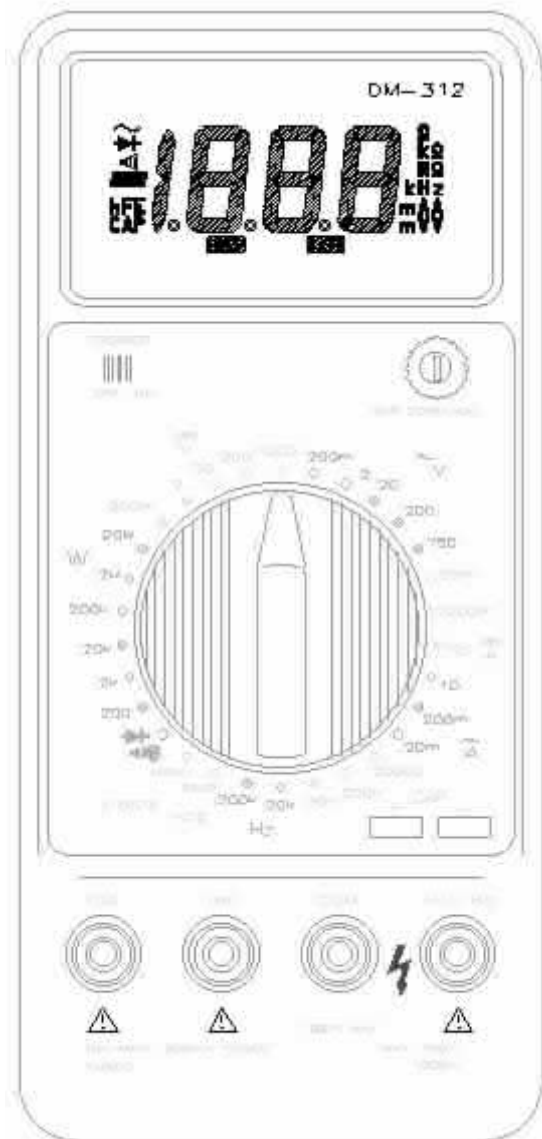


Adjustment and Test procedure Manual
for digital multimeter
Model: DM-312



LG Precision Co., Ltd.

1999/8/12

P/N:

Revision History

[illegible]

General Specifications of DM-312

Display: 3½ Digit Multimeter**Battery Life:** Typical 200 hours**Operating Temperature:** 0°C ~ 40°C ($\leq 80\%$ RH)**Storage temperature:** -10°C ~ 60°C ($\leq 70\%$ RH)**Accuracy guaranteed temperature:** 23°C $\pm$ 5°C ($\leq 80\%$ RH)**Maximum Reading Rate:** 2 readings / second

Explanation of each part of DM-312

(1) LCD Display**(2) Capacitance Zero Adjustment**

Used for zero display adjustment in capacitance measure mode.

(3) Power S/W**(4) Rotary S/W**

Used for selecting mode and range.

