GLF70205/GLF70206 Smart Charger

Preliminary Specification

1 Description

The GLF70205/GLF70206 is a 1.04A highly integrated single cell linear battery charger IC with power path management for wearable and IoT devices using Li-ion/Li-Polymer batteries. The I^2C serial interface with charging and system setting can be allowed to control flexibly.

The GLF70205/GLF70206 can automatically complete charger phase include pre-charge, fast charge, charge termination. Also monitor battery temperature during charging. Power path management will provide higher priority system load even with depleted battery.

The device owns full system reset, include watchdog and PWRKEY reset, also supports ship mode to save power consumption.

The GLF70205/GLF70206 is available in a 1.42x1.42mm, 9-ball / 0.5-pitch CSP package and DFN2x3-8L package.

2 Application

IoT device

Smart watches

BT headsets/TWS earbuds

3 Features

- Linear Single Cell Battery Charger
  - ±0.4% charger voltage regulation@25℃
  - 28V maximum input voltage rating
  - Low to 1mA terminal current with 2mA
  - ITERM supports double rate setting
  - Pre charge current supports quadruple
  - Max charging current reach to 1.04A linear charger
  - Support 1μA ultra low power mode
  - Default 4.65V regulation, max to 4.85V
  - Support safety timer during charging
  - Support battery NTC detection
- Power Path Management
  - Max to 1.2A IINDPM and 4.6V VINDPM
  - Support Supplement mode from battery during DPM happens
  - Support PWRKEY and COLD Reset
- I^2C interface configure function options
- Full charging and fault status indication and report to host via INT
- Full device protection，include OVP / OCP / SCP / OTP
- Support Ship mode
  - Low to 300nA current
  - Configurable BATFET_DIS delay time
  - Configurable time and action to wake up from ship mode
- Safety-related certification：
  - IEC62368 CB certification
  - CQC: GB4943.1-2022

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4 Typical Application Circuit

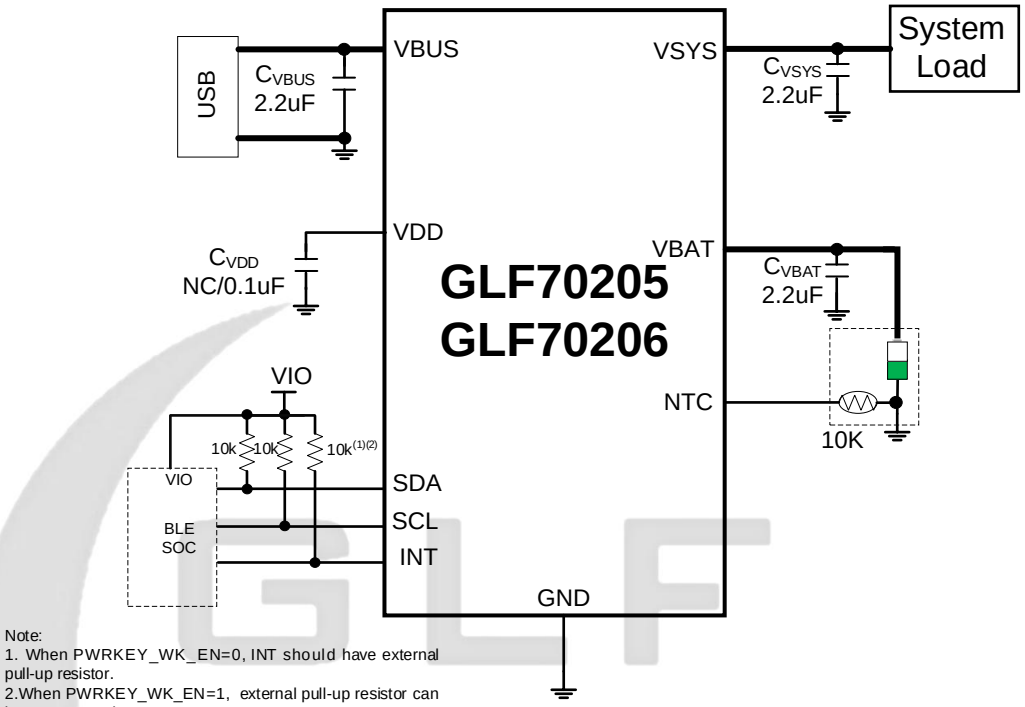

Figure 1 Application

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5 Pin Out

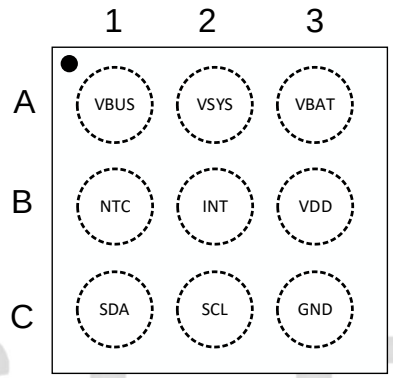

Figure 2 CSP-9 1.42 x 1.42mm Top View

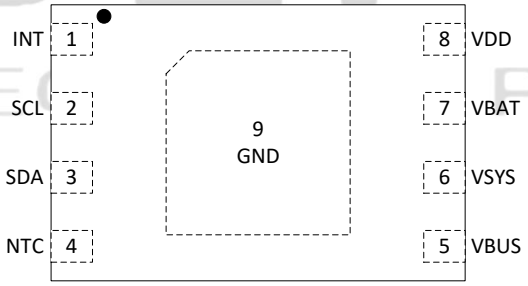

Figure 3 DFN2x3-8L Top View

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Pin Functions:

Name	No.		Type	Description
	CSP	DFN		
VBUS	A1	5	P	Charger input voltage, place a at least 2.2μF cap as close as to GND.
VSYS	A2	6	P	System connection point, place at lease 2.2μF cap as close as to the SYS pin.
VBAT	A3	7	P	Battery connection point, place at least 2.2μF cap as close as to the BAT pin.
NTC	B1	4	AI	Battery temperature sense input, place a negative temperature coefficient thermistor from NTC to GND.
INT	B2	1	DIO	Open-drain interrupt output and key input, place the INT to power rail via 10 kΩ resistor. The INT pin sends active low 256us pulse to host to report charger device status and fault. INT is also used to disconnect the system from the battery. Pull INT from high to low for >16s. The battery FET turns off and then on again automatically after TRST_DUR regardless of the INT state. Never let it floating if not use INT or PWRKEY function, it should pull high with at most 100k resistor.
VDD	B3	8	P	Internal power supply with external 0.1μF cap.
SDA	C1	3	DIO	I^2C Interface data. Connect SDA to the logic rail through a at most 10kΩ resistor.
SCL	C2	2	I	I^2C Interface clock. Connect SCL to the logic rail through a at most 10kΩ resistor.
GND	C3	EPAD	G	Power ground.

6 Order Information

Part No.	Package	Description					SPQ
		CEB	ICC	VBAT_REG	NTC	Addr	
GLF70205-S87	CSP-9	Enable	8mA	4.2V	Disable	07H	3000
GLF70206-D37	DFN2x3-8L	Enable	8mA	4.2V	Disable	07H	4000

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7 Electrical Characteristic

7.1 Absolute Maximum Ratings

Symbol	Description	Value	Unit
VBUS	Voltage range	-0.6 to 28	V
VSYS		6	V
VDD, NTC, SCL, SDA, INT		6	V
Junction temperature, T_J	Junction temperature range	-40 to 150	℃
Storage temperature, T_{STG}	Storage temperature range	-40 to 150	℃
PD	Internal power dissipation	900	mW

7.2 ESD Ratings

			Value	Unit
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per Mil-Std-883H Method 3015.81, all pins	4000	V
		Charged device model (CDM), per JS-002-2018, all pins	500	V

7.3 Thermal Information

Thermal Metric		Package Type	Unit
$R_{\theta JA}$	Junction-to-ambient thermal resistance	WLCSP1.42x1.42-9B	110℃/W
$R_{\theta JA}$	Junction-to-board thermal resistance	DFN2x3-8L	85℃/W

7.4 Recommended Operation Conditions

Symbol	Description	Min	Max	Unit
VBUS	Voltage range	3.5	5.5	V
VBAT			4.65	V
VSYS			4.85	V
ICHG	Current range	Max to 1040		mA
IDSG		Max to 3.2		A
Junction temperature, T_J	Junction temperature range	-40	125	℃
Ambient temperature, T_A	Ambient temperature range	-40	85	℃

Note: Stress over absolute maximum rating as listed may cause permanent damage to device.

