

1 Overview

This document describes the format and usage of NMEA messages for Orion GPS navigation software. It also details the implementation specifics of NMEA input commands and output sentences supported by Orion.

2 Message Format

Orion NMEA messages conform to the NMEA-0183 Ver. 3.01 (January 1, 2002) standard with implementation specifics as noted below.

Commands start with a dollar-sign (“\$”), followed by “PUNV”, and a comma (“,”). The command text (which is defined in section 4) comes next, followed by an asterisk (“*”), two-digit hexadecimal checksum, and the <carriage return> <new line> characters.

Example:

```
$PUNV,<command>*cc<carriage return><new line>
```

2.1 Checksum Calculation

In accordance with NMEA-0183, the checksum is calculated by taking the 8 bit exclusive OR of all characters between (but not including) the “\$” and the “*”. The checksum is then appended after the “*” as a 2 character hexadecimal number.

If a command’s checksum is omitted or illegal the command will be rejected and an error message issued.

A command with the checksum value “cc” (two lower case “c” characters) will be accepted as valid (this is primarily used for testing purposes).

2.2 Sentence Termination Delimiter

All sentences end with the sentence termination delimiter <carriage return><new line>. This combination is “\r\n” in C-language format and hexadecimal ASCII values are 0Dh 0Ah. Both characters are required for a command to be recognized.

2.3 NMEA Message Sizes

In accordance with NMEA-0183, the maximum number of characters between the starting delimiter “\$” and the terminating <CR><LF> should be 79. That is, the maximum needed buffer size should be 82 for one output sentence.

For input NMEA commands, the maximum size accepted is 128 characters.

3 Standard NMEA Output Sentences

The following format conventions have been used in accordance with the NMEA standard with implementation specifics noted:

- When a data field is null, the unit of measure field will also be null.
- Three digits are used for decimal fraction of seconds in UTC time.
- Four digits are used for decimal fraction of minutes in latitude and longitude.
- Two digits are used for Satellite IDs, with a leading zero if necessary.
- DTM: Six digits are used for decimal fraction of latitude and longitude offsets. Two digits are used for decimal fraction of altitude offset. Datum Subdivision Code is null.
- GGA: UTC starts from zero time and changes to measured time when the fix becomes valid. Altitude is reported referenced to the ellipsoid, and the Geoidal Separation is null.
- GLL: UTC time field as in GGA.
- GSA: Satellite ID numbers are in the range 00 to 99.
- GSV: No implementation-specific notes.
- RMC: UTC time field as in GGA. Course and Speed over ground as in VTG. Magnetic Variation is null.
- VTG: Course over ground is reported with 0.1 degree precision, Speed over ground is reported with 0.1 unit precision for both knots and km/h fields. Magnetic Course is null.
- ZDA: Local zone hours are presented as user has configured. Default is null. The hour zone is reported with two digits (with leading zero when necessary), and with leading minus sign when necessary. Local zone minutes are presented as two digits (with leading zero when necessary) and is always zero or positive. UTC time field as in GGA.

Message ID	Description	Default
DTM	Datum reference	N
GGA	GPS fix data	Y
GLL	GPS latitude & longitude	N
GSA	DOP and active satellites	Y
GSV	Satellites in view	Y
RMC	Recommended Minimum GNSS Data	Y
VTG	Course over ground and ground speed	N
ZDA	Time, date, & local time zone	N

Table 1 – Standard NMEA Output Sentences

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3.1 DTM – Datum reference

This sentence contains the ID of the datum selected, along with configured offsets.

```
$GPDTM,W84,,0.000000,S,0.000000,W,0.00,W84*50
```

Name	Description	Type	Example
MsgID	DTM Header		\$GPDTM
DatumID	Local Datum ID		W84
DatumSubD	Datum Subdivision Code		<null>
LatOfs	Latitude Offset (in minutes)		0.000000
LatDirection	N = North S = South		S
LonOfs	Longitude Offset (in minutes)		0.000000
LonDirection	E = East W = West		W
AltOfs	Altitude Offset (in meters)		0.00
RefDatum	Reference Datum ID		W84
ChkSum	Checksum		*50
EOL	NMEA end of line		<CR> <LF>

Table 2 – DTM Sentence Fields

Refer to Section 6 for Datum ID codes.

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3.2 GGA – GPS Fix Data

This sentence contains the position, time and quality of the navigation fix.

