Reference material

Signalling Supply Adjustment Guideline

This legacy document is published as historical reference material. The content described might be of assistance to individuals and organisations performing work on Transport for NSW Rail Assets.

This document refers to organisational and positional roles and responsibilities in place prior to 1 July 2013 and may have been superseded by other documents.

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SIGNALLING POWER SUPPLY

ADJUSTMENT GUIDELINE

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1 Introduction

This document provides guidelines on the adjustment of signalling power supplies and the preferred values.

2 Definitions

Maximum voltage limit

Maximum voltage limit is the voltage that the measured voltage should not exceed. The power supply should be readjusted if the measured voltage exceeds the maximum voltage limit or a Signal Engineering waiver sought.

Minimum voltage limit

Minimum voltage limit is the voltage that the measured voltage should not fall below. The power supply should be readjusted if the measured voltage is below the minimum voltage limit or a Signal Engineering waiver sought.

Target voltage range

Target voltage range is the voltage range that the power supply should be adjusted to fall within when it is adjusted.

3 AC Power Supply Adjustment

3.1 Characteristics of the typical, Supplies

Most normal supplies are fed from the Railway 11kV network. The Railway 11kV feeders are regulated at the feed sub-station. However the Electrical Operating Centre (EOC) can switch to contingency feed arrangements, which can cause a significant voltage change at signalling locations.

Some signalling supplies are fed from the Railway 33kV network. The Railway 33kV feeders are not regulated, and the Electrical Operating Centre can switch the feed arrangements. Both of these factors can cause significant voltage changes at a signalling location.

Most emergency supplies are fed from one of the Energy Distributors. These are generically known as the "Council" supply.

3.2 Objective of adjustment

The objective of supply voltage adjustment at the power supply location is two fold.

1. Make an adjustment that will keep the voltage in tolerance for the equipment whilst allowing for the expected supply voltage fluctuations.
2. Compensate for some of the voltage drop in the signalling power distribution feeders.

3.3 Voltage range and limits

The nominated supply voltage at the signalling power supply location for 120V distribution is 120 to 127VAC (nominal to +6%).

The nominated 240V supply voltage at the signalling power supply location for 415V distribution is 240 to 254VAC (nominal to +6%).

At signalling locations that are fed from the signalling power supply location the voltage for steady state conditions is to be in the range of 114V to 132V (-5% to +10%).

At signalling locations that are fed from the signalling power supply location the voltage during the operation of points, train stops etc is to be in the range of 108V to 132V (-10% to +10%).

At signalling locations that are fed from the signalling power supply location the voltage during the initial start of operation of points, train stops etc is to be in the range of 102V to 132V (-15% to +10%). The initial dip duration is to be less than 0.25 seconds.

The voltage at the feed end of any 415V feeder should be in the range of 390 to 456V (-6% to +10%) with a nominal value of 402 to 427V (-3% to +3%).

3.4 Method of adjustment for 120V supply and distribution

Measure the voltage at 120V switchboard with the ECO switched to the Normal supply.

The measurement is made over a 10 minute period with the meter on AC voltage, set for min/max. The measurement period should include the passing of at least one train and the operation of points (if present).

The multimeter's min/max setting provides three readings minimum, maximum, and average voltage.

If the **minimum voltage** is less than 115.2V (-4%) without any power interruption then the supply should be brought to the Maintenance Signal Engineers attention for further investigation.

If the **maximum voltage** is more than 132V (+10%) without any power interruption then the supply should be brought to the Maintenance Signal Engineers attention for further investigation.

If the **average voltage** is outside the range of 120 to 127V (nominal to +6%) then confirm with the Electrical Operating Centre or Electrical Maintenance Engineer as to feeder voltage (11 or 33kV) and the switching arrangement for the supply. The load and feed arrangements should be as close to normal as possible.

If the normal supply average voltage is outside the nominated voltage ranges then it should be re-adjusted.

Feed Arrangement	**11kV**	**33kV**
Standard feeder average voltage	120 - 127 (nominal to +6%)	117 - 132 (-2.5% to +10%)
Contingency feeder average voltage	117 - 132 (-2.5% to +10%)	115.2 - 134.4 (-4% to +12%

The Emergency supply can be measured with no load or measured on load while the normal supply is being adjusted. No load voltage should be in the range of 123 to 132V (+2.5% to +10%). These values are higher to allow for voltage drop when on load.

