

## Using the MCP2120 Developer's Board for "IR Sniffing"

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### INTRODUCTION

When developing applications using a network protocol standard, it is helpful to "see" the data being transmitted between the devices. When the network protocol standard uses a physical medium, a logic analyzer can be used to view the data transmitted over the cable. A different method must be used during the development of an infrared application, however, since the medium being used for the transfer of information is light (IR), and not a physical medium that can be connected to a cable.

This application note will discuss the implementation of an "IR Sniffer" using the MCP2120 Developer's Board connected to a PC running a program called "Listen32".

This application note will:

- Discuss the requirements for capturing the IR data
- Provide an introduction on how to read the captured data
- Discuss some of the system's limitations

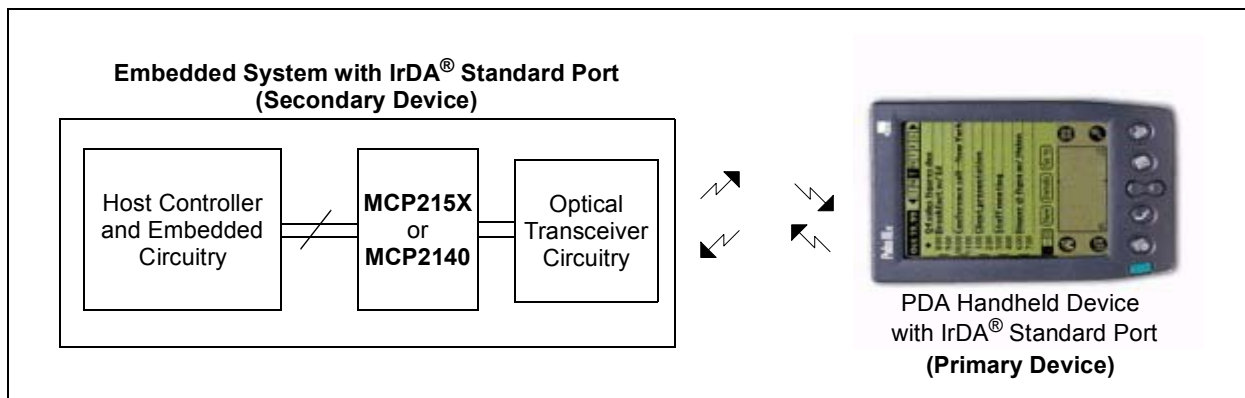
This implementation provides a low-cost method for "seeing" the IR data communication between a Primary Device and a Secondary Device. While there are third-party tools that can accomplish this, these tools tend to be quite expensive.

Figure 1 shows an IrDA® standard system where a Palm™ PDA device is communicating with an embedded system. In this example, the Palm PDA operates as the Primary Device and the embedded system operates as the Secondary Device.

For the purposes of this Application Note, it is assumed that the reader has an understanding of the IrDA Standard Protocol (and its terminology) and the connection sequence between a Primary Device and a Secondary Device. An overview of this sequence can be found in [Appendix A: "Overview of the IrDA® Standard Connection Sequence"](#), the MCP21XX device data sheets and the IrDA.org documentation (located at [www.irda.org](http://www.irda.org)).

The MCP2120 Developer's Board is contained in the MCP2120/MCP2150 Developer's Kit, Part Number DM163008.

**FIGURE 1: PALM™ PDA - EMBEDDED SYSTEM BLOCK DIAGRAM**



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## THE HARDWARE SETUP

To capture the data transmitted from the Primary Device and the Secondary Device, the MCP2120 Developer's Board must be able to "see" the IR data from both devices. Since IR is directional, something must be done to ensure that the light from both devices can be detected by the MCP2120 Developer's Board receiver. This is accomplished by using a little trick. Most IrDA standard devices will not receive when they are transmitting because they don't want to pick up the data they just transmitted. Therefore, if a mirror or bright white paper is placed opposite the device, it would not see the reflected data (see Figure 2).

**Note:** If the captured data does not follow the expectation for frame sequence, then you may need to:

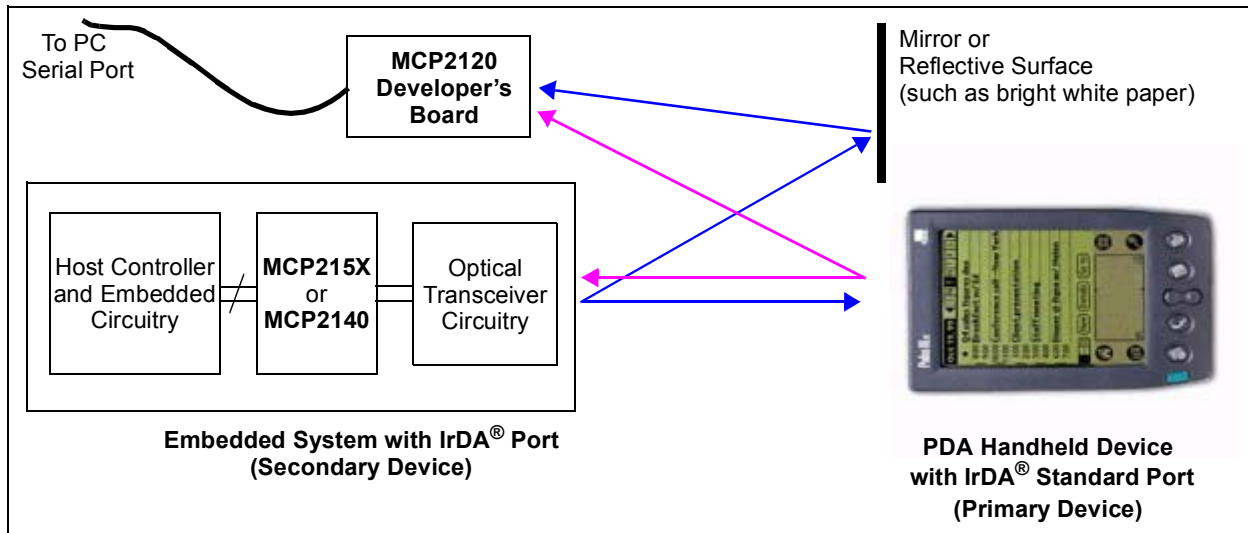
1. Adjust your reflective surface
2. Use a better reflective surface.

The success of this method is also dependent on the strength of the transmitters and the sensitivity of the receiver circuit.

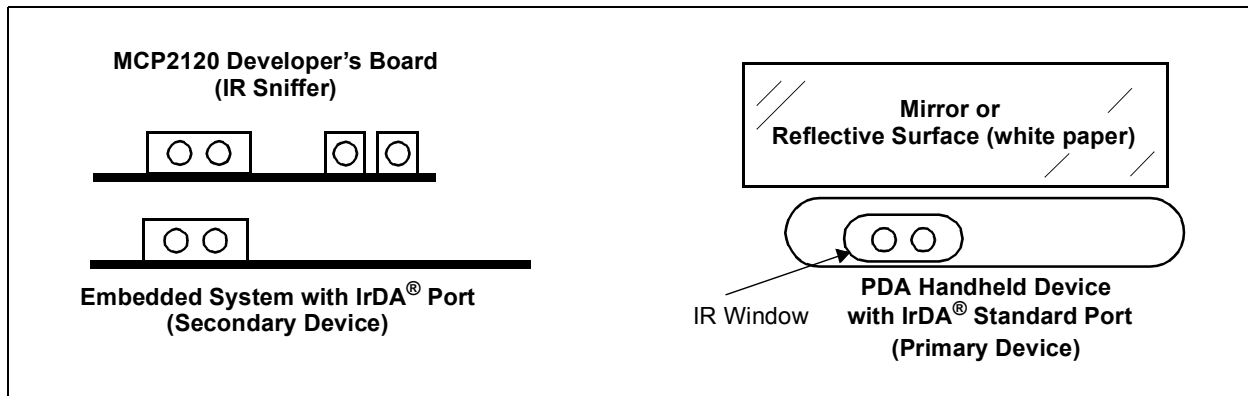
The MCP2120 Developer's Board is actually stacked on top of the embedded system (Secondary Device), with the optical transceivers close to each other, while the mirror/white paper is just above the PDA IR window (see Figure 3).

