RFD V4 BETA AT Command and Parameter Overview Application Note

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1 Key Features

- List of AT Commands
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2 Disclaimer and Limitations

The V4 BETA firmware is under active development, there may be significant changes to the operation between firmware releases. Known bugs and issues are listed in the firmware release notes. It is possible that further faults may be found during use. This firmware is to be considered experimental and should be used as such.

Any bugs, issues, general feedback or questions should be addressed to the team via email at beta@rfdesign.com.au

Note: The V4 BETA firmware is currently only configurable by AT Commands. It is not compatible with the modem tools GUI.

Note: The V4 BETA firmware is currently only compatible with the V2 hardware revision of the x series modem. See the x series modem datasheet for details on how to identify the modem hardware version if you are unsure.

3 AT Commands

3.1 AT Commands:

Note: The BETA firmware is currently **only configurable** by AT Commands.

The AT command mode can be entered by sending '+++', without quotes, sequence in a serial terminal connected to the radio at the correct baud rate, 57600 by default.

If successful, an 'OK' will be displayed on the screen and the modem will stop displaying incoming data from the remote modem, if any.

In command mode, you can use the AT commands to manage the local modem settings.

AT Command	Description
ATI	Shows the firmware version, country code and hardware revision
ATI1	Shows the firmware version number
ATI2	Shows the board type code
ATI3	Shows board frequency code
ATI4	Shows board version
ATI5	Shows user settable EEPROM parameters and their values (not all values maybe shown due to limitations in the UART buffer)
ATI5:x:y	A subset of the ATI5 command. It displays only the specified parameters in the range x to y inclusive. Example usage ATI5:6:11 will print parameters S6 through S11
ATI6	Show radio packet information about data sent and received on each port. Information on internal data queues. (Used for internal testing)
ATI7	Show timing information about TDM process. (Used for internal testing)
ATI8	Display Device 64-bit unique ID
ATI9	Calibration validation test
ATI10:n	Displays radio S parameter number 'n' and valid settings range.
ATI11	Show information on RC data packets sent or received, if any. Only works if the node is configured as an RC input or RC output.
ATI12	Show the current external node priority list entries
ATO	Exits AT command mode
ATSn=X	Sets radio 'S' parameter number 'n' to 'X'
ATZ	Reboots the radio
AT&F	Resets all parameters to factory defaults
AT&UPDATE	Reset and enter boot mode
AT&R	Record default PPM stream for PPM output (vehicle side)
AT&T	Disables debugging report
AT&T=RSSI	Enables RSSI debugging report

AT commands should be followed by a carriage return /r or newline /n character. In most terminal programmes this can be done by pressing the enter key.

All successful commands, except ATZ, will return an 'OK'

Note: Modem parameters are saved whenever changes are made but modems need to be rebooted after any settings have been modified to activate changes.

3.2 RTI commands:

Command mode can be used to issue commands to other, remote, nodes in the network. This can be done on a broad cast basis by issuing the commands below. Alternatively, the commands can be directed to a target node by adding '@X', without quotes and substituting the desired NODEID for X.

Example:
RTI
All nodes in range will respond with firmware version, country code and hardware revision

RTI@2
Only node 2 will respond with firmware version, country code and hardware revision

AT Command	Description
RTI	Shows the firmware version, country code and hardware revision
RTI1	Shows the firmware version number
RTI2	Shows the board type code
RTI3	Shows board frequency code
RTI4	Shows board version
RTI5	Shows user settable EEPROM parameters and their values (not all values maybe shown due to limitations in the UART buffer)
RTI5:x:y	A subset of the RTI5 command. It displays only the specified parameters in the range x to y inclusive. Example usage ATI5:6:11 will print parameters S6 through S11
RTI6	Show radio packet information about data sent and received on each port. Information on internal data queues. (Used for internal testing)
RTI7	Show timing information about TDM process. (Used for internal testing)
RTI8	Display Device 64-bit unique ID
RTI9	Calibration validation test
RTI10:n	Displays radio S parameter number 'n' and valid settings range.
RTI11	Show information on RC data packets sent or received, if any. Only works if the node is configured as an RC input or RC output.
ATI12	Show the current external node priority list entries
ATO	Exits AT command mode
ATSn=X	Sets radio 'S' parameter number 'n' to 'X'
ATZ	Reboots the radio
AT&F	Resets all parameters to factory defaults
AT&UPDATE	Reset and enter boot mode