The signalling AC supply voltage is adjusted by altering tappings on the step-down isolating transformer.

Adjustments must be made in accordance with the relevant procedures. This usually requires the involvement of the Electrical Discipline.

UPS's and GGI's provide a regulated output voltage. A configuration setting is used to set their output voltage. An output voltage of 123V (+2.5%) is preferred for this equipment.

3.5 Method of adjustment for signalling extended voltage distribution.

At the supply end:

- Set the primary tapping based on the measured supply voltage. The chosen tap should normally be a lower voltage that the measured voltage. For example set on the 230V tap for a measured voltage of 238V.
- Set the secondary tapping to the lowest tap that provides a feed voltage 415V or more. The feed voltage should not exceed 477 volts (+15% from nominal voltage).

At the load end:

- Set the primary tapping based on the measured feeder voltage, whilst all standing load is connected. The chosen tap should normally be a lower voltage that the measured voltage. For example set on the 405V tap for a measured voltage of 408V.
- Set the secondary tapping should be set to the 120V tap unless the location has a particular problem or no adjustment taps are not available on the primary.

The transformers at the load end should not normally be adjusted to boost the voltage at a location. If the voltage at a location needs to be increased then the feed transformer should be adjusted to increase the voltage on the feeder.

Set to work adjustments should aim for 122 to 125V, as the supply will not have the full load when the adjustment is made.

3.6 SSI Isolation Transformer adjustment procedure

Set primary tap based on the measured voltage or the next voltage tap up from the measured voltage.

Set secondary to the desired voltage:

- Aim for 103 to 106Vac in locations fed from a regulated 120V supply.
- Aim for 105 to 108Vac in locations fed from a 120V supply that is not regulated.

Regulation of the 120V supply is usually provided by a UPS, a static switch with power conditioner, or a GGI.

3.7 ECO adjustment

3.7.1 Voltage Sensing

A PILZ S1UM or an EMAIL 2V330 provides the voltage sensing. These units should be calibrated offsite, however a temporary adjustment procedure is provided in case a calibrated unit is not available. A correctly calibrated unit should be installed as soon as practical.

Re-calibration is performed in a workshop environment, as it requires the use of a variable AC supply.

3.7.2 Adjustment of PILZ S1UM voltage sensing relay

The PILZ S1UM voltage sensing unit is typically set for:

Pick Up voltage: 115Vac

Drop Away voltage: 100Vac

Pick up time delay: 7 seconds

The DIP switches are typically set for:

S1 0.5 (to give a 250V measuring range)

S2 1

The particular values are detailed on Signalling Circuit book.

If a PILZ S1UM needs to be replaced due to a failure and only a non-calibrated S1UM is available then it can be set to a set of approximate values for a 120V supply by:

- Set S1, and S2 as above.
- Set the U% adjustment potentiometer to not quite half way between the 40 and 60 % marks (~47%) for about 115Vac pick up voltage.
- Set the U_{hyst} adjustment potentiometer to approximately 88% to give about 100Vac drop away voltage.
- Set t_r to about 7 seconds pick up time delay.

3.7.3 Adjustment of 2V330

Field adjustment of a 2V330 when a calibrated unit is not available is by:

Switch 1 ON (AC)

Switch 2 OFF (Non latching)

Switch 3 ON (High range)

Switch 4 OFF (Fast response time)

Pick up volts (on high range) is set to 115V, which is half way between the 2nd and 3rd marking.

Drop out % is set to 88% to give about 100Vac drop away voltage.

3.7.4 Economising resistor for AC coils

Some AC coils have an economising resistor fitted to improve the drop away time. These ECOs are called High Speed ECOs because of the fast drop away time. All ECOs contactors have a fast pick up. No adjustment is required. When the economising resistor is in circuit the voltage on the contactor coil should be between 95V to 115V when the supply voltage is more than 120Vac.

3.7.5 Economising resistor for DC coils

Some DC coils have an economising resistor fitted because the coil is not continuously rated at the operate voltage. The coil and economising resistor are matched. No adjustment is required. The voltage on the coil will be dramatically less (typically less than 1/3 of the operate voltage) when the economising resistor is in circuit.

3.8 Transformer adjustment procedure

This procedure is the general procedure for the adjustment of a transformer.

Measure the incoming supply, and note the primary transformer tap.

