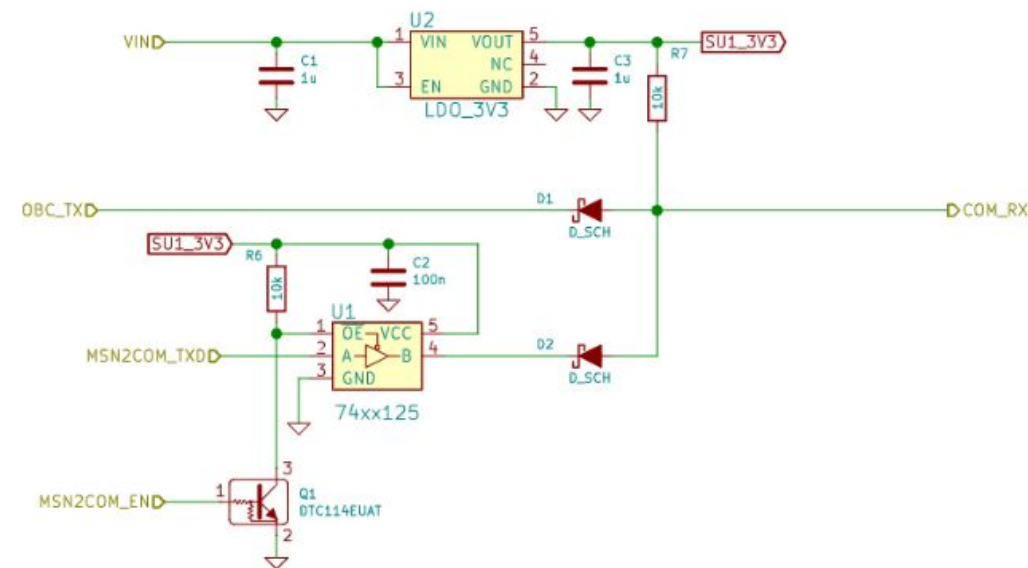
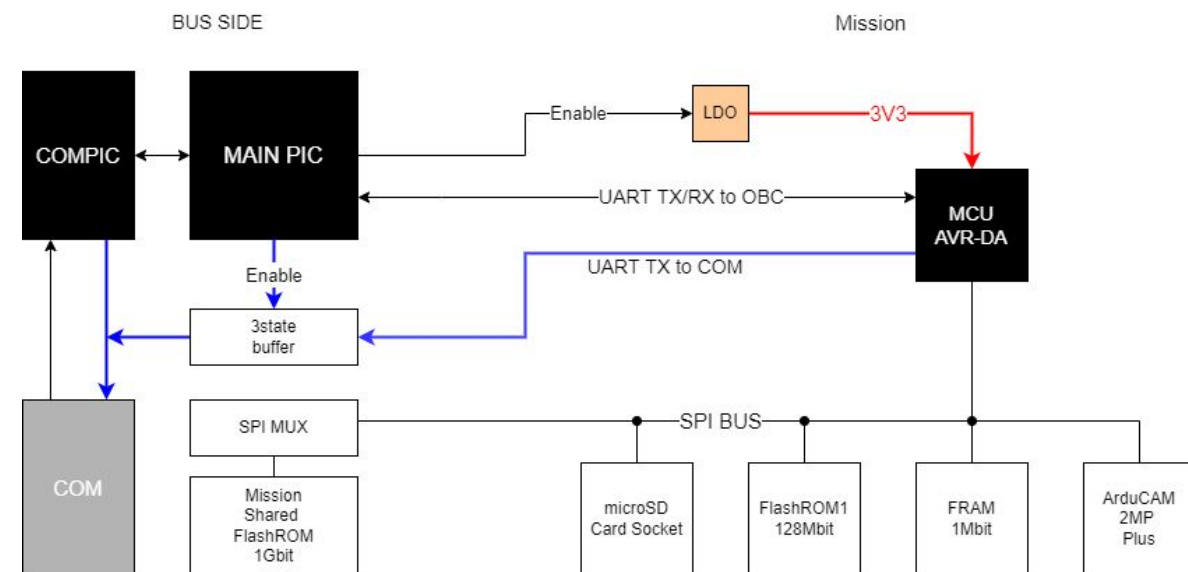
COM board NFM output procedure

1. Enable UTX (COMPIC)
2. Send FM Mode command (via UTX config UART (COMPIC))
3. Enable Mission Data Line (MainPIC)
4. Streaming PCM data (Mission)

Format: signed 8bit 8kps WAV

Design points

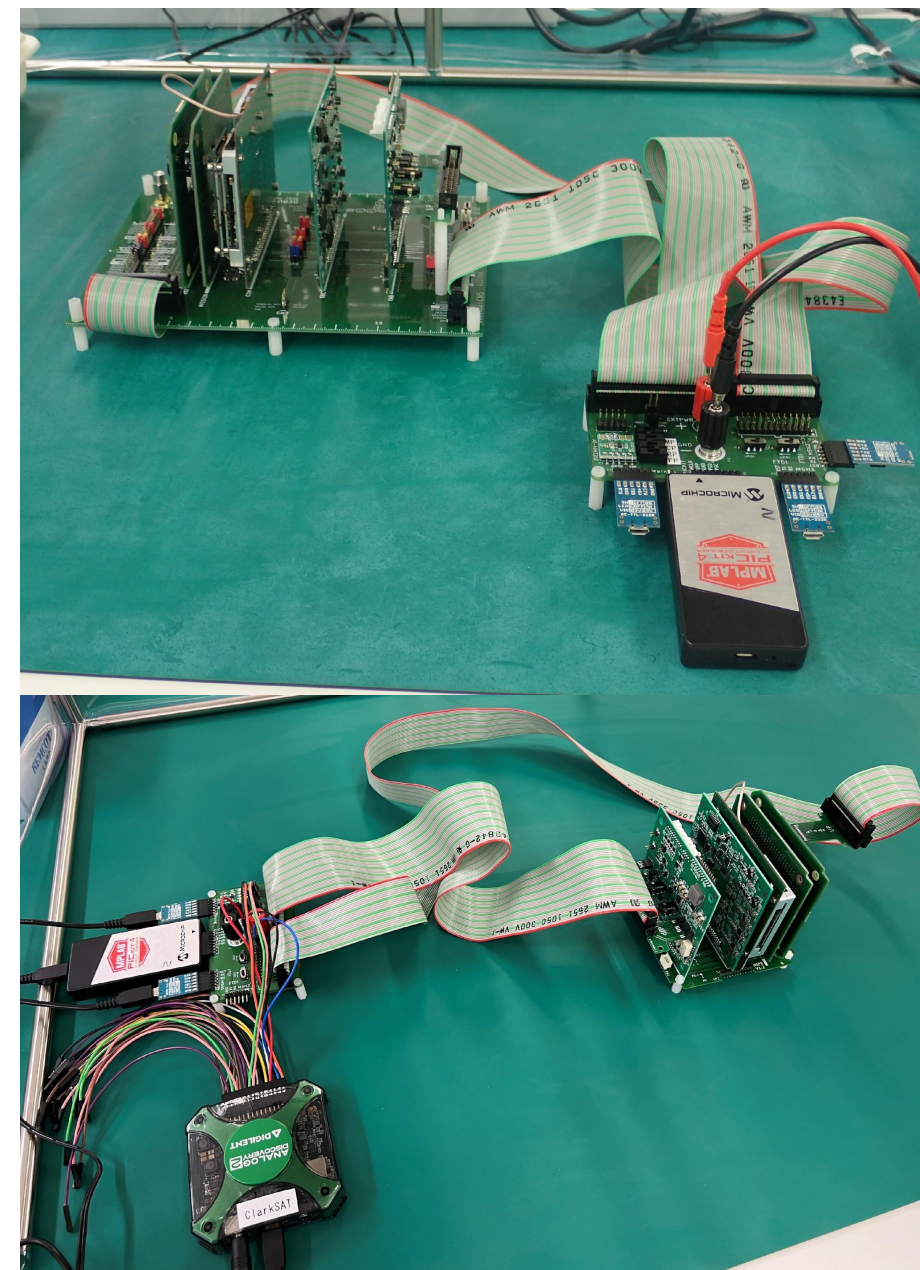
- Minimize risk for downlink data line (OBC to COM)
- MainPIC handle Streaming data input