4 S Parameter Definitions

4.1 S parameter settings table:

Reg #	S Register Name	Default Value	Minimum Value	Maximum Value	Same for all nodes	Master Only
S0	FORMAT (Not user settable. Set by the firmware)	Firmware dependant	N/A	N/A	Yes	No
S1	BITRATE	64	12	1000	Yes	No
S2	FREQMIN	915000 /868000	902000 /870000	928000 /865000	Yes	No
S3	FREQMAX	921000 /869000	903000 /870000	928000 /866000	Yes	No
S4	NUMCHANS	23	1	51	Yes	No
S5	XTRALONGRNG	0	0	1	Yes	No
S6	P2PAUTO	1	0	1	Yes	No
S7	TOTALUS	39891	5000	220000	Yes	No
S8	SLOTS	2	0	63	Yes	No
S9	SLOTIDS	2	0	2^{64} -1	No	No
S10	NODEID	1	0	62	No	No
S11	NETID	0	0	31	Yes (In the same network)	No
S12	NETWORKS	1	1	31	Yes	No
S13	BINDID	0	0	3	Yes	No
S14	DESTID	63	0	63	No	No
S15	HOPSMAX	1	1	7	Yes	No
S16	VALIDHOPSMIN	0	0	7	No	No
S17	VALIDHOPSMAX	7	0	7	No	No
S18	PRI	1	1	3	No	No
S19	SLOTTXMODE	7	0	7	No	No
S20	ENCRYPTLVL	0	0	2	Yes	No
S21	S1BAUD	57600	9600	1200000	No	No
S22	S1DATATYPE	0	0	2	Yes	No
S23	S1KBPS	1000	0	1000	No	No
S24	S1RXROUTE	0	0	3	No	No
S25	S2BAUD	57600	9600	1200000	No	No
S26	S2DATATYPE	0	0	2	Yes	Yes
S27	S2KBPS	1000	0	1000	No	No
S28	S2RXROUTE	1	0	3	No	No
S29	S2ATMODE	0	0	1	No	No
S30	TXPOWER	30	0	30	Yes	Yes
S31	ANTMODE	0	0	4	No	No
S32	RATE/FREQBAND	0	0	0	Yes	No
S33	RSVD1	NA	NA	NA	NA	NA
S34	RSVD2	NA	NA	NA	NA	NA
S35	PIN0TYPE(13)	1	0	28	No	No
S36	PIN1TYPE(15)	0	0	28	No	No

Reg #	S Register Name	Default Value	Minimum Value	Maximum Value	Same for all nodes	Master Only
S37	PIN2TYPE(14)	20	0	28	No	No
S38	PIN3TYPE(12)	21	0	28	No	No
S39	PIN4TYPE(10)	19	0	28	No	No
S40	PIN5TYPE(8)	18	0	28	No	No
S41	PINRTSTYPE(3)	16	0	28	No	No
S42	PINCTSTYPE(11)	0	0	28	No	No
S43	RCFRAMELOSS	50	5	6666	No	No
S44	RCINMINMS	12	5	200	No	No
S45	PINDEFAULT	1,1,0,0,0,0,0,0,	0 (each element)	1 (each element)	No	No
S46	PINMIRROR	0,1,2,3,4,5,6,7,	0 (each element)	7 (each element)	No	No
S47	RCDEFS	1500,1500,1500, 1500,1500,1500, 1500,1500,1500, 1500,1500,1500, 1500,1500,1500, 1500,1000,1000,	900 (each element)	2100 (each element)	No	No
S48	ENCRYPTKEY	96,61,235,16,21, 202,113,190,43, 115,174,240,133 ,125,119,129,31 ,53,44,7,59,97,8, 215,45,152,16,16 3,9,20,223,244,	0 (each element)	255 (each element)	Yes	No
S49	FWDTABLE	64,64,64,64,64, 64,64,64,64,64, 64,64,64,64,64, 64,64,64,64,64,	0 (each element)	64 (each element)	No	No

4.2 S parameter definitions and purposes:

4.2.1 Miscellaneous settings:

Format - Packet Format

A read-only parameter. The FormatId is always the first parameter and is used to identify the format of the data.

