Features

- Built in 5 full-swing/constant voltage drivers switched by serial control, three of those drivers being with brake function.
- Built in 1 constant current driver for shutter.
- Low on-resistance(1.25Ω, sum of on-resistance of upside and bottom side)
- Build-in thermal shutdown (TSD, $150℃$)
- CH1~CH4 corresponds to control of 2-2 phase or 1-2 phase.
- All power supply systems(VCC, VM1～4) can be set up with an independent power supply.
- Power save mode corresponds by serial control setup and exterior pin control.
- All initial serial control setting is set to "0", so IC can work if power save pin pulls high.
- The reference voltage, Vref, to be divided for exterior VC setup.
- VC can be setup in DAC from built-in voltage 1V.
- PI (photo interrapter drive) 2CH built-in. ON resistance change is possible.
- Small 40QFN ($6*6mm$) is adopted.

Applications

- Stepping motor driver/ DC motor driver motor driver for DSC

General Description

AT5557 is a 6-channel H-Bridge motor drivers IC for the digital camera and so on.

It has five full-swing/constant voltage drivers and one constant current driver. AT5557 can be operated in serial control mode or full exterior control mode. When operating in full exterior control mode, the mode of each CH is fixed by initial serial control setting. When operating in serial control mode, the mode of each driver can be setting by serial control.

Block Diagram

Aimtron reserves the right without notice to change this circuitry and specifications.

Pin Configurations

Top pins (left to right): VM1 (40), PI1 (39), IN12A (38), IN12B (37), IN12C (36), VC (35), VREF (34), IN6A (33), IN6B (32), VM4 (31)

Left pins (top to bottom):
OUT1A (1), OUT1B (2), OUT2A (3), OUT2B (4), PGND1 (5), PGND2 (6), OUT3A (7), OUT3B (8), OUT4A (9), OUT4B (10)

Right pins (top to bottom):
OUT6B (30), OUT6A (29), RNF (28), AGND (27), PS (26), VCC (25), SCLK (24), PGND3 (23), OUT5B (22), OUT5A (21)

Bottom pins (left to right): VM2 (11), PI2 (12), IN34A (13), IN34B (14), IN34C (15), SDAT (16), SLD (17), IN5A (18), IN5B (19), VM3 (20)

Center: AT5557

Ordering Information

Part number	Package	Marking
AT5557N_GRE	QFN-40, Green	☐☐☐☐

☐☐☐☐: **Date Code**

For more marking information, contact out sales representative directly

Pin Description

Pin NO.	Symbol	I/O	Description
1	OUT1A	O	H-bridge output terminal 1A of the constant voltage driver1
2	OUT1B	O	H-bridge output terminal 1B of the constant voltage driver1
3	OUT2A	O	H-bridge output terminal 2A of the constant voltage driver2
4	OUT2B	O	H-bridge output terminal 2B of the constant voltage driver2
5	PGND1	G	GND of Power VM1
6	PGND2	G	GND of Power VM2
7	OUT3A	O	H-bridge output terminal 3A of the constant current driver3
8	OUT3B	O	H-bridge output terminal 3B of the constant current driver3
9	OUT4A	O	H-bridge output terminal 4A of the constant current driver4
10	OUT4B	O	H-bridge output terminal 4B of the constant current driver4
11	VM2	P	Power supply for CH3, 4 motors
12	PI2	O	PI2 driver output
13	IN34A	I	CH3, 4 STM control
14	IN34B	I	CH3, 4 STM control
15	IN34C	I	CH3, 4 STM control
16	SDAT	I	Serial control signal
17	SLD	I	Serial control signal
18	IN5A	I	CH5 DCM control
19	IN5B	I	CH5 DCM control
20	VM3	P	Power supply for CH5 motor
21	OUT5A	O	H-bridge output terminal 5A of the constant voltage driver5
22	OUT5B	O	H-bridge output terminal 5B of the constant voltage driver5
23	PGND3	G	GND of Power VM3
24	SCLK	I	Serial control signal
25	VCC	P	Control power supply
26	PS	I	Power save which can force all outputs to become open state
27	AGND	G	GND
28	RNF	G	Current detection terminal for the constant current driver6
29	OUT6A	O	H-bridge output terminal 6A of the constant current driver6
30	OUT6B	O	H-bridge output terminal 6B of the constant current driver6
31	VM4	P	Power supply for CH6 motor
32	IN6B	I	CH6 control
33	IN6A	I	CH6 control
34	VREF	I	Reference voltage being divided for VC using
35	VC	I	VC
36	IN12C	I	CH1, 2 STM control
37	IN12B	I	CH1, 2 STM control
38	IN12A	I	CH1, 2 STM control
39	PI1	O	PI1 driver output
40	VM1	P	Power supply for CH1, 2 motors

Absolute Maximum Ratings

(Ta=+25°C)

Parameter	Symbol	Rated Value		Unit
		Min.	Max.	
Supply Voltage VCC	VCC	-0.5	+6.0	V
Supply Voltage VM1, 2, 3, 4	VM1, 2, 3, 4	-0.5	+6.0	V
Control Input Voltage	VIN	-0.5	VCC	V
Power Dissipation	Pd	-	1100	mW
Instantaneous Output Current	Iout	-	800	mA
Operating Temperature	Topr	-20	+85	℃
Junction Temperature	Tj	-	+150	℃
Storage Temperature range	Tstg	-55	+150	℃
Minimum ESD Rating (Human Body Model)	V_{ESD}	-	2	KV

