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MCDT INSTRUCTION MANUAL

MCDT Multi-Channel Data Transceiver
P/N 10D1037

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Form #: 30Z0250
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MCDT Instruction Manual

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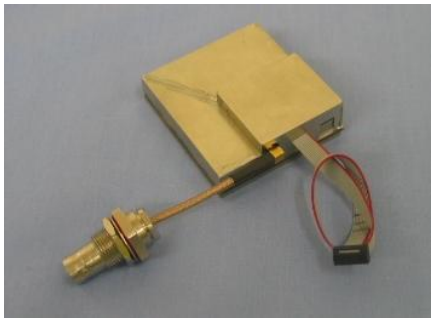
Section 1: MCDT Multi-Channel Data Transceiver

Description

The Multi-Channel Data Transceiver (MCDT) is available as a modular modem to OEM users who want to design it into their own equipment. Equipped with RS-485 communications, the MCDT can be set up using a personal computer. The MCDT is capable of transmitting or receiving SEIWG-5 data messages, including a status code and distinct ID, over a radio frequency. This frequency is selectable via synthesizer control circuits, providing a selection of up to 1920 RF channels, depending on the model's frequency range. The MCDT comes in Low-Band, Medium-Band, and High-Band models, having the following frequency ranges:

Low Band	Medium Band	High Band
Channel 001 = 138.025 MHz	Channel 001 = 154.005 MHz	Channel 001 = 162.00625 MHz
Channel 600 = 153.000 MHz	Channel 1600 = 162.000 MHz	Channel 1920 = 174.000 MHz



Antenna: MMCX plug to accept user-supplied antenna
Power Supply: User-supplied, 4.8V to 16.5VDC nominal, 18 VDC absolute maximum

Connections:

Function	J1 (10-pin FTS-105)	Via
Vin [Input] 4.8 to 16.5 VDC	1, 2	E1
GND	8, 9, 10	E8
RS485 – A+ [I/O]	5	E4
RS485 – B– [I/O]	4	E5
Transmit Drive [Output] Active low	3	E3
VCC [Out] 5.4VDC	6	E2
Wakeup [I/O] Active low	7	E6

Current Draw approximations:

Mode	Current	Comments
Sleep	33uA	RS485 command will wake unit up
Active	7.0mA	Receiver Off / Microprocessor On
Transmission(1Watt)	57ms @ 1.5A	Pulse Current Provided by Super Caps
Transmission(2Watt)	57ms @ 3A	Pulse Current Provided by Super Caps
Receiver On	12.6mA	Receiver On – Waiting for valid RF message
Receiver Active	16.9mA	RF message received – Microprocessor On

Design Features

- ID Code Selection 000-999 for EMIDS, 000-063 for all other formats
- Directional, sensor fault, low battery, tamper, and test status codes for EMIDS format
- Able to receive and transmit MIDS 20-bit, MMIDS / EMIDS 29-bit messages, TRSS, or REMBASS
- MMCX antenna port matched to 50 ohms
- Conformal-coated and shielded circuit assembly

Operation

Connections to the MCDT can be made using a ribbon cable connected to J1 or using flying leads soldered directly to the VIAS. *See Connections table* above to determine pin outs. Using the settings provided in *Section 3: Serial Interface*, open a serial communication program such as HyperTerminal and supply power to the MCDT. Upon establishing a connection to the MCDT, the computer screen will display "BL<LF><CR>" for one second and then display the version information. This indicates a ready status.
The "BL" (Boot Loader) response provides for one (1) second the opportunity to enter the programming mode. Sending a "P" will enter the firmware upgrade mode and erase the firmware of the device. Therefore, the user is advised not to send any characters to the unit, especially not the character "P", to the unit before the version information is received.

Section 2: MCDT Operation

During normal operation, the MCDT is capable of sending and receiving SEIWG-5 messages via the serial port and via radio frequency. The MCDT assumes a low-power shut-down mode to conserve power when not in use.

Receiving/Transmitting

ITEMS REQUIRED

1. DC Power Source: 4.8 to 16.5 Volts
2. Personal Computer with COM port (RS-232 or USB)
3. RS-485 Adapter Cable to convert RS-485 to PC's COM port format
4. Serial Communications Program such as HyperTerminal

SETUP

1. Set the Channel. (Default CHR 001)
2. Enable receiver, if desired. Transmit is always enabled. (Default RCV ON)
3. Enable TRSS format, or disable TRSS for EMIDS format. (Default TRSS OFF)
4. Enable Push to send messages out serial port, or disable PUSH to poll for messages. (Default PUSH ON)

RF Link

The operational range of the RF link is dependent upon various conditions. The high frequency of the RF link works best under line of sight conditions. RF range may vary from 0.5 kilometer to 5 kilometers for open areas using the 1-Watt setting. Greater range may be expected using the 2-Watt setting.

