ADDNICS

Ultra-compact UHF communication board

for CubeSat

ADD1397B

Interface Control Document

Rev.C

2021.10.11

ADDNICS

Revision History

Rev.	Date	Writer	Annotations
A	2020.11.25		Initial Release
B	2020.11.25		Correction by manufacture
C	2021.10.11		Reflect the latest version

1 Overview

This communication board is an ultra-compact UHF communication system for a CubeSat. Depending on the option setting, it is possible to do various communications. This data sheet corresponds to Option 01.

2 Production Composition

Table 2-1 shows the product configuration, Figure 2-1 shows the product block diagram, and Figure 2-2 shows the COM board circuit diagram.

Table 2-1 Product Configurations

No.	Name	Quantity	Remarks
1	Ultra-compact UHF communication board ADD1397B	1	
	UHF MOUNT (base)		4.2V power-enabled version
	UHF RX (GFSK DEM)		
	RX CONT (BIT SYNC & AX.25 DEC)		
	UHF BTX (0.1W CW TX)		
	UHF TX (0.8W I/Q MOD & PA)		
	TX CONT(GMSK&AX.25 GEN)		
2	Test results	1	

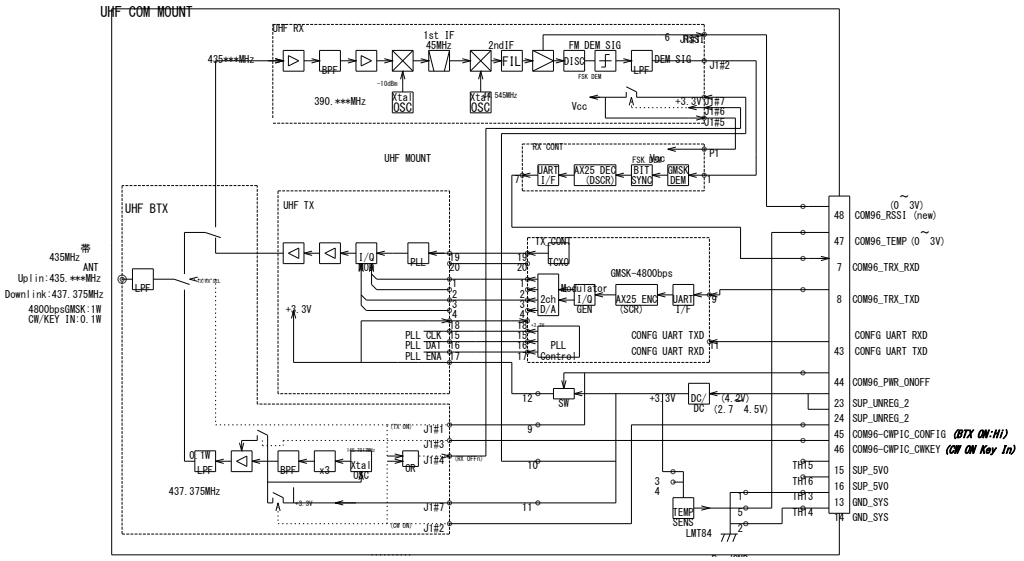


Figure 2-1 Block Diagram of Communication System

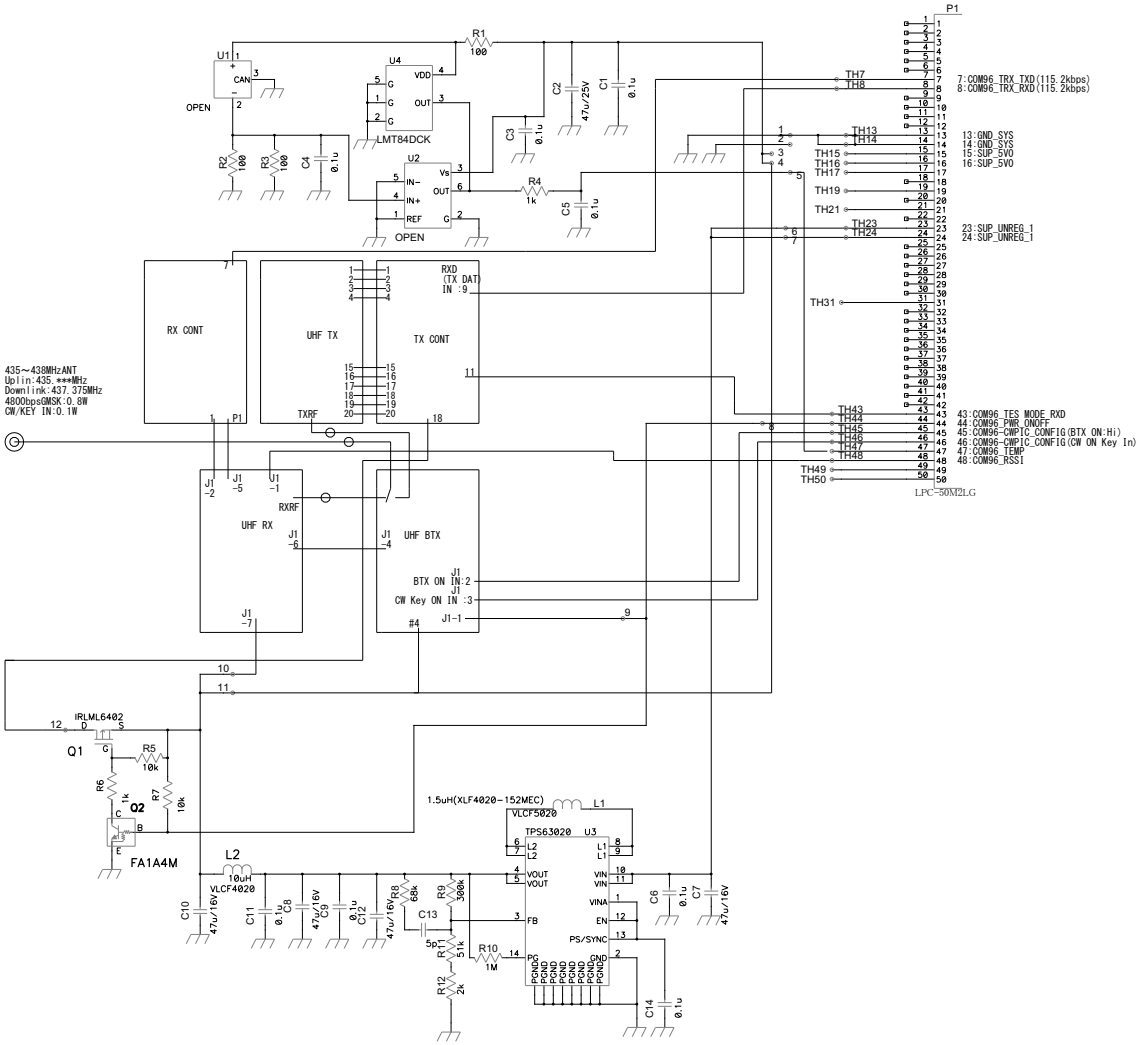


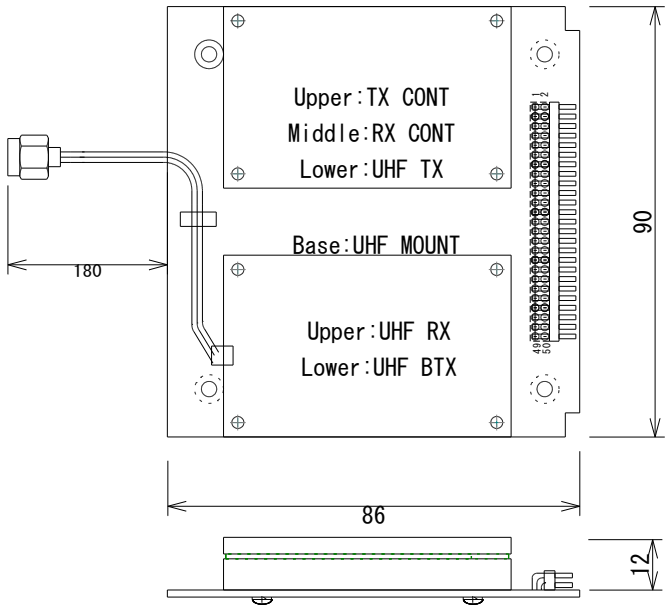
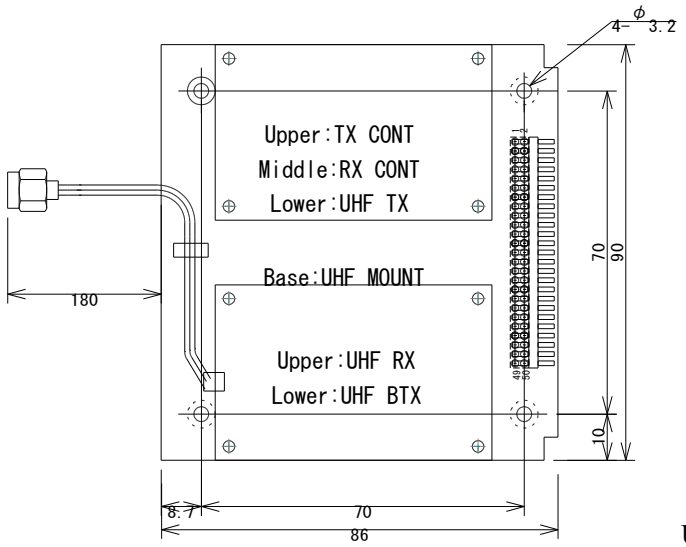
Figure 2-2 Circuit Diagram of COM Board

