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The High-Performance Alternative™

PowerDNA DNA-GPS
GPS Receiver System
—
User Manual

High Performance GPS Receiver
for a PowerDNA, UEILogger, or UEIPAC Cube

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Chapter 1 Introduction

This document outlines the feature set and use of the DNA-GPS Receiver System when used with a PowerDNA, UEILogger, or UEIPAC Cube. This manual describes the following products:

- DNA-GPS Receiver System for mounting on a PowerDNA, UEILogger, or UEIPAC Cube (supplied with a DNA-SL-501 Serial Communication Layer).
- DNA-STP-GPS Terminal Panel Board, designed as a convenient connection interface between a PowerDNA, UEILogger, or UEIPAC Cube and a Garmin GPS 16-HVS Receiver mounted on the Cube
- Accessory modules such as cables.

1.1 Organization

This DNA GPS Receiver System Manual is organized as follows:

Introduction

This chapter provides an overview of DNA-GPS Receiver System features, functions, and accessories.

DNA-GPS Receiver System

This chapter provides an overview of the device architecture, connectivity, logic, and accessories for the DNA-GPS Receiver System.

Programming with High-Level API

This chapter provides a reference to the DNA-SL-501 Serial Communication Layer User Manual for instruction on how to program the system.

Appendices

Accessories

This appendix provides a list of accessories available for use with a DNA-GPS Receiver System.

Index

This is an alphabetical index of topics covered in this manual.

NOTE: A glossary of terms used with the PowerDNA Cube and layers can be viewed and/or downloaded from www.ueidaq.com

Manual Conventions

To help you get the most out of this manual and our products, please note that we use the following conventions:

Tips are designed to highlight quick ways to get the job done, or reveal good ideas you might not discover on your own.

NOTE: ***Notes alert you to important information.***

CAUTION! Caution advises you of precautions to take to avoid injury, data loss, and damage to your boards or a system crash.

Text formatted in **bold** typeface generally represents text that should be entered verbatim. For instance, it can represent a command, as in the following example: “You can instruct users how to run setup using a command such as **setup.exe**.”

1.2 The DNA-GPS Receiver System

This manual describes the DNA-GPS Receiver System. It also describes the DNA-STP-GPS Terminal Panel accessory board. The technical specifications for the DNA-GPS Receiver System are listed in **Table 1-1**.

Technical Specifications:

GPS Receiver	Garmin GPS 16-HVS
Positional Accuracy	<3 meters in DGPS WAAS mode <15 meters in Standard mode
Velocity Accuracy	0.1 knot RMS
Acquisition Times	
Reacquisition	less than 2 seconds
Cold acquisition	approximately 45 seconds
Skysearch/Autolocate®	5 minutes
1 PPS Accuracy	±1 μS
1 PPS Display	1 PPS LED flash on DNA-STP-GPS board
Output connection	5 meter cable, terminated in RJ-45. DNA-STP-GPS splits RJ-45 into easily used serial, power and 1 PPS connections
Serial Output Protocol	NMEA 0183 v2 or v3 as well a variety of other ASCII sentences
Size	3.58" diameter, 1.65" high
Weight	11.7 oz, with 5 meter cable
Operating Temperature	-30°C to +85°C
Moisture resistance	IEC 60539 IPX7 (immersion in 1 meter of water for 30 minutes)
Power Supply	+9-36 VDC, less than 600 mW (fully compatible with standard PowerDNA power supplies)

Table 1-1 DNA-GPS Receiver System Technical Specifications

In WAAS mode, the Garmin GPS receiver provides location information with an error of less than 3 meters within areas served by WAAS (Wide Area Augmentation System), which basically means North America. WAAS is a system that broadcasts data that corrects standard GPS signals for errors caused by atmospheric and ionospheric disturbances and satellite orbit and clock drift. This broadcast signal can be received by the Garmin 16-HVS Receiver in WAAS mode.

In areas where WAAS is not available, the GPS system provides location information with a positional error of less than 15 meters.

