



GLOBAL SPECIALTIES
INSTRUMENTS

Operation & Service Manual

Pulse Generator

Model : 4010

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MODEL NO. OF THE INSTRUMENT : 4010

SR. NO. OF THE INSTRUMENT : 0336326

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Section 1

Safety Instructions

- 1.1 Prior to applying power to the instrument, ensure that earth is available at the power outlet.

Intentional interruption of the grounding system, by use of two-wire plug adapters or two wire extension cords must be considered an unsafe practice.

- 1.2 Be sure that only correct power fuse with required V/I ratings is installed for replacement purpose.

Incorrect fuse rating can result in fire &/or serious damage or harm to human life & property.

- 1.3  Refer to Manual.

Section 2

Technical Specifications

2.1 FREQUENCY RANGE

Internal	: 0.1Hz to 10MHz in 8 decade ranges & variable.
Stability Internal Mode	: 0.5%.
X'tal Spot Frequencies	: 10MHz, 1MHz, 100KHz, 10KHz, 1KHz, 100Hz, 10Hz, 1Hz.
Stability X'tal Mode	: 200 ppm.
Warm up Time	: 30 minutes.

2.2 TRIGGERING

Internal	: 0.1Hz to 10MHz.
External	: 10Hz to 10MHz.
Manual	: 1 pulse out for each switch press.
Ext. Trig-Input	: $\pm 1V$ to $\pm 10V$ p-p sine & square waveform.
Trig. Output	: TTL pulse ($Z_o=50$ ohms)

2.3 RATE : 100nsec - 0.1sec (8 decade range & variable adj.).

2.4 WIDTH : 50nsec - 50msec (6 decade range and variable).

2.5 DELAY : 0 - 2 μ sec variable w.r.t. trigger output.

2.6 OUTPUT POLARITY : Normal / Inverting.

2.7 OUTPUT

Pulse Out : 0.5V - 5V at 50 ohms.
Impedance : 50 ohms.
Rise & Fall Time : 12nsec.
Output Terminal : BNC connector.

2.8 POWER SUPPLY

Voltage : 115V & 230V AC $\pm 10\%$, 47Hz - 63Hz
switchable.
Consumption : 10VA.

2.9 PHYSICAL

Dimensions : 275 (W) x 86 (H) x 310 (D) mm
approx.
Weight : 3 Kgs. approx.

Section 3

General Description

3.1 INTRODUCTION

Global's Pulse Generator Model 4010 is specifically designed to include only the basic facilities of a Pulse Generator in order to make it handy and easy to operate unit. It offers pulse repetition rate from 0.1Hz to 10MHz with rise & fall time <12nsec, pulse width from 50nsec to 50msec & pulse amplitude from 0.5V to 5V across 50 ohms. Provision for external triggering and monopulse generation is also done. The x'tal mode gives accurate eight spot frequencies derived from 10MHz crystal source.

This manual contains information pertaining to the specifications, installation and operation of Global Pulse Generator Model 4010.

3.2 APPLICATIONS

The name Pulse Generator tends to conjure up images of an instrument that is primarily intended for use with digital circuit. The generator can be used to test the digital circuits to provide noise-free pulse, to define the resonant frequency of the L-C circuit, defining R-C times testing the quality of power supply, to test power amplifiers.

3.3 INSTALLATION DATA

The instrument is shipped ready for bench operation. The front panel must remain unobstructed to allow cable connections and switch/knob operation.

Do not throw the packing material, as it can be useful while returning the instrument to factory for calibration / servicing.

3.4 POWER REQUIREMENTS

Global 4010 has a three conductor power cord that grounds the instrument chassis when connected to a compatible power receptacle. The instrument operates over a nominal 115V/ 230V AC $\pm 10\%$, 47Hz - 63Hz supply.

3.5 INCOMING CONFIDENCE CHECK

Prior to packaging the instrument for shipment, extensive operational and calibration procedures were performed to verify conformity to specifications. To ensure the electronic integrity of the instrument, you must perform the following confidence check.

Adjust the settings by using range select switch and controls.

- | | | |
|------------------|---|----------------|
| 1. Model Select | : | X-TAL. |
| 2. Rate (s) | : | 1MHz |
| 3. Width (s) | : | 50ns to 500ns. |
| 4. Width Control | : | Minimum. |
| 5. Output | : | Maximum. |

Check the output pulse waveform on oscilloscope. Check all the controls and 'Polarity' control.

