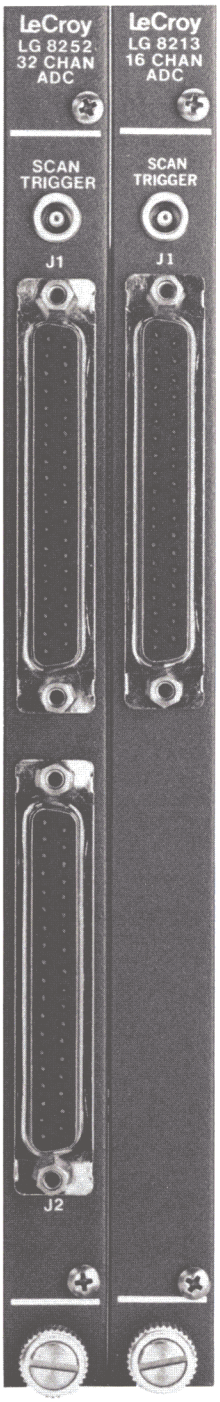
TECHNICAL DATA

LeCroy



Models LG8252 and LG8213

Fast Scan, 32 and 16 Channel Data Loggers

- **High Sensitivity: 12 bits (0.025% Resolution)**
- **Two Digitizing Modes: Continuous Scan or Single Scan**
- **Asynchronous Readout: Any Channel can be read at any time**
- **Bipolar or Unipolar operation over a 10 volt range**
- **Differential Inputs: common mode noise rejection**
- **Flexible Readout: Block Transfer (DMA) or address selection**
- **Sample and Hold Acquisition for high speed, high accuracy**

The LeCroy Model LG8252 is a 32-input ADC intended for use in general purpose voltage-monitoring applications. The Model LG8213 is a 16-channel version with identical characteristics unless otherwise noted. The >10MΩ inputs of the LG8252 respond to voltages over a 10-volt range, converting them to proportional 12-bit digital data words. An on-board switch provides the choice of a unipolar mode, 0 to +10 volts, or a bipolar mode, −5 to +5 volts. The differential inputs suppress common mode signals and noise.

The voltage levels at the 32 inputs on the front panel connectors are converted sequentially, requiring a maximum of 60 microseconds/channel for conversion and storage in random access memory. During readout the addressed 12-bit data word is placed on the Dataway without any interference with a store cycle, should one be present (asynchronous readout). In the Continuous Scan Mode each channel of the LG8252 continuously updates its memory every 2 ms (1 ms for the LG8213).

Random access readout over the CAMAC Dataway allows the flexibility of reading individual channels or subgroups of the 32 channels more frequently than others, permitting low maintenance items to be monitored compatibly with ones that demand a higher level of attention. Alternatively, a block transfer mode is incorporated which permits all channels to be read sequentially. Q = 0 is generated after the last channel is read in block transfer mode.

In the Single Scan Mode, either an input into the front-panel Scan Trigger or the CAMAC function F(25)•A(0) initializes the address to Channel 1 and starts a single scan of all channels. This mode thus permits all 32 measurements to be more clearly related in time to some external event or reference. LAM may be generated after the scan is completed.

Innovators in Instrumentation

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SPECIFICATIONS
Models LG8252 and LG8213
FAST SCAN 32 AND 16 CHANNEL DATA LOGGERS

Analog Inputs:	32(16) differential voltage-sensing inputs; direct coupled; >10 MΩ impedance; front-panel connectors mate with LeCroy model CK2232 Connector Kit (2 required for LG8252).
Input Protection:	± 300V for Transients (≤100μsec), ± 50V for dc.
Full-Scale Range:	Bipolar Mode – 5 to + 15 volts between minus and plus input (– 10 to + 10 volts jumper selectable). Unipolar Mode: 0 to + 10 volts between minus and plus input.
Common Mode Input Voltage Range:	± 13V.
Common Mode Rejection Ratio:	60 dB at 60 Hz.
Integral Non-linearity:	± 1/2 count (± 0.012% of full scale).
ADC Resolution:	12 bits (± 0.025% relative accuracy). Input source impedance of less than 50 KΩ is required for 1 bit accuracy over full range.
Accuracy:	± 2.4 mV.
Temperature Coefficient:	Accuracy, 30 PPM/degree C, linearity 20 PPM/degree C.
Conversion Time:	<60μsec per channel. Total scan time is approximately 2 msec. (1 msec for LG8213).
Operating Modes:	In the Continuous Scan Mode, continuously converted data is always available for readout.
	In the Single Scan Mode, the data acquired during a scan is available until a new scan is initiated. A scan may be initiated either by a Scan Trigger input or by an F(25)•A(0) CAMAC cycle.
Readout Time:	Readout may proceed at the fastest rate (1μsec/word) permitted by the CAMAC standard.
Data:	The proper CAMAC function and addressing scheme gates the 12 binary bits of the selected channel onto the R1 to R12 Dataway bus lines. The user may select either offset binary format or 2's complement format (sign bit is extended through R16).

