

eTPU Automotive Function Set (Set 2)

by: **Geoff Emerson**
East Kilbride
U.K.

1 Introduction

This application note complements AN3768SW describing the enhanced time processing unit (eTPU) automotive function set (set 2). Set 2 is a set of example functions that show how the eTPU can be used in a typical engine management application. AN3768SW contains the binary image of the eTPU code, source code, and the interface files for the function application programming interfaces (APIs). Set2 contains CRANK, CAM, KNOCK_WINDOW, FUEL, SPARK, and TOOTHGEN functions. These are discussed in this application note. AN3768SW is available to download at Freescale.com.

2 Function Set Overview

The eTPU Automotive Function Set consists of the following eTPU functions. Dedicated application notes and API software are available for each function.

Table 1. eTPU Functions

Function	Description	Related Application Note
CAM & CRANK	Engine position functions	AN3769
KNOCK_WINDOW	Knock window function	AN3772
FUEL	Fuel function	AN3770
SPARK	Spark function	AN3771
TOOTHGEN	Tooth generator function	AN3801

The eTPU functions are configurable and adjustable using various parameters and options, giving the user the ability to customize these functions to their specific application.

Contents

1 Introduction.....	1
2 Function Set Overview.....	1
2.1 CAM and CRANK Functions.....	2
2.2 KNOCK_WINDOW.....	2
2.3 FUEL.....	2
2.4 SPARK.....	2
2.5 TOOTHGEN.....	2
3 Function Set Usage	2
4 Files Included.....	3
4.1 eTPU Code.....	3
4.2 CPU Interface Files.....	3
5 Conclusion.....	4

Function Set Usage

To support the eTPU functions, versions of the standard eTPU header files `etpuc.h` (version 1.01) and `etpuc_common.h` (version 1.1) from ByteCraft were used.

The following sections briefly describe the purpose of each eTPU function. Refer to the application notes in the table for more details.

2.1 CAM and CRANK Functions

The CAM and CRANK (engine position) functions measure the speed and position of a rotating engine. The CAM and CRANK together generate an angle counter. The angle counter is synchronized with the CRANK wheel angle and provides a counter representation of the instantaneous position of the engine.

2.2 KNOCK_WINDOW

The KNOCK_WINDOW function outputs a number of angle-based knock windows with specified properties within a complete engine cycle and without CPU intervention. This function works in conjunction with CRANK and CAM eTPU functions to produce pulses referenced to angles on the crankshaft. These pulses can be used to gate the analog to digital converter sampling of the knock sensor in a knock detection application.

2.3 FUEL

The fuel function generates one or more fuel injection pulses controlling the amount of fuel in the intake manifold. Fuel injection pulses start at a defined engine angle and end at a specified time after start. Multiple additional injection pulses are allowed. The eTPU synchronization functions CAM and CRANK provide angular information to the fuel function.

2.4 SPARK

The spark function controls the generation of spark pulses synchronized to specific angular positions of a rotating engine, thus controlling the ignition timing of the engine. The eTPU engine position functions CAM and CRANK provide angular information to the spark function.

2.5 TOOTHGEN

The toothgen function generates signals for input to the engine position functions (CAM and CRANK) for development and test purposes. This function generates a pair of output signals. The first one is a continuous output signal that mimics the pattern of a signal from a CRANK sensor on an automobile. The second signal is a single pulse CAM pulse per engine cycle.

3 Function Set Usage

The eTPU general function set release consists of the following items.

- eTPU Function Source Code and Binary Image — The eTPU function source code and the compiled binary image are included in the following package, available on the Freescale website.
 - AN3768SW — Automotive Set Function Set (Set 2) source code and compiled binary image

It is not necessary for the user to compile the eTPU function source code. Only advanced eTPU users can modify the eTPU functions and then recompile using a suitable compiler. The CPU application needs to load the compiled eTPU code into eTPU shared code memory (SCM). The eTPU code binary image is included together with other initialization items in the `etpu_set2.h` file. The eTPU module initialization can be handled by the `fs_etpu_init(...)` function, this is one of the standard eTPU utilities (`etpu_util.c/.h`). The eTPU utilities are available on the Freescale website. See “[General C Functions for the eTPU](#)” and AN2864SW.

