# Output Voltage Programming (Trim) for Delphi DNL/DNM/DNS series POLs

The Delphi series DNL/DNM/DNS (DNX) single output, non-isolated point of load DC/DC converters are the latest offering from a world leader in power systems technology and manufacturing -- Delta Electronics, Inc. This product family works from a variety of wide range inputs and provides an easy-to-use single output in an industry DOSA standard, compact package.

The DNX converters have flexible and programmable built-in tracking and sequencing features to enable a variety of startup voltages as well as sequencing and tracking between power modules. The built-In tracking function (option code A) is fully DOSA compliant which Delta is a member of. In addition, the DNX converters are fully compatible with external tracking devices from Summit Micro (please see AN-206).

The DNX series provides a programmable output voltage from 0.75V to 5.0V (DNX12) or 0.75 V to 3.3V (DNX04) using an external resistor. This application note provides the trim information for both the programmable and fixed output DNX series.

## 1. Output Voltage Programming for DNL04/ DNM04/DNS04 (2.4~5.5Vin) series having programmable outputs

The output voltage of the DNL04/DNM04/DNS04 (DNX04) can be trimmed between 0.7525Vdc and 3.3Vdc by connecting a resistor between the TRIM and GND pins of the module (shown as Rtrim in Figure 1). The output voltage of the module will be 0.7525 Vdc without this external resistor. The following equation defines the value of the resistor Rtrim for a desired output voltage Vo:

$$Rtrim = \left[\frac{21070}{Vo - 0.7525} - 5110\right]\Omega$$

For example, to trim the output voltage of the DNL04 module to 1.8Vdc, Rtrim is :

$$Rtrim = \left[\frac{21070}{1.8 - 0.7525} - 5110\right]\Omega = 15K\Omega$$

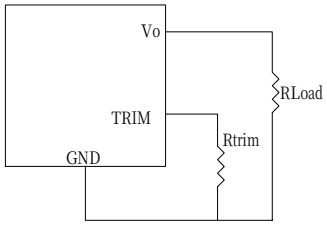


***Figure 1:*** *Circuit configuration to trim the output voltage with an external resistor*

DNX04 can also be trimmed by applying a voltage between the TRIM and GND pins (Figure 2). The following equation defines the value of Vtrim needed for a desired output voltage Vo:

$$Vtrim = 0.7 - 0.1698 \times (Vo - 0.7525)$$

For example, to trim the output voltage of a DNX04 module to 3.3 Vdc, Vtrim is as follows :

$$Vtrim = 0.7 - 0.1698 \times (3.3 - 0.7525) = 0.267V$$

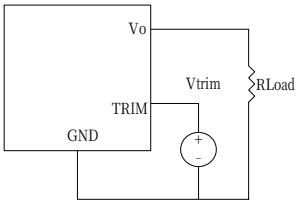


***Figure 2:*** *Circuit Configuration to trim output voltage with external voltage source*

Table 1 below provides Rtrim values for some common output voltages and Table 2 provides values of external voltage source, Vtrim, for the same common output voltages.

| Vo(V) | Rtrim(KΩ) |
|---|---|
| 0.7525 | Open |
| 1.2 | 41.97 |
| 1.5 | 23.08 |
| 1.8 | 15.00 |
| 2.5 | 6.95 |
| 3.3 | 3.16 |

**Table 1**

| Vo(V) | Vtrim(V) |
|---|---|
| 0.7525 | Open |
| 1.2 | 0.624 |
| 1.5 | 0.573 |
| 1.8 | 0.522 |
| 2.5 | 0.403 |
| 3.3 | 0.267 |

**Table 2**

## 2. Output Voltage Programming for DNL12/ DNM12/DNS12 (8~14Vin) series having programmable outputs

The output voltage of the DNL12/DNM12/DNS12 (DNX12) can be trimmed between 0.7525Vdc and 5.0Vdc by connecting a resistor between the TRIM and GND pins of the module (shown as Rtrim in Figure 1). The output voltage of the module will be 0.7525 Vdc without this external resistor. The following equation defines the value of the resistor Rtrim for a desired output voltage Vo:

$$Rtrim = \left[\frac{10500}{Vo - 0.7525} - 1000\right]\Omega$$

For example, to trim the output voltage of the DNL12 module to 3.3Vdc, Rtrim is :

$$Rtrim = \left[\frac{10500}{2.5475} - 1000\right]\Omega = 3.122k\Omega$$

DNX12 can also be trimmed by applying a voltage between the TRIM and GND pins (Figure 2). The following equation defines the value of Vtrim needed for a desired output voltage Vo:

$$Vtrim = 0.7 - \left[(Vo - 0.7525) \cdot 0.0667\right]$$

For example, to trim the output voltage of a DNX12 module to 3.3 Vdc, Vtrim is as follows :

$$Vtrim = 0.7 - \left[2.5475 \cdot 0.0667\right] = 0.530V$$

Table 3 below provides Rtrim values for some common output voltages and Table 4 provides values of external voltage source, Vtrim, for the same common output voltages.

| VO (V) | Rtrim (KΩ) |
|---|---|
| 0.7525 | Open |
| 1.2 | 22.464 |
| 1.5 | 13.047 |
| 1.8 | 9.024 |
| 2.5 | 5.009 |
| 3.3 | 3.122 |
| 5.0 | 1.472 |

**Table 3**

**Table 4**

| VO (V) | Vtrim (V) |
|---|---|
| 0.7525 | Open |
| 1.2 | 0.670 |
| 1.5 | 0.650 |
| 1.8 | 0.630 |
| 2.5 | 0.583 |
| 3.3 | 0.530 |
| 5.0 | 0.4167 |

## 3. Output Voltage Programming for DNL04/ DNM04/DNS04 (2.4~5.5Vin) series having fixed outputs

Although DNX04 and DNX12 are offered with a wide output trim, some customers may prefer a fixed output version and then trim the output voltages up or down as in older generation converters. Sections 3 and 4 show the trim equations for these situations.

