

Eclipse Series

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R220 Receiver Operation and Maintenance Manual

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B Parts List

WARNING

Changes or modifications not expressly approved by RF Technology could void your authority to operate this equipment. Specifications may vary from those given in this document in accordance with requirements of local authorities. RF Technology equipment is subject to continual improvement and RF Technology reserves the right to change performance and specification without further notice.

1 Operating Instructions

1.1 Front Panel Controls and Indicators

1.1.1 Mon. Volume

The Mon. Volume control is used to adjust the volume of the internal loudspeaker and any external speaker connected to the test socket. It does not effect the level of the 600 Ω line or direct audio output.

1.1.2 Mon. SQ.

The Mon. SQ. switch allows all squelch functions controlling the monitor output to be disabled. When the switch is in the Mon. SQ. position the audio at the monitor speaker is controlled by the noise detector. The CTCSS, carrier and external squelch functions are disabled. This can be useful when you are trying to trace the source of on-channel interference or when setting the noise squelch threshold. the audio from the 600 Ω line and direct outputs is not effected by the switch position.

1.1.3 N.SQ

The N.SQ trimpot is used to set the noise squelch sensitivity. Use the following procedure to set the noise squelch to maximum sensitivity.

1. Set the toggle switch to the Mon. Sq. position and set the Mon. Volume control to 9 o'clock.

2. Turn the N. SQ. adjustment counter clockwise until the squelch opens and noise is heard from the speaker. Adjust the VOLUME to a comfortable listening level.
3. In the absence of any on channel signal, turn the N.SQ. screw clockwise until the noise in the speaker is muted. Then turn the screw two additional turns in the clockwise direction.

1.1.4 C.SQ

The C.SQ trimpot is used to set the carrier squelch sensitivity. Carrier squelch is useful at higher signal levels than those at which noise squelch and can be used typically from 1-200 μ V input.

It is provided mainly for use in fixed link applications where a high minimum signal to noise ratio is required or where very fast squelch operation is required for data transmission. The carrier squelch will open and close in less than 2 mSec.

In most base station applications carrier squelch is disabled by turning the adjustment counter clockwise until the screw clicks.

The carrier squelch may be set to a predetermined level with the Techelp/Service Monitor 2000 software or by using the following procedure:

1. First turn the adjustment fully counter-clockwise. Then set the noise squelch as above.
2. Connect a source of an on channel signal with the desired threshold level to the receiver's RF input.
3. Turn the screw clockwise until the SQ LED goes OFF. Then turn the screw back until the LED just comes ON.

1.1.5 LINE

The LINE trimpot is used to set the line and direct audio output level. It is normally set to give 0dBm (775mV) to line with a standard input signal equal to 60% of maximum deviation at 1 KHz. The level can be measured between test socket pins 6 and 1 and set as desired.

1.1.6 PWR LED

The PWR LED shows that the dc supply is connected to the receiver.

1.1.7 SQ LED

The SQ LED comes on when the audio to the line and direct outputs is un-squelched.

The LED and squelch function are controlled by noise, carrier and tone squelch circuits.

1.1.8 ALARM LED

The ALARM LED can indicate the detection of several different fault conditions by the self test circuits. The alarm indicator shows the highest priority fault present. Receivers using software issue 5 and higher use the cadence of the LED flash sequence to indicate the alarm condition. Refer to table 1.

LED Flash Cadence	Fault Condition
5 flashes, pause	Synthesizer unlocked
4 flashes, pause	Tuning voltage outside limits
3 flashes, pause	Signal level below preset threshold (fixed link)
1 flash, pause	dc supply voltage low or high
LED ON continuously	External squelch is active

Table 1: Interpretations of LED flash cadence

Receivers using software issue 4 and lower use the LED flash rate to indicate the alarm condition. Refer to table 2.

Indication	Fault condition
Flashing, 8 per second	Synthesizer unlocked
Flashing, 4 per second	Tuning voltage outside 2-7 Vdc
Flashing, 2 per second	Signal level below preset threshold (fixed links)
Continuous	dc supply voltage low or high

Table 2: Interpretations of LED flash speed, for early models.

2 Receiver Internal Jumper Options

In the following subsections an asterisk (*) signifies the standard (Ex-Factory) configuration of a jumper.

2.1 JP1: 240 Hz Notch Filter

JP1 allows the 240Hz notch filter in the normal audio path to be bypassed.

Condition	Position
Notch Filter In	1-2 *
Notch Filter Out	2-3

2.2 JP2: Audio Response

Condition	Position
750 uSec. de-emphasis	1-2 *
Flat response	2-3

2.3 JP3: Audio Filter In/Out

JP3 bypasses the 300Hz high-pass filter and 240Hz notch filter if necessary.

Condition	Position
Hi-pass, Notch In	2-3 *
Flat response	1-2

2.4 JP4: 600Ω Line dc Loop COS

JP4 allows the dc return path through the output audio transformer to be broken, to permit dc signaling via the audio pair or wires.

Condition	Position
dc Loop Configured by JP7, JP8, JP9	1-2 *
dc Loop Not used	2-3

2.5 JP6: COS Polarity

Condition	Position
Active on Signal	2-3 *
Active on No Signal	1-2

2.6 JP7, JP8, JP9: dc Loop COS Configuration (JP4 1-2)

These settings are relevant when the Carrier Operated Switch (COS) signal is to be used across the same wires as the audio. Refer to setting of JP4, in section 2.4. They control the levels and connection into the audio balanced line circuitry.

Condition	JP7	JP8	JP9
Source +12 Vdc Loop	2-3	ON	1-2 *
Free Switch Output	1-2	ON	2-3

2.7 JP7, JP8, JP9: Direct Output COS (JP4 2-3)

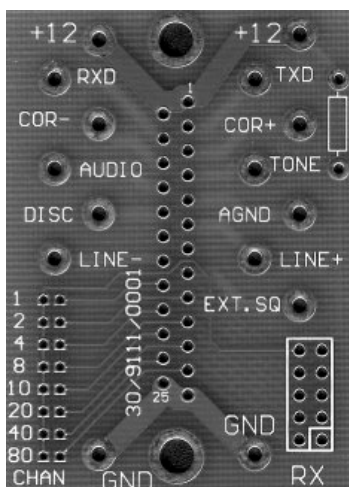
In this arrangement, the COS signal is taken via the separate COS+ and COS- outputs, either with free (floating) output or with +12Vdc pull-up.

Condition	JP7	JP8	JP9
+12 Vdc Direct Output	2-3	OFF	OFF
Free Switch Output	1-2	OFF	OFF

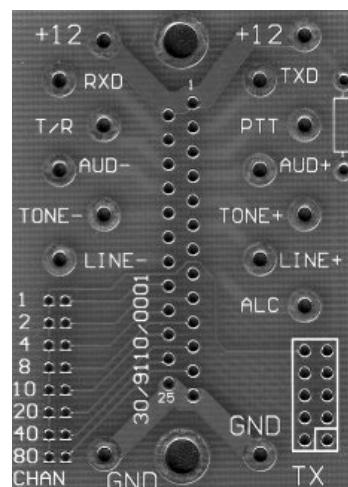
2.8 JP11 EPROM Type

Condition	Position
27C256	2-3 *
27C64	1-2

* = Standard Ex-Factory Configuration



RX PCB



TX PCB

The Receiver and Transmitter modules plug into the back plane DB25/F connectors

Miniature spade connectors (2.1 x 0.6 x 7mm) are captive/ soldered at the labelled points.

To configure: Solder wire connections between appropriate points.

