User's Manual:
Dual Channel Agile Receiver
(DCAR)

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--- IMPORTANT CAUTIONS ---

For proper operation, set the Frequency Band of Each Channel to its respective operating center frequency. Instructions are on *page 6* and on the DCAR front panel.

The Preferred Coupling Mode is AC Coupling. See *page 9* for a discussion.

Meter readings are only accurate when outputs are terminated in 50 Ohm loads.

If an overload alarm is active (red) immediately correct the problem by decreasing the applied signal level, increasing the attenuation or putting the receiver into SAFE MODE. Prolonged operation in an overload condition may cause permanent damage to the DCAR or devices connected to the DCAR.

Introduction:

The DCAR converts an RF signal centered at between 50 MHz and 1 GHz to baseband. There are two baseband outputs that are in quadrature with one another. These two outputs are named I (In-phase) and Q (Quadrature). Matched lowpass filters are placed in the I and Q output signal paths. These lowpass filters have variable cutoff frequencies settable to 156 KHz, 312 KHz, 625 KHz, 1.25 MHz, 2.5 MHz and between 5 MHz and 72 MHz with a 1 MHz step size plus a filter bypass mode with a cutoff of ~100 MHz.

Each channel requires a Local Oscillator (LO) input operating at twice the center frequency of the input signal. The required LO level is +10 dBm ± 3 dB.

The DCAR can be locally controlled via its front panel, or remotely via either RS232 or Ethernet connections. A detailed description of the protocol is given in Appendix 4. There are four message types that allow for sending commands to the receiver and receiving receiver status. Communications is selected via a rear panel switch. There are three options: LAN (Ethernet), UDP protocol; or via RS232 at data rates of 9.6K bps and 57.6K bps.

Front Panel Controls

Attenuator Selection:

Press the button next to the Attenuator display that is to be set.

Options are:

Channel 1, RX ATTEN
Channel 1, TX ATTEN
Channel 2, RX ATTEN
Channel 2, TX ATTEN

The display of the attenuator being set remains bright while the other three attenuator displays along with the cutoff displays are dim.

Adjust the attenuation by turning the “ATTENUATOR AND LPF CUTOFF ADJUST” knob.

Attenuators change in 1 dB steps between 0 dB and 70 dB (-10 dB and 70 dB if the cutoff is less than 5 MHz).

If it is desired to cancel setting the attenuator and return to the initial attenuation, press the “CANCEL” button next to the “ATTENUATOR AND LPF CUTOFF ADJUST” knob.

Once the attenuation is set to the desired value, there are five options to lock in the value.

Options are:

1. Press inward on the "ATTENUATOR AND LPF CUTOFF" knob. This locks in the value just set and exits the attenuator setting mode.
2. Press the button corresponding to the attenuator being set. This locks in the value just set and exits the attenuator setting mode.
3. Press the button corresponding to the next attenuator or cutoff to set. This locks in the value just set and allows editing the value of the newly selected attenuator or cutoff.
4. Just walk away. After one minute the value is locked in. During the one minute prior to being locked in, the attenuator remains set to the new value, but may be changed by turning the knob.
5. Press any button except CANCEL on the panel. This locks in the value just set, exits attenuator setting mode, and executes the operation commanded by the latest button press.

Attenuator Operation:

The RF and TX attenuators can be adjusted over a 70 dB range. In order to maintain reasonable noise figure performance at high attenuation levels, RF amplifiers are switched out as the attenuation is increased.

There are two 31.5 dB step attenuators and two 20 dB gain amplifiers (See the block diagram in Appendix 3).

At 0 dB attenuation, both attenuators are set to 0 dB and both 20 dB gain amplifiers are switched in. As the attenuation is increased in 1 dB steps, each attenuator's attenuation is increased by 0.5 dB. When the total attenuation reaches 20 dB, the second RF amplifier is switched out and both attenuators are reset to 0 dB.

As the attenuation continues to increase in 1 dB steps from 20 dB toward 40 dB, the attenuators are each once again both increased in 0.5 dB steps until they together reach 20 dB (10 dB each). At this point the second RF amplifier is switched out and the attenuators are again set to 0 dB. The gain has now been reduced 40 dB by the removal of both of the 20 dB gain stages.

The final 30 dB of attenuation is obtained via the two attenuators.

Cutoff Selection:

Press the button next to the Cutoff display that is to be set.

Options are:

Channel 1, LPF CUTOFF

Channel 2, LPF CUTOFF

The display of the cutoff being set remains bright while the other cutoff display and four attenuator displays are dim.

Adjust the cutoff by turning the "ATTENUATOR AND LPF CUTOFF ADJUST" knob.

Values are: 0.156 MHz (displayed .016), 0.312 MHz (displayed .031), 0.625 MHz (displayed .063), 1.25 MHz, 2.5 MHz, 5 MHz to 72 MHz in 1 MHz steps, and filter bypass (displayed as bp). Filter bypass yields a cutoff of approximately 100 MHz.

If it is desired to cancel setting the cutoff and return to the initial cutoff, press the "CANCEL" button next to the "ATTENUATOR AND LPF CUTOFF ADJUST" knob.

Once the cutoff is set to the desired value, there are five options to lock in the value.

Options are:

1. Press inward on the "ATTENUATOR AND LPF CUTOFF" knob. This locks in the value just set and exits the cutoff setting mode.
2. Press the button corresponding to the cutoff being set. This locks in the value just set and exits the cutoff setting mode.
3. Press the button corresponding to the next cutoff or attenuator to set. This locks in the value just set and allows editing the value of the newly selected attenuator or cutoff.
4. Just walk away. After one minute the value is locked in. During the one minute prior to being locked in, the cutoff remains set to the new value, but may be changed by turning the knob.
5. Press any button except CANCEL on the panel. This locks in the value just set, exits cutoff setting mode, and executes the operation commanded by the latest button press.

Frequency Band Selection:

This is an **EXTREMELY IMPORTANT** parameter that needs to be correctly set for proper DCAR operation. Both channels need to be individually set. This is a "hidden function" that takes extra operator effort. The following procedure is also detailed on the front panel.

To avoid possible setup errors, it is advised to also set the **DEFAULT VALUE** as detailed below.

The Frequency Band Selection sets the center frequency being used to within 50 MHz maximum error (100 MHz steps).

The Frequency Band Selection is a second function under the LPF CUTOFF button.

To access the Frequency Band Selection for a channel, press the desired channel's LPF CUTOFF button and hold it until a beep is heard.

The display of the Frequency Band being set remains bright while the other cutoff display and four attenuator displays are dim.

Using the knob, select the frequency nearest the center frequency being received. This is typically equal to the (LO Frequency)/2.

Options are:

100 for 50 MHz to <150 MHz

200 for 150 MHz to <250 MHz

300 for 250 MHz to <350 MHz

400 for 350 MHz to <450 MHz

500 for 450 MHz to <550 MHz

600 for 550 MHz to <650 MHz

700 for 650 MHz to <750 MHz

800 for 750 MHz to <850 MHz

900 for 850 MHz to <950 MHz

999 for 950 MHz to 1,000 MHz

If it is desired to cancel setting the Frequency Band and return to the original value, press the "CANCEL" button next to the "ATTENUATOR AND LPF CUTOFF ADJUST" knob.

Once the Frequency Band is set to the desired value, there are five options to lock in the value.

Options are:

1. Press inward on the “ATTENUATOR AND LPF CUTOFF” knob. A double-beep will be heard. This locks in the value just set, saves the value as the **DEFAULT VALUE** and exits the Frequency Band setting mode. This is the **ONLY** way to set the default value.

   The default value is used to set the Frequency Band when the receiver is powered up or rebooted.

   NOTE: the **DEFAULT VALUE** can ONLY be set from the front panel and only by using the above procedure.

2. Press the button corresponding to the Frequency Band being set. This locks in the value just set and exits the Frequency band setting mode. The default value is not changed.

3. Press the button corresponding to the next cutoff or attenuator or frequency band to set. This locks in the value just set and allows editing the value of the newly selected attenuator or cutoff or frequency band. The default value is not changed.

4. Just walk away. After one minute the value is locked in. During the one minute prior to being locked in, the frequency band remains set to the new value, but may be changed by turning the knob. The default value is not changed.

5. Press any button except CANCEL on the panel. This locks in the value just set, exits frequency band setting mode, and executes the operation commanded by the latest button press. The default value is not changed.

Meter Function Select:

There are two multifunction meter displays, Meter A and Meter B, immediately beneath the LPF CUTOFF displays. The meter display function is selected by pressing the button to the right of the Channel 2 meter display. Repeatedly pressing the button causes the displayed value to cycle through the various options. Both meters in a row display the same function.

Meter A, the top row of meters, has the following options:

Pin (dBm), the RF input power in dBm
Pout I (dBm), the I output power in dBm
Vout I (mV rms), the I output signal voltage in mV RMS
Offset I (mV), the I output DC offset in mV

Meter B, the bottom row of meters, has the following options:

P_{LO} in (dBm), the LO input power in dBm
Pout Q (dBm), the Q output power in dBm
Vout Q (mV rms), the Q output signal voltage in mV RMS
Offset Q (mV), the Q output DC offset in mV

One of the panel configuration DIP switches (see Appendix 2) allows configuring both Meter A and Meter B to cycle through their display options together when the Meter A button is pressed and for the Meter B button to only control the Meter B options. To date, the operators seem to prefer this option.

The other meter configuration option is for the Meter A and Meter B buttons to only control their respective meters.

NOTE 1: all 8 meter options can be simultaneously read using the remote control interface.

NOTE 2: Meter accuracy of outputs is predicated on the respective output being terminated in a 50 Ohm load. If the outputs are terminated in other than 50 Ohms, the meter readings will not accurately reflect the output powers and voltages.

Receive, Transmit and Safe Modes:

Each of these functions has its own button.