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7.5 Electrical Characteristic Table

VBUS=5.0V, VBAT=3.7V and TJ=25℃ for typical values(unless otherwise noted)

Parameter	Description	Test Conditions	Min	Typ	Max	Unit
Quiescent Current						
IBAT_Q	VBUS=0, VSYS=VBAT=4.4V, load=0			3.2		μA
	Ultra low power mode, VBUS=0, VSYS=VBAT=4.4V, load=0, UVLO is off			1.1		μA
	VBAT=4V, VBUS=0, VSYS=0, ship mode			0.38		μA
	Charge Done, VBAT=4.4V			16		μA
IIN_Q	VBUS=5V, charger disable			1		mA
	VBUS=5V, HIZ mode			330		μA
ON Resistance						
VBUS TO VSYS	VBUS=4.5V, 0.1A@25℃			290		mΩ
BATFET	VBAT=4.0V, 0.1A@25℃			120		
Input Operation Condition						
VBUS	VBUS operating range		3.5		5.5	V
VBUS_UVLO	Rising		3.4	3.5	3.6	
	Hysteresis			100		mV
VBUS_OVP	Input rising threshold		5.9	6.0	6.1	V
			6.4	6.5	6.6	
	Hysteresis			300		mV
VBAT_UVLO	Falling threshold		2.78	2.82	2.86	V
	Hysteresis			150		mV
VBAT_OVP	Higher than VBAT_Target		120	150	190	mV
	VBAT_OVP_HYS			50		
System Voltage Regulation						
VSYS_REG	System voltage regulation, VBUS=5V		4.45		4.85	V
VSYS_REG	Default			4.650		
VSYS_REG_ACC			-2		+2	%
VSYS_DSG	VBAT=4.2V,VSYS discharge resistor			880		Ω
Battery Voltage Regulation						
VBAT_REG_RNG	Battery voltage range		4.0		4.6	V
VBAT_REG_ACC	Charge voltage regulation accuracy VBAT=4.2V, -10 to 60℃		-0.5		+0.5	%
VBAT_PRE	PRE charge to fast charge，default		2.9	3.0	3.1	V
	Hysteresis			0.13		
VRE_CHG	Charger auto-recharge, default		0.14	0.2	0.26	
Charge Current Regulation						
ICHG_ACC	Charge current regulation accuracy	ICC=000000b	7.2	8	8.8	mA
		ICC=001011b	93	96	99	
		ICC=001111b	123	128	134	

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Electrical Characteristic(continued)

		ICC=111000b	431	456	481	
		ICC=111111b	758	792	835	
Pre-Charge & Terminal Current Regulation						
IPRE_RNG	Quadruple=0, VBAT<VBAT_PRE		1		31	mA
	Quadruple=1		4		124	
IPRE_STEP	Quadruple=0			2		
	Quadruple=1			4		
IPRE_ACC	IPRE 3mA Set		-50		+50	%
	IPRE 15mA Set		-20		+20	
	IPRE 21mA Set		-15		+15	
	IPRE 31mA Set		-15		+15	
ITERM_ACC	ITERM 1mA Set		-60		+60	%
	ITERM 3mA Set		-50		+50	
	ITERM 9mA Set		-30		+30	
	ITERM 11mA Set		-10		+10	
	ITERM 31mA Set		-10		+10	
Input Current Regulation						
	IINDPM= 300mA Set			280	300	mA
	INDPM= 500mA Set			466	500	
	IINDPM= 1200mA Set			1120	1200	
Input Voltage Regulation						
VINDPM_RNG	VINDPM Regulation Range		4.2		4.7	V
VINDPM_ACC	VINDPM = 4.6V Regulation Accuracy		-3		+3	%
NTC Configure						
Cold Threshold	Cold=0℃		54	58	62	
Hot Threshold	Hot=45℃		17	20	23	
	Hot=50℃		14	17	20	
	Hot=55℃		12	15	18	
	Hot=60℃		10	13	16	
Hysteresis	Recovery			2		%
Thermal Shut Down						
Thermal Regulation	120℃ Set			105		℃
TSHUT	Thermal shutdown			140		℃
	Hysteresis	Auto-Recovery		15		
Timing						
RSTLEVEL	INT PIN pull low time to reset, default		15.42	16	17.48	S
ONLEVEL	INT PIN pull low time to exit ship mode, default		1.88	2.0	3.7	
TRST_DUR	VSYS is off time before auto on, default		3.85	4.0	4.36	
SHIP_DGL	Enter ship mode deglitch time, default		0.96	1.0	1.09	
WDT_TIMER	Watch dog timer, enable &default		154.2	160	174.8	

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Electrical Characteristic(continued)

Safety TIMER	1H pre-charge fixed timer	1.09	1.0	1.24	H
	Fast charge timer, 5h set	5.07	5.0	5.75	
	Fast charge timer, 8h set	8.08	8.0	9.17	
FSCL	I^2C clock	10		400	kHz
Logic Level					
VL	VIO=1.8V, Low logic voltage threshold			0.4	V
VH	VIO=1.8V, High logic voltage threshold	1.3			

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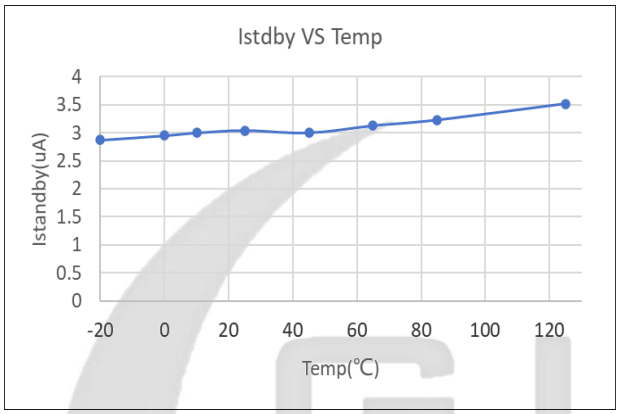
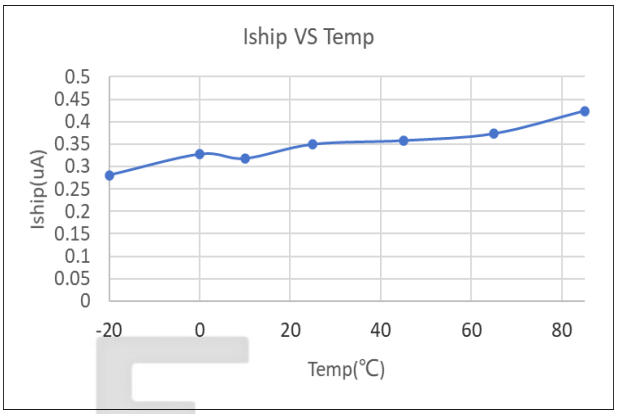
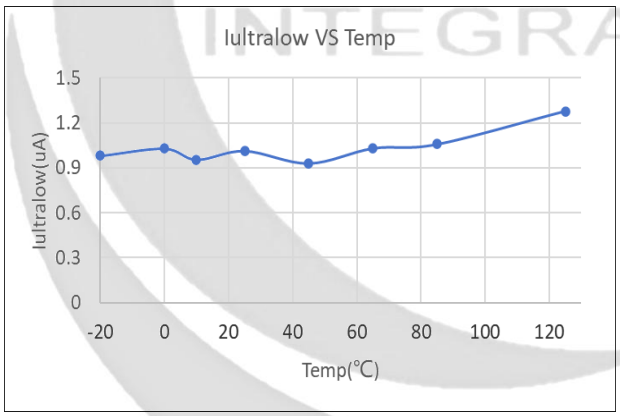
7.6 Typical Characteristic



