# TM/TC EGSE

*Telemetry and Telecommands EGSE*


*Telemetry and Telecommands EGSE (case open)*

## 1 General Description

Model 6304A is a telemetry and telecommands (TM/TC) EGSE. This unit is designed to drive latching type microwave relays with HLC/HPC commands.

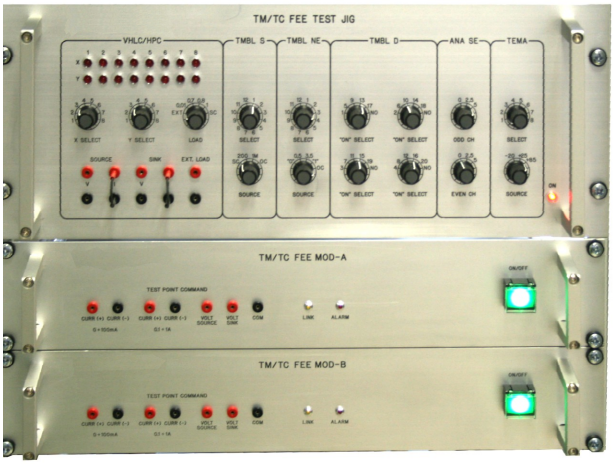


*Fig.1 – Two TM/TC units (main and redundant) and the FEE test equipment ready for rack mounting.*

The telecommands are generated by the internal source/sink pulse generator (100ms or 750ms selectable). During the pulse, current, voltage, and timing are monitored for every failure condition.

Pulse is routed by an 8x8 matrix, giving a a total of 64 telecommands.

Telemetry acquisition is available both in analog mode (16 single-ended channels, 8 thermistor channels) having a resolution of 12 bits, both in digital mode (16 single-ended channels for switch closures, 32 digital bi-level inputs).

Unit is interfaced with a control computer through a LAN or RS232 interface.

Command language is compliant with the SCPI protocol (see para 3.1), and is accessible either by a Telnet console or by a TCP Socket.

Design has been made to be interfaced with flight units, so a complete FMECA analysis has been made.

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## 2 Microprocessor Features

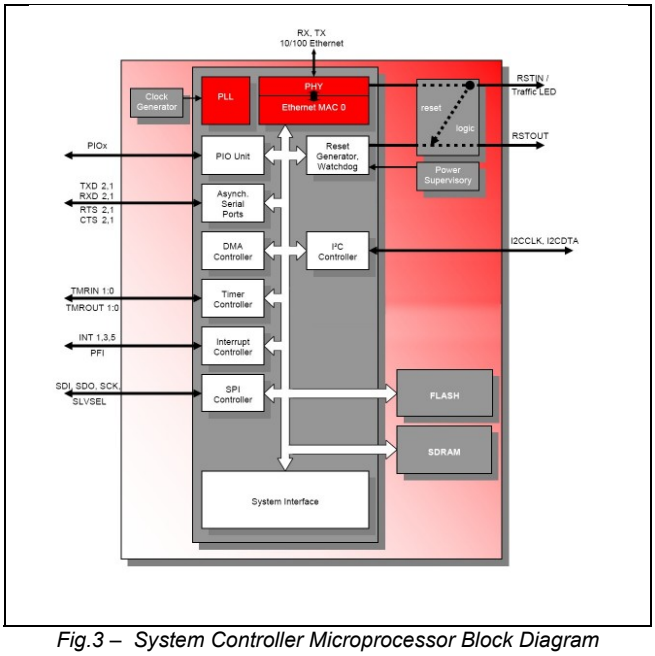


*Fig.3 – System Controller Microprocessor Block Diagram*

- The microcontroller is based on a X86-Family CPU running at 40 MHz and 512K of RAM.
- A built-in Ethernet interface (10/100 BaseT) is included.
- Serial interface provide remote control via RS-232, and firmware upload/device initialization.
- All peripherals are controlled by means of the I2C bus.
- Internal timers ensure the precise control of timed events.
- The control firmware run on an embedded RTOS (Real Time Operating System).
- The TCP/IP stack supports http, Telnet, ftp, mail protocols.
- The FEE system software is resident in the microprocessor itself, allowing the access of the unit from any software platform running a Telnet client and an http browser.
- Low-level interface (and remote programming) is accomplished by means of an TCP socket interface, or through the Telnet console (Command Level I/F).

## 3 Software Description

The communication between the EGSE System Controller (SC) and the TM/TC FEE is implemented by a standard 10/100 Base-T LAN interface, using the RJ45 type of connectors.

Thanks to this interface, and by means of a standard intranet, this allows the decentralization of the SC from the TM/TC FEE. The communication protocol between the SC and the FEE uses the standard TCP/IP protocol.

