

MCA-527

Digital Multi-Channel Analyzer

Description of the MCA527 Oscilloscope Mode

Exclusion of liability

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1 Mca527osc.dll

If you are developing a MS Windows (32 bit) application, the easiest way to use the MCA527 oscilloscope mode is linking the mca527osc.dll to your application. Mca527osc.dll is the library that is used by our own applications. Only one function has to be called from your application. If you are interested in mca527osc.dll, ask [GBS Elektronik GmbH](#) for required files and information.

2 Programming the MCA527 Oscilloscope Mode

If you are developing for other operation systems, you have to use the firmware commands directly. This requires some more information about the functional principle of the MCA527 oscilloscope mode. This chapter approaches the needed firmware commands. Further information about it you can find within the document "Description of the MCA527 Firmware Commands"¹.

This description refers to MCA527 firmware version 11.16 or higher.

2.1 Preliminary Consideration

This chapter contains advices for developers. You are free to heed they or not. The advices are particularly helpful if your application shall have regards for other applications especially from GBS Elektronik GmbH.

Typically, the oscilloscope mode is only a temporary mode within an application. In the most cases an application runs the MCA527 in MCA mode and only switches to the oscilloscope mode for checking the signal shape.

Before an application enters the oscilloscope mode, it should make provision for safely returning to the previous mode. The needed data should be saved within the data user memory. This practice is recommendable with regard to possible software crashes, connection interrupts or other mishaps.

Before an application exits the oscilloscope mode, it should save all used parameters, that are not automatically saved by the MCA527, within the user data memory. This is advantageous for re-entering the oscilloscope mode.

The following table shows the use of the user data memory by our "MCA-527 Oscilloscope" application.

Byte offset 260	The string "OSCI" declares the validity of the oscilloscope setup.
Byte offset 264	Vertical offset [mV]: With assistance of this value, the ground line is shifted. The value is converted into an offset DAC value.
Byte offset 266	Bit 5 ... 0: Volt/DIV: 0=ADC full scale, 1=2V, 2=1V, 3=500mV, ..., 11=1mV Bit 11 ... 6: Vertical position: -5,-4,-3, -2, -1, 0, 1, 2, 3, 4, 5 Bit 15 ... 12: Trigger mode: 0=Free run, 1=Continues, 2=Single
Byte offset 268	Trigger level [mV]: Used if Volt/DIV is unequal to "ADC full scale".
Byte offset 270	Trigger level [ADC digits]: Used if Volt/DIV is equal to "ADC full scale".
Byte offset 272	5 bytes reserved
Byte offset 277	Bit 0: reserved, Bit 1: reserved, Bit 2: "Min" button checked, Bit 3: "Max" button checked, Bit 4: "P-P" button checked, Bit 5: "Avg" button checked, Bit 6: "RMS" button checked, Bit 7: "SD" button checked
Byte offset 278	18 bytes reserved

¹ MCA527_Firmware_Commands_XXXX_XX_XX.pdf

2.2 Settings

The oscilloscope mode is entered with the firmware command `CMD_SET_GENERAL_MODE`. Set the general mode to `GMODE_OSCILLOSCOPE = 2`.

The fundamental parameters for the oscilloscope mode are trigger source, threshold, resolution and position. They can be set with the firmware command `CMD_SET_OSCI_TRIGGER`.

The **trigger source** can be set to:

0	untriggered
1	triggered at rising edge
2	triggered at falling edge
3	triggered at both edges
4	triggered by the selected trigger filter ²

The **threshold** can be from 0 to 16383. It refers to ADC digits and is meaningful if the trigger source is set to rising, falling or both edges. It is possible to convert the ADC digits into voltage values. This conversion is described in chapter 2.5.

The **resolution** specifies the time interval between two data points. The values -5 ... 0 result in the same time interval but with the assistance of this values, the application can scale the time axis of the oscilloscope screen. (The right column shows the resulting interval per division for an oscilloscope screen with 500 pixel width and 10 divisions.)

The resolution can be set to:

-5	100ns	(100ns/DIV)
-4	100ns	(200ns/DIV)
-3	100ns	(500ns/DIV)
-2	100ns	(1µs/DIV)
-1	100ns	(2µs/DIV)
0	100ns	(5µs/DIV)
1	200ns	(10µs/DIV)
2	400ns	(20µs/DIV)
3	1µs	(50µs/DIV)
4	2µs	(100µs/DIV)
5	4µs	(200µs/DIV)
6	10µs	(500µs/DIV)
7	20µs	(1ms/DIV)
8	40µs	(2ms/DIV)
9	100µs	(5ms/DIV)
10	200µs	(10ms/DIV)
11	400µs	(20ms/DIV)
12	1ms	(50ms/DIV)
13	2ms	(100ms/DIV)

The **position** can be from 0 to 499. It defines the data point that marks the trigger point and is meaningful if the trigger source is set to "triggered".

