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A Nine Year Old Bug in the COBS Scheduler

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1 INTRODUCTION

While testing a patch to move thermal standard monitoring channel functionality to unused thermal control circuits on the spacecraft simulator a bug in the scheduler for low priority processes in the COBS was discovered. The bug is described in the next section. A solution and the associated changes to existing software documentation (SMILEs, loads and procedures) will also be given.

2 THE BUG

The patch is reusing the code area of the ESR_GyroSet.Process function (0x57E2 – 0x5870). This process was (supposedly) decoupled from the scheduler by the 1999 gyroless patch (CSEC011). Only changing the first word (at 0x57E2) was sufficient to immediately cause a COBS warm startup. The reason given in the RMS fault register was watchdog error. This points to active code being overwritten.

It turned out that ESR_GyroSet.Process was still being called by the low priority process scheduler in LP_OpCtrl.Process. The scheduler is running in an endless loop. Here is the actual source code:

```
-------------------------------------------------------------------------------
--                                  Process                                  --
-------------------------------------------------------------------------------
--
--
--      Executes the low priority process. This operation
--      will never return.
--


    procedure  Process is

    --
    -- Variables
    --

    TmpB    :   integer;    -- Temporary stotage of Timer B


    begin

        Scheduler.StopAbeyanceMode;

        loop
            Scheduler.Synchronize;

            OTB(0);
            -- Application functions
            HGA_Stat.Process;
            ESRW.Process;
            ESR_GyroSet.Process;
            ESR_Mon.Process;
            ExpMon.Process;
            FreeProcess.Process;
            GyroMon.Process;
```

```
            HGA_Mon.Process;
            HGA_Nom.Process;
            IIDE.Process;
            ISA_SAD.Process;
            MinMaxMon.Process;
            RAAD_Mon.Process;
            StartUpDld.Process;
            StdMon.Process;
            SubHeatMon.Process;
            TC_WD.Process;
            TR_ThmCtrl.Process;
            TR_ThmMon.Process;
            ThmCtrl.Process;
            ThmCirc.Process;     -- Process Thermal Control Mode2
            ThmRecfg.Process;    -- Process to check switching of LCL
            ThmMon.Process;
            ThrusterMon.Process;

            TC_Exec.Process;
            CtxtMgr.Save;


            TmpB := ITB;                        -- Store the maximum value of
                                                -- the process cycle. Max in
            if  TmpB > TimerB                   -- the range 0 < Max < 5.46 s
            then
                TimerB := TmpB;
            end if;

        end loop;

    end Process;
```

When looking at the compiler assembly listing it turns out that the compiler has unrolled this loop. The actual code for the loop looks like this:

```
I#5L:       Scheduler.Synchronize;
            OTB(0);
            HGA_Stat.Process;
            ESRW.Process;
            ESR_GyroSet.Process;
            ESR_Mon.Process;
            ExpMon.Process;
            FreeProcess.Process;
            GyroMon.Process;
            HGA_Mon.Process;
            HGA_Nom.Process;
            IIDE.Process;
            ISA_SAD.Process;
            MinMaxMon.Process;
            RAAD_Mon.Process;
            StartUpDld.Process;
            StdMon.Process;
            SubHeatMon.Process;
            TC_WD.Process;
            TR_ThmCtrl.Process;
            TR_ThmMon.Process;
            ThmCtrl.Process;
            ThmCirc.Process;
            ThmRecfg.Process;
```

```
            ThmMon.Process;
            ThrusterMon.Process;

            TC_Exec.Process;
            CtxtMgr.Save;

            TmpB := ITB;
            if  TmpB > TimerB
            then
                goto I#82L;
            end if;

            Scheduler.Synchronize;
            OTB(0);
            HGA_Stat.Process;
            ESRW.Process;
            ESR_GyroSet.Process;
            ESR_Mon.Process;
            ExpMon.Process;
            FreeProcess.Process;
            GyroMon.Process;
            HGA_Mon.Process;
            HGA_Nom.Process;
            IIDE.Process;
            ISA_SAD.Process;
            MinMaxMon.Process;
            RAAD_Mon.Process;
            StartUpDld.Process;
            StdMon.Process;
            SubHeatMon.Process;
            TC_WD.Process;
            TR_ThmCtrl.Process;
            TR_ThmMon.Process;
            ThmCtrl.Process;
            ThmCirc.Process;
            ThmRecfg.Process;
            ThmMon.Process;
            ThrusterMon.Process;

            TC_Exec.Process;
            CtxtMgr.Save;

            TmpB := ITB;
            if  TmpB <= TimerB
            then
                goto I#5L;
            end if;

I#82L:      TimerB := TmpB;

            goto I#5L;
```

Note that it takes 2 seconds to go through the unrolled loop due to the two calls to Scheduler.Synchronize.

The gyroless patch (CSEC011) overwrites the calls to ESR_GyroSet.Process, FreeProcess.Process, GyroMon.Process, ISA-SAD.Process and RAAD_Mon.Process in the **first** sequence with NOP instructions, but it leaves the same calls in the **second** sequence unchanged. The entry for

ISA_SAD.Process in the first sequence is then replaced by a call to GyrolessOpCtrl which in turn calls the gyroless processes (ACU_ResetMon, CRP_FlagMon, RW_SpeedMon, HXFlagMon, ExpOffPointing).
The entry for RAAD_Mon.Process in the first sequence is replaced by a call to RW_LimUpd.Process in the recent patches for automation (CSEC016).
Again, these changes are not done in the **second** sequence.

All of the functions called by the scheduler use FunStatus.IsAuthorized to check if they have to run. The authorization status is a 2 word (32 bits) field (AuthorizedTbl at 0xCAC7, 0XCAC8) which before the gyroless only used bits 0 through 20. The five gyroless functions use bits 21 through 26 and the recently added reaction wheel speed limits update function uses bit 27. The last bit (bit 31) is reserved to indicate the presence of the gyroless patch.
The same bit organization is used to define which functions are authorized at warm startup in the 32 bit WarmTbl at 0xCAC9, 0xCACA.

The situation for the execution profile is different. Each execution profile uses the 10 most significant bits of a 16 bit word. The table containing the executions profiles has a fixed size of 281 entries. Therefore the five gyroless functions (ACU_ResetMon, CRP_FlagMon, …) reuse the entries of the five obsolete pre gyroless functions (ESR_GyroSet, FreeProcess, …). These five entries are set to execute every second by the gyroless patch. The variable used to index in the execution profile table is the process id (ProcId). All functions (except RW_LimUpd) call Scheduler.Start to find out if they have to execute in the current 1 second slot.

