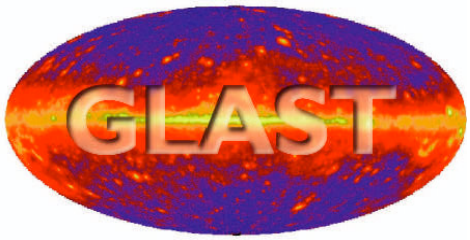

LAT Flight Software

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, TKR 3-in-a-row signals, and the deadtime. 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.

Because all counters register are saturating, they will stop counting once the maximum value is reached. In order to prevent saturation, the counters are reset after each sample interval. The resulting values reflect counts for a single specified interval.

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

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 telemetry using either the diagnostic or 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, TEM, 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. Each sample generally contains the raw counter data read from the registers, a delta time covering the duration of the sample, the timestamp for the start of the collection, and a data mask describing what components were included in the sample.

Because all counter registers are saturating, they will stop counting once the maximum value is reached. In order to prevent saturation, the counters are reset after each sample interval. The resulting values reflect counts for a single specified interval.

2.2.0 CAL LRS Counter Data

These registers count CAL specific trigger primitives in the low and high energy ranges. CAL low-rate science data consists of two 16 bit counters and a 32 bit time delta specified in microseconds. 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

These register count TKR specific trigger primitives for 3-in-a-row signals. TKR low-rate science data consists of four 16 bit counters and a 32 bit time delta specified in microseconds. 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

These registers count the number of times a signal was present in any of the ACD's 108 tiles. ACD tile counter data consists of two 16 bit counters for each tile pair, and a 32 bit time delta specified in microseconds. 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

2.2.3 TEM Deadtime Counter Data

These registers count the deadtime incurred in the TEM by CAL and TKR trigger primitives. TEM deadtime counter data consists of a 32 bit counter for each of the 16 TEMs, and a 32 bit time delta specified in microseconds. The TEM enable mask is also included in the reported data.

see [1] section 2.3.5 for specifics on interpreting the TEM deadtime 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_start() - starts 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 the following telecommands:

Command	APID	Function Code	Description
LMCCALLRS	0x69c	0	Initiates collection of CAL low-rate science data
LMCTKRLRS	0x69c	1	Initiates collection of TKR low-rate science data
LMCACDTILEAPAIR	0x69c	2	Initiates collection of a pair of ACD tile counter data
LMCACDTILEALL	0x69c	3	Initiates collection of all ACD tile counter data
LMCSTOPCOUNT	0x69c	4	Terminates active counter operations
LMCTEMDEADTIME	0x69c	5	Initiates collection of TEM deadtime low-rate science data
LMCNOOP	0x69c	6	No Operation

4.0.0 LMCCALLRS

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

Parameter	Description
LMCINTERVAL	Time between counter samples, minimum of 50 milliseconds, maximum of 65535 milliseconds

Parameter	Description
LMCCOUNT	Number of counter samples to perform
LMCCALMASK	32 bit low-rate science multiplex mask
LMCTEMMASK	16 bit enable word specifying which TEMs to sample
LMCDEST	Destination data stream: 0 = diagnostic, 1 = science

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

4.0.1 LMCTKRLRS

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

Parameter	Description
LMCINTERVAL	Time between counter samples, minimum of 50 milliseconds, maximum of 65535 milliseconds
LMCCOUNT	Number of counter samples to perform
LMCTKRMASK	32 bit low-rate science multiplex mask
LMCTEMMASK	16 bit enable word specifying which TEMs to sample
LMCDEST	Destination data stream: 0 = diagnostic, 1 = science

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

4.0.2 LMCACDTILEPAIR

This command initiates sampling of ACD tile counters at the specified rate, for the specified tile pair. Sample data is packed into telemetry packets up to a maximum of 27 samples per packet. Note that tile *pair* and tile *all* counter operations are mutually excusive.

Parameter	Description
LMCINTERVAL	Time between counter samples, minimum of 50 milliseconds, maximum of 65535 milliseconds
LMCCOUNT	Number of counter samples to perform
LMCTILEID0	ACD tile number
LMCTILEID1	ACD tile number
LMCDEST	Destination data stream: 0 = diagnostic, 1 = science

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

4.0.3 LMCACDTILEALL

This command initiates sampling of all ACD tile counters at the specified rate. Each sample generates two telemetry packets, each containing data for 54 tiles. Note that tile *pair* and tile *all* counter operations are mutually excusive.

Parameter	Description
LMCINTERVAL	Time between counter samples, minimum of 50 milliseconds, maximum of 65535 milliseconds
LMCCOUNT	Number of counter samples to perform
LMCDEST	Destination data stream: 0 = diagnostic, 1 = science

4.0.4 LMCTEMDEADTIME

This command initiates sampling of TEM deadtime counters at the specified rate. Each sample generates one telemetry packet.

