GCE A LEVEL – NEW

A490U20-1A

S19-A490U20-1A

MONDAY, 10 JUNE 2019 – AFTERNOON

ELECTRONICS – A level component 2

Data Booklet

A clean copy of this booklet should be issued to candidates for their use during each A Level Electronics examination.

Centres are asked to issue this booklet to candidates at the start of the A Level Electronics course to enable them to become familiar with its contents and layout.

A490U201A
01

Preferred Values for resistors

The figures shown below and their decade multiples and sub-multiples are the E24 series of preferred values.

10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91.

Standard Multipliers

Prefix	Multiplier
T	$\times 10^{12}$
G	$\times 10^{9}$
M	$\times 10^{6}$
k	$\times 10^{3}$

Prefix	Multiplier
m	$\times 10^{-3}$
μ	$\times 10^{-6}$
n	$\times 10^{-9}$
p	$\times 10^{-12}$

Useful equations

$$C = \frac{Q}{V}$$

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$C = \frac{C_1 C_2}{C_1 + C_2}$$

$$C = C_1 + C_2$$

$$V_{rms} = \frac{V_0}{\sqrt{2}}$$

$$I_{rms} = \frac{I_0}{\sqrt{2}}$$

$$I_C = h_{FE} I_B$$

$$I_D = g_M (V_{GS} - 3)$$

$$P = I_D^2 r_{DSon}$$

$$A + \overline{A} \,.\, B = A + B$$

$$A \,.\, B + A = A \,.\, (B + 1) = A$$

$$G = \frac{V_{OUT}}{V_{IN}}$$

$$G = 1 + \frac{R_F}{R_1}$$

$$G = -\frac{R_F}{R_{IN}}$$

$$V_{OUT} = -R_F\left(\frac{V_1}{R_1} + \frac{V_2}{R_2} + ...\right)$$

$V_{OUT} = V_S$ for $V_+ > V_-$

$V_{OUT} = -V_S$ for $V_+ < V_-$

$V_{OUT} = V_{IN}$

$$\text{slew rate} = \frac{\Delta V_{OUT}}{\Delta t}$$

$\text{slew rate} = 2\pi f V_P$

$$\text{resolution} = \frac{\text{i/p voltage range}}{2^n}$$

$$X_C = \frac{1}{2\pi f C}$$

$$X_L = 2\pi f L$$

$$Z = \sqrt{R^2 + X^2}$$

$$f_0 = \frac{1}{2\pi\sqrt{L\,C}}$$

$$R_D = \frac{L}{r_L C}$$

$$Q = \frac{f_0}{\text{bandwidth}} = \frac{2\pi f_0 L}{r_L}$$

$$N_{CH} = \frac{\text{available bandwidth}}{\text{channel bandwidth}}$$

$\text{maximum data rate} = 2 \times \text{available bandwidth}$

$$G_{dB} = 10\log_{10}\frac{P_{OUT}}{P_{IN}}$$

$$SNR_{dB} = 10\log_{10}\frac{P_S}{P_N} = 20\log_{10}\frac{V_S}{V_N}$$

$$m = \frac{(V_{max} - V_{min})}{(V_{max} + V_{min})} \times 100\%$$

$$\beta = \frac{\Delta f_c}{f_i}$$

$$\text{Bandwidth} = 2(\Delta f_0 + f_i) = 2(1+\beta) f_i$$

$c = f\lambda$

$$V_{OUT} = V_{DIFF}\left(\frac{R_F}{R_1}\right)$$

A490U201A
03

Turn over.

$T = RC$

$V_C = V_0\left(1 - e^{-\frac{t}{RC}}\right)$

$V_C = V_0 e^{-\frac{t}{RC}}$

$t = -RC\ln\left(1 - \frac{V_C}{V_0}\right)$

$t = -RC\ln\left(\frac{V_C}{V_0}\right)$

$f \approx \frac{1}{RC}$

$f = \frac{1}{T}$

$T = 1.1RC$

$t_H = 0.7(R_1 + R_2)C$

$t_L = 0.7R_2C$

$f = \frac{1.44}{(R_1 + 2R_2)C}$

$\frac{T_{ON}}{T_{OFF}} = \frac{R_1 + R_2}{R_2}$

$V_r = \frac{I}{f_r C}$

$V_L \approx V_Z\left(1 + \frac{R_F}{R_1}\right)$

$\phi = \tan^{-1}\left(\frac{R}{X_C}\right)$

$f_b = \frac{1}{2\pi R C}$

$V_{OUT} \approx V_{IN} - 0.7$

$V_{OUT} \approx V_{IN} - 3$

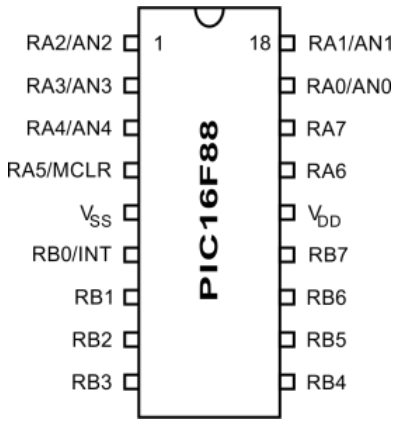
$P_{MAX} = \frac{V_S^2}{8R_L}$

PIC Information

The PIC programs include 'equate' statements that define the following labels:

Label	Description
PORTA	input / output port A
PORTB	input / output port B
TRISA	the control register for port A
TRISB	the control register for port B
STATUS	the status register
INTCON	the interrupt control register
W	Destination d = W, result stored in working register
F	Destination d = F, result stored in specified file register
RP0	the register page selection bit 0
Z	the zero flag status bit
GIE	the global interrupt controller bit
INT0IE	the external interrupt enable bit

Pinout for 16F88 PIC IC:



List of commands

Mnemonic	Operands	Description
addlw	k	Add working register to literal k
andlw	k	AND working register with literal k
bcf	f, b	Clear bit b of file register f
bsf	f, b	Set bit b of file register f
btfsc	f, b	Bit test bit b of file register f, skip if clear
btfss	f, b	Bit test bit b of file register f, skip if set
call	label	Call subroutine at label
clrf	f	Clear file register f
comf	f, d	Complement file register f
decfsz	f, d	Decrement file register f, skip if zero
goto	label	Unconditional Branch to label
incf	f, d	Increment file register f
iorlw	k	Inclusive OR working register with literal
movf	f, d	Move file register f
movlw	k	Move literal to working register
movwf	f	Move working register to file register f
nop	-	No Operation
retfie	-	Return from interrupt service routine and set global interrupt enable bit GIE
return	-	Return from Subroutine
sublw	k	Subtract W from literal

Number system notation

Decimal	d'153'
Hex	h'99'
Binary	b'10011001'

Structure of the INTCON register

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
GIE	PEIE	TMR0IE	INT0IE	RBIE	TMR0IF	INT0IF	RBIF

Structure of the STATUS register

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
IRP	RP1	RP0	$\overline{TO}$	$\overline{PD}$	Z	DC	C

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