

## APPENDIX DSI - ANTENNA DEPLOYMENT SAFETY INTERLOCK OPTION

## REVISION HISTORY

DATE	DESCRIPTION	SOFTWARE VERSION
7 December 2004	Initial Release	1.46
1 December 2005	DEPLOY mode update	1.55

## 1.0 INTRODUCTION

This appendix describes the installation requirements and operational characteristics of the optional "antenna deployment safety interlock" feature of the RC3000 satellite antenna controller. The intent of this optional feature is to mechanize a positive means for observing that the satellite antenna is not deployed in an unsafe environment such as within the proximity of overhead power lines.

**NOTE: this optional feature is intended to aid in the achievement of safe antenna operations. It is the antenna integrator's responsibility to ensure that this and other system safety items are correctly implemented in order to fully comply with any required safety standards.**

## 1.1 Appendix Organization

This appendix is provided as a supplement to the baseline RC3000 manual. The unique items relating to the antenna deployment safety interlock option are described via a paragraph numbering scheme that corresponds to the baseline RC3000 manual's paragraph numbering.

## 1.2 Features

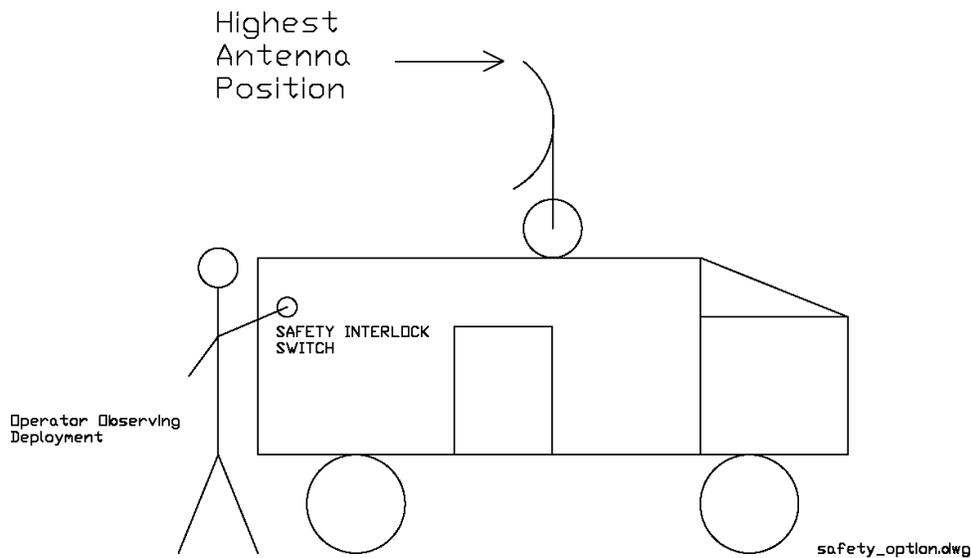
Software Configuration. This feature is designated as one of the remote control options of the RC3000.

Remote Control Option Designation	Monitor and Control Software Enabled	ANTENNA SAFETY INTERLOCK option
N		
O		YES
P	YES	YES
R	YES	

The software containing the safety feature would therefore be designated as either RC3K-ab-xyO or RC3K-ab-xyP.

### 1.3 Safety Option Theory

This option provides a mechanism to require an operator to visually confirm that the satellite antenna will not contact any potentially dangerous obstacles. This confirmation is achieved by requiring the operator to hold down a "safety interlock" button until the antenna has initially reached its highest point. Also, anytime that the RC3000 is powered on, the button must be activated to confirm a safe overhead environment in order to allow azimuth movement or elevation up movement. This button is required to be placed in a position that would allow direct observation of the antenna as it is raised.