Receiver DB25/F	RX PCB	DESCRIPTION		TX PCB	Transmitter DB25/F
1, 14	+12V	+12V DC SUPPLY		+12V	1, 14
2	TXD	TX Data		TXD	2
15	RXD	RX Data		RXD	15
3	COR+	Carrier Operate Sw+	PressToTalk input	PTT	3
16	COR-	Carrier Operate Sw-	Tx/Rx output	T/R	16
4	TONE	Subtone output	Hi Z audio input+	AUD+	4
17	AUDIO	Audio output	Hi Z audio input-	AUD-	17
5	AGND	Audio Ground	Ext tone input+	TONE+	5
18	DISC	Discriminator output	Ext tone input-	TONE-	18
6	LINE+	Line output+	Line input+	LINE+	6
20	LINE-	Line output-	Line input-	LINE-	20
8	EXT SQ	Ext Squelch input	Auto Level Control	ALC	8
13, 25	GND	Ground, 0V		GND	13, 25
21	BCD 1	Channel select 1's digit		BCD 1	21
9	BCD 2	Channel select 1's digit		BCD 2	9
22	BCD 4	Channel select 1's digit		BCD 4	22
10	BCD 8	Channel select 1's digit		BCD 8	10
23	BCD 10	Channel select 10's digit		BCD 10	23
11	BCD 20	Channel select 10's digit		BCD 20	11
24	BCD 40	Channel select 10's digit		BCD 40	24
12	BCD 80	Channel select 10's digit		BCD 80	12

3 Receiver I/O Connections

3.1 25 Pin Connector

The D-shell 25 pin connector is the main interface to the receiver. The pin connections are described in table 3.

Function	Signal	Pins	Specification
dc Power	+12 Vdc -12 Vdc	1, 14 13, 25	+11.4 to 16 Vdc
Channel Select	1 2 4 8 10 20 40 80	21 9 22 10 23 11 24 12	BCD Coded 0 = Open Circuit or 0 Vdc 1 = +25 to +16 Vdc
RS232 Data	In Out	15 2	Test and Programming use 9600, 8 data 2 stop bits
600 Ω Line	In Out	20 6	Transformer Isolated Balanced 0dBm Output
150 Ω / Hybrid		7 19	
Discriminator		18	AC coupled, unsquelched
Direct Audio Output		17	Direct AC Coupled Audio
Audio Ground		5	Direct Audio Ground
Sub-Audible Audio Out		4	Unsquelched, 1-250 Hz
Carrier Operated Sw	+	3	Opto-coupled Transistor
Carrier Operated Sw	-	16	Switch (10mA)
External Squelch	Input	8	<1 Vdc to Squelch >2 Vdc or open ckt to unsquelch

Table 3: Pin connections and explanations for the main, 25-pin, D-shell Connector

4 Frequency Programming

Channel and tone frequency programming is most easily accomplished with RF Technology TecHelp/Service Monitor 2000 software. This software can be run on an IBM compatible/Windows PC and provides a number of additional useful facilities.

TecHelp/Service Monitor 2000 allows setting of the adaptive noise squelch threshold, provides a simple means of calibrating the signal strength output and minimum signal alarm.

TecHelp/Service Monitor 2000 can be supplied by your dealer, distributor or by contacting RF Technology direct.

5 Circuit Description

The following descriptions should be read as an aid to understanding the block and schematic diagrams at the rear of this manual.

5.1 RF Section

A two pole voltage tuned filter (D13, D14, L35-39) is used to limit the RF band width prior to the RF amplifier transistor Q1. The tuning voltage is supplied by the frequency synthesizer through voltage follower U28D. The circuit values are chosen so that the centre frequency tracks the VCO frequency.

RF amplifier transistor Q1 is followed by a second two pole voltage tuned filter (D15, D16, L28-32) which provides additional image and spurious frequency rejection. The filter output is connected to the RF input port of the mixer MX1.

MX1 is a high level double balanced diode ring mixer with excellent intermodulation performance. It has a conversation loss of approximately 6 dB. The gain between the receiver input and the mixer input is approximately 10 dB so that the total gain between the antenna input and the IF input 3-4dB.

Monolithic amplifiers MA1, MA2 and transistor Q5 amplify the VCO output to the necessary LO level for MX1 approximately +13dBm.

The network C8, C9 L1-3 and R6 passes the IF frequency of 45 MHz and terminates the RF and LO components.

5.2 IF Section

The first IF amplifier uses two parallel connected JFET transistors Q2 and Q3 to obtain 8-10 dB gain. The two transistors provide improved dynamic range and input matching over a single transistor.

A two pole 45 MHz crystal filter XF1 is used between the first and second IF amplifiers. The second IF amplifier Q4 provides additional gain of 6-10dB. A two pole crystal filter is used between Q4 and the 2nd oscillator mixer. These two crystal filters provide some adjacent channel rejection and all of the second IF image frequency rejection.

U1 is a monolithic oscillator and mixer IC. It converts the 45 MHz IF signal down to 455 KHz. The second oscillator frequency or 45.455 MHz is controlled by crystal Y1. The 455 KHz output of the second mixer is fed through a ceramic filter CF1 to the second IF amplifier transistor Q27. Q27 provides an additional 15 dB gain ahead of the limiter and discriminator IC U3.

The limiter/discriminator IC U3 further amplifies the signal and passes it through CF2. CF2 does not contribute to the adjacent channel rejection but is used to reduce the wide band noise input to the limiter section of U3.

The limiter section of U3 drives the quadrature detector discriminator. C31 and IF tuned circuit L10 comprise the discriminator phase shift network.

U3 also has a received signal strength indicator output (RSSI). The RSSI voltage connects to the test socket for alignment use. The RSSI voltage is also used by the microprocessor for the adaptive noise squelch, carrier squelch and low signal alarm functions.

Dual op-amp U2 is used to amplify and buffer the discriminator audio and RSSI outputs.

5.3 VCO Section

The Voltage Controlled Oscillator uses a junction FET Q6 which oscillates at the required mixer injection frequency. Varactor diode D4 is used by the PLL circuit to keep the oscillator on the desired frequency. Transistor Q7 is used as a filter to reduce the noise on the oscillator supply voltage.

5.4 PLL Section

The synthesizer frequency reference is supplied by a temperature compensated crystal oscillator (XO1). The frequency stability of the oscillator is better than 1 ppm.

The 12 MHz output of Q25 or XO1 is amplified by Q8 to drive the reference input of the PLL synthesizer IC U4. This IC is a single chip synthesizer which includes a 1.1 GHz pre-scaler, programmable divider, reference divider and phase/frequency detector. The frequency data is entered a serial data link from the microprocessor.

The phase detector output signals of U4 are used to control two switched current sources. The output of the positive and negative sources' Q10 and Q16, produce the tuning voltage which is smoothed by the loop filter components to bias the VCO varactor diode D4.

5.5 Audio Signal Processing

A 4 KHz low pass filter (U27b) is used to remove high frequency noise from the signal. A 300 Hz high pass filter (U26a,b) then removes the sub-audible tones. A 240 Hz notch filter (U26c,d) is used to improve the rejection of tones above 200 Hz. The high pass and notch filters can be bypassed by internal jumpers JP1 and JP3.

The audio frequency response can be set for either 750 uS de-emphasis or a flat characteristic by JP2. JP2 selects the feedback network of amplifier U27c.

After de-emphasis and filtering, the audio signal is applied to the inputs of two analog switches (U17a,b). These switches are controlled by the micro-controller and squelch or mute the audio to the line and monitor output circuits. The monitor output can be set for noise squelch only operation by S1.

The audio from U17a is adjusted by the volume control before connecting to the monitor output amplifier U5. U5 drives the internal speaker and can also supply 3-5 watts to an external loudspeaker.

The audio from U17b is adjusted by RV3 before connecting to the line output IC (U22a,b). U22 is a dual amplifier connected in a bridge configuration to drive the 600 Ω line output transformer T1.

5.6 Noise Filter, Amplifier and Detector

The unfiltered audio from the discriminator is fed to trimpot RV4 which is used to set the noise squelch threshold. From RV4 the audio goes to the noise filter (U27a). This is a 10 KHz high pass filter and is used to eliminate voice frequency components.

