MODEL 5333B

SCANNING ADC

OPERATIONS MANUAL

BI RA SYSTEMS, INC.
2404 COMANCHE NE
ALBUQUERQUE, NEW MEXICO 87107
USA

PHONE NUMBER (505) 881-8887 FAX NUMBER (505) 888-0651

NOV 1991

TABLE OF CONTENTS

FIGURES AND TABLES

MODEL 5333B

SCANNING ADC OPERATING PROCEDURES

1.0 GENERAL

It is assumed that the module is in calibration for the ADC full-scale range selected for use. Altering the range requires verification of gain and offset of the ADC. See **CALIBRATION PROCEDURE** for adjustment.

Prior to use, analog input cables to the front panel J1, J2 connectors must be fabricated. Connector pin numbers and corresponding channel assignments are given in the text.

Socket mounted 1M ohm balanced termination resistors are factory installed and supplied with the module. The resistors are located at U38, R31, U49, R30, U3, R12, U15 and R13. The components may be removed or altered in value at the discretion of the user to increase or decrease the analog input impedance. It is noted that the analog inputs to the 5333B cannot be totally isolated; a return path must be provided for amplifier bias current. In general the larger the balanced return resistor, the greater the common mode voltage to the amplifier. Unused scanned inputs shall be short to GND.

The front panel RA00.250 TRIG connector may be used as an external clock input by enabling the SINGLE SCAN mode. Wire-wrap **TRIG SEL** posts allow clocking at a high-going (H) or low-going (L) edge.

All switches and strap terminals are clearly identified and are accessible from the component side of the PC board. The panel may be removed for access.

2.0 SWITCH, STRAP AND POTENTIOMETER FUNCTION

The following Paragraphs 2.0 through 6.0 describe the use of the components. Refer to the component layout drawing **FIGURE 2.0A** for component location and referenced **5333-D-004** schematic drawing.

2.1 SWITCHES

There are six individual switches.

2.1.1 ADC RANGE SELECT

(5333B Input Voltage Range) SW1, SW2, SW3 select the full-scale range of the module via U11 ADC85CZ-12. Each switch has 2 positions C1 and C2. **TABLE 2.1.2** lists the possible settings of the switches and the corresponding input voltage range. The resulting status bits read by the F3 A0 command are also shown. The module is shipped from the factory with the -/+10V range selected and calibrated unless otherwise specified at the time of purchase.

TABLE 2.1.1 ADC RANGE SELECT WITH CORRESPONDING STATUS BIT DATA

INPUT VOLTAGE RANGE	SWITCH POSITION			F3A0 STATUS			
	SW3	SW2	SW1	R7	R6	R5	R4
+/-10	C1	C1	C1	1	1	1	1
+/-5	C2	C1	C1	0	1	1	1
+/-2.5	C2	C1	C2	0	1	0	1
0 TO +10	C2	C2	C1	0	0	1	1
0 TO +5	C2	C2	C2	0	0	0	1
ERROR	C1	C2	X	1	0	X	0
	C1	X	C2	1	X	0	0

X = DON'T CARE

2.1.2 CHANNEL LENGTH SELECT

There are 32 channels beginning with 0 and ending with 31. Channel length is determined by the setting of individual switches 1 through 5 of SW4. Each switch carries a binary weight as shown in **Table 2.1.2.** Channels are sequentially scanned from address 0 through 31. Any number of sequential channels from 1 through 32 may be selected to be active. **The module is shipped from the factory with SW4 set for 32 active channels unless specified differently at the time of purchase.**

The switches are set to the **LAST CHANNEL NUMBER** to be scanned.

2.1.3 CHANNEL RATE SELECT (continued)

Wire-wrap posts are numbered in the same fashion as an IC DIP. An open = 0 and a short = 1.

For example to change the rate of scan per channel to 40us (25KHz) individual SW5 switches=100001. Switch 1 closed (short), switches 2, 3, 4 & 5 open, and switch 6 closed (short). In lieu of the switch, short posts 1 to 12 and 6 to 7; all other posts 2 to 11, 3 to 10, 4 to 9, 5 to 8 are open.

