

MILTECH 2022

Multi-Functional USB/Ethernet/Serial COMs Transceiver

Hardware User Guide



Milpower Source P/N: 1-2022-000

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1. Introduction

The MILTECH 2022 Transceiver Unit was introduced for allowing Discrete IOs and RS232/RS422/RS485 Serial interfaces over IP communications. This implementation allows controlling legacy RS232/RS422/RS485 equipment and any discrete IOs by remote terminal via Ethernet infrastructure.

In addition, the MILTECH 2022 also supports USB to Ethernet and USB to RS232/RS422/RS485 functionality including USB Power Delivery charge.

MILTECH 2022 Transceiver Unit Supported operating modes/functionality:

- Bidirectional transfer of RS232/RS422/RS485 and Bidirectional transfer of Discrete IOs communications over standard 1G 1000Base-T (copper) Ethernet interfaces based on MT-2022 unit and a remote PC application.
- Bidirectional transfer of RS232/RS422/RS485 and Bidirectional transfer of Discrete IOs communications over standard 1G 1000Base-T (copper) Ethernet interfaces (Using two Back-to-Back MT-2022 Transceiver units connected via Ethernet). (future support only).
- Each MT-2022 transceiver provides 2 x RS232/RS422 full duplex ports, 1 x RS485 port and 4 x IOs (2 IN +2 OUT).
- The MT-2022 Transceiver can also act as USB to Ethernet bridge allowing Ethernet connectivity to mobile devices (e.g. Tactical Tablets, Smartphones) including simultaneous 10W Power Delivery Charging.
- The unit configuration/mode settings is supported via a local USB/UART management port or via a TCP/IP based web browser application

A hardware User Guide for Milpower's MILTECH 2022 rugged Transceiver unit is provided in this document. This document provides technical hardware related information on the Transceiver unit including communications/power spec. details, external interfaces, and mechanical data.

Applicable Design documents:

Document Name	Description	Designed By	Release Date
MILTECH 2022 Rev-1	Board schematics	Milpower	01/31/24
MILTECH 2022 Front Panel Interfaces pinout V1.0	Connectors ICD	Milpower	01/18/24
1-2022-icd-09-01-2024.PDF	Mechanical ICD	Milpower	01/09/24

2. High Level Specification Details

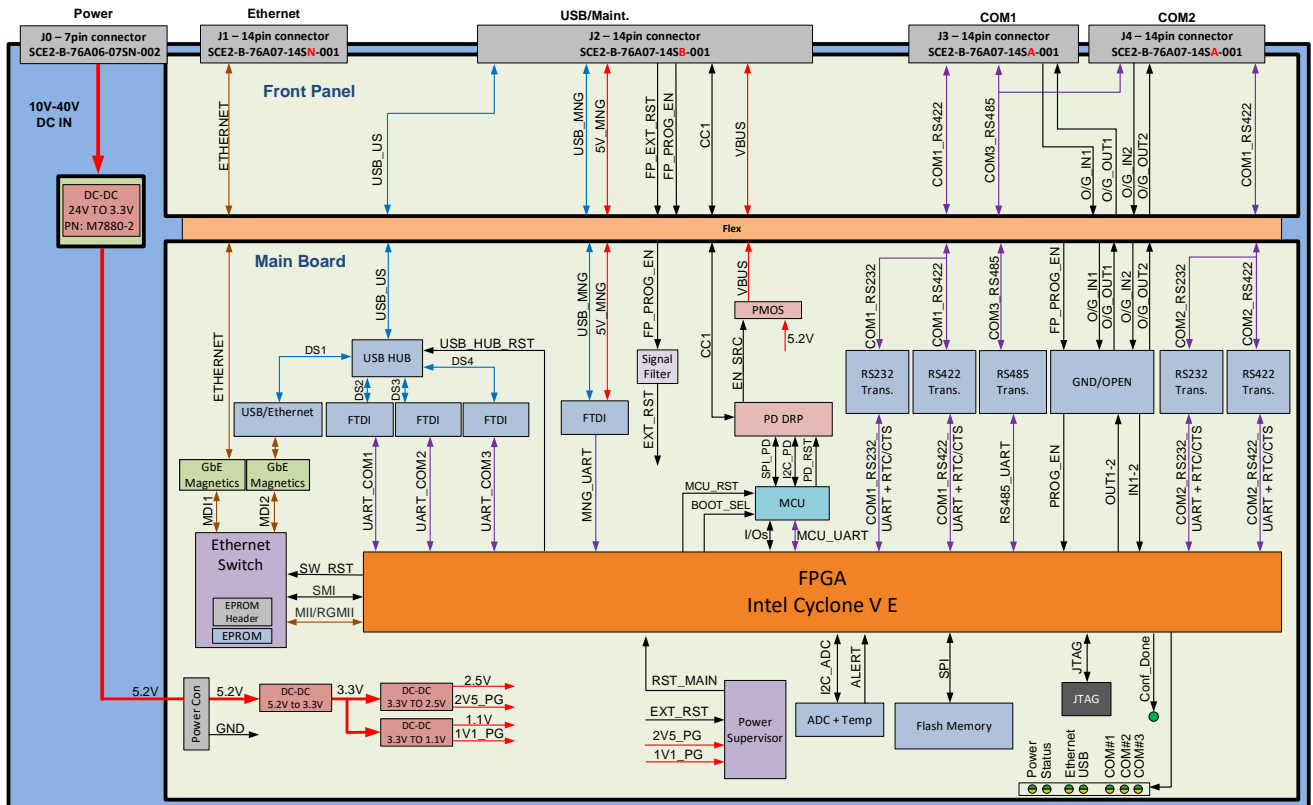
Milpower Source Part Number: **1-2022-000**