RECEIVE MODE:

Pressing the green RECEIVE button sets the attenuator for each receiver channel to its receive value. The receive attenuator values are the top row of three digit displays. When the receive mode is selected, the receive attenuator displays are bright and the transmit attenuator displays are dim, as shown in the photograph at the beginning of this section. The green LED next to the receive button is illuminated.

While in receive mode, the T/R status connector on the rear panel is open circuited (see rear panel descriptions for more detail on this port).

TRANSMIT MODE:

Pressing the blue TRANSMIT button selects the transmit attenuator values, which are in the second row of three digit displays. When selected, the transmit

attenuator displays are bright and the receive attenuator displays are dim. The blue LED next to the TRANSMIT button is illuminated.

While in transmit mode, the T/R status connector on the rear panel is short circuited (see rear panel descriptions for more detail on this port).

SAFE MODE:

SAFE MODE is designed to protect the DCAR from excessive power levels that could cause damage. Excessive input or output levels automatically switch the DCAR to SAFE Mode. The DCAR can also be manually placed in SAFE Mode by pressing the red button located at the lower right corner of the panel. While in SAFE Mode, the red switch cap is illuminated.

The Safe Mode button can be configured two ways using the panel configuration DIP switches (see Appendix 2). One option is to toggle between Safe Mode and the previous mode. This is the preferred setting. The other Safe Mode option only switches to Safe Mode. In this mode, subsequent button presses while in Safe Mode have no effect.

It is recommended that the receiver be placed in SAFE MODE prior to connecting cables to the receiver.

The receiver also automatically enters SAFE mode when operating in DC Coupled mode and while performing an offset null operation. Once the null operation is complete, the receiver returns to its previous state.

Output Coupling Modes (AC or DC):

The I and Q output of each channel can be configured to be either AC or DC coupled. Each channel can be independently configured. It is **HIGHLY RECOMMENDED** to operate both channels in the **AC COUPLED** mode.

Pressing the OUTPUT COUPLING button for a channel toggles that channel's output coupling between AC coupling and DC coupling.

The default coupling mode is used when the DCAR is powered up or rebooted. The default mode (AC or DC) is configured using the front panel DIP switches (see Appendix 2). **The recommended default coupling is AC**.

When operating in AC coupled mode, any DC offsets are continuously nulled out. The closed loop bandwidth of this operation has a single pole 2.5 Hz lowpass response. The resultant channel output has a highpass response with a single pole 2.5 Hz highpass response. Each channel's high frequency cutoff is selected using the Cutoff Selection as detailed above.

When operating in DC coupled mode there can be DC offsets. The dominate cause of these offsets is temperature variations. As the temperature changes so do the offsets. These can be nulled by pressing the DC offset null button (see below), however the offsets may reoccur if the temperature changes after a DC offset null has been performed. This is why AC coupling is the preferred mode of operation. AC coupling continuously nulls out any DC offsets. **With a 2.5 Hz cutoff, AC coupling has virtually no effect on the received signal fidelity.** This has been verified both through simulations and via tests at Goldstone.

OFFSET NULL:

The Offset Null button is only functional in DC Coupled mode. When pressed, the offset present in either of the two channels operating in DC coupled mode is nulled out. While the offset nulling operation is being performed, the receiver channel is placed into SAFE Mode. This removes any signals that could interfere with the nulling operation. The nulling operation can take up to half a second. Once the offset is deemed nulled, the channel returned to the configuration it was in prior to the nulling operation.

ALARMS:

There are nine conditions monitored and cause an alarm if out of range. If there is an existing alarm condition, the LED indicator corresponding to that alarm condition is red. If there was an alarm, but it has subsequently cleared, the indicator is yellow. Yellow indications may be cleared by pressing the ALARM RESET button. This button will NOT clear red indications. If a LED is not illuminated, it indicates that there is neither an active nor latched alarm. All is well.

Alarms:

CH 1 O.L. (Channel 1 Overload)
CH 2 O.L. (Channel 2 Overload)
CH 1 L.O. (Channel 1 Local Oscillator Signal)
CH 1 L.O. (Channel 2 Local Oscillator Signal)
CH 1 FAIL (Channel 1 Failure)
CH 2 FAIL (Channel 2 Failure)
+V SUP (Positive Voltage Supply Failure)
-V SUP (Negative Voltage Supply Failure)
HI TEMP (Excessive Temperature)

Alarm conditions can be configured to trigger the audible alarm when an alarm transitions from OK (LED is not illuminated) to alarm (red). See Appendix 2 for details on audible alarm configuration. The audible alarm can be silenced by pressing Alarm Silence or Alarm Reset. Alarm reset also resets yellow, latched, alarms. So it is best to silence the alarm using the ALARM SILENCE button if it is desired to later view conditions that were in alarm but then cleared.

If there is an alarm, the audible alarm is silenced, and the alarm subsequently clears (goes to yellow), and then alarms again (goes to red), the audible alarm will NOT again sound. This allows the alarm to be silenced and not become an annoyance for an alarm condition that is blinking on and off.

Alarm Descriptions:

CH 1 O.L. and CH 2 O.L. (Channel 1 or Channel 2 Overload)
Indicates that either the RF Input or an I and/or Q output of one or both channels is above the specified limits. This may trigger the DCAR into SAFE MODE depending on the degree of overload.

CH 1 L.O. and CH 2 L.O. (Channel 1 and/or Channel 2 LO Out of Spec.)
Indicates that the Local Oscillator level of the respective channel(s) is outside the specified limits.

CH1 FAIL and CH2 FAIL (Channel 1 and/or Channel 2 Failure)
Indicates that the front panel controller can no longer communicate with the failed receiver channel.

+SUP and –SUP (Positive or Negative Supply Out of Spec)
Indicates that one or both power supplies is outside its specified voltage. The thresholds are set around 0.5V above and below the desired voltage.

HI TEMP (Over Temperature Condition)
Indicates that there is an over temperature condition in any of the following: one or both of the receiver channels, the secondary voltage regulator assembly, the front panel. A HI TEMP condition is most likely caused by a fan failure.

ALARM SILENCE:

When pressed, silences the audible alarm. Alarm indicators are not affected.

ALARM RESET:

When pressed, clears any latched (yellow) alarm indicators and silences the audible alarm.

Latched alarms indicate that an alarm has triggered and subsequently cleared. If the audible alarm has been silenced, a latched alarm that returns to an alarm state will not trigger the audible alarm. This allows the alarm to be silenced and not become an annoyance for an alarm condition that is blinking on and off.

Rebooting DCAR:

Simultaneously pressing and then releasing “CH2 OUTPUT COUPLING” and “OFFSET NULL” and SAFE MODE” reboots the front panel and the processor on each of the two RF channels.

REMOTE CTRL Indicators:

There are four green LED indicators in this section. Three of the indicators indicate which communications mode is selected by the rear panel remote control mode selector switch. Only one of these indicators will illuminate at a time. The DATA indicator flashes each time a valid message is received.

RS232-57.6K indicates RS232 mode with a 57.6Kbps data rate.

RS232-9.6K indicates RS232 mode with a 9.6Kbps data rate.

LAN indicates communications over the LAN (Ethernet) input via the UDP Protocol.

DATA flashes each time a valid message is received.

LAST SET BY Indicators:

These four indicators indicate which function last updated the receiver's state. Their purpose is to allow the operator to understand why things may not be as might be assumed. For example, if the operator pressed the TRANSMIT button, and this caused an overload condition, the receiver will enter SAFE MODE. The LAST SET BY display will show ALARM, indicating that the alarm circuitry modified the receiver's state after the operator pressed the TRANSMIT button.

Possible LAST SET BY Display Options are:

