

## Easy Bootloader Library for PIC24/dsPIC33/PIC32MM Communications Protocol

The communications protocol implemented by the *ex\_boot\_uart* and *ex\_boot\_i2c* example EZBL bootloader projects is described in this document. Although the implementations are almost identical, the protocols differ slightly due to I<sup>2</sup>C's master oriented paradigm in which the slave bootloader has no ability to initiate communications.

EZBL is a file oriented bootloader in which the host or master node need-not know anything about the target device. Individual flash read/write functions are not communicated on the bus and the host node remains unaware of what is contained in the file that it presents to a bootloader. In this paradigm, the Bootloader node remains fully responsible for detecting and decoding the .bl2 image file from the host, erasing appropriate flash pages, programming the provided data, verifying the flash via read-back comparisons, checking for file transfer integrity, and flagging the final Application flash as ready for execution. The host-node requires remain comparatively very simple and only need to understand/adhere to the flow control signaling emitted by the Bootloader.

Unless specified otherwise, all multi-byte fields employed in this specification are always transmitted in Little-Endian byte order or pre-stored serialized file byte order.

Bit transmission order within bytes matches the underlying transmission medium's bit ordering method. Logically, the smallest unit of data in this specification is one byte, or 8 bits.

### Discrepancies

If details of this protocol specification are unclear or discrepancies in behavior are observed, be sure to directly read the source code implementing the protocol. All UART protocol handling by the bootloader is implemented in the *ezbl\_lib/weak\_defaults/i2c\_fifo.c* file while I<sup>2</sup>C protocol handling is in *ezbl\_lib/weak\_defaults/i2c\_fifo.c*. Higher layer processing is done in *ezbl\_lib/sectioned\_functions/EZBL\_Install2Flash.c*.

Be sure to verify physical transactions occurring on the UART pins or I<sup>2</sup>C bus by using an UART/ I<sup>2</sup>C Bus Sniffer or Logic Analyzer.

On the I<sup>2</sup>C master or PC, the code within the *ezbl\_tools.jar*'s *Communicator.java* class provides the file transfer data, flow control limiting and return value status reporting. Lower level details, passing data to system drivers and interpretation and stripping of Frame Header bytes (applicable to I<sup>2</sup>C only) from read data occurs in the *ezbl\_comm.exe* process.

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## Base Protocol, including UART

The protocol used by the `ex_boot_uart` project is asynchronous, full or half duplex, point-to-point serial (or point to multi-point with restrictions). The default `ex_boot_uart` project settings target:

1. UART2 peripheral on most targets, especially on Explorer 16/32 PIMs
2. 1 start bit, 8 data bits, 1 stop bit
3. No parity
4. No hardware flow control, no XON/XOFF software flow control
5. Auto-baud baud rate synchronization with the host PC choosing the actual communications bit rate. Valid baud rates depend on the target hardware, but rates up to 460800 baud can normally be achieved with the Explorer 16 and many PIMs. High baud rates will also work when electrically possible (ex: using MCP2200 with direct logic level interface).

This section is relevant to other protocols besides UART, including I<sup>2</sup>C.

### General Operation

UARTs without hardware flow control pose a challenge for bootloading as bootloading involves lengthy flash page erase and flash word/double-word write operations. However, they generally are cheap and easy to use, require only 2 wires (plus ground), can readily pass through electrical isolation barriers and can operate at quite high speeds.

To accommodate some timing requirements, EZBL places independent TX and RX software FIFOs on the communications inputs/outputs to enable buffering of data quickly in an ISR and processing at any other rate from the main()/IPL0 context.

Additionally, EZBL implements a software flow control method whereby the host cannot send data to the Bootloader until the Bootloader advertises how many bytes of RX free space it has available and is willing to accept from the host. In this manner, the communications supports either full-duplex mediums (like classic RS232) or half-duplex variants (like I<sup>2</sup>C), so long as a carrier sense mechanism exists in the hardware such that the bootloader and host node can never try to transmit a byte of data simultaneously and lose data in the process.

The bootloader can generate flow control advertisements periodically and piecewise incrementally before prior advertisements are serviced. In other words, a new advertisement can show up at the host before the host responds with anything for an earlier advertisement. This attempts to generate a smooth, continuous flow of feed data to the Bootloader while attempting to minimize the effects of higher latency communications links where lockstep flow control algorithms would reduce throughput.

Overall bootloading communications transitions through four phases:

- 1.) Offer
- 2.) Accept/Erase
- 3.) Transfer/Programming
- 4.) Status/Termination

### Phase 1: Offer

Communications start with the host node transmitting the first 64 bytes of the firmware image file verbatim (**.bl2** file). These 64-bytes contain auto-baud synchronization characters, a fixed EZBL bootloader wakeup sequence, file type identification, length, target BOOTID bootloader identification, APPID\_VER application version data, and encryption parameters (if applicable). For more information on the contents of a .bl2 file, see the *BL2 File Format Specification* document.

The recipient bootloaders receive the auto-baud characters and switch baud rate to match in hardware (if applicable), then look for the fixed EZBL bootloader wakeup sequence in the communications RX ISR. Only with an exact 64-bit wake up match will any processing continue. Mismatches will reset the sequence decoder and be left as unhandled data in the RX FIFO for processing as Application specific data outside the EZBL bootloader (i.e. the bootloader is built to ignore everything and passively listen only).

If a wake up match is made, extended processing continues within the EZBL\_Install2Flash() ezbl\_lib.a function, executing at IPL0 in the background.

Extended processing includes checking for image validity and image applicability via the BOOTID field. If the image contents are for a different EZBL bootloader, the extended processing will be abandoned and the Bootloader will return to a passive/dormant state without generating any TX data back to the host.

If the BOOID field does match, but the APPID\_VER field is unacceptable to the bootloader, then communications jumps to Phase 4.) Status/Termination with a failing return code to immediately notify the host that the offered .bl2 file is unwanted.

For the remaining cases where everything is valid, processing moves to the Accept/Erase phase.

### Phase 2: Accept/Erase

If the .bl2 file offering is deemed by the Bootloader to be valid for programming, the bootloader will respond with a 16-bit, byte little-endian keep-alive flow control advertisement to signify that the host has touched a wanting recipient and should continue to transmit the file. The value of this special keep-alive message is 0xFFFF0 (-16).

Before the bootloader can program anything, it must first erase any existing Application (or target partition), which is typically a very lengthy process of 10's of milliseconds to a few seconds long. During this time, the Bootloader will periodically send keep-alive flow control advertisements of 0xFFFF0 to prevent timeout on the host node.

To accelerate the erase stage and avoid unnecessary flash endurance loss, the Bootloader implements read-before-erase checking where each page is blank checked and erased only if required. This creates variable erase stage timing, but can greatly decrease overall bootloading time during development (where the flash size may be much bigger than the application code you are repeatedly bootloading) and during production programming (where parts start out in an erased state, excluding the bootloader occupied pages).

Upon erase/blank-check completion, a flow advertisement is generated requesting the maximum amount of data that can fit in the bootloader's RX FIFO (always a positive number <= 32,767). This starts the flow of bulk data for programming and processing advances to phase 3: transfer/programming.

### Phase 3: Transfer/Programming

In this phase, the host node continues to send sequential bytes to the bootloader from the .bl2 file following the header. The bootloader decodes, programs data records to flash, reads the flash back to check for mismatches, and generates flow requests periodically to ensure the RX FIFO stays as full as possible. Often, however, the hardware will program data faster than the communications link delivers it.

In this case, the RX FIFO stays mostly empty, but larger RX FIFO allocations can still lead to superior bootloading throughput on account of better burst transmission handling. For example, a UART on a PC acting as a host will typically go through a USB to UART converter which adds appreciable round-trip communications latency (ex: 3ms for a 1-byte echo). Additionally, the PC software will be subject to several 10s of millisecond execution stalls due to the non-real time nature of PC multitasking OSes. By allocating a larger bootloader RX FIFO size, the bootloader can advertise bigger free-space numbers in flow control messages, resulting in the PC and USB to UART tasks delivering larger payloads when given execution time.

During this transfer/programming stage, more bootloading errors can occur than in the prior stages. For example, if the .bl2 file was built incorrectly or otherwise has a data record in it targeting a flash program address that is invalid on the target microcontroller, then the bootloader will still try to program and verify the contents via read-back. However, for unimplemented program space addresses read by the CPU, an Address Error Trap will be generated, which will typically reset the bootloader. The host node will stop receiving flow control messages, so will eventually time out and report a generic timeout error to the user. Such a run-time error, however, might suggest faulty image generation rather than a communications glitch or other error.

If at any time the RX programming data targets a Bootloader reserved flash address, the Bootloader will skip programming of that address but proceed with read-back verification. Any mismatches in non-programmable Bootloader regions will be flagged, but not reported to the host until .bl2 file completion occurs and phase 4: termination/status is reached. This type of error means the wrong Bootloader exists in the target relative to what the Application project was built with, but does not result in outright bootload abort since the error may be benign if the Application does not use any EZBL APIs or variables after being launched.

If at any time a read-back mismatch occurs in an Application-space flash address (that cannot be reconciled due to expected hardware behaviors or specific data masking), the Bootloader will immediately abort further programming and proceed to the phase 4: termination/status state.

Also, all communications on the bus are timed events. If the Bootloader has been receiving and programming data, but then the host falls off the bus or otherwise stops communicating with the Bootloader, then the Bootloader will time out and proceed to phase 4. Likewise, if the host node stops seeing flow control advertisements from the bootloader, the host node will time out and abort further transmission of the .bl2 file contents.

A possibility exists in which the bootloader gets out of sync with the host due to data being dropped or corrupted while communicating. The bootloader could be expecting data to arrive and the host will be waiting for the next flow control advertisement from the bootloader. Both the bootloader and host nodes will terminate by timeout in this case. Because of this scenario, it is recommended that the host-side timeout always be set slightly longer than the bootloader-side timeout. This will increase the likelihood that the bootloader's timeout return status code will be received by the host node and displayed, if applicable, rather than having to actually timeout on the host without any indicator as to what went wrong.

After all .bl2 bytes are received and programmed by the Bootloader (the bootloader tracks bytes to EOF based on the file length in the starting 64-bit byte offer), phase 4: status/termination is entered.

#### Phase 4.) Status/Termination

A 16-bit zero flow control advertisement from the Bootloader to the host node indicates bootload termination with a 16-bit status code immediately following indicating the final disposition of the firmware update. For example, on the wire, one may see (hex bytes):

```
00 00 01 00
```

The first two bytes are the 0x0000 flow control message indicating bootload termination, while the 0x0001 status code indicates successful bootload completion with all addresses programmed and verified. 0x0001 corresponds to the `EZBL_ERROR_SUCCESS` constant in the `ezbl.h` header file.

The status sequence is identical for successful and failed bootload attempts, but in failure cases, the bootload termination may occur prior to the End-Of-File (EOF) being transmitted by the host node and the 16-bit status code will be something other than `EZBL_ERROR_SUCCESS`. If early termination occurs, the host node may optionally continue to transmit the firmware image until EOF occurs as the Bootloader will ignore remaining bytes.

In the Bootloader, for otherwise successful bootload sequences, the last 4 bytes of the .bl2 file will be checked. These contain a CRC32 pre-computed by the ezbl\_tools.jar tool when the .bl2 file was generated at compile-time. The CRC covers all of the .bl2 file data starting after the 16-byte auto-baud/bootloader wake up SYNC field data up until the CRC32 field is reached. Therefore, verifying this field validates that everything that happened to the .bl2 file after being built up until the bootloader saw and processed it has proceeded without data corruption. It therefore confirms that no communications corruption took place.

Once CRC32 verification passes, a final flag is written to flash indicating that the bootloader is allowed to pass execution over to the new Application image upon future device reset (EZBL\_IsAppPresent() returns 1). This flag exists on the first page of the Application, so it is also the first page to be erased during phase 2: accept/erase, ensuring a partially bootloaded or partially erased application can never be inadvertently executed.

In the event anything went wrong, there will be a partial application in a known invalid state in flash. This invalid flash state is not fatal to the bootloader, which will continue to operate normally and continue to accept new .bl2 image transfers. Even if power is lost, the PIC/dsPIC will reset back into the bootloader, allowing new bootload attempts without permanently bricking the device.

For failing cases, the final status code provides very limited detail as to exactly what went wrong in the bootloading process. This aspect is by design so as to minimize chances of an attacker gaining useful information about the flash contents when device Code Protect is enabled. In such an environment, even emitting the address where a failure occurred can lead to a complete compromise of a system inadvertently by allowing an attacker to repeatedly probe the bootloader with different data until a new failing address is returned.

As a side effect, debugging many failures can be somewhat challenging. Do not be afraid to pull out a logic analyzer and run the target bootloader in a debugger. Specific causes of failure can vary greatly when bootloading, sometimes relating to the baud rate, wireless/Bluetooth/GPRS/etc. communications latency exceeding timeouts, incorrect BOOTID strings at build time, mismatched Application code for the programmed Bootloader, inadvertent RAM corruption in an ISR, hardware write protection, illegal data record addresses in the .hex/.bl2 image file, electrical environment, and generically, software errors or misunderstandings regarding expected behavior. The possibilities are virtually endless without a one-size-fits-all solution.

In many cases, a good strategy is to save a flash contents dump from MPLAB® X IDE to a file, issue a flash read-back ICSP programmer/debugger command, again save the flash contents dump from the IDE to a file, and then use a graphical file comparison tool to identify what exists in flash post-termination and what should have been in flash based on what the compiler generated when building the Application project. This file comparison can be augmented with EZBL communications log data and/or logic analyzer data to build a picture as to what was being handled at the time of bootload failure. [Appendix A](#) contains a full example bootloading sequence which can be used to visualize data flow in both directions.

### Performance/Throughput

Transmission of bytes both into and out of the PIC/dsPIC occurs via two independent communications queues (FIFOs). For UART bootloaders, these are instanced in either a `uart_fifo.c` file, or from a pre-compiled `uart_fifo.o/uart1_fifo.o/uart2_fifo.o` object file in the `ezbl_lib.a` archive. Similarly, for I<sup>2</sup>C bootloaders, these are instanced in either an `i2c_fifo.c` file, or from a pre-compiled `i2c_fifo.o/i2ct1_fifo.o/i2c2_fifo.o` archived object file.

