Interface Control Document
Switchbox Packet Protocol

NORTHROP GRUMMAN CORPORATION

Electronic Systems
Remotec, Incorporated
Oak Ridge, Tennessee

Approvals and Signatures

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Electronic Systems
Rev 0.01

NORTHROP GRUMMAN PROPRIETARY LEVEL 2

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Purpose

The purpose of this document is to define the serial protocol of the command data transmitted by the Andros Switchbox to the Andros Vehicle.

Scope

The interface described here is based upon:
1. Micro-Encoder firmware version CONCTL22.
2. Micro-Encoder Assembly B-7050-9525 Revision 3.

Reference:

- CONCTL22 Mapping of Inputs-to-Packet.xls, Remotec, 2004.

Hardware Configuration

The serial port configuration is:

Description	Settings
Baud Rate	9600
Data Bits	8
Parity	None
Stop Bits	1
Flow Control	None

Currently the packets are transmitted at a frequency of once every 40mS. Basically, the CPU on the Micro-Encoder board repeatedly scans the inputs and transmits the packet as fast as it can.

Packet Structure

The communications protocol is unidirectional: commands are sent from the switchbox to the vehicle.

The packet structure is defined as:

Field Description	Size, in bytes	Notes
Header	2	Binary
Data	32	ASCII
Footer	2	Binary

The Header consists of two Start of Packet (SOP) characters. The value of the SOP character is 0xF1, so the Header is {0xF1, 0xF1}.

The Footer consists of a 16-bit checksum, ~~of ASCII~~ /OF ASCII calculated over the 32-byte Data field. The checksum value is transmitted least-significant-byte first.

The Data consists of sixteen 8-bit values. Each Data value is converted to 2 ASCII characters before being transmitted. For example the, the 8-bit value 0x3C would be converted to the two ASCII characters '3' and 'C' (0x33 and 0x43); then the ASCII pair would be transmitted most-significant-nibble first (i.e. the '3' would be transmitted first).

Note that the SOP character:
1. Should never be found within the Data field.
2. May be found within the Footer.

Data Structure

The structure of the Data field is defined as:

Data Byte #	Data Bit #	Signal Description
0	0	Tool On
0	1	Safety/vehicle 1 to drive, 0 is safe
0	2	Drive Brake 1 to drive, 0 is stopped
0	3	Speed high
0	4	Front Art. Up
0	5	Front Art. Down
0	6	Rear Art. Up
0	7	Rear Art. Down
1	0	P/T Left
1	1	P/T Right
1	2	P/T Up
1	3	P/T Down
1	4	Focus down
1	5	Focus up
1	6	Iris up
1	7	Iris down
2	0	zoom down
2	1	zoom up
2	2	Inset 4
2	3	Logic '1'
2	4	Logic '1'
2	5	Inset 3
2	6	fiber unwind
2	7	fiber takeup
3	0	Weapon 1
3	1	Weapon 2
3	2	Weapon 3

Handwritten annotations:
- F1 F1
- FUp: 31 32
- FDN: 32 32
- FUp: 31 32
- RUp: 34 32
- ~~Weapit~~ Safe: 30 30
- XMIT 2nd 0 LSB
- XMIT 1st 2 MSB

Handwritten left margin (vertical): MUST BE ON to MOVE ARM + ARTICULATER + SAFETY TURN ON

Data Byte #	Data Bit #	Signal Description
3	3	Shotgun
3	4	Logic '0'
3	5	Logic '1' cleared
3	6	Logic '0'
3	7	Laser
4	0	Shoulder CW
4	1	Shoulder CCW
4	2	Torso left
4	3	Torso right
4	4	Wrist CW
4	5	Wrist CCW
4	6	Gripper rot. CCW
4	7	Gripper rot. CW
5	0	Gripper open
5	1	Gripper close
5	2	Elbow CW
5	3	Elbow CCW
5	4	Logic '1'
5	5	Logic '0'
5	6	Logic '0'
5	7	Logic '1'
6	0 - 7	Calculated Pivot Analog Value
7	0 - 7	Calculated Drive Analog Value
8	0 - 7	Arm Speed Analog Input
9	0 - 7	Light Analog Input
10	0	P/T extend up
10	1	P/T extend down
10	2	Wrist extend left
10	3	Wrist extend right
10	4	Graphics down
10	5	Graphics up
10	6	Weapon 4
10	7	Enable key
11	0	Dipswitch
11	1	Dipswitch
11	2	Dipswitch
11	3	Dipswitch
11	4	Dipswitch
11	5	Dipswitch
11	6	Dipswitch
11	7	Dipswitch
12	0	Logic '0'
12	1	Logic '0'
12	2	Logic '0'
12	3	Logic '0'
12	4	Logic '0'

