Serial Communications Protocol Definition

Project: DC-2/MC-1

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Major rev 0
Minor rev 5

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1 Documents

The following documents should also be used with this document to understand how this protocol can be used with a DC-2/MC-1.

070-13227 MANUAL,OWNER'S,DC2
070-13278 MANUAL,OWNER'S,MC1

2 Definitions

System Parameter: A user changeable variable that stores a specific value that describes an operating condition for the DC-2/MC-1 system.

Effect: An effect describes a particular type of processing on the audio data stream.

Effect Parameter: A changeable variable that stores a specific state or condition that controls the way the effect functions or processes the audio.

HOST: The device initiating or receiving the serial communication packets to/from the DC-2/MC-1.

DC-2/MC-1: The Lexicon product receiving or transmitting the serial communication packets to/from the HOST.

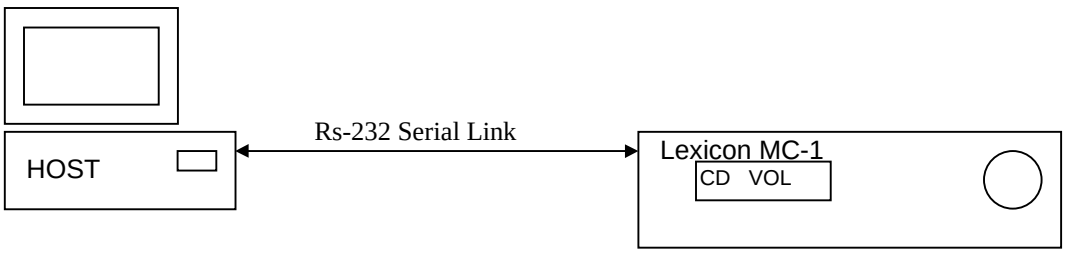
Nonvolatile RAM: The area of memory in a DC-2/MC-1 that stores users adjustable parameters. The Nonvolatile RAM is battery backed, to maintain values during DC-2/MC-1 power down.

3 Abbreviations

SOP Start of Packet
EOP End of Packet
ACK Acknowledge
NAK No Acknowledge
FPD Front Panel Display

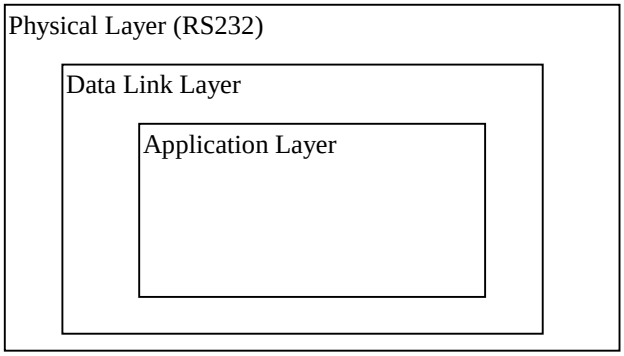
4 General Description

The intention of the DC-2/MC-1 serial port and protocol communication is for an external connected HOST to control and obtain status from the DC-2/MC-1. The protocol has been designed to focus on two specific goals. The first, is HOST uploading and downloading of DC-2/MC-1 configuration, and system/effect setups. The second, is HOST control of basic user adjustable parameters.(i.e. input, volume, balance…)



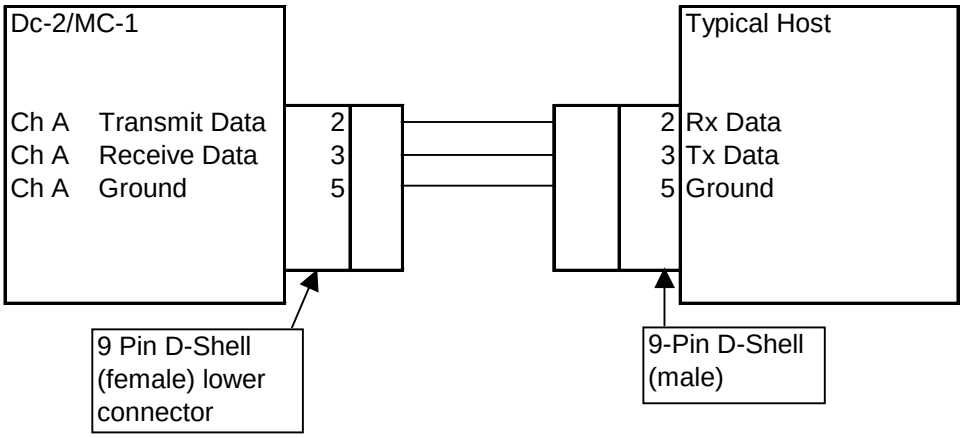
The DC-2/MC-1 uses simple notification, command, response and acknowledgment packets to have communication transactions with a given HOST. This protocol is designed for point to point communication between a HOST and DC-2/MC-1. The DC-2/MC-1 Protocol is a 3 layered system. The DC-2/MC-1 serial protocol allows for the DC-2/MC-1, or the HOST to initiate a communication transaction. Most transactions are initiated by the HOST. DC-2/MC-1 then responds to the HOST command with either a response or acknowledgment packet. There are a few asynchronous notifications that DC-2/MC-1 initiates indicating system changes. Each transaction initiated must wait for a corresponding response before initiating the next transmission.

The 3 protocol layers are: Physical, Data Link, and Application Layers.



5 Physical Layer

5.1 DB-9 RS232 Connector



Note: The wiring requirements for a 9 pin to 9 pin serial connection, are a male to female straight through cable.

5.2 Serial Port Driver

DC-2/MC-1 serial port has been setup to operate as follows:

Operating Mode:	Full Duplex
Baud rate:	19.2K baud
Data Size:	8 bits
Parity:	Odd
Stop Bits:	1

5.3 Errors

The DC-2/MC-1 will detect parity, framing and data overrun errors. If an error is detected by the DC-2/MC-1, the DC-2/MC-1 will transmit an NAK packet with a error code of: DC_ERR_PARTIY, DC_ERR_FRAME, DC_ERR_OVER, corresponding to the error detected. If any of the physical layer errors are detected, the complete packet is corrupted and the DC-2/MC-1 will reset the transaction and begin to look for a start of packet byte.

All Error codes are listed in Appendix B Error Codes.

5.4 DC-2/MC-1 Receive Buffer

The DC-2/MC-1 has an internal receive buffer. The buffer is 256 Bytes and will transmit a NAK packet with an error code of DC_ERR_BUFFER_FULL to the HOST if the buffer is full. If the buffer is full, all data transmitted to the DC-2/MC-1 will be ignored. Therefore, making the currently transmitted packet, if partially transmitted invalid.

5.5 DC-2/MC-1 Hardware Verification

This test verifies the RS232 ports are working by comparing the transmitted signal (at pin 2) to the received signal (at pin 3) . The DC-2/MC-1 transmits a know test signal just following a power up. The DC-2/MC-1 monitors the serial port receivers while transmitting the test signal. If the signals are the same, the test passes. In order to test this circuit, (1 for Dc-2 and 2 for MC-1) RS232 Wraparound plug(s) are needed and must be installed at the female D9 connector(s) on the rear panel of the DC-2/MC-1/SDP-3 labeled “RS232”. The wraparound plug shorts pins 2 to 3, allowing for the MC-1 to receive the signal it is transmitting. Once installed, power cycle the DC-2/MC-1/SDP-3 and verify the following message is displayed on the VFD about 20 seconds after power up:

SERIAL PORT A PASSED
SERIAL PORT B PASSED

This message is displayed for about 2 seconds before entering normal operating mode. If either or both messages are not displayed, the test failed.

6 Data Link Layer

The data link layer is used to define a transmission packet. The layer appends a header and tail that encloses the transmitted application packet data. The data link header will contain the start of packet byte and count of bytes to follow. The data link tail will contain the end of packet byte.

Data Link Header:		
Byte Number	Description	Value
First Byte(0)	Start of Packet(SOP)	0xF1
Byte(1)	DLL Data Count	nn
Application Header:		
Byte(2)	Command	nn
Byte(3)	APP Data Count(number of application data bytes to Follow)	nn
Application Data:		
Byte(4)	Data[0]	nn
Byte(5)	Data[1]	nn
…	Data[…]	nn
Last Data Byte -1	Data[Data Count -1]	nn
Data Link Tail:		
Last Byte	End of Packet (EOP)	0xF2

6.1 Errors

If the number of DLL data bytes received is the same as the data count and an EOP has not been received, the DC-2/MC-1 responds by transmitting a NAK packet with an error code DC_ERR_INVALID_PACKET. The DC-2/MC-1 then continues to look for a SOP byte and will not process the erroneous application packet. The HOST can use this as an indicator to retransmit the corrupted packet.

7 Application Layer

7.1 DC-2/MC-1 Asynchronous Notification Packets

DC-2/MC-1 has been designed to transmit the asynchronous notification packets following these system changes:

1. Power On
2. Entering Standby
3. Front Panel Display update and
4. Parameter Value Changes.

The notification packets are defined as follows:

7.1.1 Wakeup Notification

By transmitting the Wakeup Notification, DC-2/MC-1 indicates the unit has just “powered on” or reset and is ready to receive host commands. If no acknowledgment is received within ACK_TIMEOUT, DC-2/MC-1 will continue to operate. This notification is primarily for the HOST to know the status of the DC-2/MC-1.

7.1.1.1 Notification Packet Description

Application Header:		
Command	DC_WAKEUP	0x01
Data Count	0	0x00
Application Data:		
	N/A	

7.1.1.2 Host Response Expected

Following the transmission of the Wakeup notification DC-2/MC-1 will wait for an ACK.

