GT5688
Programming Guide

Address: Floor 13, Phase B, Tengfei Industrial Building, Futian Free Trade Zone, Shenzhen, China. Post code: 518000
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Contents

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1. I²C Interface

GT5688 interfaces with the host via 6 pins: VDD, GND, SCL, SDA, INT and RESET.

The INT (Interrupt) pin of the host can be rising/falling-edge triggered. In addition, when INT is set as input, the host should leave it floating, with no internal pull-up nor pull-down; the host controls the RESET pin of the GT5688 by driving it high or low. To ensure reliable reset, it is recommended that RESET pin be driven low for longer than 100μs.

GT5688 communicates with host via standard I²C interface, with a maximum transmission rate of 400K bps. When the host communicates at rates exceeding 200K bps, it is required to pay special attention to the resistance of the external pull-up resistor of I²C interface to ensure the Rise time and Fall time of SCL and SDA signals comply with the requirements specified in GT5688 datasheet. GT5688 invariably serves as slave device in communication and its I²C slave address consists of 7 address bits and 1 Read/Write control bit. The high-order 7 bits are slave address while bit 0 is Read/Write control bit. GT5688 supports two slave addresses which are shown below:

7-Bit Address	8-Bit Write Address	8-Bit Read Address
0x5D	0xBA	0xBB
0x14	0x28	0x29

Upon each power-on or reset, it is required to select I²C address using INT pin. For detailed timings, please refer to section 4.1 and section 4.2.

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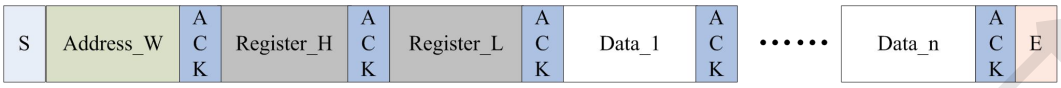
2. I²C Timings

2.1 Timing for Write Operation



S: Start condition.

Address_W: slave address with Write control bit.

ACK: Acknowledgement signal.

Register_H, Register_L: 16-bit register address from which Write Operation starts

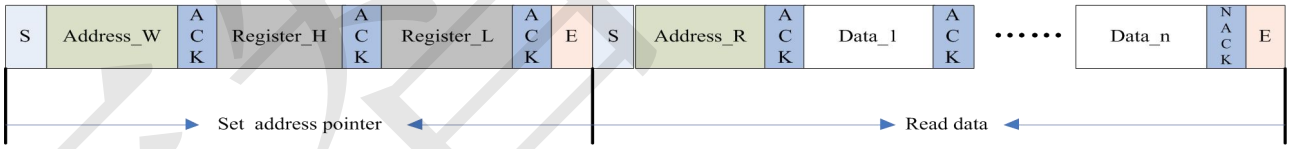
Data_1 to Data_n: Data bytes 1 to n.

E: Stop condition.

After setting the address pointer for Write operation, it is allowed to write one or more than one byte data at a time. GT5688 will automatically update the address pointer and store the data bytes in sequence.

2.2 Timing for Read Operation

First, set address pointer based on the aforesaid Write Operation timing sequence. Then, resend Start condition to perform Read addressing and read data.



Address_R: Slave address with Read control bit.

NACK: Host issues NACK after reading the last byte.

After setting Read address, the host can read one or more than one byte at a time. GT5688 will automatically update the address pointer and send subsequent data in sequence.

The Stop condition (the first E signal as shown in the above diagram) after setting the address pointer is optional. However, the repeated Start condition has to be sent.

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3. Register Map

3.1 Real-time Command Registers (Write only)

Addr	Name	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0x8040	Command	0x00: Read coordinates status; 0x01: Read diff data & raw data; 0x02: Read diff data & raw data; 0x03: baseline update (Internal test); 0x04: baseline calibration (Internal test); 0x05: Screen off; 0x06: Enter Charge mode; 0x07: Exit Charge mode ; 0x08 :Enter Gesture mode ; 0x0b: Finger touch detection mode (weak signal touch is not supported) 0x0c: Auto-switch mode (automatically switch between finger touch detection mode and gloved hand touch detection mode) 0x20: Enter slave approach mode 0x21: Enter master approach mode 0x22: Enter data transmission mode 0x28: Exit slave approach mode 0x29: Exit master approach mode 0x31: Save customized gesture templates; 0x35: Clear gesture templates in the touch IC; 0x37: Delete a certain gesture template; 0x39: Query the gesture template ; 0xAA: used by ESD protection mechanism; driver reads and checks the value of 0x8040, and writes 0xAA to 0x8040 periodically.							
0x8041	Command_Data	Data corresponds to commands (for commands without data, please issue 0)							
0x8042	Command_Checksum	Checksum of the command and data [sum (0x8040~0x8042)==0]							
0x8043	ESD_Check	Used by ESD used by ESD protection mechanism; reset to 0 upon initialization; after that, the driver implements Read/Write operation.							
0x8044	Request	Request initiatively sent by the firmware to the host							
0x8045	FW_Status_L	Firmware status word							
0x8046	FW_Status_H								

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3.2 Configuration Registers (R/W)

Register	Config Data	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0x8050	Config_ Version	Bit 7 is the stationary configuration flag (0: unfixed; 1: fixed); bit 0 to bit 6 indicate the version number of configuration file.							
0x8051	X Output Max (Low Byte)	Resolution of X axis							
0x8052	X Output Max (High Byte)								
0x8053	Y Output Max (Low Byte)	Resolution of Y axis							
0x8054	Y Output Max (High Byte)								
0x8055	Touch Number	Reserved				Fingers supported: 1 to 10			
0x8056	Module_ Switch1	Water_SpeedLimit_En	Water_ Large Restrain_En	Stretch_Rank 00：0.4P 01：0.4P 10：0.4P 11 ： user-defined coefficient		X2Y	Sito	INT triggering mechanism	
0x8057	Module_ switch2	STP_SE: Enable Special processing algorithm for special patterns		FirstFilter_Dis: Whether to increase the filter intensity for the first touch	Water_SITO	Water_Proof_Disable	SelfCap_ ResistCommon: self-cap common-mode interference suppression enable bit	SelfCap_ WaterProof: self-cap waterproof function enable bit	Touch_ Key 0: do not support touch key; 1: support touch key.

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0x8058	Module_Switch3	Key_Restrain_Dis: touch key suppression disable bit（ after finger leaves screen）	Force_DownEdgeRef 0: Compatible with the old versions 1: Enable falling-edge triggered update	INT_Wakeup 0: High-level wakeup 1: low-level wakeup	Check_Screen_Neg. 1: Enable algorithm for counting the negative values on the entire touch screen. 0: disable.	Water_Single_Dis whether to enable waterproof function when a single touch is detected; 0: Enable; 1: Disable.	Water_Shape_En: Enable anti-bending algorithm when there is water on screen.	Reserved	Shape_En: anti-bending algorithm enable bit. 0:Dis 1:En
0x8059	Module_Switch4	Monitor_En: whether to enable baseline monitor under temp_config	Drop_Water_En:	Driver_Resersal: Tx channels connect to touch panel in reversed order	Sensor_Resersal: Rx channels connect to touch panel in reversed order	Force_Self_RectFilter:	LowPower_Dis: disable low power mode	LargeCoor_En: Report coordinate of palm touch	Expand_En: touch latency improvement algorithm enable bit
0x805A	Module_Switch5	Reserved			RC_TYPE: 00:RC default parameters 01:RC configurable parameters 10:RC Auto-scanned parameters		0: Edge coordinate suppression is valid on bottom half of the touch screen; 1: Edge coordinate suppression is valid on the entire	Edge_MultiRes_En: If two or more concurrent touches are detected on touch screen edge and the distance between adjacent two	Reserved

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				screen.	touches is smaller than a certain distance, these touches will be suppressed. 0: Disable; 1: Enable.	
0x805B	Noise_Reduction	H-shaped photolithography pattern far-end trough clipping coefficient N; Far-end trough clipping is implemented based on the near-end data. Generally, only coefficient of the H-shaped pattern can be configured.	Noise mitigation amount (0 to 15 valid, coefficient is 1)			
0x805C	Screen_Touch_Level	Threshold for touch to be detected on touch screen				
0x805D	Screen_Leave_Level	Threshold for touch to be released on touch screen				
0x805E	Sys_Control	Refresh_Rate: Report rate (period: 5+N ms)	Low_Power_Control: no-touch duration for entering low power mode (0s to 15s)			
0x805F	Shake_Count	De-jitter count for touch-up (this touch-up de-jitter count cannot be greater than that of touch-down)	De-jitter count for touch-down			
0x8060	X_Threshold	X-position delta threshold for coordinate to be reported: 0-255 (coefficient is 1, based on the reported resolution. If this field is set to 0, GT5688 will keep reporting coordinates continuously when touch is present)				
0x8061	Y_Threshold	Y-position delta threshold for coordinate to be reported: 0-255 (coefficient is 1, based on the reported resolution; If this field is set to 0, GT5688 will keep reporting coordinates continuously when touch is present)				
0x8062	Space	Space of top border (coefficient: 32)	Space of bottom border (coefficient: 32)			
0x8063		Space of left border (coefficient: 32)	Space of right border (coefficient: 32)			
0x8064	Large_Touch	The number of nodes within one large-area touch				
0x8065	Stretch_R0	Coefficient of stretch zone 1				
0x8066	Stretch_R1	Coefficient of stretch zone 2				
0x8067	Stretch_R2	Coefficient of stretch zone 3				
0x8068	Filter	First_Filter	Normal_Filter (the filtered delta between the last reported coordinate and the coordinate to be reported; coefficient is 4)			
0x8069	Mini_Filter	Reserved	De-jitter	FirstFilter	Mini filter configuration during X/Y-direction	