So what actually happened after we started using the gyroless patch in 1999?
Most of the functions are being called every second (the ones in both the first and the second sequence). The gyroless functions get only called once every 2 seconds, since the call to GyroLessOpCtrl is only in the first sequence. But the five obsolete functions (ESR_GyroSet, FreeProcess, GyroMon, ISA-SAD and RAAD_Mon) are still being called every 2 seconds since they are in the second sequence. These calls do not do any harm, since these functions are inhibited (Authorization status is false) and hence return immediately.
Also the recent RW_LimUpd function only gets called every 2 seconds instead of every second. This function does not have an execution profile (no room in table) and therefore does not call Scheduler.Start.

What happened when we tried to write new code in the ESR_Gyroset.Process area was that we overwrote the initial stack manipulation code (saving of registers used by the function on the stack). When ESR_GyroSet.Process was called from the second sequence in LP_OpCtrl.Process the stack became unbalanced and at the return of ESR_GyroSet.Process we returned to an unknown address and the program flow went haywire, causing a watchdog timeout. This was verified by also replacing the second call to ESR_GyroSet.Process at 0x3282,0x3283 by NOP instructions. With both calls to ESR_GyroSet.Process replaced by NOP instructions running the test of the patch to use thermal control circuits for temperature standard monitoring as described in SH/PRG/TN/664 worked as expected.

3 THE FIX

From the description in the previous section the fix is obvious: repeat the changes done in the first sequence for the second sequence. This affects the loads, documentation and procedures of the gyroless patch (CSEC011) and the reaction wheel speed limits updating patch (CSEC016).

3.1 The Gyroless Patch CSEC011

The calls to ESR_GyroSet.Process, FreeProcess.Process, GyroMon.Process, ISA_SAD.Process and RAAD_Mon.Process in the first sequence are replaced by NOP instructions in load FSM19990830120000.TCM used to load the patch, part I (step 4 in section 4.2 of P-SHM-NOT-0007-SE, COBS Gyroless Functions – Software User's Manual). Here is the relevant part of the FSM19990830120000.TCM load (almost at the end):

```
KNK2C000  0X3244,0XFF00,0XFF00;
KNK2C000  0X324A,0XFF00,0XFF00,0XFF00,0XFF00;
KNK2C000  0X3254,0XFF00,0XFF00;
KNK2C000  0X3258,0XFF00,0XFF00;
```

These four lines have to be replaced by the following:

```
KNK2C000  0X3244,0XFF00,0XFF00;
KNK2C000  0X324A,0XFF00,0XFF00,0XFF00,0XFF00;
KNK2C000  0X3254,0XFF00,0XFF00;
KNK2C000  0X3258,0XFF00,0XFF00;
KNK2C000  0X3282,0XFF00,0XFF00;
KNK2C000  0X3288,0XFF00,0XFF00,0XFF00,0XFF00;
KNK2C000  0X3292,0XFF00,0XFF00;
KNK2C000  0X3296,0XFF00,0XFF00;
```

The resulting modified load is FSM20080618000001.TCM.

In the COBS Gyroless SUM (P-SHM-NOT-0007-SE) change the text of step 4.1 to (new text in *italics*):

4.1. Send the telecommands contained by the file *FSM20080618000001.TCM*. The patch will load at addresses (hex) 3244-3245, 324A-324D, 3254-3255, 3258-3259, *3282-3283, 3288-328B, 3292-3293, 3296-3297*, 3A2B, 5EA4, 8C61-8C6A, 9000-981B and FC00. The telecommands are mutually independent, and may be individually repeated if necessary.

The table in the corresponding verification step 5.3 has to be replaced by the following one:

Word in dump	*Address (hex)*	*Value (hex)*
DAT_1	3244	FF00
DAT_2	3245	FF00
DAT_7	324A	FF00
DAT_8	324B	FF00

DAT_9	324C	FF00
DAT_10	324D	FF00
DAT_17	3254	FF00
DAT_18	3255	FF00
DAT_21	3258	FF00
DAT_22	3259	FF00
DAT_63	3282	FF00
DAT_64	3283	FF00
DAT_69	3288	FF00
DAT_70	3289	FF00
DAT_71	328A	FF00
.DAT_72	328B	FF00
DAT_79	3292	FF00
DAT_80	3293	FF00
DAT_83	3296	FF00
DAT_84	3297	FF00

The second call to GyrolessOpCtrl (0x9025) has to be added to the load FSM19990830125959.TCM. Here are the telecommands in the load:

```
KNK2C000  0X58D8,0X900B;
KNK2C000  0X3254,0X7EF0,0X9025;
```

The modified load FSM20080618000002.TCM contains the following commands:

```
KNK2C000  0X58D8,0X900B;
KNK2C000  0X3254,0X7EF0,0X9025;
KNK2C000  0X3292,0X7EF0,0X9025;
```

Change the text of step 6.1 to the following (new text in *italics*):

6.1. Send the telecommands contained by the file *FSM20080618000002.TCM*. The Patch will load at addresses (hex) 3254-3255, *3292-3293* and 58D8. (This step makes the Gyroless process control code execute as part of COBS. Within one second, Gyroless functions will be initialized and ready for operation.)

The table in the corresponding verification step 7.3 has to be replaced by the following one:

Word in dump	*Address (hex)*	*Value (hex)*
DAT_1	3254	7EF0
DAT_2	3255	9025
DAT_63	3292	7EF0
DAT_64	3293	9025

3.2 The Reaction Wheel Speed Limits Updating Patch CSEC016

For the reaction wheel speed limits updating patch we have to add the second call to RW_LimUpd.Process to the load FSM20070322000008.TCM. With the added command the modified load FSM20080618000003.TCM contains the following commands:

```
KNK2C000  0X3258,0X7EF0,0X8CCD;
KNK2C000  0X3296,0X7EF0,0X8CCD;
```

The load to remove the patch (FSM20070322000009.TCM) has to be modified accordingly. The commands in the modified load FSM20080816000004.TCM are:

```
KNK2C000  0X3A2B,0X001A;
KNK2C000  0X3258,0XFF00,0XFF00;
KNK2C000  0X3296,0XFF00,0XFF00;
```

The following modifications need to be made to P-SHM-NOT-10001-SE, Iss 3, COBS Patches for Automated Operations – Technical Note.

Replace the text of step 9.1 in section 4.1.2.2 with the following (modified text in *italics*):

9.1. Send the telecommands contained by the file *FSM20080618000003.TCM*. (This makes the new function execute as part of COBS.)

