



FS9912_LCS2

FS9912 standard code for 3,000 counts low cost scale application.

Data Sheet

TD-0405004

Rev. 1.4

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Table of Contents

	Page
1. FEATURES.....	3
2. BLOCK DIAGRAM	3
3. PIN DIAGRAM.....	4
4. PIN DESCRIPTION	6
5. ELECTRICAL CHARACTERISTICS.....	6
6. TYPICAL APPLICATION CIRCUIT	7
7. CALIBRATION SETTINGS.....	7
8. OPERATION FUNCTIONS	8
8.1 Power-on Self-Checking Procedures:	8
8.2 Display:.....	8
8.3 ZERO Reset and ZERO Point Tracing	8
8.4 ON/OFF Key	9
8.5 ON/ZERO/(TARE)/OFF Key	9
8.6 TARE Key	9
8.7 MODE Key.....	9
8.8 Net/Gross (SetPcs) Key	9
8.9 RS232 transmission specification:.....	9
9. LCD DISPLAY	11
10. CALIBRATION FLOW	12
11. PARAMETER SETTINGS	13
11.1 93C46 memory plan	13
11.2 Default Parameter list	13
11.3 Description:.....	14
12. IC REVISION HISTORY TABLE	16
13. PACKAGE OUTLINE.....	17
14. ORDERING INFORMATION.....	18

1. Features

- 1) ADC displays 3 times per sec.
- 2) 4 x 1.5V (or 3 x 1.5V) battery.
- 3) Current consumption of the chip is less than 2mA. Current consumption of the scale system (e.g. 400Ω Load Cell) can be controlled to be less than 5mA through program skill.
- 4) In Sleep Mode, chip current consumption is less than 1uA and the system current consumption (add low-voltage detecting circuit) is less than 5uA.
- 5) 1/3 bias, 1/4 duty 4 x 16 LCD driver circuit (3V Vpp).
- 6) 14-bit ADC resolution; scale external display accuracy: settable, maximum accuracy is 6553; default accuracy is 2000.
- 7) SCALE: 2000g/1g (default), 2000g/1g (default), weight/verification-scale-interval is settable.
- 8) Sleep Mode (auto turn off). If the scale is at Same Display in 2 minutes (default, time is settable), the system will turn off.
- 9) Key functions: ON/OFF, ON/Zero/(Tare)/OFF, Tare, Mode and Net/Gross (SetPCS).
- 10) Scale unit: g, Kg, Lb, oz, Catty (Taiwanese Kg), Tale (tl.T, Taiwanese Hg), ...(settable, 3 units for switching at most).
- 11) Data transmission: RS232 2400bps (Data bit: 8, Parity: none).
- 12) 2.7KHz/4KHz (settable) Buzzer output.
- 13) Power low detecting (Detected when power on).
- 14) Back-Light control output, automatically turned off in 15 seconds (default, time is settable).
- 15) Package: dice form, 64-pin LQFP