7.1.1.2.1 Actions to Response Codes

ACK	DC-2/MC-1 continues to operate.
NAK Error Code	DC-2/MC-1 will retransmit the Wakeup Notification until it receives an ACK or it reaches the RETRANSMIT_COUNT. If the RETRANSMIT_COUNT is exceeded then DC-2/MC-1 continues to operate.

7.1.2 Sleep Notification

By transmitting the Sleep Notification, DC-2/MC-1 indicates the unit is shutting down into a standby mode. Because the hard power switch could be activated independently of the DC-2/MC-1 system software, hard power down will not be notified. Acknowledgment of the Sleep Notification is not required. This notification is primarily for the HOST to know the operating status of the DC-2/MC-1.

7.1.2.1 Notification Packet Description

Application Header:		
Command	DC_SLEEP	0x02
Data Count	0	0x00
Application Data:		
	N/A	

7.1.3 Front Panel Display Buffer

DC-2/MC-1 will transmit the front panel display buffer following the update to the DC-2/MC-1 front panel display. The DC-2/MC-1 front panel display is 2 X 20 ASCII character display. The HOST can control the operation of this notification message by FPD internal control registers. Individual notifications can be enabled or disabled and the minimum transmit interval can be adjusted. Transmission of the display buffer is asynchronous to other host/DC-2/MC-1 communication and will only transmit following the completion of any communication exchanges in progress or pending. The FPD control register command packets are described in section 7.3.14 Get FPD Control Registers.

7.1.3.1 Notification Packet Description

Application Header:		
Command	DC_FPD	0x03
Data Count	42	0x2A
Application Data:		
Data[0] - Data[21]	Line1	ch ch ch... 0x00
Data[22] - Data[42]	Line2	ch ch ch ... 0x00

7.1.3.2 Data Description

Line1

Data Type: Null(0x00) terminated ASCII character string.
Max Length: DISP_LINE_LENGTH defined in Appendix E Protocol Constants.

Line2

Data Type: Null(0x00) terminated ASCII character string.
Max Length: DISP_LINE_LENGTH defined in Appendix E Protocol Constants.

The DC-2/MC-1 includes 8 custom characters that are defined to display increments of a display block. (i.e. Volume Bar) The custom characters are ASCII character codes 08 - 0F(hex). The codes are used as follows:

'08' - left 1 bar
'09' - left 2 bars
'0A' - left 3 bars
'0B' - left 4 bars
'0C' - Full Cell
'0D' - Underscore
'0E' - right 3 bars
'0F' - not in use

7.1.3.3 HOST Response

The DC-2/MC-1 does not look for any response from the HOST.

7.1.4 Parameter Change Notification

DC-2/MC-1 will transmit predetermined parameter change notifications. If a parameter value is changed due to any user action or system action the DC-2/MC-1 will transmit the current value of the parameter that is changing.

7.1.4.1 Notification Packet Description

Application Header:		
Command	DC_PARAM_CHG_MSG	0x04
Data Count	2	0x02
Application Data:		
Data[0]	ParamId	nn
Data[1]	Value	nn

7.1.4.2 Data Description

ParamId:
DataType: Unsigned 8 bit integer
Max: Set by the System Parameter Count in the “Unit Configuration Packet”.
Value: The Current Value for this system parameter.
Data Type: Unsigned 8 bit integer
Max: Set by the Max Value per the System Parameter Definition response Packet for the Parameter Id of this packet.

7.1.4.3 HOST Response

The DC-2/MC-1 does not look for any response from the HOST.

7.1.4.4 Supported System Parameters

The following parameters will be supported by this Parameter Change Notification:

Parameter	DC-2/MC-1 Parameter Name
Current Effect	PROGRAM
Mute	MUTE
System Volume	VOLUME
Balance	LR_BALANCE
Input Selection	INPUT
Record/Zone 2 On/Off	RECORD_ENABLED
Zone 2 Volume	Z2_VOL

Zone 2 Balance	Z2_BAL
Zone 2 Mute	Z2_MUTE
Bass	BASS
Treble	TREBLE
Loudness	LOUDNESS
Tilt	TILT
Menu Background On/Off	MENU_BKGND

The parameter definitions for each of these parameters can be obtained by querying the DC-2/MC-1 with the DC_CMD_GET_SYS_PARAM_BY_NAME command. The DC_RESP_SYS_PARAM_DEF will contain the ParamId for each of the parameters. The ParamId may change with s/w version changes, but the Parameter Name will not.

7.2 Acknowledgment Packets

Acknowledge and No Acknowledge packets are used to communicate transmission, packet and data validation status. Both the HOST and DC-2/MC-1 can transmit and receive these packets.

7.2.1 Acknowledge

7.2.1.1 Packet Description

Application Header:		
Command	DC_ACK	0xE0
Data Count	1	0x01
Application Data:		
Data[0]	Command	nn

7.2.1.2 Data Description

Command:
DataType: Valid DC-2/MC-1 command as defined in Appendix A Command Codes.

7.2.2 No Acknowledge

7.2.2.1 Packet Description

Application Header:		
Command	DC_NACK	0xE1
Data Count	2	0x02
Application Data:		
Data[0]	Command	nn
Data[1]	ErrorCode	nn

7.2.2.2 Data Description

Command:
DataType: Valid DC-2/MC-1 command as defined in Appendix A Command Codes.
ErrorCode:
DataType: Error code as defined in Appendix B Error Codes.

7.3 Host Initiated Command Packets

The DC-2/MC-1 serial communication protocol has been designed to respond to the following commands as described below. Each command is transmitted to the DC-2/MC-1 with the identified parameters. If the command is successfully received and processed by the DC-2/MC-1, the unit will respond with the described response packet or action.

7.3.1 Reset Unit

Commands the DC-2/MC-1 to soft reset.

7.3.1.1 Command Packet Description

Application Header:		
Command	DC_CMD_RESET	0x10
Data Count	0	0x00
Application Data:		
	N/A	

7.3.1.2 DC-2/MC-1 Response

The DC-2/MC-1 will perform and internal reset. After reset the DC-2/MC-1 will go through a soft power-up initialization. This includes transmitting the “Wakeup Notification Packet”. A soft reset does not reinitialize the DC-2/MC-1. Nonvolatile RAM is maintained.

7.3.2 Restore Defaults

Commands DC-2/MC-1 restore the system and effect parameters to the factory defaults.

7.3.2.1 Command Packet Description

Application Header:		
Command	DC_CMD_RESTORE_DEFAULTS	0x13
Data Count	0	0x00
Application Data:		
	N/A	

7.3.2.2 DC-2/MC-1 Response

The DC-2/MC-1 will reset, clear any saved system and effect parameters in Nonvolatile RAM, and restore the factory default system and effect parameters. After reset the DC-2/MC-1 will go through a soft power-up initialization. This includes transmitting the “Wakeup Notification Packet”.

7.3.3 Send IR Command

Transmits IR command key codes to the DC-2/MC-1.

7.3.3.1 Command Packet Description

Application Header:		
Command	DC_CMD_IR	0x14
Data Count	1	0x01
Application Data:		
Data[0]	KeyCode	nn

7.3.3.2 Data Description

KeyCode:

Data Type: Unsigned 8 bit integer.
Valid Values: Appendix C DC-2/MC-1 IR-Codes

7.3.3.3 DC-2/MC-1 Response

The KeyCode is processed as a valid IR code. No acknowledgment will be sent from DC-2/MC-1.

7.3.3.4 Data Validation

The KeyCode data will be verified as a legal IR code. If the Code is not valid the DC-2/MC-1 will not respond.

7.3.4 Get DC-2/MC-1 Unit Configuration

Request to DC-2/MC-1 for it's current unit configuration. DC-2/MC-1 will respond with "Unit Configuration Packet". The HOST should use this information to determine if any information saved by the HOST is current.

7.3.4.1 Command Packet Description

Application Header:		
Command	DC_CMD_GET_CONFIG	0x15
Data Count	0	0x00
Application Data:		
	N/A	

7.3.4.2 DC-2/MC-1 Unit Configuration Response Packet

Application Header:		
Command	DC_RESP_UNIT_CONFIG	0x80
Data Count	25	0x19
Application Data:		
Data[0]	ProductId	nn
Data[1]	Software Type	nn
Data[2]	Software Level	nn
Data[3]	Software Major Revision	nn
Data[4]	Software Minor Revision	nn
Data[5]	Protocol Major Revision	nn
Data[6]	Protocol Minor Revision	nn
Data[7]	Total Number of System Parameters	nn
Data[8]	Total Number of Effects	nn
Data[9]	TimeStamp[0]	ch
Data[10]	TimeStamp[1]	ch
Data[11]	TimeStamp[2]	ch
Data[12]	TimeStamp[3]	ch
Data[13]	TimeStamp[4]	ch
Data[14]	TimeStamp[5]	ch
Data[15]	TimeStamp[6]	ch
Data[16]	TimeStamp[7]	ch
Data[17]	TimeStamp[8]	ch
Data[18]	TimeStamp[9]	ch
Data[19]	TimeStamp[10]	ch
Data[20]	TimeStamp[11]	ch
Data[21]	TimeStamp[12]	ch
Data[22]	TimeStamp[13]	ch
Data[23]	TimeStamp[14]	ch
Data[24]	TimeStamp[15]	0x00

7.3.4.3 Data Description

ProductId: This unsigned 8 bit value describes the product.

Product ID	
Lexicon Dc-2	1
Lexicon MC-1	2
JBL Synthesis SDP-3	3

Software Type: An unsigned 8 bit value indicating the current configuration of the unit's software. The following table shows the values assigned to the available types:

SW Type	
THX	1
AC3	2
DTS	3

Software Level: The following table shows the values assigned to the possible software levels:

SW Level	
RELEASED	0
PRE_ALPHA	1
ALPHA	2
BETA	3
GAMMA	4
UNSUPPORTED	5

*Note: SW level indicates the status of the DC-2/MC-1 internal application software.

