

$f_c = 80 \text{ kHz}$

Robust Lee 7

23/11/2015

Transients and more..

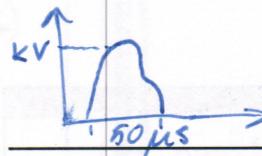


1

Transients

- "Slow" transients Surge, positive or negative
Rise time 1,2 μs
Pulse width 50 μs
Amplitude 1-2 kV
Happens when lightning strikes

2



Transients

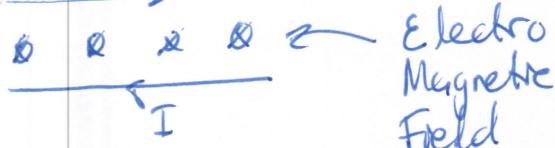
- Fast transients Burst
rise time 5 ns
Pulse width 50 ns
Amplitude 0,5 – 2 kV
Contacts break inductive load

3



Induced Current

23/11/2015



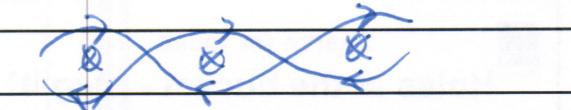
General solutions: Field-to-cable coupling, reduction

Reducing loop area:

- Twisting:

Shielded cables: see special section

- Note that the ground structure is larger



Currents cancel out in twisted cables

Filter

CM

DM

Also some DM-filtering

Also some CM-filtering

\oplus = disturbance

Non working filters

Shield wall

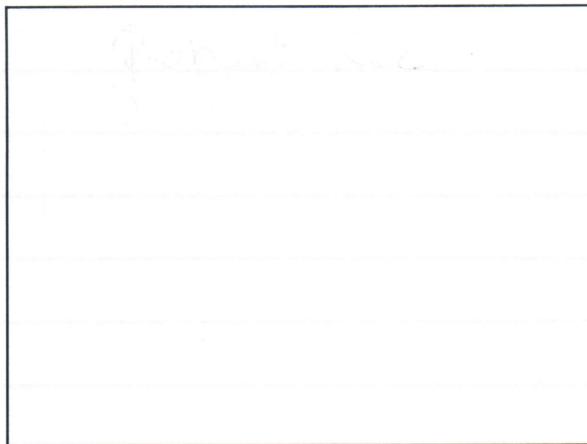
Connection impedance

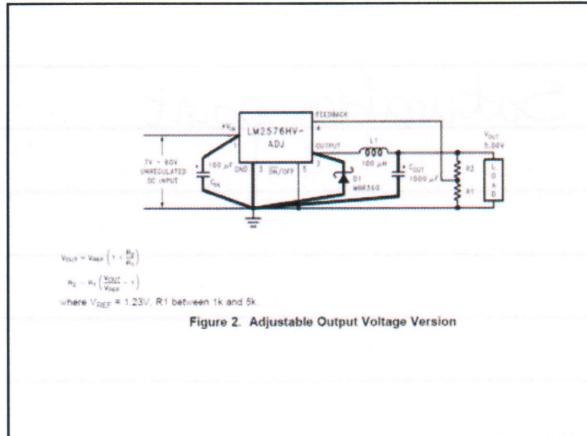
$Z_{connection} = \text{high} = \text{bad filter}$

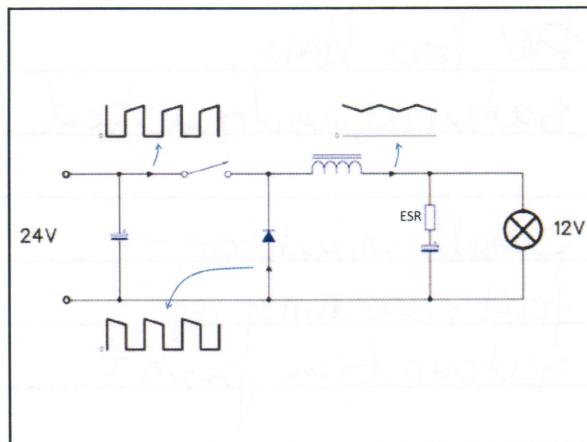
$= \text{no shield} = \text{bad filter}$

