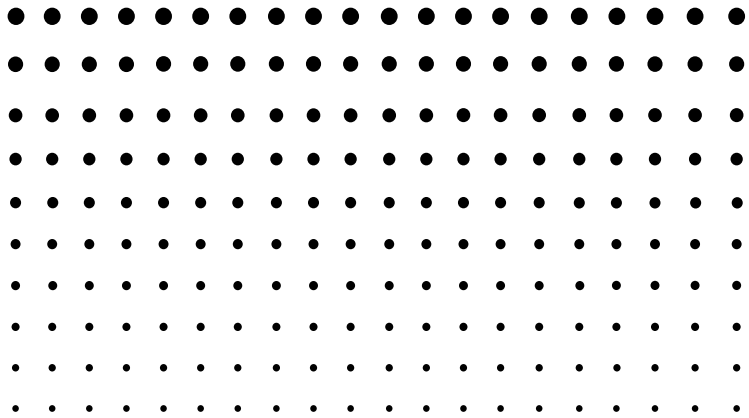


# EA-200

## Technical Reference



<http://world.casio.com/edu/>

### Contents

- Sampling ..... 2
- Analog Sampling ..... 3
- Memory ..... 3
- Pulse Sampling ..... 4
  
- Command Tables ..... 5
- Command 1: Channel Settings ..... 9
- Command 3: Sampling and Trigger Settings ..... 12
- Command 4: Conversion Equation Settings ..... 14
- Command 5: Data Range Settings ..... 15
- Command 7: Status Check ..... 16
- Command 10: Power Supply Setting ..... 17
  
- RS-232C Communication ..... 17

# Sampling

## 1. Channel

	Channel Name	Number of Channels	Details
Analog	CH1-3	3	Voltage, resistance, pulse period
Pulse	SONIC	1	Pulse interval, pulse period
Digital I/O	DIG I/O	1	8-bit input/output, 1-bit clock
Mic	Mic	1	Recording ( $\pm 1.5V$ )
Analog Output	CH3 speaker	1	CH3: output function 12-bit D/A ( $\pm 3V$ )

## 2. Types of Sampling

	Range	Resolution	Sampling Interval	Notes
Voltage	0-5V	1.2mV	20 $\mu$ sec-16000sec	12-bit A/D
	$\pm 10V$	4.9mV		
Resistance	1-100 $\Omega$	—	—	Refer to "Pulse Sampling" on page 4.
Pulse period	0-600sec	0.868 $\mu$ sec		
Pulse interval	1-100msec		8msec-16000sec	

## 3. Sampling Methods

Configuring the Calculator for Sampling

Mode	Fast	Normal	Extended*1	Period Frequency	Fast Output	Normal Output
Enabled CH	CH1 or Mic	CH1-3, SONIC, DIG I	CH1-3, SONIC, DIG I	CH1 or SONIC	Speaker or CH3	CH3 or DIG O
Trigger Source						
Communication	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Key Press	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Trigger	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Countdown	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Clock Source						
Timer	20-100 $\mu$ sec	0.1msec $\times$ Number of Channels to 300sec	300-16000sec	—	20-54 $\mu$ sec	10msec-300sec
Communication	<input checked="" type="radio"/>	<input type="radio"/>	—	—	—	—
Key Press	<input checked="" type="radio"/>	<input type="radio"/>	—	—	—	—
Trigger	<input checked="" type="radio"/>	<input type="radio"/>	—	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Communication while Sampling	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	—	—

\*1 Warm up is not supported during long-period sampling.

\*2 SONIC sampling triggered by CH1, CH2, or CH3 is not supported.

## <Stand-alone Sampling Method>

### Auto Setup

When the Setup key is pressed...

Enters the sampling setup ready state.

Supports bundled sensors (temperature, voltage, photo) only.

### <Setup Details>

Channel Settings	Auto-ID is read from CH1, CH2, CH3, and SONIC. (Mic and Digital I/O are not supported.) When no Auto-ID is available... CH1, CH2, CH3: Operation=10 (Voltage 1 to 5V) SONIC: Not used
Sampling Period	Furthest Interval among the used Auto-ID is used.
Data Send Priority	Non real-time type

### <Data Send Priority>

Channel Priority: Sampling time, SONIC, CH1, CH2, CH3

\* Different from normal. Refer to "Memory" on page 3.

# Analog Sampling

Channel Names: CH1, CH2, CH3

## 1. CH1, CH2, CH3 Connector Specifications

Pin Number	
1	Vin ±10V (CH3: Vin±5V and ±3Vout)
2	GND
3	Vres
4	Auto-ID
5	+5.3V DC
6	Vin-low 0~5V

## 2. Types of Sampling

### ① Voltage

Two sampling ranges are shown below.

- ±10V 1pin (CH3: ±5V)
- 0 to 5V Pin 6

### ② Resistance

Two sampling ranges are shown below.

- pin6: 1~100kΩ
- pin4: Auto-ID

### ③ Pulse period

Two sampling ranges are shown below

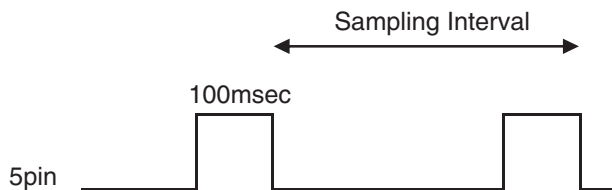
- ±10V 1pin (CH3: ±5V)
- 0 to 5V Pin 6

For details, refer to "Pulse Sampling" on page 4.