Parameter	Functionality
Unit Dimensions	4.72" (L) x 2.88" (W) x 1.4" (H) / 120mm (L) x 73.1mm (W) x 35.7mm (H)
Unit interfaces	J0 (PWR): SCE2-B-76A06-07SN-002 J1 (Ethernet): SCE2-B-76A07-14SN-001 J2 (USB and IO): SCE2-B-76A07-14SB-001 J3 (COM1): SCE2-B-76A07-14SA-001 J4 (COM2): SCE2-B-76A07-14SA-001
Power input	J0: 10-40V DC input range. Note: based on integrated Milpower M7880-2 Module
Power consumption	~4.1W (Typical, no USB PD charge) ~14.5W (Inc USB PD 10W charge)
Communications Ports	J1: 1 x 10/100/1000Base-T Copper ports (integrated magnetics + ESD protection) J2: <u>USB2</u> with support in PD DRP power (optional acts as 10W PD SRC when attached to relevant USB Data host with Dual Role Power) <u>USB2</u> Management port (see management section bellow) J3: Full Duplex RS232 or RS422 (optional RTS/CTS, selectable by firmware) + Half Duplex RS485 <u>Discrete I/Os:</u> - 1 x OPEN/GND IN - 1 x OPEN/GND OUT J4: Full Duplex RS232 or RS422 (optional RTS/CTS, selectable by firmware) + Half Duplex RS485 <u>Discrete I/Os:</u> - 1 x OPEN/GND IN - 1 x OPEN/GND OUT Note1: total of 3 COMs, RS485 in both J3 and J4 are shorted Note2: integrated RS485 120ohm termination and RX echo is selectable by firmware
Management	J2: Dedicated USB2 management (in addition to User USB2 port) port for optional external host management - Host console commands for identifying unit status, enabling/disabling unit ports, reading unit BIT and upgrading the unit firmware LEDs: Power, BIT Status, ETH Link/Activity, COM1 Activity and Mode, COM2 Activity and Mode, COM3 Activity and Mode (see LEDs indications section)
Temperature	-40C – 71C, convection cooled
EMI/EMC Environmental	MILSTD-461G MILSTD-810H MILSTD-1275B IP67

3. MILTECH 2022 TRANSCEIVER Unit Information

3.1 Unit Block Diagram

Following is the MILTECH 2022 Transceiver unit detailed block diagram:

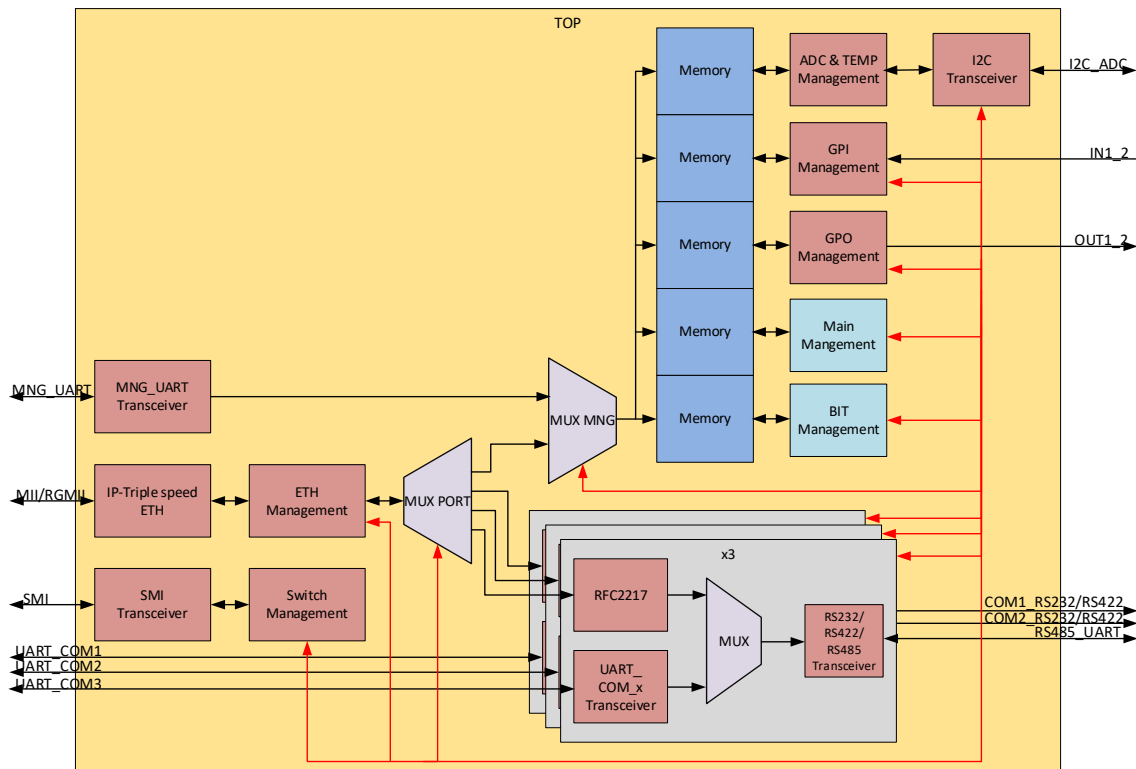


The MILTECH 2022 Unit is based on Intel FPGA firmware used for encapsulating and decapsulating the 3x UART ports over the Giga-bit Ethernet interface. Two of the UART ports can be routed to external equipment either as RS232 or RS422 (firmware selectable) whereas the third port is dedicated for RS485 Half Duplex. A lightly managed Gigabit Ethernet Switch is utilized in the MT2022 unit with the following ports: One external 10/100/1000BT port (accessible in J1), one internal RGMII port for the FPGA and one internal port for a USB/Ethernet Bridge IC. The internal Switch RGMII port allows the FPGA firmware access to the external RX/TX ethernet packets. The FPGA encapsulates transmitted UARTs and Discrete inputs states over the transmitted Ethernet packets and decapsulates received UART data and discrete outputs from the received Ethernet packets. This FPGA implementation is based on the TCP/IP RFC 2217 serial over Ethernet protocol. The FPGA uses a fixed IP address and provide per port configuration for the 1-3 UART ports as well as for the Discrete I/Os (2 x OPEN/GND IN and 2 x OPEN/GND OUT). An additional MT2022 functionality is the integrated USB/Ethernet bridge that allows and external USB2 host (e.g. PC or Mobile device) an internet access based on the integrated Switch connectivity. Additional operating mode supported by J2 USB2 user port is the USB to COM1/COM2/COM3 functionality. Furthermore, USB Power Delivery charge of up to 10W is supported on this external USB port (J2) simultaneously with the data connectivity.

The unit supports a dedicated USB management interface (J2 interface connector, in addition to the USB2 user port, see section 6.3) that optionally allows an external host monitoring and control over the unit operation as well as Built-in Self-Test status monitoring and other control/monitoring options (refer to section 8 for details). MILTECH 2022 comprises of Milpower's wide range DC-DC module (PN M7880-2, see section 9) for providing the required power for the unit internal circuitry and USB Power Delivery charge power.

3.2 The MILTECH 2022 Unit FPGA Firmware

The MILTECH 2022 is based on an advanced Intel FPGA that is responsible for the data path processing and for the unit management. Following is high level block diagram of the FPGA firmware:



The major FPGA firmware board interfaces are the RGMII port (Ethernet connectivity to/from Ethernet Switch), SMI for optional Ethernet Switch Management, I2C for on board ADC (BIT voltage rails readout and temperature sensor readout), Management UART (routed to J2 management connector via FTDI USB/UART device), two Discrete IO inputs, two Discrete IO outputs, the 3 configurable external COM ports and the 3 internal UART ports (routed to a USB HUB via USB/UART devices, the USB HUB upstream is the external user USB2 port of J2).

The external COM1-COM3 MT2022 ports are routed to two optional FPGA firmware paths (firmware configured by external host):

1. RFC2217 decoder/encoder that allows the COMs over IP mode
2. On board internal FTDI USB/UART devices (UART_COM1-3) that allows the USB2 to COM1/COM2/COM2 mode

The user configures the MT2022 desired operating mode and related configuration via external PC GUI. The external PC host is connected to the MT2022 management interface using the external J2 USB dedicated management port. This allows per port (COM1-COM2) configuration (RS232 or RS422) and settings (baud rates, flow control, RS485 echo, RS485 termination etc.)

3.2.1 TCP/IP Communication Structure

The system communication, whether it is between two MT2022 units or whether it is between a MT2022 unit and an external host computer, is based on Ethernet TCP/IP whereas 4 ports are in use:

- Port 1 is for UART1 communication transmit/receive (RS232 or RS422 Full Duplex, firmware selectable, interface connector J3).
- Port 2 is for UART2 communication transmit/receive (RS232 or RS422 Full Duplex, firmware selectable).
- Port 3 is for UART3 communication transmit/receive (dedicated RS485 Half Duplex port).
- Port 4 is for system management which also includes GPIO and status reading.

3.2.1.1 TCP/IP Port 1..3

The UART over IP implementation is based on the RFC2217 protocol.

