

# DC 502, MOD 128S

## HIGH SENSITIVITY

### 550 MHz COUNTER

*Except as detailed in this supplement, all other standard DC 502 operating instructions, specifications, and servicing information remain unchanged.*

#### Description

The DC 502, MOD 128S, Frequency Counter measures frequencies from 10 Hz to 550 MHz or total events up to  $10^7$  at a maximum rate of 550 MHz. MOD 128S increases the  $\div 10$  PRE-SCALE INPUT sensitivity for counting low amplitude signals in the 50 MHz to 550 MHz range. An AC-coupled, pre-amp pre-scaler circuit board, using five TEKTRONIX linear amplifier IC's, replaces the standard pre-scaler circuit board.

The DIRECT INPUT channel of the DC 502 does not change.

#### Input Signals

With input signal amplitudes of at least 1 mV RMS, the  $\div 10$  PRE-SCALE INPUT channel responds to frequencies from 50 MHz to 450 MHz. With signals of at least 2 mV RMS, the response goes up to 550 MHz. The dynamic operating range for this input extends to 1 V RMS. A maximum input voltage limit of 10 V, peak-to-peak, should be observed to avoid damage to the input circuitry.

#### Theory of Operation

**General.** 50 MHz to 550 MHz signals applied to J180 are AC-coupled into a  $50 \Omega$  environment, then AC-coupled through five stages of push-pull cascode amplifiers. Transformer action couples the signal from the last stage into a divide-by-ten counter. The pre-scaled output of the divide-by-ten counter passes through a buffering output amplifier before it is coupled to the gating logic of the counting circuitry.

**Pre-amplifier.** All stages have identical bias-setting, gain-setting, and power supply decoupling components in their external circuitry. Base lead pins 12, 14, and 16 are connected to bias-setting resistor-divider strings, while pins 1 and 13 receive the AC-coupled, push-pull output from the collector circuits of the preceding stage.

The input circuits of input stage U410 only are connected as a single-ended  $50 \Omega$  input. Thus, pin 13 of U410 is held at AC ground and the base resistors connected to pins 14 and 16 are different values than are those in the other four stages.

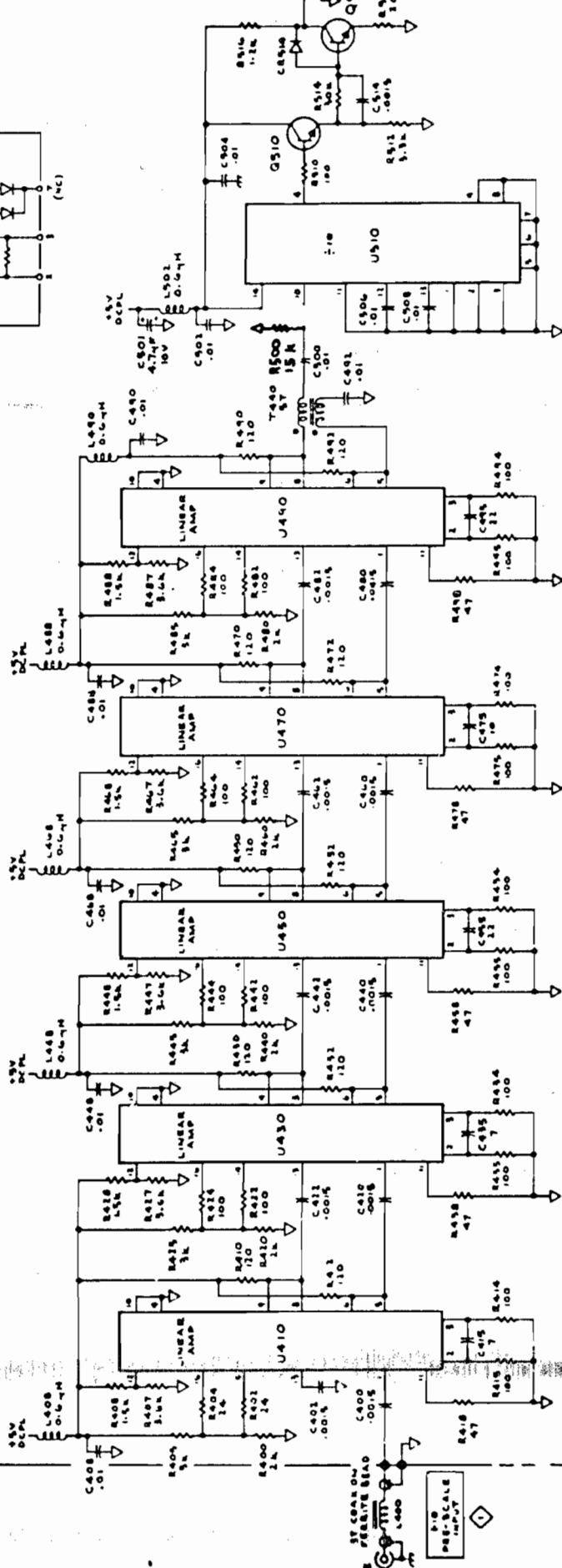
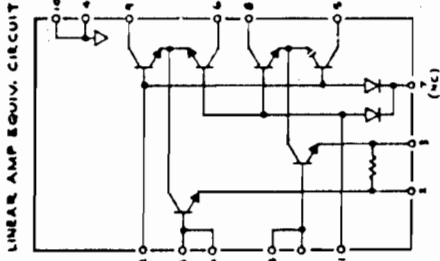
Different value capacitors are connected between emitter lead pins 2 and 3 of each stage. With the series inductance present in each emitter lead, these capacitors form tuned circuits to give emitter peaking for each stage and smooth out frequency response from about 300 MHz to 550 MHz.

