



Using the GETDATA2 program for data observation and collection

Introduction

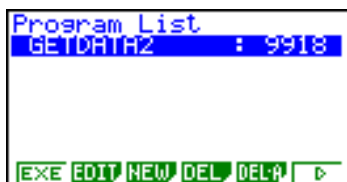
GETDATA2 is the big brother of the GET DATA program. If you are new to data logging with the Casio EA-100 Data Analyzer / CFX9850G calculator combination then it is recommended that you spend some time using the basic set of 3 probes supplied with the EA-100 and set up your experiments using GET DATA.

Once you are familiar with the basics of data logging, then this is the program for you. The program allows you to use any type of probe, any combination of up to four probes, individual calibration or conversion equations for all probes and use of one probe to trigger data collection. Conversion equations are useful to transform the data from one unit to another such as Centigrade to Fahrenheit. Triggering is essential to capture data over very short time intervals, such as recording the sound of a gunshot.

Real-time data logging and graphing is possible where sample intervals are 1-2 seconds or more, enabling the progress of chemical reactions or other experiments to be seen instantly. Variables can also be plotted 'live' independently of time, such as pressure v temperature when investigating properties of gases.

For long experiments or data sampling activities, once the sampling is underway the calculator can be disconnected from the EA-100 and data retrieved at a later stage.

Starting out



Transmit the program into your calculator, switch to program mode and start the program. There is no need for the EA-100 unit to be connected to the calculator at this stage.



The default opening screen (main menu) is shown.

If someone else has been using the program previously, then the parameters may look quite different.



Choose **Help**.

Some help screens are included at various stages to jog your memory about the available options.

OK returns you back to the main menu.



Using the GETDATA2 program for data observation and collection

Setting up probes

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Temp - - -
Samples: 15
Interval: 2
Tot time: 30
Rec Time: Abs
PROBE SETUP Choose channel
|CH1|CH2|CH3|SONIC| |Done|
```

Choose **SetP** from the main menu to set up probes and then choose which channel on the EA-100 you wish to plug the probe into.

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Temp - - -
Samples: 15
Interval: 2
Tot time: 30
Rec Time: Abs
PROBE SETUP Use CH1?
|Yes|No| | | |
```

Confirm your choice with **Yes** or **No**. **No** is also used to de-select a particular probe/channel.

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Temp - - -
Samples: 15
Interval: 2
Tot time: 30
Rec Time: Abs
PROBE SETUP Choose probe
|Temp|Lght|Volt|PrSS|Help| >>
```

Choose from the selection of probes.

```
HELP. Supported probes are..
Temp: temperature (°C)
Lght: Lght
Volt: voltage (V)
PrSS: pressure (kPa)
Mic: microphone
C1: Custom 1
C2: Custom 2
C3: Custom 3
|OK|
```

Help summarises the selection.

Please see the section on use of individual probes at the end of this document for more details.

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Temp - - -
Samples: 15
Interval: 2
Tot time: 30
Rec Time: Abs
PROBE SETUP Choose probe
|Mic|C1|C2|C3| | >>
```

>> displays further choices.

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Temp - - -
Samples: 15
Interval: 2
Tot time: 30
Rec Time: Abs
PROBE SETUP Calibrate?
|Yes|No|Cstm| |Help|
```

After selecting a probe you have the option to calibrate it. For the moment, press **No**. **No** selects the default stored calibration as supplied by probe manufacturers and returns you to the start of probe set up. You can now set up more channels or choose **DONE** to return to the main menu.

Calibration and conversion equations are explained later.

```
HELP. Calibrate options:
F1 Run calibration experiment
F2 Use default values
F3 Use custom conversion eqn
|OK|
```

Help reminds you of the calibration options.



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Setting up sampling

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Lght - - -
Samples: 15
Interval: 2
Tot time: 30
Rec Time: Abs
SETUP SAMPLING
[Reset] [Smp1] [Intv] [RecT] [Help] [Done]
```

Choose **SetS** from the main menu.

```
HELP
Sampling options are..
F1 Reset all
F2 Set number of Samples
F3 Set time between Samples
F4 Record time options
F5 Return to main menu
[OK]
```

Help explains the options at this stage.

