



SC115

CS I/O 2G Flash Memory
Drive with USB Interface



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- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations, such as those of the FAA in the USA.
- Use only qualified personnel for installation, use, and maintenance of tripods and towers, and any attachments to tripods and towers. The use of licensed and qualified contractors is highly recommended.
- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
- Wear a **hardhat** and **eye protection**, and take **other appropriate safety precautions** while working on or around tripods and towers.
- **Do not climb** tripods or towers at any time, and prohibit climbing by other persons. Take reasonable precautions to secure tripod and tower sites from trespassers.
- Use only manufacturer recommended parts, materials, and tools.

Utility and Electrical

- **You can be killed** or sustain serious bodily injury if the tripod, tower, or attachments you are installing, constructing, using, or maintaining, or a tool, stake, or anchor, come in **contact with overhead or underground utility lines**.
- Maintain a distance of at least one-and-one-half times structure height, 20 feet, or the distance required by applicable law, **whichever is greater**, between overhead utility lines and the structure (tripod, tower, attachments, or tools).
- Prior to performing site or installation work, inform all utility companies and have all underground utilities marked.
- Comply with all electrical codes. Electrical equipment and related grounding devices should be installed by a licensed and qualified electrician.

Elevated Work and Weather

- Exercise extreme caution when performing elevated work.
- Use appropriate equipment and safety practices.
- During installation and maintenance, keep tower and tripod sites clear of un-trained or non-essential personnel. Take precautions to prevent elevated tools and objects from dropping.
- Do not perform any work in inclement weather, including wind, rain, snow, lightning, etc.

Maintenance

- Periodically (at least yearly) check for wear and damage, including corrosion, stress cracks, frayed cables, loose cable clamps, cable tightness, etc. and take necessary corrective actions.
- Periodically (at least yearly) check electrical ground connections.

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SC115 CS I/O 2G Flash Memory Drive with USB Interface

1. Introduction

The SC115 is a portable 2-GB memory drive (thumb drive) compatible with Campbell Scientific CRBasic data loggers that have a CS I/O port. It shuttles data, OS, and program files between Campbell Scientific data loggers and a computer, or it remains connected to the data logger to augment data memory. It can be used in tandem with an external memory card.

The SC115 can also be used as a CS I/O to USB communications interface.

2. Cautionary Statements

- Corruption of multiple data files may occur if the SC115 is removed from the host data logger or computer during data transfer.
- Do not disconnect the SC115 from the host while the LED is flashing or lit. Always use the **Safely Remove Hardware** utility provided in the Windows® operating system prior to removal from a computer.
- Some data-collection modes increase the risk of inadvertently disconnecting the SC115 from the data logger during data transfer. See Section 12.1, *Preventing Data Corruption (p. 17)*, to assess the risk in a particular application.
- Always click **Disconnect** in the data logger support software prior to removing the SC115 when it is a communications interface. See Section 11, *Serial Communications Interface Function (p. 16)*, for communication interface details and precautions.
- Before the SC115 can be used as a CS I/O to USB communications interface or be configured through the *Device Configuration Utility (DevConfig)*, the device driver must be installed. *DevConfig* is used to install the device driver. Under **Device Type**, select **Peripheral | SC115**. Click **Install USB Driver** and follow the prompts.

3. Initial Inspection

Upon receipt of the SC115, inspect the packaging and contents for damage. File damage claims with the shipping company. Immediately check package contents against the shipping documentation. Contact Campbell Scientific concerning discrepancies.

4. Quickstart

The primary function of the SC115 is as a portable memory drive (thumb drive) to collect data from compatible Campbell Scientific data loggers (see Section 6, *Specifications (p. 3)*, for compatibility). Simply connect the CS I/O

connector of the SC115 to the CS I/O connector of a properly programmed data logger, and data is transferred automatically.

Memory drive setup (see Section 7, *Setup (p. 4)*, for complete instructions):

- SC115 – shipped from the factory ready for use in most applications.
- Data logger – as shown in the following code example, insert the **TableFile()** instruction into the data logger CRBasic program immediately following the **DataInterval()** instruction. This configuration enables the SC115 to collect the newest data in the data-collection mode (see Section 8.1, *Data-Collection Modes (p. 4)*). Note that in data-collection mode, data will only be written to the SC115 when it is first attached to a data logger. While left connected, no new data will be written to the SC115. Additional data will not be written to the SC115 until it is disconnected and reconnected to the data logger. For complete programming examples, see Section 10.5, *Example Programs (p. 12)*.

NOTE Use “CS9” as the drive name for GRANITE-series data loggers. Use “USB” as the drive name for all other CRBasic data loggers.

```
DataTable (Hourly,1,-1)
DataInterval (0,60,Min,0)
TableFile ("USB:"+Status.SerialNumber+"_Filename",8,-1,0,0,Min,0,0)
Sample (1,PanelTempC,FP2)
Minimum (1,BattVolt,FP2,0,False)
EndTable
```

5. Overview

The SC115 is a portable 2-GB memory drive (thumb drive) compatible with CRBasic data loggers that have a CS I/O port. It can be used in tandem with an external memory card. It shuttles data, OS, and program files between Campbell Scientific data loggers and a computer, or it remains connected to the data logger to augment data memory.

The SC115 can also be used as a CS I/O to USB communications interface.