The +5 V power supply is extensively decoupled at every stage to prevent signal feedback through the power supply. The decoupling inductors and capacitors are located as close to the IC pins as the physical layout permits.

**$\div 10$  Counter and Output Amplifier.** The differential (push-pull) output of U490 is converted by T490 to a single-ended input for the  $\div 10$  counter. DC-blocking capacitor C500 couples the amplified signal to pin 10, the high impedance input of the  $\div 10$  counter, U510. R500 sets the DC bias at pin 10. Pins 12, 13, and 14 are decoupled right at the terminal connections to the circuit board and the remaining unused pins are connected to signal ground.

Pin 4 of U510 produces one output cycle, a level change of about 0.5 V, for every ten input events to pin 10. The base of Q510 swings between approximately 3.4 V and 3.9 V. The emitter-follower action of Q510 provides substantial current drive to the base of Q515, which would saturate during no-signal conditions except for CR515. The collector of Q515 can, therefore, respond immediately to signal changes, producing a TTL-compatible output to drive pin 9 of U160C in the gating logic to the Decade Counting Units.





A5 AMP AND PRE-SCALER BOARD

\* EXISTING FRONT PANEL JACK

# ELECTRICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

## ABBREVIATIONS AND REFERENCE DESIGNATORS

A	Assembly, separable or repairable	FL	Filter	PTM	paper or plastic, tubular molded
AT	Attenuator, fixed or variable	H	Heat dissipating device (heat sink, etc.)	R	Resistor, fixed or variable
B	Motor	HR	Heater	RT	Thermistor
BT	Battery	J	Connector, stationary portion	S	Switch
C	Capacitor, fixed or variable	K	Relay	T	Transformer
Cer	Ceramic	L	Inductor, fixed or variable	TP	Test point
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	U	Assembly, inseparable or non-repairable
CRT	cathode-ray tube	M	Meter	V	Electron tube
DL	Delay line	Q	Transistor or silicon-controlled rectifier	Var	Variable
DS	Indicating device (lamp)	P	Connector, movable portion	VR	Voltage regulator (zener diode, etc.)
Elect.	Electrolytic	PMC	Paper, metal cased	WW	wire-wound
EMC	electrolytic, metal cased	PT	paper, tubular	Y	Crystal
EMT	electrolytic, metal tubular				
F	Fuse				

