

LiveStrong Treadmill RS485 Communication

[Google Search](#)

From <https://www.eevblog.com/forum/beginners/treadmill-motor-controller-interfacing-with-arduino/?PHPSESSID=3mcu5kkmeatp7vb9bjn525v3c4>

Hey this is an old thread, but I have done exactly the thing you are asking... in fact I found this post while searching for the treadmill controller and wanted to leave some info for the next person:

The comms interface for the controller isn't straight PWM, it uses RS-485. Here is a link to my writeup: <https://elliotmade.com/2020/06/26/treadmill-controller-reverse-engineering/>

I didn't completely reverse the protocol, but I figured out enough to run it. I never found any official documentation (not surprising), but also did not expect to. I left an arduino sketch there as well that can start/stop and control the speed. Couple other notes:

- *The controller gets mad without the encoder plugged in*
- *If you don't send it a packet within a few seconds of booting, it also gets mad*
- *It also requires continuous communication or it will stop (for safety). When stopped or at a steady state, you should continually send the same packet*
- *The speed commands have to be ramped up. You can't go from 0-4000 in one step, rather you have to send some intermediate speeds as it accelerates (safety?)*
- *Don't have to ramp down, just send a slower speed and it will coast until it reaches it*
- *I'm an amateur at such things, so what I did is probably super dangerous... so watch out! (mine is on a belt grinder now, dangerous by design)*

Cheers

See <https://elliotmade.com/2020/06/26/treadmill-controller-reverse-engineering/>

Speed to Byte Message:

MPH	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Measured RPM
0.0	0	255	241	2	0	0	221	0
0.5	0	255	241	2	0	161	16	
	00	FF	F1	02	00	A1	10	
0.6	0	255	241	2	0	195	201	
0.7	0	255	241	2	0	230	186	
0.8	0	255	241	2	1	8	144	
0.9	0	255	241	2	1	42	116	
		FF	F1	02	01	2A	74	
1.0	0	255	241	2	1	76	105	332
1.1	0	255	241	2	1	111	188	
1.2	0	255	241	2	1	145	33	
1.3	0	255	241	2	1	179	197	
1.4	0	255	241	2	1	213	216	
1.5	0	255	241	2	1	248	18	
1.6	0	255	241	2	2	26	156	
1.7	0	255	241	2	2	60	188	
1.8	0	255	241	2	2	94	101	
1.9	0	255	241	2	2	129	79	
2.0	0	255	241	2	2	163	171	670
2.1	0	255	241	2	2	197	182	
2.2	0	255	241	2	2	231	82	
2.3	0	255	241	2	3	10	43	
2.4	0	255	241	2	3	44	11	
2.5	0	255	241	2	3	78	210	

2.6	0	255	241	2	3	112	8	
2.7	0	255	241	2	3	147	154	
2.8	0	255	241	2	3	181	186	
2.9	0	255	241	2	3	215	99	
3.0	0	255	241	2	3	249	250	1016
3.1	0	255	241	2	4	28	96	
3.2	0	255	241	2	4	62	132	
3.3	0	255	241	2	4	96	229	
3.4	0	255	241	2	4	130	70	
3.5	0	255	241	2	4	165	87	
3.6	0	255	241	2	4	199	142	
3.7	0	255	241	2	4	233	23	
3.8	0	255	241	2	5	11	64	
3.9	0	255	241	2	5	46	51	
4.0	0	255	241	2	5	80	212	1358
4.1	0	255	241	2	5	114	48	
4.2	0	255	241	2	5	148	87	
4.3	0	255	241	2	5	183	130	
4.4	0	255	241	2	5	217	38	
4.5	0	255	241	2	5	251	194	
4.6	0	255	241	2	6	29	136	
4.7	0	255	241	2	6	64	186	
4.8	0	255	241	2	6	98	94	
4.9	0	255	241	2	6	132	57	
5.0	0	255	241	2	6	166	221	1700
5.1	0	255	241	2	6	200	121	
5.2	0	255	241	2	6	235	172	
5.3	0	255	241	2	7	13	63	
5.4	0	255	241	2	7	47	219	
5.5	0	255	241	2	7	81	60	
5.6	0	255	241	2	7	116	79	
5.7	0	255	241	2	7	150	236	
5.8	0	255	241	2	7	184	117	
5.9	0	255	241	2	7	218	172	
6.0	0	255	241	2	7	253	189	2042
6.1	0	255	241	2	8	31	135	
6.2	0	255	241	2	8	65	230	
6.3	0	255	241	2	8	99	2	
6.4	0	255	241	2	8	134	54	
6.5	0	255	241	2	8	164	175	
6.6	0	255	241	2	8	202	118	
6.7	0	255	241	2	8	236	86	
6.8	0	255	241	2	9	15	112	
6.9	0	255	241	2	9	49	234	
7.0	0	255	241	2	9	83	51	2385
7.1	0	255	241	2	9	117	19	
7.2	0	255	241	2	9	152	158	
7.3	0	255	241	2	9	186	122	
7.4	0	255	241	2	9	220	103	
7.5	0	255	241	2	9	254	131	
7.6	0	255	241	2	10	33	132	
7.7	0	255	241	2	10	67	93	
7.8	0	255	241	2	10	101	125	
7.9	0	255	241	2	10	135	222	
8.0	0	255	241	2	10	170	20	2725