2.1 Mechanical characteristics

The mechanical characteristics of the product are shown in Table 2.1.

Table 2.1 Mechanical Characteristics

Mass	
Dimensions	90 mm x 86 mm (maximum part height: 12 mm)

Physical configuration	 Unit: mm
Mounting hole location	 Unit: mm
Fastener information	N/A The board shall be mounted using the through-holes at the four corners
Center of mass location	N/A
3D CAD model	N/A

2.2 Thermal characteristics

The thermal characteristics of the product are shown in Table 2.2.

Table 2.2 Thermal Characteristics

Heat dissipation	To be calculated from the power consumption and RF power output
Allowable temperature range	Operating temperature: -20 to +60 degree C
Temperature sensor type	CMOS sensor (LMT84, TEXAS INSTRUMENTS), Standard accuracy: ±0.4 degree C

2.3 Electrical characteristics

The electrical characteristics of the product are shown in Table 2.3.

Table 2.3 Electrical Characteristics

UHF Transmitter	**UTX**
Transmission frequency	437.375 MHz
Transmission power	0.8 W(+20%,-50%)
Modulation scheme / bitrate	GMSK / 4,800bps
Middle occupied bandwidth	Less than 12.5kHz
Protocol	AX.25 (0 + 7E + Scramble)
UHF Receiver	**URX**
Received frequency	435.*** MHz
Modulation scheme / bitrate	GFSK / 4,800bps
Protocol	AX.25 (Descramble→7E7E42h Detection→ Delete 0 → UART conversion)
Receiver sensitivity	-113dBm (with direct connection via cable between the receiver and a ground station radio)
Beacon Transmitter	**UBTX**
Transmission frequency	437.375MHz
Transmission power	0.1W (+20%, -50%)
Modulation	On/Off Keying
Occupied bandwidth	Less than 400Hz

Input voltage	+2.7～+4.5V
Ground / bonding point	50PIN interface connectors #13, #14 PIN
Input condition	GND line connect to #23 and #24 PINs, power line connected to #13 and #14PIN.
Operation mode	1) Receiving mode 2) 0.1W CW transmission mode (CW Key ON/OFF) 3) 0.8W GMSK transmission mode
Power consumption (in-rush, peak, nominal)	Nominal power consumption 1) Receiving mode: 170mW 2) 0.1W CW transmission mode: 600mW or lower 3) 0.8W GMSK transmission mode: 4.6W or lower
Failure detection and recovery	N/A
Fault isolation	N/A

2.4 Control Interfaces

Table 2.4-1 and Table 2.4-2 show the product interface specifications and control interfaces.

Table 2.4-1 Interfaces Specifications

Connector	Power and data connectors (LPC− 50M2LG：HTK) SMA-P connector
Pin assignment table	Refer to Table 2.4-2
Full name of signal	Refer to Table 2.4-2
Acronym for signal	Refer to Table 2.4-2
Types of signal	Refer to Table 2.4-2
Current and Voltage	Refer to Table 2.4-2
Input or output	Refer to Table 2.4-2
Frequency or bit rate	Refer to Table 2.4-2
HOT/ Return pairing information	Refer to Table 2.4-2
Wire gauge	-
Onboard housekeeping data availability	#47 PIN: Temperature sensor voltage output (the relationship between the output voltage and temperatureis shown in the figure below.)