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			count equals to First_Filter	_Middle: First_Filter on center area (not on the outmost channel)	line drawing process. If the coordinates on one direction is changing more significantly than those on the other, and the coordinate diff data on the direction with minor changes is within configured range, this coordinate will be filtered.
0x806A	Combine_Dis	In Charge mode, upper limit of the palm touch gradient threshold will increase by N×5. Recommended setting: N=7.			Distance for adjacent touch points to be combined, 0 to 15 configurable. Combine distance= Sqrt (the configured value*2) pitch. For backward compatibility, 0 indicates that Combine distance is 2 pitches.
0x806B	Split_Set	Distance between adjacent touch points for a palm touch to be separated, 0 to 15 configurable. Separation distance= Sqrt (the configured value*2) pitch. For backward compatibility, 0 indicates that Separation distance is Sqrt (12) pitch.			Distance between adjacent touch points for a normal-size touch to be separated, 0 to 15 configurable. Separation distance = Sqrt (the configured value*2) pitch. For backward compatibility, 0 indicates that Separation distance is Sqrt (7) pitch.
0x806C	WaterFrameTime	Time needed to update the backup data frame when there is water drops on touch screen. Unit: one scan period. Configured values smaller than 8 indicate 32. To ensure that slow slide can be detected and reported, it is recommended that this value should not be less than 8.			
0x806D	WaterUpdateTime	No-touch duration to enable Fast Update when there is water on screen. Unit: one scan period. Configured values smaller than 10 indicate 100. To ensure that finger slow approaching can be detected and reported, it is recommended that this value should not be less than 10.			
0x806E	S_FeedBack	Negative feedback for linearity correction to S-shaped line (Unit: 1/256)			
0x806F	Screen_Neg_Thres	Threshold for a negative value to be counted. Valid range: 1-15.coefficient: 5; when diff data is smaller than the threshold（-N*5）, quantity of negative value +1; If this field is set to 0, the threshold is -Leavelevel/2.			Baseline update threshold. If the quantity of the negative values that are smaller than the threshold in high-order 4 bits on the entire screen+ N*10 ≥ g_CellTotal/2, then update the baseline
0x8070	Shape_Control_Val	Threshold to enable heavy-press processing = Configured value *Touch level. Threshold to enable ultra-heavy-press processing = (Configured value +1)*Touch level. Enable new anti-bending algorithm when the delta is greater than the threshold to enable heavy-press processing; new anti-bending algorithm is disabled when configured value is smaller than 3.			Magnification factor of delta caused by bending; greater configuration leads to greater reduction; Recommended settings: 1 to 4; If this field is set to 0, no processing is needed when heavy press is detected while the magnification factor for ultra-heavy press is 2.
0x8071	ExpandFactor	ExpandFactor			Smooth_Weight

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		Valid range: 0-15; coefficient: 1. Smaller value leads to greater stretching and lower touch latency; greater value leads to slighter stretching and higher latency. This parameter may cause the reported coordinate to be ahead of actual finger position during line drawing process.			Valid range: 0-15; coefficient: 1. Greater value leads to greater smoothing and greater touch latency; smaller value leads to slighter smoothing and lower latency.
0x8072	Charging_Level_Factor	After Charge command is sent, the thresholds on screen will be magnified. Charging_Level_Factor indicates the magnification factor. Original threshold×Magnification factor/256+Original threshold=Threshold in Charge mode.			
0x8073	UNEVEN_DENSITY	Coordinate unevenness correction coefficient			
0x8074	ObjAvg	The average value of the entire screen after calibration			
0x8075	ObjMinW	ObjMin			ObjW:
0x8076	Back_Shape_Restrain	On-off switch for anti-bending algorithm due to press from the back in water state.	Data uniformity threshold to enable anti-bending algorithm due to press from the back side of device: 0-127 configurable; 0: disabled; 1-127 is the threshold to enable anti-bending algorithm.		
0x8077	GreenMode_Control	GreenMode period（unit: ms）			
0x8078	EDGE_COMPLEM_THRES	Edge compensation Threshold (0-255, greater configured value indicates more rigorous compensation conditions)			
0x8079	EDGE_COMPLEMENT_X	X-direction compensation coefficient (0-255, no edge compensation when this parameter is configured to 0; greater configured value indicates greater compensation value.			
0x807A	EDGE_COMPLEMENT_Y	Y-direction compensation coefficient (0-255, no edge compensation when this parameter is configured to 0; greater configured value indicates greater compensation value.			
0x807B	Large_Top_Limit	Upper threshold of palm touch			
0x807C	Large_Low_Limit	Lower threshold of palm touch			
0x807D	Large_Touch	Number of nodes within one palm touch			
0x807E	Drv_GroupA_Num	AllDriving	Reserved		Driver_Group_A_Number
0x807F	Drv_GroupB_Num	Reserved		Dual_Freq	Driver_Group_B_Number
0x8080	Sensor_Num	Sensor_Number			
0x8081	FreqA_Factor	Drive frequency Multiplier Factor of Driver Group A GroupA_Frequency = Multiplier Factor * Fundamental Frequency			
0x8082	FreqB_Factor	Drive frequency Multiplier Factor of Driver Group B			

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		GroupB_Frequency = Multiplier Factor * Fundamental Frequency				
0x8083	Pannel_BitFreqL	Fundamental Frequency of Driver Groups A and B （61.0352*1~61.0352*256*5 Hz）				
0x8084	Pannel_BitFreqH					
0x8085	Self_Tx_Ctrl	Self_Rx_PGA_AAF_Corner	RG_RXRINZ	Self_TxRef_TRIM（4 gain levels, configurable）	Self_TxRef_SEL	Self_DAC_Gain （8 gain levels, configurable） 0：Gain Max. 7：Gain Min.
0x8086	Self_Rx_Ctrl	Self_PGA_C	Self_PGA_R（4 gain levels, configurable）	Self_Rx_Vcmi（4 gain levels, configurable）		Self_PGA_GainC （4 gain levels, configurable）
0x8087	Pannel_Tx_Ctrl	Pannel_Rx_PGA_AAF_Corner	RG_RXRINZ	Pannel_TxRef_TRIM（4 gain levels, configurable）	Pannel_TxRef_SEL	Pannel_DAC_Gain （8 gain levels, configurable） 0：Gain Max. 7：Gain Min.
0x8088	Pannel_Rx_Ctrl	Pannel_PGA_C	Pannel_PGA_R（4 gain levels, configurable）	Pannel_Rx_Vcmi（4 gain levels, configurable）		Pannel_PGA_GainC（4 gain levels, configurable）
0x8089	Pannel_Dump_Shift	Reserved			The magnification factor of the sampled raw data (2^N)	
0x808A	Drv_Frame_Control	Temp. Config	Repeat_Num: repeated sampling count	SubFrame_DrvNum: the number of sampling driver groups. Acceptable settings: 3, 4, 5, 6,7; Do not configure this parameter to a number other than the ones listed above. Otherwise, error may occur.		
0x808B	ADC_TAB_Period	Reserved				
0x808C	PGA_GAINF	Reserved				
0x808D	Freq_Hopping_Start	Start frequency for frequency hopping (the unit: BitFreq)				
0x808E	Freq_Hopping_End	End frequency for frequency hopping (the unit: BitFreq)				
0x808F	Hopping_Flag	Hopping_En: Frequency hopping enable bit	Delay_Hopping: disable frequency hopping when touch	Dis_Force_Ref: Baseline update during frequency hopping. 0:	Seamless_Hopping_En	Reserved

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			is detected on screen	Enable; 1: disable		
0x8090	Noise_Detect_Times	Detect_Stay_Times (measurement count on each frequency within each noise detection; 2 is recommended for small screen; 1 is recommended for large screen)	Detect_Confirm_Times (noise detection count for noise level confirmation; 20 to 30 is recommended)			
0x8091	Hoppging_Threshold	Fast_Hopping_Limit: fast hopping is enabled only when the interference value of current frequency is greater than Fast_Hopping_Limit*4. The minimum setting of this limit is 5.	Hopping_Hit_Threshold (Conditions for selecting optimized frequency: Current operating frequency interference – Minimum interference>Configured value×4, then optimized frequency is selected and frequency hopping is enabled)			
0x8092	Noise_Min_Threshold	If the minimum interference caused by ESD is greater than this threshold, fast attenuation algorithm is enabled. If set to 0, this function is disabled and configured to high value (such as 200 or higher) has the equivalent effect. To enable this function, it is recommended to set the value 5 to 20 higher than the noise of the lowest noisy frequency (LCD interference and common-mode interference, whichever is greater).				
0x8093	Noise_PGA_GAIN	Reserved	Noise_PGA_GAINF			
0x8094	Noise_Dump_Shift	Reserved	Noise_Dump_RightShift	Noise_Dump_Shift		
0x8095	Hopping_seg1_Normalize	Seg1 Normalize coefficient (sampled value *N / 128= Raw data)				
0x8096	Hopping_seg1_Factor	Seg1 Central Frequency Multiplier Factor (applicable to driver A; the factor of driver B can be calculated based on that of driver A)				
0x8097	Hopping_seg2_Normalize	Seg2 Normalize coefficient (sampled value *N / 128= Raw data)				
0x8098	Hopping_seg2_Factor	Seg2 Central Frequency Multiplier Factor (applicable to driver A; the factor of driver B can be calculated based on that of driver A)				
0x8099	Hopping_seg3_Normalize	Seg3 Normalize coefficient (sampled value *N / 128= Raw data)				
0x809A	Hopping_seg3_Factor	Seg3 Central Frequency Multiplier Factor (applicable to driver A; the factor of driver B can be calculated based on that of driver A)				
0x809B	Hopping_seg4_Normalize	Seg4 Normalize coefficient (sampled value *N / 128= Raw data)				