TABLE 2.1.3 CHANNEL SCAN RATE FREQUENCY SELECT

SW INDIVIDUAL SWITCH SETTING			4	0	0	0	0	1	1	1	1
			5	0	0	1	1	0	0	1	1
1	2	3	6	0	1	0	1	0	1	0	1
0	0	0		1M	100K	10K	1K	100	10	1	1/10
0	0	1		100K	10K	1K	100	10	1	1/10	1/100
0	1	0		500K	50K	5K	500	50	5	1/2	1/20
0	1	1		333.3K	33.3K	3.3K	333.3	33.3	3.33	1/3	1/30
1	0	0		250K	25K	2.5K	250	25	2.5	1/4	1/40
1	0	1		200K	20K	2K	200	20	2	1/5	1/50
1	1	0		166.6K	16.6K	1.6K	166.6	16.6	1.6	1/6	1/60
1	1	1		83.3K	8.3K	883.3	83.3	8.3	0.83	1/12	1/120

WARNING: Frequency shall not exceed 100KHz. 0 = open; 1 = short

2.1.4 SCAN REPETITION RATE

Scan repetition rate is the rate at which all active channels are scanned. The maximum rate to assure that each cycle initiates a new scan is determined by the Channel Rate of Scan (See PARA. 2.1.3) and the number of active channels.

For a factory shipped module strapped for a Channel Scan Rate of 10us, the maximum rate to assure each cycle starts a new scan is stated by Formula 2.1.4.

FORMULA 2.1.4

Max Scan Rep Rate = [10 exp (-6) SEC. x No. Act. Chan.] [exp (-1)]

2.2 STRAP SELECTS

There are eleven strap terminals grouped in three sets of three and one set of two. Units are strapped for 2's complement, -/+10V input range, Positive Edge Triggered, Inhibit Sign Extension, and Enabled Read Channel Address, when shipped from the factory unless specified at the time of purchase. Their locations are shown in **Figure 2.0** Component Layout and are described as follows:

2.2.1 CHANNEL ADDRESS READ SELECT

Strap points E1, E2, and G3 are located between U8 and U9. The function of the straps is to either enable or disable the Channel Address data R21 (MSB) through R17 (LSB) associated with the converted ADC data for an (F0 + F1) An or F2 A0 read command. **Table 2.2.1** indicates the strapping.

TABLE 2.2.1 CHANNEL ADDRESS DATA ENABLE/DISABLE STRAPPING

STRAP	OPEN	READ CHANNEL ADD. R17 - R20
E1 TO E2	G3	ENABLE
E1 TO G3	E2	DISABLE

2.2.2 ADC MSB AND SIGN EXTENSION SELECT

The MSB or its complement may be strapped for 2's complement or binary data representation. Data is presented to the dataway as shown in **Table 2.2.2** for the corresponding strapping of the MSB. E3 is DB12 (data bit 12) routed to the dataway. DB12 = 1 is automatically extended to 16 bits [R14, R14, R15, R16 = 1 when R12 = 1]. To inhibit the extension, short the wire-wrap posts E6 to E7.

2.3 POTENTIOMETER

There are six pots R1, R28, R5, R6, R9 and R10. All pots are related to analog voltage adjustments.

2.3.1 POWER ADJUST

±22V - R1 and R28 are adjustments for the negative and positive voltage applied to the multiplexers (U13, U27, U39, U58) and the input stage of the gain-of-one instrumentation amplifier U12. The voltage at U1 Negative Regulator output is set to -21.9V ± .1V, and U2 Positive Regulator output is set +21.9V ± .1V. The voltage magnitude shall **NEVER** exceed 22.OVDC.

The 22V levels allow a large common mode range input of greater than ±17.5V peak to peak; typical is ±20V.

2.3.2 ANALOG TO DIGITAL CONVERTER

R5, R6 adjust the OFFSET and GAIN of the ADC. ADC gain is factory set and should need no adjustment. The offset may require adjustment anytime the RANGE of the ADC is changed. See CALIBRATION PROCEDURE.

2.3.3 INSTRUMENTATION AMPLIFIER

The gain of the amplifier is determined by U17 5.0K resistor pack. The resistors are matched to within .01% and track within 2-3ppm.

R10 is factory set and adjusts the OFFSET of the output stage. R10 will rarely require adjustment.

3.0 INDICATORS

Two front panel LEDs are provided.