Debug Board development

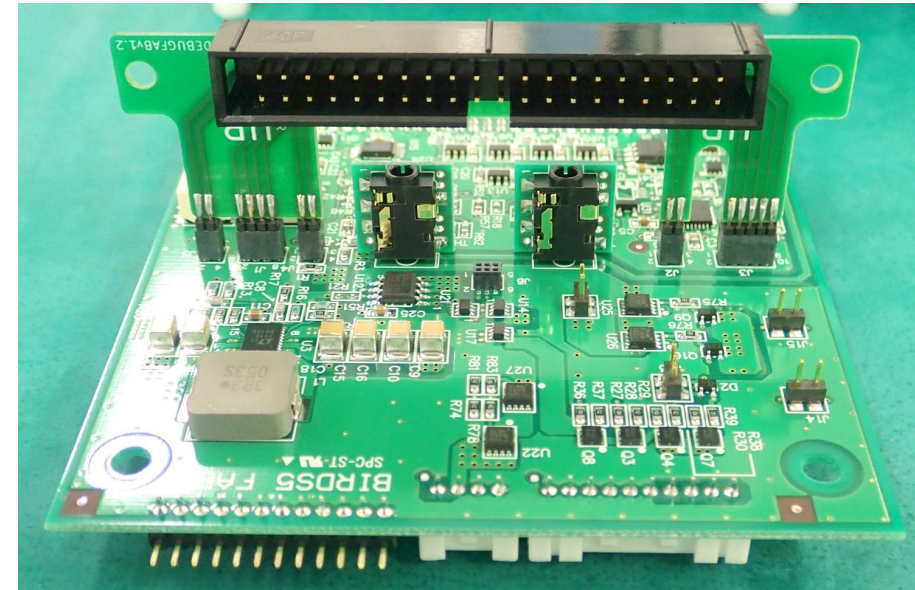
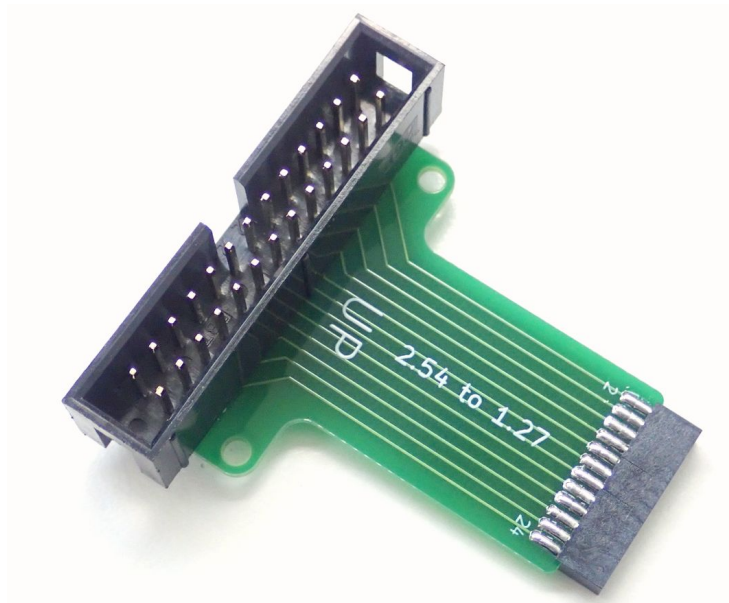
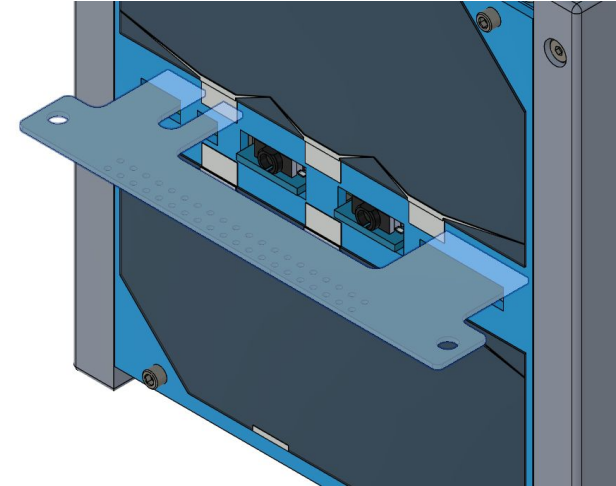
Design Policy

- Simplified assembly & Test procedures
- Reduce harness complexity & Human errors
 - Off-the-shelf harnesses
(MIL-C-83503, IDC Ribbon Cable)
- Maximize electrical test opportunity
- The interface board can be used in the same way for post-assembly satellites.



FAB / RAB access pin to Flat cable conversion board

- 1.27mm pitch to 2.54mm pitch conversion
- MIL-C-83503 Connector



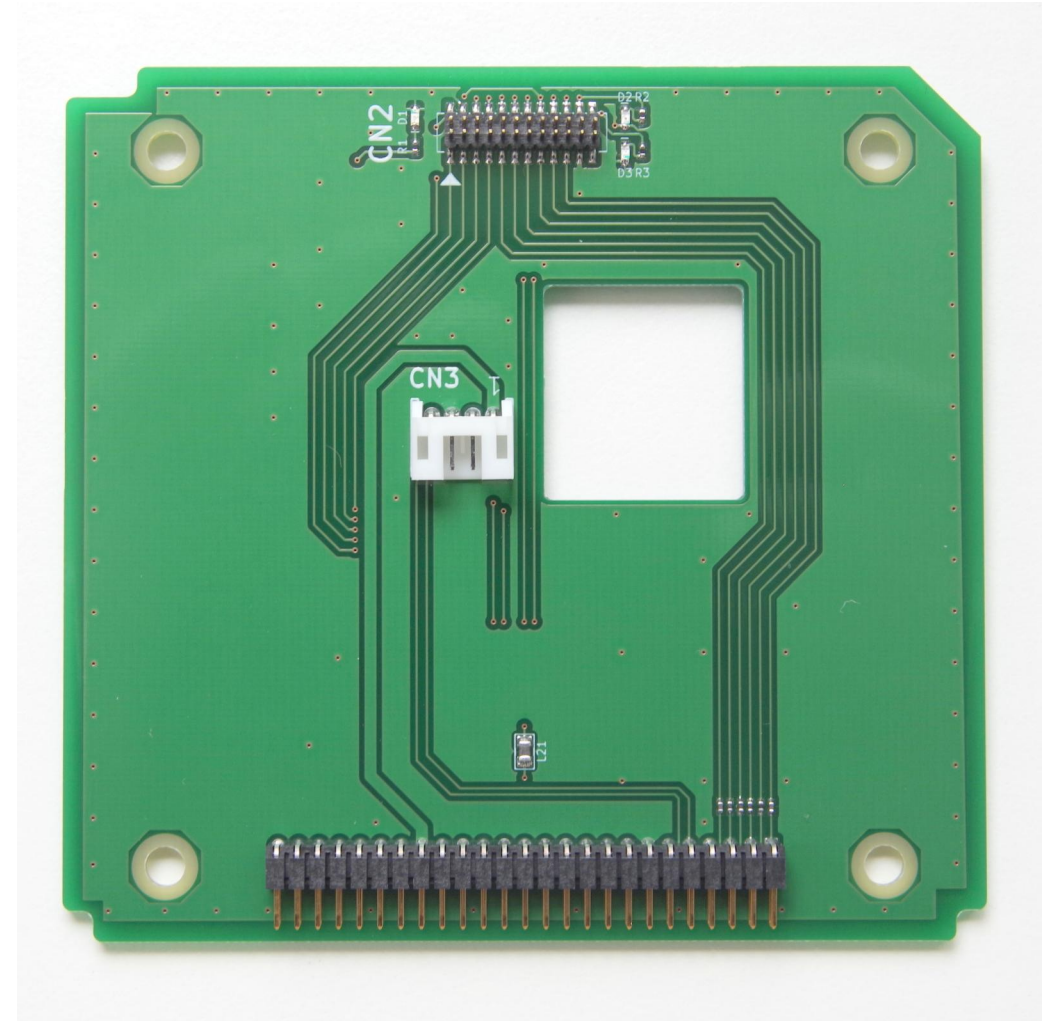
Power
GND
DATA SIGNAL
STATE_SIGNAL
ANALOG Voltage
No connection
BUS

