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## Software Download Algorithm for PSE Controllers

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### Introduction

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This application note explains the software download process that must be implemented to update or initiate a new software for the PoE controller. Microchip updates its software to keep abreast of IEEE<sup>®</sup> 802.3af/at/bt standard modifications and increase product quality.

This download process is applicable to the PD69100, PD692x0, and PD39210 PoE controllers.

A new firmware can be downloaded directly from the Host CPU, utilizing a series of protocol commands, explained in the following [Download Process: Valid Firmware Exists](#), [Download Process: Invalid or Non-Existing Firmware](#), and [Download File: S19](#) sections. To utilize the I<sup>2</sup>C communication for the download process, see the [Use of I<sup>2</sup>C](#) section.

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## 1. Download Process

Perform the following steps:

Send the 'Get System Status' message to check the firmware validity. (CPU status-1 Bit1 = 1 indicates invalid firmware). For more information, see the *Serial Communication Protocol User Guide*.

- If a valid firmware is detected, perform the downloading process as shown in the following [Download Process: Valid Firmware Exists](#) section.
- If an invalid firmware is detected, perform the downloading process as shown in the [Download Process: Invalid or Non-Existing Firmware](#) section.

### 1.1 Download Process: Valid Firmware Exists

This section specifies the download process for a controller already containing a valid firmware.

All letters signed with “” should be sent as chars or strings (ASCII value). “\r” and “\n” represent “Carriage return” and “Line feed” ASCII codes 0x0D and 0x0A respectively.

**Table 1-1. Download Process Sequence**

| Step | Action                          | Host Command                                                                                  | Controller Response                          |                                 | Comment                                                                                            |
|------|---------------------------------|-----------------------------------------------------------------------------------------------|----------------------------------------------|---------------------------------|----------------------------------------------------------------------------------------------------|
|      |                                 |                                                                                               | OK                                           | Error                           |                                                                                                    |
| 1    | Enter program mode              | Send the “Download” command                                                                   | OK report                                    | Error report                    | Immediate response.<br>See <i>Serial Communication Protocol User Guide</i> , section “Report Key”. |
| 2    | Await for boot section response | —                                                                                             | “TPE\r\n”                                    | —                               | Response within 100 ms.                                                                            |
| 3    | Erase memory                    | “E”                                                                                           | “TOE\r\n”                                    | None                            | Response within 100 ms.                                                                            |
| 4    | Wait for erasure                | —                                                                                             | “TE\r\n” and then “TPE\r\n” (Within 100 ms). | “TNE\r\n” or “TNV\r\n” or none. | Erasure might last up to 5 s.                                                                      |
| 5    | Program memory                  | “P”                                                                                           | “TOP\r\n”                                    | None                            | Response within 100 ms.                                                                            |
| 6    | Send all lines of S19 file.     | Send S19 lines, one by one, till EOF.<br><br><b>Lines begin with “S0” should not be sent.</b> | “T*\r\n”                                     | “TNP\r\n” or “TNV\r\n” or none. | Response within 100 ms per line.                                                                   |
| 7    | End of file                     | —                                                                                             | “TP\r\n”                                     | None                            | Response within 100 ms.                                                                            |
| 8    | Await                           | —                                                                                             | —                                            | —                               | Wait at least 400 ms.                                                                              |
| 9    | Reset Controller                | “RST”                                                                                         | System status telemetry                      | —                               | Response within 10 s.                                                                              |

**Table 1-2. Download**

| [1]KEY                                       | [2]ECHO  | [3]Subject             | [4]Subject1 | [5]Subject2 | [6]DATA    | [7]DATA    | [8]DATA |
|----------------------------------------------|----------|------------------------|-------------|-------------|------------|------------|---------|
| <i>Program</i><br>(0x01)                     | ##       | <i>Flash</i><br>(0xFF) | 0x99        | 0x15        | 0x16       | 0x16       | 0x99    |
| [9]DATA                                      | [10]DATA | [11]DATA               | [12]DATA    | [13]DATA    | [14]CSum H | [15]CSum L |         |
| <i>N</i>                                     | <i>N</i> | <i>N</i>               | <i>N</i>    | <i>N</i>    | ##         | ##         |         |
| This command initiates the download process. |          |                        |             |             |            |            |         |

## 1.2 Download Process: Invalid or Non-Existing Firmware

When the controller is “empty” (was not loaded in factory), or its firmware is invalid (for example, after a download process is interrupted in the middle), the same process as described in the previous paragraph should be followed, except for step 1, which must be substituted with the following entry.