CAMAC COMMANDS

Z and C: INITIALIZE and CLEAR both terminate scanning, reset and disable LAM, and enable continuous scan mode.

Q: A Q = 1 is generated in response to all valid F and A commands except for the following cases: 1) F(2)•A(0) when data is not valid (1st and 34th command for LG8252 and 1st and 18th command for LG8213); 2) F(8)•A(0) if internal LAM is not set; and 3) F(27)•A(0) if Continuous Scan mode is enabled.

L: In the single scan mode only, a Look-At-Me signal is generated after all inputs have been digitized unless previously disabled by F(11)•A(0). LAM is disabled for the duration of N and cleared by Z, C F(9)•A(0), or F(10)•A(0).

X: An X = 1 (Command Accepted) response is generated when a valid F, N, and A command is applied.

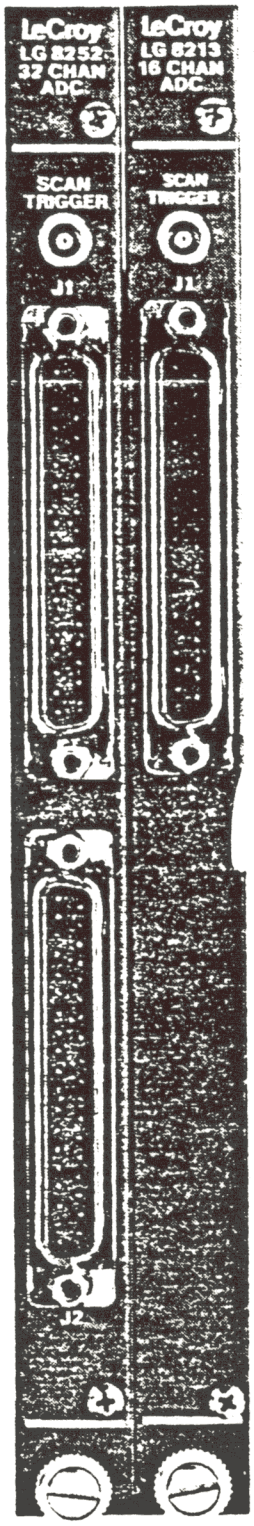
CAMAC FUNCTIONS

F(0)•A(i):	i = 0-15, read the data from input (i + 1). Requires N.
F(1)•A(i):	i = 0-15, read the data from input (i + 17). Requires N.
F(2)•A(0):	Read data in block transfer mode. First and last F(2)•A(0) commands respectively set up and terminate the mode (data transferred during these two cycles is not valid). A total of 34 (18) F(2)•A(0) commands must be issued to read all 32 (16) channels of the LG8252 (LG8213). Scanning is interrupted for the duration of the block transfer. Block transfer mode may be terminated early by use of Z, C, or F(9)•A(0).
F(8)•A(0):	Q = 1 is returned if internal LAM is set.
F(9)•A(0):	Equivalent to Z or C.
F(10)•A(0):	Reset LAM (also terminates scanning).
F(11)•A(0):	Disable LAM.
F(24)•A(0):	Disables Single Scan mode and LAM. Enables Continuous Scan mode.
F(25)•A(0):	Initiates scanning of all inputs beginning with Channel 1. Requires N and S2. Required following Z, C, F(9), or F(24) to begin continuous scan. May be used to initiate Single Scan.
F(26)•A(0):	Enables Single Scan Mode and LAM. Disables Continuous Scan Mode.
F(27)•A(0):	Test Continuous Scan Mode. Q = 1 is returned if Single Scan mode is enabled.

