HOLT INTEGRATED CIRCUITS

Sept, 2013

QSG-6140RT
HI-6140 Application RT Development Kit

Introduction

The Holt HI-6140 Remote Terminal Application Development Kit demonstrates the broad feature set of Holt's Enhanced Bit Rate (EBR), MIL-STD-1553B protocol device; the HI-6140. The HI-6140 is combined with a microcontroller and Holt's HI-4853 RS485 transceivers to produce a complete 10Mbps Remote Terminal. The board can be used to develop MMSI systems complying with SAE specification AS5652, this specification uses standard MIL-STD-1553B protocol and Manchester coding, but has an enhanced bit rate of 10Mbps RS485 bus interface. Each kit contains two boards, a lower microcontroller board and the upper HI-6140 RT board; see picture below.

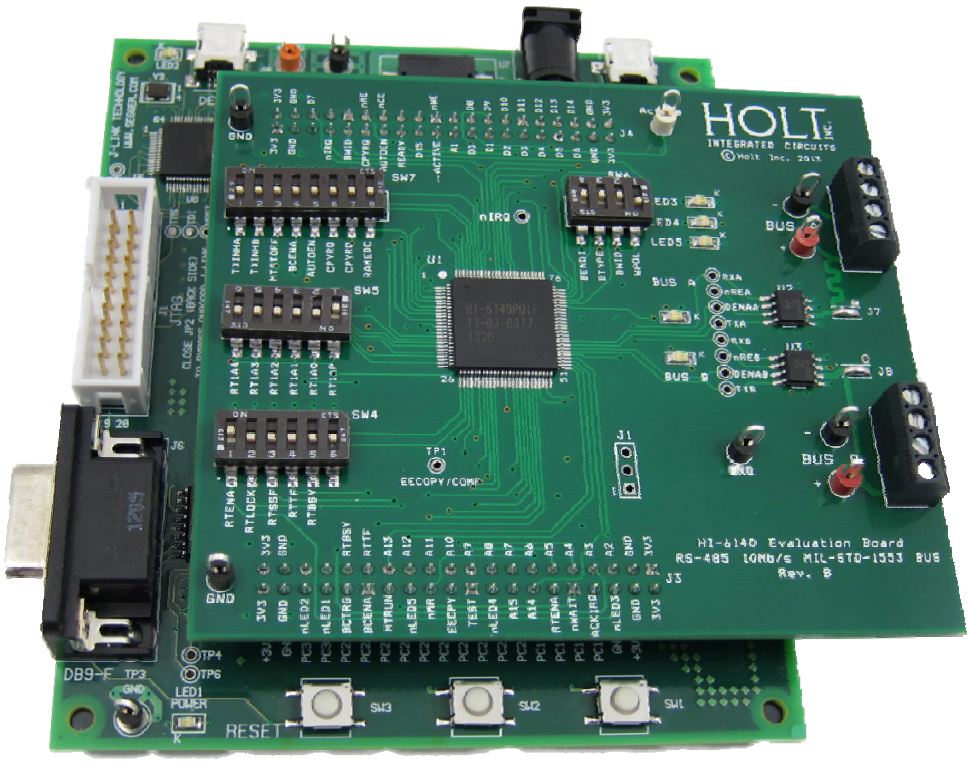


Figure 1 – HI-6140 RT board assembled on microcontroller board

For MMSI applications this kit only supports Remote Terminal development. If an MMSI Bus Controller evaluation kit is required, please order the separate HI-6140 BC evaluation kit.

A ready to run ANSI C language reference project is provided for the ARM Cortex M3 evaluation platform, demonstrating operation for a Remote Terminal only. For convenience, this kit includes IAR Systems Embedded Workbench® for ARM, and a fully integrated debug interface for the ARM Cortex M3 microcontroller.

This guide describes how to set up and run the board. Additional support material and all required project software are found in the included Holt CD-ROM. A version of the demonstration software is already programmed into the microcontroller flash; the board is operational right out of the box without installing or running the provided software development tools.

Evaluation Kit Contents

- This User Guide.
- Holt HI-6140 RT Project Software and Documentation CD.
- Installation CD for IAR Systems Embedded Workbench® for ARM (32KB KickStart).
- Plug-in DC power supply.
- USB debug interface cable.
- RS-232 serial cable, DB-9M to DB-9F for console I/O using a connected computer.
- 2-board assembly comprised of
    - Upper HI-6140 RT board with two RS485 links.
    - Lower MCU board with ARM Cortex M3 16-/32-bit microprocessor, debug interface and regulated 3.3VDC power supply.

Hardware Design Overview

Refer to the CD included in the kit, for design documentation including schematic diagrams and bills of material for the upper and lower circuit boards.

The HI-6140 board can be separated from the provided MCU board for connection to a user-supplied alternate microprocessor or FPGA board. The inter-board headers are located on 0.1” (2.54 mm) grid for compatibility with generic prototyping boards. All host interface signals go through the inter-board headers.

The lower ARM Cortex M3 MCU board is based on the flash-programmable Atmel AT91SAM3U-EK microprocessor. A UART-based serial port provides RS-232 console I/O (optional). An uncommitted USB 2.0 port is available for future expansion. Two pushbuttons are available for software interaction. A

RESET pushbutton resets the ARM microprocessor, which in turn controls the HI-6140 Master Reset signal.

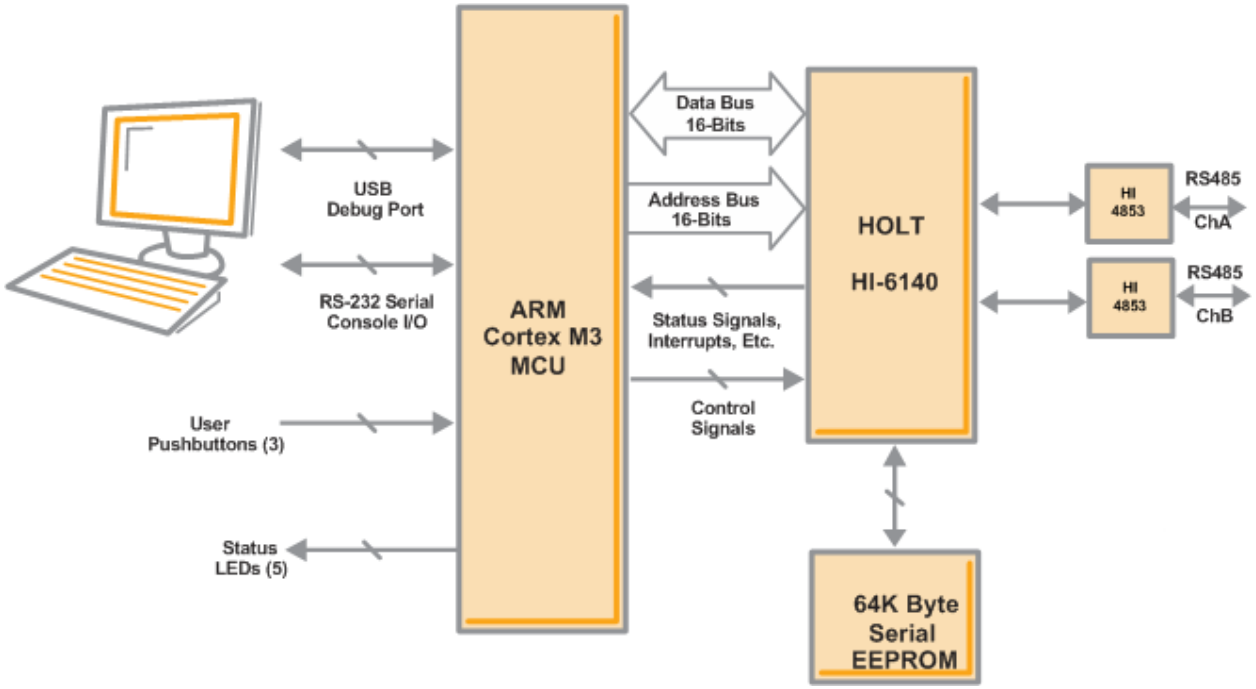


Figure 2 - Evaluation Board Block Diagram

The ARM Cortex M3 board includes "J-Link On Board" debug interface, licensed from www.segger.com, providing out-of-box readiness without having to buy a costly JTAG debug cable. The kit includes a simple USB cable for connecting the board's debug interface to your computer. (For users already owning an ARM debug interface with ribbon-cable connector, an ARM-standard 2x10 debug connector provides debug connectivity. In this case, jumper JP2 on the bottom of the lower board should be soldered closed to disable "J-Link On Board").

As shown in figure 2, the upper board contains a HI-6140 and two RS485 transceivers. Data is passed to the RS485 transceivers for transmission over 120 ohm screen twisted pairs at 10Mbps. For testing, a Bus Controller (BC) is required. A HOLT HI-6140 BC evaluation card (not included) can be used for this purpose.

The figure below shows the top level view of the board.