See RMC for Fix Status, Fix Mode, Fix Date, Speed, and True Course.

See GSA for Fix Type, PDOP, and VDOP.

```
$GPGGA,042626.001,3345.7471,N,11750.8451,W,1,04,8.7,32.28,M,,,,*16
```

Name	Description	Type	Example
MsgID	GGA Header		\$GPGGA
FixTime	Fix Time (UTC)	hh.mmss.sss	042626.001
Lat	Latitude	ddmm.mmmm	3345.7471
LatDirection	N = North S = South		N
Lon	Longitude	dddmm.mmmm	11750.8451
LonDirection	E = East W = West		W
FixQuality	0 = No fix 1 = Valid Fix		1
SatsUsed	Number of satellites in solution		04
HDOP	Horizontal Dilution of Precision		8.7
Alt	Altitude (in meters) (referenced to the Ellipsoid)		32.28
AltUnit	Altitude Unit (M = meters)		M
GeoSep	Geoidal Separation (in meters)		<null>
GeoSepUnit	Geoidal Separation Unit		<null>
DGPSage	DGPS age (in seconds)		<null>
DGPSstaID	DGPS Reference Station ID		<null>
ChkSum	Checksum		*16
EOL	NMEA end of line		<CR> <LF>

Table 3 – GGA Sentence Fields

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3.3 GLL – Geographic Position – Latitude/Longitude

This sentence contains the fix latitude and longitude.

```
$GPGLL,3345.7471,N,11750.8451,W,042628.001,A,A*4E
```

Name	Description	Type	Example
MsgID	GLL Header		\$GPGLL
Lat	Latitude	ddmm.mmmm	3345.7471
LatDirection	N = North S = South		N
Lon	Longitude	dddmm.mmmm	11750.8451
LonDirection	E = East W = West		W
FixTime	Fix Time (UTC)	hhmmss.sss	042628.001
FixStatus	V = No fix A = Valid Fix		A
FixMode	N = No Fix A = Autonomous Mode		A
ChkSum	Checksum		*4E
EOL	NMEA end of line		<CR> <LF>

Table 4 – GLL Sentence Fields

3.4 GSA – GNSS DOP and Active Satellites

This sentence contains the mode of operation, type of fix, PRNs of the satellites used in the solution as well as PDOP, HDOP and VDOP.

```
$GPGSA,A,3,15,22,18,21,03,14,09,19,16,26,,1.5,1.0,1.2*3E
```

Name	Description	Type	Example
MsgID	GSA Header		\$GPGSA
OpMode	A = Automatic M = Manual (not used by Orion)		A
FixType	1 = No fix 2 = 2D fix 3 = 3D fix		3
SatID01	SV on channel 01		15
...
SatID12	SV on channel 12		<null>
PDOP	Position Dilution of Precision		1.5
HDOP	Horizontal Dilution of Precision		1.0
VDOP	Vertical Dilution of Precision		1.2
ChkSum	Checksum		*3E
EOL	NMEA end of line		<CR> <LF>

Table 5 – GSA Sentence Fields

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3.5 GSV – GNSS Satellites in View

This sentence contains the PRNs, azimuth, elevation, and signal strength of all satellites in view.

```
$GPGSV,3,1,10,03,37,299,47,09,15,094,41,14,34,193,49,15,68,031,52*72
$GPGSV,3,2,10,16,07,242,42,18,58,025,50,19,08,322,40,21,53,086,52*76
$GPGSV,3,3,10,22,62,292,50,26,06,035,37*70
```

Name	Description	Type	Example
MsgID	GSV Header		\$GPGSV
NumMsgs	Total number of GSV sentences		3
MsgNum	Sentence number (of the total)		1
NumSatView	Number of satellites in view		10
SatID1	SV on channel 1, 5 or 9		03
Elevation1	Elevation (in degrees)		37
Azimuth1	Azimuth (in degrees True)		299
C/No1	C/No of satellite (in dB-Hz)		47
SatID2	SV on channel 2, 6 or 10		09
Elevation2	Elevation		15
Azimuth2	Azimuth		094
C/No2	C/No of satellite		41
SatID3	SV on channel 3, 7 or 11		14
Elevation3	Elevation		34
Azimuth3	Azimuth		193
C/No3	C/No of satellite		49
SatID4	SV on channel 4, 8 or 12		15
Elevation4	Elevation		68
Azimuth4	Azimuth		031
C/No4	C/No of satellite		52
ChkSum	Checksum		*72
EOL	NMEA end of line		<CR> <LF>

Table 6 – GSV Sentence Fields

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3.6 RMC – Recommended Minimum Specific GNSS Data

This sentence contains the recommended minimum fix information.