8.1	0	255	241	2	10	204	9	
8.2	0	255	241	2	10	238	237	
8.3	0	255	241	2	11	16	132	
8.4	0	255	241	2	11	51	81	
8.5	0	255	241	2	11	85	76	
8.6	0	255	241	2	11	119	168	
8.7	0	255	241	2	11	153	118	
8.8	0	255	241	2	11	188	5	
8.9	0	255	241	2	11	222	220	
9.0	0	255	241	2	12	0	105	3070
9.1	0	255	241	2	12	34	141	
9.2	0	255	241	2	12	101	161	
9.3	0	255	241	2	12	103	69	
9.4	0	255	241	2	12	137	139	
9.5	0	255	241	2	12	171	127	
9.6	0	255	241	2	12	206	49	
9.7	0	255	241	2	12	240	235	
9.8	0	255	241	2	13	18	188	
9.9	0	255	241	2	13	52	156	
10.0	0	255	241	2	13	87	116	3414
10.1	0	255	241	2	13	121	237	
10.2	0	255	241	2	13	155	78	
10.3	0	255	241	2	13	173	110	
10.4	0	255	241	2	13	224	92	
10.5	0	255	241	2	14	2	210	
10.6	0	255	241	2	14	36	242	
10.7	0	255	241	2	14	70	43	
10.8	0	255	241	2	14	105	131	
10.9	0	255	241	2	14	139	32	
11.0	0	255	241	2	14	173	0	3752
11.1	0	255	241	2	14	207	217	
11.2	0	255	241	2	14	242	80	
11.3	0	255	241	2	15	20	195	
11.4	0	255	241	2	15	54	39	
11.5	0	255	241	2	15	88	131	
11.6	0	255	241	2	15	123	86	
11.7	0	255	241	2	15	157	49	
11.8	0	255	241	2	15	191	213	
11.9	0	255	241	2	15	225	180	
12.0	0	255	241	2	16	4	119	3996

Arduino Code

```

/*
 * Encoder on A2, A3
 * Button on A1
 * MAX 485: 5v to DE, D8 to DI. A and B to A and B of the treadmill controller
 * TM1637 display clock on 2, data on 3
 * Short out the middle "safety key" pins
 * Take power from one of the treadmill controller pins (which one?)
 * Treadmill header has 8 pins (left to right, latch at the bottom):
 * 1 - 12v
 * 2 - 12v
 * 3 - A or B?
 * 4 - Safety switch
 * 5 - Safety switch
 * 6 - A or B?
 * 7 - Ground

