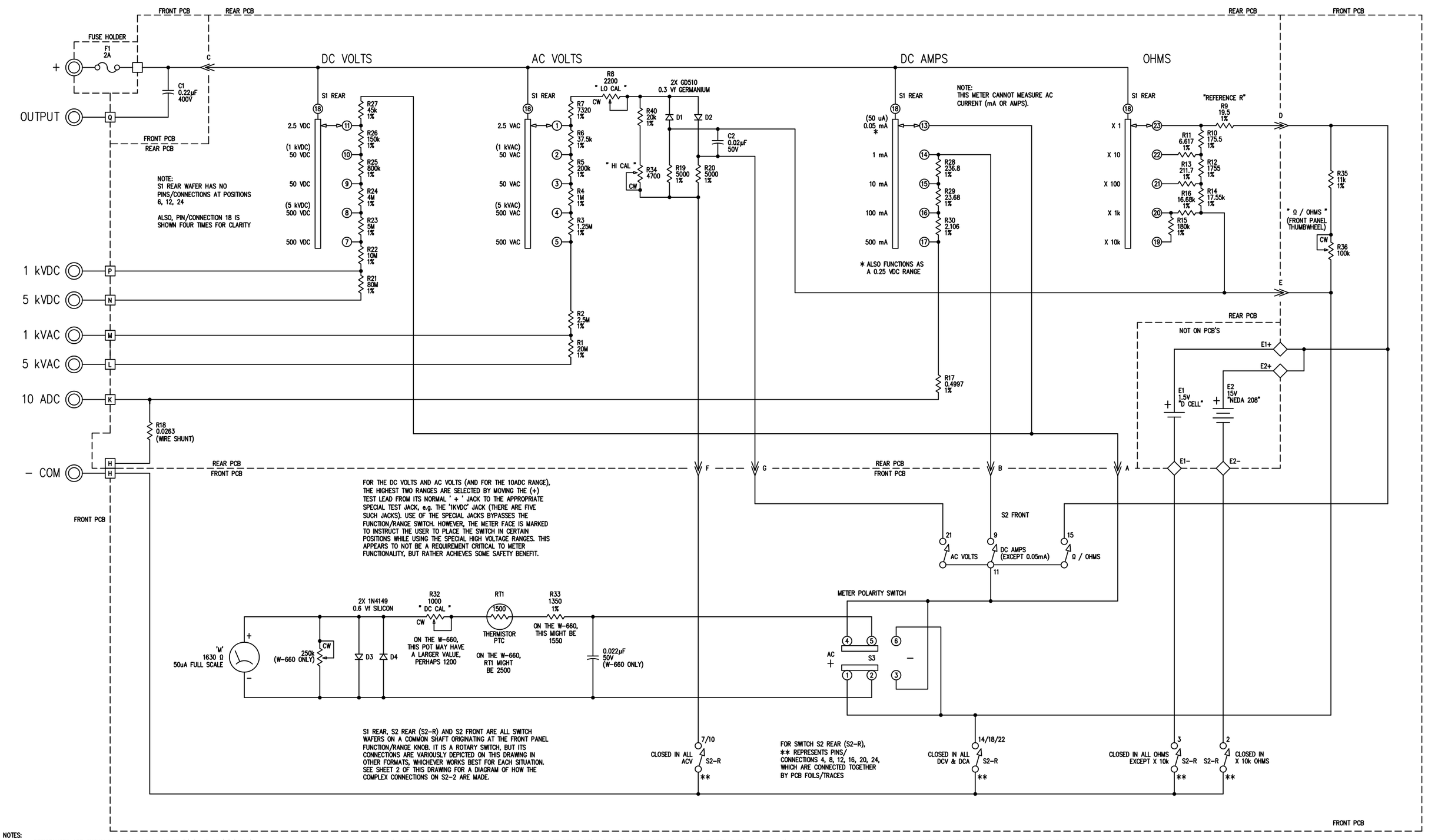


NOTES:

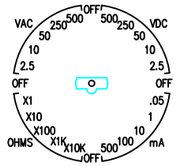
1) ALL RESISTANCES ARE SHOWN IN OHMS UNLESS MARKED 'k' (KILO) OR 'M' (MEGA).
2) RESISTOR WATTAGES ARE NOT MARKED ON THE HEATHKIT DOCUMENTATION OR ON THE ACTUAL PARTS, SO ARE NOT SHOWN HERE.
3) THIS SCHEMATIC APPLIES TO THE ORIGINAL WESTON MODEL 660 (W–660) AS WELL AS TO ITS KIT VERSION PRODUCED BY HEATHKIT AS THE MODEL IM–105. BECAUSE A HEATHKIT MANUAL WAS AVAILABLE WHEN PREPARING THIS SCHEMATIC, THE HEATHKIT COMPONENT REFERENCES, e.g. 'R27', ARE PROVIDED BUT ARE PROBABLY NOT APPLICABLE TO THE WESTON VERSION, FOR WHICH NO DOCUMENTATION WAS AVAILABLE. COMPONENT VALUES ARE THE SAME BETWEEN BOTH VERSIONS, EXCEPT AS SPECIFICALLY NOTED. THE CHANGES ARE PRIMARILY IN THE FINAL 'METER CIRCUIT', WITH A CAPACITOR AND A TRIM POTENTIOMETER BEING PART OF THE WESTON PRODUCT BUT OMITTED FROM THE HEATHKIT VERSION, AND THE VALUES OF THE THREE RESISTORS IN SERIES WITH THE METER MOVEMENT HAVING SLIGHTLY DIFFERENT VALUES, WHICH ARE SHOWN HERE BASED ON PHYSICAL MEASUREMENT AND/OR COMPONENT MARKINGS.
4) THERMISTOR RT1 IS NOMINALLY 1500 OHMS AT 'ROOM TEMPERATURE' BUT INCREASES RESISTANCE WHEN ITS TEMPERATURE RISES ('PTC' OR POSITIVE TEMPERATURE COEFFICIENT). THIS MAY BE FOR TEMPERATURE STABILIZATION OF THE METER, BUT IT MORE LIKELY HAS A RAPID RESPONSE SUCH IF THE OVER–VOLTAGE CLAMPING DIODES D3 & D4 ARE CONDUCTING, THE INCREASED CURRENT (WELL ABOVE THE 50uA EXPECTED FOR A FULL SCALE READING) WILL CAUSE THE THERMISTOR TO HEAT UP, SUCH THAT ITS RESISTANCE INCREASES TO LIMIT CURRENT IN THE METER CIRCUIT. THE THERMISTOR USED ON THE W–660 IS MARKED SUCH THAT IT MIGHT HAVE A NOMINAL RESISTANCE OF 2500 OHMS INSTEAD OF THE 1500 OHMS USED ON THE IM–105.
5) COMPONENTS ARE VARIOUSLY MOUNTED ON THE FRONT PANEL, THE FRONT PCB (PRINTED CIRCUIT BOARD), THE REAR PCB, OR ON THE INSIDE OF THE MOLDED BLUE LEXAN CASE. A SQUARE SYMBOL SUCH AS □, EITHER WITH OR WITHOUT A LETTER DESIGNATOR IN THE RANGE H ~ Q (I, J, AND O ARE NOT USED), DENOTES A PCB PAD ON EITHER BOARD TO WHICH ONE OF THE FRONT PANEL BANANA JACKS IS BOLTED TO MAKE ELECTRICAL CONNECTION. IN THE CASE OF THE PCB PAD MARKED 'H', THERE IS PHYSICAL CONNECTION TO BOTH PCB'S BUT ELECTRICAL CONNECTION TO ONLY THE FRONT PCB.
6) THE TWO PCB'S ARE ELECTRICALLY INTERCONNECTED BY INTER–PCB PIN AND SOCKET CONNECTORS, WHICH ARE SHOWN USING THIS SYMBOL ≫ AND GIVEN LETTER DESIGNATIONS A ~ G. THE DIRECTION OF THE CONNECTOR ARROWS POINTS FROM REAR PCB TO FRONT PCB.
7) THE TWO BATTERIES HAVE WIRES TO CONNECT THEM TO THE FRONT PCB. THE PCB HOLES RECEIVING THESE WIRES ARE DESIGNATED HERE WITH THIS DIAMOND SHAPED SYMBOL ◇ AND THE PCB MARKINGS FOR THE HOLES ARE ALSO SHOWN.
8) THIS SCHEMATIC WAS DRAWN, USING AUTOCAD, AS A MEANS TO GET A LEGIBLE SCHEMATIC FOR THE HEATHKIT MP–105 AND WESTON 660. AN EFFORT HAS BEEN MADE TO SIZE AND SCALE COMPONENTS AND TEXT FOR THE LARGEST AND BEST VISIBILITY AND LEGIBILITY WHILE STILL FITTING ON A NORMAL 11 X 17" SHEET OF PAPER.
9) THE COPYRIGHT HOLDER HEREBY GIVES PERMISSION TO FREELY DISTRIBUTE THIS DOCUMENT, AS LONG AS NO ALTERATIONS ARE MADE AND CREDIT IS GIVEN, ALONG WITH THE COPYRIGHT NOTICE.

REVISION A 10–20–2022

HEATHKIT IM–105 MULTIMETER (ALSO FOR WESTON 660) SCHEMATIC DIAGRAM

SHEET 1 OF 4

HEATHKIT IM-105 & WESTON 660 "S2 REAR" SWITCH LAYOUT



LEFT-TO-RIGHT, TOP-TO-BOTTOM ORDER IS FROM LEFT (9 O'CLOCK) SWITCH "OFF" POSITION

NOTES ON SWITCH COMMONS:

- POSTS 7 & 10 ARE CONNECTED ON PCB TO INTER-BOARD CONNECTOR ' F '

- POSTS 4, 8, 12, 16, 20, 24 ARE CONNECTED ON PCB TO FRONT PANEL ' - COM '

- POSTS 14, 18, 22 ARE CONNECTED ON PCB TO POLARITY SWITCH S3 PINS 1 & 6

- POST 2 IS CONNECTED ON PCB TO BATTERY ' E2 (-) ' [15V]

- POST 3 IS CONNECTED ON PCB TO BATTERY ' E1 (-) ' [1.5V]

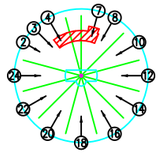
- NOTICE THAT THE POST 2 CONTACT IS SHORTER THAN THE OTHERS, AND ONLY MAKES CONTACT WITH THE SMALL EXTENDED TAB ON THE WAFER CONTACT ON ONE OF THE 24 POSSIBLE SWITCH POSITIONS (i.e. X10k).

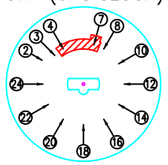
NOTES ON WHY THIS DRAWING EXISTS:

- ORIGINAL HEATHKIT SCHEMATIC SHOWS SWITCH GANG / WAFER ' S1 REAR ' CLEARLY IN REGARD TO WHICH CONTACT POSTS ARE ACTIVE IN EACH SWITCH POSITION, AND SWITCH GANG / WAFER ' S2 FRONT ', WHILE NOT AS CLEAR, CAN EASILY BE INTERPOLATED FROM WHAT IS SHOWN IN ORDER TO UNDERSTAND THOSE SWITCH CONNECTIONS.

- ORIGINAL HEATHKIT SCHEMATIC, HOWEVER, IS A TOTAL MESS IN REGARD TO THE CONNECTIONS MADE BY SWITCH GANG / WAFER ' S2 REAR ' (S2-R), AND THIS IS COMPLICATED BY THAT SIDE OF THE WAFER BEING INVISIBLE WHILE MOUNTED ON THE PCB. THE CONNECTIONS MADE HERE ARE FAIRY EASY TO APPROXIMATE BY STUDY OF WHICH ' MUST ' BE MADE BY THIS SWITCH IN ORDER FOR THE METER TO FUNCTION, BUT TROUBLESHOOTING SWITCH ISSUES (e.g. WITH A CONTINUITY TESTER) IS DIFFICULT WITHOUT HAVING A CLEAR DIAGRAM OF HOW THE WAFER'S CONTACT PLATE AND TWO-TIERED CONTACTS MAKE VARIOUS CONNECTIONS BETWEEN POSTS IN EACH OF THE 24 SWITCH POSITIONS.

