INSTRUCTION DATA

Dowty RFL Industries Inc. • Boonton, New Jersey

Model 65 AGC
Automatic-Gain-Control Module

DESCRIPTION

GENERAL

The Model 65 AGC Automatic-Gain-Control Module is an element of the RFL Series 6515 Single-Sideband Carrier System. In a typical system the 65 AGC is fed a pilot tone whose amplitude is compared against an internal reference. The difference between the two is used to control the gain of an amplifier in which the wideband composite signal, comprising all information passed through the system, is automatically adjusted to the nominal level. Because the pilot tone is part of the composite signal, the AGC system holds the level of all signals at the desired amplitude.

The Model 65 AGC will maintain the level of the composite signal at its output within ±1 dB for an input variation of +15 to −25 dB, referenced to 0.033V rms. It contains a detector for failure of the pilot tone. Failure of that signal is indicated both by extinguishing a lamp and by release of a relay with two sets of Form-C contacts, used for additional indication. (The relay is optional).

The philosophy of the design of the 65 AGC will be evident from a study of its block diagram, Figure 2.

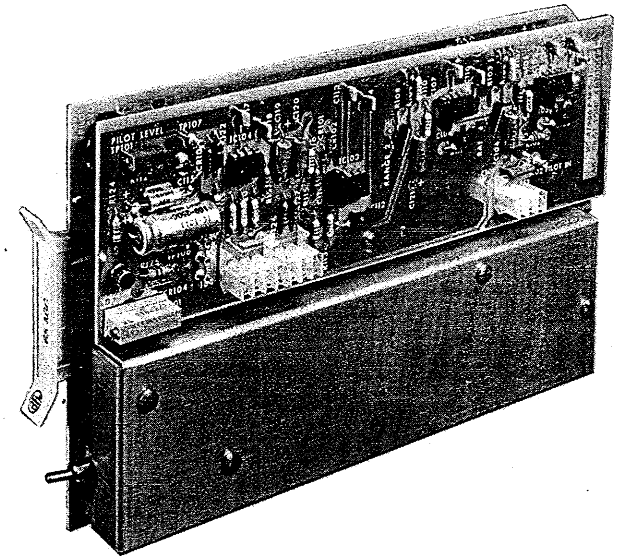


Figure 1. Model 65 AGC Automatic-Gain-Control Module.

