E

EA-200

Technical Reference

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

CASIO®

Contents

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 (±1.5V)
Analog Output	CH3 speaker	1	CH3: output function 12-bit D/A (±3V)

2. Types of Sampling

	Range	Resolution	Sampling Interval	Notes
Voltage	0–5V	1.2mV	20μsec–16000sec	12-bit A/D
	±10V	4.9mV		
Resistance	1–100Ω	—		
Pulse period	0–600sec	0.868μsec	—	Refer to “Pulse Sampling” on page 4.
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	○	○	○	×	○	○
	Key Press	○	○	○	○	○	○
	Trigger	○	○	○	○	×	×
	Countdown	○	○	○	×	×	×
Clock Source							
	Timer	20–100μsec	0.1msec × Number of Channels to 300sec	300–16000sec	—	20–54μsec	10msec–300sec
	Communication	×	○	—	—	—	—
	Key Press	×	○	—	—	—	—
	Trigger	×	○*2	—	○	×	×
Communication while Sampling		×	○	○	×	—	—

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

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

<Stand-along 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

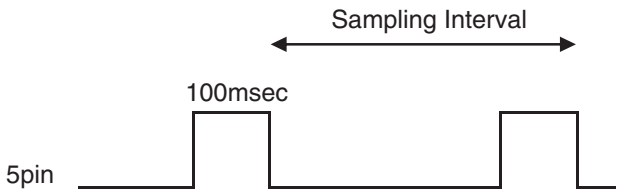
① Voltage
Two sampling ranges are shown below.
- ±10V 1pin (CH3: ±5V)
- 0 to 5V Pin 6

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).

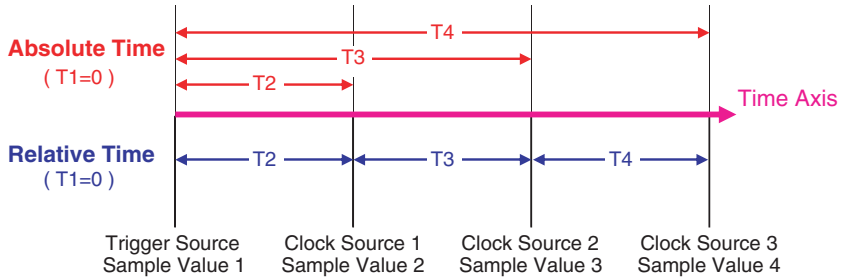


Power supplied during ready state.

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^n 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.)

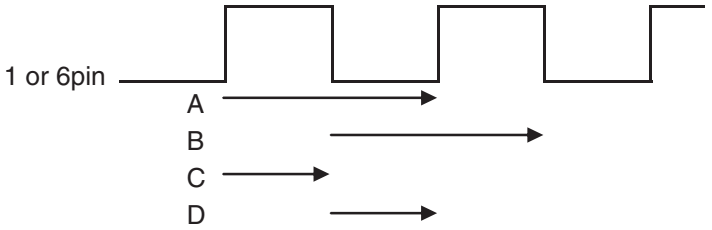
1. SONIC Connector Specifications

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 (±10V) (for Voltage probe)	2	d/dt, d^2/dt^2	—	
		4	Resistance	10	FFT-Real	1 to 13	Samples used
		5	Period	11	FFT-Real, Imaginary	(*6)	2^n (2–8192)
		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^2/dt^2		
		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	**Data String Output Loops**		**Data string**		—	
		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
				11	FFT-Real, Imaginary	(*6)	2^n (2–8192)
11	Analog Out CH3 1pin ±3Vout	**Data String Output Loops**		**Data Output Selection**		**Data string**	
		0	Clear the analog out or speaker.	*0	Data string	±1.5	Output data element value
12	Speaker	1 to 65535 (*1)	Number of output data elements	1	Channel 1		
				2	Channel 2		
				3	Channel 3		
				10	Microphone		

• 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 (±10V)	±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		**Trigger Edge (Operation = 11)**	
				*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	Off
				*1	Absolute time recording
				2	Relative time recording

