VFM4
SERIES
Protocol

Serial/Pulse

(Preliminary Copy)

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1. VFM4 Series Protocol

1.1 Introduction:

VFM4 Serial protocol provides a one-way communication with the control system, that is, messages are transferred via the DATA line from the validator to control system. Three control lines are used, they are: ACCEPT, SEND (from control system to validator), and INTERRUPT (from validator to control system). Two interfaces are furnished to permit the maximum versatility, one being the Serial Interface and other the Pulse Interface.

1.2 Serial Non-Isolated Data Link Interface:

This interface provides logic level (TTL/CMOS) serial communications between the validator and the controller using handshaking method. It allows the communication, when a bill is recognized by the validator. The messages emerge in the order of an 8-bit word. The interface utilizes one serial output line from the validator (DATA), and three control lines, two from the control system, ACCEPT ENABLE and SEND, and one from the validator, INTERRUPT. In addition, GROUND should be connected from the validator to control system, i.e., both the validator and the control system should have common GROUND. The validator is continually in passive mode. When any event takes place within the validator, it will respond with a request to send message to the control system. As an example, one of these events could be a bill being accepted by the validator.

1.2.1 Messaging system:

Generally two messages come into view per bill. One is a credit message and the other one is a confirmation message. Both will be sent according to the timing diagram (Figure 1). As soon as validator acknowledges a bill insertion, the validator pulls the INTERRUPT line low and informs the controller, its intention to send a message. In response, SEND line, from the controller goes LO (T1 in Figure 1), this grants permission to the validator to send data (T2 in Figure 1). The validator, then responds, by transmitting a credit message, distinguishing the denomination of the inserted bill. The data comes out via the DATA line in a serial fashion with one start bit, 8-data bits and one stop bit with a 600-baud rate. After the controller receive the last bit, it raises the SEND LINE high (T4 in Figure 1). The validator responses (T3 in Figure 3) by raising the INTERRUPT line high. If the validation is successful, a DENOMINATION message is sent to the control system, upon receiving this message, the control system, has to determine whether to accept or return the bill. If the bill is going to be returned, the controller raises the ACCEPT line within (T5 in Figure 1). After the INTERRUPT line goes high, and keeps the ACCEPT line high for a time duration of T6 (Figure 1), this tells the validator to return the bill, the validator reverses the transport, and the bill is returned. On the contrary, if the control system decided to accept the bill, it will not generate this pulse. The absence of the pulse on the ACCEPT line this time is interpreted by the validator to accept the bill, so the bill passes through the transport system to the stacker, i.e., the bill is VEND. In both cases, a second message, RETURN or VEND is ready to be sent to the control system by the validator, and the same timing sequence is repeated for the control lines, after that, the communication session ends. In special cases, other than two messages may be sent per bill inserted.

The following paragraphs describe three different types of types of messaging systems:

One Message:

If the inserted bill is rejected for any reason, one message will be sent, which is SLUG.

Two Messages:

If the inserted bill passes validation, the Two Messages will take place. First one will be the type of denomination waiting to be accepted or rejected by the controller. The second message will be the confirmation of accept or reject.

Three Messages:

If a bill is identified and accepted, then Two Messages are delivered. If, at this time, the stacker is full and is incapable to stack, a Stacker Full message will be transmitted in addition to the Two Messages.

The message sequence illustrated above should not be confused with the retransmission of a message. A retransmission of a specific message, can be accomplished and is commonly done with the intention of validation of the earliest message. This maneuver can be conducted for any number of repeat message. After the desired number of credit messages has been obtained, the procedure to get the confirmation message can proceed per the timing diagram. If a transmission of the confirmation message is required, the identical operation isused, to retransmit the credit message. Discipline of the bill type accepted can be retrieved by the controller, at the time of acceptance or by the DIP switches setup mounted on the validator. An acceptance can be prohibited by the controller.