Even in a situation where two systems are connected to each other, the transfer of UART information will be based on the RFC2217 protocol.

All the information about the protocol can be obtained from the following link:

<https://www.rfc-editor.org/rfc/rfc2217.html>

On the computer side, the remote software integrates a 3rd party (HHD) virtual port software that is described in the following link: <https://www.hhdsoftware.com/virtual-serial-ports>

3.2.1.2 TCP/IP Port 4

In this port the TCP data is built from command/description, address, and data, where we there are several command/descriptions, each structured differently:

- Cyclic status data transfers sent from MT2022 unit to host or paired MT2022 unit
- Host write to MT2022 FPGA memory map
- Host read from MT2022 FPGA memory map
- MT2022 FPGA firmware update by host

According to the TCP protocol, each packet has an ACK response packet from the remote party. Whenever it is necessary to provide a reply, such as reading from FPGA internal memory, then the requested data is integrated within the ACK packet.

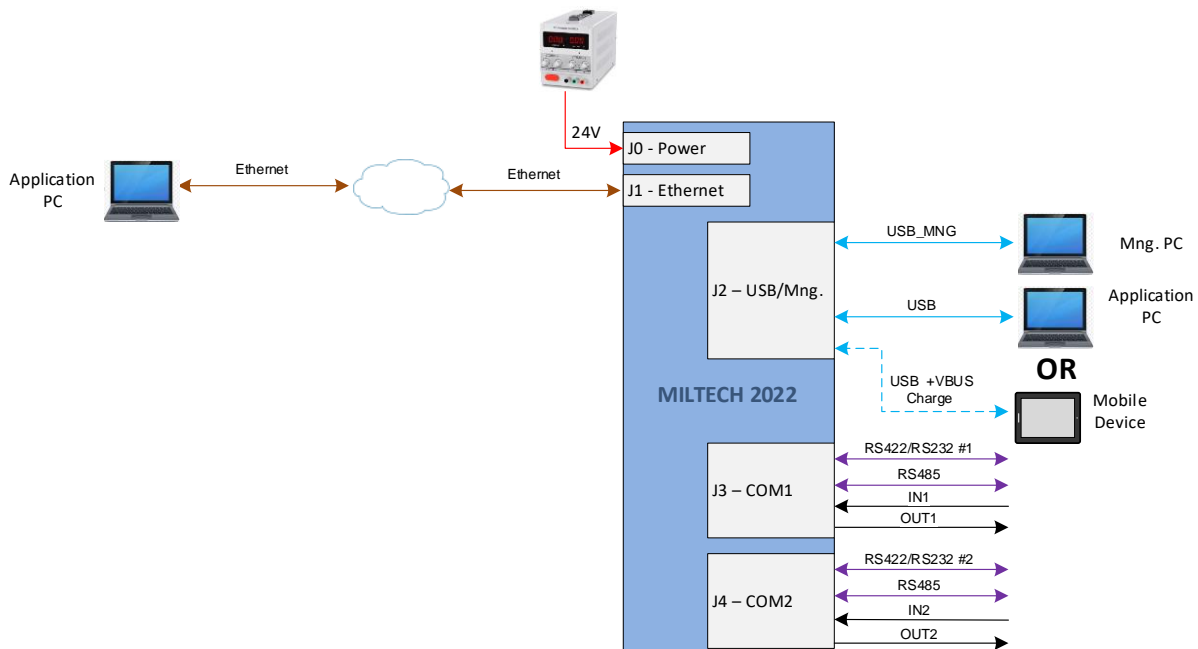
4. MILTECH 2022 Operating Modes

The MILTECH 2022 Transceiver unit can be activated in several operating modes that are detailed in this section. The actual operating mode and other mode dependent features are configurable through the external MT2022 management GUI (via the dedicated USB2 management port).

4.1 Serial Terminal Server Mode

On the remote equipment site, the MILTECH 2022 is connected to up to two RS232/RS422 (per port configuration) devices, Single Half Duplex RS485 device and/or Discrete I/Os (2x OPEN/GND IN and 2x OPEN/GND OUT). These COM and IOs can be controlled by a remote PC via Ethernet.

