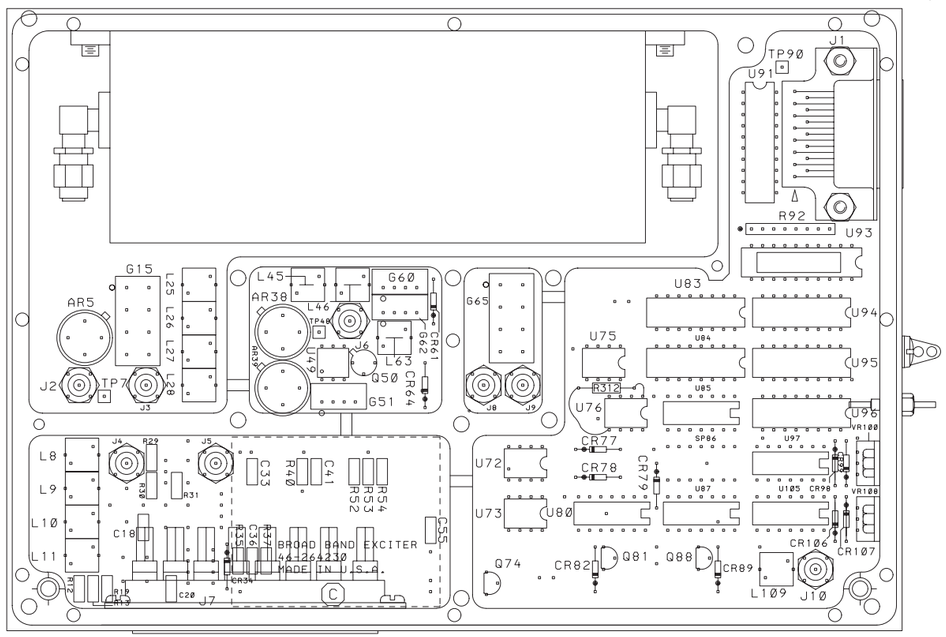
MR2 A15 A20 A3
BROADBAND EXCITER

46–264230G1–D, G2–E



Description

GENERAL ELECTRIC

46-264230-S
CONT ON SHEET 2 SH NO. 1

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING : -
APPLIED PRACTICES: 46-208600 | SURFACES: √ | TOLERANCES ON DIMENSIONS: DECIMALS (2 PLACES) | DECIMALS (3 PLACES) | ANGLES ± | REV AF | 46-264230-S | CONT ON SHEET 2 SH NO. 1

TITLE: SCHEMATIC DIAGRAM
BROADBAND EXCITER
FIRST MADE FOR MRSPEC_4.5

P/L ISSUED
46-264230G1-D
46-264230G2-E

THE REVISION NUMBER OF THIS SHEET IS THE CONTROL NUMBER OF THIS ENTIRE DOCUMENT. THIS REVISION NUMBER MUST INCREASE WHENEVER ANY SHEET IS CHANGED.

PCN #	171751	-	158733	158952	171127	171496
DATE / SHT	1JUN91	9FEB90	9MAR90	21JUN90	12SEP90	6MAR91
2	AE	AA	AB	AC	AC	AD

MA2 A15 A20 A3

SINE/TTL CONVERTER
+15V
C306 0.1
R305 220
J10 10 MHZ IN
C316 220
C308 0.01
Q88 2N3906
CR89
C317 680
L109 288
R307 10K
R295 910
R297 220
C296 0.1
74LS90 U105

10:1 DIVIDER

2:1 FREQ. DIVIDER
FREF 1 MHZ [2-B1]
FREF 0.5MHZ
U87 74LS92

190-270 MHZ VCO COURSE TUNE
Q74 78L05 +15V
C221 0.1
C33 0.1
C55 0.1
G192 Z-COMM VCO M1800081
C41 1000
R40 3.3K
R53 10
R54 300
R52 300

6dB DIRECTIONAL COUPLER
G173 TDC 6-1
G168 MD110

FINE TUNE MIXER
J4 66MHZ IN
R29 300
R30 10
R31 300
C152 2.2
C154 15
C156 10
C158 68
L8 6S
L9 4S
L10 4S
L11 11S
C151 22
C153 33
C155 36
C157 20
R13 10
R12 470

210 MHZ LP FILTER/66 MHZ NOTCH

TO DIGITAL EXCITER BOARD J1 SEL BBNDB
U80 HCT04
R234 100K

CR99 VR100 7805 CR98 C328 10UF 25V TP90 +18V IN +5V
CR107 VR108 7815 CR106 C318 10UF 25V TP48 TP7 +15V C331 10UF 25V

U96 MC 12013
R327 1K
C326 0.01
C330 0.01
R329 56

U94 LS193
U95 MC 12014
U83 MC 4018
C251 33
U84 MC 4018

J1 CTUNE0 CTUNE3 CTUNE5 CTUNE6 CTUNE7 CTUNE4 CTUNE2 CTUNE1
TO DIGITAL EXCITER BOARD
U91 HCT244
U93 27S29 PROM 512X8
R92 100K
R301 100K

DIVIDE BY N
(N = 380 TO 570)

TO DIGITAL EXCITER BOARD J1 L04-PRES

FREQUENCY/PHASE COMPARATOR
U97 MC4044
R271 5.6K
R230 5.6K
C265 1000
R215 5.6K
C216 0.01
U72 OPA-27
R276 5.6K
R278 5.6K
R272 5.6K
C273 0.01
C232 0.1
R231 22
C277 1000
CR78 CR77
R274 10K

LOOP AMPLIFIER AND FILTER
+5V
R233 100K
C236 0.1
U73 LM393
C275 0.01
C217 0.1
R218 68K
C220 0.1
R219 1K
R37 10K
C36 1000
SCHOTTKY CR34 HSCH-3486
R35 56
HCT04 U80
HCT04 U80

LOOP LOCK AMPLITUDE DETECT

AR160 UTO 222 +28dB GAIN BLOCK
AR159 UTO 561 +14dB GAIN BLOCK
C20 0.1
C18 0.1
R19 470
2dB ATTENUATOR
G169 TDC 6-1
G174 TDC 10-1
J5 BROADBAND SYNTH (L04) (+24dbm)
HL0 [2-F8]
16dB DIRECTIONAL COUPLERS

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS SURFACE MOUNT 1/8W, 5% AND ARE IN OHMS
CAPS-ALL FRACTIONAL VALUES - UF, ALL OTHERS-PF
ALL INDUCTORS ARE IN NH.
ALL DIODES ARE 1N4148
2. *INDICATES AN ACTIVE LOW.

REVISIONS				PRINTS TO	
AE	GT_6MAR91	AB	DLW_9MAR90	748	
PCN_171496		PCN_158733			
AF	DPB_1JUN91	AC	FEP_21JUN90		
PCN_171751		PCN_158952			
		AD	FEP_12SEP90		
		PCN_171127			

MADE BY F.PIERCE_16OCT89
ISSUED R.WEBB 9FEB90
APPROVALS RCR 9FEB90
MEDICAL SYSTEMS MILWAUKEE, WISCONSIN
46-264230-S CONT ON SHEET 2 SH NO. 1

MR2 A15 A20 A3

GENERAL ELECTRIC

46-264230-S
CONT ON SHEET - SH NO. 2

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING : -
APPLIED PRACTICES: 46-280680 | SURFACES: √ | TOLERANCES ON DIMENSIONS: DECIMALS (2 PLACES) | DECIMALS (3 PLACES) | ANGLES ±

REV AE
46-264230-S
CONT ON SHEET - SH NO. 2

TITLE SCHEMATIC DIAGRAM
BROADBAND EXCITER
FIRST MADE FOR MRSPEC_4.5

P/L ISSUED

LOOP AMPLIFIER AND FILTER

120 MHZ VCO

10dB DIRECTIONAL COUPLER

6dB ATTENUATOR

DEVICES SHOWN TOP VIEW

LM393

MC4018 MC12014 74LS193

C302 ,C303, C320,C325

74HCT244 27S29

C300,C319

MC12013

C309

74LS90 74LS92

C298,C315

C285 ,C304, C310

MC4044 74HCT04

MC12019

7805 7815

U310

+DC AR2 UTO561 UTO222 PA2

MD110 MD138

T9-1

TDC6-1 TDC10-1 TSC2-1

Z-COMM
1 GND
2 +15
3 VC
4 FR OUT
5 +15
6 +5VDC
7 GND
8 GND

78L05

2N3906

HCT04

UNUSED GATE

12dB GAIN BLOCK

10dB GAIN BLOCK

[1-A8] FREF 1 MHZ

U87 74LS92 DIVIDE BY 6

U85 MC4044 FREQUENCY/PHASE COMPARATOR

U75 OPA-22

U49 T9-1

G51 TDC 10-1

AR39 PA2

AR38 UTO 561

U76 MC12019 DIVIDE BY 20 ECL

Q81 2N3906

CR82

CR84 MV104

Q50

U310

L63 85

CR79

R280 1K

ECL TO TTL CONVERTER

120 MHZ BANDPASS FILTER

L45 110

L46 110

10dB DIRECTIONAL COUPLER G60 TDC 10-1

J6 120MHZ(L03) (+21dbm)

FOR G1: 46-301880P1
FOR G2: 46-301880P2

117.5 BANDPASS FILTER
K&L 4C20-117.4/1.25-EO/EO
G353

J9 J2

G65 MD 110

AR5 A82

G15 2,4,5,6 MD138

22dB GAIN BLOCK

J8 2.5MHZ IN

86MHZ LO-PASS FILTER

J3 9-86 MHZ OUT

L03-PRES

J1 TO DIGITAL EXCITER BOARD

U80

U73 LM393

SCHOTTKY CR61 HSCH-3486

G62 TSC 2-1

3dB SPLITTER

LLO

[1-F10] HLO

LOOP LOCK AND AMPLITUDE DETECT

LOW LOCAL OSCILLATOR MIXER

HIGH LOCAL OSCILLATOR MIXER

10dB ATTENUATOR

REVISIONS				PRINTS TO	
AE	DPB_1JUN91	AB	DLW_9MAR90	740	
PCN_171751			PCN_158733		
		AC	FEP_21JUN90		
			PCN_158952		
		AD	GT_6MAR91		
			PCN_171496		