NOTE: Elevating an antenna will increase transmission and/or reception range significantly. The use of relays/repeaters can also be used to increase transmission ranges. Also transmitting and receiving antennas should both point in the same direction (typically up) so they have the same polarization.

Section 3: Serial Interface

The MCDT defaults to a low-power shut down mode. Upon receiving an RF message, the MCDT will send the message via the serial port and then return to shut-down immediately. The user may initiate serial communication by sending the MCDT two ASCII characters. After 1 minute of inactivity on the serial port, the MCDT returns to low-power shut down mode. If the user disables the PUSH setting and the MCDT has a new message on hold in the buffer, the shut-down mode will be prevented because this condition pulls the Wakeup [I/O] line low.

The MCDT communicates over RS-485. Send a command followed by a carriage return (<CR>). Settings are retained only until power is turned off unless the SAV command is used to store them to the unit's flash memory. When sending commands and queries, a two-digit hexadecimal checksum (cs) can be used to check data integrity. This is done by preceding the command with "#" and following the command with the checksum value and a carriage return. If a checksum is not desired, simply do not include the # or checksum (cs) value.

SETTINGS

38400 baud, fixed
No parity
8 bit
1 stop bit
No flow control

Checksum:

To use checksum begin the command with "#" and end the command with the calculated checksum (cs) value followed by the carriage return <CR>. A command with an invalid checksum is ignored and no reply is sent. The checksum is a 2 digit hexadecimal calculated as the 2's compliment of the sum of the command string.

Using the checksum also allows and requires using the serial ID. The universal ID is X, so all units will acknowledge these commands. The unit will respond with its specific ID

Example:

Sample syntax:

Action	**With Checksum**	**Without Checksum**
Get channels:	`#XCHN04<CR>`	`CHN<CR>`
Returns:	*`#AChnR 2 ChnX 456B0<CR>`*	*`CHNR 2 CHNX 456<CR>`*
Set channels to 2:	`#XCHN 2B2<CR>`	`CHN 2<CR>`
Returns:	*`#ACHNR 2 CHNX 21D<CR>`*	*`CHNR 2 CHNX 2<CR>`*

Note: "A" is just a sample serial ID, and may be different.

Example checksum calculator

```
char CRC2sComp( char *buffr, int end)
{//creates 2's complement
        int c;
        int calcSum = 0;
        for( c = 0; c <= end; c ++ )
           calcSum += buffr[c];
        calcSum ^= 0xFF;        //1's complement
        calcSum += 1;   //now 2's complement
        return (char)(calcSum);
}
```

Message Serial Format

Decoded message is sent via RS-485:
RXM XX YYY ZZ<CR>, where XX = Message Type, YYY = ID code, and ZZ = status code; all values are hexadecimal.

MESSAGE TYPE (XX)

The message type consists of two (2) hexadecimal characters. The first character shows the parity; the most significant bit will be set if the parity is bad. The second character identifies the type.

Examples of parity:

Good parity	0X	(0000xxxx in binary)
Bad parity	8X	(1000xxxx in binary)

List of types:

MIDS	X7	
EMIDS/TRSS	XD	(EMIDS format if TRSS mode OFF (default) / TRSS format if TRSS ON)
REMBASS	X6	

NOTE: Because EMIDS and TRSS have the same message *type*, the message *format* is distinguished based on whether TRSS mode is enabled (TRSS format) or disabled (EMIDS format).

The MCDT can receive MIDS and REMBASS messages at any time without setting the unit to a particular mode. In addition, the unit can receive either EMIDS or TRSS messages, but the user must specify which for the MCDT to expect since these two have the same message type.

ID CODE (YYY)

The unit ID code consists of three (3) hexadecimal characters, but only EMIDS messages use all three. MIDS, TRSS and REMBASS are limited to ID codes 000-03F (63). EMIDS uses 000-3E7 (999).

STATUS CODE (ZZ)

Status Codes depend upon the message format. MIDS has no status code, and these characters should always be 00. EMIDS status codes are listed in the following table:

