

IRU3055 EVALUATION BOARD USER GUIDE

INTRODUCTION

The IRU3055 is a 3-phase synchronous Buck controller which provides high performance DC to DC converter for high current and low voltage applications, such as power supply for Intel or AMD processors. It can meet Intel VRM 9.0 specifications. The IRU3055 features on-Board DAC that programs the output voltage from 1.075V to 1.850V, loss-less short circuit protection, programmable switching frequency, soft-start, 3-phase on-board MOSFET drivers and PGood function, etc. The evaluation board is designed to provide 60A load at 1.5V output. The output voltage droop function is also included to meet the Intel specification.

(see the IRU3055 data sheet for detailed description).

SPECIFICATION DATA

$V_{IN}=12V$

$V_{OUT}=1.5V @ (D4=0 \text{ and } D0=0)$

$I_{OUT}=60A$

switching frequency $F_s=150KHz$

INPUT/OUTPUT CONNECTIONS

The following is the input/output connections:

Inputs:

JP1: Power input, +12V,+5V and GND

JP2: Power input, +IN and RETURN

JP3: 20-pin ATX connector

JP4: Jumper. The power input of converter. It can be configured at +5V or +12V. Default is +12V input.

JP7: DAC input setting. '0' is set by using a 2-pin short connector. Default setting is '1' for each input. Default setting is 1.075V. To provide a 1.5V output, the pin "D4" and "D0" should be set to '1' by using 2-pin short connector.

Outputs:

JP5: + V_{OUT} output

JP6: +GND output

JP8: PGood output

JP9: 3.3V input and 1.2V VID and VIDGood output

JP10: Tektronics probe test point

INSTRUCTIONS

Short Circuit Test

The IRU3055 provides hiccup mode current limit. It senses the $R_{DS(ON)}$ of low side MOSFET in channel 1 and provides lossless over current protection. It can be tested by shorting the output terminal to ground through a short piece of wire.

V_{DROOP} Function

In this demo-board, the voltage droop function is provided by default. The output voltage decreases as load current increases. The output voltage versus load line falls into the specification by INTEL.

The voltage droop function can be disabled by setting resistor R33 to zero or to short. In that case, the IRU3055 regulates the output voltage to the set voltage by the DAC setting. The output voltage does not linearly decrease as load current increases.

