# LocSense Technology Inc.

# Binary Message Protocol

# User's Guide

Version 1.5

May 30, 2005

## REVISION HISTORY

| Revision | Update Summary | Date |
|---|---|---|
| 1.0 | **Initial release** | 2004-8-6 |
| 1.1 | **Added Trace log command set** | 2004-10-15 |
| 1.2 | **Corrected message User PVT I** | 2004-10-26 |
| 1.3 | - **Added Message Extended Trace Status**<br>- **WAAS Control** | 2005-4-14 |
| 1.4 | - **Changed Update rate (LS-4100 products only)** | 2005-5-16 |
| 1.5 | - **Added command 17h / 18h**<br>- **Added messages 8Bh / 8Ch**<br>- **Added command 12h (1PPS)** | 2005-5-30 |

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# LOCSENSE BINARY MESSAGE STRUCTURE

The LocSense binary message comprises of binary string with length of up to 255 characters. It has the following format:

**Format**
%%<Message Start>Message Body><Message End><CR><LF>

| Description | | Value | |
|---|---|---|---|
| Leading Byte 1 | | % | 25h |
| Leading Byte 2 | | % | 25h |
| Message Start | Message Type | | |
| | Message ID | | |
| Message Body | | | Up to 250 bytes |
| Message End | Checksum Byte | <CS> | xxh |
| Ending Byte 1 | | <CR> | 0Dh |
| Ending Byte 2 | | <LF> | 0Ah |

**Message Start**: <Frame Type> <Frame ID>

Message Type: ACK (06h), NAK (15h), Input (F1h), Output (F2h)
Message ID: Number between 0x01, 0xEF

**Message Body**: Contains input parameter or output information related to the particular message.

**Message End**: Checksum byte. The checksum is calculated by performing exclusive-or, XOR, of all bytes from <Message Type> till the last byte prior to <Checksum Byte>:

CS = CS ^ <Data Byte>, where initially CS = 0

**Sample C-Code for Calculating Checksum**

```
char BIN_ComputeChecksum( char* buf, int len )
{   int     i;
    char chksum;

    chksum = 0;

    for (i=0; i<len; i++ ) chksum ^= buf[i];

    return sum;
}
```

**Sample Binary Message**: The following binary message sets baud-rate to 19200.

```
25 25 f1 02 00 02 fd 7f 00 00 00 00 73 0d 0a
```

# BINARY INPUT MESSAGE TYPE <F1h>

This group of binary messages are used to configure the GPS receiver, or to request information from the GPS receiver. If the receiver carries out the command successfully, ACK binary message is returned; otherwise NAK binary message is returned.

**Data Types Used**

| | |
|---|---|
| UINT08: 8bit unsigned integer | SINT16: 16bit signed integer |
| UINT16: 16bit unsigned integer | SINT32: 32bit signed integer |
| UINT32: 32bit unsigned integer | SPFP: 32bit single precision floating point number |
| SINT08: 8bit signed integer | DPFP: 64bit double precision floating point number |

**Byte Ordering**

All data is in little-endian format, with low-order byte (LSB) at lower address.

**ACK/NAK**

An output ACK message indicates GPS accepts the message while NAK indicates GPS cannot execute the command at the moment. **However, an error input command will not get any acknowledge message from GPS.**

***Command*** ***Restart (01h)*** ***(All GPS modules)***

***String*** *%%<F1h><01h>< Parameter Bytes><CS><CR><LF>*

***Length*** *2 + 16 = 18*

***Response*** ***ACK*** *%%<06h><01h><CS><CR><LF>*

***NAK*** *%%<15h><01h><CS><CR><LF>*

***Description*** *Force system to restart*

| ***Parameters*** | | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|---|
| *Restart Type* | | *0: Hardware Reset (all parameters below are unused)*<br>*1: Initialized Restart* | *UNT08* | *-* | *1* |
| *Start Mode* | | *When Restart type is Initialized Restart*<br>*1: Hot start*<br>*2: Warm start*<br>*3: Cold start* | *UINT08* | *-* | *2* |
| *(UTC) Date & Time* | *Year* | *>= 1980* | *UINT16* | *-* | *3 – 4* |
| | *Month* | *1 ~ 12* | *UINT08* | *-* | *5* |
| | *Day* | *1 ~ 31* | *UINT08* | *-* | *6* |
| | *Hour* | *0 ~ 23* | *UINT08* | *-* | *7* |
| | *Minute* | *0 ~ 59* | *UINT08* | *-* | *8* |
| | *Second* | *0 ~ 59* | *UINT08* | *-* | *9* |
| *Reserved* | | *-* | *UINT08* | *-* | *10* |
| *(WGS-84) Initial Position* | *Latitude* | *Between – 9000 and 9000*<br>*> 0: North Hemisphere*<br>*< 0: South Hemisphere* | *SINT16* | *1/100 degree* | *11 – 12* |
| | *Longitude* | *Between – 18000 and 18000*<br>*> 0: East Hemisphere*<br>*< 0: West Hemisphere* | *SINT16* | *1/100 degree* | *13 – 14* |
| | *Altitude* | *Between –1000 and 18300* | *SINT16* | *Meter* | *15 – 16* |

***Command*** ***Baud-Rate Configuration (02h)*** ***(All GPS modules)***

***String*** *%%<F1h><02h>< Parameter bytes><CS><CR><LF>*

***Length*** *2 + 8 = 10*

***Response*** ***ACK*** *%%<06h><02h><CS><CR><LF>*

***NAK*** *%%<15h><02h><CS><CR><LF>*

***Description*** *Configure serial port baud-rate (UART2 is supported for LS-40EB only)*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *UART Selection* | *0: UART1*<br>*1: UART2* | *UNT08* | *-* | *1* |
| *Baud Rate* | *0: 4800*<br>*1: 9600*<br>*2: 19200* | *UNT08* | *-* | *2* |
| *All non-used byte should be set to 0* | | | | *3 - 8* |

***Command*** ***Set Datum (03h)*** ***(All GPS modules)***

***String*** *%%<F1h><03h>< Parameter bytes><CS><CR><LF>*

***Length*** *2 + 8 = 10*

***Response*** ***ACK*** *%%<06h><03h ><CS><CR><LF>*

***NAK*** *%%<15h><03h ><CS><CR><LF>*

***Description*** *Used to setup datum parameters for position transformation if non-WGS84 datum is required. Refer to Appendix A and B for the parameters to use.*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Ellipsoid index* | *See appendix A* | *UINT16* | *-* | *1 – 2* |
| *Delta X* | *See appendix B* | *SINT16* | *Meter* | *3 – 4* |
| *Delta Y* | *See appendix B* | *SINT16* | *Meter* | *5 – 6* |
| *Delta Z* | *See appendix B* | *SINT16* | *Meter* | *7 – 8* |

***Command*** ***Set NMEA Configuration (04h)*** ***(All GPS modules)***

***String*** *%%<F1h><04h>< Parameter bytes><CS><CR><LF>*

***Length*** *2 + 8 = 10*

***Response*** ***ACK*** *%%<06h><04h ><CS><CR><LF>*

***NAK*** *%%<15h><04h ><CS><CR><LF>*

***Description*** *Define the output interval between two consecutive NMEA sentences of the same type. When all values are set to 0, no NMEA message is output.*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Checksum flag* | *0: Disable, 1:Enable* | *UINT08* | *-* | *1* |
| *RMC Interval* | *0 ~ 255, 0: Disable* | *UINT08* | *Second* | *2* |
| *VTG Interval* | *0 ~ 255, 0: Disable* | *UINT08* | *Second* | *3* |
| *GGA Interval* | *0 ~ 255, 0: Disable* | *UINT08* | *Second* | *4* |
| *GSA Interval* | *0 ~ 255, 0: Disable* | *UINT08* | *Second* | *5* |
| *GSV Interval* | *0 ~ 255, 0: Disable* | *UINT08* | *Second* | *6* |
| *GLL Interval* | *0 ~ 255, 0: Disable* | *UINT08* | *Second* | *7* |
| *ZDA Interval* | *0 ~ 255, 0: Disable* | *UINT08* | *Second* | *8* |

| | | | |
|---|---|---|---|
| ***Command*** | | ***Query Firmware Version (05h)*** | ***(All GPS modules)*** |
| ***String*** | | *%%<F1h><05h>< Parameter bytes><CS><CR><LF>* | |
| ***Length*** | | *2 + 2 = 4* | |
| ***Response*** | ***ACK*** | *%%<06h><05h><CS><CR><LF>* | |
| | ***NAK*** | *%%<15h><05h><CS><CR><LF>* | |
| | ***80h*** | *See message 80h for firmware version information* | |