See GGA for Fix Quality, Sats Used, HDOP, Altitude, Geoidal Separation, and DGPS data.

See GSA for Fix Type, PDOP and VDOP.

\$GPRMC,042626.001,A,3345.7471,N,11750.8451,W,0.0,270.0,140707,, ,A*77

Name	Description	Type	Example
MsgID	RMC Header		\$GPRMC
FixTime	Fix Time (UTC)	hhmmss.sss	042626.001
FixStatus	V = No fix A = Valid Fix		A
Lat	Latitude	ddmm.mmmm	3345.7471
LatDirection	N = North S = South		N
Lon	Longitude	dddmm.mmmm	11750.8451
LonDirection	E = East W = West		W
Speed	Speed (in knots)		0.0
Tcourse	True Course (in degrees)		270.0
FixDate	Fix Date (UTC)	ddmmyy	140707
MagVar	Magnetic Variation (in degrees)		<null>
MVdirection	Magnetic Variation Direction (E/W)		<null>
Fix Mode	N = No fix A = Autonomous		A
ChkSum	Checksum		*77
EOL	NMEA end of line		<CR> <LF>

Table 7 – RMC Sentence Fields

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3.7 VTG – Course Over Ground and Ground Speed

This sentence contains the course and speed of the navigation solution.

\$GPVTG,270.0,T,,0.0,N,0.0,K,A*45

Name	Description	Type	Example
MsgID	VTG Header		\$GPVTG
Tcourse	True Course (in degrees)		270.0
ReferenceT	T = True		T
Mcourse	Magnetic Course (in degrees)		<null>
ReferenceM	M = Magnetic		<null>
Speed	Speed (in knots)		0.0
UnitN	N = Knots (Nautical Miles per Hour)		N
SpeedKPH	Speed (in Kilometers per Hour)		0.0
UnitK	K = KPH		K
Mode	N = No fix A = Autonomous		A
ChkSum	Checksum		*45
EOL	NMEA end of line		<CR> <LF>

Table 8 – VTG Sentence Fields

3.8 ZDA – Time and Date

This sentence contains UTC date & time, and local time zone offset information.

\$GPZDA,042626.001,14,07,2007,,*54

Name	Description	Type	Example
MsgID	ZDA Header		\$GPZDA
Time	hhmmss.sss		042626.001
Day	Day (UTC)	dd	14
Month	Month (UTC)	mm	07
Year	Year (UTC)	yyyy	2007
TZH	Local Time Zone Offset Hours		<null>
TZM	Local Time Zone Offset Minutes		<null>
ChkSum	Checksum		*54
EOL	NMEA end of line		<CR> <LF>

Table 9 – ZDA Sentence Fields

4 NMEA Input Commands

Orion may not recognize commands if they are input at a rate greater than one per second.

All commands are in upper case unless stated otherwise.

If valid, the CONFIG, STOP, SLEEP, and START commands will be echoed back to the sender and GETCONFIG will generate a CFG_R response. Otherwise, an error message will be sent.

The commands recognized by Orion are:

Command	Description
GETCONFIG	Read configuration information
CONFIG	Set configuration
STOP	Stop navigation
SLEEP	Stop navigation and enter sleep mode
START	Immediate restart

Table 10 – Orion NMEA commands

4.1 GETCONFIG Command

The GETCONFIG command allows the user to read the current system configuration.

For details of each field, please refer to the CONFIG command in section 4.2 .

The format of the GETCONFIG command is:

```
$PUNV,GETCONFIG,<section ID>*cc
```

4.1.1 Section 00 - Output Configuration

Read the current output configuration:

```
$PUNV,GETCONFIG,00*41
```

The response message is:

```
$PUNV,CFG_R,00,00,0,1000,UART,MASK,*cc
```

UART = serial bit rate

MASK = NMEA message mask

4.1.2 Section 03 – Time Zone Configuration

Read the current time zone configuration:

```
$PUNV,GETCONFIG,03*42
```

The response message is:

```
$PUNV,CFG_R,03,TZH,TZM*cc
```

TZH = Time zone offset hours

TZM = Time zone offset minutes

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4.1.3 Section 13 – Datum Configuration

Read the current datum configuration:

```
$PUNV,GETCONFIG,13*43
```

The response message is:

```
$PUNV,CFG_R,13,Dx,Dy,Dz,Da,Df,Name,ID*cc
```

Dx, Dy, Dz = Datum Offset values for X, Y, and Z coordinates (in meters).

