Iac - Ignition Angle Calculation

1 [Ignition Angle Calculation] Ignition Angle Calculation

1.1 Overview [Overview]

Figure 1: [Iac Function Overview]
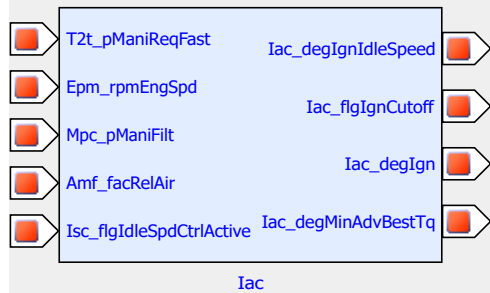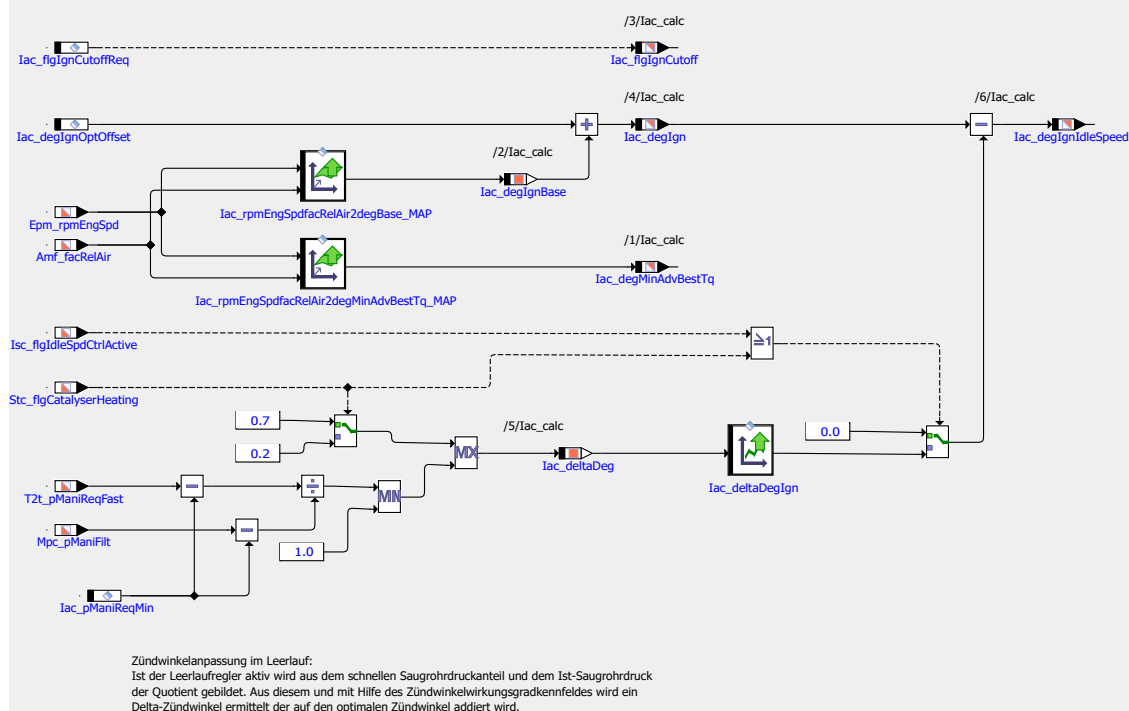

Figure 2: [IgnitionAngle.Main]

Zündwinkelanpassung im Leerlauf:
Ist der Leerlaufregler aktiv wird aus dem schnellen Saugrohrdruckanteil und dem Ist-Saugrohrdruck der Quotient gebildet. Aus diesem und mit Hilfe des Zündwinkelwirkungsgradkennfeldes wird ein Delta-Zündwinkel ermittelt der auf den optimalen Zündwinkel addiert wird.