- THIS DIAGRAM IS AN ATTEMPT TO CLARIFY THE ABOVE ISSUE, AND IS BASED ON CAREFUL STUDY OF THE METER CIRCUIT, EXTRAPOLATION OF WHAT LITTLE ACCURATE INFORMATION THE HEATHKIT SCHEMATIC ' DOES ' SHOW IN THIS REGARD, AND CONTINUITY CHECKS MADE ON A WORKING IM-105 METER.



OFF (9 O'CLOCK)

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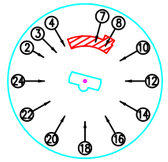
2.5VAC

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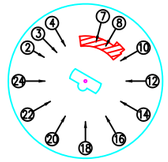
10VAC

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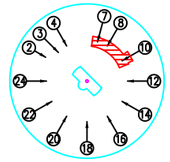
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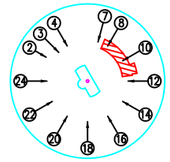
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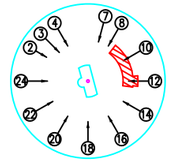
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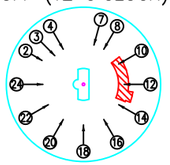
OFF (12 O'CLOCK)

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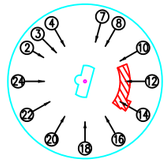
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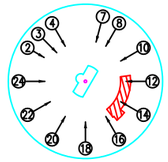
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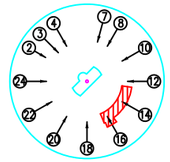
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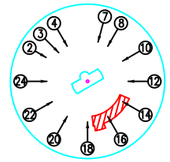
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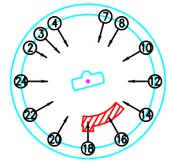
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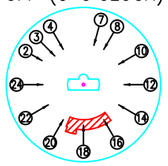
OFF (3 O'CLOCK)

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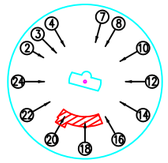
0.05 mA

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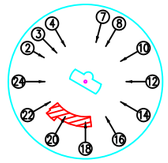
1mA

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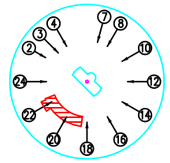
10mA

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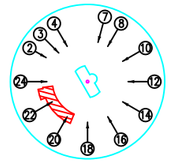
100mA

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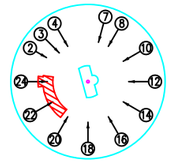
500mA

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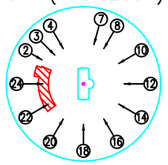
OFF (6 O'CLOCK)

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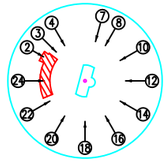
X10k

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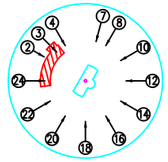
X1k

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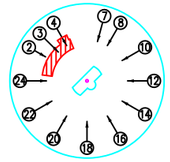
X100

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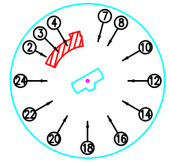
X10

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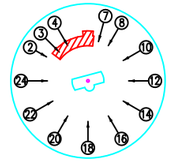
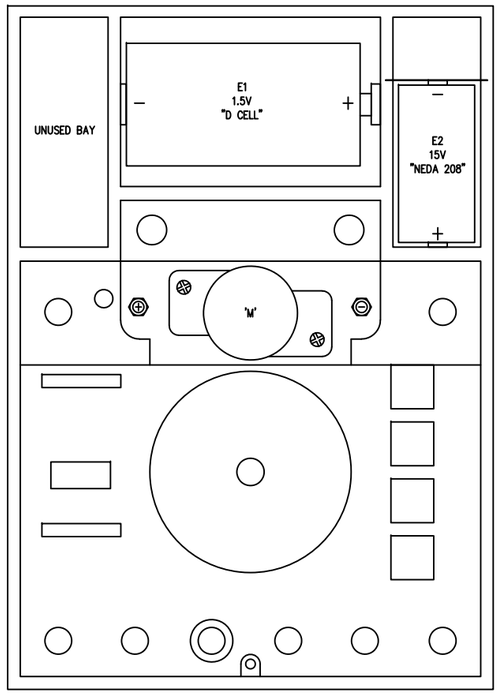
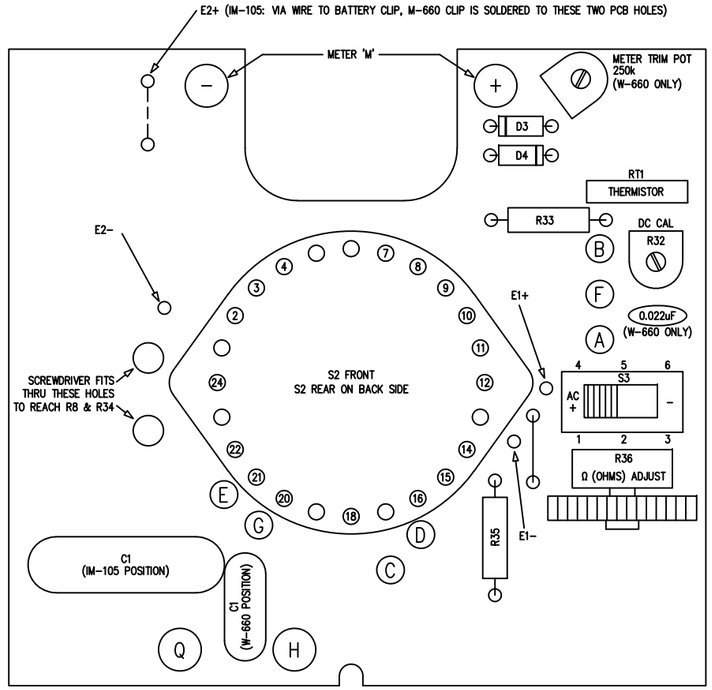
X1

