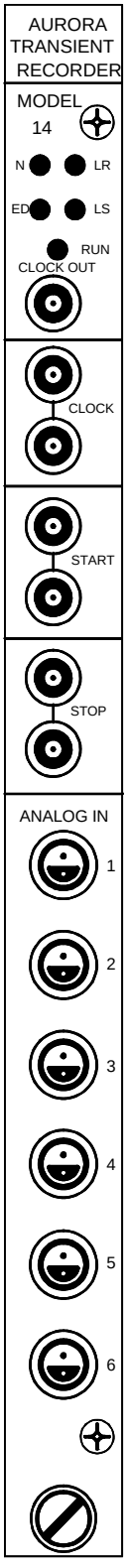
JORWAY

# MODEL AURORA 14

## 1 MHz, 12 BIT TRANSIENT RECORDER
*includes FASTCAMAC Level 1 Operation*

- INDEPENDENT ADC PER CHANNEL
- SIX CHANNELS PER MODULE
- 128K WORDS OF MEMORY PER CHANNEL , 512K ,1MEG OPTIONAL
- SINGLE WIDTH CAMAC MODULE
- MULTIPLE MODES INCLUDING BURST AND PRE/POST TRIGGERING
- DIGITIZING RATE - 1 MHz DOWN TO DC ( SINGLE PULSE MODE )
- FASTCAMAC READS - DATA TRANSFERS OF 7.5 MEGABYTES/SEC




The Aurora 14 Transient Recorder is fully self contained analog waveform digitizer capable of simultaneous sampling of data on six separate channels all at rates up to 1 MHz. Housed in a single width CAMAC module, each channel contains a separate differential amplifier, sample/hold, 12 bit Analog to Digital Converter, and up to 1024K word memory. With a separate A to D converter per channel, no analog multiplexer is required, resulting in excellent reduction of crosstalk between channels. Overloading of one channel has a negligible effect on other channels.

The self contained nature of the Aurora 14 make it a fine independent building block for large multichannel transient recorder systems. Systems can be easily expanded or rearranged at a minimum expense. Servicing of large systems is also improved by the independent nature of this self contained transient recorder.

CAMAC commands for the Aurora 14 have been selected so the module can be operated as software compatible with the Aurora 12 100 KHz Transient Recorder. In addition the Aurora 14 contains a variety of modes including pretrigger/post-trigger, multiple cycles and burst which greatly enhance the versatility of the module. Provision has been made for a clock output which can be used to operate other Aurora 14 recorders as slaves so multiple modules track a master recorder.

The Aurora 14 is provided with a variety of front panel controls and CAMAC commands to control its operation. Signals to be digitized are applied to front panel 2 pin LEMO connectors. Strap selections provide range selections for 0 to +2.5, to +5 ,to +10,+/-2.5 ,+/- 5 or +/-10 volts. The basic digitizing rate can selected by CAMAC command to further divide the internal 1 MHz crystal oscillator or external clock. External clock rates cover the range of 1 MHz down to DC (single pulse) providing great versatility of operation. Digitizing (termed START) can be initiated by either a CAMAC command or by a front panel start input. Once started, analog data will be captured simultaneously by the sample and hold at each channel, digitized by the ADCs and stored in memory. Recording will proceed in a manner based on the digitizing mode selected by a CAMAC write into the module Status Register. Recording will generally continue until stopped (termed STOP) by a front panel stop input, a CAMAC stop command, memory full (termed OVERFLOW) or post-trigger counter (termed PTS).

The feature of FASTCAMAC operation has been added to the Aurora 14. The module responds to the FASTCAMAC F5 command providing Level 1 reads with data transfers every 400 nanoseconds. Transfer rates for long blocks at 7.5 megabytes per second can be achieved in the 24 bit format.

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DIGITIZING MODES. (Modes are selected by writing bits 9-11 in the Status Register. The memory address should be set to zero and the digitizing mode selected before recording commences)

Mode 0: Pre/Post Trigger and Aurora 12 Mode.

This mode starts digitizing on START and will digitize until OVERFLOW or STOP occurs if the PTS counter is set to zero. With the PTS counter at zero this mode is identical to the Aurora 12. If the PTS counter is set to a non zero value, digitizing will continue for the duration of the PTS value or until OVERFLOW if it occurs sooner.

Mode 1: Cyclic Buffer

A START will initiate digitizing. Digitizing will continue without stopping at OVERFLOW until a STOP is received. At STOP, digitize will continue for the duration of the PTS counter for non zero values. When overall recording is finished, the memory address counter can be read to determine where to align the address with the data recorded.

Mode 2: Multiple START-STOP

This mode allows multiple START-STOP digitizing sequences to be applied to the Aurora 14. After each STOP, digitizing will continue for the duration of the non zero PTS counter value. Unlike the Cyclic Buffer mode all digitizing will stop when OVERFLOW occurs. If the duration of the START-STOP period is not constant, it may be helpful to record a timing gate on one analog channel to frame the multiple sequences stored in memory.