Clark Sat RAB

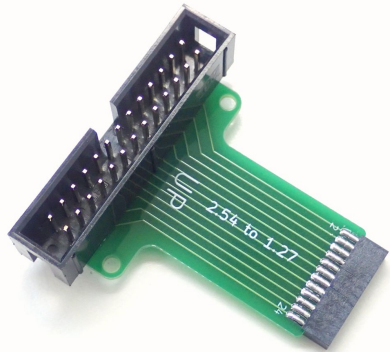
Features

- BIRDS-3 based
- Add OBC-BUS debug output
- Add 3 LEDs. (near CN2) for test
- 2 control from Main OBC GPIO
- 1 control from Mission MCU
- Add EMI Filter

PCB:2-layer, $t=1.6\text{mm}$



RAB Interface board pin assignment

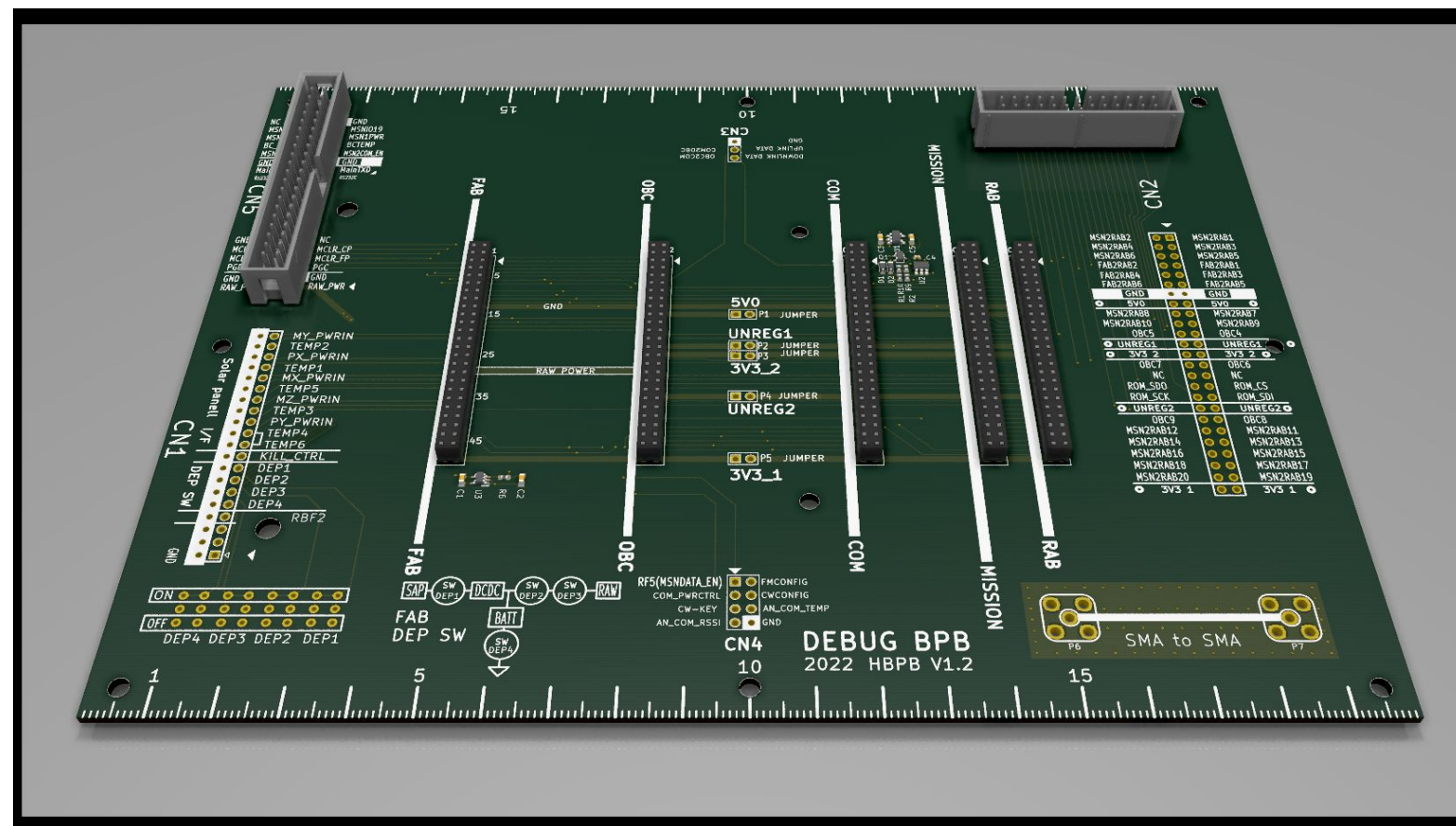


BIRDS	Onboard I/O	MIL26PIN	Onboard I/O	BIRDS
MSN2RAB_GIO10	MSN2_DEBUG_TX	1	2	3V3_2
MSN2RAB_GIO9	MSN2_DEBUG_RX	3	4	GND
MSN2RAB_GIO8	MSN1_DEBUG_TX	5	6	MSN_ROM_SCK
MSN2RAB_GIO7	MSN1_DEBUG_RX	7	8	MSN_ROM_MOSI
MSN2RAB_GIO6	MSN2_PROG_CLK	9	10	MSN_ROM_MISO
MSN2RAB_GIO5	MSN2_PROG_DAT	11	12	MSN_ROM_CS
MSN2RAB_GIO4	MSN2_RESET	13	14	MSN2_UART_TX
MSN2RAB_GIO3	MSN1_PROG_CLK	15	16	MSN2_UART_RX
MSN2RAB_GIO2	MSN1_PROG_DAT	17	18	MSN1_UART_TX
MSN2RAB_GIO1	MSN1_RESET	19	20	MSN1_UART_RX
GND		21	22	RAB_LED_RED
NC		23	24	RAB_LED_GREEN
NC		25	26	NC