The verification table in step 10.3 has to be replaced by:

Word in Dump	*Address (hex)*	*Value (hex)*
DAT_1	3258	7EF0
DAT_2	3259	8CCD
DAT_63	3296	7EF0
DAT_64	3297	8CCD

For the unpatch procedure in section 4.1.3.2 replace the text of step 3.1 with:

3.1. Send the telecommands contained by the file *FSM20080618000004.TCM*.

The corresponding verification table in step 4.5 has to be replaced with:

Word in Dump	*Address (hex)*	*Value (hex)*
DAT_1	3258	FF00
DAT_2	3259	FF00
DAT_63	3296	FF00
DAT_64	3297	FF00

In section 5.3 (Patches to COBSV14) in the description of the RW Speed Limits Updating Function patch the text of the second item has to be replaced by (modified text in *italics*):

2. In `LP_OpCtrl.Process`, the *four* NOP instructions previously written by the Gyroless patch to replace the *two calls* to `RAAD_Mon.Process`, are replaced by *two calls* to `RW_LimUpd.Process`.

3.3 TSTOL Procedures and Loads

The corresponding TSTOL procedures k_gl_upld, k_patch_rwsl_upd.prc and k_unptch_rwsl_upd.prc will have to be updated accordingly.
The following four loads will have to be replaced:

Original load name	*New load name*
FSM19990830120000.TCM	FSM20080618000001.TCM
FSM19990830125959.TCM	FSM20080618000002.TCM
FSM20070322000008.TCM	FSM20080618000003.TCM
FSM20070322000009.TCM	FSM20080618000004.TCM

The four new loads are listed below with the added commands highlighted in yellow.