'Reset all' clears all channels except CH1, which is set to take 15 samples at 2 second intervals using a temperature probe and with absolute time recording.

```
HELP
Real-time Graph options when:
Probes RecTime Interval
1 Abs 2.000000
unnum Abs 2.000000
unnum Off 2.000000
unnum Abs 2.000000
[OK]
```

Help also summarises conditions for real time data graphing.

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Lght - - -
Samples: 15
Interval: 2
Tot time: 30
Rec Time: Abs
Rec Time option?
[Off] [Abs] [Rel] [Help]
```

RecT offers the choice of 3 record time options:

Off – time will not recorded or stored in a List.

Abs – time will be recorded continuously from the start.

Rel – time intervals between samples will be recorded.

```
HELP
Record time options are..
F1 Off - time not recorded
F2 Absolute, sequential time
F3 Relative, time intervals
[OK]
```

Help summarises the record time options.

```
Time (seconds)
between samples
Type number, then EXE
[.001 to 16000]
?
0.1
```

Choose **Intv** to set the time interval between samples.

Enter a value and press EXE.

```
Number of samples
Type number, then EXE
[1 to 255]
?
100
```

Choose **Smpl** to set the number of data samples required.

Enter a value and press EXE.



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All set to GO!

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Lght - -
Samples: 100
Interval: 0.1
Tot time: 10
Rec Time: Abs
Wait! Checking memory...
Go Get Sets SetP Help Exit
```

Go initiates sampling. The EA-100 must be on and connected to the calculator at this stage.

First a memory check is carried out – sampling a large number of points with several probes can use up all your free memory, an annoying thing to discover after the experiment is over!

See memory notes below if you get a Mem ERROR.

You may also be offered the option for a real-time plot at this stage. See below for details.

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Lght - -
Samples: 100
Interval: 0.1
Tot time: 10
Rec Time: Abs
Wait! Initialising EA100...
Go Get Sets SetP Help Exit
```

Next, the EA-100 is initialised ready for sampling.

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Lght - -
Samples: 100
Interval: 0.1
Tot time: 10
Rec Time: Abs
All OK. F1 to Start Sampling
Go Get Sets SetP Help Exit
```

When all is set and experimental equipment is ready press **Go**.

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Lght - -
Samples: 100
Interval: 0.1
Tot time: 10
Rec Time: Abs
Sampling... When DONE press F1
F1 Halt Quit
```

The word ‘Sampling’ will flash on the EA-100 screen. Wait until this stops and ‘Done’ appears (again on the EA-100) before continuing.

For long experiments choose the **Quit** option to return to the main menu and **Exit** from the program. Data can be retrieved from the EA-100 later using the **Get** option, freeing up your calculator for other work.

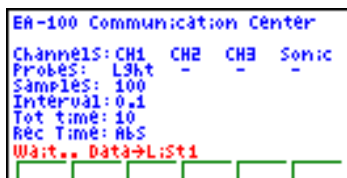
```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Lght - -
Samples: 100
Interval: 0.1
Tot time: 10
Rec Time: Abs
Press HALT on EA100, then OK
OK
```

If things aren’t working out as planned with your experiment use the **Halt** option to stop sampling and return to the main menu.



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Download from the EA-100



Data is transferred to the calculator in two situations. The first is when sampling has finished and you continue by pressing F1. The second is when you choose **Get** from the main menu, either because you quit the program whilst sampling took place or you wish to download sampled data into several calculators. In this second case, it is important that the channel(s) and record time settings match the original set up otherwise data transfer will fail.

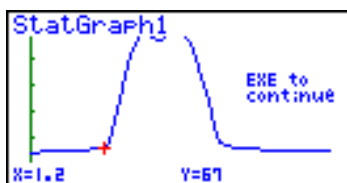


Once data is transferred to the lists (in order Time, CH1, CH2, etc where used) the option to Round can be chosen.

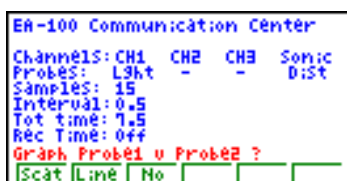
<i>Rounding is</i>	<i>Max value in List</i>	<i>Rounding</i>
<i>carried out as</i>	<i>< 10</i>	<i>2 dp</i>
<i>shown:</i>	<i>10 - 100</i>	<i>1 dp</i>
	<i>> 100</i>	<i>0 dp</i>



If record time was set to Abs then the option to graph time v data is available. Choose from a scatterplot, an xy line plot or no graph. The line option is usually best.



Here a line plot was chosen for a single probe. If more than one probe was used, each plot is superimposed on top of the others. Pressing SHIFT F1 and using the cursor keys enables tracing along the last graph drawn. Press EXE to return to the main menu.



If record time was set to Off and two probes were used then the option to graph one probe v the other is available. Choose from a scatterplot, an xy line plot or no graph. The scatterplot is usually best.



Here a scatterplot of distance from light source v light intensity is shown. SHIFT F1 again enables tracing through the points. Press EXE to return to the main menu.



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Real time sampling

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Lght - -
Samples: 50
Interval: 2
Tot time: 100
Rec Time: Abs
Display plot real-time?
Yes No
```