MADE BY F.PIERCE_16OCT89
ISSUED R.WEBB_8FEB90

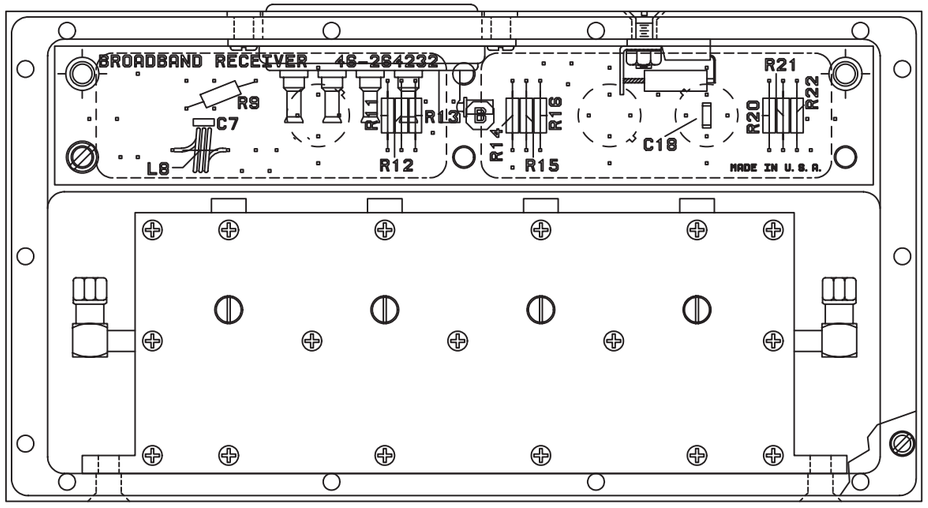
APPROVALS RCR 9FEB90

MEDICAL SYSTEMS — MILWAUKEE, WISCONSIN

46-264230-S
CONT ON SHEET - SH NO. 2

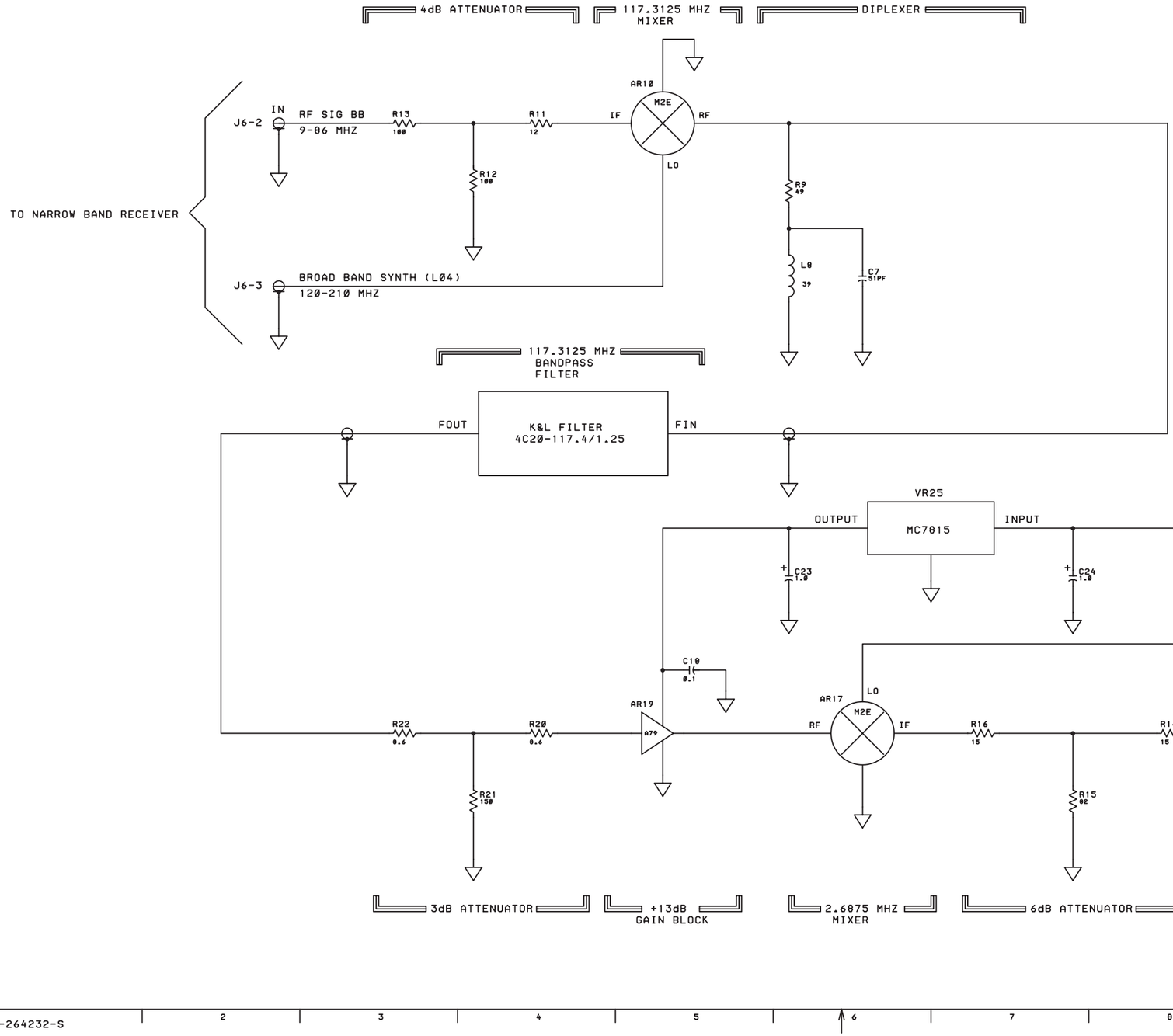
MR2 A15 A18 A3
BROADBAND RECEIVER

46–264232G1–B, G2–B



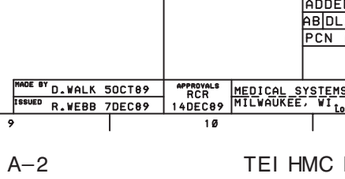
Description

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-
APPLIED PRACTICES
46-208600
REV AB
46-264232-S
CONT ON SHEET - SHT NO. 1
TITLE
SCHEMATIC DIAGRAM
BROADBAND RECEIVER
FIRST MADE FOR MR SYS CA4
46-264232-S
CONT ON SHEET - SHT NO 1
46-26423261-B
46-26423262-B



GAIN ADJUSTMENT CHART			
ATTENUATION -dB	R20	R21	R22
0	JUMPER	OPEN	JUMPER
1	JUMPER	470 OHMS	6.2 OHMS
2	6.2 OHMS	220	6.2
3	9.1	150	9.1
4	12	100	12
5	12	82	15
6	15	68	18
7	18	56	22
8	22	47	22
9	24	39	24
10	27	36	27

DEVICES SHOWN TOP VIEW:



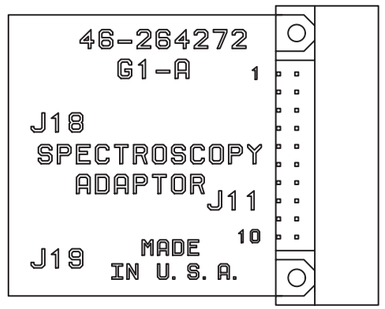
NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE 0.25W, 1%
   AND ARE IN OHMS.
   ALL CAPACITORS ARE IN MFD.
   ALL INDUCTORS ARE IN nH.

REVISIONS			PRINTS TO
NR	DLW 19JAN90	740	
	ADDED G2		
AB	DLW 30MAR90		
	PCN 158784		

MADE BY	APPROVALS	DIV OR DEPT	
D.WALK 5OCT89	RCR 14DEC89	MEDICAL SYSTEMS	46-264232-S
ISSUED R.WEBB 7DEC89		MILWAUKEE, WI. LOCATION	CONT ON SHEET - SHT NO. 1

MG2 A16 A6
MG2 A16 A7 A3
SPECTROSCOPY ADAPTOR

46–264272G1–A



Description

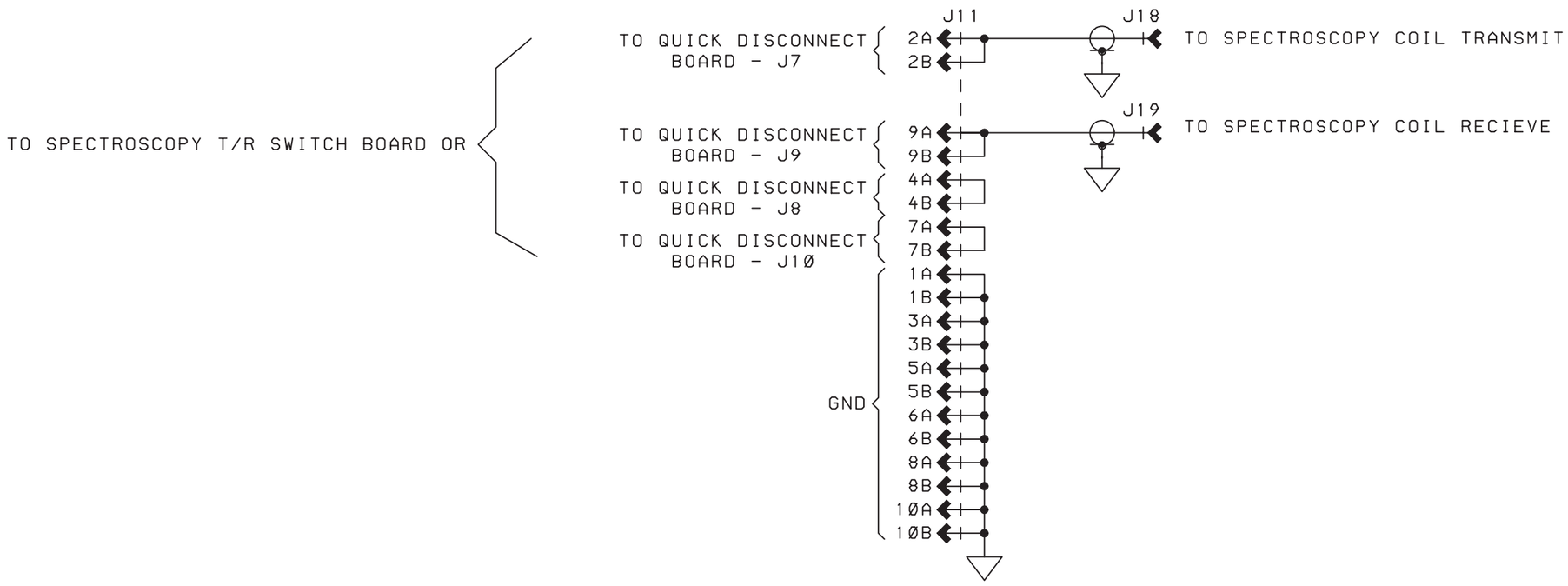
DRAWING NO. 46-264272-S SHT NO. 1 CONT ON SHEET -

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-	REV AB	TITLE
APPLIED PRACTICES 46-208600	46-264272-S CONT ON SHEET - SHT NO. 1	SCHEMATIC DIAGRAM SPECTROSCOPY ADAPTOR FIRST MADE FOR SPECTROSCOPY COIL QUICK DISCONNECT

46-264272-S
CONT ON SHEET - SHT NO 1

MG2A16A6
MG2A16A7A3

46-264272G1-A



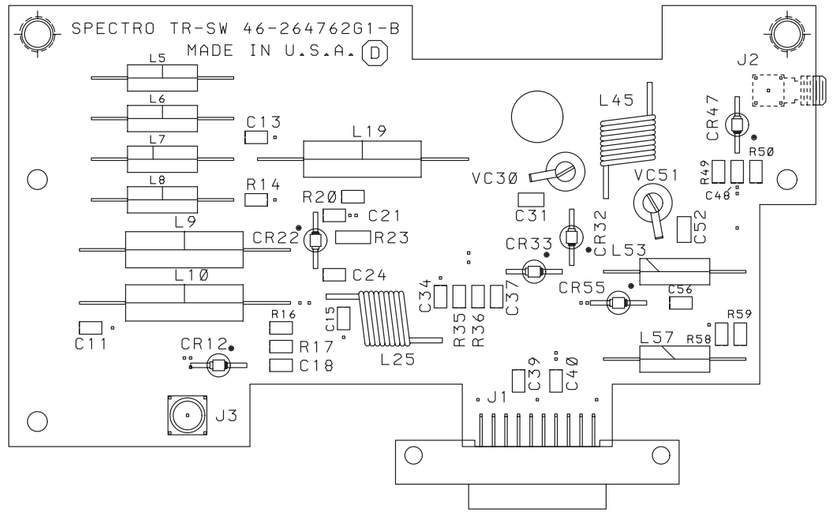
REVISIONS		PRINTS TO	
AB	DPB 24OCT9Ø	74Ø	
	PCN 171248		

MADE BY	APPROVALS	DIV OR DEPT	
R. LISOWSKI 1ØJUN87	RCR 27JUL87	MEDICAL SYSTEMS	46-264272-S
ISSUED B. AHONEN 14JUL87		MILWAUKEE, WI. LOCATION	CONT ON SHEET - SHT NO. 1

46-264272-S

MG2 A16 A7 A2
SPECTRO T/R SWITCH

46–264762G1–B



Description

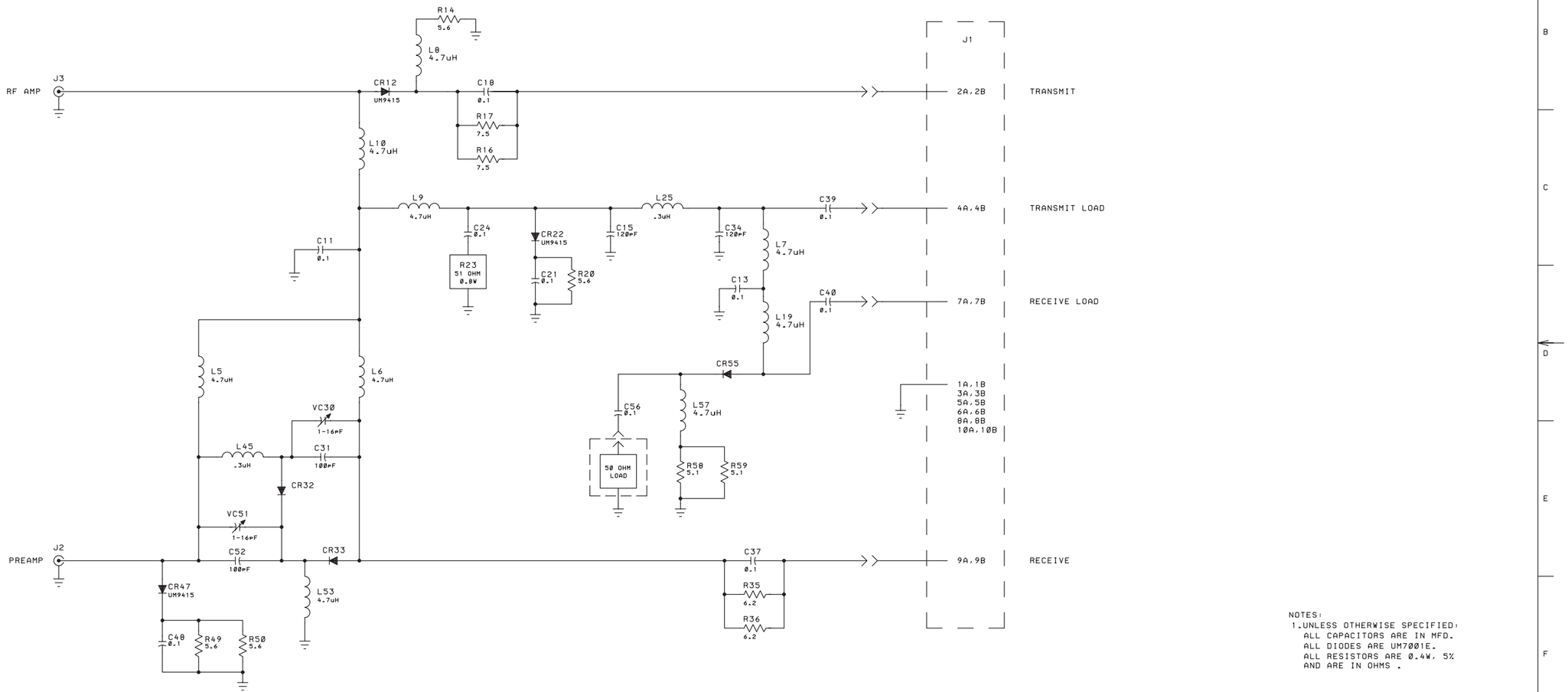
DRAWING NO. 46-264762-S CONT ON SHEET - SHT NO. 1

MG2 A16 A7 A2

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-	REV AC	TITLE
APPLIED PRACTICES 46-208600	46-264762-S CONT ON SHEET - SHT NO. 1	SCHEMATIC DIAGRAM SPECTRO T/R SWITCH
		FIRST MADE FOR MR SPECT 4.5

46-264762-S CONT ON SHEET - SHT NO 1

46-264762G1-B



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITORS ARE IN MFD.
   ALL DIODES ARE UM7001E.
   ALL RESISTORS ARE 0.4W, 5%
   AND ARE IN OHMS .

