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Model No. ST400-CP

Protocol Description

&

USER MANUAL

Table of Contents

Manual Version ……..…….…… 1.4 073004
Document No. …….……. ST400-CP User Manual.doc

1. REVISION HISTORY

122203 Rev. 1.0	Original Document
010804 Rev. 1.1	Added Highlight Byte to the LCD command.
012304 Rev 1.2	Added RS422 Controller jumper configuration
071304 Rev 1.3	Added "I" command to draw tables.
073004 Rev. 1.4	Added "P" command to clear a part of the display.

2. OVERVIEW

a. DESCRIPTION

The ST400 will operate as an event driven device, transmitting information to the External Control System (ECS) when a change is detected.

In addition, the ECS may poll the ST400-CP at any time for current status information.

Key Press Decoding

The ST400 will automatically detect and decode changes in the state of its 46 keys. It will return the state of all keys on the keyboard any time there is a change detected. The state of the keyboard is returned as 12 bytes, 6 bytes for Key Change bitmap (each key is represented by a bit) and 6 bytes for Key State bitmap of the key (each key is represented by a bit). If a bit is set in the Key Change Bitmap – the corresponding key's state was changed. If a bit is cleared in the Key Change Bitmap, the corresponding key's state was not changed. If a bit in the Key State bitmap is set – the corresponding key is pressed. If the bit is cleared, the corresponding key is released.

Key LEDs

The Key LEDs are controlled by the ECS. Using appropriate commands, each led may be individually controlled, turned ON or OFF. The ECS sends a five (5) byte, bit mapped value to the ST400 to control the state of each LED. When a bit is set, the LED is turned on. When a bit is cleared, the LED is turned off.

LCD Display

The LCD Display is controlled by ECS. Using appropriate commands, the ECS can display null-terminated strings at a specified row and column. It can display characters of 4 different sizes – normal, double-high, double-wide and double-high-double-wide characters. It can also display highlighted text and draw tables in various parts of the display.

Wheel

The Wheel mode is configured by ECS. Three different wheel modes are supported– Off, Jog, and Shuttle (with mechanical detents). Wheel Position information will be automatically sent to the ECS when wheel movement is detected and the current wheel mode is not OFF.

In OFF mode, the wheel will not return position information and the mechanical detents will not be energized.

In JOG mode, the Wheel Position will be returned as a one byte, signed value that represents the pulse rate (pulses per time period). A pulse rate of zero means that the wheel has not moved. A positive position value represents Clockwise movement. A negative position value represents Counter-Clockwise movement. The mechanical detents will not be energized in JOG mode.

In SHUTTLE mode, Wheel Position will be returned as a one byte, signed value that represents the position of the wheel. When the SHUTTLE mode command is received, the ST400 sets the current wheel position as the STILL or zero position of the wheel. The Wheel Position value indicates movement of the wheel from the STILL position. A positive Wheel Position value represents Clockwise wheel movement from the STILL position. A negative Wheel Position value represents Counter-Clockwise wheel movement from STILL position. The mechanical detents will automatically energize when the maximum clockwise or maximum counter-clockwise Wheel Position value is reached. The mechanical detents will automatically de-energize when the Wheel Position value is less than the maximums. Using appropriate commands, the wheel mode, resolution, maximum clockwise, and maximum counter-clockwise values may be set.

T-bar

The T-bar is always enabled and will automatically send position information to the ESC when movement is detected. The lowest point in its travel is the STILL or zero position. The T-bar Position is a one byte, unsigned value that represents the position of the T-bar relative to the STILL position. The T-bar cannot be configured by the ECS. It's resolution, maximum and minimum position values are set by the factory.

b. FUNCTION CHART

Control Panel Functional Area	Controlled By
Wheel Movement Detection	ST400
T-bar Movement Detection	ST400
Key Press Detection and Decoding	ST400
Wheel Mode Configuration	External Control System (ECS)
Key LEDs On/Off	ECS
LCD Display Text	ECS

3. INSTALLATION

a. Connect the supplied power supply, Model AP4108, into the connector labeled POWER on the rear of the ST400. Plug the Power Supply into a wall outlet, 90 VAC to 240 VAC.