Software Major Revision: An unsigned integer value indicating the unit's major software version. The host should use this information to determine if new effects, effect parameters, or system parameters have been added or removed.

Software Minor Revision: An unsigned integer value indicating this units minor software version. Indicates the units software operation has changed but effects, effect parameters, or system parameters have not changed.

Protocol Major Revision: An unsigned integer value indicating the serial communication protocol major version. The host should use this value to determine if new commands, notifications, or response packets have been added or deleted from this specification.

Protocol Minor Revision: An unsigned integer value indicating the serial communication protocol minor version. The host should use this value to determine if the existing commands, notifications, or response packets have changed in this specification

Total Number of System Parameters: An unsigned integer value indicating the maximum number of system parameters for this version of software. This should be used to determine the data count for the "DC-2/MC-1 System Parameter Values Packet" and "Set System Parameter Values Packet".

Total Number of Effects: An unsigned integer value indicating the maximum number of effects available for this version of software. This should be used to determine the maximum EffectId used in the "Get Effect Definition Packet", "Get Effect Parameter Definition Packet", "Set Effect Name Packet" , and "Set Effect Parameter Values Packet".

TimeStamp: Is a null terminated ASCII text string describing the build date and time of the current ROM. The Format of this text string is:
"yy/mm/dd(sp)hh:mm"
yy- is the last two digits of the year (i.e. year 1999 = 99, year 2000 = 00)
mm - is the month
dd- is the day
(sp) - is an ASCII space character (0x20)
hh - is the hour
mm - is the minute

7.3.5 Get System Status

Request to DC-2/MC-1 for it's current system status. DC-2/MC-1 will respond with "System Status Packet".

7.3.5.1 Command Packet Description

Application Header:		
Command	DC_CMD_GET_SYS_STATUS	0x16
Data Count	0	0x00
Application Data:		
	N/A	

7.3.5.2 System Status Response Packet

Application Header:		
Command	DC_RESP_SYS_STATUS	0x81
Data Count	10	0x0A
Application Data:		
Data[0]	System Volume	nn
Data[1]	Current Input	nn
Data[2]	Current EffectId	nn
Data[3]	Current Input Sample Rate	nn
Data[4]	Current Input Format	nn
Data[5]	Mute Active	nn
Data[6]	Effect Bypass Active	nn
Data[7]	Left/Right Balance	nn
Data[8]	Front/Back Balance	nn
Data[9]	Video Synch	nn

7.3.5.3 Data Description

System Volume:
- Data Type: Unsigned 8 bit integer.
- Maximum Value: 92
- Conversion: 0 = -80 dB
  92 = +12 dB

Current Input:
- Data Type: Unsigned 8 bit integer.
- Definition: Appendix D Input Id's

Current EffectId:

Data Type: Unsigned 8 bit integer.
Maximum Value: Set by “Total Number of Effects” in the “Unit Configuration” Packet.

Current Input Sample Rate
Data Type: Unsigned 8 bit integer.

SAMPLE RATE	
RATE_UNKNOWN	0
RATE_44	1
RATE_48	2
RATE_88	3
RATE_96	4

Current Input Format:
Data Type: Unsigned 8 bit integer.

DATA STREAM TYPE	
INSTREAM_UNKNOWN	0
INSTREAM_AC3	1
INSTREAM_PCM	2
INSTREAM_ANALOG	3
INSTREAM_DTS	4
INSTREAM_AC3_20	5
INSTREAM_AC3_51	6

Mute Active:
Data Type: Boolean.
TRUE: System Mute is Active
FALSE: System is unmuted.

Effect Bypass Active:
Data Type: Boolean.
TRUE: Effect Bypass is Active
FALSE: Effect Bypass is not Active.

Left/Right Balance:
Data Type: Unsigned 8 bit integer.
Maximum Value: 32
Conversion: 0 = Left
32 = Right

Front/Back Balance:
Data Type: Unsigned 8 bit integer.
Maximum Value: 32
Conversion: 0 = Front
32 = Back

Video Synch:
Data Type: Boolean.
TRUE: DC-2/MC-1 has detected Video Synch for current video input
FALSE: DC-2/MC-1 can not detect Video Synch for the current video input

7.3.6 Get Record/Zone 2 Status

Request to DC-2/MC-1 for current Record/Zone2 Status. DC-2/MC-1 will respond with “Record/Zone2 Status Packet”.

7.3.6.1 Command Packet Description

Application Header:		
Command	DC_CMD_GET_REC_STATUS	0x17
Data Count	0	0x00
Application Data:		
	N/A	

7.3.6.2 Record/Zone2 Status Response Packet

Application Header:		
Command	DC_RESP_REC_ZONE2_STATUS	0x82
Data Count	5	0x05
Application Data:		
Data[0]	Zone2 Volume	nn
Data[1]	Assigned Input	nn
Data[2]	Zone2 Mute Active	nn
Data[3]	Record Active	nn
Data[4]	Zone2 Balance	nn

7.3.6.3 Data Description

Zone2 Volume:
- Data Type: Unsigned 8 bit integer.
- Maximum Value: 92
- Conversion: 0 = -80 dB
  92 = +12 dB

Assigned Input:

Indicates the input that is currently assigned for the record/zone2 outputs.
- Data Type: Unsigned 8 bit integer.
- Definition: Appendix D Input Id's

Zone2 Active:
- Data Type: Boolean.
- TRUE: Zone2 Outputs are active.
- FALSE: Zone2 Outputs are not active.

Record Active:
- Data Type: Boolean.
- TRUE: Digital Record Output is active
- FALSE: Digital Record Output is not Active.

Zone 2 Balance:
- Data Type: Unsigned 8 bit integer.
- Maximum Value: 32
- Conversion: 0 = Left
  32 = Right

7.3.7 Get System Parameter Definition

There are two ways to request a DC-2/MC-1 system parameter definition. The first is by Parameter Id and the second by parameter name. DC-2/MC-1 will respond with "System Parameter Definition Packet".

7.3.7.1 Get System Parameter Definition by Id Command Packet

Error! Not a valid link.

7.3.7.2 Data Description

ParamId:
- DataType: Unsigned 8 bit integer

Max: Set by the System Parameter Count in the “Unit Configuration Packet”.

7.3.7.3 Data Validation:

The ParamId must be a valid parameter number. If it is not the DC-2/MC-1 will respond with a NAK packet and error code DC_ERR_ INVALID_PARAM_NUMBER.

7.3.7.4 Get System Parameter Definition by Name Command Packet

Application Header:		
Command	DC_CMD_GET_SYS_PARAM_BY_NAME	0x19
Data Count	strlen(ParamName) + 1	nn
Application Data:		
Data[0]-Data[DataCount-1]	ParamName	ch ch ch … 0x00

7.3.7.5 Data Description

ParamName:

Data Type: Null(0x00) terminated ASCII character string.
Max Length: PARAM_NAME_LENGTH defined in Appendix E Protocol Constants.

7.3.7.6 Data Validation:

The ParamName must be a valid Parameter name. If it is not the DC-2/MC-1 will respond with a NAK packet and error code DC_ERR_ INVALID_PARAM_NAME.

7.3.7.7 System Parameter Definition Response Packet

This packet describes the defining information for a given system parameter.

Application Header:		
Command	DC_RESP_SYS_PARAM_DEF	0x83
Data Count	3 + strlen(ParamName) + 1	nn
Application Data:		
Data[0]	ParamId	nn
Data[1]	MaxValue	nn
Data[2]	Value	nn
Data[3]- Data[DataCount-1]	ParamName	ch ch ch … 0x00

7.3.7.8 Data Description

ParamId: The Integer Id assigned to this system parameter.
Data Type: Unsigned 8 bit integer
Max: Set by the System Parameter Count in the “Unit Configuration Packet”

MaxValue: Maximum Value allowed for this system parameter.
Data Type: Unsigned 8 bit integer
Max: 255

Value: The Current Value for this system parameter.
Data Type: Unsigned 8 bit integer
Max: MaxValue(in this Packet)

ParamName:

Data Type: Null(0x00) terminated ASCII character string.
Max Length: PARAM_NAME_LENGTH defined in Appendix E Protocol Constants.

7.3.8 Get System Parameter Values

Request to DC-2/MC-1 for all current system parameter values. DC-2/MC-1 will respond with the "System Parameter Values Packet".

7.3.8.1 Command Packet Description

Application Header:		
Command	DC_CMD_GET_SYS_PARAM_VALUES	0x1A
Data Count	0	0x00
Application Data:		
	N/A	

7.3.8.2 System Parameter Values Response Packet

Application Header:		
Command	DC_RESP_SYS_PARAM_VALUES	0x84
Data Count	SYS_PARAM_COUNT	nn
Application Data:		
Data[0]	sys_param_value[0]	nn
Data[1]	sys_param_value[1]	nn
Data[…]	sys_param_value[…]	nn
Data[SYS_PARAM_COUNT-1]	sys_param_value[SYS_PARAM_COUNT-1]	nn

7.3.8.3 Data Description

sys_param_value:

Data Type: Unsigned 8 bit integer Array.
Max: Dependent on the parameter definition.

7.3.9 Get Effect Definition by Id

Request to DC-2/MC-1 for an effect definition. DC-2/MC-1 will respond with "Effect Definition Packet".

7.3.9.1 Command Packet Description

Application Header:		
Command	DC_CMD_GET_EFFECT	0x1B
Data Count	1	0x01
Application Data:		
Data[0]	EffectId	nn

7.3.9.2 Data Description

EffectId:

Data Type: Unsigned 8 bit integer
Max: Set by the Effect Count in the "Unit Configuration Packet".