2. Block Diagram

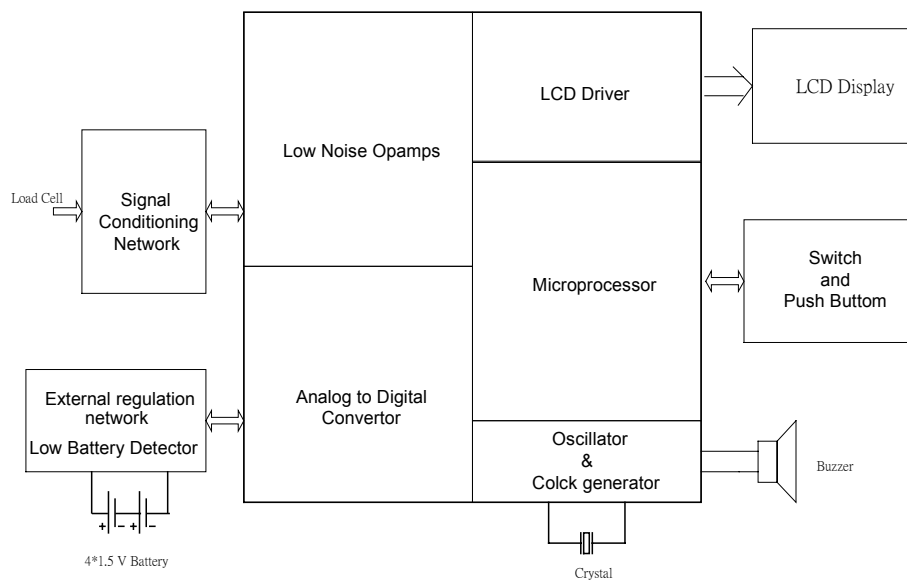


Figure 1 FS9912_LCS2 Top Block Diagram

3. Pin Diagram

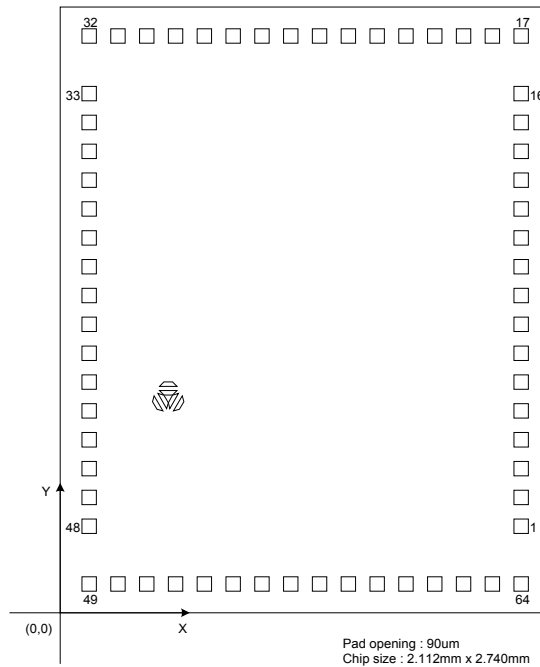
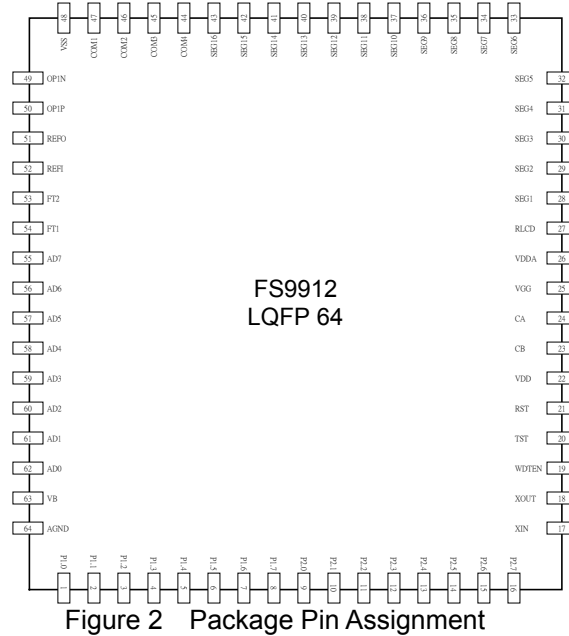


Figure 3 Diagram of Pad Layout (Substrate should be connected to VSS)

Pad Coordinate

Pad No.	Name	X[mm]	Y[mm]	Pad No.	Name	X[mm]	Y[mm]
1	P1.0	2.035	0.385	33	SEG6	0.077	2.320
2	P1.1	2.035	0.525	34	SEG7	0.077	2.180
3	P1.2	2.035	0.665	35	SEG8	0.077	2.040
4	P1.3	2.035	0.790	36	SEG9	0.077	1.915
5	P1.4	2.035	0.915	37	SEG10	0.077	1.790
6	P1.5	2.035	1.040	38	SEG11	0.077	1.665
7	P1.6	2.035	1.165	39	SEG12	0.077	1.540
8	P1.7	2.035	1.290	40	SEG13	0.077	1.415
9	P2.0	2.035	1.415	41	SEG14	0.077	1.290
10	P2.1	2.035	1.540	42	SEG15	0.077	1.165
11	P2.2	2.035	1.665	43	SEG16	0.077	1.040
12	P2.3	2.035	1.790	44	COM4	0.077	0.915
13	P2.4	2.035	1.915	45	COM3	0.077	0.790
14	P2.5	2.035	2.040	46	COM2	0.077	0.665
15	P2.6	2.035	2.180	47	COM1	0.077	0.525
16	P2.7	2.035	2.320	48	VSS	0.077	0.385
17	XIN	2.035	2.663	49	OP1N	0.077	0.077
18	XOUT	1.885	2.663	50	OP1O	0.225	0.077
19	WDTEN	1.745	2.663	51	REFO	0.365	0.077
20	TST	1.620	2.663	52	REFI	0.490	0.077
21	RST	1.495	2.663	53	FT2	0.615	0.077
22	VDD	1.370	2.663	54	FT1	0.740	0.077
23	CB	1.245	2.663	55	AD7	0.865	0.077
24	CA	1.120	2.663	56	AD6	0.990	0.077
25	VGG	0.995	2.663	57	AD5	1.115	0.077
26	VDDA	0.870	2.663	58	AD4	1.240	0.077
27	RLCD	0.745	2.663	59	AD3	1.365	0.077
28	SEG1	0.620	2.663	60	AD2	1.490	0.077
29	SEG2	0.495	2.663	61	AD1	1.615	0.077
30	SEG3	0.370	2.663	62	AD0	1.740	0.077
31	SEG4	0.230	2.663	63	VB	1.880	0.077
32	SEG5	0.082	2.663	64	AGND	2.035	0.077

