	BMS Device Driver API List	
		Ver 1.5.0

KA49517/522 Reference Solution
BMS Device Driver API List

Compliant with Functional safety Standard (ISO26262) ☐ Required ■ No

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Issue date
22/1/2021

Issued by.
Nuvoton Technology Singapore Pte Ltd

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		Ver 1.5.0

Change history

Version		Approved date	Author	Approver	Changes
Current	New				
---	1.0.0	2020.09.25	HeWF	HengSM	Initial version

1.0.0	1.1.0	2020.10.30	HeWF	HengSM	1. "BMS Device Driver API List"
					   Removed: vBMIC_Start_Init, vBMICSetRegChkState
					   Added: vBMIC_PreDischarge_FET_Out, vBMIC_PreCharge_FET_Out
					
					2. "BMS DD API Macro & Data Struct"
					   Added Device Driver file lists
					   Added Device Driver Type define in "sys_type.h"
					   Changed type in Data Struct to type name as type defined.
					   Changed usSCDInfo_delay to ulSCDInfo_delay
					
					3. "BMS Device Driver API List"
					   Changed type in API argument & return to type name as type defined.
					
					4. Added "Appendix"
					   "1. Device Driver Software Flow & State Transition Diagram"

1.1.0	1.2.0	2020.11.13	HeWF	HengSM	1. Device Driver API Macro Define
					   Bold to highlight compile option for 49517 or 49522 BMIC AFE board.
					
					2. "BMS DD API Macro & Data Struct"
					   struct "TBMIC_Info" removed member "ulVref1V_uV" as VREV1 not used.
					
					3. "Appendix"
					   Added "2. BMIC Device Driver software – MCU peripheral related routines"
					   Added "3. Thermistor for temperature conversion"

Change history

Version		Approved date	Author	Approver	Changes
Current	New				
1.2.0	1.3.0	2020.11.18	HeWF	HengSM	1. "Appendix" 3. Thermistor for temperature conversion add explanation on provided DD source code configuration – BMIC Internal pull-up R used and external cap value. 2. "Appendix" Added "4. Shunt Resistor used for current measurement" 3. "Appendix" Added "5. BMIC Device Driver Software ROM / RAM size estimation" 4. "Appendix" Added "6. BMIC Device Driver Software developed on main loop" 5. "Appendix" Added "7. BMIC Device Driver Version"
1.3.0	1.4.0	2020.12.1	HeWF	HengSM	1. "BMS Device Driver API List" Changed "getBMIC_Ctrl_Status" return type from USHORT to UCHAR Added "vBMIC_SetCellbalanceReq", "ulBMIC_GetCellbalanceReqPack", "ulBMIC_GetCellbalanceReq", "bBMIC_ChkCellbalance" 2. "Appendix" "4. Shunt Resistor used for current measurement" change description as Shunt Resistor change from constant define to variable. "7. BMIC Device Driver Version" version info updated.
1.4.0	1.5.0	2020.12.30	HeWF	HengSM	1. "Device Driver API Macro Define" Changed "_BMIC_49522_" to "BMIC_49522" 2. Removed "Appendix" As contents in "Appendix" will be covered in software user manual which created seperatedly.

Device Driver File Lists

folder	subfolder	files	Remarks
BMS	drv	drv_bmic.c	BMS device driver source file
		drv_spi.c	BMS SPI Tx/Rx routine
	inc	drv_bmic.h	BMS device driver header file
		drv_spi.h	BMS SPI header file
		portio.h	BMS port define header file
		sys_type.h	BMS DD type define header file
		tsk_bmic.h	BMS task header file
	tsk	tsk_bmic.c	BMS task source file – device driver controller

Device Driver Type Define

File name	Typedef	Remarks
sys_type.h	typedef uint8_t UCHAR;	unsigned 8bit
	typedef int8_t CHAR;	signed 8bit
	typedef uint16_t USHORT;	unsigned 16bit
	typedef int16_t SHORT;	signed 16bit
	typedef uint32_t ULONG;	unsigned 32bit
	typedef int32_t LONG;	signed 32bit
	typedef uint64_t ULLONG;	unsigned 64bit

