Electronics

OPERATOR'S MANUAL

DUAL BAND BIDIRECTIONAL AMPLIFIER

MODEL A300

P/N 001-0300-001

Weston, Ontario

GUARANTEE

This unit is guaranteed for a period of one year from the date of shipment against failure due to defective parts or improper assembly.

This guarantee is limited to replacement of defective material and does not cover damages or other costs resulting from the use of this material whether used correctly or otherwise.

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SECTION 1. GENERAL INFORMATION

1. INTRODUCTION

1.1.1 **Scope of Manual** - This manual is intended to familiarize service personnel working on the Dual Band Bidirectional Amplifier A300 with all pertinent aspects of the amplifier. Included in this manual are a brief physical description, a technical summary, installation information and operating data.

1.1.2 **Purpose of Equipment** - The A300 amplifier is used as a drop-in booster for SMR (800 MHz trunking) and PCS signals carried on 50 ohm coax cable. The amplifier will simultanously amplify signals in the SMR and PCS transmit bands in one direction and the SMR and PCS receive bands in the opposite direction. A typical use of the A300 is to provide SMR and PCS phone coverage in underground installations.

1.1.3 **Physical Description** - The bidirectional amplifier, shown in Figure 3-1, is designed to be mounted on a flat vertical surface. The unit has two N connectors for connection to the distribution cable and two BNC test ports to check RF signals. A 5-pin DIN receptacle is provided for local power source connection. Color coded indicators provide visual display of the unit's operating status.

1.1.4 **Electrical Description** - The bidirectional amplifier provides approximately 20 dB of gain for signals in the 804 - 824 MHz and 1850 - 1910 MHz bands in the direction of J1 to J2 (antenna to base) and the same amount of gain for signals in the 850 - 870 MHz and 1930 - 1990 MHz bands in the opposite direction (J2 to J1).

1.1.4.1. - The unit is locally powered through a 5-pin DIN receptacle. The P.G. Electronics PS293 power source should be used to power the unit. The unit provides DC continuity from J1 to J2 to allow powering of downstream amplifiers from upstream power sources such as PS212 and PS213. Local power is isolated from J1 and J2.

1.1.4.2. - The unit monitors bias conditions of active devices in the RF path and monitors downlink power in both bands. If one of these devices draws more or less than a predetermined limit, or if the RF downlink power is low then the FAULT indicator will go on. Under normal operating condition only the green NORMAL indicator will be on.

1.1.4.3. - If a FAULT condition is detected the unit transmits a low frequency identification code along the cable center conductor. The burst transmission is repeated at approximately 80 second intervals, while a fault condition exists. The fault reporting circuitry is powered from the cable.

1.1.4.4 - If a NORMAL condition exists in the amplifier a low frequency OK identification code will be transmitted on the cable at intervals of approximately 80 minutes.

1.1.4.5 – The unit has an adjustable attenuator in each band to allow operation at reduced gain. The attenuator is settable in 1 dB steps up to 15 dB either manually or by using an optional AUTOSET control board.

1.2 TECHNICAL SUMMARY

TABLE 1-1

Performance Characteristics and Salient Features of the A300 SMR/PCS Bidirectional Amplifier

Parameter	Specification			
1. Input Power:	24 - 28 VDC @ 3 A Max. (use PS293)			
	SMR		**PCS**	
2. Frequency Range*: (MHz)	Uplink: 804-824	Downlink: 850-870	Uplink: 1850-1910	Downlink: 1930-1990
3. Gain:	20dB ±1.5dB			
4. Impedance	50 Ohms			
5. VSWR	2:1 Typical, 3:1 Maximum			
	SMR		**PCS**	
6. Composite Output Power Rating** (dBm)	Uplink: +9	Downlink: +24	Uplink: +4	Downlink: +24
7. Output 1dB Compression Point (dBm)	Uplink: +17	Downlink: +33	Uplink: +12	Downlink: +33
8. 3rd Order Output Intercept Point (dBm)	Uplink: +32	Downlink: +45	Uplink: +27	Downlink: +45
9. Attenuator Range	0 to 15 dB in 1 dB steps (in each band)			
10. Environmental Limits	(a) Temperature Range: -30°C to 60°C operating (b) Relative Humidity: to 90%			
11. Dimensions and Weight				
(a) Overall Dimensions:	9.8”(249mm) L x 6.7”(170mm) W x 6.7”(170mm) H			
(b) Mounting Hole Dims:	9.0”(229mm) x 5.0”(127mm)			
(c) Weight:	6.0. lb (2.7 kg)			
12. Connectors:				
RF Input/Output	Type N Female			
RF Test Input/Output	Type BNC Female			
DC supply	5-pin DIN receptacle			

NOTES: * Specifications apply only across the customers actual bands, not across the whole PCS spectrum.