Da = Datum value for the semi-major axis (in meters).

Df = Datum value for flattening.

Name = Name of the configured datum (see Section 6 for Datum names & IDs)

ID = ID of the configured datum (see Section 6 for Datum names & IDs).

4.1.4 Section 17 - Position Pinning & 2D/3D Startup Configuration

Read the current Position Pinning and 2D/3D start mode configuration:

```
$PUNV,GETCONFIG,17*47
```

The response message is:

```
$PUNV,CFG_R,17,PosThreshold,VelThreshold,2DStartMode*cc
```

- **PosThreshold** = Threshold value (meters) for position jump. Position will not be pinned if this value is reached.
- **VelThreshold** = Threshold value (meters/second) for position jump. Position will not be pinned if this value is reached.
- **2DStartMode** = indicates whether the receiver will initially enter 2D fix mode (using last navigated altitude) during a restart.
 - 0: only 3D start is allowed
 - 3: enable 2D cold start (if no last known good fix) & auto start (with last known good fix),

4.1.5 Section 09 - Version Number

Read the software version number:

```
$PUNV,GETCONFIG,09*48
```

The response message is:

```
$PUNV,CFG_R,09,OrionVersion,<variable number of fields>*cc
```

OrionVersion is the Orion version string

The remaining values are hardware configuration values.

Note - This message is also sent at power up and reset.

Example-\$PUNV,CFG_R,09,1.2.0-432,UBP_1.0,8130,2,1008,1,3,3000,16367600*58

Example-\$PUNV,CFG_R,09,1.2.2-499-U121,UBP_1.0,8130,5,1008,1,3,0,16367600*25

4.2 CONFIG Command

The CONFIG command allows the user to change the configuration of the system. This configuration takes effect immediately. It is also stored in non-volatile media and will therefore persist across power cycles.

The format of the CONFIG command is:

\$PUNV,CONFIG,<section id>,<variable number of comma separated fields>*cc

4.2.1 Section 00 - Output Configuration

Set the output configuration:

\$PUNV,CONFIG,00,00,0,1000,**UART**,**MASK***cc

UART communication speed (UART)	NMEA mask (MASK)
4800 = 4800 bps	01 = GGA
9600 = 9600 bps	02 = GLL
14400 = 14400 bps	04 = GSA
19200 = 19200 bps	08 = GSV
38400 = 38400 bps	
57600 = 57600 bps	10 = RMC
115200 = 115200 bps	20 = VTG
	40 = ZDA
	80 = DTM
Default : 4800	Default : 1D

Table 11 – Output Configuration Parameters

UART is the UART communication speed in bits per second. All communications use 8 data bits, no parity, and one stop bit.

MASK is a two-digit hexadecimal number which enables selected output NMEA sentences. Each NMEA output sentence is assigned a bit in the mask.

Examples:

Only transmit the GSA, GSV, VTG, ZDA, and DTM sentences:

\$EC = GSA (\$4) + GSV (\$8) + VTG (\$20) + ZDA (\$40) + DTM(80)

Transmit the default sentences:

\$1D = GGA (\$1) + GSA (\$4) + GSV (\$8) + RMC (\$10)

- Orion will check the maximum length of NMEA sentences when changing the output configuration. If the speed is set to 4800 bps and the selected sentences total more than 450 characters, the command will be rejected and an error message issued. If all the specified sentences are desired, a speed greater than 4800 bps must be selected.

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Examples:

Send all sentences except DTM at 115200 bps:

```
$PUNV,CONFIG,00,00,0,1000,115200,7F*cc
```

Change speed to 9600 bps with default output sentences:

```
$PUNV,CONFIG,00,00,0,1000,9600,1D*70
```

Disable sending of all NMEA sentences:

```
$PUNV,CONFIG,00,00,0,1000,4800,0*36
```

Send the default sentences:

```
$PUNV,CONFIG,00,00,0,1000,4800,1D*73
```

4.2.2 Section 03 - Time Zone Offset Configuration

Set the time zone offset:

```
$PUNV,CONFIG,03,TZH,TZM*cc
```

Time Zone Offset Hours (TZH)	Time Zone Offset Minutes (TZM)
-11, -10, ... , -1, 0, 1, ... , 12	0, 15, 30, 45
Default : not set (0)	Default : not set (0)

Table 12 – Time Zone Offset Configuration Parameters

TZH is the UTC offset in whole hours.