3.3.1 FSM20080618000001.TCM

```
/* ---------------------------------------------            */
/* File Name : FSM20080618000001.TCM                        */
/* File type : Memory Load File                             */
/* Memory load TCMs for loading new data into memory        */
/*                                                          */
/* This file replaces FSM19990830120000.TCM                 */
/* See SH/PRG/TN/668 for details                             */
/* ---------------------------------------------            */

LOADTYPE = FSM
TYPE     = 0
ORIG_ID  = tvoverbe
SUBSYS   = CDMU
CRE_DATE = 2008/06/18 12:00:00
EARLIEST = 2008/06/18 12:00:00
LATEST   = 2089/07/14 00:00:00
RECORDS  = 172
END


KNK2C000  0X9001,0X0000,0X0001,0X0000,0XFC08,0X0000,0XFC0C,0X0000,0XCE5E,0X0000,0X0007,0X9F33,0X8234,0X7EF0,0X3161;
KNK2C000  0X900F,0X8530,0X0016,0X7EF0,0X3161,0X8530,0X0017,0X7EF0,0X3161,0X8530,0X0018,0X7EF0,0X3161,0X8530,0X0019;
KNK2C000  0X901D,0X7EF0,0X3161,0X8530,0X001A,0X7EF0,0X3161,0X8F33,0X7FF0,0X9F24,0X8530,0XFC00,0X7EF0,0X065F,0XF320;
KNK2C000  0X902B,0X7A14,0X7EF0,0X904F,0X7EF0,0X911A,0X7EF0,0X927C,0X7EF0,0X9338,0X7EF0,0X947B,0X7EF0,0X9589,0X7EF0;
KNK2C000  0X9039,0X96CE,0X7EF0,0X9737,0XB144,0X7EF0,0X066A,0X7EF0,0X90A5,0X7EF0,0X974C,0X7EF0,0X9288,0X7EF0,0X9344;
KNK2C000  0X9047,0X7EF0,0X94CB,0X7EF0,0X9595,0X7EF0,0X96E0,0X8F24,0X7FF0;
KNK2C000  0X9767,0X0000,0X0000,0X0000;
KNK2C000  0X904F,0X9F34,0X8530,0X0016,0X7EF0,0X3161,0X8530,0X0017,0X7EF0,0X3161,0X8530,0X0018,0X7EF0,0X3161,0X8530;
KNK2C000  0X905D,0X0019,0X7EF0,0X3161,0X8530,0X001A,0X7EF0,0X3161,0XB144,0X8530,0X0016,0X7EF0,0X31B0,0X8530,0X0017;
KNK2C000  0X906B,0X7EF0,0X31B0,0X8530,0X0018,0X7EF0,0X31B0,0X8530,0X0019,0X7EF0,0X31B0,0X8530,0X001A,0X7EF0,0X31B0;
KNK2C000  0X9079,0X8540,0X976A,0X8231,0X7EF0,0X3103,0X8540,0X976A,0X8235,0X7EF0,0X3103,0X8540,0X976A,0X823A,0X7EF0;
KNK2C000  0X9087,0X3103,0X8540,0X976A,0X823B,0X7EF0,0X3103,0X8540,0X976A,0X8234,0X7EF0,0X3103,0XB144,0X8530,0X002B;
KNK2C000  0X9095,0X7EF0,0X5911,0X8530,0X002C,0X7EF0,0X5911,0X8530,0X002D,0X7EF0,0X5911,0X8530,0X002E,0X7EF0,0X5911;
KNK2C000  0X90A3,0X8F34,0X7FF0,0X9F34,0XB144,0X8530,0X001F,0X7EF0,0X31B0,0X7EF0,0X3158,0X8F34,0X7FF0,0X9F34,0X7EF0;
KNK2C000  0X90B1,0X10A8,0X8F34,0X7FF0;
KNK2C000  0X976A,0XFFC0;
KNK2C000  0X90B4,0X9F3C,0X85FF,0XFFFF,0XC233,0X85C3,0X976B,0X806C,0X0003,0X805C,0X0002,0X804C,0X0001,0X803C,0X0000;
```

```
KNK2C000  0X90C2,0X7EF0,0X14EC,0X85FF,0X0001,0X8F3C,0X7FF0,0X9F26,0X85FF,0XFFFE,0XC233,0X8523,0X976B,0X0B00,0X8062;
KNK2C000  0X90D0,0X0003,0X8052,0X0002,0X8042,0X0001,0X8032,0X0000,0X7EF0,0X14A3,0X0B01,0X803F,0X0001,0X7EF0,0X1572;
KNK2C000  0X90DE,0X8122,0X75FB,0X85FF,0X0002,0X8F26,0X7FF0,0X7FF0;
KNK2C000  0X976B,0X0007,0X000A,0X0000,0X0001,0X0007,0X000A,0X0000,0X0041,0X0007,0X0002,0X0001,0X0000,0X0007,0X0002;
KNK2C000  0X9779,0X0002,0X0080,0X0007,0X0002,0X0001,0X0001,0X0007,0X0002,0X0002,0X0081,0X0007,0X0002,0X0001,0X0002;
KNK2C000  0X9787,0X0007,0X0002,0X0002,0X0082,0X0007,0X0002,0X0001,0X0003,0X0007,0X0002,0X0002,0X0083,0X0007,0X0002;
KNK2C000  0X9795,0X0001,0X0004,0X0007,0X0002,0X0002,0X0084,0X0007,0X0002,0X0001,0X0010,0X0007,0X0002,0X0002,0X0090;
KNK2C000  0X97A3,0X0007,0X0002,0X0001,0X0011,0X0007,0X0002,0X0002,0X0091,0X0007,0X0002,0X0001,0X0012,0X0007,0X0002;
KNK2C000  0X97B1,0X0002,0X0092,0X0007,0X0002,0X0001,0X0013,0X0007,0X0002,0X0002,0X0093,0X0007,0X0002,0X0001,0X0014;
KNK2C000  0X97BF,0X0007,0X0002,0X0002,0X0094,0X0007,0X0002,0X0001,0X001F,0X0007,0X0002,0X0002,0X00BA,0X0007,0X0003;
KNK2C000  0X97CD,0X0001,0X0059,0X0007,0X0003,0X0002,0X00D8,0X0002,0X0002,0X0001,0X003D,0X0002,0X0002,0X0002,0X00BD;
KNK2C000  0X90E5,0X9F3C,0X8133,0X7502,0X7403,0X8220,0X7410,0XB1CC,0X8020,0XFC90,0X6142,0X4A27,0X0001,0X7507,0X8020;
KNK2C000  0X90F3,0XFC90,0X4A27,0X0007,0XF221,0X7A02,0X82C0,0X812C,0X8F3C,0X7FF0,0X9F34,0X4A3A,0X0116,0X7B07,0X8143;
KNK2C000  0X9101,0XA240,0X8234,0X7EF0,0X28E9,0X7408,0X8143,0X4A41,0XFEEA,0XA240,0X8235,0X7EF0,0X28E9,0X8F34,0X7FF0;
KNK2C000  0X910F,0X9F33,0X8230,0X7EF0,0X1723,0X8122,0X7503,0XB122,0X7402,0X8123,0X8F33,0X7FF0,0X9F3C,0X85FF,0XFFFF;
KNK2C000  0X911D,0XB1CC,0X813C,0X7EF0,0X9133,0XF232,0X7B0B,0X81C3,0XA2C0,0X813C,0X7EF0,0X9133,0XF232,0X7B04,0X81C3;
KNK2C000  0X912B,0XA2C0,0X74F2,0X9100,0XFC90,0X85FF,0X0001,0X8F3C,0X7FF0,0X9F1D,0X85FF,0XFFFF,0X82C4,0X802F,0X0003;
KNK2C000  0X9139,0XA122,0X8512,0XFC88,0X812C,0X81D1,0XA112,0X8521,0XFFFB,0X813C,0X8112,0X7EF0,0X28E4,0X9021,0X0000;
KNK2C000  0X9147,0XF235,0X7B0E,0X81C3,0XA2C0,0X812C,0XA1D2,0X813C,0X7EF0,0X28E4,0X09FB,0XF235,0X7B04,0X81C3,0XA2C0;
KNK2C000  0X9155,0X74E2,0X85FF,0X0001,0X8F1D,0X7FF0,0X9F1B,0X85FF,0XFFFD,0X7EF0,0X910F,0X8032,0X97E9,0X7EF0,0X90B4;
KNK2C000  0X9163,0X0B00,0X0300,0X0B01,0X0301,0X6112,0X4A27,0X0001,0X8112,0X0301,0X6162,0X4A27,0X0001,0X81B2,0X8121;
KNK2C000  0X9171,0XE32B,0X8112,0X0301,0X6122,0X4A27,0X0001,0X81B2,0X0301,0X61E2,0XE3B2,0X812B,0XE121,0X85FF,0X0003;
KNK2C000  0X917F,0X0B01,0X8F1B,0X7FF0,0X9F13,0X85FF,0XFFFF,0X7EF0,0X910F,0XC229,0X8512,0X97EB,0XA113,0X8031,0X0008;
KNK2C000  0X918D,0X7EF0,0X90C8,0X85FF,0X0001,0X8F13,0X7FF0,0X9F0D,0X85FF,0XFFFC,0XB122,0X903F,0X0000,0X0300,0X0B01;
KNK2C000  0X919B,0X7EF0,0X910F,0X0B02,0X82C0,0X822F,0XB12C,0X8112,0X0301,0X6A21,0X61E2,0X8112,0X0302,0XC229,0X85D2;
KNK2C000  0X91A9,0X97EB,0X812C,0XA122,0X810D,0XA1D2,0X852D,0XFFFE,0XA112,0X8031,0X0000,0X7EF0,0X90C8,0XF2C3,0X7B14;
KNK2C000  0X91B7,0XA2C0,0X822F,0XB12C,0X8112,0X0301,0X6A21,0X61E2,0X811C,0XA111,0XA110,0XA112,0X8031,0XFFFE,0X7EF0;
KNK2C000  0X91C5,0X90C8,0XF2C3,0X7B03,0XA2C0,0X74D6,0X85FF,0X0004,0X8F0D,0X7FF0,0X9F1D,0X85FF,0XFFFC,0X82C4,0X802F;
KNK2C000  0X91D3,0X0006,0X8112,0XA122,0X85B2,0X97DB,0X81DC,0XA1BD,0X85AB,0XFFFB,0X80BA,0X0000,0X7524,0X813C,0X81B2;
KNK2C000  0X91E1,0X7EF0,0X28E4,0X0B00,0X85AB,0XFC88,0XA1AD,0X85BA,0XFFFB,0XF02B,0X0000,0X7517,0X81A2,0X7EF0,0X28D9;
KNK2C000  0X91EF,0X8122,0X7512,0X90AB,0X0000,0X803D,0X97E2,0X7EF0,0X90FC,0X0B02,0X0302,0X9020,0XFC90,0X8031,0X97E3;
KNK2C000  0X91FD,0X7EF0,0X90E5,0X0B03,0X8122,0X7A05,0XF2C5,0X7B05,0XA2C0,0X74CD,0X8220,0X7402,0XB122,0X85FF,0X0004;
KNK2C000  0X920B,0X0B01,0X8F1D,0X7FF0,0X8020,0XFC90,0X6162,0X4A27,0X000F,0X7FF0,0X8020,0XFC90,0X6122,0X4A27,0X0001;