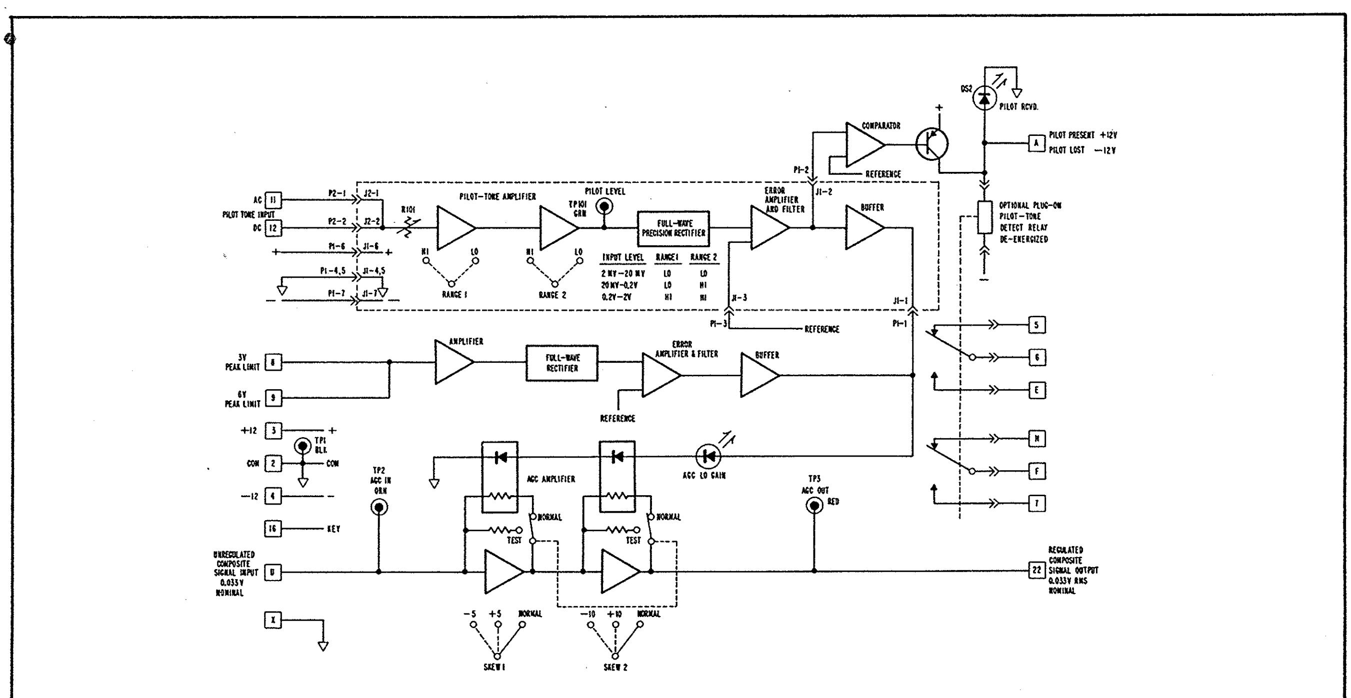


Figure 2. Block diagram of Circuits, Model 65 AGC.

APPLICATION

GENERAL

In most cases the 65 AGC will operate in conjunction with a signalling transceiver. The pilot tone, derived from that transceiver, will be used by the 65 AGC as the regulating signal. Generally, all bandpass filtering will be done on the signalling receiver, but a separate filter card may replace the transceiver in cases where the transceiver is not used.

The pilot tone may also be derived from the Model 65 SYNC Synchronizer card.

REPEATER–STATION APPLICATION

Some applications involve translating a group of signals down to some intermediate frequency, regulating, amplifying, and retranslating without reaching the baseband frequency. In such cases, the 65 AGC will be able to operate in conjunction with the Model 65 DNCONV Downconverter which would contain appropriate filters. This will enable the 65 AGC to operate from a tone located anywhere in the frequency range from 4 to 60 kHz. The 65 DNCONV will translate a tone down to baseband where it will be filtered with a selective bandpass filter. The tone will then enter the pilot-tone input of the 65 AGC.

SERIES 6515 Model 65 AGC Automatic-Gain-Control Modules	Basic Card HB-47260	Pilot-Tone-Detect Relay Option HB-47267		
65 AGC	•			
65 AGC-1	•	•		

SUMMARY OF TECHNICAL DATA

Input Level: 0 dBmo = 0.033 Vrms.

Dynamic Range: +15 dBmo to −25 dBmo. The dynamic range may be skewed by ±5, ±10, or ±15 dB.

Input Impedance: 10K ohms, unbalanced. This reduces to 5.6K for −5 dB skew, and increases to 17.8K for +5 dB skew.

Frequency Range: 4 to 60 kHz.

Output Level: 0.033 Vrms.

Output Impedance: The device appears as a voltage source of zero internal impedance.

Stiffness Ratio: ±1 dB change at the output for +15 to −25 dBmo change at the input.

Peak Detector and Limiter: Depending upon waveshape or on the number of discrete signals, the auxiliary peak detector will reduce the gain to maintain linear operation when the input to it peaks at 6 to 10 volts for the six-volt-limit input, or at 3 to 5 volts for the three-volt-limit input.

Distortion: Distortion and intermodulation products will be less than −60 dBmo for output levels of less than 0.33 Vrms (+20 dBmo).

Pilot-Tone Input Level: 0.002 to 2.0 Vrms in three decade ranges selected by placement of a jumper.

Pilot-Tone Input Impedance: 10K ohms.

