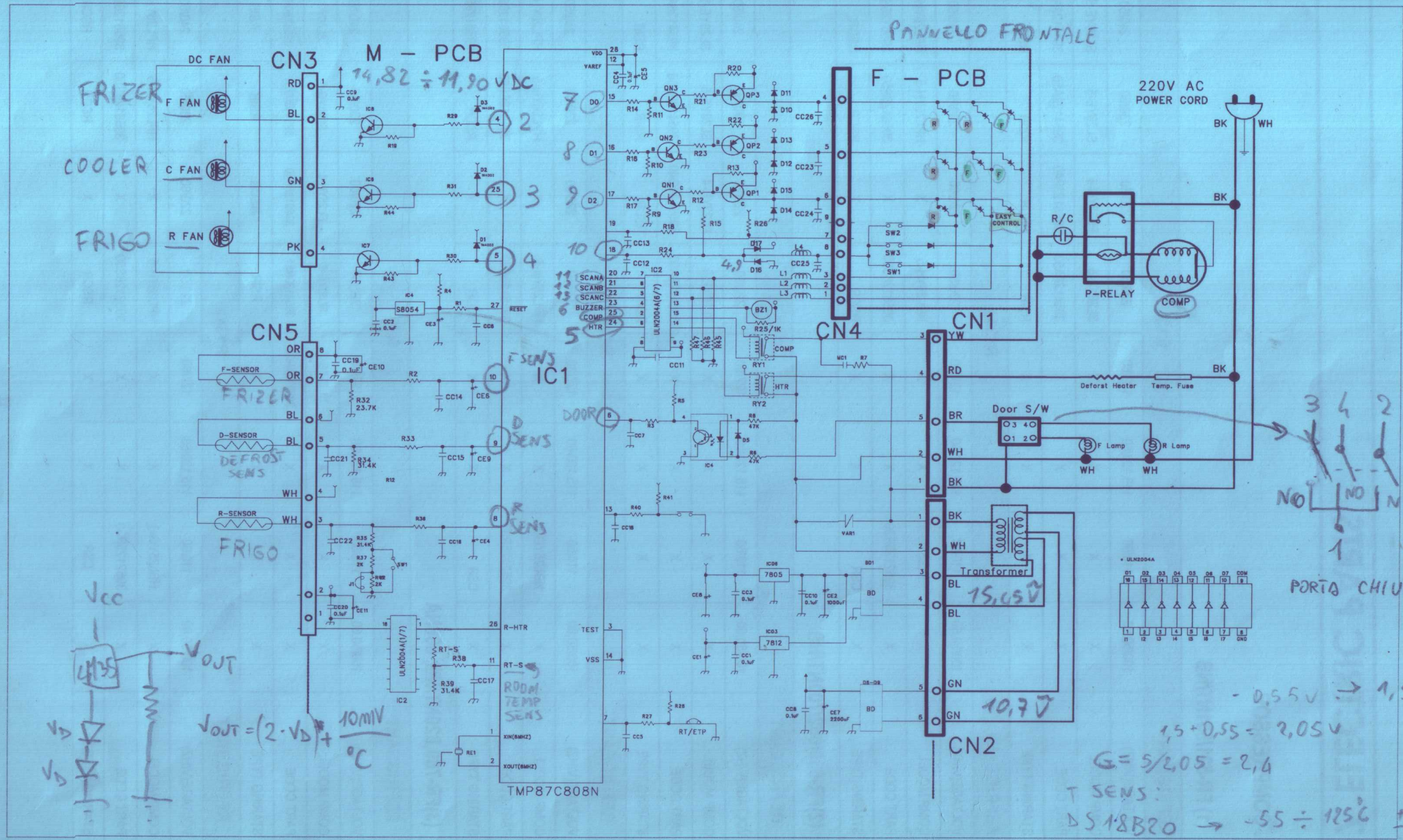
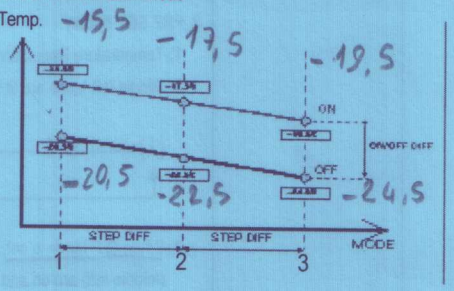
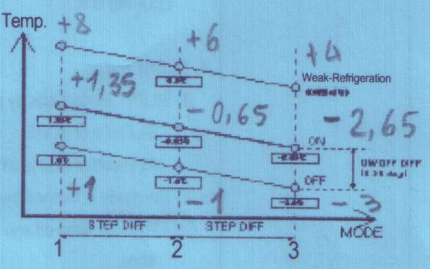
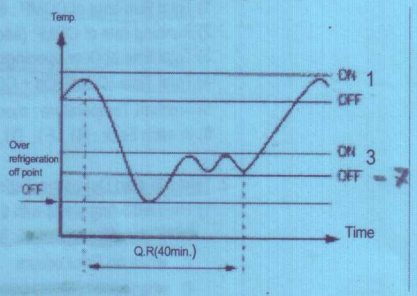
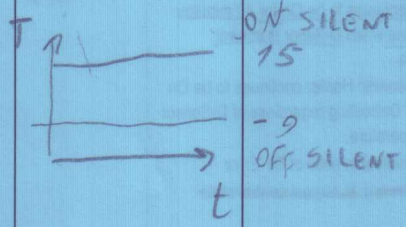
5. CIRCUIT DIAGRAM (FR-630,662,700,780,820NT/NB,860NA)