- eTPU Function APIs — The eTPU function APIs enable the use of eTPU functions in applications. The eTPU function API source code is included in the following packages available on the Freescale website.
 - AN3769SW — *CAM and CRANK (Engine Position) eTPU Functions API*
 - AN3772SW — *KNOCK_WINDOW eTPU function API*

- AN3770SW — *FUEL eTPU function API*
- AN3771SW — *SPARK eTPU function API*
- AN3801SW — *TOOTHGEN eTPU function API*

The eTPU function APIs include CPU functions that demonstrate how to initialize, control, and monitor the eTPU function. The CPU application does not need to access eTPU channel registers and or function parameters directly. Instead, the CPU application can use the eTPU function APIs.

4 Files Included

The following files are included in AN3768SW:

etpu_set2\etpu_set2.h	Image of eTPU code for host CPU, generated by ByteCraft eTPU compiler
etpu_set2\makefile	A makefile used to build the code
etpu_set2\etpuc_set2.cod	Debug information for set2 functions

4.1 eTPU Code

etpu_set2\etpu_set2.c	Top level file for set2 functions
etpu_set2\etpuc.h	Standard, include file for eTPU code
etpu_set2\etpuc_common.h	Defines application-friendly macros and functions for common tasks
etpu_set2\etpuc_util.h	Macros from Bytecraft used by some of the functions
etpu_set2\etpuc_cam.h	Header file for the eTPU CAM function
etpu_set2\etpuc_cam.c	C source for the eTPU CAM function
etpu_set2\etpuc_crank.h	Header file for the eTPU CRANK function
etpu_set2\etpuc_crank.c	C source for the eTPU CRANK function
etpu_set2\etpuc_knock_window.h	Header file for the eTPU KNOCK_WINDOW function
etpu_set2\etpuc_knock_window.c	C source for the eTPU KNOCK_WINDOW function
etpu_set2\etpuc_fuel.c	C source for the FUEL function
etpu_set2\etpuc_spark.c	C source for the eTPU SPARK function
etpu_set2\etpuc_toothgen.c	C source for the eTPU SPARK function

4.2 CPU Interface Files

These files are automatically generated by the eTPU compiler and provide an interface between the eTPU code and the CPU code. All references to the automotive set functions must be made with information in these files. This allows only symbolic information to be referenced allowing the eTPU code to be optimized without effecting the CPU code.

etpu_set2\cpu\etpu_cam_auto.h	CAM function interface information
etpu_set2\cpu\etpu_crank_auto.h	CRANK function interface information
etpu_set2\cpu\etpu_knock_window_auto.h	KNOCK_WINDOW function interface information
etpu_set2\cpu\etpu_fuel_auto.h	FUEL function interface information

Conclusion

etpu_set2\cpu\etpu_spark_auto.h

SPARK function interface information

etpu_set2\cpu\etpu_toothgen_auto.h

TOOTHGEN function interface information

5 Conclusion

This application note provides a description of the eTPU Automotive Function Set (Set 2) and complements AN3768SW. AN3768SW contains the binary image of the eTPU code and source code.

How to Reach Us:

Home Page: www.freescale.com

E-mail: support@freescale.com

USA/Europe or Locations Not Listed:

Freescale Semiconductor
 Technical Information Center, CH370
 1300 N. Alma School Road
 Chandler, Arizona 85224
 +1-800-521-6274 or +1-480-768-2130

Europe, Middle East, and Africa:

Freescale Halbleiter Deutschland GmbH
 Technical Information Center
 Schatzbogen 7
 81829 Muenchen, Germany
 +44 1296 380 456 (English)
 +44 8 52200080 (English)
 +44 80 92103 559 (German)
 +33 1 69 35 48 48 (French)
support@freescale.com

Japan:

Freescale Semiconductor Japan Ltd.
 Headquarters
 ARCO Tower 15F
 1-8-1, Shimo-Meguro, Meguro-ku,
 Tokyo 153-0065
 Japan
 0120 191014 or +81 3 5437 9125
support.japan@freescale.com

Asia/Pacific:

Freescale Semiconductor China Ltd.
 Exchange Building 23F
 No. 118 Jianguo Road
 Chaoyang District
 Beijing 100022
 China
 +86 10 5879 8000
support.asia@freescale.com

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