

MOAS II Programming Manual

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Revision History

Version	Date	Author	Change
0.1	17 Feb 2012	Paul Young	Initial document
0.2	25 Feb 2012	Paul Young	Small fixes and reformatting
0.3	28 Mar 2012	Paul Young	Additional antenna events
0.4	18 Sep 2012	Paul Young	Field test
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Introduction

The YCCC MOAS II is a second-generation relay controller. It is designed specifically for use in amateur radio stations.

History

The original MOAS (Mother of all Switches) was developed in 2004. It consisted of a controller, which was a stand-alone box with rotary encoders, an LCD display, and band decoders, and a switch, which controlled the relays. The two boxes were connected via an RS-232 link. It was not easy to reproduce. There were some design errors, notably the radio inhibit lines were connected to the controller. And the number of high and low side outputs (source and sink) was fixed because the switch used parallel drivers for high side.

PCs have become more powerful over the years and screens have become larger. At this time it is probably more effective to control the switch with a PC rather than using a stand-alone controller. And there are a lot of things a PC can do that the controller could not.

The MOAS II is an update of the switch, using a slightly more powerful microprocessor. It has the radio inhibits. All outputs can be high side. And it has some new features.

Features

The original MOAS switch was designed to work with a fairly dumb controller. As a result the switch has some intelligence. A programmer can decide which features to use.

Relays

The MOAS II supports 64 independent relays, numbered 0-63. These correspond to the 64 relay outputs.

Stations

The MOAS II supports six stations, numbered 1-6. There are six T/R input lines and six inhibit outputs.

Antennas

The MOAS II supports 64 antennas, numbered 0-63. Antennas are tracked by the switch. Software which uses the MOAS II can use or ignore antennas. There are two things the MOAS II uses antennas for – conflict checking and selecting fast or slow transitions.

Operation

MOAS Antennas

The MOAS knows about 64 antennas. Normally antenna 63 is treated as “no antenna”.

The MOAS does not know which relays are needed to connect a station to a particular antenna. That information is provided as part of the command to use the antenna.

The programmer can use antennas in several ways. Every different variation of a physical antenna could be a MOAS antenna. For example, a four-square could be four MOAS antennas. Or only antennas that have a different topology could be different. In this case a four-square would be one MOAS antenna. Or physical antennas may have no relation to MOAS antennas. Or the MOAS antennas may not be used at all.

Stations and Antennas

Each station has three associated antennas, the transmit antenna, the receive antenna, and the alternate receive antenna.

- The transmit antenna is the antenna used when transmitting.
- The receive antenna is the antenna which is normally used when receiving. This may be the same as the transmit antenna.
- The alternate receive antenna is an antenna can be used when another station or stations are transmitting. When they transmit the antenna is automatically switched to the alternate antenna.

Relays

Each station has six sets of relays

- The transmit antenna relays are set when the station is transmitting.
- The receive antenna relays are set when the station is receiving unless it is receiving on the alternate receive antenna.
- The alternate receive antenna relays are set when the station is receiving on the alternate receive antenna.
- The extra relays are set when the station transmits and are reset when it stops transmitting.
- The set on transmit relays are set when the station starts transmitting. They will be set until a station resets them.
- The reset on transmit relays are reset when a station starts transmitting. They are only reset if they have been set as set on transmit relays.

Normally either transmit, receive, or alternate receive relays will be set.

There is also one set of relays that will always be set. These are used in cases where the switch intelligence is not desired.

Antenna switching

The MOAS II has two methods of switching between antennas:

- The fast method is to simply change the relays.
- The slow method is to change the relays but also to assert the inhibit line for the station for a specified number of milliseconds.

The fast method takes advantage of the time between when a radio asserts the amplifier key line and when it starts to deliver RF. This time is intended to be sufficient for the amplifier relays to change. If the antenna relays change within this time then it is always safe to switch an antenna while the radio is receiving because the switching will be completed before any RF can be delivered.

The fast method also relies on the latency of the MOAS II, which is less than 200 μ s worst case.