**Table 1-3. Download Process Sequence**

| Step | Action             | Host Command       | Controller Response |       | Comment                                                           |
|------|--------------------|--------------------|---------------------|-------|-------------------------------------------------------------------|
|      |                    |                    | OK                  | Error |                                                                   |
| 1    | Enter program mode | “E”, “N”, “T”, “R” | —                   | None  | Keep a minimum of 10 ms delay between each transmitted character. |

**Note:** Invalid or non-existing firmware can be monitored by a continuous System Status telemetry with byte 3 bit 1 set to ‘1’ (programming required), in less than five seconds.

### 1.3 Download File: S19

The “\*.S19” download file contains data in lines beginning with “S”. All letters in line must be sent as chars (ASCII value). “\r” and “\n” represent “carriage return” and “new line” ASCII codes.

- Lines beginning with “S0” are remarks and must not be written to the controller.
- Lines beginning with “S3” contain the data to be sent.
- “S7” designates the last line.

**Figure 1-1. S19 File Example**

|               |    |                                                                          |
|---------------|----|--------------------------------------------------------------------------|
| Remark        | S0 | Power Over Ethernet                                                      |
|               | S0 | Product Number: 24                                                       |
|               | S0 | Software Number: 0352                                                    |
|               | S0 | Param. Number: 00                                                        |
|               | S0 | Build: 030                                                               |
|               | S0 | File Name - 24035200_1000_030.s19                                        |
|               | S0 | Base On File - FSL_BT_2020_02_13_10_39.elf                               |
|               | S0 |                                                                          |
| Firmware Line | S3 | 238000003BDF68BD37C6555B17C6AA5B17169D8CC6555B17C6AA5B1716C4AEC6555B17B4 |
|               | S3 | 238020C6AA5B1787C716A07ECC00011686B7393B343519FA886CA6866A70EC846C71EC95 |
|               |    | .                                                                        |
|               | S3 | 23808016A07E7B0819169F0A16A33AD72635CC0801169EB0F6081987B746E6EA088B7B76 |
|               | S3 | 1380A0081AC6555B17C6AA5B17CC08013BF6081A8716ADA51B826B80F60819E0807B0892 |
| End Of File   | S7 | 030000FC                                                                 |