SCHEMATIC

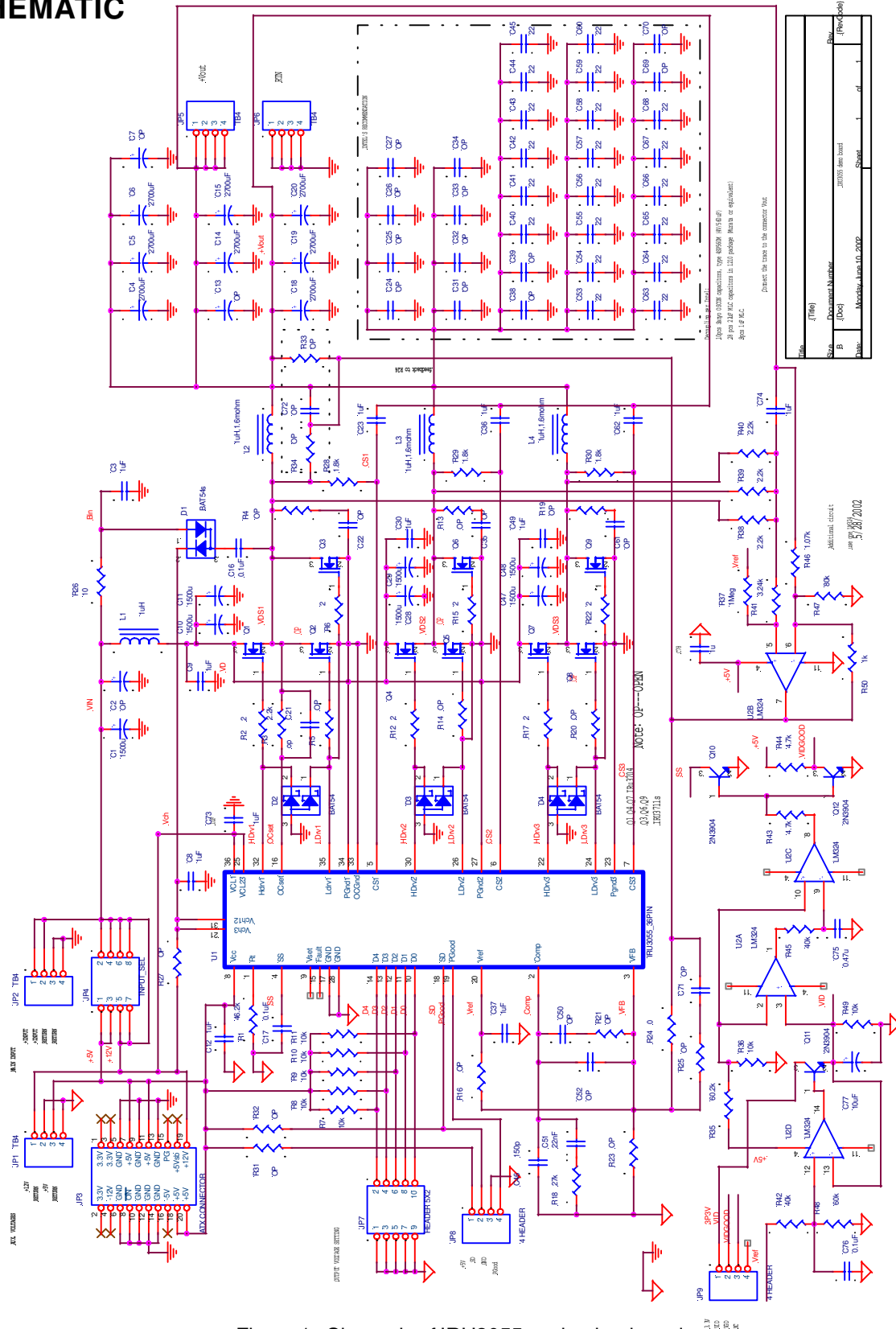


Figure 1 - Schematic of IRU3055 evaluation-board.

PARTS LIST

| Ref Desig | Description | Value | Qty | Part# | Manuf | Web site (www.) |
|--------------------------|-----------------------|--------------------|-----|------------------------------|-----------|----------------------|
| Q1,Q4,Q7 | MOSFET | 20V, 9mΩ | 3 | IRF3704S | IR | irf.com |
| Q3,Q6,Q9 | MOSFET | 20V, 6mΩ | 3 | IRF3711S | IR | |
| Q10,11,12 | Transistor | 2N3904 | 3 | | | |
| U1 | Controller | Synchronous PWM | 1 | IRU3055 | IR | |
| U2 | OPAMP | | 1 | LM324,14-pin SOIC | 3M | |
| D1 | Schottky Diode | | 1 | BAT54S | IR | |
| D2,D3,D4 | Schottky Diode | | 3 | BAT54A | IR | |
| L1 | Inductor | 1.3μH, 10A | 1 | Z9479-A | Coilcraft | coilcraft.com |
| L2,L3,L4 | Inductor | 1μH, 20A | 3 | T60-18 core, 6 turns #14 AWG | | |
| C1,10,11,28,29,47,48 | Cap,Electrolytic | 1500μF, 16V | 7 | EEU-FJ1C152 | Panasonic | maco.panasonic.co.jp |
| C3,8,9,30,49 | Cap, Ceramic | 1μF, X7R, 25V | 5 | ECJ-3YB1E105K | Panasonic | |
| C4,5,6,14,15,18,19,20 | Cap,Electrolytic | 2700μF, 6.3V, 13mΩ | 8 | EEU-FJ0J222 | Panasonic | |
| C12,23,36,37,62,73,74,78 | Cap, Ceramic | 1μF, Y5V, 16V | 8 | ECJ-2VF1C105Z | Panasonic | |
| C16,17,76 | Cap, Ceramic | 0.1μF, Y5V, 25V | 3 | ECJ-2VF1E104Z | Panasonic | |
| C46 | Cap, Ceramic | 150pF, 50V, Y5 | 1 | ECU-V1H151JCG | Panasonic | |
| C51 | Cap, Ceramic | 22nF, Y5V, 25V | 1 | ECJ-2VF1E223K | Panasonic | |
| C75 | Cap, Ceramic | 0.47μF, X&R, 16V | 1 | ECJ-2YB1C474K | Panasonic | |
| C77 | Capacitor | 15μF, Tantalum | 1 | ECS-TOJX156R | Panasonic | |
| R1 | Resistor | 46.4K, 1% | 1 | | | |
| R2,6,12,15,17,22 | Resistor | 2.15Ω, 5% | 6 | | | |
| R3 | Resistor | 2.21K, 1% | 1 | | | |
| R7,8,9,10,11,36,49 | Resistor | 10K, 1% | 7 | | | |
| R18 | Resistor | 26.7K, 1% | 1 | | | |
| R24 | Resistor | 0Ω | 1 | | | |
| R26 | Resistor | 10Ω, 5% | 1 | | | |
| R28,29,30 | Resistor | 1.8K, 1% | 3 | | | |
| R35,R48 | Resistor | 60.4K, 1% | 2 | | | |
| R37 | Resistor | 1M, 1% | 1 | | | |
| R38,39,40 | Resistor | 2.21K, 1% | 3 | | | |
| R41 | Resistor | 3.24K | 1 | | | |
| R42,R45 | Resistor | 40.2K, 1% | 2 | | | |
| R43,R44 | Resistor | 4.64K, 5% | 2 | | | |
| R46 | Resistor | 1.07K | 1 | | | |
| R47 | Resistor | 80.6K, 1% | 1 | | | |
| R50 | Resistor | 1K | 1 | | | |
| JP1,2,5,6 | Terminal | | 4 | ED1973-ND | DigiKey | |
| JP3 | Terminal | | 1 | 147379 | Jameco | |
| JP7 | Terminal | | 1 | S201205-ND | | |
| JP8,JP9 | Terminal | | 2 | S1012-04-ND | DigiKey | |
| JP10 | Scope Probe Connector | | 1 | 131503100 | Tektronix | |