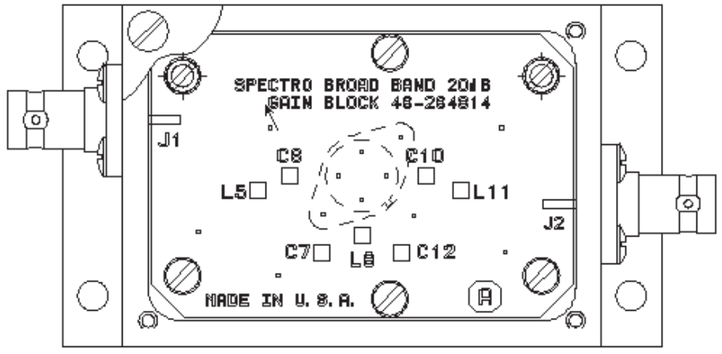
REVISIONS		PRINTS TO
B	DLW 12JUN89	740
	GEN. CHNGS.	
AB	DLW 20FEB90	
	PCN 158677	
AC	FEP 12FEB91	
	PCN 171522	

MADE BY G.TESKE 17MAY89	APPROVALS RCA 20OCT89	DIV OR DEPT MEDICAL SYSTEMS 46-264762-S
ISSUED R.BECERRA 18OCT89		LOCATION MILWAUKEE, WI. CONT ON SHEET - SHT NO. 1

TEI HMC IET/IO HREROOHE T

PP1 A13
SPECTRO BROADBAND 20dB GAIN BLOCK

46–264814G1–A

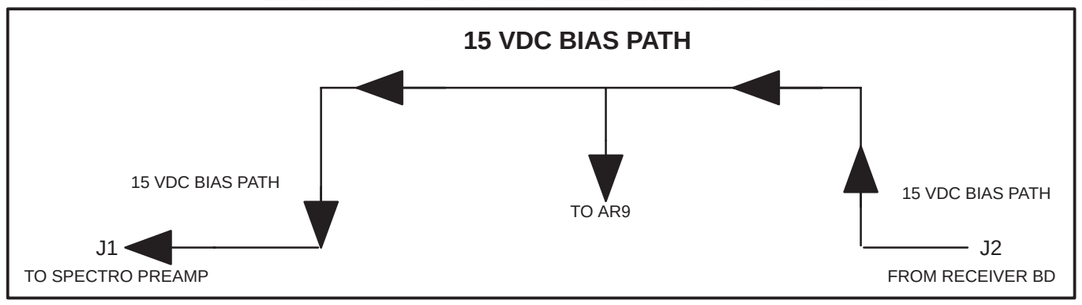


Description

The Spectroscopy BroadBand 20 dB Gain Block was designed to augment receive channel gain from the RF Preamp to the RF Receiver. Located at the Penetration Panel it provides roughly 20 dB of signal ammplification at all frequencies of multinuclear interest while ensuring a total noise figure of less than 1 dB for the composite receive channel. In general, the +15 VDC bias applied to port J2 (Output) enables the active device for proper RF operation over the frequency range. Capacitors C6 and C10 accomplish DC blocking at the input and output of the device while inductors L5, L8, and L11 act as RF chokes. Capacitors C7 and C12 route any residual RF in the DC bypass path to ground. This configuration bridges the DC supply from ports J2 (Output) to J1 (Input) so as to supply DC current to the preamp.

As a continuity check with no bias applied, the DC resistance at ports J1 and J2 to Ground (common) should be observed infinite (1 to 10 Megaohms). The resistance measured through the device, J1 center conductor to J2 center conductor, should be observed at 4 to 6 ohms.

EXPLANATION OF +15 VDC PATH FROM RECEIVER BD. TO SPECTRO PREAMP



DRAWING NO. 46-264814-S SHT NO. 1 CONT ON SHEET -

PP1 A13

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-

APPLIED PRACTICES

REV A EAA

46-264814-S

CONT ON SHEET - SHT NO. 1

GENERAL ELECTRIC

46-264814-S

CONT ON SHEET - SHT NO 1

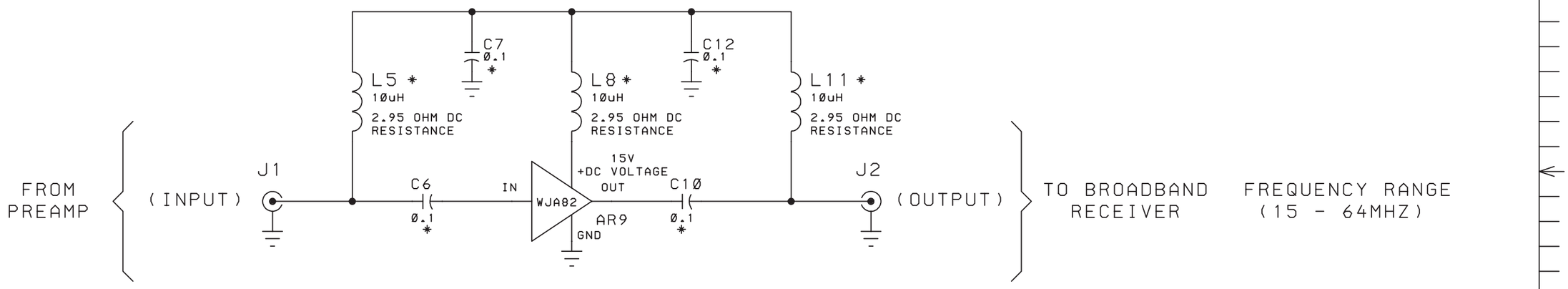
TITLE

SCHEMATIC DIAGRAM
SPECTRO BROAD BAND 20dB GAIN BLOCK

FIRST MADE FOR MR

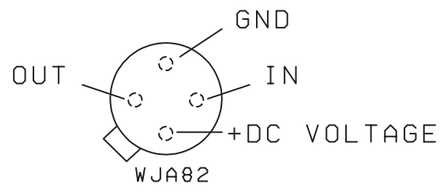
P/L ISSUED

46-264814G1-A



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITORS ARE IN MFD.
2. "*" INDICATES SURFACE MOUNTED
   COMPONENT.

ALL DEVICES SHOWN TOP VIEW



REVISIONS	PRINTS TO	
	740	

MADE BY G. TESKE 18MAR89

ISSUED

APPROVALS

MEDICAL SYSTEMS DIV OR DEPT
MILWAUKEE, WI. LOCATION

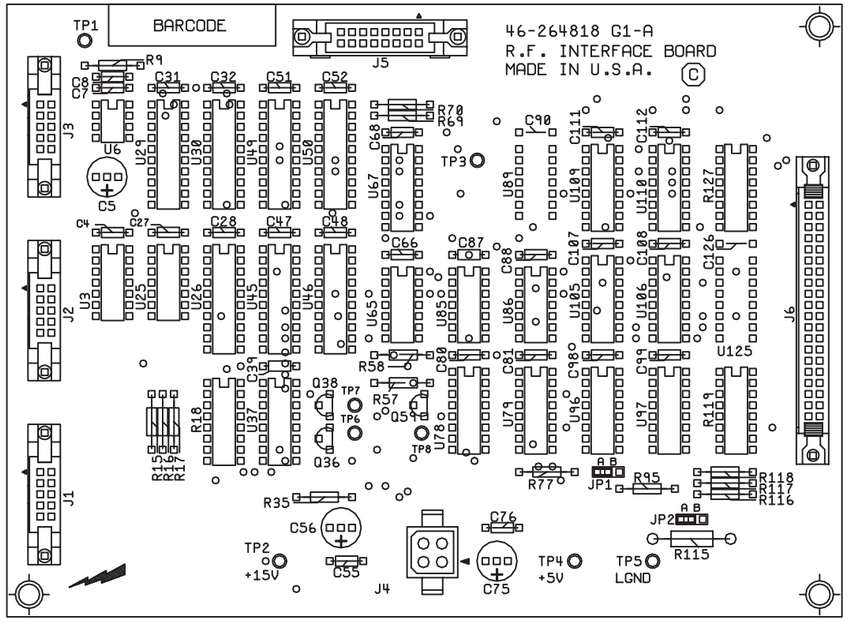
46-264814-S

CONT ON SHEET - SHT NO. 1

TEI HMC IET/IO HREROOHE T

MR6 A2 A4
RF INTERFACE

46–264818G1–C



Description

The RF Interface Board connects to a bi–directional communication (Bicycle) link via connector J6. The RF Interface Board serves as an interface that controls/monitors the Spectroscopy amplifier when commanded by the host computer and it links up with the power monitor to inhibit the Spectroscopy amplifier output in the event an unsafe condition is detected. This board communicates with the power monitor by sending an echo of the Unblank signal. If the unsafe condition is detected an Rflock signal is transmitted to the RF Interface Board which in turn generates a shutdown signal to inhibit the amplifier output. As long as the shutdown signal is not cleared, the Unblank signal will remain inhibited from being applied to the amplifier.

J1 — connects to the band selectable filter (Fist1rtn, Fist2rtn, Fist3rtn, +15 VDC)
J2 — connects to the Power Monitor (Ublks*–p/n, Rflck–p/n, Rflck*–p/n)
J3 — connects to the dynamic disable board (UBLNS*–P/N)
J4 — connects to the power supply (+5 VDC, +15 VDC, Common)
J5 — connects to the BroadBand RF Amplifier
J6 — connects to the bi–directional Bicycle link

GENERAL ELECTRIC
46-264818-S
CONT. ON SHEET 2 SH NO.1
UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING : -
APPLIED PRACTICES: 46-280680 | SURFACES: ✓ | TOLERANCES ON DIMENSIONS: DECIMALS (2 PLACES) ± | DECIMALS (3 PLACES) ± | ANGLES ±
REV AD
46-264818-S
CONT. ON SHEET 2 SH NO. 1
TITLE SCHEMATIC DIAGRAM
RF_INTERFACE_BOARD
FIRST MADE FOR SPECTROSCOPY_AMPLIFIER
P/L ISSUED
46-264818G1-C

MAG A2 A4

ADDRESS DECODING

FROM CPS (GRADIENT CAB)

J6
17 ADR0-P
18 ADR0-N
19 ADR1-P
20 ADR1-N
21 ADR2-P
22 ADR2-N
23 ADR3-P
24 ADR3-N
32 READ*-N
31 READ*-P
35 STRB0*-P
36 STRB0*-N
27 STRB1*-P
28 STRB1*-N
1 DAT0-P
2 DAT0-N
3 DAT1-P
4 DAT1-N
5 DAT2-P
6 DAT2-N
7 DAT3-P
8 DAT3-N
9 DAT4-P
10 DAT4-N
11 DAT5-P
12 DAT5-N
13 DAT6-P
14 DAT6-N
15 DAT7-P
16 DAT7-N

R119 10K RST16BU (1–16)
R127 10K RST16BU (1–16)
R95 4.7K
R118 4.7K
R117 4.7K
R116 4.7K
U97 26LS32
U96 26LS32
U106 26LS32
U110 26LS32
ADR0
ADR1
ADR2
ADR3
READ
STRB0*
STRB1*
LGND
BD-WR*

R77 10K +5V ENHI
U79 HCT138 → WR-01H* [2-B3], WR-03H* [2-F7]
U78 HCT138 → RD-01H* [2-B5], RD-02H* [2-D3], RD-03H* [2-F9]
U86 LS32 → RDORSTB*
U85 LS04
U65 LS08 → BD-RD
JP1 A/B
U86 LS32 → STRB*
U85 LS04 → STRB
U105 3487 → DAT0-P DAT0-N DAT1-P DAT1-N DAT2-P DAT2-N DAT3-P DAT3-N
U109 3487 → DAT4-P DAT4-N DAT5-P DAT5-N DAT6-P DAT6-N DAT7-P DAT7-N
BD-RD
DAT0-DAT7 [2-A2]

R70 1K +5V
U67 3487 → UBLKS*-P J2 pin 1, UBLKS*-N J2 pin 2 (TO POWER MONITOR)
[2-H8] UBLKS*
ACK*-P J6 pin 33, ACK*-N J6 pin 34 (TO CPS (GRADIENT CAB))
ENBL

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE 0.25W, 5%
   AND ARE IN OHMS
   ALL CAPACITORS ARE IN MFD
   ALL INVERTERS ARE 1N7404
   ALL DIODES ARE 1N4148
2. * INDICATES AN ACTIVE LOW.

THE REVISION NUMBER OF THIS SHEET IS THE CONTROL NUMBER OF THIS ENTIRE DOCUMENT. THIS REVISION NUMBER MUST INCREASE WHENEVER ANY SHEET IS CHANGED.