3.6 ACCESSORIES

- | | | |
|------------------------|---|-------|
| 1. BNC to BNC | - | 1 No. |
| 2. 50 ohms Termination | - | 1 No. |

3.7 CLEANING

As an electronic instrument, due care should be taken to keep the instrument away from dusty environment. The customer is advised to clean only the external part of the instrument with a soft moist cloth. Special care should be taken while cleaning the front panel. No chemicals or solvents must be used to clean the instrument.

3.8 STORAGE

There are no special instructions for storage. The instrument should be shelved in a reasonably clean environment and protected from dirt and moisture. Do not wrap air-tight with plastic.

Section 4

Operating Instructions & Adjustments

4.1 FRONT PANEL CONTROLS

The front panel controls are functionally grouped and clearly designated for ease of operation. Their functions are described below :

1. POWER ON
Power pilot lamp.
2. RATE (Variable)
The period is short at "MIN" position (counter clockwise) and period is long at "MAX" position as a pulse period (or frequency) variable controller.
3. DELAY (Variable)
To delay the pulse out against trigger output. The variable limit is 0 - 2 μ s.
4. WIDTH
To control the pulse width.
5. OUTPUT LEVEL POT
Pulse output level controller (1V - 10V).

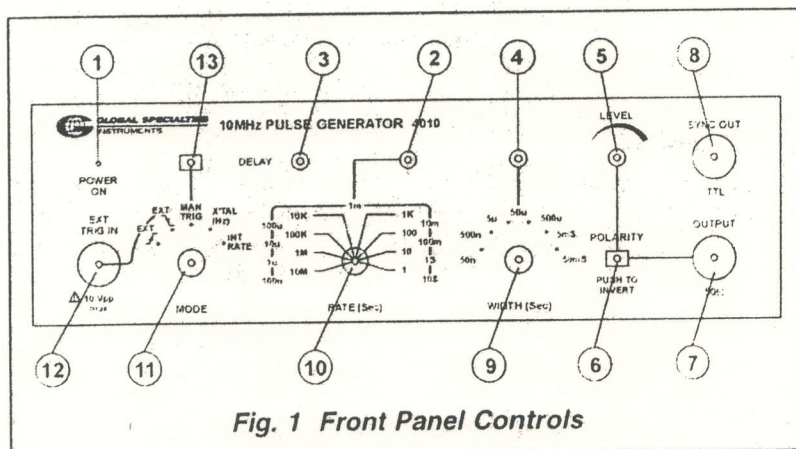


Fig. 1 Front Panel Controls

6. POL
Output polarity select switch of pulse.
7. OUTPUT BNC CONNECTOR
The pulse out BNC-connector with output impedance of 50 ohms.
8. SYNC OUT
As a trigger out BNC connector output impedance is 50 with TTL level output.
9. WIDTH (S) RANGE
As a pulse width time select switch it has a 5 range of 50ns - 5ms.
10. RATE (S) RANGE
As a pulse period time select switch it has a 8 range of 100ns to 10s. Also spot frequencies derived from crystal oscillator are selected by this switch (10MHz, 1MHz, 100KHz, 10KHz, 1KHz, 100Hz, 10Hz and 1Hz).
11. MODE
X-TAL
It is a standard frequency oscillator mode select. It generates standard frequency from crystal oscillator circuit.
INT RATE
In this mode trigger to the pulse circuit is applied from internal oscillator & rate is controlled by Rate switch.
EXT TRIGGER
In this mode trigger to the pulse circuit is applied from "EXT TRIG IN". Trigger on rising or falling edge is selected from mode switch.
MAN TRIGGER
In this mode manual trigger is selected.
12. TRIGGER IN BNC
The maximum input of trigger input BNC connector is 10Vp-p.

13. PUSH ON SWITCH

One pulse is generated when push the button under mode setting of manual trigger position.

4.2 REAR PANEL CONTROLS

1. POWER ON SWITCH

This is a Power ON / OFF switch.

2. FUSE

This is a fuse in series with mains supply.
(For 230V - 250mA & For 115V - 500mA)

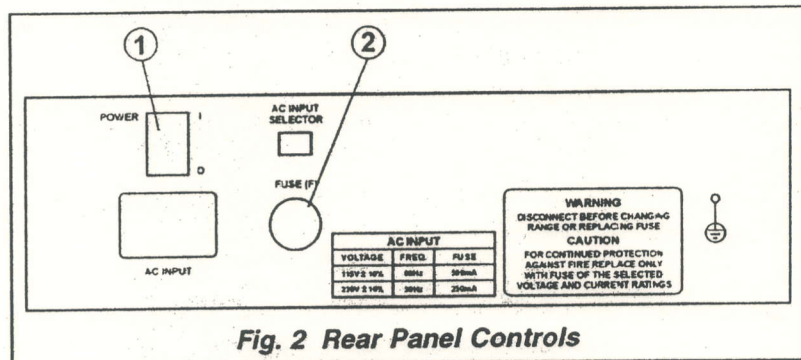


Fig. 2 Rear Panel Controls

4.3 PRECAUTIONS

To obtain the optimum performance of the 4010, the following procedure should be adopted.