***Description*** *Retrieve version information of the firmware.*
*When CRC is enabled, it may take up to one second to calculate the CRC value.*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Firmware type* | *0: Boot code*<br>*1: System code* | *UINT08* | *-* | *1* |
| *CRC* | *0: No CRC*<br>*1: CRC information is requested* | *UINT08* | *-* | *2* |

| | | | |
|---|---|---|---|
| ***Command*** | | ***Restore Factory Default (08h)*** | ***(All GPS modules)*** |
| ***String*** | | *%%<F1h><08h>< Parameter bytes><CS><CR><LF>* | |
| ***Length*** | | *2 + 4 = 6* | |
| ***Response*** | ***ACK*** | *%%<06h><08h><CS><CR><LF>* | |
| | ***NAK*** | *%%<15h><08h><CS><CR><LF>* | |

***Description*** *Restore all configurable settings to factory default value.*
*All user settings will be erased.*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Restoration Key* | *0x53434C50* | *UINT32* | *-* | *1 - 4* |

| | | | |
|---|---|---|---|
| ***Command*** | | ***Set ID (0Dh)*** | ***(All GPS modules)*** |
| ***String*** | | *%%<F1h><0Dh>< Parameter byte><CS><CR><LF>* | |
| ***Length*** | | *2 + 9 = 11* | |
| ***Response*** | ***ACK*** | *%%<06h><0Dh><CS><CR><LF>* | |
| | ***NAK*** | *%%<15h><0Dh><CS><CR><LF>* | |

***Description*** *Setup User ID for the module.*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Type* | *1: User ID type* | *UINT08* | *-* | *1* |
| *ID* | *1~2^32* | *UINT32* | *-* | *2 - 5* |
| *Reserved* | *-* | *UINT32* | *-* | *6 - 9* |

| | | | |
|---|---|---|---|
| ***Command*** | | ***Query Module ID (0Eh)*** | ***(All GPS modules)*** |
| ***String*** | | *%%<F1h><0Eh>< Parameter byte><CS><CR><LF>* | |
| ***Length*** | | *2 + 1 = 3* | |
| ***Response*** | ***ACK*** | *%%<06h><0Eh><CS><CR><LF>* | |
| | ***NAK*** | *%%<15h><0Eh><CS><CR><LF>* | |
| | ***85h*** | *See message 85h for detail* | |

***Description*** *Retrieve User ID of the module.*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Type* | *1: User ID retrieval* | *UINT08* | *-* | *1* |

***Command*** ***Set DOP Mask (0Fh)*** ***(All GPS modules)***

***String*** *%%<F1h><0Fh>< Parameter byte><CS><CR><LF>*

***Length*** *2 + 4 = 6*

***Response*** ***ACK*** *%%<06h><0Fh><CS><CR><LF>*

***NAK*** *%%<15h><0Fh><CS><CR><LF>*

***Description*** *To set the DOP mask value and which type of DOP mask to use. When the calculated DOP value is higher than this mask value, no valid position data will be available.*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | *Byte #* |
|---|---|---|---|---|
| *DOP Mask Reference* | *0: Disable DOP masking*<br>*1: Use GDOP*<br>*2: Use PDOP* (default)*<br>*3: Use HDOP* | *UINT08* | *-* | *1* |
| *GDOP Mask value* | *0 ~ 255* | *UINT08* | *-* | *2* |
| *PDOP mask value* | *0 ~ 255* | *UINT08* | *-* | *3* |
| *HDOP Mask value* | *0 ~ 255* | *UINT08* | *-* | *4* |

| | | | |
|---|---|---|---|
| ***Command*** | | ***Set Elevation Mask (10h)*** | ***(All GPS modules)*** |
| ***String*** | | *%%<F1h><10h>< Parameter byte><CS><CR><LF>* | |
| ***Length*** | | *2 + 1 = 3* | |
| ***Response*** | ***ACK*** | *%%<06h><10h><CS><CR><LF>* | |
| | ***NAK*** | *%%<15h><10h><CS><CR><LF>* | |

***Description*** *Set satellite elevation mask value. Satellite with elevation angle below this mask value is not used for position fix*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | *Byte #* |
|---|---|---|---|---|
| *Mask value* | *0 ~ 89* | *UINT08* | *Degree* | *1* |

***Command*** ***DGPS control (11h)*** ***(All GPS modules)***

***String*** *%%<F1h><11h>< Parameter byte><CS><CR><LF>*

***Length*** *2 + 2 = 4*

***Response*** ***ACK*** *%%<06h><11h><CS><CR><LF>*

***NAK*** *%%<15h><11h><CS><CR><LF>*

***Description*** *Enable / disable DGPS*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | *Byte #* |
|---|---|---|---|---|
| *Item* | *0: Disable*<br>*1: Waas / Egnos* | *UINT08* | *-* | *1* |
| *Reserved* | *-* | *UINT08* | *-* | *2* |

| | | |
|---|---|---|
| ***Command*** | ***1PPS control (12h)*** | ***(All GPS modules)*** |
| ***String*** | *%%<F1h><11h>< Parameter byte><CS><CR><LF>* | |
| ***Length*** | *2 + 3 = 5* | |
| ***Response*** ***ACK*** | *%%<06h><12h><CS><CR><LF>* | |
| ***NAK*** | *%%<15h><12h><CS><CR><LF>* | |

***Description***

*Enable / disable 1PPS and setup pulse width.*

*- 1PPS signal is output when GPS satisfies the following condition at least 3 minutes*
- *stationary state.*
- *3D position fix.*

*- Any interrupt on one of the conditions results in restarting the counter (3 minutes).*
*- Pulse width = type x Multiplier*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | *Byte #* |
|---|---|---|---|---|
| *Item* | *0: Disable*<br>*1: 1PPS without Pulse*<br>*2: 1PPS with Pulse* | *UINT08* | *-* | *1* |
| *Pulse Type* | *0: 20 ms*<br>*1: 1 ms*<br>*2: 20 us*<br>*3: 1 us* | *UINT08* | *-* | *2* |
| *Multiplier* | *1 ~ 16* | *UINT08* | *-* | *3* |

***Command*** ***Set Output Format (13h)*** ***(All GPS modules)***

***String*** *%%<F1h><13h>< Parameter byte><CS><CR><LF>*

***Length*** *2 + 1 = 3*

***Response*** ***ACK*** *%%<06h><13h><CS><CR><LF>*

***NAK*** *%%<15h><13h><CS><CR><LF>*

***Description*** *Change to different message output format*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Type* | *0: No output (Permanent change*)*<br>*1: NMEA (Permanent change*)*<br>*2: Binary (Temporary change, back to original after recycle power)*<br>*3. Binary (Permanent change*)*<br><br>**'Permanent change' means setting will be saved into flash for LS-40xx.* | *UINT08* | *-* | *1* |

| | | | |
|---|---|---|---|
| ***Command*** | | ***Query Navigation Parameters (17h)*** | ***(All GPS modules)*** |
| ***String*** | | *%%<F1h><17h>< Parameter byte><CS><CR><LF>* | |
| ***Length*** | | *2 + 1 = 3* | |
| ***Response*** | ***ACK*** | *%%<06h><17h><CS><CR><LF>* | |
| | ***NAK*** | *%%<15h><17h><CS><CR><LF>* | |
| | ***86h*** | *See message 86h for detail* | |

***Description*** *Query current navigation parameters:*

*Position update rate*
*DOP mask*
*Elevation mask*
*1PPS parameter*
*DGPS*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *type* | *0: all* | *UINT08* | *-* | *1* |

| | | | |
|---|---|---|---|
| ***Command*** | | ***Query System Settings (18h)*** | ***(All GPS modules)*** |
| ***String*** | | *%%<F1h><18h>< Parameter byte><CS><CR><LF>* | |
| ***Length*** | | *2 + 1 = 3* | |
| ***Response*** | ***ACK*** | *%%<06h><18h><CS><CR><LF>* | |
| | ***NAK*** | *%%<15h><18h><CS><CR><LF>* | |
| | ***87h*** | *See message 87h for detail* | |

***Description*** *Query current system settings:*

*NMEA configuration*
*Firmware revision*
*IO settings*
*Output format*
*Locale*
*Datum*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *type* | *0: all* | *UINT08* | *-* | *1* |