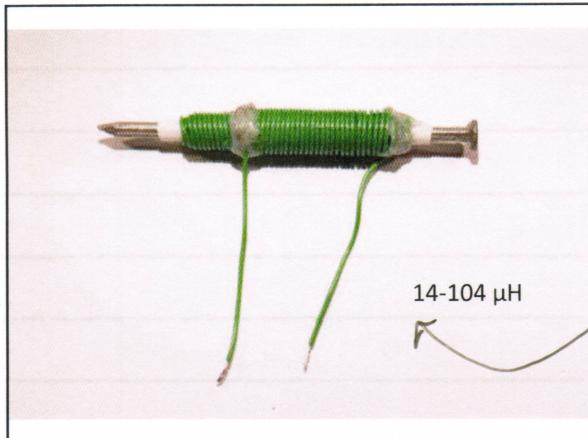
Worst:

The filter is shunted









Without ferrite core (nail)

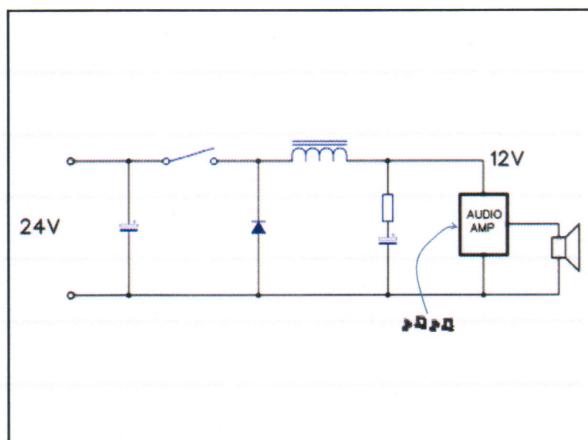
Inductance does not affect performance of lump.

Amplifier is also unaffected

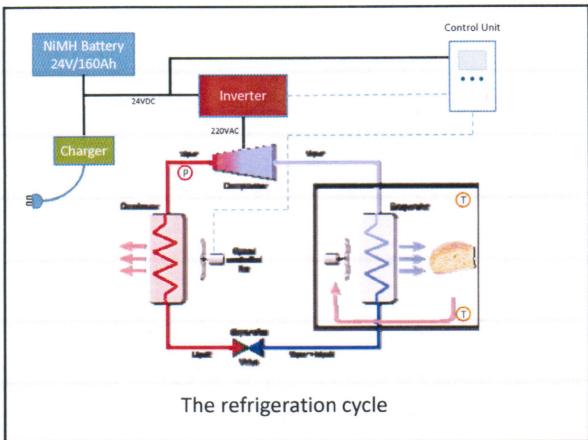
A radio attuned to an overtone of the switching frequency will catch the signal of a buck converter

[Amplitude modulation, AM-band]

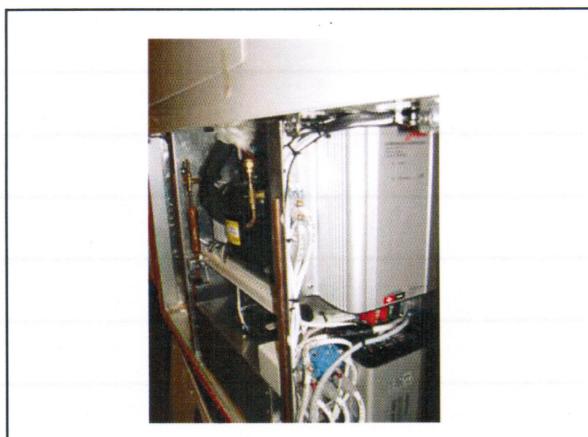
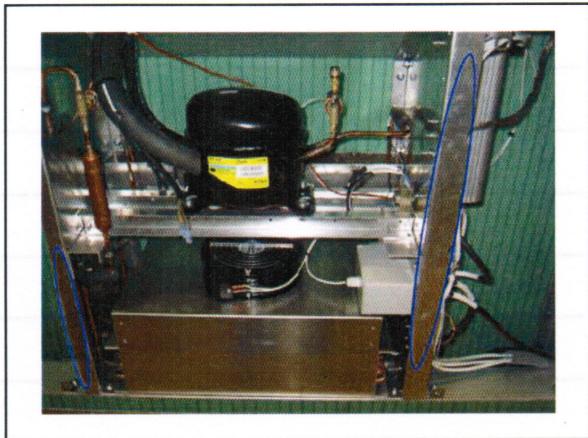
Big core \rightarrow no saturation \rightarrow good