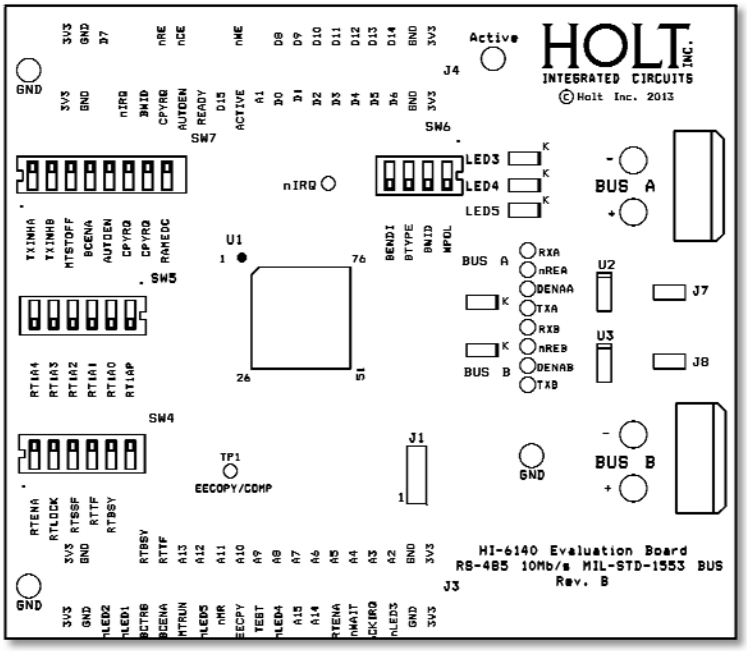


Figure 3 - Evaluation Board Top Level View

Demonstration using the preprogrammed instructions

The Holt HI-6140 RT Card comes pre-programmed to operate as a Remote Terminal.

In most cases just one of the two RS485 busses will be used.

Follow the instructions below to set up and test the board:

1. Using the provided DB-9 serial cable, connect the MCU board to the serial port on the Windows computer; if there is no serial port then use a USB-Serial dongle. Plug-in the provided 5V DC power supply and connect the cable to the power input jack on the lower circuit board.

2. The preprogrammed demonstration provides console I/O between the MCU board serial port and a Windows computer running a terminal emulation program. If using Vista or Windows or Windows 8, install TeraTerm and run it.
   If using XP or Windows 2000, you may instead open HyperTerminal from the Windows "Accessories" program group, although TeraTerm is recommended. Configure the TeraTerm program for serial port (not TCP I/P), 115,200 baud, no parity, 8 data bits, 1 stop bit, flow control off. If configured correctly, a text header appears when power is applied, or when the RESET pushbutton is pressed, as shown below:

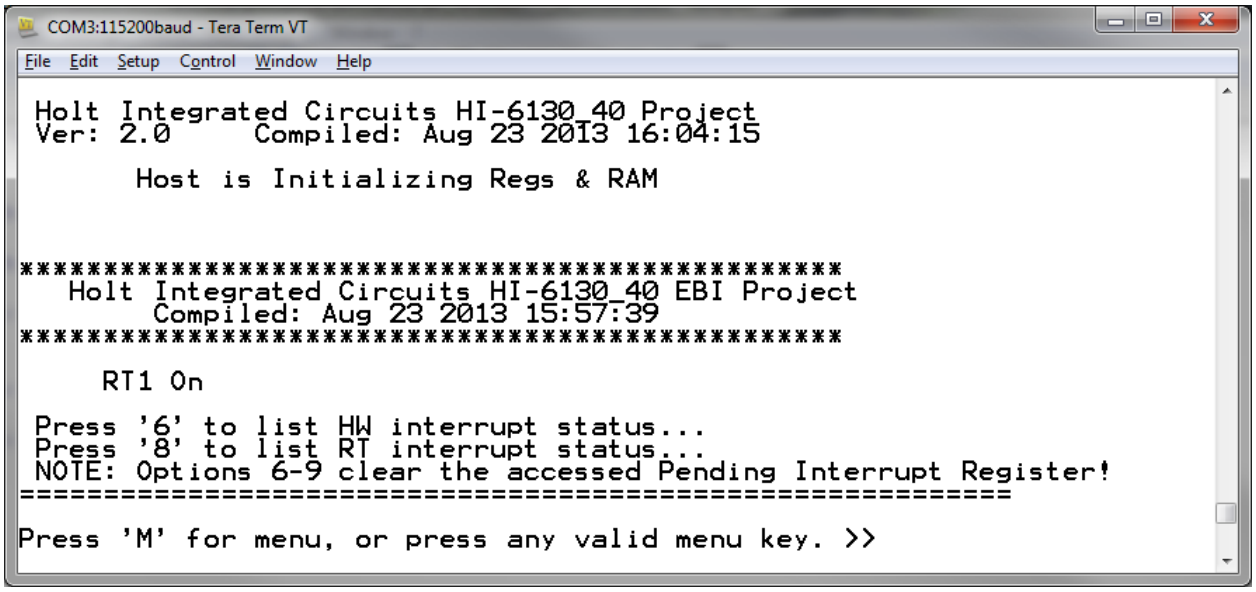


Figure 4 – Initialization Screen Shot

3. Note that software reports RT1 On, in the case of the HI-6140 there is only RT1 (no RT2). There are two utilities that display the interrupt status of the RT board. Most of the bus activity comes from the Bus Controller, the function of the RT is to wait for and respond to messages addressed to it, so there are minimal features on the RT screen.

4. For a system test, the RT should be connected to a BC card. If available, the Holt BC card can be used as the BC. Connect a screen twisted pair cable from the BC terminals to the RT terminals. For short range testing, clip on leads will suffice, however check that both sides of the cable are equal lengths. Set the RT address using the switch SW5, note that the last switch is parity and it must conform to odd parity. For odd RT addresses the parity bit is logic '0' and for even addresses the parity bit is logic '1'. When using with the Holt MMSI BC card, messages are sent to RT addresses 0 to 3, the RT card should have a corresponding address.

5. To observe bus activity, connect a differential oscilloscope to the BUS A, red and black test points (+ and -). The test point labeled ACTIVE goes high when the HI-6140 RT is processing a message received with a matching RT address. This can be used as a convenient trigger point for the oscilloscope. A waveform similar to the one below should be seen, showing the 10Mbps RS485 Manchester encoded data. The second word shows the RT responding to message 2 from the Holt BC card, with a 'Status' word.