1.2 Zündwinkel [Zündwinkel]

Im Modul Zündwinkel (IngnitionAngle) wird aus der Drehzahl Epm_rpmEngSpd und der re- lativen Füllung Amf_facRelAir zum einen der Basiszündwinkel Iac_degIgnBase bestimmt und zum anderen der optimale Zündwinkel Iac_degMinAdvBestTq . Der Basiszündwinkel beschreibt den Winkel des höchsten Drehmoments, bei dem gerade noch kein Klopfen auftritt. Er wird über das Kennfeld Iac_rpmEngSpdfacRelAir2degBase_MAP berechnet und kann anschließend zur Sicherheit mit dem Offset Iac_degIgnOptOffset nach spät verschoben werden, bevor der einzustellende Zündwinkel Iac_degIgn als Nachricht weiter- gegeben wird. Hierbei bedeutet, im Gegensatz zur Smartmotorsteuerung, ein positiver Wert, dass die Zündung vor dem oberen Zündtotpunkt stattfindet, ein negativer Winkel danach, d. h. durch die Grundparametrierung des Offsets Iac_degIgnOptOffset mit -5,0°KW wird der Zündwinkel nach spät gezogen.

Über das Kennfeld Iac_rpmEngSpdfacRelAir2degMinAdvBestTq_MAP wird der optimale Zündwinkel bestimmt, d. h. der Winkel, bei dem der Motor unter den vorherrschenden Bedingungen das höchste Drehmoment abgeben würde. Die Zündung darf in der Regel nicht bei diesem Winkel stattfinden, da unter Umständen erhebliches Klopfverhalten auftritt und der Motor in kürzester Zeit zerstört wird. Beide Kennfelder sind direkt dem Funktionsrahmen der Smartmotorsteuerung entnommen.

Die Auswertung der Funktion Iac_calc erfolgt im Synchron-Raster. Durch das Flag Iac_flgIgnCutoffReq kann die Zündung manuell aus- und eingeschaltet werden. Sonst wird zu keinem Zeitpunkt die Zündung ausgeschaltet, d. h. auch bei Aussetzung der Eispritzung wird weiterhin gezündet.

Hint:

Vermutlich aufgrund eines Fehlers in der Basissoftware wird, nach einer erfolgreichen Synchronisation des Motors, kein Zündsignal ausgegeben, solange nicht mindestens einmal die Einspritzung eingeschaltet war. Danach kann die Zündung bis zum nächsten Verlust der Synchronisation unabhängig von der Einspritzung aus- und eingeschaltet werden, auch wenn diese nicht einspritzt.

2 [C-Code Source]