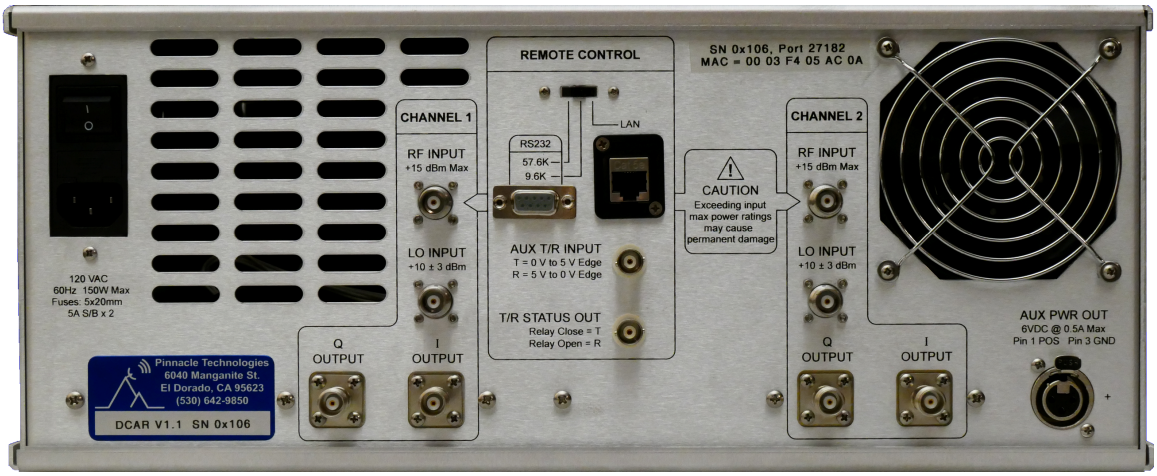
REMOTE

PANEL

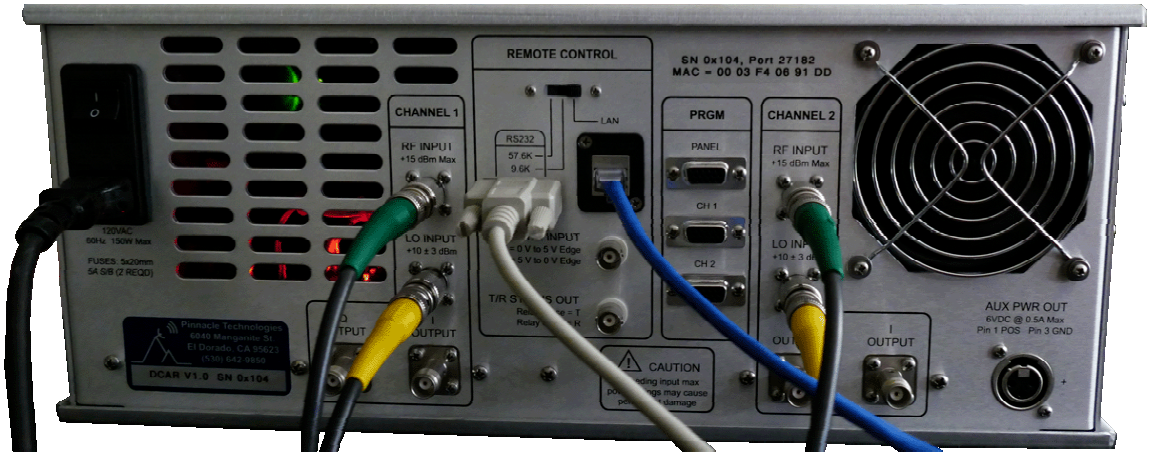
AUX T/R

ALARM

Rear Panel Connections and Controls



DCAR V1.1



DCAR V1

The photo above shows the rear panel layout. The panel is grouped into sections. Each of these sections is discussed below.

REMOTE CONTROL Section:

Inputs and outputs to and from this section facilitate receiver remote control.

The selector switch at the top of the section is used to select the mode of operation. The selected mode is displayed on the front panel as discussed above. Whenever a good message is received, the DATA light on the front panel flashes.

Communications is either via RS232 (9.6K or 57.6K) or by Ethernet (LAN) using the UDP protocol. The underlying data protocol is the same for both RS232 and LAN operation.

The receiver always operates in slave mode. It never initiates a communications session, it only responds to inquiries or commands from the master. There is a response to every VALID received message. Depending on the received message, the response may be requested data, or just a “message received” response. Appendix 5 is an in-depth discussion of the DCAR communications protocol.

AUX T/R INPUT:

This input allows a 5V logic level to switch the receiver between transmit and receive modes. The input is floating, meaning the shield is not connected to chassis ground. The center pin is the positive input. The required current is about 4 mA.

To switch from Receive to Transmit, apply +5V across the connector between the shield and the center pin. To switch back to Receive, remove the voltage. The "LAST SET BY" indicator will show "AUX T/R".

This is an edge triggered input that allows other users, such as the front panel or the remote control, to override this control input. All control inputs are, in fact, effectively edge triggered, allowing any input device to override another. The last device issuing a command has priority.

For example, if while in Transmit Mode via "AUX T/R", someone presses "RECEIVE" on the front panel, the receiver will switch to Receive Mode even though the "AUX T/R" input is commanding Transmit. With this example, the "LAST SET BY" indicator will now show "PANEL". The "AUX T/R" input needs to be cycled to Receive and back to Transmit if it is desired to override the front panel command just issued.

Depending on the front panel configuration (see Appendix 2), it's possible to disable AUX T/R when the receiver is in SAFE mode. This is the recommended front panel configuration. Disabling AUX T/R while in SAFE mode prevents another system that is unaware that the DCAR is being placed into an unsafe condition from repeatedly doing so.

T/R STATUS OUT:

This output is a contact closure that indicates whether the receiver is in Transmit or Receive Mode. The contact is closed while in Transmit Mode.

This is a floating output, meaning that neither of the two contacts is connected to chassis ground nor other internal circuitry other than the solid state relay.

The switch can handle voltages of either polarity and can sink up to 50 mA. There is a 10V unipolar TVS across this line, so the maximum voltage that can be applied is 10V. This output is protected for inductive load spikes by the TVS, however the 50 mA current limit must be observed to avoid damage.

LAN:

This input allows receiver remote control over a LAN via Ethernet using the UDP protocol. This functionality is implemented using a Netburner SBL2eX device. Instructions on configuring this device can be found in Appendix 4. The DCAR communications protocol can be found in Appendix 5.

RS232:

RS232 only uses RX and TX. There is no flow control. This allows multiple DCARs to be connected in parallel and addressed from a single serial port.

The DCAR communications protocol can be found in Appendix 5.

CHANNEL 1 and CHANNEL 2 Sections:

These two sections correspond to the two receiver channels, and are identical. There are two inputs and two outputs for each channel. These are:

RF Input
LO Input
I Output
Q Output

All RF inputs and outputs use TNC connectors.

Detailed information on these ports can be found in the DCAR specifications, Appendix 1

PRGM (programming) Section (V1.0 only):

The three PRGM (programming) inputs allow the front panel and each of the two receiver channels to be programmed without removing the DCAR from the rack.

To avoid probable disabling of the DCAR, these connectors should ONLY be used by or under the direction of Pinnacle Technologies.

AUX PWR Out:

This is a 5V, 0.5 Amp DC output. It's intended use is for powering a Valon (valonrf.com) dual frequency synthesizer. This synthesizer can be used as a signal source to the DCAR's two LO inputs.

The connector is an XLR female. Pin 1 is positive, Pin 3 is ground.

Appendix 1

DCAR Specifications

RF Input Frequency Range	50 MHz to 1 GHz
Maximum RF Input Power	+10 dBm, Zin = 50 Ohms
Local Oscillator (LO) Input	+10 dBm ± 3 dBm , Zin = 50 Ohms LO Frequency = 2x the RF Input center frequency.
Maximum I or Q Output Power	+13 dBm, 1V RMS (Sine Wave) +3 dBm, 0.3V RMS (Noise) Zout = 50 Ohms
I and Q Lowpass Filter 3 dB Cutoff Range	156 KHz to 72 MHz
Lowpass Filter 3 dB Frequencies	156 KHz, 312 KHz, 625 KHz, 1.25 MHz, 2.5 MHz, and 5 MHz to 72 MHz in 1 MHz steps. Filter Bypassed (~100 MHz Cutoff)
Lowpass Filter Prototype	<5 MHz: 9^{th} Order Linear Phase ≥5 MHz: 6^{th} Order Butterworth
RF Input Attenuation Controls	RF input attenuation controls that facilitate setting the output levels. There are receive and transmit values for each channel.
RF Input Attenuation Control Range	0 to 70 dB (Cutoff is 5 MHz and above) –10 dB to 70 dB (Cutoff is below 5 MHz)
Transmit and Receive Modes	Allows switching between different preset attenuation values via the front panel or remote control. When in Transmit mode, there is a relay contact closure available on the rear panel.
Safe Mode	Terminates the RF inputs into 50 Ohms and sets the attenuators to their maximum values. The receiver automatically switches to Safe Mode if the maximum input or output levels are exceeded.
Output Coupling	DC coupled or AC coupled (~2.5 Hz 1 pole highpass when AC coupled)
Meter A Functions	RF Input Power (dBm) Pout I (dBm) Vout I (mV RMS) DC Offset I (mV)
Meter B Functions	LO Input Power (dBm) Pout Q (dBm) Vout Q (mV RMS) DC Offset Q (mV)

Appendix 1

Front Panel Numeric Displays	Five Displays for Each Channel: Attenuation (RX Mode) Attenuation (TX Mode) Lowpass Filter Cutoff Metering A Metering B
Indicator Lights	Meter Function Transmit/Receive Remote Control Last Set By Indicator Alarm Status Coupling (AC or DC)
Push-Button Functions	Edit CH1 RX Attenuation Edit CH2 RX Attenuation Edit CH1 TX Attenuation Edit CH2 TX Attenuation Edit CH1 Lowpass Filter Cutoff Edit CH2 Lowpass Filter Cutoff Cancel Last Parameter Edit Meter A Function Select Meter B Function Select Receive Mode Transmit Mode Safe Mode CH 1 Coupling (Toggle AC/DC) CH2 Coupling (Toggle AC/DC) DC Offset Null (Only When DC Coupled) Alarm Silence Alarm Reset
Remote Control	Remote control allows configuration and monitoring of all parameters via: RS232 at 9,600 or 57,600 BPS (DB9 Connector) or UDP (RJ45 Connector)
AUX T/R Input	A 0V to 5V transition switches to Transmit Mode A 5V to 0V transition switches to Receive Mode (floating ground BNC Connector)
T/R Status Output	A contact closure when in Transmit Mode (floating ground BNC Connector)
All RF I/O Connectors	TNC Female
AC Power	120 VAC ± 20V, 50 to 60 Hz, 55 Watts Maximum
Operating Temperature	0°C to 40°C (Internal Receiver Module Temperature)
Model Number	DCAR V1.0

Appendix 2

V1.2 **DCAR Front Panel DIP Switch Configuration** October 9, 2020

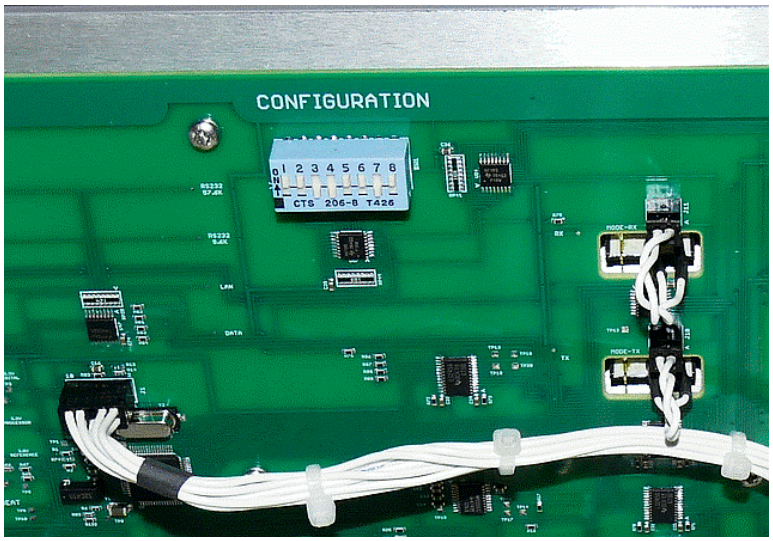
This document describes the front panel DIP switch configuration options.