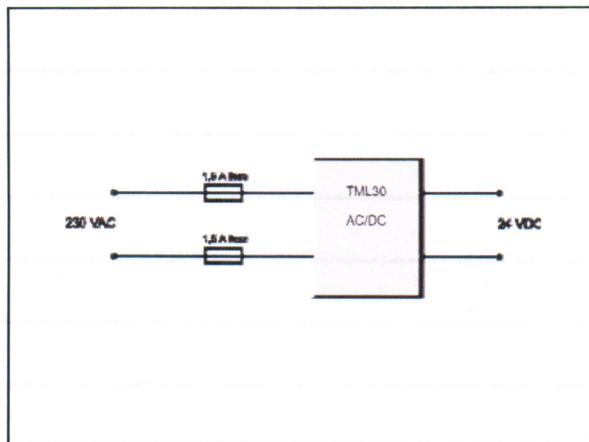


AirContainer



The refrigeration cycle





Everything works fine – time for EMC certification

Air Container

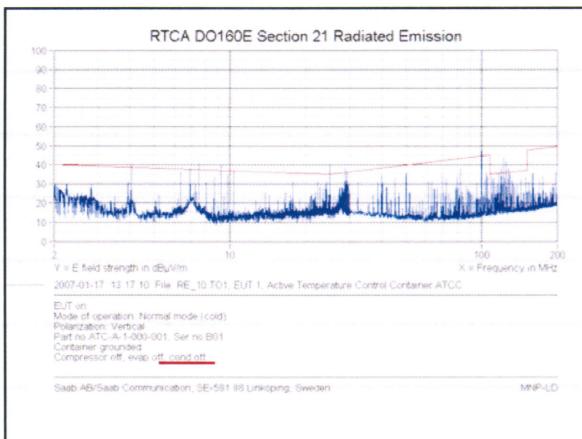
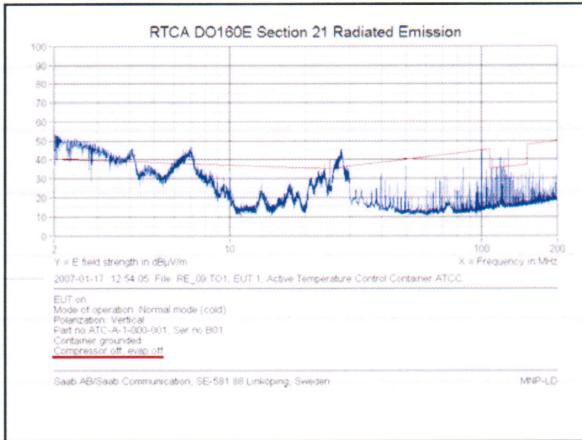
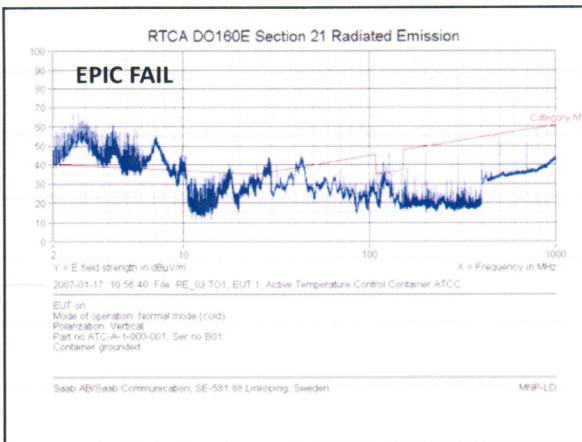
Design Specification
Main Control Unit