If the real time sampling option is available then choose **Yes** or **No**. This option is available when:

Probes	Record Time	Interval
1	Abs	>1.2s
2	Abs	>1.8s
2	Off	>1.8s
3	Abs	>2.5s

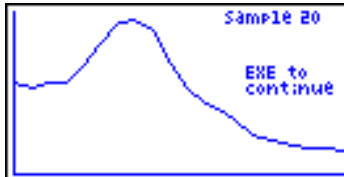
Bear in mind that once real time sampling is chosen, it is not possible to later use the Get option to download copies of the data. Sampled data is stored straight to Lists, where it can be later analysed.

```
Vertical graph scl
Ymin → Ymax
Ymin?
0
Ymax?
500
```

If **Yes** was chosen you will need to set up graph scales.

Use the EA-100 unit in multimeter mode to get an idea of the range of values expected.

For 2 probes with record time Off, both vertical and horizontal scales need setting.



This is an example of real time sampling with one probe and record time set to absolute.



This is an example of real time sampling with two probes and record time set to off.



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Exit the program

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Temp - - -
Samples: 15
Interval: 2
Tot time: 30
Rec Time: Abs
EXIT! Save current Settings?
|Yes|No|_|_|_|_|
```

Choosing **Exit** from the main menu prompts whether you wish to save current settings. Choose **Yes** or **No**. This is useful if you plan to repeat the experiment or download data later.

```
Settings data Saved
in Matrix Z
Calculator RESET
or other use of Matrix Z
will lose this data
(C) Charlie Watson 13:Sept:99
|OK|
```

The settings are saved in Matrix Z, and the program reminds you of this and gives a couple of warnings.

Check you have the latest version of GETDATA2 from the date on this screen. Updates probably exist if your program is more than 6 months old.

Check out at the ACES website:
<http://www.school.casio.com.au>

or the authors site:
<http://carmen.murdoch.edu.au/~cwatson/casio.html>

Probe calibration

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Temp - - -
Samples: 15
Interval: 2
Tot time: 30
Rec Time: Abs
PROBE SETUP Calibrate?
|Yes|No|CStm|Help|_|
```

Choosing **Yes** from the probe calibration menu leads you through the following screens.

```
HELP. Calibrate options:
F1 Run calibration experiment
F2 Use default values
F3 Use custom conversion eqn
|OK|
```

Help summarises the options available.

```
Calibration expt
to find a,b: y=ax+b
How many cal. points
?
2
```

Calibration experiments need a minimum of two points. Only linear calibration is currently possible. Enter the number of points and press EXE.