A relatively small TX FIFO (default 32 bytes) is implemented in software to allow multiple data chunk requests or status response bytes to be sent back to the host device in a streaming fashion that avoids stalling the CPU under most circumstances. FIFO size can be quite small - even 8 bytes - minimizing RAM use, as communications are largely one sided with the majority of traffic being sent from the host down to the bootloader. In the event too many response bytes are generated and the TX FIFO is full, then execution of further bootloader operations is

stalled until adequate TX FIFO space is freed up, which is generally an automatic happening due to the asynchronous activity in a bootloader communications ISR.

The RX FIFO implemented in software is significantly larger (default 96 bytes) and allows faster communications, even in the presence of higher communications latency. When transferring the new firmware image, the software RX FIFO is never subject to overflow because the bootloader never requests more data than can fit at any given moment into the FIFO. However, the RX FIFO cannot be smaller than 64-bytes as the first 64 bytes of the .bl2 file offering from the host is transmitted onto the wire without any software flow control provisions.

In general, the larger the RX FIFO, the faster the bootloader will operate -- subject to an upper speed cap defined by the baud rate and other hardware considerations. For example, transferring a 256,799 byte .bl2 file to a 70 MIPS dsPIC33EP512MU810 test target using the MCP2221 for UART emulation may require 10.3 seconds, or 24.4KB/s at 460800 baud and 96 bytes of RX FIFO space in the Bootloader. However, the same file transferred at 761900 baud from an MCP2200 with a 1024 byte Bootloader RX FIFO may take either 5.56 seconds (45.1KB/s) or even 4.07 seconds (61.7KB/s) when the Bootloader does not have to erase any pages before starting the programming phase. Such high speeds may make EZBL bootloaders an attractive production programming tool for some, especially larger, system designs. Devices could even be ordered from Microchip with SQTP

A roughly equivalent test with 256,754 bytes of .bl2 data on a 16 MIPS PIC24FJ1024GB610 can achieve 11.1 seconds (22.6KB/s) at 96 byte RX FIFO buffering and 460800 baud. Again switching to the MCP2200 and testing at a higher baud rate and 1024 byte RX FIFO, overall performance may increase to 6.85 seconds (36.6KB/s) or 5.46 seconds (45.9KB/s) for the no-erase case. These faster numbers were measured at a selected baud rate of 571000 baud.

Both 761900 and 571000 baud are non-standard values chosen to optimize performance.

- Baud rates exceeding 761900 are unlikely to work as the Bootloader does not exercise any DMA hardware. As a result, the 4-byte hardware RX FIFO in the UART peripheral will overflow while the CPU is stalled for a prior flash double-word write operation. Such circumstances will normally result in data loss and the protocol does not support retransmissions, so the entire Bootloader operation will be terminated as a failure.
- A baud rate of 571000 was used on PIC24F hardware due to the very limited baud granularity available when clocked at the 16 MHz maximum rate supported by PIC24F devices. 571000 allows nearly zero baud rate error and is likely to work from the internal FRC +PLL clock source at 16 MIPS.

## I<sup>2</sup>C

The protocol used by the *ex\_boot\_i2c* project is I<sup>2</sup>C slave mode. The default *ex\_boot\_i2c* project settings target:

1. I<sup>2</sup>C peripheral 1 (generally SDA1/SCL1 device pins, but will be ASDA1/ASCL1 on some Explorer 16/32 PIMs)
2. 7-bit I<sup>2</sup>C slave address of 0x60
3. 400kHz baud rate

### General Operation

I<sup>2</sup>C is implemented exactly as the UART protocol in all feasible respects. The net data sent from the I<sup>2</sup>C master to the slave bootloader remains simply the *.bl2* application image file verbatim. Flow control advertisements, early abort, and final status messages remain the only data passed from the bootloader to the master. However, the I<sup>2</sup>C physical layer dictates a few adjustments outlined here.

### Flow Control

I<sup>2</sup>C as a bus protocol supports clock-stretching as a means of flow control with each byte being ACKnowledged by the I<sup>2</sup>C hardware in order to detect unheard transmissions. However, EZBL makes minimal use of clock stretching and only extends clocks when mandatory in order to prevent data loss.

Specifically, clock stretching is invoked automatically by the hardware when the I<sup>2</sup>C slave ISR is blocked from executing. For the default EZBL project, this occurs only while the CPU is stalled due to an ongoing flash erase or flash programming operation. The master node initiates I<sup>2</sup>C read and write commands asynchronous to the EZBL target, with no knowledge as to whether the PIC is in the middle of a flash operation.

As soon as the CPU resumes execution, the I<sup>2</sup>C slave ISR will service the master request and lift the clock stretch.

Additionally, the implemented algorithm ensures that all I<sup>2</sup>C transactions (to the EZBL target's I<sup>2</sup>C slave address) are always ACKnowledged with no need for the master to ever retransmit anything. The only I<sup>2</sup>C transactions that will be NAK'ed are ones which occur while the I<sup>2</sup>C hardware peripheral is not initialized or logically present on the bus. I.e. the PIC may be busy performing a reset, frozen by a debugger, or has the bootloader turned off.

The software RX FIFO flow advertisement algorithm described in the UART protocol is implemented in I<sup>2</sup>C unchanged. This throttles the master transmissions to match the bootloader programming/verify rate without causing unnecessary I<sup>2</sup>C bus blocking by extended clock stretching or NAKing transfers and requiring the master implementation to be more complicated.

### Slave TX to Master RX Data

As the I<sup>2</sup>C protocol is master-slave oriented and the EZBL bootloader operates exclusively as an I<sup>2</sup>C slave, it is not possible for the bootloader to initiate any data transfers to the master device. This complicates the RX FIFO flow advertisement transmissions, early abort and final bootload status reporting back to the master device.

To allow bi-directional transactions, EZBL requires that the I<sup>2</sup>C master poll the bootloader for outbound data by issuing periodic I<sup>2</sup>C read transactions of 1 or more bytes. At the start of all I<sup>2</sup>C read requests (and restarts), the bootloader will emit a 1-byte indicator (header) that specifies how many bytes of data are presently waiting for transmission in the bootloader's software TX FIFO. Following this header byte, if the master node continues to issue I<sup>2</sup>C clocks, the bootloader will begin popping data from the FIFO and transmitting it onto the I<sup>2</sup>C bus.

If the master issues an I<sup>2</sup>C read for exactly one byte and then terminates the transaction, the master will gain knowledge of the TX FIFO status and be able to issue a subsequent I<sup>2</sup>C read to collect the data. However, in this case, the subsequent read request will trigger another TX FIFO data count transmission, so the master should generate a read for at least 1 byte plus the previously captured data count in order to collect all of the data that the bootloader had pending for transmission. Additionally, the master should save the second data count indicator



and subtract off the number of bytes popped in order to see if the bootloader generated more TX data while the master was busy issuing the I<sup>2</sup>C reads.

This algorithm can result in appreciable bus overhead if the master always issues polling requests just to see if data is waiting. To minimize this, the master may issue speculative reads in order to both get present FIFO data count information and pop some FIFO data in the same I<sup>2</sup>C read transaction. For example, because all bootloader messages back to the master are sized to be a multiple of 16-bits and are predominantly periodic flow control advertisements, the master may reduce overhead by issuing fixed speculative 3 byte I<sup>2</sup>C reads. The first byte will get the TX FIFO data count, and the remaining two bytes will return two bytes of data from the FIFO.

In the event the master tries to read data while the FIFO sits at 0 remaining bytes, the bootloader will transmit new TX FIFO data count bytes, and if non-zero, follow immediately with the data from the FIFO. This implies that continued I<sup>2</sup>C read clocking will normally shift out zeros (i.e. no TX FIFO data count bytes available), then if the bootloader simultaneously generates some data, the next I<sup>2</sup>C byte read will be the generated data size, followed by the data. Each I<sup>2</sup>C byte read while the TX FIFO is empty therefore mimics a new I<sup>2</sup>C read request, but without requiring a repeat of the I<sup>2</sup>C protocol overhead containing the initial I<sup>2</sup>C slave target address, R/W indicator bit, and ACK.

### **MCP2221/ezbl\_comm.exe/ezbl\_tools.jar Implementation**

The default I<sup>2</sup>C master implementation in the EZBL distribution uses the MCP2221 connected to a Windows based PC to generate/receive I<sup>2</sup>C data.

**ezbl\_comm.exe** operates at the lowest layer, communicating via statically linked MCP2221 object code with the MCP2221 USB hardware. In this layer, the Slave TX to Master RX polling is implemented with the TX FIFO data count bytes getting stripped off and processed such that the data passed to the next layer up (the **ezbl\_tools.jar** utility) appears to be identical for both UART and I<sup>2</sup>C bootloader targets.

Additionally, **ezbl\_comm.exe** generates the I<sup>2</sup>C slave target address byte. This value is passed from the user command line that invoked **ezbl\_tools.jar** to **ezbl\_comm.exe** via a command line argument as well when this communications processes is internally launched.

The data is physically passed from **ezbl\_comm.exe** to/from **ezbl\_tools.jar** via named uni-directional pipes. Specifically the two pipes are named **\\.\pipe\ezbl\_pipe\_out\_to\_com** and **\\.\pipe\ezbl\_pipe\_in\_from\_com**.

I<sup>2</sup>C throughput with the MCP2221 and EZBL's software protocol is extremely poor (on the order of 3KB/s for default FIFO sizes, up to ~9KB/s for a 1024 byte RX FIFO). This is due to limitations predominantly in the MCP2221's round trip communications latency (i.e. switching from I<sup>2</sup>C read transaction to a I<sup>2</sup>C write transaction, and then back to a I<sup>2</sup>C read).

The realized net throughput should not be used to gauge bootloading performance with other I<sup>2</sup>C masters or protocol efficiency. Throughput is expected to exceed an order of magnitude improvement when paired with other I<sup>2</sup>C master devices.

## Appendix A: Example Communications Sequence

This example was generated for an upload of `ex_app_led_blink.production.bl2` to `ex_boot_i2c` via the MCP2221 and I2C. However, this appendix also serves as a UART reference as I2C is only superficially different at this level, differing only by the launch command line (different `-com=x` and `-baud=` parameters) and the relative timing between the host PC TXing data and data being RX'ed from the Bootloader.

Hyperlinks in the data flow indicate significant state boundaries and point back to the relevant section of text.

```
ezbl_comm.exe communications log started at 4/3/2017 1:29:21 PM
```

```
ezbl_integration\ezbl_comm.exe -com=I2C -baud=400000 -slave_address=96 -
log=C:\Users\c12128\AppData\Local\Temp\ezbl_comm_log.txt
```

```
Usage: ezbl_comm.exe [-com=COMx] [-baud=x] [-slave_address=x] [-persist] [-log]
```

Opens a communications port and bridges read and write data to two unidirectional named pipes. The pipe names are:

```
\\.\pipe\ezbl_pipe_in_from_com
and
\\.\pipe\ezbl_pipe_out_to_com
```

Parameters:

```
-com=COMx
Communications port to open. Can be for example, COM1, \\.\COM10, or
I2C for MCP2221. You must have the \\.\ prefix on COM10 and above.
-baud=x
Baud rate, or physical bit rate of the communications medium. Example:
115200, 460800, 400000. When unspecified, a default of 115200 baud is
used for UARTs and 400000 baud for I2C.
-slave_address=x
Address of the I2C slave when using I2C communications (ignored for
UART mode)
-persist
ezbl_comm.exe process will reopen the local pipes for a new session
when the attached process closes its pipe handles.
-log
Displays timestamped TX and RX bytes of all data passing through.
```

Timestamp: Direction Size @ Offset in stream (direction specific)

```
-----
0.022672: TX 64 @ 0:
  55 55 55 55 55 55 55 55 4D 43 55 50 48 43 4D 45  UUUUUUUUMCUPHCME
  42 4C 32 42 84 31 00 00 D2 8A 33 37 A3 0B 1B A2  BL2B.1....37....
  15 B4 AD A8 8E 22 55 2D 21 06 00 00 0D 00 01 00  ...."U-!.....
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
0.085696: RX 2 @ 0:
  F0 FF ..
0.152640: RX 2 @ 2:
  F0 FF ..
0.184719: RX 2 @ 4:
  F0 FF ..
0.193690: RX 2 @ 6:
  80 00 ..
0.195312: TX 128 @ 64:
  D8 30 00 00 00 00 00 00 64 02 04 00 00 00 10 1C .0.....d.....
  00 14 1C 00 18 1C 00 1C 1C 00 20 1C 00 24 1C 00  ....$..
  28 1C 00 2C 1C 00 30 1C 00 34 1C 00 38 1C 00 58  (,..0..4..8..X
  02 00 50 1D 00 40 1C 00 44 1C 00 48 1C 00 4C 1C  ..P..@..D..H..L.
  00 50 1C 00 54 1C 00 58 1C 00 5C 1C 00 60 1C 00  .P..T..X..\'..
  50 1D 00 64 1C 00 5E 02 00 6C 1C 00 70 1C 00 74  P..d..^..l..p..t
  1C 00 78 1C 00 50 1D 00 50 1D 00 50 1D 00 50 1D  ..x..P..P..P..P.
  00 7C 1C 00 80 1C 00 84 1C 00 88 1C 00 8C 1C 00  .|.....
0.223743: RX 10 @ 8:
  14 00 18 00 18 00 18 00 18 00  ....
0.225313: TX 116 @ 192:
```

