

DST2496I2

DATA STATION TERMINATION UNIT With LINE OR LOCAL POWER

CLEI Code DSTOBFCAA

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1.0 GENERAL DESCRIPTION

1.01 The DST2496I2 is a full function analog Data Station Termination Unit in a 200-type shelf form factor that performs standard and advanced DST2496I2 functions. The DST2496I2 can be powered locally or via line power, and can be programmed to respond to a variety of loopback frequencies in addition to the standard 2713Hz.

Reissue

1.02 Issue 2 of the DST2496 improves the products ability to detect 2413 Hz frequency. Whenever this practice is reissued or revised, the reason for reissue or revision will be stated in this paragraph. Rev. 001 reflects corporate address and phone number change.

1.03 Standard features include:

- Remote loopback via 2713 Hz tone (as per Bellcore PUB 43004), or programmable for 2413Hz, 2513Hz, 2813Hz, or 2913Hz Loopback
- Line Power or Local Power Options
- Extended temperature range -40° to 85°C
- Manual loopback activation and deactivation
- Remote or Local Provisioning
- 20 minute loopback time-out on tone activated loopback
- 3-tone and 4-tone remote alignment of the receive channel gain and equalization at either DLP (Data Level Point) or TLP (Transmission Level Point)
- Remotely variable transmit channel gain: -8 dB, 0 dB, +4 dB
- Transformer coupled, balanced facility side ports switch selectable for 150/600/1200 ohm impedance

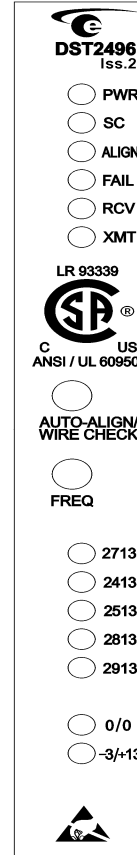


Figure 1. DST2496I2

- Facility side self-resetting fuses and solid state overvoltage suppressors
- Transformer coupled, balanced, 600 ohm 4/2-wire drop side port(s) include overvoltage suppressors
- Switch selectable sealing current options: generate internally with power-on 'ZAP', terminate, or provide externally via the SX leads on the card edge
- Operation from -24 VDC to -55 Vdc power source
- Operation from sealing current (8mA typical)
- Front panel LED indicators: RX activity, TX activity, sealing current, power, and mode of operation
- 100 Hz increment transponder: returns nearest xx14 Hz tone from 300 Hz to 3200 Hz or quiet-line termination
- Auto-slope transponder returns 1004 Hz, 404 Hz, 2804 Hz tone sequence

- Non-volatile memory for retention during power outages
- Recessed WIRE CHECK pushbutton activates the wiring check mode which allows verification of proper hook-up
- Wiring check mode deactivation by pressing the WIRE CHECK pushbutton, 60 minute time-out, or by sending loopback activation tone
- TEK leads on card edge open during loopback
- Locally or remotely activated Auto Align mode by which two units align each other independently
- Switch selectable 2- or 4-wire drop side interface

2.0 APPLICATIONS

2.01 The DST2496I2 provides an interface between a 600-ohm 4-wire or 2-wire data set and a 4-wire voice quality transmission line. The unit provides equalization, impedance matching, line conditioning, sealing current, test tones, and loopback.

Loopback

2.02 The DST2496I2 is set to a factory default 2713Hz loopback frequency, but can be configured for the alternate loopback frequencies associated with FAA (2413Hz) and other utility-type applications (2513, 2813, 2913Hz). Operating mode can be changed remotely from Command Mode via tone commands, or manually from the front panel.

2.03 Remote loopback is activated by a 2713 Hz (or other programmed frequency) ±7 Hz tone at >-30 dBm on the receive channel. The tone must appear for at least 2.5 s and then be removed in order to be valid. Loopback is deactivated by the same tone appearing for at least 0.9 s. The DST2496I2 will automatically time out of loopback after 20 minutes.

Operating Levels

2.04 Receive channel gain and equalization are automatically set by performing a 3 or 4 tone alignment. The incoming receive signal passes through overcurrent and overvoltage protection circuitry and is coupled through a multi-impedance (150/600/1200 ohm) transformer to the processing circuitry. The processed receive signal is coupled to the terminal equipment via a 600 ohm output transformer.

2.05 Transmit-out channel level is factory set for -8dB DLP +5dB TLP. Transmit out levels are remotely adjustable in Command Mode in .5dB increments. Incoming signal from demarc is coupled through a 600 ohm transformer to the processing circuitry. The processed transmit signal is coupled to the facility lines through a multi-impedance (150, 600, 1200 ohm) transformer and subsequent overvoltage and overcurrent protection devices.

Table 1. Operating Levels

PORT	Standard Levels -3/+13 TLP		FAA 0.0/0.0 TLP	
	TLP	DLP	TLP	DLP
RCV IN	+5 to -10 (TLP) or -8 to -23 (DLP) all modes			
RCV OUT	-3	-16	0	-13
XMT IN	+13	0	0	-13
XMT OUT	+5	-8	+5	-8
* XMT OUT level adjustment range +7 to -16dBm (TLP) or -6 to -29dBm (DLP)				

2.06 Facility side transient protection consists of self-resetting PolySwitch™ fuses and solid-state overvoltage protection. This protection scheme is designed to withstand lightning induced transients and protect the circuitry of the DST2496I2. Customer side protection includes solid-state overvoltage suppression to protect the customer and customer equipment.

Power

2.07 The DST2496I2 derives power either from a local DC power supply (-24 to -56Vdc), or from line power from the central office or remote end simplex power source. The DST2496I2 first looks to the local power source, and if unavailable, can automatically switch to the line powering (simplex) source if it exists on the facility.

2.08 The DST2496I2 has a sealing current (simplex) supply that provides a nominal 20 mA simplex current to the facility side. This current source may be bypassed so that the unit provides a return path for the sealing current generated at the facility or so that sealing current may be provided by an external module (i.e.. to the simplex leads). The front panel SEALING CURRENT LED (SC) is illuminated whenever there is sealing current present.

LED Indicators

2.09 The DST2496I2 has 13 front panel LED indicators – PWR (POWER), SC (SEALING CURRENT), Align (LOOPBACK/ALIGN), FAIL, RX (Receive), TX (Transmit), loopback frequency indicators 2713, 2413, 2513, 2813, 2913, and demarc level indicators 0/0 & -3/+13. See **Figure 1**: Front View of the DST2496I2 for more information.

The green *PWR* LED indicates that the module is powered. The green *SC* LED indicates the presence of simplex current on the facility. The yellow *ALIGN* LED reflects the mode of the module and can be interpreted according to Table 2: Mode Indicators. The red *FAIL* LED indicates the unit is in Wire Test Mode, or has failed to align to C5 conditioning. The *TX* & *RX* LEDs indicate the presence of data (-22 dBm threshold) on the transmit and receive channels, respectively.

Table 2: Mode Indicators

MODE	ALIGN LED	FAIL LED
Normal Operation	Off	Off
Loopback	Flashing	Off
Command Mode	On	Off
Wiring Check	Off	Flashing
C5 Align Failure	Off	On (5 minutes)

Loopback Frequency

The red LED’s marked 2713, 2413, 2513, 2813, & 2913 indicate the frequency that the unit is programmed to respond to loopback and command mode commands. Only one of the five loopback frequency LED indicators will be lit at any time. The DST2496I2 is set to factory default of 2713Hz loopback, and this is the top LED in the sequence. The next most common loopback frequency is 2413Hz for FAA circuit applications, and this is second in the sequence. The other LEDs for 2513, 2813, and 2913Hz are occasionally used for utility applications. Whichever frequency the unit is currently programmed to use, the corresponding LED will be illuminated.

