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**2008® SERIES REMOTE PROTOCOL MANUAL**



## **2008<sup>®</sup> Series Remote Protocol Manual**

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## About This Manual

The purpose of the *2008 Series Remote Protocol Manual* is to provide a guideline for software developers to generate external applications to be used in conjunction with the 2008T, 2008K, 2008K<sup>2</sup>, and/or the 2008K@Home™ hemodialysis machine(s). It is not intended as a guide for performing hemodialysis, a medical treatment that should only be performed under the supervision of a licensed physician.

Developers should use this document in conjunction with the appropriate operator's manual, depending on the model of hemodialysis machine:

- 2008T Hemodialysis Machine Operator's Manual – P/N 490122
- 2008K Hemodialysis Machine Operator's Manual – P/N 490042
- 2008K2 Hemodialysis Machine Operator's Manual – P/N 490136
- 2008K@Home User's Guide – P/N 490180

This manual is organized to guide a software application developer through the syntax expected by the Remote Protocol associated with 2008 Series hemodialysis machines. It begins with the general Communications Protocol Overview, which describes the communications settings necessary for the transmission of data. Next, the manual details the data format used when communicating with the machine. Finally, the manual leads the developer through the two communication protocols that may be used with a 2008 series hemodialysis machine: standard and checksum. Also included in the appendices are details about the data sent to the machine and the expected information returned by the machine.

**NOTICE:** New information and materials regarding the 2008T BlueStar® and 2008T machines running software versions 2.71 and above are marked with **red text**.

The organization of the *2008 Series Remote Protocol Manual* is as follows:

- **Preface**  
General information: how the manual is organized, word definitions, etc.
- **Chapter 1 – Communications Protocol Overview**  
Introduces the operator to the machine interface communication and the framework for communication with a 2008 Series hemodialysis machine.
- **Chapter 2 – Data Format**  
Provides instructions on the structure of the data transmitted to and from the machine.

- **Chapter 3 – Standard Communication Protocol**  
Describes the standard packet structure involved in communicating with the machine.
- **Chapter 4 – Checksum Communication Protocol**  
Guides the user through the steps and structure involved in the checksum procedure.
- **Appendix A: Commands**
- **Appendix B: Group Codes**
- **Appendix C: Field Codes**
- **Appendix D: Patient Prescription**
- **Appendix E: Service Mode Parameters**
- **Appendix F: Dialysis Mode Parameters**
- **Appendix G: Preventative Maintenance Settings**

## Definitions

Abbreviation	Meaning
ASCII	American Standard Code for Information Interchange.
Machine	Any 2008 Series hemodialysis machine (i.e. 2008K, 2008K <sup>2</sup> , 2008K@Home, 2008T).
RS232	Recommended Standard 232 of serial communication.
Host	The computer or hardware that houses the communicating application.
<SOH>	ASCII control character 0x01. Start of header.
<STX>	ASCII control character 0x02. Start of transmission.
<ETX>	ASCII control character 0x03. End of transmission.
<ACK>	ASCII control character 0x06. Positive acknowledgement.
<NAK>	ASCII control character 0x15. Negative acknowledgement.
TMP	Trans-Membrane Pressure.
BTM	Blood Temperature Module.
BVM	Blood Volume Module.
UF	Ultrafiltration.
SVS	Sodium Variation System.
Kecn	Effective Conductivity Clearance.
Kt/V	Dialysis Treatment Adequacy.
OLC	Online Clearance.
LV	Low Volume.
O Art	Zero Arterial Pressure. In service mode, this sets the lower arterial pressure limit at 0.
PM	Preventative Maintenance.
TS-enabled	Time Stamp Enabled. Turns on "On Occurrence" Mode.

## *Questions?*

For further information regarding the communication protocols related to the 2008 Series hemodialysis machines, please contact:

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## Chapter 1 – Communications Protocol Overview

Asynchronous RS232 serial communication is used to communicate between the 2008 Series machine and the Host. The data transmission uses Transmit and Receive lines. The baud rate is 9600, 8 data bits, 1 stop bit, no parity. No hardware handshaking is supported.

On all 2008 series machines, the serial communications protocol is available on an isolated D-type 9-pin plug serial port on the back of the machine. On this connector, pin 2 is transmit, pin 3 is receive, and pin 5 is signal ground. When connecting to a standard 9-pin serial port on a PC, the cable may be wired with all pins straight through. No other ground connection other than pin 5 on the serial port connector should be made between the Host and the machine to prevent leakage current from the Host from entering the machine. The 9-pin connector shells should not be wired together on the cable.

There are two types of communication protocols that can be used when interacting with a 2008 Series hemodialysis machine:

- [Standard Protocol](#)

This is the fundamental layer of data protocol. It involves a simple set of request and response data packets without handshaking. (See Chapter 3 for more information.)

- [Checksum Protocol](#)

This is the data protocol that encapsulates the data inside. This protocol adds header and checksum components for data security, as well as handshaking to enhance communication. The Checksum Protocol is also referred to as “New Protocol.” (See Chapter 4 for more information.)

Most communications (with the exception of Patient Prescription, available only for 2008T software version 2.71 or higher) are initiated by the Host, which can send multiple data packets at a time. These packets can specify requests for information to be transmitted back from the machine, as well as the frequency at which the data is sent. The machine, in turn, sends the corresponding field data back to the Host either by the specified time interval or, if configured using 2008T software version 2.71 or greater, on occurrence. The only exception to sending data out during the interval (if configured) is for alarm packets, which send as soon as the alarm occurs.

The communication can be configured to run either protocol by entering the machine’s Service Mode. To enter Service Mode, turn on the machine and press the [Enter] key when prompted “Press CONFIRM For Service Mode”. After the machine boots up in Service Mode, navigate to the *Options* menu and select *Comm Options*.



On this screen, the “New Protocol” button controls the communication type. Touching the “New Protocol” button switches the options between *Yes* (Checksum Protocol) and *No* (Standard Protocol). After selecting the intended protocol, press the [Enter] key to confirm the selection.

2008T machines contain an optional built-in PC known as the CDX. The communication protocol used to communicate with the CDX PC is selected from the Service Mode screen. Enter Service mode and select either the “CDX New Protocol” (for 2008T machines) or the “CDX” button (for 2008T software version 2.71 or greater) to change the communication type. Touch the button to switch between *Yes* and *No*. *Yes* enables communication with the CDX PC inside the machine; *No* enables communication with the RS232 serial port on the back of the machine. The CDX connects from serial port COM1 to the 2008 series processor for serial communications.

For 2008T software versions 2.71 or greater, only one serial port may be used at a time. Should communications through the RS232 serial port not work, or connection to the CDX be unsuccessful, check to make sure that another connection to a serial port is not in use.

## Chapter 2 – Data Format

A packet contains a single Data Section that may fall under one of three categories:

- Control,
- Field, or
- Acknowledgement.

### *Control*

A Control-type data packet can only be sent from the Host to the 2008 Series hemodialysis machine.

The data may include one or more of the following components: Commands, Group Codes, and Interval Updates. Each component should be separated by a comma.

- A *Command* is a 2- or 3-character string that prompts the machine to perform a function. No data is transmitted back from the machine in response to a Command.
- A *Group Code* is a 2-character string that prompts the machine to send Field packets back to the Host that correspond with the designated group. (See Appendix B.)
- An *Interval Update* is a 2- or 3-character string that prompts the machine to change the frequency at which data is sent back from the machine. The default interval is 0 seconds. The minimum interval in Standard Protocol is 10 seconds; the minimum interval in Checksum Protocol is 11 seconds. The maximum interval for Standard Protocol and Checksum Protocol is 600 seconds (10 minutes). **For 2008T machines running software version 2.71 or greater, the maximum interval is 10800 seconds (3 hours) if Timestamp (TS) is enabled.** When an Interval Update successfully transmits, the machine's internal interval timer resets.

When each component is received, the machine updates an internal list of controls, adding the component to the list if it was not already called. Duplicate controls shall be treated as if only one instance of the control is made. Invalid controls shall be ignored by the machine. The only way to clear the list is to send a Reset Command "CX". This Command also resets the interval to 0 unless followed by an Interval Update.

Components of a Control-type data packet are read from left to right. Items listed before a Reset Command are cleared and replaced with the items after "CX". Also, in the case of multiple Interval Updates, only the rightmost integer is considered.

Below are some examples of valid **Control**-type Data Sections\*:

*Example 1: CX*

0x43 0x58

*Situation:* Single Control

*Result:* Prompts the machine to reset communications (including the interval).

*Example 2: DI,VX,013*

0x44 0x49 0x2C 0x56 0x58 0x2C 0x30 0x31 0x33

*Situation:* Multiple Controls

*Result:* Prompts the machine to send DI and VX group data packets (TP, DF, CD, BF; VP, VH, VL) to the Host every 13 seconds.

*Example 3: BP,CX,DI*

0x42 0x50 0x2C 0x43 0x58 0x2C 0x44 0x49

*Situation:* Embedded CX

*Result:* Prompts the machine to reset communications (including the interval) and send DI group data packets (TP, DF, CD, BF). Data is not sent from the machine until an interval update. The BP preceding CX is ignored.

*Example 4: BP,011,DI,015*

0x42 0x50 0x2C 0x30 0x31 0x31 0x2C 0x44 0x49 0x2C 0x30 0x31 0x35

*Situation:* Multiple *Interval Updates*

*Result:* Prompts the machine to send BP and DI group data packets (SY, DY, PL, MA; TP, DF, CD, BF) to the Host every 15 seconds.

*Example 5: BP,BP*

0x42 0x50 0x2C 0x42 0x50

*Situation:* Duplicate *Group Codes*

*Result:* Prompts the machine to send BP group data packets (SY, DY, PL, MA). This occurs at the specified interval.

\* Each example shows the ASCII string of the **Controls**. The subsequent line represents the hexadecimal ASCII of the data.