CONNECTION DIAGRAM

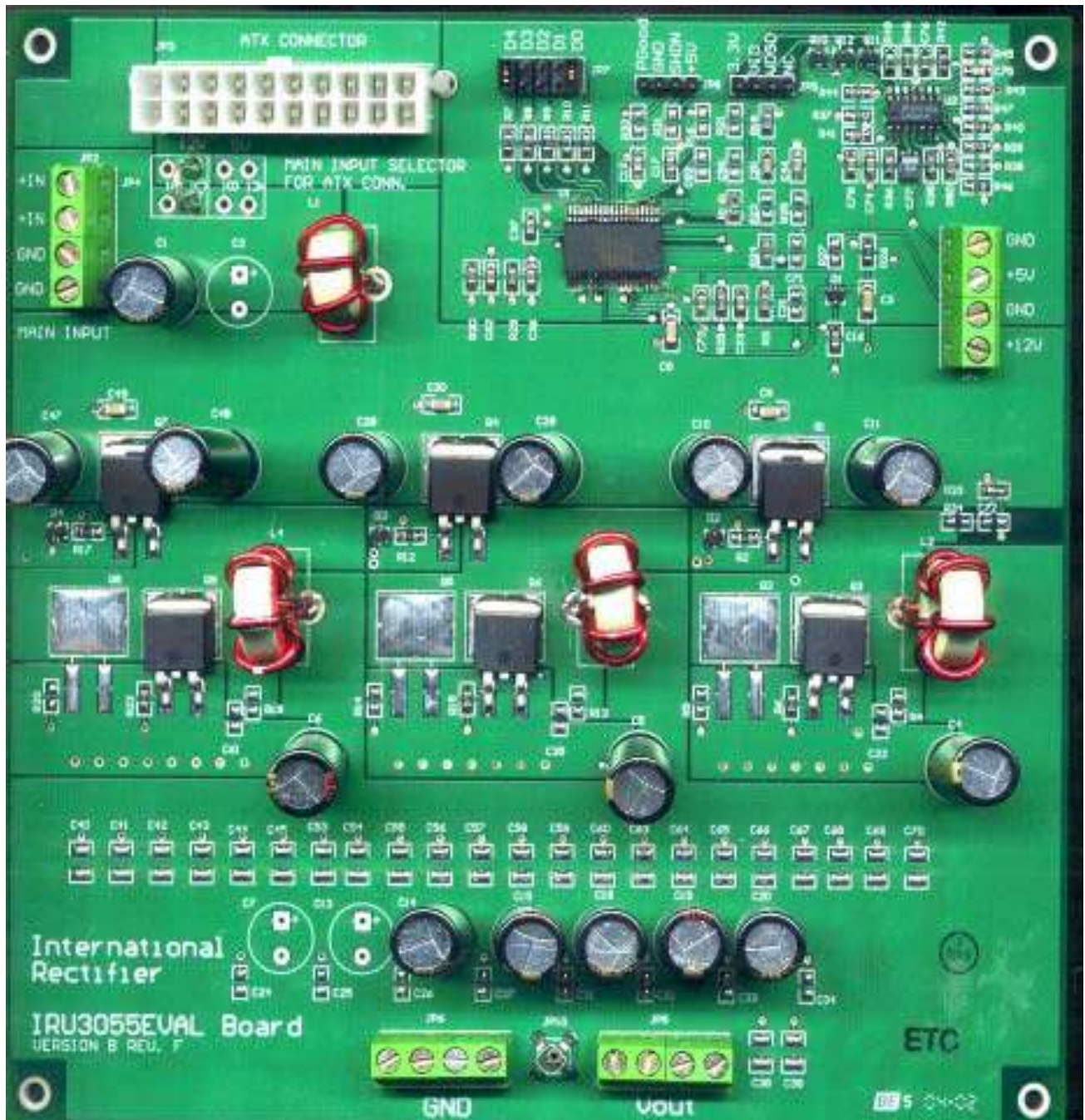


Figure 2 - Picture of IRU3055 evaluation-board.

LAYOUT

The top side (component) layer for IRU3055 Eval board is shown in Figure 3. The input capacitors are all located close to the MOSFETs. All the decoupling capacitors, charge pump capacitors and feedback components are located close to IC. The feedback pin V_{FB} is connected

to the output voltage at the output terminal.

The PCB is a 4-layer board. One layer is dedicated to Power GND. The analog GND is separated from the PGND and is connected at a single point.