Pilot-Tone Frequency: 1 to 60 kHz. If the pilot tone is not band limited, an external filter must be used with the 65 AGC.

Pilot-Tone Detector: The optional pilot-tone-detect relay will drop out when the input is below −31 dBmo.

Power Requirements: Both +12 Vdc, 130 mA, and −12 Vdc, 100 mA.

Dimensions: The Model 65 AGC occupies a circuit card 4.71 inches high by 8 inches deep, and it occupies three one-half-inch module spaces in an RFL Model 68 Chassis.

INSTALLATION AND MAINTENANCE

INTRODUCTION

When supplied by RFL as an element of a complete Series 6515 Single-Sideband Carrier System, the Model 65 AGC will be mounted in a chassis and interconnected as part of the system, and no special procedures for installation should be necessary. For other cases, including routine maintenance, the following notes will be helpful.

Figure 3 shows connections to the circuit card. Reference to the schematic of the circuit will make the meaning of the designations clearer. One suitable mating connector is TRW-Cinch Part 251-22-30-261, RFL Part HA-38545.

The following alignment procedure is recommended at time of installation when these circuit cards are used independently from a complete RFL system, and subsequently in all installations at times of periodic maintenance.

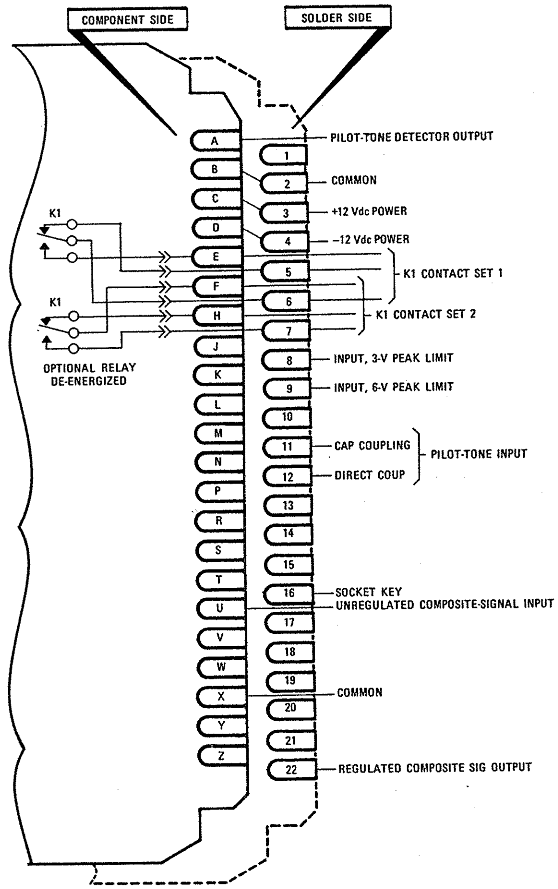


Figure 3. Edge-connector terminal assignments, Model 65 AGC.

ALIGNMENT PROCEDURE

TEST EQUIPMENT

The following test equipment is recommended:

(1) a high-impedance frequency-selective voltmeter, calibrated so that 0 dBm corresponds to 0.775 Vrms across 600 ohms.

(2) A cathode-ray oscilloscope.

(3) An oscillator with frequency range from at least 4 to 60 kHz.

(4) RFL Card Extender, Model HB-39585, to facilitate access to the circuit card.

PROCEDURE

(1) Turn Normal/Test switch to TEST.

(2) Set up the system so that a test tone enters the 65 AGC at normal level of 0.033 Vrms.

(3) Note that the level at TP3, AGC OUT, is the same as at TP2, AGC IN, within ±0.5 dB.

(4) Observe TP101, PILOT LEVEL, for a pilot-tone level of approximately 3.4 Vrms. Check with an oscilloscope for a clean sinewave. If this tone is not present, the system must be checked for generation of a pilot tone. The pilot-tone level at the input must correspond to the setting of the level jumpers listed in the table at the top-left corner of Figure 5.