ROTATION FROM REFERENCE = -345 DEG

REVISION B 10-23-2022

HEATHKIT IM-105 MULTIMETER
(ALSO FOR WESTON 660)
SCHEMATIC DIAGRAM
SHEET 2 OF 4



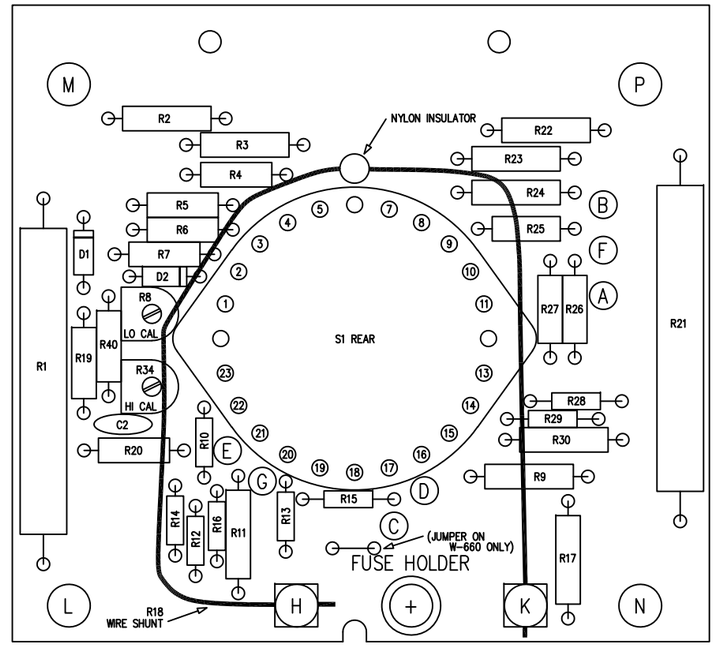
REAR VIEW OF OPENED METER CASE



FRONT PCB (PRINTED CIRCUIT BOARD)

VIEWED FROM COMPONENT SIDE

APPROXIMATELY TO SCALE, NOT ACTUAL SIZE



REAR PCB (PRINTED CIRCUIT BOARD)

VIEWED FROM COMPONENT SIDE

APPROXIMATELY TO SCALE, NOT ACTUAL SIZE

METER DISASSEMBLY INSTRUCTIONS:

1) USE A #12 HEX DRIVER, INSERTED FROM OUTSIDE OF THE FRONT PANEL, INTO THE "– COM", "+" AND "10ADC" TEST LEAD JACKS. UNSCREW THE "+" JACK, ALLOWING IT AND THE FUSE HOLDER TO BE COMPLETELY REMOVED FROM THE FRONT. UNSCREW THE "– COM" AND "10ADC" JACKS UNTIL THEY ARE TURNING FREELY; THEY DO NOT REMOVE OUT THE FRONT, BUT RATHER REMAIN INSIDE THE METER CASE. THIS PROCESS MECHANICALLY RELEASES THE BOTTOM OF THE TWO PCB'S FROM THE CASE.
2) REMOVE THE REAR PANEL OF THE METER BY FIRST REMOVING THE THUMBSCREW AT THE BOTTOM REAR CENTER, AND THEN SLIDING THE REAR PANEL DOWNWARDS AND OUTWARDS.
3) REMOVE THE BATTERIES "E1" AND "E2". LIFT THEIR BATTERY CONTACTS OUT FROM THEIR ASSOCIATED SLOTS IN THE CASE, SO THAT THE BATTERY CLIPS HANG FREELY FROM THEIR WIRES (ON THE WESTON 660 METER, THE "E2+" BATTERY CLIP WILL PROBABLY BE SOLDERED DIRECTLY TO THE TWO HOLES ON THE FRONT PCB, RATHER THAT BEING WIRED TO THE PCB.)
4) UNSCREW THE TWO HEXAGONAL–HEADED BOLTS ON EITHER SIDE OF THE METER MOVEMENT "M" WHICH PASS THROUGH THE METER "+" AND "–" HOLES ON THE REAR PCB. THIS DISCONNECTS THE METER MOVEMENT ELECTRICALLY, AND ALSO MECHANICALLY RELEASES THE TOP OF THE TWO PCB'S FROM THE CASE.
5) USE TWO SCREWDRIVERS OR SIMILAR TOOLS TO GET AHOLD OF THE REAR PCB AND PULL IT STRAIGHT BACK FROM THE CASE. THE FRONT PCB MIGHT COME WITH IT, OR IT MAY REMAIN INSIDE THE CASE, REQUIRING SUBSEQUENT REMOVAL; THIS DEPENDS ON HOW FIRMLY THE INTER–PCB PLUG CONNECTIONS TRY TO HOLD THE TWO PCB'S TOGETHER.
6) THE BLACK KNOB SHAFT WILL REMAIN IN PLACE INSIDE THE CASE.

METER REASSEMBLY INSTRUCTIONS:

1) SLIDE THE FRONT PCB INTO THE CASE, COMPONENT SIDE TOWARDS THE FRONT OF THE CASE, AND TAKING CARE TO ALIGN THE BLACK KNOB SHAFT'S KEY RIDGE WITH THE KEYWAY IN THE SWITCH 'S2' WAFER, AND ALSO TAKING CARE TO FIT THE KNURLED PROTRUSION OF THE POLARITY SWITCH S3 THROUGH THE SLIDING PLASTIC DUST COVER INSIDE THE FRONT OF THE CASE. THE TOP OF THE PCB MUST REST AGAINST THE REAR OF THE METER MOVEMENT. ON THE WESTON 660 METER, THE "E2+" BATTERY CONTACT WILL NEED TO BE CAREFULLY ALIGNED WITH ITS POSITION INSIDE THE CASE WHILE THE FRONT PCB IS BEING INSERTED INTO THE CASE. SLIDE ALL REMAINING BATTERY CONTACTS INTO THEIR RESPECTIVE SLOTS THAT ARE MOLDED INTO THE CASE.
2) SLIDE THE REAR PCB INTO THE CASE, COMPONENT SIDE TOWARDS THE FRONT OF THE CASE, AND TAKING CARE TO ALIGN THE SWITCH 'S1' WAFER'S KEYWAY WITH THE KEY RIDGE ON THE SWITCH SHAFT. THE REAR (FOIL SIDE) OF THE REAR PCB MUST BE FULLY INSIDE THE REAR EDGE OF THE CASE. SOME FORCE WILL BE NEEDED WHEN INSERTING THE REAR PCB, AS SEVERAL INTER–PCB CONNECTORS MUST MATE TOGETHER.
3) INSERT THE TWO LONG HEXAGONAL–HEAD BOLTS THROUGH THE REAR PCB HOLES ON EITHER SIDE OF THE METER MOVEMENT "M", AND WHEN THEIR HEADS ARE NEARLY AGAINST THE FOIL SIDE OF THE REAR PCB, TURN THEM CLOCKWISE TO SCREW THEM INTO THE THREADED HOLES IN THE METER MOVEMENT. NOTE THAT SHOULDERS ON THE TWO SCREWS PRESS AGAINST THE FOIL SIDE OF THE FRONT PCB, AND THIS IS WHERE THE ELECTRICAL CONNECTION TO THE METER MOVEMENT IS MADE.
4) USE A #12 HEX DRIVER, INSERTED THROUGH THE FRONT PANEL AT THE "– COM" AND "10ADC" JACK POSITIONS, TO SCREW THOSE TWO JACKS INTO THE SQUARE POSTS AT THOSE POSITIONS. WHEN THESE SCREWS ARE TIGHT, USE THE SAME HEX DRIVER TO INSERT THE FUSE HOLDER INTO THE POSITION FOR THE "+" JACK AND TURN CLOCKWISE UNTIL TIGHT (THE 2A FUSE MUST BE IN THE FUSEHOLDER).
5) INSERT THE "E1" AND "E2" BATTERIES INTO THEIR POSITIONS INSIDE THE CASE, TAKING CARE TO GET THEIR POLARITY CORRECT.
6) INSERT THE REAR PANEL BY FIRST SLIDING ITS TOP EDGE INTO THE RECESSES ON THE SIDES OF THE CASE'S REAR EDGE, THEN SLIDING THE TOP OF THE REAR PANEL TOWARDS THE TOP OF THE CASE, THEN PUSHING THE BOTTOM OF THE REAR PANEL DOWN INTO THE CASE AND SECURING IT WITH THE THUMBSCREW.

METER CALIBRATION INSTRUCTIONS:

1) REMOVE THE METER'S TEST LEADS. CAREFULLY USE A SMALL FLAT BLADE SCREWDRIVER TO RAISE THE UPPER LEFT OR UPPER RIGHT CORNER OF THE METER'S FRONT FACEPLATE (ABOVE EITHER OF THE TWO '1KV' JACKS), LIFTING THE CORNER JUST ENOUGH TO ALLOW SLIPPING THE SCREWDRIVER UNDER THE FACEPLATE UNTIL IT REACHES THE CIRCULAR FLANGE THAT SURROUNDS THE 'RANGE' SWITCH KNOB. THE LEXAN FACEPLATE IS HELD TO THE METER CASE ONLY BY ITS FRICTION FIT WITH THE RANGE SWITCH KNOB'S FLANGE. TWIST THE SCREWDRIVER SO THAT ITS BLADE ROTATES FROM A FLAT ORIENTATION TO A VERTICAL ORIENTATION, PRYING THE FACEPLATE AWAY FROM THE FRONT OF THE METER CASE. WORK THE SCREWDRIVER BLADE AROUND THE TOP EDGE OF THE KNOB FLANGE UNTIL THE FACEPLATE POPS LOOSE FROM THE FLANGE. REMOVE THE FACEPLATE AND SET IT UP SO THAT IT CAN BE REFERRED TO DURING CALIBRATION.
2) USE THE METER MOVEMENT'S 'ZERO ADJUST' SCREW, WHICH IS LOCATED ON THE METER'S FRONT PANEL BELOW THE BRAND NAMES "HEATHKIT" OR "WESTON", TO BRING THE METER POINTER TO THE '0' POSITION AT THE LEFT SIDE OF THE METER SCALE WHEN THE METER'S TEST LEADS ARE NOT CONNECTED TO ANYTHING. SET POLARITY SWITCH S3 TO ITS LEFT POSITION (AC/+).
3) ALL CALIBRATION STEPS BELOW ARE DONE BY INSERTING A SMALL FLAT–BLADE SCREWDRIVER THROUGH AVAILABLE OPENINGS IN THE FRONT OF THE METER CASE, ALIGNING THE BLADE WITH THE VARIOUS TRIM POTENTIOMETERS ON THE TWO PCB'S; WHEN ADJUSTING THE THE "LO CAL" (R8) AND "HI CAL" (R34) TRIM POTS, THE SCREWDRIVER MUST PASS THROUGH HOLES IN THE FRONT PCB IN ORDER TO REACH THE POTS ON THE REAR PCB.
4) SPECIAL STEP FOR THE WESTON 660 (NOT APPLICABLE TO THE IM–105): SET "DC CAL" TRIM POT R32 TO THE CENTER OF ITS ROTATION. TURN THE RANGE KNOB UNTIL IT IS IN THE "0.05mA" POSITION. WITH THE TEST LEADS IN THE "+" AND "– COM" JACKS, CONNECT THE METER IN SERIES WITH ANOTHER MILLIAMMETER (e.g. A MODERN DIGITAL MULTIMETER IN "mA" MODE), AND A 100k RESISTOR AND A LOW VOLTAGE POWER SUPPLY CAPABLE OF PROVIDING A STABLE 5V WHILE BEING ABLE TO FINELY ADJUST THE VOLTAGE. ADJUST THE VOLTAGE UNTIL THE DIGITAL MULTIMETER SHOWS 50uA (0.05mA). ADJUST THE 250k TRIM POT ON THE WESTON 660 METER'S FRONT PCB (ADJACENT TO THE METER MOVEMENT'S "+" TERMINAL) UNTIL A FULL SCALE METER READING (0.05mA) IS REACHED. THIS PROCESS SHOULD SET THE METER MOVEMENT'S SHUNT (THE TRIM POT) TO HAVE THE MOVEMENT RESPONDING WITH ITS RATED FULL SCALE READING WHEN 50uA IS PASSED THROUGH IT. NOTE THAT THIS PROCEDURE WAS ARRIVED AT WITHOUT THE BENEFIT OF THE WESTON METER'S OFFICIAL CALIBRATION INSTRUCTIONS, AND THERE MIGHT BE A BETTER METHOD.
5) DC VOLTS CALIBRATION METHOD A: TURN THE RANGE KNOB TO THE 0.05mA POSITION. APPLY A PRECISION 0.250V DC VOLTAGE TO THE TEST LEADS, AND ADJUST THE "DC CAL" TRIM POT R32 TO GET A FULL SCALE METER READING. METHOD B: TURN THE RANGE KNOB TO THE 10VDC POSITION, APPLY A KNOWN REGULATED 5VDC POWER SOURCE TO THE TEST LEADS, AND ADJUST "DC CAL" R32 TO GET A 5V METER READING (OTHER KNOWN VOLTAGES IN THE SAME RANGE WILL ALSO WORK, e.g. A 10V SOURCE WILL REQUIRE ADJUSTING FOR A FULL SCALE READING). FOR THE WESTON 660, IF THE METER CANNOT BE CALIBRATED IN THIS STEP, THAT PROBABLY MEANS THAT THE METER MOVEMENT SHUNT TRIM POT, ADJUSTED IN STEP 4, ABOVE NEEDS TO BE SLIGHTLY TWEAKED AND THEN RETRY THIS STEP.
6) AC HIGH VOLTS CALIBRATION: USE A VARIAC (ADJUSTABLE VOLTAGE AC TRANSFORMER), AND CONNECT A MODERN VOLTMETER TO IT, ADJUSTING THE VARIAC FOR SOME STABLE VOLTAGE AROUND 100VAC. TURN THIS IM–105/W–660 METER'S RANGE KNOB TO THE 250VAC POSITION, AND CONNECT ITS TEST LEADS TO THE VARIAC, AND ADJUST THE "HI CAL" TRIM POT R34 TO GET A READING OF 100V ON THE AC SCALE OF THE METER. NOTE THAT THE AC AND DC SCALES ARE SLIGHTLY OFFSET, BUT THE RANGE NUMBERING IS SHOWN ONLY ONCE IN BETWEEN THE TWO SCALES; IT IS NECESSARY TO MENTALLY OFFSET THE NUMBERING TO THE APPROPRIATE SCALE WHILE CALIBRATING OR USING THE METER.
7) AC LOW VOLTS CALIBRATION METHOD A: SIMILARLY TO CALIBRATING FOR HIGHER VOLTAGE, USE A VARIAC TO PRODUCE A VOLTAGE OF 2.5VAC, VERIFYING WITH ANOTHER METER. WITH THE RANGE KNOB IN THE 2.5VAC POSITION, ADJUST THE "LO CAL" TRIM POT R8 FOR A FULL SCALE METER READING. METHOD B: USE A FUNCTION GENERATOR CAPABLE OF OUTPUTTING A PRECISION SINE WAVE OF LOW FREQUENCY (RECOMMENDED BETWEEN 50Hz AND 100Hz) AT A LOW VOLTAGE OF 2.5VAC, VERIFIED WITH ANOTHER METER, AND WITH THE TEST LEADS CONNECTED TO THE FUNCTION GENERATOR, ADJUST "LO CAL" TRIM POT R8 FOR A FULL SCALE METER READING.
8) THIS METER DOES NOT HAVE A MEANS TO CALIBRATE DC mA/AMPS OR RESISTANCE/OHMS, RELYING ON COMPONENT TOLERANCES TO MAINTAIN ACCURACY. HOWEVER, WHEN MEASURING RESISTANCE, ALWAYS START BY CONNECTING THE TEST LEADS TOGETHER AND ADJUSTING THE METER'S FRONT PANEL "Ω" (OHMS) THUMBWHEEL (R36) FOR A FULL SCALE READING, PRIOR TO CONNECTING THE TEST LEADS TO THE RESISTOR/RESISTANCE TO BE MEASURED. NOTE THAT THIS METER HAS TWO BATTERIES WHICH ARE USED ONLY WHEN MEASURING RESISTANCE; THE "E1" BATTERY IS USED FOR ALL OHMS RANGES BELOW X 10k, WHILE THE 15V "E2" BATTERY IS USED ONLY FOR THE X 10k RANGE. IF THE METER SEEMS TO BE WORKING PROPERLY IN ONE OHMS RANGE BUT NOT ANOTHER, IT MIGHT BE DUE TO ONE OF THE BATTERIES BEING DEPLETED AND IN NEED OF REPLACEMENT.
9) WITH CALIBRATION COMPLETED, REMOVE THE TEST LEADS FROM THE METER AND REPLACE THE FACEPLATE BY POSITIONING IT WITH ITS CENTRAL ROUND CUTOUT OVER THE RAISED FLANGE OF THE RANGE SWITCH KNOB, AND THEN STARTING AT THE TOP OF THE CUTOUT, FIRMLY PRESS THE FACEPLATE DOWN AGAINST THE FRONT OF THE METER CASE, WORKING AROUND THE SWITCH TOWARDS THE BOTTOM OF THE CUTOUT, UNTIL THE FACEPLATE IS FLAT AGAINST THE CASE; IT IS HELD IN PLACE BY FRICTION BETWEEN ITS CUTOUT AND THE RANGE SWITCH'S RAISED FLANGE.

SPECIFICATIONS:

DC VOLTS –
- SIX RANGES, 0.25V (USE THE 0.05mA RANGE SWITCH POSITION), 2.5V, 10V, 50V, 250V, 500V, PLUS 1000V AND AND 5000V USING THE DEDICATED JACKS
- INPUT RESISTANCE (SENSITIVITY) 20,000 OHMS PER VOLT
- ACCURACY IS +/– 3% OF FULL SCALE, CALIBRATED TO STANDARDS

AC VOLTS –
- SIX RANGES, 0.25V (USE THE 0.05mA RANGE SWITCH POSITION), 2.5V, 10V, 50V, 250V, 500V, PLUS 1000V AND AND 5000V USING THE DEDICATED JACKS
- INPUT RESISTANCE (SENSITIVITY) 5,000 OHMS PER VOLT
- INPUT CAPACITANCE IS LESS THAN 20pF
- ACCURACY IS +/– 4% OF FULL SCALE
- FREQUENCY RESPONSE (LOW IMPEDANCE SOURCE) 10Hz TO 100kHz ON 2.5V, 10V, 50V RANGES, 10Hz TO 50kHz ON 250V AND 500V RANGES, NOT SPECIFIED FOR 1kV & 5kV 'RANGES'
- MAXIMUM AC VOLTAGE + DC VOLTAGE OFFSET = 400V

