APPLICATION NOTES

4D SYSTEMS
TURNING TECHNOLOGY INTO ART

Serial uSD Card Access FAT16

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Description

This application note explains how to access the uSD card mounted on a Picaso or a Diablo16 display module in the Serial environment. Here is a list of items required to replicate this application:

- Any of the following Picaso display modules:

uLCD-24PTU gen4-uLCD-24PT	uLCD-28PTU gen4-uLCD-28PT	uVGA-III gen4-uLCD-32PT

  and other superseded display modules which support the ViSi environment

- The target module can also be a Diablo16 display

gen4-uLCD-24D Series	gen4-uLCD-28D Series	gen4-uLCD-32D Series
gen4-uLCD-35D Series	gen4-uLCD-43D Series	gen4-uLCD-50D Series
gen4-uLCD-70D Series		
uLCD-35DT	uLCD-43D Series	uLCD-70DT

  Visit www.4dsystems.com.au/products to see the latest display module products that use the Diablo16 processor.

- 4D Programming Cable / µUSB-PA5/µUSB-PA5-II
  for non-gen4 displays (uLCD-xxx)
- 4D Programming Cable & gen4-IB / gen4-PA / 4D-UPA,
  for gen-4 displays (gen4-uLCD-xxx)
- micro-SD (µSD) memory card
- Workshop 4 IDE (installed according to the installation document)
- When downloading an application note, a list of recommended application notes is shown. It is assumed that the user has read or has a working knowledge of the topics presented in these recommended application notes.

Content

Application Overview

In this application note, the basic commands available for accessing a FAT16-formatted uSD card are discussed. The sample application uses the File Mount, File Open, File Write, File Read, and File Close commands to show the basics of writing to and reading from a uSD card.

This application note uses a Picaso display module as the sample model, but the procedures are also applicable to Diablo16 display modules. The main difference between a Picaso display and a Diablo16 display with respect to the Serial environment is the bytes used for the serial commands. The serial command bytes for clearing the screen and sending a string, for instance, are different for each graphics processor.

	Picaso	Diablo16
Clear screen	0xFFCD	0xFF82
Put string	0x0018	0x0018

A user with a Diablo16 display module must have to consider this fact when using this application note as a reference.

Setup Procedures

The display must be configured as a slave device first before it can be controlled by a host. For instructions on how to launch Workshop 4, how to connect the display module to the PC, and how to configure the display as a slave device, kindly refer to the section "**Setup Procedure**" of any of the application notes below. Choose according to your display module's processor.

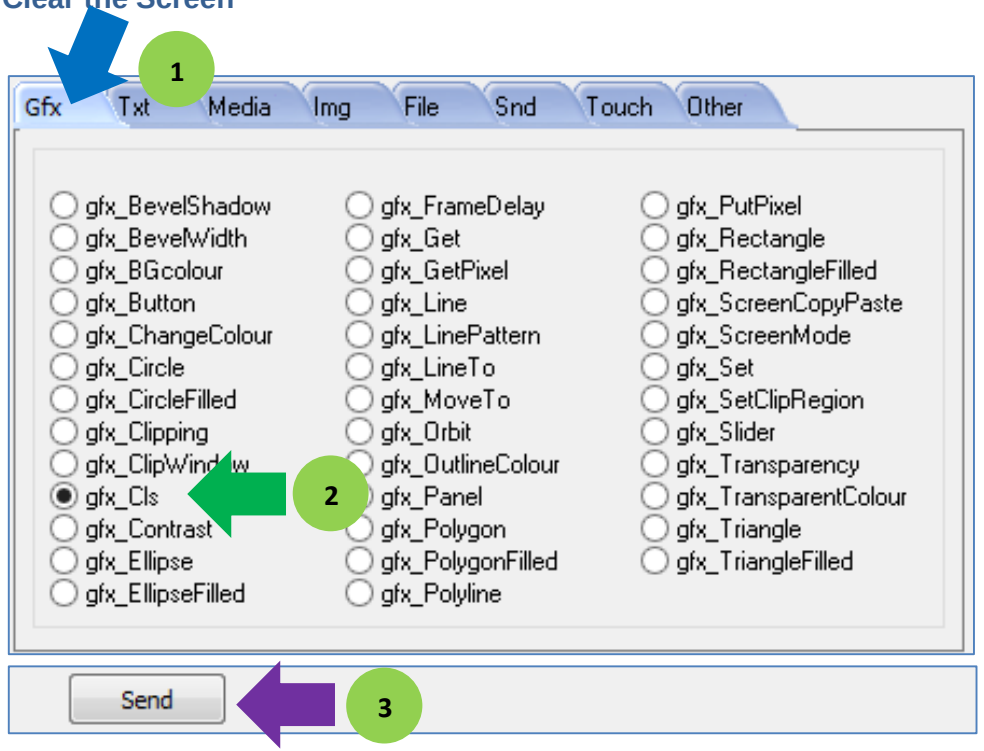
Serial Picaso Getting Started - The SPE Application