Figure A-1 shows an overview of the IrDA standard connection sequence and some common IrDA standard terminology.

**FIGURE 2: IR SNIFFER SETUP USING THE MCP2120 DEVELOPER'S BOARD**



**FIGURE 3: FRONT VIEWS OF IR SNIFFER SETUP**



## MCP2120 Developer's Board Setup

The MCP2120 is an encoder/decoder device. That is, it converts between the UART (at a specified baud rate) and IrDA standard data formats. For this application (IR sniffer), we are only using the decoding capabilities (i.e., converting from the IrDA standard data format to the UART data format).

When “sniffing” IrDA standard IR data, the protocol used determines how the IR baud rate will behave. For the IrCOMM protocol, the capabilities of the Primary Device and the Secondary Device will determine the negotiated IR baud rate. All communication starts at 9600 Baud. Most Primary Devices support communication up to 115.2 Kbaud. The MCP215X devices support communication up to 115.2 Kbaud, while the MCP2140 is fixed at 9600 Baud.

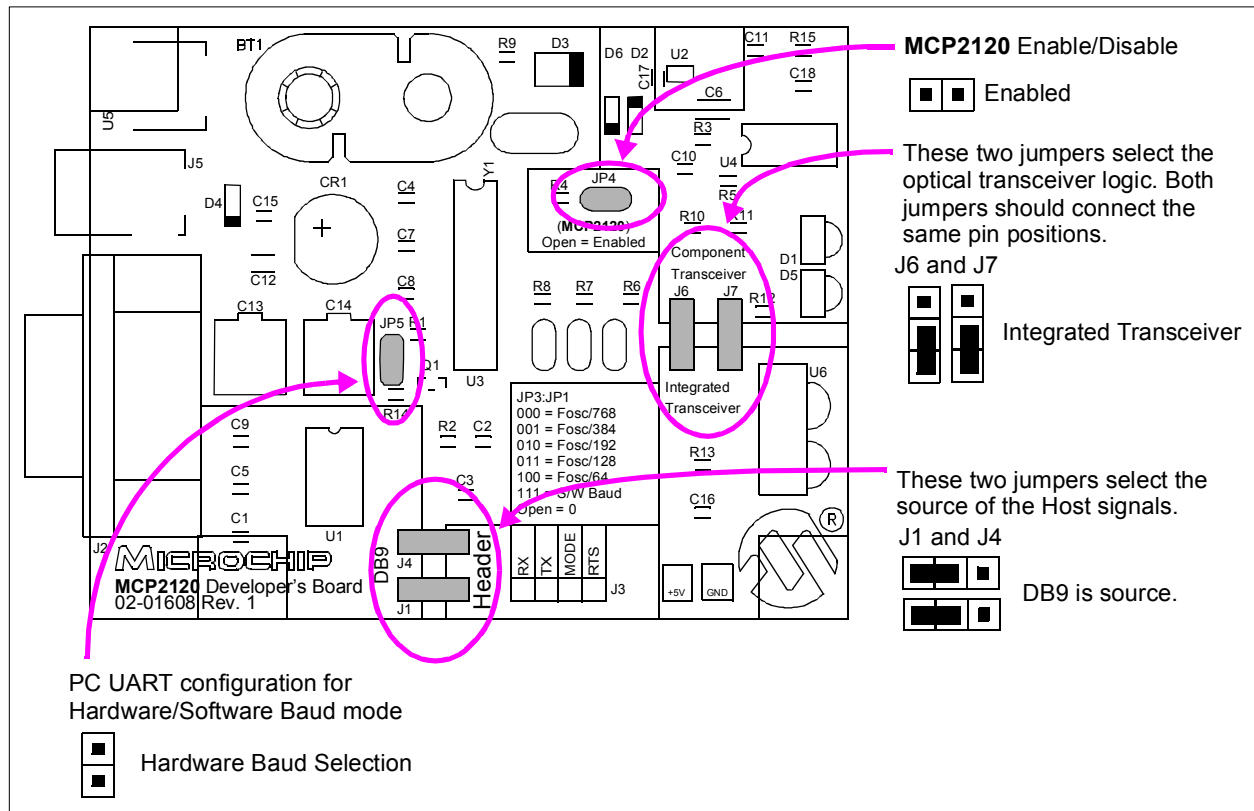
What does this mean? Well, for the MCP2140, the MCP2120 Developer's Board can be configured for 9600 baud, and the entire IR communication would be captured. **Appendix B: “MCP2140 IR Communication Capture”** shows the capture of IR communication between the MCP2140 and a Palm PDA.

However, with the MCP215X devices, the baud rate can be negotiated to one of the available selections between 9600 Baud and 115.2 Kbaud. In most cases, the Primary Device will support 115.2 Kbaud.

If the MCP2120 Developer's Board was configured for 9600 Baud, only the first part of the IR communication would be captured until the Primary Device and Secondary Device switched baud rates. Likewise, if the MCP2120 Developer's Board was configured for 115.2 Kbaud, then only the second part of the IR communication would be captured (i.e., from the point that the Primary Device and Secondary Device switched from 9600 Baud to the new baud rate - 115.2 Kbaud). **Appendix C: “MCP215x IR Communication Capture”** shows two captures of IR communication between the MCP2150 and a PDA. The first at 9600 baud and the second at 115.2 Kbaud.

