

MAXREFDES70# Code Documentation

V02.00

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Contents

1	Main Page	1
1.1	Introduction	1
2	Data Structure Index	3
2.1	Data Structures	3
3	File Index	5
3.1	File List	5
4	Data Structure Documentation	7
4.1	Energy_ResultsStruct Struct Reference	7
4.1.1	Detailed Description	7
4.1.2	Field Documentation	7
4.1.2.1	EnthalpyAtCold_JperKg	7
4.1.2.2	EnthalpyAtHot_JperKg	7
4.1.2.3	EnthalpyDelta_JperKg	7
4.1.2.4	MassFlow_kgPerh	7
4.2	Flow_ResultsStruct Struct Reference	8
4.2.1	Detailed Description	8
4.2.2	Field Documentation	8
4.2.2.1	FlowVelocity_mPerS	8
4.2.2.2	TOF_DIFF_DeltaT_S	8
4.2.2.3	TOF_DiffData	8
4.2.2.4	VolumetricFlow_m3PerS	8
4.2.2.5	VolumetricFlowCorrected_m3PerS	8
4.2.2.6	VolumetricFlowGainFactor	8
4.3	Hit_ResultsStruct Struct Reference	9
4.3.1	Detailed Description	9
4.3.2	Field Documentation	9
4.3.2.1	Hit1Data	9

4.3.2.2	Hit2Data	9
4.3.2.3	Hit3Data	9
4.3.2.4	Hit4Data	9
4.3.2.5	Hit5Data	9
4.3.2.6	Hit6Data	9
4.3.2.7	HitAverageData	9
4.3.2.8	t1Ratior2	10
4.3.2.9	t2RatiorIdeal	10
4.4	PointOfTimeSampleDataStruct Struct Reference	10
4.4.1	Detailed Description	10
4.4.2	Field Documentation	10
4.4.2.1	POT_EnergyFactors	10
4.4.2.2	POT_FlowFactors	10
4.4.2.3	POT_TemperatureData	10
4.4.2.4	POT_TimeData	10
4.5	Temperature_ResultsStruct Struct Reference	11
4.5.1	Detailed Description	11
4.5.2	Field Documentation	11
4.5.2.1	Register_Value	11
4.5.2.2	TemperatureDegreeC	11
4.6	TemperatureResultsAllPortsStruct Struct Reference	11
4.6.1	Detailed Description	11
4.6.2	Field Documentation	11
4.6.2.1	TempResultsAllPorts	11
4.7	tm_withMilli Struct Reference	12
4.7.1	Detailed Description	12
4.7.2	Field Documentation	12
4.7.2.1	milliSeconds	12
4.7.2.2	Time	12
5	File Documentation	13
5.1	src/batteryLevel.c File Reference	13
5.1.1	Function Documentation	13
5.1.1.1	batteryLevel	13
5.1.1.2	WaitForComparatorUpdate	13
5.2	src/batteryLevel.h File Reference	14
5.2.1	Detailed Description	14

5.2.2	Function Documentation	15
5.2.2.1	BatteryLevel	15
5.3	src/dogm163.c File Reference	15
5.3.1	Detailed Description	16
5.3.2	Function Documentation	16
5.3.2.1	Delay	16
5.3.2.2	DOGM163_ClearChars	17
5.3.2.3	DOGM163_Init	17
5.3.2.4	DOGM163_PowerOff	17
5.3.2.5	DOGM163_PrintChars	17
5.3.2.6	DOGM163_PrintInteger	17
5.3.2.7	DOGM163_PrintWelcomeMsg	17
5.3.2.8	DOGM163_SpiTransmit	17
5.3.2.9	DOGM163_WriteCmdByte	17
5.3.2.10	DOGM163_WriteDataByte	18
5.4	src/dogm163.h File Reference	18
5.4.1	Detailed Description	19
5.4.2	Function Documentation	19
5.4.2.1	DOGM163_ClearChars	19
5.4.2.2	DOGM163_Init	19
5.4.2.3	DOGM163_PowerOff	20
5.4.2.4	DOGM163_PrintChars	20
5.4.2.5	DOGM163_PrintInteger	20
5.4.2.6	DOGM163_PrintWelcomeMsg	20
5.4.2.7	DOGM163_SpiTransmit	20
5.4.2.8	DOGM163_WriteCmdByte	20
5.4.2.9	DOGM163_WriteDataByte	21
5.5	src/lookUpTables.h File Reference	21
5.5.1	Variable Documentation	21
5.5.1.1	PT1000_LOOKUPTABLE	21
5.5.1.2	SPEED_OF_SOUND_LOOKUP	21
5.5.1.3	VOLUMETRIC_FLOW_CORRECTION_TABLE	22
5.5.1.4	WATER_DENSITY_LOOKUPTABLE	22
5.5.1.5	WATER_ENTHALPY_LOOKUPTABLE	22
5.6	src/MAXREFDES70.c File Reference	23
5.6.1	Detailed Description	26
5.6.2	Macro Definition Documentation	27

5.6.2.1	AVGDOWN_REG	27
5.6.2.2	AVGUP_REG	27
5.6.2.3	BLOCK_ERASE_FLASH	27
5.6.2.4	CALIBRATES	27
5.6.2.5	COLD_TEMP_PORT	27
5.6.2.6	DAY_DATE	27
5.6.2.7	EVTMG1	28
5.6.2.8	EVTMG2	28
5.6.2.9	EVTMG3	28
5.6.2.10	HALT	28
5.6.2.11	HFRCO_FREQUENCY	28
5.6.2.12	HIT1DOWN_REG	28
5.6.2.13	HIT1UP_REG	28
5.6.2.14	HIT2DOWN_REG	28
5.6.2.15	HIT2UP_REG	28
5.6.2.16	HIT3DOWN_REG	28
5.6.2.17	HIT3UP_REG	28
5.6.2.18	HIT4DOWN_REG	29
5.6.2.19	HIT4UP_REG	29
5.6.2.20	HIT5DOWN_REG	29
5.6.2.21	HIT5UP_REG	29
5.6.2.22	HIT6DOWN_REG	29
5.6.2.23	HIT6UP_REG	29
5.6.2.24	HOT_TEMP_PORT	29
5.6.2.25	INITIALIZE	29
5.6.2.26	INTERRUPT_REG_TE	29
5.6.2.27	INTERRUPT_REG_TEMP_EVTMG	29
5.6.2.28	INTERRUPT_REG_TO	29
5.6.2.29	INTERRUPT_REG_TOF	30
5.6.2.30	INTERRUPT_REG_TOF_EVTMG	30
5.6.2.31	INTERRUPT_REG_TOF_FLASH	30
5.6.2.32	INTERRUPT_STATUS	30
5.6.2.33	LDO_OFF	30
5.6.2.34	LDO_ON	30
5.6.2.35	LDO_TIMED	30
5.6.2.36	LSBIT_TOF_VALUE	30
5.6.2.37	MAX35101_CS_High	30

5.6.2.38 MAX35101_CS_Low	30
5.6.2.39 MAX_DISPLAY_REPEAT	30
5.6.2.40 MINS_HRS	31
5.6.2.41 MONTH_YEAR	31
5.6.2.42 NO_RX	31
5.6.2.43 NO_TX	31
5.6.2.44 NUMBER_TEMPERATUE_PORTS_USED	31
5.6.2.45 PI	31
5.6.2.46 PIPELENGTH_IN_FLOW_M	31
5.6.2.47 PIPERADIUS_M	31
5.6.2.48 READ_FLASH	31
5.6.2.49 REFERENCE_TEMP_PORT	31
5.6.2.50 RESET	31
5.6.2.51 RTD_RREF_VALUE	32
5.6.2.52 SECONDS	32
5.6.2.53 SECONDS_PER_HR	32
5.6.2.54 SPI_BAUDRATE	32
5.6.2.55 SPI_PERCLK_FREQUENCY	32
5.6.2.56 T1_AVG	32
5.6.2.57 T1_REG	32
5.6.2.58 T2_AVG	32
5.6.2.59 T2_REG	32
5.6.2.60 T3_AVG	32
5.6.2.61 T3_REG	32
5.6.2.62 T4_AVG	33
5.6.2.63 T4_REG	33
5.6.2.64 T4MHZ	33
5.6.2.65 TEMPERATURE	33
5.6.2.66 TOF_DIFF	33
5.6.2.67 TOF_DIFF_AVG_REG	33
5.6.2.68 TOF_DIFF_REG	33
5.6.2.69 TOF_DOWN	33
5.6.2.70 TOF_UP	33
5.6.2.71 TRANSFER_TO_FLASH	33
5.6.2.72 USING_EVENT_TIMING_MODES_READ_AVERAGE	33
5.6.2.73 WRITE_FLASH	34
5.6.3 Enumeration Type Documentation	34

5.6.3.1	anonymous enum	34
5.6.4	Function Documentation	34
5.6.4.1	Calcuete_Temperature	34
5.6.4.2	Calculate_Energy_Parameters	34
5.6.4.3	Calculate_Enthalpy	34
5.6.4.4	Calculate_Flow_Parameters	34
5.6.4.5	Calculate_Mass_Flow	35
5.6.4.6	Calculate_Piecewise_Energy	35
5.6.4.7	Calculate_Piecewise_Volume	35
5.6.4.8	Calculate_TimeDifference	35
5.6.4.9	Calculate_TOF_Velocity	35
5.6.4.10	Calculate_Volumetric_Flow	35
5.6.4.11	Delay	35
5.6.4.12	Display	35
5.6.4.13	FloatToString	35
5.6.4.14	GPIO_EVEN_IRQHandler	36
5.6.4.15	GPIO_ODD_IRQHandler	36
5.6.4.16	init	36
5.6.4.17	LinearInterpolation	36
5.6.4.18	main	36
5.6.4.19	MAX35101_BlockErase_Flash	36
5.6.4.20	MAX35101_Disable_LDO	36
5.6.4.21	MAX35101_Enable_LDO	36
5.6.4.22	MAX35101_Read_2WordValue	36
5.6.4.23	MAX35101_Read_Flash	36
5.6.4.24	MAX35101_Read_Register	36
5.6.4.25	MAX35101_Send_Opcode	37
5.6.4.26	MAX35101_SendConfigs	37
5.6.4.27	MAX35101_SetTime	37
5.6.4.28	MAX35101_Update_TemperatureData	37
5.6.4.29	MAX35101_Update_TOF_AVG_DIFFData	37
5.6.4.30	MAX35101_Update_TOF_DIFFData	37
5.6.4.31	MAX35101_UpdateAndGetTime	37
5.6.4.32	MAX35101_Write_Flash	37
5.6.4.33	MAX35101_Write_Register	37
5.6.4.34	SPI_Read_Word	37
5.6.4.35	SPI_Send_Byte	37