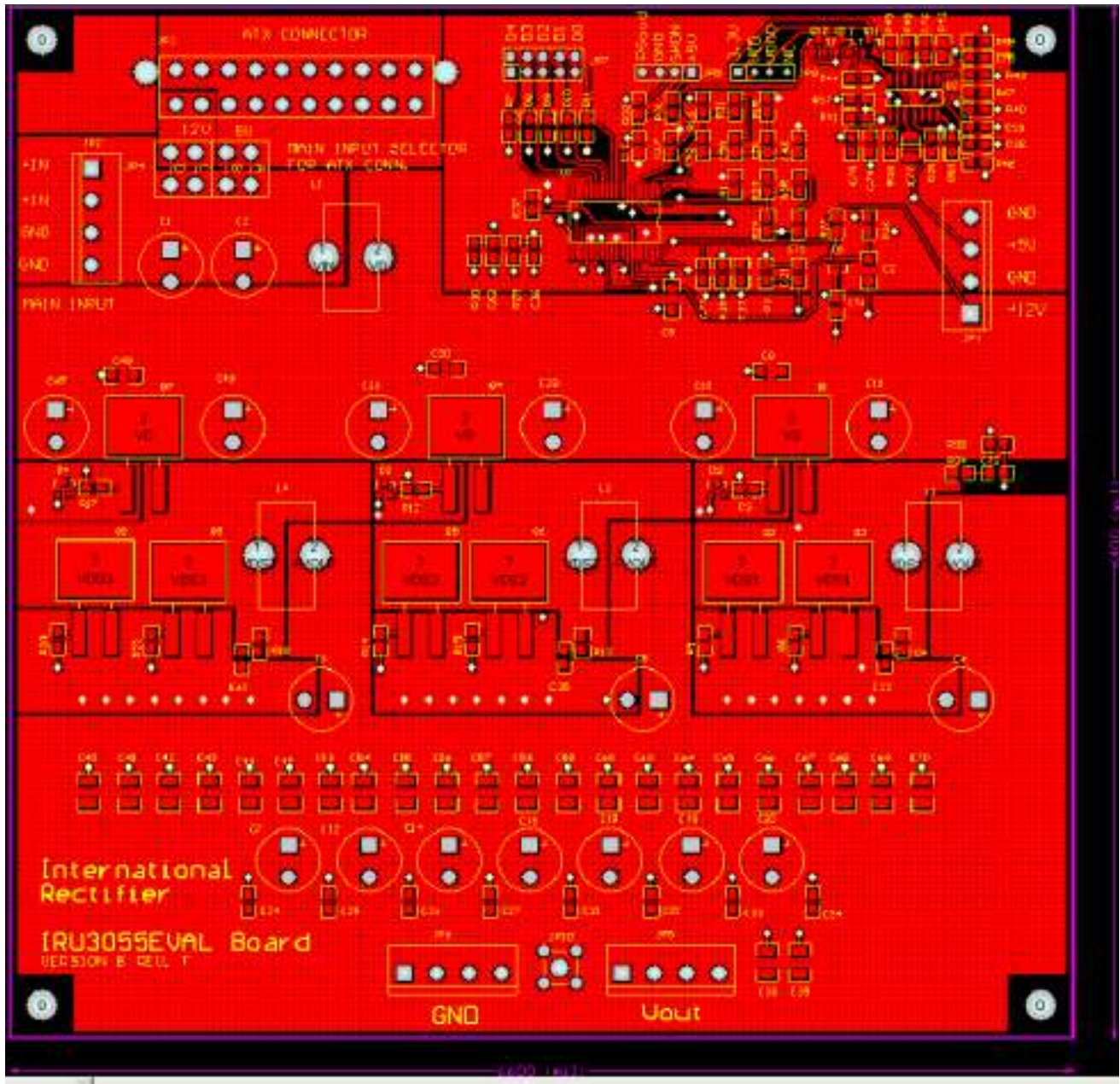


Figure 3 - Top layer of IRU3055 demo-board PCB layout.