The system also outputs a 1 PPS (pulse per second) signal that is synchronized to UTC time within ±1 microsecond. This signal provides a convenient means of synchronizing systems anywhere in the world. A green LED mounted on the DNA-STP-GPS accessory board indicates the current status of this signal.

A DNA-STP-GPS terminal board is supplied as a standard accessory with each GPS Receiver system to facilitate the connections between the Garmin unit and the associated Cube. As illustrated in **Figure 1-2** and also in **Figure A-1** in the Appendix, this board connects the receiver signal from the Garmin unit to two RJ-45 connectors, one of which is used for two DB-9 Serial Line connectors, and one of which is used for the Sync input to the Cube. The accessory board also provides a BNC connector that can be used to output the 1PPS GPS signal for synchronizing other devices to UTC time. An LED mounted on the board flashes with the 1 PPS signal, confirming satellite synchronization and presence of the signal

Figure 1-1 is a photo of the DNA-GPS Receiver System mounted on a PowerDNA Cube.

Figure 1-1. DNA-GPS Receiver System and PowerDNA Cube

1.3 Device Architecture

The DNA-GPS Receiver System consists of a Garmin GPS 16-HVS receiver mounted on the top of a PowerDNA, UEILogger, or UEIPAC Cube, as shown in
Figure 1-1. The Cube contains at least one DNA-SL-501 Serial Communication layer board. The system is usually provided with additional accessory items such as RS-232/485 serial cables, power supply cables, Sync cable, and a DNA-STP-GPS terminal panel that facilitates the various connections between the Garmin receiver and the Cube. These accessories are described more fully in the Appendix on page 14.

A functional block diagram of the major components of a complete PowerDNA, UEILogger, or UEIPAC GPS system is shown in **Figure 1-2**. The diagram shows the interconnections between the Garmin receiver, an associated Cube, and a DNA-STP-GPS terminal board

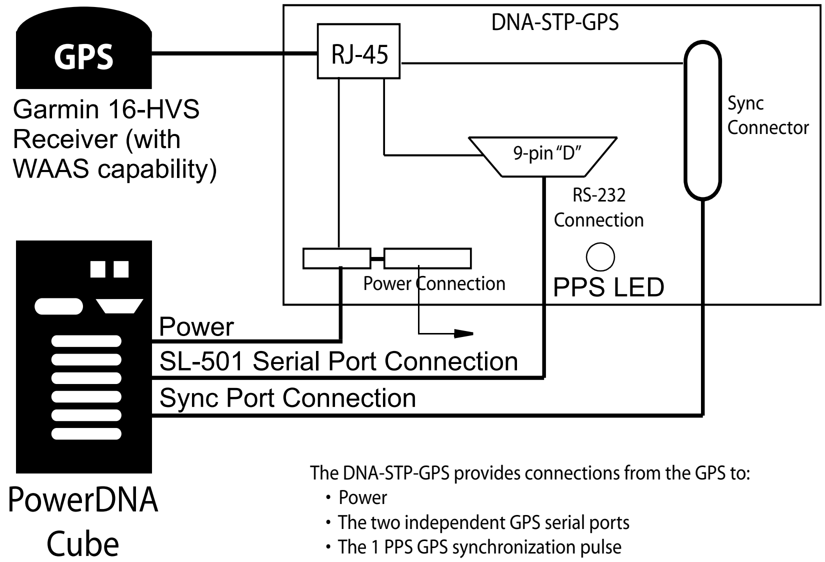


Figure 1-2 . Block Diagram of DNA-GPS Receiver System Architecture

1.4 DNA-SL-501 Layer capabilities

Since the DNA-GPS Receiver System requires a DNA-SL-501 layer to be supplied with the Cube, the following information about the SL-501 is included in this manual. For more detailed information, refer to the SL-501 User Manual and Datasheet.

Using the RS-232 or RS-485 standard, the controller is capable of communicating at speeds of 256Kbit/s for RS-232 and 1Mbit/s for RS-485. When in RS-485 mode, the layer is compatible with RS-422 networks.

