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	Argument	Description
0	0-127	Set signal attenuator on channel 0
1	0-127	Set signal attenuator on channel 1
2	0-127	Set signal attenuator on channel 2
3	0-127	Set signal attenuator on channel 3
4	0-127	Set trigger attenuator on channel 0
5	0-127	Set trigger attenuator on channel 1
6	0-127	Set trigger attenuator on channel 2
7	0-127	Set trigger attenuator on channel 3
8	0,1	Turn on/off 12V for channel 0
9	0,1	Turn on/off 12V for channel 1
10	0,1	Turn on/off 12V for channel 2
11	0,1	Turn on/off 12V for channel 3
12		*Unused*
13	0,1	Turn on/off 5V
14	0,1	Turn on/off 12V
15	0,1	Turn on/off both 5V and 12V

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

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

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 0x20.

Housekeeping

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 0x14 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
0x14	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.