7.3.9.3 Data Validation:

The EffectId must be a valid Effect Id. If it is not the DC-2/MC-1 will respond with a NAK packet and error code DC_ERR_ INVALID_EFFECT_ID.

7.3.9.4 Effect Definition Response Packet

Application Header:		
Command	DC_RESP_EFFECT_DEF	0x85
Data Count	2 + strlen(EffectName) + 1	nn
Application Data:		
Data[0]	EffectId	nn
Data[1]	MaxParameters	nn
Data[2]- Data[DataCount-1]	EffectName	ch ch ch … 0x00

7.3.9.5 Data Description

EffectId:

Data Type: Unsigned 8 bit integer
Max: Set by the Effect Count in the "Unit Configuration Packet".

MaxParameters: Maximum number of parameters assigned to this effect.

EffectName:

Data Type: Null(0x00) terminated ASCII character string.
Max Length: EFFECT_NAME_LENGTH defined in Appendix E Protocol Constants.

7.3.10 Get Effect Parameter Definition

Request to DC-2/MC-1 for an effect parameter definition. DC-2/MC-1 will respond with "Effect Parameter Definition Packet".

7.3.10.1 Command Packet Description

Application Header:		
Command	DC_CMD_GET_EFFECT_PARAM_DEF	0x1C
Data Count	2	0x02
Application Data:		
Data[0]	EffectId	nn
Data[1]	ParamId	nn

7.3.10.2 Data Description

EffectId:

Data Type: Unsigned 8 bit integer.
Max: Set by the Effect Count in the "Unit Configuration Packet".

ParamId:

Data Type: Unsigned 8 bit integer.
Max: Set by the Parameter Count in the "Effect Definition Packet".

7.3.10.3 Data Validation:

The EffectId must be a valid Effect Id. If it is not the DC-2/MC-1 will respond with a NAK packet and error code DC_ERR_ INVALID_EFFECT_ID. The ParamId must be a valid Parameter number. If it is not the DC-2/MC-1 will respond with a NAK packet and error code DC_ERR_ INVALID_PARAM_NUMBER.

7.3.10.4 Effect Parameter Definition Response Packet

Application Header:		
Command	DC_RESP_EFFECT_PARAM_DEF	0x86
Data Count	4	0x04
Application Data:		
Data[0]	EffectId	nn
Data[1]	ParamId	nn
Data[2]	MaxValue	nn
Data[3]	Value	nn

7.3.10.5 Data Description

EffectId:
Data Type: Unsigned 8 bit integer.
Max: Set by the Effect Count in the "Unit Configuration Packet".
ParamId:
Data Type: Unsigned 8 bit integer.
Max: Set by the Parameter Count in the "Effect Definition Packet".
MaxValue: Maximum Value allowed for this parameter.
Data Type: Unsigned 8 bit integer
Max: 255
Value: The Current Value for this parameter.
Data Type: Unsigned 8 bit integer
Max: MaxValue(in this Packet)

7.3.11 Get Effect Parameter Values

Request to DC-2/MC-1 for an effect's parameter values. DC-2/MC-1 will respond with "Effect Parameter Values Packet".

7.3.11.1 Command Packet Description

Application Header:		
Command	DC_CMD_GET_EFFECT_PARAM_VALUES	0x1D
Data Count	1	0x01
Application Data:		
Data[0]	EffectId	nn

7.3.11.2 Data Description

EffectId:
Data Type: Unsigned 8 bit integer.
Max: Set by the Effect Count in the "Unit Configuration Packet".

7.3.11.3 Data Validation:

The EffectId must be a valid Effect Id. If it is not the DC-2/MC-1 will respond with a NAK packet and error code DC_ERR_ INVALID_EFFECT_ID.

7.3.11.4 Effect Parameter Values Response Packet

Application Header:		
Command	DC_RESP_EFFECT_PARAM_VALUES	0x87
Data Count	1 + EffectParamCount	nn
Application Data:		
Data[0]	EffectId	nn
Data[1]	effect_param_value[0]	nn
Data[…]	effect_param_value[…]	nn
Data[DataCount-1]	effect_param_value[EffectParamCount-1]	nn

7.3.11.5 Data Description

EffectId:

Data Type: Unsigned 8 bit integer.
Max: Set by the Effect Count in the "Unit Configuration Packet".

effect_param_value:

Data Type: Unsigned 8 bit integer array.
Max: Dependent on the parameter definition

7.3.12 Get Custom Name

Request to DC-2/MC-1 for an effect definition. DC-2/MC-1 will respond with "Custom Name Packet".

7.3.12.1 Command Packet Description

Application Header:		
Command	DC_CMD_GET_CUST_NAME	0x2B
Data Count	0	0x00
Application Data:		
	N/A	

7.3.12.2 Data Description

N/A

7.3.12.3 Custom Name Response Packet

Application Header:		
Command	DC_RESP_CUST_NAME	0x89
Data Count	strlen(CustomName) + 1	nn
Application Data:		
Data[0]- Data[DataCount-1]	CustomName	ch ch ch … 0x00

7.3.12.4 Data Description

CustomName:

Data Type: Null(0x00) terminated ASCII character string.
Max Length: CUSTOM_NAME_LENGTH defined in Appendix E Protocol Constants.

7.3.13 Get Input Name by Id

Request to DC-2/MC-1 for an input name. DC-2/MC-1 will respond with "Input Name Packet".

7.3.13.1 Command Packet Description

Application Header:		
Command	DC_CMD_GET_INPUT_NAME	0x2D
Data Count	1	0x01
Application Data:		
Data[0]	InputId	nn

7.3.13.2 Data Description

InputId:

Data Type: Unsigned 8 bit Integer
Max Value: 7
Conversion: Input Id are defined in Appendix D Input Id's

7.3.13.3 Data Validation:

The InputId must be a valid Input number. If it is not the DC-2/MC-1 will respond with a NAK packet and error code DC_ERR_ INVALID_INPUT_ID.

7.3.13.4 Input Name Response Packet

Application Header:		
Command	DC_RESP_INPUT_NAME	0x8A
Data Count	strlen(InputName) + 2	nn
Application Data:		
Data[0]	InputId	nn
Data[2]- Data[DataCount-1]	InputName	ch ch ch … 0x00

7.3.13.5 Data Description

InputId:

Data Type: Unsigned 8 bit Integer
Max Value: 7
Conversion: Input Id's are defined in Appendix D Input Id's

InputName:

Data Type: Null(0x00) terminated ASCII character string.
Max Length: INPUT_NAME_LENGTH defined in Appendix E Protocol Constants.

7.3.14 Get FPD Control Registers

Request to DC-2/MC-1 for FPD control registers. DC-2/MC-1 will respond with "FPD Control Register Packet".

7.3.14.1 Command Packet Description

Application Header:		
Command	DC_CMD_GET_FPD_CONTROL	0x29
Data Count	0	0x00
Application Data:		
	N/A	

7.3.14.2 FPD Control Register Response Packet

Application Header:		
Command	DC_RESP_FPD_CONTROL	0x88
Data Count	4	0X04
Application Data:		
Data[0]	FPD_CtrlReg0	nn
Data[1]	FPD_CtrlReg1	nn
Data[2]	FPD_CtrlReg2	nn
Data[4]	FPD_MinUpdate	nn

7.3.14.3 Data Description

FPD_CtrlReg0: BitPack as defined in Appendix F FPD Control Registers
FPD_CtrlReg1: BitPack as defined in Appendix F FPD Control Registers
FPD_CtrlReg2: BitPack as defined in Appendix F FPD Control Registers
FPD_MinUpdate: This value sets the minimum time between FPD Notification Transmissions.
Data Type: Unsigned 8 bit integer
Default: 50(100 mSec)
Range: 50 - 255 counts
Conversion: 500 counts/sec

7.3.15 Set System Parameter Values

Command DC-2/MC-1 to replace the system parameter values with the values in this packet.

7.3.15.1 Command Packet Description

Application Header:		
Command	DC_CMD_SET_SYS_PARAM_VALUES	0x1E
Data Count	SYS_PARAM_COUNT	nn
Application Data:		
Data[0]	sys_param_value[0]	nn
Data[1]	sys_param_value[1]	nn
Data[…]	sys_param_value[…]	nn
Data[SYS_PARAM_COUNT-1]	sys_param_value[SYS_PARAM_COUNT-1]	nn

7.3.15.2 Data Description

sys_param_values:
Data Type: Array of unsigned 8 bit Integers
Max Each value is set by its system parameter definition.
Array Size: Set by the System Parameter Count in the “Unit Configuration Packet”.

7.3.15.3 DC-2/MC-1 Response

The DC-2/MC-1 will assign the values from the packet to the system parameter values in Nonvolatile RAM, and reset the unit to initialize the new values.

7.3.15.4 Data Validation

If any of the values exceeds it’s maximum value the DC-2/MC-1 will ignore the command and transmit a DC_NAK command with an error code DC_INVALID_DATA.

7.3.16 Set Effect Parameter Values

Commands DC-2/MC-1 to replace the given effect parameter values with the values in this packet.

7.3.16.1 Command Packet Description

Application Header:		
Command	DC_CMD_SET_EFFECT_PARAM_VALUES	0x1F
Data Count	EFFECT_COUNT[EffectId] + 1	nn
Application Data:		
Data[0]	EffectId	nn
Data[1]	effect_param_value[0]	nn
Data[…]	effect_param_value[…]	nn
Data[DataCount-1]	effect_param_value[EFFECT_COUNT-1]	nn

7.3.16.2 Data Description

EffectId:

Data Type: Unsigned 8 bit integer.
Max: Set by the Effect Count in the “Unit Configuration Packet”.

effect_param_value:

Data Type: Unsigned 8 bit integer array.
Max: Dependent on the parameter definition

7.3.16.3 DC-2/MC-1 Response

The DC-2/MC-1 will assign the values from the packet to the effect parameter values in Nonvolatile RAM. If the effect is active the DC-2/MC-1 will reload the effect to activate all the parameter values.

