

ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Find the *EIP 545A* at our website: *Click HERE*

PROGRAMMABLE FREQUENCY DIVIDER

The programmable frequency divider uses a two modulus (divide number) prescaler (U5, U6) and two programmable counters (A & B). The prescaler is used to divide the VCO frequency down to a lower frequency which can be handled by low power schottky TTL programmable counters. The two modulus prescaler permits prescaling without loss of resolution. At the start of the programmable frequency divider cycle, the prescaler is set to divide by the larger modulus (41), and both programmable counters have been loaded with their respective program numbers from the PIA. The programmable counters each decrement 1 count for each output pulse from the prescaler. When programmable counter B (U12, U13) reaches the count of zero the 40/41 control flip-flop (part of U11)changes state and causes the prescaler to divide by the lower modulus (40). When programmable counter A reaches the count of 2 the D input of the PL period flip-flop (part of U11) goes high, so that on the count of 1 the flip-flop changes state, which causes both programmable counters to be reloaded with their respective program numbers and the 40/41 control flip-flop to reset (prescaler in ÷ 41 state). The very next count causes the PL period flip-flop to reset, starting the programmable frequency divider cycle over again. The equation for the divide ratio of the programmable frequency divider N_d is:

$$N_d = 40\ (N_{\text{counter A}}) + N_{\text{counter B}}$$

with the condition that:

$$N_{\text{counter B}} \text{ must not exceed } N_{\text{counter A}}$$

The weighting of the command bits is:

U9 P_1 – 400MHz	U10 P_1 – 4MHz
U9 P_0 – 200MHz	U10 P_0 – 2MHz
U8 P_3 – 160MHz	U13 P_3 – 1.6MHz
U8 P_2 – 80MHz	U13 P_2 – 0.8MHz
U8 P_1 – 40MHz	U13 P_1 – 0.4MHz
U8 P_0 – 20MHz	U13 P_0 – 0.2MHz
U10 P_3 – 16MHz	U13 P_1 – 100KHz
U10 P_2 – 8 MHz	U13 P_0 – 50KHz

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PAGE LEFT BLANK INTENTIONALLY

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A108 CONVERTER CONTROL

2020200-04 A

REF DES	DESCRIPTION	EIP NO.	PER ASSY	TYP MFG NO.	TYP FSCM NO.
A108	CONVERTER CONTROL ASSY	2020200-02	1	EIP	34257
C1	Disc, .005μF, 20%, 100V	2150008	1	TG-D50	56289
C2	Disc, .01μF, 20%, 100V	2150003	14	TG-S10	56289
C3	Cer, .047 μF, 10%, 50V	2150016	1	6123X7R473KA50K	13011
C4	Tant, 1μF, 10%, 35V	2300008	3	TAPA 1.0M35	14433
C5	C4				
C6	C2				
C7	Cer,.001 μF, 20%, 100V	2150001	4	5GA-D10	56289
C8	C4				
C9	Tant, 33μF, 10%, 10V	2300015	2	TAPA 33M10	14433
C10	C7				
C11	C7				
C12	C7				
C13 thru C17	C2				
C18	Tant, 10pF, 20%, 25V	2300029	4	DF106M25S	72136
C19	C18				
C20	C9				
C21	C18				
C22 thru C24	C2				
C25	Cer, 560pF, 5%, 100V	2150029	2	SR211A561JAA	14158
C26	Tant, .47μF, 20%, 35V	2300005	1	TAPA-47M35	14433
C27	Cer .022 μF, 15%, 50V	2350027-00	1	2130X7R050R223K	26654
C28	C18				
C29	C2				
C30	Cer, 330pF, 10%, 100V	2150030	1	SR211A331KAA	14158
C31	Tant, 2.2μF, 50%, 16V	2300012	1	TAPA 2-2M16	14433
C32	Mica, 82pF, 5%, 500V	2260032	2	CD10ED820J03	72136
C33	C2				
C34	Mica, 430-470 pF, 5%, 500V, SAT	2259999	1		
C35	Mica, 470 pF, 5%, 500V	2250018	1	DM-15-471J	72136
C36	Mica, S.A.T.	2269999	1	30pF, NOM.	
C37	Cer, .1μF, 10%, 50V	2150028	1	RC50104KB	Murata
C38	C2				
C39	Cer, 2200pF, 5%, 100V	2150026	1	SR211A22JAA	14158
C40	C25				
C41	C2				
C42	C32				
CR1	Hot Carrier	2710004-00	1	5082-2835	28480
CR2	Zener, 56V	2704758-00	1	IN4757	07263
CR3	General Purpose	2704148	14	IN4148	07263
CR4	Zener, 6.2V	2700827	1	IN827	07263
CR5	Power Rectifier	2704001	1	IN4001	07263
CR6 thru CR18	CR3				
L1	Inductor, 100μH	3520007	1	1537-76	99800
L2	Inductor, 1μH	3510018	1	1537-12	99800
L3	Inductor, 4700μH	3510017	2	1641-475	99800
L4	L3				
Q1	PNP	4710009	1	MJE350	04713
Q2	PNP Amplifier	4710018	1	MPSL51	04713
Q3	NPN General Purpose	4704124	1	2N4124	04713

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A108 CONVERTER CONTROL

2020200-04 A

REF DES	DESCRIPTION	EIP NO.	UNITS PER ASSY	TYP MFG NO.	TYP FSCM NO.
R1	Res, 7.23K, 1/10W, 1%	4120021	1	VAR-1/10C-6-1%-723K	ACI
R2	Comp, 4.7K, 5%, 1/4W	4010472	1	RC07GF472J	81349
R3	Comp, 1K, 5%, 1/4W	4010102	6	RN55C4992F	81349
R4	Not Used				
R5	Met Ox, 390 ohm, 2%, 1/4W	4130391	2	C4/2%/390	24546
R6	Not Used				
R7	Not Used				
R8	R3				
R9	Not Used				
R10	Not Used				
R11	Not Used				
R12	Not Used				
R13	R5				
R14	Comp, 750, 5% 1/4W	4010751	1	RC07GF751J	81349
R15	Comp, 820K, 5%, 1/4W	4010824	1	RC07GF824J	81349
R16	R3				
R17	Met Ox, 1.6K, 2%, 1/4W	4130162	1	C4/2%/1.6K	24546
R18	Comp, 1.60K, 5%, 1/4W	4010164	1	RC07GF164J	81349
R19	Prec, 3.01K, 1%, 1/10W	4120020	1	VAR-1/10C-6-1%	ACI
R20	Comp, 10K, 5%, 1/4W	4010103	3	RC07GF103J	81349
R21	Comp, 82K, 5%, 1/4W	4010823	1	RC07GF823J	81349
R22	R20				
R23	R20				
R24	R3				
R25	Wire Wound 5, 1%, 7W	4110003	1	T7 (10 PPM)	12463
R26	Comp, 2.7K, 5%, 1/4W	4010272	1	RC07GF272J	81349
R27	Comp, 51, 5%, 1/4W	4010510	2	RC07GF510J	81349
R28	Comp, 390, 5%, 1/4W	4010391	3	RC07GF391J	81349
R29	R28				
R30	R28				
R31	R3				
R32	Comp, 100, 5%, 1/4W	4010101	3	RC07GF101J	81349
R33	R3				
R34	Comp, 2.4K, 5%, 1/4W	4010242	1	RC07GF242J	81349
R35	R32				
R36	Comp, 220K, 5%, 1/4W	4010224	1	RC07GF224J	81349
R37	R32				
R38	Comp, 4.3K, 5%, 1/4W NOM S.A.T.	4010999	1	SAT	81349
R39	Comp, 2K, 5%, 1/4W	4010202	1	RC07GF202J	81349
R40	R27				
R41	Comp, 1.5M, 5%, 1/4W	4010155	1	RC07GF155J	81349
R42	Comp, 300, 5%, 1/4W	4010301	1	RC07GF301J	81349
R43	Comp, 8.2K, 5%, 1/4W	4010822	1	RC07GF822J	81349
R44	Comp, 51K, 5%, 1/4W	4010513	2	RC07GF513J	81349
R45	Comp, 5.1K, 5%, 1/4W	4010512	1	RC07GF512J	81349
R46	R44				
R47	Comp, 3.3K, 5%, 1/4W	4010332	1	RC07GF332J	81349
U1	Prec, J-FET Op Amp	3041016	1	OP16FJ	06665
U2	12 Bit DAC	3050012	1	H57541-J	0000X
U3	Op Amp, Lin.	3040741	1	LM741CN	27014
U4	Peripheral Interface Adaptor	3086821	2	MC68B21P	04713
U5	Two-Mod Prescaler	3112013-02	1	MC12013L	04713
U6	Digital Dual "D" Flip-flop	3110131	1	MC10131L	04713
U7	U4				
U8 thru U10	UP/DOWN Counter	3084192	4	DM74LS192N	27014

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A108 CONVERTER CONTROL

2020200-04 A

REF DES	DESCRIPTION	EIP NO.	UNITS PER ASSY	TYP MFG NO.	TYP FSCM NO.
U11	Counter Control Logic	3112014	1	MC12014P	04713
U12	UP/DOWN Counter	3084193	1	DM74LS193N	27014
U13	U8				
U14	Phase Frequency Detector	3014044	1	MC4044P	04713
U15	Quad Dual Flip-flop	3084175	1	SN74LS175	01295
U16	Decade Counter	3084490	1	SN74LS490N	01295
U17	J-FET Op Amp	3040071	2	TL071CP	01295
U18	Quad 2 INP NAND	3087400	1	DM74LS00	27014
U19	U17				
TP1 Thru TP7	PCB, .040D, Pin; Gold	2620032	15	460-2970-02-03	71279
TP8	Not used				
TP9 Thru TP16	TP1				
S1	Switch, Dip, SPDT	4540007	1	435469-9	51216

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

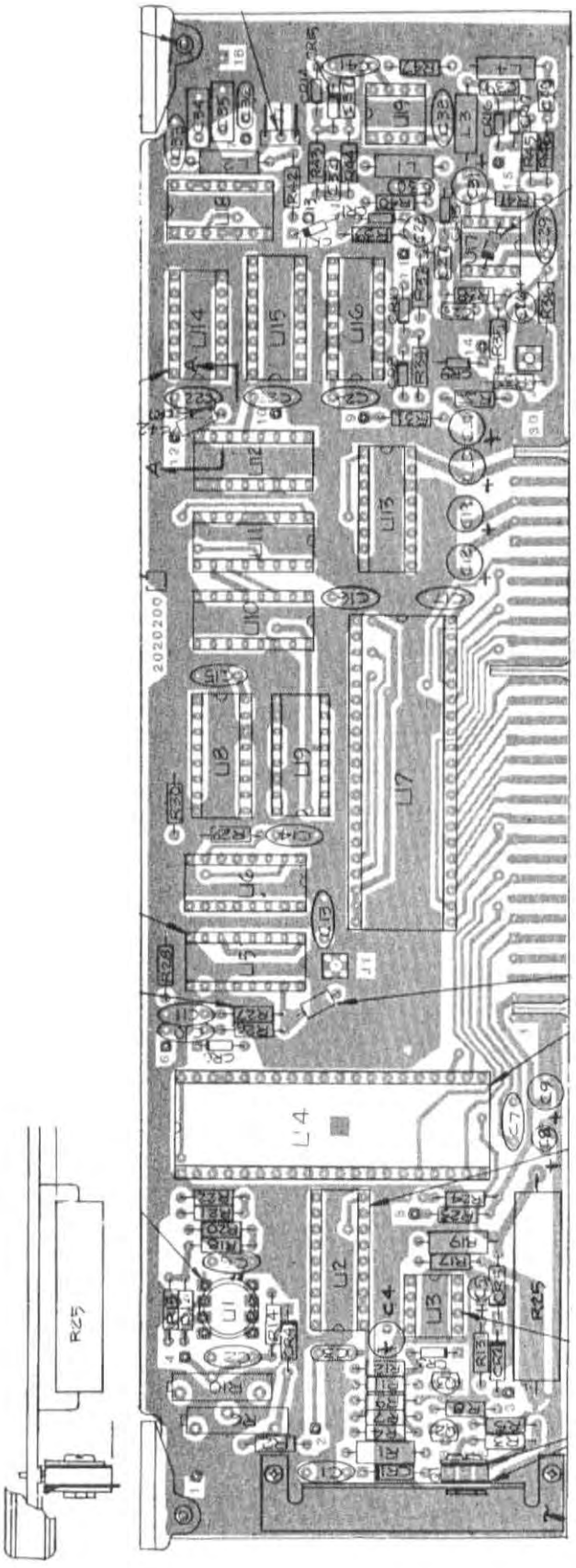
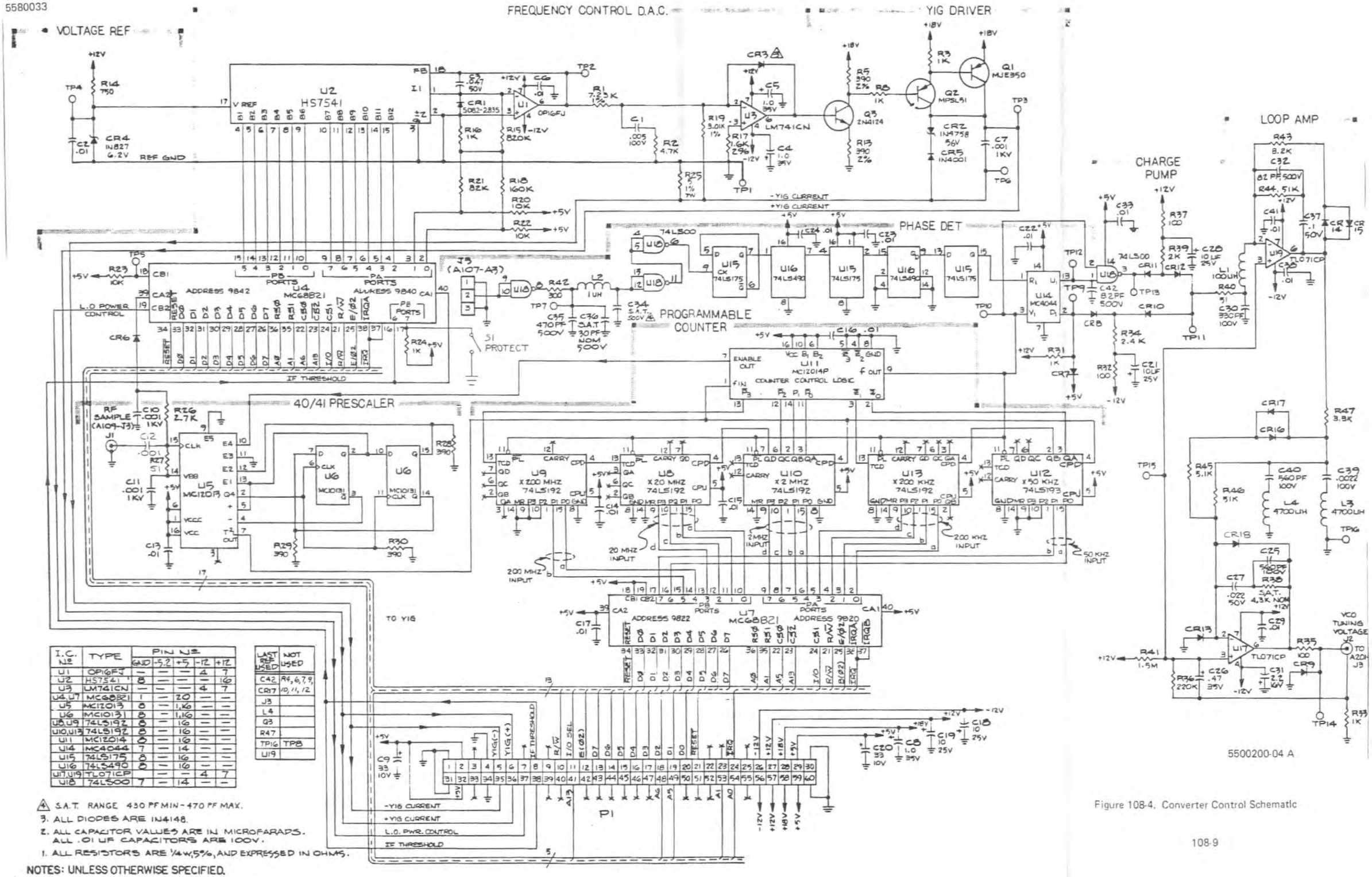


Figure 108-3. Converter Control Component Locator

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



I.C. NO	TYPE	PIN NO				
		GND	-5.2	+5	-12	+12
U1	OP16FJ	—	—	—	4	7
U2	HS7541	8	—	—	—	16
U3	LM741CN	—	—	—	4	7
U4,U7	MC6882I	1	—	20	—	—
U5	MC12013	8	—	1,16	—	—
U6	MC10131	8	—	1,16	—	—
U8,U9	74LS192	8	—	16	—	—
U10,U13	74LS192	8	—	16	—	—
U11	MC12014	8	—	16	—	—
U14	MC4044	7	—	14	—	—
U15	74LS175	8	—	16	—	—
U16	74LS490	8	—	16	—	—
U17,U19	TL071CP		—	—	4	7
U18	74LS00	7	—	14	—	—

LAST REF USED	NOT USED
C42	R4, 6, 7, 9,
CR17	10, 11, 12,
J3	
L4	
Q3	
R47	
TP16	TP8
U19	

4. S.A.T. RANGE 430 PF MIN - 470 PF MAX.
3. ALL DIODES ARE IN4148.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS. ALL .01 UF CAPACITORS ARE 100V.
1. ALL RESISTORS ARE 1/4W, 5%, AND EXPRESSED IN OHMS.

NOTES: UNLESS OTHERWISE SPECIFIED.

Figure 108-4. Converter Control Schematic

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A109
BAND 2 CONVERTER
(2020139)

The Band 2 Converter accepts Band 1 and Band 2 RF signals from the front panel, and local oscillator (LO) signal from the Band 3 Converter (A203). The appropriate signal is selected and processed to produce an IF signal between 10 Hz and 200 MHz. The IF signal output is sent to the Count Chain board (A106), and lock information is routed through the PIA (peripheral interface adapter) U2 to the Microprocessor (A105).

IMPEDANCE CONVERTER

Band 1 input from the front panel enters the converter at J6 and is terminated by R75. The signal is coupled to the input of a field effect transistor (FET) amplifier (Q15) through an RC network (R73, C42). Two limiter diodes (CR4, CR5) protect the FET against large input signals. The FET is a source follower with slightly less than unity gain. The FET drives a buffer amplifier (Q14) which has enough gain to increase the impedance converter overall gain to near unity. A decoupling capacitor (C39) controls the amplifiers low frequency cutoff, and C41 provides high frequency peaking to keep the gain flat to frequencies above 100 MHz.

SIGNAL SELECT

The output of the impedance converter circuit drives one input of the signal select circuitry. Signal selection is made by enabling one of three differential amplifiers, U4A, U4B, or U5A. When Band 1 is selected, a logic high signal on the PIA (U2 pin 2) turns on Q16. Q16 biases on the current source in U4A. This current source generates an 11mA current which is split between the two differential amplifier transistors in U4A. The currents from pins 5 and 6 flow through matched collector loads (R94, L7/R95, L8). R94 and R95 are equal, and are selected for the proper low frequency gain during board alignment. Inductors L7 and L8 provide peaking to give an approximate flat gain through 200MHz. Diodes CR9 and CR10 provide limiting on very strong signals to prevent the next stage from being over driven.

The next stage is a differential amplifier similar to U4A, but it is driven differentially. To generate a single ended output signal, one output of U5B (pin 12) is passed through a current mirror (Q18). The output of the current mirror is then added to the second output of U5B (pin 11) at J5. The load for this stage is a 51 ohm resistor located on the A106 Count Chain board in order to terminate the coax for RF signals. In the quiescent state, the current from Q18 equals the collector current of the differential amplifier U5B, and the output current is zero. When a signal is applied, the current will be unbalanced to generate a signal at the load resistor. To provide frequency compensation of the current mirror, an RC network (R108, C34) is connected between the emitter of Q18 and ground.

BAND 1 LOCK DETECTOR

The output signal at J5 is coupled to detector CR12. Amplifier U6 is a threshold comparator that will produce a logic low signal when the IF output from J5 is more than –6dBm. The output of U6 goes through a resistor divider network to generate a 5V TTL logic signal for the PIA. R90 provides about 1 dB of positive feedback at threshold level to prevent eratic output from the comparator.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

ISOLATION AMPLIFIER

The Band 2 input signal enters on J4. This RF signal is terminated in 50 ohms by the combination of R1 and the input impedance of the amplifier. The input signal level is detected by CR1, filtered by C3, and applied to one input of the Band 2 lock detector (U1).

The isolation amplifier is a common base amplifier with a gain of −10 dB. An input signal range of +10 to −20dBm is translated to a 0 to −30dBm range into the mixer so the mixer will be in its linear range for all signal input levels. The amplifier peaks slightly near 1 GHz to overcome an increase in mixer conversion loss at these frequencies.

MIXER OPERATION

The local oscillator (LO) is applied to the IF terminal and the IF is removed from the LO terminal. This swap allows the mixer (MX1) to be unbalanced and act as a low loss attenuator for signals between 10MHz and 200MHz where no mixing is necessary. The mixer has a nominal 400MHz LO for signals between 200MHz and 600MHz; and has a nominal 800MHz LO for signals between 600MHz and 1GHz. A 980MHz LO allows operation with input signals to 1160MHz.

IF AMPLIFIER

The output of the mixer drives an IF amplifier through a 7 section, 200MHz low-pass filter. The IF amplifier is a "feedback pair" amplifier whose gain is stabilized by feedback, to be equal to 24dB. Inductor L6 is used to extend the high frequency response to 200MHz. The 1 pF capacitor (C26) between R34 and R35 is a low pass filter to reduce the 1200 to 1500 MHz LO harmonics that reach the IF amplifier.

BAND 2 LOCK DETECTOR

The IF amplifier output goes to the signal select circuit and to the Band 2 Lock Detector. The Band 2 Lock Detector has a voltage proportional to the IF level on the positive input, and a voltage proportional to the RF signal on the Negative input. The conversion gain from RF input to IF amplifier output is a +6dB for all valid signals, and less than −6dB for all spurious signals. The output of U1 is positive only when a valid IF signal is present. A small offset is added by R12 and R13 to guarantee a non lock condition when no signal is present. Resistor R90 provides about 1dB of positive feedback to prevent eratic output from noise at the point of threshold.

LO BUFFER

The VCO signal from the Band 3 Converter (A201A, J2) enters on J1. The signal goes through a 6 dB attenuator (R111, R112, R114), and a low pass filter (L1, C63, C64 to attenuate high order harmonics), and is terminated by a 51 ohm resistor (R16). Two high input impedance signal splitters (Q2, Q3) get their input signals from R16. Q2 and Q3 operate on the same basic principal. One output is taken from the emitter (acting as an emitter follower) which provides unity gain for the input signal. The AC terminating impedance on the emitter is adjusted to be 50 ohms so the amplifier will act as a unity gain amplifier for the 50 ohm load which terminates the collector when a coax cable is connected. U2 has an additional transformer (T1) in its collector lead to increase the signal output to J3 by about 4 dB.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

DIVIDE-BY-TWO

The emitter output of Q3 drives the input of a divide-by-two IC (U3). The impedance is held at 50 ohms by two terminating/biasing resistors (R61, R62). The resistors keep the input bias to U3 below the emitter-coupled logic (ECL) low level (approx. −2.0V). The microprocessor enables self-test by putting a low level signal on pin 5 of the PIA (U2). This turns on Q13, and raises the voltage at U3 pin 7 to the center of an ECL signal (approx. −1.2V). This allows U3 to divide the input signal by two. The output of U3 goes to the signal select circuits.

LO SELECT

The signal from the emitter of Q2 drives the LO select circuitry. The LO provides one (of three) signals to the mixer (MX1). In Band 2A a bias current is generated to unbalance the mixer and allow signals below 190MHz to pass. In Band 2B a 370MHz or 425MHz LO signal is generated that will mix with signals of 200 to 600MHz, and provide the 10 to 200MHz IF signal desired. In Band 2C a 750MHz, 850MHz or 980MHz LO signal is generated to mix with input signals between 600MHz and 1160MHz to provide the desired IF signal.

In Band 2A, the 3ma current to bias mixer MX1 is generated when Q12 is turned on by the PIA, to apply +12V to MX1 through R57. This will allow signals to pass that are less than the cutoff frequency of the low pass filter (200MHz). The LO signal to mixer MX2 from Q2 is not allowed to pass MX2 because of the inherent balance of the mixer. No signal can enter pin 2 of MX2 because Q7 has been saturated, removing bias from buffer Q5, and shunting any RF signals to ground.

When Band 2B is selected, Q12 is turned off thus balancing mixer MX1; Q6 is turned on to unbalance mixer MX2. With MX2 unbalanced, the LO signal from Q2 can pass through MX2 and be amplified by Q10 and Q11, and be applied to mixer MX1.

When Band 2C is selected both Q6 and Q12 are off, and both mixers are balanced. In this mode Q7 is shut off and an LO signal is applied to pin 1 and 2 of MX2. The sum output of MX2 is selected by a DC blocking capacitor (C31). This sum (that is two times the incoming LO frequency) is amplified by Q10 and Q11 and applied to MX1.

The Q10 and Q11 amplifier is a series shunt pair. Q10 applies most of the RF input signal across the emitter resistor R47. This determines the transistor emitter current, which will be the collector current if the output is terminated in a low impedance. Q11 is used as a current-to-voltage converter. The output voltage of this converter is the product of the input current times the feedback resistor (R51). Since the input of this stage is a summing junction, it appears very close to zero ohms to the previous stage, Q10. The voltage gain of the two transistors can be approximated by R51/R47, which is about 3 or 10dB. Since the gain required at 800MHz is slightly greater than required at 400MHz, a low pass matching network (consisting of L2 and C20 peaks the output signal current to MX1 at 800 MHz. The remaining components around Q10 and Q11 are used to bias the transistors. Shunt biasing is used to provide collector bias voltages of 3.4V for Q10, and 4.7V for Q11.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPTION SELECTION

Provision has been made on this assembly for a set of jumpers that will let the microprocessor know when it has the components required for a 548A (26.5 GHz) counter, and if it has an extended frequency option (Option 06). These jumpers are read by the microprocessor when the counter is turned on, and will select micro code which is applicable only when those options are available. A jumper from E1 to E3 (from pins 8 and 9 on the PIA U2) indicate that this is a 548A counter. A jumper from E2 to E4 indicates that Option 06 (Band 4) has been installed.

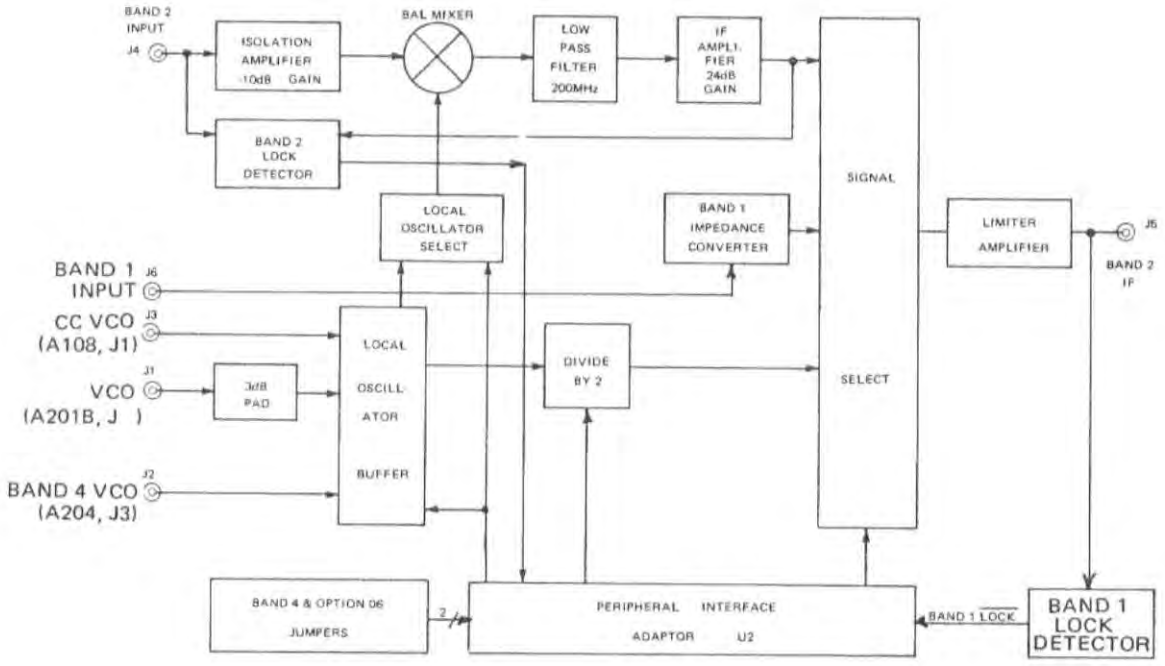


Figure 109-1. Band 2 Converter Block Diagram

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A109 BAND 2 CONVERTER

2020139-05 A

REF DES	DESCRIPTION	EIP NO.	UNITS PER ASSY	TYP MFG NO.	TYP FSCM NO.
A109	Band 2 Converter Assy	2020139-03	1	EIP	34257
C1	Cer, .01μF, 10%, 100V	2150014-00	9	6123X7R103KA100	26654
C2	C1				
C3	Cer, .001μF 10%, 100V	2150015	11	6183X7R102KA100	26654
C4 thru C6	C1				
C7	Mica, 100pF, 5%, 500V	2260034	3	FD101J03	72136
C8	Disc, .001μF, 20%, 100 V	2150001	8	SGA - D10	56289
C9	Disc, .01μF, 20%, 100V	2150003	11	TG - S10	56289
C10	C8				
C11	C8				
C12	C7				
C13	C8				
C14	C7				
C15 thru C18	C3				
C19	C8				
C20	Mica, 1pF, 100%, 500V	2260005	2	CD010C03	56289
C21	Mica, 18pF, 5%, 500V, NOM - S.A.T	2260999	1		
C22	Mica, 33pF, 5%, 500V, NOM - S.A.T.	2260999	2		
C23	C22				
C24	Mica, 27pF, 5%, 500V NOM S.A.T.	2260999	1		
C25	C1				
C26	C20				
C27	Not Used				
C28	C1				
C29	C9				
C30	C1				
C31	C3				
C32	C3				
C33	C1				
C34 thru C36	C3				
C37	C9				
C38	C3				
C39	Tant, 100μF, 20%, 6.3V	2300024	1	TAG20 - 47/6.3 - 50	14433
C40	C9				
C41	Mica, 22pF, 5%, 500V	2260017	1	ED220J03	72136
C42	Mica, 47pF, 5%, 6.3V	2260004	1	DM10 - 470J	72136
C43	Tant, 33μF,10%, 10V	2300015	6	TAG20 - 33/10 - 50	14433
C44	C9				
C45	C43				
C46	C8				
C47 thru C49	C9				
C50	Tant, 10μF, 20%, 25V	2300029	3	TAG20 - 10/25	14433
C51	C43				
C52	C9				
C53	C9				
C54	Mica, 18pF, 5%, 500V	2260015	1	CD180J03	56289
C55	C8				
C56	C8				
C57	C50				

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A109 BAND 2 CONVERTER, continued

2020139-05 A

REF DES	DESCRIPTION	EIP NO.	UNITS PER ASSY	TYP MFG NO.	TYP FSCM NO.
C58	C43				
C59	C9				
C60	C43				
C61	C50				
C62	C43				
C63	Mica, 8pF, 13%, 500V	2660011	2	CD080J03	56289
C64	C63				
CR1	Mix UHF	2710038	3	ND4991	00005
CR2	Not Used				
CR3	CR1				
CR4	Fast Switch, GP	2704148	3	IN4148	07263
CR5	CR4				
CR6 thru CR10	Not Used				
CR11	CR4				
CR12	CR1				
L1 thru L5	Part of Board				
L6	Inductor, 0.47 μH	3510006	1	DD - 0.47	99800
L7	L1				
L8	L1				
MX1	Balanced Mixer	2030016	2	TFM-2	
MX2	MX1				
Q1	NPN, RF	4710030	8	BFR-90	04713
Q2	Q1				
Q3	Q1				
Q4	PNP, General Purpose	4704124	1	2N4124	04713
Q5	Q1				
Q6	PPNP, General Purpose	4704126	7	2N4126	04313
Q7	Q1				
Q8	Q1				
Q9	Q1				
Q10	NPN, RF, graded	4710030-02	1	BFR-90	
Q11	Q1				
Q12	Q6				
Q13	Q6				
Q14	NPN, RF	5280047	2	2N4261	01295
Q15	NN-Channel, JFET	4704416	1	2N4416	04713
Q16	Q6				
Q17	Q6				
Q18	Q14				
Q19	Q6				
Q20	Q6				
R1	Comp, 150, 5%, 1/8 W	4000151	1	RC05GF151J	81349
R2	Res, MF, 75.0, 1%, 1/8W	4067509	1	RN55D7509F	24546
R3	Res, 1.1K, 2%, 1/4W	4130112	1	C4/2%/10	24546
R4	Res, 820, 2%, 1/4W	4130820	4	C4/2%/820	24546
R5	Comp, 33, 5%, 1/8 W	4000330	1	RC05GF330J	81349
R6	Comp, 51, 5%, 1/8 W	4000510	1	RC05GF510J	81349
R7	Comp, 10K, 5%, 1/4 W	4010103	3	RC07GF103J	81349
R8	Met Ox, 8.2K, 2%, 1/4 W	4130822	2	C4/2%/8.2K	81349
R9	Met Ox, 30K, 2%, 1/4 W	4130303	1	C4/2%/30K	24546
R10	Met Ox, 43K, 2%, 1/4 W	4130433	2	C4/2%/43K	24546
R11	Comp, 43K, 5%, 1/4 W	4010433	1	RC07GF433J	81349
R12	Res, M/OX, SAT (15 NOM)	4130999	4	C4/2%/15K	24546
R13	Res, MF, 12.1, 1%, 1/8W	4061219	1	RN55D1219F	24546