** Refer to Table 1-2 for definition of composite output power rating.

NOTE IMPORTANT RATING INFORMATION

Manufacturer's rated output power of this equipment is for single carrier operation. For situations when multiple carrier signals are present, the rating would have to be reduced as per Table 1-2, especially where the output signal is re-radiated and can cause interference to adjacent band users. This output power reduction is to be achieved by reduction of input power or by gain reduction and not by an attenuator at the output of the device.

TABLE 1-2

Rated Power Output for Linear Operation

The total composite output power in multiple tone or wideband signals shall NOT exceed the following level or else it may result in improper operation of the device and cause interference. The composite output power rating is defined as the total average RMS output power of all inband signals. The unit should be operated at or below this level to ensure linear operation with low distortion. This holds true for any number of carriers with total average power adding up to the composite output power rating listed in the table below.

SMR Base Transmit (Downlink)	+24 dBm
SMR Portable Transmit (Uplink):	+9 dBm
PCS Base Transmit (Downlink):	+24dBm
PCS Portable Transmit (Uplink):	+4dBm

SECTION 2. THEORY OF OPERATION

2.0 GENERAL

As explained in Section 1, the A300 is a bidirectional amplifier, which provides 20 dB of gain in both the SMR and PCS wireless transmit and receive bands. The block diagram of the amplifier is shown in Figure 2-1.

2.1 DESCRIPTION

2.1.1 - The unit is composed of two diplexers, two independent bidirectional amplifiers and alarm and voltage regulation circuits.

2.1.2 - The diplexers U1 and U2 divide power between the SMR and PCS bidirectional amplifiers. In each bidirectional amplifier additional bandpass diplexers separate signals for the uplink and downlink amplifiers.

2.1.3 - The bias condition of devices in the amplifiers is monitored. If the bias changes outside certain limits a fault condition is indicated. The downlink RF output power in each band is also monitored. If the power in either band drops below established limits a FAULT condition is indicated.

When a FAULT condition occurs the unit transmits the unit identification (or "Fault Code") by two level amplitude modulation of a low frequency carrier placed on the cable center conductor. The signal is transmitted as a short burst repeated at approximately 80 second intervals while the fault condition persists. The fault code can be reprogrammed as described in Section 3.2. While a NORMAL condition exists the amplifier transmits an OK code at intervals of approximately 80 minutes.

2.1.4 - The voltage regulators take 24 - 28 VDC input and provide 20 VDC and 12 VDC outputs. A zener diode provides transient protection against voltage spikes on the cable.

2.1.5 - The A300 dual band bidirectional amplifier requires external DC power to be supplied through the 5-pin DIN receptacle. The unit should be powered locally by the PS293 external power source. The local power source is isolated from J1 and J2.

The unit provides DC continuity from J1 to J2 to allow downstream cable powered amplifiers to receive their power from upstream power sources such as the PS212 and PS213. In addition, status signals from downstream cable powered amplifiers are passed through the amplifier from J1 to J2.