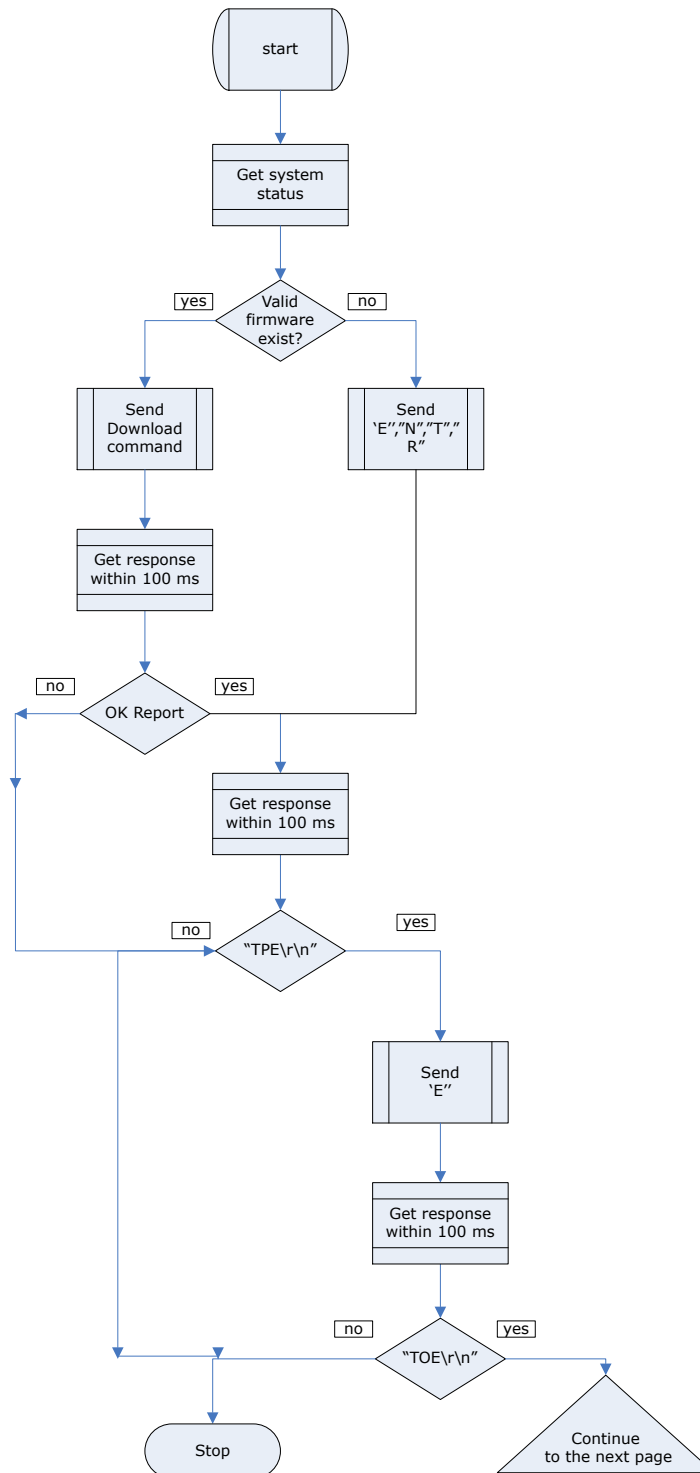
### 1.4 Use of I<sup>2</sup>C

When utilizing the I<sup>2</sup>C communication for the download process, data is transmitted and received as single bytes. Single byte includes Start bit, address, R/W bit, data byte, and Stop bit.

## 2. Software Download Flow Chart

The following flow charts show the step-wise implementation of the software download process.