1. **Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.**
2. **Device are ESD sensitive. Handling precaution recommended. The Human Body model is a 100pF capacitor discharged through a 1.5KΩ resistor into each pin.**

Recommended Operating Conditions

(Ta=+25°C)

| Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
Supply Voltage VCC	VCC	+2.5	-	+5.5	V
Supply Voltage VM1, 2, 3, 4	VM1, 2, 3, 4	+1.9	-	+5.5	V
Control Input Voltage	VIN	0	-	VCC	V
H-Bridge Output Current	Iout	-400		+400	mA
Logic Input Frequency	Fin	0		100	kHz

Electrical Characteristics

(T_a =+25℃, VCC = 3.3V, VM=5.0, unless otherwise noted.)

Parameter	Symbol	Condition	Values			Unit
			Min.	Typ.	Max.	
Circuit Current						
VCC Stand by Current	ICCST	RESET	-	1	5.0	μA
VM Stand by Current	IMST	RESET, (VM1+VM2+VM3+VM4)	-	1	5.0	μA
Circuit Current	ICC	PS=H; All input, PI1, PI2 open	-	0.6	2.0	mA
	IVM		-	0.6	2.0	mA
Power Save						
H Level Input Voltage	VPSH		2.0	-	-	V
L Level Input Voltage	VPSL		-	-	0.8	V
H Level Input Current	IPSH		-	5	20	μA
L Level Input Current	IPSL		-1	0	-	μA
Pull-down Resistance	RIN		-	1.5	-	MΩ
Control Input PIN/Serial Input PIN						
H Level Input voltage	VINH		2.0	-	-	V

L Level Input voltage	VINL		-	-	0.8	V
H Level Input current	INH		-	5	20	μA
L Level Input current	INL		-1	0	-	μA
Pull-down Resistance	RIN		-	1.5	-	MΩ
UVLO						
UVLO	VUVLO		1.7	2.0	2.3	V
Power-On-Reset Voltage	VRESET		0.8	1.6	2.4	V
Vref						
VREF Output Voltage	VREF	Iout=0 ~ 1mA	0.98	1.0	1.02	V
CH1~CH5 Divers						
Output ON Resistance	RON	Iout=+-200mA, Sum of on-resistance	-	1.25	1.8	Ω
Output Constant Voltage 1	Vout1	VC=1V (exterior VC setup), DAC: 4V, No-load	3.79	4.00	4.21	V
Output Constant Voltage 2	Vout2	VC=internal VC setup, DAC: 4V, No-load	3.79	4.00	4.21	V
CH6 Constant Current Driver						
Output ON Resistance	RON	Iout=+-200mA, Sum of on-resistance	-	1.25	1.8	Ω
Output Limit Voltage 1	VOL1	DAC=0.31V (exterior VC setup), RNF=1Ω, RM=5Ω	0.30	0.31	0.32	V
Output Limit Voltage 2	VOL2	VC=internal VC setup, RNF=1Ω, RM=5Ω	0.30	0.31	0.32	V
Serial Control						
SCLK frequency	fsclk		-	4.0	5.0	MHz
SLD setup time	Tsets		200	-	-	nS
SLD hold time	Tholds		100	-	-	nS
SLD negate time	Tnegs		200	-	-	nS
SDAT setup time	Tsetd		60	-	-	nS
PI Driver						
On Current 1	IPION1	It is referred as PI terminal voltage=2.2V after 200Ω setup	3.7	5.0	6.3	mA
On Current 2	IPION2	It is referred as PI terminal voltage=2.2V after 150Ω setup	5.8	7.5	9.2	mA
On Current 3	IPION3	It is referred as PI terminal voltage=2.2V after 100Ω setup	7.4	10.0	12.6	mA
On Voltage 4	VPION4	It is referred as Iout=20mA after 20Ω setup	-	0.4	0.5	V
It is leak current when OFF	Ioff	VCC PIOUT	-2.0	0	2.0	μA
TSD						
Thermal Shut Down Temperature	TTSD	Tip temperature in case H-bridge output turns OFF	-	150	-	°C
Note: Temperature Hysteresis 30°C						

1. Serial Data Input Setting
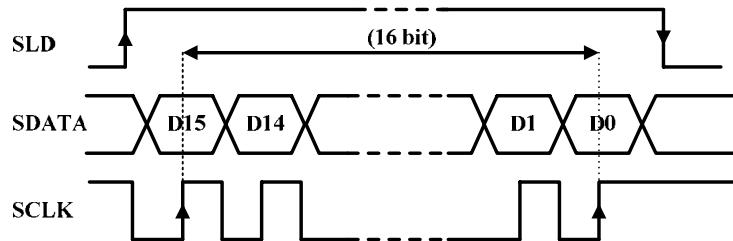
2. Serial Port Write Timing
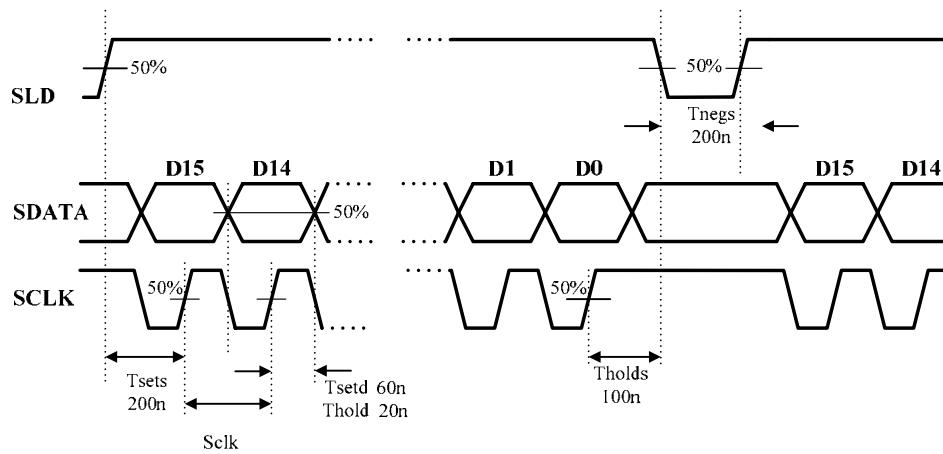
Input-Output Logic Table