### Pin 5 +5.3V Power Supply

Supplied from 100 msec before Clock Source.

Variable using power supply command (Command 10).

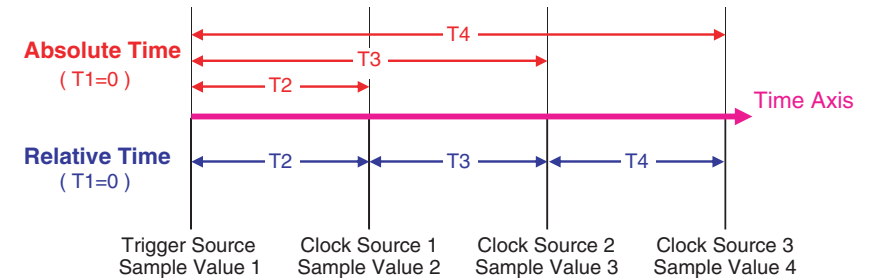


Power supplied during ready state.

# Memory

## 1. Sampling Time Data

<Absolute Time and Relative Time>



## 2. Number of Sample Data

Number of Sample Data: 120000

### • Number of Sampling Channels and Number of Sample Data

Number of Sampling Channels	Clock Source	Maximum Number of Sample Data
1	Clock Source = Timer	120000
2		60000
3		40000
4		30000
5		24000
0	Clock Source = External Trigger	60000
1		40000
2		30000
3		24000
4		20000
5	17140	

The maximum number of sample data when a timer is the sampling trigger is calculated using the following formula:  
120000 ÷ [Number of Channels Used]

The maximum number of sample data when an external trigger is the clock source is calculated using the following formula:  
120000 ÷ ([Number of Channels Used] + 1)

\* The number of samples is 2<sup>n</sup> when FFT Samples (n) is used.

### 3. Data Send Priority

#### 1. Real-time Type

(Selected using Command 12)

Channel Priority: CH1, CH2, CH3, SONIC, DIG IN, sampling time

- Variable (1 data)  
Sends the data of the channel with highest priority among {CH1, CH2, CH3, SONIC, DIG IN, sampling time}.  
The data with the second highest and subsequent priorities is not sent.
- List (N line data)  
{CH1 data n, CH2 data n, CH3 data n, SONIC data n, DIG IN data n, sampling time n}  
(n: number of samples at the point that request is made)

#### 2. Non Real-time Type

(Selected using Command 12)

Channel Priority: Sampling time, mic, CH1, CH2, CH3, SONIC, DIG IN

- Variable (1 data)  
First sends the oldest data on the highest priority channel.  
Next sends the next oldest data upon request.  
Next channel data is sent after all the data of the current channel is sent.
  - When List type data is requested part way through  
The channel's data is sent as a list.
  - When Matrix type data is requested part way through  
Sent as Matrix type.
- List (N line data)  
Sends the data of the highest priority channel.  
{CH\* data1, CH\* data2, CH\* data3, ... CH\* data n}  
Next sends the next highest priority channel's data upon request.
  - \* Sample data that is not configured is omitted.
  - \* After everything is sent, returns to the beginning when a data request comes in.

## Pulse Sampling

Channel Name: SONIC

(Pulse period sampling is also supported on CH1.)

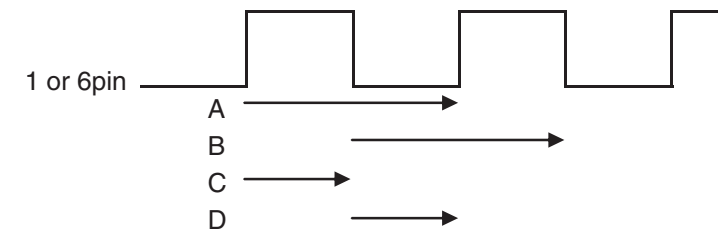
#### 1. SONIC Connector Specifications

Pin Number	Pulse Period	Pulse Interval
1	Vin ±10V	Sampling end pulse
2	Not used	Sampling output pulse
3	Auto-ID	Auto-ID
4	+5.3V DC	+5.3V DC
5	GND	GND
6	Vin-low 0–5V	Not used

#### 2. Types of Sampling

##### ① Pulse Period Sampling

Channel	CH1, SONIC
Supported Sampling Input Voltage	±10V (1pin), 0–5V (6pin)
Trigger Level (V)	Pin 1: ±10V 12-bit D/A (Resolution: 4.9mV) Pin 6: 0 to 5V 12-bit D/A (Resolution: 1.2mV)
Range	0 to 600 sec (4 Sampling Intervals: A to D)
Resolution	0.868μsec
Input Impedance	1MΩ
Rising/Falling switchable (4 methods: A to D)	



When using the EA-2

- Use the bundled AC adaptor.
- Minimum sampling interval is 0.02 sec.  
(When the subject is 3 meters or less away.)

# Command Tables

## Command 1 - Channel Setup

\*: parameter value marked with asterisk are initial defaults.