4.2.2 Network Layer Settings:

NODEID - Node Identifier

The NodeID parameter is an address identifier for the node. Each NODEID should only be used once in each network. Value is 0 to 62. (63 is reserved for broadcast)

Note: NODEID must be unique for each node with a given NETID i.e. all nodes in a network need a unique NODEID but the same NODEID can be reused across different networks (i.e. different NETIDs)

NETID - Network Identifier

The NetID parameter represents the network ID of this node. Multiple networks can exist in the same frequency space under the control of a single master node. Data is only passed within the same network. Data cannot move between networks. Each network will only be visible to nodes with the same network ID. The master network is NETID=0 and must exist. Permissible values are from 0 to (NUMCHANS – 1).

Note that this field sets a channel offset from the master network 0. As such some settings may work better than others for avoiding RF interference between nodes.

NETWORKS - Number of Networks

This number is the total number of networks. i.e. the total of all different NetIDs that are configured on an installation with the one master node. This number is needed to adjust timing for the case of more than 1 network.

BINDID - Binding Identifier

The BindID parameter allows the use of multiple groups in the same area. The value range is 0 to 3. Only radios will filter packets and only receive those from radios with the same BINDID.

Note: This should not be used. This has not been toughly tested at this time. Ideally only two sets of radios should be in the same range of each other and **the best method** to ensure proper operation is to **use different frequency bands** for the different groups of radios.

DESTID - Destination Node Identifier

The DESTID parameter dictates where the node will send data. A value of 63 will broadcast messages to the entire network. A receiving node will discard received messages unless the address matches its own or is 63.

HOPSMAX - Maximum Number of Hops

The HOPSMAX parameter represents the system's absolute maximum number of hops. Hops refer to forwarded paths. Hops are used when nodes cannot see the master node. It must be the same value for all modems. This value allows the system to adjust timing for nodes that are syncing off a non 0 NetId network.

VALIDHOPSMIN - Minimum Acceptable Number of Hops

The VALIDHOPSMIN parameter specifies the minimum number of hops required to accept packets.

Note: This parameter is for debugging purposes of forwarding network tests. i.e. for a chain of 3 nodes forwarding the Min,Max for Node 0 would be 0,1 , for Node1 0,2, for node 3 1,2 In normal operation this parameter needs to be set to its default value of 0 for hopping to behave correctly.

VALIDHOPSMAX - Maximum Acceptable Number of Hops

The VALIDHOPSMAX parameter specifies the maximum number of hops required to accept packets.

Note: This parameter is for debugging purposes of forwarding network tests. i.e. for a chain of 3 nodes forwarding the Min,Max for Node 0 would be 0,1 , for Node1 0,2, for node 3 1,2

In normal operation this parameter needs to be set to its default value of 0 for hopping to behave correctly.

PRI - Node Priority

The Pri parameter represents the priority of this node's packets. 1 indicates low priority, 2 indicates medium priority, and 3 indicates the highest priority. Lower priority nodes can be forced to give up half of it slot to priority 3 nodes. Priority 2 will take over remaining unused portions of lower priority node slots but will not force the yielding half of their slot.

Note: An RC input device should be priority 3 and other nodes to lower priorities.

Note: Priority can also be used when you wish a node to get more bandwidth than others, but typically modifying serial bandwidth on other nodes is a more reliable way to achieve this.

FWDTABLE - Forwarding Table

The FWDTABLE parameter is an array of forwarding table entries. Up to twenty comma separated entries can be set in the table and represent 10 pairs of source and destination nodes. Settings for the table can be configured in the following ways:

- A source address of 64 indicates a bypassed pair in the table.
- Source of 63 means forward packets from all nodes.
- Any other source values will forward data from the specific node.
- A destination of 64 indicates will use the forward destination address in the incoming packet.
- A destination value of 63 overwrites the destination of the incoming packet and instead sets the system to broadcast the forwarded data.
- Any other value overwrites the destination of the incoming packet and instead sets the destination ID to the specified node from the table.

Note: If the forwarding buffer is full and further data to be forwarded is received this newest data will be discarded.