The DIP switch is located near the top center of the front panel circuit board, as shown it the photo below.

The options selected by this switch are set when the DCAR boots. Changing a switch causes an immediate reboot.

There is a label on the inside of the top cover that shows the switch functions.

Be sure to ground yourself to the DCAR chassis when changing the switch to avoid static (ESD) damage to the panel.



The functions for each switch are given below. Switch 1 is the left-most switch.

SW1 ON = Beep on Alarm

SW2 ON = SAFE Text Display

SW3 ON = AC Couple on Boot
OFF = DC couple on Boot

SW4 ON = Meter & Alarm Buttons Cause Last Set By (LSB) Panel

SW5 ON = Disable Aux T/R Input While in SAFE Mode

SW6 ON = SAFE Mode SW Toggles

SW7 ON = 7 Segment Displays Bright

SW8 ON = Top Meter Button Controls Both Displays

Appendix 2

The Factory recommended defaults are:

SW1 = ON: Beep on Alarm is enabled

SW2 = ON: “SAFE” is displayed as text while in SAFE mode

SW3 = ON: AC Coupled mode is the default

SW4 = OFF: Meter and Alarm buttons do NOT cause a Last Set By Panel indication.

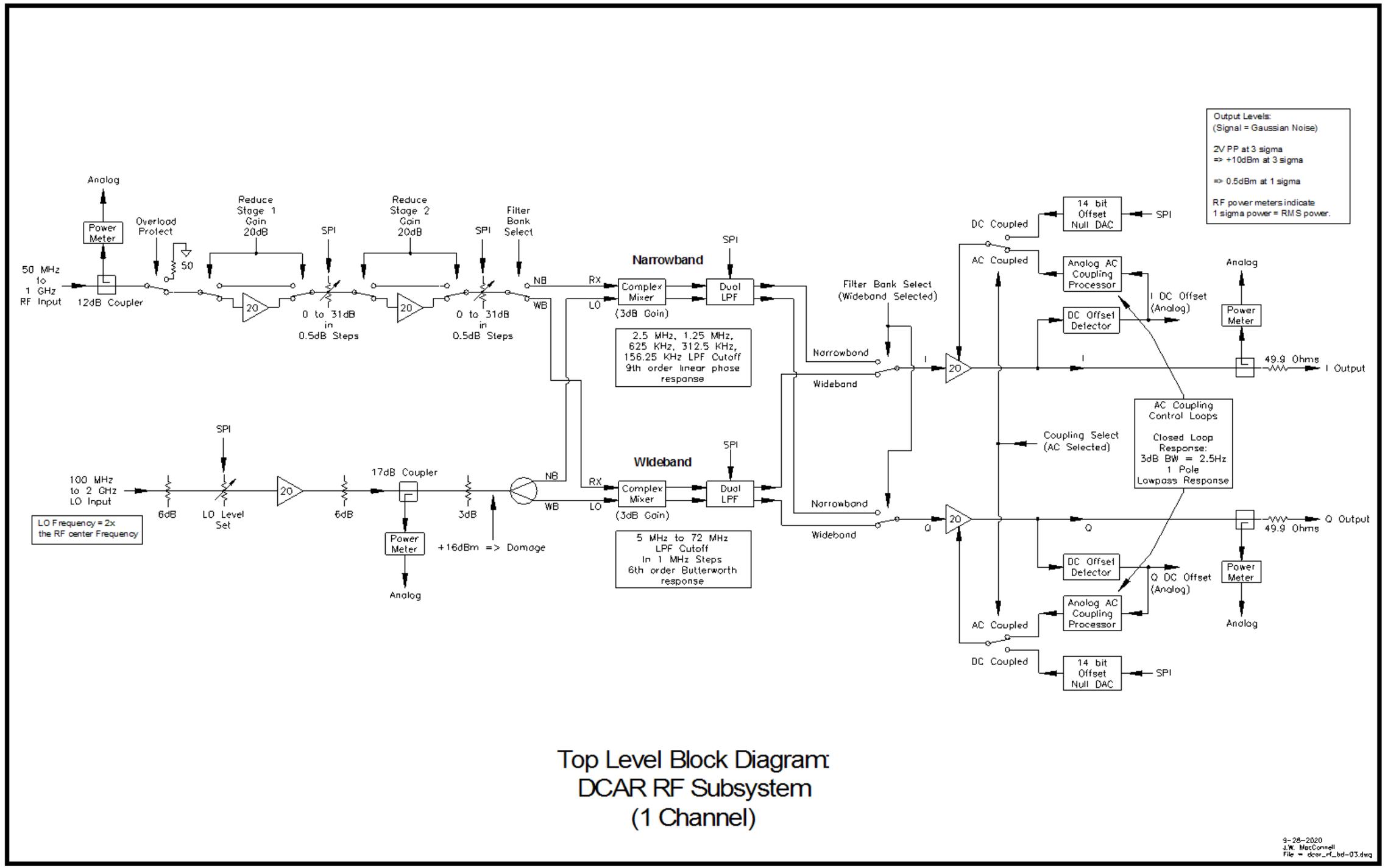
SW5 = ON: Disable the AUX T/R input while in Safe Mode.

SW6 = ON: The Safe Mode switch toggles between Safe and the previous setting.

SW7 = OFF: The display intensity is dim.

SW8 = ON: The top meter button controls both meter displays.

Appendix 3
DCAR Block Diagram



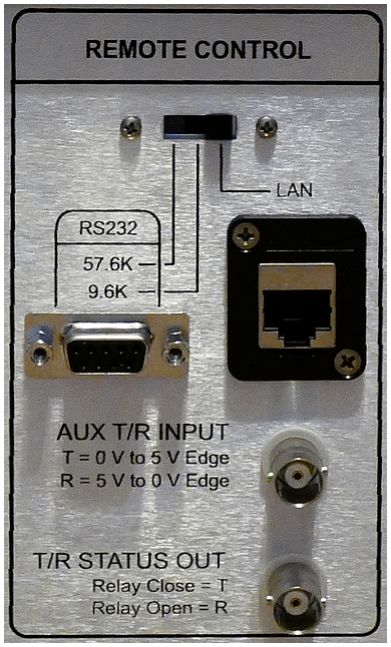
Top Level Block Diagram:
DCAR RF Subsystem
(1 Channel)

This document discusses setting up the DCAR RS232 and LAN remote control interfaces.

The DCAR remote control can be configured to operate using one of three different interfaces:

RS232 at 9.6K
RS232 at 57.6K
LAN (UDP Protocol)

The selection is made using the rear panel selector switch in the Remote Control section and is displayed on the front panel in the Remote CTRL section (see photos below)



The DATA LED flashes each time data is received by the DCAR.

RS232:

Multiple DCARs can be connected in parallel when using RS232. This allows controlling multiple DCARs from a single serial port.

The DCAR serial number is used as the address in accessing a particular DCAR.

Only the RX and TX data lines are used. Flow control is not supported.

The maximum command rate is three commands per second.

LAN:

The UDP protocol is used when communicating via the LAN port.

The same message structure is used with both the RS232 and LAN ports.

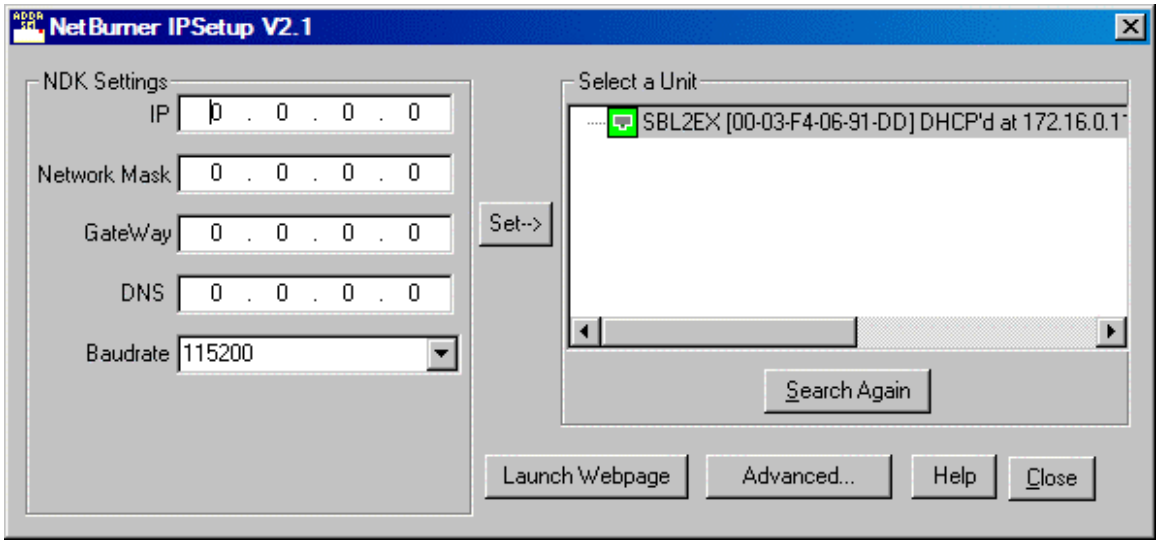
Be sure the DCAR address (the DCAR's serial number) used in DCAR messages corresponds to that DCAR's Network IP address. If the two addresses do not correspond, communication attempts will fail.