KNK2C000  0X9219,0X7FF0,0X8020,0XFC90,0X6152,0X4A27,0X0001,0X7FF0,0X8020,0XFC90,0X6132,0X4A27,0X0001,0X7FF0,0X9F33;
KNK2C000  0X9227,0X85FF,0XFFFF,0XB122,0X4A31,0X006F,0X7EF0,0X90FC,0X85FF,0X0001,0X8F33,0X7FF0,0X9F33,0X85FF,0XFFFF;
KNK2C000  0X9235,0X8235,0X7EF0,0X90FC,0X0B00,0X0300,0X6122,0X4A27,0X0001,0X85FF,0X0001,0X8F33,0X7FF0,0X7FF0;
KNK2C000  0X97DB,0X0001,0X0001,0X0001,0X0001,0X0000,0X0001,0X0000,0X0000,0X0000,0X0001,0X0000,0X000A,0X0195;
KNK2C000  0X97E9,0X0000,0X0001,0X000C,0X0002,0X000E,0X0004,0X0010,0X0006,0X0012,0X0008,0X0014,0X000A,0X000D,0X0003;
KNK2C000  0X97F7,0X000F,0X0005,0X0011,0X0007,0X0013,0X0009,0X0015,0X000B;
KNK2C000  0X9242,0X9F33,0X8530,0XFC05,0X7EF0,0X065F,0X8F33,0X7FF0,0X9100,0XFC91,0X9100,0XFC92,0X7FF0,0X9F34,0X85FF;
KNK2C000  0X9250,0XFFFF,0X7EF0,0X312D,0X7EF0,0X5E20,0X8530,0X0017,0X7EF0,0X3161,0X8530,0X0018,0X7EF0,0X3161,0X8530;
KNK2C000  0X925E,0X0019,0X7EF0,0X3161,0X8530,0X001A,0X7EF0,0X3161,0X8530,0X0016,0X7EF0,0X3161,0XB144,0X8530,0X002B;
KNK2C000  0X926C,0X7EF0,0X5911,0X8530,0X0017,0X7EF0,0X90C8,0X8530,0X0016,0X7EF0,0X90C8,0X7EF0,0X3130,0X85FF,0X0001;
KNK2C000  0X927A,0X8F34,0X7FF0,0X9F34,0X9100,0XFC91,0X9110,0XFC92,0X8240,0X8530,0XFC05,0X7EF0,0X066A,0X8F34,0X7FF0;
KNK2C000  0X9288,0X9F24,0X85FF,0XFFFF,0X8530,0X0016,0X7EF0,0X316A,0X8122,0X7A04,0X9110,0XFC92,0X742A,0X8241,0XB133;
KNK2C000  0X9296,0X7EF0,0X3093,0X8122,0X7524,0X8020,0XFC92,0X7503,0X7EF0,0X9249,0X7EF0,0X915A,0X8540,0XFC91,0X8132;
KNK2C000  0X92A4,0X7EF0,0X5468,0X7EF0,0X9242,0XF020,0XFC91,0X7911,0X8540,0X9767,0X8530,0X0093,0X7EF0,0X90AF,0X8530;
KNK2C000  0X92B2,0X002B,0X7EF0,0X58E9,0X8122,0X7505,0X7EF0,0X924E,0X7EF0,0X5921,0X7EF0,0X30FB,0X85FF,0X0001,0X8F24;
KNK2C000  0X92C0,0X7FF0,0X9F33,0X8530,0XFC06,0X7EF0,0X065F,0X8F33,0X7FF0,0X9F33,0X9100,0XFC93,0XB133,0X7EF0,0X9133;
KNK2C000  0X92CE,0X9030,0XFC94,0X8F33,0X7FF0,0X9F0C,0X85FF,0XFFFA,0X853F,0X0000,0X7EF0,0X0F1B,0X852F,0X0003,0X8232;
KNK2C000  0X92DC,0X85CF,0X0000,0X932C,0X8650,0X9001,0X863F,0X0003,0X7EF0,0X0FB6,0X0F03,0X853F,0X0003,0X7EF0,0X0FBB;
KNK2C000  0X92EA,0X8122,0X75FB,0X85FF,0X0006,0X8F0C,0X7FF0,0X9F25,0X85FF,0XFFFF,0X7EF0,0X312D,0X8530,0X0018,0X7EF0;
KNK2C000  0X92F8,0X3161,0X7EF0,0X5E20,0X8240,0XB133,0X7EF0,0X54F1,0X7EF0,0X209A,0X8153,0X8143,0X8530,0X799D,0X7EF0;
KNK2C000  0X9306,0X2009,0X8154,0X8240,0X8530,0X79A4,0X7EF0,0X2009,0X7EF0,0X92D2,0X8530,0X0018,0X7EF0,0X90C8,0X7EF0;
KNK2C000  0X9314,0X92D2,0X8145,0X8530,0X79A4,0X7EF0,0X2009,0X8134,0X7EF0,0X9182,0X8234,0X7EF0,0X9193,0X7EF0,0X92D2;
KNK2C000  0X9322,0X8230,0X7EF0,0X9182,0X7EF0,0X92D2,0X8134,0X7EF0,0X9182,0X8530,0X0017,0X7EF0,0X3161,0X8530,0X002C;
KNK2C000  0X9330,0X7EF0,0X5911,0X7EF0,0X3130,0X85FF,0X0001,0X8F25,0X7FF0,0X9F34,0X9100,0XFC93,0X9110,0XFC94,0X8240;
KNK2C000  0X933E,0X8530,0XFC06,0X7EF0,0X066A,0X8F34,0X7FF0,0X9F0C,0X85FF,0XFFF9,0X8530,0X0017,0X7EF0,0X316A,0X8122;
KNK2C000  0X934C,0X7A04,0X9110,0XFC94,0X7452,0X8245,0XB133,0X7EF0,0X3093,0X8122,0X754C,0X8020,0XFC94,0X7503,0X7EF0;
KNK2C000  0X935A,0X92C8,0X7EF0,0X91CE,0X8122,0X7541,0X7EF0,0X920E,0X81C3,0X8112,0X0B06,0X7EF0,0X921A,0X8122,0X7509;
KNK2C000  0X9368,0X7EF0,0X9214,0X8122,0X7505,0X80B1,0X97FF,0X7502,0X82C0,0X8540,0XFC93,0X813C,0X7EF0,0X5468,0X7EF0;
KNK2C000  0X9376,0X92C1,0XF020,0XFC93,0X7926,0X801F,0X0006,0XB100,0X9B1F,0X0001,0X8520,0XFF00,0X3701,0X0B01,0X8520;
KNK2C000  0X9384,0X00FF,0X3702,0X0B02,0X8520,0XFF00,0X3702,0X0B02,0X8520,0X00FF,0X3703,0X0B03,0X854F,0X0001,0X8530;
KNK2C000  0X9392,0X0094,0X7EF0,0X90AF,0X8530,0X002C,0X7EF0,0X58E9,0X8122,0X7505,0X7EF0,0X92F0,0X7EF0,0X5921,0X7EF0;
KNK2C000  0X93A0,0X30FB,0X85FF,0X0007,0X8F0C,0X7FF0,0X7FF0;
KNK2C000  0X97FF,0X0000,0X0000,0X0000,0X0000,0X0001,0X0000,0X0000,0X0001,0X0000,0X0000,0X0000,0X0000,0X0000,0X0000;
KNK2C000  0X980D,0X0000,0X0000;
KNK2C000  0X93A6,0X9F33,0X85FF,0XFFFF,0X802F,0X0001,0X0B00,0X0300,0X61E2,0X7505,0X0300,0X4A27,0X0FFF,0X7405,0X0300;
KNK2C000  0X93B4,0X4A27,0X0FFF,0XB422,0X85FF,0X0001,0X8F33,0X7FF0,0X9F3D,0X85FF,0XFFFE,0XB1CC,0X8133,0X7802,0X82C0;
KNK2C000  0X93C2,0X82D0,0X65EC,0X97CF,0X0000,0X8520,0X8FFF,0X3700,0X0B00,0XA433,0X8540,0X0FFF,0X973F,0X0000,0X0300;
KNK2C000  0X93D0,0X85FF,0X0002,0X8F3D,0X7FF0,0X9F33,0X8530,0XFC07,0X7EF0,0X065F,0X8F33,0X7FF0,0X9F33,0X85FF,0XFFFF;
KNK2C000  0X93DE,0XB122,0XB122,0XA620,0X9003,0X7EF0,0X065F,0X8132,0X7EF0,0X93A6,0X85FF,0X0001,0X8F33,0X7FF0,0X9F33;
KNK2C000  0X93EC,0X85FF,0XFFFF,0XB122,0XB122,0XA620,0X9005,0X7EF0,0X065F,0X8132,0X7EF0,0X93A6,0X85FF,0X0001,0X8F33;
KNK2C000  0X93FA,0X7FF0,0X9F2C,0X85FF,0XFFFF,0XB1CC,0X812C,0X9102,0XFC95,0XF2C2,0X7B09,0XA2C0,0X812C,0X9102,0XFC95;
KNK2C000  0X9408,0XF2C2,0X7B03,0XA2C0,0X74F4,0X8231,0X7EF0,0X9133,0X9100,0XFC99,0X85FF,0X0001,0X8F2C,0X7FF0,0X9F0C;
KNK2C000  0X9416,0X85FF,0XFFFA,0X853F,0X0000,0X7EF0,0X0F1B,0X852F,0X0003,0X8232,0X85CF,0X0000,0X932C,0X8650,0X9001;
KNK2C000  0X9424,0X863F,0X0003,0X7EF0,0X0FB6,0X0F03,0X853F,0X0003,0X7EF0,0X0FBB,0X8122,0X75FB,0X85FF,0X0006,0X8F0C;
KNK2C000  0X9432,0X7FF0,0X9F25,0X85FF,0XFFFF,0X7EF0,0X312D,0X8530,0X0017,0X7EF0,0X3161,0X7EF0,0X5E20,0X8240,0XB133;
KNK2C000  0X9440,0X7EF0,0X54F1,0X7EF0,0X209A,0X8153,0X8143,0X8530,0X799D,0X7EF0,0X2009,0X8154,0X8240,0X8530,0X79A4;
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KNK2C000  0X944E,0X7EF0,0X2009,0X7EF0,0X9415,0X8530,0X0018,0X7EF0,0X90C8,0X7EF0,0X9415,0X8145,0X8530,0X79A4,0X7EF0;
KNK2C000  0X945C,0X2009,0X8134,0X7EF0,0X9182,0X8234,0X7EF0,0X9193,0X7EF0,0X9415,0X8230,0X7EF0,0X9182,0X7EF0,0X9415;
KNK2C000  0X946A,0X8134,0X7EF0,0X9182,0X8530,0X0018,0X7EF0,0X3161,0X8530,0X002D,0X7EF0,0X5911,0X7EF0,0X3130,0X85FF;
KNK2C000  0X9478,0X0001,0X8F25,0X7FF0,0X9F2C,0X85FF,0XFFFD,0X9110,0XFC99,0X8240,0X8530,0XFC07,0X7EF0,0X066A,0XB1CC;
KNK2C000  0X9486,0X812C,0X9102,0XFC95,0X8530,0XF001,0X7EF0,0X93BB,0X0B01,0X8142,0X81BC,0XB1AA,0XB1AA,0X878A,0XA6A0;
KNK2C000  0X9494,0X9003,0X813B,0X7EF0,0X066A,0X8530,0X0FFF,0X7EF0,0X93BB,0X0B02,0X8142,0XA680,0X9005,0X8139,0X7EF0;
KNK2C000  0X94A2,0X066A,0XF2C2,0X7B23,0XA2C0,0X812C,0X9102,0XFC95,0X8530,0XF001,0X7EF0,0X93BB,0X0B01,0X8142,0X81BC;
KNK2C000  0X94B0,0XB1AA,0XB1AA,0X878A,0XA6A0,0X9003,0X813B,0X7EF0,0X066A,0X8530,0X0FFF,0X7EF0,0X93BB,0X0B02,0X8142;
KNK2C000  0X94BE,0XA680,0X9005,0X8139,0X7EF0,0X066A,0XF2C2,0X7B03,0XA2C0,0X74C0,0X85FF,0X0003,0X8F2C,0X7FF0,0X9F0E;