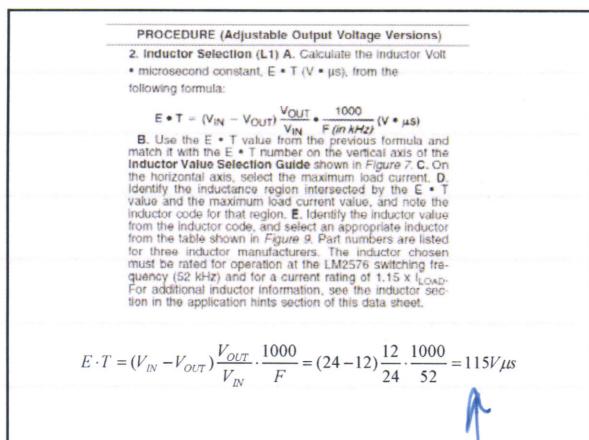
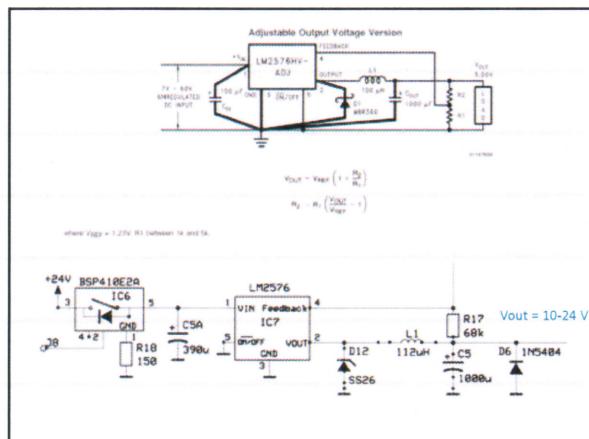
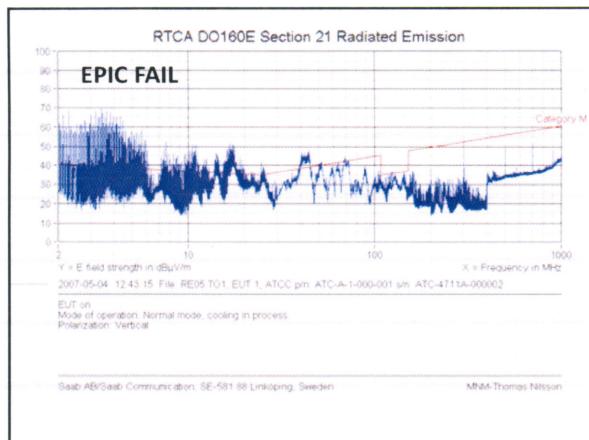
ATC-A-1-410-001
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Draft-3

6. ENVIRONMENTAL CONDITIONS

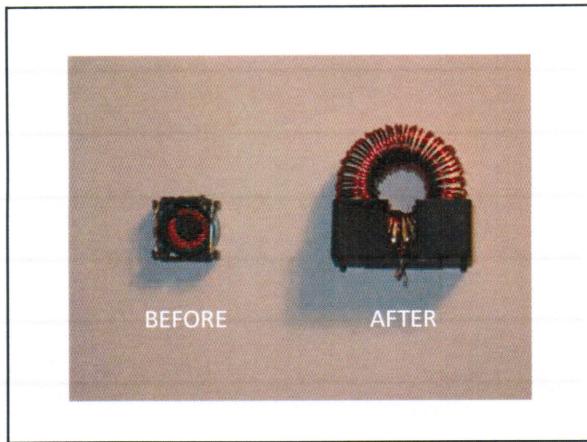
The MCU shall without mal-function or degradation of life be capable of meeting the requirements in this specification subjected to the environmental conditions specified in the document RTCA DO-160E. The categories as stated below apply for the different sections.