SHT \ DATE	24JUL89	21SEP89	16JAN90	27FEB90	31DEC90	
PCN #	-	-	158492	158687	171340	-
2	A	AA	AB	AC	AD	-

REVISIONS			PRINTS TO
AB	GJO____16JAN90		740
	PCN__158492		
AC	FEP____27FEB90		
	PCN__158687		
AD	FEP____31DEC90		
	PCN__171340		

DRAWN BY R.MARIOLIA
ISSUED R.MARIOLIA__22SEP89
APPROVALS RCR 9/26/89
MEDICAL SYSTEMS MILWAUKEE, WISCONSIN
46-264818-S CONT. ON SHEET 2 SH. NO. 1

GENERAL ELECTRIC

46-264818-S
CONT. ON SHEET - SH NO. 2

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING : -
APPLIED PRACTICES: 46-208680 | SURFACES: ✓ | TOLERANCES ON DIMENSIONS: DECIMALS (2 PLACES) ± | DECIMALS (3 PLACES) ± | ANGLES ±

REV AD
46-264818-S
CONT. ON SHEET - SH NO. 2

TITLE SCHEMATIC DIAGRAM
RF_INTERFACE_BOARD
FIRST MADE FOR SPECTROSCOPY_AMPLIFIER
P/L ISSUED

MAG A2 A4

COMMAND REGISTER

DAT0-DAT7

[1-F9]

U26 LS273 (D0-D7, Q0-Q7, CLR, CK)

DAT0 DAT1 DAT2 DAT3 DAT4 DAT5 DAT6 DAT7

PWRON
FLTRST
FILSTG1
FILSTG2

WR-01H* [1-A7]

RESET*

U45 HCT244

AD-01H* [1-A10]

POWER ON RESET

+5V
A9 1K
TP1
RESET*
TL770SA U6 (CT, SENSE, REF, RESIN*, RST, RST*)
C5 33 35V
C8 0.1 50V

CPS (GRADIENT CAB)
J6 37
BPW48
JP2
R115 100 .5W
J5 12

+5V
R58 1K

U46 HCT244

SHTDWN
UBLKS

J5
ACON
FAULTRST
PWRSHDWN
UBLANKS
SPECTROSCOPY RF AMPLIFIER

TP7
FIST1RTN
J1
Q38 VN0300M

TP6
FIST2RTN
Q36 VN0300M

BAND SELECTABLE FILTER

+15V
+15V
+15V
TP8
FIST3RTN
Q59 VN0300M

U3 LS86
U25 LS08
U86 LS32
U85 LS04

SPARES
+5V
R57 10K
U65 LS08
U25 LS08
U25 LS08
U3 LS86
U3 LS86
U3 LS86

UNUSED GATES
R18 4.7K
RST16B
R18 4.7K
RST16B

AMP STATUS REGISTER

J5
BROAD BAND RF AMPLIFIER
FLT
DUCYFLT
PUWIFLT
OVHFLT
BIASON*
ACONRDBK
SHTDWN
+5V
R69 10K

U50 HCT244
U49 HCT244
DAT0 DAT1 DAT2 DAT3 DAT4 DAT5 DAT6 DAT7

[1-A10] RD-02H*

TEST REGISTER

PWRONRD

U30 LS273 (D0-D7, Q0-Q7, CLR, CK)
DAT0 DAT1 DAT2 DAT3 DAT4 DAT5 DAT6 DAT7

WR-03H* [1-B7]
RESET*
RD-03H* [1-B10]

U29 HCT244

TP3
UBLKS
U65 LS08
U85 LS04
UBLKS* [1-D8]

J2
TO POWER MONITOR
RFLCK-P
RFLCK-N
RFLCK*-N
RFLCK*-P
R15 120
R17 120
R18 4.7K
RST16B

U37 26LS32

U89 LS32
U86 LS32
U85 LS04
SHTDWN1

J3
FROM DYNAMIC DISABLE
UBLNS*-P
UBLNS*-N
R16 120
R35 10K

J4
POWER SUPPLY
C75 33 35V
C76 0.1 50V
C99,C98,C81,C80,C112,C111,C107,C108,C68,C52,C51,C32,C31,C48,C47,C90 17
C28 0.1 50V
C88,C87,C66,C4 C7,C39,C27 8
C56 22 35V
C55 0.1 50V
TP2 +15V
TP4 +5V
TP5

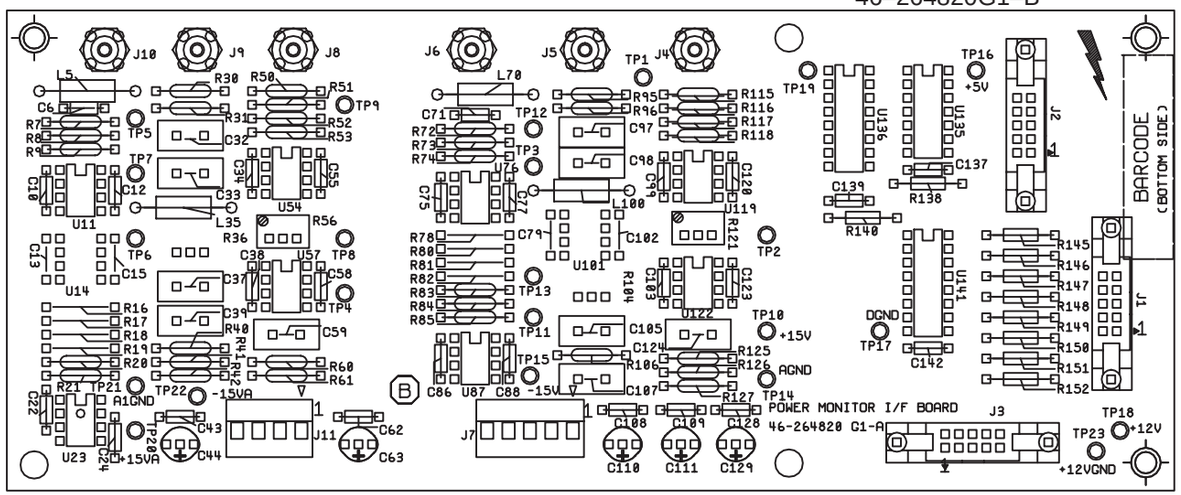
DEVICE CODES
LS32 LS04 LS08
26LS32 ACT138 3487
HCT244 LS273
TL770SA

REVISIONS			PRINTS TO
	AB	GJO...16JAN90	740
		PCN...158492	
	AC	FEP...27FEB90	
		PCN...158687	
	AD	FEP...31DEC90	
		PCN...171340	

DRAWN BY R.TARALIA
ISSUED R.TARALIA...16JAN90
APPROVALS ACH 26/9/89
MEDICAL SYSTEMS MILWAUKEE, WISCONSIN
46-264818-S
CONT. ON SHEET - SH. NO. 2

MR1 A3 A7
POWER MONITOR I/F

46–264820G1–B



Description

Note

FMI 60420 REMOVES THIS BOARD (M1040FF) ONLY.

GENERAL ELECTRIC

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING : -
APPLIED PRACTICES 46-200600 | SURFACES ✓ | TOLERANCES ON DIMENSIONS: DECIMALS (2 PLACES) ± | DECIMALS (3 PLACES) ± | ANGLES ±

REV AB
46-264820-S
CONT. ON SHEET 2 SH NO. 1

TITLE SCHEMATIC DIAGRAM
POWER-MONITOR-I/F
FIRST MADE FOR MR-SPECT-4.5
P/L ISS
46-2648

MR1 A3 A7

FROM BROAD BAND RF CABINET

J4 TP1 R116 36.5 "1%" 0.25W R115 150 "1%" 0.25W R117 37.5 "1%" 0.25W AGND
R13 10K "0.1%" 0.25W R14 10K "0.1%" 0.25W R15 10K "0.1%" 0.25W R16 10K "0.1%" 0.25W
U119 LT 1007
TP2 R121 20K 0.5W CW R118 2.43K "1%" 0.25W
R83 10K "1%" 0.25W R84 4.99K "1%" 0.25W
R85 10K "1%" 0.25W TP11
U87 LT 1007
R73 10K "0.1%" 0.25W
R72 1K "0.1%" 0.25W R74 10K "0.1%" 0.25W
U76 LT 1007
L70 10 UH C71 0.1 50V R26 1K "0.1%" 0.25W
TP12 J6
TO ANALOG SENSE BD (POWER MONITOR)

FROM NARROW BAND RF CABINET

J5 TP3 L100 10 UH R95 2.8K "1%" 0.25W R96 100 "1%" 0.25W C97 150PF 500V C98 51pf 500V C105 51pf 500V R106 100 "1%" 0.25W C107 150PF 500V R127 2.8K "1%" 0.25W DGND
U122 LT 1007
C124 5PF 500V R126 90.9K "1%" 0.25W R125 10K "1%" 0.25W
TP13

+15V TP10 J7 C129 10UF "20%" 35V C120 0.01UF 50V C128 0.01UF 50V C123 0.01UF 50V C88 0.01UF 50V C77 0.01UF 50V TP14 DGND AGND
-15V C111 10UF "20%" 35V C99 0.01UF 50V C109 0.01UF 50V C103 0.01UF 50V C86 0.01UF 50V C75 0.01UF 50V TP15 -15V
+5V TP16 C110 10UF "20%" 35V C100 0.01UF 50V C137 0.01UF 50V C139 0.01UF 50V C142 0.01UF 50V TP17 DGND

FROM BROAD BAND RF CABINET

J8 TP9 R51 36.5 "1%" 0.25W R50 150 "1%" 0.25W R52 37.5 "1%" 0.25W AGND
R17 10K "0.1%" 0.25W R18 10K "0.1%" 0.25W R19 10K "0.1%" 0.25W R25 10K "0.1%" 0.25W
U54 LT 1007
TP8 R56 20K 0.5W CW R53 2.43K "1%" 0.25W
R21 10K "1%" 0.25W R42 4.99K "1%" 0.25W
R20 10K "1%" 0.25W TP6
U23 LT 1007
R7 10K "0.1%" 0.25W
R8 1K "0.1%" 0.25W R9 10K "0.1%" 0.25W
U11 LT 1007
L5 10 UH C6 0.1 50V R27 1K "0.1%" 0.25W
TP5 J10
TO ANALOG SENSE BD (POWER MONITOR)

FROM NARROW BAND RF CABINET

J9 TP7 L35 10 UH R30 2.8K "1%" 0.25W R31 100 "1%" 0.25W C32 150PF 500V C33 51pf 500V C37 51pf 500V R41 100 "1%" 0.25W C39 150PF 500V R40 2.8K "1%" 0.25W AGND
U57 LT 1007
C59 5PF 500V R60
TP4

+15VA TP20 J11 C44 10UF "20%" 35V C12 0.01UF 50V C24 0.01UF 50V C58 0.01UF 50V C43 0.01UF 50V C55 0.01UF 50V TP21 A1GND
-15VA TP22 C63 10UF "20%" 35V C10 0.01UF 50V C22 0.01UF 50V C38 0.01UF 50V C62 0.01UF 50V C34 0.01UF 50V

8=2

THE REVISION NUMBER OF THIS SHEET IS THE CONTROL NUMBER OF THIS ENTIRE DOCUMENT. THIS REVISION NO MUST INCREASE WHENEVER ANY SHEET IS CHANGED.

SHT \ DATE	PCN #	-	-	158779	-
2	A	11-10-89	11-10-89	1MAY90	-
	A	AA	AB	-	

GENERAL ELECTRIC

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING : -						
APPLIED PRACTICES	SURFACES	TOLERANCES ON DIMENSIONS			REV A	TITLE SCHEMATIC DIAGRAM
46-200600	✓	DECIMALS (2 PLACES) ±	DECIMALS (3 PLACES) ±	ANGLES ±	46-264820-S	POWER-MONITOR-I/F
					CONT. ON SHEET - SH NO. 2	FIRST MADE FOR MR-SPECT-4.5
						P/L ISS

TO BROAD BAND RF CABINET

J1
1 UBLKS⌀-P
2 UBLKS⌀-N
3 RFLCK-P
4 RFLCK-N
7 RFLCK⌀-P
8 RFLCK⌀-N

R151 120 "5%" 0.25W
R152 4.7K "5%" 0.25W
R150 4.7K "5%" 0.25W
R147 4.7K "5%" 0.25W
R146 120 "5%" 0.25W
R145 4.7K "5%" 0.25W
R148 10K "5%" 0.25W
R149 10K "5%" 0.25W

U141 26LS32
U135 LS08

TP19

U136 3487
IN1 IN2 IN3 IN4
OUT1 OUT2 OUT2 OUT3 OUT3 OUT4 OUT4
EN A/B EN C/D

R140 1K "5%" 0.25W

+5V

J3
1 UBLK⌀-P
2 UBLK⌀-N
3 RFLCK-P
4 RFLCK-N
7 RFLCK⌀-P
8 RFLCK⌀-N
9 +12V
5 +12VGND

TO CONTROL BOARD (POWER MONITOR)

TP23
TP18

TO NARROW BAND RF CABINET

J2
1 UBLKI⌀-P
2 UBLKI⌀-N
3 RFLCK-P
4 RFLCK-N
7 RFLCK⌀-P
8 RFLCK⌀-N
9 +12V
5 +12VGND

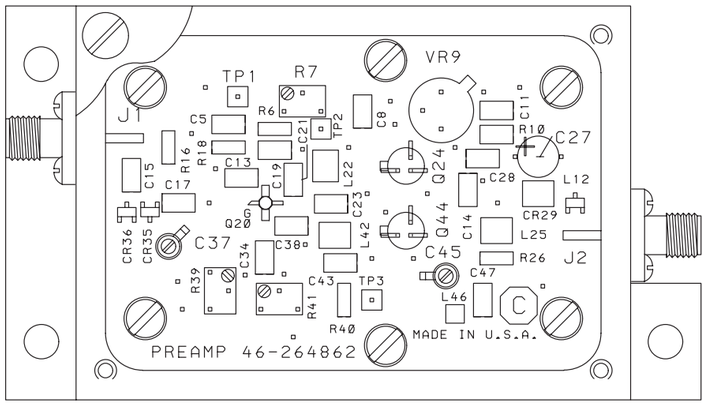
R138 1K "5%" 0.25W

U135 LS08

+15V +5V +5V

MG2 A16 A7 A2
SPECTROSCOPY PREAMP (Phosphorus)

46–264862G1–B



Description

The preamp provides the first stage of amplification for the MR signal in the receive path. The preamp is part of the Spectroscopy TR Module which is placed at the front of the head carriage slide trolley when Multinuclear BroadBand scanning is selected. The J2 RF output port of the preamp requires +15 VDC, +/– 10% @ 100 mAmps. The +15 VDC preamp bias originates in the Systems Cabinet TPS Power Supply and is supplied to the Receiver Board and BB Receiver Module via the backplane. The Spectroscopy AUX port preamp bias will measure +15 VDC after a Broad-Band Spectroscopy protocol is selected and pulsed once. The spectroscopy preamp bias is sent down the selected AUX receive coaxial cable to power the 20 dB gain block and the preamp. The total nominal gain of the preamp is +35 dB, +/– 3 dB, this gain can be measured by injecting an RF signal at the specified frequency with a maximum level of –10 dBm (nominally this is –30 dBm). The noise figure should be less than 0.5 dB.

