RFSD-2 / RFSD-2D Operation Manual

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APPLIED INSTRUMENTS MODEL RFSD-2 / RFSD-2D
RF SIGNAL DETECTOR

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1.0 OVERVIEW

The RFSD-2 / RFSD-2D is a dual pilot carrier-monitoring device that continuously monitors the amplitude of two fixed pilot carriers. These carriers can be either Analog (RFSD-2) or QAM Digital (RFSD-2D). Based on pilot amplitudes along with logical signal comparison parameters, the RFSD-2 / RFSD-2D either sends a Switch Command Output to the Applied Instruments RPS-4/TTL RF Switch unit via a DB-25 connector (external RF Switch Option), or controls an internal RF switch unit directly (internal RF Switch Option). This command causes a switch to a STANDBY set of carriers if the preferred MAIN set of carriers fails. The unit indicates the carrier amplitude levels via a LCD display, shows the status of several alarms (based on logical signal comparison parameters), and provides alarm contact closures to interface to other status monitoring devices. A front panel keypad facilitates an interface to the programmable parameters to control how the unit reacts to changing signal conditions.

NOTE: It is to be understood that the "Switch Command Output" mentioned throughout this manual is either routed to an external RPS-4 RF Switch via a rear panel DB-25 connector (external RF Switch option), or, routed to a RF Switch internally housed within the RFSD-2 unit (internal RF Switch option). In either case, the Switch Command Output operation is identical - only the location of the actual RF switch may differ.

1.1 FEATURES

- **Dual receivers.** The model RFSD-2 / RFSD-2D contains two RF receivers. These receivers monitor pilot level conditions and, along with the Receiver Decision Logic parameters, determine switching action depending on system configuration.

- **Internal A/D converter provides real-time digital amplitude display.** Amplitude readings have a range of - 10.0 dBmV to +30.0 dBmV with 0.1 dB resolution.

- **Microprocessor control provides user programmability.** Programmable parameters include: Upper and Lower amplitude setpoints (separate for each pilot, setpoints determine status of pilot amplitude, either acceptable or unacceptable), Receiver Decision Logic (P1 AND P2, P1 OR P2, P1 ONLY, P2 ONLY, P1: Primary [MAIN] - P2: Backup [STANDBY]), switching time delays (switch-to-standby, switch-to-main), Switchback Mode (Automatic or Manual). Front panel keypad allows system to be configured to user needs.

- **Status monitoring alarms.** These alarms show Urgent (a switch-to-standby has occurred), Non-Urgent (a switch-to-standby has not occurred, but an out-of-tolerance condition exists), and Alarm Receiving Attention (ARA) status (the alarm has been acknowledged by the system operator). The front panel includes LED indicators to inform the operator of alarm status and the rear panel includes relay contact closures that can be connected to status monitoring equipment or alarm sounders.

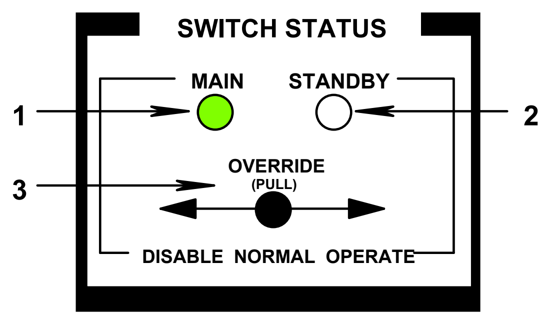
- **Manual switch override control.** Manually selectable override choices: OPERATE - instructs the Switch Command Output to the switch-to-standby position, regardless of the status of the pilot carrier(s), NORMAL - the Switch Command Output position is controlled by the status of the pilot carrier(s), and DISABLE - instructs the Switch Command Output to the switch-to-main position, regardless of the status of the pilot carrier(s).

2.0 OPERATION

The operation of the RFSD-2 / RFSD-2D is divided into several operation centers that interact with each other. These operation centers are: 1) dual pilot carrier amplitude measurement, 2) dual pilot setpoint comparison, 3) evaluation of Receiver Decision Logic parameters, 4) Switch Command Output delay timer, 5) setting or clearing of alarm status and the Switch Command Output, and 6) acknowledgment of an alarm condition via the ARA (Alarm Receiving Attention) button. These operation centers are described in detail in the following manual pages. Before operating the unit, please become familiar with the front panel controls / indicators and rear panel connections.

2.1 FRONT PANEL CONTROLS

- **2.11 SWITCH STATUS**



1. MAIN LED - This green LED lights when the Switch Command Output is in the MAIN (high) position.

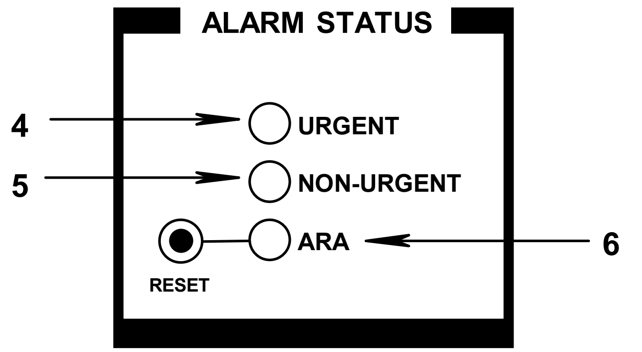
2. STANDBY LED - This red LED lights when the Switch Command Output is in the STANDBY (low) position.

3. MAIN / STANDBY OVERRIDE SWITCH - This pull-to-operate switch is used to allow the RFSD-2 / RFSD-2D to automatically control the Switch Command Output, or manually control the Switch Command Output regardless of the RFSD-2 / RFSD-2D decision circuitry. In the **DISABLE** position, the Switch Command Output is set to the MAIN (high) position and cannot change. In the **OPERATE** position, the Switch Command Output is set to the STANDBY (low) position and cannot change. In the **NORMAL** position, the Switch Command Output is controlled by the RFSD-2 / RFSD-2D amplitude measurement and Receiver Logic Decision circuitry.

NOTE: The override switch is a three-position switch that locks in each position. This is to eliminate unintentional switching. To enact a switch change, pull the shaft outward to clear the locking notch, move the toggle to the desired position, then return the shaft to its locked position.

NOTE: It is to be understood that the "Switch Command Output" mentioned throughout this manual is either routed to an external RPS-4 RF Switch via a rear panel DB-25 connector (<u>external RF Switch option</u>), or, routed to an RF Switch internally housed within the RFSD-2 unit (<u>internal RF Switch option</u>). In either case, the Switch Command Output operation is identical - only the location of the actual RF switch may differ.

- **2.12 ALARM STATUS**



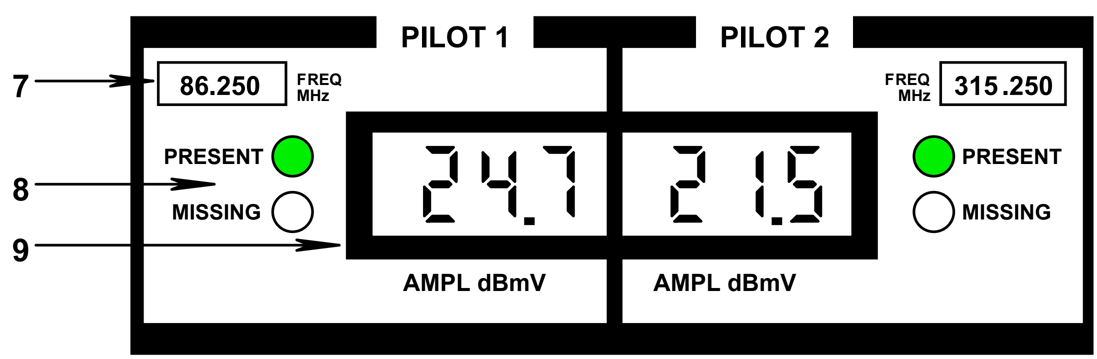
4. URGENT LED - This red LED flashes when the amplitude measurement and Receiver Decision Logic circuitry determine an Urgent alarm condition exists. The Urgent alarm relay contacts close under the flashing Urgent LED condition; this set of two, isolated relay contacts can be connected to status monitoring equipment or an alarm sounder.