***Command*** ***Set Local Time (19h)*** ***(All GPS modules)***

***String*** *%%<F1h><19h>CS><CR><LF>*

***Length*** *2 + 5 = 7*

***Response*** ***ACK*** *%%<06h><19h><CS><CR><LF>*

***NAK*** *%%<15h><19h><CS><CR><LF>*

***Description*** *Set up user local time information. This command is useful to instruct module to output time information based on used zone.*
*When flag is set to 0, system time is equal to UTC time.*
*When flag is set to 1, system time is adjusted to local time*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | *Byte #* |
|---|---|---|---|---|
| *Flag* | *0:only local time is affected (e.g. ZDA sentence)*<br>*1:both local and system time are affected (e.g. GGA sentence)* | *UINT08* | *-* | *1* |
| *Time Zone Hour (GMT+-)* | *-12 ~ +12* | *SINT08* | *Hour* | *2* |
| *Time Zone Minute (GMT+-)* | *-59 ~ +59*<br>*'sign' should be the same as used for Hour* | *SINT08* | *Minute* | *3* |
| *Time Zone Second (GMT+-)* | *-59 ~ +59*<br>*'sign' should be the same as used for Hour* | *SINT08* | *Second* | *4* |
| *Adjust* | *Normal: 0*<br>*For Daylight Saving Time or Summer Time* | *SINT08* | *Hour* | *5* |

***Command*** ***~~Set Binary Configuration (1Ah)~~*** ***(Removed*)***

***String*** *%%<F1h><1Ah>CS><CR><LF>*

***Length*** *2 + 4 = 6*

***Response*** ***ACK*** *%%<06h><1Ah><CS><CR><LF>*

***NAK*** *%%<15h><1Ah><CS><CR><LF>*

***Description*** *Configure Binary output format*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Binary* | *0: disable, 1: enable*<br>*Bit 0: reserved*<br>*Bit 1: User PVT II information*<br>*Bit 2: User Satellite information*<br>*Bit 3: User Measurement Information*<br>*Default: 000Eh when switched to binary output* | *UINT16* | *-* | *1 - 2* |
| *Reserved* | *-* | *-* | *-* | *3 - 4* |

* No longer supported

***Command*** ***Set Extended Datum (1Bh)*** ***(All GPS modules)***

***String*** *%%<F1h><1Bh>< Parameter bytes><CS><CR><LF>*

***Length*** *2 + 22 = 24*

***Response*** ***ACK*** *%%<06h><1Bh ><CS><CR><LF>*

***NAK*** *%%<15h><1Bh ><CS><CR><LF>*

***Description*** *Set up datum parameters used for position transformation*
*This command is used to input datum parameter other than build-in supported ones.*
*All information provided is based on WGS84 at initial position information.*

| ***Parameters*** | | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | *Byte #* |
|---|---|---|---|---|---|
| *Ellipsoid Parameters* | *A* | *Semi-major axis* | *DPFP* | *-* | *1 – 8* |
| | *1/f* | *Inversed Flattening* | *DPFP* | *-* | *9 – 16* |
| *Delta X* | | *+- 2^15* | *SINT16* | *Meter* | *17 – 18* |
| *Delta Y* | | *+- 2^15* | *SINT16* | *Meter* | *19 – 20* |
| *Delta Z* | | *+- 2^15* | *SINT16* | *Meter* | *21 - 22* |

***Command*** ***Record Trace (1Dh)*** ***(Product dependent*)***

***String*** *%%<F1h><1Dh>< Parameter bytes><CS><CR><LF>*

***Length*** *2 + 8 = 10*

***Response*** ***ACK*** *%%<06h><1Dh ><CS><CR><LF>*

***NAK*** *%%<15h><1Dh ><CS><CR><LF>*

***Description***

*Start/stop recording the user trace.*
*Parameter Distance is the distance between two contiguous recorded points. Time Period is the time between two contiguous recorded points. When one of two parameters reaches the criteria, this trace is recorded. If one of the parameter is 0, it is ignored. If both parameters are 0, the trace is recorded in every single second. When Recording time is 65535(0xFFFF), the trace is recorded continuously. When recording reaches the storage limitation, system will erase the earliest records to make space for newest records. Technically, it is a FIFO ring buffer.*

*Note: This ring buffer is consisted of 128 blocks in LS-40MM/CM/SM/EB. Each block contains 512 bytes. When ring buffer is full, system erases the oldest whole block to make room for incoming records. Users should see a 100% used percentage of ring buffer when ring buffer is full, however, the number of logged records may be reduced because the erased block contains more than one records while only one new coming record is added at that moment.*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Action* | *0: stop, 1: start* | *UINT08* | *-* | *1* |
| *Format* | *0: Packed data* | *-* | *-* | *2* |
| *Distance* | *0 ~ 65535* | *UINT16* | *Meter* | *3 – 4* |
| *Time period* | *0 ~ 65535* | *UINT16* | *Second* | *5 – 6* |
| *Recording time* | *0 ~ 65535*<br>*65535 (0xFFFF): no limitation (limitation in buffer size)* | *UINT16* | *Second* | *7 – 8* |

* This function is supported on LS-40MM/SM/CM/EB.

| | | |
|---|---|---|
| ***Command*** | ***Read Trace Log (1Eh)*** | ***(Product dependent*)*** |
| ***String*** | *%%<F1h><1Eh>< Parameter bytes><CS><CR><LF>* | |
| ***Length*** | *2 + 7 = 9* | |
| ***Response*** ***ACK*** | *%%<06h><1Eh ><CS><CR><LF>* | |
| ***NAK*** | *%%<15h><1Eh ><CS><CR><LF>* | |
| ***88h*** | *Packed Trace data (See output message 88h)* | |

***Description*** *Start/stop reading the trace log.*
*A NAK message is returned when system is in recording. When logged records are outputting, the normal position messages (NMEA/Binary) are temporarily disabled until reading stops.*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Action* | *0: stop, 1: start* | *UINT08* | *-* | *1* |
| *(Reserved)* | *-* | *UINT08* | *-* | *2* |
| *Start #* | *0 ~ 65535 (zero-based)* | *UINT16* | *-* | *3 – 4* |
| *(Reserved)* | *-* | *UINT08* | *-* | *5* |
| *Baud rate* | *0: 4800*<br>*1: 9600*<br>*2: 19200* | *UINT08* | *-* | *6* |
| *Port* | *0 = RS232 COM 1* | *UINT08* | *-* | *7* |

* This function is supported on LS-40MM/SM/CM/EB.

| | | | |
|---|---|---|---|
| ***Command*** | | ***Maintain Trace (1Fh)*** | ***(Product dependent*)*** |
| ***String*** | | *%%<F1h><1F>< Parameter bytes><CS><CR><LF>* | |
| ***Length*** | | *2 + 2 = 4* | |
| ***Response*** | ***ACK*** | *%%<06h><1Fh ><CS><CR><LF>* | |
| | ***NAK*** | *%%<15h><1Fh><CS><CR><LF>* | |
| | ***89h/8Ah*** | *When Action is 0 (see output message 89h/8Ah)* | |

***Description*** *Parameter Power-on is used to configure the GPS to start/stop recording when GPS is powered on. When status only is requested, field Power on should be set to 0 to prevent GPS from starting recording on next power-on.*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Action* | *0: Read status,<br>1: Clear all trace records* | *UINT08* | *-* | *1* |
| *Power on* | *0: begin with stop trace,<br>1: begin with start trace* | *UINT08* | *-* | *2* |

* This function is supported on LS-40MM/SM/CM/EB.

| | | | |
|---|---|---|---|
| ***Command*** | | ***Set Update Rate (20h)*** | ***(LS-4100 chipset only)*** |
| ***String*** | | *%%<F1h><20>< Parameter bytes><CS><CR><LF>* | |
| ***Length*** | | *2 + 1 = 4* | |
| ***Response*** | ***ACK*** | *%%<06h><20h ><CS><CR><LF>* | |
| | ***NAK*** | *%%<15h><20h><CS><CR><LF>* | |

***Description*** *Change position update rate. When higher update rate is used, command 0x2 and 0x4 may be used to adjust the buadrate and NMEA period for secure the integrity of the output.*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *rate* | *1~5* | *UINT08* | *Hz* | *1* |

## BINARY OUTPUT MESSAGE TYPE <F2h>

This group of binary messages is output in response to commands that requests additional receiver information.