The SC115 has a USB 2.0 compatible connector used to attach the SC115 to a computer USB port to allow stored data files to be copied to the computer. It also has a CS I/O 9-pin connector that attaches the SC115 to the CS I/O port of compatible Campbell Scientific data loggers. The SC115 may be connected directly to a computer or data logger, or connected through the supplied extension cables.

The 5 Vdc (pin 1) of the CS I/O interface determines whether the SC115 is used as a memory drive or as a CS I/O-to-USB communications interface. If the 5 Vdc pin is not driven high, it acts as a memory drive. If the 5 Vdc pin is driven high by the data logger, the SC115 will serve as a communications interface.

5.1 Memory Drive Function

As a memory drive, when the SC115 is attached to the CS I/O port of a data logger, the LED (Light Emitting Diode) first flickers as the SC115 and data logger negotiate communications. The data logger determines if the **TableFile()** instruction is set to write to an SC115. The LED flickers as the data logger copies data files to the SC115. The LED stops flickering when data transfer is complete, and the SC115 can safely be disconnected.

As a memory drive, when the SC115 is attached to a computer, the LED first lights solidly as it communicates with the computer to obtain a unique address. Once negotiations are finished, the LED extinguishes and the SC115 appears as a removable drive in Windows® Explorer. Data files on the SC115 can be copied or moved to other drives. Files, such as CRBasic program files or operating system (OS) files, can be copied or moved from computer drives to the SC115.

5.2 Communications Interface Function

As a communication device, the SC115 provides pass-through communications.

5.3 Features

- Portable 2-GB memory drive
- Shuttles data, OS, and program files or remains connected to data logger to augment memory
- Can be used as a CS I/O to USB communications interface
- Mean time between failure (MTBF): >1,000,000 hrs
- Sealed, over-moulded case. No serviceable parts.

6. Specifications

Compatibility

Data loggers: GRANITE series, CR9000X, CR6, CR3000, CR1000X, CR800 series, CR5000, CR1000

NOTE

A data logger can have only one SC115 connected.

Temperature

Operating: -25 to 50 °C

Power requirement

Source: 12 Vdc from data logger CS I/O port, or 5 Vdc through computer USB port

Load

Idle: 200 µA

Active: 35 mA

Memory

Capacity: 2 GB

Media: Flash

Transfer Speed over CS I/O:	Approximately 4 to 8 kBps ¹
Weight:	0.64 kg (0.14 lbs)
Dimensions:	105 x 43 x 21 mm (4.2 x 1.7 x 0.8 in)
Compliance information:	View the EU Declaration of Conformity at: www.campbellsci.com/sc115

¹This transfer speed is suitable for most environmental applications. However, high frequency applications (for example, sub-minute TableFile() output intervals) are best served by a CFM100 or NL116 with a compact flash card due to faster transfer speeds across the peripheral bus compared to the CS I/O bus.

7. Setup

The data logger requires inclusion of specific code in its CRBasic program to store data to the SC115. In rare instances, the SC115 may require a change to its default configuration through Device Configuration Utility software v. 1.5 or higher.

7.1 Data Logger CRBasic Programming

The data logger CRBasic program needs to include a **TableFile()** instruction to store data logger data on the SC115. The **TableFile()** instruction is entered in the declaration of the data table after the **DataInterval()** instruction. The parameters entered for the **TableFile()** instruction depend on the data-storage mode used (refer to Section 8, *Data-Storage Modes (p. 4)*). Section 10, *Data Logger Programming (p. 6)*, discusses, in detail, data logger programming, and provides several data logger programming examples.

7.2 SC115 Settings (Optional)

The default SDC addressing in the SC115 is adequate for most applications. For exceptional circumstances, the CS I/O SDC address can be altered using *DevConfig* v. 1.5 or higher (see Section 14.1, *SDC Addressing (p. 20)*).

NOTE

Before the SC115 can be configured through *DevConfig*, the device driver must be installed. *DevConfig* is used to install the device driver. Under **Device Type**, select **Peripheral | SC115**. Click **Install USB Driver** and follow the prompts.

8. Data-Storage Modes

The data logger CRBasic program specifies the SC115 data-storage mode through the **TableFile()** instruction. The **TableFile()** instruction also determines what data the SC115 will receive from the data logger. Data-collection modes and residential modes are available.

8.1 Data-Collection Modes

Data-collection modes are sometimes referred to as ‘plug and pull’ collection. The SC115 is plugged into the data logger then pulled from it. With these modes, data collection is automatically initiated by connecting the SC115 to

the data logger. The SC115 only collects data already contained in data logger memory at the time of connection. Additional data will not be collected until the SC115 is disconnected and then reconnected to the data logger.

Both standard and enhanced data-collection modes are available. With the standard mode, the SC115 collects the newest data (data written to the data logger memory since the last connection). With the enhanced mode, the SC115 collects all of the data stored in the data logger's memory every time the SC115 is reconnected.

NOTE To use the enhanced data-collection mode, the data logger must have a newer operating system (OS 22 or higher).

8.1.1 Programming for the Data-Collection Modes

The standard mode is enabled in the **TableFile()** instruction by entering 0 for both the *NumRecs* (*Number of Records*) parameter and the *Interval* parameter. The enhanced mode is enabled by entering 0 for the *NumRecs* parameter and entering -1 for the *Interval* parameter.