{ 1, Channel, Operation, Post-Processing, FFT Samples }

Channel		Operation		Post-Processing		FFT Samples		
0	Clear all channels	---		---		---		
*1	Channel 1	0	Clear the selected channel.	*0	None			
2	Channel 2	*1	Auto-ID	1	d/dt	---		
3	Channel 3	2	Voltage ( $\pm 10V$ ) (for Voltage probe)	2	d/dt, d <sup>2</sup> /dt <sup>2</sup>			
		4	Resistance	10	FFT-Real	1 to 13	Samples used 2 <sup>n</sup> (2–8192)	
		5	Period	11	FFT-Real, Imaginary	(*6)		
		6	Frequency					
		7	Temperature (Celsius)					
		8	Temperature (Fahrenheit)					
		9	Light					
		10	Voltage (0–5V)					
		11	Absolute Time					
4	SONIC Channel	0	Clear the SONIC channel.	*0	None			
		*1	Meters	1	d/dt	---		
		2	Meters	2	d/dt, d <sup>2</sup> /dt <sup>2</sup>			
		3	Feet					
		5	Period					
		6	Frequency					
		11	Absolute Time					
5	DIG IN Port	0	Clear the digital input channel.	---		---		
		*1	Active					
6	DIG OUT Port	<b>Data String Output Loops</b>		<b>Data string</b>				
		0	Clear the digital input channel.	0 to 255	Output data element value	---		
		1 to 32 (*1)	Number of output data elements					
10	Microphone	0	Clear the Microphone.	*0	None			
		*1	Active	10	FFT-Real	1 to 13	Samples used 2 <sup>n</sup> (2–8192)	
				11	FFT-Real, Imaginary	(*6)		
11	Analog Out CH3 1pin $\pm 3V_{out}$	<b>Data String Output Loops</b>		<b>Data Output Selection</b>		<b>Data string</b>		
		0	Clear the analog out or speaker.	*0	Data string	$\pm 1.5$	Output data element value	
		1 to 65535 (*1)	Number of output data elements	1	Channel 1			
				2	Channel 2			
				3	Channel 3			
				10	Microphone			
12	Speaker							

• Channel = 1, 2, 3 or 4, Operation = 5, 6, 11

{ 1, Channel, Operation, Pin No, Trigger Threshold, Trigger Edge }

Pin No		Trigger Threshold		Trigger Edge (Operation = 5, 6)	
*2	1pin Vin ( $\pm 10V$ )	$\pm 10$	Set input voltage threshold value –10 to +10.	*0	Rising edge to rising edge
				1	Falling edge to falling edge
				2	Rising edge to falling edge
				3	Falling edge to rising edge
10	6pin Vin-low (0–5V)	0 to 5		<b>Trigger Edge (Operation = 11)</b>	
				*0	Rising edge
				1	Falling edge
				2	Rising and falling edge

- Record Time for Operations 5, 6, and 11 must be 2, 1, and 1 respectively.
- Trigger Source for Channels 1, 2, 3, and 4 must be 2, 3, 4, and 12 respectively.
- Clock Source must be 10.

## Command 3 - Sample and Trigger Setup

{ 3, Sampling Interval, Number of Samples, Record Time, Trigger Source, Trigger Threshold, Trigger Edge, Clock Source }

Sampling Interval		Number of Samples		Record Time	
0.00002 to 16000 (*0.1)	Number of seconds	1 to 120000 (*100)	Number of samples	0 *1 2	Off Absolute time recording Relative time recording

Trigger Source		Trigger Threshold		Trigger Edge		Clock Source	
*1	[START/STOP] key	—		—		*0	Timer (Sample interval)
2 or 5 3 or 6 4 or 7 8 9	CH1 CH2 CH3 DIG IN Clock DIG IN 8-bit data	Sampled Values • Corrected values when Command 4		0 *1 2	Falling edge Rising edge Rising and falling edge	*10 (1 to 5)	Same as Trigger Source
		—					
10	Microphone	Sampled Values $\pm 1.5V$		0 *1 2	Falling edge Rising edge Rising and falling edge		
11	SONIC	Distance • Unit depends on Command 1. (*0.05)		0 1 *2 3	Falling edge Rising edge Difference with previous value is below Difference with previous value is above		
20	Count down	<b>Count Number (sec)</b>		—			
		1 to 10 (*10)		—			
-1	Command 8	—		—			

## Command 4 - Conversion Equation Setup

{ 4, Equation Number, Equation Type, Number Format, Constants }

Equation Number		Equation Type		Number Format		Constants	
* 0	Clear All equations.	* 0	Clear equation selected by the equation number parameter.				
1	Equation 1 (Channel 1)	1	Polynomial $K_0+K_1X+K_2X^2+\dots+K_nX^n$ *1	* 0	Standard	$K_0(, K_1, \dots, K_9)$ *3,4	
2	Equation 2 (Channel 2)	2	Mixed polynomial $K_{-m}X^{-m}+\dots+K_{-1}X^{-1}+K_0+K_1X+\dots+K_nX^n$ *2	10	Integer part (Decimal part cut off.)	$K_{-4}(, \dots, K_{-1}, K_0, K_1, \dots, K_5)$ *3,4	
3	Equation 3 (Channel 3)	3	Power $K_0X^{(K_1)}+K_2$				$K_0(, K_1, K_2, K_3)$ *3,4
		4	Modified power $K_0K_1^{(X)}+K_2$				
		5	Logarithmic $K_0+K_1 \ln(X)$				
		6	Modified logarithmic $K_0+K_1 \ln(1/X)$				
		7	Exponential $K_0 e^{(K_1X)}+K_2$				
		8	Modified exponential $K_0 e^{(K_1/X)}+K_2$				
		9	Geometric $K_0 X^{(K_1X)}+K_2$				
		10	Modified geometric $K_0 X^{(K_1/X)}+K_2$				
		11	Reciprocal logarithmic $[K_0+K_1 \ln(K_2X)]^{-1}+K_3$				
		12	Steinhart-Hart model $[K_0+K_1 (\ln 1000X)+K_2(\ln 1000X)^3]^{-1}+K_3$				
4	Equation 4 (SONIC channel)	* 0	Clear equation 4.	<b>Unit</b>		<b>Temperature</b>	
		1	Temperature used by distance conversion expression	* 0	°C (Celsius)	Temperature (*20)	
				1	°F (Fahrenheit)		
				2	°C (Celsius)		
				3	K (kelvin)		
		4	°R (Rankin)				

\*1 Polynomial: Input constants in sequence, from n = 0 to 9.