The UART16550 runs at a base-block frequency of 66MHz, with a FIFO size of 2048.

Each port has independently programmable:

- Baud/bit rate
- UART interrupt
- Timeout interrupt
- TX/RX FIFO interrupt
- Error interrupt (4 per port)

1.5 Wiring & Connectors

A DNA-CBL-COM (see **Figure 1-3**) from the 37-pin connector of the SL-501 provides four individual 9-pin ports, labeled by port as (1), (2), (3), (4).

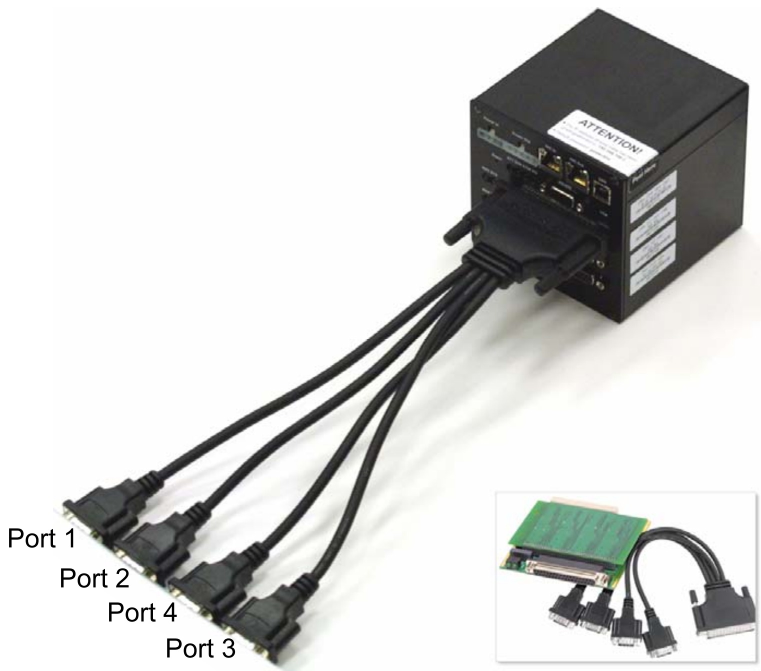
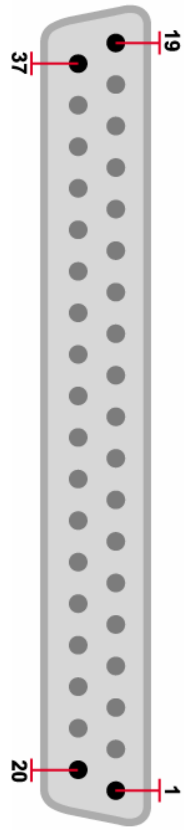


Figure 1-3. SL-501 with Cables

The following signals are located at the connector:

- GNDx - Isolated ground for the corresponding serial port
- TXDx/RXDx RS-232: Transmit/Receive
- RTSx/RCTSx RS-232: request to Send/Clear to Send
- TXx+/TXx- RS-485: Transmit pair
- RXx+/RXx- RS-485: Receive pair

The B-size 37-pin female D-Sub connector on the SL-501 is divided into four 9-pin D-connector serial ports by a DNA-CBL-COM cable with the pinout shown in **Figure 1-4**.