DO-160E Section	Category
4 Temperature and Altitude	A3
21 Emission of Radio Frequency Energy	M

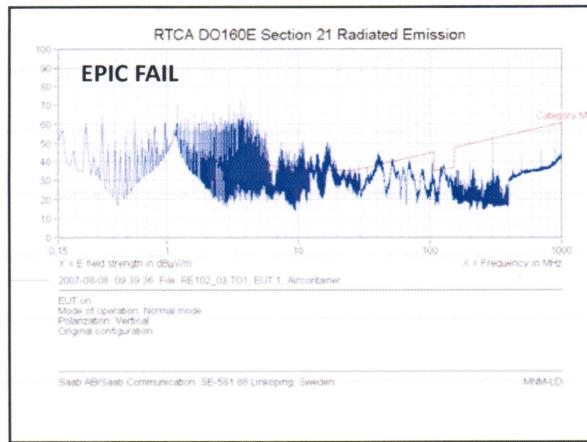




Spänningstidytta, area corresponds to magnetic energy

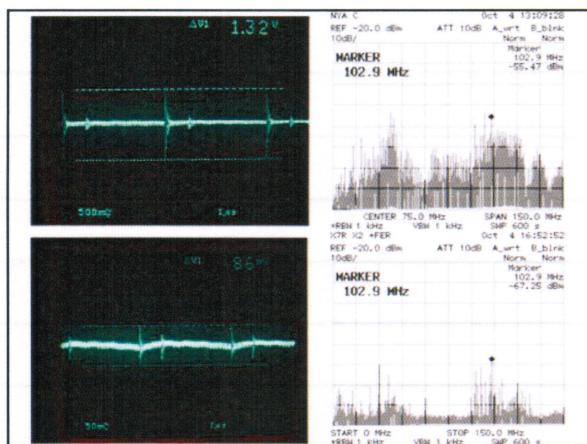
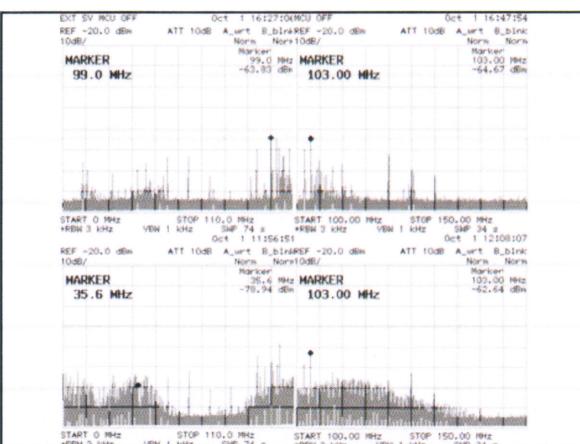


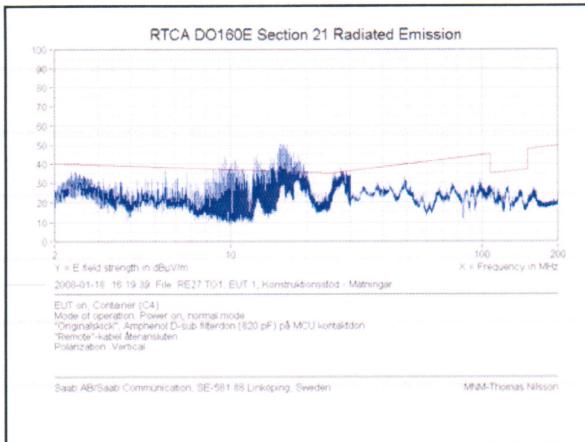
Everything fixed – time for another shot at EMC



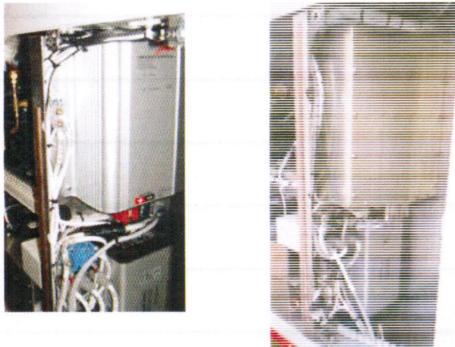
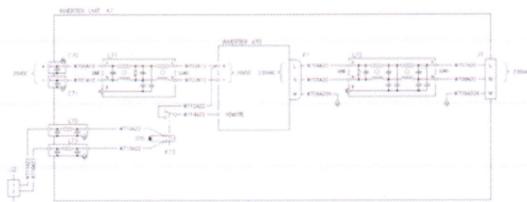
New DC/DC converter