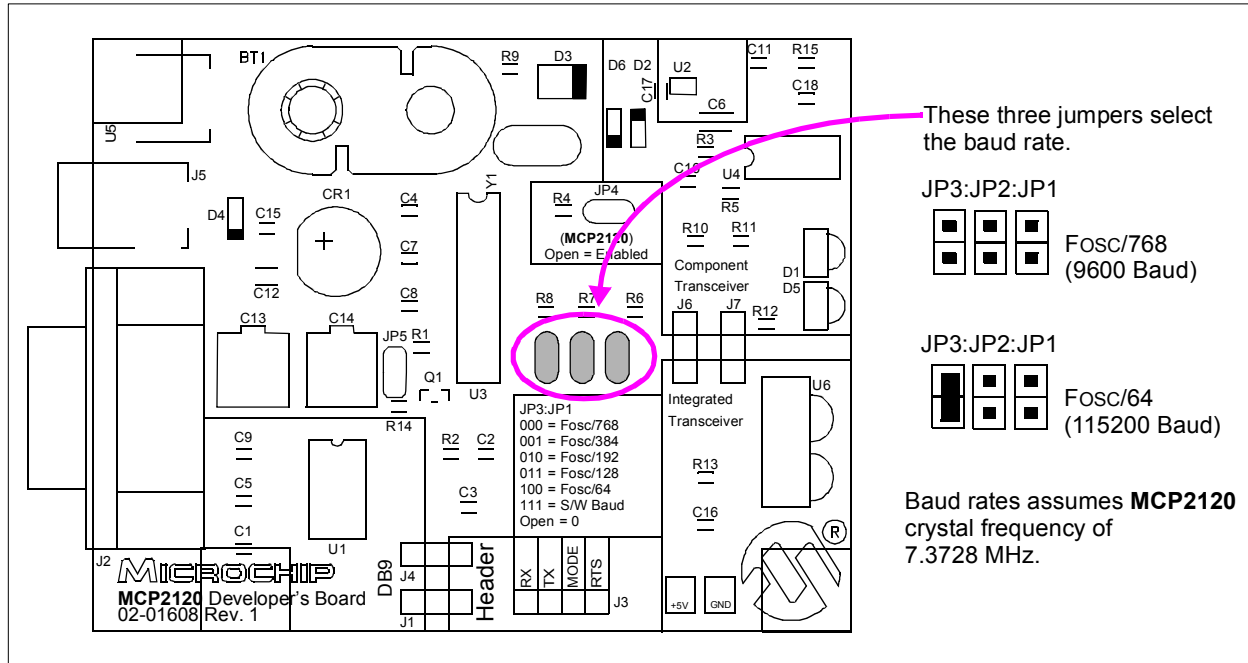
Figure 4 shows the jumper configuration for the general setup of the MCP2120 Developer's Board, while Figure 5 shows how to configure the jumpers for the two main baud rates (9600 baud and 115200 baud). The baud rate is dependent on the MCP2120's operational frequency. These baud rate jumper settings are based on the MCP2120 having a crystal frequency of 7.3728 MHz. For additional information on the operation of the MCP2120 Developer's Board, please refer to the MCP2120/MCP2150 Developer's Board User Guide (DS51246).

**FIGURE 4: MCP2120 DEVELOPER'S BOARD JUMPER SETUP**



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**FIGURE 5: SELECTING THE BAUD RATE FOR THE MCP2120 DEVELOPER'S BOARD**



## THE SOFTWARE

To capture the data on the PC from the MCP2120 Developer's Board, a third-party program called "Listen32" was used. Listen32 was chosen due to its capability to display the data that is received in several formats, including hexadecimal. This is required because numerous hex values are not displayable when using many terminal programs since they only display the ASCII character (many hex values are non-printing characters).

Listen32 was developed by Win-Tech Software Design. Their web site is:

<http://www.win-tech.com>

To use the program, you will need to select the **Setup** → **Hardware** menu. Here you will select the characteristics of the UART port that the MCP2120 Developer's Board is connected to. For both the MCP2140 and MCP215X devices, the port should be configured for "No parity", 8 data bits and 1 Stop bit. The baud rate MUST match the baud rate of the MCP2120 Developer's Board and should match the IR baud rate that you wish to monitor. Table 1 shows how the baud rates will work with the MCP21XX devices. Then select OK.

**TABLE 1: LISTEN32 BAUD RATE SELECTION <sup>(2)</sup>**

Baud Rate	MCP2140	MCP215x
9600	Entire IR Communication (NDM, Discovery and NRM)	NDM and Discovery up to when baud rate changes <sup>(1)</sup>
115200	N.A.	Discovery after baud rate changes and NRM

**Note 1:** Entire IR Communication (NDM, Discovery and NRM) if Primary Device specifies 9600 baud rate in Discovery mode.

**2:** To better understand what the terms "NDM", "Discovery" and "NRM" represent, please refer to [Appendix A: "Overview of the IrDA® Standard Connection Sequence"](#).

Ensure that the program displays the information in the correct numerical base (Num Base). Navigate to the **Setup** → **Preferences** → **Num Base** menu and select **Hex**. Then select **OK**. This will ensure that you see the hex value of the data that is received.

Before you start the capture, you should clear the Listen32 receive buffer. This is done by selecting **Clear Buffer** from the **Edit** pull-down menu (**Edit** → **Clear Buffer**).

Now you are ready to use Listen32 for capturing data. You can do this by either clicking on the "green light" icon (in the tool bar), or by selecting **File** → **New/Collect**. Once this is done, Listen32 will prompt you to specify the serial port, for which you will select the port that is connected to the MCP2120 Developer's Board.

Once the IR communication is complete, clicking on the "red light" icon (in the tool bar) ends the data-capture process. You can then save the file by selecting **Save As** from the **File** pull-down menu (**File** → **Save As**). It is suggested that you select the .TXT format (not the .LSN) so that you can format the captured information in your favorite text editor.

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## LIMITATIONS

Some of the limitations of this technique are discussed below, and depend on the MCP21XX protocol handling device used.

### For a System using an MCP2140 Device

This technique will capture the entire IR communication since the IR data remains at 9600 Baud for all states (NDM, Discovery and NRM).

You will need to parse the saved text file from the Listen32 program.

### For a System using an MCP215X Device

If the Primary Device (such as a PC or PDA) will negotiate a communication baud rate greater than 9600 Baud, then either:

1. the MCP2120 Developer's Board can be configured to capture the first portion of the IR communication, when IR data is transmitted at 9600 Baud. This occurs during the NDM and Discovery states, up to where the IR Baud rate is changed, or
2. the MCP2120 Developer's Board can be configured to capture the second portion of the IR communication, when IR data is transmitted at faster than 9600 Baud (such as 115.2 Kbaud). This occurs during the Discovery state once the IR baud rate is changed, and the NRM state.

In these cases, you are not able to see the entire IR communication in a single capture.

If the Primary Device's baud rate will remain at 9600 Baud, the entire IR communication can be captured.

You will also need to parse the saved text file from the Listen32 program.

## IR CAPTURE EXAMPLES

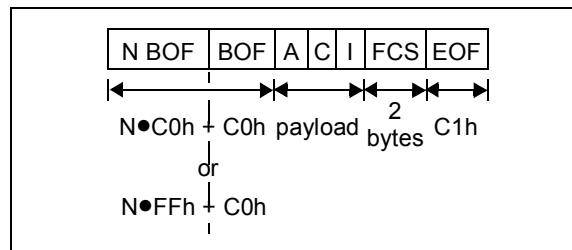
An embedded system that transmits a 250 byte table to a PDA was implemented. The embedded system's host controller will send the data to the MCP21XX device, which will then format the data for the IrCOMM frame and transmit to the PDA. Each appendix will show the data as it was saved by the Listen32 program (in .TXT format), and then that data formatted into the IR frames.

**Appendix B: "MCP2140 IR Communication Capture"** shows the capture of IR communication between the MCP2140 and a PDA.

**Appendix C: "MCP215x IR Communication Capture"** shows two captures of IR communication between the MCP2150 and a PDA. The first at 9600 Baud and the second at 115.2 Kbaud.

The beginning of a frame (BOF) will start with a C0h character, but may have preceding FFh characters. (See [Figure B-1](#), Frame 1). The end of the frame is signified with a C1h character. [Figure 6](#) shows the structure of the IrLAP frame.

