Load Switch

Power Component: C750/C755

Product Description

The C75x Power Component series is a customizable Load Switch with current protection and soft-start to control in-rush current. Combine the C750/755 component with other Power Components to create a highly-integrated, custom-defined, AnDAPT AmP™ on-demand power management device.

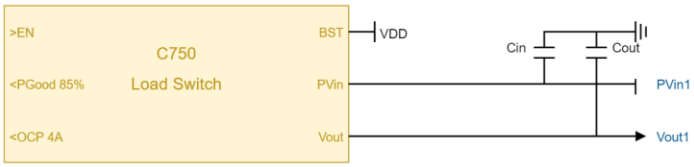
Features

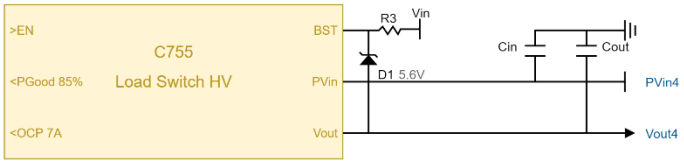
- Output voltage from 0.5V to 2.5V (C750) and 1.8V to 5V (C755)
- Low RDS_{ON} MOSFET: 30mΩ
- Maximum output current: 6A (AmP8D6)
- Soft-start slew rate to control inrush current
- OCP Current limit protection
- Short-circuit protection (SCP)
- Additional communication capabilities – I75x, P75x
- Power-good flag output and Enable input
- –40°C to +125°C operating junction temperature
- One SIM element used from AmP platform

Applications

- Reverse-current protection
- Power isolation; reduce leakage current
- Protect circuits from inrush current or current spikes
- Reduce power and extend battery life; turn off power to unused circuits

Figure 1: C75x application schematics





Product Detail

The C75x is a single channel high-side load switch designed for operation from 0.5V to 5.0 V. This load switch provides power domain isolation. The device contains a low on-resistance, N-channel MOSFET that supports more than 6A of continuous current and minimizes power loss. In addition, the device features over current and over voltage protection to protect the device against fault conditions.

The C750 is designed to cover the lower voltage range (0.5V to 2.5V) while the C755 is designed to cover the higher voltage range (1.8V to 5V). Overlap in the voltage range is provided for user convenience.

The Load Switch is controlled by an on and off input, which is capable of interfacing directly with low-voltage control signals. The integrated linear Scalable Integrated MOSFET (SIM) provides up to 6A, output current. The maximum current is defined by the AmP device selected. The integrated current sense provides over-current protection (OCP).

The C75x has control and status pins including an enable input, a power-good output. The Load Switch parameters are specified by the power engineer using AnDAPT's cloud-based WebAmp™ development software.

Part number	AmP Platform	IOUT Max	VOUT Max
C750	AmPxD6	6A	2.5V
C755	AmPxD6	6A	5.0V

Pin Description Table

Port Name	Analog/ Digital	Input/ Output	Description
Pvin	Analog	I/P	Power switch input voltage
V_{OUT}	Analog	O/P	Power switch output voltage
BST	Analog	I/P	Bootstrap Connect to Vdd for C750. Connect to external Zener diode for C755.
EN	Digital	I/P	Enable input, logic high turns on power switch.
PGood	Digital	O/P	Power Good indicator. Turns High when output voltage reach 85% of V_{OUT}
OCP	Digital	O/P	Over Current Indicator Turns high when current exceeds OCP level

System Characteristics

Table 1: lists the system characteristics for the C75x Power Component when implemented in an AnDAPT AmP device.

Table 1: System Characteristics

Parameters	Min	Typ	Max	Units
Input voltage (C750)	0.6		2.5	V
Input Voltage (C755)	1.8		5	V
Output Current (I_{OUT})			6	A
Output MOSFET switch ($R_{DS(on)}$)		30		mΩ
Current Limit – OCP (C750)	I_{OUT}		7	A
Current Limit – OCP (C755)	I_{OUT}		7	A
Overvoltage protection trip point range (OVP) C75x		V_{OUT} + 1V		V

For other device specifications, see the AnDAPT AmP Platform datasheet.