	J1		DB-9*	RS-232	RS-485
Serial Port 1	19	>	3	TXD1	TX1-
	37	>	2	RXD1	RX1+
	18	>	7	RTS1	TX1+
	36	>	8	CTS1	RX1-
	17	-	6	-	-
	35	>	5	GND1	GND1
	16	-	4	-	-
	34	-	1	-	-
	15	-	9	-	-
Serial Port 2	33	>	3	TXD2	TX2-
	14	>	2	RXD2	RX2+
	32	>	7	RTS2	TX2+
	13	>	8	CTS2	RX2-
	31	-	6	-	-
	12	>	5	GND2	GND2
	30	-	4	-	-
	11	-	1	-	-
	29	-	9	-	-
Serial Port 4	10	>	3	TXD4	TX4-
	28	>	2	RXD4	RX4+
	9	>	7	RTS4	TX4+
	27	>	8	CTS4	RX4-
	8	-	6	-	-
	26	>	5	GND4	GND4
	7	-	4	-	-
	25	-	1	-	-
	6	-	9	-	-
Serial Port 3	24	>	3	TXD3	TX3-
	5	>	2	RXD3	RX3+
	23	>	7	RTS3	TX3+
	4	>	8	CTS3	RX3-
	22	-	6	-	-
	3	>	5	GND3	GND3
	21	-	4	-	-
	2	-	1	-	-
	20	-	9	-	-
	1	-		-	-