LAYOUT

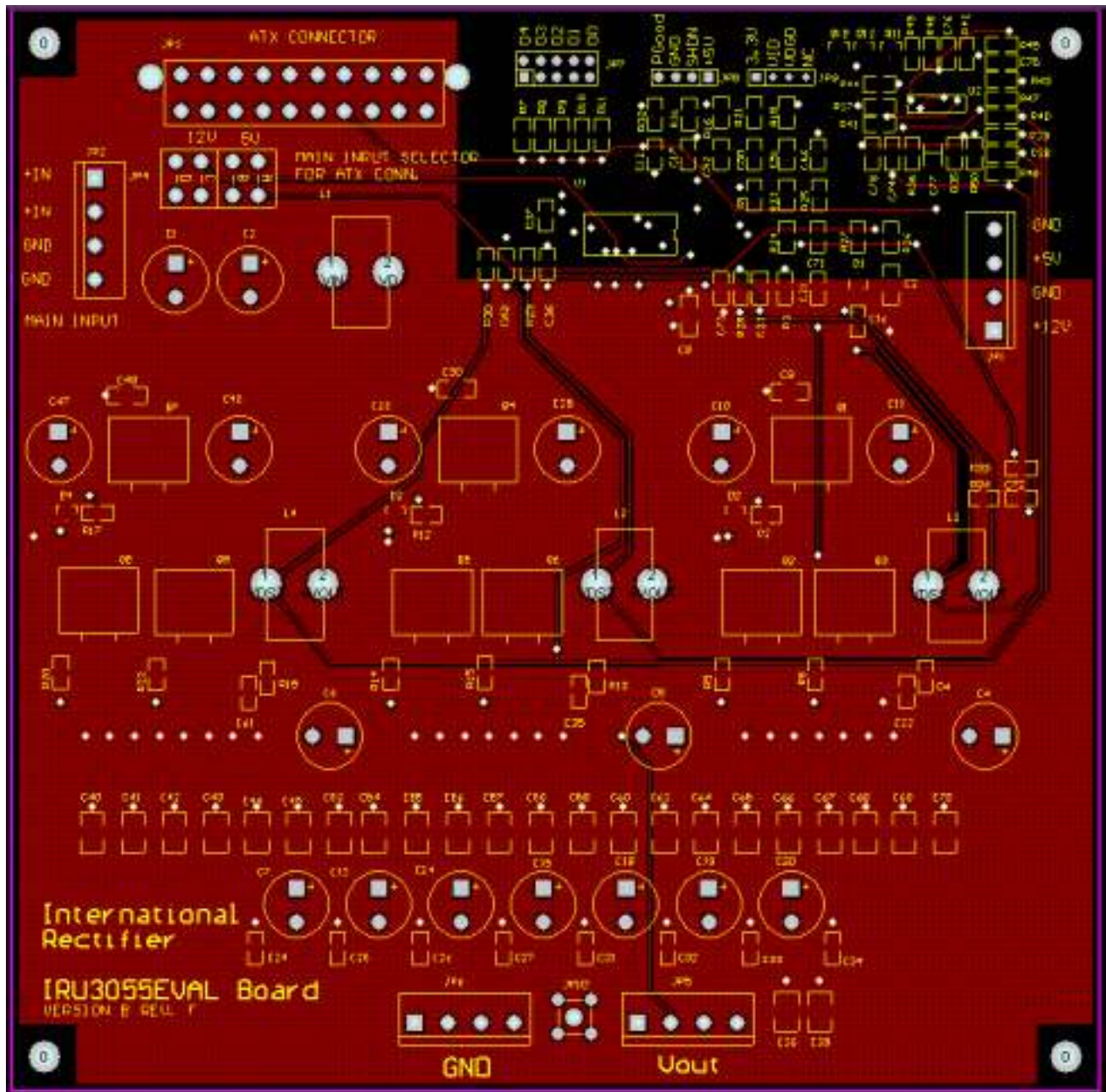


Figure 4 - Second layer of IRU3055 demo-board PCB layout.