NO	CONTROL FUNCTION	CONTROL OBJECTS	CONTENTS	REMARK
2	Temperature Regulation of Freezer Compartment	1. COMP 2. F-FAN	1. Temperature regulation by FRZ.SET Button. (1) → 1 → 2 → 3 → Q.F 2. COMP and F-Fan are controlled by On/Off point of each mode. 3. Freezer Compartment ON / OFF DIFF : 5℃ (Middle(2)-OFF : -22.5) 4. "3 "/ "1" DIFF : 2℃ 5. Control Point of each Mode  6. COMP and F-FAN are ON during Q.F Mode regardless of F-Sensor. (Approximately 150minutes)	▶ Reference ON/OFF Diff : Fixed by Micom STEP Diff : Fixed by Micom Comp&C-Fan are Coworking
3	Temperature Regulation of Refrigerator (Freshfood Compartment)	1. COMP 2. R-FAN	1. Temperature regulation by REF.SET Button. (1) → 1 → 2 → 3 → Q.F 2. R-Fan is controlled by On/Off-point of each mode. 3. ON / OFF DIFF : 0.35℃ (Middle("1") Off-point : -1.0℃) 4. "3" / "1" DIFF : 2℃  5. Prevention of Weak-refrigeration 1) When weak-refrigeration is sensed, COMP turns on regardless of F-Sensor. 2) When R-Sensor reaches to R-Fan Off-point, COMP is controlled by F-Sensor and R-FAN turns off. 3) Sensing point of weak-refrigeration ; R-S Off-point of each mode +7℃ 4) Finishing point of weak-refrigeration ; same as R-S Off-point 6. Q.R(Quick Refrigeration) continues for 40minutes.	ON/OFF, Diff : Can not be changed STEP DIFF : Can not be changed → RSens < RTon

NO	CONTROL FUNCTION	CONTROL OBJECTS	CONTENTS	REMARK
3	Temperature Regulation of Refrigerator (Freshfood Compartment)	1. COMP 2. R-FAN	* In case Q.R starts during 1(refrigeration) mode  1) R-Fan and COMP continue to be On until the R-Sensor reaches to Off-point(-7℃) of over-refrigeration. 2) It continues to be 3 until Q.R ends after reaching to Off-point of over-refrigeration. 3) It returns to normal[previous] state when Q.R (40 minutes) ends.	
4	SILENT Control  	1. COMP 2. R-FAN 3. F-FAM 4. Custom LED	1. SILENT Mode starts by pressing the button. 2. Terms to start SILENT Mode ① F-Sensor ≤ 15℃ ② Restart of SILENT within 40 minutes after the mode ③ F-Sensor error ④ Door Switch error ⑤ In Defrosting Mode (HTR Defrosting, Pause, Fan-delay) ⑥ SILENT starts if conditions ① to ⑤ happen. 3. Once SILENT starts, all the electric devices (COMP, F-Fan, R-Fan) turn Off and only SILENT Icon is lit. 4. Terms to finish SILENT Mode ① F-Sensor ≥ -9℃ ② More than 130 minutes of Limit-time ③ F-Sensor error ④ In case any other button is pressed during SILENT Mode ⑤ Door opened time is more than 30 seconds during the mode. ⑥ If the mode is finished by ①, ② and ③, F/R-Fan Delay time is set to 5 minutes, and prevention of SILENT Restart time is set to 40 minutes. 5. When the mode is finished all the electric devices and C-LEDs return to normal [previous] state. 6. Pre-cool continues after SILENT Mode. 7. Q.F and Q.R continue after SILENT Mode for the rest time.	