Demarc Levels

2.10 The customer levels at the point of demarcation (demarc) can be changed independently from the loopback frequency. The **0/0** or the **-3/+13** LED will indicate which levels are currently programmed.

The drop side (demarc) levels are defaulted to level of -3RCV/+13XMT (TLP) when the unit is shipped from the factory. The unit can be optioned for 0/0 (TLP) interface levels from the front panel switch or remotely via command mode tones.

2.11 The power supply is fully regulated to provide a constant voltage to all on-board systems. Regulator dropout occurs at -22 Vdc input voltage. At approximately -60 Vdc the power input protection diode starts to conduct. This limits the high-end voltage. The voltage for the sealing current supply is provided directly from the edge connector and thus is dependent on the applied input voltage.

3.0 INSTALLATION

3.01 Upon receipt of the equipment, perform a visual inspection for signs of damage. If the equipment has been damaged in transit, immediately report the damage to the transportation company and to Ingenuity Communications per instructions in paragraph 6.

CAUTION

Product contains static sensitive components. Electrostatic discharge (ESD) procedures must be followed.

3.02 Prior to applying power to the DST2496I2 set the option switches as required (see section 5: Options).

3.03 The DST2496I2 mounts in one position of any standard 200 or 400-type shelf, or mounting. **NOTE:** Pin 1 is used for manual loopback, and many newer digital NCTE mountings use this pin for ground. If the DST2496I2 goes into loopback immediately when installed in a mounting shelf, then change option S6 (see para. 4.06) near pin 1 on the card edge connector to allow operation in the shelf. Using this option, manual loopback can still be achieved using the manual loopback button or remote loopback command.

3.04 Electrical connections are made through the 56-pin card edge connector. The pin designations are outlined in Table 2: DST2496I2 Pin Designations.

Table 3: DST2496I2 Pin Designations

PIN	NAME	DESCRIPTION
7	RT	Receive In Tip
13	RR	Receive In Ring
9	SXR	Receive Simplex
41	TT	Transmit Out Tip
47	TR	Transmit Out Ring
43	SXT	Transmit Simplex
5	DRT	Receive Out Tip (4W)
15	DRR	Receive Out Ring (4W)
55	DTT	Transmit In Tip (4W), In/Out Tip (2W)
49	DTR	Transmit In Ring (4W), In/Out Ring (2W)
21	TEK5	Terminal Equipment Control
23	TEK6	Terminal Equipment Control
1	MNLB	Manual Loopback
19	MNLG	Manual Loopback Ground
35	-BATT	-24 Vdc to -56 Vdc filtered input
17	GND	Ground
	CH	Chassis Ground
27	GND	

Powering

3.05 The DST2496I2 will operate via local or line power. Local power from -22 to -56 Vdc (nominal -48Vdc) at 50mA is recommended. The unit first looks to the local power source, and if not found, then looks to simplex power (line power) of >8mA @ -48Vdc. If the unit loses local power during normal operation, internal circuitry will automatically switch to line power, if available. Once local power is restored, the unit will switch back to the local source.

Wiring Check

3.06 Once the DST2496I2 has been installed in the mounting shelf, the Wire Check feature can be used to check for proper wiring continuity to the transmission ports of the unit. Using a pen (or similar instrument), the **Auto-Align/Wire Check** button is pressed for less than 5 seconds and released. (Pressing the button greater than 5 seconds initiates **Command Mode**).

The unit sends out tones per Table 4 until the switch is again pressed, or until the unit reaches the one-hour time-out.

Table 4: Wire Check

PORT	4W Demarc	2W Demarc
RCV IN	Continuous 1234Hz	Continuous 1234Hz
XMT OUT	Interrupted 1234Hz	Interrupted 1234Hz
RCV OUT	Continuous 1234Hz	
XMT IN/2W	Interrupted 1234Hz	Interrupted 1234Hz
In 2W applications, RCV OUT & XMT IN utilize the same pairs (XMT IN, T&R, pins 55 & 49).		

4.0 OPTIONS

4.01 The DST2496I2 has switch selectable options for the facility impedance, sealing current and 2-wire/4-wire interface modes. Refer to **Figure 3: Option Switch Locations**.

Facility Impedance Switch (SW1)

4.02 Set SW1 for 150, 600, or 1200 ohms as required by the facility line impedance.

2W/4W Drop Side Interface Switch (SW2)

4.03 Set SW2 to 4W (4-wire, 600 ohm) or 2W (2-wire, 600 ohm) as required by the drop side (data modem) equipment.

Sealing Current Select Switch (SW4)

4.04 Set SW4 to GEN if sealing current generation is required. In this mode, the DST2496I2 will supply -48Vdc at 20ma, typical, to the facility. The far end unit (such as another DST2496I2) should be set to TERM to complete the circuit. **NOTE:** The DST2496I2 must be locally powered to operate in this mode.

Set SW4 to SX (center position) to turn off sealing current or to provide sealing current externally via the SX leads on the card edge.

Set SW4 to TERM to complete the sealing current path if sealing current is being supplied by the facility. This is the factory default switch setting. SW4 must be set for TERM for simplex current (remote) powering. If local power is present on the edge connector (pins 17 and 35), the DST2496I2 will power from the local power source. If the local power source is not present, the DST2496I2 will operate from the sealing current (8mA typical) if switch SW4 is set to TERM.

LED Indicators

4.05 The DST2496I2 is equipped with 13 LED indicators (see Figure 1.). Upon initial installation, the Power LED will illuminate, along with the other default settings: 2713HZ, -3/+13. Additional LED's will illuminate (XMT, RCV, SC) depending on the circuit status and option settings during initial installation.

Manual Loopback Option Active or Open

4.06 Switch J1, J2 provide manual loopback when pin 1 is connected to ground (pin 19), and must be set in the

same positions for proper operation. These are factory set "Open". In many of the more recent NCTE mounting shelf designs, pin 1 is normally connected to ground. If the DST2496I2 enters loopback when power is first applied to the unit, it will be necessary to change opt. J1/J2 to the "open" position. This will not affect either remote or front panel loopback operation. **NOTE:** In some older multi-mount shelves, pin 19 is common across card positions and this can create a service-affecting conflict between different manufacturer's DST units. If pin J1/J2 are in the active positions, test for continuity to be certain that pin 19 is NOT common across the backplane of a multi-mount shelf.

5.0 OPERATION AND ALIGNMENT

Command Mode, Lpbk Frequency, & Demarc Levels

5.01 The front panel recessed FREQ button allows for local selection of loopback activation frequencies and demarcation signal levels.

5.02 When the unit has been powered and wiring has been verified, the unit is factory optioned to loopback at 2713Hz, and -3/+13 (TLP) signal levels at the demarc.