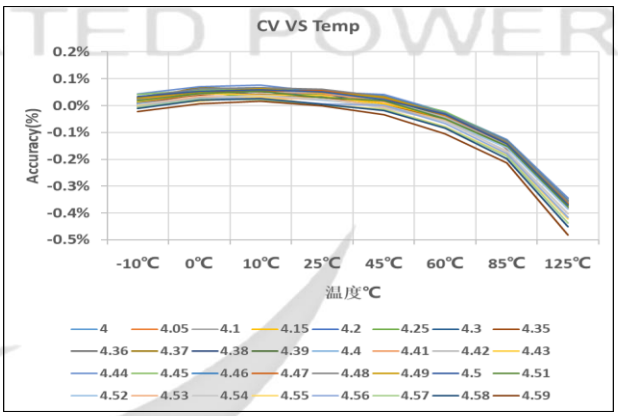
Istdby VS Temp



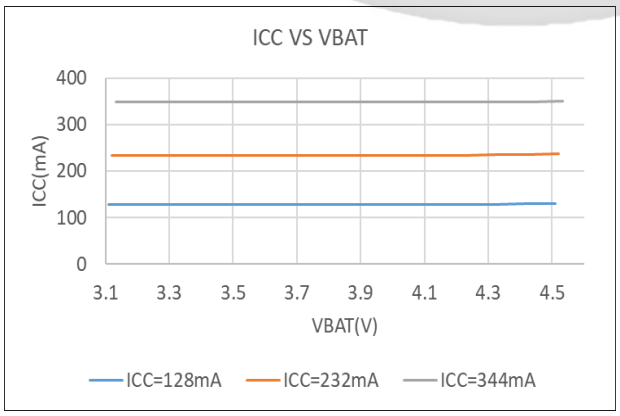
Iship VS Temp



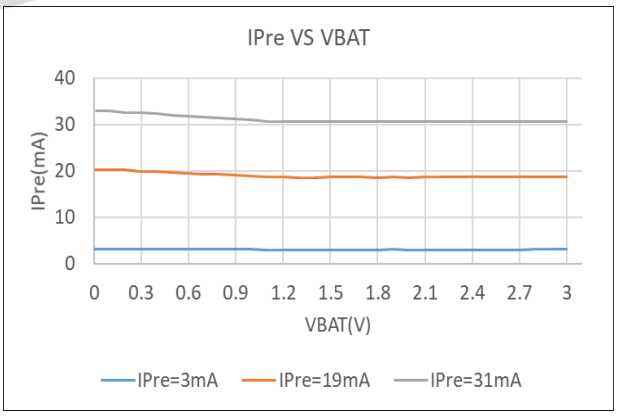
Iultralow VS Temp



CV VS Temp



ICC VS VBAT



IPre VS VBAT

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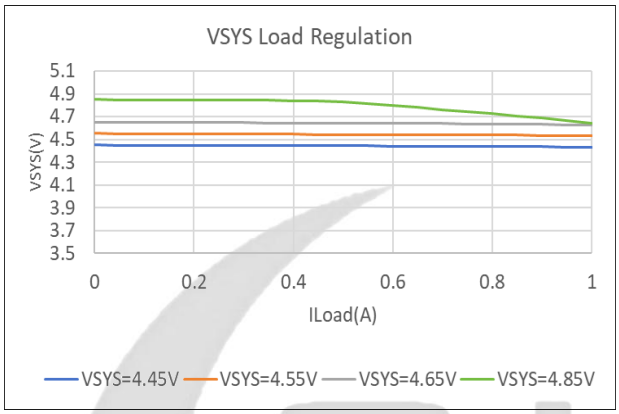
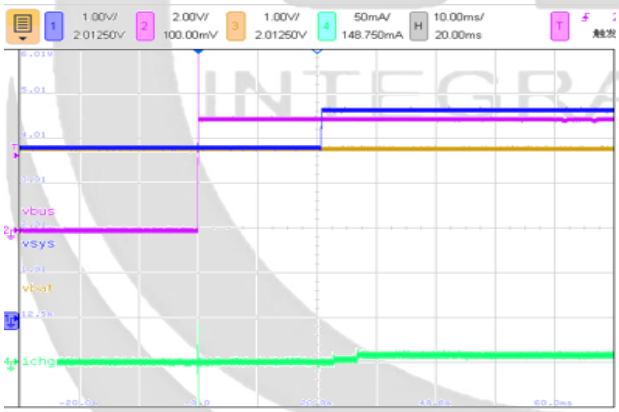
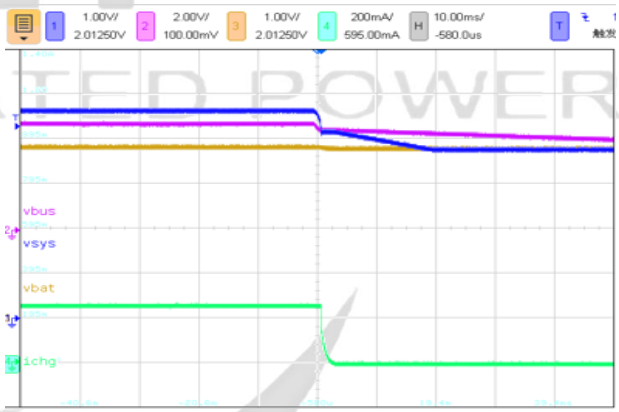


VSYS Load Regulation

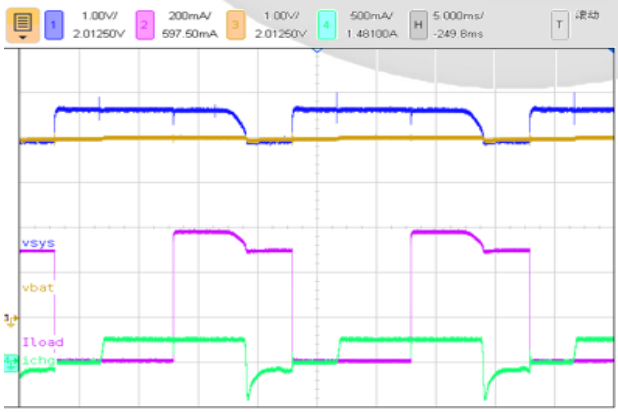
Key Reset



VBUS Insert



VBUS Plug out



VINDPM to Supplement Mode

IINDPM to Supplement Mode

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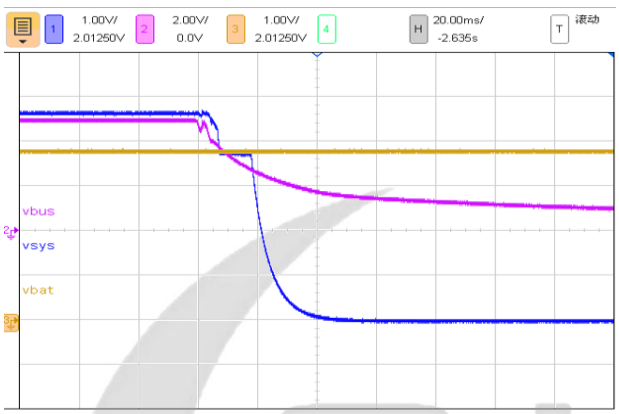
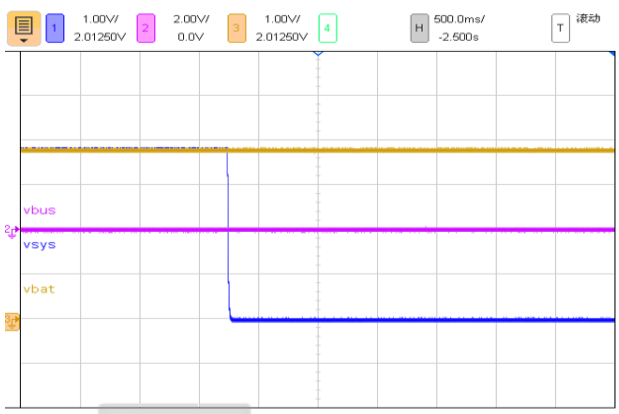
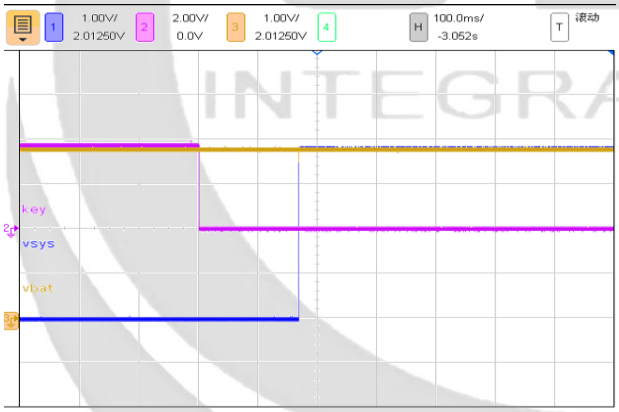


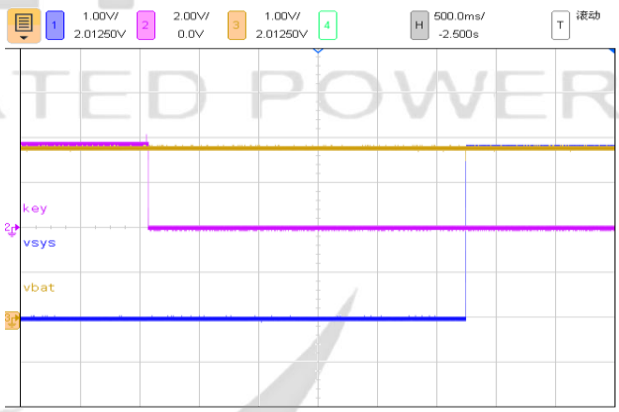
VBUS Plug Out Enter Ship Mode



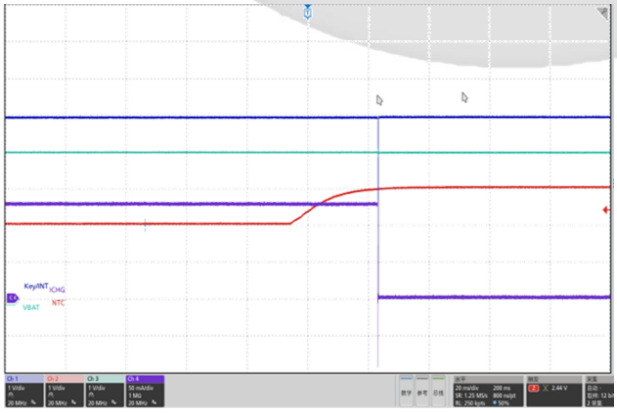
BATFET_DIS CMD Enter Ship Mode



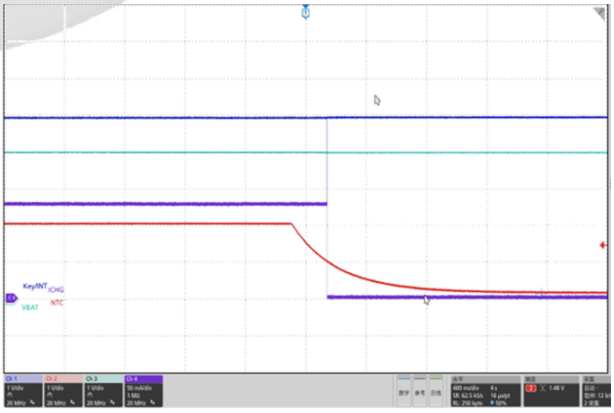
Short Key 150ms wake up



Long Key 2s wake up



NTC Cold Entry



NTC Hot Enty

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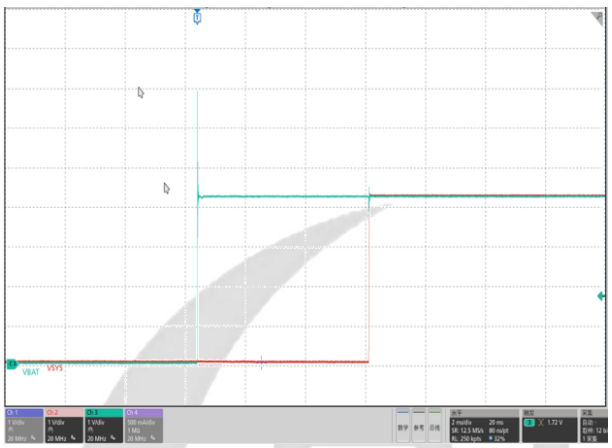
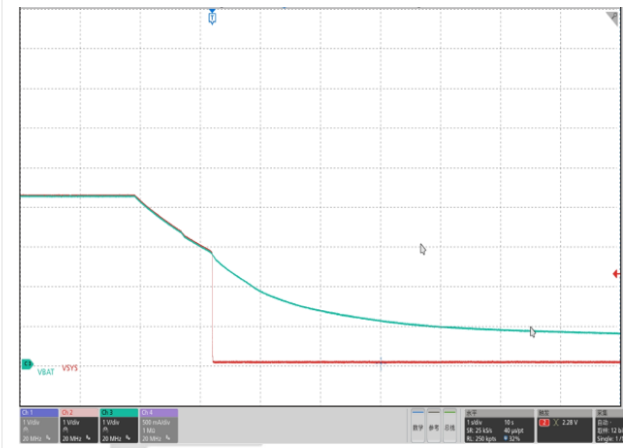