LAYOUT

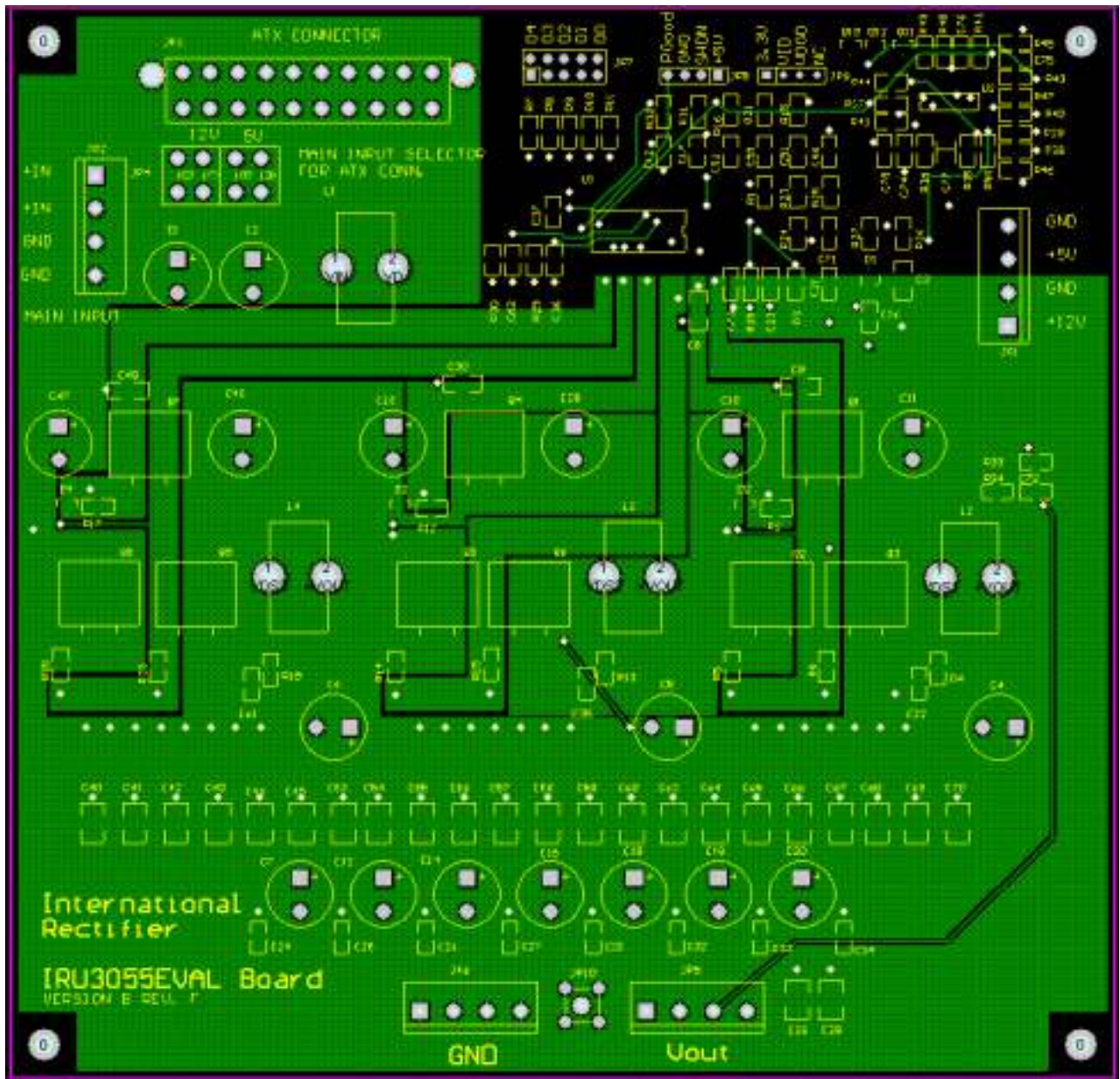


Figure 5 - Third layer of IRU3055 demo-board PCB layout.

LAYOUT

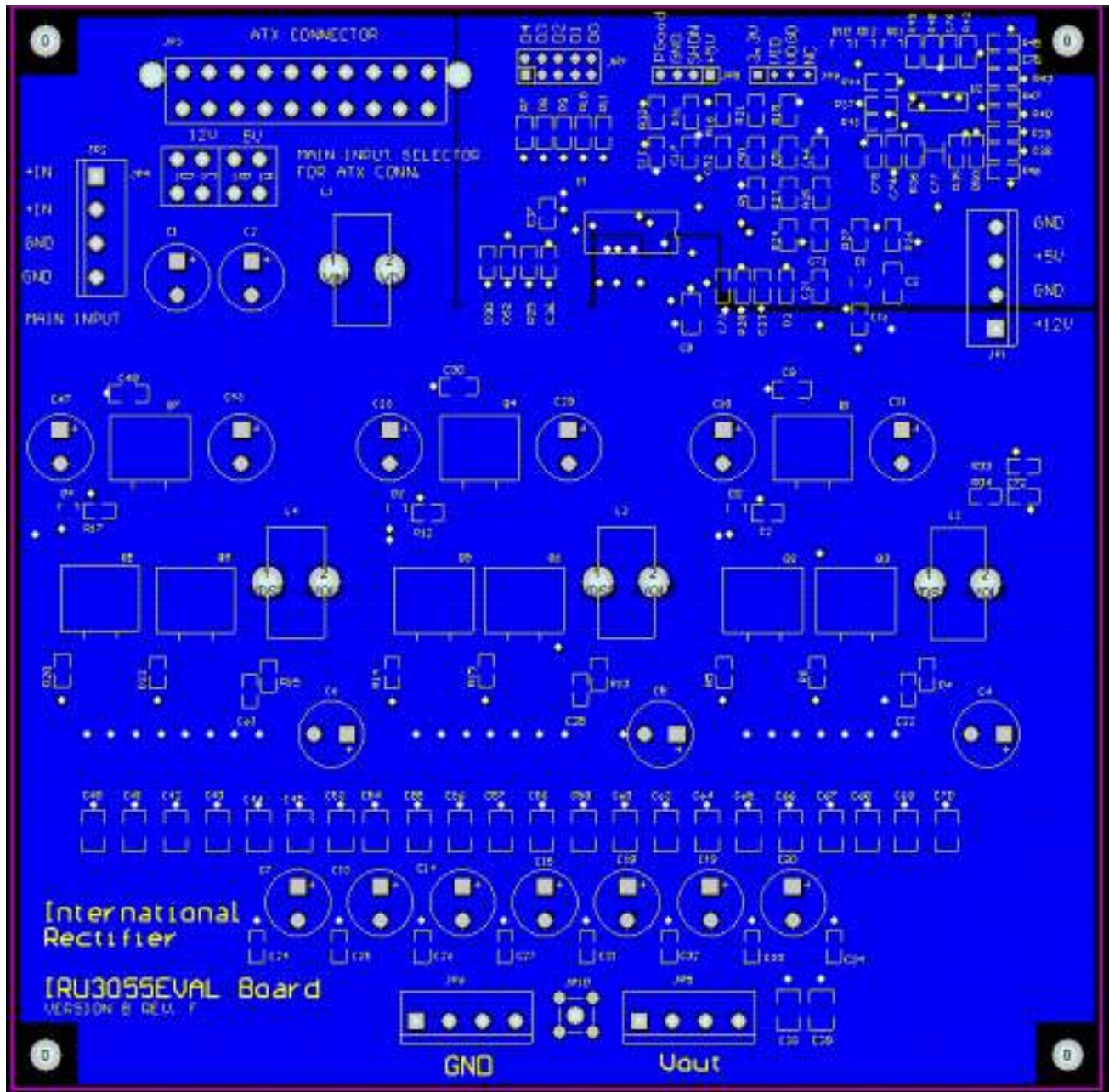


Figure 7 - The bottom layer of IRU3055 demo-board PCB layout.

TEST WAVEFORMS WITHOUT ACTIVE VOLTAGE DROOP (R33=0)

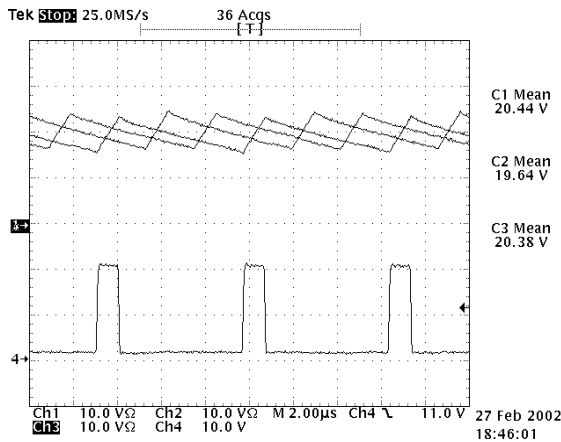


Figure 8 - 3-Phase inductor current at 60A load, Ch1, Ch2 and Ch3: 10A/div. Ch4: gate signal.

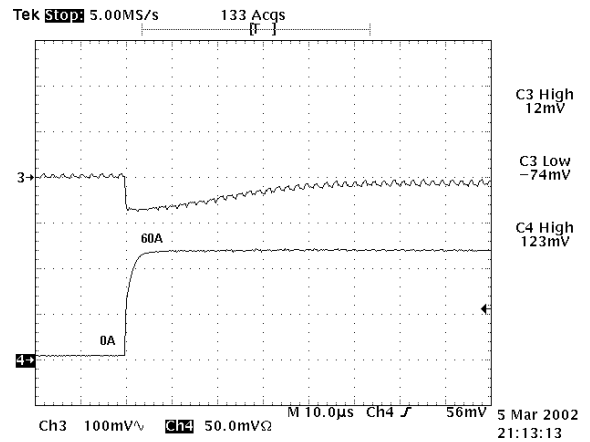


Figure 11 - Zoomed 60A Load dynamic (rising). Ch3: Output voltage, 100mV/div, AC. Ch4: Load current, 20A/us, sensed by 2mΩ resistor, 25A/div.

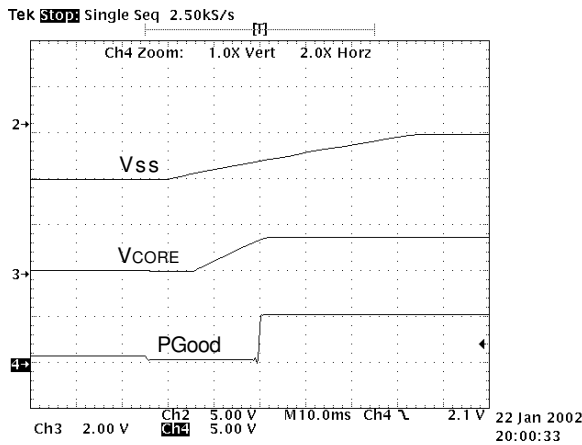


Figure 9 - Soft-start, Vcore and PGood.

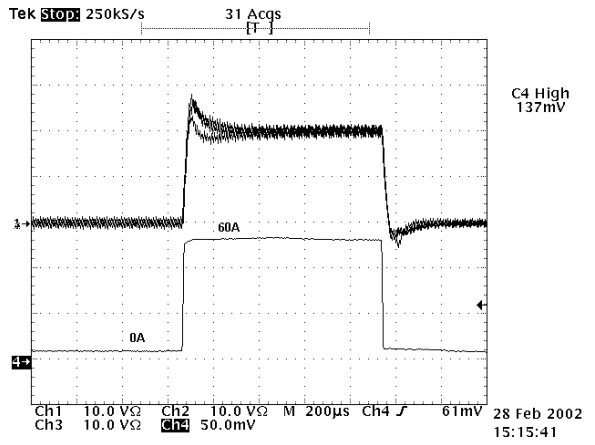


Figure 12 - 60A load dynamic waveforms with three-phase inductor current. Ch1, Ch2 and Ch3: Inductor current, 10A/div. Ch4: Load current, 20A/us, sensed by 2mΩ resistor, 25A/div.

