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Application Note

AN000586

TDC-GP30

How to Write Custom Firmware

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1 Introduction

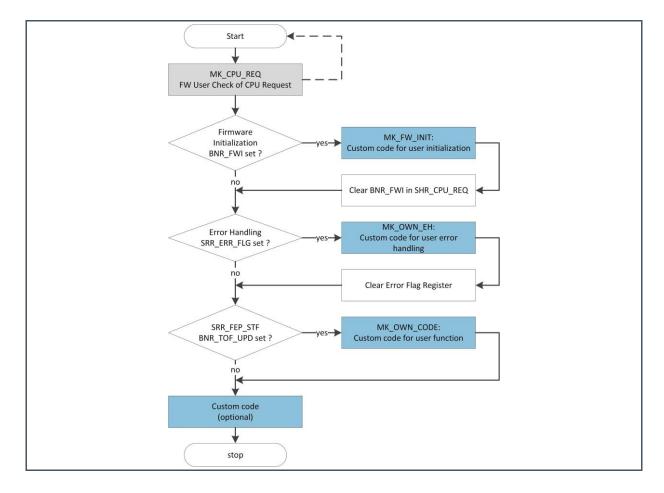
TDC-GP30 is a system-on-chip solution for ultrasonic flow metering. Using its integrated CPU and code memory, TDC-GP30 can be operated with a dedicated firmware for evaluation of results and operational control.

This application note describes how to write a customized firmware.

Following the naming convention, the modified file should be saved with a different name such as A1.F1.11.YY, where F indicates it is an **ams** example code.

Figure 1 shows the basic flow diagram of the main program.

Figure 1: Firmware Custom Code



For illustrative purposes, a very simple example is used:

With each TOF measurement a counter (NUMBER_OF_RUNS) is increased. Also, a pulse is generated on GPIO4 that lasts until the next CPU call.

2 **Preparation**

2.1 Project Files

Please do not make any changes in the system folder. Copy all the files into your private folder for making changes if needed.

- The assembler source file (in our example: GP30Y_A1.F1.11.01_GPIO_toggling.asm).
- The compiled .hex-file that is downloaded into the chip (in our example: GP30Y_A1.F1.11.01_GPIO_toggling.hex).
- The firmware data file, including configuration and other data. It is also downloaded into the chip (in our example: GP30Y_A1.F1.11.01_GPIO_toggling.dat).
- .h files are headers containing the register descriptions of the device. They are needed for successful compilation (typically those are GP30Y_A1.D2.11.04.h, GP30Y_REG_A1.2.h, and GP30Y_ROM_A1.common.h).

2.2 Open the .asm Example

• Launch GP30 evaluation software and select Assembler in Firmware menu.

Figure 2 :