1. Select a location free from dust and humidity.
2. Do not operate the instrument where mechanical vibrations are excessive or near a instrument which generates strong electric or magnetic fields.
3. Ensure that proper mains voltage 115V AC or 230V AC is selected. Failure to do so may permanent damage the instrument.

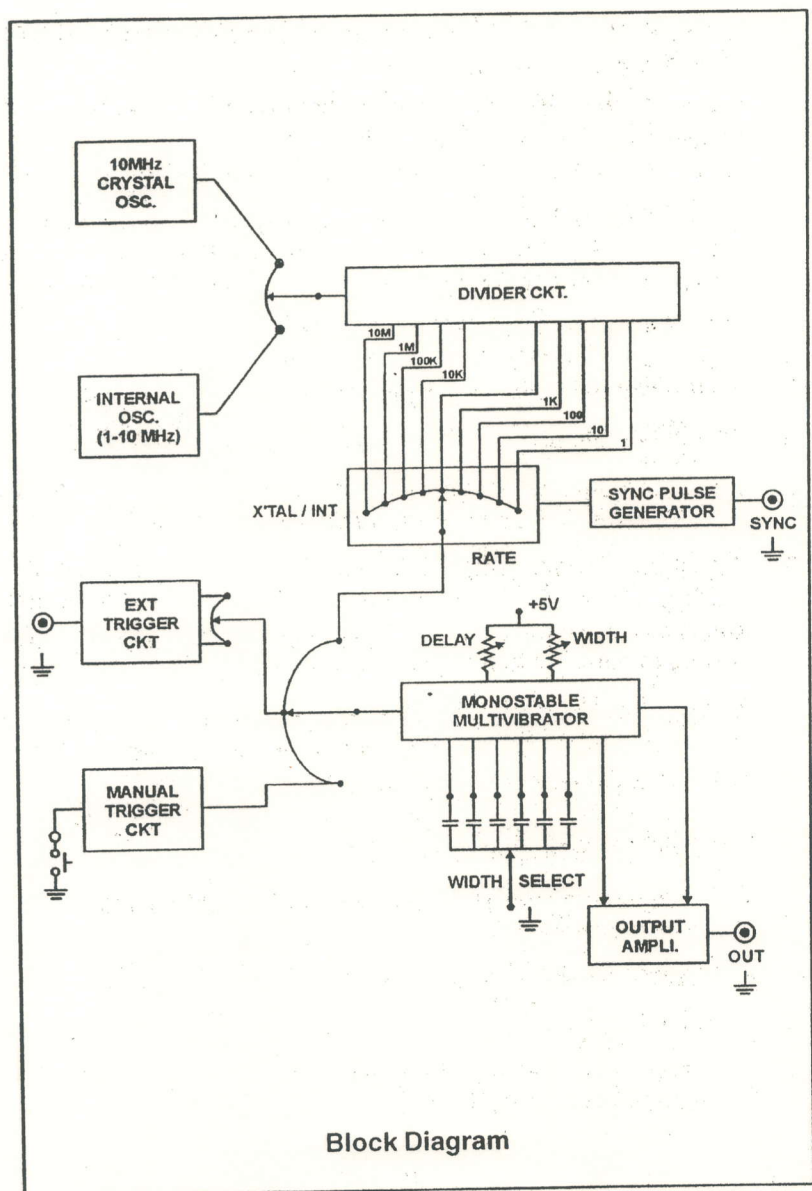
Section 5

Test & Calibration Procedure

1. Check +5V and +15V at Pin No. 3 of IC7805 and IC7815, respectively.
2. Go to X-TAL mode and set crystal frequency at 10MHz by VC2. Check the lower frequency ranges on counter.
Note : X-TAL frequency always should be within 0.1%. While selecting the required frequency also select approximate pulse width.
3. Adjust the overlapping and underlapping of pulse period. Goto internal mode. Select lowest pulse period (100n - 1 μ s) first and keep rate pot at minimum.
Adjust minimum pulse period by VR3.
Now keep the rate pot maximum and adjust overlapping by VC3 on frequency counter.
4. Clean the pulses for any irregularities by VC1 on scope.
5. Adjust the output voltage to 10V peak at open circuit and 5Vp into 50E on scope using VR1 keeping level pot maximum.
6. Adjust pulse width using VCG check for underlapping and overlapping of pulse width pot for all pulse width ranges (50n - 50ms).
Note : For given pulse width range select approximate rate. Keep delay pot and rate pot at minimum position.
7. Set 1Vp-p sinewave on a standard signal generator and apply it to external BNC. Select external mode and connect output to CRO. Adjust VR2 to get output pulse.
8. Check manual triggering. Only one pulse is obtained by pressing the MAN switch once.
9. Check sync output on CRO. It should be 2.5Vp into 50E.
10. Check output polarity.
11. Check delay on a dual channel CRO with sync out as reference to the output pulse on INT mode.

Section 6

Block Diagram & Circuit Description



CIRCUIT DESCRIPTION

6.1 TRIGGERING SOURCES

1. Crystal Oscillator
2. Rate Generator (Linear Variable Triggering)
3. External Triggering by Positive Edge of Signal
4. External Triggering by Negative Edge of Signal
5. Manual Triggering

6.2 CRYSTAL OSCILLATOR

Crystal oscillator generates TTL square wave with 10MHz frequency. U6E along with 10MHz Crystal C21, C22, VC2 forms a Crystal oscillator. R22 is used to pull U6E NOT in active region of operation. To meet Barkhausen's criteria for oscillations, NOT Gate provides 180° phase shift and remaining phase shift is provided by Crystal & associated passive components. U6D is used to avoid any loading on crystal oscillator.

