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APPLE/TOP0 IR COMMANDS version 1.0  
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This document specifies all of the currently envisioned channels, processes, and commands, along with their code assignments, being sent between the Apple and Topo. These code assignments should be generally transparent to the base communicator, except for its default values for carrier, ACK's, and the base communicator channel#(s).

(dddd) or (d1d2d3d4) represent four characters (bytes) of 8-bit data being transmitted. Numbers are two's complement unless otherwise specified. All data values generally occupy two bytes (0-FFFF), except where otherwise noted. A flag value of 0 means False; 1 or any other value means True. All values are in hex, unless otherwise specified. Counters, such as "characters 1-6", always start at 1 unless otherwise specified. Bits always start at 0, i.e. bits0-7.

### Request Format

All REQUEST commands, which require an answer to be returned, are always in the range 80-FF (i.e. high bit is set). The REQUEST message always includes the (d1d2d3d4) data field, which contains the necessary information to indicate where the reply should be sent. d1d2d3 are used as the first three bytes of the return message over TOBS.

### UNIVERSAL Command Rules

Universal commands are recognized by all processes. The same general functionality is implied for any given process, although the details of function and implementation will vary somewhat from process to process. For any case where the particular universal command is not applicable to a particular process, the process should still handle it gracefully, usually by performing a no-operation.

## UNIVERSAL Commands

RESET	00-CANCEL the last command(s), and set all parameters to their power-on values.
CANCEL	01-stop processing of any previous command(s).
ABORT-REQUEST	02-cancel any previous status REQUEST(s).
TOBS-XMIT-OK	03-the addressed process(es) may talk to the TOBS.
TOBS-XMIT-NOT-OK	04-the addressed process(es) may NOT talk to the TOBS.
SELF-TEST	05-perform the internal self-test routine.
NO-OPERATION	06-null command.
MOTION-STOP	07-if the addressed process is a MOTION process, stop all motion and cancel any buffered commands. Otherwise, do nothing.
REQUEST-PROCESS#	A0-returns (d1d2). d1d2 is the process# of the answering process. This command is useful for determining the presence or absence of any given process, or can be used with an ALL-CALL process to poll all of the processes on the Topo.
REQUEST-SELFTEST-STATUS	A1-returns (d1d2). d1d2 (0-FFFF) is the result of a previous SELF-TEST command. 0 = fail, 1 = OK 2 = no test performed, 3 = not completed. (d3d4 are available for various error codes in the future.)
REQUEST-REVISION	C0-returns (d1.d2,d3.d4). d1.d2-is the version # (0.0 - 99.99) of the answering process. d3.d4 is the PROM # (0.0 - 99.99) of the answering process. Numbers are coded in BCD, so 98.76 is coded as: 10011000 01110110.
REQUEST-TYPE	E0-returns (d1d2d3d4). d1-d4 is a 4-byte description of the answering process in ASCII. Current descriptions are: switches-SWBS, IR control-IRLD, utility-UTCL, speech-SPEC, motion-MTN1.

## SWITCH Control Commands

SET-HEADFOLLOW 39-(d1d2). Enable or disable automatic head-follow, based on flag d1d2 (true means enable).

LOADBUF-CHARS1-3 7E-(d1,d2d3d4). Load characters 1-3 of the message buffer associated with the indicated switch. d1 is the switch # (0-FF). d2-d4 are message characters 1-3. Headswitches use switch#1-4. Bumpswitches 0-13 map onto 80-8D ("on" buffers) and 90-9D ("off" buffers).

LOADBUF-CHARS4-5 7D-(d1,d2d3). Load characters 4-5 of the message buffer associated with the indicated switch. d1 is the switch #. d2d3 are message characters 4-5.

LOADBUF-CHARS6-7 7C-(d1,d2d3). Load characters 6-7 of the message buffer associated with the indicated switch. d1 is the switch #. d2d3 are message characters 6-7.

REQUEST-BUMPSWITCH BE-returns (d1d2). d1d2 uses 14 bits representing 14 flags, one for each potential bumpswitch sensor. Bits 8-13 correspond to the first set of six bumpswitches. Bits 0-7 correspond to the second set of eight bumpswitches. Bits 14-15 are 0's.

REQUEST-HEADSWITCH BF-returns (d1d2). Bits 1-4 of d2 are four flags, one for each latched headswitch value. All other bits are zero.

*all 7B*

## Switch Number Assignments

### Head Switches

1-FWD  
2-LEFT  
3-RIGHT  
4-BACK

### Bump Switches

0-7  
and  
8-13 (initial set of 6)

REQUEST-HEADSWITCH returns d1-d2 = 00000000 000ddddd  
4321

REQUEST-BUMPSWITCH returns d1-d2 = 00ddddd dddddd  
DCBA98 76543210

LOADBUF commands use switch#'s:

Headswitches = 1-4  
Bumpswitches (on) = 80-8D  
Bumpswitches (off) = 90-9D

## SPEECH Commands

SAY 7F-(dddd). Send (dddd) to the ECHO speech module.

REQUEST-  
SPEECH-  
STATUS DF-returns (d1d2d3d4). d1d2 is a flag indicating if the ECHO speech module is currently talking. d3d4 is a flag indicating if the ECHO speech module buffer is full.

## IR CONTROL Commands

SET-IR-TIMEOUT 38-(d1d2). Set the signal loss timeout value. IR timeout is activated if no valid packet is detected in the specified time. d1d2 is the new timeout time X 10ms. Valid values are 1-255, i.e. 10ms - 2.55 sec. The default value is 128, i.e. 1.28 sec. Note that values less than 30 or so (300 ms) will result in near-continuous IR timeouts.

SET-PRIVATE 3F-(d1d2). Command Topo to change its private channel ID to the new number. d1d2 is the channel# 20-2F.

SET-NO-IR-  
BEHAVIOR 5C-(d1d2d3d4). Set Topo's actions after IR timeout has occurred. d1d2 is a flag indicating if Topo should beep upon IR timeout. The default is true, which enables the beep. d3d4 is a flag which, if true, indicates that Topo should automatically revert to headfollow mode on IR timeout. If headfollow is already active, then this flag has no effect. The default is true.

1.02 Comm  
now and  
later

SET-PUBLIC 5F-(d1d2d3d4). Enable or disable Topo to listen on the given public channel. Has no effect on other channels. d1d2 is the public channel 7C-7F. d3d4 is a flag (true means enable).

REQUEST-  
CHANNEL-  
SETTINGS DA-(d1d2d3d4). Return current channel data. d1d2 is the onboard default channel. d3d4 is the current private channel being listened to. Both values 20-2F.

SAYWHAT? FF-retransmit last reply, whether ACK, message, or whatever. Should only be sent by the datalink.

## MOTION Commands

For motion commands, positive velocity is forward, positive turns are clockwise.

SET-SMOOTH	3A-(d1d2 ). Set Topo's motion mode to smooth if the flag d1d2 is true. Set to exact mode (stop after each movement) if the flag is false.
GO-TURN	3B-(d1d2 ). Command Topo to turn at the indicated turnrate, but do not alter the current forward velocity. d1d2 is the new turnrate, +/- 0-7FFF deg/sec.
GO-FWD	3C-(d1d2 ). Command Topo to move forward at the indicated velocity, but do not alter the current turnrate. d1d2 is the new forward velocity, +/- 0-7FFF cm/sec.
SET-RAMP	3D-(d1d2 ). Set the motion ramp rate parameter to the indicated value. d1d2 is the new ramp rate value, 0-FFFF cm/sec/sec.
SET-SPEED	3E-(d1d2 ). Set the target velocity parameter to the indicated value. d1d2 is the new value, 0-FFFF cm/sec.
GO	5D-(d1d2,d3d4). Directly set the wheel speeds. d1d2 is the turnrate, +/- 0-7FFF cm/sec. d3d4 is the forward velocity, +/- 0-7FFF deg/sec.
ARC	5E-(d1d2,d3d4). Start a distance movement, using the given values for angle and distance and using previously set values for velocity and ramp rate. d1d2 is the total turn angle, +/- 0-7FFF deg/sec. d3d4 is the distance covered, +/- 0-7FFF cm/sec.
REQUEST-MAX-RAMP	BD-returns (d1d2 ). Gets the maximum allowed value for the motion ramp rate parameter (0-FF).
REQUEST-MAX-SPEED	DB-returns (d1d2,d3d4). Gets the maximum allowed turnrate and velocity. d1d2 is the turnrate, d3d4 is the velocity. Both values 0-FFFF.
REQUEST-MOTION-QUEUESIZE	DC-returns (d1d2,d3d4). Gets the current status of the motion queue. d1d2 is the count of commands pending, 0-FFFF. d3d4 is the count of space remaining, 0-FFFF.
REQUEST-VELOCITY	DD-returns (d1d2,d3d4). Gets the current velocity values from the velocity control sequencer, i.e. the current Topo speed. d1d2 is the current turnrate, +/- 0-7FFF. d3d4 is the current velocity +/- 0-7FFF.

REQUEST-  
POSITION DE-returns (d1d2,d3d4). Gets the current Topo position, relative to 0,0 at the beginning of the latest motion command. d1d2 is the current angle, +/- 0-7FFF. d3d4 is the current distance, +/- 0-7FFF.

#### IR Channel Groupings

01-0F - Ack's  
10-1F - Other channels  
20-2F - TOPO private channels  
30-3F - open  
40-4F - open  
50-5F - open  
60-6F - open  
70-7F - public channels

#### Process Groupings

0 - All Call  
80-8F - Comm.  
90-9F - open  
A0-AF - open  
B0-BF - open  
C0-CF - open  
D0-DF - open  
E0-EF - Sensor (reserved)  
F0-FE - Motion  
FF - Null Process

#### Command Number Groupings

Command numbers (values are 0-FF) are grouped into the following classifications:

00-1F	command, no data parameters
20-3F	command, single data parameter
40-5F	command, two data parameters
60-7F	command, special (or multiple data parameters)
80-9F	request, unallocated
A0-BF	request, return single parameter
C0-DF	request, return two parameters
E0-FF	request, special (or return multiple parameters)

## IR Channel Assignments

0F	short ACK channel (one character only)
10	base communicator message return channel
1F	null channel (used for carrier)
20-2F	Topo channels (Topo #'s 0-15 decimal)
70-7F	public channels F4-F1

## Process Assignments

00	ALL CALL
01-7F	(IR return processes)
80	Comm. board null process
81	SWITCHES
82	IR CONTROL
83	(special IR relay, reserved)
84	UTILITY
8C	SPEECH
F0	MOTION
FF	NUL PROCESS

## Command Number Summary

00	RESET	universal-no data
01	CANCEL	universal-no data
02	ABORT-REQUEST	universal-no data
03	TOBS-XMIT-OK	universal-no data
04	TOBS-XMIT-NOT-OK	universal-no data
05	SELF-TEST	universal-no data
06	NO-OPERATION	universal-no data
07	MOTION-STOP	universal-no data
08-1F	(open)	-----
20-37	(open)	-----
38	SET-IR-TIMEDOUT	82 IRctrl did2=timeout time X 10ms
39	SET-HEADFOLLOW	81 switch did2=flag (headfollow?)
3A	SET-SMOOTH	F0 motion did2=flag (smooth?)
3B	GO-TURN	F0 motion did2=turnrate
3C	GO-FWD	F0 motion did2=fwd. vel.
3D	SET-RAMP	F0 motion did2=ramp rate
3E	SET-SPEED	F0 motion did2=speed param.
3F	SET-PRIVATE	82 IRctrl did2=ch#
40-5B	(open)	-----
5C	SET-NO-IR-BEHAVIOR	82 IRctrl did2=flag (beep?), d3d4=flag (auto-headfollow?)
5D	GO	F0 motion did2=turnrate, d3d4=fwd. vel.
5E	ARC	F0 motion did2=angle, d3d4=dist.
5F	SET-PUBLIC	82 IRctrl did2=ch#, d3d4=flag
60-7B	(open)	-----
7C	LOADBUF-CHARS6-7	81 switch d1=sw.#, d2d3=chars6-7

70	LOADBUI-CHARS4-5	81 switch d1=sw.#, d2=d3=4, d4=5
7F	LOADBUI-CHARS1-3	81 switch d1=sw.#, d2-d4=chars1-3
7F	SAY	8C speech d1d2d3d4=speech data
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80-9F (open)		
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A0	REQUEST-PROCESS#	universal-returns d1d2=process#**
A1	REQUEST-SELFTEST- STATUS	universal-returns d1d2=result
A2-BC (open)		
BD	REQUEST-MAX-RAMP	F0 motion returns d1d2=ramp rate
BE	REQUEST-BUMPSWITCH	81 switch returns d1d2=bits0-13
BF	REQUEST-HEADSWITCH	81 switch returns d1d2=bits1-4
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CO	REQUEST-REVISION	universal-returns d1.d2=process vers.# d3.d4=prom #
C1-D9 (open)		
DA	REQUEST-CHANNEL- SETTINGS	82 IRctrl returns d1d2=default channel d3d4=current channel
DB	REQUEST-MAX-SPEED	F0 motion returns d1d2=max. turnrate, d3d4=max. velocity
DC	REQUEST-MOTION- QUEUESIZE	F0 motion returns d1d2=commands pending, d3d4=space remaining
DD	REQUEST-VELOCITY	F0 motion returns d1d2=turnrate, d3d4=fwd. velocity
DE	REQUEST-POSITION	F0 motion returns d1d2=current angle, d3d4=current distance
DF	REQUEST-SPEECH- STATUS	8C-speech returns d1d2=talking flag, d3d4=buffer full flag
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EO	REQUEST-TYPE	universal-returns dddd=process descript.
E1-FE (open)		
FF	SAYWHAT?	82 IRctrl returns repeat of last IR msg.

#### Revision Information

v1.01 Comm. PROM conforms to the above specifications.  
 v1.00 Comm. PROM does not have command#s 38 and 5C implemented.  
 It does have the following:  
 7B SET-NO-IR 81 switch d1d2=flag (auto headfollow?)  
 d3d4=timedout time X 10ms