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A109 BAND 2 CONVERTER, continued

2020139-05 A

REF DES	DESCRIPTION	EIP NO.	UNITS PER ASSY	TYP MFG NO.	TYP FSCM NO.
R14	Comp, 36, 5%, 1/4 W	4010360	1	RC07GF360J	81349
R15	Comp, 11, 5%, 1/4 W	4010110	2	RC07GF110J	81349
R16	Res, MF, 51.1, 1%, 1/8W	4065119	2	RN55D51R1F	24546
R17	Comp, 1K, 5%, 1/4 W	4010102	4	RC07GF102J	81349
R18	R4				
R19	R15				
R20	Res, CC, 1/4W, 5% SAT	4010999	1		
R21	Comp, 220, 5%, 1/4 W	4010221	2	RC07GF221J	81349
R22	Comp, 20K, 5%, 1/4 W	4010203	1	RC07GF203J	81349
R23	Res, CC 820, 1/4W, 5%	4010821	2	RC07GF821J	81349
R24	Comp, 10, 5%, 1/8 W	4010100	11	RC07GF100J	81349
R25	Met Ox, 750, 2%, 1/4 W	4130751	2	C4/2%/750	24546
R26	Comp, 11k, 5%, 1/4 W	4010113	3	RC07GF113J	81349
R27	Met Ox, 4.7K, 2%, 1/4 W	4130472	1	C4/2%/4.7K	24546
R28	Res, MF, 33.2, 1%, 1/8W	4063329	2	RN55D3329F	24546
R29	Comp, 4.7K, 5%, 1/4 W	4010472	2	RC07GF472J	81349
R30	R26				
R31	Comp, 8.2K, 5%, 1/4 W	4010822	2	RC07GF822J	81349
R32	R7				
R33	R7				
R34	Res, MF, 27.4, 1%, 1/8W	4062749	1	RN55D2749F	24546
R35	Res, MF, 24.3, 1%, 1/8W	4062439	1	RN55D24R3F	24546
R36	R24				
R37	Comp, 10, 5%, 1/8 W	4000100	1	RC05F100J	81349
R38	R17				
R39	R4				
R40	R4				
R41	R24				
R42	R16				
R43	R24				
R44	Comp, 910, 5%, 1/4 W	4010911	1	RC07GF911J	81349
R45	Comp, 3.9K, 5%, 1/4 W	4010392	3	RC07GF392J	81349
R46	Comp, 27K, 5%, 1/4 W	4010273	1	RC07GF273J	81349
R47	R28				
R48	Comp, 3.3K, 5%, 1/4 W	4010332	1	RC07GF332J	81349
R49	Comp, 390, 5%, 1/4 W	4010391	1	RC07GF391J	81349
R50	Comp, 13K, 5%, 1/4 W	4010133	1	RC07GF133J	81349
R51	Res, MF, 121, 1%, 1/8W	4061210	1	RN55D1210F	24546
R52	R24				
R53	R31				
R54	R26				
R55	R25				
R56	R24				
R57	R12 (4.3K NOM)	4130999	1	C4/2%/4.3K	
R58	R17				
R59	R45				
R60	R12 (300 or 560 NOM)				
R61	Res, MF, 82.5, 1%, 1/8W	4068259	1	RN55D82R5F	24546
R62	Res, MF, 130.0,1%, 1/8W	4061300	2	RN55D1300F	24546
R63	Comp, 510, 5%, 1/4 W	4010511	1	RC07GF511J	81349
R64	Comp, 51, 5%, 1/4 W	4010510	2	RC07GF510J	81349
R65	Comp, 200, 5%, 1/4 W	4010201	1	RC07GF201J	81349
R66	Comp, 160K, 5%, 1/4 W	4010164	1	RC07GF164J	81349
R67	Met Ox, 1.8K, 2%, 1/8 W	4130182	1	C4/2%/1.8K	24546
R68	R24				
R69	Met Ox, 510, 2%, 1/4 W	4130511	2	C4/2%/510	24546
R70	R12 (1.2K NOM)	4130999	1	C4/2%/1.2K	24546
R71	R29				
R72	R24				

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A109 BAND 2 CONVERTER, continued

2020139-05 A

REF DES	DESCRIPTION	EIP NO.	UNITS PER ASSY	TYP MFG NO.	TYP FSCM NO.
R73	Comp, 1M, 5%, 1/4 W	4010105	2	RC07GF105J	81349
R74	R64				
R75	R73				
R76	Met Ox, 2.2K, 2%, 1/4 W	4130222	3	C4/2%/2.2K	24546
R77	Met Ox, 3.9K, 2% , 1/4W	4130392	3	C4/2%/3.9K	24546
R78	Comp, 5.6K, 5%, 1/4 W	4010562	1	RC07GF562J	81349
R79	Comp, 3.6K, 5%, 1/4 W	4010362	3	RC07GF362J	81349
R80	Met Ox, 7.5K, 2%, 1/4 W	4130752	3	C4/2%/7.5K	24546
R81	R76				
R82	R24				
R83	Met Ox, 200, 2%, 1/4 W	4130201	3	C4/2%/200	24546
R84	R77				
R85	Met Ox, 330, 2%, 1/4 W	4130331	1	C4/2%/330	24546
R86	Comp, 6.8K, 5%, 1/4 W	4010682	2	RC07GF682J	81349
R87	R79				
R88	R80				
R89	R8				
R90	Comp, 75K, 5%, 1/4 W	4010753	1	RC07GF753J	81349
R91	Met Ox, 33K, 2%, 1/4 W	4130333	1	C4/2%/33K	24546
R92	Met Ox, 160, 2%, 1/4 W	4130161	1	C4/2%/161	24546
R93	R21				
R94	Res, MF, SAT., 1/8W, 1% (12.1 NOM)	4069999	2	C4/2%/12	24547
R95	R94				
R96	R83				
R97	R83				
R98	R77				
R99	R86				
R100	R79				
R101	R80				
R102	R10				
R103	R76				
R104	Comp, 180, 5%, 1/4 W	4010181	1	RC07GF181J	81349
R105	R24				
R106	Res, MF, 90.9, 1%, 1/8W	4069099	1	RN55D9099F	24546
R107	R62				
R108	R24				
R109	R69				
R110	R17				
R111	Comp, 160, 5%, 1/4 W	4010161	2	RC07GF161J	81349
R112	R111				
R113	Res, MF, 20.0, 1%, 1/8W	4062009	1	RN55D2009F	24546
R114	Met Ox, 2K, 2%, 1/4 W	4130202	2	C4/2%/2K	24546
R115	R114				
R116	Met Ox, 9.1K, 2%, 1/4 W	4130912	2	C4/2%/9.1K	24546
R117	R116				
R118	Comp, 300K 5%, 1/4 W	4010301	1	RC07GF301J	81349
R119	R45				
R120	R23				
R121	Comp, 68, 5%, 1/4 W	4010680	1	RC07GF560J	81349
R122	Comp, 100K, 5%, 1/4 W	4010101	1	RC07GF100J	81349

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A109 BAND 2 CONVERTER, continued

REF DES	DESCRIPTION	EIP NO.	UNITS PER ASSY	TYP MFG NO.	TYP FSCM NO.
TP1 thru TP16	Conn, Pin, .040D	2620032	16	460 - 2970 - 02 - 03	71279
U1	Prec, JFET Op Amplifier	3041016	1	OP16FJ	06665
U2	Periph. Interface Adaptor	3086821	1	68B21P	04713
U3	750 MHz, D-Type Flip Flop	3001106	1	MC11C06	07263
U4	Dual/Diff. Amplifier	3043049	2	CA3049	27014
U5	U4				
U6	Op Amplifier	3040741	1	I M741C	27014

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

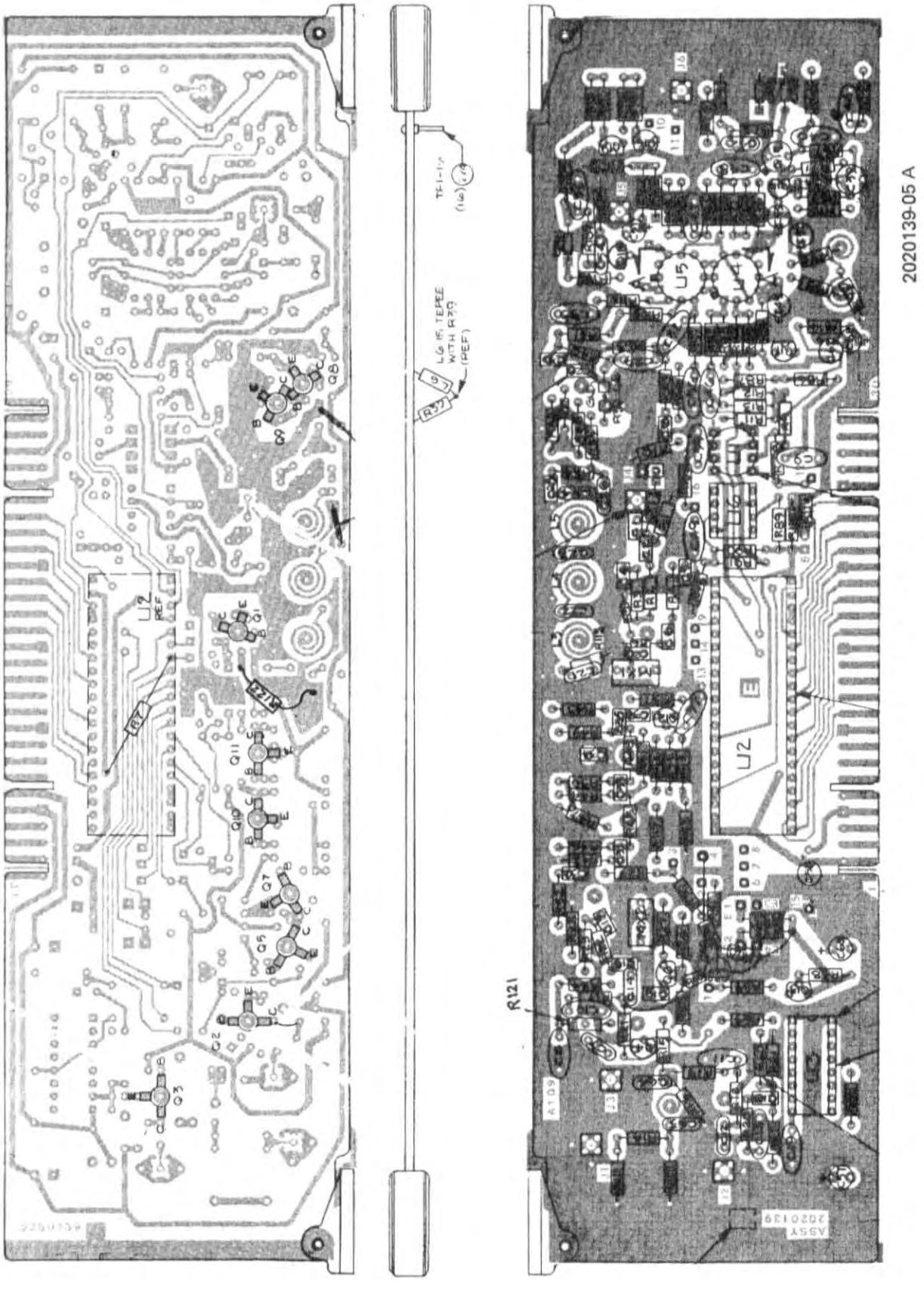
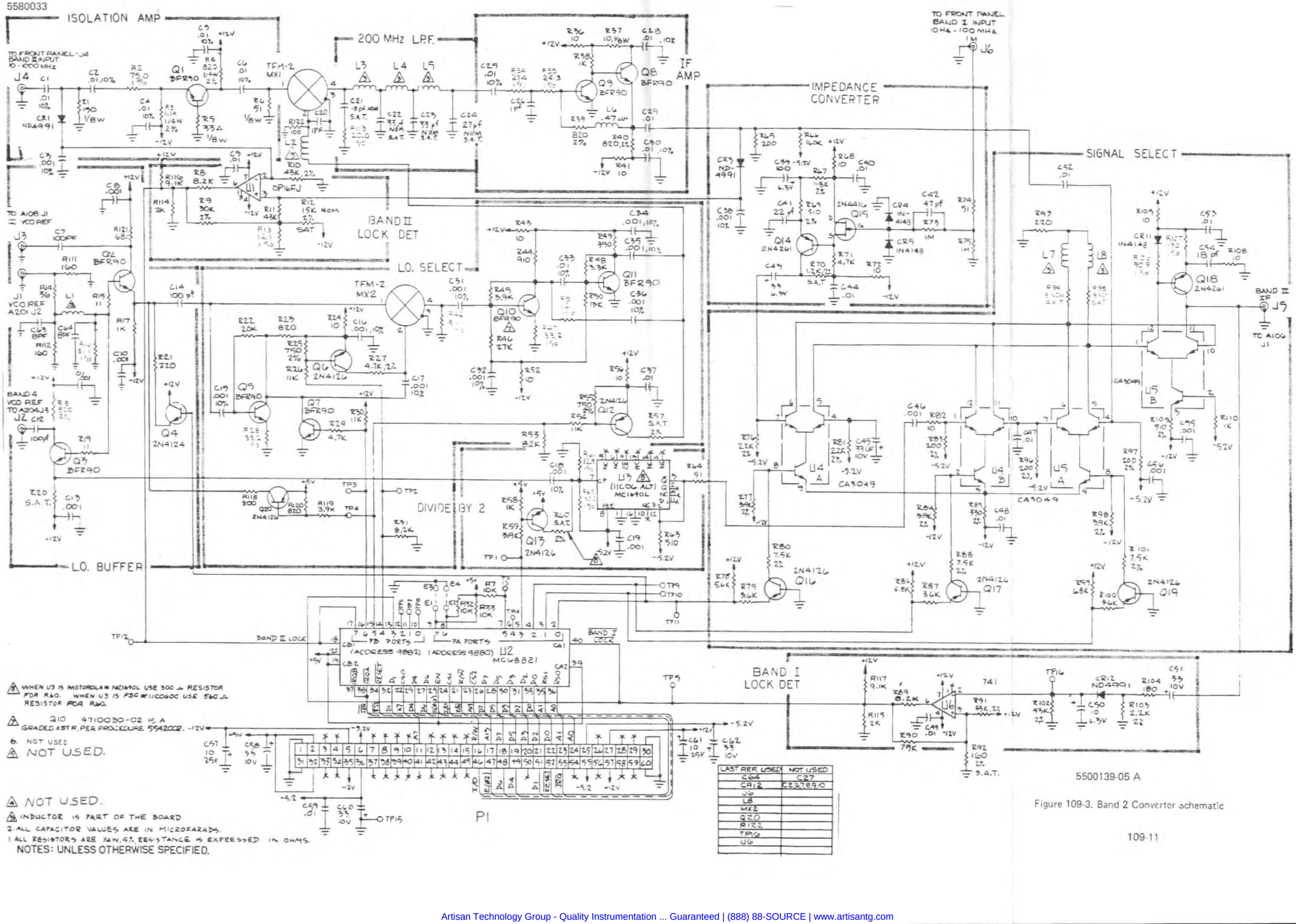


Figure 109-2 . Band 2 Converter Component Locator

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5580033



⚠ WHEN U3 IS MOTOROLA = MC1690L USE 300 Ω RESISTOR FOR R60. WHEN U3 IS FSC = 11C06DC USE 560 Ω RESISTOR FOR R60.

⚠ Q10 4710030-02 IS A GRADED AST R, PER PROCEDURE 5542002. -12V

6. NOT USED.

⚠ NOT USED.

⚠ NOT USED.

⚠ INDUCTOR IS PART OF THE BOARD

2. ALL CAPACITOR VALUES ARE IN MICROFARADS.

1. ALL RESISTORS ARE ¼W, 5%. RESISTANCE IS EXPRESSED IN OHMS.

NOTES: UNLESS OTHERWISE SPECIFIED.

LAST REF. USED	NOT USED
C64	C27
CR12	C23,78,10
J6	
L8	
MX2	
Q20	
R122	
TP16	
U6	

5500139-05 A

Figure 109-3. Band 2 Converter schematic

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A110
FRONT PANEL
DISPLAY AND KEYBOARD
(2020140)

The Front Panel Display and Keyboard assembly (A110) is divided into two functional sections.

- Numeric display and annunciators
- Keyboard

NUMERIC DISPLAY AND ANNUNCIATORS

This section of the assembly contains 12 common anode seven-segment numeric display units (DS1-DS12), two green LEDs (DS37 and DS38), and a maximum of 24 yellow LEDs (DS13-DS36).

The 12 seven-segment LEDs are mounted side by side, with space between each third digit from the right. The corresponding cathode segments of the seven-segment LEDs are connected, and the drive signal come from segment drivers Q3 through Q10. The signals to drive the digits come from the digit drivers located on the Front Panel Logic board (A111).

The 24 yellow LEDs (DS13-DS36) are divided into three groups of eight LEDs each. The anodes of all LEDs in each group are connected. The cathode of each LED in a group is connected to one of the segments drivers (Q3-Q10). With this arrangement each group of annunciator lights can be regarded as similar to one seven-segment LED. The digit drives for the three groups of annunciator lights also come from the Front Panel Logic board (A111).

The two green LEDs (DS37 and DS38) are driven by Q1 and Q2. When these LEDs light, they indicate that GATE and CONVERTER SEARCH are in operation.

KEYBOARD

This section of the assembly makes provision for a maximum of 25 (single-pole double-throw) switches, of which only 21 are used. The switches are arranged in a 4 row by 6 column matrix, with the extra switch taking the row 4 column 7 position. The columns are connected to +5V through the resistor network (RN1) on the Front Panel Logic board (A111).

The keyboard is continuously scanned. The signals scanning the keyboard are derived from A111. To scan the keyboard the 4 rows are grounded sequentially. When a row is grounded, and a key in that row is pushed, one of the columns will be grounded. This information is sent to the A111 board where key debouncing is performed.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PAGE BLANK INTENTIONALLY

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A110 FRONT PANEL DISPLAY AND KEYBOARD

2020140-02-B

REF DES	DESCRIPTION	EIP NO.	UNITS PER ASSY	TYP MFG NO.	TYP FSCM NO.
A110	Front Panel Display & Keyboard	2020140-01	1	EIP	34257
Q1 thru Q10	PNP, Amp.	4710019	10	MPS - D55	04713
R1	Comp, 4.7K, 5%, 1/4 W	4010472	2	RC07GF472J	81349
R2	Comp, 130, 5%, 1/4 W	4010131	2	RC07GF131J	81349
R3	R1				
R4	R2				
R5	Comp, 240, 5%, 1/4 W	4010241	8	RC07GF241J	81349
R6	Comp, 18, 5%, 1/4 W	4010180	8	RC07GF180J	81349
R7	R5				
R8	R6				
R9	R5				
R10	R6				
R11	R5				
R12	R6				
R13	R5				
R14	R6				
R15	R5				
R16	R6				
R17	R5				
R18	R6				
R19	R5				
R20	R6				
DS1 thru DS12	LED, Numeric, Indicator	2800024	12	TIL - 312	28480
DS13 thru DS36	LED, Lamp, Yel 0.15 x 0.25	2800020	24	MV53124	50522
DS37	LED, Lamp, Grn ,. 12 OD	2080018	2	MV5274	50522
DS38	DS37				
S1	Switch, Mon, SPDT	4500013	21	REK71882	14433
S2 thru S5	Not Used				
S6 thru S25	S1	4500013	21	REK	
P1	9 pin Recept.	2620065	1	22 - 14 - 209	0000A
P2	17 pin Recept.	2620067	1	22 - 14 - 2171	0000A
P3	13 pin Recept.	2620066	1	22 - 14 - 212	0000A

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

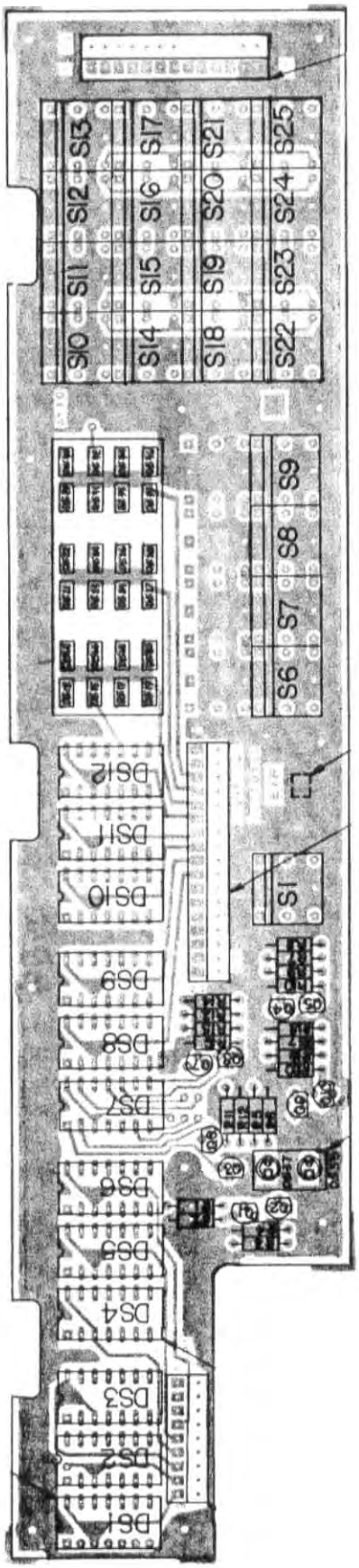
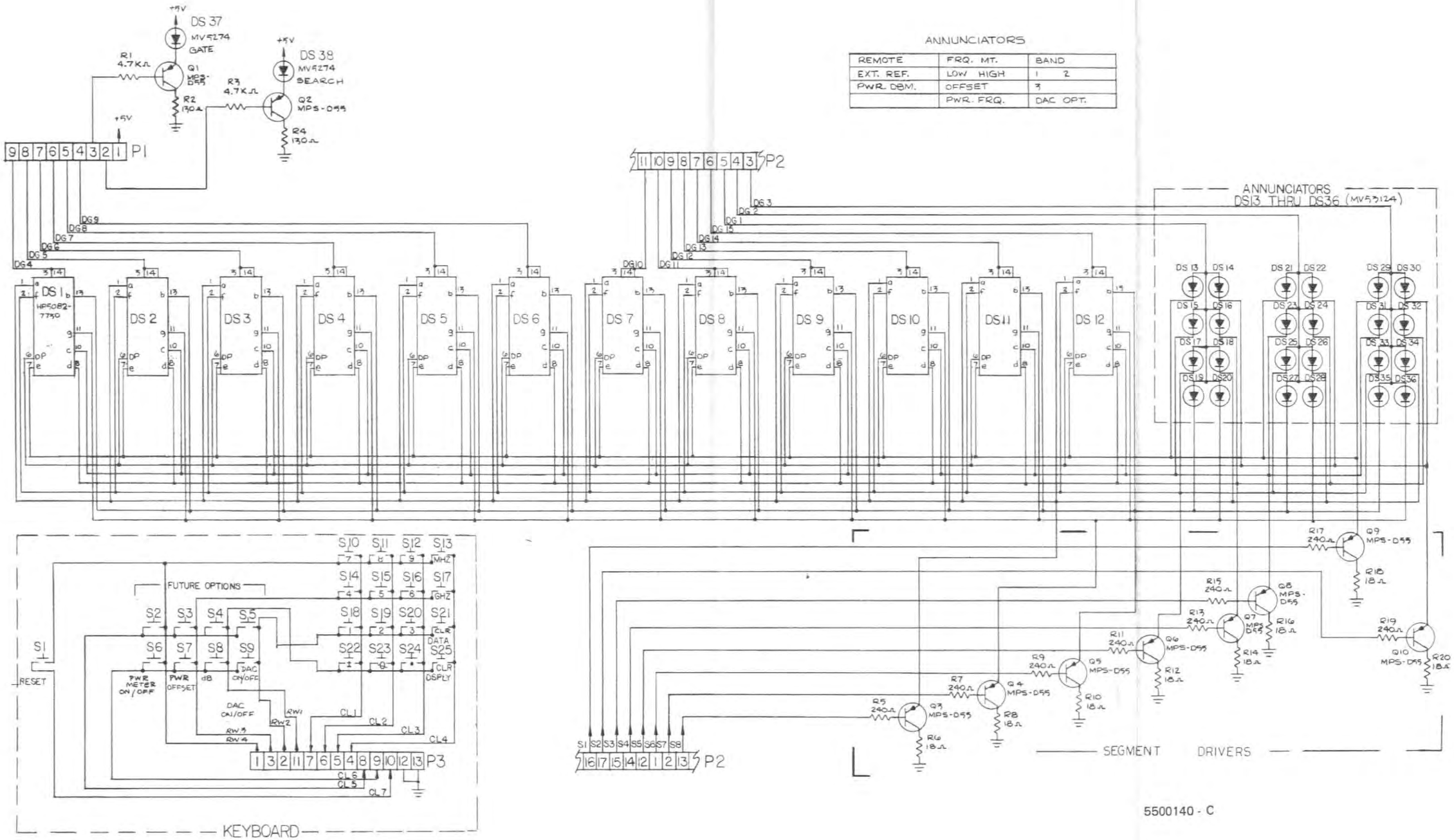


Figure 110-1. Front Panel Display and Keyboard Component Locator

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

ANNUNCIATORS

REMOTE	FRQ. MT.	BAND
EXT. REF.	LOW HIGH	1 2
PWR. DBM.	OFFSET	3
	PWR. FRQ.	DAC OPT.



5500140 - C

Figure 110-2. Front Panel Display and Keyboard Schematic

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A111
FRONT PANEL LOGIC
(2020191)

The Front Panel Logic assembly (A111) contains logic circuitry for control of two functions.

- DISPLAY CONTROL
- KEYBOARD CONTROL

The +5 V power supply to the front panel assemblies (A110 and A111) is regulated by a voltage regulator that is located behind the A111 board. For heatsinking purposes, this voltage regualtor is mounted on the chassis. Please refer to figure 111b. Front Panel Logic block diagram on page 111-3.

DISPLAY CONTROL

The twelve 7-segment LEDs and the three groups of annunciator lights on A110 are multiplexed. To turn on a particular segment in a digit, both the digit driver for that digit and the segment driver for that segment must be on.

The display logic is in constant operation in either the self-scan mode or the memory update mode.

SELF-SCAN MODE

This is the normal operating mode. In this mode the display scan clock is clocking the display counter (U6). The state of the display counter determines which digit will be turned on.

The state of the display counter is decoded by 4 to 16 line multiplexer (U2), and the appropriate digit driver is turned on. At this time the display memory (U7 and U8) is read, and the on/off information (stored in the display memory for that specific digit), turns the segment drivers (A110) on or off.

The display intensity is controlled by varying the duty cycle of the multiplexing. This is done by varying the resistance of the potentiometer (R4) which, in turn, varies the length of time the decoder (U2) and the display memories (U7, U8) are disabled between each scan clock cycle.

At the start of each gate operation the GATE light control is triggered, and the GATE LED lights for the length of the GATE.

MEMORY UPDATE MODE

In this mode the multiplexer logic is disabled by setting the display scan/$\overline{\text{update}}$ control line (PA4) to logic 0. The microprocessor controlled clock ($\overline{\text{clock}}$, PA1) is used to clock the display counter(U6).

Before updating the display memory (U7 and U8), the display counter is cleared by setting the clear/load control line (PA5) to logic 1, and clocking the clock input of U6. Update mode timing is illustrated in figure 111a.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

KEYBOARD CONTROL

When the keyboard is not being read by the microprocessor, the Keyboard READ/$\overline{\text{SCAN}}$ control line (PA0) is at logic 0. All the outputs of the shift register are at logic 0. If no key on the keyboard is pushed, all the inputs to the 8-input NAND gate (U13) are at logic 1 level. When a key is pushed, the column containing that key will be grounded. The output of U13 goes to logic 1 and C7 (in the debounce circuit) starts to discharge. When the voltage across C7 reaches approximately +0.7 V above ground, the debounce circuit will trigger the interrupt input on the PIA (U11, pin 18) indicating that a key is being pushed.

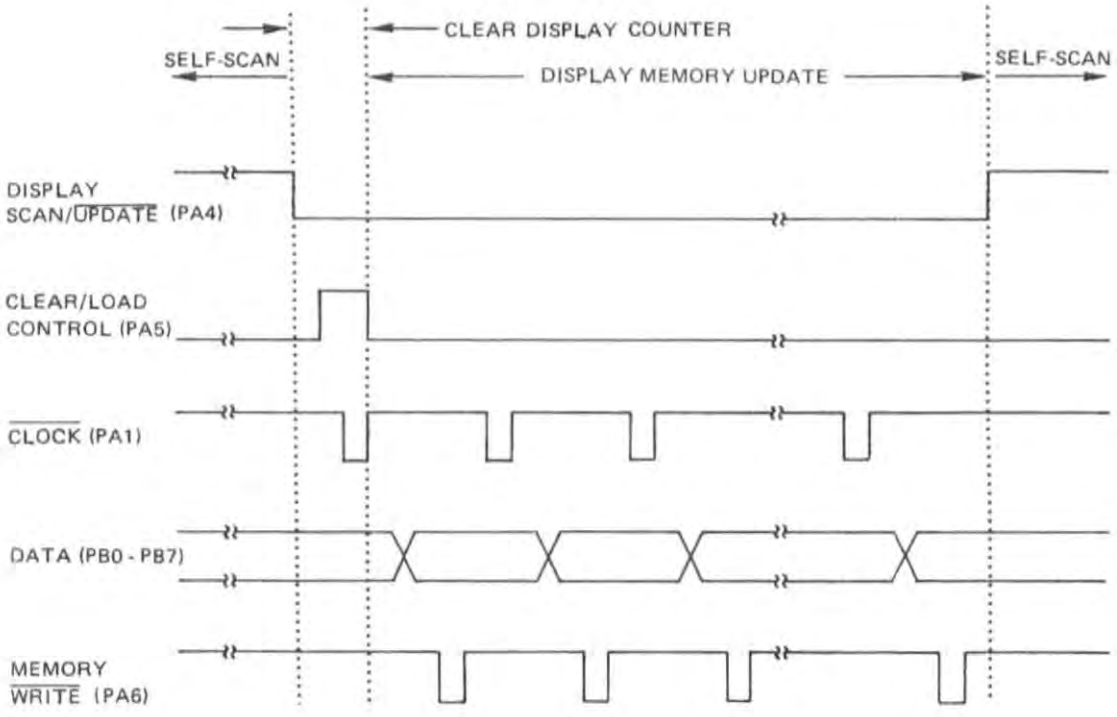


Figure 111-1. Memory Update Mode Sequence

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

READ KEYBOARD

When the microprocessor needs to read the keyboard, a logic 1 is put on the keyboard READ/$\overline{\text{SCAN}}$ control line (PA0). This enables the data buffer (U9). A 0111 is then loaded into the shift register (U3) by putting a logic 1 on the CLEAR/LOAD control line (PA5) and clocking the clock input of U3. The logic 0 at the output of the shift register (U3) is shifted through the shift register once. The microprocessor reads the keyboard row and column information with the logic 0 at each of the 4 outputs of U3 to determine the coordinate of the key pushed. After the keyboard is read, the keyboard READ/$\overline{\text{SCAN}}$ line is returned to logic 0.