Device Driver API Macro Define

File name	Macro Name	Value	Remarks
drv_bmic.h	BMIC_49522	0	Default: 49517 used (If BMIC AFE board is 49517, please "define BMIC_49522 (0u)"
		1	49522 used (If BMIC AFE board is 49522, please "define BMIC_49522 (1u)"
	MAX_CELL_NUM	22	Maximum cell number when BMIC_49522 defined as 1
		17	Maximum cell number When BMIC_49522 defined as 0 (default)
	MIN_CELL_NUM	4	Minimum cell number
	THERMISTOR_NUM	5	Number of thermistor

Device Driver API Data Struct

File name	Data Struct Name	Data Struct Member	Type	Element Size	Content	Remarks
drv_bmic.h		BMICMeasured	bool	1	0: not received any measurement data '1: Have received measurement data.	
		lBatPackCur_100uA	LONG	1	low speed current calculated result in 100uA.	
		lBatPackFastCur_100uA	LONG	1	high speed current calculated result in 100uA.	
		ulBlkVol_uV	ULONG	MAX_CELL_NUM	cell voltage calculated result in uV	
		sTemp_01Cdeg	SHORT	THERMISTOR_NUM	temperature calculated in Cdeg.	
		ulVpackV_uV	ULONG	1	VPACK voltage calculated result in uV	

Device Driver API Data Struct

File name	Data Struct Name	Data Struct Member	Type	Element Size	Content	Remarks
	TBMIC_Info	ulVdd55V_uV	ULONG	1	VDD55 voltage calculated result in uV	
		ulVdd18V_uV	ULONG	1	VDD18 voltage calculated result in uV	
		ulVRegextV_uV	ULONG	1	VREG_EXT voltage calculated result in uV	
		ulVref2V_uV	ULONG	1	VREF2 voltage calculated result in uV	
		ulVpackSumV_uV	ULONG	1	Summed cell voltages in uV	
		ulBatPackMinBlkVol_uV	ULONG	1	Battery pack minimum cell voltage in uV	
		ulBatPackMaxBlkVol_uV	ULONG	1	Battery pack maximum cell voltage in uV	
		ullChgSum_AD	ULLONG	1	Battery pack charge amount in AD value	
		ullDisChgSum_AD	ULLONG	1	Battery pack discharge amount in AD value.	
		ulBatPackErr	ULONG	1	Battery pack error info	
		ulBatPackErrLog	ULONG	1	Battery pack error log	
		usBatPackErrNum	USHORT	1	Battery pack error number	
	TBMICCellConf	ulCellPos	ULONG	1	Battery pack cell connection position	
		ucSeriesCount	UCHAR	1	Battery pack cell count	
		ucCellTempCount	UCHAR	1	Battery pack thermistor count	
		ulCellTempPos	ULONG	1	Battery pack thermistor position	
	TBMICSetParam	usOCInfo_cur	USHORT	1	Over current detection threshold in mA	
		usOVInfo_vol	USHORT	1	Over voltage detection threshold in mV	
		usOVInfo_delay	USHORT	1	Over voltage detection delay in msec	
		usOVInfo_hys	USHORT	1	Over voltage hysteresis level in mV	
		usUVInfo_vol	USHORT	1	Under voltage detection threshold in mV	
		usUVInfo_delay	USHORT	1	Under voltage detection delay in msec	
		usUVInfo_hys	USHORT	1	Under voltage hysteresis level in mV	
		usOCCInfo_cur	USHORT	1	Over current at charge detection threshold in A	
		usOCCInfo_delay	USHORT	1	Over current at charge detection delay in msec	
		usOCDInfo_cur	USHORT	1	Over current at discharge detection threshold in	
		usOCDInfo_delay	USHORT	1	Over current at discharge detection delay in msec	
		usSCDInfo_cur	USHORT	1	Short circuit at discharge detection threshold in A	
		ulSCDInfo_delay	ULONG	1	Short circuit at discharge detection delay in usec	
		usOTInfo_temp	USHORT	1	Over temperature threshold	
		usOTInfo_temp_recover	USHORT	1	Over temperature recover threshold	
		usLTInfo_temp	USHORT	1	Low temperature threshold	
		usLTInfo_temp_recover	USHORT	1	Low temperature recover threshold	
		usOTBatChrgInfo_temp	USHORT	1	Over temperature at charge threshold	
		usOTBatChrgInfo_temp_recover	USHORT	1	Over temperature at charge recover threshold	
		usLTBatChrgInfo_temp	USHORT	1	Low temperature at charge threshold	
		usLTBatChrgInfo_temp_recover	USHORT	1	Low temperature at charge recover threshold	