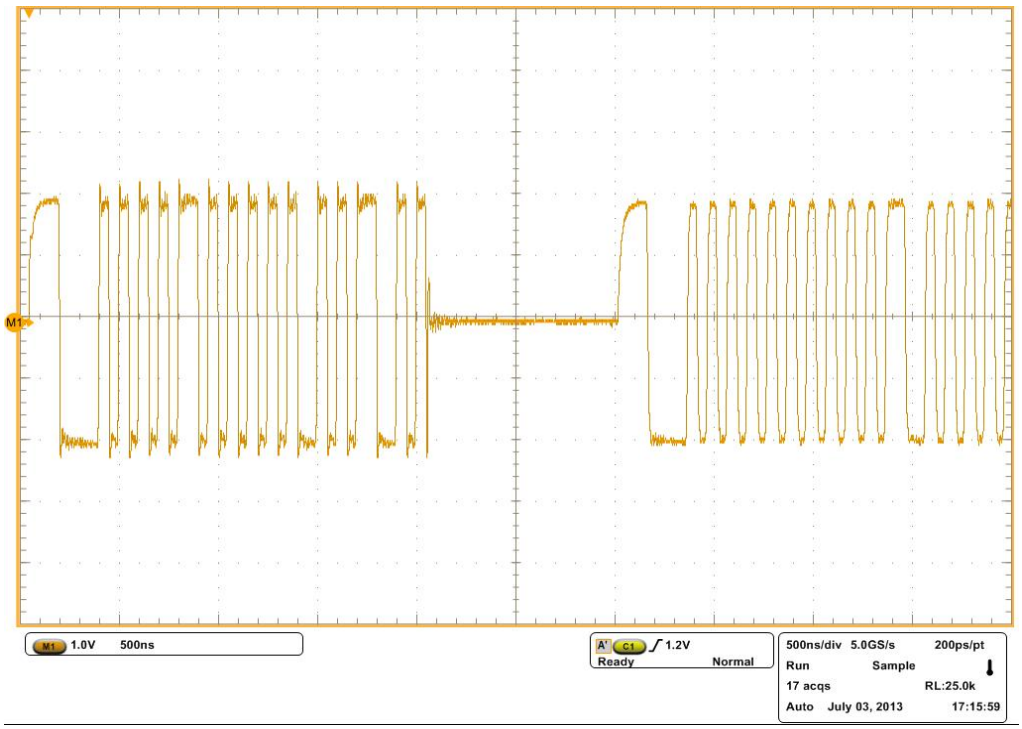


Figure 5 – Message 2, RS485 waveform

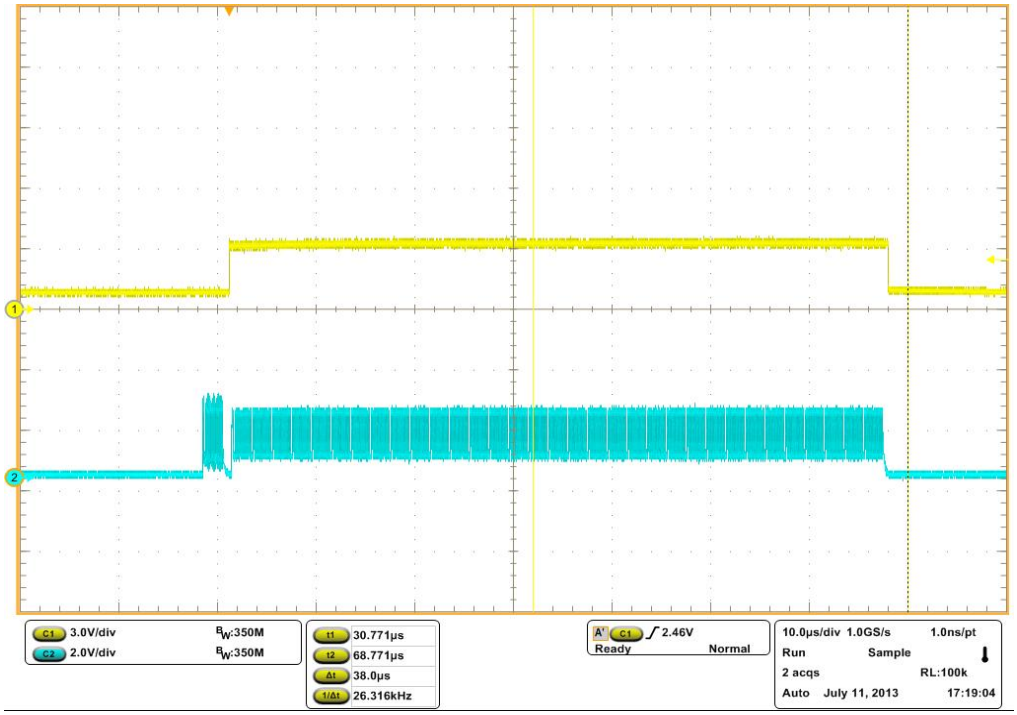
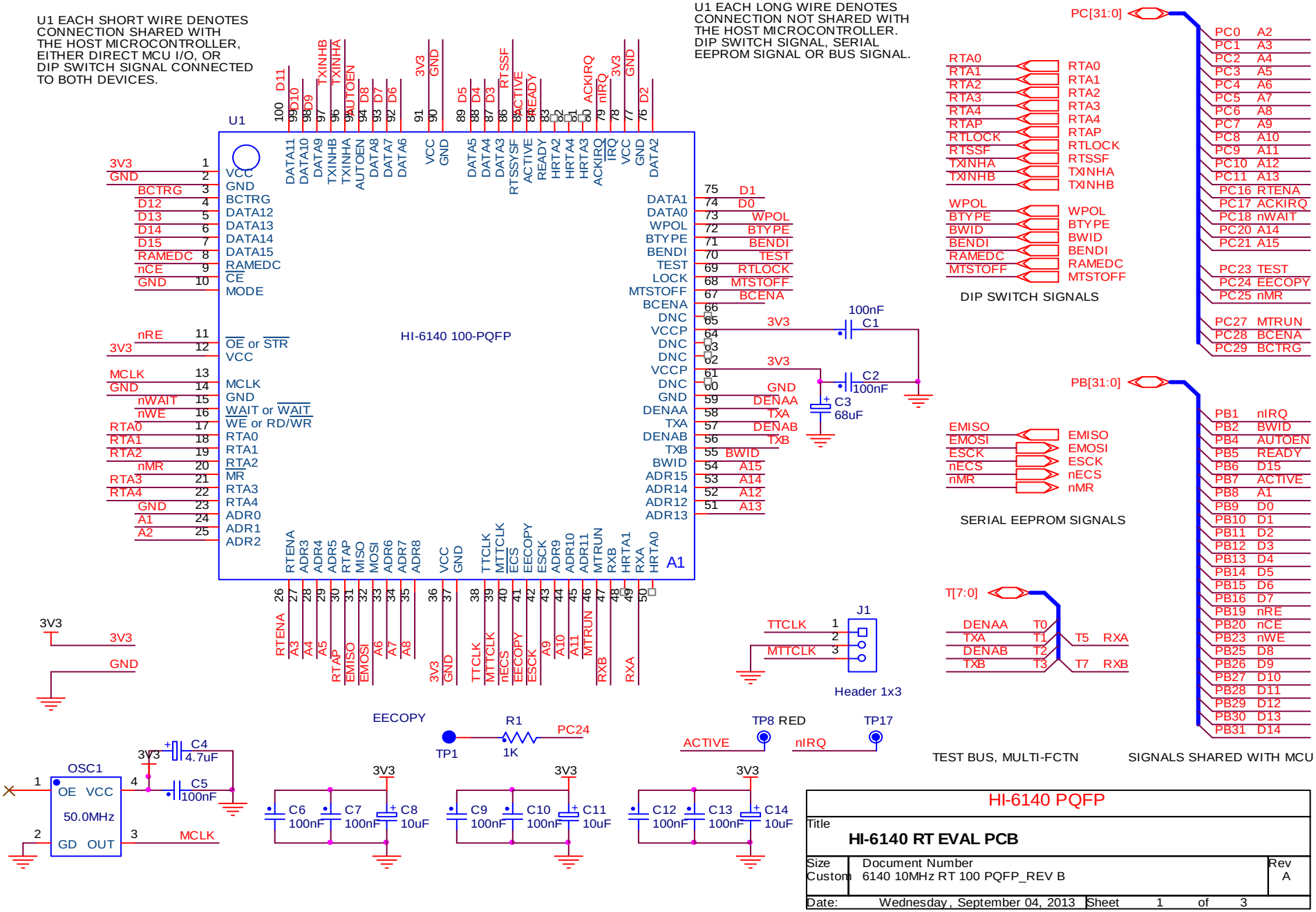
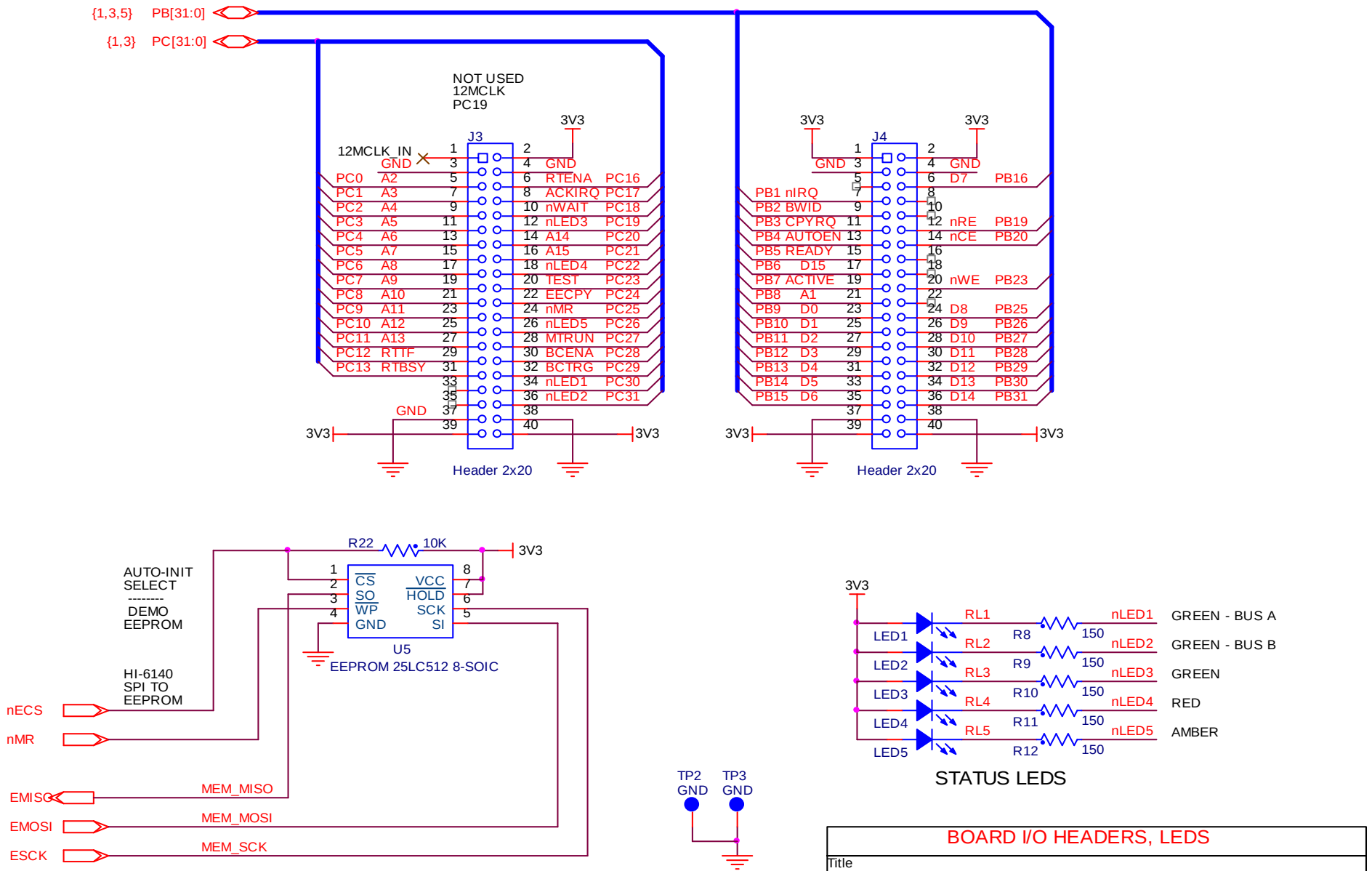


