DVDO iScan™ Duo Serial Automation Protocol

(Software version 2.10 B62n)

5/18/10

This document describes the iScan™ Duo's serial protocol when it is connected to an automation system controller.

1. Connection

The RS-232 interface port at the rear panel of the iScan Duo is used to communicate with the system controller. The DB-9 (female) connector pin-out is given below.

Pin 2	TXD	Output
Pin 5	GND	
Pin 3	RXD	Input
Pin 8	RTS	Input *Optional*
Pin 7	CTS	Output *Optional*

The iScan Duo uses a standard RS-232 1:1 (extension) DB9 Male to DB9 Female cable to connect to the system controller.

The communications (COM) port parameters for the iScan Duo are:

Baud Rate 19200 (default)
Data Bits 8
Parity None
Stop Bits 1
Flow Control None

The following baud rates (bps) can be selected by the user: 4800, 9600, 14400, 19200, 38400, 57600 and 115200.

Hardware flow control is also supported.

2. Notation and Convention

$ Any number or alphabet that is preceded with a $ is considered an hexadecimal number; Otherwise it is considered an ASCII character, except for NULL, STX and ETX which are described below.

Host	The computer or system controlling the iScan Duo
Transaction	Communication in either direction between Host and iScan Duo
ASCII hexadecimal	An ASCII character representing a hexadecimal value, for example the ASCII letter 'A'.
' '	An ASCII string is shown in quotes.

3. Protocol Summary

The system controller always initiates a transaction by sending a packet to the iScan Duo which, always responds back with an acknowledgement. The iScan Duo never initiates a transaction to the system controller.

The protocol is based on ASCII characters. Four ASCII non-printable control characters are used.

ASCII	**Hex**	**Description**
NULL	$00	Ignore or End of String
STX	$02	Start of text
ETX	$03	End of text
SPACE	$20	'Space' key on keyboard

The list of all ASCII characters used by the iScan Duo serial automation protocol and their hexadecimal equivalent values are given in Section 9.

Each transaction from either the system controller or the iScan Duo has the following formats

STX [Transaction Type] [Data Count] [ID] NULL [Value] NULL [Checksum] ETX
STX [Transaction Type] [Data Count] [ID] NULL [Checksum] ETX

Each portion of the packet is described below.

STX	Start of transaction
Transaction Type	Type of transaction in 2 ASCII hexadecimal characters.
Data Count	Number of ASCII characters in the packet up. The count does not include checksum or ETX. Fixed at 2 ASCII hexadecimal numbers.
Value	Data section of the transaction. The protocol supports variable data sizes and types. Value = <Parameter1>

	Value = <Parameter1>SPACE<Parameter2> Value = <Parameter1>SPACE<Parameter2>SPACE<Parameter3> Some transactions have no entry for Value
Checksum	Checksum (2 ASCII hexadecimal characters) is optional when transaction is from the host to the iScan Duo. The iScan Duo always returns a checksum. Section 9 shows how checksum is calculated with this protocol. The examples in this document do not include checksums when transactions are initiated by the host.
ETX	End of transaction

3.1 Recommended practices

- Monitor the iScan Duo's response to a command to ensure reliable communications.
- When multiple commands are required to be sent to the iScan, send one command at a time. A complete response should be received by the Host before sending the next command.
- There is a possibility that an error may occur in during communication between the Host and the iScan Duo. The Host should re-send the command if
  a) iScan Duo's acknowledge packet shows that an error has occurred
  b) iScan Duo does not respond after 1 second.

4.0 Transaction Types

The supported transaction types are summarized in the table below.

Transaction	Code	Description
Command	30	Host send a command to the iScan Duo to perform a function
Response	01	iScan Duo tells Host it has received the command
Query	20	Host queries the iScan Duo for information
Reply	21	iScan Duo responds to Host query command
Error	02	iScan Duo responds to Host control command with an error

4.1. Command (30) and Response (01)

The controller sends a Command packet to change a setting in the iScan Duo.
The iScan Duo always responds with a Response packet.

The Command packet is described below.

STX 30 DataCount ID NULL Value NULL ETX

DataCount	Number of ASCII characters before ETX (2 characters)
ID	Type of command (2 characters)
Value	Depends on ID

The Value entry is dependent on the ID string and is organized as shown below

1) <Parameter1>
2) <Parameter1>Space<Parameter2>
3) <Parameter1>Space<Parameter2>Space<Parameter3>

4.1.1 Single Parameter entry

This is the most common entry for Command packets.