4. Pin Description

Name	In/Out	Pin No	Description
P1.0~P1.7	I/O	1~8	I/O Port 1
P2.0~P2.7	I/O	9~16	I/O Port 2
XIN	I	17	4MHz Oscillator Input
XOUT	O	18	4MHz Oscillator Output
WDTEN	I	19	Watchdog Timer Enable Control
TST	I	20	Testing Mode
RST	I	21	CPU Reset
VDD	I	22	Positive Power Supply
CB	I/O	23	Charge Pump Capacitor Negative Connection
CA	I/O	24	Charge Pump Capacitor Positive Connection
VGG	I/O	25	Charge Pump Voltage
VDDA	I/O	26	Analog Power Output
RLCD	I/O	27	LCD Bias Voltage Input
SEG1~SEG16	O	28~43	LCD Segment Driver Output
COM4~COM1	O	44~47	LCD Common Driver Output
VSS	I	48	Negative Power Supply (Ground)
OP1N	I	49	OPAMP 1 Negative Input
OP1O	I	50	OPAMP 1 Output
REFO	O	51	Band gap Reference Output
REFI	I	52	ADC Reference Voltage Input
FT2, FT1	I/O	53,54	ADC Pre-Filter Capacitor Connection
AD7~AD0	I	55~62	Analog Input Channel
VB	I	63	Analog Circuit Bias Current Input
AGND	I/O	64	Analog Ground

5. Electrical Characteristics

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage to Ground Potential	-0.3 to 5.0	V
Applied Input/Output Voltage	-0.3 to VDD+0.3	V
Ambient Operating Temperature	0 to +70	°C
Storage Temperature	-55 to +150	°C
Soldering Temperature, Time	260°C, 10 Sec	

6. Typical Application Circuit

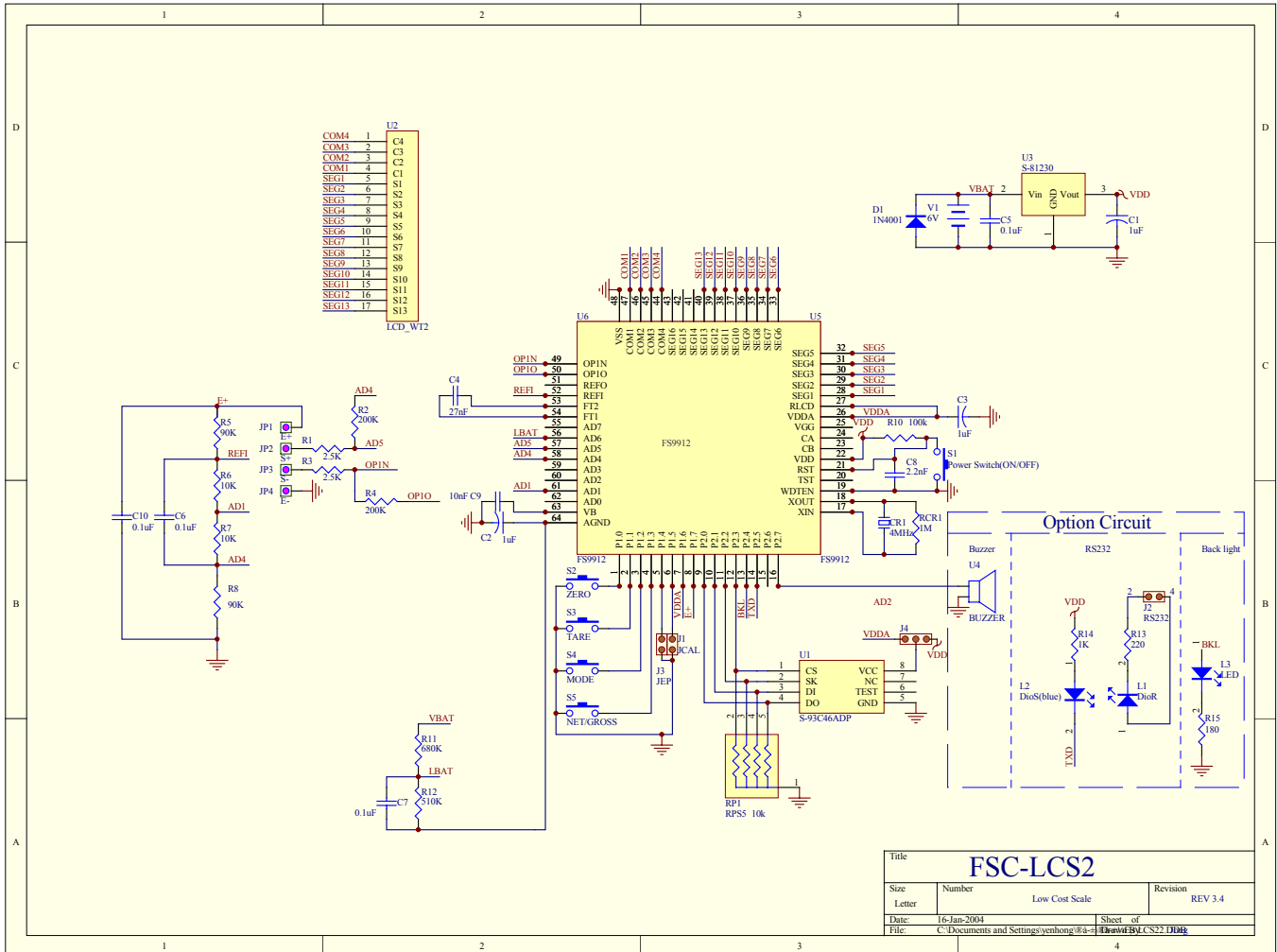


Figure 4 FSC9912_LCS2 Application Circuit Diagram

7. Calibration Settings

JCAL(PT1.5): Calibration procedure: When the system is on, press Zero button and hold (>3sec), then the system is in calibration process. When the system is off, the system cannot be calibrated.