(5) If the level is not correct, adjust R101. After the pilot-tone level is correct, turn the Normal/Test switch to NORMAL.

(6) With the switch at NORMAL, observe that the level at TP3, AGC OUT, is the same as at TP2, AGC IN. Readjust R101 if necessary.

(7) Set the skew straps to the desired setting as follows (refer to Figure 4):

Skew 1	Skew 2	Dynamic Range (dBmo)	
Normal	Normal	+15	−25
+5	Normal	+20	−20
−5	Normal	+10	−30
Normal	+10	+25	−15
	−10	+5	−35
+5	+10	+30	−10
−5	−10	0	−40

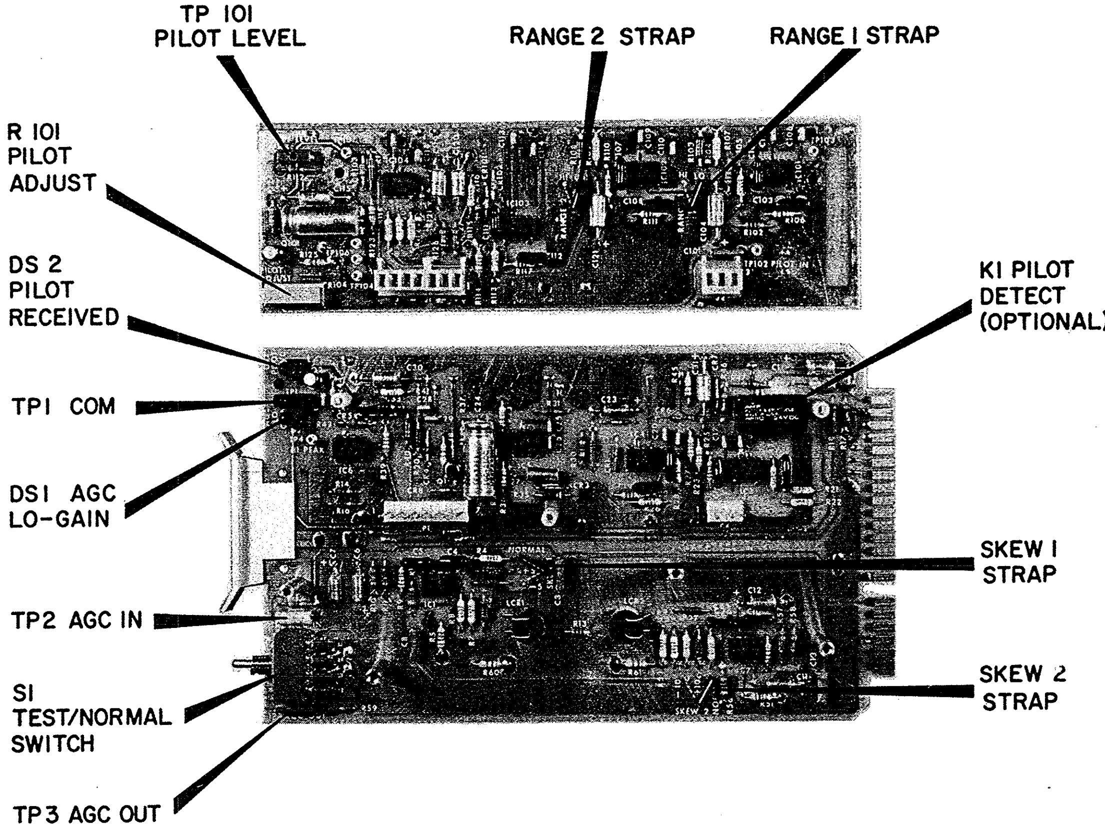


Figure 4. Location of adjustments, Model 65 AGC.

