Itc - Injection Time Calculation

1 [Injection Time Calculation] Injection Time Calculation

1.1 [Overview]

Figure 1: [Itc Function Overview]

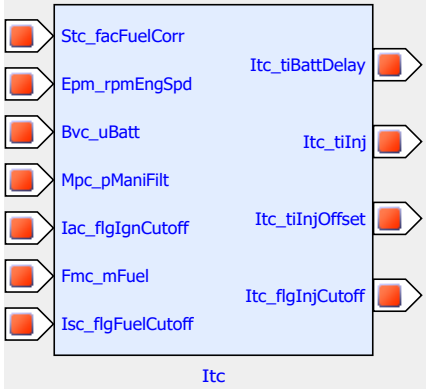
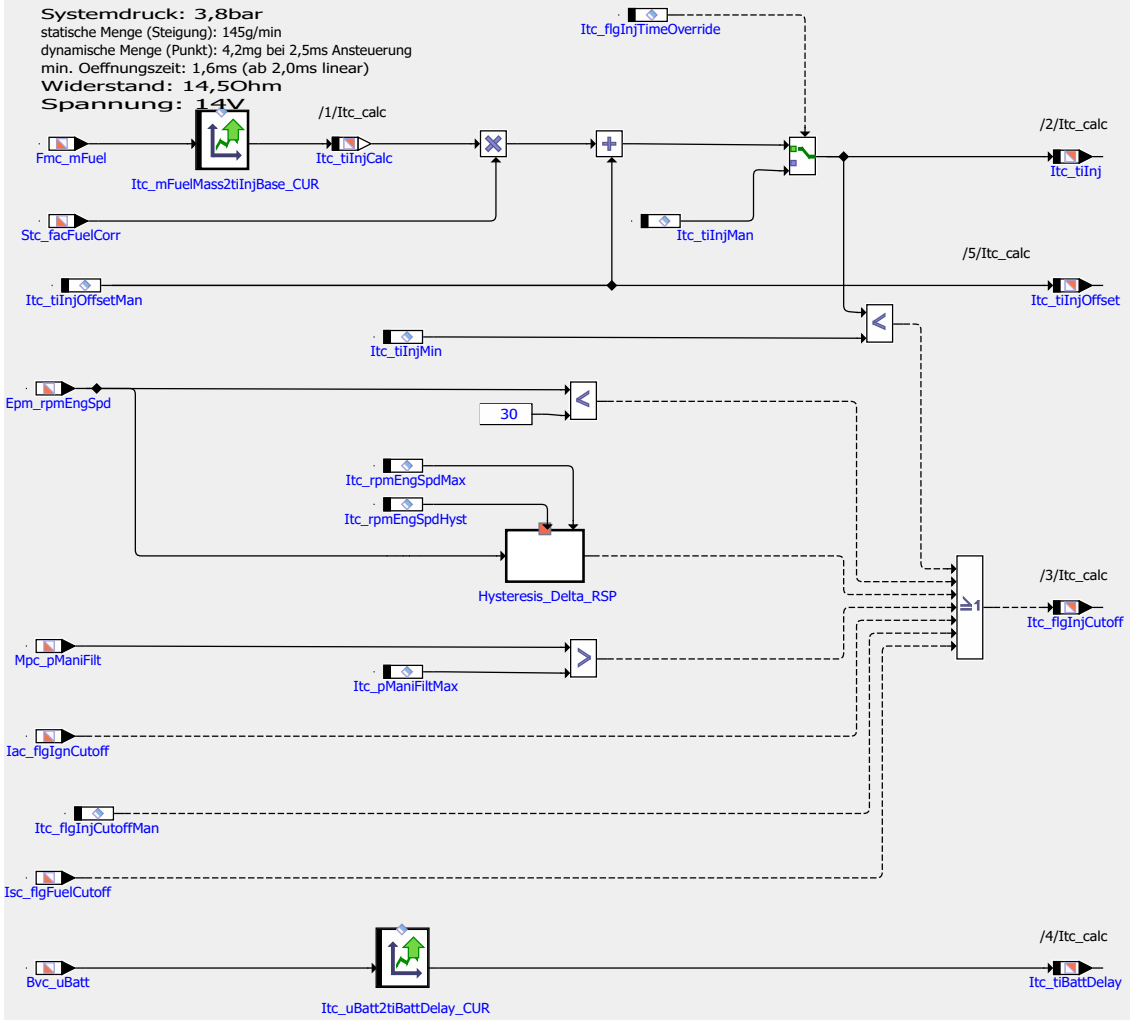


Figure 2: [InjectionTime.Main]



1.2 [Einspritzzeit]