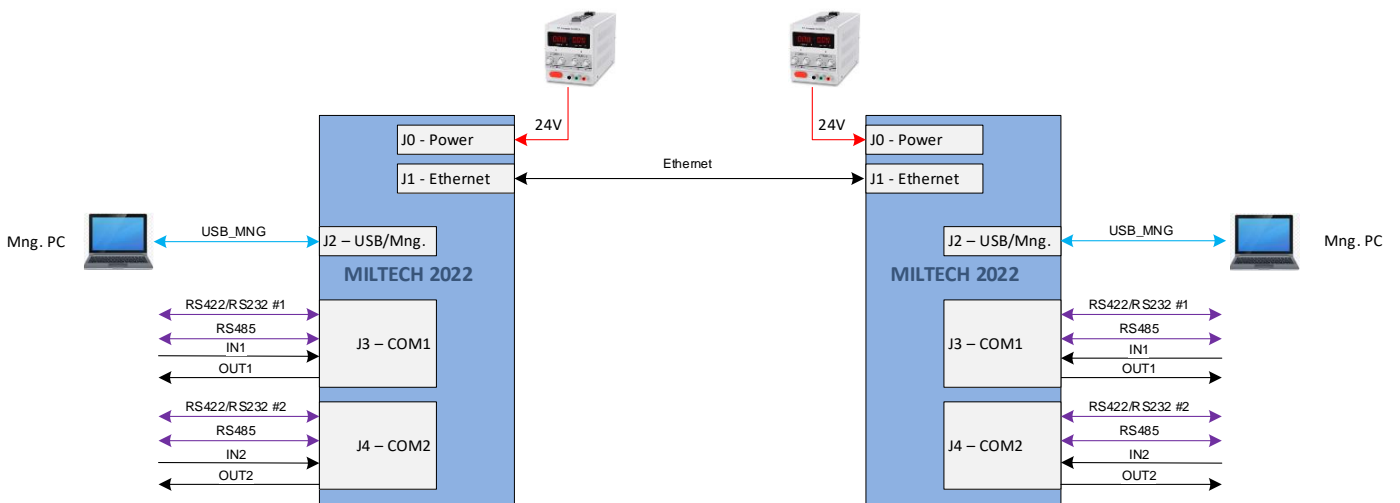
The MT2022 FPGA firmware implements the TCP/IP RFC2217 serial over Ethernet protocol for each of the three end-to-end ports. A dedicated TCP/IP port is allocated for the unit Discrete IOs control.



For example, this mode allows opening a Virtual COM in a remote PC and controlling the far end serial and IOs equipment.

4.2 Serial/Discrete IO Bridge System

This mode allows bridging serial (RS232/RS422/RS485) communications and/or Discrete IOs via two back-to-back MT2022 units. The two MT2022 units are communicated via Ethernet network. Each unit has a fixed IP address with per port assignment of the serial COMs and Discrete IOs attached to the unit interface connectors. The FPGA firmware implements the TCP/IP RFC2217 serial over Ethernet protocol for each of the four end-to-end ports. A dedicated TCP/IP port is allocated for the unit Discrete IOs end to end control.

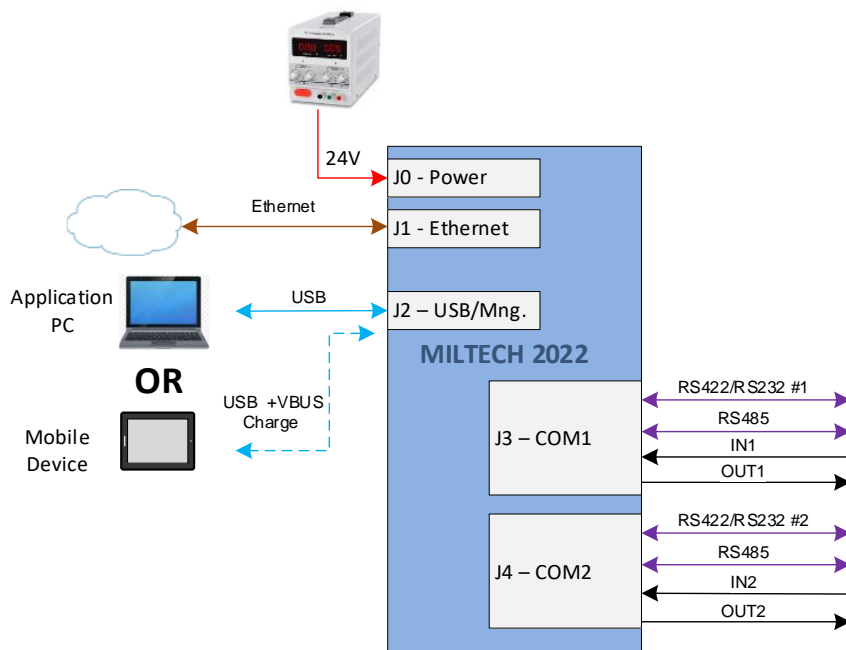


4.3 USB to RS232/RS422/RS485 Mode

Alternative mode for controlling the 3 external COM ports is the USB2 to COM1/COM2/COM3 mode.