3.1 N LED

The indicator is controlled by a retriggerable Single Shot U43. The indicator flashes each time the module is addressed. Typical ON time is 100ms and will remain lighted if this rate is exceeded.

4.0 COMMANDS (continued)

FUNCTION CODES

COMMANDS	ACTION
F8 A0	Test LAM. LAM is active in Single Scan Mode only. LAM is set at completion of scan of active channels. Q is returned if LAM is set and enabled.
F9 A0	Terminates scan, resets LAM, and enables Continuous Mode.
F10 A0	Resets LAM in Single Scan Mode and terminated scanning in all modes.
F11 A0	Disables LAM. Q if in Single Scan Mode.
F24 A0	Disables Single Scan Mode and LAM. Enables Continuous Mode.
F25 A0	Initiates scanning of active channels beginning with Channel 0. Required after F9 A0, F24 A0, or (Z + C) to begin Continuous Scan. May be used to initiate a Single Scan. Command clears LAM in Single Scan Mode.
F26 A0	Enables Single Scan Mode. Disables Continuous Mode.
F27 A0	Test Continuous Scan Mode. Q if true. (Z + C) S2. Same as F9 A0

5.0 FRONT PANEL CONNECTORS

5.1 ANALOG INPUTS

Connectors are J1 upper and J2. Dependent of option they may be DD50P or DD37S. Pin assignments are shown in **Table 5.1.**

6.0 ANALOG INPUT SPECIFICATIONS

6.1 INPUT RANGE

The range is selected by SW1, SW2, and SW3, near the ADC. Ranges are BIPOLAR 5, 10, 2.5V and UNIPOLAR 0 to 5, 0 to 10V. See **PARA. 2.1.1.** for switch settings.

6.2 COMMON MODE VOLTAGE RANGE

Common mode plus signal range is to at least $\pm$17.5V. The input circuits including the multiplexer and input stage of the instrumentation amplifier have power supply voltage levels of $\pm$22V to assure a high common mode input level. Typically the level may be within 2V of either rail.

CMRR at DC is typically 80dB and at 120Hz 65dB.

6.3 INPUT RESISTANCE

The input resistance is determined primarily by the value of the socketed terminating resistors at U49, R30 and U38, R31 which provide a return path for amplifier bias current in event the signal source is floating. U49, R30 and U38, R31 are terminations for respective channel groups 0-7 and 8-15. The module is shipped from the factory with 1.0M ohm resistors which provide a balance return of 2.0M ohm. These terminations are not required if the signal source supplies an amplifier bias current return path. Care must be taken to prevent excessive return impedance so that Common Mode pickup is not excessive. The value selected for U49, R30, U38, R31 resistors is dependent of the signal source impedance. The termination should be as small as possible to reduce common mode pickup.

The terminating resistors employ 4 each standard 0.5W resistors R12, R13, R30, R31 and 4 each standard DIP pull up resistor packages.

Sixteen pin headers may also be constructed for special applications such as mixed termination values or filter capacitors. Remember that an amplifier bias return path is always required.

6.7 ANALOG TO DIGITAL CONVERTER (continued)

OFFSET and GAIN adjustments are provided. Anytime the ADC range is altered, the calibration must be verified by inputting known levels of highly accurate, stable analog input and adjusting the ADC as required to produce the correct output. See CALIBRATION PROCEDURE **PARA. 8.0.**

7.0 OPERATING MODES

The Model 5333B has two operating modes:

(1) Continuous

(2) Single Scan

The basic difference of the two modes is that SINGLE SCAN utilizes CAMAC LAM as an indication that a scan of all active channels has been completed. SINGLE SCAN is usually employed when the user requires the active channels to be scanned in response to an EXT TRIG (SCAN TRIG) or a computer controlled command (F25 A0) when in the SINGLE SCAN MODE. In Single Scan the internal Scan Rep. Rate Clock is disabled. Independent of the mode, the internal CHAN SCAN RATE CLOCK is operable, and the last converted data may be read from memory. Dataway R22 is provided to monitor operation of the module. The signal is derived from U42 Single Shot which is triggered for 0.75 seconds after the active channels are scanned. If triggered faster than 0.75 seconds, the Single Shot remains triggered and R22 = 1 for data read commands.