VBAT Power On



VBAT Power Off

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8 Operation and Control

8.1 Function Block Diagram

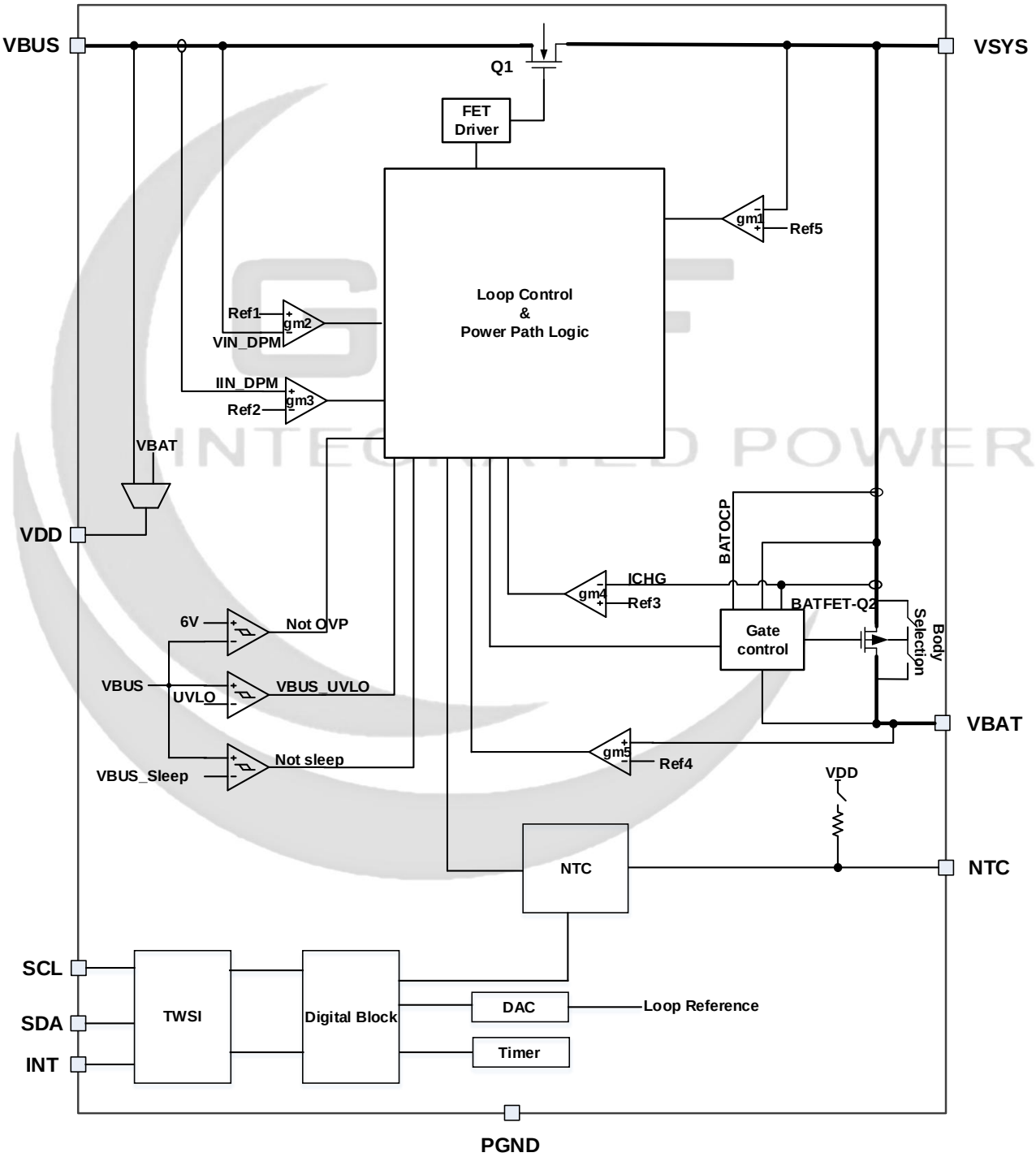

Figure 4 Block Diagram

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8.2 Power Path Control

GLF70205/GLF70206 integrates a LDO1 between VBUS and VSYS, VSYS to VBAT is a linear charger LDO2 with a programmed current and voltage by registers, VSYS is default 4.65V as VSYS_REG. The power path function allows the input source to power the system priority and charge the battery simultaneously. When the input power is limited due to an input current or voltage limit, GLF70205/GLF70206 will auto reduce the charge current until the battery supplements the system load.

VBUS power path and charging path can be controlled by register as listed:

	Hi-Z mode and Charge mode	
	Set Hi-Z bit 1	Set CEB bit 0
LDO1 FET	OFF	x
LDO2 BATFET Charge	x	ON
LDO2 BATFET Discharge	x	x

x=don't care

8.2.1 Input Current and Voltage Power Management

In order to prevent the input source (USB or Adapter) being over loaded, GLF70205/GLF70206 has input current (IINDPM) and voltage (VINDPM) limit when system load is higher than the rating of the input source. The default input current limit is 500mA, and the default VINDPM 4.6V. While the input limit is reached, the LDO1 are regulated so that the total input power is limited. As a result, the system voltage drops. Once the system voltage declines to a minimum value of VSYS_REG -130mV and VBUS-345mV, the charge current is reduced to prevent the system voltage from dropping further.

The VINDPM regulates the input voltage to VINDPM_SET when the load is over the input power capacity. VINDPM function can be disabled by register.

8.2.2 Battery Supplement Mode

The charger current is reduced to keep the input current or input voltage in regulation when DPM occurs. If the charge current is reduced to zero and the input source is still overloaded due to a heavy system load, the system voltage begins decreasing. Once the system voltage drops to 30mV below the battery voltage, GLF70205/GLF70206 enters battery supplement mode, and the ideal diode mode is enabled. The BATFET is regulated to keep VBAT-VSYS at 22.5mV when supplement current * RBATFET is lower than 22.5mV. The BATFET is fully turned on to maintain the ideal forward voltage. When the system load decreases, once VSYS is higher than VBAT+30mV, the ideal diode mode disables.

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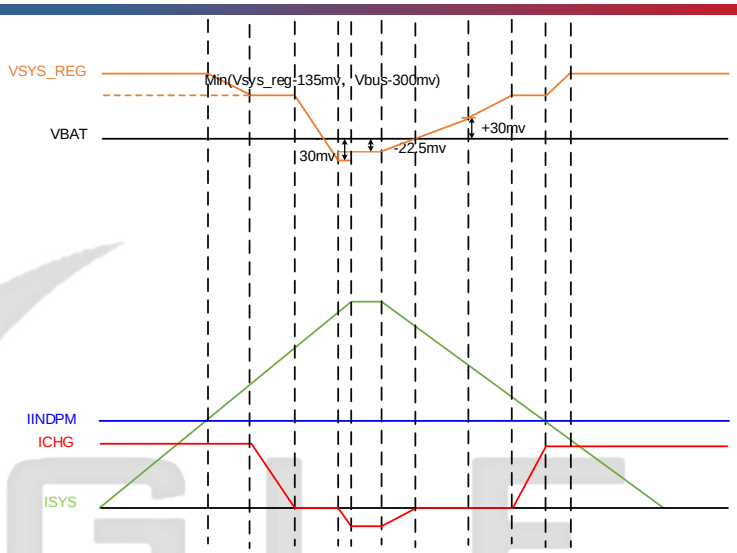

Figure 5 Dynamic Power Management

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8.3 Power On and Reset

8.3.1 POR

GLF70205/GLF70206 powers internal bias circuits from VDD, and VDD is from the higher voltage between VBUS and VBAT. When VDD is OK, I²C interface is ready for communication and all the registers are reset to default value, the host can access all registers after POR.

8.3.2 Power Up from Battery Without Input Source

If only the battery is present and voltage is above VBAT_UVLO rising, the device will enter discharge mode. The BATFET will fully on and VBAT connect VBAT to VSYS. The BATFET typical is 120mΩ@25℃. Typical 3.2μA low quiescent current minimize the conduction loss and maximize the battery run time.

During discharging mode, when BATFET current exceeds the programmable discharge current limit (2A default), GLF70205/GLF70206 will enter hiccup mode as the over current protection (OCP) happens. The discharge current can be programmed high to 3.2A through the I²C.

BATFET will turn off when VBAT falls to VBAT_UVLO falling threshold, it will protect the battery from over discharge.

Also watchdog timer can be available during discharging mode, the timer is not enabled by default. User can configure EN_WDT_DSG bit to 1 to enable discharge watch dog timer.

8.3.3 Power Up from Input Source

After an input source plugs in, the device will check the input voltage to determine VBUS power path. The input voltage checks as following:

1. VBUS is higher VBUS_UVLOZ;
2. VBUS is higher VBAT+130mV;
3. VBUS is lower VBUS_OVP;

If above conditions are all valid, VBUS_PG bit will set to 1. VBUS_PG interrupt will alert.