5.6.4.36	SysTick_Handler	38
5.6.4.37	USART2_sendBuffer	38
5.6.5	Variable Documentation	38
5.6.5.1	delayCount	38
5.6.5.2	DisplayMode	38
5.6.5.3	displayPowerOff	38
5.6.5.4	displayRepeat	38
5.6.5.5	energyAddition	38
5.6.5.6	energyAddition1	38
5.6.5.7	energyAdditionsTracker	38
5.6.5.8	EVT_STARTED	38
5.6.5.9	flags	38
5.6.5.10	InterruptRegisterValue	39
5.6.5.11	Last_TempUpdate	39
5.6.5.12	output	39
5.6.5.13	POR	39
5.6.5.14	POT_Data	39
5.6.5.15	POT_Data_Last	39
5.6.5.16	POTCount	39
5.6.5.17	previousDisplayMode	39
5.6.5.18	reg	39
5.6.5.19	TDF	39
5.6.5.20	TDM	39
5.6.5.21	TMF	40
5.6.5.22	TMM	40
5.6.5.23	TotalEnergy	40
5.6.5.24	TotalVolume_m3	40
5.6.5.25	valueAdditionsTracker	40
5.6.5.26	volumeAddition	40
5.6.5.27	volumeAddition1	40

Chapter 1

Main Page

1.1 Introduction

This is the code documentation for the MAXREFDES70# reference design.

The Files page contains the File List page and the Globals page.

The Globals page contains the Functions, Variables, and Macros sub-pages.

Chapter 2

Data Structure Index

2.1 Data Structures

Here are the data structures with brief descriptions:

Energy_ResultsStruct	7
Flow_ResultsStruct	8
Hit_ResultsStruct	9
PointOfTimeSampleDataStruct	10
Temperature_ResultsStruct	11
TemperatureResultsAllPortsStruct	11
tm_withMilli	12

Chapter 3

File Index

3.1 File List

Here is a list of all files with brief descriptions:

src/ batteryLevel.c	13
src/ batteryLevel.h	14
src/ dogm163.c	15
src/ dogm163.h	18
src/ lookUpTables.h	21
src/ MAXREFDES70.c	23

Chapter 4

Data Structure Documentation

4.1 Energy_ResultsStruct Struct Reference

Data Fields

- float [MassFlow_kgPerh](#)
- float [EnthalpyAtHot_JperKg](#)
- float [EnthalpyAtCold_JperKg](#)
- float [EnthalpyDelta_JperKg](#)

4.1.1 Detailed Description

Definition at line 195 of file MAXREFDES70.c.

4.1.2 Field Documentation

4.1.2.1 float EnthalpyAtCold_JperKg

Definition at line 198 of file MAXREFDES70.c.

4.1.2.2 float EnthalpyAtHot_JperKg

Definition at line 197 of file MAXREFDES70.c.

4.1.2.3 float EnthalpyDelta_JperKg

Definition at line 199 of file MAXREFDES70.c.

4.1.2.4 float MassFlow_kgPerh

Definition at line 196 of file MAXREFDES70.c.

The documentation for this struct was generated from the following file:

- [src/MAXREFDES70.c](#)

4.2 Flow_ResultsStruct Struct Reference

Data Fields

- `int32_t` [TOF_DiffData](#)
- `float` [TOF_DIFF_DeltaT_S](#)
- `float` [FlowVelocity_mPerS](#)
- `float` [VolumetricFlow_m3PerS](#)
- `float` [VolumetricFlowGainFactor](#)
- `float` [VolumetricFlowCorrected_m3PerS](#)

4.2.1 Detailed Description

Definition at line 181 of file MAXREFDES70.c.

4.2.2 Field Documentation

4.2.2.1 `float` FlowVelocity_mPerS

Definition at line 189 of file MAXREFDES70.c.

4.2.2.2 `float` TOF_DIFF_DeltaT_S

Definition at line 188 of file MAXREFDES70.c.

4.2.2.3 `int32_t` TOF_DiffData

Definition at line 187 of file MAXREFDES70.c.

4.2.2.4 `float` VolumetricFlow_m3PerS

Definition at line 190 of file MAXREFDES70.c.

4.2.2.5 `float` VolumetricFlowCorrected_m3PerS

Definition at line 192 of file MAXREFDES70.c.

4.2.2.6 `float` VolumetricFlowGainFactor

Definition at line 191 of file MAXREFDES70.c.

The documentation for this struct was generated from the following file:

- `src/`[MAXREFDES70.c](#)

4.3 Hit_ResultsStruct Struct Reference

Data Fields

- uint32_t [Hit1Data](#)
- uint32_t [Hit2Data](#)
- uint32_t [Hit3Data](#)
- uint32_t [Hit4Data](#)
- uint32_t [Hit5Data](#)
- uint32_t [Hit6Data](#)
- uint32_t [HitAverageData](#)
- char [t1Ratiot2](#)
- char [t2RatiotIdeal](#)

4.3.1 Detailed Description

Definition at line 163 of file MAXREFDES70.c.

4.3.2 Field Documentation

4.3.2.1 uint32_t Hit1Data

Definition at line 164 of file MAXREFDES70.c.

4.3.2.2 uint32_t Hit2Data

Definition at line 165 of file MAXREFDES70.c.

4.3.2.3 uint32_t Hit3Data

Definition at line 166 of file MAXREFDES70.c.

4.3.2.4 uint32_t Hit4Data

Definition at line 167 of file MAXREFDES70.c.

4.3.2.5 uint32_t Hit5Data

Definition at line 168 of file MAXREFDES70.c.

4.3.2.6 uint32_t Hit6Data

Definition at line 169 of file MAXREFDES70.c.

4.3.2.7 uint32_t HitAverageData

Definition at line 170 of file MAXREFDES70.c.

4.3.2.8 char t1RatIot2

Definition at line 171 of file MAXREFDES70.c.

4.3.2.9 char t2RatIotIdeal

Definition at line 172 of file MAXREFDES70.c.

The documentation for this struct was generated from the following file:

- src/[MAXREFDES70.c](#)

4.4 PointOfTimeSampleDataStruct Struct Reference

Data Fields

- [Flow_ResultsStruct POT_FlowFactors](#)
- [Energy_ResultsStruct POT_EnergyFactors](#)
- [tm_withMilli POT_TimeData](#)
- [TemperatureResultsAllPortsStruct POT_TemperatureData](#)

4.4.1 Detailed Description

Definition at line 202 of file MAXREFDES70.c.

4.4.2 Field Documentation

4.4.2.1 Energy_ResultsStruct POT_EnergyFactors

Definition at line 204 of file MAXREFDES70.c.

4.4.2.2 Flow_ResultsStruct POT_FlowFactors

Definition at line 203 of file MAXREFDES70.c.

4.4.2.3 TemperatureResultsAllPortsStruct POT_TemperatureData

Definition at line 206 of file MAXREFDES70.c.

4.4.2.4 tm_withMilli POT_TimeData

Definition at line 205 of file MAXREFDES70.c.

The documentation for this struct was generated from the following file:

- src/[MAXREFDES70.c](#)

4.5 Temperature_ResultsStruct Struct Reference

Data Fields

- uint32_t [Register_Value](#)
- float [TemperatureDegreeC](#)

4.5.1 Detailed Description

Definition at line 152 of file MAXREFDES70.c.

4.5.2 Field Documentation

4.5.2.1 uint32_t Register_Value

Definition at line 153 of file MAXREFDES70.c.

4.5.2.2 float TemperatureDegreeC

Definition at line 154 of file MAXREFDES70.c.

The documentation for this struct was generated from the following file:

- src/[MAXREFDES70.c](#)

4.6 TemperatureResultsAllPortsStruct Struct Reference

Data Fields

- [Temperature_ResultsStruct TempResultsAllPorts](#) [NUMBER_TEMPERATUE_PORTS_USED]

4.6.1 Detailed Description

Definition at line 158 of file MAXREFDES70.c.

4.6.2 Field Documentation

4.6.2.1 Temperature_ResultsStruct TempResultsAllPorts[NUMBER_TEMPERATUE_PORTS_USED]

Definition at line 159 of file MAXREFDES70.c.

The documentation for this struct was generated from the following file:

- src/[MAXREFDES70.c](#)

4.7 tm_withMilli Struct Reference

Data Fields

- struct tm [Time](#)
- uint32_t [milliSeconds](#)

4.7.1 Detailed Description

Definition at line 176 of file MAXREFDES70.c.

4.7.2 Field Documentation

4.7.2.1 uint32_t milliSeconds

Definition at line 178 of file MAXREFDES70.c.

4.7.2.2 struct tm Time

Definition at line 177 of file MAXREFDES70.c.

The documentation for this struct was generated from the following file:

- src/[MAXREFDES70.c](#)

Chapter 5

File Documentation

5.1 src/batteryLevel.c File Reference

```
#include "batteryLevel.h"
#include "em_chip.h"
#include "em_device.h"
#include "em_cmu.h"
#include "em_system.h"
#include "em_vcmp.h"
```

Functions

- void [WaitForComparatorUpdate](#) ()
Wait for comparator propagation delay.
- int [batteryLevel](#) (void)
Check battery voltage (connected to EFM32 VDDIO).

5.1.1 Function Documentation

5.1.1.1 int batteryLevel (void)

Check battery voltage (connected to EFM32 VDDIO).

Continuously compare battery voltage against a VCMP trigger level, if VCMPOUT is negative, use that level as battery voltage.

Definition at line 76 of file batteryLevel.c.

5.1.1.2 void WaitForComparatorUpdate ()

Wait for comparator propagation delay.

Definition at line 58 of file batteryLevel.c.

5.2 src/batteryLevel.h File Reference

Functions

- int [BatteryLevel](#) (void)

5.2.1 Detailed Description

```
Project: MAXREFDES70
Filename: batteryLevel.c
Description: This module contains the battery level test function for the
             implementation of the example
             program for the MAXREFDES70.
```

Revision History:

09-26-2014 Rev 01.00 MG Initial release.

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```
Project: MAXREFDES70
Filename: batteryLevel.h
Description: This module contains the battery level test function for the
             implementation of the example
             program for the MAXREFDES70.
```

Revision History:

09-26-2014 Rev 01.00 MG Initial release.

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Definition in file [batteryLevel.h](#).

5.2.2 Function Documentation

5.2.2.1 int BatteryLevel (void)

5.3 src/dogm163.c File Reference

```
#include <stdio.h>
#include "dogm163.h"
#include "batteryLevel.h"
#include "em_cmu.h"
#include "em_gpio.h"
#include "em_usart.h"
```

Functions

- void [Delay](#) (uint32_t dlyTicks)
Delays number of msTick Systicks (typically 1 ms)
- int [DOGM163_SpiTransmit](#) (uint8_t *data, uint32_t len)
Transmit data on the SPI interface.
- int [DOGM163_WriteCmdByte](#) (uint8_t byte)
Write a command byte to the DOGM163.
- int [DOGM163_WriteDataByte](#) (uint8_t byte)
Write a data byte to the DOGM163.
- void [DOGM163_Init](#) (void)
Initialize DOGM163 display.
- void [DOGM163_PowerOff](#) (void)
Power off DOGM163 display.
- int [DOGM163_ClearChars](#) (uint8_t start_row, uint8_t start_column, uint8_t number)
- int [DOGM163_PrintChars](#) (uint8_t start_row, uint8_t start_column, uint8_t number, char *string)

- int [DOGM163_PrintInteger](#) (uint8_t start_row, uint8_t start_column, uint8_t width, uint16_t integer)
- void [DOGM163_PrintWelcomeMsg](#) (void)

5.3.1 Detailed Description

```
Project: MAXREFDES70
Filename: dogm163.c
Description: This module contains the display module functions for the
             implementation of the example
             program for the MAXREFDES70.
```

Revision History:

09-26-2014 Rev 01.00 MG Initial release.

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Definition in file [dogm163.c](#).

5.3.2 Function Documentation

5.3.2.1 void Delay (uint32_t dlyTicks)

Delays number of msTick Systicks (typically 1 ms)

Parameters

<i>dlyTicks</i>	Number of ticks to delay
-----------------	--------------------------

Definition at line 1393 of file MAXREFDES70.c.

5.3.2.2 int DOGM163_ClearChars (uint8_t start_row, uint8_t start_column, uint8_t number)

Definition at line 211 of file dogm163.c.

5.3.2.3 void DOGM163_Init (void)

Initialize DOGM163 display.

This function initializes the DOGM163 display module. Check the battery voltage level to adjust LCD contrast. Calibrated relationship between LCD contrast and battery voltage level: LCD contrast C5|C4|C3|C2|C1|C0 = 85 - battery voltage level (22: 2.4V ... 58: 3.6V, each level increase = 0.034V).

Definition at line 145 of file dogm163.c.

5.3.2.4 void DOGM163_PowerOff (void)

Power off DOGM163 display.

This function completely shut down the DOGM163 display module.

Definition at line 199 of file dogm163.c.

5.3.2.5 int DOGM163_PrintChars (uint8_t start_row, uint8_t start_column, uint8_t number, char * string)

Definition at line 226 of file dogm163.c.

5.3.2.6 int DOGM163_PrintInteger (uint8_t start_row, uint8_t start_column, uint8_t width, uint16_t integer)

Definition at line 244 of file dogm163.c.

5.3.2.7 void DOGM163_PrintWelcomeMsg (void)

Definition at line 266 of file dogm163.c.

5.3.2.8 int DOGM163_SpiTransmit (uint8_t * data, uint32_t len)

Transmit data on the SPI interface.

Parameters

in	<i>data</i>	Pointer to the data to be transmitted.
in	<i>len</i>	Length of data to transmit.

Returns

EMSTATUS code of the operation.

Definition at line 62 of file dogm163.c.

5.3.2.9 int DOGM163_WriteCmdByte (uint8_t byte)

Write a command byte to the DOGM163.

Parameters

<i>in</i>	<i>byte</i>	Byte to be wirtten to DOGM163.
-----------	-------------	--------------------------------

Returns

EMSTATUS code of the operation.

Definition at line 97 of file dogm163.c.

5.3.2.10 int DOGM163_WriteDataByte (uint8_t byte)

Write a data byte to the DOGM163.

Parameters

<i>in</i>	<i>byte</i>	Byte to be written to DOGM163.
-----------	-------------	--------------------------------

Returns

EMSTATUS code of the operation.

Definition at line 122 of file dogm163.c.

5.4 src/dogm163.h File Reference

```
#include <stdint.h>
```

Functions

- int [DOGM163_SpiTransmit](#) (uint8_t *data, uint32_t len)
Transmit data on the SPI interface.
- int [DOGM163_WriteCmdByte](#) (uint8_t byte)
Write a command byte to the DOGM163.
- int [DOGM163_WriteDataByte](#) (uint8_t byte)
Write a data byte to the DOGM163.
- void [DOGM163_Init](#) (void)
Initialize DOGM163 display.
- void [DOGM163_PowerOff](#) (void)
Power off DOGM163 display.
- int [DOGM163_ClearChars](#) (uint8_t start_row, uint8_t start_column, uint8_t number)
- int [DOGM163_PrintChars](#) (uint8_t start_row, uint8_t start_column, uint8_t number, char *string)
- int [DOGM163_PrintInteger](#) (uint8_t start_row, uint8_t start_column, uint8_t width, uint16_t integer)
- void [DOGM163_PrintWelcomeMsg](#) (void)

5.4.1 Detailed Description

```
Project: MAXREFDES70
Filename: dogm163.h
Description: This module contains the display module functions for the
             implementation of the example
             program for the MAXREFDES70.
```

Revision History:

09-26-2014 Rev 01.00 MG Initial release.

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Definition in file [dogm163.h](#).

5.4.2 Function Documentation

5.4.2.1 int DOGM163_ClearChars (uint8_t start_row, uint8_t start_column, uint8_t number)

Definition at line 211 of file dogm163.c.

5.4.2.2 void DOGM163_Init (void)

Initialize DOGM163 display.

This function initializes the DOGM163 display module. Check the battery voltage level to adjust LCD contrast. Calibrated relationship between LCD contrast and battery voltage level: LCD contrast C5|C4|C3|C2|C1|C0 = 85 - battery voltage level (22: 2.4V ... 58: 3.6V, each level increase = 0.034V).

Definition at line 145 of file dogm163.c.

5.4.2.3 void DOGM163_PowerOff (void)

Power off DOGM163 display.

This function completely shut down the DOGM163 display module.

Definition at line 199 of file dogm163.c.

5.4.2.4 int DOGM163_PrintChars (uint8_t start_row, uint8_t start_column, uint8_t number, char * string)

Definition at line 226 of file dogm163.c.

5.4.2.5 int DOGM163_PrintInteger (uint8_t start_row, uint8_t start_column, uint8_t width, uint16_t integer)

Definition at line 244 of file dogm163.c.

5.4.2.6 void DOGM163_PrintWelcomeMsg (void)

Definition at line 266 of file dogm163.c.

5.4.2.7 int DOGM163_SpiTransmit (uint8_t * data, uint32_t len)

Transmit data on the SPI interface.

Parameters

in	<i>data</i>	Pointer to the data to be transmitted.
in	<i>len</i>	Length of data to transmit.

Returns

EMSTATUS code of the operation.

Definition at line 62 of file dogm163.c.

5.4.2.8 int DOGM163_WriteCmdByte (uint8_t byte)

Write a command byte to the DOGM163.

Parameters

in	<i>byte</i>	Byte to be wirtten to DOGM163.
----	-------------	--------------------------------

Returns

EMSTATUS code of the operation.

Definition at line 97 of file dogm163.c.

5.4.2.9 int DOGM163_WriteDataByte (uint8_t byte)

Write a data byte to the DOGM163.

Parameters

<i>in</i>	<i>byte</i>	Byte to be written to DOGM163.
-----------	-------------	--------------------------------

Returns

EMSTATUS code of the operation.

Definition at line 122 of file dogm163.c.

5.5 src/lookUpTables.h File Reference**Variables**

- const float [WATER_DENSITY_LOOKUPTABLE](#) [151]
- const float [WATER_ENTHALPY_LOOKUPTABLE](#) [151]
- const float [PT1000_LOOKUPTABLE](#) [101][10]
- const float [SPEED_OF_SOUND_LOOKUP](#) [101]
- const float [VOLUMETRIC_FLOW_CORRECTION_TABLE](#) [24][2]

5.5.1 Variable Documentation**5.5.1.1 const float PT1000_LOOKUPTABLE[101][10]**

Definition at line 117 of file lookUpTables.h.

5.5.1.2 const float SPEED_OF_SOUND_LOOKUP[101]**Initial value:**

```
= {
1402.3, 1407.3, 1412.2, 1416.9, 1421.6, 1426.1, 1430.5, 1434.8, 1439.1,
1443.2,
1447.2, 1451.1, 1454.9, 1458.7, 1462.3, 1465.8, 1469.3, 1472.7,
1476.0, 1479.1,
1482.3, 1485.3, 1488.2, 1491.1, 1493.9, 1496.6, 1499.2, 1501.8,
1504.3, 1506.7,
1509.0, 1511.3, 1513.5, 1515.7, 1517.7, 1519.7, 1521.7, 1523.5,
1525.3, 1527.1,
1528.8, 1530.4, 1532.0, 1533.5, 1534.9, 1536.3, 1537.7, 1538.9,
1540.2, 1541.3,
1542.5, 1543.5, 1544.6, 1545.5, 1546.4, 1547.3, 1548.1, 1548.9,
1549.6, 1550.3,
1550.9, 1551.5, 1552.0, 1552.5, 1553.0, 1553.4, 1553.7, 1554.0,
```

```

1554.3, 1554.5,
1554.7, 1554.9, 1555.0, 1555.0, 1555.1, 1555.1, 1555.0, 1554.9,
1554.8, 1554.6,
1554.4, 1554.2, 1553.9, 1553.6, 1553.2, 1552.8, 1552.4, 1552.0,
1551.5, 1551.0,
1550.4, 1549.8, 1549.2, 1548.5, 1547.5, 1547.1, 1546.3, 1545.6,
1544.7, 1543.9,
1543.0 }

```

Definition at line 322 of file lookUpTables.h.

5.5.1.3 const float VOLUMETRIC_FLOW_CORRECTION_TABLE[24][2]

Initial value:

```

= {
    { 0, 0 },
    { 0.0033, 0 },
    { 0.0119, 0.404040 },
    { 0.0162, 0.503703704 },
    { 0.0222, 0.594594595 },
    { 0.0324, 0.668518519 },
    { 0.05256, 0.735159817 },
    { 0.0663, 0.755656109 },
    { 0.09264, 0.815414508 },
    { 0.11796, 0.841302136 },
    { 0.1776, 0.861486486 },
    { 0.2304, 0.880208333 },
    { 0.27, 0.908444444 },
    { 0.35046, 0.899845917 },
    { 0.4941, 0.912932605 },
    { 0.65562, 0.929623867 },
    { 0.9663, 0.934492394 },
    { 1.4703, 0.946337482 },
    { 3, 1 },
    { 4, 1 }
}

```

Definition at line 349 of file lookUpTables.h.

5.5.1.4 const float WATER_DENSITY_LOOKUPTABLE[151]

Definition at line 46 of file lookUpTables.h.

5.5.1.5 const float WATER_ENTHALPY_LOOKUPTABLE[151]

Definition at line 81 of file lookUpTables.h.

5.6 src/MAXREFDES70.c File Reference

```
#include "em_device.h"
#include "em_chip.h"
#include "em_cmu.h"
#include "em_emu.h"
#include "em_gpio.h"
#include <stdio.h>
#include <stdlib.h>
#include <time.h>
#include <stdbool.h>
#include "lookUpTables.h"
#include "dogm163.h"
```

Data Structures

- struct [Temperature_ResultsStruct](#)
- struct [TemperatureResultsAllPortsStruct](#)
- struct [Hit_ResultsStruct](#)
- struct [tm_withMilli](#)
- struct [Flow_ResultsStruct](#)
- struct [Energy_ResultsStruct](#)
- struct [PointOfTimeSampleDataStruct](#)

Macros

- #define [TOF_UP](#) 0x00
- #define [TOF_DOWN](#) 0x01
- #define [TOF_DIFF](#) 0x02
- #define [TEMPERATURE](#) 0x03
- #define [RESET](#) 0x04
- #define [INITIALIZE](#) 0x05
- #define [TRANSFER_TO_FLASH](#) 0x06
- #define [EVTMG1](#) 0x07
- #define [EVTMG2](#) 0x08
- #define [EVTMG3](#) 0x09
- #define [HALT](#) 0x0a
- #define [LDO_TIMED](#) 0x0b
- #define [LDO_ON](#) 0x0c
- #define [LDO_OFF](#) 0x0d
- #define [CALIBRATES](#) 0x0e
- #define [READ_FLASH](#) 0x90
- #define [WRITE_FLASH](#) 0x10
- #define [BLOCK_ERASE_FLASH](#) 0x13
- #define [SECONDS](#) 0x30
- #define [MINS_HRS](#) 0x31
- #define [DAY_DATE](#) 0x32
- #define [MONTH_YEAR](#) 0x33
- #define [INTERRUPT_STATUS](#) 0xFE

- #define T1_REG 0xE7
- #define T2_REG 0xE9
- #define T3_REG 0xEB
- #define T4_REG 0xED
- #define T1_AVG 0xF0
- #define T2_AVG 0xF2
- #define T3_AVG 0xF4
- #define T4_AVG 0xF6
- #define HIT1UP_REG 0xC5
- #define HIT2UP_REG 0xC7
- #define HIT3UP_REG 0xC9
- #define HIT4UP_REG 0xCB
- #define HIT5UP_REG 0xCD
- #define HIT6UP_REG 0xCF
- #define AVGUP_REG 0xD1
- #define HIT1DOWN_REG 0xD4
- #define HIT2DOWN_REG 0xD6
- #define HIT3DOWN_REG 0xD8
- #define HIT4DOWN_REG 0xDA
- #define HIT5DOWN_REG 0xDC
- #define HIT6DOWN_REG 0xDE
- #define AVGDOWN_REG 0xE0
- #define TOF_DIFF_REG 0xE2
- #define TOF_DIFF_AVG_REG 0xE5
- #define INTERRUPT_REG_TO 0x8000
- #define INTERRUPT_REG_TOF 0x1000
- #define INTERRUPT_REG_TE 0x0800
- #define INTERRUPT_REG_TOF_EVTMG 0x0200
- #define INTERRUPT_REG_TEMP_EVTMG 0x0100
- #define INTERRUPT_REG_TOF_FLASH 0x0080
- #define NUMBER_TEMPERATUE_PORTS_USED 3
- #define HOT_TEMP_PORT 0
- #define COLD_TEMP_PORT 1
- #define REFERENCE_TEMP_PORT 2
- #define USING_EVENT_TIMING_MODES_READ_AVERAGE
- #define T4MHZ (float)250/(float)1000000000
- #define LSBIT_TOF_VALUE (1/(float)65536) * T4MHZ
- #define PI 3.14
- #define SECONDS_PER_HR 3600
- #define MAX_DISPLAY_REPEAT 9000
- #define MAX35101_CS_Low() GPIO_PinOutClear(gpioPortB, 8)
- #define MAX35101_CS_High() GPIO_PinOutSet(gpioPortB, 8)
- #define RTD_RREF_VALUE 1000
- #define PIPELENGTH_IN_FLOW_M 0.0717
- #define PIPERADIUS_M 0.008
- #define HFRCO_FREQUENCY 14000000
- #define SPI_PERCLK_FREQUENCY HFRCO_FREQUENCY
- #define SPI_BAUDRATE 1000000
- #define NO_RX 0
- #define NO_TX NO_RX

Enumerations

- enum {
[Display_Off](#) = 0, [Display_Welcome](#) = [Display_Off](#) + 1, [Display_Clock](#) = [Display_Welcome](#) + 1, [Display_Temp](#) = [Display_Clock](#) + 1,
[Display_TOFDIFF](#) = [Display_Temp](#) + 1, [Display_Volumetric_Flow](#) = [Display_TOFDIFF](#) + 1, [Display_Total_Volume](#) = [Display_Volumetric_Flow](#) + 1, [Display_Energy](#) = [Display_Total_Volume](#) + 1,
[Display_TDF_Config](#) = [Display_Energy](#) + 1, [Display_TDM_Config](#) = [Display_TDF_Config](#) + 1, [Display_TMF_Config](#) = [Display_TDM_Config](#) + 1, [Display_TMM_Config](#) = [Display_TMF_Config](#) + 1,
[Display_Last](#) = [Display_TMM_Config](#) + 1 }

Functions

- void [Display](#) (void)
- void [MAX35101_SetTime](#) (void)
- bool [Calculate_Temperature](#) (uint32_t tempRegisterData, uint32_t RefRegisterData, float *TempDestination)
- bool [Calculate_TOF_Velocity](#) (int32_t TOF_DiffData, float *FlowVelocity, float Temperature, float *TOF_DIFF_DeltaT_S)
- void [Calculate_TimeDifference](#) (tm_withMilli *t1, tm_withMilli *t2, float *difference_sec)
- bool [Calculate_Volumetric_Flow](#) (float Velocity_mPerS, float *VolumetricFlow_m3PerS, float *VolumetricGainfactor, float *VolumetricFlowCorrected_m3PerS)
- bool [Calculate_Mass_Flow](#) (float VolumetricFlow_m3PerS, float *MassFlow_kgPerHr, float Temperature)
- bool [Calculate_Enthalpy](#) (float TemperatureAtCold, float TemperatureAtHot, float *EnthalpyAtCold_JperKg, float *EnthalpyAtHot_JperKg, float *DeltaEnthalpy_JperKg)
- bool [Calculate_Piecewise_Energy](#) (PointOfTimeSampleDataStruct *POT1, PointOfTimeSampleDataStruct *POT2, float *EnergyForTime_J)
- bool [Calculate_Piecewise_Volume](#) (PointOfTimeSampleDataStruct *POT1, PointOfTimeSampleDataStruct *POT2, float *Volume_m3)
- bool [MAX35101_Send_Opcode](#) (char opcode)
- bool [MAX35101_Read_Register](#) (char address, uint16_t *results)
- bool [MAX35101_Read_2WordValue](#) (char startingAddress, uint32_t *results)
- bool [MAX35101_Update_TOF_DIFFData](#) (Flow_ResultsStruct *TOF_DIFF_Results)
- bool [MAX35101_UpdateAndGetTime](#) (tm_withMilli *RTCTimeStamp)
- bool [MAX35101_Update_TOF_AVG_DIFFData](#) (Flow_ResultsStruct *TOF_DIFF_Results)
- bool [MAX35101_Write_Register](#) (char address, uint16_t DataToWrite)
- bool [MAX35101_Update_TemperatureData](#) (TemperatureResultsAllPortsStruct *TempResultsToUpdate)
- float [LinearInterpolation](#) (float X1Low, float X2High, float Y1Low, float Y2High, float XnewLookup)
- int [FloatToString](#) (float fNumber, uint8_t precision, char *output)
- void [Delay](#) (uint32_t dlyTicks)
Delays number of msTick SysTicks (typically 1 ms)
- void [init](#) (void)
- bool [SPI_Send_Byte](#) (char dataByte)
- bool [SPI_Read_Word](#) (uint16_t *results)
- bool [MAX35101_SendConfigs](#) (void)
- bool [Calculate_Flow_Parameters](#) (Flow_ResultsStruct *TOF_DIFF_ResultsToUse, TemperatureResultsAllPortsStruct *TemperatureResultsToUse)
- bool [Calculate_Energy_Parameters](#) (Flow_ResultsStruct *TOF_DIFF_ResultsToUse, TemperatureResultsAllPortsStruct *TemperatureResultsToUse, Energy_ResultsStruct *EnergyToUse)
- bool [MAX35101_Enable_LDO](#) (void)
- bool [MAX35101_Disable_LDO](#) (void)
- bool [MAX35101_Write_Flash](#) (uint16_t StartingFlashAddress, uint16_t WriteLength, uint16_t *DataToWrite)

- bool `MAX35101_Read_Flash` (uint16_t FlashAddress, uint16_t ReadLength, uint16_t *DataToRead)
- bool `MAX35101_BlockErase_Flash` (uint16_t AddressBlock)
- void `GPIO_ODD_IRQHandler` (void)
- void `GPIO_EVEN_IRQHandler` (void)
- int `main` (void)
- void `SysTick_Handler` (void)
- void `USART2_sendBuffer` (char *txBuffer, int bytesToSend)

Variables

- `TemperatureResultsAllPortsStruct Last_TempUpdate`
- `PointOfTimeSampleDataStruct POT_Data [1]`
- `PointOfTimeSampleDataStruct POT_Data_Last`
- int `POTCount` = 0
- float `TotalEnergy` = 0
- float `TotalVolume_m3` = 0
- int `POR` = 0
- uint16_t `TDF`
- uint16_t `TDM`
- uint16_t `TMF`
- uint16_t `TMM`
- uint16_t `reg` = 0
- char `output` [49]
- uint8_t `DisplayMode` = `Display_Off`
- uint8_t `previousDisplayMode` = `Display_Off`
- int `displayRepeat` = 0
- bool `displayPowerOff` = true
- bool `EVT_STARTED` = false
- uint32_t `delayCount` = 0
- float `energyAddition` [30]
- float `energyAddition1`
- int `energyAdditionsTracker` = 0
- float `volumeAddition` [30]
- float `volumeAddition1`
- int `volumeAdditionsTracker` = 0
- uint32_t `flags`
- uint16_t `InterruptRegisterValue`

5.6.1 Detailed Description

```

Project: MAXREFDES70
Filename: MAXREFDES70.c
Description: This module contains the Main application for the
             implementation of the example
             program for the MAXREFDES70.
```

Revision History:

09-26-2014 Rev 01.00 MG Initial release.

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Definition in file [MAXREFDES70.c](#).

5.6.2 Macro Definition Documentation

5.6.2.1 **#define AVGDOWN_REG 0xE0**

Definition at line 127 of file MAXREFDES70.c.

5.6.2.2 **#define AVGUP_REG 0xD1**

Definition at line 120 of file MAXREFDES70.c.

5.6.2.3 **#define BLOCK_ERASE_FLASH 0x13**

Definition at line 97 of file MAXREFDES70.c.

5.6.2.4 **#define CALIBRATES 0x0e**

Definition at line 94 of file MAXREFDES70.c.

5.6.2.5 **#define COLD_TEMP_PORT 1**

Definition at line 144 of file MAXREFDES70.c.

5.6.2.6 **#define DAY_DATE 0x32**

Definition at line 103 of file MAXREFDES70.c.

5.6.2.7 #define EVTMG1 0x07

Definition at line 87 of file MAXREFDES70.c.

5.6.2.8 #define EVTMG2 0x08

Definition at line 88 of file MAXREFDES70.c.

5.6.2.9 #define EVTMG3 0x09

Definition at line 89 of file MAXREFDES70.c.

5.6.2.10 #define HALT 0x0a

Definition at line 90 of file MAXREFDES70.c.

5.6.2.11 #define HFRCO_FREQUENCY 14000000

Definition at line 1402 of file MAXREFDES70.c.

5.6.2.12 #define HIT1DOWN_REG 0xD4

Definition at line 121 of file MAXREFDES70.c.

5.6.2.13 #define HIT1UP_REG 0xC5

Definition at line 114 of file MAXREFDES70.c.

5.6.2.14 #define HIT2DOWN_REG 0xD6

Definition at line 122 of file MAXREFDES70.c.

5.6.2.15 #define HIT2UP_REG 0xC7

Definition at line 115 of file MAXREFDES70.c.

5.6.2.16 #define HIT3DOWN_REG 0xD8

Definition at line 123 of file MAXREFDES70.c.

5.6.2.17 #define HIT3UP_REG 0xC9

Definition at line 116 of file MAXREFDES70.c.

5.6.2.18 #define HIT4DOWN_REG 0xDA

Definition at line 124 of file MAXREFDES70.c.

5.6.2.19 #define HIT4UP_REG 0xCB

Definition at line 117 of file MAXREFDES70.c.

5.6.2.20 #define HIT5DOWN_REG 0xDC

Definition at line 125 of file MAXREFDES70.c.

5.6.2.21 #define HIT5UP_REG 0xCD

Definition at line 118 of file MAXREFDES70.c.

5.6.2.22 #define HIT6DOWN_REG 0xDE

Definition at line 126 of file MAXREFDES70.c.

5.6.2.23 #define HIT6UP_REG 0xCF

Definition at line 119 of file MAXREFDES70.c.

5.6.2.24 #define HOT_TEMP_PORT 0

Definition at line 143 of file MAXREFDES70.c.

5.6.2.25 #define INITIALIZE 0x05

Definition at line 85 of file MAXREFDES70.c.

5.6.2.26 #define INTERRUPT_REG_TE 0x0800

Definition at line 134 of file MAXREFDES70.c.

5.6.2.27 #define INTERRUPT_REG_TEMP_EVTMG 0x0100

Definition at line 136 of file MAXREFDES70.c.

5.6.2.28 #define INTERRUPT_REG_TO 0x8000

Definition at line 132 of file MAXREFDES70.c.

5.6.2.29 #define INTERRUPT_REG_TOF 0x1000

Definition at line 133 of file MAXREFDES70.c.

5.6.2.30 #define INTERRUPT_REG_TOF_EVTMG 0x0200

Definition at line 135 of file MAXREFDES70.c.

5.6.2.31 #define INTERRUPT_REG_TOF_FLASH 0x0080

Definition at line 137 of file MAXREFDES70.c.

5.6.2.32 #define INTERRUPT_STATUS 0xFE

Definition at line 105 of file MAXREFDES70.c.

5.6.2.33 #define LDO_OFF 0x0d

Definition at line 93 of file MAXREFDES70.c.

5.6.2.34 #define LDO_ON 0x0c

Definition at line 92 of file MAXREFDES70.c.

5.6.2.35 #define LDO_TIMED 0x0b

Definition at line 91 of file MAXREFDES70.c.

5.6.2.36 #define LSBIT_TOF_VALUE (1/(float)65536) * T4MHZ

Definition at line 233 of file MAXREFDES70.c.

5.6.2.37 #define MAX35101_CS_High() GPIO_PinOutSet(gpioPortB, 8)

Definition at line 308 of file MAXREFDES70.c.

5.6.2.38 #define MAX35101_CS_Low() GPIO_PinOutClear(gpioPortB, 8)

Definition at line 307 of file MAXREFDES70.c.

5.6.2.39 #define MAX_DISPLAY_REPEAT 9000

Definition at line 259 of file MAXREFDES70.c.

5.6.2.40 #define MINS_HRS 0x31

Definition at line 102 of file MAXREFDES70.c.

5.6.2.41 #define MONTH_YEAR 0x33

Definition at line 104 of file MAXREFDES70.c.

5.6.2.42 #define NO_RX 0

Definition at line 1405 of file MAXREFDES70.c.

5.6.2.43 #define NO_TX NO_RX

Definition at line 1406 of file MAXREFDES70.c.

5.6.2.44 #define NUMBER_TEMPERATUE_PORTS_USED 3

Definition at line 142 of file MAXREFDES70.c.

5.6.2.45 #define PI 3.14

Definition at line 235 of file MAXREFDES70.c.

5.6.2.46 #define PIPELENGTH_IN_FLOW_M 0.0717

Definition at line 345 of file MAXREFDES70.c.

5.6.2.47 #define PIPERADIUS_M 0.008

Definition at line 384 of file MAXREFDES70.c.

5.6.2.48 #define READ_FLASH 0x90

Definition at line 95 of file MAXREFDES70.c.

5.6.2.49 #define REFERENCE_TEMP_PORT 2

Definition at line 145 of file MAXREFDES70.c.

5.6.2.50 #define RESET 0x04

Definition at line 84 of file MAXREFDES70.c.

5.6.2.51 #define RTD_RREF_VALUE 1000

Definition at line 314 of file MAXREFDES70.c.

5.6.2.52 #define SECONDS 0x30

Definition at line 101 of file MAXREFDES70.c.

5.6.2.53 #define SECONDS_PER_HR 3600

Definition at line 237 of file MAXREFDES70.c.

5.6.2.54 #define SPI_BAUDRATE 1000000

Definition at line 1404 of file MAXREFDES70.c.

5.6.2.55 #define SPI_PERCLK_FREQUENCY HFRCO_FREQUENCY

Definition at line 1403 of file MAXREFDES70.c.

5.6.2.56 #define T1_AVG 0xF0

Definition at line 110 of file MAXREFDES70.c.

5.6.2.57 #define T1_REG 0xE7

Definition at line 106 of file MAXREFDES70.c.

5.6.2.58 #define T2_AVG 0xF2

Definition at line 111 of file MAXREFDES70.c.

5.6.2.59 #define T2_REG 0xE9

Definition at line 107 of file MAXREFDES70.c.

5.6.2.60 #define T3_AVG 0xF4

Definition at line 112 of file MAXREFDES70.c.

5.6.2.61 #define T3_REG 0xEB

Definition at line 108 of file MAXREFDES70.c.

5.6.2.62 #define T4_AVG 0xF6

Definition at line 113 of file MAXREFDES70.c.

5.6.2.63 #define T4_REG 0xED

Definition at line 109 of file MAXREFDES70.c.

5.6.2.64 #define T4MHZ (float)250/(float)1000000000

Definition at line 232 of file MAXREFDES70.c.

5.6.2.65 #define TEMPERATURE 0x03

Definition at line 83 of file MAXREFDES70.c.

5.6.2.66 #define TOF_DIFF 0x02

Definition at line 82 of file MAXREFDES70.c.

5.6.2.67 #define TOF_DIFF_AVG_REG 0xE5

Definition at line 129 of file MAXREFDES70.c.

5.6.2.68 #define TOF_DIFF_REG 0xE2

Definition at line 128 of file MAXREFDES70.c.

5.6.2.69 #define TOF_DOWN 0x01

Definition at line 81 of file MAXREFDES70.c.

5.6.2.70 #define TOF_UP 0x00

Definition at line 80 of file MAXREFDES70.c.

5.6.2.71 #define TRANSFER_TO_FLASH 0x06

Definition at line 86 of file MAXREFDES70.c.

5.6.2.72 #define USING_EVENT_TIMING_MODES_READ_AVERAGE

Definition at line 149 of file MAXREFDES70.c.

5.6.2.73 #define WRITE_FLASH 0x10

Definition at line 96 of file MAXREFDES70.c.

5.6.3 Enumeration Type Documentation

5.6.3.1 anonymous enum

Enumerator:

Display_Off
Display_Welcome
Display_Clock
Display_Temp
Display_TOFDIFF
Display_Volumetric_Flow
Display_Total_Volume
Display_Energy
Display_TDF_Config
Display_TDM_Config
Display_TMF_Config
Display_TMM_Config
Display_Last

Definition at line 212 of file MAXREFDES70.c.

5.6.4 Function Documentation

5.6.4.1 bool Calculate_Temperature (uint32_t tempRegisterData, uint32_t RefRegisterData, float * TempDestination)

Definition at line 315 of file MAXREFDES70.c.

5.6.4.2 bool Calculate_Energy_Parameters (Flow_ResultsStruct * TOF_DIFF_ResultsToUse, TemperatureResultsAllPortsStruct * TemperatureResultsToUse, Energy_ResultsStruct * EnergyToUse)

Definition at line 417 of file MAXREFDES70.c.

5.6.4.3 bool Calculate_Enthalpy (float TemperatureAtCold, float TemperatureAtHot, float * EnthalpyAtCold_JperKg, float * EnthalpyAtHot_JperKg, float * DeltaEnthalpy_JperKg)

Definition at line 455 of file MAXREFDES70.c.

5.6.4.4 bool Calculate_Flow_Parameters (Flow_ResultsStruct * TOF_DIFF_ResultsToUse, TemperatureResultsAllPortsStruct * TemperatureResultsToUse)

Definition at line 346 of file MAXREFDES70.c.

5.6.4.5 `bool Calculate_Mass_Flow (float VolumetricFlow_m3PerS, float * MassFlow_kgPerHr, float Temperature)`

Definition at line 436 of file MAXREFDES70.c.

5.6.4.6 `bool Calculate_Piecewise_Energy (PointOfTimeSampleDataStruct * POT1, PointOfTimeSampleDataStruct * POT2, float * EnergyForTime_J)`

Definition at line 504 of file MAXREFDES70.c.

5.6.4.7 `bool Calculate_Piecewise_Volume (PointOfTimeSampleDataStruct * POT1, PointOfTimeSampleDataStruct * POT2, float * Volume_m3)`

Definition at line 518 of file MAXREFDES70.c.

5.6.4.8 `void Calculate_TimeDifference (tm_withMilli * t1, tm_withMilli * t2, float * difference_sec)`

Definition at line 482 of file MAXREFDES70.c.

5.6.4.9 `bool Calculate_TOF_Velocity (int32_t TOF_DiffData, float * FlowVelocity, float Temperature, float * TOF_DIFF_DeltaT_S)`

Definition at line 359 of file MAXREFDES70.c.

5.6.4.10 `bool Calculate_Volumetric_Flow (float Velocity_mPerS, float * VolumetricFlow_m3PerS, float * VolumetricGainfactor, float * VolumetricFlowCorrected_m3PerS)`

Definition at line 385 of file MAXREFDES70.c.

5.6.4.11 `void Delay (uint32_t dlyTicks)`

Delays number of msTick Systicks (typically 1 ms)

Parameters

<i>dlyTicks</i>	Number of ticks to delay
-----------------	--------------------------

Definition at line 1393 of file MAXREFDES70.c.

5.6.4.12 `void Display (void)`

Definition at line 1096 of file MAXREFDES70.c.

5.6.4.13 `int FloatToString (float fNumber, uint8_t precision, char * output)`

Definition at line 543 of file MAXREFDES70.c.

5.6.4.14 void GPIO_EVEN_IRQHandler (void)

Definition at line 792 of file MAXREFDES70.c.

5.6.4.15 void GPIO_ODD_IRQHandler (void)

Definition at line 770 of file MAXREFDES70.c.

5.6.4.16 void init (void)

Definition at line 1351 of file MAXREFDES70.c.

5.6.4.17 float LinearInterpolation (float *X1Low*, float *X2High*, float *Y1Low*, float *Y2High*, float *XnewLookup*)

Definition at line 532 of file MAXREFDES70.c.

5.6.4.18 int main (void)

Definition at line 1060 of file MAXREFDES70.c.

5.6.4.19 bool MAX35101_BlockErase_Flash (uint16_t *AddressBlock*)

Definition at line 749 of file MAXREFDES70.c.

5.6.4.20 bool MAX35101_Disable_LDO (void)

Definition at line 692 of file MAXREFDES70.c.

5.6.4.21 bool MAX35101_Enable_LDO (void)

Definition at line 685 of file MAXREFDES70.c.

5.6.4.22 bool MAX35101_Read_2WordValue (char *startingAddress*, uint32_t * *results*)

Definition at line 1297 of file MAXREFDES70.c.

5.6.4.23 bool MAX35101_Read_Flash (uint16_t *FlashAddress*, uint16_t *ReadLength*, uint16_t * *DataToRead*)

Definition at line 726 of file MAXREFDES70.c.

5.6.4.24 bool MAX35101_Read_Register (char *address*, uint16_t * *results*)

Definition at line 1317 of file MAXREFDES70.c.

5.6.4.25 bool MAX35101_Send_Opcode (char opcode)

Definition at line 1284 of file MAXREFDES70.c.

5.6.4.26 bool MAX35101_SendConfigs (void)

Definition at line 1258 of file MAXREFDES70.c.

5.6.4.27 void MAX35101_SetTime (void)

Definition at line 1559 of file MAXREFDES70.c.

5.6.4.28 bool MAX35101_Update_TemperatureData (TemperatureResultsAllPortsStruct * TempResultsToUpdate)

Definition at line 572 of file MAXREFDES70.c.

5.6.4.29 bool MAX35101_Update_TOF_AVG_DIFFData (Flow_ResultsStruct * TOF_DIFF_Results)

Definition at line 603 of file MAXREFDES70.c.

5.6.4.30 bool MAX35101_Update_TOF_DIFFData (Flow_ResultsStruct * TOF_DIFF_Results)

Definition at line 612 of file MAXREFDES70.c.

5.6.4.31 bool MAX35101_UpdateAndGetTime (tm_withMilli * RTCTimeStamp)

Definition at line 662 of file MAXREFDES70.c.

5.6.4.32 bool MAX35101_Write_Flash (uint16_t StartingFlashAddress, uint16_t WriteLength, uint16_t * DataToWrite)

Definition at line 698 of file MAXREFDES70.c.

5.6.4.33 bool MAX35101_Write_Register (char address, uint16_t DatatoWrite)

Definition at line 1332 of file MAXREFDES70.c.

5.6.4.34 bool SPI_Read_Word (uint16_t * results)

Definition at line 1438 of file MAXREFDES70.c.

5.6.4.35 bool SPI_Send_Byte (char dataByte)

Definition at line 1430 of file MAXREFDES70.c.

5.6.4.36 void SysTick_Handler (void)

Definition at line 1385 of file MAXREFDES70.c.

5.6.4.37 void USART2_sendBuffer (char * *txBuffer*, int *bytesToSend*)

Definition at line 1408 of file MAXREFDES70.c.

5.6.5 Variable Documentation**5.6.5.1 uint32_t delayCount = 0**

Definition at line 262 of file MAXREFDES70.c.

5.6.5.2 uint8_t DisplayMode = Display_Off

Definition at line 256 of file MAXREFDES70.c.

5.6.5.3 bool displayPowerOff = true

Definition at line 260 of file MAXREFDES70.c.

5.6.5.4 int displayRepeat = 0

Definition at line 258 of file MAXREFDES70.c.

5.6.5.5 float energyAddition[30]

Definition at line 502 of file MAXREFDES70.c.

5.6.5.6 float energyAddition1

Definition at line 502 of file MAXREFDES70.c.

5.6.5.7 int energyAdditionsTracker = 0

Definition at line 503 of file MAXREFDES70.c.

5.6.5.8 bool EVT_STARTED = false

Definition at line 261 of file MAXREFDES70.c.

5.6.5.9 uint32_t flags

Definition at line 768 of file MAXREFDES70.c.

5.6.5.10 uint16_t InterruptRegisterValue

Definition at line 790 of file MAXREFDES70.c.

5.6.5.11 TemperatureResultsAllPortsStruct Last_TempUpdate

Definition at line 240 of file MAXREFDES70.c.

5.6.5.12 char output[49]

Definition at line 254 of file MAXREFDES70.c.

5.6.5.13 int POR = 0

Definition at line 251 of file MAXREFDES70.c.

5.6.5.14 PointOfTimeSampleDataStruct POT_Data[1]

Definition at line 246 of file MAXREFDES70.c.

5.6.5.15 PointOfTimeSampleDataStruct POT_Data_Last

Definition at line 247 of file MAXREFDES70.c.

5.6.5.16 int POTCount = 0

Definition at line 248 of file MAXREFDES70.c.

5.6.5.17 uint8_t previousDisplayMode = Display_Off

Definition at line 257 of file MAXREFDES70.c.

5.6.5.18 uint16_t reg = 0

Definition at line 253 of file MAXREFDES70.c.

5.6.5.19 uint16_t TDF

Definition at line 252 of file MAXREFDES70.c.

5.6.5.20 uint16_t TDM

Definition at line 252 of file MAXREFDES70.c.

5.6.5.21 uint16_t TMF

Definition at line 252 of file MAXREFDES70.c.

5.6.5.22 uint16_t TMM

Definition at line 252 of file MAXREFDES70.c.

5.6.5.23 float TotalEnergy = 0

Definition at line 249 of file MAXREFDES70.c.

5.6.5.24 float TotalVolume_m3 = 0

Definition at line 250 of file MAXREFDES70.c.

5.6.5.25 int volueAdditionsTracker = 0

Definition at line 517 of file MAXREFDES70.c.

5.6.5.26 float volumeAddition[30]

Definition at line 516 of file MAXREFDES70.c.

5.6.5.27 float volumeAddition1

Definition at line 516 of file MAXREFDES70.c.

Index

AVGDOWN_REG
 MAXREFDES70.c, [27](#)
AVGUP_REG
 MAXREFDES70.c, [27](#)

BatteryLevel
 batteryLevel.h, [15](#)
batteryLevel
 batteryLevel.c, [13](#)
batteryLevel.c
 batteryLevel, [13](#)
 WaitForComparatorUpdate, [13](#)
batteryLevel.h
 BatteryLevel, [15](#)

CALIBRATES
 MAXREFDES70.c, [27](#)
COLD_TEMP_PORT
 MAXREFDES70.c, [27](#)
Calculate_Temperature
 MAXREFDES70.c, [34](#)
Calculate_Energy_Parameters
 MAXREFDES70.c, [34](#)
Calculate_Enthalpy
 MAXREFDES70.c, [34](#)
Calculate_Flow_Parameters
 MAXREFDES70.c, [34](#)
Calculate_Mass_Flow
 MAXREFDES70.c, [34](#)
Calculate_Piecewise_Energy
 MAXREFDES70.c, [35](#)
Calculate_Piecewise_Volume
 MAXREFDES70.c, [35](#)
Calculate_TOF_Velocity
 MAXREFDES70.c, [35](#)
Calculate_TimeDifference
 MAXREFDES70.c, [35](#)
Calculate_Volumetric_Flow
 MAXREFDES70.c, [35](#)

DAY_DATE
 MAXREFDES70.c, [27](#)
DOGM163_ClearChars
 dogm163.c, [16](#)
 dogm163.h, [19](#)
DOGM163_Init
 dogm163.c, [17](#)
 dogm163.h, [19](#)
DOGM163_PowerOff
 dogm163.c, [17](#)
 dogm163.h, [19](#)
DOGM163_PrintChars
 dogm163.c, [17](#)
 dogm163.h, [20](#)
DOGM163_PrintInteger
 dogm163.c, [17](#)
 dogm163.h, [20](#)
DOGM163_PrintWelcomeMsg
 dogm163.c, [17](#)
 dogm163.h, [20](#)
DOGM163_SpiTransmit
 dogm163.c, [17](#)
 dogm163.h, [20](#)
DOGM163_WriteCmdByte
 dogm163.c, [17](#)
 dogm163.h, [20](#)
DOGM163_WriteDataByte
 dogm163.c, [18](#)
 dogm163.h, [21](#)
Delay
 dogm163.c, [16](#)
 MAXREFDES70.c, [35](#)
delayCount
 MAXREFDES70.c, [38](#)
Display
 MAXREFDES70.c, [35](#)
Display_Clock
 MAXREFDES70.c, [34](#)
Display_Energy
 MAXREFDES70.c, [34](#)
Display_Last
 MAXREFDES70.c, [34](#)
Display_Off
 MAXREFDES70.c, [34](#)
Display_TDF_Config
 MAXREFDES70.c, [34](#)
Display_TDM_Config
 MAXREFDES70.c, [34](#)
Display_TMF_Config
 MAXREFDES70.c, [34](#)
Display_TMM_Config

- MAXREFDES70.c, [34](#)
- Display_TOFDIFF
 - MAXREFDES70.c, [34](#)
- Display_Temp
 - MAXREFDES70.c, [34](#)
- Display_Total_Volume
 - MAXREFDES70.c, [34](#)
- Display_Volumetric_Flow
 - MAXREFDES70.c, [34](#)
- Display_Welcome
 - MAXREFDES70.c, [34](#)
- DisplayMode
 - MAXREFDES70.c, [38](#)
- displayPowerOff
 - MAXREFDES70.c, [38](#)
- displayRepeat
 - MAXREFDES70.c, [38](#)
- dogm163.c
 - DOGM163_ClearChars, [16](#)
 - DOGM163_Init, [17](#)
 - DOGM163_PowerOff, [17](#)
 - DOGM163_PrintChars, [17](#)
 - DOGM163_PrintInteger, [17](#)
 - DOGM163_PrintWelcomeMsg, [17](#)
 - DOGM163_SpiTransmit, [17](#)
 - DOGM163_WriteCmdByte, [17](#)
 - DOGM163_WriteDataByte, [18](#)
 - Delay, [16](#)
- dogm163.h
 - DOGM163_ClearChars, [19](#)
 - DOGM163_Init, [19](#)
 - DOGM163_PowerOff, [19](#)
 - DOGM163_PrintChars, [20](#)
 - DOGM163_PrintInteger, [20](#)
 - DOGM163_PrintWelcomeMsg, [20](#)
 - DOGM163_SpiTransmit, [20](#)
 - DOGM163_WriteCmdByte, [20](#)
 - DOGM163_WriteDataByte, [21](#)
- EVT_STARTED
 - MAXREFDES70.c, [38](#)
- EVTMG1
 - MAXREFDES70.c, [27](#)
- EVTMG2
 - MAXREFDES70.c, [28](#)
- EVTMG3
 - MAXREFDES70.c, [28](#)
- Energy_ResultsStruct, [7](#)
 - EnthalpyAtCold_JperKg, [7](#)
 - EnthalpyAtHot_JperKg, [7](#)
 - EnthalpyDelta_JperKg, [7](#)
 - MassFlow_kgPerh, [7](#)
- energyAddition
 - MAXREFDES70.c, [38](#)

- energyAddition1
 - MAXREFDES70.c, [38](#)
- energyAdditionsTracker
 - MAXREFDES70.c, [38](#)
- EnthalpyAtCold_JperKg
 - Energy_ResultsStruct, [7](#)
- EnthalpyAtHot_JperKg
 - Energy_ResultsStruct, [7](#)
- EnthalpyDelta_JperKg
 - Energy_ResultsStruct, [7](#)
- flags
 - MAXREFDES70.c, [38](#)
- FloatToString
 - MAXREFDES70.c, [35](#)
- Flow_ResultsStruct, [8](#)
 - FlowVelocity_mPerS, [8](#)
 - TOF_DIFF_DeltaT_S, [8](#)
 - TOF_DiffData, [8](#)
 - VolumetricFlow_m3PerS, [8](#)
 - VolumetricFlowCorrected_m3PerS, [8](#)
 - VolumetricFlowGainFactor, [8](#)
- FlowVelocity_mPerS
 - Flow_ResultsStruct, [8](#)
- GPIO_EVEN_IRQHandler
 - MAXREFDES70.c, [35](#)
- GPIO_ODD_IRQHandler
 - MAXREFDES70.c, [36](#)
- HALT
 - MAXREFDES70.c, [28](#)
- HFRCO_FREQUENCY
 - MAXREFDES70.c, [28](#)
- HIT1DOWN_REG
 - MAXREFDES70.c, [28](#)
- HIT1UP_REG
 - MAXREFDES70.c, [28](#)
- HIT2DOWN_REG
 - MAXREFDES70.c, [28](#)
- HIT2UP_REG
 - MAXREFDES70.c, [28](#)
- HIT3DOWN_REG
 - MAXREFDES70.c, [28](#)
- HIT3UP_REG
 - MAXREFDES70.c, [28](#)
- HIT4DOWN_REG
 - MAXREFDES70.c, [28](#)
- HIT4UP_REG
 - MAXREFDES70.c, [29](#)
- HIT5DOWN_REG
 - MAXREFDES70.c, [29](#)
- HIT5UP_REG
 - MAXREFDES70.c, [29](#)
- HIT6DOWN_REG

- MAXREFDES70.c, 29
- HIT6UP_REG
 - MAXREFDES70.c, 29
- HOT_TEMP_PORT
 - MAXREFDES70.c, 29
- Hit1Data
 - Hit_ResultsStruct, 9
- Hit2Data
 - Hit_ResultsStruct, 9
- Hit3Data
 - Hit_ResultsStruct, 9
- Hit4Data
 - Hit_ResultsStruct, 9
- Hit5Data
 - Hit_ResultsStruct, 9
- Hit6Data
 - Hit_ResultsStruct, 9
- Hit_ResultsStruct, 9
 - Hit1Data, 9
 - Hit2Data, 9
 - Hit3Data, 9
 - Hit4Data, 9
 - Hit5Data, 9
 - Hit6Data, 9
 - HitAverageData, 9
 - t1Ratior2, 9
 - t2RatiorIdeal, 10
- HitAverageData
 - Hit_ResultsStruct, 9
- INITIALIZE
 - MAXREFDES70.c, 29
- INTERRUPT_STATUS
 - MAXREFDES70.c, 30
- init
 - MAXREFDES70.c, 36
- InterruptRegisterValue
 - MAXREFDES70.c, 38
- LDO_OFF
 - MAXREFDES70.c, 30
- LDO_ON
 - MAXREFDES70.c, 30
- LDO_TIMED
 - MAXREFDES70.c, 30