**Data Types Used**

(See Binary Input Message Type <F1h>)

**Byte Ordering**

(See Binary Input Message Type <F1h>)

***Message*** ***Firmware Revision (80h)*** ***(All GPS modules)***

***String*** *%%<F2h><80h>< Information bytes><CS><CR><LF>*

***Length*** *2 + 22 = 24*

***Description***

- *Output the revision information of LocSense firmware.*
- *This message is provided by request***.**

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Revision code* | *Xxxxxxxxxxx* | *UINT08* | *-* | *1-12* |
| *Date* | *Example: 0xYYMMDD*<br>*031101: 2003/11/01*<br>*This value is represented as 0x031101* | *UINT32* | *-* | *13-16* |
| *Time* | *Example: 0xHHMMSS*<br>*120801: 12:08:01*<br>*This 4-byte value has value 0x120801* | *UINT32* | *-* | *17-20* |
| *CRC* | *CRC of the firmware code* | *UINT16* | *-* | *21-22* |

***Message*** ***Module ID (85h)*** ***(All GPS modules)***

***String*** *%%<F2h><85h>< Information bytes><CS><CR><LF>*

***Length*** *2 + 5 = 7*

***Description*** *Provides module Identifier*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Type* | *1: User ID* | *UINT08* | *-* | *1* |
| *ID* | *0 ~ 2^32* | *UINT32* | *-* | *2 - 5* |

***Message*** ***Navigation Parameters (86h)*** ***(All GPS modules)***

***String*** *%%<F2h><86h>< Information bytes><CS><CR><LF>*

***Length*** *2 + 18 = 20*

***Description*** *Used to show current navigation parameters*

| ***Parameters*** | | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|---|
| *Update rate* | | *0 ~ 5* | *UINT08* | *Hz* | *1* |
| *DOP* | *Mask* | *0: Disable,<br>1: GDOP<br>2: PDOP<br>3: HDOP:* | *UINT08* | *-* | *2* |
| | *GDOP* | 0 ~ 255 | *UINT08* | *Degree* | *3* |
| | *PDOP* | 0 ~ 255 | *UINT08* | *Degree* | *4* |
| | *HDOP* | 0 ~ 255 | *UINT08* | *Degree* | *5* |
| *Elevation mask* | | *0 ~ 89* | *UINT08* | *Degree* | *6* |
| *DGPS* | | *0: disable 1: WAAS* | *UINT08* | *-* | *7* |
| *1PPS* | *Signal* | *0: off, 1: on* | *UINT08* | *-* | *8* |
| | *Width* | *0: 2ms, 1: 1ms, 2: 20us, 3:1us* | *UINT08* | *-* | *9* |
| | *Multiplier* | *1 ~ 16* | *UINT08* | *-* | *10* |
| *Reserved 1* | | *0* | *UINT32* | *-* | *11 ~ 14* |
| *Reserved 2* | | *0* | *UINT32* | *-* | *15 ~ 18* |

***Message*** ***Systems Settings (87h)*** ***(All GPS modules)***

***String*** *%%<F2h><87h>< Information bytes><CS><CR><LF>*

***Length*** *2 + 48 = 50*

***Description*** *Used to show current system settings*

| ***Parameters*** | | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|---|
| *COM 1* | | *0: 4800<br>1: 9600<br>2: 19200* | *UINT08* | *-* | *1* |
| *COM 2* | | *0: 4800<br>1: 9600<br>2: 19200* | *UINT08* | *-* | *2* |
| *NMEA* | *Check sum* | *0: Disable, 1: Enable* | *UINT08* | *-* | *3* |
| | *RMC* | *0 ~ 255, 0: Disable* | *UINT08* | *Degree* | *4* |
| | *VTG* | *0 ~ 255, 0: Disable* | *UINT08* | *Degree* | *5* |
| | *GGA* | *0 ~ 255, 0: Disable* | *UINT08* | *Degree* | *6* |
| | *GSA* | *0 ~ 255, 0: Disable* | *UINT08* | *Degree* | *7* |
| | *GSV* | *0 ~ 255, 0: Disable* | *UINT08* | *Degree* | *8* |
| | *GLL* | *0 ~ 255, 0: Disable* | *UINT08* | *Degree* | *9* |
| | *ZDA* | *0 ~ 255, 0: Disable* | *UINT08* | *Degree* | *10* |
| *Output Format* | | *0: No output<br>1: NMEA<br>2: Binary (Temporary)<br>3: Binary (Permanent)* | *UINT08* | *Degree* | *11* |
| *Locale* | *Flag* | *0:only local time is affected<br>(e.g. ZDA sentence)<br>1:both local and system time are affected<br>(e.g. GGA sentence)* | *UINT08* | *-* | *12* |
| | *Hour* | *-12 ~ +12* | *SINT08* | *Hour* | *13* |
| | *Minutes* | *-59 ~ +59<br>'sign' is the same as used for Hour* | *SINT08* | *Minute* | *14* |
| | *Second* | *-59 ~ +59<br>'sign' is the same as used for Hour* | *SINT08* | *Second* | *15* |
| | *Adjusted Hour* | *Normal: 0<br>For Daylight Saving Time or Summer Time* | *SINT08* | *Hour* | *16* |
| *Datum* | *Ellipsoid Index* | *0 ~ 23: system defined, 65535 : User defined* | *UINT16* | *-* | *17 - 18* |
| | *A* | *Semi-major axis* | *DPFP* | *-* | *19 – 26* |
| | *1/f* | *Inversed Flattening* | *DPFP* | *-* | *27 – 34* |
| | *Delta X* | *+- 2^15* | *SINT16* | *Meter* | *35 – 36* |
| | *Delta Y* | *+- 2^15* | *SINT16* | *Meter* | *37 – 38* |
| | *Delta Z* | *+- 2^15* | *SINT16* | *Meter* | *39 – 40* |
| *Reserved 1* | | *0* | *UINT32* | *-* | *41 – 44* |
| *Reserved 2* | | *0* | *UINT32* | *-* | *45 – 48* |

***Message*** ***Packed Trace Data (88h)*** ***(Product dependent*)***

***String*** *%%<F2h><88h>< Information bytes><CS><CR><LF>*

***Length*** *2 + 18 = 20*

***Description*** *Used to output logged trace records*

| ***Parameters*** | | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|---|
| *GPS Time* | Week No | *Bit [31: 20]* | *UINT32* | *-* | *1 – 4* |
| | TOW | *Bit [19: 0]* | | | |
| *Position (ECEF)* | *X* | +/- 2^31 | *SINT32* | *Meter* | *5 – 8* |
| | *Y* | +/- 2^31 | *SINT32* | *Meter* | *9 – 12* |
| | *Z* | +/- 2^31 | *SINT32* | *Meter* | *13 – 16* |
| *Information* | *Latest Flag* | *Bit [15]: 1- the last record* | *UINT16* | *-* | *17 - 18* |
| | *Mode* | *Bit [13]: 0 - 2D fix, 1 - 3D fix* | | | |
| | *DGPS* | *Bit [12]: 0-No, 1-Yes* | | | |
| | *Velocity* | *bit [9:0]* | | *Meter/s* | |

***Message*** ***Trace Buffer Status (89h)*** ***(LS-40xx series)***

***String*** *%%<F2h><89h>< Information bytes><CS><CR><LF>*

***Length*** *2 + 7 = 9*

***Description*** *Used to show status of the trace buffer*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *State* | *0: stop, 1: recording, 2: Reading* | *UINT08* | *-* | *1* |
| *Size - 1* | *0 ~ 255* | *UINT08* | *K byte* | *2* |
| *Used Percentage* | *0 ~ 100* | *UINT08* | *%* | *3* |
| *# of records logged* | *0 ~ 65535* | *UINT16* | *-* | *4 – 5* |
| *Reading Position* | *0 ~ 65535 (zero-based)* | *UINT16* | *-* | *6 - 7* |

***Message*** ***Extended Trace Buffer Status (8Ah)*** ***(LS-4100 chipset only)***

***String*** *%%<F2h><8Ah>< Information bytes><CS><CR><LF>*

***Length*** *2 + 11 = 13*

***Description*** *Used to show status of extended trace buffer*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *State* | *0: stop, 1: recording, 2: Reading* | *UINT08* | *-* | *1* |
| *Size - 1* | *0 ~ 255* | *UINT08* | *64K byte* | *2* |
| *Used Percentage* | *0 ~ 100* | *UINT08* | *%* | *3* |
| *# of records logged* | *0 ~ 2^32-1* | *UINT32* | *-* | *4 – 7* |
| *Reading Position* | *0 ~ 2^32-1 (zero-based)* | *UINT32* | *-* | *8 – 11* |