The slow method asserts the inhibit line at the same time as the relay lines are changed. The duration of the inhibit is programmable and affects all stations. The minimum is 1 ms and the maximum is 9999 ms.

Switching between transmit antennas may be fast or slow. The MOAS II has a 64x64 triangular array, called the Fast table, which specifies the transition type for each combination of antennas. There are commands to set and clear bits.

Switching between receive antennas is always fast. If the station starts transmitting while the antenna is switching it will immediately start the appropriate fast or slow transition to the transmit antenna.

An antenna can be set to have a slow transition with itself. This would be appropriate if, for example, a four-square had slow switching relays. If the PC sets an antenna to the same antenna and same relays as it already has the transition will always be fast and may be in wait mode even if the station is in interrupt mode since nothing is changed.

Switching between the receive antenna and the alternate receive antenna is always fast.

If switching between the transmit antenna and receive antenna is slow the transmit antenna will be used for receiving.

Hot switching protection

The MOAS II will not switch an antenna for a station which is transmitting. The station can be in two modes, wait or interrupt. If it is in wait mode the MOAS II will wait until the station stops transmitting and will then switch the antenna. If it is in interrupt mode the inhibit line for the station will be asserted. The switch will wait a fixed number of milliseconds and will then switch the antenna. The delay can be set from 0 to 99 ms and affects all stations. The antenna will then be switched using the slow method regardless of what is in the fast table.

Conflicts

If an antenna is in use by a station any antenna which conflicts with it cannot be used by any other station. Normally an antenna conflicts with itself but it is possible for multiple antennas to conflict – for example, if a four-square is shown as four antennas they would all conflict since only one station can use the physical antenna at a time.

The MOAS II has a 64x64 triangular array, called the Conflicts table, which specifies the antennas which conflict. Normally antenna 63 is set so that it does not conflict with itself because it is used for “no antenna”.

If the PC sends a command to set a station to an antenna which has a conflict the request will be held until the antenna becomes available or until a different antenna is requested for that station.

The routine which checks antenna commands for conflicts and sets the antennas is called the conflict resolver. It is able to solve situations where the antennas can be changed only if more than one change at a time. For example it is possible to swap antennas between two stations by changing one and then the other – the first change will cause a conflict and the second change will allow it to be resolved by switching them simultaneously.

The rules for alternate receive antennas are different. If there is a conflict between an alternate receive antenna and a transmit or receive antenna then when the alternate receive antenna is selected the station will not close any relays. Normally this means that no antenna will actually be connected. And alternate receive antennas are not checked for conflicts with each other.

The conflict resolver can be turned on and off by the PC. When it is off no antenna commands will change antennas. When it is turned on all pending antenna changes will be processed. This can be used to ensure that antenna changes for multiple stations happen simultaneously.

Inhibits

There are three reasons a station might be inhibited.

- The station can be inhibited because of a slow antenna switching operation.
- PC can inhibit or uninhibit a station.
- A station transmitting can inhibit another station. The MOAS II can be configured for which stations inhibit which. It is possible to set two stations to inhibit each other as an interlock so that only one can transmit at a time.

The inhibit polarity (ground to inhibit or ground to uninhibit) can be set per-station.

There are two types of inhibit. The default type, “Always”, activates the inhibit output whenever one of the reasons for inhibiting a station occurs. The other type, “Inhibit Only on Transmit” activates the inhibit output when one of the reasons for inhibiting a station occurs and the radio tries to transmit. “Inhibit Only on Transmit” is useful for inhibiting a radio which does not have an inhibit input. A relay can be placed between the radio and the amplifier or antenna and this relay can be activated by the inhibit output in order to disconnect the radio or connect it to a dummy load.

Receive Delay

Although the MOAS II is fast enough to follow QSK most antenna switching systems are not. The MOAS II can set a delay between the time the T/R line drops and the time the antenna is switched to receive. This delay is per-station. The minimum is 0 ms and the maximum is 9999 ms.

Shared Antennas

The MOAS II can handle shared transmit antenna systems. The configuration of a shared system cannot be changed if any station is transmitting on it. Also all stations using it must change their antenna selections to reflect the new configuration at the same time.