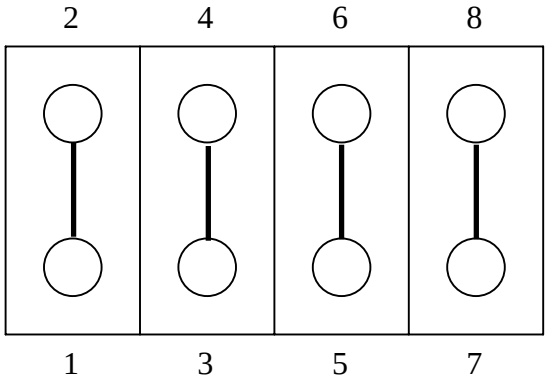
b. Plug one end of a 9-conductor, RS422 serial cable into the 9-pin connector labeled SP2 on the rear of the ST400. Plug the other end of the cable into the 9-pin connector on the External Control System (ECS).

c. SP2 is configured for RS232 DTE when shipped from the factory. Refer to the following sections "RS422 DEVICE Configuration" and "RS232 DTE Configuration", to change the configuration of SP2.

Installation is complete.

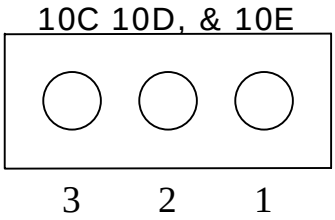
RS422- CONTROLLER Configuration

10A – JUMPER 1 TO 2, 3 TO 4, 5 TO 6, AND 7 TO 8
(Located behind the SP2 connector on the main pcb)

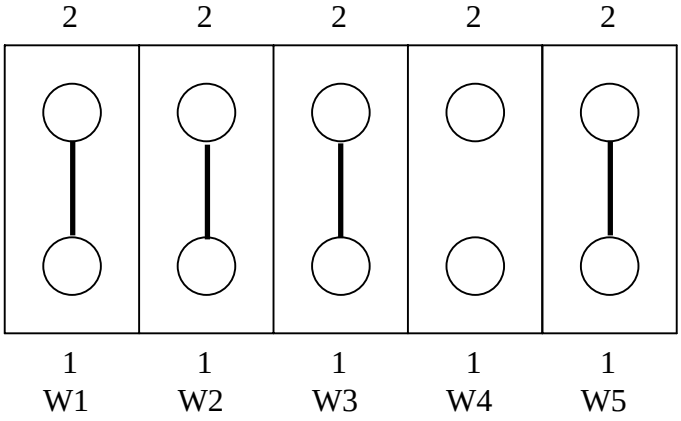


10A

10C – JUMPER 2 TO 3
10D – JUMPER 2 TO 3
10E – JUMPER 2 TO 3
10F – JUMPER 2 TO 3 (V4.1 pcb)
10H – JUMPER 1 TO 2 (V4.1 pcb)
(All located directly in front of 10A header)

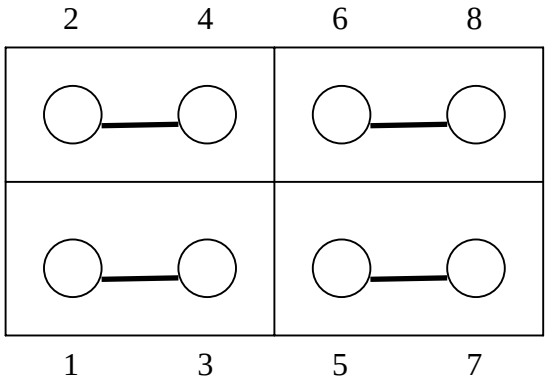


JUMPER - W1B, W2B. W3B, AND W5B
(Located between the SP1 and SP2 connectors on the main pcb)



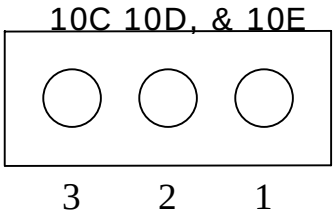
RS422 DEVICE Configuration

10A – JUMPER 1 TO 3, 5 TO 7, 2 TO 4, AND 6 TO 8
(Located behind the SP2 connector on the main pcb)