***Message*** ***~~User Position, Velocity & Time I (D0h)~~*** ***(Removed*)***

***String*** *%%<F2h><D0h>< Information bytes><CS><CR><LF>*

***Length*** *2 + 41 = 43*

***Description*** *Provide user PVT solution in ECEF format.*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Week No* | *1 ~ 65535* | *UINT16* | *-* | *1 – 2* |
| *Time of Week* | *0 ~ 2^32* | *UINT32* | *-* | *3 – 6* |
| *Date* | *Example: 0xYYMMDD*<br>*031101 - 2003/11/01*<br>*This value is represented as 0x031101* | *UINT32* | *-* | *7 – 10* |
| *Time* | *Example: 0xHHMMSS*<br>*120801 - 12:08:01*<br>*This value is represented as 0x120801* | *UINT32* | *-* | *11 – 14* |
| *X* | *+- 2^31* | *SINT32* | *Meter* | *15 – 18* |
| *Y* | *+- 2^31* | *SINT32* | *Meter* | *19 – 22* |
| *Z* | *+- 2^31* | *SINT32* | *Meter* | *23 – 26* |
| *DX* | *+- 2^15* | *SINT16* | *Meter* | *27 – 28* |
| *DY* | *+- 2^15* | *SINT16* | *Meter* | *29 – 30* |
| *DZ* | *+- 2^15* | *SINT16* | *Meter* | *31 – 32* |
| *Fix Indicator* | *0: Autonomous mode*<br>*1: Differential mode*<br>*5: Data not valid* | *UINT08* | *-* | *33* |
| *Quality of fix* | *0: no fix, 1: 2D, 2; 3D, 3: 3D+DGPS* | *UINT08* | *-* | *34* |
| *Number of SV (Line of sight)* | *0 ~ 12* | *UINT08* | *-* | *35* |
| *Number of SV in fix* | *0 ~ 12* | *UINT08* | | *36* |
| *GDOP* | *1 ~ 255, 255 indicates > 25.5* | *UINT08* | *1/10* | *37* |
| *PDOP* | *1 ~ 255, 255 indicates > 25.5* | *UINT08* | *1/10* | *38* |
| *HDOP* | *1 ~ 255, 255 indicates > 25.5* | *UINT08* | *1/10* | *39* |
| *VDOP* | *1 ~ 255, 255 indicates > 25.5* | *UINT08* | *1/10* | *40* |
| *TDOP* | *1 ~ 255, 255 indicates > 25.5* | *UINT08* | *1/10* | *41* |

*** No longer supported**

***Message*** ***User Position, Velocity & Time II (D1h)*** ***(All GPS modules)***

***String*** *%%<F2h><D1h>< Information bytes><CS><CR><LF>*

***Length*** *2 + 37 = 39*

***Description*** *Provide user PVT solution in Geodetic coordinates*

| ***Parameters*** | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|
| *Week No* | *1 ~ 65535* | *UINT16* | *-* | *1 – 2* |
| *Time of Week* | *0 ~ 2^32* | *UINT32* | *-* | *3 – 6* |
| *Date* | *Example: 0xYYMMDD*<br>*031101 - 2003/11/01*<br>*This value is represented as 0x031101* | *UINT32* | *-* | *7 – 10* |
| *Time* | *Example: 0xHHMMSS*<br>*120801 - 12:08:01*<br>*This value is represented as 0x120801* | *UINT32* | *-* | *11 – 14* |
| *Latitude* | *- 90 ~ +90* | *SPFP* | *-* | *15 – 18* |
| *Longitude* | *-180 ~ +180* | *SPFP* | *-* | *19 – 22* |
| *Altitude* | *-1000 ~ +18000* | *SINT16* | *Meter* | *23 – 24* |
| *Heading* | *0 ~ 359* | *UINT16* | *Degree* | *25 – 26* |
| *Speed* | *0 ~ 500* | *UINT16* | *m/s* | *27 – 28* |
| *Fix Indicator* | *0: Autonomous mode*<br>*1: Differential mode*<br>*5: Data not valid* | *UINT08* | *-* | *29* |
| *Quality of fix* | *0: no fix, 1: 2D, 2; 3D, 3: 3D+DGPS* | *UINT08* | *-* | *30* |
| *Number of SV (line of sight)* | *0 – 12* | *UINT08* | *-* | *31* |
| *Number of SV in fix* | *0 – 12* | *UINT08* | | *32* |
| *GDOP* | *1 ~ 255, 255 indicates > 25.5* | *UINT08* | *1/10* | *33* |
| *PDOP* | *1 ~ 255, 255 indicates > 25.5* | *UINT08* | *1/10* | *34* |
| *HDOP* | *1 ~ 255, 255 indicates > 25.5* | *UINT08* | *1/10* | *35* |
| *VDOP* | *1 ~ 255, 255 indicates > 25.5* | *UINT08* | *1/10* | *36* |
| *TDOP* | *1 ~ 255, 255 indicates > 25.5* | *UINT08* | *1/10* | *37* |

***Message*** ***User Satellite Information (D2h)*** ***(All GPS modules)***

***String*** *%%<F2h><D2h>< Information bytes><CS><CR><LF>*

***Length*** *2 + 102 = 104*

***Description*** *Provides satellite view information.*

| ***Parameters*** | | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|---|
| *Week No* | | *1 ~ 65535* | *UINT16* | *-* | *1 - 2* |
| *Time of week* | | *0 ~ 2^32* | *UINT32* | *-* | *3 - 6* |
| *SV 1* | *PRN* | *0: invalid data set*<br>*1 ~ 32: GPS*<br>*33,35,42,44,47,50: WAAS/EGNOS* | *UINT08* | *-* | *7* |
| | *Health* | *0: OK, > 0: error code* | *UINT08* | | *8* |
| | *Azimuth* | *0 ~ 359* | *UINT16* | *Degree* | *9 – 10* |
| | *Elevation* | *0 ~ 90* | *UINT08* | *Degree* | *11* |
| | *C/No* | *0 ~ 255* | *UINT08* | *--* | *12* |
| | *Status* | *BIT0 = 1: Acquired*<br>*BIT4 = 1: Frame Sync*<br>*BIT5 = 1: Get Ephemeris*<br>*Bit 8 = 1: Position Fix* | *UINT16* | *-* | *13 - 14* |
| *SV 2* | *See SV1* | | | | *15 – 22* |
| *SV 3* | *See SV1* | | | | *23 - 30* |
| *SV 4* | *See SV1* | | | | *31 – 38* |
| *SV 5* | *See SV1* | | | | *39 - 46* |
| *SV 6* | *See SV1* | | | | *47 – 54* |
| *SV 7* | *See SV1* | | | | *55 – 62* |
| *SV 8* | *See SV1* | | | | *63 – 70* |
| *SV 9* | *See SV1* | | | | *71 - 78* |
| *SV 10* | *See SV1* | | | | *79 - 86* |
| *SV 11* | *See SV1* | | | | *87 – 94* |
| *SV 12* | *See SV1* | | | | *95 - 102* |

***Message*** ***User Measurement Information (D3h)*** ***(All GPS modules)***

***String*** *%%<F2h><D3h>< Information bytes><CS><CR><LF>*

***Length*** *2 + 152 = 154*

***Description*** *Provide channel measurement information.*

| ***Parameters*** | | ***Data (Range)*** | ***Type (Little-endian)*** | ***Unit*** | ***Byte #*** |
|---|---|---|---|---|---|
| *Week No* | | *1 ~ 65535* | *UINT16* | *-* | *1 – 2* |
| *Time of week* | | *0 ~ 2^32* | *UINT32* | *-* | *3 – 6* |
| *Clock Offset* | | *0 ~ 65535* | *UINT16* | *-* | *7 – 8* |
| *SV 1* | *PRN* | *1 ~ 32* | *UINT08* | *-* | *9* |
| | *Reserved* | *-* | *UINT08* | *-* | *10* |
| | *Pseudo-range* | +/- 2^31 | *SINT32* | *Meter* | *11– 14* |
| | *Delta Range* | +/- 2^31 | *SINT32* | *Meter* | *15 – 18* |
| | *Doppler* | 0 ~ 65535 | *UINT16* | *-* | *19 – 20* |
| *SV 2* | | *See SV1* | | | *21 – 32* |
| *SV 3* | | *See SV1* | | | *33 – 44* |
| *SV 4* | | *See SV1* | | | *45 – 56* |
| *SV 5* | | *See SV1* | | | *57 – 68* |
| *SV 6* | | *See SV1* | | | *69 – 80* |
| *SV 7* | | *See SV1* | | | *81 – 92* |
| *SV 8* | | *See SV1* | | | *93 – 104* |
| *SV 9* | | *See SV1* | | | *105 – 116* |
| *SV 10* | | *See SV1* | | | *117 – 128* |
| *SV 11* | | *See SV1* | | | *129 – 140* |
| *SV 12* | | *See SV1* | | | *141 – 152* |

# APPENDIX

## A. Ellipsoid List

| Ellipsoid Index | Ellipsoid | Semi-major axis (a) | Inversed Flattening (1/f) |
|---|---|---|---|
| 1 | Airy 1830 | 6377563.396 | 299.3249646 |
| 2 | Modified Airy | 6377340.189 | 299.3249646 |
| 3 | Australian National | 6378160 | 298.25 |
| 4 | Bessel 1841 (Namibia) | 6377483.865 | 299.1528128 |
| 5 | Bessel 1841 | 6377397.155 | 299.1528128 |
| 6 | Clarke 1866 | 6378206.4 | 294.9786982 |
| 7 | Clarke 1880 | 6378249.145 | 293.465 |
| 8 | Everest (India 1830) | 6377276.345 | 300.8017 |
| 9 | Everest (Sabah Sarawak) | 6377298.556 | 300.8017 |
| 10 | Everest (India 1956) | 6377301.243 | 300.8017 |
| 11 | Everest (Malaysia 1969) | 6377295.664 | 300.8017 |
| 12 | Everest (Malay. & Sing) | 6377304.063 | 300.8017 |
| 13 | Everest (Pakistan) | 6377309.613 | 300.8017 |
| 14 | Modified Fischer 1960 | 6378155 | 298.3 |
| 15 | Helmert 1906 | 6378200 | 298.3 |
| 16 | Hough 1960 | 6378270 | 297 |
| 17 | Indonesian 1974 | 6378160 | 298.247 |
| 18 | International 1924 | 6378388 | 297 |
| 19 | Krassovsky 1940 | 6378245 | 298.3 |
| 20 | GRS 80 | 6378137 | 298.257222101 |
| 21 | South American 1969 | 6378160 | 298.25 |
| 22 | WGS 72 | 6378135 | 298.26 |
| 23 | WGS 84 | 6378137 | 298.257223563 |