The requirement of not changing the configuration is met by using the antenna system table. All antennas which are part of the shared system should be assigned the same antenna system number in the table. All changes to the antenna system will be done only when all stations which are changing their configurations are in receive.

The other requirement, that all stations must change their selection at the same time is met by turning the conflict resolver off before sending the antenna commands for all of the stations and then turning it on immediately after.

Status

The MOAS II can respond to status requests and it can generate status messages based on events.

- It will respond to a ping message with whether or not it is in operator mode.
- It will respond to a box status message with Transmit/Receive status and antennas for all stations.
- It will respond to an inhibit polarity message with a list of stations that are set to low to unhibit.
- It will respond to a unit identifier query with the stored unit number.
- It will respond to a relays message with a list of relays which are selected.

The MOAS II will optionally send events when any of the following are changed:

- Transmit/Receive of any station
- Antenna changes which are successful or in conflict
- Inhibit changes caused by a command from the PC

These events can be turned on or off by the PC.

Unit Identifier

Each MOAS II can be assigned a unit number from 0-99. The MOAS II will remember that number and will return it if queried. This is useful if a station has several MOAS II boxes.

Active and inactive

When the MOAS II powers up it is inactive. The relays are all off. The conflict resolver is not running and antenna commands will not change the relays.

When it is set into active mode it will respond to all pending antenna changes, inhibit changes etc.

There is no command to change the MOAS II from active to inactive. There is a reset command which will set it to power-up state.

Power on state

This is the state of the box on power-on or following a reset:

- The switch is not active.
- All stations are set to antenna 63 for transmit, receive, and alternate receive.
- No antenna outputs are selected.
- No transmit, receive, alternate, extra, set on transmit, or reset on transmit relays are set.
- Stations are inhibited according to their inhibit polarity.
- The conflict table has no antennas in conflict, even with themselves.
- The fast table has all antennas as slow.
- No antennas are part of an antenna system.
- All stations are in wait mode.
- The receive delay is set to 0 ms.
- The inhibit time is set to 20 ms.
- The inhibit type is “Always”, not “Inhibit Only on Transmit”.
- The interrupt mode delay time is set to 0 ms.
- No station will be inhibited by another station.
- No station will be inhibited by computer command.
- No status messages will be sent by the switch.

Communications

The MOAS II uses an FTDI USB chip by default. If appropriate drivers are installed on the PC it will appear as a serial port. The serial port will operate at 9600 baud, one stop bit, no parity.

Input

The longest command is an antenna selection that sets all 64 relays. This command would be 69 characters long.

A 128 byte circular buffer is used for character input. Commands can be of variable length and it is possible to create a command which is longer than the buffer. Commands longer than about 40 bytes should be split into multiple commands. With this restriction it is believed that commands are processed quickly enough that it is not possible to overflow this buffer.

Output

If status messages are used there can be a lot of output. Rather than use a long output buffer the output is split into two pieces.

There is a 32 byte status text buffer. The text for one or more commands may be in this buffer.

There is a 128 entry circular buffer. Each entry contains one status command to be sent, encoded in an internal format. When there is space in the status text buffer the next status from the circular buffer is formatted.

It is possible, with sufficient activity, to overflow the circular buffer. This can be caused by a large number of transmit/receive events. It can also be caused by sending large numbers of

status commands which return more bytes than the length of the command. If a status message is lost it is completely lost, there will not be any garbled or partial messages sent. The exception to this is if the switch is reset while sending a message.

No messages should be lost in normal operation.

Commands

All characters used in commands are from the 7 bit ASCII character set.

Commands are variable length. They consist of a command character, possibly a sub-command character, command-specific data, and a terminating semicolon.

The dollar sign is an abort character. Anything from the start of a command to the dollar sign will be ignored. This is not useful for computer control of the box but is very useful when typing commands by hand for testing because it can be used to wipe out an incorrectly typed command.

All characters equal to or below ASCII space (hex 20) are ignored.

The characters used for commands are not used in the bodies of any messages.

