

[4040/SQP205]

Standard Grade
Technological Studies

NATIONAL
QUALIFICATIONS

Data Booklet

For the use of candidates during revised Standard Grade coursework and in examinations.

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Basic Units

Quantity	Symbol	Unit	Abbreviation
Length	l, L	metre	m
Distance	s, x	metre	m
Area	a	metre ²	m ²
Time	t	second	s
Velocity	v	metre/second	m/s
Mass	m	kilogram	kg
Weight	w	newton	N
Force	F	newton	N
Work	W	joule	J
Energy	E	joule	J
Power	P	watt	W
Torque	T	Newton metre	Nm
Temperature	t	kelvin, celsius	K, °C
Current	I	ampere	A
Voltage	V	volt	V
Resistance	R	ohm	Ω
Frequency	f	hertz	Hz
Capacitance	C	farads	F

Decimal Prefixes

Prefix	symbol	multiplying factor
tera	T	10 ¹²
giga	G	10 ⁹
mega	M	10 ⁶
kilo	k	10 ³
milli	m	10 ⁻³
micro	μ	10 ⁻⁶
nano	n	10 ⁻⁹
pico	p	10 ⁻¹²

Formulae

Pneumatic Systems

Pressure, force & area $P = \frac{F}{a}$ $F = Pa$ $a = \frac{F}{P}$

Area of circle $a = \frac{\pi d^2}{4}$ $d = \text{Diameter}$ π is 3.14

Energy & Power

Potential energy $E_p = mgh$

Gravity $g = 9.81 \text{ m/s}^2$

Kinetic energy $E_k = \frac{1}{2} mv^2$

Strain energy $E_s = \frac{1}{2} Fx$ x is change in length

Electrical energy $E_e = VIt$

Heat energy $E_h = Cm \Delta T$ C is specific heat capacity in J/kgK
 C of water $C_w = 4190 \text{ J/kgK}$

Work done $W = Fs$

Power $P = \frac{E}{t}$ or $\frac{W}{t}$

Electrical power $P = VI$ or $\frac{V^2}{R}$ or $I^2 R$

Mechanical power $P = Fv$
 $P = 2\pi nT$ π is 3.14
 T is torque in Nm
 n is number of rev/s

Torque $T = Fr$

Efficiency $\eta = \frac{\text{Output Energy}}{\text{Input Energy}}$ or $\frac{\text{Output Power}}{\text{Input Power}}$

Mechanical Systems

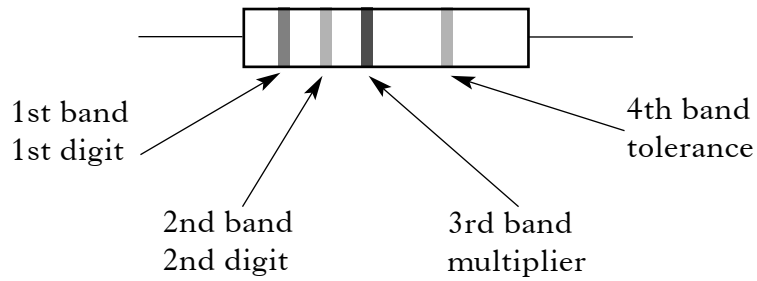
Mechanical Advantage	$MA = \frac{\text{Load}}{\text{Effort}}$
Velocity Ratio	$VR = \frac{\text{distance moved by effort}}{\text{distance moved by load}}$
Torque	$T = Fr$
Efficiency	$\eta = \frac{MA}{VR}$
Moment of force	$M = Fx$ x is the perpendicular distance
Principle of moments	$\Sigma \text{ moments} = 0$ or $\Sigma \text{ CWM} = \Sigma \text{ ACWM}$
Circumference of circle	$c = \pi d$ π is 3.14