**FIGURE 6: IRLAP FRAME**



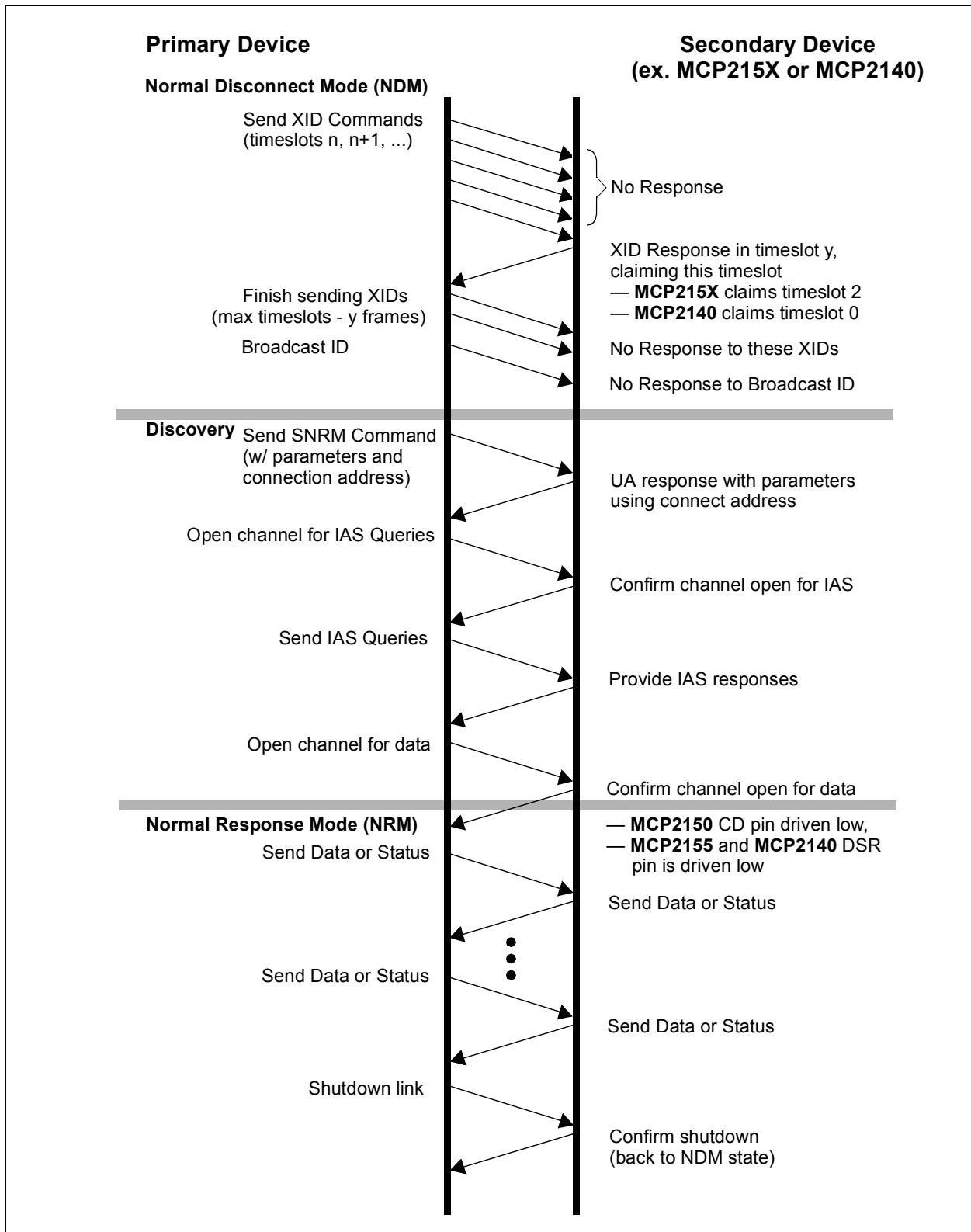
The address byte (A field) is odd for the Primary Device, as well as the Secondary Device (See [Figure B-1](#), Frames 1 and 2). The control byte (C field) differentiates between different types of frames. The information field (I field) carries the data. If the first 4 characters of the I field are xxh:04h:00h:00h, the following information in the I field is data payload. That is, this is the data that the host controller is sending to the Primary Device (See [Figure B-1](#), Frame 30).

## SUMMARY

It is sometimes useful in the debugging process of an IrDA standard system to monitor the IR communications. The MCP2120 Developer's Board allows the implementation of a low-cost IR sniffer, which will assist in the system development of your application from both the Primary Device application program to the embedded system (Secondary Device) hardware and firmware.