<table>
<tr><th>NO</th><th>CONTROL FUNCTION</th><th>CONTROL OBJECTS</th><th>CONTENTS</th><th>REMARK</th></tr>
<tr><td>5</td><td>Defrosting Period</td><td>1. Defrosting Mode</td><td>1. What to be considered in determining Defrosting Period
1) Total Run-time of COMP : 6, 8, 10, 12, 14 hours
2) Running-rate of COMP (each 2hours running-rate) : more than 80%
3) Total time of Door openings : 10minutes
4) Total Time (COMP-On + COMP-Off) : 60hours
5) Ambient Temperature : more than 35℃
6) In each Error : R1, F1, D1, F3, RT-S, Door-SW Error

2. Terms to start Defrosting Period
1) The Defrosting starts with the following conditions, in case total COMP-run time passes 6, 8, 10 or 12hours
ç when an Error occurs
è when running-rate of COMP is more than 80%
ë when total Door-opening time is more than 10minutes
ê when the ambient temperature is more than 35℃
2) Defrosting starts unconditionally when total COMP-run time passes 14 hours, under the condition that terms of 1) are not satisfied.
3) Defrosting starts immediately when Total-time (COMP-On + Off time) is more than 60 hours, under the condition that terms of 1) and/or 2) are not satisfied.</td><td></td></tr>
<tr><td>6</td><td>Defrostiong Mode</td><td>1.COMP
2. F-FAN
3. R-FAN
4. HEATER</td><td>1. Defrosting Period

Pre-cool
1) Time : 50minutes.
2) COMP and F-Fan are On, R-fan is in Control, and HTR is off
3) Pre-cool turns off when F-Sensor ≤ -27℃.

Heater Defrostiong
1) Heater turns off when D-Sensor ≥ 10℃.
2) Limit time : 80minutes
3) Heater continues to be On for 40 minutes of limit time when D-Sesor is in error.
4) Limit time
① 30seconds: Heater continues to be On after Defrosting regardless of D-Sensor temperature.
② 40minutes: in case of D1-Error
③ 80minutes: in normal control state

Pause
1) Time : 4minutes
2) COMP, F-Fan and R-Fan are Off.

Fan-delay
1) Time : 5minutes
2) Only COMP is On, while F or R-Fan is Off.

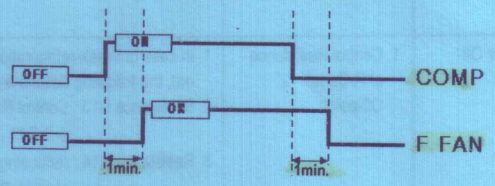
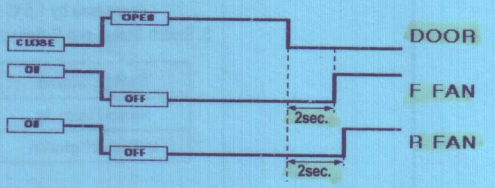
2. Output Control and Limit Time of each Defrosting Mode
<table><tr><th></th><th>Pre-cool</th><th>HTR Defrosting</th><th>Pause</th><th>Fan-delay</th></tr><tr><td>COMP</td><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td></tr><tr><td>F-Fan</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td></tr><tr><td>R-Fan</td><td>Control</td><td>OFF</td><td>OFF</td><td>OFF</td></tr><tr><td>Heater</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td></tr><tr><td>Limit Time</td><td>50 min.</td><td>① 80 min.
② 40 min.
(In D-Sensor error)</td><td>4 min.</td><td>5 min.</td></tr></table></td><td>50 min