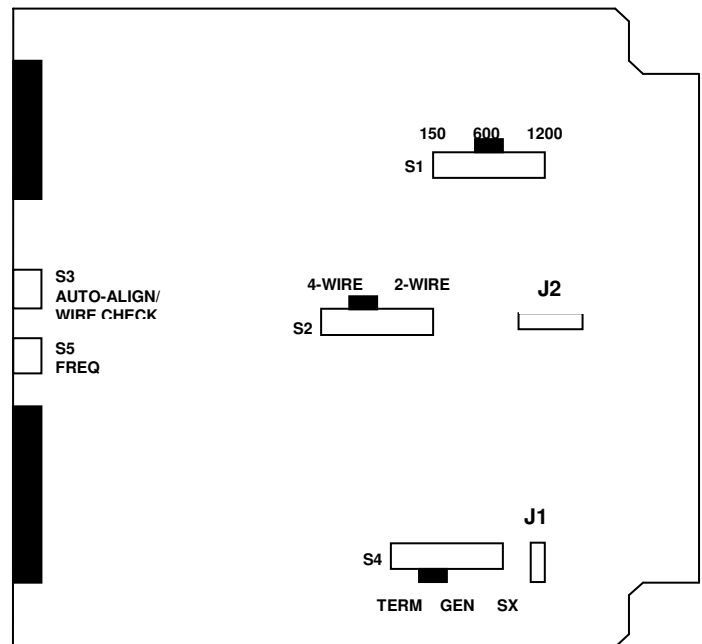


Figure 2: Option Switch Locations

The technician can program the DST2496I2 for other frequencies and levels by depressing and releasing the FREQ button. Each time the button is pressed, the LED on the front panel illuminates the next available frequency or level. When the desired option is illuminated, the unit will wait 5 seconds, and then set to that option and store the setting in non-volatile memory. **NOTE:** These optioned can also be changed remotely. See paragraph 5.33 for instructions on changing loopback/command mode frequencies and demarc levels.

Default Settings

5.03 To return the DST2496I2 to the default parameters, press and hold the **FREQ** button for greater than 10 seconds. The default settings are: 2713Hz LPBK, -3/+13 dBm demarc levels, flat equalization, & fixed gain.

Loopback

5.04 The loopback frequency of the DST2496I2 can be locally or remotely programmed to any one of the following five frequencies: 2713, 2413, 2513, 2813, or 2913Hz. The DST2496I2 is set at the factory to loopback at 2713Hz, and this is the most commonly used frequency. FAA circuit applications usually require 2413Hz & 0/0 dBm demarc levels, and the other loopback frequencies are occasionally used for some utility applications.

5.05 The currently programmed loopback frequency will be indicated by the front panel LED. To initiate loopback, send 2713Hz (or other programmed frequency) for greater than 1.5 seconds (but less than 30 seconds) and remove the tone. The DST2496I2 enters loopback.

Unit Identification

5.06 The DST2496I2 has been designed to incorporate the features of several older generation DST's into one unit. To identify this unit, when the DST2496I2 receives the loopback command, it returns a repeating ramp-up tone until the loopback tone is removed, or until it enters command mode.

Menu/Command Mode

5.07 The DST2496I2 can be placed in Menu/Command mode at any time directly from idle mode. From Menu/Command mode the DST2496I2 can be configured, aligned and other special modes accessed (refer to **Figure 5: DST2496I2 Command Mode Menu**).

Send the loopback activation tone (2713Hz or other programmed loopback frequency) for a minimum of 30 seconds. The DST2496I2 will respond with the command mode menu tone of 1014 Hz. **NOTE:** If the DST2496I2 is idle in command mode for greater than 5 minutes, it will exit command mode and return to normal.

The 1014 Hz menu tone signifies entry into the Menu/Command mode where the user can select TLP or DLP alignment levels, select TX gain levels, change loopback frequencies & demarc levels, and access transponder, and alignment modes of operation.

TLP/DLP Toggle

5.08 The DST2496I2 acknowledges command tones by returning response tones after reception of the command.

To toggle between TLP and DLP levels, send either 2804 Hz or 2904Hz for 5 s or greater when the unit is in the Command Mode. Listen for the 13 dB change in level (+13dB for toggle to TLP, -13dB drop for toggle to DLP).

When the 2804/2904Hz tone is removed, the unit returns to Command Mode.

Exit Command Mode

5.09 Command mode can be exited at any time while the unit is transmitting the 1014Hz command tone by sending the loopback activation tone for a minimum of 5 seconds. The DST2496I2 will return to idle mode.

Remote Alignment

5.10 Alignment of the DST2496I2 gain and equalization parameters is accomplished remotely from the facility via the central office or remote test system.

First, the desired reference level must be selected. The DST2496I2 defaults to TLP (+5 dBm) reference level when Menu/Command mode is activated. In the TLP mode the DST2496I2 aligns its gain and equalization parameters based on tones originating from the test center at +5 dBm. Tones generated by the DST2496I2 during alignment and transponder modes also originate at +5 dBm. In the DLP mode, the DST2496I2 aligns its gain and equalization parameters based on tones originating from the test center at -8 dBm. Tones generated by the DST2496I2 during alignment and transponder modes also originate at -8 dBm. If necessary, verify TLP/DLP setting per paragraph 5.08 above.

The remote alignment procedure can be abandoned at any point in the process by sending the loopback activation tone for 5 s or greater. In this event the previous alignment settings are maintained.

Four-Tone Alignment

5.11 The four-tone alignment procedure is recommended for all installations. The four-tone alignment procedure is detailed in Table 8: Four-Tone Alignment Procedure.

Three-Tone Alignment

5.12 The three-tone alignment procedure is intended for use on non-loaded cable installations. The three-tone alignment procedure is detailed in Table 6: Three-Tone Alignment Procedure.

Three or Four Tone Alignment Procedures

5.13 To continue with the alignment procedure from Command Mode, record the level of the 1014 Hz Command Mode tone received from the remote DST2496I2. Send 1004 Hz for a minimum of 5 seconds to proceed with the alignment. The DST2496I2 will respond with 2814 Hz, indicating entry into the alignment sequence. Record each level as received. The technician follows with similar tones, sending 2804Hz. The unit again responds with 414Hz, and the technician sends 404Hz. The unit responds with 1814Hz for 120 seconds.

(5.13 Continued) If the technician sends 1004Hz at this point, or waits for the 120 second timer to expire, then the unit aligns to three tones. Refer to Table 6 for the 3-tone alignment procedure or Table 8 for the 4-tone alignment procedure.

5.14 If the technician sends 1804Hz while the unit is returning 1814Hz, then the unit aligns to four tones. The DST2496I2 calculates receive gain and equalizer settings based on the amplitudes of the received tones. The resulting receive channel response is flat. Upon completion of either 3 or 4 tone alignment, the DST2496I2 will signal success or failure of the alignment process. If C5 conditioning requirements are met, a ramp-up tone sequence from 314Hz to 3014Hz is returned by the unit, and the unit drops out of Command Mode and enters Loopback. A ramp down sequence from 3014Hz to 314Hz will be returned if the unit fails to meet C5 conditioning parameters, and the "FAIL" Led indicator will illuminate for 5 minutes.

5.15 The DST2496I2 enters loopback immediately after three or four tone alignment to allow the test technician to verify alignment settings. Even if the unit fails to align to C5 conditioning, it is possible that alignment meets lesser acceptable parameters such as C2, and this can only be verified manually. The FAIL LED will illuminate on the DST2496I2 for 5 minutes after alignment that fails to meet C5 parameters, and then is extinguished.

5.16 The new gain and equalization settings are stored in non-volatile memory for retention during power fail situations. The DST2496I2 is shipped with a default of 8 dB receive channel loss and flat receive equalizer response.

Quiet Termination / Transponder

5.17 The DST2496I2 features a full range transponder: 314 to 3214 Hz, 100 Hz steps. The quiet termination and transponder tests can be performed referenced specifically at either TLP or DLP levels, or referenced to current test mode. In TLP mode, the DST2496I2 output is normally at +5dBm, or at the current XMT OUT level established in the XMT OUT Level Adjust Mode if such adjustment was necessary. In DLP mode, the DST2496I2 returns tones at -8 dBm, or at the current XMT OUT level established in the XMT OUT Level Adjust Mode if such adjustment was necessary.