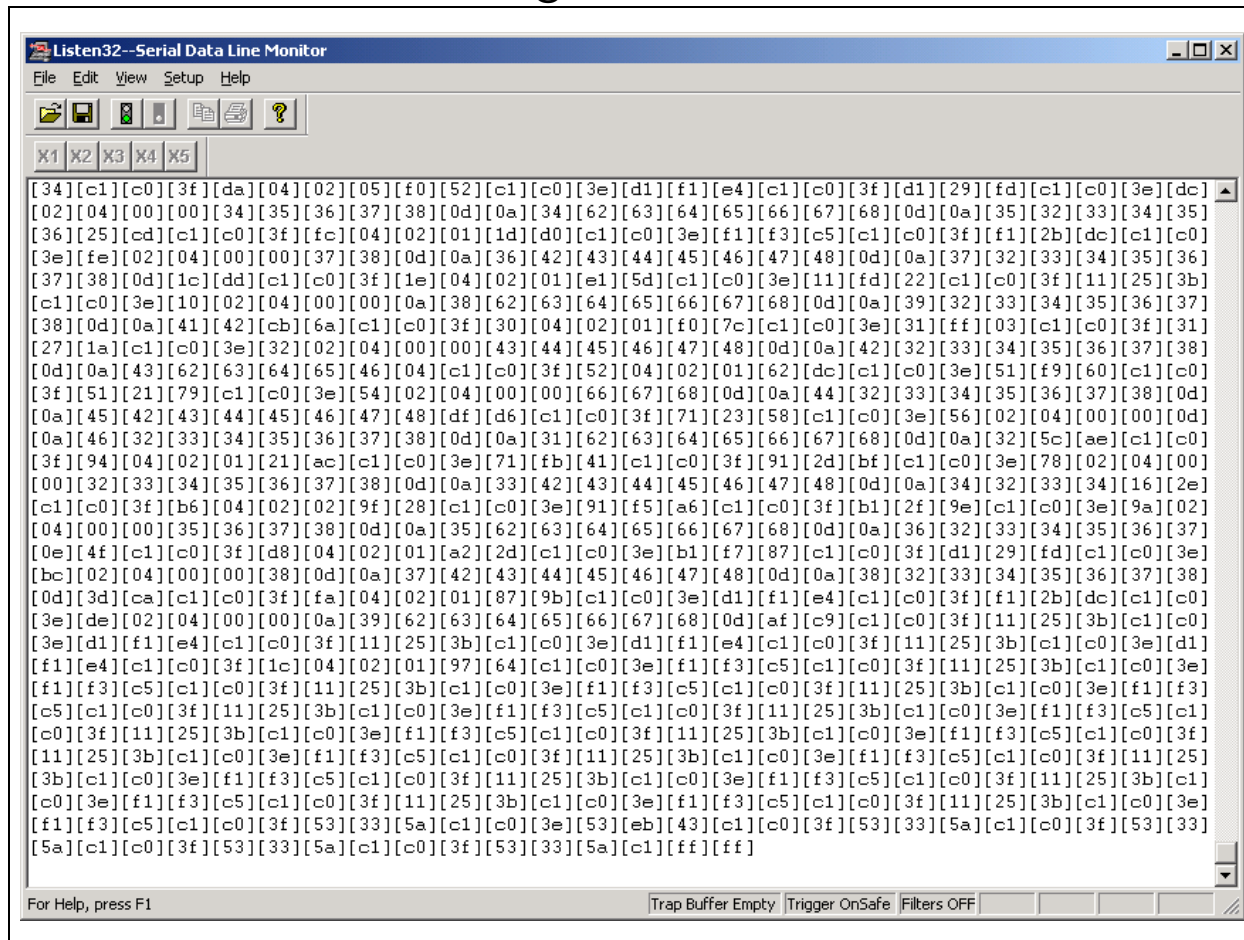
## APPENDIX A: OVERVIEW OF THE IRDA® STANDARD CONNECTION SEQUENCE

FIGURE A-1: CONNECTION SEQUENCE



## APPENDIX B: MCP2140 IR COMMUNICATION CAPTURE

FIGURE B-1: MCP2140 RAW CAPTURE @ 9600 BAUD





**FIGURE B-1: MCP2140 FORMATTED CAPTURE @ 9600 BAUD - PAGE 1**

Frame #	Frame Sent By	Frame Data
1	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][3f][01][68][ac][38][48] [ff][ff][ff][ff][01][00][00][7b][bd][c1]
2	S	[c0][fe][bf][01][b5][b5][b5][b5][68][ac][38][48][01][00][00][90][04][00] [4d][43][50][32][31][34][30][20][41][35][f0][6f][c1]
3	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][3f][01][68][ac][38][48] [ff][ff][ff][ff][01][01][00][a3][a4][c1]
4	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][3f][01][68][ac][38][48] [ff][ff][ff][ff][01][02][00][cb][8e][c1]
5	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][3f][01][68][ac][38][48] [ff][ff][ff][ff][01][03][00][13][97][c1]
6	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][3f][01][68][ac][38][48] [ff][ff][ff][ff][01][04][00][1b][da][c1]
7	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][3f][01][68][ac][38][48] [ff][ff][ff][ff][01][05][00][c3][c3][c1]
8	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][3f][01][68][ac][38][48] [ff][ff][ff][ff][01][ff][00][82][04][00][49][72][43][4f][4d][d0][c7][c1]
9	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][93][68][ac][38][48][b5] [b5][b5][b5][3e][01][01][3f][82][01][01][83][01][0f][84][01][01][85] [01][08][86][01][07][08][01][ff][83][7d][e0][c1]
10	S	[c0][3e][73][b5][b5][b5][b5][68][ac][38][48][01][01][02][82][01][01][83] [01][01][84][01][01][85][01][80][86][01][07][08][01][ff][b9][15][c1]
11	P	[ff][c0][3f][11][25][3b][c1]
12	S	[c0][3e][11][fd][22][c1]
13	P	[c0][3f][10][80][01][01][00][fc][d7][c1]
14	S	[c0][3e][31][ff][03][c1]
15	P	[c0][3f][11][25][3b][c1]
16	S	[c0][3e][30][81][00][81][00][ed][79][c1]
17	P	[c0][3f][32][00][01][84][0b][49][72][44][41][3a][49][72][43][4f][4d][4d] [13][49][72][44][41][3a][54][69][6e][79][54][50][3a][4c][73][61][70] [53][65][6c][64][f6][c1]
18	S	[c0][3e][52][01][00][84][00][00][01][00][04][01][00][00][00][04][d3][47][c1]
19	P	[c0][3f][54][84][02][01][00][01][03][00][01][04][1f][ad][c1]
20	S	[c0][3e][74][82][04][81][00][05][1a][e6][c1]
21	P	[c0][3f][71][23][58][c1]
22	S	[c0][3e][71][fb][41][c1]
23	P	[c0][3f][76][04][02][00][17][10][04][00][00][c2][00][11][01][03][12][01] [00][13][02][11][13][14][02][13][11][20][01][0c][af][a8][c1]
24	S	[c0][3e][96][02][04][01][1a][1c][c1]
25	P	[c0][3f][91][2d][bf][c1]
26	S	[c0][3e][91][f5][a6][c1]
27	P	[c0][3f][98][04][02][00][00][35][cc][57][c1]
28	S	[c0][3e][b8][02][04][01][0b][3d][c1]
29	P	[c0][3f][b1][2f][9e][c1]
30	S	[c0][3e][ba][02][04][00][00] ----- [31][32][33][34][35][36][37][38][0d][0a] [32][42][43][44][45][46][47][48][0d][0a]                      Data Payload [33][32][33] ----- [15][34][c1]

**Legend:** P = Primary Device                      S = Secondary Device

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**FIGURE B-2: MCP2140 FORMATTED CAPTURE @ 9600 BAUD - PAGE 2**

Frame #	Frame Sent By	Frame Data
31	P	[c0][3f][da][04][02][05][f0][52][c1]
32	S	[c0][3e][d1][f1][e4][c1]
33	P	[c0][3f][d1][29][fd][c1]
34	S	[c0][3e][dc][02][04][00][00]
		-----
		[34][35][36][37][38][0d][0a]
		[34][62][63][64][65][66][67][68][0d][0a] <b>Data Payload</b>
		[35][32][33][34][35][36]
		-----
		[25][cd][c1]
35	P	[c0][3f][fc][04][02][01][1d][d0][c1]
36	S	[c0][3e][f1][f3][c5][c1]
37	P	[c0][3f][f1][2b][dc][c1]
38	S	[c0][3e][fe][02][04][00][00]
		-----
		[37][38][0d][0a]
		[36][42][43][44][45][46][47][48][0d][0a] <b>Data Payload</b>
		[37][32][33][34][35][36][37][38][0d]
		-----
		[1c][dd][c1]
39	P	[c0][3f][1e][04][02][01][e1][5d][c1]
40	S	[c0][3e][11][fd][22][c1]
41	P	[c0][3f][11][25][3b][c1]
42	S	[c0][3e][10][02][04][00][00]
		-----
		[0a]
		[38][62][63][64][65][66][67][68][0d][0a] <b>Data Payload</b>
		[39][32][33][34][35][36][37][38][0d][0a]
		[41][42]
		-----
		[cb][6a][c1]
43	P	[c0][3f][30][04][02][01][f0][7c][c1]
44	S	[c0][3e][31][ff][03][c1]
45	P	[c0][3f][31][27][1a][c1]
46	S	[c0][3e][32][02][04][00][00]
		-----
		[43][44][45][46][47][48][0d][0a]
		[42][32][33][34][35][36][37][38][0d][0a] <b>Data Payload</b>
		[43][62][63][64][65]
		-----
		[46][04][c1]
47	P	[c0][3f][52][04][02][01][62][dc][c1]
48	S	[c0][3e][51][f9][60][c1]
49	P	[c0][3f][51][21][79][c1]
50	S	[c0][3e][54][02][04][00][00]
		-----
		[66][67][68][0d][0a]
		[44][32][33][34][35][36][37][38][0d][0a] <b>Data Payload</b>
		[45][42][43][44][45][46][47][48]
		-----
		[df][d6][c1]