\*2 Mixed polynomial: Input constants in sequence from m = 4 to 1, and n = 0 to 5.

\*3 Input of zero for constants can be skipped if all remaining constants are not used.

\*4 Input 0 for constants that are not used.

- When the conversion result of the "conversion equation" selected by Command 4 causes an overflow, the EA-200 sends a result of zero (0) to the calculator.

## Command 5 - Data Range Setup

{ 5, Channel Select, Data Select, Data Begin, Data End, Step, K (, FFT Samples) }

Channel Select		Data Select		Data Begin	Data End	Step	K	FFT Samples
* 0	Current send channel	* 0	Raw data	1 to 120000	1 to 120000	Data Range Steps	(*255)	1 to 13: Samples used
1	Channel 1	1	d/dt	(*1)	* 0: Last sample	-1: Data range number / K		(*6) $2^n(2-8192)$
2	Channel 2	2	$d^2/dt^2$			(*1)		
3	Channel 3	10	FFT-Real					
4	SONIC channel	11	FFT-Imaginary					
5	DIG IN channel							
6	Recorded time data							
10	Microphone							

## Command 6 - System Setup

{ 6, Command, Auto Power Off Time }

Command		APO Time (sec)	
0 or 2	Abort Sampling ( *0)	—	
3	Turns sound off		
4	Turns sound on		
10	APO (Auto Power Off)	* 0	1800
		1	10
		2	360

## Command 8 - Sampling Start

{ 8 }

## Command 10 - Sensor Warmup

{ 10, Warmup Time (sec) }

Warmup Time (sec)	
0.1 to 360	Warmup time (sec) ( *0.1)
0	Auto
-1	None
-2	Normal warmup

## Command 11 - Buzzer and LED Operation Commands

{ 11, Output Select, Length, Period }

Output Select		Length (sec)	Period (sec)
* 0	Buzzer	Operating Time (sec)	Period (sec)
2	Ready LED		
3	Sampling LED		
4	Error LED		
5	Batt LED		
			—

- An error occurs when fraction data is sent.
- Send commands to the EA-200 in accordance with the command table contents.
- An error occurs when a parameter that does not exist in the command table is sent.
- The EA-200 uses six digits for internal calculations.

## Command 12 - Data Send Sequence

{ 12, Send Sequence }

Send Sequence	
* 0	Non-real Time Format
1	Real Time Format



# Command 1: Channel Settings

{ 1, Channel, Operation, Post-Processing }

## 1. Channel

- 0 Clear all Command 1 data.
- 1 Specify CH1.
- 2 Specify CH2.
- 3 Specify CH3.
- 4 Specify SONIC channel.
- 5 Specify Digital In channel.
- 6 Specify Digital Out channel.
- 10 Specify mic.
- 11 Specify Analog Out.
- 12 Specify speaker.

## 2. Operation

Analog CH1, CH2, CH3

(Channel = 1, 2, 3)

- 0 Clear Command 1 data of specified channel.
- 1 Auto-ID  
Perform sampling using automatically recognized sensor.  
Perform 0 to 5V sampling when recognition is not possible.
- 2 Voltage sampling  $\pm 10V$
- 4 Resistance sampling 1–100k $\Omega$
- 5 Period sec
- 6 Frequency Hz
- 7 Temperature –29 to 130°C
- 8 Temperature –4 to 266°F
- 9 Light quantity 100 to 999
- 10 Voltage sampling 0 to 5V
- 11 Time sec (Relative time sampling from sampling start)

SONIC

(Channel = 4)

- 0 Clear Command 1 data of SONIC channel.
- 1 Auto-ID  
Perform sampling in automatically detected unit.
- 2 Meter
- 3 Feet
- 5 Period sec
- 6 Frequency Hz
- 11 Time sec (Relative time sampling from sampling start)

Digital I/O

Pin: Clock: 1

GND: 1

Signal: 8 (8-bit TTL 0 to 5V)

Digital In

(Channel = 5)

- 0 Clear Dig I channel information.
- 1 Active  
Read information of digital connector Pin 8.  
0 to 255

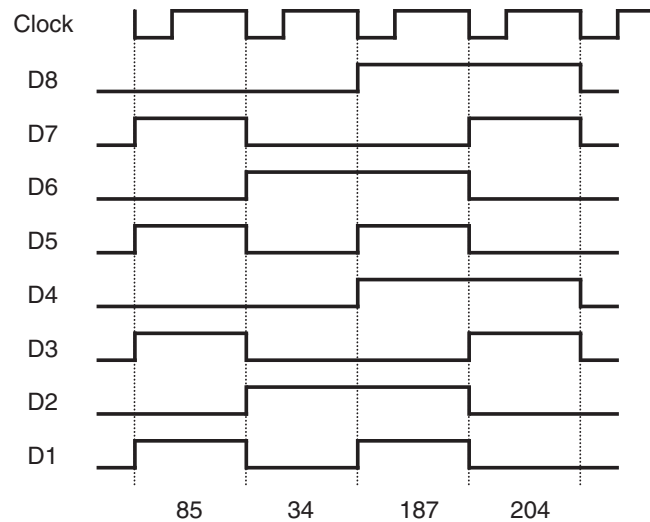
Digital Out

(Channel = 6)

- 0 Clear Dig O channel information.
- 1 to 32 Number of loops  
Number of outputs of list values

### Output Example

When the list is: 85(1010101), 34(100010), 187(10111011), 204(11001100)



### Mic

(Channel = 10)

- 0 Clear channel information.
- 1 Active

### Analog Out, speaker

(Channel = 11, 12)

- 0 Clear channel information.
- 1-65535 Number of loops

### Select Data

Select the data to be output by the sampling period.

