Evaluates: MAX20360

General Description

The MAX20360 evaluation kit (EV kit) is a fully assembled and tested circuit board that demonstrates the MAX20360 ultra low-power wearable power management integrated circuit (PMIC). The MAX20360 includes voltage regulators such as bucks, boost, buck-boost, and linear regulators, and a complete battery management solution with battery seal, charger, power path, and fuel gauge.

The device is configurable through an I²C interface that allows for programming various functions and reading device status. The EV kit GUI application sends commands to the MAXPICO2PMB# adapter board to configure the device.

The MAX20360EVKIT# has no harvester feature. The MAX20360HEVKIT# has a harvester feature enabled and can be connected to MAX20361EVKIT# to evaluate the interaction between the two devices.

Features

- USB Power Option
- Flexible Configuration
- On-Board LED Current Sink and Battery Simulation
- Sense Test Point for Output-Voltage Measurement
- Filter Test Point for Haptic-Waveform Measurement
- Windows[®] 8/Windows 10-Compatible GUI Software
- Fully Assembled and Tested

EV Kit Contents

- MAX20360 EV kit
- MAXPICO2PMB# board
- Two USB A to USB micro-B cables

EV Kit Files

FILE	DESCRIPTION
MAX20360EVKitSetupVxxx.exe	PC GUI Program

Ordering Information appears at end of data sheet.

Windows is a registered trademark and service mark of Microsoft Corporation.

Quick Start

Required Equipment

Note: In the following sections, software-related items are identified by **bold** text. Text in bold refers to items directly from the install of EV kit software.

- MAX20360 EV kit
- Windows PC with USB ports
- One USB A to USB micro-B cable and MAXPICO2PMB# adapter board
- One USB A to USB micro-B cable or power supply (for battery simulation or battery voltage)
- Optional one USB A to USB micro-B cable or power supply (for charger input CHGIN)
- Voltmeter

Procedure

The EV kit is fully assembled and tested. To verify board operation, follow these steps:

- Visit <u>https://www.maximintegrated.com</u> to download the latest version of the EV kit software, MAX-20360EVKitSetupVxxx.zip located on the MAX20360 EV Kit web page. Download the EV kit software to a temporary folder and unzip the zip file.
- Install the EV kit software on your computer by running the MAX20360EVKitSetupVxxx.exe program inside the temporary folder.
- 3) Verify that all jumpers are in their default positions, as shown in Table 1.
- 4) Connect the type-A end of a cable to the PC and micro-USB end of a cable to MAXPICO2PMB# board, and connect the MAXPICO2PMB# to J13 located on lower left of the EV kit board.
- 5) Connect a USB A to micro-B cable from the computer to J21 on the upper right corner of the EV kit board to use VBUS to power the battery simulation circuits on the board, or power the battery simulation circuits from the VHC test point. (Use a Li-ion battery or power source to evaluate the device if not using the battery simulation circuits. Connect the battery or power source to J2 on the EV kit board. Skip step 6 if not using the battery simulation.)



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- 6) Use a voltmeter to check VHC is approximately 5V; BATSIM test point is approximately 3.7V. To adjust the BATSIM voltage, turn the R58 BATSIM potentiometer. Place shunt on JP9, then confirm that TP1 CSN is the set BATSIM voltage.
- On the computer, open the MAX20360 GUI. For the MAX20360EVKIT#, the status bar on the bottom displays MAX20360 Not Found (Figure 1). The IC is in Seal Mode.
 For the MAX20360HEVKIT#, the status bar on the bottom displays Connected (Figure 2). The IC is in Battery Recovery Mode.

ieneral	Charger	Buck 1	Buck 2	Buck 3	Buck-Boost	Boost and LEDs	Other DC-DC	Load Switches	Haptic Driver	Register Ma	D		
L											Rea	IA be	
Devic	e Info			CL	Irrent Limitin	g		Monito	r Mux		T CO	a / u	
Chip Pwr	Rev RstCfg		0x00 0110		input Current CHGIN Currei	Limit nt Limiter Blanking	g Time	MON	Pin Source Resistive Parti	tion Selector		Ŧ	
PFNs	and MPC	s			No Blankin 0.5ms	g		1 : 2 :	1 1				
PFN PFN	1 State 2 State	N N	lot Active lot Active		1ms 10ms			● 3:* ● 4:*	1 1 	114			
MPC MPC	0 State 1 State		Low Low		SYS Minimum	n Voltage			Uff Mode Cond Illed Low by 59	kΩ Resistor			
MPC MPC	2 State 3 State		Low Low	(· · ·	1 1 1 1	3.6V		-2				
MPC MPC	C4 State C5 State		Low Low			Set							
MPC MPC	C6 State C7 State		Low Low	Inte	errupts and S	Status				F	Read In	iterrupts	;
	0			In	terrupt Name	Mask	Status						
MPC	Configura	ition		T	nmStatInt	\checkmark	Thermistor m	onitoring disabl	led. ThmStat =	110 (See Dat	tasheet	() .	
MPC	Select	MF	•C0 •	ILi	mInt	\square	CHGIN input	current below li	mit.				
M	PC0 Outp	ut Value		U	sbOVPInt	\checkmark	CHGIN overv	oltage not detec	ted.				
M	IPC0 Outp	ut Confi	g	Us	sbOkInt	\square	CHGIN input	voltage not pres	sent or outside of	of valid range			
M	PC0 Direc	tion		S	/sBatLimInt	\checkmark	Charge curre	nt actively being	g reduced to req	gulate VSYS	collaps	e.	
M	PC0 Resi	stor Pre	sence	Ba	atGoodInt	\checkmark	VBAT > VBAT	UVLO or CHO	GIN input voltage	e not present			
M	PC0 Resi	stor Cor	nfig	12	cCrcFailInt	\checkmark							

Figure 1. MAX20360 Not Found Status

- Press the PB1 (/KIN) button shortly, then the device enters ON mode. For the MAX20360EVKIT, the GUI then shows **Connected** and the registers are read and displayed (Figure 2).
- 10) To evaluate the battery charger, shunt J4 and plug in the USB micro-B cable to J1 of the EV kit to use USB VBUS power, or externally supply the charging power on TP9 CHGIN.
- 9) The EV kit is now ready for additional evaluation.