VC2 is variable capacitor which adjusts load on crystal which is used to adjust Crystal oscillator frequency accurately.

6.3 RATE GENERATOR (LINEAR VARIABLE TRIGGERING)

Monostable multivibrator AM26S02 U7A with U6C forms an astble oscillator whose frequency is inversely proportional to RC time constant C35, VC3 and VR3 & External POT connected to JP4. Maximum Rate of triggering is adjusted by VC3 variable capacitor.

6.4 EXTERNAL TRIGGERING BY NEGATIVE / POSITIVE EDGE OF SIGNAL

Capacitor C31, C32 & C34 along with R26 D12 & D13 forms protection circuit and AC coupling of pulse generator to external signal. R18, R19 & VR2 provides D.C shift so that TTL compatible voltage levels of external signal can be formed. 74LS132 is a Schmitt NAND gate. Output of this gate are fast rising edges which are required for triggering.

Output of U3B is equivalent of Negative edge triggering to external signal. This output of U3B is again inverted using U6A which is equivalent of positive edge triggering of external signal.

6.5 MANUAL TRIGGERING

Schmitt NAND, U3A & U3D forms RS flip-flop. By pressing Manual trigger push switch we can place logic 0 on input of these gates. The moment we press switch trigger pulse is generated. R12-C12 and R15-C18 forms debounce circuit for switch.

6.6 TRIGGERING RATE DIVIDER:

We can select suitable triggering source from front panel knob. Selected triggering signal is given to (Divide by 10) divider chain. 74LS390 is dual BCD divider. Selected triggering signal is divided by 10, 100, 1k, 10k, 100k, 1M. e.g. if we select Crystal osc. as triggering source then this divider chain will give us triggering rate frequencies of 1MHz, 100kHz, 10kHz, 1kHz, 100Hz, 10Hz along with undivided 10MHz.

6.7 DELAY & WIDTH SETTING

Now this signal (termed as CLK_OUT) is applied to another monostable multivibrator U10A. This monostable decides delay function of Pulse generator. We can vary the delay from 0 to 2 m Sec i.e. width is variable from 0 to 2 m Sec of this multivibrator. We can adjust this delay using front panel knob DELAY. This delayed pulse is applied to U10B monostable multivibrator. This monostable decides width of Pulse generator. From front panel knob named WIDTH we can select suitable width capacitor from capacitor bank. Values in this capacitor bank are such that we get 50n, 500n, 5 m, 50 m, 500 m, 5 m, 50 m pulse width ranges. Required Width is settable using WIDTH pot. Width POT changes resistance value of RC time constant required for U10B monostable multivibrator for particular width range.