The maximum command rate is three commands per second

The LAN connection is implemented using a NetBurner SBL2eX-100IR device.

DCARs are typically shipped configured for DHCP operation. A fixed IP address can be set for each DCAR if requested.

The NetBurner program, IPSetup.exe, can be used to discover the IP address assigned to a particular DCAR (see screenshot below).



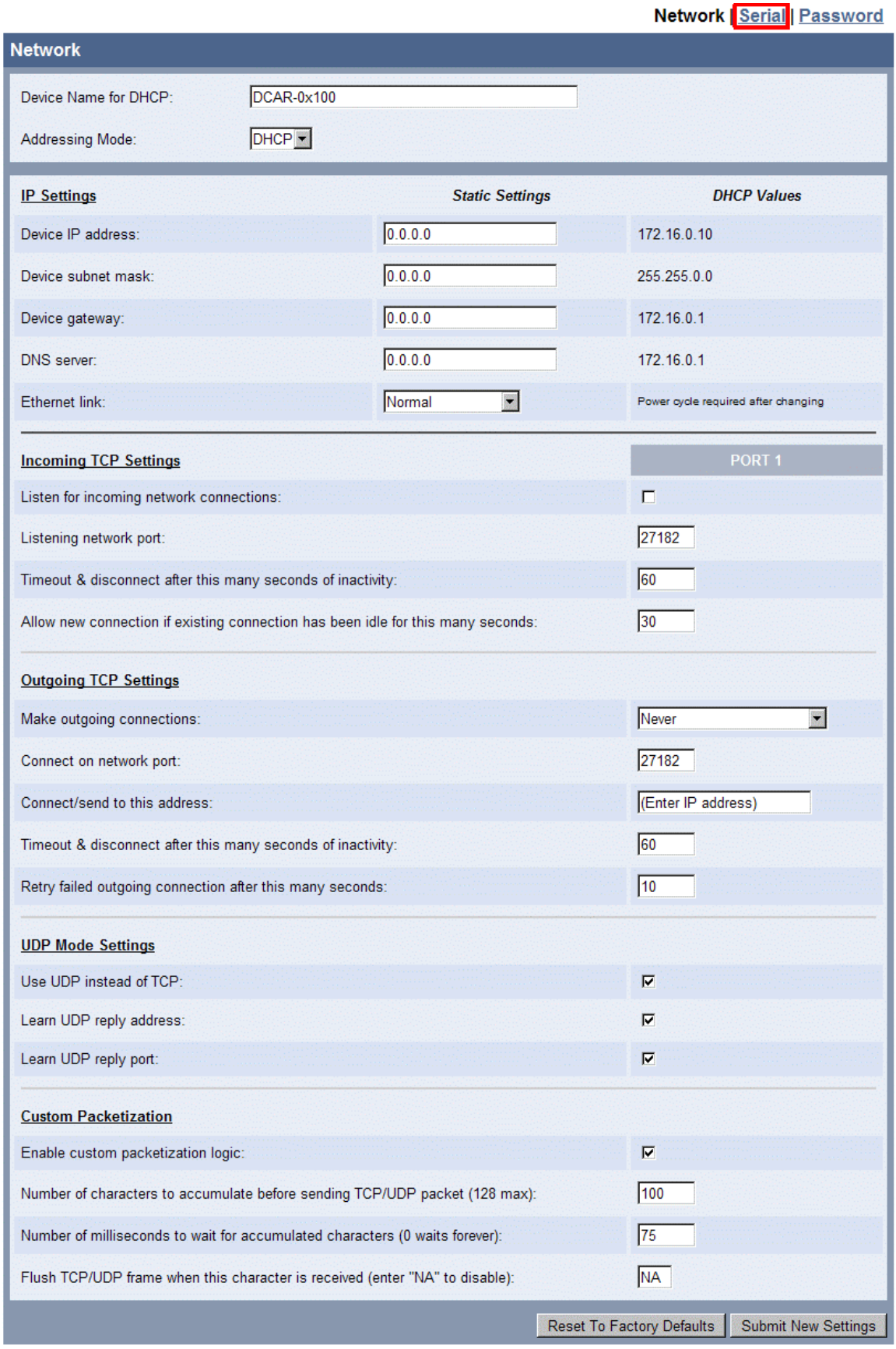
A static IP address can be set by setting the appropriate values in the left pane (NDK Settings) and then pressing the "Set-->" button. It takes up to a minute for the new address to be discovered by the network. **It is recommended to set static IP addresses from the web page as detailed below.**

The MAC address for each DCAR is printed under the left front rack handle and on the rear panel.

Usually, but not always, IPSetup.exe can discover a DHCP configured device on a network that is not configured for DHCP. Some networks are so "locked down" that IPSetup.exe cannot discover the SBL2eX. If this is the case, it is necessary to connect the DCAR to a router that is configured for DHCP.

NEXT, press the "Launch Webpage" button, which launches a configuration web page in the SBL23eX. This web page is used to configure the SBL23eX for DCAR operation. A screenshot of the web page is shown below.

Appendix 4



The screenshot above shows the proper configuration for operation with a DCAR. If using DHCP, ensure that your web page is configured EXACTLY as above with the exception of the

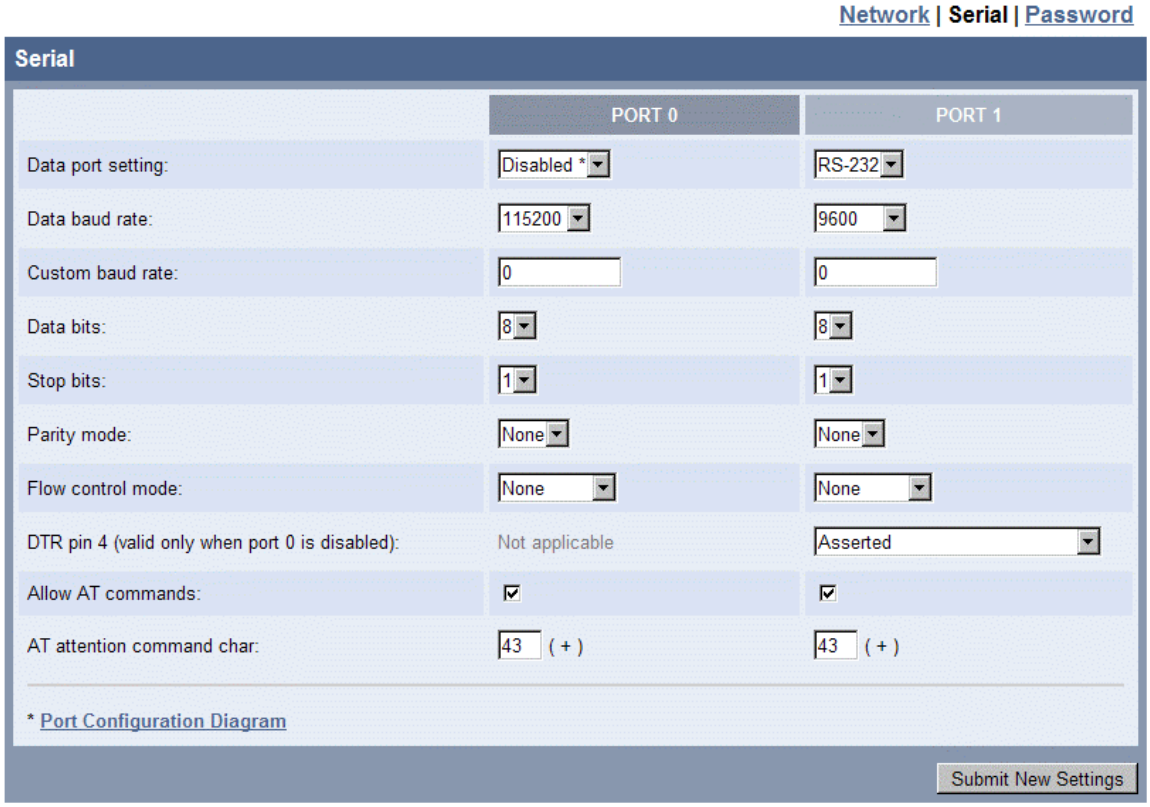
"DHCP Values" and the "Device Name for DHCP" which will be unique to your particular situation. The "DHCP Values" values are read-only and cannot be set. It is recommended that the "Device Name for DHCP" field be set to reflect your DCAR's serial number (replace the 0x100 value shown above with your DCAR's serial number).

If using a static IP address, set the "Addressing Mode" field to "Static" and set the "Static Settings" fields to the appropriate values for your network.

The default DCAR network port is 27182. This can be changed if desired (in 2 fields above).

Press the "Submit New Settings" Button.

NEXT, press the "Serial" tab at the top of the web page (outlined in red on the screenshot above). The screenshot below shows the serial port setup screen.



Ensure that your web page is configured EXACTLY as shown above.

Press the "Submit New Settings" Button.

Once all the above settings are made the DCAR should be ready to communicate over a LAN.

Section 3.2 of SBL23X-UsersManual.pdf further discusses configuring the network parameters within the device.

This document defines the communications protocol between the GSSR radar system control software (controller) and the Dual Channel Agile Receiver (DCAR).

Version 2.x of the protocol is for DCAR Firmware Versions 5 and above. Version 5 firmware is backwards compatible with Version 4 and earlier firmware and associated control software. The functional modifications to the protocol are:

1. The addition of a "No Change" value for each parameter in the T14 Message.
2. The T15 Message reports whether or not the alarm beeper is beeping.

The DCAR is a slave to the controller, and never initiates communications. It only responds to commands or queries from the controller. Whenever a properly formatted message is sent to a DCAR it either responds with the requested message type, or a confirmation message. If a message arrives at a DCAR with errors, such as a CRC error or an incorrect address, or an improperly formatted message, the DCAR does not respond. The reason for not responding under these conditions is because multiple DCARs can be connected in a multi-drop topology (in parallel). If multiple receivers simultaneously respond there will be communications channel collisions. Not responding to messages with the above mentioned errors prevents this from occurring.

To prevent overwhelming a DCAR with message traffic, incoming messages are limited to an average of 10 per second with the ability to handle short bursts at greater rates. This is implemented as follows: each time a message arrives at the DCAR it increments a counter. Once the counter reaches five, further messages are ignored. Every 100 mS, the counter is decremented by one.

Depending on the message definition, messages may be either fixed length or variable length. All messages have a CRC at the end. The polynomial used is the CCITT polynomial, 0x11021.

All words (2 bytes) are sent high byte followed by the low byte.

The DCAR can communicate via RS232 or via UDP. The message structures are identical in either case.

RS232 data rates can be 9,600 or 56,700 bits per second. When using RS232, multiple DCARs may be connected in parallel.

The data rate and communications mode (RS232 or LAN) are set via a three position switch on the rear panel. The options are 57.6K (RS232), 9.6K (RS232), and LAN (UDP)

The DCAR device address is its serial number.

The following message types are defined in this document:

Type 12: Send a command to the DCAR	(Controller to DCAR)
Type 13: Message confirmation and error reporting	(DCAR to Controller)
Type 14: Send all DCAR parameters to the DCAR	(Controller to DCAR)
Type 15: Read all DCAR parameters from the DCAR	(DCAR to Controller)

Message Type 12 Definition {Send Command to DCAR}:

The Type 12 message is used to send commands from the Controller to the DCAR. The DCAR will respond to a Type 12 message with either a Type 13 or a Type 15 message depending on the request. The Type 12 message has a fixed length of 8 bytes.

Data Field Definitions (Message Type 12):

Function Name	Number of Bytes	Notes
Preamble	2	Value = 0x89FC
Type	1	Value = 0x0C
Destination Address	2	DCAR's Address, unsigned
Command	1	unsigned
CRC	2	unsigned
Total Message Length:	8	bytes

ALL messages are sent most significant bit (MSB) first. In the table above, bytes are sent from top to bottom.

Function Descriptions (Message Type 12):

Preamble: 2 Bytes. Indicates the start of a message. Value = 0x89FC

Type: 1 Byte. The Message Type defines the structure of the message. Message Type 12 is fixed length and format. Value = 0x0C.

Destination Address: 2 Bytes. The device address the message is being sent to. The DCAR's address is its serial number.

Command: 1 Byte. This is the function that the DCAR is to execute. The commands are:

Command	Function
0x00	Ping the DCAR (T13 DCAR Response)
0x01	Receive Mode (Put the DCAR into Receive Mode) (T13 DCAR Response)
0x02	Transmit Mode (Put the DCAR into Transmit Mode) (T13 DCAR Response)
0x03	Safe Mode (Put the DCAR into Safe Mode) (T13 DCAR Response)
0x04	Null the DC Offset of both channels (T13 DCAR Response)
0x05	Alarm Reset (equivalent to pressing the Alarm Reset and then the Alarm Silence buttons on the front panel). It both clears and silences the alarm. (T13 DCAR Response)
0x06	Alarm Silence (Silence the audio alarm. Equivalent to pressing the Alarm Silence button on the front panel). (T13 DCAR Response)
0x07	Request a Type 15 Status Message from DCAR (T15 DCAR Response)

CRC: 2 Bytes. This is the CRC computed on all bits EXCEPT the Preamble bits. The CRC polynomial used is 0x11021. This is the CCITT polynomial. When computing the CRC, the seed bits (bits placed in the CRC's position when computing the CRC) are 0xFFFF. Additionally, a "Phantom" byte with the value 0x80 is placed in front of the entire message and computed into the CRC. This is required to ensure detection of missing leading zeros. The "Phantom" byte is not transmitted with the message. When checking the CRC, the result of the CRC will equal the seed if the message is good.

EXAMPLE: Following is an example Type 12 message sending a 0x01 command to address 0x0100. The following steps show the procedure used in computing the CRC.

Shown Prior to computing the CRC:

Function	(Phantom)	(Type)	(Destination Adr)	(Command)	(CRC 16)
# of bytes	2	1	2	1	2
Value	0x0080	0x0C	0x0100	0x01	0xFFFF

After the CRC is computed using the CCITT Polynomial, 0x11021:

Function	(Phantom)	(Type)	(Destination Adr)	(Command)	(CRC 16)
# of bytes	2	1	2	1	2
Value	0x0080	0x0C	0x0100	0x01	0xB50C

The message as sent. The phantom is not sent. The Preamble is sent:

Function	(Preamble)	(Type)	(Destination Adr)	(Command)	(CRC 16)
# of bytes	2	1	2	1	2
Value	0x89FC	0x0C	0x0100	0x01	0xB50C

Message Type 13 Definition {Message Confirmation}:

The Type 13 message is sent from the DCAR to the Controller upon receipt of a Controller message when no other DCAR response message is required. It reports whether the message was successfully received by the DCAR. It also reports certain errors. The Type 13 message has a fixed length of 8 bytes.

Data Field Definitions (Message Type 13):

Function Name	Number of Bytes	Notes
Preamble	2	Value = 0x89FC
Type	1	Value = 0x0D
Source Address	2	DCAR's Address, unsigned
Response	1	unsigned
CRC	2	unsigned
Total Message Length:	8	bytes

ALL messages are sent most significant bit (MSB) first. In the table above, bytes are sent from top to bottom.

Function Descriptions (Message Type 13):

Preamble: 2 Bytes. Indicates the start of a message. Value = 0x89FC

Type: 1 Byte. The message type defines the structure of the message. Message Type 13 is fixed length and format. Value = 0x0D

Source Address: 2 Bytes. The DCAR address the message is being sent from. A DCAR's address is its serial number.

Response: 1 Byte. This is the Conformation Message result status. The codes are:

Response	Result Status
0x00	Message Received with no errors (Also is the Ping Response)
0x01	Parameter(s) out of range
0x02	Unknown Command or Request

CRC: 2 Bytes. This is the CRC computed on all bits EXCEPT the Preamble bits. The CRC polynomial used is 0x11021. This is the CCITT polynomial. When computing the CRC, the seed bits (bits placed in the CRC's position when computing the CRC) are 0xFFFF. Additionally, a "Phantom" byte with the value 0x80 is placed in front of the entire message and computed into the CRC. This is required to ensure detection of missing leading zeros. When checking the CRC, the result of the CRC will equal the seed if the message is good.

Message Type 14 Definition {Send All Parameters to DCAR}:

The Type 14 message is sent from the Controller to the DCAR. It configures all configurable operational parameters. The DCAR responds with a either a Type 13 status message or a Type 15 "Read All" message depending on the setting of a Protocol Flag. The Type 14 message has a fixed length of 19 bytes.

New in Version 5 of the DCAR software is a value that signals "NO CHANGE" from whatever the current value is. The "NO CHANGE" value is 0xC0. Parameters where this value can be applied are indicated by a * following the Function Name. Version 5 and later software versions are backwards compatible with the Version 4 software Type 14 command structure.

Data Field Definitions (Message Type 14):

Function Name	Number of Bytes	Notes
Preamble	2	Value = 0x89FC
Type	1	Value = 0x0E
Destination Address	2	DCAR's Address, unsigned
Protocol Flags	1	Protocol related flags
ATT-RX-CH1 *	1	Attenuation dB, 1dB/count, signed, -10 to +70 dB
ATT-TX-CH1 *	1	Attenuation dB, 1dB/count, signed, -10 to +70 dB
Lowpass Filter Cutoff – CH1 *	1	0 to 73: 5 to 72 in MHz, 0 to 4 and 73 are special
Frequency Band – CH1 *	1	Frequency Band /100, unsigned (1 to 10)
ATT-RX-CH2 *	1	Attenuation dB, 1dB/count, signed, -10 to +70 dB
ATT-TX-CH2 *	1	Attenuation dB, 1dB/count, signed, -10 to +70 dB
Lowpass Filter Cutoff – CH2 *	1	0 to 73: 5 to 72 in MHz, 0 to 4 and 73 are special
Frequency Band – CH2 *	1	Frequency Band /100, unsigned (1 to 10)
Mode *	1	RX = 0, TX = 1, Safe = 2, unsigned
Bit Values *!	1	Individual Bit Values, unsigned
Spare 1 *	1	Unassigned, for future use
CRC	2	unsigned
Total Message Length:	19	bytes

* = 0xC0 does not change existing value
*! = 0xC0 special case. See details below.

ALL messages are sent most significant bit (MSB) first. In the table above, bytes are sent from top to bottom.

Function Descriptions (Message Type 14):

Preamble: 2 Bytes. Indicates the start of a message. Value = 0x89FC.

Type: 1 Byte. The message type defines the structure of the message. Message Type 14 is fixed length and format. Value = 0x0E.

Destination Address: 2 Bytes. The device address the message is being sent to. The DCAR's address is its serial number.

Protocol Flags: 1 Byte. Flags that relate only to the communications protocol, not to DCAR commands.

Bit	Function
0	Set = DCAR Responds with T15 message, Clear = Respond with T13 message
1 – 7	Not currently used

ATT-RX-CH1: 1 Byte. The DCAR's Channel 1 Receive Mode Attenuator setting. Each count is 1 dB. The range is 0 dB to 70 dB for cutoffs greater than or equal to 5 MHz. The range is -10 dB to 70 dB for cutoffs less than 5 MHz. Negative values correspond to gain.
A value of 0xC0 retains the current value (does not change existing value)

ATT-TX-CH1: 1 Byte. The DCAR's Channel 1 Transmit Mode Attenuator setting. Each count is 1 dB. The range is 0 dB to 70 dB for cutoffs greater than or equal to 5 MHz. The range is -10 dB to 70 dB for cutoffs less than 5 MHz. Negative values correspond to gain.
A value of 0xC0 retains the current value (does not change existing value).