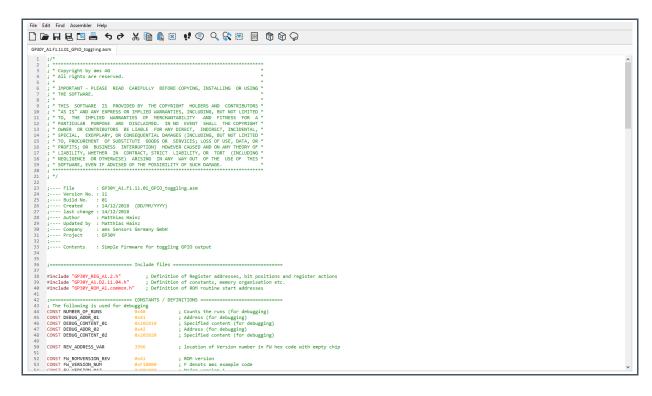
Image: State State Other State State Image: State State State Assessing State State State Assessing State Sta									
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CPU Value Arg. Rate Tors Tors Arg. Rate Tors Tors <th< th=""><th>Firmware Download</th><th></th><th>Time of Fligh</th><th>t Measurement</th><th></th><th></th><th></th><th>2-</th><th>Wire Temperature Measurement</th></th<>	Firmware Download		Time of Fligh	t Measurement				2-	Wire Temperature Measurement
wig. Rate: Arg. Rate: Org. # Name: Results / ns Arg. Rate: Org. 1 TOF SUM AVG UP 7388.6 7388.6 1880.0 1 TOF SUM AVG UP 7388.6 7388.6 1880.0 1 TOF SUM AVG UP 7388.6 7388.6 1880.0 1 TOF JUP 60083.2 1972.2 1 TOF JUP 70083.5 1983.7 1 TOF SUM AVG DOWN 7083.6 7083.7 1 TOF JUP 70083.7 7083.7 1982.4 1 TOF DOWN 60083.1 60083.1 1983.4 1 TOF DOWN 7083.6 1974.4 1983.4 1983.5 1 TOF DOWN 7083.6 1974.4 1983.6 1974.4 1983.6 1983.4 1983.5 1 TOF DOWN 7083.6 1974.4 1983.6 1983.6 1974.6 10	CPUIValuer								
# Name Reults / ni Average/m Std. Der./p Manue Control Contro Control Contro	Crovinces						Write Config	Current Temperature	Sensor accuracy ppm/K
I Tops Number Production Production Production 1 Top SUMA VSD DOWN 7388.6 1880.0 1 <td></td> <td></td> <td></td> <td>Avg. Rate: 1</td> <td>Avg. Rate: 100</td> <td></td> <td></td> <td>20,00</td> <td>4000</td>				Avg. Rate: 1	Avg. Rate: 100			20,00	4000
1 100 F SUM AVO UP 7988.6 7988.6 1880.0 2 100 F SUM AVO DVN 7988.6 1980.2 1000.1 10000 Calculated Temperature Bealts 3 100 F SUM AVO DVN 7988.6 6088.3 1987.7 1000.1 10000 Calculated Temperature Bealts 0 10000 10000 10000 0 10000 10000 10000 0 10000 10000 10000 10000 0 10000 10000 10000 10000 10000 10000 0 10000 10000 10000 0 10000 10000 10000 00000 10000 10000 00000 <	# Nan	ne	Results / ns	Average/ns	Std. Dev./ps	^	Start Measurement	RC/Rref current T	RH/Rref current T Open Graph
2 TOF SUM AVX DOWN 7988.6 7988.6 1872.2 3 TOFI UP 6005.3 6005.3 1872.6 4 TOF2_UP 6008.3 1878.6 1878.6 5 TOF3_UP 7008.1 1978.6 1878.6 6 TOF4_UP 7008.3 1978.6 1878.6 7 TOFS_UP 7008.3 1978.6 1878.6 9 TOF7_UP 7008.3 7008.3 1878.6 10 TOFS_UP 7008.3 7008.3 1878.6 11 TOFI UP 7008.3 7008.3 1878.6 11 TOFI UP 7008.3 1883.6 1874.6 10 TOF2 UP 7008.3 1883.6 1874.6 11 TOF1 DOWN 6008.3 6008.3 1883.6 12 TOF2 DOWN 7008.4 1708.4 1871.1 19 dft. TOF 1 0.0076 0.076 9.6 10 Offed DOWN 7008.4 1708.4 1871.1 19 dft. TOF 2 0.488 0.4808.1 10.0 0.0076<	1 TOF SUN	AVG UP	73583,6	73583,6	1880,0		Read Config from RAM first		
3 TOFI UP 6003.3 6003.3 1078,7 4 TOF2, UP 7003.1 7003.3 1078,3 5 TOF2, UP 7003.3 7003.4 1703.5 6 TOF2, UP 7003.7 7003.7 1902.4 7 TOF2, UP 7003.7 7003.7 1902.4 8 TOF2, UP 7003.7 7003.7 1902.4 10 TOF2, UP 7003.7 7003.7 1902.4 10 TOF2, UP 7003.7 7003.7 1902.4 10 TOF2, UP 7003.4 1808.2 1072.2 10 TOF2, UP 7003.4 1808.2 1072.2 10 TOF2, UP 7003.4 1808.2 1002.4 12 TOF2, DOWN 7003.6 1076.4 1002.4 0010110.4 00001.1 0010110.4 00001.1 0010110.4 00001.1 0010110.4 00001.1 0010110.4 00001.1 0010110.4 00001.1 0010110.4 00001.1 0010110.4 00001.1 0010110.4 00001.1 0010110.4 0000110.4 0000110.4 00001.1							(Use with GP30 Firmware only!)		(J) ·
4 TOF2_UP 4008.3.2 1878,6 5 TOF3_UP 7008.3.1 1978,6 6 TOF4_UP 7008.3.1 1008.5 7 TOF5_UP 7008.3.7 7008.3.7 1082,4 8 TOF5_UP 7008.3.7 7008.3.7 1082,4 10 TOF3_UP 7008.3.4 1082,4 10 TOF3_UP 7008.3.4 1083,2 11 TOF1_DOWN 6608.3.3 1083,3 13 TOF3_DOWN 7008,4.0 1084,4 14 TOF4_UP 7008,4.0 1084,4 15 TOF3_DOWN 7008,4.0 1876,4 15 TOF5 DOWN 7008,4.0 1876,4 15 TOF5 DOWN 7008,4.0 1876,4 16 TOF5 DOWN 7008,4.0 1876,4 17 TOF3 DOWN 7008,4.0 1876,5 20 diff. TOF 3 0.016.0 97,6 21 diff. TOF 3 0.016.0 97,6 22 diff. TOF 4 -0.0510 92,6 0.016.0 21 diff.	3 TOF1 UP		68085,3	68085,3	1878,7		GP30 Status		
