ARA RF Advanced Front End (ARAFE): Slave Communication Document

This document details the communication protocol to the ARA RF Advanced Front End (ARAFE) slave (quad) modules. This communication protocol is typically performed by the ARAFE Master, in response to commands from software.

Overall Physical Layer

The ARAFE slave communication is performed over the +15V DC power supply line, using an on-off keying (OOK) signaling mechanism at approximately 1 MHz. “On” is interpreted as a digital 0, and “off” is interpreted as a digital 1. Characters are then sent as a typical UART, at 9600 bps, 8 bits, no parity, and 1 stop bit.

Packets from Master (bytes)

‘!’	‘M’	‘!’	command	argument	0xFF

Responses from Slave (bytes)

‘!’	‘S’	‘!’	ack	0xFF

Normal Commands (command 0-15)

Command structure is [type][flag][sub-command]=[7:6][5:4][3:0]

Available types are:

0x00: attenuator

0x40: sensor

0x80: info

0xC0: misc

Normal Commands (command 0-15)

Command	Description
Type 0x00	
00	Signal channel 0
01	Signal channel 1
02	Signal channel 2
03	Signal channel 3
04	Trigger channel 0
05	Trigger channel 1
06	Trigger channel 2
07	Trigger channel 3
08-3F	Repeat as above: 0x08 = sig chan 0, 0x09 = sig chan 1, 0x0E=0x3F=trig chan 3, etc.
Type 0x40	
40	Sensor 0
41	Sensor 1
42	Sensor 2

43	Sensor 3
44-47	Last two bits of last ADC
48-7F	Repeat as above
Type 0x80	
80-9F	Read/Write Device Info Eight bit argument: 1,0,0,W/R,A3,A2,A1,A0 A[3:0] = address of byte in the device_info W/R = 1 for write, 0 for read That is, 85 = read device info 5, 95 = write device info 5 (8->9 for switch from read to write)
A0-BF	Shadow of 80-9F (ie, A1 = 81)
Type 0xC0	
C0	Turn on/off 12V for channel 0
C1	Turn on/off 12V for channel 1
C2	Turn on/off 12V for channel 2
C3	Turn on/off 12V for channel 3
C4	Turn on/off 5V regulator
C5	Turn on/off 12V regulator
C6	Turn on/off 5V regulator (Shadow C4)
C7	Turn on/off 12V regulator (Shadow C5)
C8-FE	Repeat as above
0XFF	**Flash**

Device Info

Each ARAFE quad has a 16-byte 'device info' structure, which contains the default settings for the attenuators as well as the default power on/off behavior.

These can be written to (for index < 12) and read from, and then stored permanently in flash so that initial power on behavior can be controlled.

Device Info Table

Index	Description
0	Default signal attenuator value for channel 0
1	Default signal attenuator value for channel 1
2	Default signal attenuator value for channel 2
3	Default signal attenuator value for channel 3
4	Default trigger attenuator value for channel 0
5	Default trigger attenuator value for channel 1
6	Default trigger attenuator value for channel 2
7	Default trigger attenuator value for channel 3
8	Default P2OUT value (see text)
9	Default P3OUT value (see text)
10	Serial number MSB
11	Serial number LSB
12	Major firmware version
13	Minor firmware version

14	0x12
15	0x34

The P2OUT and P3OUT values control which voltages are enabled automatically at power on. Note that improperly programming these values may cause some problems with the default attenuator programming, but most likely not. (In detail, P2OUT/P3OUT can also set the LE pin for each attenuator, which is supposed to be pulsed high after the data is clocked in. The LE pin is set low at the beginning, so this should not cause problems, but there is some possibility).

Default Power Enable Locations [Need to redo this]

Voltage	Bit to Set to Turn On By Default
5V	P3OUT | 0x1
12V	P3OUT | 0x80
12V 0	P3OUT | 0x40
12V 1	P3OUT | 0x10
12V 2	P3OUT | 0x08
12V 3	P2OUT | 0x01

By default, the +5V and +12V turn on automatically. **None** of the 12V 0/1/2/3 turn on to prevent DC voltage from being present on the RF input (via the bias tee) by default.

Writing/Reading/Flashing Device Info [Need to redo this]

To **write** to the device info, the command should be a bitwise OR of 0x80 with the device info address, and the argument should be the value. That is, to write 0x12 to device info 10, you would send command = 0x80 | (10), and argument = 0x12.

To **read** from the device info, the command should be a bitwise OR of 0x40 with the device info address. The argument is unused. The value read from the device info is contained in the *ack* byte.

To **flash** the device info, send command 0xFF.

Housekeeping [Need to redo this]

There are 3 sensors in the ARAFE slave, and 4 possible housekeeping commands. The sensors are *nominally* 10 bits, but only 1 byte is returned with each command. The most significant 8 bits are returned with each sensor read, and the low 2 bits can be obtained with a 0x44 through 0x47 command.

Command	Return 'ack' value
0x10	MSP430 temperature, top 8 bits
0x11	+5V current, top 8 bits
0x12	+12V current, top 8 bits
0x13	Fault detection (Fault if very low if 0x12 is high), top 8 bits
0x44->0x47	Low 2 bits of last conversion

The fault detection circuit works by comparing the value read with the +12V current.

- +12V current roughly 0, fault detection > 0: **no fault** and **no current**

- +12V current roughly 0, fault detection roughly 0: **fault** on one of the outputs
- +12V current above 0, fault detection above 0: **normal operation**

The remaining case (+12V current above 0, fault detection 0) should never occur.