**NOTE: this feature allows initial confirmation of safe antenna position after the powering up of the RC3000 antenna control unit. Another potential safety issue is that of vehicle movement with the antenna raised. The antenna integrator must mechanize an "antenna stow/vehicle interlock" in order to assure that the vehicle is not moved into dangerous obstacles while the antenna is not stowed.**

## 2.0 INSTALLATION

### 2.1 Equipment Mounting

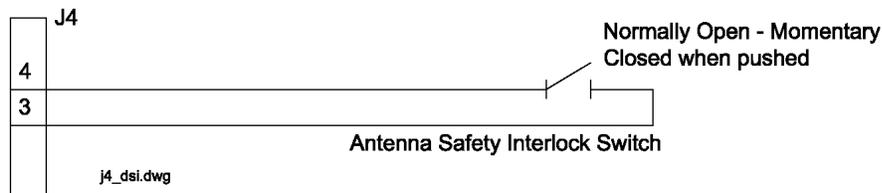
The antenna safety interlock button must be placed on the exterior of the vehicle where the operator will have a clear view of the antenna's full range of movement.

**NOTE: it is the antenna integrator's responsibility to ensure that the safety interlock button is placed where the operator can continuously and responsibly observe the environment overhead during movement of the antenna.**

### 2.2 Electrical connections

The antenna safety interlock button must be a momentary, normally-open switch. This means that the operator must push the button with continuous pressure to close the switch and that the switch will open immediately when released.

The safety interlock button shall be connected to pins 3 and 4 of the J4 (Pulse) connector on the back of the RC3000. The following diagram shows this connection:



Reference section 2.2.10 of the RC3000 User's Manual to see the allocation of the other pins of connector J4 that may be used to implement azimuth and elevation pulse sensors.

The RC3000 circuitry that senses the switch closure generates a very low current. For this reason, the safety interlock switch must have low contact resistance.

As stated in section 2.1, the safety interlock switch must be placed on the exterior of the vehicle. This requirement places environmental requirements (watertight, UV resistant, etc.) on the switch. The antenna integrator must ensure that the chosen switch meets the environmental needs of an exterior placement.

## 2.3 Initial Configuration

Initial testing of the safety interlock option's installation may be performed via the LIMITS MAINTENANCE screen (see section 3.3.2.5). From this screen, observe that the sensed state of the safety interlock switch changes from 0 to 1 as the button is pushed. When the button is released, the sensed state should return to 0.

Further testing of this feature's functionality will have to be performed in an environment where the antenna may be safely raised to its highest position.

## 3.0 Operation Overview

The RC3000's software maintains an "antenna\_safe" flag that indicates whether or not an explicit action has been taken by the operator to confirm that the antenna has been deployed in a safe overhead environment. When the RC3000 powers up, the antenna\_safe flag is set false. The controller must sense that the antenna has moved to its highest point and that the safety interlock switch has been pressed before it will set the antenna\_safe flag true. Until the antenna\_safe flag is true, elevation movement in the up direction and all azimuth movement will be prohibited.

The mechanization of the antenna\_safe flag is designed to require the operator to observe the overhead environment every time the RC3000 antenna controller is powered on. As stated in section 2.1, it is critical that the safety interlock switch be placed in a position where the antenna's full range of movement may be observed.

The following paragraphs give more detail of the safety interlock option's operation.

## 3.2 Operating Group

### POWER ON

At power on, the state of the safety interlock switch is checked. If the safety interlock switch is sensed in the closed position, the RC3000 will consider this an attempt to bypass the safety feature and will allow no further controller operation. If this situation occurs, the following screen will appear:

```
** SAFETY SWITCH CLOSED AT POWER UP **
! SWITCH MUST BE NORMALLY OPEN !
! <CORRECT SWITCH> TO ALLOW OPERATION !
```

This situation is an exceptional condition that should not normally be encountered. If it is, the controller should be powered off and the safety interlock switch and/or its wiring must be corrected so that the switch is sensed in the open state at power on.

Also at power on, the antenna\_safe flag is set false. When the flag is false, an RC3000 alarm condition (see section 3.4 of the user's manual) is activated. This alarm will stay active until the antenna\_safe flag has been reset to the true state.