## B. Datum Reference List

| Datum Name | Delta X | Delta Y | Delta Z | Ellipsoid | Ellipsoid Index | Region of Use |
|---|---|---|---|---|---|---|
| WGS-84 | 0 | 0 | 0 | WGS 84 | 23 | Global |
| WGS-84 | 0 | 0 | 0 | WGS84 | 23 | Global |
| Adindan | -118 | -14 | 218 | Clarke 1880 | 7 | Burkina Faso |
| Adindan | -134 | -2 | 210 | Clarke 1880 | 7 | Cameroon |
| Adindan | -165 | -11 | 206 | Clarke 1880 | 7 | Ethiopia |
| Adindan | -123 | -20 | 220 | Clarke 1880 | 7 | Mali |
| Adindan | -166 | -15 | 204 | Clarke 1880 | 7 | MEAN FOR Ethiopia; Sudan |
| Adindan | -128 | -18 | 224 | Clarke 1880 | 7 | Senegal |
| Adindan | -161 | -14 | 205 | Clarke 1880 | 7 | Sudan |
| Afgooye | -43 | -163 | 45 | Krassovsky 1940 | 19 | Somalia |
| Ain el Abd 1970 | -150 | -250 | -1 | International 1924 | 18 | Bahrain |
| Ain el Abd 1970 | -143 | -236 | 7 | International 1924 | 18 | Saudi Arabia |
| American Samoa 1962 | -115 | 118 | 426 | Clarke 1866 | 6 | American Samoa Islands |
| Anna 1 Astro 1965 | -491 | -22 | 435 | Australian National | 3 | Cocos Islands |
| Antigua Island Astro 1943 | -270 | 13 | 62 | Clarke 1880 | 7 | Antigua (Leeward Islands) |
| Arc 1950 | -138 | -105 | -289 | Clarke 1880 | 7 | Botswana |
| Arc 1950 | -153 | -5 | -292 | Clarke 1880 | 7 | Burundi |
| Arc 1950 | -125 | -108 | -295 | Clarke 1880 | 7 | Lesotho |
| Arc 1950 | -161 | -73 | -317 | Clarke 1880 | 7 | Malawi |
| Arc 1950 | -143 | -90 | -294 | Clarke 1880 | 7 | Mean for Botswana, Lesotho, Malawi, Swaziland, Zaire, Zambia, and Zimbabwe |
| Arc 1950 | -134 | -105 | -295 | Clarke 1880 | 7 | Swaziland |
| Arc 1950 | -169 | -19 | -278 | Clarke 1880 | 7 | Zaire |
| Arc 1950 | -147 | -74 | -283 | Clarke 1880 | 7 | Zambia |
| Arc 1950 | -142 | -96 | -293 | Clarke 1880 | 7 | Zimbabwe |
| Arc 1960 | -160 | -6 | -302 | Clarke 1880 | 7 | Mean for Kenya and Tanzania |
| Arc 1960 | -157 | -2 | -299 | Clarke 1880 | 7 | Kenya |
| Arc 1960 | -175 | -23 | -303 | Clarke 1880 | 7 | Taanzania |
| Ascension Island 1958 | -205 | 107 | 53 | International 1924 | 18 | Ascension Island |
| Astro Beacon E 1945 | 145 | 75 | -272 | International 1924 | 18 | Iwo Jima |
| Astro DOS 71/4 | -320 | 550 | -494 | International 1924 | 18 | St Helena Island |
| Astro Tern Island (FRIG) 1961 | 114 | -116 | -333 | International 1924 | 18 | Tern Island |
| Astronomical Station 1952 | 124 | -234 | -25 | International 1924 | 18 | Marcus Island |
| Australian Geodetic 1966 | -133 | -48 | 148 | Australian National | 3 | Australia; Tasmania |
| Australian Geodetic 1984 | -134 | -48 | 149 | Australian National | 3 | Australia; Tasmania |
| Ayabelle Lighthouse | -79 | -129 | 145 | Clarke 1880 | 7 | Djibouti |
| Bellevue (IGN) | -127 | -769 | 472 | International 1924 | 18 | Efate & Erromango Islands |
| Bermuda 1957 | -73 | 213 | 296 | Clarke 1866 | 6 | Bermuda |
| Bissau | -173 | 253 | 27 | International 1924 | 18 | Guinea-Bissau |
| Bogota Observatory | 307 | 304 | -318 | International 1924 | 18 | Colombia |
| Bukit Rimpah | -384 | 664 | -48 | Bessel 1841 | 5 | Indonesia(Bangka & Belitung Ids) |
| Camp Area Astro | -104 | -129 | 239 | International 1924 | 18 | Antarctica(McMurdo Camp Area) |
| Campo Inchauspe | -148 | 136 | 90 | International 1924 | 18 | Argentina |
| Canton Astro 1966 | 298 | -304 | -375 | International 1924 | 18 | Phoenix Islands |
| Cape | -136 | -108 | -292 | Clarke 1880 | 7 | South Africa |
| Cape Canaveral | -2 | 151 | 181 | Clarke 1866 | 6 | Bahamas; Florida |
| Carthage | -263 | 6 | 431 | Clarke 1880 | 7 | Tunisia |
| Chatham Island Astro 1971 | 175 | -38 | 113 | International 1924 | 18 | New Zealand (Chatham Island) |
| Chua Astro | -134 | 229 | -29 | International 1924 | 18 | Paraguay |
| Corrego Alegre | -206 | 172 | -6 | International 1924 | 18 | Brazil |
| Dabola | -83 | 37 | 124 | Clarke 1880 | 7 | Guinea |
| Deception Island | 260 | 12 | -147 | Clarke 1880 | 7 | Deception Island; Antarctia |
| Djakarta (Batavia) | -377 | 681 | -50 | Bessel 1841 | 5 | Indonesia (Sumatra) |
| DOS 1968 | 230 | -199 | -752 | International 1924 | 18 | New Georgia Islands (Gizo Island) |