1. Full Exterior Mode (PS PIN=H)

CH1~CH4: Stepping motor full-swing control

1-2 phase control mode truth value table

IN12A (IN34A)	IN12B (IN34B)	IN12C (IN34C)	OUT1A (OUT3A)	OUT1B (OUT3B)	OUT2A (OUT4A)	OUT2B (OUT4B)	CH1 (CH3)	CH2 (CH4)
H	H	L	H	L	H	L	forward rotation	forward rotation
L	H	H	Z	Z	H	L	OFF	forward rotation
L	H	L	L	H	H	L	reverse rotation	forward rotation
L	L	H	L	H	Z	Z	reverse rotation	OFF
L	L	L	L	H	L	H	reverse rotation	reverse rotation
H	L	H	Z	Z	L	H	OFF	reverse rotation
H	L	L	H	L	L	H	forward rotation	reverse rotation
H	H	H	H	L	Z	Z	forward rotation	OFF

2-2 phase control mode truth value table

IN12A (IN34A)	IN12B (IN34B)	IN12C (IN34C)	OUT1A (OUT3A)	OUT1B (OUT3B)	OUT2A (OUT4A)	OUT2B (OUT4B)	CH1 (CH3)	CH2 (CH4)
H	H	L	H	L	H	L	forward rotation	forward rotation
L	H	L	L	H	H	L	reverse rotation	forward rotation
L	L	L	L	H	L	H	reverse rotation	reverse rotation
H	L	L	H	L	L	H	forward rotation	reverse rotation

CH5: DC motor full-swing control

IN5A	IN5B	OUT5A	OUT5B	MODE
L	L	Z	Z	OFF
H	L	H	L	forward rotation
L	H	L	H	reverse rotation
H	H	L	L	brake

CH6: constant-current control for Shutter

IN6A	IN6B	OUT6A	OUT6B	MODE
L	L	Z	Z	OFF
H	L	H	L	forward rotation
L	H	L	H	reverse rotation
H	H	L	L	brake

< Notes >

Electric current in the OUTXA $\rightarrow$ OUTXB direction is being made (+) = forward rotation.

H: Hi level; L: Low level; Z: Hi impedance

2. Serial Control Mode

CH1~CH4: Stepping motor full-swing & constant-voltage control

1-2 phase control mode truth value table

IN12A (IN34A)	IN12B (IN34B)	IN12C (IN34C)	OUT1A (OUT3A)	OUT1B (OUT3B)	OUT2A (OUT4A)	OUT2B (OUT4B)	CH1 (CH3)	CH2 (CH4)
H	H	L	H	L	H	L	forward rotation	forward rotation
L	H	H	Z	Z	H	L	OFF	forward rotation
L	H	L	L	H	H	L	reverse rotation	forward rotation
L	L	H	L	H	Z	Z	reverse rotation	OFF
L	L	L	L	H	L	H	reverse rotation	reverse rotation
H	L	H	Z	Z	L	H	OFF	reverse rotation
H	L	L	H	L	L	H	forward rotation	reverse rotation
H	H	H	H	L	Z	Z	forward rotation	OFF

2-2 phase control mode truth value table

IN12A (IN34A)	IN12B (IN34B)	IN12C (IN34C)	OUT1A (OUT3A)	OUT1B (OUT3B)	OUT2A (OUT4A)	OUT2B (OUT4B)	CH1 (CH3)	CH2 (CH4)
H	H	L	H	L	H	L	forward rotation	forward rotation
L	H	L	L	H	H	L	reverse rotation	forward rotation
L	L	L	L	H	L	H	reverse rotation	reverse rotation
H	L	L	H	L	L	H	forward rotation	reverse rotation

CH6: Constant-current control for Shutter

CH6 IN/IN control mode truth value table

IN6A	IN6B	OUT6A	OUT6B	MODE
L	L	Z	Z	OFF
H	L	H	L	forward rotation
L	H	L	H	reverse rotation
H	H	L	L	brake

CH6 EN/IN control mode truth value table

IN6A	IN6B	OUT6A	OUT6B	MODE
L	-	Z	Z	OFF
H	L	H	L	forward rotation
H	H	L	H	reverse rotation