THEORY OF OPERATION

AGC–SIGNAL PATH

The unregulated, wideband composite signal enters the 65 AGC at Terminal U, Figure 5, which is the input to the variable-gain amplifier consisting of IC1 and IC2. The nominal test-tone level at this point is 0.033 Vrms. The variable-gain amplifier is nominally at unity gain, and components which control the gain are LED-coupled photo-resistors LCR1 and LCR2. These change the feedback factor of the operational amplifiers according to the amount of current fed into them from a control loop. There are two cascaded stages, each with a SKEW jumper which allows the dynamic range to be skewed by ±5 dB (SKEW 1), ±10 dB (SKEW 2), or ±15 dB (SKEW 1 and SKEW 2). Terminal 22 is the output for the regulated composite signal. The Test/Normal switch, S1, allows the photo-couplers to be bypassed. This sets the gain of IC1 and IC2 at unity to facilitate testing the system.

PRIMARY–CONTROL LOOP

The gain of the AGC amplifier is normally controlled by the level of the pilot tone as received at Terminal 11, used for ac-coupled input, or at Terminal 12, used for dc-coupled input. The gain of the pilot-tone amplifier, IC101 and IC102, is set to obtain an output of approximately 3.4 Vrms from IC102. The RANGE jumpers allow the pilot amplifier to accommodate a range of input-signal levels as shown in the table at the upper left of Figure 5.

From the pilot-tone amplifier the signal is fed to a precision full-wave rectifier, IC103, rectified, and then compared against the voltage across CR4, a 6.2-V zener diode, which acts as a gain reference. The difference voltage is amplified and filtered by an error amplifier, IC104. The filter is a single-pole RC network with a time constant of several seconds. The AGC time constant varies from several seconds at high input-signal levels to a fraction of a second at low levels of input signal.

The output of the error amplifier is buffered by emitter follower Q101 and then fed to the LED-coupled photo-resistors of each of the two cascaded variable-gain amplifier stages, IC1 and IC2. The gain of the AGC amplifier is controlled by changing the feedback ratios according to the magnitude of the error signal. DS1, an LED, provides visual indication of the state of the gain-controlled amplifier. A higher input signal will cause a brighter indication from the LED.

SECONDARY–LOOP CONTROL

Supplementing the primary-control loop, discussed in the foregoing, is a secondary loop which acts to control gain when the input signal has extremely high amplitude. This accommodates the case where the AGC circuit calls for maximum gain, as during startup or after accidental loss of signal. Thus, under the abnormal condition of extremely high-amplitude signals, the secondary loop can override the control of the primary loop, reduce the gain of the AGC amplifier, and thus maintain linear operation.

The input to the peak detector is applied at either Terminal 8, when a three-volt limit is required, or at Terminal 9 when a six-volt limit is desired. The signal enters the input of the full-wave rectifier, IC3 and IC4, and the rectified signal then enters a peak detector formed by R30, R32, and C23. The output of the peak detector is compared against the voltage across CR4, the gain reference. The difference voltage is amplified and filtered by error amplifier IC5, in which the filter is a single-pole RC network with a time constant of several seconds. The output of the error amplifier is buffered by emitter follower Q1 and summed with the output of Q101 of the primary-control loop.

The secondary-control loop will contribute to the current through LCR1 and LCR2 only if the peak input voltage exceeds the voltage limit of the input terminal chosen, either three or six volts.

PILOT–CARRIER ALARM CIRCUIT

The output of error amplifier IC104 is compared, at IC6, to a 1-Vdc signal derived from CR4 through R40 and R41. If the output from IC104 drops below 1 Vdc, the output of IC6 will swing high, to V+, and cause pilot-tone indicator DS2 to extinguish. This will occur when the input signal drops below −31 dBmo. In addition, the pilot-tone-detect relay, K1, an optional plug-on relay, will drop out.