Auto-calibration	ON	OFF
JCAL	1	0

“1” means related Jumper short circuit; “0” means related Jumper open circuit.

8. Operation Functions

8.1 Power-on Self-Checking Procedures:

- All LCD signals light up when power on; the system is processing zero reset. If the zero point is not stable, it displays "Unst".
- TEST EEPROM(93c46): If there is no EEPROM or after changing EEPROM without recalibration or data loss (ChkSum error), it will display "ErrE" and the system automatically turns off 30 seconds later. If there is no parameter setting value in calibration, it will act with default value automatically and write the value into EEPROM.
- Power-on zero resetting range: <20%F.S. (default, can be set); if it is out of range, it displays "outZ".
- Power on low voltage detecting: The first low voltage is about vbat=3.6V (Voltage detection is settable. Please refer to section "Parameter Settings"). In this situation, a low voltage symbol is displayed and the scale still functions normally. Second low voltage is about vbat=3.5V (Active/disable and voltage detection are settable. Please refer to section "Parameter Settings"), the system will display a low voltage symbol, but the scale can not function and will automatically turn off 30 seconds later.

8.2 Display:

- Display the limit of weight range: maximum weight = max. weight + 9d. The system displays "EEEEEE" when overload.
- If the weight is less than 0, the value is displayed with a negative sign.
- Power low: When battery is low, the display shows a battery symbol.
- Zero symbol (ZERO): When scaled zero, the system displays ZERO.
- Tare symbol (TARE): When the scale is in tare situation, the system displays TARE. In this situation, ZERO cannot be displayed. After tare and remove the tare object to make the scale empty (ZERO and TARE displayed at the same time), the TARE symbol will be cleared if TARE key is pressed.
- A/DC output range testing: if the result is lower than the A/DC resolution range, it displays "LLLLL"; if the result is beyond the A/DC resolution range, it displays "HHHHH". The purpose of this test is when the input signal being abnormal, the system can detect the problem (such as Load Cell damaged).

8.3 ZERO Reset and ZERO Point Tracing

- Zero point tracing means to trace the initial zero point, and only works under the display value being zero. Correction speed is settable.
- Range of zero point tracing: The sum of zero reset and zero point tracing must not be over 4% (default, settable) F.S. of the maximum scale.

8.4 ON/OFF Key

- Press the key to turn off during system is in power on status. (Turn off)
- Press the key to turn on during system is in power off status. (Turn on)

8.5 ON/ZERO/(TARE)/OFF Key

- Press the key to turn on during system is in power off status. (Turn on)
- Zero (default): If the weight is less than 4% (default, settable) F.S., the system will do zero reset. Otherwise the system acts nothing.
- Zero/Tare Integration: If the weight is less than 4% (default, settable) F.S., the system will do zero reset. If it is over the range of zero reset, the system will do Tare action.
- Press the key (>3sec) to turn off during system is in power on status. (Turn off)

8.6 TARE Key

- When the system is on, press this key, and the system will operate TARE function.
- The effect of TARE: The scale weight display = maximum scale – amount of tare. For example: the maximum scale of a scale is 2kg and the TARE amount is 1kg, the scale will display 1kg + 9d.
- No TARE for negative value

8.7 MODE Key

- Press this key to switch the weight unit in the power on status. (Unit 1 -->Unit 2 -->Unit 3 -->Pcs(Unit 4)).
- Mode Memory Function: When power off, the system will memory the current mode. When power on next time, the mode will be same as before power off last time.
- 1 oz = 28.349523125g. 1 Catty = 600g.

8.8 Net/Gross (SetPcs) Key

- The function is to switch net weight and gross weight in general status. In Pcs status, push the SetPcs key, and it will switch sequentially S= 10, S= 20, S= 50, S=100, which means samples setup. Then push the “Mode” key, the LCD displays “CAL” that means the system is sampling.

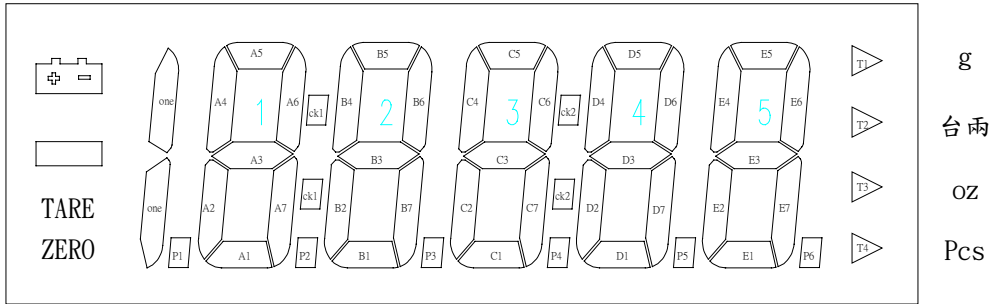
8.9 RS232 transmission specification:

- The first character is symbol code (ASCII code 30~3fh). Bit 0 means “ZERO” symbol, bit 1 means “TARE” symbol, bit 2 means “-“symbol, and bit 3 means battery symbol.