## Field

A **Field**-type data packet can only be sent from the 2008 Series hemodialysis machine to the Host. **Field**-type data packets contain information requested by previous **Control**-type data packets. These packets are sent continuously at the specified interval until a *Reset Command* is received.

This data is composed of any number of **Field** items. Each item is separated by a comma. If there is no data to be transmitted under Standard Protocol, the Data Section remains empty but the packet is sent at the specified interval. If there is no data to be transmitted in Checksum Protocol, the machine does not send any packet back.

Each item has two components: a 2-character *Field Code* and a corresponding *Field Value*. For non-2008T machines and 2008T machines with software versions prior to 2.71, certain *Field Codes* are only available when running Checksum Protocol. The format of the *Field Value* is dependent on the *Field Code*. (See Appendix C for more information.)

Below are some examples of valid **Field**-type Data Sections\*:

### Example 1: UR0600,UTT

0x55 0x52 0x30 0x36 0x30 0x30 0x2C 0x55 0x54 0x54

*Situation:* Host sent UF *Group Code*

*Result:* UF rate (xxxx) = 600 mL/min.

UF on (T/F) = True

### Example 2: RIF,DSF,DIT,BST

0x52 0x49 0x46 0x2C 0x44 0x53 0x46 0x2C 0x44 0x49 0x54 0x2C 0x42  
0x53 0x54

*Situation:* Host sent MS *Group Code*

*Result:* Rinse Mode (T/F) = False

Disinfect Mode (T/F) = False

Dialysis Mode (T/F) = True

Blood Sensed (T/F) = True

\* Each example shows the ASCII string of the **Fields**. The subsequent line represents the hexadecimal ASCII of the data. Items within the result parentheses display the *Field Value* data formats of their respective *Field Codes*.

## Acknowledgment

Either the Host or the 2008 Series hemodialysis machine can send an **Acknowledgement**-type data packet. It sends only in Checksum Protocol after receiving a Control or Field packet.

This data is generated after verifying the checksum of a received **Control**-type or **Field**-type data packet. The result of the verification dictates the appropriate acknowledgement response.

The Data section can contain exactly one of two characters\*:

<ACK>

0x06

*Description: Sends a Positive Acknowledgement response.*

<NAK>

0x15

*Description: Sends a Negative Acknowledgement response.*

\* Each **Acknowledgement** is a one-character response. The subsequent line represents the hexadecimal ASCII of the data.

The <ACK> *Positive Acknowledgement* sends in response to a valid checksum. Likewise, the <NAK> *Negative Acknowledgment* sends in response to an invalid checksum. Further explanation is provided in [Chapter 4 – Checksum Communication Protocol](#).

## Chapter 3 – Standard Communication Protocol

The Standard Communication Protocol is the basic layer of data transmission between the Host and the 2008 Series hemodialysis machine. Upon machine start-up, the interval at which **Field** packets are sent defaults to 0 seconds (i.e. no packet sent). The machine waits to receive an initial **Control** packet from the Host. When receiving a **Control** packet, the machine updates an internal list of **Controls** and sends the appropriate **Field** packets to the Host at a specified interval. If the machine receives a lone *Reset Command*, it stops sending **Field** packets.

The data packet of the Standard Communication Protocol follows the following format:



Section	Length (Bytes)	Description
Data	Size (variable)	ASCII Packet information (See Chapter 2 – Data Format)
<CR>	1	Carriage Return character (ASCII hexadecimal 0x0D)

Below are some examples of valid Standard Protocol data packets\*:

### Example 1: CX,015<CR>

0x43 0x58 0x2C 0x30 0x31 0x35 0x0D

*Situation:* Control Packet sent from the Host to the machine.

*Result:* Clear the internal list and set the interval to 15 seconds.

### Example 2: UR0700,UTT<CR>

0x55 0x52 0x30 0x37 0x30 0x30 0x2C 0x55 0x54 0x54 0x0D

*Situation:* Field Packet sent from the machine to the Host.

*Result:* UF Rate = 700 mL/min.

UF on = True

\* Each example shows the ASCII representation of the Standard data packet. The subsequent line represents the same information in hexadecimal ASCII.

## Chapter 4 – Checksum Communication Protocol

The Checksum Communication Protocol provides another layer of security to the already existing Standard Communication Protocol. The receiving member validates each Control and Field packet through the verification of the checksum. This protocol differs from the Standard Communication Protocol in its handshaking procedure and in its data packet format.

### *Handshaking Process*

For every Control or Field packet sent, there are two members: a Sender and a Receiver. When transmitting a Control packet, the Host is the Sender and the machine is the Receiver. Likewise, when transmitting a Field packet, the machine is the Sender and the Host is the Receiver.

When the Sender transmits a data packet, it initializes an internal counter and waits up to 5 seconds for an Acknowledgment response. If the Receiver does not send this response within 5 seconds, the Sender should time out after 5 seconds, increment the count, and send the packet again. This situation may occur when the Receiver fails to detect incoming data.

Otherwise, if the Receiver successfully obtains the sent data packet, it verifies that the checksum in the packet corresponds with the received data. If the checksum is valid, the Receiver returns a Positive Acknowledgement response with the same sequence number as the data packet it validated. If the checksum is invalid, the Receiver returns a Negative Acknowledgment response with the same sequence number as the data packet it attempted to validate.

When the Sender identifies a Positive Acknowledgment response, it resets the internal counter and proceeds to send the next data packet. If the Sender encounters a Negative Acknowledgment response, it increments the count and resends the original data packet. This cycle can be repeated until 3 send attempts have been made (i.e. the count reaches 3). At this point, the Sender resets the internal counter and proceeds to send the next data packet.

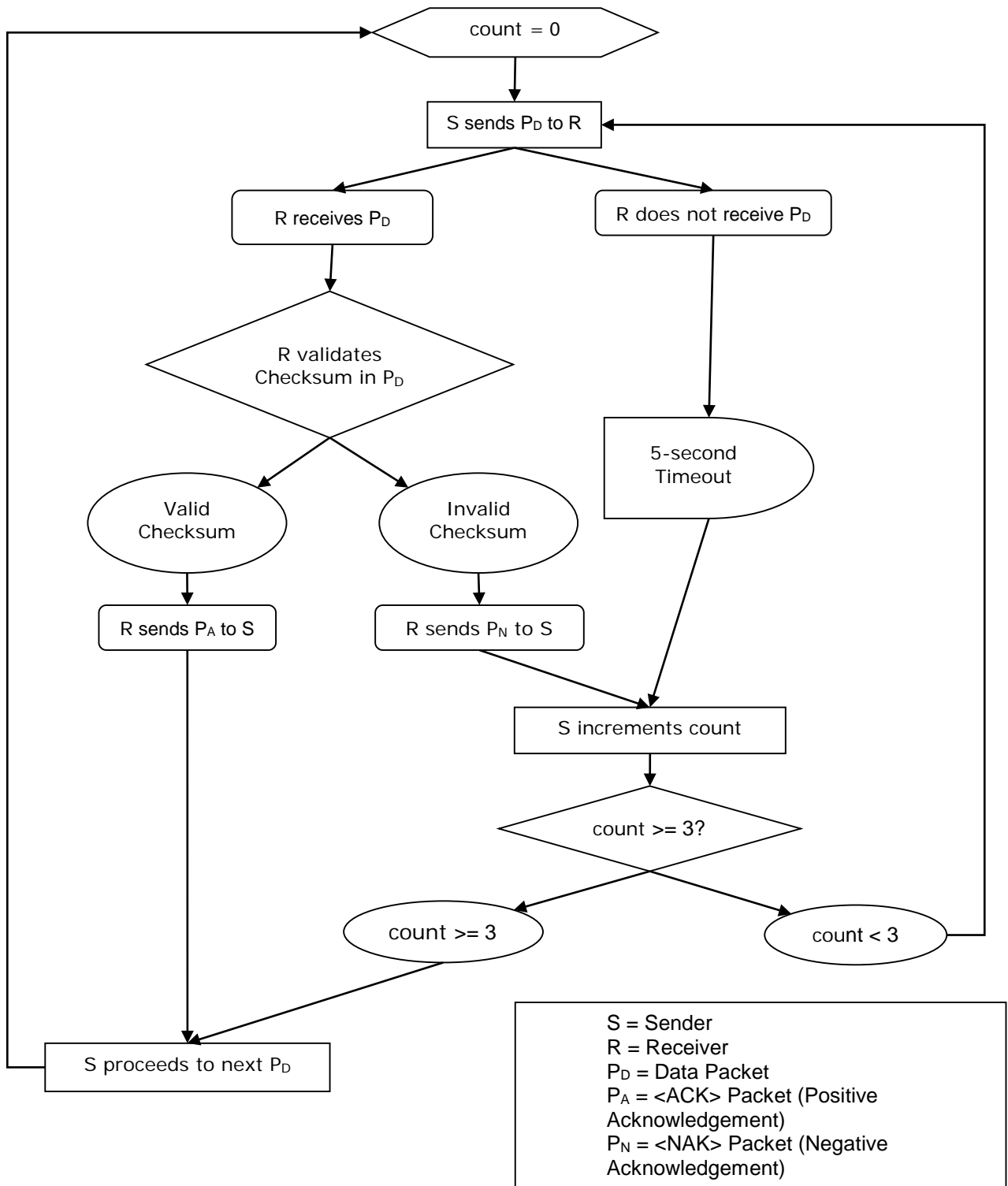
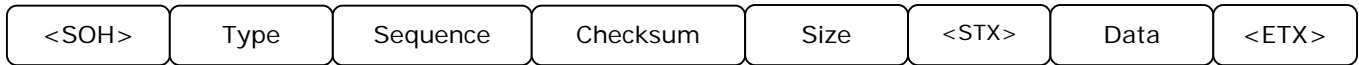


Figure 1 – Checksum Communication Protocol Handshaking Process



## Packet Format

The data packet of the Checksum Communication Protocol follows the following format:



Name	Length (Bytes)	Description
<SOH>	1	Start of packet/header <SOH>. (ASCII hexadecimal 0x01) Represents the beginning of a Checksum Communication Packet. If missing, the packet is ignored.
Packet Type	1	Designates the packet type. If data is returned in a single packet, the packet type is designated as full "F". (ASCII hexadecimal 0x46)  If data is returned in multiple packets, the corresponding packet types are designated as beginning "B" (ASCII hexadecimal 0x42), middle "M" (ASCII hexadecimal 0x4D), or end "E" (ASCII hexadecimal 0x45). The first and last packets of the data are designated with the "B" and "E" packet types, respectively. Packets sent between these two packets are designated with the "M" packet type. The concatenation of all data from the "B", "M", and "E" packets represents the full data for the associated field.
Sequence Number	1	Number of sequence from hexadecimal 0 to F. (ASCII hexadecimal 0x30 to 0x39, 0x41 to 0x46) Incremented each time a new <b>Field</b> or <b>Control</b> packet is sent. An <b>Acknowledgement</b> packet uses the same sequence number as the original packet it is responding to. The Host and the Machine maintain their own independent sequence counter. When a sequence number reaches F, the next number wraps back to 0.
Checksum	4	Data checksum in hexadecimal. Calculated as the sum of the ASCII hexadecimal values that make up the Data Section.
Size	3	Number of bytes in the Data Section. Expressed in decimal format.