Scan Trigger:	Positive-going TTL-compatible pulse applied to front-panel LEMO-type connector initiates Single Scan of all inputs beginning with Channel 1. Input impedance, 510 Ω . Pulse width should be greater than 100 nsec and less than 50 μsec. Inputs during scan will re-initialize scan beginning at Channel 1. Factory option allows use of complementary TTL pulses (input resistance is 2.7 KΩ resistor pull-up to + 5V).
Mode Selection Switches:	Bipolar/Unipolar mode and offset binary/2's complement readout mode are selected by side panel switches.
Packaging:	In conformance with CAMAC standard for nuclear modules (ESONE Committee Report EUR4100 and IEEE #583). RF-shielded CAMAC #1 module.
Power Requirements:	750 mA at + 6 V 50 mA at + 24 V 50 mA at – 24 V

SPECIFICATIONS SUBJECT TO CHANGE

Scan Trigger Input: Initiates scan and digitization of all channels. Accepts a positive or negative going TTL pulse (determined by internal jumper and component selection). Pulse width, 100nSec to 50µSec.



J1 inputs: Differential signal inputs for channels 1-16. Bottom two connectors are chassis ground points.

J2 inputs: Differential signal inputs for channels 17-32 (Model LG8252 only). Bottom two connectors are chassis ground points.

2.0 Comparison of LG8213/LG8252

This manual describes the operation of LG8213 and LG8252 modules. The LG8213 is a 16 channel version of the LG8252, and the differences between the modules are summarized below:

	LG8252	LG8213
Maximum Scan Time (60 µsec/channel)	2 msec (60 µsec/channel)	1 msec
Random Access Readout F(0)A(0-15)=chan.1-16		F(0)A(0-15)=chan.1-16
Block Transfer Readout successiverequires18 successive		requires 34
	F(2) commands for 32 channel readout	F(2) commands for 16 channel readout

Some circuitry dealing with channels 17-32 is not present in the LG8213. Additionally, the position of several internal jumpers is dependent on 16 or 32 channel operation. In all other respects, the LG8252 and LG8213 are virtually identical.

3.0 CAMAC Control

Note: All commands require A(0), unless specifically stated otherwise.

- SETUP COMMANDS

F(9)	Reset module. F(9) terminates any scan in progress, reset the LAM, and enables continuous scan mode.
F(10)	Reset LAM. Also terminates any scan in progress.
F(11)	Disable LAM. This must be issued after an F(26).
F(24)	Disable Single Scan mode, disable LAM. (Continuous Scan mode enabled).
F(25)	Initiate Scan.
F(26)	Enable Single Scan mode, enable LAM. (Continuous Scan mode disabled).

- READOUT COMMANDS

F(0)•A(I)	Read data from channel I+1 (I=0,1,2,...,15)
F(1)•A(I)	Read data from channel I+17 (I=0,1,2,...,15) (LG8252 only)
F(2)	Block Transfer. First F(2) sets up DMA mode and sets readout address to channel 1. Successive F(2) commands then sequentially read all channels. Q=1 for valid data. The 34th F(2) (or 18th for the LG8213) produces a Q=0 response, and the unit returns to the mode previously enabled. (If single scan mode was enabled, another F(25) is necessary to initiate another scan).

All readout operations are non-destructive.

- MODULE STATUS TESTS

F(8)	Test LAM status. Q=1 if LAM set.
F(27)	Test continuous/single scan mode. Q=1 if single scan mode is enabled.

- CAMAC STATUS AND CONTROL SIGNALS

X	An X=1 is returned for every valid CAMAC command.
L	In single scan mode, an L=1 response is returned following a complete scan of all channels (if so enabled). The LAM is disabled in continuous scan mode.
Q	A Q=1 is returned for every valid CAMAC command, with the exception of F(2), F(8), and F(27). (See description of these commands for conditions affecting Q response).
Z, C	Reset module. Same as F(9).

OPERATIONAL DESCRIPTION

4.0 GENERAL

The LeCroy LG8252 (LG8213) is a 32 (16) channel differential input ADC. The channels are sequentially connected to the inputs of a differential amplifier by time-multiplexed CMOS analog gates. The single-ended output of the amplifier is connected through a sample and hold circuit to a 12-bit successive approximation ADC. The 12-bit word is written into an internal memory which has a capacity of one word for each of the input channels.