Sixbit

A single character is used to represent one of the 64 antennas or 64 relays. The characters are also used in the relay status information. This representation is referred to as sixbit because it contains six binary bits of information. The following is the table of numbers and the corresponding characters:

Number	Character	Number	Character	Number	Character	Number	Character
0	0	16	G	32	W	48	m
1	1	17	H	33	X	49	n
2	2	18	I	34	Y	50	o
3	3	19	J	35	Z	51	p
4	4	20	K	36	a	52	q
5	5	21	L	37	b	53	r
6	6	22	M	38	c	54	s
7	7	23	N	39	d	55	t
8	8	24	O	40	e	56	u
9	9	25	P	41	f	57	v
10	A	26	Q	42	g	58	w
11	B	27	R	43	h	59	x
12	C	28	S	44	i	60	y
13	D	29	T	45	j	61	z
14	E	30	U	46	k	62	{
15	F	31	V	47	l	63	}

Commands list

Character	Command	Description
!	Antenna	Set an antenna for a station
%	Conflict Table	Set or clear all or part of the conflict table
&	Fast Table	Set or clear all or part of the fast table
(Inhibit	Inhibit selected stations from transmitting
~	Inhibit Other Station	Sets stations to be inhibited when another station transmits
^	Inhibit Polarity	Sets inhibit outputs high to inhibit or low to inhibit
[Inhibit Time	Set the number of milliseconds inhibit will be used when an antenna is switched
=	Inhibit Type	Sets stations to “Always” or “Inhibit Only on Transmit”
]	Interrupt mode delay	Set the time after inhibit is set before a station changes antennas in interrupt mode
/	Mode	Sets stations to wait or inhibit mode
'	Ping	Send a ping response showing that the box is connected
\	Receive Delay	Set the time after the amp key line drops before a station goes into receive
	Relay status	Send relay status
*	Set state	Set box state or reset the box
"	Status	Send status of the box
_	System	Set or clear all or part of the antenna system table
)	Uninhibit	Allow selected inhibited stations to transmit
:	Unit ID	Set or query the unit identifier
@	Use Alternate Antenna	Set stations to be switched to the alternate antenna when another station transmits

Vendor extension Send vendor-specific information

Antenna

This command specifies an antenna and relays for a station. The format is:

```
!{Station number} {Type} {Antenna} {Relays};
```

Station number is 1-6 or 0.

If 1-6 is specified the antenna and relays apply to that station.

If 0 is specified the relays will be set immediately in addition to the relays which are selected for each station and will remain set until another antenna command changes them. The type should be X and the antenna should be 0.

Type is one of the following:

- T The command changes the transmit antenna
- R The command changes the receive antenna
- B The command changes both the transmit and receive antennas
- A The command changes the alternate receive antenna
- X The command sets extra relays to be activated while the station transmits
- S The command sets extra relays to be activated when a station starts transmitting.
- C The command sets extra relays to be deactivated when a station starts transmitting.

Antenna number is one sixbit character specifying the antenna number, 0-63. It should be zero if the type is X.

Relays are zero or more sixbit characters specifying the relays, 0-63, which will be set to connect the station to the antenna.

If this command is issued while the MOAS II is not active the antennas will be remembered and will be selected when the box state is changed to active.

Response

If antenna change events are on and the resolver is on there will be one or more antenna events. See the events chapter for details.

Examples

```
!1B1123;
```

This command sets station 1 to antenna 1 and selects relays 1, 2, and 3.

```
!4TAF;
```

This command sets the station 4 transmit antenna to antenna 10 and selects relay 15.

```
!2X0z};
```

This command sets the station 4 extra relays (set on transmit) to 61 and 63.

Conflict table

This command clears or sets part or all of the conflict table. The format is:

`%{Sub command}{Antenna pairs};`

Sub command is one of the following:

- 0 Set no the table so no antennas are in conflict
- 1 Set the table so all antennas are in conflict
- C Set the specified pairs of antennas to be in conflict
- c Set the specified pairs of antenna to not be in conflict

Antenna pairs are groups of two sixbit characters which specify two antennas which will be set according to the sub command. If the sub command is 0 or 1 the antenna pairs should be omitted.