eneral Charger Buck 1 Buck 2 Buck 3 Buck-Boost Boost and LEDs Other DC-DC Load Switches Haptic Driver Register Map Device Info Current Limiting Monitor Mux Read Chip Rev 0x03 Input Current Limit 450mA * MON Pin Source Hi-Z PFNs and MPCs No Blanking • No Blanking • 1:1 • 2:1 • 3:1 • 4:1 PFN2 State Not Active • 10ms • 10ms • 1:1 • 2:1 • 3:1 • 4:1 MPC0 State Low MPC4 State Low SYS Minimum Voltage • Hi-Z • Hi-Z • Hi-Z MPC4 State Low Set 3.6V • Hi-Z • Read Interrupts and Status Read Interrupt Name MPC Configuration MPC VTHM DIS). No thermistor detected (VTHM > VTHM DIS). • No thermistor detected (VTHM > VTHM DIS).	Charger Buck 1 Buck 2 Buck 3 Buck-Boost Boost and LEDs Other DC-DC Load Switches Haptic Driver Register Map Device Info Current Limiting Monitor Mux Read A Chip Rev 0x03 Input Current Limit 450mA MON Pin Source Hi-Z PFNs and MPCs Input Current Limiter Blanking 0.5ms 1ms 0.5ms 3.1 PFN1 State Active 10ms 1ms 3.6V 4.1 MON Off Mode Condition MPC3 State Low SYS Minimum Voltage 3.6V Hi-Z Hi-Z MPC5 State Low Set 3.6V Hi-Z Hi-Z	All
Device Info Current Limiting Monitor Mux Read Chip Rev 0x03 Input Current Limit 450mA MON Pin Source Hi-Z PKNs and MPCs Input Current Limiter Blanking Time No Blanking 0.5ms 111 2:1 3:1 PFN1 State Active 10ms 10ms 3:1 3:1 4:1 MON Off Mode Condition SYS Minimum Voltage 9 Ulled Low by 59kΩ Resistor Hi-Z Hi-Z MPC4 State Low Set 3.6V Hi-Z Read MPC State Low Set 3.6V Read MPC4 State Low Set No thermistor detected (VTHM > VTHM DIS). MPC Configuration Interrupt Name Mask Status ThmStatInt	Device Info Current Limiting Monitor Mux Read A Chip Rev 0x03 Input Current Limit 450mA • MON Pin Source Hi-Z PFNs and MPCs O.5ms 0.5ms 0.5ms 0.11 0.5ms 0.11 0.11 PFN1 State Active No Blanking 0.5ms 0.11 0.11 0.11 PFN2 State Not Active 10ms 11ms 0.11 0.11 0.11 PFN2 State Low MPC1 State Low MON Off Mode Condition Pulled Low by 59kΩ Resistor MPC3 State Low Set Hi-Z Hi-Z	All T
Chip Rev 0x03 PwrRstCfg 1011 PFNs and MPCs CHGIN Current Limit 450mA PFNs and MPCs No Blanking PFN1 State Active PFN2 State Not Active MPC0 State Low MPC2 State Low MPC4 State Low MPC6 State Low MPC Configuration Interrupts and Status MPC Configuration Interrupt Name Mask MPC Configuration Mask	Chip Rev 0x03 PwrRstCfg 1011 PFNs and MPCs CHGIN Current Limit 450mA PFN1 State Active PFN2 State Not Active MPC0 State Low MPC1 State Low MPC3 State Low MPC3 State Low MPC5 State Low MPC5 State Low MPC5 State Low	v
PFNs and MPCs • No Blanking • O.o.Sms • O.o.Sms	PFNs and MPCs • No Blanking • Offer Gurrent Einner Dianking mite • No Blanking • Offer Gurrent Einner Dianking mite • Inner Dianking mite PFNs and MPCs • No Blanking • Offer Gurrent Einner Dianking mite • Inner Dianking mite • Inner Dianking mite PFNs and MPCs • No Blanking • Offer Gurrent Einner Dianking mite • Inner Dianking mite • Inner Dianking mite PFN1 State Not Active • Offer Gurrent Einner Dianking mite • Inner Dianking mite • Inner Dianking mite PFN2 State Not Active • Offer Gurrent Einner Dianking mite • Inner Dianking mite • Inner Dianking mite MPC0 State Low • Offer Gurrent Einner Dianking mite • Inner Dianking mite	
PFN1 State Active PFN2 State Not Active MPC0 State Low MPC1 State Low MPC2 State Low MPC3 State Low MPC4 State Low MPC5 State Low MPC6 State Low MPC7 State Low MPC Configuration Interrupts and Status MPC Configuration Interrupt Name Mask MPC State Low MPC Configuration Interrupt Name	PFN1 State Active PFN2 State Not Active MPC0 State Low MPC1 State Low MPC2 State Low MPC3 State Low MPC4 State Low MPC5 State Low MPC5 State Low MPC5 State Low	
Imposition Low MPC1 State Low MPC2 State Low MPC3 State Low MPC4 State Low MPC5 State Low MPC6 State Low MPC7 State Low MPC Configuration Interrupts and Status MPC Configuration Interrupt Name MPC Configuration ThmStatint	MPC1 State Low SYS Minimum Voltage MPC2 State Low MPC3 State Low MPC4 State Low MPC5 State Low	
MPC5 State Low MPC6 State Low MPC7 State Low Interrupts and Status Read Interrupts and Status MPC Configuration Interrupt Name MBK Status ThmStatint Interrupts of detected (VTHM > VTHM DIS).	MPC5 State Low	
MPC Configuration Interrupt Name Mask Status ThmStatInt Image: Configuration of the state of the st	MPC6 State Low MPC7 State Low Interrupts and Status	rrupts
ThmStatInt Information VTHM DIS).	MPC Configuration	
	ThmStatInt ✓ No thermistor detected (VTHM > VTHM_DIS).	
MPC Select MPC0 - ILimInt CHGIN input current limit active.	MPC Select MPC0 v ILimInt CHGIN input current limit active.	
MPC0 Output Value UsbOVPInt CHGIN overvoltage not detected.	MPC0 Output Value UsbOVPInt CHGIN overvoltage not detected.	
MPC0 Output Config UsbOkInt 🗹 CHGIN input voltage not present or outside of valid range.	MPC0 Output Config UsbOkInt 🗹 CHGIN input voltage not present or outside of valid range.	
MPC0 Direction SysBatLimInt 🗹 Charge current actively being reduced to regulate VSYS collapse	MPC0 Direction SysBatLimInt Charge current actively being reduced to regulate VSYS collapse.	
MPC0 Resistor Presence BatGoodInt VBAT > VBAT_UVLO or CHGIN input voltage not present.	MPC0 Resistor Presence BatGoodInt VBAT > VBAT > VBAT_UVLO or CHGIN input voltage not present.	
MPC0 Resistor Config I2cCrcFailInt	MPC0 Resistor Config I2cCrcFailInt	

Figure 2. Connected Status

Detailed Description of Software

Software Startup

Upon starting the program, the EV kit software automatically searches for the USB interface circuit and then for the IC device addresses. The EV kit enters the normal operating mode when the connection is established and addresses are found. If the USB connection is not detected, the status bar displays **Not Connected**. If the USB connection is detected, but the MAX20360 is not found, the status bar shows **MAX20360 Not Found**.

ToolStrip Menu Bar

The ToolStrip menu bar (<u>Figure 3</u>) is located at the top of the GUI window. This bar comprises **File**, **Device**, **Options**, and **Help** menus; each function is detailed in the following sections.

File Menu

The **File** menu contains the option to exit out of the GUI program.

Device Menu

The **Device** menu provides the ability to connect or disconnect the EV kit to the GUI. The **Advanced** \rightarrow **I**²**C Read/Write** menu allows to read from or write to a select-

ed register with a specified slave address. The **Advanced** \rightarrow **Use USB2PMB2#** option should be checked if using with the USB2PMB2# adapter board.

Options Menu

The **Options** menu provides several settings to access additional features offered by the GUI. The **Disable Polling** option allows registers to be read manually instead of receiving automatic frequent register updates from the IC. The **Lock/Unlock** option allows for the lock or unlock of the charger, bucks, boost, buck-boost, and LDOs through I²C. The **Use Fletcher-16 Checksum** is checked by default. The EV kit IC has the checksum enabled (i2c_crc_ena = enabled). Uncheck the **Use Fletcher-16 Checksum** if evaluating an IC with checksum option disabled.

Help Menu

The **Help** menu contains the **About** option, which displays the GUI splash screen indicative of the GUI version being used.

🔞 Wearable Power Management Solution (MAX20360) EV Kit Tool

File Device Options Help

Figure 3. The ToolStrip Menu Items

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Tab Controls

The MAX20360 EV kit software GUI provides a convenient way to test the features of the MAX20360. Each tab contains controls relevant to various blocks of the device. Changing these interactive controls triggers a write operation to the MAX20360 to update the register contents. The **Read All** button reads all the configuration registers that are visible on the current tab page. The **Interrupts and Status** section in each tab shows the state of the status registers and their corresponding interrupts. Checking or unchecking the **Mask** option controls which interrupts cause the INT output to be pulled low when asserted. Click the **Read Interrupts** button to read and clear the interrupts visible in the current tab. Asserted interrupts are denoted by bold text in the **Interrupt Name**. All statuses are polled continuously. The polling feature can be disabled in the **Options** section of the menu bar by selecting **Disable Polling**.

General Tab

The **General** tab (Figure 4) provides information on device info, PFNs and MPCs status and configuration. Charger input current and voltage limit setting, IVMON setting, and some general interrupts and status are also found under this tab.

ile De	vice Opti	ons Help	0								
General	Charger	Buck 1	Buck 2	Buck 3	Buck-Boost	Boost and LEDs	Other DC-DC	Load Switches	Haptic Driver	Register Map	
Devic	e <mark>Inf</mark> o			CL	urrent Limitin	g		Monitor	Mux		Read All
Chip Pwr	Rev RstCfg		0x03 1011		Input Current	Limit	450mA	MON	Pin Source Resistive Parti	tion Selector	Hi-Z *
PFNs	and MP	Cs			 No Blankin 0.5ms 	g		• 1:1			
PFN PFN MPC	I1 State I2 State	N	Active ot Active		1ms 10ms			- 3:1 4:1 MON	Off Mode Cond	dition	
MPC MPC	C1 State		Low		SYS Minimum	voltage	3.6V	Pu • Hi-	lled Low by 59 Z	kΩ Resistor	
MPC	C4 State C5 State		Low			Set					
MPC MPC	C6 State C7 State		Low Low	Inte	errupts and S	Status				R	ead Interrupts
MDC	Configur	otion		In	terrupt Name	Mask	Status				
MPC	Comigui	ation		Tł	nmStatInt	\checkmark	No thermisto	r detected (VTH	M > VTHM_DIS	5).	
MPC	C Select	MF	• 0.0°	ILi	imInt	\square	CHGIN input	current limit acti	ve.		
N	IPC0 Out	out Value		Us	sbOVPInt	\square	CHGIN overv	oltage not detec	ted.		
N	IPC0 Out	out Config	9	Us	sbOkInt	\checkmark	CHGIN input	voltage not pres	ent or outside o	of valid range.	
N	IPC0 Dire	ction		S	ysBatLimInt	\square	Charge curre	ent actively being	reduced to reg	gulate VSYS c	ollapse.
N	IPC0 Res	istor Pres	sence	Ba	atGoodInt	\square	VBAT > VBAT	LOVLO or CHG	IN input voltage	e not present.	
M	IPC0 Res	istor Con	fig	12	cCrcFailInt	\checkmark					
					1			1			

Figure 4. General Tab

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Charger Tab

The **Charger** tab (Figure 5) provides options to set charger voltage, current, and timer in different charging states. The thermistor monitor configuration can be accessed by clicking the **Advanced** button.