It may be negative, zero, or positive and is generally negative for West longitudes.

TZM is the additional minutes of UTC offset.

It must be zero or positive.

Note that this time zone offset has no effect on the timestamps in NMEA sentences which are always in UTC.

Examples:

Set the -8 hour time zone (U. S. Pacific Standard Time):

```
$PUNV,CONFIG,03,-8,0*31
```

Set the UTC time zone (no offset):

```
$PUNV,CONFIG,03,0,0*14
```

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4.2.3 Section 13/16 - Datum Configuration

a. Set a built-in datum:

```
$PUNV,CONFIG,16,ID*cc
```

ID is the ID of the desired datum. See Section 6 for built-in datum codes.

Default is 1 (WGS-84).

b. Set a custom datum configuration:

```
$PUNV,CONFIG,13,Dx,Dy,Dz,Da,Df,Name,0*cc
```

Dx, Dy, and Dz are the X, Y, and Z coordinate offsets in meters.

The defaults are 0.0, 0.0, 0.0 .

Da is the semi-major axis in meters. The default is 6378137.

Df is the flattening coefficient. The default is 0.003352810664 .

Name is the name of the datum. Maximum is 8 characters.

Examples:

Select the "TOY-B" (South Korean) datum:

```
$PUNV,CONFIG,16,211*0E
```

Select the default datum (WGS-84):

```
$PUNV,CONFIG,16,1*0D
```

4.2.4 Section 17 - Position Pinning & 2D/3D Startup

Set position pinning and 2D/3D startup parameters:

```
$PUNV,CONFIG,17,PosThreshold,VelThreshold,2D/3DStartMode*cc
```

PosThreshold is the threshold value for position jump. Position pinning will be disabled if this value is reached.

VelThreshold is the threshold value for velocity calculation. Position pinning will be disabled if this value is reached.

2DStartMode indicates whether the receiver will enter 2D startup initially during a cold start based upon last navigated altitude.

2D/3D Start Mode
0 = only 3D startup allowed
1 = Reserved. Do not use
2 = Reserved. Do not use
3 = 2D startup is allowed
Default: 3

Table 13 – 2D/3D Start Mode Configuration Parameter

Example:

Set the default settings:

```
$PUNV,CONFIG,17,50.0,1.0,3*3A
```

4.3 STOP Command

Stop navigation:

```
$PUNV,STOP*29
```

4.4 SLEEP Command

Enter the sleep mode:

```
$PUNV,SLEEP*7E
```

To wake up from sleep, send a command to the serial port. Since the command will not be executed, its content is arbitrary. Orion always wakes in the AUTO mode.

If the board design includes an external RTC (please refer to the module Data Sheet), the SLEEP command can specify a sleep duration. Note that the receiver will wake up on UART activity or when the duration expires, whichever occurs first.

```
$PUNV,SLEEP,HH,MM,SS*CC
```

HH is hours [0 to 24]

MM is minutes [0 to 59]

DD is seconds [0 to 59]

Maximum sleep time is 24,59,59 and minimum is 00,00,05.

Example (sleep for 30 seconds):

```
$PUNV,SLEEP,00,00,30*cc
```

4.5 START Commands

Cause an immediate restart:

```
$PUNV,START,AUTO*52
```

```
$PUNV,START,COLD*59
```

```
$PUNV,START,WARM*59
```

```
$PUNV,START,HOT*0E
```

```
$PUNV,START,FAST*5D
```

The START command will be echoed only after the system has stopped (which takes approximately one second). Until then Orion will produce navigation data.

The table below shows which data elements are required for each start mode.

	Fast	Hot	Warm	Cold
Almanac	+	+	+	-
Ephemeris	+	+	-	-
Time accuracy	~10 ms	~300s	~300s	-
Last known good fix	+	+	+	-

Table 14 – Start Mode Required Data

5 ERR Message

The ERR message is sent as a response to an invalid command. Its format is:

`$PUNV,ERR,ID,ERROR,DATA*cc`

ID is the section ID which causes the error (05 = NMEA command processor).

