Specification for :

# MASCOT ™ / DMS Interface

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## 1.0 OVERVIEW

This document describes the unidirectional interface requirements for the MASCOT™ family of Multispecies Hematology instruments. The purpose of this document is to supply the information necessary to develop computer programs that will automate the flow of data between the MASCOT™ instrument family and Data Management Systems (DMS).

In order to increase the generality of the interface, maximum use of the configurable features has been made.

## 2.0 HARDWARE

The MASCOT™ will interface to a DMS through a standard RS232 communications port. The interface connector for the DMS port is located on the rear panel of the instrument behind the electronics compartment. The standard configuration for the DMS port is a DCE type interface.

### 2.1 Signals Supported

The following signals are supported by the DMS interface.

DMS Port Connector Pinout (DCE Configuration). A 9 pin female "D" connector is used.

| | |
|---|---|
| PIN 1 Data Carrier Detect (DCD) | OUTPUT; Provided by MASCOT™ in DCE configurations interfaces requiring this signal. DCD is True whenever DSR is True. |
| PIN 2 Receive Data (RxD) | OUTPUT; Data from MASCOT™ to DMS. |
| PIN 3 Transmit Data (TxD) | INPUT; Data from DMS to MASCOT™. |
| PIN 4 Data Terminal Ready (DTR) | INPUT; True indicates to MASCOT™ that the DMS is attached and that its communications port is initialized. |
| PIN 5 Signal Ground (SG) | The Signal Reference Level. |
| PIN 6 Data Set Ready (DSR) | OUTPUT; True indicates to DMS that MASCOT™ is attached and that its DMS communications port is initialized. |

| | |
|---|---|
| PIN 7 Request to Send (RTS) | INPUT; True indicates to MASCOT™ that a character may be sent to the DMS. False indicates that no new transmission may begin. MASCOT™ will complete transmission of the current character but no new characters will be sent from MASCOT™ to the DMS after Request to Send goes False. |
| PIN 8 Clear to Send (CTS) | OUTPUT; Set True by MASCOT™ when ready to receive data. |
| PIN 9 Ring Indicator (RI) | Unused. |

### 2.2 Cabling

A standard nine line one-to-one serial extension cable should suffice for most DMS interfaces to a standard P.C. (A Null Modem is NOT required.)

## 3.0 TRANSMISSION FORMAT

Asynchronous full-duplex transmission is used. The following transmission characteristics are configurable. (The default values for MASCOT™ are in parentheses.)

BAUD Rate: 110,150,300,600,1200,2400,4800,(9600)
DATA Bits: 7,(8)
PARITY: (none), even, odd
STOP Bits: 1, (2)

Note: Baud Rates of 600 or less may degrade MASCOT™ throughput when the handshake option is enabled.

Baud Rates of 150 or less will significantly degrade MASCOT™ sample throughput whether the handshake option is enabled or not.

## 4.0 MESSAGE PROTOCOL

This section defines the message structure for the transmission of a data stream between MASCOT™ and a DMS.

## 4.1 Format

There are five parts to each data stream message. Within each part there may be several blocks and within each block there are multiple fields. All fields have a fixed length and are space filled.

The definition of the various message components is as follows:

STX: Start of Text (Hex value 02) - Signals the start of the actual data stream transmission. A field separator is not used between the STX and the first field of the header.

Field Separator: Used to distinguish the beginning of one field from the end of the preceding field. A comma (Hex value 2C) is used as the field separator.

Checksum: An error checking facility. The checksum consists of two ASCII characters representing the hex number calculated as follows:

1. Sum all characters (module 256) in the message excluding the STX, Checksum, and ETX.

2. Take the 2's complement of the result.

The DMS can compare the transmitted checksum with a calculated checksum. If the values are not equal, the message should be considered erroneous.

ETX: End of Text (Hex value 03) - Indicates the end of a data stream transmission.

The general format of a message and the definition of each part is as follows:

STX - Header Block - Message Blocks - Checksum - ETX

STX: Start of Text.

Header Block: General information which applies to the message contents.

Message Blocks: Data specific to the Message Type.

Checksum: Message error checking.

ETX: End of Text.

## 4.2 Handshake and Error Checking

MASCOT™ will not transmit unless both DTR and RTS are True.

Associated with the transmission of data is a "handshake". The handshake is an acknowledgment of a transmission between MASCOT™ and the DMS. The handshake takes one of two forms; "ACK" acknowledge (Hex value 06) or "NAK" not acknowledge (Hex value 15).

The ACK/NAK handshake is optional and may be enabled or disabled. When the handshake is disabled, MASCOT™ will assume all transmissions to the DMS are successful and will simply ignore any missed or erroneous messages received by the DMS.

When the handshake option is enabled, MASCOT™ "expects" an ACK or a NAK from the DMS. It will wait for a response from the DMS (after a data stream transmission) for up to 30 seconds. When neither an ACK nor a NAK is received within the time-out period, MASCOT™ will time-out (an error condition).