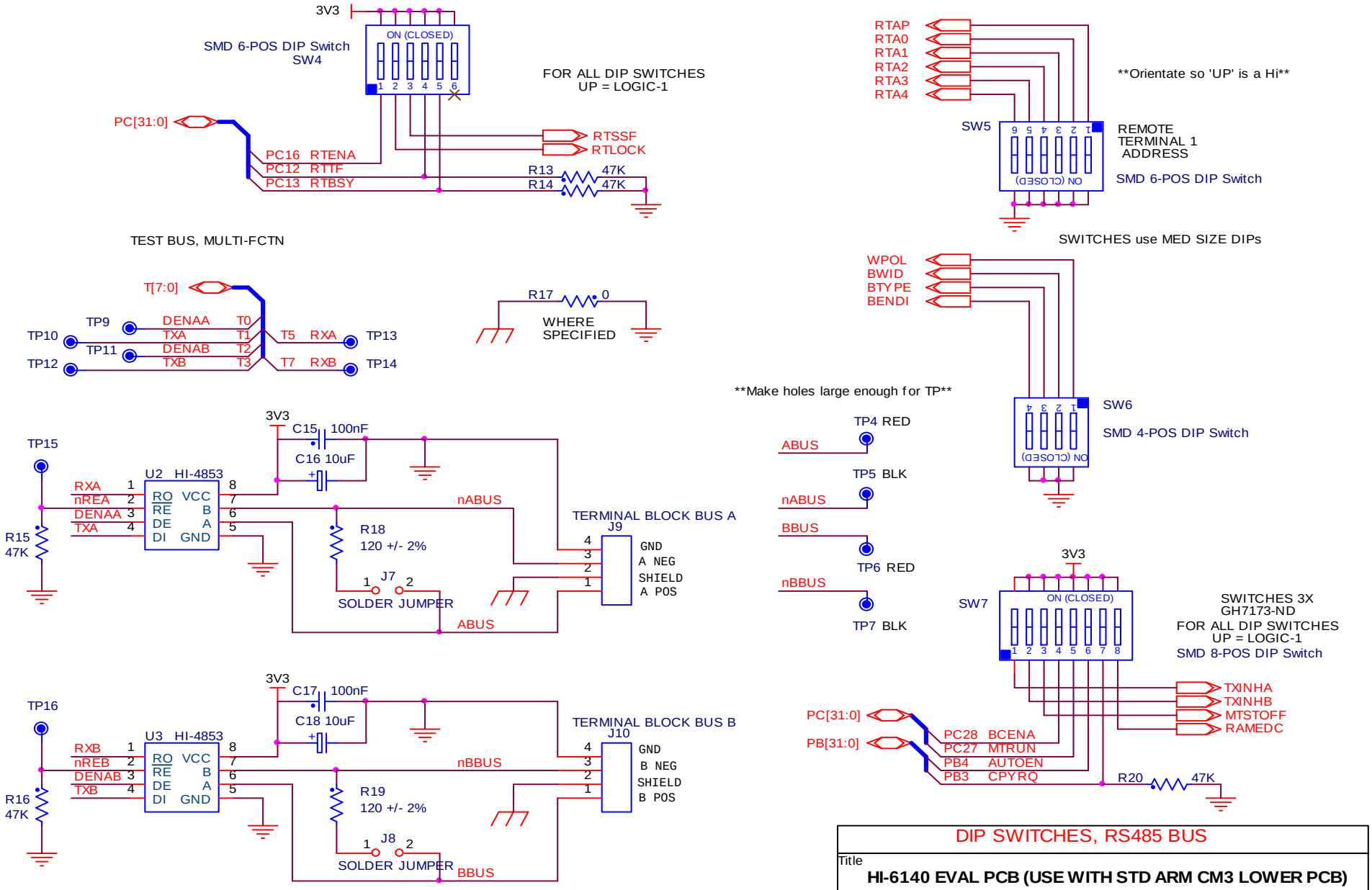
Figure 6 – Message 6, BC transmit command followed with RT response of 32 data words. Top trace is the RT ACTIVE signal

6. Full details of how to send messages to the RT and checking the RT response are provided in the HI-6140BC Quick Start Guide (QSG-6140BC) provided in the HI-6140BC ADK.


U1 EACH SHORT WIRE DENOTES CONNECTION SHARED WITH THE HOST MICROCONTROLLER, EITHER DIRECT MCU I/O, OR DIP SWITCH SIGNAL CONNECTED TO BOTH DEVICES.
U1 EACH LONG WIRE DENOTES CONNECTION NOT SHARED WITH THE HOST MICROCONTROLLER. DIP SWITCH SIGNAL, SERIAL EEPROM SIGNAL OR BUS SIGNAL.
U1
HI-6140 100-PQFP
A1
PC[31:0]
DIP SWITCH SIGNALS
PB[31:0]
SERIAL EEPROM SIGNALS
T[7:0]
TEST BUS, MULTI-FCTN
SIGNALS SHARED WITH MCU
J1
Header 1x3
OSC1
50.0MHz
EECOPY
ACTIVE
nIRQ
TP1
TP8 RED
TP17
HI-6140 PQFP
HI-6140 RT EVAL PCB
Document Number
6140 10MHz RT 100 PQFP_REV B
Wednesday, September 04, 2013



BOARD I/O HEADERS, LEDS		
Title: **HI-6140 EVAL PCB (USE WITH STD ARM CM3 LOWER PCB)**		
Size: A	Document Number: 6140 100 PQFP.DSN	Rev: B
Date: Wednesday, September 04, 2013	Sheet 2 of 3	



DIP SWITCHES, RS485 BUS		
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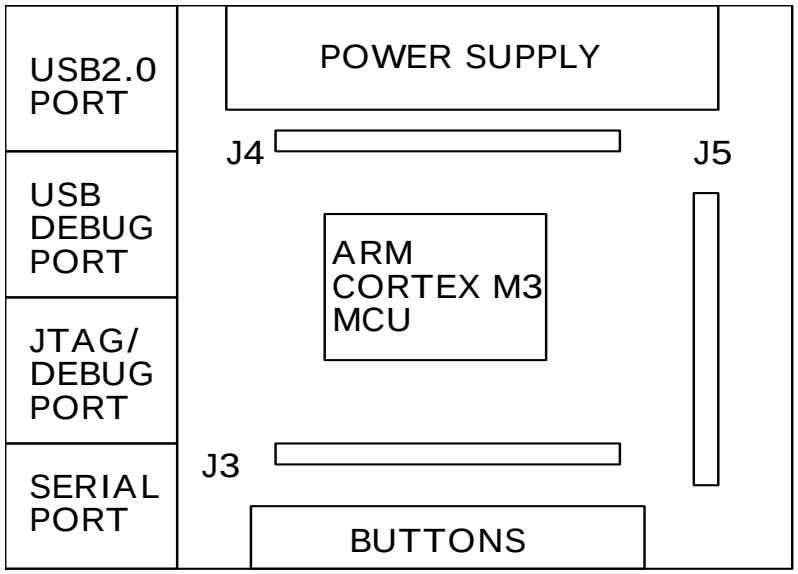
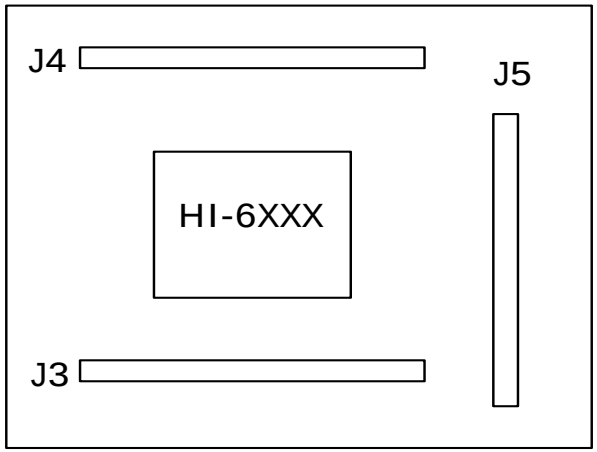
Size: A	Document Number: 6140 100 PQFP.DSN	Rev: B
Date: Wednesday, September 04, 2013	Sheet 3 of 3	