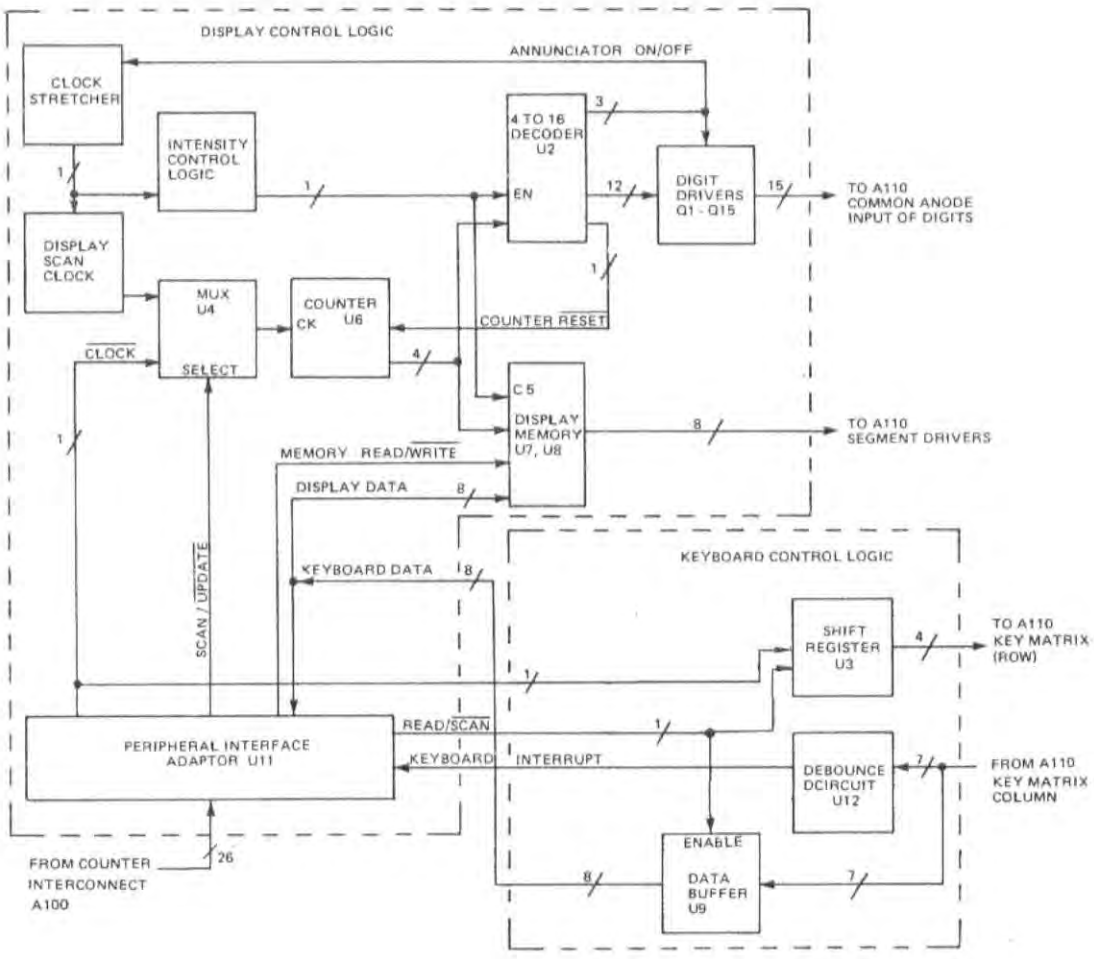


Figure 111-2. Front Panel Logic Block Diagram

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A111 FRONT PANEL DRIVER

2020191-02 A

REF DES	DESCRIPTION	EIP NO.	UNITS PER ASSY	TYP MFG NO.	TYP FSCM NO.
A111	Front Panel Driver Assy	2020191	1	EIP	34257
C1	Tant, 0.1μF, 10%, 35V	2300020	1	TAPA .10M35	14433
C2	Cer., .002μF, 20%, 1KV	2150005	2	TG - S20	56289
C3	C2				
C4	Not Used				
C5	Tant, 47μF, 20%, 16V	2300025	1	TAPA 47M16	14433
C6	Tant, 2.2μF, 20%, 16V	2300012	1	TAPA 2.2M16	14433
C7	Tant, 22μF, 20%, 16V	2300030	1	TAPA 22M16	14433
C8	Tant, .33μF, 20%, 35V	2310031	1	TAPA .33M16	14433
C9	Tant, 33μF, 20%, 10V	2300015	1	TAPA 33M16	14433
C10 thru C15	Cer., .01μF, 20%, 100V	2150003	6	TG - S10	56289
CR1	General Purpose	2704148	1	IN4148	07263
J1	9 Pin Male	2620062	1	22 - 03 - 2091	0000B
J2	17 Pin Male	2620064	1	22 - 03 - 2171	0000B
J3	13 Pin Male	2620063	1	22 - 03 - 2131	0000B
J4	4 Pin, FR. LOCK	2620068	1	640456-4	74868
J5	3 Pin	2620121	1	640456-3	74868
P2	26 Pin, Right Angle	2620131	1	3493 - 1002	76381
Q1 thru Q15	PNP, Power , Darlington	4710027	15	MPS - D54	04713
Q16	NPN, General Purpose	4704124	2	2N4124	04713
Q17	Q16				
R1	Comp, 10K, 5%, 1/4W	4010103	2	RC07GF103J	81349
R2	Comp, 220, 5%, 1/4W	4010221	1	RC07GF221J	81349
R3	Comp, 75K, 5%, 1/4W	4010753	1	RC07GF753J	81349
R4	Variable, Cer., 200K, KT05, 0.5W	4250022	1	72XR200	73138
R5	Comp, 120K, 5%, 1/4W	4010124	1	RC07GF124J	81349
R6	Comp, 2.4K, 5%, 1/4W	4010242	1	RC07GF242J	81349
R7 thru R21	Comp, 1K, 5%, 1/4W	4010102	15	RC07GF102J	81349
R22	Not Used				
R23	Comp, 15K, 5%, 1/4W	4010153	1	RC07GF153J	81349
R24	Comp, 390, 5%, 1/4W	4010391	1	RC07GF391J	81349
R25	Comp, 200, 5%, 1/4W	4010201	1	RC07GF201J	81349
R26	Comp, S.A.T., 1K, NOM , 1/4W, 5%	4010999	1		
R27	R1				
R28	Not Used				
R29	Comp, 2.2K, 5%, 1/4W	4010222	1	RC07GF222J	81349
R30	Not Used				
R31	Comp, 27K, 5%, 1/4W	4010273	1	RC07GF273J	81349
R32 thru R34	Comp, 39K, 5%, 1/4W	4010393	3	RC07GF393J	81349
RN1	Network, 9 x 10K, 0.2W, 2%	4170003	2	785-1-R10K	32997
RN2	RN1				
RN3	Network, 7 x 10K, 0.3W, 2%	4170004	1	784-1-R10K	32997

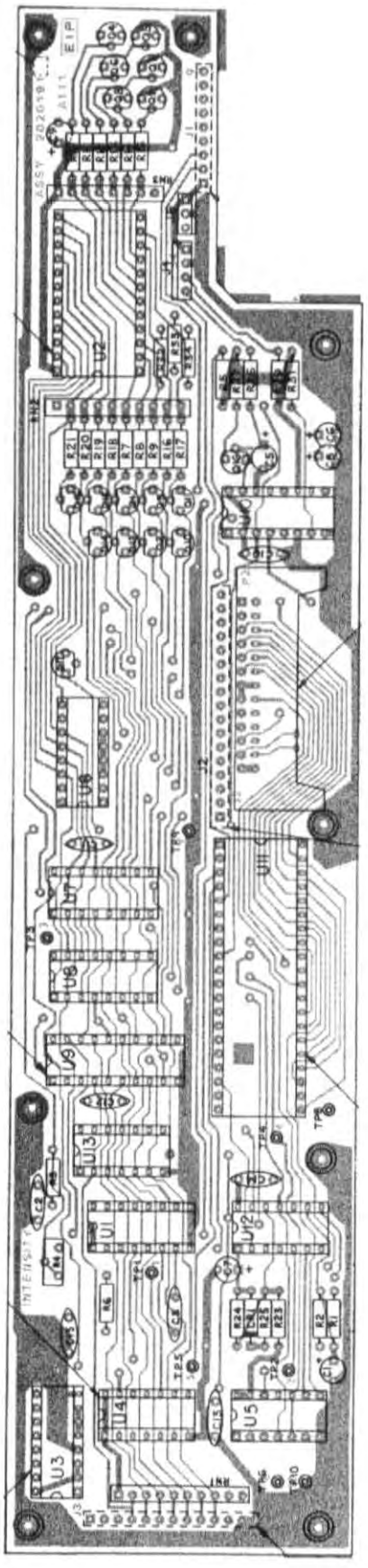
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A111 FRONT PANEL DRIVER continued

2020191-02 A

REF DES	DESCRIPTION	EIP NO.	UNITS PER ASSY	TYP MFG NO.	TYP FSCM NO.
TP1 thru TP6	.040D Pin , Gold	2620032	9	460-2970-02-03	71279
TP7	Not Used				
TP8 thru TP10	TP1				
U1	TTL, Monostable, MV	3084123	2	DM74LS123N	0000X
U2	4-16 Line Decoder	3074154	1	DM74154N	0000X
U3	4 Bit Shift Register	3084195	1	DM74LS195N	0000X
U4	AND - OR - INVERT Gates	3087451	1	SN74LS51N	01295
U5	Quad, 2 INP NAND Gate	3084132	1	DM74LS132N	0000X
U6	Binary Sync Clear	3084163	1	SN74LS163	01295
U7	Bipolar RAMS	3057489	2	DM74LS189	0000X
U8	U7				
U9	Oct Bus Trans	3084244	1	SN74LS244N	01295
U10	U1				
U11	Periph, Interface Adaptor	3086821	1	68B21P	04713
U12	Hex Inverter	3087414	1	SN74LS14N	01295
U13	8INP NAND Gates	3087430	1	DM74LS30N	0000X
U14	Pos. Voltage Regulator (reference only - U14 part of front panel power supply)	3057805	1	MC7805CT	04713

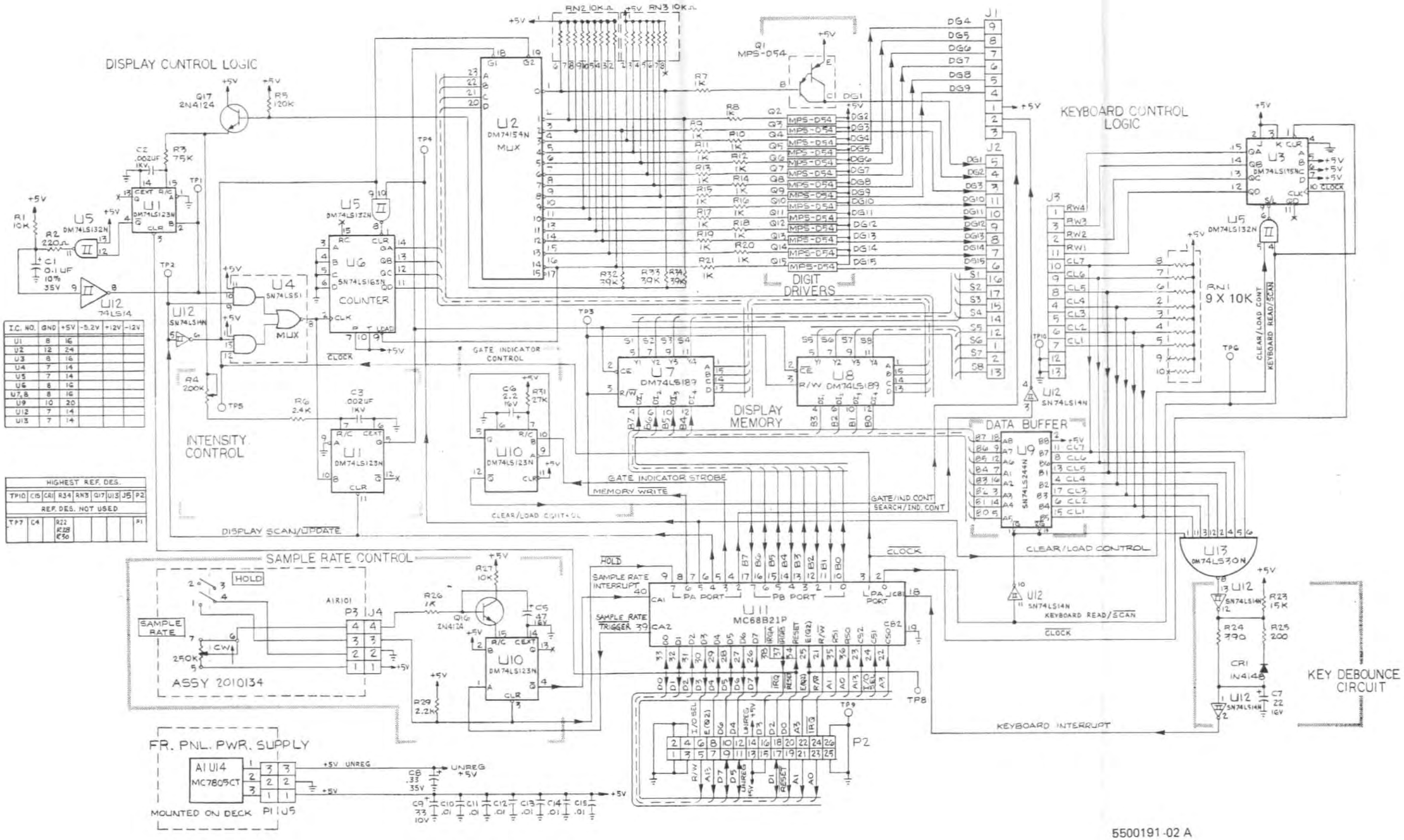
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



2020191 -02 A

Figure 111-3. Front Panel Component Locator

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



I.C. NO.	GND	+5V	-5.2V	+12V	-12V
U1	8	16			
U2	12	24			
U3	8	16			
U4	7	14			
U5	7	14			
U6	8	16			
U7,8	8	16			
U9	10	20			
U12	7	14			
U13	7	14			

HIGHEST REF. DES.								
TP10	C15	CR1	R34	RN3	Q17	U13	J5	P2
REF. DES. NOT USED								
TP7	C4	R22 R28 R30						P1

5500191-02 A

Figure 111-4. Front Panel Logic Schematic

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

A203
BAND 3 MICROWAVE CONVERTER

The A203 Microwave Converter consists of three functional sections:

- Voltage Control Oscillator
- IF Amplifier
- Microwave (YIG)

CAUTION

Disassembly of the A203 Microwave Converter
will void the EIP warranty.

The assembly drawing and schematic for both the VCO and IF circuits are not available. The entire A203 assembly must be tested as a complete unit to ensure proper performance of the counter. Repair of the Microwave (YIG) module can only be done at the factory. The VCO and IF Amplifier boards require special test equipment, therefore field repair is not recommended.

The Band 3 Converter is a complete microwave subsystem (see Figure 203-1) which converts an input signal in the 1 to 18 (26.5) GHz range down to an IF of 127MHz. Down conversion is achieved in this heterodyne system by combining the input signal with a harmonic of a precisely known reference signal (F_{VCO}). The mixer then produces a signal (F_{IF}) equal to the difference between the input and reference harmonic. If this difference is close to 127MHz, it is amplified to a level of about 0dBm and then counted. The input signal is then determined from the equation $F_{IN} = NF_{VCO} + F_{IF}$. F_{VCO} is set by the instrument program via a phase locked loop located on the converter control board (A108) and is thus known exactly. Harmonics of the VCO are produced by the comb generator and coupled to the mixer. The frequency ranges of the VCO and IF are such that for any VCO frequency and any input frequency, only one harmonic can produce an IF frequency. The YIG filter located between the RF input and the mixer is used to approximately determine the input frequency and from this information the desired values of N, F_{VCO} and +/– are determined.

Two other outputs are obtained from the Band 3 Converter. The first is an analog signal which is a measure of input RF power. The second is a digital signal $\overline{\text{(IF THRESHOLD)}}$ which indicates that an IF signal exists at a level of -3dBm or greater.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

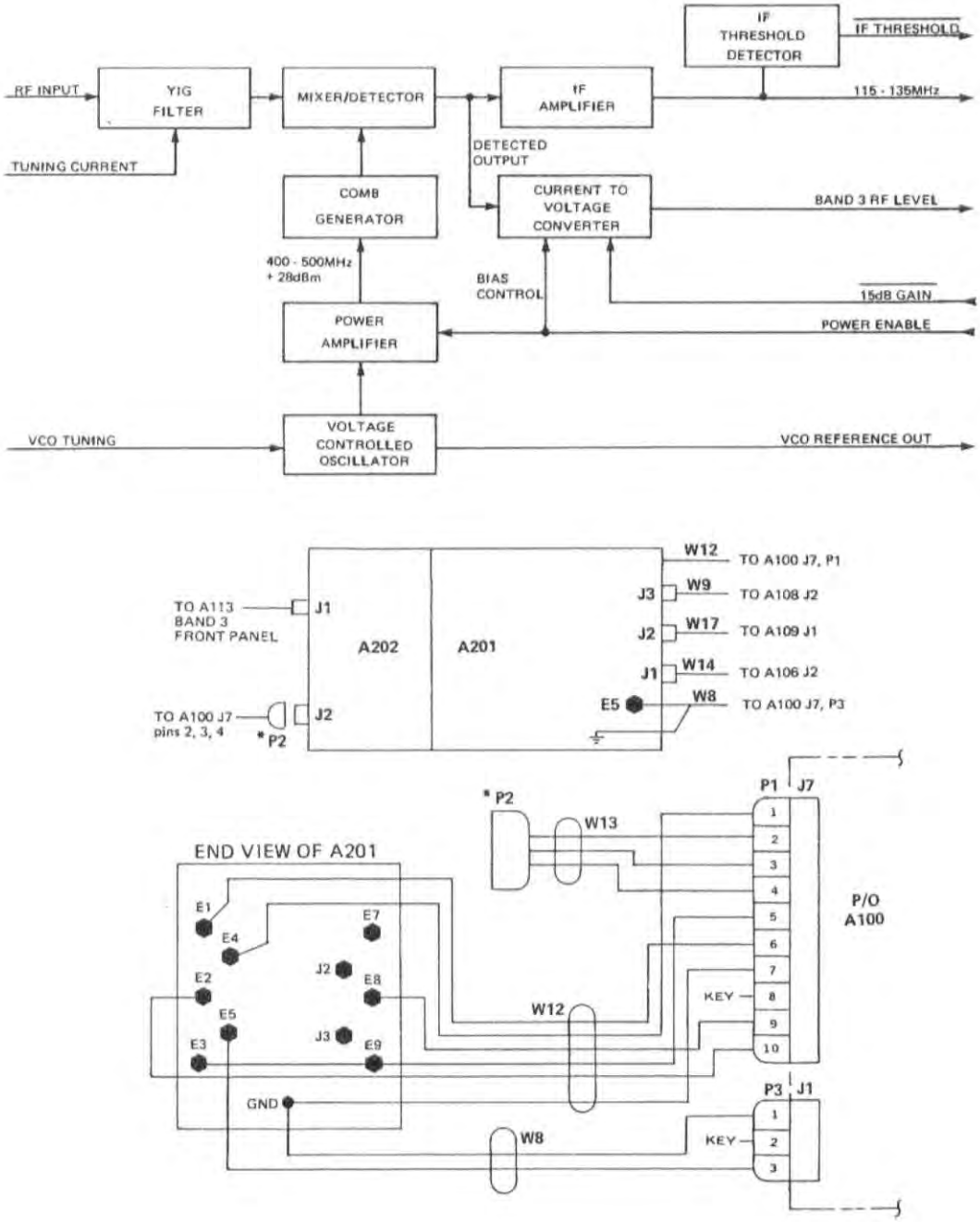


Figure 203-1. Band 3 Microwave Converter Diagram

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Section 10
Options

Section 10 provides descriptions, specifications (where applicable), schematic diagrams and component locators for the options available for use with the Model 545 or 548 counter.

OPTION

01 D TO A CONVERTER

DAC will convert any three consecutively displayed digits into an analog voltage output on rear panel.

02 POWER MEASUREMENT

1 to 18/26.5 GHz will measure sine wave amplitude to 0.1 dBm resolution and display simultaneously with frequency.
Power offset to 0.1 dB resolution, selectable from front panel.
Option will not degrade the basic performance of the counter.

03 TIME BASE OSCILLATOR $< 5 \times 10^{-9}$ (2010143-03).

04 TIME BASE OSCILLATOR $< 1 \times 10^{-9}$ (2010143-04).

05 TIME BASE OSCILLATOR $< 5 \times 10^{-10}$ (2010143-05).

06 EXTENDED FREQUENCY CAPABILITY - 548A
Use in conjunction with model 590 Frequency Extension Cable Kit and optional Remote Sensors models 91 thru 95.

07 REMOTE PROGRAMMING/BCD output

08 GENERAL PURPOSE INTERFACE BUS (GPIB)

09 REAR PANEL INPUT

10 CHASSIS SLIDES

13 MATE-CIIL INTERFACE

14 0.1 Hz RESOLUTION

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPTION 01
DIGITAL TO ANALOG CONVERTER

Option 01 will convert three consecutive digits to an analog voltage, available on the rear panel. The output will reflect the display, and substitute zeros for any non-numeric characters that appear. The output will be updated after every display update.

SPECIFICATIONS

Output Voltage	0.000 V to 0.999 V
Accuracy (25° C)	± 0.5 % ±1 mV
Temp. Stability (0-50° C)	± 0.01 % / °C
Resolution	1 mV
Load Impedance	1 K ohm minimum
Connector	BNC female (on rear panel)
Protection	± 10 V or dc applied to output connector will not cause damage. No damage will occur by any load.

OPERATION

On power up the DAC is in off state.

LOCAL OPERATION WITH KEYBOARD

A three key sequence selects the location of the three digits desired, by entering the most significant digit wanted. Digits are numbered 01 through 12.

PRESS : DAC [ ] [X] [X] XX can vary from 01 to 12.

EXAMPLES :

DAC [ ] [0] [1] 1 Hz digit selected

DAC [ ] [0] [2] 10 Hz, 1 Hz digits selected

DAC [ ] [0] [3] 100 Hz, 10 Hz, 1 Hz digits

DAC [ ] [0] [4] 1 kHz, 100 Hz, 10 Hz digits

•
•
•

DAC [ ] [1] [2] 100 GHz, 10 GHz, 1 GHz digits

After pressing DAC [ ] , the display will show the present DAC status, e.g., DAC OFF or DAC XX, and three decimal points will show the locations of the currently selected digits (if DAC is on).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

After pressing the first [X], the display will show the temporary entry, e.g., DAC X , but the three decimal points will still show the previous DAC status.

After pressing the second [X], the display will show the new entry, e.g., DAC X X , and the three decimal points will move to the new places. The DAC output will start to be updated accordingly. Release of the button pressed will return the display back to normal frequency display.

Any wrong key pressed will result in displaying ERROR 10. The operator must restart the key sequence to enter the correct data.

To clear display from DAC data, ERROR display, or ignoring half-sequence entered, press [CLEAR DISPLAY]. Display will return to normal and DAC status will not be changed.

To shut off DAC press [DAC] [DATA CLEAR] or [DAC] [0] [0]

REMOTE OPERATION

For remote operation through GPIB, refer to the GPIB (Option 08) section of this manual.

For remote operation through BCD/RMT, refer to the BCD/RMT (Option 07) section of this manual.

THEORY OF OPERATION

A simplified block diagram of the DAC board is shown in figure 01-1.

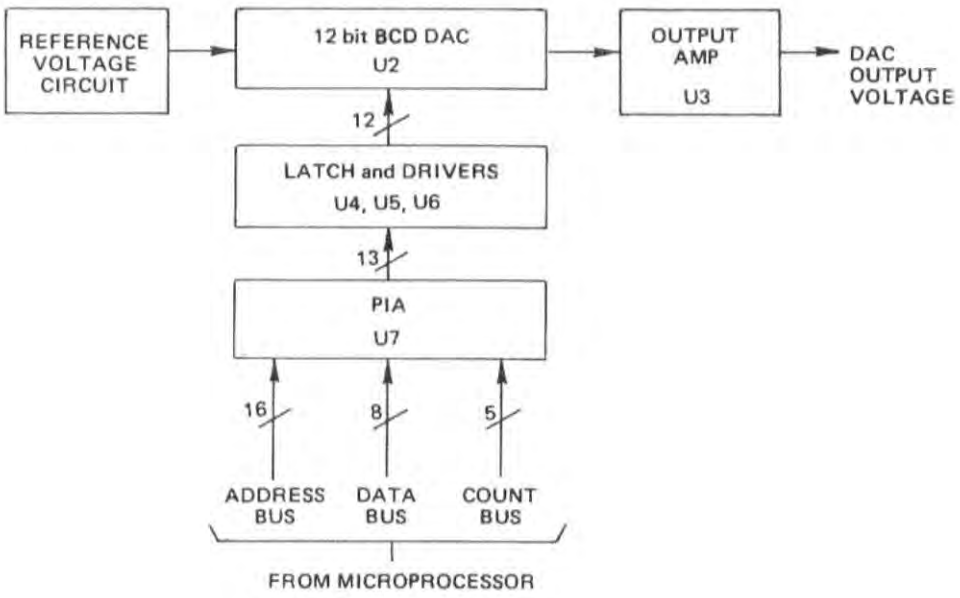


Figure 01-1. DAC Board, Simplified

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

HARDWARE

PIA AND LATCH DRIVER BLOCKS

The three selected digits are manipulated by the program and sent to the PIA. First the two LSD's are sent to port A, then the third digit (MSD) plus a positive-going pulse (on pin 14 of U7) that triggers the latch U6 so that the complete 12 bit word appears to the DAC inputs (U2). U4 and U5 are level translators from T^2L to CMOS for the DAC.

ANALOG BLOCKS

The DAC is referenced to a 1 volt reference voltage that is generated by CR1 zener and U1 Operational Amplifier. Gain adjustment is provided to calibrate the reference voltage. The DAC U2 converts the 12 bit digital inputs to an analog voltage (0.000V – 0.999V). The output amplifier U3 provides the necessary I/V conversion, output isolation and protection. Zero offset adjustment is provided for calibration purposes, also.

SOFTWARE

The DAC software is described in figures 01-2 and 01-3.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

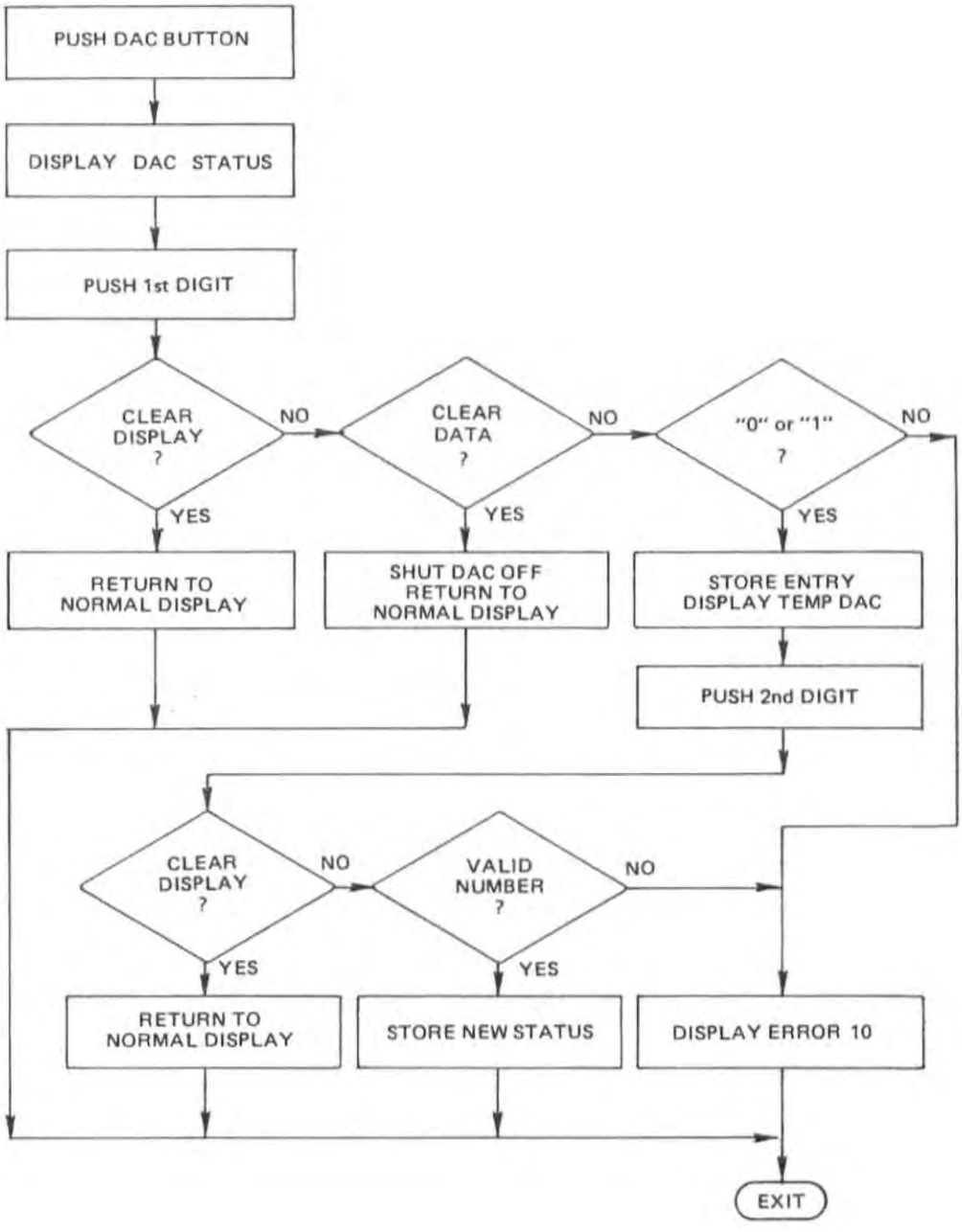


Figure 01-2. Keyboard Control

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

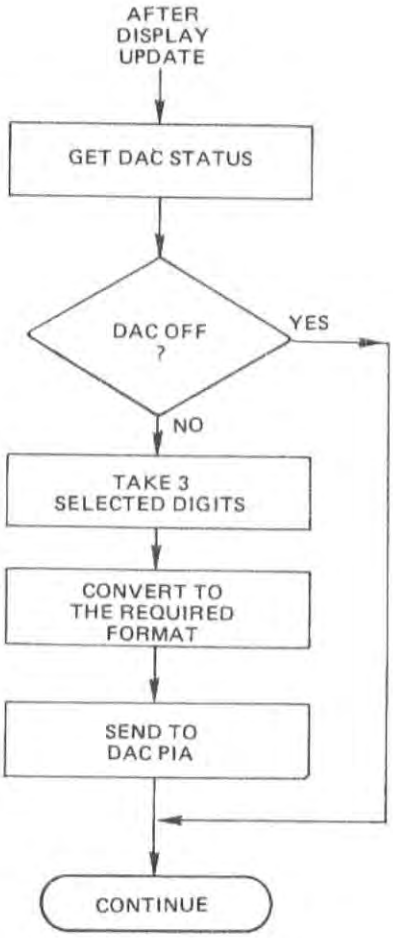


Figure 01-3. DAC Board Update

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

CALIBRATION

The following instruments or their equivalents are required to perform calibration of the DAC board. Calibration is required every six months or after the board has been repaired.

BRAND	MODEL	TYPE	SPECIFICATIONS
Fluke	8050A	DVM	4 ½ digit resolution

ZERO OFFSET CALIBRATION

1. Turn on the counter with no input, so that the display shows all zeros.
2. PUSH [DAC] [0] [3]
3. Connect digital volt meter to the rear DAC output.
4. Adjust R6 to reach 0.000 volts on the DVM display.

FULL SCALE CALIBRATION

1. Short TP3 to TP4.
2. Adjust R4 to reach 1.000 volts on the DVM display.
3. Remove the short.

The calibration for the DAC board is complete.

PERFORMANCE TESTS

Refer to the instruments table in Calibration for the required test equipment.

Connect the DVM to the DAC output (rear panel). Connect rear 10 MHz output to Band 1 input.

ENTER : [BAND] [1] [RESOL] [2] Display shows 10.000 0 MHz .

ACCURACY TEST

ENTER : [DAC] [0] [6] DVM should read 0±1mV.

ENTER : [FREQ OFFSET] [•] [9] [9] [9] [MHz] DVM should read 0.999±0.006 V.

Repeat the second test in accuracy for entries between .888 and .111. DVM should read the entry ± 1 mV ± 0.5 % of entry.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TROUBLESHOOTING

1. If zero offset calibration cannot be achieved, check that all digital inputs to U2 (pins 3 to 15) are at "low" levels (+ 0.5 V). If they are not, replace U2 or U3.

2. If full scale calibration cannot be achieved, check that voltage at TP1 is 6.2 volts. If voltage is wrong, replace CR1 or R1 after verifying the +12 V supply. If the voltage at TP1 is 6.2 volts, check TP2. The voltage at TP2 should be 1.000 volts. If it is not, the failure is in U1 or the resistors R2, R3, or R4. If TP2 voltage is still not 1.000 volts, replace U2.

3. The digital lines in the DAC board can be checked in three ways.

   - With a static test implemented by connecting the rear time base 10 MHz output to Band 1 input.