**Legend:** P = Primary Device      S = Secondary Device

**FIGURE B-3: MCP2140 FORMATTED CAPTURE @ 9600 BAUD - PAGE 3**

Frame #	Frame Sent By	Frame Data
51 52	P S	[c0][3f][71][23][58][c1] [c0][3e][56][02][04][00][00] ----- [0d][0a] [46][32][33][34][35][36][37][38][0d][0a]      Data Payload [31][62][63][64][65][66][67][68][0d][0a] [32] ----- [5c][ae][c1]
53 54 55 56	P S P S	[c0][3f][94][04][02][01][21][ac][c1] [c0][3e][71][fb][41][c1] [c0][3f][91][2d][bf][c1] [c0][3e][78][02][04][00][00] ----- [32][33][34][35][36][37][38][0d][0a] [33][42][43][44][45][46][47][48][0d][0a]      Data Payload [34][32][33][34] ----- [16][2e][c1]
57 58 59 60	P S P S	[c0][3f][b6][04][02][02][9f][28][c1] [c0][3e][91][f5][a6][c1] [c0][3f][b1][2f][9e][c1] [c0][3e][9a][02][04][00][00] ----- [35][36][37][38][0d][0a] [35][62][63][64][65][66][67][68][0d][0a]      Data Payload [36][32][33][34][35][36][37] ----- [0e][4f][c1]
61 62 63 64	P S P S	[c0][3f][d8][04][02][01][a2][2d][c1] [c0][3e][b1][f7][87][c1] [c0][3f][d1][29][fd][c1] [c0][3e][bc][02][04][00][00] ----- [38][0d][0a] [37][42][43][44][45][46][47][48][0d][0a]      Data Payload [38][32][33][34][35][36][37][38][0d] ----- [3d][ca][c1]
65 66 67 68	P S P S	[c0][3f][fa][04][02][01][87][9b][c1] [c0][3e][d1][f1][e4][c1] [c0][3f][f1][2b][dc][c1] [c0][3e][de][02][04][00][00] ----- [0a] [39][62][63][64][65][66][67][68][0d]      Data Payload ----- [af][c9][c1]

**Legend:** P = Primary Device      S = Secondary Device

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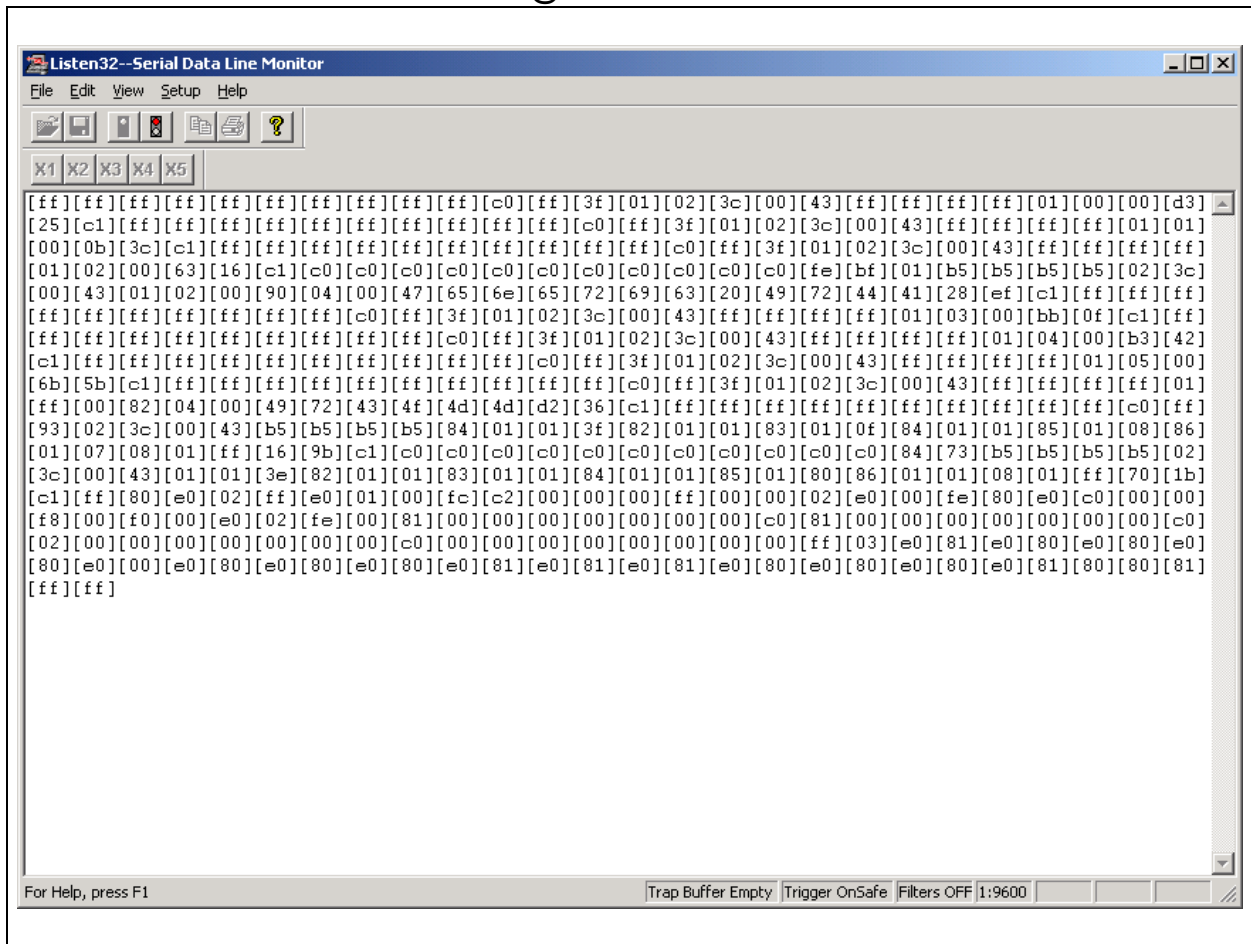
**FIGURE B-4: MCP2140 FORMATTED CAPTURE @ 9600 BAUD - PAGE 4**

Frame #	Frame Sent By	Frame Data
69	P	[c0][3f][11][25][3b][c1]
70	S	[c0][3e][d1][f1][e4][c1]
71	P	[c0][3f][11][25][3b][c1]
72	S	[c0][3e][d1][f1][e4][c1]
73	P	[c0][3f][11][25][3b][c1]
74	S	[c0][3e][d1][f1][e4][c1]
75	P	[c0][3f][1c][04][02][01][97][64][c1]
76	S	[c0][3e][f1][f3][c5][c1]
77	P	[c0][3f][11][25][3b][c1]
78	S	[c0][3e][f1][f3][c5][c1]
79	P	[c0][3f][11][25][3b][c1]
80	S	[c0][3e][f1][f3][c5][c1]
81	P	[c0][3f][11][25][3b][c1]
82	S	[c0][3e][f1][f3][c5][c1]
83	P	[c0][3f][11][25][3b][c1]
84	S	[c0][3e][f1][f3][c5][c1]
85	P	[c0][3f][11][25][3b][c1]
86	S	[c0][3e][f1][f3][c5][c1]
87	P	[c0][3f][11][25][3b][c1]
88	S	[c0][3e][f1][f3][c5][c1]
89	P	[c0][3f][11][25][3b][c1]
90	S	[c0][3e][f1][f3][c5][c1]
91	P	[c0][3f][11][25][3b][c1]
92	S	[c0][3e][f1][f3][c5][c1]
93	P	[c0][3f][11][25][3b][c1]
94	S	[c0][3e][f1][f3][c5][c1]
95	P	[c0][3f][11][25][3b][c1]
96	S	[c0][3e][f1][f3][c5][c1]
97	P	[c0][3f][11][25][3b][c1]
98	S	[c0][3e][f1][f3][c5][c1]
99	P	[c0][3f][11][25][3b][c1]
100	S	[c0][3e][f1][f3][c5][c1]
101	P	[c0][3f][11][25][3b][c1]
102	S	[c0][3e][f1][f3][c5][c1]
103	P	[c0][3f][11][25][3b][c1]
104	S	[c0][3e][f1][f3][c5][c1]
105	P	[c0][3f][53][33][5a][c1]
106	S	[c0][3e][53][eb][43][c1]
107	P	[c0][3f][53][33][5a][c1]
108	P	[c0][3f][53][33][5a][c1]
109	P	[c0][3f][53][33][5a][c1]
110	P	[c0][3f][53][33][5a][c1][ff][ff]