LOWER CIRCUIT BOARD

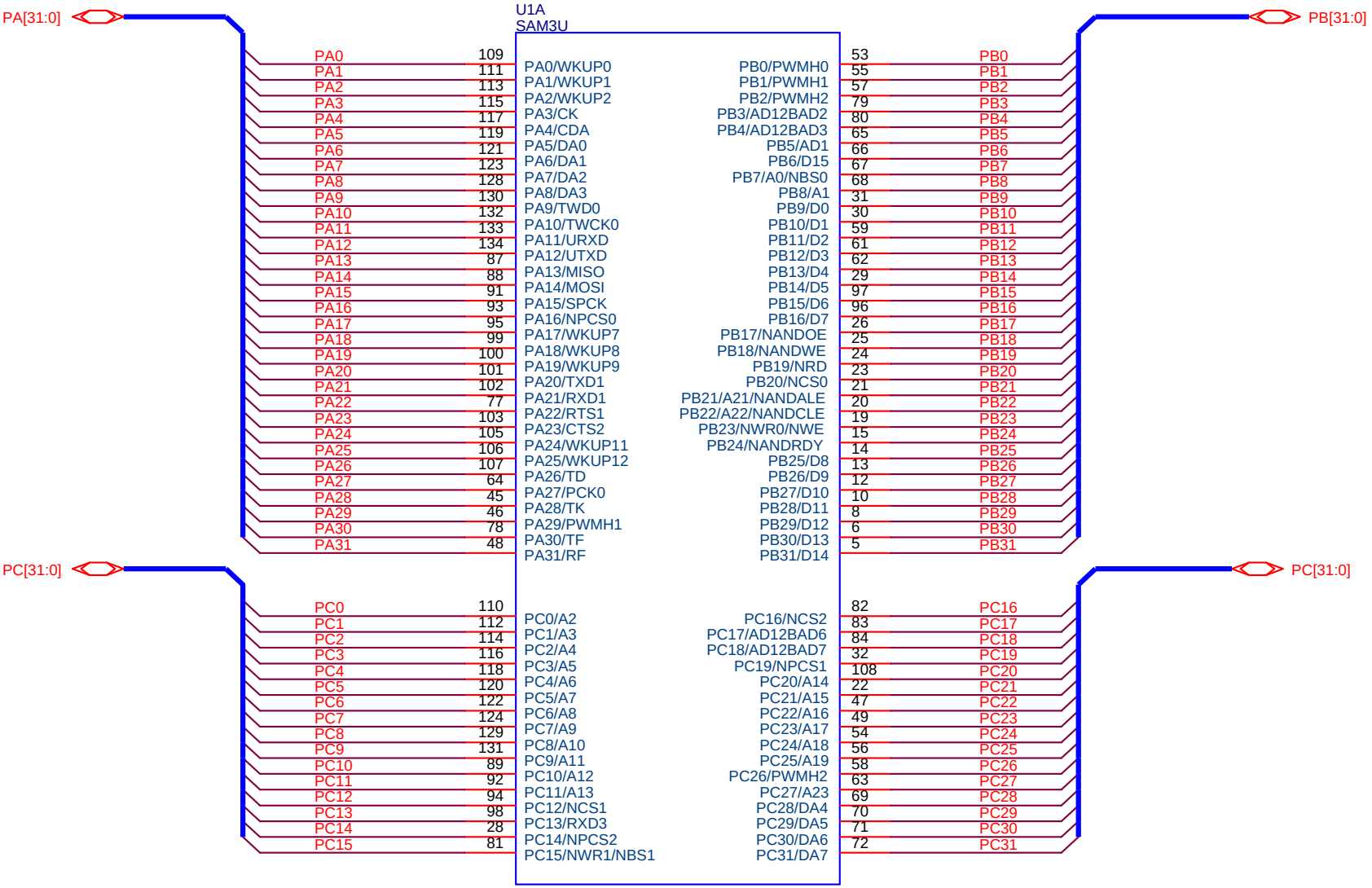


STACKING UPPER CIRCUIT BOARD

J3,J4 & J5 ARE DUAL-ROW STACKING RECEPTACLES (LOWER BOARD) AND HEADERS (UPPER BOARD).

HOLT INTEGRATED CIRCUITS, Mission Viejo, CA, USA		
Title: ARM CORTEX M3 MICROCONTROLLER BOARD		
Size: A	Document Number: CM3 BOARD REV C.DSN	Rev: C
Date: Thursday, October 06, 2011	Sheet 1 of 7	

BUTTONS



ARM CORTEX M3 PIO

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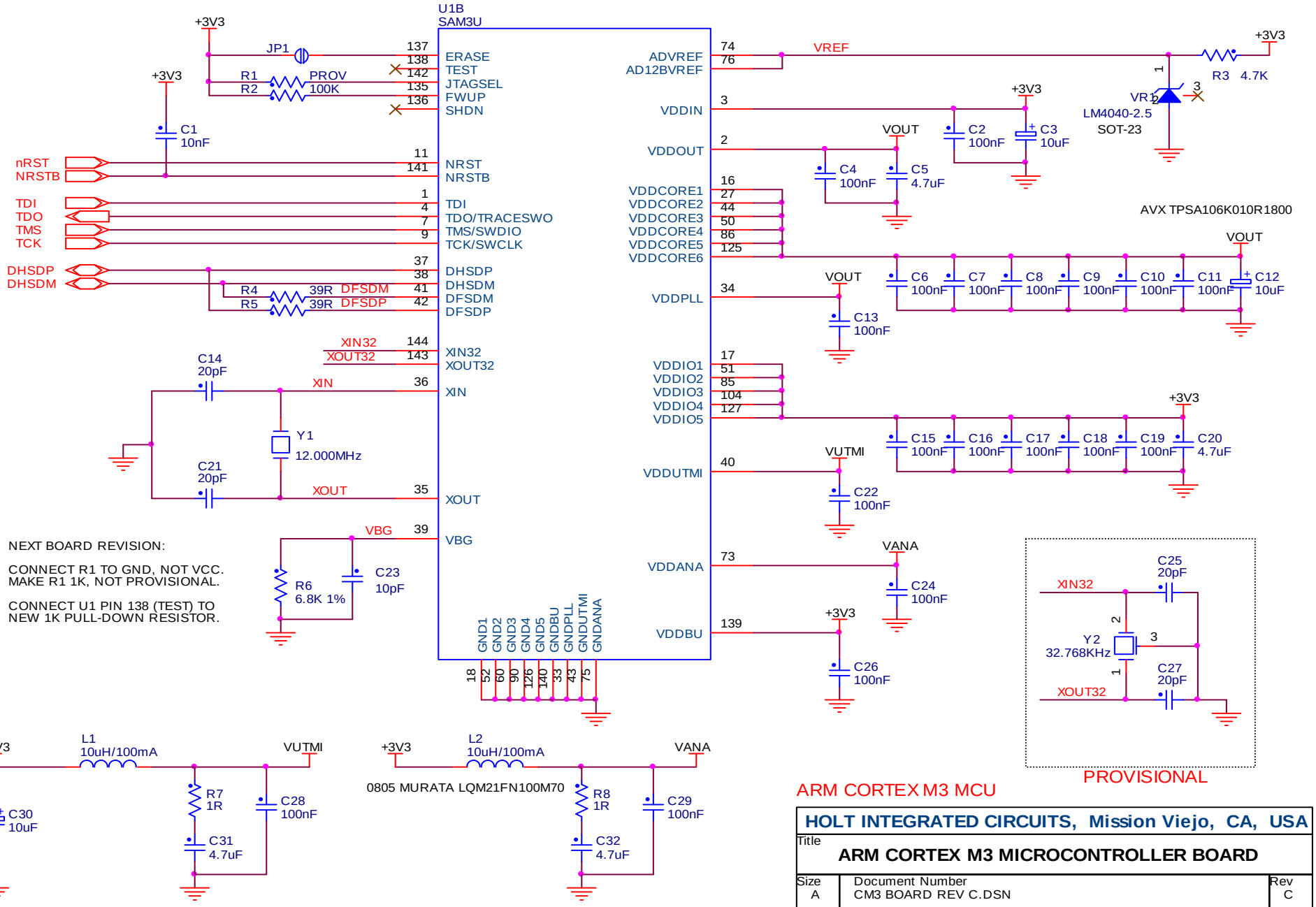
Date: Thursday, October 06, 2011	Sheet 2 of 7	