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0x809C	Hopping_seg4_Factor	Seg4 Central Frequency Multiplier Factor (applicable to driver A; the factor of driver B can be calculated based on that of driver A)	
0x809D	Hopping_seg5_Normalize	Seg5 Normalize coefficient (sampled value *N / 128= Raw data)	
0x809E	Hopping_seg5_Factor	Seg5 Central Frequency Multiplier Factor (applicable to driver A; the factor of driver B can be calculated based on that of driver A)	
0x809F	Hopping_seg6_Normalize	Seg6 Normalize coefficient (sampled value *N / 128= Raw data)	
0x80A0	Jitter_Threshold	Seamless frequency hopping backup raw data jitter threshold， recommended setting in low sensitivity sate: 15; recommended setting in high sensitivity state: 30.	
0x80A1	Avg_Thre	Seamless frequency hopping average value threshold: N*2	
0x80A2	Max_Thre	Seamless frequency hopping maximum value threshold: N*4	
0x80A3	Key 1	Key 1 location: 0-255 valid (0 indicates no key is available. When the values of these four registers for keys are multiples of 8, it indicates independent key design solution.)	
0x80A4	Key 2	Key 2 location: 0-255 valid (0 indicates no key is available. When the values of these four registers for keys are multiples of 8, it indicates independent key design solution.)	
0x80A5	Key 3	Key 3 location: 0-255 valid (0 indicates no key is available. When the values of these four registers for keys are multiples of 8, it indicates independent key design solution.)	
0x80A6	Key 4	Key 4 location: 0-255 valid (0 indicates no key is available. When the values of these four registers for keys are multiples of 8, it indicates independent key design solution.)	
0x80A7	Key_Area	Timeout setting for long-press (1s to 16s). if set to 0, the setting is 3 seconds.	Key active area configuration (single side): 0-15 valid
0x80A8	Key_Touch_Level	Touch key touch threshold	
0x80A9	Key_Leave_Level	Touch key release threshold	
0x80AA	Key_Sens	KeySens_1 (Sensitivity coefficient of Key 1)	KeySens_2 (Sensitivity coefficient of Key 2)
0x80AB	Key_Sens	KeySens_3 (Sensitivity coefficient of Key 3)	KeySens_4 (Sensitivity coefficient of Key 4)
0x80AC	Key_Restrain	The key is suppressed within this period after finger leaves screen (unit: 100ms).	Adjacent independent key suppression parameter (When the second largest value> the largest value * Key_Restrain/16, no key is reported); recommended configuration is 7±2.
0x80AD	Key_DownEdge_Filter	Reserved	The period of time that touch keys are suppressed after finger slides to leave from the bottom of the screen (unit: 100ms). Valid range: 0~15.

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0x80AE		Reserved						
0x80AF		Reserved						
0x80B0	LINK_SWITCH	Period_ Switch_Dis: Scan period switchover disable bit	LinkLarge_En Whether to use palm touch thresholds to assist in HotKnot proximity detection.	Reserved	Move_ Window_ Dis	Hotknot cycle: Implement HotKnot detection once every N+1 refresh cycles in active mode; Valid range: 0~3.	LINK_PXY_EN (proximity detection enable bit)	LINK_FUN_EN (Link function enable bit)
0x80B1	LINK_THRESHOLD	Data_NoiseThreshold: threshold to start data transmission						
0x80B2	PXY_THRESHOLD	Pxy_ NoiseThreshold: threshold for a HotKnot terminal to be detected						
0x80B3	Link_DUMP_SHIFT	Period_Default (default detection period)	Reserved	RG_RXRINZ	Rx_Self: Self-cap receiving mode enable bit	Link_Dump_shift		
0x80B4	Link_Rx_Ctrl	Link_PGA_C	Link_PGA_R（4 gain levels, configurable）	Link_RxVCMRZ	Link_Rx_Vcmi（4 gain levels, configurable）	Link_PGA_GainC（4 gain levels, configurable）		
0x80B5	FREQ_GAIN0	400K gain adjustment, adjustment amount is N/8. Invalid when N=0.				450K gain adjustment, adjustment amount is N/8. Invalid when N=0.		
0x80B6	FREQ_GAIN1	300K gain adjustment, adjustment amount is N/8. Invalid when N=0.				350K gain adjustment, adjustment amount is N/8. Invalid when N=0.		
0x80B7	FREQ_GAIN2	200K gain adjustment, adjustment amount is N/8. Invalid when N=0.				250K gain adjustment, adjustment amount is N/8. Invalid when N=0.		

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0x80B8	FREQ_GAIN3	Reserved	150K gain adjustment, adjustment amount is N/8. Invalid when N=0.
0x80B9	SELF_LARGE_THRESHOLD	Palm touch threshold in self-cap mode (to assist in HotKnot proximity detection)	
0x80BA	SELF_LARGE_CONSISTENCY	Palm touch data uniformity threshold in self-cap mode（set value× 50 = threshold, to assist in HotKnot proximity detection）	
0x80BB	SELF_LARGE_TIME	Maximum duration of palm touch in self-cap mode（to assist in Hotknot proximity detection）	
0x80BC	PXY_THRESHOLD_HIGH	The increment of the HotKnot proximity detection threshold when no palm touch is detected（default setting: PXY_THRESHOLD × 3 / 2）	
0x80BD	Edge_Res_Area	Coordinate suppressed area within left/right border, unit: 1/64 pitch	
0x80BE	Edge_Res_Bottom	Coordinate suppressed area within bottom border, unit: 1/64 pitch	
0x80BF	HighSens_Delay	Duration of the high sensitivity state. If set to 0, GT5688 will not exit high sensitivity state before finger touch is detected.	
0x80C0	HighSens_AddTime	The minimum duration of weak-signal swipe to enable high-sensitivity detection. （unit: one main loop）	
0x80C1	HighSens_Dis	The minimum distance of weak-signal swipe to enable high-sensitivity detection. （this minimum distance is (absolute distance)^2; unit: 1/4 pitch）	
0x80C2	HighSens_Click_Time1	The minimum duration of a weak-signal tap to enable high sensitivity detection（unit: one main loop）	
0x80C3	HighSens_Click_Time2	The maximum duration of a weak-signal tap to enable high sensitivity detection（unit: one main loop）	
0x80C4	Level_Shift	H_Combine_factor: in high sensitivity state, the distance for touch points to be separated or combined is magnified. The separation/combine distance in high sensitivity state= normal separation/combine distance×1/2*√（4+H_Combine_factor）.	The magnification factor of the finger touch threshold and high-sensitivity detection threshold
0x80C5	Key_Finger_Leave_Level	Finger release threshold on touch key	
0x80C6	Key_Finger_Touch_Level	Finger touch threshold on touch key	
0x80C7	Key_HighSens_Low_Level	Lower threshold to enable high sensitivity detection on touch key	
0x80C8	Key_HighSens_High_Level	Upper threshold to enable high sensitivity detection on touch key	
0x80C9	Finger_Leave_Level	Finger Release (touch-up) threshold on touch screen	
0x80CA	Finger_Touch_Level	Finger Touch(touch-down) threshold on touch screen	
0x80CB	HighSens_Low_	Lower threshold for high sensitivity detection on touch screen	

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	Level		
0x80CC	HighSens_High_Level	Upper threshold for high sensitivity detection on touch screen	
0x80CD	SelfCancel_R0	SelfCap RC parameter, the first Driver group R (0-255)	
0x80CE	SelfCancel_R1	SelfCap RC parameter, the second Driver group R (0-255)	
0x80CF	SelfCancel_R2	SelfCap RC parameter, Sensors R (0-255)	
0x80D0	Self_BitFreqL	Fundamental frequency of main system in self-cap mode（61.0352*1~61.0352*256*5 Hz）	
0x80D1	Self_BitFreqH		
0x80D2	Self_Factor	Multiplier factor of Drive frequency in SelfCap mode. Drive Frequency = Multiplier factor * Fundamental frequency	
0x80D3	Selfcap_Frame_Num	SelfCap_Dump_Shift	Reserved
0x80D4	Self_Drv_Touch Level	Threshold for touch to be detected on Drive line in self-cap mode	
0x80D5	Self_Sen_Touch Level	Threshold for touch to be detected on Sense line in self-cap mode	
0x80D6	Self_LeaveLevel	Leave threshold in self-cap mode, mainly used in self-cap baseline update	
0x80D7	HighSens_Self_Drv_TouchLevel	Threshold for touch to be detected on self-cap Tx line（High sensitivity）	
0x80D8	HighSens_Self_Sen_TouchLevel	Threshold for touch to be detected on self-cap Rx line（High sensitivity）	
0x80D9	SelfCancel_C0	SelfCap RC parameter, the first Driver group C (0-127)	
0x80DA	SelfCancel_C1	SelfCap RC parameter, the second Driver group C (0-127)	
0x80DB	SelfCancel_C2	SelfCap RC parameter, Sensors C (0-127)	
0x80DC ~ 0x80E9	Sensor_CH0~ Sensor_CH13	The Rx channel number on chip corresponding to the ITO Rx channel number on touch sensor	
0x80EA~ 0x8103	Driver_CH0~ Driver_CH25	The Tx channel number on chip corresponding to the ITO Tx channel number on touch sensor	
0x8104	Driver_Gain0~1	Channel 1 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.	Channel 0 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.
0x8105	Driver_Gain2~3	Channel 3 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.	Channel 2 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.
0x8106	Driver_Gain4~5	Channel 5 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.	Channel 4 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.
0x8107	Driver_Gain6~7	Channel 7 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.	Channel 6 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.
0x8108	Driver_Gain8~9	Channel 9 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.	Channel 8 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.
0x8109	Driver_Gain10~11	Channel 11 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.	Channel 10 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.