Customizable Options

Table 2 lists the various customizable options available for the C750 Power Component. These options are set graphically in the WebAmp development software.

Table 2: C750 Customizable Options

Option	Units
Input/Output voltage	V
Output Current	A
Enable OCP output to signal when overcurrent protection is triggered	On/Off
Overcurrent protection level (I_{OUT}+1A)	A
Enable soft start	On/Off
Use optional PGood output to signal “power good”	On/Off

Advanced Capabilities and Options

Table 3 lists derivatives of the C75x component with additional capabilities plus other similar components potentially suitable for this application.

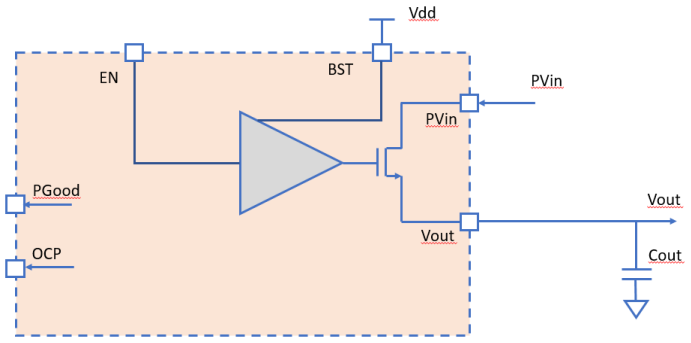
Table 3: C75x Advanced Capabilities Options

Description	Part Number
Standard Pro Series version (this component)	C75x
Add external control via I^2C bus interface	I75x
Add telemetry and dynamic voltage scaling via DVS interface	P75x

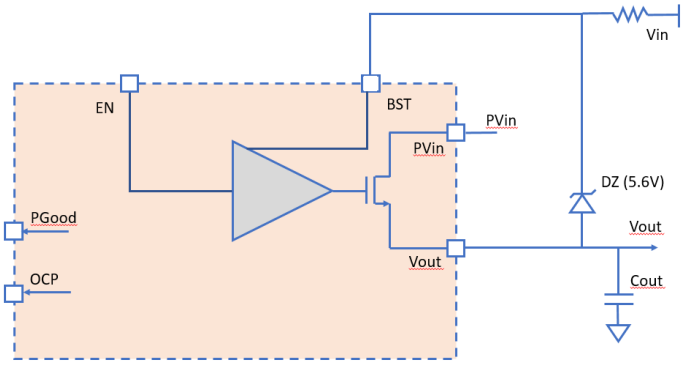
Theory of Operation

The C750/C755 power component is a Load Switch used to provide power domain isolation under the control of an on/off (EN) digital input. The load switch is a low on-resistance N-channel MOSFET that supports up to 6A of continuous load current and minimizes power loss. A block diagram is shown below:

Block Diagram C750



Block Diagram C755



A 330kΩ resistor needs to be inserted between the BST pin and V_{IN}.

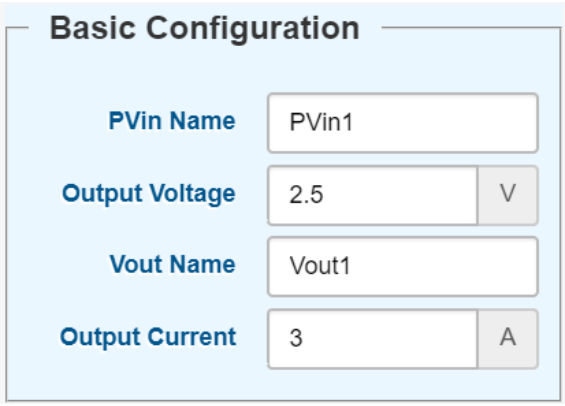
Feature Description

Several parameters can be adjusted using the WebAmp tool. When using the C75x in an adaptable product, the values by default are listed below