- The second, ninth, and twelfth characters are space characters.
- The third to eighth characters are values (ASCII code).
- The tenth character is the first decimal symbol code (ASCII code "1" means integer, "2" means decimal one, "4" means decimal two, "8" means decimal three, "16" means decimal four.) The twelfth character is the second decimal symbol code ("0" means none, "1" means the decimal exist.)
- Other messages mean transmission ASCII code directly. For example, "unSt", "outZ", "ErrE", "EEEE",

9. LCD Display

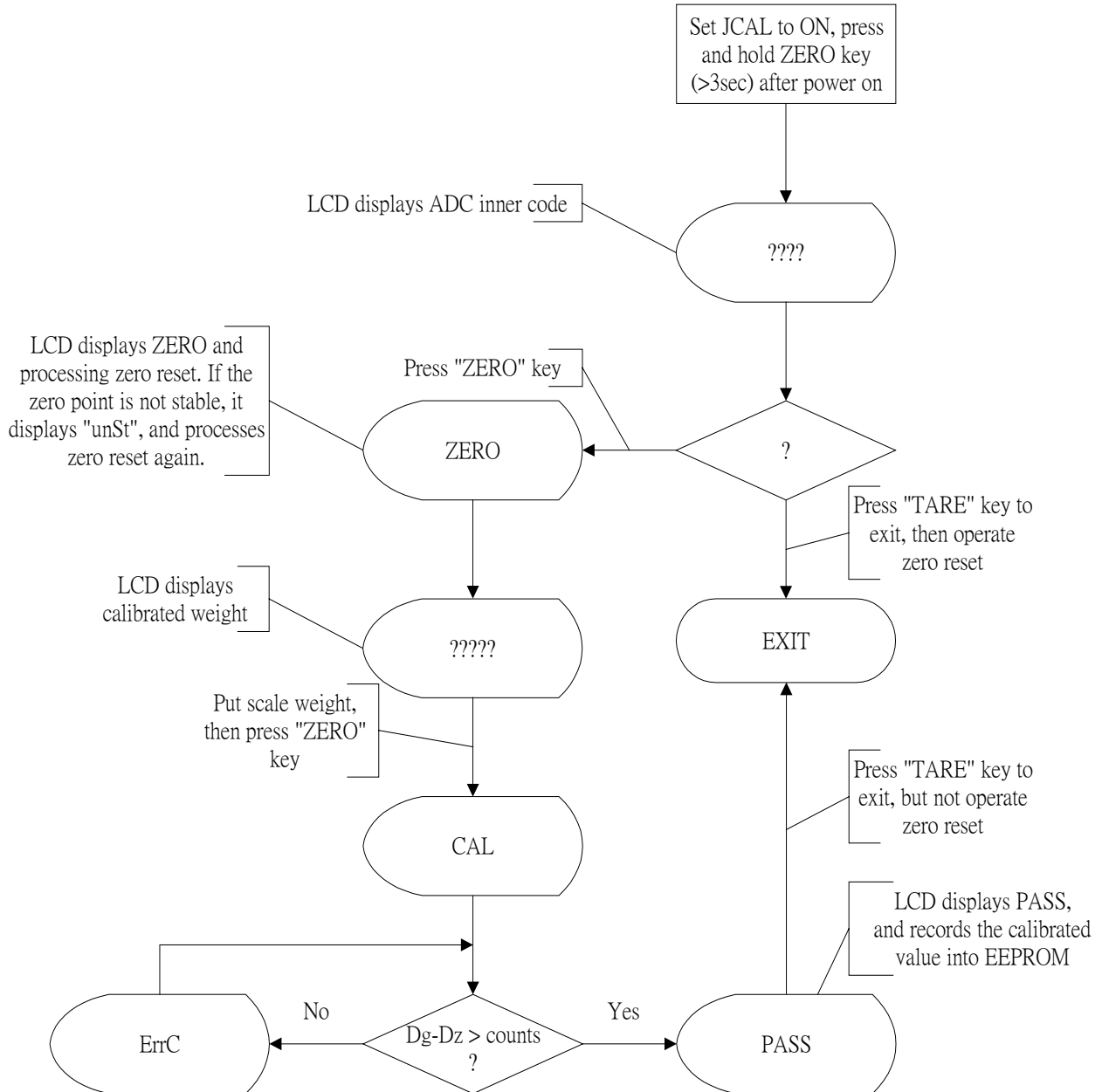
- LCD DISPLAY



- LCD DISPLAY FORMAT

	COM1	COM2	COM3	COM4
SEG1	ZERO	TARE		
SEG2	P1	ck1	ck2	one
SEG3	A1	A2	A3	A4
SEG4	P2	A7	A6	A5
SEG5	B1	B2	B3	B4
SEG6	P3	B7	B6	B5
SEG7	C1	C2	C3	C4
SEG8	P4	C7	C6	C5
SEG9	D1	D2	D3	D4
SEG10	P4	D7	D6	D5
SEG11	E1	E2	E3	E4
SEG12	P6	E7	E6	E5
SEG13	T4	T3	T2	T1