CH3~CH5: DC motor full-swing & constant-voltage control

DC motor drive by completeness serial control is possible. In combination with IN input, it corresponds also to a PWM drive.
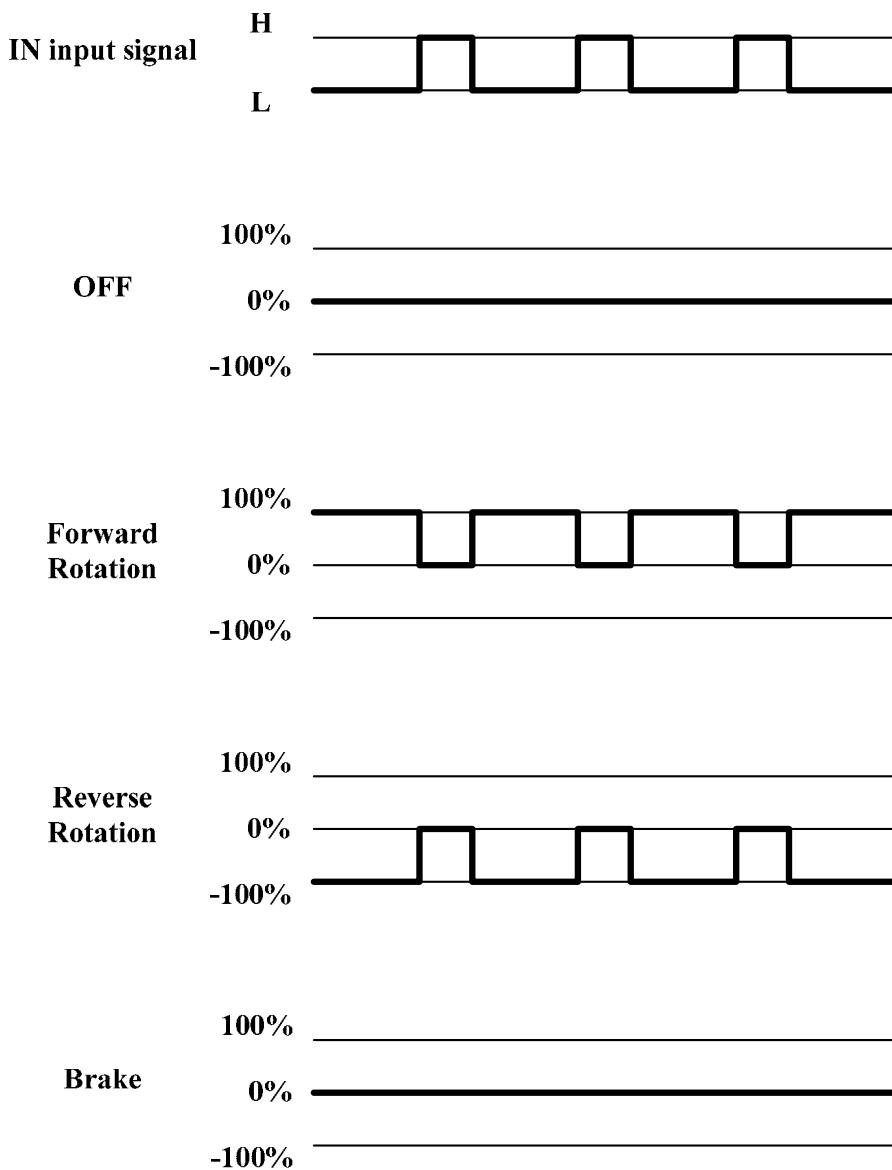
Serial Control Map

No	Contents	Address b15	b14	b13	Data B12	B11	B10	B9	B8	B7	B6	B5
1	Mode setup (Table1~Table8)	0	0	0	CH1, 2 Full swing/ constant voltage	CH3, 4 Full swing/ constant voltage	CH5 Full swing/ constant voltage	CH6 IN/IN EN/IN	CH3, 4 Simultaneous control	CH3, 4 STM/DCM	DCM input set up	CH5 control switch exterior/internal
2	CH1~CH4 Disable bit setup (Table9)	0	0	1	CH1, 2 Disable bit	CH3, 4 Disable bit						
3	CH1~CH5 DCA setup (Table10, 11)	0	1	0	CH1, 2 3bit DAC			CH3, 4 5bit DAC				
4	CH3 DCM control (Table12)	0	1	1	3CH DCM 2bit control							
5	CH4 DCM control (Table12)	1	0	0	4CH DCM 2bit control							
6	CH5 DCM control (Table12)	1	0	1	5CH DCM 2bit control							
7	PI setup (Table13, 14)	1	1	0	PI1 OFF/ON	PI2 OFF/ON	PI1 ON Resistance	PI2 ON Resistance				
8	PS/RESET (Table15, 16)	1	1	1	PS(Power save)							

	B4	B3	B2	B1	B0
	VC setup inside/exterior	CH6 4bit DAC			
CH5 5bit DAC					
RESET					

→ A mode setup, initial setting bit
→ Control bit
→ Motor drive control bit

< Notes >
(1) A setup of DAC is disregarded at the time of a full swing setup.
(2) CH3, 4 2bit control is disregarded at the time of a stepping motor setup.
(3) All initial setting after RESET release is set to "0".