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0x810A	Driver_Gain12~13	Channel 13 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.	Channel 12 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.
0x810B	Driver_Gain14~15	Channel 15 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.	Channel 14 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.
0x810C	Driver_Gain16~17	Channel 17 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.	Channel 16 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.
0x810D	Driver_Gain18~19	Channel 19 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.	Channel 18 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.
0x810E	Driver_Gain20~21	Channel 21 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.	Channel 20 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.
0x810F	Driver_Gain22~23	Channel 23 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.	Channel 22 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.
0x8110	Driver_Gain24~25	Channel 25 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.	Channel 24 adjustment coefficient N; adjustment amount is N/16. Invalid when N=0.
0x8111	Edge_Res_Area	De-jitter count when exiting edge coordinate suppression. Setting to 0 indicates 50. Setting to 1~15, the de-jitter count will be N*5. Unit: one main loop/ scan cycle.	Reserved
0x8112	Edge_Diff_Threshold	If the size of the touch point is 1X3 or 2X4, and the delta on the left/right side of the touch is greater than the threshold, the touch will be regarded as a palm touch.	
0x8113	Proximity_Area_Limit	Reserved	
0x8114	Proximity_Press_Time1	Reserved	
0x8115	Proximity_Press_Time2	Reserved	
0x8116	Proximity_Large_Touch	Reserved	
0x8117	Proximity_Drv_Select	Reserved	Reserved
0x8118	Proximity_Sens_Select	Reserved	Reserved
0x8119	Proximity_Touch_Level	Reserved	
0x811A	Proximity_Leave_Level	Reserved	
0x811B	Proximity_Sample_Add_Times	Reserved	
0x811C	Proximity_Shake_Count	Reserved	
0x811D	Proximity_Func_Switch	Reserved	Reserved

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0x811E	Proximity_Line_Dist_Limit	Reserved							
0x811F	Proximity_Down Update	Reserved				Reserved			
0x8120	Proximity_Stable_Time	Reserved							
0x8121		Reserved							
0x8122		Reserved							
0x8123	Centroid_Ctl	The proportion of Centroid algorithm in coordinate calculation. Proportion in edge-region coordinate calculation: bit 0-3; proportion in central-region coordinate calculation: bit 4-7.							
0x8124	DS_UNSP_Level	Reserved							
0x8125	Gesture_Edge_Res	Coordinate suppression range on the left/right side of the gesture; unit: 1/64 pitch							
0x8126	Gesture_Time_Set	Gesture_Time_Set : 0 indicates this function is disabled; other values will enable IO pin to cooperate with IR sensor to detect gesture. If no gesture is detected within this Gesture_Time_Set, GT5688 will enter Doze mode to save power.（setting to 1 indicates 40ms; setting to other values indicate 100×(N－1) ms.				dbClickLimit_X: X-direction channel edge within which double-tap gesture is invalid.			
0x8127	DbClkAreaLimit	Y-direction channel top edge (where the origin point lies) within which double-tap gesture is invalid.				Y-direction channel bottom edge within which double-tap gesture is invalid.			
0x8128	Gesture_Switch4	Reserved						Gesture_Hop_Dis: disable frequency hopping in gesture mode	Mul_stroke_En: customized multi-stroke gesture enable bit
0x8129	Gesture_Switch1	Swipe left	Swipe up	Swipe right	w	o	m	e	c
0x812A	Gesture_Switch2	Swipe down	z	s	^	>	v	Two-finger swipe-down	Two-finger swipe-up
0x812B	Gesture_Switch3	Custom_En:	Report coordi			Swipe gesture	Double-tap on	Double-tap on	Tap on touch

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		customized gesture enable bit	nate according to protocol 2	f	@	is valid only at the bottom of the screen (the last Tx line)	touch screen	touch key	key
0x812C	Gesture_DumpShift	GestureMutualDumpShift: magnification factor of mutual-cap raw data in gesture mode (2^N)				GestureSelfDumpShift: magnification factor of self-cap raw data in gesture mode (2^N)			
0x812D	Pannel_PGA_GainC	Reserved					Pannel_Mutual_PGA_GainC （8 gain levels, configurable）		
0x812E	Gesture_BitFreqL	Fundamental frequency of Driver groups A and B in gesture mode (61.0352*1~61.0352*256*5 Hz)							
0x812F	Gesture_BitFreqH								
0x8130	Gestrue_Self_Rx_Ctrl	Gesture_Self_PGA_GainC	Gesture_Self_PGA_R （4 gain levels, configurable）		Gesture_Self_Rx_Vcmi （ gain levels, configurable）		Gesture_Self_PGA_GainC （ 8 gain levels, configurable）		
0x8131	Gesture_Ctrl_1	Gesture_INT_Time: INT pulse width setting in gesture mode Valid range: 0~15. Pulse width=(N+1)×250us; If set to 15, after awakened, GT5688 will keep outputting high until host finishes reading the wakeup info.				Gesture_Combine_Dis: Touch point Combination distance in gesture mode; configurable range: 0~15. Touch point Combination distance=Sqrt (configured value×2) pitch. If set to 0, the combination distance is 2 pitches.			
0x8132	Gesture_Refresh_Rate	Report rate in gesture mode (Period: 5+ms)							
0x8133	Gesture_Large_Touch	Number of nodes within one palm touch in gesture mode							
0x8134	Gesture_Dis	Gesture_Width: Minimum distance for left/right swipe gesture to be valid. Unit: 1/16; Setting to 0 indicates 5.				Gesture_Height: Minimum distance for up/down swipe gesture to be valid. Unit: 1/16; Setting to 0 indicates 8.			
0x8135	Gesture_TimeOut	DoubleClick_TimeOut: the maximum time interval between the two taps of double-tap gesture（Unit:100ms）					Gesture_Self_Sito	Gesture_Self_Sample: 0x10: collect raw data on Rx; 0x11: collect raw data on Tx; Others: collect raw data on both Rx and Tx.	

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0x8136	Gesture_Touch_Level	Touch threshold in gesture mode	
0x8137	NewGreenWakeUpLevel	Threshold to wake up GT5688 after it enters NewGreen mode due to no touch being detected for a long period in Gesture mode	
0x8138	GESTURE_CTRL_2	Time interval between adjacent two strokes of a single-finger multi-stroke gesture (Unit:100ms. Maximum setting: 1 sec.)	Reserved
0x8139	GESTURE_MIN_RESTRAIN	DoubleClick_Dist: maximum distance between the two taps of a double-tap gesture. Unit: 0.5 pitch.	Minimum distance of a valid gesture. If Gesture width/height< 3 + (Gesture_Min_Restrain/2) pitches, the gesture is invalid.
0x813A	HV_Factor	Slope configuration for X-direction swipe gesture to be valid. 0-15 configurable; 1（40°）≤ k ≤ 15（13°）. Greater value requires smaller angle between swipe gesture and X axis.	Slope configuration for Y-direction swipe gesture to be valid. 0-15 configurable; 1（51°）≤ k ≤ 15（78°）. Greater value requires smaller angle between swipe gesture and Y axis.
0x813B	Gesture_Limit_Timer	The minimum duration of a valid single-stroke wakeup gesture (unit: 100ms); configurable range: 0~15; the minimum duration = N ×100ms. If the duration of a single-stroke wakeup gesture is shorter than the set value, this wakeup gesture is invalid. If set to 0, this time limit is invalid.	The maximum duration of a valid single-stroke wakeup gesture (unit: 1 sec.); configurable range: 0~15; If the duration of a single-stroke wakeup gesture is longer than the set value, this wakeup gesture is invalid. If set to 0, this time limit is invalid.
0x813C	Config_Chksum_H	Configuration checksum (16-bit) （Big Endian Mode: High-order bits stored at low-order address）	
0x813D	Config_Chksum_L		
0x813E	Config_Fresh	Configuration refreshed flag (host writes 1 to this address)	

[0x8056] Module_Switch1

Bit7:Water_SpeedLimit_En: fast swipe speed limit when there is water on screen

Bit6:Water_LargeRestrain_En: palm suppression enable bit when there is water on screen

Bit5-bit4: Stretch_rank, stretching method

00,01,02: Slight stretching 0.4P

03: User-defined stretching coefficient

Bit3: X2Y: X and Y axes switchover

Bit2:Sito: SITO algorithm enable bit

Bit1-Bit0: INT triggering mechanism. 00: rising-edge triggered; 01: falling-edge triggered; 02: low-level

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triggered; 03: high-level triggered.

[0x8057] Module_Switch2

Bit7-bit6:STP_SE: algorithms for special patterns

00: Disabled;

01: Silk screen printing H-shaped pattern;

10: Reserved.

11: Photolithography H-shaped pattern.

Bit5:FirstFilter_Dis: Increase filter intensity for the first touch.

Bit4: Water_SITO: Decide whether to enable SITO algorithm when there is water on screen.

0:Dis

1:En

Bit3: Water_Proof_Disable:

0: waterproof is enabled;

1: waterproof is disabled.