Electrical/Electronic

Ohm's law	$V = IR$ $R = \frac{V}{I}$ $I = \frac{V}{R}$
Resistors in series	$R_t = R_1 + R_2 + R_3$
Resistors in parallel	$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
for 2 resistors in parallel	$R_t = \frac{R_1 R_2}{(R_1 + R_2)}$
Kirchoff's 1st Law (parallel branch)	$I_t = I_1 + I_2 + I_3 \dots$
Kirchoff's 2nd Law (series circuit)	$V_t = V_1 + V_2 + V_3 + \dots$
Voltage Divider	$\frac{V_1}{V_s} = \frac{R_1}{R_t}$
Bi-polar transistor gain	$h_{FE} = \frac{\text{Collector current } (I_c)}{\text{Base current } (I_b)}$ $I_e \approx I_c$
Saturated Transistor	$V_{be} = 0.7 \text{ V}$

Resistor Colour Coding

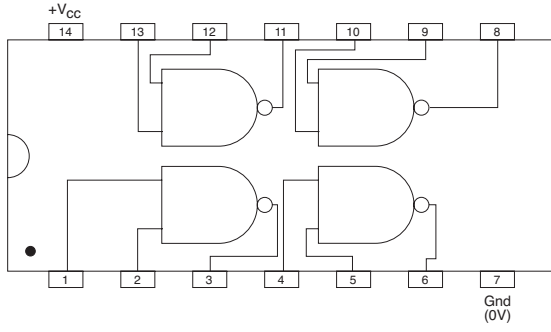
4 Band Resistor Colour Code Layout



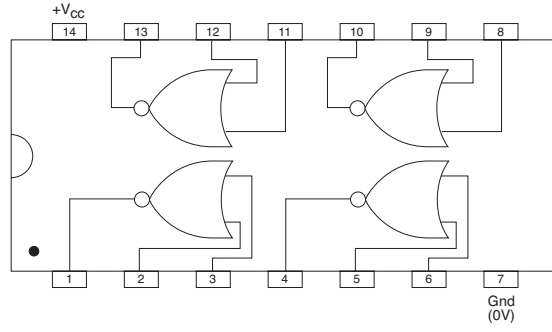
1st and 2nd Colour Band	Digit	Multiplier
Black	0	$\times 1$
Brown	1	$\times 10$
Red	2	$\times 100$
Orange	3	$\times 1000$ or 1 k
Yellow	4	$\times 10\,000$ or 10 k
Green	5	$\times 100\,000$ or 100 k
Blue	6	$\times 1\,000\,000$ or 1 M
Violet	7	Silver is divide by 100
Grey	8	Gold is divide by 10
White	9	Tolerances: <ul style="list-style-type: none">• Brown 1%• Red 2%• Gold 5%• Silver 10%• None 20%