6.8 OUTPUT AMPLIFIER

This signal is applied to Amplifier section. Amplifier operates on +15 Volts and gives 0.5 volts to 5 volts in 50 ohms. (1 volt to 10 Volt with no load) Amplitude level is settable using LEVEL POT. Transistor Q1, Q2 & Q3 forms a preamplifier and Q5, Q6 forms output power amplifier.

6.9 SYNC OUTPUT

Sync output provides reference signal with respect to delay is adjusted. This sync signal has fixed width of 50nS. This signal is generated by U7B monostable multivibrator. Transistor Q7 is sync amplifier who provides suitable power level to drive output of 50 ohms.

Section 7 Trouble Shooting

For easy trouble shooting of the instrument a detailed trouble shooting chart is provided. This contain observation likely faults & test point to be checked.

<i>Sr. No.</i>	<i>Observations</i>	<i>Likely Faults</i>	<i>Points to be Checked</i>
1.	No Output at X'tal mode / Int. Rate	1. No. Mains Supply 2. Regulated supplies +5V & +15V 3. 10MHz crystal frequency 4. Divider Circuit 5. Monostable 6. Output Amplifier	Check fuse on rear panel. Check DC voltages at pin 3 of IC U2 +5V, IC U1 +15V. Check 10MHz frequency at pin no. 10 of IC U6. Check all the frequency (i.e. from 10MHz to 1Hz) at respective pin of IC as per ckt. diag. Check IC U6 (74LS04) & IC U7A (26502) check Int out at pin 6 of IC 26S02. Check transistor Q2 to Q6 as per ckt. diag.
2.	Ext. Trigger Circuit	IC74LS132 & IC74LS04	Check external signal at pin 6 of IC U3 & pin 2 of IC U6.
3.	Manual Trigger	Push Switch IC U3	Check push switch & IC U3 (74HC132)
4.	No. SYNC. Output	Transistor Q1, Diode D1	Check Transistor Q1. (2N2369) & Diode D1 (1N4148).