TLP/DLP Transponder

5.18 To activate TLP Quiet Term./Transponder from Command Mode, send 804 Hz. To activate in DLP, send 1304Hz. To activate in current mode (either TLP or DLP), send 404Hz. (See Figure 4: DST2496I2 Command Mode Flowchart for more information.)+

5.19 Upon detecting 804, 1304 or 404Hz while in Command Mode, the DST2496I2 applies a quiet termination at the XMT IN port and sets a 20-minute timer. The technician performs noise measurements at the RCV OUT port. If no tones are received within the 20-minute time period, the unit returns to normal. If the unit detects the

Loopback tone (2713Hz or alternate programmed frequency), the unit returns to Command Mode.

Full Range Transponder

5.20 The full range transponder allows test technicians to perform detailed level verifications tests over the full range of frequencies from 300 – 3200Hz. The full range transponder is accessed from the Quiet Termination/Transponder Mode while in Command Mode. To activate the full range transponder mode, send any tone except 404 Hz or Loopback for >5 seconds while in the Quiet Termination Mode. If the unit receives 404Hz as the first tone, it will initiate 4-Tone Auto Sweep (see para. **6.13**) The DST2496I2 responds with the XX14 Hz tone nearest the tone being sent to it. Each new tone must be sustained for at least 3 seconds. For example, send a tone between 1751 Hz and 1850 Hz for 3 seconds, and the DST2496I2 will respond with 1814 Hz. The transponder tones originate at the selected TLP or DLP level.

5.21 Difficulty may arise when using the transponder with tones near the loopback activation frequency. Loopback activation frequency tones applied for 5 seconds will return the DST2496I2 to idle mode. Also, 15 seconds after the input signal to the DST2496I2 is removed or drops below -30 dBm a quiet termination will result. This will be maintained until a valid tone is sent or 20 minutes elapses. After 20 minutes the DST2496I2 will return to normal idle operation. The operation of the 100 Hz transponder is demonstrated in Table 12: Full Frequency Sweep Procedure. The procedure for using the transponder quiet termination is presented in Table 15: Transmit Channel Noise Testing.

4-Tone Auto Sweep

5.22 The 4-tone auto sweep is activated only from Quiet Termination Mode. Upon detecting 404Hz as the first tone while in Quiet Termination Mode, the DST2496I2 sweeps 1014Hz, 2814Hz, 414Hz, and 1814Hz each for 15 seconds from the XMT OUT port (pins 41, 47), and then returns to a quiet termination and resets the timer circuit to 20 minutes.

Auto Slope Transponder

5.23 The DST2496I2 includes an Auto Slope Transponder on the RCV IN port (pins 7, 13). The Auto Slope Transponder is activated by sending 604Hz into the RCV IN port for 5 seconds while in the Command Mode. The DST2496I2 will respond by sending (out of the RCV IN port) 1008 Hz for 60 s followed by a quiet termination for 60 seconds. The unit then sweeps (at 0dBm) 408 Hz for 30 seconds, 1808Hz for 30 seconds, and then 2808 Hz for 30 seconds. The DST2496I2 will return to Command Mode after completion of the tones.

Alignment Query

5.24 The Alignment Query command allows the remote technician to verify the DST2496I2 alignment status. This is activate from Command Mode by

(5.24 Continued) sending 1204Hz to the unit. The unit returns a ramp up tone (300 – 3000Hz) indicating that the unit met C5 parameters during its most recent alignment, or a ramp down tone if it failed. The unit then returns to Command Mode.

Power Query

5.25 The Power Query command allows the remote test technician to determine if a power interruption has occurred since the last alignment or query. To perform a power query, send 1504Hz to the unit while in Command Mode. The unit returns a ramp up sequence (300 to 3000 Hz) if power has not been interrupted since the last query or alignment, or a ramp down sequence if a failure has occurred.

Auto-Alignment

5.26 The DST2496I2 will automatically align another DST2496I2 or compatible data station termination unit. The Auto-Alignment process can be initiated either remotely or from the front panel of the DST2496I2. Press and hold the AUTO-ALIGN/WIRE CHECK on the front face of the DST2496I2 to begin the Auto-Alignment process. The LOOPBACK/ALIGN LED indicator will initially light and begin to flash when the process begins. At this point the pushbutton can be released.

5.27 To remotely initiate Auto-Alignment, send either 1804Hz or 1904Hz for 5 seconds or greater while in Command Mode, then remove tone and monitor the circuit. The DST2496I2 initiates the Auto-Alignment sequence and sends tone sequences to the remote DST2496I2 (or other remote align DST2496I2 with 2713Hz loopback frequency) to align the remote unit receive gain and equalization. The local DST2496I2 is also aligned for receive gain and equalization. An alternating acknowledgment tone is sent to confirm proper C5 conditioning. An alternating 1004/404 Hz tone indicates successful C5 conditioning. A constant 704 Hz tone indicates a failure to condition the channel to within C5 parameters. The DST2496I2 then returns to Command Mode.

XMT OUT Level Adjust

5.28 The XMT OUT (pins 41, 47) level can be adjusted from +7 dBm to -16dBm TLP (-6 to -29dBm DLP). The XMT OUT level is adjusted by adding gain/loss to the +5.0dBm TLP level until the desired result is obtained. Gain/loss is adjusted in .5 dB increments. Also, the XMT OUT level can be set to -16dBm by sending a single command.

5.29 To access the XMT OUT Level Adjust sub-menu, send 1704Hz to the unit while in Command Mode. The unit responds with a quiet termination for 1 second and then re-applies the 1014Hz command tone. **Note:** The unit sets a 5-minute timer between tones in this mode. If a tone is not received within 5 minutes of the previous tone, the unit returns to normal/idle operation.

Adding Gain, Loss

5.30 The test technician adds gain by sending and removing a 2222Hz tone. Each time the DST2496I2

receives the 2222Hz tone in this mode, .5dB of gain is added to the XMT OUT port. When the desired level is obtained, send loopback activation tone (2713Hz, or alternate programmed tone) for greater than 5 seconds to return the unit to Command Mode.

5.31 To add loss, send and remove a 2111Hz tone to the unit while in XMT OUT Level Adjust mode. Each time the tone is sent/removed; the unit adds .5dB of loss to the XMT OUT port. When the desired level is obtained, send loopback activation tone (2713Hz, or alternate programmed tone) for greater than 5 seconds to return the unit to Command Mode.

-16dBm XMT OUT Level Adjust

5.32 To set the XMT OUT port to a -16 dBm level, send and remove a 2333Hz tone while in the XMT OUT Level Adjust sub-menu from the Command Mode. Upon receipt of this tone, the DST2496I2 sets the XMT OUT port to -16dBm level. When the desired level is obtained, send loopback activation tone (2713Hz, or alternate programmed tone) for greater than 5 seconds to return the unit to Command Mode.

Changing Loopback Frequency & Demarc Level Remotely via Command Mode

5.33 To change the loopback activation frequency or demarc levels remotely, the test technician sends either 704Hz or 1604Hz to the unit while in Command Mode. The DST2496I2 returns alternating 1014Hz/xx50Hz tone for two seconds, holding at xx50Hz, where xx = the first two numbers of the active programmed loopback frequency (i.e.: if 1014Hz/2750Hz alternating holding at 2750Hz is the sequence, then 2713Hz is the active loopback frequency). The five possibilities are: 2713Hz, 2413Hz, 2513Hz, 2813Hz, 2913Hz. See **Figure 4:** DST2496I2 Command Mode for more details.