4.2.3 Encryption Settings:

ENCRYPTLVL - Encryption Level

The Encrypt parameter specifies the encryption level. A value of 0 indicates no encryption. 1 will use 128-bit AES encryption. 2 will use 256-bit AES encryption.

Note: This setting must match on all nodes.

ENCRYPTKEY - Encryption Key

Defines the private key is used to encrypt and decrypt data transmitted over the air. It is a 32-byte value. The first 16-bytes are used when the encryption level is set to AES128. All 32-bytes are used when encryption level is set to AES256 encryption.

Note: This setting must match on all nodes.

4.2.4 Serial Port Configuration:

S1BAUD - Serial Port 1 Baud Rate

The S1BAUD parameter sets the baud rate for Serial Port 1. Typically, this is set to a value that is similar to the air rate.
Valid settings are 9600,57600,115200,230400,460800,1000000,1200000

S1DATATYPE - Serial Port 1 Data Type

The S1DATATYPE parameter specifies the protocol used for the data on Serial Port 1. 0 is for Mav. 1is for SAS binary protocol. 2 is for Raw data.

Note: In Raw mode data is broken into blocks based on a 10mS break in data or maximum block size slot data size is reached.

S1KBPS - Serial Port 1 Bandwidth Limit

The S1Kbps parameter represents the bandwidth limit in kilobits per second for Serial 1. This enables throttling of data on this port. Use this if you wish to ensure that a fixed bandwidth is not exceeded. Typically, this limit is accurate to within +/-1Kbps of this parameter setting. 0 will disable this port. 1000 removes any limits.

S1RXROUTE - Serial Port 1 Input Route

The S1RXROUTE parameter determines the serial port on the receiving node which the data will be output:

- A value of 0 sets output to port 1.
- A value of 1 sets output to port 2.
- A value of 2 sets output to port 1 of the receiving modem and echo the input to serial port 2 of the transmitting modem
- A value of 3 sets output to port 2 of the receiving modem and echo the input to serial port 2 of the transmitting modem

S2BAUD - Serial Port 2 Baud Rate

The S2BAUD parameter sets the baud rate for Serial Port 2. See S1BAUD

Note that the serial port pins must be configured in the relevant PINTYPE parameters

S2DATATYPE - Serial Port 2 Data Type

The S2DataType parameter specifies the protocol used for Serial 2. See S1DATATYPE

Note that the serial port pins must be configured in the relevant PINTYPE parameters

S2KBPS - Serial Port 2 Bandwidth Limit

The S2BPS parameter represents the bandwidth limit in kilobits per second for Serial 2. See S2KBPS

Note that the serial port pins must be configured in the relevant PINTYPE parameters

S2RXROUTE - Serial Port 2 Input Route

The S2RXROUTE parameter determines the serial port on the receiving node which the data will be output:

- A value of 0 sets output to port 1.
- A value of 1 sets output to port 2.

- A value of 2 sets output to port 1 of the receiving modem and echo the input to serial port 1 of the transmitting modem
- A value of 3 sets output to port 2 of the receiving modem and echo the input to serial port 1 of the transmitting modem

Note that the serial port pins must be configured in the relevant PINTYPE parameters

S2ATMODE - Serial Port 2 default AT Mode

The S2ATMODE parameter determines if the port is set to AT command mode on boot. If enabled the Auxiliary Tx and Rx pins will be configured automatically at the baud rate set by the S2BAUD parameter. There is no text "OK" output on boot however, any commands will be responded to as per standard AT command. The port will become available shortly after boot.

Note that the serial port pins must be configured in the relevant PINTYPE parameters

4.2.5 Link and RF Parameters:

BITRATE - RF Air Data Rate in Kbps

The BITRATE parameter represents the bit rate of the radio data link in kilobits per second.

Note: This does not represent the data throughput of the link as there are various overheads that will reduce the actual throughput. Actual throughput is generally on the order of 80-85% of the BITRATE parameter settings.

FREQMIN - Minimum Frequency

The FREQMIN parameter specifies the minimum frequency in kHz of the lowest channel.

FREQMAX - Maximum Frequency

The FREQMAX parameter specifies the maximum frequency in kHz of the highest channel.