Changing the conflict table while the MOAS II is active will not affect currently set antennas and may or may not affect pending antenna changes.

Response

None.

Examples

```
%0;%C00112233445566778899AABBCCDDEEFF;
```

These commands clear the conflicts table and set antennas 0 through 15 to be in conflict with themselves.

Fast table

This command clears or sets part or all of the fast table. The format is:

`&{Sub command}{Antenna pairs};`

Sub command is one of the following:

- 0 Set the table to not allow fast switching for any antennas
- 1 Set the table to allow fast switching for all antennas
- F Set the specified pairs of antennas to allow fast switching
- f Set the specified pairs of antenna to not allow fast switching

Antenna pairs are groups of two sixbit characters which specify two antennas which will be set according to the sub command. If the sub command is 0 or 1 the antenna pairs will be ignored.

Changing the fast table while the MOAS II is active may or may not affect antenna switching.

Response

None.

Examples

```
&1;&f12;
```

These commands set all antennas to fast except when switching between antennas 1 and 2.

Inhibit

This command inhibits a station from transmitting. The format is:

```
({Stations});
```

Stations are 1-6 and are zero or more stations which should not be allowed to transmit.

This command is not affected by the inhibit time. A station may also be inhibited because an antenna is being changed or because another station is transmitting, and this command will not affect that inhibit.

The box will send an Inhibit response if inhibit responses are turned on and the MOAS II is active.

Response

This is sent if inhibit response is enabled. The format is:

```
({Stations});
```

Stations are the stations which are currently inhibited by a command.

Examples

```
(12;
```

This command inhibits stations 1 and 2 from transmitting. If inhibit status is enabled this could be the response:

```
(12;
```

Stations 1 and 2 are unable to transmit because of an inhibit command.

Inhibit Other Station

This command sets which other stations are inhibited when the specified station transmits. The format is:

```
~{Station number} {Stations}
```

Station number is 1-6 and is the station which may transmit.

Stations are 1-6 and are zero or more stations which should not be allowed to transmit when the station specified in Station is transmitting.

Response

None.

Examples:

~12;~21;

This command sets station 2 to be inhibited when station 1 transmits and vice versa.

Inhibit Polarity

This command sets the inhibit outputs so they pull down to inhibit a radio or pull down to enable a station. The format is:

^{Sub command} {Stations};

Sub command is one of the following:

- 0 Set all stations to inhibit when pulled down
- 1 Set all stations to enable when pulled down
- E Set the specified stations to enable when pulled down
- I Set the specified stations to inhibit when pulled down

Stations are 1-6 and are one or more stations which should have the polarity set.

Response

None.

Examples

^0;^E1;

These commands set all stations to be inhibited when the output is pulled down except for station 1 which is enabled when the output is pulled down.

Inhibit Time

This command sets the slow transition inhibit time. This is the time that the box will wait after activating an inhibit for a station in order to change antennas before deactivating it. The format is:

[{Time};

Time is the one to four digit time in milliseconds.

If this command is used while the MOAS II is active it may not take effect immediately.

Response

None.

Examples

[30;

This command sets the inhibit time to 30 ms.

Inhibit Type

This command sets the inhibit type to “Always” or “Inhibit Only on Transmit”. This only affects when the inhibit line is activated. The inhibit logic is otherwise not affected. The format is:

={Sub command} {Stations};

Sub command is one of the following:

- 0 Set all stations to always inhibit when activated.
- 1 Set all stations to only inhibit when the station tries to transmit.
- A Set the specified stations to always inhibit when activated.
- T Set the specified stations to only inhibit when the station tries to transmit.

Stations are 1-6 and are one or more stations which should have the inhibit type set.

Response

None.

Examples

=0;=T1;

These commands set all stations to be inhibited always except for station 1 which is inhibited when the radio tries to transmit.

Interrupt Mode Delay

This command sets the time that the box will wait after inhibiting a station in interrupt mode before changing the antenna. The format is:

] {Time};

Time is the one or two digit time in milliseconds.

If this command is used while the MOAS II is active it may not take effect immediately.

Response

None.

Examples

]20;

This command sets the interrupt delay time to 20 milliseconds.