Bit2: SelfCap_ResistCommon: self-cap common-mode interference suppression algorithm enable bit.

Bit1: SelfCap_WaterProof: self-cap waterproof function enable bit

Bit0:Touch_Key: touch key enable bit

[0x8059] Module_Switch4

Bit7: Monitor_En: whether to monitor the baseline under temp_config

0: disable baseline monitor under temp_config;

1: enable baseline monitor under temp_config.

Bit6: Drop_Water_En: enable algorithm to eliminate false detection caused by water drop

Bit5:Driver_Resersal: whether the Tx channels connect to the touch panel in reversed order.

0: in order;

1: in reversed order.

Bit4:Sensor_Resersal: whether the Rx channels connect to the touch panel in reversed order

0: in order;

1: in reversed order.

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Bit3: Force_Self_RectFilter_En: enable self-cap filter

Bit2:LowPower_Dis: disable low power mode.

0: Enter low power mode normally;

1: Do not enter low power mode.

Bit1: LargeCoor_En: Enable palm touch coordinates reporting

Bit0:Expand_En: Enable touch latency improvement algorithm

[0x8068] Filter

Bit7-bit6: First_Filter: the filter parameter used when finger is touched down and starts to move for the first time.

0x00: filter 126 coordinates;

0x01: filter 90 coordinates;

0x10: filter 54 coordinates;

0x11: filter Normal_Filter/2 coordinates.

Bit5-bit0: Normal_Filter: the filtered delta between the previous reported coordinate and the coordinate to be reported; coefficient is 4.

[0x8069] Mini_Filter

Bit4: FirstFilter_Middle: FirstFilter for touches on the non-edge area (not on the outermost channel)

0: Filtered value: First_Filter;

1: Filtered value: 54.

Bit3-bit0: Mini_Filter: Mini filter configuration during X/Y-direction line drawing process. If the coordinates on one direction is changing more significantly than those on the other and the coordinate diff data on the direction with minor changes is within this threshold, this coordinate will be filtered.

0: Mini_Filter is 4;

1~15: Mini_Filter is N;

[0x80B3] Link_DUMP_SHIFT

Bit7:Period_Default: default detection period

0: 80us;

1:160us.

Bit5:RG_RXRINZ

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Bit4:Rx_Self: Enable self-cap receiving

0: Normal receiving;

1:Self-cap receiving;

Bit3-Bit0:Link_Dump_shift

For details of the configuration and debugging methods, please refer to “GT5688 Configuration Guide”.

3.3 Coordinate Registers

Addr	Access	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0x8140	R	Product ID (first byte，ASCII, for example: 5)							
0x8141	R	Product ID (second byte，ASCII, for example: 6)							
0x8142	R	Product ID (third byte，ASCII, for example: 6)							
0x8143	R	Product ID (fourth byte，ASCII , for example: 8)							
0x8144	R	CID							
0x8145	R	Patch major version number							
0x8146	R	Patch minor version number							
0x8147	R	MASK major version number							
0x8148	R	MASK minor version number							
0x8149	R	MASK internal version number							
0x814A	R	BondingOption				Vendor_ID			
0x814B	R	checksum							
0x814C	R	Reserved							
0x814D	R	Reserved							
0x814E	R/W	Buffer Status	Large Detect	Proximity Valid	HaveKey	Number of Touch Points			
0x814F	R	Touch Sta	Hover Sta	HotKnot	Reserved	track_id			
0x8150	R	Hotknot=0: point 1 x coordinate (low byte) Hotknot=1：Bit7,Pxy_Status; Bit6,Approch_Valid							
0x8151	R	Hotknot=0: point 1 x coordinate (high byte) Hotknot=1：Bit7,Pxy_Status; Bit6,Approch_Valid							
0x8152	R	point 1 y coordinate (low byte)							
0x8153	R	point 1 y coordinate (high byte)							
0x8154	R	Point 1 size (W)							
0x8155	R	point 1 size (H)							
0x8156	R	Reserved							
0x8157	R	Touch Sta	Hover Sta	Reserved		track_id			
0x8158	R	point 2 x coordinate (low byte)							

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0x8159	R	point 2 x coordinate (high byte)				
0x815A	R	point 2 y coordinate (low byte)				
0x815B	R	point 2 y coordinate (high byte)				
0x815C	R	point 2 size (W)				
0x815D	R	point 2 size (H)				
0x815E	R	Reserved				
0x815F	R	Touch Sta	Hover Sta	Reserved	track_id	
0x8160	R	point 3 x coordinate (low byte)				
0x8161	R	point 3 x coordinate (high byte)				
0x8162	R	point 3 y coordinate (low byte)				
0x8163	R	point 3 y coordinate (high byte)				
0x8164	R	point 3 size (W)				
0x8165	R	point 3 size (high byte)				
0x8166	R	Reserved				
0x8167	R	Touch Sta	Hover Sta	Reserved	track_id	
0x8168	R	point 4 x coordinate (low byte)				
0x8169	R	point 4 x coordinate (high byte)				
0x816A	R	point 4 y coordinate (low byte)				
0x816B	R	point 4 y coordinate (high byte)				
0x816C	R	point 4 size (W)				
0x816D	R	point 4 size (H)				
0x816E	R	Reserved				
0x816F	R	Touch Sta	Hover Sta	Reserved	track_id	
0x8170	R	point 5 x coordinate (low byte)				
0x8171	R	point 5 x coordinate (high byte)				
0x8172	R	point 5 y coordinate (low byte)				
0x8173	R	point 5 y coordinate (high byte)				
0x8174	R	point 5 size (W)				
0x8175	R	point 5 size (H)				
0x8176	R	Reserved				
0x8177	R	Touch Sta	Hover Sta	Reserved	track_id	
0x8178	R	point 6 x coordinate (low byte)				
0x8179	R	point 6 x coordinate (high byte)				
0x817A	R	point 6 y coordinate (low byte)				
0x817B	R	point 6 y coordinate (high byte)				
0x817C	R	point 6 size (W)				
0x817D	R	point 6 size (H)				
0x817E	R	Reserved				

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0x817F	R	Touch Sta	Hover Sta	Reserved	track_id
0x8180	R	point 7 x coordinate (low byte)			
0x8181	R	point 7 x coordinate (high byte)			
0x8182	R	point 7 y coordinate (low byte)			
0x8183	R	point 7 y coordinate (high byte)			
0x8184	R	point 7 size (W)			
0x8185	R	point 7 size (H)			
0x8186	R	Reserved			
0x8187	R	Touch Sta	Hover Sta	Reserved	track_id
0x8188	R	point 8 x coordinate (low byte)			
0x8189	R	point 8 x coordinate (high byte)			
0x818A	R	point 8 y coordinate (low byte)			
0x818B	R	point 8 y coordinate (high byte)			
0x818C	R	point 8 size (W)			
0x818D	R	point 8 size (H)			
0x818E	R	Reserved			
0x818F	R	Touch Sta	Hover Sta	Reserved	track_id
0x8190	R	point 9 x coordinate (low byte)			
0x8191	R	point 9 x coordinate (high byte)			
0x8192	R	point 9 y coordinate (low byte)			
0x8193	R	point 9 y coordinate (high byte)			
0x8194	R	point 9 size (W)			
0x8195	R	point 9 size (H)			
0x8196	R	Reserved			
0x8197	R	Touch Sta	Hover Sta	Reserved	track_id
0x8198	R	point 10 x coordinate (low byte)			
0x8199	R	point 10 x coordinate (high byte)			
0x819A	R	point10 y coordinate (low byte)			
0x819B	R	point 10 y coordinate (high byte)			
0x819C	R	point 10 size (W)			
0x819D	R	point 10 size (H)			
0x819E	R	Reserved			
0x819F	R	KeyValue			
0x81A0	R	CheckSum [sum(0x814E:cur,len)==0], length="Touch Points"*8+3			

Supplementary description on some registers:

[0x814A] Bit3~Bit0:Vendor_ID

The ID of the current module is codetermined by pins *sensor_opt1* and *sensor_opt2* in the circuit.

Different combinations of their connections can identify 6 Vendor IDs as shown below:

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sensor_opt1	sensor_opt2	Vendor_id
GND	GND	0
VDDIO	GND	1
NC	GND	2
GND	300K	3
VDDIO	300K	4
NC	300K	5

[0x814E]

Bit7: Buffer status, 1 = coordinate (or key) is ready for host to read; 0 = coordinate (or key) is not ready and data is not valid. After reading coordinates, host should configure this flag (or the entire byte) to 0 via I^2C.

Bit4: HaveKey, 1 : key is touched; 0 : key is released.

Bit3~0: Number of touch points.

[0x814F]

Bit7: touch_sta. 1 indicates high-sensitivity touch coordinate;

0 indicates normal-sensitivity touch coordinate.

Bit5: Hotknot. 1 indicates the information in the following bytes is HotKnot-related.

0 indicates the information in the following bytes is not HotKnot-related.

Bit3~0: track id. The ID number of the touch point.

[0x8177]: KeyValue

The address of KeyValue is not fixed. Instead, it stays behind valid coordinates. For example, 0x8177 is the address of the KeyValue when there are 5 coordinates on touch panel. However, if there are 4 coordinates on touch panel, the address of the KeyValue will be 0x816F.