80 min MAX

4 min

5 min

C-Fan and COMP are co-working.
stesso pin nel IC.</td></tr>
</table>

NO	CONTROL FUNCTION	CONTROL OBJECTS	CONTENTS	REMARK
			4) d1 Error ① Occurrence : D-Sensor disconnection/short-circuit ② Control : by limit time(40min.) of Defrosting-return ③ Dissolution : if D-Sensor is in normal state, it is finished by itself. 5) door Error ① Occurrence : when door-opening is sensed for more than 1 hour ② Control : deletion of Door SW sensing function ③ Dissolution : if Door SW open-close is sensed, it ends by itself. ④ Display dissolution : after Custom LED Display Mode (Door SW should be in normal state if Error Display Mode is to start.) 6) C1 Error ① Occurrence : when COMP runs continuously for more than 3 hours while D-Sensor is above -5℃ ② Control : normal running ③ Dissolution : when D-Sensor temperature is below -5℃ while Comp is Off 7) F3 Error ① Occurrence : by limit time of 80min. at defrosting-return ② Control : deletion of Pre-cool mode at defrosting mode ③ Dissolution : the end of defrosting is done by D-Sensor	
8	Forced Defrosting	1. Defrosting Mode	※ A/S (Heater) Forced Defrosting 1. Start : press REF.SET Button 5 times while pressing FRZ.SET Button (It is impossible in the state of Energy Consumption Forced Defrosting.) 2. Process 1) Let Heater On for 30seconds. 2) Delete Pre-cool of normal defrosting mode. HTR Defrosting → Pause → Fan Delay → Normal Running 3. Heater turns Off when D-Sensor temperature is more than 10, 30 seconds after Heater On.	
9	Time Delay of Electric Devices	1. F-Fan 2. R-Fan	1. F-Fan Time Delay in COMP On/Off ☞ F-Fan turns On/Off 1 minute after COMP On/Off.  2. F-fan, R-fan will be delayed to open door easily. 	
10	Initial Defrosting	Defrosting Mode	1. Defrosting mode starts when D-Sensor ≤ 3.5℃ at initial power supply. (It starts from Pre-cool.)	COMP delayed for 6min. at initial defrosting

<table>
<tr><th>NO</th><th>CONTROL FUNCTION</th><th>CONTROL OBJECTS</th><th>CONTENTS</th><th>REMARK</th></tr>
<tr><td>11</td><td>Explanation after Delivery</td><td>Electric Devices</td><td>1. Start : press both buttons for 3 seconds after initial power supply (plug-in).
2. Electric devices turn Off for 3 hours.
3. Display works in normal way.</td><td></td></tr>
<tr><td>12</td><td>Prevention of COMP Restart</td><td>COMP</td><td>1. COMP does not restart for 6 minutes after COMP Off, though F-Sensor turns On.</td><td>6min. delay</td></tr>
<tr><td>13</td><td>Buzzer Alarm</td><td>Buzzer</td><td>1. Buzzer rings by pressing F-PCB Buttons.
2. Buzzer rings for 1 second after initial power supply (plug-in).
3. Buzzer rings for 1 second at the start of A/S Forced Defrosting.
4. Buzzer rings every 1 minute after door opening.
(It rings within 5minutes and ring-time is prolonged as time passes.)
5. Buzzer makes short ring every 5 seconds in Error Display.</td><td></td></tr>
<tr><td>14</td><td>Demonstration Function</td><td>Electric Devices</td><td>1. Start : open and close Refrigerator[Freshfood Compartment] Door 5 times while pressing FRZ.SET Button.

2. Control
1) Electric devices turn Off except for F-Fan and R-Fan.
2) Fan Control
<table>
<tr><th></th><th>Door Open</th><th>Door Close</th></tr>
<tr><td>F-FAN</td><td>ON</td><td>OFF</td></tr>
<tr><td>R-FAN</td><td>ON</td><td>OFF</td></tr>
</table>
3. Dissolution :
1) Open and close Refrigerator[Freshfood Compartment] Door 5 times while pressing REF.SET Button in Demonstration mode.
2) Supply the power again(plug-out and plug-in)</td><td></td></tr>
<tr><td>15</td><td>Control of R-Sensor Off-Point</td><td>1. Control Resistance of R-Sensor “2” Off-point</td><td>1. In case of Weak-refrigeration (though R-Fan and COMP work on and on), the following actions are to be done.
2. Resistance R13 : Control Resistance of R-Sensor Middle(“2”) Off-point (- 1.0℃ , 31.4 kΩ)
3. Resistance R14 : reduceing R-Sensor Resistance by 1.5Ę in case of weak-Refrigeration (-2.5℃ , 2.15 kΩ)
4. SW1 : during A/S, if SW1 is opened, R-Sensor Middle Off-point decreases by 1.5℃.
5. Switch Status and R-Sensor Middle Off-point
<table>
<tr><th>Switch Status</th><th>R-Sensor Middle Off-point</th></tr>
<tr><td>Normal / Using Jig</td><td>-1.0</td></tr>
<tr><td>In Weak-refrigeration</td><td>-2.5</td></tr>
</table></td><td></td></tr>
</table>

CN 1

BK, WH } 230,9 ~V — common input compressor
YW
RD
BR → con WH 230~V porte chiuse
1~V porte aperte

CONDENS.