# Microchip Easy Bootloader Library for PIC24/dsPIC33 and PIC32MM

```

    90 1C 00 94 1C 00 98 1C 00 9C 1C 00 50 1D 00 50 .....P..P
    1D 00 50 1D 00 A0 1C 00 A4 1C 00 50 1D 00 50 1D ..P.....P..P.
    00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 .P..P..P..P..P..
    50 1D 00 50 1D 00 50 1D 00 A8 1C 00 AC 1C 00 50 P..P..P.....P
    1D 00 50 1D 00 50 1D 00 B0 1C 00 50 1D 00 50 1D ..P..P....P..P.
    00 B4 1C 00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 ....P..P..P..P..
    50 1D 00 50 1D 00 50 1D 00 B8 1C 00 BC 1C 00 50 P..P..P.....P
    1D 00 50 1D ..P.
0.253746: RX 10 @ 18:
    18 00 18 00 18 00 18 00 18 00 .....
0.255312: TX 120 @ 308:
    00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 C0 1C 00 .P..P..P..P.....
    50 1D 00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 50 P..P..P..P..P..P
    1D 00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 50 1D ..P..P..P..P..P..
    00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 .P..P..P..P..P..
    50 1D 00 50 1D 00 50 1D 00 50 1D 00 C4 1C 00 C8 P..P..P..P.....
    1C 00 CC 1C 00 D0 1C 00 D4 1C 00 50 1D 00 50 1D .....P..P.
    00 50 1D 00 50 1D 00 D8 1C 00 DC 1C 00 E0 1C 00 .P..P.....
    50 1D 00 50 1D 00 50 1D P..P..P.
0.283656: RX 10 @ 28:
    18 00 18 00 18 00 18 00 18 00 .....
0.285301: TX 120 @ 428:
    00 50 1D 00 E4 1C 00 E8 1C 00 EC 1C 00 F0 1C 00 .P.....
    F4 1C 00 F8 1C 00 FC 1C 00 00 1D 00 50 1D 00 50 .....P..P
    1D 00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 50 1D ..P..P..P..P..P..
    00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 .P..P..P..P..P..
    50 1D 00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 50 P..P..P..P..P..P
    1D 00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 50 1D ..P..P..P..P..P..
    00 50 1D 00 04 1D 00 08 1D 00 50 1D 00 50 1D 00 .P.....P..P..
    50 1D 00 50 1D 00 50 1D P..P..P.
0.309725: RX 10 @ 38:
    18 00 18 00 18 00 18 00 18 00 .....
0.311330: TX 120 @ 548:
    00 50 1D 00 50 1D 00 0C 1D 00 10 1D 00 14 1D 00 .P..P.....
    18 1D 00 1C 1D 00 50 1D 00 20 1D 00 50 1D 00 50 .....P.. ..P..P
    1D 00 24 1D 00 28 1D 00 2C 1D 00 30 1D 00 34 1D ..$. (.,.,.0..4.
    00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 50 1D 00 .P..P..P..P..P..
    50 1D 00 50 1D 00 50 1D 00 38 1D 00 3C 1D 00 50 P..P..P..8..<..P
    1D 00 50 1D 00 40 1D 00 44 1D 00 48 1D 00 4C 1D ..P..@..D..H..L.
    00 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
    FF FF FF FF FF FF FF FF .....
0.335725: RX 10 @ 48:
    18 00 18 00 18 00 18 00 18 00 .....
0.337328: TX 120 @ 668:
    FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
    FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
    FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
    FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
    FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
    FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
    FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
    FF FF FF FF FF FF FF FF .....
0.362724: RX 10 @ 58:
    18 00 18 00 18 00 18 00 18 00 .....
0.364328: TX 120 @ 788:
    FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
    FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
    FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
    FF FF FF FF 00 1C 00 80 AF 00 84 AF 00 98 AF 00 .....
    A4 AF 00 A8 AF 00 B0 AF 00 00 B0 00 00 00 00 00 .....
    1C 00 80 AF 00 84 AF 00 98 AF 00 A4 AF 00 A8 AF .....
    00 B0 AF 00 00 00 00 00 1C 00 00 1C 00 0C 1C 00 .....
    A8 AF 00 AC AF 00 80 AF .....
0.392654: RX 10 @ 68:
    18 00 18 00 18 00 18 00 18 00 .....
0.394305: TX 120 @ 908:
    00 06 00 00 FF FF 00 FF FF FF 98 AF 00 12 00 00 .....
    F8 FF 00 FF FF FF 1B FE 00 FF FF FF C8 FC 00 FF .....

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# Microchip Easy Bootloader Library for PIC24/dsPIC33 and PIC32MM

```

FF FF A8 AF 00 0C 00 00 DE 7F 00 FF FF FF FE FF .....
00 FF FF FF 94 AF 00 06 00 00 FF 7F FF FF FF FF .....
68 10 AF F0 0C 37 0B 01 37 68 30 AF 03 0D 37 8B h...7..7h0...7.
00 37 4F 18 21 0E FF 22 0E 01 88 00 00 00 00 00 .7O.!...".....
20 00 00 E0 02 00 32 00 01 20 20 02 88 14 00 07 .....2.. .....
0B 01 07 00 00 E0 03 00 .....
0.418628: RX 10 @ 78:
18 00 18 00 18 00 18 00 18 00 .....
0.427626: TX 120 @ 1028:
3A 00 29 21 01 00 20 02 00 37 00 00 20 01 00 20 :.)!.. ..7.. ..
81 0F 70 01 00 32 0F 00 07 00 00 20 00 00 E0 02 ..p..2.....
00 32 00 00 02 00 00 00 96 0B 02 00 00 00 00 40 .2.....@
DA 00 00 FE 40 04 20 00 00 E0 02 00 32 00 20 20 ....@. ....2.
90 01 88 00 00 06 A1 02 88 80 04 78 00 00 EB 1F .....x....
00 37 E2 84 44 54 A0 B4 99 05 BA E2 84 44 54 A0 .7..DT.....DT.
B4 99 06 BA E2 84 44 54 A0 B4 00 06 EB 47 6F DE .....DT.....Go.
FD 07 B2 AE 01 88 63 6C .....cl
0.465712: RX 10 @ 88:
18 00 18 00 18 00 18 00 18 00 .....
0.467301: TX 120 @ 1148:
E1 03 00 3A 0A D8 01 00 00 EB 0E 00 37 60 6C E1 ...:.....7`l.
08 00 3A 00 4D EB 0A 05 E8 02 00 39 34 20 EC 0A ...:M.....94 ..
F0 A0 8B 05 E9 F9 FF 3E 04 00 37 61 68 E1 01 00 .....>..7ah...
32 00 86 EB 0B 00 07 19 C7 BA 19 05 BA 0E 04 E0 2.....
03 00 3A 0A 00 E0 DB FF 3A 00 00 06 FE 07 B2 AE ...:.....
02 88 8A 04 78 F5 FF 37 0C D0 A3 E2 0F 4D 1C 00 ....x..7.....M..
39 89 02 78 35 4D BA 0A 05 E8 02 00 39 34 20 EC 9..x5M.....94 .
0A F0 A0 8B 05 E9 0F 00 .....
0.495684: RX 10 @ 98:
18 00 18 00 18 00 18 00 18 00 .....
0.497304: TX 120 @ 1268:
32 25 4D BA 0A 05 E8 02 00 39 34 20 EC 0A F0 A0 2%M.....94 ....
8B 05 E9 08 00 32 0C 00 E0 06 00 32 15 CD BA 0A .....2.....2....
05 E8 02 00 39 34 20 EC 0A F0 A0 8B 05 E9 89 84 .....94 .....
E8 54 A0 B4 0B 00 E0 E2 FF 3A 00 00 06 99 02 BA .T.....:.....
05 5D 78 8B 05 E9 F7 FF 32 C8 2A DE 05 5D 78 8B .]x.....2.*..]x.
05 E9 F3 FF 32 0C 00 E0 F1 FF 32 19 DD BA EE FF .....2.....2....
37 00 00 00 00 00 00 00 00 00 00 00 00 00 00 7.....
00 00 00 00 00 00 00 00 .....
0.521639: RX 10 @ 108:
18 00 18 00 18 00 18 00 18 00 .....
0.523332: TX 120 @ 1388:
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00 00 00 80 9F BE 82 9F BE 84 1F 78 08 00 FA 00 .....x....
80 20 90 00 90 01 00 A1 11 00 98 20 10 80 80 00 . .....
78 00 18 A3 3A 00 32 73 10 80 41 02 B2 02 02 20 x...:2s..A....
82 8F 50 35 00 3A 76 30 A8 E2 8A 80 21 16 21 91 ..P5.:v0....!!..
0F 51 04 00 39 11 00 20 A1 83 88 76 90 A8 0D 00 .Q..9.. ..v....
37 E2 15 21 92 00 78 83 58 78 01 09 78 22 8B 80 7..!..x.Xx..x"..
24 16 21 14 02 41 84 8F $.!..A..
0.548779: RX 10 @ 118:
18 00 18 00 18 00 18 00 18 00 .....
0.550327: TX 120 @ 1508:
50 01 00 39 F2 8A 88 12 00 20 C1 15 21 91 08 41 P..9..... ..!..A
D1 34 24 C1 BF 9F 51 05 25 D1 BF 9F 81 34 24 E1 .4$...Q.%....4$.
BF 9F 51 20 B0 F1 BF 9F C1 83 80 E7 80 60 C1 83 ..Q .....`...
88 68 82 57 01 01 42 92 CF 51 0A 00 3A 81 00 E8 .h.W..B..Q.:...
C1 83 88 E7 8F 50 0C 00 36 76 90 A8 C1 15 21 11 .....P..6v....!..
84 88 A1 14 21 01 84 88 06 00 37 78 30 EF 8F F8 ....!.....7x0...
97 81 CF 51 02 00 3A 11 00 20 C1 83 88 E5 00 60 ...Q.....`...
E4 8F 50 2A 00 3A 00 58 ..P*.:X
0.575735: RX 10 @ 128:
18 00 18 00 18 00 18 00 18 00 .....
0.577334: TX 120 @ 1628:
A3 0A 00 3A 50 8A 80 D0 83 88 48 00 DE 02 00 32 ...:P.....H....2
F0 0F 20 D0 83 88 7A 10 F8 0C 02 F9 76 90 A8 1E .. ..z.....v...
00 37 00 00 E0 1C 00 35 7A 10 E2 0A 00 3A 50 8A .7.....5z.....P.
80 D0 83 88 48 00 DE 02 00 32 F0 0F 20 D0 83 88 ....H....2.. ...

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```

    7A 10 F8 0C 02 F9 76 90 A8 10 00 37 E1 14 21 11    z.....v....7...!
    00 78 30 81 FB 62 10 88 80 08 78 91 8A 80 02 15    .x0..b....x.....
    21 12 81 40 82 0F 50 01 00 39 71 8A 88 11 00 20    !..@..P..9q....
    A0 14 21 10 88 10 76 10                            ..!...v.
0.601720: RX 10 @ 138:
    18 00 18 00 18 00 18 00 18 00                    .....
0.603307: TX 120 @ 1748:
    A8 7A 30 ED E0 83 80 01 00 21 90 80 60 01 00 3A    .z0.....!...`...
    10 C0 A0 00 80 FA 4F 02 78 4F 01 BE 4F 00 BE 00    .....O.xO..O...
    40 06 00 68 A9 80 1F 78 00 00 EB 50 30 EC 52 B0    @..h...x...P0.R.
    B4 54 B0 B4 56 B0 B4 00 12 21 00 00 E0 42 20 AE    .T..V....!...B .
    20 11 04 00 00 00 4F 00 78 00 40 06 00 00 05 60    .....O.x.@....`
    22 B8 06 02 20 00 00 D0 81 80 D2 04 82 D2 85 82    "... ..
    D2 00 00 A0 02 02 52 83 82 5A 03 00 31 02 02 42    .....R..Z..1..B
    83 82 4A 00 00 A1 06 03                            ..J.....
0.627712: RX 10 @ 148:
    18 00 18 00 18 00 18 00 18 00                    .....
0.629333: TX 120 @ 1868:
    E9 F3 FF 3A 00 00 06 09 00 37 30 42 78 B1 41 78    ...:.....70Bx.Ax
    83 4F 52 04 00 32 10 00 20 06 00 31 00 80 EB 00    .OR..2.. ..1....
    00 06 02 01 E9 02 00 E0 F5 FF 3A 00 00 EB 00 00    .....:.....
    06 4C 45 00 44 73 00 3A 20 00 30 30 00 30 30 00    .LE.Ds.: .00.00.
    30 30 00 30 30 00 20 20 00 00 00 00 00 00 00 40    00.00. ....@
    00 00 20 00 00 60 00 00 D2 8A 00 33 37 00 A3 0B    .. ..`.....37...
    00 1B A2 00 15 B4 00 AD A8 00 8E 22 00 55 2D 00    .....".U-.
    00 00 00 00 00 00 00 00                            .....
0.653713: RX 10 @ 158:
    18 00 18 00 18 00 18 00 18 00                    .....
0.655334: TX 120 @ 1988:
    00 00 00 00 42 6F 00 6F 74 00 6C 6F 00 61 64 00    ....Bo.ot.lo.ad.
    65 72 00 20 20 00 20 20 00 20 00 00 00 00 8F      er. . . ....
    06 B0 88 9F BE 8A 9F BE 8C 9F BE 8E 1F 78 00 04    .....x...
    78 82 10 E2 84 02 32 02 C0 21 03 00 20 92 8F 9F    x.....2..!.. ...
    A3 8F 9F B2 8F 9F C3 8F 9F 00 82 20 0A 84 20 00    .....
    05 55 0A 85 D1 80 04 EB 11 84 80 91 06 78 00 00    .U.....x..
    00 18 01 78 80 01 EB E8 0F 51 E0 8F 59 6B 02 3E    ...x.....Q..Yk.>
    02 06 01 08 00 37 2A 00                            .....7*.
0.679642: RX 10 @ 168:
    18 00 18 00 18 00 18 00 18 00                    .....
0.681337: TX 120 @ 2108:
    37 BF 00 37 DB 00 37 11 01 37 64 01 37 9E 01 37    7..7..7..7d.7..7
    D9 01 37 F2 01 37 80 05 EB 1C 00 37 42 00 20 E0    ..7..7....7B. .
    F8 2F 0F 00 40 22 12 02 00 00 00 20 C4 24 21 23    ./..@".....$!#
    24 7F 81 97 8F 89 97 80 0F 51 81 8F 59 09 00 3A    $......Q..Y...
    01 84 80 11 01 78 00 00 EB 26 12 02 00 00 00 1B    .....x...&.....
    00 20 0B 0C 78 0B 06 78 FD 01 37 12 00 20 11 84    . .x..x..7.. ..
    80 C0 F8 2F 0F 00 40 26 12 02 00 00 00 1B 00 20    .../..@&.....
    11 84 80 32 00 20 91 0F                            ...2. ..
0.706664: RX 10 @ 178:
    18 00 18 00 18 00 18 00 18 00                    .....
0.708340: TX 120 @ 2228:
    11 E0 FF 3E B3 01 37 80 05 EB 00 06 EB F0 02 20    ...>..7.....
    80 8F 56 EC 01 36 02 03 20 E0 FB 2F 0F 00 40 26    ..V..6.. ../.@&
    12 02 00 00 00 03 03 20 E2 FB 2F 0F 01 41 60 00    ..... ../.A`.
    B8 DE 13 02 00 00 00 40 0C 98 51 0C 98 1F A0 97    .....@..Q.....
    AF A0 97 80 02 B1 01 80 B1 20 0C 98 31 0C 98 1B    ..... ..1...
    00 20 4B 14 98 E1 FB 2F 8F 80 40 68 80 40 02 01    . K..../..@h.@..
    20 81 4E 28 B2 04 02 00 00 00 00 00 E0 05 00 32    .N(.....2
    A0 FE 2F 40 14 98 80 00                            ../@.....
0.733710: RX 10 @ 188:
    18 00 18 00 18 00 18 00 18 00                    .....
0.735341: TX 120 @ 2348:
    20 00 0C 78 C9 01 37 08 00 78 E2 FB 2F 0F 01 41    ..x..7..x../..A
    F8 00 41 11 01 BE 02 A8 BE 21 01 90 00 00 00 B1    ..A.....!.....
    01 90 22 00 98 33 00 98 00 00 20 00 00 E0 20 00    .."....3.....
    32 24 00 20 80 00 EB 3F 89 97 CF 89 97 C0 FA 2F    2$. ...?...../
    0F 00 40 90 13 02 00 00 00 D0 2C 21 EF 98 97 80    ..@.....,!....
    8F 50 14 00 3A 28 02 90 B8 02 90 48 03 90 D8 03    .P.: (.....H....