Figure 2-1. Download Process Sequence



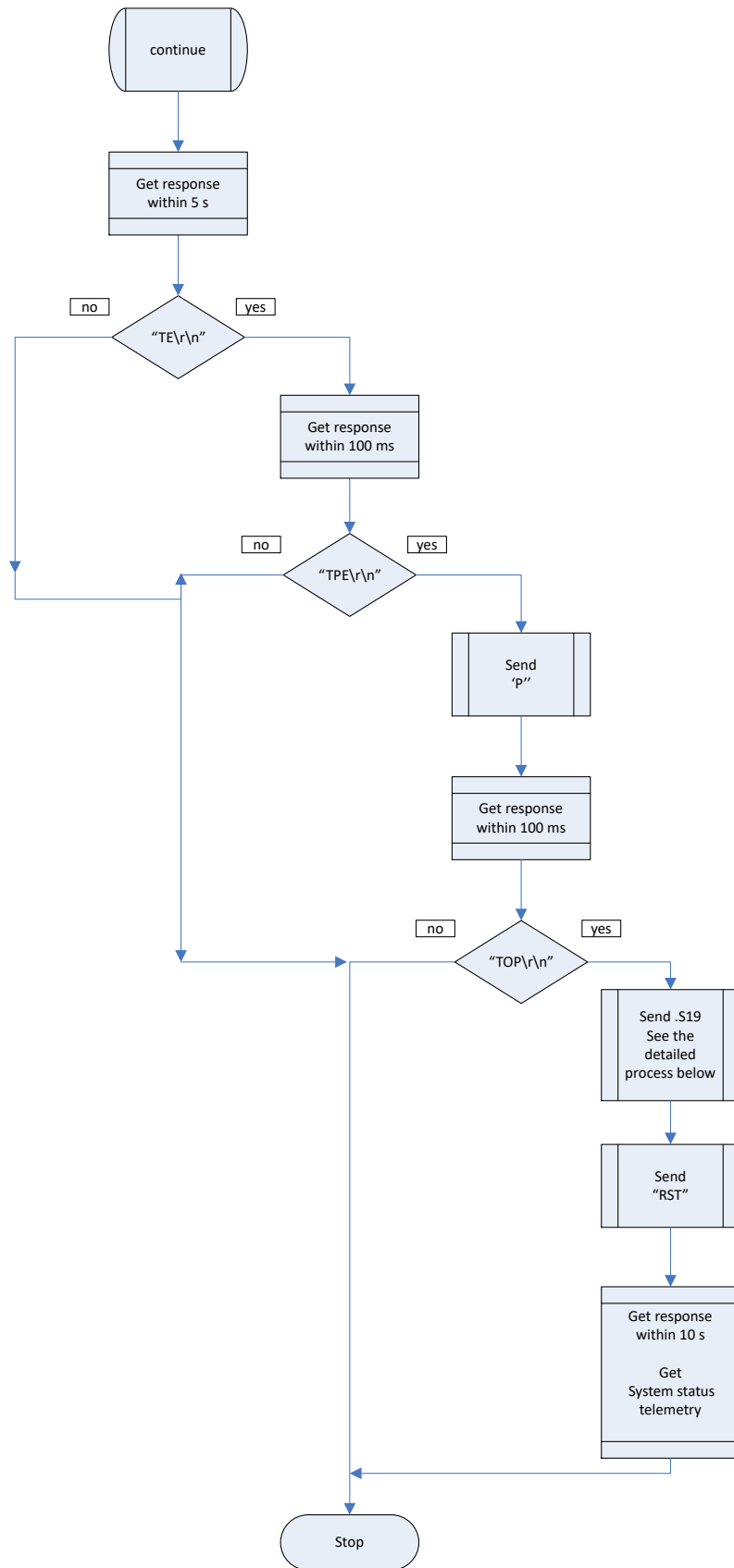