NUMCHANS - Number of RF Channels

The NUMCHANS parameter indicates the number of RF channels to assign within the frequency band defined by FREQMIN and FREQMAX. Typically, 23 for AU or 51 for US. The number of channels should be set so that the channel spacing is at least 250kHz for every air rate except for 430kbps which uses 500kHz minimum spacing. Calculate channel spacing = (FREQMAX-FREQMIN)/(NUMCHANS+1). 1MBps can be 1 channel or channel spacing of > 1MHz

Note: If only a single channel is set its frequency will be in the middle of the FREQMIN and FREQMAX parameters.

XTRALONGRANGE - Extended Range Operation

This parameter is only to be used for operation where special antennas are used and when operating beyond standard ranges (typically greater than 40Km at 64K air Rate). This would be cases like between two balloons or two airborne vehicles.

Note: Enabling this field **WILL reduce your throughput.** Do not enabled unless you are doing something very extraordinary and can cope with the reduction of throughput.

P2PAUTO - Automatic Point-to-point Mode

The P2PAUTO parameter determines the radio linking mode. A value of 0 sets the modem to manual mode linking mode, while a value of 1 enables automatic linking mode.

Note: Automatic linking can only operate for a pair of modems. For larger networks manual mode and induvial NODEIDs must be set.

Note: Automatic linking has an impact on the linking time.

Note: For optimal operation of automatic linking mode, the two nodes should be powered up at different times.

TOTALUS - Slot duration

The TOTALUS parameter represents the total time in microseconds of 1 RF slot, including all idle times. This time will be automatically altered by the firmware on reboot if it the specified values do not result in sufficient size for transmission of the maximum mavlink2 packet or a slot larger than ~1000 bytes of payload data. It must be the same value for all modems.

Note: Slot duration can also be affected by the HOPSMAX and NETWORKS parameter, ensure these values matches for all nodes.

SLOTS - Number of slots

The SLOTS parameter specifies the number of data slots in this network. Typically, equal to the number of nodes in the network but may be increased if nodes have more than 1 slot allocated to them such as if they require more guaranteed bandwidth or when setup for data forwarding.

Note: It must be the same value for all modems within a NETWORKID.

SLOTIDS - Slot Bit Mask

The SLOTIDS parameter defines the network slot IDs for the node. If one node requires more guaranteed bandwidth than others (like the forwarding node), then assign it more than 1 slot. It represents a bitfield with 64 bits. As such settings will be in powers of two (e.g., 1, 2, 4, 8) or as the sum of multiple individual slots (e.g., 3, 5, 6, 7).

Note: No 2 nodes should be assigned any of the same SLOTIDS.

Note: SLOTID must be unique for each node on a network i.e. no bitfield should be reused.

Note that if a node has more than 1 slot the slots should be spaced apart rather than sequential.

SLOTTXMODE- Slot Radio Tx types

The SLOTTXMODE represents when a node may transmit. It represents a bitfield with 3 bits.

- Bit 0 is transmitted on slots the node owns through the SLOTIDS setting. This should always be set.
- Bit 1 permits transmission on a slot given up to it by another node.
- Bit 2 permits transmission in the sync slot. This applies to master Node only.

Note: Default value is 7 (all slots enabled).

Note: If a network was required to have 2 co-located nodes on different networks, then each should have the same NODEIDs and have SlOTTXMODE set to 1 to avoid them transmitting whilst the other was receiving.

TXPOWER - RF Transmit Power

The TXPOWER parameter represents the transmit power in dBm.

ANTMODE - Antenna Port Functions

The ANTMODE parameter specifies the antenna port operating mode.

- A value of 0 sets automatic diversity mode.
- A value of 1 sets all transmission and receiving to use antenna port A1.
- A value of 2 sets all transmission and receiving to use antenna port A2.
- A value of 3 sets transmission to use antenna port A1 and receiving to use port A2.

Note: Unused modem ports must not be terminated in short circuits or RF loads.

COUNTRYOPT - Country Rate or Frequency Band Options

The COUNTRYOPT parameter determines which of the alternative sets of RF parameters to use on a region locked modem. The exact parameter settings will depend on the region the modem is locked to. The region locked modem restricted settings, such as frequency, number of channels etc. are updated automatically on reboot of the modem based on the setting of this parameter.

Note: This parameter will not affect an unlocked modem.