<STX>	1	Start of Packet Data/Acknowledgement <STX>. (ASCII hexadecimal 0x02) Represents the beginning of the Data Section.
Data	Size ( $\leq 999$ )	ASCII Packet Data. If <i>Positive Acknowledgment</i> , this section only contains <ACK> (ASCII hexadecimal 0x06). If <i>Negative Acknowledgement</i> , this section only contains <NAK> (ASCII hexadecimal 0x15). <b>Data requested may be sent in multiple data packets.</b> See <a href="#">Chapter 2 – Data Format</a> .
<ETX>	1	End of Packet Data <ETX>. (ASCII hexadecimal 0x03) Represents the end of the Data section, as well as the end of the Checksum packet.

Below are some examples of valid Checksum Protocol data packets\*:

*Example 1: CX*

Item	Value	ASCII Hexadecimal
Checksum	$0x43 + 0x58 = 0x009B$	0x30 0x30 0x39 0x42
Size	002	0x30 0x30 0x32
Packet	<SOH>F0009B002<STX>CX<ETX>	0x01 0x46 0x30 0x30 0x39 0x42 0x42 0x30 0x30 0x32 0x02 0x43 0x58 0x03

*Example 2: BV,011*

Item	Value	ASCII Hexadecimal
Checksum	$0x42 + 0x56 + 0x2C + 0x30 + 0x31 + 0x31 = 0x0156$	0x30 0x31 0x35 0x36
Size	006	0x30 0x30 0x36
Packet	<SOH>F00156006<STX>BV,011<ETX>	0x01 0x46 0x30 0x30 0x31 0x35 0x36 0x30 0x30 0x36 0x02 0x42 0x56 0x2C 0x30 0x31 0x31 0x03

*Example 3: UR0600,UTT*

Item	Value	ASCII Hexadecimal
Checksum	$0x55 + 0x52 + 0x30 + 0x36 + 0x30 + 0x30 + 0x2C + 0x55 + 0x54 + 0x54 = 0x0296$	0x30 0x32 0x39 0x36
Size	010	0x30 0x31 0x30
Packet	<SOH>F00296010<STX>UR0600,UTT<ETX>	0x01 0x46 0x30 0x30 0x32 0x39 0x36 0x30 0x31 0x30 0x02 0x55 0x52 0x30 0x36 0x30 0x30 0x2C 0x55 0x54 0x54 0x03

*Example 4: <ACK>*

Item	Value	ASCII Hexadecimal
Checksum	$0x06 = 0x0006$	0x30 0x30 0x30 0x36
Size	001	0x30 0x30 0x31
Packet	<SOH>F00006001<STX><ACK><ETX>	0x01 0x46 0x30 0x30 0x30 0x30 0x36 0x30 0x30 0x31 0x02 0x06 0x03

*Example 5a: <NAK>*

Item	Value	ASCII Hexadecimal
Checksum	$0x15 = 0x0015$	0x30 0x30 0x31 0x35
Size	001	0x30 0x30 0x31
Packet	<SOH>F00015001<STX><NAK><ETX>	0x01 0x46 0x30 0x30 0x30 0x31 0x35 0x30 0x30 0x31 0x02 0x15 0x03

**Note:** With 2008T software versions earlier than v2.71, the *Negative Acknowledgement* packet has a different format, as shown below. In this packet, no “End of Transmission” character <ETX> is sent.

*Example 5b: <NAK>*

Item	Value	ASCII Hexadecimal
Checksum	0x15 = 0x0015	0x30 0x30 0x31 0x35
Size	001	0x30 0x30 0x31
Packet	<SOH>F00015001<STX><ACK><NAK>	0x01 0x46 0x30 0x30 0x30 0x31 0x35 0x30 0x30 0x31 0x02 0x06 0x15

\* Each example shows the intended data to be transmitted and its corresponding Checksum packet. The sequence number for all these examples is 0.

## Appendix A - Commands

Command Code	Meaning	Comments
CX	Resets communications	Send as the first command, or whenever needed. This command should be sent individually and not mixed with other groups or commands. If CX is sent in a group, all commands prior to CX will be ignored.
DXF*	Turns Green traffic/status light off	
DXT*	Turns Green traffic/status light on	
EXF*	Turns Yellow traffic/status light off	
EXT*	Turns Yellow traffic/status light on	
CG	Changes the color of the communication icon for a 60-second duration (only available in Checksum Protocol on the 2008K@Home)	<p>This command changes the color of the communication icon (phone) in the dialogue box to:</p> <p>Grey – power on or dialysis paused</p> <p>Green – signal received during treatment</p> <p>Red – no signal received in 1 minute during treatment</p>
###	Communication interval time; begins sending data packets every ### seconds	<p>ASCII number from minimum to 600. Minimum is 10 in Standard Protocol; minimum is 11 in Checksum Protocol. If out of range, the interval time defaults to 000.</p> <p>In Standard Protocol, an interval time of less than minimum means that no packets transmit from the machine, regardless of the controls.</p> <p>In Checksum Protocol, an interval of 0 seconds means that packets are not transmitted from the machine.</p>

\* The traffic/status light control can only be enabled by setting an option in the machine's Service Mode. To enter Service Mode, turn on the machine and press the [Enter] key when prompted "Press CONFIRM For Service Mode". After the machine boots up in Service Mode, navigate to the Options menu and select Hardware Options. On this screen, the Beacon button controls the input for the traffic/status light. Use the [Up] and [Down] arrow keys to select FDS08 and press the [Enter] key to confirm the selection. When using the traffic/status light commands, it is recommended to turn one light off when turning the other on to avoid confusion.

## Appendix B – Group Codes

### General Groups

Group Code	Machine data packet includes:	Software Version	Comments
AL	AA, AB, AC, AD, AF, AL, AN, AR, AT, AU, AV	All except for AD	Alarms. <b>Note:</b> AD is active with TS-enabled on 2008T software v2.71 or greater.
BP	DU, DY, MA, MU, PL, PU, SU, SY	All except DU, MU, PU, SU	Blood Pressure Module Data. <b>Note:</b> DU, MU, PU, SU are active with TS-enabled on 2008T software v2.71 or greater.
BT	HA, RE, TA, TB, TE, TV	All	Blood Temperature Module (BTM) and Heparin Data.
BV	HB, HT, RB, TR	All	Blood Volume Module (BVM) Data.
CL	DK, EK, HC, KE, KO, KT, PK, PN, VS	All	Clearance Data.
CM	BA, CB, CC, CH, CM, CO, CP, CW, DA, DV, MO, OA	All except DA, DV	Crit-Line Module Data. (Crit-Line is only available on 2008T machines v2.48 or later.) <b>Note:</b> DA and DV are active with TS-enabled on 2008T software v2.71 or greater.
DC	AE, CA, CI, CT, DX, FM, K+, MG, NB, ST, TD	≥ 2.71	Concentrate Data (on Dialysate Screen). If an SVS program is active, the returned parameters are associated only with the base values (i.e., Na base).
DI	BF, CD, DF, TP	All	Dialysate Values.
FL	FA, P1, P2, P3, P4, P5, P6	All	Access Flow and Plasma Data.
GG	FG, JG, MH, PM, SN, XN, ZO	≥ 2.71	Configuration Data. Because GG sends out a larger array, it should be requested individually and not mixed with other groups.
KA	K1, K2, K3, K4, K5, K6, K7, K8, K9	≥ 2.71	Kecn Data.

Group Code	Machine data packet includes:	Software Version	Comments
KS	DK, HA, HI, HR, HS, HV, KT, QB, QD, TT, TX	All except HI, HS, HV	Treatment Data. <b>Note:</b> HI, HS and HV are active with TS-enabled on 2008T software v2.71 or greater.
LS	SL	≥ 2.71	Beacon Status.
MS	BD, BS, DI, DL, DP, DS, HD, RI	All except BD, DL, DP, HD	Machine States. <b>Note:</b> BD, DL, DP and HD are active with TS-enabled on 2008T software v2.71 or greater.
NM	NM	≥ 2.71	Status Box Message.
OZ	PS	≥ 2.71	Crit-Line Printability.
PR	AP, TM, VP	All	Pressure Values.
SS	PE, PR, PX, WA, WE	All	Safety System. (Pulse Oximeter and Wireless Wetness Detector only available on the 2008K@Home.)
TN	TN	≥ 2.71	Treatment Number.
UF	UR, UT	All	Ultrafiltrate Values.
VR	MN, VA, VB, VC, VD, VF, VR, VU	All except for MN, VA, VB, VC, VD, VF, VU	Machine Information. Must be requested individually and not mixed with other groups. <b>Note:</b> MN, VA, VB, VC, VD, VF and VU are active with TS-enabled on 2008T software v2.71 or greater.
VX	VH, VL, VP	All	Venous Group. <b>Note:</b> VX is for standard protocol only unless 2008T software v2.71 or greater. For v2.71 or greater, VX is also available for checksum protocol.
XT	BI, BV, MI, NB, NS, PA, RT, SP, ST, UF, UG, UP, UV	All	Extra Values.