Basic setting sequence	8	↓	1	↓	3	↓	2	↓	7	↓	4, 5, 6
	Power save release (Indispensable)		Mode initial setting (Indispensable)		Constant voltage setup (Arbitrary)		Disable control setup (Indispensable)		PI setup (Arbitrary)		CH3~CH5 DCM setup

Serial Setting Table

Address: < b15, b14, b13 > = < 0, 0, 0 > : (Table1～Table8)

Table1 → CH1~CH5 Output mode setup

b12		b11		b10	
0	1	0	1	0	1
Full swing	Constant voltage	Full swing	Constant voltage	Full swing	Constant voltage

Table2 → CH6 Control system setup

b9	
0	1
IN6A=IN IN6B=IN	IN6A=EN IN6B=IN

Table3 → CH3, 4 Simultaneous control of DC motor

b8	
0	1
CH3, 4 independent control	CH3, 4 simultaneous control

Table4 → CH3,4 The input terminal at the time of STM/DCM setup

b7	
0	1
STM	DCM
IN34A=A input	IN34A=CH3 PWM IN
IN34B=B input	IN34B= CH4 PWM IN
IN34C=C input	IN34C= CH5 PWM IN

Table5 → CH3~CH5 DCM incoming signal MODE setup

b6			
0		1	
Input=L	Input=H	Input=L	Input=H
Active	OFF	OFF	Active

Table6 → CH5 Control input setup

b5	
0	1
PIN IN5A/IN5B control	Serial control

Table7 → VC setup

b4	
0	1
Built-in VREF	Exterior VC

Table8 → CH6 DAC setup

b3	b2	b1	b0	RNF voltage value
0	0	0	0	310
0	0	0	1	300
0	0	1	0	290
0	0	1	1	280
0	1	0	0	270
0	1	0	1	260
0	1	1	0	250
0	1	1	1	240
1	0	0	0	230
1	0	0	1	220
1	0	1	0	210
1	0	1	1	200
1	1	0	0	190
1	1	0	1	180
1	1	1	0	170
1	1	1	1	160

Unit [mV]

Address: < b15, b14, b13 > = < 0, 0, 1 >: (Table9)

Table9 → Disable Bit setup

b12		b11	
0	1	0	1
CH1, 2 Disable	CH1, 2 Enable	CH3, 4 Disable	CH3, 4 Enable

Note: If PS PIN=H, this setup is disregarded.

Address: < b15, b14, b13 > = < 0, 1, 0 >: (Table10, 11)

Table10 → CH1, 2 DAC setup

b12	b11	b10	Constant voltage value
0	0	0	4.0
0	0	1	3.5
0	1	0	3.0
0	1	1	2.5
1	0	0	2.0
1	0	1	1.5
1	1	0	1.0
1	1	1	Prohibition of a setup

Unit [V]

Table11 → CH3~CH5 DAC setup

b9/b4	b8/b3	b7/b2	b6/b1	b5/b0	Constant voltage value
0	0	0	0	0	4.0
0	0	0	0	1	3.9
0	0	0	1	0	3.8
0	0	0	1	1	3.7
0	0	1	0	0	3.6
0	0	1	0	1	3.5
0	0	1	1	0	3.4
0	0	1	1	1	3.3
0	1	0	0	0	3.2
0	1	0	0	1	3.1
0	1	0	1	0	3.0
0	1	0	1	1	2.9
0	1	1	0	0	2.8
0	1	1	0	1	2.7
0	1	1	1	0	2.6
0	1	1	1	1	2.5
1	0	0	0	0	2.4
1	0	0	0	1	2.3
1	0	0	1	0	2.2
1	0	0	1	1	2.1
1	0	1	0	0	2.0
1	0	1	0	1	1.9
1	0	1	1	0	1.8
1	0	1	1	1	1.7
1	1	0	0	0	1.6
1	1	0	0	1	1.5
1	1	0	1	0	1.4
1	1	0	1	1	1.3
1	1	1	0	0	1.2
1	1	1	0	1	1.1
1	1	1	1	0	1.0
1	1	1	1	1	0.9

Unit [V]

Address: < b15, b14, b13 >

= < 0, 1, 1 > =CH3,   < 1, 0, 0 >=CH4, < 1, 0, 1 >=CH5: (Table12)

Table12 → CH3~CH5 Control of DC motor

b12	b11	MODE
0	0	OFF
1	0	Forward rotation
0	1	Reverse rotation
1	1	Brake

Address: < b15, b14, b13 > = < 1, 1, 0 >: (Table13, 14)

Table13 → PI ON/OFF setup

b12		b11	
0	1	0	1
PI1=OFF (output "Hi-Z")	PI1=ON (output "L")	PI2=OFF (output "Hi-Z")	PI2=ON (output "L")

Table14 → PI ON resistance

b10, b8	b9, b7	PI ON resistance
0	0	Full on (20 ohm)
0	1	100 ohm
1	0	150 ohm
1	1	200 ohm

Address: < b15, b14, b13 > = < 1, 1, 1 >: (Table15, 16)

Table15 → PS setup

b12	
0	1
Power Save	Active

Table16 → RESET setup

b0	
0	1
SET	RESET

Note: RESET clears itself and returns to an initial value.