Mode 3: Burst Mode ,Multiple START's

Upon receipt of a START, digitizing will commence and last for the duration of the PTS counter. Each successive START received will duplicate recording for the same PTS duration. Digitizing will terminate at STOP or OVERFLOW.

Mode 4: Master/Slave Mode

In this mode, one Aurora 14 is selected as a master in a mode from 0 to 3. Additional Aurora 14's are selected for Mode 4 (Slave operation). The clock output of the master is connected to the clock input of the slave modules. When the master is commanded to digitize, the same internal strobe which triggers the Hold-ADC Convert-Store process is delivered as a clock to the Slave modules to duplicate this process.

Alternatively, a module in Mode 4 will accept an external gated clock to trigger the digitize process. For example Transient Recorder Clock modules can be used to provide change in clock frequency during digitizing. Care must be exercised in control of the clock as the modules clock synchronizing circuits have been disabled. Start and Stop inputs on the Slave modules should be left open.

## SPECIFICATIONS

ANALOG INPUTS

| | |
|---|---|
| Differential: | 2 Pin LEMO (Type RAO302) |
| Input Range: | ±5V (factory set)or ±2.5V,±10V |
| | 0 to 2.5,5V,10V; plug selectable |
| Input Impedance: | 100K Ohm |
| Analog Bandwidth: | 750 KHz |
| CMRR, Common Mode Rejection Ratio: | 70 dB |
| Crosstalk: | 60 dB |

ADC

| | |
|---|---|
| Resolution: | 12 Bits-No Missing Codes |
| Accuracy: | 0.1% of full scale |
| Aperture Delay: | 15 nsec |
| Aperture Jitter: | 40 psec. |
| Sampling Rate: | DC(Single Pulse) to 1 MHz |

POWER

+6V, 1240ma; -6V, 325ma
+24V, 100ma; +24V, 75ma

MEMORY

128K x 12 bit per channel
512K Optional (Option 1),1024K (Option 2)

FRONT PANEL 1 pin LEMO CONNECTORS

INPUTS Start, Stop, Clock In -- LEMO Type RA0250
Input Impedance: 2 bridged inputs for daisy chaining
10K Impedance
Logic Levels: TTL, positive transition is active edge.

OUTPUT Clock Out : TTL levels.

FRONT PANEL INDICATORS

N Light: On for approx. 30ms or duration of dataway N.
RUN Light: On during digitizing (digitize mode is selected and a start has been received)
ED Light: On when module LAM is enabled.
LS Light: On when module LAM source is set.
LR Light: LAM Request, On when dataway L is set (LAM source is set and LAM is enabled)

DATA FORMAT

Waveform Data: 12 bits per word offset binary.
12 Bit Format, R1 LSB or
24 Bit Format, with bits R1-R12 for channel 1,3,5 and bits R13-24 for channels 2, 4, 6.

Module ID: 19 bit word, Bits -
1 thru 8, decimal 14(Model #)
9 thru 19, Option & Rev #'s

POST TRIGGER SAMPLE REGISTER (PTS): 8 Bit Register used to select the number of 1K samples for post trigger operation. In Mode 3 value in register selects number of 1K samples which will be made following a START signal. When 512K or 1024K memory is used samples are in 2K increments.

ADDRESS COUNTER: 20 bit Counter which addresses module memory. MSB 18 and 19 are used only with 512K memory. MSB 20 is used for 1024K memory

STATUS AURORA 12 FORMAT, 8 bit word: F(0)A(0)

| Bits | Function | Value | Selection |
|---|---|---|---|
| 1-6 | Analog Range (fixed at 1) | 1 | Analog Range of +/- 5 V |
| 7 | Fixed Bit | 1 | |
| 8 | Int./Ext. Clock | 0 | Ext. Clock |
| | | 1 | Int. Clock |

STATUS AURORA 14 FORMAT, 19 bit word:
Read @ F(1)A(4)
Write @F(17)A(4) to Bits 1-4, 9-15

| Bits | Function | Value | Selection |
|---|---|---|---|
| 1-3 | Clock Speed | 0 | 1 MHz |
| | | 1 | 500 KHz |
| | | 2 | 250 KHz |
| | | 3 | 100 KHz |
| | | 4 | 50 KHz |
| | | 5 | 25 KHz |
| | | 6 | 10 KHz |
| 4 | Int./Ext. Clock | 0/1 | Ext./Int. |
| 5-7 | Channel select for Read | 0 | Channel 1 |
| | | 1 | 2 |
| | | 2 | 3 |
| | | 3 | 4 |
| | | 4 | 5 |
| | | 5 | 6 |
| 8 | 12/24 Bit Format | 0/1 | 12/24 Bit Format |
| 9-11 | Mode | 0 | Aurora 12, PTS |
| | | 1 | Cyclic Buffer |
| | | 2 | Multiple Start-Stop |
| | | 3 | Burst |
| | | 4 | Master/Slave |
| 12 | Clock Output Control | 0 | Continuos |
| | | 1 | Gated (Mode 4) |
| 13 | In Polarity - Stop | 0-pos. 1-neg. | |
| 14 | In Polarity - Start | 0-pos. 1-neg. | |
| 15 | In Polarity - Clock | 0-pos. 1-neg. | |
| 16 | Memory Size | 0 | 128 K |
| | | 1 | 512 K or 1024 K |