The noise signal is then amplified by U27d and fed to the noise detector. The noise detector consists of D6, Q17 and U26c. D6 and Q17 are a charge pump detector and pull the input to U26c low as the noise increases. U26c has positive feedback and acts like a schmitt trigger. The output of U26c goes high when noise is detected. It connects to the micro-controller and to analog switch U17d. U17d varies the gain of the noise amplifier to provide approximately 2dB hysteresis.

5.7 Sub-Tone Filter and CTCSS

The discriminator audio is fed through cascaded low pass filters U28a and U28b to filter out the voice frequency components. The filtered sub-tone audio is supplied to the CTCSS hybrid and the rear panel system connector. The filtered output can be used for re-transmission of CTCSS or DCS.

The CTCSS decoder module is a micro-controller base hybrid module. Under control of the main microprocessor U15 it can decode all 38 EIA tones and 12 additional commonly used tones. The decode bandwidth is set to 1% but may be changed to 2% by a jumper on the printed circuit board.

5.8 External Squelch

The audio output can be muted through pin 8 of the receiver system connector P1. When pin 8 is pulled to less than 1 volt above ground, the micro-controller U15 will mute the audio output.

This facility can be used to mute the audio during transmission, as is required in single frequency systems, by simply connecting pin 8 of the receiver to the transmitter T/R relay driver output (pin 16 on Eclipse transmitters).

5.9 Microprocessor Controller

The microprocessor controller circuit uses an advanced eight bit processor and several support chips. The processor U15 includes EE memory for channel frequencies, tones, and other information. It also has an asynchronous serial port and an analog to digital converter.

The program is stored in U12, a CMOS EPROM. U13 is an address latch for the low order address bits. U11 is used to read the channel select lines onto the data bus. U7 is an address decoder for U11 and U12. U14 is a supervisory chip which keeps the processor reset unless the +5 Volt supply is within operating limits. U16 translates the asynchronous serial port data to standard RS232 levels.

The analog to digital converter is used to measure the received signal strength, tuning voltage, dc supply voltage and the carrier squelch setting.

5.10 Carrier Operated Switch

The carrier operated switch is an opto-coupled (ISO1) output. Internal jumpers (JP4,7,8,9) can be connected to provide loop source, loop switch, free switch and various other configurations.

The COS can be set to be active (switch closed) on carrier or active in the absence of carrier.

The generic term ``Carrier Operated Switch" may be misleading in this case. SINCE, if a sub-audible tone has been programmed for the channel in use, the COS is controlled by carrier and tone detection.

5.11 Voltage Regulator

The dc input voltage is regulated down to 9.4 Vdc by a discrete regulator circuit. The series pass transistor Q20 is driven by error amplifiers Q21 and Q22. Q23 is used to start up the regulator and once the circuit turns on, it plays no further part in the operation.

This circuit is short circuit and overload protected. It provides much better line isolation and lower dropout voltage than can be obtained with current integrated circuit regulators.

6 Alignment Procedure

The following procedures may be used to align the receiver for optimum performance. Normally only RF alignment will be required when changing frequencies. IF alignment should only be necessary after repairs on that part of the circuit.

Reference oscillator or TCXO calibration may be required periodically due to crystal aging. The aging should be less than 1 ppm/year.

6.1 Standard Input Signal

RF Signal Generator
50 Ω output impedance
Frequency range 215 - 240 MHz
FM modulation at 1KHz
1.5KHz peak for 12.5KHz channel spacing

6.2 RF Alignment

Alignment Frequency	
215 - 240 MHz range	221.000 MHz

Step	Input	Measure	Adjust
1	Select alignment frequency channel	dc Volts on test socket pin 9 to pin 1	L34 to read 4.00Vdc
2	Signal generator on centre frequency channel to J1. Modulation off.	dc Volts on test socket pin 7 to pin 1	Generator level to read 1 - 2 Vdc
3	Signal generator on centre frequency channel to J1. Modulation off.	dc Volts on test socket pin 7 to pin 1	L29, 31, 36, 38 for maximum reading. Reduce generator output to keep below 2 Vdc

6.3 IF Alignment

Step	Input	Measure	Adjust
1	Signal generator on center frequency channel to J1. Modulation OFF	dc Volts in test socket pin 7 to pin 1	Generator level to read 1 - 2 Vdc
2	Signal generator on center frequency channel to J1. Modulation OFF	dc Volts in test socket pin 7 to pin 1	L5, L6, L7, L8 for maximum reading. Reduce generator output to keep below 2 Vdc
3	Set generator level to 10 μ V	Frequency U3 pin 9	L9 to read 455 KHz +/- 10Hz
4	Set generator level to 1 millivolt. Modulation ON.	Audio level test socket pin 6 to pin 1	Line level (RV3) to obtain approx. 1 Vrms
5	Set generator level to 1 millivolt. Modulation ON.	Audio level test socket pin 6 to pin 1	L10 for maximum
6	Set generator level to 1 millivolt. Modulation ON.	Audio level P1 pin 18 to pin 5	RV1 for .5 Vrms
7	Set generator level to approx. 25 μ V	SINAD on test socket pin 6 to pin 1	Reduce generator level to obtain 12 Db SINAD. Carefully adjust L5, L6, L7, L8 to obtain the best SINAD. Reduce generator output to maintain 12 dB SINAD

6.4 Line Level Adjustment

Step	Input	Measure	Adjust
1	Signal generator on centre frequency channel to J1. Modulation ON. Level 1 millivolt	Audio level test socket pin 6 to pin 1	RV3 for 390 mV rms

6.5 Reference Oscillator Calibration

Step	Input	Measure	Adjust
1	None required	Frequency junction of R69 and R26 on the top of the PCB. (LO input to the mixer)	C181 or XO1 for L.O. +/-100 Hz L.O. = $F_c + 45$ MHz

7 Specifications

7.1 General Description

The receiver is a high performance, frequency synthesized, narrow band FM unit which can be used in conjunction with transmitter and power supply modules as a base station or as a stand alone receiver. All necessary control and 600 Ω line interface circuitry is included.

7.1.1 Channel Capacity

Although most applications are single channel, it can be programmed for up to 100 channels numbered 0-99. This is to provide the capability of programming all channels into all of the receivers used at a given site.

7.1.2 CTCSS

The CTCSS tone or no tone can also be programmed for each channel. So that each channel number can represent unique RF and tone frequency combination.

7.1.3 Channel Programming

The channelling information is stored in a non-volatile memory chip and can be programmed via the front panel test connector using a PC and RF Technology supplied TechHelp/Service Monitor 2000 software.

7.1.4 Channel Selection

Channel selection is by eight channel select lines. These are available through the rear panel connector.

A BCD active high code applied to the lines selects the required channel. This can be supplied by pre-wiring the rack connector so that each rack position is dedicated to a fixed channel.

BCD switches inside the receiver can be used to pre-set any desired channel. These eliminate the need to externally select the channel.

7.1.5 Microprocessor

A microprocessor is used to control the synthesizer and squelch functions and facilitate the channel frequency programming. With the standard software it also can provide fault monitoring and reporting.

7.2 Physical Configuration

The receiver is designed to fit in a 19 inch rack mounted frame. The installed height is 4 RU (178 mm) and the depth 350 mm. The receiver is 63.5 mm or two Eclipse modules wide.

7.3 Front Panel Controls, Indicators and Test Points

7.3.1 Controls

Mute defeat switch - toggle (Overrides CTCSS, noise and carrier squelch at the monitor output)

Monitor Speaker Volume - Knob

Line Output Level - screwdriver adjust multiturn pot

Noise Squelch Setting - screwdriver adjust multiturn pot

Carrier Squelch Setting - screwdriver adjust multiturn pot

7.3.2 Indicators

Power ON - Green LED

Squelch Open - Yellow LED

Fault Indicator - Flashing Red LED

7.3.3 Test Points

Line Output Level - 1 + Gnd

Receive Signal Strength - 1 + Gnd

Tuning Voltage - 1 + Gnd

Serial Data (RS232) - 2 + Gnd

7.4 Electrical Specifications**7.4.1 Power Requirements**

Operating Voltage - 10.5 to 16 Vdc

Current Drain - 250mA Max.

