

MIRI Detector Readout Slow

JWST MIRI's **SLOW** mode readout pattern offers fewer detector artifacts and slightly lower detector noise than the "fast mode", making it a good choice for faint source medium-resolution spectroscopy where the sky backgrounds are very low.

Introduction

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Long MULTIACCUM exposures can maximize signal-to-noise in detector noise-dominated regimes. **SLOW**¹ mode is therefore the default readout mode for [medium-resolution spectroscopy](#) (although [FAST mode](#) will be available for bright targets.) Just like in **FAST** mode, $N_{\text{groups}} > 4$ is required (and $N_{\text{groups}} > 10$ is suggested) for **SLOW** mode in order to optimize the calibration procedure, particularly cosmic ray removal.

Following [MIRI readout terminology](#), **SLOW** mode obtains nine samples of a pixel ($N_{\text{sample}} = 9$; $t_1 = 23.88992$ s). The first sample is ignored and the remaining eight samples are averaged to output a single result before being returned to the ICDH (ISIM Command and Data Handling). $N_{\text{sample}} = 9$ is a fixed parameter in **SLOW** mode and cannot be altered by the observer. The user can alter the number of groups (N_{groups}) and integrations (N_{int}). All groups will be stored and downloaded.

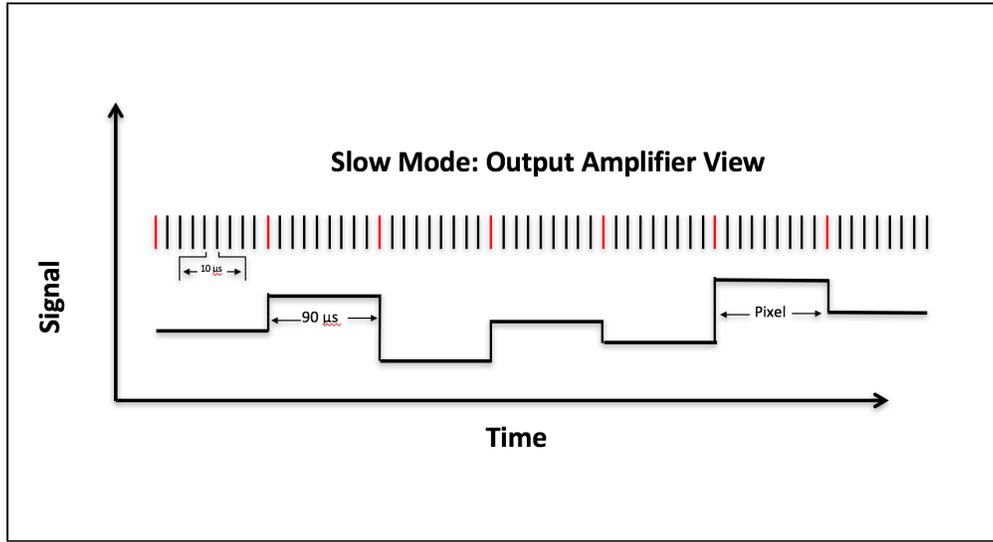
¹ ***Bold italics*** font style is used to indicate parameters, parameter values, and/or special requirements that are set in the APT GUI.

Pixel perspective

From a pixel's point of view, the **SLOW** mode pattern starts with a read-reset frame, followed by $N_{\text{groups}} - 1$ read-only frames while integrating.

The focal plane electronics (FPE) dwells at each pixel for $N_{\text{sample}} = 9$ (90 μs in total). However, the FPE will only record the final eight measurements to allow for ample pixel settling time. Those eight samples will be averaged in the FPE signal chain and reduced to 16 bits before being sent to the ICDH. The time between sampling each pixel is $t_1 = 23.88992$ s because the entire sensor chip assembly (SCA) is read before returning to a particular pixel. The integration ends with a read-reset after the specified number of N_{groups} ; this integration timing pattern may be repeated N_{int} times for an exposure.

Figure 2. SLOW mode sampling pattern from the output amplifier point of view



The horizontal axis is time and the vertical axis is pixel signal strength. Each signal level corresponds to a different pixel. The pixel signal levels chosen here are just for illustrative purposes, but the horizontal line highlights that the values are assumed to be relatively constant over the 80 μs of the sampling. Pixel sampling is represented by vertical black lines. Note that the FPE will only record the final eight measurements to allow for ample settling time. The time between samples is 10 μs , with the first and last sample ignored in each group.