There are two basic modes of operation- continuous and single scan. In continuous scan mode, the channels are continuously scanned so that information in memory is always updated. In single scan mode, all channels are scanned only once; in this way, the scan may be initiated so that the data stored in memory is related in time to some external event.

A maximum of 2 msec is required to scan all 32 channels of the LG8252 (1 msec for the 16 channels in the LG8213). Each channel requires a maximum of approximately 60 µsec total conversion time, which can be broken down as follows: the input signal is sampled for 30 µsec; 2 µsec are then allowed for the sample and hold circuit to settle; the ADC then converts the analog signal into digital information, which takes a maximum of 25 µsec.

4.1 ANALOG INPUTS

The inputs to the 32 channels consist of 32 pairs of contacts located at the front panel connectors J1 and J2. Each input pair is multiplexed through dual analog switches into high impedance, unity gain differential amplifiers. The input voltage range in the unipolar mode is 0 to +10 VDC. In the bipolar mode, the range is normally $\pm$5 V, but can be changed to $\pm$10 V by means of an internal jumper. The desired mode is selected by jumpers which are accessible through the side panel.

In the unipolar mode, the leftmost connector pin should be positive with respect to its mate. Using channel 1 as an example, pin 1 should be positive with respect to pin 20. (See Table I).

Common mode input voltage range is $\pm$13 V with respect to local ground. In order to remain within a linear region, the analog signal must not exceed this limit.

The extremely high input impedance (>10 MΩ) makes it possible to connect the inputs to almost any voltage source with negligible loading effects. Because the LG8252/LG8213 has differential inputs and high common mode rejection (>60 dB), the effects of common mode voltages on the input leads can be almost completely cancelled out of the measurements. However, the high input impedance does tend to make the inputs susceptible to pick-up form stray electromagnetic fields; it is therefore recommended that steps be

taken to minimize this effect by using good grounding practices, twisted pair input lines, and shielding.

To obtain accurate measurements of the source voltage, the source output impedance should be low compared to the input impedance of the measuring instrument. The LG8252/LG8213 open gate input has an effective capacitance of 80-100 pf and the source impedance must be low enough (>50 kΩ for this capacitance to charge to the proper level in the 30 µsec tracking time allowed. A low source impedance also helps minimize the effects of analog gate capacitive feedback to the inputs and minimizes pick-up on the leads. Therefore, the source impedance should be as low as possible, and in any case less than 50 kΩ if the input-to-output variations are large and maximum resolution of the ADC is required.

Pins 19 and 37 of both J1 and J2 are grounded to the chassis. (These are the bottom input contact pair). It is highly recommended that unused inputs be tied to these ground points to eliminate undesired crosstalk effects.

When the analog input voltage is outside the limits of ±15 V (±2 V in the power off state), the input impedance of the analog gates drops. Some internal protection has been provided to prevent damage to the unit under these conditions. Series 10K ohm resistors have been inserted in each input line to protect against voltage transients of ±300 V and DC overloads of ±50 VDC (±37 VDC in the power off state). Sustained voltage outside the protection limits may damage the protection resistors and other components. Series diodes and resistors have been placed in the power supply lines to the analog switches as extra protection against damage to the switches by excessive voltage when in the power off state.

4.2 SCAN TRIGGER INPUT

A scan may be initiated by applying a pulse to the front panel LEMO connector instead of issuing an F(25) command. Although the scan trigger may be used in either continuous or single scan mode, its intended use is to correlate data with a timed external event (single scan mode). Normally, the LG8252/LG8213 is jumpered so that the input pulse should be a TTL positive-going pulse; input impedance is 510 Ω. If so desired, the circuitry can be easily be altered to accomodate a negative-going TTL pulse (refer to jumper options); input impedance in this case would be 2.7 kΩ. Assuming the usual positive-pulse configuration, the scan is started upon receipt of a positive-going edge. However, if the level were to remain positive (greater than 0.8 V), the multiplexer address counters would continually be reset; normal scanning would not occur until the input pulse dropped to a TTL low level. Therefore, the pulse width should be no greater than 50 µsec; minimum width should be no less than 100 nsec.