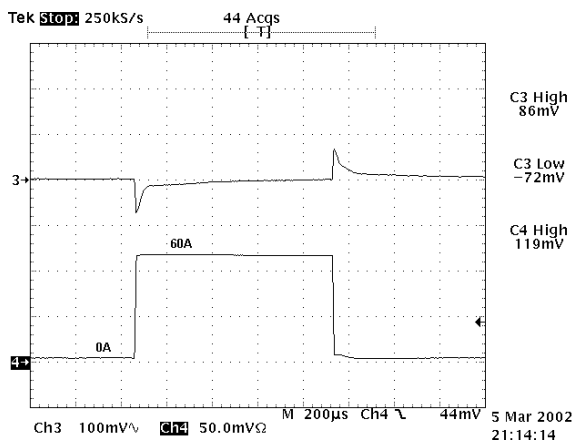


Figure 10 - 60A Dynamic load response with 20A/µs slew rate. Ch3: Output voltage, 100mV/div, AC. Ch4: Load current, 20A/us, sensed by 2mΩ resistor, 25A/div.

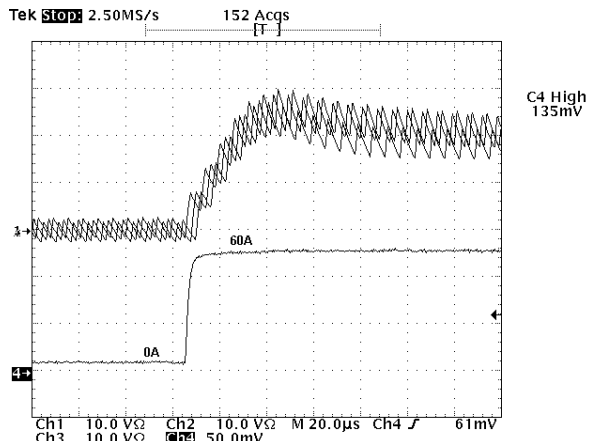


Figure 13 - 60A load dynamic waveforms with three-phase inductor current. (Zoomed) Ch1, Ch2 and Ch3: Inductor current, 10A/div. Ch4: Load current, 20A/us, sensed by 2mΩ resistor, 25A/div.

TEST WAVEFORMS WITH ACTIVE VOLTAGE DROOP (R33=OPEN)

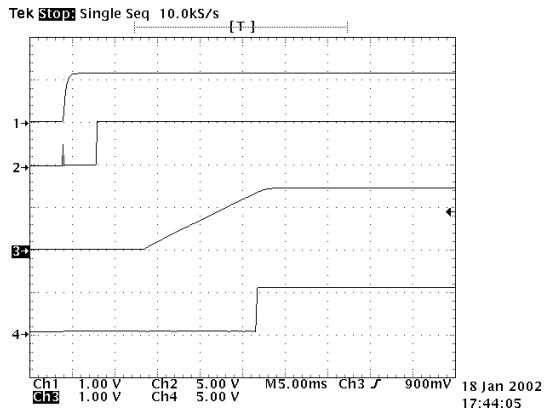


Figure 14 - Soft-start.
 Ch1: 1.2V VID. Ch2: VID Good.
 Ch3: 1.5V Output. Ch4: PGood.

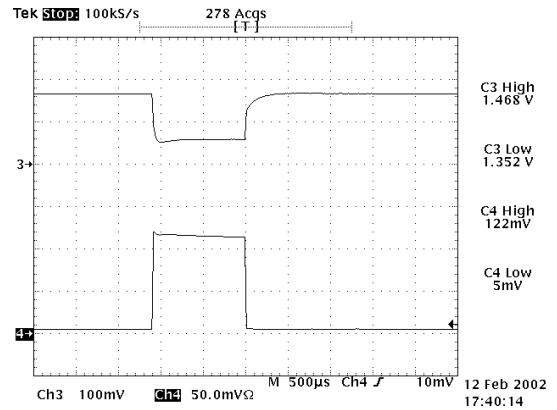


Figure 15 - 60A Load dynamic with 20A/ μ s slew rate.
 Ch4: Output current, sensed through 2m Ω resistor, 25A/div.
 Ch3: Output voltage, DC offset 1.3V, 100mV/div.

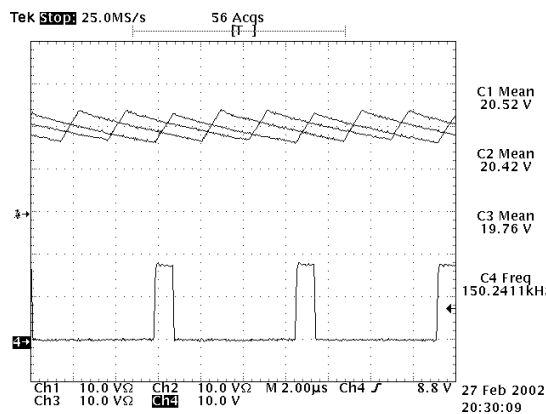


Figure 16 - 3-Phase inductor current at 60A load,
 Ch1, Ch2 and Ch3: 10A/div and gate signal.