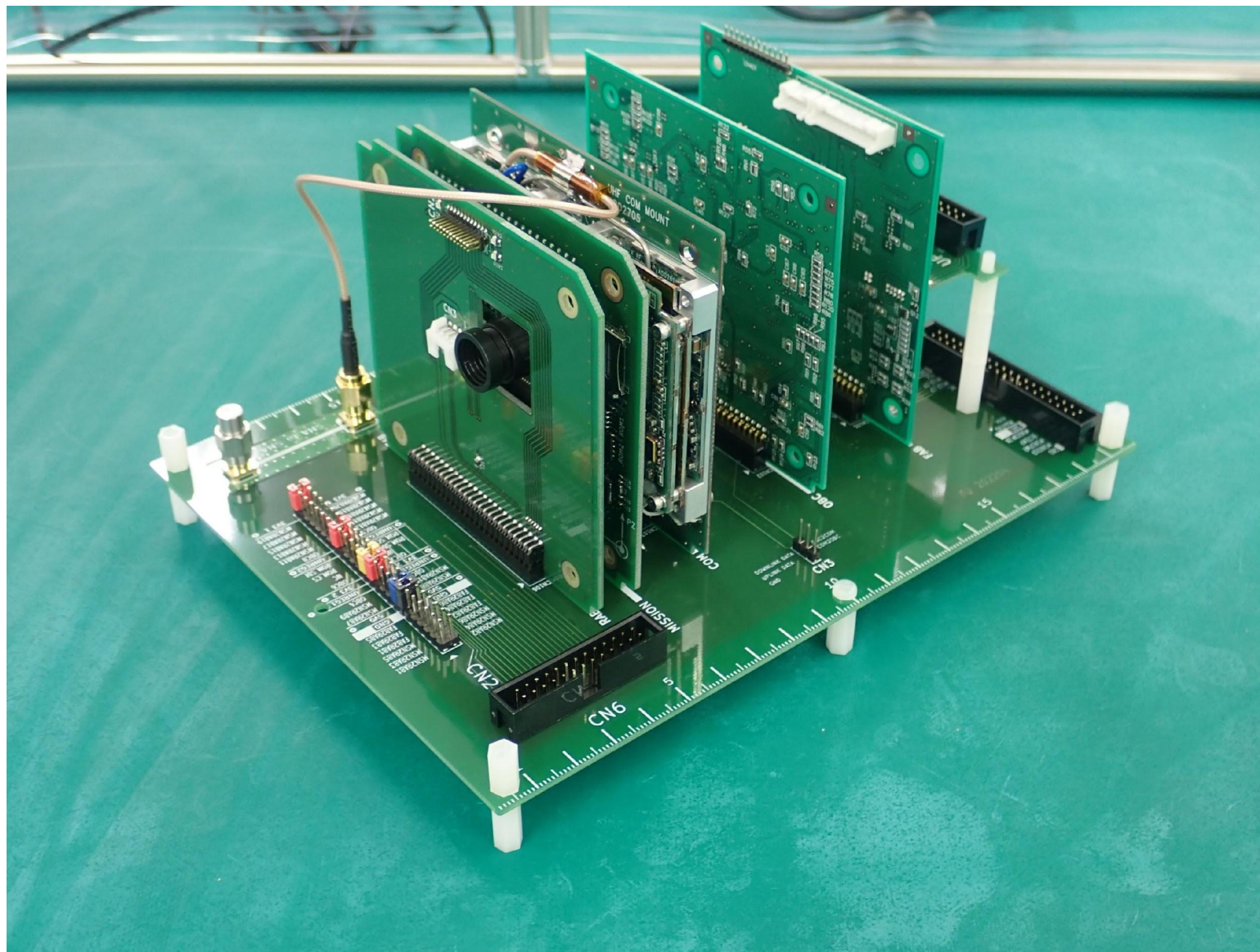
Power
GND
DATA SIGNAL
STATE SIGNAL
ANALOG Voltage
No connection
BUS

- FAB, RAB interface
 - MIL connector

- 2.54mm pitch header
 - FAB Power INPUT & Deployment switch
 - Mission 50pin
 - COM control I/O
- SMA port with microstrip line (for COMboard)
- 200x150mm 2-layer PCB

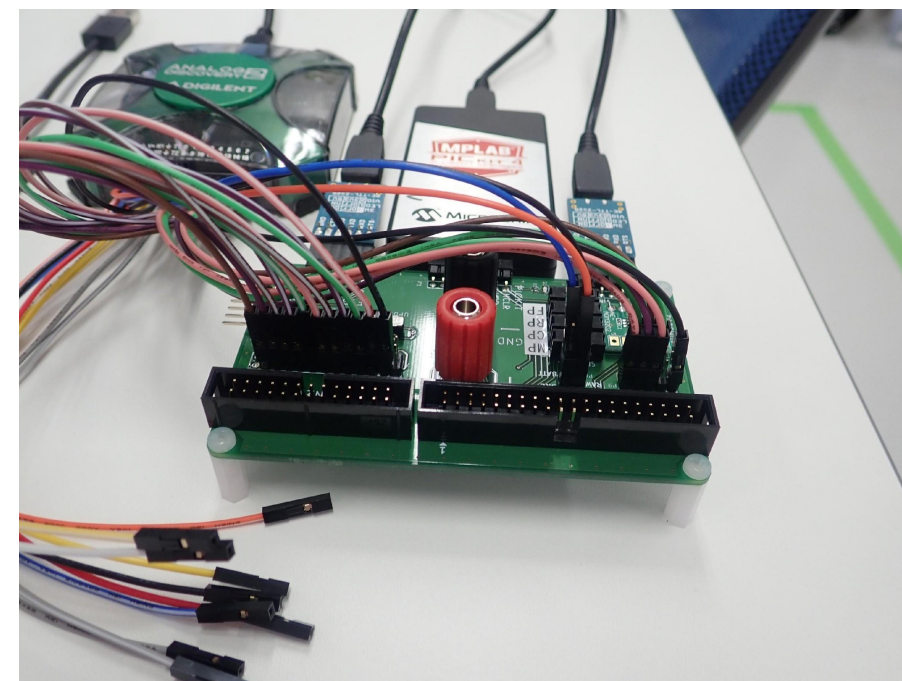
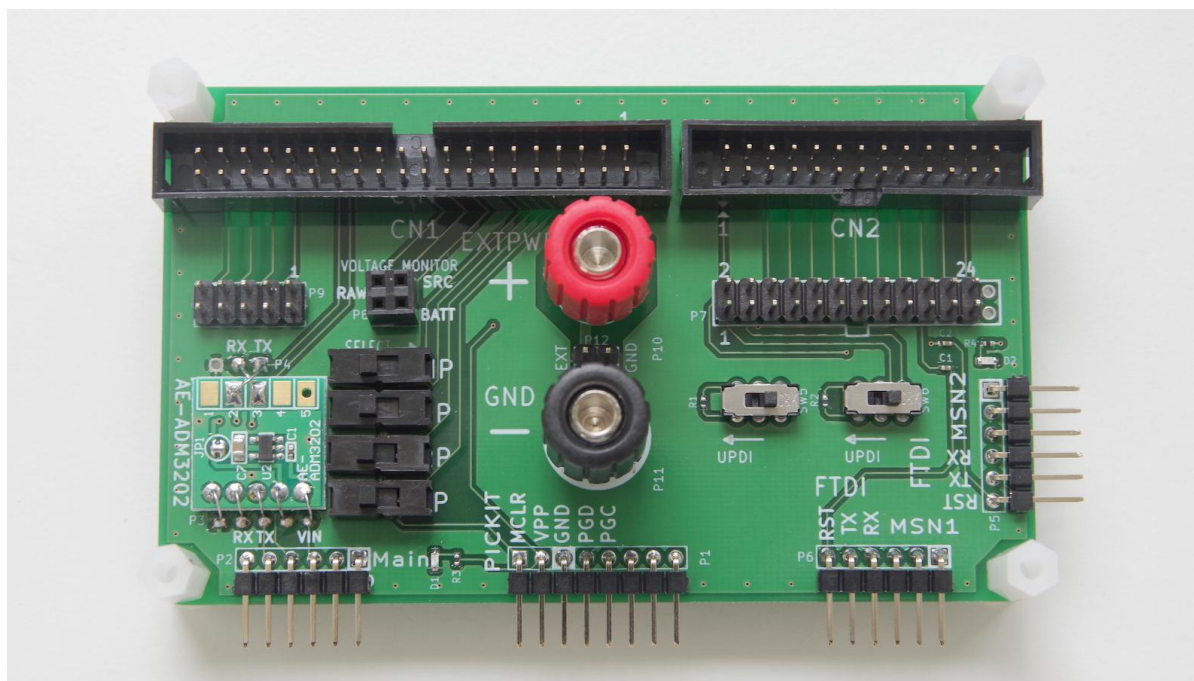