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# Microchip Easy Bootloader Library for PIC24/dsPIC33 and PIC32MM

```

    90 00 00 00 6F 90 97 FF 90 97 0F 99 97 9F 99 97    ....O.....
    00 20 E1 01 A8 E1 02 B0                            . ....
0.759708: RX 10 @ 198:
    18 00 18 00 18 00 18 00 18 00                    .....
0.761343: TX 120 @ 2468:
    E1 03 B8 E1 06 00 31 90 FE 2F 40 14 98 70 00 20    .....1../@..p.
    00 0C 78 0B 06 78 9B 01 37 00 00 20 00 00 E0 0B    ..x..x..7..
    00 3A E0 7F 9F D0 FD 2F 0F 00 40 73 81 57 EF 78    :...../..@s.W.x
    97 D0 C0 70 E1 7F 9F 82 0F 50 FB FF 3A 01 04 E0    ...p....P.:...
    D3 00 3A 00 00 20 00 00 E0 12 00 32 28 08 90 00    :... ..2(...
    00 00 B8 08 90 80 02 B0 01 80 B0 C2 FA 2F 0F 01    ...../..
    41 00 00 02 00 00 00 00 E0 07 00 3D 50 FE 2F    A.....=P./
    40 14 98 70 00 20 00 0C                            @..p. ..
0.788725: RX 10 @ 208:
    18 00 18 00 18 00 18 00 18 00                    .....
0.790337: TX 120 @ 2588:
    78 1B 00 20 0B 06 78 78 01 37 99 83 80 09 00 E0    x.. ..xx.7.....
    11 00 32 0A 01 78 80 00 EB 00 82 20 04 18 02 00    ..2..x.....
    00 00 68 30 EF 6A 30 EF 00 00 EB 90 83 88 F8 17    ..h0.j0.....
    02 00 00 00 10 84 80 8E 15 02 00 00 00 00 84 80    .....
    8E 15 02 00 00 00 00 00 EB 70 0C 98 80 00 20 10    .....p....
    04 98 60 00 B8 00 14 98 11 14 98 20 00 20 00 0C    ..`.....
    78 00 84 80 10 00 E0 07 00 3A 01 FF 2F E1 87 9F    x...../...
    22 00 20 C1 F8 2F 8F 80                            ". ../.
0.815706: RX 10 @ 218:
    18 00 18 00 18 00 18 00 18 00                    .....
0.817338: TX 120 @ 2708:
    40 F2 12 02 00 00 00 09 00 E0 01 00 32 00 60 FE    @.....2.`.
    18 00 90 7E 10 B4 70 3E B1 88 10 90 01 00 40 F0    ...~..p>.....@.
    83 88 7E 00 44 BC 0D 02 00 00 00 1B 00 20 00 06    ..~.D.....
    EB 00 00 E0 41 01 3A 11 84 80 91 06 78 60 0C 98    ....A.:.....x`.
    40 00 20 00 0C 78 28 08 90 00 00 00 B8 08 90 43    @. ..x(.....C
    02 20 83 0F 50 E0 8F 58 06 00 3E 40 02 20 70 0C    . ..P..X..>@. p.
    98 60 00 20 10 04 98 1B 00 20 29 00 37 08 11 90    .`. .... ).7...
    00 00 00 98 11 90 E0 0F                            .....
0.847631: RX 10 @ 228:
    18 00 18 00 18 00 18 00 18 00                    .....
0.856622: TX 120 @ 2828:
    51 E0 8F 59 06 00 3A 80 00 20 70 0C 98 30 00 20    Q..Y... p..0.
    10 04 98 1B 00 20 1D 00 37 F0 3D 20 7E 30 B4 C0    .... ..7.= ~0..
    00 20 70 0C 98 80 8F 56 01 00 36 7D 0C 98 F8 08    . p....V..6}....
    90 00 03 20 80 8F 50 01 00 36 70 0C 98 78 0B 90    ... ..P..6p..x..
    61 32 B8 82 0F 52 83 8F 5A 02 00 39 72 0C 98 05    a2...R..Z..9r...
    00 37 62 00 20 11 00 09 02 83 D8 01 00 53 70 0C    .7b. ....Sp.
    98 50 00 20 10 04 98 1B 00 20 01 00 37 80 05 EB    .P. .... ..7...
    10 84 80 B0 00 90 00 00                            .....
0.882625: RX 10 @ 238:
    18 00 18 00 18 00 18 00 18 00                    .....
0.884317: TX 120 @ 2948:
    00 68 08 90 00 87 50 22 01 20 81 0F 51 01 00 3E    .h....P". ..Q..>
    82 00 78 78 09 90 81 0F 57 02 00 31 80 0F 51 13    ..xx....W..1..Q.
    00 36 80 0F 51 06 00 36 00 84 80 B0 00 90 10 80    .6..Q..6.....
    50 00 06 EB E1 0F 50 F0 00 36 EE 87 9F 22 00 20    P.....P..6..."
    C1 F8 2F 8F 80 40 00 84 80 F2 12 02 00 00 00 68    ../.@.....h
    08 90 0E 07 40 6E 0C 98 1B 00 20 78 09 90 00 06    ...@n.... x....
    EB 82 8F 56 E1 00 39 28 08 90 00 00 00 B8 08 90    ...V..9(.....
    02 00 50 E0 80 58 20 0C                            ..P..X .
0.912603: RX 10 @ 248:
    18 00 18 00 18 00 18 00 18 00                    .....
0.914313: TX 120 @ 3068:
    98 31 0C 98 68 08 90 02 00 50 60 0C 98 11 84 80    .1..h....P`.....
    E0 FB 2F 0F 00 40 26 12 02 00 00 00 F8 09 90 E2    ../.@&.....
    FB 2F 0F 01 41 48 08 90 00 00 00 D8 08 90 DE 13    ./..AH.....
    02 00 00 00 40 0C 98 51 0C 98 18 00 90 E3 0F 50    ....@..Q.....P
    0D 00 3A 00 02 20 08 00 40 78 09 90 E1 FB 2F 8F    :... ..@x..../.
    80 40 16 17 02 00 00 00 B8 60 90 78 60 90 00 C0    .@.....`x`...
    70 02 00 32 B0 FE 2F 3A FF 37 98 00 90 01 0C 78    p..2../:..7.....x
    1B 00 20 0B 06 78 B3 00                            .. ..x..

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0.938694: RX 10 @ 258:
18 00 18 00 18 00 18 00 18 00 .....
0.940349: TX 120 @ 3188:
37 3F 88 97 CF 88 97 6C 00 40 E0 80 48 D0 8F 9F 7?.....l.@..H...
E1 8F 9F 09 00 E0 01 00 32 00 60 FE 66 F9 2F 0F .....2.`.f./
03 43 15 00 20 00 02 EB F8 09 90 E2 FB 2F 0F 01 .C.. ...../..
41 28 10 90 00 00 00 B8 10 90 42 0A 02 00 00 00 A(.....B.....
F0 87 9F 81 8F 9F E4 F9 2F 0F 02 42 F8 09 90 E2 ...../..B.....
FB 2F 0F 01 41 28 10 90 00 00 00 B8 10 90 7C 0F ./..A(.....|.
02 00 00 00 7F 81 97 8F 89 97 22 14 98 33 14 98 .....".3..
F8 08 90 00 00 00 08 11 .....
0.964695: RX 10 @ 268:
18 00 18 00 18 00 18 00 18 00 .....
0.966313: TX 120 @ 3308:
90 00 00 00 98 11 90 01 01 51 E0 81 59 02 14 98 .....Q..Y...
13 14 98 31 00 20 01 0C 78 00 00 E0 02 00 3D 80 ...1. ..x.....=.
FE 2F 01 FF 37 00 00 E0 7B 00 32 70 FE 2F 40 14 ./..7...{.2p./@.
98 1B 00 20 0B 06 78 78 00 37 80 01 EB E3 87 9F .. ..xx.7.....
22 00 20 C1 F8 2F 8F 80 40 00 84 80 F2 12 02 00 ". ../.@.....
00 00 48 09 90 00 00 00 D8 09 90 C0 F1 2D 41 14 ..H.....-A.
22 80 0F 51 81 8F 59 1D 00 3A D0 2C 21 E0 9F 9F "...Q..Y...:,!...
28 00 90 B8 00 90 48 01 (.....H.
0.992698: RX 10 @ 278:
18 00 18 00 18 00 18 00 18 00 .....
0.994344: TX 120 @ 3428:
90 D8 01 90 E0 97 9F F1 97 9F 82 9F 9F 93 9F 9F .....
C1 FA 2F 8F 80 40 68 80 40 5F A9 97 EF A9 97 02 ../.@h.@_.....
88 BE 7F A9 97 8F B1 97 C2 9F 9F D3 9F 9F F0 3D .....=
20 7E 30 B4 23 01 20 01 01 78 3F 88 97 CF 88 97 ~0.#. ..x?.....
40 0A 02 00 00 00 02 00 37 60 FE 2F 40 14 98 C8 @.....7`./@...
11 90 E3 87 9F 22 00 20 C1 F8 2F 8F 80 40 00 84 .....". ../.@...
80 F2 12 02 00 00 00 0C EB 82 30 EF 1B 00 20 .....0...
00 06 EB 3C 00 37 00 84 ...<.7..
1.019698: RX 10 @ 288:
18 00 18 00 18 00 18 00 18 00 .....
1.021348: TX 120 @ 3548:
80 B0 00 90 90 80 50 80 05 EB 00 06 EB E4 8F 50 .....P.....P
35 00 36 81 00 20 01 0C 78 EC 87 9F 22 00 20 C1 5.6. ....x..." .
F8 2F 8F 80 40 F2 12 02 00 00 00 48 10 90 E0 87 ./..@.....H....
9F 22 00 20 C1 F8 2F 8F 80 40 00 84 80 F2 12 02 ". ../.@.....
00 00 00 1B 00 20 0B 06 78 22 00 37 80 05 EB 00 .... ..x".7....
06 EB 0D 00 E0 1E 00 32 28 09 90 00 00 00 B8 09 .....2(.....
90 61 6A B8 82 0F 52 83 8F 5A 06 00 39 82 06 78 .aj...R..Z..9..x
00 00 EB 26 12 02 00 00 ...&....
1.046716: RX 10 @ 298:
18 00 18 00 18 00 18 00 18 00 .....
1.048346: TX 120 @ 3668:
00 00 0C EB 82 30 EF 0D 01 78 11 84 80 00 00 EB .....0...x.....
26 12 02 00 00 00 28 08 90 00 00 00 B8 08 90 0D &.....(.....
00 50 E0 80 58 20 0C 98 31 0C 98 1B 00 20 00 06 .P..X ..1....
EB 02 00 37 1B 00 20 0B 06 78 84 17 02 00 00 00 ...7... ..x.....
00 02 BE 0B 00 E0 02 00 32 00 0C 98 11 0C 98 08 .....2.....
09 90 00 00 00 98 09 90 02 01 52 83 81 5A 68 00 .....R..Zh.
90 00 00 00 F8 00 90 80 0F 51 81 8F 59 25 00 36 .....Q..Y%.6
C0 FE 2F 40 14 98 18 80 ../@....
1.073690: RX 10 @ 308:
18 00 18 00 18 00 18 00 18 00 .....
1.075317: TX 120 @ 3788:
E9 E3 0F 50 1B 00 3E 80 00 EB E1 87 9F 22 00 20 ...P..>.....".
C1 F8 2F 8F 80 40 00 84 80 F4 B7 9F 85 BF 9F F2 ../.@.....
12 02 00 00 00 48 11 90 E2 87 9F 22 00 20 C1 F8 .....H.....".
2F 8F 80 40 00 84 80 F2 12 02 00 00 00 00 81 EB /..@.....
11 84 80 00 00 EB 26 12 02 00 00 00 8F BA 97 00 .....&.....
00 00 7F B2 97 00 00 00 00 04 0C 98 15 0C .....
98 00 0C EB 82 30 EF 10 84 80 00 00 E0 03 00 32 .....0.....2
09 06 76 9E FD 3A 11 00 ..v.....
1.105694: RX 10 @ 318:
18 00 18 00 18 00 18 00 18 00 .....

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# Microchip Easy Bootloader Library for PIC24/dsPIC33 and PIC32MM

```

1.107347: TX 120 @ 3908:
  37 09 00 E0 0F 00 32 68 01 90 00 00 00 F8 01 90 7.....2h.....
  00 84 80 54 15 02 00 00 00 22 83 80 33 83 80 45 ...T.....".3..E
  18 DD CB 10 DE 81 00 70 45 10 DD 40 16 02 00 00 .....pE..@....
  00 00 00 FE 00 F0 A7 00 00 EA 00 00 E9 4F 00 DE .....O..
  01 00 37 00 00 EB 4F 07 78 00 00 00 4F 06 BE 00 ..7...O.x...O...
  00 00 4F 05 BE 00 00 00 4F 04 BE 8F 06 B1 00 00 ..O.....O.....
  06 00 00 FE 60 22 B8 03 00 E0 A6 00 32 C8 0B DE ....`".....2...
  A4 00 3A 57 3E 20 87 1F ...:W> ..

