

# Monitor and Control Firmware Summary

GBT K-Band Focal Plane Array Critical Design Review

January, 2009

## Introduction

The GBT Monitor and Control (M&C) software provides an abstraction of GBT hardware systems through entities known as managers. These managers deal with the specifics of communication to different types of hardware and provide a common interface for higher order software used by scientists and engineers (Astrid, CLEO, etc). The KFPA manager will communicate to a hardware controller over a network, and will require additional software or firmware to complete the path to hardware access.

## Requirements

The firmware is constrained by existing monitor and control infrastructure, by scientific requirements, and by the challenges associated with creating a multi-pixel array receiver.

1. Firmware will integrate with the existing GBT M&C infrastructure<sup>1</sup>
2. All hardware parameters will be monitored and logged on a real-time schedule, except while observations are underway<sup>2</sup>
3. Pixels will be arbitrarily selectable as sub-arrays for observing<sup>3</sup>

## Single Pixel Prototype

The firmware for the single pixel, comprised of a simple C language program placed on a microcontroller, acts as a gateway between the IIC bus and the manager, allowing remote access to hardware physically residing with the receiver.

For the KFPA single pixel tests, a simple HTTP-based interface was built into the firmware, and a web page was the primary method for users to monitor the hardware and set up receiver configurations.

The single pixel firmware was a success, with only a few minor IIC-related problems, which were easily corrected. The Integrated Downconverter Module interface did not function properly through the microcontroller, but this is now understood as a wiring issue, not an inherent issue with the firmware nor the hardware.

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1 “Array M&C Software Design.” Feb. 2008. <<https://safe.nrao.edu/wiki/bin/view/Kbandfpa/ArrayMnCSoftwareDesign>>

2 “HEMT Bias Card.” Jul. 2008. <<https://safe.nrao.edu/wiki/bin/view/Kbandfpa/HEMTBiasCard>>

3 “Spectral Line Observations with the GBT KFPA.” Aug. 2008.

<<https://safe.nrao.edu/wiki/bin/view/Kbandfpa/SciPlanning>> (notes by Glen Langston)

<<https://safe.nrao.edu/wiki/pub/Kbandfpa/SciPlanning/obsmodes4.pdf>> (original source)

## Seven Pixel Design

In order to accommodate the increased complexity of the seven pixel KFPA as well as provide integration with the existing M&C infrastructure, several changes will be made to the firmware.

To effectively communicate with the manager, the firmware will utilize a custom protocol, which will be parsed and then mapped to hardware parameters via an addressing schema based on the final hardware layout.

Calculations by Galen Watts prove that a single microcontroller is sufficient to monitor all receiver parameters<sup>1</sup> in real time for the seven pixel array<sup>4</sup>.

## Further Considerations

There are several pieces of the firmware still to be detailed:

- The protocol used to communicate between the manager and the microcontroller
- The addressing model for the microcontroller to access hardware

Because pixels will be selectable in sub-arrays for observing, it would be advantageous for the manager communication protocol and microcontroller addressing model to allow similar selection for monitor parameters, should such a scheme prove feasible.

## Conclusions

The knowledge gained from the single pixel prototype has proven invaluable in refining the design for a multi-pixel array receiver with a distributed monitor and control system.

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4 "KFPA M&C Hardware and LNA Bias System." Feb. 2008.  
<<https://safe.nrao.edu/wiki/pub/Kbandfpa/ConceptualDesignReview/MonCntrlNotes.pdf>>