Example: Set Brightness to 8

STX 30 05 21 NULL 8 NULL ETX

DataCount	**05**
ID	**21** (Brightness)
Value	**8**

The Response packet is described below.

STX 01 05 1 NULL 30 NULL 5C ETX

DataCount	**05**
ID	**1** (Acknowledge)
Value	**30**
Checksum	**5C**

4.1.2 Two Parameter entries

User Chromaticity and Color Gamut commands use two parameters as shown below

STX 30 DataCount DD NULL <Color Index> Space <Value> NULL ETX
STX 30 DataCount DE NULL <Color Index> Space <Value> NULL ETX

Color Index refers to color primaries : red-x,red-y,green-x,green-y,blue-x,blue-y,white-x,white-y
Value is the offset value for the specified Color Index.

Here's a specific example of a Color Gamut command which writes -0.1234 offset to the Red-x primary.

STX 30 0D DE NULL ‘0 -0.1234’ NULL ETX

DE	Color Gamut command
‘0 -0.1234’	‘Value *note the space between ‘0’ and ‘-0.1234’*
0D	13 characters including the 2 NULL characters

The space between the characters are only shown to make the script more readable with the exception of the space character between the Color index (0) and Value (-0.1234).

See Section 5.0 for more details

4.1.2 Three Parameter commands

The Gray Scale Command use three parameters as shown below

STX 30 DataCount DF NULL <Color> Space <Level> Space <Value> NULL ETX

Color refers to the Primary colors
Level refers to gray scale levels (0 IRE to 100 IRE)
Value refers to offset for specified primary colors

Here’s a specific example of a Gray Scale command. It writes -0.2 offset to Green Primary of 100 IRE pattern.

STX 30 0D DF NULL '1 10 -0.2' NULL ETX ;

DF	Gray Scale command
‘1 10 -0.2’	Index of Green, 100 IRE, -0.2 value (note the space) ‘’ is used only for illustration. It is not used in the protocol.
0D	13 characters including the 2 NULL characters

See Section 5.0 for more details

4.2. Query (20) and Reply (21)

The Host sends a Query packet to read a setting in the iScan Duo as shown below. There are 2 types of query commands 1) with value 2) with no value

STX 20 DataCount ID NULL Value NULL ETX
STX 20 03 ID NULL ETX (no Value)

DataCount	Number of ASCII characters before ETX (2 bytes)
ID	Type of command (2 bytes)
Value	Depends on ID, may not be present

Example: Query brightness setting

STX 20 03 21 NULL ETX

The iScan Duo responds to the Query packet with a Reply packet, shown below.

STX 21 DataCount ID NULL Value NULL Checksum ETX

DataCount	Number of ASCII characters before ETX
ID	Type of command (2 bytes)
Value	Depends on ID
Checksum	Calculated using method shown in Section 9

Example: Reply to Query brightness (ID 21) setting above

STX 21 05 21 NULL 8 NULL 65 ETX

Note that the Query packet above does not have a parameter for Value.

Query packets can also have parameters just like Command packets. The reply packet is the same for these packets.

Here are three specific examples

1) Queries Red-x Chromaticity value for User Chromaticity command

STX 20 05 DD NULL 0 NULL ETX

DD	User Chromaticity command
05	Five characters including NULLs
0	Index for Red-x

2) Queries Red-y Chromaticity value for Color Gamut command

STX 20 05 DE NULL 1 NULL ETX

DE	Color Gamut command
05	Five characters including NULLs
1	Index for Red-y

3) Queries Red Primary value for Gray Scale 90IRE command

STX 20 07 DF NULL '0 9' NULL ETX

DF	Gray Scale command
07	Seven characters including NULLs
'0 9'	Index for Red and 90 IRE respectively

Note the spacing between 0 and 9
'' is used only for illustration. It is not used in the protocol.

4.3. Error (02)

The iScan Duo responds to an invalid packet from the system controller with an Error packet. The Error packet has the following format.

STX 02 02 ERR NULL Checksum ETX

02	DataCount (ERR and NULL)
ERR:	Error code, one or two ASCII characters
Checksum	Calculated using method shown in Section 9

Example: Error code 6 is returned

STX 02 02 6 NULL FC ETX

The error codes are listed below:

1	Invalid check sum
2	Invalid packet id (query, command, etc…)
3	Invalid setting id (brightness, contract, etc…)
4	Range error. The host attempts to set a value outside the range of the setting.
5	Bad packet character (not using valid characters) or packet was used in the wrong place.
6	The last byte of the packet was not received within 100ms of the first byte.
7	Un-terminated value data. The last data byte was not a NULL character.
8	Bad data. The data value(s) passed were not correctly formatted for the setting.
9	Too many or too few data values were passed for the packet type.
10	The setting indicated in a Command packet is not a writeable setting.
11	The packet is larger than the maximum packet size.