DebugBPB with internal boards



Clark Sat external Interface board (Debug FAB)

- FAB/RAB Interface (Two MIL connectors)
- External power input
- Power BUS voltage monitor
- OBC/FAB PIC programming interface (PICKIT4 header & MCU select Switch)
- Main PIC RS232 level Converter to FTDI header
- Two Mission MCU Program/UART Debug Interface



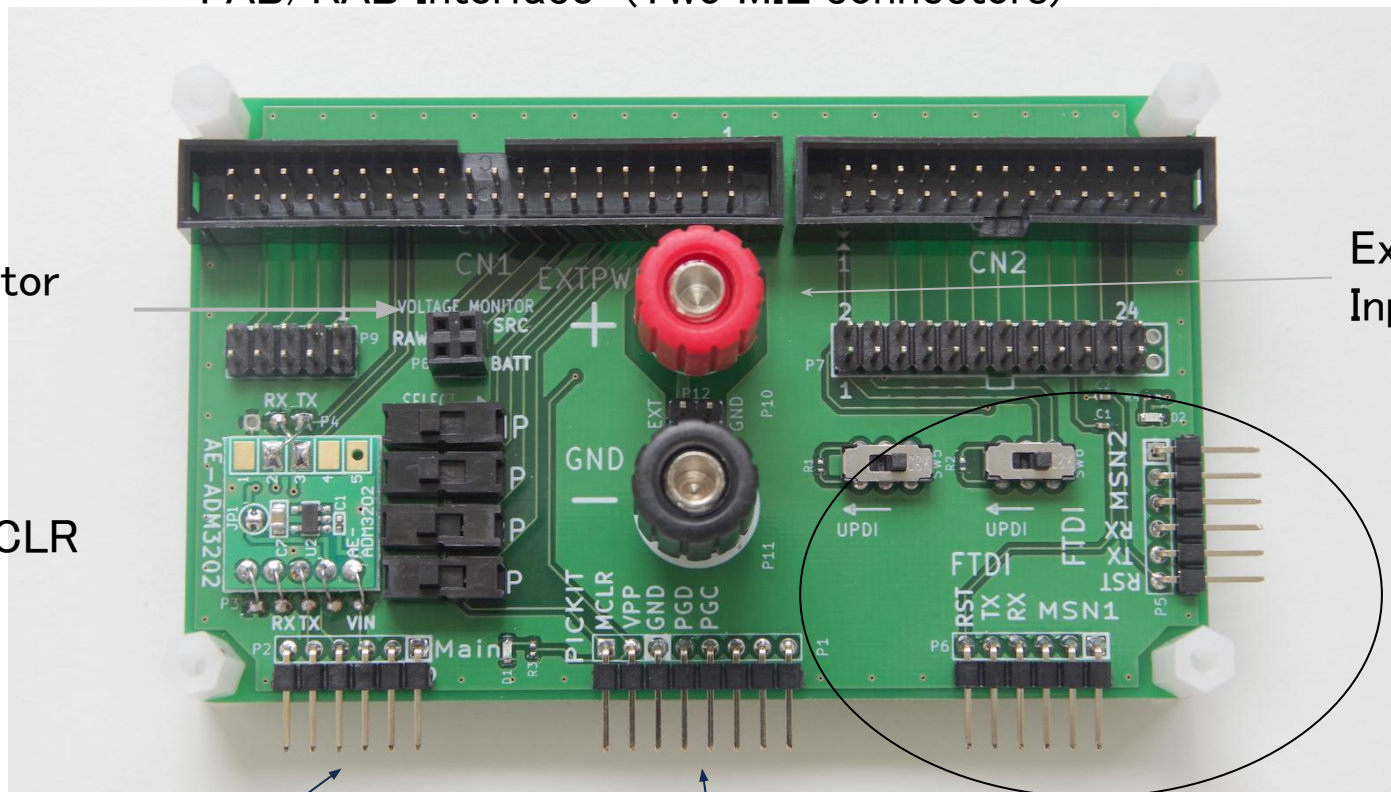
Clark Sat external Interface board (Debug FAB)

FAB/RAB Interface (Two MIL connectors)