VBUS power path is enabled after VBUS_PG is set, VSYS is regulated at 4.65V default. If VSYS is below 2.0V, VSYS short circuit will trigger. LDO1 will enter hiccup mode similar to BATFET OCP protection.

GLF70205/GLF70206 has input over voltage protection (OVP), typical threshold is 6.0V, option 6.5V. If the device triggers OVP, LDO1 will turn off immediately.

8.3.4 Ultra Low Power Mode

In discharging mode, the device works in normal standby mode by default. The quiescent current is as low as 3.2μA. Also, the device supports an ultra-low-power mode with a current of 1μA by setting R05[1]=1. In ultra-low-power mode, the BATFET power MOSFET is only on 1/4, and OCP is still active, only VBAT_UVLO is disabled. R05[1] will be auto reset when vsys reset happens.

8.3.5 Reset

The device has following reset methods besides POR:

1. REG_RST: If the bit is set, some registers will be reset. This bit will be cleared automatically.

2. Watchdog Reset: Charging and discharging mode have watch dog timer enable bit control respectively. Watchdog timer during charge is enabled by default. When this timer is enabled, any successful I²C write operation communication will reset this timer. When I²C timer expires, many registers will be reset to default value (refer to register table), and VSYS will be low for TRST_DUR with VSYS_DSG pull down.

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Once watchdog timer expires, only WDT_RST bit can reset the timer.

3. PERKEY Reset

PWRKEY PIN is multiplexing to INT PIN. If PWRKEY keeps low time more than RSTLEVE, it will trigger VSYS reset, LDO1 and BATFET will both turn off for TRST_DUR, and then recovery automatically. The PWRKEY low time can be programmed by RSTLEVEL bits.

4. Cold Reset: If the bit is set, VSYS reset will happens automatically. It is helpful to clear the running environment before system software update or release from unstable situations. This bit will automatically cleared after writing 1.

8.4 Charger

8.4.1 Charging Process

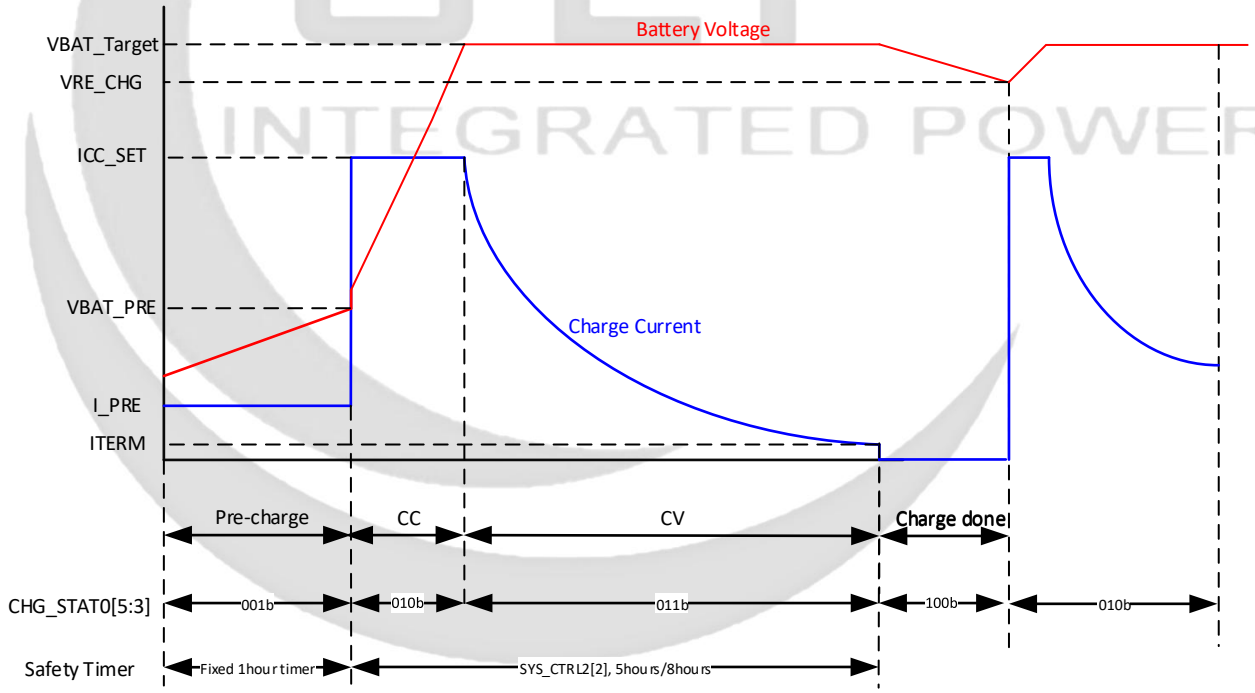

Figure 6

GLF70205/GLF70206 provides three main charging phases: pre-charge, constant current charge and constant voltage charge.

1. Phase 1 (pre charge): The GLF70205/GLF70206 enter pre-charge mode under the deeply depleted battery until the battery voltage reaches pre-charge to fast charge threshold (VBAT_PRE). The pre-charge current is also programmed through REG00H[5:2]. If VBAT_PRE is not reached before the pre-charge timer (fixed 1 hour) expires, the charge cycle stops, and a corresponding timeout fault signal is alerted.

2. Phase 2 (constant current charge): When the battery voltage exceeds VBAT_PRE, GLF70205/GLF70206 enters a fast charge phase. The fast charge current can be programmed via REG02H[5:0].

3. Phase 3(constant voltage charge): When the battery voltage rises to the battery target voltage(VBAT_REG) set via REG04H[7:3], the charge mode changes from CC mode to CV mode, and the

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charge current starts decreasing.

The charge cycle is considered to be completed when the charge current(ICHG) reaches the termination current threshold(ITERM). The BATFET will turn off and charge status updated to charge done.

The termination charge current threshold(ITERM) can be programmed via REG03H[3:0].
GLF70205/GLF70206 also supports not charge termination after reaching the ITERM during CV mode, EOC_EN bit. The relevant configuration states are as follows:

EOC_EN	IBAT reach Iterm during CV mode	
	Operation	Charger status
0	Keep CV	Charge，no safety timer
1	Charge done	Charge done assert

In default mode, the charge enable bit CEB is 0, means charger is enable. Following conditions are all valid to start a new charge cycle:

1. Charge enable bit CEB=0, &
2. VBUS_PG bit =1, &
3. Not TSHUT, &
4. NTC is normal, &
5. Safety timer not expire, &
6. BATFET_DIS bit =9, &
7. Not BAT_OVP.

8.4.2 Automatic Recharge

When the battery is fully charged and charging is terminated, the battery may be discharged due to system consumption or self-discharge. When the battery voltage is discharged below the recharge threshold and VBUS is still available, GLF70205/GLF70206 can begin another new charging cycle automatically without having to restart a charging cycle manually.

Recharge threshold is default VBAT_REG-200mV, and can be programmed to VBAT_REG-100mV. The auto-recharge function is valid only when EOC_EN =1.

8.4.3 Battery OVP

GLF70205/GLF70206 is with a built-in battery over-voltage limit (about 150mV higher than VBAT_REG). When a battery over-voltage event occurs, the device suspends charging immediately and asserts a fault.

8.4.4 Safety Timer

GLF70205/GLF70206 provides a pre-charge and fast-charge safety timer to prevent an extended charging cycle due to abnormal battery conditions. The safety timer is fixed 1 hour when the battery voltage is lower than VBAT_PRE. The fast charge safety timer starts when the battery enters fast-charge mode. The fast-charge safety timer can be programmed through the I^2C. The safety timer can be disable via I^2C. The following actions can restart the safety timer. Once the timer expired, BATFET will turn off and asserts a fault status. Following actions will restart safety timer:

1. VBUS re-plug in.
2. Write charge enable bit CEB from 1 to 0.
3. Write safety enable bit from 0 to 1.
4. EN_HIZ bit toggles.

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Following table is GLF70205/GLF70206 charging configure by default:

Default mode	GLF70205/GLF70206
VSYS_REG	4.65V
Constant Charge voltage	4.2V
Constant Charge current	8mA
Pre-charge current	3mA
Termination current	3mA
NTC	Disabled
Safety timer	5 hours

8.4.5 Battery Temperature NTC

The GLF70205/GLF70206 keeps monitoring the battery temperature during the whole charging cycle. This is accomplished by monitoring the voltage at the NTC pin. This function is disabled by default and can be enabled by REG06[7].

NTC resistors recommended are listed as below:

R value@25℃	B value
10k	B（25/85）=3435K
10k	B（25/85）=3380K

The external NTC resistor should be connected to NTC and GND. 20K internal pull-up resistance is connected to VDD. The cold(0℃) and hot protection(45℃) threshold are respectively 60% and 20% of the VDD voltage. NTC hot temperature threshold supports setting 45℃/50℃/55℃/60℃.