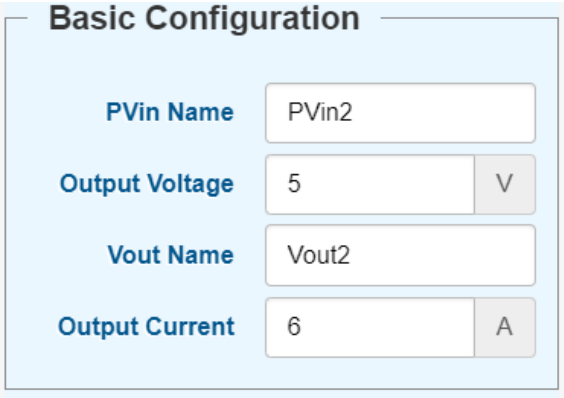
Basic Configuration

You can adjust the output voltage and the maximum output current.

For C750, the default value is 2.5V for V_{OUT} and 3A for the output current.



For C755, the default value is 5V for V_{OUT} and 6A for the output current



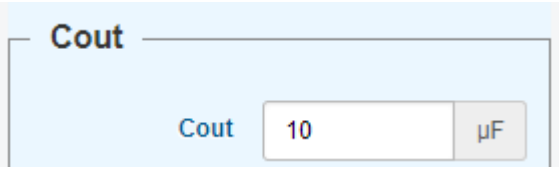
Output Capacitance

The C_{OUT} determines the slew rate of the output voltage during soft start. The default value is 10uF.

Slew rate (SR) is a function of the capacitance and the current

SR = I_{OUT}/C_{OUT}

For 6A, 10uF, the slew rate will be 0.6V/us



Input Capacitance

The input capacitance C_{IN} is used to reduce the sensitivity of the circuit to the PCB layout, especially when high source impedance or long input traces are encountered.

A 10uF minimum capacitance is recommended.

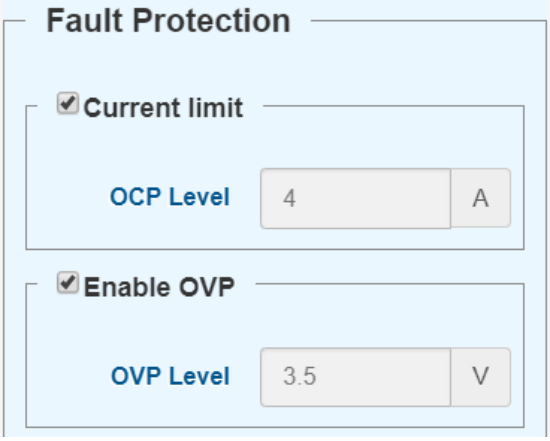
Fault Protection

The C75x is protected against damage due to excessive power dissipation by current limit (OCP) and output voltage protection (OVP).

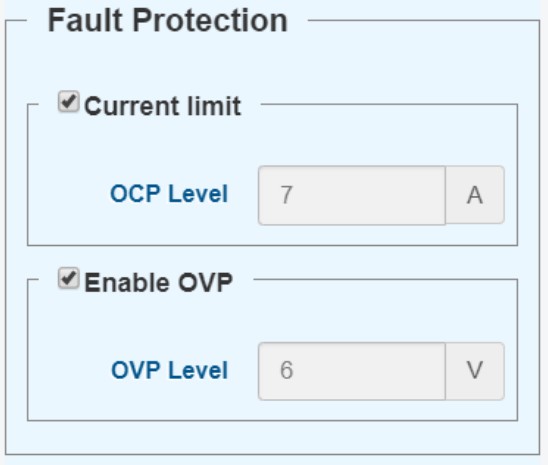
When the output load exceeds the over current limit, the C75x turns off and PGood is deasserted.