     ENTER : [BAND] [1] [RESOL] [2] Display shows 10.000 0 MHz

     ENTER : [DAC] [0] [6]

     Now entering [FREQ OFFSET] [•] [X] [X] [X] [MHz] will cause a display of 10.XXX0 MHz.

     The XXX are selected to the DAC board, so the three BCD's should appear on U7, pins 2 to 13 (pin 2 is the LSB). On pin 14 there should be positive pulses. Checking two combinations like 777 and 888 can locate a fault in the digital path between U7 outputs and U2 inputs.

   - A dynamic test that is provided with the DAC option.

     ENTER : [TEST] [1] [1]

     A continuous count ramp from 000 to 999 is sent to the DAC board, regardless of DAC status or display.

     Connect the DAC rear output to an oscilloscope. A ramp should be observed going from 0 to .999 volts. The ramp is built with 1 mV amplitude steps. Any failure in one or more digital lines in the board will cause either breaking in the ramp or a multiple amplitude steps (2mV, 4 mV, ect.). Careful analysis will show the bad line or lines.

   - Signature analysis while operating in the dynamic test just described, and checking the following signatures.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

DAC OPTION SIGNATURES

	START	STOP	CLOCK
CONNECTIONS	A106 TP5	A106 TP5	A105 TP8
BUTTONS	OUT ↑	IN ↓	IN ↓

LINE	SIGNATURE
U4 pin – 2	46F0
4	79HH
6	7U60
8	4F30
10	9115
12	17HP
+5 V	1915
U5 pin – 2	2597
4	7P0U
6	U8A9
8	P1C0
10	7808
12	7C4C
U6 pin – 2	2597
5	7P0U
6	U8A9
9	P1C0
12	7808
15	7C4C
16	46F0
19	79HH

LINE	SIGNATURE
+5 V	1915
U7 pin – 2	0F91
3	7F31
4	4CA3
5	3241
6	U738
7	5UPU
8	0659
9	5HHF
10	7U60
11	4F30
12	9115
13	17HP
14	30UC

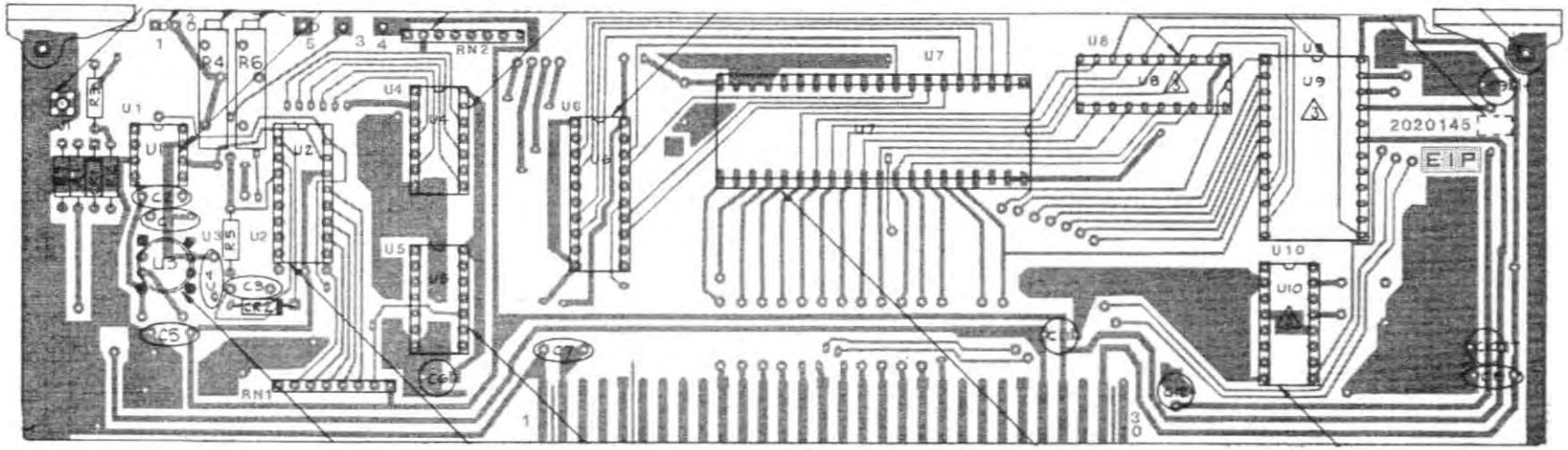
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPTION 01 – DIGITAL TO ANALOG CONVERTER

2020145-03 A

REF DES	DESCRIPTION	EIP NO.	UNITS PER ASSY	TYP MFG NO.	TYP FSCM NO.
A104	Digital to Analog Converter Assy	2020145-02	Ref.	EIP	
C1	Cer, .01 μF, 20%, 100V	2150003	6	TG-S10	56289
C2	C1				
C3	Mica, 100pF, 5%, 500V	2260034	1	CD10FD101J03	56289
C4	C1				
C5	C1				
C6	Tant, 33 μF, 20%, 10V	2300015	3	TAG20-33/10-50	14433
C7	C1				
C8	C1				
C9	C6				
C10	Tant, 10 μF, 20%, 25V	2300029	2	TAG20-10/25-20	14433
C11	C10				
C12	C6				
CR1	Zener, 6.2V	2700827	1	IN827 or IN827A	
CR2	Shottky, Barrier	2710004	1	5082-2835	07263
R1	Res, 750, 5%, 1/4W	4010751	1	RC07GF751J	81349
R2	Res, 20K, 1%, 1/4W	4052002	1	RN55C2002F	81349
R3	Res, 2.87K, 1/8W, 1%	4062871	1	RN55D2871F	81349
R4	Variable, 500 ohm, 10%	4280009	1	89PR500	
R5	Res, 10K, 5%, 1/4W	4010103	1	RC07GF103J	81349
R6	Variable, 10K ohm, 10%	4280006	1	89PR10K	
R7	Res, 1K, 5%, 1/4W	4010102	1	RC07GF102J	81349
RN1	Network of 7 X 10K, 0.3W, 2%	4170004	2	4308R-101-103	32997
RN2	RN1				
U1	Op Amplifier	3040741	1	LM741CN	0000X
U2	DAC	3050752	1	AD7525KN	0000X
U3	Prec, Op Amplifier, JFET	3041016	1	OP16FP	06665
U4	Hex Buffer	3007407	2	DM7407N	0000X
U5	U4				
U6	8 Bit Latch	3034373	1	MM74C373N	
U7	PIA	3086821	1	MC68B21P	04731
TP1 Thru TP5	PCB, .040D Pin, Gold	2620032	5	460-2970-02-03	71279

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

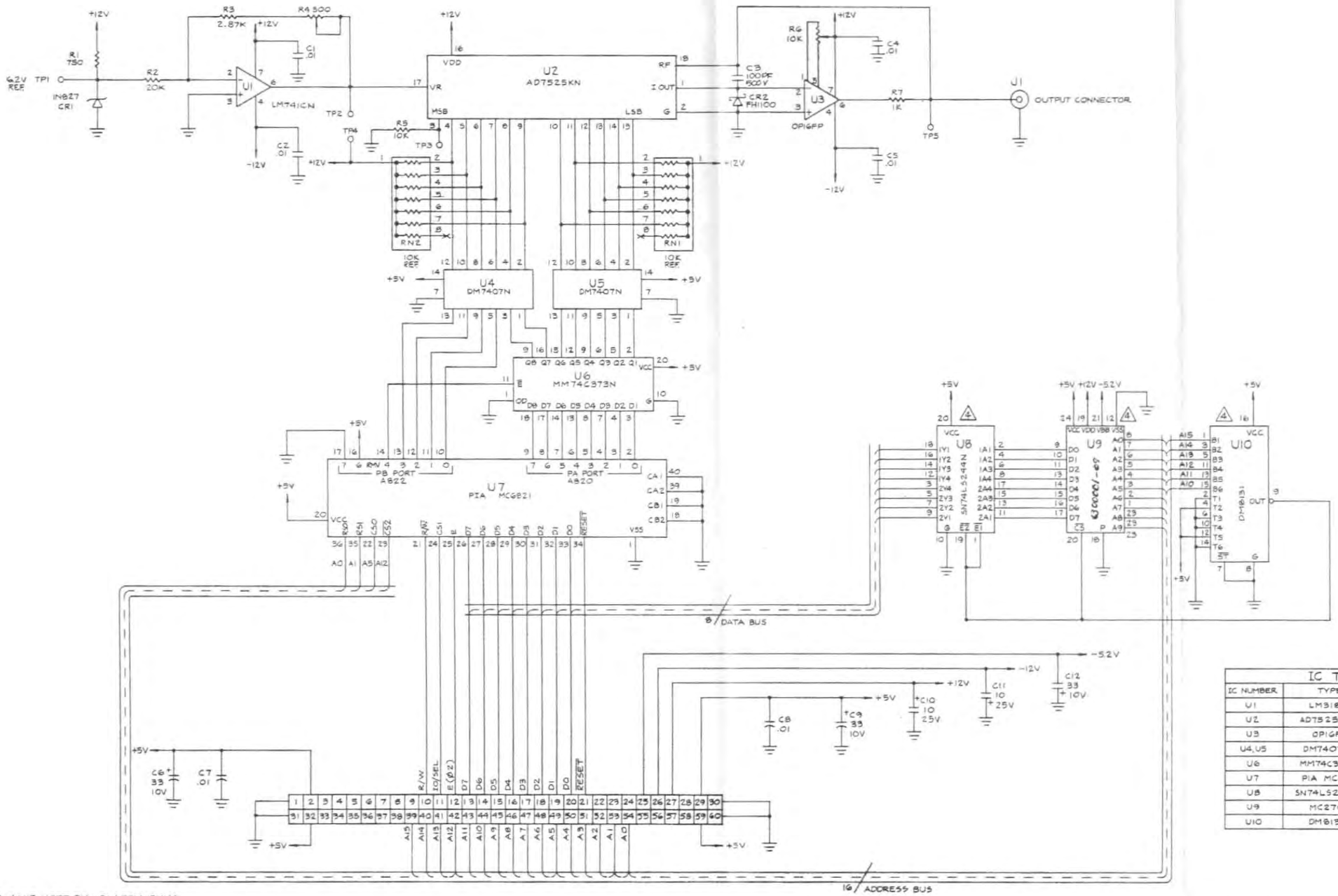


U8, U9, U10 are not used in models 545A/548A

2020145 -03 A

Figure 01-4. DAC Component Locator

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



⚠4 U8, U9 & U10 USED ON -01 ASSY. ONLY.

IC TABLE		PIN NO.				
IC NUMBER	TYPE	GND	+12	-12	+5	-5.2
U1	LM318N	3	7	4		
U2	AD7525KN	2	16			
U3	OP16FP	3	7	4		
U4,U5	DM7407N	7			14	
U6	MM74C373N	10			20	
U7	PIA MC6821	1			20	
U8	SN74LS244N	10			20	
U9	MC2708	18	19		24	21
U10	DM8131	8			16	

5500145 -03 A

Figure 01-5. DAC Schematic

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPTION 02
POWER MEASUREMENT

Option 02 measures the power of signals applied to Band 3. The power is displayed (to 0.1 dB resolution) simultaneously with frequency (to 100 kHz max. resolution). For A M and F M averaging purposes, gate time is controllable in the power meter mode, through the resolution function. Power gate time mirrors frequency gate time. For example, in resolution 0 the frequency gate time is 1 second, and the power gate time is 1 second. In resolution 1 the frequency gate time is 100 msec., and the power gate time is 100 msec. Option 02 allows power offsets from -99.9 dB to 99.9 dB, with a 0.1 dB resolution and will not degrade the basic performance of the counter.

SPECIFICATIONS

ACCURACY	± 1.2 dB Typical 0-50° C ± 0.5 dB Typical 25° C
TIME ADDED	1 GATE TIME + 50 msec.
RESOLUTION	0.1 dB POWER, Sensitivity to -10 dBM; 0.2 dBm to overload, Selectable 100 KHz -1 GHz Frequency
RANGE	Entire Operating Range of Band 3

KEYBOARD OPERATION

To turn the power meter ON or OFF, PRESS: POWER METER ON/OFF [ ]

If the power meter option is off, pushing the POWER METER ON/OFF key will turn the power meter on. Pushing that key again will turn the power meter off. If the counter is displaying only frequency it will begin displaying frequency and power. If the counter is displaying frequency and power it will begin displaying frequency only.

Turn the power meter on. Observe the display. Frequency is displayed on the left, and power is displayed on the right. The dBm annunciator lights to indicate power meter operation. If the power of the signal is too small to measure, the display will show EE.E in the power meter digits. (Since 0 dBm is a valid power. 00.0 cannot be used as a no-power indicator.)

When the power meter option is on, the frequency measurements displayed on the front panel are to a maximum resolution of 100 kHz. The last selected time will be retained.

Power meter offset function enables the entry of a positive or negative power offset to 0.1 dB resolution. The offset will be incorporated into the power measurement after the next gate.

TO INPUT POWER OFFSETS

PRESS: POWER METER OFFSET [ ] Notice flashing annunciator and power offset last entered.

PRESS: [#] Number keys corresponding to desired power offset.

PRESS: dB [ ] To terminate input sequence. Notice OFFSET PWR annunciator solidly lit after terminator key is released.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TO RECALL STORED OFFSETS

PRESS: POWER METER OFFSET — Stored offset is displayed.

PRESS: CLEAR DISPLAY — Returns counter to display measurements.

TO REMOVE POWER OFFSETS

PRESS: POWER METER OFFSET, DATA CLEAR OR POWER METER OFFSET, 0, dB OR POWER METER OFFSET, dB

GPIB OPERATION

PA – Power Active. Turns POWER METER option on.

PP – Power Passive. Turns POWER METER option off.

PO – Power Offset. Enables entry of positive or negative power offsets to 0.1 dB resolution. Take a new reading after data entry if counter is not in HOLD.

THEORY OF OPERATION

The power meter uses the Schottky diode in the microwave converter as its power sensor. The output of the diode detector is connected to a programmable gain attenuator, which consists of two switchable gain stages (one is in the IF Amplifier A201B and one is on the Gate Generator A107) and two 8 bit attenuators. A comparator, set to 100 mV, and a TTL latch provide output information to the microprocessor. See figure 02-1.

After the counter has a signal, and has taken a frequency reading, it starts the power meter task. This triggers the gate time counter, resets the TTL power latch, moves the yig ±50 MHz (to insure that the signal peak is passed through), then checks the TTL power latch. If the latch is set, the attenuation is increased in 3 dB steps (until the signal is attenuated below the level of the comparitor), then back one step. If maximum attenuation is reached, and the latch is still being set, the word OVERLOAD is displayed and the task is exited.

When the latch is first checked, if it is still reset, the attenuation is decreased in 3 dB steps until the comparator level is reached. If minimum attenuation (maximum gain) is reached, the display is set to EE.E, and the task is exited.

After the attenuation is adjusted to a 3 dB resolution a successive approximation is performed to find the attenuation to a 0.1 dB resolution. The attenuation is stored, and if the gate time counter is not finished, the cycle is repeated. When the gate time counter is finished all the readings are averaged to eliminate the effects of AM on the signal.

The "power vs power" and "power vs frequency" corrections are added, and the sum is displayed. A detailed flowchart of the power meter is shown is figure 02-2.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

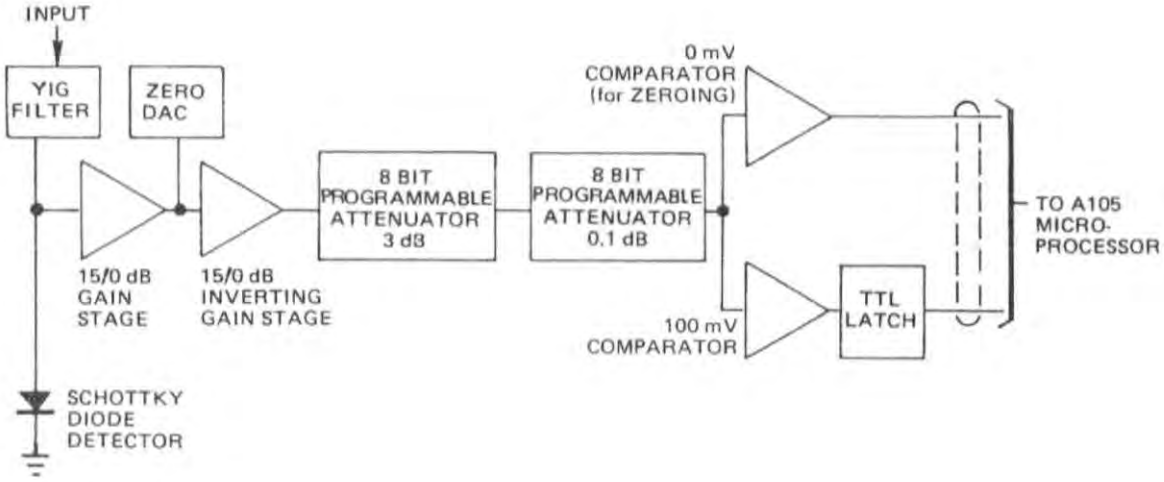


Figure 02-1. Power Meter Hardware

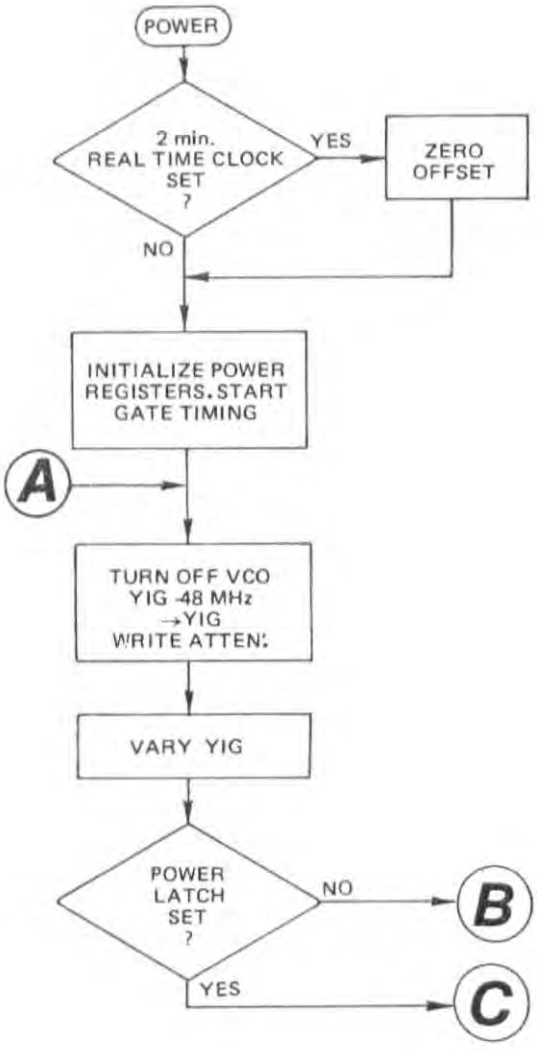


Figure 02-2. Power Meter Task

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

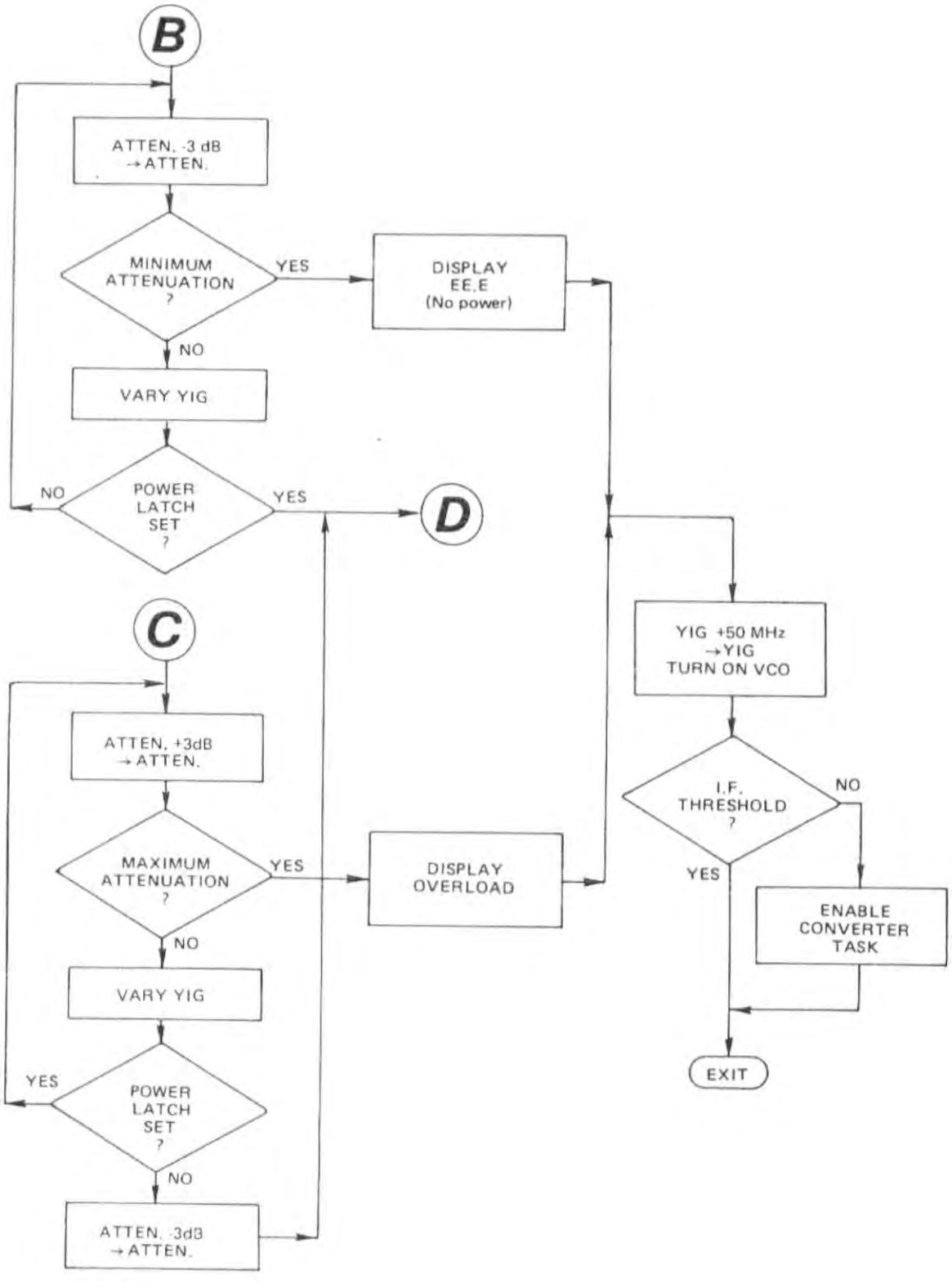


Figure 02-2. Power Meter Task, continued

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

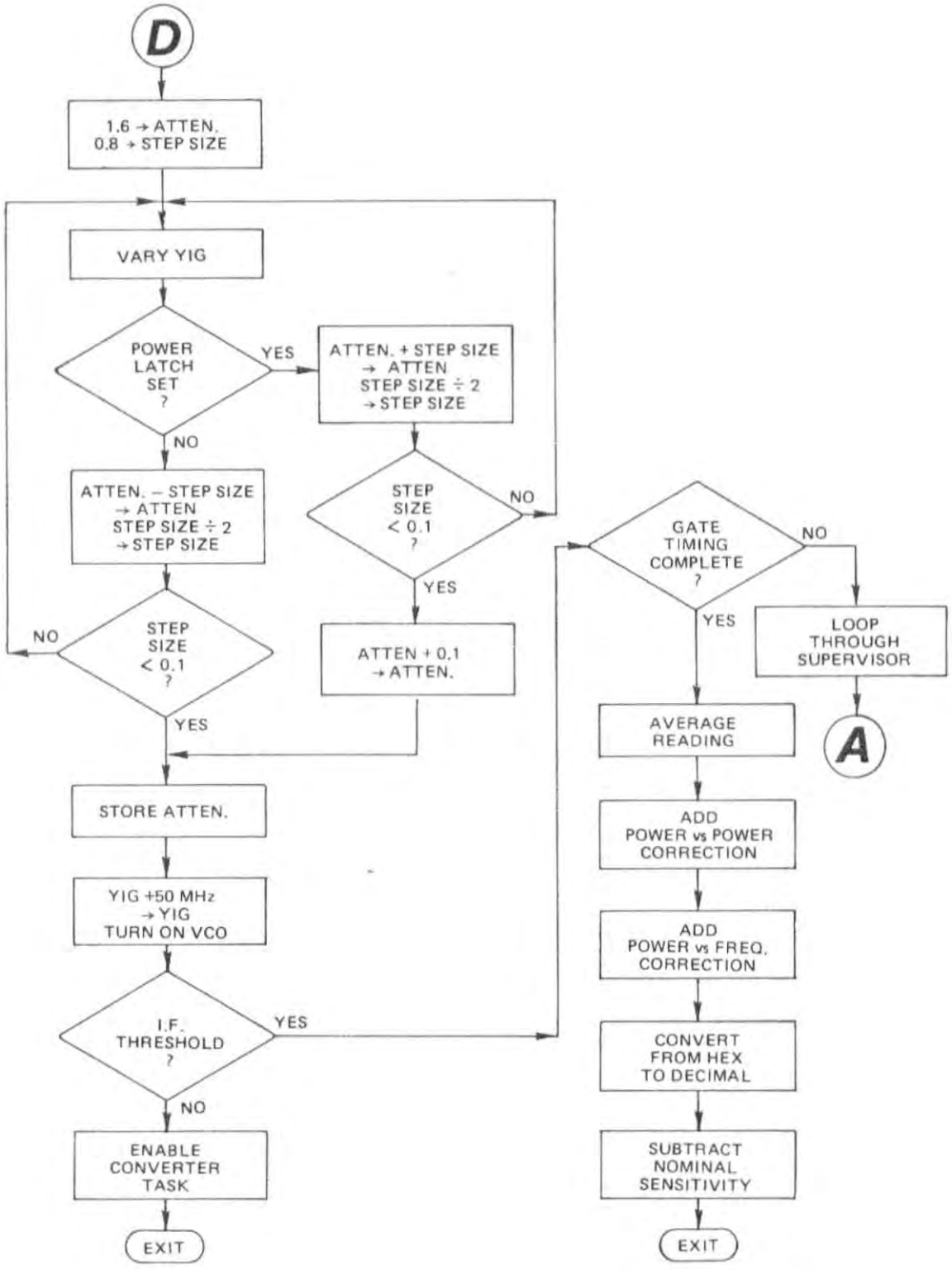


Figure 02-2. Power Meter Task, continued

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

CALIBRATION

The power meter contains 690 correction factors, stored in PROM.

The 150 "power vs power" correction factors compensate for variations from square law in the detector and power meter circuits. They are divided into three tables. The first table corrects variations below 10 GHz. The second corrects variations between 10 and 20 GHz. The third corrects variations above 20 GHz.

The 540 "power vs frequency" correction factors compensate for variations in the detector output at different frequencies. "Power vs frequency" corrections cover 0-27 GHz every 50 MHz.

The power meter is calibrated at the factory using specialized automatic test equipment. Because of the accuracy required, recalibration in the field is not recommended. If, however, recalibration is required, use the procedures given herein.

The test equipment required for calibration is:

MFG	MODEL	DESCRIPTION	CRITICAL PARAMETERS
H.P.	435A	Power Meter	Measures -30 to +15 dBm
Wavetek	2002	Sweeper	950 MHz - 2 GHz
EIP	928	Microwave Source	1 GHz -18.6 GHz
HP	8690A 8696A	Microwave Sweeper	18 GHz - 26.5 GHz
E.H.		PROM Programmer	Programs TI 2516 PROMS and performs check sums

CAUTION

Be sure all connections are clean
and tight. Loose or dirty connections
will cause calibration errors.

1. Duplicate the power meter PROM, zeroing all corrections (address 0000-02EC in the PROM) and setting address 02F6 to FF. Install the uncorrected PROM in the counter.

2. Set the Wavetek to 2 GHz ±1 MHz. Connect the Wavetek to band 3 of the counter. Adjust the output until the counter reads -35 dBm.

3. Connect Wavetek to the power meter. Subtract the counter reading from the power meter reading. Round the result (R_1) to 0.1 dBm.

4. Using the following formulas, justify the correction to a number between 10 and 20.

$$\text{int}\,(R_1) - 1 = N \; ; \; (\text{int}\,(R_1) = \text{Whole number portion of } R_1)$$

$$10\,(R_1 - N) = \text{CORR}_{10}$$

$$\text{Convert CORR}_{10}\,(\text{decimal}) \rightarrow \text{CORR}_{16}\,(\text{hexadecimal})$$

(R_1 is the result of step 3.)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5. Program the correction in these locations.

   0000 - 0005 inclusive
   0032 - 0037 inclusive
   0064 - 0069 inclusive

6. Connect the Wavetek to the counter. Increase power until the counter reads 1 dB higher.

7. Connect the Wavetek to the power meter. Subtract the counter reading from the power meter reading. Round the result (R_2) to 0.1 dBm.

8. Using the following formulas, calculate the correction.

   $$10 (R_2 - N) = CORR_{10}$$

   $$\text{Convert } CORR_{10} \rightarrow CORR_{16}$$

   (R_2 is the result of step 7, and N was found in step 4.)

9. Program the correction in the 3 addresses found by the following formulas.

   $$40 + P = \text{Add } 1_{10}, \text{Add } 1_{10} \rightarrow \text{Add } 1_{16}$$

   $$40 + P + 50 = \text{Add } 2_{10}, \text{Add } 2_{10} \rightarrow \text{Add } 2_{16}$$

   $$40 + P + 100 = \text{Add } 3_{10}, \text{Add } 3_{10} \rightarrow \text{Add } 3_{16}$$

   (P is the power the counter was set at in step 6.)

10. Repeat steps 6 through 9 until overload is reached on the counter.

11. Install the partially corrected PROM in the counter.

12. Set the Wavetek to 950 MHz, about -15 dBm.

13. Measure the power on the counter and power meter. Subtract the counter reading from the power meter reading. Round the results to 0.1 dBm. Multiply the results by 10 and convert to hex.

14. Program the correction in the address found by the following formula.

    $$\frac{\text{FREQ (MHz)}}{50} + 150 = \text{Add}_{10}$$

    $$\text{Add}_{10} \rightarrow \text{Add}_{16}$$

15. Increase frequency by 50 MHz. Repeat steps 13 and 14. Change the sweepers as necessary, until the upper frequency limit of the counter is reached.

Refer to section 9, pages 107-5 through 107-9, for parts list and schematic diagram. The counter recalibration is now complete.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

16. Perform a check sum on the corrected PROM.

17. Calculate the program number by the following formula:

FE (hexadecimal) - M = Program number

M = Last two digits of the check sum found in Step 16.