5 TOF3_UP 7003,1 100,1 100 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 1 0 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0							Measurement Cycle Timer is OFF		
6 TOF4_UP 70083,3 70083,5 1088,6 7 TOF5_UP 7008,1 7008,2 7008,3 7008,3 7008,3 7008,3 7008,3 7008,3 7008,3 7008,3 7008,3 7008,3 7008,3 7008,3 7008,3 7008,3 7008,4 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td>Stop Measurement Cycle Timer</td><td></td><td></td></td<>							Stop Measurement Cycle Timer		
8 TOP6_UP 7903.7 7903.7 1902.1 9 TOF7_UP 7403.5 7403.5 1874.8 10 TOF2_UP 7403.5 1874.8 1874.8 11 TOF1 DVN 66005.3 66005.3 1865.5 13 TOF2 DOWN 66003.1 1685.5 13 TOF5 DOWN 7703.6 1706.4 1706.4 100.0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 <									
9 TOF7_UP 7408.3.5 1474.8 10 TOF7_UP 7408.3.5 1874.8 11 TOF8_UP 7408.3.4 1686.3.5 11 TOF1 DOWN 6608.3.1 1686.3.5 13 TOF3 DOWN 7708.4.6 7908.4.6 1686.3.5 13 TOF3 DOWN 7708.3.6 1767.4.6 100.000 100.000 0.01.000 100.000 0.01.000								Measureme	nt Values
9 TOF7_UP 7403.3 1874.8 10 TOF2_UP 7403.3 1874.8 11 TOF1 DUWN 4003.3 1983.3 12 TOF1 DUWN 4003.3 1983.3 13 TOF3 DOWN 7003.0 1983.4 14 TOF4 DOWN 7003.6 1074.2 15 TOF5 DOWN 7003.0 1083.4 14 TOF4 DOWN 7003.6 1074.2 15 TOF5 DOWN 7003.4 1874.6 16 TOF6 DOWN 7003.4 1874.6 18 TOF6 DOWN 7003.4 1874.6 19 diff. TOF 1 0.0075 956. 21 diff. TOF 2 0.1488 0.1488 92.5 21 diff. TOF 3 0.1166 94.8 0.0166 94.8 22 diff. TOF 7 -0.054 10.05 2.0 2.0 2.0 22 diff. TOF 7 -0.0510 92.5 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0007 0.056 0.007							System Reset	# Name F	Results Unit A Apply RDSON compensation
10 TOF 6, µP 7903,4 1888,2 11 TOF DOWN 6606,3 1660,5 100,5 110,5 100,5									0 Apply Gain compensation
11 1001 PU VINI 00003,3 1000,3 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>0</td>									0
13 TOF3 DOWN 7003.0 1003.4 1003.4 14 TOF4 DOWN 71003.6 17063.6 1876.4 15 TOF5 DOWN 72004.0 1876.4 1876.4 17 TOF5 DOWN 72004.6 1876.4 1876.4 17 TOF5 DOWN 72004.6 1876.4 1876.4 18 TOF6 DOWN 72004.4 1871.1 196.4 197.4 197.4 19 deft. TOF 1 0.0076 0.076 97.5 2 187.0 187.0 180.4 187.1 19 deft. TOF 2 0.1488 92.5 2 2 187.0 187.0 187.0 187.0 187.0 187.0 199.0 187.0 199.0 189.0							Release Bus Master after Reset	0 0 1	0 v Mult. Gain Comp. 1,25
14 TOF 3DUWN 7003,0 1003,0 1003,4									
Init Tor PA DOWN 7/083/8 7/083/8 18/8/4 15 TorSp DOWN 7/083/8 18/8/3 17 TorSp DOWN 7/083/8 18/8/3 18 TorSp DOWN 7/083/8 18/8/3 18 TorSp DOWN 7/083/8 18/8/3 19 diff. Tor 1 0.0076 0.0076 19 diff. Tor 1 0.0076 0.0076 20 diff. Tor 3 0.1160 9.48 21 diff. Tor 4 0.0076 9.69 22 diff. Tor 5 0.0763 97.6 24 diff. Tor 6 0.068 99.0 23 diff. Tor 6 0.068 99.0 23 diff. Tor 6 0.068 99.0 23 diff. Tor 6 0.068 99.0 24 diff. Tor 6 0.069 99.0 watch dig to 10.007 25 diff. Tor 6 0.0076 92.6 watch dig to 10.007 26 diff. Tor 7 -0.0610 92.4 watch dig to 10.007 26 diff. Tor 5 0.027 0.015							Disable Watchdog		
15 TOF DOWN 7204.0 187.2 16 TOF DOWN 7208.4 7208.4 188.0.3 17 TOF DOWN 7208.8 1880.3 187.1 18 TOF DOWN 7208.4 1880.3 187.1 19 diff. TOF 1 0.0076 0.956 6 20 diff. TOF 2 0.448 92.5 2 21 diff. TOF 3 0.106 9.488 92.5 22 diff. TOF 3 0.0166 97.6 2 23 diff. TOF 6 -0.0688 99.0 2 24 diff. TOF 7 -0.0610 0.068 92.4 26 diff. TOF 7 -0.0610 0.0168 97.6 26 diff. TOF 7 -0.0610 0.0175 37.6 27 diff. TOF 7 -0.0610 0.0267 0.015 2 26 diff. TOF 7 -0.0610 0.0175 37.6 2 Write TOF Values to File - - - - UART Tork SUM AUG 0.0019 39.6 - - <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Enable Watchdog</td> <td></td> <td>Gain Factor 0,9998</td>							Enable Watchdog		Gain Factor 0,9998