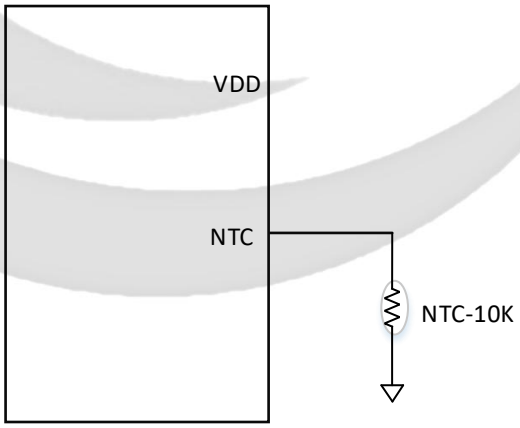

Figure 7

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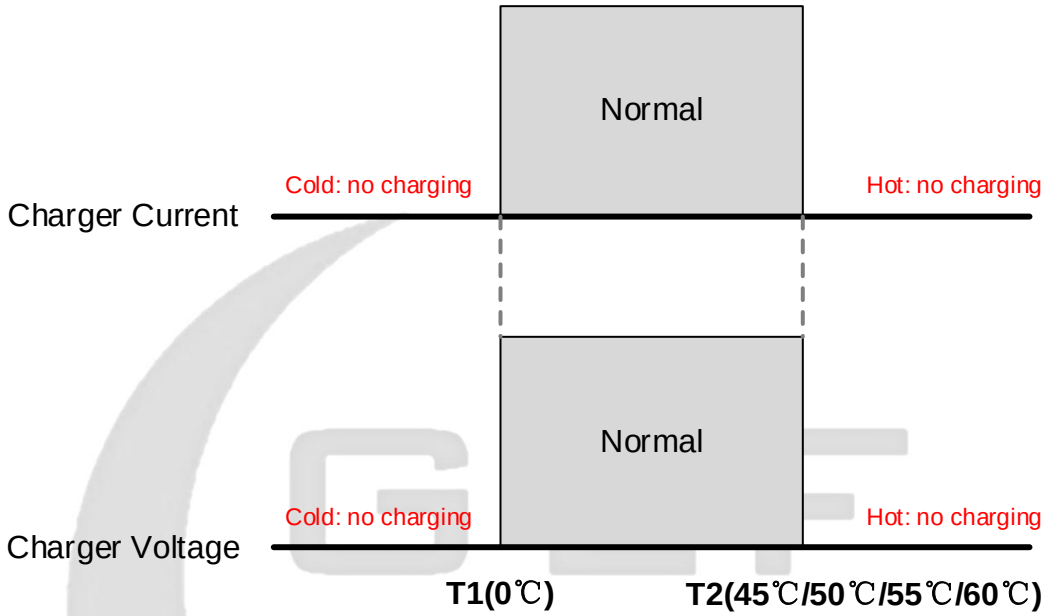

Figure 8

8.5 Ship Mode

8.5.1 Enter ship mode

To extend battery life and minimize power consumption when the system is powered off during system idle, shipping, or storage, the device turns off BATFET so that the system voltage is shutdown to minimize the battery leakage current. When the host sets the BATFET_DIS bit, the charger can turn off the BATFET immediately or delay by SHIP_DGL bits configured. When the input source is attached, the device not enter ship mode until input source removes. System voltage drops to zero with VSYS_DSG resistor pull down after entering ship mode and I^2C communication is not available.

8.5.2 Exit ship mode

The device enter ship mode after setting BATFET_DIS to 1, following two actions can wake up from ship mode:

1. VBUS plug in;
2. PWRKEY be low longer 2s (option: 200ms).

PWRKEY wake up can be disabled by PWRKEY_WK_EN bit, default is disabled.

8.6 Interrupt Event

The GLF70205/GLF70206 also has an alert mechanism that can output an interrupt signal via INT to notify the system of the operation by outputting a 256μs INT pulse. All of the below events can trigger an INT output:

- VBUS Power Good
- Charge done
- Charging status change

Any fault in REG09H and REG58H(watchdog timer fault, input fault, thermal fault, safety timer fault, battery OVP fault, battery low fault, NTC fault) occurs, the GLF70205/GLF70206 sends out an INT pulse and

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latches the fault state in REG09H. After the GLF70205/GLF70206 exits the fault state, the fault bit is reset after the host reads REG09H. The INT signal can be masked when the corresponding control bit is set in REG06H and REG50(INT_Enable_0).

8.7 I2C Interface Operation

The device supports the I2C serial bus and data transmission protocol to configure charger initialization. It operates as a slaver on the I2C bus. Support I2C fast mode 400K frequency. The pull-up resistor can be selected in the range of 1k-10k and the typical value is 4.7k when I2C frequency is 400kHz. The VIO level support from 1.2V to 5V. Also the slaver address can be configured to 7-bit 0x01 under multi-slavers application, the default 7-bit address is 0x07.

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9 Registers

Register Base Attributes

Attribute	Abbreviation	Description
Read Only	RO	This bit can be read only by host. Writes have no effect.
Read/Write	RW	This bit can be read or written by host.
Write Only	W	This bit can only be written only by host. Read from this bit return '0'.
Reserved	RSV	This bit reserved for future expansion and its value must not be modified by host.
Write 1 Clear	W1C	This bit will be self-cleared by host write to '1'. Writes to '0' have no effect.
Read Clear	RC	This bit only be cleared by host read operation. Writes have no effect.

1. DPM_SET

Address: 00H Reset: 86H

Bit	Name	Description	Reset	R/W	Default
7:6	VINDPM_SET	VINDPM_SET: 00: disable 01: 4.2V 10: 4.6V 11: 4.7V	By REG	RW	10
5:2	IPRE_SET	Pre charge mode current set 1m+2m*N	By WDT By REG	RW	0001
1:0	IINDPM_SET	IINDPM_SET: 00: disable 01: 300mA 10: 500mA 11: 1200mA	By REG	RW	10

2. SYS_CTRL0

Address: 01H Reset: A2H

Bit	Name	Description	Reset	R/W	Default
7:6	RSTLEVEL	Pull INT low to disconnect the battery then auto on 11: 20s 10:16s 01:12s 00: 8s	By WDT By REG	RW	10
5	TRST_DUR	VSYS off time before auto on 1: 4s 0: 2s	By REG	RW	1
4	EN_HiZ	VBUS power path enable control bit 1: enable 0: disable	By WDT By REG By VBUS_PLUG_IN	RW	0
3	CEB	Charger enable control bit 1: disable 0: enable	By WDT By REG	RW	0
2	ICC_Offset	Offset of ICC R02[5:0]. If the bit is set, final ICC=248mA+R02[5:0] 1: 248mA offset addition 0: 0mA offset addition	By WDT By REG	RW	0
1:0	VBAT_UVLO	Battery UVLO falling threshold , hys is about =150mV 00: 2.42V 01: 2.64V 10: 2.82V 11: 2.9V	By REG	RW	10

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3. SYS_CTRL1

Address: 02H Reset: 00H

Bit	Name	Description	Reset	R/W	Default
7	REG_RST	Register reset control bit 1: reset 0: keep Write 1 will auto be 0	By REG	W1C	0
6	WDT_RST	Watch dog timer reset 1: reset 0: keep Write 1 will auto be 0 and timer will reset，after watchdog fault, Only write 1 will restart timer and exit default mode.		W1C	0
5:0	ICC_SET	Fast current set during CC mode: If 000000≤code ≤111000(Decimal =56), step is 8mA, ICC=8m+8m *N, range 456mA Code: 111001 - 111111: ICC=456+48m*(code-56), 48mA step	By WDT By REG	RW	000000

4. IDSG/ITERM_SET

Address: 03H Reset: 81H

Bit	Name	Description	Reset	R/W	Default
7:6	IBATFET_OCP	BATFET over discharge current set 00: disable 01: 1000mA 10: 2000mA 11: 3200mA	By WDT By REG	RW	10
5	IPRE_Quadruple	IPRE quadruple set base on R01[5:2] 1: Quadruple 0: not Quadruple	By WDT By REG	RW	0
4	ITERM_Double	ITERM double set base on R03[3:0] 1: Double 0: not Double	By WDT By REG	RW	0
3:0	ITERM_SET	CV mode terminal current set 1m+2m*N	By WDT By REG	RW	0001

5. BAT_VOL_SET

Address: 04H Reset: 23H

Bit	Name	Description	Reset	R/W	Default
7:3	VBAT_Target	CV mode target voltage set，range 4.0 to 4.59V 00000 -00111: VBAT_Target = 4.0+50mV*N 01000 – 11111: VBAT_Target = 4.35 + 10mV *(N-7) VBAT_Target > 4.59V is clamped to 4.59V (11111)	By WDT By REG	RW	00100
2	BAT_LOW	Battery low warning alert INT threshold 0: 3.3V 1: 3.5V	By REG	RW	0

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1	VBAT_PRE	Battery pre-charge voltage set 1: 3.0V 0: 2.8V	By WDT By REG	RW	1
0	VRE_CHG	Auto re-charge voltage below target voltage 1: 200mv 0: 100mv	By WDT By REG	RW	1

6. SYS_CTRL2

Address: 05H Reset: 78H

Bit	Name	Description	Reset	R/W	Default
7	EN_WDT_DSG	Watchdog timer control enable during discharging 1: enable 0: disable	By REG	RW	0
6:5	WDT_TIMER	Watch dog timer set 11: 160s 10: 80s 01: 40s 00: disable	By REG	RW	11
4	EOC_EN	Termination is allowed or not 1: enable 0: disable	By WDT By REG	RW	1
3	EN_TIMER	Safety timer set during charging 1: enable 0: disable	By WDT By REG	RW	1
2	CHG_TIMER	Fast charging mode timer set 1: 8h 0: 5h	By WDT By REG	RW	0
1	Ultra_Low_Power	Ultra low power mode enable 1: enable 0: disable	By WDT By REG By SYS_RESET	RW	0
0	VBUS_RESET_EN	VSYS reset happens when VBUS plug in. 1: enable 0: disable	By WDT By REG	RW	0

7. SYS_CTRL3

Address: 06H Reset: 40H

Bit	Name	Description	Reset	R/W	Default
7	NTC_EN	NTC enable during charging 1: enable 0: disable	By WDT By REG	RW	0
6	TMR2X_EN	Safety timer double during DPM / Thermal 1: enable 0: disable	By REG	RW	1
5	BATFET_DIS	BATFET force off control bit when charge or discharge, when set 1, enter ship mode w/o vbus, the bit will be set to 0 after exiting ship mode. 1: force off 0: keep on	By REG By WDT By VBUS_Plug_In	RW	0
4	PG_INT_CONTR	VIN power good int enable control	By WDT	RW	0