18. Program address 02F6 with the program number found in Step 17.

19. Calibration is now complete.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

THIS PAGE LEFT BLANK INTENTIONALLY.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

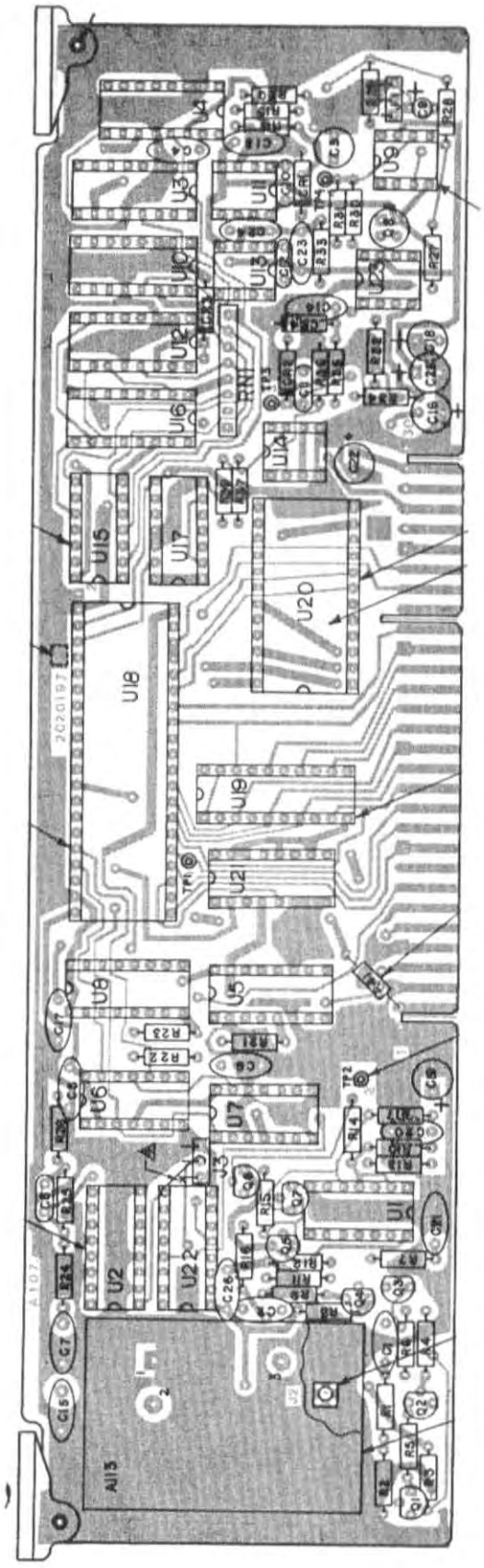
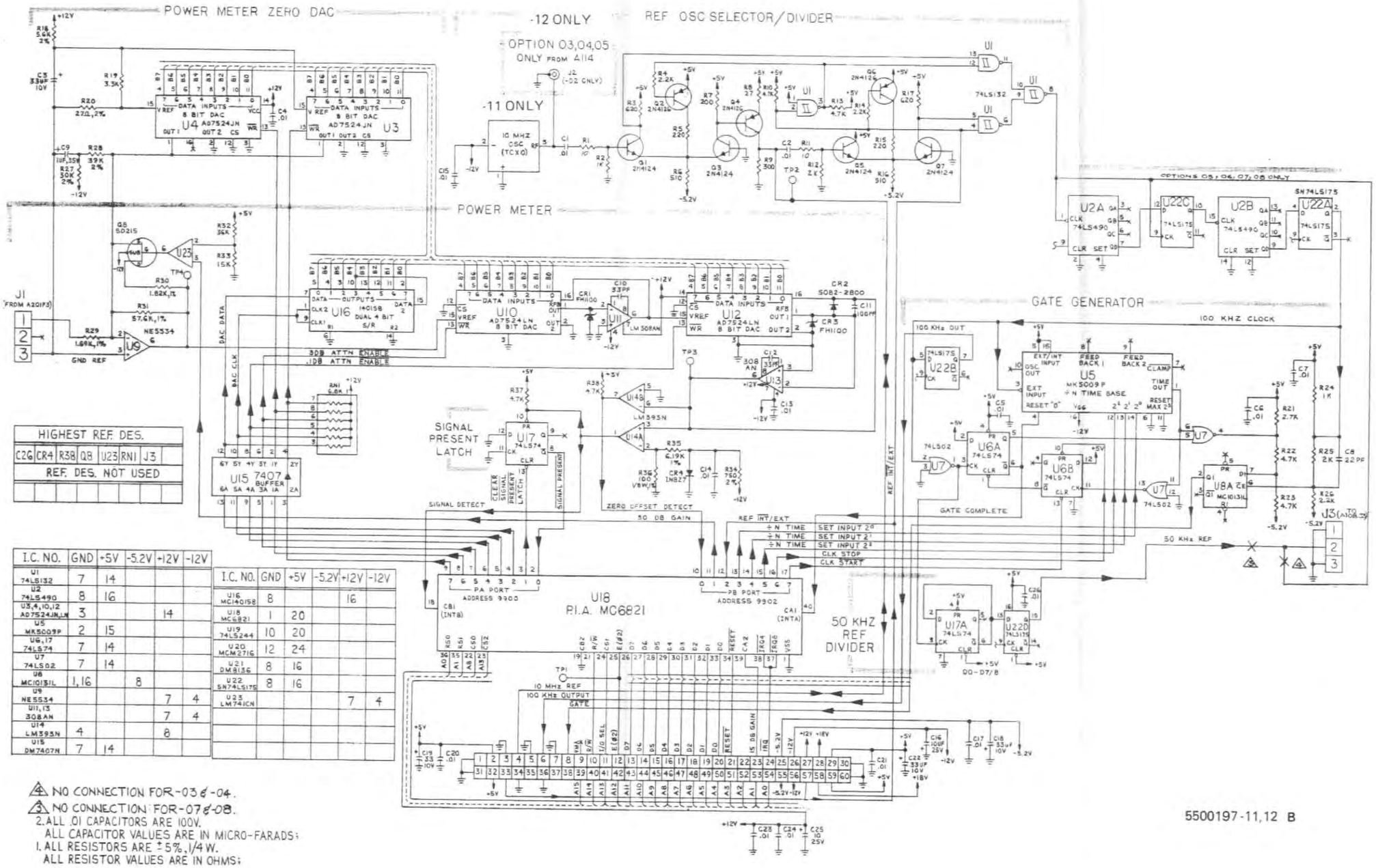


Figure 02-3. Gate Generator Component Locator

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



I.C. NO.	GND	+5V	-5.2V	+12V	-12V
U1 74LS132	7	14			
U2 74LS490	8	16			
U3,4,10,12 AD7524JN,LN	3			14	
U5 MK5009P	2	15			
U6,17 74LS74	7	14			
U7 74LS02	7	14			
U8 MC1013L	1,16		8		
U9 NE5534				7	4
U11,13 308AN				7	4
U14 LM393N	4			8	
U15 DM7407N	7	14			

I.C. NO.	GND	+5V	-5.2V	+12V	-12V
U16 MC14015B	8			16	
U18 MC6821	1	20			
U19 74LS244	10	20			
U20 MCM2716	12	24			
U21 DM8136	8	16			
U22 SN74LS175	8	16			
U23 LM741CN				7	4

4 NO CONNECTION FOR -036-04.
3 NO CONNECTION FOR -078-08.
2. ALL .01 CAPACITORS ARE 100V.
ALL CAPACITOR VALUES ARE IN MICRO-FARADS;
1. ALL RESISTORS ARE ±5%, 1/4 W.
ALL RESISTOR VALUES ARE IN OHMS;

5500197-11,12 B

Figure 02-4. Gate Generator Schematic

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPTIONS 03, 04, 05
TIME BASE OSCILLATORS

Three Time Base Oscillators are available as options for either the model 545A or 548A. These high stability options enhance the accuracy of the counter by the addition of oven stabilized crystal oscillators. These oscillators improve counter operation by reducing both time temperature variations.

When any one of these options is installed, the TCXO is removed from the Gate Generator board (A107) and the following components are added.

- One of three Oven Oscillators (A114) mounted on the chassis.
- 28 VDC Power Supply board (A112) , assembly part number 2010226
- Power Supply Transformer T1 (part number 4900006) mounted on A112.
- Time Base Adjustment Pot J2 (part number 2010190) mounted on the rear panel.
- Related interconnecting cable harnesses.

	OPTION 03	OPTION 04	OPTION 05
CHARACTERISTIC	2030010 - 01	2030010 - 02	2030010 - 03
AGING RATE/24 HOURS (After 72 hour warm-up)	$< \lvert 5 \times 10^{-9} \rvert$	$< \lvert 1 \times 10^{-9} \rvert$	$< \lvert 5 \times 10^{-10} \rvert$
SHORT TERM STABILITY (1 second average)	$< 1 \times 10^{-10}$ rms	$< 1 \times 10^{-10}$ rms	$< 1 \times 10^{-10}$ rms
0° to + 50° C TEMPERATURE STABILITY	$< \lvert 6 \times 10^{-8} \rvert$	$< \lvert 3 \times 10^{-8} \rvert$	$< \lvert 3 \times 10^{-8} \rvert$
± 10% LINE VOLTAGE CHANGE	$< \lvert 5 \times 10^{-10} \rvert$	$< \lvert 2 \times 10^{-10} \rvert$	$< \lvert 2 \times 10^{-10} \rvert$

Figure 03/04/05-1. Time Base Oscillator Option Specifications

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

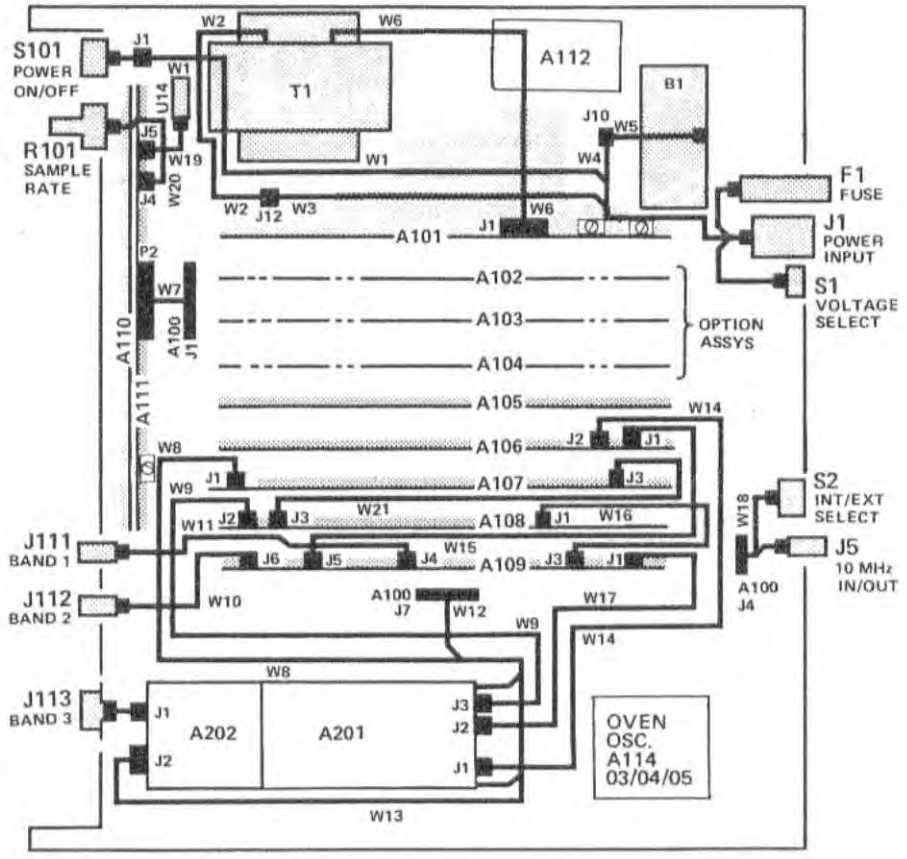


Figure 03/04/05-2. Component Location, Time Base Option

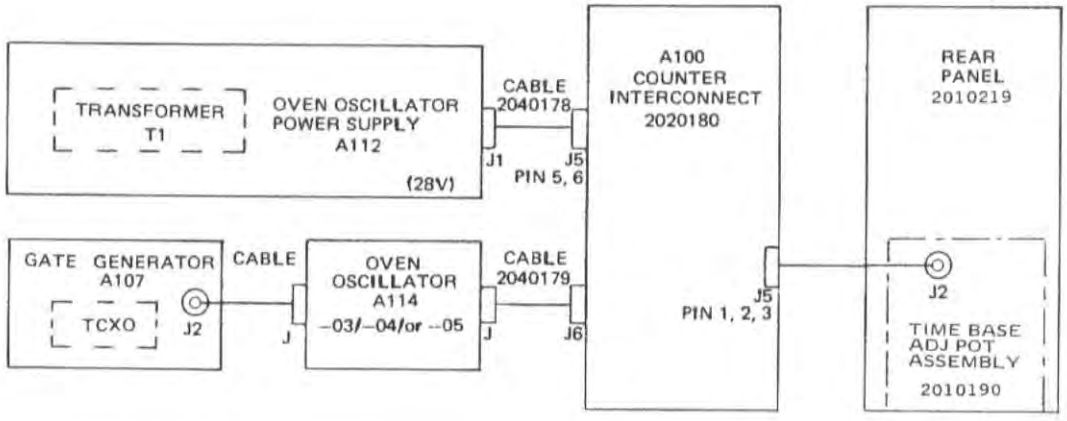


Figure 03/04/05-3. Time Base Option, Interconnection Diagram

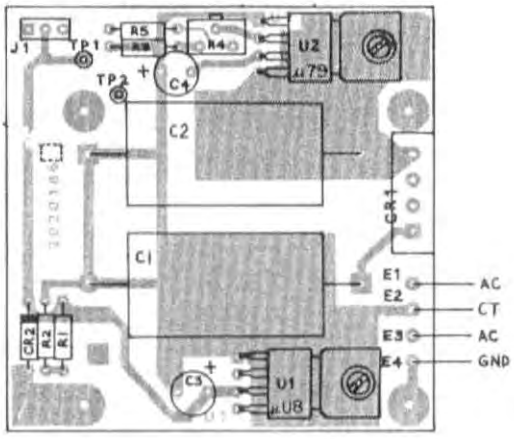
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OVEN OSCILLATOR POWER SUPPLY

The Oven Oscillator Power Supply board (A112) is a simple 28V regulated, current limited power supply. U1 and U2 provide voltage regulation, thermal protection and current limiting.

The transformer T1, CR1, C1 and C2 provide a 40V nominal unregulated DC voltage. The output voltage is set by voltage divider R5, R3 and R4. These resistors were selected so that 28V out provides 2.23V at U2 pin 2 (to U2 pin 1). Diode CR2 protects the supply from being pulled more negative than ground. See the schematic in figure 03/04/05-6.

The power supply (A112) is on and operating as long as the counter is connected to an active AC power source. The counter's POWER ON/OFF switch on the front panel does not control this assembly.



2020186

Figure 03/04/05-4. Oven Oscillator Power Supply (A112) Component Location

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OVEN OSCILLATOR CALIBRATION

When options 03, 04 or 05 are installed in the counter, the effects of temperature perturbations and aging must still be considered, although the magnitude of the inaccuracies associated with each oscillator are greatly reduced.

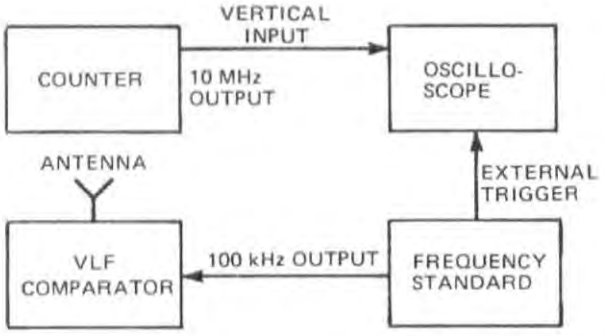
Full benefit of the oven stabilized oscillator characteristics can only be realized if the oscillator is running continuously (with counter always connected to a source of AC power). Under these conditions the perturbations in frequency will generally be in the positive direction for either an increase or decrease in temperature from + 25° C. The aging characteristic is also generally in the positive direction.

How frequently the oscillator is adjusted is determined by the level of accuracy required. To adjust the oscillator to an inaccuracy of less than 1×10^{-9} parts, relative to a standard, use this procedure. The test is illustrated in figure 03/04/05 - 5.

Observe the drift of the oscilloscope pattern. The fractional frequency offset is computed from:

$$\frac{T_{\text{drift of zero crossing}}}{T_{\text{observation time of drift}}} = \frac{\triangle f}{f}$$

If the pattern drifts, at a rate of .01 microsecond every 10 seconds, the frequency is in error by 1 part in 10^9.



OVEN OSCILLATOR A114

Figure 03/04/05-5. Time Base Calibration.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

All frequency checks and adjustments should be made only after the oscillator has been connected to its power source for 24 hours. If the oscillator has been disconnected from its power source for more than 24 hours it may require 72 hours of continuous operation to achieve the specified frequency aging rate.

To measure oscillator frequency:

1. Connect the counter's internal oscillator output signal from the 10 MHz IN/OUT connector (on the rear panel of the counter) to the vertical input of the oscilloscope.

2. Trigger oscilloscope externally with the frequency standard. The VLF Comparator is used to determine the absolute frequency of the standard.

3. Set oscilloscope sweep rate to 0.1 μ sec/cm and expand X10; this results in a sweep rate of .01 μ sec/cm.

4. Adjust oscilloscope vertical controls for maximum gain.

5. Determine the frequency difference (see page 6-24).

6. Horizontal drift of oscilloscope display in μ sec/sec, is a measure of the difference between the frequency standard and the counter oscillator frequency. If the difference is excessive for the desired counter application, vary the TIME BASE ADJUST control on the rear panel of the counter until the pattern stops drifting.

NOTE

For highest accuracy, the counter should be operated for 72 hours prior to adjustment.

OPTION 03/04/05 - TIME BASE OSCILLATOR PCB ASSYs 2020186 - B

REF DES	DESCRIPTION	EIP NO.	UNITS PER ASSY	TYP MFG NO.	TYP FSCM NO.
A112	OSCILLATOR POWER SUPPLY	2020186	1	EIP	
C1	Elec, 680 uF, 40V	2200021	2	3074JH681T040JPB	80031
C2	C1				
C3	Tant, 10 uF, 25V	2300029	2	DF106M25S	NEC
C4	C3				
CR1	Bridge Rectifier	2710019	1	SBMB1	14099
CR2	Rectifier	2704001	1	IN4001	
R1	Met Ox, 3.3K, 2%	4130332	1	C4/2%/3.3K	24546
R2	Met Ox, 2K, 2%	4130202	1	C4/2%/2K	24646
R3	Met Ox, 560, 2%	4130561	1	C4/2%/560	24546
R4	Variable, Cer, 500, 10%	4250014	1	72XR500	73138
R5	Met Ox, 3.6K, 2%	4130362	1	C4/2%/3.6K	24546
U1	Positive Voltage Regulator	3040780	1	uA78MGUIC	07263
U2	Negative Voltage Regulator	3040790	1	uA79MGUIC	07263

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

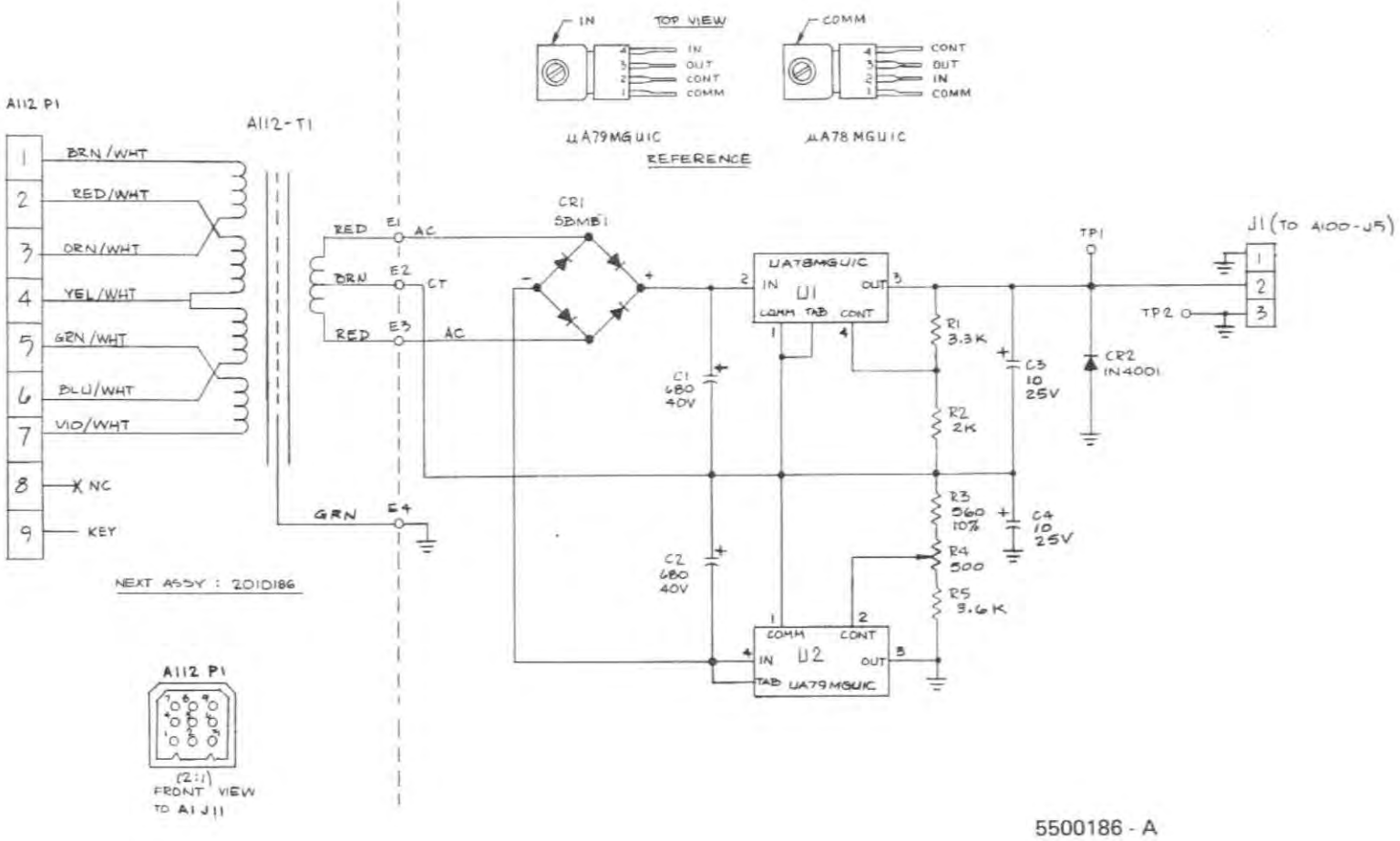


Figure 03/04/05-6. Time Base Option Schematic

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPTION 06
EXTENDED FREQUENCY CAPABILITY

The frequency range extension option is available on the 548A counter. This option, when used with the model 590 Frequency Extension Cable kit and one of the optional remote sensors, enables the counter to count signals above 26.5 GHz. The option consists of:

- Band 4 Converter Module, A204
- Band 4 Software
- Coax Cable, Front panel to A204 J1 - P/N 2040232
- Coax Cable, Front panel to A204 J2 - P/N 2040231

SPECIFICATIONS

BAND	FREQUENCY RANGE	SENSITIVITY (TYPICAL)	MAX. INPUT	REMOTE SENSOR MODEL
41	26.5-40 GHz	{ -25 dBm typ. -20 dBm min. }	+5 dBm	91
42	40-60 GHz	-25 dBm	+5 dBm	92
43	60-90 GHz	-25 dBm	+5 dBm	93
44	90-110 GHz	-25 dBm	+5 dBm	94

OPERATION

To operate the counter in the 26.5 - 40 range, connect the short cable (supplied with the frequency extension kit) from the lower output jack on the front panel, to the Band 3 input. Connect the long cable from the upper outjack to the remote sensor.

PRESS:	[BAND]	BAND annunciator blinks
PRESS:	[4]	BAND 4 annunciator blinks
PRESS:	[1]	BAND 4 annunciator lights stays on

The counter is now in the proper mode for operation.

NOTE: Before connecting the remote sensor to the frequency source, verify that the power level is within the limits specified for the sensor. When you connect the sensor the counter will automatically display the reading.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

THEORY OF OPERATION – HARDWARE

When measuring a signal frequency greater than 26.5 GHz the 548A using the Option 06 Frequency Extension with a model 590 kit and a 91 remote sensor, down converts the input to approximately 1.0 GHz. This signal is then fed to the Band 3 input, where a second conversion produces a 125 MHz IF.

A multiplier chain increases the VCO output frequency to the 5.28-6 GHz range, which is referenced to the time base. See Figure 06-1. This signal provides the local oscillator (LO) power, which is transmitted to the remote sensor, an external harmonic mixer. When the input frequency and harmonics of the LO, (generated in the mixer) combine, a first IF is generated in the range of 1.00-1.35 GHz.

A diplexer separates the LO and IF signals received from the harmonic mixer. The level of the IF is then increased to a minimum of -25 dBm via the IF amplifier, then supplied to the Band 3 converter input.

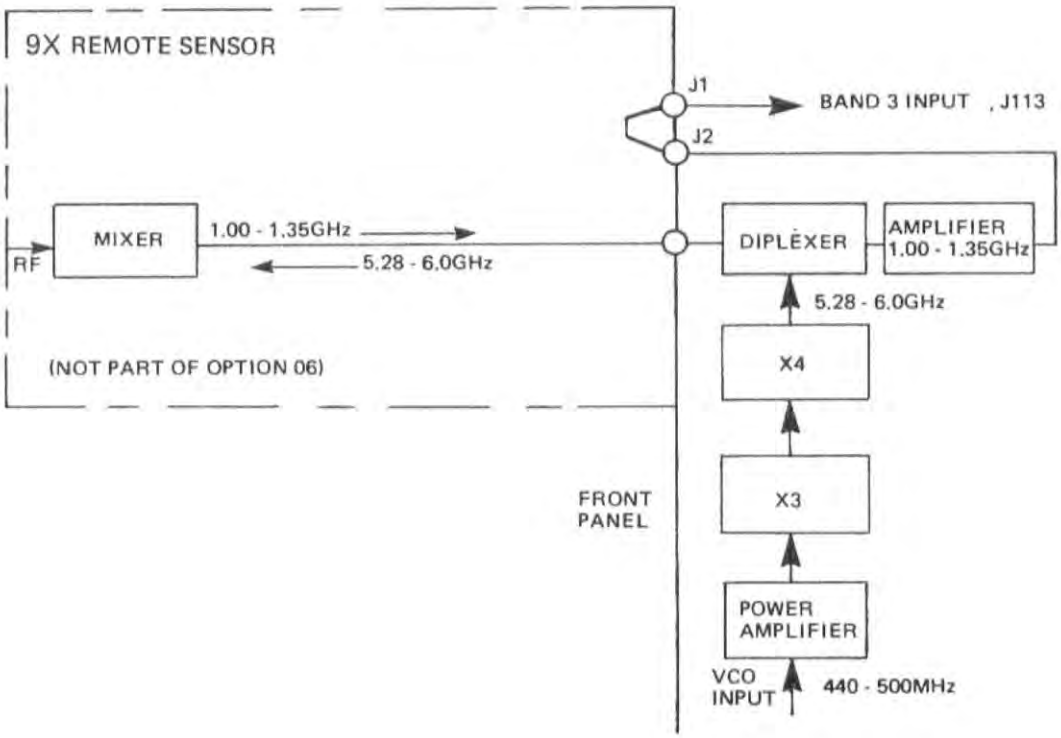


Figure 06-1. Frequency Extension Block Diagram

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

THEORY OF OPERATIONS – SOFTWARE (LOCKING ROUTINE)

The Band 4 software performs two main functions: it locks onto an incoming RF signal, and it tracks an RF signal once it is locked.

The locking routine is called by the supervisor when any of the following conditions are met:

1. Selection of Band 4
2. Software called from the source lock routine.
3. Lose of IF threshold after being locked.
4. Any reset condition.

LOCKING PROCESS

Initialization

The initialization routine clears the working table (BANDTB) for Band 4 and loads from PROM the table of constants that is used by the program for the selected Band 4 subband. BANDTB is an area in RAM that is 40 bytes long.

VCO Sweep

This routine steps the VCO frequency by a step size stored in BANDTB. After each step, it checks the VCO frequency for three stop points.

1. Top VCO frequency limit (depends on subband),
2. Wraparound frequency
3. Lockout frequency

If the top VCO frequency has been reached and no signal has been found, the program returns to the supervisor. If the top frequency is reached, and a signal has been detected, the VCO is set to its low limit and the bottom range is searched until the wraparound frequency is reached.

If the wraparound frequency has been reached (the frequency at which the last VCO frequency has produced the strongest IF signal), then the program stays at this frequency, and performs the centering and harmonic number calculation routines.

If a lockout frequency (a VCO frequency at which erroneous locking results) is detected, the VCO frequency will be incremented by :

8 * step size = new VCO frequency

and the program continues from this frequency.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

After each VCO step, the YIG filter is swept to see if a signal is detected by the power DAC attenuator. If a signal is detected, the YIG is swept back and forth, and the attenuation is increased until the signal is lost. At this point a new VCO frequency is stepped and the process of signal detection continues and the power DAC is left at the last setting to detect the next highest signal.

Centering and Harmonic Numbering Determination

After the VCO sweep routine is complete and the VCO frequency is set, the incoming signal is mixed with a harmonic of the VCO frequency to produce a signal in a predetermined passband region (1.05 GHz to 1.25 GHz). Then a small VCO frequency is incremented to determine the mix side. After the VCO step, if the resulting IF increases, it is high side mix, otherwise, it is low side mix. The IF is then stepped to 1.05 GHz (or as close as possible) by using the following formula to calculate the VCO step size:

$$\frac{(\text{IF} - 1050\ \text{MHz}) * 100}{12 * \text{N_MAX}}$$

Where N_MAX is the highest harmonic number allowed in the subband.

The above calculation is performed at most twice to bring the IF to 1.05 GHz. At this point the YIG is centered and the centering frequency FYIG1 and VCO frequency FVCO1 are stored. Next the VCO is stepped to bring the IF to around 1.25 GHz and a new centering takes place. This second center frequency is stored for later calculation of the harmonic number. Next the signal is stepped to its previous position and centered. This center frequency is now compared to FYIG1, and must be within 6 MHz. If it is not within 6 MHz, it is assumed that the signal is moving, and the Band 4 program exited.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The IF frequency step size, caused by the VCO frequency step, is used to determine the harmonic number by the following equation,

$$\frac{\Delta \text{ IF FREQ. DUE TO VCO STEP}}{\text{HARMONIC SPACING}} = \text{HARMONIC \#(N)}$$

Where harmonic spacing = VCO step size X 12

CALCULATION ROUTINE – The calculation routine is used to find the approximate RF frequency F_{IN} in the following manner.

1. Compute $F' = 12\,N \times F_{VCO}$
2. Center the YIG filter on the first IF
3. Convert the binary YIG frequency to BCD
4. Compute $F_{IN} = F' \pm F_{YIG}$ (where F_{YIG} gives the approximate value for the first IF).
5. Compute a corrected VCO frequency using the equation:

$$F_{VCO} = (F_{IN} \pm 125) / (12N \pm 2)$$

Then tune the VCO with the corrected frequency and center the first IF frequency in the YIG passband

SHALLOW SEARCH – This routine tests for a signal in the IF passband. If a signal is present, the routine is exited. If a signal is not present, the routine will search an RF range of ±60 MHz (in steps of 200 kHz), for the signal, and continues if a signal is found. If a signal is not found, the Band 4 program returns control to the supervisor.

BAND 4 TRACKING – The tracking routine centers the second IF in the following range.

$$115 \text{ MHz} < \text{2nd IF SIGNAL} < 135 \text{ MHz}$$

This routine is called from outside of the Band 4 program to track a signal. A test is first made to determine if an IF threshold is present. If IF threshold is present it continues, if not the program returns to the supervisor to start the locking process from the beginning.

This routine reads the second IF frequency and computes the new VCO frequency so that the second IF is in the range given above. A new YIG frequency is calculated and the VCO and YIG are "tuned" to produce a new IF. A new FLO (frequency added to the second IF to produce the displayed frequency), is calculated. The equation for this process is:

$$F_{LO} = F_{VCO}\,(12\,N \pm 2)$$

The YIG frequency is: NEW $F_{YIG} = 2$ (NEW VCO) + 125 MHz.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PERFORMANCE TESTS

The Band 4 converter module is not field repairable. When a malfunction is suspected, its operation can be checked from the front panel as follows:

IF AMPLIFIER — Apply a -50 dBm signal to the diplexer port (upper output jack) from 1.0 to 1.35 GHz. Output should be greater than -13dBm as checked on a spectrum analyzer to the IF output (lower jack).

LO SIGNAL — Connect a spectrum analyzer to the diplexer port (upper output jack). Using the following formula, set the VCO frequency between 440 and 500 MHz. The spectrum analyzer should show the 12th harmonic of the VCO frequency (5.28-6 GHz). The spectrum analyzer signal should be +8 dBm minimum, and free of breakup and spurious signals to -30 dBc.