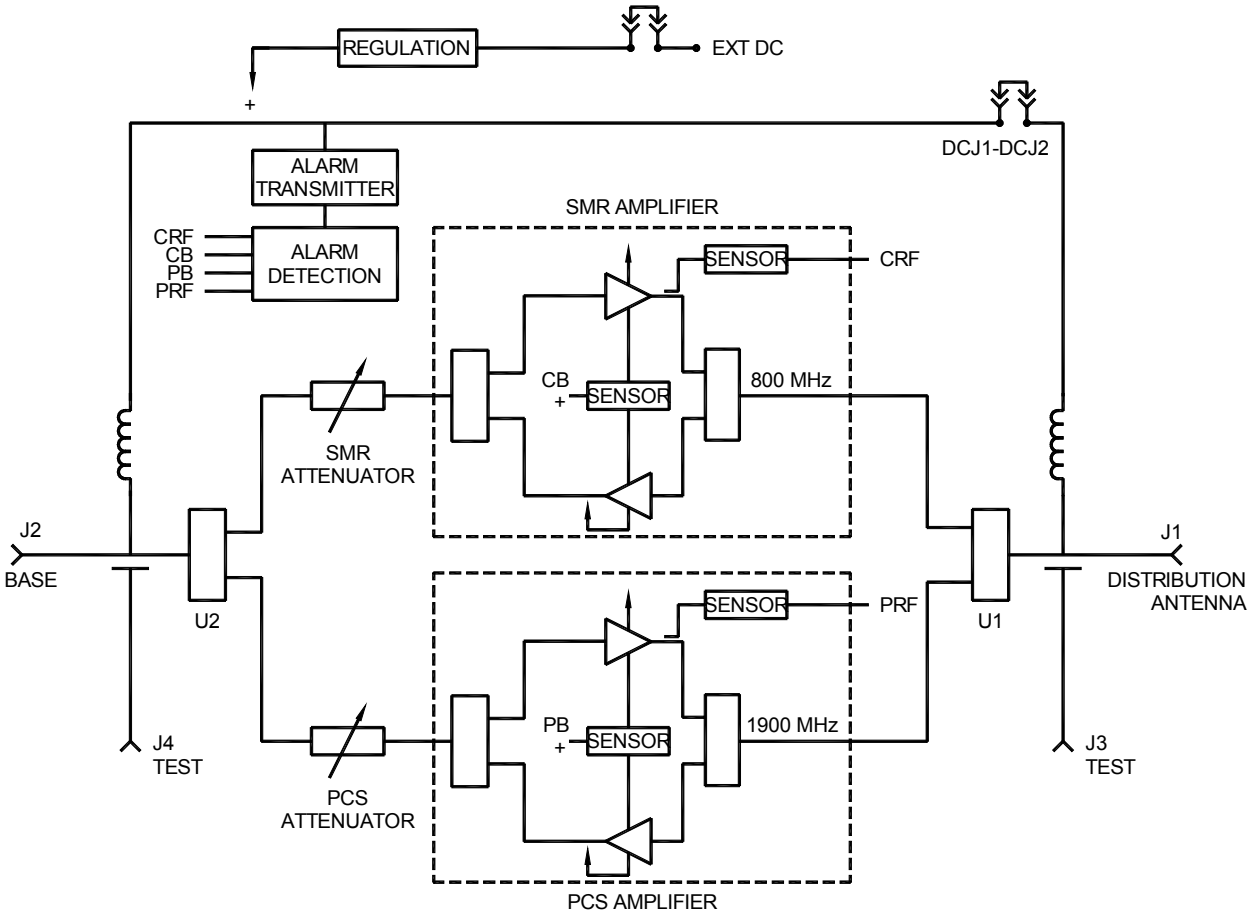


Figure 2-1. A300 Bidirectional Amplifier - Block Diagram

2.2 FAULT REPORTING

2.2.1 General - The amplifier incorporates a number of circuits to detect deviations in important performance parameters. The unit reports alarm conditions to a remote Monitor unit such as the Model PS212.

The various functions are described in this section and may also be referenced in Section 4 where the programming of amplifier options is discussed.

2.2.2 Report Types - The unit generates two types of reports depending on the status of the amplifier as determined by the built in monitor circuits. Each type consists of a numeric code sent as low frequency tones along the coaxial cable for decoding at the monitor unit.

Under normal operation the unit will transmit an "OK" code at intervals of approximately 80 minutes. This enables the system monitoring unit to keep track that the whole system is connected and operational. In this mode a local green NORMAL LED lamp is illuminated on the side of the amplifier.

In the event that a fault is detected in the amplifier, as described later, a "FAULT" code is transmitted on the cable at intervals of approximately 80 seconds. In this mode a local red FAULT LED is illuminated on the amplifier. Four LEDs on the side of the unit indicate which specific local condition is causing the overall FAULT condition as described in the next section.

In each case the code transmitted identifies the transmitting amplifier by the FAULT CODE programmed in that particular amplifier as described later in Section 4.6. Before shipment P.G. programs each amplifier with an arbitrary code from 1 to 199 which is also shown by a label on the outside of the unit.

NOTE: - Older models of P.G. bidirectional amplifiers such as the A181 or A188 transmitted only fault codes, but are compatible with the fault codes transmitted by the A300. When used with a PS212 Monitor, the A181 or A188 codes should be entered in the ID list as "FAULT ONLY" (TFO) type units. If the A300 is used with a PS200 PS/Monitor the OK code transmission (STATUS option) should be disabled (section 4.4) as it will cause the PS200 to display a FAULT alarm. Fault codes above 199 should not be set on any amplifiers since they may be incorrectly interpreted by the newer PS212.

2.2.3 Fault Conditions - The A300 circuitry monitors four separate parameters in the unit. These are (a) the bias currents drawn by devices in both the amplifiers and (b) the presence of downlink RF output power in each band. Each function can be disabled as described in Section 4, if the unit is being used in a restricted operational mode.

The DC current monitoring triggers a fault condition if DC bias current deviates outside predetermined high or low current limits.

The downlink RF output power from each frequency band is monitored by separate detectors and a FAULT condition is triggered if the level in either band drops below a nominal level of + 5 dBm. If the amplifier is to be installed at a point in the system where the output power in either band may be less than +7 dBm then the RF monitor circuit for the appropriate band should be disabled as described in Section 4 herein.