(5) Capacitance Socket

Used for inserting capacitance to measure

(6) Transistor Socket

Used for inserting transistor to measure

(7) Terminal Ω -V-Hz

Used for AC/DC voltage, Resistance and frequency measure terminal

(8) Terminal COM

Used for common terminal

(9) Terminal mA

Used for measuring DC/AC current below 200mA current

(10) Terminal 10A

Used for measuring DC/AC current below 10A

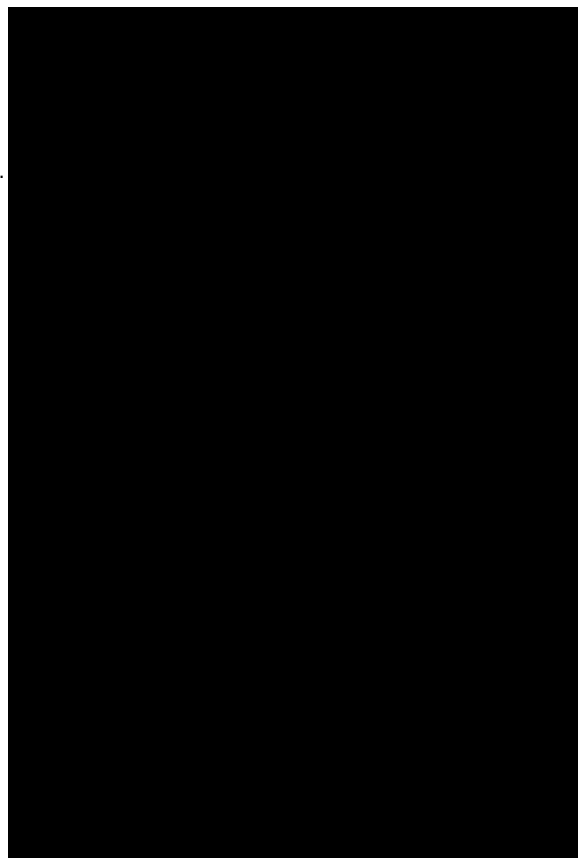


Fig 1 - Front View of DM-312

**Note**

Adjustment and Test of DM-312 should be conducted under proper test environment.

Check temperature and relative humidity before adjustment and test.

Accuracy guaranteed temperature: 23°C $\pm$ 5°C (Below 80% RH)

n Test Equipment List

DMM Calibrator: 1set
 Decade Resistor: 1 set
 Decade Capacitor: 1set
 Signal Generator: 1set
 DC Power Supply (0 ~ 12V) or 9V Battery

n Calibration Procedure

1. Power On Test

Turn DM-312 on by using slide S/W. and check LCD display is turned on.

2. LCD Display Test

Check LCD Display to each range by selecting range with Rotary S/W. Below chart shows correct display

Function	LCD Display to each range
DC VOLTAGE	00.0mV → .000V → 0.00V → 00.0V → 000V
AC VOLTAGE	00.0 → .000 → 0.00 → 00.0 → 000
DC CURRENT	0.00mA → 00.0mA → 0.00A
AC CURRENT	0.00 → 00.0 → 0.00
RESISTANCE	1 .Ω → 1. kΩ → 1 . kΩ → 1 .kΩ → 1. MΩ → 1 . MΩ
CAPACITANCE	000 → 00.0 → 0.00
HFE	000 → 000
FREQUENCY	0.00 → 00.0
DIODE & CONTINUITY	1

3. Low Battery Warning Display Test

Check a message, "BATT" on LCD display when Power supply or Battery Voltage goes below 6.4V.

4. Adjustment of DC voltage, AC voltage DC current, Capacitance and Frequency.

Function	Adjustment Specification	Procedure
DC Voltage	189.8~190.2	1. Set Rotary S/W to DC Voltage 200mV range 2. Apply DC 190mV to Terminal COM and Terminal V of DM-312 with a calibrator 3. Adjust VR1 to be displayed 190.0mV on LCD display
AC Voltage	189.5~ 190.5	1. Set Rotary S/W to AC Voltage 200mV range 2. Apply AC 190mV/60Hz to Terminal COM and Terminal V with a calibrator 3. Adjust VR2 to be displayed 190.0mV on LCD display
DC Current	9.95 ~ 10.05	1. Set Rotary S/W to DC Current 10A Mode 2. Apply DC 10A current to terminal COM and Terminal 10A with a calibrator 3. Adjust MN Wire to be displayed 10.00A on LCD display with a ripper
Capacitance	189.5 ~ 190.5	1. Set Rotary S/W to "CAP" 200nF Range 2. Set 00.0 display with ZERO ADJ. 3. Apply 190nF between CAP jack with a decade capacitor 4. Adjust VR5 to be displayed 190.0 on LCD display
	18.95 ~ 19.05	1. Set Rotary S/W to "CAP" 20μF Range 2. Set 00.0 display with ZERO ADJ. 3. Apply 19μF between CAP jack with a Decade capacitor 4. Adjust VR3 to be displayed 19.00 on LCD display
Frequency	18.95 ~ 19.05	1. Set Rotary S/W to "Hz" 20KHz Range 2. Apply 19KHz/RMS 100mV to Terminal V and Terminal COM. 3. Adjust VR7 to be displayed 19.00 kHz on LCD display
	189.5 ~ 190.5	1. Set Rotary S/W to "Hz" 20KHz Range 2. Apply 190KHz/RMS 100mV to Terminal V and Terminal COM. 3. Adjust VR6 to be displayed 190.0 kHz on LCD display