RUN STATUS REGISTER, [3 Bit Word : Read F(1)A(0)]

| | | |
|---|---|---|
| 1 | Run | 1 Digitizing in progress |
| 2 | Address overflow | 1 Overflow has occurred |
| 3 | Mode CMD (Command) or DAQ (Acquisition) | 0 CMD or Read Mode<br>1 DAQ Digitizing enabled. |

AURORA 14 ADC RANGE, [18 Bit Word: Read F(1)A(5)]

| | CH1 | CH2 | CH3 | CH4 | CH5 | CH6 | Range |
|---|---|---|---|---|---|---|---|
| Bit | 1 | 4 | 7 | 10 | 13 | 16 | 1=5V,0=2.5V |
| Bit | 2 | 5 | 8 | 11 | 14 | 17 | 1=Range x2, 0= x1 |
| Bit | 3 | 6 | 9 | 12 | 15 | 18 | 1=Bipolar,0=Unipolar |

CAMAC COMMANDS

(# indicates commands which can not be performed in (DAQ) Data Acquisition Mode)

(* indicates compatible Aurora 12 commands, Commands F(0)A(0), F(9)A(0), F(17)A(0+1) not recommended for Aurora 14 software as they are duplicated and expanded by other commands.)

#*F(0)A(0): Read Aurora 12 format status word.

F(1)A(0): Read Run Status Word.

# F(1)A(2): Read Memory Address Register.

# F(1)A(3): Read PTS,( Post Trigger Sample) Reg.

# F(1)A(4): Read Status Reg.(Aurora 14 Format).

F(1)A(5): Read ADC Range Register.

#*F(2)A(0): Read Waveform data of selected channel and increment RAM address if in Command Mode.

# F(5)A(0): FASTCAMAC Read, same as F(2)A(0) except data is applied to dataway and RAM address incremented for each S1

#*F(6)A(0): Read module ID.

*F(8)A(0): Test LAM; Q=1 if request present.

*F(9)A(0): Aurora 12 Reset. Clear ADC, all registers, over flow and LAM flag. Sets PTS value at zero,clock at internal and 1 MHz. Selects channel for read at zero and 12 bit format. Enables (DAQ) mode for digitizing..

F(9)A(1): Master Reset. Same as F(9)A(0) except module is set for CMD mode.

F(9)A(2): Selective Reset. Clear ADC, clear memory address register, LAM and overflow flag. Maintains PTS value and enables module for digitize (DAQ Mode). Other Status Register bits are not affected.

# F(9)A(3): Clear Memory Address Register.

*F(10)A(0): Clear LAM source FF.

#*F(16)A(0-5): Write sub address of channel to be read out, clear LAM, A(0)=Ch.1, A(1)=Ch.2 etc. Effective only in read mode. Data = any value.

# F(16)A(6): Write channel to be read on write lines W1 - W3, and 12/24 Bit data format on W4 (1 = 24 Bit select)

#*F(17)A(0): Select Int. Clock, Data = any value.

#*F(17)A(1): Select Ext. Clock, Data = any value.

# F(17)A(2): Write Memory Address Register.

# F(17)A(3): Write PTS Register.

# F(17)A(4): Write Status Register Bits 1-4, and Bits 9-15 (Aurora 14 Format).

# F(20)A(0): Write data into RAM for test, 24 bit format, autoincrement address.

*F(24)A(0): Clear ED FF to disable LAM mask.

*F(24)A(1): Select (CMD) Command (Read) Mode.

*F(25)A(0): Start digitizing.

*F(25)A(1): Stop digitizing.

*F(26)A(0): Set ED FF to enable LAM mask.

*F(26)A(1): Select (DAQ) Mode for digitize.

*F(27)A(0): Test LAM source FF; Q=1 if set.

*(Z) S2: Clear all registers and flags in a manner identical to F(9)A(1). Disables LAM Mask and clears LAM.

X: Generated for all above commands.

Q: For F(8) and F(27), Q response depends on LAM. In Command Mode all other commands respond with Q = 1 except for F(2) where Q=0 will occur on the last F(2 ) read+1 (signifying last word in memory encountered on previous read). However in mode 1 and F(2), Q=1 will occur for all addresses enabling reads to wrap around to zero at the maximum address. In DAQ Mode, commands marked with # can not be executed and will respond with Q =0. All other commands will be executed and will respond with Q = 1.

PACKAGE SIZE CAMAC-Single Width Module.