7.1 CONTINUOUS

The CONTINUOUS MODE is selected after the module is cleared. An F25 A0 will initiate the scan of all active channels. The rate of scan is determined by the U55 SCAN REP. RATE CLOCK selected by SW6. Each channel is scanned at the selected rate of the U54 CHAN SCAN RATE CLOCK. Channel Scan Rate is factory strapped (see **PARA 2.1.3**) for 100KHz (10us period).

8.2 PRELIMINARY

A. Remove component side cover from the 5333B for access to strap points and switches.

B. Enable Read Chan Address. Strap terminals E1 to E2 to allow Channel number data for Read commands on R21 (MSB) through R17 (LSB).

C. Set ADC range to that required using **TABLE 2.1.1** and **PARA 2.1.1** Strap MSB according to **TABLE 2.2.2.**

D. Set active number of Channels to ONE (SW4 individual switches 1 through 5 closed) as specified in **TABLE 2.1.2** and **PARA 2.1.4.**

E. Set Channel SCAN REP. RATE to 2.5 KHz (SW6 individual switches 2, 3, 4, 6, open 1, 5 CLOSED) using **TABLE 2.1.4.**

F. Turn CAMAC crate POWER OFF if ON.

G. Install 5333B mounted in Model 8201-1 extender into crate and turn crate POWER ON.

H. Set Model AN 3100 Calibrator output voltage to 0.0000V. Connect the calibrator ANALOG (+) and (-) OUTPUT to Model 5333B CHAN 0 input in accordance with **TABLE 5.1** dependent of the input connector. Connect the calibrator balanced return to CAMAC ground.

I. Allow 15 minutes for equipment stabilization.

8.3 ADJUST ±22.0VDC

This voltage is factory set and should rarely require adjustment. Verify and adjust if needed U1, and U2 voltage across C18 and C19 (NEG 22V and POS 22V).

WARNING: DO NOT EXCEED 22V OR DAMAGE TO ASSOCIATED CIRCUITS MAY RESULT.

Adjust R1 NEG and R28 POS voltage adjust to within the specified tolerance.

Negative Voltage should be adjusted to -21.9V ±.1V.

Positive Voltage should be adjusted to +21.9V ±.1V.

8.4 SET AMPLIFIER OFFSET/VERIFY GAIN

A. Issue CAMAC Z + C to reset all circuits. (F9 A0)

8.6 SET ADC OFFSET AND GAIN (continued)

F. Set calibrator for 0.0000VDC and repeat steps D and E until proper readings are attained.

G. If UNIPOLAR, calibration is complete. If BIPOLAR, set calibrator to -FA +2LSB and verify correct data.

H. Repeat steps C through G so that all data is correct for channel 0.

I. Set calibrator to 0.0000V and remove from the 5333B. Turn CAMAC crate power OFF.

J. Break down the test set up.

K. Set the number of active channels using SW4 and **TABLE 2.1.2.**

L. Replace Model 5333B side cover. Unit is ready to be placed in operation.

9.0 OPERATING MODES

9.1 PRELIMINARY

Verifying all strapping, number of active channels, ADC full scale range, etc. Install unit into CAMAC System and connect user supplied ANALOG and TRIG IN cables as required for operation. See **PARA. 4.0 COMMANDS** for definition.

9.2 CONTINUOUS MODE

A. Issue Z + C to clear the module.

B. F25 A0 to initiate scanning of active channels. Front panel CONT LED lights and remains lighted. Active channels are scanned at the internal SCAN REP RATE selected by SW6 or at the completion of the last channel scan. Channel data is stored in RAM.

C. F27 A0 may be used to test CONT MODE. Q if true.

D. (F0 + F1) An or F2 A0 BLOCK READ may be used to retrieve the data. Data format is dependent of strapping. Note that R22 indicates channels have been read and scanned within approximately 0.75 seconds of the occurrence. When the SCAN REP RATE is less than 0.75 seconds and data is read after that time, R22 = 0 to indicate time-out. F2 A0 may be used to transfer data of all ACTIVE channels. F2 A0 BLOCK TRANSFER halts the CONTINUOUS MODE during readout of data. DATA OF ALL ACTIVE CHANNELS MUST BE READ TO COMPLETE THE BLOCK TRANSFER CYCLE. See **PARA 4.0 COMMANDS.**