To trim up the fixed output DNX04 modules with an external resistor, please connect Rtrim-up between the TRIM and GND pins (Figure 3). The value of Rtrim-up is defined as:

$$R_{trim-up} = \frac{21070}{|\Delta V_{out}|} - 5110 \quad \Omega$$

$|\Delta V_{out}|$ is the difference between desired output voltage and nominal voltage set-point.

For example, to trim up the output voltage of a 3.3Vout module (DNL04S3R3R16P B) by 10% to 3.63, $R_{trim-up}$ is as follows:

$$|\Delta V_{out}| = |3.63 - 3.30| = 0.33V$$

$$R_{trim-up} = \frac{21070}{0.33} - 5110 \quad \Omega = 58.738k\Omega$$

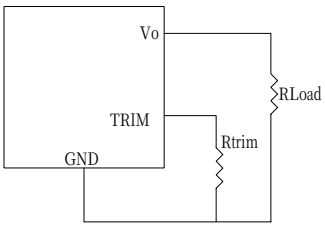


***Figure 3:*** *Circuit Configuration to trim up*

To trim down the fixed output DNX04 modules with an external resistor, please connect Rtrim-down between the TRIM and GND pins (Figure 4). The value of Rtrim-down is defined as:

$$R_{trim-down} = \left[\left(\frac{V_{out} - 0.7}{|\Delta V_{out}|} - 1\right) \times 30100\right] - 5110 \quad \Omega$$

where Vout is the nominal set point voltage of a module and $|\Delta Vout|$ is the difference between desired output voltage and nominal voltage set-point.

For example, to trim down the voltage of a 3.3Vout module (DNL04S3R3R16P B) by 10% to 2.97V, Rtrim-down is as follows:

$$|\Delta V_{out}| = |2.97 - 3.30| = 0.33V$$

$$Vout = 3.3V$$

$$R_{trim-down} = \left[\left(\frac{3.3 - 0.7}{0.33} - 1\right) \times 30100\right] - 5110 \quad \Omega$$

$$R_{trim-down} = 201.94 \quad k\Omega$$

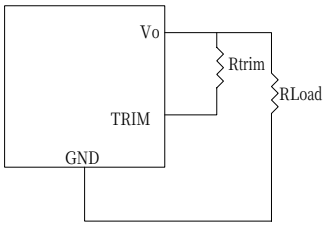


***Figure 4:*** *Circuit Configuration to trim down*

To trim up with an external voltage source, apply a voltage from TRIM pin to ground using the following equation:

$$V_{trim-up} = 0.7 - \left[|\Delta V_{out}| \times \frac{5110}{30100}\right]$$

To trim down using an external voltage source, apply a voltage from TRIM pin to ground using the following equation:

$$V_{trim-down} = 0.7 + \left[|\Delta V_{out}| \times \frac{5110}{30100}\right]$$

$|\Delta V_{out}|$ is the difference between desired output voltage and nominal voltage set-point. If the TRIM feature is not being used, leave the TRIM pin open..

## 4. Output Voltage Programming for DNL12/ DNM12/DNS12 (8~14Vin) series having fixed outputs

To trim up the fixed output DNX12 modules with an external resistor, please connect Rtrim-up between the TRIM and GND pins (Figure 3). The value of Rtrim-up is defined as:

$$R_{trim-up} = \frac{10500}{|\Delta V_{out}|} - 1000 \quad \Omega$$

$|\Delta V_{out}|$ is the difference between desired output voltage and nominal voltage set-point.

For example, to trim up the output voltage of a 3.3Vout module (DNL12S3R3R16P B) by 10% to 3.63, $R_{trim-up}$ is as follows:

$$|\Delta V_{out}| = |3.63 - 3.30| = 0.33V$$

$$R_{trim-up} = \frac{10500}{0.33} - 1000 \quad \Omega = 30.818k\Omega$$

To trim down the fixed output DNX12 modules with an external resistor, please connect Rtrim-down between the TRIM and GND pins (Figure 4). The value of Rtrim-down is defined as:

$$R_{trim-down} = \left[\left(\frac{V_{out} - 0.7}{|\Delta V_{out}|} - 1\right) \times 15000\right] - 1000 \quad \Omega$$

where Vout is the nominal set point voltage of a module and $|\Delta Vout|$ is the difference between desired output voltage and nominal voltage set-point. For example, to trim down the voltage of a 3.3V module (DNL12S3R3R16P B) by 10% to 2.97V, Rtrim-down is calculated as follows:

$$|\Delta V_{out}| = |2.97 - 3.30| = 0.33V$$

$$Vout = 3.3V$$

$$R_{trim-down} = \left[\left(\frac{3.3 - 0.7}{0.33} - 1\right) \times 15000\right] - 1000 \quad \Omega$$

$$R_{trim-down} = 102.18 \quad k\Omega$$

To trim up with an external voltage source, apply a voltage from TRIM pin to ground using the following equation:

$$V_{trim-up} = 0.7 - \left[|\Delta V_{out}| \times \frac{1000}{15000}\right]$$

To trim down using an external voltage source, apply a voltage from TRIM pin to ground using the following equation:

$$V_{trim-down} = 0.7 + \left[|\Delta V_{out}| \times \frac{1000}{15000}\right]$$

$|\Delta V_{out}|$ is the difference between desired output voltage and nominal voltage set-point. If the TRIM feature is not being used, leave the TRIM pin open.

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