1.131687: RX 10 @ 328:
  18 00 18 00 18 00 18 00 18 00 .....

1.133322: TX 120 @ 4028:
  78 54 00 F8 88 9F BE 8A 9F BE 8C 9F BE 01 78 A3 xT.....x.
  06 00 3A 04 D8 A3 02 00 32 29 47 AF 01 60 A2 04 ...:.....2)G..`..
  C0 A7 01 60 A0 3B 00 24 2D 00 20 04 F0 A0 AC 72 ...`.;.$-....r
  20 0C 00 E0 06 00 32 04 F0 A1 0B 00 24 E8 CF 40 .....2.....$.@
  02 00 32 4D 00 20 1B 00 24 06 00 FA 0D 06 D0 8C ..2M. ..$.
  87 47 0F 04 78 80 04 EB DC EA 2D 0C 28 E1 05 00 .G..x.....-.(...
  32 0A 01 20 C2 2B DD 87 04 45 89 87 47 89 87 47 2.. .+...E..G..G
  7E 10 F8 7E 30 EF 8E 03 ~..~0...

1.158628: RX 10 @ 338:
  18 00 18 00 18 00 18 00 18 00 .....

1.160351: TX 120 @ 4148:
  78 8B 1B 78 80 9B BE 0C 28 E1 65 00 32 08 06 78 x..x....(.e.2..x
  02 00 37 03 00 09 36 1E 78 85 02 E9 FC FF 31 06 ..7...6.x....1.
  00 20 A6 02 88 06 21 20 29 E7 AF FE FF 37 02 00 . ....! )....7..
  37 16 1E BA 36 9E BA 0A 85 E9 FC FF 31 54 00 37 7...6.....1T.7
  8F 05 78 0D 06 E9 0C 80 09 80 9F EB 03 00 E9 00 .x.....
  80 09 B2 5D 78 03 81 55 80 01 EB 8D 00 D0 0F 00 ...]x..U.....
  A7 80 00 EB 0D 00 D1 02 00 09 B2 5B 78 80 DB EB .....[x...
  00 00 E9 FB FF 3A 81 87 .....:..

1.186624: RX 10 @ 348:
  18 00 18 00 18 00 18 00 18 00 .....

1.188353: TX 120 @ 4268:
  57 0D 06 E9 0C 80 09 C7 0F 48 39 00 31 47 05 BE W.....H9.1G..
  8D 00 45 60 86 4D 08 03 BE 08 00 37 36 08 E1 36 ..E`.M.....76..6
  E0 E1 42 80 EE 36 50 E1 36 D8 E1 42 00 B7 00 00 ..B..6P.6..B....
  A6 2C 00 37 E4 83 53 F6 FF 31 00 00 EB A1 0F 20 .,7..S..1.....
  64 03 47 04 F0 A7 36 00 BE A1 02 88 8D 00 D1 8E d.G...6.....
  03 78 86 72 20 29 E7 AF FE FF 37 02 00 09 37 1B .x.r )....7...7.
  78 37 08 BB 37 98 BB 81 00 E9 FC FF 3A 6A 32 21 x7..7.....:j2!
  FE B0 97 7F B8 97 01 00 .....

1.213692: RX 10 @ 358:
  18 00 18 00 18 00 18 00 18 00 .....

1.215352: TX 120 @ 4388:
  B8 8A 03 50 0A 00 20 1A 00 A0 00 00 EB 1A 00 A7 ...P.. .....
  FE FF 37 04 A0 A7 00 60 FE 18 18 02 00 00 00 07 ..7.....`.....
  0B 78 B1 09 B0 01 0B 78 29 E7 A8 00 00 00 00 00 .x.....x).....
  00 04 B8 A3 29 E7 AF FE FF 3A 28 18 02 00 00 00 .....):.....(.....
  E2 03 47 00 00 EB 97 9B 46 97 1B 48 0D 00 D1 00 ..G.....F..H....
  80 46 80 81 51 B3 FF 31 80 81 41 A6 FF 3A 00 FF .F..Q..1..A....
  23 28 27 B6 80 27 EB 1E 00 90 AE 00 90 00 80 FA #('..'.
  4F 06 BE 4F 05 BE 4F 04 O..O..O.

1.241675: RX 10 @ 368:
  18 00 18 00 18 00 18 00 18 00 .....

1.243349: TX 120 @ 4508:
  BE 54 00 F9 80 27 EB 7E 30 EF 00 00 06 E6 87 47 .T...'.~0.....G
  88 9F BE 8A 9F BE 8C 9F BE 8E 1F 78 68 30 EF 6A .....xh0.j
  30 EF 72 30 EF 7E 30 EF EE 0E 02 00 00 00 20 14 0.r0..~0.....
  02 00 00 00 96 10 02 00 00 00 02 50 28 60 00 B8 .....P(`..
  F6 16 02 00 00 00 01 06 20 00 00 EB 0A 10 02 00 .....
  00 00 C0 10 21 00 08 EB 00 83 80 11 83 80 C0 88 ....!.....
  88 D1 88 88 22 83 80 33 83 80 45 18 DD CB 10 DE ....".3..E....
  81 00 70 45 10 DD 60 22 ..pE..`"

1.269637: RX 10 @ 378:
  18 00 18 00 18 00 18 00 18 00 .....

1.278614: TX 120 @ 4628:
  B8 60 33 B8 00 02 52 81 82 5A 60 03 5B E0 83 5B .`3...R..Z`. [...[

```



# Microchip Easy Bootloader Library for PIC24/dsPIC33 and PIC32MM

```

C1 76 21 60 13 21 42 13 02 00 00 00 84 17 02 00 .v!\`!.!B.....
00 00 00 05 BE 00 06 BE 8E 11 21 00 60 FE 84 17 .....!\`...
02 00 00 00 00 04 BE 00 83 80 11 83 80 4C 09 DD .....L..
44 00 DE 00 00 71 C4 08 DE 0A 01 54 8B 81 5C 80 D....q....T..\
0F 51 81 8F 59 0B 00 36 0A 05 40 8B 85 48 02 81 .Q..Y..6..@..H..
21 03 00 20 F2 B7 9F 83 BF 9F 7F B0 97 8F B8 97 !.. .....
12 00 20 DC 17 02 00 00 .....
1.311702: RX 10 @ 388:
18 00 18 00 18 00 18 00 18 00 .....
1.313353: TX 120 @ 4748:
00 76 10 E2 03 00 32 76 30 EF 08 06 BE 14 00 37 .v....2v0.....7
0C 04 54 8D 84 5C BE 0F 54 AE 8F 5C 0F 00 36 A0 ..T..\..T..\..6.
14 02 00 00 00 00 00 E0 0B 00 32 C2 7E 21 03 00 .....2~!..
20 F2 B7 9F 83 BF 9F 7F B0 97 8F B8 97 F2 0F 20 .....
DC 17 02 00 00 00 9C 17 02 00 00 01 40 FE CB .....@..
FF 37 0A 00 FA 88 9F BE 8A 9F BE 8C 9F BE 30 07 .7.....0.
98 4F 07 98 C0 02 20 01 00 20 20 18 02 00 00 00 .O.... ..
00 02 BE 80 05 78 80 80 .....x..
1.342686: RX 10 @ 398:
18 00 18 00 18 00 18 00 18 00 .....
1.344353: TX 120 @ 4868:
E8 01 00 A1 81 87 47 4E 05 90 80 00 EB C2 22 20 .....GN....."
03 00 20 0A 00 78 90 13 02 00 00 00 35 00 37 00 .. .x.....5.7.
40 EB 50 47 98 0A 00 78 B0 40 78 21 47 98 B0 40 @.PG...x.@x!G..@
78 31 47 98 10 40 78 40 47 98 63 00 45 10 4F 78 x1G...@x@G.c.E.Ox
4A 40 90 10 47 98 2A 40 90 E8 4F 40 04 00 32 14 J@..G.*@..O@..2.
00 20 00 04 E0 05 00 3D 01 00 37 84 00 20 3E 00 . ....=.7.. >.
90 00 00 E0 17 00 32 1E 06 78 E6 06 45 1E 04 90 .....2..x..E...
00 00 00 AE 04 90 80 02 .....
1.387619: RX 10 @ 408:
18 00 18 00 18 00 18 00 18 00 .....
1.389058: TX 120 @ 4988:
EB 8C 01 78 0D 01 78 08 00 BE 5A 0E 02 00 00 00 ...x..x...Z.....
00 00 E0 0A 00 32 F0 3D 20 F0 83 88 00 03 EB D5 .....2.= .....
EA 2D 00 02 EB 8C 01 78 0D 01 78 08 00 BE A8 11 .-.....x..x.....
02 00 00 00 1E 00 78 00 00 00 80 85 55 E6 85 55 .....x.....U..U
66 00 40 00 05 45 E6 8F 55 C9 FF 3E CE 07 90 00 f.@..E..U..>....
00 00 00 00 00 4F 06 BE 00 00 00 4F 05 BE 00 00 .....O.....O....
00 4F 04 BE 00 80 FA 00 00 06 88 9F BE 8A 9F BE .O.....
8C 9F BE 8E 1F 78 00 07 .....x..
1.413683: RX 10 @ 418:
18 00 18 00 18 00 18 00 18 00 .....
1.414953: TX 120 @ 5108:
78 01 46 78 15 4E A8 11 4E A9 84 17 02 00 00 00 x.Fx.N..N.....
C2 82 80 D3 82 80 02 00 50 83 80 58 E2 82 80 F3 .....P..X....
82 80 82 0F 50 83 8F 58 F5 FF 39 15 6E A9 11 6E ....P..X..9.n..n
A9 61 00 67 45 00 DD A1 70 80 01 50 A1 81 00 70 .a.gE...p..P...p
A1 70 88 10 AE A9 10 2E A9 8D 00 20 08 02 20 09 .p.....
00 20 8A 00 20 0B 00 20 15 4E A9 14 2E A9 0C 04 . . . .N.....
E0 01 00 3D 14 2E A8 0C 46 46 08 00 BE 36 17 02 ...=.FF...6..
00 00 00 15 4E A8 0A 00 ....N...
1.439683: RX 10 @ 428:
18 00 18 00 18 00 18 00 18 00 .....
1.440953: TX 120 @ 5228:
BE 36 17 02 00 00 00 8D 06 E9 F1 FF 3A 84 17 02 .6.....:...
00 00 00 C0 82 88 D1 82 88 30 84 80 45 00 DD 80 .....0..E...
00 EB E0 82 88 F1 82 88 0E 00 E0 0D 00 3A 0C 06 .....:...
FB 63 00 66 80 0F 56 0A 00 3A 20 83 80 31 83 80 .c.f..V.: .1..
00 00 40 81 80 48 E0 82 88 F1 82 88 6E 30 EF 70 ..@..H.....n0.p
30 EF 01 00 37 6E 30 EC 00 02 20 01 00 20 36 17 0...7n0... .. 6.
02 00 00 00 15 6E A8 4F 07 78 4F 06 BE 4F 05 BE .....n.O.xO..O..
4F 04 BE 00 00 06 0C 00 O.....
1.465678: RX 10 @ 438:
18 00 18 00 18 00 18 00 18 00 .....
1.466954: TX 120 @ 5348:
FA 88 9F BE 8A 1F 78 00 05 78 00 20 20 01 00 20 .....x..x. ..
F0 B7 9F 81 BF 9F 00 01 20 01 00 20 80 04 78 00 ..... ..x.
04 EB 38 00 37 72 80 57 B2 16 02 00 00 00 2C 00 ..8.7r.W.....,