Polarity - Negative Ground

7.4.2 Frequency Range and Channel Spacing

215 – 240 MHz 12.5KHz

7.4.3 Frequency Synthesizer Step Size

5.0 or 6.25 KHz

7.4.4 Frequency Stability

+/- 1 ppm, 0 to +60 C

7.4.5 Nominal Antenna Impedance

50Ω

7.4.6 IF Frequencies

First IF frequency 45 MHz

Second IF frequency 455 KHz

7.4.7 Sensitivity

-120 dBm Max. for 12 dB SINAD

-117 dBm Max. for 20 dB Quieting

7.4.8 Selectivity

12 KHz spacing - 70dB per ECR-235

7.4.9 Spurious and Image Rejection

90dB

7.4.10 Intermodulation

80dB

7.4.11 Modulation Acceptance BW

12.5 KHz spacing - 3.75 KHz per RS204C

7.4.12 Noise Squelch

Adjustment Range: 6 - 18 dB SINAD

Attack Time: 20 mSec. above 20dB Quieting

Release Time: 150 mSec. at 20dB Quieting decreasing to 20ms above $2\mu\text{V}$ preset threshold

Hysteresis: Hysteresis is equal to approximately 2dB change in noise quieting

7.4.13 Carrier Level Squelch

Carrier level squelch can be used when it is necessary to set the opening point above 26dB SINAD as may be required in link applications. The minimum adjustment range is 1 to 200 μ V.

7.4.14 Receiver Frequency Spread

Less than 1 dB change in sensitivity over the band

7.4.15 Receiver Conducted Spurious Emissions

Less than -57dBm from 1 to 2900 MHz

7.4.16 Audio Frequency Response

600 Ω Line and Direct Output: +1/-3dB 300-3000 Hz relative to either a flat response or 750 μ s de-emphasis with the high pass and notch filters bypassed.

+1/-6 dB with the filters in circuit.

Sub-Audio Output: +1/-3dB 67-250 Hz

7.4.17 Audio Output Level

600 Ω Line: Adjustable -10 to +10dBm

Monitor Loudspeaker: 5 Watts with external speaker, 0.3 Watt with internal speaker

Discriminator and Sub-Audio: Nominally equal to 1 volt peak at rated system deviation

7.4.18 Audio Distortion

750 μ s De-Emphasis: Less than 3% at 1 KHz and 60% of rated system deviation

Flat Response: Less than 5% at 1 KHz and 60% of rated system deviation

7.4.19 Channel Select Input/Output

Coding: 8 lines BCD coded 00-99

Logic Input Levels: 0 = < 0.4 Volts
1 = > 3.5 Volts

Internal 10K pull down resistors selects Channel 00 when all inputs are O/C.

7.4.20 Carrier Operated Switch Output

Floating Opto-Coupler Output: The carrier operated switch output is via an opto-coupler. Collector and emitter connections are available to allow connection for source or sink.

The opto-coupler can be linked inside the receiver to be on when a carrier is detected or to be on in the absence of carrier.

Connection to Remote Switch via 600Ω Line: Internal connections are provided so that the opto-coupler can be connected to the 600Ω line for use over a single pair. This permits remote switching with no extra connections.

Current Source/Sink, Collector Voltage: The COS output is implemented with an optocoupler whose ratings are:\

I_c = 10mA Maximum

V_c = 30 Volts Maximum

7.4.21 CTCSS

The CTCSS decoding is provided by a hybrid module. This provides programmable decoding of all 38 EIA and 12 other common tones. Refer to table 4.

Frequency	EIA Number
No Tone	
67.0	A1
69.4	
71.9	B1
74.4	C1
77.0	A2
79.7	C2
82.5	B2
85.4	C3
88.5	A3
91.5	C4
94.8	B3
97.4	
100.0	A4
103.5	B4
107.2	A5
110.9	B5
114.8	A6
118.8	B6
123.0	A7
127.3	B7
131.8	A8
136.5	B8
141.3	A9
146.2	B9
151.4	A10
156.7	B10
159.8	
162.2	A11
165.5	
167.9	B11
171.3	
173.8	A12
177.3	
179.9	B12
183.5	
186.2	A13
189.9	
192.8	B13
196.6	
199.5	
203.5	A14
206.5	
210.7	B14
218.1	A15
225.7	B15
229.1	
233.6	A16
241.8	B16
250.3	A17
254.1	

Table 4: Tone Squelch Frequencies

7.4.22 External Squelch Input

An external input is provided to squelch or mute the receiver audio output. This may be used in conjunction with an external decoder or to mute the receiver during transmissions.

External Squelch Input can be connected to the T/R Relay pin on Eclipse transmitters mute the receiver during transmission.

7.5 Connectors

7.5.1 Antenna Connector

Type N Female Mounted on the module rear panel

7.5.2 Power & I/O Connector

25-pin ``D" Male Mounted on the rear panel

7.5.3 Test Connector

9-pin ``D" Female mounted on the front panel

A Engineering Diagrams

A.1 Circuit diagram

Figure 1 shows the detailed schematic diagram with component numbers and values

B Parts List

C1 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C10 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C100 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C101 CAP 4N7 10% COG RAD.2
 46/2000/04N7
 C102 CAP 27P 2% 100V NPO RAD.1
 45/2680/027P
 C103 CAP 1N5 10% 50V COG RAD.2
 46/2000/01N5
 C104 CAP 100N 5% 50V MKT RD.2
 47/2007/100N
 C105 CAP 470U 25V RB ELECTRO
 41/2001/470U
 C106 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C107 CAP 10N 1% 63V KP7.5
 47/2007/010N
 C108 CAP 10N 1% 63V KP7.5
 47/2007/010N
 C109 CAP 10N 1% 63V KP7.5
 47/2007/010N
 C11 CAP CAP 47P 2% 100V NPO RAD.1
 45/2680/047P
 C110 CAP 10N 1% 63V KP7.5
 47/2007/010N
 C111 CAP 1U0 10% 50V MKT
 47/2007/01U0
 C112 CAP 10N 1% 63V KP7.5
 47/2007/010N
 C113 CAP 10N 1% 63V KP7.5
 47/2007/010N
 C114 CAP 10N 1% 63V KP7.5
 47/2007/010N
 C115 CAP 10N 1% 63V KP7.5
 47/2007/010N
 C116 CAP 10N 1% 63V KP7.5
 47/2007/010N
 C117 CAP 10N 1% 63V KP7.5
 47/2007/010N
 C118 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C119 CAP 47U 25V RB ELECTRO
 41/2001/047U
 C12 CAP CAP 33P 2% 100V NPO RAD.1
 45/2680/033P
 C120 CAP 1N0 5% 100V NPO RAD.2
 46/2000/01N0
 C121 CAP 2N2 5% 400V MKT RAD.2
 47/2040/02N2
 C122 CAP 15N 5% 400V MKT RAD.2
 47/2040/015N
 C123 CAP 33N 5% 400V MKT RAD.2
 47/2040/033N
 C124 CAP 6N8 10% 400V MKT RD.2
 47/2040/06N8
 C125 CAP 10N 10% 400V MKT RD.2
 47/2040/010N
 C126 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C127 CAP 470U 25V RB ELECTRO
 41/2001/470U
 C128 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C129 CAP 47U 25V RB ELECTRO
 41/2001/047U
 C13 CAP CAP 33P 2% 100V NPO RAD.1
 45/2680/033P
 C130 CAP 470U 25V RB ELECTRO
 41/2001/470U
 C131 CAP 1U0 10% 50V MKT
 47/2007/01U0
 C132 CAP 1U0 10% 50V MKT
 47/2007/01U0