eral Cha	ger Buck 1	Buck 2	Buck 3	Buck-Boost	Boost and LEDs	Other DC-DC	Load Switches	Haptic Driver	Register Map	
harger S	ettings								Rea	ad All
Ena	ole Charger					Recharge T	hreshold		BatReg - 70mV	•
Cha	rger Auto-St	top				Charge Don	e Threshold		0.3 x IFChg	Ŧ
Cha	rger Auto-R ed Pre-Cha	estart arge Mode				Precharge V	/oltage Threshold		3.15V	*
BAT	Pull-Down	Resistor				Precharge C	Current		0.05 x IFChg	•
Battery R	egulation Vo	oltage		4.35V	T	Precharge T	limer		60min	*
Step Cha	rge Voltage	Threshold		3.80V	•	Fast Charge	e Timer		600min	•
Step Cha	rge Hystere	sis		400mV	•	Maintain Cha	arge Timer		60min	~
Step Cha	rge Current	Scaling		1.0 x IFC	hg 🔻					
SYS UVL	O Falling Th	nreshold		2.7V	•	Thermistor I	Monitoring Charg	er Settings	Advance	ed
iterrupts a	nd Status								Read Ir	nterrupts
nterrupt N	ame	Mask	Status	;						
ChgStatInt		\checkmark	Charg	er off.						
ChgJEITAS	DInt	\checkmark	Charg	er operating n	ormally or disable	ed.				
ChgJEITAF	egInt	\checkmark	Charg	er operating n	ormally or disable	ed.				
ChgTmoIn		\checkmark	Charg	er operating n	ormally or disable	ed.				
ChgThmSI	Dint	\checkmark	Input li	miter and cha	arger operating no	rmally.				
			Charg	er sten chara	e current reductio	n not active				

Figure 5. Charger Tab

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Buck1/2/3, Buck Boost Tab

The **Buck1**, **Buck2**, **Buck3**, and **Buck Boost** tabs (Figure 6, 7, 8, and 9) provide options to enable buck/buck boost, set buck/buck boost voltages, inductor current settings, DVS mode and voltage setting, and some additional settings.

uck 1 General Settings Dynamic Voltage Scaling Real Buck 1 Enable Configuration Buck 1 DVS Mode Disabled Enabled by MPC Image Image Image Output Voltage Introductor Peak Current Image Image Inductor Peak Current Image Image Image Image Image Imag	eral Charger Buck 1 Buck 2 Buck 3 Buck-Boost Boos	t and LEDs	Other DC-DC	Load Switches	Haptic Driver	Register Map	
Buck 1 Pirable Configuration Enabled Enabled by MPC Output Voltage Output Voltage Inductor Peak Current Inductor Peak Current Inductor Peak Current OmA Passive Discharge Active Discharge Low EMI Mode Forced PWM Mode	uck 1 General Settings	Dynam	ic Voltage Sca	aling			Read All
Output Voltage Inductor Peak Current Inductor Peak Current Set by Lookup Table Adaptive Peak Current Passive Discharge Active Discharge Low EMI Mode Forced PWVM Mode	Enabled Enabled by MPC O T Disabled	Buck Buck Buck	1 DVS Mode 1 Alternate Volta 1 Alternate Volta	age 1 age 2		Disabled 0.55V 0.55V	• •
Set Inductor Peak Current Inductor Peak Current Set by Lookup Table Adaptive Peak Current Passive Discharge Active Discharge Low EMI Mode Forced PWVM Mode Buck 1 Additional Settings Buck 1 Additional Settings Buck 1 Additional Settings Fast Load Transient Response Mode Disabled Enable Integrator Enable FET Scaling Enable PGOOD Comparator	Output Voltage	Buck Buck	1 Alternate Volta 1 Alternate Volta	age 3 age 4		0.55V 0.55V	v
	Set Inductor Peak Current Inductor Peak Current Set by Lookup Table Adaptive Peak Current Passive Discharge Active Discharge Low EMI Mode Forced PWM Mode	Buck 1	Additional Se Load Transient Enable Integrato Enable FET Sca Enable LX Sens Enable PGOOE	ttings Response Mode or aling se Control O Comparator	•	Disabled	v
terrupts and Status	errupts and Status					Re	ad Interrupts
nterrupt Name Mask Status	nterrupt Name Mask Status						

Figure 6. Buck1 Tab

neral Charger Buck	1 Buck 2	Buck 3	Buck-Boost	Boost and LEDs	Other DC-DC	Load Switches	Haptic Driver	Register Map	
Buck 2 General Set	ings			Dynan	nic Voltage Sc	aling			Read All
Buck 2 Enable Con Enabled	iguration			Buck	2 DVS Mode			Disabled	v
Enabled by MPC	1 *			Buck	2 Alternate Volt	age 1		0.55V	Ψ.
 Disabled 				Buck	2 Alternate Volt	age 2		0.55V	Ŧ
Output Voltage				Buck	2 Alternate Volt	age 3		0.55V	Ŧ
		<u>.</u>	1.8V	Buck	2 Alternate Volt	age 4		0.55V	•
	Set			Buck 2	Additional Se	ettings			
Inductor Peak Curre	ent Current Set	by Looki	0mA	Fast	Load Transient	Response Mode	•	Disabled	•
Adaptive Peak	Current	-,			Enable Integrat	or			
Passive Disch	arge				Enable FET Sc	aling			
Active Dischar	qe				Enable LX Sen:	se Control			
Low EMI Mode					Enable PGOO	O Comparator			
Sorced PWM I	lode								
Interrupts and Status								Rea	d Interrupts
Interrupt Name	Mask	Status							
ThmBk2Int	\checkmark	Buck2	operating nor	mally.					

Figure 7. Buck2 Tab

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neral Charger Buck 1	Buck 2	Buck 3	Buck-Boost	Boost and LEDs	Other DC-DC	Load Switches	Haptic Driver	Register Map		
Buck 3 General Setting	s			Dynan	nic Voltage Sc	aling			Read All	
Buck 3 Enable Configur Enabled Disabled Disabled Output Voltage Inductor Peak Current Adaptive Peak Cur Passive Discharge Low EMI Mode Forced PWM Mod	ation 2	by Looku	0mA ıp Table	Buck Buck Buck Buck	3 DVS Mode 3 Alternate Volt 3 Alternate Volt 3 Alternate Volt 3 Alternate Volt 4 Additional Se Load Transient Enable Integrat Enable FET Sc Enable LX Sen Enable PGOOI	age 1 age 2 age 3 age 4 ettings Response Mode or aling se Control D Comparator		Disabled 0.55V 0.55V 0.55V Disabled		
Interrupts and Status								Re	ead Interrupt	s
Interrupt Name	Mask	Status								
ThmBk3Int	\checkmark	Buck3	operating nor	mally.						

Figure 8. Buck3 Tab

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neral Charger Buck 1 Buck 2 Buck 3 Buck-Boost Boost	t and LEDs	Other DC-DC	Load Switches	Haptic Driver	Register Map	
Inductor Peak Current Setting 2 Inductor Peak Current Setting 2 OmA • Inductor Peak Current Setting 2 Inductor Peak Current Setting 2 Inductor Peak Current Setting 2 Inductor Peak Current Setting 2	Buck-B Buck-B Buck-B Buck-B Buck-B Buck-B Fast I Switc	Conter DC-DC ic Voltage Sca Boost DVS Mo Boost Alternate Boost Alternate Boost Alternate Boost Alternate Coost Addition Load Transient hing Frequency Enable Voltage Low EMI Enable FET Sc.	Load Switches aling de 2 Voltage 1 2 Voltage 2 2 Voltage 3 2 Voltage 4 al Settings Response Mode 7 Threshold Transistion Ram	P Haptic Driver	Register Map R Disabled 2.5V 2.5V 2.5V 2.5V 2.5V 2.5V 2.5V 2.5V	ead All
Buck Only Mode Interrupts and Status Interrupt Name Mask Status BBstFaultInt Buck-Boost operating norm	nally.	Enable Zero-Cr	ossing Compara	tor	Read	Interrupts

Figure 9. Buck Boost Tab

Boost and LEDs Tab

The **Boost and LEDs** tab (Figure 10) provide options to enable boost, set boost voltage, inductor current settings, enable LEDs, and LED current sink setting.

neral Charger Buck 1 Buck	k 2 Bu	ick 3 Buck-Boost	Boost ar	nd LEDs	Other DC-DC	Load Switches	Haptic Driver	Register Map	
Boost Settings				LEDs				Rea	id All
Boost Enable Configuration Enabled Enabled by MPC Disabled	•			LED (Open Detectior Current Step	n Status: 000		0.6mA	v
Output Voltage				LED0	Enable		0.6	Off	*
· · · · · · · · · · · · · · · · · · ·	iet	12V		LED0	Dropout Regu	lation Voltage	0.0	200mV	• •
Inductor Peak Current		100mA	T		ED0 Boost Lo	op Enable			
Inductor Peak Current	Set by I	_ookup Table		LED1	Enable			Off	•
Adaptive Peak Current				LED1	Current		0.6	3mA/1.0mA/1.2mA	v
Fast Start Enable FET Scaling				LED2	Enable			Off	Ŧ
				LED2	Current		0.6	omA/1.0mA/1.2mA	•
nterrupts and Status								Read Ir	iterrupts
Interrupt Name Ma	sk S	tatus							
BstFaultInt	И В	oost operating nor	mally.						

Figure 10. Boost and LEDs Tab

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Other DC-DC Tab

The **Other DC-DC** tab (Figure 11) includes SFOUT, Charge Pump, LDO1, and LDO2 settings.