5.34 To change the active Loopback and Command Mode frequency, send:

- 2713Hz > 5 seconds, unit responds with alternating 1014Hz/2750Hz for two seconds and holds at 2750Hz for five seconds, then returns to Command Mode. Unit is set to 2713Hz Command Mode/Loopback frequency.
- 2413Hz > 5 seconds, unit responds with alternating 1014Hz/2450Hz for two seconds and holds at 2450Hz for five seconds, then returns to Command Mode. Unit is set to 2413Hz Command Mode/Loopback frequency.
- 2513Hz > 5 seconds, unit responds with alternating 1014Hz/2550Hz for two seconds and holds at 2550Hz for five seconds, then returns to Command Mode. Unit is set to 2513Hz Command Mode/Loopback frequency.

- 2813Hz > 5 seconds, unit responds with alternating 1014Hz/2850Hz for two seconds and holds at 2850Hz for five seconds, then returns to Command Mode. Unit is set to 2813Hz Command Mode/Loopback frequency.
- 2913Hz > 5 seconds, unit responds with alternating 1014Hz/2950Hz for two seconds and holds at 2950Hz for five seconds, then returns to Command Mode. Unit is set to 2913Hz Command Mode/Loopback frequency.

5.35 While in the Loopback Frequency & Level Selection menu, the technician can also toggle the customer demarc level. After the unit has received the 704Hz or 1604Hz tone and holds at the xx50Hz loopback frequency, send 2600Hz. The unit returns a ramp up sequence to set at -3/+13 TLP demarc levels, or a ramp down sequence to set at 0/0 TLP levels.

Demarc Level Query & Adjustment

5.36 To set the demarc levels directly from Command Mode; send 1404Hz while at the 1014Hz Command Mode frequency prompt. The unit returns 1014Hz/xx50Hz for two seconds and holds at 414Hz if the demarc levels are 0/0 TLP, or 2814Hz if the demarc levels are -3/+13 TLP.

5.37 To set the unit demarc levels at 0/0 TLP, send 404Hz. The unit returns 1014Hz/xx50Hz alternating for two seconds and holds 414Hz for 5 seconds. The unit is now set to 0/0 TLP, and returns to Command Mode.

5.38 To set the unit demarc levels at -3/+13 TLP, send 2804Hz. The unit returns 1014Hz/xx50Hz alternating for two seconds and holds 2814Hz for 5 seconds. The unit is now set to -3/+13 TLP, and returns to Command Mode.

Factory Default Settings

5.39 To restore the unit to factory default settings, send 2600Hz to the unit while in Command Mode. The factory default settings are:

- RCV OUT = -3dBm TLP
- XMT IN = +13 dBm TLP
- XMT OUT = +5 dBm TLP
- EQ = Flat
- Loopback = 2713Hz

Exit Command Mode

5.40 To exit Command Mode, send the currently programmed loopback tone (2713Hz or alternate tone if programmed) > 5 seconds. The front panel LEDs indicate the current loopback frequency setting.

6.0 WARRANTY

6.01 All products manufactured by Enginuity Communications are warranted to be free from defects from workmanship and components for a period of five years from date of shipment. During this period any defective

products shipped prepaid to Enginuity Communications will be repaired or replaced at our discretion and returned at no further cost to the customer. Enginuity Communications shall not be liable for any consequential or indirect damage of any type or nature, nor for any cost of reinstallation. Any product that has been subject to improper installation, unauthorized alteration, accident or misuse is rendered void of warranty.

6.02 Enginuity Communications also provides a repair service for products not covered by warranty. Charges will be levied for labor, components, and transportation.

6.03 To return a unit for repair contact Enginuity Communications and obtain a Return Authorization Number. Be prepared to provide the following information:

1. Product Name
2. Product Model Number
3. Contact person and phone number
4. Your company name and return address

Package the unit in its original shipping carton or adequate substitute, along with a description of the problem or defect. Clearly mark the outside of the carton with the Return Authorization Number. Send the unit to the appropriate shipping address shown below:

Warranty and Repair depot address:

Enginuity Communications
Attn: Repair Department
3545 Stern Avenue
St. Charles, IL 60174
Voice 630-444-0778
Fax 630-444-0779

7.0 SPECIFICATIONS

7.01 Transmit/Receive Channels

- 4W Facility Side Impedance: balanced 150/600/1200 ohms selectable
- 2W/4W Drop Side Impedance: balanced 600 ohms
- Echo Return Loss: >20 dB
- Receive Channel Gain/Equalization: Automatically set, compensates for line impairments up to 15 dB loss at 1004Hz
- Maximum Output Levels: +5 dBm TX (RX and TX channels)
- Maximum Input Levels: +5 dBm (RX channel) +13 dBm (TX channel)
- Peak to Average Ratio (P/AR): >98
- Idle Noise: <17 dBmC0

7.02 Loopback

- Activation Frequency: 2713/2413/2513/2813 or 2913 Hz \pm 7 Hz, no activation outside \pm 37 Hz
- Activation Threshold:
 - -30 dBm, no activation below -36 dBm
 - Guard Margin: 12 dB \pm 6 dB
 - Tone Duration for Activation: 2.5 s
 - Tone Duration for Release: 0.9 s
 - Time Out Duration: 20 min \pm 1%
- Manual Loopback: Card Edge pin 1 connected to pin 19 will initiate manual loopback
- Loopback Gain: 16 dB

7.03 Transponder

- Transponder Bandwidth: 314 Hz to 3214 Hz
- Transponder Time Out: 20 minutes \pm 1%
- Transponder Output Level: +5 TLP or -8 DLP
- Transponder Deactivation: Loopback Activation Tone for 5 s to return to idle mode
- Transponder Threshold:
 - 30 dBm or greater: valid output tone
 - <-30 dBm: quiet termination

7.04 Wire Check

- Wire Check Activation: Depress and release S3
- Wire Check Tones:
 - RX Channel line & drop side ports: Continuous 1234 Hz tone
 - TX Channel line & drop side ports: Pulsing 1234 Hz tone
- Wire Check Time-Out Duration: 1 hour
- Wire Check Deactivation: Depress and release SW2 or reception of Loopback Activation Tone

7.05 Alignment

- 3 or 4 tone alignment using 1004 Hz, 2804 Hz, 404 Hz and 1804 Hz (optional)
- Alignment Mode Deactivation: Loopback Activation Tone for 5 s or time-out after 5 minutes

7.06 Sealing Current Generator

- 20 mA nominal with power-on 'ZAP'

7.07 Power Supply

- Input Voltage: -24 to -55 Vdc
- Maximum Current: 50 mA
- Sealing Current (simplex) Powered Operation: 8 mA (typical)

7.08 Physical

- Mounting: 400-type or 200-style shelf via 56-pin card edge connector

- Size: 5.58" H x 5.90" D x 0.7" W
- Weight: 0.7 lb.

7.09 Factory Default Settings

- RX Channel: 8 dB Loss, Flat Response
- TX Channel: 8 dB Loss, Pre-equalization disabled
- Loopback: 2713Hz
- -3/+13dBm TLP demarcation point levels

8.0 MAINTENANCE TESTING PROCEDURES

8.01 The following tables detail the steps to be performed for different alignments and option selections. These tables can be used for new installations or maintenance testing.

8.02 Test Center refers to the Central Office or remote test point where the alignment and configuration sequences are originated.