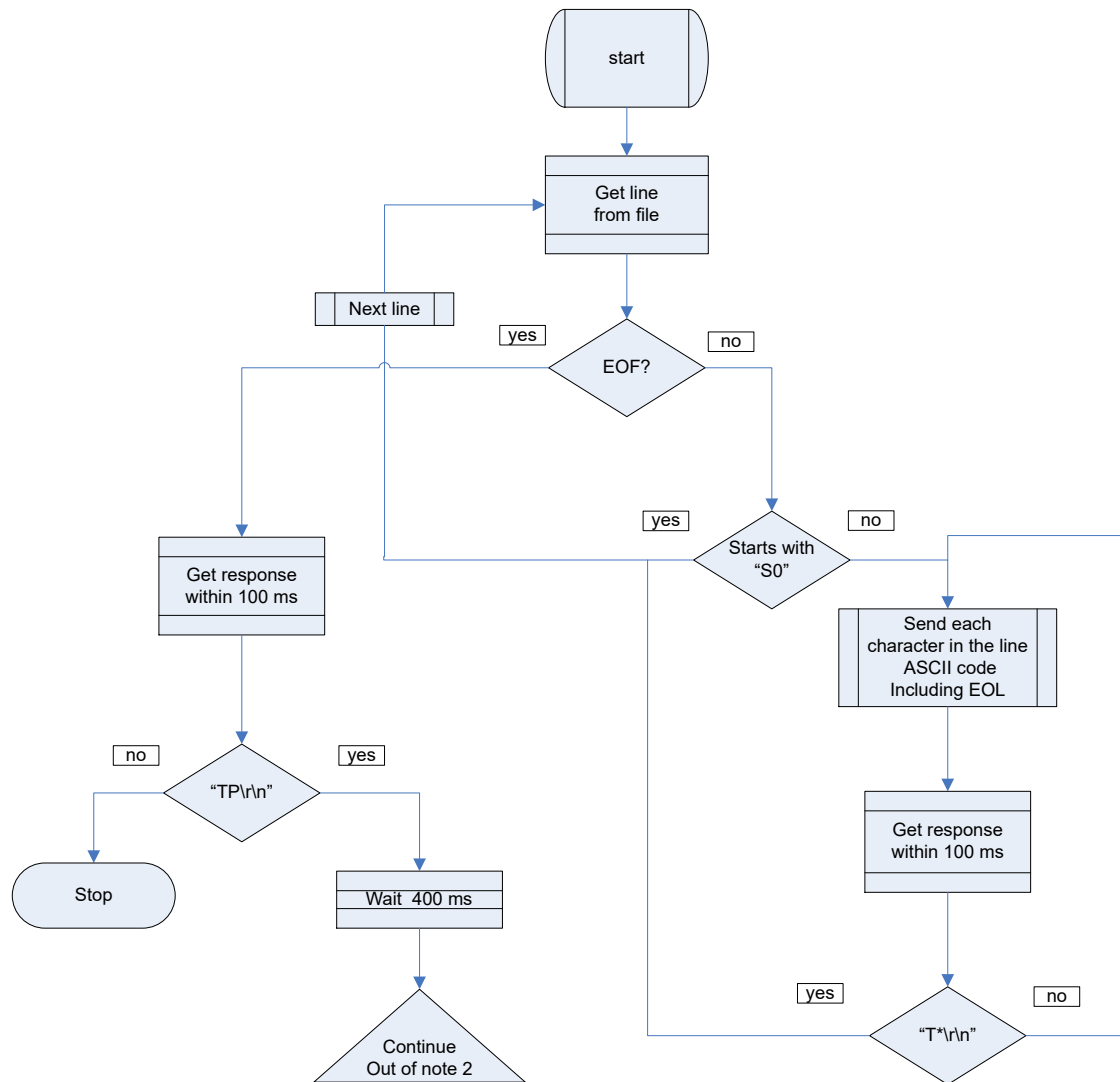