1.2.2 ACCEPT ENABLE:

ACCEPT ENABLE Active LO logic-input line

When a bill has been validated, the status of this line decides whether the bill is to be credited or returned. A delay of one second should be allowed when this line is de-activated (transition to the high state) to permit a bill to be waiting to be accepted.

1.2.3 INTERRUPT:

INTERRUPT - Active low logic output line.

This line confirms that activity has taken place in the validator and a status message is prepared for transmission. While this line is active (low), the ACCEPT ENABLE input is disregarded. Currency receiving will be inhibited. The INTERRUPT line will continue to be active, if the SEND signal is re-activated within the designated time. This permits time for a supplementary SEND signal to be received, indicating a retransmission request.

1.2.4 SEND:

SEND - Active low logic input line.

In reply to an INTERRUPT signal, the controller will provide a SEND signal, to initiate the serial transfer of the status message from the validator to controller.

1.2.5 DATA:

DATA - Active low logic output line

Validator sends an 8-bit status messages, serially bit by bit, to the controller, as described in Figure 3. In response to a SEND signal from the controller. This process can be repeated, if an additional SEND signal is transmitted by the controller to the validator. The message will be delivered by a logical “0”, Start bit (logic low) and is succeeded by a logic “1” Stop bit (logic high).

1.2.6 ESCROW:

ESCROW

In this mode, it is assumed the bill is validated successfully, and the control system has received the first message, which is the DENOMINATION. The controller is capable of escrowing the bill obtained for indefinite period of time, before accepting or rejecting the bill.

To hold a bill in ESCROW:

The controller maintains SEND line LO, after the last data transmission. The validator will now hold the bill indefinitely in this state.

To accept the bill:

The controller raised SEND line to HI and ACCEPT ENABLE line maintain LO. At this point, the bill will be accepted by the validator and an additional status message will be transmitted by the validator to acknowledge the accepting of the bill.

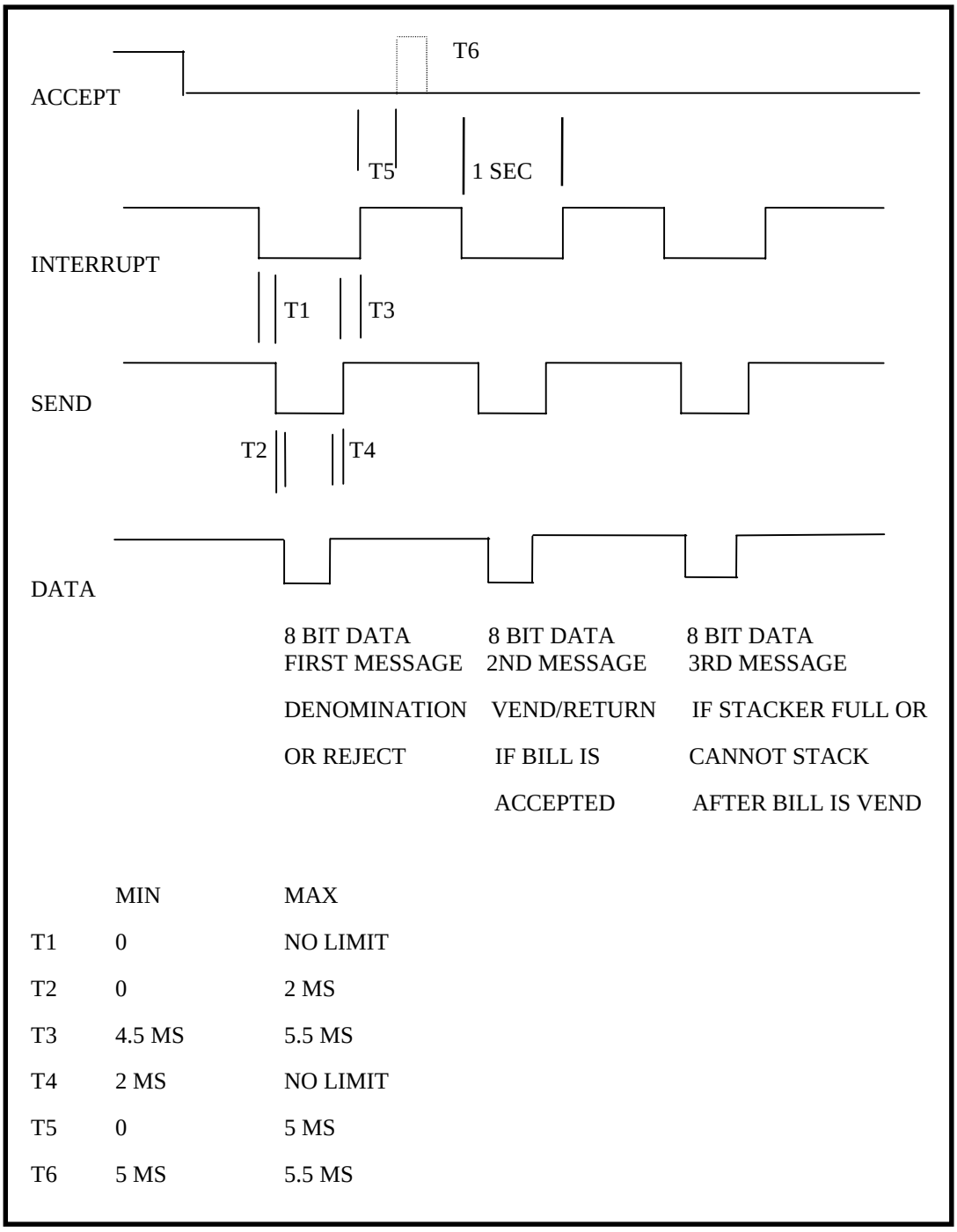
To return the bill:

The controller raise SEND line HI and wait for the INTERRUPT line to go HI. Then the controller raise ACCEPT ENABLE line HI. At this point the validator will return the bill and will generate a status signal.

1.2.7 REQUEST FOR MESSAGE RE-TRANSMISSION:

The control system can request for re-transmission of the previous message from the validator. See Figure 3 Retransmission timing (T4) after the last bit of a message is received, the controller raises the SEND line and keeps it high for the duration of (T3). Then the replica of the previous message will be sent out by the validator. This process can be repeated as often as requested by the control system.

1.3 Timing Diagram (Serial):



	MIN	MAX
T1	0	NO LIMIT
T2	0	2 MS
T3	4.5 MS	5.5 MS
T4	2 MS	NO LIMIT
T5	0	5 MS
T6	5 MS	5.5 MS

Figure 1: Timing for Accept or Return

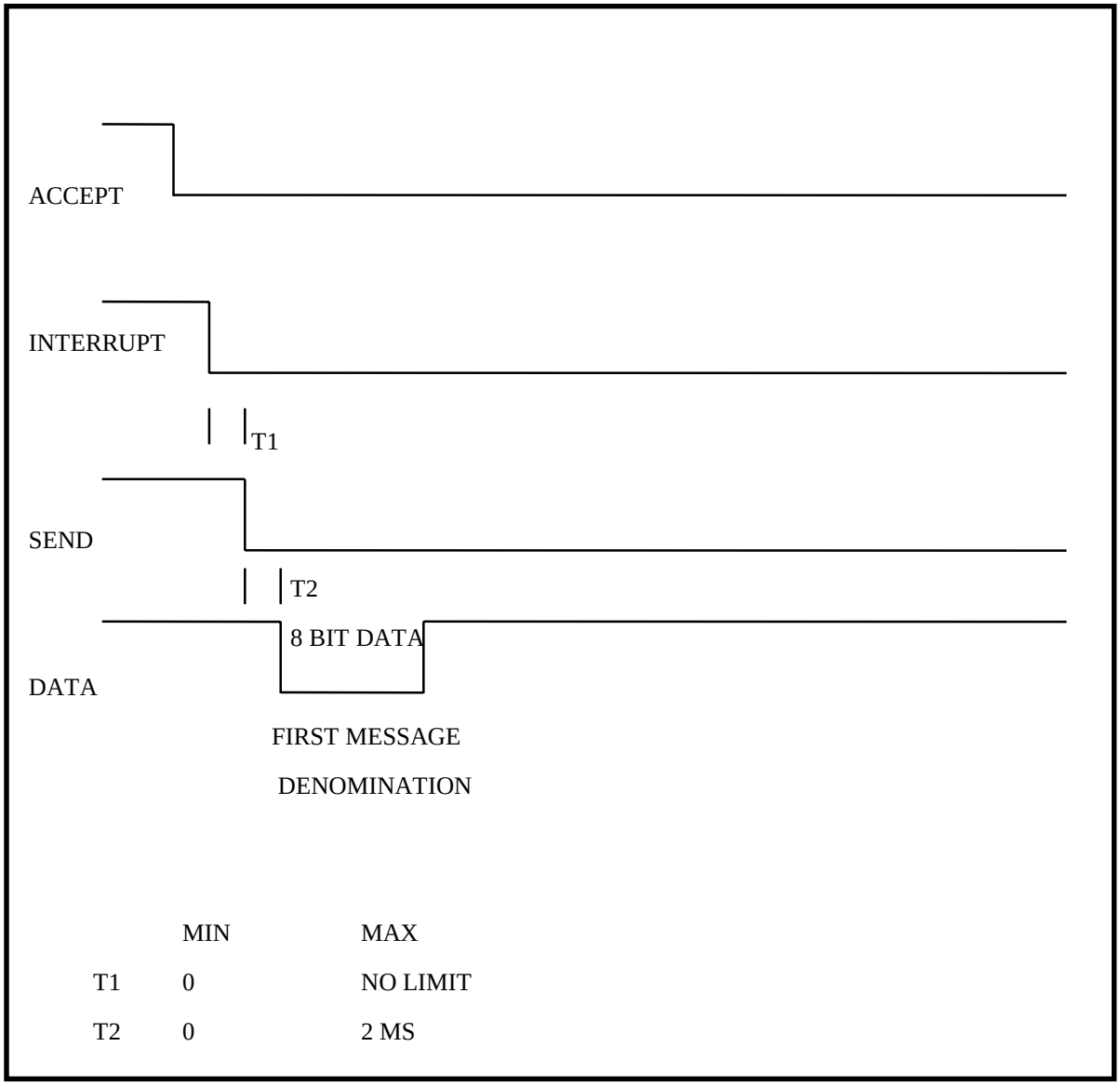
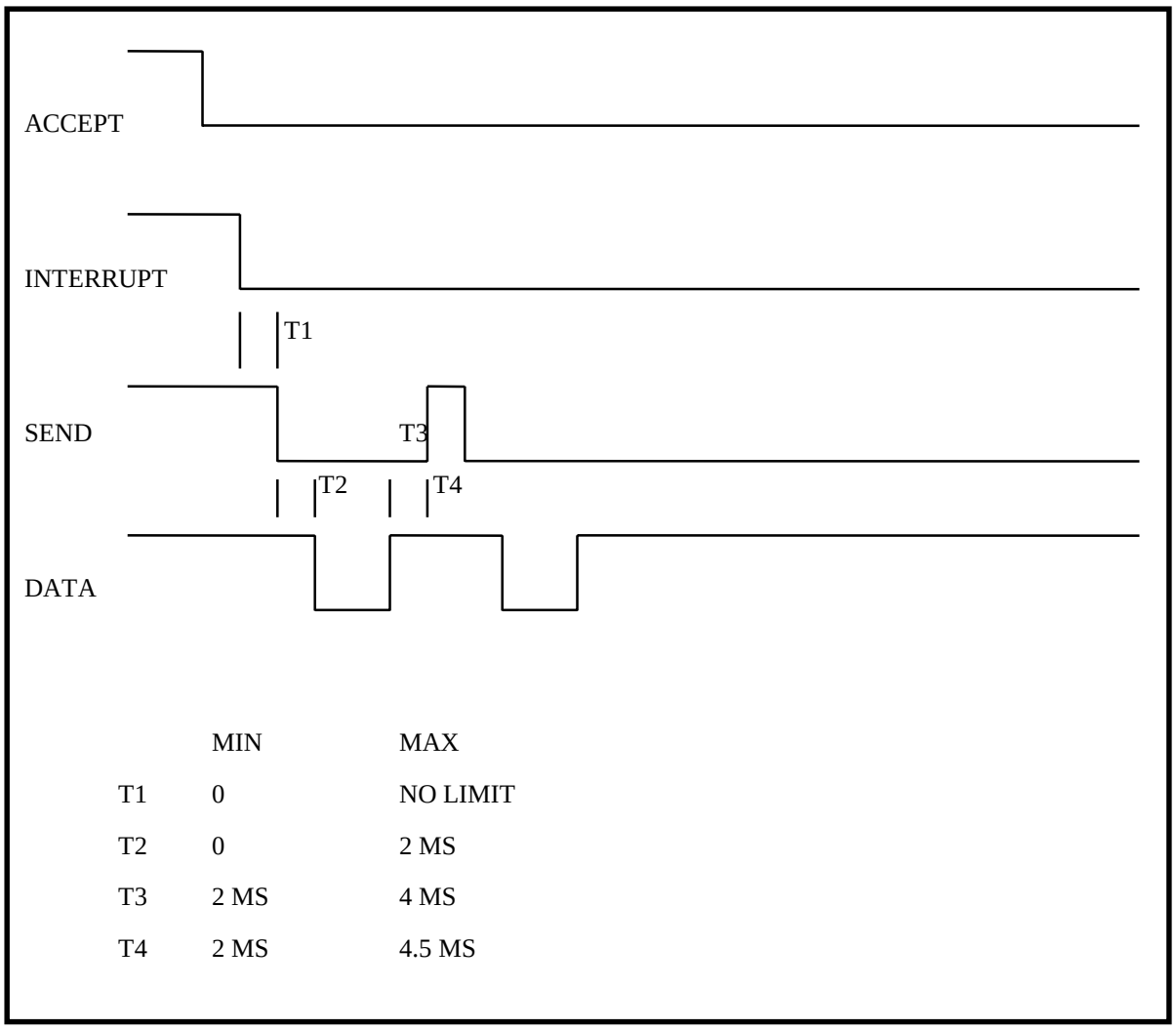