4.3 CONTINUOUS SCAN MODE

Upon receipt of a module reset command (Z, C, or F9), the LG8252/LG8213 is placed in continuous scan mode. Also, an F(24) will enable continuous scan mode if previously disabled. A subsequent F(25) or scan trigger will initiate scanning. The LAM is always disabled in continuous scan mode.

Approximately every 60 μsec the analog switch network switches from one channel to the next. After switching, 30 μsec are allowed for the voltage at the sample and hold input to settle. At this time, a hold command is issued. After a 2 μsec delay ("hold" settling time), a convert command is issued. The ADC requires a maximum of 25 μsec to digitize the data, after which the digital information is stored in memory. The next channel is then addressed. This process is continuous and automatic, and will continue until an F(2) block transfer read out command is issued, or an F(9), A, or C is issued to terminate scanning. NOTE: If an F(9) precedes a series of F(2) commands, the address counter will not be reset. The presence of a Q=1 after Q=0 wil indicate the start of valid data beginning with channel 1.

4.4 SINGLE SCAN MODE

Issuing an F(26) command will enable single scan mode. At the same time, the LAM function is enabled; a subsequent F(11) command will disable the LAM. The scan may be initiated either with an F(25), or a front panel scan trigger. All 32 channels will be scanned only once, with L=1 at the conclusion of the scan (if so enabled). The data in memory remains fixed until another F(25) or scan trigger is issued, at which time another single scan will be started.

4.5 DATA READOUT

Data may be read at any time via read line R1-R12. (In 2's complement mode, R13-R16 are also used - refer to Section 4.6). Readout is non-destructive.

4.5.1 RANDOM ACCESS

The data for any channel may be read by issuing an F(0) or F(1) command accompanied by A(0-15). F(0)•A(0-15) selects channels 1-16, while F(1)•A(0-15) selects channels 17-32. (The LG8213 will recognize only F(0) as a valid random access readout command). Readout can take place during scanning as internal circuitry insures that read and write never overlap. Thus, CAMAC readout takes place with no noticeable interruption of the scanning cycle. NOTE: The F(0) and F(1) readout commands should only be issued following the completion of a single scan, or during a continuous scan. An F(9) or F(10) command issued prior to an F(0) or F(1) will inhibit proper memory addressing operations.

4.5.2 BLOCK TRANSFER

Data can be read out of memory as a block of 32 words without CAMAC addressing by issuing 34 successive F(2) commands. The first command reset the address counters, inhibits scanning, and enables a Q=1 response for the next 32 F(2) commands which read the data from memory in numerical sequence. The 34th F(2) command is indicated with a Q=0 response; the module will return to the scanning mode previously enabled. In single scan mode, a F(25) or scan trigger is required to initiate another scan.

4.6 JUMPER OPTIONS

Binary/2's Complement-
The data that appears on read lines R1-R16 may be formatted as either binary or 2's complement information. The selection is made by means of 2 jumpers which are accessible through the side panel.

With the jumpers in the binary position, data will be presented on read lines R1-R12 as either straight binary (unipolar mode), or offset binary (bipolar mode). In the unipolar mode, 0 V will be coded as all 0's, and +10 V (full scale) will be coded as all 1's. In bipolar mode (assuming a $\pm$5 V range), -5 V will coded as all 0's, while +5 V will be coded as all 1's. Read lines R13-R16 will always equal 0.

With the jumpers in the 2's complement position, the data will appear as straight binary in the unipolar mode. However, in the bipolar mode, the data will appear in effect as offset binary with the MSB inverted, with read lines R13-R16 following the MSB (R12). Thus, the code for -5 V would be 1111 1000 0000 0000, and the code for +5 V would be 0000 0111 1111 1111. Refer to Table II for a summary.