Below are examples of **TableFile()** instructions that enable data-collection modes. The first **TableFile()** instruction enables the standard data-collection mode. The second **TableFile()** instruction enables the enhanced data-collection mode. See Section 10.5.1, *Data-Collection Mode Examples (p. 12)*, for more detailed program code.

NOTE Use "CS9" as the drive name for GRANITE-series data loggers. Use "USB" as the drive name for all other CRBasic data loggers.

```
TableFile("USB:"+Status.SerialNumber+"_FileName",8,-1,0,0,Hr,0,0)
```

```
TableFile("USB:"+Status.SerialNumber+"_FileName",8,-1,0,-1,Hr,0,0)
```

8.1.2 Multiple Data Loggers

The data-collection modes allow one SC115 to be used with multiple data loggers. When using multiple data loggers, specify a unique file name for each instance of the **TableFile()** instruction (see Section 10.1.1, *FileName (p. 9)*). This avoids overwriting data files from other data loggers.

8.2 Resident Mode

NOTE Resident modes increase the risk of data corruption. Review Section 12.1, *Preventing Data Corruption (p. 17)*, before employing a resident mode.

In the resident modes, the SC115 remains attached to a single data logger allowing it to be used as resident external memory. The data logger can be programmed to bale data to the SC115 at regular intervals or at uniform bale sizes.

When data retrieval is required, 1) a second SC115 is swapped with the first, or 2) the SC115 is removed, milked of data (perhaps by copying or moving data to a computer), and then reconnected to the data logger.

NOTE To avoid losing data when the SC115 is disconnected from the data logger, the data logger must have sufficient storage memory allocated in **DataTable()** / **EndTable** declarations in the form of internal or external card memory to cover the period the SC115 is not present.

8.2.1 Programming for the Resident Modes

A resident mode that collects data at regular intervals is enabled in the **TableFile()** instruction by entering zero or a positive value for the *NumRecs/TimeIntoInterval* parameter and entering a non-zero, positive value for the *Interval* parameter. To collect data at uniform bale sizes, enter a non-zero, positive value for the *NumRecs* parameter and enter zero for the *Interval* parameter.

Below are **TableFile()** instruction examples that enable resident modes. The first **TableFile()** instruction sets the data logger to bale data to the SC115 at midnight each day. The second **TableFile()** instruction sets the data logger to send bales of 24 records to the SC115. See Section 10.5.2, *Resident Interval Mode Example (p. 14)*, for more detailed program code.

NOTE Use “CS9” as the drive name for GRANITE-series data loggers. Use “USB” as the drive name for all other CRBasic data loggers.

```
TableFile("USB:FileName", 8, -1, 0, 24, Hr, 0, 0) 'Interval trigger
```

```
TableFile("USB:FileName", 8, -1, 24, 0, Hr, 0, 0) 'Number of records trigger
```

9. Retrieving Data from SC115

To retrieve data from the SC115, plug it into a computer USB port. The SC115 becomes a memory drive on the computer, and data files can be copied, moved, or deleted with the common file handling functions of Windows®. Multiple SC115s can be connected to a computer simultaneously and data passed between them. When used as a communications interface, however, only one SC115 should be connected to a computer.

Before disconnecting the SC115 from the computer, run the **Safely Remove Hardware** utility in Windows®.

10. Data Logger Programming

When used as a memory drive, the SC115 requires a **TableFile()** instruction in the data logger CRBasic program. **TableFile()** creates a file from data table records, and writes the file to the SC115. The **TableFile()** instruction must be within the **DataTable()** / **EndTable** declaration.

10.1 DataTable() and TableFile() Instructions

DataTable() and **TableFile()** instructions work together. The data table size declared in **DataTable()** determines the size of the **TableFile()** buffer. For instance, a programmer may attempt to conserve data logger memory by setting **DataTable() Size** to 0 with the thought that doing so will direct data to only be written to the SC115 when it is attached for milking. However, such a programming tactic will result in failure since, in setting the **DataTable()** size to zero, the programmer also sets the **TableFile()** data buffer to zero.

At the opposing extreme, if the same memory-conscious programmer sets **DataTable() Size** to auto-allocate (-1), there is a high probability that the data logger will allocate far more memory for **TableFile()** buffering than is needed, which will consume memory that may be better used elsewhere.

CAUTION

Memory allocated by the **DataTable()** instruction acts as the buffer for **TableFile()** data, so the **DataTable() Size** parameter must be declared large enough to buffer the **TableFile()** output between collection visits with the SC115.

TableFile() syntax is reviewed below with comments specific to SC115 applications. For more detail, consult CRBasic Editor Help. **TableFile()** is included in the **DataTable() / EndTable** declaration as shown in the programming examples in Section 10.5, *Example Programs (p. 12)*.

`TableFile(a, b, c, d, e, f, g, h)`

- a* = "Drive:FileName." Drive: use "CS9" as the drive name for GRANITE-series data loggers; use "USB" as the drive name for all other CRBasic data loggers. Set a filename unique to each instance of TableFile() instruction. See Section 10.1.1, *FileName (p. 9)*, for required syntax.
- b* = *Options*. Most common file format is code 8 (TOA5). See CRBasic Help for details.
- c* = *MaxFiles*. -1 invokes auto allocation.
- d* = *NumRecs / Time Into Interval*. Data-collection modes: enter 0. Resident modes: enter number of records (integer > 0) or enter time into interval (integer ≥ 0). See following TABLE 10-1 and Section 10.1.4, *NumRecs/TimeIntoInterval Parameter (p. 10)*, for explanation.
- e* = *Interval*. Data-collection modes: enter 0 to collect newest data or enter -1 to collect all of the data logger's data. Resident mode: enter 0 if parameter *d* is set to number of records, otherwise enter time interval (integer > 0). See following TABLE 10-1 and Section 10.1.5, *Interval Parameter (p. 11)*, for detail.
- f* = *Units*. Enter units for time interval. Ignored at compilation if parameter *e* is 0 or -1.
- g* = *OutStat*. Optional. Set to 0 or see CRBasic Help.
- h* = *LastFileName*. Optional. Set to 0 or see CRBasic Help.