The local fault indicators indicate specific faults as follows:

SMR

BIAS Bias fault in the SMR amplifier
PWR Low downlink RF power from the SMR amplifier

PCS

BIAS Bias fault in the PCS amplifier
PWR Low downlink RF power from the PCS amplifier

NOTE: There is a certain situation in which the red “FAULT” indicator will be on even though none of the cellular or PCS “BIAS” or ‘PWR” indicators are on. This situation occurs when the unit is receiving local power and downlink RF powers are normal but the cable power is not present. This indicates that the cable power source located upstream has been switched off or has shut down.

SECTION 3. INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS

3.1 UNPACKING AND INSPECTION

The following checks are recommended after receipt of the equipment from shipping agent:

1. Check for any external damage that could have occurred in transit. If damage is found, report to the shipping agent and to the supplier immediately.

2. Check that all items on the packing slip are present. If any are missing, report to the supplier immediately.

3. The amplifiers all have been programmed at the factory with the following settings.

   DC Continuity: - J1 and J2 both connected for through power.
   Alarm options: - Bias and RF engaged for both bands.
   Alarm Code: - Consecutive numbers assigned.
   (Check for duplication if two lots used).
   Attenuation: - -Set to zero attenuation in both bands if autoset board not installed.

   It is suggested that known changes required to these settings be made on the bench before the units are installed at the site. Consult section 4.0 for more information on this task.

3.2 INSTALLATION

The bidirectional amplifier is designed for mounting on a flat vertical surface The unit is mounted with the indicator side down for adequate air circulation. Proceed as follows:

1. Locate a suitable mounting location, allow a clearance of at least 5 inches (13 cm) to route mating cable and connectors to the unit. Drill four pilot holes on 9 x 5 inch centers for No.10 fasteners.

2. Mount the amplifier ensuring there is good air circulation around the amplifier.

3. Connect J2, "BASE" to the cable leading to the base transmitter.

4. Connect J1, "ANTENNA" to the cable leading to the distribution antenna(s).

   If it is known that the programming has been correctly preset as required by the system plan then this completes the installation. It is recommended the alarm code, alarm option settings and attenuation settings for each amplifier be recorded on the system "as-built" drawing. Otherwise perform the steps below as required.

5. If DC continuity, attenuation, alarm options or alarm code must be changed, remove the cover plate from the amplifier to provide access to the programming jumpers.

   NOTE: Section 4.0 of this manual describes programming details. For convenience a reduced size copy of diagram Figure 4-1 is provided on the inside of the amplifier cover as a reference.

6. If the unit is NOT required to pass DC down the line to another amplifier then it is recommended that the DC jumper to J1 be removed to provide DC isolation at J1. See Section 4.1.

7. If certain fault alarms should be disabled then reprogram the appropriate jumpers as described in Section 4.3.

8. If it is required to change the factory set alarm code then program the appropriate jumpers as described in Section 4.6.

9. If the SMR and/or PCS attenuators must be set then refer to section 4.2. If the optional AUTOSET control board is fitted, skip this step.

10. Replace the amplifier cover. NOTE: It must be correctly oriented to fit properly.

This completes the installation.