**Legend:** P = Primary Device                      S = Secondary Device

## APPENDIX C: MCP215X IR COMMUNICATION CAPTURE

FIGURE C-1: MCP2150 RAW CAPTURE @ 9600 BAUD



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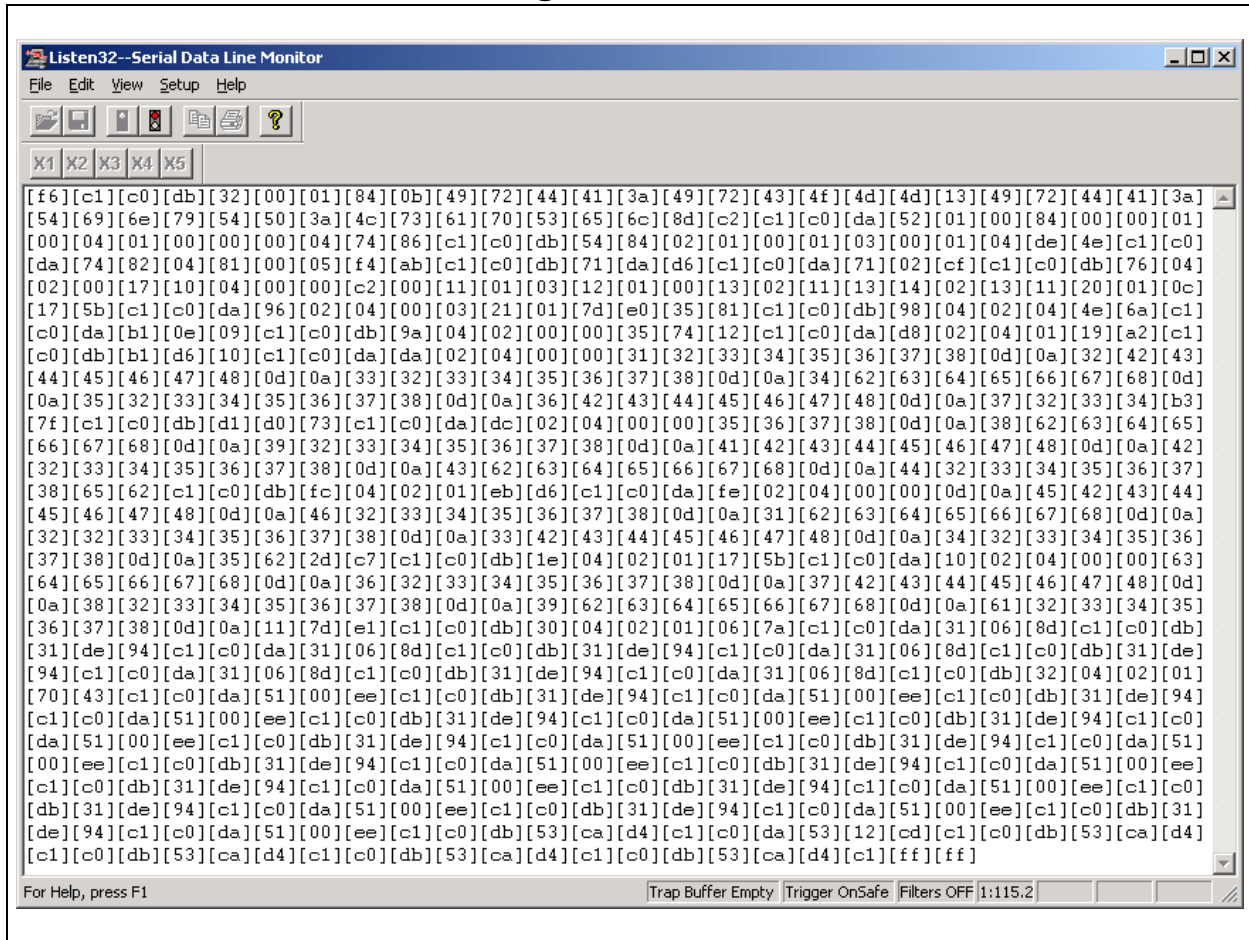
**FIGURE C-1: MCP2150 FORMATTED CAPTURE @ 9600 BAUD - PAGE 1**

Frame #	Frame Sent By	Frame Data
1	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][3f][01][02][3c][00][43] [ff][ff][ff][ff][01][00][00][d3][25][c1]
2	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][3f][01][02][3c][00][43] [ff][ff][ff][ff][01][01][00][0b][3c][c1]
3	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][3f][01][02][3c][00][43] [ff][ff][ff][ff][01][02][00][63][16][c1]
4	S	[c0][c0][c0][c0][c0][c0][c0][c0][c0][c0][fe][bf][01][b5][b5][b5][b5] [02][3c][00][43][01][02][00][90][04][00][47][65][6e][65][72][69][63] [20][49][72][44][41][28][ef][c1]
5	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][3f][01][02][3c][00][43] [ff][ff][ff][ff][01][03][00][bb][0f][c1]
6	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][3f][01][02][3c][00][43] [ff][ff][ff][ff][01][04][00][b3][42][c1]
7	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][3f][01][02][3c][00][43] [ff][ff][ff][ff][01][05][00][6b][5b][c1]
8	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][3f][01][02][3c][00][43] [ff][ff][ff][ff][01][ff][00][82][04][00][49][72][43][4f][4d][4d][d2] [36][c1]
9	P	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][c0][ff][93][02][3c][00][43][b5] [b5][b5][b5][84][01][01][3f][82][01][01][83][01][0f][84][01][01][85] [01][08][86][01][07][08][01][ff][16][9b][c1]
10	S	[c0][c0][c0][c0][c0][c0][c0][c0][c0][c0][84][73][b5][b5][b5][b5][02] [3c][00][43][01][01][3e][82][01][01][83][01][01][84][01][01][85][01] [80][86][01][01][08][01][ff][70][1b][c1]
11	<b>Note 1</b>	[ff][80][e0][02][ff][e0][01][00][fc][c2][00][00][00][ff][00][00][02][e0] [00][fe][80][e0][c0][00][00][f8][00][f0][00][e0][02][fe][00][81][00] [00][00][00][00][00][00][c0][81][00][00][00][00][00][00][00][00][00] [00][00][00][00][00][00][00][c0][00][00][00][00][00][00][00][ff] [03][e0][81][e0][80][e0][80][e0][80][e0][00][e0][80][e0][80][e0][80] [e0][81][e0][81][e0][81][e0][80][e0][80][e0][80][e0][81][80][80][81] [ff][ff]

**Legend:** P = Primary Device                      S = Secondary Device

**Note 1:** The information captured here is “garbage data”. That is, the data that was communicated between the Primary Device and Secondary Device at 115200 baud, but captured by the MCP2120 Developer’s Board at 9600 baud.