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	OL	1: off 0: on	By REG		
3	CHG_DONE_INT_EN	Charge complete int enable control 1: off 0: on	By WDT By REG	RW	0
2	CHG_STAT_INT_EN	Charging status dynamic change int enable control, Include: not charge to charge, Pre into CC, CC into CV, not charge into CC (Auto recharge) 1: off 0: on	By WDT By REG	RW	0
1	NTC_Transition_EN	Battery temp region change int enable 1: off 0: on	By WDT By REG	RW	0
0	BATOVP_INT EN	Battery OVP int enable. 1: off 0: on	By WDT By REG	RW	0

8. SYS_CTRL4

Address: 07H Reset: 0AH

Bit	Name	Description	Reset	R/W	Default
7	COLD_RESET	VSYS reset by software command 1: VSYS reset (auto be 0 after write 1) 0: no action		W1C	0
6:5	NTC_HOT	NTC hot temp threshold setting. 00: 45℃ 01: 50℃ 10: 55℃ 11: 60℃	By WDT By REG	RW	00
4	THERMAL_REG	Die temp control by Thermal loop 0: 120℃ 1: disable	By REG	RW	0
3	WDT_VSYS_RST	Watch dog fault VSYS reset enable control 1: enable 0: disable	By REG	RW	1
2	KEY_WK_SET	KEY wake up time set 1: 125-187ms 0: 2-3s	By WDT By REG	RW	0
1:0	VSYS_REG	VSYS_Reg SET 00: 4.45V 01: 4.55V 10: 4.65V 11: 4.85V	By WDT By REG	RW	10

9. CHIP_STAT0

Address: 08H Reset: 00H

Bit	Name	Description	Reset	R/W	Default
7	WDT_FAULT	WDT FAULT		RO	0
6	IINDPM_STAT	1: in IINDPM 0: not IINDPM		RO	0

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5:3	CHG_STAT	100: charge done 011: CV mode 010: CC mode 001: pre-charge mode 000: not charging		RO	000
2	VINDPM_STAT	1: in VINDPM 0: not VINDPM		RO	0
1	VBUS_PG_STAT	1: Power Good 0: not good		RO	0
0	THERM_STAT	1: In thermal regulation 0: not		RO	0

10. CHIP_STAT1

Address: 09H Reset: 00H

Bit	Name	Description	Reset	R/W	Default
7:6	SHIP_DGL	Enter ship mode deglitch time 11: disable 10: 4s 01: 2s 00: 1s	By REG	RW	00
5	VIN_Fault	0: normal 1: VIN OVP or plug out		RC	0
4	TSHUT	1: Thermal shutdown 0: normal		RC	0
3	VBAT_OVP	1: BAT_OVP 0: not BAT_OVP		RC	0
2	Safety_mode	Charger safety timer expired 1: expired 0: not		RC	0
1	NTC HOT	1: HOT 0: not HOT		RO	0
0	NTC COLD	1: COLD 0: not COLD		RO	0

11. CHIP_STAT2

Address: 0BH Reset: 00H

Bit	Name	Description	Reset	R/W	Default
7	VBUS_OVP	1: VBUS OVP 0: not VBUS OVP		RO	0
6	Ultra-low power mode	1: enter ultra low power mode 0: not enter ultra low power mode	VBUS plug in	RO	0
5	Hiccup latch state	Hiccup once happened, write 1 will clear it. 1: happened before 0: not happened	W1C	R / W1C	0
4:3	Reserved				00
2:1	Working_Mode	00: Discharging 01: Charging 10: Only VBUS Power Supply 11: xx		RO	11
0	BAT_LOWV	1: BAT_LOWV 0: not BAT_LOWV		RO	0

12. CHIP_ID&Version

Address: 0CH Reset: 00H

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Bit	Name	Description	Reset	R/W	Default
7:5	VERSION	A version		RO	000
4	Reserved				0
3	ADDR_SET	1: 01H 0: 07H		RO	0
2:0	CHIP_ID	GLF70205/GLF70206 Identification Code		RO	00

13. SYS_CTRL5

Address: 1BH Reset: 04H

Bit	Name	Description	Reset	R/W	Default
7:3	Reserved				00000
2	Charger_SLP_EN	Charger input voltage sleep detection enable 1: enable 0: disable	By WDT By REG	RW	1
1	VBUS_OVP_SEL	1: 6.5V 0: 6.0V	By WDT By REG	RW	0
0	PWRKEY_WK_EN	PWRKEY be low 2s to exit ship mode 1: enable 0: disable	By WDT By REG	RW	0

14. INT_Enable_0

Address: 50H Reset: 40H

Bit	Name	Description	Reset	R/W	Default
7	Watch_Dog_INT_EN rising	Watch dog time expire int enable control 1: off 0: on	By WDT By REG	RW	0
6	BAT_LOW_INT_EN rising	Battery voltage be low 1: off 0:on	By WDT By REG	RW	1
5:0	Reserved				000000

15. INT_STAT0

Address: 58H Reset: 00H

Bit	Name	Description	Reset	R/W	Default
7	Watch_Dog_INT	Watch dog time expire IRQ, i2c read will clear it when the state exit.		RC	0
6	BAT_LOW_INT	Battery voltage low IRQ, i2c read will clear it when the state exit.		RC	0
5:0	Reserved				000000

Efuse Default Table

Efuse Bits	Default
CEB	0: Charger enable(GLF70205-S87 & GLF70206-D37)
ICC_SET	000000: 8mA ICC set

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ITERM_SET	0001: 3mA
VBAT_Target	00100: 4.2V
VINDPM	10: 4.6V
IINDPM	10: 500mA
Address	07h
NTC_EN	0: Disable
KEY_WK_SET	0: 2-3s
VBUS_OVP_SEL	0: 6.0V
PWRKEY_WK_EN	0: Disable

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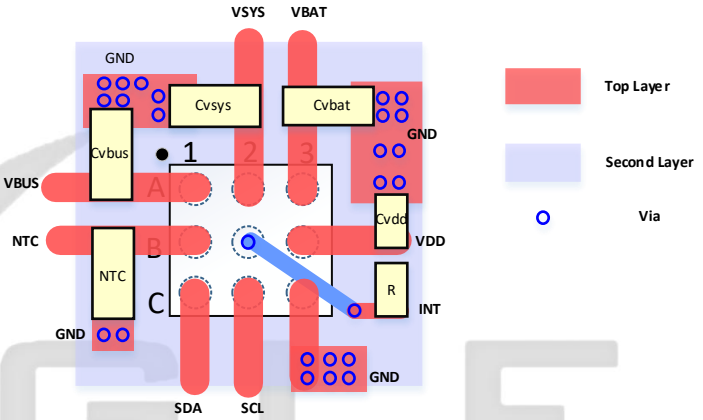
10 PCB Layout



Component	Type	Description	Man	Value	Qua
C_{VBUS}、C_{VBAT}	SMT	CAP/0603/2.2μF/X5R/10%/25V	Samsung or similar	2.2μF/25V	3
		CAP/0603/2.2μF/X5R/10%/25V		2.2μF/25V	
C_{VSYS}		CAP/0603/2.2μF/X5R/10%/25V		2.2μF/25V	
C_{VDD}		CAP/0402/0.1μF/X5R/10%/10V		NC/0.1μF/10V	1

1、Place C_{VBUS}, C_{VBAT}, C_{SYS}, C_{VDD} as close as possible to the IC, to decrease the impedance and inductance.

2、Pour ground copper to GND ball.

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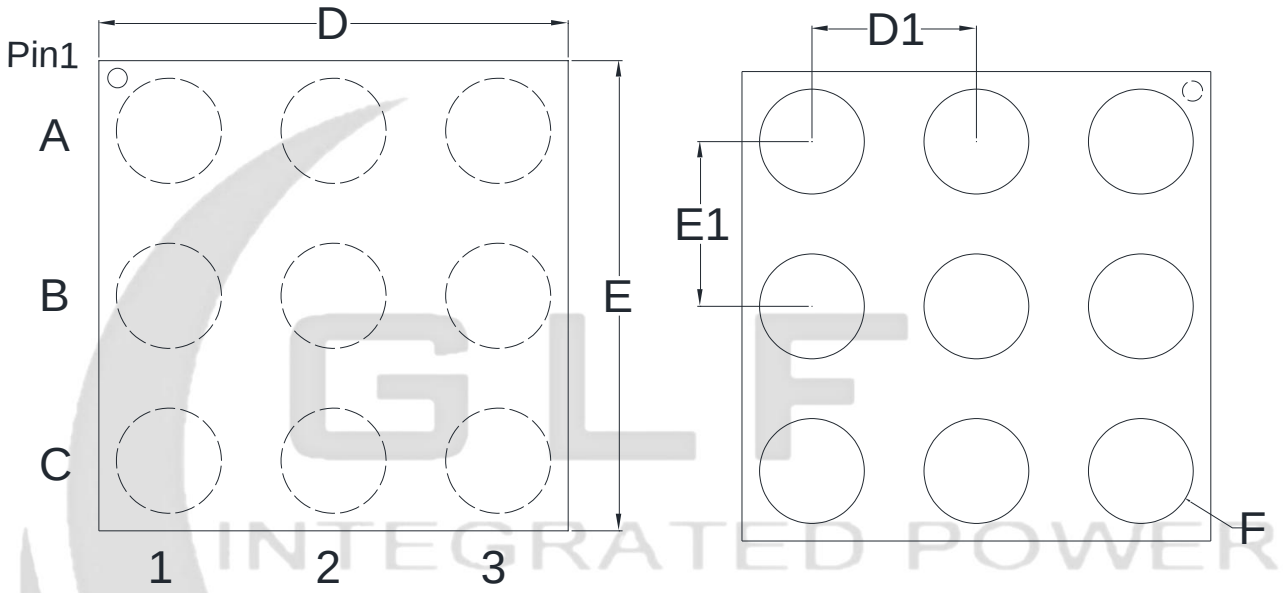
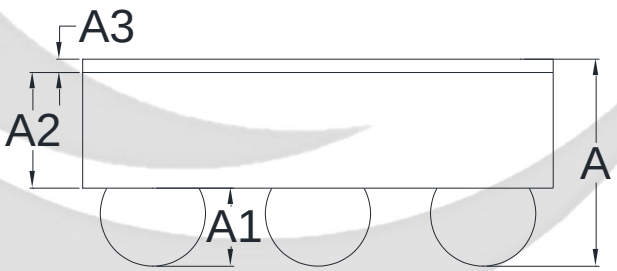
11 Package Outline Dimensions