ERROR is the error number defined in the section.

DATA is error specific optional data.

ID	ERROR	Description
5 (NMEA)	1	Illegal command form
5 (NMEA)	2	Illegal command prefix
5 (NMEA)	3	Illegal command
5 (NMEA)	4	Illegal section ID
5 (NMEA)	5	Illegal parameter.
5 (NMEA)	6	Illegal checksum.
5 (NMEA)	7	Illegal message.

Table 15 – Error Codes

Examples of error messages:

Illegal checksum:

`$PUNV,ERR,05,00006,00000*5B`

Illegal command:

`$PUNV,ERR,05,00003,00000*5E`

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6 Datum Codes

ID	NAME	Region of use
0	"000"	User defined
1	"WGS84"	Global
2	"ADI-M"	Ethiopia; Sudan
3	"ADI-E"	Burkina Faso
4	"ADI-F"	Cameroon
5	"ADI-A"	Ethiopia
6	"ADI-C"	Mali
7	"ADI-D"	Senegal
8	"ADI-B"	Sudan
9	"AFG"	Somalia
10	"AIN-A"	Bahrain
11	"AIN-B"	Saudi Arabia
12	"AMA"	American Samoa Islands
13	"ANO"	Cocos Islands
14	"AIA"	Antigua (Leeward Islands)
15	"ARF-A"	Botswana
16	"ARF-H"	Burundi
17	"ARF-B"	Lesotho
18	"ARF-C"	Malawi
19	"ARF-M"	MEAN FOR Botswana; Lesotho; Malawi; Swaziland; Zaire; Zambia; Zimbabwe
20	"ARF-D"	Swaziland
21	"ARF-E"	Zaire
22	"ARF-F"	Zambia
23	"ARF-G"	Zimbabwe
24	"ARS-M"	MEAN FOR Kenya; Tanzania
25	ARS-A	Kenya
26	"ARS-B"	Tanzania
27	"ASC"	Ascension Island
28	"ATF"	Iwo Jima
29	"SHB"	St Helena Island
30	"TRN"	Tern Island
31	"ASQ"	Marcus Island
32	"AUA"	Australia; Tasmania

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ID	NAME	Region of use
33	"AUG"	Australia; Tasmania
34	"PHA"	Djibouti
35	"IBE"	Efate & Erromango Islands
36	"BER"	Bermuda
37	"BID"	Guinea-Bissau
38	"BOO"	Colombia
39	"BUR"	Indonesia (Bangka & Belitung Ids)
40	"CAZ"	Antarctica (McMurdo Camp Area)
41	"CAI"	Argentina
42	"CAO"	Phoenix Islands
43	"CAP"	South Africa
44	"CAC"	Bahamas; Florida
45	"CGE"	Tunisia
46	"CHI"	New Zealand (Chatham Island)
47	"CHU"	Paraguay
48	"COA"	Brazil
49	"DAL"	Guinea
50	"DID"	Deception Island; Antarctica
51	"BAT"	Indonesia (Sumatra)
52	"GIZ"	New Georgia Islands (Gizo Island)
53	"EAS"	Easter Island
54	"EST"	Estonia
55	"EUR-E"	Cyprus
56	"EUR-F"	Egypt
57	"EUR-G"	England; Channel Islands; Scotland; Shetland Islands
58	"EUR-K"	England; Ireland; Scotland; Shetland Islands
59	"EUR-C"	Finland; Norway
60	"EUR-B"	Greece
61	"EUR-H"	Iran
62	"EUR-I"	Italy (Sardinia)
63	"EUR-J"	Italy (Sicily)
64	"EUR-L"	Malta
65	"EUR-M"	MEAN FOR Austria; Belgium; Denmark; Finland; France; W Germany; Gibraltar; Greece; Italy; Luxembourg; Netherlands; Norway; Portugal; Spain; Sweden; Switzerland
66	"EUR-A"	MEAN FOR Austria; Denmark; France; W Germany; Netherlands; Switzerland