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3.4 Gesture Registers

（Gesture Feature Registers: share the addresses with the Coordinate Registers）

Addr	Access	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0x8140	R	Product ID (first Byte，ASCII G)							
0x8141	R	Product ID (second Byte，ASCII E)							
0x8142	R	Product ID (third Byte，ASCII S)							
0x8143	R	Product ID (fourth Byte，ASCII T)							
0x8144	R	Gesture major version number							
0x8145	R	Gesture minor version number							
0x8146	R	Gesture internal version number							
0x8147	R	MASK major version number							
0x8148	R	MASK minor version number							
0x8149	R	MASK internal version number							
0x814A	R	BondingOption				Vendor_ID			
0x814B	R	checksum							
0x814C	R/W	Gesture types（ASCII character indicates 0x21 - 0x7F），swipe right（0xAA），swipe left（0xBB），swipe down（0xAB），swipe up（0xBA），double-tap（0xCC）, single tap on touch key （0xC1, 0xC2, 0xC4, 0xC8, the low-order four bits store the KeyValue），customized gestures (0x01~0x0A)							
0x814D	R	The number of touch points of a gesture（coordinates stored at 0x 8A40）							
0x814E	R	0x02: report all points; 0x03: report feature points. 0x10: single-stroke gesture; 0x20: multi-stroke gesture.							
0x814F	R	The number of data bytes in Buffer							
0x8150 to 0x816F	R	Data in Buffer							
0x8170	R	Checksum (calculation starts from the address 0x814C)							

（Gesture Coordinate Registers）

Addr	Access	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0x8A40	R	Gesture point 1 x coordinate（low byte）							
0x 8A41	R	Gesture point 1 x coordinate（high byte）							
0x 8A42	R	Gesture point 1 y coordinate（low byte）							
0x 8A43	R	Gesture point 1 y coordinate（high byte）							
0x 8A44~ 0x 8B3F	R	Gesture point 2~64 coordinate（the number of coordinates equals to the value at 0x814D）							

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3.5 Command Status Registers

Addr	Access	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0x81A8	R	GT5688_Status： 0x00：touch detection mode；0x88: slave approach mode; 0x99: master approach mode; 0xAA: Receive mode; 0xBB: Send mode, indicates the Transmit Buffer is refreshed correctly.							
0x 81A9	R	GT5688_Status_Bak：GT5688_Status backup							

These registers are used to check whether the commands are sent successfully by querying the status of the GT5688. Data in this field is valid at any time.

3.6 HotKnot status registers

Addr	Access	Items	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0x8800	R	HotKnotSendStatus	HotKnot Send status register							
0x8801	R	HotKnotRevStatus	HotKnot Receive status register							
0x8802	R	HotKnotSendStatusBak	HotKnot Send status register backup							
0x8803	R	HotKnotRevStatusBak	HotKnot Receive status register backup							
0x8804~ 0x880E		NC	Reserved							
0x880F	R/W	HotKnotNotifyStatus	When there is event needs to be handled by the host, GT5688 will write 0xAA to this address and notify the host via INT. After the event is handled, the host sends another command other than 0xAA. And GT5688 will back to work again. Otherwise, it will wait for 252 Ticks (10ms/tick) before starting to work again.							

Data in this area is valid only in Receive mode or Send mode.

3.7 HotKnot Transmit Buffer

Addr	Access	Items	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0x8980	W	DataLength	valid data length							
0x8981	W	Data0	The first data byte							
0x8982	W	Data1	The second data byte							
.....	W	.....	.....							

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0x89FF	R/W	Data127	The 128th data byte
0x8A00		DataChkSum	Checksum, come after data, not fixed in this address
0x8A7F~ 0x8A80		NC	Reserved
0x8A81	W	DataFresh	Fixed in this address, data buffer refreshed flag (host writes 0xAA)

1) This area can be written only when GT5688 operates in Receive Mode. Otherwise, unpredictable results will occur.

2) After sending the outgoing data through I2C interface, write 0xAA to 0x8A81 and GT5688 will start transmitting data as a HotKnot terminal. Otherwise, it will stay in Receive Mode.

3) When writing to 0x8980, make sure the Hotknot FW is running, which can be distinguished by reading firmware version number.

4) Data packet length supported: 2, 4, 8, 16, 32, 64 or 128 bytes.

3.8 HotKnot Receive Buffer

Addr	Access	Items	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0x8B00	R/W	HotKnotRevStatus	buffer status							
0x8B01	R/W	DataLength	valid data length							
0x8B02	R	Data0	The first data byte							
0x8B03	R	Data1	The second data byte							
.....	R	.....	.....							
0x8B81	R	Data127	The 128th data byte							
0x8B82 -0x8B83	R	DataChkSum	Data CRC16 check, come after data, not fixed in this address							

1) **0x8B00.bit7:** buffer status as 1 indicates data in Receive Buffer is ready to be read. The corresponding HotKnotRevStatus is 0x03;

2) Data in this area is valid only in Receive mode. buffer status as 1 indicates data in Receive Buffer is ready to be read;

3) DataLength ≤ 128 bytes.

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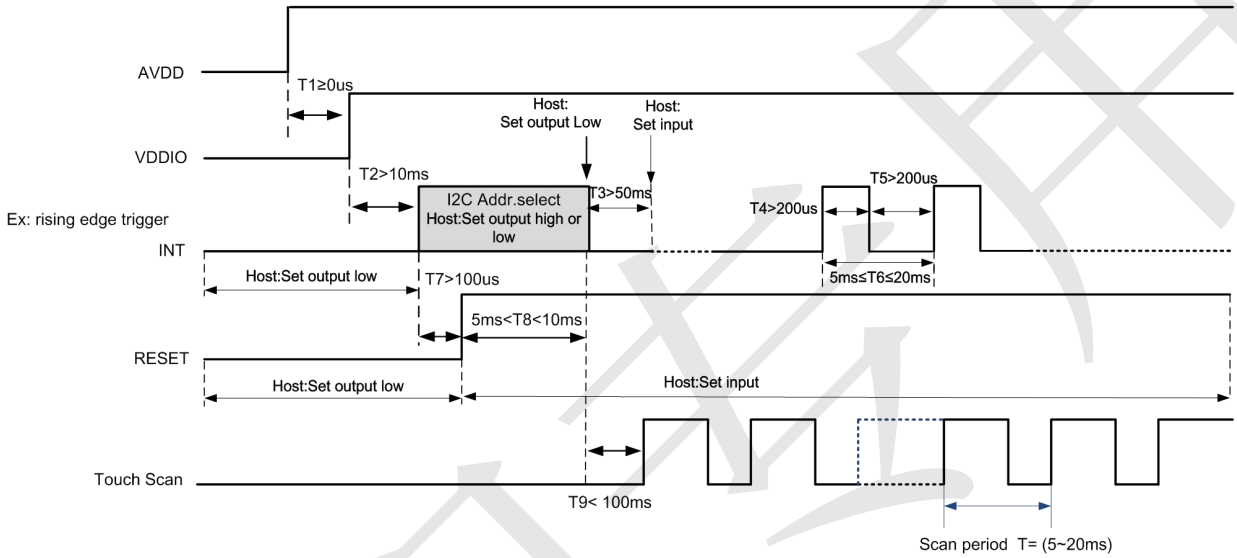
4) Data packet length supported: 2, 4, 8, 16, 32, 64 or 128 bytes.

4. Power-on Initialization and Modification of Register Value

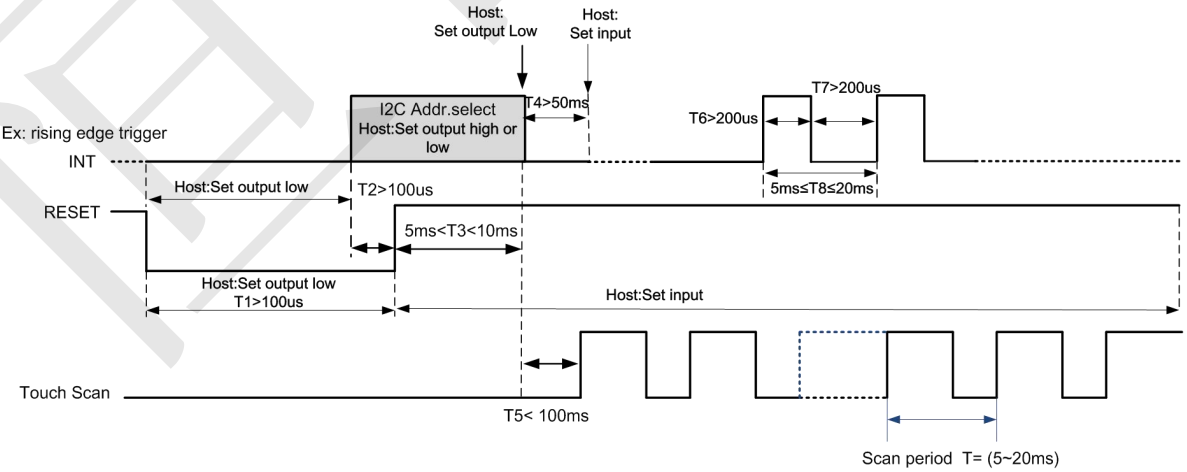
4.1 Power-On Timing

After power-on, the host needs to control such GT5688 pins as AVDD, VDDIO, INT and Reset according to the timing sequence shown below:



Whether host outputs high or low after INT T2 depends on which I²C slave address the host employs to communicate with GT5688. If the address is 0x28/0x29, host outputs high; if the address is 0xBA/0xBB, host outputs low.

