TPRO-VME /TSAT-VME
SYNCHRONIZABLE TIMECODE GENERATOR with VME BUS INTERFACE

VxWorks Driver
Application Programmer's Guide

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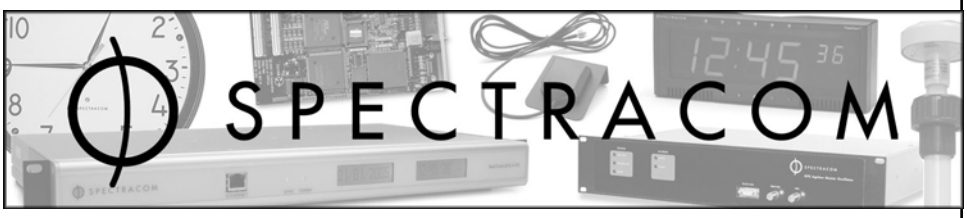

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Table of Contents

1 Overview

The VxWorks Driver for the Spectracom TPRO/TSAT PCI boards provides the interface for multiple users to access the board using the API documented in Chapter Three.

The TPRO-VME performs timing and synchronization functions referenced to an input timecode signal. The board synchronizes its on-board clock to the incoming timecode. The clock is also provided as an IRIG-B output. Other features include a time-tag TTL input, a 1 Mhz TTL output, and two user-configurable TTL pulse rate outputs.

The board continues to increment time (“freewheel”) in the absence of an input timecode. Thus, the host computer can set the on-board clock over the VME bus, and the board can be used as an IRIG-B timecode generator.

The input timecode format (IRIG-B, IRIG-A, NASA36, SR3, or 2137) is automatically detected. Synchronization to the input timecode is also automatic and a propagation delay offset may be specified to compensate for cable delays.

Front panel indicators include presence of input timecode and successful synchronization. An optional seven segment LED display shows day and time in DDD:HH:MM:SS format.

The timecode input is an amplitude modulated sine wave. The peak amplitude can be between 0.5 Vp-p and 8.0 Vp-p. The timecode input is differential; the board does not reference this signal to ground. A single-ended input (referenced to ground) is also acceptable.