C133 CAP 1U0 10% 50V MKT
 47/2007/01U0
 C134 CAP 2U2 10% 100V MKT RD.2
 47/2010/02U2
 C135 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C136 CAP 470U 25V RB ELECTRO
 41/2001/470U
 C137 CAP 10U 35V RAD ELECTRO
 41/2001/010U
 C138 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C139 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C14 CAP CAP 100N 10% 63V X7R 1206
 46/3310/100N
 C140 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C141 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C142 CAP 10U 35V RAD ELECTRO
 41/2001/010U
 C143 CAP 10U 35V RAD ELECTRO
 41/2001/010U
 C144 CAP 10U 35V RAD ELECTRO
 41/2001/010U
 C145 CAP 10U 35V RAD ELECTRO
 41/2001/010U
 C146 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C147 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C148 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C149 CAP 1N0 5% 100V NPO RAD.2
 46/2000/01N0
 C15 CAP CAP 1N0 5% 100V NPO RAD.2
 46/2000/01N0
 C150 CAP 1N0 5% 100V NPO RAD.2
 46/2000/01N0
 C151 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C152 CAP 470U 25V RB ELECTRO
 41/2001/470U
 C153 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C154 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C155 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C156 CAP 1N0 5% 100V NPO RAD.2
 46/2000/01N0
 C157 CAP 18P 2% 100V NPO RAD.1
 45/2680/018P
 C158 CAP 18P 2% 100V NPO RAD.1
 45/2680/018P
 C159 CAP 10U 35V RAD ELECTRO
 41/2001/010U
 C16 CAP CAP 33P 2% 100V NPO RAD.1
 45/2680/033P
 C160 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C161 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C162 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C163 CAP 10U 35V RAD ELECTRO
 41/2001/010U
 C164 CAP 10U 35V RAD ELECTRO
 41/2001/010U
 C165
 C166 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C167 CAP 10U 35V RAD ELECTRO
 41/2001/010U
 C169 CAP 10P 5% 63V NPO SM1206

46/3300/010P
 C17 CAP 33P 2% 100V NPO RAD.1
 45/2680/033P
 C170 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C171 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C172 CAP 47P 5% 63V NPO SM1206
 46/3300/047P
 C173
 C174
 C175 CAP 10P 5% 63V NPO SM1206
 46/3300/010P
 C176 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C177 CAP 47P 5% 63V NPO SM1206
 46/3300/047P
 C178
 C179
 C18 CAP 33P 2% 100V NPO RAD.1
 45/2680/033P
 C180 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C185 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C186 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C187 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C188 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C19 CAP 33P 2% 100V NPO RAD.1
 45/2680/033P
 C2 CAP 100N 10% 63V X7R 1206
 46/3310/100N
 C20 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C21 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C22 CAP 10P 2% 100V NPO RAD.1
 45/2680/010P
 C23 CAP 33P 2% 100V NPO RAD.1
 45/2680/033P
 C24 CAP 22P 2% 100V NPO RAD.1
 45/2680/022P
 C25 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C26 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C27 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C28 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C29 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C3 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C30 CAP 10U 35V RAD ELECTRO
 41/2001/010U
 C31 CAP 10P 2% 100V NPO RAD.1
 45/2680/010P
 C32 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C33 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C34 CAP 100P 2% 100V NPO RAD1
 45/2680/100P
 C35 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C36 CAP 47U 25V RB ELECTRO
 41/2001/047U
 C37 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C38 CAP 1N0 5% 100V NPO RAD.2
 46/2000/01N0
 C39 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C4 CAP 100N 10% 63V X7R 1206
 46/3310/100N
 C40 CAP 1N0 5% 100V NPO RAD.2
 46/2000/01N0
 C41 CAP 10U 35V RAD ELECTRO

41/2001/010U
 C42 CAP 33P 2% 100V NPO RAD.1
 45/2680/033P
 C43 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C44 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C45 CAP 15P 5% 63V NPO SM1206
 46/3300/015P
 C46 CAP 15P 5% 63V NPO SM1206
 46/3300/015P
 C47 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C48 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C49 CAP 100N 10% 63V X7R 1206
 46/3310/100N
 C5 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C50 CAP 56P 5% 63V NPO SM1206
 46/3300/056P
 C53 CAP 100N 10% 63V X7R 1206
 46/3310/100N
 C54 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C55 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C56 CAP
 C57 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C59 CAP 10U 35V RAD ELECTRO
 41/2001/010U
 C60 CAP 27P 5% 63V NPO SM1206
 46/3300/027P
 C62 CAP 100P 5% 63V NPO 1206
 46/3300/100P
 C63 CAP 100P 5% 63V NPO 1206
 46/3300/100P
 C64 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C65 CAP 100N 10% 63V X7R 1206
 46/3310/100N
 C66 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C67 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C68 CAP 100N 10% 63V X7R 1206
 46/3310/100N
 C69 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C7 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C70 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C71 CAP 47P 2% 100V NPO RAD.1
 45/2680/047P
 C72 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C73 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C74 CAP 100N 10% 63V X7R 1206
 46/3310/100N
 C75 CAP 100N 10% 63V X7R 1206
 46/3310/100N
 C76 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C77 CAP 10U 35V RAD ELECTRO
 41/2001/010U
 C78 CAP 4N7 10% COG RAD.2
 46/2000/04N7
 C79 CAP 47N 20% 50V X7R RD.2
 46/2001/047N
 C8 CAP 56P 5% 63V NPO SM1206
 46/3300/056P
 C80 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C81 CAP 10N 10% 50V X7R RAD.2
 46/2001/010N
 C82 CAP 47N 20% 50V X7R RD.2
 46/2001/047N
 C83 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0

C84 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C85 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C86 CAP 1N0 5% 63V NPO SM1206
 46/3300/01N0
 C87 CAP 4P7 5% 63V NPO SM1206
 46/3300/04P7
 C88 CAP 100N 10% 63V X7R 1206
 46/3310/100N
 C89 CAP 100N 10% 50V X7R RD.2
 46/2001/100N
 C9 CAP 68P 5% 63V NPO SM1206
 46/3300/068P
 C90 CAP 1N2 5% NPO RAD.2
 46/2000/01N2
 C91 CAP 1U0 10% 50V MKT
 47/2007/01U0
 C92 CAP 100N 5% 50V MKT RD.2
 47/2007/100N
 C93 CAP 22N 10% 63V MKT RAD.2
 47/2007/022N
 C94 CAP 1N2 5% NPO RAD.2
 46/2000/01N2
 C95 CAP 100N 5% 50V MKT RD.2
 47/2007/100N
 C96 CAP 22N 10% 63V MKT RAD.2
 47/2007/022N
 C97 CAP 47U 25V RB ELECTRO
 41/2001/047U
 C98 CAP 1N0 5% 100V NPO RAD.2
 46/2000/01N0
 C99 CAP 1N0 5% 100V NPO RAD.2
 46/2000/01N0
 CF2 FILTER CERAMIC CFU455B
 34/2000/CFUB
 D1 DIO ZEN 5V1 BZX84C5V1 SOT
 21/3040/C5V1
 D10 DIODE 8V2 ZENER
 21/1040/B8V2
 D11 DIODE LED RED RT ANG MTG
 21/1010/LEDR
 D12 DIODE LED GRN RT ANG MTG
 21/1010/LEDG
 D13 DIO VCAP MMBV432L SOT23
 21/3060/V432
 D14 DIO VCAP MMBV432L SOT23
 21/3060/V432
 D15 DIO VCAP MMBV432L SOT23
 21/3060/V432
 D16 DIO VCAP MMBV432L SOT23
 21/3060/V432
 D17 DIODE SILICON IN4148
 21/1010/4148
 D2 DIO BAND SW BA682 SOD80
 21/3050/0682
 D3 DIO SHTKY BAT17 SOT23
 21/3030/0017
 D4 DIO VCAP MMBV432L SOT23
 21/3060/V432
 D5 DIODE SILICON IN4148
 21/1010/4148
 D6 DIODE SILICON IN4148
 21/1010/4148
 D7 DIODE LED YEL RT ANG MTG
 21/1010/LEDY
 D8 DIO ZEN 1N4751 30V 1W AXI
 21/1040/4751
 D9 DIODE 3AMP 1KV RECTIFIER
 21/1080/5408
 H1 HYBRED CTCSS
 18/1000/1752
 IS01 IC OPTO-ISOLATOR 4N35
 25/1010/4N35
 JP1 CON 3WAY HEADER
 35/2501/0003
 JP11 CON 3WAY HEADER
 35/2501/0003
 JP12 CON 2WAY HEADER
 35/2501/0002
 JP2 CON 3WAY HEADER
 35/2501/0003