Figure 2-2. Transmitting S19 Lines



## 2.1 Reference Code for I<sup>2</sup>C Download Process

The following reference code is a template for the download algorithm and cannot be used as it is in user applications.

```

private void DownloadFirmwareFunc (object sender, EventArgs e)
{
    //-----Variable Definitions-----
    \byte [] getsystemstatus = { 0x02, 0x02, 0x07, 0x3D, 0x00, 0x00, 0x00, 0x00, 0x00,
    0x00, 0x00, 0x00, 0x00, 0x00, 0x48 };
    // "Get System Status" Command
    byte [] enter = { (byte)'E', (byte)'N', (byte)'T', (byte)'R' };
    byte [] download = { 0x01, 0x01, 0xFF, 0x99, 0x15, 0x16, 0x16, 0x99, 0x00, 0x00,
    0x00, 0x00, 0x02, 0x74 };
    // "Download" Command
    byte [] byteArr = new byte[15];
    byte [] Temp = new byte[1];
    string sLine = "";
    StreamReader objReader = new StreamReader ("C:\\SWLoading\

```



```

\pol30k.s19");
// path to .S19 File

//-----Download Procedure-----
I2C_AsyncClient.Read(ref byteArr, 15);           //read get system status
if (byteArr[0] == 0x03 && byteArr[1] != 0x00 && byteArr[2] == 0x00) // if firmware is
                                                    // damaged?
{
    I2C_AsyncClient.SendData(ref download, 15);    // send download
    Thread.Sleep(100); // wait 100ms
    I2C_AsyncClient.Read(ref byteArr, 15);          // read "Report Key"
}
else                                              // else
{
    for (int i = 0; i < 14; i++)
        I2C_AsyncClient.Read(ref byteArr, 1);      // read all system status bytes
                                                    // in range (14 bytes)

    for (int i = 0; i < 4; i++)
    {
        Temp[0] = enter[i];
        I2C_AsyncClient.SendData(ref Temp, 1);      // send ENTR
    }
}
Thread.Sleep(100);                               // wait 100ms
for (int i = 0; i < 5; i++)
    I2C_AsyncClient.Read(ref byteArr, 1);          // read TPE\r\n

byteArr[0] = ((byte)'E');
I2C_AsyncClient.SendData(ref byteArr, 1);          // Sending 'E' - erasing memory

Thread.Sleep(100);
for (int i = 0; i < 5; i++)
    I2C_AsyncClient.Read(ref byteArr, 1);          // read TOE\r\n

Thread.Sleep(5000);                               // wait 5s
for (int i = 0; i < 4; i++)
    I2C_AsyncClient.Read(ref byteArr, 1);          // read TE\r\n

Thread.Sleep(100);                               // wait 100ms
for (int i = 0; i < 5; i++)
    I2C_AsyncClient.Read(ref byteArr, 1);          // read TPE\r\n

byteArr[0] = ((byte)'P');                          // Sending 'P' - program memory
I2C_AsyncClient.SendData(ref byteArr, 1);
Thread.Sleep(100);

                                                    // wait 100ms
for (int i = 0; i < 5; i++)
    I2C_AsyncClient.Read(ref byteArr, 1);          // read TOP\r\n

//-----Load .S19 Procedure-----
sLine = objReader.ReadLine();                      // get first line from .S19
while (sLine != null)                             // while not end of file
{
    byteArr = new byte[(sLine.Length)];
    byteArr = Encoding.ASCII.GetBytes(sLine);      // convert each character in line
                                                    // to its ASCII code

    if (byteArr[1] == 0x30)                         //skip line that starts with "S0"
        sLine = objReader.ReadLine();
    else
    if (byteArr[1] == 0x31 || byteArr[1] == 0x39)
    {
        for (int i = 0; i < (byte) byteArr.Length; i++)
        {
            Temp[0] = byteArr[i];
            I2C_AsyncClient.SendData (ref Temp, 1);
        }

        byteArr[0] = (byte)'\r'; I2C_AsyncClient.SendData(ref byteArr, 1);
        byteArr[1] = (byte)'\n'; I2C_AsyncClient.SendData(ref byteArr, 1);

        Thread.Sleep(100);                          // wait for 100ms
    }
}

```

```

for (int i = 0; i < 4; i++)
{
    I2C_AsyncClient.Read(ref Temp, 1);           // reading T*\r\n or TP\r\n
    byteArr[i] = Temp[0];
}

if (byteArr[0] == 0x54 && byteArr[1] == 0x2a)    // if read T*\r\n
    sLine = objReader.ReadLine();               // read next line
else if (byteArr[0] == 0x54 && byteArr[1] == 0x50) // if read TP\r\n
{
    sLine = null;                               //end of file
    MessageBox.Show("END of File");
}
}
}

```

Excute hardware reset at the end of process.

## 2.2 Logfile I<sup>2</sup>C Download Process

The following table lists an example logfile of the complete download process. This log file is the actual communication between the Host to the Controller over the I<sup>2</sup>C.