Device Driver API Function List

File name	API Function	API Function Overview	Argument			Return value	
			Type	Variable Name	Content	Type	Content
drv_bmic.c	vBMIC_InitParams	Initialize BMIC_Drv, BMIC_Info, BMICSetParam data struct & other control variables / flags.	–	–	–	–	–
	vBMIC_Ctrl_Startup	BMIC_Drv.ucBMIC_Ctrl_Status: BMIC_STARTUP BMIC start up process: Control register initial settings & readback for verification, TMONIn internal pull-up resistance readback. Cell configuration init – cell list making, OUVCTL1&2, ALARM_CTL2&3 settings for OV/UV/OCD/OCC/SCD detection threshold. If startup process complete, transit to BMIC_NORMAL If fail, transit to BMIC_RESTART	–	–	–	–	–
	vBMIC_Ctrl_Normal	BMIC_Drv.ucBMIC_Ctrl_Status: BMIC_NORMAL Latch low speed current conversion result Trigger & readback cell voltage, other voltage measurement result & high speed current ADC conversion for 6 times, get max/min/average ADC result and calculate cell voltage conversion value. If there is temperature read request, readback TMONI voltage conversion result and calculate temperature. Read low speed current ADC result and sum for Discharge / Charge amount. Read register & check status register for OV/UV/OCD/OCC/SCD status etc, if OV/UV/OCD/OCC/SCD flag on, set error flags and clear error status. If there is SPI error, transit to BMIC_SPIERR. If there is shutdown request, transit to BMIC_SHUTDOWN.	–	–	–	–	–
	vBMIC_Ctrl_SpiErr	BMIC_Drv.ucBMIC_Ctrl_Status: BMIC_SPIERR Control VPC signal and check SPI communication If SPI communication still NG, transit to BMIC_RESTART If SPI communication is OK, transit to BMIC_NORMAL.	–	–	–	–	–

File name	API Function	API Function Overview	Argument			Return value	
			Type	Variable Name	Content	Type	Content
	vBMIC_Ctrl_Restart	BMIC_Drv.ucBMIC_Ctrl_Status: BMIC_RESTART Control BMIC SHDN signal & VPC signal & transit to BMIC_STARTUP	–	–	–	–	–
	vBMIC_Ctrl_Shutdown	BMIC_Drv.ucBMIC_Ctrl_Status: BMIC_SHUTDOWN Control BMIC SHDN signal & VPC signal & transit to BMIC_STARTUP	–	–	–	–	–
	vBMIC_ShutdownRequest	Set BMIC shutdown request flag.	–	–	–	–	–
	getBMIC_Ctrl_Status	Get BMIC control state	–	–	–	UCHAR	BMIC control status
	vBMIC_Thermistor_readReq	Set request to read thermistor voltage & calculate temperature	UCHAR	req	thermistor read request on/off	–	–
	vBMIC_Discharge_FET_Out	Set BMIC discharge MOSFET on / off	UCHAR	output	Discharge FET output on/off	–	–
	vBMIC_Charge_FET_Out	Set BMIC charge MOSFET on / off.	UCHAR	output	Charge FET output on/off	–	–
	vBMIC_PreDischarge_FET_Out	Set BMIC pre discharge MOSFET on / off via GPOH2	UCHAR	output	GPOH2 output on/off	–	–
			UCHAR	fet_setting	GPOH pin use FET control or not		
	vBMIC_PreCharge_FET_Out	Set BMIC pre discharge MOSFET on / off via GPOH1	UCHAR	output	GPOH1 output on/off	–	–
			UCHAR	fet_setting	GPOH pin use FET control or not		
	vBMIC_SHDN_Out	Set BMIC SHDN control signal	UCHAR	output	BMIC SHDN control	–	–
	vBMIC_FETOFF_Out	Set BMIC FETOFF control signal	UCHAR	output	BMIC FETOFF control	–	–