- 0 List data
- 1 CH1 sampled values
- 2 CH2 sampled values
- 3 CH3 sampled values
- 10 Mic sampled values

### Step

(Select Data 1, 2, 3, 10)

- Number of steps for output sampled data
- 1, 2, 4, 8, 16

### <Output Trigger>

Following receipt of Command 3, output starts as soon as a Trigger Source is generated.

The following can be specified as a Trigger Source.

0: None, 1: [Start] key, 10: Countdown, Command 8

Output is interrupted when the Start/Stop key is pressed.

### <Analog Out Port>

Output is from Pin 1 of CH3.

Vout  $\pm$ 3V (Iout maximum 100mA)

## Analog, SONIC Sampling

### 3. Post-Processing

(Operation 1-4, 7-10)

0 None (no calculation)

1 d/dt

2 d<sup>2</sup>/dt<sup>2</sup>

10 FFT (Fast Fourier Transformation)-Real

11 FFT-Real, Imaginary

### Calculation Methods

<<First derivative>>

$$(dx/dt)_n = (X_{n+1} - X_{n-1}) / (2t)$$

$$(dx/dt)_1 = (X_2 - X_1) / t$$

$$(dx/dt)_m = (X_m - X_{m-1}) / t$$

x<sub>n</sub>: nth data

t: Sampling period

m: Maximum value of n

<<Second derivative>>

$$(d^2x/dt^2)_n = (X_{n+1} - 2 * X_n + X_{n-1}) / t^2$$

$$(d^2x/dt^2)_1 = (X_3 - 2 * X_2 + X_1) / t^2$$

$$(d^2x/dt^2)_m = (X_m - 2 * X_{m+1} + X_{m-2}) / t^2$$

\* First and second derivatives are supported only when timer is the sampling trigger.

## <<FFT>>

Frequency characteristics are calculated from sampled values and sampling period.

The number of FFT target data items ( $2^n$ ) is input to parameter n.

1-13 ( $2^{13} = 8192$ )

### Calculation Timing

When data is requested

### Sent Timing

- When 1 (d/dt)  
After sampled data is sent, linear data is sent when data is requested.
- When 2 (d/dt,  $d^2/dt^2$ )  
After sampled data is sent, linear data is sent when data is requested.  
In addition, quadratic data is sent when data is requested.
- When 10 and 11 (FFT)  
After sampled data is sent, FFT real number part data is sent when data is requested.  
In addition, FFT imaginary number part data is sent when data is requested.

## Period Frequency Sampling

{ 1, Channel, Operation, Pin No, Trigger Threshold, Trigger Edge }

(Operation 5, 6, 11)

Compares 12-bit D/A thresh and sampled data, and measures the pulse interval.

Time resolution is  $0.868\mu\text{sec}$ .

Read either of two pins → Set by sampled pin number

4 pulse interval types → Set by trigger edge

## 4. Pin No

Specify the pin number for reading the period frequency.

2 1pin  $V_{in} \pm 10V$

10 6pin  $V_{in-low} 0-5V$

## 5. Trigger Threshold

Threshold voltage value for comparison with sampled values.

## 6. Trigger Edge

- Period, frequency sampling (Operation= 5, 6)

- 0 Rising-Rising
- 1 Falling-Falling
- 2 Rising-Falling
- 3 Falling-Rising

- Time (Operation = 11)

- 0 Rising
- 1 Falling
- 2 Both (Rising and Falling)

## Command 3: Sampling and Trigger Settings

{ 3, Sampling Interval, Number of Samples, Record Time, Trigger Source, Trigger Threshold, Trigger Edge, Clock Source }

### 1. Sampling Interval (sec)

0.00002–0.0001: Fast sampling  
0.0001–300: Normal sampling  
300–16000: Extended sampling

This parameter is ignored when click edge is not timer.

### 2. Number of Samples

1 to 120000 Limited only by available memory.  
–1 Sampled with each data request  
Real-time (simultaneous) sampling

### 3. Record Time

0 None  
1 Absolute time recording  
2 Relative time recording

### 4. Trigger Source

0 None  
Start sampling immediately upon receipt of Command 3.

1 [Start/Stop]  
Start sampling when [Start/Stop] key is pressed.

2 CH1 Trigger  
3 CH2 Trigger  
4 CH3 Trigger

10 Microphone Trigger

11 SONIC Trigger  
Start sampling in accordance with Motion Sensor (EA-2) sampled data.  
Trigger monitor interval is in accordance with sampling interval.