5. NON-URGENT LED - This red LED flashes when the amplitude measurement and Receiver Decision Logic circuitry determine a Non-Urgent alarm condition exists. The Non-Urgent alarm relay contacts close under the flashing Non-Urgent LED condition; this set of two, isolated relay contacts can be connected to status monitoring equipment or an alarm sounder.

6. ARA (Alarm Receiving Attention) LED and ARA reset button - This yellow LED lights solidly when the ARA reset button has been pressed therefore acknowledging an existing alarm condition. The ARA alarm relay contacts close under the lit ARA LED condition; this set of two, isolated relay contacts can be connected to status monitoring equipment or an alarm sounder.

NOTE: The alarm relay contacts, either Urgent or Non-Urgent, are CLOSED when the matching LEDs are flashing. After acknowledging the alarm condition by pressing the ARA button, the flashing alarm LED is then solidly lit and the matching alarm relay contacts open.

- **2.13 AMPLITUDE DISPLAY**



NOTE: The following applies to both pilot one and pilot two displays.

7. PILOT FREQUENCY INDICATION - Marked frequency indicates the frequency of the pilot level receiver.

8. PRESENT / MISSING LEDs - These LEDs provide a quick status indication of the measured pilot carrier. Their operation depends on the position of the Switch Command Output, as follows:

- **Switch Command Output in the MAIN (high) position:**

  If the measured pilot carrier is above the lower setpoint, it is considered **PRESENT** and the green **PRESENT** LED will light. If the measured pilot carrier is below the lower setpoint, it is considered **MISSING** and the red **MISSING** LED will light.

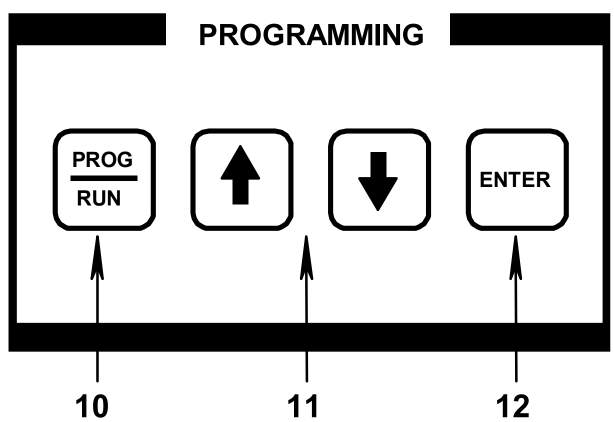
- **Switch Command Output in the STANDBY (low) position:**

  If the measured pilot carrier is below the upper setpoint, it is considered **MISSING** and the red **MISSING** LED will light. If the measured pilot carrier is above the upper setpoint, it is considered **PRESENT** and the green **PRESENT** LED will light.

9. AMPLITUDE DISPLAY - The pilot amplitudes are displayed during the normal RUN mode. These displays are also used in the programming mode to indicate the programmable parameters.

NOTE: It is to be understood that the "Switch Command Output" mentioned throughout this manual is either routed to an external RPS-4 RF Switch via a rear panel DB-25 connector (external RF Switch option), or, routed to a RF Switch internally housed within the RFSD-2 unit (internal RF Switch option). In either case, the Switch Command Output operation is identical - only the location of the actual RF switch may differ.

- **2.14 PROGRAMMING**



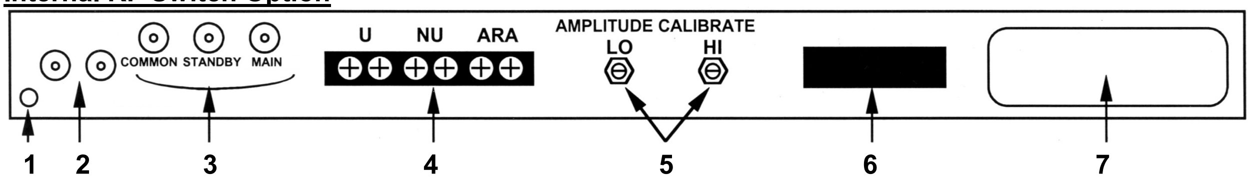
10. PROGRAM / RUN KEY - This key is used to change between the PROGRAMMING mode and the RUN mode.

11. UP ARROW / DOWN ARROW KEYS - These arrows allow scrolling through the programmable parameters as well as changing the programmable data.

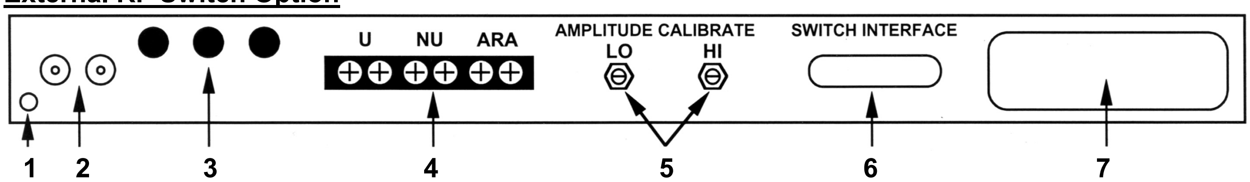
12. ENTER KEY - This key is used to initiate the data change mode and enter newly changed data.

2.2 REAR PANEL CONNECTIONS

Internal RF Switch Option



External RF Switch Option



1. Grounding stud **-** Connect to system common ground.

2. RF sense input - Type 'F' or type 'BNC' connector(s), connect to signal tap point(s). ***NOTE: There may be a single RF input connector or dual, separate RF input connectors, either type 'F' or type 'BNC', depending on the input option selected.***

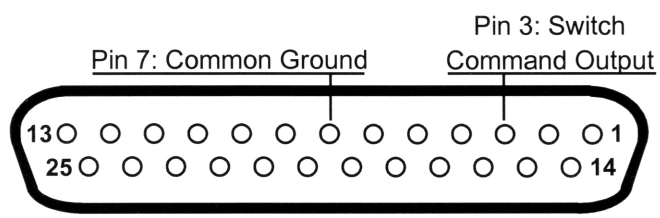
NOTE: If the two pilots to be monitored are on the same RF coaxial cable or tap-point, a single sense input option is used. The single input is split internally and then fed to each of the two receivers. If the two pilots to be monitored are on two different RF coaxial cables or tap-points, a dual sense input option is used. The two inputs are then fed directly to each receiver. If the two pilots to be monitored are of the SAME frequency, as in a Primary [MAIN]-Backup [STANDBY] situation, these signals will be on two different RF coaxial cables, and a dual sense input option is used. The two inputs are then fed directly to each identical frequency receiver.

3. RF Switch - Connect **MAIN** to main signal source, **STANDBY** to standby signal source, and **C**OMMON to common system output. ***NOTE: These connections are only present with the internal RF switch option; there will be plug buttons on units with the external RF Switch option.***

4. Alarm contact closure strip - Each alarm (Urgent, Non-Urgent) and the ARA indicator consists of two, isolated relay contacts that can be connected to status monitoring equipment or alarm sounders.

5. Amplitude calibration adjustment controls - These potentiometers are used to calibrate the amplitude measurement system to a known accurate source.