**Table 2-1. Example Logfile**

| Index | Time step m:s.ms.us | Transaction Length | Transaction (R/W) | Data in HEX (* represents NACK)           | Remark                                                                                                               |
|-------|---------------------|--------------------|-------------------|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| 63    | 0:56.505.218        | 15 B               | <b>Write</b>      | 01 0D FF 99 15 16 16 99 4E 4E 4E 4E 04 06 | Host writes the "Download command " in 15 bytes transaction.                                                         |
| 64    | 0:56.611.614        | 1 B                | Read              | 52*                                       | Controller transmits its acknowledge, it can be read in a single byte or 15 bytes. This example shows a single byte. |
| 65    | 0:56.612.489        | 1 B                | Read              | 0D*                                       |                                                                                                                      |
| 66    | 0:56.613.423        | 1 B                | Read              | 00*                                       |                                                                                                                      |
| 67    | 0:56.614.413        | 1 B                | Read              | 00*                                       |                                                                                                                      |
| 68    | 0:56.615.418        | 1 B                | Read              | 4E*                                       |                                                                                                                      |
| 69    | 0:56.616.438        | 1 B                | Read              | 4E*                                       |                                                                                                                      |
| 70    | 0:56.617.407        | 1 B                | Read              | 4E*                                       |                                                                                                                      |
| 71    | 0:56.618.462        | 1 B                | Read              | 4E*                                       |                                                                                                                      |
| 72    | 0:56.619.432        | 1 B                | Read              | 4E*                                       |                                                                                                                      |
| 73    | 0:56.620.392        | 1 B                | Read              | 4E*                                       |                                                                                                                      |
| 74    | 0:56.621.376        | 1 B                | Read              | 4E*                                       |                                                                                                                      |
| 75    | 0:56.622.381        | 1 B                | Read              | 4E*                                       |                                                                                                                      |
| 76    | 0:56.623.371        | 1 B                | Read              | 4E*                                       |                                                                                                                      |
| 77    | 0:56.624.376        | 1 B                | Read              | 03*                                       |                                                                                                                      |
| 78    | 0:56.626.751        | 1 B                | Read              | 1D*                                       |                                                                                                                      |

.....continued

| Index | Time step m:s.ms.us | Transaction Length | Transaction (R/W) | Data in HEX (* represents NACK)                                                                                                                             | Remark                            |
|-------|---------------------|--------------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| 79    | 0:56.783.598        | 1 B                | Read              | 54*                                                                                                                                                         | Controller transmits: TPE\r\n.    |
| 80    | 0:56.784.358        | 1 B                | Read              | 50*                                                                                                                                                         |                                   |
| 81    | 0:56.785.392        | 1 B                | Read              | 45*                                                                                                                                                         |                                   |
| 82    | 0:56.786.397        | 1 B                | Read              | 0D*                                                                                                                                                         |                                   |
| 83    | 0:56.787.387        | 1 B                | Read              | 0A*                                                                                                                                                         |                                   |
| 94    | 0:56.911.235        | 1 B                | <b>Write</b>      | 45                                                                                                                                                          | Host writes E, to erase memory.   |
| 95    | 0:57.017.920        | 1 B                | Read              | 54*                                                                                                                                                         | Controller transmits: TOE\r\n.    |
| 96    | 0:57.019.471        | 1 B                | Read              | 4F*                                                                                                                                                         |                                   |
| 97    | 0:57.020.445        | 1 B                | Read              | 45*                                                                                                                                                         |                                   |
| 98    | 0:57.021.430        | 1 B                | Read              | 0D*                                                                                                                                                         |                                   |
| 99    | 0:57.032.984        | 1 B                | Read              | 0A*                                                                                                                                                         |                                   |
| 100   | 1:02.034.287        | 1 B                | Read              | 54*                                                                                                                                                         | Controller transmits: TE\r\n.     |
| 101   | 1:02.035.292        | 1 B                | Read              | 45*                                                                                                                                                         |                                   |
| 102   | 1:02.036.262        | 1 B                | Read              | 0D*                                                                                                                                                         |                                   |
| 103   | 1:02.037.251        | 1 B                | Read              | 0A*                                                                                                                                                         |                                   |
| 104   | 1:02.038.256        | 1 B                | Read              | 54*                                                                                                                                                         | Controller transmits: TPE\r\n.    |
| 105   | 1:02.039.261        | 1 B                | Read              | 50*                                                                                                                                                         |                                   |
| 106   | 1:02.040.246        | 1 B                | Read              | 45*                                                                                                                                                         |                                   |
| 107   | 1:02.041.270        | 1 B                | Read              | 0D*                                                                                                                                                         |                                   |
| 108   | 1:02.042.255        | 1 B                | Read              | 0A*                                                                                                                                                         |                                   |
| 112   | 1:02.162.090        | 1 B                | <b>Write</b>      | 50                                                                                                                                                          | Host writes P, to program memory. |
| 113   | 1:02.268.665        | 1 B                | Read              | 54*                                                                                                                                                         | Controller transmits: TOP\r\n.    |
| 114   | 1:02.270.295        | 1 B                | Read              | 4F*                                                                                                                                                         |                                   |
| 115   | 1:02.271.265        | 1 B                | Read              | 50*                                                                                                                                                         |                                   |
| 116   | 1:02.272.305        | 1 B                | Read              | 0D*                                                                                                                                                         |                                   |
| 117   | 1:02.273.295        | 1 B                | Read              | 0A*                                                                                                                                                         |                                   |
| 118   | 1:02.295.376        | 56 B               | <b>Write</b>      | 53 33 31 39 30 30 30 30 31 34 30 30 37 30 31 46 30 30 32 30 41 35 43 33 30 30 30 30 37 44 42 46 30 30 30 30 38 35 42 46 30 30 30 30 30 30 30 30 33 42 0D 0A | Host writes the S19 file line.    |