10. Calibration Flow



11. Parameter Settings

11.1 93C46 memory plan

Address	Define	Address	Define	Address	Define	Address	Define
00H		10H	W_unit1	20H	calResL	30H	E_flag4
01H		11H	W_unit2	21H	calResH	31H	
02H	5a	12H	W_unit3	22H	W_ch2L	32H	Res4L
03H	a5	13H	Res1L	23H	W_ch2M	33H	Res4H
04H	DzsL	14H	Res1H	24H	W_ch2H	34H	W_min4
05H	DzsH	15H	Res2L	25H	W_ch3L	35H	W_point4
06H	DgL	16H	Res2H	26H	W_ch3M	36H	W_ch4L
07H	DgH	17H	Res3L	27H	W_ch3H	37H	W_ch4M
08H	5a	18H	Res3H	28H	apo_numL	38H	W_ch4H
09H	a5	19H	W_min1	29H	apo_numH	39H	
0aH	DzsL	1aH	W_min2	2aH	P_gainL	3aH	Lb1L
0bH	DzsH	1bH	W_min3	2bH	P_gainM	3bH	Lb1H
0cH	DgL	1cH	W_point1	2cH	P_gainH	3cH	Lb2L
0dH	DgH	1dH	W_point2	2dH	E_flag1	3dH	Lb2H
0eH	55	1eH	W_point3	2eH	E_flag2	3eH	
0fH	aa	1fH	BackLi	2fH	E_flag3	3fH	

11.2 Default Parameter list

Address	Define	Address	Define	Address	Define	Address	Define
00H		10H	8f	20H	d0	30H	00
01H		11H	5f	21H	07	31H	
02H		12H	2f	22H	88	32H	
03H		13H	20	23H	88	33H	
04H		14H	4e	24H	08	34H	
05H		15H	ae	25H	a4	35H	
06H		16H	29	26H	49	36H	
07H		17H	80	27H	0b	37H	
08H		18H	3e	28H	04	38H	
09H		19H	01	29H	01	39H	
0aH		1aH	05	2aH	00	3aH	
0bH		1bH	05	2bH	00	3bH	
0cH		1cH	01	2cH	00	3cH	
0dH		1dH	04	2dH	08	3dH	
0eH	55	1eH	04	2eH	41	3eH	
0fH	aa	1fH	0f	2fH	20	3fH	

11.3 Description:

- 5a and a5: Calibration determined parameter. Without this parameter, the system is treated as no calibration.
- DzsL and DzsH: Calibrate Zero point.
- DgL and DgH: Calibrate Load point.
- 55 and aa: Parameter sets parameter. Without this parameter, it would be taken as no parameter set.
- W_unit1, W_unit2, and W_unit3: Parameter for unit set. The default value is 8fh, 5fh, and 2fh respectively. Bits 0~3 of these three values must be corresponded.

bit	7	6	5	4	3	2	1	0
W_unit	unitL1	unitL2	unitL3	unit_hex	unitL1en	unitL2en	unitL3en	Pcs_en

unitL1: 1 means the Lcd triangle spot T1 is on.

unitL2: 1 means the Lcd triangle spot T2 is on.

unitL3: 1 means the Lcd triangle spot T3 is on.

unit_hex: 1 means if hex is represented in the set unit, such as pound, or ounce.

unitL1_en, unitL2_en, and unitL3_en: 1 means enable of the corresponding unit switch.

Pcs_en: 1 means there are simple calculating functions.

- Res1L and Res1H: Main Unit maximum counts (x10).
- Res2L and Res2H: Second Unit maximum counts (x10).
- Res3L and Res3H: Third Unit maximum counts (x10).
- W_min1: Main Unit minimum resolution. Default value is 1. 1, 2, 5, 10, 20, 50, 100, 200.
- W_min2: Second Unit minimum resolution. Default value is 5.
- W_min3: Third Unit minimum resolution. Default value is 5.
- W_point1, W_point2, and W_point3: Unit decimal point position. Default values are 1, 4, and 4 respectively.
Integer: 1
Decimal one: 2
Decimal two: 4
Decimal three: 8
Decimal four: 16
- BackLi: Back-Light time setup. 1~255 seconds, 0 means 256 seconds. Default value is 15.
- CalResH and CalResL: Main unit calibration counts. Default value is 07d0h(2000).
- W_ch2H, W_ch2M, and W_ch2L: Parameters for Main Unit switch to Second Unit.
- W_ch3H, W_ch3M, and W_ch3L: Parameter for Main Unit switch to Third Unit parameter.
- apo_numH and apo_numL: Sleep time setup. 0082h means about 1 minute. Default value is 0104h.
- P_gainH, P_gainM, and P_gainL: Pcs simple calculation gain value.
- E_flag1: Default value is 00001000b.

bit	7	6	5	4	3	2	1	0
E_flag1	Sym	Lbatf	openU1	openU0	auto_zero3	auto_zero2	auto_zero1	auto_zero0

auto_zero[3:0]: Auto zero tracing speed control. Default value is 8.

openU[1:0]: Power On Unit, 00: Main Unit, 01: Second Unit, 10: Third Unit, 11: Simple Calculation.

Lbatf: Enable of the second low voltage enforces turning off. When vbat=3.5V ± 5%, the system only displays low voltage symbol.