## Special Groups

Send	Receive	Software Version	Comments
{ }	AA, AB, AC, AD, AF, AL, AN, AP, AR, AT, AU, AV, BF, BS, CD, DF, DI, DS, DY, MA, PL, RI, SY, TM, TP, UR, UT, VP	All for Standard Protocol	<p>Equivalent to sending the following groups (immediately): AL, BP, DI, MS, PR, and UF.</p> <p>When the machine receives { }, it will return the appropriate Field Packets according to the Immediate transmission setting and the TS-enabled condition. The internal list will not be updated by this <i>Control</i>.</p> <p><b>Note:</b> For software versions earlier than 2.71, the { } field works only with the Standard Protocol.</p>
AG	All fields	≥ 2.71	Equivalent to sending every group except for special groups and groups associated with the Immediate transmission setting (i.e., GG and VR). TS-enabled only.
CA	CZ	≥ 2.71	The CA Group requests the return of Crit-Line data points via the CZ Field. TS-enabled only.
DD	DD	≥ 2.71	The DD Group requests the return of Disinfection data via the DD Field. TS-enabled only.
PP	PP	≥ 2.71	The PP Group is sent from the Machine to the Host along with a patient ID. In response, the Host is expected to respond with Patient Prescription data. See Appendix D for more information. TS-enabled only.
TS	TI, TY, TZ	≥ 2.71	<p>The TS Group enables not only the addition of timestamps to subsequent data packets, but also certain fields that would not otherwise be returned. These fields are marked in Appendix C as “TS-Enabled”.</p> <p>After the TS Group is sent, fields indicated by both Interval and On Occurrence transmission settings will be returned On Occurrence only.</p>



**Note:** These special groups must be requested individually and not mixed with other groups. This will allow the complete set of data to be returned. Failure to request individually could result in additional data being returned with the data set.

## Appendix C – Field Codes

### General Fields

Group Code	Field Code	Field	Format (units)	No Data	TS-enabled	Transmission Settings			Comments
						Interval	On Occurrence*	Immediate	
AL	AA	Level Detector Alarm	T/F	F		✓	✓		
	AB	Blood Pump Alarm	T/F	F		✓	✓		
	AC	Conductivity Alarm	T/F	F		✓	✓		
	AD	Blood Pressure Alarm	T/F	F		✓	✓		Any systolic, diastolic, pulse, MAP alarm, high or low. <b>Note:</b> Active with TS-enabled on 2008T software V2.71 or greater.
	AF	Dialysate Flow Alarm	T/F	F		✓	✓		
	AL	Blood Leak Alarm	T/F	F		✓	✓		
	AN	Check Access Alarm	T/F	F		✓	✓		Sends 'T' if venous needle disconnected (2008K machine only). Otherwise, sends 'F'.
	AR	Arterial Alarm	T/F	F		✓	✓		
	AT	Temperature Alarm	T/F	F		✓	✓		
	AU	TMP Alarm	T/F	F		✓	✓		
	AV	Venous Alarm	T/F	F		✓	✓		
BP	DU	Diastolic Pressure Limits	UUULLL [mmHg]	N/A	✓		✓		Upper (UUU) and Lower (LLL) diastolic pressure limits.
	DY	Diastolic Pressure	xxx [mmHg]	000		✓	✓		

Group Code	Field Code	Field	Format (units)	No Data	TS-enabled	Transmission Settings			Comments
						Interval	On Occurrence*	Immediate	
BP	MA	Mean Arterial Pressure (MAP)	xxx [mmHg]	000		✓	✓		
	MU	MAP Limits	UUULLL [mmHg]	N/A	✓		✓		Upper (UUU) and Lower (LLL) MAP limits.
	PL	Pulse	xxx [bpm]	000		✓	✓		
	PU	Pulse Limits	UUULLL [bpm]	N/A	✓		✓		Upper (UUU) and Lower (LLL) pulse limits.
	SU	Systolic Pressure Limits	UUULLL [mmHg]	N/A	✓		✓		Upper (UUU) and Lower (LLL) systolic pressure limits.
	SY	Systolic Pressure	xxx [mmHg]	000		✓	✓		
BT	HA	Total heparin infused	xx.x [mL]	000		✓			Sent with BT and KS groups. If requested by both groups, this value sends twice.
	RE	BTM, % recirculation	±xxx.x [%]	+1000		✓	✓		
	TA	BTM Tart	xx.x [°C]	000		✓	✓		
	TB	BTM Tbody	xx.x [°C]	000		✓	✓		
	TE	BTM change in energy	±xxx.x [kJ/h]	-0000		✓	✓		
	TV	BTM Tven	xx.x [°C]	000		✓	✓		

Group Code	Field Code	Field	Format (units)	No Data	TS-enabled	Transmission Settings			Comments
						Interval	On Occurrence*	Immediate	
BV	HB	Hemoglobin (HgB)	±xxx.x	-0000		✓	✓		
	HT	Hematocrit (Hct)	±xxx.x [%]	-0000		✓	✓		
	RB	Relative Blood Volume (RBV)	±xxx.x [%]	-0000		✓	✓		
	TR	Trend	xxx	000		✓	✓		001 – ↑ 002 – ↗ 003 – ↔ 004 – ↘ 005 – ↓
CL	DK	Delivered Single Pool (sp) Kt/V	xxx.xx	00000		✓	✓		Sent with CL and KS groups. If requested by both groups, this value sends twice.  <b>Note:</b> Sends in checksum protocol. In 2008T software v2.71 or greater it sends with both checksum and standard protocols.
	EK	Delivered Equilibrated (E) Kt/V	x.xx	000		✓			
	HC	Hematocrit	xxx [%]	000		✓			
	KE	Mean Kecn	xxx	000		✓			
	KO	Overall mass transfer coefficient multiplied by dialyzer surface area (KOA)	xxxx	0000		✓			
	KT	Delivered Kt	xxxx.x [L]	00000		✓	✓		Sent with CL and KS groups. If requested by both groups, this value sends twice.  <b>Note:</b> Sends in checksum protocol. In 2008T software v2.71 or greater it sends with both checksum and standard protocols.

Group Code	Field Code	Field	Format (units)	No Data	TS-enabled	Transmission Settings			Comments
						Interval	On Occurrence*	Immediate	
CL	PK	Projected Single Pool (sp) Kt/V	x.xx	000		✓			
	PN	First Plasma Na	xxx.x [mEq/L]	0000		✓			Same as P1 Field (from FL Group) unless no data. <b>If requested by both groups, this value sends twice.</b>
	VS	Body Volume	xx.x [L]	000		✓	✓		
CM	BA	BV Alert Level	±xxxx [%]	-0000		✓			
	CB	RBV (Crit-Line)	±xxx.x [%]	-0000		✓			
	CC	Hematocrit	±xxx.x [%]	-0000		✓			
	CH	HgB	±xxx.x	-0000		✓			
	CM	Crit-Line Marker	xxx	000		✓			000 – No profile / No Crit-Line SYM – Symptom Marker INT – Intervention Marker
	CO	O <sub>2</sub> Sat.	±xxx.x [%]	-0000		✓			
	CP	Profile (Crit-Line)	xxx	000		✓			000 – No profile / No Crit-Line 00A – Profile A 00B – Profile B 00C – Profile C
	CW	Crit-Line Low Alarm	xxx	000		✓			000 – No Warning NCA – Crit-Line: No Comm SYS – Crit-Line: System Error OBS – Crit-Line: Obstruction NBS – Crit-Line: No Blood Sensed BVA – Rel. Blood Volume Low O2A – Oxygen Saturation Low PRF – Failed to Print

Group Code	Field Code	Field	Format (units)	No Data	TS-enabled	Transmission Settings			Comments
						Interval	On Occurrence*	Immediate	
CM	DA	Calibration Date (Crit-Line)	mmddyyyy	00000000	✓	✓			Month (mm), day (dd), year (yyyy) Included only in the first interval for each treatment.
	DV	Last Verification Date (Crit-Line)	mmddyyyy	00000000	✓	✓			Month (mm), day (dd), year (yyyy) Included only in the first interval for each treatment.
	MO	Min. O <sub>2</sub> Sat	±xxx.x [%]	-0000		✓			
	OA	O <sub>2</sub> Alert Level	±xxxx [%]	-0000		✓			
DC	AE	Acetate electrolyte mEq/l	xx.x [mEq/l]	N/A	✓		✓		
	CA	Ca <sup>++</sup> electrolyte mEq/l	xx.x [mEq/l]	N/A	✓		✓		
	CI	Citrate mEq/l	xx.x [mEq/l]	N/A	✓		✓		
	CT	Concentrate Type	String	N/A	✓		✓		Maximum length = 8 characters. Examples: 6601-2 or FC5002
	DX	Dextrose electrolyte mg/dl	xxxx [mg/dl]	N/A	✓		✓		
	FM	Concentrate type/family	String	N/A	✓		✓		Maximum length = 18 characters. Options: 45x 72.00g/l Bic, 45x 79.25g/l Bic, 45x 81.25g/l Bic
	MG	Mg <sup>++</sup> electrolyte mEq/l	xx.x [mEq/l]	N/A	✓		✓		