Logic IC's Pin out Diagrams

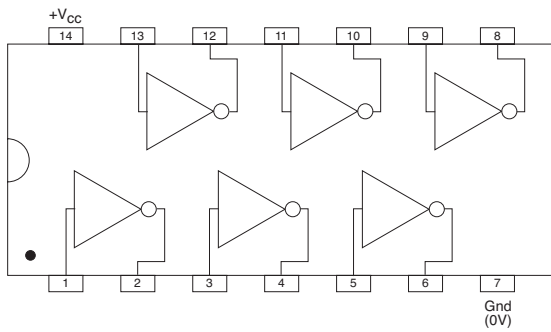
7400



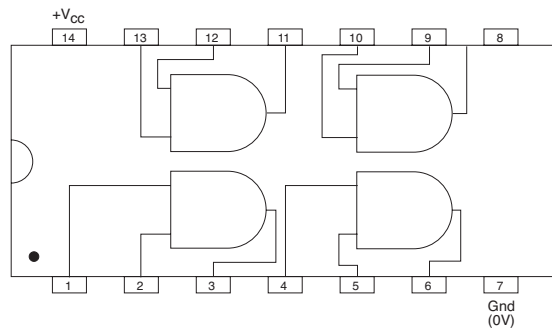
7402



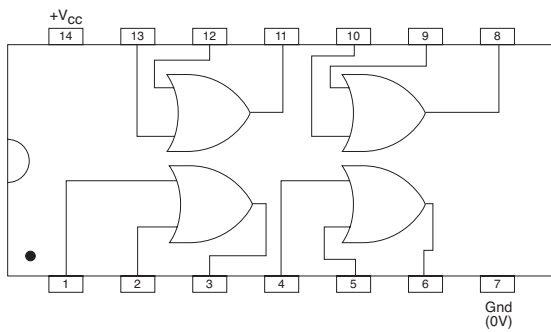
7404



7408

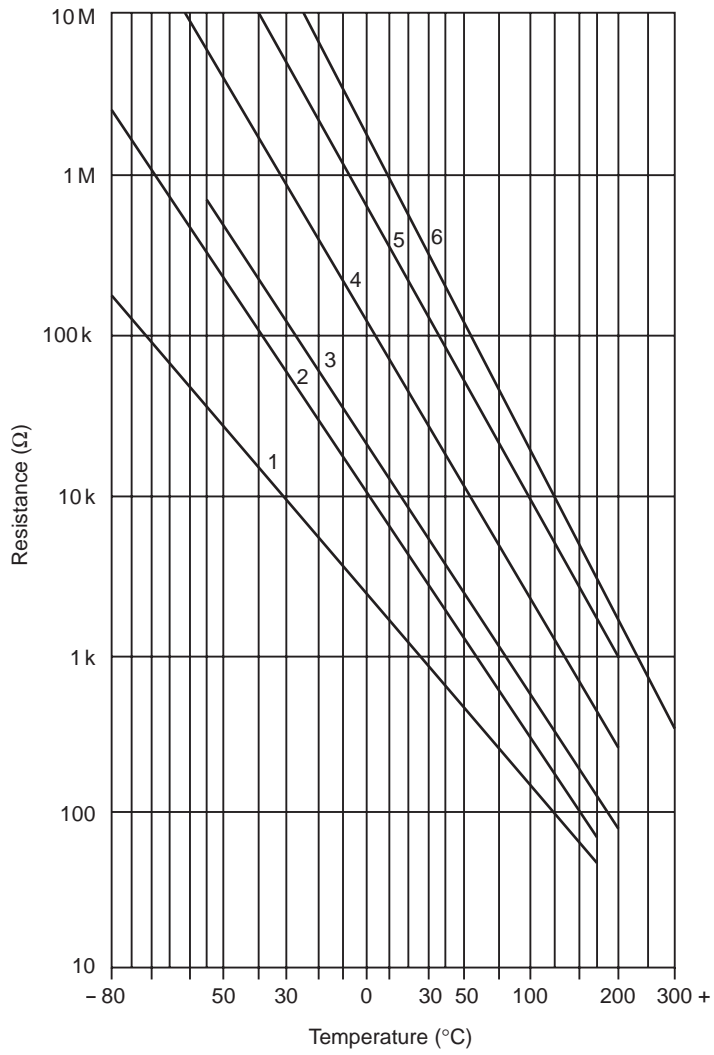


7432



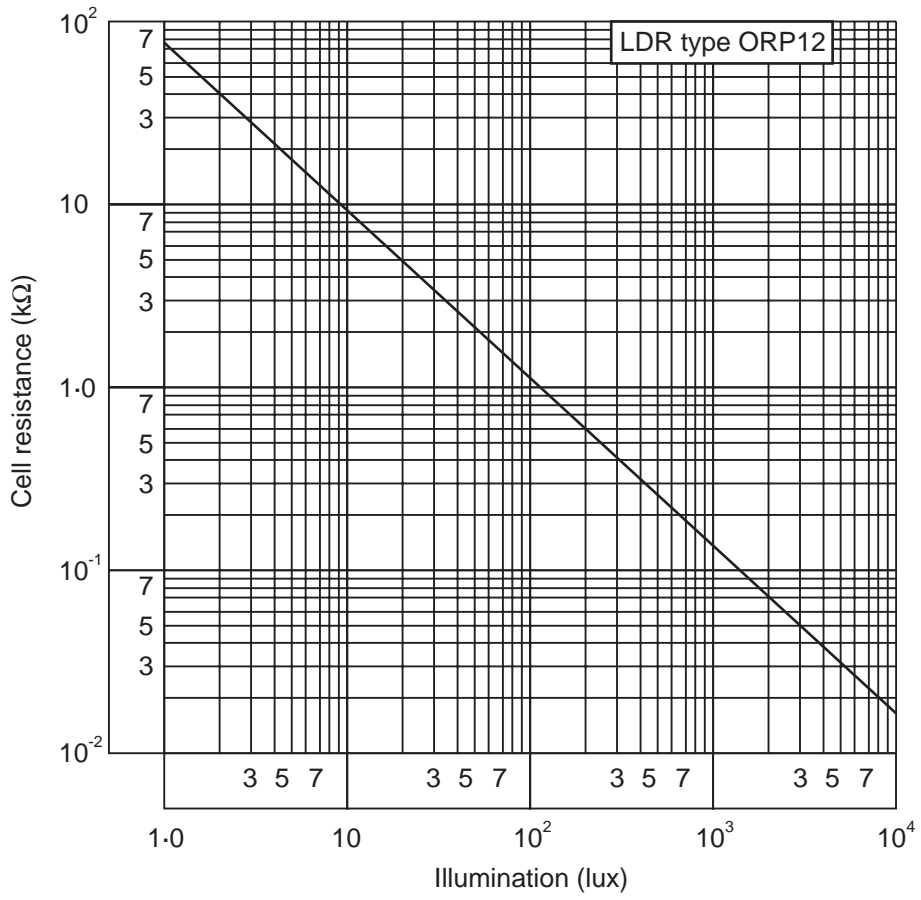
Graphs for Thermocouple and LDR

Thermistors



Thermistor Types	
1	151-136
2	151-142
3	256-045
4	151-158
5	256-051
6	151-164

Light Dependent Resistor (LDR)



Binary Weighting of Data Lines

7	6	5	4	3	2	1	0	Bits
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
128	64	32	16	8	4	2	1	Weighting

Decimal	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
10	1010
11	1011
12	1100
13	1101
14	1110
15	1111

Symbols for Flow Charts

Data symbol



Data, medium unspecified. Usually used for inputs and outputs.

Line symbol



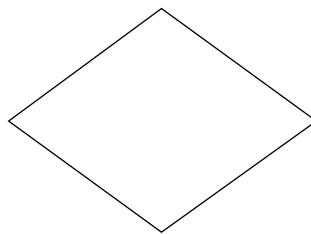
A line represents the flow of data or control. Solid or open arrowheads can be added to indicate direction of flow.

Process symbol



Predefined process consisting of one or more program steps specified elsewhere.

Decision symbol



Decision or switching type of function with a single entry but two alternative exits, only one of which is activated after evaluation of the condition shown in the symbol.

Sub-procedure symbol



Entry to or exit from a sub-procedure

Special symbol



Terminator—an exit to or an entry from the outside environment.

PBASIC Instruction Set

INPUT/OUTPUT LOW HIGH SENSOR	Make pin output and switch it low. Make pin output and switch it high. Reads the analogue input (A or B) and gives scaled value 1–240.
TIME PAUSE	Pause for 0–65535 milliseconds.
LOOPING FOR . . . NEXT	Establish a FOR–NEXT loop.
PROGRAM FLOW IF . . . THEN GOTO	Compare and conditionally jump. Jump to address.
SUBROUTINES GOSUB RETURN	Jump to subroutine at address. Return from subroutine.
NUMERICS LET	Allocate variables using mathematical equations.
POWER CONTROL END	Sleep until the power cycles or the computer connects.
MISCELLANEOUS SYMBOL % DIRS	Allocate a symbol for a variable or value. Set pin conditions to input/output.