APPLICATION NOTE

for DJT090_DLynxII_Series_Single_Evaluation_Board

V1.2

Contents

DESCRIPTION

The DJT090A0X43-SRPZ (later refer as DJT090) Digital DLynxII™ power modules are non-isolated dc-dc converters that can deliver up to 90A of output current. These modules operate over a 7 to 14.4Vdc input range and provide a precisely regulated output voltage from 0.5 to 2Vdc. The module employs a novel charge mode control which ensures loop stability, provides fast transient response and reduces amount of required output capacitance. Up to eight modules can be connected in parallel to form a high current rail. The key features include: digital PMBus™ interface, remote ON/OFF, output voltage sequencing, tracking of an external analog signal, synchronization to an external clock, pre-biased start up, cycle-by-cycle output overcurrent protection, input and output under-voltage and over-voltage protections, under-temperature and over-temperature protections and more. The module has an extensive set of PMBus™ commands for both control and monitoring of the system parameters. System diagnostic is facilitated by a black-box event recorder that will log the selected fault events and will provide valuable inside for debugging. The DJT090A0X43-SRPZ power module is highly configurable, and yet easy to use. For more details refer to the product datasheet. DJT090A0X43-SRPZ single evaluation board (later refer as EVM) provides user a quick start for DC and transient analysis up to 90A. For transient analysis, an on-board pulse load is provided for ease tests.

PRECAUTION

The DJT090 single EVM can deliver up to 90A DC current. Any unintended connection can cause danger to both the EVM and user, user precaution is advised. DJT090 single EVM can only be evaluated at room temperature of 25 degree Celsius, and is assumed to have proper air flow for heat dissipating. Do NOT apply reverse voltage, larger than -0.5V, on the output terminal, this will damage the EVM.

GETTING STARTED

Required Equipment and Accessory

DJT090 single EVM is preconfigured which provides maximum ease to evaluate. See below list for required equipment and accessory.

- Power supply (20V/40A and up is recommended)
- DC Load (Chroma 63600 Modular DC Electronics Load is recommended, 80V/80A/dual channel)
- ABB USB to I2C dongle
- PC with ABB DPI-CLI Tool

Optional Equipment and Accessory

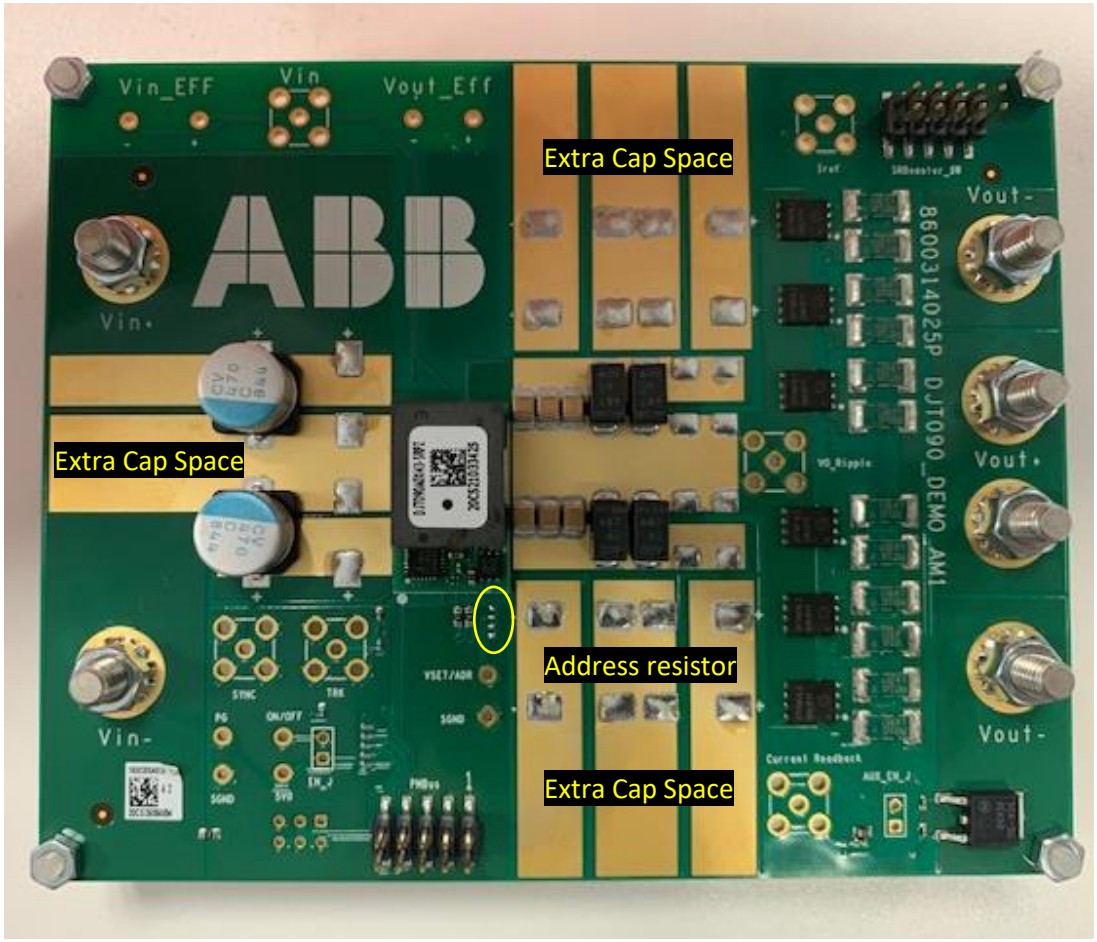
Standard probing technics can be performed, ABB encourages user to use co-axial cable for output signal measurement in order to examine the ideal performance of DJT090. User is recommended to prepare following equipment and accessory for proper measurement and on-board pulse load control.

- SMA connector (Digikey PN: ARF1963-ND or equivalent)

- SMA to BNC cable (Digikey PN: ACX1717-ND or equivalent)
- 2.54mm 2x1 headers and jumpers
- Function Generator
- Multimeter

Eval Board Terminals/Ports

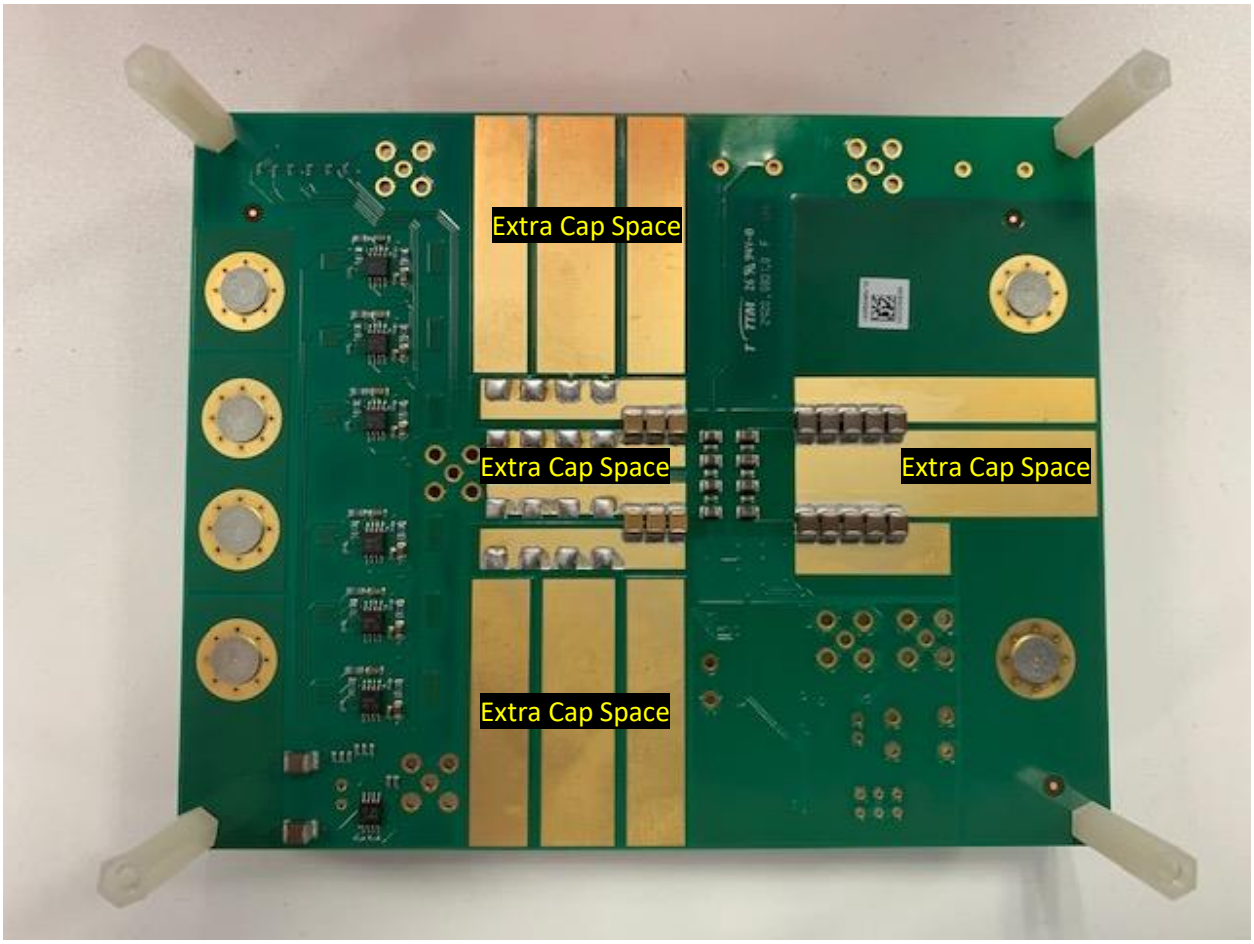
Following diagram and table illustrate all locations and purposes of all terminals/ports.



Top View

Name	Description
Vin+	M5*0.8 stud, positive input voltage terminals, one M5 k-lock nut is included.
Vin-	M5*0.8 stud, negative input voltage terminals, one M5 k-lock nut is included.
Vout+	M5*0.8 stud, positive output voltage terminals, one M5 k-lock nut is included.
Vout-	M5*0.8 stud, negative output voltage terminals, one M5 k-lock nut is included.
Vin_EFF	Efficiency measurement for input voltage
Vout_Eff	Efficiency measurement for output voltage, AUX_EN_J must be disconnected while measuring efficiency
SYNC	SMA connector for measuring SYNC signal
TRK	SMA connector for feed in track/seq signal
PG	Power good test point
SGND	Signal ground
5V0	On board 5V test point, 40mA maximum

ON/OFF	Enable signal test point
EN_J	Jumper for connecting ON/OFF to on board 5V reference
VSET/ADR	Address resistor network midpoint
PMBus	PMBus port for connecting to ABB DPI-CLI tool, notice Pin1 location
Iref	SMA socket for pulse load current input reference
SRBooster_SW	Jumpers for boost pulse loads, jump all by default
VO_Ripple	SMA socket for output voltage measurement, remote sensing point.
Current_Readback	SMA socket for pulse load current read back
AUX_EN_J	Jumpers for enable pulse loads, disconnect when to measure efficiency
Extra Cap Space	Solder mask free area for populating extra capacitors



Bottom View

Name	Description
Extra Cap Space	Solder mask free area for populating extra capacitors

Input/Output Cable

The EVM provides M5x0.8 stud for external connections. One M5 k-lock nut is included for each stud. The maximum input current for single EVM can go over 30A, user must choose proper input cable size. The output voltage of the single EVM can range from 0.5V to 2V, and is capable of delivering up

to 90A. Cable voltage drop must be controlled in this application. In general, output connection should be kept as short as possible by means of reducing voltage drop on each cable.

Input/Output Measurement

To measure Input/Output voltage properly, SMA connectors are recommended to be populated at Vin and VO_Ripple. Ideally oscilloscope should use 50Ω input impedance for measuring output voltage ripple, or use a 50Ω attenuator in series with 1MΩ input impedance. Set the oscilloscope to 10mV/div or below to examine ultra-low ripple performance of DJT090s.

On-Board Pulse Load

To use on-board pulse load, SMA connectors are recommended to be populated at IRef and Current_Readback. Short all SRTBooster with jumpers. Short AUX_EN_J with a jumper. Efficiency measurement will be compromised if AUX_EN_J is jumped.

Address Resistor

By default, the PMBus address resistors are set to 1.2V output and with a PMBus address of 0x1A. Any need to change the address must be done prior powering up the EVM. For PMBus address resistor selection, please refer to DJT090A0X43-SRPZ datasheet.

Input/Output Capacitor

The single EVM comes with limited amount of input and output capacitors. Although the amount of capacitors is sufficient to evaluate the basic performance, user needs to decide whether to change/add more capacitors to unleash superior performance of DJT090. For output impedance matching purposes, capacitors should be placed symmetrically. POSCAP is recommended. Each channel contains following amount of capacitors,

- Input capacitor: 2x470uF (Aluminum Polymer) + 10x22uF (Ceramic)
- Output capacitor: 4x680uF (Tantalum Polymer 18mΩ ESR) + 12x47uF (Ceramic)

Enable Jumper

Short EN_J will connect EN/ONOFF pin to on-board 5V reference. This will start the module.

TRK/Seq

To use track or sequence feature, SMA connector is recommended to be populated at TRK.

SYNC

To measure SYNC signal, SMA connector is recommended to be populated at SYNC.

START EVM

The input voltage for the EVM is from 7V to 14.4V, and the input voltage must not exceed 15V. The input current should be limited to 35A. All ABB measurement are evaluated at 12V rated input. The default output of DJT090 EVM is set to be 1.2V. Short EN_J to start the module. Connect ABB DPI-CLI dongle to PMBus port (notice pin 1 location) to use PMBus commands. All EVM board is pre-configured in the factory, user doesn't require to perform any additional configuration before

turning on the EVM. Refer to DPI-CLI User Guide and DJT090 datasheet for detailed PMBus commands.

ON-BOARD PULSE LOAD

The on-board pulse load provides user a quick and ease way to measure transient performance of single DJT090. In theory, the pulse load will track external arbitrary current reference and apply it on the output rail. Total six channel of pulse load can operate together to achieve 6x pulse capability. For using on-boar pulse load,

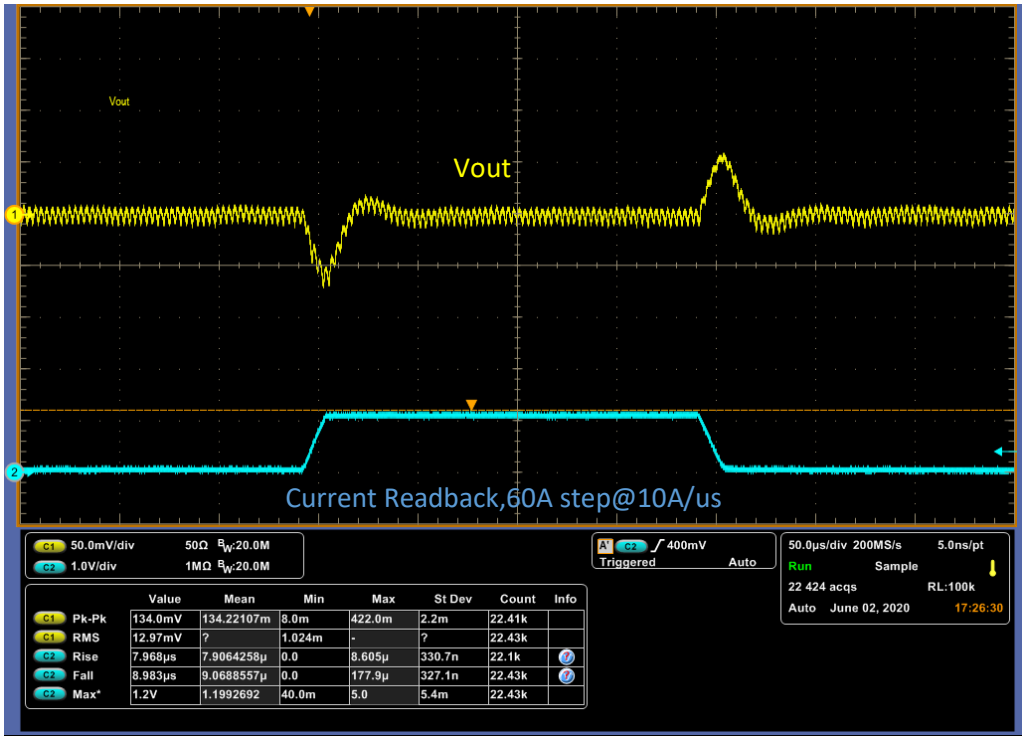
- Connect input power
- Connect output DC load if needed (the pulse load can operate on top of external DC load. e.g. use external load to sink 30A and use on-board pulse load to pulse additional 30A current)
- Short AUX_EN_J with jumper
- Short all SRBooster_SW with jumpers
- Connect Iref to function generator
- Connect VO_Ripple to Oscilloscope Channel 1 via co-axil cable, use 50Ω input impedance or use 50Ω attenuator in series with 1MΩ input impedance.
- Connect Current_Readback to oscilloscope Channel 2 via co-axil cable, use 1MΩ input impedance

Now the EVM setup is ready to perform transient analysis. User can simply control the pulse load by applying an external arbitrary voltage reference on Iref by function generator. Parameters to setup on the function generator,

- Switch to pulse mode
- Set frequency to 100Hz
- Set duty to 5% MAX! (on-board pulse load can take maximum 15W loss, reduce duty if pulse load exceeds 15W loss)
- Set output voltage high level to desired current value using roughly 51A/V ratio (1.0V = 51A) 5V maximum. Due to cable losses and other issues, use Current_Readback as reference to calculate actual output current waveform.
- Set output voltage low level to 10mV (a small current will be applied)
- Set rising/falling edge of the pulse to the desired value, 100ns minimum.

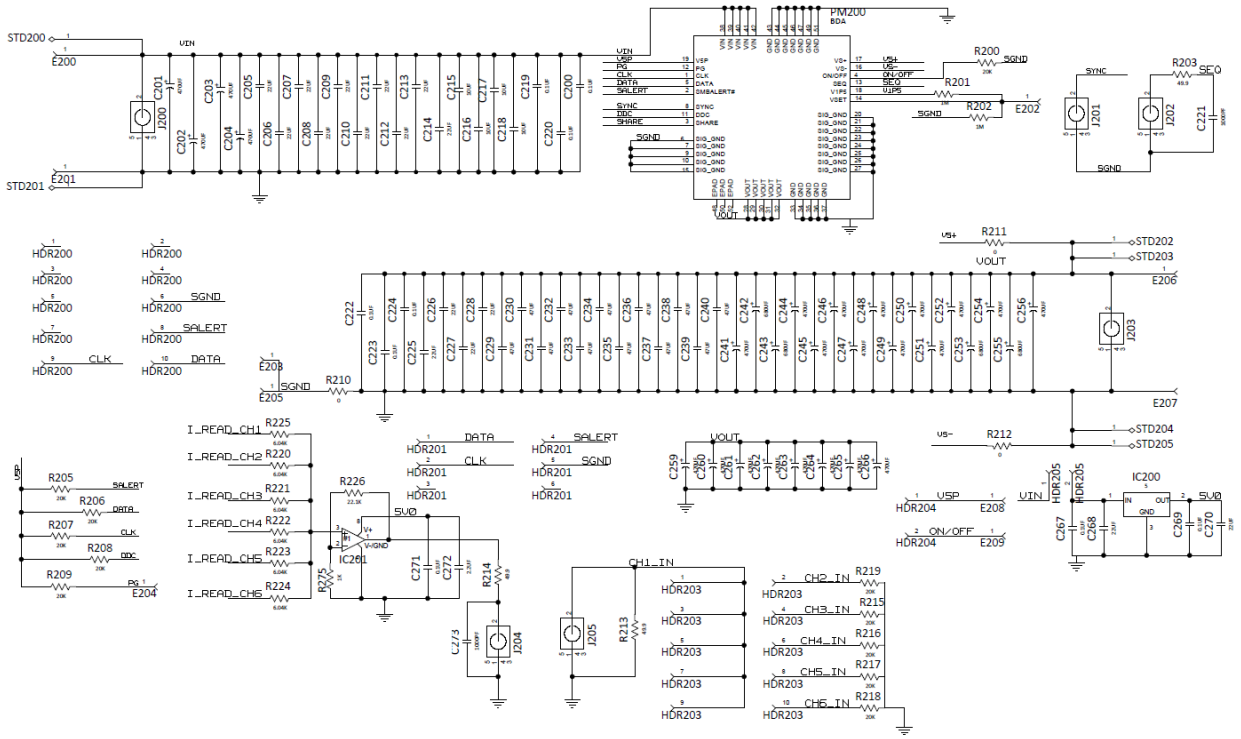
Upon complete, power the EVM and enable the output of the function generator. Use oscilloscope to examine the performance.

- Use VO_Ripple to examine undershoot/overshoot of the output, adjust horizontal/vertical axis to proper range.
- Use Current_Readback to see actual load current waveform. Use 51A/V conversion ratio interpreting the pulse load current. Readback is a more accurate way to determine output current characteristics. For example, regardless high level voltage setting, if Readback shows a 1V step with a 1us rising time, it is equivalent to apply a 51A/us trainset on the output rail.

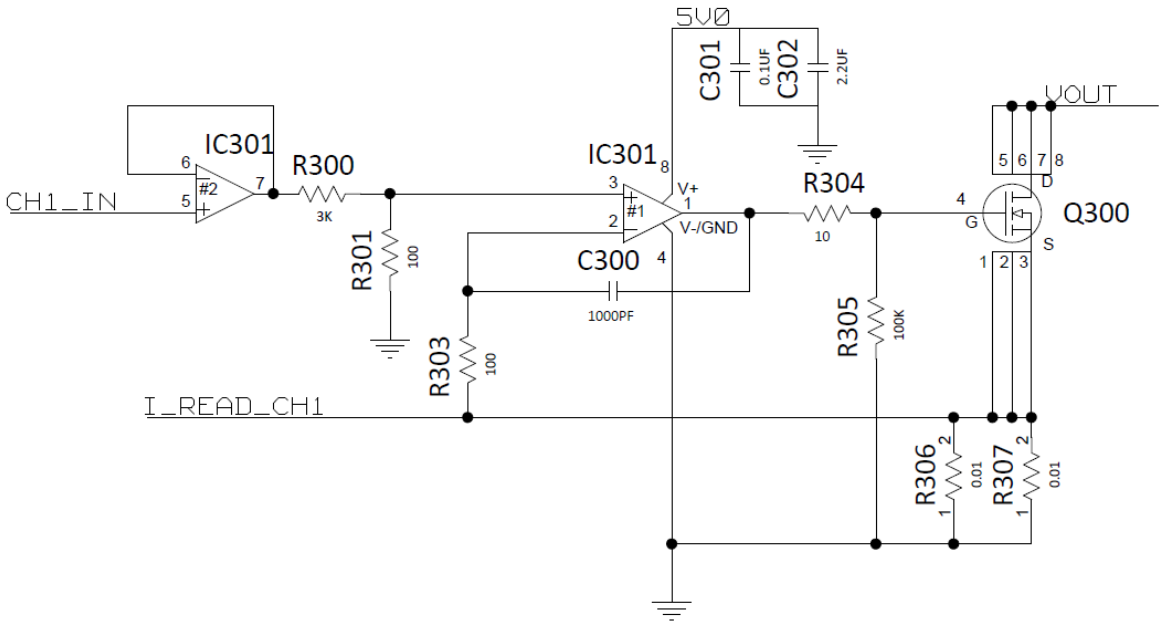


Typical Transient

SCHEMATIC



Main Power Train and Aux Circuit



Pulse Load (1 out of 6 is shown, the rest are duplicated)

Change History (excludes grammar & clarifications)

Version	Date	Description of the change
Draft	06/12/2020	Draft
V1.0	07/10/2020	Initial Release
V1.1	09/29/2020	Minor Revision
V1.2	11/10/2020	Minor Revision

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