JP3 CON 3WAY HEADER
 35/2501/0003
 JP4 CON 3WAY HEADER
 35/2501/0003
 JP6 CON 3WAY HEADER
 35/2501/0003
 JP7 CON 3WAY HEADER
 35/2501/0003
 JP8 CON 2WAY HEADER
 35/2501/0002
 JP9 CON 3WAY HEADER
 35/2501/0003
 L1 IND 220N 10% CHOKE SM1008
 37/3320/220N
 L10 INDUCTOR VAR 455KHz 10mm
 37/2031/97HM
 L11 IND 3U3 10% CHOKE SM1008
 37/3320/03U3
 L12 INDUCTOR 1uH AXIAL
 37/2021/001U
 L13 IND 39N 10% CHOKE SM1008
 37/3320/039N
 L14 IND 220N 10% CHOKE SM1008
 37/3320/220N
 L15 IND 18N 10% CHOKE SM1008
 37/3320/018N
 L16 IND 220N 10% CHOKE SM1008
 37/3320/220N
 L17 FERRITE BEAD SMD
 37/3321/LM31
 L18 IND 3U3 10% CHOKE SM1008
 37/3320/03U3
 L19 RES 33K 5% .25W SM1206
 51/3380/033K
 L2 IND 220N 10% CHOKE SM1008
 37/3320/220N
 L20 IND 3U3 10% CHOKE SM1008
 37/3320/03U3
 L21 FERRITE BEAD SMD
 37/3321/LM31
 L22 FERRITE BEAD SMD
 37/3321/LM31
 L23 INDUCTOR 150mH 10RBH
 37/2021/1RBH
 L24 IND 6 HOLE FERRITE RFC
 37/1021/0001
 L25 FERRITE BEAD SMD
 37/3321/LM31
 L26 INDUCTOR 1uH AXIAL
 37/2021/001U
 L27 IND 3U3 10% CHOKE SM1008
 37/3320/03U3
 L28 IND 8N2 10% CHOKE SM1008
 37/3320/08N2
 L3 IND 220N 10% CHOKE SM1008
 37/3320/220N
 L30 IND 680N 10% CHOKE SM1008
 37/3320/680N
 L32 IND 8N2 10% CHOKE SM1008
 37/3320/08N2
 L33 IND 3U3 10% CHOKE SM1008
 37/3320/03U3
 L35 IND 8N2 10% CHOKE SM1008
 37/3320/08N2
 L37 IND 680N 10% CHOKE SM1008
 37/3320/680N
 L39 IND 8N2 10% CHOKE SM1008
 37/3320/08N2
 L4 INDUCTOR 1uH AXIAL
 37/2021/001U
 L40 INDUCTOR 1uH AXIAL
 37/2021/001U
 L41
 L42 IND 220N 10% CHOKE SM1008
 37/3320/220N
 L5 INDUCTOR 680N 10mm
 37/2021/680N
 L6 INDUCTOR 680N 10mm
 37/2021/680N
 L7 INDUCTOR 680N 10mm
 37/2021/680N
 L8 INDUCTOR 680N 10mm

37/2021/680N
 L9 INDUCTOR 1.5u 10mm
 37/2021/1.5U
 MA1 AMP MMIC MWA0211L SOT143
 24/3010/211L
 MA2 AMP MMIC VAM-6
 24/3010/VAM6
 MA3 AMP MMIC MWA0211L SOT143
 24/3010/211L
 MA4 AMP MMIC MWA0211L SOT143
 24/3010/211L
 MX1 MIXER RFMX 1-13
 37/2070/0113
 P1 FILT D RT AGL 25W M 1NF
 35/5011/025M
 P2 FILT D RT AGL 9W F FERRIT
 35/5012/009F
 PROG. IC EPROM 27C256
 26/2090/C256
 Q1 TRSTR NPN MRF9511 SOT143
 27/3020/9511
 Q10 TRSTR GP PNP 2N3906 T092
 27/2010/3906
 Q11 TRSTR GP PNP MPS3640
 27/2010/3640
 Q12 TRSTR GP NPN 2N3904 T092
 27/2020/3904
 Q13 TRSTR GP PNP MPS3640
 27/2010/3640
 Q14 TRSTR GP NPN MPS2369 T092
 27/2010/2369
 Q15 TRSTR GP NPN 2N3904 T092
 27/2020/3904
 Q16 TRSTR GP PNP 2N3906 T092
 27/2010/3906
 Q17 TRSTR GP NPN 2N3904 T092
 27/2020/3904
 Q18 TRSTR GP NPN 2N3904 T092
 27/2020/3904
 Q19 TRSTR GP NPN 2N3904 T092
 27/2020/3904
 Q2 FET NJ J309 T092M
 27/2030/J309
 Q20 TRSTR PNP MJF6107 T0220
 27/2010/6107
 Q21 TRSTR GP NPN 2N3904 T092
 27/2020/3904
 Q22 TRSTR GP NPN 2N3904 T092
 27/2020/3904
 Q23 FET NJ 2N5459 T092M
 27/2030/5459
 Q24 TRSTR GP NPN 2N3904 T092
 27/2020/3904
 Q26 TRSTR GP NPN 2N3904 T092
 27/2020/3904
 Q27 TRSTR GP NPN 2N3904 T092
 27/2020/3904
 Q3 FET NJ J309 T092M
 27/2030/J309
 Q4 FET NJ 2N5484 T092M
 27/2030/5484
 Q5 TRSTR RF NPN MRF5812 S08
 27/3020/5812
 Q6 FET NJ MMBFJ309 SOT23
 27/3030/J309
 Q7 TRSTR GP NPN 2N3904 T092
 27/2020/3904
 Q8 TRSTR GP NPN MPS2369 T092
 27/2010/2369
 Q9 TRSTR GP NPN 2N3904 T092
 27/2020/3904

 R1 RES 220 5% 0.25W SM1206
 51/3380/0220
 R10 RES 150 5% 0.25W AXIAL
 51/1040/0150
 R100 RES 10M 5% 0.25W AXIAL
 51/1040/010M
 R101 RES 6K49 1% 0.25W AXIAL
 51/1010/6K49
 R102 RES 28K7 1% 0.25W AXIAL
 51/1010/28K7