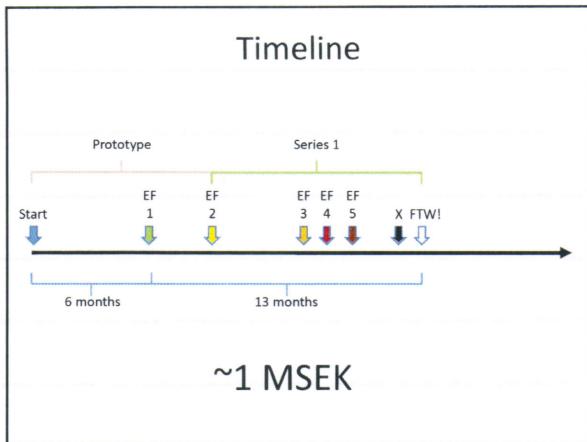
LM2675: 260 kHz 5 V, 1 A





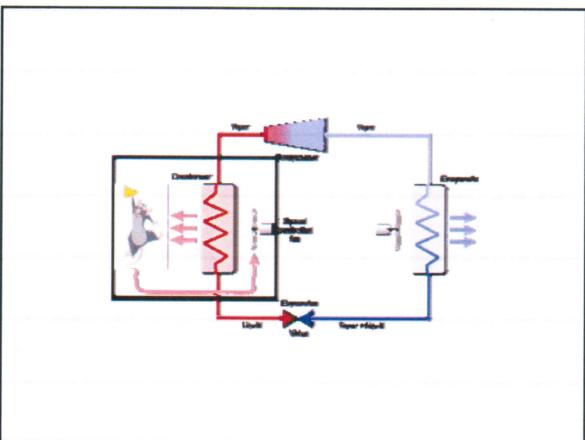
Inverter silencer





But...

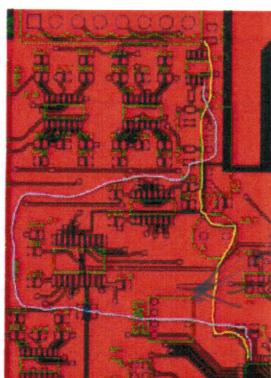




Problems...

1. Emissions too high
2. Sensitive to imposed interference – temperature values go bananas
3. The control unit does not turn on properly
4. The control unit reboots a lot

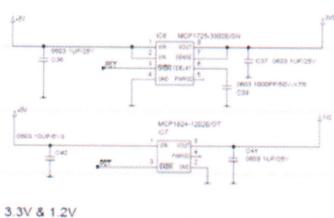
Bananas temperature



Keep a signal and its ground return close together!

Becomes an antenna

Turn-on problem



3.3V & 1.2V

47.4.1 Power-up Sequence

Table 47-5. Power-On-Reset (POR) Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{DD}	Threshold Voltage Rising	Measuring Slope of $+2.0\text{mV}/\text{Clock}$	0.70	0.75	1.00	V
V_{DD}	Threshold Voltage Falling	0.60	0.75	0.9	V	
t_{POR}	Reset Time	0.0	140	200	μs	

VDDBU powers the Backup power switch. It must be always powered to ensure correct behavior.

VDDCORE and VDDIO are controlled by internal POR (Power On Reset) to guarantee that the power source reaches the required voltage prior to the release of POR.

* VDDCORE, VDDIO, VDDIO1, VDDIO2, VDDIOP1 and VDDIOP2 must NOT be powered until VDDCORE has reached a level superior to V_{DD} .

Turn-on problem

Figure 47-2. VVDDCORE and VVDDIO Constraints at Startup