BUS voltage monitor

OBC/FAB PIC MCLR
select Switch

External Power
Input

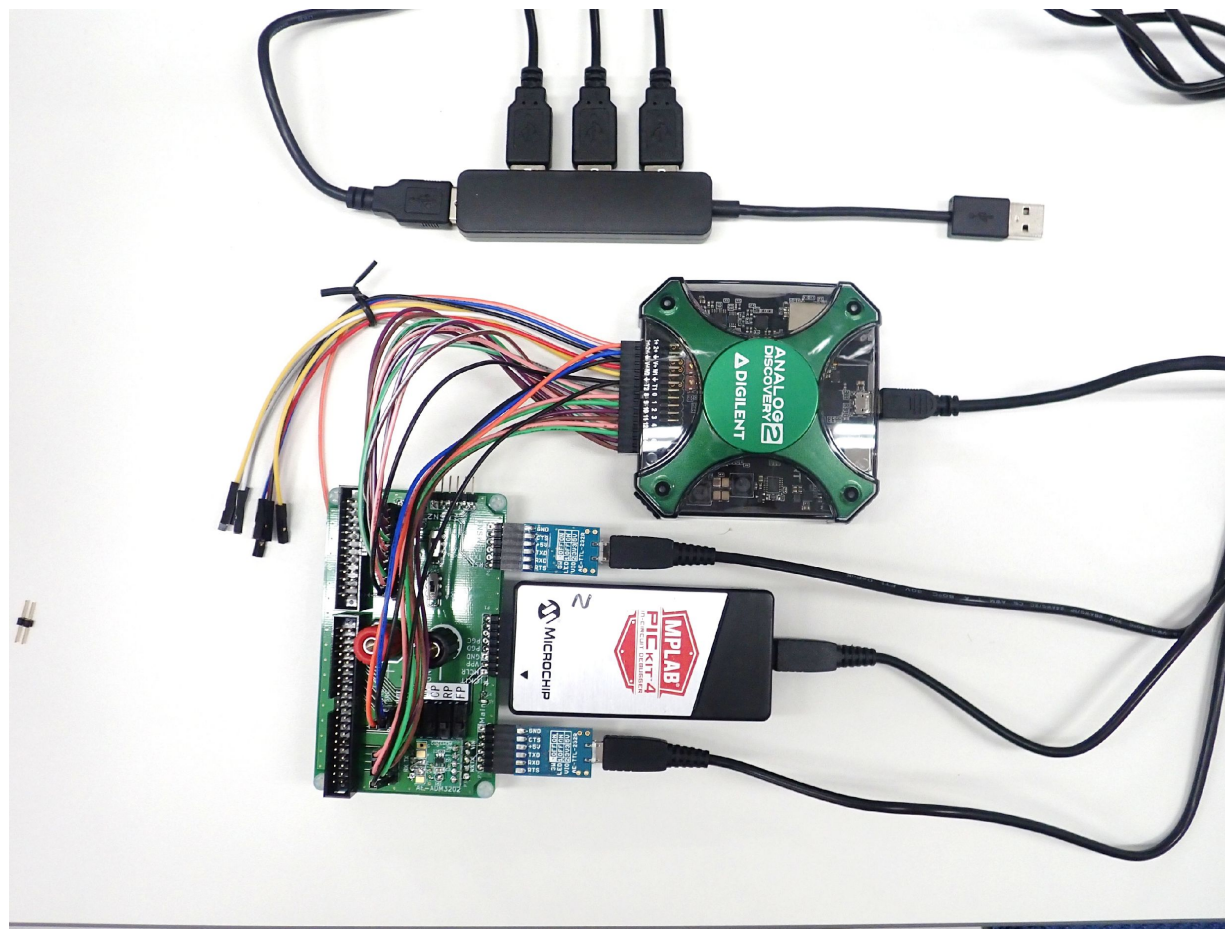


Main PIC RS232
To CMOS UART

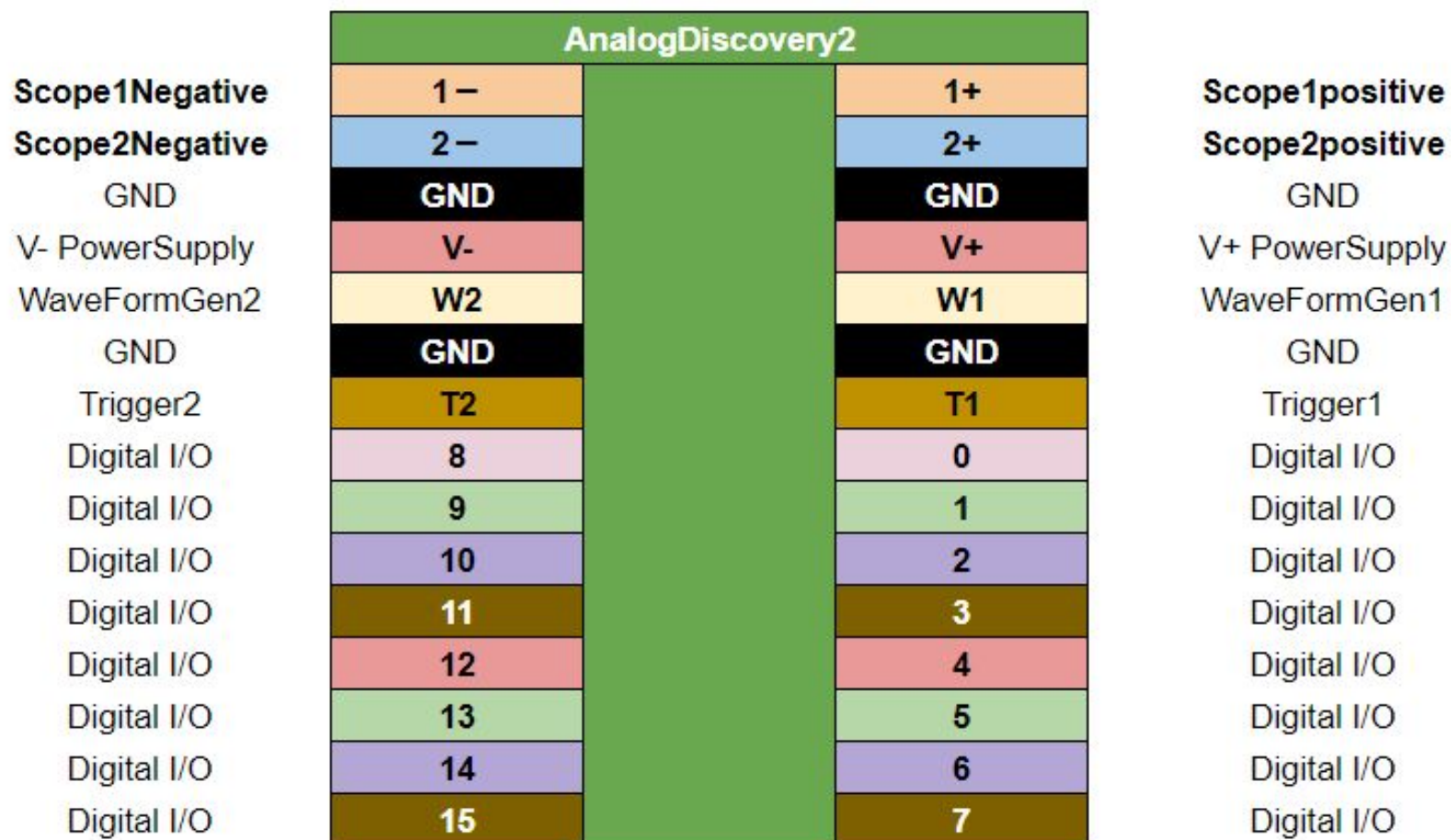
PICKIT Header

Mission MCU Program &
UART Debug Interface

External Interface board & Tools connection



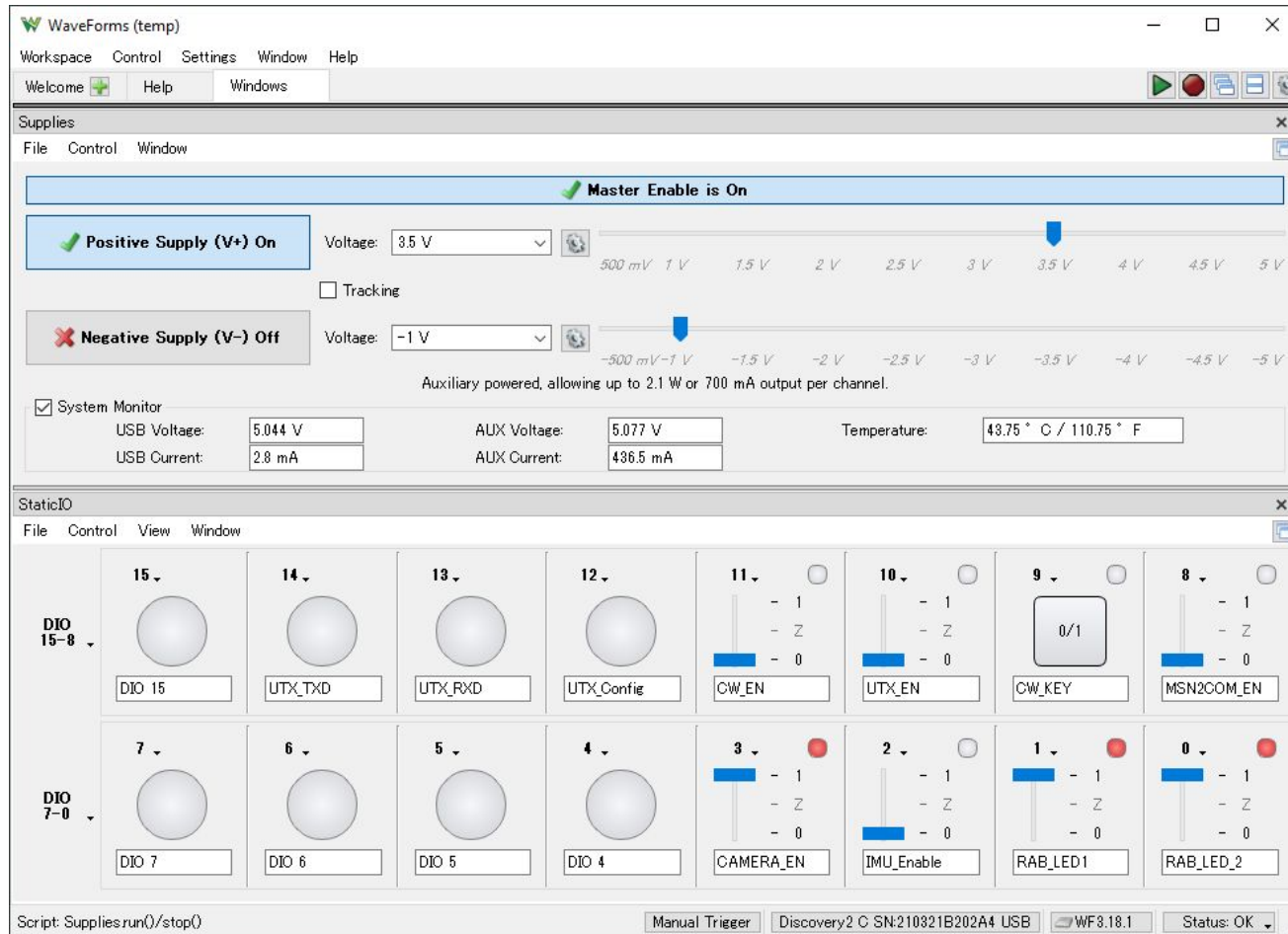
AnalogDiscovery2 for Debugging



AD2 BASIC functions

- Scope, Voltage monitor