KNK2C000  0X94CC,0X85FF,0XFFF5,0X8530,0X0018,0X7EF0,0X316A,0X8122,0X7A04,0X9110,0XFC99,0X746F,0X824A,0XB133,0X7EF0;
KNK2C000  0X94DA,0X3093,0X8122,0X7569,0X8020,0XFC99,0X7503,0X7EF0,0X93FB,0X8231,0X7EF0,0X91CE,0X8122,0X755D,0XB1CC;
KNK2C000  0X94E8,0X813C,0X7EF0,0X9226,0X8132,0X7EF0,0X93A6,0X0B00,0XB1DD,0X81B2,0X7EF0,0X9214,0X8122,0X7519,0X90BF;
KNK2C000  0X94F6,0X0002,0X813C,0X7EF0,0X93DB,0X0B07,0X7EF0,0X93EB,0X0B08,0XB1EE,0XF12B,0X7602,0X82E0,0XB122,0XF0BF;
KNK2C000  0X9504,0X0007,0X7602,0X8220,0X81BE,0XE3B2,0X4AB9,0X0001,0X7502,0X82D0,0X812C,0X8542,0XFC95,0X813D,0X7EF0;
KNK2C000  0X9512,0X5468,0X81D2,0X7EF0,0X93D4,0X0B09,0XF02D,0XFC95,0X7922,0X811C,0XB100,0XA210,0X9B1F,0X0003,0X8520;
KNK2C000  0X9520,0XFF00,0X3703,0X0B03,0X8520,0X00FF,0X3704,0X0B04,0X8520,0XFF00,0X3704,0X0B04,0X8520,0X00FF,0X3705;
KNK2C000  0X952E,0X0B05,0X854F,0X0003,0X8530,0X0095,0X7EF0,0X90AF,0X8530,0X002D,0X7EF0,0X58E9,0X8122,0X7A05,0XF2C2;
KNK2C000  0X953C,0X7B07,0XA2C0,0X74AA,0X7EF0,0X9433,0X7EF0,0X5921,0X7EF0,0X30FB,0X85FF,0X000B,0X8F0E,0X7FF0,0X7FF0;
KNK2C000  0X954A,0X9F33,0X8530,0XFC10,0X7EF0,0X065F,0X8F33,0X7FF0,0X9F33,0X9100,0XFC9A,0X8230,0X7EF0,0X9133,0X9100;
KNK2C000  0X9558,0XFC9B,0X8F33,0X7FF0,0X9F34,0X85FF,0XFFFF,0X7EF0,0X312D,0X7EF0,0X5E20,0X8530,0X0016,0X7EF0,0X3161;
KNK2C000  0X9566,0X8530,0X0017,0X7EF0,0X3161,0X8530,0X0018,0X7EF0,0X3161,0X8530,0X001A,0X7EF0,0X3161,0X8530,0X0019;
KNK2C000  0X9574,0X7EF0,0X3161,0XB144,0X8530,0X002E,0X7EF0,0X5911,0X8530,0X0017,0X7EF0,0X90C8,0X8530,0X0016,0X7EF0;
KNK2C000  0X9582,0X90C8,0X7EF0,0X3130,0X85FF,0X0001,0X8F34,0X7FF0,0X9F34,0X9100,0XFC9A,0X9110,0XFC9B,0X8240,0X8530;
KNK2C000  0X9590,0XFC10,0X7EF0,0X066A,0X8F34,0X7FF0,0X9F2C,0X85FF,0XFFFF,0X8530,0X0019,0X7EF0,0X316A,0X8122,0X7A04;
KNK2C000  0X959E,0X9110,0XFC9B,0X7437,0X824B,0XB133,0X7EF0,0X3093,0X8122,0X7531,0X8020,0XFC9B,0X7503,0X7EF0,0X9551;
KNK2C000  0X95AC,0X8230,0X7EF0,0X91CE,0X8122,0X7525,0XB1CC,0X7EF0,0X9214,0X8122,0X7506,0X7EF0,0X9220,0X8122,0X7502;
KNK2C000  0X95BA,0X81C3,0X8540,0XFC9A,0X813C,0X7EF0,0X5468,0X7EF0,0X954A,0XF020,0XFC9A,0X7911,0X8540,0X9767,0X8530;
KNK2C000  0X95C8,0X0096,0X7EF0,0X90AF,0X8530,0X002E,0X7EF0,0X58E9,0X8122,0X7505,0X7EF0,0X955B,0X7EF0,0X5921,0X7EF0;
KNK2C000  0X95D6,0X30FB,0X85FF,0X0001,0X8F2C,0X7FF0,0X9F33,0X8530,0XFC11,0X7EF0,0X065F,0X8F33,0X7FF0,0X9F13,0X85FF;
KNK2C000  0X95E4,0XFFFF,0X8530,0XFC12,0X7EF0,0X065F,0X0B00,0X802F,0X0003,0X8112,0X0300,0X6A21,0X62E2,0X85FF,0X0001;
KNK2C000  0X95F2,0X0B01,0X8F13,0X7FF0,0X9F2D,0X8123,0XB133,0X81D2,0XB1CC,0XB1CC,0XA6C0,0X9007,0X813D,0X7EF0,0X066A;
KNK2C000  0X9600,0X8F2D,0X7FF0,0X9F33,0X9100,0XFC9C,0X8232,0X7EF0,0X9133,0X9100,0XFC9D,0X8F33,0X7FF0,0X9F04,0X7EF0;
KNK2C000  0X960E,0X0F38,0XA703,0XA600,0X9001,0X9600,0XFC9E,0X8F04,0X7FF0,0X9F34,0X8630,0XFC9E,0X7EF0,0X57B3,0X8F34;
KNK2C000  0X961C,0X7FF0,0X9F16,0X85FF,0XFFFB,0X803F,0X0007,0X7EF0,0X269F,0X8122,0X7506,0X7EF0,0X9616,0X0B04,0X8122;
KNK2C000  0X962A,0X75F6,0X842F,0X000A,0X0B01,0X802F,0X000A,0X8112,0X8022,0X0001,0X0B02,0X8021,0X0002,0X0B03,0X856F;
KNK2C000  0X9638,0X0001,0X805F,0X0009,0X804F,0X0008,0X7EF0,0X2521,0X85FF,0X0005,0X8F16,0X7FF0,0X9F33,0X8530,0X001A;
KNK2C000  0X9646,0X7EF0,0X90C8,0X8530,0X001B,0X7EF0,0X90C8,0X8F33,0X7FF0;
KNK2C000  0X980F,0X9819,0X0000,0X0000;
KNK2C000  0X964E,0X9F36,0X8560,0X980F,0X8254,0X8248,0XB133,0X7EF0,0X961D,0X8F36,0X7FF0;
KNK2C000  0X9812,0X981A,0X0000,0X0001;
KNK2C000  0X9658,0X9F36,0X8560,0X9812,0X8550,0X0018,0X8249,0X8230,0X7EF0,0X961D,0X8F36,0X7FF0;
KNK2C000  0X9815,0X9819,0X0000,0X0000;
KNK2C000  0X9663,0X9F36,0XB144,0X8237,0X7EF0,0X95F5,0X8560,0X9815,0X8254,0X824A,0XB133,0X7EF0,0X961D,0X8F36,0X7FF0;
KNK2C000  0X9671,0X7FF0,0X9F24,0X85FF,0XFFF5,0X7EF0,0X312D,0X8630,0X9009,0X7EF0,0X960C,0X8239,0X7EF0,0X95E2,0X8122;
KNK2C000  0X967F,0X7503,0X7EF0,0X9643,0X8235,0X7EF0,0X95E2,0X8122,0X7503,0X7EF0,0X964E,0X8236,0X7EF0,0X95E2,0X8122;
KNK2C000  0X968D,0X7503,0X7EF0,0X9658,0X8237,0X7EF0,0X95E2,0X8122,0X7503,0X7EF0,0X9663,0X8230,0X7EF0,0X95E2,0X8122;
KNK2C000  0X969B,0X7503,0X7EF0,0X9671,0X8231,0X7EF0,0X95E2,0X8122,0X7503,0X7EF0,0X9671,0X8232,0X7EF0,0X95E2,0X8122;
KNK2C000  0X96A9,0X7503,0X7EF0,0X9671,0X8233,0X7EF0,0X95E2,0X8122,0X7503,0X7EF0,0X9671,0X8234,0X7EF0,0X95E2,0X8122;
KNK2C000  0X96B7,0X7503,0X7EF0,0X9671,0X8238,0X7EF0,0X95E2,0X8122,0X7503,0X7EF0,0X9671,0X823A,0X7EF0,0X95E2,0X8122;
KNK2C000  0X96C5,0X7503,0X7EF0,0X9671,0X7EF0,0X3130,0X85FF,0X000B,0X8F24,0X7FF0,0X9F34,0X9100,0XFC9C,0X9110,0XFC9D;
KNK2C000  0X96D3,0X8240,0X8530,0XFC11,0X7EF0,0X066A,0X8040,0X9818,0X8530,0XFC12,0X7EF0,0X066A,0X8F34,0X7FF0,0X9F24;
KNK2C000  0X96E1,0X85FF,0XFFFF,0X8530,0X001A,0X7EF0,0X316A,0X8122,0X7A04,0X9110,0XFC9D,0X742B,0X8244,0XB133,0X7EF0;
KNK2C000  0X96EF,0X3093,0X8122,0X7525,0X8020,0XFC9D,0X7503,0X7EF0,0X9602,0X8232,0X7EF0,0X91CE,0X8122,0X7519,0X7EF0;
KNK2C000  0X96FD,0X9232,0X8540,0XFC9C,0X8132,0X7EF0,0X5468,0X7EF0,0X95DB,0XF020,0XFC9C,0X790D,0X8540,0X9767,0X8530;
KNK2C000  0X970B,0X0097,0X7EF0,0X90AF,0X8530,0X001A,0X7EF0,0X3161,0X7EF0,0X9672,0X7EF0,0X30FB,0X85FF,0X0001,0X8F24;
KNK2C000  0X9719,0X7FF0,0X7FF0;
KNK2C000  0X9818,0X0000,0XCCCC,0X0007,0X0001;
KNK2C000  0X971B,0X9F1C,0X85FF,0XFFFF,0X7EF0,0X065F,0XF320,0X7503,0X8122,0X7A10,0XB1CC,0XF320,0X7A02,0X82C0,0X8124;
KNK2C000  0X9729,0X814C,0X8113,0X8132,0X7EF0,0X5911,0X8540,0XAAAA,0X8131,0X7EF0,0X066A,0X85FF,0X0001,0X8F1C,0X7FF0;
KNK2C000  0X9737,0X9F34,0X8540,0XAAAA,0X8530,0XFC01,0X7EF0,0X066A,0X8530,0XFC02,0X7EF0,0X066A,0X8530,0XFC03,0X7EF0;
KNK2C000  0X9745,0X066A,0X8530,0XFC04,0X7EF0,0X066A,0X8F34,0X7FF0,0X9F34,0X8540,0X002B,0X8530,0XFC01,0X7EF0,0X971B;
KNK2C000  0X9753,0X8540,0X002C,0X8530,0XFC02,0X7EF0,0X971B,0X8540,0X002D,0X8530,0XFC03,0X7EF0,0X971B,0X8540,0X002E;
KNK2C000  0X9761,0X8530,0XFC04,0X7EF0,0X971B,0X8F34,0X7FF0;
KNK2C000  0X8C61,0X0001,0X0001,0X0001,0X0001,0X0001,0X0001,0X0001,0X0001,0X0000;
KNK2C000  0X3244,0XFF00,0XFF00;
KNK2C000  0X324A,0XFF00,0XFF00,0XFF00,0XFF00;
KNK2C000  0X3254,0XFF00,0XFF00;
KNK2C000  0X3258,0XFF00,0XFF00;
KNK2C000  0X3282,0XFF00,0XFF00;
KNK2C000  0X3288,0XFF00,0XFF00,0XFF00,0XFF00;
KNK2C000  0X3292,0XFF00,0XFF00;
KNK2C000  0X3296,0XFF00,0XFF00;
KNK2C000  0X5EA4,0X7FF0;
KNK2C000  0X3A2B,0X001A;
KNK2C000  0XFC00,0XFFFF;
KNK2C000  0X9000,0X4DC7;
```