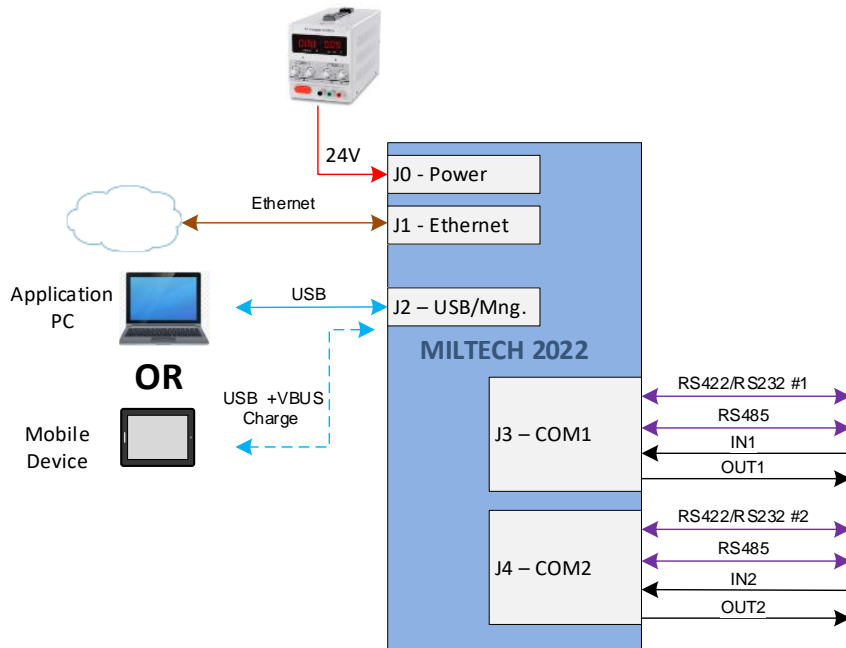
This mode allows a USB host PC access to three legacy 2 x RS232/RS422 and 1 x RS485 ports. The PC will identify the integrated FTDI devices and will install the required drivers to identify the 3 COM ports. The FPGA based routing of the 3 physical COM ports allows varies customer dependent configurations such as: COM1 and COM2 RS232 or RS422, COM1 and COM2 CTS/RTS enable/disable, COM3 RS485 port internal 120 ohm termination enable/disable, RS485 RX echo (Tx data echo to Rx path) enable/disable and more.

In case that a Mobile device is connected as the USB data host (e.g. Tablet, Smartphone) it will be charged using the MT2022 Power Delivery controller at 10W, simultaneously with the data transfer (assuming that the mobile device supports Power Delivery 3.0).



4.4 USB to Ethernet Mode

The MT2022 supports also a mode that allows an external USB data host, internet connectivity based on the integrated USB/Ethernet bridge and Ethernet Switch. In case that a Mobile device is connected as the USB data host (e.g. Tablet, Smartphone) it will be charged using the MT2022 Power Delivery controller at 10W, simultaneously with the data transfer (assuming that the mobile device supports Power Delivery 3.0).



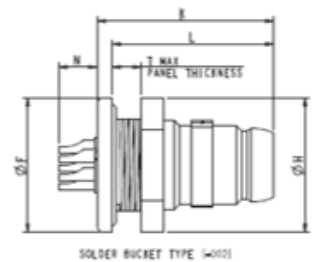
6. Unit External Interface Connectors ICD

6.1 Power Interface (J0)

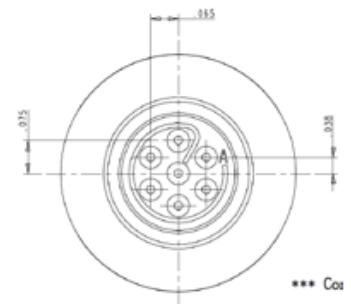
DC Power Input			
J0 - POWER			
Pin #	Signal Name	Signal Description	Comment
A	N.C		
B	N.C		
C	24V_IN	Power in +24V	Input DC range: 12V-28V
D	24V_IN	Power in +24V	Input DC range: 12V-28V
E	GND	Power in 24V RTN	Input DC range: 12V-28V
F	GND	Power in 24V RTN	Input DC range: 12V-28V
G	N.C		

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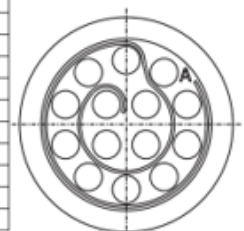
6.2 Ethernet Interface (J1)

Ethernet Ports					
J1 - Ethernet					
Pin #	Signal Name	Signal Description	Electrical Interface	Direction	Comment
A	MDI_A_P	Ethernet pair 0 signal P	10/100/1000BT	BiDIR	Supports 10/100/1000BT IEEE 802.3az standard - BLU
B	MDI_A_N	Ethernet pair 0 signal N	10/100/1000BT	BiDIR	Supports 10/100/1000BT IEEE 802.3az standard - BLU/W
C	MDI_B_P	Ethernet pair 1 signal P	10/100/1000BT	BiDIR	Supports 10/100/1000BT IEEE 802.3az standard - ORNG
D	MDI_C_P	Ethernet pair 2 signal P	10/100/1000BT	BiDIR	Supports 10/100/1000BT IEEE 802.3az standard - GRN
E	MDI_C_N	Ethernet pair 2 signal N	10/100/1000BT	BiDIR	Supports 10/100/1000BT IEEE 802.3az standard - GRN/W
F	MDI_B_N	Ethernet pair 1 signal N	10/100/1000BT	BiDIR	Supports 10/100/1000BT IEEE 802.3az standard - ORNG/W
G	MDI_D_P	Ethernet pair 3 signal P	10/100/1000BT	BiDIR	Supports 10/100/1000BT IEEE 802.3az standard - BRN
H	MDI_D_N	Ethernet pair 3 signal N	10/100/1000BT	BiDIR	Supports 10/100/1000BT IEEE 802.3az standard - BRN/W
J					
K					
L					
M					
N					
P	CHASSIS	chassis signal			