6. Switch interface **-** Type 'DB-25' connector, connect to Model RPS-4/TTL to control RF switching function. ***NOTE: This connector is only present with the external RF switch option; there will be a plug button on units with the internal RF Switch option.***

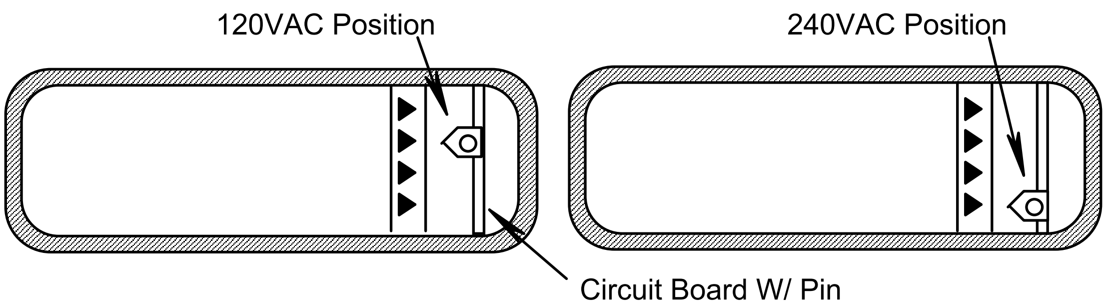


7. Power input **-** Source for input power: **Standard VAC**, 110/120VAC/60Hz, 1/2A fuse (220/240VAC / 50-60Hz, 1/4A fuse). See the following section regarding line voltage selection. **Optional -48VDC**: An optional -48VDC input power option is also available, 75 mA @ -48VDC.

2.21 LINE VOLTAGE SELECTION

Applicable in the standard VAC input configuration only, the AC receptacle can be set for the available AC line voltage, either 110/120VAC or 220/240VAC. To set the desired voltage, remove the AC line cord from the AC input receptacle. Remove the fuseholder cover. Remove the vertical printed circuit board with a needle-nose pliers or similar tool; a fair amount of force is necessary. Rotate the white plastic pin so that it is pointing **opposite** the desired line voltage nomenclature, i.e., opposite 120 for 110/120VAC or opposite 240 for 220/240VAC. Re-insert the printed circuit board in the same manner it was removed, ensuring the white plastic pin points to the left as shown below. Press firmly to ensure the board is fully seated. Install the proper fuse (110/120VAC - 1/2A, 220/240VAC - 1/4A) in the fuse holder cover and insert the cover onto the AC receptacle. The white plastic pin should protrude through the hole of the fuseholder cover to indicate the line voltage selected.

NOTE: Although there are adjustment holes for 100VAC and 220VAC, these settings are not available on this unit. Use only 120VAC or 240VAC.



NOTE: This selection is not available or applicable on the -48VDC power input option.

2.22 POWER-UP CONDITIONS

Upon a power-up condition, or if a power failure occurs for a sufficient length of time to cause a microprocessor reset, the Non-Urgent LED will flash at a rate twice that of a normal, pilot-carrier-caused alarm condition. This is to inform the system operator of a power-up or power interruption condition and differentiate from a pilot carrier level caused Non-Urgent alarm condition. Once the unit is powered, pressing the ARA button will clear the power-up Non-Urgent alarm indication.

NOTE: With no power applied to the RFSD-2 / RFSD-2D, the Urgent relay is CLOSED. This can be used by status monitoring equipment to denote a power failure.

A self-test mode is also available. The self-test mode is eight seconds in length, divided into two parts. To evoke the testing mode, press and HOLD either arrow key while applying power through the AC receptacle. During the first four-second phase, the unit will light all LEDs (except STANDBY=OFF), set the Switch Command Output to MAIN (high), close all relay contacts, and display all LCD segments. During the last four-second phase, the unit will extinguish all LEDs (except STANDBY=ON), set the Switch Command Output to STANDBY (low), open all relay contacts, and display the microprocessor version number.

NOTE: This testing mode does not occur under normal power-up conditions - it occurs ONLY if an arrow key is held during power-up. Under normal power-up or power interruption conditions (exceeding 250 mS), the unit resets and then quickly resumes normal operation.

2.3 PILOT CARRIER AMPLITUDE MEASUREMENT

The RF pilot signals are connected to the rear panel RF connector. The incoming pilot signals are fed into two fixed frequency receivers, either narrow-band Analog or QAM Digital, that produce an output proportional to RF input. Pilot carrier amplitude levels between -10.0 dBmV and +30.0 dBmV can be measured in 0.1 dB resolution. The RFSD-2 / RFSD-2D microprocessor continuously monitors the output of the two RF receivers (real-time multiplexed) and displays the amplitude levels, in dBmV, via a dual reading LCD display. These measurements are also available to the microprocessor to compare to the programmable setpoints to determine the acceptability of the pilot carrier amplitudes.

2.4 AMPLITUDE CALIBRATION VERIFICATION

All test equipment should, from time to time, have its calibration measured against a known accurate standard. The basis of accuracy of the RFSD-2 / RFSD-2D is its calibration to a reference signal of known level. The accuracy of the meter is then as accurate as the stated level of the calibration signal. The rear panel of the RFSD-2 / RFSD-2D contains two amplitude adjustment controls that adjust the amplitude readout of the two pilot monitoring channels. To correct or calibrate the amplitude readouts, perform the following steps:

NOTE: These steps should be performed after the unit has been installed in its normal operating environment, power has been applied, and the unit allowed to stabilize for one hour.

1) Connect to the rear panel RF input connector a stable, accurate, CW signal source (RFSD-2) or QAM Digital (RFSD-2D), of known amplitude (preferably at +10.0 dBmV) at the frequency of pilot 1.

2) Note the reading of the pilot 1 amplitude LCD readout. If the display differs from the known source, adjust the pilot 1 amplitude adjustment control until the reading matches the known source.

3) Repeat for the frequency of pilot 2.

2.5 SETPOINT COMPARISON

The RFSD-2 / RFSD-2D compares the received pilot carrier level amplitudes with UPPER and LOWER amplitude setpoints. There are separate UPPER and LOWER setpoints associated with each of the two pilot receivers. These setpoints determine the range of acceptable pilot carrier amplitudes. These setpoints can be set between -10.0 dBmV and +30.0 dBmV. The method of setting of these setpoints is described in section <u>3.0 Programming Mode</u>. A given pilot amplitude can be considered PRESENT or MISSING depending on the level of the setpoints. Front panel PRESENT and MISSING LEDs assist the operator in quickly determining the status the pilot signal levels. The result of the pilot level / UPPER-LOWER setpoint comparison is given to the Receiver Decision Logic parameters to determine that, if any, action should be taken. To obtain an understanding of the operation of the setpoints and present/missing status, refer to the following setpoint comparison example and drawings.

NOTE: By definition, an acceptable pilot carrier amplitude as determined by the programmable setpoints, is considered as PRESENT. An unacceptable pilot carrier amplitude, as determined by the programmable setpoints, is considered as MISSING. A pilot does not actually have to be below the lowest measurable amplitude level of -10.0 dBmV to be considered as "MISSING".

2.51 SETPOINT COMPARISON EXAMPLE

NOTE: The following example, for simplicity, deals with one pilot carrier only. In the actual operation of the RFSD-2 / RFSD-2D, the Receiver Decision Logic parameters determine how the carriers are considered, either together, separately, or one pilot only.

In the sample system shown, the normal level of the pilot carrier is +15 dBmV. This pilot level represents the associated levels of all other carriers within this system. In this example, the lowest amplitude that still provides an acceptable level of signal quality is +0 dBmV. If the signal level amplitude decreases below +0 dBmV, the quality of the system signals is unacceptable and an alternative signal source is desired (switch-to-standby).

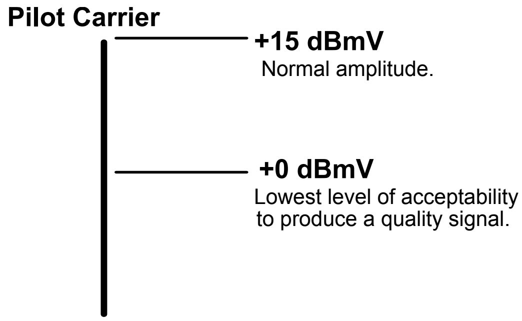


Fig. 1: Normal System Levels Example

If a single setpoint determined when to switch-to-main (acceptable signal level) or switch-to-standby (unacceptable signal level), system noise or pilot carrier instability could lead to "chattering" back-and-forth if the signal hovers right around the +0 dBmV point.