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# Microchip Easy Bootloader Library for PIC24/dsPIC33 and PIC32MM

```

37 08 04 E8 9A 0F 54 22 00 36 08 0D 78 42 00 20 7.....T".6..xB.
03 00 20 00 22 20 01 00 20 60 14 02 00 00 00 00 .. ." .. `.....
00 E0 19 00 3A 4F F0 97 E9 4F 40 05 00 36 10 00 ....:O...O@..6..
20 64 0C 02 00 00 00 10 00 20 24 00 37 1F B8 97 d..... $.7...
AF B8 97 D4 16 02 00 00 .....
1.491679: RX 10 @ 448:
18 00 18 00 18 00 18 00 18 00 .....
1.492936: TX 120 @ 5468:
00 00 00 E0 0B 00 3A E0 7B 20 7E 30 B4 1F B8 97 .....: { ~0....
AF B8 97 18 16 02 00 00 00 00 00 00 EB 64 0C 02 00 .....d...
00 00 10 00 20 13 00 37 02 40 20 1F B8 97 AF B8 .... .7.@ .....
97 00 00 41 E0 80 48 90 BF 9F A1 BF 9F 1F BA 97 ...A..H.....
AF BA 97 3F B8 97 CF B8 97 80 0F 52 81 8F 5A CD ...?.....R..Z.
FF 39 E4 84 54 09 00 E0 C6 FF 3A 7E 30 EF 00 00 .9..T.....:~0...
EB 4F 05 78 00 00 00 4F 04 BE 00 80 FA 00 00 06 .O.x...O.....
60 22 B8 88 9F BE 8A 9F `".
1.517702: RX 10 @ 458:
18 00 18 00 18 00 18 00 18 00 .....
1.526605: TX 120 @ 5588:
BE 54 00 F8 05 00 E0 42 20 AF 8F 02 78 E4 82 42 .T.....B ...x..B
01 78 A3 06 00 3A 04 D8 A3 02 00 32 29 47 AF 01 .x.....:2)G..
60 A2 04 C0 A7 01 60 A0 A1 02 88 80 00 EB 29 E7 `.....`.....).
AF FE FF 37 03 00 37 00 80 E8 42 00 AF 54 20 EC ...7..7...B..T.
83 01 E9 29 00 39 82 1A 78 D1 00 20 F6 FF 2F F7 ...).9..x... ./
0F 20 32 43 78 83 01 E9 05 00 39 B2 48 78 83 01 . 2Cx.....9.Hx..
E9 03 00 39 B2 43 78 02 00 37 04 30 A0 04 20 A0 ...9.Cx..7.0..
10 04 BA 90 84 BA 88 9A .....
1.552677: RX 10 @ 468:
18 00 18 00 18 00 18 00 18 00 .....
1.553958: TX 120 @ 5708:
BE 86 9A BE E3 0F 62 0B 00 32 06 83 EA 87 C3 EA .....b..2.....
08 05 63 89 85 63 04 00 A7 0A 03 BE 08 05 73 89 .c..c.....s.
85 73 04 10 A7 0A 03 BE 60 44 B8 08 03 53 89 83 .s.....`D...S..
5B EC 0F 62 03 00 32 80 03 EB 04 30 A7 F6 0F B2 [...b..2....0....
EA 82 52 87 00 73 D2 FF 32 A6 02 80 86 22 78 80 ..R..s..2...."x.
22 78 01 00 78 54 00 F9 4F 05 BE 4F 04 BE 00 00 "x..xT..O..O....
06 A1 09 20 00 01 EB 80 07 20 33 74 20 80 49 78 ... .. 3t .Ix
81 49 78 82 49 78 71 05 .Ix.Ixq.
1.578674: RX 10 @ 478:
18 00 18 00 18 00 18 00 18 00 .....
1.579956: TX 120 @ 5828:
20 12 00 20 60 04 20 23 74 20 80 49 78 81 49 78 .. ` . #t .Ix.Ix
82 49 78 42 07 AB FE FF 3A 00 00 2B 20 3A 88 A0 .IxB.....+ :.
04 20 30 3A 88 10 00 20 A2 09 20 81 07 20 33 74 . 0:.. .. 3t
20 81 49 78 82 49 78 80 49 78 72 05 20 61 04 20 .Ix.Ix.Ixr. a.
23 74 20 81 49 78 82 49 78 80 49 78 42 07 AB FE #t .Ix.Ix.IxB...
FF 3A 01 02 20 12 3A 80 02 80 60 FD FF 32 11 0E ... ..`..2..
A8 43 EC A9 63 CC A9 11 AE A8 11 8E A8 1B 8E A8 .C..c.....
C0 C2 B3 C6 E6 B7 F0 0F .....
1.605676: RX 10 @ 488:
18 00 18 00 18 00 18 00 18 00 .....
1.606959: TX 120 @ 5948:
2C 7C 06 B6 00 30 B3 E0 33 88 15 EE A9 11 EE A9 ,|...0..3.....
63 EC A9 1E AE A9 1E 2E A9 1F 4E A9 15 6E A8 11 c.....N..n..
6E A9 14 AE A9 10 AE A9 15 EE A8 1A CE A8 1A EE n.....
A8 1E CE A9 1E EE A9 10 CE A8 10 EE A8 00 D8 21 .....!
C1 42 20 00 00 06 F0 87 47 88 9F BE 8A 9F BE 8E .B .....G.....
1F 78 02 04 BE 04 07 78 0E 00 E0 01 00 3A 78 87 .x.....x.....:x.
57 60 55 B8 8E 02 78 0B 02 78 08 01 BE 5A 0E 02 W`U...x..x...Z..
00 00 00 00 00 E0 2E 00 .....
1.631694: RX 10 @ 498:
18 00 18 00 18 00 18 00 18 00 .....
1.632958: TX 120 @ 6068:
32 1E 02 BE 82 00 20 03 00 20 40 22 20 01 00 20 2..... @" ..
60 14 02 00 00 00 00 00 E0 14 00 3A 2E 40 90 00 `.....:@..
04 E0 07 00 3D 0B 00 E0 1D 00 3A 1E 00 BE 00 00 ....=.....:....
00 2E 04 90 9B 00 20 E6 FF 37 1E 02 BE 02 01 20 .....7.....
03 00 20 00 21 20 01 00 20 60 14 02 00 00 00 00 .. .! .. `.....

```

# Microchip Easy Bootloader Library for PIC24/dsPIC33 and PIC32MM

```

00 E0 11 00 32 1A 00 20 E3 8F 54 0F 00 36 2E 01 ....2.. ..T..6..
90 00 00 00 82 84 54 E3 84 54 89 04 44 24 00 20 .....T..T..D$.
05 00 20 3E 00 42 00 00 .. >.B..
1.665670: RX 10 @ 508:
18 00 18 00 18 00 18 00 18 00 .....
1.666944: TX 120 @ 6188:
00 AE 80 4A 63 04 41 CE FF 37 CA FF 2F 01 00 37 ...Jc.A..7../..7
00 85 EB 0A 00 78 4F 07 78 00 00 00 4F 05 BE 00 .....xO.x...O...
00 00 4F 04 BE 0F 01 B1 00 00 06 88 9F BE 8A 1F ..O.....
78 00 05 78 81 04 78 18 C0 B3 F0 07 20 80 8F 54 x..x..x.....T
01 00 3E 00 44 EB 61 04 64 4A 44 DD 08 60 A0 08 ..>.D.a.dJD..`..
C0 A0 00 00 20 01 20 20 01 00 70 E0 83 88 00 08 .... ..p....
EB 74 30 EF 76 30 EF 76 90 A8 7A 30 EF 60 E7 A9 .t0.v0.v...z0.`..
00 02 EB E3 82 21 00 01 .....!..
1.691672: RX 10 @ 518:
18 00 18 00 18 00 18 00 18 00 .....
1.692960: TX 120 @ 6308:
20 01 00 20 00 01 78 E0 16 21 01 00 20 80 00 78 .. ..x..!.. ..x
A0 14 21 C8 17 02 00 00 00 24 83 21 80 01 EB 00 ..!.....$.!....
08 20 01 00 20 00 01 78 C0 08 21 01 00 20 80 00 .. ..x..!.. ..
78 C0 15 21 C8 17 02 00 00 00 10 01 20 D0 8A 88 x..!.....
00 01 20 60 8B 88 E0 83 80 08 08 78 04 22 EF 08 .. `.....x.."..
22 EF 39 10 88 5A 10 88 00 80 20 90 00 90 01 10 ".9..Z....
A1 11 00 98 90 00 90 01 00 A1 11 00 98 52 17 02 .....R..
00 00 00 E0 83 80 01 00 .....
1.717670: RX 10 @ 528:
18 00 18 00 18 00 18 00 18 00 .....
1.718962: TX 120 @ 6428:
28 10 88 70 4F 05 78 4F 04 BE 00 00 06 15 EE A9 (...pO.xO.....
15 6E A8 11 EE A9 11 6E A9 10 AE A9 10 2E A9 11 .n.....n.....
4E A9 15 EE A9 32 83 80 F9 11 B9 20 83 80 79 00 N...2.....y.
B8 81 00 41 40 16 02 00 00 00 15 EE A8 5C 30 EF ...A@.....\0.
5E 30 EF 01 C3 B3 00 00 EB 14 0D 02 00 00 00 20 ^0.....
83 80 31 83 80 00 00 40 81 80 48 E0 82 88 F1 82 ..1....@..H....
88 01 C3 B3 00 00 EB 14 0D 02 00 00 00 01 C3 B3 .....
00 00 EB 14 0D 02 00 00 .....
1.747668: RX 10 @ 538:
18 00 18 00 18 00 18 00 18 00 .....
1.748964: TX 120 @ 6548:
00 91 C3 B3 00 00 EB 14 0D 02 00 00 00 41 C1 B3 .....A..
00 00 EB 14 0D 02 00 00 00 61 C5 B3 00 00 EB 14 .....a.....
0D 02 00 00 00 D1 C6 B3 00 00 EB 14 0D 02 00 00 .....
00 01 C7 B3 00 00 EB 14 0D 02 00 00 00 C1 C0 B3 .....
00 00 EB 14 0D 02 00 00 00 61 C0 B3 00 00 EB 14 .....a.....
0D 02 00 00 00 11 C0 B3 00 00 EB 14 0D 02 00 00 .....
00 00 00 06 88 B0 BF 3E 00 32 6F B8 97 4C 00 DE .....>.2o..L..
3B 00 3A 8A 10 AC 39 00 ;:....9.
1.773615: RX 10 @ 548:
18 00 18 00 18 00 18 00 18 00 .....
1.774942: TX 120 @ 6668:
3A 36 00 F8 32 00 F8 00 00 F8 81 1F 78 82 9F BE :6..2.....x...
84 9F BE 86 9F BE 07 05 21 25 84 80 95 02 78 82 .....!%....x.
11 F8 CF 82 42 37 03 48 97 03 48 42 60 EF 82 08 ...B7.H..HB`...
21 82 01 78 12 01 10 1E 00 32 E2 00 41 31 28 E1 !..x....2..A1(
31 B0 E1 31 B8 E1 F8 FF 33 82 1F 78 85 1F 78 86 1..1....3..x..x.
9F BE B1 02 10 31 03 18 B1 03 18 42 20 AF 92 09 .....1.....B ...
78 52 89 42 52 09 4B 52 89 4B 20 18 21 01 00 20 xR.BR.KR.K .!..
80 9F BE 42 00 90 D2 00 ...B....
1.800665: RX 10 @ 558:
18 00 18 00 18 00 18 00 18 00 .....
1.801963: TX 120 @ 6788:
90 80 9F BE 00 40 06 42 60 EF 4F 03 BE CF 02 78 .....@.B`.O....x
4F 01 78 10 09 98 00 00 EB DF FF 37 4F 03 BE 4F O.x.....7O..O
02 BE 4F 01 BE CF 00 78 00 00 F9 32 00 F9 36 00 ..O....x...2..6.
F9 8A 10 A9 4F 00 78 00 40 06 00 00 FE 60 22 B8 ...O.x.@....".
01 78 A3 06 00 3A 04 D8 A3 02 00 32 29 47 AF 01 .x...:.....2)G..
60 A2 04 C0 A7 01 60 A0 80 9F BE 82 9F BE 54 00 `.....`.....T.
F8 A1 02 88 03 00 E0 2A 00 32 67 00 20 E3 9F 53 .....*.2g. ..S

```

# Microchip Easy Bootloader Library for PIC24/dsPIC33 and PIC32MM

```

A6 72 20 06 00 E0 04 00 .r .....
1.826662: RX 10 @ 568:
18 00 18 00 18 00 18 00 18 00 .....
1.827955: TX 120 @ 6908:
32 F7 BF 9F 00 10 A7 04 F0 A0 00 10 A1 00 00 A1 2.....
29 E7 AF FE FF 37 FF BB 97 80 80 EB 90 C0 BA B0 )....7.....
1F BA CF 9F 60 66 38 E1 04 00 3A 90 C0 BA CF 9F ....`f8.....
60 B0 00 BA CF 9F 60 00 00 E0 42 20 AF 54 20 EC `.....`...B .T .
04 F0 A7 E3 83 53 04 F0 A1 CF 8F EA 04 00 3A 07 .....S.....:
01 41 87 81 51 07 00 36 E9 FF 37 00 D9 EB 83 01 .A..Q..6..7.....
E9 03 00 32 87 03 E9 FB FF 3A E3 FF 37 8F 87 E9 ...2.....7...
54 00 F9 4F 01 BE 4F 00 T..O..O.
1.865663: RX 10 @ 578:
18 00 18 00 18 00 18 00 18 00 .....
1.866965: TX 120 @ 7028:
BE 42 0A 04 00 00 00 15 00 20 05 00 A6 05 00 20 .B.....
01 00 E0 42 20 AF 00 00 05 80 1F 78 82 1F 78 02 ...B .....x..x.
00 FD 31 03 90 C1 01 90 21 02 90 06 83 41 81 01 ..1.....!....A..
90 84 03 53 00 18 E1 42 00 AE 03 00 78 02 00 E0 ...S...B....x...
06 00 3A 00 02 42 B1 03 90 06 20 E1 42 00 AF 07 ...:..B.... .B...
02 52 11 00 37 80 01 78 03 38 E1 42 00 AE 87 01 .R..7..x.8.B....
78 03 00 E0 03 00 32 83 03 E9 07 80 09 34 59 78 x.....2.....4Yx
06 20 E1 42 20 AF 41 02 . .B .A.
1.899690: RX 10 @ 588:
18 00 18 00 18 00 18 00 18 00 .....
1.900966: TX 120 @ 7148:
90 83 03 50 03 00 32 87 03 E9 07 80 09 34 59 78 ...P..2.....4Yx
05 00 E0 02 00 3A A4 00 98 91 08 10 E1 03 90 81 .....:.....
01 78 4F 01 78 CF 00 78 07 00 E0 42 20 AE 07 00 .xO.x..x...B ...
01 00 00 06 6C 10 00 02 00 00 80 00 00 58 10 00 ....l.....X..
04 00 00 80 00 00 5C 10 00 04 00 00 80 00 00 6E .....\......n
10 00 02 00 00 80 00 00 70 10 00 02 00 00 80 00 .....p.....
00 0C 11 00 2A 00 00 80 00 00 6E 11 00 10 00 00 ....*.....n.....
80 00 00 8C 10 00 80 00 .....
1.929661: RX 10 @ 598:
18 00 18 00 18 00 18 00 18 00 .....
1.930966: TX 120 @ 7268:
00 80 00 00 78 10 00 02 00 00 80 00 00 7E 10 00 ....x.....~..
02 00 00 80 00 00 80 10 00 02 00 00 80 00 00 82 .....:.....
10 00 02 00 00 80 00 00 84 10 00 02 00 00 80 00 .....:.....
00 7E 11 00 04 00 00 80 00 00 68 10 00 04 00 00 .~.....h.....
80 00 00 8A 10 00 02 00 00 80 00 00 00 00 00 E0 .....:.....
02 40 02 00 78 24 00 32 15 02 90 35 03 90 95 01 .@..x$.2...5....
53 C5 03 90 06 83 43 84 03 53 00 18 E1 42 00 AE S....C...S...B..
03 00 78 80 01 78 03 38 ..x..x.8
1.959662: RX 10 @ 608:
18 00 18 00 18 00 18 00 18 00 .....
1.961023: TX 120 @ 7388:
E1 42 00 AE 87 01 78 03 00 E0 04 00 32 83 03 E9 .B....x.....2...
07 80 09 31 5A 78 95 8A 41 06 20 E1 42 20 AF 45 ...1Zx..A. .B .E
02 90 03 00 50 04 00 32 80 03 E9 07 80 09 31 5A ....P..2.....1Z
78 95 0A 40 94 02 98 00 80 41 D5 03 90 85 01 78 x..@.....A.....x
80 80 50 07 00 E0 42 20 AE 07 00 01 00 00 06 84 ..P...B .....
9F BE 86 1F 78 80 9F BE B2 17 02 00 00 00 8E 16 ....x.....
02 00 00 00 CF 02 78 7F BA 97 E8 83 57 37 03 78 .....x.....W7.x
37 03 73 37 03 73 17 00 7.s7.s..
1.985663: RX 10 @ 618:
18 00 18 00 18 00 18 00 18 00 .....
1.986964: TX 120 @ 7508:
32 04 03 78 09 00 09 00 1B EB 75 02 98 47 F0 A6 2..x.....u..G..
09 00 37 E8 83 57 68 03 42 37 1B EA B7 82 EA 60 ..7..Wh.B7.....`
9B 4A B7 82 EA 60 9B 4A 02 00 09 C6 23 78 7F BB .J...`.J....#x..
97 37 2B 40 37 AB 48 37 2B 49 7F BB 97 87 08 21 .7+@7.H7+I.....!
17 0B 78 86 0B 78 E8 87 57 00 00 06 04 00 E0 09 ..x..x..W.....
00 32 80 02 78 62 08 B8 36 00 20 11 00 09 46 88 .2..xb..6. ...F.
D8 00 01 41 03 80 B0 A7 02 80 A3 02 88 29 E7 AF ...A.....)....
FE FF 37 61 02 52 02 00 ..7a.R..
2.012660: RX 10 @ 628:

```

# Microchip Easy Bootloader Library for PIC24/dsPIC33 and PIC32MM

```

18 00 18 00 18 00 18 00 18 00 .....
2.013958: TX 120 @ 7628:
A7 0B 00 37 02 01 E9 61 02 42 01 10 A6 0B 00 37 ...7...a.B....7
02 81 E8 92 5A BA 04 82 E9 0D 00 39 02 00 37 D2 ...Z.....9..7.
5A BA D2 5A BA C2 DA BA 02 01 E8 42 20 AF 54 20 Z..Z.....B .T
EC 63 02 52 F8 FF 31 62 02 42 02 00 33 04 80 09 .c.R..1b.B..3...
D2 5A BA A7 02 88 00 00 06 00 80 EA 81 80 EA 85 .Z.....
00 20 06 32 28 87 DB 2E 10 00 37 B2 5A 78 B2 52 . .2(.....7.Zx.R
78 04 00 68 84 00 20 81 00 D1 00 80 D3 02 00 39 x..h.. .....9
06 00 68 87 80 68 81 00 ..h..h..
2.038677: RX 10 @ 638:
18 00 18 00 18 00 18 00 18 00 .....
2.039964: TX 120 @ 7748:
D1 00 80 D3 02 00 39 06 00 68 87 80 68 04 02 E9 .....9..h..h...
F4 FF 3A E2 81 51 EE FF 3B E2 81 41 04 00 32 12 ....Q...;..A..2.
40 68 44 00 20 03 00 20 EC FF 37 00 80 EA 81 80 @hD. . . .7.....
EA 00 00 06 04 00 FA 88 9F BE 00 04 BE 00 01 EB .....
12 8C 88 02 10 20 22 84 88 82 08 21 02 00 E0 02 ..... ".....!....
00 32 88 30 EF 8A 70 EF 05 A1 A9 00 30 20 04 21 .2.0..p.....0 .!
B7 04 21 A9 F2 FC 2F 40 10 20 10 08 61 04 41 A8 .!..../@. .a.A.
02 A1 EF F8 8B 88 09 8C .....
2.072655: RX 10 @ 648:
18 00 18 00 18 00 18 00 18 00 .....
2.073970: TX 120 @ 7868:
88 F8 17 02 00 00 00 08 00 BE BC 15 02 00 00 00 .....
05 E1 A8 4F 04 BE 00 80 FA 00 00 06 0C 00 FA 88 ...O.....
1F 78 8A 9F BE 02 04 78 04 05 BE F0 B7 9F 81 BF .x.....x.....
9F 0E 00 37 72 80 57 B2 16 02 00 00 00 1F B8 97 ...7r.W.....
AF B8 97 80 0F 55 81 8F 5D 05 00 39 3F B8 97 CF .....U..].9?...
B8 97 80 0F 55 81 8F 5D 05 00 39 64 04 54 08 00 ....U..].9d.T..
E0 F0 FF 3A 00 00 EB 01 00 37 10 00 20 4F 05 BE ....7.. O..
00 00 00 4F 04 78 00 80 ...O.x..
2.098654: RX 10 @ 658:
18 00 18 00 18 00 18 00 18 00 .....
2.099968: TX 120 @ 7988:
FA 00 00 06 A7 02 80 00 00 20 29 E7 AF FE FF 37 ..... )....7
00 00 E0 0C 00 3A 01 00 20 A1 02 88 A1 C0 21 D2 .....:.. ..!..
2C 21 31 C0 BA 00 80 FD 31 40 BA A7 02 88 00 00 ,!1.....1@.....
51 42 20 AE 00 00 05 10 00 05 C4 FF 2A 05 00 20 QB .....*..
05 70 A0 A5 02 88 14 01 BA 94 81 BA 4C 13 DE C4 .p.....L...
19 DD 06 80 71 02 81 EA F4 FF 20 04 01 61 EE FF ....q.....a..
37 00 00 FE 29 E7 AF FE FF 37 40 39 88 F7 83 80 7...)....7@9....
7E 30 EF 01 3B B8 61 32 ~0...;a2
2.124650: RX 10 @ 668:
18 00 18 00 18 00 18 00 18 00 .....
2.125938: TX 120 @ 8108:
21 B7 09 B0 81 00 53 18 18 02 00 00 00 71 39 88 !.....S.....q9.
80 00 EB 77 39 88 29 E7 A8 00 00 00 00 00 00 02 ...w9.).....
00 A6 28 18 02 00 00 00 80 03 EB 02 08 A3 29 E7 ..(.....).
AF FE FF 3A 29 C7 A9 02 00 A7 28 18 02 00 00 00 ....:). ....(.....
00 00 06 12 00 FA 88 1F 78 E1 4C 28 74 81 57 10 .....x..L(t.W.
00 09 31 59 78 11 01 B1 68 83 80 60 83 88 6E 81 ..lYx...h..`..n.
57 71 00 20 14 C3 B3 81 01 DE 03 08 A3 01 00 32 Wq. ....2
04 49 78 81 00 E9 02 01 .Ix.....
2.150653: RX 10 @ 678:
18 00 18 00 18 00 18 00 18 00 .....
2.151971: TX 120 @ 8228:
E8 E1 8F 40 F8 FF 3A 74 81 57 11 00 20 00 00 EB ...@...:t.W.. ...
F6 16 02 00 00 00 08 00 78 4F 04 78 00 80 FA 00 .....xO.x....
00 06 00 00 E0 1A 00 32 70 02 90 04 00 E0 42 20 .....2p.....B
AE 04 04 01 88 9F BE 8A 9F BE 8C 1F 78 02 04 BE .....x....
00 06 78 84 17 02 00 00 00 05 BE 1C 00 E0 07 ..x.....
00 32 84 17 02 00 00 00 0A 00 50 8B 80 58 08 00 .2.....P..X..
E1 09 88 E1 F7 FF 34 4F 06 78 4F 05 BE 4F 04 BE .....4O.xO..O..
42 20 AE 00 00 05 10 00 B .....
2.176649: RX 10 @ 688:
18 00 18 00 18 00 18 00 18 00 .....
2.177948: TX 120 @ 8348:

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# Microchip Easy Bootloader Library for PIC24/dsPIC33 and PIC32MM

```

05 11 00 20 0F 00 A7 01 00 20 02 82 20 07 00 37    ... ..7
11 00 20 0F 00 A7 01 00 20 00 00 E0 42 20 AF 00    .. ..B ..
00 05 02 80 20 80 09 90 43 1A DE 04 00 A1 04 01    )....C.....
41 EF 81 61 00 00 EB 12 18 A5 00 80 D2 E0 80 40    A..a.....@
12 98 AD 00 00 06 88 9F BE 00 04 BE 00 83 88 11    .....
83 88 40 1F B0 01 80 B0 82 3E 20 03 00 20 92 04    ..@.....> ..
02 00 00 00 20 83 88 31 83 88 00 12 2A 71 00 20    ....1....*q.
08 00 40 89 80 48 02 24    ..@...H.$
2.202647: RX 10 @ 698:
18 00 18 00 18 00 18 00 18 00    .....
2.203960: TX 120 @ 8468:
24 F3 00 20 92 04 02 00 00 00 30 84 88 4F 04 BE    $.. .....0..O..
00 00 06 88 9F BE 80 04 78 01 04 78 09 00 E0 01    .....x..x....
00 3D 79 83 80 08 00 E0 01 00 3D 88 83 80 89 40    .=y.....=....@
78 01 74 A0 08 00 44 02 4E 28 00 00 41 90 C0 70    x.t...D.N(..A..p
00 00 EB 14 0D 02 00 00 00 79 83 88 88 83 88 4F    .....y.....O
04 BE 00 00 06 00 00 FE 29 E7 AF FE FF 37 A2 02    .....).7..
80 A1 02 88 03 08 BB A2 02 88 50 39 88 61 39 88    .....P9.a9.
20 04 24 28 C7 A8 28 C7    ..$(..(
2.228655: RX 10 @ 708:
18 00 18 00 18 00 18 00 18 00    .....
2.229964: TX 120 @ 8588:
AE 10 84 B2 00 01 EB 51 3E 20 E0 14 02 00 00 00    .....Q> .....
29 E7 AF FE FF 37 29 C7 A9 00 00 06 88 9F BE 8A    )....7).....
9F BE 00 04 BE 84 17 02 00 00 00 00 05 BE 80 01    .....
EB 03 00 E0 42 20 AE 01 40 FE 84 17 02 00 00 00    ....B ..@.....
0A 02 50 8B 82 58 04 01 54 85 81 5C F6 FF 31 4F    ..P..X..T..\.1O
05 BE 4F 04 BE 00 00 06 83 1F 78 82 1F 78 80 1F    ..O.....x..x..
78 8E 16 02 00 00 00 CF 03 78 4F 00 40 CF 80 48    x.....xO.@..H
60 01 49 8A 10 AC 57 02    `..I...W.
2.254642: RX 10 @ 718:
18 00 18 00 18 00 18 00 18 00    .....
2.255962: TX 120 @ 8708:
BE 80 23 78 81 2B 78 82 2B 78 42 20 AF 8A 10 A9    ..#x.+x.+xB ....
00 00 52 81 80 5A 00 00 06 24 84 80 A3 82 80 92    ..R..Z...$.
82 80 81 82 80 14 00 78 94 0F 10 FA FF 39 04 05    .....x.....9..
21 34 08 E1 34 90 E1 34 98 E1 24 18 21 F3 FF 3A    !4..4..4..$.!...
14 00 40 E0 80 48 60 01 49 E0 81 49 00 00 06 A4    ..@..H`.I..I....
02 80 30 01 BE A3 02 88 29 E7 AF FE FF 37 12 18    ..0.....).7..
BA 12 98 BA 02 81 E8 E0 81 49 A3 02 88 12 18 BA    .....I.....
12 88 BA 6A 00 50 02 98    ...j.P..
2.280642: RX 10 @ 728:
18 00 18 00 18 00 18 00 18 00    .....
2.281950: TX 120 @ 8828:
E8 60 88 49 A4 02 88 00 00 06 A2 02 80 A1 02 88    .`.I.....
F3 3F 20 83 80 EA 00 80 60 00 82 EB 10 C2 BA B0    .? .....`.....
00 BA 01 02 62 84 80 EA 04 00 3A 83 81 E9 F9 FF    ....b.....:....
31 A2 02 88 10 00 05 A2 02 88 00 00 05 88 9F BE    1.....
02 04 78 EA 15 02 00 00 00 98 40 78 01 04 E0 07    ..x.....@x....
00 32 19 00 20 09 00 78 14 0D 02 00 00 00 D8 40    .2.. ..x.....@
78 01 04 E0 FA FF 3A 4F 04 BE 00 00 06 02 02 E9    x.....:O.....
05 00 33 81 01 70 03 00    ..3..p..
2.310641: RX 10 @ 738:
18 00 18 00 18 00 18 00 18 00    .....
2.311949: TX 120 @ 8948:
A6 03 00 37 04 80 09 31 58 78 00 00 06 82 01 D1    ...7...1Xx.....
83 01 E9 03 00 33 03 80 09 31 18 78 02 00 A7 31    ....3...1.x...1
58 78 00 00 06 F0 3F B1 01 80 B1 06 00 35 EE 03    Xx....?.....5..
09 00 00 00 40 3F B1 01 80 B1 FB FF 3D 10 00 B0    ....@?.....=...
20 3F B0 02 00 35 00 80 09 00 00 00 00 06 48    ?...5.....H
88 A8 48 A8 A9 48 C8 A9 48 E8 A9 48 08 A8 48 28    ..H..H..H..H(H
A9 48 48 A9 48 68 A9 00 82 20 90 00 90 01 00 A0    .HH.Hh... ..
11 00 98 00 00 06 C0 10    .....
2.336590: RX 10 @ 748:
18 00 18 00 18 00 18 00 18 00    .....
2.337978: TX 120 @ 9068:
21 12 05 02 00 00 00 82 10 E2 05 00 32 22 83 80    !.....2"..
33 83 80 60 13 21 68 16 02 00 00 00 00 EB 00    3..`.!h.....