To convert from the desired VCO frequency to the PIA program number:

EXAMPLE (440.75 MHz)

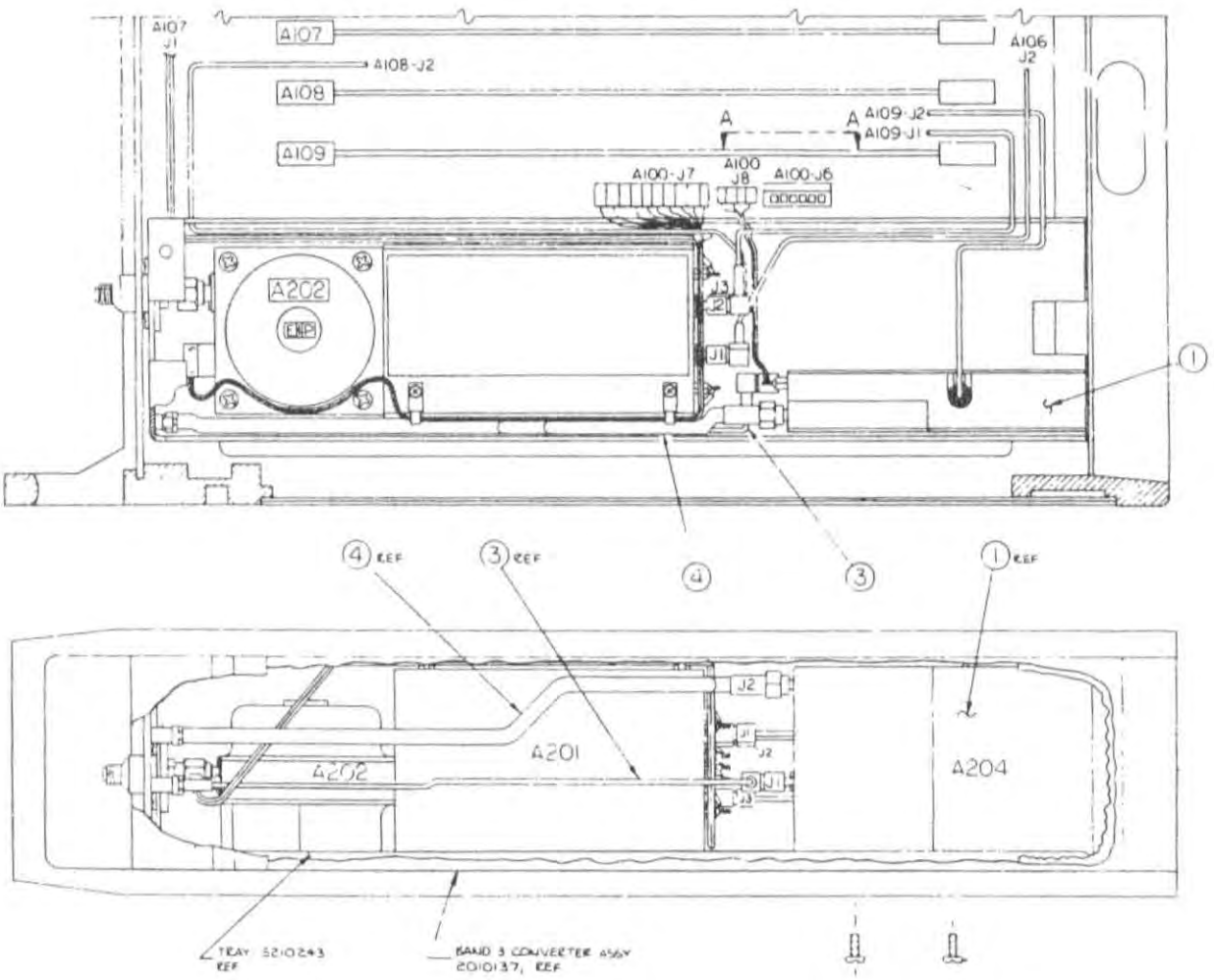
1. Round the desired frequency to a multiple of 50 KHz (The resolution of the VCO frequency is 50 KHz).
2. Multiply the desired frequency (in MHz) by 5 . . . . . 440.75 X 5 = 2203.75
3. If the result contains no fractional part, go to step 8.
4. Multiply only the fractional part by 16 . . . . . .75 x 16 = 12
5. Add the result to the most significant digit from step 2 . . . . . MSD of 2203.75 = 2 – 2 + 12 = 14
6. Convert the result to hexadecimal . . . . . $14_{10} = E_{16}$
7. Replace the MSD from step 2 with the result from step 6 and drop the fractional part . . . . . 2203.75 → E203
8. The two most significant digits are programmed to address 1822, and the two least significant digits are programmed to address 1820.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

To remove a defective converter:

1. Remove the line cord and both the top and bottom cover of the counter.
2. Remove the two screws holding the converter in place from the bottom.
3. Remove coaxial cables and unplug DC harness.
4. Lift the converter out of the counter.

To replace, proceed in the reverse order. See Figure 06-5 for location of the converter in the counter.



① Band 4 Converter – 2010229

③ Cable (FP to A204J1) – 2040232-01

④ Cable (FP to A204J2) – 2040231-01

Figure 06-2. Location of Installed Band 4 Converter (A204)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPTION 07
REMOTE PROGRAMMING/BCD OUTPUT

This option makes it possible to use a conventional printer or other readout device, and remotely program the functions that are normally done on the front panel of the counter.

SPECIFICATIONS

BCD OUTPUT

FORMAT	11 digits plus sign in parallel
"0" STATE	0.4 Volts at 4mA
"1" STATE	2.7 Volts at –400μA
NEGATIVE REF.	Ground
POSITIVE REF.	+5 Volts at 2K Ω Source Impedance
PRINT COMMAND	20 μs wide TTL Low level logic signal
INHIBIT INPUT	2 to 50 Volts High level logic signal

REMOTE PROGRAMMING

INPUT LOADING	1 low power SchottkyTTL load plus 10K pull up to +5 Volts
FUNCTIONS	All front panel controls except: Power ON/OFF, Sample rate, Clear Display, and test functions greater than 01.
OUTPUT LEVEL	Refer to "0" State and "1" State for BCD.

OPERATION

BCD OUTPUT

This binary-coded decimal (BCD) output (plus sign information) represents any numerical data that would normally be displayed by the eleven digits on the front panel of the counter. When the information being displayed represents the frequency alone the minus sign refers to the frequency. When the information being displayed represents frequency and power the minus sign refers to the power.

A 20 microsecond print command is provided to indicate when the data is valid. An inhibit command is provided that will prevent the data from being altered.

BCD OUTPUT PIN CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION	PIN	FUNCTION	PIN	FUNCTION
1	10^{1} A	16	10^{8} B	31	10^{3} D	46	10^{0} C
2	10^{1} B	17	10^{9} A	32	10^{4} C	47	10^{0} D
3	10^{2} A	18	10^{9} B	33	10^{4} D	48	Print Command
4	10^{2} B	19	10^{10} A	34	10^{5} C	49	Minus Sign
5	10^{3} A	20	10^{10} B	35	10^{5} D	50	Ground
6	10^{3} B	21	10^{0} A	36	10^{6} C		
7	10^{4} A	22	Inhibit	37	10^{6} D		
8	10^{4} B	23	10^{0} B	38	10^{7} C		
9	10^{5} A	24	–Ref.	39	10^{7} D		
10	10^{5} B	25	+Ref.	40	10^{8} C		
11	10^{6} A	26	10^{1} C	41	10^{8} D		
12	10^{6} B	27	10^{1} D	42	10^{9} C		
13	10^{7} A	28	10^{2} C	43	10^{9} D		
14	10^{7} B	29	10^{2} D	44	10^{10} C		
15	10^{8} A	30	10^{3} C	45	10^{10} D		

NOTE

The 10^{0} bit is the least significant digit, and corresponds to the 1 Hz output.

A, B, C, and D are the 1, 2, 4, and 8 bits of each binary coded decimal output digit.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

REMOTE PROGRAMMING

All front panel functions can be remotely programmed except the Power on/off, Sample Rate, Clear Display, and test functions greater than 01. All the inputs are activated by a ground contact closure, or a "0" level TTL signal (0 = true). The input load is equal to one low power Schottky TTL load plus a 10 KΩ pullup to +5 volts.

CONTROL LINE FUNCTIONS

REMOTE ENABLE – A low level on this line transfers counter control from the front panel keyboard to the rear panel remote programming connector.

INPUT DATA – A low level on this line initiates a data read cycle to read the function/program data contained on the 22 data input lines. If this line is held low the counter will continuously poll the input data.

DATA ACCEPTED – This signal is output from the counter to the controller. The line goes high when data is being read by the counter, and goes low upon completion of a data read cycle.

PROGRAM DATA – A low level on this line indicates that the 22 data lines will be interpreted as program data. A high level on this line indicates that these lines will be interpreted as function data.

DATA LINE FUNCTIONS

RESET COUNTER – A low level on this line will reset the counter and initiate a new search for a valid signal.

UPDATE READING – A low level on this line will cause the counter to take a new reading, update the front panel display, and update the BCD output.

BAND SELECT (3 lines) – These lines select the band, or Test 01, in accordance with the following:

C	B	A	BAND
0	0	0	Test 01
0	0	1	Band 1
0	1	0	Band 2
0	1	1	Band 3
1	0	0	Band 4.1*
1	0	1	Band 4.2*
1	1	0	Band 4.3*
1	1	1	Band 4.4*

*In counters that do not have Option 6, the C bit does not apply.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

RESOLUTION (4 lines) – These lines program the remote resolution. A four digit BCD number (0 through 9) will indicate the number of digits that are blanked.

DAC SELECT (4 lines) – These lines select the most significant digit of the DAC option (01), when it is installed in the counter. A hexadecimal number (1 to B) will select digit 1 to 11 as the MSD of the 3 digits output to the DAC. Any other digit disables the DAC option.

HOLD MODE – A low level on this line will place the counter in the hold mode (data not updated until the counter is reset).

FAST CYCLE – A low level on this line will place the counter in the fast cycle mode (no display time).

POWER METER – A low level on this line will enable the power meter on counters with Option 02.

VIEW FUNCTION LINES (5 lines) – A low level on one of these lines will cause the counter to display the indicated function on the front panel and the BCD output. If more than one line is enabled at a time, the counter will display the first one found in the following order.

1. DAC Select
2. Frequency Limit Low
3. Frequency Limit High
4. Frequenty Offset
5. Power Offset

PROGRAM LINE FUNCTIONS

PROGRAM SELECT (2 lines) – These two lines select one of four functions to be programmed by the program data in accordance with the following.

SELECT BIT b	a	FUNCTION PROGRAMMED
0	0	Frequency limit low
0	1	Frequency limit high
1	0	Frequency Offset
1	1	Power Offset

MINUS SIGN – When this line is low the four digits of programming data are interpreted as a negative number.

EXPONENT (3 lines) – These three lines are interpreted as a BCD number (0 to 7). This number is the power of 10 that is to be multiplied, times the four digits of data (data X 10^X). This multiplier is used for all frequency input data, and is ignored for the power input data.

DIGIT 1 TO DIGIT IV (4 lines each) – These are four BCD digits that represent the input data. Digit 1 is the MSD and Digit IV is the LSD. For power input, a decimal point is located between Digit II and Digit III, and Digit IV is not used.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

DATA ENTRY

Preceeding any data entry sequence, the counter must be placed in the remote mode (remote enable line low). Once in remote mode, the input data line is brought low to initiate a data read sequence. The data read is normally function data. When the program data line is brought low, the data read will be interpreted as program data. The data accept line will go high to indicate that the data has been latched in, and will remain high while the counter processes this data.

Figure 07-1 shows the data entry timing sequence. The input data line debounce time (1) is typically 16 to 18 ms. Data is latched into the counter 48 μs before the data accept line goes high (2). As soon as the data accept line goes high, all data (except remote enable) can be removed. The data accept line stays high while the counter processes the input data. This process is data dependent, and can take from 1 to 140 ms (3). To prevent the counter from setting the poll mode, the input data line must go high within 100 μs after the data accept line goes low (4). If poll mode is set, the next data read cycle will occur between 0 and 100 ms after the high to low transition of the data accept line. After this first data read cycle, all subsequent data read cycles will occur at 100 ms intervals.

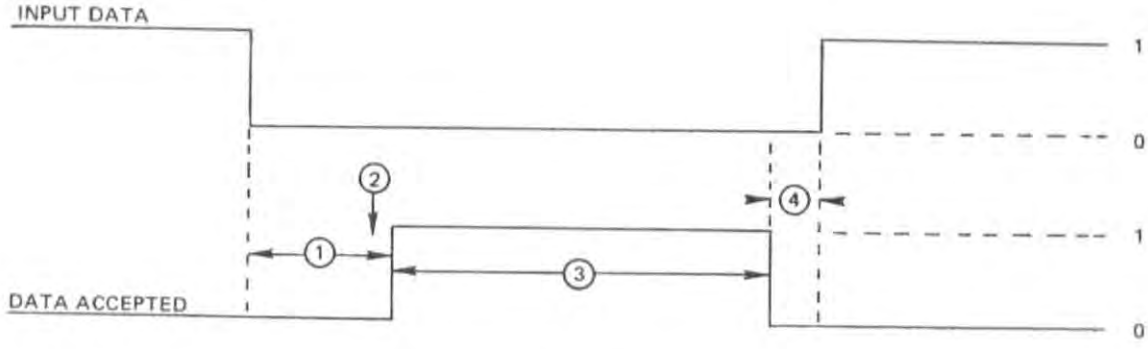


Figure 07-1. Data Entry Timing

DATA ENTRY EXAMPLE

The following example remotely programs the counter to be in Band 3 with 1 kHz resolution, and a -160 MHz frequency offset.

1. Put counter in remote mode by bringing the remote enable line low.
2. Set the program data to be entered by bringing the program data line low.
   a. Set digit 1=1
      Set digit 2=6
      Set digit 3=0
      Set digit 4=0
   b. Set the exponent =5 (1600×10^5)
   c. Set program select A=0, B=1 (frequency offset)
   d. Set minus sign low (negative offset)
3. Enter program data by bringing the input data line low until the data accept line goes high.
4. Set the remote function data.
   a. Return all lines high except the remote enable line.
   b. Set the resolution A and B lines low (resolution 3).
   c. Set the Band select C line low (Band 3).

   NOTE: Counters that do not have Option 06 (Band 4) will set Band 3, even with the select line C high.
5. Enter function data by bringing the input data line low until the data accept line goes high.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

REMOTE PROGRAMMING PIN CONNECTIONS

PIN	FUNCTION DATA	PROGRAM DATA
1-5	BCD Data (Do not use these pins)	
6-12	Ground	
13	DAC Select A	Digit II A
14	DAC Select B	Digit II B
15	DAC Select C	Digit II C
16	DAC Select D	Digit II D
17	Resolution A	Digit I A
18	Resolution B	Digit I B
19	Resolution C	Digit I C
20	Resolution D	Digit I D
21-24	No connection	
25	Program Data)	Program Data)
26	Remote Enable) Control Lines	Remote Enable) Control Lines
27	Input Data)	Input Data)
28	Data Accepted)	Data Accepted)
29	View Power Offset	Digit IV A
30	View Frequency Offset	Digit IV B
31	View Frequency Limit High	Digit IV C
32	View Frequency Limit Low	Digit IV D
33	View DAC Select	Digit III A
34	Power Meter Enable	Digit III B
35	Fast Cycle Mode	Digit III C
36	Hold Mode	Digit III D
37	Ground	Ground
38-44	No connection	
45	Band Select A	Exponent A
46	Band Select B	Exponent B
47	Band Select C	Exponent C
48	(No function)	Minus Sign
49	Update Reading	Program Select A
50	Reset Counter	Program Select B

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

THEORY OF OPERATION

The BCD/REMOTE programming board takes data from the display and formats it as parallel data output for the rear panel. It also receives counter control and programming information from the 26 line input on the rear panel to provide for remote control of the counter.

BCD THEORY OF OPERATION

During each update cycle, the counter checks for the existence of the BCD/RMT board. If the board exists, the program checks the state of the inhibit input. If the inhibit input is true (+2 to +50V on the input), the program jumps past the BCD output but the counter continues to update the display. If the input is low, the program scans through each of the 11 digits (LSB to MSB). Each digit is checked, and any non-numerical digit is replaced by a zero. The resulting BCD digit is then sent to U2 through 4 bits of port B of the PIA (U14). After each digit is made available to U2, 4 clock pulses (BCD Clock) are sent to U2 (through U7) to shift all the data in the shift registers to the right by 4 bits (1 digit). At the end of these data shift pulses, a BCD load pulse enters the new data into U2. When the last digit (MSB) is entered into U2, the sign bit is simultaneously entered into U1. After all the data has been entered into the shift register, the program sends out a 20 microsecond print command.

REMOTE PROGRAMMING THEORY OF OPERATION

When the remote enable line is high, none of the other remote programming lines can effect the counter. When the remote enable line is brought low, the counter changes from local to remote operating conditions and switches control for the counter from the front panel keyboard to the rear panel remote programming connector. When in the remote mode, the counter waits for an input from the INPUT DATA request line. When the input data line is brought low, the data direction control line is sent low to put U9 in the low impedance buffer mode. The RMT LOAD line is then toggled to load all remote input data into the input registers (U8–U12). The counter then changes the data accepted output from a low to a high to indicate that the data has been read. The 8 bits of data into U14 (from U8 and U10), are read by the microprocessor. Groups of 4 clock pulses are then sent out (on the RMT CLOCK line), to shift the input data into U10 where the data is read by the microprocessor through U14. When all the data has been read, the data direction control line is returned to a high level, and the data accept line is returned to low, indicating the data has been accepted by the counter.

When the INPUT DATA line is held low, the counter sets a flag and returns to read the input data at approximately 100 millisecond intervals. This continues until the INPUT DATA line is returned to high, at which time the counter returns to the condition where it is waiting for a high to low transition on the INPUT DATA line.

When the remote enable line is returned to the high state (local mode), the counter exercises a clear display function and then returns to the (previous) local mode condition.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

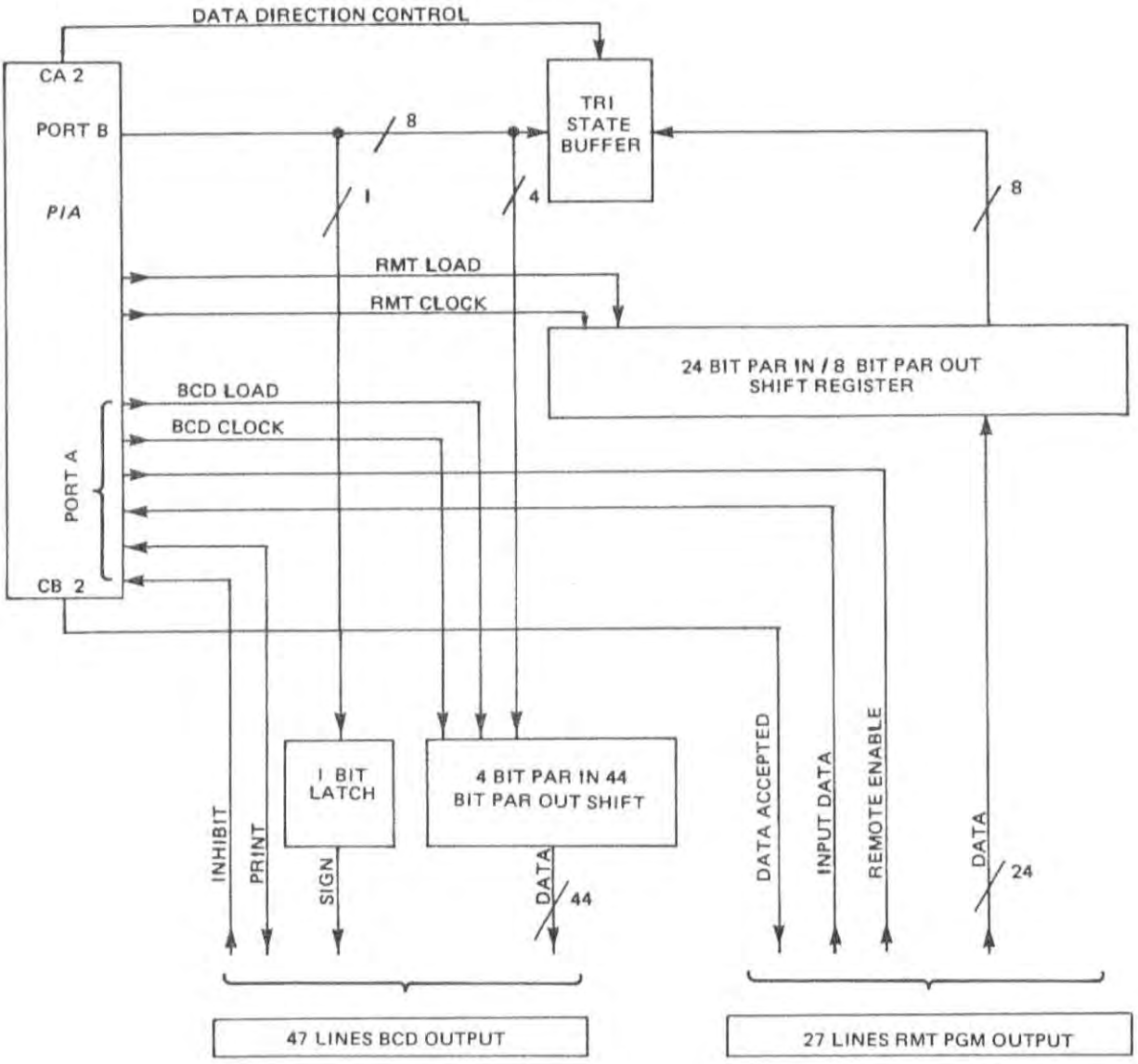


Figure 07-2. Remote Programming/BCD Output Simplified Block Diagram

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

LEFT BLANK INTENTIONALLY

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPTION 07 - REMOTE PROGRAMMING / BCD OUTPUT

2020132 - E

REF DES	DESCRIPTION	EIP NO.	UNITS PER ASSY	TYP MFG NO.	TYP FSCM NO.
07	REMOTE PROGRAMMING / BCD , PCB	2020132		EIP	34257
-1	Bail Mount Kit	5000195	1	3475-1	76381
-2	Cable, Flat Ribbon (to A100 J2, J3)	2040176-01	2		
-3	PCB Assy, A102 A	2020132	1	EIP	
C1	Tant, 33uF, 10%, 10V	2300015	1	TAG-20-33/10-50	14433
C2 thru C5	Cer, .01uF, 20%, 100V	2150003	4	TAG-S10	56289
Q1	Transistor, NPN	4704401	1	2N4401	04713
R1	Comp, 1 K, 5 %, ¼ W	4010102	1	RC07GF102J	81349
R2	Comp, 5.6K, 5%, ¼ W	4010562	4	RC07GF562J	81349
R3	Comp, 10K, 5%, 1/8 W	4010103	1	RC07GF103J	81349
R4	R2				
R5	Comp, 2.7K, 5%, ¼ W	4010272	2	RC07GF272J	81349
R6	R5				
R7	R2				
R8	R2				
RN1 thru RN3	Network, 10 pin , 10K, 2%, 1.25W	4170003	3	4310R-102-56	32997
TP1 thru TP11	.040 Dia. Conn. Pin	2620032	11	460-2970-02-03	71279
U1	4 bit Shift Register	3084195	4	DM74LS195	01295
U2	U1				
U3 thru U7	8 Bit Parallel OUT Register	3074164	5	DM74164	01295
U8	U1				
U9	Line Driver/Octal Buffer Inverter	3084244	1	SN74LS244N	01295
U10	U1				
U11	8 bit Shift Register	3084166	2	74LS166	01295
U12	U11				
U13	Hex Inverter/Schmitt Trig.	3087414	1	DM74LS14N	01295
U14	P.I.A.	3086821	1	MC6821	04713

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

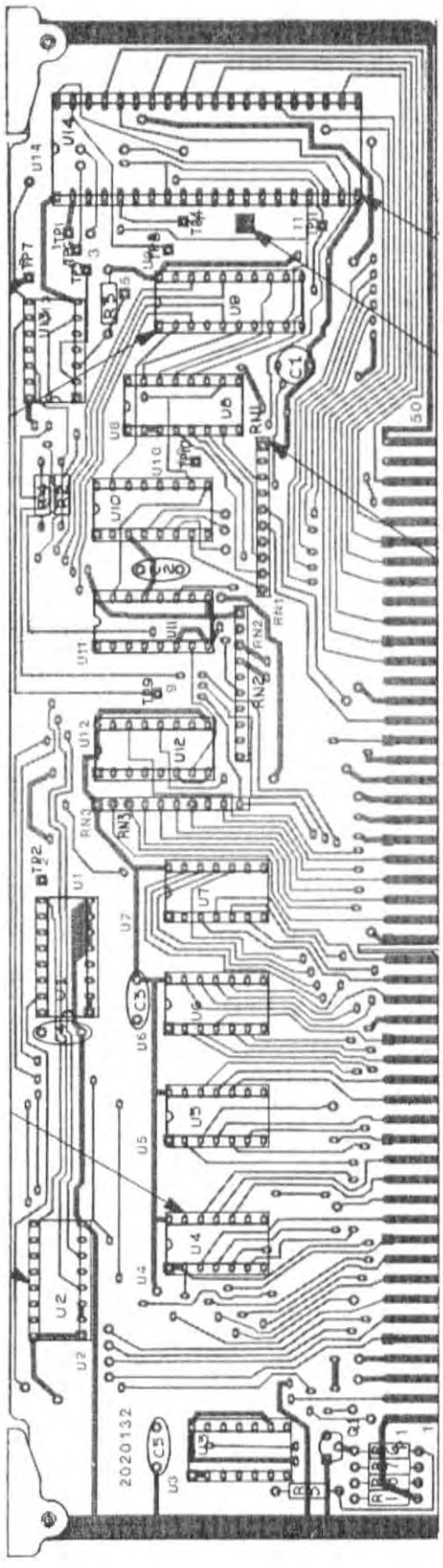
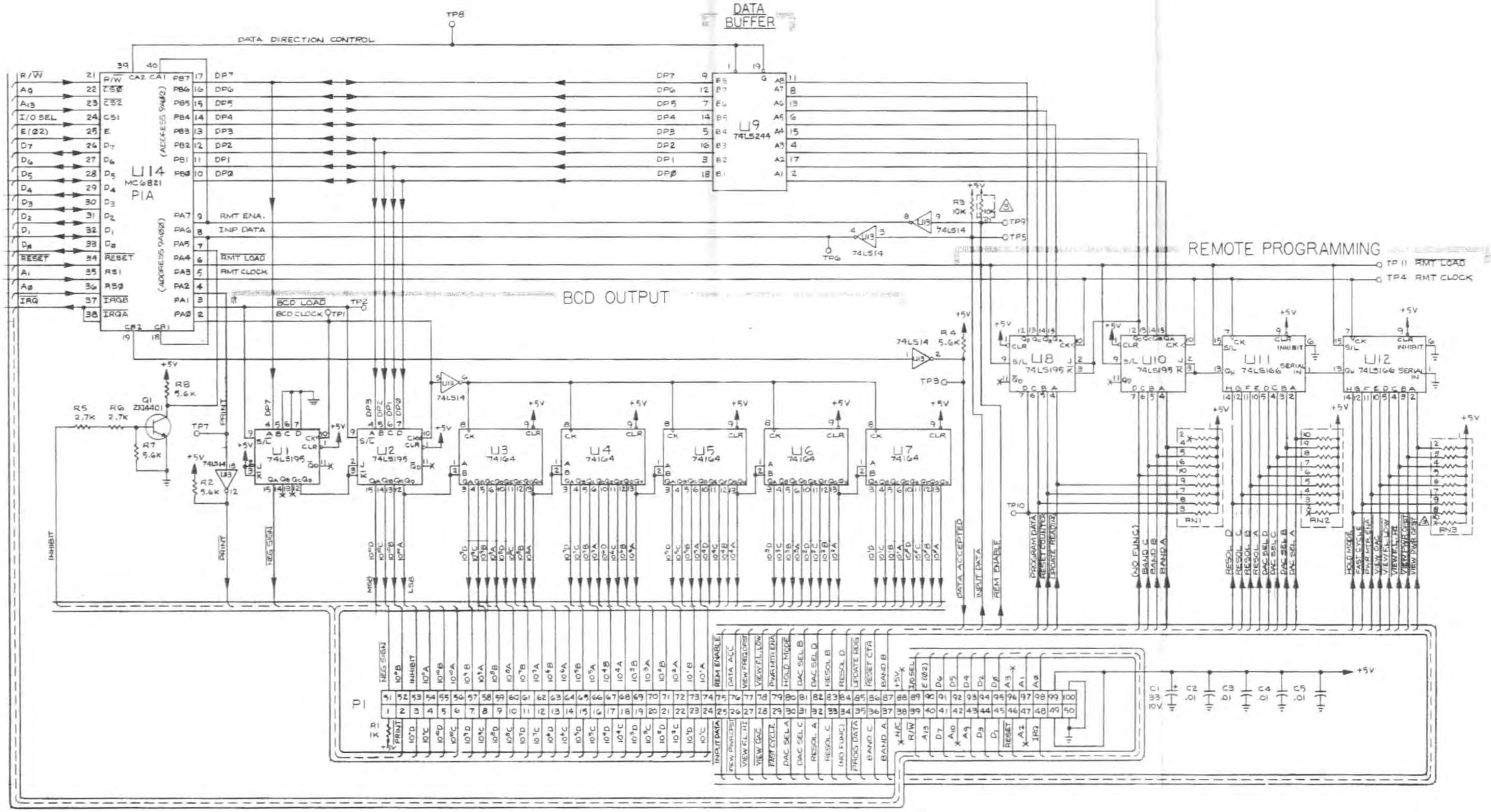


Figure 07-3. Remote Programming / BCD Output, Component Locator

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



I.C.NO.	TYPE	PIN NO. GND	PIN NO. +5V
U1,U2,U8,U10	74LS195	8	16
U3,4,5,6,7	74164	7	14
U11,U12	74LS166	8	16
U9	74LS244	10	20
U13	74LS14	7	14
U14	MC6821	1	20

⚠2 RESISTOR AT TP9 PART OF RN3 PIN 10.

5500132 - B

Figure 07-4. Remote Programming/BCD Output Schematic Diagram

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPTION 08

GENERAL PURPOSE INTERFACE BUS

Option 08 makes 545A/548A microwave counters fully compatible with the General Purpose Interface Bus (GPIB). With this option the counter can respond to remote control instructions and can output measurement results via the IEEE 488-1978 Bus interface. At the simplest level the counter can output data to other devices such as the HP 5150A Thermal Printer. In more sophisticated systems a calculator or other system controller can remotely program the counter, trigger measurements, and read results. Of course, a calculator or computer adds other benefits to a GPIB based measurement system. The calculator can manipulate data to compute the mean and standard deviation, check for linearity, and compare results to limits, or perform many other functions.

GPIB FUNCTIONS IMPLEMENTED

The GPIB interface function subsets implemented are:

SH1	complete capability
AH1	complete capability
T5	basic talker, serial poll, Talk Only mode, unaddress if MLA
L3	basic listener, Listen Only mode, unaddress if MTA
SR1	complete capability
RL1	complete capability
DC1	complete capability
DT1	complete capability

NOTE

When DEVICE CLEAR or SELECTED DEVICE CLEAR GPIB bus command is received, the counter will revert to the power on state. When DEVICE TRIGGER GPIB bus command is received, the counter will initiate a new frequency reading cycle. The converter will not be reset. When counter is in REMOTE the RESET key, on the front panel keyboard, acts as the RETURN to LOCAL key.

SETTING ADDRESS SWITCH

The counter employs a decimal address switch locate on the top edge of A102. It is set for decimal address 19 at the factory. To verify the switch setting without removing the top of the counter, simply initiate test 10; enter 9C04 and read the address on the display. A description of test 10 can be found on page 6-7. After reading the address, terminate the test by pushing the clear display key.

The address switch is also used to put the counter in the Talk Only (TO) or Listen Only (LO) mode. To put the counter in the Listen Only mode simply set the address switch to 41 or any number higher.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The counter can be put in four different modes of operation in the Talk Only mode. The following is a list of the address settings for entering these modes.

ADDRESS	MODE OF OPERATION
32	Continuous output determined by SAMPLE RATE control. Exponent in scientific format.
33	Continuous output - fast active. SAMPLE RATE control inactive. Exponent in scientific format.
34	Continuous output determined by SAMPLE RATE control. Exponent in zero output format.
35	Continuous output - fast active. SAMPLE RATE control inactive. Exponent in zero output format.

NOTE

In the Talk Only or the Listen Only mode, the address of the counter is always automatically set to decimal 0.

DEVICE DEPENDENT DATA INPUT

It takes a specific amount of time for the counter to process the input data (error checking, formatting, changing the mode of operation, etc.). To prevent the data rate of the bus from slowing down while the counter is doing input data processing, the data is accepted as soon as it is available on the bus, and it is temporarily stored in memory. The size of the storage memory is 100 characters.

The users of the GPIB option need to be aware that there is a difference between accepting data and complying with it. If the counter is asked to output a reading before it has finished processing the input data, the output will be in error if the operator makes the assumption that the counter is in the mode that was just programmed. To prevent this, sufficient programmed delays must be provided, or use must be made of the counter's Service Request status byte. See Service Request (SR) command description.

GPIB INSTRUCTION FORMAT

<OP CODE> <NUMBER> <TERMINATOR>

OPERATION CODE or OP CODE can take any of the following formats:

<LETTER> <LETTER> or <LETTER> <DIGIT>

Example: FH (Frequency limit high) or B3 (band 3)

The NUMBER portion of the statement can take the form of any of the following:

<SIGN> <DIGIT STRING>

Example: –2457

<SIGN> <DIGIT STRING> • <DIGIT STRING>

Example: –3.483

NOTE: Spaces within the <OP CODE> and <NUMBER> portions of the instructions are always ignored.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The TERMINATOR allows the operator to choose the scale of an input number as well as implement special functions.

TERMINATOR = G/M/K/H/D/P/C

G, M, K, H, represent GHz, MHz, kHz and Hz respectively
D = dB, P = clear data, (equivalent to "clear data" key on keyboard)
C = clear display (equivalent to "clear display" key on keyboard)

FORMAL DEFINITION OF INSTRUCTIONS

<OP CODE> <NUMBER> <TERMINATOR>

<OP CODE> ::= <LETTER> <LETTER> | <LETTER> <DIGIT>

<NUMBER> ::= <SIGN> <DIGIT STRING> |
<SIGN> <DIGIT STRING> . <DIGIT STRING> |
NULL

<TERMINATOR> ::= G | M | K | H | D | P | C | NULL

<SIGN> ::= + | − | NULL

<DIGIT STRING> :: <DIGIT> <DIGIT> <DIGIT>- - - - - - -

<LETTER> ::= A | B | C | D | E | F | G | H | I | J | K | L | M | N |
O | P | Q | R | S | T | U | V | W | X | Y | Z

<DIGIT> :: = 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PROGRAM CODE SET

Codes underlined indicate start-up conditions. These conditions are set by the device clear or selected device clear, or power on.

