LM1 Serial Logger Specification #1

Date: Oct. 17 2003

The LM-1 will output serial data always whether recording is on or off.

1. Serial Interface Settings

The LM-1 serial interface is set to

8 data bits
1 stop bit
no parity
19.2 kBaud.

2. Serial Protocol Format

The serial data consists of packets of 16 bytes (in normal operation every 81.92 msec).

The packets are organized as eight 16 bit numbers in big endian order.

Only the first Byte of a packet has the high bit set to denote a packet start.

The following table shows the bit/word order of a packet.
The descriptions of each WORD follows below.

The length of eight numbers may not be assumed. LM-1 versions without aux input may only send the first three words. LM1's with more than 5 aux inputs can send more words. During Warmup or error conditions the LM-1 may send only the first two words.

WORD	Bit 15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	R	F3	F2	F1	F0	0	AF7	0	AF6	AF5	AF4	AF3	AF2	AF1	AF0
1	0	0	L12	L11	L10	L9	L8	L7	0	L6	L5	L4	L3	L2	L1	L0
2	0	0	mb2	mb1	mb0	bv9	bv8	bv7	0	bv6	bv5	bv4	bv4	bv2	bv1	bv0
3..7	0	0	0	0	0	Aux9	Aux8	Aux7	0	Aux6	Aux5	Aux4	Aux3	Aux2	Aux1	Aux0

The first word of a packet contains function/status information.
The second word contains Lambda or status detail information.
The third word contains the battery voltage as seen by the LM-1.
The remaining words contain digitized auxiliary input data digitized to 10 bits.

2.1 Function/Status Word (Word 0)

Bit 15 of always set

Bit 14 (R) is set if currently recording to Flash in LM-1

Bit 13..10 (Func3..0) are function/status bits how interpret the next word (Lambda Word).

Func3..0

0000	Lambda valid and Aux data valid, normal operation.
0001	Lambda value contains O2 level in 1/10%
0010	Free air Calib in progress, Lambda data not valid
0011	Need Free air Calibration Request, Lambda data not valid
0100	Warming up, Lambda value is temp in 1/10% of operating temp.
0101	Heater Calibration, Lambda value contains calibration countdown.
0110	Error code in Lambda value
0111	Lambda Value is Flash level in 1/10%
1xxx	reserved

Bit 8 contains high bit (bit 7) of AFR multiplier (AF7)

Bit 7 always 0

Bit 6..0 contain remaining 7 bits of AFR multiplier (AF6..AF0).

AFR multiplier is stochiometric AFR value of current fuel setting in the LM-1 times 10. E.g. 147 for gasoline (14.7).
Air/Fuel Ratio = ((L12..L0) + 500)* (AF7..0) / 10000

2.2 Lambda Word (Word 1)

Lambda in 0.001 Lambda increments when F3..F0 is 0000, offset by 0.5 Lambda.

L = 0 -> 0.5 Lambda
L = 1022 -> 1.522 Lambda
L = 1023 Lambda = 1.523
L = 8191 Lambda = 8.691

2.3 Battery Voltage (Word 2)

Battery voltage digitized to 10 bit (bv9..bv0) and battery divider (mb2..mb0). Calculate battery voltage in Volt as
bv * 5 * mb / 1023.

2.4 Aux Input (Word 3..7)

Aux Inputs digitized to 10 bits. 0 = 0V, 1023 = 5V.

If RPM converter is used, Multiply WORD 3 value by 10 to get rpm.