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|---|---|---|---|---|---|---|
| Easter Island 1967 | 211 | 147 | 111 | International 1924 | 18 | Easter Island |
| Estonia; Coordinate System 1937 | 374 | 150 | 588 | Bessel 1841 | 5 | Estonia |
| European 1950 | -104 | -101 | -140 | International 1924 | 18 | Cyprus |
| European 1950 | -130 | -117 | -151 | International 1924 | 18 | Egypt |
| European 1950 | -86 | -96 | -120 | International 1924 | 18 | England; Channel Islands; Scotland; Shetland Islands |
| European 1950 | -86 | -96 | -120 | International 1924 | 18 | England; Ireland; Scotland; Shetland Islands |
| European 1950 | -87 | -95 | -120 | International 1924 | 18 | Finland; Norway |
| European 1950 | -84 | -95 | -130 | International 1924 | 18 | Greece |
| European 1950 | -117 | -132 | -164 | International 1924 | 18 | Iran |
| European 1950 | -97 | -103 | -120 | International 1924 | 18 | Italy (Sardinia) |
| European 1950 | -97 | -88 | -135 | International 1924 | 18 | Italy (Sicily) |
| European 1950 | -107 | -88 | -149 | International 1924 | 18 | Malta |
| European 1950 | -87 | -98 | -121 | International 1924 | 18 | Mean for Austria; Belgium; Denmark; Finland; France; W Germany; Gibraltar; Greece; Italy; Luxembourg; Netherlands; Norway; Portugal; Spain; Sweden; Switzerland |
| European 1950 | -87 | -96 | -120 | International 1924 | 18 | Mean for Austria; Denmark; France; W Germany; Netherlands; Switzerland |
| European 1950 | -103 | -106 | -141 | International 1924 | 18 | Mean for Iraq; Israel; Jordan; Lebanon; Kuwait; Saudi Arabia; Syria |
| European 1950 | -84 | -107 | -120 | International 1924 | 18 | Portugal; Spain |
| European 1950 | -112 | -77 | -145 | International 1924 | 18 | Tunisia |
| European 1979 | -86 | -98 | -119 | International 1924 | 18 | Mean for Austria; Finland; Netherlands; Norway; Spain; Sweden; Switzerland |
| Fort Thomas 1955 | -7 | 215 | 225 | Clarke 1880 | 7 | Nevis; St. Kitts (Leeward Islands) |
| Gan 1970 | -133 | -321 | 50 | International 1924 | 18 | Republic of Maldives |
| Geodetic Datum 1949 | 84 | -22 | 209 | International 1924 | 18 | New Zealand |
| Graciosa Base SW 1948 | -104 | 167 | -38 | International 1924 | 18 | Azores (Faial; Graciosa; Pico; Sao Jorge; Terceira) |
| Guam 1963 | -100 | -248 | 259 | Clarke 1866 | 6 | Guam |
| Gunung Segara | -403 | 684 | 41 | Bessel 1841 | 5 | Indonesia (Kalimantan) |
| GUX 1 Astro | 252 | -209 | -751 | International 1924 | 18 | Guadalcanal Island |
| Herat North | -333 | -222 | 114 | International 1924 | 18 | Afghanistan |
| Hermannskogel Datum | 653 | -212 | 449 | Bessel 1841 (Namibia) | 4 | Croatia -Serbia, Bosnia-Herzegovina |
| Hjorsey 1955 | -73 | 46 | -86 | International 1924 | 18 | Iceland |
| Hong Kong 1963 | -156 | -271 | -189 | International 1924 | 18 | Hong Kong |
| Hu-Tzu-Shan | -637 | -549 | -203 | International 1924 | 18 | Taiwan |
| Indian | 282 | 726 | 254 | Everest (India 1830) | 8 | Bangladesh |
| Indian | 295 | 736 | 257 | Everest (India 1956) | 10 | India; Nepal |
| Indian | 283 | 682 | 231 | Everest (Pakistan) | 13 | Pakistan |
| Indian 1954 | 217 | 823 | 299 | Everest (India 1830) | 8 | Thailand |
| Indian 1960 | 182 | 915 | 344 | Everest (India 1830) | 8 | Vietnam (Con Son Island) |
| Indian 1960 | 198 | 881 | 317 | Everest (India 1830) | 8 | Vietnam (Near 16øN)) |
| Indian 1975 | 210 | 814 | 289 | Everest (India 1830) | 8 | Thailand |
| Indonesian 1974 | -24 | -15 | 5 | Indonesian 1974 | 17 | Indonesia |
| Ireland 1965 | 506 | -122 | 611 | Modified Airy | 2 | Ireland |
| ISTS 061 Astro 1968 | -794 | 119 | -298 | International 1924 | 18 | South Georgia Islands |
| ISTS 073 Astro 1969 | 208 | -435 | -229 | International 1924 | 18 | Diego Garcia |
| Johnston Island 1961 | 189 | -79 | -202 | International 1924 | 18 | Johnston Island |
| Kandawala | -97 | 787 | 86 | Everest (India 1830) | 8 | Sri Lanka |
| Kerguelen Island 1949 | 145 | -187 | 103 | International 1924 | 18 | Kerguelen Island |
| Kertau 1948 | -11 | 851 | 5 | Everest (Malay. & Sing) | 12 | West Malaysia & Singapore |
| Kusaie Astro 1951 | 647 | 1777 | -1124 | International 1924 | 18 | Caroline Islands |
| Korean Geodetic System | 0 | 0 | 0 | GRS 80 | 20 | South Korea |
| L. C. 5 Astro 1961 | 42 | 124 | 147 | Clarke 1866 | 6 | Cayman Brac Island |

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|---|---|---|---|---|---|---|
| Leigon | -130 | 29 | 364 | Clarke 1880 | 7 | Ghana |
| Liberia 1964 | -90 | 40 | 88 | Clarke 1880 | 7 | Liberia |
| Luzon | -133 | -77 | -51 | Clarke 1866 | 6 | Philippines (Excluding Mindanao) |
| Luzon | -133 | -79 | -72 | Clarke 1866 | 6 | Philippines (Mindanao) |
| M'Poraloko | -74 | -130 | 42 | Clarke 1880 | 7 | Gabon |
| Mahe 1971 | 41 | -220 | -134 | Clarke 1880 | 7 | Mahe Island |
| Massawa | 639 | 405 | 60 | Bessel 1841 | 5 | Ethiopia (Eritrea) |
| Merchich | 31 | 146 | 47 | Clarke 1880 | 7 | Morocco |
| Midway Astro 1961 | 912 | -58 | 1227 | International 1924 | 18 | Midway Islands |
| Minna | -81 | -84 | 115 | Clarke 1880 | 7 | Cameroon |
| Minna | -92 | -93 | 122 | Clarke 1880 | 7 | Nigeria |
| Montserrat Island Astro 1958 | 174 | 359 | 365 | Clarke 1880 | 7 | Montserrat (Leeward Islands) |
| Nahrwan | -247 | -148 | 369 | Clarke 1880 | 7 | Oman (Masirah Island) |
| Nahrwan | -243 | -192 | 477 | Clarke 1880 | 7 | Saudi Arabia |
| Nahrwan | -249 | -156 | 381 | Clarke 1880 | 7 | United Arab Emirates |
| Naparima BWI | -10 | 375 | 165 | International 1924 | 18 | Trinidad & Tobago |
| North American 1927 | -5 | 135 | 172 | Clarke 1866 | 6 | Alaska (Excluding Aleutian Ids) |
| North American 1927 | -2 | 152 | 149 | Clarke 1866 | 6 | Alaska (Aleutian Ids East of 180øW) |
| North American 1927 | 2 | 204 | 105 | Clarke 1866 | 6 | Alaska (Aleutian Ids West of 180øW) |
| North American 1927 | -4 | 154 | 178 | Clarke 1866 | 6 | Bahamas (Except San Salvador Id) |
| North American 1927 | 1 | 140 | 165 | Clarke 1866 | 6 | Bahamas (San Salvador Island) |
| North American 1927 | -7 | 162 | 188 | Clarke 1866 | 6 | Canada (Alberta; British Columbia) |
| North American 1927 | -9 | 157 | 184 | Clarke 1866 | 6 | Canada (Manitoba; Ontario) |
| North American 1927 | -22 | 160 | 190 | Clarke 1866 | 6 | Canada (New Brunswick; Newfoundland; Nova Scotia; Quebec) |
| North American 1927 | 4 | 159 | 188 | Clarke 1866 | 6 | Canada (Northwest Territories; Saskatchewan) |
| North American 1927 | -7 | 139 | 181 | Clarke 1866 | 6 | Canada (Yukon) |
| North American 1927 | 0 | 125 | 201 | Clarke 1866 | 6 | Canal Zone |
| North American 1927 | -9 | 152 | 178 | Clarke 1866 | 6 | Cuba |
| North American 1927 | 11 | 114 | 195 | Clarke 1866 | 6 | Greenland (Hayes Peninsula) |
| North American 1927 | -3 | 142 | 183 | Clarke 1866 | 6 | Mean for Antigua; Barbados; Barbuda; Caicos Islands; Cuba; Dominican Republic; Grand Cayman; Jamaica; Turks Islands |
| North American 1927 | 0 | 125 | 194 | Clarke 1866 | 6 | Mean for Belize; Costa Rica; El Salvador; Guatemala; Honduras; Nicaragua |
| North American 1927 | -10 | 158 | 187 | Clarke 1866 | 6 | Mean for Canada |
| North American 1927 | -8 | 160 | 176 | Clarke 1866 | 6 | Mean for CONUS |
| North American 1927 | -9 | 161 | 179 | Clarke 1866 | 6 | Mean for CONUS (East of Mississippi; River Including Louisiana; Missouri; Minnesota) |
| North American 1927 | -8 | 159 | 175 | Clarke 1866 | 6 | Mean for CONUS (West of Mississippi; River Excluding Louisiana; Minnesota; Missouri) |
| North American 1927 | -12 | 130 | 190 | Clarke 1866 | 6 | Mexico |
| North American 1983 | 0 | 0 | 0 | GRS 80 | 20 | Alaska (Excluding Aleutian Ids) |
| North American 1983 | -2 | 0 | 4 | GRS 80 | 20 | Aleutian Ids |
| North American 1983 | 0 | 0 | 0 | GRS 80 | 20 | Canada |
| North American 1983 | 0 | 0 | 0 | GRS 80 | 20 | CONUS |
| North American 1983 | 1 | 1 | -1 | GRS 80 | 20 | Hawaii |
| North American 1983 | 0 | 0 | 0 | GRS 80 | 20 | Mexico; Central America |
| North Sahara 1959 | -186 | -93 | 310 | Clarke 1880 | 7 | Algeria |
| Observatorio Meteorologico 1939 | -425 | -169 | 81 | International 1924 | 18 | Azores (Corvo & Flores Islands) |
| Old Egyptian 1907 | -130 | 110 | -13 | Helmert 1906 | 15 | Egypt |
| Old Hawaiian | 89 | -279 | -183 | Clarke 1866 | 6 | Hawaii |

