Packet Transfer Protocol

(Rev 1.0)

Packet Format

| START BYTE | CMD | Payload Length | <Payload> | <CRC16> | END BYTE |

- START BYTE: 0xAA
- END BYTE: 0xBB
- CMD: Command code indicating the packet type
- Payload Length: Length of the payload in bytes (excluding START BYTE, CMD, CRC16, and END BYTE)
- Payload: Data associated with the command (varies based on CMD type)
- CRC16: 16-bit CRC checksum for packet integrity verification

Packet Descriptions

1. Start/Header Packet

| START BYTE | CMD | Payload Length | <Payload> | <CRC16> | END BYTE |

- CMD: 0x01 (Start/Header Packet)
- Payload:
  - File Length (4 bytes, represents total file size)
  - File Checksum (4 bytes, 32-bit checksum of the file)
  - Version Count (2 bytes, version number of the file)
- Payload Length: 10 bytes (total of file length, checksum, and version count)

2. Erase Memory Packet

| START BYTE | CMD | Payload Length | <Payload> | <CRC16> | END BYTE |

- CMD: 0x02 (Erase Memory Command)
- Payload: No payload
- Payload Length: 0 (indicates no additional data)

3. Firmware Packet

| START BYTE | CMD | Payload Length | <Payload> | <CRC16> | END BYTE |

- CMD: 0x03 (Firmware Data Packet)

- Payload:

 - Firmware Data bytes (actual firmware chunk, up to the specified Payload Length)

- Payload Length: Length of the firmware data in the current packet

4. End Packet

| START BYTE | CMD | Payload Length | <Payload> | <CRC16> | END BYTE |

- CMD: 0x04 (End of Transfer)

- Payload: No payload

- Payload Length: 0 (indicates no additional data)

5. Update Firmware Packet

| START BYTE | CMD | Payload Length | <CRC16> | END BYTE |

- CMD: 0x05 (Update Firmware Command)

- Payload: No payload

- Payload Length: 0 (indicates no additional data)

6. Response Packet

| START BYTE | CMD | Payload Length | Response Code | <CRC16> | END BYTE |

- CMD: Response to the previous command

- Response Code:

  - 0: OK

  - 1: NACK

  - 2: Checksum Verification Failed

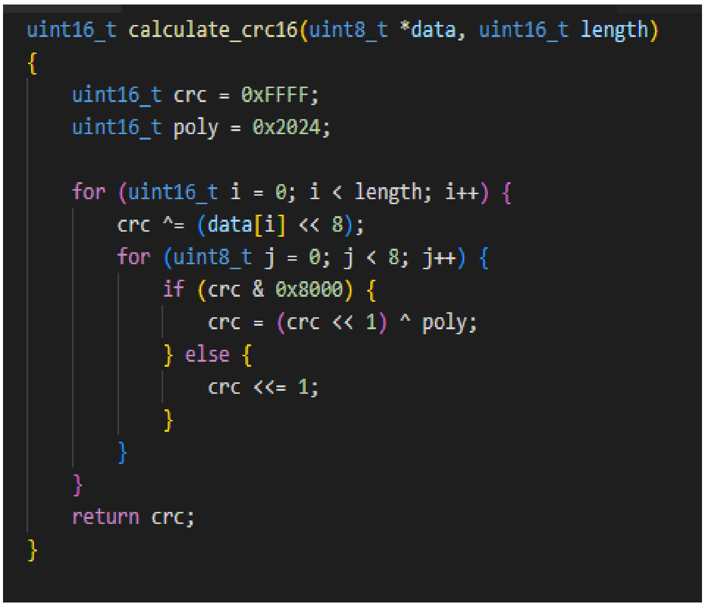
  - 3: Firmware Update Failed

- Payload Length: 1 (length of the response code)

CRC16 Calculation

To ensure packet integrity, a CRC16 checksum is calculated for the CMD, Payload Length, and Payload fields. Below is the implementation of the CRC16 calculation used

- Initial CRC Value: The initial CRC value is set to 0xFFFF.
- Polynomial: The polynomial used for the CRC calculation is 0x2024.
- The CRC is calculated over the CMD, Payload Length, and Payload fields, excluding the START BYTE and END BYTE.
- The <CRC16> value should be appended before sending the packet, and verified upon reception.



```
uint16_t calculate_crc16(uint8_t *data, uint16_t length)
{
    uint16_t crc = 0xFFFF;
    uint16_t poly = 0x2024;

    for (uint16_t i = 0; i < length; i++) {
        crc ^= (data[i] << 8);
        for (uint8_t j = 0; j < 8; j++) {
            if (crc & 0x8000) {
                crc = (crc << 1) ^ poly;
            } else {
                crc <<= 1;
            }
        }
    }
    return crc;
}
```

- Initial CRC Value: The initial CRC value is set to 0xFFFF.
- Polynomial: The polynomial used for the CRC calculation is 0x2024.

- The CRC is calculated over the CMD, Payload Length, and Payload fields, excluding the START BYTE and END BYTE.
- The <CRC16> value should be appended before sending the packet, and verified upon reception.

Example Packet Structures

1. **Start/Header Packet Example**:

   0xAA 0x01 0x0A 0x00 0x00 0x02 0x58 0x12 0x34 0x56 0x78 0x01 0x00 <CRC16> 0xBB

Explanation:

- 0xAA: START BYTE
- 0x01: CMD: Start/Header
- 0x0A: Payload Length: 10 bytes
- 0x00 0x00 0x02 0x58: File Length (600 bytes)
- 0x12 0x34 0x56 0x78: File Checksum
- 0x01 0x00: Version Count
- <CRC16>: 16-bit CRC value calculated for the above fields
- 0xBB: END BYTE

2. **Response Packet Example (OK Response)**:

   0xAA 0x01 0x01 0x00 <CRC16> 0xBB

   0xAA: START BYTE

   0x01: CMD: Response to Start/Header

   0x01: Payload Length: 1 byte (Response Code)

   0x00: Response Code: OK

   <CRC16>: 16-bit CRC value for the above fields

   0xBB: END BYTE

Troubleshooting

Error Type	Possible Causes	Suggested Action
Checksum Verification Failed	Incorrect CRC16 calculation, data corruption	Recalculate CRC or request retransmission
Firmware Update Failed	File integrity issues, version mismatch, memory error	Retry update, check memory health
NACK Received	Invalid command or sequence	Ensure the correct command sequence