R103 RES 562K 1% 0.25W AXIAL
 51/1010/562K
 R104 RES 28K7 1% 0.25W AXIAL
 51/1010/28K7
 R105 RES 6K49 1% 0.25W AXIAL
 51/1010/6K49
 R106 RES 562K 1% 0.25W AXIAL
 51/1010/562K
 R107 RES 75K 1% 0.25W AXIAL
 51/1010/075K
 R108 RES 10K 5% 0.25W AXIAL
 51/1040/010K
 R109 RES 3K57 1% 0.25W AXIAL
 51/1010/3K57
 R11 RES 5K6 5% 0.25W AXIAL
 51/1040/05K6
 R110 RES 3K57 1% 0.25W AXIAL
 51/1010/3K57
 R111 RES 3K57 1% 0.25W AXIAL
 51/1010/3K57
 R112 RES 10K 5% 0.25W AXIAL
 51/1040/010K
 R113 RES 390 5% 0.25W AXIAL
 51/1040/0390
 R114 RES 10K 5% 0.25W AXIAL
 51/1040/010K
 R115 RES 39 5% 0.25W AXIAL
 51/1040/0039
 R116 RES 220 5% 0.25W AXIAL
 51/1040/0220
 R117 RES 10 5% 0.25W AXIAL
 51/1040/0010
 R118 RES 2R2 5% 0.25W AXIAL
 51/1040/02R2
 R119 RES 10K 5% 0.25W AXIAL
 51/1040/010K
 R12 RES 150 5% 0.25W AXIAL
 51/1040/0150
 R120 RES 330 5% 0.25W AXIAL
 51/1040/0330
 R121 RES 33K 5% 0.25W AXIAL
 51/1040/033K
 R122 RES 270 5% 0.25W AXIAL
 51/1040/0270
 R123 RES 2K2 5% 0.25W AXIAL
 51/1040/02K2
 R124 RES 2K2 5% 0.25W AXIAL
 51/1040/02K2
 R125 RES 680 5% 0.25W AXIAL
 51/1040/0680
 R126 RES 680 5% 0.25W AXIAL
 51/1040/0680
 R127 RES 680 5% 0.25W AXIAL
 51/1040/0680
 R128 RES 1K5 5% 0.25W AXIAL
 51/1040/01K5
 R129 RES 6K8 5% 0.25W AXIAL
 51/1040/06K8
 R13 RES 12K 5% 0.25W AXIAL
 51/1040/012K
 R130 RES 680 5% 0.25W AXIAL
 51/1040/0680
 R131 RES 10K 5% 0.25W AXIAL
 51/1040/010K
 R132 RES 51K1 1% 0.25W AXIAL
 51/1010/51K1
 R133 RES 274K 1% 0.25W AXIAL
 51/1010/274K
 R134 RES 10K 5% 0.25W AXIAL
 51/1040/010K
 R135 RES 10K 5% 0.25W AXIAL
 51/1040/010K
 R136 RES 10K 5% 0.25W AXIAL
 51/1040/010K
 R137 RES 1K0 5% 0.25W AXIAL
 51/1040/01K0
 R138 RES 5K11 1% 0.25W AXIAL
 51/1010/5K11
 R139 RES 47 5% 0.25W AXIAL
 51/1040/0047
 R14 RES 1K0 5% 0.25W AXIAL
 51/1040/01K0

R140 RES 680 5% 0.25W AXIAL
 51/1040/0680
 R141 RES 4K7 5% 0.25W AXIAL
 51/1040/04K7
 R142 RES 10M 5% 0.25W AXIAL
 51/1040/010M
 R143 RES 4K7 5% 0.25W AXIAL
 51/1040/04K7
 R144 RES 4K7 5% 0.25W AXIAL
 51/1040/04K7
 R145 RES 4K7 5% 0.25W AXIAL
 51/1040/04K7
 R146 RES 10M 5% 0.25W AXIAL
 51/1040/010M
 R147 RES 10K 5% 0.25W AXIAL
 51/1040/010K
 R148 RES 1K0 5% 0.25W AXIAL
 51/1040/01K0
 R149 RES 5K11 1% 0.25W AXIAL
 51/1010/5K11
 R150 RES 2K2 5% 0.25W AXIAL
 51/1040/02K2
 R151 RES 680 5% 0.25W AXIAL
 51/1040/0680
 R152 RES 5K11 1% 0.25W AXIAL
 51/1010/5K11
 R153 RES 100K 5% 0.25W AXIAL
 51/1040/100K
 R154 RES 64K9 1% 0.25W AXIAL
 51/1010/64K9
 R155 RES 680 5% 0.25W AXIAL
 51/1040/0680
 R156 RES 1K0 5% 0.25W AXIAL
 51/1040/01K0
 R157 RES 10K 5% 0.25W AXIAL
 51/1040/010K
 R16 RES 1K0 5% 0.25W AXIAL
 51/1040/01K0
 R160 RES 100K 5% 0.25W SM1206
 51/3380/100K
 R161 RES 100K 5% 0.25W SM1206
 51/3380/100K
 R162 RES 270 5% 0.25W SM1206
 51/3380/0270
 R163 RES 100K 5% 0.25W SM1206
 51/3380/100K
 R164 RES 100K 5% 0.25W SM1206
 51/3380/100K
 R166 RES 15R 5% 0.25W SM1206
 51/3380/0015
 R168 RES 100K 5% 0.25W SM1206
 51/3380/100K
 R169 RES 100K 5% 0.25W SM1206
 51/3380/100K
 R17 RES 68K 5% 0.25W AXIAL
 51/1040/068K
 R170 RES 270 5% 0.25W SM1206
 51/3380/0270
 R171 RES 100K 5% 0.25W SM1206
 51/3380/100K
 R172 RES 100K 5% 0.25W SM1206
 51/3380/100K
 R177 RES 1K0 5% 0.25W AXIAL
 51/1040/01K0
 R178 RES 1K0 5% 0.25W AXIAL
 51/1040/01K0
 R179 RES 680 5% 0.25W AXIAL
 51/1040/0680
 R18 RES 470K 5% 0.25W AXIAL
 51/1040/470K
 R180 RES 470K 5% 0.25W AXIAL
 51/1040/470K
 R181 RES 4K7 5% 0.25W AXIAL
 51/1040/04K7
 R182 RES 100 5% 0.25W AXIAL
 51/1040/0100
 R183 RES 3K3 5% 0.25W AXIAL
 51/1040/03K3
 R184 RES 3K3 5% 0.25W AXIAL
 51/1040/03K3
 R185 RES 470K 5% 0.25W SM1206
 51/3380/470K

R186 RES 10 5% 0.25W AXIAL
 51/1040/0010
 R187 RES 100K 5% 0.25W AXIAL
 51/1040/100K
 R188 RES 10K 5% 0.25W AXIAL
 51/1040/010K
 R19 RES 10K 5% 0.25W AXIAL
 51/1040/010K
 R2 RES 1K0 5% 0.25W SM1206
 51/3380/01K0
 R20 RES 10K 5% 0.25W AXIAL
 51/1040/010K
 R21 RES 470 5% 0.25W AXIAL
 51/1040/0470
 R22 RES 1K0 5% 0.25W AXIAL
 51/1040/01K0
 R23 RES 680 5% 0.25W AXIAL
 51/1040/0680
 R25 RES 100K 5% 0.25W AXIAL
 51/1040/100K
 R26 RES 270 5% 0.25W SM1206
 51/3380/0270
 R27 RES 270 5% 0.25W SM1206
 51/3380/0270
 R28 RES 1K0 5% 0.25W SM1206
 51/3380/01K0
 R29 RES 39R 5% 0.25W SM1206
 51/3380/0039
 R3 RES 680 5% 0.25W SM1206
 51/3380/0680
 R30 RES 39R 5% 0.25W SM1206
 51/3380/0039
 R31 RES 180 5% 0.25W SM1206
 51/3380/0180
 R32 RES 390 5% 0.25W SM1206
 51/3380/0390
 R33 RES 270 5% 0.25W SM1206
 51/3380/0270
 R34 RES 10K 5% 0.25W SM1206
 51/3380/010K
 R35 RES 10K 5% 0.25W SM1206
 51/3380/010K
 R36 RES 10R 5% 0.25W SM1206
 51/3380/0010
 R37 RES 2K2 5% 0.25W SM1206
 51/3380/02K2
 R38 RES 1K0 5% 0.25W SM1206
 51/3380/01K0
 R39 RES 100 5% 0.25W SM1206
 51/3380/0100
 R4 RES 47R 5% 0.25W SM1206
 51/3380/0047
 R40 RES 100 5% 0.25W SM1206
 51/3380/0100
 R41 RES 100 5% 0.25W SM1206
 51/3380/0100
 R42 RES 100 5% 0.25W SM1206
 51/3380/0100
 R43 RES 220 5% 0.25W AXIAL
 51/1040/0220
 R44 RES 47R 5% 0.25W SM1206
 51/3380/0047
 R45 RES 15R 5% 0.25W SM1206
 51/3380/0015
 R46 RES 22 5% 0.25W AXIAL
 51/1040/0022
 R47 RES 560 5% 0.25W AXIAL
 51/1040/0560
 R48 RES 680 5% 0.25W AXIAL
 51/1040/0680
 R49 RES 680 5% 0.25W AXIAL
 51/1040/0680
 R5 RES 47R 5% 0.25W SM1206
 51/3380/0047
 R50 RES 100 5% 0.25W AXIAL
 51/1040/0100
 R51 RES 1K0 5% 0.25W AXIAL
 51/1040/01K0
 R52 RES 3K3 5% 0.25W AXIAL
 51/1040/03K3
 R53 RES 1K0 5% 0.25W AXIAL
 51/1040/01K0