7.3.16.4 Data Validation

If a value is passed that exceeds the maximum value of that parameter the DC-2/MC-1 will ignore the command and transmit a DC_NAK command with an error code DC_ERR_INVALID_DATA.

7.3.17 Set Effect Name by Effect Id

Sets an effect name to the transmitted value for a given effect.

7.3.17.1 Command Packet Description

Application Header:		
Command	DC_CMD_SET_EFFECT_NAME	0x20
Data Count	strlen(EffectName) + 2	nn
Application Data:		
Data[0]	EffectId	nn
Data[1]-Data[DataCount-1]	EffectName	ch ch ch … 0x00

7.3.17.2 Data Description

EffectId:

Data Type: Unsigned 8 bit integer
Max: Set by the Effect Count in the “Unit Configuration Packet”.

EffectName:

Data Type: Null(0x00) terminated ASCII character string.
Max Length: EFFECT_NAME_LENGTH defined in Appendix E Protocol Constants.

7.3.17.3 DC-2/MC-1 Response

The DC-2/MC-1 will copy the Effect Name to Nonvolatile RAM. If the effect being adjusted is active the effect will be reloaded for the changes to be initialized.

7.3.17.4 Data Validation:

The Effect Id must be a valid Effect Id. If it is not the DC-2/MC-1 will respond with a NAK packet and error code DC_ERR_ INVALID_EFFECT_ID. If an invalid string is passed, DC-2/MC-1 will ignore the command and transmit a DC_NAK command with an error code DC_ERR _INVALID_DATA.

7.3.18 Set System Volume

Commands DC-2/MC-1 to set the system volume with the value in this packet.

7.3.18.1 Command Packet Description

Application Header:		
Command	DC_CMD_SET_SYS_VOLUME	0x21
Data Count	1	0x01
Application Data:		
Data[0]	Value	nn

7.3.18.2 Data Description

Value:

Data Type:	Unsigned 8 bit integer.
Max:	92
Conversion:	0 = -80 dB
	92 = +12 dB

7.3.18.3 DC-2/MC-1 Response

The DC-2/MC-1 will assign the value from the packet to the system volume.

7.3.18.4 Data Validation

If a value is passed that exceeds the maximum value of that parameter the DC-2/MC-1 will ignore the command and transmit a DC_NAK command with an error code DC_ERR_INVALID_DATA.

7.3.19 Set Main Balance

Commands DC-2/MC-1 to set the system balance to the value in this packet.

7.3.19.1 Command Packet Description

Application Header:		
Command	DC_CMD_SET_SYS_BALANCE	0x22
Data Count	1	0x01
Application Data:		
Data[0]	Value	nn

7.3.19.2 Data Description

Value:

Data Type:	Unsigned 8 bit integer.
Maximum Value:	32
Conversion:	0 = Left
	32 = Right

7.3.19.3 DC-2/MC-1 Response

The DC-2/MC-1 will assign the value from the packet to the system balance.

7.3.19.4 Data Validation

If a value is passed that exceeds the maximum value of that parameter the DC-2/MC-1 will ignore the command and transmit a DC_NAK command with an error code DC_INVALID_DATA.

7.3.20 Set Front/Back Balance

Commands DC-2/MC-1 to set the front/back balance to the value in this packet.

7.3.20.1 Packet Description

Application Header:		
Command	DC_CMD_SET_FRONT_BACK_BALANCE	0x23
Data Count	1	0x01
Application Data:		
Data[0]	Value	nn

7.3.20.2 Data Description

Value:

Data Type:	Unsigned 8 bit integer.
Max:	32
Conversion:	0 = Front
	32 = Back

7.3.20.3 DC-2/MC-1 Response

The DC-2/MC-1 will assign the value from the packet to the front/back balance.

7.3.20.4 Data Validation

If a value is passed that exceeds the maximum value of that parameter the DC-2/MC-1 will ignore the command and transmit a NAK command with an error code DC_ERR_INVALID_DATA.

7.3.21 Set Active Effect by Id

Commands DC-2/MC-1 to set the active effect to the value in this packet.

7.3.21.1 Command Packet Description

Application Header:		
Command	DC_CMD_SET_EFFECT	0x24
Data Count	1	0x01
Application Data:		
Data[0]	EffectId	nn

7.3.21.2 Data Description

EffectId:

Data Type:	Unsigned 8 bit integer
Max:	Set by the Effect Count in the “Unit Configuration Packet”.

7.3.21.3 DC-2/MC-1 Response

The DC-2/MC-1 will load the desired effect.

7.3.21.4 Data Validation

If a value is passed that exceeds the maximum value of that parameter the DC-2/MC-1 will ignore the command and transmit a NAK command with an error code DC_ERR_INVALID_DATA.

7.3.22 Set Record/Zone2 Input

Sets the Record/Zone 2 input. If Record/Zone2 was inactive, this command will set the input then activate the Record/Zone 2 function.

7.3.22.1 Command Packet Description

Application Header:		
Command	DC_CMD_SET_REC_INPUT	0x25
Data Count	1	0x01
Application Data:		
Data[0]	InputId	nn

7.3.22.2 Data Description

InputId:

Data Type: Unsigned 8 bit Integer
Max Value: 7
Conversion: Input Id's are defined in Appendix D Input Id's

7.3.22.3 DC-2/MC-1 Response

7.3.22.4 Data Validation:

The InputId must be a valid Input Id. If it is not the DC-2/MC-1 will respond with a NAK packet and error code DC_ERR_ INVALID_INPUT_ID. If the input selection is disallowed(input blocked, digital input not selected…) DC-2/MC-1 will respond with a NAK packet and error code DC_ERR_INVALID_INPUT If the input is assigned the DC-2/MC-1 will respond with an ACK Packet.

7.3.23 Clear Record/Zone2 Input

Clears or Unassign's the Record/Zone 2 input. If Record/Zone2 is active, this command will unassign the zone 2 input and set the record outputs to the main input source.

7.3.23.1 Packet Description

Application Header:		
Command	DC_CMD_CLEAR_REC_INPUT	0x26
Data Count	1	0x01
Application Data:		
Data[0]	InputId	nn

7.3.23.2 Data Description

InputId:

Data Type: Unsigned 8 bit Integer
Max Value: 7
Conversion: Input Id's are defined in Appendix D Input Id's

7.3.23.3 DC-2/MC-1 Response

7.3.23.4 Data Validation

The InputId must be a valid Input Id. If it is not the DC-2/MC-1 will respond with a NAK packet and error code DC_ERR_ INVALID_INPUT_ID. If the input is unassigned the DC-2/MC-1 will respond with an ACK Packet. If the record/zone 2 function was not active the DC-2/MC-1 will respond with an ACK packet.

7.3.24 Set Zone2 Volume

Commands DC-2/MC-1 to set the system volume with the value in this packet.

7.3.24.1 Command Packet Description

Application Header:		
Command	DC_CMD_SET_ZONE2_VOLUME	0x27
Data Count	1	0x01
Application Data:		
Data[0]	Value	nn

7.3.24.2 Data Description

Value:

Data Type:	Unsigned 8 bit integer.
Max:	92
Conversion:	0 = -80 dB
	92 = +12 dB

7.3.24.3 DC-2/MC-1 Response

The DC-2/MC-1 will assign the value from the packet to the zone2 volume.

7.3.24.4 Data Validation

If a value is passed that exceeds the maximum value of that parameter the DC-2/MC-1 will ignore the command and transmit a NAK command with an error code DC_ERR_INVALID_DATA.

7.3.25 Set Zone2 Left/Right Balance

Commands DC-2/MC-1 to set the Zone2 balance to the value in this packet.

7.3.25.1 Packet Description

Application Header:		
Command	DC_CMD_SET_ZONE2_BALANCE	0x28
Data Count	1	0x01
Application Data:		
Data[0]	Value	nn

7.3.25.2 Data Description

Value:

Data Type:	Unsigned 8 bit integer.
Maximum Value:	32
Conversion:	0 = Left
	32 = Right

7.3.25.3 DC-2/MC-1 Response

The DC-2/MC-1 will assign the value from the packet to the Zone2 balance.

7.3.25.4 Data Validation

If a value is passed that exceeds the maximum value of that parameter the DC-2/MC-1 will ignore the command and transmit a NAK command with an error code DC_ERR_INVALID_DATA.

7.3.26 Set Custom Name

Sets the Custom Name that can be displayed when the unit powers up.

7.3.26.1 Packet Description

Application Header:		
Command	DC_CMD_SET_CUST_NAME	0x2C
Data Count	1 + strlen(CustomName) + 1	nn
Application Data:		
Data[0]	CustomNameEnable	nn
Data[1]-Data[DataCount-1]	CustomName	ch ch ch … 0x00

7.3.26.2 Data Description

CustomNameEnable: Enables/Disables the Custom Name Display.
- DataType: Boolean
- TRUE: CustomName Enabled
- FALSE: CustomName Disabled

CustomName:
- Data Type: Null(0x00) terminated ASCII character string.
- Max Length: CUSTOM_NAME_LENGTH defined in Appendix E Protocol Constants.

7.3.26.3 DC-2/MC-1 Response

If the custom name enable is TRUE then the custom name banner is display on “power on”. If the Custom Name Enable is FASLE the custom name is not displayed. The CustomName string is copied to Nonvolatile RAM. The DC-2/MC-1 will Ack when completed with this command.