5. Test

5-1 No Input on DC Voltage Mode

- n Specification : $\pm 0.1\text{mV}$
- n Set Rotary S/W to DC Voltage 200mV range and check DM-312 to meet the above specification.

5-2 Short-circuit on DC Voltage Mode

- n Specification : $\pm 0.1\text{ mV}$
- n Set Rotary S/W to DC Voltage 200mV range and Short-circuit between terminal COM and terminal V
- n Check DM-312 to meet the above specification.

5-3 DC Voltage Measurement Test

Set Rotary S/W to DC Voltage Mode and Apply below voltage to terminal COM and terminal V to each range with a calibrator

Range	Customer Specification	Factory Specification	Test DC Voltage
DC 200mV	$\pm(0.5\% + 1\text{dgt})$	$\pm(0.4\% + 1\text{dgt})$	190mV
DC 2V			1.9V
DC 20V			19V
DC 200V			190V
DC 1000V			1000V

5-4 AC Voltage Measurement Test

Set Rotary S/W to AC Voltage Mode and Apply below voltage to terminal COM and terminal V to each range with a calibrator. Check the measurement value to each frequency, 60Hz and 400Hz.

Range	Customer Specification	Factory Specification	Test AC Voltage
AC 200mV	$\pm(0.75\%+3\text{dgt})$	$\pm(0.65\%+3\text{dgt})$	190mV/60Hz 190mV/400Hz
AC 2V			1.9V/60Hz 1.9V/400Hz
AC 20V			19V/60Hz 19V/400Hz
AC 200V			190V/60Hz 190V/400Hz
AC 750V			750V/60Hz 750V/400Hz

5-5 DC Current Measurement Test

Set Rotary S/W to DC Current Mode and Apply below DC current to terminal COM and terminal mA to each range with a calibrator. Check the measurement value to each range

Range	Customer Specification	Factory Specification	Test DC Current
DC 20mA	$\pm(0.75\%+1\text{dgt})$	$\pm(0.65\%+1\text{dgt})$	19mA
DC 200mA			190mA



Apply below DC current to **terminal COM and terminal 10A** with a calibrator.

Range	Customer Specification	Factory Specification	Test DC Current
DC 10A	$\pm(1.2\%+1\text{dgt})$	$\pm(1.1\%+1\text{dgt})$	9A

5-6 AC Current Measurement Test

Set Rotary S/W to AC Current 20mA Mode and Apply below AC current to terminal COM and terminal mA to each range with a calibrator. Check the measurement value to each range

Range	Customer Specification	Factory Specification	Test AC Current
AC 20mA	$\pm(1.0\%+3\text{dgt})$	$\pm(0.9\%+3\text{dgt})$	19mA/60Hz 19mA/400Hz
AC 200mA			190mA/60Hz 190mA/400Hz



Apply below AC current to **terminal COM and terminal 10A** with a calibrator.