Trigger Souce		Trigger Threshold	Trigger Edge		Clock Source	
*1	[START/STOP] key	—	—		*0	Timer (Sample interval)
2 or 5	CH1	Sampled Values	0	Falling edge	10 (1 to 5)	Same as Trigger Source
3 or 6	CH2	• Corrected values when Command 4	*1	Rising edge		
4 or 7	CH3		2	Rising and falling edge		
8	DIG IN Clock	—				
9	DIG IN 8-bit data	0–255 (D7–D0) (*1)	—			
10	Microphone	Sampled Values ±1.5V	0	Fallig edge		
			*1	Rising edge		
			2	Rising and falling edge		
11	SONIC	Distance • Unit depends on Command 1. (*0.05)	0	Falling edge	—	
			1	Rising edge		
			*2	Difference with previous value is below		
			3	Difference with previous value is above		
20	Count down	**Count Number (sec)**	—			
		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	$K_0+K_1X+K_2X^2+...+K_nX^n$ *1	* 0	Standard	K_0(, K_1, ..., K_9) *3,4
2	Equation 2 (Channel 2)	2	Mixed polynomial	$K_{-m}X^{-m}+...+K_{-1}X^{-1}+K_0+K_1X+.....+K_nX^n$ *2	10	Integer part (Decimal part cut off.)	K_{-4}(, ..., K_{-1}, K_0, K_1, ..., K_5) *3,4
3	Equation 3 (Channel 3)	3	Power	$K_0X^{(K1)}+K_2$			
		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	$K_0\,e^{(K_1X)}+K_2$			K_0(, K_1, K_2, K_3) *3,4
		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.		**Unit**		**Temperature**
		1	Temperature used by distance conversion expression		* 0	°C (Celsius)	Temperature
					1	°F (Fahrenheit)	(*20)
					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 ±10V
4 Resistance sampling 1–100kΩ
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

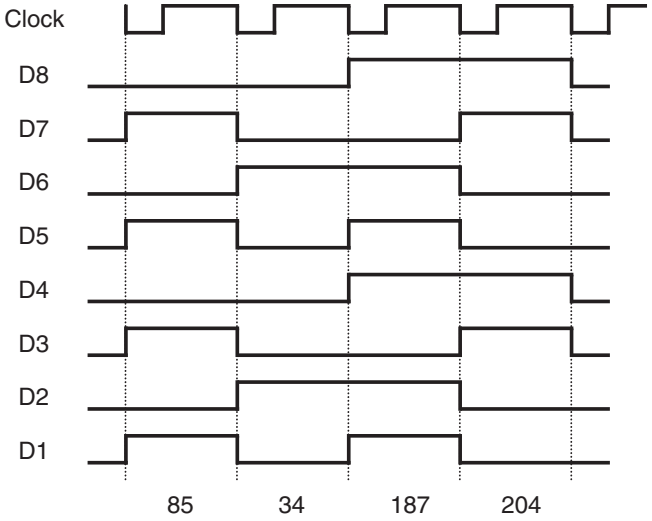
Digital Out

(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 ±3V (Iout maximum 100mA)

Analog, SONIC Sampling

3. Post-Processing

(Operation 1–4, 7–10)

0 None (no calculation)

1 d/dt

2 d^2/dt^2

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_n: 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 0.868μsec.

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 Vin ±10V

10 6pin Vin-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.

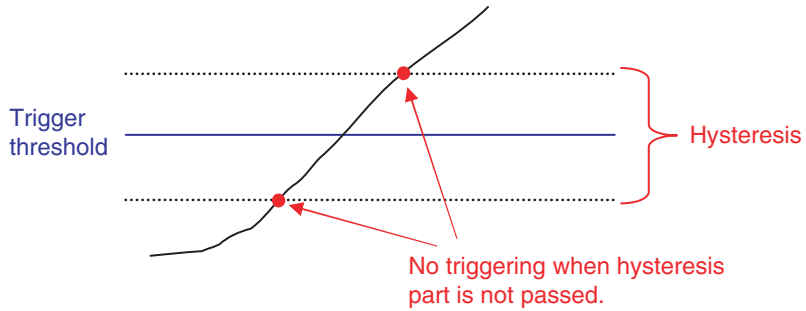
–1 Wait for Command 8

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

5. Trigger Threshold

Hard trigger

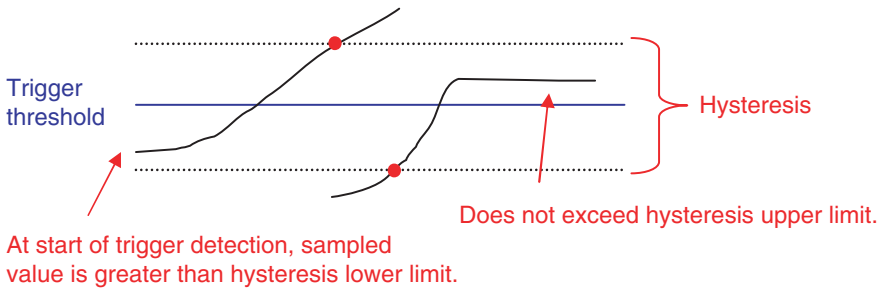
(Trigger Source = 2, 3, 4, 12)



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] ≦ [Trigger Threshold]

1 Rising
Sampling started when [Sample Value] ≧ [Trigger Threshold]

2 Both (Rising and Falling)

SONIC Trigger

(Trigger Source = 11)