STATUS CODE	ALARM	TAMP/TEST	LOBATT	R>L	L>R	MEANING
00	0	0	0	0	0	RESERVED
01	0	0	0	0	1	RESERVED
02	0	0	0	1	0	RESERVED
03	0	0	0	1	1	FAULT
04	0	0	1	0	0	RESERVED
05	0	0	1	0	1	RESERVED
06	0	0	1	1	0	RESERVED
07	0	0	1	1	1	FAULT, LOBATT
08	0	1	0	0	0	TEST
09	0	1	0	0	1	RESERVED
0A	0	1	0	1	0	RESERVED
0B	0	1	0	1	1	TEST, FAULT
0C	0	1	1	0	0	TEST, LOBATT
0D	0	1	1	0	1	RESERVED
0E	0	1	1	1	0	RESERVED
0F	0	1	1	1	1	TEST, FAULT, LOBATT
10	1	0	0	0	0	ALARM
11	1	0	0	0	1	ALARM, L>R
12	1	0	0	1	0	ALARM, R>L
13	1	0	0	1	1	ALARM, FAULT
14	1	0	1	0	0	ALARM, LOBATT
15	1	0	1	0	1	ALARM, L>R, LOBATT
16	1	0	1	1	0	ALARM, R>L, LOBATT
17	1	0	1	1	1	ALARM, FAULT, LOBATT
18	1	1	0	0	0	TAMP
19	1	1	0	0	1	RESERVED
1A	1	1	0	1	0	RESERVED
1B	1	1	0	1	1	TAMP, FAULT
1C	1	1	1	0	0	TAMP, LOBATT
1D	1	1	1	0	1	RESERVED
1E	1	1	1	1	0	RESERVED
1F	1	1	1	1	1	TAMP, FAULT, LOBATT

Status Code Table

Commands

?…….. Brings up the help menu

The current help menu (without checksums) appears as follows:

```
Commands
---------
HELP/?:  Show this menu
CHR:     Get/Set rcv Chan
CHX:     Get/Set xmit Chan
MSG:     Get rcvd msg
PWR:     Get/Set xmt pwr level
PSH:     Get/Set push mode
RCV:     Get/Set receive mode
RSS:     Get receive signal strength
RST:     Reset
SAV:     Save Current Parameters
SLP:     Sleep
SRN:     Get unit serial num
TMP:     Read Temp
TRS:     Turn TRSS Format On/Off
TXM:     Xmit msg, type, ID, stat
VER:     Show versions
```

CHR…Get/Set the receive channel. (Follow with SAV command.)

Low Band: 0-600

Med Band: 0-1600

High Band: 0-1920

Get the channel:	CHR<CR>
Returns:	*CHR Z<CR>*
Set the channel:	CHR Z<CR>
Returns:	*CHR Z SET<CR>* Or *CHR Z ERR<CR>* if invalid value given

CHX…Get/Set the transmit channel. (Follow with SAV command.)

Low Band: 0-600

Med Band: 0-1600

High Band: 0-1920

Get the channel:	CHX<CR>
Returns:	*CHX Z<CR>*
Set the channel:	CHX Z<CR>
Returns:	*CHX Z SET<CR>* Or *CHX Z ERR<CR>* if invalid value given

MSG….. Recall a previous message.

0-9 with 0 being most recent message, and 9 being the oldest message

Get a message:	MSG X<CR>
Returns:	*RXM TT III SS<CR>, where TT is the message type,III is the ID, and SS is the status code*

NEW…..Read New messages. Use when PUSH is OFF. (This command is not listed under Help menu.)

Poll for a new message:	NEW<CR>
Returns:	*RXM TT III SS<CR>, where TT is the message type,III is the ID, and SS is the status code*
Returns if no new message:	*RXM<CR>*

PSH….Get/Set to push new messages out the serial port.

1 = ON (New messages pushed out the serial port when received)

0 = OFF (must poll for new messages)

Get PUSH mode:	PSH<CR>
Returns:	*PSH Z<CR>*
Set PUSH mode:	PSH Z<CR>
Returns:	*PSH Z<CR>*

PWR…Get/Set the transmitter power level.

1 = 1 watt transmit power at least

2 = 2 watt transmit power at least

Get power level:	PWR<CR>
Returns:	*PWR Z<CR>*
Set power level:	PWR Z<CR>
Returns:	*PWR Z<CR>*

RCV ….. Get/Set receive mode.

1 = ON (receiver enabled)

0 = OFF (receiver disabled)

Get receive mode:	RCV<CR>
Returns:	*RCV Z<CR>*
Set receive mode:	RCV Z<CR>
Returns:	*RCV Z<CR>*

RSS….. Get the receive signal strength.

Returns a value from 0- 10230

Get RSSI:	RSS<CR>
Returns:	*RSS Z<CR>*
Conversion	dBm = 0.0106 * Z – 150dBm

dBm	RSS value
-91	5284
-101	4523
-111	3570
-121	2591

RST……Reset the unit. No return string.

Reset the unit:	RST<CR>
Returns:	

SAV …...Save the current parameters in flash memory. Use this to store any parameter changes.

Save current settings:	SAV<CR>
Returns:	*SAV MCDT DATA<CR>*

SLP…….Shut down the serial port immediately to conserve power.

Enter low power mode:	SLP<CR>
Returns:	*SLP<CR>*

SRN…. Get the unit serial number.

The serial number is a string up to 20 characters long.

Get serial number:	SRN<CR>
Returns:	*SRN Z<CR>*

TEMP… Get the board temperature in degrees Celsius, with a tenth degree precision.