```

```
#include <AltSoftSerial.h>  
//https://www.pjrc.com/teensy/td_libs_AltSoftSerial.html  
  
#include <SimpleTimer.h>  
//https://github.com/jfturcot/SimpleTimer  
  
#include <RotaryEncoder.h>  
//http://www.mathertel.de/Arduino/RotaryEncoderLibrary.aspx  
//https://github.com/mathertel/RotaryEncoder  
  
#include "OneButton.h"  
//https://github.com/mathertel/OneButton  
  
#include <TM1637Display.h>  
//https://github.com/avishorp/TM1637  
  
#include <EEPROMex.h>  
//https://github.com/thijse/Arduino-EEPROMEX  
  
const int encoderButton = A1;  
const int encoderA = A2;  
const int encoderB = A3;  
const int dispClock = 2; //D2  
const int dispData = 3; //D3  
  
AltSoftSerial ss;  
SimpleTimer timer;  
OneButton encoderButt(encoderButton, true);  
RotaryEncoder encoder(A2, A3);  
TM1637Display display1(dispClock, dispData);  
  
bool halt = true;  
int setSpeed = 0;  
int curSpeed = 0; //ramp this up until it reaches the set speed  
int savedSpeed = 0;  
const int speedCount = 123;  
  
const byte b1[] =  
{0,0,0,0,1,1,1,1,1,1,1,1,2,2,2,2,2,2,2,3,3,3,3,3,3,3,4,4,4,4,4,4,4,5,5,5,5,5,5,5,5,6,6,6,6,6,6,6,7,7,7,7,7,7,  
,  
7,8,8,8,8,8,9,9,9,9,9,9,9,9,10,10,10,10,10,10,10,11,11,11,11,11,11,11,12,12,12,12,12,12,12,12,13,13,13,13,  
,13,13,14,14,14,14,14,14,14,14,14,15,15,15,15,15,15,15,16,16,16,16,16,16,16};  
const byte b2[] =  
{0,161,195,230,8,42,76,111,145,179,213,248,26,60,94,129,163,197,231,10,44,78,112,147,181,215,249,28,62,96,130,16  
5,199,233,11,46,80,114,148,183,217,251,29,64,98,132,166,200,235,13,47,81,116,150,184,218,253,31,65,99,134,164,20  
2,236,15,49,83,117,152,186,220,254,33,67,101,135,170,204,238,16,51,85,119,153,188,222,0,34,101,103,137,171,206,2  
40,18,52,87,121,155,173,224,2,36,70,105,139,173,207,242,20,54,88,123,157,191,225,4,20,54,88,123,157,191,225};  
const byte b3[] =  
{221,16,201,186,144,116,105,188,33,197,216,18,156,188,101,79,171,182,82,43,11,210,8,154,186,99,250,96,132,229,70  
,  
87,142,23,64,51,212,48,87,130,38,194,136,186,94,57,221,121,172,63,219,60,79,236,117,172,189,135,230,2,54,175,118  
,  
86,112,234,51,19,158,122,103,131,132,93,125,222,20,9,237,132,81,76,168,118,5,220,105,141,161,69,139,127,49,235,1  
88,156,116,237,78,110,92,210,242,43,131,32,0,217,80,195,39,131,86,49,213,180,119,195,39,131,86,49,213,180};  
const int sfm[] =  
{0,262,314,366,418,471,523,575,628,680,732,785,837,889,941,994,1046,1098,1151,1203,1255,1308,1360,1412,1464,1517  
,  
1569,1621,1674,1726,1778,1831,1883,1935,1987,2040,2092,2144,2197,2249,2301,2355,2406,2458,2510,2563,2615,2667,27  
21,2772,2824,2878,2929,2981,3033,3087,3138,3190,3244,3295,3347,3401,3453,3504,3556,3610,3661,3713,3767,3818,3870  
,  
3924,3976,4027,4079,4133,4184,4236,4290,4342,4393,4447,4499,4550,4602,4656,4708,4759,4813,4865,4916,4970,5022,50  
74,5125,5179,5231,5282,5336,5388,5440,5493,5545,5597,5648,5702,5754,5805,5859,5911,5963,6016,6068,6120,6171,6225  
,6277,6329,6382,6434,6486,6539,6591,6643};
```

```

//eeprom memory locations
const int memAddress = 20;
const int memBase = 350;

void setup() {
  //interrupts for encoder
  PCICR |= (1 << PCIE1);    // This enables Pin Change Interrupt 1 that covers the Analog input pins or Port C.
  PCMSK1 |= (1 << PCINT10) | (1 << PCINT11); // This enables the interrupt for pin 2 and 3 of Port C.
  //Serial.begin(9600);
  ss.begin(9600);
  timer.setInterval(100, sendSpeedPacket);
  encoderButt.attachClick(startStop);

  // Set Up EEPROM
  EEPROM.setMemPool(memBase, EEPROMSizeNano);

  //Load the stored speed value
  setSpeed = EEPROM.readInt(memAddress);

  display1.setBrightness(2);
  updateDisplay();
}

void loop() {
  // put your main code here, to run repeatedly:
  timer.run();
  encoderButt.tick();
  readEncoder();
  updateDisplay();
}

void sendSpeedPacket() {
  if(halt == true) { //send the stop packet
    ss.write((byte)0);
    ss.write((byte)255);
    ss.write((byte)241);
    ss.write((byte)2);
    ss.write((byte)0);
    ss.write((byte)0);
    ss.write((byte)221);
  }
  else { //send the current speed packet
    ss.write((byte)0);
    ss.write((byte)255);
    ss.write((byte)241);
    ss.write((byte)2);
    ss.write((byte)b1[curSpeed]);
    ss.write((byte)b2[curSpeed]);
    ss.write((byte)b3[curSpeed]);
  }

  if (halt == true){
    curSpeed = 0;
  }

  if (curSpeed < setSpeed && halt == false) { //this ramps the sent speed up until it hits the set speed
    curSpeed++;
  }
  if (curSpeed > setSpeed && halt == false) { //this immediately reduces the sent speed to the set speed
    curSpeed = setSpeed;
  }

  //Serial.print(halt);
  //Serial.print(" ");
  //Serial.println(curSpeed);
}

void startStop () {