Mode

This command sets the mode for specified stations. The format is:

```
{Sub command} {Stations};
```

Sub command is one of the following:

W Set the mode to wait

I Set the mode to interrupt

The remaining characters are the stations to set.

If the mode is changed while the MOAS II is active it may not affect any pending operations.

Response

None.

Examples

```
/I123456;
```

This command sets all six stations to interrupt mode.

Ping

This command requests a minimal status (pong) from the box. The format is:

```
;
```

Response

If the box is active it will respond:

```
;
```

If the box is not active it will respond:

```
;
```

Examples

```
;
```

This command requests a minimal status. The box might respond:

```
;
```

Receive Delay

This command sets how long the amp key line must be inactive before the radio is in receive. The format is:

```
\{Station number} {Time};
```

Station number is 1-6 and is the station whose receive delay is being set.

Time is the one to four digit time in milliseconds.

If this command is used while the MOAS II is active it may not take effect immediately.

Response

None.

Examples

```
\1200;
```

This command sets station 1 to go into receive 200 ms after the amp key line drops.

Relay Status

This command requests the relay status from the box. The status includes the current settings of the 64 relays. The format is:

```
|;
```

Response

The response describes the state of all of the relays. The format is:

```
|{Relays};
```

Relays is 64 bits of data encoded as six relays per character using the same sixbit encoding as for antenna numbers. There are a total of 11 characters of relay information. The first two bits are unused and will be zero.

To check whether a specific relay is set, divide the relay number by 6. Then index that many characters from the right of the relays string and convert the character from sixbit to a number. The relay bit will be the relay number mod 6.

Examples

```
|;
```

This command requests a relay status response. The response could be:

```
|00000000007;
```

Relays 0, 1, and 2 are selected.

```
|000000003y0;
```

Relays 8, 9, 10, 10, 11, 12, and 13 are selected.

Set State

This command activates or resets the box, and turns on or off. The format is:

```
*{Sub commands};
```

Sub command is one or more of the following:

- 0 Reset the box to power-on state
- 1 Activate the box.
- A Send antenna change event messages
- a Do not send antenna change event messages

- T Send transmit/receive change event messages
- t Do not send transmit/receive change event messages
- I Send inhibit and uninhibit status change messages
- i Don't send inhibit and uninhibit status messages
- R Turn on the conflict resolver
- r turn off the conflict resolver
- X Send extra relay and antenna 0 change messages
- x Don't send extra relay and antenna 0 change messages

If the box is active the command to activate it is ignored. The Reset and Activate subcommands should not be combined with other other subcommands. The Activate command also turns on the conflict resolver.

Response

None. **Examples**

```
*ATI;*1;
```

These commands turn on status messages and activate the switch.

Status

This command requests a status from the box. The format is:

```
"{Sub command};
```

Sub command is one of the following:

- B Send the current antennas, transmit/receive states, and inhibit states.
- I Send the inhibit polarity information

Response

The response to a box status command describes the state of each station. The format is:

```
"B{TR status}{TX antenna}{RX antenna}{Alt RX antenna};
```

TR status is six characters, one for each station. The characters are:

- T Station is transmitting
- R Station is receiving
- I Station is inhibited due to a command

TX antenna is six sixbit characters, one for each station. The characters are the transmit antenna for the station.

RX antenna is six sixbit characters, one for each station. The characters are the receive antenna for the station.

Alt RX antenna is six sixbit characters, one for each station. The characters are the alternate receive antenna for the station.

The response to an inhibit polarity status command shows the stations which are inhibited when pulled down. The format is:

```
"I{Stations};
```

Stations is the list of stations which are uninhibited when pulled down.

Examples

```
"B;
```

This command requests a box status. The response could be:

```
"BTRRRRR16}}}}16}}}}}}}}}}};
```

Station 1 is transmitting and the others are receiving. Station 1 is using antenna 1. Station 2 is using antenna 2. The rest are using antenna 63. All alternate receive antennas are antenna 63.

```
"I;
```

This command requests the inhibit polarity status. The response could be:

```
"I1;
```

Station 1 is uninhibited when pulled down. The others are inhibited when pulled down.