You can enable or disable fault protection for current limit and OVP.

The default values are listed below for the C750

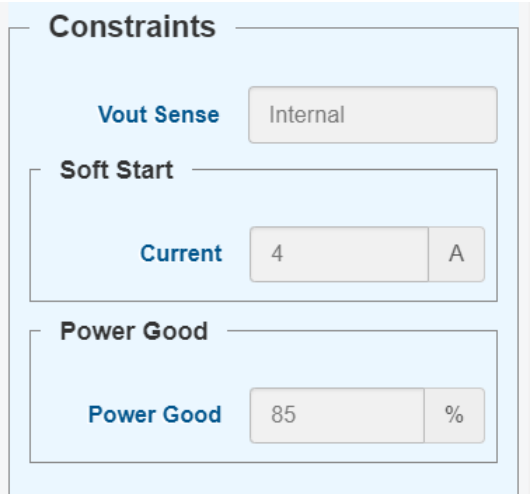


For the C755 the default values are:

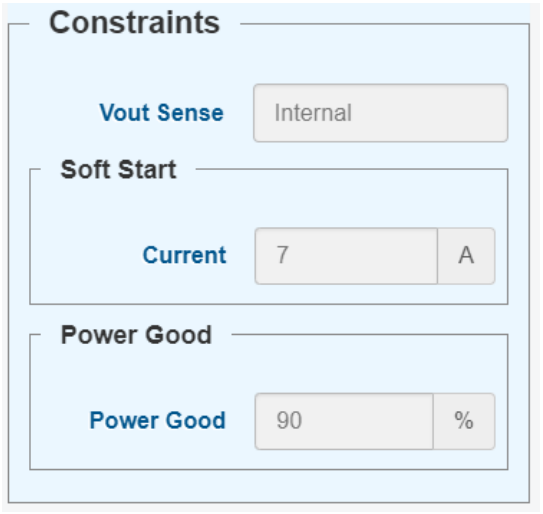


Other Configuration (Constraints)

By default, the V_{OUT} Sense is internal for the C75x.



For the C755, default values are:



Soft start is set at 1A above the maximum current value of the device.

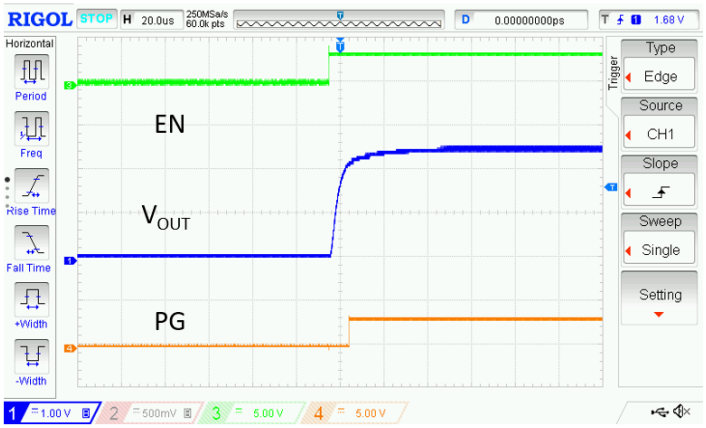
The Soft start feature is always enabled and allows a controlled ramp of the output based on the value set by C_{OUT}.