7.3.26.4 Data Validation:

If an invalid string is passed, DC-2/MC-1 will ignore the command and transmit a DC_NAK command with an error code DC_INVALID_DATA.

7.3.27 Set Input Name by Id

Sets an Input Name to the transmitted value for a given input.

7.3.27.1 Command Packet Description

Application Header:		
Command	DC_CMD_SET_INPUT_NAME	0x2E
Data Count	strlen(InputName) + 2	nn
Application Data:		
Data[0]	InputId	0 to 7
Data[1]-Data[DataCount-1]	InputName	ch ch ch ... 0x00

7.3.27.2 Data Description

InputId:
- Data Type: Unsigned 8 bit Integer
- Max Value: 7
- Conversion: Input Id are defined in Appendix D Input Id’s

InputName:
- Data Type: Null(0x00) terminated ASCII character string.
- Max Length: INPUT_NAME_LENGTH defined in Appendix E Protocol Constants.

7.3.27.3 DC-2/MC-1 Response

DC-2/MC-1 will copy the InputName to the given input.

7.3.27.4 Data Validation:

The InputId must be a valid Input Id. If it is not the DC-2/MC-1 will respond with a NAK packet and error code DC_ERR_ INVALID_INPUT_ID. If the InputName string exceeds the INPUT_NAME _LENGTH, the DC-2/MC-1 will ignore the command and transmit a DC_NAK command with an error code DC_ERR_INVALID_DATA.

7.3.28 Set FPD Control Registers

Sets FPD Control Registers to the transmitted values.

7.3.28.1 Command Packet Description

Application Header:		
Command	DC_SET_FPD_CONTROL	0x2A
Data Count	4	0x04
Application Data:		
Data[0]	FPD_CtrlReg0	nn
Data[1]	FPD_CtrlReg1	nn
Data[2]	FPD_CtrlReg2	nn
Data[4]	FPD_MinUpdate	nn

7.3.28.2 Data Description

FPD_CtrlReg0: BitPack as defined in Appendix F FPD Control Registers
FPD_CtrlReg1: BitPack as defined in Appendix F FPD Control Registers
FPD_CtrlReg2: BitPack as defined in Appendix F FPD Control Registers
FPD_MinUpdate: This value sets the minimum time between FPD Notification Transmissions.

Data Type: Unsigned 8 bit integer
Default: 50(100 mSec)
Range: 50 - 255 counts
Conversion: 500 counts/sec

7.3.28.3 DC-2/MC-1 Response

The control register values transmitted will be copied over to the registers stored in nonvolatile RAM. The FPD_MinUpdate will be range limited. The DC-2/MC-1 will respond with an ACK Packet.

7.3.29 Host Wakeup

By transmitting the Wakeup Notification, the Host indicates it has just “powered on” or reset and is ready to receive DC-2/MC-1 Notifications or Responses. If no acknowledgment is received within ACK_TIMEOUT, the Host should indicate that the DC-2/MC-1 was not found.

7.3.29.1 Command Packet Description

Application Header:		
Command	HOST_WAKEUP	0x11
Data Count	0	0x00
Application Data:		
	N/A	

7.3.29.2 Data Description

N/A

7.3.29.3 DC-2/MC-1 Response

The DC-2/MC-1 will respond to this command with an ACK.

7.3.30 Host Sleep

By transmitting the Sleep command, the Host indicates it has just "powered down" and will no longer respond to DC-2/MC-1 Notifications. No Acknowledgment is expected.

7.3.30.1 Packet Description

Application Header:		
Command	HOST_SLEEP	0x12
Data Count	0	0x00
Application Data:		
	N/A	

7.3.30.2 Data Description

N/A

7.3.31 Get Communication Configuration

Request to DC-2/MC-1 for the current communications configuration for the serial port and protocol. The DC-2/MC-1 responds to this command with a Communication Configuration Packet.

7.3.31.1 Command Packet Description

Application Header:		
Command	DC_CMD_GET_COM_CONFIG	0x2F
Data Count	0	0x00
Application Data:		
	N/A	

7.3.31.2 System Parameter Values Response Packet

Application Header:		
Command	DC_RESP_COM_CONFIG	0x8C
Data Count	1	0x01
Application Data:		
Data[0]	Configuration Register 0	nn

7.3.31.3 Data Description

Data Word	Bit	Definition
0	0	Acknowledge Enable
0	1	Parameter Change Enable
0	2	LED Acknowledge Enable

Acknowledge Enable: TRUE Indicates the DC-2/MC-1 will transmit Acknowledge Notification's to the Host.

FALSE Indicates the DC-2/MC-1 will not transmit any positive Acknowledge Notification messages. The DC-2/MC-1 will always transmit NAK error notification messages.

Parameter Change Enable: TRUE Indicates the DC-2/MC-1 will transmit any parameter change Notification as specified in the Parameter Change Notification Message.

FALSE Indicates the DC-2/MC-1 will not transmit parameter change Notifications.

LED Acknowledge Enable: TRUE Indicates the DC-2/MC-1 will light the green standby LED to indicate the DC-2/MC-1 is receiving data on the RS232 serial port, and will light the Red Overload LED to indicate the Dc-2/MC-1 is transmitting data on the RS232 serial port.
FALSE Indicates the DC-2/MC-1 will not light the green standby or the red overload LED's.

7.3.32 Set Communication Configuration

The Set Communication Configuration Command allows the serial port user to setup the various serial port/ protocol configuration parameters.

7.3.32.1 Command Packet Description

Application Header:		
Command	DC_CMD_SET_COM_CONFIG	0x30
Data Count	1	0x01
Application Data:		
Data[0]	Configuration Register 0	nn

7.3.32.2 Data Description

Data Word	Bit	Definition
0	0	Acknowledge Enable
0	1	Parameter Change Enable
0	2	LED Acknowledge Enable

Acknowledge Enable: TRUE Indicates the DC-2/MC-1 will transmit Acknowledge Notification's to the Host.
FALSE Indicates the DC-2/MC-1 will not transmit any positive Acknowledge Notification messages. The DC-2/MC-1 will always transmit NAK error notification messages.

Parameter Change Enable: TRUE Indicates the DC-2/MC-1 will transmit any paramter change Notification as specified in the Parameter Change Notification Message.
FALSE Indicates the DC-2/MC-1 will not transmit parameter change Notifications.

LED Acknowledge Enable: TRUE Indicates the DC-2/MC-1 will light the green standby LED to indicate the DC-2/MC-1 is receiving data on the RS232 serial port, and will light the Red Overload LED to indicate the Dc-2/MC-1 is transmitting data on the RS232 serial port.
FALSE Indicates the DC-2/MC-1 will not light the green standby or the red overload LED's.

7.3.32.3 DC-2/MC-1 Response

The data values transmitted will be copied over to the registers stored in nonvolatile RAM. The DC-2/MC-1 will respond with an ACK Packet.

7.3.33 Set Mute

The Set Mute Command message allows the RS232 users to set/clear the DC-2/MC-1 mute state directly.

7.3.33.1 Command Packet Description

Application Header:		
Command	DC_CMD_SET_MUTE	0x31
Data Count	1	0x01
Application Data:		
Data[0]	Mute State	nn

7.3.33.2 Data Description

MUTE State: Value Definition

0 UNMUTE The user mute state is set to unmuted. The DC-2/MC-1 may still be muted for other internal reasons.

1 USER MUTE The system volume decrements by the specified user amount as set in the OUTPUT LEVELS Menu.

2 FULL MUTE The system is fully muted.

7.3.33.3 DC-2/MC-1 Response

The DC-2/MC-1 will set the mute state according to the value transmitted. The DC-2/MC-1 may still be full muted if other conditions require the audio path to be muted. This is only a direct access to the user mute state.

7.3.33.4 Data Validation

The Data value transmitted to the DC-2/MC-1 will be verified as a valid value. If Valid the DC-2/MC-1 will set/clear the mute and respond with an ACK Packet. If the data value is invalid the DC-2/MC-1 will respond with an DC_ERR_INVALID_DATA error NAK.

7.3.34 Set Output Level Adjustments

The Set Output level adjustments Command message allows the RS232 users to set the DC-2/MC-1's output level adjustments to a given value. These adjustments can otherwise be set through the Internal or External Noise Output Level Menus.

7.3.34.1 Command Packet Description

Application Header:		
Command	DC_CMD_SET_OUTPUT_ADJ	0x32
Data Count	2	0x02
Application Data:		
Data[0]	Adjustment Value	nn
Data[1]	Output ID	nn

7.3.34.2 Data Description

Adjustment Value: Unsigned 8 bit Integer
Range: 0 - 40 Counts
Conversion: 0 = -10 dB
40 = +10 dB
Step: 0.5 dB /Count

Output Id: Unsigned 8 bit Integer

Speaker	Id #
Center	0
Subwoofer	1
Front Left	2
Front Right	3
Side Left	4
Side Right	5
Rear Left	6
Rear Right	7

7.3.34.3 DC-2/MC-1 Response

The output ID will be verified for validity. The output adjustment will be range checked. The Output Id must be a valid Id number as stated in this document. If it is not the DC-2/MC-1 will respond with a NAK packet and error code DC_ERR_ INVALID_PARAM_NUMBER. If the output adjustment value is out of range the DC-2/MC-1 will respond with a NAK error DC_ERR_INVALID_DATA. Otherwise the DC-2/MC-1 will set the adjustment value and respond with an ACK.
Sets the Custom Name that can be displayed when the unit powers up.

7.3.35 Send Display String Command

This command allows the Host to send a 40 character string to the Dc-2/Mc-1 for display on the OSD and Front Panel Displays.