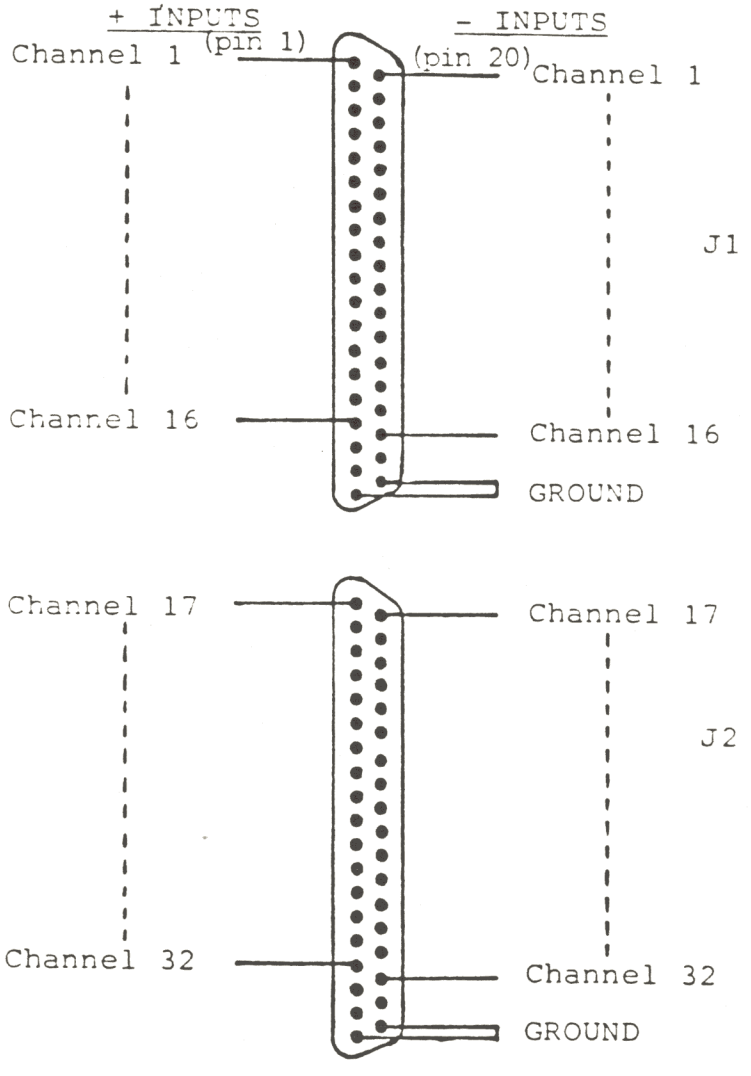
$\pm$5 V/$\pm$10 V Bipolar Range or 0 V to +10 V Unipolar range. See side panel for jumper configurations.

Positive edge/Negative edge scan trigger -

For positive edge trigger: connect jumper from point E16 to E17 (located near I.C. 8F). Install a 510 Ω resistor at location R80. Point E15 and location R121 should be left open.

For negative edge trigger: connect a jumper from point E16 to E15. Install a 2.7 kΩ resistor at location R121. Point E17 and location R80 should be left open. See figure XX.

TABLE I: Input connector pin assignments



NOTE: J2 is included on the LG8252 only.

TABLE II: Output Code Summary

NOTE: ±5 V Bipolar range is assumed.

DATA FORMAT: BINARY

Unipolar Mode	Bipolar Mode	Output Code			
0.0000 V	-5.0000 V	0000	0000	0000	0000
0.0024	-4.9976	0000	0000	0000	0001
1.2500	-3.7500	0000	0010	0000	0000
2.5000	-2.5000	0000	0100	0000	0000
5.0000	0.0000	0000	1000	0000	0000
7.5000	2.5000	0000	1100	0000	0000
8.7500	3.7500	0000	1110	0000	0000
9.9976	4.9976	0000	1111	1111	1111

DATA FORMAT: TWO'S COMPLEMENT

Unipolar Mode	Output Code			
0.0000 V	0000	0000	0000	0000
0.0024	0000	0000	0000	0001
1.2500	0000	0010	0000	0000
2.5000	0000	0100	0000	0000
5.0000	0000	1000	0000	0000
7.5000	0000	1100	0000	0000
8.7500	0000	1110	0000	0000
9.9976	0000	1111	1111	1111

Bipolar Mode	Output Code			
-5.0000 V	1111	1000	0000	0000
-4.9976	1111	1000	0000	0001
-3.7500	1111	1010	0000	0000
-2.5000	1111	1100	0000	0000
0.0000	0000	0000	0000	0000
2.5000	0000	0100	0000	0000
3.7500	0000	0110	0000	0000
4.9976	0000	0111	1111	1111