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.....continued

| Index | Time step m:s.ms.us | Transaction Length | Transaction (R/W) | Data in HEX (* represents NACK) | Remark                                                         |
|-------|---------------------|--------------------|-------------------|---------------------------------|----------------------------------------------------------------|
| 17335 | 2:37.860.138        | 1 B                | Read              | 03*                             | Controller transmits "System Status", with echo equal to 0xFF. |
| 17336 | 2:37.860.897        | 1 B                | Read              | FF*                             |                                                                |
| 17337 | 2:37.861.882        | 1 B                | Read              | 00*                             |                                                                |
| 17338 | 2:37.862.872        | 1 B                | Read              | 02*                             |                                                                |
| 17339 | 2:37.863.877        | 1 B                | Read              | 00*                             |                                                                |
| 17340 | 2:37.864.866        | 1 B                | Read              | 00*                             |                                                                |
| 17341 | 2:37.865.871        | 1 B                | Read              | 00*                             |                                                                |
| 17342 | 2:37.866.871        | 1 B                | Read              | FF*                             |                                                                |
| 17343 | 2:37.868.011        | 1 B                | Read              | C0*                             |                                                                |
| 17344 | 2:37.868.866        | 1 B                | Read              | 00*                             |                                                                |
| 17345 | 2:37.869.871        | 1 B                | Read              | 00*                             |                                                                |
| 17346 | 2:37.870.875        | 1 B                | Read              | 00*                             |                                                                |
| 17347 | 2:37.871.880        | 1 B                | Read              | 00*                             |                                                                |
| 17348 | 2:37.873.015        | 1 B                | Read              | 02*                             |                                                                |
| 17349 | 2:37.873.890        | 1 B                | Read              | C3*                             |                                                                |

### 3. Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

| Revision | Date    | Description                                                                                                                                                                                                                                                                                                                                                            |
|----------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| B        | 06/2020 | The following changes were made: <ul style="list-style-type: none"><li>• Changed PD69100 and PD692x0 PoE controllers to PD69100, PD692x0, and PD39210 PoE controllers in the <a href="#">Introduction</a> section.</li><li>• Removed PD692x0 in <a href="#">Table 1-1</a>.</li><li>• Replaced PD692x0 with the term Controller in <a href="#">Table 2-1</a>.</li></ul> |
| A        | 06/2020 | The following changes were made: <ul style="list-style-type: none"><li>• Updated the application note as per Microchip standards.</li><li>• Made changes in the <a href="#">Introduction</a> section.</li><li>• Changed TN140 to AN3497.</li></ul>                                                                                                                     |
| 1.1      | 07/2008 | This was the first publication of the document.                                                                                                                                                                                                                                                                                                                        |

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