TABLE 1.
REPLACEABLE PARTS
DRFL Model 65 AGC Automatic Gain Control Module, Assembly Number HB-47260

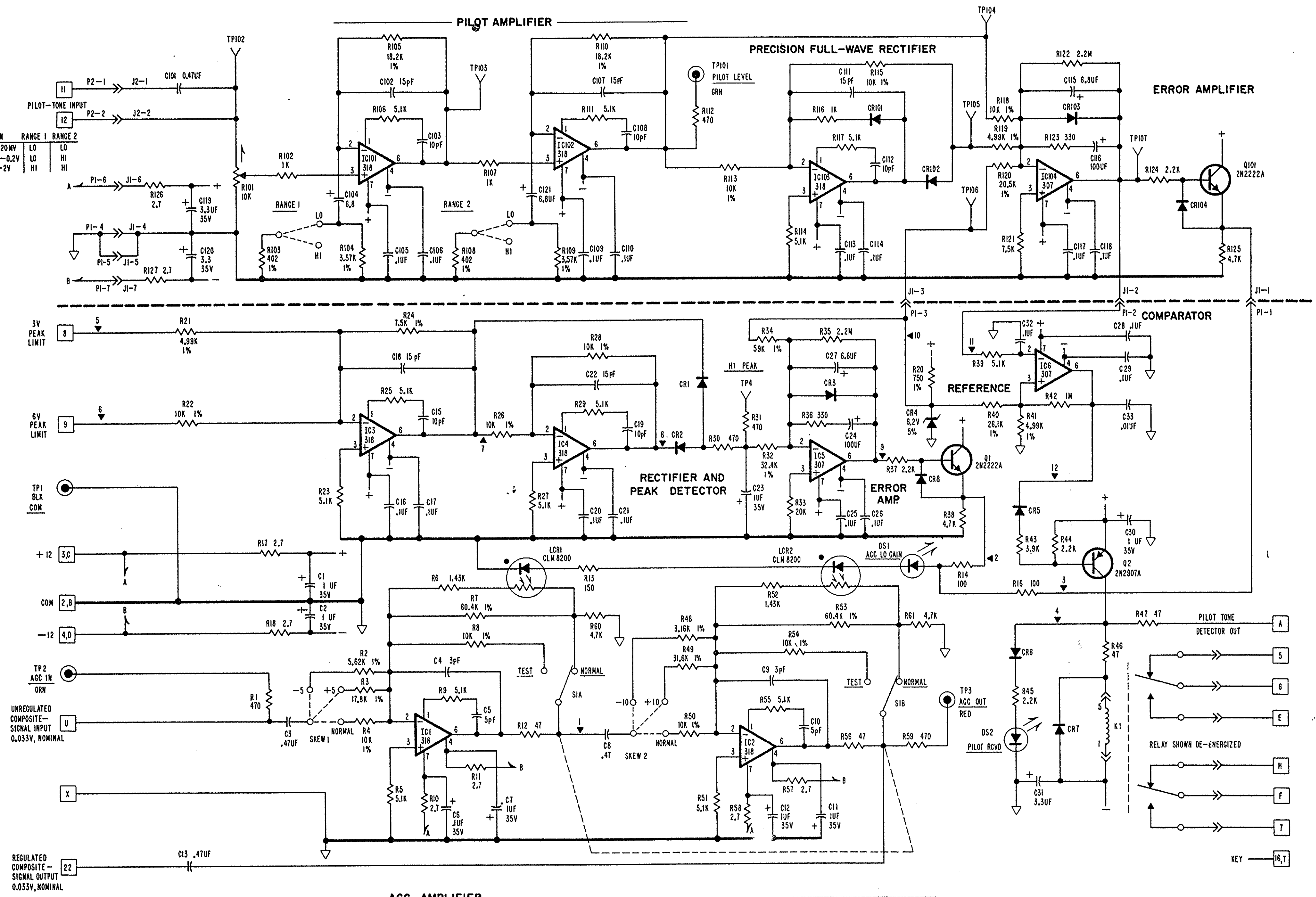
Circuit Symbol (Figure 5)	Description	DRFL Part Number
	CAPACITORS	
C1, 2, 6, 7, 11, 12, 23, 30	Capacitor, tantalum, 1μf, 10%, 35V, Kemet T110A105K035AS or equiv.	1007 1156
C3, 8, 13, 101	Capacitor, ceramic, 0.47μf, +80 -20%, 50V, Sprague 5CZ5U474D8050C5 or equiv.	1007 939
C4, 9	Capacitor, mica, 3pf, ±0.5pf, 500V, Electro-Motive DM-15 or equiv.	16502
C5, 10	Capacitor, mica, 5pf, ±0.5pf, 500V, Electro-Motive DM-15 or equiv.	16503
C14	Not used	
C15, 19, 103, 108, 112	Capacitor, mica, 10pf, 5%, 500V, Electro-Motive DM-15 or equiv.	16504
C16, 17, 20, 21, 25, 26, 28, 29, 32, 105, 106, 109, 110, 113,114, 117	Capacitor, ceramic, 0.1μf, 50V, Type GMV, Centralab CY20C104P or equiv.	1007-1366
C18, 22, 102, 107, 111	Capacitor, mica, 15pf, 5%, 500V, Electro-Motive DM-15 or equiv.	16506
C24, 116	Capacitor, electrolytic, 100μf, -10 +75%, 25V, Sprague 30D107G025DD2 or equiv.	1007 882
C27, 104, 115, 121	Capacitor, tantalum, 6.8μf, 20%, 35V, Kemet T322D685M035AS or equiv.	1007 655
C31, 119, 120	Capacitor, tantalum, 3.3μf, 20%, 35V, Kemet T322C335M035AS or equiv.	1007 1260
C33	Capacitor, ceramic disc, 0.01μf, 20%, 100V, Sprague C023B101F103M or equiv.	1007 1261
C34-100	Not used	
C118	Capacitor, ceramic, 0.1μf	1007 1366X
	RESISTORS	
R1, 30, 31, 59, 112	Resistor, metal film, 475 ohm, 1%, ¼W, Type RN¼	0410 1257
R2	Resistor, metal film, 5.62K, 1%, ¼W, Type RN¼	0410 1360
R3	Resistor, metal film, 17.8K, 1%, ¼W, Type RN¼	0410 1408