Parameter	Description
LMCINTERVAL	Time between counter samples, minimum of 50 milliseconds, maximum of 65535 milliseconds
LMCCOUNT	Number of counter samples to perform
LMCTKRDSAB	Bit to disable counting of TKR contributed deadtime
LMCCALDSAB	Bit to disable counting of CAL contributed deadtime
LMCTOTALDSAB	Bit to disable counting of the CAL and TKR deadtime sums
LMCTEMMASK	16 bit enable word specifying which TEMs to sample
LMCDEST	Destination data stream: 0 = diagnostic, 1 = science

see [1] section 2.3.5 for specifics on setting the TEM deadtime masks

4.0.5 LMCSTOPCOUNT

This command stops the specified counter operation.

Parameter	Description
LMCCOUNTOPCODE	Opcode of counter operation to terminate

Opcode	Description
0	All active counters

Opcode	Description
1	CAL low-rate science counter
2	TKR low-rate science counter
3	ACD tile counters, either type
4	ACD tile counters, either type
5	TEM deadtime low-rate science counter

4.0.6 LMCNOOP

This command takes no parameters and if received will elicit a success response. The purpose of this command is to verify task communications without taking any action.

4.1 Diagnostic Telemetry

This section describes the diagnostic telemetry interface for the LMC package. LMC diagnostic packets are self-describing and fixed 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

Name	APID	Description
cal_cnt	0x2c3	CAL Low Rate Science Counters
tkr_cnt	0x2c4	TKR Low Rate Science Counters
acd_cnt	0x2c5	ACD Tile Low Rate Science Counters
dead_cnt	0x2c6	TEM Deadtime Low Rate Science Counters

4.1.1 CAL LRS Telemetry

Mnemonic	Description
LMCTSSECS	The seconds part of the timestamp for the start of the sample
LMCTSUSECS	The microseconds part of the timestamp for the start of the sample
LMCTEMENABLE	The TEM enable mask as contained in the initiating telecommand
LMCCALLRSMASK	The CAL enable mask as contained in the initiating telecommand
LMCCALTEM[X]DT	Elapsed time in microseconds of the sample duration for TEM X, where X=0-15

Mnemonic	Description
LMCCALTEM[X]CNT0	The raw CAL counter 0 data for TEM X, X=0-15
LMCCALTEM[X]CNT1	The raw CAL counter 1 data for TEM X, X=0-15

4.1.2 TKR LRS Telemetry

Mnemonic	Description
LMCTSSECS	The seconds part of the timestamp for the start of the sample
LMCTSUSECS	The microseconds part of the timestamp for the start of the sample
LMCTEMENABLE	The TEM enable mask as contained in the initiating telecommand
LMCTKRLRSMASK	The TKR enable mask as contained in the initiating telecommand
LMCTKRTEM[X]CNT[Y]D	Elapsed time in microseconds of the sample duration for TEM X counter Y, where X=0-15, Y=0-1
LMCTKRTEM[X]CNT[Y]U	The raw TKR upper counter Y data for TEM X, X=0-15, Y=0-1
LMCTKRTEM[X]CNT[Y]L	The raw TKR lower counter Y data for TEM X, X=0-15, Y=0-1

4.1.3 ACD LRS Telemetry

Mnemonic	Description
LMCTSSECS	The seconds part of the timestamp for the start of the first sample
LMCTSUSECS	The microseconds part of the timestamp for the start of the first sample
LMCACDCNT[X]T[Y]ID	ACD Tile ID, where X=0-1 (counter index) , Y=0-107 (tile ID)
LMCACDCNT[X]DT	Elapsed time in microseconds of the sample duration for counter index X, where X=0-1 (counter index)
LMCACDCNT[X]T[Y]VAL	The raw ACD tile counter data, where X=0-1 (counter index) , Y=0-107 (tile ID)

4.1.4 TEM LRS Telemetry

Mnemonic	Description
LMCTSSECS	The seconds part of the timestamp for the start of the sample
LMCTSUSECS	The microseconds part of the timestamp for the start of the sample
LMCTEMENABLE	The TEM enable mask as contained in the initiating telecommand
LMCTEMDEADMASK	The TEM deadtime enable mask as contained in the initiating telecommand
LMCDEADTEM[X]DT	Elapsed time in microseconds of the sample duration for TEM X, where X=0-15
LMCDEADTEM[X]CNT	The raw deadtime counter for TEM X, where X=0-15

4.2 Science Telemetry

When the destination for the telemetry is specified to be the science stream, the data is packed into datagrams, up to a maximum size of 65536 bytes. Each datagram contains data of only one type, specified by the ID in the datagram header. Within a datagram the data itself is organized into the same packet structure as for the diagnostic stream, with each packet preceded by its size (in bytes) specified as a 32-bit integer.