Sym: change LCD symbol, 0: "one" (com4, seg2), "ck2" (com3, seg2); 1: "one" (com3, seg2), "ck2" (com4, seg2).

- E_flag2: Default value is 01000001b.

bit	7	6	5	4	3	2	1	0
E_flag2	zero3	zero2	zero1	zero0	ChopFreq	BeepFreq	Hys_num1	Hys_num0

Zero [3:0]: range of Key zero reset and zero point tracing, 0~15%.

ChopFreq: opamp Chopper Freq. 0: 2KHz, 1: 1KHz.

BeeperFreq: Buzzer output frequency. 0: 2.7KHz, 1: 4.0KHz.

Hys_num[1:0]: hysteresis range setup. 00: ± 0.1 , 01: ± 0.2 , 10: ± 0.3 , 11: ± 0.4 . The hysteresis range is mainly for adding the stability of value. This value means to ignore the output if instant change does not exceed the set value. The Unit is external resolution (Counts).

- E_flag3: Power on zero reset range setup, 1~100%. Default value is 20.
- E_flag4: Default value is 00000000b.

bit	7	6	5	4	3	2	1	0
E_flag4	D_power	Z/T	off_RS232	WU4_en	no_Z	M_Hold	no_bat	bat_l

D_power: Cancel save power mode. No switch when measuring Load Cell power. Consumption current increased, but scale stability promoted.

Z/T: Combination of Zero Key and Tare Key.

off_RS232: Cancel RS232 transmission.

no_Z: No zero reset when power on and take directly calibrated zero point as zero point.

M_Hold: Hold maximum displayed value. Press any key to cancel. Cancel temporarily during return zero.

no_bat: No low battery detection when power on. Take PT1.4 as low battery detection status input. "0" stands for low voltage.

bat_l: ADC value of low battery detection when power on. "0" means using default value; "1" means using EEPROM parameter.

	A	B	C	D
30H	Lb1L	Lb1H	Lb2L	Lb2H

Lb1L, Lb1H: ADC value of the first low battery detection.

Lb2L, Lb2H: ADC value of second low battery detection.

WU4_en: Cancel PCS. Enable the fourth unit switch. The related parameter address is as follow:

byte	0	1	2	3	4	5	6	7	8
30H	E_flag4		Res4L	Res4H	W_min4	W_point4	W_ch4L	W_ch4M	W_ch4H

- The meaning of Default value:
 - Calibration Unit: Main Unit is g. Calibration weight is 2000g.
 - Power On Unit: Main Unit.
 - Switchable Unit: Second Unit is Catty and Tale. Third Unit is oz, Simple Calculation (Pcs).
 - Max. weight: Main Unit is 2000g. Second Unit is 3 Catties, 5.35 Tale. Third Unit is 80.00 oz. Overload display is current unit plus 9d.
 - Min. weight: Main Unit is 1g. Second Unit is 0.05 Tales. Third Unit is 0.05 oz.
 - Accuracy: Main Unit is 1g. Second Unit is 0.05 Tales. Third Unit is 0.05 oz.
 - Unit switch (W_ch) parameter definition: Highest 4 bits mean integer; sequent 20 bits means decimal. They must be calculated with W_min and W_point.

For example: 1g = 0.02666667 Tales = 0.03527396 oz

$$g \rightarrow \text{Tale} = 0.02666667 * 2^{20} * 10^{W_point} / W_min = 0.02666667 * 2^{20} * 100 / 5 = 088888h$$

$$g \rightarrow \text{oz} = 0.03527396 * 2^{20} * 10^{W_point} / W_min = 0.03527396 * 2^{20} * 100 / 5 = 0b49a4h$$

- 93c46 parameter settings can be changed by keys.

Steps:

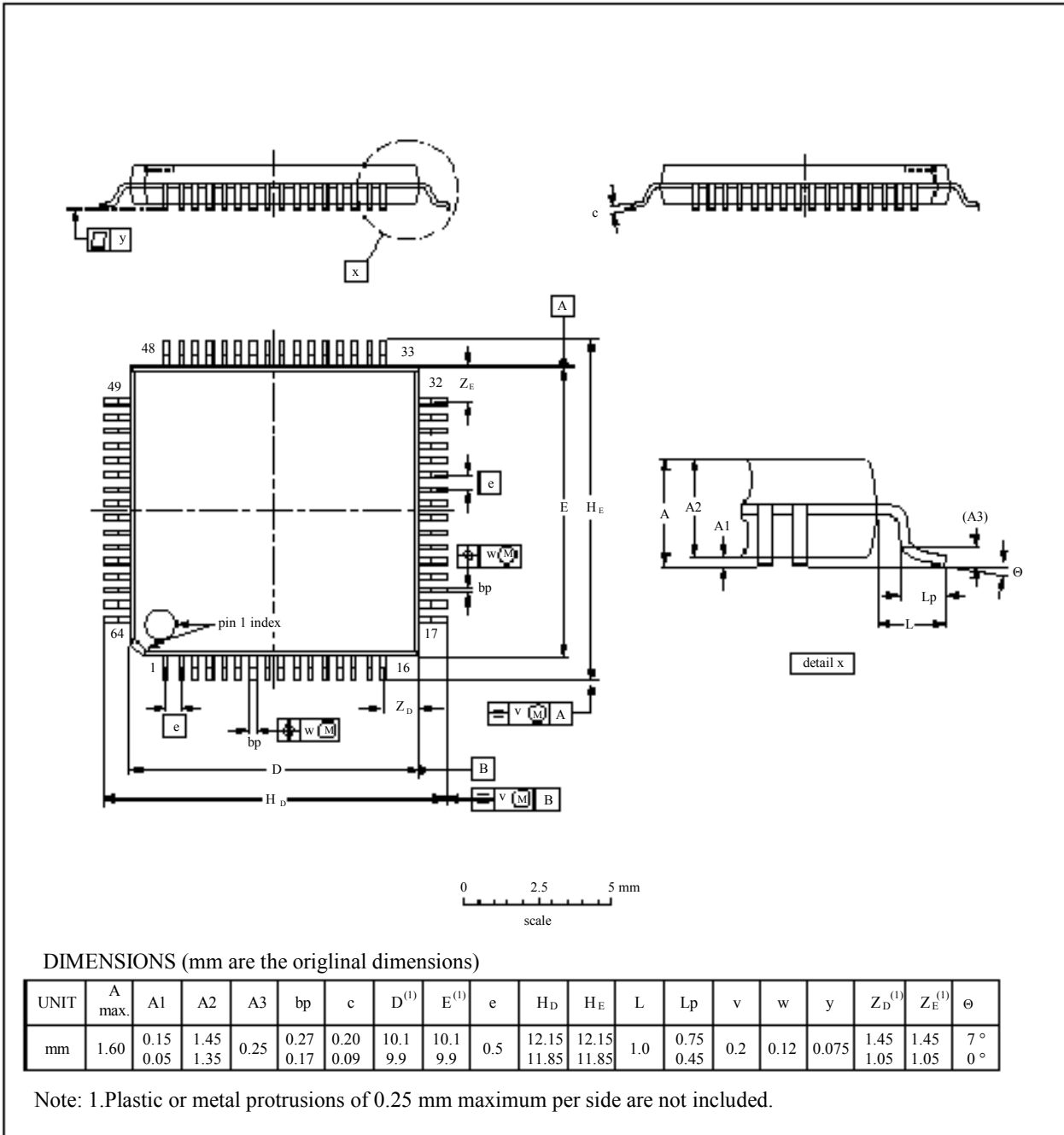
- Press and hold Mode Key (>3sec) when power on. The system will enter EEPROM and display "E:0E:55". LCD_T1 will lights up. "0E" means address and "55" means value.
- To press Zero Key, the address will plus 1; to press Mode Key, the address will minus 1.
- Press and hold Mode Key (>3 sec). The system will enter value change. LCD_T3 will lights up.
- To press Zero Key, the value will plus 1; to press Mode Key, the value will minus 1.
- Press and hold Mode Key (>3 sec) to write the value, and return to "2".

12.IC Revision History Table

Item	LCS1	LCS2_v1	LCS2_v2	LCS2_v3	LCS2_v4	LCS2_v5	LCS2_v6
FS9912 code number	3	13	18	36	98	185	262
FSC's inside part number (the way to distinguish the version; the information on the outside package)	A-9912C-003-AB0	A-9912D-013-AB0	A-9912E-018-AB0	A-9912E-036-AB0	A-9912E-098-???	A-9912R-185-???	A-9912R-262-0407
1 Max counts	3276	6553	6553	6553	6553	6553	6553
2 "ZERO" & "1" Display bug	Yes	No	No	No	No	No	No
3 Program HEX to BCD bug	Yes	Yes	No	No	No	No	No
4 Program HEX to BCD bug (the first one of the 3 digits no function bug)	No	No	Yes	Yes	Yes	Yes	No
5 Turn on unit problem (Less than 4 unit functions)	No	Yes	Yes	No	No	No	No
6 LCD symbol change (one & ck2)	No	No	Yes	Yes	Yes	Yes	Yes
7 Max Hold bug	No	No	Yes	No	No	No	No
8 Low battery detect channel	AD7	AD6	AD6	AD6	AD6	AD6	AD6
9 93c46 setup online	No	Yes	Yes	Yes	Yes	Yes	Yes
10 ON/Z/OFF (>3sec)	No	Yes	Yes	Yes	Yes	Yes	Yes
11 Mode 記憶功能	No	Yes	Yes	Yes	Yes	Yes	Yes
12 Double power (E+)	No	Yes	Yes	Yes	Yes	Yes	Yes
13 Z/T	No	Yes	Yes	Yes	Yes	Yes	Yes
14 off_RS232	No	Yes	Yes	Yes	Yes	Yes	Yes
15 no_Z	No	Yes	Yes	Yes	Yes	Yes	Yes
16 M_Hold	No	Yes	Yes	Yes	Yes	Yes	Yes
17 no_bat	No	Yes	Yes	Yes	Yes	Yes	Yes

13. Package Outline

LQFP64: plastic low profile quad flat package; 64 leads; body 10 x 10 x 1.4 mm



14. Ordering Information

Product Number	Package Type
FS9912_LCS2	Dice form (64 pins), 64-pin LQFP