0 Falling
Sampling started when [Sample Value] ≦ [Trigger Threshold]

1 Rising
Sampling started when [Sample Value] ≧ [Trigger Threshold]

2 Difference Falling
Sampling started when [Sample Value] ≧ [Trigger Threshold]

3 Difference Rising
Sampling started when [Current Value] – [Previous Value] ≧ [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	$K_0+K_1X+K_2X^2+\ldots+K_nX^n$	n = 0 to 9
2	Mixed Polynomial	$K_{-m}X^{-m}+\ldots+K_{-1}X^{-1}+K_0+K_1X+\ldots\ldots+K_nX^n$	m = 1 to 4 n = 0 to 5 m+n > 0 $X \neq 0$
3	Power	$K_0X^{(K1)}+K_2$	X > 0
4	Modified power	$K_0K_1{}^{(X)}+K_2$	$K_1 \geqq 0$
5	Logarithmic	K_0+K_1 ln(X)	X > 0
6	Modified logarithmic	K_0+K_1 ln(1/X)	X > 0
7	Exponential	$K_0\ e^{(K1X)}+K_2$	
8	Modified exponential	$K_0\ e^{(K1/X)}+K_2$	$X \neq 0$
9	Geometric	$K_0\ X^{(K1X)}+K_2$	$X \geqq 0$
10	Modified geometric	$K_0\ X^{(K1/X)}+K_2$	X > 0
11	Reciprocal logarithmic	$[K_0+K_1\ \text{ln}(K_2X)]^{-1}+K_3$	$K_2X > 0$
12	Steinhart-Hart model	$[K_0+K_1\ (\text{ln}\ 1000X)+K_2\ (\text{ln}\ 1000X)^3]^{-1}+K_3$	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)
°F = (9/5) × °C + 32
2 °C (Celsius)
3 K (Kelvin)
4 °R (Rankin)
R = 1.8 × °C + 491.67

4. Constants and Temperature

• Constants

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

Polynomial: Input constants in sequence from Kn = 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 × °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^2/dt^2
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 ever other data item).
–1 Send using step equivalent to [Number of Sampled Data] ÷ [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

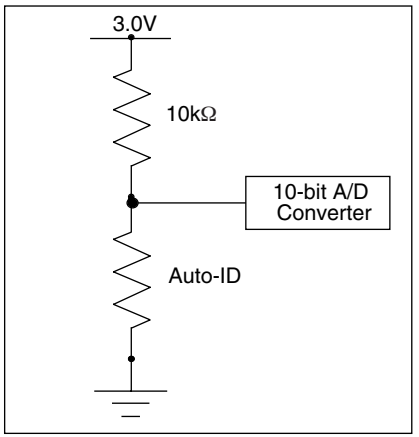
Line			
1	Basic Information	Status	0: Standby (No Sample Data in EA-200) 1: Ready 2: Sampling 3: Standby (Sample Data in EA-200)
2		Error Code	= 0: Normal ≠ 0: Error Integer: Command number Decimal Part: Parameter position Example: 3.2 Command 3 is the second parameter. Sampling interval value error
3		Battery Condition	0 to 999 < 450: low battery
4		Version No.	
5	Auto-ID	CH1	0 to 1023 Calculation Method: (See circuit diagram) 1023(bit)×R÷(R+10(kΩ)) R:Auto-ID(kΩ)
6		CH2	
7		CH3	
8		SONIC	
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_0	
:		:	
28		Constants K_9	
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_0
:		:
48		Constants K_9
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_0
:		:
68		Constants K_9
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 Out or Speaker Setup	Data String Output Loops
93		CH3 or Speaker
94		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 (Ω) for CH1, CH2, CH3, and SONIC
  A reading in the vicinity of 999 kΩ 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 ±1.5%.

Send38K

Calculator / PC		EA-200
0×15	→	
	←	Code A
Header1	→	
	←	Code B
Data1	→	
	←	Code B
0×15	→	
	←	Code A
Header2	→	
	←	Code B
Data2	→	
	←	Code B
:	:	:
0×15	→	
	←	Code A
HeaderN	→	
	←	Code B
DataN	→	
	←	Code B

Code A
0×05 : Retry
0×13 : OK
0×22 : Error

Code B
0×05 : Retry
0×06 : OK
0×22 : Error

Receive38K

Calculator / PC		EA-200
0×15	→	
	←	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	0×FF	Area	Check sum

Type (Char, 1byte)

A ASCII

Form (Char, 1byte)

V Variable
L List

Line (Hex, 2byte Big endian)

0×0001~
*Variable:0×0001

Offset (Hex, 4byte Big endian)

0×0001

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’

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