5.0 List of Commands

The table below describes the supported commands in the iScan Duo with current release software. All commands can be queried unless otherwise specified.

5.1 Single parameter commands

Command Name	ID	Parameter Name	Parameter Value
Input Select	4C	Auto	0
		Video 1	1
		Video 2	2
		Video 3	3
		S-Video	4
		Component 1	5
		Component 2	6
		HDMI 1	7
		HDMI 2	8
		HDMI 3	9
		HDMI 4	10
		HDMI 5	11
		HDMI 6	12
		HDMI 7	13
		HDMI 8	14
		VGA	15
Brightness	21	Range	-100…+100
Contrast	22	Range	-100…+100
Saturation	23	Range	-100…+100
Hue	24	Range	-100…+100
Y/C Delay	27	Range	-100…+100
CUE Correction	28	Off	0
		On	1
		Auto	2
Mosquito Noise Reduction	C8	Off	0
		Low	1
		High	3

Detail Enhancement	C9	Range	-100…+100
Edge Enhancement	CA	Range	-100…+100
Horizontal Stretch	40	Range	0…+100 (%)
Vertical Stretch	41	Range	0…+100 (%)
Horizontal Shift	42	Range	Dep. on H. Stretch
Vertical Shift	43	Range	Dep. on V. Stretch
Zoom	46	Range	0…+100 (%)
Select Audio Input	4A	HDMI	1
		Coax	2
		Optical 1	3
		Optical 2	4
		Optical 3	5
		Analog Stereo 1	6
		Analog Stereo 2	7
Audio Delay	4B	Range	-56..+200 (ms)
Mask Level	4E	Range	0..100 (IRE)
Border Level	4F	Range	0..100 (IRE)
Output Select	60	HDMI 1	1
		HDMI 2	2
Output Video Format	61	Auto	0
		480p	3
		576p	4
		720p50	5
		720p60	6
		1080i50	7
		1080i60	8
		1080p24	9
		1080p25	10
		1080p50	12
		1080p60	13
		VGA	14
		SVGA	15
		XGA	16
		SXGA	17

Display Aspect Ratio	6A	Auto	0
		16:9	1
		4:3	2
Underscan	8B	Range	0…+20 (%)
Output Color Space	6C	Auto	0
		RGB	1
		YCbCr 4:2:2	2
		YCbCr 4:4:4	3
Output YCbCr	E5	Auto	0
		BT.601	1
		BT.709	2
Output Video Level	E6	Auto	0
		Video	1
		Computer (PC)	2
Output HDCP Mode	EA	On	1
		Auto	2
Input Video Level	F0	Auto	0
		Video	1
		Computer (PC)	2
Input Color Space	87	Auto	0
		RGB	1
		YCbCr 422	2
		YCbCr 444	3
Input Colorimetry	EF	Auto	0
		ITU BT.601	1
		ITU BT.709	2
Power	A1	Off	0
		On	1
Auto Standby	83	Off	0
		On	1
Auto Wakeup	2E	Off	0
		On – Mode 1	1
		On – Mode 2	2
Menu Time-Out	F5	Off	0

		40 seconds	1
		160 seconds	2
Test Pattern	80	Off	0
		Frame and Geometry	1
		Brightness Contrast	2
		Alternating pixels	3
		Vertical Lines	4
		Horizontal Lines	5
		Judder	6
		8 Color Bars 75 IRE	7
		8 Color Bars 100 IRE	8
		10 IRE	9
		20 IRE	10
		30 IRE	11
		40 IRE	12
		50 IRE	13
		60 IRE	14
		70 IRE	15
		80 IRE	16
		90 IRE	17
		100 IRE	18
		Gray Ramp	19
		Cross Hatch Coarse	20
		Cross Hatch Fine	21
		Focus	22
		Half Pattern Black White	23
		Half Pattern 7-Color Bars 75 IRE	24
		Half Pattern 7-Color Bars 100 IRE	25
		Half Pattern 8-Color Bars 75 IRE	26
		Half Pattern 8-Color Bars 100 IRE	27
		White	28