- LSBIT_TOF_VALUE
 - MAXREFDES70.c, 30
- Last_TempUpdate
 - MAXREFDES70.c, 39
- LinearInterpolation
 - MAXREFDES70.c, 36
- lookUpTables.h
 - PT1000_LOOKUPTABLE, 21
- MAXREFDES70.c
 - Display_Clock, 34
 - Display_Energy, 34
 - Display_Last, 34
 - Display_Off, 34
 - Display_TDF_Config, 34
 - Display_TDM_Config, 34
 - Display_TMF_Config, 34
 - Display_TMM_Config, 34
 - Display_TOFDIFF, 34
 - Display_Temp, 34
 - Display_Total_Volume, 34
 - Display_Volumetric_Flow, 34
 - Display_Welcome, 34
 - MAX35101_BlockErase_Flash
 - MAXREFDES70.c, 36
 - MAX35101_CS_High
 - MAXREFDES70.c, 30
 - MAX35101_CS_Low
 - MAXREFDES70.c, 30
 - MAX35101_Disable_LDO
 - MAXREFDES70.c, 36
 - MAX35101_Enable_LDO
 - MAXREFDES70.c, 36
 - MAX35101_Read_2WordValue
 - MAXREFDES70.c, 36
 - MAX35101_Read_Flash
 - MAXREFDES70.c, 36
 - MAX35101_Read_Register
 - MAXREFDES70.c, 36
 - MAX35101_Send_Opcode
 - MAXREFDES70.c, 36
 - MAX35101_SendConfigs
 - MAXREFDES70.c, 37
 - MAX35101_SetTime
 - MAXREFDES70.c, 37
 - MAX35101_Update_TemperatureData
 - MAXREFDES70.c, 37
 - MAX35101_UpdateAndGetTime
 - MAXREFDES70.c, 37
 - MAX35101_Write_Flash
 - MAXREFDES70.c, 37
 - MAX35101_Write_Register
 - MAXREFDES70.c, 37
 - MAXREFDES70.c
 - AVGDOWN_REG, 27
 - AVGUP_REG, 27
 - CALIBRATES, 27
 - Calculate_Temperature, 34
 - Calculate_Energy_Parameters, 34
 - Calculate_Enthalpy, 34
 - Calculate_Flow_Parameters, 34
 - Calculate_Mass_Flow, 34
 - Calculate_Piecewise_Energy, 35
 - Calculate_Piecewise_Volume, 35

Calculate_TOF_Velocity, 35
 Calculate_TimeDifference, 35
 Calculate_Volumetric_Flow, 35
 DAY_DATE, 27
 Delay, 35
 delayCount, 38
 Display, 35
 DisplayMode, 38
 displayPowerOff, 38
 displayRepeat, 38
 EVT_STARTED, 38
 EVTMG1, 27
 EVTMG2, 28
 EVTMG3, 28
 energyAddition, 38
 energyAddition1, 38
 energyAdditionsTracker, 38
 flags, 38
 FloatToString, 35
 HALT, 28
 HIT1DOWN_REG, 28
 HIT1UP_REG, 28
 HIT2DOWN_REG, 28
 HIT2UP_REG, 28
 HIT3DOWN_REG, 28
 HIT3UP_REG, 28
 HIT4DOWN_REG, 28
 HIT4UP_REG, 29
 HIT5DOWN_REG, 29
 HIT5UP_REG, 29
 HIT6DOWN_REG, 29
 HIT6UP_REG, 29
 INITIALIZE, 29
 init, 36
 InterruptRegisterValue, 38
 LDO_OFF, 30
 LDO_ON, 30
 LDO_TIMED, 30
 Last_TempUpdate, 39
 LinearInterpolation, 36
 MAX35101_BlockErase_Flash, 36
 MAX35101_CS_High, 30
 MAX35101_CS_Low, 30
 MAX35101_Disable_LDO, 36
 MAX35101_Enable_LDO, 36
 MAX35101_Read_2WordValue, 36
 MAX35101_Read_Flash, 36
 MAX35101_Read_Register, 36
 MAX35101_Send_Opcode, 36
 MAX35101_SendConfigs, 37
 MAX35101_SetTime, 37
 MAX35101_Update_TemperatureData, 37
 MAX35101_UpdateAndGetTime, 37
 MAX35101_Write_Flash, 37
 MAX35101_Write_Register, 37
 MINS_HRS, 30
 MONTH_YEAR, 31
 main, 36
 NO_RX, 31
 NO_TX, 31
 output, 39
 PI, 31
 PIPERADIUS_M, 31
 POR, 39
 POT_Data, 39
 POT_Data_Last, 39
 POTCount, 39
 previousDisplayMode, 39
 READ_FLASH, 31
 RESET, 31
 reg, 39
 SECONDS, 32
 SPI_BAUDRATE, 32
 SPI_Read_Word, 37
 SPI_Send_Byte, 37
 SysTick_Handler, 37
 T1_AVG, 32
 T1_REG, 32
 T2_AVG, 32
 T2_REG, 32
 T3_AVG, 32
 T3_REG, 32
 T4_AVG, 32
 T4_REG, 33
 T4MHZ, 33
 TDF, 39
 TDM, 39
 TEMPERATURE, 33
 TMF, 39
 TMM, 40
 TOF_DIFF, 33
 TOF_DOWN, 33
 TOF_UP, 33
 TotalEnergy, 40
 TotalVolume_m3, 40
 USART2_sendBuffer, 38
 valueAdditionsTracker, 40
 volumeAddition, 40
 volumeAddition1, 40
 WRITE_FLASH, 33
 MINS_HRS
 MAXREFDES70.c, 30
 MONTH_YEAR
 MAXREFDES70.c, 31
 main
 MAXREFDES70.c, 36
 MassFlow_kgPerh
 Energy_ResultsStruct, 7

milliseconds
 tm_withMilli, [12](#)

 NO_RX
 MAXREFDES70.c, [31](#)
 NO_TX
 MAXREFDES70.c, [31](#)

 output
 MAXREFDES70.c, [39](#)

 PI
 MAXREFDES70.c, [31](#)
 PIPERADIUS_M
 MAXREFDES70.c, [31](#)
 POR
 MAXREFDES70.c, [39](#)
 POT_Data
 MAXREFDES70.c, [39](#)
 POT_Data_Last
 MAXREFDES70.c, [39](#)
 POT_EnergyFactors
 PointOfTimeSampleDataStruct, [10](#)
 POT_FlowFactors
 PointOfTimeSampleDataStruct, [10](#)
 POT_TemperatureData
 PointOfTimeSampleDataStruct, [10](#)
 POT_TimeData
 PointOfTimeSampleDataStruct, [10](#)
 POTCount
 MAXREFDES70.c, [39](#)
 PT1000_LOOKUPTABLE
 lookUpTables.h, [21](#)
 PointOfTimeSampleDataStruct, [10](#)
 POT_EnergyFactors, [10](#)
 POT_FlowFactors, [10](#)
 POT_TemperatureData, [10](#)
 POT_TimeData, [10](#)
 previousDisplayMode
 MAXREFDES70.c, [39](#)

 READ_FLASH
 MAXREFDES70.c, [31](#)
 RESET
 MAXREFDES70.c, [31](#)
 RTD_RREF_VALUE
 MAXREFDES70.c, [31](#)
 reg
 MAXREFDES70.c, [39](#)
 Register_Value
 Temperature_ResultsStruct, [11](#)

 SECONDS
 MAXREFDES70.c, [32](#)
 SECONDS_PER_HR
 MAXREFDES70.c, [32](#)

 SPI_BAUDRATE
 MAXREFDES70.c, [32](#)
 SPI_Read_Word
 MAXREFDES70.c, [37](#)
 SPI_Send_Byte
 MAXREFDES70.c, [37](#)
 src/MAXREFDES70.c, [23](#)
 src/batteryLevel.c, [13](#)
 src/batteryLevel.h, [14](#)
 src/dogm163.c, [15](#)
 src/dogm163.h, [18](#)
 src/lookUpTables.h, [21](#)
 SysTick_Handler
 MAXREFDES70.c, [37](#)

 T1_AVG
 MAXREFDES70.c, [32](#)
 T1_REG
 MAXREFDES70.c, [32](#)
 t1Ratiot2
 Hit_ResultsStruct, [9](#)
 T2_AVG
 MAXREFDES70.c, [32](#)
 T2_REG
 MAXREFDES70.c, [32](#)
 t2RatiotIdeal
 Hit_ResultsStruct, [10](#)
 T3_AVG
 MAXREFDES70.c, [32](#)
 T3_REG
 MAXREFDES70.c, [32](#)
 T4_AVG
 MAXREFDES70.c, [32](#)
 T4_REG
 MAXREFDES70.c, [33](#)
 T4MHZ
 MAXREFDES70.c, [33](#)
 TDF
 MAXREFDES70.c, [39](#)
 TDM
 MAXREFDES70.c, [39](#)
 TEMPERATURE
 MAXREFDES70.c, [33](#)
 TMF
 MAXREFDES70.c, [39](#)
 TMM
 MAXREFDES70.c, [40](#)
 TOF_DIFF
 MAXREFDES70.c, [33](#)
 TOF_DIFF_DeltaT_S
 Flow_ResultsStruct, [8](#)
 TOF_DIFF_REG
 MAXREFDES70.c, [33](#)

- TOF_DOWN
 - MAXREFDES70.c, [33](#)
- TOF_DiffData
 - Flow_ResultsStruct, [8](#)
- TOF_UP
 - MAXREFDES70.c, [33](#)
- TempResultsAllPorts
 - TemperatureResultsAllPortsStruct, [11](#)
- Temperature_ResultsStruct, [11](#)
 - Register_Value, [11](#)
 - TemperatureDegreeC, [11](#)
- TemperatureDegreeC
 - Temperature_ResultsStruct, [11](#)
- TemperatureResultsAllPortsStruct, [11](#)
 - TempResultsAllPorts, [11](#)
- Time
 - tm_withMilli, [12](#)
- tm_withMilli, [12](#)
 - milliSeconds, [12](#)
 - Time, [12](#)
- TotalEnergy
 - MAXREFDES70.c, [40](#)
- TotalVolume_m3
 - MAXREFDES70.c, [40](#)
- USART2_sendBuffer
 - MAXREFDES70.c, [38](#)
- valueAdditionsTracker
 - MAXREFDES70.c, [40](#)
- volumeAddition
 - MAXREFDES70.c, [40](#)
- volumeAddition1
 - MAXREFDES70.c, [40](#)
- VolumetricFlow_m3PerS
 - Flow_ResultsStruct, [8](#)
- VolumetricFlowCorrected_m3PerS
 - Flow_ResultsStruct, [8](#)
- VolumetricFlowGainFactor
 - Flow_ResultsStruct, [8](#)
- WRITE_FLASH
 - MAXREFDES70.c, [33](#)
- WaitForComparatorUpdate
 - batteryLevel.c, [13](#)