ARM CORTEX M3 MCU

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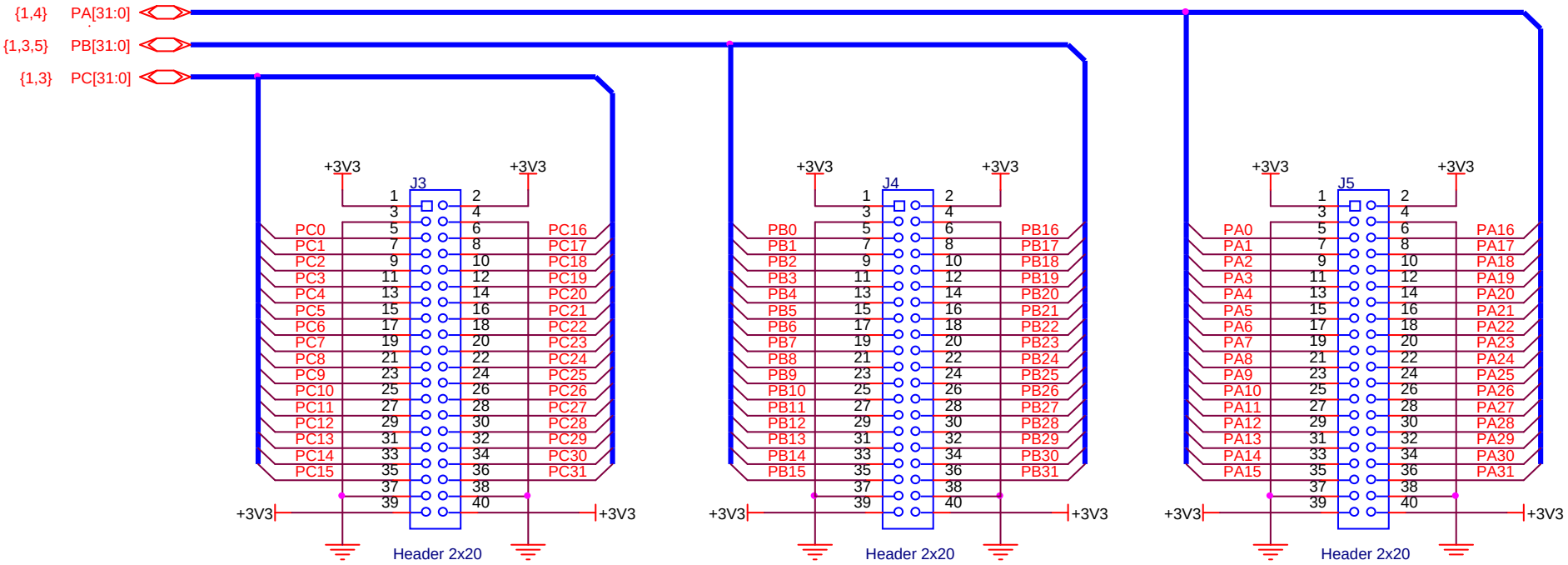
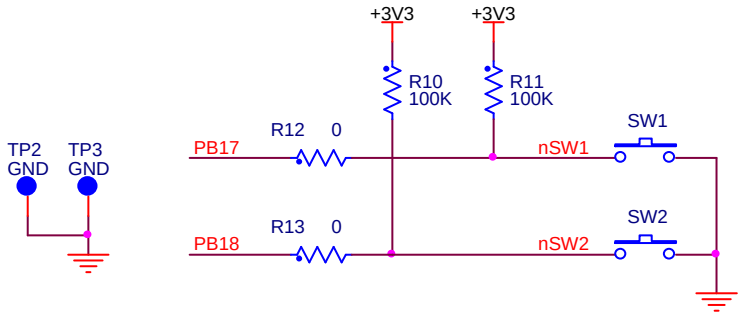
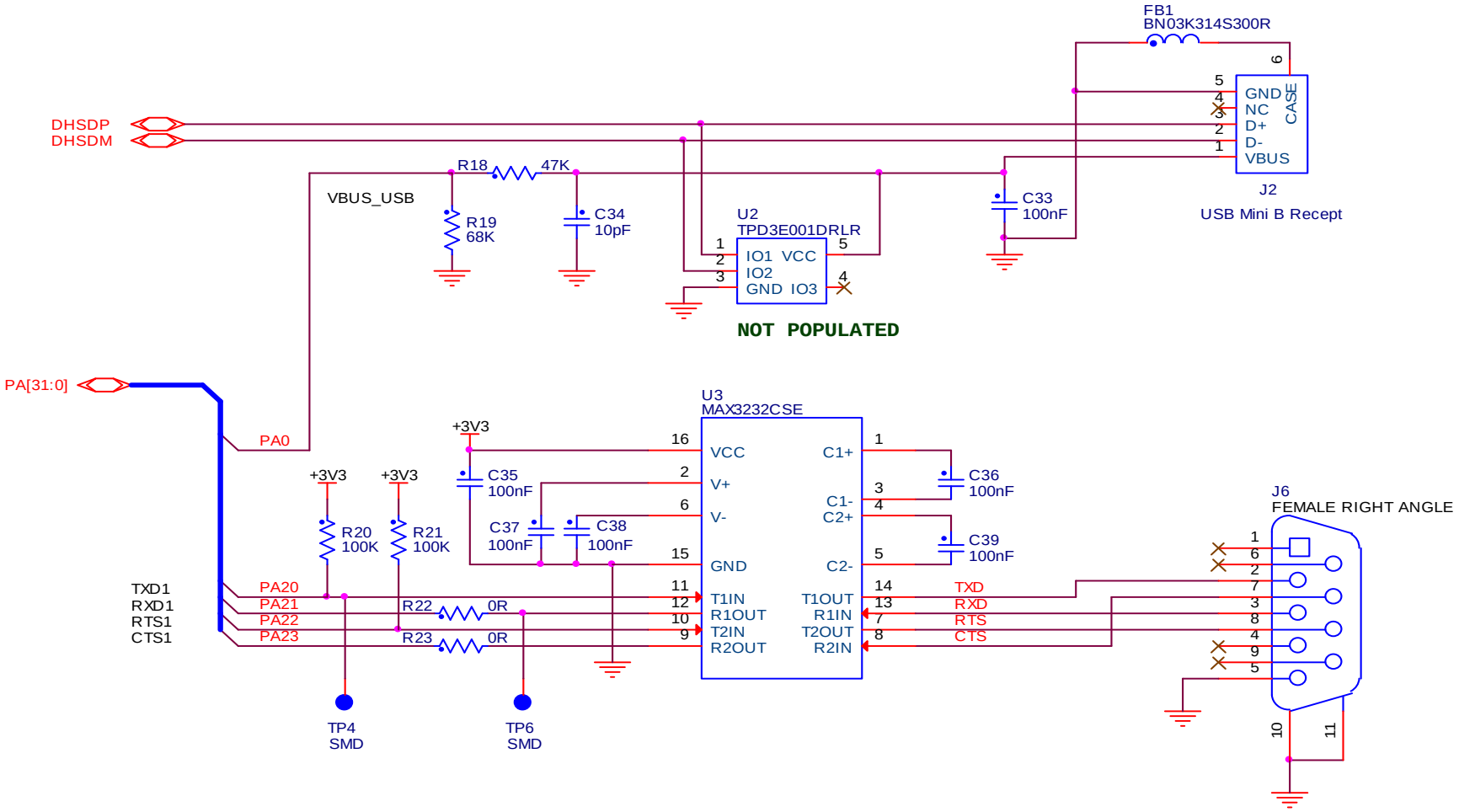
Date: Thursday, October 06, 2011	Sheet 3 of 7	





BOARD I/O HEADERS, BUTTONS

HOLT INTEGRATED CIRCUITS, Mission Viejo, CA, USA		
Title: ARM CORTEX M3 MICROCONTROLLER BOARD		
Size: A	Document Number: CM3 BOARD REV C.DSN	Rev: C
Date: Thursday, October 06, 2011	Sheet 4 of 7	



USB & RS-232 SERIAL

HOLT INTEGRATED CIRCUITS, Mission Viejo, CA, USA		
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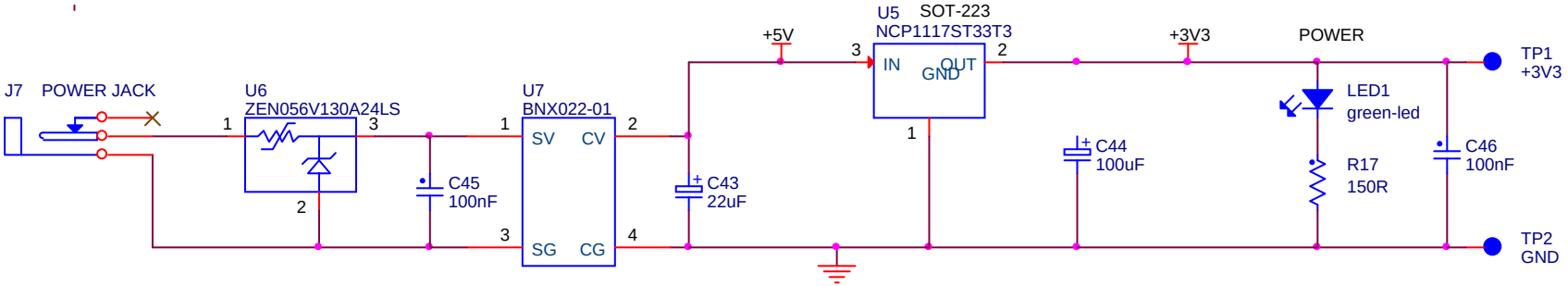
Size: A	Document Number: CM3 BOARD REV C.DSN	Rev: C
Date: Thursday, October 06, 2011	Sheet 5 of 7	