```

```

    halt = !halt;
    EEPROM.writeInt(memAddress, setSpeed); //save the speed every time the button is pushed... so that on next
    power up it is not zero
}

void readEncoder() {
    static int pos = 0;

    int newPos = encoder.getPosition();
    if (pos > newPos) {
        setSpeed = setSpeed - 1;
    }
    else if (pos < newPos) {
        setSpeed = setSpeed + 1;
    }
    pos = newPos; //--keep

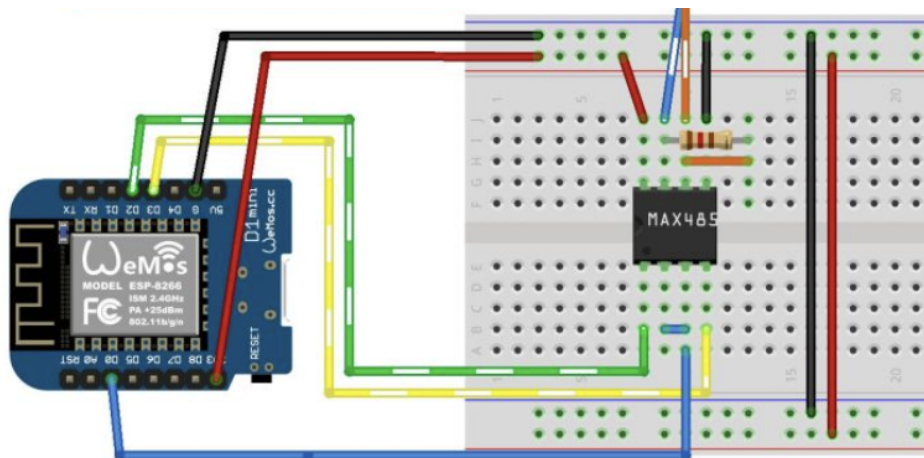
    setSpeed = constrain(setSpeed, 0, speedCount);
}

ISR(PCINT1_vect) {
    encoder.tick(); // just call tick() to check the state.
}

void updateDisplay() {
    display1.showNumberDecEx(sfm[setSpeed], 0, true); //Set time should always show on display 1
    // Serial.print("Minutes: ");
    // Serial.print(seconds / 60);
    // Serial.print("Seconds: ");
    // Serial.println(seconds & 60);
}

```

Example ESP8266 Code



<https://www.mischianti.org/2020/05/11/interface-arduino-esp8266-esp32-rs-485/>

Sample Code for ESP8266 Wemos:

```

#include "Arduino.h"
#include <SoftwareSerial.h>

```

[illegible]

```

    halt=true;
}

void processSerial(){
    processReceived();
    sendSpeedPacket();
}

void processReceived(){

    digitalWrite(SER_CONTROL_PIN, SER_RX_VALUE);// Init receive

    if (serialPort.available()){
        dataReceived = serialPort.readString();
        Serial.print("Data received ");
        Serial.println(dataReceived);
    }
}

void sendSpeedPacket() {

    if(halt == true) { //send the stop packet
        serialPort.write((byte)0);
        serialPort.write((byte)255);
        serialPort.write((byte)241);
        serialPort.write((byte)2);
        serialPort.write((byte)0);
        serialPort.write((byte)0);
        serialPort.write((byte)221);
    }
    else { //send the current speed packet
        serialPort.write((byte)0);
        serialPort.write((byte)255);
        serialPort.write((byte)241);
        serialPort.write((byte)2);
        serialPort.write((byte)b1[curSpeed]);
        serialPort.write((byte)b2[curSpeed]);
        serialPort.write((byte)b3[curSpeed]);
    }

    if (halt == true){
        curSpeed = 0;
    }

    if (curSpeed < setSpeed && halt == false) { //this ramps the sent speed up until it hits the set speed
        curSpeed++;
    }
    if (curSpeed > setSpeed && halt == false) { //this immediately reduces the sent speed to the set speed
        curSpeed = setSpeed;
    }

    Serial.print(halt);
    Serial.print(" ");
    Serial.println(curSpeed);
}