DISPLAY

DA – Display Active: Output Frequency Reading to Front Panel and Bus
DP – Display Passive: Output Frequency Reading to Bus only
DN – Display Normal

BAND

B1 – Band 1: 10Hz - 100MHz
B2 – Band 2: 10MHz - 1GHz
B3 – Band 3: 1GHz - 18GHz (Model 545A) / 26.5GHz (Model 548A)
B4 – Band 4: (Model 548A / Option 06)

RESOLUTION

R0 – Resolution 0 = 1Hz
R1 – Resolution 1 = 10Hz
R2 – Resolution 2 = 100Hz
R3 – Resolution 3 = 1KHz
R4 – Resolution 4 = 10KHz
R5 – Resolution 5 = 100KHz
R6 – Resolution 6 = 1MHz
R7 – Resolution 7 = 10MHz
R8 – Resolution 8 = 100MHz
R9 – Resolution 9 = 1GHz

MEASUREMENT FUNCTIONS

FA – Fast Active (Ignore sample rate Pot)
FP – Fast Passive (Terminates FA)
RS – Reset Basic Counter and Converter. Take a new reading after reset.
HA – Hold Active
HP – Hold Passive

DATA MANIPULATION FUNCTIONS

FO – Frequency Offset. Take a new reading after data entry if counter not in hold.
PO – Power Offset. Take a new reading after data entry if counter not in hold.
*OA – Offset Active:
—Add Frequency Offset to Frequency Reading
—Add Power Offset to Power Reading if Power Meter Function is active
OP – Offset Passive (Terminates OA)
ML – Multiplier. Multiplies frequency readings by an integer number.

*In Start-up Condition, although OA is Active, "0" (zero) Frequency and Power Offsets are programmed.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

POWER METER

PA – Power Meter Option Active. Initiate a new gate.
PP – Power Meter Option Passive (Terminates PA)

*MEASUREMENT PARAMETERS

FH – Frequency Limit High. Basic counter and converter will be reset after data entry.
FL – Frequency Limit Low. Basic counter and converter will be reset after data entry.

SELF-TEST FUNCTIONS

TA – Test Active.
TP – Test Passive. (clear test function)

DATA FORMAT

EZ – Exponent Zero
ES – Exponent Scientific

DATA OUTPUT

BR – Output both frequency and power readings
FR – Output frequency readings only
PR – Output power readings only

SERVICE REQUEST

SR – Service request enable

DAC OPTION

DC – Select DAC option

*Measurement parameters: Standard Software
Limits of 950MHz (LOW) and 18.5GHz (HIGH) (27GHz for Model 548A) are featured in each counter at turn on.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

DESCRIPTION OF AVAILABLE COMMANDS

DISPLAY

DA - Display Active - Outputs readings to both front panel and GPIB bus

DP – Display Passive - Outputs readings to GPIB bus only. It will decrease the cycle time of the counter.

DN – Display Normal - Resets display only; used for clearing error messages on the display. Cannot be used after verifying preprogrammed data such as Frequency Offsets or Frequency Limits. This OPCODE affects only the display.

BAND

B1 – Selects Band 1

B2 – Selects Band 2

B3 – Selects Band 3

B4 – Selects Band 4. Requires an additional digit input to designate individual remote sensors.

Example: B41 = remote sensor 1 which covers range of 26.5 to 40GHz.

RESOLUTION

R0 thru
R9 – Resolution 0 thru 9 - Picks the front panel resolution from 1Hz to 1GHz. Also chooses gate time which is related to resolution: 1Hz = 1 Sec, 10Hz = 100 Sec. 100Hz = 10 msec. 1kHz to 1GHz = 1 msec.

MEASUREMENT FUNCTIONS

FA – Fast Active - Causes the counter to go into the fast cycle mode of operation. In this mode, the front panel sample rate/hold control is inactive and the fastest sample rate is attained. The counter will not go into the Fast Active mode of operation until Hold Active is disabled.

FP – Fast Passive - Terminates FA.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

RS – Reset Basic Counter and Converter - Re-acquires input signal and takes a new reading. Has the same function as manual reset button.

HA – Hold Active - The counter stops taking readings and the last frequency and power readings are displayed and held. The counter can be directed to take one reading when it is in this mode by sending Device Trigger or Selected Device Trigger GPIB bus command to the counter. It will also update the reading if the RS mnemonic is received.

HP – Hold Passive - Terminates HA.

DATA MANIPULATION FUNCTIONS

FO – Frequency Offset - Enables entry of frequency offsets. (1 Hz resolution available.) A new gate will be initiated after data entry if counter is not in HOLD.

PO – Power Offset - Enables entry of power offsets. Take a new reading after data entry if counter is not in HOLD.

OA – Offset Active - Add frequency offset to frequency readings. Add power offset to power readings if power meter function is active.

OP – Offset Passive - Does not add frequency and power offset to readings.

ML – Multiplier - Enables entry of a 2-digit frequency readings multiplier. The multiplier must be an integer between 00 and 99. The results are to 1kHz resolution. A new reading will be initiated after the data entry if the counter is not in HOLD. If the results of the multiplications are larger than, or equal to 999.999999999GHz, the counter will output 999.999999999GHz to the bus if asked to output readings.

POWER METER

PA – Power Active - Enables power meter option.

PP – Power Passive - Terminates power meter option.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

MEASUREMENT PARAMETERS

FH — Frequency Limit High - Enables entry of frequency limit high (10 MHz resolution available). The basic counter and converter will be reset after the data entry.

FL — Frequency Limit Low - Enables entry of frequency limit low (10 MHz resolution available). The basic counter and conveter will be reset after the data entry.

SELF-TEST FUNCTIONS

TA — Test Active - Enables the counter to perform the selected test function by entering the mnemonic TA followed by two digits. When Test 05, 08, 09, or 10 is active and the counter is being asked to output data, the data that is displayed on the front panel is the data being output.

The output data format is as follows:

XXXXXXXXXXXXCRLF

X = alpha-numeric
CR = carriage return
LF = line feed

For detailed descriptions of tests 01 through 09 and test 11, see the section on Keyboard Controlled Circuit Tests.

Test 10 operates in the following manner:

1. To activate Test 10 input TA10.
2. To read the data stored in a specific memory location, input the address of the memory location in a four digit hexadecimal number. Enable the counter to talk and then read data from the counter.
3. To alter the data stored in a certain memory location:

   If 2. has been performed - input the desired data for that memory location.

   If 2. has not been performed - input the memory address, followed by a two digit hexadecimal number.

TP — Test Passive - Terminates test function.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

DATA FORMAT

EZ – Exponent Zero - output format.

ES – Exponent Scientific - output format.

DATA OUTPUT

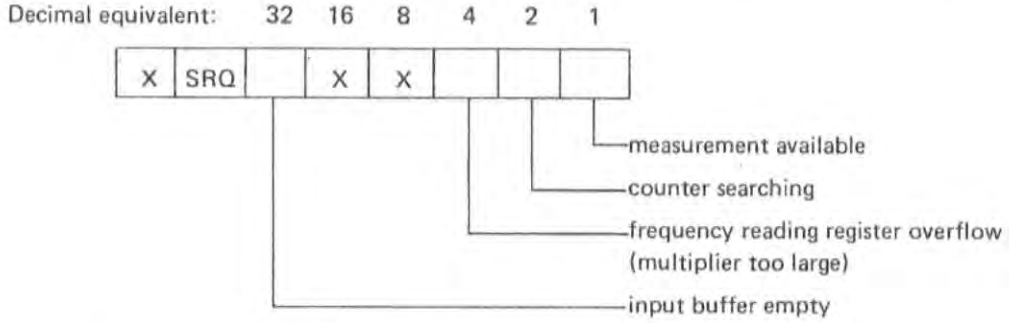
BR – Output both frequency and power readings. (See section on output data format.)

FR – Output frequency readings only. (See section on output data format.)

PR – Output power readings only. (See section on output data format.)

SERVICE REQUEST

SR – Service Request Enable - Enables the counter to send Service Request to the bus when a certain event has taken place in the counter. To enable the function, input SR followed by two decimal digits. The two digits are the decimal equivalent of the content of the eight bit status register. More than one bit of the status register can be set.



To disable the Service Request function, input SR00.

NOTE

Even when the Service Request function is disabled, the Service Request status byte will still be continuously altered to reflect the internal states of the counter.

EXAMPLE: To enable service request on measurement available or input buffer empty, send SR33.

DAC OPTION

DC – DAC Option - Enables the DAC option to convert three consecutive digits to an analog voltage, available on the rear panel. The output will reflect the display, and zeros are substituted for any non-numeric characters that appear. The output will be updated after every display update.

DC00 – turns DAC option off
DC01 – selects 1 Hz digit
thru
DC12 – selects 100 GHz, 10GHz and 1 GHz digits.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

DATA OUTPUT FORMAT

The 545A/548A transmit the following string of characters to output a measurement.

Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Format																		
EZ (Exponent Zero)	␣	±	D	D	D	D	D	D	D	D	D	D	D	D	E	0	CR	LF
ES (Exponent SCI)*	±	D	D	D	D	D	D	D	D	D	D	D	D	D	E	D	CR	LF
Power**	␣	␣	␣	␣	␣	␣	␣	␣	␣	␣	±	D	D	D	.	D	CR	LF

Freq. + Power

- FREQ in EZ mode: ␣ ± D D D D D D D D D D D E 0 , ␣␣␣␣␣␣␣␣␣␣␣ ± D D D . D CR LF
- FREQ in ES mode: ± D D D D D D D D D D D D E D , ␣␣␣␣␣␣␣␣␣␣␣ ± D D D . D CR LF

When the counter is in Test 05, 08, 09, or 10, the output will reflect the data on the display. The format is as follows:

XXXXXXXXXXXXCRLF.

␣ = Blank
D = Digit
X = Alpha-numeric
CR = Carriage Return
LF = Line Feed

*in Exponent Scientific one digit represents the position of the decimal point. Exponent digit can be either 0, 3, 6, or 9.

**The power information always have the decimal point fixed for 0.1dB resolution.

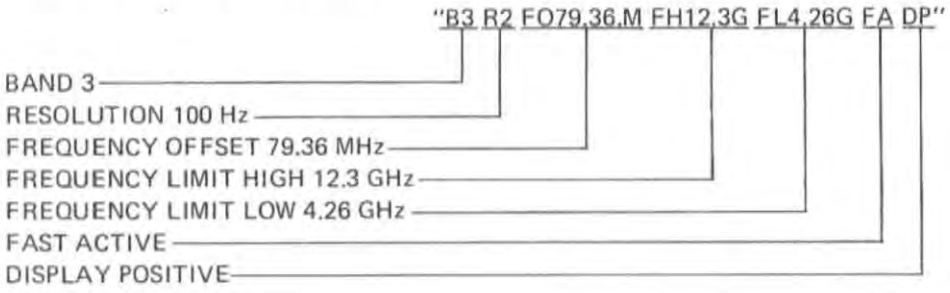
Under different output modes, the following counter outputs can be expected by a listener.

OUTPUT MODE	COUNTER OPERATING MODE	OUTPUT
BR	PA	FREQ + PWR
	PP	FREQ
	TA01	FREQ
FR	PA	FREQ
	PP	FREQ
	TA01	FREQ
PR	PA	PWR
	PP	−999.9
	TA01	−999.9
BR, FR or PR	TA 05, 08, 09, or 10	Data on front panel display

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PROGRAM EXAMPLES

The examples given here assume an address setting of decimal 19 or ASCII talk address "S" and listen address "3" for the counter. By addressing the counter to listen and sending the following program string, it sets up the following measurement conditions.



The following programs illustrate how controllers function with the counter. These programs cause the counter to make a series of frequency measurements. The calculators read the measurements into memory and print the results. The programs assume the counter Talk and Listen address is decimal "19."

```
HP 9825A    0:   dim A (10)
            1:   rem 7
            2:   wrt 719, "B3R2FO-4.55M"
            3:   wait 300
            4:   for 1 = 1 to 10
            5:   red 719, A (I)
            6:   prt A (I)
            7:   next I
            8:   end
HP 9845A   10:   output 719, "B3R2FO-4.55M '
           15:   wait 300
           20:   input 719, A
           30:   print "Frequency minus offset equals," A
           40:   Go to 20
TED 4051   10:   print @19: "B3R2FO-4.55M"
           20:   input @ 19: A
           30:   print "Frequency minus offset equals," A
           40:   Go to 20
```

The 9825A program will cause the counter to take a series of ten readings, print them on the 9825A paper tape and stop. Notice that an offset of 4.55 MHz is subtracted from each reading.

The program shown for the 9845A and TEK 4051 cause the counter to make a frequency measurement and print that measurement. To end the program, initiate a "STOP" command. This is accomplished on the 9845A with the key labeled "STOP." On the TEK 4051 use the key labeled "BREAK." To restart the program enter the RUN statement followed by the line number that is printed in the INTERRUPT message.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

READING A MEASUREMENT

To read a measurement from the counter to a calculator, the counter must first be addressed to talk and the calculator to listen. The examples below indicate how a calculator may read a measurement from the counter.

```
10 red 719, A
20 prt A                    } HP 9825A

10 input @ 19:A
20 print A                  } TEK 4051

10 enter 719, A
20 print A                  } HP 9845A
```

The EIP counters can use two different modes. HA which takes one reading then waits for a reset command or a Device Trigger GPIB Bus Command. In this condition the counter is sent a reset or Device Trigger and (when addressed to talk) a new reading is output to the BUS. The counter will hold that particular reading on the display until another reset command or Device Trigger command is received. The other mode is HP or HOLD PASSIVE. In this mode data is read out in a normal BUS fashion. The display automatically updates corresponding to the sample rate chosen. In this condition successive readings can be output without generating a reset or Device Trigger command each time.

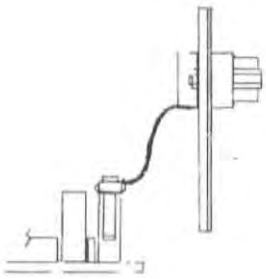
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

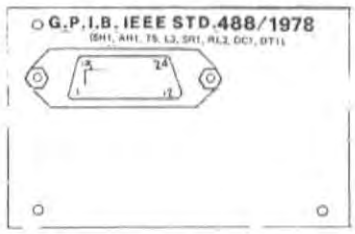
ADDRESS CHARACTERS		ADDRESS CODES					
Listen	Talk	binary					decimal
		5	4	3	2	1	*
SP	@	0	0	0	0	0	00
!	A	0	0	0	0	1	01
"	B	0	0	0	1	0	02
#	C	0	0	0	1	1	03
$	D	0	0	1	0	0	04
%	E	0	0	1	0	1	05
&	F	0	0	1	1	0	06
'	G	0	0	1	1	1	07
(	H	0	1	0	0	0	08
)	I	0	1	0	0	1	09
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
–	M	0	1	1	0	1	13
.	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
0	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	26
;	[	1	1	0	1	1	27
<	/	1	1	1	0	0	28
=	]	1	1	1	0	1	29
>	^	1	1	1	1	0	30

* Decimal Talk/Listen Address is provided as a cross reference for those controllers which use decimal address.

Figure 08-1. Allowable Address Codes

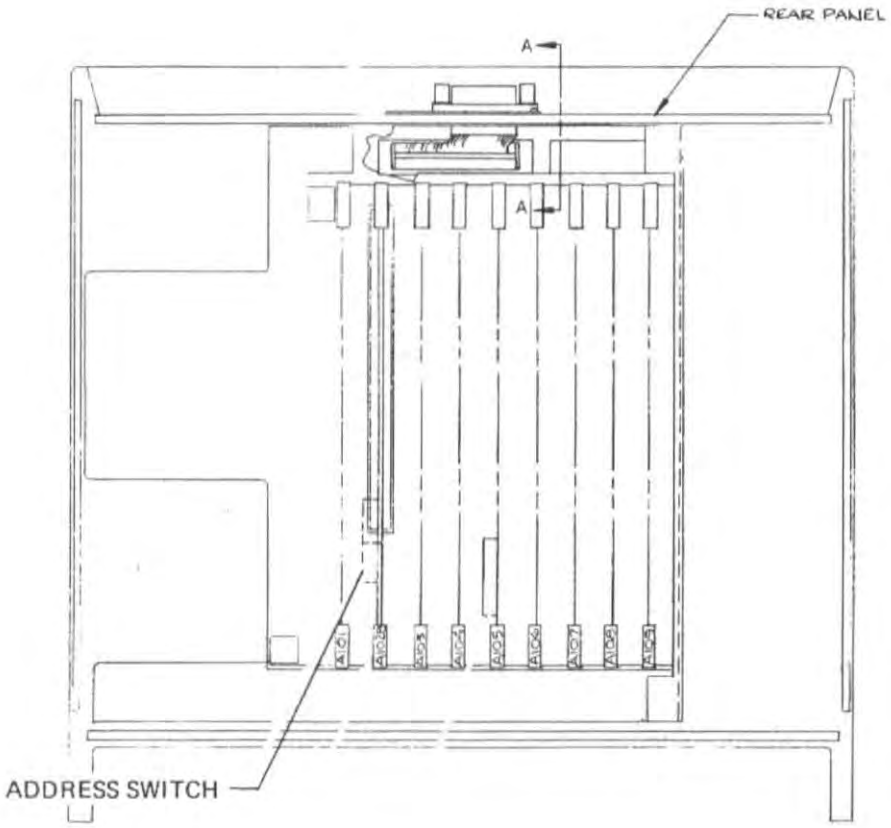
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com





DETAIL A-A

CONTACT	SIGNAL LINE	CONTACT	SIGNAL LINE
1	DIO 1	13	DIO 5
2	DIO 2	14	DIO 6
3	DIO 3	15	DIO 7
4	DIO 4	16	DIO 8
5	EOI	17	REN
6	DAV	18	GND. (6)
7	NRFD	19	GND. (7)
8	NDAC	20	GND. (8)
9	IFC	21	GND. (9)
10	SRQ	22	GND. (10)
11	ATN	23	GND. (11)
12	SHIELD	24	GND. LOGIC



SEE G.P.I.B MANUAL FOR ADDRESS SETTING INSTRUCTIONS.

Figure 08-2. Location of GPIB in Counter

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPTION 08—GENERAL PURPOSE INTERFACE BUS

2020133-02 A

REF DES	DESCRIPTION	EIP NO.	UNITS PER ASSY	TYP MFG NO.	TYP FSCM NO.
08	GPIB Option	2010232		EIP	34257
-1	PCB Assy, GPIB (A102B)	2020133	1	EIP	34257
C1	Cer, .01μF, 20%, 100V	2150003	3	TG - S10	56289
C2	C1				
C3	C1				
C4	Tant, 33μF, 20%, 10V	2300015	2	TAG20 - 33/10 - 50	14433
C5	C4				
R1 thru R8	Comp, 5.6K, 5%, 1/4W	4010562	8	RC07GF562J	81349
SW1A and SW1B	Thumbwheel Switch	4540004	2	1X2270 - 0000	
TP1 thru TP6	P.C. pin 0.040 diameter	2620032	6	460-2970-02-03	71279
U1 thru U4	Quad 3-state Bus Transciever	3053448	4	MC3448	04713
U5	Hex Inverter	3087404	1	74LS04	27014
U6	General Purpose Interface Adaptor	3050027	1	MC68B488P	04713
U7	Tri Input NAND Gate	3087410	1	74LS10	27014
U8	Oct Bus Transciever	3084245	1	74LS245	27014

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

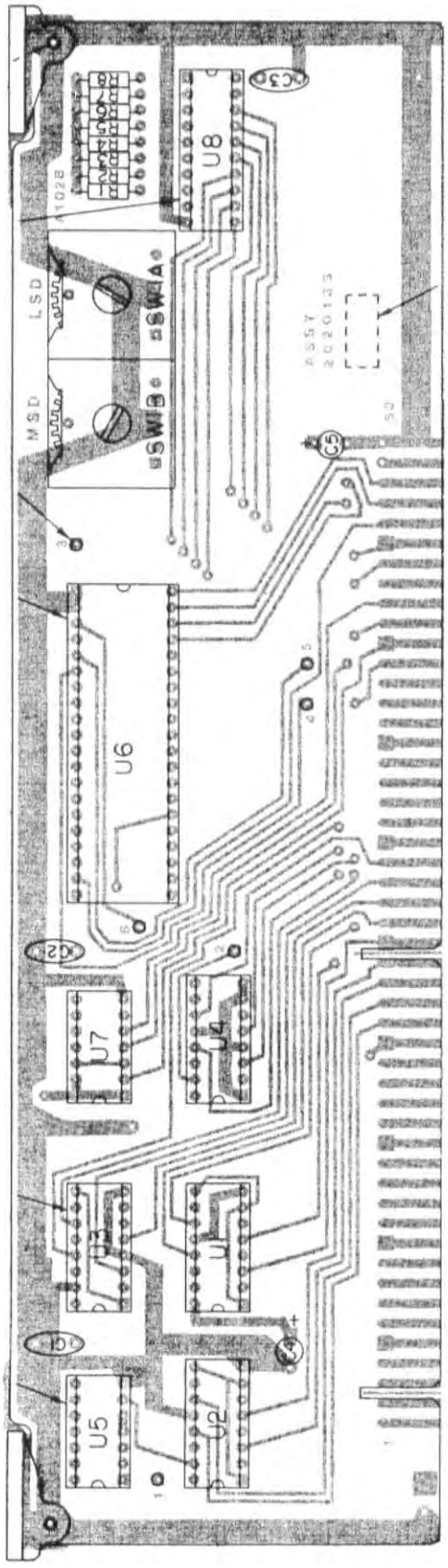
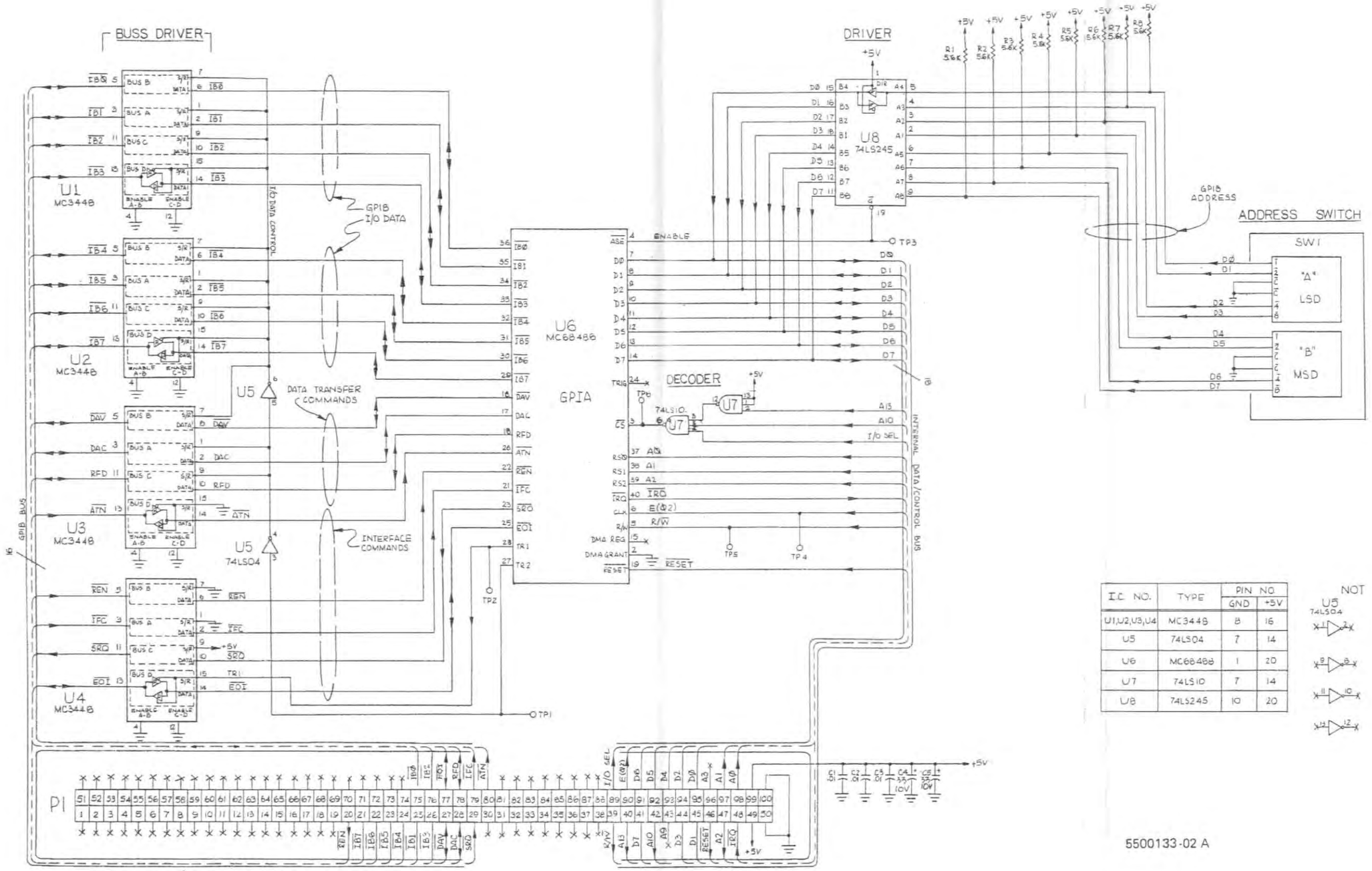


Figure 08-3. GPIB Component Locator

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5580033



I.C. NO.	TYPE	PIN NO	
		GND	+5V
U1,U2,U3,U4	MC3448	8	16
U5	74LS04	7	14
U6	MC68488	1	20
U7	74LS10	7	14
U8	74LS245	10	20

NOT USED

U5 74LS04

U7 74LS10

5500133-02 A

Figure 08-4. GPIB Schematic

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPTION 09
REAR PANEL INPUT

Option 09 provides rear panel input for 545A/548A counters and counters equipped with option 06 in the following manner:

545A / 548A COUNTERS :

1. Reversing the converter assembly so that the Band 3 input connector protrudes through the hole in the rear panel that is identified as J113.

2. Reversing the Band 1 and Band 2 connectors to the holes marked J111 and J112 respectively on the rear panel.

Option 06 Equipped Counters:

1. Reversing the converter assembly so that the Band 3 input connector protrudes through the hole in the rear panel that is identified as J113. Reversing the Remote Sensor and Band 3 jumper connectors to the holes marked J114A (Rmt. Sensor) and J114B (Band 3 connector) respectively.

2. Reversing the Band 1 and Band 2 connectors to the holes marked J111 and J112 respectively on the rear panel.

NOTE: The specifications for the counter do not change when the input is from the rear panel.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

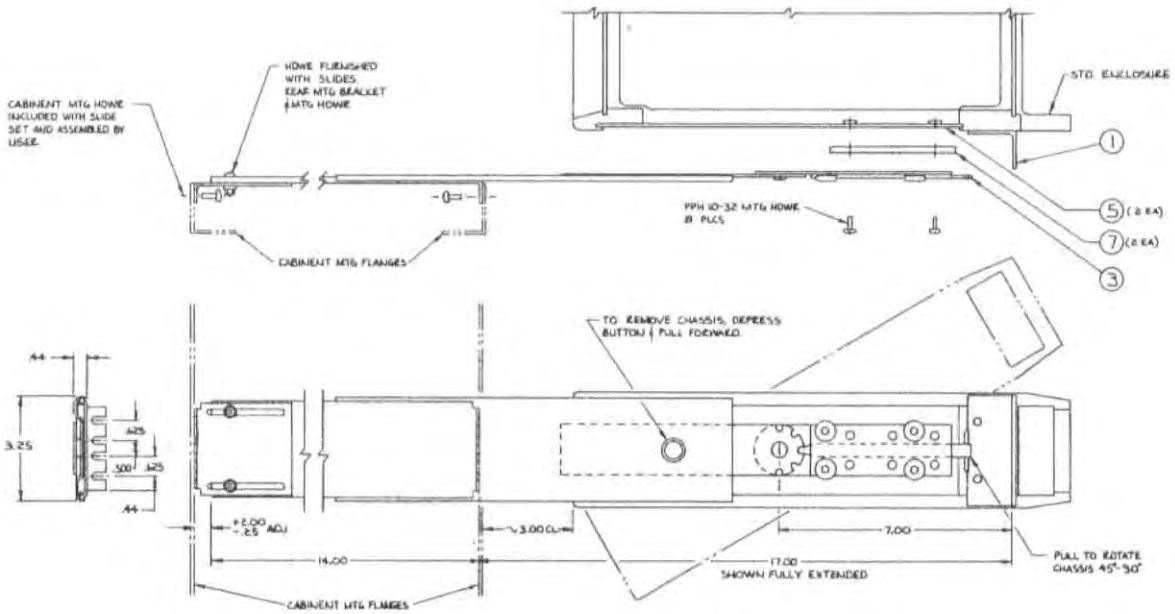
OPTION 10
CHASSIS SLIDE

Option 10 equips your counter with the hardware required to mount the unit in a standard 19" wide console. With the chassis slide installed the counter can be serviced without removing it from the rack.

The option consists of:

OPTION 10 – 2010147

①	Rack Mount Kit	– 2010008-01
③	Slide Set	– 5000189
⑤	Side Panels	– 5210179
⑦	Spacers	– 5210249



1. All MTG HDWR and hole spacing conforms to MIL-STD-189.
2. To install slides in field; Remove top cover and top frame; Mount special side panels (5210179) on Std. enclosure.
3. Item numbers within ◯ symbol are on P/L 2010147. All other items assembled or exploded are shown for clarification or reference only.

Side View of Counter With Option 10 Installed

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPTION 13
MATE–CIIL INTERFACE

INTRODUCTION

This document defines the MATE–CIIL interface for the EIP Microwave Model 545A/548A Counter. It explains the general format and processing of CIIL operation codes, and gives a detailed definition of the CIIL operation codes used for the 545A/548A counter.

CIIL DESCRIPTION

CIIL stands for Control Interface Intermediate Language. It is a common interface language that operates with associated protocols between a computer subsystem and instrumentation connected to it via an IEEE 488 communication bus. The environment is expected to be an automatic test station. It is the intent of this interface to allow for the interchangeability of IEEE 488 compatible instrumentation with minimum impact upon other system elements.

The GPIB interface of the 545/548 counters is fully compatible with the IEEE 488–1978 standard. With the GPIB interface, the counter can respond to remote control instructions and can output measurement results via the IEEE 488–1978 bus interface.

The IFC and DCL command of IEEE 488–1978 are implemented as per the CIIL specification.

FUNCTIONAL SUMMARY

This interface provides the following functions:

* Accepts control computer input and translates the standard program instructions of the MATE–CIIL into those required by the 545A/548A counter.
* Establishes the timing required to operate in the MATE Test Executive environment.
* Formats measurement responses and transmit upon request to the control computer.
* Provides the means to perform confidence and built–in test.
* Controls input signals.
* Generates status messages.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

GENERAL RULES FOR INPUT AND OUTPUT

INPUT

CIIL input commands implemented in the 545A/548A Counter are shown in Table 1.

TABLE 1

COMMAND	DESCRIPTION
<verbs>:	
FNC	function
INX	initiate
FTH	fetch
OPN	open
CLS	close
STA	status
RST	reset
CNF	confidence test
IST	built in test
GAL	go to alternate language
<set codes>:	
SET	set
SRX	set maximum
SRN	set minimum
<nouns>:	
ACS	AC signal
RPS	ramp signal
TRI	triangular wave signal
SQW	square wave
WAV	waveform
<chan num>:	
:CH1 or :CH01	band 1
:CH2 or :CH02	band 2
:CH3 or :CH03	band 3
:CH41	band 41
:CH42	band 42
:CH43	band 43
:CH44	band 44
<modifiers>:	
VRMS	voltage-TRMS
FREQ	frequency
POWR	power
FRES	frequency resolution
TIMP	test-equip-IMP

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

FORMAT OF INPUTS

There are nine transmission commands applicable to the counter in the CIIL language. At the start of each command, the instrument is listen-addressed by the control computer. The end of transmission is indicated by <cr, lf>. Each transmission command begins with its own characteristic <verb>. They are as follows:

FNC	(function) set up the instrument
INX	initiate a measurement
FTH (fetch)	transmit results to the control computer
CLS	close the primary input path
OPN	open the primary input path
RST	reset the instrument
STA	report status
IST	initiate built-in test
CNF	initiate confidence test
*GAL	go to alternate language

* NOTE:

Once the controller issues the GAL string, the counter goes to native language mode. The way to return to MATE-CIIL mode is by issuing MA string (see paragraph 3.12); IFC, DCL command sequence or power on.