FIGURE C-2: MCP2150 RAW CAPTURE @ 115200 BAUD



## FIGURE C-3: MCP2150 FORMATTED CAPTURE @ 115200 BAUD - PAGE 1

Frame #	Frame Sent By	Frame Data
	Note 1	[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][ff] .....[ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][ff][ff]
	P S P S P S P S	[c0][db][11][dc][b5][c1] [c0][da][11][04][ac][c1] [c0][db][10][80][01][01][00][43][45][c1] [c0][da][31][06][8d][c1] [c0][db][11][dc][b5][c1] [c0][da][30][81][00][81][00][47][d9][ff][f6][c1] [c0][db][32][00][01][84][0b][49][72][44][41][3a][49][72][43][4f][4d][4d] [13][49][72][44][41][3a][54][69][6e][79][54][50][3a][4c][73][61][70] [53][65][6c][8d][c2][c1] [c0][da][52][01][00][84][00][00][01][00][04][01][00][00][00][04][74][86][c1]
	P S P S P S P S P S	[c0][db][54][84][02][01][00][01][03][00][01][04][de][4e][c1] [c0][da][74][82][04][81][00][05][f4][ab][c1] [c0][db][71][da][d6][c1] [c0][da][71][02][cf][c1] [c0][db][76][04][02][00][17][10][04][00][00][c2][00][11][01][03][12][01] [00][13][02][11][13][14][02][13][11][20][01][0c][17][5b][c1] [c0][da][96][02][04][00][03][21][01][7d][e0][35][81][c1] [c0][db][98][04][02][04][4e][6a][c1] [c0][da][b1][0e][09][c1] [c0][db][9a][04][02][00][00][35][74][12][c1] [c0][da][d8][02][04][01][19][a2][c1]
	P S	[c0][db][b1][d6][10][c1] [c0][da][da][02][04][00][00] ----- [31][32][33][34][35][36][37][38][0d][0a] [32][42][43][44][45][46][47][48][0d][0a] [33][32][33][34][35][36][37][38][0d][0a] [34][62][63][64][65][66][67][68][0d][0a]           Data Payload [35][32][33][34][35][36][37][38][0d][0a] [36][42][43][44][45][46][47][48][0d][0a] [37][32][33][34] ----- [b3][7f][c1]
	P S	[c0][db][d1][d0][73][c1] [c0][da][dc][02][04][00][00] ----- [35][36][37][38][0d][0a] [38][62][63][64][65][66][67][68][0d][0a] [39][32][33][34][35][36][37][38][0d][0a] [41][42][43][44][45][46][47][48][0d][0a]           Data Payload [42][32][33][34][35][36][37][38][0d][0a] [43][62][63][64][65][66][67][68][0d][0a] [44][32][33][34][35][36][37][38] ----- [65][62][c1]

Legend: P = Primary Device                      S = Secondary Device

Note 1: The information captured here is "garbage data". That is, the data that was communicated between the Primary Device and Secondary Device at 9600 baud, but captured by the MCP2120 Developer's Board at 115200 baud. Only a portion of this "garbage data" is shown due to space limitations (indicated by .....).



**FIGURE C-4: MCP2150 FORMATTED CAPTURE @ 115200 BAUD - PAGE 2**

Frame #	Frame Sent By	Frame Data
	P S	<pre>[c0][db][fc][04][02][01][eb][d6][c1] [c0][da][fe][02][04][00][00] ----- [0d][0a] [45][42][43][44][45][46][47][48][0d][0a] [46][32][33][34][35][36][37][38][0d][0a] [31][62][63][64][65][66][67][68][0d][0a] [32][32][33][34][35][36][37][38][0d][0a] [33][42][43][44][45][46][47][48][0d][0a] [34][32][33][34][35][36][37][38][0d][0a] [35][62] ----- [2d][c7][c1]</pre> <p style="text-align: right;">Data Payload</p>
	P S	<pre>[c0][db][1e][04][02][01][17][5b][c1] [c0][da][10][02][04][00][00] ----- [63][64][65][66][67][68][0d][0a] [36][32][33][34][35][36][37][38][0d][0a] [37][42][43][44][45][46][47][48][0d][0a] [38][32][33][34][35][36][37][38][0d][0a] [39][62][63][64][65][66][67][68][0d][0a] [61][32][33][34][35][36][37][38][0d][0a] ----- [11][7d][e1][c1]</pre> <p style="text-align: right;">Data Payload</p>
	P S P S P S P S P S P S P S P S P S P S P S	<pre>[c0][db][30][04][02][01][06][7a][c1] [c0][da][31][06][8d][c1] [c0][db][31][de][94][c1] [c0][da][31][06][8d][c1] [c0][db][31][de][94][c1] [c0][da][31][06][8d][c1] [c0][db][31][de][94][c1] [c0][da][31][06][8d][c1] [c0][db][31][de][94][c1] [c0][da][31][06][8d][c1] [c0][db][32][04][02][01][70][43][c1] [c0][da][51][00][ee][c1] [c0][db][31][de][94][c1] [c0][da][51][00][ee][c1] [c0][db][31][de][94][c1] [c0][da][51][00][ee][c1] [c0][db][31][de][94][c1] [c0][da][51][00][ee][c1] [c0][db][31][de][94][c1] [c0][da][51][00][ee][c1] [c0][db][31][de][94][c1] [c0][da][51][00][ee][c1]</pre>

**Legend:** P = Primary Device                      S = Secondary Device

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**FIGURE C-5: MCP2150 FORMATTED CAPTURE @ 115200 BAUD - PAGE 3**

Frame #	Frame Sent By	Frame Data
	P	[c0][db][31][de][94][c1]
	S	[c0][da][51][00][ee][c1]
	P	[c0][db][31][de][94][c1]
	S	[c0][da][51][00][ee][c1]
	P	[c0][db][31][de][94][c1]
	S	[c0][da][51][00][ee][c1]
	P	[c0][db][31][de][94][c1]
	S	[c0][da][51][00][ee][c1]
	P	[c0][db][31][de][94][c1]
	S	[c0][da][51][00][ee][c1]
	P	[c0][db][31][de][94][c1]
	S	[c0][da][51][00][ee][c1]
	P	[c0][db][31][de][94][c1]
	S	[c0][da][51][00][ee][c1]
	P	[c0][db][31][de][94][c1]
	S	[c0][da][51][00][ee][c1]
	P	[c0][db][53][ca][d4][c1]
	S	[c0][da][53][12][cd][c1]
	P	[c0][db][53][ca][d4][c1]
	P	[c0][db][53][ca][d4][c1]
	P	[c0][db][53][ca][d4][c1]
	P	[c0][db][53][ca][d4][c1][ff][ff]

**Legend:** P = Primary Device                      S = Secondary Device

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