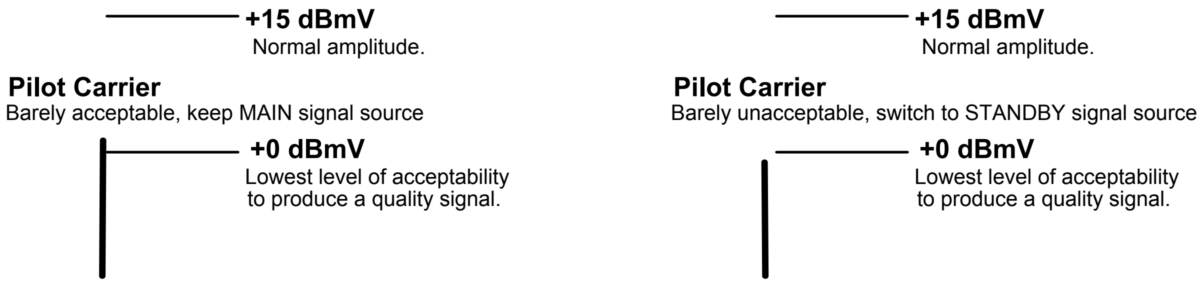


Fig. 2: Acceptable and Unacceptable System Levels w/o Hysteresis Example

To eliminate possible switch instability (chattering), two setpoints are used, UPPER and LOWER. The LOWER setpoint determines at what point a *decreasing from acceptable to unacceptable* signal level causes a switch-to-standby command, and the UPPER setpoint determines at what point a *raising from unacceptable to acceptable* signal level causes a switch-to-main command. The area between these two points is the hysteresis area that prevents switch chatter.

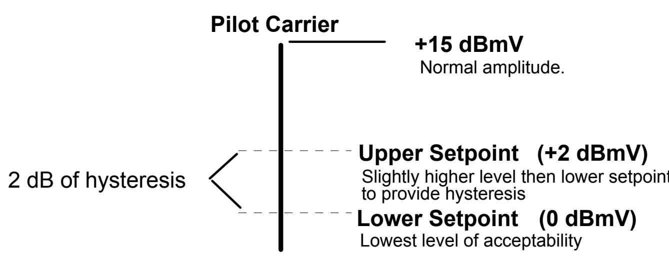


Fig. 3: UPPER and LOWER Setpoints Example, Pilot at Normal Condition

If a signal starts at the normal level of +15 dBmV, the Switch Command Output will be in the switch-to-main position. If the carrier then decreases below the UPPER setpoint, no change occurs because the signal level is still above the lowest level of acceptability as set by the lower setpoint. *It is important to note that the signal level below the UPPER setpoint is still considered acceptable* because it originally started above the UPPER setpoint. Once the signal level decreases below the LOWER setpoint, it has clearly crossed the point of unacceptability, and a switch-to-standby command is given. If the carrier then increases above the LOWER setpoint, no change occurs because the signal level is still below the UPPER setpoint. *It is important to note that the signal level above the LOWER setpoint is still considered unacceptable* because it originally started below the LOWER setpoint. Once the signal level increases above the UPPER setpoint, it has clearly crossed the point of acceptability, and a switch-to-main command is given. This UPPER setpoint / LOWER setpoint hysteresis function prevents switch chattering when the signal level is moving about the LOWER setpoint, slightly above and slightly below.

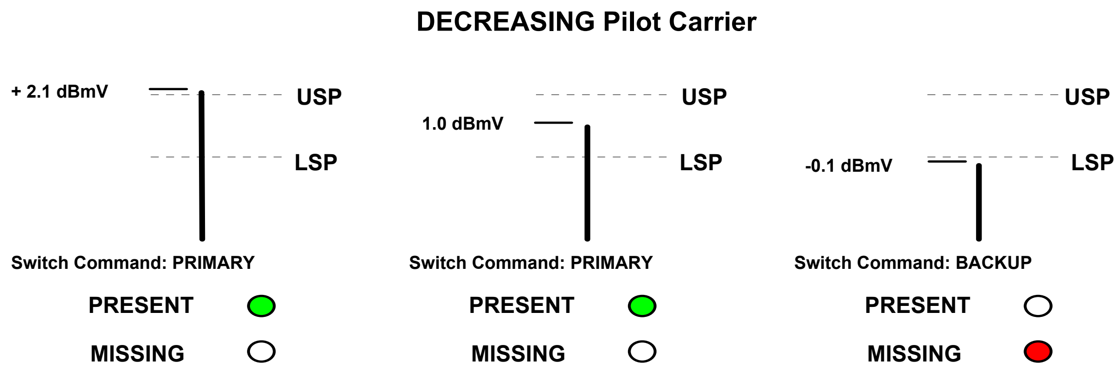


Fig. 4: Decreasing Pilot Carrier verses Setpoints and Switch Command Example

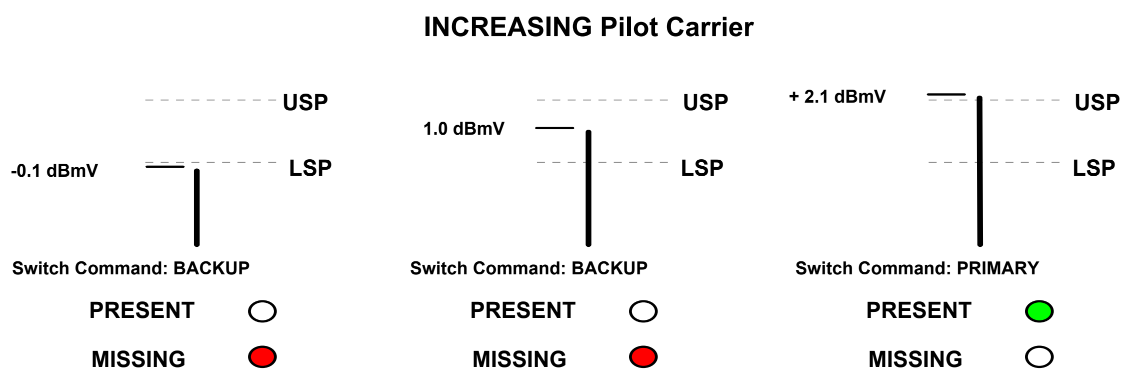


Fig. 5: Increasing Pilot Carrier verses Setpoints and Switch Command Example

To restate, the LOWER setpoint should be thought of as *the lowest point a previously acceptable signal level can fall* before being considered unacceptable. The UPPER setpoint should be thought of *as the lowest point a previously unacceptable signal level must rise* before being considered acceptable. True, there is a paradox region between the LOWER and UPPER setpoints where the same signal level could be considered acceptable in one case (decreasing signal not yet causing a switch-to-standby command) and unacceptable in another (increasing signal not yet causing a switch-to-main command), but this is the tradeoff necessary to provide the stability the hysteresis function brings.

NOTE: Clearly the case of a total failing pilot carrier that then totally reappears as normal is a case where the hysteresis function is irrelevant and unused.

2.6 EVALUATION OF RECEIVER DECISION LOGIC PARAMETERS

The RFSD-2 / RFSD-2D will set a Switch Command Output and the status of various alarms based on the setpoint comparator status (PRESENT or MISSING) and Receiver Decision Logic parameters. These Receiver Decision Logic parameters will determine what switching actions are / are not taken based on a truth table of receiver conditions verses switching / alarm action.

NOTE: Only one Receiver Decision Logic mode can be selected at a time. The method of setting of the Receiver Decision Logic parameters is described in section <u>3.0 Programming Mode</u>.