- **Power Supply (1to5V)**
 - MAX 2A with External power source
- Signal Generator
- **Digital I/O**
 - Static I/O control
 - Logic Analyzer
 - Protocol TRX (UART,SPI,I2C)

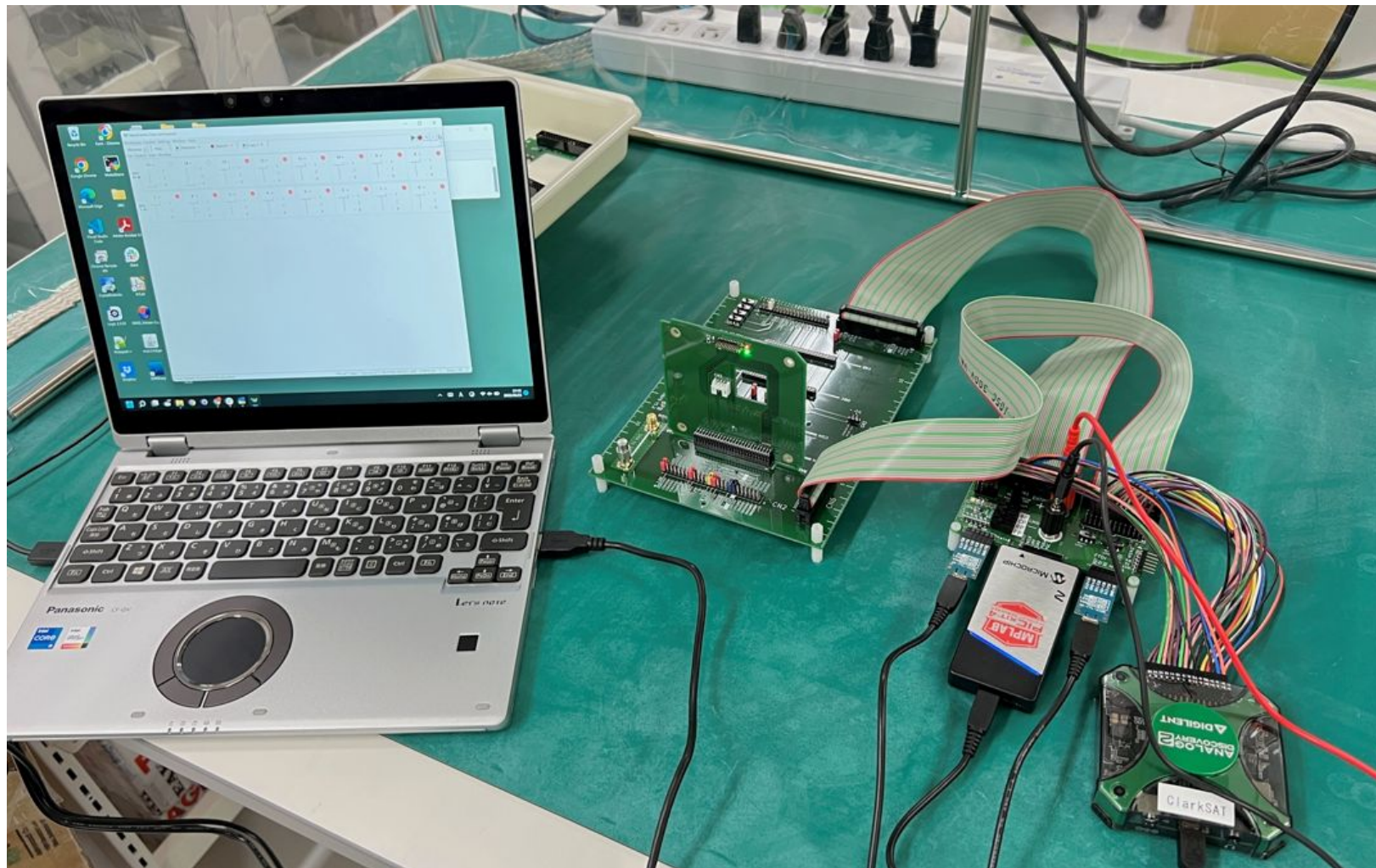
Hardware Control with AnalogDiscovery2



AD2 BASIC functions

- **Power Supply (1to5V)**
 - MAX 2A with External power source
- **Digital I/O**
 - Static I/O control
 - Logic Analyzer
 - Protocol TRX (UART,SPI,I2C)