10 10/10/9 20/00/0 20/00/0 10/00/0 10/00/0 10/00/0 11/0 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td>Watabalan is Disabled</td><td></td><td></td></t<>							Watabalan is Disabled		
18 TOF8 DOWN 7983.4 1791.1 19 diff. TOF 1 0,0076 95,6 20 diff. TOF 1 0,0076 95,6 21 diff. TOF 2 0,488 92,5 21 diff. TOF 3 0,1066 94,88 22 diff. TOF 4 -0,054 105.6 23 diff. TOF 5 0,0763 97,6 24 diff. TOF 6 -0,056 90,01 25 diff. TOF 7 -0,0610 92,4 25 diff. TOF 7 -0,0610 92,4 25 diff. TOF 5 0,073 93,5 Wate TOF Values to File - Wate TOF Values to File - 00DNT minteto File - - <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td>watchdog is Disabled</td><td></td><td>HS Clock</td></td<>							watchdog is Disabled		HS Clock
18 TOF B DOWN 2003,4 2003,4 187,1 19 dff. TOF 1 0,0075 50,5 20 dff. TOF 2 0,488 0,488 92,5 21 dff. TOF 3 0,1106 94,8 22 dff. TOF 4 -0,054 405,8 23 dff. TOF 5 0,0783 97,6 24 dff. TOF 5 0,0160 94,8 25 dff. TOF 6 -0,054 40,051 26 dff. TOF 7 -0,0610 92,6 27 dff. TOF 5 0,019 92,6 Wite TOF Values to File								HS clk pariod in ps (ideal)	HS clk period/ns Cal Factor HS clock
Image: Specific Control									
2i difl. ToF 2 0,1106 94,8 2i difl. ToF 3 0,1106 94,8 2i difl. ToF 4 -0,0554 -0,0544 10,58 2i difl. ToF 5 -0,0565 -0,1056 99,0 2i difl. ToF 7 -0,0106 92,4 - - - - Amplitude Measurement parts are pay interest and pay interes							Pico Prog FW Version		
Zi diff. TOF 4 -0.0954 105.8 Cemm. w/ GPB 0X Zi diff. TOF 5 0.0783 0.0783 97.6 Zi diff. TOF 5 0.0783 97.6 Zi diff. TOF 7 -0.0610 9.010 92.4 Zi diff. TOF 7 -0.0610 9.010 92.4 Zi diff. TOF 8 -0.0267 70.15 7.1 Zi diff. TOF 8 -0.0267 70.15 7.1 Write TOF Values to File -0.0267 0.019 92.5 - Write TOF Values to File - - Bandrate 113200 - Open TOF Values C. Laibration Pulse Width Ratio DOWN 66 0.63 0.3 0.72 - 6 0.031 9.21.3 0.5 0.513.0 - - -							21	according to setting in row	Apply calibrated clock period to display values
Image: Solution of the second secon									Amplitude Messurement
24 dff. TOF 6 -0,1068 -0,1068 99,0 25 dff. TOF 7 -0,0610 9,2,4 26 dff. TOF 8 -0,0267 101,5 27 dff. TOF 8 -0,0267 101,5 27 dff. TOF SUM AVG 0,0019 93,6 - Write TOF Values to File - Baudrate 13200 - Open TOF Graph Oblater, Calibration 0,63 0,83 0 0,03 0,63 0,63 - 0 Dent Winte D File Pulse Width Ratio UP Pulse Width Ratio DOWN Selected Baudrate 0 0,63 0,83 0,72 -							Comm. w/ GP30 OK		Ampitude measurement
25 diff. TOF 7 -0.0610 -0.0610 92,4 -<								1	Measurement Values
26 diff. TOF 8 -0,0257 -0,0257 101,5 27 diff. TOF SUM AVG 0,0019 33,6								# Name R	esults / mV Std Dev. / mV With Result Avgd
27 diff. TOF SUM AVG 0.0019 93,6 V Write TOF Values to File Baudrate 18300 3 AVI down 0,35 0,72 v Open TOF Graph Oblaser, Calibration 0,63 0,93 0,92 v Calibration Values Image: Calibration Values Image: Calibration Values Image: Calibration Values Image: Calibration Values Image: Calibration Values									
Write TOF Values to File Baudrate 4800 Open TOF Graph Values f. Calibration Pulse Wridth Ratio UP Pulse Wridth Ratio DOWN Baudrate 115200 Open TOF Graph Values f. Calibration 0.63 0.63 Selected Baudrate 115200							O UART - Interface		
Calibration Values Calibration Value Value Value Values Calibration Value Value Value Value Values Calibration Value V	27 diff. TOF		1.1	0,0019	39,0	~		3 AM diff	0,35 0,72 🗸
Open TOF Graph O'klue f. Calibration 0.63 0.63 Selected Baudrate I AM ACAL High 2513.06									Calibration Values
Open TOF Graph OValues f. Calibration 0.63 0.63 Selected Baudrate 1 AM CAL High 2513,08				Pulse Width Ratio UP	Pulse Width Ratio D	OWN	Baudrate 115200	=	Name Results ^
Q AB TOE Volume 1270.24	Open TOF Graph	h 🔿 Values f.	. Calibration				Selected Baudrate	1	AM CAL High 2513,08
4800 2 AM CAE LOW 12/3/34 V			Values	14-2	0,00	_	4800	2	AM CAL Low 1279,34 🗸