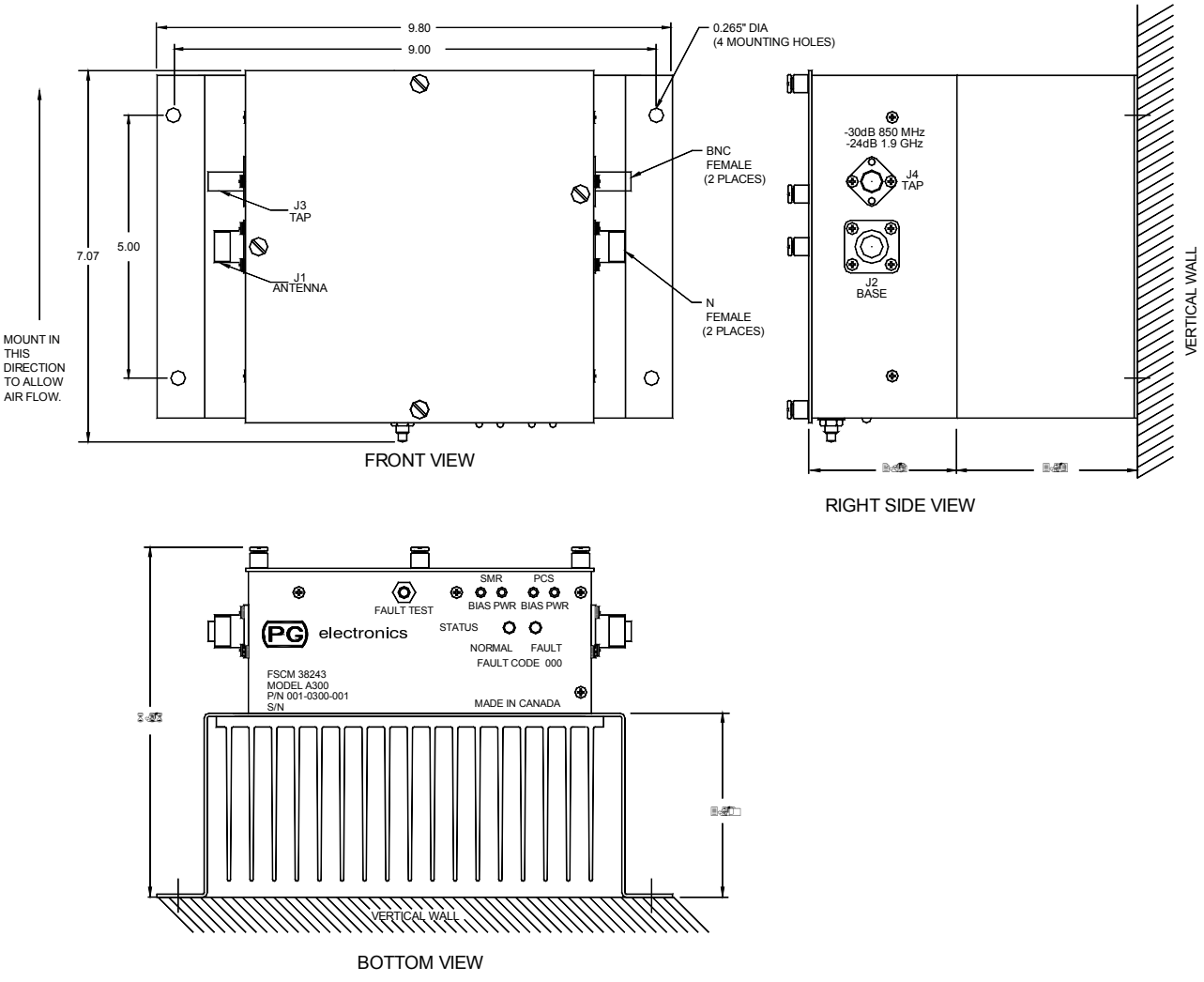


Figure 3-1. Installation Data

3.3 OPERATING INSTRUCTIONS

The A300 dual band bidirectional amplifier has no external controls. When powered the unit will amplify signals in each band and in each direction.

When the green light is on, bias conditions of active devices in the RF paths are within specifications and the downlink power in each band is above the minimum preset limit. The red FAULT light goes on whenever a monitored active device in the RF paths has failed or the downlink output power is too low. Corrective action is to check if the input power in each band is correct and then to check the fault conditions as indicated below.

3.4 FAULT CONDITIONS

If the FAULT light is illuminated it indicates that one of the following conditions have occurred. Four LEDs on the side of the unit show the status of the RF and DC bias alarms and indicate the source of the fault conditions.

3.4.1 Low RF power ("PWR" LED on) - Check the level of RF power out of the amplifier by connecting a meter or spectrum analyzer to the Test Port J3. The actual level is higher than the measured level by 30 dB at SMR and 24 dB at PCS frequencies. If the RF fault option is enabled a fault will occur if the RF power in either band falls below approximately +5 dBm.

By measuring the RF input power at J4 the correct functioning of the amplifier can be checked. The gain should be approximately 20 dB minus the inserted attenuation.

3.4.2 DC Bias Change ("BIAS" LED on) - A DC bias alarm indicates a fault in the amplifier for the particular frequency band indicated. This condition mandates replacement of the amplifier except as noted below.

NOTE: - The SMR uplink amplifier will show a DC bias alarm if the amplifier is driven into saturation by excessive RF power levels. A true DC bias fault will persist when RF carriers have been reduced in level.

SECTION 4. PROGRAMMING OPTIONS

4.0 PROGRAMMING OPTIONS

The amplifier contains a number of options which are programmed before the unit is installed, or may be adjusted during system installation or modification. They are set in a default setting by PG before shipment. A summary diagram of these jumpers is affixed to the inside of the removable amplifier cover for use in the field, but a larger view is shown herein (Fig 4-1) together with the following description of these settings.

It is suggested that when jumpers are removed to break a circuit, that they be reinstalled on one pin at the same location to keep them readily available if the option is reselected at a later date.

4.1 DC CONTINUITY (DC)

A DC jumper is provided to permit the amplifier to isolate J1 from DC if there is NO need for downstream power and particularly if a DC grounded device is installed in series with the amplifier. Removing the jumper breaks the DC connection from connector J2 to J1, and is recommended practice.