R54 RES 3K3 5% 0.25W AXIAL
51/1040/03K3
R55 RES 2K2 5% 0.25W AXIAL
51/1040/02K2
R56 RES 1K0 5% 0.25W AXIAL
51/1040/01K0
R57 RES 4K7 5% 0.25W AXIAL
51/1040/04K7
R58 RES 2K2 5% 0.25W AXIAL
51/1040/02K2
R59 RES 560 5% 0.25W AXIAL
51/1040/0560
R6 RES 47R 5% 0.25W SM1206
51/3380/0047
R60 RES 10K 5% 0.25W AXIAL
51/1040/010K
R61 RES 1K0 5% 0.25W AXIAL
51/1040/01K0
R62 RES 1K0 5% 0.25W AXIAL
51/1040/01K0
R63 RES 1K0 5% 0.25W AXIAL
51/1040/01K0
R64 RES 1K0 5% 0.25W AXIAL
51/1040/01K0
R65 RES 1K0 5% 0.25W AXIAL
51/1040/01K0
R66 RES 1K0 5% 0.25W AXIAL
51/1040/01K0
R67 RES 1K0 5% 0.25W AXIAL
51/1040/01K0
R68 RES 180 5% 0.25W SM1206
51/3380/0180
R69 RES 18R 5% 0.25W SM1206
51/3380/0018
R7 RES 1R0 5% 0.25W SM1206
51/3380/01R0
R70 RES 1R0 5% 0.25W SM1206
51/3380/01R0
R71 RES 220K 5% 0.25W AXIAL
51/1040/220K
R72 RES 47K 5% 0.25W AXIAL
51/1040/047K
R73 RES 51K 5% 0.25W AXIAL
51/1040/051K
R74 RES 51K 5% 0.25W AXIAL
51/1040/051K
R75 RES 51K 5% 0.25W AXIAL
51/1040/051K
R76 RES 47K 5% 0.25W AXIAL
51/1040/047K
R77 RES 47K 5% 0.25W AXIAL
51/1040/047K
R78 RES 47K 5% 0.25W AXIAL
51/1040/047K
R79 RES 10K 5% 0.25W AXIAL
51/1040/010K
R8 RES 150 5% 0.25W AXIAL
51/1040/0150
R80 RES 1K0 5% 0.25W AXIAL
51/1040/01K0
R81 RES 10K 5% 0.25W AXIAL
51/1040/010K
R82 RES 6K8 5% 0.25W AXIAL
51/1040/06K8
R83 RES 1K0 5% 0.25W AXIAL
51/1040/01K0
R84 RES 270K 5% 0.25W AXIAL
51/1040/270K
R85 RES 22K 5% 0.25W AXIAL
51/1040/022K
R86 RES 6K8 5% 0.25W AXIAL
51/1040/06K8
R87 RES 220K 5% 0.25W AXIAL
51/1040/220K
R88 RES 5K6 5% 0.25W AXIAL
51/1040/05K6
R89 RES 100K 5% 0.25W AXIAL
51/1040/100K
R9 RES 150 5% 0.25W AXIAL
51/1040/0150
R90 RES 150K 5% 0.25W AXIAL
51/1040/150K

R91 RES 560K 5% 0.25W AXIAL
51/1040/560K
R92 RES 10K 5% 0.25W AXIAL
51/1040/010K
R93 RES 2K2 5% 0.25W AXIAL
51/1040/02K2
R94 RES 2K2 5% 0.25W AXIAL
51/1040/02K2
R95 RES 64K9 1% 0.25W AXIAL
51/1010/64K9
R96 RES 64K9 1% 0.25W AXIAL
51/1010/64K9
R97 RES 64K9 1% 0.25W AXIAL
51/1010/64K9
R98 RES 15K 5% 0.25W AXIAL
51/1040/015K
R99 RES 15K 5% 0.25W AXIAL
51/1040/015K
RN1 RES PACK 100K X8 DIP16
52/2002/100K
RN2 RES PACK 10K SIP10
52/2002/010K
RV1 TRIMPOT 10K 1 TURN VERT
53/1020/010K
RV3 TRIMPOT 10K MULTITURN HOR
53/2060/010K
RV4 TRIMPOT 10K MULTITURN HOR
53/2060/010K
RV5 TRIMPOT 10K MULTITURN HOR
53/2060/010K
T1 TRANSFORMER LINE 600 OHM
37/2040/5065
U1 IC MIXER RX NE612N
25/2050/612N
U11 IC 3 STATE BUF 74HC244N
26/2030/244N
U12 IC EPROM 27C256
26/2090/C256
U13 IC 8 BIT LATCH 74HC573N
26/2030/C573
U14 IC MICRO SUPER MC34064P-5
26/2000/064P
U15 IC MICRO 68HC11A1P
26/2000/HC11
U16 IC RS232 INTER MAX232C
26/2001/232C
U17 IC ANALOG GATE MC14066B
26/2040/4066
U2 IC DUAL OP AMP MC3458
25/2050/3458
U22 IC DUAL OP AMP MC1458B
25/2050/1458
U24 IC HEX INVERT CD4049
26/2040/4049
U26 IC QUAD OP AMP TLC274
25/2050/274C
U27 IC QUAD OP AMP TLC274
25/2050/274C
U28 IC QUAD OP AMP TLC274
25/2050/274C
U3 IC IF AMP LIM DISC NE614A
25/2020/614A
U4 IC FREQ SYN MB1501 S016SP
26/2000/1501
U5 IC AUDIO AMP TDA2003
25/2070/2003
U6 IC VOLT REGULATOR LM7805
25/2040/7805
U7 IC QUAD NAND 74C00 DIP14
26/2031/4C00
XF1 CRYSTAL FILTER
33/2000/45MZ
XF2 CRYSTAL FILTER
33/2000/45MZ
Y1 CRYSTAL,45.455 HC-45/U
32/2045/45M4
Y2 CRYSTAL 5.0MHZ
32/2049/05M0
Y3 CRYSTAL 8.0MHZ
32/2049/08M0

L29 COIL 10mm 2T SHLD FRT COR

37/2022/0311
L31 COIL 10mm 2T SHLD FRT COR
37/2022/0311
L34 COIL 1 turn
37/2021/0310
L36 COIL 10mm 2T SHLD FRT COR
37/2022/0311
L38 COIL 10mm 2T SHLD FRT COR
37/2022/0311

CF1 FILTER CERAMIC CFS455G
34/2000/CFSG
R15 RES 470 5% 0.25W AXIAL
51/1040/0470
R24 RES 33K 5% 0.25W AXIAL
51/1040/033K

R220 TCX0 Ref. Osc.

X01 TCX0 12 MHz, HI-Q TC0474
32/3031/12.0