Group Code	Field Code	Field	Format (units)	No Data	TS-enabled	Transmission Settings			Comments
						Interval	On Occurrence*	Immediate	
DC	NB	Na base	xxxx [mEq/L]	N/A	✓		✓		Sent with DC and XT groups.
	ST	Bicarbonate	xxxx [mEq/L]	N/A	✓		✓		Sent with DC and XT groups.
	TD	Theoretical Conductivity	xx.x [mS/cm]	N/A	✓		✓		
DI	BF	Blood flow rate	xxxx [mL/min.]	0000		✓	✓		<b>Note:</b> On the 2008K machine, this value may be inaccurate if a Blood Pump Serial Communication cable (P/N 670658-Q) is not installed. Please see Bulletin 11-FHK-001 Rev B for more details.
	CD	Conductivity	xx.xx [mS/cm]	0000		✓			
	DF	Dialysate flow rate	xxxx [mL/min.]	0000		✓	✓		
	TP	Monitor Temp	xx.xx [°C]	0000		✓			
FL	FA	Access Flow	±xxxx	-0000		✓	✓		
	P1-P6	Plasma Na 1 – Plasma Na 6	xxx.x	0000		✓	✓		Values send when the system takes an OLC measurement.
GG	FG	Service Mode Configuration	String	N/A	✓			✓	See Appendix E.
	JG	Dialysis Mode Configuration	String	N/A	✓			✓	See Appendix F.
	MH	Machine Hours	xxxxx		✓			✓	
	PM	Preventive Maintenance Settings	String	N/A	✓			✓	See Appendix G.
	SN	Machine Serial Number	String		✓			✓	

Group Code	Field Code	Field	Format (units)	No Data	TS-enabled	Transmission Settings			Comments
						Interval	On Occurrence*	Immediate	
GG	XN	UI-MICS Software Version	x.xx		✓			✓	
	ZO	Time Zone	±xxx		✓			✓	UTC, Newfoundland is -033.
KA	K1 – K9	Sequence of Kecn values from 1 to 9	hhmm xxx T		✓		✓		Time: hours (hh) and minutes (mm); Kecn value (xxx); and Test Type (T): access flow (A), manual (M), or normal (N). “ ” is the delimiter between the above values.
KS	DK	Delivered Single Pool (sp) Kt/V	xxxx.x [L]	00000		✓	✓		Sent with CL and KS groups. <b>Note:</b> Sent in checksum protocol only, but in 2008T software V2.71 or greater it sends with both checksum and standard protocols.
	HA	Total heparin infused	xx.x [mL]			✓			Sent with BT and KS groups.
	HI	Infusion time	hhmm		✓		✓		Time: hours (hh) and minutes (mm).
	HR	Heparin rate	xx.x [mL/h]				✓		
	HS	Syringe Type	X		✓		✓	HS	Index of selected syringe: 0 – 10cc BD Black 1 – 10cc Terumo 2 – 12cc Monoject 3 – 10cc Braum 4 – 10cc Monoject 5 – 10cc Nipro 6 – 10cc SOL-Care
	HV	Bolus Volume	xx.x [mL]		✓		✓		



Group Code	Field Code	Field	Format (units)	No Data	TS-enabled	Transmission Settings			Comments
						Interval	On Occurrence*	Immediate	
KS	KT	Delivered Kt	xxxx.x [L]	00000		✓	✓		Sent with CL and KS groups. <b>Note:</b> Sends in checksum protocol. In 2008T software v2.71 or greater it sends with both checksum and standard protocols.
	QB	Average Blood Flow Rate (Qb)	xxxx [mL/min]			✓	✓		
	QD	Average Dialysate Flow Rate (Qd)	xxxx [mL/min]			✓	✓		
	TT	Treatment time	xxxx [min.]			✓			
	TX	Treatment (Tx) clock status	T/F	F		✓	✓		T – Tx Running F – Tx Paused
LS	SL	Status light	X		✓		✓		G – Green Y – Yellow R – Red F – Off
MS	BD	Chemical Disinfect	T/F		✓		✓		'T' if in chemical disinfection portion of the Chemical/Rinse or Chemical/Dwell Programs.
	BS	Blood Sensed	T/F			✓	✓		'T' if blood is sensed in the Dialysis Program.
	DI	Dialysis or SLED Program	T/F			✓	✓		'T' if in Dialysis or SLED Program.
	DL	Idle Mode	T/F		✓		✓		'T' if Idle Mode is active in the Dialysis Program.
	DP	Prime	T/F		✓		✓		'T' if Prime/Recirculation is active in the Dialysis Program.

Group Code	Field Code	Field	Format (units)	No Data	TS-enabled	Transmission Settings			Comments
						Interval	On Occurrence*	Immediate	
MS	DS	Disinfection Program	T/F			✓	✓		'T' if in Acid Clean, Chemical/Rinse, Chemical/Dwell, or Heat Disinfection Program.
	HD	Heat Disinfect	T/F		✓		✓		'T' if in heat disinfection portion of the Heat Disinfection Program.
	RI	Water Rinse	T/F			✓	✓		'T' if water rinse is active (e.g., Rinse Program, Pre-rinse of Chemical/Rinse Program).
NM	NM	Status Box Message	String	N/A	✓		✓		Indicates the message appearing in the Status Box.
OZ	PS	Crit-Line Print Screen	T/F	F	✓		✓		Indicates whether Crit-Line data can be printed (i.e., end of treatment).
PR	AP	Arterial pressure	±xxx [mmHg]	-000		✓			
	TM	TMP	±xxx [mmHg]	-000		✓			
	VP	Venous pressure	±xxx [mmHg]	-000		✓			Sent with PR and VX groups. If requested by both groups, this value sends twice.
SS	PE	Pulse Error	T/F	F		✓	✓		For all warnings, sends 'T' if Pulse Oximeter Error occurs.
	PR	Pulse Rate from Pulse Oximeter	xxxx [bpm]	0000		✓	✓		
	PX	Pulse Alarm	T/F	F		✓	✓		
	WA	Wetness Alarm	T/F	F		✓	✓		'T' if wetness is detected.
	WE	Wetness Error	T/F	F		✓	✓		'T' if communication fails or low battery is detected.

Group Code	Field Code	Field	Format (units)	No Data	TS-enabled	Transmission Settings			Comments	
						Interval	On Occurrence*	Immediate		
TN	TN	Number of Treatments	X		✓		✓		Returns the number of treatments executed since 12:00 AM. A treatment is identified when the Tx clock has run for at least 1 hour while blood is sensed and a new treatment has not initiated (e.g., New Tx button press).	
UF	UR	UF rate	xxxx [mL/h]	0000		✓	✓			
	UT	UF on	T/F			✓	✓			
VR	MN	Machine family name	String		✓			✓	Name of machine, i.e. "2008T", "2008K", "2008K2", "2008K@Home". 12 characters maximum.	
	VA	Actuator/Test board software version	xx.xx		✓			✓		
	VB	bi <sup>2</sup> bag Interface board software version	x.xx	[blank]	✓			✓	For bi <sup>2</sup> bag machines only.	
	VC	Functional board hardware version	x		✓			✓	'2' – 190620	
	VD	Functional board CPLD version	xxx		✓			✓	From 000 to 015.	
	VF	Remote Protocol version	x.xx		✓			✓		
	VR	Functional Board software version number	xx.xx				✓		✓	Transmission setting is Interval only until TS is enabled. Once TS is enabled, transmission setting is Immediate.
	VU	User Interface board software version	xx.xx		0000	✓			✓	For 2008T machines only. Returns 0000 for other machines.

Group Code	Field Code	Field	Format (units)	No Data	TS-enabled	Transmission Settings			Comments
						Interval	On Occurrence*	Immediate	
VX	VH	Venous High Limit	xxxx			✓			Venous High Limit = 20 mmHg.* [xxxx value] – 100 mmHg
	VL	Venous Low Limit	xxxx			✓			Venous Low Limit = 20 mmHg.* [xxxx value] – 100 mmHg
	VP	Venous pressure	±xxx [mmHg]	-000		✓			Sent with PR and VX groups.
XT	BI	Na start	xxxx [mEq/L]			✓	✓		<b>Note:</b> Sends in checksum protocol. In 2008T software v2.71 or greater it sends with both checksum and standard protocols.
	BV	Blood volume processed	xxx.xx [L] (BTM) xxx.x [L] (else)			✓			BV sends with an extra digit if BTM group is selected, else it sends with only 4 digits.
	MI***	Machine ID	String	00000000		✓	✓		9 characters. If fewer than 9 characters, it sends trailing spaces (e.g. 'machine ').
	NB	Na base	xxxx [mEq/L]			✓	✓		Sent with DC and XT groups. If requested by both groups, this value sends twice. <b>Note:</b> Sends in checksum protocol. In 2008T software V2.71 or greater it is sent out with both checksum and standard protocols.
	NS	SVS On/Off	T/F			✓	✓		<b>Note:</b> Sent in checksum protocol. In 2008T software v2.71 or greater it sends with both checksum and standard protocols.

Group Code	Field Code	Field	Format (units)	No Data	TS-enabled	Transmission Settings			Comments
						Interval	On Occurrence*	Immediate	
XT	PA**	Patient ID	String			✓	✓		2008T: 10 characters. No data string sends if no patient ID.
	RT	RTD	xxxx [min.]			✓			RTD time in minutes.
	SP	SVS profile #	xxx			✓	✓		000 – SVS Off 001 – Step SVS Profile 002 – Linear SVS Profile 003 – Exponential SVS Profile  <b>Note:</b> SP sent in checksum protocol only if NOT 2008T software v2.71 or greater.
	ST	Bicarbonate	xxxx [mEq/L]			✓	✓		Sent with DC and XT groups.  <b>Note:</b> Sends in checksum protocol. In 2008T software v2.71 or greater it sends with both checksum and standard protocols.
	UF	UF Time	xxxx [min.]			✓			<b>Note:</b> Sends in checksum protocol. In 2008T software V2.71 or greater it sends with both checksum and standard protocols.
	UG	UF goal	xxxx [mL]			✓	✓		
	UP	UF profile #	xxx	000			✓	✓	000-008.  <b>Note:</b> Sends in checksum protocol. In 2008T software V2.71 or greater it sends with both checksum and standard protocols.
	UV	UF removed	xxxx [mL]				✓		

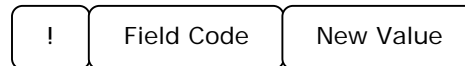
\* Alarms shown in the “On Occurrence” column are sent upon occurrence in the following format:



In the event of a Conductivity Alarm (AC), the data “!AC” will be sent at the time of the alarm and “ACT” will be sent for the subsequent packets.