Figure 2: Timing for Escrow



	MIN	MAX
T1	0	NO LIMIT
T2	0	2 MS
T3	2 MS	4 MS
T4	2 MS	4.5 MS

Figure 3: Timing for Request for Retransmission

1.4 Pulse Interface:

The Pulse Interface furnishes one or more pulse per denomination accepted. This is accomplished either by TTL compatible, open collector logic-level line, or by relay contacts. Two different pulse patterns are available and the preferred pattern is set by a DIP switch. The number of pulses per denomination is also switch selectable.

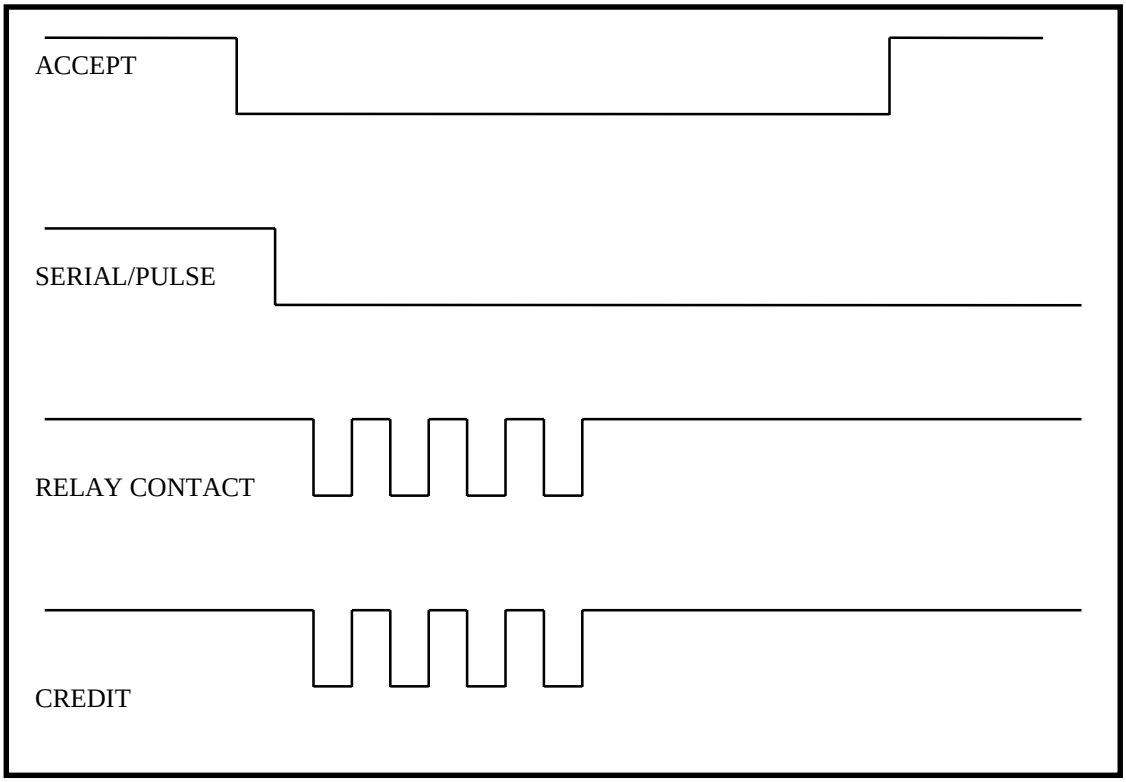
1.4.1 ACCEPT ENABLE:

This line will permit acceptance of any denomination. When this line goes LO to HIGH, then the bill will be accepted.

1.4.2 OUTPUTS:

There are two mode by which credit can be read. One method is the Normally Open relay contacts and the other is the CREDIT line. The CREDIT output is an open collector and TTL compatible. The timing for the pulses are 50 ms ON/50 ms OFF when the pulse-time selection switch is OFF, and 60 ms ON/ 300 ms OFF pulse pattern when the switch is ON. The number of pulse per denomination is also switch selectable.

1.5 Timing Diagram (Pulse):



1.6 HEX CODE MESSAGES:

1.6.1 $1 CREDIT:

COMMAND = 81 HEX

1.6.2 $2 CREDIT:

COMMAND = 82 HEX

1.6.3 $5 CREDIT:

COMMAND = 83 HEX

1.6.4 $10 CREDIT:

COMMAND = 84 HEX

1.6.5 $20 CREDIT:

COMMAND = 85 HEX

1.6.6 $50 CREDIT:

COMMAND = 86 HEX

1.6.7 $100 CREDIT:

COMMAND = 87 HEX

1.6.8 VEND:

COMMAND = 89 HEX

1.6.9 RETURNED:

COMMAND = 8A HEX

1.6.10 REJECT:

COMMAND = 8B HEX

1.6.11 FAILURE:

COMMAND = 8C HEX

1.6.12 STACKER FULL:

COMMAND = 8D HEX

1.6.13 JAM-STKR.LESS

COMMAND = 8D HEX

1.6.14 SRC REMOVED:

COMMAND = 8E HEX

1.6.15 SRC REMOVED:

COMMAND = 8E HEX