While the alarm condition is active, the following message will flash on line 4 of the LCD:

**!! SAFETY INTERLOCK MUST BE RESET !!**

For the antenna\_safe flag to be reset to the true state, the controller must sense that the antenna is at or above its highest (face vertical) position in elevation and that the safety interlock switch has been depressed. There are two basic examples of how the antenna\_safe flag may be reset:

- 1) if the antenna is stowed at power on, a DEPLOY action may be requested from the MENU mode. The DEPLOY mode will prompt the operator to press the safety interlock switch to start the deploy action. Since the antenna is below its highest position, the safety interlock switch must be held closed until the antenna has reached the face vertical position. If anytime during the deployment the operator believes that the antenna will encounter a dangerous obstacle, the safety interlock switch may be released and the movement will stop immediately.
- 2) if the antenna has been previously moved above the face vertical position and the controller powered off, the antenna\_safe flag will be false when the controller is turned back on. Since the controller can sense that the dish is already beyond its highest point, a one time push of the safety interlock switch will extinguish the alarm condition and normal antenna operation may be resumed. This second example condition requires the operator to observe the antenna's overhead environment before movement will be allowed but doesn't require the dish to be totally stowed then redeployed just to extinguish the alarm condition.

**NOTE: this second example condition assumes that an "antenna stow/vehicle inhibit" interlock has been mechanized that would not allow the vehicle to be moved with the antenna not stowed.**

The antenna's "highest point" is defined in software as the sensed elevation angle where the antenna's face is vertical. Further movement "up" from this point will actually bring the antenna structure below this face vertical position. This face vertical elevation angle is hardcoded into the software as the particular antenna's "RF offset" angle. For example, when the Vertex 2.4m. DMK reflector is at the face vertical position, its sensed elevation look angle will be 22.3 degrees. **It is imperative that the elevation calibration described in section 2.3.2 of the RC3000 user's manual be performed correctly so that the antenna's position is sensed correctly.**

The following paragraphs describe how the safety feature affects the operation of specific RC3000 modes.

### 3.2.1 MANUAL mode

If safety interlock alarm is active, the safety interlock switch would have to be held down to allow elevation up movement. This would require 2 people (one to hold the safety interlock switch and one to hold the elevation up jog key on the RC3000 front panel).

NOTE: as discussed in the second example above, if the antenna is already above its highest point, the alarm may be extinguished by a single push of the safety interlock button. This would just require one operator.

#### 3.2.2.1 DEPLOY

If antenna\_safe flag is false when the DEPLOY mode is entered, the following prompt will be displayed:

```
<MODE> MENU (DO NOT DEPLOY)          DEPLOY
PRESS <SAFETY BUTTON> TO INITIATE
BUTTON MUST BE HELD UNTIL FULLY DEPLOYED
```

A single operator may initiate the deploy function by pushing the safety switch.

If the switch is released before the antenna has reached its highest position, the movement will stop and the DEPLOY mode will reset to the initial state shown above. The user may restart movement by reengaging the safety interlock switch.

#### 3.2.2.3 LOCATE

In order to perform the automatic movements associated with the LOCATE mode, the antenna\_safe flag must be true. The most typical operational sequence of events will therefore be that a DEPLOY function must be performed prior to initiating a LOCATE.

#### 3.3.1.3.10 Stow & Deploy Positions

As described above, the antenna\_safe flag will be conditioned based on the face vertical position of the dish. To make sure the DEPLOY mode moves the antenna to at least the face vertical position, the elevation deploy (EL\_DEP) position should be set to a value at or above the face vertical position.

### 3.3.2.5 Limits Maintenance

The instantaneous sensed state of the safety interlock switch may be monitored at the LIMITS maintenance screen.

AZIM	CW:0	CCW:1	STOW:0	(0-OFF)	LIMITS
ELEV	UP:1	DN:1	STOW:1	(1- ON)	ACTIVE
POL	CW:0	CCW:1	STOW:*	<b>SAFE:1</b>	
<BKSP>MAKE		LIMITS	INACTIVE	<MODE>EXIT	

SAFE:1

The SAFE field shows the sensed status of the switch. When a "0" is displayed, the switch is sensed as open. When a "1" is displayed, the switch is sensed as closed.

## 3.4 ALARM DISPLAYS

When the antenna\_safe flag is false the following alarm message will be flashed on line 4:

**!! DEPLOY INTERLOCK MUST BE RESET !!**

NOTE: the safety interlock alarm is given lower display priority than alarm conditions such as an axis jam. After resetting a jam alarm, the safety interlock alarm may then appear.