A standard port is used to access the optional internal webserver (port 80), and the remote-programming Telnet data socket (port 5025).

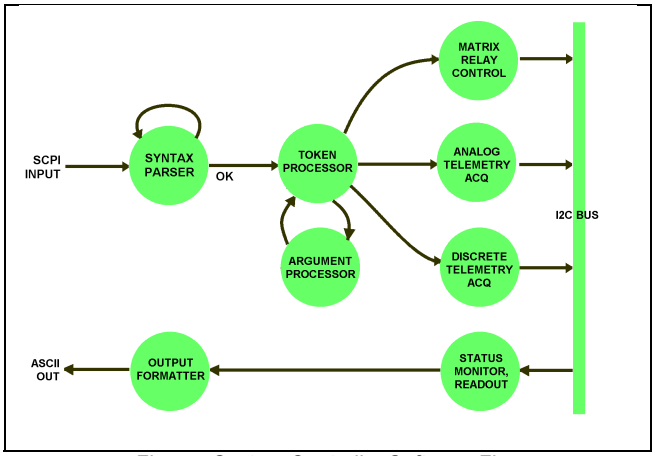


*Fig.4 – System Controller Software Flow*

The unit can be configured and controlled with the optional webserver, allowing a graphical user interface to control and read the TM/TC.

A special section will enable the user to send and receive commands in the same manner used by the remote programming feature, thru the Telnet port and sockets.

The software required to test and validate the TC/TM FEE (System Controller Simulator, SCS) is embedded in the FEE itself.

System software resides in the Microprocessor Internal Disk, allowing the access of the unit from any software platform capable of running a Telnet client and an HTTP Browser.

The Microprocessor runs a Real Time Operating System (RTOS), resident in its internal Solid State Disk.

This RTOS will ensure the correct execution of commands in the expected timeframe, which are synchronized with the internal hardware timers.

The firmware will consist mainly in the following 3 modules:

- command parser (Telnet port, and data socket)
- CGI-based application (interface with the Webserver)
- hardware interface layer. (control of the I2C bus and GPIOs)

This system is specifically designed to link the TM/TC FEE hardware in order to generate all specified HLC's/HPC's and to monitor all TM's status and the Alarm

conditions, by decoding the commands received through the Telnet port, and to present them in graphical manner by means of the CGI interface with the Webserver

## 3.1 SCPI Commands

The TM/TC Front End Equipment can be operated through the LAN interface by sending commands and parameters, which consists of a series of ASCII characters.

Programming and data formats are described in the following paragraphs.

### 3.1.1 SCPI Syntax

SCPI commands are organized in a tree structure (refer to figure 5).

Each level in the hierarchy is called a subsystem. This hierarchical approach permits the same command names to be re-used many times, and facilitate the expansion of the keywords to fulfill future requirements.

### 3.1.2 Long and Short Form Commands

The command names are written with mixed capitalization. Every SCPI command name has a short form, and most also have a long form.

The notation used in this document is to show the short form in upper case, with the remainder of the name which creates the long form shown in lower case.

There are no intermediate forms of the command name – the exact short or long form must be sent. However, there is no necessity to use the mixed capitalization - the equipment accepts commands in any combination of upper and lower case.

With few exceptions, every SCPI command has a corresponding query.

The command is used to set a control point in the instrument; the query is used to determine the present setting of the control point. The query is simply the command name with a `?' attached.

There are also some queries which have no corresponding command. For example, the `MEASure?` query causes the instrument to perform a telemetry reading and to return the corresponding value.

### 3.1.3 Separators and Terminators

In addition to keywords and parameters, SCPI program statements require the following:

- *Parameter Separators*. Parameters which follows a command must be separated from the command keyword by a space (ASCII coded byte 20 hexadecimal).
- *Keyword Separators*. Keywords are separated by a colon (:), a semicolon (;), or both. Important Proper use of the (:) and the (;) is very important to the construction of command messages. The colon (:) indicates the root level in the tree structure.
- *Program Line Terminators*. A terminator informs the parser that it has reached the end of a statement. Interpretation and execution of the command(s) begin when the terminator is received.

The termination occurs with specific terminator codes, such as <CR> which stands for "Carriage Return" and is represented by the ASCII coded byte 13 hexadecimal and/or <LF> which stands for "Line Feed" and is represented by the ASCII coded byte 0A hexadecimal.

### 3.1.4 Parameters

Most commands require a parameter and most queries will return a parameter.

Parameters are data values that the parser expects to find after certain keywords. All data programmed to or returned from is ASCII.

The data may be numerical data or character strings. Numerical data used in this equipment consists of digits with no decimal point.

### 3.1.5 Keywords

The following figure 5 lists all the keywords defined and recognized by the equipment.