When MASCOT™ transmits a data stream message and the DMS receives it in an understandable form, the DMS should respond with an ACK. If the data stream transmitted by MASCOT™ cannot be understood, the DMS should respond with a NAK. MASCOT™ will retransmit the save data stream until an ACK is received or until three transmissions are attempted (each in response to another NAK). When the maximum number of retransmissions has been exceeded, MASCOT™ will shut down the datastream until the operator reinitializes the DMS port.

If the DMS sets either the DTR or RTS lines False during the transmission process, MASCOT™ will cease transmissions until DTR and RTS are set True again. If either of these signals remain False for more than 30 consecutive seconds during a transmission, MASCOT™ will shut down the datastream until the operator reinitializes the DMS port.

# 5.0 DATA STREAM MESSAGE DEFINITIONS

This section describes each of the Data Stream message types that may be transmitted by the MASCOT™ to the DMS.

## 5.1 General Properties of Data Stream Messages

1. All data is in ASCII.

2. Each Data Stream message begins with an STX and ends with an ETX character.

3. Commas are used as field separators within blocks and a <Carriage Return> and <Line Feed> is used as a block separator. A comma is not used between the STX and the first field or between the last field (checksum) and the ETX.

4. To be considered successful, each transmission must be acknowledged by an ACK. (Only if the ACK/NAK handshake is enabled).

5. Numeric fields are right justified and blank filled.
   Alphanumeric fields are left justified and blank filled.

6. Each message has a header block followed by one or more data blocks.

The Header has a minimum of four fields; (1) Message Type, (2) Sequence Number, (3) Instrument ID, (4) Instrument Number.

Message Type: 2 Character Numeric Field (ASCII) identifying the message type being transmitted.

Sequence Number: 3 Character Numeric Field (ASCII) which is an integer that is incremented for each message transmitted. The sequence number allows the DMS to detect data transmissions that were not received. The sequence number will begin with a value of zero and be incremented to a value of 255 at which point it will be rolled over to initial value of zero. (NOTE: When messages are retransmitted, the sequence number in the retransmitted message is the same as transmitted in the original message).

Instrument ID: 5 Character Alphanumeric Field (ASCII) identifying the model type of the MASCOT™.

Instrument Number: 2 Character Numeric Field (ASCII) which can be set to a value between 0 and 99 for those installations which have more than one MASCOT™ analyzer.

All message headers contain these four fields. Additional fields and blocks are added to the header for various message types.

## 5.2 Data Stream Message Types

At present there is one data stream message type supported by MASCOT™. The Message Type is the first field in the header and is denoted by in integer value. The Message Type field follows the STX.

## 5.3 Test Results

STX - Header Block - Test Result Blocks - Checksum - ETX

**Header Block:** The Test Results Header Block has ten fields; The four common message header fields: (1) Message Type, (2) Sequence Number, (3) Instrument ID, (4) Instrument Number along with (5) Sample ID, (6) Species, (7) Test Number, (8) Date, (9) Time and (10) Sample Type.

Sample ID: 10 Character Alphanumeric Field (ASCII).

Species: 11 Character Alphanumeric Field (ASCII) corresponding to the species.

Test Number: 5 Character Numeric Field (ASCII) corresponding the Test # which appears on the MASCOT™ Sample Analysis Screen and Printout. The range of test numbers is from 1 to 9999 and normally increments for each sample.

Date: 8 Character Alphanumeric Field (ASCII). Two formats are available:

| | |
|---|---|
| U.S. | mm/dd/yy |
| European | dd-mm-yy |

mm = month dd = day yy = year

Time: 8 Character Alphanumeric Field (ASCII). The time format is:

hh:mm:ss

hh = hours (0 - 23) mm = minutes ss = seconds

Sample Type: 1 Character Alphanumeric Field (ASCII) identifying the type of sample run. The possible sample types are as follows:

B = Background (Start Up)
C = Clean (Long or Short Clean)
P = Prime
S = Sample

**Test Result Blocks:** The Test Result Blocks have six fields; (1) Test ID, (2) Result, (3) Flags, (4) Units, (5) Status, (6) Error Code ID

Test ID: 6 Character Alphanumeric Field (ASCII) containing the test name. (e.g. WBC RBC HB, etc.)

Result: 6 Character Floating-Point Alphanumeric Field (ASCII right justified) containing the numeric test result including decimal point. Leading zeros (starting two places to the left of the decimal point) are suppressed and blank filled. The Result field can also contain a 6 character (ASCII) error message instead of an actual result.

Flags: 3 Character Alphanumeric Field (ASCII) containing flagging information. (See Reference Manual for detailed explanations of flagging information.)

Units: 6 Character Alphanumeric Field (ASCII) containing the units in which the test is reported.

Status: 1 Character Numeric Field (ASCII) indicating the status of a particular result (0 = not available, 1 = available). If a result is not available the Result, Flag, and Error Code Fields are blank. A result is not available if the particular MASCOT™ instrument model does not provide the parameter.

Error Code ID: 3 Character Numeric Field (ASCII) containing an error code. The possible error codes are as follows:

0 No Errors.
100 Calculation Error (Data Field = "------")

There are multiple test result blocks within each Data Stream Message. Each test result block is terminated with a <Carriage Return> and <Linefeed>.