12 SONIC Trigger  
Same as 2–7.

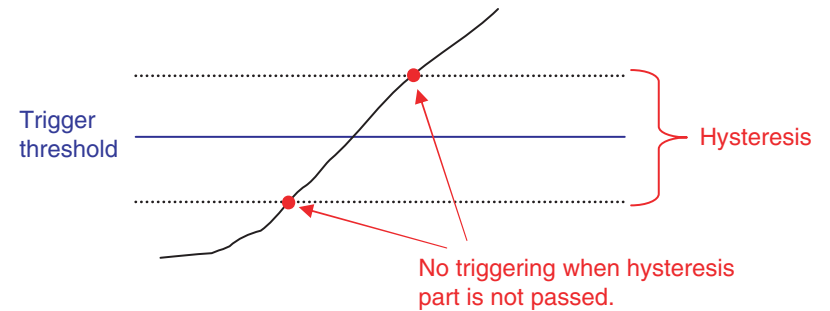
20 Countdown  
When [Start/Stop] key is pressed or when Command 8 is received, countdown is performed by beeping at 1-second intervals the number of times specified by count number, and then sampling starts.

–1 Wait for Command 8

When 1–12  
Upon receipt of Command 8, sampling starts regardless of specified trigger state.

### 5. Trigger Threshold

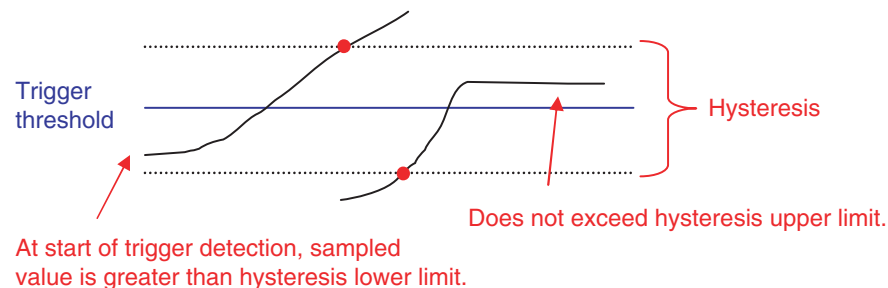
Hard trigger  
(Trigger Source = 2, 3, 4, 12)



Hysteresis

±10V (1pin)	Approximately ±0.27V
Temperature °C	Approximately ±2°C
Temperature °F	Approximately ±3.6°F
0 to 5V (Pin 6)	Approximately ±67.5mV

### Non-triggering Example (Trigger Edge = Rising)



To trigger at a target threshold, increase or decrease the hysteresis part with the edge settings to specify the threshold.  
However, make sure sampled value is outside of hysteresis range.

### Countdown

(Trigger Source = 10)

1-10 Countdown (sec)

\* Do not press SETUP, START/STOP, or ON/OFF key during countdown.

### SONIC Trigger

(Trigger Source = 11)

Distance (meters)

## 6. Trigger Edge

### Hard trigger

(Trigger Source = 2, 3, 4, 12)

- 0 Falling  
Sampling started when [Sample Value]  $\leq$  [Trigger Threshold]
- 1 Rising  
Sampling started when [Sample Value]  $\geq$  [Trigger Threshold]
- 2 Both (Rising and Falling)

### SONIC Trigger

(Trigger Source = 11)

- 0 Falling  
Sampling started when [Sample Value]  $\leq$  [Trigger Threshold]
- 1 Rising  
Sampling started when [Sample Value]  $\geq$  [Trigger Threshold]
- 2 Difference Falling  
Sampling started when [Sample Value]  $\geq$  [Trigger Threshold]
- 3 Difference Rising  
Sampling started when [Current Value] - [Previous Value]  $\geq$  [Trigger Threshold]

## 7. Clock Source

- 0 Timer  
Conforms to sampling interval.
- 10 Same as Trigger Source  
Sampled at same timing as Trigger Source.  
Timer when Trigger Source is 0, 10, 11.

# Command 4: Conversion Equation Settings

{ 4, Equation Number, Equation Type, Number Format, Constants }

## 1. Equation Number

- 0 Clear all Command 4 data.
- 1 Specify CH1.
- 2 Specify CH2.
- 3 Specify CH3.
- 4 Specify SONIC channel.

## 2. Equation Type

Analog CH1, CH2, CH3  
(Channel = 1, 2, 3)

Equation Name	Format	Restrictions
1 Polynomial	$K_0 + K_1X + K_2X^2 + \dots + K_nX^n$	$n = 0$ to 9
2 Mixed Polynomial	$K_{-m}X^{-m} + \dots + K_{-1}X^{-1} + K_0 + K_1X + \dots + K_nX^n$	$m = 1$ to 4 $n = 0$ to 5 $m+n > 0$ $X \neq 0$
3 Power	$K_0X^{(K_1)} + K_2$	$X > 0$
4 Modified power	$K_0K_1^{(X)} + K_2$	$K_1 \geq 0$
5 Logarithmic	$K_0 + K_1 \ln(X)$	$X > 0$
6 Modified logarithmic	$K_0 + K_1 \ln(1/X)$	$X > 0$
7 Exponential	$K_0 e^{(K_1X)} + K_2$	
8 Modified exponential	$K_0 e^{(K_1/X)} + K_2$	$X \neq 0$
9 Geometric	$K_0 X^{(K_1X)} + K_2$	$X \geq 0$
10 Modified geometric	$K_0 X^{(K_1/X)} + K_2$	$X > 0$
11 Reciprocal logarithmic	$[K_0 + K_1 \ln(K_2X)]^{-1} + K_3$	$K_2X > 0$
12 Steinhart-Hart model	$[K_0 + K_1 (\ln 1000X) + K_2 (\ln 1000X)^3]^{-1} + K_3$	$X > 0$

SONIC

(Channel = 4)

- 0 Clear conversion equation.
- 1 Conversion equation temperature specification

## 3. Number Format and Unit

### • Number Format

Analog CH1, CH2, CH3

(Channel = 1, 2, 3)

- 0 Standard
- 10 Integer part only

### • Unit

SONIC

(Channel = 4)

- 0 °C (Celsius)
- 1 °F (Fahrenheit)  
 $^{\circ}\text{F} = (9/5) \times ^{\circ}\text{C} + 32$
- 2 °C (Celsius)
- 3 K (Kelvin)
- 4 °R (Rankin)  
 $R = 1.8 \times ^{\circ}\text{C} + 491.67$

## 4. Constants and Temperature

### • Constants

Analog CH1, CH2, CH3

(Channel = 1, 2, 3)

Polynomial: Input constants in sequence from  $K_n = 0$   
Mixed polynomial: Input constants in sequence from  $m = 4$  to 1,  $n = 0$  to 5.