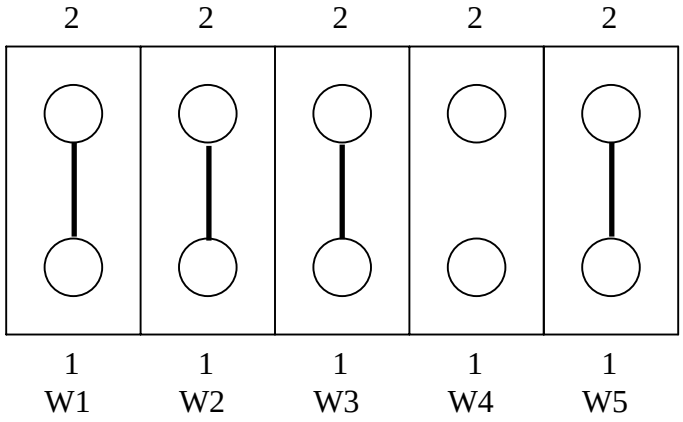


10A

10C – JUMPER 2 TO 3
10D – JUMPER 2 TO 3
10E – JUMPER 2 TO 3
(All located directly in front of 10A header)

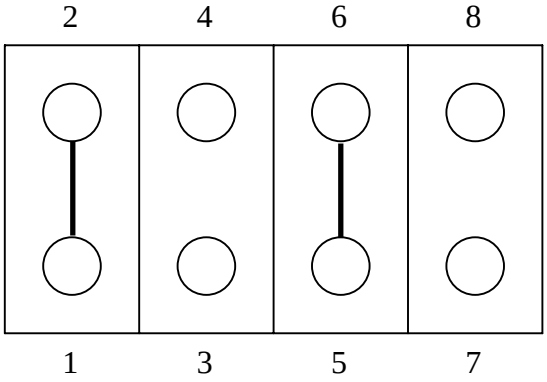


JUMPER - W1B, W2B. W3B, AND W5B
(Located between the SP1 and SP2 connectors on the main pcb)



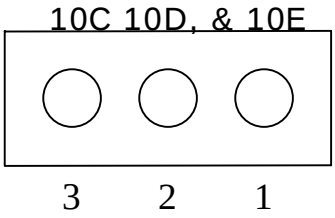
RS232 DTE Configuration

10A – JUMPER 1 TO 2 AND 5 TO 6 ONLY
(Located behind the SP2 connector, on the main pcb)

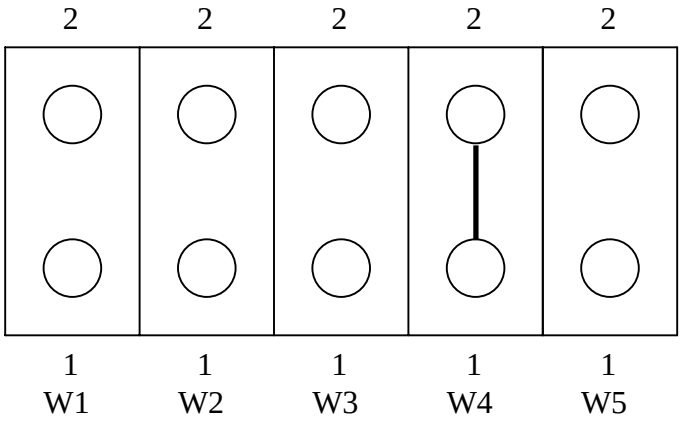


10A

10C – JUMPER 1 TO 2
10D – JUMPER 1 TO 2
10E – JUMPER 1 TO 2
(All located directly in front of 10A header)



JUMPER – W4B ONLY
(Located between the SP1 and SP2 connectors on the main pcb)



4. POWER UP DEFAULTS

The ST400 powers up in the following default state:

The LCD display is blank.
All LEDs are off.
The wheel is set to OFF mode.
The ST400 is ready to receive commands from ECS.