3.3.2 FSM20060816000002.TCM

```
/* ---------------------------------------------          */
/* File Name : FSM20080618000002.TCM                      */
/* File type : Memory Load File                           */
/* Memory load TCMs for loading new data into memory      */
/*                                                        */
/* This file replaces FSM19990830125959.TCM               */
/* See SH/PRG/TN/668 for details                          */
/* ---------------------------------------------          */

LOADTYPE = FSM
TYPE     = 0
ORIG_ID  = tvoverbe
SUBSYS   = CDMU
CRE_DATE = 2008/06/18 12:59:59
EARLIEST = 2008/06/18 12:59:59
LATEST   = 2089/07/14 00:00:00
RECORDS  = 3
END


KNK2C000  0X58D8,0X900B;
KNK2C000  0X3254,0X7EF0,0X9025;
KNK2C000  0X3292,0X7EF0,0X9025;
```

3.3.3 FSM20060816000003.TCM

```
/* ---------------------------------------------          */
/* File Name : FSM20080618000003.TCM                      */
/* File type : Memory Load File                           */
/* Memory load TCMs for loading new data into memory      */
/*                                                        */
/* This file replaces FSM20070322000008.TCM               */
/* See SH/PRG/TN/668 for details                          */
/* ---------------------------------------------          */

LOADTYPE = FSM
TYPE     = 0
ORIG_ID  = tvoverbe
SUBSYS   = CDMU
CRE_DATE = 2008/06/18 15:30:41
EARLIEST = 2008/06/18 15:30:41
LATEST   = 2089/07/14 00:00:00
RECORDS  = 2
END


KNK2C000  0X3258,0X7EF0,0X8CCD;
KNK2C000  0X3296,0X7EF0,0X8CCD;
```