2 Application Example

```
/*************************************************************************
  TPRO/TSAT VME Test Program

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               Bridgewater, NJ 08807

               e-mail: info@dspcon.com

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*************************************************************************/

/*************************************************************************
  appmain.c
*************************************************************************/

#include <vxWorks.h>

#include <semLib.h>
#include <taskLib.h>

#include <stdlib.h>           /* ansi run-time support */
#include <stdarg.h>           /* ansi run-time support */
#include <string.h>           /* ansi run-time support */

#include "tpro.h"


TPRO_BoardObj Board;


/*************************************************************************
  open
*************************************************************************/

void open (void)
{
  /**
  ***  open device
  **/

  Board.intLevel = 5;
  Board.intVector = 0xC0;
  Board.a16baseAddr = 0x0700;
  Board.boardOptions = TPRO_M_OPTION;

  if (TPRO_open (&Board) != TPRO_SUCCESS) {
    printf ("Open Failed!!\n");
    return;
  }
}


/*************************************************************************
  close
*************************************************************************/

void close (void)
{
  /**
  ***  close device
  **/

  if (TPRO_close (&Board) != TPRO_SUCCESS) {
    printf ("Could not close device!!\n");
    return;
  }
  printf ("\n");
}


/*************************************************************************
  get_time
*************************************************************************/
```

```
void get_time (void)
{
  STATUS rv;
  TPRO_TimeObj TproTime;


  /**
  ***  get time
  **/

  printf ("Retrieving Time....\n");
  if (TPRO_getTime (&Board, &TproTime) != TPRO_SUCCESS) {
    printf ("Get Time Failed!!\n");
    return;
  }

  printf ("  Days: %d\n", TproTime.days);
  printf ("  Hours: %d\n", TproTime.hours);
  printf ("  Minutes: %d\n", TproTime.minutes);
  printf ("  Seconds: %f\n", TproTime.seconds);
  printf ("\n");
}


/*************************************************************************
  clear_time
*************************************************************************/

void clear_time (void)
{
  STATUS rv;
  TPRO_TimeObj TproTime;


  /**
  ***  clear time
  **/

  TproTime.days = 0;
  TproTime.hours = 0;
  TproTime.minutes = 0;
  TproTime.seconds = 0.0;

  printf ("Setting Time....\n");
  if (TPRO_setTime (&Board, &TproTime) != TPRO_SUCCESS) {
    printf ("Set Time Failed!!\n");
    return;
  }
  printf ("\n");
}


/*************************************************************************
  disable_synch
*************************************************************************/

void disable_synch (void)
{
  STATUS rv;
  unsigned char cmd = 0;


  /**
  ***  disable synchronization
  **/

  printf ("Disabling synchronization....\n");
  if (TPRO_synchControl (&Board, &cmd) != TPRO_SUCCESS) {
    printf ("Unable to disable synchronization!!\n");
    return;
  }
  printf ("\n");
}


/*************************************************************************
  enable_synch
*************************************************************************/

void enable_synch (void)
```

```
{
  STATUS rv;
  unsigned char cmd = 1;


  /**
  ***  enable synchronization
  **/

  printf ("Enabling synchronization....\n");
  if (TPRO_synchControl (&Board, &cmd) != TPRO_SUCCESS) {
    printf ("Unable to enable synchronization!!\n");
    return;
  }
  printf ("\n");
}


/*****************************************************************************
  synch_status
*****************************************************************************/

void synch_status (void)
{
  STATUS rv;
  unsigned char stat;


  /**
  ***  check synchronization status
  **/

  printf ("Checking synchronization....");
  if (TPRO_synchStatus (&Board, &stat) != TPRO_SUCCESS) {
    printf ("Synchronization status failed!!\n");
    return;
  }
  printf ("status => %d\n", stat);
  printf ("\n");
}


/*****************************************************************************
  wait_event
*****************************************************************************/

void wait_event (void)
{
  STATUS rv;
  TPRO_WaitObj waitObj;


  /**
  ***  wait for event
  **/

  printf ("\nWaiting for event....\n");
  waitObj.ticks = 1000;
  if (TPRO_waitEvent (&Board, &waitObj) == TPRO_TIMEOUT_ERR) {
    printf ("TIMEOUT ERROR!!!\n\n");
    return;
  }

  printf ("  Days: %d\n", waitObj.days);
  printf ("  Hours: %d\n", waitObj.hours);
  printf ("  Minutes: %d\n", waitObj.minutes);
  printf ("  Seconds: %f\n", waitObj.seconds);

  printf ("\n");
}


/*****************************************************************************
  sim_event
*****************************************************************************/

void sim_event (void)
{
  STATUS rv;
```

```
  /**
  ***  simulate event
  **/

  if (TPRO_simEvent (&Board) != TPRO_SUCCESS) {
    printf ("Unable to simulate event!!\n\n");
    return;
  }
  printf ("Simulated Time-tag event!!\n");
  printf ("\n");
}


/*************************************************************************
  get_altitude
*************************************************************************/

void get_altitude (void)
{
  STATUS rv;
  TPRO_AltObj altitude;


  /**
  ***  get altitude
  **/

  if (TPRO_getAltitude (&Board, &altitude) != TPRO_SUCCESS) {
    printf ("Unable to retrieve altitude!!\n\n");
    return;
  }
  printf ("Altitude: %f\n", altitude.meters);
  printf ("\n");
}


/*************************************************************************
  get_latitude
*************************************************************************/

void get_latitude (void)
{
  STATUS rv;
  TPRO_LatObj latitude;


  /**
  ***  get latitude
  **/

  if (TPRO_getLatitude (&Board, &latitude) != TPRO_SUCCESS) {
    printf ("Unable to retrieve latitude!!\n\n");
    return;
  }
  printf ("Latitude:\n");
  printf (" Degrees: %d\n", latitude.degrees);
  printf (" Minutes: %f\n", latitude.minutes);
  printf ("\n");
}


/*************************************************************************
  get_longitude
*************************************************************************/

void get_longitude (void)
{
  STATUS rv;
  TPRO_LatObj longitude;


  /**
  ***  get longitude
  **/

  if (TPRO_getLongitude (&Board, &longitude) != TPRO_SUCCESS) {
    printf ("Unable to retrieve longitude!!\n\n");
    return;
  }
  printf ("Longitude:\n");
  printf (" Degrees: %d\n", longitude.degrees);
```

```
  printf (" Minutes: %f\n", longitude.minutes);
  printf ("\n");
}
```

3 Interface to the VxWorks Driver API

NOTE: The distribution media contains three directories containing the appropriate files:

- "Documentation" – directory containing the TPRO-VME_Application Prog Guide_Ed 1.pdf
- "H" – directory containing the tpro.h header file
- "Lib" – directory containing the tprovme.o import library

3.1 Header File

The following is the "TPRO.H" API Interface Header File.

```
/*****************************************************************************
  DSPCon TPRO/tSAT - Interface Header

               DSPCon, Inc.
               380 FootHill Road
               Bridgewater, NJ 08807

               e-mail: info@dspcon.com

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  Use of copyright notice is precautionary and does not imply publication
*****************************************************************************/

/*****************************************************************************
  TPRO.H
*****************************************************************************/

#ifndef _defined_TPRO_
#define _defined_TPRO_


/*===========================================================================
                      HARDWARE OPTION DEFINES
===========================================================================*/

#define TPRO_NO_OPTIONS       (0)           /*-- no option -----------*/
#define TPRO_M_OPTION         (1)           /*-- -M option -----------*/
#define TPRO_INT32_OPTION     (2)           /*-- INT32 option --------*/


/*===========================================================================
                    TPRO SYNCHRONIZATION DEFINES
===========================================================================*/

#define TPRO_FREEWHEEL        (0)
#define TPRO_SYNCHRONIZE      (1)


/*===========================================================================
                          TPRO ERROR CODES
===========================================================================*/

#define TPRO_SUCCESS                 (0)    /** success **/
#define TPRO_HANDLE_ERR              (1)    /** error creating handle to device **/
#define TPRO_DEVICE_NOT_OPEN_ERR     (4)    /** tpro device was not opened **/
#define TPRO_FREQ_ERR                (6)    /** invalid frequency **/
#define TPRO_DAY_PARM_ERR            (8)    /** invalid day parameter **/
#define TPRO_HOUR_PARM_ERR           (9)    /** invalid hour parameter **/
#define TPRO_MIN_PARM_ERR           (10)    /** invalid minutes parameter **/
```

```
#define TPRO_SEC_PARM_ERR           (11)    /** invalid seconds parameter **/
#define TPRO_DELAY_PARM_ERR         (12)    /** invalid delay factor **/
#define TPRO_TIMEOUT_ERR            (13)    /** device timed out **/
#define TPRO_COMM_ERR               (14)    /** error communicating with driver **/


/*=========================================================================
                        TPRO BOARD OBJECT
=========================================================================*/

typedef struct TPRO_BoardObj
{ /*-----------------------------------------------------------------------*/
  void *hnd;                                /*-- handle to our device */

  unsigned short a16baseAddr;               /*-- A16 base address ----*/
  unsigned short boardOptions;              /*-- tpro board options --*/

  unsigned char  intLevel;                  /*-- VME interrupt level -*/
  unsigned char  ttagVector;                /*-- time tag int vector -*/
  unsigned char  ppsVector;                 /*-- pps vector -INT32 ---*/

  unsigned char driver[7];                  /*-- driver version ------*/
} /*-----------------------------------------------------------------------*/
TPRO_BoardObj;


/*=========================================================================
                       TPRO ALTITUDE OBJECT
=========================================================================*/

typedef struct TPRO_AltObj
{ /*-----------------------------------------------------------------------*/
  float         meters;                     /*-- meters --------------*/
} /*-----------------------------------------------------------------------*/
TPRO_AltObj;


/*=========================================================================
                 TPRO LONGITUDE/LATTITUDE OBJECT
=========================================================================*/

typedef struct TPRO_LongLat
{ /*-----------------------------------------------------------------------*/
  unsigned short degrees;                   /*-- degrees -------------*/
  float         minutes;                    /*-- minutes -------------*/
} /*-----------------------------------------------------------------------*/
TPRO_LongObj, TPRO_LatObj;


/*=========================================================================
                         TPRO TIME OBJECT
=========================================================================*/

typedef struct TPRO_TimeObj
{ /*-----------------------------------------------------------------------*/
  double        seconds;                    /*-- seconds -------------*/
  unsigned char  minutes;                   /*-- minutes -------------*/
  unsigned char  hours;                     /*-- hours ---------------*/
  unsigned short days;                      /*-- days ----------------*/
} /*-----------------------------------------------------------------------*/
TPRO_TimeObj;


/*=========================================================================
                         TPRO WAIT OBJECT
=========================================================================*/

typedef struct TPRO_WaitObj
{ /*-----------------------------------------------------------------------*/
  int ticks;                                /*-- # ticks to wait -----*/
```

```
  double  seconds;                          /*-- seconds -------------*/
  unsigned char  minutes;                   /*-- minutes -------------*/
  unsigned char  hours;                     /*-- hours ---------------*/
  unsigned short days;                      /*-- days ----------------*/
} /*-------------------------------------------------------------------*/
TPRO_WaitObj;


/*=====================================================================
                    PUBLIC ROUTINE PROTOTYPES
=====================================================================*/

unsigned char TPRO_open             (TPRO_BoardObj *hBoard);
unsigned char TPRO_close            (TPRO_BoardObj *hBoard);

unsigned char TPRO_getAltitude      (TPRO_BoardObj *hBoard, TPRO_AltObj *Altp);
unsigned char TPRO_getLatitude      (TPRO_BoardObj *hBoard, TPRO_LatObj *Latp);
unsigned char TPRO_getLongitude     (TPRO_BoardObj *hBoard, TPRO_LongObj *Longp);
unsigned char TPRO_getTime          (TPRO_BoardObj *hBoard, TPRO_TimeObj *Timep);
unsigned char TPRO_setPropDelayCorr (TPRO_BoardObj *hBoard, int *us);
unsigned char TPRO_setTime          (TPRO_BoardObj *hBoard, TPRO_TimeObj *Timep);
unsigned char TPRO_simEvent         (TPRO_BoardObj *hBoard);
unsigned char TPRO_synchControl     (TPRO_BoardObj *hBoard, unsigned char *enbp);
unsigned char TPRO_synchStatus      (TPRO_BoardObj *hBoard, unsigned char *status);
unsigned char TPRO_waitEvent        (TPRO_BoardObj *hBoard, TPRO_WaitObj *waitp);

#endif  /** _defined_TPRO_ **/
```

3.2 TPRO API — Routine Descriptions

3.2.1.1.1 TPRO_open

unsigned char TPRO_open (TPRO_BoardObj *hBoard);

This routine sets the handle to the timing board and initializes the interrupt parameters (level and vector). The A16 base address, all interrupt elements, and the board options element must be set before calling this routine.

Arguments: Pointer to TPRO_BoardObj object

Returns: TPRO_OK on success
TPRO Error code otherwise

3.2.1.1.2 TPRO_close

unsigned char TPRO_close (TPRO_BoardObj *hBoard);

This routine frees the bus handle.

Arguments: Pointer to TPRO_BoardObj object

Returns: TPRO_OK on success
TPRO Error code otherwise

3.2.1.1.3 TPRO_getAltitude

TPRO_getAltitude
unsigned char TPRO_getAltitude (TPRO_BoardObj *hBoard, TPRO_AltObj *Altp);

This routine retrieves altitude information from the timing board. Only TSAT boards can retrieve satellite information.

Arguments: Pointer to TPRO_BoardObj object
Pointer to TPRO_AltObj object

Returns: TPRO_OK on success
TPRO Error code otherwise

3.2.1.1.4 TPRO_getLatitude

unsigned char TPRO_getLatitude (TPRO_BoardObj *hBoard, TPRO_LatObj *Latp);

This routine retrieves latitude information from the timing board. Only TSAT boards can retrieve satellite information.

Note: If the reported value is greater than or equal to 180, subtract 180 degrees and change the sign to negative (representing a latitude south of the equator).

Arguments: Pointer to TPRO_BoardObj object
Pointer to TPRO_LatObj object

Returns: TPRO_OK on success
TPRO Error code otherwise

3.2.1.1.5 TPRO_getLongitude

unsigned char TPRO_getLongitude (TPRO_BoardObj *hBoard, TPRO_LongObj *Longp);

This routine retrieves longitude information from the timing board. Only TSAT boards can retrieve satellite information.

Note: If the reported value is greater than or equal to 180, subtract 180 degrees and change the sign to negative (representing a west longitude).

Arguments: Pointer to TPRO_BoardObj object
Pointer to TPRO_LongObj object

Returns: TPRO_OK on success
TPRO Error code otherwise

3.2.1.1.6 TPRO_getTime

unsigned char TPRO_getTime (TPRO_BoardObj *hBoard, TPRO_TimeObj *Timep);

This routine retrieves the time information from the timing board.

Arguments: Pointer to TPRO_BoardObj object
Pointer to TPRO_TimeObj object

Returns: TPRO_OK on success
TPRO Error code otherwise

3.2.1.1.7 TPRO_setPropDelayCorr

unsigned char TPRO_setPropDelayCorr (TPRO_BoardObj *hBoard, int *us);

This routine sets the propagation delay correction delay factor.

Arguments: Pointer to TPRO_BoardObj object
Pointer to integer containing correction factor in microseconds

Returns: TPRO_OK on success
TPRO Error code otherwise

3.2.1.1.8 TPRO_setTime

unsigned char TPRO_setTime (TPRO_BoardObj *hBoard, TPRO_TimeObj *Timep);

This routine is used to set the current time to the timing board. This routine only works when the board is NOT synchronized to an input.

Arguments: Pointer to TPRO_BoardObj object
Pointer to TPRO_TimeObj object

Returns: TPRO_OK on success
TPRO Error code otherwise

3.2.1.1.9 TPRO_simEvent

unsigned char TPRO_simEvent (TPRO_BoardObj *hBoard);

This routine is used to simulate external time tag events.

Arguments: Pointer to TPRO_BoardObj object

Returns: TPRO_OK on success
TPRO Error code otherwise

3.2.1.1.10 TPRO_synchControl

unsigned char TPRO_synchControl (TPRO_BoardObj *hBoard, unsigned char *enbp);

This routine is used to control whether the board synchronizes to external source or "freewheels".

Arguments: Pointer to TPRO_BoardObj object
Pointer to unsigned char containing the values
[TPRO_FREEWHEEL, TPRO_SYNCHRONIZE]

Returns: TPRO_OK on success
TPRO Error code otherwise

3.2.1.1.11 TPRO_synchStatus

unsigned char TPRO_synchStatus (TPRO_BoardObj *hBoard, unsigned char *status);

This routine is used to decipher the timing boards synchronization state (synchronized or freewheeling).

Arguments: Pointer to TPRO_BoardObj object
Pointer to unsigned char containing synchronization status
[TPRO_FREEWHEEL, TPRO_SYNCHRONIZE]

Returns: TPRO_OK on success
TPRO Error code otherwise

3.2.1.1.12 TPRO_waitEvent

unsigned char TPRO_waitEvent (TPRO_BoardObj *hBoard, TPRO_WaitObj *waitp);

This routine is used to retrieve the latched time of an external event. The wait object contains a timeout period along with elements of time representing the event time.

Arguments: Pointer to TPRO_BoardObj object
Pointer to TPRO_WaitObj object

Returns: TPRO_OK on success
TPRO Error code otherwise

REVISION HISTORY

Revision Level	*ECN Number*	*Description*
A	**2187**	First draft of Spectracom documentation for this product.

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