Range	Customer Specification	Factory Specification	Test AC Current
AC 10A	$\pm(2.0\%+5\text{dgt})$	$\pm(1.9\%+5\text{dgt})$	9A/60Hz 9A/400Hz

5-7 Resistance Measurement Test

Set Rotary S/W to Resistance Measure Mode and Apply below resistance value to terminal COM and terminal V to each range with decade resistor. Check the measurement value to each range

Range	Customer Specification	Factory Specification	Test Resistance value
200Ω	$\pm(0.5\%+4\text{dgt})$	$\pm(0.4\%+4\text{dgt})$	190Ω
2kΩ	$\pm(0.5\%+1\text{dgt})$	$\pm(0.4\%+1\text{dgt})$	1.9kΩ
20kΩ			19kΩ
200kΩ			190kΩ
2MΩ			1.9MΩ
20MΩ	$\pm(1.0\%+1\text{dgt})$	$\pm(0.9\%+1\text{dgt})$	10MΩ

5-8 Capacitance Measurement Test

Set Rotary S/W to "CAP" 200nF range and adjust ZERO ADJ to be displayed 00.0

And apply below capacitance value between CAP jack with a decade capacitor

Range	Customer Specification	Factory Specification	Test Capacitance Value
2000pF	$\pm(2.0\%+6\text{dgt})$	$\pm(1.9\%+6\text{dgt})$	1900pF
200nF			190nF
20μF	$\pm(5.0\%+4\text{dgt})$	$\pm(4.9\%+4\text{dgt})$	19μF

5-9 Frequency Measurement Test

Set Rotary S/W to "HZ" mode and apply below frequency value to terminal COM and terminal V with a signal generator

Range	Customer Specification	Factory Specification	Test Frequency Value
20KHz	$\pm(2.0\%+3\text{dgt})$	$\pm(1.9\%+3\text{dgt})$	19KHz/RMS 100mV
200KHz			190KHz/RMS 100mV

5-10 Transistor hFE Measurement Test

Set Rotary S/W to "hFE" mode and insert transistor below to transistor socket

Range	Customer Specification	Factory Specification	Test Transistor
NPN		120 ~ 240	3198Y
PNP			1266Y

5- 11Diode & Continuity Test

Set Rotary S/W to diode & continuity test mode and apply a diode to terminal COM and terminal V with forward direction.

Range	Customer Specification	Factory Specification
Diode		Forward Direction : ≥ 450 Reverse Direction : 1

Set Rotary S/W to diode & continuity test mode and Short-circuit between terminal COM and terminal V. Buzzer will sound when measurement is lower than 200Ω .

Range	Customer Specification	Factory Specification
Continuity		Open Circuit : 1 Short Circuit : less than 0.4

5-12 Short-circuit ohm Test

Set Rotary S/W to Resistance measure mode and short-circuit to terminal COM and terminal V