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ID	NAME	Region of use
67	"EUR-S"	MEAN FOR Iraq; Israel; Jordan; Lebanon; Kuwait; Saudi Arabia; Syria
68	"EUR-D"	Portugal; Spain
69	"EUR-T"	Tunisia
70	"EUS"	MEAN FOR Austria; Finland; Netherlands; Norway; Spain; Sweden; Switzerland
71	"FOT"	Nevis; St. Kitts (Leeward Islands)
72	"GAA"	Republic of Maldives
73	"GEO"	New Zealand
74	"GRA"	Azores (Faial; Graciosa; Pico; Sao Jorge; Terceira)
75	"GUA"	Guam
76	"GSE"	Indonesia (Kalimantan)
77	"DOB"	Guadalcanal Island
78	"HEN"	Afghanistan
79	"HER"	Croatia -Serbia, Bosnia-Herzegovina
80	"HJO"	Iceland
81	"HKD"	Hong Kong
82	"HTN"	Taiwan
83	"IND-B"	Bangladesh
84	"IND-I"	India; Nepal
85	"IND-P"	Pakistan
86	"INF-A"	Thailand
87	"ING-B"	Vietnam (Con Son Island)
88	"ING-A"	Vietnam (Near 16 $\frac{1}{2}$ N)
89	"INH-A1"	Thailand
90	"IDN"	Indonesia
91	"IRL"	Ireland
92	"ISG"	South Georgia Islands
93	"IST"	Diego Garcia
94	"JOH"	Johnston Island
95	"KAN"	Sri Lanka
96	"KEG"	Kerguelen Island
97	"KEA"	West Malaysia & Singapore
98	"KUS"	Caroline Islands
99	"KGS"	South Korea
100	"LCF"	Cayman Brac Island
101	"LEH"	Ghana

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ID	NAME	Region of use
102	"LIB"	Liberia
103	"LUZ-A"	Philippines (Excluding Mindanao)
104	"LUZ-B"	Philippines (Mindanao)
105	"MPO"	Gabon
106	"MIK"	Mahe Island
107	"MAS"	Ethiopia (Eritrea)
108	"MER"	Morocco
109	"MID"	Midway Islands
110	"MIN-A"	Cameroon
111	"MIN-B"	Nigeria
112	"ASM"	Montserrat (Leeward Islands)
113	"NAH-A"	Oman (Masirah Island)
114	"NAH-C"	Saudi Arabia
115	"NAH-B"	United Arab Emirates
116	"NAP"	Trinidad & Tobago
117	"NAS-D"	Alaska (Excluding Aleutian Ids)
118	"NAS-V"	Alaska (Aleutian Ids East of 180°W)
119	"NAS-W"	Alaska (Aleutian Ids West of 180°W)
120	"NAS-Q"	Bahamas (Except San Salvador Id)
121	"NAS-R"	Bahamas (San Salvador Island)
122	"NAS-F"	Canada (Alberta; British Columbia)
123	"NAS-H"	Canada (Manitoba; Ontario)
124	"NAS-G"	Canada (New Brunswick; Newfoundland; Nova Scotia; Quebec)
125	"NAS-I"	Canada (Northwest Territories; Saskatchewan)
126	"NAS-J"	Canada (Yukon)
127	"NAS-O"	Canal Zone
128	"NAS-T"	Cuba
129	"NAS-U"	Greenland (Hayes Peninsula)
130	"NAS-P"	MEAN FOR Antigua; Barbados; Barbuda; Caicos Islands; Cuba; Dominican Republic; Grand Cayman; Jamaica; Turks Islands
131	"NAS-N"	MEAN FOR Belize; Costa Rica; El Salvador; Guatemala; Honduras; Nicaragua
132	"NAS-E"	MEAN FOR Canada
133	"NAS-C"	MEAN FOR CONUS
134	"NAS-A"	MEAN FOR CONUS (East of Mississippi; River Including Louisiana; Missouri; Minnesota)