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00 06 22 84 80 83 82 80 12 00 78 92 0F 10 FC FF ..".....x.....
39 81 82 80 03 08 E1 23 18 21 F8 FF 3A 13 00 40 9.....#.!...:@
E0 80 48 00 00 06 A0 14 02 00 00 00 00 00 E0 06 ..H.....
00 32 02 01 FC 20 07 21 00 88 EB 0C 1C 02 00 00 .2... !.....
00 00 00 FE 00 00 06 81 08 21 01 00 37 82 00 78 .....!..7..x
11 01 78 02 00 E0 04 00 ..x.....
2.362646: RX 10 @ 758:
18 00 18 00 18 00 18 00 18 00 .....
2.363979: TX 120 @ 9188:
32 80 0F 51 FA FF 3A 90 08 78 10 00 05 00 00 05 2..Q...:..x.....
80 02 EB 05 08 78 32 00 98 41 00 98 11 00 98 21 .....x2..A.....!
00 98 53 00 98 64 00 98 75 00 98 00 00 06 F1 0F ..S..d..u.....
B2 81 0F 70 04 00 32 80 9F BE 02 00 BE 04 01 BE ...p..2.....
06 02 BE 00 00 06 00 80 EA 6C 10 B6 1A 15 02 00 .....l.....
00 00 00 80 EA 00 00 06 F0 FF 20 40 08 B6 00 E0 ..... @....
A0 00 42 88 20 68 A8 00 00 06 02 00 E0 03 00 32 ..B. h.....2
02 01 E9 02 80 09 01 58 .....X
2.388644: RX 10 @ 768:
18 00 18 00 18 00 18 00 18 00 .....
2.389980: TX 120 @ 9308:
78 00 00 06 6C 90 B6 1A 15 02 00 00 00 00 00 06 x...l.....
00 08 20 CF 1F 70 10 02 80 00 40 06 63 00 B8 81 .. ..p....@.c...
00 D1 00 80 D3 00 00 06 48 00 DD CF 1F 70 00 40 .....H....p.@
06 76 50 A8 00 00 06 76 70 A8 00 00 06 FF FF FF ..vP....vp.....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
2.420588: RX 10 @ 778:
18 00 18 00 18 00 18 00 18 00 .....
2.429571: TX 120 @ 9428:
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
2.455651: RX 10 @ 788:
18 00 18 00 18 00 18 00 18 00 .....
2.456983: TX 120 @ 9548:
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
2.481648: RX 10 @ 798:
18 00 18 00 18 00 18 00 18 00 .....
2.482984: TX 120 @ 9668:
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
2.507640: RX 10 @ 808:
18 00 18 00 18 00 18 00 18 00 .....
2.508984: TX 120 @ 9788:
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....

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FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF .....
2.533638: RX 10 @ 818:
18 00 18 00 18 00 18 00 18 00 .....
2.534983: TX 120 @ 9908:
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
2.559656: RX 10 @ 828:
18 00 18 00 18 00 18 00 18 00 .....
2.560991: TX 120 @ 10028:
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
2.593635: RX 10 @ 838:
18 00 18 00 18 00 18 00 18 00 .....
2.594984: TX 120 @ 10148:
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
2.620566: RX 10 @ 848:
18 00 18 00 18 00 18 00 18 00 .....
2.629570: TX 120 @ 10268:
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
2.655592: RX 10 @ 858:
18 00 18 00 18 00 18 00 18 00 .....
2.656985: TX 120 @ 10388:
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
2.685634: RX 10 @ 868:
18 00 18 00 18 00 18 00 18 00 .....
2.686985: TX 120 @ 10508:
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF .....
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2.914640: RX 10 @ 938:
18 00 18 00 18 00 18 00 18 00 .....
2.916595: TX 120 @ 11348:
00 02 00 00 4C 45 00 44 73 00 3A 20 00 30 30 00 ....LE.Ds.: .00.
30 30 00 30 30 00 30 30 00 20 20 00 00 00 00 41 00.00.00. ....A
70 00 70 6C 00 69 63 00 61 74 00 69 6F 00 6E 20 p.p.l.i.c.a.t.i.o.n
00 20 20 00 20 20 00 00 00 00 4F 18 21 0E FF 22 . . ....O.!.."
0E 01 88 00 00 00 00 20 00 00 E0 02 00 32 00 .....2.
01 20 20 02 88 14 00 07 80 00 07 00 00 E0 03 00 . ....
3A 00 06 22 01 00 20 02 00 37 00 00 20 01 00 20 :.."..7.. ..
81 0F 70 01 00 32 0F 00 ..p..2..
2.943653: RX 10 @ 948:
18 00 18 00 18 00 18 00 18 00 .....
2.945593: TX 120 @ 11468:
07 00 00 20 00 00 E0 02 00 32 00 00 02 00 00 00 ... ..2.....
F0 1F 02 00 00 00 00 40 DA 00 00 FE 00 03 20 00 .....@.....
00 E0 02 00 32 00 20 20 90 01 88 00 00 06 A1 02 ....2. ....
88 80 04 78 00 00 EB 1F 00 37 E2 84 44 54 A0 B4 ...x.....7..DT..
99 05 BA E2 84 44 54 A0 B4 99 06 BA E2 84 44 54 .....DT.....DT
A0 B4 00 06 EB 47 6F DE FD 07 B2 AE 01 88 63 6C .....Go.....cl
E1 03 00 3A 0A D8 01 00 00 EB 0E 00 37 60 6C E1 .....7`l.
08 00 3A 00 4D EB 0A 05 ...:M...
2.971623: RX 10 @ 958:
18 00 18 00 18 00 18 00 18 00 .....
2.973592: TX 120 @ 11588:
E8 02 00 39 34 20 EC 0A F0 A0 8B 05 E9 F9 FF 3E ...94 .....>
04 00 37 61 68 E1 01 00 32 00 86 EB 0B 00 07 19 ..7ah...2.....
C7 BA 19 05 BA 0E 04 E0 03 00 3A 0A 00 E0 DB FF .....:.....
3A 00 00 06 FE 07 B2 AE 02 88 8A 04 78 F5 FF 37 :.....x..7
0C D0 A3 E2 0F 4D 1C 00 39 89 02 78 35 4D BA 0A .....M..9...x5M..
05 E8 02 00 39 34 20 EC 0A F0 A0 8B 05 E9 0F 00 ...94 .....
32 25 4D BA 0A 05 E8 02 00 39 34 20 EC 0A F0 A0 2%M.....94 ....
8B 05 E9 08 00 32 0C 00 .....2..
3.003622: RX 10 @ 968:
18 00 18 00 18 00 18 00 18 00 .....
3.005595: TX 120 @ 11708:
E0 06 00 32 15 CD BA 0A 05 E8 02 00 39 34 20 EC ...2.....94 .
0A F0 A0 8B 05 E9 89 84 E8 54 A0 B4 0B 00 E0 E2 .....T.....
FF 3A 00 00 06 99 02 BA 05 5D 78 8B 05 E9 F7 FF :.....]x.....
32 C8 2A DE 05 5D 78 8B 05 E9 F3 FF 32 0C 00 E0 2.*..]x.....2...
F1 FF 32 19 DD BA EE FF 37 00 00 00 00 00 00 00 ..2.....7.....
00 00 00 00 00 80 9F BE 00 00 FA 00 40 DA 01 46 .....@..F
80 00 70 28 00 80 60 00 46 88 00 80 FA 4F 00 BE ..p(..`F....O..
00 40 06 00 00 05 06 00 .@.....
3.033624: RX 10 @ 978:
18 00 18 00 18 00 18 00 18 00 .....
3.035595: TX 120 @ 11828:
FA 10 07 98 41 47 98 15 4E A8 11 4E A9 00 00 00 ....AG..N..N....
84 17 02 00 00 00 00 01 BE 00 80 80 11 80 80 00 .....
01 51 81 81 59 20 80 80 31 80 80 80 0F 51 81 8F .Q..Y ..1....Q..
59 F4 FF 39 15 6E A9 11 6E A9 1E 00 90 00 40 78 Y..9.n..n....@x
61 40 60 00 80 FB 61 00 60 45 00 DD A1 70 80 01 a@`...a.`E...p..
50 A1 01 00 70 A0 70 88 10 AE A9 10 2E A9 00 00 P...p.p.....
EB 00 0F 78 14 00 37 15 4E A9 14 2E A9 4E 40 90 ...x..7.N...N@.
00 04 E0 01 00 3D 14 2E .....=.
3.069624: RX 10 @ 988:
18 00 18 00 18 00 18 00 18 00 .....
3.079556: TX 120 @ 11948:
A8 4E 40 90 00 00 FB 00 00 40 40 47 98 00 02 20 .N@.....@G...
01 00 20 36 17 02 00 00 15 4E A8 80 00 20 01 .. 6.....N...
00 20 36 17 02 00 00 00 1E 0F E8 1E 00 78 E7 0F . 6.....x..
50 E9 FF 36 84 17 02 00 00 00 80 88 11 80 88 P..6.....
30 84 80 45 00 DD 80 00 EB 20 80 88 31 80 88 1E 0..E.....1...
00 90 00 00 E0 10 00 3A 4E 40 90 00 00 FB E3 00 .....N@.....
60 4E 40 90 00 00 FB 80 8F 50 0C 00 3A 20 83 80 `N@.....P.: :
31 83 80 00 00 40 81 80 1....@..
3.111620: RX 10 @ 998:
18 00 18 00 18 00 18 00 18 00 .....

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3.113601: TX 120 @ 12068:
 48 20 80 88 31 80 88 08 30 EF 0A 30 EF 03 00 37 H ..1...0..0...7
 40 80 80 00 00 E8 40 80 88 00 02 20 01 00 20 36 @.....@.... .. 6
 17 02 00 00 00 15 6E A8 00 80 FA 00 00 06 18 00 .....n.....
 FA 30 0F 98 00 D6 29 E4 00 47 10 00 09 B0 58 78 .0....)..G....Xx
 10 01 B1 62 80 80 12 07 98 BE 08 90 61 80 88 00 ...b.....a...
 00 EB 00 0F 78 0E 00 37 61 80 80 72 00 20 1E 00 ....x..7a..r. ..
 51 00 08 DE 61 00 60 00 40 78 00 04 E0 05 00 32 Q...a.`.@x.....2
 9E 00 78 66 80 40 64 00 ..xf.@d.

3.139617: RX 10 @ 1008:
 18 00 18 00 18 00 18 00 18 00 .....

3.141599: TX 120 @ 12188:
 40 11 C3 B3 01 77 78 1E 0F E8 1E 00 78 E7 0F 50 @....wx.....x..P
 EF FF 36 64 00 47 00 01 78 11 00 20 00 00 EB 30 ..6d.G..x... ..0
 20 02 00 00 00 1E 00 90 00 80 FA 00 00 06 04 00 .....
 FA 00 0F 78 11 07 98 1E 00 78 00 00 E0 02 00 3D ...x.....x.....=
 41 80 80 01 0F 78 1E 00 90 00 00 E0 02 00 3D 51 A....x.....=Q
 80 80 11 07 98 1E 00 90 80 00 40 40 D5 29 00 80 .....@@@.)..
 40 10 00 78 80 40 78 1E 00 78 00 40 78 80 C0 70 @..x.@x..x.@x..p
 00 C8 B3 00 C0 70 80 40 .....p.@

3.167616: RX 10 @ 1018:
 18 00 18 00 18 00 18 00 18 00 .....

3.169602: TX 120 @ 12308:
 78 00 00 EB 9C 1E 02 00 00 00 9E 00 78 41 80 88 x.....xA..
 9E 00 90 51 80 88 00 80 FA 00 00 06 04 00 FA 22 ...Q....."
 D7 29 80 00 EB 00 00 EB 30 20 02 00 00 00 84 17 .).....0 .....
 02 00 00 00 00 8F BE 01 00 37 00 00 00 84 17 02 .....7.....
 00 00 00 3E 01 50 AE 81 58 00 83 80 11 83 80 81 ...>.P..X.....
 00 D1 00 80 D3 80 0F 51 81 8F 59 F4 FF 36 00 83 .....Q..Y..6..
 80 11 83 80 81 00 D1 00 80 D3 1E 0F 40 5E 97 48 .....@^.H
 10 00 20 80 20 02 00 00 ... ..

3.203617: RX 10 @ 1028:
 18 00 18 00 18 00 18 00 18 00 .....

3.205602: TX 120 @ 12428:
 00 EB FF 37 06 00 FA 00 0F 78 11 07 98 22 07 98 ...7.....x..."..
 9E 00 90 1E 00 78 AC 1F 02 00 00 00 09 00 37 2E .....x.....7.
 00 90 10 40 78 AE 00 90 81 00 E8 21 07 98 80 40 ...@x.....!...@
 78 10 00 20 9C 1E 02 00 00 00 2E 00 90 10 40 78 x.. .....@x
 00 04 E0 F3 FF 3A 00 80 FA 00 00 06 00 10 00 04 .....:.....
 00 00 80 00 00 04 10 00 04 00 00 80 00 00 08 10 .....
 00 02 00 00 80 00 00 0A 10 00 02 00 00 80 00 00 .....
 0C 10 00 02 00 00 80 00 .....

3.244612: RX 10 @ 1038:
 18 00 18 00 18 00 18 00 18 00 .....

3.246199: TX 120 @ 12548:
 00 00 00 00 02 00 FA 00 0F 78 60 80 80 1E 00 68 .....x`....h
 5C 1F 02 00 00 00 80 FA 00 00 06 03 00 00 00 \.....
 80 AF 00 00 FF FF 00 03 00 00 00 98 AF 00 00 F8 .....
 FF 00 03 00 00 00 9C AF 00 00 1B FE 00 03 00 00 .....
 00 A0 AF 00 00 C8 FC 00 03 00 00 00 A8 AF 00 00 .....
 DE 7F 00 03 00 00 00 AC AF 00 00 FE FF 00 03 00 .....
 00 00 B0 AF 00 00 DE FF 00 03 00 00 00 FC AF 00 .....
 00 FE 1F 00 AB 6A A9 C7 .....j..

3.278640: RX 10 @ 1048:
 18 00 14 00 16 00 16 00 16 00 .....

3.280200: TX 32 @ 12668:
 23 17 42 75 5C 7F 9B 71 79 47 CA 7D E7 5F 63 48 #.Bu\..qyG.}._cH
 64 C2 EB 26 48 99 9E 40 6F BE D7 6A F1 33 75 1A d..&H..@o..j.3u.

3.306602: RX 4 @ 1058:
 00 00 01 00 ....

3.312667: ConnectNamedPipe() return in COMInToPipeThreadProc(): 232
The pipe is being closed.

3.315616: PeekNamedPipe() return in PipeOutToCOMThreadProc(): 109

```

The pipe has been ended.

3.315728: ezbl\_comm.exe closing normally