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Probe calibration (continued)

```
Calibrate Probe...
1st remove all other
Probe(s) from EA100

Then press EXE
```

Remove all other probes from the EA-100 before beginning the calibration.

```
Point 1 Wait for
steady reading then
long press EXE
Reading= 105.6
* recorded *
Value?
100
```

Once a steady reading is achieved on the calculator screen hold EXE down until * recorded * appears. Then enter the known value at this calibration point and press EXE.

```
Point 2 Wait for
steady reading then
long press EXE
Reading= 194.9
* recorded *
Value?
200
```

Repeat the above steps for all calibration points.

```
Using y=ax+b coeffs
a=1.119820829
b=-18.25307951

EXE to cont..
```

The final screen shows you the calculated linear conversion equation which will automatically be applied to all sampled data by the EA-100 unit.

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Lght - -
Samples: 15
Interval: 2
Tot time: 30
Rec Time: Abs

Go Get Sets SetP Help Exit
```

Note that the main menu screen displays a small orange 'c' above any channel using either calibrated or custom conversion equations.

Custom conversion equations

```
Custom conv eqn
y=ax+b
a?
1.8
b?
32
```

When offered the calibrate probe option, choosing **Cstm** allows you to enter your own conversion custom equation. Enter a value for 'a', press EXE, a value for 'b' and press EXE to return to the main menu. A small orange 'c' will be displayed just above the channel to indicate the use of a conversion equation.

The screen shown is an example of how to take temperature readings in Fahrenheit instead of the default Centigrade units. See the individual probe information below for more conversion equations for different probes.



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Using a trigger to initiate data sampling

Triggering means you set a value for the probe to reach before sampling begins.

For example, you might want to record the air temperature overnight. With the temperature probe in CH1 and a light probe in CH3, you can start sampling when it gets dark by setting the light probe as a trigger. The trigger value would be about 50 and triggering should occur as the light intensity falls down through this value.

Alternatively, you might want to find the speed of sound by clapping your hands near the microphone and measuring the time an echo takes to bounce back off a nearby wall. The time would be very short and if sampling was started manually it would be nearly impossible to capture the sounds at the right time. In this case use the microphone in CH3 and set a trigger value of about 3 to rise through before sampling begins. Background noise would not trigger sampling but a loud clap will, which is exactly what is required.

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Lght - -
Samples: 15
Interval: 2
Tot time: 30
Rec Time: Abs
PROBE SETUP Set Trigger?
Yes No
```

To use this option you must connect the trigger probe in CH3. The final option when setting up a probe in CH3 is to use it as a trigger.

```
Trigger value
?
250
Enter 0 for falling
or 1 for rising
?
1
```

Choose **Yes** and type in a value for the triggering to occur at, followed by EXE. Next decide whether the value should be reached by falling or rising and enter the appropriate 0 or 1, followed by EXE.

Remember to take into account the use of any conversion or calibration equations set when choosing the trigger value.

```
EA-100 Communication Center
Channels: CH1 CH2 CH3 Sonic
Probes: Lght - Lght -
Samples: 15
Interval: 2
Tot time: 30
Rec Time: Abs
Go Get Sets SetP Help Exit
```

Note the use of a trigger is shown in the main menu by a red 'T' underneath the CH3 probe.



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A note on calculator memory

If you reset your calculator before using this program, once the program is loaded and running the free memory will be around 16 000 bytes. Every number stored in a list needs 10 bytes, which means you should be able to store 1600 numbers in the lists. With a maximum of about 250 numbers per list that equates to 5 full lists, or 250 samples with time recorded + 4 probes. In other words, you should not encounter any memory problems (Mem ERROR). However, using any of the Help options within the program eats up a further 4100 bytes (maximum), so avoid this when using more than 2 probes. Also, any existing programs, matrices, list files, tables, dynamic graphs will all eat up free memory on a calculator which has not been reset first. The use of Memory Reset is therefore recommended before large sample activities are carried out with the GETDATA2 program.