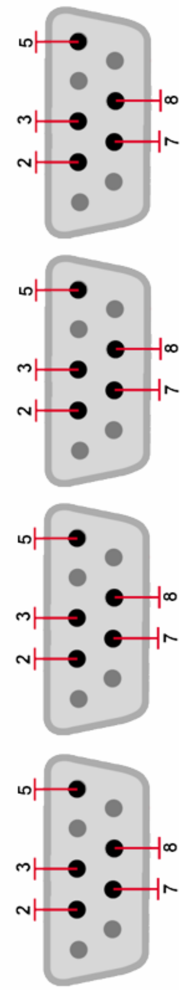


Figure 1-4 . SL-501 Pinout

Chapter 2 Programming with the High Level API

Since the DNA-GPS Receiver System requires that a DNA-SL-501 Serial Communication layer be installed in the associated PowerDNA, UEILogger, or UEIPAC Cube, please refer to the code examples for the DNA-SL-501 Layer included with the PowerDNA Software Suite provided with your Cube. One of these examples is shown below.

```
//=========================================================================
//
// NAME:    SampleGPS.c
//
// DESCRIPTION:
//
// This example shows how to interface with a GARMIN GPS receiver.
// It continuously read incoming NMEA messages on serial port 0 in
// a dedicated thread.
// The main thread is configured to handle the 1 PPS timing
// signal coming from the GPS (You need to connect that signal to
// PowerDNA's SyncIn connector with the DNA-GPS-STP terminal block).
//
//
// ------------------------------------------------------------------
//
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// United Electronic Industries Confidential Information.
//
//=======================================================================
#include <stdio.h>
#include <stdint.h>
#include <stdlib.h>
#include <netinet/in.h>
#include <unistd.h>
#include <signal.h>
#include <math.h>
#include <sys/time.h>
#include <sched.h>
#include <pthread.h>

#include "PDNA.h"
#include "ParseParams.h"
#include "nmeap.h"

static nmeap_context_t nmea;   /* parser context */
static nmeap_gga_t     gga;  /* this is where the data from GGA
                                /* messages will show up */
static nmeap_rmc_t     rmc;   /* this is where the data from RMC
                                  /* messages will show up */


// The GPS is sending data at 9600bps 8N1
#define CHANNEL_CFG DQCFG_501(DQ_SL501_OPER_NORM, \
```

```
                              DQ_SL501_MODE_232, \
                              DQ_SL501_BAUD_9600, \
                              DQ_SL501_WIDTH_8, \
                              DQ_SL501_STOP_1, \
                              DQ_SL501_PARITY_NONE)

int stop = 0;
PDNA_PARAMS params = { 0, 1, {0}, 100.0 };
int handle = 0;

// Handler for SIGINT
void signalhandler(int sig)
{
    stop = 1;
}

static void print_gga(nmeap_gga_t *gga)
{
    printf("Latitude = %.6f\n"
            "Longitude = %.6f\n"
            "Altitude = %.0f m\n"
            "Time = %lu\n"
            "Satellites = %d\n"
            "Quality = %d\n"
            "HDOP = %f\n"
            "geoid = %f\n",
            gga->latitude  ,
            gga->longitude,
            gga->altitude ,
            gga->time     ,
            gga->satellites,
            gga->quality   ,
            gga->hdop      ,
            gga->geoid);
}

void* SerialReadThreadProc(void *arg)
{
    int ret = DQ_SUCCESS;
    sigset_t set;
#define BUFSIZE 128
    char buffer[BUFSIZE];

    sigemptyset(&set);
    sigaddset(&set, SIGINT);
    pthread_sigmask(SIG_BLOCK, &set, NULL);

    ret = nmeap_init(&nmea, NULL);
    if (ret != 0)
    {
        fprintf(stderr, "nmeap_init %d\n",ret);
        return NULL;
    }
```

```
   /*  add standard GPGGA parser     */
    ret = nmeap_addParser(&nmea,"GPGGA",nmeap_gpgga,NULL,&gga);
    if (ret != 0)
    {
        fprintf(stderr, "nmeap_add %d\n",ret);
        return NULL;
    }

/*  add standard GPRMC parser     */
    ret = nmeap_addParser(&nmea,"GPRMC",nmeap_gprmc,NULL,&rmc);
    if (ret != 0)
    {
        fprintf(stderr, "nmeap_add %d\n",ret);
        return NULL;
    }

    while(!stop)
    {
        int bufferLength;

        ret = DqEmb501Receive(handle, params.device, params.channels[0],
(unsigned char*)buffer, BUFSIZE, 2000, '\n');
        if(ret < 0)
        {
            printf("Error %d receiving from serial port\n", ret);
            break;