Fields shown in the “On Occurrence” column display ‘0’-filled data until new and valid data values are available, unless otherwise stated in the table. For example, if the ‘BP’ group data is requested by the Host but the Blood Pressure Module data is not available, the machine should return the field data ‘SY000,DY000,PL000,MA000’.

Items designated by the “On Occurrence” column are sent when its value changes. A maximum of 1 value per field code per minute is sent out. It may take up to one minute to send the first value out. The following format is used:



To enable “On Occurrence”, send Group Code TS. On Occurrence and TS commands are **only** available on 2008T software versions 2.71 or greater. After TS is sent, TS-enable is turned on. When in a TS-enabled state, the fields indicated by both the Interval and On Occurrence transmission settings are returned On Occurrence only.

After the TS is sent, all On Occurrence fields (except for AL-related fields) are sent to baseline the values. These baseline values may take up to a minute to be sent out. Afterwards, if the value has changed, the field is transmitted within a minute of the change. If TS is not enabled and the data is interval data as designated by the “Interval” column, these fields are sent only at the specified Interval.

AL-related fields are transmitted On Occurrence regardless of the TS-enabled state. If an alarm occurs, the alarm field is sent immediately per the exclamation (i.e., “!”) description above, but without a new value. If the alarm is cleared, the field is sent on occurrence.

\*\* Patient ID is set by navigating to the Test & Options screen. Select the “Patient ID” button and enter the characters with the keyboard. Press [Enter] to confirm the entered Patient ID.

\*\*\* Machine ID is set by entering Service Mode. Navigate to the Options page and select Comm Options. Select the “Machine Name” button and use the keyboard to enter the Machine ID. Press [Enter] to confirm the entered Machine ID.

**Note:** Formats indicated by this table are meant as placeholders. “x”s are replaced by the characters of the Field Values. Positive signs (+) and negative signs (-) are included in the sent data in the implied position shown. Decimal places (.) are implied and will not appear in the data packet. If the data is out of range, the machine will return all 9’s (e.g., if the format indicates “xx.x” but the value is 103.5, the returned value is 999).

Not all field codes may be returned on all the machines. Group data sent from the Crit-Line module (CM) is only available on the 2008T machine, v2.48 or later. Host software should be written to expect new future Field Codes.

The transmission behavior of various fields may be different between Remote Protocol versions (retrievable via the VF field of the VR group). Take care to check Host software compatibility with these changes.

## Special Fields

Group Code	Field Code	Field	Format (units)	No Data	Comments
CA	CZ	Crit-Line Data Array for all displayed Crit-Line data points	[±bbb.b,hhh.h,ooo.o,MMM]...CCCC	F	<p>Sends data array only if machine finishes treatment (i.e., Print button is available on the Crit-Line Screen). Otherwise, send 'F'.</p> <p>Each data point is wrapped by square brackets (i.e., "[ ]") and the values for each data point is comma-delimited (i.e., ","):                     <ul style="list-style-type: none"> <li>Relative Blood Volume (bbb.b)</li> <li>Hematocrit (hhh.h)</li> <li>Oxygen Saturation (ooo.o)</li> <li>Marker (MMM): No marker (000), Symptom (SYN), or Intervention (INT)</li> </ul> </p> <p>After sending the array, a 4-character hexadecimal checksum (CCCC) (i.e., 16-bit checksum) of the full data array completes the field. This checksum is calculated as the sum of the ASCII hexadecimal values that make up the CZ data array.</p> <p>Due to size of the CZ data array, multiple data packets may be returned for the single CZ field. If the Checksum Communication Protocol is selected, each data packet has its own checksum and the "B", "M", and "E" packet types are used.</p> <p>During this time, any alarms that are sent by the Machine are sent immediately after the full CZ data is transmitted. Other fields that are to be sent by the Machine (e.g., on Interval transmission) will be suppressed during CZ data transmission and are sent within a minute after sending the full array.</p>
DD	DD	Disinfection Data Array for up to 1200 last disinfection cycles	[T,hhmm,mmddyyy]...CCCC	F	<p>Sends data array only if machine is in Select Program Screen. Otherwise, send 'F'.</p> <p>Each disinfection entry is wrapped by square brackets (i.e., "[ ]") and the values for each entry is comma-delimited (i.e., ","):                     <ul style="list-style-type: none"> <li>Type (T): chemical (C) or heat (H)</li> <li>Time: hours (hh) and minutes (mm) Note: This is in 24 hour clock notation.</li> <li>Date: month (mm), day (dd), year (yyyy)</li> </ul> </p> <p>After sending the full data array, a 4-character hexadecimal checksum (CCCC) (i.e., 16-bit checksum) of the full data array completes the field. This checksum is calculated as the sum of the ASCII hexadecimal values that make up the DD data array.</p> <p>Due to size of the array, multiple data packets may be returned for the single DD field. If the Checksum Communication Protocol is selected, each data packet has its own checksum and the "B", "M", and "E" packet types are used.</p> <p>During this time, any alarms that are sent by the Machine are sent immediately after the full DD data is transmitted. Other fields that are to be sent by the Machine (e.g., on Interval transmission) will be suppressed during DD data transmission and are sent within a minute after sending the full array.</p>
PP	PP	Patient Prescription	String	N/A	See Appendix D.



Group Code	Field Code	Field	Format (units)	No Data	Comments
TS	TI	Time stamp of time message sent (24-hr)	hhmm	N/A	Time: hours (hh) and minutes (mm). Timestamp from real-time clock. This field is appended to the end of every interval packet sent from the Machine to the Host. Sent on interval.
	TY	Treatment start time (24-hr)	hhmm	0000	Time: hours (hh) and minutes (mm). Treatment starts when the Tx Clock runs for the first time after the New Tx key is pressed or when the Tx Clock is running and blood is sensed, whichever occurs first. Sent on occurrence.
	TZ	Treatment end time (24-hr)	hhmm	0000	Time: hours (hh) and minutes (mm). Treatment ends when the Tx Clock is paused and blood is not sensed. The timestamp will indicate the time at which the Tx Clock was last paused, but the field will not be sent until blood is not sensed. Sent on occurrence.

Except for the TS Group, each special field is sent back immediately and only once.

## Appendix D – Patient Prescription (Field Control Code PP)

The Patient Prescription Control and Field serve to load the machine with patient prescription parameters. To do so, the machine sends a request for the patient prescription by sending Group Code PP and the corresponding patient ID. The host is expected to supply the patient prescription information to the machine.

### Patient Prescription Request

To request patient prescription information, the machine sends a request to the host in the form of a PP Control. This Control must be accompanied by a Patient ID argument that can be up to 10 characters long.

Below are some examples of valid patient prescription requests:

#### Example 1: PPJOE\_MOT

0x50 0x50 0x4A 0x4F 0x45 0x5F 0x4D 0x4F 0x54

*Situation:* Patient ID = "JOE MOT"

*Result:* Requests patient prescription for the patient with the ID "JOE MOT".

#### Example 2: PPfressy4040

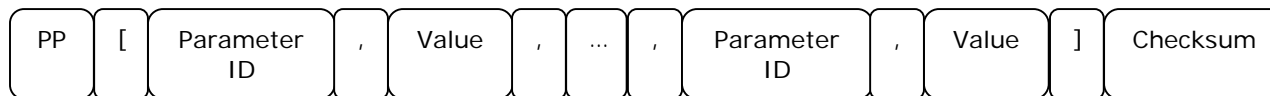
0x50 0x50 0x66 0x72 0x65 0x73 0x73 0x79 0x34 0x30 0x34 0x30

*Situation:* Patient ID = "fressy4040"

*Result:* Requests patient prescription for the patient with the ID "fressy4040".

### Patient Prescription Download (Field Code PP)

In response to a request for a patient's prescription, the Host is expected to respond with one or more prescription parameters for the machine to download. The returned patient prescription follows the following format:



Name	Length (bytes)	Description
PP	2	Field Code. (ASCII hexadecimal 0x50 0x50) Represents the beginning of a Patient Prescription Data Packet.
[	1	Open square bracket. (ASCII hexadecimal 0x5B) Designates the start of patient prescription data.
Parameter ID	6	Designates the unique ID for a patient prescription parameter.
Value	Variable	Designates the value associated with previously identified parameter(s) for the prescription.
,	1	Parameter Delimiter. (ASCII hexadecimal 0x2C) Separates the parameters and values to delimit separate data.
]	1	Checksum ID. (ASCII hexadecimal 0x5D) Designates the end of patient prescription data.
Checksum	4	4-character Data checksum in hexadecimal. Calculated as the sum of the ASCII hexadecimal values that make up the prior characters, starting from the first "P" in the field code to the final "]" that signifies the end of the data. Represents the end of a Patient Prescription Data Packet.

**Note:** If the Checksum Protocol is used, the sequence number of the Field response should match the sequence number of the Control request.

