LAT Flight Software

LMC Manual

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Manual for the LAT multiplexed counters package.

Contents

0 Introduction

The LMC package implements access to the low-rate multiplexed science counters for the CAL, TKR, and ACD hardware.

0.0 Overview

Each TEM maintains registers for counting of the CAL trigger primitives and the TKR 3-in-a-row signals. Each counter is multiplexed by setting its corresponding counter mask register. ACD tile counters are accessed through the GEM. The GEM maintains three registers the collectively multiplex and count the number of time a signal is present in any two of the ACD's 108 tiles. One register selects which tile pair to count, and the two remaining registers contain the corresponding counter values.

All counters registers are saturating. They will stop counting once the maximum value is reached. Counters are reset by restarting the counting process, either by writing to the counter, or writing to the multiplexing register.

0.1 Reference Documentation

1. LAT-TD-00605, "Tower Electronics Module - Programming ICD specification", by Michael Huffer
2. LAT-TD-01545, "GLT Electronics Module - Programming ICD specification", by Michael Huffer

1 Package Description

This section describes the CMX package layout for LMC.

1.0 Shareables

- liblmc - The main LMC library
- liblmc_scp - SCP (Spacecraft control program) telecommand routines

1.1 Executables

- N/A

1.2 Utilities

- N/A

2 Implementation

This section provides an overview of the LMC software implementation.

2.0 Task Architecture

LMC is implemented as an ITC delegated task. The task performs the following primary functions:

- Receive, validate, and process telecommand packets
- Construct and submit LCB command lists
- Validate and process LCB result lists
- Packetize counter data and telemeter using the science data interface

2.0.0 Execution

LMC utilizes wake-up timers (WUT) provided by the PBS package to allow for simultaneous fixed interval sampling of each counter. Each LCB result list callback strobes the WUT at parameterized intervals. This results in the resubmission of the LCB command list, which continues until the specified sample limit has been reached, or until the stop command is received.

2.1 Control Structures

For each counter type, CAL, TKR, and ACD, a separate control block is maintained. Each control block contains a WUT, LCB command and result lists, and packet data buffers.

2.2 Counter Data

The counter data reported for each subsystem is described in the following sections.

2.2.0 CAL LRS Counter Data

CAL low-rate science data consists of two 16 bit counters and a 32 bit time delta specified in LCB clock tics. The masks specified in the telecommand are reported back with the counter data.

see [1] section 2.3.3.3 for specifics on interpreting the CAL counter data

2.2.1 TKR LRS Counter Data

TKR low-rate science data consists of four 16 bit counters and a 32 bit time delta specified in LCB clock tics. The masks specified in the telecommand are reported back with the counter data

see [1] section 2.3.4.4 for specifics on interpreting the TKR counter data

2.2.2 ACD Tile Counter Data

ACD tile counter data consists of two 16 bit counters for each tile pair, and a 32 bit time delta specified in LCB clock tics. The tile numbers are also included in the reported data.

see [2] section 2.6.2 for specifics on interpreting the ACD tile counter data

3 Programming

The LMC package provides several public control interfaces that are used to initialize, start, and stop the LMC system.

3.0 Initialization

The LMC initialization call takes no parameters.

LMC_initialize()

3.1 Application Control

LMC_startTask(TASK_att *attr) - starts the LMC task. Takes a pointer to a task attribute block.

LMC_stopTask() - stops the LMC task

LMC_shutdown() - releases all LMC memory resources

4 Command and Telemetry

This section covers the command and telemetry interfaces of the LMC package.

4.0 Telecommands.

The LMC package system supports five telecommands:

1. initiate collection of CAL low-rate science data
2. initiate collection of TKR low-rate science data
3. initiate collection of an ACD tile counter pair
4. initiate collection of all ACD tile counters
5. stop collection of specified active counters

4.0.0 LMCCALLRS: Command

This command initiates sampling of CAL low-rate science counters at the specified rate, for the enabled TEMs. Each sample generates one telemetry packet.

4.0.0.0 LMCCALLRS: Parameters

interval - time between counter samples, minimum of 100 milliseconds, maximum of 4000 milliseconds

count - number of counter samples to perform.

cal_mask - 32 bit low-rate science multiplex mask

tem_enable - 16 bit enable word specifying which TEMs to sample.

see [1] section 2.3.3.2 for specifics on setting the CAL mask

4.0.1 LMCTKRLRS: Command

This command initiates sampling of CAL low-rate science counters at the specified rate, for the enabled TEMs.

4.0.1.0 LMCTKRLRS: Parameters

interval - time between counter samples, minimum of 100 milliseconds, maximum of 4000 milliseconds

count - number of counter samples to perform.

tkr_mask - 16 bit low-rate science multiplex mask

tem_enable - 16 bit enable word specifying which TEMs to sample.

see [1] section 2.3.4.3 for specifics on setting the TKR mask

4.0.2 LMCACDTILEPAIR: Command

This command initiates sampling of ACD tile counters at the specified rate, for the specified tile pair. Each sample generates one telemetry packet containing counter values for both tiles. Note that tile *pair* and tile *all* counter operations are mutually excusive.

4.0.2.0 LMCACDTILEPAIR: Parameters

interval - time between counter samples, minimum of 100 milliseconds, maximum of 4000 milliseconds

count - number of counter samples to perform.

tile_0 - ACD tile number

tile_1 - ACD tile number

see [2] section 2.6.2 for specifics on setting the ACD tile numbers

4.0.3 LMCACDTILEALL: Command

This command initiates sampling of all ACD tile counters at the specified rate. Each sample generates two telemetry packets. Note that tile *pair* and tile *all* counter operations are mutually excusive.

4.0.3.0 LMCACDTILEALL: Parameters

interval - time between counter samples, minimum of 100 milliseconds, maximum of 4000 milliseconds

count - number of counter samples to perform.

4.0.4 LMCSTOPCOUNT: Command

This command stops the specified counter operation.

4.0.4.0 LMCSTOPCOUNT: Parameters

See Figure 1 for the valid counter opcode values.

opcode - counter opcode specifying which counter(s) to stop.

```
typedef enum _LMC_CmdOpcode {
    LMC_OP_ALL             = 0,       /*!< All counters                    */
    LMC_OP_CAL             = 1,       /*!< CAL low rate science            */
    LMC_OP_TKR             = 2,       /*!< TKR low rate science            */
    LMC_OP_TILE_PAIR       = 3,       /*!< ACD tile pair counters          */
    LMC_OP_TILE_ALL        = 4,       /*!< ACD all tile counters           */
} LMC_CmdOpcode;
```

Figure 1 LRS Counter Opcodes

4.1 Telemetry

This section describes the telemetry interface for the LMC package. LMC packets are self-describing and variable length. The content/format is determined by the multiplex setting specified in the initiating telecommand. For detailed descriptions of the packet layouts, refer to the LAT Telecommand and Telemetry document.

4.1.0 Packet Descriptions

TBD.