Im Modul Einspritzzeit (InjectionTime) wird die Kraftstoffmasse Fmc_mFuel in die Ein- -spritzzeit Itc_tiInj gewandelt, evaluiert, ob eine Einspritzung Itc_flgInjCutoff = true stattfinden muss und die batteriespannungsabhängige Verzugszeit Itc_tiBattDelay der Einspritzdüsen berechnet. Nach dem vollständigen Öffnen und vor dem Schließbeginn des Einspritzventils besteht ein linearer Zusammenhang zwischen der eingespritzten Kraftstoff- menge und der

Öffnungszeit. Die Geradengleichung (s. Gleichung 5.11) entsteht durch eine statische und eine dynamische Menge. Zur Berechnung der Einspritzzeit aus der Kraft- stoffmenge ist die Umkehrfunktion ist in der Kennlinie Itc_mFuelMass2tiInjBase_CUR hinterlegt.

Während des Öffnens ist das Verhältnis nicht linear und muss bei Bedarf durch Versuche ermittelt werden. Die Nichtlinearität durch das Schließen des Ventils kann vernachlässigt werden, da im Steuergerät explizit eine Löschdiode verbaut ist, die den Spulenstrom sehr schnell abbaut, wodurch das Ventil sehr schnell geschlossen wird.

Ein Aussetzen der Einspritzung erfolgt bei:

- einer Einspritzzeit kleiner Itc_tiInjMin = 2000µs
- einer Drehzahl kleiner 30 1/min
- einer Drehzahl größer Itc_rpmEngSpdMax = 6000 1/min (maximale Drehzahl – Wiedereinsetzen gesteuert durch Hysterese Itc_rpmEngSpdHyst = 150 1/min bei 5850 1/min)
- einem Saugrohrdruck von mehr als Itc_pManiFiltMax = 2000hPa
- eeiner Aussetzung der Zündung um zu vermeiden, dass Kraftstoff unverbannt in das Abgassystem gerät
- dem Setzen des Flags Itc_flgInjCutoffMan

Um zu vermeiden im nichtlinearen Bereich der Einspritzventile zu arbeiten, wird bei einer Einspritzzeit unterhalb 2ms abgeschalten.

Die Einspritzabschaltung aufgrund eines zu hohen Saugrohrdrucks wird aus Sicherheits- gründen durchgeführt. Im Motor ist kein Ladedrucksensor verbaut, d. h., der Ladedruck kann nicht direkt gemessen werden, sondern nur auf Basis von Drehzahl, Saugrohrdruck, Drosselklappenstellung und Wastegatestellung abgeschätzt werden. Dabei können sehr leicht Fehler passieren, was eine Zerstörung des Abgasturboladers zur Folge haben könnte. Um dies zu verhindern, wird im Modul Momentenumrechnung Abschnitt 5.6.8 festgelegt, dass bei Drücken über 1500hPa die Drosselklappe immer vollständig geöffnet ist und dadurch die Annahme getroffen, dass der Druck vor Drosselklappe dem Saugrohrdruck entspricht. Sobald also der maximal gewünschte Ladedruck von 1bar erreicht ist, wird ausgesetzt (pmax = pUmgebung + pAufladung,max).

Die batteriespannungsabhängige Verzugszeit Itc_tiBattDelay wird aus der Batteriespan- nung Bvc_uBatt über die Kennlinie Itc_uBatt2tiBattDelay_CUR ermittelt. Sie ist dem Funktionsrahmen der Smartmotorsteuerung entnommen, liegt für 6V bei rund 2,3ms und fällt mit steigender Spannung in Form einer Exponentialfunktion auf 0ms ab, die bereits bei rund bis 14V erreicht werden.

Gleichung 5.11 zeigt den Zusammenhang zwischen Einspritzmenge und Einspritzzeit im linearen Bereich (s. auch Abschnitt A.8).

Figure 3: [itc_png_1]

$$m_K = c_1 \times t_E - c_2 \qquad \text{für } t_E > 2ms$$

$$c_1 = 145\frac{g}{min} \approx 2{,}42\frac{mg}{ms}$$

$$c_2 = 4{,}2mg - c_1 \times 2{,}5ms \approx -1{,}84mg$$

m_K	Krafstoffmasse
t_E	Ventilansteuerzeit
c_1	statische Menge (Steigung)
c_2	Verschiebung (aus dynamischer Menge)

Die Auswertung der Funktion Itc_calc erfolgt im Synchron-Raster. Durch das Flag Itc_flgInjTimeOverride kann die Einspritzzeit manuell mit Itc_tiInjMan überschrieben werden, bevor sie als Nachricht weitergereicht wird.