The action items taken based on pilot level / programmable setpoint comparison are: a) set the alarms to the appropriate state, b) set the Switch Command Output to the appropriate logic level (HI=MAIN, LOW=STANDBY). The alarms are divided into two types: Urgent and Non-Urgent. An Urgent alarm is always accompanied by the output of a switch-to-standby command - except within the P-b Primary [MAIN]-Backup [STANDBY] Logic Mode; a Non-Urgent alarm warns of a degrading situation. The programmable Receiver Decision Logic parameters determine the action taken based on pilot amplitude / setpoint comparison inputs. These logic parameters are: P1 **AND** P2, P1 **OR** P2, P1 **ONLY**, P2 **ONLY**, P1: **Primary [MAIN]** - P2: **Backup [STANDBY]**. These determine if the carrier levels are considered *jointly* (P1 **AND** P2), *separately* (P1 **OR** P2), or *singly* (P1 **ONLY**, P2 **ONLY**), or in a Primary-Backup situation (P1: **Primary [MAIN]** - P2: **Backup [STANDBY]**). The actions taken for a given pilot carrier(s) condition(s) may differ depending on the Receiver Decision Logic mode chosen. The following truth table shows how each Receiver Decision Logic mode affects the alarms and Switch Command Output:

IMPORTANT: To understand the switching action controlled by the Receiver Decision Logic, one must have a clear understanding of how the Switch Command Output position (MAIN or STANDBY) and hysteresis affect whether a carrier is considered PRESENT or MISSING. Refer to the previous figures: Fig. 4 Increasing Pilot Carrier verses Setpoints and Switch Command Example and Fig. 5 Decreasing Pilot Carrier verses Setpoints and Switch Command Example. In any case, if the Switch Command Output has changed to the STANDBY position, the carrier or carriers, depending on Receiver Logic Mode chosen, must rise in amplitude above the UPPER setpoint to cause the Switch Command Output to return to the MAIN position.

Receiver Decision Logic Mode: **[AND] P1 AMPLITUDE *AND* P2 AMPLITUDE**

P1 STATUS	P2 STATUS	Switch Status / Urgent Alarm	Non-Urgent Alarm
PRESENT	PRESENT	Not Switched / Not Activated	Not Activated
PRESENT	*MISSING*	Not Switched / Not Activated	Activated
MISSING	PRESENT	Not Switched / Not Activated	Activated
MISSING	*MISSING*	Switched and Activated	Not Activated

Receiver Decision Logic Mode: **[OR] P1 AMPLITUDE *OR* P2 AMPLITUDE**

P1 STATUS	P2 STATUS	Switch Status / Urgent Alarm	Non-Urgent Alarm
PRESENT	PRESENT	Not Switched / Not Activated	Not Activated
PRESENT	*MISSING*	Switched and Activated	Not Activated
MISSING	PRESENT	Switched and Activated	Not Activated
MISSING	*MISSING*	Switched and Activated	Not Activated

Receiver Decision Logic Mode: **[P1] P1 AMPLITUDE *ONLY* (P2 IGNORED)**

P1 STATUS	P2 STATUS	Switch Status / Urgent Alarm	Non-Urgent Alarm
PRESENT	IGNORED	Not Switched / Not Activated	Not Activated
MISSING	IGNORED	Switched and Activated	Not Activated

Receiver Decision Logic Mode: **[P2] P2 AMPLITUDE *ONLY* (P1 IGNORED)**

P1 STATUS	P2 STATUS	Switch Status / Urgent Alarm	Non-Urgent Alarm
IGNORED	PRESENT	Not Switched / Not Activated	Not Activated
IGNORED	*MISSING*	Switched and Activated	Not Activated

Receiver Decision Logic Mode: **[P-b] P1 PRIMARY [MAIN] - P2 BACKUP [STANDBY]**

P1 STATUS	P2 STATUS	Switch Status	Urgent Alarm	Non-Urgent Alarm
PRESENT	PRESENT	Not Switched	Not Activated	Not Activated
PRESENT	*MISSING*	Not Switched	Not Activated	Activated
MISSING	PRESENT	Switched	Not activated	Activated
MISSING	*MISSING*	Not Switched	Activated	Not Activated

Fig. 6: Switch Control Status / Alarm Status verses Receiver Decision Logic Mode

2.7 PROGRAMMABLE DELAYS

The Receiver Decision Logic has two associated programmable delays regarding alarms and the Switch Command Output. These delays are: Delay Primary [MAIN]-to-Backup [STANDBY], and Delay Backup [STANDBY]-to-Primary [MAIN]. Although these delays refer to switching operation, the alarm status is delayed as well. The reason for these delays is to reduce fleeting alarms or switching caused by a false or random, non-continuous fault condition. When the Receiver Decision Logic determines an alarm and / or switching action is needed, this condition is input to the delay timer. If the condition persists for the time set in the delay parameters, the condition is then passed along to the alarm / Switch Command Output processing center. The appropriate alarm / switching action is then taken. There are separate delays regarding Primary [MAIN]-to-Backup [STANDBY] and Backup [STANDBY]-to-Primary [MAIN]. The method of setting of these delays is described in section 3.0 Programming Mode.

2.8 ACKNOWLEDGMENT OF AN ALARM CONDITION VIA THE ARA BUTTON

The function of the ARA (Alarm Receiving Attention) button is to clear down the ALARM NOTIFICATION condition only - the switch status stays as is. If an alarm condition has occurred, pressing the ARA button will: 1) reset (open) both alarm relays, 2) replace the flashing alarm LED with a solid illumination, and 3) set (close) the ARA relay and light the ARA LED. Example: P1 fails while the unit is in the P1 OR P2 mode. This causes an Urgent alarm condition: the Switch Command Output is set to STANDBY, the Urgent alarm relay closes, and the Urgent LED flashes. An operator then presses the ARA button: the Switch Command Output stays in the STANDBY position, the Urgent alarm relay opens; the Urgent LED now solidly illuminates, and the ARA relay closes with the ARA LED solidly lit. If the pilot amplitudes are restored to normal, the Receiver Decision Logic function will: reset the Switch Command Output to MAIN, extinguish the Urgent LED, open the ARA relay and extinguish the ARA LED.

NOTE: If the faulty condition that caused an alarm condition is restored <u>before</u> the ARA button is pressed to acknowledge the alarm condition, the appropriate relay alarm will remain closed and the matching LED will continue to flash. Once the ARA button is pressed (again, a normal condition already exists), all alarm relays will open and all alarm LEDs will extinguish. No ARA relay closure or LED response will occur.

3.0 PROGRAMMING MODE

The RFSD-2 / RFSD-2D has a Programming Mode in which the programmable data parameters can be adjusted. These parameters include: upper and lower setpoint - pilot one, upper and lower setpoint - pilot two, receiver logic mode, Switchback Mode, delay time, and the special case of Switchback Mode = MANUAL, a manual Switchback reset position. These settable parameters are available via a menu within the Program Mode.

3.1 ENTERING THE PROGRAMMING MODE

To enter the Programming Mode, press the **PROG / RUN** key. This will cause the unit to enter the Programming Mode. The Pilot 1 - Pilot 2 real-time amplitude displays will be replaced by a menu of programmable options.