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-

APPLIED PRACTICES
46-208600

REV AB
46-264862-S
CONT ON SHEET - SHT NO. 1

TITLE
SCHEMATIC DIAGRAM
SPECTROSCOPY PREAMP (PHOSPHORUS)
FIRST MADE FOR MR

46-264862-S
CONT ON SHEET - SHT NO 1

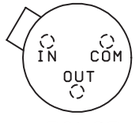
MG2A16A7 A2

46-264862G1-B

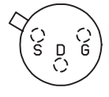
0.35 TO 0.4 VDC
V_D ADJUST
TP2
TP1
V_D ADJUST
R6 10 *
R7 200 0.5W
CW
VR9 78L05
OUT
IN
COM
R10 100 400MW
C5 0.01 *
C8 0.01 *
C11 0.01 *
C28 0.01 *
C27 10 25V
L12 10uH *
MAXIMUM RESISTANCE DC - 8.1 OHMS
L22 10uH *
MAXIMUM RESISTANCE DC - 8.1 OHMS
OPERATING FREQUENCY (25.8 MHZ)
I_D
V_D
Q24 U310 *
G
S
D
I_{DT}
MAXIMUM RESISTANCE DC - 8.1 OHMS
L25 10uH *
R26 910 *
CR29 MMBD201 *
J2 OUTPUT
TO 20 DB GAIN BLOCK
C23 0.01
C21 120PF *
C17 20PF *
C37 0.8-8PF 500V *
Q20 * FSC10LF/FA
J1 INPUT
FROM T/R SWITCH
C15 0.01 *
INPUT TUNING
R16 51K *
CR35 MMBD201 *
CR36 MMBD201 *
L48 1.5uH 0.01 OHM DC RESISTANCE
C13 0.01
C19 0.01
R18 100
I_D ADJUST
R39 200 0.5W
CW
C34 0.01
C38 0.01
L42 10uH *
MAXIMUM RESISTANCE DC - 8.1 OHMS
Q44 U310 *
C45 0.8-8PF 500V *
OUTPUT TUNING
C14 20PF *
L46 1.2uH * 2 OHM DC RESISTANCE
C47 0.01 *
I_{DT} ADJUST
R41 200 0.5W
CW
C43 0.01 *
TP3
0.3 VDC
I_{DT} ADJUST
R40 10 *

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS AND ARE 0.125W, 5%.
   ALL CAPACITORS ARE IN MFD AND ARE 50V, 10%.
2. "*" INDICATES SURFACE MOUNTED COMPONENT.

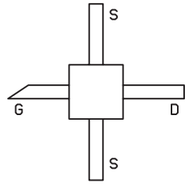
ALL DEVICES SHOWN TOP VIEW



78L05



U310



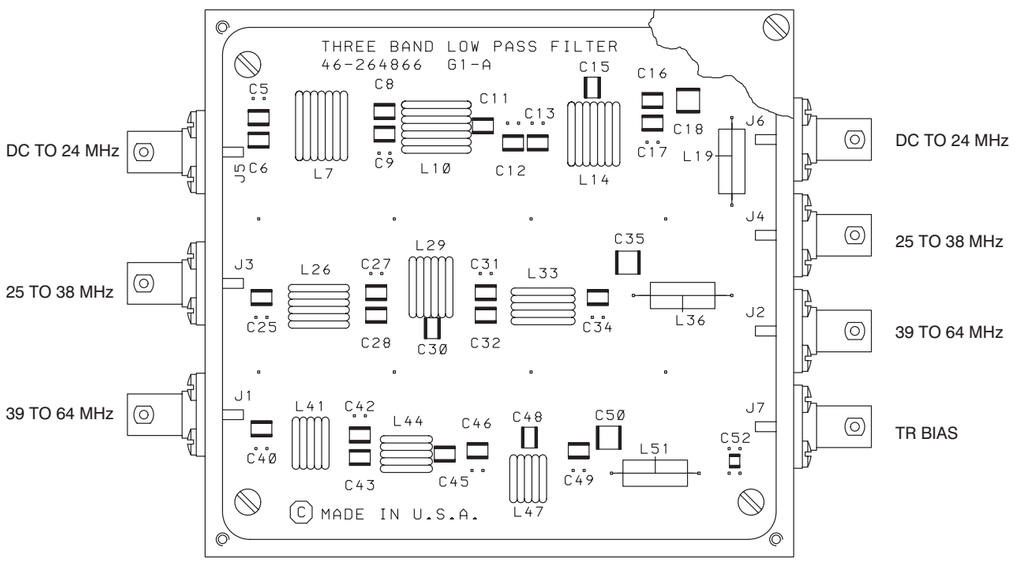
FSC10LF/FA

REVISIONS		PRINTS TO	
AB DLW 16FEB90		740	
PCN 158690			

MADE BY	APPROVALS	DIV OR DEPT	
G.TESKE 7MAR89	RCR 4MAY89	MEDICAL SYSTEMS	46-264862-S
ISSUED R.BECERRA 2MAY89		MILWAUKEE, WI. LOCATION	CONT ON SHEET - SHT NO. 1

MR6 A2 A2
THREE BAND LOW PASS FILTER

46–264866G1–B



Description

The Three Band Low Pass Filter is used to remove the harmonics at the output of the Spectroscopy RF Amplifier. The Three Band Low Pass Filter has three independent low pass filters. A set of relay switches select which of the three frequency bands the RF will pass through.

The first band (25 MHz) has input J5 and output J6. The loss within the pass–band (DC to 24 MHz) is ≤ 0.25 dB. The stop–band has a minimum attenuation of 40 dB for frequencies greater than 50 MHz.

The second band (40 MHz) has input J3 and output J4. The loss within the pass–band (DC to 38 MHz) is ≤ 0.25 dB. The stop–band has a minimum attenuation of 40 dB for frequencies greater than 80 MHz.

The third band (64 MHz) has input J1 and output J2. The loss within the pass–band (DC to 64 MHz) is ≤ 0.25 dB. The stop–band has a minimum attenuation of 40 dB for frequencies greater than 130 MHz.

The remaining connector J7 is used to introduce the DC bias for the Spectroscopy TR Module and coil. This DC bias originates in the RF Cabinet as the Spectro TR Bias signal and is controlled by the unblank signal.

MAG A2 A2

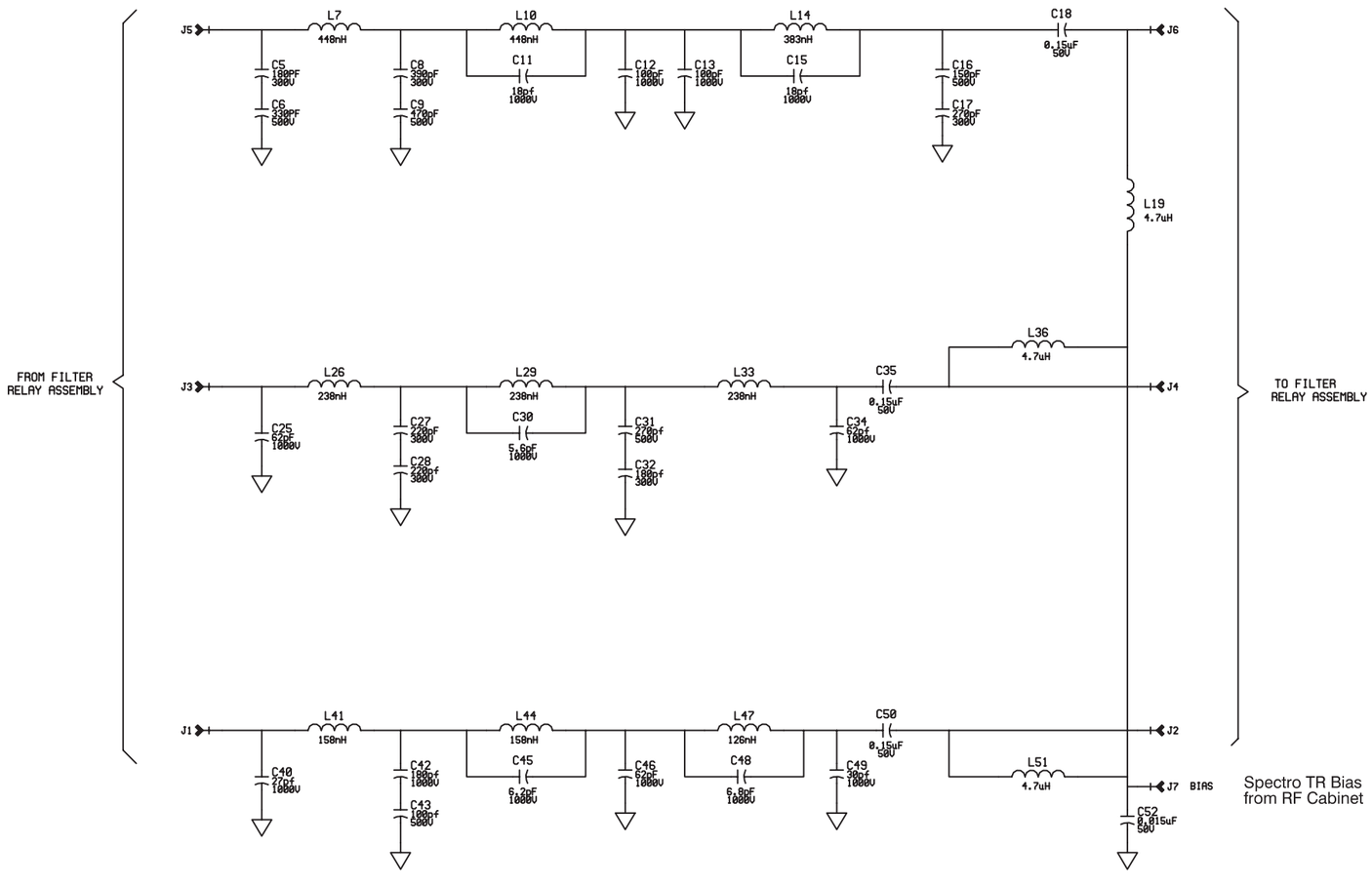
GENERAL ELECTRIC

46-264866-S
CONT. ON SHEET - SH NO.1

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING : -
APPLIED PRACTICES: 46-280680 | SURFACES: √ | TOLERANCES ON DIMENSIONS: DECIMALS (2 PLACES) ± | DECIMALS (3 PLACES) ± | ANGLES ±

REV AC
46-264866-S
CONT. ON SHEET - SH NO. 1

TITLE SCHEMATIC DIAGRAM
THREE_BAND_LOW_PASS_FILTER
FIRST MADE FOR RF_CABINET
P/L ISSUED
46-264866G1-B

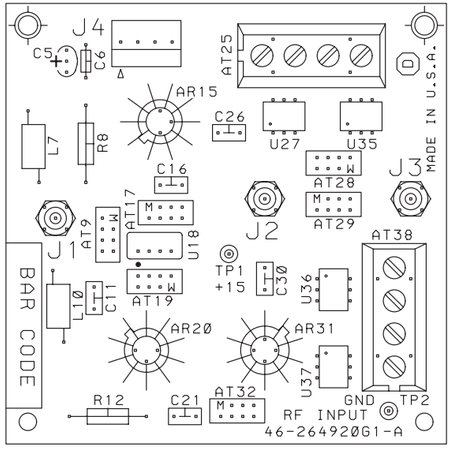


REVISIONS		PRINTS TO
	AB DPB_22OCT90	740
	PCN_171257	
	AC DPB_24MAY91	
	PCN_171761	

MADE BY F.PIERCE_13JUL89
TRACED B.BRIER_19OCT89
APPROVALS RCR 30OCT89
MEDICAL SYSTEMS — — — — — — — — DRAFTING DEPT. MILWAUKEE, WISCONSIN
46-264866-S
CONT. ON SHEET - SH. NO. 1

MR6 A2 A7
RF INPUT

46–264920G1–A



Description

The RF Input board's purpose is to accept +10 dBm of RF at J1 from the exciter and to provide an adjustable RF Input to the BroadBand RF Amplifier or the Narrowband RF Amplifier. The J3 output port sends the RF signal to the Narrowband RF Amplifier, AT38 adjusts this RF signal level range between +14 to –1 dBm. The J2 output port sends the RF signal to the Multi–Nuclear BroadBand RF Amplifier, AT25 adjusts this RF signal level range between +6 to –9 dBm.