System

This command clears or sets part or all of the antenna system table. The format is:

```
_ {Sub command} {Antenna and system pairs};
```

Sub command is one of the following:

- 0 Set the table to 0 (no antennas have an antenna system)
- S Set the specified antennas to the specified systems

Antenna and system pairs are groups of two sixbit characters. The first character specifies an antenna. The second character specifies an antenna system (0 is used for no antenna system.) If the sub command is 0 the antennas and systems will be ignored.

Changing the antenna system table while the MOAS II is active may or may not affect antenna switching.

Response

None.

Examples

```
_0;_112131;
```

These commands set all antennas to have no antenna system except antennas 1, 2, and 3 which have are antenna system 1.

Uninhibit

This command allows a station which was inhibited by the inhibit command to transmit. The format is:

```
{Stations};
```

Stations are 1-6 and are zero or more stations which should be allowed to transmit.

The box will send an Uninhibit response if inhibit responses are turned on and the MOAS II is active.

Response

This is sent if inhibit response is enabled. The format is:

```
)Stations};
```

Stations are the stations which are currently inhibited by a command.

Examples

```
)12;
```

This command allows stations 1 and 2 to transmit if they were inhibited by the inhibit command. If inhibit status is enabled this could be the response:

```
)3456;
```

Stations 3, 4, 5, and 6 are unable to transmit because of an inhibit command.

Unit ID

This command sets or queries the unit identifier. The format is:

```
:Identifier];
```

Unit identifier is an optional one or two digit number.

If the unit identifier is provided the command sets the unit number.

It is recommended that the unit number not be changed while the MOAS II is active.

Response

The format is

```
:Version} {Unit ID};
```

Version is a three character version number. The first character is the major version number and the second and third characters are the minor version number.

Unit ID is the one or two digit unit identifier for this box.

Examples

```
:1;
```

This command sets the unit number to 1. The response could be:

```
:1001;
```

This box is running V1.00 firmware and is unit 1.

Use Alternate Antenna

This command sets which other stations use their alternate antenna when the specified station transmits. The format is:

@{Station number} {Stations}

Station number is 1-6 and is the station which may transmit.

Stations are 1-6 and are zero or more stations which will use their alternate receive antenna when the station specified in Station is transmitting.

Response

None.

Examples:

@12;

This command sets station 2 to use the alternate antenna when station 1 transmits.

Vendor Extension

This command is used for vendor extensions such as debugging tools. The format is:

#{vendor specific};

Response

Vendor-specific information.

Examples

None available.

Errors

If the box cannot process a command it sends an error response. The format is:

?{Error};

Error is a single character. The currently defined errors are:

- U An unknown command was received.
- A The command had an invalid argument.
- T A command was issued where a transmitting station inhibits or changes the antenna of other stations. One of the other stations is the transmitting station. For example ~11 says when station 1 is transmitting inhibit station 1 and @212 says when station 2 is transmitting switch stations 1 and 2 to alternate receive antennas.
- C A communications error occurred
- F The input buffer overflowed

Examples

?A;

A command had an invalid argument

Events

Events messages look similar to commands but they are sent by the MOAS II to the computer.

Status List

Character	Command	Description
!	Antenna	Antenna change event
>	Receive	Station started receiving
<	Transmit	Station started transmitting

Antenna

This event is sent if antenna change events are enabled. It is sent when an antenna change is being processed by the conflict resolver. The format is:

!{Station number} {Status} {Antenna};

Station number is 1-6 and is the station which has an antenna change being processed.

Status is one of the following:

- C Transmit antenna change has a conflict with another station's antenna
- c Receive antenna change has a conflict with another station's antenna
- F Transmit antenna change has become active and the resulting transition between transmit and receive antennas will be fast.
- f Receive antenna change has become active and the resulting transition between transmit and receive antennas will be fast.
- S Transmit antenna change has become active and the resulting transition between transmit and receive antennas will be slow.
- s Receive antenna change has become active and the resulting transition between transmit and receive antennas will be slow.
- A An alternate receive antenna has been set and it is not in conflict with any transmit or receive antenna being used by another station.
- a An alternate receive antenna has been set and it is in conflict with a transmit or receive antenna being used by another station.