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2.3 Assembler File Description

- Open .asm file and adjust date, file name, author and notes on changes
- Tip: Double click on the #include files to show them on the menu tab.
- Search for the section of the source code that is designated to custom code

Figure 3 : Spots for Custom Code



3 Assembler Programming

3.1 Declaration

First, variables and constants should be declared. In our example, these are:

- NUMBER_OF_RUNS. Counts the number of TOF measurements
- DEBUG_ADDR_xx determines the USER RAM address for debugging.
- DEBUG_CONTENT_xx uses different values for debugging.
- REV_ADDRESS_VAR is the location of the version number in the FW hex code.
- FW_VERSION stands for the complete version number, including 4 bytes (ROM version, FW type and version number, major and minor release number, build).

Figure 4 : Parameter Declaration

42	;	= CONSTANTS / DE	FINITIONS ====================================
43	; The following is used for de	ebugging	
44	CONST NUMBER_OF_RUNS	0x40	; Counts the runs (for debugging)
45	CONST DEBUG_ADDR_01	0x41	; Address (for debugging)
46	CONST DEBUG_CONTENT_01	0x101010	; Specified content (for debugging)
47	CONST DEBUG_ADDR_02	0x42	; Address (for debugging)
48	CONST DEBUG_CONTENT_02	0x202020	; Specified content (for debugging)
49			
50	CONST_REV_ADDRESS_VAR	3996	; location of Version number in FW hex code with empty chip
51			
52	CONST FW_ROMVERSION_REV	0xA1	; ROM version
53	CONST FW_VERSION_NUM	0xF10000	; F denots ams example code
54	CONST FW_VERSION_MAJ	0x001000	; Major version 1
55	CONST FW_VERSION_MIN	0x000100	; Minor version 1
56	CONST FW_VERSION_BLD	0x000001	; Current build 01
57	CONST FW_VERSION	FW_VERSION_NUM	+ FW_VERSION_MAJ + FW_VERSION_MIN + FW_VERSION_BLD ;
50			

After declaration we add a code snippet that:

- Increment the register at location (NUMBER_OF_RUNS).
- Jump once into MK_FW_INIT subroutine after the start to initialize TDC-GP30 with needed details.
- Jump at the error in the MK_OWN_EH subroutine for error handling.
- Read the BNR_TOF_UPD flag (TOF Update) in register SRR_FEP_STF (status register). If this bit is set, jump into MK_OWN_CODE subroutine.



Figure 5 : Custom Code 1

```
_____
63
64
   ;======================= Check of CPU Requests - Main Firmware routine
65
   125
66
   ; This routine checks the status flags for activity requests and calls the according routines
   ; Inputs : Status flags in SRR_FEP_STF, SRR_ERR_FLG and SHR_CPU_REQ
; Output : all processing done and status flags cleared
67
68
   ; (total)unused : (all used)
69
   ; Temporary RAM : -
71
   ; Permanent RAM :
72
   ; Routines used :
73
74
75
   MK CPU REQ:
76
77
   ; ----- Counts the runs (for debugging)
    ramadr NUMBER_OF_RUNS
79
     incr r
80
   ; -----
81
   82
   84
85
86
87
   88
   89
90
91
92
93
94
95
   ramadr SRR_FEP_STF ;-- Set RAM Address to SRR_FEP_STF
skipBitC r, BNR_TOF_UPD, 1 ;-- Check US_TOF_UPD Flag
jsub MK_OWN_CODE ;-- Jump to User Code
96
97
98
99
  MK_STOP:
     ramadr SHR_CPU_REQ ; Set RAM Address to SHR_CPU_REQ
clear r ; Clear SHR_CPU_REQ
104
     clear
105
106
     clrwdt.
                            ; Clearing watchdog
  stop
108
   109
       End of Main Program MK_CPU_REQ
```

3.2 Initialization of TDC-GP30

The call of the subroutine MK_FW_INIT is important to initialize TDC-GP30. Especially to initialize the USER RAM cells to zero, to load the First Hit Level (FHL) into the System Handling Register (SHR) and to clear the Firmware Init Flag.