If the tap is not correct then:

- Isolate the supply in accordance with Signalling Maintenance procedures.
- Prove de-energised.
- Change the tap setting.
- Re-connect, restore the supply, and re-measure the voltage.

Signalling discipline transformers have had their tap voltage labelled by:

- reference to a common or 0V, and a voltage on each tap.
- Or by a voltage between a pair of terminals.

The reference 0V terminal is sometimes labelled as COM, C, Neutral, or 0V.

The tap voltage determined by subtracting the numbers on the tap terminals when a reference terminal is used. For example: 120V minus 0V is for 120 volts. 120V minus 5V is for 115 volts.

The tap with the low number (like 5V) is normally positive for power transformers, but is often negative in DC power supplies.

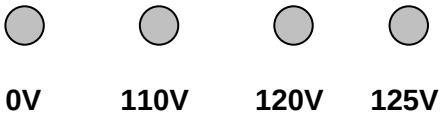
Electrical discipline transformers mostly have their taps marked as a percentage change from the rated voltage, like +2.5%, -2.5%, +5%, and -5%. The minus taps are for a lower voltage input or output. The positive taps are for a higher voltage input or output.

Setting the primary tap based on the primary voltage is preferred as it helps manage transformer inrush current.

The secondary tapping is set to the required voltage.

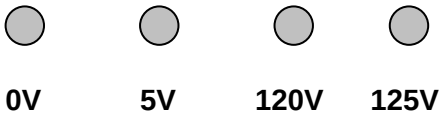
Some examples with different terminal layouts are:

Example 1:



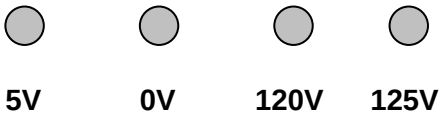
The voltage from 0V to 120V is 120V. The voltage from 110V to 125V is 15V.

Example 2:



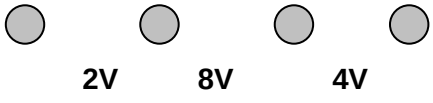
The voltage from 0V to 120V is 120V. The voltage from 5V to 120V is 115V.

Example 3:



Because the 0V terminal is not on the end, the 5V terminal is for -5V. The voltage from 0V to 120V is 120V. The voltage from 5V to 120V is 125V.

Example 4:



The voltage from the left of the 2V to the right of the 8V is 10V.

The voltage from the left of the 8V to the right of the 4V is 12V.

4 DC Power Supply Adjustment

4.1 Unfiltered power Supplies

DC401, Store 107 (DC402), Store 87 (DC403), and Store 103 (DC404) are unfiltered power supplies.

Adjust the transformer primary tap as per the *Procedure to adjust the Power Supply Primary Voltage* in section 4.8.

Adjust the transformer secondary tap as per the *Procedure to adjust the Power Supply Secondary Voltage* in section 4.9 to achieve an output voltage in the target voltage range for the type of power supply.

Type	Target Voltage range	Maximum Voltage limit	Minimum Voltage limit
50V Internal	52-56	60 Note 4 64V	47.5
50V External	52-56	60 Note 4 69V	50
24V	22-28	32	22 Note 5 20V

Notes:

1. 50V QTD5 relays made before 1999 are rated for 55 volts maximum continuous voltage. 50V QTD5 relays made after 1999 are rated for 60 volts maximum continuous voltage.
2. Unfiltered power supplies provide a peak voltage that is equal to the measured DC voltage divided by 0.63. This means that the peak voltage on a 50 volt power supply is typically 82V or more.
3. Unfiltered power supplies have an AC voltage that is typically from half to equal to the measured DC voltage.
4. If the voltage adjustment cannot be achieved then the cause could be capacitance in one of the loads. Set the multimeter on AC voltage and measure the output of the power supply. If the AC voltage is less than one third of the DC value then the cause is likely to be capacitance in one or more of the loads. Lightly loaded power supplies can be filtered by less than 100uF of capacitance. Possible causes are Yellow Elsafe immunisation modules, and incorrectly designed slow release circuits. Higher voltages up to the values noted are acceptable in this case if no QTD5 relays are used on the power supply.
5. The lower voltage is acceptable for diagram or indication supplies to reduce the brightness of the diagram lights.

4.2 General Switchmode power supplies

Switchmode power supplies generally are set for 120V, 240V or are universal units that accept input voltages from 90 to 260VAC.