2 Device Optio	ns Help	0										
neral Charger	Buck 1	Buck 2	Buck 3	Buck-Boost	Boost and LEDs	Other DC-DC	Load Switches	Haptic Driver	Register N	Лар		
SFOUT and CF	þ			LDC	1 Settings		L	.DO 2 Settings	;	Re	ad All	
Safe Output LI Enabled Enabled by Disabled Safe Output LI	DO Enat MPC	ole Config	guration e		00 1 Enable Conf Enabled Enabled by MPC Disabled	iguration		LDO 2 Enable Enabled Enabled by Disabled	e Configurat	ion •		
5.0V3.3V				O	utput Voltage		0.5V		e		0.9V	
Charge Pump Enabled Enabled by Disabled	Enable (Configura	ation		Load Switch M	Set ode arge		Load Sw	Set itch Mode Discharge			
Charge Pump 6.6V 5.0V	Output \	/oltage		C	Active Dischar	ge		Active Di	scharge	/CCINT		
Passive [Discharg	e										
Interrupts and S	tatus								(Read I	nterrup	ts
Interrupt Name		Mask	Status									
ThmLDO_LSW	Int	\checkmark	LDO1,	LDO2, LSW	1, and LSW2 are	operating norm	ally.					
UVLOLDO1Int		\checkmark	LDO1	is operating r	iormally.							
UVLOLDO2Int		\checkmark	LDO2	is operating r	iormally.							

Figure 11. Other DC-DC Tab

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Load Switches Tab

The Load Switches tab (Figure 12) includes Load Switch 1 and Load Switch 2 settings.

		VIAA20300) EV KIL 1001			
Device Options F eneral Charger Buck	Help	Buck 3 Buck-Boost	Boost and LEDs	Other DC-DC Load Switches Haptic Driver	Register Map
	Duoki	Duck Doot	20001011022200		
Load Switch 1 Settin	ngs			Load Switch 2 Settings	Read All
Load Switch 1 Enabled Enabled Enabled by MPC Disabled	ele Configura	ation		Load Switch 2 Enable Configuration Enabled Enabled by MPC	
Passive Discha	arge			Passive Discharge	
Active Discharg	ge			Active Discharge	
Low Quiescent Curr	rent			Low Quiescent Current	
Voltage Protection	n Enabled			Voltage Protection Enabled	
Voltage Protection	n Disabled.	Low Quiescent Curren	ıt.	Voltage Protection Disabled. Low Qu	uiescent Current.
 Voltage Protection 	n Disabled.	Low Quiescent Curren	it.	 Voltage Protection Disabled. Low Qu 	uiescent Current.
Voltage Protection	n Disabled.	Low Quiescent Curren	it.	 Voltage Protection Disabled. Low Qu 	uiescent Current. Read Interrupts
Voltage Protection Interrupts and Status	Mask	Low Quiescent Curren	it.	Voltage Protection Disabled. Low Qu	uiescent Current.
Voltage Protection Interrupts and Status Interrupt Name ThmLDO_LSWInt	Mask	Low Quiescent Curren Status LDO1, LDO2, LSW1	I, and LSW2 are	Voltage Protection Disabled. Low Qu Orgenting normally.	uiescent Current. Read Interrupts
Voltage Protection Interrupts and Status Interrupt Name ThmLDO_LSWInt LSW1TmoInt	Mask	Low Quiescent Curren Status LDO1, LDO2, LSW1 LSW1 is operating n	I, and LSW2 are ormally.	Voltage Protection Disabled. Low Qu Orgenating normally.	uiescent Current.
Voltage Protection Interrupts and Status Interrupt Name ThmLDO_LSWInt LSW1TmoInt LSW2TmoInt	Mask	Low Quiescent Curren Status LDO1, LDO2, LSW1 LSW1 is operating n LSW2 is operating n	I, and LSW2 are ormally.	Voltage Protection Disabled. Low Qu Orgenting normally.	uiescent Current.

Figure 12. Load Switches Tab

Evaluates: MAX20360

Haptic Driver Tab

The **Haptic Driver** tab (Figure 13) provides options to choose actuator type, haptic driver mode and different settings for each mode. To unmask the haptic interrupts, the HptStatIntM bit in 0x0D IntMask3 register also needs to be unmasked.

eral Charger Buck 1 Buck 2 Buck 3 Buck-Boost Boost and LEDs	Other DC-DC Load Switches	Haptic Driver	Register Map			
laptic Driver Settings	RAM Haptic Pattern Mo	de	Read	IIA II		
Haptic Pattern Mode	RAM Address		0x00			
Real-Time I ² C External Triggered	Last Sample		Last Sample	•		
Disabled Acuator Type Selection	Duration	-1	60ms	• •		
● ERM ● LRA	Wait		50ms			
Full-Scale Voltage 3.00V -	Repeat	Repeat Re				
Automatic Level Compensation	Start Address	Start Address 0x00 * W				
Automatic Braking Resonant Frequency Initial Guess 200Hz	Real-Time I ² C Mode					
Autotune Status: Resonant frequency locking was not achieved. Resonant Frequency Result: 200.00Hz	Amplitude	0.00% of VFS	•			
Run Autotune Run	External Triggered Mod	e				
Haptic Fault: No haptic driver fault detected.		Amplitude	Durati	ion		
Unlock Haptic Driver Unlock	Overdrive -100	0.00% of VFS	* 20ms	Ŧ		
nterrupts, Statuses, and Interrupt Masks	Active -49	.61% of VFS	▼ 500ms	. .		
Haptic Interrupts and Statuses Open Status Panel	Braking +10	0.00% of VFS	• 160ms			

Figure 13. Haptic Driver Tab

Register Map Tab

The **Register Map** tab (Figure 14) provides all names and values of MAX20360 registers. Click **Read All** on the top right corner to perform a burst read of all registers.

The left table shows the register to be read from or written to. The right table contains descriptions for each register field of the selected 8-bit register. All bits, along with their field names, are displayed at the bottom of the page.

To set a bit, click the bit label. **Bold** text represents logic 1 and regular text represents logic 0. To configure the changes to the device, click the **Write** button at the bottom right.

neral Cha	arger Buck 1	Buck 2	Buck 3	Buck-Boo	st	Boost and LEDs	s Other DC-DC	Load S	witches	Haptic Driver	Register Map							
												Read All						
Register N	Лар											rtead / th						
Slave Address	Register Address	Regis	ster	Value	^	Field	Name		Status of	De	scription	abla						
0xA0	0x00	HptSta	tus0	0x00		Bit [7]	HptHDINDis	t	hreshold	napuc unver H	Din voltage dis	able						
0xA0	0x01	HptSta	tus1	0x00					Status of haptic driver overcurrent protection on the									
0xA0	0x02	HptSta	tus2	0x00		Bit [6]	HptDRPOCPLow	' i	DRP low-side switch.									
0xA0	0x03	HptIn	t0	0x00		Status of h		haptic driver ov	vercurrent prot	ection on the	,							
0xA0	0x04	HptIn	it1	0x00		Dir [J]	HPEDRINOCPLOW DR		DRN low-side switch.									
0xA0	0x05	HptInt2		0x00	Bit M HotDRPOCPHigh Status of haptic driver overcu		Status of haptic driver		vercurrent prot	ection on the	,							
0xA0	0x06	HptIntM	as <mark>k</mark> 0	0x00				DRP high-side switch.										
0xA0	0x07	HptIntM	ask1	0x00		Bit [3]	HptDRNOCPHigh		[3] HptDRNOCPHigh Status of haptic driver overcurrent protection on the			ection on the	;					
0xA0	0x08	HptIntM	ntMask2 02				- pro- training.	. 1	DRN high	-side switch.								
0xA0	0x09	HptControl HptRTI2CPat		HptControl		0x00		0x00	0x00		Bit [2]	HptThm		Status of	haptic driver th	ermal protection	on.	
0xA0	0x0A			HptRTI2CPat 0x00		Bit [1]	HptClkOn	otClkOn Status of haptic drive		haptic driver cl	:lock.							
0xA0	0x0B	HptRAMF	PatAdd	0x00		Bit [0]	HotEral ock	\$	Status of haptic driver BEMF re		EMF resonant	nant frequency						
0xA0	0x0C	HptP	rot	0x04		Dir [0]	ripti rqeock	1	ocking.									
0xA0	0x0D	HptUn	lock	0x00														
0xA0	0x11	HPTC	fg0	0x0E														
0xA0	0x12	HPTC	fg1	0x8B														
0xA0	0x13	HPTC	fg2	0x8B														
0xA0	0x14	HPTC	fg3	0x19														
0xA0	0x15	HPTC	fq4	0x03	¥													
7		6		5		4	3		2		1	0						
HptHD	NDis Hp	tDRPOCPLo	w Hpt	DRNOCPL	w	HptDRPOCPHi	gh HptDRNOCPH	ligh	HptThr	n Hpt	ClkOn	HptFrqLock						
Note: Click	text to set o	r clear bit a	and "Writ	e" to com	mit t	to device. Bold	text is logic 1. Reg	gular tex	kt is logic	0.	Rea	d Write	е					

Figure 14. Register Map Tab

Evaluates: MAX20360

Detailed Description of Hardware

The MAX20360 EV kit evaluates the MAX20360 ultra low-power wearable PMIC, which communicates over the I²C interface. The EV kit demonstrates the IC features such as bucks, buck-boost, boost, LED current sink, linear regulators, battery charger, and haptic driver. The EV kit uses the IC in a 72-bump wafer-level package on a proven, six-layer PCB design. The EV kit can use USB VBUS 5V DC for battery and charger input power source. Alternatively, the EV kit can be powered from an external power supply. Figure 15 and Figure 16 show the EV kit and block annotated pictures.