4.2.6 GPIO Pin Settings:

PIN#TYPE(*) – Pin function for GPIO pin # (This corresponds to X modem header pin number *)

This parameter configures the functions of a given GPIO pin as per the following:
0 – GPI sets the pin as a General Purpose Input (GPI) with a Vin Max of 3.3V a Vhigh 2.3V a Vlow 1V and an average input impedance of approximately 40k Ohms
1 – RESET Pulling this pin high will force the modem to reset.
2 – MIRROR sets the pin as an input the state of which will be mirrored on the pin prescribed on in the PINMIRR parameter on the remote modem, provided that remote modem pin is configured as GPO
3 – GPO sets the pin as a General Purpose Output (GPO) with a Vout Max of 3.3V a Vhigh 2.3V a Vlow 1V and maximum drive current of approximately 20 mA
4 – GPO_WOR General Purpose Output Wired OR gate with high side drive pull down.
5 – GPO_WAND General Purpose Output Wired AND gate with low side drive pull up.
6 – STATLED the state of this pin is the same as that of the modem status (green) LED. High indicating the LED is on and low indicating the LED is off
7 – RXLED the state of this pin is the same as that of the modem data (red) LED. High indicating the LED is on and low indicating the LED is off.
8 – RSVD unused value reserved for future functions
9 – PPMIn the pin acts as an input for reading PPM signals that will be transmitted in RC passthrough mode. The pin has a Vin Max of 3.3V a Vhigh 2.3V a Vlow 1V and an average input impedance of approximately 40k Ohms.

10 – PPMOut the pin acts as a PPM stream with failsafe mode output when the modem is configured for RC Passthrough. The pin has a Vout Max of 3.3V a Vhigh 2.3V a Vlow 1V and maximum drive current of approximately 20 mA. The failsafe is defined by the RCDEFS parameter.
11 – PPMOutNoFS the pin acts as a no failsafe PPM stream output when the modem is configured for RC Passthrough. The pin has a Vout Max of 3.3V a Vhigh 2.3V a Vlow 1V and maximum drive current of approximately 20 mA.
12 – SBUSIn10 the pin acts as an input for reading 10 channel SBUS signals that will be transmitted in RC passthrough mode. There is support for 8 analog and 2 digital channels. The pin has a Vin Max of 3.3V a Vhigh 2.3V a Vlow 1V and an average input impedance of approximately 40k Ohms. (using this mode will save some bandwidth)
13 – SBUSIn18 the pin acts as an input for reading 18 channel SBUS signals that will be transmitted in RC passthrough mode. There is support for 16 analog and 2 digital channels. The pin has a Vin Max of 3.3V a Vhigh 2.3V a Vlow 1V and an input impedance of approximately 40k Ohms.
14 – SBUSOut the pin acts as a SBUS stream with failsafe mode output when the modem is configured for RC Passthrough. The pin has a Vout Max of 3.3V a Vhigh 2.3V a Vlow 1V and maximum drive current of approximately 20 mA. The failsafe is defined by the RCDEFS parameter.
15 – SBUSOutNoFS the pin acts as a no failsafe SBUS stream output when the modem is configured for RC Passthrough. The pin has a Vout Max of 3.3V a Vhigh 2.3V a Vlow 1V and maximum drive current of approximately 20 mA.
16 – RTS Sets the pin to act as the Ready to Send (RTS) flow control pin for serial port 1
17 – CTS Sets the pin to act as the Clear to Send (CTS) flow control pin for serial port 1
18 – AUXTX Sets the pin to act as the transmit (TX) pin of serial port 2
19 – AUXRX Sets the pin to act as the receive (RX) pin of serial port 2
20 – AUXRTS Sets the pin to act as the Ready to Send (RTS) flow control pin for serial port 2
21 – AUXCTS Sets the pin to act as the Clear to Send (CTS) flow control pin for serial port 2
22 – 485EN Sets the pin to toggle the enable line of an external 485 to UART interface controller. Used in some RFD products, not intended for user functions.
23 – TDMSLOT Used for internal testing
24 – RFTX Used for internal testing
25 – RFRX Used for internal testing
26 – RFLNAEN Used for internal testing
27 – RFPAEN Used for internal testing
28 – DBGSER Used for internal testing

PINRTSTYPE(3) – Pin function for x modem header pin 3

Configures the operation of pin 3 of the x modem header for hardware flow control RTS pin. Setting options as per PIN#TYPE(*) above.