POWER SUPPLY

HOLT INTEGRATED CIRCUITS, Mission Viejo, CA, USA		
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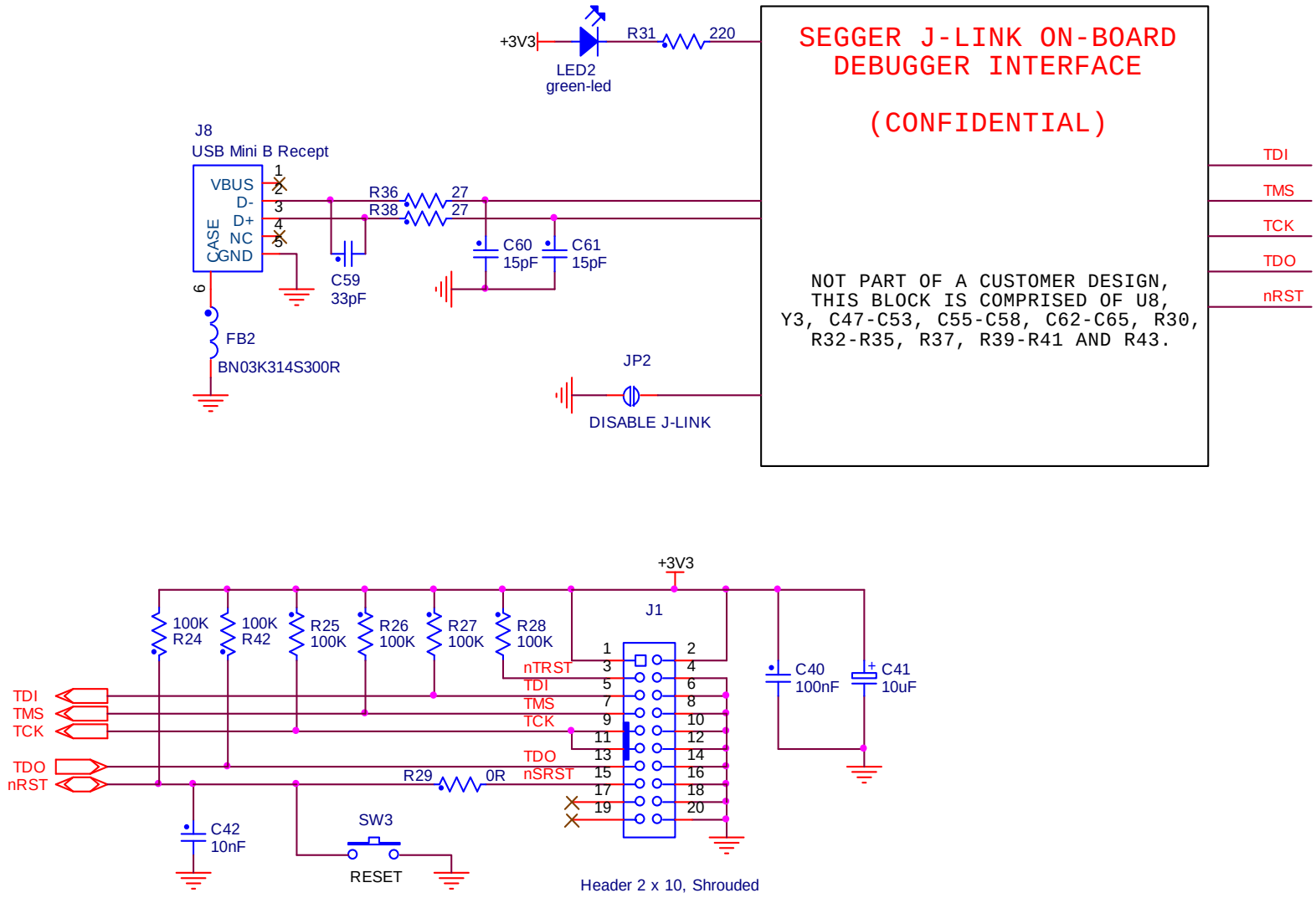
Size: A	Document Number: CM3 BOARD REV C.DSN	Rev: C
Date: Thursday, October 06, 2011	Sheet 6 of 7	



DEBUG INTERFACE

HOLT INTEGRATED CIRCUITS, Mission Viejo, CA, USA		
Title: ARM CORTEX M3 MICROCONTROLLER BOARD		
Size: A	Document Number: CM# BOARD REV C DSN	Rev: C
Date: Thursday, October 06, 2011	Sheet 7 of 7	

Bill of Materials			HI-6140RT Rev.B Evaluation Board		4-Sept-13
Item	***Qty***	***Description***	***Reference***	***DigiKey***	***Mfr P/N***
1	11	Capacitor, Cer 0.1uF 20% 50V Z5U 0805	C1,C2,C5,C6,C7,C9,C10, C12,C13,C15,C17	399-1176-1-ND	Kemet C0805C104M5UACTU
2	1	Capacitor, Cer 4.7uF 10% 6.3V X5R 0805	C4	399-3134-1-ND	Kemet C0805C475K9PACTU
3	5	Capacitor, Cer 10uF 10% 6.3V X5R 0805	C8,C11,C14,C16,C18	399-3138-1-ND	Kemet C0805C106K9PACTU
4	1	Capacitor 68uF 10% 6.3V Tant 400 mOhm SMD EIA 6032-28	C3	495-1507-1-ND	T495C686K006ZTE400
5	2	Terminal Block 3.5MM 4Pos PCB Mounted	J9,J10	ED1516-ND	On Shore Tech ED555/4DS
6	2	Header, Male 2x20 0.1" Pitch, 0.230" Pins, 0.120" Tail	J3,J4	S2012E-20-ND	Sullins PEC36DAAN
7	1	Header, 1x3, 0.1" pitch	J1	DO NOT STUFF	
8	2	Solder Jumper	J7,J8	DO NOT STUFF	
9	1	LED Yellow 0805	LED5	160-1175-1-ND	Lite On LTST-C170YKT
10	3	LED Green 0805	LED1,LED2, LED3	160-1179-1-ND	LiteOn LTST-C170GKT
11	1	LED Red 0805	LED4	160-1176-1-ND	LiteOn LTST-C170CKT
12	1	Osc, 50MHz 25ppm 3.3V SMD 5x7mm	OSC1	535-10087-1-ND	Abracon ASV-50.000MHZ-E-T
13	2	Resistor, 120 Ohm 5% 1/4W 1206	R18,R19	P120ECT-ND	Panasonic ERJ-8GEYJ121V
14	5	Resistor, 150 5% 1/8W 0805	R8,R9,R10,R11,R12	P150ACT-ND	Panasonic ERJ-6GEYJ151V
15	1	Resistor, 1.0K 5% 1/8W 0805	R1	P1.0KACT-ND	Panasonic ERJ-6GEYJ102V
16	1	Resistor, 10K 5% 1/8W 0805	R21	P10KACT-ND	Panasonic ERJ-6GEYJ103V
17	5	Resistor, 47K 5% 1/8W 0805	R13,R14,R15,R16,R20	P47KACT-ND	Panasonic ERJ-6GEYJ473V
18	1	DIP Switch 4-Position SMD	SW6	CT2194MST-ND	CTS 219-4MST
19	2	DIP Switch 6-Position SMD	SW4,SW5	CT2196MST-ND	CTS 219-6MST
20	1	DIP Switch 8-Position SMD	SW8	CT2198MST-ND	CTS 219-8MST
21	5	Test Point, Gnd, Black Insulator, 0.062" hole	TP2,TP3,TP5,TP7,TP9	5011K-ND	Keystone 5011
22	2	Test Point, Red Insulator, 0.062" hole	TP4,TP6	5010K-ND	Keystone 5010
23	1	Test Point, ACTIVE, White Insulator, 0.062" hole	TP8	5012K-ND	Keystone 5012
24	1	IC HI-6140 100-PQFP	U1	Holt IC	Holt HI-6140
25	2	IC HI-4853 8-SOIC	U2,U3	Holt IC	Holt HI-4853
26	1	IC, Serial EEPROM 512Kbit 20MHz SPI 8-SOIC, Microchip	U4	25LC512-I/SN-ND	Microchip 25LC512-I/SN