Typical Characteristics

Unless otherwise specified: TA = 25°C

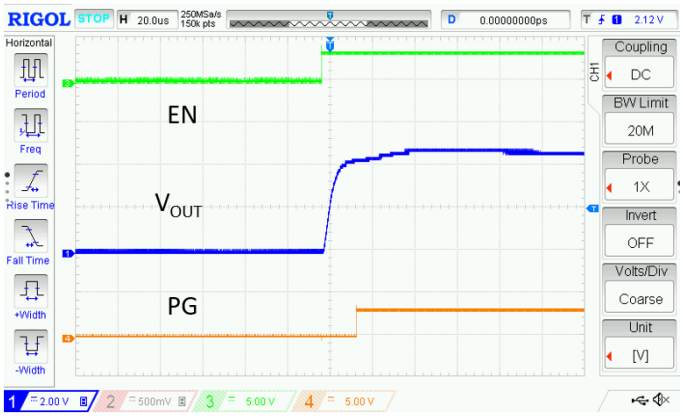
Soft Start C750

V_{OUT}= 2.5V No load



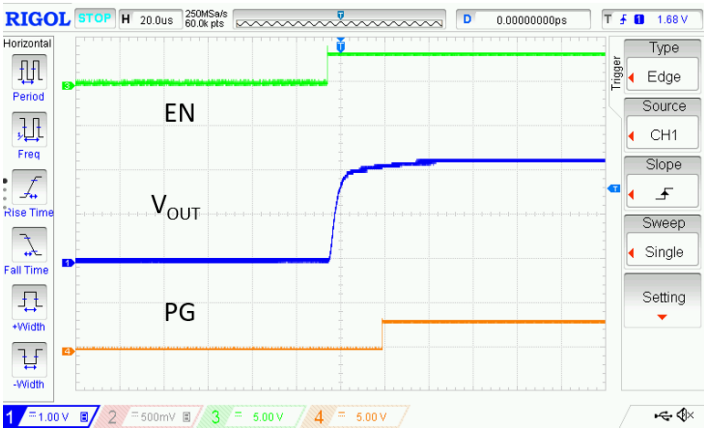
Soft Start C755

V_{OUT}= 5V, 2.3 Ohm load



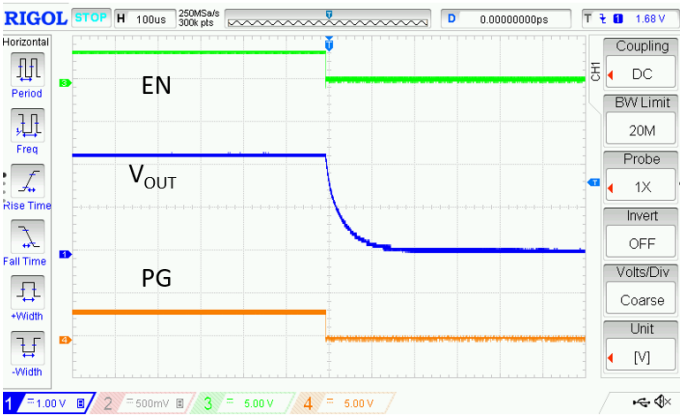
Soft Start C750

V_{OUT} = 2.5V, 1.2 Ohm load



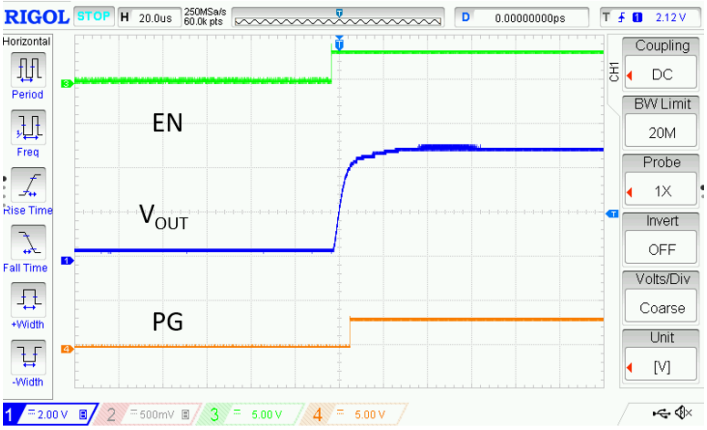
Soft Stop C750

V_{OUT}= 2.5V 1.2 Ohm Load



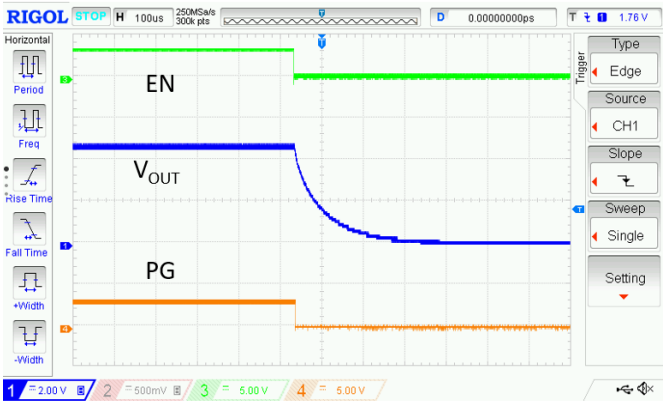