		Red	29
		Green	30
		Blue	31
		Cyan	32
		Magenta	33
		Yellow	34
		Black	35
Info Screen	A5	Off	0
		Input Status	1
		Picture Controls	2
		Output Status	3
		About	4
Factory Default	AC	All	0
		Name	1
		Picture Controls	2
		Output Format	3
Select Audio Output	BA	Auto	0
		HDMI Video	1
		HDMI Audio	2
		Optical	3
Game Mode	2D	Off	0
		On	1
1:1 Frame Rate	2F	Off	0
		On	1
Input Aspect Ratio-Presets	30	16:9 Full Frame	1
		4:3 Full Frame	2
		4:3 Letter Box	3
		Panorama	4
		User Preset	5
Input HDCP Mode	86	Off	0
		On	1
PReP Control 480p/576p	B6	Auto	0
		Off	1
PReP Control 1080p	B7	Auto	0

		Off	1
Hot Plug Source	71	Auto	0
		Off	1
Deinterlacer Mode	49	Film Bias	0
		Video	1
		2:2 Even	2
		2:2 Odd	3
		Auto	6
		Forced 3:2	8
		Forced 2:2	10
Frame lock Mode	74	Auto	0
		Unlock	1
Remote Navigation	A2	Left	1
		Right	2
		Up	3
		Down	4
		Menu	5
		Enter/OK	6
		Exit	7
Input Chromaticity	DB	Auto	0
		RGBs/709	1
		NTSC	2
		PAL/SECAM	3
		SMPTE-C	4
		CIE 1931	5
		AppleRGB	6
		Adobe 1998	7
Output Chromaticity	DC	Auto	0
		RGBs/709	1
		NTSC	2
		PAL/SECAM	3
		SMPTE-C	4
		CIE 1931	5
		AppleRGB	6

		Adobe 1998	7
		User	8

5.2 Two parameter commands

Command Name	**ID**	**Parameter 1 Name**	**Parameter1 Value**	**Parameter 2 Name**	**Parameter1 Value**
User Chromaticity	DD	Red-x	0	Range	Min: Max:
		Red-y	1		
		Green-x	2		
		Green-y	3		
		Blue-x	4		
		Blue-y	5		
		White-x	6		
		White-y	7		
Color Gamut	DE	Red-x	0	Range	Min: Max:
		Red-y	1		
		Green-x	2		
		Green-y	3		
		Blue-x	4		
		Blue-y	5		
		White-x	6		
		White-y	7		

5.3 Three parameter commands

Command Name	**ID**	**Parameter 1**		**Parameter 2**		**Parameter 3**	
		Name	**Value**	**Name**	**Value**	**Name**	**Value**
Gray Scale	DF	Red	0	0 IRE	0	Range	Min: -20.0IRE Max: +20.0IRE Value is constrained by total IRE range
		Green	1	10 IRE	1		
		Blue	2	20 IRE	2		
				30 IRE	3		
				40 IRE	4		

				50 IRE	5		from 0 to 100
				60 IRE	6		
				70 IRE	7		
				80 IRE	8		
				90 IRE	9		
				100 IRE	10		

5.1 Query Only Commands

Command Name	ID	Parameter Name	Parameter Value
Product Name	A8	None	None
Version Number	A9	None	None

6. Command Examples

This section provides detailed examples of commands in ASCII that the controller will generate to change the iScan Duo's settings. The iScan Duo will respond with the following string

STX 01 05 1 NULL 30 NULL 5C ETX

Notes:
a) These commands are generated without checksums.
b) A positive number does not need the '+' sign. However '+' is also accepted by the protocol.

STX 3 0 0 5 2 1 NULL 1 NULL ETX	Set Brightness to 1
STX 3 0 0 6 2 1 NULL 1 0 NULL ETX	Set Brightness to 10
STX 3 0 0 7 2 1 NULL - 1 0 NULL ETX	Set Brightness to -10
STX 3 0 0 5 2 2 NULL 0 NULL ETX	Set Contrast to 1
STX 3 0 0 6 2 2 NULL 1 0 NULL ETX	Set Contrast to 10
STX 3 0 0 7 2 2 NULL - 1 0 NULL ETX	Set Contrast to -10
STX 3 0 0 5 2 3 NULL 1 NULL ETX	Set Saturation to 1
STX 3 0 0 6 2 3 NULL 1 0 NULL ETX	Set Saturation to 10
STX 3 0 0 7 2 3 NULL - 1 0 NULL ETX	Set Saturation to -10
STX 3 0 0 7 4 0 NULL 1 2 0 NULL ETX	Set Horizontal Stretch to 120
STX 3 0 0 7 4 1 NULL 1 2 0 NULL ETX	Set Vertical Stretch to 120
STX 3 0 0 7 4 2 NULL 1 2 0 NULL ETX	Set Horizontal Shift to 120
STX 3 0 0 7 4 3 NULL 1 2 0 NULL ETX	Set Vertical Shift to 120
STX 3 0 0 6 4 6 NULL 1 0 NULL ETX	Set Zoom to 10%