2 [C-Code Source]

2.1 [Code Listing]

```
/* BEGIN: ASCET REGION "Generation Information" */
/*****************************************************************************
 * BEGIN: Generation Information
 *----------------------------------------------------------------------------
 * Component:..............Module
 * Name:..................."InjectionTime"
 * Implementation:........."Impl"
 * Dataset:................"Data"
 * Specification:..........Block Diagram
 * Version:................<empty String>
```

```
 * Library Path:............."smartm160\Project_SmartM160\Function_Modules"
 *-----------------------------------------------------------------------------
 * Project Name:............."FlexECU_M160"
 * Project Library Path:....."smartm160\Project_SmartM160\"
 *-----------------------------------------------------------------------------
 * Generation Date:.........03.12.2014
 * Generation Time:.........13:41:34
 *-----------------------------------------------------------------------------
 * ASCET Version:...........V6.1.4 RB-DGS 2.3
 * ASCET-MD Version:........V6.1.4
 * ASCET-RP Version:........V6.1.4
 * ASCET-SE Version:........V6.1.4.28.19 CID[610]
 *-----------------------------------------------------------------------------
 * END: Generation Information
 ******************************************************************************/
/* END: ASCET REGION "Generation Information" */

/* BEGIN: ASCET REGION "Project Options" */
/*****************************************************************************
 * BEGIN: Project Options "Build"/"Code"
 *-----------------------------------------------------------------------------
 *    Build
 *-----------------------------------------------------------------------------
 * Code Generator:..........Object Based Controller Implementation
 * Compiler:................Microsoft Visual C++ 2008
 * Operating System:........GENERIC_OSEK
 * Target:..................ANSI-C
 *-----------------------------------------------------------------------------
 *    Code
 *-----------------------------------------------------------------------------
 * Add Comment with Generation Information for each Component [true]: true
 * Add Comment with Implementation Information for each Assignment Statement [true]: true
 * Add Comment with Specification Source for each Statement [true]:..true
 * Add parenthesis for readability [false]:.........................false
 * Casting [MISRA]:.................................................MISRA
 * Force Parenthesis for Binary Logical Operators [false]:..........false
 * Generate Define Directives for Enum Values [false]:..............false
 * Prefix for Component Names [<empty String>]:.....................<empty String>
 * Protected against division by zero [true]:.......................true
 * Protected Division against Signed Overflow [true]:...............true
 * Protected Vector Indices [true]:.................................true
 *-----------------------------------------------------------------------------
 *    Code.Compiler
 *-----------------------------------------------------------------------------
 * Division truncation direction [Zero (T-division)]:..............Zero (T-division)
 * Inline directive [__inline]:.....................................__inline
 * Integer Bit Size [32]:...........................................32
 * Private directive [static]:......................................static
 * Public directive [<empty String>]:...............................<empty String>
 *-----------------------------------------------------------------------------
 *    Code.FixedPoint
 *-----------------------------------------------------------------------------
 * Allow Double bit Size for Division Numerators [true]:............true
 * Allow Limit Service for Assignment Limitation [true]:............true
 * Arithmetic Service Set [<None>]:.................................<None>
 * Generate Limiters (may be changed locally) [true]:...............true
 * Generate Round Operation on float to integer Assignment [true]:...true
 * Maximum bit Length (float) [64]:.................................64
 * Maximum bit Length (int) [32]:...................................32
 * Result on Division by Zero [numerator]:..........................numerator
 * Temp Vars always 32 bit (integer) [false]:.......................false
 * Use power of 2 approximations of literals [false]:...............false
 * Use SHIFT Operation on Signed Values instead of DIV Operation [true]: true
 * Use SHIFT Operation on Signed Values instead of MUL Operation [true]: true
 *-----------------------------------------------------------------------------
 *    Code.Optimizations
 *-----------------------------------------------------------------------------
 * Auto-inline private methods (Smaller code-size - may be changed locally) [false]: false
 * Generate well-formed switch [false]:.............................false
 * Hierarchical Code-Generation (may be changed locally) [false]:....false
 * Initialise history variable with zero [false]:...................false
 * Optimize Direct Access Methods (Multiple Levels) [false]:........false
 * Optimize Direct Access Methods (One Level) [false]:..............false
 * Optimize Static Actions (Restricted Modelling) [false]:..........false
 * Outline Generated Methods (may be changed locally) [false]:.......false
 *-----------------------------------------------------------------------------
 *    Code.Production
 *-----------------------------------------------------------------------------
 * Add Implementation Definitions [true]:...........................true
 * Generate Access Macros for [(variables, messages)]:..............(variables, messages)
 * Generate Access Methods for dT (Alternative: use OS dT directly) [true]: true
 * Generate Data Structures [USELOCAL]:.............................USELOCAL
 * Generate Map File [true]:........................................true
 * Generate OS Configuration [true]:................................true
 *-----------------------------------------------------------------------------
```

```
 *    Station.Build
 *-------------------------------------------------------------------------
 * Use Customized Data Type Names [false]:.......................false
 *-------------------------------------------------------------------------
 * END: Project Options "Build"/"Code"
 ***************************************************************************/
/* END: ASCET REGION "Project Options" */
/* BEGIN: ASCET REGION "ASCET-SE AddOn Options" */
/***************************************************************************
 * BEGIN: ASCET-SE AddOn Options
 * -------------------------------------------------------------------------
 *     Code
 * -------------------------------------------------------------------------
 * checkMemSectionVolatility [true]:.............................false
 * checkMultipleSend [false]:....................................false
 * distribVarMemClass ["DISTRRAM"]:..............................."RAM"
 * genAlwaysInitValues [false]:..................................true
 * genLogicElementsAs [PACKED_BITFIELD]:.........................PACKED_BITFIELD
 * genObjList [false]:...........................................false
 * implInfoComments [true]:......................................true
 * initTaskMemClass ["ASD_INIT_TASK_MEM"]:........................"ASD_INIT_TASK_MEM"
 * isrMemClass ["ASD_ISR_MEM"]:..................................."ASD_ISR_MEM"
 * mainMemClass ["ASD_EXT_CODE_MEM"]:............................."ASD_EXT_CODE_MEM"
 * optimizeUnusedCode [true]:....................................true
 * paramAsSysConst [false]:......................................false
 * pragmaMemClassAtDecl [false]:.................................false
 * pragmaMemClassEnabled [true]:.................................false
 * referenceMemClass ["REFRAM"]:.................................."RAM"
 * shortNames [false]:...........................................false
 * taskMemClass ["ASD_TASK_MEM"]:................................."ASD_TASK_MEM"
 * virtualParameterMemClass ["VIRT_PARAM"]:......................."VIRT_PARAM"
 * -------------------------------------------------------------------------
 *     Code.Appearance
 * -------------------------------------------------------------------------
 * braceLineFeed [true]:.........................................true
 * genDate [<undef>]:............................................<undef>
 * genTime [<undef>]:............................................<undef>
 * generateSignatureDecorationComments [true]:...................true
 * lineFeedPosition [LEFT]:......................................LEFT
 * maxIdentLength [0]:...........................................40
 * maxRightLength [60]:..........................................60
 * minLeftLength [8]:............................................8
 * preventIndentStructInit [true]:...............................true
 * -------------------------------------------------------------------------
 *     OS
 * -------------------------------------------------------------------------
 * Os-Config-C_gen_declaration_alarms [false]:...................false
 * Os-Config-C_gen_declaration_appmodes [false]:.................false
 * Os-Config-C_gen_dt_calc [false]:..............................true
 * Os-Config-C_gen_initCOM [false]:..............................false
 * Os-Config-C_gen_inittask [false]:.............................true
 * Os-Config-C_gen_main [false]:.................................false
 * Os-Config-C_gen_process_container [false]:....................true
 * Os-Config-C_gen_startuphook [false]:..........................false
 * asd_exclusive_area ["ASD_EXCLUSIVE_AREA"]:....................."ASCET_exclusive_area"
 * messageDoInit [false]:........................................false
 * messageExternalMessageCopies [false]:.........................false
 * messageGenOSEKDeclarations [true]:............................false
 * messageIgnoreUsageInInitTask [false]:.........................false
 * messageOverloadInitValues [<undef>]:..........................<undef>
 * messageUsageVariant [OPT_COPY]:...............................NON_OPT_COPY
 * modularMessageUse [false]:....................................false
 * osAppModePattern ["%name%"]:..................................."appmode_%name%"
 * osStartupFunction [<undef>]:..................................<undef>
 * -------------------------------------------------------------------------
 *     OS.OIL
 * -------------------------------------------------------------------------
 * OIL-COOP-RESOURCE-name ["ASD_Cooperative_Res"]:................."ASD_Cooperative_Res"
 * OIL-outputFile ["temp.oil"]:..................................."temp.oil"
 * -------------------------------------------------------------------------
 *     SERAP
 * -------------------------------------------------------------------------
 * SERAPRefPageMemoryClass ["SERAP_REF"]:........................."SERAP_REF"
 * SERAPWorkPageMemoryClass ["SERAP_WORK"]:......................."SERAP_WORK"
 * serap [false]:................................................serap
 * serapEmbedded [true]:.........................................true
 * -------------------------------------------------------------------------
 *     Virtual Address Tables
 * -------------------------------------------------------------------------
 * addressTable [true]:..........................................false
 * addressTableMemoryClass ["VATROM"]:............................."VATROM"
 * -------------------------------------------------------------------------
 * END: ASCET-SE AddOn Options
 ***************************************************************************/
```

```
/* END: ASCET REGION "ASCET-SE AddOn Options" */
/* BEGIN: ASCET REGION "Module Data Definitions" */

/**************************************************************************
 * BEGIN: DEFINITION OF SUBSTRUCT VARIABLE 'Itc_RAM'
 * ------------------------------------------------------------------------
 * memory class:.............................'RAM'
 * model name:...............................'Itc'
 * data set:.................................'INJECTIONTIME_IMPL_Data'
 * ------------------------------------------------------------------------*/
struct INJECTIONTIME_IMPL_RAM_SUBSTRUCT Itc_RAM = {
   /* substruct: Itc_RAM.Hysteresis_Delta_RSP (modeled as:'Hysteresis_Delta_RSP.Itc') */
   {
      /* struct element:'Itc_RAM.Hysteresis_Delta_RSP.hysterese' (modeled
 as:'hysterese.Hysteresis_Delta_RSP.Itc') */
      false
   }
};
/* ------------------------------------------------------------------------
 * END: DEFINITION OF SUBSTRUCT VARIABLE 'Itc_RAM'
 **************************************************************************/

/**************************************************************************
 * BEGIN: DEFINITION OF COMPONENT VARIABLE 'Itc'
 * ------------------------------------------------------------------------
 * memory class:.............................'ROM'
 * model name:...............................'Itc'
 * data set:.................................'INJECTIONTIME_IMPL_Data'
 * ------------------------------------------------------------------------*/
const struct INJECTIONTIME_IMPL Itc = {
   /* substruct: Itc.Hysteresis_Delta_RSP (modeled as:'Hysteresis_Delta_RSP.Itc') */
   {
      /* type descriptor pointer 'HYSTERESIS_DELTA_RSP_IMPL_RAM' for memory class substruct for 'RAM' */
      &Itc_RAM.Hysteresis_Delta_RSP
   }
};
/* ------------------------------------------------------------------------
 * END: DEFINITION OF COMPONENT VARIABLE 'Itc'
 **************************************************************************/

/* END: ASCET REGION "Module Data Definitions" */

/* BEGIN: ASCET REGION "Exported Data Definitions" */

/**************************************************************************
 * BEGIN: DEFINITION OF VARIABLE 'Itc_flgInjCutoffMan'
 * ------------------------------------------------------------------------*/
const uint8 Itc_flgInjCutoffMan = false;
   /* min=0, max=1, Identity, limit=yes */
/* ------------------------------------------------------------------------
 * END: DEFINITION OF VARIABLE 'Itc_flgInjCutoffMan'
 **************************************************************************/


/**************************************************************************
 * BEGIN: DEFINITION OF VARIABLE 'Itc_flgInjTimeOverride'
 * ------------------------------------------------------------------------*/
const uint8 Itc_flgInjTimeOverride = false;
   /* min=0, max=1, Identity, limit=yes */
/* ------------------------------------------------------------------------
 * END: DEFINITION OF VARIABLE 'Itc_flgInjTimeOverride'
 **************************************************************************/


/**************************************************************************
 * BEGIN: DEFINITION OF CHARACTERISTIC TABLE 'Itc_mFuelMass2tiInjBase_CUR'
 * ------------------------------------------------------------------------*/
const struct CharTable1_uint16_3_uint32_INJECTIONTIME_IMPL_TYPE Itc_mFuelMass2tiInjBase_CUR = {
      3,
      {
         32, 38, 7798
      },
      {
         0, 174, 49174
      }
   };
   /* result: min=0.0, max=3300000.0, ident, limit=no */
   /* x axis: min=0.0, max=9.99984741210938e-1, fac_65536 */
/* ------------------------------------------------------------------------
 * END: DEFINITION OF CHARACTERISTIC TABLE 'Itc_mFuelMass2tiInjBase_CUR'
 **************************************************************************/


/**************************************************************************
 * BEGIN: DEFINITION OF VARIABLE 'Itc_pManiFiltMax'
```

```
 * ----------------------------------------------------------------------------*/
const uint32 Itc_pManiFiltMax = 200000U;
   /* min=0.0, max=4294967295.0, ident, limit=yes */
/* ----------------------------------------------------------------------------
 * END: DEFINITION OF VARIABLE 'Itc_pManiFiltMax'
 ******************************************************************************/


/******************************************************************************
 * BEGIN: DEFINITION OF VARIABLE 'Itc_rpmEngSpdHyst'
 * ----------------------------------------------------------------------------*/
const real32 Itc_rpmEngSpdHyst = 150.0F;
   /* min=0.0, max=+oo, ident, limit=yes */
/* ----------------------------------------------------------------------------
 * END: DEFINITION OF VARIABLE 'Itc_rpmEngSpdHyst'
 ******************************************************************************/


/******************************************************************************
 * BEGIN: DEFINITION OF VARIABLE 'Itc_rpmEngSpdMax'
 * ----------------------------------------------------------------------------*/
const real32 Itc_rpmEngSpdMax = 6000.0F;
   /* min=0.0, max=+oo, ident, limit=yes */
/* ----------------------------------------------------------------------------
 * END: DEFINITION OF VARIABLE 'Itc_rpmEngSpdMax'
 ******************************************************************************/


/******************************************************************************
 * BEGIN: DEFINITION OF VARIABLE 'Itc_tiInjCalc'
 * ----------------------------------------------------------------------------*/
uint32 Itc_tiInjCalc = 0;
   /* min=0.0, max=3300000.0, ident, limit=yes */
/* ----------------------------------------------------------------------------
 * END: DEFINITION OF VARIABLE 'Itc_tiInjCalc'
 ******************************************************************************/


/******************************************************************************
 * BEGIN: DEFINITION OF VARIABLE 'Itc_tiInjMan'
 * ----------------------------------------------------------------------------*/
const uint32 Itc_tiInjMan = 0;
   /* min=0.0, max=3300000.0, ident, limit=yes */
/* ----------------------------------------------------------------------------
 * END: DEFINITION OF VARIABLE 'Itc_tiInjMan'
 ******************************************************************************/


/******************************************************************************
 * BEGIN: DEFINITION OF VARIABLE 'Itc_tiInjMin'
 * ----------------------------------------------------------------------------*/
const uint16 Itc_tiInjMin = 1000;
   /* min=0.0, max=65535.0, ident, limit=yes */
/* ----------------------------------------------------------------------------
 * END: DEFINITION OF VARIABLE 'Itc_tiInjMin'
 ******************************************************************************/


/******************************************************************************
 * BEGIN: DEFINITION OF VARIABLE 'Itc_tiInjOffsetMan'
 * ----------------------------------------------------------------------------*/
const sint16 Itc_tiInjOffsetMan = 0;
   /* min=-10000.0, max=10000.0, ident, limit=yes */
/* ----------------------------------------------------------------------------
 * END: DEFINITION OF VARIABLE 'Itc_tiInjOffsetMan'
 ******************************************************************************/


/******************************************************************************
 * BEGIN: DEFINITION OF CHARACTERISTIC TABLE 'Itc_uBatt2tiBattDelay_CUR'
 * ----------------------------------------------------------------------------*/
const struct CharTable1_uint16_17_uint16_INJECTIONTIME_IMPL_TYPE Itc_uBatt2tiBattDelay_CUR = {
      17,
      {
         0, 3338, 6656, 9994, 13332, 16671, 19988, 23327, 26665, 30003, 33321, 36659,
         39997, 43336, 46653, 49992, 53330
      },
      {
         2460, 2460, 2460, 2460, 2220, 1100, 620, 380, 100, 0, 0, 0, 0, 0, 0, 0, 0
      }
   };
   /* result: min=0.0, max=26214.0, ident, limit=yes */
   /* x axis: min=0.0, max=31.99951171875, fac_2048 */
/* ----------------------------------------------------------------------------
 * END: DEFINITION OF CHARACTERISTIC TABLE 'Itc_uBatt2tiBattDelay_CUR'
```

```
 ****************************************************************************/

/* END: ASCET REGION "Exported Data Definitions" */

/*****************************************************************************
 * BEGIN: DEFINITION OF MESSAGES
 * ---------------------------------------------------------------------------
 * Total size is [bytes]:.....................9
 * ---------------------------------------------------------------------------*/
/* messages of memory class:.............................................'RAM' */
/* messages of size [bytes]:.............................................4 */
/* modelled as 'Itc_tiInj' */
uint32 Itc_tiInj;
/* messages of size [bytes]:.............................................2 */
/* modelled as 'Itc_tiBattDelay' */
uint16 Itc_tiBattDelay;
/* modelled as 'Itc_tiInjOffset' */
sint16 Itc_tiInjOffset;
/* messages of size [bytes]:.............................................1 */
/* modelled as 'Itc_flgInjCutoff' */
uint8 Itc_flgInjCutoff;
/* ---------------------------------------------------------------------------
 * END: DEFINITION OF MESSAGES
 ****************************************************************************/

#define _Hysteresis_Delta_RSP Itc.Hysteresis_Delta_RSP
#define _Hysteresis_Delta_RSP_REF_ (&(Itc.Hysteresis_Delta_RSP))
#define _Itc_flgInjCutoffMan Itc_flgInjCutoffMan
#define _Itc_flgInjTimeOverride Itc_flgInjTimeOverride
#define _Itc_mFuelMass2tiInjBase_CUR Itc_mFuelMass2tiInjBase_CUR
#define _Itc_mFuelMass2tiInjBase_CUR_REF_ (&(Itc_mFuelMass2tiInjBase_CUR))
#define _Itc_pManiFiltMax Itc_pManiFiltMax
#define _Itc_rpmEngSpdHyst Itc_rpmEngSpdHyst
#define _Itc_rpmEngSpdMax Itc_rpmEngSpdMax
#define _Itc_tiInjCalc Itc_tiInjCalc
#define _Itc_tiInjMan Itc_tiInjMan
#define _Itc_tiInjMin Itc_tiInjMin
#define _Itc_tiInjOffsetMan Itc_tiInjOffsetMan
#define _Itc_uBatt2tiBattDelay_CUR Itc_uBatt2tiBattDelay_CUR
#define _Itc_uBatt2tiBattDelay_CUR_REF_ (&(Itc_uBatt2tiBattDelay_CUR))

/* BEGIN: ASCET REGION "Component Functions" */
/*****************************************************************************
 * BEGIN: FUNCTIONS OF COMPONENT
 ****************************************************************************/

/* BEGIN: ASCET REGION "Process Definition 'Itc_calc'" */
/*****************************************************************************
 * BEGIN: DEFINITION OF PROCESS 'INJECTIONTIME_IMPL_Itc_calc'
 * -------------------------------------------------------------------------
 * model name:.................................'Itc_calc'
 * memory class:...............................'CODE'
 * -------------------------------------------------------------------------*/
//#if defined(COMPILE_UNUSED_CODE) || defined(COMPILE_UNUSED__INJECTIONTIME_IMPL_Itc_calc)
/* messages used by this process */

/* public Itc_calc []  */

void INJECTIONTIME_IMPL_Itc_calc (void)
{
   /* temp. variables */
   uint32 _t1uint32;
   sint32 _t1sint32;

   /* define local message copies */
   uint16 Bvc_uBatt__INJECTIONTIME_IMPL_Itc_calc;
   sint16 Epm_rpmEngSpd__INJECTIONTIME_IMPL_Itc_calc;
   uint16 Fmc_mFuel__INJECTIONTIME_IMPL_Itc_calc;
   uint8 Iac_flgIgnCutoff__INJECTIONTIME_IMPL_Itc_calc;
   uint8 Isc_flgFuelCutoff__INJECTIONTIME_IMPL_Itc_calc;
   uint8 Itc_flgInjCutoff__INJECTIONTIME_IMPL_Itc_calc;
   uint16 Itc_tiBattDelay__INJECTIONTIME_IMPL_Itc_calc;
   uint32 Itc_tiInj__INJECTIONTIME_IMPL_Itc_calc;
   sint16 Itc_tiInjOffset__INJECTIONTIME_IMPL_Itc_calc;
   uint16 Mpc_pManiFilt__INJECTIONTIME_IMPL_Itc_calc;
   uint16 Stc_facFuelCorr__INJECTIONTIME_IMPL_Itc_calc;
   /* receive messages implicitly */
   {
      DisableAllInterrupts();
      Bvc_uBatt__INJECTIONTIME_IMPL_Itc_calc = Bvc_uBatt;
      Epm_rpmEngSpd__INJECTIONTIME_IMPL_Itc_calc = Epm_rpmEngSpd;
      Fmc_mFuel__INJECTIONTIME_IMPL_Itc_calc = Fmc_mFuel;
      Iac_flgIgnCutoff__INJECTIONTIME_IMPL_Itc_calc = Iac_flgIgnCutoff;
      Isc_flgFuelCutoff__INJECTIONTIME_IMPL_Itc_calc = Isc_flgFuelCutoff;
      Itc_flgInjCutoff__INJECTIONTIME_IMPL_Itc_calc = Itc_flgInjCutoff;
```

```
      Itc_tiBattDelay__INJECTIONTIME_IMPL_Itc_calc = Itc_tiBattDelay;
      Itc_tiInj__INJECTIONTIME_IMPL_Itc_calc = Itc_tiInj;
      Itc_tiInjOffset__INJECTIONTIME_IMPL_Itc_calc = Itc_tiInjOffset;
      Mpc_pManiFilt__INJECTIONTIME_IMPL_Itc_calc = Mpc_pManiFilt;
      Stc_facFuelCorr__INJECTIONTIME_IMPL_Itc_calc = Stc_facFuelCorr;
      EnableAllInterrupts();
   }
   /* Itc_calc: sequence call #1  */
   /* assignment to Itc_tiInjCalc: min=0, max=3300000, hex=phys, limit=(maxBitLength: true, assign: true), zero
 incl.=true  */
   _Itc_tiInjCalc
      = CharTable1_getAt_u16u32(_Itc_mFuelMass2tiInjBase_CUR_REF_,Fmc_mFuel__INJECTIONTIME_IMPL_Itc_calc);
   /* Itc_calc: sequence call #2  */
   _t1sint32
      = ((_Itc_flgInjTimeOverride) ? (sint32)_Itc_tiInjMan : (_t1uint32
      = (_Itc_tiInjCalc >> 3) * Stc_facFuelCorr__INJECTIONTIME_IMPL_Itc_calc / 125U ,  (sint32)_t1uint32 +
 _Itc_tiInjOffsetMan));
   /* assignment to Itc_tiInj: min=0, max=3300000, hex=phys, limit=(maxBitLength: true, assign: true), zero
 incl.=true  */
   Itc_tiInj__INJECTIONTIME_IMPL_Itc_calc
      = ((_t1sint32 >= 0) ? (((uint32)_t1sint32 <= 3300000U) ? (uint32)_t1sint32 : 3300000U) : 0U);
   /* Itc_calc: sequence call #3  */
   Itc_flgInjCutoff__INJECTIONTIME_IMPL_Itc_calc
      = (((_Itc_flgInjTimeOverride) ? (sint32)_Itc_tiInjMan : (_t1uint32
      = (_Itc_tiInjCalc >> 3) * Stc_facFuelCorr__INJECTIONTIME_IMPL_Itc_calc / 125U ,  (sint32)_t1uint32 +
 _Itc_tiInjOffsetMan))) < (sint32)_Itc_tiInjMin || Epm_rpmEngSpd__INJECTIONTIME_IMPL_Itc_calc < 60
      || HYSTERESIS_DELTA_RSP_IMPL_out(_Hysteresis_Delta_RSP_REF_,
 (real64)Epm_rpmEngSpd__INJECTIONTIME_IMPL_Itc_calc * 0.5, (real64)_Itc_rpmEngSpdHyst,
 (real64)_Itc_rpmEngSpdMax)
      || (uint32)Mpc_pManiFilt__INJECTIONTIME_IMPL_Itc_calc << 2 > _Itc_pManiFiltMax
 || Iac_flgIgnCutoff__INJECTIONTIME_IMPL_Itc_calc || _Itc_flgInjCutoffMan ||
 Isc_flgFuelCutoff__INJECTIONTIME_IMPL_Itc_calc;
   /* Itc_calc: sequence call #4  */
   /* assignment to Itc_tiBattDelay: min=0, max=26214, hex=phys, limit=(maxBitLength: true, assign: true), zero
 incl.=true  */
   Itc_tiBattDelay__INJECTIONTIME_IMPL_Itc_calc
      = CharTable1_getAt_u16u16(_Itc_uBatt2tiBattDelay_CUR_REF_,Bvc_uBatt__INJECTIONTIME_IMPL_Itc_calc);
   /* Itc_calc: sequence call #5  */
   /* assignment to Itc_tiInjOffset: min=-10000, max=10000, hex=phys, limit=(maxBitLength: true, assign: true),
 zero incl.=true  */
   Itc_tiInjOffset__INJECTIONTIME_IMPL_Itc_calc = _Itc_tiInjOffsetMan;
   /* send messages implicitly */
   {
      DisableAllInterrupts();
      Itc_flgInjCutoff = Itc_flgInjCutoff__INJECTIONTIME_IMPL_Itc_calc;
      Itc_tiBattDelay = Itc_tiBattDelay__INJECTIONTIME_IMPL_Itc_calc;
      Itc_tiInj = Itc_tiInj__INJECTIONTIME_IMPL_Itc_calc;
      Itc_tiInjOffset = Itc_tiInjOffset__INJECTIONTIME_IMPL_Itc_calc;
      EnableAllInterrupts();
   }
}
/* ----------------------------------------------------------------------------
 * END: DEFINITION OF PROCESS 'INJECTIONTIME_IMPL_Itc_calc'
 ****************************************************************************/
#endif
/* END: ASCET REGION "Process Definition 'Itc_calc'" */


/* ****************************************************************************
 * END: FUNCTIONS OF COMPONENT
 ****************************************************************************/
/* END: ASCET REGION "Component Functions" */
```