### Patient Prescription Parameters (Group/Field Code PP)

Parameter Type	Parameter ID	Parameter	Value Format [units]	Equivalent Field Code	Comment
Dialysate Settings	DSCONC	Concentrate	String	CT	Maximum length = 8 characters. Examples: 6601-2 or FC5002
	DSNAGO	Base Na+	xxx.x [mEq/L]	NB	The format of DSNAGO is different from the format of the NB field.
	DSNABI	Bicarbonate	xxx.x [mEq/L]	ST	The format of DSNABI is different from the format of the ST field.
	DSDITP	Temperature	xx.x [°C]		
	DSDLFW	Dialysate Flow	xxxx [mL/min.]	DF	
	DSDFAE	Auto Dialysate Flow Enabled	T/F		AutoFlow I/O.
	DSDFRT	Auto Dialysate Flow Setting	x.x		Options: 1.5 or 2.0.
	DSNPTP	SVS Profile	x	SP	0 – SVS Off 1 – Step SVS Profile 2 – Linear SVS Profile 3 – Exponential SVS Profile
	DSNAST	Start Na+	xxx.x [mEq/L]	BI	The format of DSNAST is different from the format of the ST field.
DSSVST	SVS-Time	hhmm		Time: hours (hh) and minutes (mm).	
Heparin Settings	DSHEPR	Heparin Rate	xx.x [ml/h]	HR	
	DSHPIT	Infusion Time	hhmm	HI	Time for continuous heparin infusion: hours (hh) and minutes (mm).
	DSHBVO	Bolus	xx.x [mL]	HV	

Parameter Type (cont.)	Parameter ID	Parameter	Value Format [units]	Equivalent Field Code	Comment
BP Settings	DSXSYP	Upper Systolic Limit	UUU [mmHg]	SU(1)	
	DSISYP	Low Systolic Limit	LLL [mmHg]	SU(2)	
	DSXDIP	Upper Diastolic Limit	UUU [mmHg]	DU(1)	
	DSIDIP	Lower Diastolic Limit	LLL [mmHg]	DU(2)	
	DSXPUL	Upper Pulse Limit	UUU [bpm]	PU(1)	
	DSIPUL	Lower Pulse Limit	LLL [bpm]	PU(2)	
	DSBPPC	Inflation Pressure	xxx [mmHg]		
	DSCYTM	Interval	hhmm		Time: hours (hh) and minutes (mm).
UF Settings	WDSRBD	Total Weight	xxx.x [kg]		Scale reading before dialysis.
	WDCTBD	Tare	xxx.x [kg]		Clothes/tare before dialysis.
	WDOTGW	Dry Weight	xxx.x [kg]		Original physician's target weight.
	WDFIDD	Additional Volume	xxxx [ml]		Fluid intake during dialysis (intended).
	DSUFVO	UF Goal	xxxx [ml]	UG	
	DSUFVS	UF Time	xxxx [min.]	UF	
	DSUFRA	UF Rate	xxxx [ml/h]	UR	
	DSUFPT	UF Profile	x	UP	0 – 8 (0 = None).

Parameter Type (cont.)	Parameter ID	Parameter	Value Format [units]	Equivalent Field Code	Comment
Miscellaneous	DSBPRA	Blood Pump Rate	xxx [mL/min.]		
	DSVURE	OLC Volume	xx.x [L]	VS	Urea-Distribution Volume.
	DSTKTV	Target Kt/V	x.xx		
	DSCRBV	BV Alert Level	xx [%]	BA	The format of DSCRBV is different from the format of the BA field.
	DSOALR	O2 Alert Level	xx [%]		

**Note:** Any parameters with “x” formats will truncate any leading zeros. (e.g., a Base Na<sup>+</sup> of 56.3 mEq/l will be returned as “563” instead of “0563”).

## Appendix E – Service Mode Parameters

The FG Field Code provides information about the Service Mode configuration of the machine. The data associated with the fields is organized in a pre-determined order. Each parameter is sub-delimited by a caret symbol (i.e., “^”, ASCII hexadecimal 0x5E).

### *Service Mode Parameters (Group Code GG, Field Code FG)*

Index	Service Mode Parameter	Format	Comment
1	User Options 1	xxxxxxxxxx	Combination of parameters. See <i>User Options Parameters</i> below.
2	User Options 2	xxxxxxx	Combination of parameters. See <i>User Options Parameters</i> below.
3	Language	X	0 – English 1 – French 2 – Spanish
4	Arterial Limits	X	0 – User Selectable 1 – 120 2 – 160 3 – 200
5	Venous Limits	X	0 – User Selectable 1 – 100 2 – 120 3 – 160 4 – 200
6	Kt/V Default	xxx	
7	Asymmetric Venous Limit	xx	
8	Auto Flow Selection	X	0 – None 1 – 1.5X 2 – 2.0X 3 – Both

Index	Service Mode Parameter (cont.)	Format	Comment
9	Beacon	X	0 – Alarm 1 – FDS08 2 – OLC 3 – Status
10	Acid Clean Time	XX	Leading zeroes will be removed.
11	Heat Disinfect Time	XX	Leading zeroes will be removed.
12	Chemical/Rinse Time	XX	Leading zeroes will be removed.
13	Chemical/Dwell Time	XX	Leading zeroes will be removed.
14	Rinse Time	XX	Leading zeroes will be removed.
15	Recirc Goal	XXXX	Leading zeroes will be removed.
16	Recirc Time	XXX	Leading zeroes will be removed.
17	Prime Amount	XX	Leading zeroes will be removed; multiply number by 100.
18	Acid Alert Default	XX	Leading zeroes will be removed.
19	Bic Alert Default	XX	Leading zeroes will be removed.
20	Max UF Rate	xxxx	
21	LV Max UF Rate	xxxx	Leading zeroes will be removed.
22	Concentrate List	String	See Concentrate List below.
23	Concentrate Selection	String	Concentrate ID for selected concentrate in Dialysis Mode.
24	Functional Board SW Version	x.xx	
25	Machine ID	String	9 characters.
26	Machine Serial Number	String	11 characters.



Index	Service Mode Parameter (cont.)	Format	Comment
27	Lock Alarm Volume	X	0 – Low 1 – Medium 2 – High 3 – Unlocked
28	Time to Low Power Mode	XX	Leading zeroes will be removed.

### User Options Parameters (Field Code FG, Index 1 and 2)

User Options parameters are combinations of multiple Service Mode settings. Each setting is associated with a value (0 or 1) and an address. The User Option parameter is equal to the bitwise OR of all addresses in the combination where the value is equal to 1. Therefore, the value of the setting can be retrieved by executing a bitwise AND with the User Options parameter and the setting address, followed by dividing by the address (i.e.,  $value = (output\ OR\ address) / address$ ).

User Options 1 Setting	Address (Hex)	Values	Example (assuming bit alignment is 0x914E80E9)
Allow Slow Flow	0x00008000	1 – Yes 0 – No	1 – Yes
Arterial Chamber	0x00000040	1 – Pre 0 – Post	1 – Pre
Audible Alarm	0x00040000	1 – Yes 0 – No	1 – Yes
Auto BP Reading	0x00000002	1 – Clock 0 – Interval	0 – Interval
Auto Flow Minimum	0x40000000	1 – 300 0 – 500	0 – 500
BTM	0x02000000	1 – Yes 0 – No	0 – No

<b>User Options 1 Setting (cont.)</b>	<b>Address (Hex)</b>	<b>Values</b>	<b>Example (assuming bit alignment is 0x914E80E9)</b>
BVM	0x08000000	1 – Yes 0 – No	0 – No
Dialysate Sampling	0x00000200	1 – Yes 0 – No	0 – No
Diasafe Auto-test	0x10000000	1 – Yes 0 – No	1 – Yes
Diasafe Filter	0x00020000	1 – Yes 0 – No	1 – Yes
Digital SN Blood Pump	0x20000000	1 – Yes 0 – No	0 – No
Ext. Pre-Rinse	0x04000000	1 – Yes 0 – No	0 – No
Forced Test	0x00004000	1 – Yes 0 – No	0 – No
Heparin Pump	0x00400000	1 – Yes 0 – No	1 – Yes
Kt/V Tolerance	0x80000000	1 – 0% 0 – 15%	1 – 0%
New Protocol	0x00000008	1 – Yes 0 – No	1 – Yes
O Art Limit	0x00100000	1 – Yes 0 – No	0 – No
OLC	0x01000000	1 – Yes 0 – No	1 – Yes
Online PHT	0x00000080	1 – Yes 0 – No	1 – Yes

<b>User Options 1 Setting (cont.)</b>	<b>Address (Hex)</b>	<b>Values</b>	<b>Example (assuming bit alignment is 0x914E80E9)</b>
Recirc Option	0x00000020	1 – Yes 0 – No	1 – Yes
Spread Limits	0x00000001	1 – Yes 0 – No	1 – Yes
T and C Mode	0x00080000	1 – Yes 0 – No	1 – Yes
Temp Comp	0x00002000	1 – Yes 0 – No	0 – No

<b>User Options 2 Setting</b>	<b>Address (Hex)</b>	<b>Values</b>	<b>Example (assuming bit alignment is 0x003B0D20)</b>
Alarm Type	0x00080000	1 – Acute 0 – Chronic	1 – Acute
Assisted Reinfusion	0x00008000	1 – Yes 0 – No	0 – No
Auto Prime	0x00004000	1 – Yes 0 – No	0 – No
CDX New Protocol	0x00000040	1 – Yes 0 – No	0 – No
Cond Alarm Position	0x00001000	1 – Unlocked 0 – Locked	0 – Locked
Crit-Line	0x00000100	1 – Yes 0 – No	1 – Yes
Crit-Line Graph	0x00000200	1 – Hct 0 – BV	0 – BV

User Options 2 Setting (cont.)	Address (Hex)	Values	Example (assuming bit alignment is 0x003B0D20)
Default Dial Flow	0x00000020 and 0x00000800	1 and 0 – 500, 1 and 1 – 600, 0 and 1 – 700, 0 and 0 – 800	1 and 1 – 600
Default Rx Screen	0x00100000	1 – Yes 0 – No	1 – Yes
HE Leak Test	0x00000400	1 – Yes 0 – No	1 – Yes
Heparin Dwell	0x00000010	1 – Yes 0 – No	0 – No
Idle Mode Flow Rate	0x00010000	1 – 100 0 – 300	1 – 100
Independent Cond Test	0x00020000	1 – Yes 0 – No	1 – Yes
New Tx Rx Warning	0x00040000	1 – Yes 0 – No	0 – No
Patient Card	0x00200000	1 – Yes 0 – No	1 – Yes
Plasma Na+	0x00002000	1 – Hide 0 – Show	0 – Show
SVS	0x00000080	1 – Yes 0 – No	0 – No

## Concentrate List (Field Code FG, Index 22)

The Concentrate List indicates the concentrates that can be selected in Dialysis Mode. Up to 10 concentrates may be specified in Service Mode. The concentrates in the list are wrapped by square brackets (i.e., “[” and “]”, ASCII hexadecimal 0x5B and 0x5D) without delimiters. Each list entry has 12 values that are sub-delimited by a caret symbol (i.e., “^”, ASCII hexadecimal 0x5E).