DC AMPS –
- MICROAMPS (0.05mA / 50uA RANGE)
  - VOLTAGE DROP = 0.25V AT FULL SCALE
  - INSERTION RESISTANCE = 5kOHM
  - ACCURACY IS +/– 2% OF FULL SCALE
- MILLAMPS (1, 10, 100, 500mA RANGES)
  - VOLTAGE DROP = FULL SCALE CURRENT MULTIPLIED BY THE INSERTION RESISTANCE
  - INSERTION RESISTANCE = 250 Ω IN 1mA RANGE, 26.2 Ω IN THE 10mA RANGE, 2.63 Ω IN 100mA RANGE, 0.526 Ω IN 500mA RANGE
  - ACCURACY IS +/– 3% OF FULL SCALE
- AMPS (USING THE DEDICATED 10ADC JACK)
  - VOLTAGE DROP = 0.270V
  - INSERTION RESISTANCE = 0.027 Ω
  - ACCURACY = +/– 3% OF FULL SCALE

RESISTANCE –
- FIVE RANGES, RX1 (APPROXIMATELY 20Ω CENTER SCALE), RX10, RX100, RX1k, RX10k
- ACCURACY = +/– 3% OF ARC
- SOURCE VOLTAGE
  - 1.5V (RX1, RX10, RX100, RX1k)
  - 15V (RX10k)

DECIBEL (dB) –
- (0 dB = 1mW INTO 600 Ω)
  - –10 TO +10 ON 2.5V RANGE
  - +2 TO +22 ON 10V RANGE (ADD 12 dB TO READING)
  - +16 TO +36 ON 50V RANGE (ADD 26 dB TO READING)
  - +30 TO +50 ON 250V RANGE (ADD 40 dB TO READING)
  - +36 TO +56 ON 500V RANGE (ADD 46 dB TO READING)

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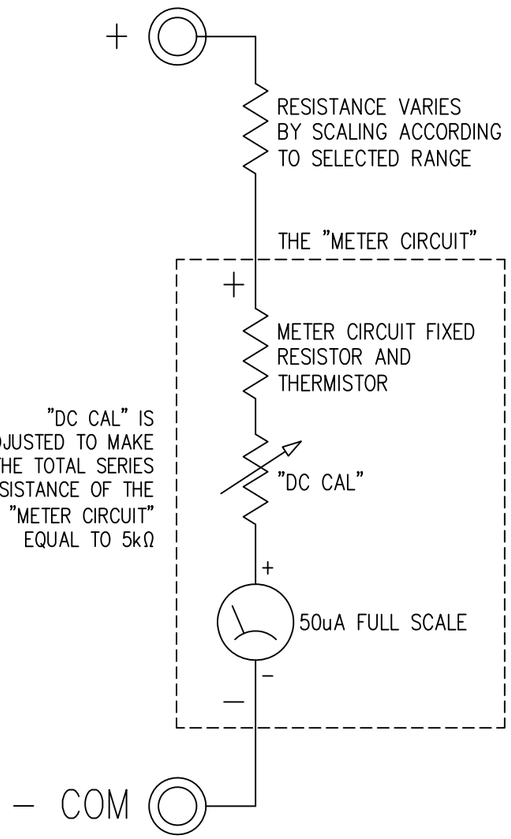
HEATHKIT IM–105 MULTIMETER (ALSO FOR WESTON 660) SCHEMATIC DIAGRAM