Application1 (CH1, 2 STM, CH3, 4 STM, CH5 DCM, CH6 Shutter)
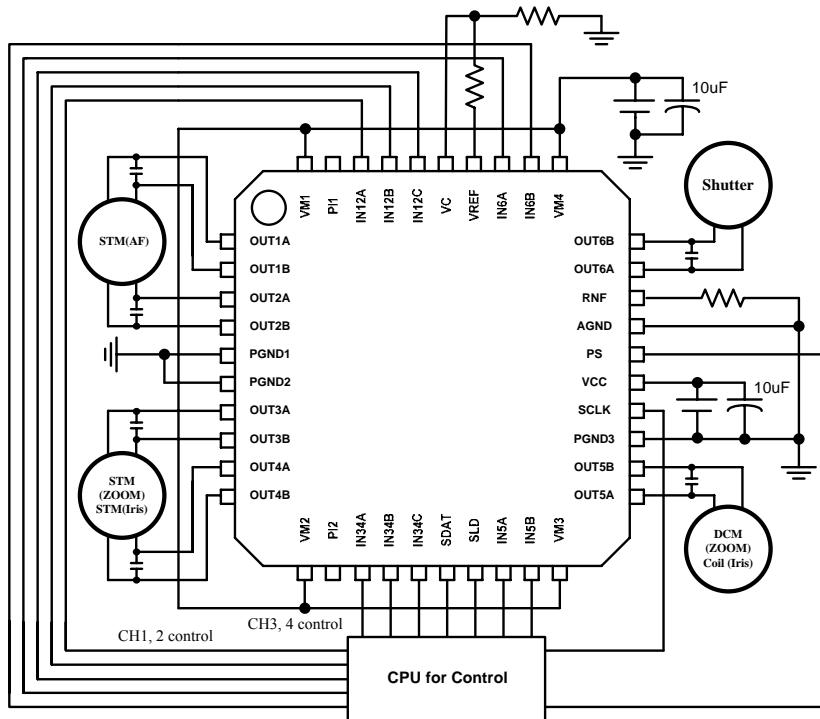
## Application2 (CH1, 2 STM, CH3, 4 STM, CH5 DCM, CH6 Shutter)

7F, No.9, Park Avenue II, Science-Based Industrial Park, Hsinchu 300,Taiwan, R.O.C.

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2/15/2006   REV:1.0   Email: service@aimtron.com.tw

17
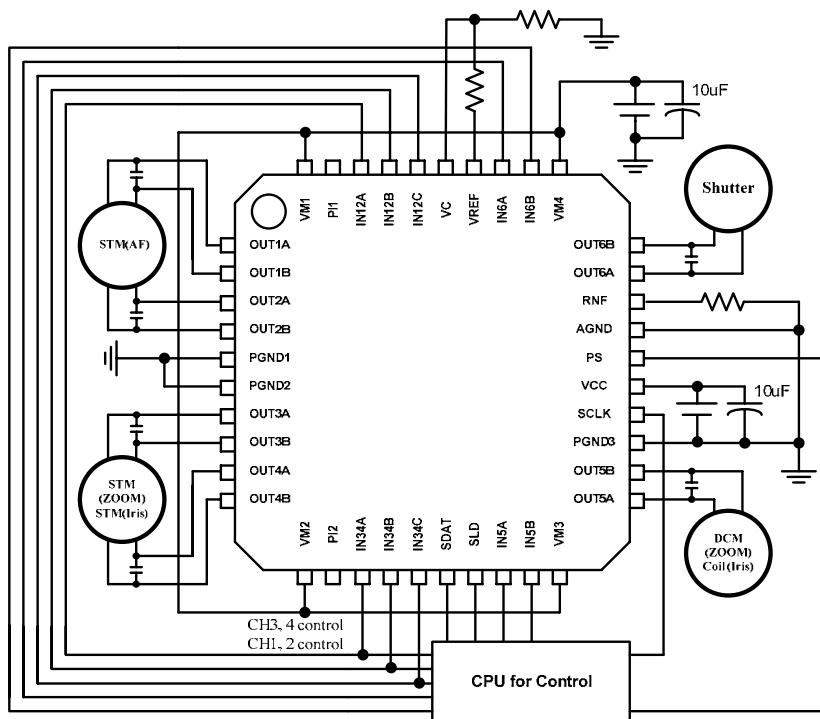
Application3 (CH1, 2 STM, CH3, 4 , 5 DCM, CH6 Shutter)

DCM control of CH3, 4, 5 is serial, and is set up.
The speed control by PWM drive is attained in
signal input at IN34A, IN34B, IN34C
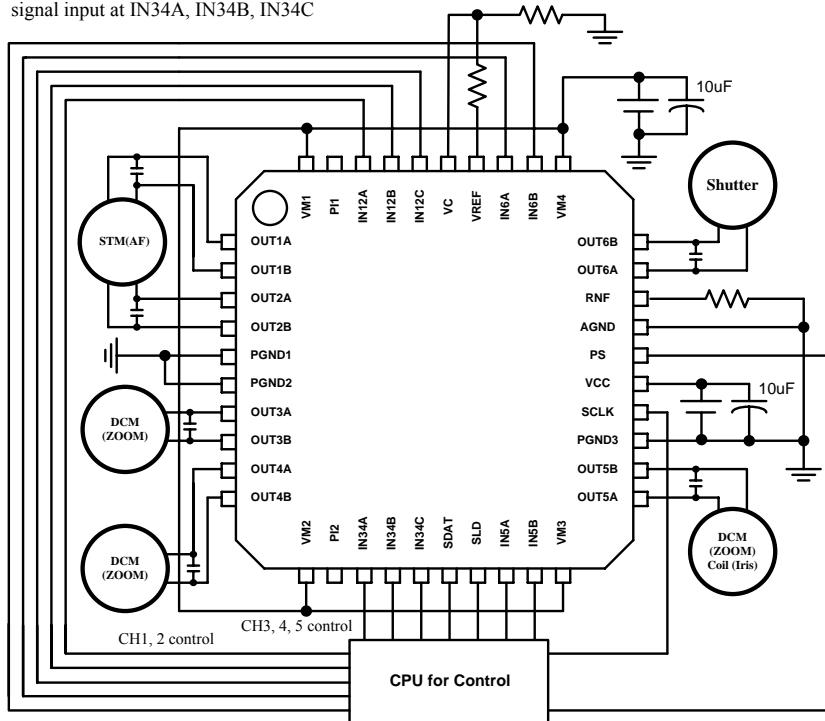
Application4 (CH1, 2 STM, CH3, 4 , 5 DCM, CH6 Shutter)

DCM control of CH3, 4, 5 is serial, and is set up.
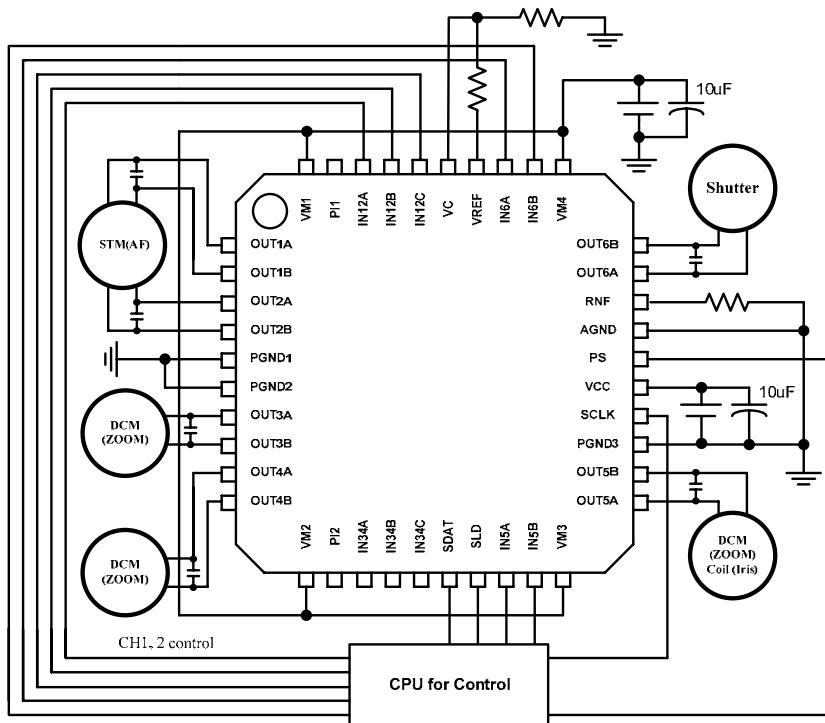
Package Outline (units:mm): QFN-40
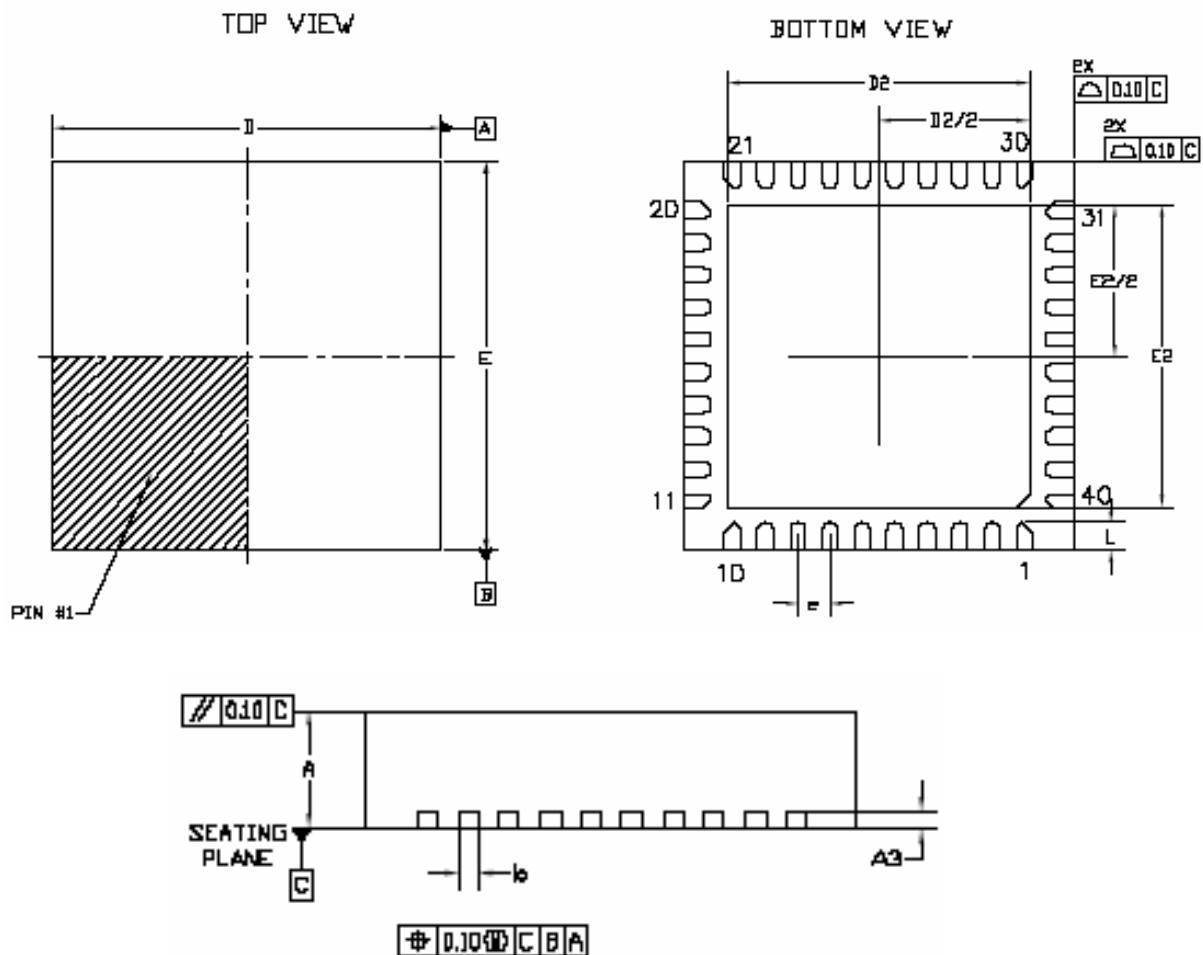
SYMBOL	COMMON					
	DIMENSIDNS MILLIMETER			DIMENSIDNS INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.7	0.75	0.8	0.027	0.029	0.031
A3	0.20 BSC.			0.008 BSC.		
b	0.18	0.25	0.30	0.007	0.010	0.012
D	5.925	6.000	6.075	0.233	0.236	0.239
D2	4.50	4.65	4.80	0.177	0.183	0.189
E	5.925	6.000	6.075	0.233	0.236	0.239
E2	4.50	4.65	4.80	0.177	0.183	0.189
e	0.50 BSC.			0.020 BSC.		
L	0.35	0.40	0.45	0.014	0.016	0.018