5. PROTOCOL DESCRIPTION

a. COMMUNICATIONS FORMAT

Baud Rate	38.4K
Parity	ODD
Data Bits	8
Start Bit	1
Stop Bit	1

b. COMMANDS

Command Format: STX + BC + CMD + DATA + CHECKSUM

STX =	0x02
BC =	Byte Count, 1 byte Byte Count includes all data bytes between BC and Checksum, exclusively.
CMD =	1 byte
DATA =	Data bytes, command specific
CHECKSUM =	Simple 8 bit sum of ALL preceding bytes (including STX)

ACK =	STX + 01 + 0x04 + Checksum
NAK =	STX + 01 + 0x05 + Checksum

ST400 **External Control System**

Key Change Command:

STX+ BC + 'K'+ KeyChange0 + KeyChange1 + … + KeyChange5 + KeyData0 + KeyData1 + … + KeyData5 + Checksum→ →

BC: Byte count = 13
KeyChange0 … KeyChange5 – bitmap of the keys that have changed their state
If a corresponding bit is set - there was a change, if a bit is cleared – no change from the previous state. See Keyboard Decode Table for bitmap decoding

KeyData0 … KeyData5 – state of the keyboard
If a corresponding bit is set - the key is pressed, if a bit is cleared – the key is released.
See Keyboard Decode Table for bitmap decoding.

← ← No response required

NOTE- Key Press/Release status is sent on every key change. If all KeyData = 0, then all keys have been released.

Key Change Status Request Command:

← ← STX + 01 + 'S' + Checksum

STX+ BC + 'S'+ KeyData0 + KeyData1 + … + KeyData5 + Checksum → →

BC: Byte count = 7

KeyData0 … KeyData5 – state of the keyboard

IF a corresponding bit is set - the key is pressed, if a bit is cleared – he key is released.

See Keyboard Decode Table for bitmap decoding.

ST400 External Control System

Key LED Control:

← ← STX + BC + 'L' + Led Data1 + Led Data2 + … + Led Data5 + Checksum

BC: Byte count = 6

Data1= LED1 (Lsb) to LED8 (Msb)

Data2= LED9 (Lsb) to LED16 (Msb)

Data3= LED17 (Lsb) to LED24 (Msb)

Data4= LED25 (Lsb) to LED32 (Msb)

Data5= LED33 (Lsb) to LED34 (Msb)

STX + 01 + ACK + Checksum → →

Wheel Mode:

← ← STX + BC + 'M'+ Wheel Divide + Min Position + Max Position + Mode byte + Checksum

BC: Byte count = 5

Wheel Divide = 1 (highest resolution) to 96 (lowest resolution)

Min Position = The lowest number that may be returned as the wheel position. It's a signed value that ranges between 0 and –127.

Max Position = The highest number that may be returned as the wheel position. It's a signed value that ranges between 0 and +127.

Mode byte: 0= Off
1= Jog
2= Shuttle

STX + 01 + ACK + Checksum → →

Wheel Position: (Automatically sent when movement is detected)

STX + 02 + 'W' + Wheel Position Byte + Checksum → →

BC: Byte Count = 2

Wheel Position Byte = -16 → +16

← ← No response required

T-bar Position: (Automatically sent when movement is detected)

STX + BC + 'T' + T-bar Position Byte + Checksum → →

BC: Byte Count = 2

T-bar Position Byte = 0 → +64

← ← No response required

Wheel Position Request:

← ← STX + BC + 'W' + Checksum
BC: Byte Count = 1

STX + 02 + 'W' + Wheel Position Byte + Checksum → →
BC: Byte Count = 2
Wheel Position Byte = -16 → +16

T-bar Position Request:

← ← STX + BC + 'T' + Checksum
BC: Byte Count = 1

STX + BC + 'T' + T-bar Position Byte + Checksum → →
BC: Byte Count = 2
T-bar Position Byte = 0 → +64

ST400 External Control System

Blank the LCD Display:

← ← STX + BC + "B" + Checksum
BC: Byte Count = 1

STX + 01 + ACK + Checksum→ →

When this command is received, the whole display is cleared.

