## Serial2 Protocol Supplement
9/21/06

Introduction

This document is intended to be a supplement to the Serial2 (MTS) Protocol specification. That document covers basic Serial 2 packeting, 'head' responsibilities, and normal 'upstream' commands.

This document includes so called out-of-band commands normally implemented by Innovate Devices. A Serial2 (MTS) device would normally respond to these commands in one of two cases:

- The device is 'head' (end of chain)
- The device has been designed with the MTS 'listen' command

In general, MTS devices are in one of three serial communication modes. 'In-band', or normal MTS sample data packets. 'Out-of-band', or 'Serial Mode'. A mode used for configuration or calibration. And 'Program Mode', used exclusively for firmware updates and the small bootstrap program included in devices for failed firmware update recovery. The basic relationship of these modes is shown in the following diagram:
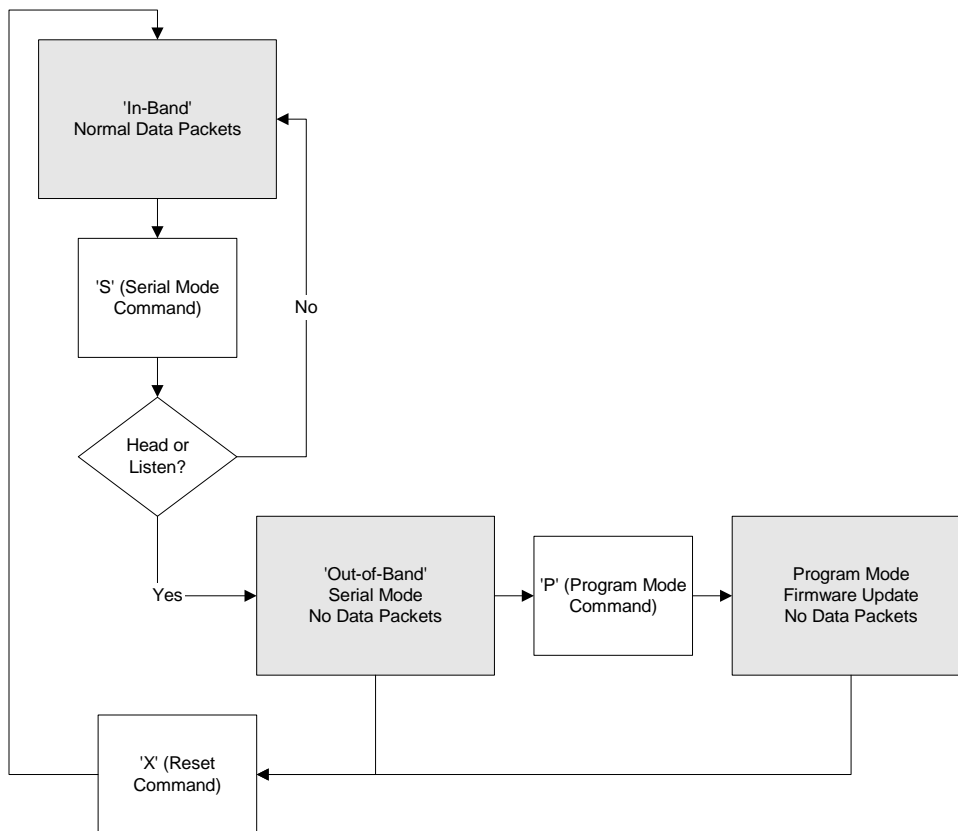
Standard Out-Of-Band (Serial Mode) Commands

Note, unless a response is specified, a '\r' is returned by all commands. If a response is specified, the '\r' is omitted.

'S'   - Enter Serial Mode. MTS packet generation should stop and the
                    device should respond with the following 15 byte binary bytes

```
/*     Device Info Description

BYTE
0,1           2 Byte Software version (Big Endian) 0x100A = 1.00a,
              0x1000 is 1.00 final

2..5          4 Byte unique Device type eg 'LMTR' is Lambda Meter

6             1 Byte Processor Version of device
              For Lambda Meter
                      0 is AtMega163
                      1 is AtMega16
                      (see LMMETER.H for other types)

7             1 Byte attribute bits
              for Lambda Meter
                      Bit 0 has Flash
                      Bit 1 has DAC
                      Bit 2 has RPM converter
                      Bit 3 spare
                      Bit 4 HW Support for NTK
                      Bit 5 HW Support for Bosch LSU 4.2
                      Bit 6 HW Support for Bosch LSU 4.9
                      Bit 7  HW Support for Future Sensor

8,9           2 Byte Max Program Memory (Big Endian)
                      0x3E00 for AtMega based Lambda Meter
                      Note:  Currently assumed boot loader follows

10            Sensor Type
                      0     Honda L1H1
                      1     Bosch LSU 4.2
                      2     Bosch LSU 4.9
                      4     Future Sensor

11            Hardware Version
                      0     First Version
                      0     1 Byte Hardware version

12            auxiliary caps
                      Bit 0 Can do serial bus 2 (MTS)
                      Bit 1 Can do auxiliary caps (eeprom bytes)
                      Bit 2 Can do name function

13,14         Reserved (0)
*/
```

'c'   - Read device configuration. Device responds with a binary configuration
                          block. Normally, DL-32, etc. collect data until .1S pause, then
                          assume block is complete.
'C'   - Write device configuration. Should be symmetric with 'c' ('c' response
                          should be legal 'C' command. Respond with '/r' for success, 00h for error.

'P'   - Enter flash program mode (see next section)

'n'   - Read Device Name. Response is always 8 chars (null padded if
                          nec. This command only works if 'name' caps is set in 'S' response.
'N'   - Write Device Name. Always followed by 8 chars. Only sent
                          if 'name' caps bit is set in 'S' response.

'e'   - Read aux EEPROM space (if cap reported)
'E'   - Write aux EEPROM space (if cap reported)

'X'   - Reset device and leave 'S' (serial) mode (no response)

Optional Out-of-Band ('Serial Mode') Commands

Devices may implement additional commands for calibration and other purposes. Some
commonly used commands are:

'k'   - Read Calibration data
'K'   - Write Calibration data

'a'   - Read raw ADC data

Commands should honor the lower-case 'set', upper-case 'get' model.

Commands with no standard response should return '\r'.

Program Mode Commands

Program mode is a 'sub' mode of serial mode, meant for re-flashing device program memory. Normally our devices all contain a fixed boot loader which immediately enters this command. The bootloader is patched to just before program update, then unpatched when successful.

'S'   - Redundant (for boot loader) sends 'S' response (see above) but stays in Program Mode.

'P'   - Redundant (for boot loader) responds with '\r' and stays in Program Mode.

'X'   - Reset device and exit program and serial mode.

'W'   - Write data block. Word address followed by processor specific block (typically 128 or 256 bytes).

'R'   - Read data block. Followed by word address. Response is processor specific block (typically 128 or 256 bytes).