Range	Customer Specification	Factory Specification
200Ω		Less than 0.4Ω

Appendix A) Bill of material

LGP P/N	Category	Specification	PCB F/N	Quantity
334-013-1	BUSHING	INPUT CORE BLACK DMM		1
334-013-2	BUSHING	INPUT CORE RED DMM		3
362-035	SPRING	SHIELD SPRING DMM	SP1	1
362-036	SPRING	CAP CHK SPRING DMM		2
384-017-1	HOLDER	BAT SNAP 9V UL		1
418-100	FILM VINYL	PPI255 W=65.0 DMM M		1
513-557R5	PCB BARE B/D	DM-312 PCB REV 5		1
521-108	SWITCH	SW SLIDE KSA-1206		1
531-400	CONNECTOR	HFE SOCKET ESQ-104-23-G-S		1
563-063-2	FUSE	250V 0.25A 50F UL&EU	F1	1
563-065	FUSE	250V 10A H216010 ULE14080	F2	1
563-068	FUSE	125V 1A 22NM MICRO 101L	F3	1
564-015	FUSE HOLDER	FUSE HOLDER FC51A(DMM)		4
571-316	VARIABLE RESISTOR	VR TMC3K B20K (SMD)	VR06	1
571-317	VARIABLE RESISTOR	VR TMC3K 200 (SMD)	VR01	1
571-319	VARIABLE RESISTOR	VR TMC3K 1K (SMD)	VR03	1
571-320	VARIABLE RESISTOR	VR TMC3K 2K (SMD)	VR02	1
571-321	VARIABLE RESISTOR	VR TMC3K 5K (SMD)	VR04	1
571-321	VARIABLE RESISTOR	VR TMC3K 5K (SMD)	VR07	1
571-322	VARIABLE RESISTOR	VR TM10K(PV) 8USB2K	VR05	1
573-098	RESISTOR	W.W 0.985 OHM 1W 0.25%	R38	1
573-142	RESISTOR	M.F 100 -OHM 1/4W -0.2/0.05%	R26	1
573-143	RESISTOR	M.G 9 MOHM 1/2W -0.2/0.05%	R21	1
573-144	RESISTOR	M.F 900 KOHM 1/4W -0.2/0.05%	R22	1
573-145	RESISTOR	M.F 90 KOHM 1/4W -0.2/0.05%	R23	1
573-146	RESISTOR	M.F 9 KOHM 1/4W -0.2/0.05%	R24	1
573-147	RESISTOR	M.F 900 OHM 1/4W -0.2/0.05%	R25	1
574-052-2	PTC	PT05MP-L1K6001	R27	1
574-052-2	PTC	PT05MP-L1K6001	R28	1
574-052-2	PTC	PT05MP-L1K6001	R27A	1
574-055	SPARK GAP	AG15PC 152FS-K2M DAIYOYDEN	SG1	1
581-160	CAPACITOR	ELEC 47UF 16V SRE-TYP	C08	1
581-160	CAPACITOR	ELEC 47UF 16V SRE-TYP	C09	1
581-160	CAPACITOR	ELEC 47UF 16V SRE-TYP	C24	1
581-162	CAPACITOR	ELEC 1UF 50V SRE-TYPE	C11	1
581-162	CAPACITOR	ELEC 1UF 50V SRE-TYPE	C13	1
581-162	CAPACITOR	ELEC 1UF 50V SRE-TYPE	C14	1
581-162	CAPACITOR	ELEC 1UF 50V SRE-TYPE	C15	1
581-162	CAPACITOR	ELEC 1UF 50V SRE-TYPE	C30	1
581-163	CAPACITOR	ELEC 0.1UF 16V SRE-TYPE T.P	C16	1
581-176	CAPACITOR	ELEC 10UF 16V SRE-TYPE	C06	1
581-194	CAPACITOR	MP 0.22UF 63V K MMY168	C02	1
581-194	CAPACITOR	MP 0.22UF 63V K MMY168	C03	1