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Rear Plug View
07-14



Part Number: SCE2-B-76A07-14SN-001

6.3 USBs and Management IOs Interface (J2)

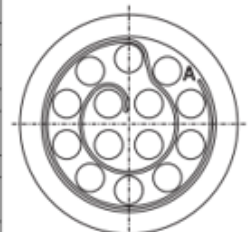
USB and IOs Ports					
J2 - USB/Maint.					
Pin #	Signal Name	Signal Description	Electrical Interface	Direction	Comment
A	VBUS	USB2.0 Vbus power input	USB2.0	IN	USB_US
B	USB1_DP	USB2.0 Data+ Signal	USB2.0	BIDIR	USB_US
C	USB1_DN	USB2.0 Data- Signal	USB2.0	BIDIR	USB_US
D	CC1	PD communication signal	Single Wire	BIDIR	USB_US
E	GND	USB2.0 GND signal	USB2.0	BIDIR	USB_US
F	5V_MNG	USB2.0 Vbus power input	USB2.0	IN	USB_MNG
G	USB2_DP	USB2.0 Data+ Signal	USB2.0	BIDIR	USB_MNG
H	USB2_DN	USB2.0 Data- Signal	USB2.0	BIDIR	USB_MNG
J	GND	USB2.0 GND signal	USB2.0	BIDIR	USB_MNG
K	EXT_GND	Discrete input/output GND reference	GND	BIDIR	
L	FP_PROG_EN	Discrete Open/GND Signal input	Discrete	IN	
M	FP_EXT_RST	Discrete Open/GND Signal input	Discrete	IN	
N	EARTH				
P	EARTH				



Part Number: SCE2-B-76A07-14SB-001

6.4 COM1/COM3 and Discrete IOs Interface (J3)

RS422/RS232/RS485 Seria and IOs COM Ports					
J3 - COM1					
Pin #	Signal Name	Signal Description	Electrical Interface	Direction	Comment
A	COM1_TX_P	COM 1 RS422 TX P/RS232 TX signal	R5422/RS232	OUT	Bus = FP1_RS422/232+CTS/RTS Dual made pin, per selected COM1 made (RS422 or RS232)
B	COM1_TX_N	COM 1 RS422 TX N signal	R5422	OUT	Bus = FP1_RS422/232+CTS/RTS
C	COM1_RX_P	COM 1 RS422 RX P/RS232 RX signal	R5422/RS232	IN	Bus = FP1_RS422/232+CTS/RTS Dual made pin, per selected COM1 made (RS422 or RS232)
D	COM1_RX_N	COM 1 RS422 RX N signal	R5422	IN	Bus = FP1_RS422/232+CTS/RTS
E	COM1_RTS_P	COM 1 RS422 RTS P/RS232 RTS signal	R5422/RS232	OUT	Bus = FP1_RS422/232+CTS/RTS Dual made pin, per selected COM1 made (RS422 or RS232)
F	COM1_RTS_N	COM 1 RS422 RTS N signal	R5422	OUT	Bus = FP1_RS422/232+CTS/RTS
G	COM1_CTS_P	COM 1 RS422 CTS P/RS232 CTS signal	R5422/RS232	IN	Bus = FP1_RS422/232+CTS/RTS Dual made pin, per selected COM1 made (RS422 or RS232)
H	COM1_CTS_N	COM 1 RS422 CTS N signal	R5422	IN	Bus = FP1_RS422/232+CTS/RTS
J	GND	COM 1 GND signal	R5422/RS232 RTN		
K	RS485_DP	RS485 Data Positive	RS485	BIDIR	Bus = FP1_RS485
L	RS485_DN	RS485 Data Negative	RS485	BIDIR	Bus = FP1_RS485
M	EXT_GND	O/G GND			
N	OUT1			OUT	
P	IN1			IN	



Part Number: SCE2-B-76A07-14SA-001

6.5 COM2/COM3 and Discrete IOs Interface (J4)

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Rear Plug View

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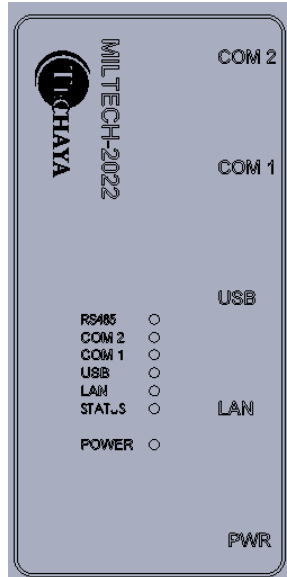