The jumper is labelled “DCJ1 DCJ2”. The jumper provides DC continuity to the J1 and J2 connectors. The “EX” is used to provide connection from the local power DC receptacle to power the amplifier. The “EX” jumper should always be installed.

NOTE: Breaking the DC connection also disconnects the low frequency FAULT code from being transmitted along the cable from a downlink amplifier or power supply.

4.2 ATTENUATION (AC AND AP)

The A300 amplifier has a nominal overall gain of 20 dB in both the SMR and the PCS frequency bands, but this gain may be reduced by built-in attenuators included in each frequency band. The attenuators are installed on the uplink side of the amplifier and hence do not have significant impact on the uplink system noise figure.

The attenuator for each band is set for values from 0 to 15 dB by four jumpers in a binary sequence. Setting the jumpers to the “IN” position inserts, 1, 2, 4 or 8 dB attenuation in the circuit for that band. Refer to the label attached to the inside of the cover for an enlarged view of these jumpers and their setting positions.

NOTE: The jumpers must be set to either the IN or OUT positions for correct attenuator operation. Do not leave open. If the optional AUTOSET control board is fitted, see Appendix A for further information.

4.3. FAULT OPTIONS (F)

The block of four jumpers for the fault options allows disabling of each of four tests by removing the appropriate jumper.

The jumpers to monitor downlink RF power are labelled CRF for the SMR band and PRF for the PCS band.

The jumpers to disable amplifier bias current monitoring are labelled CB for the SMR amplifier and PB for the PCS amplifier.