LGP P/N	Category	Specification	PCB F/N	Quantity
581-195	CAPACITOR	MP 0.1UF 63V J MMY168	C04	1
581-195	CAPACITOR	MP 0.1UF 63V J MMY168	C05	1
581-195	CAPACITOR	MP 0.1UF 63V J MMY168	C12,C25	2
581-204	CAPACITOR	MP 0.01UF 63V J MMY168	C26	1
585-154-1	DIODE	RL105	D01	1
585-154-1	DIODE	RL105	D02	1
585-154-1	DIODE	RL105	D5,D6	2
585-248	DIODE	KDS226 (SMD) KEC	D03	1
585-248	DIODE	KDS226 (SMD) KEC	D04	1
591-647-2	IC	MC74HC00AD (SMD) MOTOROLA	U03	1
591-648	IC	TC7106ACKW A-D CON TELEDYNE	U01	1
591-650	IC	NJM062M-T1 OP-AMP NJRC	U04	1
591-651-1	IC	TIMER TS555ID THOMSON	U5,U7,U8	3
591-653-1	IC	LM393D (SMD) MOTOROLA	U06	1
591-660	IC	MC14070BD	U02	1
611-665	TRANSISTOR	KRC110S (SMD)	Q03	1
611-670	TRANSISTOR	KTC3875Y (SMD) SOT-23	Q01	1
611-670	TRANSISTOR	KTC3875Y (SMD) SOT-23	Q02	1
611-671	TRANSISTOR	SS8050 SAMSUNG	Q04	1
611-671	TRANSISTOR	SS8050 SAMSUNG	Q05	1
637-013	BUZZER	BUZZ SBT-11P	B1	1
873-028R	MN WIRE	MN WIRE CM2 10MOHM	R39	1
873-027	Mn WIRE CM2 DIA 1.6MM	Mn WIRE CM2 DIA1.6MM		1
CK1HI101J	CAPACITOR	CER 100PF 50V J (2012)	C01	1
CK1HI101J	CAPACITOR	CER 100PF 50V J (2012)	C21	1
CK1HI102K	CAPACITOR	CER 1000PF 50V K (2012)	C17	1
CK1HI104M	CAPACITOR	CER 0.1UF 50V M (2012)	C23	1
CK1HI104M	CAPACITOR	CER 0.1UF 50V M (2012)	C31	1
CK1HI150J	CAPACITOR	CER 15PF 50V J (2012)	C27	1
CK1HI221J	CAPACITOR	CER 220PF 50V J (2012)	C07	1
CK1HI224M	CAPACITOR	CER 0.22UF 50V M (3216)	C29	1
CK1HI272K	CAPACITOR	CER 2700PF 50V K (2012)X7R	C28	1
CK1HI680J	CAPACITOR	CER 68PF 50V J (2012)	C22	1
CK2HI102K	CAPACITOR	CER 1000PF 500V K (1808)	C19	1
RD0BP105J	RESISTOR	C.F 1 MOHM 1/4W 5%	R40	1
RG0CP226J	RESISTOR	M.G 22 MOHM 1/2W 5%	R41	1
RM2P1303J	RESISTER	M.F 130KOHM 2W 5%	R50	1
RMAH1000J	RESISTOR	M.F 100 -OHM 1/8W 5% (3216)	R46	1
RMAH1001F	RESISTOR	M.F 1 KOHM 1/8W 1% (3216)	R35	1
RMAH1002F	RESISTOR	M.F 10 KOHM 1/8W 1% (3216)	R42	1
RMAH1002F	RESISTOR	M.F 10 KOHM 1/8W 1% (3216)	R43	1
RMAH1003J	RESISTOR	M.F 100 KOHM 1/8W 5% (3216)	R06	1
RMAH1003J	RESISTOR	M.F 100 KOHM 1/8W 5% (3216)	R30	1
RMAH1004F	RESISTOR	M.F 1 MOHM 1/8W 1% (3216)	R13	1
RMAH1004F	RESISTOR	M.F 1 MOHM 1/8W 1% (3216)	R14	1