Get temperature:	TMP<CR>
Returns:	*TMP Z.Z<CR>*

TRS…..Get/Set TRSS message format.

1 = ON (TRSS message format enabled, EMIDS disabled)

0 = OFF (TRSS message format disabled, EMIDS enabled)

Get TRSS format:	TRS<CR>
Returns:	*TRS Z<CR>*
Set TRSS format:	TRS 1<CR>
Returns:	*TRS 1<CR>*
Set EMID format:	TRS 0<CR>
Returns:	*TRS 0<CR>*

TXM…...Transmit Message; explained in Transmitting section below.

Send RF message:	TXM TT III SS<CR>, where TT is the message type, III is the ID, and SS is the status code
Returns:	*TXM XX YYY ZZ<CR>*

VER….. Get the firmware version.

Get version:	VER<CR>
Returns:	*MCDT VV.VVV B<CR>, where MCDT is the model VV.VVV is the version, and B is the frequency band*

Section 4: Maintenance

OPERATOR MAINTENANCE:

The MCDT has been designed as low cost low maintenance equipment. All components are conformal coated which reduces the amount of maintenance required. The only required operator maintenance is to inspect the equipment for damage and keep the equipment clean of dirt, grime, and caked on mud.

- NOTE: Do not submerge the equipment in water. This could result in damage.

DEPOT MAINTENANCE:

Upper echelon maintenance will be performed by the supplier of the equipment. If the equipment is beyond the user capability to repair, it can be returned to the supplier for test and evaluation. Upon completion of the inspection, the supplier will notify the user if the unit can be repaired. If the equipment is not covered by the warranty, an estimate will be provided for repair costs. If the equipment is not repairable, the supplier will specify replacement costs. (Note: See warranty below for return procedures.)

EQUIPMENT STORAGE:

Upon return to the facility, clean equipment as noted in operator maintenance above. Remove batteries from all equipment to prevent possible damage. If batteries are left in the equipment, transmitters will continue to send fault alarms every 10 minutes causing a continuous drain on the batteries and possibly resulting in damaged or ruptured batteries. After cleaning, return the equipment to the storage cases. Store in a dry, room temperature environment.

WARRANTY:

Qual-Tron, Inc. guarantees all products to be free from defects in materials and workmanship for 12 months from the date of purchase. Damage due to misuse, accidents, lightning strikes, unauthorized service, environmental conditions beyond the equipment specifications, acts of war or damage other than fair, wear and tear is excluded from this warranty.

RETURN PROCEDURES:

For support and service, please contact the following. To return any material, contact Qual-Tron, Inc. to receive a Return Material Authorization (RMA) number. Once an RMA number has been assigned, ship the material to the address below and reference the RMA number on the packing slip. Qual-Tron will return the equipment as quickly as possible to the user.

QUAL-TRON, INC.
Attn: Sales
9409 E. 55th Place
Tulsa, OK 74145

Ph: 918-622-7052
Fax: 918-664-8557
email: sales@qual-tron.com

TROUBLESHOOTING GUIDE:

Defect	Possible Cause	Corrective Action	Stage Area	Empl Site
Will not turn on	Battery low voltage	Check power supply	X	
Does not receive/transmit alarms	Battery low voltage	Check power supply	X	
	Transmitter & receiver too close to each other	Experiment with antenna combinations (with & without)	X	X
	Frequency	Verify transmitter and receiver are on the same frequency	X	
	Receiver not enabled	Verify receive mode is on	X	
	Wrong message format	Check TRSS mode	X	

Section 5: Frequency/Channel Calculations

Frequency Ranges				
Frequency Range	Frequency		Channel Steps	Max Channels
	Min	Max		
Low	138 MHz	154 MHz	25 kHz	600
Mid	154 MHz	162 MHz	5 kHz	1600
High	162 MHz	174 MHz	6.25 kHz	1920

Channel to Frequency Calculation

Channel * Channel Step + Min Frequency = Frequency for Channel

Examples:

- Low Band Channel 20
- 20 * 0.025 +138 =138.5 MHz
- Mid Band Channel 300
- 300 * 0.005 + 154 = 155.5 MHz

Frequency to Channel Calculation

(Frequency – Min Frequency) / Channel Step = Channel for Frequency

Examples:

- Low Band 151.5 MHz
- (151.5 – 138) / 0.025 = Channel 540
- High Band 172.5 MHz
- (172.5 – 162) / 0.00625 = Channel 1680

Section 6: FCC RF Exposure Limits:

This device complies with the MPE requirements by providing a safe separation distance of 30 cm between the antenna, including any radiating structure, and any persons when normally operated.

CAUTION:

The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This device is approved with emissions having a source-based time-averaging duty factor not exceeding 50%.

Operating at a lower duty cycle than 50% will allow proportionately shorter exposure distance than 30 cm.