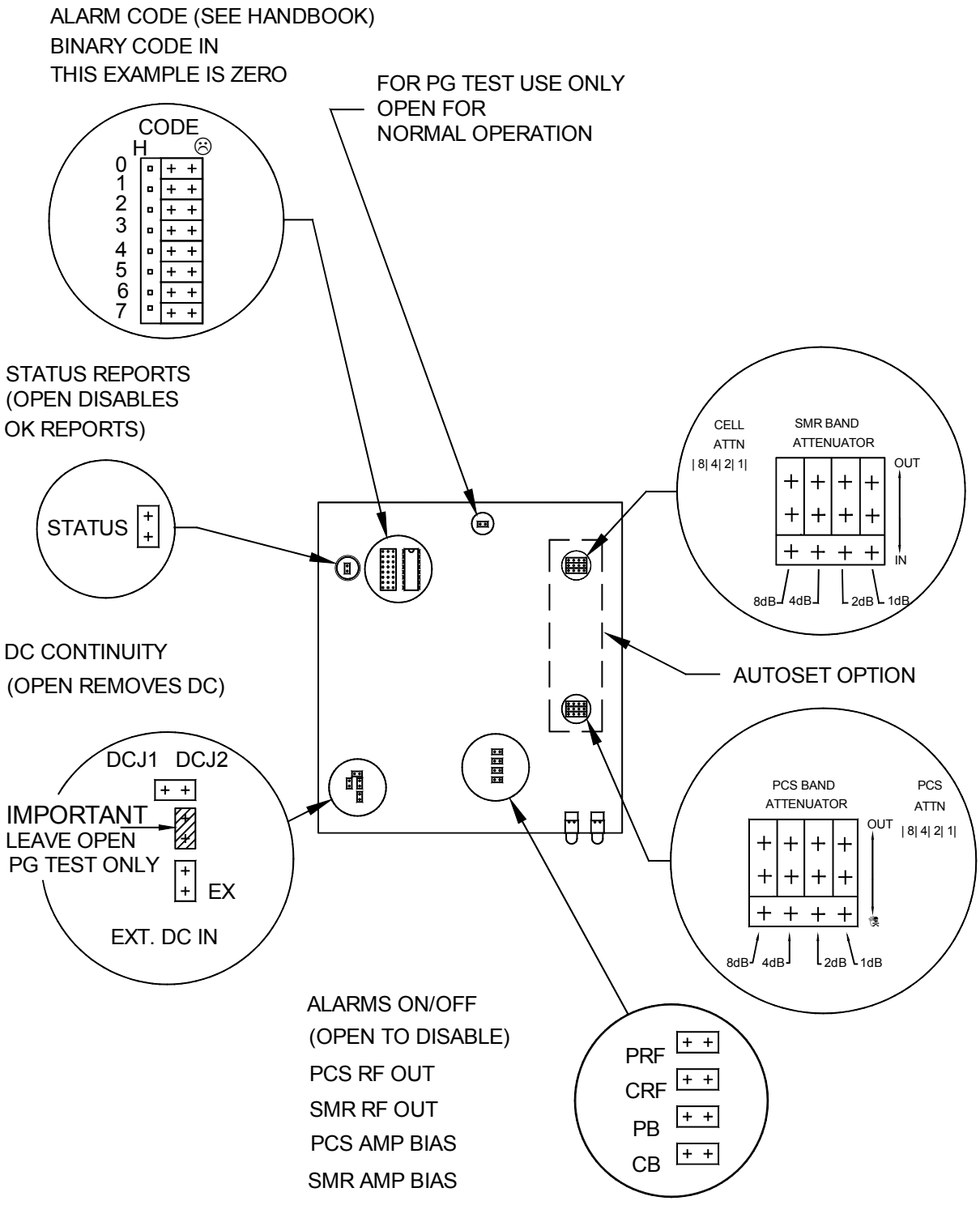


Figure 4-1. A300 Programming Options - Jumper Locations

4.4 STATUS OPTION (S)

If it is desired to use the amplifier in a system that has "Fault only" monitoring such as is provided by the PS200 unit, then the "OK" reports may be disabled by removing the STATUS jumper.

4.5 TEST (T)

The test jumper location does not have any function in normal system operation. It is provided for use in FAT testing in the factory by speeding up the rate of OK code reporting. It should be open for normal operation.

4.6 FAULT CODE (C)

If it is required to change the factory set Fault Code to the operator's custom plan then follow the following steps:

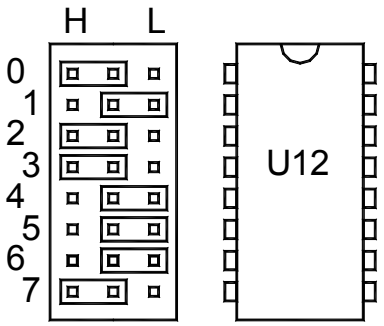
1. Refer to the jumper field with a block of eight jumpers labelled 0 to 7 in Figures 4-1 and 4-2.

2. The code is programmable in binary with the numbers 0 to 7 representing the power of 2, i.e., the jumper is $2^3 = 8$. When the jumper is on the H side the count is included. When the jumper is on the L side the count is zero for that binary digit.

3. Before reprogramming check the examples, Figure 4-2, and examine the factory set code as a starting point.

NOTE: The center pin “C” MUST be jumpered to EITHER the “H” or “L” side for a correct code to be sent. Do not leave open.

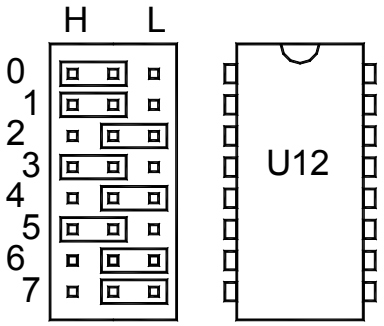
EXAMPLE 1:



$2^0 \times 1 = 1$
$2^1 \times 0 = 0$
$2^2 \times 1 = 4$
$2^3 \times 1 = 8$
$2^4 \times 0 = 0$
$2^5 \times 0 = 0$
$2^6 \times 0 = 0$
$2^7 \times 1 = 128$
code = 141

H = HIGH OR IN
L = LOW OR OUT

EXAMPLE 2:



$2^0 \times 1 = 1$
$2^1 \times 1 = 2$
$2^2 \times 0 = 0$
$2^3 \times 1 = 8$
$2^4 \times 0 = 0$
$2^5 \times 1 = 32$
$2^6 \times 0 = 0$
$2^7 \times 0 = 0$
code = 43

H = HIGH OR IN
L = LOW OR OUT

NOTE: DO NOT SET FAULT CODE ABOVE 199.
FAULT CODES ABOVE 199 ARE RESERVED

Figure 4-2. Fault Code Setting Examples

APPENDIX A

AUTOSET ATTENUATION OPTION (IF INSTALLED)

A-1 GENERAL

The AUTOSET optional gain control board installs on the jumper pins normally used for manual setting of the gain control attenuators referred to in Paragraph 4.2.

When installed the AUTOSET board automatically limits the amplifier output power to the maximum composite level compatible with low intermodulation performance.

A-2 INSTALLATION

The AUTOSET board has four jumpers which are set depending on whether the amplifier is being used as an IN-LINE or ANTENNA amplifier. An IN-LINE amplifier normally passes power to downlink amplifiers and is set to a slightly lower power level to minimize cascading of IM products. The jumpers are set in accordance with Figure A-1.

A-3 OPERATION

The AUTOSET controls each individual amplifier on a stand-alone basis. The AUTOSET system has two modes of operation.

When initially powered the AUTOSET goes into an AGC mode where it tracks the composite output power and adjusts the attenuator to maintain maximum output power. This mode continues for approximately 90 minutes until the system achieves temperature stability.

At this point the AUTOSET switches to a LIMITER mode in which it only adds attenuation if the power input increases above the final setting value. This eliminates the system hunting which might interact with system power control or cause near/far loss of signal.