Bill of Materials			ARM Cortex M3 MCU Board		Revised: 9 Sept 2011
Item	***Qty***	***Description***	***Reference***	***DigiKey***	***Mfr P/N***
1	1	PCB, Bare, Evaluation Board, revision B or C	N/A	--------	
2	1	Ferrite Bead, 220 Ohm @ 100MHz 300mA DC 0805	FB1	732-1602-1-ND	Wurth 742792034
3	2	Capacitor, Ceramic 10nF 10% 50V X7R 0805	C1,C42	399-1158-1-ND	Kemet C0805C103K5RACTU
4	2	Capacitor, Ceramic 10pF 10% NP0 C0G 0V 0805	C23,C34	478-3731-1-ND	AVX 080551A100KAT2A
5	4	Capacitor, Ceramic 20pF 5% NP0 C0G 0V 0805	C14,C21,C25, C27	478-3735-1-ND	AVX 080551A200JAT2A
6	28	Capacitor, Ceramic 100nF 20% 50V Z5U 0805	C2,C4,C6-C11, C13,C15-C19, C22,C24,C26, C28,C29,C33, C35-C40,C45-46	399-1176-1-ND	Kemet C0805C104M5UACTU
7	4	Capacitor, Tantalum 4.7uF 10% 10V Low ESR SMD 1206	C5,C20,C31, C32	478-2391-11-ND	AVX TPSA475K010R1400
8	4	Capacitor, Tantalum 10uF 10% 10V Low ESR SMD 1206	C3,C12,C30,C41	478-3317-1-ND	AVX TPSA106K010R1800
9	1	Capacitor 22uF 10% 6.3V Tantalum Low ESR SMD C	C43	495-1504-1-ND	Kemet B45197A1226K309
10		Capacitor 100uF 10% 6.3V Tantalum Low ESR SMD C	C44	495-1509-1-ND	Kemet B45197A1107K309
11	1	Header, Male Shrouded 2x10 0.1" Pitch	J1	MHB20K-ND	3M 2520-6002UB
12	1	Connector, Receptacle USB Mini B Rt-Angle PCB Mount	J2	H2959CT-ND	Hirose UX60-MB-5ST
13	1	Connector DB9F, Right-Angle PCB Short Body, Board Lock	J6	182-109FE-ND	NorComp 182-009-213R-561
14	1	Jack, DC Power, 2.5mm ID x 2.1mm pin	J7	CP-102AH-ND	CUI PJ-102AH
15	2	Receptacle, Female 2x20 0.1" Pitch, 8.5mm Height, 3.2mm Solder Tails	J3,J4	S6104-ND	Sullins PPTC202LFBN-RC
16	1	Receptacle, Female 2x4 0.1" Pitch, 8.5mm Height, 3.2mm Solder Tails	J5A (J5 lower end, close to Bus B)	S7072-ND	Sullins PPTC042LFBN-RC
17	1	Receptacle, Female 2x5 0.1" Pitch, 8.5mm Height, 3.2mm Solder Tails	J5B (J5 upper end, close to Bus A)	S6105-ND	Sullins PPTC052LFBN-RC
18	1	Solder Jumper	JP1	SOLDER CLOSED	
19	2	Inductor, 10uH, 100mA 0805	L1,L2	490-4029-1-ND	Murata LQM21FN100M70L
20	1	LED Green 0805	LED1	160-1179-2-ND	LiteOn LTST-C170GKT

21	0	Resistor, Prov 1/8W 0805	R1	DO NOT STUFF	
22	5	Resistor, 0 ohm 1/8W 0805	R12,R13,R22, R23,R29	311-0ARCT-ND	Panasonic ERJ-6GEY0R00V
23	2	Resistor, 1.0 5% 1/8W 0805	R7,R8	P1.0ACT-ND	Panasonic ERJ-6GEYJ1R0V
24	2	Resistor, 39 5% 1/8W 0805	R4,R5	P39ACT-ND	Panasonic ERJ-6GEYJ390V
25	1	Resistor, 150 5% 1/8W 0805	R17	P150ACT-ND	Panasonic ERJ-6GEYJ151V
26	1	Resistor, 4.7K 5% 1/8W 0805	R3	P4.7KACT-ND	Panasonic ERJ-6GEYJ472V
27	1	Resistor, 6.8K 5% 1/8W 0805	R6	P6.8KACT-ND	Panasonic ERJ-6GEYJ682V
28	1	Resistor, 47K 5% 1/8W 0805	R18	P47KACT-ND	Panasonic ERJ-6GEYJ473V
29	1	Resistor, 68K 5% 1/8W 0805	R19	P68KACT-ND	Panasonic ERJ-6GEYJ683V
30	10	Resistor,100K 5% 1/8W 0805	R2,R10,R11, R20,R21,R24, R25,R26,R27, R28	P100KACT-ND	Panasonic ERJ-6GEYJ104V
31	3	Pushbutton	SW1,SW2,SW3	P10886SCT-ND	Panasonic EVQ-QWS02W
32	2	Test Point, Black Insulator, 0.062" hole	TP2,TP3	5011K-KD	Keystone 5011
33	1	Test Point, Orange Insulator, 0.062" hole	TP1	5008K-ND	Keystone 5008
34	1	Test Point, Yellow Insulator, 0.062" hole	TP4	5009K-ND	Keystone 5009
35	2	Test Point, Hole / Pad Only	TP5,TP6		
36	1	IC, MCU 32-Bit 256KB Flash, 144-LQFP	U1	ATSAM3U4EA-AU-ND	Atmel ATSAM3U4EA-AU
37	1	IC, ESD Protection Array 3-Channel SOT-5	U2	296-21885-1-ND	Texas Inst TPD3E001DRLR
38	1	IC, RS232 Driver/Receiver 3.0 to 5.5VDC 16-SOIC (3.9mm wide)	U3	296-19752-1-ND	Texas Inst MAX3232EIDR
39	1	IC, Single Inverter 74LVC1G04 SC70-05	U4	296-11600-1-ND	Texas Inst SN74LVC1G04DCKR
40	1	IC Voltage Regulator 3.3V 1A LDO, SOT-223	U5	497-1228-1-ND	ST Micro LD1117AS33TR
41	1	PolyZen 5.6V PPTC protected Zener SMD	U6	ZEN056V130A24LSCT-ND	Tyco ZEN056V130A24LS
42	1	Filter, EMI 35dB 10A 1MHz-1GHz SMD	U7	490-5052-1-ND	Murata BNX022-01L
43	1	IC Voltage Ref 2.5V 1% Micropower SOT-23	VR1	576-1047-1-ND	Micrel LM4040DYM3-2.5
44	1	Crystal 12.00MHz, 50ppm 20pF, HC-49US leaded	Y1	631-1105-ND	Fox FOXSLF/120-20
45	1	Crystal, 32768 Hz 12.5pF cylinder leaded	Y2	535-9033-1-ND	Abracon AB26TRB-32.768KHZ-T

		J-Link On-Board Circuitry…			
46	10	Capacitor, Ceramic 100nF -20% / +80% 25V Y5V 0603	C48-C53, C55-C58	490-1575-1-ND	Murata GRM188F51E104ZA01D
47	1	Capacitor, Ceramic 33pF 5% 50V C0G 0603	C59	490-1415-1-ND	Murata GRM1885C1H330JA01D
48	2	Capacitor, Ceramic 15pF 5% 50V C0G 0603	C60,C61	490-1407-1-ND	Murata GRM1885C1H150JA01D
49	2	Capacitor, Ceramic 10pF 5% 50V C0G 0603	C62,C63	490-1403-1-ND	Murata GRM1885C1H100JA01D
50	1	Capacitor, Ceramic 1nF 20% 50V X7R 0603	C64	490-1495-1-ND	Murata GRM188R71H102MA01D
51	1	Capacitor, Ceramic 10nF 10% 50V X7R 0603	C65	490-1512-1-ND	Murata GRM188R71H103KA01D
52	1	Capacitor, Ceramic 4.7uF -20% / +80% 6.3V 0603	C47	587-1313-1-ND	Taiyo Yuden JMK212F475ZD-T
53	1	Ferrite Bead, 220 Ohm @ 100MHz 300mA DC 0805	FB2	SAME AS FB2 ABOVE	
54	1	Solder Jumper	JP2	LEAVE OPEN	
55	1	Connector, Receptacle USB Mini B Rt-Angle PCB Mount	J8	SAME AS J2 ABOVE	
56	1	LED Green 0805	LED2	SAME AS LED1 ABOVE	
57	1	Resistor, 0 ohm 1/10W 0603	R30	P0.0GCT-ND	Panasonic ERJ-3GEY0R00V
58	1	Resistor, 220 ohm 5% 1/10W 0603	R31	P220GCT-ND	Panasonic ERJ-3GEYJ221V
59	2	Resistor, 1.5K ohm 5% 1/10W 0603	R32,R41	P1.5KGCT-ND	Panasonic ERJ-3GEYJ152V
60	1	Resistor, 47K ohm 5% 1/10W 0603	R33	P47KGCT-ND	Panasonic ERJ-3GEYJ473V
61	1	Resistor, 100 ohm 5% 1/10W 0603	R34,R35,R37 R39	P100GCT-ND	Panasonic ERJ-3GEYJ101V
62	1	Resistor, 27 ohm 5% 1/10W 0603	R36,R38	P27GCT-ND	Panasonic ERJ-3GEYJ270V
63	1	Resistor, 300 ohm 5% 1/10W 0603	R40	P300GCT-ND	Panasonic ERJ-3GEYJ301V
64	1	IC AT91SAM7S64 64-PQFP programmed by Segger	U8	from Segger	
65	1	Crystal 18.432MHz, 30ppm 10pF, SMD 3.2x2.5 mm	Y3	535-10909-1-ND	Abracon ABM8G-18.432MHZ-4Y-T3
		Off Board…			
66	1	Cable USB-A to Mini USB-B 2 meters		AE10628-ND	Assman AK672M/2-2-GR-R

REVISION HISTORY

Revision	Date	Description of Change
QSG-6140RT, Rev. New	7-16-13	Initial Release
QSG-6140RT, Rev. A	8-12-13	Added BOM
QSG-6140RT, Rev. B	9-05-13	Added pictures, BOM and schematic for Rev B board