Timing for host resetting GT5688:



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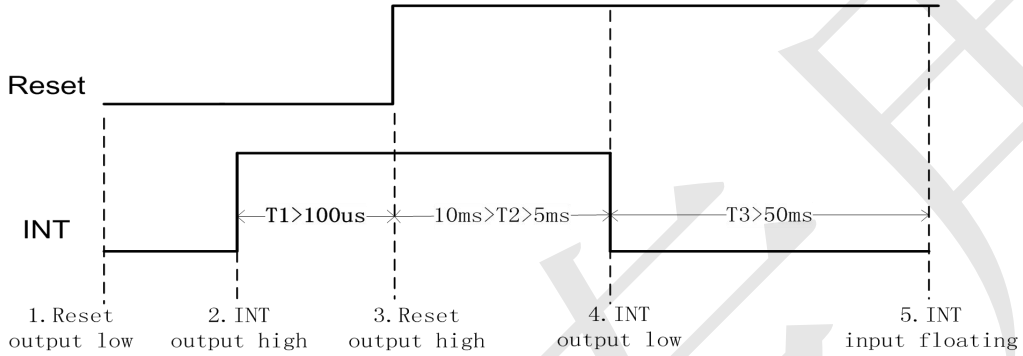
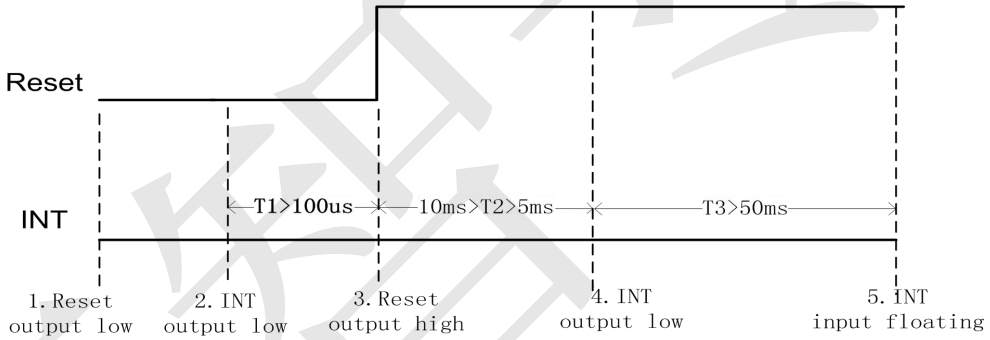
4.2 I²C address selection during power-on or reset process

GT5688 supports two I²C slave device addresses: 0xBA/0xBB and 0x28/0x29. Host needs to select the I²C slave address during power-on initialization or Reset process (via Reset pin). Host can select the I²C address by controlling Reset and INT timing sequence. Diagram below provides details:

Timing sequence for setting slave address to 0x28/0x29:



Timing sequence for setting slave address to 0xBA/0xBB:



4.3 Send Configuration after Power-on

During the power-on process, after host sets its INT as floating input, it is required to wait for 50ms before deciding whether to send the configuration. If request “0x01” is received, send the configuration; otherwise, it is unnecessary to do so.

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4.4 Host responds to the “INT Request”

1) Description on the Request Data

Data	Description
0x00	The ACK sent by host to touch IC
0x01	Request host to send configuration
0x03	Request host to reset GT5688
0xFF	Idle
Others	Reserved

2) Respond to Request “0x01”

a) If the interrupt is received and 0x814E=0, the host reads 0x8044 (“Request” register). “0x8044=0x01” indicates the request “0x01”.

b) Write the configuration parameters to the configuration area via I^2C (please refer to section 3.2).

c) Write a “0” to 0x8044 via I^2C. The implementation of request “0x01” is finished.

3) Respond to Request “0x03”

a) If the interrupt is received and 0x814E=0, the host reads 0x8044 (“Request” register). “0x8044=0x03” indicates the request “0x03”.

b) Reset GT5688 according to the Reset timing sequence. The implementation of request “0x03” is finished.

4.5 Register Value Modification

GT5688 supports Register Value Modification. When modifying any register in the configuration area (0x8050 ─ 0x813B) based on the timing sequence as specified in section 2, it is required to update Config_Chksum (0x813C/0x813D) and set Config_Fresh (0x813E) to 1 at the end. Otherwise, the modification is invalid; when modifying any registers outside configuration area, it is unnecessary to modify Config_Chksum and Config_Fresh.

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5. Coordinates Reading

GT5688 supports reading coordinate by periodic polling and interrupt request. To lighten the burden on the host, INT request is recommended.

When periodic polling is employed, the host reads coordinates through the following steps:

Based on the timing sequence specified in section 2, the host first reads register 0x814E.

a) If the data in buffer is ready (butter status= 1), it reads coordinate and touch key information based on finger touch number and touch key status.

b) If it is found out in step 1 that data in buffer is not ready (buffer status= 0), it will read again 1ms later.

The timing sequence for triggering an interrupt (take the rising-edge triggered interrupt for example; the timing for falling-edge triggered interrupt has the opposite INT waveform):

1) In standby mode, INT outputs low.

2) Drive INT from low to high (rising edge) when any coordinate is refreshed.

3) After the rising edge in step 2, INT will keep outing high until next period (the period is configurable by setting Refresh_Rate). The host is supposed to finish reading the coordinate as soon as possible and reset buffer status (0x814E) to 0.

a) If the host fails to finish reading the coordinates within one scan cycle, GT5688 will output one INT pulse again instead of update coordinates even if it the coordinate is refreshed.

b) GT5688 will not stop outputting INT pulse until the host reads the coordinate successfully.

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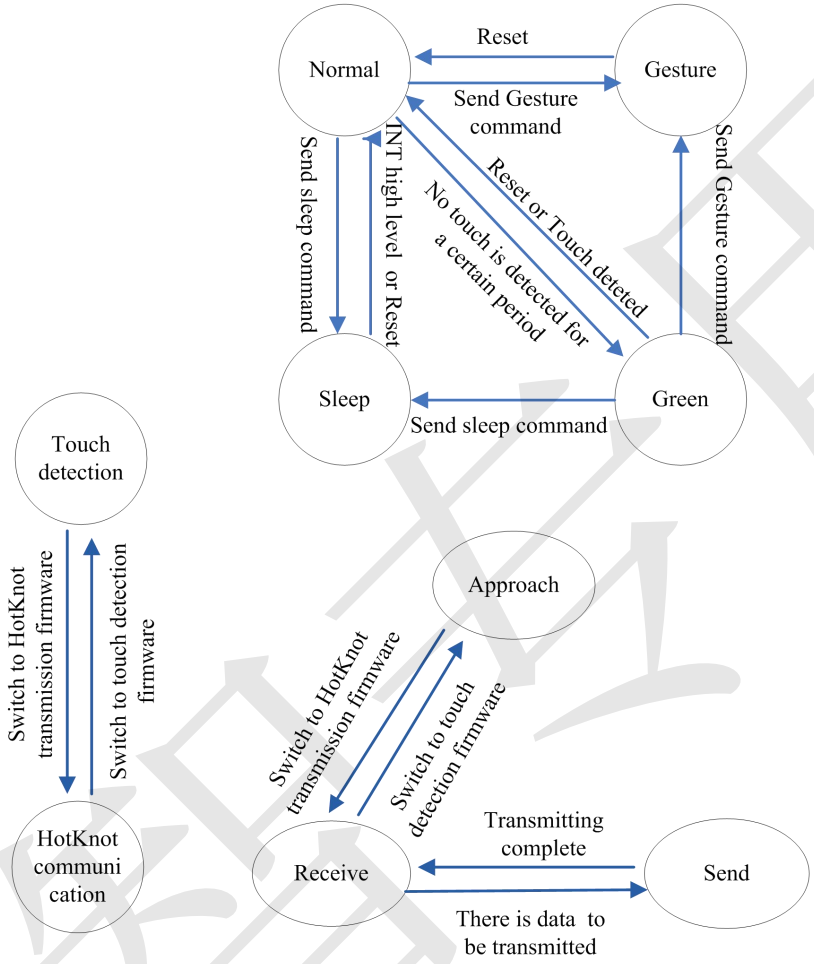
6. Operation Modes Transition



6.1 Normal Mode

When GT5688 is operating in Normal mode, its fastest coordinate refresh period is 5ms-20ms (subject to configuration. One step is 1ms).

6.2 Green mode

When no touch is detected for a certain period (0s~15s, subject to configuration; one step is 1s) in Normal mode, GT5688 will enter Green mode to reduce power consumption.

In Green mode, the scan period for GT5688 is about 40ms. It automatically enters Normal mode if any touch is detected.

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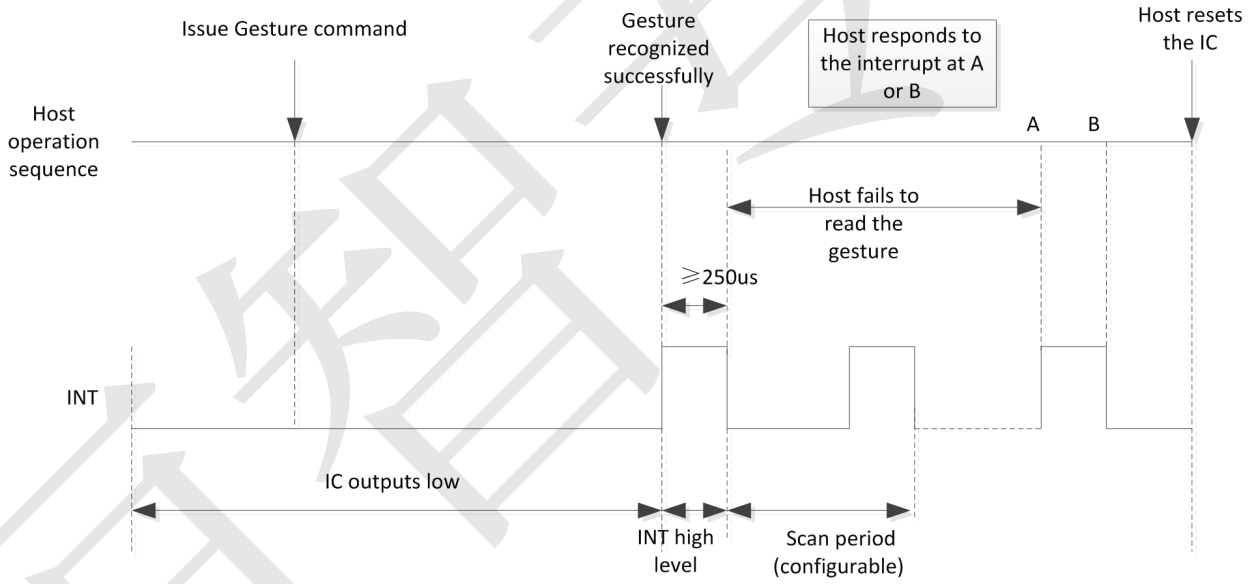
6.3 Gesture mode

After the host enables GT5688 to enter Gesture mode by sending corresponding I²C command, wake-up can be achieved by swipe, double-tap, or writing of specified letters on the touch panel (TP).

In Gesture mode, when GT5688 detects any finger swipe (for a sufficiently long distance), double-tap, writing of specified letters on the TP, INT will output a pulse for longer than 250us or keep output high/low (subject to configuration). The host will be awakened and turn on the screen after receiving such pulse or level.

The waveform of waking up the host by driving INT high:

(The INT low level wake-up presents a reversed waveform)



6.4 Sleep mode

GT5688 enters Sleep mode if it receives corresponding I²C command from the host (before sending the command, drive INT low or high or leave it floating according to the configuration). The host INT status is codetermined by external conditions and configuration to save power and ensure the INT of GT5688 serves as input pin in Sleep mode and the host can obtain high/low level by pulling INT up/down.

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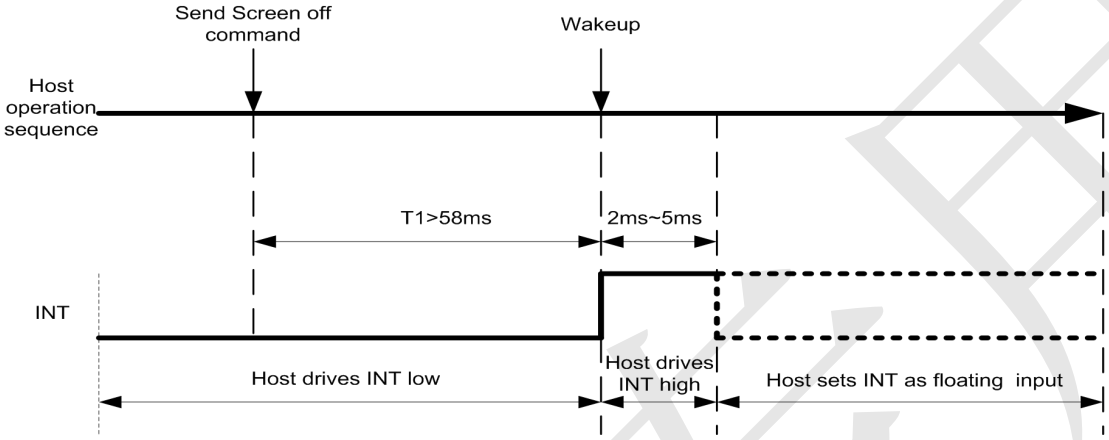
GT5688 exits Sleep mode and enters Normal Mode when the host drives INT high/low for 2ms~5ms. The time interval between issuing the screen-off command and wakeup should be longer than 58ms.

The diagram below illustrates the INT high level wake-up (the INT low level wake-up presents a reversed waveform):



6.5 Approach Mode

When GT5688 operates in Normal mode and Green mode, the host can send command 0x20 or 0x21 to enable GT5688 to enter Approach mode. In this mode, touch detection and HotKnot proximity detection alternate. If the host sends 0x21 to GT5688, GT5688 will work as a transmitting terminal and transmit signals with a specified pattern and frequency via Tx and Rx channels. Then, GT5688 detects whether there are feedback signals with the same specified pattern and frequency from the receiving terminal. This helps to determine whether any receiving terminal exists. If the host sends 0x20 to GT5688, GT5688 will work as a receiving terminal and detect signals with a specified pattern and frequency from the transmitting terminal. If such a signal is detected, GT5688 responds using signals with the specified pattern and frequency to the transmitting terminal. In Approach mode, when detecting any HotKnot-compatible terminal within the near-field range, GT5688 will notify the host via INT to capture status. To ensure reliable detection between the transmitting terminal and the receiving terminal, it is required to keep detecting for a minimum of 150ms after the two terminals have detected each other. Then the host sends HotKnot transmission firmware to enable GT5688 to enter Receive mode.

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6.6 Receive Mode

When GT5688 operates in Approach mode, after notified that GT5688 has successfully detected another HotKnot terminal, the host sends HotKnot transmission firmware to enable GT5688 to enter Receive mode. In Receive mode, GT5688 continues to detect frame start signal, once the signal is detected, GT5688 begins to detect and receive data. When the receiving process is complete, GT5688 verifies the data. If GT5688 finds erroneous data, the receiving process begins again. If the data is found to be correct, GT5688 notifies the host via INT to read data in the Receive Buffer.

6.7 Send Mode

When GT5688 works in Receive mode, the host sends outgoing data to the Transmit Buffer. When detecting that the Transmit Buffer is refreshed and there is data to be sent, GT5688 automatically switches from Receive mode to Send mode. In Send mode, GT5688 sends a frame start signal. If it detects ACK fed back from the receiving terminal, it continues to send the data signal. After sending a data chunk, GT5688 begins to detect ACK. If it does not detect any ACK or if it detects an erroneous ACK, GT5688 will resend the data chunk. If this resending fails over 5 times, it will resend the current data frame another time to the receiving terminal until the host enables GT5688 to exit Send mode due to timeout. If GT5688 detects ACK and sends the data successfully, it will automatically switch to Receive mode after the host completes the data processing or due to timeout.

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7. Host System Driver Modification in Gesture Mode

7.1 Enter Gesture mode after Screen-off

1) If screen-off is achieved by pressing Power key (or any other key), send Command 0x08, 0x00 and 0XF8 to 0x8040, 0x8041 and 0x8042 respectively;
2) If screen-off is achieved due to timeout, send Command 0x08, 0x00 and 0XF8 to 0x8040, 0x8041 and 0x8042 respectively;
3) When the screen is off, if there is swipe, double-tap or writing of specified letters on the touch panel, INT pin will output a pulse for longer than 250us (subject to configuration) to notify the host. The host reads the value of 0x814C after receiving such pulse. If the value meets wake-up conditions, the host wakes up and turns on the screen. Otherwise, the host resets 0x814C and waits for the next pulse.

7.2 Enter Sleep Mode after Screen-off

1) If screen-off is achieved by pressing Power key (or any other key), send Command 0x05, 0x00 and 0xFB to 0x8040, 0x8041 and 0x8042 respectively;
2) If screen-off is achieved due to timeout, send Command 0x05, 0x00 and 0XFB to 0x8040, 0x8041 and 0x8042 respectively;
3) In Sleep mode, the host can be awakened only by pressing power key (or home key).

7.3 Wake up the host by pressing power key (or home key)

If awakened by pressing power key (or home key) from any modes, the host will reset the IC according to the Reset timing.

7.4 Recommended to apply in conjunction with IR

If gesture wake-up function is applied in conjunction with IR, the host can enable GT5688 to enter Sleep mode to reduce power consumption when IR detects shielding object while screen-off. Otherwise, GT5688 enters Gesture mode. To enter different modes, use the methods described above (reset is required before sending command)

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8. Reading Coordinate in Gesture Mode

In Gesture mode, when 0x814C is not 0, the host can acquire the wakeup trajectory of user by reading the gesture features and gesture coordinates.

The gesture protocol type: the host obtains the gesture protocol type by reading the register 0x814E.

The supported protocol types are shown below:

Bit5~bit4（auxiliary information）:

0x01: Single-stroke gesture;

0x02: Multi-stroke gesture;

Others: NULL

Bit1~bit0 (Gesture coordinates):

0x02: Report all points;

0x03: Report feature points;

Others: NULL

Gesture auxiliary information: the host obtains the length of the auxiliary information by reading the register 0x814F and then acquires the auxiliary information by reading the registers from 0x8150 to 0x8170 according to the length.

Multi-stroke gesture breaking points: the end point of each stroke within a multi-stroke gesture. The sequence numbers of the strokes start from 0.

Gesture coordinates: the host obtains the number of coordinates of the gesture trajectory by reading the register 0x814D and then reads the registers from 0xA2A0 to 0xA39F according to the principle that every four registers correspond to one coordinate. By synthesizing the above information, the host obtains the accurate touch trajectory of user. The 16-bit checksums of the gesture trajectory are stored at 0x8171~0x8172.

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9. Revision History

Revision	Date	Description
Rev.00	2015-05-15	Preliminary version
Rev.01	2015-10-26	Initial release
Rev.01a	2015-12-25	Modified description on registers 0x8058, 0x8069, 0x806F, 0x80A0, 0x80A1, 0x80A2 and 0x8057.

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