Figure 15. MAX20360 EV Kit Board Picture

Evaluates: MAX20360



Figure 16. MAX20360 EV Kit Block Annotated Picture

Evaluates: MAX20360

Hardware Setup

To use the EV kit with the GUI, connect the MAXPICO2PMB# to the PMOD connector in the bottom left corner of the board. The MAXPICO2PMB# also provides 3.3V to the logic voltage VIO of the EV kit when shunting J20. Use the J21 USB VBUS to power the battery simulation circuits on the EV kit to supply BAT of the IC. Turning the R58 potentiometer can change the BATSIM voltage. Connect BATSIM to BAT of the IC with shunt on JP9. Alternatively, instead of using battery simulation circuits on the board, connect a Li-ion battery on J2 connector. Use the J1 USB VBUS as CHGIN source and place shunt on J4.

PFNs and MPCs States

The PFNs and MPCs can be pulled up to VIO through a 100 k Ω resistor, or connected to ground through 100 k Ω resistor.

Regulators and Peripherals

All regulator outputs are made available on test points. The inputs to the LDO1, LDO2, Load Switch 1, and Load Switch 2 must be supplied externally through test points. The LDO2 input can be supplied from VCCINT of IC if set through the I²C. Bucks, buck-boost, and boost output have sense test points which provide easy voltage measuring.

Thermistor and SET Adjustment

When the J6 shunt is installed, THM is pulled up to TPU through a $10k\Omega$ resistor. Header J19 is used to select the pull-down resistor for THM. When pin 1 and 2 is shunted, potentiometer R14 is used to simulate a thermistor at THM. When pin 2 and 3 is shunted, a fixed $10k\Omega$ resistor is connected between THM and ground.

Header J18 is used to select the resistor for R_{ISET} which sets the fast-charge current I_{FCHG}. Shunting pin 1 and 2 selects potentiometer R63. Change R_{ISET} to change I_{FCHG}. Shunting the pin 2 and pin 3 selects a fixed 10k Ω resistor, which sets fast-charge current to 0.2A.

INT and **RST** LED Indicators

Shunts can be installed on J7 and J8 to show the status of $\overline{\text{INT}}$ and $\overline{\text{RST}}$ as LED indicators, DS2 and DS3. When the corresponding LED illuminates, it verifies the active-low output is pulled low.

Haptic Driver

Select haptic driver supply using J23. When pin 1 and 2 is shunted, HDIN is powered from SYS. When pin 2 and 3 is shunted, HDIN is sourced from BBOUT. The haptic driver output is available on J5 where an LRA or ERM vibration motor can be connected. By shunting J24 and J25, haptic waveform can be measured with the on board low-pass filters which convert pulse-width-modulation (PWM) to sinewave.

LED Current Sink

The EV kit includes multiple LEDs to test the LED0, LED1, and LED2 current sinks. The current source for LED1 and LED2 can be connected to SYS by shunting J14. The current source for LED0 can be selected between SYS and BSTOUT by J17. Using J16, select between sinking the current from one LED or three LEDs for LED0.

Jumper Setting

<u>Table 1</u> shows the detailed jumper setting, and <u>Table 2</u> shows the connector description.

JUMPER	SHUNT POSITION	DESCRIPTION						
J3	1-2*	CSN connect to FGBAT						
J4	1-2	CHGIN connect to USB VBUS from J1						
J6	1-2*	THM connect to TPU for thermistor monitoring						
J7	1-2*	INT connect to pull up VIO and DS2.						
J8	1-2*	RST connect to pull up VIO and DS3.						
	1-2	MPC0 pull down to ground						
J9	1-3	MPC0 connect to GPIO3						
	1-4	MPC0 pull up to VIO						
	1-2	PFN1 pull down to ground						
J10	1-3	PFN1 connect to GPIO1						
	1-4	PFN1 pull up to VIO						

Table 1. Jumper Setting

JUMPER	SHUNT POSITION	DESCRIPTION						
	1-2	MPC1 pull down to ground						
J11	1-3	MPC1 connect to GPIO4						
	1-4	MPC1 pull up to VIO						
	1-2	PFN2 pull down to ground						
J12	1-3	PFN2 connect to GPIO2						
	1-4	PFN2 pull up to VIO						
J14	1-2	LED1/LED2 supply from SYS voltage						
14.0	1-2	LED0 connect to one LED						
J 10	2-3	_ED0 connect to three LEDs						
147	1-2	LED0 supply from SYS						
JT	2-3	LED0 supply from BSTOUT						
J18	1-2	ISET connect to potentiometer						
	2-3*	ISET connect to $10k\Omega$ (fast-charge current 0.2A)						
140	1-2	THM connect to potentiometer						
119	2-3*	THM connect to 10kΩ (50%/room zone)						
J20	1-2*	VIO connect to 3.3V from PMOD						
J22	1-2*	VHC connect to USB VBUS from J21						
J23	1-2*	HDIN connect to SYS						
	2-3	HDIN connect to BBOUT						
J24	4 1-2 DRP connect to low-pass filter which convert PWM to sinewave, measure filtered wa DRP_F							
J25	1-2	DRN connect to low-pass filter which convert PWM to sinewave, measure filtered waveform at DRN_F						
107	1-2	MPC4 pull up to VIO						
JZI	2-3	MPC4 pull down to ground						
100	1-2	MPC3 pull up to VIO						
JZ8	2-3	MPC3 pull down to ground						
120	1-2	MPC7 pull up to VIO						
330	2-3	MPC7 pull down to ground						
124	1-2	MPC6 pull up to VIO						
331	2-3	MPC6 pull down to ground						
100	1-2	MPC2 pull up to VIO						
333	2-3	MPC2 pull down to ground						
10.4	1-2	MPC5 pull up to VIO						
J34	2-3	MPC5 pull down to ground						
100	1-2	SDA connect to ground						
138	2-3	SCL connect to ground						
JP9	1-2	BATSIM connect to CSN						

Table 1. Jumper Setting (continued)

*Default position.

Evaluates: MAX20360

Table 2. Connectors Description

CONNECTOR	DESCRIPTION
J1	Connect to USB cable for CHGIN voltage
J2	Connect to battery
J5	Connect to LRA/ERM haptic actuator
J13	Connect to MAXPICO2PMB#
J15	Connect to MAX20361 EV kit
J21	Connect to the USB cable for battery simulation

Interaction with the MAX20361 EV Kit

The MAX20360 PMIC (version with harvester enabled, HrvEn = 1) can seamlessly interact with the MAX20361 solar energy harvester. Interactions between the MAX20360 charger and the MAX20361 harvester can be evaluated with the MAX20360HEVKIT# and MAX20361EVKIT#.

Hardware Settings

Follow the below jumper settings for the interaction test.

MAX20361EVKIT# Jumper Settings:

- 1) Follow default jumper settings in Table 1 of the MAX20361 EV kit data sheet.
- For JU2 and JU3, connect jumper position 3–4 so EN and WAKE are connected to interaction connec-tor S1.
- 3) Connect JU9 to bring SYS to interaction connector S1.
- Utilize the on-board current source for a steady input current. Refer to the On-Board Current Source section of the MAX20361 EV kit data sheet.
- 5) The highest on-board input current is recommended. Connect jumper position 1–2 of JU15 to select the highest current source.

MAX20360HEVKIT# Jumper Settings:

- 1) Follow default jumper settings in <u>Table 1</u>.
- 2) Remove the jumpers on J30 and J31 so MPC6 and MPC7 are left unconnected. When the

MAX20360HEVKIT# and the MAX20361EVKIT# are connected, the MAX20360 MPC6 pin is connected to the MAX20361 $\overline{\text{EN}}$ pin, and the MAX20360 MPC7 pin is connected to the MAX20361 WAKE pin.

 Either the battery simulator (power through J21) or an actual Lithium-ion battery (connected to J2) can be used for the interaction test. Remember to disconnect JP9 when using the actual Lithium-ion battery.

Software Settings

Refer to the following registers to configure the parameters of the interaction test.

For the MAX20361, field WakeThr[2:0] of register 0x05 WakeCfg determines the SYS/BAT voltage threshold that the WAKE output is asserted. During interaction, when WAKE is high, the MAX20360 enters ON Mode.

For the MAX20360, registers ThmCfg2, HrvCfg0, and HrvCfg1 offer some settings for how the harvester and PMIC interaction takes place. Refer to the *MAX20361 Harvester Interaction* section in the **MAX20360 IC data sheet**.

Interaction Process

To start the test, connect two EV kits using the S1 of the MAX20361EVKIT# and J15 of the MAX20360HEVKIT#. When the MAX20361 harvester SYS or output current is charging the BAT node of the MAX20360 PMIC, the MAX20361 harvest counter updates, which indicates the number of LX pulses transferred from SRC to SYS and correlates to the SYS charging current.