Display On:

← ← STX + BC + "N" + Checksum
BC: Byte Count = 1

STX + 01 + ACK + Checksum→ →

When this command is received, the display turns ON.

Display Off:

← ← STX + BC + "F" + Checksum

STX + 01 + ACK + Checksum→ →

When this command is received, the display turns OFF.

LCD Display Text:

← ← STX + BC + "D" + Row + Column + Size + Highlight Byte + Text (null-terminated) + Checksum

BC – Byte count of all bytes of the command excluding STX and Checksum
Row – Starting row of the display from 0 to 29
Column – Starting column of text – from 0 to 39
Size - 00 – Normal
01 – Double Wide
02 – Double High
03 – Double Wide, Double High
Highlight Byte – 00 – Highlight off (black characters on the white background)
01 – Highlight on (white characters on the black background)
Text – Up to 248 bytes of data, null terminated.

STX + 01 + ACK + Checksum→ →

NOTES:
The row and column are always set based on normal (the smallest) character size.
You should double the row number if you're using Double High characters (size = 2 or 3) and you should double the column number anytime you're using Double Wide Characters (size = 1 or 3).

When the text reaches the end of line, it wraps around to the next line, starting with Column 0.
When the text reaches the bottom of the screen, it does not wrap around to the top of the display. The text is truncated.

If there is no text added to the command (NULL-termination immediately follows the SIZE byte), the specified row gets cleared (column byte is disregarded).

LCD Insert Table:

← ← STX + BC + "I" + Border style (single-line or double-line)
+ Intersections style (single-line or double-line)
+ Number of Rows
+ Number of Columns
+ X coordinate of the Upper Left-hand Corner
+ Y coordinate of the Upper Left-hand Corner
+ Width of Column 1 (in characters)
+ ...
+ Width of Column n (in characters)
+ Height of Row 1 (in characters)
+ ...
+ Height of Row n (in characters)
+ Checksum

Where:
BC – Byte count of all bytes of the command excluding STX and Checksum
Single Line = 0
Double Line = 1
Number of Rows = 1 – 29
Number of Columns = 1 – 39
X coordinate of the Upper Left-hand Corner = 0 – 39
Y coordinate of the Upper Left-hand Corner = 0 – 29
The Width of an individual column may vary between 0 and 39 depending on the number of columns defined (see Note 1 below)
The Height of an individual row may vary between 0 and 29 depending on the number of rows defined (see Note 2 below)

STX + 01 + ACK + Checksum→ →

NOTES:

1. Total width of (Column1+ ...+ Column n) cannot exceed Maximum Width.
   Maximum Width = Total Display Length – X coordinate of the Upper Left-hand Corner – Number of Lines
   Total Display Length = 40 characters
   Number of Lines = Number of Columns + 1
2. Total height of (Row1 + ... + Row n) cannot exceed Maximum Height
   Maximum Height = Total Display Height – Y coordinate of the Upper Left-hand Corner – Number of Lines
   Total Display Hight = 30
   Number of Lines = Number of Rows + 1
3. All intersections are drawn in the same style lines (single-line or double-line depending on the specified style).
4. All outside boarders are drawn in the same style lines (single-line or double-line depending on the specified style).
5. The display within the table will be cleared. The display outside the table borders will not be touched.

LCD Clear Part of the Display:

← ← STX + BC + "P" + Number of Rows (height of the space to clear),
+ Number of Columns (width of the space to clear)
+ X coordinate of the Upper Left-hand Corner
+ Y coordinate of the Upper Left-hand Corner
+ Checksum

Where:
BC – Byte count of all bytes of the command excluding STX and Checksum
Number of Rows = 1 – 29
Number of Columns = 1 – 39
X coordinate of the Upper Left-hand Corner = 0 – 39
Y coordinate of the Upper Left-hand Corner = 0 – 29

STX + 01 + ACK + Checksum→ →

This command allows to clear a box on the display. All parameters assume small-size characters.