        }

        bufferLength = ret;
        buffer[bufferLength] = '\0';
        //printf("%s", buffer);

        // Send message to parser
        ret = nmeap_parseBuffer(&nmea, buffer, &bufferLength);

      /*  process the return code      */
        switch (ret)
        {
        case NMEAP_GPGGA:
            /* GOT A GPGGA MESSAGE */
            print_gga(&gga);
            break;
        case NMEAP_GPRMC:
            /* GOT A GPRMC MESSAGE */
            //print_rmc(&rmc);
            break;
        default:
            break;
        }
    }

    return NULL;
}
```

```
int main(int argc, char* argv[])
{
    int ret = 0;
    double duration;
    int count = 0;
    struct timeval tv1, tv2;
    pthread_t recvThread;


    DqInitDAQLib();

    ParseParameters(argc, argv, &params);

    signal(SIGINT, signalhandler);

    // open communication with IOM and receive IOM crucial
     // identification data
    if ((ret = DqOpenIOM("127.0.0.1", DQ_UDP_DAQ_PORT, 2000, &handle,
NULL)) < 0) {
       printf("Error %d In Initializing Communication with IOM\n", ret);
        return ret;
    }

    // set channel configuration
    if ((ret = DqAdv501SetChannelCfg(handle, params.device,
params.channels[0], CHANNEL_CFG)) < 0) {
        printf("error %d in DqAdv501SetChannelCfg()\n", ret);
        goto finish_up;
}

    if ((ret = DqAdv501SetTimeout(handle, params.device,
params.channels[0], 1000)) < 0) { // 1 second timeout for xmit
        printf("error %d in DqAdv501SetTimeout\n", ret);
        goto finish_up;
    }

    if ((ret = DqAdv501SetTermLength(handle, params.device,
params.channels[0], 1)) < 0) { // 8 bytes at a time
        printf("error %d in DqAdv501SetTermLength\n", ret);
        goto finish_up;
    }

    if ((ret = DqAdv501SetWatermark(handle, params.device,
params.channels[0], DQL_IOCTL501_SETTXWM, 1)) < 0) { // internal
                                                       // fifos @ 512
        printf("error %d in DqAdv501SetWatermark TX", ret);
        goto finish_up;
    }

    if ((ret = DqAdv501SetWatermark(handle, params.device,
params.channels[0], DQL_IOCTL501_SETRXWM, 1)) < 0) {
        printf("error %d in DqAdv501SetWatermark RX\n", ret);
        goto finish_up;
    }

if ((ret = DqAdv501Enable(handle, params.device, TRUE)) < 0) {
```

```
        printf("Error %d in DqAdv501Enable()\n", ret);
        goto finish_up;
}

    // Start thread that will read position data comming from the GPS
    pthread_create(&recvThread, NULL, SerialReadThreadProc, NULL);

    ret = DqEmbConfigureEvent(handle, DqEmbEventSyncIn, 0);
    if(ret < 0)
    {
        fprintf(stderr, "Error %d configuring event\n", ret);
        return ret;
    }

    gettimeofday(&tv1, NULL);
    while(!stop)
    {
        DQ_EMBEDDED_EVENT evt;

        ret = DqEmbWaitForEvent(handle, 2000, &evt);
        if(ret < 0)
        {
            fprintf(stderr, "Error %d configuring event\n", ret);
            return ret;
        }

        if(evt & DqEmbEventTimeout)
            printf("Timeout event\n");

        if(evt & DqEmbEventSyncIn)
            printf("SyncIn event\n");

        //usleep(100000);

        count++;
    }

    gettimeofday(&tv2, NULL);
    duration = ((tv2.tv_sec-tv1.tv_sec) + (tv2.tv_usec-tv1.tv_usec)/
1000000.0);
    printf("Executed %d iterations in %f s (%f updates per sec.)\n",
count, duration, count/duration);

    ret = DqEmbCancelEvent(handle, DqEmbEventSyncIn);
    if(ret < 0)
    {
        fprintf(stderr, "Error %d cancelling event\n", ret);
        return ret;
    }

    pthread_join(recvThread, NULL);

finish_up:
    if ((ret = DqAdv501Enable(handle, params.device, FALSE)) < 0) {
```

```
        printf("Error %d in DqAdv501Enable()\n", ret);
    }

    if (handle) {
       DqCloseIOM(handle);
    }

    DqCleanUpDAQLib();

    return 0;
}
```