In the PMIC ON Mode, WAKE is asserted and $\overline{\text{EN}}$ is low. The SYS current keeps charging the battery until the BAT voltage reaches the harvester battery-regulation voltage set in HrvBatReg. When SYS charging halts, the harvest counter stops updating.

In PMIC Battery Recovery Mode, both WAKE and $\overline{\text{EN}}$ are low. The SYS current keeps charging the battery until the BAT voltage reaches the WAKE threshold to enter PMIC ON Mode.

Fuel Gauge Software

The MAX20360 integrates the MAX17260, an ultralow-power fuel gauge IC which implements the Maxim ModelGauge™ m5 algorithm with high-side current sensing. Use the MAX20360 Fuel Gauge GUI and MAXPICO2PMB to evaluate the ModelGauge™ m5 fuel gauge.

Sense Resistor

The default Sense Resistor (R5) on the MAX20360 EV kit is 0.01Ω . To obtain the most accurate testing data, please replace R5 with the actual Sense Resistor used in the actual application.

Software Installation

Visit <u>www.maximintegrated.com</u> to download the latest version of the Fuel Gauge EV kit software, MAX17260GUISetupxxx.zip located on the <u>MAX20360</u> <u>EV Kit web page</u>. Download the software to a temporary folder and unzip the zip file. Install the Fuel Gauge EV kit software on your computer by running the MAX17260GUISetupxxx.exe program inside the temporary folder.

Hardware Setup

The following procedure applies to the MAX20360 EV kit:

- 1) Connect the MAXPICO2PMB Adapter Board to J13 of the MAX20360 EVKIT.
- 2) Connect jumper J4 and remove jumper JP9.
- 3) Connect the application's battery to jumper J2 and ensure the battery's polarity connection.

4) Connect the MAXPICO2PMB Adapter Board to the computer USB port via USB A to USB Micro-B cable.

Communication Port

The Fuel Gauge software automatically finds the MAXPICO2PMB adapter when connected to any USB port. Communication status is shown on the right-hand side of the bottom status bar. (See Figure 17.) If the adapter is not found, a **No USB Adapter** message is displayed. If the adapter is found, but the MAX20360 EV kit board is not found, a **No Slave Device** message is displayed. If the communication is valid, a green bar updates as the software continuously reads the IC registers. If the MAXPICO2PMB is connected, the status bar should be active. The bottom status bar also displays information on data logging status, the communication mode, hibernation status, selected current-sense resistor value, device serial number, and the GUIs version number.

Program Tabs

All functions of the program are divided under four tabs in the main program window. Click on the appropriate tab to move to the desired function page. Located on the **ModelGauge m5** tab is the primary user information measured and calculated by the IC. The **Graphs** tab visually displays fuel gauge register changes over time. The **Registers** tab allows the user to modify common fuel gauge registers one at a time. The **Configure** tab allows for special operations such as initializing the fuel gauge logging and performing fuel gauge reset. All tabs are described in more detail in the following sections.

Mode: Active	SN:	Sense: 10.0 mΩ	Battery Profile: 1	Rev: 0000	NO SLAVE DEVICE	

Figure 17. Bottom Status Bar

Evaluates: MAX20360

ModelGauge m5 Tab

The **ModelGauge m5** tab displays the important output information read from the IC. Figure 18 shows the format of the ModelGauge m5 Tab. Information is grouped by function and each is detailed separately.

State-of-Charge

The **State-of-Charge** group box displays the main output information from the fuel gauge: state-of-charge of the cell, remaining capacity, time-to-full, and time-to-empty.

Cell Information

The **Cell Information** group box displays information related to the health of the cell such as the cell's age,

internal resistance, present capacity, number of equivalent full cycles, and change in capacity from when it was new.

Measurements

The **Measurements** group box displays ADC measurements that are used by the fuel gauge to determine stateof-charge.

Alerts

The **Alerts** group box tracks all eleven possible alert trigger conditions. If any alert occurs, the corresponding checkbox is checked for the user to see. The clear alerts button resets all alert flags.



Figure 18. ModelGauge m5 Tab

Evaluates: MAX20360

At Rate

The **At Rate** group box allows the user to input a hypothetical load current and the fuel gauge calculates the corresponding hypothetical Qresidual, TTE, AvSOC, and AvCap values.

Graphs Tab

Figure 19 shows the format of the **Graphs** Tab. Graph information is grouped into four categories: voltages, temperatures, capacities, and currents. The user can

turn on or off any data series using the check boxes on the right-hand side of the tab. The graph visible viewing area can be adjusted from 10 minutes up to 1 week. The graphs remember up to 1 week worth of data. If the viewing area is smaller than the time range of the data already collected, the scroll bar below the graphs can be used to scroll through graph history. All graph history information is maintained by the program. Graph settings can be changed at any time without losing data.



Figure 19. Graphs Tab

Evaluates: MAX20360

Registers Tab

The **Registers** tab allows the user access to all fuel gauge-related registers of the IC. <u>Figure 20</u> shows the format of the **Registers** tab. By using the drop-down menu on the left side of the tab, the user can sort the registers either by function or by their internal address. Each line of data contains the register name, register address, a

hexadecimal representation of the data stored in the register, and if applicable, a conversion to application units. To write a register location click on the button containing the register name. A pop-up window allows the user to enter a new value in either hexadecimal units or application units. The main read loop temporarily pauses while the register updates.

Hex Value ×1C3F 28.246°C					ation	Informa	Configure	Registers	(Franke	Viodol Caudo mb
Hex Value ×1C3F 28.246°C								riegisters [Graphis	auge no
Hex Value Value x102F 28.246°C										
Hex Value x1C3F 28.246°C										
Hex Value x1C3F 28.246°C							stor Data	Dogi	olav	Dice
x1C3F 28.246°C	Hov	Addr	Tomporatures	10	Hox	Addr		Not	moerature	Voltage and Tel
20.240 0	Ov1C3E	0.008	Tomp		OxB95E		VCall		inperature	voltage and re
1BF2 27 945°C	Ox105F	0x16	ΔναΤΔ	7\/	OxB95D	0x19			ter Viewer	Show Regis
x88D0 53 443%	0x88D0	0x27	AIN	NV	0x0000	0xBC	VRinnle			
xEE56	0xEE56	0x2C	TGain				Trappio			
x1DA4	0x1DA4	0x2D	TOff							
x1C3F 28.246°C	0x1C3F	0x34	DieTemp							
Contract Contractor										
Valu										
		3 3								

Figure 20. Registers Tab

Configure Tab

The **Configure** tab allows the user to access any general IC functions not related to normal writing and reading of register locations. Figure 21 shows the format of the **Configure** tab. Each group box of the **Configure** tab is described in detail in the following sections.

Read/Write Register

The user can read a single register location by entering the address in hex and clicking the **Read** button. The user can write a single register location by entering the address and data in hex and clicking the **Write** button. The read loop is temporarily paused each time to complete this action.

Log Data to File

Data logging is always active when the EV kit software starts. The default data log storage location is the My Documents/Maxim Integrated/MAX17260/Datalog.csv. The user can stop data logging in by clicking the **Stop** button. The user can resume logging by clicking the **Start** button. All user available IC registers are logging in a .csv formatted file. The user can adjust the logging interval at any time. The user can also enable or disable the event logging at any time. When event logging is enabled, the data log also stores any IC write or reads that are not part of the normal read data loop and indicates any time communication to the IC is lost. The GUI automatically begins writing to a new file on each launch. To manually begin logging into a new file, click the **Advance** button.

	Graphs Regi	sters Configure In	formation	n de l'alement	
Log Data to File				Reset IC	
IC registers will b format. The datal can be adjusted log is started aut increment the da Path	e stored in the se og interval is fixed from 5 seconds to omatically every talog number and	elected logfile at the data d at 2 minutes while the o 5 minutes when the IC 10,000 lines to limit file s force the start of a new	alog interval using a .csv IC is in hibernate mode and is in active mode. A new data sizes. The Advance button will data log file earlier if desired.	Click the POR button to reset the IC. Afterwards a battery profile will need to be selected and loaded.	
Documents Max	im Integrated\MA	X17260\Data Logs\Data	log000003.csv	Read/Write Register	
Stop Adva	ance 15≑	Interval (seconds) 🔽	Reads or Writes a single register location. Valid register addresses are any location from 00 through FF. Use the full 8 bit address in hexadecimal below.		
Battery Selection					
The MAX17260 r system. The EV connected to the Profile Desc	nust be configure Kit software trac IC is changed, t ription	d for the battery that is ks individual batteries as he user will need to sele	Register h Write Data h Read		
1 New I	Profile			Save and Restore	
Other Settings	(Change Battery		Registers defined as Save and Restore contain cell characterization information that changes over time. Host software tracks these values and loads them back into the IC any time it is reset. The user can change the save interval or force a	
5	nfigured for intern lue is adjustable	al or external temperatu to a value between 0.1m	re measurements. Also the $Ω$ and 1.0 $Ω$.	save restore line doc call change the date interval of loce a save or restore using the controls below.	

Figure 21. Configure Tab

Reset IC

Clicking the **POR** button sends the software POR command to the command register to fully reset the operation the same as if the IC had been power cycled. Note that resetting the IC when the cell is not relaxed causes fuel gauge error.

