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Getting Started with TempDAQ

Thank you for purchasing TempDAQ. This analog breakout box allows your existing CarDAQ2534 or CarDAQ-Plus hardware to measure up to 6-channels of temperature data or analog voltages.

TempDAQ measures a temperature range -200°C to +1250°C better than 1°C of resolution. CarDAQ2534 users, please contact DrewTech about a factory-upgrade (0.1% tolerance resistors) which improves accuracy from 2°C to better than 1°C. This change is already present for CarDAQ-Plus.

Your package includes: the TempDAQ hardware, an interface cable, and a CD including sample programs and source code. Please visit the DrewTech website for manual or software updates.

Hardware Setup

Connect TempDAQ to CarDAQ2534's analog port using the included interface cable. Verify that the red power LED on the rear panel lights when connected to a powered CarDAQ.

Note: If the power light is off, check the serial number of CarDAQ2534. Any CarDAQ2534 before serial number 1656 (Rev J) requires a factory-performed upgrade. Please contact DrewTech for further information.

Powering CarDAQ

Remember that your PC cannot provide CarDAQ2534 with power over its RS-232 or Ethernet ports. There are three options for powering the CarDAQ2534:

1. Attached to a vehicle: The vehicle supplies power on pin 16 of its OBD-II (SAE J1962) connector. CarDAQ is powered whenever it is connected to a vehicle.

2. Signal breakout box: Using the DrewTech J1962 to banana jack adapter, apply between +6 to +15 VDC at the Vbatt (pin 16) terminal. Use ChGnd (pin 4) for reference.
3. Custom harness: Using the CarDAQ connector kit (available upon request), build a custom wiring harness. Refer to pin diagrams in the CarDAQ2534 manual for details.

Software setup

Install the CarDAQ driver software normally; all TempDAQ functionality is provided through cardaq32.dll, and no additional configuration is required for TempDAQ features.

Sample programs and source code are available on the DrewTech website, and on the CD included in this package.

Using TempDAQ

TempDAQ is a temperature compensated amplifier that reads voltage from K-type thermocouples, and scales it to 0-27V so CarDAQ can use the full dynamic range of its A/D subsystem. It also provides BNC inputs to read 0-27v range signals.

Connecting Sensors

The TempDAQ™ supports up to 6-channels of analog input, using K-type thermocouple or BNC connectors.

Connect either a BNC or K-type thermocouple to the appropriate channel on TempDAQ's front panel. Then choose the appropriate input: set the switch up for thermocouple, or down for BNC input.

Measuring Temperatures

The TempDAQ CD includes source code and a sample program AnalogDemo.exe for reading temperatures. Run this program to verify that the sensors and hardware have been connected properly.

TempDAQ scales and offsets a K-type thermocouple's voltage so CarDAQ can use its A/D dynamic range. Given that the PassThruIoctl functions return a voltage (mV), calculate the thermocouple's voltage output (mV) using the following equation:

$$V_{TC} = (V_{CARDAQ} - 6125) / 393.9;$$

NIST provides inverse approximations for temperature as a function of voltage (mV) for K-type thermocouples. The functions are of the form:

$$\text{Temp} = d_0 + d_1V_{TC} + d_2V_{TC}^2 + \dots + d_NV_{TC}^N$$

The AnalogDemo source code implements this inverse approximation in function tempC(). Refer to the NIST ITS-90 tables if you wish to implement your own conversion functions.

Measuring Voltages

TempDAQ does not scale voltages on the BNC inputs. The PassThruIoctl functions return the actual voltage (mV) present at the BNC.

Developing Custom Applications

CarDAQ is fully compliant with the PassThru (SAE J2534) API, which protects your investment in developing custom software. This syntax and set of driver functions allows a software application to discover and use any vendor's PassThru hardware, with any modern automotive diagnostic protocol.

Since temperature and voltage measurement is currently unique to DrewTech, we provide vendor-specific extensions to the PassThruIoctl function.

DrewTech's j2534_v0202.h file defines several new PassThruIoctl modes for reading temperature data:

ioctl Mode	pInput	pOutput
READ_ANALOG_CH1 ... CH6	NULL	ulong*
READ_CH1_VOLTAGE ... CH6	NULL	ulong[]

There are two new parameters for PassThruIoctl SET_CONFIG and GET_CONFIG:

SCONFIG Parameter Name	ID	Value
ADC_READINGS_PER_SECOND	0x10000	Rate in Hz
ADC_READINGS_PER_SAMPLE	0x20000	# Averages

DrewTech also offers a complete set of LabVIEW VIs for CarDAQ2534, with native datatypes and context-sensitive help. Please contact DrewTech for information about using TempDAQ with LabVIEW.