RS422/RS232/RS485 Seria and IOs COM Ports					
J4 - COM2					
Pin #	Signal Name	Signal Description	Electrical Interface	Direction	Comment
A	COM2_TX_P	COM 2 RS422 TX_P/RS232 TX signal	RS422/RS232	OUT	Bus = FP2_RS422/232+CTS/RTS Dual made pin, per selected COM1 mode (RS422 or RS232)
B	COM2_TX_N	COM 2 RS422 TX_N signal	RS422	OUT	Bus = FP2_RS422/232+CTS/RTS
C	COM2_RX_P	COM 2 RS422 RX_P/RS232 RX signal	RS422/RS232	IN	Bus = FP2_RS422/232+CTS/RTS Dual made pin, per selected COM1 mode (RS422 or RS232)
D	COM2_RX_N	COM 2 RS422 RX_N signal	RS422	IN	Bus = FP2_RS422/232+CTS/RTS
E	COM2_RTS_P	COM 2 RS422 RTS_P/RS232 RTS signal	RS422/RS232	OUT	Bus = FP2_RS422/232+CTS/RTS Dual made pin, per selected COM1 mode (RS422 or RS232)
F	COM2_RTS_N	COM 2 RS422 RTS_N signal	RS422	OUT	Bus = FP2_RS422/232+CTS/RTS
G	COM2_CTS_P	COM 2 RS422 CTS_P/RS232 CTS signal	RS422/RS232	IN	Bus = FP2_RS422/232+CTS/RTS Dual made pin, per selected COM1 mode (RS422 or RS232)
H	COM2_CTS_N	COM 2 RS422 CTS_N signal	RS422	IN	Bus = FP2_RS422/232+CTS/RTS
J	GND	COM 2 GND signal	RS422/RS232 RTN		
K	RS485_DP	RS485 Data Positive	RS485	BIDIR	Bus = FP1_RS485
L	RS485_DN	RS485 Data Negative	RS485	BIDIR	Bus = FP1_RS485
M	EXT_GND	O/G_GND			
N	OUT1			OUT	
P	IN1			IN	

Part Number: SCE2-B-76A07-14SA-001

7. Unit Front Panel LEDs

The MILTECH-2022 unit front panel includes the following LED indication array:



LEDs description:

LED	OFF	Solid Green	Blinking Green	Solid Orange	Blinking Orange
Power	Unit is off	Unit is ON	NA	Unit is in STBY (TBD)	NA
Status	Unit is off	BIT passed	NA	BIT Failed	NA
LAN	Unit is off or No Link	RX/TX Activity	NA	NA	OFF -10/100 ON – 1000
USB	Unit is off or No Link	HS	NA	FS	NA
COM1	Unit is off or No Link	RS232	RS232 Activity	RS422	RS422 Activity
COM2	Unit is off or No Link	RS232	RS232 Activity	RS422/ RS485 FD	RS422/RS485 Activity
RS485	Unit is off or No Link	RS485 Half Duplex	RS485	RS485 Full Duplex *	NA

8. Unit Management Interface

The MILTECH-2022 unit supports a dedicated USB2 management interface (allocated in J2 interface connector) that optionally can be accessed by an external host or a certified technician for monitoring and controlling the unit operation. This includes:

1. FPGA firmware upgrade
2. Unit Built in Self-Test (BIT) status
3. Unit mode setting and configuration
4. Unit Reset

Note that this USB2 port acts as UART COM port, the FTDI bridge IC is located on the MT2022 unit so a direct USB PC is supported.

During power up cycle there are 5 seconds that allows entering a technician mode, via the MT2022 COM port (PC COM terminal). This local UART based communication port allows access whenever the Ethernet TCP/IP link fails or in case of local unit configuration/monitoring by technician.

To enter the technician mode, the system has 5 seconds to receive "bd" in ascii from the user via the technician port.

UART Management Port characteristics

The technician UART port is based on the following UART parameters:

Baud rate : 115200bps
Data bits : 8bit
Parity : non
Stop bit : 1bit
Mode : async (no flow control)

9. Unit Power Supply

The MILTECH-2022 unit is powered by external 9.5-40V DC input applied to interface connector J0 (see section 6.1).

The unit has an integrated power supply based on Milpower M7880-2 DC-DC module that delivers a regulated 5.2V DC output to the MT2022 main board for powering it's internal circuitry and for the USB Power Delivery optional charging power.

Following is the M7880 DC-DC module specifications:

Input Voltage	9.5V to 40V (Full performance). Nominal input of 28V
Input Transient 100V/50m	Working.
Output voltage	5.2V±3%.
Output Ripple	<50mVpp
Efficiency	>77% @ 28V input voltage and full load
Pout	Maximum 15W
Active OV protection	5.9V
Passive OV protection	3W Zener 6.2V
Input OV/UV	Vin<8.6V Vin>51±2V
Output Over/Under Shoot for Dynamic load 30% to 100%	<5%
Output OK indication	LED
Input EMI Filtering	DM & CM
Input ripple	<60mV
Frequency	200kHz