Section 8

Circuit Diagrams

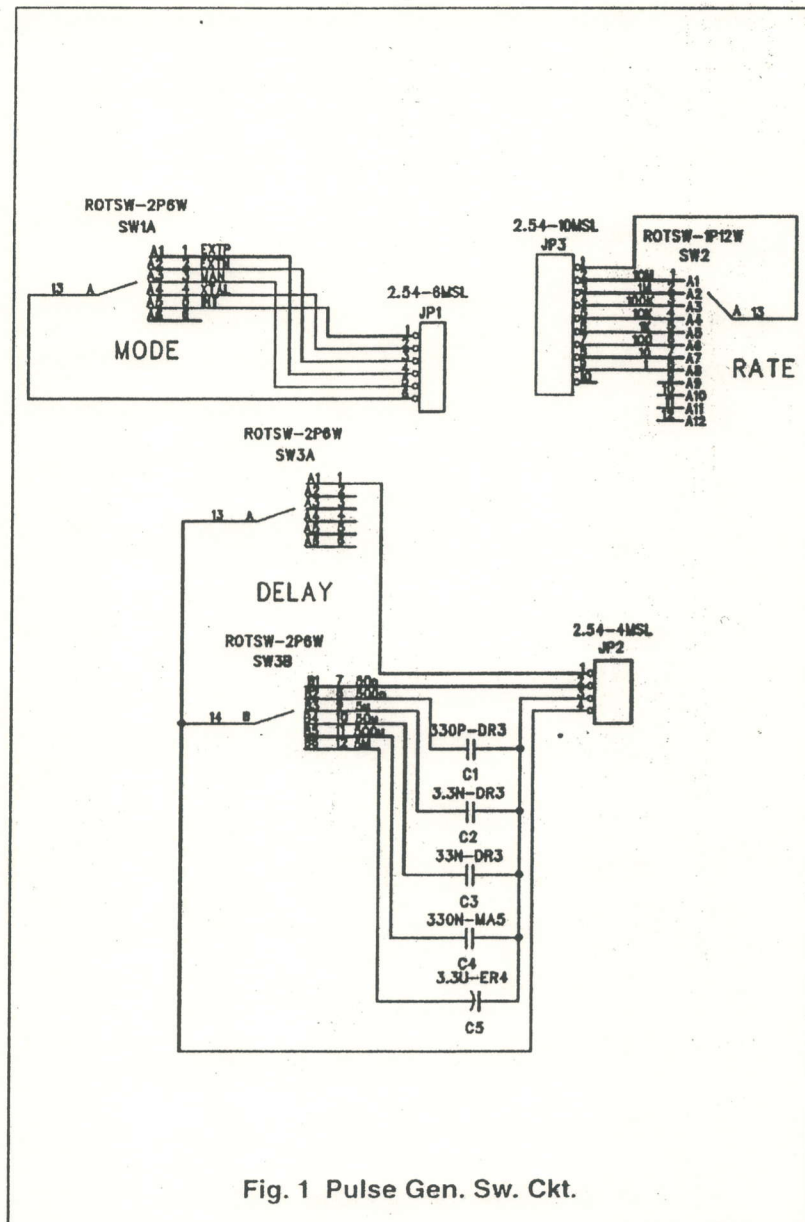


Fig. 1 Pulse Gen. Sw. Ckt.

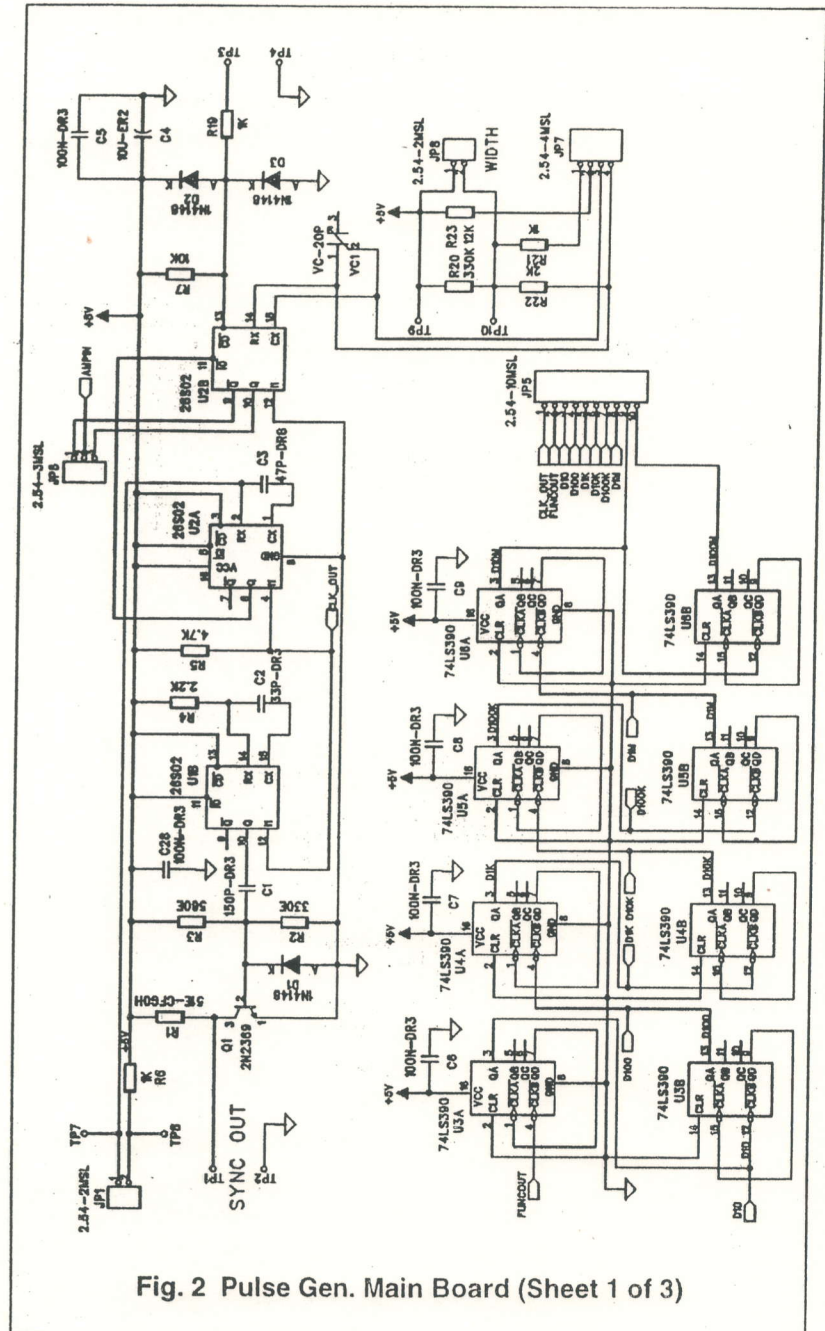


Fig. 2 Pulse Gen. Main Board (Sheet 1 of 3)

Fig. 3 Pulse Gen. Main Board (Sheet 2 of 3)