Figure 6 : Initialization of TDC-GP30

```
186
   :------
   ;=================== place your own code here for initialization
187
   188
   ; The subroutine is to configure a fixed value for the ZCD_FHL_U and ZCD_FHL D bits.
189
190
   ; These First Hit Level (FHL) values are specific to the hardware.
191
   ; Inputs
192
   ; Output
              .
193
   ; (total)unused : (all used)
194
   ; Temporary RAM : -
   ; Permanent RAM : -
195
196
   ; Routines used : -
197
    198
199
   MK_FW_INIT:
200
201
      jsub
              ROM USER RAM INIT
                             ; Initialising all USER RAM cells to 0
202
              FWD R1 FHL VALUE
                              ;---- Value for the first hit level
203
      ramadr
204
      move
              x, r
205
206
              SHR_ZCD_FHL_U
                              ; Setting the same FHL for Up and Down
      ramadr
207
      move
              r, x
208
              SHR_ZCD_FHL_D
      ramadr
209
      move
              r, x
210
211
   MK_FW_INIT_END:
212
213
      ramadr
              SHR_CPU_REQ
                              ; Set RAM Address to SHR_CPU_REQ
214
              r, BNR_FWI
                              ; Clear Firmware Init Flag
      bitclr
215
216
      jsubret
                              ; Jump Back
217
    218
219
        End of Subroutine MK FW INIT
    :
220
```

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3.3 Error Handling

The subroutine is not active yet as it is not written for now. This routine only clears the error flag register.

Figure 7 : Error Handling Subroutine

```
113
   ;======================== place your own code here for error handling
114
   115
116 ; The subroutine is not active yet and just clears the error flag register
          :
117
   ; Inputs
                 _
118 ; Output
119 ; (total)unused : (all used)
120
   ; Temporary RAM : -
121
   ; Permanent RAM : -
122
   ; Routines used : -
123
   ;======
124
125 MK OWN EH:
126
127
   ; ----- Writes into RAM (for debugging)
    move y, DEBUG_CONTENT_01
ramadr DEBUG_ADDR_01
128
129
     move r, y
130
131 ; -----
132
133
     134
     nop
                           ;---
135
   ;
                           ;---
      nop
                           ;---
136 ; nop
137
   ; nop
                            ;---
      138
139
140 MK_OWN_EH_END:
141
     ramadr SHR_EXC ; Set RAM Address to SHR_EXC
bitset r, BNR_EF_CLR ; clear error flag register
142
                             ; Set RAM Address to SHR EXC
143
144
145
      jsubret
146
147
   .....
148 ; End of Subroutine MK OWN EH
```

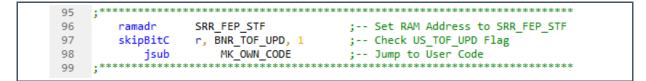
3.4 Jump to Toggling Subroutine

The subroutine does the following:

- Checks, whether a TOF measurement triggered the CPU
- If yes, Jump to MK_OWN_CODE

Figure 8 :

Main Custom Subroutine



- Set the pointer address to the SHR_GP0 register (GPO control register).
- Set and clear bit BNR_GP04_OUT (GPIO4). This timing takes about 200 ns, which corresponds to the time needed by DSP clock to set and clear the GPIO.
- Return to previous routine.

Figure 9 : Main Custom Subroutine

```
151
   ;====== place your own code here for post processing
152
   ;------
153
                                        154
   ; The subroutine is simple firmware for toggling GPIO output
155
   ; Inputs : -
   ; Output
156
             .
   ; (total)unused : (all used)
157
158
   ; Temporary RAM : -
   ; Permanent RAM : -
159
160
   ; Routines used : -
   ;----
161
            _____
162
163
   MK OWN CODE:
164
165
   ; ----- Writes into RAM (for debugging)
166
     move y, DEBUG_CONTENT_02
167
     ramadr DEBUG_ADDR_02
168
     move r, y
169
   ; -----
170
   ; ~400us after TOF measurement (including both directions)
171
172
      ramadr SHR_GPO
                         ; set and reset takes about ~200ns
173
      bitset
             r, BNR_GPO4_OUT
174
            r, BNR_GPO4_OUT
      bitclr
175
      ; bitinv r, BNR GPO4 OUT ; toggling between the TOF measurements
176
177
178 MK_OWN_END:
179
180
      jsubret
181
182
   End of Subroutine MK_OWN_CODE
183
184
```



3.5 Compile

- Select the Assembler menu, Compile (or press F5)
- After pressing Compile and Download, the output window should show "Processing was successful" and "Hex-File transferred to Download window". The Compile Options are used to configure whether the download is executed after each compile.