A note on probes

Temperature	The supplied temperature probe does not react quickly to large temperature changes, so beware of this when sampling. Default unit is degrees Centigrade, range from -20 to 130 C. Use custom conversion equation for readings in Fahrenheit: $a = 1.8$ $b = 32$ Kelvin: $a = 1$ $b = 273.2$
Light	The supplied light probe measures relative intensity with values ranging from 100 to 999. Readings outside this range are often returned but they cannot be relied upon.
Voltage	The supplied voltage probes return voltages in the range from -10 to 10 V.
Pressure	The Vernier pressure probe has a range of 0 to 690kPa. Use custom conversion equation for readings in Atmospheres: $a = 2.20$, $b = 0$ Mm Hg: $a = 1670$, $b = 0$ In Hg: $a = 65.8$, $b = 0$ Bar: $a = 2.23$, $b = 0$ Psi: $a = 32.3$, $b = 0$



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A note on probes (cont)

- Microphone** The Vernier electret microphone returns a voltage centered on 2.5V (depending on internal batteries – see below). This voltage changes as the pressure on the microphone changes. The EA-100 minimum sample interval is 0.001s, which means that if trying to capture sound waves, the sampled frequencies need to be below about 200Hz. Even at 200Hz, only 5 points will be sampled per wave, which is barely enough. Also, a total of only 10 samples will still show 2 to 3 complete waves. Beware of sample rates which are close to multiples of the frequency.
- Custom** Select these options for any other probes. Use the manufacturers' specifications to complete a custom conversion equation or carry out a calibration experiment for each one.
- Motion detector** This probe has to be connected via the Sonic port and returns measurements in the range 0.5 to 6m. Use a custom conversion equation for readings in feet with $a = 0.305$ and $b = 0$.

Note: Experience shows that the state of the EA-100 internal batteries usually effects the accuracy of most probes which use amplifiers. The use of an external 6V power supply for the EA-100 can lead to more consistent and reproducible results.

Probes not supported

- Heart rate** The program GETPULSE (free from ACES website) is the best vehicle to explore heart rates. If you want to have a look at how the Heart Rate probe works with GETDATA2, set up a custom channel with 200 samples at 0.03s intervals. You will then see that the amplifier takes around 3 seconds to adjust before a pulse becomes visible.
- Ph** The program GETPH (free from ACES website) is designed for use with the Vernier Ph System. The nature of the amplifier in this system makes it unsuitable for use with GETDATA2. Again, you can set up a custom channel (use the manufacturers calibration equation with $a = -3.838$ and $b = 13.72$), but the time the amplifier needs to 'warm up' means sampling times of less than a minute produce very inaccurate results.



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Lists

The Lists in the graphics calculator (STAT or LIST mode) are used to store sampled data as follows:

- List 1 - time (seconds) or data from lowest channel used if record time off.
- List 2 - data from next channel used
- List 3 - data from next lowest channel (if used)
- List 4 - data from remaining channel (if used)
- List 5 - data from remaining channel (if used)

Eg. If the record time was Abs, the voltage probe was in CH1 and the temperature probe in CH3 then List 1 would contain times, List 2 would contain voltages and List 3 would contain temperatures.

Error messages

To clear an error message on the EA-100 unit press **HALT**.

To clear an error message on the graphics calculator press **AC/ON**.

Typical causes of the following error messages are:

Com ERROR	Cable missing or not properly inserted between calculator and EA-100. Make sure cable is inserted at both ends with a 'click'. Also error message still on EA-100 screen, probes not in correct sockets or too many probes connected during calibration.
Mem ERROR	Not enough memory free on calculator - you need to free up memory (see above) or take fewer samples. Check memory usage in MEM from the MAIN MENU.
Syn ERROR	The GETDATA2 program has become corrupted. Delete and load a fresh version.
Ma ERROR	Usually caused by the calculator trying to divide by zero - for instance when trying to auto-scale a graph but all data points have the same value. Check your probe set up – are they all in the correct sockets?

The program GETDATA2 was first written, documented and released by Charlie Watson in September 1999. It is freely available, together with sample data logging activities for biology, chemistry and physics from the Australian Casio Education Site (<http://www.school.casio.com.au>).

Charlie Watson may be contacted through his website (<http://carmen.murdoch.edu.au/~cwatson/casio.html>)