```

```
$ sort tmp.txt | uniq -c
411
 4 +1
 4 +2
 1 01 1a fe df 00 fd ce 1a ec fe 3a ac fe
 1 01 1a fe df 00 fd ce 1a ec fe 5e f4 fd
 1 01 1a fe df 00 fd ce 1a ec fe 76 2c fe
 2 01 1a fe df 00 fd ce 1a ec fe 7a b4 fc
 1 01 1a fe df 00 fd ce 1a ec fe e6 d4 fc
 2 01 1a fe df 00 fd f2 1a ec fe fe fa ff
 1 01 1a fe df 00 fd f6 1a ec fe fe b6 fe
 2 01 1a fe df 00 fd fa 1a ec fe fe a6 fe
 4 01 1a fe df 00 fd fe 1a ec fe fe ea ff
19 01 26 f6 ff af 1f 00 fd ce 26 fc 76 fe
 1 01 26 f6 ff af 1f 00 fd f6 26 fc aa ff
 1 01 26 f6 ff af 1f 00 fd fa 26 fc 82 fe
10 01 26 f6 ff af 1f 00 fd fe 26 fc 9a fe
18 01 3a f6 ff bd be 00 fd ce 3a fc ce ff
 5 01 3a f6 ff bd be 00 fd f6 3a fc 12 fe
10 01 3a f6 ff bd be 00 fd fe 3a fc 22 ff
 5 01 3a f6 ff ff 45 00 fd f2 3a fc 0a fe
 6 01 3a f6 ff ff 45 00 fd fa 3a fc 3a ff
 1 01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
 1 01 0d fe df 00 fd ce 1a ec fe
 1 01 13 f6 ff af 1f 00 fd ce 26 fc 76 fe
 1 01 1a fe df 00 fd ce 1a ec fe 72
35 01 1a fe df 00 fd fe 1a ec fe fe ea ff
15 01 1a fe df 00 fd fe 1a ec fe fe ea ff
 4 01 26 f6 ff af 1f 00 fd ce 26 fc 76 fe
 5 01 3a f6 ff bd be 00 fd ce 3a fc ce ff
199 01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
41 01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
 1 01 3a f6 ff ff 45 f4 fe 3a fc 22 ff
 1 01 3e ff 1f 00 fd fe 3e fe 7e fe
 1 01 be f6 ff 0b c2 00 fd fe be fc a6 fe
```

Byte Stream

Bytes

```
01 3a f6 ff bd be 00 fd ce 3a fc ce ff
01 be f6 ff 0b c2 00 fd fe be fc a6 fe
01 26 f6 ff af 1f 00 fd ce 26 fc 76 fe
```

```
01 3a f6 ff bd be 00 fd ce 3a fc ce ff
```

```
01 13 f6 ff af 1f 00 fd ce 26 fc 76 fe
```

```
01 0d fe df 00 fd ce 1a ec fe
```

```
01 3e ff 1f 00 fd fe 3e fe 7e fe
```

```
01 be f6 ff 0b c2 00 fd fe be fc a6 fe
```

```
+1
```

```
01 1a fe df 00 fd fe 1a ec fe fe ea ff
```

```
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
```

```
+1
```

```
01 1a fe df 00 fd fe 1a ec fe fe ea ff
```

```
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
```

+1

```
01 1a fe df 00 fd fe 1a ec fe fe ea ff
```

```
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
```

+2

```
01 1a fe df 00 fd fe 1a ec fe fe ea ff
```

```
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
```

+2

```
01 1a fe df 00 fd fe 1a ec fe fe ea ff
```

```
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
```

+2

```
01 1a fe df 00 fd fe 1a ec fe fe ea ff
```

```
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
```

+2

```
01 1a fe df 00 fd fe 1a ec fe fe ea ff
```

```
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
```

+1

```
01 1a fe df 00 fd fe 1a ec fe fe ea ff
```

```
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
```

```
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
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01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
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01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
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01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
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```
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
```

```
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
```

[illegible]

[illegible]

[illegible]

01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 1a fe df 00 fd fe 1a ec fe fe ea ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 1a fe df 00 fd fe 1a ec fe fe ea ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
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01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 1a fe df 00 fd fe 1a ec fe fe ea ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
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01 1a fe df 00 fd fe 1a ec fe fe ea ff
01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
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01 3a f6 ff ff 45 f4 fe 3a fc 22 ff

01 3a f6 ff ff 45 00 fd fe 3a fc 22 ff
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01 3a f6 ff ff 45 00 fd fa 3a fc 3a ff
01 26 f6 ff af 1f 00 fd fa 26 fc 82 fe
01 3a f6 ff ff 45 00 fd fa 3a fc 3a ff
01 1a fe df 00 fd fa 1a ec fe fe a6 fe
01 3a f6 ff ff 45 00 fd fa 3a fc 3a ff
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