### • Temperature

SONIC

(Channel = 4)

Sound velocity is calculated from this value and unit.  
Sound Velocity m/s =  $331.5 + 0.6 \times ^{\circ}\text{C}$   
Default sonic velocity is 343 m/s.

## Command 5: Data Range Settings

{ 5, Channel Select, Data Select, Data Begin, Data End, Step, K (, FFT Samples) }  
Cannot be used during sampling.

### 1. Channel Select

- 0 Highest priority data
- 1 Specify CH1.
- 2 Specify CH2.
- 3 Specify CH3.
- 4 Specify SONIC channel.
- 5 Specify Digital In
- 6 Specify recorded time data.
- 10 Specify mic.

Send sequence of the specified channel's sampled data takes priority.

### 2. Data Select

- 0 Raw data
- 1 d/dt
- 2 d<sup>2</sup>/dt<sup>2</sup>
- 9 A/D value
- 10 FFT (real number part)
- 11 FFT (imaginary number part)

Send sequence of the specified data takes priority.

For calculation method and other information, see "3. Post-Processing" on page 10.

### 3. Data Begin

1–120000

Sends data specified by number.

### 4. Data End

1–120000

0 Last sample

Sends from data start number up to number of data specified by this number.

When 0, sends up to end of data.

### 5. Step

1– Number of steps (Specifying 2 sends every other data item).

–1 Send using step equivalent to  $[\text{Number of Sampled Data}] \div [\text{Specified Value K}]$   
(rounded up).

### FFT Samples

1 to 13

FFT calculation number of samples  $2^n$

\* This parameter is ignored when "Data Select" is not "FFT".

# Command 7: Status Check

{ 7 }

After Command 7 is received, this function sends EA-200 status information upon a data request from the calculator.

## Status Request

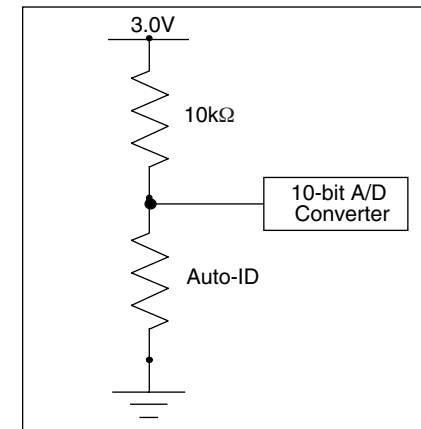
Line		Status		
1	Basic Information	Status	0: Standby (No Sample Data in EA-200) 1: Ready 2: Sampling 3: Standby (Sample Data in EA-200)	
2		Error Code	= 0: Normal ≠ 0: Error Integer: Command number Decimal Part: Parameter position  Example: 3.2 Command 3 is the second parameter. Sampling interval value error	
3		Battery Condition	0 to 999  < 450: low battery	
4		Version No.		
5	Auto-ID	CH1	0 to 1023	
6		CH2	Calculation Method:	
7		CH3	(See circuit diagram)	
8		SONIC	$1023(\text{bit}) \times R + (R + 10(\text{k}\Omega))$ R:Auto-ID(k $\Omega$ )	
9	Channel 1 Setup	Operation		
10		Pin No		
11		Post-Processing		
12		Trigger Edge		
13		Trigger Threshold		
14		Sampling Range Maximum Value		
15		Sampling Range Minimum Value		
16		Equation Number		
17		Number Format		
18		Number of Constants		
19		Constants K <sub>0</sub>		
:		:		
28		Constants K <sub>9</sub>		
29		Channel 2 Setup	Operation	
30			Pin No	

Line			
31	Channel 2 Setup	Post-Processing	
32		Not used	
33		Not used	
34		Sampling Range Maximum Value	
35		Sampling Range Minimum Value	
36		Equation Number	
37		Number Format	
38		Number of Constants	
39		Constants K <sub>0</sub>	
:		:	
48		Constants K <sub>9</sub>	
49		Channel 3 Setup	Operation
50			Pin No
51			Post-Processing
52			Not used
53			Not used
54			Sampling Range Maximum Value
55			Sampling Range Minimum Value
56	Equation Number		
57	Number Format		
58	Number of Constants		
59	Constants K <sub>0</sub>		
:	:		
68	Constants K <sub>9</sub>		
69	Channel SONIC Setup	Operation	
70		Pin No	
71		Post-Processing	
72		Trigger Edge	
73		Trigger Threshold	
74		Equation Number	
75		Number Format	
76		Number of Constants	
77		SONIC filter	
78		Constants	
79	Not used		
:			
87			
88	Channel DIG IN Setup	Operation	
89	Channel DIG OUT Setup	Data String Output Loops	
90		Loop Counter	
91		Number of Data String	