Battery Selection

Clicking the **Change Battery** button opens the battery selector window. In this window, a battery profile is created. The battery profile stores the EZ Config or custom INI for that battery, as well as any learned parameters, if the save and restore function is used. Ideally, a new profile is created for each battery to store these parameters. The software automatically programs the IC when the **Save Profile and Update IC** button is clicked.

Save and Restore

The EV Kit software periodically saves the values from registers related to cell characteristics that change over time. These values are then restored into an IC after reset so that the fuel gauge remains accurate as the cell ages. The software automatically performs a save operation every 10 cycles or when the software exits. The user can change the save interval or force a save operation at any time by clicking the **Save** button. To restore this information after the IC has been power cycled or reset through software, click the **Restore** button.

ModelGauge m5 EZ Configuration

Before the IC accurately fuel gauges the battery pack, it must be configured with characterization information. This

can be accomplished in two ways. The first is through a custom characterization procedure that can be performed by Maxim under certain conditions. The result is an .INI summary file that contains information that can be programmed into the IC on the **Configure** tab. Contact Maxim for details on this procedure.

The second method is the ModelGauge m5 EZ configuration. This is the default characterization information shipped inside every IC. This default model produces accurate results for most applications under most operating conditions. It is the recommended method for new designs as it bypasses the custom cell characterization procedure. Some additional information is required from the user for EZ configuration initialization.

For EZ configuration, click the **Import INI File** button in the Information tab, or click **Change Battery** in the **Configure** tab. A **Battery Selector** panel as shown in <u>Figure 22</u> pops out. In the panel, select **Use Default IC Settings (EZ Config)** option. Fill in the rated battery capacity and the charge termination current, select the battery chemistry in the **Model ID** drop down menu, and select the minimum system voltage in the Empty Voltage drop down menu. Check the **Charge voltage is greater than 4.275V** box if the full charge voltage is higher than 4.275V. After configuring these items, click the **Save Profile** and Update **IC button to load the EZ configuration** into the chip.

For characterized battery, choose the **Load INI File** option in the **Battery Selector** panel, and select the **INI file** provided from MAXIM, then click **Save Profile and Update IC** button to load configuration.

A battery profile must be loaded into the IC for proper operation and no battery profiles are available, a new one must be create an INI file. Also select whether or not to restore battery history to restore history information. A different profile should be kept all batteries so that the correct battery profile is used each tim	. If this is the first time the software ha d. Select either EZ Configuration or loa information after the model is loaded. It for each battery used with the EV Kit. I e.	s been launched d the profile from is recommended Make sure to labe
Battery Profile Description		
1 (new) New Profile		
INI File Option		
1500 Cell Size (mAH) 3.3 ✓ Empty Voltage (V per cell) 100.00 Charge Termination Current (mA) ✓ Charge voltage is greater than 4.275V	LiCoO2 (Common) Model Contact Maxim for special cell ch listed in the Model ID drop down be 10 Recommend RSense	ID* emistries not ox. Resistor (mΩ)
Path: N/A		Select File
Save and Restore Option Restore Saved Fuel Gauge Data After Loading the Mode Use Existing IC Fuel Gauge Register Data After Loading	I the Model	

Figure 22. New Battery Selector Panel

Ordering Information

PART	HARVESTER ENABLE	TYPE
MAX20360EVKIT#	NO	EVKIT
MAX20360HEVKIT#	YES	EVKIT

#Denotes RoHS compliant.

Evaluates: MAX20360

MAX20360 EV Kit Bill of Materials

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	BATSIM, TP1-TP6, TP10-TP13, TP18-TP21	_	15	5003	KEYSTONE	N/A	TEST POINT; PIN DIA=0.11N; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; ORANGE; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
2	BBOUT_S, BK1OUT_S-BK3OUT_S, BSTOUT_S, DRN_F, DRP_F, TP14-TP17, TP36, TP37	_	13	5002	KEYSTONE	N/A	TEST POINT; PIN DIA=0.11N; TOTAL LENGTH=0.31N; BOARD HOLE=0.041N; WHITE; PHOSPHOR BRONZE WIRE SILVER;
3	C1	_	1	C1005X7R1H104K050BB; GRM155R71H104KE14; C1005X7R1H104K050BE; UMK105B7104KV-FR	TDK;MURATA; TDK; TAIYO YUDEN	0.1UF	CAP; SMT (0402); 0.1UF; 10%; 50V; X7R; CERAMIC
4	C2	_	1	C1005X5R1V225K050BC	TDK	2.2UF	CAP; SMT (0402); 2.2UF; 10%; 35V; X5R; CERAMIC
5	C3, C5, C13-C17, C21, C22	-	9	C1005X5R0J475K050BC	ТДК	4.7UF	CAP; SMT (0402); 4.7UF; 10%; 6.3V; X5R; CERAMIC
6	C4	_	1	C1005X5R0J225K050BC; CL05A225KQ5NSN	TDK; SAMSUNG	2.2UF	CAP; SMT (0402); 2.2UF; 10%; 6.3V; X5R; CERAMIC
7	C6-C9, C11, C18, C20, C40	-	8	GRM155R60J226ME11	MURATA	22UF	CAP; SMT (0402); 22UF; 20%; 6.3V; X5R; CERAMIC;
8	C10, C19	—	2	GRM188R6YA106MA73	MURATA	10UF	CAP; SMT (0603); 10UF; 20%; 35V; X5R; CERAMIC
9	C12	-	1	GRM155R71A273KA01; 0402ZC273KAT2A; CC0402KRX7R6BB273	MURATA;AVX;YAGEO	0.027UF	CAP; SMT (0402); 0.027UF; 10%; 10V; X7R; CERAMIC
10	C23, C27	-	2	GRM31CR71H475KA12; GRJ31CR71H475KE11; GXM31CR71H475KA10; UMK316AB7475KL	MURATA;MURATA; MURATA; TAIYO YUDEN	4.7UF	CAP; SMT (1206); 4.7UF; 10%; 50V; X7R; CERAMIC
11	C24	-	1	C1608X5R1H104K080AA	TDK	0.1UF	CAP; SMT (0603); 0.1UF; 10%; 50V; X5R; CERAMIC
12	C25, C33, C35-C38	_	6	C1005X7R1C104K050BC; ATC530L104KT16; 0402YC104KAT2A; C0402X7R160-104KNE; CL05B104KO5NNNC; GRM155R71C104KA88; C1005X7R1C104K; CC0402KRX7R7BB104; EMK150B7104KV; CL05B104KO5	TDK; AMERICAN TECHNICAL CERAMICS; AVK; VENKEL LTD.; SAMSUNG ELECTRONICS; MURATA.TDK; YAGEO PHICOMP; TAIYO YUDEN; SAMSUNG ELECTRONICS	0.1UF	CAP; SMT (0402); 0.1UF; 10%; 16V; X7R; CERAMIC
13	C26	-	1	C0603C225K9PAC; GRM188R60J225KE01; C1608X5R0J225K080AB	KEMET; MURATA;TDK	2.2UF	CAP; SMT (0603); 2.2UF; 10%; 6.3V; X5R; CERAMIC;
14	C28	_	1	C0603C475K9PAC	KEMET	4.7UF	CAP; SMT (0603); 4.7UF; 10%; 6.3V; X5R; CERAMIC;
15	C29	-	1	C0402X7R500-222KNE; GRM155R71H222KA01; C1005X7R1H222K050BA	VENKEL LTD.; MURATA;TDK	2200PF	CAP; SMT (0402); 2200PF; 10%; 50V; X7R; CERAMIC
16	C30	-	1	C0603C104K8RAC	KEMET	0.1UF	CAP; SMT (0603); 0.1UF; 10%; 10V; X7R; CERAMIC
17	C31	_	1	C3216X5R1C476M160AB; GRM31CR61C476ME44	TDK;MURATA	47UF	CAP; SMT (1206); 47UF; 20%; 16V; X5R; CERAMIC
18	C32	_	1	C3216X5R1H106K160AB; GRM31CR61H106KA12	TDK;MURATA	10UF	CAP; SMT (1206); 10UF; 10%; 50V; X5R; CERAMIC
19	C34	-	1	GRM188R60J105KA01	MURATA	1UF	CAP; SMT (0603); 1UF; 10%; 6.3V; X5R; CERAMIC;
20	DS1-DS3, DS10	-	4	LG L29K-G2J1-24	OSRAM	LG L29K-G2J1-24	DIODE; LED; SMT (0603); Vf=1.7V; lf(test)=0.002A; -40 DEGC TO +100 DEGC
21	DS4, DS8, DS9	_	3	LTST-C171TBKT	LITE-ON ELECTRONICS INC.	LTST-C171TBKT	DIODE; LED; SMD LED; BLUE; SMT (0805); PIV=5V; IF=0.020A
22	DS5-DS7	_	3	LTST-C150KRKT	LITE-ON ELECTRONICS INC.	LTST-C150KRKT	DIODE; LED; STANDARD; RED; SMT (1206); PIV=2V; IF=0.02A; -30 DEGC TO +85 DEGC
23	J1, J21	_	2	ZX62D-B-5P8	HIROSE ELECTRIC CO LTD.	ZX62D-B-5P8	CONNECTOR; MALE; SMT; MICRO UNIVERSAL SERIES BUS B-TYPE CONNECTOR; RIGHT ANGLE; 5PINS
24	J2, J5	_	2	800-10-002-10-001000	MILLMAX	800-10-002-10-001000	CONNECTOR; MALE; TH; SINGLE ROW; STRAIGHT; 2PINS
25	J3, J4, J6-J8, J14, J20, J22, J24, J25, JP9	_	11	PBC02SAAN	SULLINS ELECTRONICS CORP.	PBC02SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 2PINS
26	J9-J12	_	4	TSW-104-07-L-S	SAMTEC	TSW-104-07-L-S	EVKIT PART-CONNECTOR; MALE; THROUGH HOLE; TSW SERIES; SINGLE ROW; STRAIGHT; 4PINS
27	J13	-	1	PBC06DBAN	SULLINS ELECTRONICS CORP.	PBC06DBAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; RIGHT ANGLE; 12PINS; 12PINS - ALTERNATE PIN NUMBERING