NOTE: The background measurement of the two pilot receive levels will continue, but the amplitude numbers will not be displayed, of course, because the displays will now be used for programming. The PRESENT and MISSING LEDs <u>are</u> updated, real-time, as dictated by the pilot carrier measurements and the setpoint parameters. If the setpoints are changed while in the Programming Mode, the PRESENT / MISSING LEDs will respond accordingly to the new data; however, NO SWITCH COMMAND OR ALARM OUTPUTS WILL CHANGE WHILE IN THE PROGRAMMING MODE - ALL CHANGES WILL BE "OFFICIALLY ACCEPTED AND ACTED UPON" UPON EXITING THE PROGRAM MODE. In other words, the amplitude measurement and PRESENT / MISSING LED operation goes on real-time, reacting to pilot level changes AND upper and lower setpoint changes, even while IN the Programming Mode. Any switch or alarm command actions are held until the Programming Mode is exited. If, upon exiting, the switch or alarm action items still exist, the unit will act upon them at that time. If data changes make what <u>was</u> a switch or alarm output

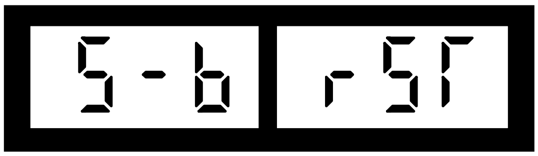
command necessary, to now be unnecessary (with the new parameters), then no action will take place upon exiting the Programming Mode.

*** <u>EXCEPTION</u> * :** The Manual Switch Reset function as described later WILL take place immediately. ***Note: See section <u>3.4 Special Case For Manual Switch Reset</u> for more information.***

3.2 SCROLLING THROUGH THE PROGRAMMABLE ITEMS MENU

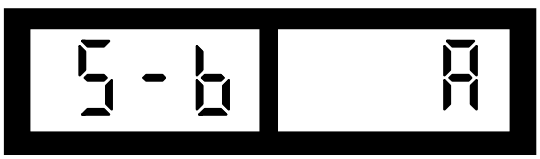
Pressing the ↑ / ↓ keys will step through the programmable menu positions that will display a menu label on one side of the LCD display and the programmable data on the other side. The menu labels are short alpha characters that can be displayed within the limitations of a seven-segment display. These positions are as follows:

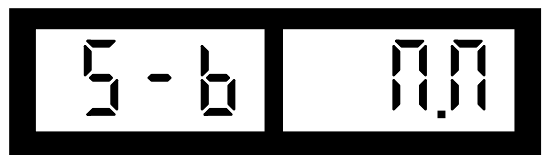
- Switchback Reset Label = **S - b | rST**



This position appears ONLY when the Switchback Mode is set to Manual. ***Note: See section 3.4 Special Case For Manual Switchback for more information.***

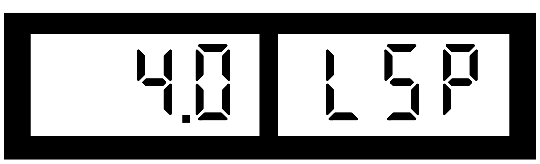
- Switchback Mode Label = **S - b | A , S - b | M**

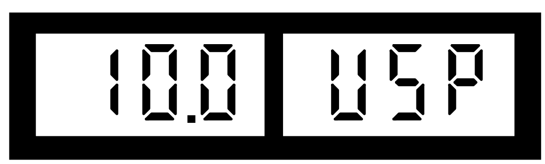




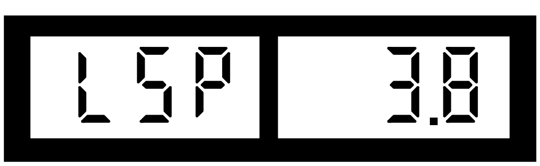
Settable to **A** or **M**. In the Automatic Switchback Mode, after a switch-to-standby command has occurred, if the Receiver Decision Logic determines pilot level(s) = PRESENT, the switch-to-main command is automatically given. In the Manual Switchback Mode, after a switch-to-standby command has occurred, a Manual Switchback position is added to the Programming Mode menu. This special position is NOT a data position; it is a Manual switchback COMMAND position and ONLY appears if the unit is in Manual Switchback Mode AND a switch-to-standby command has occurred.

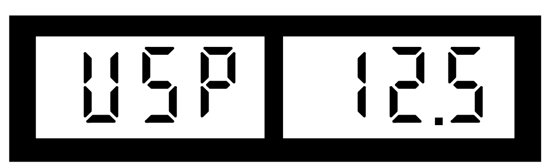
- Pilot 1 - Lower Setpoint Label = **data | LSP**
- Pilot 1 - Upper Setpoint Label = **data | USP**





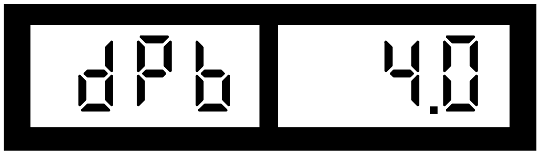
- Pilot 2 - Lower Setpoint Label = **LSP | data**
- Pilot 2 - Upper Setpoint Label = **USP | data**

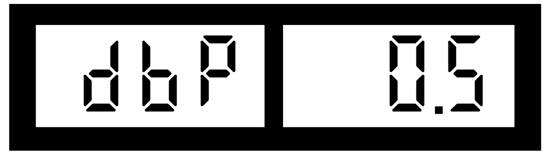




Setpoint range is between -10.0 dBmV and +30.0 dBmV. When setting the setpoints for pilot 1, the numeric data appears under the pilot 1 side and the LSP / USP label will appear under the pilot 2 side. When setting the setpoints for pilot 2, the numeric data appears under the pilot 2 side and the LSP / USP label will appear under the pilot 1 side. ***NOTE: The lower setpoint cannot be set above the upper setpoint, just as the upper setpoint cannot be set below the lower setpoint. This is to eliminate overlapping or reversed setpoints.***

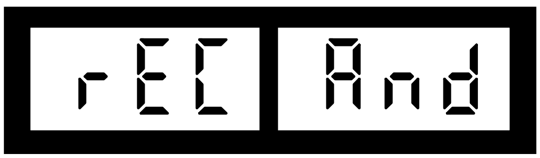
- Delay Primary [MAIN]-to-Backup [STANDBY] Label = **dPb | data**
- Delay Backup [STANDBY]-to-Primary [MAIN] Label = **dbP | data**

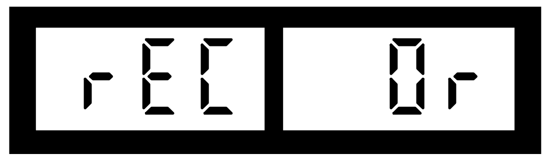


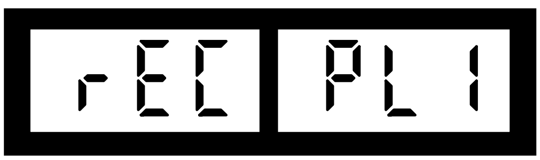


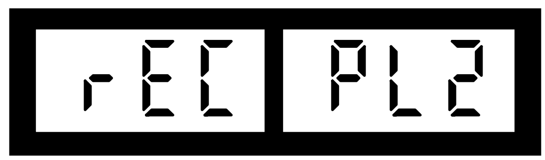
These delays are programmable, from 0 to 11.0 seconds, in 0.5-second increments. These set a delay from the time the measurement / receiver logic output function determines a switch / alarm action item should take place and the command is actually given. The Primary [MAIN]-to-Backup [STANDBY] delay time is used when the Switch Command Output is in the Primary [MAIN] position, and the Backup [STANDBY]-to-Primary [MAIN] delay time is used when the Switch Command Output is in the Backup [STANDBY] position.

- Receiver Logic Status   Label = **rEC | data**









The receiver logic status can be set to P1 AND P2, P1 OR P2, PL1, PL2, P-b. These determine the end decision on how to react to the measured pilot carriers. ***NOTE: P-b example similar, not shown.***

3.3 VERIFYING / CHANGING PROGRAMMABLE DATA

One can *verify* the value of any programmable item by ↑ / ↓ keying to the desired position and *observing* the displayed data. To *change* the currently display data setting, press and HOLD the **ENTER** key for > 1 second while in the menu position of the data to be changed. When the unit has sensed a key press of sufficient length, it will enter the Change Programming Mode. The menu data label section of the display will flash, indicating a data change can now be made. Pressing the ↑ / ↓ keys (while the data label is flashing) will increment / decrement the data; numbers are incremented / decremented numerically, options will step through their associated programmable choices. Once the data has been changed to the desired reading via the ↑ / ↓ keys, pressing the **ENTER** key will accept the new data and store the variable into <u>non-permanent memory only at this time</u>. If a change is initiated, and then NOT desired, pressing the **PROG/RUN** key (while the data label is flashing, and <u>not</u> for >1 second) will cancel the change and return the data to the former state. ONLY THE **ENTER** KEY WILL CAUSE A VALUE CHANGE.

NOTE: If the user presses and HOLDS the ↑ / ↓ keys when changing setpoint data, the numbers will automatically increment or decrement (depending on direction) in 0.1 increments. When an integer dBmV value is passed as the ↑ / ↓ key is held down, the numbers will then change in whole dB increments, i.e. 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 4.0, 5.0, 6.0, etc. This facilitates quicker scrolling of setpoint data.

Once the **ENTER** key is pressed (or the **PROG/RUN** key to cancel), the data label portion of the display will stop flashing. The ↑ / ↓ keys will then continue to scroll through the programmable menu positions. When all programming is finished, press the **PROG/RUN** key (<u>not</u> for > 1 second) to exit the Programming Mode and return to the run mode. Only when the **PROG/RUN** key is pressed to EXIT the Programming Mode will the new data be written to permanent memory. A four-minute time-out exists such that if the Programming Mode is entered (regardless if data was changed or not), and the **PROG/RUN** was NOT pressed to exit the Programming Mode, the unit will return to the RUN mode and restore the data values held in permanent memory. **ANY DATA CHANGED AND STORED IN TEMPORARY MEMORY IS DISCARDED AND REPLACED WITH PERMANENT MEMORY DATA.**

NOTE: To quickly exit the Programming Mode and discard ALL changed data, press and HOLD either ↑ / ↓ key for > four seconds. This must be done within the Programming Mode, not within the CHANGE data mode.

To review, the **ENTER** key accepts new data into temporary memory, but the **PROG/RUN** key exiting the Programming Mode accepts the new data as new operating parameters and a store to permanent memory.

To review the Programming steps:

1) Enter the Program Mode by pressing the **PROG/RUN** key.

2) Scroll through the programmable menu items by pressing the ↑ / ↓ keys. Stop at any menu item where a change is desired.

3) Enter the Change Data Mode by pressing and HOLDING the **ENTER** key (for > 1 second).

4) After the data label starts flashing, use the ↑ / ↓ keys to change the data to the desired value.

5) To accept the new data, press the **ENTER** key. To cancel the change and return to the old data, press the **PROG/RUN** key (<u>not</u> for > 1 second).

6) Repeat steps 2 - 5 for all desired data changes. To exit the Program Mode and return to the run mode, press the **PROG/RUN** key (<u>not</u> for > 1 second). If the new settings are inappropriate, simply DO NOT press the **PROG/RUN** key, wait for the four minute time-out or press either arrow key for > four seconds, and the unit will return to its previous state with no programming changes saved.

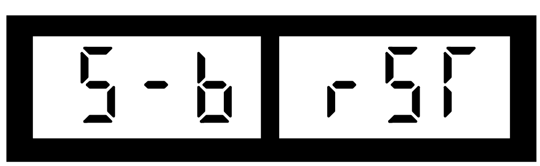
3.4 SPECIAL CASE FOR MANUAL SWITCH RESET

One additional menu item will be present if the Switchback Mode is set to the MANUAL mode <u>and</u> a switch-to-standby *has* occurred. A Switchback RESET position is added to the TOP of the programmable data choices. THIS IS A SWITCH RESET POSITION, NOT A PROGRAMMABLE DATA PARAMETER POSITION. ***NOTE: If a switch-to-standby has occurred with the Switchback Mode set to MANUAL, and the condition is cleared to allow a manual Switchback to take place, the amplitude displays will flash* S - b rST *for one second every seven seconds. This is to remind the operator a manual Switchback is needed.***

To manually reset the switch in the Switchback Mode = MANUAL once a switch-to-standby has occurred, (assuming the setpoint comparison and Receiver Decision Logic parameters have been satisfied):

1) Enter the Program Mode by pressing the **PROG/RUN** key.

2) In this special case, the first menu position will show **S-b rST** (not flashing). <u>The switch is now ready to be reset at this point</u>. Pressing the **ENTER** key will reset the switch to the Primary [MAIN] position, AND automatically exit the programming mode. Pressing **PROG/RUN** key (without pressing **ENTER**) will exit the Programming Mode with NO switch reset. Pressing the ↑ / ↓ keys will scroll through the other programmable data menu positions.



If the setpoint comparison and Receiver Decision Logic parameters are not satisfied to allow a switchback command, the entire **S-b rST** display will flash to notify the user, and a switchback will NOT take place if the **ENTER** key is pressed. Since the amplitude measurement process and PRESENT / MISSING LED status is continuous, the operator can determine the reason for switchback being disallowed, even within the Programming Mode. If any of the setpoints are changed within the Programming Mode, AND they become such that the setpoint comparison and Receiver Decision Logic parameters ARE satisfied, scrolling to the **S-b rST** position WILL now allow a switchback, even before exiting the Programming Mode. This is a special case that does not follow the "No action until EXITING the Programming Mode" as described earlier. Two scenarios are possible under this situation:

GIVEN: User enters the Programming Mode to reset the switch with the setpoint comparison and Receiver Decision Logic parameters NOT satisfied. The **S-b rST** display flashes indicating a manual switchback CANNOT occur. User then scrolls to and changes the necessary level setpoint or Receiver Decision Logic parameters, pressing **ENTER** to store those "unofficial" changes in temporary memory. Now having the setpoint comparison and Receiver Decision Logic parameters satisfied (required pilot(s) showing PRESENT), user scrolls to the now non-flashing **S-b rST** position, presses the **ENTER** key and the switch-to-main back command IS given. THEN ...

1) User EXITS Programming Mode - switch is already reset AND NOW changed parameters become "Official" and stored to permanent memory. Unit continues with no changes.

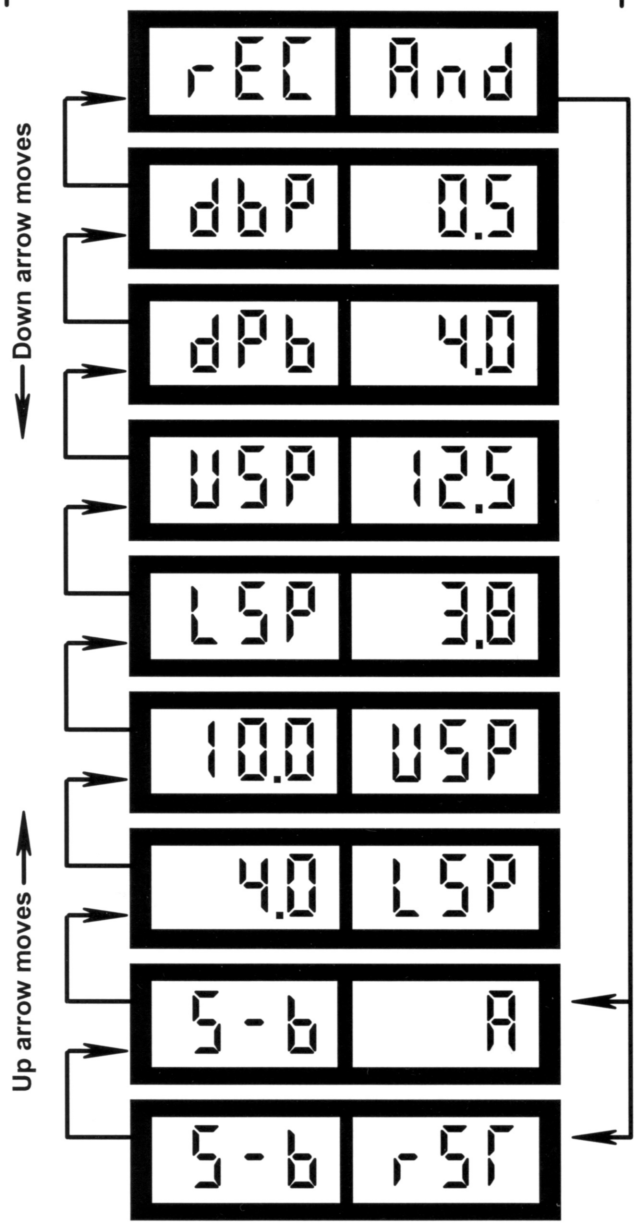
Or ...

2) User FAILS to EXIT Programming Mode - four minute time-out expires - unit EXITS Programming Mode and RESTORES existing permanent memory values. Assuming the original, restored setpoint comparison and Receiver Decision Logic parameters still NOT satisfied, unit re-issues a switch-to-standby command.

To exit the Program Mode and return to the run mode, press the **PROG/RUN** key (<u>not</u> for > 1 second). ***NOTE: exiting the Program Mode WITHOUT pressing the* ENTER *key will NOT reset the switch position***. Using this method, the switch reset can be accomplished with two keystrokes, PROG/RUN - ENTER. Also, changing the Switchback Mode to Automatic WILL cause a switchback to Primary [MAIN] (IF the setpoint comparison and Receiver Decision Logic parameters so allow) as well as changing the Switchback Mode.

NOTE: Once the Switchback has been accomplished, the* S-b rST *position will no longer appear in the menu because there is no switch-to-standby command to reset. Upon leaving the Program Mode and re-entering or scrolling to other menu positions with the ↑ / ↓ keys, the* S-b rST *position will NOT be available (the switch is ALREADY reset), and will not become available until a new switch-to-standby in the Manual mode has occurred.

Menu Positions Available	Programmable Data Choices



Receiver Logic: And, Or, PL1, PL2, P-b
Example shows 'And' Logic Mode.

Delay backup-to-Primary: 0.0 to 11.0 (seconds) in 0.5 second increments.
Example shows 0.5 second delay.

Delay Primary-to-backup: 0.5 to 11.0 (seconds) in 0.5 second increments.
Example shows 4.0 second delay.

Upper Setpoint, Pilot 2: Settable from -10.0 dBmV to +30.0 dBmV
Example shows 12.5 dBmV

Lower Setpoint, Pilot 2: Settable from -10.0 dBmV to +30.0 dBmV
Example shows 3.8 dBmV

Upper Setpoint, Pilot 1: Settable from -10.0 dBmV to +30.0 dBmV
Example shows 10.0 dBmV

Lower Setpoint, Pilot 1: Settable from -10.0 dBmV to +30.0 dBmV
Example shows 4.0 dBmV

Switchback mode: (A)utomatic, or, (M)anual.
Example shows A for Automatic.

Switchback Reset: Special position for manual switchback. Only appears if a manual switchback is needed.

Fig. 7: Programmable menu choices within Programming Mode

4.0 SPECIFICATIONS

DUAL RF RECEIVERS:

Frequency Range	5 MHz to 860 MHz
IF Bandwidth, RFSD-2 (Analog)	280 kHz , ± 30 kHz at 6 dB points, 600 kHz at 40 dB points
Input port return loss	> 18 dB
Spurious responses	> 40 dB down from indicated level
Peak detector error, RFSD-2 (Analog)	< 1.0 dB TV composite modulated signal verses a CW signal

AMPLITUDE MEASUREMENT:

Display type	Dual reading LCD, three digits each pilot
Amplitude measurement range	-10.0 to +30.0 dBmV
Amplitude measurement resolution	0.1 dB
Amplitude measurement accuracy	± 0.75 dB (from +20° C to +30° C) ± 2.00 dB (from 0° C to +45° C)
Amplitude Calibration	Accessible via two rear panel adjustment controls.

PROGRAMMING:

Receiver Decision Logic modes	P1 AND P2, P1 OR P2, P1 ONLY, P2 ONLY, P1 Primary - P2 Backup
Programmable setpoint range	
Upper setpoint	Value of lower setpoint to +30.0 dBmV
Lower setpoint	-10.0 dBmV to value of upper setpoint
Total settable range	-10.0 dBmV to +30.0 dBmV
Switchback Modes	Automatic, Manual
Switch command delays	Main-to-Standby, Standby-to-Main, 0s to 11.0s in 0.5 second increments, separately programmable

RF SWITCH: (Internal RF Switch Option ONLY)

Frequency Range	DC to 1000 MHz
Impedance	75 ohms
Maximum signal	250 mW

Insertion Loss *		Port to Port Isolation *		Return Loss *	
5 MHz	0.2 dB	5 MHz	>80 dB	5 MHz	>30 dB
50 MHz	0.2 dB	50 MHz	>75 dB	50 MHz	>30 dB
650 MHz	0.8 dB	650 MHz	>55 dB	650 MHz	>17 dB
750 MHz	0.9 dB	750 MHz	>47 dB	750 MHz	>14 dB
860 MHz	1.0 dB	860 MHz	>46 dB	860 MHz	>14 dB
1000 MHz	1.1 dB	1000 MHz	>46 dB	1000 MHz	>12 dB

* (Main-to-Common, Standby-to-Common)

CONNECTORS:

RF receiver input	Type F or type BNC, (depending on option), 75 Ω
Urgent, Non-Urgent, ARA alarms	Contact closures provided via screw terminal strip, two isolated contacts per alarm, six terminals total

CONNECTOR: (External RF Switch Option ONLY)

Switch Command Output	Type DB-25, pin 7 output, pin 3 ground

INTERFACE:

Alarm indication:

Front panel alarm indicators

Urgent, Non-Urgent, ARA ....LED

Main, Standby switch position ....LED

Alarm relays

Contact resistance............................100 mΩ contact resistance

Minimum current rating ....10 µA @ 10 mV DC

Max voltage....................................60 VDC, 40VAC

Max current ....1A @ 30VDC

Programming ....Four position keypad

Memory ....All programmable parameters stored in non-volatile memory

INTERFACE: (External RF Switch Option ONLY)

Switch Command Output ....Active LOW = switch-to-standby

ENCLOSURE:

Temperature range ....Operating 0° C to 45° C

Power..110/120 VAC 60 Hz / 220/240 VAC 50-60 Hz
Optional -48VDC Input, 75 mA @ -48VDC

Size ....19” Rack Mount, 1-3/4”H, 10”D

Note regarding EMC standards: The model RFSD-2 / RFSD-2D conforms to DIRECTIVE, 89/336/EEC (CE MARK).

5.0 WARRANTY

The Applied Instruments RFSD-2 is warranted against defects in materials and workmanship for a period of twelve months. Applied Instruments agrees to repair or replace any assembly or component found to be defective under normal use during this period. Our obligation under this warranty is limited solely to repairing the instrument proven to be defective within the scope of the warranty when returned to the factory. Transportation to the factory is to be prepaid by the customer. Authorization (RMA#) by Applied Instruments is required prior to shipment.

Applied Instruments assumes no liability for secondary charges or consequential damages and, in any event, Applied Instruments’ liability for breach of warranty under any contract shall not exceed the purchase price of the instrument shipped, and against which a claim is made.

Any application recommendation made by Applied Instruments for the use of its products is based upon tests believed to be reliable, but Applied Instruments makes no guarantee of the results to be obtained. This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for Applied Instruments any liability in connection with the sale of our products other than that set forth herein.

Applied Instruments, Inc.
5230 Elmwood Avenue
Indianapolis, IN 46203 USA
http://www.appliedin.com

Tel: (317) 782-4331
Toll-free USA Tel: (800) 244-2976
Fax: (317) 786-9665
Email: info@appliedin.com

APPLIED INSTRUMENTS, INC.
RF TEST AND MEASUREMENT