PINCTSTYPE(11) – Pin function for x modem header pin 11

Configures the operation of pin 11 of the x modem header for hardware flow control CTS pin. Setting options as per PIN#TYPE(*) above.

PINMIRR - Pin Mirroring Table

This list specifies the output pins of the receiving modem that will mirror the inputs of MIRROR configured pins of this modem. The first position in the list maps the pin of the receiving modem that will output the mirror of PIN0 etc. For example, the default configuration of 0,1,2,3,4,5,6,7, maps each pin to the same pin as output while 1,2,3,4,5,6,7,0, would map pin 0 input to pin 1 output pin1 input to pin2 output etc.

Note that there is no support for multiple inputs to be mapped to the same output e.g. 1,1,1,2,3,4,5, would not be valid

Note that values in the table that relate to pins that have not been configured as MIRROR will be ignored.

Note that if the specified pin of the receiving modem is not configured as a GPO, GPO_WOR or GPO_WAND the pin mirror information is ignored.

Note that this function is primarily intended for Point to Point configurations. If used in a mesh, then all nodes on the same network that have a mapped output pin set as an output will mirror the input signal.

Multiple nodes must not be configured to drive the same output pins on receiving modems.

4.2.7 RC Parameters

RCFrameLoss - RC Failsafe Loss Threshold

This parameter determines how many RC frames can be missed before fail-safe is triggered. Each frame is approximately 20 milliseconds.

RCInMinmS - Minimum RC Update Interval

This parameter specifies the minimum update time in milliseconds for RC input. If an RC frame arrives before this time, it is discarded. This can be used to limit excess frames going over the air, usually for SBUS outputting frames at 7ms.

RCDEFS – Failsafe Output Definitions

A table of signal levels representing the output signal of the 18 possible channels of an RC signal. Only 16 channels are applicable for PPM. This parameter is only applicable if the output pin is configured to support failsafe modes.

5 Useful Links

FTDI USB Drivers

https://ftdichip.com/drivers/

RFD Modem Firmware and documentation

https://rfdx.atlassian.net/wiki/spaces/TS/pages/452198432/RFD+x2+Family

RFD Store

https://store.rfdesign.com.au

MAVPROXY Documentation

https://ardupilot.org/mavproxy/

6 Glossary

Term	Description
AES	Advanced Encryption Standard. A data encryption protocol meeting the specifications established in the ISO/IEC 18033-3 standard.
Baud	Unit of measurement of symbol rate. This is an indication of data transfer speed of serial connections
EEPROM	Electronically Erasable Programmable Read Only Memory a type of memory.
RX	Receive/Receiver of data transfer from an external source.
TX	Transmit/Transmitter of data to a receiver.
MAVLink	Micro Air Vehicle Link. A protocol for telemetry data exchange between compatible ground control software and autonomous vehicle controllers.
PPM	Pulse Position Modulation. This is an encoding standard used by radio controller to send data about the position of multiple servo motors.
RC	Remote Control. Wireless control of vehicles using protocols such as PPM and SBUS
RFD	RF Design. The Australian company who designed, build and support the x series modems among other products.
SBUS	Serial Bus protocol created by Futaba. This is an encoding standard used by radio controller to send data about the position of multiple servo motors.
Serial	A protocol for sending and receiving data in a sequential manner.
UART	Universal Asychronous Receiver Transmitter. Hardware implementation of a serial data protocol.
USB	Universal Serial Bus. Hardware implementation of a serial data protocol commonly found on PCs and electronic devices. Physical ports can differ based on various type standards such as Type A and Type C.
Throughput	Measure of data transfer speed/rate.
RF	Radio Frequency. A term used to describe a portion of the electromagnetic spectrum. Commonly encompassing frequencies between a few tens of kilohertz and a couple of hundred gigahertz.
Latency	The time delay between signal input and output.
Failsafe	A defined signal or behaviour to indicate loss of direct control.
GPIO	General Purpose Input Output. A microcontroller pin that can be configured for various input and output functions

7 Revision History

Version	Date	Changes
1.0	21/10/24	BETA Initial release document