Lowpass Filter Cutoff - CH1: 1 Byte. The DCAR's Channel 1 "I" and "Q" lowpass filter cutoff values. The values are as follows:

Value	Function
0	156.25 KHz
1	312.5 KHz
2	625 KHz
3	1.25 MHz
4	2.5 MHz
5 to 72	Cutoff Frequency in MHz
73	The Lowpass Filter is bypassed (Cutoff is ~100 MHz)
0xC0	Retains the current value.

Frequency Band – CH1: 1 Byte. The DCAR's Channel 1 Frequency Band in 100 MHz steps. For example, use Band 1 for frequencies between 50 MHz and 149 MHz. Use Band 2 for frequencies between 150 MHz and 249 MHz. The range of values is 1 to 10. The receiver's specified upper frequency limit is 1 GHz, so value 10 is only for 950 MHz to 1 GHz.
A value of 0xC0 retains the current value (does not change existing value)

ATT-RX-CH2: 1 Byte. The DCAR's Channel 2 Receive Mode Attenuator setting. Each count is 1 dB. The range is 0 dB to 70 dB for cutoffs greater than or equal to 5 MHz. The range is -10 dB to 70 dB for cutoffs less than 5 MHz. Negative values correspond to gain.
A value of 0xC0 retains the current value (does not change existing value)

ATT-TX-CH2: 1 Byte. The DCAR's Channel 2 Transmit Mode Attenuator setting. Each count is 1 dB. The range is 0 dB to 70 dB for cutoffs greater than or equal to 5 MHz. The range is -10 dB to 70 dB for cutoffs less than 5 MHz. Negative values correspond to gain.
A value of 0xC0 retains the current value (does not change existing value)

Lowpass Filter Cutoff – CH2: 1 Byte. The DCAR's Channel 2 "I" and "Q" lowpass filter cutoff values. The values are as follows:

Value	Function
0	156.25 KHz
1	312.5 KHz
2	625 KHz
3	1.25 MHz
4	2.5 MHz
5 to 72	Cutoff Frequency in MHz
73	The Lowpass Filter is bypassed (Cutoff is ~100 MHz)
0xC0	Retains the current value.

Frequency Band – CH2: 1 Byte. The DCAR's Channel 2 Frequency Band in 100 MHz steps. For example, use Band 1 for frequencies between 50 MHz and 149 MHz. Use Band 2 for frequencies between 150 MHz and 249 MHz. The range of values is 1 to 10. The receiver's specified upper frequency limit is 1 GHz, so value 10 is only for 950 MHz to 1 GHz.
A value of 0xC0 retains the current value (does not change existing value)

Mode: 1 Byte. The operating mode of both channels: Receive, Transmit, or Safe.

Value	Function
0	Receive Mode
1	Transmit Mode
2	Safe Mode
0xC0	Retains the current value.

Bit Values: 1 Byte. Individual bit values or flags.
The no change value, 0xC0, behaves in a unique way for this parameter. If 0xC0 is set, it only affects bits 0 and 1. The remaining bits (5, 4, 3, 2) must be set with each instance of a T14 message.

Example 1: to retain the bit 0 and 1 states while doing an offset null, the value in this parameter would be $0xC0 + 2^2 = 0xC0 + 4 = 0xC4$.

Example 2: to retain the bit 0 and 1 states while doing an alarm silence, the value in this parameter would be $0xC0 + 2^4 = 0xC0 + 0x10 = 0xD0$.

Example 3: to retain the bit 0 and 1 states while doing an alarm silence and an offset null, the value in this parameter would be $0xC0 + 2^4 + 2^2 = 0xC0 + 0x10 + 0x04 = 0xD4$.

Bit	Function
0	CH1 AC Coupled: Set = AC Coupled, Clear = DC Coupled
1	CH2 AC Coupled: Set = AC Coupled, Clear = DC Coupled
2	Set = Do an offset null (both channels)
3	Set = Reset Alarm
4	Set = Silence Alarm
5	Unassigned, for future use
0xC0	Retains the current value of bits 0 and 1 ONLY.

Spare 1: 1 Byte. Unassigned, for future use.

CRC: 2 Bytes. This is the CRC computed on all bits EXCEPT the Preamble bits. The CRC polynomial used is 0x11021. This is the CCITT polynomial. When computing the CRC, the seed bits (bits placed in the CRC's position when computing the CRC) are 0xFFFF. Additionally, a "Phantom" byte with the value 0x80 is placed in front of the entire

message and computed into the CRC. This is required to ensure detection of missing leading zeros. When checking the CRC, the result of the CRC will equal the seed if the message is good.

Message Type 15 Definition {Read All DCAR User Parameters}:

The Type 15 message is sent from a DCAR to the Controller. It allows viewing all parameters that can be configured by the Type 14 message, plus the measured DC offset from the "I" and "Q" channels, measured "I" and "Q" RF levels, and RF and LO Input levels along with other useful parameters.

WARNING: 2 byte values **OFTEN** do not fall on word boundaries. It is best to treat all incoming data as individual bytes and combine 2 byte values appropriately.

The following will safely combine 2 bytes into a 2 byte word:
`((hi_byte<<8) & 0xFF00) | (lo_byte & 0xFF)`

CAUTION: The above creates a 2_byte, 16 bit, word. If working with **signed values** and words more than 16 bits are used, then ensure that the sign is properly extended.

For example, suppose the decimal value is –1234. The representations for this value at different lengths are shown below:

`0xFB2E` (16 bit word)
`0xFFFF FB2E` (32 bit word)
`0xFFFF FFFF FFFF FB2E` (64 bit word)

Data Field Definitions (Message Type 15):

Function Name	Number of Bytes	Notes
Preamble	2	Value = 0x89FC
Type	1	Value = 0x0F
Source Address	2	DCAR's Address, unsigned
MODE	1	RX = 0, TX = 1, Safe = 2, unsigned
Last Set By	1	unsigned
Alarm Red	2	Alarm (RED) Indicator States, unsigned
Alarm Yellow	2	Alarm (YEL) Indicator States, unsigned
ATT-RX-CH1	1	Attenuation dB, 1dB/count, signed, -10 to +70 dB
ATT-TX-CH1	1	Attenuation dB, 1dB/count, signed, -10 to +70 dB
Lowpass Filter Cutoff-CH1	1	0 to 73: 5 to 72 in MHz, 0 to 4 and 73 are special
Frequency Band-CH1	1	Frequency Band /100, unsigned (1 to 10)
RF Input Power-CH1	2	Power in dBm, 0.1 dBm per count, signed
LO Input Power-CH1	2	Power in dBm, 0.1 dBm per count, signed,
"I" Output Power-CH1	2	Power in dBm, 0.1 dBm per count, signed
"Q" Output Power-CH1	2	Power in dBm, 0.1 dBm per count, signed
"I" Output DC Offset-CH1	2	Measured DC offset, 0.1 mV per count, signed
"Q" Output DC Offset-CH1	2	Measured DC offset, 0.1 mV per count, signed
Temperature-CH1	1	Receiver #1 Temperature, 0.5°C/Count, signed
Bit Values-CH1	1	Individual Bit Values, CH1, unsigned
Version-CH1	1	Receiver #1 Firmware Version, unsigned
Serial Number-CH1	2	Receiver #1 Serial Number, unsigned
ATT-RX-CH2	1	Attenuation dB, 1dB/count, signed, -10 to +70 dB
ATT-TX-CH2	1	Attenuation dB, 1dB/count, signed, -10 to +70 dB
Lowpass Filter Cutoff-CH2	1	0 to 73: 5 to 72 in MHz, 0 to 4 and 73 are special
Frequency Band-CH2	1	Frequency Band /100, unsigned (1 to 10)
RF Input Power-CH2	2	Power in dBm, 0.1 dBm per count, signed
LO Input Power-CH2	2	Power in dBm, 0.1 dBm per count, signed,
"I" Output Power-CH2	2	Power in dBm, 0.1 dBm per count, signed
"Q" Output Power-CH2	2	Power in dBm, 0.1 dBm per count, signed
"I" Output DC Offset-CH2	2	Measured DC offset, 0.1 mV per count, signed
"Q" Output DC Offset-CH2	2	Measured DC offset, 0.1 mV per count, signed
Temperature-CH2	1	Receiver #2 Temperature, 0.5°C/Count, signed
Bit Values-CH2	1	Individual Bit Values, CH2, unsigned
Version-CH2	1	Receiver #2 Firmware Version, unsigned
Serial Number-CH2	2	Receiver #2 Serial Number, unsigned
Power Supply +12V	2	+12V Supply Voltage, 0.1V per count, unsigned
Power Supply –12V	2	|-12V|, Supply Voltage, 0.1V per count, unsigned
Power Supply Temperature	1	Temperature, 0.5°C/Count, signed
Bit Values	1	Individual Bit Values, unsigned
Version: Panel Software	1	Panel Firmware Version, unsigned
Serial Number: DCAR	2	DCAR's Serial Number, unsigned
CRC	2	unsigned
Total Message Length:	64	bytes

ALL messages are sent most significant bit (MSB) first. In the table above, bytes are sent from top to bottom.

Function Descriptions (Message Type 15):

========== T15 Protocol Related Values

Preamble: 2 Bytes. Indicates the start of a message. Value = 0x89FC.

Type: 1 Byte. The message type defines the structure of the message. Message Type 15 is fixed length and format. Value = 0x0F.

Source Address: 2 Bytes. The DCAR address the message is being sent from. A DCAR's address is its serial number.

========== T15 Front Panel Values

MODE: 1 Byte. Indicates the selected mode of operation. The options are:

Value	Function
0	Receive
1	Transmit
2	Safe

Last Set By: 1 Byte. Indicates the selected mode of operation. The options are:

Value	Function
0	Panel
1	Remote (RS232 or LAN)
2	AUX T/R
3	Alarm

ALARM RED: 2 Bytes. Bit values that indicate the **RED** alarm conditions.