Kct. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
<b>ASSEMBLY</b>				
A5	670-2624-00			AMP & PRE-SCALER Circuit Board Assembly
<b>CAPACITORS</b>				
C400	283-0219-00			1500 pF, Cer, 50 V, 20%
C402	283-0219-00			1500 pF, Cer, 50 V, 20%
C408	283-0204-00			0.01 $\mu$ F, Cer, 50 V, 20%
C415	283-0157-00			7 pF, Cer, 500 V, 5%
C420	283-0219-00			1500 pF, Cer, 50 V, 20%
C422	283-0219-00			1500 pF, Cer, 50 V, 20%
C435	283-0157-00			7 pF, Cer, 500 V, 5%
C440	283-0219-00			1500 pF, Cer, 50 V, 20%
C442	283-0219-00			1500 pF, Cer, 50 V, 20%
C448	283-0204-00			0.01 $\mu$ F, Cer, 50 V, 20%
C455	283-0154-00			22 pF, Cer, 50 V, 5%
C460	283-0219-00			1500 pF, Cer, 50 V, 20%
C462	283-0219-00			1500 pF, Cer, 50 V, 20%
C468	283-0204-00			0.01 $\mu$ F, Cer, 50 V, 20%
C475	283-0175-00			10 pF, Cer, 200 V, 5%
C480	283-0219-00			1500 pF, Cer, 50 V, 20%
C482	283-0219-00			1500 pF, Cer, 50 V, 20%
C488	283-0204-00			0.01 $\mu$ F, Cer, 50 V, 20%
C490	283-0204-00			0.01 $\mu$ F, Cer, 50 V, 20%
C492	283-0204-00			0.01 $\mu$ F, Cer, 50 V, 20%
C495	283-0154-00			22 pF, Cer, 50 V, 5%
C500	283-0204-00			0.01 $\mu$ F, Cer, 50 V, 20%
C501	290-0524-00			4.7 $\mu$ F, Elect., 10 V, 20%
C502	283-0204-00			0.01 $\mu$ F, Cer, 50 V, 20%
C504	283-0204-00			0.01 $\mu$ F, Cer, 50 V, 20%
C506	283-0204-00			0.01 $\mu$ F, Cer, 50 V, 20%
C508	283-0204-00			0.01 $\mu$ F, Cer, 50 V, 20%
C514	283-0114-00			0.0015 $\mu$ F, Cer, 200 V, 5%
C520	290-0524-00			4.7 $\mu$ F, Elect., 10 V, 20%

## ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
<b>DIODE</b>				
CR514	152-0322-00			Silicon, A1108
<b>INDUCTORS</b>				
L400	276-0573-00			Core, ferrite
L408	108-0262-00			0.6 $\mu$ H
L448	108-0262-00			0.6 $\mu$ H
L468	108-0262-00			0.6 $\mu$ H
L488	108-0262-00			0.6 $\mu$ H
L490	108-0262-00			0.6 $\mu$ H
L502	108-0262-00			0.6 $\mu$ H
L515	276-0573-00			Core, ferrite
L520	108-0538-00			2.7 $\mu$ H
<b>TRANSISTORS</b>				
Q510	151-0190-00			Silicon, NPN, 2N3904 or TE3904
Q515	151-0225-00			Silicon, NPN, 2N3563 or CS23366
<b>RESISTORS</b>				
R400	317-0202-00			2 k $\Omega$ , 1/8 W, 5%
R402	317-0240-00			24 $\Omega$ , 1/8 W, 5%
R404	317-0240-00			24 $\Omega$ , 1/8 W, 5%
R405	317-0302-00			3 k $\Omega$ , 1/8 W, 5%
R407	317-0362-00			3.6 k $\Omega$ , 1/8 W, 5%
R408	317-0152-00			1.5 k $\Omega$ , 1/8 W, 5%
R410	317-0121-00			120 $\Omega$ , 1/8 W, 5%
R412	317-0121-00			120 $\Omega$ , 1/8 W, 5%
R414	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R415	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R418	317-0470-00			47 $\Omega$ , 1/8 W, 5%
R420	317-0202-00			2 k $\Omega$ , 1/8 W, 5%
R422	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R424	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R425	317-0302-00			3 k $\Omega$ , 1/8 W, 5%
R427	317-0362-00			3.6 k $\Omega$ , 1/8 W, 5%
R428	317-0152-00			1.5 k $\Omega$ , 1/8 W, 5%
R430	317-0121-00			120 $\Omega$ , 1/8 W, 5%
R432	317-0121-00			120 $\Omega$ , 1/8 W, 5%
R434	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R435	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R438	317-0470-00			47 $\Omega$ , 1/8 W, 5%
R440	317-0202-00			2 k $\Omega$ , 1/8 W, 5%
R442	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R444	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R445	317-0302-00			3 k $\Omega$ , 1/8 W, 5%
R447	317-0362-00			3.6 k $\Omega$ , 1/8 W, 5%
R448	317-0152-00			1.5 k $\Omega$ , 1/8 W, 5%
R450	317-0121-00			120 $\Omega$ , 1/8 W, 5%
R452	317-0121-00			120 $\Omega$ , 1/8 W, 5%
R454	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R455	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R458	317-0470-00			47 $\Omega$ , 1/8 W, 5%
R460	317-0202-00			2 k $\Omega$ , 1/8 W, 5%
R462	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R464	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R465	317-0302-00			3 k $\Omega$ , 1/8 W, 5%