Reflow Profiles
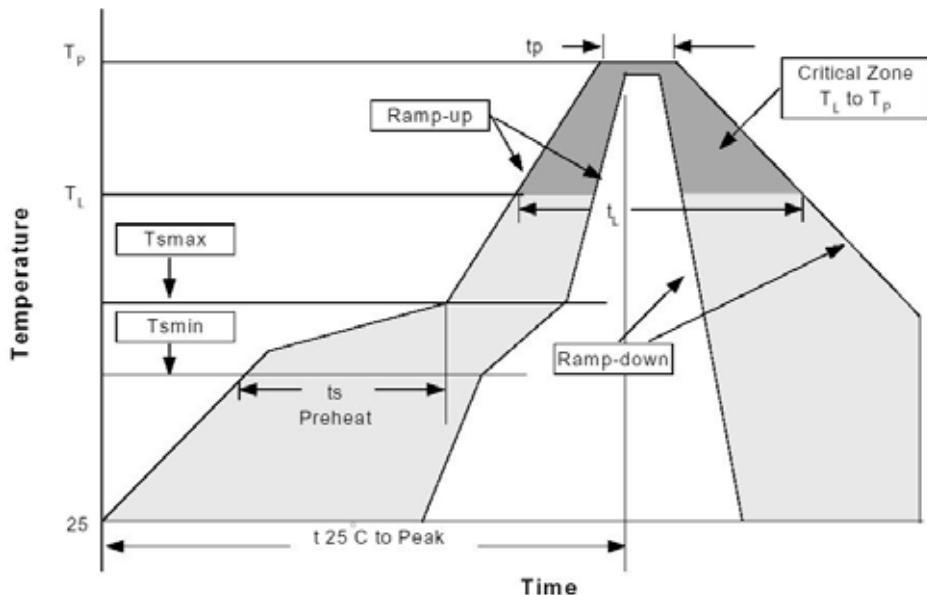
Profile Feature	Sn-Pb Eutectic Assembly		Pb-Free Assembly	
	Large Body Pkg. thickness ≥2.5mm or Pkg. volume ≥350mm^3	**Small Body Pkg. thickness <2.5mm or Pkg. volume <350mm^3**	**Large Body Pkg. thickness ≥2.5mm or Pkg. volume ≥350mm^3**	**Small Body Pkg. thickness ≥2.5mm or Pkg. volume ≥350mm^3**
Average ramp-up rate (T_L to T_P)	3° C/second max.		3° C/second max.	
Preheat -Temperature Min(Tsmin) -Temperature Max (Tsmax) -Time (min to max)(ts)	100° C 150° C 60-120 seconds		150° C 200° C 60-180 seconds	
Tsmax to T_L -Ramp-up Rate			3° C/second max.	
Time maintained above: -Temperature (T_L) -Time (t_L)	183° C 60-150 seconds		217° C 60-150 seconds	
Peak Temperature(T_P)	225+0/-5° C	240+0/-5° C	245+0/-5° C	250+0/-5° C
Time within 5° C of actual Peak Temperature (t_P)	10-30 seconds	10-30 seconds	10-30 seconds	20-40 seconds
Ramp-down Rate	6° C/second max.		3° C/second max.	
Time 25° C to Peak Temperature	6 minutes max.		8 minutes max.	

*All temperatures refer to topside of the package, measured on the package body surface.