c. CONFIGURATION TABLES

1) LED Data Format Table:

LED DATA1:
Led ON: Bit= 1 Led OFF: Bit= 0

- Bit7= LED #8
- Bit6= LED #7
- Bit5= LED #6
- Bit4= LED #5
- Bit3= LED #4
- Bit2= LED #3
- Bit1= LED #2
- Bit0= LED #1

LED DATA2:
Led ON: Bit= 1 Led OFF: Bit= 0

- Bit7= LED #16
- Bit6= LED #15
- Bit5= LED #14
- Bit4= LED #13
- Bit3= LED #12
- Bit2= LED #11
- Bit1= LED #10
- Bit0= LED #9

LED DATA3:
Led ON: Bit= 1 Led OFF: Bit= 0

- Bit7= LED #24
- Bit6= LED #23
- Bit5= LED #22
- Bit4= LED #21
- Bit3= LED #20
- Bit2= LED #19
- Bit1= LED #18
- Bit0= LED #17

LED DATA4:
Led ON: Bit= 1 Led OFF: Bit= 0

- Bit7= LED #32
- Bit6= LED #31
- Bit5= LED #30
- Bit4= LED #29
- Bit3= LED #28
- Bit2= LED #27
- Bit1= LED #26
- Bit0= LED #25

LED DATA5:
Led ON: Bit= 1 Led OFF: Bit= 0

- Bit7= Undefined
- Bit6= Undefined
- Bit5= Undefined
- Bit4= Undefined
- Bit3= Undefined
- Bit2= Undefined
- Bit1= LED #34
- Bit0= LED #33

2) Keyboard Decoding Table:

In a Change Bitmap:
Bit = 1 – the key's state has changed, Bit = 0 – the state has not changed.

In a State Bitmap:
Bit = 1 – the key is pressed, Bit = 0 – the key is released.

KeyData0:
- Bit0= Key 1
- Bit1= Key 2
- Bit2= Key 3
- Bit3= Key 4
- Bit4= Key 5
- Bit5= Key 6
- Bit6= Key 7
- Bit7= Key 8

KeyData1:
- Bit0= Key 9
- Bit1= Key 10
- Bit2= Key 11
- Bit3= Key 12
- Bit4= Key 13
- Bit5= Key 14
- Bit6= Key 15
- Bit7= Key 16

KeyData2:
- Bit0= Key 17
- Bit1= Key 18
- Bit2= Key 19
- Bit3= Key 20
- Bit4= Key 21
- Bit5= Key 22
- Bit6= Key 23
- Bit7= Key 24

KeyData3:
- Bit0= Key 25
- Bit1= Key 26
- Bit2= Key 27
- Bit3= Key 28
- Bit4= Key 29
- Bit5= Key 30
- Bit6= Key 31
- Bit7= Key 32

KeyData4:
- Bit0= Key 33
- Bit1= Key 34
- Bit2= Key 35
- Bit3= Key 36
- Bit4= Key 37
- Bit5= Key 38
- Bit6= Key 39
- Bit7= Key 40

KeyData5:
- Bit0= Key 41
- Bit1= Key 42
- Bit2= Key 43
- Bit3= Key 44
- Bit4= Key 45
- Bit5= Key 46
- Bit6= Undefined
- Bit7= Undefined

d. COMMAND EXAMPLES

ST400 **External Control System**

1) Keyboard status request with the response that indicates that all keys are released.

🡐🡐 0x2 + 0x01 + ‘S’ + 0x56

0x2 + 0x07 + ‘S’ + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x5C 🡒🡒

2) Instruction to turn on LEDs 1 and 9.