Serial Diablo16 Getting Started - The SPE Application

These application notes also introduce the user to the Serial Protocol thru the use of the Serial Commander.

Control the Display

Clear the Screen



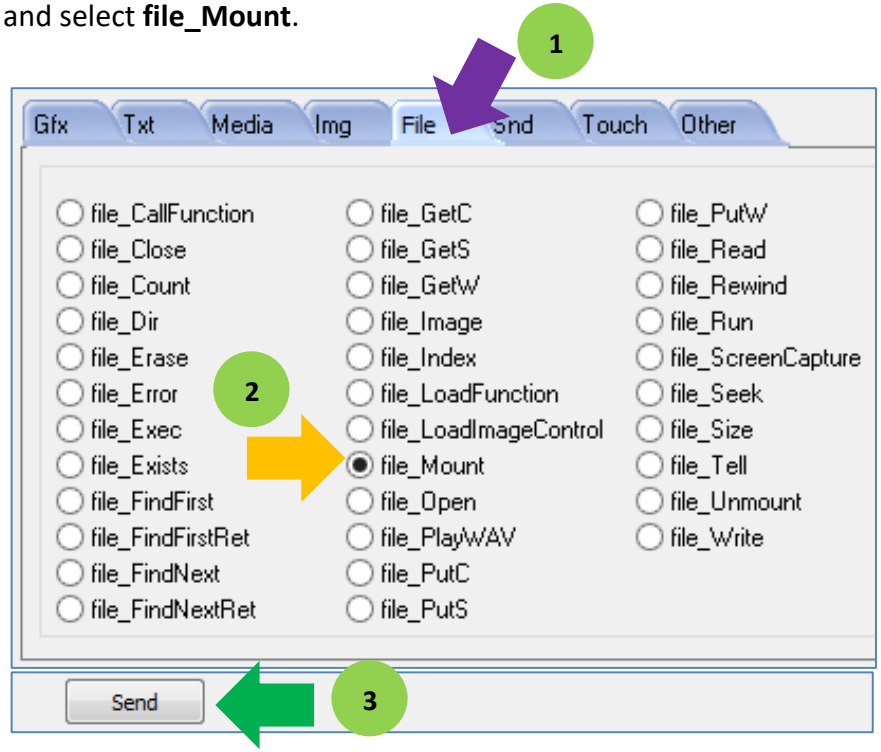
The bytes sent and received are:

```
gfx_Cls[FFCD ] 0.020 (ACK)
```

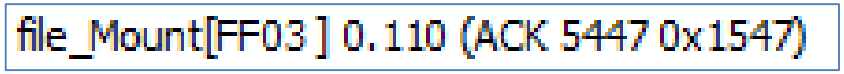
The screen should now be cleared.

Mount the uSD Card

Mount a FAT16-formatted uSD card on to the display module. Go to the **File** tab and select **file_Mount**.



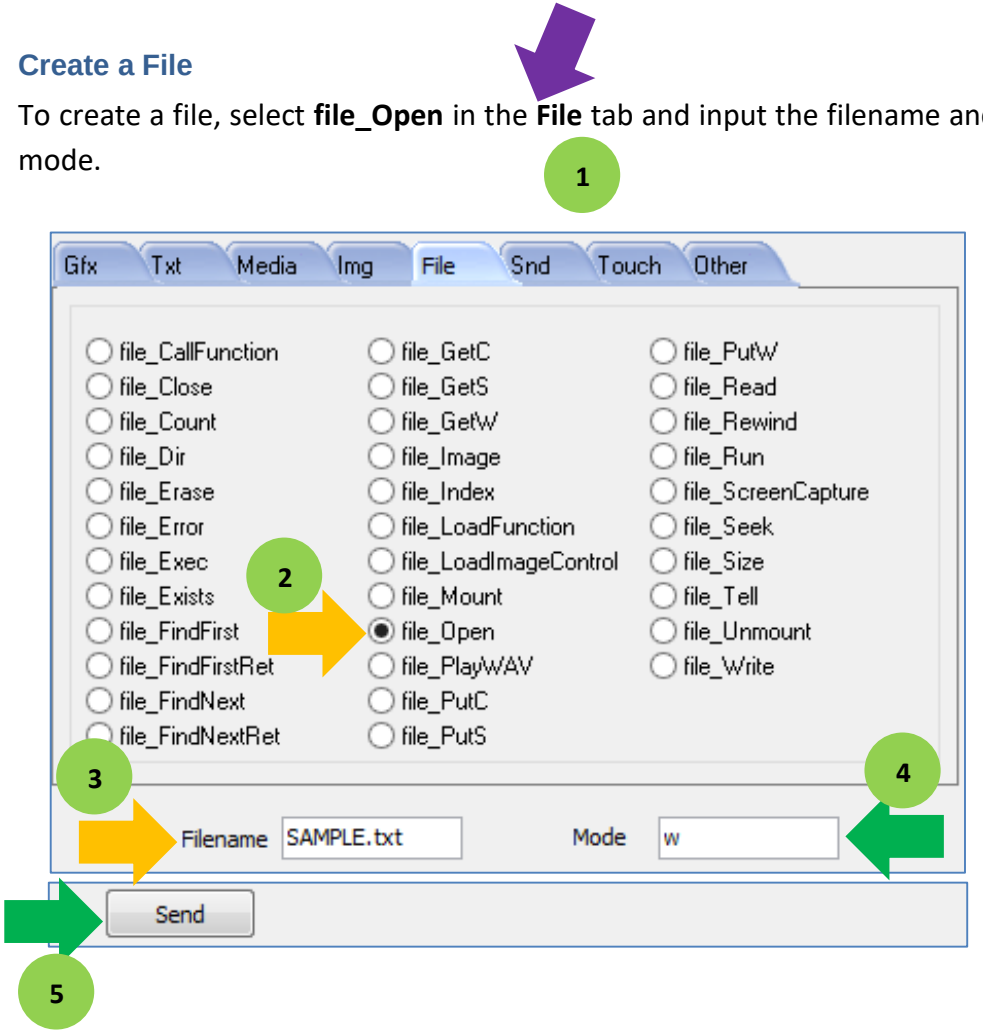
The bytes sent and received are:



This command starts up the FAT16 disk file services and allocates a small 20 byte control block for subsequent use. The **file_Mount** command must be sent before any other FAT16 file related functions can be used. The response will be an **ACK (0x06)** followed by a non-zero number **(5447 decimal or 0x1547 hexadecimal** in this example) if the command is successful, or zero (**0x00**) if unsuccessful.

Create a File

To create a file, select **file_Open** in the **File** tab and input the filename and mode.



The bytes sent and received are:

```
file_Open[000A "SAMPLE.txt" 'w'] 0.039 (ACK 5162 0x142A)
```

The returned value "**5162**" or "**0x142A**" in hexadecimal is the 16-bit file handle. **This value could be different in your case.**

The filename parameter is the name of the file to be opened (passed as a string). The mode parameter can be any of the following:

FILE_READ or 'r'
FILE_WRITE or 'w'
FILE_APPEND or 'a'

Note: If a file is opened for write mode 'w', and the file already exists, the operation will fail.

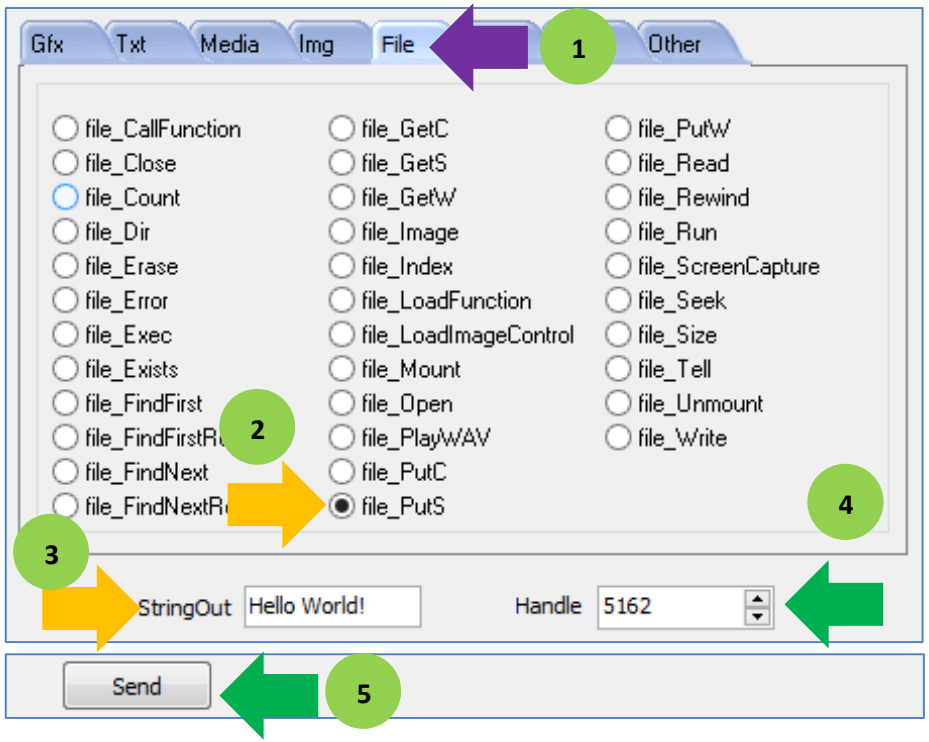
This command creates a new text file named "SAMPLE.txt" in the uSD card. The mode is 'w', which means that the file is opened for writing. **The display replies with the file handle if the file exists or if opened successfully. The file 'handle' that is created is now used as reference for further file commands such as "File Close", etc.**

For File Write and File Append modes ('w' and 'a') the file is created if it does not exist. If the file is opened for append and it already exists, the file pointer is set to the end of the file ready for appending, else the file pointer will be set to the start of the newly created file.

If the file was opened successfully, the internal error number is set to 0 (i.e. no errors) and can be read with the "File Error" command. For File Read mode ('r') the file must exist else a null handle (0x00, 0x00) is returned and the 'file not found' error number is set which can be read with the "File Error" command.

Write a String to the File

To write a string to the file, select **file_PutS** in the **File** tab and input the string and file handle. Note that the file handle refers to “SAMPLE.txt”, which was opened previously.



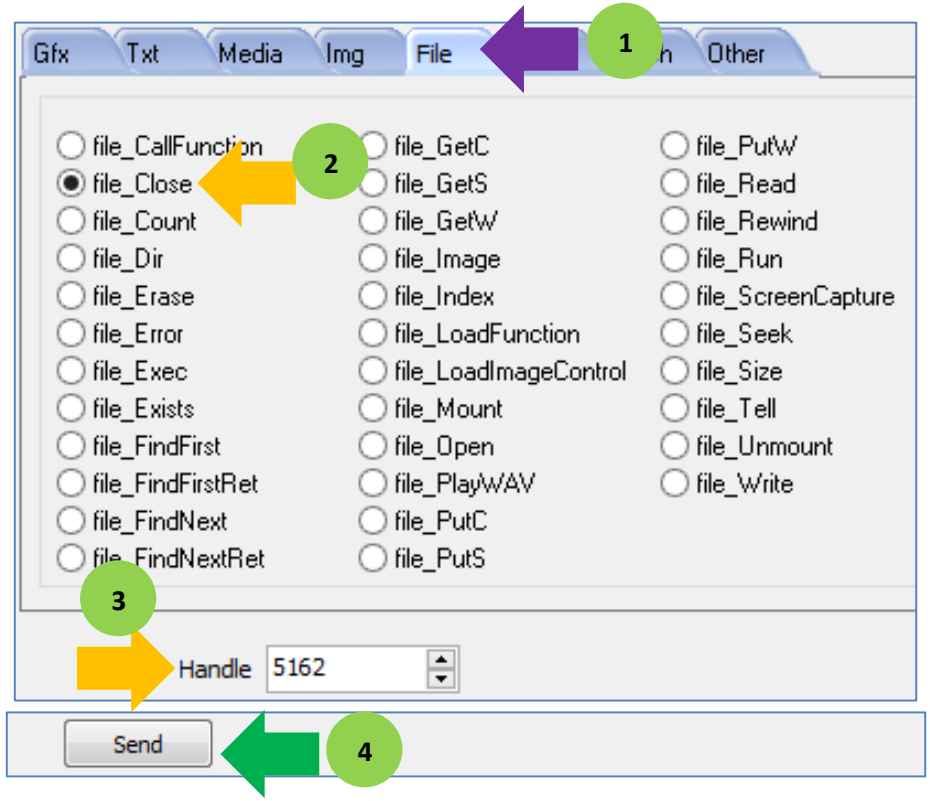
The bytes sent and received are:

```
file_PutS[0020 "Hello World!" 142A] 0.022 (ACK 12 0x000C)
```

This function writes a null terminated string to the file, at the position indicated by the associated file-position pointer and advances the pointer appropriately. The file must be previously opened with 'w' (write) or 'a' (append) modes. The display replies with an **ACK** and the **number of characters** written (excluding the null terminator).

Close the File

To close the file, select **file_Close** in the **File** tab and input the file handle. Note that the file handle refers to “SAMPLE.txt”.



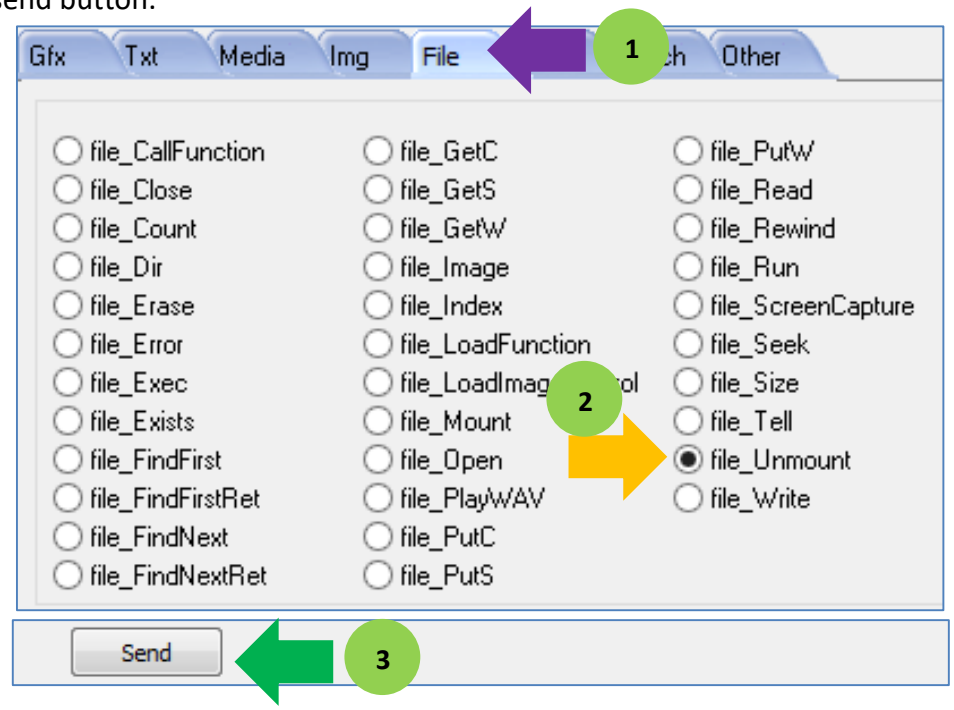
The bytes sent and received are:

```
file_Close[FF18 142A] 0.015 (ACK 1 0x0001)
```

The **file_Close** command will close a previously opened file. The display replies with an **ACK** and the **status**. Value of status can either be "**1**", which means that the file was successfully **closed**, or "**0**", which means that the file was **not closed**.

Unmount the uSD Card

To unmount the uSD card, select **file_Umount** in the **File** tab and click on the send button.



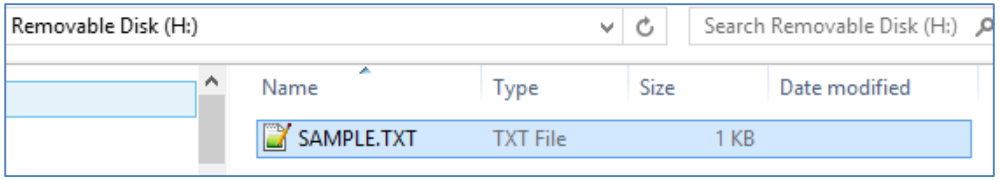
The bytes sent and received are:

```
file_Unmount[FF02 ] 0.004 (ACK)
```

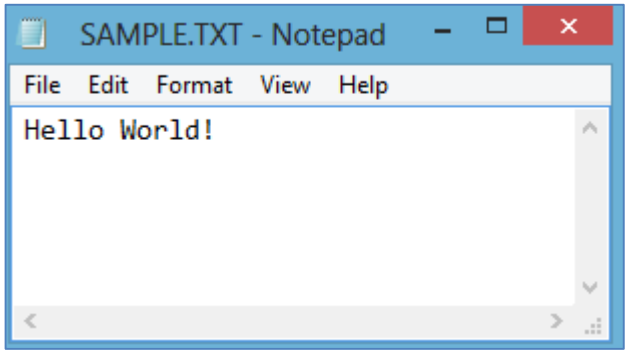
The **file_Unmount** command releases any buffers for FAT16 and unmounts the Disk File System. The display replies with an ACK.

Edit the Contents of the Text File

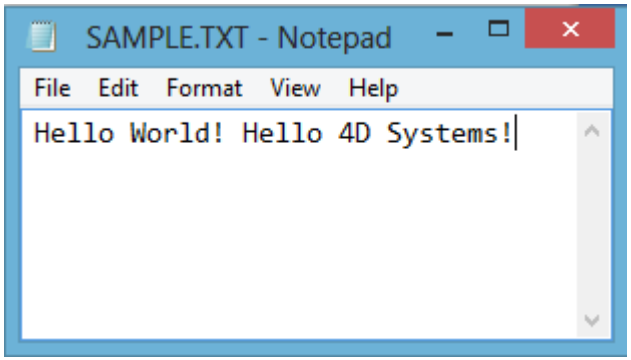
In the file explorer in Windows, the file “SAMPLE.txt” should be present in the uSD card.



The file should also contain the string “Hello World!”.



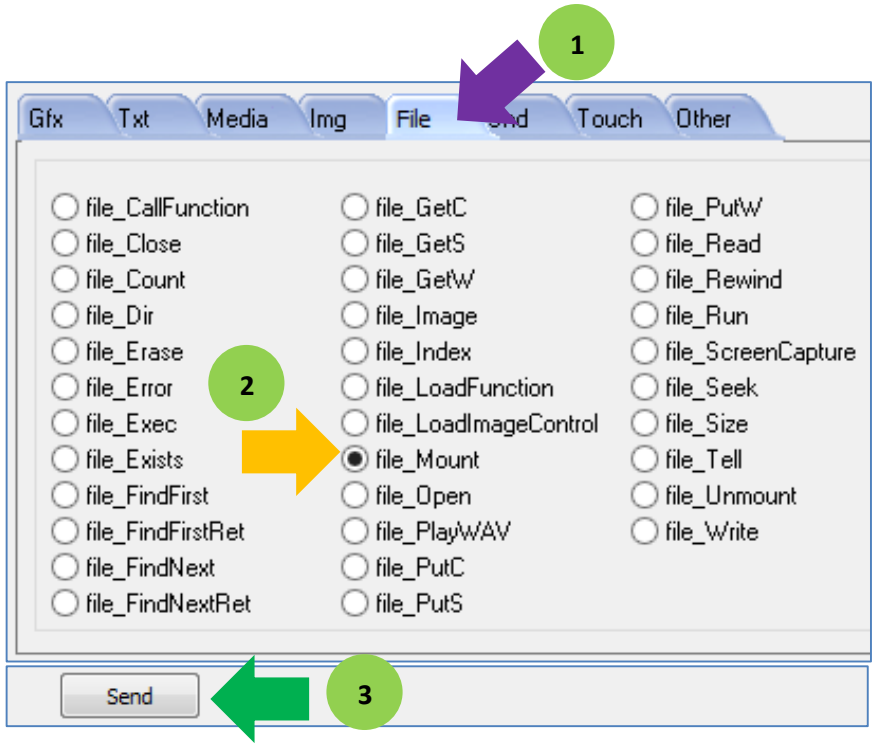
Append a string to the file. Here, the string “Hello 4D Systems!” is added.



Save the file, unmount the uSD card from the PC, and mount it back to the display module.

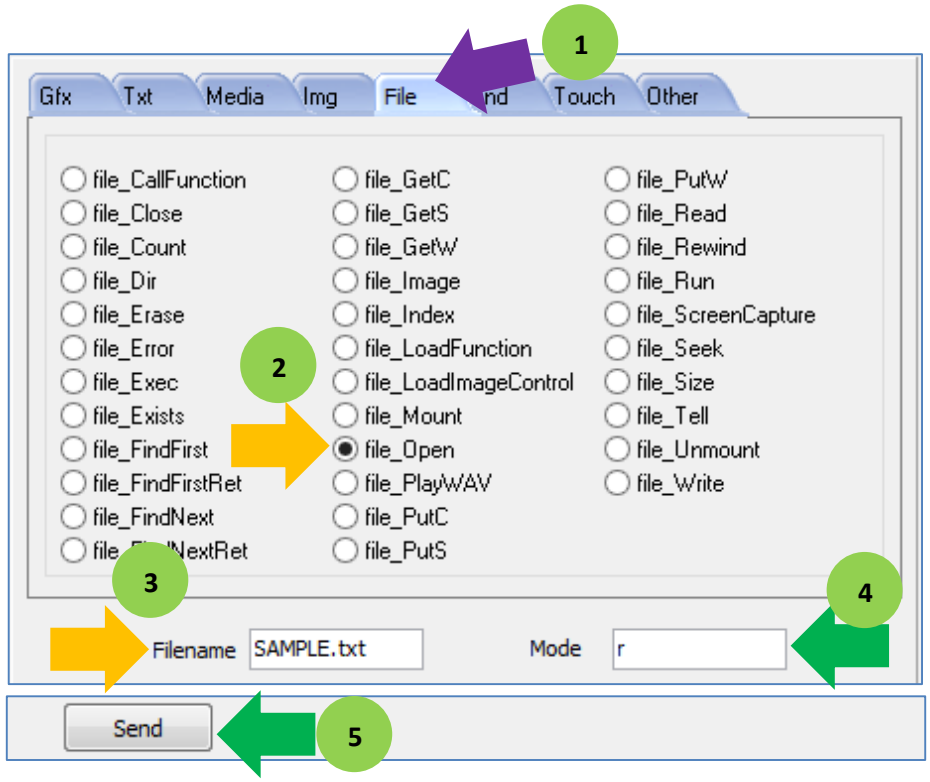
Mount the uSD Card

With the uSD card mounted onto the display module, it is necessary to perform a **file_Mount** first before sending any FAT-16 command, as was demonstrated earlier.