DC 502, MOD 178S

## ELECTRICAL PARTS LIST (cont)

Ch. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
<b>RESISTORS (cont)</b>				
R467	317-0362-00			3.6 k $\Omega$ , 1/8 W, 5%
R468	317-0152-00			1.5 k $\Omega$ , 1/8 W, 5%
R470	317-0121-00			120 $\Omega$ , 1/8 W, 5%
R472	317-0121-00			120 $\Omega$ , 1/8 W, 5%
R474	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R475	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R478	317-0470-00			47 $\Omega$ , 1/8 W, 5%
R480	317-0202-00			2 k $\Omega$ , 1/8 W, 5%
R482	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R484	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R485	317-0302-00			3 k $\Omega$ , 1/8 W, 5%
R487	317-0362-00			3.6 k $\Omega$ , 1/8 W, 5%
R488	317-0152-00			1.5 k $\Omega$ , 1/8 W, 5%
R490	317-0121-00			120 $\Omega$ , 1/8 W, 5%
R492	317-0121-00			120 $\Omega$ , 1/8 W, 5%
R494	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R495	317-0101-00			100 $\Omega$ , 1/8 W, 5%
R498	317-0470-00			47 $\Omega$ , 1/8 W, 5%
R500	317-0153-00			15 k $\Omega$ , 1/8 W, 5%
R510	315-0101-00			100 $\Omega$ , 1/4 W, 5%
R512	315-0332-00			3.3 k $\Omega$ , 1/4 W, 5%
R514	315-0303-00			30 k $\Omega$ , 1/4 W, 5%
R516	315-0122-00			1.2 k $\Omega$ , 1/4 W, 5%
R517	317-0200-00			20 $\Omega$ , 1/8 W, 5%
<b>TRANSFORMER</b>				
T490	120-0340-00			Toroid, 5 turns bifilar
<b>INTEGRATED CIRCUITS</b>				
U410	155-0078-02			Monolithic, vert amp., selected
U430	155-0078-02			Monolithic, vert amp., selected
U450	155-0078-02			Monolithic, vert amp., selected
U470	155-0078-02			Monolithic, vert amp., selected
U490	155-0078-02			Monolithic, vert amp., selected
U510	156-0278-00			Divide by 10 ctr., SP630B

## MECHANICAL PARTS

333-1724-00 1 PANEL, front

## Change:

## RESISTORS

R307 *	303-0132-00	1.3 k $\Omega$ , 1 W, 5%
R350 *	305-0101-00	100 $\Omega$ , 2 W, 5%

\* Effective S/N B081646.