Appendices

Accessories

This appendix provides a list of accessories available for the DNA-GPS Receiver System (preassembled with a DNA-SL-501 Serial Communication Layer).

DNA-CBL-COM Cable

A DNA-CBL-COM Cable with a DB-37 on one end and 4 DB-9 Serial Port Connectors on the other end as shown in **Figure 1-3** on page 6. See **Figure 1-4** on page 7 for pinout. One cable may be used with each SL-501 board in the PowerDNA Cube.

DNA-STP-GPS Terminal Panel

This accessory board provides a convenient interface between the Garmin GPS receiver and the PowerDNA, UEILogger, or UEIPAC Cube. The layout of the board is shown in **Figure A-1** below. **Figure 1-2** on page 5 shows a block diagram of the cable connections.

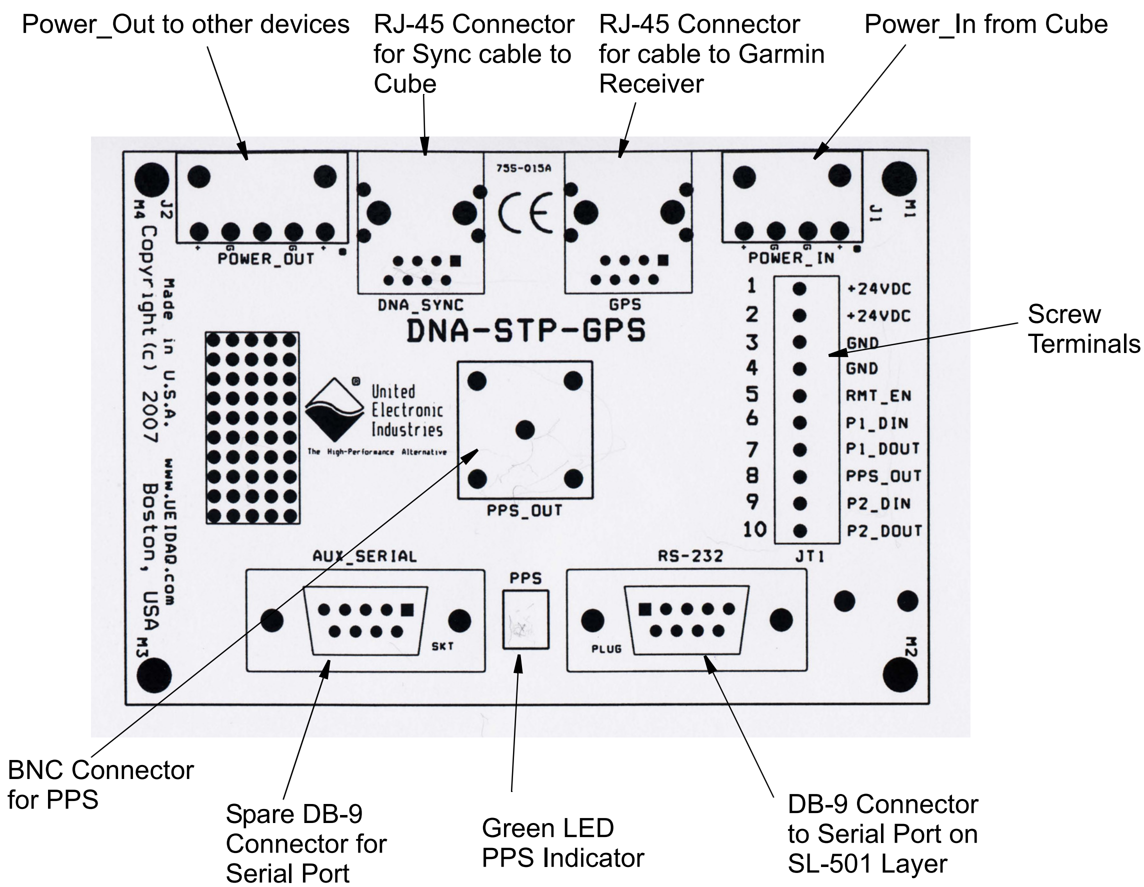

Figure 1-1. DNA-STP-GPS Terminal Board Layout

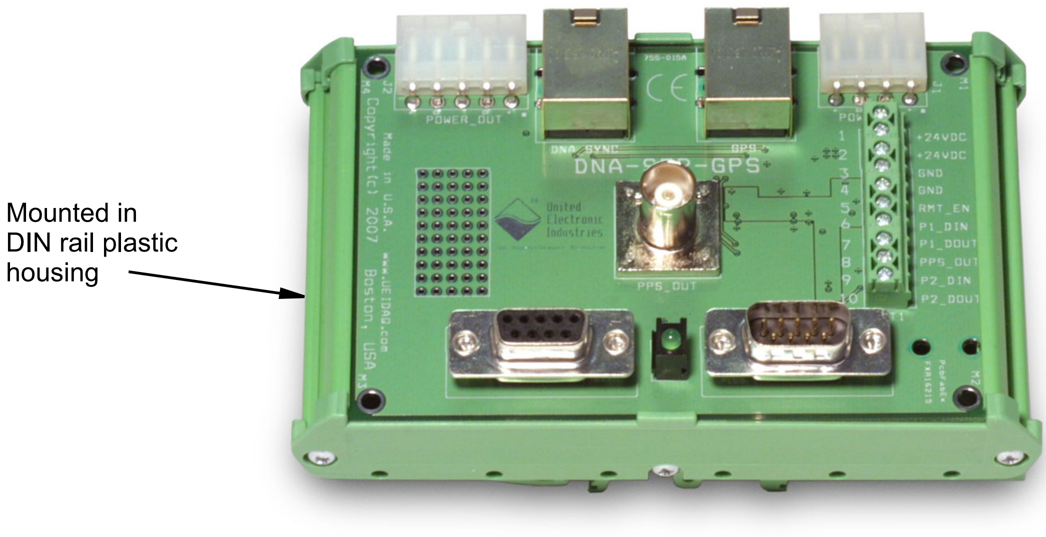

Figure 1-2. Photo of DNA-STP-GPS Board

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