Commands and queries are listed in the short or long form. The parser will recognize both.

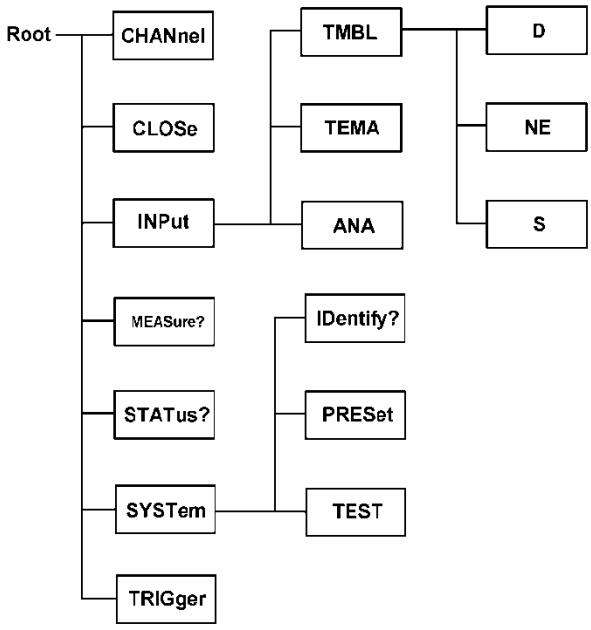


*Fig.5 – SCPI implementation Command Tree Structure*

# 4 Performances

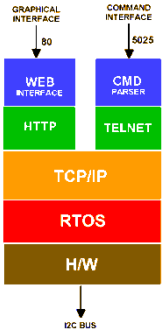


*Fig.6 – TM/TC FEE data Structure*

- The TM/TC FEE is able to provide up to 64 commands lines.
- The line commands (positive and return) are addressed with 64 DPDT relays arranged in a 8x8 matrix.
- Only one source/sink driver is used to provide the command, in fact:
  - the source /sink driver is controlled to provide the duration time of relative command (100ms @ HLC, 750ms @ HPC).
  - the current is limited for the relative command if required
- The matrix is addressed with I2C bus commands through the microprocessor.
- Securities are provided for the following items:
  - current limit
  - overvoltage of HPC/HLC pulse
  - watchdog for duration of command
- Monitoring:
  - Status of amplitude of command
  - ON/OFF status of SOURCE/SINK driver
  - Status of 8x8 matrix
- All alarm conditions are encoded in a single byte (Service Request byte). Detailed error ID are also provided.
- Test Point Measurement (made available on the front panel):
  - Command current
  - Source voltage
  - Sink voltage
- External Harness: no harness is foreseen on the payload. Therefore the connection from TM/TC_FEE to each user is representative of flight harness and don't take into account the routing on payload.

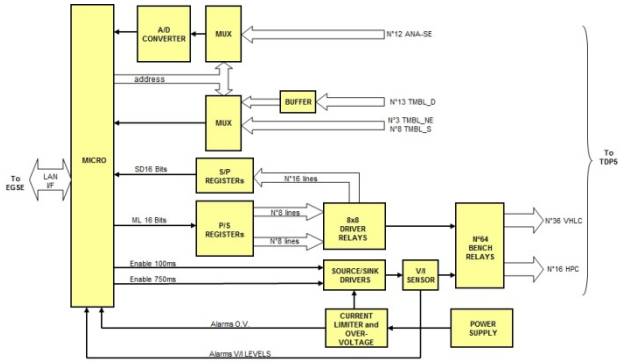


*Fig.7 – TM/TC FEE Block Diagram – Microprocessor section*

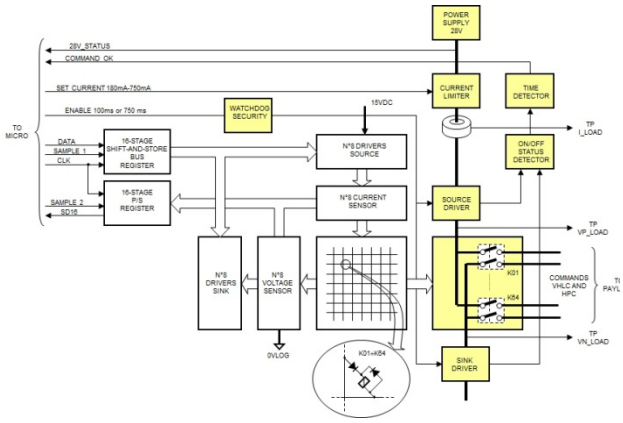


*Fig.8 – TM/TC FEE Block Diagram – TDP5 section*



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Datasheet: DS-155/A – 13/03/2014 (issue 5b)