Handwritten right margin notes:

x38 | x0 = 0 = 128

x38 | x30 = 0 = 128

0 = no current   255 = full current

0 = off   255 = full on

D switch
39   33

46

Data Byte #	Data Bit #	Signal Description
12	5	Logic '0'
12	6	Logic '0'
12	7	Logic '0'
13	0	Inset video 1
13	1	Inset video 2
13	2	Main video 2
13	3	Main video 3
13	4	Main video 4
13	5	Speed low
13	6	Weapon 5
13	7	Weapon 6
14	0 - 7	Battery Voltage Analog Input
15	0 - 7	0x02 hard-coded value

An activated switch (i.e. the switch's contacts are closed) will be represented by the Boolean value '1' in the appropriate Data field.

Packet Validation

Several of the data fields in the packet have fixed values. This is for the purpose of verifying the packet contents. These fields are:

Byte	Bit(s)	Value
2	3	1
2	4	1
3	4	0
3	5	1
3	6	0
5	4	1
5	5	0
5	6	0
5	7	1
11	0-7	Optional
15	0-7	0x02

The value of byte #11 is determined by a dipswitch. The standard vehicle software ignores this field; the vehicle software can optionally be built to filter packets based upon this field.

Example

An example packet follows:

Byte #	Value	ASCII Equivalent	Description / Interpretation
0	0xF1		SOP
1	0xF1		SOP

2	0x30	0	
3	0x30	0	Byte 0 → 00
4	0x30	0	
5	0x30	0	Byte 1 → 00
6	0x31	1	
7	0x43	C	Byte 2 → 1C
8	0x32	2	
9	0x30	0	Byte 3 → 20
10	0x30	0	
11	0x30	0	Byte 4 → 00
12	0x39	9	
13	0x30	0	Byte 5 → 90
14	0x37	7	
15	0x46	F	Byte 6 → 7F
16	0x37	7	
17	0x45	E	Byte 7 → 7E
18	0x33	3	
19	0x45	E	Byte 8 → 3E
20	0x30	0	
21	0x30	0	Byte 9 → 00
22	0x30	0	
23	0x30	0	Byte 10 → 00
24	0x46	F	
25	0x46	F	Byte 11 → FF
26	0x46	F	
27	0x46	F	Byte 12 → FF
28	0x32	2	
29	0x30	0	Byte 13 → 20
30	0x43	C	
31	0x43	C	Byte 14 → CC
32	0x30	0	
33	0x32	2	Byte 15 → 02
34	0xF2		
35	0x06		Checksum → 06F2

Guess x44|x32

Checksum calc

Sum all data ~~packets~~ values

Send 1st byte then 2nd byte

~~16 bits:~~

Zero the ~~first~~ byte

30 hex = 48
31 hex = 49

$(16 \times 2)(48) + 70 =$ Checksum $= 1606 \Rightarrow$ x06 46

1602 $\Rightarrow$ x06 42

1606 $\Rightarrow$ x06 46

1600 $\Rightarrow$ x06 40

1598 $\Rightarrow$ x06 3E

3682
3453

#This is the configuration file for the packet generator

# Baud rate setting: 9600, 19200, 38400, 57600, 115200
baudrate=9600

# Serial port
serialport=/dev/ttyUSB0

# Robot type: F6A, VA1, WOLVERINE, HD1, PROWLER, RAV, RONS
robot=HD1 ← apply SC to mini Androus

# Control code: 8 bit hex value according to the dip switches in the switchbox
code=01 ⇒ Switch Box ?

(handwritten annotations)

3C — hex
1   43 → ASCII
30

Hex 3C
c
ASCII 33 43

04

front out up — 04
front out down — 05
front out up — 04
rear out up — 06

04

Hex 04

128
64
32
224 - E (hi)

1100|1100 = 204
12 or 112   12

10 =

~~0001 0000 = 128~~
1000 0000 = 178
8

Front set up

(Ø8) — Hex

Hx 3Ø   2Ø8 8

19

| Ø | 8 | ⊃ ASCI
3Ø   38

Ø
Byte 1 ¦ byte 2
Ø ¦ 8

Ø
3, 0

0000 |

Features

- Grip rotation 360°
- Common, modular electronics with JAUS (Joint Architecture for Unmanned System) compliant software
- Moulded front-drive range integrates microphone, speaker, drive camera, firing circuits and LED lighting
- Quick release lithium polymer battery
- On screen graphics showing vehicle orientation, feedback from on-board sensors and errors and failures of joints
- 9 factory position presets and up to 10 user-defined position presets
- New Tac-1 operator control unit with 21cm integrated LCD monitor making it hand portable and user-friendly
- New manipulator options with 6 degrees of freedom and quick release gripper/tool system

Product Specification

Stowed Dimensions (LxWxH)	1.209m x 0.66m x 0.635m
Typical Weight	118kg
Cameras and Lighting	3 main cameras with the possibility of 1 addition
Arm	1 x colour camera with low light switching capability, Extra low light colour PTZ with full 360° 215:1 continuous pan, 180° tilt, 215:1 zoom, Auto/manual focus and iris, LED light with remote switching from white to infrared, Motorised camera extender
Front Drive	1 x colour camera with manually adjustable tilt
Rear Drive	1 x black and white low light with fixed focus, Optional weapons camera and laser sighting systems available
Mission Time	4-6hrs (mission dependant)
Drag Capacity	70kg (terrain dependant)
Speed	8.4km/h
0-100m Acceleration	45 seconds

Capabilities

Reach and Payload

Vertical Reach 1.32m
Horizontal Reach 0.85m
57kg 23kg

Stair Climbing

37°
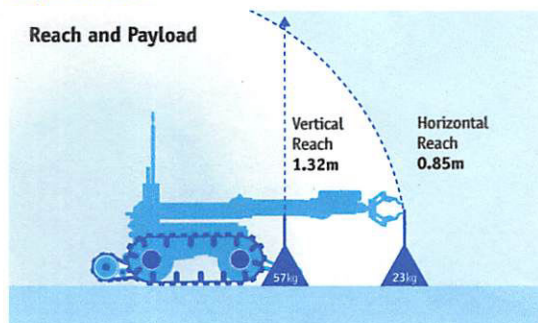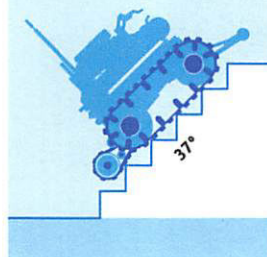
Confined Space Access

0.66m
0.64m

Neutral Turn

1.21m
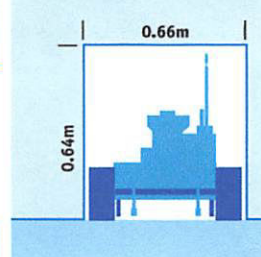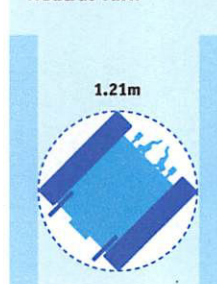
Negotiating Trenches and Kerbs

0.20m
0.51m
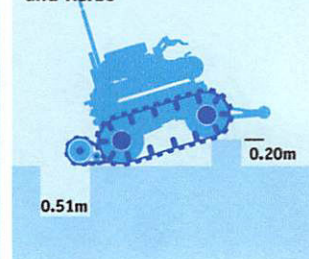
Communication Link Options

1000m Radio (Digital)
200m Radio (Analogue)
365.7m Fibre Optic
100.6m Cable

1000m   500m   200m   100m   50m
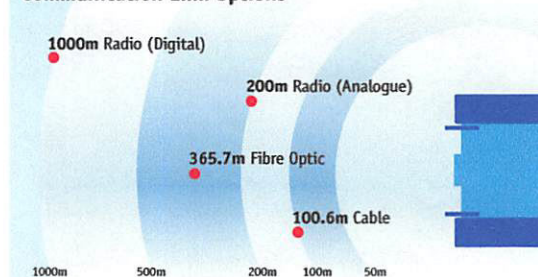
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THE VALUE OF PERFORMANCE.

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