Table Sat configuration



Unit test with
AnalogDiscovery2

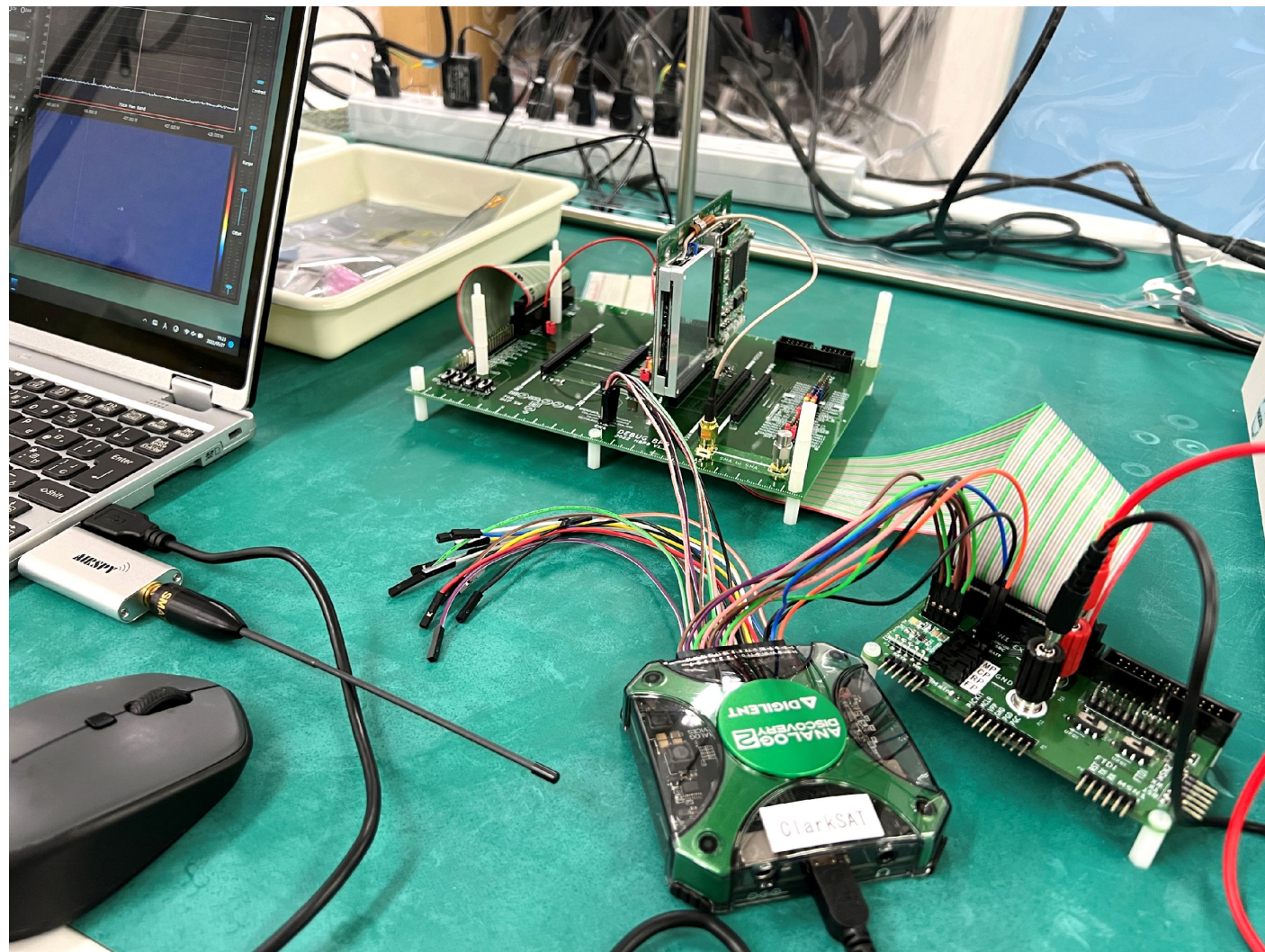
(example: RAB LED ON)

COM board unit test with Debug BPB

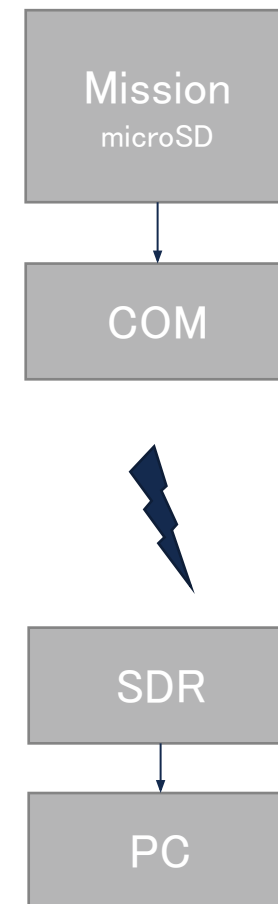
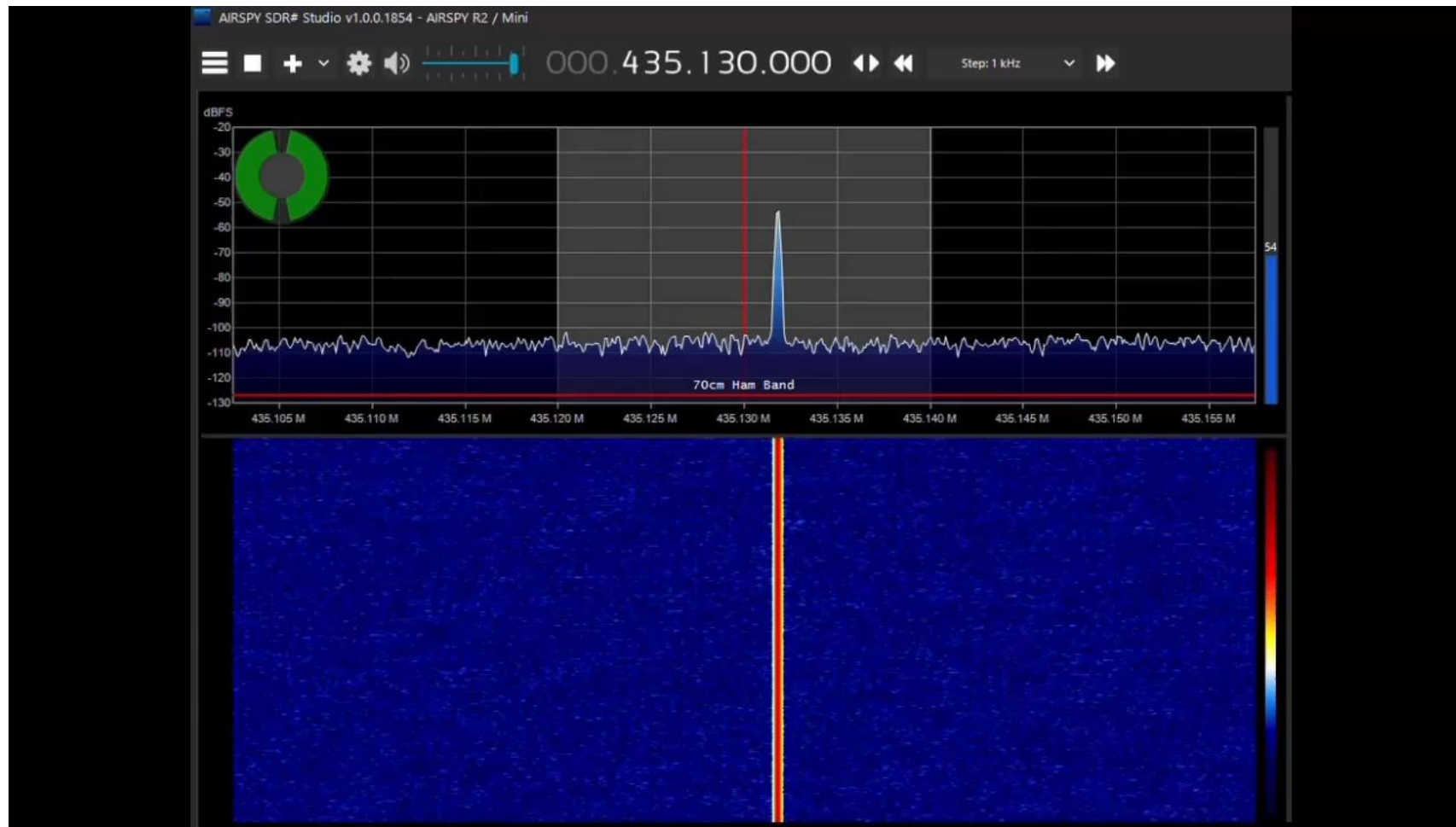
COM board unit test on Debug BPB

AnalogDiscovery2 config

- Static IO control
 - UTX power
 - UBTX power
 - CW-KEY
- UART(protocol)
 - UTX config command



Digitaltalker / SSTV transmit test (movie)



⚠️note: audio parameters and data streaming jitter have not been adjusted