SHEET 3 OF 4

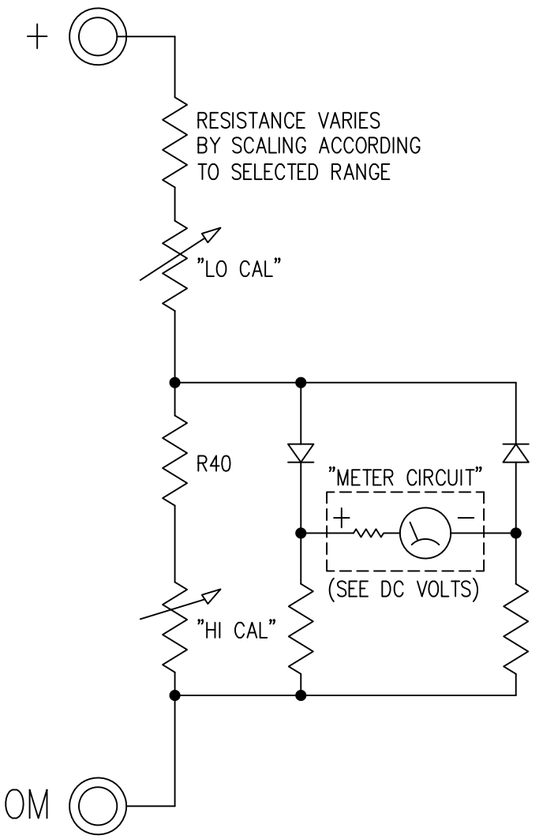
SIMPLIFIED THEORY OF CIRCUIT OPERATION

DC VOLTS



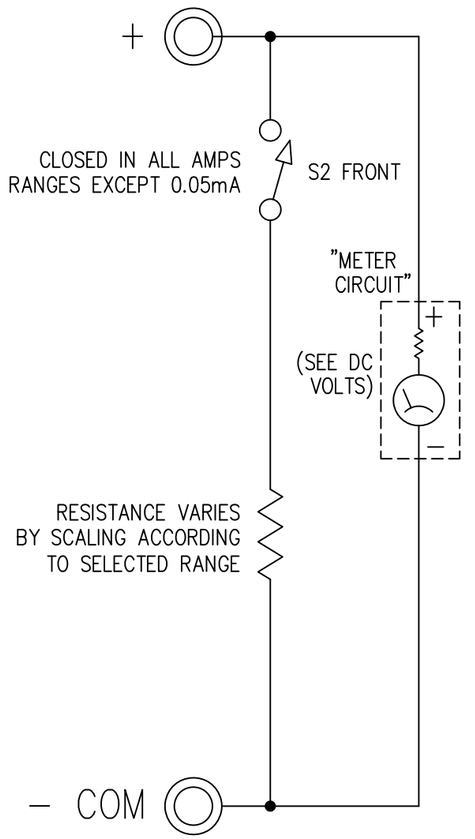
THE 'METER CIRCUIT" BLOCK IS CALIBRATED TO HAVE AN OVERALL RESISTANCE OF 5kΩ. IN THE LOWEST DC VOLTS RANGE (2.5VDC), AN ADDITIONAL SERIES RESISTANCE OF 45k IS ADDED, FOR A TOTAL OF 50k, SO A VOLTAGE OF 2.5V APPLIED ACROSS THE '+' AND '– COM' TERMINALS RESULTS IN A CURRENT OF 50uA THROUGH THE METER, GIVING A FULL–SCALE READING. FOR HIGHER VOLTAGE RANGES, THE ADDED SERIES RESISTANCE IS INCREASED FROM 45k TO LIMIT THE FULL–SCALE CURRENT TO 50uA.

AC VOLTS



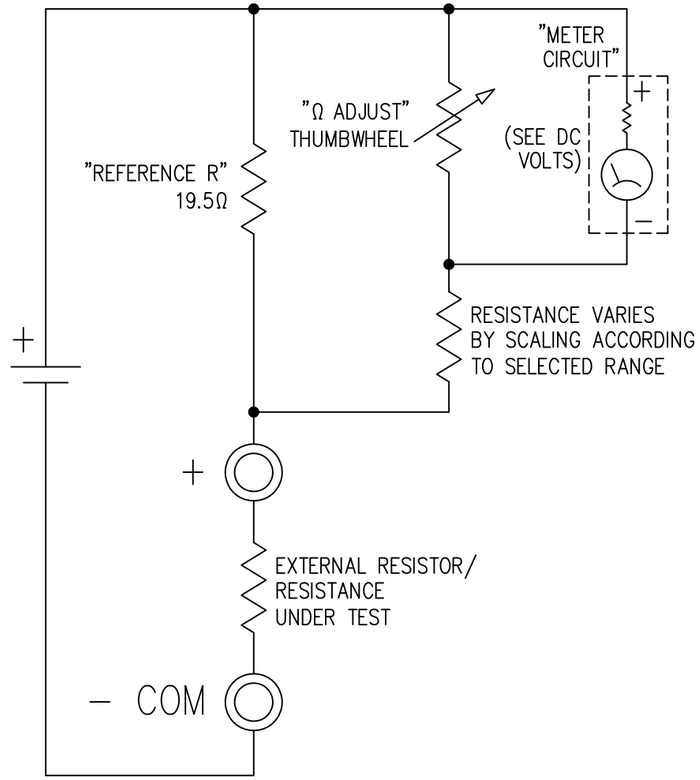
THE 'METER CIRCUIT" BLOCK IS IDENTICAL TO THAT OF THE DC VOLTS FUNCTION. A RECTIFIER, CONSISTING OF TWO DIODES AND TWO RESISTORS, CHANGES THE AC CURRENT IN THE CIRCUIT TO A DC CURRENT SUITABLE FOR THE "METER CIRCUIT". A VARIABLE RESISTANCE ("HI CAL" & R40) ACROSS THE RECTIFIER ACTS TO SHUNT SOME CURRENT AROUND THE RECTIFIER AND "METER CIRCUIT", ALLOWING GENERAL AC CALIBRATION. A VARIABLE SERIES RESISTANCE ("LO CAL") ALLOWS ADDITIONAL CALIBRATION IN THE LOWEST RANGES. AS WITH THE DC VOLTS CIRCUIT, ADDITIONAL RESISTANCE IS ADDED AS REQUIRED IN THE DIFFERENT RANGES.

DC AMPS



THE 'METER CIRCUIT" BLOCK IS IDENTICAL TO THAT OF THE DC VOLTS FUNCTION. IN THE LOWEST RANGE, 0.05mA (50uA), THE CURRENT BEING TESTED IS PASSED DIRECTLY THROUGH THE "METER CIRCUIT" SINCE IT RESPONDS TO 50uA WITH A FULL–SCALE READING. IN THE HIGHER RANGES, A VARIABLE SHUNT RESISTANCE IS ADDED IN PARALLEL WITH THE "METER CIRCUIT", SUCH THAT MOST OF THE TESTED CURRENT FLOWS THROUGH THE SHUNT, AND ONLY A MAXIMUM OF 50uA FLOWS THROUGH THE "METER CIRCUIT". THIS METER DOES NOT MEASURE AC AMPS.

OHMS



THE 'METER CIRCUIT" BLOCK IS IDENTICAL TO THAT OF THE DC VOLTS FUNCTION. AN EXCITATION VOLTAGE FROM THE BATTERY CAUSES CURRENT TO FLOW THROUGH A PRIMARY RESISTOR VOLTAGE DIVIDER COMPRISED OF THE "REFERENCE R" AND THE RESISTOR UNDER TEST. WITH DIFFERENT TEST RESISTANCES, THE VOLTAGE DROP ACROSS THE "REFERENCE R" CHANGES. A SECONDARY VOLTAGE DIVIDER, WITH A RESISTANCE MUCH HIGHER THAN THE FIRST DIVIDER (TO MINIMIZE LOADING), AND COMPRISED OF THE "Ω ADJUST" THUMBWHEEL POTENTIOMETER AND A VARIABLE SCALING RESISTANCE, TAKES A FRACTION OF THE VOLTAGE DROPPED ACROSS THE "REFERENCE R" AND APPLIES IT TO THE "METER CIRCUIT".

IN THE ABOVE FOUR SIMPLIFED CIRCUIT DIAGRAMS, WHERE A RESISTOR IS SHOWN WITH THE TEXT "RESISTANCE VARIES BY SCALING ACCORDING TO SELECTED RANGE", IT REPRESENTS THE COMBINATION OF SCALING RESISTORS AS SELECTED BY THE RANGE SWITCH "S1 REAR" FOR EACH FUNCTION AND RANGE.

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HEATHKIT IM–105 MULTIMETER
(ALSO FOR WESTON 660)
SCHEMATIC DIAGRAM
SHEET 4 OF 4