2.1 [Code Listing]

```
/* BEGIN: ASCET REGION "Generation Information" */
/*****************************************************************************
 * BEGIN: Generation Information
 *---------------------------------------------------------------------------
 * Component:...............Module
 * Name:....................."IgnitionAngle"
 * 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]:......................................................false
 * 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" */

/**************************************************************************
 * DEFINITION OF COMPONENT VARIABLE OMITTED
 * --------------------------------------------------------------------------
 * memory class:..................................'ROM'
 * model name:....................................'Iac'
 * reason:........................................no local elements
 * --------------------------------------------------------------------------*/

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

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

/**************************************************************************
 * BEGIN: DEFINITION OF VARIABLE 'Iac_degIgnBase'
 * --------------------------------------------------------------------------*/
sint8 Iac_degIgnBase = 0;
    /* min=-72.0, max=78.0, IGN_4div3, limit=yes */
/* --------------------------------------------------------------------------
 * END: DEFINITION OF VARIABLE 'Iac_degIgnBase'
 **************************************************************************/


/**************************************************************************
 * BEGIN: DEFINITION OF VARIABLE 'Iac_degIgnOptOffset'
 * --------------------------------------------------------------------------*/
const sint8 Iac_degIgnOptOffset = 0;
    /* min=-72.0, max=78.0, IGN_4div3, limit=yes */
/* --------------------------------------------------------------------------
 * END: DEFINITION OF VARIABLE 'Iac_degIgnOptOffset'
 **************************************************************************/


/**************************************************************************
 * BEGIN: DEFINITION OF CHARACTERISTIC TABLE 'Iac_deltaDegIgn'
 * --------------------------------------------------------------------------*/
const struct CharTable1_uint16_12_uint8_IGNITIONANGLE_IMPL_TYPE Iac_deltaDegIgn = {
    12,
    {
        1000, 1200, 1900, 2800, 4000, 5500, 7000, 8200, 9000, 9750, 9900, 10000
    },
    {
        74, 74, 74, 74, 67, 53, 60, 44, 30, 20, 11, 0
    }
};
    /* result: min=0.0, max=55.5, IGN_4div3, limit=no */
    /* x axis: min=0.1, max=1.0, fac_10000 */
/* --------------------------------------------------------------------------
 * END: DEFINITION OF CHARACTERISTIC TABLE 'Iac_deltaDegIgn'
 **************************************************************************/


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

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


/****************************************************************************
 * BEGIN: DEFINITION OF VARIABLE 'Iac_pManiReqMin'
 * ---------------------------------------------------------------------------*/
const uint16 Iac_pManiReqMin = 20000;
   /* min=0.0, max=65535.0, ident, limit=yes */
/* ---------------------------------------------------------------------------
 * END: DEFINITION OF VARIABLE 'Iac_pManiReqMin'
 ****************************************************************************/


/****************************************************************************
 * BEGIN: DEFINITION OF CHARACTERISTIC TABLE 'Iac_rpmEngSpdfacRelAir2degBase_MAP'
 * ---------------------------------------------------------------------------*/
const struct CharTable2_sint16_16_uint16_16_sint8_IGNITIONANGLE_IMPL_TYPE Iac_rpmEngSpdfacRelAir2degBase_MAP = {
     16,
     16,
     {
        1500, 2000, 2500, 3000, 3500, 4000, 4500, 5000, 5500, 6000, 7000, 8000, 9000,
        10000, 10500, 11600
     },
     {
        84, 104, 196, 257, 319, 376, 438, 499, 557, 618, 680, 737, 799, 860, 918, 979
     },
     {
        41, 40, 34, 28, 21, 16, 8, 0, 0, 0, 0, 0, 0, 0, 0, 0,
        41, 40, 34, 28, 21, 16, 8, 5, 0, 0, 0, 0, 0, 0, 0, 0,
        40, 40, 34, 28, 21, 16, 9, 6, 0, 0, 0, 0, 0, 0, 0, 0,
        40, 40, 35, 29, 22, 16, 10, 7, 0, 0, 0, 0, 0, 0, 0, 0,
        40, 40, 35, 29, 24, 20, 11, 7, 1, 0, 0, 0, 0, 0, 0, 0,
        40, 40, 34, 28, 25, 24, 11, 7, 2, 0, 0, 0, 0, 0, 0, 0,
        40, 40, 37, 30, 27, 25, 13, 8, 4, 1, 1, 0, 0, 0, 0, 0,
        40, 40, 39, 32, 29, 26, 14, 9, 6, 3, 1, 0, 0, 0, 0, 0,
        40, 40, 38, 31, 28, 24, 15, 11, 9, 5, 3, 2, 0, 0, 0, 0,
        40, 39, 36, 30, 27, 22, 15, 13, 11, 7, 5, 3, 0, 0, 0, 0,
        40, 38, 31, 30, 27, 23, 21, 16, 11, 6, 4, 2, 1, 0, 0, 0,
        34, 33, 28, 26, 23, 22, 21, 18, 14, 11, 6, 4, 2, 1, 0, 0,
        38, 37, 33, 30, 26, 23, 20, 14, 13, 11, 8, 5, 3, 2, 1, 0,
        40, 40, 37, 31, 28, 25, 22, 17, 13, 11, 8, 6, 4, 3, 2, 1,
        40, 40, 33, 30, 27, 25, 24, 20, 18, 14, 10, 7, 5, 4, 3, 2,
        40, 40, 34, 31, 28, 27, 26, 22, 20, 16, 11, 8, 6, 5, 4, 3
     }
  };
  /* result: min=-96.0, max=95.25, IGN_4div3, limit=no */
  /* x axis: min=0.0, max=16383.5, fac_2 */
  /* y axis: min=0.0, max=2.5, fac_512 */
/* ---------------------------------------------------------------------------
 * END: DEFINITION OF CHARACTERISTIC TABLE 'Iac_rpmEngSpdfacRelAir2degBase_MAP'
 ****************************************************************************/


/****************************************************************************
 * BEGIN: DEFINITION OF CHARACTERISTIC TABLE 'Iac_rpmEngSpdfacRelAir2degMinAdvBestTq_MAP'
 * ---------------------------------------------------------------------------*/
const struct CharTable2_sint16_16_uint16_16_sint8_IGNITIONANGLE_IMPL_TYPE Iac_rpmEngSpdfacRelAir2degMinAdvBestTq
_MAP = {
     16,
     16,
     {
        1500, 2000, 2500, 3000, 3500, 4000, 4500, 5000, 5500, 6000, 7000, 8000, 9000,
        10000, 10500, 11600
     },
     {
        84, 104, 196, 257, 319, 376, 438, 499, 557, 618, 680, 737, 799, 860, 918, 979
     },
     {
        41, 40, 34, 28, 21, 16, 8, 0, 0, 0, 0, 0, 0, 0, 0, 0,
        41, 40, 34, 28, 21, 16, 8, 5, 0, 0, 0, 0, 0, 0, 0, 0,
        40, 40, 34, 28, 21, 16, 9, 6, 0, 0, 0, 0, 0, 0, 0, 0,
        40, 40, 35, 29, 22, 16, 10, 7, 0, 0, 0, 0, 0, 0, 0, 0,
        40, 40, 35, 29, 24, 20, 11, 7, 1, 0, 0, 0, 0, 0, 0, 0,
        40, 40, 34, 28, 25, 24, 11, 7, 2, 0, 0, 0, 0, 0, 0, 0,
        40, 40, 37, 30, 27, 25, 13, 8, 4, 1, 1, 0, 0, 0, 0, 0,
        40, 40, 39, 32, 29, 26, 14, 9, 6, 3, 1, 0, 0, 0, 0, 0,
        40, 40, 38, 31, 28, 24, 15, 11, 9, 5, 3, 2, 0, 0, 0, 0,
        40, 39, 36, 30, 27, 22, 15, 13, 11, 7, 5, 3, 0, 0, 0, 0,
        40, 38, 31, 30, 27, 23, 21, 16, 11, 6, 4, 2, 1, 0, 0, 0,
```

```
                  34, 33, 28, 26, 23, 22, 21, 18, 14, 11, 6, 4, 2, 1, 0, 0,
                  38, 37, 33, 30, 26, 23, 20, 14, 13, 11, 8, 5, 3, 2, 1, 0,
                  40, 40, 37, 31, 28, 25, 22, 17, 13, 11, 8, 6, 4, 3, 2, 1,
                  40, 40, 33, 30, 27, 25, 24, 20, 18, 14, 10, 7, 5, 4, 3, 2,
                  40, 40, 34, 31, 28, 27, 26, 22, 20, 16, 11, 8, 6, 5, 4, 3
            }
      };
      /* result: min=-96.0, max=95.25, IGN_4div3, limit=no */
      /* x axis: min=0.0, max=16383.5, fac_2 */
      /* y axis: min=0.0, max=2.5, fac_512 */
/* --------------------------------------------------------------------------
 * END: DEFINITION OF CHARACTERISTIC TABLE 'Iac_rpmEngSpdfacRelAir2degMinAdvBestTq_MAP'
 ****************************************************************************/

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

/****************************************************************************
 * BEGIN: DEFINITION OF MESSAGES
 * --------------------------------------------------------------------------
 * Total size is [bytes]:........................4
 * -------------------------------------------------------------------------*/
/* messages of memory class:.........................................'RAM' */
/* messages of size [bytes]:.............................................1 */
/* modelled as 'Iac_degIgn' */
sint8 Iac_degIgn;
/* modelled as 'Iac_degIgnIdleSpeed' */
sint8 Iac_degIgnIdleSpeed;
/* modelled as 'Iac_degMinAdvBestTq' */
sint8 Iac_degMinAdvBestTq;
/* modelled as 'Iac_flgIgnCutoff' */
uint8 Iac_flgIgnCutoff;
/* --------------------------------------------------------------------------
 * END: DEFINITION OF MESSAGES
 ****************************************************************************/

#define _Iac_degIgnBase Iac_degIgnBase
#define _Iac_degIgnOptOffset Iac_degIgnOptOffset
#define _Iac_deltaDegIgn Iac_deltaDegIgn
#define _Iac_deltaDegIgn_REF_ (&(Iac_deltaDegIgn))
#define _Iac_flgIgnCutoffReq Iac_flgIgnCutoffReq
#define _Iac_pManiReqMin Iac_pManiReqMin
#define _Iac_rpmEngSpdfacRelAir2degBase_MAP Iac_rpmEngSpdfacRelAir2degBase_MAP
#define _Iac_rpmEngSpdfacRelAir2degBase_MAP_REF_ (&(Iac_rpmEngSpdfacRelAir2degBase_MAP))
#define _Iac_rpmEngSpdfacRelAir2degMinAdvBestTq_MAP Iac_rpmEngSpdfacRelAir2degMinAdvBestTq_MAP
#define _Iac_rpmEngSpdfacRelAir2degMinAdvBestTq_MAP_REF_ (&(Iac_rpmEngSpdfacRelAir2degMinAdvBestTq_MAP))

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

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

/* public Iac_calc []  */

void IGNITIONANGLE_IMPL_Iac_calc (void)
{
    /* temp. variables */
    sint8 _t1sint8;
    sint16 _t1sint16;
    uint32 _t1uint32;
    sint32 _t1sint32;
    uint32 _t2uint32;
    sint32 _t2sint32;
    sint32 _t3sint32;
    sint32 _t4sint32;
    uint16 _t1uint16;
    sint32 _t5sint32;
    uint8 _t1uint8;

    /* define local message copies */
    uint16 Amf_facRelAir__IGNITIONANGLE_IMPL_Iac_calc;
    sint16 Epm_rpmEngSpd__IGNITIONANGLE_IMPL_Iac_calc;
    sint8 Iac_degIgn__IGNITIONANGLE_IMPL_Iac_calc;
    sint8 Iac_degIgnIdleSpeed__IGNITIONANGLE_IMPL_Iac_calc;
    sint8 Iac_degMinAdvBestTq__IGNITIONANGLE_IMPL_Iac_calc;
    uint8 Iac_flgIgnCutoff__IGNITIONANGLE_IMPL_Iac_calc;
```

```
    uint8 Isc_flgIdleSpdCtrlActive__IGNITIONANGLE_IMPL_Iac_calc;
    uint16 Mpc_pManiFilt__IGNITIONANGLE_IMPL_Iac_calc;
    uint8 Stc_flgCatalyserHeating__IGNITIONANGLE_IMPL_Iac_calc;
    uint16 T2t_pManiReqFast__IGNITIONANGLE_IMPL_Iac_calc;
    /* receive messages implicitly */
    {
        DisableAllInterrupts();
        Amf_facRelAir__IGNITIONANGLE_IMPL_Iac_calc = Amf_facRelAir;
        Epm_rpmEngSpd__IGNITIONANGLE_IMPL_Iac_calc = Epm_rpmEngSpd;
        Iac_degIgn__IGNITIONANGLE_IMPL_Iac_calc = Iac_degIgn;
        Iac_degIgnIdleSpeed__IGNITIONANGLE_IMPL_Iac_calc = Iac_degIgnIdleSpeed;
        Iac_degMinAdvBestTq__IGNITIONANGLE_IMPL_Iac_calc = Iac_degMinAdvBestTq;
        Iac_flgIgnCutoff__IGNITIONANGLE_IMPL_Iac_calc = Iac_flgIgnCutoff;
        Isc_flgIdleSpdCtrlActive__IGNITIONANGLE_IMPL_Iac_calc = Isc_flgIdleSpdCtrlActive;
        Mpc_pManiFilt__IGNITIONANGLE_IMPL_Iac_calc = Mpc_pManiFilt;
        Stc_flgCatalyserHeating__IGNITIONANGLE_IMPL_Iac_calc = Stc_flgCatalyserHeating;
        T2t_pManiReqFast__IGNITIONANGLE_IMPL_Iac_calc = T2t_pManiReqFast;
        EnableAllInterrupts();
    }
    /* Iac_calc: sequence call #1  */
    /* assignment to Iac_degMinAdvBestTq: min=-128, max=127, hex=4/3phys+0, limit=(maxBitLength: true, assign:
true), zero incl.=true  */
    Iac_degMinAdvBestTq__IGNITIONANGLE_IMPL_Iac_calc
        =
CharTable2_getAt_s16u16s8(_Iac_rpmEngSpdfacRelAir2degMinAdvBestTq_MAP_REF_,Epm_rpmEngSpd__IGNITIONANGLE_IMPL_Iac_calc
    /* Iac_calc: sequence call #2  */
    _t1sint8
        =
CharTable2_getAt_s16u16s8(_Iac_rpmEngSpdfacRelAir2degBase_MAP_REF_,Epm_rpmEngSpd__IGNITIONANGLE_IMPL_Iac_calc,Amf_fac
    /* assignment to Iac_degIgnBase: min=-96, max=104, hex=4/3phys+0, limit=(maxBitLength: true, assign: true),
zero incl.=true  */
    _Iac_degIgnBase
        = ((_t1sint8 >= -96) ? ((_t1sint8 <= 104) ? _t1sint8 : 104) : -96);
    /* Iac_calc: sequence call #3  */
    Iac_flgIgnCutoff__IGNITIONANGLE_IMPL_Iac_calc = _Iac_flgIgnCutoffReq;
    /* Iac_calc: sequence call #4  */
    _t1sint16 = (sint16)_Iac_degIgnOptOffset + _Iac_degIgnBase;
    /* assignment to Iac_degIgn: min=-96, max=104, hex=4/3phys+0, limit=(maxBitLength: true, assign: true), zero
incl.=true  */
    Iac_degIgn__IGNITIONANGLE_IMPL_Iac_calc
        = (sint8)(((_t1sint16 >= -96) ? ((_t1sint16 <= 104) ? _t1sint16 : 104) : -96));
    /* Iac_calc: sequence call #5  */
    _t1uint8
        = ((Isc_flgIdleSpdCtrlActive__IGNITIONANGLE_IMPL_Iac_calc ||
Stc_flgCatalyserHeating__IGNITIONANGLE_IMPL_Iac_calc) ? (_t1sint16
        = ((Stc_flgCatalyserHeating__IGNITIONANGLE_IMPL_Iac_calc) ? 2000 : 7000) , _t1uint32
= (uint32)Mpc_pManiFilt__IGNITIONANGLE_IMPL_Iac_calc << 2 , _t1sint32 = (sint32)_t1uint32 -
(sint32)_Iac_pManiReqMin , _t2uint32 = (uint32)T2t_pManiReqFast__IGNITIONANGLE_IMPL_Iac_calc << 2 , _t2sint32
= ((sint32)_t2uint32 - (sint32)_Iac_pManiReqMin) * 5000 , _t3sint32
        = (_t1sint32 , ((_t1sint32 == 0) ? _t2sint32 : _t2sint32 / _t1sint32)) , _t4sint32
        = ((_t3sint32 >= -1073741824) ? ((_t3sint32 <= 5000) ? _t3sint32 << 1 : 10000) : (sint32)SINT32_MIN) ,
_t5sint32
        = ((_t1sint16 >= _t4sint32) ? (_t1uint16
        = ((Stc_flgCatalyserHeating__IGNITIONANGLE_IMPL_Iac_calc) ? 2000U : 7000U) , (sint32)_t1uint16) :
_t4sint32) , CharTable1_getAt_u16u8(_Iac_deltaDegIgn_REF_,(uint16)_t5sint32)) : 0U);
    _t1sint16 = Iac_degIgn__IGNITIONANGLE_IMPL_Iac_calc - (sint16)_t1uint8;
    /* assignment to Iac_degIgnIdleSpeed: min=-96, max=104, hex=4/3phys+0, limit=(maxBitLength: true, assign:
true), zero incl.=true  */
    Iac_degIgnIdleSpeed__IGNITIONANGLE_IMPL_Iac_calc = (sint8)(((_t1sint16 > -96) ? _t1sint16 : -96));
    /* send messages implicitly */
    {
        DisableAllInterrupts();
        Iac_degIgn = Iac_degIgn__IGNITIONANGLE_IMPL_Iac_calc;
        Iac_degIgnIdleSpeed = Iac_degIgnIdleSpeed__IGNITIONANGLE_IMPL_Iac_calc;
        Iac_degMinAdvBestTq = Iac_degMinAdvBestTq__IGNITIONANGLE_IMPL_Iac_calc;
        Iac_flgIgnCutoff = Iac_flgIgnCutoff__IGNITIONANGLE_IMPL_Iac_calc;
        EnableAllInterrupts();
    }
}
/* -------------------------------------------------------------------------
 * END: DEFINITION OF PROCESS 'IGNITIONANGLE_IMPL_Iac_calc'
 ************************************************************************/
#endif
/* END: ASCET REGION "Process Definition 'Iac_calc'" */


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