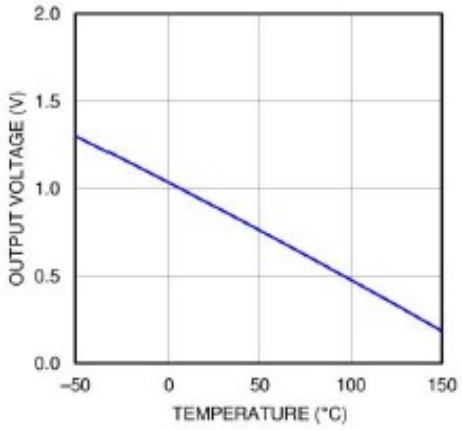
	 #48 PIN: Voltage monitor output of received input signal
Data interface specification	UART Bitrate: 115.2kbps, Data Length: 8bits, Stop Bit: 1bit Parity: No, Flow Control: No
Analog Ground or digital Ground	#13, #14 are connected to the internal circuit ground
RF Cable Interface	SMA-P Cable (180mm length)

Table 2.4-2 Control Interfaces

Pin assignment			Signal Characteristic		Communication Characteristic					Note
No	Name	Abbreviation	Type	In or Out	Type	Frequency	Current (mA)	Voltage (V)	Connection	
1										
2										
3										
4										
5										
6										
7	Received Data Output (UART)	COM96_TRX_TXD	LVTTL	O	UART	115.2kbps	Less than 10mA			
8	Transmission Data Input (UART)	COM96_TRX_RXD	LVTTL	I	UART	115.2kbps	Less than 10mA			
9										
10										
11										
12										
13	Ground	GND_SYS								Connect to COM board GND
14	Ground	GND_SYS								Connect to COM board GND
15										
16										
17										
18										
19										
20										
21										
22										
23	Power Input	SUP_UNREG_2	POWER	I		DC	Less than 2A	2.7～4.5V		
24	Power Input	SUP_UNREG_2	POWER	I		DC	Less than 2A	2.7～4.5V		
25										
26										
27										
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44	GMSK Ttransmission On/OFF Control Input	COM96_PWR_ONOFF	ANALOG	I	Level	DC～1kHz	Less than 10mA	0～5V		OFF when 0V Input
45	CW transmission On/OFF Control Input	COM_CWPIC_CONFIG	LVTTL	I	Level	DC～100Hz	Less than 10mA	0～3.3V		CW TX OFF when 0V input
46	CW Key Input	COM_CWPIC_CWKEY	LVTTL	I	Level	DC～100Hz	Less than 10mA	0～3.3V		CW OFF when OV input
47	Temperature Sensor Voltage Output	COM96_TEMP	ANALOG	O	Level	DC～100Hz	Less than 10mA			
48	Received Signal Input Monitor Voltage Ouput	COM_RSSI	ANALOG	O	Level	DC～100Hz	Less than 10mA			
49										
50										

2.4.1 Received data output (#7 PIN, COM96 TRX RXD)

When data in AX.25 format is received, binary data is output by UART.

After GFSK demodulation and de-scramble, the receiver deletes "0" after 5bits continuous "1" from the preamble part (0x7E7E) + ASCII "B" (0x42) character to the end flag (0x7E) and makes output.

2.4.2 Transmission data input (#8 PIN, COM96 TRX TXD)

When "1" of 6bits are consecutive in the bit stream of binary data input from UART, "0" is inserted. After scrambling, GMSK modulation is applied and RF is transmitted.

When no data is entered, the preamble data (0x7E7E) is scrambled.

The input data buffer (FIFO) is 2,048 bytes. The data is made output as one data until the buffer (FIFO) becomes empty.

The data input to through #8 pin should be faster than 4800 bps so that the next packet data can be sent seamlessly. The default speed is set to 115200 bps.

2.4.3 Mode Change Settings command (#43 PIN, CONFIG UART RXD)

Table 2.4.3 shows the mode change commands. The mode can be changed by entering the command in the Table into CONFIG UART RXD (# 43).

Table 2.4.3 Mode Change Command

Project.	Command	Content.
Transmission on / off control	RON[CR]	Transmission output ON
	ROF[CR]	Transmission output OFF
Modulation on / off control	MON[CR]	Modulation ON Normal transmission state
	MOF[CR]	Modulation OFF Unmodulation (used for frequency measurement, etc.)
Transmission data source selection	PNN[CR]	Transmit internally generated PN9 data

	PNF[CR]	Transmit data from a device connected to UART 1

When the power is turned on, the default setting is (RON, MON, PNF).

(When the power is turned on, a signal GMSK modulated by an external data is made output with 0.8W.)

2.5 Software

For the software of the product, it is shown in Table 2.5.

Table 2.5 Software

Development kit availability	-
Sample code availability	-

2.6 Others

Table 2.6-1 shows product testing and flight heritage.

Table 2.6-1 Others

Results of the test	The qualification test model and the flight models were tested by incorporating the COM board into BIRDS-2, BIRDS-3 and BIRDS-4 satellite systems. The system went through vibration and thermal vacuum tests based on ISO-19683.
Flight heritage	With the operation of three BIRDS-3 satellites, the total cumulative time in orbit is more than 3 years.