Evaluates: MAX20360

MAX20360 EV Kit Bill of Materials (continued)

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
28	J15	-	1	PEC04SBAN	SULLINS ELECTRONICS CORP.	PEC04SBAN	CONNECTOR; MALE; THROUGH HOLE; 0.100INCH CONTACT CENTERS; MALE BREAKAWAY HEADERS; RIGHT ANGLE; NO MOUNTING; 4PINS
30	L1-L3, L5	_	4	DFE201612E-2R2M	MURATA	2.2UH	INDUCTOR; SMT (0806); WIREWOUND CHIP; 2.2UH; TOL=+/-20%; 1.8A
31	L4	-	1	DFE201612E-4R7M	MURATA	4.7UH	INDUCTOR; SMT (0806); METAL; 4.7UH; 20%; 1.20A
32	PB1	-	1	1825910-6	TE CONNECTIVITY	1825910-6	SWITCH; SPST; THROUGH HOLE; 24V; 0.05A; TACTILE SWITCH; RCOIL=0 OHM; RINSULATION=100M OHM; TE CONNECTIVITY
33	R1, R13, R15, R16	-	4	ERJ-2RKF1001	PANASONIC	1К	RES; SMT (0402); 1K; 1%; +/-100PPM/DEGC; 0.1000W
34	R2, R10, R11, R38-R40, R49, R53	-	8	CRCW040210K0FK; RC0402FR-0710KL	VISHAY DALE; YAGEO PHICOMP	10K	RES; SMT (0402); 10K; 1%; +/-100PPM/DEGC; 0.0630W
35	R3, R4, R44, R47, R55, R60	_	6	ERJ-2RKF3000	PANASONIC	300	RES; SMT (0402); 300; 1%; +/-100PPM/DEGC; 0.1000W
36	R5	_	1	ERJ-2LWFR010	PANASONIC	0.01	RES; SMT (0402); 0.01; 1%; 0 TO +500PPM/DEGC; 0.2000W
37	R6	-	1	ERJ-2GEJ103	PANASONIC	10K	RES; SMT (0402); 10K; 5%; +/-200PPM/DEGC; 0.1000W
38	R7, R17-R21, R23-R35, R41, R45, R46, R48, R50, R57	-	25	ERJ-2GEJ104	PANASONIC	100K	RES; SMT (0402); 100K; 5%; +/-200PPM/DEGC; 0.1000W
39	R8, R9, R12, R42	_	4	CRCW0402499RFK	VISHAY DALE	499	RES; SMT (0402); 499; 1%; +/-100PPM/DEGC; 0.0630W
40	R14, R63	-	2	PV36Y105C01B00	MURATA	1M	RESISTOR; THROUGH-HOLE-RADIAL LEAD; PV36 SERIES; 1M OHM; 10%; 100PPM; 0.5W; TRIMMER POTENTIOMETER; 25 TURNS; MOLDER CERAMIC OVER METAL FILM
41	R22, R36, R37	-	3	CRCW040210R0JNEDHP	VISHAY DRALORIC	10	RES; SMT (0402); 10; 5%; +/-200PPM/DEGK; 0.2000W
42	R43	-	1	CRCW04024K70FK; MCR01MZPF4701	VISHAY DALE; ROHM SEMICONDUCTOR	4.7K	RES; SMT (0402); 4.7K; 1%; +/-100PPM/DEGC; 0.0630W
43	R51	-	1	ERJ-2GE0R00	PANASONIC	0	RES; SMT (0402); 0; JUMPER; JUMPER; 0.1000W
44	R52	-	1	ERJ-2RKF5100	PANASONIC	510	RES; SMT (0402); 510; 1%; +/-100PPM/DEGC; 0.1000W
45	R54, R56	-	2	WSL0805R1000FEA18	VISHAY DALE	0.1	RES; SMT (0805); 0.1; 1%; +/-75PPM/DEGC; 0.1250W
46	R58	-	1	3296Y-1-253LF	BOURNS	25K	RESISTOR; THROUGH-HOLE-RADIAL LEAD; 3296 SERIES; 25K OHM; 10%; 100PPM; 0.5W; SQUARE TRIMMING POTENTIOMETER; 25 TURNS; MOLDER CERAMIC OVER METAL FILM
47	R59	-	1	ERJ-2RKF1152	PANASONIC	11.5K	RES; SMT (0402); 11.5K; 1%; +/-100PPM/DEGC; 0.1000W
48	R61	-	1	CRCW04023K40FK	VISHAY DALE	3.4K	RES; SMT (0402); 3.4K; 1%; +/-100PPM/DEGC; 0.0630W
49	SPACER1-SPACER4	-	4	9032	KEYSTONE	9032	MACHINE FABRICATED; ROUND-THRU HOLE SPACER; NO THREAD; M3.5; 5/8IN; NYLON
50	SU3, SU4, SU6-SU12, SU14, SU16-SU20, SU23-SU25, SU27, SU28, SU30, SU31, SU33, SU34	-	24	S1100-B; SX1100-B; STC02SYAN	KYCON;KYCON; SULLINS ELECTRONICS CORP.	SX1100-B	TEST POINT; JUMPER; STR; TOTAL LENGTH=0.24IN; BLACK; INSULATION=PBT; PHOSPHOR BRONZE CONTACT=GOLD PLATED
51	TP7-TP9, VHC	-	4	5000	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; RED; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
52	TP22-TP33	-	12	5001	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; BLACK; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
53	U1	_	1	MAX20360	MAXIM	MAX20360	EVKIT PART - IC; WEARABLE POWER NAMAGEMENT SOLUTION; PACKAGE OUTLINE DRAWING: 21-100373; WLP 72 PINS; 0.5MM PITCH; PACKAGE CODE: W724A4+1
54	U2	_	1	OPA569AIDWPR	TEXAS INSTRUMENTS	OPA569AIDWPR	IC; AMP; RAIL-TO-RAIL I/O; POWER AMPLIFIER; WSOIC20-EP 300MIL
55	U3	_	1	MAX8880EUT+	MAXIM	MAX8880EUT+	IC; VREG; ULTRA-LOW-IQ LOW-DROPOUT LINEAR REGULATOR WITH POK; SOT23-6
56	U4	-	1	NC7WZ07P6X	FAIRCHILD SEMICONDUCTOR	NC7WZ07P6X	IC; BUF; TINY LOGIC ULTRA-HIGH SPEED DUAL BUFFER; SC70-6
57	PCB	-	1	MAX20360	MAXIM	PCB	PCB:MAX20360
58	MISC1, MISC2	DNI	2	AK67421-0.5	ASSMANN	AK67421-0.5	CONNECTOR; USB CABLE; MALE-MALE; USB_2.0; 5PINS-4PINS; 500MM
59	MISC3	DNI	1	MAXPICO2PMB#	MAXIM	MAXPICO2PMB#	ACCESSORY; BRD; PACKOUT; PICO2PMB USB ADAPTER BOARD
TOTA	L		230]			

MAX20360 EV Kit Schematics





MAX20360 EV Kit Schematics (continued)



MAX20360 EV Kit Schematics (continued)

Evaluates: MAX20360



MAX20360 EV Kit PCB Layouts

MAX20360 EV Kit PCB Layout—Silk Top



MAX20360 EV Kit PCB Layout—Top



MAX20360 EV Kit PCB Layout—Layer2



MAX20360 EV Kit PCB Layout—Layer3

Evaluates: MAX20360



MAX20360 EV Kit PCB Layouts (continued)



MAX20360 EV Kit PCB Layout—Layer5



MAX20360 EV Kit PCB Layout—Bottom

Evaluates: MAX20360

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	8/20	Release for Market Intro	—
1	4/21	Updated the <i>General Description</i> and <i>Procedure</i> sections; updated Table 2, Figures 2 and 4, and the Bill of Materials, Schematics, and PCB Layout sections; added the <i>Interaction with the MAX20361 EV Kit, Hardware Settings, Software</i> <i>Settings,</i> and <i>Interaction Process</i> sections; added MAX20360HEVKIT# to the <i>Ordering Information</i>	1–3, 5, 20–21, 23, 26, 28
2	7/21	Updated the <i>USB2PMB2#</i> to <i>MAXPICO2PMB#</i> in the entire document, updated Figure 15, Figure 16, and the Bill of Materials. Added <i>Fuel Gauge</i> section.	1, 2, 4, 16–18, 20–29

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