8.03 The DST2496I2 is equipped to provide a variety of maintenance testing features to enable remote maintenance testing. These features include: quiet termination/full range transponder, 4-tone auto sweep, 4-tone auto-sweep (RCV IN port), and power & alignment queries.

Loopback from Idle state

8.04 The DST2496I2 can be programmed for any one of five loopback frequencies (see para. **2.02**, & **5.01** – **5.06**) Loopback is activated when the programmed frequency (2713Hz default) is received >1.5 seconds<30 seconds. If the tone is not removed within 30 seconds, the unit will enter Command Mode.

While in loopback, the "Align" LED will flash on the front panel, and the RCV IN & XMT OUT paths are interconnected via a loopback amplifier. The amplifier automatically inserts 16dB of gain to provide an equal level loopback condition. The data modem equipment at the demarcation point is isolated from the transmission path during loopback.

8.05 During normal loopback, the test technician can send and receive tones, and record the results to compare against baseline measurements taken at initial installation, if available.

Loopback Release

8.06 To release loopback, the test technician sends the loopback frequency (2713Hz default) to the DST2496I2 for >.9 seconds. Upon detecting this signal, the unit releases loopback, extinguishes the "Align" LED on the front panel, and returns to its normal state. If loopback is not released by a tone within 20 minutes, the internal timer circuit will automatically release and

(8.06 Continued) return the unit to normal. On the front panel, and returns to its normal state. If loopback is not released by a tone within 20 minutes, the internal timer circuit will automatically release and return the unit to normal.

Command Mode Features

8.07 For further instructions on maintenance testing using specific Command Mode functions, such as Power Query, Alignment Query, Level Adjust, Transponder Mode(s), or to reset the unit to factory default settings; please refer to the appropriate paragraphs in **Section 5.0** of this document.

Table 5: Command Mode Activation

Step	Test Center Action	Remote DST2496I2 Action
1	Send loopback activation tone for a minimum of 30 s	Enters Command Mode, Responds with 1014 Hz, originating at +5 dBm TLP
2	Remove loopback activation tone	Responds with 1014 Hz, originating at +5 dBm TLP
3	Proceed with necessary configuration and setup procedures	

Table 6: Three-Tone Alignment Procedure

Step	Test Center Action	Remote DST2496I2 Action
1	Activate Command mode (see Table 5)	Responds with 1014 Hz, originating at +5 dBm TLP
2	TLP alignment: proceed to step 4 DLP alignment: send 2804 Hz or 2904Hz for 5 s or greater, remove tone proceed to step 4 Toggle TLP/DLP: send 2804/2904 Hz for 5 s or greater	Responds with 1014 Hz, originating at -8 dBm DLP Responds with 1014 Hz, originating at selected level
3	Record level of 1014 Hz in Table 7, column A. Send 1004 Hz at TLP or DLP as applicable.	Responds with 2814 Hz at selected TLP/DLP level
4	Record level of 2814 Hz in Table 7, column A. Send 2804 Hz at TLP or DLP as applicable.	Responds with 414 Hz at selected TLP/DLP level
5	Record level of 414 Hz in Table 7, column A. Send 404 Hz at TLP or DLP as applicable.	Responds with 1814 Hz at selected TLP/DLP level
6	Wait for 60 s time-out	Calculates gain & equalization, Responds with acknowledgment: 300 - 3000Hz ramp up = PASS 3000-300Hz ramp down = FAIL Returns to loopback mode
7	Send 404 Hz, record level of returning 404 Hz in Table 7, column B	Loopback
8	Send 1004 Hz, record level of returning 1004 Hz in Table 7, column B	Loopback
9	Send 2804 Hz, record level of returning 2804 Hz in Table 7, column B	Loopback
10	Send loopback activation tone for 0.9s or greater	Loopback is deactivated, returns to idle

Table 7: Three-Tone Alignment Results and Calculations

Frequency	A Alignment Level	B Loopback Level	C = B - A RX Channel Attenuation	D = C - 16 dB Customer RX Level
1014 Hz/1004 Hz				
2814 Hz/2804 Hz				
414 Hz/404 Hz				

Table 8: Four-Tone Alignment Procedure

Step	Test Center Action	Remote DST2496I2 Action
1	Activate Menu/Command mode (see Table 5)	Responds with 1014 Hz, originating at +5 dBm TLP
2	TLP alignment: proceed to step 4 DLP alignment: send 2804 Hz or 2904Hz for 5 s or greater, remove tone proceed to step 4 Toggle TLP/DLP: send 2804/2904 Hz for 5 s or greater	Responds with 1014 Hz, originating at -8 dBm DLP Responds with 1014 Hz, originating at selected level
3	Record level of 1014 Hz in Table 9, column A, Send 1004 Hz at TLP or DLP as applicable	Responds with 2814 Hz at selected TLP/DLP level
4	Record level of 2814 Hz in Table 9, column A, Send 2804 Hz at TLP or DLP as applicable	Responds with 414 Hz at selected TLP/DLP level
5	Record level of 414 Hz in Table 9, column A, Send 404 Hz at TLP or DLP as applicable	Responds with 1814 Hz at selected TLP/DLP level
6	Record level of 1814 Hz in Table 9, column A, Send 1804 Hz at TLP or DLP as applicable	Calculates gain & equalization, Responds with acknowledgment: 1004/404 Hz = PASS 704 Hz = FAIL Returns to loopback
7	Send 404 Hz, record level of returning 404 Hz in Table 9, column B	Loopback
8	Send 1004 Hz, record level of returning 1004 Hz in Table 9, column B	Loopback
9	Send 2804 Hz, record level of returning 2804 Hz in Table 9, column B	Loopback
10	Send 1804 Hz, record level of returning 1804 Hz in Table 9, column B	Loopback
11	Send loopback activation tone for 0.9 s or greater	Loopback is deactivated, returns to idle

Table 9: Four-Tone Alignment Results and Calculations

Frequency	A Alignment Level	B Loopback Level	C = B - A RX Channel Attenuation	D = C - 16 dB Customer RX Level
1014 Hz/1004 Hz				
2814 Hz/2804 Hz				
414 Hz/404 Hz				
1814 Hz/1804 Hz				

Table 10: XMT OUT Level Adjust Procedure

Step	Test Center Action	Remote DST2496I2 Action
1	Activate Menu/Command mode (see Table 5)	Responds with 1014 Hz, originating at +5 dBm TLP
2	Send 1704 Hz	Responds with Quiet Termination 1 second, then 1014Hz at current XMT OUT level
3	To adjust level: Add Gain: send/remove 2222 Hz Add Loss: send/remove 2111 Hz Add Gain or Loss to desired level Set -16 dBm: send/remove 2333Hz	Responds with .5 dB Gain Responds with .5 dB Loss Responds with -16dBm XMT OUT(pins 41, 47) level
4	Send loopback activation tone for 5 s or greater	Returns to Command mode

Table 11: Loopback Activation Frequency Procedure

Step	Test Center Action	Remote DST2496I2 Action
1	Activate Menu/Command mode (see Table 5)	Responds with 1014 Hz, originating at +5 dBm TLP
2	Send 104Hz or 1604Hz	Responds with 1014/xx50Hz & holds xx50Hz (xx = 27 for 2713Hz Loopback, or 24, 25, 28, or 29 for alternate programmed frequencies of 2413, 2512, 2813, or 2913Hz)
3	Send desired loopback set frequency (2713, 2413, 2513, 2813, or 2913Hz)	Unit responds 1014/xx50Hz for 2 secs, holds xx50 for 5 secs.
4		Returns to Command Mode