DRAWING NO. 46-264920-S SHT NO. 1 CONT ON SHEET -

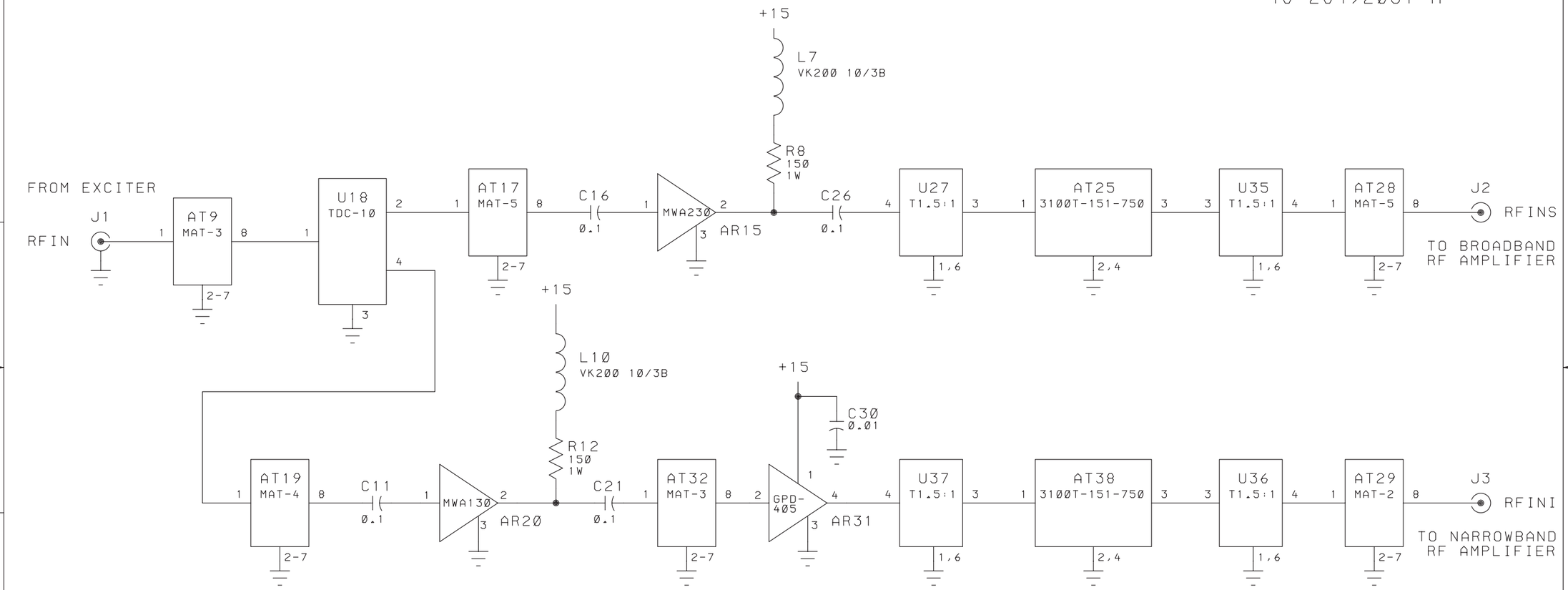
MR6A2 A7

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-	REV AB	TITLE
APPLIED PRACTICES 46-208600	46-264920-S CONT ON SHEET - SHT NO. 1	SCHEMATIC DIAGRAM RF INPUT FIRST MADE FOR MR

46-264920-S
CONT ON SHEET - SHT NO 1

P/L ISSUED

46-264920G1-A



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS
   ALL CAPACITORS ARE IN MFD

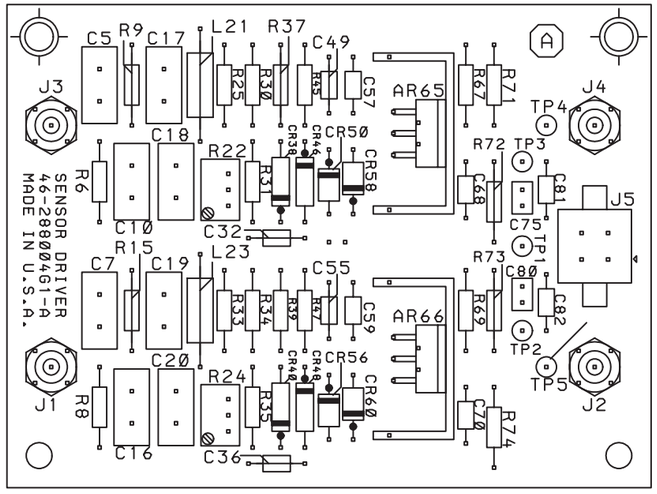
REVISIONS		PRINTS TO
B DLW 14JUN89		740
GEN. CHNGS.		
AB DLW 20JAN90		
PCN 158634		

MADE BY	APPROVALS	DIV OR DEPT	
G. TESKE 19MAY89	RCR 13SEP89	MEDICAL SYSTEMS	46-264920-S
ISSUED R. MAROLIA		MILWAUKEE, WI. LOCATION	CONT ON SHEET - SHT NO. 1

TEI HMC IET/IO HREROOHE T

MR6 A2 A5
SENSOR DRIVER

46–288004G1–A



Description

Note

FOR M1040FF: The Sensor Driver Board was removed by FMI 60420, SPECTRO POWER MONITOR UPGRADE (FOR PRE 5.4 PRODUCTION SYSTEMS, M1040FF). If Sensor Driver Board is present in the system then FMI 60420 needs to be performed on the system (4.X – 5.3 HARDWARE / M1040FF ONLY).

FOR M1040FK: The Sensor Driver Board may be present but is not connected or used.

DRAWING NO. 46-288004-S SHT NO. 1 CONT ON SHEET -

MR6 A2 A5

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:-
APPLIED PRACTICES 46-208600

REV AA
46-288004-S
CONT ON SHEET - SHT NO. 1

TITLE
SCHEMATIC DIAGRAM
SENSOR DRIVER
FIRST MADE FOR MR SPECT 4.5

46-288004-S
CONT ON SHEET - SHT NO. 1

46-288004G1-A

LOW PASS FILTER

50 OHM DRIVER

SENSOR ELEMENT J1 SMB

L23 10uH

R8 2.0K
R15 100
C19 150pF
C16 51pF
C7 51pF
R33 100
C20 150pF
R35 2.0K

+15V
C55 .01
CR56 1N4001
TP5
L165 AR66
CR60 1N4001
C59 .01
-15V
SMB J2 POWER MONITOR
C70 .1
R74 1

CR40 1N914
+15V R39 1K
R24 1K .5W 10% CW OFFSET
R34 4.2K
C36 .1
-15V R47 1K
CR48 1N914
R73 10.2K
R69 2.0K

TO POWER SUPPLY

J5
+15V
TP2
C80 .1
C82 .01
TP1
C75 .1
C81 .01
TP3
-15V

LOW PASS FILTER

50 OHM DRIVER

SENSOR ELEMENT J3 SMB

L21 10uH

R6 2.0K
R9 100
C17 150pF
C10 51pF
C5 51pF
R25 100
C18 150pF
R31 2.0K

+15V
C49 .01
CR50 1N4001
TP4
L165 AR65
CR58 1N4001
C57 .01
-15V
SMB J4 POWER MONITOR
C60 .1
R72 1

CR30 1N914
+15V R37 1K
R22 1K .5W 10% CW OFFSET
R30 4.2K
C32 .1
-15V R45 1K
CR46 1N914
R71 10.2K
R67 2.0K

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE 0.25W, 1%
AND ARE IN OHMS
ALL CAPACITORS ARE IN MFD

REVISIONS	PRINTS TO
	740

MADE BY D.WALK 17AUG89
ISSUED
APPROVALS
MEDICAL SYSTEMS DIV OR MILWAUKEE, WI DEPT LOCATION
46-288004-S
CONT ON SHEET - SHT NO. 1

46-288004-S

2A-A

TEI HMC IET/IO HREROOHE T

POWER I/F PANEL

46–301698S

Description

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:–				
APPLIED PRACTICES	SURFACES	TOLERANCES ON DIMENSIONS		
		DECIMALS (2 PLACES)	DECIMALS (3 PLACES)	ANGLES
	✓	±	±	±

FOLD

REV. ~~A~~ ~~B~~ 0

46-301698S
CONT ON SHEET — SH NO. 1

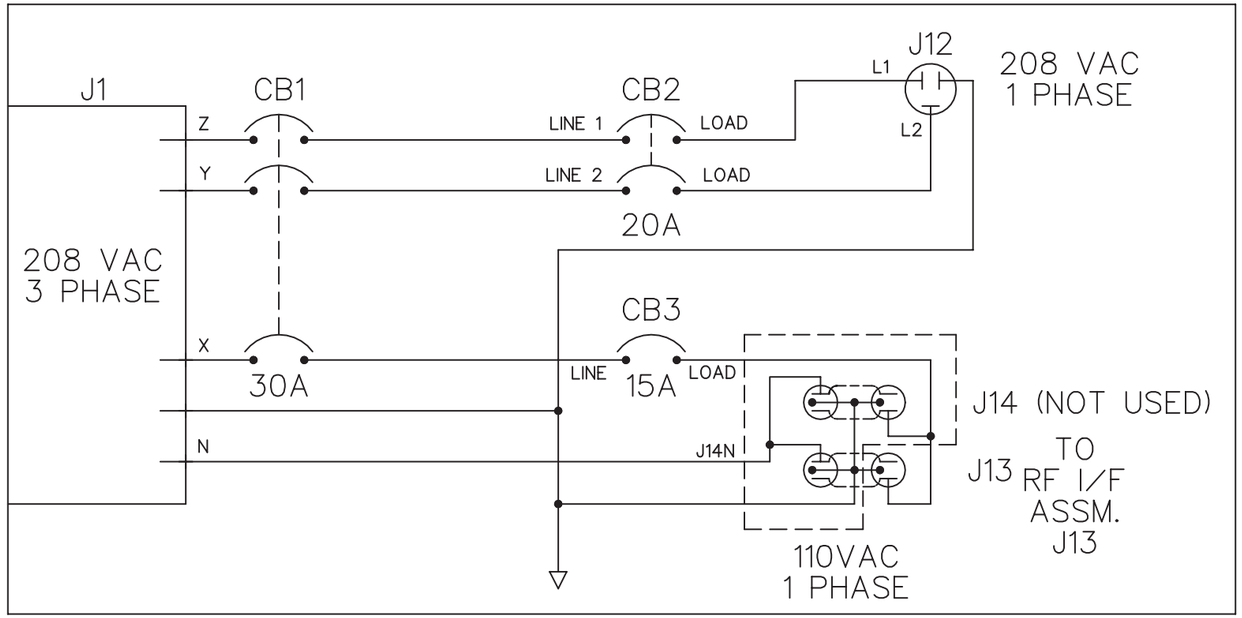
GE Medical Systems

46-301698S
CONT ON SHEET — SH NO. 1

TITLE
SCHEMATIC
FIRST MADE FOR MRSPECT4.5

//STA6/USER/MRSPECT4.5/S301698D01

TO
ENI
AMPLIFIER
AC LINE



TO
PDU (PD1)
A2TS1–4,5,6

P/R

U/O

CAD

APPROVALS		
	NAME	DATE
TECH		
DES		
ENG		
MFG		

FOLD

REVISIONS			PRINTS TO	
B	MITCH. MARASGOS 90AUG15	NCN	742	
208 & 110 VAC 1 PHASE WERE 3 PHASE. ADDED Z,Y, X & N TO J1. J14N ADDED. CB2 & CB3 LINE & LOADS ADDED. J12 L1 & L2 ADDED. MR6 A3 CONNECTION POINTS TABLE DELETED.				

MADE BY MITCH. MARAGOS 90MAR19
ISSUED

APPROVALS

GE MEDICAL SYSTEMS — DIV OR DEPT.
MILWAUKEE, WISCONSIN — LOCATION

46-301698S
CONT ON SHEET — SH NO. 1

FILTER RELAY

46–301704S

Description

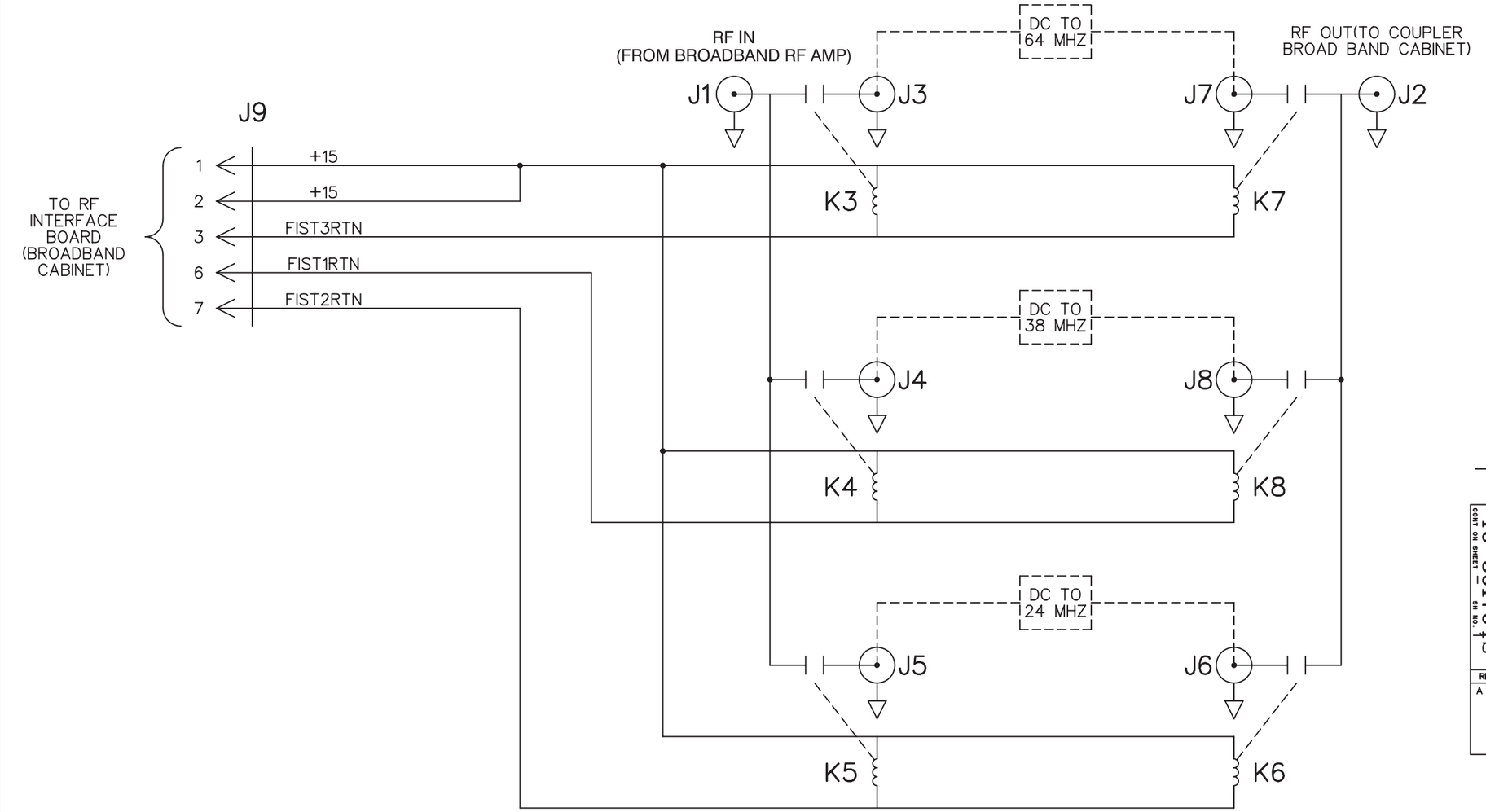
The Filter Relay Assembly is controlled through the software selection of the frequency and/or nuclei (the NUC Control Vartiable ultimately overrides any frequency selection). The RF enters into the Assembly at a common point and exits the Assembly at a common point. Three sets of relays are available which directly correspond to three frequency sensitive Low–Pass Filter networks. The Filter Relay Assembly essentially steers the BroadBand RF frequency to the proper frequency sensitive circuitry (3 Band Low–Pass Filter).