Line		
92	Channel Analog	Data String Output Loops
93	Out or Speaker	CH3 or Speaker
94	Setup	Data Output Selection
95		Number of Steps 1,2,4,8,16
96		Loop Counter
97		Number of Data String
98	Sample and Trigger Setup	Sampling Interval (sec)
99		Number of Samples
100		Record Time
101		Clock Source
102		Trigger Source
103		Trigger Edge
104		Trigger Threshold
105		Not used

- Last error code: 0 = no errors  
An error causes a 3-digit error code to appear on the display. The first digit indicates the command number, while the remaining two digits indicate the parameter where the error occurred (i.e. first parameter is indicated by 01, second indicated by 02, and so on).
- Auto-ID resistance value ( $\Omega$ ) for CH1, CH2, CH3, and SONIC  
A reading in the vicinity of 999 k $\Omega$  indicates that the applicable channel is open.
- List of all active channels (Variable)

Circuit Diagram





## Command 10: Power Supply Setting

{ 10, Warmup Time (sec) }

Supply starts after receipt of Command 10 when supply time is not zero.  
If a sampling Trigger Source is generated before supply time is reached, supply time takes priority and sampling starts after it is reached. When parameter is -1, however, sampling starts as soon as sampling Trigger Source is generated.

- 1-360 Supply time (sec) of 5.3V from Pin 5 to sensor  
Decimal part ignored.
- 0 Corresponds to sensor information supply time.
- 1 Corresponds to sensor information supply time.  
Sampling Trigger Source takes priority over supply time.
- 2 Following receipt of command, power is supplied continuously to the sensor.  
However, the default setting for extended sampling is 100 msec.

- Sampling trigger takes priority over supply time.
- Default is 100 msec. (See "Analog Sampling" on page 3.)

## RS-232C Communication

- (1) RS-232C cross cable
- (2) Start bit : 1 bit
- (3) Stop bit : 2 bits
- (4) Baud rate : 38400 bps.
- (5) Parity bit : none.
- (6) The communication system shall be half duplex system without Xon/off control.
- (7) Frequency deviation should be kept within  $\pm 1.5\%$ .

### Send38K

Calculator / PC                      EA-200

0x15	→	
	←	Code A
Header1	→	
	←	Code B
Data1	→	
	←	Code B
0x15	→	
	←	Code A
Header2	→	
	←	Code B
Data2	→	
	←	Code B
:	:	:
0x15	→	
	←	Code A
HeaderN	→	
	←	Code B
DataN	→	
	←	Code B

Code A  
0x05 : Retry  
0x13 : OK  
0x22 : Error

Code B  
0x05 : Retry  
0x06 : OK  
0x22 : Error

**Receive38K**

Calculator / PC EA-200

0x15	→	
	←	Code A
Request Header	→	
	←	Header
Code B	→	
	←	Packet1
Code B	→	
	←	Packet2
		:
Code B	→	
	←	PacketN
Code B	→	

**Send38K**

**Header 15 byte**

Send38k: Type=A

:	N	Type	Form	Line	Offset	Packet size	0xFF	Area	Check sum
---	---	------	------	------	--------	-------------	------	------	-----------

Type (Char, 1byte)

A ASCII

Form (Char, 1byte)

V Variable  
L List

Line (Hex, 2byte Big endian)

0x0001~  
\*Variable:0x0001

Offset (Hex, 4byte Big endian)

0x0001

Packet size (Hex, 2byte)

max : 1024 byte  
\*Without ':' and Checksum

Area (Char, 1byte)

A All  
S Start  
M Middle  
E End

**Receive38K**

**Request Header 15 byte**

:	R	Type	Form	All FFh (10byte)	Check sum
---	---	------	------	------------------	-----------

Type

A ASCII

Form (Char, 1byte)

V Variable  
L List

**Packet**

Type: A (Ascii)

:	ASCII Number 1	,	ASCII Number 2	,	...	ASCII Number N	Check sum
---	----------------	---	----------------	---	-----	----------------	-----------

◇ Checksum (1 byte)

Checksum is added to the end of every returned header data proper.

“Checksum” is the code (hexadecimal number) to check if data transfer is successful. The method to calculate the code is as follows:

- ① Except the star code, add the data code to send (hexadecimal number) one by one byte.
- ② As a result, one byte of the code that excludes the overflowed digit is set to “SUM”.
- ③ Calculate the complementary number for 2 of SUM’. The answer is used as the checksum code.

The specific example is shown below.

Data (Example)	:	1	2	3	X	4	5	6	EOF	SUM	
Middle code		3A	31	32	33	39	34	35	36	FF	43 ← Hexadecimal number

```

31 Calculate the complementary number for 2 of SUM'.
+32
+33
+39 The complementary number for 2 of &HBD
+34 (=10111101) is &H43 (=01000011).
+35 Therefore, put &H43 in the checksum.
+36
+FF
-----
2BD
=SUM'

```

**CASIO®**

**CASIO COMPUTER CO., LTD.**

6-2, Hon-machi 1-chome  
Shibuya-ku, Tokyo 151-8543, Japan

## Free Manuals Download Website

<http://myh66.com>

<http://usermanuals.us>

<http://www.somanuals.com>

<http://www.4manuals.cc>

<http://www.manual-lib.com>

<http://www.404manual.com>

<http://www.luxmanual.com>

<http://aubethermostatmanual.com>

Golf course search by state

<http://golfingnear.com>

Email search by domain

<http://emailbydomain.com>

Auto manuals search

<http://auto.somanuals.com>

TV manuals search

<http://tv.somanuals.com>