Switchmode power supplies provide a regulated output voltage that is either fixed or has a limited range of adjustment. The output voltage is normally adjusted by use of a screwdriver to turn a potentiometer clockwise to increase voltage or anticlockwise to decrease voltage.

If the current limiting is provided, then it is set as per the *Procedure to adjust current limiting* in section 4.7.

Type	Target Voltage range	Maximum Voltage limit	Minimum Voltage limit
50V Internal	51.5-52.5	56	48
50V External	53.5-55.5	56	50
24V	24.5-25.5	28	20
12V	12.0-12.5	13	11

Note: 50V QTD5 relays made before 1999 are rated for 55 volts maximum continuous voltage. 50V QTD5 relays made after 1999 are rated for 60 volts maximum continuous voltage.

4.3 General power supplies with battery backup

Power supplies generally are set for 120V, 240V or accept input voltages from 90 to 260VAC.

The power supplies generally have a limited range of output voltage adjustment.

Some of these supplies may be adjusted by a transformer primary tap as per the *Procedure to adjust the Power Supply Primary Voltage* in section 4.8.

Some of these supplies may be adjusted by a transformer secondary tap as per the *Procedure to adjust the Power Supply Secondary Voltage* in section 4.9 to achieve an output voltage in the target voltage range for the type of power supply.

Some of these supplies may have fine adjustment of their output voltage by adjustment of a variable resistor. Refer to the applicable equipment manual for details on how to adjust.

If the current limiting is provided, then it is set as per the *Procedure to adjust current limiting* in section 4.7.

Supply Type	Battery Type	Battery Float Voltage Range	Preferred Battery float voltage
50V	Nicad (38 cells)	54.0-56.0	55.1
50V	Lead Acid (24 cells)	52.8-56.0	54.4
24V	Nicad (19 cells)	27.0-28.0	27.5
24V	Lead Acid (12 cells)	26.5-28.0	27.2
15V	Nicad (12 cells)	17.1-17.7	17.5
12V	Nicad (10 cells)	14.25-14.75	14.5
12V	Lead Acid (6 cells)	13.4-13.9	13.6

Float voltage of Nicad cell is 1.45V with a maximum 1.50V and minimum 1.43V.

Float Voltage of Lead Acid cell is 2.26V with a maximum 2.45V and minimum 2.2V.

Float current for Sealed lead acid >0mA per AH (that is, not discharging).

Float current for Nicad is to be more than +2mA per AH and should be less than +20mA per AH based on the C_5 AH capacity.

Note: 50V QTD5 relays made before 1999 are rated for 55 volts maximum continuous voltage. 50V QTD5 relays made after 1999 are rated for 60 volts maximum continuous voltage.

4.4 No break power Supplies

Store 92 (DC502), DC503, and Store 95 (DC504) are no break power supplies.

Adjust the transformer as per the *Procedure to adjust the Power Supply Primary Voltage* in section 4.8.

Then adjust the transformer as per the *procedure to adjust the Power Supply Secondary Voltage* in section 4.9 to achieve an output voltage in the target voltage range for the type of power supply.

Type	Target Voltage range	Maximum Voltage limit	Minimum Voltage limit
50V Internal	52-56	59	47.5
50V External	52-56	60	50
24V	25-28	32	22

Note: 50V QTD5 relays made before 1999 are rated for 55 volts maximum continuous voltage. 50V QTD5 relays made after 1999 are rated for 60 volts maximum continuous voltage.

4.5 Audio Frequency Track Circuit Power Supplies

4.5.1 Spec1022 (DC501)

Specification 1022 (DC501) Power supplies are used for FS2500 and TI21 track circuit's transmitters and receivers. This power supply is not a regulated power supply and must be adjusted so that the output voltage stays within the range of 22.5 and 30.5 volts DC over the expected variation of the 120V supply.

Adjust the input transformer as per the *Procedure to adjust the Power Supply Primary Voltage* in section 4.8. The 5V primary tap on these power supplies is a -5V tap.

Measure the DC output voltage. Set the secondary tapping to adjust the output voltage to close to 26 volts. COM to 0-2A gives a lower output voltage and is the appropriate tap in almost all cases. COM to 2-4.4A gives a higher output voltage, used only when the supply is heavily loaded.