🡐🡐 0x2 + 0x06 + ‘L’ + 0x01 + 0x01 + 0x00 + 0x00 + 0x00+ 0x56

0x02 + 0x01 +0x04 +0x07 🡒🡒

6. SPECIFICATIONS

Power:	90 VAC to 265 VAC adapter supplied with IEC connector APX Model #AP4108 +5v @ 4A, +12v @ 1.0A, -12V @ 0.6A	
Size:	[L" x W" x H"] 12 3/4" x 8" x 1 3/4" (front) 3 5/8" (rear) [8 5/8" high to top of display]	
Weight:	10 lbs.	
Rear Panel Connectors:	VTR1, 2, 3, 4, 5, 6, 7, 8	(All DB9F)
	GPI	(DBF25F)
	Power	(DB9M)
	Keyboard	(6-pin mini DIN)
	Ref. Video In	(BNC)
	Ground	Threaded stud
Display:	Easy to read, back-lit LCD display	
Jog/Shuttle Wheel:	With mechanical detents	

POWER CONNECTOR
9-Pin D-Type, Female (DB9M)

Pin #				
	1	+5v DC	6	+5 VDC
	2	+5v DC	7	Ground
	3	Ground	8	Ground
	4	+12 VDC	9	Ground
	5	–12 VDC		

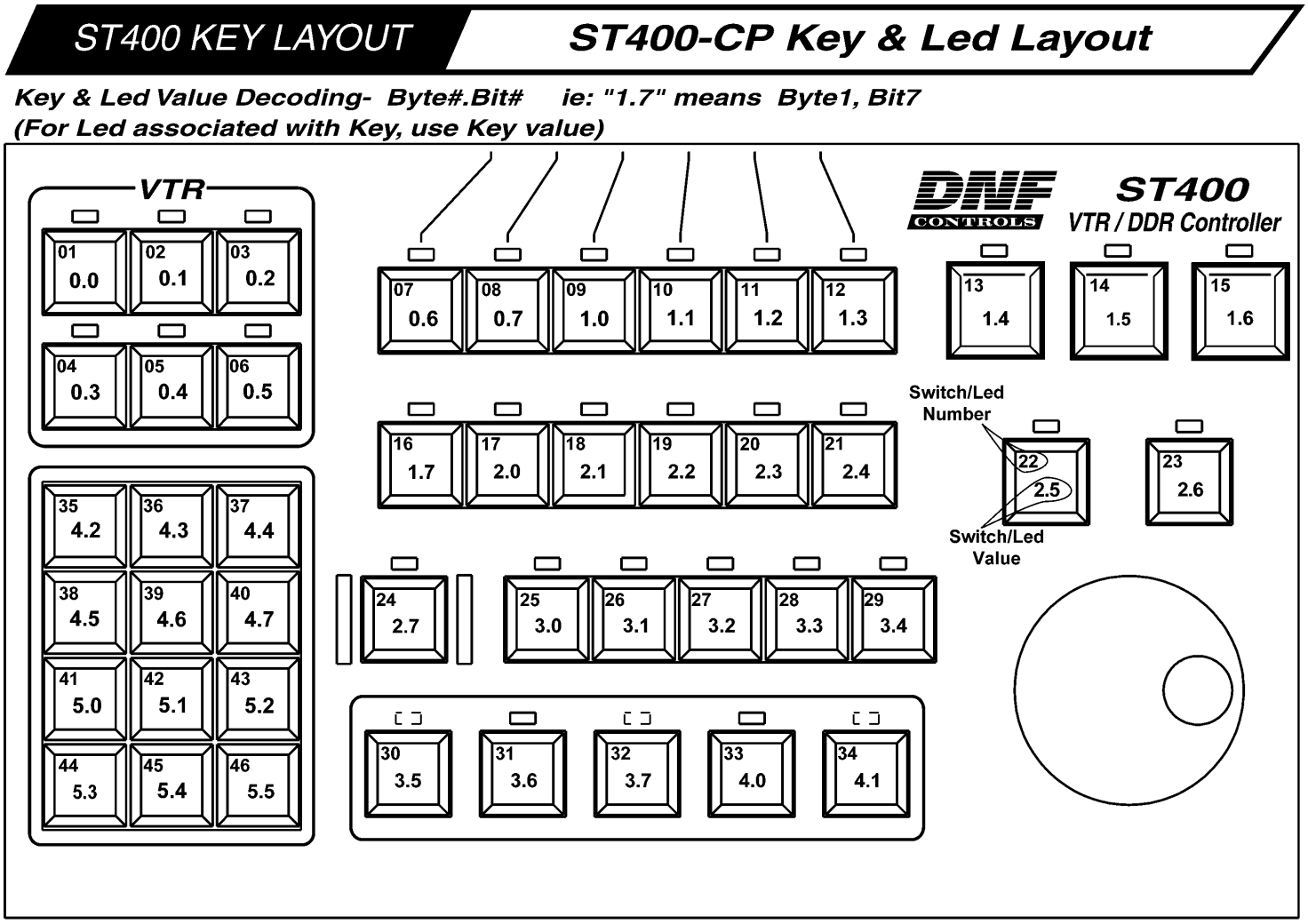
SP2 Connector, RS232 PINOUT
9-Pin D-Type, Female

Pin #				
	1	No connection	6	No connection
	2	Receive ←	7	No connection
	3	Transmit →	8	No connection
	4	No connection	9	No connection
	5	Ground		

SP2 Connector, RS422 PINOUT
9-Pin D-Type, Female

Pin #				
	1	Frame Ground	6	No connection
	2	Transmit A →	7	Transmit B →
	3	Receive B ←	8	Receive A ←
	4	Ground	9	Frame Ground
	6	No connection		

7. KEY LAYOUT


ST400 KEY LAYOUT
ST400-CP Key & Led Layout
Key & Led Value Decoding- Byte#.Bit# ie: "1.7" means Byte1, Bit7
(For Led associated with Key, use Key value)
VTR
01 0.0
02 0.1
03 0.2
04 0.3
05 0.4
06 0.5
35 4.2
36 4.3
37 4.4
38 4.5
39 4.6
40 4.7
41 5.0
42 5.1
43 5.2
44 5.3
45 5.4
46 5.5
07 0.6
08 0.7
09 1.0
10 1.1
11 1.2
12 1.3
16 1.7
17 2.0
18 2.1
19 2.2
20 2.3
21 2.4
24 2.7
25 3.0
26 3.1
27 3.2
28 3.3
29 3.4
30 3.5
31 3.6
32 3.7
33 4.0
34 4.1
DNF CONTROLS
ST400
VTR / DDR Controller
13 1.4
14 1.5
15 1.6
Switch/Led Number
22 2.5
23 2.6
Switch/Led Value

8. DNF CONTROLS LIMITED WARRANTY

DNF Controls warrants its product to be free from defects in material and workmanship for a period of one (1) year from the date of sale to the original purchaser from DNF Controls.

In order to enforce the rights under this warranty, the customer must first contact DNF's Customer Support Department to afford the opportunity of identifying and fixing the problem without sending the unit in for repair. If DNF's Customer Support Department cannot fix the problem, the customer will be issued a Returned Merchandise Authorization number (RMA). The customer will then ship the defective product prepaid to DNF Controls with the RMA number clearly indicated on the customer's shipping document. The merchandise is to be shipped to:

DNF Controls
12843 Foothill Blvd., Suite D
Sylmar, CA 91342
USA

Failure to obtain a proper RMA number prior to returning the product may result in the return not being accepted, or in a charge for the required repair.

DNF Controls, at its option, will repair or replace the defective unit. DNF Controls will return the unit prepaid to the customer. The method of shipment is at the discretion of DNF Controls, principally UPS Ground for shipments within the United States of America. Shipments to international customers will be sent via air. Should a customer require the product to be returned in a more expeditious manner, the return shipment will be billed to their freight account.

This warranty will be considered null and void if accident, misuse, abuse, improper line voltage, fire, water, lightning or other acts of God damaged the product. All repair parts are to be supplied by DNF Controls, either directly or through its authorized dealer network. Similarly, any repair work not performed by either DNF Controls or its authorized dealer may void the warranty.

After the warranty period has expired, DNF Controls offers repair services at prices listed in the DNF Controls Price List. DNF Controls reserves the right to refuse repair of any unit outside the warranty period that is deemed non-repairable.

DNF Controls shall not be liable for direct, indirect, incidental, consequential or other types of damage resulting from the use of the product.

# # #