PassThruIoctl (GET_CONFIG and SET_CONFIG)

Syntax

```
#include "j2534_v0202.h"
long PassThruIoctl(unsigned long ChannelID, unsigned long
    IoctlID, SCONFIG_LIST *pInput, NULL);
```

Description

The PassThruIoctl function is a general purpose I/O control function for modifying the vehicle network interface characteristics. TempDAQ defines two new parameters to configure the ADCs on an existing logical communications channel:

ADC_READINGS_PER_SECOND is the total number of voltage readings each second (Hz) for all 6 channels.

ADC_READINGS_PER_SAMPLE specifies the number of voltage readings to average for each sample. Usually, set this to 1.

The A/D sampling rate is equal to the number of readings per second divided by the number of readings per sample.

Parameters

ChannelID

Logical communication channel identifier

IoctlID

GET_CONFIG or SET_CONFIG

pInput

Pointer to list of parameters to read, or parameter-value pairs to set.

pOutput

NULL

See Also

PassThruIoctl (READ_ANALOG_CH1 ... 6)

Example

```
SCONFIG param[10];
SCONFIG_LIST list;

param[0].Parameter = ADC_READINGS_PER_SECOND;
param[0].Value = 10;

list.NumOfParams = 1;
list.ConfigPtr = param;

RetVal = PassThruIoctl(ChannelID, SET_CONFIG, &list, NULL);
```

PassThruIoctl (READ_ANALOG_CH1 ... CH6)

Syntax

```
#include "j2534_v0202.h"
long PassThruIoctl(unsigned long ChannelID, unsigned long
    IoctlID, void *pInput, void *pOutput);
```

Description

The PassThruIoctl function is a general purpose I/O control function for modifying the vehicle network interface characteristics. TempDAQ extends this function to read temperature information.

This mode returns all buffered samples (mV) on a specific ADC channel (1 to 6) since the previous call.

Parameters

ChannelID

Logical communication channel identifier

ioctlID

READ_ANALOG_CH1, ..., READ_ANALOG_CH6

pInput

Requested number of ADC samples to read. If not enough samples are available, function returns actual number read.

pOutput

Pointer to array where requested A/D samples (mV) will be copied.

See Also

PassThruIoctl (GET_CONFIG and SET_CONFIG)

Example

```
// Request 20 ADC samples in mV
unsigned long values[20];
```

```
int num = 20;

RetVal = PassThruIoctl(ChannelID, READ_ANALOG_CH1, &num,
    values);
if (RetVal != STATUS_NOERROR)
{
    PassThruGetLastError(errstring);
    printf("Reading ADC failed! Code %d (%s)\n", RetVal,
        errstring);
    exit(1);
}
```

PassThruIoctl (READ_CH1_VOLTAGE ... CH6)

Syntax

```
#include "j2534_v0202.h"
long PassThruIoctl(unsigned long ChannelID, unsigned long
    IoctlID, void *pInput, void *pOutput);
```

Description

The PassThruIoctl function is a general purpose I/O control function for modifying the vehicle network interface characteristics. TempDAQ extends this function to read temperature information.

This ioctl mode returns the most recent sample (mV) on a specific ADC channel (1 to 6), and flushes all other samples currently in the queue.

Parameters

ChannelID

Logical communication channel identifier

ioctlID

READ_ANALOG_CH1, ..., READ_ANALOG_CH6

pInput

NULL

pOutput

Pointer to unsigned long where most recent value (mV) will be copied. Following this call, buffered samples will be flushed.

See Also

PassThruIoctl (GET_CONFIG and SET_CONFIG)

Example

```
// Read the most recent ADC sample in mV
```

```
RetVal = PassThruIoctl(ChannelID, READ_CH1_VOLTAGE, NULL,
    &value);
if (RetVal != STATUS_NOERROR)
{
    PassThruGetLastError(errstring);
    printf("Reading ADC failed! Code %d (%s)\n", RetVal,
        errstring);
    exit(1);
}

// For TempDAQ, find thermocouple value in degC
voltage = (value - 6125) / 393.9;
temp = tempC(voltage);
```

Troubleshooting and Support

DrewTech is available 9:00am to 5:30pm eastern standard time, Monday through Friday, to answer any questions. Please email support@drewtech.com if you need assistance.

If TempDAQ Doesn't Power-on or Read Inputs

If the power light is on, verify that the front panel is selecting the correct input: thermocouple or BNC.

If the power light is off, check the serial number of CarDAQ2534. Any CarDAQ2534 before serial number 1656 (Rev J) requires a factory-performed upgrade. Please contact DrewTech for further information.

Improving CarDAQ2534 A/D Accuracy

When connected to a standard CarDAQ2534, TempDAQ can measure a wide temperature range with 2°C accuracy and 1°C resolution.

A factory-performed CarDAQ2534 upgrade is available (0.1% tolerance resistors) which improves accuracy to better than 1°C. Please contact Drewtech for further information.