STX 3 0 0 5 4 A NULL 1 NULL ETX	Audio input HDMI assigned
STX 3 0 0 7 4 B NULL - 1 0 NULL ETX	Audio Delay = -10ms
STX 3 0 0 6 4 B NULL 5 0 NULL ETX	Audio Delay = 50ms
STX 3 0 0 5 4 C NULL 1 NULL ETX	Input Select = Video 1
STX 3 0 0 5 3 0 NULL 1 NULL ETX	Input Aspect Ratio 16:9 FF
STX 3 0 0 6 6 1 NULL 1 3 NULL ETX	Select 1080p format
STX 3 0 0 5 8 0 NULL 1 NULL ETX	Select Test Pattern – Frame Geometry
STX 3 0 0 6 8 0 NULL 2 0 NULL ETX	Select Test Pattern – Cross Hatch Coarse
STX 3 0 0 5 8 3 NULL 1 NULL ETX	Auto Standby mode is On
STX 3 0 0 5 A 1 NULL 1 NULL ETX	Turn Power On

7. Query Packet Examples

The Host sends a query command as shown below

STX 20 03 ID NULL ETX

Some examples

Host sends	STX 2 0 0 3 2 1 NULL ETX	Query Brightness
iScan Duo responds	STX 2 1 0 5 2 1 NULL 1 NULL 5 E ETX	Brightness is 1
Host sends	STX 2 0 0 3 2 2 NULL ETX	Query Contrast
iScan Duo responds	STX 2 1 0 6 2 2 NULL 1 0 NULL 9 0 ETX	Contrast is 10

Note: '5E' and '90' are checksum values.

Host sends	STX 20 03 A8 NULL ETX	Query Product Name
iScan Duo responds	STX 21 0D A8 **iScanDuo** 68 ETX	
Host sends	STX 20 03 A9 NULL ETX	Query Firmware Version
iScan Duo responds	STX 21 0E A9 **2.00B0.62b** 7E ETX	

8. Error Packet Examples

Sometimes the iScan Duo will send an Error packet in response to a packet sent from the Host. Refer to section 4.3 for a complete list of error codes.

The common error packets are described below.

a. Invalid Setting

STX 0 2 0 2 **2** NULL F 8 ETX

Error Code 2: This packet is sent typically when the controller is querying an invalid setting.

b. Timeout

STX 0 2 0 2 **6** NULL F C ETX

Error Code 6: This packet is sent typically when the controller is querying an invalid setting.

Note: 'F8' ad 'FC' are checksum values.

9. ASCII to Hex Conversion Table

ASCII	HEX
0	$30
1	$31
2	$32
3	$33
4	$34
5	$35
6	$36
7	$37
8	$38
9	$39
A	$41
B	$42
C	$43
D	$44
E	$45
F	$46
-	$2D
+	$2B
.	$2E
STX	$02
ETX	$03
NULL	$00
SPACE	$20

10. Checksum Calculation

This is best done with an example.

We want to add the ASCII Checksum value for the command packet below

STX 30 05 21 NULL 8 NULL Checksum ETX

1. Convert ASCII values before **Checksum** to hexadecimal

$02	$33$30	$30$35	$32$31	$00	$38	$00
STX	30	05	21	NULL	8	NULL

2. The addition results in $165 (use a hex calculator or similar tools). Since checksum is 2 ASCII characters, we drop '1' and keep '65'.
3. The Command packet with checksum is shown below.

STX 30 05 21 NULL 8 NULL 65 ETX

11. History

10/12/09	Rev 1.00 Release.	
10/22/09	Rev 1.01 B49 Release.	Corrected flow control – None
2/15/10	Rev 2.0 B51 Release.	
	Added remote navigation A2 commands	
	Modified factory default commands	
5/18/10	Rev 2.10 B62n Release.	
	Added more control commands (Gray entries in Section 5.1 and 5.2)	