THIRD ANGLE PROJECTION | UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:– APPLIED PRACTICES | SURFACES ✓ | TOLERANCES ON DIMENSIONS: DECIMALS ☐ PLACES ± | DECIMALS ☐ PLACES ± | ANGLES ±

GE Medical Systems

TITLE
FILTER, RELAY
FIRST MADE FOR MRSPECT4.5

46-301704S CONT ON SHEET — SH NO. 1



DRAWING NO. 46-301704S CONT ON SHEET — SH NO. 1

REV. A

APPROVALS	NAME	DATE
TECH		
DES		
ENG		
MFG		

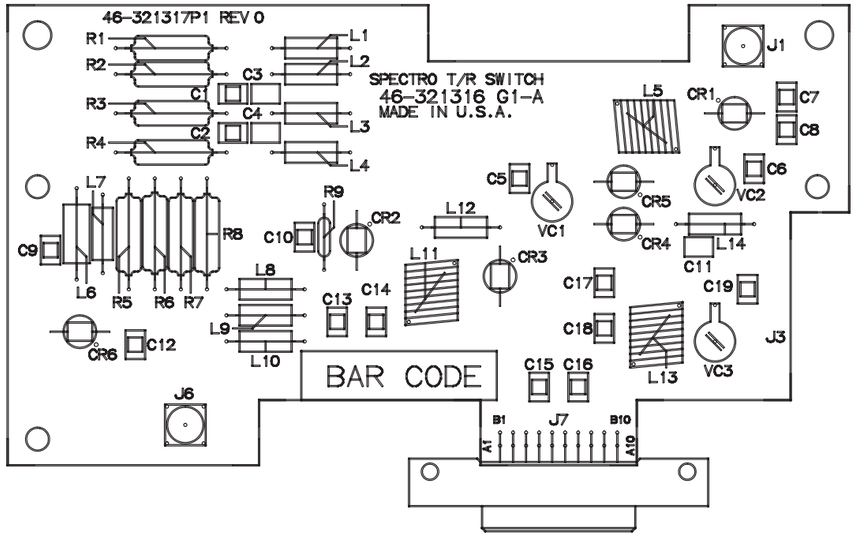
REVISIONS

PRINTS TO: 740

MADE BY A. GRULKE 89NOV30
ISSUED
APPROVALS
GE MEDICAL SYSTEMS MILWAUKEE, WISCONSIN — DIV OR DEPT. — LOCATION
46-301704S –CONT ON SHEET — SH NO. 1

MG2 A16 A7 A2
SPECTRO TR SWITCH

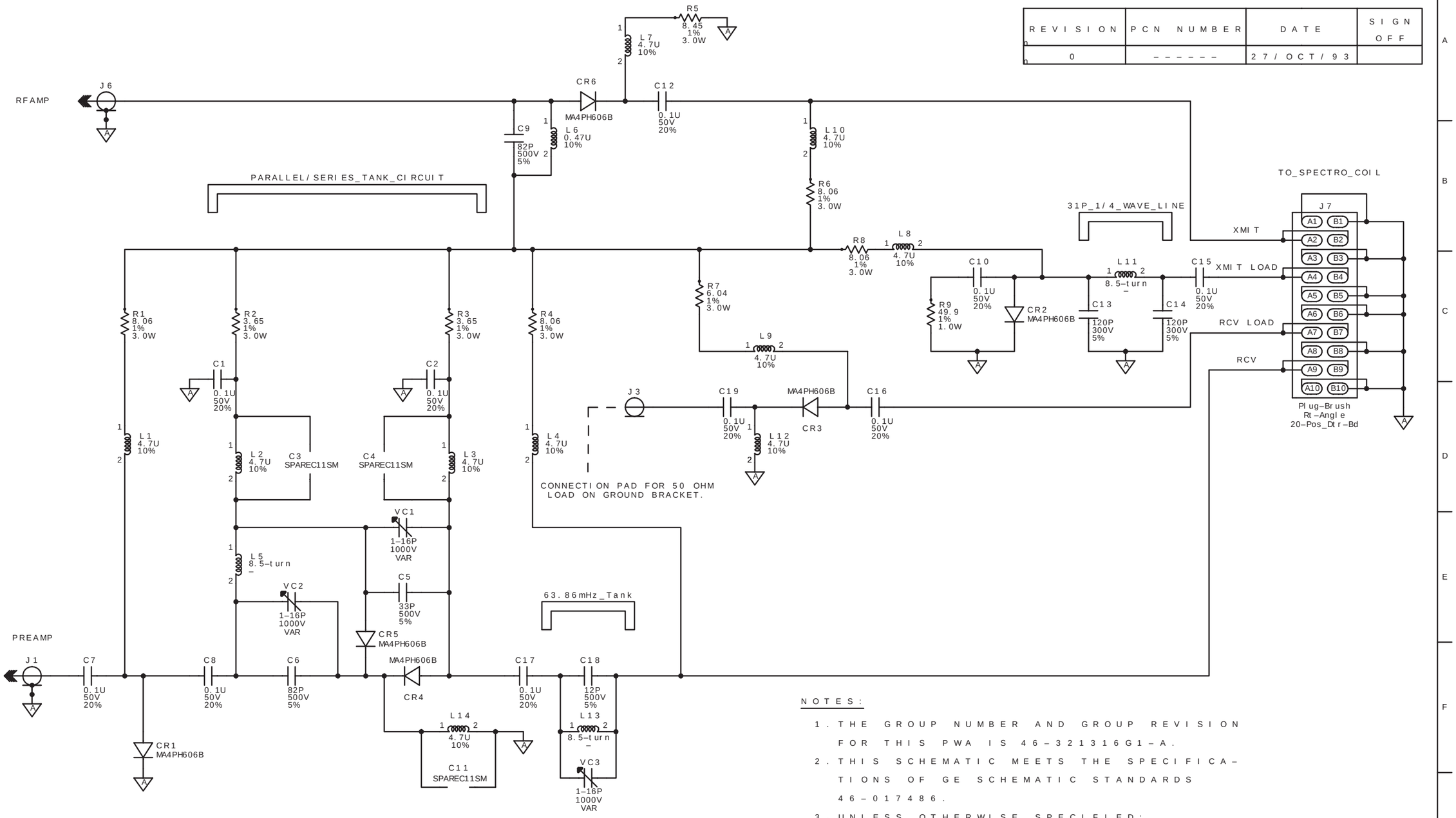
46–321316G1–B



Description

The Spectro TR Switch is used to switch the between the transmit and receive modes. The UNBLANK signal drives the TR Bias voltage mode. A bias voltage that originates from the TR Driver circuitry (under UNBLANK control) in the RF Amplifier Cabinet is used to either forward or reverse bias PIN diodes. When transmitting, a positive voltage is supplied via the transmit heliax. This forward biases the PIN diodes which in turn connect the transmitter to the coil. It also shorts the input to the preamplifier, which protects it from being damaged by the high level of RF present during the transmit cycle. When receiving, a negative voltage is supplied is supplied via the transmit heliax. This reverse biases the PIN diodes which in turn disconnects the transmit heliax from the coil and connects the preamplifier to the coil.

REVISION	PCN NUMBER	DATE	SIGN OFF
0	------	27/OCT/93	



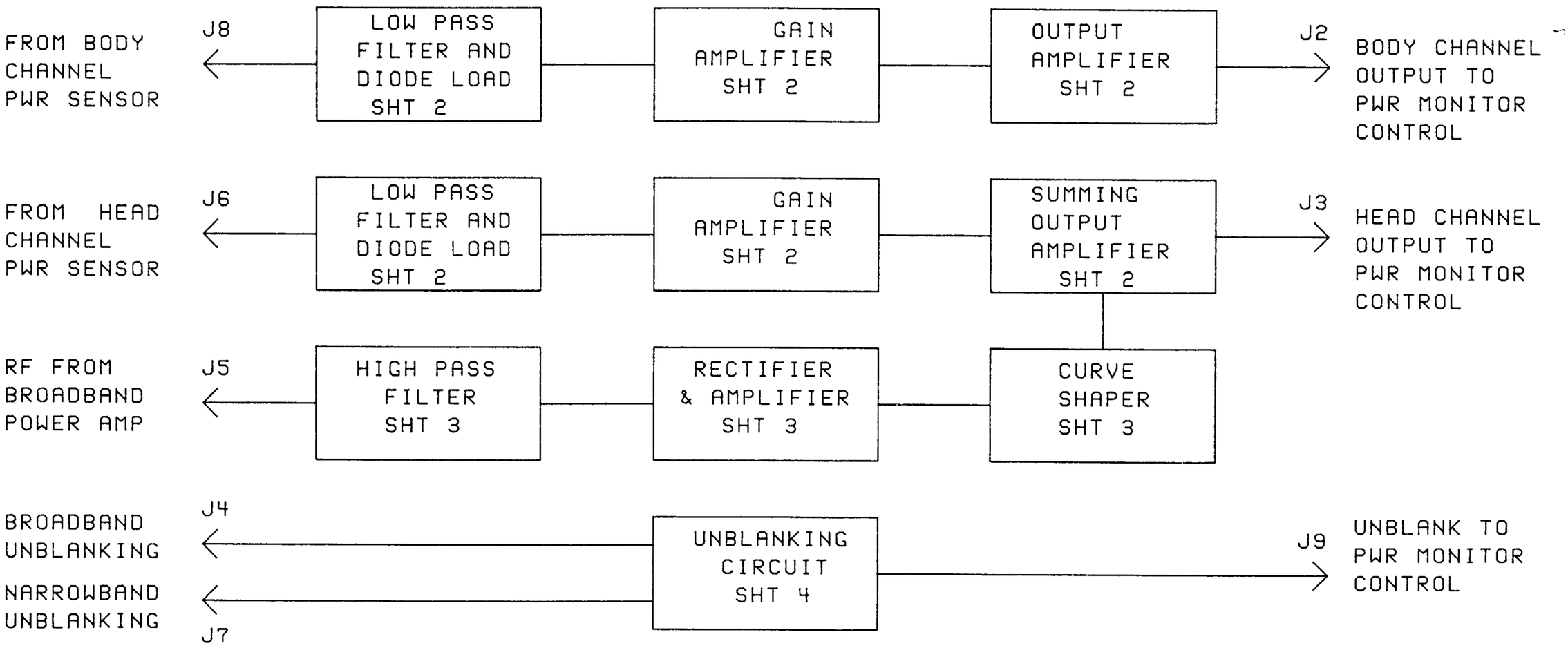
NOTES:

1. THE GROUP NUMBER AND GROUP REVISION FOR THIS PWA IS 46-321316G1-A.
2. THIS SCHEMATIC MEETS THE SPECIFICATIONS OF GE SCHEMATIC STANDARDS 46-017486.
3. UNLESS OTHERWISE SPECIFIED:
   RESISTORS ARE IN OHMS
   CAPACITORS ARE IN FARADS.
   INDUCTORS ARE IN HENRIES.