Updating CarDAQ's Drivers and Firmware

Your CarDAQ contains field-upgradeable firmware. Updates are regularly released which: include new features, improve performance, and correct problems. Please visit DrewTech's download page at:

<http://www.drewtech.com/downloads>

Apply power to CarDAQ. Run J2534install.exe, similar to a new installation, to install the new J2534 DLL on the PC. Then, run cardaq_setup.exe to reprogram CarDAQ with the new firmware.

Specifications and Connectors

TempDAQ (Rev. A) Specifications:

Name	Value
Input Voltage Range	6VDC to 15VDC
Operating Temperature	Commercial Range (0°C to +70°C)

CarDAQ utilizes Switchcraft's EN3 weather-tight series for all external connections. Pin 1 is indicated by a small bump inside the male connector at the "11 o'clock" position. The remaining pins are in a counter-clockwise pattern, with the last pin in the center for the six and eight pin connectors.

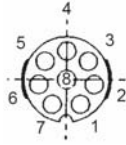
Analog Connector (TempDAQ)

Mating connector: DB-15F

Pin #	Function	Direction
1	Channel 1	Out
2	Channel 2	Out
3	Channel 3	Out
4	Channel 4	Out
5	Channel 5	Out
6	Channel 6	Out
7 to 14	Ground	
15	Battery Voltage	In

Analog Connector (CarDAQ2534)

Mating connector: EN3C8F (DigiKey P/N SC1164-ND). The male image below was obtained from Switchcraft's product data sheet.



CarDAQ's 12-bit analog inputs are setup for an input range of 0 to 27.5VDC and electrically protected against reverse voltage and over voltage conditions.

Pin #	Function	Direction
1	Channel 1	In
2	Channel 2	In
3	Channel 3	In
4	Channel 4	In
5	Channel 5	In
6	Channel 6	In
7	Battery Voltage	Out
8	Ground	

Analog Connector (CarDAQ-Plus)

Mating connector: Male D-Sub High Density 15 (Digikey P/N T815M-ND).

Pin #	Function	Direction
10	Channel 1	In
14	Channel 2	In
4	Channel 3	In
8	Channel 4	In
5	Channel 5	In
2	Channel 6	In
6	Battery Voltage	Out
1, 3, 5, 7, 9, 11, 13, 15	GND	

Notices about Testing and Certification

Drew Technologies equipment is designed and built using best commercial practices. None of our equipment is subjected to any kind of compliance testing nor is the equipment certified to meet any particular requirements with regards to EMI, EMC, ESD, or others. This applies to all of our products unless specified otherwise.

Additional details are provided here.

Statements

Our equipment is marketed only to the automotive and related industries.

Users of our equipment are intended to be qualified engineers and technicians.

Our equipment is intended for use in an industrial environment.

Our equipment is intended to be test equipment.

Our equipment requires integration with other test equipment to function. At a minimum a computer and a 'unit under test' are required. The 'unit under test' may be a module, several modules, an entire motor vehicle, or similar test set-up.

Our equipment is not intended for use by consumers or in a consumer environment.

We do not sell to individual consumers.

United States

The governing body is the FCC (Federal Communications Commission).

Point #1

The controlling law is Title 47, Code of Federal Regulations, Part 15 "Radio Frequency Devices".

We state that our equipment is classified as a: "Class A Digital Device." We cite 47 CFR, Part 15, Subpart A, section 15.3 "Definitions", paragraph (h): "Class A digital device. A digital device that is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home."

Additionally, our equipment is considered an un-intentional radiator.

We state that our equipment is exempt from the certification requirements of Part 15. We cite 47 CFR, Part 15, Subpart B, section 15.103 "Exempted Devices", paragraph (c): "A digital device used exclusively as industrial, commercial, or medical test equipment."

We do not test our equipment to meet any requirements of 47 CFR Part 15.

Point #2

The controlling law is Title 47, Code of Federal Regulations, Part 18 "Industrial, Scientific, and Medical Equipment".

We cite 47 CFR, Part 18, Subpart A, section 18.115 "Elimination and investigation of harmful interference". The user assumes responsibility for eliminating the source of harmful interference.

European Union

The governing body is the European Community (and its various bodies).

Point #1

The governing Directive is: EMC Directive (89/336/EEC including all amendments). We do not test our equipment to meet this directive. (See Point #3, below.)

Point #2

The governing Directive is: Low Voltage Directive (73/23/EEC including all amendments). We do not test our equipment to meet this directive. (See Point #3, below.)

Point #3

Our equipment can only be sold and exported to EU customers under very narrow terms. Our equipment has no intrinsic function (it requires other equipment with which to work). Our equipment is considered a component of a larger equipment item or system. The customer is responsible for integrating our equipment into their equipment or system. The customer is responsible for all subsequent testing and certification of the resulting equipment or system.

All questions should be addressed to: Engineering Dept., Drew Technologies, Inc.