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ID	NAME	Region of use
135	"NAS-B"	MEAN FOR CONUS (West of Mississippi; River Excluding Louisiana; Minnesota; Missouri)
136	"NAS-L"	Mexico
137	"NAR-A"	Alaska (Excluding Aleutian Ids)
138	"NAR-E"	Aleutian Ids
139	"NAR-B"	Canada
140	"NAR-C"	CONUS
141	"NAR-H"	Hawaii
142	"NAR-D"	Mexico; Central America
143	"NSD"	Algeria
144	"FLO"	Azores (Corvo & Flores Islands)
145	"OEG"	Egypt
146	"OHA-A"	Hawaii
147	"OHA-B"	Kauai
148	"OHA-C"	Maui
149	"OHA-M"	MEAN FOR Hawaii; Kauai; Maui; Oahu
150	"OHA-D"	Oahu
151	"FAH"	Oman
152	"OGB-A"	England
153	"OGB-B"	England; Isle of Man; Wales
154	"OGB-M"	MEAN FOR England; Isle of Man; Scotland; Shetland Islands; Wales
155	"OGB-C"	Scotland; Shetland Islands
156	"OGB-D"	Wales
157	"PLN"	Canary Islands
158	"PIT"	Pitcairn Island
159	"PTB"	MEAN FOR Burkina Faso & Niger
160	"PTN"	Congo
161	"POS"	Porto Santo; Madeira Islands
162	"PRP-A"	Bolivia
163	"PRP-B"	Chile (Northern; Near 19¿S)
164	"PRP-C"	Chile (Southern; Near 43¿S)
165	"PRP-D"	Colombia
166	"PRP-E"	Ecuador
167	"PRP-F"	Guyana
168	"PRP-M"	MEAN FOR Bolivia; Chile; Colombia; Ecuador; Guyana; Peru; Venezuela
169	"PRP-G"	Peru

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ID	NAME	Region of use
170	"PRP-H"	Venezuela
171	"HIT"	Chile (Near 53 $\frac{1}{2}$ S) (Hito XVIII)
172	"PUR"	Puerto Rico; Virgin Islands
173	"PUK"	Russia
174	"QAT"	Qatar
175	"QUO"	Greenland (South)
176	"REU"	Mascarene Islands
177	"EUR-I"	Italy (Sardinia)
178	"SPK-A"	Hungary
179	"SPK-B"	Poland
180	"SPK-C"	Czechoslovakia
181	"SPK-D"	Latvia
182	"SPK-E"	Kazakhstan
183	"SPK-F"	Albania
184	"SPK-G"	Romania
185	"CCD"	Czechoslovakia (Prior 1 JAN 1993)
186	"SAE"	Espirito Santo Island
187	"SAO"	Azores (Sao Miguel; Santa Maria Ids)
188	"SAP"	East Falkland Island
189	"SCK"	Namibia
190	"SGM"	Salvage Islands
191	"SRL"	Sierra Leone
192	"SAN-A"	Argentina
193	"SAN-B"	Bolivia
194	"SAN-C"	Brazil
195	"SAN-D"	Chile
196	"SAN-E"	Colombia
197	"SAN-F"	Ecuador
198	"SAN-J"	Ecuador (Baltra; Galapagos)
199	"SAN-G"	Guyana
200	"SAN-M"	MEAN FOR Argentina; Bolivia; Brazil; Chile; Colombia; Ecuador; Guyana; Paraguay; Peru; Trinidad & Tobago; Venezuela
201	"SAN-H"	Paraguay
202	"SAN-I"	Peru
203	"SAN-K"	Trinidad & Tobago
204	"SAN-L"	Venezuela
205	"SOA"	Singapore

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ID	NAME	Region of use
206	"TAN"	Madagascar
207	"TIL"	Brunei; E. Malaysia (Sabah Sarawak)
208	"TOY-A"	Japan
209	"TOY-M"	MEAN FOR Japan; South Korea; Okinawa
210	"TOY-C"	Okinawa
211	"TOY-B"	South Korea
212	"TDC"	Tristan da Cunha
213	"MVS"	Fiji (Viti Levu Island)
214	"VOR"	Algeria
215	"WAK"	Wake Atoll
216	"ENW"	Marshall Islands
217	"WGS72"	Global Definition
218	"WGS84"	Global Definition
219	"YAC"	Uruguay
220	"ZAN"	Suriname
221	"KKJ"	Finland

Table 16 – Datums

7 Notices

All reference and informational documents (including marketing information, specifications, reference designs, etc.) are provided for information only and are subject to change without notice. Reasonable efforts have been made in the preparation of these document to assure their accuracy, however Micro Modular Technologies Pte. Ltd. assumes no liability resulting from errors or omissions in these, or any document, or from the use of the information contained herein. Micro Modular Technologies Pte. Ltd. reserves the right to make changes in the product design and specifications as needed and without notification to its users. Please check our website for the most current documentation. All information contained herein is the property of Micro Modular Technologies Pte Ltd. and may not be copied or reproduced, other than for your information, without prior written consent.

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