4.5.2 Store 93 (DC701)

Store 93 (DC701) power supplies do not have any adjustment available to the maintainer. When installed a new or reconditioned power supply should be in the range of 23 to 26 volts. If the output voltage of an existing unit is outside the range of 22.5 to 28.0 volts then it is considered faulty and to be replaced.

If the supply voltage is below 110VAC or likely to drop below 110VAC due to the operation of loads like points and train stops then the Store 93 power

supply must be Exectronics brand unit that has a clearly labelled serial number and identification dated after 1998.

4.5.3 CSEE

The CSEE UM71 power supply is not normally adjusted. The primary tappings are normally set for 120V. However if the supply voltage is below 110VAC or likely to drop below 110VAC due to the operation of loads like points and train stops then the tappings should be changed to set the power supply for 110V operation.

4.5.4 Switchmode

Switchmode power supplies in redundant configurations are sometimes used as audio frequency track circuit power supplies. They are setup as per the general switchmode power supplies for 24V.

The voltage should be in the range of 23 to 26 volts when measured across the fuse and negative terminals for the track circuit equipment.

4.6 Microlok Power Box power supply adjustment

The Power Box power supplies used for Microlok are plug-in euro-card style power supplies. De-coupling diodes are mounted in the euro-card sub-rack as required.

The power supplies have voltage sensing connections that must be connected to the supply outputs for the power supplies to work.

The power supplies need ventilation space around them to allow the supplies to stay within their operating temperatures.

A B12/N12 supply is always used. The other supplies are used as required for the particular installation.

All of these power supplies are external to the Microlok card file, as the cards that plug into the Microlok card file do not require adjustment.

4.6.1 B12/N12 Supply

The B12/N12 supply float charges a sealed lead acid battery. The supply needs to ensure that the float charge voltage remains in the range of 13.5 to 13.8v. A higher voltage than 13.8V may over charge and damage the battery. 13.6V is preferred for normal locations. The sealed lead acid battery float voltage varies based on temperature. 13.6 volts is suitable from 15 to 35°C. 13.8 volts is suitable for 10°C.

Output Voltage is to be set to 13.6 volts at the bus.

Current limiting is normally set to 100% or 110% of the rated current.

Over Voltage Protection is not normally adjusted.

4.6.2 B15/N15 supply

The B15/N15 supply must not exceed 18V or damage to the lamp driver or output cards will occur.

Output Voltage is to be set to 16.2 volts. In special cases it may be set to a maximum of 17.0V, when necessary to achieve the required voltage for all equipment.

Current limiting is normally set to 100% or 110% of the rated current.

Over Voltage Protection is to be set to 17.8 volts.

4.6.3 B50/N50 supply

Output Voltage is to be set to 52.0 volts.

Current limiting is normally set to 100% or 110% of the rated current.

Over Voltage Protection is to be set to 55 volts or the maximum available as it is not normally required to protect the equipment.

4.6.4 5V, +12V, -12V External Microlok supply

The voltages for the external Microlok supplies should be set at 5.1, +12.0, and –12.0 Volts.

Normally the current limiting and over voltage protection should be factory preset.

4.6.4.1 5V supply

Output Voltage is to be set to 5.1 volts +/- 0.1 volts. Measure on the Microlok cardfile terminals or the bus.

Current limiting is normally set to 110% of the rated current.

Over Voltage Protection is to be set to 5.5 volts.

4.6.4.2 +12/-12V supply

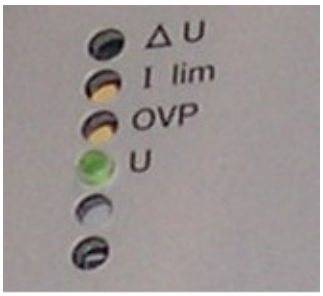
Output Voltage is to be set to 12.0 volts, +/- 0.2 volts.

Current limiting is normally set to 110% of the rated current.

Over Voltage Protection is to be set to 12.5 volts.

4.6.5 Adjustments

Adjustments are made using the potentiometers on the front panel of the power supplies as shown in the picture.



ΔU adjusts the output voltage.

I lim adjusts the current limiting.

OVP adjusts the over voltage protection.

Note that the battery charger module does not have the OVP adjustment on the front panel.

4.6.6 Current limiting adjustment

Current limiting must be set to ensure the supply is limited to its maximum capacity. If the current limiting is too low, then the supplies may shut down during normal operation. If the current limiting is set too high, the units may be damaged.