7.3.35.1 Packet Description

Application Header:		
Command	DC_CMD_SET_DISPLAY_STR	0x33
Data Count	1 + strlen(DisplayStr) + 1	nn
Application Data:		
Data[0]	DisplayFlags	nn
Data[1]-Data[DataCount-1]	DisplayStr	ch ch ch … 0x00

7.3.35.2 Data Description

Display Command Flags:

Data Word	Bit	Definition
0	0	FPD only: If set TRUE, the display string will only be sent to the FPD device for display.
0	1	Undefined.
0	2	Undefined.
0	3	Undefined.
0	4	Undefined.
0	5	Undefined.
0	6	Undefined.
0	7	Undefined.

Display String:

Data Type: Null(0x00) terminated ASCII character string.
Max Length: 40 Characters.

7.3.35.3 DC-2/MC-1 Response

The display string is sent to the OSD and Front Panel Displays. The DC-2/MC-1 will ACK when completed with this command.

7.3.35.4 Data Validation:

If a string length exceeds the 40 character maximum the string will be truncated before displaying and the DC-2/MC-1 transmit a DC_NAK command with an error code DC_INVALID_DATA.

8 Internal Use

8.1.1 Debug Character

Not Supported for External Distribution.

8.1.2 PEEK Command

Not Supported for External Distribution.

8.1.3 POKE Command

Not Supported for External Distribution.

9 Appendix A Command Codes

Notifications:		
	DC_NO_CMD	0x00
	DC_WAKEUP	0x01
	DC_SLEEP	0x02
	DC_FPD	0x03
	DC_PARAM_CHG_MSG	0x04
	DC_PEEK	0x08
	DC_POKE	0x09
	DC_DEBUG_STRING	0x40
	DC_DEBUG_CHAR	0x41

Host Commands:		
	DC_CMD_RESET	0x10
	HOST_WAKEUP	0x11
	HOST_SLEEP	0x12
	DC_CMD_RESTORE_DEFAULTS	0x13
	DC_CMD_IR	0x14
	DC_CMD_GET_CONFIG	0x15
	DC_CMD_GET_SYS_STATUS	0x16
	DC_CMD_GET_REC_STATUS	0x17
	DC_CMD_GET_SYS_PARAM_BY_ID	0x18
	DC_CMD_GET_SYS_PARAM_BY_NAME	0x19
	DC_CMD_GET_SYS_PARAM_VALUES	0x1A
	DC_CMD_GET_EFFECT	0x1B
	DC_CMD_GET_EFFECT_PARAM_DEF	0x1C
	DC_CMD_GET_EFFECT_PARAM_VALUES	0x1D
	DC_CMD_SET_SYS_PARAM_VALUES	0x1E
	DC_CMD_SET_EFFECT_PARAM_VALUES	0x1F
	DC_CMD_SET_EFFECT_NAME	0x20
	DC_CMD_SET_SYS_VOLUME	0x21
	DC_CMD_SET_SYS_BALANCE	0x22
	DC_CMD_SET_FRONT_BACK_BALANCE	0x23
	DC_CMD_SET_EFFECT	0x24
	DC_CMD_SET_REC_INPUT	0x25
	DC_CMD_CLEAR_REC_INPUT	0x26
	DC_CMD_SET_ZONE2_VOLUME	0x27
	DC_CMD_SET_ZONE2_BALANCE	0x28
	DC_CMD_GET_FPD_CTRL	0x29
	DC_CMD_SET_FPD_CTRL	0x2A
	DC_CMD_GET_CUST_NAME	0x2B
	DC_CMD_SET_CUST_NAME	0x2C
	DC_CMD_GET_INPUT_NAME	0x2D
	DC_CMD_SET_INPUT_NAME	0x2E
	DC_CMD_GET_COM_CONFIG	0x2F
	DC_CMD_SET_COM_CONFIG	0x30
	DC_CMD_SET_MUTE	0x31
	DC_CMD_SET_OUTPUT_ADJ	0x32
	DC_CMD_SEND_DISPLAY_STR	0x33

Responses		
	DC_RESP_UNIT_CONFIG	0x80
	DC_RESP_SYS_STATUS	0x81
	DC_RESP_REC_ZONE2_STATUS	0x82
	DC_RESP_SYS_PARAM_DEF	0x83
	DC_RESP_SYS_PARAM_VALUES	0x84
	DC_RESP_EFFECT_DEF	0x85
	DC_RESP_EFFECT_PARAM_DEF	0x86
	DC_RESP_EFFECT_PARAM_VALUES	0x87
	DC_RESP_FPD_CTRL_STATUS	0x88
	DC_RESP_CUST_NAME	0x89
	DC_RESP_INPUT_NAME	0x8A
	DC_RESP_PEEK_VALUE	0x8B
	DC_RESP_COM_CONFIG	0x8C
Acknowledgments		
	DC_ACK	0xE0
	DC_NAK	0xE1

10 Appendix B Error Codes

Error	Code(Hex)
NO_ACK	0x00
DC_NO_ERROR	0x01
DC_ERR_PARITY	0x02
DC_ERR_FRAMING	0x03
DC_ERR_OVERRUN	0x04
DC_ERR_INVALID_PACKET	0x05
DC_ERR_TIME_OUT	0x06
DC_ERR_BUFFER_FULL	0x07
DC_INVALID_COUNT	0x10
DC_INVALID_CMD	0x11
DC_INVALID_DATA	0x12
DC_INVALID_ADDRESS	0x13
DC_INVALID_EFFECT_ID	0x14
DC_INVALID_PARAM_ID	0x15
DC_INVALID_NAME	0x16
DC_INVALID_INPUT	0x17

11 Appendix C DC-2/MC-1 IR-Codes

Function	Hex Code	Shift Functions	Hex Code	Rec Function	Hex Code
Off	19	Trigger Off	99	Zone-2: Off	59
On	18	Trigger On	98	Zone-2: On	58
OSD Off	02	Menu Back Off	82	Reserved	42
FrontPanel Off	03	reserved	83	Reserved	43
LIGHT	N/A		-		-
FrontPanel On	04	reserved	84	Reserved	44
OSD On	05	Menu Back On	85	Status Menu	45
Menu Up	01	Fade Front	81	Reserved	41
Done	0A	Balance Left	8A	Z-2: Bal Left	4A
SPARE	06	SPARE	86	SPARE	46
Select	08	Balance Right	88	Z-2: Bal Right	48
Menu Down	1D	Fade Rear	9D	Reserved	5D
Mute	15	Full Mute	95	Z-2: Mute	55
Effect +	1A	Center Bal/Fad	9A	Lock the LOCK	5A
Effect -	1B	EQ Off	9B	Reserved	5B
Volume +	17	Volume +5dB	97	Z-2: Volume +	57
Volume -	16	Volume –5dB	96	Z-2: Volume -	56
VCR	13	Bass +	93	R/Z-2: VCR	53
DVD	12	Treble +	92	R/Z-2: DVD	52
V-DISC	11	Tilt +	91	R/Z-2: V-DISC	51
TV	10	Loudness On	90	R/Z-2: TV	50
AUX	0F	Bass -	8F	R/Z-2: AUX	4F
CD	0E	Treble -	8E	R/Z-2: CD	4E
TUNER	0D	Tilt -	8D	R/Z-2: TUNER	4D
TAPE	0C	Loudness Off	8C	R/Z-2: TAPE	4C
Dolby	20	Nightclub	A0	Z-2 Vol: -30dB	60
THX	21	Concert Hall	A1	Z-2 Vol: -20dB	61
Logic7	22	Church	A2	Z-2 Vol: -10dB	62
dts	23	Cathedral	A3	Z-2 Vol: +00dB	63
2-Chan On/Off	24	Expansion Ports*	A4	Volume: -30dB	64
Party	25	Panorama	A5	Volume: -20dB	65
TV Matrix	26	Mono Logic	A6	Volume: -10dB	66
Music	27	Music Surround	A7	Volume: +00dB	67
SPARE	28	SPARE	A8	SPARE	68
SPARE	29	SPARE	A9	SPARE	69
SPARE	2A	SPARE	AA	SPARE	6A
SPARE	2B	SPARE	AB	SPARE	6B
SPARE	2C	SPARE	AC	SPARE	6C
SPARE	2D	SPARE	AD	SPARE	6D
SPARE	2E	SPARE	AE	SPARE	6E
SPARE	2F	SPARE	AF	SPARE	6F
null	30	null	B0	null	70

12 Appendix D Input Id's

Input Name	Input Id
Tape	0
Tuner	1
Cd	2
Aux	3
TV	4
V-Disc	5
DVD	6
VCR	7

13 Appendix E Protocol Constants

Constant	Value(Dec)	Units
FPD_LINE_LENGTH	20	Chars
PARAM_NAME_LENGTH	20	Chars
EFFECT_NAME_LENGTH	13	Chars
CUSTOM_NAME_LENGTH	20	Chars
INPUT_NAME_LENGTH	8	Chars
INTER_PACKET_TIME	200	mSec
SOP	0xF1	Hex
EOP	0xF2	Hex

DATA STREAM TYPE	
INSTREAM_UNKNOWN	0
INSTREAM_AC3	1
INSTREAM_PCM	2
INSTREAM_ANALOG	3
INSTREAM_DTS	4
INSTREAM_AC3_20	5
INSTREAM_AC3_51	6
SAMPLE RATE	
RATE_UNKNOWN	0
RATE_44	1
RATE_48	2
RATE_88	3
RATE_96	4

14 Appendix F FPD Control Registers

Control Reg 0	Bit
USER_MSG	0
REC_BLOCK_MSG	1
SYS_VOL_MSG	2
LOCKED_MSG	3
DIG_IN_NOLOCK_MSG	4
SPEAKER_ERR_MSG	5
LR_BALANCE_MSG	6
FB_BALANCE_MSG	7

Control Reg 1	Bit
SYS_MUTE_MSG	0
EQ_BASS_MSG	1
EQ_TREBLE_MSG	2
EQ_TILT_MSG	3
PGM_CHG_MSG	4
NOISE_ACTIVE_MSG	5
Z2_KEY_ERR_MSG	6
REC_SRC_ERR_MSG	7

Control Reg 2	Bit
Z2_VOLUME_MSG	0
Z2_BALANCE_MSG	1
Z2_MUTE_MSG	2
REC_SELECT_MSG	3
DIG_REC_ERR_MSG	4
BYPASS_ERR_MSG	5
MAIN_DISP_MSG	6
DTS_ERR_MSG	7

15 Application Notes and Examples

15.1 Box initializations:

15.1.1 DC-2/MC-1:

When the DC-2/MC-1 is powered on it will initialize the serial port and then transmit the DC_WAKEUP Packet, and look for an ACK from the HOST. Currently if an ACK is not received the DC-2/MC-1 continues to operate. This message is mostly for the HOST to know if the DC-2/MC-1 is in an operational state.