GENERAL RULES

It takes a specific amount of time for the counter to process the input data (error checking, formatting, changing the mode of operation, etc.). To prevent the data rate of the bus from slowing down while the counter is doing input data processing, the data is accepted as soon as it is available on the bus, and it is temporarily stored in memory. The size of the storage memory is 148 characters. This is the maximum length of any one command string.

All strings are processed and requested actions performed independently. No string depends on a previous string or setup except as specified. There are no incremental or partial setups. If the FNC string is not complete, or contains an error, the counter does not use information from the last setup to complete or correct the current one. Rather, an error message is generated for transmission to the control computer and the counter reverts to the state that it was in just before the error message was processed.

Anywhere one blank, <b>, is indicated, the instrument accepts multiple blanks as if they were one blank.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The following notation describes the various input (and output) strings.

|	= exclusive OR
<b>	= one ASCII blank
[ ]	= optional field
. . .	= field that may be repeated as often as required
<set code>	= SET | SRX | SRN
<noun>	= three ASCII characters (see table 1)
<modifier>	= four ASCII characters (see table 1)
<mchar>	= FREQ | POWR
<chan num>	= 1 | 2 | 3 | 01 | 02 | 03 | 41 | 42 | 43 | 44
<value>	= any ASCII encoded number in floating point or integer or engineering notation. The maximum number of digits in the numeric integer without leading zeros is 12. The maximum number of digits in the exponent is 3 (with or without leading zeros).
<cr, lf>	= ASCII encoded carriage return and line feed.

OUTPUT

FORMAT OF OUTPUTS

After the transmission of the INX, FTH, and STA type strings, the counter responds with one of the following messages depending on which of the above 3 <verb> was just previously received.

1. F07HFC1:<ASCII message> <cr, lf>
2. F05HFC1:<ASCII message> <cr, lf>
3. <b> <cr, lf>
4. <b> <value>

GENERAL RULES

After receiving the INX, FTH, and STA strings, the counter can be talk-addressed. It takes a specific amount of time for the counter to process the input string. If the controller talk-addresses the counter before the counter finishes processing the input string, erroneous output may result. To prevent such erroneous output, the programmer must provide sufficient programmed delays or use the counter's Service Request status byte.

FORMAT AND PROCESS OF MATE-CIIL STRINGS

FNC STRING

FORMAT OF FNC

The information contained in FNC string for measurement setup shall be encoded as follows:

FNC<b> <noun> <b> <mchar> <b>:CH<chan num>[<b> <set code> <b><modifier> <b> <value>]. . .<cr, lf>

As can be seen from the above, each optional field consists of :

<b> <set code> <b> <modifier> <b> <value>

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The order within the FNC string of each optional field is random and depends only on the programmer. The <mchar> field just after the <noun> indicates the parameter to be measured. For the 545A/548A counter, only frequency and power can be measured.

<chan num> AND <mchar> RELATIONSHIP

The acceptable value of <chan num> depends on <mchar>. <chan num> meanings and allowable combinations are shown below:

<chan num>	counter band	<mchar>
1 or 01	1	FREQ
2 or 02	2	FREQ
3 or 03	3	FREQ | POWR
41	41	FREQ
42	42	FREQ
43	43	FREQ
44	44	FREQ

If any other <chan num>/<mchar> combination appears in the FNC string, an error message will be generated for transmission to the control computer.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

<chan num>, <noun>, and <modifier> Relationship

Channel Number	Valid Noun	Valid Modifier	Measured Characteristics
1	ACS RPS TRI SQW WAV	VRMS FREQ TIMS FRES	10 Hz ≤ Frequency ≤ 100 MHz
2	See Above	See Above	10 MHz ≤ Frequency ≤ 1 GHz
3	See Above	VRMS FREQ POWR ** FRES TIMP	0.95 GHz ≤ frequency ≤ 26.5 GHz * ** 1 to 18/26.5 GHz will measure sine wave amplitude to 0.1 dBm resolution
41 ***	See Above	VRMS FREQ TIMS FRES	26.5 GHz ≤ frequency ≤ 40 GHz
42 ***	See Above	See Above	40 GHz ≤ frequency ≤ 60 GHz
43 ***	See Above	See Above	60 GHz ≤ frequency ≤ 90 GHz
44 ***	See Above	See Above	90 GHz ≤ frequency ≤ 110 GHz

NOTE * = For 545A the value is 18.5 GHz instead of 26.5 GHz

** = Applied if Option 02 is included

*** = Applied if Option 06 is included.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PROPERTIES OF <set code>

All <modifiers> for the counter may appear as many as 3 times, each with a different <set code> and <value>. However, only one <value> will be used. (with the exception of setting frequency in channel 3. See below) The correct set code is determined by the following priority lists:

SRX
SET
SRN

This means that if SRX is missing, then the <value> associated with SET is used. If SET is also missing, then the <value> associated with SRN is used.

MEASUREMENT SETUP

The counter is capable of two measurements. Therefore <mchar> can only be one of the following:

FREQ
POWR

If any other <mchar> is given, an error message will be generated for transmission to the control computer.

The only <modifiers> that can have an effect on the counter setup are :

FRES
FREQ

FREQUENCY RESOLUTION

The <value> associated with FRES will be rounded to the closest integer:

1	1E5
10	1E6
100	1E7
1E3	1E8
1E4	1E9

FREQUENCY

The effect of FREQ on counter setup depends on the <set codes> that are present and <chan num>. Let <f.ul> and <f.ll> be two counter setup parameters. They are determined from the following tables:

let <f.srx> be the <value> associated with SRX FREQ
let <f.srn> be the <value> associated with SRN FREQ
let <f.set> be the <value> associated with SET FREQ

Note: x indicates the <value> was specified in FNC string.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

<chan num>	<f.set>	<f.srn>	<f.srx>	<f.ll>	<f.ul>
3	x			.95E9	26.5E9 (Note)
3		x		<f.srn>	26.6E9 (Note)
3			x	.95E9	<f.srx>
3	x	x		<f.srn>	26.5E9 (Note)
3	x		x	.95E9	<f.srx>
3		x	x	<f.srn>	<f.srx>
3	x	x	x	<f.srn>	<f.srx>

Note: For 545A the value is 18.5E9

RANGE CHECKING

No <modifiers> are necessary for the counter to make a measurement. The entire instrument setup can be determined by the FNC string. (See 3.1). However, some <modifiers>, if received, will cause the counter to do range checking.

The following <modifiers>, if present, are range checked as indicated as a function of <chan num>:

<chan num>	<modifier>	<value> range
1	FREQ	10 to 100E6
	VRMS	25E-3 to 120
	TIMP	1E6 only
	POWR	ignored
2	FREQ	10E6 to 1E9
	POWR	-20 to 10
	TIMP	50 only
	VRMS	ignored
3	FREQ	0.95E9 to 26.5E9 (Note 1)
	POWR	-30 to 7
	TIMP	50 only
	VRMS	ignored
41	FREQ	26.5E9 to 40E9
	POWR	-25 to 5
	TIMP	ignored (Note 2)
	VRMS	ignored (Note 2)
42	FREQ	40E9 to 60E9
	POWR	-25 to 5
43	FREQ	60E9 to 90E9
	POWR	-25 to 5
44	FREQ	90E9 to 110E9
	POWR	-25 to 5

Note 1: For 545A ,the value is 18.5E9.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Note 2: For band 4X, both TIMP and VRMS are ignored.

FRES need not be range checked. If any <modifier> <value> is found to be out of range, an error message will be generated for transmission to the control computer.

CLS STRING

FORMAT OF CLS

The counter connects to the outside world via four main input ports. A programmer who wishes to connect the instrument to one of these input ports, issues CLS command. This appears as a small string with only a <chan num> option.

CLS<b>:CH<chan num> <cr, lf>

As with the FNC string, <chan num> depends on the input band the programmer wishes to use.

It is possible for the FNC, or setup string, to contain a <chan num> that is not the same as the one included in the CLS string. Although this would cause a measurement to be taken using a path that has not yet been closed, it is an acceptable setup since the actions of each transmission are being determined independently without knowledge of previous transmissions, except where indicated.

PROCESS OF CLS

The processing of CLS is the same as selecting the band on the counter. While processing the CLS command, the counter switches the Count Chain from a previously selected band to the one corresponding to new input channel number.

OPN STRING

FORMAT OF OPN

A programmer who wishes to disconnect the instrument from the input port, issues an OPN command. This also appears as a small string with only a <chan num> option.

OPN<b>:CH<chan num> <cr, lf>

PROCESS OF OPN

The OPN command implies that the instrument has the capability to logically isolate its input from the outside world via an internal mechanism controlled by the instrument itself.

When the channel specified in the OPN command is already open, the counter does nothing.

RST STRING

FORMAT OF RST

The format of the RST string is as follows:

RST<b> <noun><b><mchar><b> : CH <chan num><cr, lf>

All fields following the <verb> RST are ignored by the counter.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PROCESS OF RST

Upon receiving and processing this command, the counter performs a reset action that causes the following initialization configuration:

CLEAR DISPLAY
DISPLAY ACTIVE
SELECT BAND 3
RESOLUTION 3
POWER METER PASSIVE
FAST PASSIVE
HOLD PASSIVE
OFFSET ACTIVE
OUTPUT TO DISPLAY AND GPIB

CNF STRING

FORMAT OF CNF

The confidence test operation code CNF has the following format:

CNF<cr, lf>

It is not part of the run-time scenario. After this message has been transmitted, the control computer must wait a specified amount of time, depending upon the resolution of the counter, before continuing to communicate to the counter.

RESOLUTION	WAIT TIME
0	1 second
10	0.1 second
100	10 millisecond
1000 or above	1 millisecond

Within this "CNF time", the counter completes the confidence test and should not be interrupted by any command. Commands sent during the CNF time may cause failure of the test. After the test is over, the counter accepts any command string. However, in general, the CNF string is followed by the STA string.

PROCESS OF CNF

The confidence test is an end-to-end test to determine whether the instrument is functioning properly. The process of CNF verifies that the Count Chain, the Gate Generator, and the VCO are operational.

At the end of the test, the counter displays 200 MHz on on the front panel. Otherwise an error message is generated.

The test status can be accessed by STA string.

IST STRING

FORMAT OF IST

The format for built-in test is as follows:

IST<cr, lf>

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

It is not part of the run-time scenario. After this message has been transmitted, the control computer must wait a specified amount of time, depending upon the resolution of the counter, before continuing to communicate to the counter.

RESOLUTION	WAIT TIME
0	1 second
10	0.1 second
100	10 millisecond
1000 or above	1 millisecond

Within this "IST time", the counter completes the confidence test and should not be interrupted by any command. Commands sent during the IST time may cause failure of the test. After the test is over, the counter accepts any command string. However, in general, the IST string is followed by the STA string.

PROCESS OF IST

The confidence test is an end-to-end test to determine whether the instrument is functioning properly. The process of IST verifies that the Count Chain, the Gate Generator, and the VCO are operational.

At the end of the test, the counter displays 200 MHz on the front panel. Otherwise,an error message is generated.

The test status can be accessed by STA string.

STA STRING

FORMAT OF STA

The format of this transmission is as follows:

STA<cr, lf>

This string requires a response to be sent from the counter to the control computer. There must be at least 300 ms wait time for the control computer before the counter can be talk-addressed. Typically, the string is sent after the completion of the built-in test,or confidence test, but it can be sent at any time.

PROCESS OF STA

There are 2 valid response to this STA string:

1. F07HFC1:<ASCII message> <cr, lf>

2. <b> <cr, lf>

Reply 1 is sent if an error has been detected in the information received in the FNC string. Also, this format is used when any failure is detected as a result of CNF or IST.

Reply 2 is used when there is no error to report either as a result of run-time request of STA, or STA request following CNF or IST.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

INX STRING

FORMAT OF INX

The format of this transmission is as follows:

INX<b> <mchar> <cr, lf>

The <mchar> included in this string must match that included in the most recent FNC transmission. If it does not, an error message is generated for transmission to the control computer. An error message is also generated if any one of the following strings are received just prior to the receipt of the INX transmission:

CNF
IST
RST
IEEE-488 bus command DCL

Any one of these would indicate that the instrument is being requested to initiate a measurement without information about the measurement setup.

Once the INX transmission is sent by the control computer and is received and acknowledged by the counter, the control computer then talk-addresses the counter. At this time the counter responds with either of two transmissions:

1. <b> <time> <cr, lf> <time> := ASCII integer in seconds

2. F07HFC1:<ASCII message><cr, lf>
   (see paragraph 3.7.2)

Transmission 1 indicates that all previous FNC string and INX string information is valid and that the counter is prepared to make a measurement of the type requested by the most recent FNC string. <time> is a number indicating the instrument's calculated estimate of the time required to make the measurement and acquire the requested data. The method of this calculation is described in paragraph 3.8.2.

Transmission 2 indicates one of the following fault messages:

1. CIIL syntax error as described throughout this specification. The syntax error may have occurred in any string since the last talk address.

2. Any other error specified in the ERROR MESSAGE section of the 545A/548A counter manual.

PROCESS OF INX

The sequence of events in response to the INX are as follows:

1. The instrument sends back <time> within 2 seconds of being talk-addressed.

2. The real time clock of the counter begins to count an amount of time that equals:

   <c time> = <time> - 2 seconds

3. Once the clock has been started, the instrument can capture the required signal data.

4. If the counter is not able to make a reading in <c time>, an error message is generated for transmission to the control computer upon receiving and processing of the FTH string. The format of this error message is described in paragraph 3.7.2.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5. If the counter is able to make the measurement, the results are saved and transmitted to the control computer upon receipt and processing of the FTH string.

TIMING CALCULATION

As indicated in the previous paragraph, <time> is returned to the control computer when the counter is talk-addressed after accepting the INX transmission. The counter has 2 seconds to respond. <time> is calculated as follows:

<time> = <c time> + 2

<c time> is the time the counter allows itself to capture the data, and prepare the data to be returned upon receipt of the FTH string. It is calculated as follows:

If the counter is in search mode:

<c time> = measurement time + acquisition time

If the counter is in measure mode:

<c time> = measurement time

The value of <time> needs to be only a rough estimate because it is used by the control computer solely as a bus time-out for the talk-address following the FTH string. If the counter answers any time before <time> runs out in the control computer, the data is accepted, allowing the testing to proceed sooner.

FTH STRING

FORMAT OF FTH

The format of this transmission is as follows:

FTH<b> <mchar>< cr, lf>

The <mchar> included in this string must match that included in the last previous INX transmission. If it does not, an error message is generated for transmission to the control computer. An error message is also generated if the counter receives any one of the following strings just prior to the receipt of the FTH transmission:

CNF
IST
RST

Any of these would indicate that the instrument is being requested to return an answer to the control computer without having taken a measurement.

Once the FTH transmission has been sent by the control computer and it is received and acknowledged by the counter, the control computer then talk-addresses the counter. At this time, the counter responds with any of this three transmissions:

1. <b> <value> <cr, lf>
2. F07HFC1:<ASCII message><cr, lf>
3. F05HFC1:<ASCII message><cr, lf>

Transmission 1 indicates that the information in all of the previous FNC strings, as well as any other strings, is valid. The measurement result is represented by <value>.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Transmission 2 indicates the following fault message:

CIIL syntax error as described throughout this specification. The syntax error may have occurred in any string since last talk-addressed.

Transmission 3 indicates the following fault message:

The measurement "timed out"; in other words, the counter was not able to detect a signal and make a measurement in the time it specified in response to the INX.

PROCESS OF FTH

The measurement data captured as a result of receiving and processing the INX is formatted upon receipt and acknowledgment of the FTH. The format is as follows:

<b> <value> <cr, lf>

There are no blanks anywhere in the <value>. The only allowable ASCII characters are: 0 1 2 3 4 5 6 7 8 9 + - . E

The FTH string is roughly equivalent to the following counter commands:

CIIL STRING	COUNTER EQUIVALENT
FTH FREQ	output frequency
FTH POWR	output power

GAL STRING

FORMAT OF GAL

The format of this string is:

GAL<cr, lf>

This <verb> is used to indicate that the next ASCII transmission is in the native language of the counter. Any command defined in the GPIB section of 545A/548A counter manual may be used as long as it is in its native mode.

MA STRING

The way to return to MATE-CIIL mode is by issuing

MA<cr, lf>

The IEEE-488 bus command DCL and power on also can cause the counter to switch back to MATE-CIIL mode.

NOTE

After transmitting the MA string, the controller must wait until the counter finishes processing the MA string before sending any other string to the counter. In this circumstance, using the counter's Service Request byte is recommended.

ERROR MESSAGES

The following error messages are added as a MATE option of the 545A/548A counter. When an error occurs, an error number will be displayed on the front panel as well as output through GPIB when the counter is talk-addressed.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The GPIB output format for error 95 is :

F05HFC1: NO SIGNAL FOUND

For others :

F07HFC1: ERROR NUMBER # (error number)

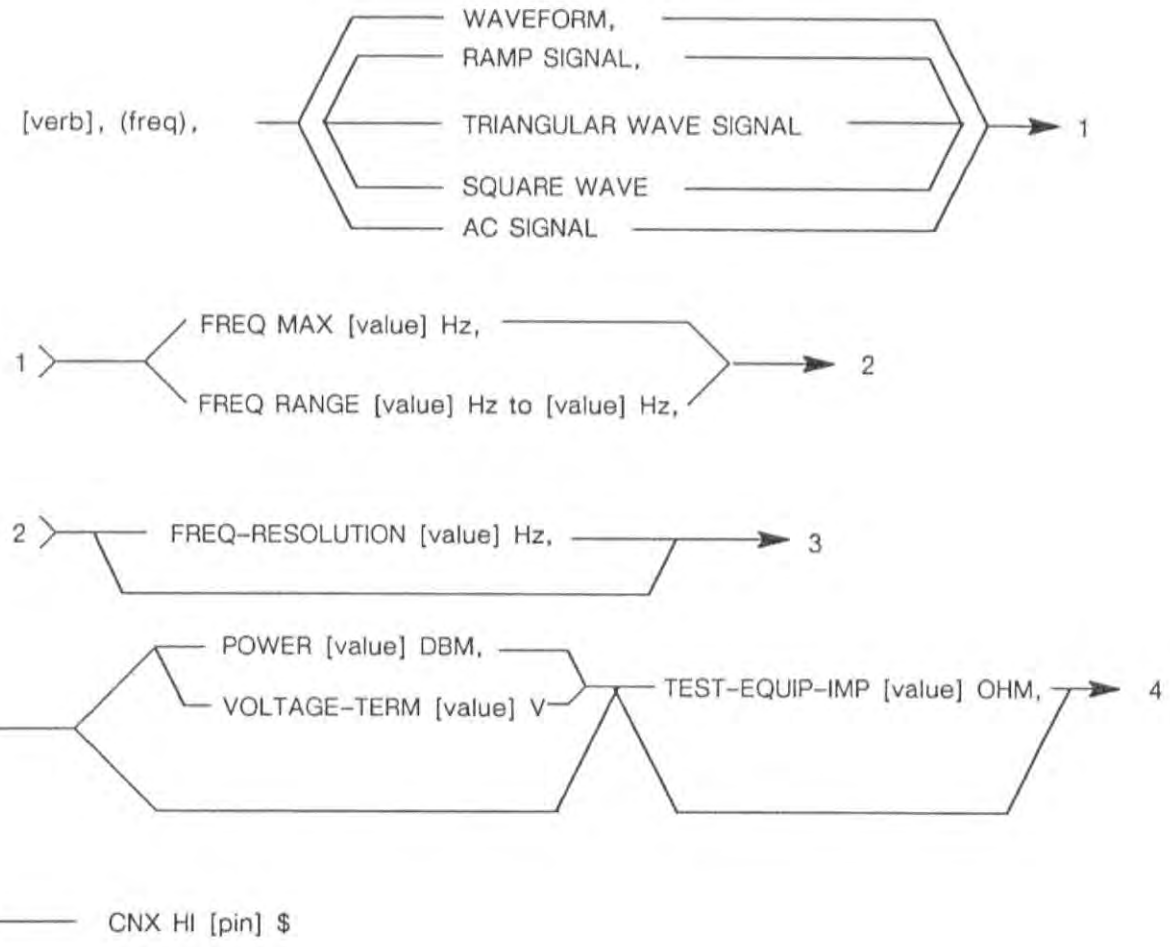
Detailed description of other error messages are as follows:

08	BIT test fail (200-MHz self test fail)
52	illegal power entry
53	illegal VRMS entry
54	illegal TIMP entry
55	illegal FREQ entry
75	undefined CIIL <verb>
76	undefined CIIL <noun>
77	undefined CIIL <mchar>
78	undefined CIIL channel number
79	illegal CIIL set code
80	undefined CIIL modifier
81	illegal CIIL value entry
82	illegal CIIL input format
85	<mchar> does not match <mchar> defined in last setup
86	<mchar> does not match <mchar> defined in last initialization
87	initialize prior to instrument setup
88	illegal noun/mchar combination

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

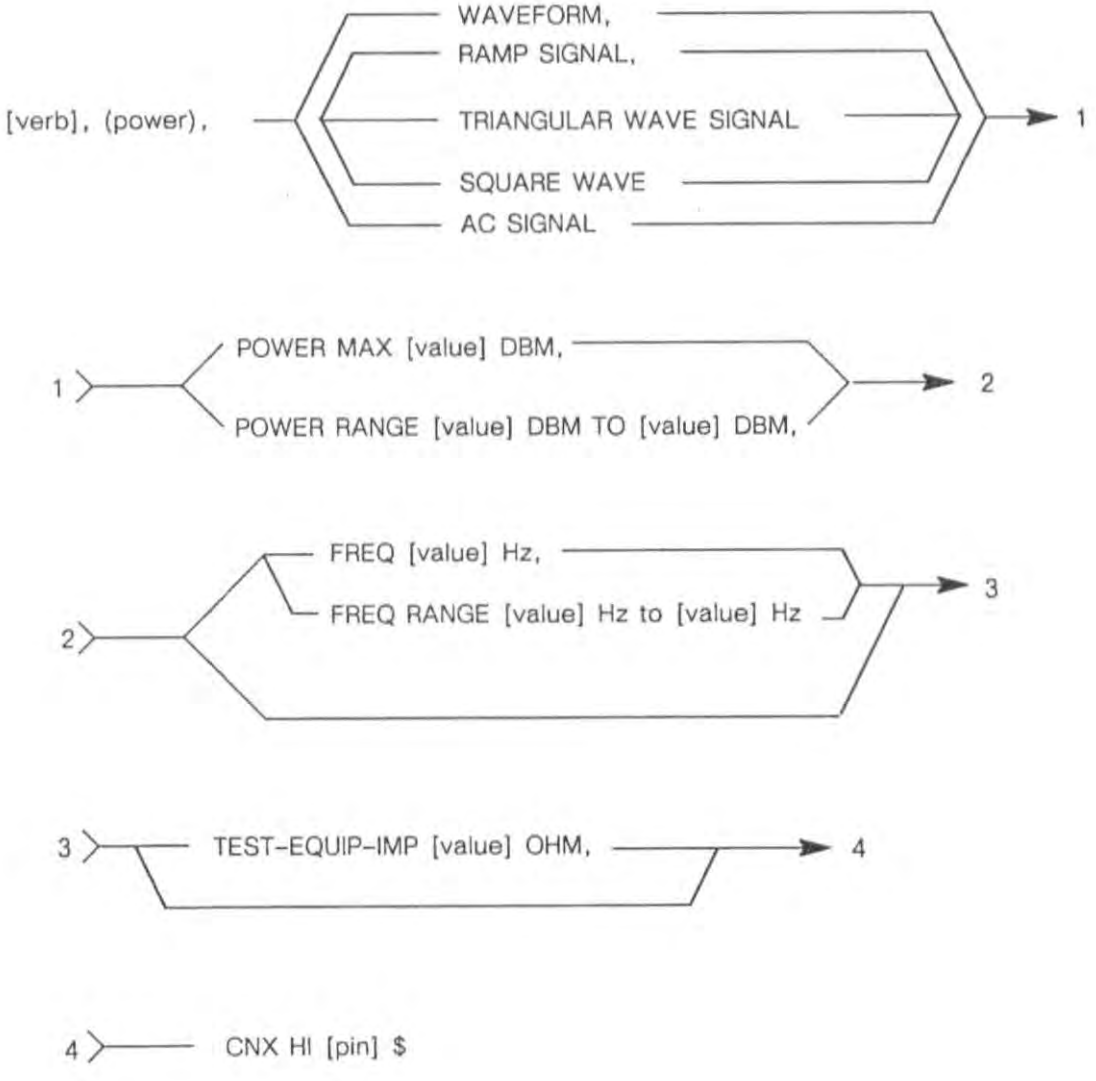
CIIL SYNTAX DIAGRAM

FREQUENCY MEASUREMENT:



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

POWER MEASUREMENT



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

OPTION 14
0.1 HZ RESOLUTION

Option 14 offers the user 0.1 Hz resolution in Band 1. In order to extend the resolution to 0.1 Hz, the gate time inside the counter is increased to 10 seconds. Therefore, if the count chain reads 11 after the 10-second gate period, then the frequency displayed is 1.1 Hz.

The significance of the digits on the front panel is shifted left three digits. If the frequency of the input signal is 9 MHz, the counter displays 9 GHz.

If the user changes the resolution during the 10-second gate period, the counter still has to wait for the 10-second gate to complete before it changes the gate time accordingly.

To change the counter gate time to 10-seconds through front panel:

1. Select "band 1".
2. Enter "res", ".1"

To change the counter gate time to 10-seconds via GPIB:

1. Command the counter "B1R.1"

To change the counter gate time to 10-seconds via MATE (Option 13), enter the following commands:

1. "CLS :CH01"
2. "FNC ACS FREQ :CH01 SET FRES 0.1"

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix A
Accessories

FURNISHED ACCESSORIES

Line Cord
Manual

ACCESSORIES AVAILABLE FOR PURCHASE

REMOTE SENSOR OPTIONS (FOR EXTENDED FREQUENCY, OPTION 06)

BAND NUMBER	PART NUMBER	FREQUENCY RANGE
91	2030022-00	26.5–40 GHz
92	2030029-00	40–60 GHz
93	2030030-00	60–90 GHz
94	2030031-00	90–110 GHz
95	2030038-00	50–75 GHz
96	2030059-00	33–50 GHz

SPECIFICATIONS

TABLE A-1. SPECIFICATIONS

BAND 4
Used with 548A Counter and 590 Frequency Extension Kit

OPTION	91	92	93	94	95	96
SELECT BAND	41	42	43	44	42 or 43	41 or 42
Waveguide Band	Ka	U	E	W	V	Q
Range	26.5–40 GHz	40–60 GHz	60–90 GHz	90–110 GHz	50–75 GHz	33–50 GHz
Sensitivity (typ)	-25dBm (-20 dBm min.)	-25 dBm	-25 dBm	-25 dBm	-25 dBm	-25 dBm
Waveguide Size	WR-28	WR-19	WR-12	WR-10	WR-15	WR-22
Waveguide Flange	UG-599/U	UG-383/U	UG-387/U	UG-387/U	UG-385/U	UG-383/U
Max. Input (typ)	+5 dBm	+5 dBm	+5 dBm	+5 dBm	+5 dBm	+5 dBm
Damage Level	+10 dBm	+10 dBm	+10 dBm	+10 dBm	+10 dBm	+10 dBm
Aquisition Time (typ)	<2.5 sec	<2.5 sec	<2.5 sec	<2.5 sec	<2.5 sec	<2.5 sec

EXAMPLE: If desired measurement is 60 – 90 GHz, the required equipment is:
Model 548A with Option 06 – Extended Frequency and
Model 590 – Extended Frequency Cable Kit with Option 93 – Remote Sensor

INSTALLATION

Before connecting the remote sensor to the frequency source, verify that the power level is within the limits specified for the sensor.

Connect the long LO cable from the upper jack to the remote sensor. When using the sensor option 91, use the SMA-TNC adapter in the 590 kit. Connect the short IF cable from the lower jack to the Band 3 input.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

CAUTION

Static discharge or ground loops can damage or destroy the diode in a remote sensor. Always connect the LO cable to the counter first, then touch the shield to the body of the sensor before connecting.

Be sure that the counter and waveguide port to which the sensor will connect have a common ground. If in doubt, connect with a ground strap before connecting the remote sensor.

OPERATION

After connection, select band 41,42,43, or 44 on the 548A counter (equipped with option 06). Select the band by:

This counter is identified by two sets of numbers, the model number 545A or 548A and a serial number that is located on a label affixed to the rear panel. Both numbers must be mentioned in any correspondence regarding this counter.

Press [BAND] [4] [1] or 42, 43, or 44.

Be certain that the band selected coincides with the remote sensor in use. See specifications in Table A-1.

NOTE

Frequency limits (low/high) and power meter function (Option 02) only operate to 26.5 GHz.

REPAIR

If loss of sensitivity occurs, the diode may be damaged. the 91 sensor diode can be replaced; all others require factory repair.

To replace the 91 sensor diode, unscrew the knurled cap and pull out the diode. Replace it with a IN53B type diode that can be ordered from EIP by part number 2730053-00 or directly from the manufacturer:

Alpha Industries, Inc.
20 Sylvan Road
Woburn MA 0-807

EIP has an assembly exchange program for rapid repair of damaged units. Consult factory for details.

SERVICE KIT

The service kit for the 545A/548A counter contains the following items and the kit itself is useful as a carrying case.

2000017-01	Calibration Kit
2020147-01	GPIB/BCD Extender Board
2020184-01	Standard Extender Board
2020185-01	Band 2 Extender Board
2040221-01	Cable, BNC to Select
2040222-01	Cable, BNC to PC JK
2610054-00	Test Cable, BNC E/Z Hook
5000094-00	IC Extractor Tool

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix B
List of Manufacturers

FSCM	MANUFACTURER
0000X	Any Manufacturer of this product.
00656	Aerovox Inc., 740 Belleville Ave, New Bedford, MA 02741
00809	Croven Ltd., Whitby, Ontario, Canada
01121	Allen-Bradley Co., South Milwaukee, WI 53204
01295	Texas Instruments Inc., Dallas, TX 75222
02660	Amphenol Connector Div., Bunker Ramo Corp., Broadview, IL 60153
02735	Solid State Div. RCA Corp., Somerville, NJ 08876
04618	American Pamcor Inc., Paoli, PA 19301
04713	Motorola Inc., Semiconductor Div., Phoenix, AZ 85008
06665	Precision Monolithic Inc., 1500 Space Park Drive, Santa Clara, CA 95050
07263	Fairchild Semiconductor, Mountain View, CA 94040
08717	Sloan Company, Sun Valley, CA 91352
09353	C & K Components Inc., Watertown, MA 02172
11236	CTS of Berne Inc., Berne, IN 46711
11237	CTS, Keen, Paso Robles, CA 93446
12463	Optronics Mfg., 2420 S. 60th St., Omaha, NE 68106
14158	AVX, Filters, 10080 Willow Creek Rd., San Diego, CA 92131
14298	American Components Inc., Conshohocken, PA 19428
14433	ITT Semiconductor Div., West Palm Beach, FL 33401
14455	Quality Hardware Mfg. Co., 12605 Daphine, Hawthorn, CA 90250
14655	Cornell Dubilier, Dept. 150, Ave. L, Newark, NJ 07101
18324	Signetics Corp., Sunnyvale, CA 94086
23880	Stanford Applied Engineering Inc., Santa Clara, CA 95050
23036	Pamotor Inc., Burlingame, CA 94010
24546	Corning Glass Works, Bradford, PA 16701
26654	Varadyne Ind., Santa Monica, CA 90404
27014	National Semiconductor Corp., Santa Clara, CA 95051
28480	Hewlett-Packard Co., Palo Alto, CA 94304
29990	ATC Div., Phase Ind., Huntington Station, NY 11746
34257	EIP Microwave Inc., Santa Clara, CA 95134
34649	Intel Corp., 3585 SW 198th Ave., Aloha, OR 97005
51406	Murata Corp. of America, 1148 Franklin Rd., Marietta, GA 30068
56289	Sprague Electric Co., North Adams, MA 01247
59660	Tusonix Inc., 2155 Forbes Bldg., Tucson, AZ 85705
70903	Belden Corp., Chicago, IL 60644
71590	Centralab Div., Globe-Union Inc., Milwaukee, WI 53201
72136	Electro Motive Corp., Sub. of Int. Elect. Corp., Florence, Santa Clara, CA 95050
72259	Nytronics Inc., Pelham Manor, NY 10803
72982	Erie Technological Products Inc., Erie, PA 16512
73445	Amperex Electronic Corp., Hicksville, NY 11802
80031	Mepco/Electra Inc., Morristown, NJ 07960
80740	Beckman Instruments Inc., Fullerton, CA 92634
81349	Military Specification
86797	Rogan Bros. Inc., Skokie, IL 60076
91637	Dale Electronics Inc., Columbus, NE 68601
95275	Vitramon Inc., Bridgeport, CT 06601
98291	Sealectro, Mamaroneck, NY 10544
99800	Delavan Div. American Precision Industries, East Aurora, NY 14052

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP