Table of Contents:
Page 1: remote sense regulation, efficiency (model t1)
Page 2: Thermal data / picture
Pages 3-4: Major switching waveforms
Pages 5-6: Output ripple
Page 7: Input ripple
Page 8: Start up / shutdown: Turn on / off thresholds not yet set (model t1)
Page 9: Programmed configuration for all 4 outputs
Pages 10-11: Start up / shutdown: after programming (model t6)
Page 12; Bode plots (model t4)

Full load testing:
PMP5099 Test Base with remote sense and 5mOhm current sense resistors for each channel:
Input: 5.09V at 3.929A to both fixture and module
All 4 channels sync'ed to TLC555 timer at 472kHz

Channel 1: AVCC 1.100V at 5.1A rating
Actual current 5.104A to Kikisui load:
1.097V at fixture sense points and 1.141V on module power connector

Channel 2: AVCCRX 1.100V at 3.45A rating
Actual current 3.42A to four 80mOhm resistors in series:
1.100V at fixture sense points and 1.134V on module power connector

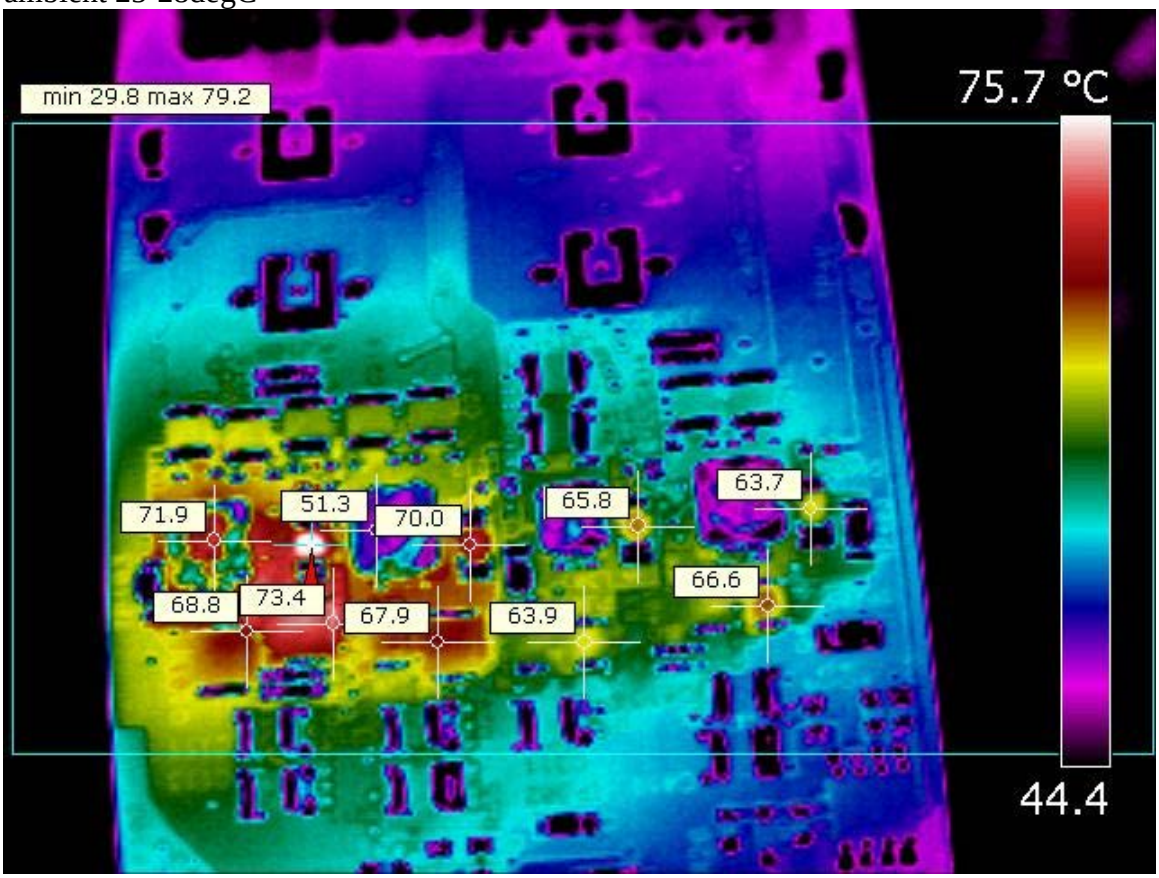
Channel 3: AVTT 1.200V at 3.45A rating
Actual current 1.50A to three 250mOhm resistors and one 40mOhms in series:
1.196V at fixture sense points and 1.212V on module power connector

Channel 4: AVCCPLL 1.800V at 2.6A rating
Actual current 2.62A to four 150mOhm resistors and one 80mOhms in series:
1.798V at fixture sense points and 1.820V on module power connector

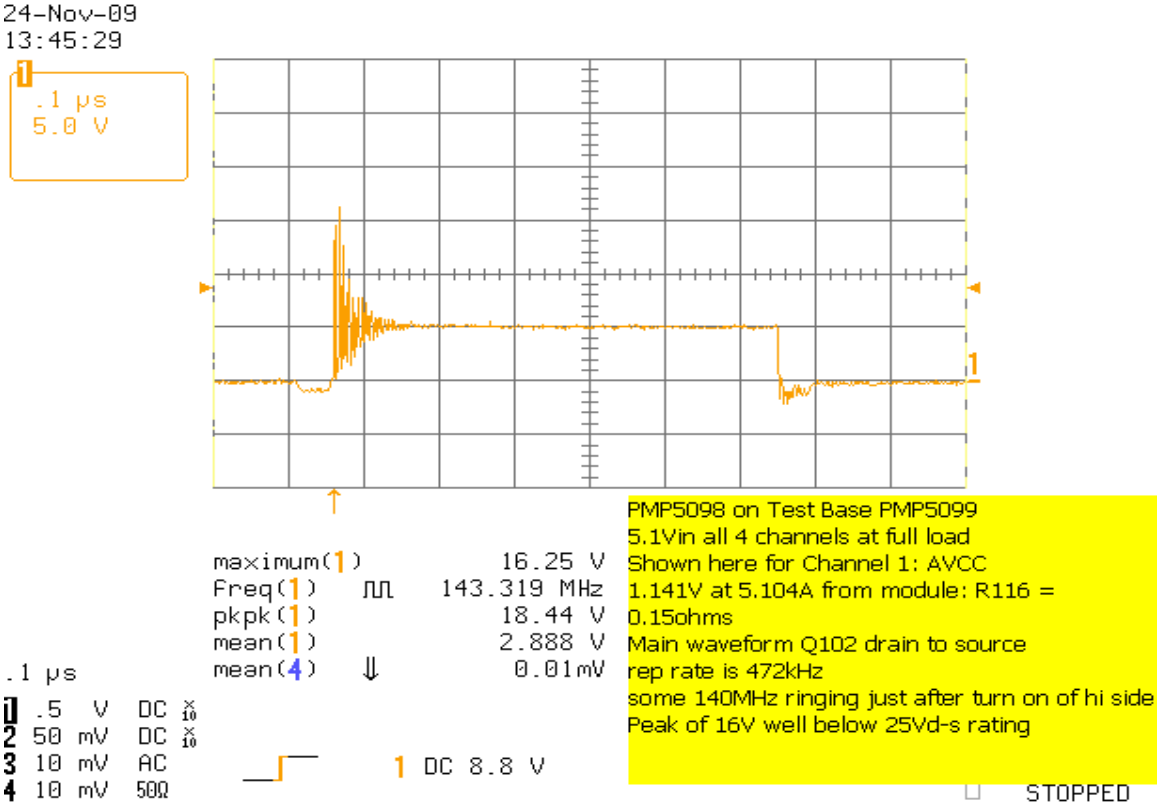
All outputs within ½ % of targets. Also at no load they were at same values within 1mV.

Power in is 20.00W
Power from all 4 outputs at the J2 MPS-08-7.70-01-L-V connector is:
5.824W + 3.878W + 1.818W + 4.768W or 16.29W
Overall efficiency is 81.5%
3.7 Watts on module board itself
See next page for Thermal data / picture

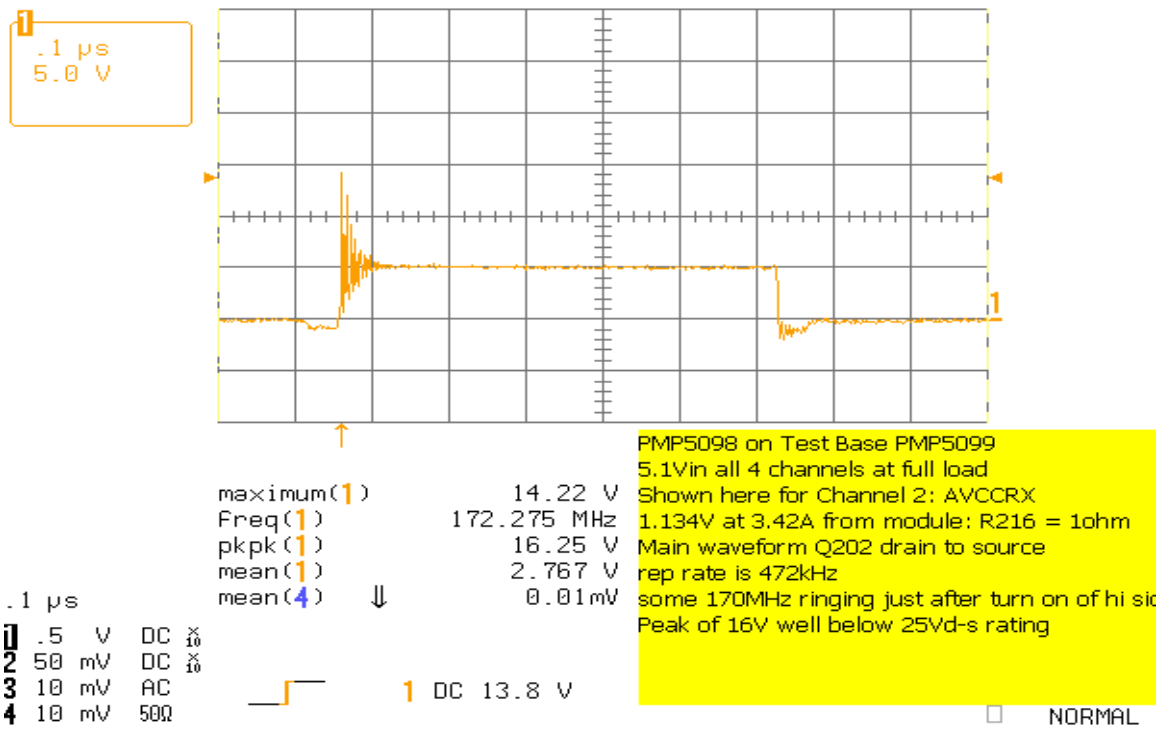
Thermal data:
PMP5098: 5.1Vin all outputs at full load 3.7W on board
Hottest snubber R116 at 79, lo side FET Q102 at 73.4
hi side Q101 at 69, choke L101 at 72, Q201/2 at 68, R216 at 70,
L201 at 51, Q302 at 64, R316 at 66, Q402 at 67, R416 at 64
ambient 25-28degC



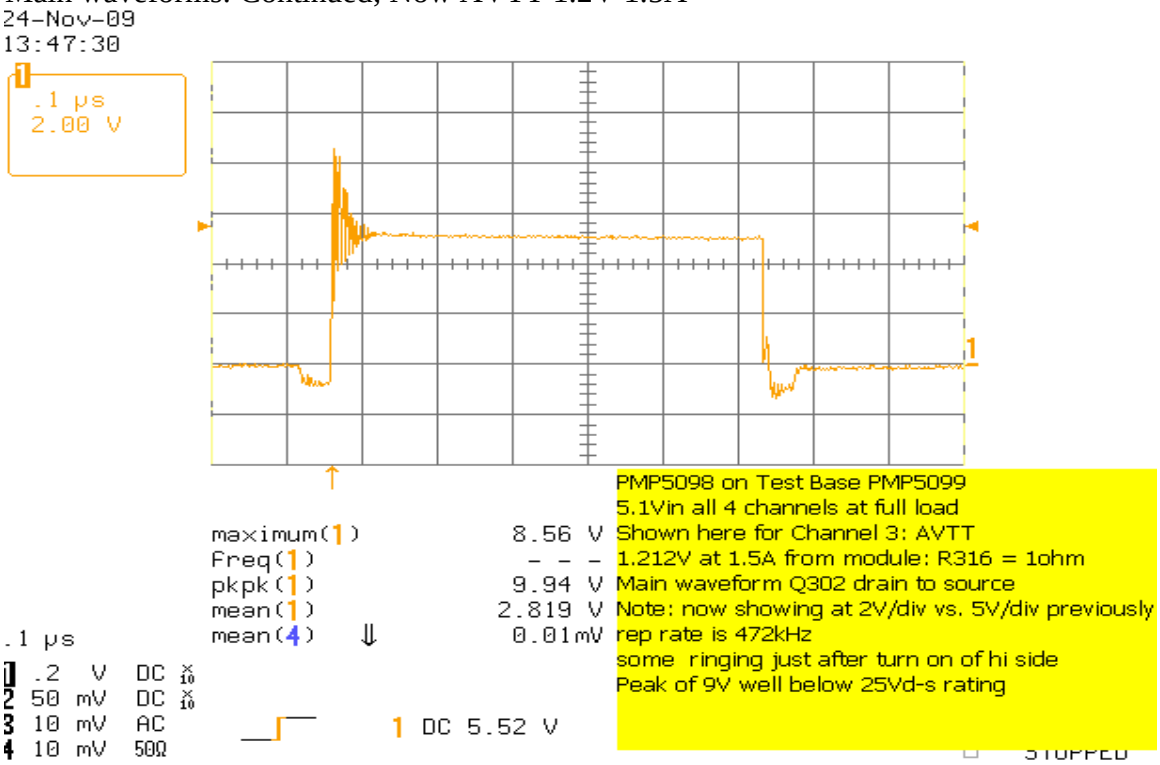
Main waveforms for each channel: start with channel 1: AVCC 1.1V 5.1A



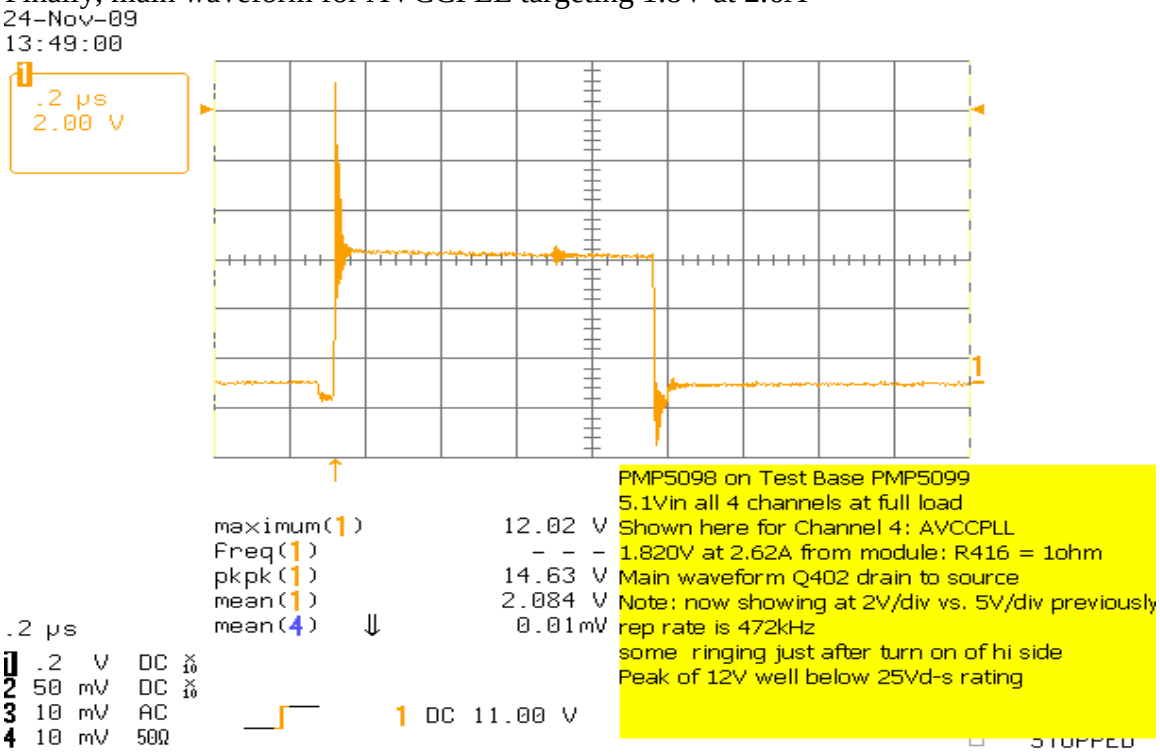
Now AVCCRX: 1.1V 3.45A



Main waveforms: Continued; Now AVTT 1.2V 1.5A

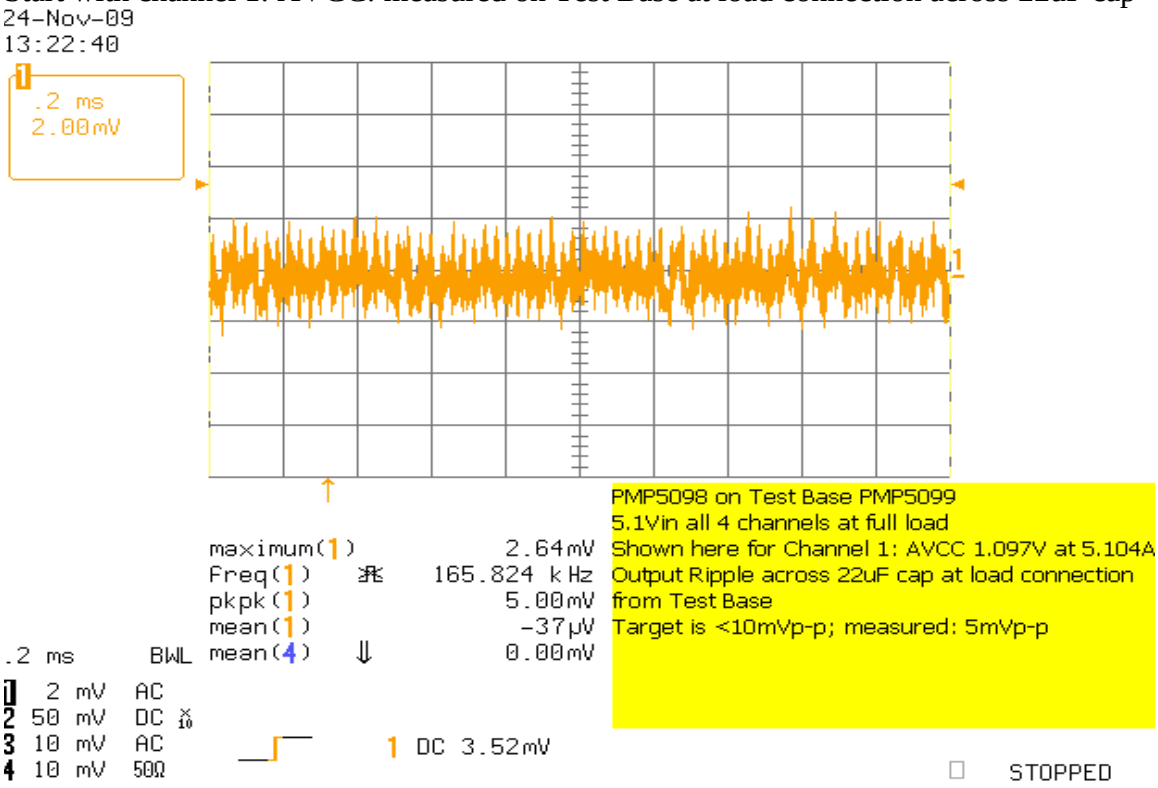


Finally, main waveform for AVCCPLL targeting 1.8V at 2.6A

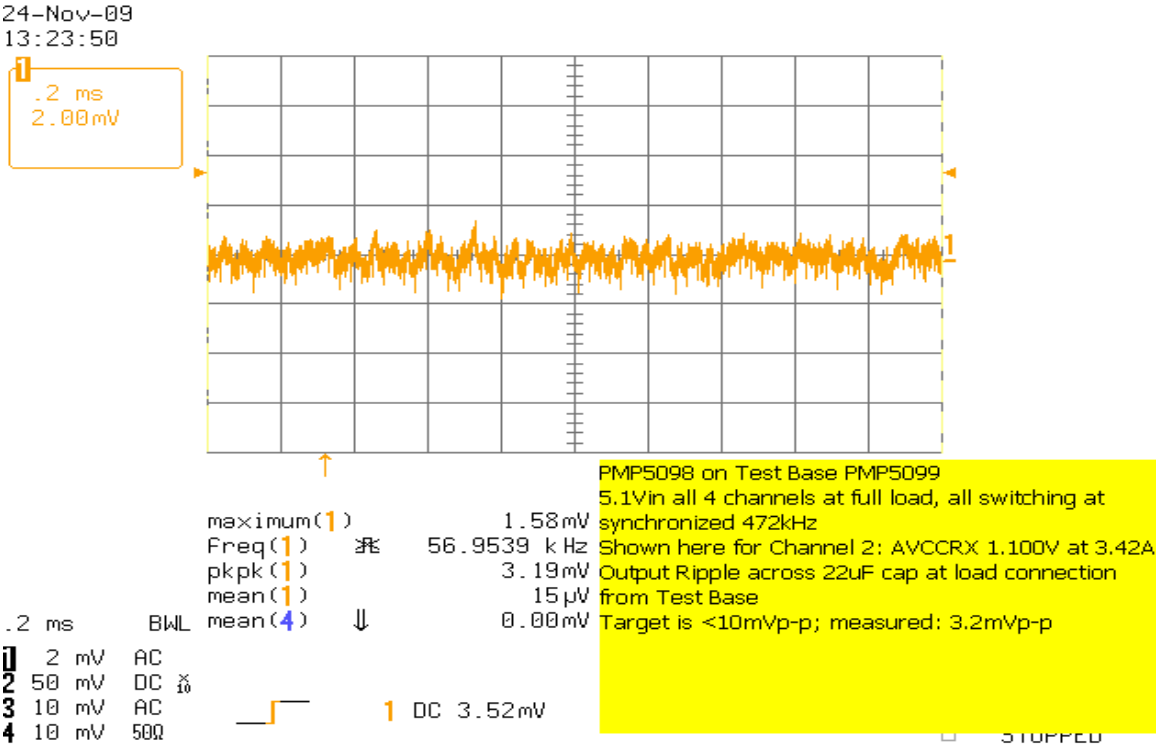


Qq

Output ripple: 5.1Vin and all 4 channels at full load:
Start with channel 1: AVCC: measured on Test Base at load connection across 22uF cap

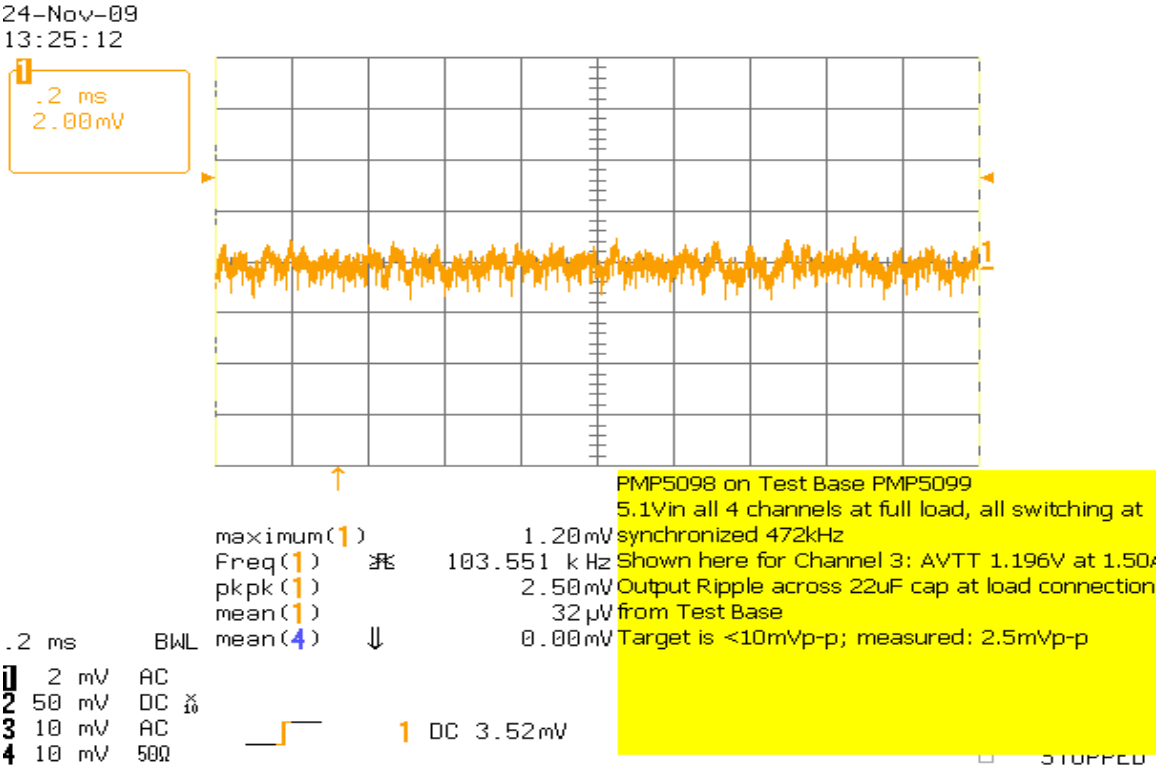


Now channel 2: AVCCRX

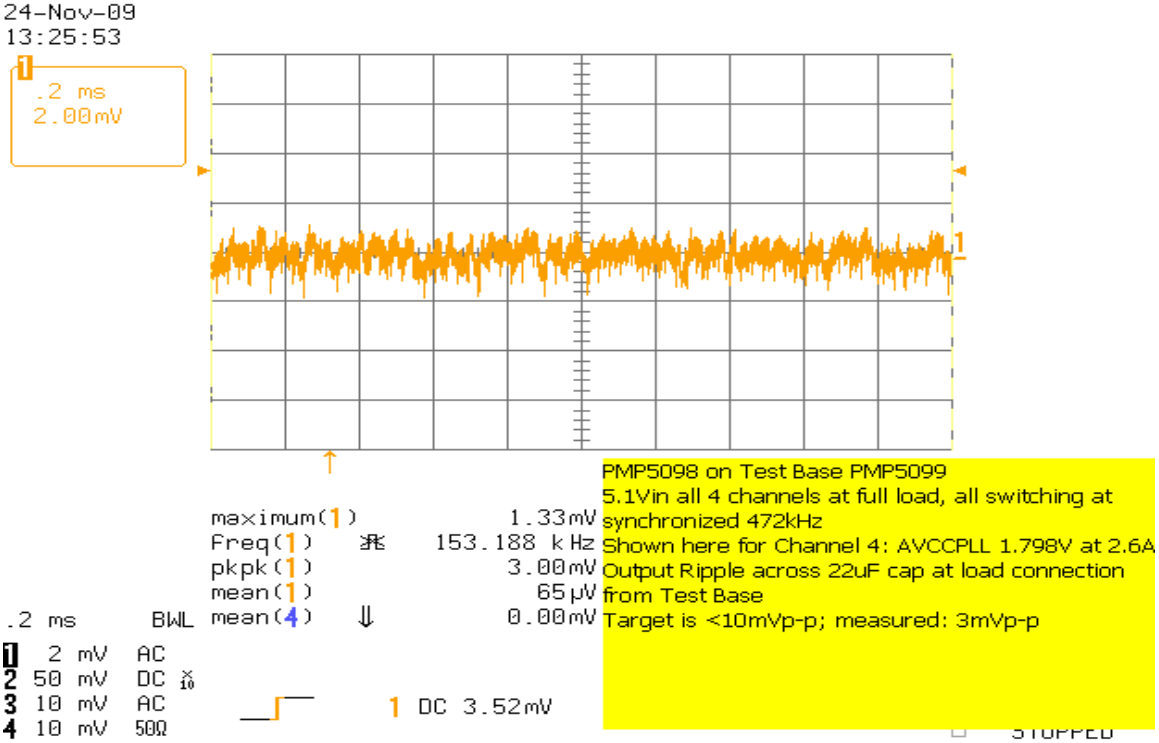


Qq

Output ripple: continued:
Now channel 3: AVTT: 1.196V at 1.50A

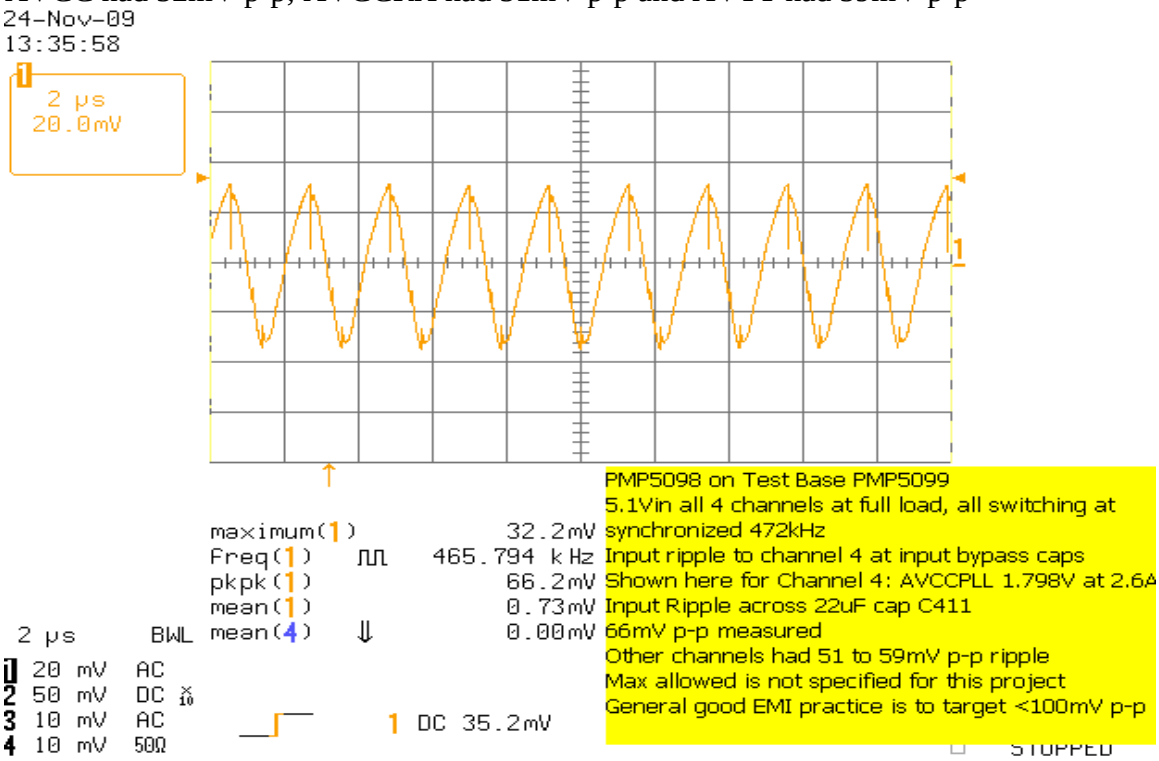


Finally, AVCCPLL 1.8V at 2.6A



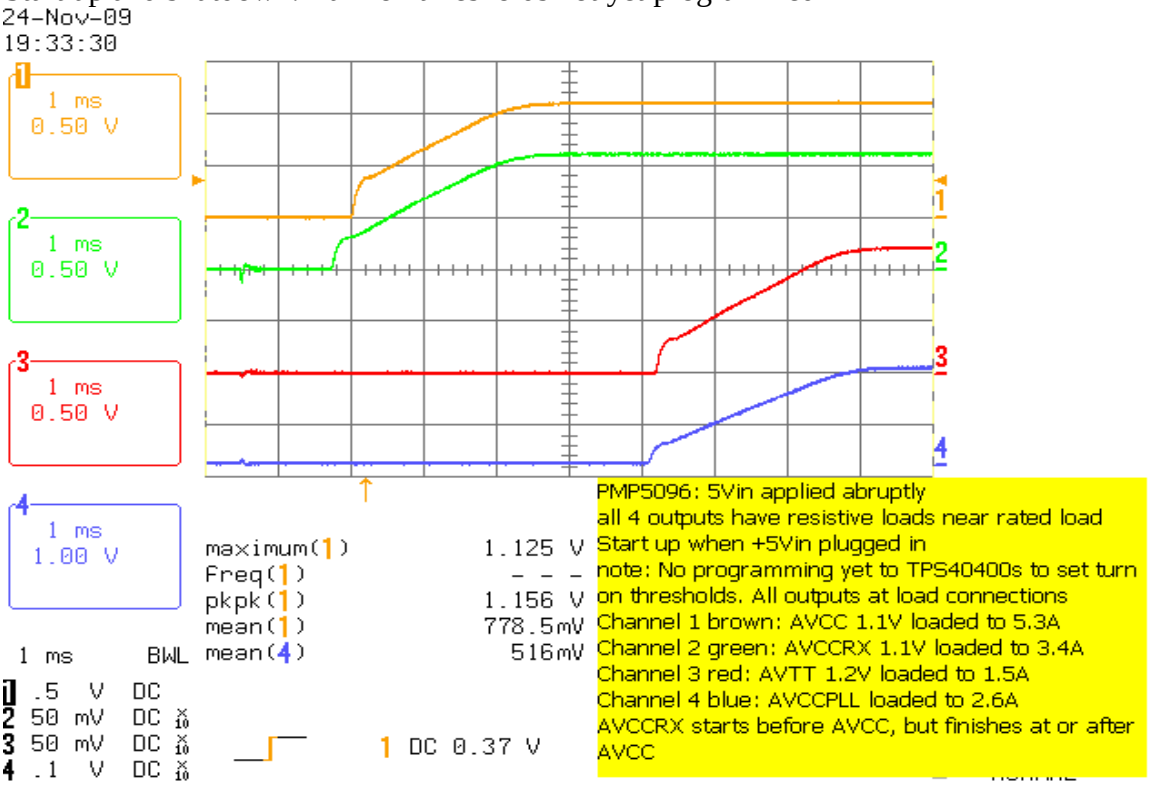
Qq

Input ripple on input bypass cap(s): Cx14 and Cx15
Worst case was channel 4 AVCCPLL: at 66mVp-p
AVCC had 52mV p-p; AVCCRX had 51mV p-p and AVTT had 59mV p-p



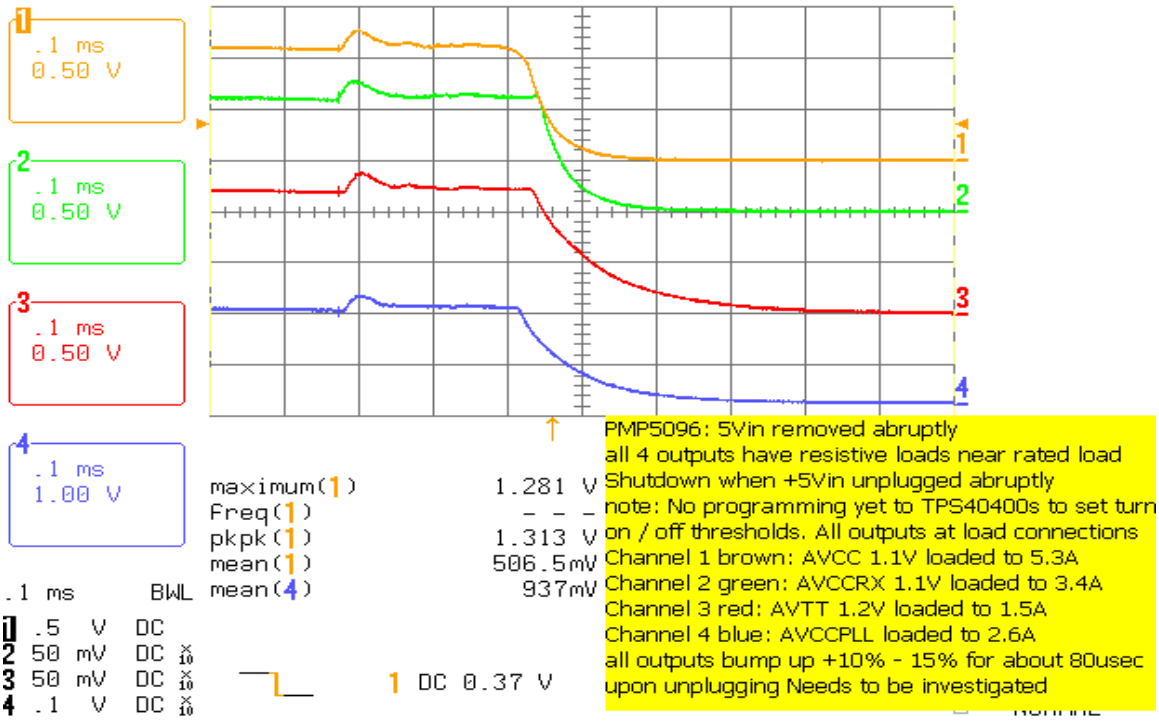
Qq

Start up and shutdown: Turn on thresholds not yet programmed



Qq

Shutdown: 5Vin removed abruptly (unplugged)



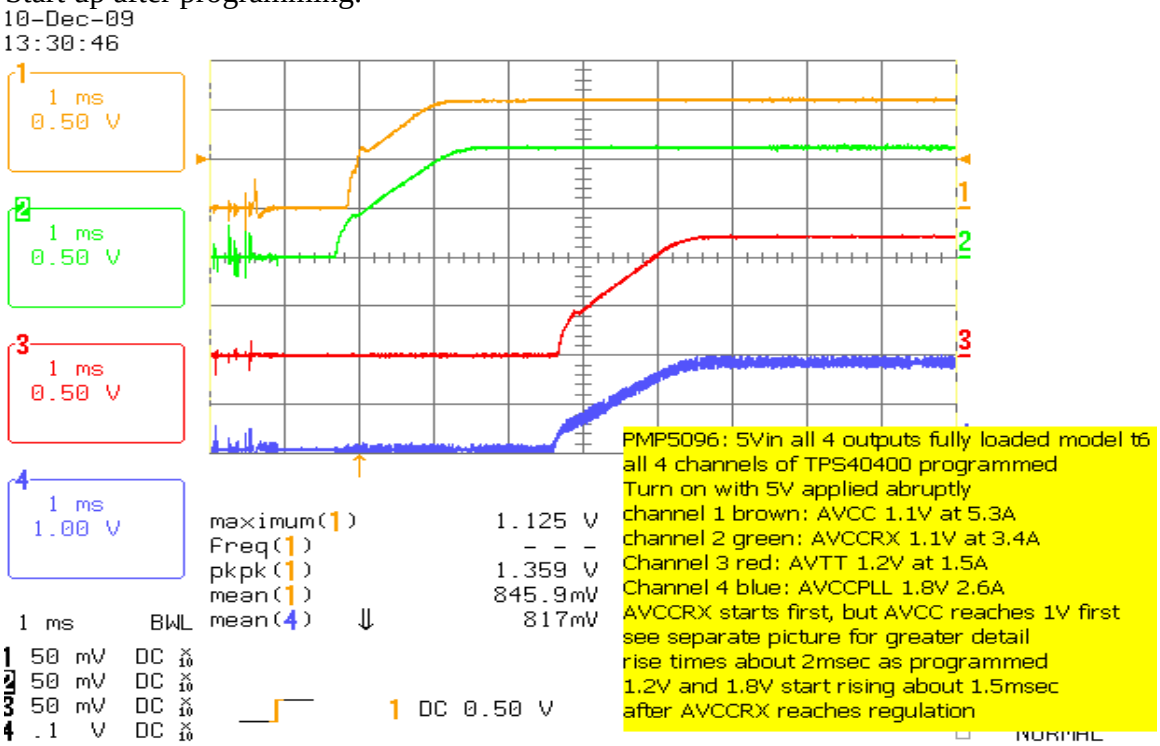
Bump up is real, as it was not seen on channel when probe tied to return

Configuration parameters for all 4 outputs:

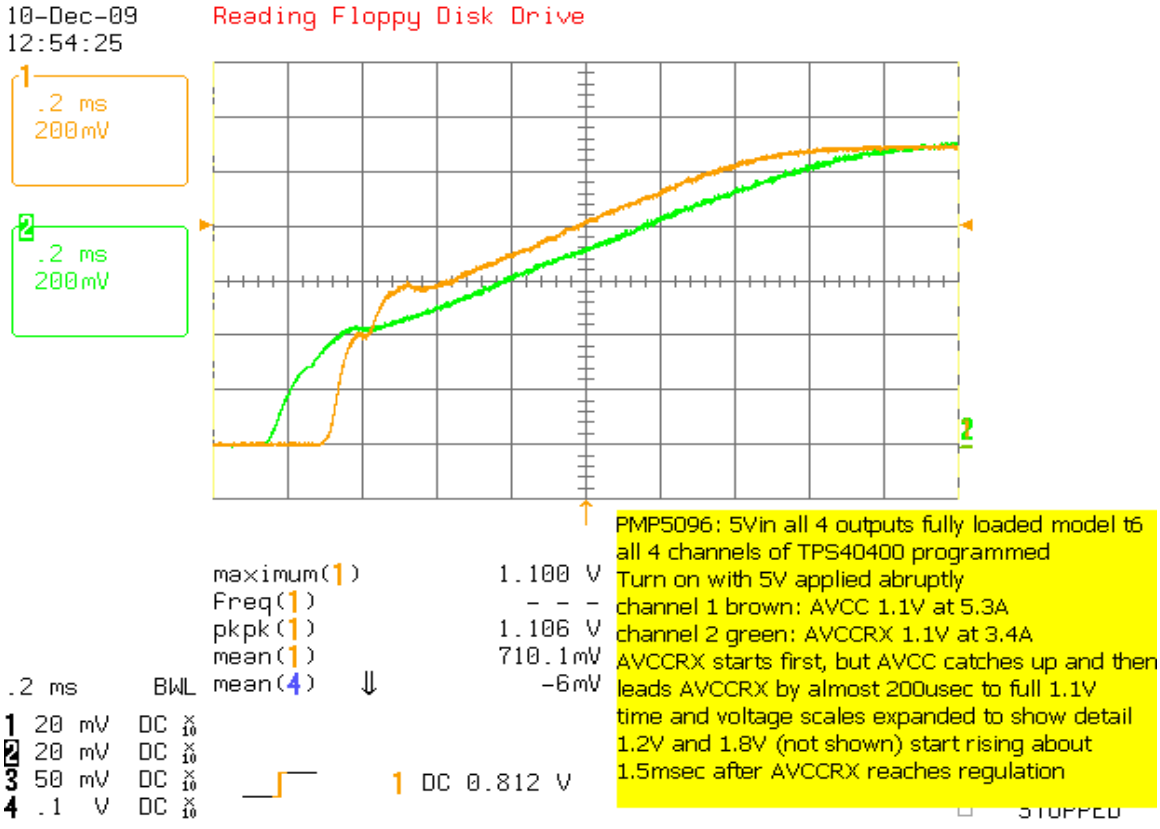
Output name	units	AVCC	AVCCRX	AVTT	AVCCPLL
Vout	Volts	1.1	1.1	1.2	5.1
Imax	Amperes	5.1	3.45	1.5	2.6
PMBus add	decimal	24	25	26	27
Alt address	decimal	32	33	34	35
Vout loop scale		0.545	0.545	0.50	0.332
Current sense	Milli-ohms	5.0	5.0	5.0	5.0
Margin High	Volts	1.21	1.21	1.319	1.979
Margin Low	Volts	0.989	0.989	1.079	1.619
Switching frequency	kHz	384	384	384	384
Toff setting	Nano-seconds	25	25	25	25
Vin on rising	Volts	4.0	4.5	4.5	4.5
Vin off falling	Volts	3.5	4.0	4.0	4.0
Overvoltage thres.	Volts	1.32	1.32	1.439	2.159
OV response	Hex see note 1	0xBC	0xBC	0xBC	0xBC
Undervoltage thres.	Volts	0.989	0.989	1.08	1.6
UV response	Hex see note 2	0x04	0x04	0x04	0x04
Overcurrent fault (OC)	Amperes	6.5	4.5	3.0	4.0
OC response	Hex see note 3	0xBC	0xBC	0xBC	0xBC
Overload warning	Amperes	6.0	4.0	2.5	3.5
Over temp. response	Hex see note 4	0xC0	0xC0	0xC0	0xC0
On / off		Always on	Always on	CNTL HI	CNTL HI
Power Good rising	Volts	1.05	1.05	1.14	1.699
Power Good falling	Volts	1.00	1.00	1.09	1.649
Rise time	Milli-sec	0.0	2.0	2.0	2.0

Notes:
1: OV response: 0xBC means immediate shutdown and continuous retry with soft-start
2: UV response: 0x04 means continue to rum uninterrupted
3: OC response: 0xBC means immediate shutdown and continuous retry with soft-start
4: OT response: 0xC0 means immediate shutdown with retry after cool down below hysteresis

Start up after programming:

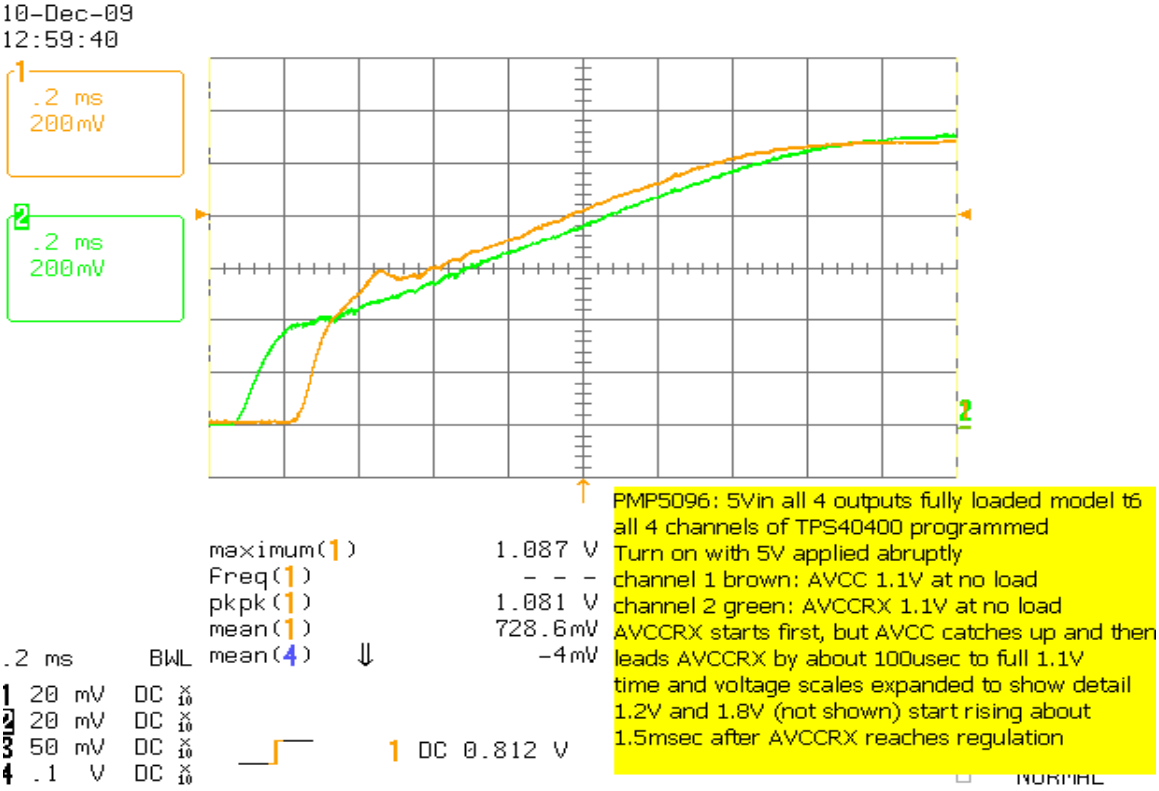


Details of race between AVCC and AVCCRX:

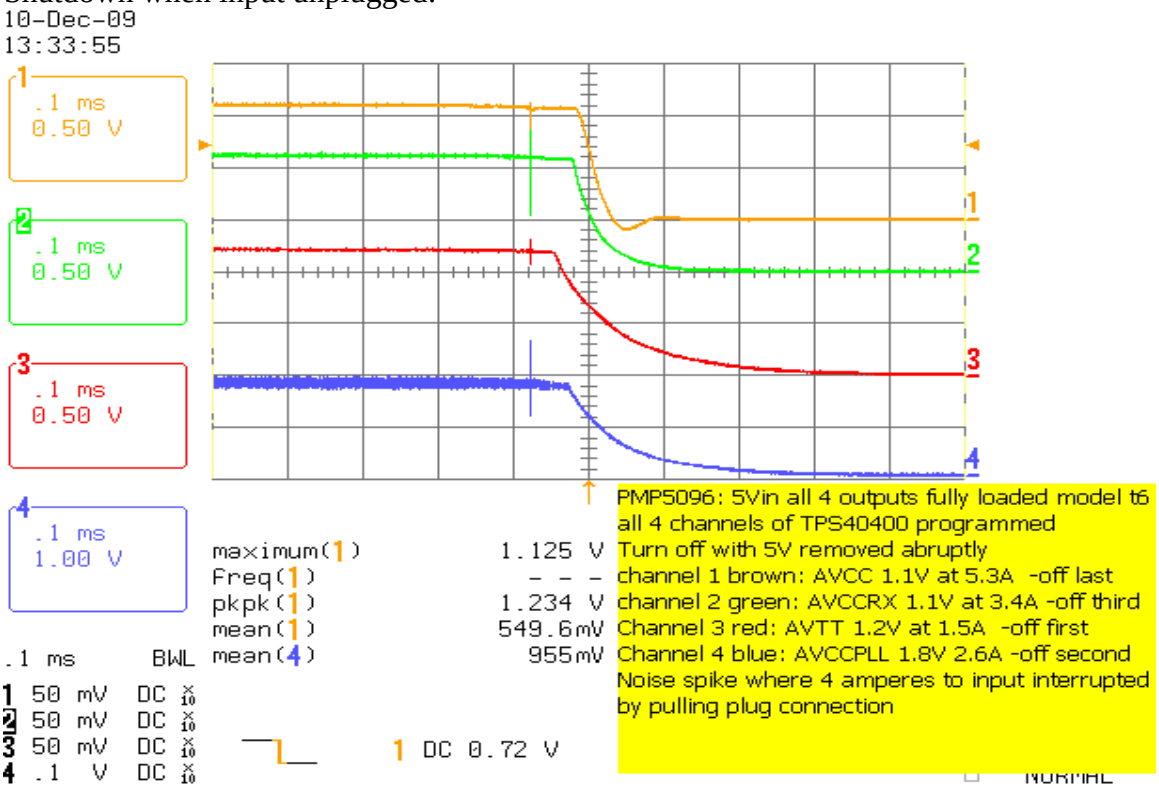


Qq

Race between AVCC and AVCCRX at no load:

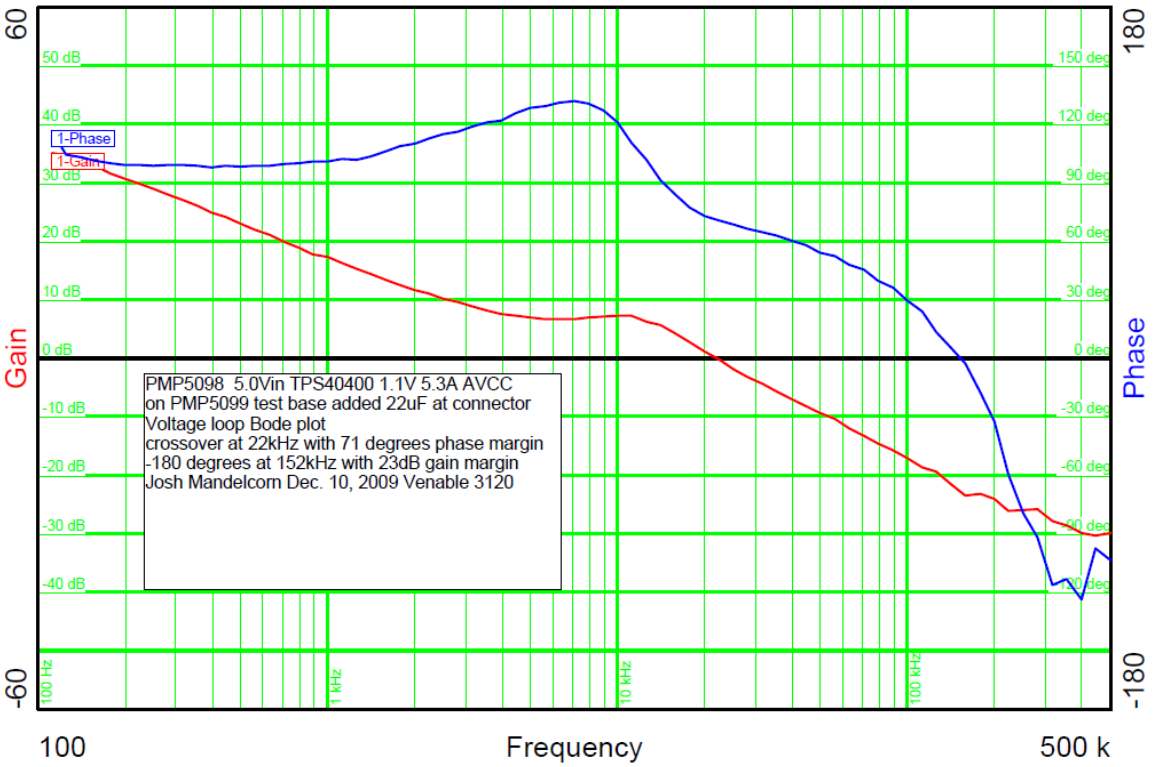


Shutdown when input unplugged:

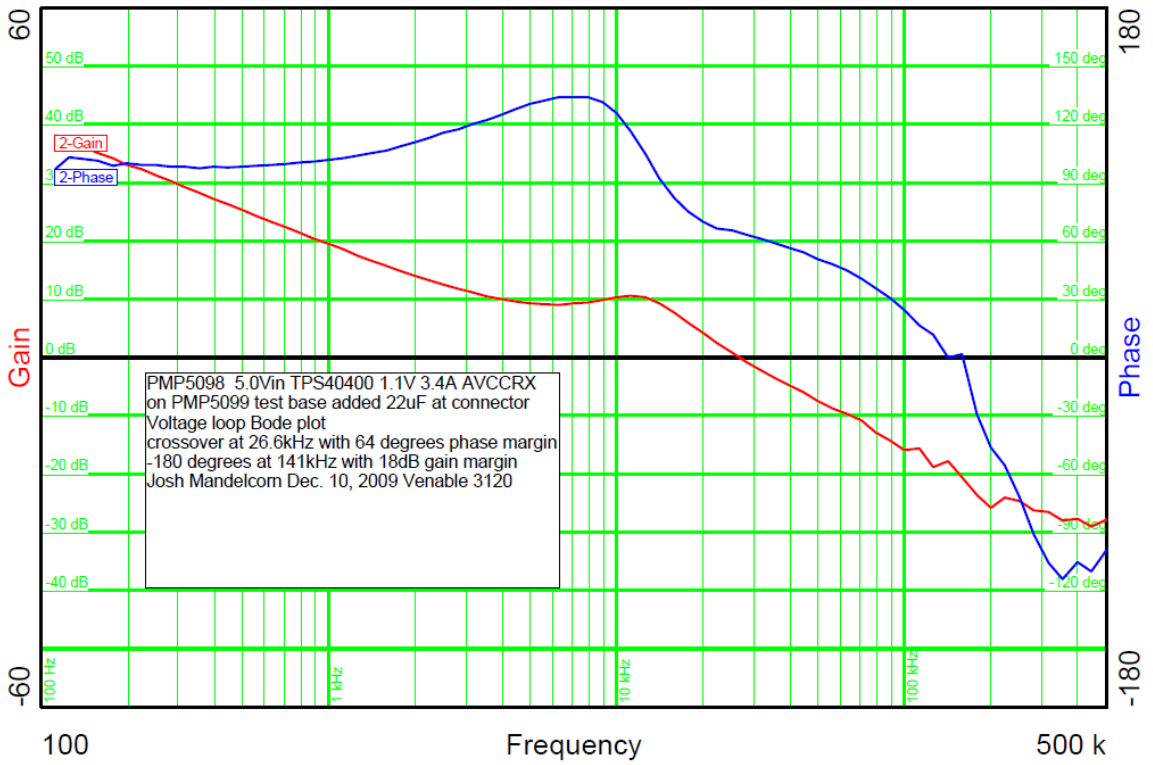


Qq

Bode Plots: (model t4 used)
AVCC:



AVCCRX: (Note: AVTT and AVCCPLL have same flter / compensation as AVCCRX)



IMPORTANT NOTICE FOR TI REFERENCE DESIGNS

Texas Instruments Incorporated ("TI") reference designs are solely intended to assist designers (“Buyers”) who are developing systems that incorporate TI semiconductor products (also referred to herein as “components”). Buyer understands and agrees that Buyer remains responsible for using its independent analysis, evaluation and judgment in designing Buyer’s systems and products.

TI reference designs have been created using standard laboratory conditions and engineering practices. **TI has not conducted any testing other than that specifically described in the published documentation for a particular reference design.** TI may make corrections, enhancements, improvements and other changes to its reference designs.

Buyers are authorized to use TI reference designs with the TI component(s) identified in each particular reference design and to modify the reference design in the development of their end products. HOWEVER, NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY THIRD PARTY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT, IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

TI REFERENCE DESIGNS ARE PROVIDED "AS IS". TI MAKES NO WARRANTIES OR REPRESENTATIONS WITH REGARD TO THE REFERENCE DESIGNS OR USE OF THE REFERENCE DESIGNS, EXPRESS, IMPLIED OR STATUTORY, INCLUDING ACCURACY OR COMPLETENESS. TI DISCLAIMS ANY WARRANTY OF TITLE AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, QUIET ENJOYMENT, QUIET POSSESSION, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS WITH REGARD TO TI REFERENCE DESIGNS OR USE THEREOF. TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY BUYERS AGAINST ANY THIRD PARTY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON A COMBINATION OF COMPONENTS PROVIDED IN A TI REFERENCE DESIGN. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, SPECIAL, INCIDENTAL, CONSEQUENTIAL OR INDIRECT DAMAGES, HOWEVER CAUSED, ON ANY THEORY OF LIABILITY AND WHETHER OR NOT TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, ARISING IN ANY WAY OUT OF TI REFERENCE DESIGNS OR BUYER’S USE OF TI REFERENCE DESIGNS.

TI reserves the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques for TI components are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

Reproduction of significant portions of TI information in TI data books, data sheets or reference designs is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards that anticipate dangerous failures, monitor failures and their consequences, lessen the likelihood of dangerous failures and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in Buyer’s safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed an agreement specifically governing such use.

Only those TI components that TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components that have ***not*** been so designated is solely at Buyer's risk, and Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265