TABLE 1.
REPLACEABLE PARTS
DRFL Model 65 AGC Automatic Gain Control Module - continued

Circuit Symbol (Figure 5)	Description	DRFL Part Number
	RESISTORS – continued	
R4, 8, 22, 26, 28, 50, 54, 113, 115, 118	Resistor, metal film, 10K, 1%, ¼W, Type RN¼	0410 1384
R5, 9, 23, 25, 27, 29, 39, 51, 55, 106, 111, 114, 117	Resistor, metal film, 5.11K, 1%, ¼W, Type RN¼	0410 1356
R6,52	Resistor, metal film, 1.43K, 1%, ¼W, Type RN¼	0410 1303
R7, 53	Resistor, metal film, 60.4K, 1%, ¼W, Type RN¼	0410 1459
R10, 11, 17, 18, 57, 58, 126, 127	Resistor, composition, 2.7 ohm, 5%, ¼W, Allen-Bradley CB Series or equiv.	1009 900
R12, 46, 47, 56	Resistor, composition, 47 ohm, 5%, ¼W, Allen-Bradley CB Series or equiv.	1009 832
R13	Resistor, metal film, 150 ohm, 1%, ¼W, Type RN¼	0410 1209
R14, 16	Resistor, metal film, 100 ohm, 1%, ¼W, Type RN¼	410 1192
R20	Resistor, metal film, 750 ohm, 1%, ¼W, Type RN¼	0410 1276
R21, 41, 119	Resistor, metal film, 4.99K, 1%, ¼W, Type RN¼	0410 1355
R24, 121	Resistor, metal film, 7.5K, 1%, ¼W, Type RN¼	0410 1372
R32	Resistor, metal film, 32.4K, 1%, ¼W, Type RN¼	0410 1433
R33	Resistor, metal film, 20K, 1%, ¼W, Type RN¼	0410 1413
R34	Resistor, metal film, 59K, 1%, ¼W, Type RN¼	0410 1458
R35, 122	Resistor, composition, 2.2M, 5%, ¼W, Allen-Bradley CB Series or equiv.	1009 820
R36, 123	Resistor, metal film, 332 ohm, 1%, ¼W, Type RN¼	0410 1242
R37, 44, 45, 124	Resistor, metal film, 2.21K, 1%, ¼W, Type RN¼	0410 1321
R38, 60, 61, 125	Resistor, metal film, 4.75K, 1%, ¼W, Type RN¼	0410 1353
R40	Resistor, metal film, 26.1K, 1%, ¼W, Type RN¼	0410 1424
R42	Resistor, composition, 1M, 5%, ¼W, Allen-Bradley CB Series or equiv.	1009 798
R43	Resistor, metal film, 3.92K, 1%, ¼W, Type RN¼	0410 1345
R48	Resistor, metal film, 3.16K, 1%, ¼W, Type RN¼	0410 1336
R49	Resistor, metal film, 31.6K, 1%, ¼W, Type RN¼	0410 1432
R62-100	Not used	
R101	Resistor, variable, cermet, 20-turn, 10K, 10%, ¾W, TRW/IRC 980-20-10K or equiv.	38543
R102, 107, 116	Resistor, metal film, 1K, 1%, ¼W, Type RN¼	0410 1288
R103, 108	Resistor, metal film, 402 ohm, 1%, ¼W, Type RN¼	0410 1250
R104, 109	Resistor, metal film, 3.57K, 1%, ¼W, Type RN¼	0410 1341
R105, 110	Resistor, metal film, 18.2K, 1%, ¼W, Type RN¼	0410 1409
R120	Resistor, metal film, 20.5K, 1%, ¼W, Type RN¼	0410 1414
	SEMICONDUCTORS	
CR1-3, 5-8, 101-104	Diode, silicon, 1N914B or 1N4448	26482
CR4	Diode, Zener, 6.2V, 400mW, 1N753A	37498
DS1, 2	Light-emitting diode, Dialight 550-0102 or equiv.	39568
IC1-4, 101-103	Operational amplifier, LM318	0620 126
IC5, 6, 104	Operational amplifier, high-performance, LM307	0620 93
LCR1, 2	Photo-coupled isolator, Clairex CLM-8200 or equiv.	46545
Q1, 101	Transistor, NPN, 2N2222A	37445
Q2	Transistor PNP, 2N2907A	37439

TABLE 1.
REPLACEABLE PARTS
DRFL Model 65 AGC Automatic Gain Control Module - continued

Circuit Symbol (Figure 5)	Description	DRFL Part Number
	MISCELLANEOUS COMPONENTS	
K1	Relay, PCB-mount, dual DPDT, 5A contacts, 24V coil, Hi-G FS5-2A-124P or equiv.	44156
S1	Switch, toggle, 4PDT, PCB-mount, Dialight 573-4118-0301-100 or equiv.	46181
TP1	Test jack, black, E. F. Johnson 105-2203-101 or equiv.	38116 3
TP2	Test jack, orange, E. F. Johnson 105-2206-101 or equiv.	38116 6
TP3	Test jack, red, E. F. Johnson 105-2202-101 or equiv.	38116 2
TP101	Test jack, green, E. F. Johnson 105-2204-101 or equiv.	38116 5
— —	Shorting bar, Augat 8136-475G1 or equiv.	42904



NOTES:
1. TWO POLES OF S1 NOT USED AND ACT AS A SHIELD
2. ALL DIODES EXCEPT CR4 ARE IN914B
3. C14, R15, R19 NOT USED
4. ◉ DENOTES FRONT PANEL TEST JACK
5. Y DENOTES TEST POINT TURRET
6. ▼ DENOTES ETCH (SOLDER) SIDE

Figure 5. Schematic of circuit, Model 65 AGC.