TABLE 10-1. Function of <i>NumRecs</i>, <i>Interval</i>, and <i>Units</i> Parameters			
<i>NumRecs/Time Into Interval</i> (d) Entry	<i>Interval</i> (e) Entry	<i>Units</i> (f) Entry	Function
0	0	N/A (compiler ignores)	When the SC115 is connected to the data logger, the data logger automatically sends to the SC115 only the data collected after the SC115 was last connected. The data logger will not send additional data if the SC115 remains connected to the data logger.
0	-1	N/A (compiler ignores)	When the SC115 is connected to the data logger, the data logger automatically sends to the SC115 all of the data contained in the data logger's memory. The data logger will not send additional data if the SC115 remains connected to the data logger.
number of data records (value > 0)	0	N/A (compiler ignores)	The data logger sends the specified number of data records to the SC115 when the data records become available. For example, if the <i>NumRecs</i> parameter is set to 20 and <i>Interval</i> is set to 0, the data logger will write twenty records to the SC115 when twenty records become available.
time into interval (value ≥ 0)	interval (value > 0)	<i>mSec</i> , <i>uSec</i> , <i>Sec</i> , <i>Min</i> , <i>Hr</i> , or <i>Day</i>	The data logger sends data to the SC115 at the specified interval. For example, when the <i>NumRecs/Time Into Interval</i> parameter is set to 0, the <i>Interval</i> parameter is set to 60 and the <i>Units</i> parameter is set to <i>Min</i> , the data logger will write data to the SC115 every 60 minutes.

The following sections explain each **TableFile()** parameter in detail.

10.1.1 FileName

The *FileName* parameter must be a string declared as Const, such as

```
Const FileName = "USB:FileName",
```

or as an expression that evaluates to a constant, such as

```
"USB:"+Variable+"FileName"
```

Quotation marks are required. The created file will have a suffix of **X.dat**, where **X** is a number that increments each time a new file is written.

NOTE

Use “CS9” as the drive name for GRANITE-series data loggers.
Use “USB” as the drive name for all other CRBasic data loggers.

When using a single SC115 to collect data from several data loggers, the **TableFile()** *FileName* parameter must be unique for each data table being collected. Otherwise, data may be overwritten on the SC115. Using a **TableFile()** instruction with parameters as shown below creates a naming scheme wherein the station name or serial number are part of the file name. This allows the source of data to be easily identified during post-processing.

```
TableFile("USB:"+Status.SerialNumber+"Filename",8,-1,0,0,Min,0,0)
```

When a program is compiled with “USB:” or “CS9:” in the file path, it searches the attached SC115 for any file names in the series. If it finds any, it uses the highest numbered file name, increments it by one, uses the result as the name for a new file, and writes the new data to the new file.

When multiple SC115s are used to collect data from multiple data loggers, it is often desirable to set the interval parameter to **-1**. If the interval parameter is set to **0** instead of **-1**, the complete set of records from a single data logger will likely be spread across all SC115s used to collect data.

CAUTION

If data is collected from a data logger using an SC115 that already contains files whose names match those created by the current data logger **TableFile()**, the old files are likely to be overwritten. Using unique filenames for each data logger, such as including the station name or serial number, is the best practice. See example in Section 10.5.1.1, *Standard Data-Collection Mode* (p. 13). A rarely used alternative is to recompile the data logger program with the second SC115 connected to collect its directory information. This is done by powering down the data logger, connecting the SC115, and then powering up the data logger.

10.1.2 Options

The *Options* parameter specifies the type of file to be saved and whether to include the header information, timestamp, and/or record number. Options 0, 8, 16, and 20 correspond to Campbell Scientific formats for TOB1, TOA5, CSIXML, and CSIJSON, respectively. Choosing an option not among these four may make the file incompatible with Campbell Scientific software that

reads or writes data files. For example, Option 7 results in a TOB1 file that cannot be read by *CardConvert* software or *View Pro* software. Refer to the CRBasic Editor Help system for a complete listing of option codes.

10.1.3 MaxFiles

The *MaxFiles* parameter specifies the maximum number of files to retain on an SC115. TABLE 10-2 reviews the options.

MaxFiles Entry	Function
X	Create Maximum of X files, ring memory (overwrite oldest file with newest file when full).
0	The filename will remain fixed with no number appended. The old file if it exists will be overwritten at each output.
-1	No limit to number of files, ring memory (overwrite oldest file with newest file when full)
-2	No limit to number of files, fill and stop memory (data logger stops writing to SC115 when SC115 is full)

When *MaxFiles* is *X*, SC115 memory may fill before X number of files is reached. If this occurs, the data logger internally reduces X to the current number of files and overwrites the oldest file with new data.

Refer to the CRBasic Help system for detailed information on this parameter.

10.1.4 NumRecs/TimeIntoInterval Parameter

Data-Collection Modes

For data-collection modes, the *NumRecs/TimeIntoInterval* parameter is set to zero, and the *Interval* parameter is set to either 0 or -1 (see Section 10.1.5, *Interval Parameter (p. 11)*). With these modes, the data logger begins writing to the SC115 as soon as it is connected to the data logger. All new records are written to a single file. See previous TABLE 10-1 and Section 10.5.1, *Data-Collection Mode Examples (p. 12)*.

Resident Modes

NOTE

Resident Mode increases the risk of data corruption. Review Section 12.1, *Preventing Data Corruption (p. 17)*, before employing a resident mode.

For resident modes, the *NumRecs/TimeIntoInterval* parameter determines when files are written to the SC115. The function of *NumRecs/TimeIntoInterval* is linked to the *Interval* parameter. If *Interval* is set to 0, enter the number of records to be included in each new file sent to the SC115. The program will create a new file each time *NumRecs* is reached. If *Interval* is set to non-zero, *NumRecs/TimeIntoInterval* becomes the time into *Interval* that the program

writes the next file. Previous TABLE 10-1 and CRBasic Editor Help provide further explanation of the interplay between *TimeIntoInterval* and *Interval*.

10.1.5 Interval Parameter

Data-Collection Modes

For data-collection modes, the *Interval* parameter determines what data is written to the SC115. Set this parameter to 0 to collect only data written to data logger memory since it was last connected. Set this parameter to -1 to collect all of the data stored in the data logger's memory. See previous TABLE 10-1.

Resident Mode

NOTE

Resident Mode increases the risk of data corruption. Review Section 12.1, *Preventing Data Corruption (p. 17)*, before employing a resident mode.

For Resident Mode, the *Interval* parameter is used to determine how frequently data is written to the SC115. By setting this parameter to a non-zero number, the data logger writes a new file to the SC115 at the interval based on this number and the *Units* parameter.

If *Interval* is set to 0, but *NumRecs/TimeIntoInterval* is set to a non-zero value, the data logger writes data to the SC115 whenever the number of new records matches the *NumRecs/TimeIntoInterval* value.

10.1.6 Units Parameter

The *Units* parameter specifies the units used by the Interval parameter. The compiler ignores this parameter if the interval parameter is set to 0 or -1.

10.1.7 OutStat Parameter

OutStat is inactive when set to 0.

When set to a variable declared as **Public** or **Dim**, *OutStat* (output status) indicates whether or not a new data file was stored the last time **TableFile()** executed. If a new file is written, -1 is stored in the variable the next time **CallTable()** is executed. If a new file is not written, 0 is stored the next time **CallTable()** is executed.

TableFile() has been designed to permit the data logger to continue program execution while data is baled, by a separate process, into the table file. The upside is that **TableFile()** does not slow program execution. The down-side is that notification that the **TableFile()** task is complete is delayed. This situation is manifest as follows.

If writing a new file takes longer than the **CallTable()** interval (the interval of the **Scan() / NextScan** construct wherein the **CallTable()** instruction resides), then the *OutStat* variable will not be updated. In other words, if the table file is large, and the scan rate is short, *OutStat* may not be updated.

10.1.8 LastFileName Parameter

Set to 0 (no last file name) if desired. The *LastFileName* parameter is a variable that contains the name of the last file written. *LastFileName* is updated the next time **CallTable()** instruction is executed.

TableFile() has been designed to permit the data logger to continue program execution while data is baled by a separate process into the table file. The upside is that **TableFile()** does not slow program execution. The down-side is that notification is delayed that the **TableFile()** task is complete. This situation is manifest as follows.

If writing a new file takes longer than the **CallTable()** interval (the interval of the **Scan()** / **NextScan** construct wherein the **CallTable()** instruction resides), then the *LastFileName* variable will not be updated. In other words, if the table file is large, and the scan rate is short, *LastFileName* may not be updated.

10.2 CardFlush Instruction

If a program **Scan()** / **NextScan** *Count* parameter is non-zero, the latest data may fail to write to the SC115 unless the **CardFlush** instruction is used. For example, with a scan count of 600, a scan interval of 100 ms, and writing a file with **TableFile()** after every 10 seconds (every 100 records), only 400–575 records may be written to the SC115 due to the program ending at the 600th scan prior to transferring all the records to the SC115. To transfer the remaining data to the SC115, place the **CardFlush** instruction between the **NextScan** and **EndProg** instructions. See Section 10.5.4, *CardFlush Example* (p. 15).

10.3 CardOut Instruction

A data logger that supports external memory cards can be programmed to simultaneously store data to internal memory, an external memory card, and an SC115. The data logger program needs to include a **CardOut()** instruction in the **DataTable()** declaration. By including **CardOut()**, the data logger can write data to the SC115 that is present only on the external memory card. See Section 12.4.1, *External Memory Card and Collection Speed* (p. 18), for more information on SC115 and external memory card interactions. See Section 10.5.5, *CardOut Example* (p. 16).

10.4 Powerup.ini

The SC115 supports the use of a powerup.ini file, which allows the host data logger to be sent a specific program or operating system at data logger power-up. Consult the powerup.ini section in the data logger manual for more information.

10.5 Example Programs

10.5.1 Data-Collection Mode Examples

NOTE

Use “CS9” as the drive name for GRANITE-series data loggers.
Use “USB” as the drive name for all other CRBasic data loggers.

10.5.1.1 Standard Data-Collection Mode

```
'Plug - Collect Data Since Last Plug - Pull

'In this example, the SC115 is connected to the data logger to collect the data
'written to the data logger memory after the last connection. It only collects
'data that were already in data logger memory when it was connected. To collect
'subsequent data, the SC115 must be disconnected then re-connected to the
'data logger. Note that the file name incorporates the system Status.SerialNumber
'variable, helping avoid file overwrites.

Public PanelTempC, BattVolt

DataTable (Hourly,1,-1)
  DataInterval (0,60,Min,0)
  TableFile ("USB:"+Status.SerialNumber+"_Filename",8,-1,0,0,Min,0,0)
  Sample (1,PanelTempC,FP2)
  Minimum (1,BattVolt,FP2,0,False)
EndTable

BeginProg
  Scan (10,Sec,3,0)
  PanelTemp (PanelTempC,250)
  Battery (BattVolt)
  CallTable Hourly
  NextScan
EndProg
```

10.5.1.2 Enhanced Data-Collection Mode Example

```
'Plug - Collect All Data - Pull

'In this example, the SC115 is connected to the data logger to collect all of
'the data stored in data logger memory. It only collects data that is already
'stored in the data logger memory when it was connected. To collect subsequent
'data, the SC115 must be disconnected and then reconnected to the data logger.

Public PanelTempC, BattVolt

DataTable (Hourly,1,-1)
  DataInterval (0,60,Min,0)
  TableFile ("USB:"+Status.SerialNumber+"_Filename",8,-1,0,-1,Min,0,0)
  Sample (1,PanelTempC,FP2)
  Minimum (1,BattVolt,FP2,0,False)
EndTable

BeginProg
  Scan (10,Sec,3,0)
  PanelTemp (PanelTempC,250)
  Battery (BattVolt)
  CallTable Hourly
  NextScan
EndProg
```

10.5.2 Resident Interval Mode Example

```
'Plug In and Leave - data baled from buffer to SC115 every 60 minutes
'In this example, the SC115 remains at the data logger as resident memory.
'This program avoids data corruption by setting TableFile() Interval to 60
'In this case, data is written only once an hour to the SC115.

Public PanelTempC, BattVolt

DataTable (Hourly,1,-1)
  DataInterval (0,1,Min,0)
  TableFile ("USB:Hourly",8,-1,0,60,Min,0,0)   'SC115 resident mode with interval
  Sample (1,PanelTempC,FP2)
  Minimum (1,BattVolt,FP2,0,False)
EndTable

BeginProg
  Scan (10,Sec,3,0)
  PanelTemp (PanelTempC,250)
  Battery (BattVolt)
  CallTable Hourly
  NextScan
EndProg
```

10.5.3 Resident Record Number Mode Examples

```
'Plug In and Leave - data baled from buffer to SC115 every 60 records
'In this example, the SC115 remains at the data logger as resident memory.
'This program avoids data corruption by setting TableFile() NumRecs to 60
'In this case, data is written only once an hour to the SC115.

Public PanelTempC, BattVolt

DataTable (Hourly,1,-1)
  DataInterval (0,1,Min,0)
  TableFile ("USB:Hourly",8,-1,60,0,Min,0,0)   'SC115 resident mode with NumRecs
  Sample (1,PanelTempC,FP2)
  Minimum (1,BattVolt,FP2,0,False)
EndTable

BeginProg
  Scan (10,Sec,3,0)
  PanelTemp (PanelTempC,250)
  Battery (BattVolt)
  CallTable Hourly
  NextScan
EndProg
```

```

'Plug In and Leave - data baled when buffer is full,
'i.e. DataTable() Size = TableFile() NumRecs (memory efficient!)

'In this example, the SC115 remains at the data logger as resident memory.
'This program avoids data corruption by setting DataTable() Size to equal
'TableFile() NumRecs. In this case, data is written only once every two hours
'to the SC115.

Public PanelTempC, BattVolt

DataTable (Hourly,1,120)
  DataInterval (0,1,Min,0)
  TableFile ("USB:Hourly",8,-1,120,0,Min,0,0)   'SC115 resident mode with NumRecs
  Sample (1,PanelTempC,FP2)
  Minimum (1,BattVolt,FP2,0,False)
EndTable

BeginProg
  Scan (10,Sec,3,0)
  PanelTemp (PanelTempC,250)
  Battery (BattVolt)
  CallTable Hourly
  NextScan
EndProg

```

10.5.4 CardFlush Example

```

'In this example, the SC115 remains at the data logger as resident memory.
'The Scan count, usually left at 0, is set to 600 in this application.
'To ensure complete collection of data, CardFlush instruction is included.

Public PanelTempC, BattVolt

DataTable (Hourly,1,-1)
  DataInterval (0,10,Sec,0)
  TableFile ("USB:Hourly",8,-1,100,0,Hr,0,0)   'SC115 resident mode with NumRecs
  Sample (1,PanelTempC,FP2)
  Minimum (1,BattVolt,FP2,0,False)
EndTable

BeginProg
  'Scan stops at count 600 - Not enough time to transfer all data!
  Scan (100,mSec,3,600)
  PanelTemp (PanelTempC,250)
  Battery (BattVolt)
  CallTable Hourly
  NextScan
  CardFlush   'Included to ensure complete data transfer to SC115
EndProg

```

10.5.5 CardOut Example

'In this example, the SC115 and an external memory card are used as external memory.'

```
Public PanelTempC, BattVolt

DataTable (Hourly,1,-1)
  DataInterval (0,1,Min,0)
  CardOut (0,-1)
  TableFile ("USB:Hourly",8,-1,0,60,Min,0,0)   'SC115 resident mode with interval
  Sample (1,PanelTempC,FP2)
  Minimum (1,BattVolt,FP2,0,False)
EndTable

BeginProg
  Scan (10,Sec,3,0)
  PanelTemp (PanelTempC,250)
  Battery (BattVolt)
  CallTable Hourly
  NextScan
EndProg
```

11. Serial Communications Interface Function

NOTE

Before the SC115 can be used as a communications interface, the device driver must be installed. *DevConfig* is used to install the device driver. Under **Device Type**, select **Peripheral | SC115**. Click **Install USB Driver** and follow the prompts.

The SC115, when used as a serial interface, uses the Campbell Scientific SDC protocol to facilitate communications between the data logger and a computer. The SDC address can be set to **7, 8, 10, or 11** (see Section 7.2, *SC115 Settings (Optional)* (p. 4)).

Consider the following points when using the SC115 as a communications interface:

- Use the provided extension cables to establish the physical connections between data logger, SC115, and computer BEFORE opening *LoggerNet*.
- When selecting a port in the *LoggerNet* Network Map for USB to CS I/O communication, the COM port *SC115 (COM#)* must be selected. *SC115 MSD (COM#)* may also appear as a choice, but must not be selected as it does not support the communications interface mode.
- Always click **Disconnect** within the data logger support software Connect window prior to breaking the physical connection between the computer, SC115 and data logger. If this rule is not observed, and communication problems develop, follow the procedure in Section 13.1, *Breaking the Physical Comms Link* (p. 19).
- Do not connect two SC115s to a computer at the same time if both are attached to powered data loggers. This can cause confusion of virtual

COM ports on the computer (as memory devices, two SC115s may be attached to a computer at the same time).

12. Troubleshooting Memory Drive

12.1 Preventing Data Corruption

To avoid corruption of SC115 memory, never remove the SC115 from the data logger during data transfer. The flashing LED indicates when data is being written to the SC115. Should the SC115 be removed while the LED is flashing, the most likely result is that the current data file will be corrupted. In addition, a FAT sector or the directory link sector may become corrupted. This condition requires that the SC115 memory be reformatted, which will result in the loss of all data.

When either the *NumRecs/TimeIntoInterval* or *Interval* parameters are set to a non-zero positive value (resident modes), there is a risk that the data logger will begin writing data to the SC115 at the exact moment it is being removed from the data logger, resulting in data corruption. To prevent this, set these parameters to values that allow the time between writing data to be easily discerned (such as an interval of 10 seconds) by watching the LED. The user then times the removal of the SC115 to occur when the data logger is not writing data. See Section 10.5.2, *Resident Interval Mode Example (p. 14)*.

Another method is to set the *NumRecs* parameter in **TableFile()** to match the *Size* parameter in the associated **DataTable()** instruction. Depending on the rate at which records are written, this can cause data to be written to the SC115 at long intervals, greatly reducing the chance of removing the SC115 from the data logger while transferring data. See Section 10.5.3, *Resident Record Number Mode Examples (p. 14)* (second example).

If SC115 data becomes corrupted, first attempt to retrieve all files from the SC115. Reformat the SC115 per Section 14.2, *Formatting Memory (p. 20)*.

12.2 Skipped Scans

To avoid skipped scans, ensure that the scan interval in the data logger program is long enough to include writing to the SC115. For example, if the program has a single **TableFile()** instruction, add at least 100 ms to the scan rate to accommodate each added **TableFile()** instruction.

Compile data logger programs in pipeline mode when possible. Data logger programs compiled in sequential mode require a longer scan interval than programs compiled in pipeline mode to avoid skipped scans. In pipeline mode, the **Scan() / NextScan** instruction *BufferOption* parameter can be increased to prevent skipped scans. In sequential mode, the **TableFile()** instruction must finish before continuing to the next instruction, resulting in skipped scans unless the scan interval is long enough to handle all communication, measurement processing, and **TableFile()** tasks. Sequential mode ignores any scan buffers that may be assigned. Programs may run as much as three times faster in pipeline mode than in sequential mode.

12.3 SC115 with Large Data Compliment

An SC115 with a large compliment of data (either a large number of files, or a few very large files) may respond slower than an SC115 with less data. Compiling data logger programs from a full SC115 may take longer than normal.

Opening the SC115 directory in support software **File Control** also takes longer if there are a large number of files within the SC115 directory. **File Control** can access approximately twenty files per second when opening the directory.

12.4 Data Collection Speed

Many factors affect collection speed in plug and pull data-collection mode. As a rough estimate, collection speed is typically 3 to 4 kB of SC115 file size per second (TFOption = 8, SDC7 set to -115200 [autobaud], no card storage module present). Following are descriptions of two factors that contribute significantly to the slowing of collection speed.

12.4.1 External Memory Card and Collection Speed

Following is a discussion of SC115 performance expectations when it is used in tandem (plug and pull data-collection mode) with a resident external memory card on a data logger.

Background – When an SC115 is configured for data-collection mode (plug and pull), and it is plugged into a data logger with a resident external memory card, and the running program is using the **CardOut()** instruction, all data present since the last collection will be automatically transferred from the data table to the SC115 file.