Antenna number is one sixbit character specifying the antenna number, 0-63. It is the antenna which is being made active or has a conflict.

If an antenna change has a conflict a message with the C or c status will be sent and the antenna will not be changed. When the conflict is resolved the antenna will be changed and another message with the F, f, S, or s status will be sent.

Examples

!1F1;!1f1;

Station 1 has changed transmit and receive antennas to antenna 1.

Extra Relays

This event is sent if extra relay events are enabled. It is sent when extra relays for station are changed or if relays for station 0 (global relays) are changed. The format is:

!{Station number}X;

Station number is 0-6 and is the station which has an antenna change being processed.

Examples

!1X;

The extra relays for station 1 have changed.

Receive

This event is sent when a station stops transmitting and starts receiving if transmit/receive events are enabled. The format is:

>{Station number} {Antenna};

Station number is 1-6 and is the station which has stopped transmitting.

Antenna is the sixbit antenna which is being used for receiving. If the antenna which was selected for receiving cannot be used because the box cannot switch between the transmitting and receiving antenna quickly this will be the antenna selected for transmitting.

Note: Alternate antennas are not shown by this status. Even if a station is receiving on the alternate antenna the normal receive antenna will be shown by this event.

Examples

>12;

Station 1 has stopped transmitting and is receiving on antenna 2.

Transmit

This status is sent when a station starts transmitting if transmit/receive events are enabled. The format is:

<{Station number} {Antenna};

Station number is 1-6 and is the station which has started transmitting.

Antenna is the sixbit antenna which is being used for transmitting.

Examples

<3p;

Station 3 has started transmitting on antenna 51.

Usage

There are several ways to use the SO2R Box, ranging from simple usage which does not use the intelligent features to complex usage which takes advantage of all of the major features.

Unintelligent

To use the box as an unintelligent switch, set it to active and send the relays to radio 0. The relays sent will take effect immediately. There will be no hot switching or other protection, and no need to connect the inhibit lines or the amplifier keying lines.

The switch can be used this way to control relays for a completely unrelated project, possibly not even involving a ham radio station.

Hot Switch Protected

To use hot-switching protection connect the amplifier key lines and the inhibit lines if the radios have an inhibit input. Assign a station number to each radio and send antenna switching commands on behalf of that station. One antenna number can be used for everything – there is no need to assign different numbers to each antenna.

If wait mode is used the antennas will only be switched while a station is receiving. Even if the radio does not have an inhibit input this will provide adequate hot switching protection if the relays switch quickly.

Conflict Protection

To use conflict protection assign an antenna number to each antenna. A collection of antennas fed by a single feedline could be assigned one antenna number or one for each combination. A group of antennas which may be selected by more than one station should be assigned one antenna number for each combination.

Create a table of conflicts. Two antennas have a conflict if, when one is in use by a station, the other cannot be used on another station. An antenna is in conflict with itself if it cannot be used by two stations at the same time. Load this information into the conflicts table.

The conflict resolver will make sure that antennas with conflicts will not be made active. This also takes care of otherwise complex operations such as having two radios swap antennas – the conflict resolver will switch them both at exactly the same time.

Amplifier switching

If a station has separate antennas for each band the MOAS II can be used to activate the correct amplifier. Instead of connecting the radio T/R lines to the amplifier and the MOAS II connect them only to the MOAS II. Connect the amplifiers to MOAS II relay outputs. Use the extra relays for the station to key the correct amplifier when the station transmits. The latency of the MOAS II is negligible for this purpose.

The set on transmit and reset on transmit can be used to share an amplifier between two radios. The amplifier will be switched to a radio when it transmits and will remain connected to that

radio until the other transmits. If the amplifier can switch bands quickly it is possible to use one amplifier for SO2R on two bands by controlling the amplifier band using MOAS II outputs.

Extra inhibits

If fewer than six stations are connected to the MOAS II there will be unused inhibit lines. The extra inhibits can be used as general purpose low-side outputs.