Index	Concentrate List Parameter	Format	Comment
1	Availability	T/F	Indicates whether a concentrate is available at the list entry. Value is 'F' if no concentrate is available.
2	Name	String	7-character string. Indicates name of concentrate at the list entry. Value is the empty string if no concentrate is available (i.e., Availability is 'F').
3	Sodium (Na <sup>+</sup> )	xxxx	Value is 0 if no concentrate is available (i.e., Availability is 'F').
4	Potassium (K <sup>+</sup> )	xx	Value is 0 if no concentrate is available (i.e., Availability is 'F').
5	Calcium (Ca <sup>++</sup> )	xx	Value is 0 if no concentrate is available (i.e., Availability is 'F').
6	Magnesium (Mg <sup>++</sup> )	xx	Value is 0 if no concentrate is available (i.e., Availability is 'F').
7	Chloride (Cl <sup>-</sup> )	xxxx	Value is 0 if no concentrate is available (i.e., Availability is 'F').
8	Acetic Acid	xx	Value is 0 if no concentrate is available (i.e., Availability is 'F').
9	Sodium Acetate	xxxx	Value is 0 if no concentrate is available (i.e., Availability is 'F').
10	Dextrose	x	Value is 0 if no concentrate is available (i.e., Availability is 'F').
11	Manufacturer	xx	Value is 0 if no concentrate is available (i.e., Availability is 'F').
12	DryConc	T/F	Value is 'F' if no concentrate is available (i.e., Availability is 'F').
13	Citrate	T/F	Value is 'F' if no concentrate is available (i.e., Availability is 'F').

**Example:** [T^2251-0 ^1000^20^25^10^1055^40^1000^5^45^F^F]  
 [T^2251-3B^1000^20^25^10^1015^40^1000^5^45^T^F]  
 [T^2251-CA^1003^20^25^10^1055^27^1000^5^45^F^T]  
 [T^G-Y,C-N^1000^25^25^25^1035^40^2000^5^45^T^F]  
 [T^G-N,C-Y^1000^25^25^25^1075^27^2000^5^45^F^T]  
 [T^G-N,C-N^1000^25^25^25^1075^30^2000^5^45^F^F]  
 [T^GyCn110^1100^25^25^25^1135^40^2000^5^45^T^F]  
 [T^GnCy110^1100^25^25^25^1175^27^2000^5^45^F^T]  
 [T^GnCn110^1100^25^25^25^1175^30^2000^5^45^F^F]  
 [F^0^0^0^0^0^0^0^0^0^0^0^0^F^F]

List Entry	1	2	3	4	5	6	7	8	9	10
Name	2251-0	2251-3B	2251-CA	G-Y,C-N	G-N,C-Y	G-N,C-N	GyCn110	GnCy110	GnCn110	N/A
Sodium (Na+)	1000	1000	1003	1000	1000	1000	1100	1100	1100	N/A
Potassium (K+)	20	20	20	25	25	25	25	25	25	N/A
Calcium (Ca++)	25	25	25	25	25	25	25	25	25	N/A
Magnesium (Mg++)	10	10	10	25	25	25	25	25	25	N/A
Chloride (Cl-)	1055	1015	1055	1035	1075	1075	1135	1175	1175	N/A
Acetic Acid	40	40	27	40	27	30	40	27	30	N/A
Sodium Acetate	1000	1000	1000	2000	2000	2000	2000	2000	2000	N/A
Dextrose	5	5	5	5	5	5	5	5	5	N/A
Manufacturer	45	45	45	45	45	45	45	45	45	N/A
DryConc	F	T	F	T	F	F	T	F	F	N/A
Citrate	F	F	T	F	T	F	F	T	F	N/A

## Appendix F – Dialysis Mode Parameters

The JG Field is intended to provide information about the Dialysis Mode configuration of the machine. The data associated with the fields is organized by a pre-determined order. Each parameter is sub-delimited by a caret symbol (i.e., “^”, ASCII hexadecimal 0x5E).

### *Dialysis Mode Parameters (Group Code GG, Field Code JG)*

Index	Dialysis Mode Parameter	Format	Comment
1	SLED	Y/N	
2	Arterial Limits	xxx	120, 160, 200
3	Venous Limits	xxx	100, 120, 160, 200
4	High Flux	Y/N	
5	Single Needle	Y/N	
6	Low Volume	Y/N	

## Appendix G – Preventative Maintenance Settings

The PM Field is intended to provide information about Preventive Maintenance. The data associated with the fields is organized in a pre-determined order. Each parameter is wrapped by square brackets (i.e., "[" and "]", ASCII hexadecimal 0x5B and 0x5D) and sub-delimited by a caret (i.e., "^", ASCII hexadecimal 0x5E).

### *Preventative Maintenance Settings (Group Code GG, Field Code PM)*

Index	Dialysis Mode Parameter	Format	Comment
1	Auto Heat Disinfect Settings	String	This string is comprised of three parts: Schedule, Off after Heat Disin, and Pre-Rinse Time. The parts are delimited by a colon symbol. Schedule is a combination of settings. See <i>Schedule</i> below. Off After Heat Disin adopts the following format: T/F. Pre-Rinse Time adopts the following format: xx (in minutes).
2	Auto Start Settings	String	This string is comprised of a Schedule. Schedule is a combination of settings. See <i>Schedule</i> below.
3	Auto CDX Settings	String	This string is comprised of a Schedule. Schedule is a combination of settings. See <i>Schedule</i> below.
4	Preventive Maintenance Reminder	String	Schedule is a combination of settings. See <i>PM Reminder</i> below.
5	Diasafe Reminder	String	Schedule is a combination of settings. See <i>Diasafe Reminder</i> below.



*Schedule (Field Code PM, Index 3)*

The Schedule provides information about Auto Heat Disinfect, Auto Start, or Auto CDX for each day of the week. Each entry in the schedule is wrapped by square brackets (i.e., "[" and "]", ASCII hexadecimal 0x5B and 0x5D) without delimiters. Each entry has three values, sub-delimited by a colon (i.e., ":", ASCII hexadecimal 0x3A).

Index	Schedule Setting	Format	Comment
1	Day of the week	xx	00 – Sunday 01 – Monday 02 – Tuesday 03 – Wednesday 04 – Thursday 05 – Friday 06 – Saturday
2	Auto Feature On/Off	xx	00 – Off 01 – Auto Heat Disinfect Off 02 – Auto Start On 03 – Auto CDX On
3	Time (min)	xxxx	Time of the day in minutes (i.e. number of minutes after midnight). If the Auto Feature is Off, Time is set to 1440 (N/A).

**Example Auto Heat Disinfect Schedule:**

[00:00:1440][01:01:1125][02:01:630][03:00:1440][04:00:1440][05:00:1440][06:01:260]

Day of the Week	00 – Sunday	01 – Monday	02 – Tuesday	03 – Wednesday	04 – Thursday	05 – Friday	06 – Saturday
Auto Heat	00 – Off	01 – On	01 – On	00 – Off	00 – Off	00 – Off	01 – On
Time	1440 – N/A	1125 – 6:45PM	630 – 10:30AM	1440 – N/A	1440 – N/A	1440 – N/A	260 – 4:20AM

*PM Reminder (Field Code PM, Index 4)*

The PM Reminder provides information about preventive maintenance. Each entry in the reminder is sub-delimited by a colon (i.e., ":", ASCII hexadecimal 0x3A).

Index	Schedule Setting	Format	Comment
1	Date	[dd:mm:yyyy:w]	d – day of the month (1-31) m – month (1-12) y – year w – day of the week (0-6 as Sunday to Saturday)
2	Time (min)	xxxx	Time of day in minutes (i.e., number of minutes after midnight).
3	Name	String	Name of the person who performed the last preventive maintenance.
4	Maintenance Interval (hours)	xxxx	Number of hours in maintenance interval (e.g., 2000).
5	Maintenance Interval (months)	xxxx	Number of months in maintenance interval (e.g., 6).
6	PM Reminder	T/F	Indicates whether the preventive maintenance reminder is enabled.

**Example:** [1:4:2017:6]:220:Ben:2000:6:T

Date	Time	Name	Maintenance Interval (hours)	Maintenance Interval (months)	PM Reminder
[1:4:2017:6] Saturday, April 1, 2017	220	Ben	2000	6	T (Enabled)

### *Diasafe Reminder (Field Code PM, Index 5)*

The Diasafe Reminder provides information about preventive maintenance. Each entry in the reminder is sub-delimited by a colon (i.e., ":", ASCII hexadecimal 0x3A).

Index	Schedule Setting	Format	Comment
1	Date	[dd:mm:yyyy:w]	d – day of the month (1-31) m – month (1-12) y – year w – day of the week (0-6 as Sunday to Saturday)
2	Time (min)	xxxx	Time of day in minutes (i.e., number of minutes after midnight).
3	Name	String	Name of the person who performed the last preventive maintenance.
4	Maintenance Interval (days)	xx	Number of days in maintenance interval (e.g., 90).
5	PM Reminder	T/F	Indicates whether the Diasafe maintenance reminder is enabled.

**Example:** [31:10:2016:1]:810:Ben:90:T

Date	Time	Name	Maintenance Interval (days)	PM Reminder
[31:10:2016:1] Monday, October 31, 2016	810	Ben	90	T (Enabled)