How it works – When **CardOut** is used in a **DataTable()** / **EndTable** declaration, the file created on the external memory card becomes an extension of the table memory. The internal memory is used as a buffer to transfer data to the external memory card. When there are enough data to warrant a write to the external memory card, the data is flushed to the card. This results in duplicate data, up to the internal table size, that will exist on the internal memory and the external memory card files. Any time the table data is retrieved via *LoggerNet* data collection, or by using the **TableFile()** instruction, the internal SRAM is searched first, then the card. So, when operating the SC115 in plug and pull mode, SRAM data is transferred first, then the external memory card is searched.

Effect – The rate of transfer is slowed, not because of the search of the card, but because of the serial communications and (even slower) if an ASCII output file is selected. This is compounded by large data files that can occur when the **CardOut** instruction is used. Searching the external memory card adds some overhead, but the vast majority of time is spent converting to ASCII and transferring across a slow serial link.

Take home – external memory card to SC115 transfer of data is about 30 to 50% slower than data logger CPU to SC115 transfer of data. For example, in testing with a CR1000 data logger with a 2 GB card attached, transfer of a 3.9 MB file (so no data were stored to the card) took approximately 16 minutes (about 250 kB per minute). However, the rate of transfer slowed to about 190

kB per minute when data logger CPU memory was allowed to ring (fill and overwrite oldest data) many times, resulting in a large amount of data on the card that was no longer present on the CPU. In this example, it took 116 minutes to transfer a 22 MB data file from the external memory card to the SC115. In the case of very large data files stored to the external memory card, it makes more sense to swap external memory cards (see the *CFM100 CompactFlash Module* user manual, available at www.campbellsci.com, for details), or use a resident SC115, rather than milking the data with the SC115 in plug and pull mode.

12.4.2 Data Type Collection Speed

File type declared in the **TableFile()** *TFOption* parameter can affect SC115 collection speed. Data is buffered in the data logger as binary. While data is collected, the data logger converts the binary to the declared data type. *TOB1* options are binary and require very little processor overhead to convert from the binary buffer. *TOA5*, *CSIXML*, and *JSON* are ASCII options and are far slower since they consume significant processor overhead to convert to ASCII from the binary buffer. *CSIXML* is especially slow. The effects on collection time will be particularly noticeable if the data logger is running a long or complex program. In short, if large files from numerous data loggers need collection, using the *TOB1* format may save considerable time. Consult the *LoggerNet* Instruction Manual for options available to convert *TOB1* data files on the computer to easier-to-read formats.

12.5 Slow Computer Boot-up

Leaving an SC115 attached to a computer while it is booting up may cause a delay of several minutes to the boot-up process on some computers. The computer will continue to boot normally if the SC115 is removed. The SC115 can then be inserted and used as normal.

12.6 Write Failure

A write failure (after retries) is interpreted to mean the memory is full. When a write failure occurs, *MaxFiles* parameter in the **TableFile()** instruction is adjusted to its current number. In addition, the data logger enters ring mode, overwriting the oldest file on the SC115 with the new data (as if the *MaxFile* parameter was set to *-1*).

The timeout period between a failed write command and a retry is 8 seconds.

13. Troubleshooting Communications Interface

13.1 Breaking the Physical Comms Link

To avoid a communications error, always click on **Disconnect** prior to physically breaking the SC115 interface link.

When the SC115 interface link between the computer and the data logger is physically broken before **Disconnect** is clicked in the support software, the software requires about one minute to process the broken link. If the link is reconnected before the break is processed, a communications error may occur. If an error occurs, use the following procedure to re-establish communications.

1. Click on the support software **Cancel** button to stop the connection attempt.
2. Disconnect the SC115 from the computer for at least one minute.
3. After one minute, reconnect the SC115 to the computer and data logger.
4. Close the support software, then reopen it, then click on **Connect**.

14. Technical Reference

14.1 SDC Addressing

SDC addressing suitable for most applications is set at the factory.

The SC115 responds to two SDC addresses. SDC address 0 is used in data-collection mode when data files are transferred from the data logger to the SC115. This setting cannot be changed.

When plugged into a USB port, addresses SDC7, SDC8, SDC10, and SDC11 are available to support Communication Interface Mode on the CS I/O port. This setting defaults to SDC7, but can be changed using *DevConfig*.

NOTE

Before the SC115 can be configured through *DevConfig*, the device driver must be installed. *DevConfig* is used to install the device driver. Under **Device Type**, select **Peripheral | SC115**. Click **Install USB Driver** and follow the prompts.

14.2 Formatting Memory

The SC115 is formatted at the factory and is ready to use out of the box. Should the SC115 require formatting, such as if the memory becomes corrupted, it can be formatted through data logger **File Control** (*LoggerNet*, *RTDAQ*, *PC400*, *PC200W* software), data logger keypad (**File | Format | USB**), or Windows® Explorer (**right click | Format**). When given an option between formatting as FAT or FAT32, always choose FAT32.

NOTE

Formatting will erase all files on the SC115.

14.3 Operating System

The SC115 is configured at the factory with an operating system. Unless notified by Campbell Scientific, the operating system (OS) does not need to be reloaded. Downloading a new OS to the SC115 should not affect files in memory. It is good practice to retrieve all files from the SC115 before loading a new OS.



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