If however power in the systems is increased by the addition of more channels the gain will adjust downward to avoid distortion products.

The AUTOSET system can be configured to operate in a continuous AGC mode by installing the “AM” shunt. In this mode, the AUTOSET operates in AGC mode indefinitely and will not switch to a LIMITER mode.

Each time the system (or amplifier) is repowered the setting cycle is repeated.

AUTOSET SHUNT POSITIONS

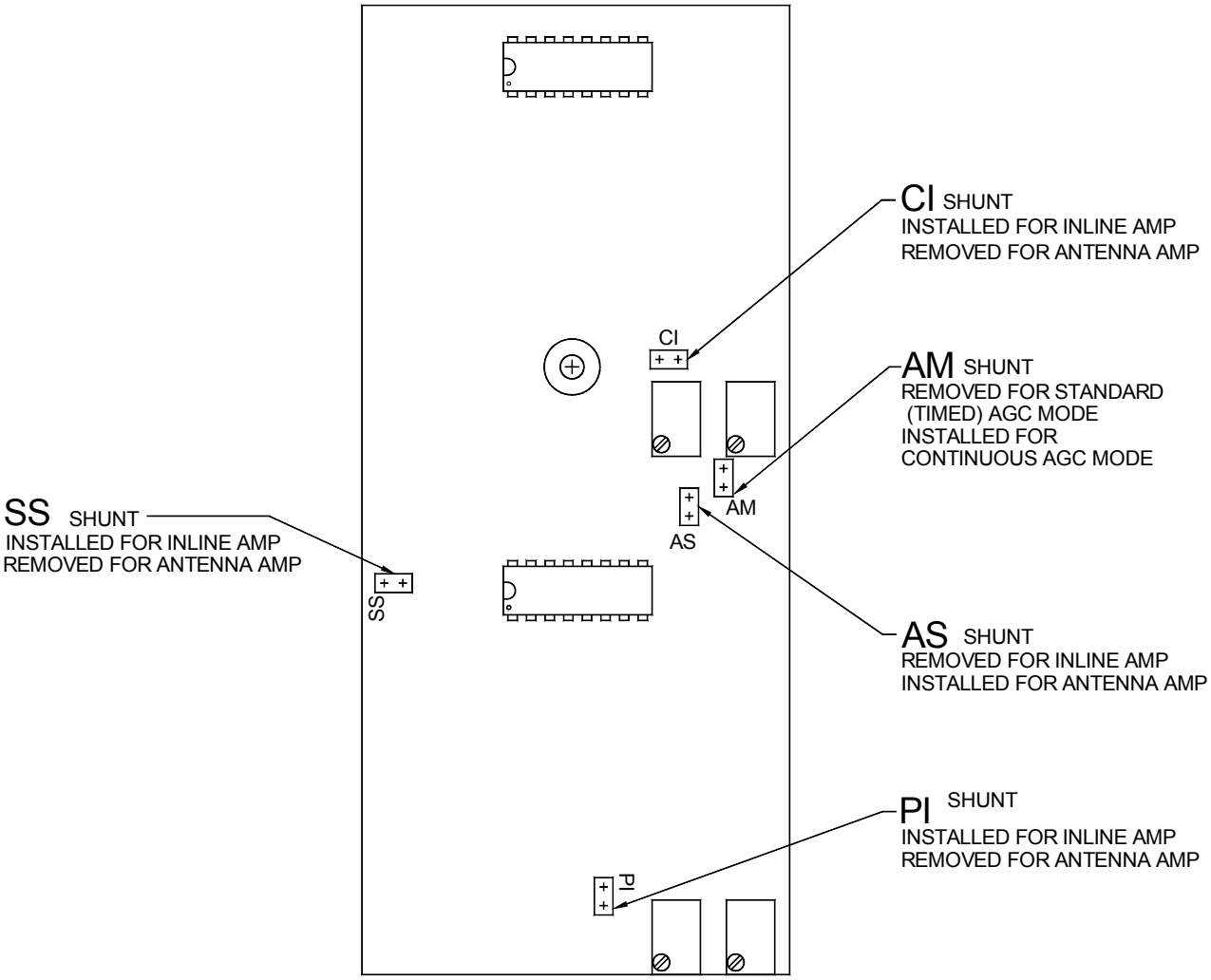


Figure A-1. Autoset Shunt Positions.

TABLE A-1

Shunt Installation

UNIT TYPE	SHUNT				
	CI	AS	PI	SS	DCJ1 DCJ2 (Mainboard)
INLINE AMPLIFIER	**I**	**R**	**I**	**I**	**I**
ANTENNA AMPLIFIER	**R**	**I**	**R**	**R**	**R**

Note: I = Shunt installed
R = Shunt removed