Red indicates a currently existing alarm condition.

For each alarm, only red or yellow will be on. Red and yellow will never be on simultaneously for any given alarm. Both red and yellow are off when there is no alarm for an item.

The bit numbering below considers the data as one 16 bit word. The most significant byte is sent first.

Bit	Function
0	Red, Channel 1 Overload
1	Red, Channel 2 Overload
2	Red, Channel 1 LO Level
3	Red, Channel 2 LO Level
4	Red, Channel 1 Receiver Failure
5	Red, Channel 2 Receiver Failure
6	Red, Positive Power Supply Failure
7	Red, Negative Power Supply Failure
8	Red, Over-Temperature
9-15	Red, Undefined

ALARM YELLOW: 2 Bytes. Bit values that indicate the **YELLOW** alarm conditions.

Yellow indicates a previous alarm condition that has subsequently cleared.

For each alarm, only yellow or red will be on. Yellow and red will never be on simultaneously for any given alarm. Both yellow and red are off when there is no alarm for an item.

Yellow indications are cleared by sending a T12 Message with the Command = "Alarm Reset" or by setting Bit 3 in the T13 Message "Bit Values" field .

The bit numbering below considers the data as one 16 bit word. The most significant byte is sent first.

Bit	Function
0	Yellow, Channel 1 Overload
1	Yellow, Channel 2 Overload
2	Yellow, Channel 1 LO Level
3	Yellow, Channel 2 LO Level
4	Yellow, Channel 1 Receiver Failure
5	Yellow, Channel 2 Receiver Failure
6	Yellow, Positive Power Supply Failure
7	Yellow, Negative Power Supply Failure
8	Yellow, Over-Temperature
9-15	Yellow, Undefined

========== T15 Channel 1 Values

ATT-RX-CH1: 1 Byte. The receiver's relative attenuation (the amount the gain is reduced from its maximum value) while in receive mode. Each count is 1 dB. The range is 0 dB to 70 dB for cutoffs greater than or equal to 5 MHz. The range is -10 dB to 70 dB for cutoffs less than 5 MHz. Negative values correspond to gain.

ATT-TX-CH1: 1 Byte. The receiver's relative attenuation (the amount the gain is reduced from its maximum value) while in transmit mode. Each count is 1 dB. The range is 0 dB to 70 dB for cutoffs greater than or equal to 5 MHz. The range is -10 dB to 70 dB for cutoffs less than 5 MHz. Negative values correspond to gain.

Lowpass Filter Cutoff-CH1: 1 Byte. The "I" and "Q" lowpass filter cutoff values. The range is as follows:

Value	Function
0	156.25 KHz
1	312.5 KHz
2	625 KHz
3	1.25 MHz
4	2.5 MHz
5 to 72	Cutoff Frequency in MHz
73	The Lowpass Filter is bypassed (Cutoff is ~100 MHz)

Frequency Band-CH1: 1 Byte. The Operating Frequency Band (center of frequency range being used) in 100 MHz steps. For example, Band 1 is used for frequencies between 50 MHz and <150 MHz. Band 2 is reported for frequencies between 150 MHz and <250 MHz. The range of values is 1 to 10. The receiver's specified upper frequency limit is 1 GHz, so value 10 is only for 950 MHz to 1 GHz.

RF Input Power-CH1: 2 Bytes. Channel 1 RF input power in dBm, 0.1 dBm per Count, signed
Returns 0x7FFF (32767) if the value is too low to be displayed.
This occurs when the level is less than –40 dBm (eg –41 dBm).

LO Input Power-CH1: 2 Bytes. Channel 1 LO input power in dBm, 0.1 dBm per Count, signed
Returns 0x7FFF (32767) if the value is too low to be displayed.
This occurs when the level is less than –30 dBm (eg –31 dBm).

"I" Output Power-CH1: 2 Bytes. Channel 1 "I" Output power in dBm, 0.1 dBm per Count, signed
Returns 0x7FFF (32767) if the value is too low to be displayed.
This occurs when the level is less than –40 dBm (eg –41 dBm).

"Q" Output Power-CH1: 2 Bytes. Channel 1 "Q" Output power in dBm, 0.1 dBm per Count, signed
Returns 0x7FFF (32767) if the value is too low to be displayed.
This occurs when the level is less than –40 dBm (eg –41 dBm).

"I" Output DC Offset-CH1: 2 Bytes. Channel 1 "I" offset value, 0.1 mV per count, signed

"Q" Output DC Offset-CH1: 2 Bytes. Channel 1 "Q" offset value, 0.1 mV per count, signed

Temperature-CH1: 1 Byte, Channel 1 Temperature, 0.5°C/Count, signed

Bit Values-CH1: 1 Byte. Individual bit values or flags.

Bit	Function
0	AC Coupling: Set = AC Coupled, Clear = DC Coupled
1 to 7	Unused at this time

Firmware Version-CH1: 1 Byte, unsigned

Serial Number-CH1: 2 Bytes, unsigned

========== T15 Channel 2 Values

ATT-RX-CH2: 1 Byte. The receiver's relative attenuation (the amount the gain is reduced from its maximum value) while in receive mode. Each count is 1 dB. The range is 0 dB to 70 dB for cutoffs greater than or equal to 5 MHz. The range is -10 dB to 70 dB for cutoffs less than 5 MHz. Negative values correspond to gain.

ATT-TX-CH2: 1 Byte. The receiver's relative attenuation (the amount the gain is reduced from its maximum value) while in transmit mode. Each count is 1 dB. The range is 0 dB to 70 dB for cutoffs greater than or equal to 5 MHz. The range is -10 dB to 70 dB for cutoffs less than 5 MHz. Negative values correspond to gain.

Lowpass Filter Cutoff-CH2: 1 Byte. The "I" and "Q" lowpass filter cutoff values. The range is as follows:

Value	Function
0	156.25 KHz
1	312.5 KHz
2	625 KHz
3	1.25 MHz
4	2.5 MHz
5 to 72	Cutoff Frequency in MHz
73	The Lowpass Filter is bypassed (Cutoff is ~100 MHz)

Frequency Band-CH2: 1 Byte. The Operating Frequency Band (center of frequency range being used) in 100 MHz steps. For example, Band 1 is used for frequencies between 50 MHz and <150 MHz. Band 2 is reported for frequencies between 150 MHz and <250 MHz. The range of values is 1 to 10. The receiver's specified upper frequency limit is 1 GHz, so value 10 is only for 950 MHz to 1 GHz.

RF Input Power-CH2: 2 Bytes. Channel 2 RF input power in dBm, 0.1 dBm per Count, signed
Returns 0x7FFF (32767) if the value is too low to be displayed.
This occurs when the level is less than –40 dBm (eg –41 dBm).

LO Input Power-CH2: 2 Bytes. Channel 2 LO input power in dBm, 0.1 dBm per Count, signed
Returns 0x7FFF (32767) if the value is too low to be displayed.
This occurs when the level is less than –30 dBm (eg –31 dBm).

"I" Output Power-CH2: 2 Bytes. Channel 2 "I" Output power in dBm, 0.1 dBm per Count, signed
Returns 0x7FFF (32767) if the value is too low to be displayed.
This occurs when the level is less than –40 dBm (eg –41 dBm).

"Q" Output Power-CH2: 2 Bytes. Channel 2 "Q" Output power in dBm, 0.1 dBm per Count, signed
Returns 0x7FFF (32767) if the value is too low to be displayed.
This occurs when the level is less than –40 dBm (eg –41 dBm).

"I" Output DC Offset-CH2: 2 Bytes. Channel 2 "I" offset value, 0.1 mV per count, signed

"Q" Output DC Offset-CH2: 2 Bytes. Channel 2 "Q" offset value, 0.1 mV per count, signed

Temperature-CH2: 1 Byte, Channel 2 Temperature, 0.5°C/Count, signed

Bit Values-CH2: 1 Byte. Individual bit values or flags.

Bit	Function
0	AC Coupling: Set = AC Coupled, Clear = DC Coupled
1 to 7	Unused at this time

Firmware Version-CH2: 1 Byte, unsigned

Serial Number-CH2: 2 Bytes, unsigned

========== T15 Power Supply Values

Voltage +12V: 2 Bytes, +12V Supply Voltage, 0.1V per count, unsigned

Voltage –12V: 2 Bytes, |-12V| Supply Voltage, 0.1V per count, unsigned
Value = absolute value of the negative supply voltage.

Temperature-Power Supply: 1 Byte, Power Supply Temperature, 0.5°C/Count, signed

========== T15 Front Panel Values

Bit Values-Panel: 1 Byte. Individual bit values or flags.

Bit	Function
0	Set = Audio Alarm (Beeper) Sounding
1 to 7	Unused at this time

Software Version: 1 Byte. The Front Panel's software version.

Serial Number: 2 Bytes. The DCAR's serial number, unsigned.

========== T15 Protocol Related Values

CRC: 2 Bytes. This is the CRC computed on all bits EXCEPT the Preamble bits. The CRC polynomial used is 0x11021. This is the CCITT polynomial. When computing the CRC, the seed bits (bits placed in the CRC's position when computing the CRC) are 0xFFFF. Additionally, a "Phantom" byte with the value 0x80 is placed in front of the entire message and computed into the CRC. This is required to ensure detection of missing leading zeros. When checking the CRC, the result of the CRC will equal the seed if the message is good.

Update History:

July 24, 2023
Revised communications protocol appendix to V2.0
Revised front and rear photos

Version 2.1

J.W. MacConnell

October 10, 2020
Highly revised version of the DCAR User Guide.

Version 2.0

J.W. MacConnell

September 27, 2014
First version of the Agile Receiver User Guide.

Version 1

J.W. MacConnell

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