Figure 10 : Assembler Output

As	sembler - C:\Users\m	hai\Desktop\TO DO\App Note\UFC\GP30Y_Example_toggling\data\GP30Y_A1.02.11.04_GPI0_toggling.asm	-	\times
File 8	dit Find Assembl	e Help		
	Comp			
	Comp	ile Options Ctrl+F5		
GP30Y	A1.D2.11.0 Down	CO_RIZIN GFOU_RIDZIICHIN GFOU_ROM_RICONNICHI		
109	Assen	blerinfo RAM (for debugging)		
110	move y, DEE	UG CONTENT 02		
111	ramadr DEBL	IG_ADDR_02		
112	move r, y			
113	;			
114				
115 116	stop			
116				
118		ain Program NK CPU REO		
119				
120	·			
121				
122				
123		place your own code here		
124				
125 126		e is not active yet and just clears the GPH flag		
126	; Inputs ; Output			
128	; (total)unused			
129	; Temporary RAM			
130	; Permanent RAM			
131	; Routines used			
132				
133				
134	; place your ow	n code here !!!!!		
135				
136 137	MK_OWN_CODE:	TOF measurement (including both directions)		- 1
137	; ~400us atter ramadr	IUP measurement (including both directions) SHR GPO : set and reset takes about ~200ns		
139	bitset	secand resectates about #200ms		
140	bitclr	, BNR GPOA GUT		
141				
142	;bitinv	r, BNR_GP04_OUT ; toggling between the TOF measurements		
143				
144	MK_OWN_END:			
145	ramadr	OWN_FLAG		
146	bitclr	r, BNR_GPIO		
147	de de set			
148	jsubret			
149				

3.6 Download Code to the Target

Attention

Be sure that the TDC-GP30 is idle.

- Open .asm file and .dat file.
- Press button "Verify FW".
- Copy "Calculated Checksum by GP30" to field "Checksum FWA manual entry".
- Press button "Download FW Code & Data".



Information

The assembler transfers the compiled code directly into the download window. So the new code can be downloaded directly by pressing "Download FW Code".

Figure 11 :