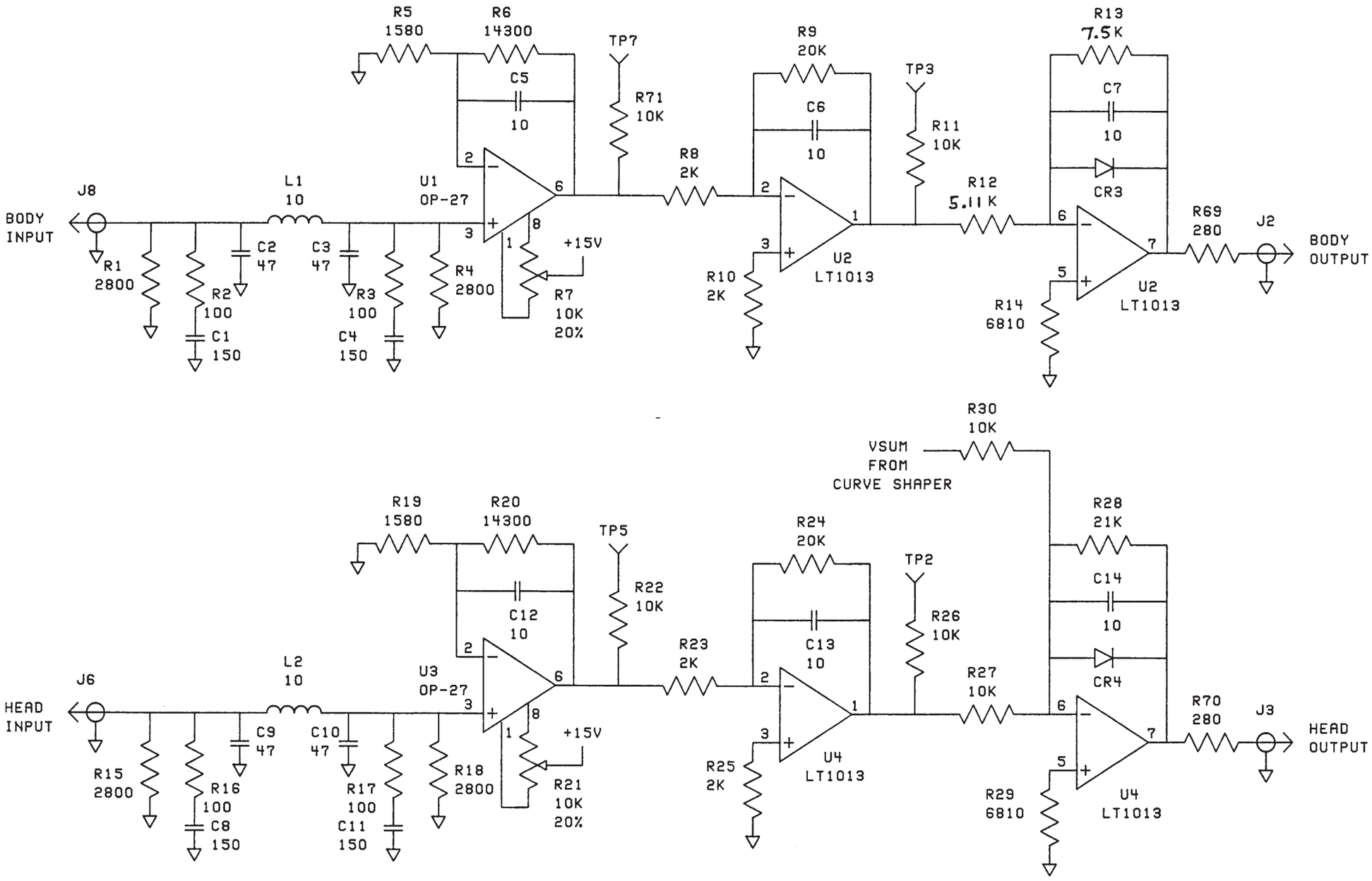
BLOCK PATHNAME	/user/body_hyb/spectr_sw SHEET 1 OF 1				
REV 0	SPECTRO T/R SWITCH	LOCATION CODE	APPROVALS	GE MEDICAL SYSTEMS	REVISIONS
DRAWING NO. 46-321316-S	FIRST MADE FOR MRSPECT4.5 (31P)	MG2-A16-A7-A1		MILWAUKEE WI	
SHT. NO. 1 CONT. ON SHT. NO. -	MADE BY Bill Kostolni DATE 27-OCT-93	ISSUED DATE	PRINTS TO 740		

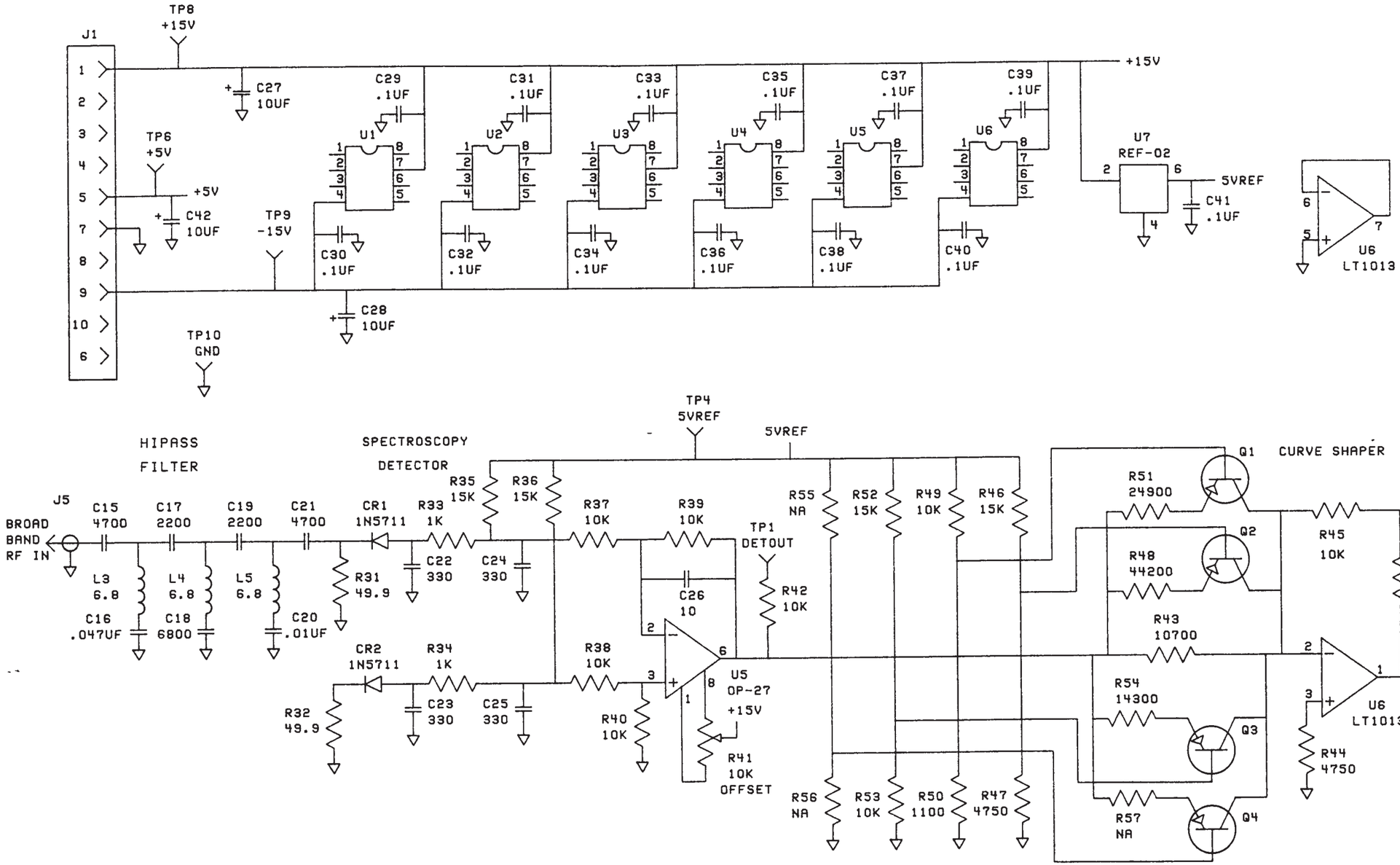
Body Gain—> 7.5K/5.11K * 20K/2K * (1+ 14300/1580) = 1.4677 * 10 * 10.051 = 147.5
If input signal = 40 mVDC * 147.5 =about 5.900 VDC

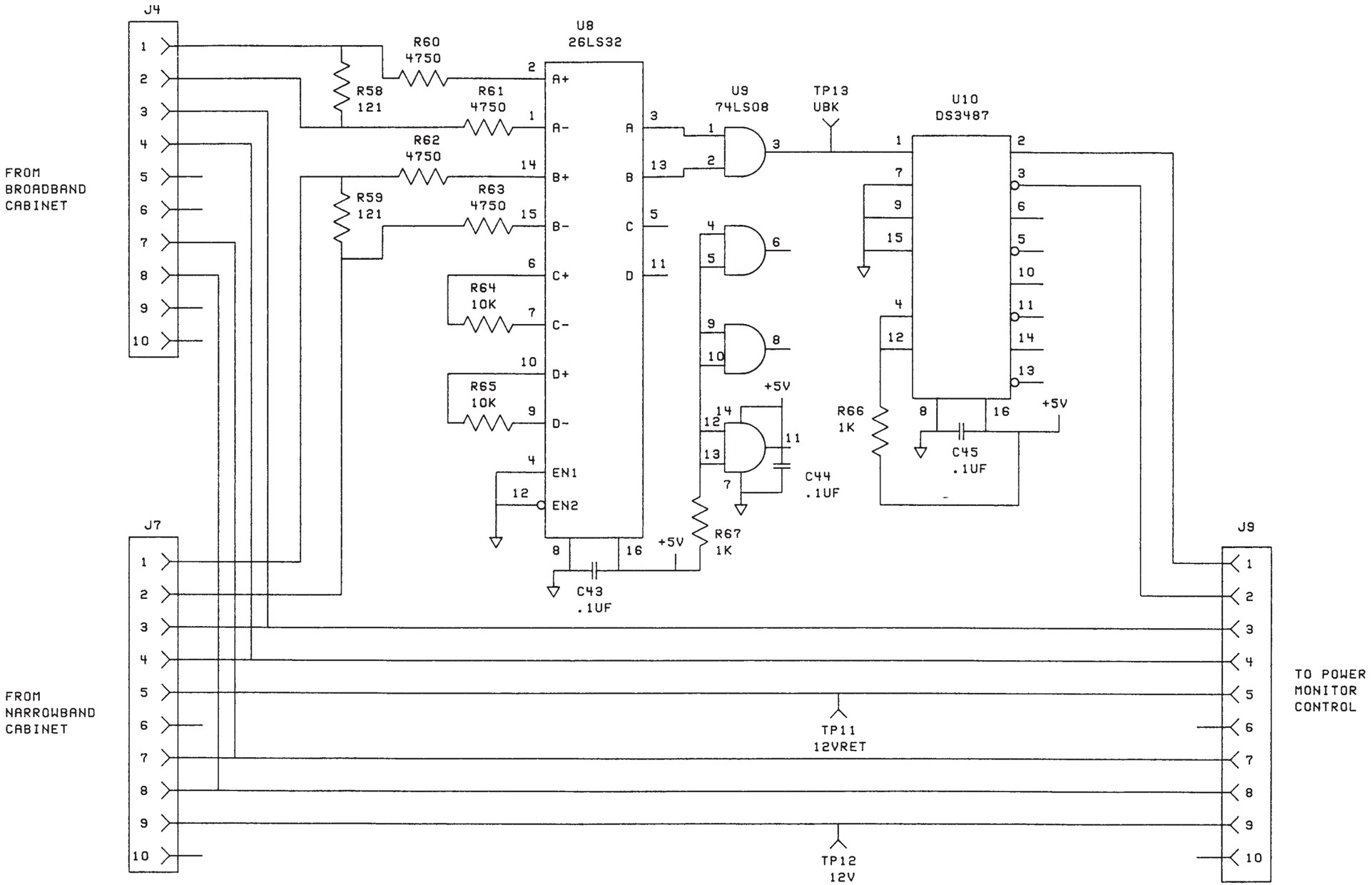
Head Gain—> 21K/10K * 20K/2K * (1+ 14300/1580) = 2.1 * 10 * 10.051 = 211.1
If input signal = 40 mVDC * 211.1 =about 8.443 VDC



SPECTROSCOPY ANALOG SENSE BOARDS, # 2143715 and # 2143715–2




J1
TP8
+15V
C27
10UF
C29
.1UF
C31
.1UF
C33
.1UF
C35
.1UF
C37
.1UF
C39
.1UF
+15V
U1
U2
U3
U4
U5
U6
U7
REF-02
5VREF
C41
.1UF
TP6
+5V
+5V
C42
10UF
TP9
-15V
C30
.1UF
C32
.1UF
C34
.1UF
C36
.1UF
C38
.1UF
C40
.1UF
C28
10UF
TP10
GND
U6
LT1013
TP4
5VREF
5VREF
HIPASS
FILTER
SPECTROSCOPY
DETECTOR
Q1
CURVE SHAPER
J5
BROAD
BAND
RF IN
C15
4700
C17
2200
C19
2200
C21
4700
CR1
1N5711
R33
1K
R35
15K
R36
15K
R37
10K
R39
10K
TP1
DETOUT
R55
NA
R52
15K
R49
10K
R46
15K
R51
24900
Q2
R48
44200
R45
10K
R68
1K
L3
6.8
L4
6.8
L5
6.8
C16
.047UF
C18
6800
C20
.01UF
R31
49.9
C22
330
C24
330
C26
10
R42
10K
R43
10700
CR2
1N5711
R34
1K
R38
10K
U5
OP-27
+15V
R41
10K
OFFSET
R32
49.9
C23
330
C25
330
R40
10K
R54
14300
Q3
R44
4750
VSUM
TO
HEAD AMP
U6
LT1013
R56
NA
R53
10K
R50
1100
R47
4750
R57
NA
Q4


J4
FROM BROADBAND CABINET
R58 121
R59 121
R60 4750
R61 4750
R62 4750
R63 4750
R64 10K
R65 10K
U8 26LS32
A+
A-
B+
B-
C+
C-
D+
D-
EN1
EN2
A
B
C
D
U9 74LS08
TP13 UBK
U10 DS3487
R66 1K
R67 1K
C43 .1UF
C44 .1UF
C45 .1UF
+5V
J7
FROM NARROWBAND CABINET
J9
TO POWER MONITOR CONTROL
TP11 12VRET
TP12 12V