3.3.4 FSM20060816000004.TCM

```
/* ---------------------------------------------          */
/* File Name : FSM20080618000004.TCM                      */
/* File type : Memory Load File                           */
/* Memory load TCMs for loading new data into memory      */
/*                                                        */
/* This file replaces FSM20070322000009.TCM               */
/* See SH/PRG/TN/668 for details                          */
/* ---------------------------------------------          */

LOADTYPE = FSM
TYPE     = 0
ORIG_ID  = enoksb
SUBSYS   = CDMU
CRE_DATE = 2008/06/18 15:30:41
EARLIEST = 2008/06/18 15:30:41
LATEST   = 2089/07/14 00:00:00
RECORDS  = 3
END
```

```
KNK2C000  0X3A2B,0X001A;
KNK2C000  0X3258,0XFF00,0XFF00;
KNK2C000  0X3296,0XFF00,0XFF00;
```

4 CONCLUSIONS

A bug in the scheduler code introduced by the gyroless patch in 1999 and a fix for it have been described.
Saab Space has reviewed this note and concurrs with the proposed changed. We will prepare a formal SMILE which will be used to modify the TSTOL procedures and the four loads.
To exterminate the bug in the current flight software a separate OCD (Operations Change Directive) will be written since we only use the TSTOL procedures when we have to restore the complete gyroless COBS software (i.e. after a warm startup).