Table 12: Quiet Termination & Full Frequency Sweep Transponder

Step	Test Center Action	Remote DST2496I2 Action
1	Activate Command Mode menu (see Table 5)	DST2496I2 returns 1014Hz command tone
2	Send: 804Hz for TLP transponder 1304Hz for DLP transponder 404Hz for current mode transponder	Unit applies quiet termination at XMT IN port (pins 55, 49) w/20 minute timer
3	Send any tone (except 404Hz as first tone). If sending 404Hz as first tone, go to step 6.	Unit returns similar tone at TLP or DLP as selected in step 2
4	Send tones, record results	Responds with same tones in 100 Hz increments
5	Send loopback tone > 5 secs	Returns to Command mode
6	Send 404Hz as first tone	Unit sweeps 414Hz, 1014Hz, 1814Hz, and 2814Hz each for 30 seconds, then quiet termination.
7	Send loopback frequency > 5 seconds	Unit returns to Command Mode

Table 13: 4-Tone Auto-Sweep (RCV IN Port) Procedure

Step	Test Center Action	Remote DST2496I2 Action
1	Activate Command Mode (see Table 5)	Unit returns 1014Hz
2	Send 604 Hz to RCV IN port (pins 7, 13), record auto tones and measure quiet termination	Unit returns 1008Hz for 60 seconds, Quiet Termination for 60 seconds, then sweeps 408, 1808, 2808 @ 0dBm (30 seconds each)
3		Unit returns to Command Mode

Table 14: Auto-Slope Transponder Sweep Results and Calculations

Frequency	A Alignment Level	B Loopback Level	C = B - A RX Channel Attenuation	D = C - 16dB Customer RX Level
1004 Hz				
2804 Hz				
404 Hz				

Table 15: Transmit Channel Noise Testing

Step	Test Center Action	Remote DST2496I2 Action
1	Activate Menu/Command mode (see Table 5)	Responds with 1014 Hz, originating at +5 dBm TLP
2	Send 404 Hz for 5 s or greater	Unit applies quiet termination at XMT IN port
3	Perform noise tests	Quiet termination
4	Send loopback activation tone for 5 s or greater	Returns to Command Mode

Frequency	A Alignment Level	B Loopback Level	C = B - A RX Channel Attenuation	D = C - 16 dB Customer RX Level
304 Hz/314 Hz				
404 Hz/414 Hz				
504 Hz/514 Hz				
604 Hz/614 Hz				
704 Hz/714 Hz				
804 Hz/814 Hz				
904 Hz/914 Hz				
1004 Hz/1014 Hz				
1104 Hz/1114 Hz				
1204 Hz/1214 Hz				
1304 Hz/1314 Hz				
1404 Hz/1414 Hz				
1504 Hz/1514 Hz				
1604 Hz/1614 Hz				
1704 Hz/1714 Hz				
1804 Hz/1814 Hz				
1904 Hz/1914 Hz				
2004 Hz/2014 Hz				
2104 Hz/2114 Hz				
2204 Hz/2214 Hz				
2304 Hz/2314 Hz				
2404 Hz/2414 Hz				
2504 Hz/2514 Hz				
2604 Hz/2614 Hz				
2704 Hz/2714 Hz				
2804 Hz/2814 Hz				
2904 Hz/2914 Hz				
3004 Hz/3014 Hz				
3104 Hz/3114 Hz				
3204 Hz/3214 Hz				