Soft Start C755

V_{OUT}= 5V No load



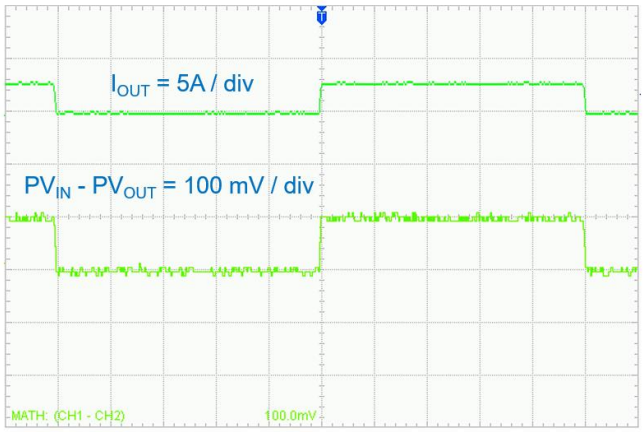
Soft Stop C755

V_{OUT}= 5V, 2.3 Ohm Load



Transient Response C750

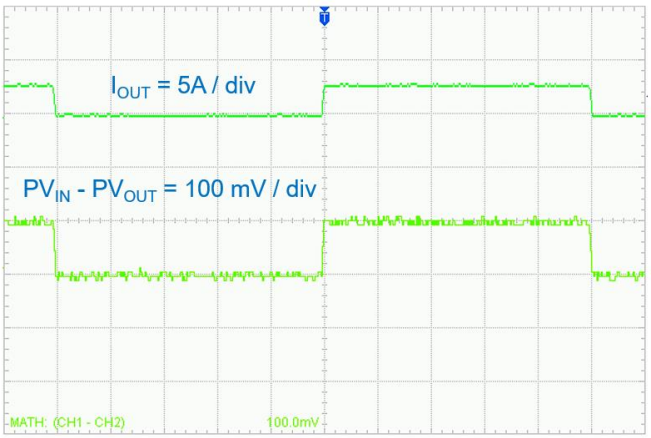
PV_{IN} = 5V, (PV_{IN} - PV_{OUT}) = 100 mV, I_{OUT} = 0 to 3A Load step



Time = 2ms / div

Transient Response C755

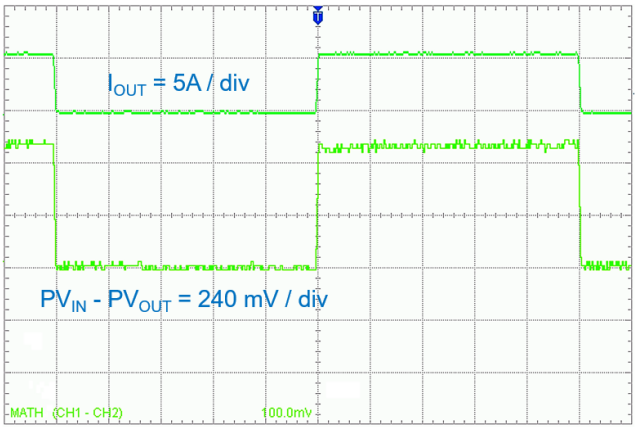
PV_{IN} = 5V, (PV_{IN} - PV_{OUT}) = 100 mV, I_{OUT} = 0 to 3A Load step