WLCSP-9



TOP VIEW

BOTTOM VIEW



SIDE VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.589	0.664	0.023	0.026
A1	0.210	0.260	0.008	0.010
A2	0.330	0.370	0.013	0.015
A3	0.035	0.045	0.001	0.002
D	1.400	1.450	0.055	0.057
E	1.400	1.450	0.055	0.057
D1	0.500 BSC.		0.020 BSC.	
E1	0.500 BSC.		0.020 BSC.	
F	0.299	0.339	0.012	0.013

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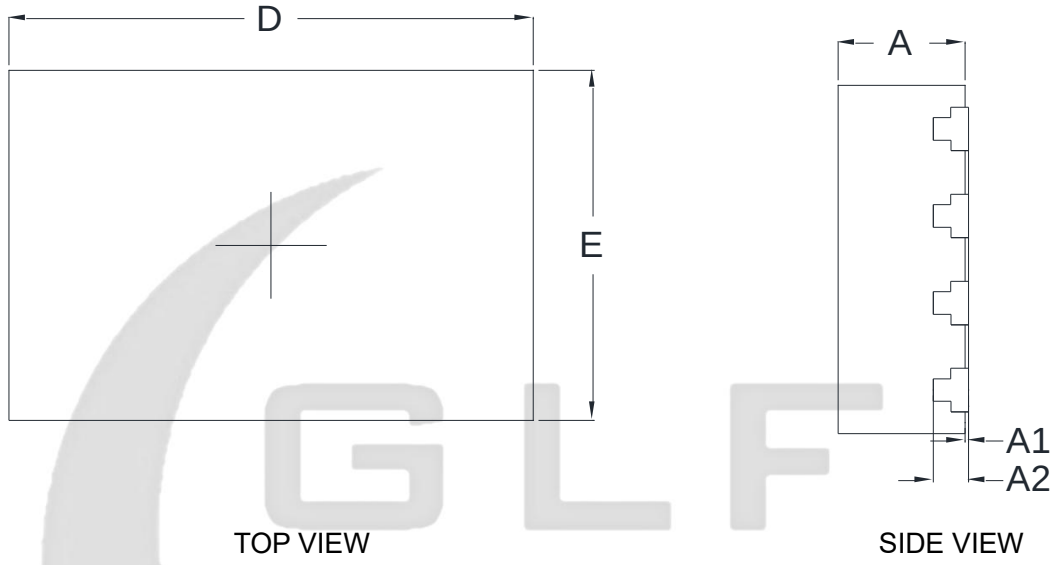
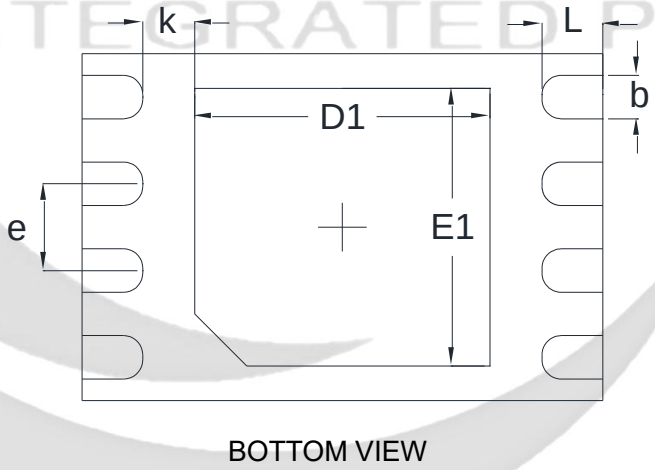
DFN2x3-8L





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF.	0.008 REF.		
b	0.200	0.300	0.008	0.012
D	2.900	3.100	0.114	0.122
E	1.900	2.100	0.075	0.083
D1	1.650	1.850	0.065	0.073
E1	1.530	1.730	0.060	0.068
e	0.500 BSC.		0.020 BSC.	
k	0.200 MIN.		0.008 MIN.	
L	0.300	0.400	0.012	0.016

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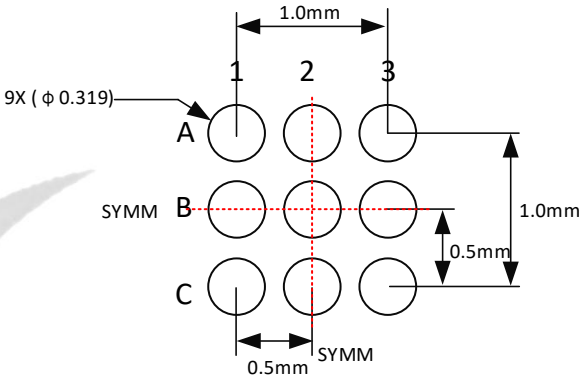
Land Pattern



Land Pattern Example

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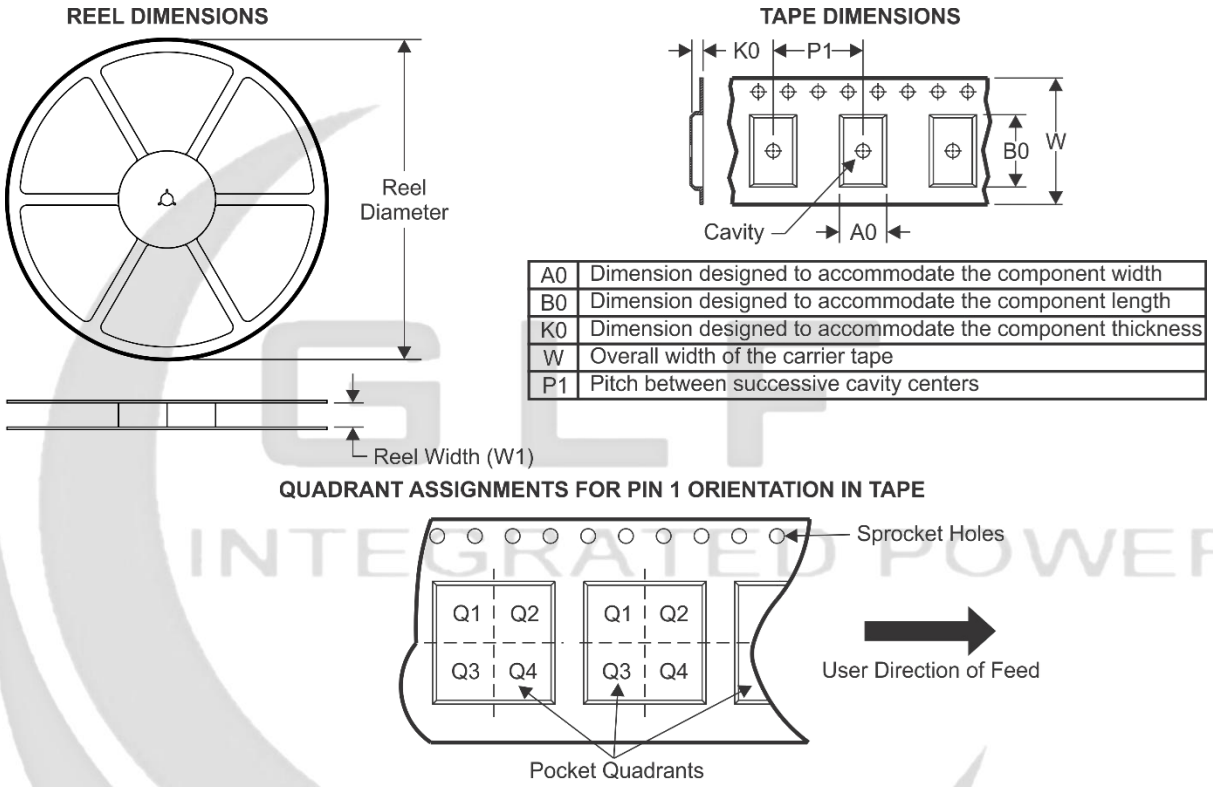
12 Tape and Reel Information



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1(mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
GLF70205	WLCSP	1.42x1.42-9B	9	3000	178	9.5	1.59	1.59	0.78	4	8	Q1
GLF70206	DFN	2X3-8L	9	4000	180	13.1	3.3	2.3	1.1	4	8	Q1

Package Quantity Information

Device	Package Type	Moisture Sensitivity Level	Qty per plate	Qty per box	Qty per trunk
GLF70205-S87	WLCSP 1.42x1.42-9B	MSL1	3000	54000	N/A
GLF70206-D37	DFN2X3-8L	MSL3	4000	40000	160000

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