Open a File for Reading

To open an existing file for reading, select **file_Open** in the **File** tab and input the filename and mode.



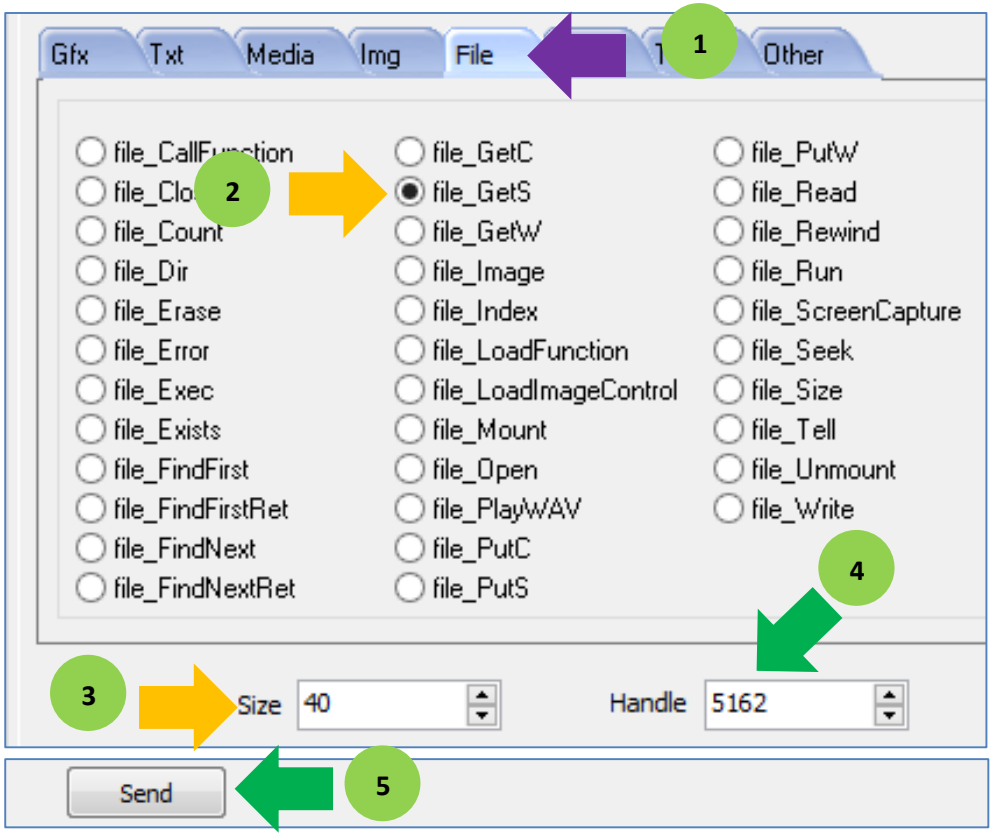
The bytes sent and received are:

```
file_Open[000A "SAMPLE.txt" 'r'] 0.022 (ACK 5162 0x142A)
```

The returned value "**5162**" or "**0x142A**" in hexadecimal is the 16-bit file handle. **This value could be different in your case.** As discussed earlier, the mode 'r' means that the file is opened for reading.

Read a String from the File

To read a string from a file, select **file_GetS** in the **File** tab. Input the size (maximum number of bytes to be read) and handle. We are expecting 30 characters from the file “SAMPLE.txt”.



The sent and received bytes are:

```
file_GetS[0007 0028 142A] 0.042 (ACK 30 0x001E, "Hello World! Hello 4D Systems!")
```

This function reads a line of text from a file at the current file position indicated by the associated file-position pointer (set by the “File Seek” or “File Index” commands) and advances the pointer appropriately. Characters are read until either a **newline** or an **EOF** is received or until the specified **maximum "size"** is reached. In all cases, the string is null terminated. The file must be previously opened with 'r' (read) mode.

The display replies with an **ACK**, the **number of characters** in the string, and the **string** itself.

Note: Before unmounting the uSD card from the display, it is necessary to close open files and perform a file_Unmount, as was demonstrated previously.

Proprietary Information

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