File name	API Function	API Function Overview	Argument			Return value	
			Type	Variable Name	Content	Type	Content
	usBMIC_ReadReg	Read BMIC register data from specified address.	UCHAR	addr	Address of BMIC register to be read	USHORT	Data of BMIC register from specified address.
	ucBMIC_Send_Req	Change BMIC register data with mask bits at specified address and save to received register data buffer if required.	UCHAR	addr	Address of BMIC register to be written	bool	true – write OK false – write NG
			USHORT	data	data to be written to BMIC register		
			USHORT	mask	data mask – register bits to be changed		
			UCHAR	mask_req	mask request, 1 to update register data in received register data buffer.		
	bBMICCheckSpiResult	Check any error in BMIC SPI communication	–	–	–	bool	true – BMIC SPI no error false – BMIS SPI has error
	BMIC_Clear_Spi_Err_counter	Clear BMIC SPI communication error count	–	–	–	–	–
	bBMIC_ChkSpiMiso	Get BMIC SDO checking result during BMIC startup.	–	–	–	bool	true – BMIC startup, SDO checking NG false – BMIC startup, SDO checking OK
	vBMIC_UvReset	Change BMIC UV detection threshold	USHORT	usUvSetVol		–	–
	vBMIC_Send_PDREG55en	Enable/disable BMIC PDREG55 output	UCHAR	pdreg55en	1: PDREG55 ON 0: PDREG55 OFF	–	–
	vBMIC_Send_OUVCTL1	Set BMIC register OUVCTL1 according to BMIC set parameters: usOCInfo_cur, usOVInfo_vol, usUVInfo_vol	–	–	–	–	–
	vBMIC_Send_OUVCTL2	Set BMIC register OUVCTL2 according to BMIC set parameters: usOCInfo_hys, usUVInfo_hys, usOVInfo_delay, usUVInfo_delay	–	–	–	–	–
	vBMIC_Send_ALARM_CTL2	Set BMIC register ALARM_CTL2 according to BMIC set parameters: usSCDInfo_cur, usOCDInfo_cur, usOCCInfo_cur.	–	–	–	–	–

File name	API Function	API Function Overview	Argument			Return value	
			Type	Variable Name	Content	Type	Content
	vBMIC_Send_ALARM_CTL3	Set BMIC register ALARM_CTL2 according to BMIC set parameters: usSCDInfo_delay, usOCDInfo_delay, usOCCInfo_delay.	–	–	–	–	–
	vBMIC_SetCellbalanceReq	Set cell numbers for Cell Balancing.	ULONG	target	Selected cells for Cell Balancing. Eg. BMIC 49517, 17 cells connected in series, Cell 17 selected for CB, target = 0x00010000; Cell 16 selected for CB, target = 0x00008000; BMIC 49517, 12 cells connected in series, Cell 12 selected for CB, target = 0x00000800; Cell 11 selected for CB, target = 0x00000400; (It's invalid to set all cells for CB, will be ignored.)	–	–
	ulBMIC_GetCellbalanceReqPack	Get cell numbers under Cell Balancing	–	–	–	ULONG	Cell numbers under Cell Balancing. Eg. BMIC 49517, 12 cells connected in series, Cell 12 under CB requested by vBMIC_SetCellbalanceReq(0x00000800), ulBMIC_GetCellbalanceReqPack() will return 0x00000800.
	ulBMIC_GetCellbalanceReq	Get cell positions under Cell Balancing.	–	–	–	ULONG	Cell positions under Cell Balancing. Eg. BMIC 49517, 12 cells connected in series, Cell 12 under CB requested by vBMIC_SetCellbalanceReq(0x00000800), ulBMIC_GetCellbalanceReq() will return 0x00010000.
	bBMIC_ChkCellbalance	Check Cell Balancing status	–	–	–	bool	false – not in CB operation true – in CB operation