Time = 2ms / div

Transient Response C750

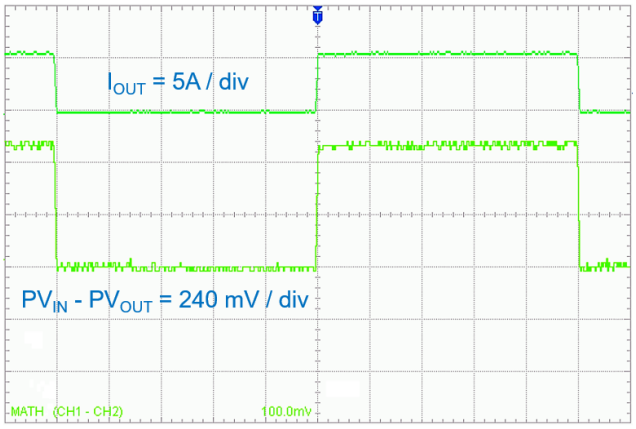
PV_{IN} = 2.5V, (PV_{IN} - PV_{OUT}) = 240 mV, I_{OUT} = 0 to 6A Load step



Time = 2ms / div

Transient Response C755

PV_{IN} = 1.8V, (PV_{IN} - PV_{OUT}) = 240 mV, I_{OUT} = 0 to 6A Load step



Time = 2ms / div

C750 Resource Usage

Circuit Stats...
- Number of AnD_Temp_Sensor 1
- Number of AnD_SIM_Linear 1
- Number of AnD_SIM_Protect 1
- Number of AnD_SIM_Sense 1
- Number of AnD_Analog_IO 6
- Number of AnD_ATC_IO 1
- Number of AnD_ATC_Comp 2
- Number of AnD_Nref_fix 3
- Number of AnD_DFF 2
- Number of LUT4 10

Resource Usage...
- io 1 used (Capacity 24)
- clb 2 used (Capacity 64)
- sim 1 used (Capacity 8)
- atc 2 used (Capacity 6)
- corner 4 used (Capacity 4)
- uLogic 10 used (Capacity 512)

Components Stats...
- $techmap\OTP_fuse_module
  - AnD_DFF 2
- OTP_fuse_module
  - AnD_ATC_Comp 1
  - AnD_Nref_fix 1
- component_1
  - AnD_ATC_Comp 1
  - AnD_Nref_fix 2
  - AnD_SIM_Linear 1
  - AnD_SIM_Protect 1
  - AnD_SIM_Sense 1

C755 Resource Usage

Circuit Stats...
- Number of AnD_Temp_Sensor 1
- Number of AnD_SIM_Linear 1
- Number of AnD_SIM_Protect 1
- Number of AnD_SIM_Sense 1
- Number of AnD_Analog_IO 6
- Number of AnD_ATC_IO 1
- Number of AnD_ATC_Comp 2
- Number of AnD_Nref_fix 3
- Number of AnD_DFF 2
- Number of LUT4 10

Resource Usage...
- io 1 used (Capacity 24)
- clb 2 used (Capacity 64)
- sim 1 used (Capacity 8)
- atc 2 used (Capacity 6)
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Components Stats...
- $techmap\OTP_fuse_module
  - AnD_DFF 2
- OTP_fuse_module
  - AnD_ATC_Comp 1
  - AnD_Nref_fix 1
- component_2
  - AnD_ATC_Comp 1
  - AnD_Nref_fix 2
  - AnD_SIM_Linear 1
  - AnD_SIM_Protect 1
  - AnD_SIM_Sense 1

Additional Resources

- AnDAPT AmP Platform datasheet

Revision History

Date	Revision
01/21/2019	Preliminary release

AnDAPT

On-Demand Power Management

www.AnDAPT.com

Trademarks