Table 16: Full Frequency Sweep Results and Calculations

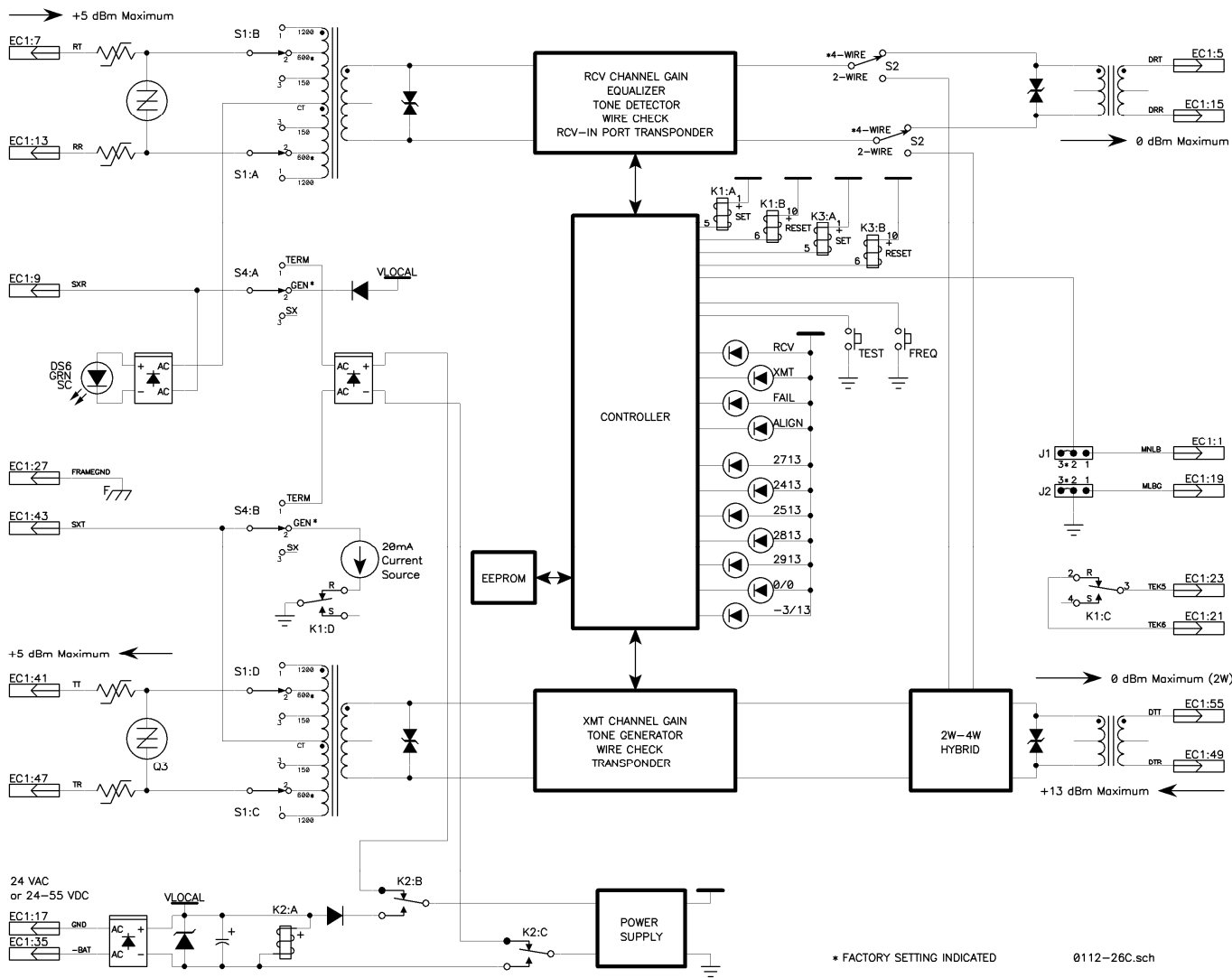


Figure 4: DST2496I2 Block Diagram

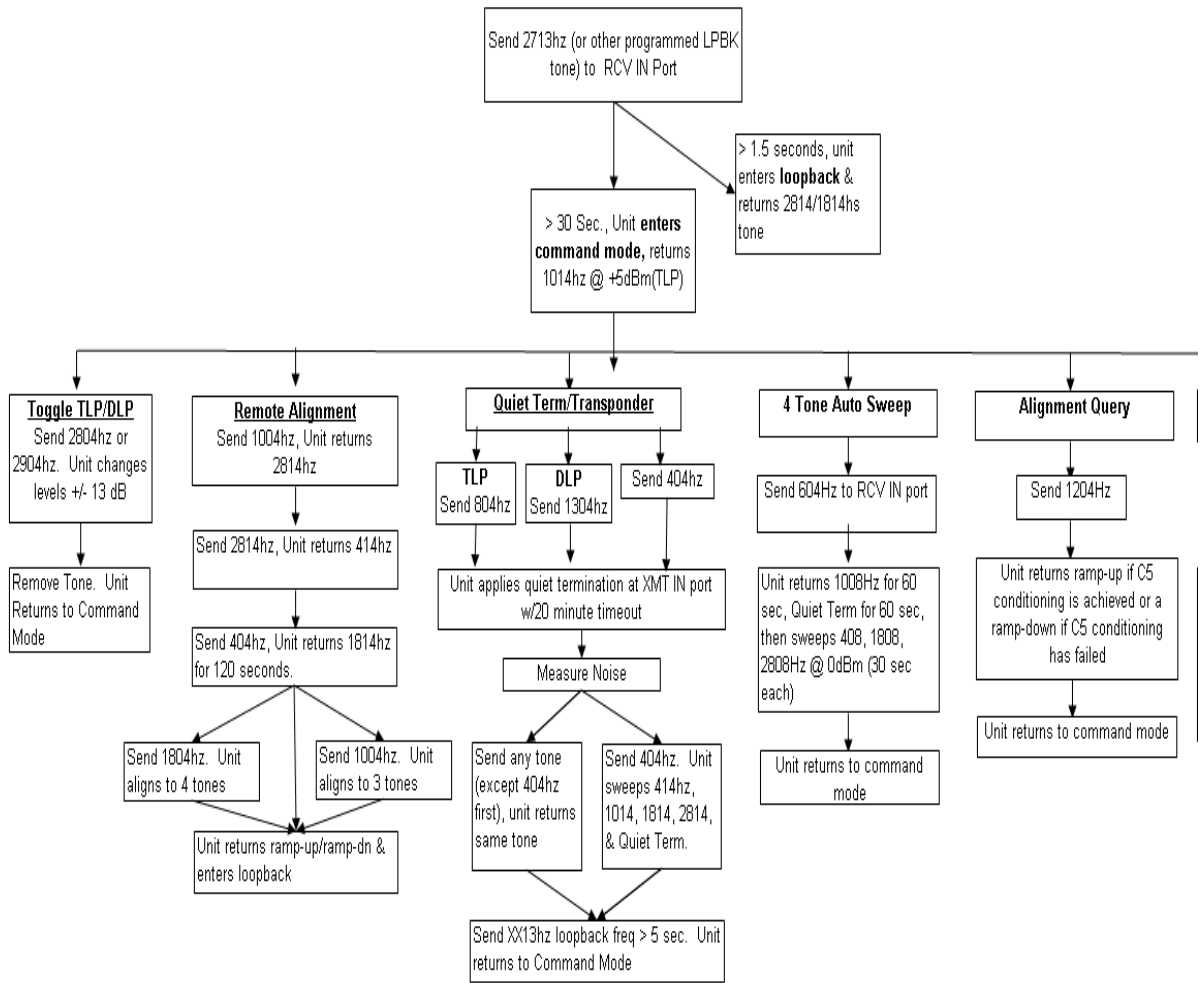


Figure 5: DST249612 Flow Chart

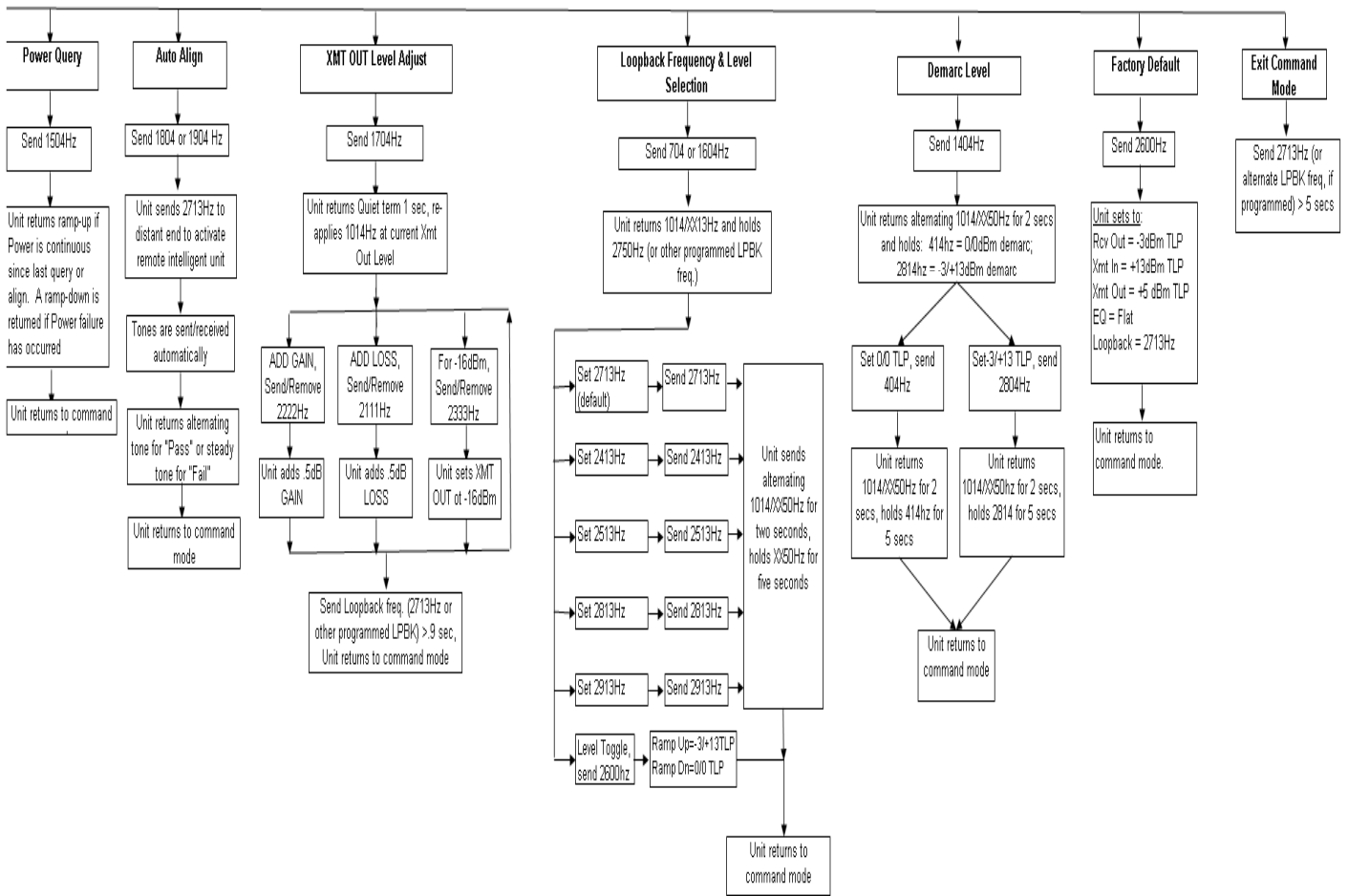


Figure 6: DST2496I2 Flow Chart