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|---|---|---|---|---|---|---|
| Old Hawaiian | 45 | -290 | -172 | Clarke 1866 | 6 | Kauai |
| Old Hawaiian | 65 | -290 | -190 | Clarke 1866 | 6 | Maui |
| Old Hawaiian | 61 | -285 | -181 | Clarke 1866 | 6 | Mean for Hawaii; Kauai; Maui; Oahu |
| Old Hawaiian | 58 | -283 | -182 | Clarke 1866 | 6 | Oahu |
| Oman | -346 | -1 | 224 | Clarke 1880 | 7 | Oman |
| Ordnance Survey Great Britain 1936 | 371 | -112 | 434 | Airy 1830 | 1 | England |
| Ordnance Survey Great Britain 1936 | 371 | -111 | 434 | Airy 1830 | 1 | England; Isle of Man; Wales |
| Ordnance Survey Great Britain 1936 | 375 | -111 | 431 | Airy 1830 | 1 | Mean for England; Isle of Man; Scotland; Shetland Islands; Wales |
| Ordnance Survey Great Britain 1936 | 384 | -111 | 425 | Airy 1830 | 1 | Scotland; Shetland Islands |
| Ordnance Survey Great Britain 1936 | 370 | -108 | 434 | Airy 1830 | 1 | Wales |
| Pico de las Nieves | -307 | -92 | 127 | International 1924 | 18 | Canary Islands |
| Pitcairn Astro 1967 | 185 | 165 | 42 | International 1924 | 18 | Pitcairn Island |
| Point 58 | -106 | -129 | 165 | Clarke 1880 | 7 | Mean for Burkina Faso & Niger |
| Pointe Noire 1948 | -148 | 51 | -291 | Clarke 1880 | 7 | Congo |
| Porto Santo 1936 | -499 | -249 | 314 | International 1924 | 18 | Porto Santo; Madeira Islands |
| Provisional South American 1956 | -270 | 188 | -388 | International 1924 | 18 | Bolivia |
| Provisional South American 1956 | -270 | 183 | -390 | International 1924 | 18 | Chile (Northern; Near 19 øS) |
| Provisional South American 1956 | -305 | 243 | -442 | International 1924 | 18 | Chile (Southern; Near 43 øS) |
| Provisional South American 1956 | -282 | 169 | -371 | International 1924 | 18 | Colombia |
| Provisional South American 1956 | -278 | 171 | -367 | International 1924 | 18 | Ecuador |
| Provisional South American 1956 | -298 | 159 | -369 | International 1924 | 18 | Guyana |
| Provisional South American 1956 | -288 | 175 | -376 | International 1924 | 18 | Mean for Bolivia; Chile; Colombia; Ecuador; Guyana; Peru; Venezuela |
| Provisional South American 1956 | -279 | 175 | -379 | International 1924 | 18 | Peru |
| Provisional South American 1956 | -295 | 173 | -371 | International 1924 | 18 | Venezuela |
| Provisional South Chilean 1963 | 16 | 196 | 93 | International 1924 | 18 | Chile (Near 53 øS) (Hito XVIII) |
| Puerto Rico | 11 | 72 | -101 | Clarke 1866 | 6 | Puerto Rico; Virgin Islands |
| Pulkovo 1942 | 28 | -130 | -95 | Krassovsky 1940 | 19 | Russia |
| Qatar National | -128 | -283 | 22 | International 1924 | 18 | Qatar |
| Qornoq | 164 | 138 | -189 | International 1924 | 18 | Greenland (South) |
| Reunion | 94 | -948 | -1262 | International 1924 | 18 | Mascarene Islands |
| Rome 1940 | -225 | -65 | 9 | International 1924 | 18 | Italy (Sardinia) |
| S-42 (Pulkovo 1942) | 28 | -121 | -77 | Krassovsky 1940 | 19 | Hungary |
| S-42 (Pulkovo 1942) | 23 | -124 | -82 | Krassovsky 1940 | 19 | Poland |
| S-42 (Pulkovo 1942) | 26 | -121 | -78 | Krassovsky 1940 | 19 | Czechoslavakia |
| S-42 (Pulkovo 1942) | 24 | -124 | -82 | Krassovsky 1940 | 19 | Latvia |
| S-42 (Pulkovo 1942) | 15 | -130 | -84 | Krassovsky 1940 | 19 | Kazakhstan |
| S-42 (Pulkovo 1942) | 24 | -130 | -92 | Krassovsky 1940 | 19 | Albania |
| S-42 (Pulkovo 1942) | 28 | -121 | -77 | Krassovsky 1940 | 19 | Romania |
| S-JTSK | 589 | 76 | 480 | Bessel 1841 | 5 | Czechoslavakia (Prior 1 JAN 1993) |
| Santo (DOS) 1965 | 170 | 42 | 84 | International 1924 | 18 | Espirito Santo Island |
| Sao Braz | -203 | 141 | 53 | International 1924 | 18 | Azores (Sao Miguel; Santa Maria Ids) |
| Sapper Hill 1943 | -355 | 21 | 72 | International 1924 | 18 | East Falkland Island |
| Schwarzeck | 616 | 97 | -251 | Bessel 1841 (Namibia) | 4 | Namibia |
| Selvagem Grande 1938 | -289 | -124 | 60 | International 1924 | 18 | Salvage Islands |

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|---|---|---|---|---|---|---|
| Sierra Leone 1960 | -88 | 4 | 101 | Clarke 1880 | 7 | Sierra Leone |
| South American 1969 | -62 | -1 | -37 | South American 1969 | 21 | Argentina |
| South American 1969, | -61 | 2 | -48 | South American 1969 | 21 | Bolivia |
| South American 1969, | -60 | -2 | -41 | South American 1969 | 21 | Brazil |
| South American 1969, | -75 | -1 | -44 | South American 1969 | 21 | Chile |
| South American 1969, | -44 | 6 | -36 | South American 1969 | 21 | Colombia |
| South American 1969, | -48 | 3 | -44 | South American 1969 | 21 | Ecuador |
| South American 1969, | -47 | 26 | -42 | South American 1969 | 21 | Ecuador (Baltra; Galapagos) |
| South American 1969, | -53 | 3 | -47 | South American 1969 | 21 | Guyana |
| South American 1969, | -57 | 1 | -41 | South American 1969 | 21 | Mean for Argentina; Bolivia; Brazil; Chile; Colombia; Ecuador; Guyana; Paraguay; Peru; Trinidad & Tobago; Venezuela |
| South American 1969, | -61 | 2 | -33 | South American 1969 | 21 | Paraguay |
| South American 1969, | -58 | 0 | -44 | South American 1969 | 21 | Peru |
| South American 1969, | -45 | 12 | -33 | South American 1969 | 21 | Trinidad & Tobago |
| South American 1969, | -45 | 8 | -33 | South American 1969 | 21 | Venezuela |
| South Asia | 7 | -10 | -26 | Modified Fischer 1960 | 14 | Singapore |
| Tananarive Observatory 1925 | -189 | -242 | -91 | International 1924 | 18 | Madagascar |
| Timbalai 1948 | -679 | 669 | -48 | Everest (Sabah Sarawak) | 9 | Brunei; E. Malaysia (Sabah Sarawak) |
| Tokyo | -148 | 507 | 685 | Bessel 1841 | 5 | Japan |
| Tokyo | -148 | 507 | 685 | Bessel 1841 | 5 | Mean for Japan; South Korea; Okinawa |
| Tokyo | -158 | 507 | 676 | Bessel 1841 | 5 | Okinawa |
| Tokyo | -147 | 506 | 687 | Bessel 1841 | 5 | South Korea |
| Tristan Astro 1968 | -632 | 438 | -609 | International 1924 | 18 | Tristan da Cunha |
| Viti Levu 1916 | 51 | 391 | -36 | Clarke 1880 | 7 | Fiji (Viti Levu Island) |
| Voirol 1960 | -123 | -206 | 219 | Clarke 1880 | 7 | Algeria |
| Wake Island Astro 1952 | 276 | -57 | 149 | International 1924 | 18 | Wake Atoll |
| Wake-Eniwetok 1960 | 102 | 52 | -38 | Hough 1960 | 16 | Marshall Islands |
| WGS 1972 | 0 | 0 | 0 | WGS 72 | 22 | Global Definition |
| Yacare | -155 | 171 | 37 | International 1924 | 18 | Uruguay |
| Zanderij | -265 | 120 | -358 | International 1924 | 18 | Suriname |

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