Firmware Download Window

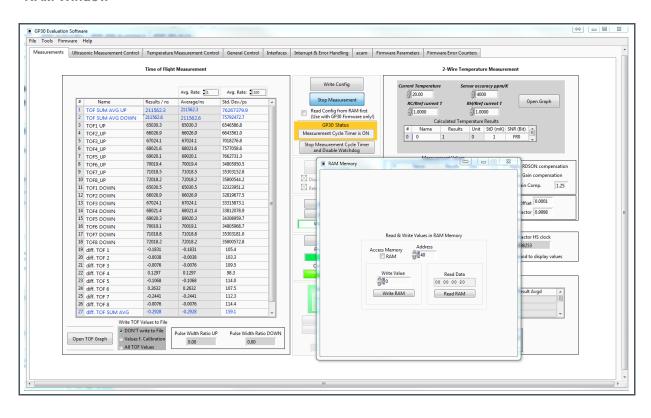
	Firmware User Code		Firmware Da	ta	
ownload Firmware		File: GP30Y_A1.F1.11.01_GPIO_toggling.dat			
Code and Data	File: GP30Y_A1.F1.11.01_GPIO_toggling.hex	Open File	FW Data 1	FW Data	2
Code and Data	Open File F2 40 FB F2 DC 61 2B CA 00 3B F2 E1 0F 49 CA 00 A 1E F2 E2 E1 33 CA 00 2C F2 DC 0B CB 01 CD 75 00	Reload File	# Value	# Value # Value	# Value
	10 10 10 F2 41 7D 00 F2 DD F1 27 CF 75 00 20 20		0 0000000	32 1A312D53 64 FFFA3B9B	96 0000000
	20 F2 42 7D F2 D3 F1 33 F1 13 CF CA F6 AA F3 6B	Save File	1 00000000	33 2F414C49 65 00000000	97 03E80000
Start Measurement	Reload File 73 F2 DA 7C F2 DB 7C F2 DC F1 17 CF 00 00 00 00 00 00 00 00 00 00 00 00 00	Transfer Configuration Settings	2 0000000	34 26484C8B 66 0000000	98 0000000
			3 FFFFFFFF	35 2E2C6372 67 00000000	99 00000000
	00 00 00 00 00 00 00 00 00 00 00 00 00	Configuration from GUI to FW Data 2	4 FFFFFFF	36 1C5B6082 68 00000000	100 0029F000
System Reset	Download FW Code 00 00 00 00 00 00 00 00 00 00 00 00 00	Configuration from FW Data 2 to GUI	5 0000000	37 494B55B4 69 00000000	101 00000000
	Download FW Code 00 00 00 00 00 00 00 00 00 00 00 00 00		6 0000000	38 505B5B84 70 0000000	102 00000000
		Transfer Calibration Parameters	7 0000000	39 6B715C7C 71 02250000	103 03C20000
	00 00 00 00 00 00 00 00 00 00 00 00 00	Calibration Parameters from File to FW Data 2	8 00000000	40 71675873 72 02250000	104 00010000
Check Status Flags	00 00 00 00 00 00 00 00 00 00 00 00 00	(opens file dialog)	9 0000000	41 00000000 73 02250000	105 00010000
		Transfer Firmware Parameters	10 0000000	42 FEE90711 74 00061400	106 38000110
Watchdog Disabled	00 00 00 00 00 00 00 00 00 00 00 00 00		11 00000000	43 FFFFE713 75 002CA2E2	107 00000055
FW Unlocked	00 00 00 00 00 00 00 00 00 00 00 00 00	From FW Parameters sheet to FW Data	12 00000000	44 00004C4C 76 000F6C3A	108 00000000
PW Onlocked		To FW Parameters sheet from FW Data	13 00000000	45 FF2B93F9 77 004A002B	109 00140020
	······································		14 00000000	46 FFFFE6A3 78 00000020	110 80000000
	Checksums	Set Bootloader Release Code	15 00000000	47 00006161 79 00000755	111 10215000
	Checksdins	Set boollouder herease code	16 6004010C	48 FF86F4CD 80 0007FFFF	112 0111F3FF
Download FW Code & Data	Calculated by Software	Download FW Data	17 D4A75A32	49 FFFFEF04 81 0001FFFF	113 004ECAE8
			18 00000000	50 00001BFB 82 0009C400	114 0091E080
System Reset and Start Measurement		Recall FW Data	19 00000067	51 FF997E5B 83 00000001	115 00793400
after Download	Read from FWD2 2AD1 🕒 PASS	Read EW Data	20 000004F9	52 FFFFEB73 84 00200000	116 04002824
			21 000007AB	53 000057F4 85 003C0000	117 03E70C83
Lock FW after Download	A1F11101 User FW Revision FA0 User FW Range	Checksums FWD1	22 00000B07	54 000CB86D 86 0000000	118 00002C10
		Calculated by Software	23 00000E43	55 00151F37 87 0000000C	119 0000D081
			24 000012DF	56 001C8A44 88 00002C94	120 84A0C47C
	Firmware Acam Code	Calculated by GP30 11CC	25 00001B53	57 00357176 89 00000004	121 401725CF
Verify FW		Read from FWD2 11CC	26 00002C4A	58 0097C276 90 00000010	122 00270808
	Checksums		27 000040AD	59 0000724A 91 0000000A	123 ABCD7654
	Calculated by GP30 2193	Checksums FWD 2	28 000054A4	60 00000F5C 92 00000BB8	124 000011CC
		Calculated by Software 58D9	29 00012170	61 000004BD 93 FFFA0000	125 000058D9
	Read from FWD2 2193 OPASS		30 0000000	62 FFFA3B9B 94 0000000B	126 00002AD1
Erase FW		Calculated by GP30 58D9 OPASS	31 1B193E25	63 FFFA3B9B 95 00008000	127 00002193
	2193 Checksum FWA manual entry A1E21102 acam FW Revision	Read from FWD2 58D9 OPASS			

4 Summary / Results

4.1 Verify Code Executing Properly

• Read registers 0x40 in the RAM memory, either by menu items Tools-RAM Memory or by the CPU Values window.

Figure 12 : RAM Window



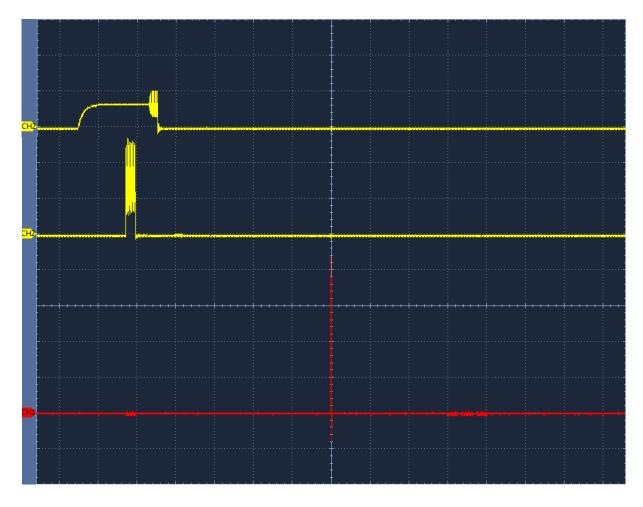


Of course, monitoring the signal at GPIO4 is the final verification. In this example, the GPIO4 is toggling after each TOF Cycle.

See Figure 13 below, red waveform refers to GPIO4 and yellow waveforms refer to TOF Cycle.

Figure 13:

Pulse at GPIO4 after TOF Measurement Sequence



(time base = 100 µs/division; voltage = 1 V/division)

amu

5 Revision Information

Changes from previous version to current revision v1-00

Page

Initial version for release

• Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.

Correction of typographical errors is not explicitly mentioned.

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