Adjust as per the *Procedure to Set Current Limiting* in section 4.7.

4.6.7 Over Voltage Protection adjustment

Set the over voltage protection to prevent harming the equipment by:

1. Disconnect the load (including any battery being float charged by the power supply).
2. Power up each power supply one at a time.
3. Set the output voltage to the **over voltage protection voltage** nominated for the type of power supply by using the top potentiometer marked **ΔU** on the module.
4. Adjust the Over Voltage Protection by using the bottom potentiometer marked **OVP** so that the power supply is turning off and on.
5. Reduce the output voltage till the output voltage is stable then increase the voltage until the Over Voltage Protection starts operating.
6. Repeat the adjustment from step 3 until the Over Voltage Protection operates at the required voltage.
7. Set the output voltage to nominal voltage.

4.6.8 Voltage adjustment

Set the output voltage by:

- Disconnect the battery if adjusting the B12/N12 supply.
- Power up each power supply one at a time and adjust to the nominated voltage at the bus using the top potentiometer marked **ΔU** on the module.
- Power up all modules and check the bus voltage after adjustment.
- Reconnect the battery if required.

4.6.9 Procedure to Adjust power supplies for load sharing

Note: *This adjustment is easier to make with a significant load on the supply.*

If multiple power supplies are configured to share the one load then they are to be adjusted as follows:

- Use a current clamp or “tong” meter to measure the current drawn from each power supply.
- Trim the voltage adjustments using **ΔU** on each supply so that the current drawn from each power supply is within 10% of the current drawn by the other supplies. This is best done with at least 1/2 the rated load current.
- Wait for 10 minutes for the operating temperatures to stabilise and re-check the current balance and that the load voltage is correct.
- Recheck the balance at least 2 days later.

4.6.10 Label

Place a sticker on unit covering the adjustment access, to prevent un-intended adjustments.

The sticker should indicate the settings and date.

4.7 Procedure to Set Current Limiting

If the switch mode power supply has adjustable current limiting, the current limiting is set as follows:-

- Determine the rated output of the unit.
- Ensure a meter is available that will read the maximum output current.
- Disconnect the load and any battery.
- Connect the meter across the output. If using a DC tong meter, place a wire across the output and use the tong meter to measure the current through it. Ensure that the wire used to short the power supply can carry the full rated current of the power supply.

- Turn on power to the power supply to be adjusted.
- Adjust the current limiting potentiometer (usually labelled as **I lim)** to 110% of the rated current if it is a single power supply, or to 100% of the rated current if the power supply is sharing the load with other power supplies.
- Turn off power to the power supply.
- Remove the meter or the wire shunt.
- Reconnect the load and any battery.
- Turn on power to the power supply.

4.8 Procedure to adjust Power Supply Primary Voltage

A number of purpose built power supplies have adjustable tappings on their transformer. The tappings allow adjustment to cater for the actual supply voltage.

Measure the supply voltage at the input to the power supply and set the tap to the closest value to the measured voltage. If the supply is expected to have significant dips due the operation of train stops and points then the supply should be set for the tap lower than the measured voltage.

The tap voltage is determined by subtracting the numbers on the tap terminals, eg 120V minus 0V is for 120 volts. 120V minus -5V plus is 125 volts.

The 0V terminal is sometimes labelled as COM, C, or Neutral.

The tap with the low number (like 5V) is normally negative for DC power supply transformer primaries.

The *Transformer adjustment procedure* in Section 3.8 provides more details.

Example 1: Measured voltage 118V. The closest tap is 120V, which is set by BX connected to 120V, and NX to 0V. The lower tap is 115V, which is set by BX connected to 115V and NX to 0V.

Example 2: Measured voltage 114V. The closest tap is 115V, which is set by BX connected to 115V, and NX to 0V. The lower tap is 110V, which is set by BX connected to 105V and NX to -5V.

4.9 Procedure to adjust Power Supply Secondary Voltage

Set secondary to obtain an output voltage in the nominated range for the type of power supply.

The tap voltage is determined by subtracting the numbers on the tap terminals, eg 24V minus 0V is for 24 volts. 24V minus -4V plus is 28 volts.

The 0V terminal is sometimes labelled as COM, or C.

The tap with the low number (like 0.5V) is normally positive on the secondary of DC power supply transformers.

The *Transformer adjustment procedure* in Section 3.8 provides more details.