4 µF
400 VAC
PO CLASS C
EAF 40405
ARANCIONE
GIALLO

CN2 tensioni di servizio

BK
\
WH } 233,7 ~V — ~~common~~ input
~~output~~ common

\

BL
BL } 15,45 ~V — out 1

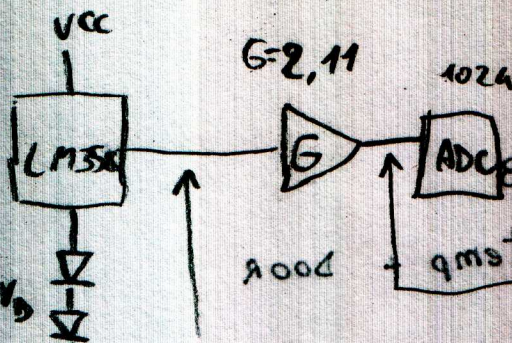
GN
GN } 10,7 ~V — out 2

CN3 ventole

RD VCC 14,82 VDC
BL freezer fan
GN compressor fan
PK frigo fan

CN4

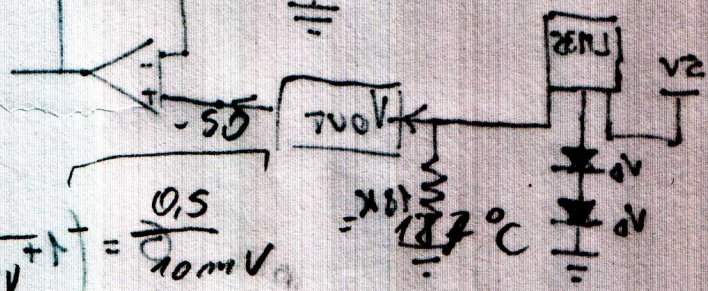
WH
WH



$$V_{OUT} = m V_D + \frac{10mV}{^\circ C} \cdot T^\circ C$$

$$SIG = m V_D G + G \frac{10mV}{^\circ C} T$$

$$T = \frac{SIG - m V_D G}{G \cdot 10mV} = \frac{SIG}{G \cdot 10mV} - \frac{m V_D}{10mV}$$



$$\frac{V_{OUT}}{2} = \left(1 + \frac{R_2}{R_1}\right) \frac{0,5}{10mV}$$

$$\frac{10\,mV}{^\circ C} + (2 \cdot V_D) = V_{OUT}$$

$$G = 2,1$$

$$R_1 = 10k \quad R_2 = 11k$$

SET UP

I-O : 16

→ 12 digitali → pin 2 ÷ 13

→ 4 analogici → 3 sens temp + DOOR

OP AMP

OUTPUT

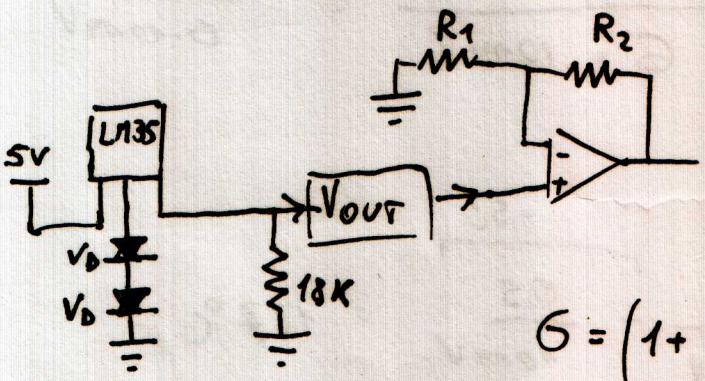
↳ #11 BUFFER

alimentazione dei buffer a 12V per evitare saturazione uscita 5V

TOT #6 LM358

TEMP SENS

LM35C (-40° ÷ 140°C)



$V_{OUT} = (2 \cdot V_D) + \frac{10\ mV}{°C}$

DIODI 1N4148

(testare se basta 1 diodo per avere $V_{OUT_{MIN}} = 0V$)

$G = \left(1 + \frac{R_2}{R_1}\right) = \frac{5\ V}{2,38\ V}$

$V_{OUT_{MAX}}$ @ 140°C e 1 diodo $V_D = 0,7$

$G = 2,1$

$R_1 = 10K \quad R_2 = 11K$

- Sensibilità ~~40~~C arduino ≃ 5 mV
- sensibilità uscita OPAMP: ~~21~~ mV/°C cioè 4,2 unità analogiche Arduino.

$n = (ST - 1) / 3$

$C = (ST - 1) \% 3$

$ST = (3 \cdot n) + C + 1$

r \ C	0	1	2
0	1	2	3
1	4	5	6
2	7	8	9