LGP P/N	Category	Specification	PCB F/N	Quantity
RMAH1004F	RESISTOR	M.F 1 MOHM 1/8W 1% (3216)	R67	1
RMAH1004J	RESISTOR	M.F 1 MOHM 1/8W 5% (3216)	R03,R44	2
RMAH1004J	RESISTOR	M.F 1 MOHM 1/8W 5% (3216)	R07	1
RMAH1004J	RESISTOR	M.F 1 MOHM 1/8W 5% (3216)	R08	1
RMAH1004J	RESISTOR	M.F 1 MOHM 1/8W 5% (3216)	R10	1
RMAH1004J	RESISTOR	M.F 1 MOHM 1/8W 5% (3216)	R11	1
RMAH1004J	RESISTOR	M.F 1 MOHM 1/8W 5% (3216)	R12	1
RMAH1004J	RESISTOR	M.F 1 MOHM 1/8W 5% (3216)	R31	1
RMAH1004J	RESISTOR	M.F 1 MOHM 1/8W 5% (3216)	R32	1
RMAH1004J	RESISTOR	M.F 1 MOHM 1/8W 5% (3216)	R34	1
RMAH1004J	RESISTOR	M.F 1 MOHM 1/8W 5% (3216)	R47	1
RMAH1004J	RESISTOR	M.F 1 MOHM 1/8W 5% (3216)	R48	1
RMAH1004J	RESISTOR	M.F 1 MOHM 1/8W 5% (3216)	R63	1
RMAH1004J	RESISTOR	M.F 1 MOHM 1/8W 5% (3216)	R64	1
RMAH10R0J	RESISTOR	M.F 10 -OHM 1/8W 5% (3216)	R53	1
RMAH1102F	RESISTOR	M.F 11 KOHM 1/8W 1% (3216)	R17	1
RMAH1103F	RESISTOR	M.F 110 KOHM 1/8W 1% (3216)	R01,R60	2
RMAH1301F	RESISTOR	M.F 1.3 KOHM 1/8W 1% (3216)	R65,R75	2
RMAH1403F	RESISTOR	M.F 140 KOHM 1/8W 1% (3216)	R59	1
RMAH1502F	RESISTOR	M.F 15 KOHM 1/8W 1% (3216)	R66	1
RMAH1503J	RESISTOR	M.F 150 KOHM 1/8W 5% (3216)	R09	1
RMAH1603F	RESISTOR	M.F 160 KOHM 1/8W 1% (3216)	R61	1
RMAH1802F	RESISTOR	M.F 18 KOHM 1/8W 1% (3216)	R51	1
RMAH1802J	RESISTOR	M.F 18 KOHM 1/8W 5% (3216)	R05	1
RMAH2003J	RESISTOR	M.F 200 KOHM 1/8W 5% (3216)	R74	1
RMAH2102F	RESISTOR	M.F 21 KOHM 1/8W 1% (3216)	R58	1
RMAH2201F	RESISTOR	M.F 2.2 KOHM 1/8W 1% (3216)	R16	1
RMAH2203F	RESISTOR	M.F 220 KOHM 1/8W 1% (3216)	R57	1
RMAH2402F	RESISTOR	M.F 24 KOHM 1/8W 1% (3216)	R68	1
RMAH2702F	RESISTOR	M.F 27 KOHM 1/8W 1% (3216)	R54	1
RMAH2702F	RESISTOR	M.F 27 KOHM 1/8W 1% (3216)	R55	1
RMAH2702F	RESISTOR	M.F 27 KOHM 1/8W 1% (3216)	R56	1
RMAH3300F	RESISTOR	M.F 330 -OHM 1/8W 1% (3216)	R18	1
RMAH3301J	RESISTOR	M.F 3.3 KOHM 1/8W 5% (3216)	R45	1
RMAH3303F	RESISTOR	M.F 330 KOHM 1/8W 1% (3216)	R62	1
RMAH4701J	RESISTOR	M.F 4.7 KOHM 1/8W 5% (3216)	R70	1
RMAH4702F	RESISTOR	M.F 47 KOHM 1/8W 1% (3216)	R02	1
RMAH4702J	RESISTOR	M.F 47 KOHM 1/8W 5% (3216)	R04	1
RMAH4702J	RESISTOR	M.F 47 KOHM 1/8W 5% (3216)	R15	1
RMAH4703F	RESISTOR	M.F 470 KOHM 1/8W 1% (3216)	R73	1
RMAH4703J	RESISTOR	M.F 470 KOHM 1/8W 5% (3216)	R72	1
RMAH5100J	RESISTOR	M.F 510 -OHM 1/8W 5% (3216)	R20	1
RMAH51R0J	RESISTOR	M.F 51 -OHM 1/8W 5% (3216)	R49	1
RMAH8200J	RESISTOR	M.F 820 -OHM 1/8W 5% (3216)	R19	1
RMAH8201F	RESISTOR	M.F 8.2 KOHM 1/8W 1% (3216)	R33	1

LGP P/N	Category	Specification	PCB F/N	Quantity
RMAH8203F	RESISTOR	M.F 820 KOHM 1/8W 1% (3216)	R69	1
RMAH8203F	RESISTOR	M.F 820 KOHM 1/8W 1% (3216)	R71	1
RMAH9103J	RESISTOR	M.F 910 KOHM 1/8W 5% (3216)	R29	1
RMBP9R00C	RESISTOR	M.F 9 -OHM 1/4W .25%	R37	1

Appendix B) Schematic Diagram of DM-312