2.3 Starting and Stopping the Oscilloscope Measurement

The oscilloscope measurement is started with the firmware command `CMD_START`. All parameters of this command are ignored in oscilloscope mode. The oscilloscope measurement is stopped again with the firmware command `CMD_STOP`. Each time before the application calls a setting firmware command, it has to stop the oscilloscope measurement and restart it again.

² see `CMD_SET_TRIGGER_FILTER`

2.4 Transferring Oscilloscope Data

The oscilloscope data are transferred with the firmware command `CMD_QUERY_OSCI_SCREEN`. This command is only callable during a running oscilloscope measurement. The use of the firmware command depends on trigger source and resolution.

2.4.1 Triggered Measurement, Resolution = 100ns

In this case, the parameter of the firmware command `CMD_QUERY_OSCI_SCREEN` is ignored. The value at byte offset 0 of the result data array is the start position of the received data within the MCA527 data memory. With the assistance of this value, the application can check the validity of the received data (byte offset 8). If it is unequal -1, the data are valid. If it is equal to the value returned by the previous call of the firmware command, the data are unchanged. The received data corresponds to the ADC value of 500 data points.

2.4.2 Triggered Measurement, Resolution > 100ns

If the interval between two data points is greater than 100ns, several samples are condensed corresponding to the resolution to one data point. Each data point consists of a data pair, minimum and maximum value of the condensed samples. As a consequence of this, the firmware command `CMD_QUERY_OSCI_SCREEN` must be called twice for transferring 500 data points. At the first call of the firmware command, the parameter must be -1. The application has to check the start position of the received data (byte offset 0 of the result data array). If it is unequal -1, the received data (byte offset 8) are valid and the application has to call the firmware command a second time to transfer the second data half. This time the parameter must be equal to the start position of the subsequent data (byte offset 4 of the result data array of the first firmware command call). The application has to check the start position of the received data (byte offset 0 of the result data array) again. There are three possible results:

1. The value (start position of the received data) is equal to the passed parameter (start position of the subsequent data). In this case, all 500 data points has been successfully received.
2. The value is equal to -1. In this case, the subsequent data are no more available. The application must restart the transfer with the first firmware command call.
3. The value (start position of the received data) is unequal to the passed parameter (start position of the subsequent data). In this case, the received data are not the subsequent data, because they are no more available, but new data are available. The application can take this data as the first data half and has to transfer the second data half by a further firmware command call with parameter equal to the start position of the new subsequent data (byte offset 4 of the result data array of the previous firmware command call).

2.4.3 Untriggered Measurement

The firmware command `CMD_QUERY_OSCI_SCREEN` is called with parameter equal to -1. If the resolution= 100ns, the received data are ready to use. If the resolution > 100ns, the firmware command has to be called a second time to transfer the second data half. This procedure is similar to procedure described in section 2.4.2.

2.4.4 Transferring Extended Oscilloscope Data

Since firmware version 12.03 the MCA527 can deliver more data than only the ADC digits. It can additionally deliver the results of a convolution of the measured data with the trigger filter and the results of a convolution of the measured data with the main filter.

A prerequisite for getting the extended oscilloscope data is, however, that the resolution = 100ns. In order that the extended oscilloscope data are calculated, the command `CMD_QUERY_OSCI_DATA_EX` instead of `CMD_QUERY_OSCI_DATA` has to be used. The command has to be passed flags that determine which calculations shall be done. The results can be read with `CMD_QUERY_OSCI_TRIGGER_FILTER_RESULTS` and `CMD_QUERY_OSCI_TRIGGER_MAIN_RESULTS`.

2.5 Conversion of ADC digits into voltage values

The conversion factor depends on the coarse gain³. It is calculated according to the following formula:

$$\text{conversion factor} = \frac{25000 \text{ mV}}{16384 \cdot \text{coarse gain}}$$

The ground line can be determined with assistance of the firmware command `CMD_QUERY_ADJUSTMENT_TABLE`. Its result array contains six pairs of calibration values. They are valid if they are unequal to -1. They are measured with the six real hardware coarse gain settings, always with Offset DAC = 1024 and Offset DAC = 15360, at open signal input. Based on these values, the ADC value which corresponds to the ground line can be interpolated.

³ Only the coarse gain values 2, 5, 10, 20, 50 and 100 are really switched by the MCA527 hardware. The higher coarse gain values are generated by the firmware with real hardware coarse gain = 100.