15.1.2 HOST:

When the HOST issues a HOST_WAKEUP Packet the DC-2/MC-1 responds with an ACK and then transmits the current FPD buffer with a DC_FPD notification. If the Host issues a HOST_WAKEUP command and does not receive the ACK it should assume it is not connected or the DC-2/MC-1 is not capable of responding on the rs-232 and therefore further serial communications will not be possible. If the DC-2/MC-1 RS232 is capable of communicating the DC-2/MC-1 will respond to a HOST_WAKEUP Command in any “On” state including standby.

15.2 Getting System Wide Status and Setup:

In order for the HOST to save a complete DC-2/MC-1 system setup it must issue several commands to learn the system configuration and then proceed to get all the data that must be saved for the complete system. A complete system setup includes all system parameter definitions and values, all effect definitions and effect parameter definitions, the DC-2/MC-1 custom name and all input names. Learning the system starts with issuing the GET_UNIT_CONFIG command. This reports back the current s/w versions, and levels and also informs the HOST of the total number of system parameters and total number of effects that are resident in the DC-2/MC-1. The HOST can now step through each system parameter and request its system parameter definition. The system parameter definition describes the parameter Id, Parameter Name, the Max value (min value is 0 for all parameters), and the current value. Following the system parameters, the HOST can also step through each effect and get its effect definition which includes the Effect Id, Effect Name, and Number of Parameters. Now for each effect the HOST can step through each effect parameter to get its definition, which includes the EffectId, Parameter Id, Max Value(min Value for all parameters is 0), and the current value. For completeness, the HOST must also get the user editable input names and the DC-2/MC-1 custom name. The HOST can get the input names by issuing a GET_INPUT_NAME command for each of the 8 inputs, and get the custom name by issuing the GET_CUSTOM_NAME command.

15.3 Downloading the System Setup to the DC-2/MC-1:

In order to download a complete system setup to the DC-2/MC-1, the HOST must first check to see if the definitions it wishes to download are current with the DC-2/MC-1 it is targeting. So the HOST should first check the unit configuration, and verify the s/w levels and versions are compatible and the number of system parameters and effects are correct. If they are not the HOST should not continue with the download, and upload the current setup and make the necessary changes so that the download will be compatible with the DC-2/MC-1. If the setup is compatible, the download should basically reverse the upload by sending the DC-2/MC-1 SET_CUST_NAME, SET_INPUT_NAME, SET_EFFECT_NAME, SET_EFFECT_PARAM_VALUES, and finally SET_SYS_PARAM_VALUES commands. For the input names , effect names and effect parameter values commands the HOST should step through each of the inputs and effects. When setting the effect that is current in the DC-2/MC-1 the DC-2/MC-1 will reload the effect in order for all the changes to be initialized. The down load should be completed by the SET_SYS_PARAM_VALUES command, because following this command the DC-2/MC-1 will reset in order for all of the system parameter changes to be initialized. Because only the parameter values are editable for both the effects and the system parameters, the HOST does not need to step through each parameter to get each definition. It only needs to assemble all the values into the SET_SYS_PARAM_VALUES and SET_EFFECT_PARAM_VALUES command packets, and download all the parameter values as a bulk data packet.

15.4 Simple System Control & System Status:

The HOST can control the system via the IR commands thus making any direct IR code a direct command. Because of some limitations in the IR codes the HOST also has direct control over the system volume, balance, fader, effect selection, zone 2 volume, balance and input selection through dedicated commands.

15.5 Examples:

The following examples show the byte's transmitted for the Get Unit Config, Get Effect Definition, and Set Input Name transactions. They are shown as they should be transmitted from left to right.

15.5.1 Get Unit Configuration

The HOST initiates by sending the GET_UNIT_CONFIG command packet:

SOP	DLL DC	CMD	AppDC	EOP
F1	03	15	00	F2

If the command is received with out error the DC-2/MC-1 responds with the UNIT_CONFIG response packet:

SOP	DLL DC	CMD	App DC	DATA0 Product Id	DATA1 SW TYPE	DATA2 SW LVL	DATA3 SW MJ REV	DATA4 SW MN REV	DATA5 PTCL MJ REV	DATA6 PTCL MN REV	DATA7 SYS PARAM COUNT	DATA8 EFFECT COUNT
F1	1C	80	19	00	03	03	03	01	01	00	BE	25

DATA9 Time Stamp	DATA10 Time Stamp	DATA11 Time Stamp	DATA12 Time Stamp	DATA13 Time Stamp	DATA14 Time Stamp	DATA15 Time Stamp	DATA16 Time Stamp	DATA17 Time Stamp	DATA18 Time Stamp	DATA19 Time Stamp	DATA20 Time Stamp	DATA21 Time Stamp	DATA22 Time Stamp	DATA23 Time Stamp	DATA24 Time Stamp	EOP
39	38	2F	30	36	2F	32	36	20	30	39	3A	35	39	00	00	F2
9	8	/	0	6	/	2	6	(sp)	0	9	:	5	9			

From the response packet we can see that the DC-2/MC-1 is configured as a
Product Id is Lexicon DC-2/MC-1
Software type DTS
Software level of alpha
Software Version 3.01
Protocol Version 1.00
with 190 system parameters
and 37 effects,
and the ROM was built
"98/06/26 09:59"

15.5.2 Get Effect Definition

Once we know how many effects the DC-2/MC-1 has resident we can then start to step through each effect for its definition. This is done by sending a GET_EFFECT command packet:

SOP	DLL DC	CMD	App DC	DATA0 EffectId	EOP
F1	04	1B	01	0F	F2

The DC-2/MC-1 responds with a DC_RESP_EFFECT_DEF packet:

SOP	DLL DC	CMD	App DC	DATA0 EffectId	DATA1 Max Params
F1	13	85	10	0F	16

DATA2 Effect Name[0]	DATA3 Effect Name[1]	DATA4 Effect Name[2]	DATA5 Effect Name[3]	DATA6 Effect Name[4]	DATA7 Effect Name[5]	DATA8 Effect Name[6]	DATA9 Effect Name[7]	DATA10 Effect Name[8]	DATA11 Effect Name[9]	DATA12 Effect Name[10]	DATA13 Effect Name[11]	DATA14 Effect Name[12]	DATA15 Effect Name[13]	EOP
4C	4F	47	49	43	20	37	20	20	20	20	20	20	00	F2
L	O	G	I	C	(sp)	7	(sp)	(sp)	(sp)	(sp)	(sp)	(sp)	00	

Here we can see that we requested effect number 16 and the DC-2/MC-1 responded with the effect number 16 definition. Effect 16 has 22 parameters and it is currently named “LOGIC 7”. Note there are trailing spaces.

15.5.3 Set Input Name

In order to change an Input name all we must do is send a DC_CMD_SET_INPUT_NAME packet:

SOP	DLL DC	CMD	App DC	DATA0 InputId	DATA1 Max Params	DATA2 Input Name[0]	DATA3 Input Name[1]	DATA4 Input Name[2]	DATA5 Input Name[3]	DATA6 Input Name[4]	DATA7 Input Name[5]	DATA8 Input Name[6]	DATA9 Input Name[7]	EOP
F1	0D	2E	0A	03	4D	59	20	49	4E	50	55	54	00	F2
					M	Y	(sp)	I	N	P	U	T	0	

Here we see that we are telling the DC-2/MC-1 to change the AUX(3) input to be renamed as “MY INPUT”.

SOP	DLL DC	CMD	App DC	DATA0 Cmd	EOP
F1	04	E0	01	2E	F2

Because the DC-2/MC-1 received and processed the command successfully the DC-2/MC-1 responds with the DC_ACK packet. Here we see that the ACK packet is responding to the DC_CMD_SET_INPUT_NAME command.

15.5.4 Send IR Command Example

SOP	DLL DC	CMD	App DC	DATA0 IR Key Code	EOP
F1	04	14	01	17	F2

This example shows how to transmit the IR command for "Volume Up". The bytes are transmitted from left to right and they are defined as:

- Byte 0: Start of Packet(F1 hex)
- Byte 1: Data Link Layer(DLL) Data Count(DC); for an IR command this would be 4 bytes to follow
- Byte 2: The Application Layer Command, in this case it is 14 hex indicating this is an IR command packet.
- Byte 3: The Application Layer Data Count(DC); for this packet it is 1 data byte to follow.
- Byte 4: The Application Command Data: This IR Command Packet is transmitting Key Code "Volume Up"(17 hex). To transmit other IR Key Codes the user would replace this byte with other IR key codes as found in Appendix C DC-2/MC-1 IR-Codes.
- Byte 5: End of Packet (F2 hex)